TNG LIMITED

December 2020

Darwin Processing Facility Rehabilitation Management Plan

Middle Arm, Darwin Harbour, NT

Prepared on behalf of TNG Limited by:

Animal Plant Mineral Pty Ltd

Lot 1817, Hundred of Ayers, Middle Arm Peninsula of Darwin Harbour

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1 DARWIN PROCESSING FACILITY

1.1 PROJECT DESCRIPTION

TNG Limited (**TNG**) proposes to construct and operate the Darwin Processing Facility at Lot 1817, Hundred of Ayers, Middle Arm Industrial Precinct, (658 Channel Island Road) Wickham **(the Project**). The Project is approximately 16 kilometres (**km**) south east of Darwin, Northern Territory (**NT**). The purpose of the Project is processing magnetite concentrate to produce higher value products for export from East Arm Wharf to international customers. The site is within the Litchfield Council Local Government Area and is adjacent to Elizabeth River, near the Elizabeth River Bridge. Access to the site is via Channel Island Road and is approximately 30 km by road from Darwin.

The Project will comprise:

- clearing of a partially vegetated allotment formerly utilised for extractive industries
- construction of a magnetite concentrate Processing Facility
- construction of a rail siding, unloading and loadout facilities on the Adelaide to Darwin railway
- unloading of concentrate from trains at the rail siding
- refining of concentrate
- recycling of process water through a Water Recycling Plant; and
- loading of trains at the rail siding with Processing Facility products for transport via rail to East Arm Wharf and waste products for transport to an approved off-site facility.

The construction period is anticipated to be 24 months, continuing over both wet and dry seasons.

The design life of the Darwin Processing Facility is 40 years. Processing of concentrate would occur at a rate of 700,000 tonnes per annum (**tpa**). The life of the processing facility mirrors the production of concentrate from the Mount Peake Mine, the primary source of concentrate for the Project. Additional concentrate may, in future, be sourced from the Mount Peake area (subject to the results of further exploration drilling and economic evaluation) or from third parties.

The Project is contained within the proposed 1,000 hectare (**ha**) Middle Arm Industrial Precinct, a Land Development Corporation initiative that provides access to industrial and commercial land under the *Land Development Corporation Act 2003*. The Precinct is designed to accommodate large strategic industrial lots for downstream gas processing and gas related industry, with access to an extensive corridor network to carry utilities, gas, feedstock, and products. The Darwin Regional Land Use Plan 2015 identifies land on Middle Arm as an area with potential for strategic industrial development, including additional deep-water port development. Land to the east of Lot 1817 is zoned Utilities, Main Roads, Proposed Main Roads, and Railway. Land to the north, south, and west contains intertidal areas and mangrove forests that connect the site to the Elizabeth River and Darwin Harbour, and has been zoned for conservation (DLPE, 2015). Development of the Darwin Processing Facility will be confined to the area of Lot 1817 adjacent to Channel Island Road, defined as the Development Envelope. In total, Lot 1817 covers 507 ha and the Development Envelope is 270.5 ha.

The Development Envelope has been allocated to maximise degraded land with little to no vegetation or soil profile. The Project will require the clearing of up to 103.9 ha of high quality native vegetation within the Development Envelope, however some may be retained for screening between the Channel Island Road and the Project.

There is 63.6 ha of land outside of the Development Envelope that is currently in a Degraded or Completely Degraded condition which is available for immediate rehabilitation using the materials present in the high quality land to be cleared.

1.2 REHABILITATION MANAGEMENT PLAN PURPOSE AND SCOPE

Environmental Impact Assessment for the Project has identified rehabilitation of existing degraded and completely degraded land outside of the Development Envelope as an important mitigation to minimise the impact of fragmentation.

This Rehabilitation Management Plan first provides context for the objectives for rehabilitation of areas outside of the Development Envelope and then details the strategy to achieve those objectives as the project proceeds through construction and into its operational lifespan of 40 years.

More specifically:

- **Section 1.3** provides a synopsis of the terrestrial fauna and flora species of conservation significance targeted by the rehabilitation activity
- **Section 1.4** describes the Management Objectives for the rehabilitation of the areas outside the Development Envelope in a manner that focuses on enhancing the habitat value or increases habitat available to those target species
- **Section 2** describes the habitat attributes required by target species, which provides a focus for monitoring of rehabilitation
- **Section 3** describes the methodology that will be used to rehabilitate the land and identifies the areas where topsoil and vegetation will be removed and applied.
- **Section 4** describes the monitoring and reporting programs that will be implemented
- **Section 5** defines the measurable and quantitative monitoring results that would trigger further management action and outlines the actions that will be taken if triggers are exceeded.

1.3 TARGET SPECIES

Darwin Cycad (*Cycas armstrongii*) is listed as Vulnerable under the Northern Territory Parks and Wildlife Conservation Act (**TPWC** Act). The species is locally common and within Lot 1817 there is an estimated 30,850 individuals of Darwin Cycad. The proposed clearing will reduce this to 8,200. Translocation of Darwin Cycad from some of the clearing areas into the rehabilitation areas will lessen this impact.

Fauna species with a greater risk of impact from the Project have been identified in the Significant Fauna Impact Assessment. The Black-footed Tree-rat, listed as Endangered under the Environmental Protection and Biodiversity Conservation Act (**EPBC** Act), and Vulnerable under the TPWC Act, has been identified at high risk as individuals have been recorded in Lot 1817 and suitable habitat is proposed to be cleared. Existing remnant habitats within Lot 1817 are currently highly fragmented by Degraded and Completely Degraded land. Further fragmentation is likely as a result of the clearing proposed for the Project. Rehabilitation of the Degraded and Completely degraded land outside of the Development Envelope is proposed to mitigate this risk.

