Report No. J020347

Targeted conservation significant flora survey of the Lamb Creek project area

Prepared for: Mineral Resources Limited
Date: 11 January 2022

Rapallo Environmental is a Western Australian consultancy with a strong reputation for technical excellence, client-focus and innovation. We build long-term alliances through outstanding delivery on a range of services to the resource sector, government and associated industries.

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Revision	Date	Prepared	Reviewed	Approved
Internal Review	21/09/2020	Cielito Marbus	Marieke Weerheim	Kate George
Draft Report V1	25/09/2020	Marieke Weerheim	Marieke Weerheim	Kate George
	01/02/2021		Sarah Osborne (MRL)	
Draft Report V2	09/09/2021	Marieke Weerheim Kate George	Kate George	Kate George
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Table of Contents

Tables

Figures

Plates

Appendices

Executive summary

Mineral Resources Limited (MRL) proposes to develop an iron ore mine with associated haul road and infrastructure at Lamb Creek. The Lamb Creek project area is located approximately 130 kilometres north-west of Newman in the East Pilbara Region of Western Australia and is accessed via the Great Northern Highway.

The Lamb Creek project area is defined as retention licence R47/19 and miscellaneous licences L47/736, L47/974, L47/1008, and M47/1592. Together these tenements cover an area of 2199 hectares. There is significant overlap between the tenements hence this number is not cumulative.

A targeted conservation significant flora survey was conducted over two phases, from 15-29 April 2020 and 12-17 May 2021. The project area at the time of the survey only included R47/19 and L47/736 and the survey area was based on footprint V1 which has now been superseded. The current footprint V3 extends outside of the survey area by 236 hectares (36%).

The targeted survey covered the following survey areas:

- Mining footprint and haul road corridor within R47/19 (271 hectares) – April 2020
- Haul road corridor within L47/736 (388 hectares) – April 2020
- Intersection version B located within L47/974 (57 hectares) – April 2020
- Great Northern Highway intersection within L47/974 (156 hectares) – May 2021

The entire survey area was covered on foot via systematic parallel traverses. Additional searches on foot and via helicopter were made outside the survey area boundaries to map the population extent of target taxa where these extended outside the survey area, and to search opportunistically for target taxa outside of the proposed project footprint.

The survey recorded one threatened flora taxon (*Seringia exastia* – Critically Endangered) from two locations near the Great Northern Highway. The listing of this species is due to a taxonomic revision where a widespread and a Threatened taxon were merged. Communications from the Department of Biodiversity, Conservation and Attractions (DBCA) confirm that the species is likely to be delisted.

Six species of Priority Flora listed by the Department of Biodiversity, Conservation and Attractions (DBCA) were recorded during the survey, comprising one Priority 2 species (*Aristida lazaridis*), four Priority 3 species (*Aristida jerichoensis* var. *subspinulifera*, *Eremophila* sp. Hamersley Range, *Rhagodia* sp. Hamersley (M.E. Trudgen 17794) *Rostellularia adscendens* var. *latifolia* and one Priority 4 species (*Goodenia nuda*).

One potentially undescribed taxon, *Euphorbia* aff. *ferdinandi* was recorded from the Great Northern Highway intersection area. This taxon may represent a new species.

The most significant finding of the survey was an extensive population of the priority two grass *Aristida lazaridis* from the Great Northern Highway intersection area.

1 Introduction

1.1 Project overview

The Lamb Creek Iron Ore Project comprises a proposed mining area, haul road, and associated infrastructure. The project is situated approximately 130 kilometres north-west of Newman in the Pilbara region of Western Australia.

Mineral Resources Limited (MRL) commissioned Rapallo Environmental (Rapallo) to conduct a targeted conservation significant flora survey of the Lamb Creek Iron Ore Project. The work was commissioned in two phases, with fieldwork completed in April 2020 and May 2021. The surveys covered a combined area of 872 hectares, hereafter referred to as the targeted survey area or simply the survey area.

The project area as well as the proposed footprint have undergone several changes since the surveys were completed, as outlined in section 1.3.

The current Lamb Creek project area (January 2022) comprises retention licence R47/19, miscellaneous licences L47/736, L47/974, L47/1008, and mining lease M47/1592. Together these tenements cover an area of 2199 hectares. There is significant overlap between the tenements (see Figure 1.1 and Table 1.2), hence this number is not cumulative.

1.2 Scope and objectives

The scope of the targeted conservation significant flora survey included:

- Review and refine desktop information on conservation significant flora taxa recorded previously within 30 kilometres of the Lamb Creek project area.
- Produce a list of target taxa for the field survey, based on the latest distribution information and habitat requirements of these species.
- Systematic searches for conservation significant flora across the targeted survey area.
- Mapping point locations and population boundaries of conservation significant flora found within the survey area, and extending outside the survey area where relevant.

The objective of the survey was to provide baseline information on conservation significant flora within the Lamb Creek project (survey area only) in order to inform project planning and environmental impact assessment (EIA), to support approval applications.

1.3 Project area, survey area, and survey periods

1.3.1 April 2020

The first targeted survey took place from 15-19 April 2020. The project area at the time comprised retention licence R47/19 and miscellaneous licence L47/736. A proposed disturbance footprint was provided by MRL in March 2020 (footprint V1).

The April 2020 targeted survey covered the entirety of footprint V1 plus an alternative intersection area for the haul road with the Great Northern Highway, referred to as intersection version B. The survey area covered in April 2020 was 716 hectares. Survey effort is mapped in Figure 3.2.

1.3.2 May 2021

The second targeted survey was completed from 12-17 May 2021. Based on the findings from the 2020 targeted survey, MRL identified an additional area near the Great Northern Highway to be covered by targeted surveys. The May 2021 survey area covered an additional area of 156 hectares.

Total area covered by the April 2020 and May 2021 surveys was 872 hectares (Table 1.1). This area will hereafter be referred to as the targeted survey area. Survey effort is mapped in Figure 3.2.

Table 1.1 Survey areas covered by the targeted flora survey

Survey area description	Survey period	Area size [1]
Mining footprint and part of haul road corridor within R47/19	15-29 April 2020	271 ha
Haul road corridor within L47/736	15-29 April 2020	388 ha
Intersection version B	15-29 April 2020	57 ha
Additional areas near the Great Northern Highway	12-17 May 2021	156 ha
Total area covered by the targeted survey		**872 ha**

Footnotes: 1) The targeted survey area extends by 3 hectares outside of the current December 2021 project area.

An updated project footprint (footprint V2) was provided in July 2021 after both field surveys had been completed. Earlier drafts of this report were based on footprint V2. However, this footprint has now been superseded by footprint V3 as outlined in section 1.3.3.

1.3.3 December 2021

A revised project area and proposed footprint (footprint V3) were provided to Rapallo in December 2021. The revised project area included two new miscellaneous licences, which overlapped significantly with the existing tenements. Table 1.2 lists all tenements included in the Lamb Creek Iron Ore project as per December 2021. A map showing tenements and their overlap is presented in Figure 1.1.

Table 1.2 Tenements of the Lamb Creek Iron Ore project

Tenement	Type	Size	Description
R47/19	Retention Licence	1200 ha	Contains proposed mining area, infrastructure, and the eastern terminus of the haul road.
L47/736	Miscellaneous Licence	390 ha	Contains proposed haul road alignment of footprint V1. Now falls mostly within L47/1008 (2 ha outside)
L47/974	Miscellaneous Licence	120 ha	Adjacent to Great Northern Highway, includes intersection version B. Falls entirely within L47/1008
L47/1008	Miscellaneous Licence	999 ha	Proposed haul road and associated infrastructure areas. Covers majority of L47/736 and all of L47/974.
M47/1592	Mining Lease	1200 ha	Same area as R47/19 (pending conversion)

The project area as per December 2021 is 2199 hectares in size. Since there are significant overlaps between the five tenements listed in Table 1.2, this number is not cumulative.

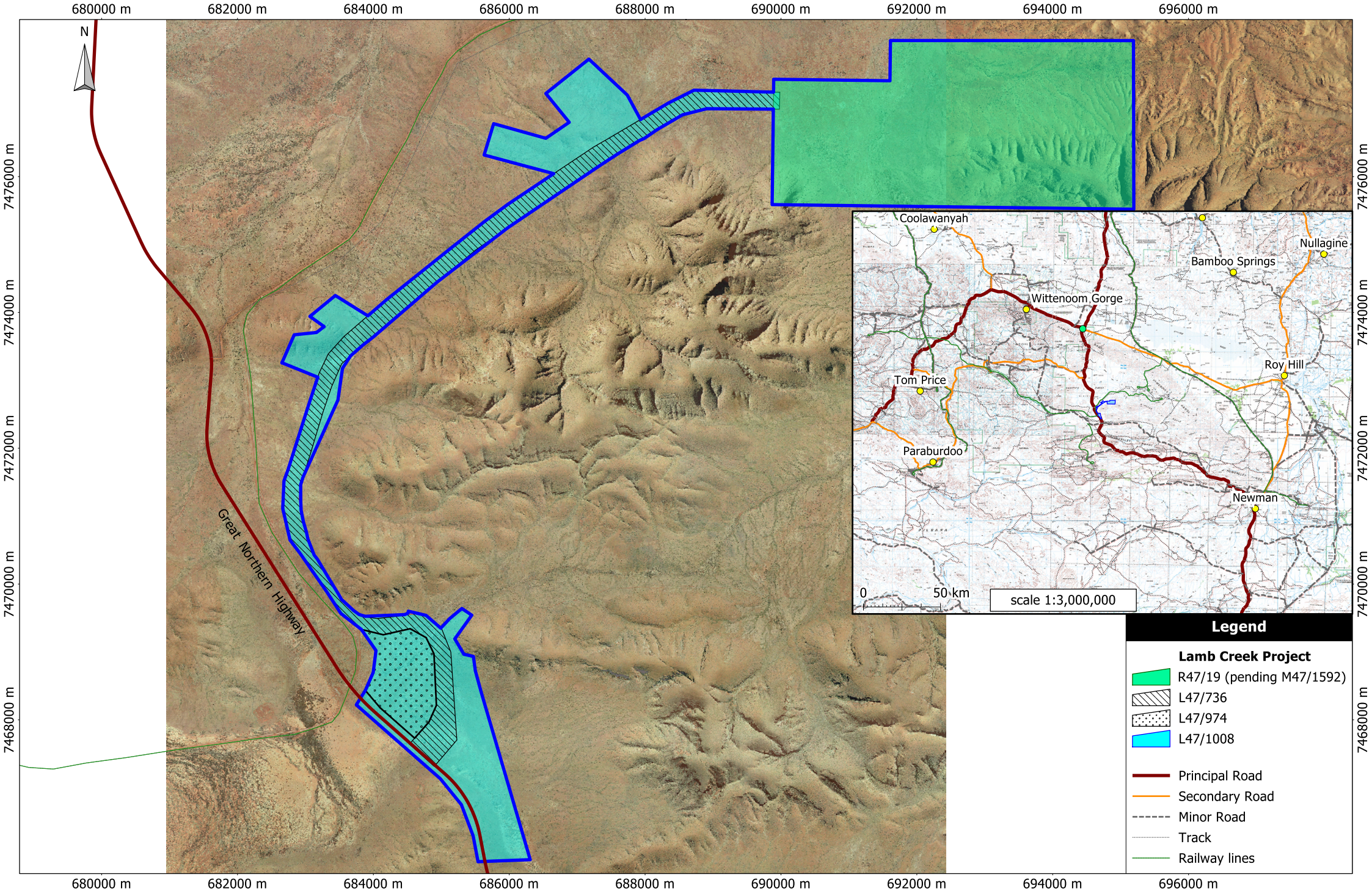
The latest project footprint, provided in December 2021 (footprint V3) is 657 hectares in size. It extends outside of the areas coved by the targeted survey by 236 hectares, hence 36% of proposed footprint V3 remains unsurveyed. The majority of the unsurveyed parts are located in R47/19.

1.4 Definitions

To aid interpretation of this report and associated mapping, Table 1.3 provides explanation of the various components of the Lamb Creek project and associated survey areas, as listed in Table 1.2, and mapped in Figure 1.1 and Figure 1.2.

Table 1.3 Project and survey area definitions

Component	Description
Project area	Project area as per December 2021, comprising tenements R47/19 (pending conversion into M47/1592), L47/736, L47/974, and L47/1008 as listed in Table 1.2. The project area has a total size of 2199 hectares. There is significant overlap between the tenements, so this number is not cumulative.
Survey area	Combined areas covered by the targeted conservation significant flora surveys completed in April 2020 (716 ha) and May 2021 (156 ha) as listed in Table 1.1, totalling an area of 872 hectares. Also referred to as the targeted survey area or the defined survey area, depending on context.
Resource area	General description of R47/19 (M47/1592) in which the proposed mine pit and associated infrastructure will be located.
Haul road corridor	General description of the area in L47/736 in which most of the proposed haul road will be located.
Great Northern Highway intersection (GNHI)	General name given to the area where the proposed haul road intersects the Great Northern Highway. Multiple versions of the intersection have been investigated since March 2020; hence this area is much wider than the rest of the haul road corridor.
Footprint V1	Proposed disturbance footprint provided by MRL in March 2020 and used to develop the initial survey area as defined in section 1.3.
Footprint V2	Revised disturbance footprint provided by MRL in July 2021.
Footprint V3	Revised disturbance footprint provided by MRL in December 2021 and used to calculate impacts to conservation significant flora recorded during the survey.
Adjacent to footprint V3	Within 100 metres of the December 2021 disturbance footprint (footprint V3).
Targeted survey	The combined surveys of April 2020 and May 2021.
Opportunistic records outside of survey area	Individual plants or populations of conservation significant flora recorded outside of the defined survey area, either through mapping of population extent beyond survey area boundaries, ground-truthing helicopter records, or by walking traverses through suitable habitats outside of footprint V1.



Rapallo environmental

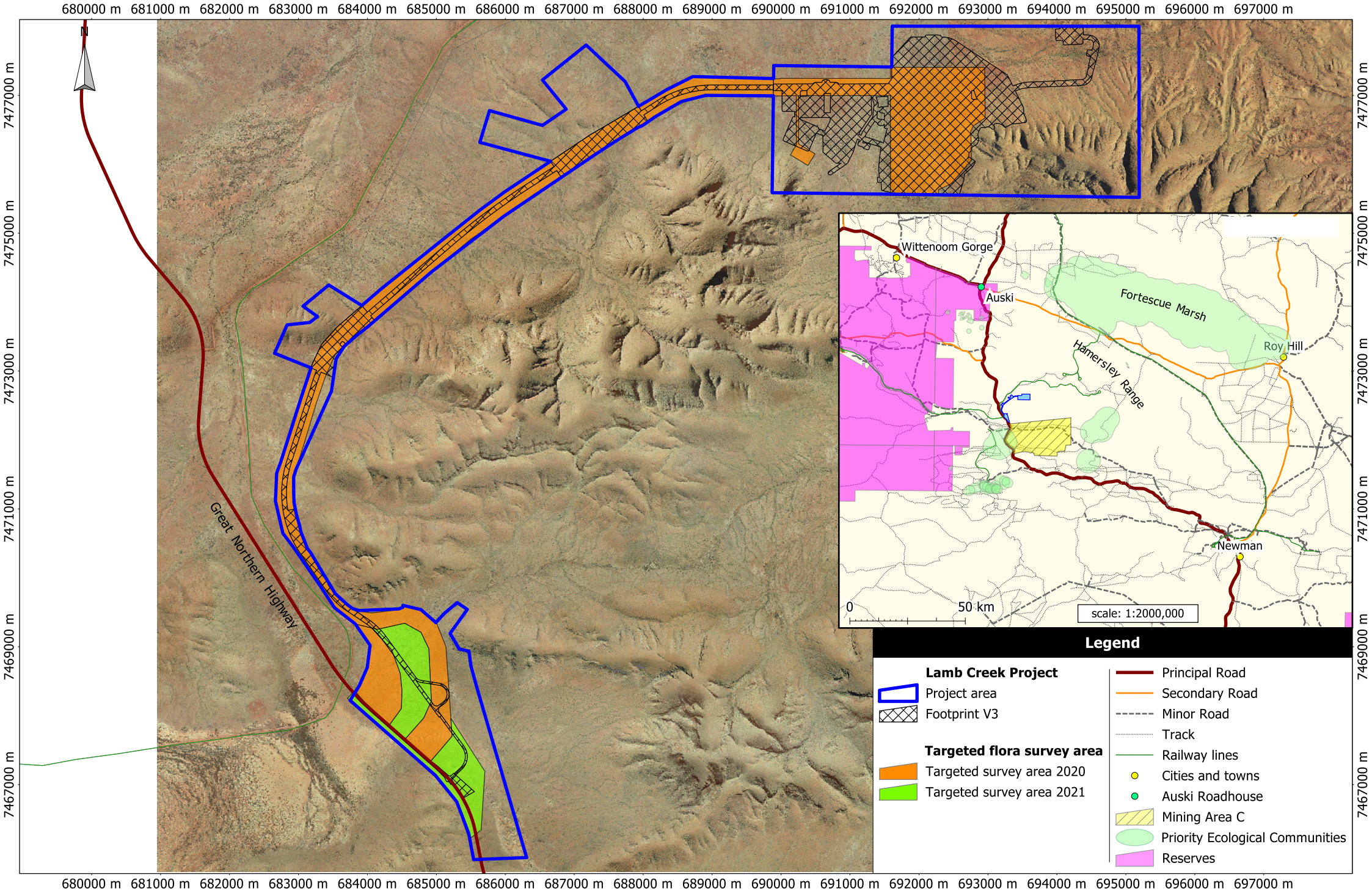
Mineral Resources Limited
Lamb Creek Project

Lamb Creek Iron Ore Project
Targeted conservation significant flora survey (April 2020, May 2021)

Original Size: A4 Scale: 1:70,000
Datum: MGA94 Zone 50
0 2 km

Figure 1.1

Tenements of the Lamb Creek Iron Ore project area as per December 2021



Rapallo environmental

Mineral Resources Limited
Lamb Creek Project

Lamb Creek Iron Ore Project
Targeted conservation significant flora survey (April 2020, May 2021)

Original Size: A4 Scale: 1:70,000
Datum: MGA94 Zone 50
0 2000 m

Figure 1.2

Location of the Lamb Creek project and delineation of the targeted survey area

2 Regional context

2.1 Climate and weather

The Lamb Creek project is situated in the Hamersley subregion (PIL03) of the Pilbara IBRA region, which is part of the Eremaean province (Beard 1990). The climate of the Hamersley IBRA subregion (PIL03) is described as semi-desert tropical. The average rainfall is 300 mm per year, usually in summer cyclonic or thunderstorm events. Winter rain is not uncommon (Kendrick 2001). Cyclones develop off the north-west coast and often cross the coastline between Karratha and Port Hedland and move inland over the Fortescue Valley system towards Newman (Beard 1990).

The closest Bureau of Meteorology (BOM) weather station to the survey area is at Newman Airport (station number 007176), located 130 kilometres south-east of the survey area (Figure 1.2). This weather station has been recording rainfall data since 1971 and temperature data since 1996.

Data recorded at Newman Airport (Figure 2.1) shows a mean annual rainfall of 324.3 millimetres (mm). Mean monthly rainfall is highest in February at 70.2 mm, and lowest in September at 3.7 mm. The hottest month is December with a mean maximum temperature of 39.3°C and a mean minimum temperature of 24.1°C. The annual wind records from 9am and 3pm show a dominant easterly throughout the day, with the strongest winds recorded in the morning of up to 30 km/hour (BOM 2021).

Evaporation rates are not recorded at the Newman Airport Weather Station. However, evaporation in the Central Pilbara Region is estimated to be between 2000 mm and 3500 mm per annum, which is approximately ten times greater than annual rainfall (Gardiner 2003). This disparity maintains a typically arid landscape, except for areas located in proximity to river systems and shallow groundwater resources.

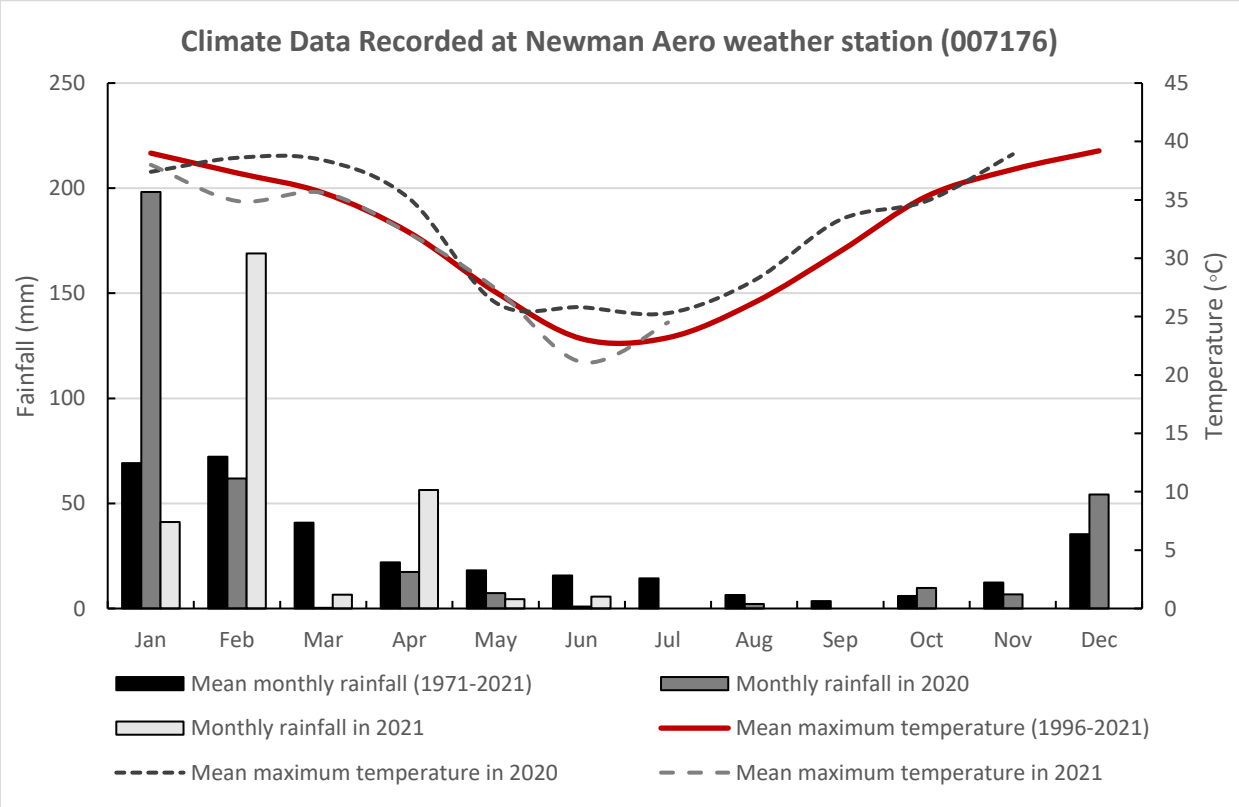


Figure 2.1 Long-term average monthly rainfall and maximum temperature, and 2020 and 2021 monthly rainfall and maximum temperatures recorded at Newman Aero weather station

The 2020 targeted survey was from 15 to 29 April 2020. Rainfall in the three months preceding the survey was higher than average for the region, with a total of 277.8 mm from January to March 2020. Temperatures during the survey were generally warm during the day, ranging from 33.9 °C to 39.7 °C during the day, and mild at night, ranging from 22.9 °C to 26.6 °C (BOM 2021).

The 2021 targeted survey was from 12-17 May 2021. Rainfall over the three months preceding the survey was above average with substantial falls recorded in February (169mm) and April (56.4 mm). Maximum mean temperatures in the month prior to the survey was 32.1 °C in line with the average. Minimum mean temperatures 17.7 °at night as per the average for Newman.

2.2 Biogeography

2.2.1 IBRA bioregions

The bioregions of Australia are described in the Interim Biogeographic Regionalisation for Australia (IBRA) (Thackway & Cresswell 1995). Bioregions are large, geographically distinct areas of land with common characteristics such as geology, landform patterns, climate, ecological features and plant and animal communities. The latest version, IBRA7, classifies Australia's landscapes into 89 large geographically distinct bioregions and 419 subregions (Department of the Environment and Energy (DotEE) 2012).

The Lamb Creek project is located in the Hamersley (PIL3) subregion of the Pilbara bioregion. The Hamersley subregion comprises the southern section of the Pilbara Craton. It is a mountainous area of Proterozoic sedimentary ranges and plateaux, dissected by gorges (basalt, shale and dolerite). Geographically it is synonymous with the Hamersley vegetation system as described by Beard (1990). The dominant vegetation is mulga low woodland over bunch grasses on fine textured soils in valley floors, and Eucalyptus leucophloia (snappy gum) over *Triodia brizoides* on skeletal soils of the ranges. Regional vegetation is further described in section 2.3. Drainage runs into either the Fortescue River to the north, the Ashburton river to the south, or the Robe river to the west (Kendrick 2001).

2.2.2 Land systems

The Lamb Creek project area traverses five land systems, as mapped by the Western Australian Land Information Authority (2018) and described by Van Vreeswyk *et al*. (2004). These are listed and summarised in Table 2.1.

The majority of the project area falls within the Boolgeeda land system, comprising stony slopes, plains, hills, and drainage floors with spinifex (Table 2.1). This land system underlies the majority of the haul road and resource area.

The Newman land system, comprising rugged mountains, ridges, and plateaux, was the second dominant, intersecting the haul road in two places and covering the south-west and south-eastern corners of the resource area. The McKay and Platform land system occurred in the north-eastern part of the resource area, while the Wannamunna land system only appeared in the southernmost part of the haul road corridor where it intersects the highway.

The vegetation in all but the Wannamunna land system is typified by spinifex grasslands. Wannamunna is characterised by hardpan plains and internal drainage tracts supporting mulga shrublands and woodlands (and occasionally eucalypt woodlands).