The Significant Fauna Impact Assessment identified the risk of inappropriate or ineffective rehabilitation to pose a high initial risk to many threated fauna species. As the degraded land occurs between the Development Envelope and the remnant high quality habitats fringing the Elizabeth River, the rehabilitated land will screen the remnant habitats from noise and light originating from the Project and will improve the hydrological function of the land. Inappropriate fire regimes and introduced species are a threatening process to many of the regional threatened fauna including the Black-footed Tree-rat, with weedy grasses such as Gamba contributing to an increased fire risk and introduced fauna exploiting disturbed areas. Rehabilitation management includes measures for weed control to reduce this risk and effective rehabilitation can reduce the advantage for introduced fauna.

Rehabilitation of degraded land for the benefit of Darwin Cycad and Black-footed Tree Rat will enhance the overall value of the site for all species of conservation significance known to occur, likely to occur or potentially able to colonise the site from adjacent sites in the future.

1.4 MANAGEMENT OBJECTIVES

Management Objectives are to:

1. Enhance the quality of currently degraded and completely degraded habitat in Lot 1817 outside of the Development Envelope for target species
2. Restore the average density of Darwin Cycad found in the regenerating Eucalypt woodland to the rehabilitation areas by transplanting individuals from the clearing areas.

2 SPECIES SPECIFIC HABITAT ATTRIBUTES

This section details the ecology and habitat requirements of the two target species. Knowledge of the habitat requirements are used to define completion criteria and remedial actions triggered through monitoring as detailed in Sections 4 and 5.

2.1 *CYCAS ARMSTRONGII* – DARWIN CYCAD

Ecology

Cycas armstrongii is a medium-sized cycad up to six m tall with a slender trunk 6 to 12 cm in diameter. Branching occurs along with occasional offsets and basal suckers. Leaves form an obliquely erect to spreading crown.

Each has 160-300 leaflets attached to the rachis at about 70° with a prominent midrib above.

The translocation of Darwin Cycads is routinely undertaken for developments in the greater Darwin region. The NT Management Plan for Cycads (Liddle, 2009) states in **Section 3.3** that:

Areas where cycads are likely to be destroyed in the pursuit of other legitimate purposes such as construction of roads or fire breaks or under a clearing permit, will be eligible for the issue of permits for utilisation by salvage… All permits for the removal of cycads will include the condition that all plants must be labelled with a Parks and Wildlife Commission approved tag prior to removal from the salvage site.

Translocation of cycads has a good chance of success provided it is done correctly. There are cycad species threatened under Commonwealth legislation that are regularly translocated if disturbance cannot be avoided.

Habitat

The species is endemic to the NT and is widespread in the Darwin region, Tiwi Islands and Coburg Peninsula – extending south to the vicinity of the Adelaide River (Kerrigan *et a*l., 2006). The species is locally abundant within most of its range yet qualifies as being Vulnerable due to a predicted reduction in population size because much of its habitat is threatened by development as part of the ongoing expansion of Darwin, and very little is included within conservation reserves (Kerrigan *et al*., 2006). Mortality in the hotter, more intense fires that result when Darwin Cycad habitat is infested with introduced grass species such as Gamba Grass is also a key threat (Kerrigan *et al.*, 2006).

Suitable Habitat in Relation to the Project Area

The Darwin Cycad is found in the Eucalypt Woodland (VA1) and regenerating Eucalypt woodland (VA2) vegetation associations in Lot 1817. In VA1 the species is present at an average density of 300 plants per hectare. In VA2 the species is found at an average density of 50 plants per hectare. Because Darwin Cycads are a threatened species, and because of their significance to the Traditional Owners cycads will be salvaged prior to works and replanted in rehabilitated areas at a density of 50 plants per hectare.

2.2 *MESEMBRIOMYS GOULDII GOULDII* – BLACK-FOOTED TREE-RAT (KIMBERLEY AND MAINLAND NORTHERN TERRITORY SUBSPECIES), DJINTAMOONGA, MANBUL

Ecology

Mesembriomys gouldii gouldii is nocturnal and predominantly dens in tree hollows, but is also known to use dense foliage, especially of *Pandanus* species. It forages on the ground and in trees, with the diet largely consisting of fruits (including from *Pandanus spiralis*) and seeds, supplemented with invertebrates, flowers, and grass. Individuals may move large distances from den sites to forage (Hill, 2012; TSSC, 2015).

This species can breed throughout the year; however, in the NT, breeding peaks in the dry season, between August and September. Gestation is between 43 to 44 days, and young are weaned within four weeks.

Habitat

This species typically inhabits lowland open forests and woodlands dominated by Darwin Woollybutt (*Eucalyptus miniata*) and Darwin Stringybark (*E. tetrodonta*), preferentially, with a relatively dense shrubby understorey, resembling the habitat preferences of *Antechinus bellus* (Hill, 2012; TSSC, 2015).

Suitable Habitat in Relation to the Project Area

Habitat suitability within Lot 1817 is high in the Eucalyptus woodland habitat type. The availability of tree hollows is limited at Lot 1817. Several clusters of trees, totalling 3.7 ha, with a size likely to provide valuable tree hollows (diameter at breast height (DBH) ≥ 50 cm) exist within the remnant Eucalyptus woodland in the site. The remaining woodland has trees predominantly with DBH less than 50 cm so it is expected *M. g. gouldii* individuals inhabiting the site are likely utilising the commonly available *Pandanus* foliage for denning rather than tree hollows.

Table 2-1 lists plants favoured by the Black-footed Tree-rat that are commonly found in the Darwin woodland landscapes and are tolerant of a water free dry season (once established). They can be planted in free draining areas to establish habitat or enhance existing vegetation (Land for Wildlife and Greening Australia, 2020).

Table 2-1. Plants favoured by the Black-footed Tree-rat

Scientific name	Common name	Habitat value
Petalostigma quadriloculare	Quinine tree	food
Acacia dimidiata	Acacia	food
Breynia cernua	Breynia	food
Grevillea dryandri	Dryander's Grevillea	food
Brachychiton paradoxum	Red flowered kurrajong	food
Planchonia careya	Cocky Apple	food
Grevillea decurrens	Clothes-peg Tree	food
Ficus aculeata	Sandpaper Fig	food
Livistona humilis	Sand Palm	food
Buchanania obovata	Green Plum	food
Acacia lamprocarpa	Wattle	food
Pandanus spiralis	Screw Palm	food and shelter
Sterculia quadrifida	Peanut Tree	food
Syzygium eucalyptoides(ssp besseri)	White Apple	food
Syzygium suborbiculare	Red bush Apple	food
Terminalia ferdinandiana	Kakadu plum	food
Acacia oncinocarpa	Wattle	food
Canarium australianum	Canarium	food
Eucalyptus miniata	Wooly butt	food and shelter
Eucalyptus tetrodonta	Darwin Stringybark	food and shelter
Corymbia ptychocarpa	Swamp bloodwood	food
Erythrophleum chlorostachyus	Ironwood	food

3 REHABILITATION METHODOLOGY

The Project Environmental Management Plan (**EMP**, EIS Supplement Appendix M) contains Procedures (**EP**'s) that support various activities that may impact the Environment. These procedures are implemented in support of this plan, as described in the Sections below. As the EMP is a living document and subject to change in support of further information or evidence that improves environmental management techniques over time, changes to Procedures will also be implemented through this Plan. Procedures as stated here are indicative only and the most current Procedure available in the EMP should be utilised.

3.1 WEED CONTROL

TNG will implement a Weed Management Procedure (EP-06) prior to and during construction / operations. Compliance with the Weed Management Procedure includes:

- Surveys will be conducted for weeds prior to the commencement of construction and periodically throughout the life of the Project. Weed data will be collected in accordance with the NT's "Weed Data Collection" guideline. Populations of weeds within the Project site will be demarcated on a site plan and entered into the GIS database;
- A list and means of identifying weeds on site will be made available to all personnel involved in or managing clearing activities through posters, identification sheets and awareness sessions;
- Site Induction of all employees/contractors will include equipment hygiene requirements;
- Minimum disturbance practices will be followed;
- All earthmoving and ground engaging equipment will be inspected and cleaned of vegetation, mud and soil prior to entry and exit from site;
- Any equipment or vehicle considered to have been working in a weed risk area will be cleaned down before being remobilised to other parts of the Project site;
- A weed seed prevention program will be designed and implemented in accordance with the "Preventing Weed Spread Is Everybody's Business" (DENR 2020) document produced by the Weed Management Branch of the NT, including:
- early control of weeds;
- hygiene procedures;
- exclusion zones for heavily infested areas;
- measures to educate contractors and maintenance staff in gamba grass identification; and
- measures to avoid passing through seeding gamba grass.
- A weed control program using chemical, mechanical and/or physical means will be implemented where weed infestations occur. Spot spraying where appropriate will be done as required;
- A gamba grass free buffer zone of 15 m in width on both sides of tracks and roads will be established and maintained (by chemical, mechanical or physical means) for all transport and service corridors prior to flowering and seeding each year; and
- Gamba grass surveys, control measures and distribution information will be recorded and provided to the Weed Management Branch of the Northern Territory Government upon request.

3.2 VEGETATION CLEARANCE

3.2.1 Procedure

Implementation of the Ground Disturbance and Vegetation Clearing Procedure (EP-05) to ensure:

- The proposed clearing has been approved
- Approved permits are assessed for compliance with permit conditions; and proposed area of clearing is demarcated prior to clearing to avoid excessive or prohibited clearing.
- Conditions in relation to soil and subsoil recovery, weed management, fauna clearing, Darwin Cycad salvage and other requirements have been assigned

3.2.2 Recovery of biomass

Areas to be cleared will be identified in the Ground Disturbance Permit.

Sufficient Darwin Cycad to repopulate rehabilitation areas to a density of 50 plants per hectare will be salvaged as described in **section 3.4**.

Figure 3.1 indicates the areas nominated for clearing through the environmental approvals process that is suitable for biomass recovery, including living and dead trees and shrubs. There is likely an overabundance of biomass in the standing live tree strata and not all of this can be accommodated in the rehabilitated areas. Much of the biomass from clearing may be used as mulch on undefined surfaces within the Development Envelope.

For the areas that are to be cleared, the biomass to be recovered will include:.

- Darwin Cycad in nominated areas
- All trees with a diameter at breast height over 50 cm (**Figure 3.1**).

These trees will be recovered as logs for use in rehabilitated areas as habitat for sheltering fauna. These trees are likely to already have hollows that will provide immediate refuge opportunities in rehabilitation areas.