Table 2.1 Land systems of the Lamb Creek project area

Name	Land type	Description	Extent
Boolgeeda Land System	Stony plains with spinifex grasslands	Stony lower slopes, stony plains below hills, and narrow sub-parallel drainage floors. Supports hard and soft spinifex grasslands or mulga shrublands. Often occurs below hill systems such as Newman and Rocklea	1330 ha
McKay Land System	Hills and ranges with spinifex grasslands	Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands. Relief up to 100 m	44 ha
Newman Land System	Hills and ranges with spinifex grasslands	Rugged high mountains, ridges and plateaux with near vertical escarpments of jaspilite, chert and shale, supporting hard spinifex grasslands. Relief up to 400 m.	499 ha
Platform Land System	Stony plains with spinifex grasslands	Stony upper plains, dissected slopes and drainage floors, supporting hard spinifex grasslands. Erosional surfaces formed by partial dissection of the old tertiary surface. The gently inclined upper plains have extensive marginal dissection zones with gently inclined to steep slopes. Floors incised up to 30 m with steep stable marginal slopes becoming wider downslope.	198 ha
Wannamunna Land System	Wash plains on hardpan with mulga shrublands	Hardpan plains and internal drainage tracts supporting mulga shrubland and woodlands, and occasionally eucalypt woodlands. Depositional surfaces, level hardpan wash plains subject to overland sheet flow. Broad internal drainage flats receiving run-on from adjacent hardpan surfaces; rare channelled tracts but mostly not organised through drainage. Relief up to 5 m.	126 ha

2.2.3 Geology

The project area is located in the south-west corner of the Roy Hill 1:250,000 Geological Survey Sheet (SF50-12: Thorne & Tyler 1997). The geology of the project area is generally defined by the assemblage of prehnite, pumpellyite, epidote, actinolite. Basement rocks comprise the early Proterozoic Brockman Iron Formation and Weeli Wolli Formation. The Brockman Iron Formation consists of banded iron formation (BIF) and shale, while the Weeli Wolli formation consists of BIF separated by shale and siltstone bands, with younger dolerite sills that intersect the sedimentary sequence.

Regionally, the fresh basement rocks are typically overlain by weathered basement rocks which occur as lateritic and basal gravel and/or conglomerate deposits. These weathered deposits underlie early Tertiary Channel Iron Deposits (CID), which are the dominant economic-grade iron deposits in the region. The CID is typically overlain by younger alluvial and colluvial gravels and sediments (Thorne & Tyler 1997).

The project area overlies the following geological units (Thorne & Tyler 1997).

- Brockman Iron Formation (PLHB): banded iron-formation, chert, and pelite (661 hectares);
- Quaternary Alluvium (Qa): unconsolidated silt, sand, and gravel; in drainage channels and on adjacent floodplains;
- Quaternary Alluvium and Colluvium (Qw): red-brown sandy and clayey soil; on low slopes and sheetwash areas; and
- Cainozoic Colluvium (Czc): partly consolidated quartz and rock fragments in silt and sand matrix; old valley-fill deposits.

2.2.4 Soils

The project area is located within the Fortescue botanical district of the Pilbara region (Beard 1990). This region is mountainous, with soils ranging from shallow, stony sandy loams along slopes, to cracking clays, stripped hardpans and calcareous loams along active waterways (Beard 1990).

The landforms of the project area are typical of the eastern Pilbara with rocky hills, small gorges, mostly seasonal watercourses and gravelly loam valleys. The soils are typified by hard red alkaline soils on plains, pediments and alluvial areas, while shallow, skeletal soils are common on ranges that rise to 1,250 metres (Beard 1990). The southern part of eastern Pilbara region is characterised by earthy loams underlain by red-brown hardpan (Beard 1975, 1990).

The project area has two distinct soil and landform assemblages. The eastern and western edges of R47/19 and the majority of the proposed haul road are characterised as soil unit Fa13 (1039 hectares). The central parts of R47/19 and the area adjacent to the Great Northern Highway are characterised as soil unit Fb3 (1160 hectares). These soil units are defined as follows (CSIRO Australia 2018):

- Fa13 – Ranges of banded jaspilite and chert along with shales, dolomites, and iron ore formations with some areas of ferruginous duricrust as well as occasional narrow winding valley plains and steeply dissected pediments. This unit is largely associated with the Hamersley and Ophthalmia Ranges. The soils are frequently stony and shallow and there are extensive areas without soil cover: chief soils are shallow stony earthy loams (Um5.51) along with some (Uc5.11) soils on the steeper slopes. Associated are (Dr2.33, Dr2.32) soils on the limited areas of dissected pediments, while (Um5.52) and (Uf6.71) soils occur on the valley plains; and
- Fb3 – High-level valley plains set in extensive areas of unit Fa13. There are extensive areas of pisolitic limonite deposits: principal soils are deep earthy loams (Um5.52) along with small areas of (Gn2.12) soils.

2.2.5 Hydrology

Within the Hamersley (PIL3) subregion drainage runs into either the Fortescue River to the north, the Ashburton river to the south, or the Robe river to the west (Kendrick 2001). The majority of the project area falls within the Fortescue River Upper Catchment with a smaller portion occurring within the Ashburton River Catchment. Nine intermittent creek lines bisect the survey area, draining into the larger Marillana Creek, and ultimately into Weeli Wooli Creek within the Fortescue River basin.

2.2.6 Topography

The project area occurs within the central Hamersley Ranges which dominate the sub-region (Thorne & Tyler 1997). The topography of the region is highly mountainous comprising three smaller ranges: Packsaddle Range in the centre, Jirrpalpur Range in the south and the Hancock Range to the north. The uplands of the survey area fall within the western edge of the Hancock Range.

The project area is located on the western edge of the Hancock Range, a location predominantly characterised by plain and valley floor. The south-eastern corner of the survey area contains significant rocky landforms associated with the Hancock Range.

2.3 Vegetation Communities

2.3.1 Botanical district

The Lamb Creek project area is situated in the Fortescue botanical district of the Pilbara region (Beard 1990), which forms part of the Eremaean Botanical Province. The Pilbara region receives a slightly higher than average rainfall compared to most of the Eremaean, due to the prevalence of cyclones off the coast, but this is not enough to modify the essentially desert appearance of the plant cover (Beard 1990).

The Fortescue botanical district consists predominantly of tree and shrub steppe communities with Eucalyptus trees, Acacia shrubs and spinifex grasses including *Triodia pungens* and *T. wiseana* (Beard 1975). Mulga (species of the *Acacia aneura* complex) occurs in valleys and short-grass plains may be present on alluvial soils (Beard 1990).

2.3.2 Vegetation system-associations

Digital maps (shapefiles) of pre-European vegetation communities, based on state-wide mapping by J.S. Beard at 1:250,000 scale, are published by the Department of Primary Industries and Regional Development (Beard 2018).

Vegetation of the Hamersley (PIL3) IBRA subregion is generally low Mulga woodland over bunch grasses on fine textured soils in the valleys with snappy gums (*Eucalyptus leucophloia*) over *Triodia brizoides* on skeletal soils of the ranges (Kendrick 2001). The mountain tops and gorges of the Hamersley subregion provide refugia for humidophile and/or fire intolerant flora, and support a diversity of range-restricted species (Kendrick 2001).

Beard (1975) mapped the vegetation system-associations of the project area as Hamersley 18: Low woodland of Acacia aneura, and Hamersley 82: Hummock-grass (*Triodia wiseana*) steppe with irregularly scattered *Eucalyptus brevifolia* trees; and Hamersley 18: Low woodland of *Acacia aneura*.

Table 2.2 Beard vegetation system-associations within the Lamb Creek project area (R47/19 and L47/736)

Beard Vegetation System and Association	Extent in project area	Total current extent in Australia (ha) [1)]	Pre-European extent remaining (%) [1)]
Hamersley 18	1297 ha	575 852 ha	99.2%
Hamersley 82	902 ha	2 157 841 ha	99.4%

Footnotes: 1) Numbers from 2018 Statewide Vegetation Statistics (DBCA 2019)

Vegetation that is not a Threatened or Priority Ecological Community may still be considered significant if it has a restricted distribution, or has experienced a degree of historical impact from threatening processes (EPA 2016a). Vegetation types retaining less than 30% of their pre-European extent generally experience accelerated species loss at an ecosystem level (EPA 2000) and are regarded as being 'vulnerable', while vegetation types retaining less than 10% of their original extent are regarded as being 'endangered' (EPA 2000, Shepherd *et al.* 2002, DER 2014a, 2016a).

As presented in Table 2.2, the Hamersley 18 and Hamersley 82 vegetation system-associations intersected by the project area still have close to 100% of their original extent remaining, and would be considered 'least concern' (DER 2014a).

2.3.3 Lamb Creek vegetation mapping

To date two detailed flora and vegetation surveys have been completed at Lamb Creek, in 2012 and 2021, as summarised in Table 2.3. The survey areas partially overlapped, together covering 1605 hectares (73%) of the project area. Approximately 594 hectares (27%) of the current Lamb Creek project area remains unsurveyed (beyond Rapallo's scope of works).

Table 2.3 Existing flora and vegetation surveys

Report title	Survey dates	Survey coverage over project area
Rapallo (2012) Level 2 flora and vegetation survey of the Lamb Creek project	March-April 2012	1394 hectares (63%) of the current project area including entirety of R47/19 and 45% of L47/746
Rapallo (2021a) Detailed flora and vegetation survey of the Great Northern Highway intersection area of the Lamb Creek project	May 2021	252 hectares (11%) of the current project area, comprising southern end of L47/1008

The majority of the project area has been burnt over recent years (after the 2012 survey), with some parts burnt several times (section 2.5). Floristic data and site photos collected in 2020 and 2021 indicate that these fires have changed both vegetation structure and floristic composition relative to 2012 (Rapallo 2021a). The 2021 survey was completed post-fire, but only overlapped with the 2012 survey area by 41 hectares. Re-surveying the 2012 vegetation mapping was beyond Rapallo's scope of works.

2.3.3.1 Lamb Creek flora and vegetation survey March-April 2012

The 2012 flora survey recorded six vegetation types, as listed in Table 2.4. The most widely occurring vegetation type in 2012 was VT1 described as *Eucalyptus gamophylla* woodland over hummock grassland (Table 2.4).

Table 2.4 Vegetation types of the Lamb Creek project area recorded in 2012 (Rapallo 2012).

Type	Vegetation description (2012)	Substrate/Landform	Land System
VT1 – *Eucalyptus gamophylla* woodland over hummock grassland	*Eucalyptus gamophylla* low open woodland over *Acacia elachantha* or **Acacia hilliana*, *Senna glutinosa* subsp. *pruinosa* open shrubland over *Triodia brizoides*, *Triodia wiseana* hummock grassland.	Clay loams with BIF and ironstone pebbles and gravel on open plains and gentle rises.	Boolgeeda, McKay, Newman, Platform
VT2 – *Eucalyptus leucophloia* subsp. *leucophloia* woodland over mixed shrubs over *Triodia wiseana* grassland	*Eucalyptus leucophloia* subsp. *leucophloia*, *Eucalyptus gamophylla* low open woodland over mixed species (typically *Gossypium robinsonii*, *Acacia hilliana*, *Grevillea wickhamii*, *Seringia nephrosperma*) scattered shrubs over *Triodia wiseana* hummock grassland.	Clays and clay loams with BIF and ironstone pebbles, cobbles, and sheetrock in gorges and rocky creeklines and on hillsides and breakaways.	Boolgeeda, Platform
VT3 – *Acacia* shrubland over hummock grassland	*Acacia bivenosa* or *Acacia adsurgens* open shrubland over *Triodia vanleeuwenii*, *Triodia wiseana* hummock grassland.	Sandy clay with ironstone gravel and pebbles on gentle slopes at bases of hills.	Boolgeeda, Newman
VT4 – *Acacia tumida* var. *pilbarensis* scrub in creeklines	*Acacia tumida* var. *pilbarensis* tall open scrub over *Themeda triandra* tussock grassland and *Triodia wiseana* open hummock grassland.	Clay loam and sandy clay with laterite pebbles in drainage lines.	Boolgeeda, Platform

Type	Vegetation description (2012)	Substrate/Landform	Land System
VT5 – Wannamunna Mulga grove	*Acacia aptaneura* low woodland over *Themeda triandra*, *Cymbopogon ambiguus*, *Chrysopogon fallax* open tussock grassland.	Sandy clay and clay on flat plains.	Boolgeeda, Wannamunna
VT6 – *Acacia aptaneura* over hummock grassland	*Acacia aptaneura* and/or *Corymbia deserticola* low woodland over *Acacia elachantha* and mixed *Eremophila* species over *Triodia wiseana* very open hummock grassland.	Broad open drainage system through stony plains with clay soils.	Boolgeeda, Wannamunna

2.3.3.2 Lamb Creek flora and vegetation survey May 2021

The 2021 survey was completed post-fire. Six vegetation types were recorded, and vegetation mapping was revised for the overlap area with the 2012 survey. The entirety of the 2012 vegetation type VT6 has been superseded by 2021 vegetation types C and D, while VT5 occurring in the overlap area has been superseded by 2021 vegetation types A, B, C and D.

Table 2.5 Vegetation types of the Great Northern Highway intersection recorded in 2021 (Rapallo 2021a)

Type	Vegetation description (2021)	Substrate	Land System
A - Low open *Eucalyptus gamophylla* woodland over *Triodia melvillei* and *T. pungens* on stony plain	*Eucalyptus gamophylla* (mallee) and *Corymbia deserticola* subsp. *deserticola* low open woodland; over *Acacia pruinocarpa*, *A. ancistrocarpa*, *A. atkinsiana* sparse shrubland; over isolated low shrubs; over isolated dwarf shrubs; over *Ptilotus calostachyus*, *Ptilotus obovatus*, *Trichodesma zeylanicum* var. *zeylanicum* sparse forbland; over *Triodia melvillei* and *Triodia pungens* sparse hummock grassland.	Stony plain	Boolgeeda (primarily), Wannamunna (minor extent)
B - Mulga and acacia low open woodland over open tussock grassland on gently sloping (drainage) plain with variable rock cover	*Acacia aptaneura* and *A. pruinocarpa* low open woodland; over sparse tall shrubland including *Eremophila longifolia* and *Santalum lanceolatum*; over mixed isolated shrubs to sparse shrubland; over isolated forbs to open forbland dominated by *Pterocaulon sphacelatum*, *Ptilotus obovatus*, and *Arivela viscosa*; over sparse to medium-dense tussock grassland dominated by *Aristida inaequiglumis*, *A. contorta* and *Themeda triandra*.	Gently sloping clay-loam plain with minor drainage channels and surface drainage	Boolgeeda
C - Mulga and acacia low open woodland over open spinifex and tussock grassland on flat plain with medium rock cover	*Acacia aptaneura*, *A. pruinocarpa* low open woodland with occasional *Corymbia deserticola*; over isolated tall shrubs to sparse tall shrubland dominated by *Hakea lorea* subsp. *lorea*, *Acacia elachantha*, *A. aptaneura*, *A. pruinocarpa*, *Santalum lanceolatum*; over isolated medium to dwarf shrubs; over sparse forbland dominated by *Pterocaulon sphacelatum*, *Arivela viscosa*, *Ptilotus obovatus*; over *Triodia pungens* and *T. melvillei* open hummock grassland, with *Themeda triandra*, *Aristida inaequiglumis*, and *A. contorta* open tussock grassland.	Clay-loam plain	Boolgeeda (primarily) Wannamunna (minor extent)

Type	Vegetation description (2021)	Substrate	Land System
D - Mulga, *Hakea lorea*, and *Eucalyptus xerothermica* low open woodland over closed tussock grassland on gently sloping clay-loam plain (no rocks)	Low open woodland of *Acacia aptaneura*, *Hakea lorea* subsp. *lorea*, and *Eucalyptus xerothermica*; over isolated tall to dwarf shrubs; over sparse forbland to isolated forbs dominated by *Pterocaulon sphacelatum*; over closed tussock grassland dominated by *Themeda triandra*, with *Aristida inaequiglumis* and *A. contorta*.	Gently sloping clay-loam plain without rocks	Wannamunna (primarily), Boolgeeda (minor extent)
E - Low mulga woodland over sparse understorey on stony plain	*Acacia aptaneura* low mulga woodland; over *Acacia pachyacra* and *A. ?sibirica* sparse shrubland; over isolated dwarf shrubs; over isolated forbs and ferns; over *Digitaria ammophila*, *Chrysopogon fallax*, *Aristida inaequiglumis* sparse tussock grassland.	Flat stony plain	Boolgeeda
F - *Triodia wiseana* hummock grassland with emergent shrubs and low trees on gently sloping stony plain	*Corymbia hamersleyana* and *Corymbia deserticola* subsp. *deserticola* isolated low trees; over isolated tall shrubs; over *Acacia ancistrocarpa* and mixed *Acacia* spp. sparse shrubland; over isolated dwarf shrubs; over isolated forbs; over *Triodia wiseana* hummock grassland.	Gently sloping stony plain	Boolgeeda

2.3.4 Weeds recorded in the Lamb Creek project area

Eleven weed species have been recorded from the Lamb Creek project to date during the 2012 and 2021 detailed flora and vegetation surveys, as listed in Table 2.6. Weed status is as per the Western Australian Organism List maintained by the Department of Agriculture and Food (DAFWA 2021). None of these weeds are listed as a Declared Pest under the Biosecurity and Agriculture Management Act 2007 (Australian Government 2012, DAFWA 2021).

Table 2.6 Weeds recorded during the 2012 and 2021 detailed flora surveys

Taxonomic Name 2021	Common name	Status 2021 (WAOL)	2012	2021
**Acacia hilliana*	Hill's tabletop wattle	Permitted - s11	9	
**Aerva javanica*	Kapok bush	Permitted - s11		1
**Bidens bipinnata*	Bipinnate beggartick	Permitted - s11	9	16
**Cenchrus ciliaris*	Buffel grass	Permitted - s11	1	30
**Cenchrus setiger*	Birdwood grass	Permitted - s11		12
**Chloris virgata*	Feathertop Rhodes grass	Permitted - s11	1	
**Malvastrum americanum*	Spiked malvastrum	Permitted - s11	1	15
**Melinis repens*	Red natal grass	Permitted - s11		1
**Portulaca oleracea*	Purslane	Permitted - s11	9	9
**Solanum lasiophyllum*	Flannel bush	Permitted - s11	24	6
**Stylosanthes hamata*	Southern pencilflower	Permitted - s11		2

*Footnotes: * indicates a flora taxon is alien to Western Australia, as per FloraBase (WA Herbarium 1998)*

2.4 Reserves and environmentally sensitive areas

Environmentally sensitive areas (ESAs) are protected under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* and are selected for their environmental values at state or national levels. The project area does not occur within an ESA, nor are there any ESAs within five kilometres of the project area, as shown by the Department of Environment Regulation (DER) Native Vegetation Map Viewer (DER 2014b).

Karijini National Park is located to the west of the project area, approximately 18 kilometres west of the intersection of the proposed haul road and the Great Northern Highway. Mungaroona Range Nature Reserve is approximately 100 kilometres northwest of the project area. The nearest Nationally Important Wetland is the Fortescue Marsh located 52 km north of the survey area (AWE 2021).

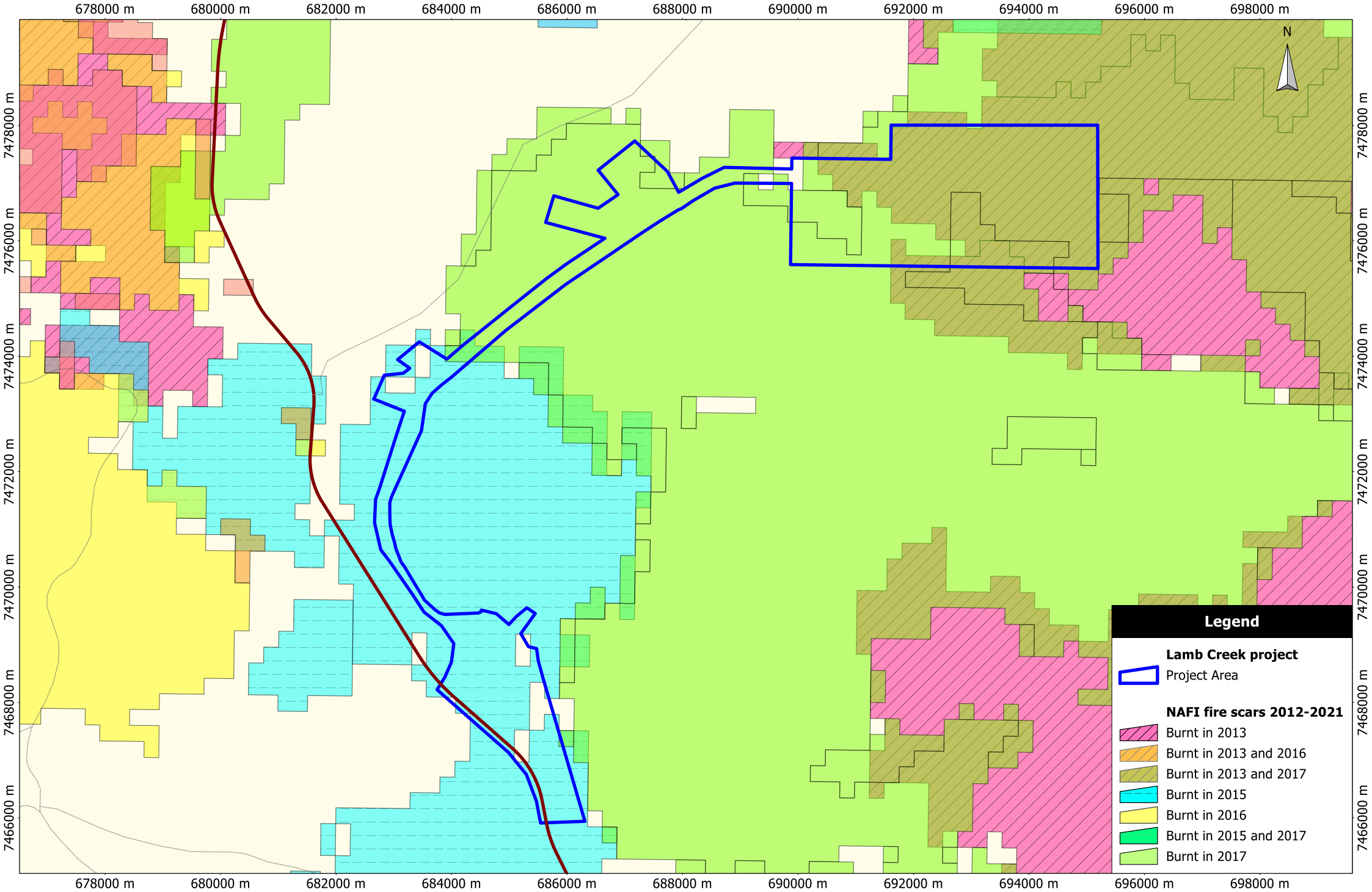
Survey data from 2012 and 2021 indicates that no currently listed Threatened or Priority Ecological Communities (TEC-PEC) occur within the surveyed parts of the Lamb Creek project (Rapallo 2012, 2021a). Further details in section 4.1.2.

2.5 Fire history

Fire mapping for Australia is available from the Northern Australia and Rangelands Fire Information (NAFI 2021) website, with fire scar data available from 2000 to present. The NAFI service displays maps of fire activity based on information from satellites, such as hotspots (locations of recently burning fires) and fire scars (maps of recently burnt country).

The majority of the project area has been burnt over recent years (after the 2012 survey), with some parts burnt several times (NAFI 2021), resulting in a mosaic of different fire ages. Floristic data and site photos collected in 2020 and 2021 indicate that these fires have changed both vegetation structure and floristic composition relative to 2012 (Rapallo 2021b).

Fire mapping over the project area between 2012 and 2021 (NAFI 2021) is shown in Figure 2.2. It must be noted that NAFI data is very broad-scale and does not show the fine-scale mosaic within the project area, nor does the mapping indicate fire intensity.



Rapallo environmental

Mineral Resources Limited
Lamb Creek Project

Lamb Creek Iron Ore Project
Targeted conservation significant flora survey (April 2020, May 2021)

Original Size: A4 Scale: 1:80,000
Datum: MGA94 Zone 50
0 3 km

Figure 2.2

NAFI fire scars across the Lamb Creek project area between 2012 and 2021

3 Methods

3.1 Desktop study

The flora desktop study comprised a search of paid and free databases, and a review of available literature relevant to the survey area. The desktop review served to compile a list of conservation significant flora taxa with the potential to occur within the survey area. Conservation codes for Australian flora are detailed Appendix I. Database search parameters are outlined in Table 3.1.