All other vegetative material is to be chipped and the chips retained on-site where required to facilitate short term soil stabilisation and long term water and nutrient retention and cycling. A proportion will be spread in the rehabilitated areas with the remainder spread on suitable surfaces within the Development Envelope or if quantities exceed on-site need, exported off site.

3.2.3 Topsoil management

The parameters of the soil on Lot 1817 are known from the soil testing undertaken to inform the EIS. The soils study initiated by TNG for Lot 1817 (Golder 2019) indicates the sand/laterite subsoil layer in the undisturbed areas is up to 2.5 m deep. In the areas where sand mining has occurred, no topsoil and very little sandy lateritic soil is present. The remaining soil profile is unsuitable for the rehabilitated areas. For this reason, only soils in areas of high quality vegetation will be recovered for use in the rehabilitation areas.

It is recommended (van Gorp and Erskine 2011, Koch 2007a; Koch 2007b; Bell 2004; Ward and Koch 2000) that topsoil is removed in two layers (known as double stripping): the upper ten to fifteen centimetres is referred to as topsoil, and the remainder is known as subsoil. Double-stripping and direct translocation of topsoil generally yields improved understory species richness and recruitment from the soil seed bank compared to stockpiling (van Gorp and Erskine 2011). Double stripping maintains the concentration of seeds and organic matter at the surface of the rehabilitated soil profile.

It is also recommended (Koch 2007a, Koch 2007b, Bell 2004, Ward and Koch 2000) that the topsoil, which contains much of the soil organic matter, nutrients, micro-organisms and seeds, is used immediately after stripping to rehabilitate a nearby area (known as direct return). Directly translocated topsoil may contain over

fifty percent of the original unmined forest topsoil seed reserve, compared to fifteen percent when topsoil is stockpiled.

To gain the maximum benefit from the seed in the topsoil it is best to carry out clearing, soil stripping, soil return and ripping in quick succession during the dry months when the maximum amount of seed is in the soil. It is preferential to avoid delays in the handling of the soil, particularly during the wet period, however to ensure all possible subsoil material is utilised, some short delays in respreading may occur.

Subsoil (below 30 cm deep) in the areas to be cleared of vegetation is required for use in levelling the Development Envelope. It has been estimated that 30,000 m^3 of subsoil will be unsuitable for the purpose of fill in the Development Envelope (Darwin Processing Facility EIS Supplement). The unsuitability of these soils as fill is due to the expected presence of tree roots and other biotic materials. This soil is suitable for use in the subsoil layer and can be applied in the rehabilitation areas. This soil can be stockpiled without loss of quality.

The preferential handling of soils for rehabilitation is to:

- Where possible, direct transfer soils to rehabilitation areas and minimise the amount of time soil is stockpiled
- Do not strip and stockpile soil when it is wet
- Soil stockpiles that have been contaminated with gamba grass will not be used as clean fill or topsoil
- Soil stripping is to occur in three stages
    - Removal of the top 10 cm of soil to a weed-free temporary storage area
    - Removal of 20 cm of subsoil with immediate translocation to the rehabilitation areas
    - Collection of soils unsuitable for fill and translocation to the rehabilitation areas. This soil may be stockpiled until suitable areas are available.
- Soil application is to occur in the following stages
    - Apply the 20 cm of subsoil mixed with the unsuitable fill material
    - Apply the 10 to 15 cm of topsoil
    - Apply 3-5 cm of wood chips
- Rip to 20 cm deep after applying the wood chips.

If it is essential to stockpile topsoil, the following actions will be applied:

- a register of topsoil stockpiles will be maintained on-site and shall record the stockpile number, the date placed, the source location, the type (topsoil/subsoil) and comments (including rehandling/relocation etc.).
- Topsoil stockpiles will be inspected regularly for erosion and weed control.
- Information on the volume of topsoil stripped and stockpiled will be recorded and reported internally and in the Annual Report;
- Status of topsoil stockpiles is to be included in the Annual Report.

Figure 3.1 shows the areas where soils are to be recovered and where they are to be applied.

Table 3-1 summarises the resources to be removed and respread in each area.