Table 3.1 Flora database search parameters

Source of information	Search area
DBCA (2021a) Threatened and Priority Flora Database (including WA Herbarium database records)	60 km radius centred on project area
DBCA (2021b) Threatened and Priority Ecological Communities (TEC-PEC) database	50 km radius centred on project area
DBCA (2021c) NatureMap online database	40 km radius centred on the project area
Department of Agriculture Water and the Environment (AWE) (2021) Protected Matters search tool	50 km radius centred on the project area

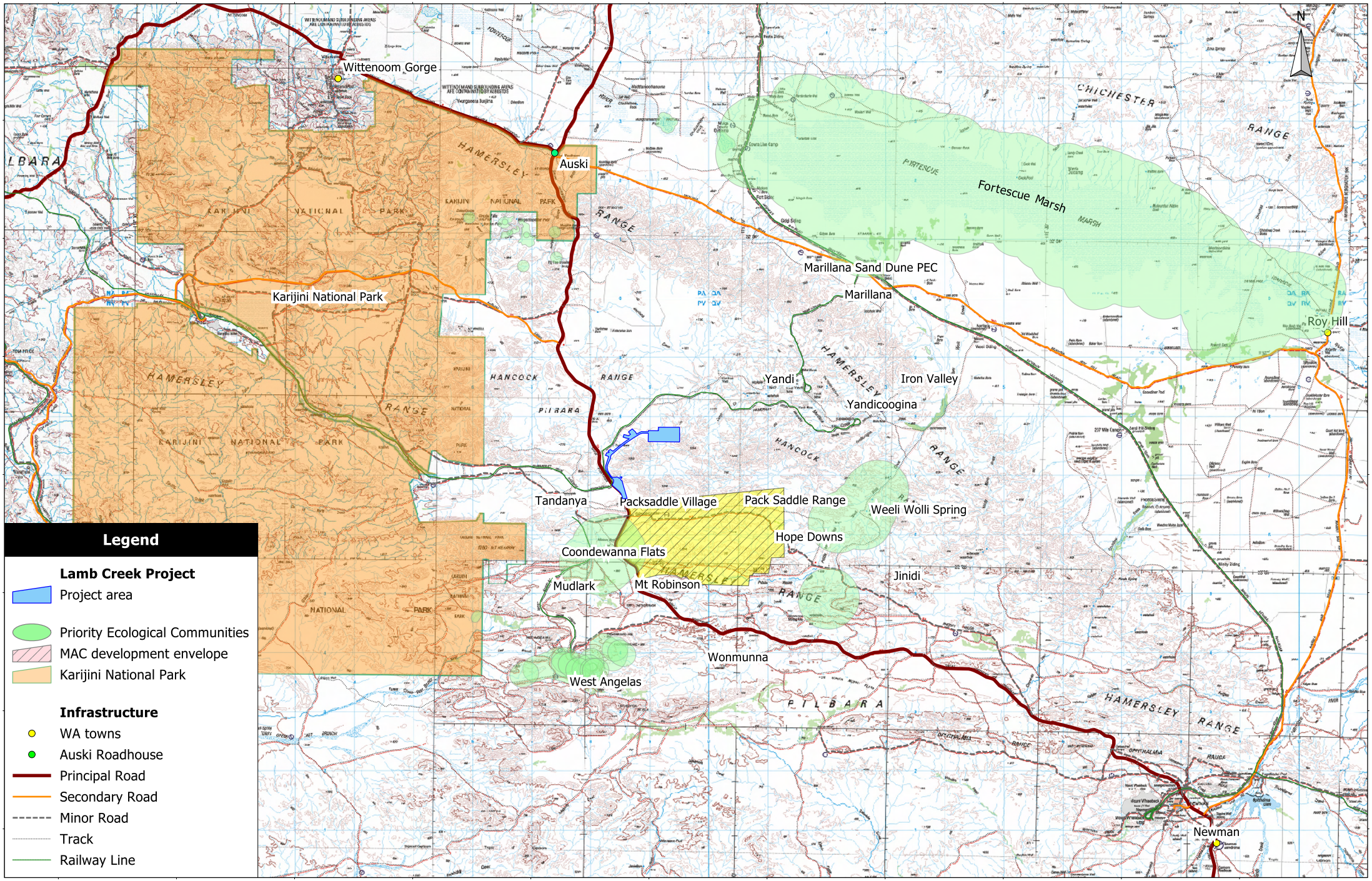
The region has had considerable flora survey effort over the last 20 years predominantly due to flora and vegetation surveys completed within, or partly within, the boundary of the Mining Area C (MAC) Development Envelope between 1997 and 2014. The MAC Development Envelope is approximately 10 kilometres (km) south of R47/19 as showed in the inset map of Figure 1.2 and in Figure 1.3 which provides regional context for the Lamb Creek project. The surveys used as part of the literature review are listed in Appendix II and generally occurred within 50 kilometres of the Lamb Creek project area.

The conservation significant taxa identified in the desktop were reviewed for likelihood of occurrence within the survey area, based on the likelihood categories outlined in Table 3.2. Field based habitat information was only available for 73% of the project area (section 2.3.3). Likelihood scores for the areas not visited by the field team are based on desktop information only. Desktop results and likelihood assessment are presented Appendix II.

Table 3.2 Likelihood assessment criteria

Rank	Criteria
Confirmed	1. The species was recorded on the project area; or 2. The species was recorded directly adjacent (within 500 m) of the project area from habitat continuing into the project area.
Likely to occur	1. There are existing records of the species in close proximity to the project area (within 20 km); and • the species is strongly linked to a specific habitat, which is present in the project area; or • the species has more general habitat preferences, and suitable habitat is present.
May potentially occur	1. There are existing records of the species from the region (within 30 km), however: • the species is strongly linked to a specific habitat, of which only a small amount is present in the project area; or • the species has more general habitat preferences, but only some suitable habitat is present.

Rank	Criteria
	2. There is suitable habitat in the project area, but there are very few or only very old (1999 or before) records from the region.
Unlikely to occur	1. The species is linked to a specific habitat, which is absent from the project area; or 2. Suitable habitat is present, however there are no existing records of the species from the locality despite reasonable previous search effort in suitable habitat; or 3. There is some suitable habitat in the project area, however the species is very infrequently recorded in the locality.
Highly unlikely to occur	1. The species is strongly linked to a specific habitat, which is absent from the project area; and/or 2. The species' range is very restricted and would not include the project area.



Rapallo environmental

Mineral Resources Limited
Lamb Creek Project

Lamb Creek Iron Ore Project
Targeted conservation significant flora survey (April 2020, May 2021)

Original Size: A4 Scale: 1:800,000
Datum: MGA94 Zone 50
0 25 km

Figure 3.1

Regional localities

3.2 Field Survey

The survey area was searched over two survey periods, with each period covering a different part, as outlined in section 1.3 and Table 1.3, and mapped in Figure 3.2. The survey teams are listed in Table 3.3. The first survey period was 15-19 April 2020, and the second survey period was 12-17 May 2021.

The survey methods were in accordance with EPA (2016b) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* and aligned with the criteria for a targeted survey.

The targeted survey area as defined in section 1.3 was searched via systematic parallel traverses, spaced approximately 50 meters apart (Figure 3.2). Traverse lines were drawn in a GIS program prior to the survey and uploaded onto hand-held Garmin GPS units for ease of navigation. The spacing of the traverses was determined with consideration given to the openness of the vegetation being surveyed, and the size and visibility of the target species. Where a target species was encountered, survey effort was intensified to locate additional individuals and/or map the extent of populations. Survey effort was also intensified within restricted or unusual landforms such as creek lines, outcroppings, or distinctive soil types.

Additional searches outside of the defined survey areas listed in Table 1.1 were completed to map the extent of conservation significant flora populations beyond the survey area boundaries, as per EPA (2016b) technical guidance, and to opportunistically search areas outside of the 2020 footprint.

During the 2020 survey, additional areas within R47/19 outside the defined survey area were searched opportunistically on foot by means of two traverses selected to sample habitats suitable to several of the target taxa which were not (well) represented in the defined survey area. These habitats included gorges and gullies, elevations greater than 900 m, south facing slopes, and larger creek lines.

Additional reconnaissance work was also completed by helicopter in 2020 to determine the extent of a large population of *Aristida lazaridis* (P2) recorded in the area adjacent to the Great Northern Highway. Identification of this grass from the air was possible because it was noted during the survey that clumps of *A. lazaridis* are distinctly visible from the air when in flower, as shown in Plate 1. During the reconnaissance flights, GPS waypoints were taken from the air, with selective waypoints subsequently ground-truthed on foot.

During the May 2021 survey, helicopters were not provided, and the survey area was small and directly adjacent to a major road. For this reason, searches for conservation significant taxa and mapping population boundaries outside of the defined survey area occurred on foot and from a vehicle.

Plate 1 ***Aristida lazaridis*** **clumps in flower as visible from the air during the 2020 field survey.**

3.2.1 Specimen collection and identification

Flora specimens were collected and pressed as per Western Australian Herbarium (2008) guidelines. Each specimen was assigned a unique field name and field number and was marked with a plant tag containing specimen and location information. All specimens were pressed and dried on the day of collection. Fragile material such as flowers, seed capsules, or very small specimens were sealed in paper bags which were marked as per the plant tags.

Taxonomic identification of flora specimens was completed by Sharnya Thomson-Yates (Table 3.3) (who was also a member of the 2021 field survey team) with the use of the WA Herbarium reference collection, latest flora identification keys, and recent scientific publications.

As per section 7.2 of EPA (2016b) and under flora licence conditions, suitable voucher specimens will be lodged with the Western Australian Herbarium.

3.3 Personnel and licensing

The personnel involved in the field survey, taxonomic identification, and the preparation of this report are listed in Table 3.3. Flora specimens were collected under Flora Taking (Biological Assessment) Licences pursuant to Regulation 62 of the *Biodiversity Conservation Regulations 2018*. As part of the license requirements, a copy of this report will be forwarded to the DBCA.

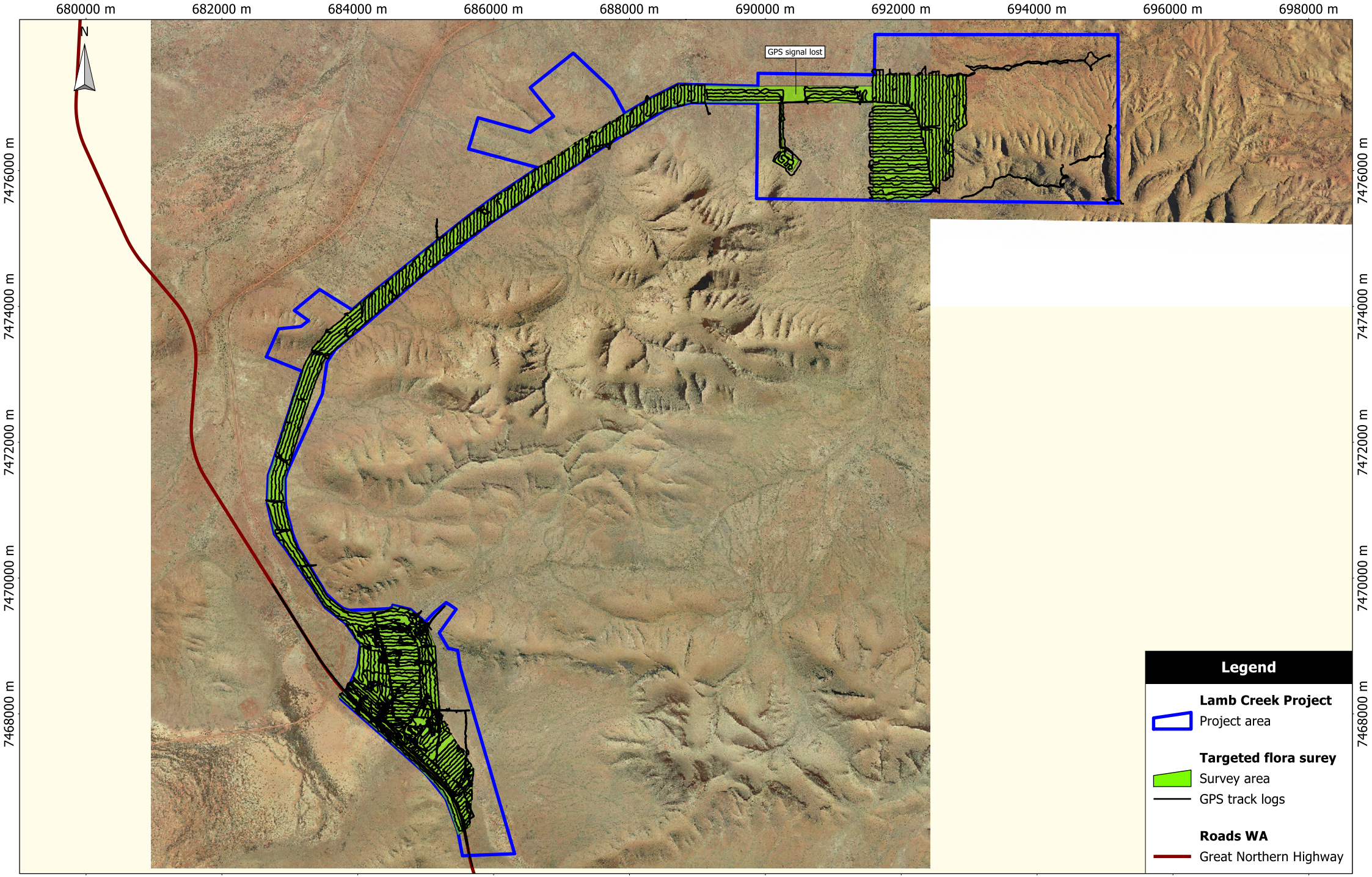
Table 3.3 Personnel involved in the project

Name	Position	Survey 1	Survey 2	Taxonomy	Reporting
Kate George	Principal Environmental Scientist				•
Marieke Weerheim	Senior Environmental Scientist	•	•		•
Cielito Marbus[1)]	Botanist	•			•
Daniel Marsh[2)]	Senior Botanist	•			
Sharnya Thomson-Yates[3)]	Botanical Taxonomist and Senior Botanist		•	•	
Linda Dalgliesh[4)]	Senior Botanist		•		
Joshua Gilovitz[5)]	Senior Botanist		•		

Footnotes: 1) Licence number FB62000066-2; 2) License number FB62000074-2 and TFL 14-1920; 3) License number FB62000183; 4) License number FB6200067-3; 5) License number FB62000331.

3.4 Nomenclature and conservation listing

Flora taxonomy and nomenclature follows FloraBase (WAH 1998-). FloraBase, the Western Australian Herbarium database (via NatureMap DBCA 2021c and the Threatened and Priority Flora database search DBCA 2021a) was utilised to verify conservation codes, distribution records, habitat requirements, and flowering times for the target taxa. Conservation codes cited in this report are as per Appendix I. Conservation codes on FloraBase are the most up to date, whereas the DBCA Threatened (Declared Rare) and Priority Flora List (DBCA 2018) was last updated on 5 December 2018.



Rapallo environmental

Mineral Resources Limited
Lamb Creek Project

Lamb Creek Iron Ore Project
Targeted conservation significant flora survey (April 2020, May 2021)

Original Size: A4 Scale: 1:70,000
Datum: MGA94 Zone 50
0 2 km

Figure 3.2

Systematic traverses walked during the targeted survey (50 m spacing)

4 Results

4.1 Flora desktop study

4.1.1 Conservation significant taxa

The desktop study found 86 significant vascular flora taxa from within 60 kilometres of the project area, with proximal records mapped in Figure 4.1. An assessment was completed as per Table 3.2 in section 3.1 to estimate the likelihood of occurrence within the project area for each of the conservation significant species identified via the database searches and literature review. Likelihood ranking was updated post-field based on habitat information.[1] Search results and likelihood ranking are presented in Appendix II and summarised in Table 4.1.

Table 4.1 Summary of Lamb Creek desktop results for conservation significant taxa

Likelihood ranking	Status[1]						Total taxa
	VU[2]	CR[3]	P1	P2	P3	P4	
Confirmed	1			1	4	1	**7**
Likely to occur			1	1	3	2	**7**
May potentially occur			1	1	2		**4**
Unlikely to occur		1	7	14	32	4	**58**
Highly unlikely to occur			4	1	5		**10**
Grand Total	**1**	**1**	**13**	**18**	**46**	**7**	**86**

Footnotes:
1. P = Priority (administered by DBCA; Biodiversity Conservation Act 2016 (BC Act)), VU = Vulnerable, CR = Critically Endangered.
2. Listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and BC Act,
3. Listed BC Act only. Refer to Appendix I for detailed explanation of conservation codes.

Two species listed as vulnerable and critically endangered were returned via the threatened and priority flora database search (DBCA 2021a) and the protected matters search (AWE 2021).

- *Thryptomene wittweri* listed as vulnerable under the BC Act and EPBC Act was assessed as unlikely to occur due to habitat requirements and distance of records from the project area (>20 kilometres). This species is not discussed further in this report.
- *Seringia exastia* listed as critically endangered under the BC Act is discussed in section 5.1.1.

Most records were DBCA listed priority flora taxa and the greater majority (80%) were ranked as unlikely to highly unlikely to occur within the Lamb Creek project area (Appendix II). These priority taxa are not discussed further in this report.

Seven conservation significant taxa were confirmed to occur, these are discussed in section 5.1. Eleven significant taxa were assessed as likely to occur, or may potentially occur on the project area, and are discussed in section 5.2.

[1] Habitat information is only available for 73% of the project area, the majority of which has been collected pre-fire.

4.1.2 Conservation significant vegetation

4.1.2.1 Listed conservation significant vegetation

Survey data from 2012 and 2021 indicates that no currently listed TEC or PEC occur within the surveyed parts (73%) of the Lamb Creek project. The nearest known PEC is subtype 2 of the Coolibah-Lignum Flats vegetation community, with the edge of the buffer zone located less than five kilometres south of the survey area (DBCA 2021b) as shown in Figure 4.1.

The Coolibah-Lignum Flats vegetation complex is described as: Woodland or forest of *Eucalyptus victrix* (coolibah) over thicket of *Duma florulenta* (lignum) on red clays in run-on zones. Associated species include *Eriachne benthamii*, *Themeda triandra*, *Aristida latifolia*, *Eulalia aurea* and *Acacia aneura* (DBCA 2021d).

Three sub-types have been identified, of which sub-type 2 occurs near the project with the edge of the buffer zone less than five kilometres from the southern edge of the project area (Figure 3.1, Figure 4.1).

1. Coolibah and mulga (*Acacia aneura*) woodland over lignum and tussock grasses on clay plains (Coondewanna Flats and Wanna Munna Flats) – Priority 3
2. Coolibah woodlands over lignum (*Duma florulenta*) over swamp wandiree (Lake Robinson is the only known occurrence) – Priority 1
3. Coolibah woodland over lignum and silky browntop (*Eulalia aurea*); two occurrences known on Mt Bruce Flats – Priority 1

The 2012 flora and vegetation survey concluded that the Coolibah-Lignum Flats PEC is unlikely to occur in the survey area because neither Coolibah (*E. victrix*) nor lignum species were recorded (Rapallo 2012). These results were supported by the 2021 detailed flora survey (Rapallo 2021a).

Onshore (2013b) reviewed vegetation mapping within Coodewanna Flats and Lake Robinson and confirmed fine-scale mapping for the two sub-types of the Coolibah-lignum Flats. They concluded that the Priority 1 sub-type 2 lies at the lowest point of the Coondewanna Flats associated with Lake Robinson, and the Priority 3(i) sub-type 1 occurs on alluvial flats (Coondewanna Flats) around Lake Robinson, to the south and found that the Great Northern Highway divides the PEC to the west from the MAC Development Envelope. Based on the Onshore (2013b) mapping, the PEC occurs ca. 12 kilometres to the south of the Lamb Creek project area.

4.1.2.2 Locally significant vegetation

Vegetation may be of significance for reasons other than a listing as a TEC or a PEC. This may include, although is not limited to, scarcity, combination of species, role as a refuge, restricted distribution and vegetation extent being below a threshold level (EPA 2004).

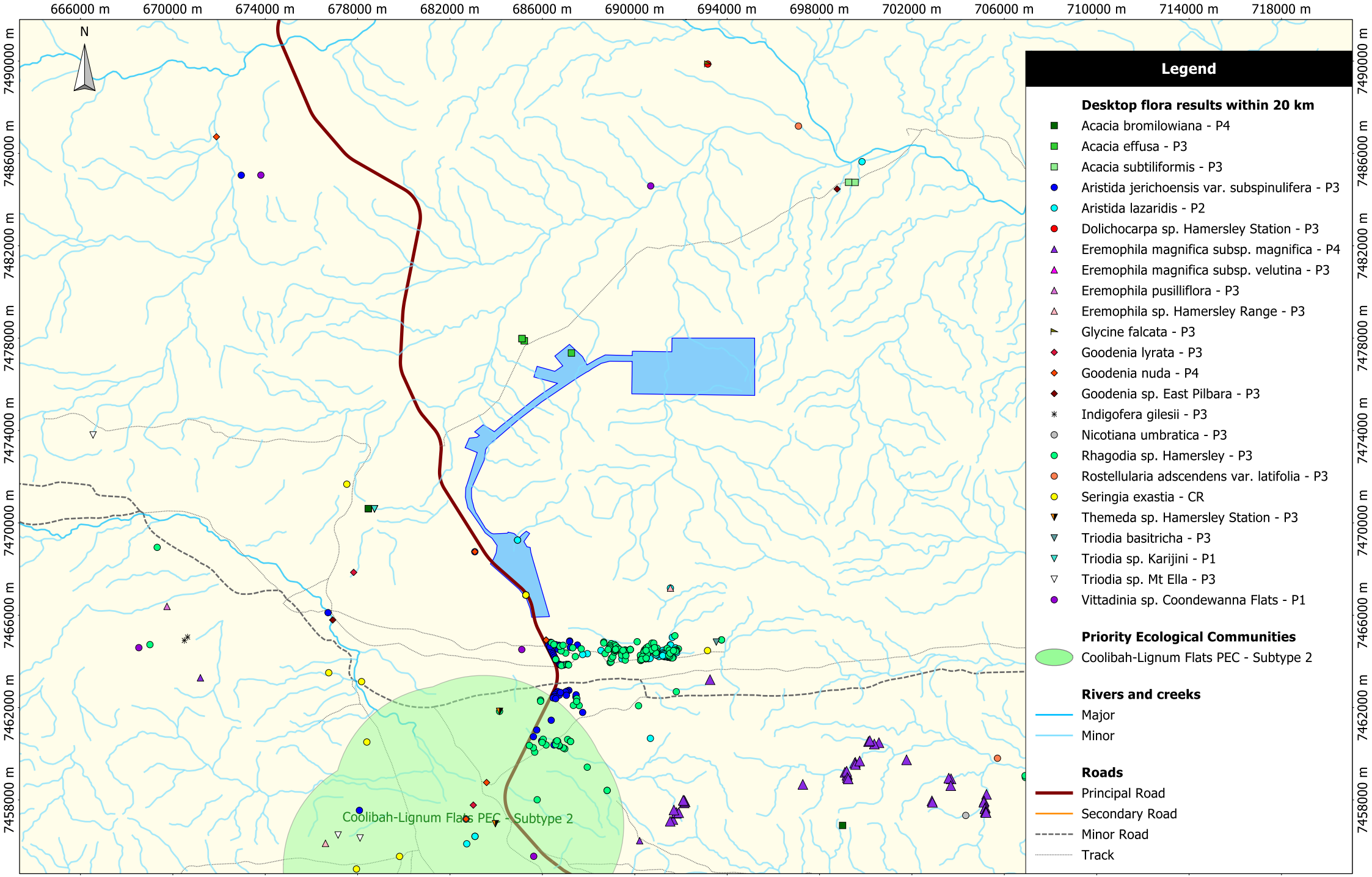
Local significance can be determined where a vegetation type is confined to a specialised habitat and/or landform that is not common in the local area or the vegetation types are supporting conservation significant species or groundwater dependent species.

Vegetation types A, B, C and D recorded in the 2021 survey of the Great Northern Highway intersection area are considered locally significant due to supporting the Priority 2 listed grass *Aristida lazaridis*, as well as other conservation significant species (Rapallo 2021a).

Vegetation types B, C, D and E are also considered locally significant because they contain *Acacia aptaneura* (mulga) as the dominant upper storey species on stony or clay plains and floodplains (Rapallo

2021a). This matches the broad description of ‘valley floor mulga’ which is listed by Kendrick as one of the “ecosystems at risk” (Kendrick 2001).

None of the flora taxa recorded during the 2012 and 2021 flora surveys were indicative of groundwater dependent vegetation. It must be noted that these surveys only covered 73% of the current project aera.



Rapallo environmental

Mineral Resources Limited
Lamb Creek Project

Lamb Creek Iron Ore Project
Targeted conservation significant flora survey (April 2020, May 2021)

Original Size: A4 Scale: 1:200,000
Datum: MGA94 Zone 50
0 5 km

Figure 4.1

Desktop records of conservation significant flora within 20 km of the Lamb Creek project

4.2 Field survey results

4.2.1 Conservation significant flora species recorded

The targeted flora survey of Lamb Creek recorded eight significant flora taxa. These included one threatened taxon, six priority flora taxa and one taxon considered significant for other reasons as per EPA (2016a, 2016b). Each of these eight taxa is discussed in detail in section 5.1.

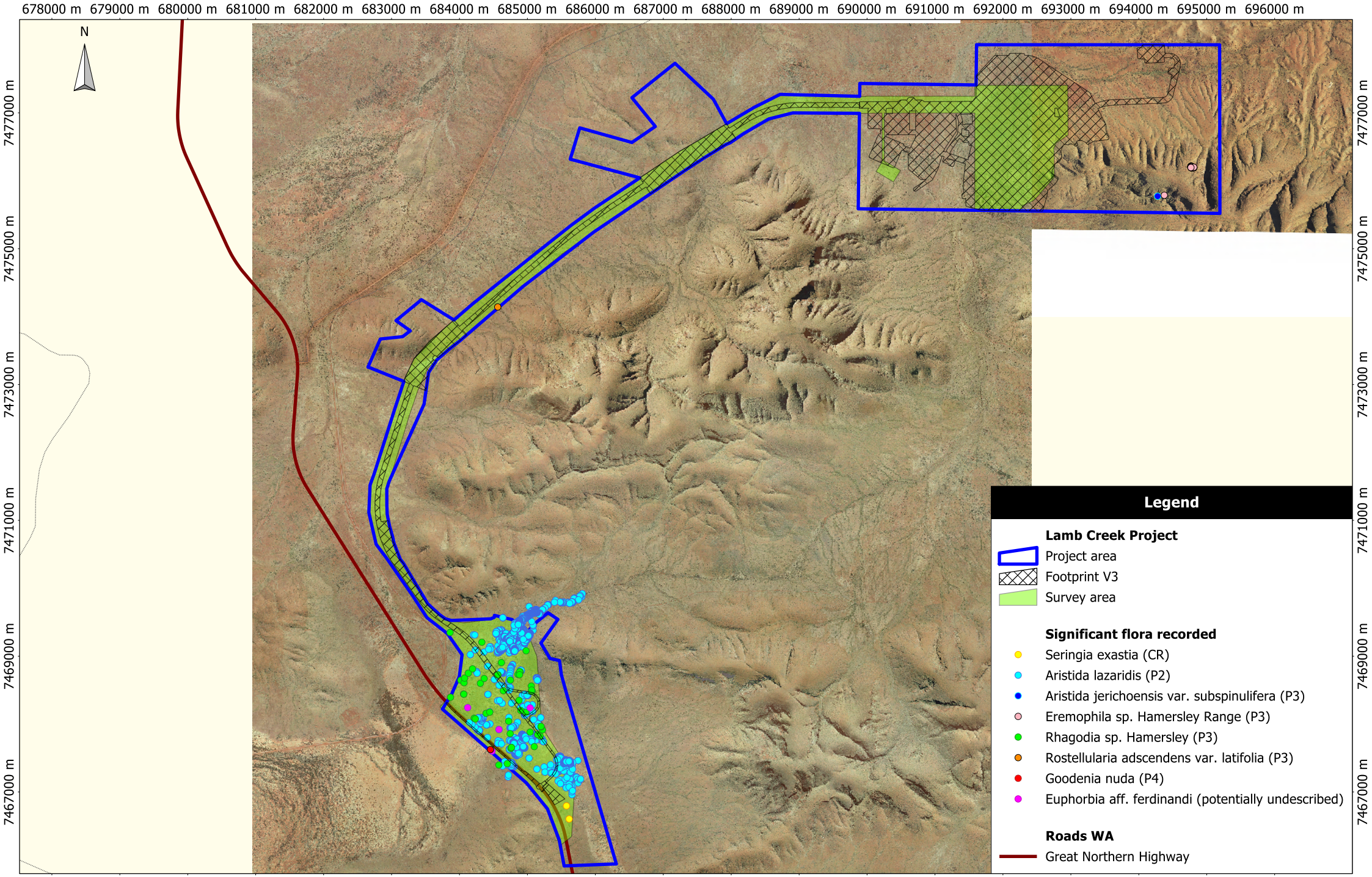
The estimated number of individual plants of each taxon recorded inside and outside the project area, targeted survey area, and footprint V3 are listed in Table 4.2.

Table 4.2 Conservation significant flora taxa recorded during the survey

Taxon	Status	Survey area[1, 2]		Project area[1, 3]		Footprint V3[1, 4]	
		In	Out	In	Out	In	Out
Seringia exastia	Critically Endangered	2		2			2
Aristida lazaridis	Priority 2	8596	4177	9816	2957	75	12698
Aristida jerichoensis var. *subspinulifera*	Priority 3		50	50			50
Eremophila sp. Hamersley Range	Priority 3		36	36			36
Goodenia nuda	Priority 4	50		50			50
Rhagodia sp. Hamersley (M. Trudgen 17794)	Priority 3	49	1	49	1	5	45
Rostellularia adscendens var. *latifolia*	Priority 3	1		1			1
Euphorbia aff. *ferdinandi*	Potentially undescribed	4		4			4

Footnotes:
1) Numbers represent the estimated number of individual plants recorded.
2) Numbers outside the defined survey area were counted opportunistically and while mapping population boundaries.
3) The targeted survey covered 869 hectares (40%) of the project area.
4) The targeted survey covered 421 hectares (64%) of footprint V3.

An overview map of all conservation significant flora recorded during the 2020 and 2021 targeted flora survey is presented in Figure 4.2. The greatest number of different conservation significant flora taxa, as well as the greatest number of individual plants, was recorded in the Great Northern Highway intersection area, as mapped in Figure 4.3. The opportunistic traverses into habitats not covered by the defined survey area recorded an additional two taxa as mapped in Figure 4.4. Conservation significant flora recorded during the survey are described further in section 5.1.



Rapallo environmental

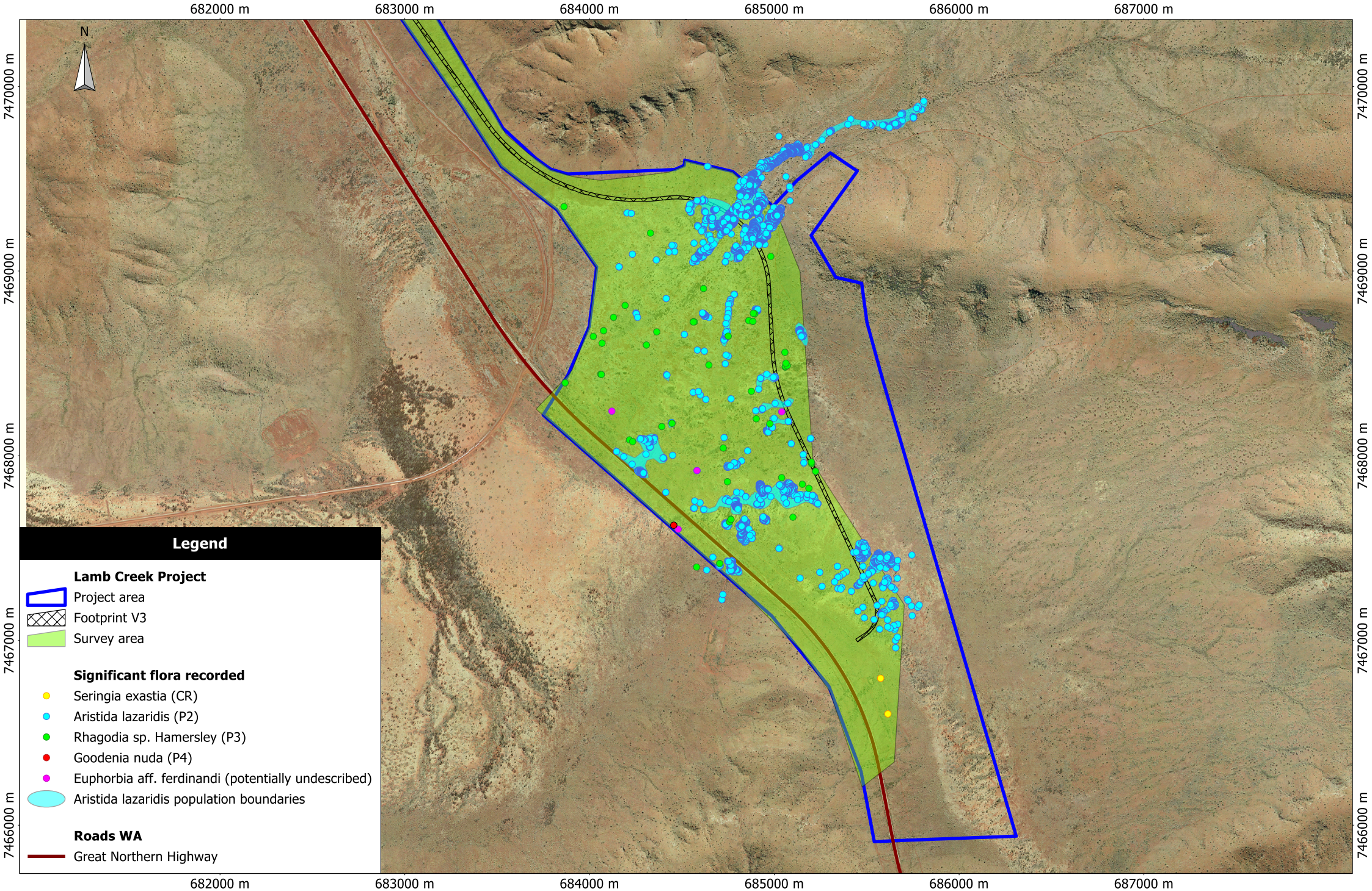
Mineral Resources Limited
Lamb Creek Project

Lamb Creek Iron Ore Project
Targeted conservation significant flora survey (April 2020, May 2021)

Original Size: A4 Scale: 1:70,000
Datum: MGA94 Zone 50
0 2 km

Figure 4.2

Conservation significant flora recorded at Lamb Creek during the targeted survey



Rapallo environmental

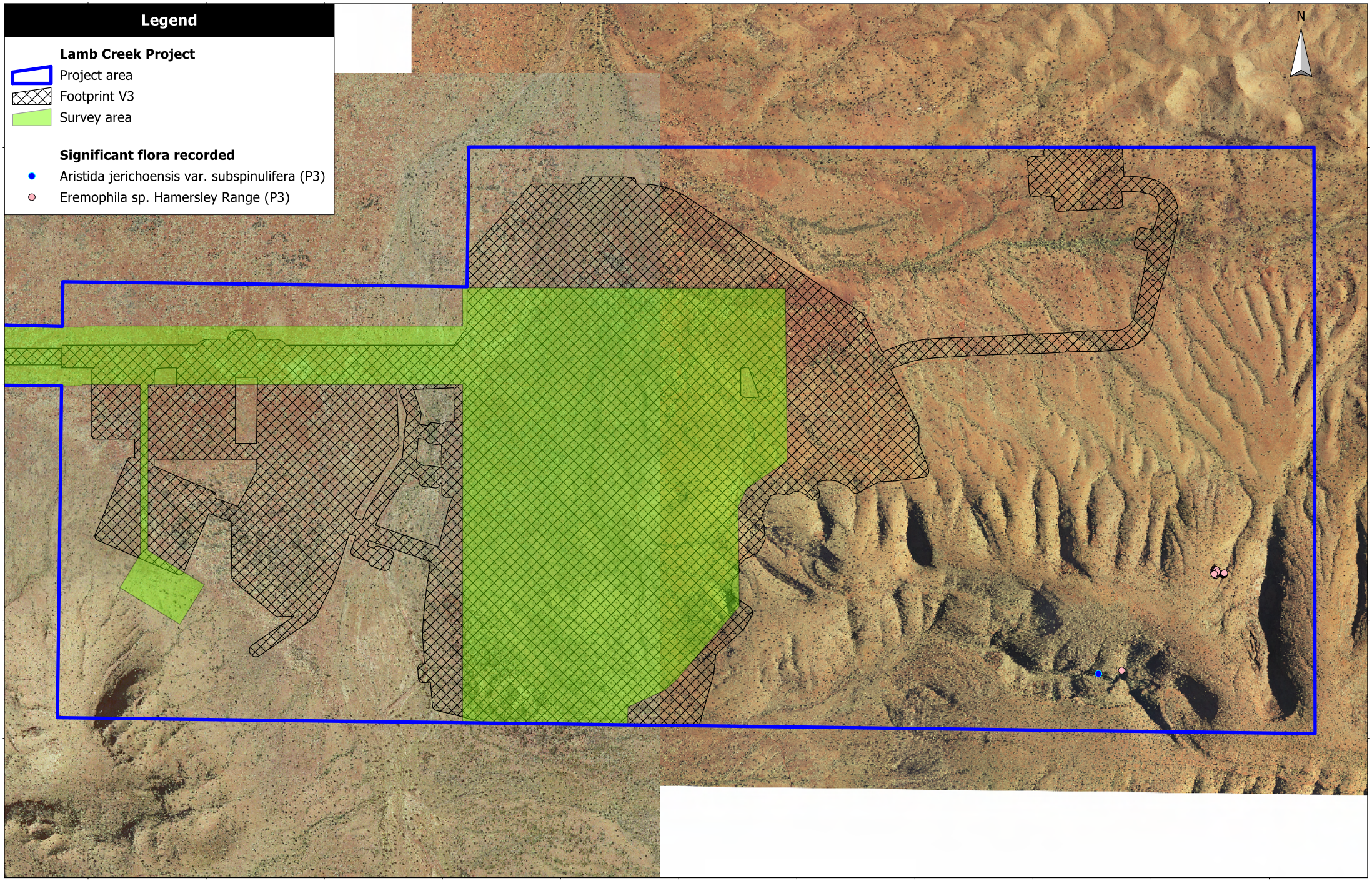
Mineral Resources Limited
Lamb Creek Project

Lamb Creek Iron Ore Project
Targeted conservation significant flora survey (April 2020, May 2021)

Original Size: A4 Scale: 1:25,000
Datum: MGA94 Zone 50
0 800 m

Figure 4.3

Conservation significant flora recorded in the Great Northern Highway intersection area



Rapallo environmental

Mineral Resources Limited
Lamb Creek Project

Lamb Creek Iron Ore Project
Targeted conservation significant flora survey (April 2020, May 2021)

Original Size: A4 Scale: 1:20,000
Datum: MGA94 Zone 50
0 500 m

Figure 4.4

Conservation significant flora recorded in the retention licence R47/19

5 Discussion

This section discusses the survey results from a project area, local and regional perspective.

5.1 Significant flora species recorded during the survey

Seven DBCA listed conservation significant flora taxa, and one potentially undescribed taxon, were recorded during the 2020 and 2021 field surveys, both from within the defined survey area and from locations outside and adjacent to the survey area while mapping population boundaries.

Recent flora and vegetation mapping (post-fire) was available for the Great Northern Highway intersection part of the survey area, as described in Rapallo (2021a), while old (pre-fire) mapping was available for the resource area and part of the haul road (Rapallo 2012). The vegetation composition and structure in the 2012 mapped areas has changed as a result of the fire (Rapallo 2021b), which must be kept in mind when interpreting significant flora locations relative to habitat. The vegetation types recorded in 2012 and 2021 are described in section 2.3.3.

The estimated number of individual plants of each conservation significant taxon per vegetation type is presented in Table 5.1 below. Where there is overlap between 2012 and 2021 vegetation mapping, only the 2021 mapping is considered. Mapping completed in 2012, which has limited relevance to flora recorded in 2020 and 2021, is only used where no current 2021 mapping is available.

Approximately 31% of the individual plants recorded were outside of any vegetation mapping. The greater majority of these were *Aristida lazaridis* (P2) records collected when mapping population boundaries outside of the defined targeted survey area. The single record of *Rostellularia adscendens* var. *latifolia* (P3) was also outside of any mapped areas. Interestingly, both records of *Seringia exastia* (CR) were from a previously cleared and revegetated area, and not from a mapped vegetation type.

No conservation significant flora were recorded from 2021 vegetation type F and from 2012 vegetation types VT3 and VT4. The entirety of the 2012 vegetation type VT6 has been superseded by 2021 vegetation types C and D.

The Great Northern Highway Intersection part of the survey area supported the overwhelming majority of conservation significant flora records, and five of the total eight taxa recorded. The overwhelming majority of these records were *Aristida lazaridis* (P2).

The greatest number of conservation significant flora records were from 2021 vegetation types C and D. Outside of 2021 mapping, the greatest number of conservation significant flora records were from 2012 vegetation type VT5. Where there was overlap between the 2012 and 2021 mapping, the 2012 vegetation type VT5 has been superseded by 2021 vegetation types A, B, C and D. The absence of a clear-cut link between 2012 and 2021 vegetation polygons is indicative of the significant changes that have occurred since the 2015 fire. As such, the 2012 vegetation mapping has limited relevance to the habitat that was present during the targeted survey.

Aristida jerichoensis var. *subspinulifera* (P3) and *Eremophila* sp. Hamersley Range (P3) were only recorded from the retention licence R47/19 from areas mapped in 2012 as VT1 and VT2. Both taxa occurred more than a kilometre outside of footprint V3. The retention licence was burnt in 2017, and no current vegetation information is available. However, the land forms associated with vegetation types VT1 and VT2 are unlikely to have changed, and would present some indication of habitat for these taxa.

Table 5.1 Conservation significant flora records relative to 2021 and 2012 vegetation types

Taxon	Status	2021 vegetation types [1]							2012 vegetation types (pre-fire) [2]					Outside of mapped areas	Total
		A	B	C	D	E	F	X	VT1	VT2	VT3	VT4	VT5		
Seringia exastia	Critically Endangered							2							**2**
Aristida lazaridis	Priority 2	125	544	1441	3392	3		4		115			3167	3982	**12773**
Aristida jerichoensis var. *subspinulifera*	Priority 3									50					**50**
Eremophila sp. Hamersley Range	Priority 3								23	13					**36**
Rhagodia sp. Hamersley (M. Trudgen 17794)	Priority 3	1	9	26	4	1				2			6	1	**50**
Rostellularia adscendens var. *latifolia*	Priority 3													1	**1**
Goodenia nuda	Priority 4				50										**50**
Euphorbia aff. *ferdinandi*	Potentially undescribed			3	1										**4**
Totals		**126**	**553**	**1470**	**3447**	**4**	**0**	**6**	**23**	**180**	**0**	**0**	**3173**	**3984**	**12966**

Footnotes:

1. 2021 vegetation types:

A - Low open Eucalyptus gamophylla woodland over Triodia melvillei and T. pungens on stony plain

B - Mulga and acacia low open woodland over open tussock grassland on gently sloping (drainage) plain with variable rock cover

C - Mulga and acacia low open woodland over open spinifex and tussock grassland on flat plain with medium rock cover

D - Mulga, Hakea lorea, and Eucalyptus xerothermica low open woodland over closed tussock grassland on gently sloping clay-loam plain (no rocks)

E - Low mulga woodland over sparse understorey on stony plain

F - Triodia wiseana hummock grassland with emergent shrubs and low trees on gently sloping stony plain

X – Not a vegetation type. Cleared, rehabilitated, Road

2: 2012 vegetation types:

VT1 – Eucalyptus gamophylla woodland over hummock grassland

VT2 – Eucalyptus leucophloia subsp. leucophloia woodland over mixed shrubs over Triodia wiseana grassland

VT3 – Acacia shrubland over hummock grassland

VT4 – Acacia tumida var. pilbarensis scrub in creeklines

VT5 – Wannamunna Mulga grove

5.1.1 *Seringia exastia* (Critically Endangered)

Seringia exastia (fringed fire-bush) is a small spreading shrub growing up to 1.5 metres tall but usually recorded around 0.5 metres (DBCA 2021c). It has been recorded in flower year-round (WAH 1998-, DBCA 2021a). The species is currently listed as Critically Endangered, but this is due to a taxonomic revision where a threatened and a common species were merged, and the name of the former was adopted as the new name, with the conservation status still attached. The current distribution map published on FloraBase (Western Australian Herbarium 1998) incorporates this revision, showing *Seringia exastia* as widespread across northern Western Australia, ranging from the Coolgardie and Murchison IBRA regions in the south to the Dampierland IBRA region in the north.

Seringia exastia was recorded at two locations near the Great Northern Highway intersection (Figure 4.3). Both locations are outside of footprint V3. The habitat was cleared and disturbed vegetation, and not mapped as a vegetation type (Rapallo 2021a). There is a threatened and priority flora database record of this taxon within the project area, on the south-western side of the Great Northern Highway (DBCA 2021a). This location was visited during the targeted survey, but the taxon was not found.

Communications received from DBCA (24/08/2021) confirm that the species is common and widespread, and that a nomination to delist the species has been prepared and considered by the WA Threatened Species Scientific Committee (TSSC). However, until changes are officially made to the Threatened species list, *S. exastia* is still legally listed as threatened flora, and authorisation to take under section 40 of the *Biodiversity Conservation Act 2016* is still required.

5.1.2 *Aristida lazaridis* (Priority 2)

Aristida lazaridis is a tufted perennial grass ranging from 0.4 to 1.5 m in height which generally flowers in April and May (WAH 1998-, DBCA 2021a). The species has been recorded in clay /loam soils on drainage lines and on slopes. The habitat often comprises mulga low open woodland with or without eucalypts, over a variety of shrubs and herbs, often over tussock grassland but sometimes with *Triodia* hummock grassland (DBCA 2021c).

A large population of *Aristida lazaridis* was recorded on the un-incised loamy valley floor drainage at the southern end of the survey area proximal to the Great Northern Highway (Figure 4.3). An estimated population of 12773 plants from 6757 point locations was recorded over the 2020 and 2021 survey periods combined. The species was recorded from all 2021 vegetation types except type F, with the greatest number of records from vegetation types B, C and D (Rapallo 2021a). Out of the total records for this species, only 75 fall within footprint V3.

Aristida lazaridis occurs as scattered plants to dense patches several hundred to a thousand plants that locally dominate or co-dominate the ground cover. The highest population estimates were recorded where *Aristida lazaridis* occurs as a co-dominant of the tussock grassland understory within vegetation types B, C, and D (Rapallo 2021a). Searches outside the survey area on foot and from helicopter recorded the species extending outside the project area within the narrow valley that runs between the two hill systems that terminate at the southern end of the haul road corridor. Populations and scattered plants identified as potential *Aristida lazaridis* have also been observed from helicopter to the southwest on the western side of the Great Northern Highway. At the time of survey in 2020 the species was in flower and could be spotted from a helicopter. However, due to the presence of six other *Aristida* species recorded from Lamb Creek during the 2012 and 2021 surveys, only ground-truthed records are presented in this

report and mapped in Figure 4.2. Plate 2 shows *Aristida lazaridis* (P2) within its habitat on the loamy drainage floor of the survey area.

Locally, a significant population of *Aristida lazaridis* has been recorded in deep loam soils along an un-incised drainage line north and west of the BHP Packsaddle Village, approximately 7 kilometres south-east of the Lamb Creek population. Onshore (2011a) reported a total of 2405 plants from 94 point locations from this population occurring within six vegetation types with the largest populations occurring within the tussock Grassland with Low Woodland of *Eucalyptus xerothermica* and *Acacia aptaneura*, *Acacia* Low Open Forest and *Triodia* Hummock Grassland vegetation communities (Onshore 2017). The closest threatened flora database records are the *Aristida lazaridis* record from the project area collected in 2012 and a 2018 record of 500+ plants from low open woodland of *Acacia aptaneura* with occasional *Acacia pruinocarpa* and *Eucalyptus xerothermica* over scattered shrubs of *Eremophila longifolia*, *Senna artemisioides* subsp. *oligophylla* and *Senna artemisioides* subsp. *helmsii* over open tussock grassland on red clay loam on floodplains and drainage areas (DBCA 2021a).

Further afield, the species has been recorded from Lake Robinson on the eastern fringe of the Coondewanna Flats (up to 20% cover, Onshore 2013c), Mudlark (up to 15% cover, (Onshore 2013b), Tandanya (up to 20% cover , (Onshore 2013c), and South Flank (13 plants, (Onshore 2012a) and West Angeles (Rio Tinto 2018).

There are 20 specimen records within the Western Australian Herbarium database, with collections from locations across approximately 130 kilometres extending from the Rangers Station at Karijini National Park to near Newman (DBCA 2021c). There are 43 records from the Rio Tinto Priority Flora database (Rio Tinto 2018) extending over 60 kilometres. In addition to these records, this species occurs over a 2,500 kilometre range across the Northern Territory and Queensland (Atlas of Living Australia 2021).

Plate 2 ***Aristida lazaridis*** **(P2) and its habitat**

5.1.3 Aristida jerichoensis var. *subspinulifera* (Priority 3)

Aristida jerichoensis var. *subspinulifera* is a compact tufted perennial grass ranging in height from 0.3 to 0.8 metres (WAH 1998-). Flowering has been recorded in the post-wet season (May) and in the dry season (July, September) (DBCA 2021a). It often occurs in mulga woodlands or acacia shrublands over *Trioda* and/or tussock grassland (DBCA 2021c).

A population of approximately 50 plants was recorded opportunistically in 2020 from a single location in the south-east corner of R47/19 within 2012 vegetation type VT2 (Figure 4.4). This area falls outside of the defined survey area, and the plants were recorded opportunistically during two selective traverses. The population was observed on a south facing rocky slope of a gorge/gully at 820 metres elevation. This location is more than a kilometre outside of footprint V3.

Locally, there is a Western Australian Herbarium record of *Aristida jerichoensis* var. *subspinulifera* from 800 metres northwest of the survey area, from a level plain of orange light clay (DBCA 2021a). *Aristida jerichoensis var. subspinulifera has been recorded* as scattered individuals or more commonly in groups of up to 300 plants within the MAC Development envelope (Onshore 2017) on red brown clay loam on hardpan intergrove plains open mulga woodland and from the Coondewanna Flats PEC (Onshore 2013a).

Compared with the collections made from the MAC Development envelope, and the habitat data in the Western Australian Herbarium database (predominantly collections from clay/loam plains/flats), the Lamb Creek habitat of high elevation, rocky gorge seems odd, however the species has been recorded near Newman on rocky upper hillslope (DBCA 2021c).

Regionally, *Aristida jerichoensis* var. *subspinulifera* has been recorded from BHP Billiton Iron Ore project areas including Area C West to Yandi (scattered plants, Onshore 2014b), Mudlark (up to 100 percent cover, (Onshore 2013b) and the Tandanya tenements up to 100 percent cover, (Onshore 2013c).

There are 39 specimen records within the Western Australian Herbarium database, with collections from locations spread across 290 kilometres extending between Nammuldi to Newman, with outliers in the Little Sandy Desert and Murchison, as well as collections from the Northern Territory and Queensland (DBCA 2021c; (Atlas of Living Australia 2021).

Plate 3 *Aristida jerichoensis* var. *subspinulifera* (P3) in rocky gorge habitat

5.1.4 Eremophila sp. Hamersley Range (K. Walker KW 136) (Priority 3)

Eremophila sp. Hamersley Range (K. Walker KW 136) is an erect perennial shrub to 2.5 metres that has been recorded flowering in the post-wet season (June) and dry season (August, September) (WAH 1998-, DBCA 2021a)

Within the survey area, two populations (in close proximity of each other) and one single plant were recorded from the eastern part of R47/19 (Figure 4.4). This area falls outside of footprint V3 by at least one kilometre. The two populations of 23 and 12 individual plants were recorded on the eastern and western slopes of a small gorge/gully within respectively 2012 vegetation types VT1 and VT2 (Plate 4). The single individual was also recorded growing on the flanks of a gorge within VT2. Most plants were 0.5 metres in height, but one individual was greater than 3 metres tall. None of the plants were in flower at the time of the survey, which occurred outside of the common flowering period for this taxon. *Eremophila* sp. Hamersley Range (K. Walker KW 136) is similar to *E. tietkensii*, primarily differing in leaf indumentum and also in floral characters (Biota 2014).

All records of *Eremophila* sp. Hamersley Range were outside of the targeted survey area, and were recorded during two selective traverses through habitat identified as potential for this taxon. Note that only a tiny fraction of potential habitat was searched, and the searches were not systematic. The aerial photograph shows that R47/19 contains a large number of gorge/gullies similar to where this taxon was recorded, including in the south-western corner of R47/19 where the current 2021 footprint extends into unsurveyed areas. It is highly likely that further populations of *Eremophila* sp. Hamersley Range occur within R47/19 including potentially within the unsurveyed part of footprint V3.

Locally, *Eremophila* sp Hamersley Range was not recorded on the MAC development envelope to the south (Onshore 2017), however it has been recorded in the ranges ca. eight kilometres south of the Lamb Creek retention licence (DBCA 2021a) and from Baby Hope Downs ca. 35 kilometres to the southeast of Lamb Creek from five locations in rocky gullies and gorges (Biota 2014).

There are fifteen specimen records within Western Australia, with Western Australian herbarium records from locations spread across 220 kilometres from Paraburdoo to Newman (WAH 1998-) and 345 records, within the Rio Tinto database; recorded from Eastern Range, Channar, Turee Syncline, Karijini National Park, West Angelas, Angelo Central and Hope Downs 1 (Rio Tinto 2016).

Plate 4 *Eremophila* sp. Hamersley Range and its north facing rocky hillside habitat

5.1.5 *Rhagodia sp. Hamersley (M.E. Trudgen 17794) (Priority 3)*

Rhagodia sp. Hamersley is an erect spindly shrub to 2 metres high, found on red sandy clay loam plains and floodplains growing in association with mulga (Western Australian Herbarium 1998-, DBCA 2021a)

Fifty plants were recorded from the Great Northern Highway area (Figure 4.3), often in association with *Acacia aptaneura* (mulga). Records occurred in every 2021 vegetation type except F (Rapallo 2021a). Records to the east of the 2021 survey area were from 2012 vegetation types VT2 and VT5, which may now no longer be relevant.

DBCA and WA Herbarium records for *Rhagodia* sp. Hamersley show flowering for this taxon in the late wet season, post-west season, and dry season. However, the majority of records year-round are of non-flowering plants, which suggest that this taxon is readily recognisable without flowers, and that it may respond to rainfall rather than season. The taxon was recorded in flower during the 2020 and 2021 targeted surveys, as shown in Plate 5.