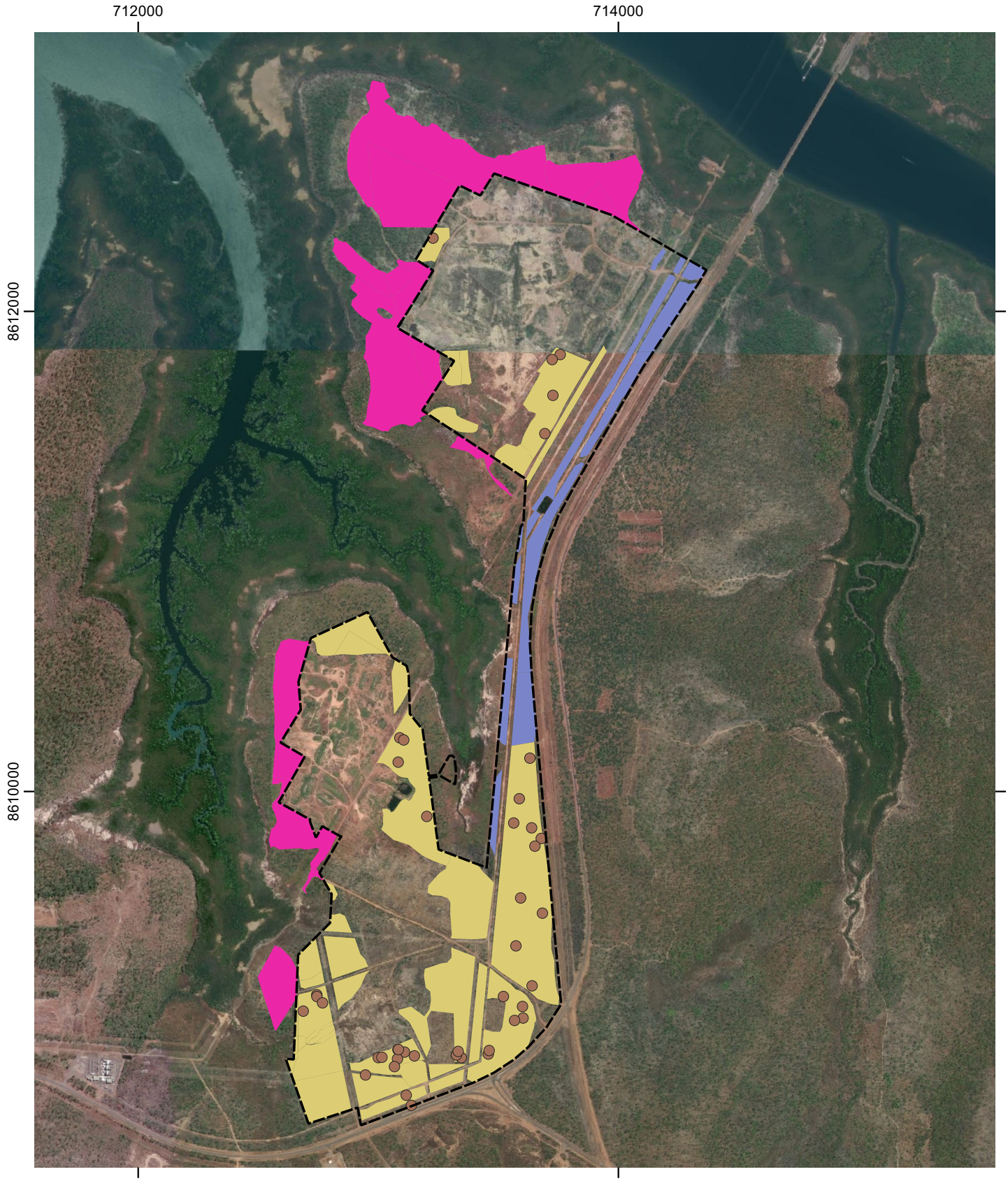

Figure 3-1. Clearing and rehabilitation areas

Legend

- Areas to be cleared
- Areas to be rehabilitated
- Vegetation likely retained
- > 50 cm DBH trees in clearing area
- EIS Supplement Development Envelope

0 250 500 m

Date: 01/12/2020
CRS: GDA 1994 MGA Zone 52

Table 3-1. Resource to be removed and respread.

Land Type	Clearing areas
Biomass recovered	All trees ≥ 50 cm DBH recovered as logs. Tree branches, mid-and under-storey vegetation chipped. Trees less than 50 cm DBH chipped.
Topsoil removed	Up to 103.9 ha Remove the top 10 cm and temporarily store Total volume up to 103,900 m^3
Subsoil removed	Up to 103.9 ha Remove 20 cm of sandy/lateritic subsoil, move to rehabilitation areas Total volume up to 207,800 m^3
Rejected Fill	Move any rejected fill material to the rehabilitation areas. Estimated total volume 30,000 m^3
Land Type	**Rehabilitation areas**
Subsoil applied	63.6 ha Respread evenly over the identified area as the first layer. Include any rejected fill material.
Topsoil applied	63.6 ha Respread evenly over the identified area, over the top of the subsoil
Biomass applied	Wood chips applied to soil surface no deeper than 30 mm.
Ripping	Ripping to 20 cm
Logs applied	Small stacks of 1-5 logs applied every 50-100 m across the area.

3.3 REHABILITATION

Soils will be immediately translocated to the designated areas, placing subsoil first then topsoil. The application of subsoils will ensure the appropriate water holding capacity is available to support the biomass and structure typical of natural Eucalypt Woodland. A sandy lateritic subsoil layer will improve the suitability of the soil for infiltration of stormwater. Increased water holding capacity of the soil will allow a denser vegetation to be supported which will increase functionality as a screen or buffer for noise and light originating from the Project.

No direct seeding or planting or application of fertiliser is expected to be required, excepting the translocation of Darwin Cycad. The fresh seedbank is expected to deliver the diversity and abundance suitable for the locality. The natural soils with the chipped canopies are expected to provide all the nutrition and microbial requirements to support plant health. However, it is important to note that application of excessive woodchips will prohibit the emergence of germinating plants.

As the areas to be rehabilitated are reasonably flat, ripping and the application of wood chip mulch are expected to provide sufficient protection from erosion. Ripping should occur on the contour where any small slope does occur. This is most likely to result in ripping parallel to the Elizabeth River. It is important to note that excessively deep ripping will cause the topsoil (and the seed bank it contains) to be buried in the subsoil and lost.

Larger vegetative material such as logs and coarse woody debris from cleared understory can be applied to any areas where small slopes do occur. This will provide additional protection from erosion.

Once the soil profile is rebuilt and woodchips are applied, stockpiled timber can be moved into position in the rehabilitated areas. It is better to create numerous small log piles rather than a few large ones in rehabilitated areas to encourage fauna return.