Locally, 13 populations of *Rhagodia* sp. Hamersley (M. Trudgen 17794) have been recorded within the MAC Development Envelope, the closest 3 kilometres south east of the Lamb Creek project area, from four vegetation communities associated with mulga and tussock grassland (Onshore 2017).

Regionally, the species is widespread on mulga plains on BHP Billiton Iron Ore's Mudlark (192 plants, (Onshore 2013b) and Tandanya (496 plants, (Onshore 2013c), tenements to the west and south-west of the MAC Development Envelope, and from the Jinidi tenement ca. 50 kilometres to the south east of Lamb Creek (scattered plants) (Onshore 2011b).

There are 63 specimen records in the Western Australian Herbarium database, with collection locations spread approximately 290 kilometres extending between Tom Price and Newman (DBCA 2021c).

Plate 5 ***Rhagodia* sp Hamersley (M.E. Trudgen 17794) in flower and growing beneath mulga on the survey area in 2020 (L) and 2021 (R).**

5.1.6 Rostellularia adscendens var. latifolia (Priority 3)

Rostellularia adscendens var. *latifolia* is an erect herb or shrub, 0.1-0.3 meters high , often recorded from loams associated with drainage/floodplain, but also from hillslopes (DBCA 2021c). Flowering has primarily been recorded in the post-wet season (April-May) but also occasionally in the dry season (August) (WAH 1998-, DBCA 2021a)

A single plant was recorded from the bank of a dry rocky creek midway along the proposed haul road alignment within L47/736 (Figure 4.2). No vegetation mapping exists for this location. The specimen was recorded in flower at the time of the survey, as shown in Plate 6. The record occurred approximately 80 meters outside of footprint V3.

Locally there are 13 populations of *Rostellularia adscendens* var. *latifolia* recorded from the MAC Development Envelope, occurring as scattered individuals or populations of up to a maximum of 82 plants across a variety of vegetation types (Onshore 2017), approximately 20 kilometres south east of the Lamb Creek retention licence.

Regionally, the species has been recorded from a number of BHP Billiton Iron Ore's project areas including Area C West to Yandi (67 plants, Onshore 2014), Mudlark (Onshore 2013b) , Tandanya (60 plants, (Onshore 2013c), Jinidi to Mainline (<2 percent cover within Weeli Wolli Creek, Onshore 2012b) and Yandi (<1 percent cover, (Onshore 2011c).

There are 39 specimen records within the Western Australian Herbarium database, with collections from locations spread across approximately 280 kilometres extending between Nammuldi and the Jimblebar to Yandi Railway, with outliers extending to Nullagine (DBCA 2021c).

There are 205 records of *Rostellularia adscendens* var. *latifolia*, within the Rio Tinto database from numerous locations (Rio Tinto 2016).

Plate 6 *Rostellularia adscendens* var. *latifolia* on rocky creek bank within the survey area

5.1.7 Goodenia nuda (Priority 4)

Goodenia nuda is a small herb, approximately 20-30 centimetres tall with yellow flowers. The species is often recorded from seasonally inundated clay soils and drainage lines, often in mulga and has been recorded flowering in the late wet and post-wet season (March-June) but also in the dry season (up until August) (WAH 1998-, DBCA 2021c).

A small population of approximately 50-100 plants was recorded during the 2021 detailed flora survey, from quadrat Q27 (Figure 4.3). This quadrat was situated on the southern side of the Great Northern Highway, and falls outside of footprint V3. *Goodenia nuda* is small, and indistinct without flowers, which indicates that additional plants or populations may have been present at the time of the survey.

Quadrat 27 falls within vegetation type D (Rapallo 2021) and is situated less than 2 kilometres south-east of a WA Herbarium record from a level plain of orange light clay recorded in 2011 (DBCA 2021a). Aerial photos show the soil colour of this clay plain quite clearly, and it extends into the GNHI survey area where Q27 was positioned. The soil at Q27 is described as clay (Plate 7).

There are 101 specimen records within the Western Australian Herbarium database, with collections from locations spread across the Pilbara with outliers in the Great Sandy Desert and Gascoyne and from 808 records, within the Rio Tinto database (Rio Tinto 2018). *Goodenia nuda* is relatively widespread across the Pilbara, recorded from a variety of habitats many associated with drainage WAH 1998-).

Plate 7 ***Goodenia nuda***

5.1.8 *Euphorbia aff. ferdinandi (potentially undescribed)*

This taxon was recorded from four locations near the Great Northern Highway (Figure 4.3). It was only recognised as a potentially undescribed species, and different from any known species, when the specimen was compared in detail with other *Euphorbia* specimens at the Western Australian Herbarium. Further advice was sought from Steve Dillon at the WA Herbarium, who advised that the specimen differed from *Euphorbia ferdinandi* by having broader seeds and a stigma opposite from what has been described for this species (S. Dillon *pers. comm*., September 2021). All locations of this taxon were within the current project area, but outside of footprint V3.

5.2 Significant species not recorded

Seven species ranked in the desktop as 'likely to occur' and four species ranked as 'may potentially occur (Appendix II) were not recorded during the survey. These taxa are discussed below.

5.2.1 *Acacia bromilowiana (Priority 4)*

Acacia bromilowiana is a shrub or tree growing to 12 metres that has been recorded on a variety of landforms in the Pilbara including: rocky hills, breakaways, scree slopes, gorges and creek beds, occurring in red skeletal stony loam, orange-brown pebbly gravel loam laterite, banded ironstone and basalt (WAH 1998-; DBCA 2021c). The species generally flowers in the dry season (July-August) but has also been recorded in flower in the post-west season (May) (WAH 1998-, DBCA 2021c).

There is a Western Australian Herbarium record dated 1992 of *Acacia bromilowiana* within 5 kilometres of the project area, recorded from the western side of the Great Northern Highway from high elevation. The species was collected from steep rocky ironstone scree, high in landscape, positioned on the edge of cliff (DBCA 2021a).

Regionally it has been recorded within the MAC Development Envelope, from the upper reaches of a gorge (Onshore 2017) and from the northern slopes of Mount Robinson (>100 plants (Onshore 2012c)). The species also occurs at surrounding BHP Billiton Iron Ore tenements and project areas including Tandanya (167 plants, (Onshore 2013c)), Mudlark 30 plants, (Onshore 2013b) and Area C West to Yandi (30 plants (Onshore 2014a)).

There are 29 specimen records within the Western Australian Herbarium database, with collections recorded from over a 320 kilometre range between Newman and 130 kilometres northwest of Tom Price, with outlying records from west of Rudall River National Park (DBCA 2021c). There are records in the Rio Tinto database from Brockman, Vivash, West Turner Syncline, Tom Price, Karijini National Park, Angelo River, West Angleas, Minga Yard, Rhodes Ridge, Shovellana, Hope Downs and Noreena Downs (Rio Tinto 2016).

Acacia bromilowiana was not recorded during the survey, and was ranked as likely to occur, on the higher elevation areas of the project area, most of which fell outside of the targeted survey area. The species has distinctive dark grey fibrous bark and glaucous and slightly pruinose phyllodes and would have been readily identifiably in the field as a taxon to collect during the survey if present in the areas surveyed. It is possible that *Acacia bromilowiana* occurs in the project area outside the area covered by the current targeted survey, including potentially in the unsurveyed part of the footprint V3.

5.2.2 *Acacia effusa* (Priority 3)

Acacia effusa is a dense, wide-spreading, multi-stemmed, domed or flat-topped, somewhat viscid shrub 0.3–1.2 metres tall. It has grey or greyish red 'minniritchi' bark (Maslin et al. 2010). It flowers May-August (WAH 1998-, DBCA 2021c).

The DBCA threatened and priority flora database shows a record of this *Acacia effusa* taxon within the current project area (Figure 4.1). The record was from 2011, with the site described as a gently inclined footslope with brown sandy loam soil (DBCA 2021a). The location where this taxon was recorded fell outside of the project area at the time of the surveys, and was not visited. No flora and vegetation surveys have been completed over this part of the project area.

Regionally the species has been recorded at Mudlark (Onshore 2013b) and from Area C West to Yandi tenements (Onshore 2014a).

There are 31 specimen records within the Western Australian Herbarium database, with collections recorded from a patchy 110 kilometre range between Marandoo and West Angeles (DBCA 2021c), it is known from a large number of records within the central southern sector of the Pilbara bioregion, including Karijini National Park. Habitat is described as lower scree slopes of low rocky ranges or alluvial plains at the base of banded ironstone ranges. It is often common where it occurs (BHP 2016).

The species was not recorded during the survey and was ranked as likely to occur on the low hills, stony plain and loamy drainage flats proximal to the Great Northern Highway. However, the targeted survey only covered 40% of the current project area.

Acacia effusa is a low spreading shrub with 'minniritchi bark and would have been readily identifiable in the field if it has been present within the survey area.

5.2.3 *Eremophila magnifica subsp. magnifica* (Priority 4)

A mid stratum shrub occurring up to 1.5 metres in height, it has been recorded on skeletal soils over ironstone and occurs on rocky scree slopes (WAH 1998-). Often occurs high in the landscape on steep to moderate slopes, summits, gullies, skeletal red gritty soil over massive banded ironstone. (DBCA 2021c). It generally flowers August to November but has also been recorded flowering in June (WAH 1998-, DBCA 2021c)

Eremophila magnifica subsp. *magnifica* is known to occur 14 kilometres west south-west of the project area from a very steep gully of silty brown loam (DBCA 2021a). There were nine populations of Eremophila magnifica subsp. magnifica represented within the MAC Development (Onshore 2017). Locally it is widespread across ranges in BHP Billiton Iron Ore's Mudlark (Onshore 2013b), Tandanya (Onshore 2013c), and Jinidi tenements (Onshore 2011b), situated to the west, south-west and east of the Proposed MAC Development Envelope. Plant density ranges from scattered individuals to populations of greater than 1,000 plants. The species typically occurs on steep to moderately sloping rocky hill slopes, hill crests, gullies and rocky drainages. *Eremophila magnifica* subsp. *magnifica* is widely collected from similar habitat at BHP Billiton Iron Ore's Eastern (Onshore 2012c) and (Onshore 2014b) operations near Newman.

There are 42 specimen records within the Western Australian Herbarium database, with collections recorded from over a 310 kilometre range between Newman and Mt Farquhar (DBCA 2021c) and 940 records, within the Rio Tinto database (Rio Tinto 2016).

Eremophila magnifica subsp. *magnifica* is a distinctive species, its leaves smell of nutmeg when crushed. It readily distinguishable from the closely related (Priority 3 listed) *E. magnifica* subsp. *velutina* by having glabrous leaves (with ciliate leaf margins) whilst *E. magnifica* subsp. *velutina* has a velvety leaf surface. The species flowers purple, primarily in August to November and would not have been flowering during the survey, however it is identifiable from vegetative material, habit, habitat and leaf surface and would have been readily identifiable in the field as a taxon to collect during if it had been encountered.

The species was not recorded during the targeted survey, and was ranked as likely to occur, on the higher elevation areas of the project area, most of which fell outside of the targeted survey area. It is possible that *Eremophila magnifica* subsp. *magnifica* occurs within the project area, and potentially within the unsurveyed part of footprint V3.

5.2.4 Eremophila pusilliflora (Priority 2)

A low-growing, open shrub 30–50 centimetres high, 50–100 centimetres wide, found on seasonally inundated alluvial plains, growing in red-brown sandy loam soils in open low shrubland with *Acacia aneura, Ptilotus nobilis*, *Goodenia* and *Triodia* species (Buirchell & Brown 2016).

Eremophila pusilliflora was recorded in 1977, 15 kilometres west of the project area on a flat plain with thin soil underlain by partly consolidated colluvium near Packsaddle Bore (DBCA 2021a).

The species is infrequently collected and was not recorded from the MAC development area, despite habitat being present (Onshore 2017).

There are 14 specimen records within the Western Australian Herbarium database, with collections recorded from over a 120 kilometre range between Auki and West Angeles (DBCA 2021c) and records ranging across 60 kilometres from the Rio Tinto Priority Flora database (Rio Tinto 2017).

The species was not recorded during the survey and was ranked as may potentially occur on the project area, noting that the targeted survey only covered 40% of the project area.

Formerly known as *Eremophila forrestii* subsp. Pingandy (M.E. Trudgen 2662), *Eremophila pusilliflora* is related to *E. forrestii*, from which it may be distinguished by its lower-growing habit, consistently smaller leaves, shorter corolla and distinctively pustulate sepals with a glabrous inner surface. The sepals turn reddish pink with age whereas those in E. *forrestii* remain the same colour (Buirchell & Brown 2016).

The species predominantly flowers between April and September but may also flower at other times of the year in response to rainfall (Buirchell & Brown 2016). The timing and conditions were suitable during the survey for flowering and due to its size, it would have been visible to collect if encountered.

5.2.5 Indigofera gilesii (Priority 3)

Indigofera gilesii is an erect perennial shrub to 1.5 metres tall with purple-pink flowers (WAH 1998-). This taxon was recorded in 1997 from a location fifteen kilometres west of the project area, from a broad open gully on the south side of a low hill. It is often recorded high in the landscape on skeletal soils in gorge or gully habitats and has been recorded flowering recorded post-wet season (June) and dry season (August) (DBCA 2021a).

There are 25 specimen records within the Western Australian Herbarium database, with collections sporadically recorded from over a 120 kilometre range from Packsaddle Bore to Newman (DBCA 2021c).

The species was not recorded during the survey, and was ranked as "may potentially occur", on the higher elevation areas of the project area, most of which fell outside of the targeted survey area. The species has been recorded flowering in the post-wet season (May, June) and dry season (August) (WAH 1998-, DBCA 2021c). The timing and conditions were suitable during the survey for flowering and due to its size, it would have been visible to collect if it was encountered.

5.2.6 Isotropis parviflora (Priority 2)

Isotropis parviflora is a low perennial herb or shrub to 0.1 metres in height flowering white to pink during March. Occurs on stony plain, lower slopes, hillcrest/upper slopes (DBCA 2021c). It is known to be a short-lived disturbance species that responds to fire and is often recorded along the berms of access tracks.

There is a record from Packsaddle Village 10 kilometres south of the project area from upper-slope, ironstone outcropping (DBCA 2021a) and it has been recorded from Billiton Iron Ore's Jinidi tenements (Onshore 2011b).

There are 28 specimen records within the Western Australian Herbarium database, with collections recorded from over a 210-kilometre range between Wittenoom Gorge and Newman. Outlier records occur in the Great Sandy Desert and the Tanami (DBCA 2021c)

The species was not recorded during the survey and was ranked as likely to occur on the project area on stony plain, lower slopes, upper slopes and hillcrests.

This species flowers predominantly in the late wet season (March), but flowering has been recorded through to the early dry season (August) (WAH 1998-, DBCA 2021c). The timing and conditions were suitable during the survey. However, due to its small size this taxon could have been overlooked. It is also short-lived post disturbance and may be under-surveyed. The possibility of this taxon occurring in the project area cannot be discounted.

5.2.7 Nicotiana umbratica (Priority 3)

Nicotiana umbratica is an erect, short-lived annual or perennial, herb, 0.3-0.7 metres high that flowers white, April to June and inhabits shallow soils, rocky outcrops (WAH 1998-). This taxon was not flagged in the DBCA search; however, one individual plant was recorded from the MAC development envelope growing under an overhang in a narrow gorge (Onshore 2011a). There are currently 23 records within the Pilbara extending approximately 180 kilometres from Shay gap to Bamboo Springs with an outlier near Karratha (DBCA 2021c).

The species was not recorded during the survey, and was ranked as "may potentially occur" on the project area.

The project area falls outside of the known distribution, however *Nicotiana umbratica* is short-lived and thus may be under-surveyed. This species has been recorded as scattered occurrence in very low numbers across similar habitat in the broader locality. Therefore, if present, it would only occur in low number. The timing and conditions were suitable during the survey however due to its small size this taxon could have been overlooked during the survey.

5.2.8 *Themeda sp. Hamersley Station (M.E. Trudgen 11431) (Priority 3)*

Themeda sp. Hamersley Station (M.E. Trudgen 11431) is a robust tall grass. There are 45 specimen records within the Western Australian Herbarium database, with collections recorded from over a 450 kilometre range from Damper to Newman, with an outlier in the Little Sandy. This species occurs in red clay pans and grass plains (DBCA 2021c). It generally flowers in August, but has been recorded flowering in July and September also (WAH 1998-, DBCA 2021c).

There is a record from the flats on the western side of the Great Northern Highway, six kilometres south of the project area from the Coondewanna Flats (DBCA 2021a) and it has been recorded from Billiton Iron Ore's Mudlark tenements (Onshore 2013b) and Tandanya tenements , (Onshore 2013c).

Themeda sp. Hamersley Station is difficult to distinguish in the field from larger individuals of the common and widespread *Themeda triandra*, which was recorded from 26 locations throughout the project area during the 2012 and 2021 surveys combined (Rapallo 2012, Rapallo 2021a) and formed a dominant component of vegetation types B, C and D of the Great Northern Highway intersection (Rapallo 2021a).

Themeda sp. Hamersley Station (M.E. Trudgen 11431) flowers in August, and the timing of the 2012, 2020 and 2021 surveys (which occurred in April and May) was outside of this flowering period. The species was not recorded during the survey, but was ranked as highly likely to occur within the loamy drainage flats proximal to the Great Northern Highway. Surveys in August are required to determine this.

5.2.9 *Triodia sp. Mt Ella (M.E. Trudgen 12739) (Priority 3)*

Triodia sp. Mt. Ella (M.E Trudgen 12739) is a perennial hummock grass to 30–60 centimetres high, 40–80 centimetres wide, very resinous and sometimes conspicuously stoloniferous. Fertile collections have been made in February and March (Barrett & Trudgen 2018) and also in September (DBCA 2021c). *Triodia* sp. Mt. Ella (M.E Trudgen 12739) a is known to occur 17 kilometres west of the project area proximal to the eastern boundary of Karijini National Park (DBCA 2021a).

The taxon has been recorded from the southern central sector of BHP Billiton Iron Ore's MAC Development Envelope (Onshore 2017). BHP Billiton Iron Ore's Mudlark (Onshore 2013b) and Tandanya, (Onshore 2013c), tenements, and from Rio Tinto's West Angelas project (Trudgen & Casson 1998). Individual occurrences in the Hamersley Range are small in area, mainly occurring at the bases of open to slight gullies on the mid- to upper slopes of large hills; however, some records are from gorges and ridges. Some occurrences are associated with iron-rich substrate in the West Angelas mining area, but the main factor affecting distribution is likely to be the deeper (moisture retaining) soils at the bases of gullies. Most records are from outcropping ironstone or ironstone gravel; the Rudall River occurrence is from creek beds on unknown geology (Barrett & Trudgen 2018). This means that the species is likely to occur, on the higher elevation areas of the project area rather than the stony plain and loamy drainage flats proximal to the Great Northern Highway.

There are 35 specimen records within the Western Australian Herbarium database, with collections recorded from locations extending over 200 kilometres from Karijini National Park to 30 kilometres east of Newman, with an outlying record from Rudall River National (DBCA 2021c). *Triodia* sp. Mt. Ella (M.E Trudgen 12739) is considered to be geographically restricted and uncommon, but unlikely to be rare (Trudgen & Casson 1998).

The species was not recorded during the survey, however, was ranked as likely to occur, on the higher elevation areas of the project area, which fell outside of the targeted survey area. In the field, *Triodia* sp.

Mt. Ella (M.E Trudgen 12739) can be separated from co-occurring species by its spreading form, extremely resinous surfaces and very strong smell of resin (Barrett & Trudgen 2018).

5.2.10 Triodia sp. Karijini (S. van Leeuwen 4111) (Priority 1)

Triodia sp. Karijini (S. van Leeuwen 4111) is a wispy perennial hummock grass to 50–100 centimetres high, non-resinous (DBCA 2021c). *Triodia karijini* belongs to the soft group, sharing the epistomatous (soft type) leaf blades (Barrett et al. 2017).

This taxon was recorded in 2011 four kilometres west of the project area, from a very steep hillslope of grey silty loam (DBCA 2021a) and has been recorded from BHP Billiton Iron Ore's Mudlark tenements (Onshore 2013b). All Western Australian Herbarium records are from high in the landscape; it occurs on or near outcropping ironstone, on summits or steep hillslopes of mountains (Barrett et al. 2017). The species has been recorded flowering recorded during the dry season (September), but most WA Herbarium records do not indicate flowering times (DBCA 2021c) .

There are 16 specimen records within the Western Australian Herbarium database, with collections sporadically recorded from over a 215 kilometre range from Brockman to Mt Robinson, (DBCA 2021c). Populations can be dense but are patchy and restricted to mountain tops and sides (Barrett et al. 2017).

The species was not recorded during the survey, and was ranked as "may potentially occur", on the higher elevation areas of the project area, which fell outside of the targeted survey.

Triodia sp. Karijini may be confused in the field with the common and widespread *Triodia melvillei* which flowers July-October. The latter species occurs within the range of *T. karijini* but can be distinguished by having prominently awned lemmas with midlobe 10–14 millimetres metre long (acute to sub-awned with midlobe 2.0–3.0 millimetre metres long in T*. karijini*), and resinous foliage (non-resinous in *T. karijini*). *Triodia melvillei* also usually occurs on red loam flats, and only rarely on rock on high mountains (Barrett et al. 2017). *Triodia melvillei* was recorded during the 2012 survey from quadrats across the project area (Rapallo 2012), however all flora surveys at Lamb Creek to date have occurred outside of the flowering periods of both species. Therefore *T.* sp. Karijini may potentially occur in the project area.

5.2.11 Vittadinia sp. Coondewanna Flats (S. van Leeuwen 4684) (Priority 1)

Vittadinia sp. Coondewanna Flats (S. van Leeuwen 4684) is a small annual herb to 30 centimetres recorded flowering post-wet (May) and during the dry season (July, September) This taxon has been recorded three kilometres south of the project area, west of the Great Northern Highway and locally this species has been recorded on the Coondewanna Flats (DBCA 2021a).

There are 17 specimen records within the Western Australian Herbarium database, with collections sporadically recorded from over a 280 kilometre range from Brockman to Newman. This species occurs in woodland to open forest of variety of mulga species and other acacias, or shrubland of acacias and other species, sometimes with eucalyptus, over diverse shrubland, often over open Triodia. Habitat is grassland mulga plain, floodplain, drainage, sandy-clay loam, (DBCA 2021c).

The species was not recorded during the survey, however, was ranked as likely to occur within the loamy plains of the project area, proximal to the Great Northern Highway. This species has been recorded as scattered occurrence in very low numbers across similar habitat in the broader locality. Therefore, if present, it would only occur in low number. The timing and conditions were suitable during the survey however due to its small size this taxon could have been overlooked.

5.3 Survey adequacy and limitations

5.3.1 Level of assessment and survey timing

Survey level and timing were as per client request. A targeted survey was initiated after a desktop review and 2012 survey results indicated a high potential for conservation significant flora occurring in the project area. The survey timing aligned with the recommended primary survey period for the Eremaean Botanical Province (EPA 2016b), and overlapped with the flowering period of the majority of flora taxa identified in the desktop as potential to occur in the survey area. The 2021 survey occurred over a smaller additional area (Table 1.1), and was specifically timed to record further individuals and populations of *Aristida lazaridis* in the area near the Great Northern Highway intersection (Appendix II).

5.3.2 Assessment against EPA technical guidance

The targeted flora survey was conducted in accordance with Environmental Protection Authority (EPA) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* and aligned with criteria for a targeted survey (EPA 2016b). The EPA technical guidance does not specify recommended methods or survey intensity for targeted surveys. However, it describes traverses of appropriate spacing as a potential method. EPA criteria specific for a targeted survey, and an assessment of the survey against these criteria, is provided in Table 5.2 below.

Table 5.2 Assessment of the survey against EPA technical guidance

EPA (2016b) criteria for targeted flora surveys	Survey met EPA criterion	Details
Targeted surveys should be undertaken when the targeted flora and/or vegetation are most detectable and identifiable in the field, usually when in flower.	Yes	The survey was completed in April 2020 and May 2021 which in the Pilbara is the post-wet season. Out of the 18 taxa identified in the likelihood assessment as confirmed, likely to occur, and may occur in the Lamb Creek project area (section 4.1 and Appendix II) the greater majority (12) had flowering periods that overlapped with the survey periods of April and May. The survey did not overlap with the flowering period for *Eremophila* sp. Hamersley Range, but this taxon could be identified without flowers. Two other taxa were recorded flowering just outside the survey periods, and therefore could possibly flower in April and May because very few records were available. Only two taxa had flowering recorded in the dry season only. In summary, the survey timing was considered appropriate to capture the flowering time of the greater majority of potential flora taxa.
All potentially suitable habitats should be systematically searched	Yes for footprint V1 Partial for footprint V3 No for project area	The survey covered the entirety of the survey area, defined in section 1.3, and thus covered all potentially suitable habitats within. However, the survey area was based on footprint V1 which has now been superseded. The current footprint V3 extends outside of the survey area, with 236 hectares (36%) not surveyed. Based on the 2012 vegetation maps, potentially suitable habitat exists in the areas not covered by the targeted survey. The targeted survey only covered 869 hectares (40%) of the project area, and did not include all the available habitats within. The current project area includes a database record of *Acacia effusa* (Priority 3) which was not visited because it fell outside of the project area at the time of the survey.

EPA (2016b) criteria for targeted flora surveys	Survey met EPA criterion	Details
Sufficient resources should be allocated for field time	Yes	The entirety of the survey area was covered by systematic traverses spaced approximately 50 m apart. EPA guidance only provides recommendations on traverse spacing for the South West Botanical Province (10 m), stating that wider transect widths may be considered acceptable for other Botanical Provinces.
Where the habitat extends outside the survey area, the full extent of a population or community should be surveyed	Yes	*Aristida lazaridis* and *Rhagodia* sp. Hamersley were found to extend beyond the boundaries of the survey area, and mapped accordingly. Extent of the *A. lazaridis* population was mapped up until 1 km north-east of the survey area boundaries. It may extend further. Rhagodia sp. Hamersley was also mapped outside the 2020 survey area, however, the majority of these records subsequently fell within the expanded survey area boundaries searched in 2021. *Rhagodia* sp. Hamersley occurred as individual shrubs spaced widely apart across the 2021 survey area, rather than as patches / populations, hence mapping population boundaries was not applicable.

5.3.3 Survey limitations table

Table 5.3 Limitations of the targeted flora survey

Aspect	Limitation	Discussion
Availability of contextual information at a regional and local scale	No	Sufficient flora and vegetation information was available for the Hamersley subregion (of the Pilbara Bioregion) to place the project area in a regional context. At a local scale, sufficient (publicly available) flora and vegetation surveys have been completed in the vicinity of the project area. This is reflected in the DBCA TPFL and Western Australian Herbarium database results, which yielded over 700 conservation significant flora records within 60 km of the survey area. In addition, there has been a significant body of work completed at Mining Area C which is in close proximity to the Lamb Creek project.
Competency/experience of the team carrying out the survey, including experience in bioregion surveyed	No	Both the 2020 and 2021 surveys were completed by a team of experienced botanists. Individually, the botanists involved in the field survey and reporting work have between 7-20 years' experience completing flora and vegetation surveys throughout Western Australia and in the Pilbara. Sharnya Thomson-Yates is also an experienced botanical taxonomist.
Proportion of flora recorded and/or collected, any identification issues	No	The targeted survey was designed to record specific taxa. The survey timing for both survey periods was within the recommended period for the Eremaean botanical province, and the majority of the target taxa were found to be in flower, enabling a full and positive identification. *Eremophila* sp. hamersley, although not in flower during the survey, could be confidently identified from vegetative material. Based on desktop results the greater majority of the taxa rated as may occur to highly likely to occur in the survey area would have been in flower and readily identifiable during the survey.

Aspect	Limitation	Discussion
Was the appropriate area fully surveyed (effort and extent)	Yes	Survey intensity was considered adequate and appropriate for recording the presence and extent of conservation significant flora in the survey area defined prior to the 2020 and 2021 field surveys. However, this survey area was based on footprint V1 which has since changed. Footprint V3 was provided after the fieldwork has been completed, with 236 hectares (36%) of footprint V3 not covered by the targeted survey. The survey area only covered 869 hectares (40%) of the current project area, with the remaining 60% containing potential habitats for several (additional) conservation significant taxa. The desktop review and likelihood scores of potential conservation significant taxa, as presented in Appendix II, were determined based on field information available for those areas covered by surveys. The current project area contains a 27% portion that has never been surveyed, including a location that contains a DBCA record *of Acacia effusa* (Priority 3). Likelihood scores for the areas not visited by the field team are based on desktop information only.
Access restrictions within the survey area	No	The majority of the project area was accessible by helicopter and some areas were accessible by vehicle. The entirety of the survey area was covered on foot. There were no survey limitations due to access restrictions.
Survey timing, rainfall, season of survey	No	The two field surveys were completed in April 2020 and May 2021, which falls within the primary recommended timing for surveys in the Eremaean botanical province (EPA 2016b), and overlaps with the flowering period of the majority of flora taxa identified in the desktop as potential to occur (see also Table 5.2). The survey area experienced good rainfall over the months preceding both surveys, and nearly all the target taxa recorded were in flower. Overall, survey timing was deemed to be appropriate for the survey area and the region, and for the taxa targeted.
Disturbances that may have affected the results of the survey (e.g. fire, flooding, clearing)	No	The majority of the survey area has been affected by fire, however the purpose of the survey work was to record what is currently present in the project area. Some taxa are fire responders, or favour disturbed conditions.

5.4 Impacts and management

Development within the proposed footprint V3 has the potential to impact conservation significant flora and vegetation through:

- Direct removal of conservation significant flora and vegetation during clearing and earthworks;
- Alteration to the volume of surface water flows causing decline to sheet flow dependent vegetation drainage flats that contain priority flora;
- Increased weed species diversity and density.

5.4.1 Direct clearing

Footprint V3 impacts several priority flora species (Table 4.2). It is recommended that infrastructure be placed to avoid significant conservation flora where possible. Where populations cannot be avoided, as may be the case with *Aristida lazaridis* it is recommended that the infrastructure be placed to avoid the highest densities, provided surface flow is maintained (section 5.4.2).

Existing management strategies used by MRL at their surrounding mining operations such as internal ground disturbance approvals system are important tools for minimising direct clearing impacts and should be applied to the Lamb Creek Iron Ore Project.

5.4.2 Alteration to surface flow

Design of the haul road and mining development should consider surface water flow to minimise obstruction to seasonal overland water flows to the loamy drainage flats proximal to the Great Northern Highway that contain the priority species *Aristida lazaridis* and *Rhagodia* sp. Hamersley and the potential for *Themeda sp. Hamersley Station* (M.E. Trudgen 11431) and *Vittadinia* sp. Coondewanna Flats (S. van Leeuwen 4684).

5.4.3 Weeds

Increasing vehicular access combined with vegetation clearing for the project has the potential to introduce and/or spread weed species that can compete with native vegetation and reduce species diversity. Existing management strategies used by MRL at their surrounding mining operations are important tools for minimising potential impacts.

It is recommended that general and species-specific weed management, hygiene, and monitoring is conducted in accordance with MRL's existing weed management procedures. Management measures may include the following:

- Mobile machinery and equipment brought to site in a clean state;
- Regular inspections for the presence of weeds within areas of disturbance, particularly in high moisture environments such as the loamy drainage flats proximal to the Great Northern Highway and
- Seasonal weed control programmes to be implemented if necessary.

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7 Appendices

List of Appendices

No	Title
Appendix I	Conservation codes for Australian flora
Appendix II	Flora desktop results: Conservation significant flora and likelihood assessment

Appendix I Conservation codes for Australian flora

Threatened species under the Commonwealth EPBC Act

Threatened fauna and flora may be listed under Section 178 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) in any one of the following categories:

EX Extinct

EW Extinct in the wild

CR Critically endangered

EN Endangered

VU Vulnerable

CD Conservation dependent

Conservation codes for Western Australian flora under the Western Australian *Biodiversity Conservation Act 2016*

Threatened, Extinct and Specially Protected fauna or flora are species which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such.

The *Wildlife Conservation (Specially Protected Fauna) Notice 2018* and the *Wildlife Conservation (Rare Flora) Notice 2018* have been transitioned under regulations 170, 171 and 172 of the *Biodiversity Conservation Regulations 2018* to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the *Biodiversity Conservation Act 2016*.

Categories of Threatened, Extinct and Specially Protected fauna and flora are:

Threatened species

Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the *Biodiversity Conservation Act 2016* (BC Act).

Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3 of the *Wildlife Conservation (Rare Flora) Notice 2018* for Threatened Flora.

The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.

CR Critically endangered species

Threatened species considered to be "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines.

Published under **schedule 1** of the *Wildlife Conservation (Rare Flora) Notice 2018* for critically endangered flora.

EN Endangered species

Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under **schedule 2** of the the *Wildlife Conservation (Rare Flora) Notice 2018 for endangered flora*.

VU Vulnerable species

Threatened species considered to be "facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines.

Published under **schedule 3** of the *Wildlife Conservation (Rare Flora) Notice 2018* for vulnerable flora.

Priority species

Priority species are possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations. In this report, priority species are given the codes P1, P2, P3 and P4.

P1 Priority 1: Poorly-known species

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

P2 Priority 2: Poorly-known species

Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

P3 Priority 3: Poorly-known species

Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

P4 Priority 4: Rare, Near Threatened and other species in need of monitoring

(a) **Rare**. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands.

(b) **Near Threatened**. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent.

(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Appendix II Flora desktop results: Conservation significant flora and likelihood assessment

Taxon	Status	Growth Form	Habitat from DBCA database records	Habitat from FloraBase	Flowering period	Habitat present at Lamb Creek?	Distance to project area	Likelihood ranking
Acacia bromilowiana	P4	Tree or shrub to 12 m high	WAH and TPFL : High in landscape, Slope, cliff, gully, crest, summit , very steep	Red skeletal stony loam, orange-brown pebbly,gravel loam, laterite, banded ironstone, basalt. Rocky hills, breakaways, scree slopes, gorges, creek beds.	May, July, August	Yes but off footprint	Within 20 km	**Likely to occur**
Acacia daweana	P3	Shrub from 0.3- 2m.	WAH: Gentle slopes, Along diffuse drainage area where it leaves low rocky hills. Low shrubland with Triodia basedowii, Acacia bivenosa, A. validinervia and A. maitlandii.	Stony red loamy soils. Low rocky rises, along drainage lines	July-October	Yes	Not within 20km	Unlikely to occur
Acacia effusa	P3	Low, dense, spreading, somewhat viscid shrub, 0.3-1 m high.	WAH: Scree, gentle slope, footslope, creeklines, low iron stone hill, stony plain base of hills , skeletal soils, red brown, Red brown clay loam.	Stony red loam. Scree slopes of low ranges.	May-August	Yes	Recorded in project area in 2011	**Likely to occur**
Acacia subtiliformis	P3	Spindly, slender, erect shrub, to 3.5 m	WAH: Calcrete slope, rise, plain	On rocky calcrete plateau.	April-June	No	Within 20 km	Unlikely to occur
Adiantum capillus-veneris	P2	Perennial small herb from 0.1-0.2m. Frond 1-2 pinnate	WAH: In wet rocky crevices, associated with gorges or springs.	Moist sheleted sites in gorges and on cliff walls.	March, September	No	Not within 20km	Unlikely to occur
Amaranthus centralis	P3	Annual Herb	WAH: Tussock grassland of Themeda triandra, Eulalia aurea and Aristida inaequiglumis with open woodland of Eucalyptus victrix and Corymbia aspera over low open woodland of Corymbia aspera and Hakea lorea subsp. lorea over high open shrubland of Gossypium robi. Low in the landscape, alluvial flats, River banks, Mulga woodland[3]	no info	No info	Yes	Not within 20km	Unlikely to occur
Ampelopteris prolifera	P3	Perennial herb/fern to 4m	no info	Near water or in wet ground.	No info	No	Not within 20km	Unlikely to occur
Aristida jerichoensis var. subspinulifera	P3	Compactly tufted perennial, grass-like or herb, 0.3-0.8 m high	WAH: Plain or Flat, clay/loam. Often mulga woodlands or acacia shrublands over spinifex and/or tussock grassland.	Hardpan plains	May, July, September	Yes	Confirmed	**Confirmed**
Aristida lazaridis	P2	Tufted perennial, grass-like or herb, 0.4-1.5 m high.	WAH: Plain, clay /loam, drainage, slope; often mulga low open woodland with or without Eucalypts, over variety of shrubs and herbs, often over tussock grassland but sometimes with Triodia hummock grassland.	Sand or loam	April, May	Yes	Confirmed	**Confirmed**
Arthropodium vanleeuwenii	P2	Perennial herb 0.3 to nearly 1m.	WAH. Moderately steep facing slopes including banded and Brockman ironstone formations on red-brown, orange-brown loams and sandy loams. Low open woodland of Eucalyptus leucophloia subsp and Corymbia hamersleyana over hummock grassland of Triodia brizoides. Other tussock grassland species include Themeda triandra. Known from two small populations growing above 900 m on south-facing hillslopes of Brockman Iron Formation in the Pilbara bioregion of Western Australia. Associated vegetation includes Eucalyptus leucophloia subsp. leucophloia, Corymbia hamersleyana, Indigofera fractiflexa, Triodia spp. and Themeda triandra. Often found growing under the Triodia and occasionally under the Themeda, very rarely growing in the open. Flowering from mid- to late September. Fruiting from late September to mid-October[4]	No info	October	Yes but off footprint	Not within 20km	Unlikely to occur
Atriplex flabelliformis	P3	Monoecious, erect, rounded perennial, herb, to 0.35 m high.	WAH: Saline areas. Often salt tolerant shrublands, over low open heath.	Clay loam, loam. Saline flats or marshes.	No info	No	Not within 20km	Highly unlikely to occur

Taxon	Status	Growth Form	Habitat from DBCA database records	Habitat from FloraBase	Flowering period	Habitat present at Lamb Creek?	Distance to project area	Likelihood ranking
Barbula ehrenbergii	P1	Moss	Moss. Shaded moist environment on rock face 1.A species of hydric environments [2]	No info	No info	No	Not within 20km	Highly unlikely to occur
Calotis squamigera	P1	Procumbent annual, herb, to 0.21 m high.	WAH: Flat. Red brown loam clay, Stony plain with sandy loam soil. Low woodland of Acacia aptaneura, over open tussock grassland of Aristida contorta and Chrysopogon fallax with high open shrubland of Acacia synchronicia and Psydrax latifolia.	Pebbly loam	July	Yes	Not within 20km	Unlikely to occur
Cladium procerum	P2	Densely tufted perennial, grass-like or herb (sedge), 2 m high.	WAH: Major creeklines , Eucalyptus camaldulensis and Melaleuca argentea open woodland	Perennial pools	July, October, November	No	Not within 20km	Highly unlikely to occur
Dampiera anonyma	P3	Multi-stemmed perennial herb, 0.5 - 1m. Blue purple flower	WAH: Hillside; rocky red ironstone.	Skeletal red-brown gravelly soil over banded ironstone, basalt, shale and Jaspilite. Hills, summits and upper slopes (>1000m)	June, July, September	No	Not within 20km	Unlikely to occur
Dampiera metallorum	P3	Rounded, multi-stemmed perennial, herb, to 0.5 m high.	WAH: Summit of hill, high in landscape, steep slope, skeletal red gritty soil over massive banded ironstone.	Skeletal red-brown gravelly soil over banded ironstone. Steep slopes, summits of hills.	April-October	Yes but off footprint	Not within 20km	Unlikely to occur
Dolichocarpa sp. Hamersley Station (A.A. Mitchell PRP 1479)	P3	no info	WAH: Cracking clay	Spreading annual herb to 10 cm tall, with blue flowers in March; occurs on cracking clay on flat to gently undulating plains with large surface rock	March, May, July	No	Within 20 km	Unlikely to occur
Dysphania congestiflora	P3	no info	WAH: Saline floodplain. Recorded from the western side of Fortescue Marsh from flats on the margin and towards the centre of seasonally inundated flood plains and lake beds, on saline, deep, light-medium to heavy clay soils. A single collection has also been recorded from the Lyndon River in close proximity to Lake Macleod [5]	No info	June, July	No	Not within 20km	Highly unlikely to occur
Eleocharis papillosa	P3	Annual, herb.	WAH: Claypan low dune/berm on eastern edge of wetland.	Red clay over granite, open clay flats. Claypans.	November	No	Not within 20km	Unlikely to occur
Eragrostis crateriformis	P3	Annual, grass-like or herb, 0.17-0.42 m high	WAH: Drainage area / floodplain.	Clayey loam or clay. Creek banks, depressions.	January-July	Yes	Not within 20km	Unlikely to occur
Eragrostis sp. Erect spikelets (P.K. Latz 2122)	P3	Erect perennial grass-like or herb to 0.3 m high	WAH: Near samphire flat. Associated species: Goodenia omeriana, G. forrestii, Cullen cinereum, Scaevola spinescens, Acacia tetragonophylla, A. victoriae. Associated species: Halosarcia spp., Eragrostis falcata (mostly as first year plants), Nicotiana sp., Swainsona sp., Angianthus sp. Low calcrete platforms/rises [12]	No info	No	No	Not within 20km	Highly unlikely to occur
Eragrostis sp. Mt Robinson (S. van Leeuwen 4109)	P1	Tussock-forming perennial, grass-like or herb, to 0.3 m high	WAH and TPFL: Open mallee shrubland; Summit of hill, steep western slopes. Skeletal gritty soil. Massive banded Brockman Iron Formation.	Red-brown skeletal soils, ironstone. Steep slopes, summits.	September	No	Not within 20km	Unlikely to occur
Eremophila magnifica subsp. magnifica	P4	Shrub, 0.5-1.5 m high.	WAH: High in landscape, steep slopes, summits, gullies, skeletal red gritty soil over massive banded ironstone of the Brockman Iron Formation.	Skeletal soils over ironstone. Rocky screes.	June-November	Yes but off footprint	Within 20 km	**Likely to occur**
Eremophila magnifica subsp. velutina	P3	Shrub, 0.5-1.5 m high.	WAH: Summit of steep hill, high in landscape, steep slopes, rock screes and cliff faces, skeletal red stony soil over massive ironstone of the Brockman Iron Formation.	Skeletal soils over ironstone. Summits.	July-October	Yes but off footprint	Not within 20km	Unlikely to occur

Taxon	Status	Growth Form	Habitat from DBCA database records	Habitat from FloraBase	Flowering period	Habitat present at Lamb Creek?	Distance to project area	Likelihood ranking
Eremophila pusilliflora	P2	Shrub to 0.5m	WAH: Low lying associated with drainage lines on red/brown clay loams and ironstone. Low open woodlands scattered with Corymbia hamersleyana and with Acacia aneura, A. inaequlatera, A. pyrifolia over hummock grasslands of T. wiseana, T. pungens and T. brizoides. TPFL: Low lying in valleys, gibber plains above drainage line with Goodenia over red clay loams. Open woodlands of Acacia aneura with Ptilotus exaltatus and Ptilotus helipteroides. Found on seasonally inundated alluvial plains between Turee Creek, Pingandy Creek and drainage systems leading into the Ashburton River, growing in red-brown sandy loam soils in open low shrubland with Acacia aneura, Ptilotus nobilis, Goodenia and Triodia species[6]	No info	April-September and after rainfall	Yes	Within 20 km	May potentially occur
Eremophila sp. Hamersley Range (K. Walker KW 136)	P3	no info	WAH: Rocky gullies and gorges. Steep rocky hill slopes and summits, high in the landscape	No info	June, August, September	Yes but off footprint	Confirmed	**Confirmed**
Eremophila sp. West Angelas (S. van Leeuwen 4068)	P1	no info	WAH: TPFL Summits and slopes of hills, high in the landscape.	No info	August, September	Yes but off footprint, infrequently recorded ain locality	Not within 20km	Unlikely to occur
Eremophila spongiocarpa	P3	Compact, succulent-leaved shrub, to 1 m high.	WAH and TPFL: Saline , Alluvial margin of marsh. Edge of marsh, saline flats, broad plain, floodplain, claypan, Slope of linear dune.	Weakly saline alluvial plain on margins of marsh.	May, August, September	No	Not within 20km	Unlikely to occur
Eremophila youngii subsp. lepidota	P4	Dense, spreading shrub, (0.2-)1-3 m high.	WAH: Mulga woodland or acacia shrublands. Can grow near salt marshes in combination with Atriplex and other chenopods.	Stony red sandy loam. Flats plains, floodplains, sometimes semi-saline, clay flats.	January-March or August, September	Yes	Not within 20km	Unlikely to occur
Euphorbia australis var. glabra	P3	Prostrate herb, 10cm	WAH: Vegetation dominated by Acacia aptaneura. Acacia aff. aneura (long, flat, recurved; F. .MR 35.3), (Eucalyptus xerothermica) low woodland over *Malvastrum americanum, Sida aff. fibulifera low open shrubland over Sporobolus australasicus scattered bunch grasses. Associated Species: Acacia tetragonophylla. Broad, flat plain; calcrete platform to west and major creekline to east. Flat, red brown loam.	Prostrate annual herb. Typically occurs on cracking clay and clay plains	No	Possible	Not within 20km	Unlikely to occur
Euphorbia clementii	P3	Erect herb to 0.6m	TPFL; Sparse low woodland over Senna spp. moderately dense low shrubland over Triodia spp. and other grasses. Rock (Laterite) and red sand. Occasional Eucalyptus leucophloia. TPFL Taxon has been recorded on plains and outwash slopes, and in minor drainage lines or areas of sheet flow. This taxon is typically a fire-responder (and relatively short-lived) and can be observed in large numbers in recently burnt areas. [7]	Gravelly hillsides, stony grounds	May-July	Yes, would be obvious but as is a big post fire coloniser	Not within 20km	Unlikely to occur
Euphorbia inappendiculata var. inappendiculata	P2	small prostrate, much branched annual herb	Acacia aptaneura dominated vegetation. Flat, red brown loam. Recorded in cracking claypans of red sandy clay at Miralga Creek [7]	No info	No info	Yes, infrequently recorded	Not within 20km	Unlikely to occur
Euphorbia inappendiculata var. queenslandica	P2	prostrate annual herb	WAH: Tussock grassland of Astrebla elymoides, Chrysopogon fallax and Urochloa occidentalis var. occidentalis with open herbs of Polymeria longifolia, with high open shrubland of Acacia synchronicia. Cracking clay soil, Gilgai plain.	No info	No info	No	Not within 20km	Unlikely to occur
Euphorbia stevenii	P3	Succulent perennial herb from 0.1-0.5	Gently sloping area to gently undulating. Soils include: Red-brown cracking clay with scattered pebbles and cobbles on the surface. Occurs with many grasses including Astrebla sp, Themeda sp and Aristida sp.	Clay, sandy soils	June	Yes, infrequently recorded in locality	Not within 20km	Unlikely to occur

Taxon	Status	Growth Form	Habitat from DBCA database records	Habitat from FloraBase	Flowering period	Habitat present at Lamb Creek?	Distance to project area	Likelihood ranking
Fimbristylis sieberiana	P3	Shortly rhizomatous, tufted perennial, grass-like or herb (sedge), 0.25-0.6 m high.	WAH: Major drainage, edge of watercourse. With Eleocharis sp. Eucalyptus camaldulensis and Melaleuca argentea open woodland over Acacia pyrifolia var. pyrifolia; Acacia tumida var. pilbarensis and Clerodendrum tomentosum mid sparse shrubland over Cladium procerum and Cyperus vaginatus sedges and Cenchrus ciliaris. Woodland to forest of Eucalyptus camaldulensis and/or Melaleuca leucadendra and Acacia coriacea subsp. pendens over high shrubland.	Mud, skeletal soil pockets. Pool edges, sandstone cliffs.	May-August	No	Not within 20km	Unlikely to occur
Geijera salicifolia	P3	Tree from 1.5m-6m	WAH: Growing in flood area at base of gorge wall. Stony.	Skeletal soils, stony soils; Massive rock scree and gorges	September	N	Not within 20km	Unlikely to occur
Glycine falcata	P3	Mat-forming perennial, herb, to 0.2 m high	WAH: Sump, low in landscape. With Cullen and Vittadinia sp., Goodenia pascua and Bulbine pendula. Often low grassland or herbland with Acacia shrublands and hummock grassland, sometimes Eucalypts. Clay soils, cracking clays	Black clayey sand. Along drainage depressions in crabhole plains on river floodplains.		No	Within 20 km	Unlikely to occur
Gompholobium karijini	P2	Low shrub growing to 70 cm tall, with coarsely fibrous, grey bark.	Eucalyptus leucophloia subsp. leucophloia over Triodia sp. Triodia hummock grassland with scattered shrubs and trees on ironstone gravel 9 Breakaway habitats and associated rocky slopes, the top edge of mesas, broadly rocky and rugged upland habitats, and incised gullies/ rocky gullies of the upland areas' and 'mesa top habitat consisting of hill top, mesa top, and broad rolling hill habitats. [10]	Typically occurs on rocky crests and slopes of hill	January, August-September	Yes but rarely collected in locality	Not within 20km	Unlikely to occur
Goodenia lyrata	P3	Prostrate herb with lyrate leaves. Ephemeral	Broad drainage tract in hardpan plain. Mulga woodland. Mulga woodland or acacia shrublands, sometimes with E. victrix, over open shrubland, herbs.	Red sandy loam. Near claypan	May, August, October	No	Within 20 km	Unlikely to occur
Goodenia nuda	P4	Erect to ascending herb, to 0.5 m high.	WAH and TPFL : Variety of habitats	No info	March-August	Yes	Confirmed	**Confirmed**
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727)	P3	Open, erect annual or biennial, herb, to 0.2 m high.	WAH and TPFL : Variety of habitats with calcrete , Grassland on crabhole clay flats.	Red-brown clay soil, calcrete pebbles. Low undulating plain, swampy plains.	March-May and after rainfall	No	Within 20 km	Unlikely to occur
Grevillea saxicola	P3	Tall shrub or tree	WAH: High in landscape, steep and undulating terrain, skeletal red-brown gritty soil over massive banded ironstone of the Brockman Iron Formation. Mulga woodlands over shrublands with Eremophilas and other species, over Scaevola. No mention of Triodia. Skeletal red-brown sandy loam on steep slopes, rocky hills and ridges, usually growing with Mulga 10	No info	February, March	No	Not within 20km	Unlikely to occur
Gymnanthera cunninghamii	P3	Erect shrub, 1-2 m high.	WAH: South facing ironstone scree slope adjacent to Weeli Wolli Creek.	Sandy soils on islands in river and creek channels	Year-round	No, very scattered distribution.	Not within 20km	Unlikely to occur
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708)	P2	Shrub to 3m.	Gorges and Gullies associated with ironstone (inc: Brockman ironstone) outcroppings and boulders. Soils include Red-brown loams amongst boulders. Rocky ground high in the landscape. Gullies and gorges. [10]	No info	No info	Yes but off footprint	Not within 20km	Unlikely to occur
Indigofera gilesii	P3	Shrub, to 1.5 m high.	WAH: Near summit of hill, high in landscape, skeletal red-brown stony soil over massive ironstone of the Brockman Iron Formation, Gorge / gully. Red brown skeletal. Continuous ironstone pebbles, Breakaway. Red dry soil.	Pebbly loam. Amongst boulders & outcrops, hills.	May, June, August	No	Within 20 km	May potentially occur