3.4 CYCAD TRANSLOCATION PROGRAM

Prior to land clearing, a schedule of progressive or staged clearing and rehabilitation works will be developed. Approximately 20,000 Darwin Cycad occur in the vegetation to be cleared. Of these, approximately 3,000 will be translocated. As the clearing and rehabilitation will be staged, areas will first be rehabilitated before Darwin Cycad are salvaged from areas that have not yet been cleared and transplanted into the rehabilitated areas. Those plants will then be extracted using the following Cycad Salvaging Procedure adapted from Forster (2004):

1. Mark each plant on one side with marker paint or fluorescent dye to ensure that the plants are replanted with a north-south orientation similar to their original one.

2. Assign an identification number to the plant and attach a filled-out Parks and Wildlife Commission approved tag.

3. Clean around individuals by hand or with machinery.

4. Trim excess or badly damaged foliage back to where the rachis is attached to the stems.

5. Spray trunks and foliage with an anti-transpirant.

6. Loosen soil around each individual using a trenching pattern (either by hand, or ideally with an excavator, backhoe or chain digger).

7. Remove each individual whilst attempting to maintain a root ball of soil (ideally this should be done by hand (small plants) or with an excavator or backhoe bucket).

8. Trim damaged roots with secateurs, apply fungicide powder.

9. Wrap and secure root ball and roots with dry hessian sacking.

10. Transport to new locality, taking care to avoid bruising of plant stems. Heavy plants should be loaded using a soft sling that is slung on a backhoe or excavator bucket and packed using rolls of hessian sacking or similar.

The replanting process will be:

1. Dig holes at the translocation locality by hand or with an excavator or back hoe. The soil should be loosened and the hole should not be much deeper than the root ball of the plants being transplanted.

2. Position plants in new hole, remove hessian sacking and trim any further damaged roots. Ensure that the north-south orientation from the old locality is maintained.

3. Pack washed river sand around the roots and root ball. This will provide a suitable substrate for new roots.

4. Backfill with the original topsoil removed from the hole.

5. Spray the trunks and foliage a second time with anti-transpirant.

6. Water thoroughly around each with ordinary water.

7. Water (5-9 L) around each root ball with a systemic fungicide.

8. Water each plant about once a month (10-20 L) depending on rainfall for the next six months or as appropriate.

9. When plants show sign of growth, water and spray thoroughly with a systemic insecticide to avert insect attack. These systemic insecticides should be applied at a high concentration.

4 MONITORING, INSPECTION, AND REPORTING

Monitoring, inspection, and reporting are key components of mitigation strategies designed to ensure target values for specific risks are achieved. **Table 4-1** lists the monitoring, inspection and reporting commitments that have been made by TNG to support and inform the mitigation strategy that are managed under other Factor Specific Management Plans or EP's in the EMP. These are to be undertaken during construction and operation. Specific rehabilitation performance monitoring is detailed in the sections below.

The monitoring, inspection and reporting items listed in **Table 4-1** are proposed for the whole of Site as detailed in the EIS Supplement and will be extended to the Rehabilitation areas. These will inform TNG whether the rehabilitation areas are successfully delivering the objectives and identify if and when remedial action is required. The information in **Table 4-1** is indicative only. Changes to Management Plans and Procedures will be followed as newer versions become available.

Table 4-1. Monitoring, inspection, and reporting of rehabilitation attributes

Proposed Monitoring and Reporting for Terrestrial Flora and Fauna			
Action	**Timing**	**Methods**	**Criteria**
Weed Survey	Prior to ground disturbance activities Quarterly and/or within 4 weeks of >25 mm of rainfall Quarterly and/or within 4 weeks after control	Visits to known locations, searches for new populations.	As per Environmental Management Plan Weed Management Procedure (EP-06) (EIS Supplement Appendix M).
Terrestrial fauna monitoring	Annually during construction and for the first year of operation (Jan-April)	Camera trapping	As per Biodiversity Management Plan EMP Appendix A
Other Inspection and Reporting			
Relevant Plan	**Monitoring/Inspection**	**Procedure (if relevant)**	**Reporting**
Environmental Management Plan	Daily inspection of high-risk locations, including to identify any new risks/unmanaged risks. Daily inspection (using GPS) during vegetation clearing to confirm clearing is within the approved envelope. Pre-clearance surveys and fauna spotters active during clearing. Weed surveys and follow-up control. Ongoing introduced and native fauna sighting and fatality reporting.	Environmental Risk Register Procedure Incident Reporting Procedure Ground Disturbance and Vegetation Clearing Procedure Weeds Management Procedure Fauna Procedure	Monthly Environmental Performance Report Half Year Report Annual Report and Performance Review
Stormwater Management Plan	Inspection of erosion and sediment controls during the wet season.	Water Management Procedure	Monthly Environmental Performance Report
Fire Management Plan	Periodic inspection of Gamba grass infestations for fire risk	NA	Annual Review

4.1 REHABILITATION MONITORING PROGRAM

Rehabilitation objectives and completion criteria need to remain flexible to allow for changes in operations, knowledge and available technologies.

Detailed records must be kept of all rehabilitation efforts and management procedures used. An appropriate system linked to GIS based information will be implemented.

The purpose of monitoring is to identify problems and act to remedy them promptly and measure whether the objectives are being met.

4.1.1 Quantitative monitoring

Method

Quantitative monitoring surveys will be conducted using the Quality Assessment Manual for Native Vegetation in the Northern Territory A1: Vegetation Condition Assessment Top End Forests and Woodlands (Brocklehurst and Price 2008).

Whilst this method has not been developed specifically with monitoring in mind it has many attributes suitable for the intended outcome, some of which are:

- The method has been developed specifically for Top End forests and Woodlands
- The method prioritises simplicity and a low number of attributes, which is suitable for multiple users not necessarily with a high level of botanical knowledge and a reasonable number of replications
- The attributes are specifically designed to assess condition in terms of biodiversity.

This method is to be applied on a trial basis, if it is found to be unsuitable an alternative method will be developed.

Natural Analogue sites will be selected within the remnant Eucalypt Woodland and Native Grassland within or near to Lot 1817. These reference sites can be measured with the method described in Brocklehurst and Price (2008) to create a local and relevant benchmark.

In addition to the requirements of the method described in Brocklehurst and Price (2008), the natural analogue sites will be recorded for the abundance of plants suitable for Black-footed Tree Rat habitat (**Table 2-1**). This can be achieved with the transect measurements by adding an extra row to **Table 2-1** (Brocklehurst and Price 2008; p. 12) called 'habitat species' and using the same methodology as for the other listed strata and using the species listed in **Table 2-1** as the target species. To facilitate this a new column needs to be added to the transect data sheet (Brocklehurst and Price 2008; Appendix 3) at the end of each of the overstorey and understorey sections, so that at each point a record is made for the category *and* whether the record is one of the species listed in **Table 2-1**.

Standing trees with hollows suitable for nesting will be unavailable in the rehabilitation area and the Black-footed Tree-rat will either use the hollows in the reclaimed logs in piles or foliage of Pandanus. As Pandanus provides both food and shelter it has significance. In the transect measurements recorded on the modified sheet in Appendix 3 the presence of Pandanus should be noted on the form with a symbol, for example the letter P.

A minimum of one natural analogue site of the Eucalypt Woodland need to be measured, on at least two occasions (end of wet season and end of dry season). However, increasing the number of analogues will give a better indication of the variability present on the site and allow more flexibility in meeting the targets. Minimum temporal monitoring of the analogues will provide a basis for the targets, however continued monitoring will allow comparison with 'like for like' in the event of poor seasonal rainfall conditions or other climate-based factors.

The number of quantitative monitoring sites in the rehabilitated areas will ultimately depend on how homogenous the rehabilitation is in terms of the factors to be recorded. A minimum of three should be set up – however, as the landscape evolves the rehabilitation area may need to be zoned into areas that are performing well, not performing, have erosion and drainage issues or weed issues etc. Each of the zones should have a minimum of one but ideally three transects installed depending on the size of the area.

Frequency

Monitoring must occur frequently at first and less as the system ages, with increased frequency after a significant environmental event such as fire or drought. In the first 2 years or until the vegetation passes the first criteria level (whichever is longer), quantitative monitoring should be carried out twice per year, once at the end of the wet season and once at the end of the dry season. Once vegetation has established and passed the first criteria level, quantitative monitoring can be conducted every two years.

Once monitoring has shown that the rehabilitation areas have met the completion criteria, rehabilitation will be complete and no further monitoring will be required.

4.1.2 Qualitative Monitoring

Qualitative monitoring surveys will be conducted using photo monitoring. This will be used to identify whether the established quantitative monitoring is capturing the heterogeneity in rehabilitation performance present at the site.

Long term photos taken from a fixed location are a universally useful tool for monitoring. Before, during and after photos are an excellent way to keep an eye on changes within the site.

The set up of photo monitoring sites will include:

- The decision on an effective place for the photo monitoring point. This may be an existing structure such as a fencepost, or will be a star picket or something similar that won't get destroyed by termites or fire.
- Locations will be marked with a GPS enabling the creation of a detailed map of where each photo point is located in relation to fixed features.
- The direction or compass bearing for the photo must be recorded to be replicated each time.
- Photo points will be numbered and labelled and photos of the number and label will be taken for inclusion in reporting.
- Photo monitoring will be done around the same time each year, with wet season and dry season photos taken in order to record differences between the seasons.
- If problem areas occur (*e.g.* lack of establishment, erosion etc) installation of extra monitoring points to cover these areas will be implemented
- Before and after photos of any maintenance activities will show the impact of restitution work.

Frequency

Monitoring must occur frequently at first and less as the system ages, with increased frequency after a significant environmental event such as fire or drought. In the first two years or until the vegetation passes the first criteria level (whichever is longer), qualitative monitoring should be carried out every month. Once vegetation has established and passed the first criteria level, qualitative monitoring can be conducted every six months, once at the end of the wet season and once at the end of the dry season until completion criteria are met.

4.1.3 Threatened Fauna Monitoring

A monitoring program for threatened fauna is described in the Biodiversity Management Plan. The monitoring will use the Camera Trapping method adopted by the Department of Environment, Parks and Water Security Flora and Fauna Branch for regional surveys on Middle Arm.

The program is scheduled to continue through construction and into the first year of operations.

5 TRIGGERS AND ADAPTIVE MANAGEMENT

5.1 TRIGGERS

Triggers for further action have been developed in relation to the quantitative monitoring strategy. The qualitative monitoring strategy is used to assess the extent of any problems identified by the quantitative monitoring strategy. If there are problems identified using the qualitative monitoring that are not being recorded by the quantitative monitoring, further quantitative monitoring sites need to be installed.

Criteria that must be met within certain timeframes to avoid further management action are listed in **Table 5-1**.

5.2 RESPONSES TO TRIGGER EXCEEDANCES

Failure to reach the criteria in the expected timeframes will trigger a management response. These criteria may need to be refined over time if the intended outcome is not being observed to be met or if other monitoring, inspection and reporting schedules - such as erosion, fauna and weed monitoring – detect issues that are not being identified in the rehabilitation monitoring.