Taxon	Status	Growth Form	Habitat from DBCA database records	Habitat from FloraBase	Flowering period	Habitat present at Lamb Creek?	Distance to project area	Likelihood ranking
Indigofera ixocarpa	P2	Shrub to 1m	WAH: Dry creekline. Ironstone rocks and loamy soil	Skeletal red soils over massive ironstone	May, June, August	Possible, very little info, infrequently recorded at locality	Not within 20km	Unlikely to occur
Iotasperma sessilifolium	P3	Erect herb	WAH: Sump, low in landscape, flat terrain, cracking red clay-loam.	Cracking clay, black loam. Edges of waterholes, plains.	September	N	Not within 20km	Highly unlikely to occur
Ipomoea racemigera	P2	Creeping annual, herb or climber.	WAH: Medium drainage line, fringing vegetation. Open forest of Eucalyptus camaldulensis and Melaleuca argentea	No info	June	N	Not within 20km	Unlikely to occur
Isotropis parviflora	P2	Shrub, 0.1 m high.	WAH: Stony plain, lower slopes, Hillcrest/upper slope.	Valley slope of ironstone plateaus, hill slopes and stony plains.	March-August	Yes	Within 20 km	**Likely to occur**
Kohautia australiensis	P2	Erect sparsely or much-branched annual, herb, 0.1-0.5 m high..	WAH: Calcrete plains, hills and rises	No info	March-May	No	Not within 20km	Unlikely to occur
Lepidium catapycnon	P4	Open, woody perennial, herb or shrub, 0.2-0.3 m high, stems zigzag.	Variety of vegetation types, typically with E. leucophloia over Acacias over Triodia. Strong habitat preference for steep upper breakaway slopes of mesa hills where it grows in skeletal light brown loam or sandy loam soils with a large proportion of loose rocks at the surface (50-100 percent) comprising a mixture of banded iron formation (BIF), banded chert and siltstone [11]	Skeletal soils. Hillsides.	May, June, August-November	No	Not within 20km	Unlikely to occur
Lindernia sp. Pilbara (M.N. Lyons & L. Lewis FV 1069)	P1	Annual or perennial herb, to 0.6 cm high	WAH: Claypan, low dune, edge of wetland.	No info	No info	No	Not within 20km	Unlikely to occur
Myriocephalus scalpellus	P1	Semi-erect herb, 0.03-0.08 m high.	WAH: At edge of claypan, In fringing vegetation.	Claypan	June	N	Not within 20km	Unlikely to occur
Nicotiana umbratica	P3	Erect, short-lived annual or perennial, herb, 0.3-0.7 m high. Fl. white, Apr to Jun. Shallow soils. Rocky outcrops.	no info	Shallow soils. Rocky outcrops.	April-June	Yes but off footprint	Not within 20km	Unlikely to occur
Olearia mucronata	P3	Densely branched, unpleasantly aromatic shrub (0.6-1m)	WAH: Steep upper slope, Soil: Red-brown scree boulders (ironstone), stones, base of south facing ironstone cliff, bordering a large scree slope.	Schistose hills along drainage channels	July-January	Yes but off footprint	Not within 20km	Unlikely to occur
Oxalis sp. Pilbara (M.E. Trudgen 12725)	P2	Small annual herb to 10 cm tall. Leaves green above, purple below	WAH: Gorge, gully, cliff	No info	May, July	Yes but off footprint	Not within 20km	Unlikely to occur
Pentalepis trichodesmoides subsp. Hispida	P2	Compact shrub to 1m	WAH: Summit of ridge, high in landscape, steep terrain, skeletal brown gritty soil over metabasaltic pillow lava, breccia; metatuff and minor cherts of the Bunjinah Formation, altitude ca. = 1020 m.	No info	August, September	No	Not within 20km	Unlikely to occur
Pilbara trudgenii	P3	Gnarled, aromatic shrub, to 1 m high.	WAH: Skeletal soil Summit, slopes, screes and cliffs. Brockman Iron Formation. With Eucalyptus leucophloia, E. gamophylla.	Skeletal, red stony soil over ironstone. Hill summits, steep slopes, screes, cliff faces.	July, September	Yes but off footprint	Not within 20km	Unlikely to occur

Taxon	Status	Growth Form	Habitat from DBCA database records	Habitat from FloraBase	Flowering period	Habitat present at Lamb Creek?	Distance to project area	Likelihood ranking
Ptilotus mollis	P4	Compact, perennial shrub, to 0.5 m high, soft grey foliage.	WAH: Steep, rocky scree slope, laterite.	Stony hills and screes.	May, July, September	Yes	Not within 20km	Unlikely to occur
Rhagodia sp. Hamersley (M. Trudgen 17794)	P3	A spindly shrub growing to 2 m tall;	WAH: Mulga over mixed grassland. Emergent eucalypts and Triodia grassland. Very open mulga woodland over patchy mixed grasses. Floodplains, hardpan plains.	Red sandy clay loam plains and floodplains growing in association with Mulga (Acacia aneura)	March, May, September	Yes	Confirmed	**Confirmed**
Rhodanthe ascendens	P1	Ascending annual herb to 0.1m	WAH: Flat terrain, low in landscape, stony gibber with red cracking clay soils. Acacia aneura over Open Tussock Grass of Aristida spp.	Clay, roadside verge	August, September	Yes, infrequently collected	Not within 20km	Unlikely to occur
Rhynchosia bungarensis	P4	Compact, prostrate shrub, to 0.5 m high.	WAH: Creekline in a gorge	Pebbly, shingly coarse sand amongst boulders. Banks of flow line in the mouth of a gully in a valley wall.	November	No	Not within 20km	Unlikely to occur
Rostellularia adscendens var. latifolia	P3	Herb or shrub, 0.1-0.3 m high.	Acacia shrubland, sometimes with Eucalypts and Corymbias, over shrublands and herblands, over tussock grassland, or Triodia pungens hummock grassland.	Ironstone soils. Near creeks, rocky hills.	April, June, August		Confirmed	**Confirmed**
Samolus sp. Fortescue Marsh (A. Markey & R. Coppen FM 9702)	P1	Erect perennial herb, 0.3-1.0 m high	Margins of semi-permanent/permanent freshwater pools and the margins of samphire shrublands where creeks discharge freshwater following periods of high rainfall. [13]	No info	September	No	Not within 20km	Highly unlikely to occur
Scaevola sp. Hamersley Range basalts (S. van Leeuwen 3675)	P2	Shrub, to 1 m high	Steep slopes and screes. Growing in Regenerating Open Shrub Mallee of Eucalyptus kingsmillii and E. gamophylla over Dwarf Scrub C/D of Triumfetta sp, Corchorus sp, Hibiscus sp. and Acacia bivenosa over Open Hummock Grass of Triodia sp.	Skeletal, brown gritty soil over basalt. Summits of hills, steep hils.	July-August	No	Not within 20km	Unlikely to occur
Seringia exastia	CR	Shrub	Variety of mulga woodlands, sometimes with Eucalypts, over Acacia shrublands over Trioda pungens hummock grassland. Gully - washout. Red sand/laterite over sandstone.	No info	Year-round	Yes	Confirmed	**Confirmed**
Sida sp. Barlee Range (S. van Leeuwen 1642)	P3	Spreading shrub, to 0.5 m high.	WAH: Cliff line and scree slopes, gorge and steep gully	Skeletal red soils pockets. Steep slope.	August	Yes but off footprint	Not within 20km	Unlikely to occur
Sida sp. Hammersley Range basalts (K. Newbey 10692)	P3	Herb or shrub to 0.15m	Plants growing amongst rocks along the south side of a small ironstone breakaway. Low open woodland over hummock grassland of Triodia sp.	No info	May, August, October	Possible, very little info, infrequently recorded at locality	Not within 20km	Unlikely to occur
Solanum kentrocaule	P3	Perennial shrub to 2.5m	WAH: Near summit of hill, high in landscape, skeletal red-brown stony soil over massive ironstone of the Brockman Iron Formation, steep slopes, steep gullies	No info	May, July, August	No	Not within 20km	Unlikely to occur
Stackhousia clementii	P3	Dense broom-like perennial, herb, to 0.45 m high.	Acacia shrubland, sometimes with E. victrix, over Acacia sclerosperma. WAH: Clay loam plains, drainage plains	Skeletal soils. Sandstone hills.	April, September		Not within 20km	Unlikely to occur
Streptoglossa sp. Cracking clays (S. van Leeuwen et a. PBS 7353)	P3	Multi stemmed annual herb	Cracking clay, Acacia aneura var. longicarpa high open shrubland over Rhagodia eremaea scattered shrubs over Aristida latifolia and Astrebla elymoides scattered tussock grasses. Acacia aneura var. longicarpa 3-5 m < 1-5%; Rhagodia eremaea 0.4-1.2 m < 1%; Aristida latifolia.	No info	June	No	Not within 20km	Unlikely to occur
Stylidium weeliwolli	P3	Annual, herb, 0.1-0.25 m high, throat appendages 4, rod-shaped.	WAH: In damp soil in rock clefts of river bed, permanent pools.	Damp soil in rock clefts of river bed, permanent pools, edge of water courses	July-October	No	Not within 20km	Unlikely to occur

Taxon	Status	Growth Form	Habitat from DBCA database records	Habitat from FloraBase	Flowering period	Habitat present at Lamb Creek?	Distance to project area	Likelihood ranking
Swainsona thompsoniana	P3	Prostrate annual herb to 10 cm high	WAH: Gently sloping area to gently undulating. Soil: Red-brown cracking clay with scattered pebbles and cobbles on the surface. Includes a flowline. Varies to areas of orange-brown cracking clay. Colluvial and alluvial gravels in fan or floodplain	No info	April, June, August	No	Not within 20km	Unlikely to occur
Synostemon hamersleyensis	P1	no info	WAH: Steep scree slope below banded iron formation cliff line with brown sandy loam soil. Steep hillslope, narrow gorge	No info	No info	Yes but off footprint	Not within 20km	Unlikely to occur
Tecticornia globulifera	P1	no info	WAH: Saline flats and marsh with light medium clay soil.	No info	No info	No	Not within 20km	Highly unlikely to occur
Tecticornia medusa	P3	no info	WAH: Growing on the lake bed a few 100 metres from the shoreline. Red clayey sand., Claypan	No info	November	No	Not within 20km	Highly unlikely to occur
Tecticornia sp. Christmas Creek (K.A. Shepherd & T. Colmer et al. KS 1063)	P1	no info	Samphire flats.	No info	No info	No	Not within 20km	Highly unlikely to occur
Tetratheca fordiana	P2	Dwarf shrub; 0.3-0.4m	WAH: Vertical cliff faces amongst ironstone. Breakaways on Skeletal soils. Scattered low trees of Eucalyptus leucophloia, E. kingsmillii over scattered shrubs of Acacia hamersleyensis over open hummock grassland of Triodia epactia, Triodia wiseana and Triodia sp. Mt Ella (M.E. Trudgen 12739) with scattered tussock grasses of Eriachne mucronata.	Shale pocket amongst ironstone	April, May	No	Not within 20km	Unlikely to occur
Teucrium pilbaranum	P2	Upright shrub, 0.2 m high	WAH: High shrubland of Acacia sclerosperma, Acacia synchronicia, Eremophila longifolia and Acacia citrinoviridis over open herbs of Malvastrum americanum, Corchorus tridens and Cleome viscosa with low open woodland of Acacia citrinoviridis and Acacia aptaneura. Plain with brown clay loam soil.	Crab hole plain in a river floodplain, margin of calcrete table.	May, September	No	Not within 20km	Unlikely to occur
Themeda sp. Hamersley Station (M.E. Trudgen 11431)	P3	Tussocky perennial, grass-like or herb, 0.9-1.8 m high.	Variety of habitats including Mulga woodlands and mixed shrublands. Cracking clays, Red clay. Clay pan, grass plain.	Red clay. Clay pan, grass plain.	July-September	Yes	Within 20 km	**Likely to occur**
Thryptomene wittweri	VU	Spreading or rounded shrub from 0.5 - 1.5(2.1m)	WAH: Growing on tops of cliffs, ledges along cliff, in rock crevices and on boulder screes in shades southerly situations. Skeletal red stony soil. Ironstone. High in landscape, rocks on edge of cliff face and growing on face itself, S aspect, skeletal red-brown soil over massive banded ironstone of the Brockman Iron Formation, lots of rock and large sheets of ironstone on surface.	Skeletal red stony soils. Breakaways, stony creek beds.	April-August	No	Not within 20km	Unlikely to occur
Triodia basitricha	P3	no info	WAH Rehabilitation adjacent to Coondewanna airstrip, Mining Area C: Isolated Eucalyptus victrix and Corymbia hamersleyana, OR isolated Corymbia opaca trees over open to sparse Acacia aptaneura, A. bivenosa, A. pruinocarpa, and other shrubs, sometimes over Triodia, sometimes over low shrubs.	No info	No info	No	Within 20 km	Unlikely to occur
Triodia sp. Karijini (S. van Leeuwen 4111)	P1	no info	WAH: Triodia hummock grassland, variety of species including T. pungens, T. wiseana, often with emergent eucalypts and Corymbias, with Acacia shrublands. Very steep hillslope of grey silty loam.	No info	September	No	Within 20 km	May potentially occur
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	Perennial, grass-like or herb, 0.4 m high.	WAH: Rocky creeklines, often grows together with Triodia pungens. With E. leucophloia and C. hamersleyana.	Light orange-brown, pebbly loam. Amongst rocks & outcrops, gully slopes.	February, March, September	Yes	Within 20 km	**Likely to occur**

Taxon	Status	Growth Form	Habitat from DBCA database records	Habitat from FloraBase	Flowering period	Habitat present at Lamb Creek?	Distance to project area	Likelihood ranking
Vittadinia sp. Coondewanna Flats (S. van Leeuwen 4684)	P1	Annual daisy	WAH: Woodland to open forest of variety of mulga species and other acacias, OR shrubland of acacias and other species, sometimes with Eucalypts, over diverse shrubland, often over open Triodia grassland (T. pungens, T. melvillei). Plain, floodplain, drainage, sandy-clay loam,	No info	May, July, September	Yes	Within 20 km	**Likely to occur**
Xerochrysum boreale	P3	no info	WAH: Mulga, stony plain	No info	No info	Yes but rarely collected in locality	Not within 20km	Unlikely to occur

Footnotes:

Additional references to FloraBase and DBCA Threatened and Priority Flora Database (including WA Herbarium records)

1 *Ecologia (2011). Munjina Roy Hill Road Realignment VCP. Report prepared for Brockman Resources*

2 *Glime, J. M. (2020). Streams: Physiological Adaptations – Water, Light, and Temperature. Chapt. 2-6. In: Glime, J. M. Bryophyte 2-6-1 Ecology. Volume 1. Habitat and Role. Ebook sponsored by Michigan Technological University and the International Association of Bryologists. Last updated 22 July 2020 and available at <http://digitalcommons.mtu.edu/bryophyte-ecology/"*

3 *ENV (2013) Christmas Creek Life of Mine Flora and Vegetation Assessment. Report prepared for FMG.*

4 *Dillon and McFarlane (2020). Leeuwen's Lily (Arthropodium vanleeuwenii: Asparagaceae), a remarkable new discovery from the Pilbara, Western Australia. Nuytsia 31: 265–269 https://florabase.dpaw.wa.gov.au/science/nuytsia/963.pdf*

5 *Dillon and Markey (2016). Dysphania congestiflora (Chenopodiaceae), a new species from Western Australia. Nuytsia 27: 133–138. https://florabase.dpaw.wa.gov.au/science/nuytsia/793.pdf*

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7 *Woodman (2019). Miralga Creek Iron Ore Project, Detailed Flora and Vegetation Survey. Unpublished report (Atlas19-07-01) prepared for Atlas Iron for Atlas Iron Limited*

8 *State Herbarium of South Australia (2021). Euphorbia stevenii - Electronic Flora of South Australia species Fact Sheet. http://flora.sa.gov.au/cgi-bin/speciesfacts_display.cgi?genus=Euphorbia&species=stevenii*

9 *Wilkins and Trudgen (2012). A new species of Gompholobium (Fabaceae: Mirbelieae) from the Pilbara bioregion of Western Australia. Nuytsia. 22(1): 31–40 https://florabase.dpaw.wa.gov.au/science/nuytsia/628.pdf "*

10 *Biota (2014). Baby Hope Downs Flora and Vegetation Survey. Report prepared for Rio Tinto*

11 *Onshore Environmental (2013d) Targeted Survey for Lepidium catapycnon at Karijini National Park. Consultants report prepared for BHP Billiton Iron Ore."*

12 *Biologic (2020). Roy Hill East of Remote MAR Borefield Reconnaissance Flora and Vegetation Survey*

13 *Markey (2017). Floristic survey and mapping of the riparian and halophyte dominated communities on the Fortescue Marsh (Martuyitha), Western Australia. Technical Report · February 2017.*

Report No. J021158

Detailed flora and vegetation Survey of the Great Northern Highway intersection – Lamb Creek Project

Prepared for: Mineral Resources Limited
Date: 29 October 2021

Rapallo Environmental is a Western Australian consultancy with a strong reputation for technical excellence, client-focus and innovation. We build long-term alliances through outstanding delivery on a range of services to the resource sector, government and associated industries.

ENVIRONMENTAL | ENGINEERING | CONSTRUCTION & OPERATIONS *NDT & Inspections* | MINING | RESOURCE MANAGEMENT

Report No. J021158
Detailed flora and vegetation survey of the Great Northern Highway Intersection – Lamb Creek project
Prepared for Mineral Resources Limited
29 October 2021

Revision	Date	Prepared	Reviewed	Approved
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Table of Contents

Tables

Figures

Appendices

Executive Summary

Mineral Resources Limited (MRL) commissioned Rapallo Environmental (Rapallo) to conduct a single-phase detailed vegetation and flora survey of the Great Northern Highway Intersection area associated with the Lamb Creek Project.

The Great Northern Highway intersection survey area (the survey area) comprised 254 hectares, beginning at the Great Northern Highway and extending north-westwards.

The objectives of the survey were to complete a desktop study and single-phase detailed flora and vegetation survey to map vegetation types, describe floristic diversity, verify desktop information, and assess whether the habitats of the survey area contain conservation significant flora and vegetation. Conservation significant flora taxa are presented in a separate targeted report (Rapallo 2021).

Methods

The single-phase flora and vegetation survey was completed by a team of three botanists over a period of six days. The work was completed in conjunction with a targeted conservation significant flora survey, which is reported on separately (Rapallo 2021).

A total of nineteen flora quadrats (50 by 50 meters) and one relevé were sampled. Additional flora taxa were recorded opportunistically while traversing between quadrats, and during the targeted survey. Preliminary vegetation boundaries were mapped in the field using aerial photographs and GPS waypoints with associated vegetation notes.

Desktop results

The desktop study returned 800 vouchered vascular plant taxa (species and subspecies) within 40 kilometres of the survey area, representing 252 genera and 79 families.

The desktop study found 86 conservation significant vascular flora taxa from within 60 kilometres of the Lamb Creek project area. A likelihood assessment was based on proximity of records and availability of habitat in the survey area. The assessment identified eleven taxa that were either confirmed, likely to occur, or may potentially occur in the survey area. Five of these were recorded during the survey.

The desktop study identified forty-eight introduced taxa (weeds). Nine of these taxa were recorded during the field survey.

The desktop returned one Priority Ecological Community (PEC) within 5 km of the survey area. This was subtype 2 of the Coolibah-Lignum Flats vegetation community, which is listed Priority 1. Results from previous surveys of the Lamb Creek project (Rapallo 2012) and the current field survey confirmed that the PEC does not occur in the survey area.

Field survey results

The survey recorded 187 flora taxa from 35 different families. These included 178 native taxa and nine introduced taxa (weeds: section 4.2.3). The most well-represented families were Poaceae (40 taxa), Fabaceae (37 taxa), and Malvaceae (16 taxa).

Of the 187 flora taxa recorded, 26 taxa (14%) were annuals, 18 (10%) were annual or short-lived perennial, 131 (70%) were perennials. Twelve taxa (6%) did not have life cycle information available.

Five conservation significant flora taxa were recorded from the survey area, as listed below. These are described and mapped in Rapallo (2021):

- *Aristida lazaridis*: Priority 2
- *Rhagodia* sp. Hamersley (M. Trudgen 17794): Priority 3
- *Goodenia nuda*: Priority 4
- *Seringia exastia*: Critically Endangered
- *Euphorbia* aff. ferdinandi: Potentially undescribed

The most commonly recorded taxon was *Aristida lazaridis*, which occurred throughout the survey area, within vegetation types A, B, C and D. *Seringia exastia*, although currently listed Critically Endangered, is listed as a result of a taxonomic revision and is likely to be de-listed in the future (DBCA communication received 24/08/2021)

Vegetation of the survey area

The vegetation across the survey area generally comprised low open woodland to isolated trees dominated by mulga (*Acacia aptaneura*) or other acacia species, over an understorey of either spinifex, tussock grasses, or a combination thereof, on a flat to gently sloping clay-loam plain. The dominant spinifex species was *Triodia pungens*, however patches dominated by *Triodia wiseana* occurred throughout the survey area, with some patches large enough to be mapped.

The vegetation of the survey area has been affected by fire, as visible on the ground during the survey, and supported by NAFI data which maps the entire survey area as having been burnt in 2015 (NAFI 2021). Disturbance notes taken during the survey indicated that fire killed between 5% and 90% of (tall) shrubs and trees in the area.

Vegetation condition across the survey area varied from Very Good to Degraded, with most of the quadrats ranked as Good (EPA 2016a: Table 2). The main reason for this ranking was fire.

Vegetation types

Vegetation types were identified and described through a combination of manual classification and statistical analysis using PATN software. Results of PATN matched well with manual classification.

Six vegetation types were mapped and described across the survey area:

- Vegetation type A – Low open *Eucalyptus gamophylla* woodland over *Triodia melvillei* and *T. pungens* on stony plain (39 ha)
- Vegetation type B – Mulga and acacia low open woodland over open tussock grassland on gently sloping (drainage) plain with variable rock cover (49 ha)
- Vegetation type C – Mulga and acacia low open woodland over open spinifex and tussock grassland on flat plain with medium rock cover (84 ha)
- Vegetation type D – Mulga, Hakea lorea, and *Eucalyptus xerothermica* low open woodland over closed tussock grassland on gently sloping clay-loam plain (no rocks) (51 ha)
- Vegetation type E – Low mulga woodland over sparse understorey on stony plain (9 ha)
- Vegetation type F – *Triodia wiseana* hummock grassland with emergent shrubs and low trees on gently sloping stony plain (4 ha)

Twenty hectares of the survey area was cleared, disturbed, contained roads, or contained regrowth or revegetation with native species. These areas did not represent a vegetation type.

Site selection and vegetation mapping was limited by the absence of a recent aerial photograph showing the current state of the vegetation within the survey area. The most recent aerials available were dated 2009 and 2013, which pre-dated the 2015 fire.

Not all vegetation types were represented adequately with quadrats, with vegetation types A and E only represented by a single quadrat, while vegetation type F was only sampled with a relevé. Additional quadrats are likely to improve vegetation community definition and mapping.

Of the six vegetation types identified in the survey area, four (A, B, C and D) were identified as being of moderate local significance due to the presence of *Aristida lazaridis* which is listed Priority 2.

1 Introduction

1.1 Project overview

The Lamb Creek Iron Ore Project comprises a proposed mining area and an associated haul road, located approximately 130 kilometres (km) north-west of Newman in the Pilbara region of Western Australia. The project occurs within retention licence R47/19 and miscellaneous licence 47/736.

Mineral Resources Limited (MRL) commissioned Rapallo Environmental (Rapallo) to conduct a single phase detailed vegetation and flora survey of the Great Northern Highway Intersection area associated with the Lamb Creek Project. The location and extent of the survey area is described in section 1.2.

The detailed vegetation and flora survey, in conjunction with a targeted survey, was completed by a team of three botanists over a period of six days, from 12th to 17th May 2021.

The targeted survey for conservation significant species is presented in (Rapallo 2021).

1.2 Survey Area

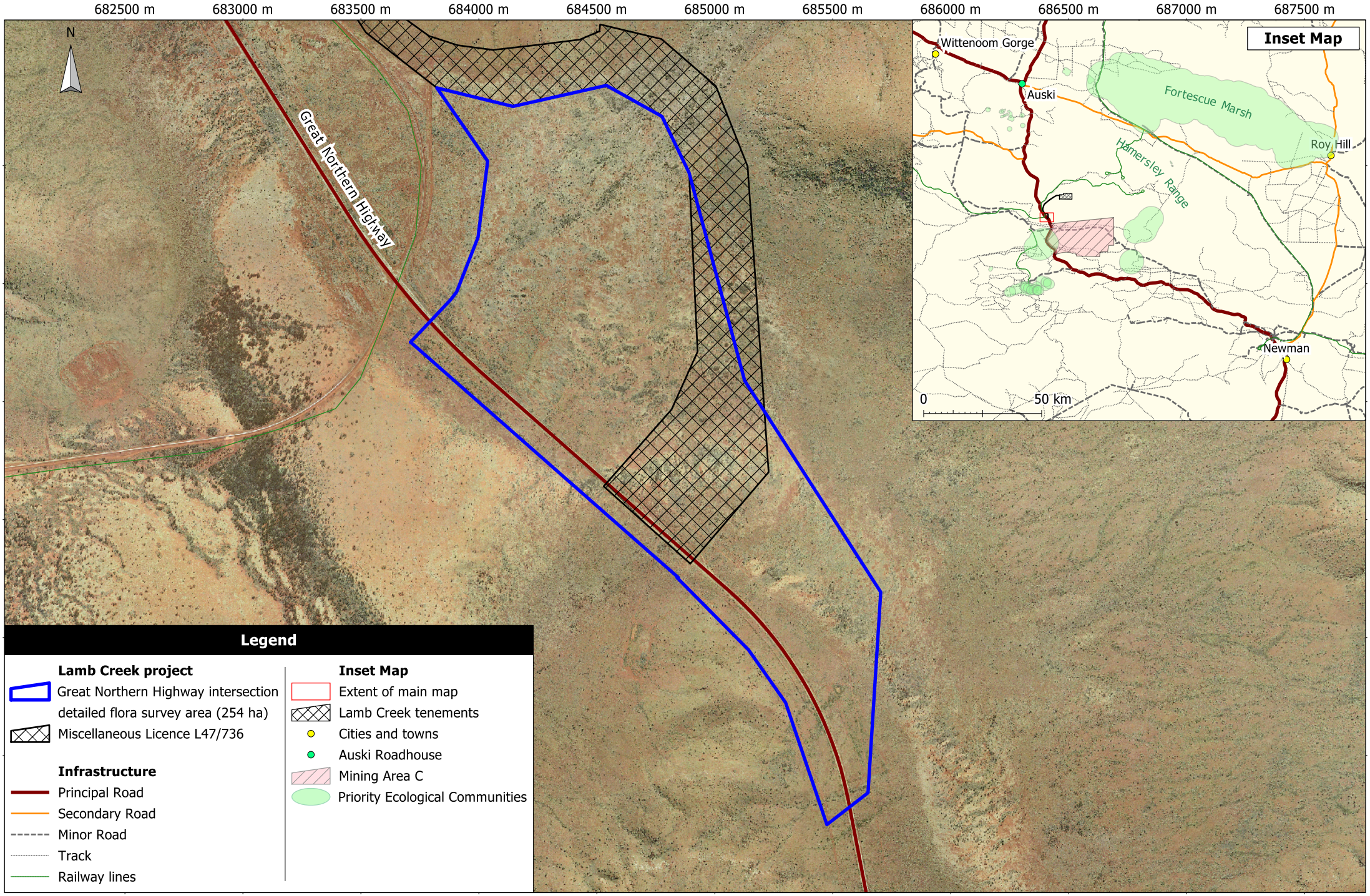
The Great Northern Highway intersection survey area comprised 254 hectares, beginning at the Great Northern Highway and extending north-westwards (Figure 1.1). Hereafter, this area will be referred to as the GNHI survey area, or simply the survey area.