Table 5-1. Rehabilitation Criteria

Timeframe	Factor	Criteria
Within 1 year of rehabilitation	Transects – total understory	If less than 25 % of points along the transects intersect with vegetation in the understory 1 year after rehabilitation has been completed, remedial action should be taken.
	Transects – categories	Excluding weeds and bare soil or rock, at least 2 categories, as defined in Brocklehurst and Price (2008), must be present or remedial action should be taken.
	Transects – categories	Grassy Weeds > 1 %. Grassy weeds are to be eradicated from the site
	Transects - categories	If more than 25 % of the points along the transect are weed species (other than grassy weeds), remedial action should be taken.
	Transects – Habitat species	At least two Habitat species must be present or remedial action should be taken.
Any monitoring period	Transects – total understory and overstory combined	If less than 25 % of points along the transects intersect with vegetation two years after

		rehabilitation has been completed, remedial action should be taken.
	Transects – categories	Excluding weeds and bare soil or rock, at least four categories (understory and overstory combined) must be present or remedial action should be taken.
	Transects – categories	Grassy Weeds > 1 %. Grassy weeds are to be eradicated from the site
	Transects - categories	If more than 25 % of the points along the transect are weed species (other than grassy weeds), remedial action should be taken.
	Transects – Habitat species	At least four Habitat species must be present and at least 25 % of transects must contain *Pandanus* or remedial action should be taken.
Criteria to be met before monitoring frequency changes from twice per year to every 2 years	All of the above, plus:	
	Tree canopy cover and canopy health	> 30 % canopy health >20 % canopy cover Relative to benchmark values
	Tree height	>25 % canopy height Relative to benchmark values
	Canopy species	> 50 % canopy species Relative to benchmark values
	Growth form cover ground stratum	> 50 % of score Relative to benchmark values
	Number of species (grass, perennial herb, broad leaved shrub)	> 25 %Relative to benchmark values
Completion criteria	Tree canopy cover and canopy health	> 50 % canopy health >30 % canopy cover Relative to benchmark values
	Tree height	>30 % canopy height Relative to benchmark values
	Canopy species	> 50 % canopy species Relative to benchmark values
	Growth form cover ground stratum	> 50 % of score Relative to benchmark values
	Number of species (grass, perennial herb, broad leaved shrub)	>30 % Relative to benchmark values

Failure to meet measures for vegetation diversity, abundance or the presence of specific species required for habitat quality will mean that supplementary seeding or planting will be required. The species in **Table 5-2** are

'proven performers' (Greening Australia 2017) for the northern savannas and should be the species considered for seed collection or planting of seedlings in underperforming rehabilitation areas. A number of species listed in **Table 5-2** are also listed as plants beneficial for Black-footed Tree Rat and should be prioritised in seeding or planting of seedlings, even if the benchmark for habitat plants is being met.

Table 5-2. Species to consider for supplementary seeding or planting of seedlings (adapted from Greening Australia 2017)

Species	Notes
Open Woodland on well-drained soil	
Acacia difficilis	Fast growing and competitive – pioneer species. Prefers sandy soils
Acacia dimidiata	Common in the Darwin region
Acacia gonocarpa	Fast growing and useful for weed suppression and screening
Acacia holosericea	Strongly competitive pioneer species. Very useful for disturbed sites but should be used with restraint
Buchanania obovata	Hardy woodland species
Cochlospermum fraseri	Tolerates poor shallow soils
Eucalyptus miniata	Fire resistant once established
Eucalyptus tetradonta	Can reproduce from root suckers
Planchonia careya	Common mid stratum Darwin species
Syzygium eucalyptoides ssp. *bleeseri*	Fire tolerant once established
Syzygium suborbiculare	Fire tolerant. Adapts well to well drained soils
Grasses – mixed habitats	
Heteropogon contortus	Commonly used for soil stabilisation, fast to establish perennial species. Can be competitive and may pose a fire hazard.
Alloteropsis semialata	Important food source for seed eating birds, early seeder.
Aristida inaequiglumis	Wide habitat tolerance including rocky and red loamy soils and sandy plains
Ectrosia schultzii	Attractive and low growing. Useful for fire breaks and access tracks
Ectrosia leparina	Useful species for firebreaks Low growing with attractive seed head.
Heteropogon triticeus	A good species for wetter areas occurring on brown and red clay loams, sandy loams and gravelly soils.
Sorghum intrans	Annual speargrass. Important species across the Top End.
Sorghum plumosum	Grows well on sandy red soils, heavy loams and creek lines.

Psuedopogantherum contortum	Common in sandy and silty soils in open woodland, depressions and swampy areas.
Seasonally inundated or waterlogged soils including drainage lines and bank stabilisation	
Acacia auriculiformis	Very fast to establish. Very useful in revegetation but may outcompete other seedlings
Alphitonia excels	Fast growing, tolerates waterlogging
Carallia brachiata	Good for bank stabilisation. More suited to permanent water source but should perform well in seasonally inundated areas with high water table.
Lophostemon lactifluus	Hardy once established. Prefers wetter areas.
Nauclea orientalis	Fast to establish, performs well if roots have permanent water (high water table)
Melaleuca spp.	Various species perform well under different conditions. Hardy once established and will tolerate both waterlogging and seasonal drought
Pandanus spiralis	Good for bank stabilisation and erosion control. Tolerates waterlogging.

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