The survey area enveloped various intersection options investigated for a proposed haul road connecting the Lamb Creek resource area with the highway. It was not bounded by a registered tenement at the time of survey, but enclosed the southern end of miscellaneous licence L47/736.

1.3 Scope and objectives

The objectives of the detailed flora and vegetation survey were to:

- Complete a desktop study to identify conservation significant flora and ecological communities that may occur in the survey area.
- Conduct a single-phase detailed flora and vegetation survey of the GNHI survey area, to map broad-scale vegetation types, describe floristic diversity, verify desktop information, and assess whether the habitats of the survey area contain conservation significant flora and vegetation.



Rapallo environmental

Mineral Resources Limited
Lamb Creek Project

Lamb Creek Iron Ore Project
Great Northern Highway intersection
detailed flora survey (May 2021)

Original Size: A4 Scale: 1:20,000
Datum: MGA94 Zone 50
0 800 m

Figure 1.1

Location of the Lamb Creek project and delineation of the survey area

2 Regional context

2.1 Climate and weather

The Lamb Creek project is situated in the Hamersley subregion (PIL03) of the Pilbara IBRA region, which is part of the Eremaean province (Beard 1990). The climate of the Hamersley IBRA subregion (PIL03) is described as semi-desert tropical. The average rainfall is 300 mm per year, usually in summer cyclonic or thunderstorm events. Winter rain is not uncommon (Kendrick 2001). Cyclones develop off the north-west coast and often cross the coastline between Karratha and Port Hedland and move inland over the Fortescue Valley system towards Newman (Beard 1990).

The closest Bureau of Meteorology (BOM) weather station to the survey area is at Newman Airport (station number 007176), located 130 kilometres south-east of the survey area. This weather station has been recording rainfall data since 1971 and temperature data since 1996.

Data recorded at Newman Airport (BoM 2021) (Figure 2.1) shows a mean annual rainfall of 324.3 millimetres. Mean monthly rainfall is highest in February at 70.2 millimetres, and lowest in September at 3.7 millimetres. The hottest month is December with a mean maximum temperature of 39.3°C and a mean minimum temperature of 24.1°C. The annual wind records from 9am and 3pm show a dominant easterly throughout the day, with the strongest winds recorded in the morning of up to 30 kilometres/hour.

Evaporation rates are not recorded at the Newman Airport Weather Station. However, evaporation in the Central Pilbara Region is estimated to be between 2000 millimetres and 3500 millimetres per annum, which is approximately ten times greater than annual rainfall (Gardiner 2003). This disparity maintains a typically arid landscape, except for areas located in proximity to river systems and shallow groundwater resources.

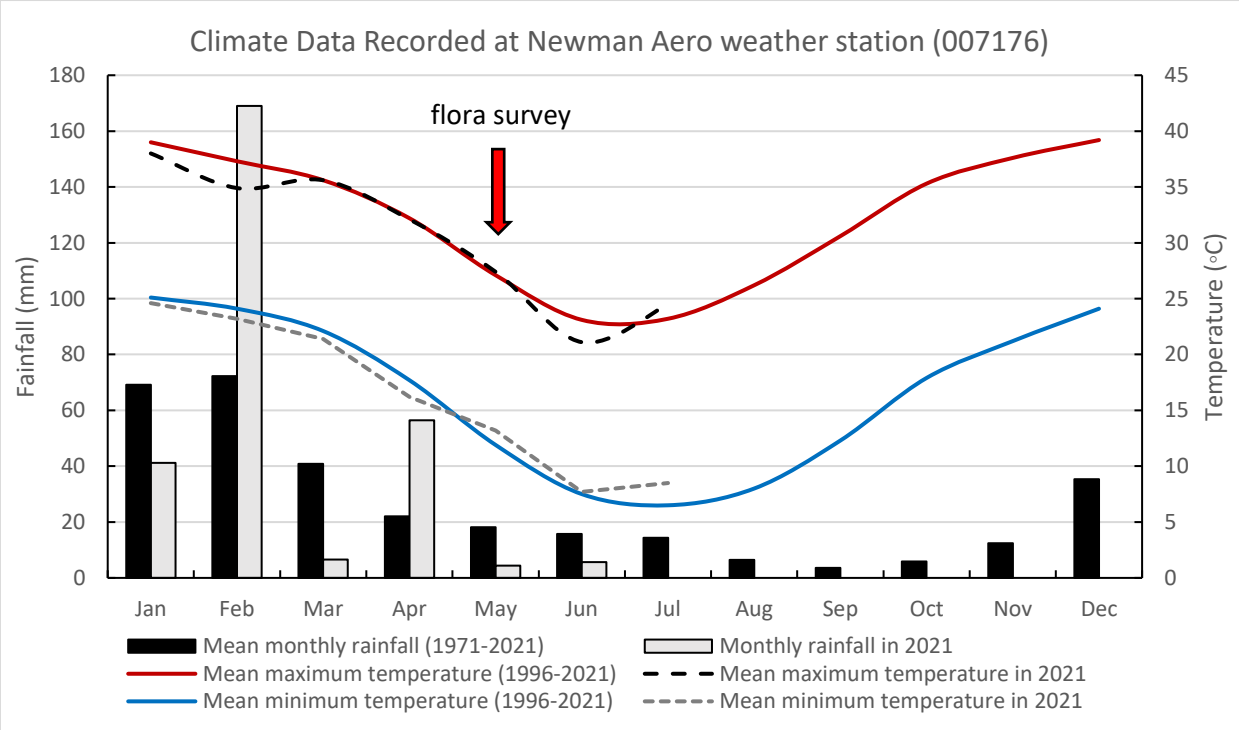


Figure 2.1 Long-term average monthly rainfall and maximum temperature, and 2021 monthly rainfall and maximum temperatures recorded at Newman Aero weather station

Rainfall over the three months preceding the survey was above average with substantial rainfall recorded in February 2021 (169 millimetres) and April (56.4 millimetres). Mean maximum and minimum temperatures during the survey (May 2021) were in line with the average, at respectively 27.4 °C during the day, and 13.2 °C at night.

2.2 Biogeography

2.2.1 IBRA bioregions

The bioregions of Australia are described in the Interim Biogeographic Regionalisation for Australia (IBRA) (Thackway & Cresswell 1995). Bioregions are large, geographically distinct areas of land with common characteristics such as geology, landform patterns, climate, ecological features and plant and animal communities. The latest version, IBRA7, classifies Australia's landscapes into 89 large geographically distinct bioregions and 419 subregions (Department of the Environment and Energy (DotEE) 2012).

The Lamb Creek project is located in the Hamersley (PIL3) subregion of the Pilbara bioregion. The Hamersley subregion comprises the southern section of the Pilbara Craton. It is a mountainous area of Proterozoic sedimentary ranges and plateaux, dissected by gorges (basalt, shale and dolerite). Geographically it is synonymous with the Hamersley vegetation system as described by Beard (1990). The dominant vegetation is mulga low woodland over bunch grasses on fine textured soils in valley floors, and *Eucalyptus leucophloia* (snappy gum) over *Triodia brizoides* on skeletal soils of the ranges. Regional vegetation is further described in section 2.3. Drainage runs into either the Fortescue River to the north, the Ashburton river to the south, or the Robe river to the west (Kendrick 2001).

2.2.2 Land System

The land systems of the Pilbara region are classified according to similarities in landform, soil, vegetation, geology and geomorphology, following van Vreeswyk *et al.* (2004). Three land systems occur on the survey area, as listed and summarised in Table 2.1.

The majority of the survey area falls within the Boolgeeda land system, comprising stony slopes, plains, hills, and drainage floors with spinifex followed by the Wannamunna land system; characterised by hardpan plains and internal drainage tracts supporting mulga shrublands and woodlands (and occasionally eucalypt woodlands). A small portion of the Newman land system, comprising rugged mountains, ridges, and plateaux, intersects the southern edge of the survey area .

Table 2.1 Land systems of the survey area

Name	Land type	Description	Extent in survey area
Boolgeeda Land System	Stony plains with spinifex grasslands	Stony lower slopes, stony plains below hills, and narrow sub-parallel drainage floors. Supports hard and soft spinifex grasslands or mulga shrublands. Often occurs below hill systems such as Newman and Rocklea	182 ha
Wannamunna Land System	Wash plains on hardpan with mulga shrublands	Hardpan plains and internal drainage tracts supporting mulga shrubland and woodlands, and occasionally eucalypt woodlands. Depositional surfaces, level hardpan wash plains subject to overland sheet flow. Broad internal drainage flats receiving run-on from	69 ha

Name	Land type	Description	Extent in survey area
		adjacent hardpan surfaces; rare channelled tracts but mostly not organised through drainage. Relief up to 5 m.	
Newman Land System	Hills and ranges with spinifex grasslands	Rugged high mountains, ridges and plateaux with near vertical escarpments of jaspilite, chert and shale, supporting hard spinifex grasslands. Relief up to 400 m.	3 ha

2.2.3 Geology

The survey area is located in the south-west corner of the Roy Hill 1:250,000 Geological Survey Sheet (SF50-12: Thorne & Tyler 1997). The geology of the survey area is generally defined by the assemblage of prehnite, pumpellyite, epidote, actinolite. Basement rocks comprise the early Proterozoic Brockman Iron Formation and Weeli Wolli Formation. The Brockman Iron Formation consists of banded iron formation (BIF) and shale, while the Weeli Wolli formation consists of BIF separated by shale and siltstone bands, with younger dolerite sills that intersect the sedimentary sequence.

Regionally, the fresh basement rocks are typically overlain by weathered basement rocks which occur as lateritic and basal gravel and/or conglomerate deposits. These weathered deposits underlie early Tertiary Channel Iron Deposits (CID), which are the dominant economic-grade iron deposits in the region. The CID is typically overlain by younger alluvial and colluvial gravels and sediments (Thorne & Tyler 1997).

The survey area overlies the following geological units (Stewart *et al.* 2008), as described below.

- Quaternary Colluvium (Qrc): Colluvium, sheetwash, talus; gravel piedmonts and aprons over and around bedrock; clay-silt-sand with sheet and nodular kankar; alluvial and aeolian sand-silt-gravel in depressions and broad valleys in Canning Basin; local calcrete, reworked laterite.
- Brockman Iron Formation (Lchk): Banded iron-formation, chert, mudstone and siltstone of Palaeozoic age

2.2.4 Soils

The survey area is located within the Fortescue botanical district of the Pilbara region (Beard 1990). This region is mountainous, with soils ranging from shallow, stony sandy loams along slopes, to cracking clays, stripped hardpans and calcareous loams along active waterways (Beard 1990).

The landforms of the survey area are typical of the eastern Pilbara with rocky hills, small gorges, mostly seasonal watercourses and gravelly loam valleys. The soils are typified by hard red alkaline soils on plains, pediments and alluvial areas, while shallow, skeletal soils are common on ranges that rise to 1,250 metres (Beard 1990). The southern part of eastern Pilbara region is characterised by earthy loams underlain by red-brown hardpan (Beard 1975, 1990).

The survey area has two distinct soil and landform assemblages. The greater majority of the survey area is characterised as soil unit Fb3, while the southern tip of the survey area falls within soil unit Fa13. These are defined as follows (CSIRO Australia 2018):

- Fb3 – High-level valley plains set in extensive areas of unit Fa13. There are extensive areas of pisolitic limonite deposits: principal soils are deep earthy loams (Um5.52) along with small areas of (Gn2.12) soils.

- Fa13 – Ranges of banded jaspilite and chert along with shales, dolomites, and iron ore formations with some areas of ferruginous duricrust as well as occasional narrow winding valley plains and steeply dissected pediments. This unit is largely associated with the Hamersley and Ophthalmia Ranges. The soils are frequently stony and shallow and there are extensive areas without soil cover: chief soils are shallow stony earthy loams (Um5.51) along with some (Uc5.11) soils on the steeper slopes. Associated are (Dr2.33, Dr2.32) soils on the limited areas of dissected pediments, while (Um5.52) and (Uf6.71) soils occur on the valley plains.

2.2.5 Hydrology

Within the Hamersley (PIL3) subregion drainage runs into either the Fortescue River to the north, the Ashburton river to the south, or the Robe river to the west (Kendrick 2001). The Great Northern Highway intersection survey area falls within the Ashburton River Catchment. One mapped intermittent creek line enters the survey area from the north-east, with the much of the survey area characterised by non-incised drainage plain, receiving run-on from adjacent hills.

2.2.6 Topography

The survey area occurs within the central Hamersley Ranges which dominate the sub-region (Thorne & Tyler 1997). The topography of the region is highly mountainous comprising three smaller ranges: Packsaddle Range in the centre, Jirrpalpur Range in the south and the Hancock Range to the north. The survey area skirts the western edge of the Hancock Range, with the survey area predominantly characterised by plain and valley floor.

2.3 Regional vegetation

2.3.1 Botanical district

The survey area is located in the Fortescue botanical district of the Pilbara region (Beard 1990), which forms part of the Eremaean Botanical Province. The Pilbara region receives a slightly higher than average rainfall than most of the Eremaean Province, due to the prevalence of cyclones off the coast, but this is not enough to modify the essentially desert appearance of the plant cover (Beard 1990).

The Fortescue district consists predominantly of tree and shrub steppe communities with *Eucalyptus* trees, *Acacia* shrubs and spinifex grasses including *Triodia pungens* and *T. wiseana* (Beard, (1975). Mulga (species of the *Acacia aneura* complex) occurs in valleys and short-grass plains may be present on alluvial soils (Beard 1990).

2.3.2 Vegetation system association

Digital maps (shapefiles) of pre-European vegetation communities, based on state-wide mapping by J.S. Beard at 1:250,000 scale, are published by the Department of Primary Industries and Regional Development (Beard 2018).

Vegetation of the Hamersley (PIL3) IBRA subregion is generally low Mulga woodland over bunch grasses on fine textured soils in the valleys with snappy gums (*Eucalyptus leucophloia*) over *Triodia brizoides* on skeletal soils of the ranges (Kendrick 2001). The mountain tops and gorges of the Hamersley subregion provide refugia for humidophile and/or fire intolerant flora, and support a diversity of range-restricted species (Kendrick 2001).

(Beard, (1975) mapped the vegetation system-associations of the survey area as Hamersley 18: Low woodland of Acacia aneura, and Hamersley 82: Hummock-grass (*Triodia wiseana*) steppe with irregularly scattered *Eucalyptus brevifolia* trees; and Hamersley 18: Low woodland of *Acacia aneura* (Table 2.2).

Table 2.2 Pre-European vegetation within the survey area

Beard Vegetation System and Association	Extent in survey area	Total current extent in Australia (1)	Pre-European extent remaining (1)
Hamersley 18	209 ha	575 852 ha	99.96
Hamersley 82	46 ha	2 157 841 ha	99.99

Footnotes: 1) Numbers from 2018 Statewide Vegetation Statistics (DBCA 2019)

Vegetation that is not a Threatened or Priority Ecological Community may still be considered significant if it has a restricted distribution, or has experienced a degree of historical impact from threatening processes (EPA 2016b). Vegetation types retaining less than 30% of their pre-European extent generally experience accelerated species loss at an ecosystem level (EPA 2000) and are regarded as being 'vulnerable', while vegetation types retaining less than 10% of their original extent are regarded as being 'endangered' (EPA 2000, Shepherd *et al.* 2002, DER 2014a, 2016b).

As presented in Table 2.2, the Hamersley 18 and Hamersley 82 vegetation system-associations intersected by the survey area still have close to 100% of their original extent remaining, and would be considered 'least concern' (DER 2014a).

2.4 Reserves and environmentally sensitive areas

Environmentally sensitive areas (ESAs) are protected under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* and are selected for their environmental values at state or national levels. The survey area does not occur within an ESA, nor are there any ESAs within five kilometres of the survey area, as shown by the Department of Environment Regulation (DER) Native Vegetation Map Viewer (DER 2014b).

Karijini National Park is located to the west of the survey area, approximately 18 kilometres west of the intersection of the proposed haul road and the Great Northern Highway. Mungaroona Range Nature Reserve is approximately 100 kilometres northwest of the survey area. The nearest Nationally Important Wetland is the Fortescue Marsh located 52 km north of the survey area (AWE 2021).

Threatened Ecological Communities and Priority Ecological Communities are addressed in section 3.1.

3 Methods

3.1 Desktop study

The desktop study comprised a search of paid and free databases, and a review of available literature relevant to the survey area. The desktop served to compile a list of conservation significant flora taxa and vegetation communities with the potential to occur within the survey area. Database search parameters are outlined in Table 3.1 below. Conservation codes for Australian flora are detailed Appendix I.

Table 3.1 Flora database search parameters

Source of information	Search area
DBCA (2021a) Threatened and Priority Flora Database (including WA Herbarium database records)	60 km radius centred on the Lamb Creek project area
DBCA (2021b) Threatened and Priority Ecological Communities (TEC-PEC) database	50 km radius centred on the Lamb Creek project area
DBCA (2021c) NatureMap online database	40 km radius centred on the Lamb Creek project area
Department of Agriculture Water and the Environment (AWE) (2021) Protected Matters search tool	50 km radius centred on the Lamb Creek project area

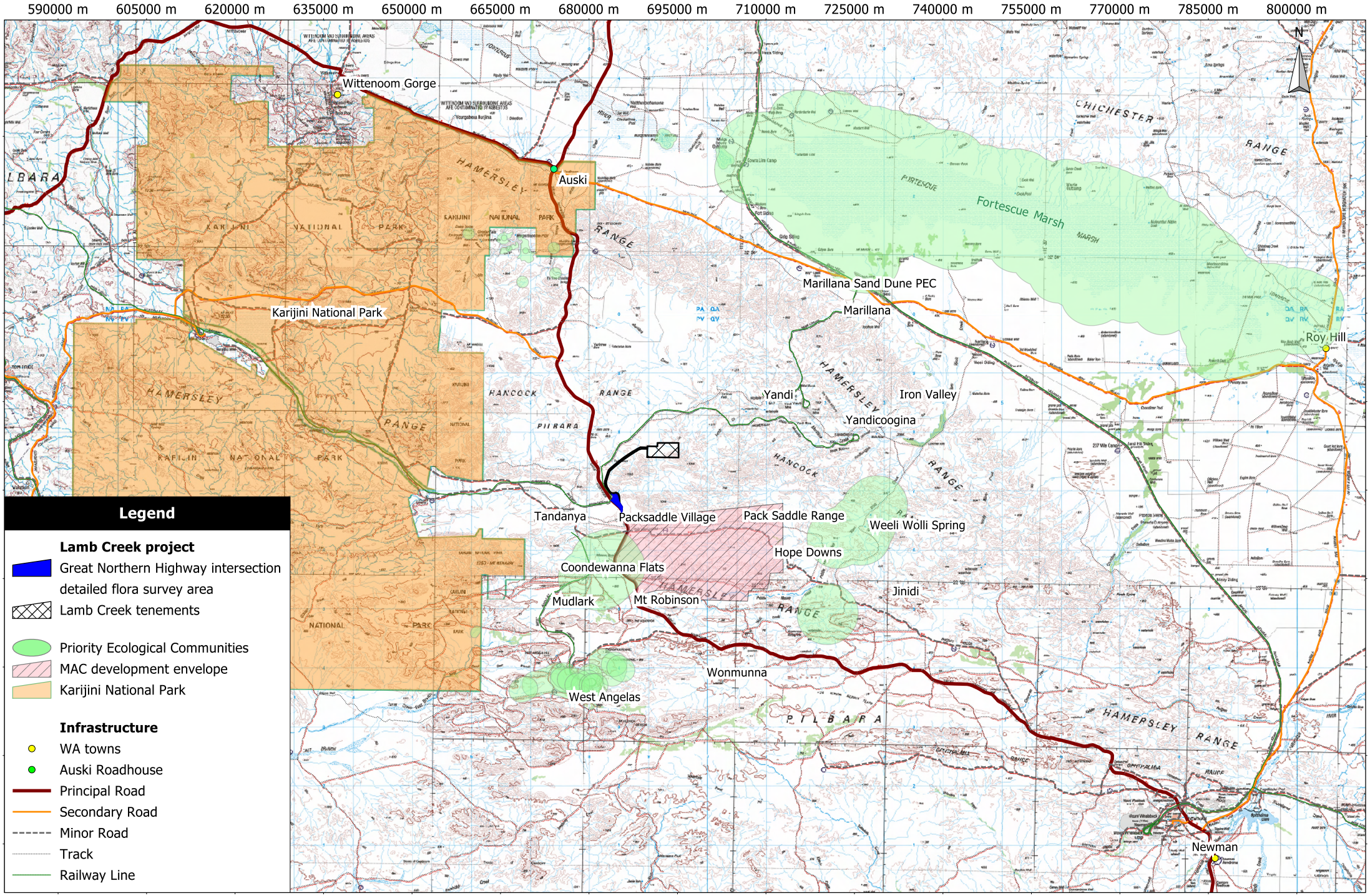
The region has had considerable flora survey effort over the last 20 years predominantly due to flora and vegetation surveys completed within, or partly within, the boundary of the Mining Area C (MAC) Development Envelope between 1997 and 2014. The MAC Development Envelope is approximately 1.3 kilometres south of the survey area (Figure 1.1: Inset Map). The surveys used as part of the literature review are listed in Appendix II and generally occurred within 50 kilometres of the survey area. Figure 3.1 provides regional context.

The conservation significant taxa identified in the desktop were reviewed for likelihood of occurrence within the GNHI survey area, based on the likelihood categories outlined in Table 3.2. Desktop results and likelihood assessment are presented in Appendix II.

Table 3.2 Likelihood assessment criteria

Rank	Criteria
Confirmed	1. The species was recorded on the survey area; or 2. The species was recorded directly adjacent (within 500 m) of the survey area from habitat continuing into the survey area.
Likely to occur	1. There are existing records of the species in close proximity to the survey area (within 20 km); and • the species is strongly linked to a specific habitat, which is present in the survey area; or • the species has more general habitat preferences, and suitable habitat is present.
May potentially occur	1. There are existing records of the species from the region (within 30 km), however: • the species is strongly linked to a specific habitat, of which only a small amount is present in the survey area; or • the species has more general habitat preferences, but only some suitable habitat is present. 2. There is suitable habitat in the survey area, but there are very few or only very old (1999 or before) records from the region.

Rank	Criteria
Unlikely to occur	1. The species is linked to a specific habitat, which is absent from the survey area; or 2. Suitable habitat is present, however there are no existing records of the species from the locality despite reasonable previous search effort in suitable habitat; or 3. There is some suitable habitat in the survey area, however the species is very infrequently recorded in the locality.
Highly unlikely to occur	1. The species is strongly linked to a specific habitat, which is absent from the survey area; and/or 2. The species' range is very restricted and would not include the survey area.



Rapallo environmental

Mineral Resources Limited
Lamb Creek Project

Lamb Creek Iron Ore Project
Great Northern Highway intersection
detailed flora survey (May 2021)

Original Size: A4 Scale: 1:800,000
Datum: MGA94 Zone 50
0 25 km

Figure 3.1

Regional localities

3.2 Field survey

A single-phase detailed flora and vegetation survey was completed by a team of three botanists over a period of six days, from 12 to 17 May 2021. The survey was completed in conjunction with a targeted conservation significant flora survey, as reported in Rapallo (2021). The survey area was accessed by four-wheel drive vehicle using existing tracks and surveyed on foot.

The survey was carried out in a manner consistent with the following documents developed by the Western Australian Environmental Protection Authority (EPA):

- Environmental Protection Authority (EPA) *Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a)

3.2.1 Quadrats

Nineteen 50 by 50 metre quadrats were sampled, as mapped in Figure 3.2. Quadrats were selected within all vegetation types discernible through aerial photography interpretation, topography, and pre-European vegetation and landform mapping, in combination with on-ground observations. It was noted while in the field that the aerial photograph available was dated, and no longer representative of the vegetation seen on the ground.

The following information was recorded at each quadrat:

- Site name, date, photographs, central GPS coordinate
- Landform, aspect, slope
- Soil type, soil colour
- Rock type, rock cover, rock size
- Vegetation condition rating (as per Table 2 in EPA 2016a)
- Disturbances noted in the area including estimated fire history
- Vascular plant species – including height and approximate foliage cover

3.2.2 Relevés

A single relevé (R01) was sampled within the only patch of *Triodia wiseana* that was large enough to sample (Figure 3.2). Patches dominated by this spinifex species were found throughout the survey area, but were generally too small to sample. Information recorded at the relevé was the same as that recorded for quadrats, but for an unbounded area.

3.2.3 Opportunistic records and field notes

Additional flora taxa were recorded opportunistically while traversing between quadrats, and during the targeted survey. The targeted component of the survey (as reported in Rapallo 2021) involved walking transects across approximately two-thirds of the detailed survey area, which enabled many additional flora records of both conservation significant and common flora taxa.

Preliminary vegetation boundaries were mapped in the field using aerial photographs and GPS waypoints with associated vegetation notes.

3.2.4 Specimen collection and identification

Flora specimens were collected and pressed and as per Western Australian Herbarium (2008) guidelines. Each specimen was assigned a unique field name and field number and was marked with a plant tag containing specimen and location information. All specimens were pressed and dried on the day of collection. Fragile material such as flowers, seed capsules, or very small specimens were sealed in paper bags which were marked as per the plant tags.

Taxonomic identification of flora specimens was completed by Sharnya Thomson-Yates (Table 3.3) with the use of the WA Herbarium reference collection, latest flora identification keys, and recent scientific publications. As per section 7.2 of EPA (2016a) and under flora licence conditions, suitable voucher specimens will be lodged with the Western Australian Herbarium.

3.2.5 Vegetation classification and mapping

Vegetation types of the survey area were classified and mapped using a combination of statistical analysis, manual classification, and field-based observations.

Quadrats were initially grouped into interim vegetation types based on quadrat data collected on species composition, vegetation structure, fire history, landform, soil, rock cover, and site photographs. Next, PATN software was used to group the quadrats based on a statistical measure of similarity of species presence and density. Finally, the grouping of quadrats produced by the PATN analysis was augmented by the interim vegetation types, quadrat data as listed above, and interpretation of aerial photography, in order to derive the final vegetation types.

3.2.5.1 PATN analysis procedure

Statistical analysis to support classification of vegetation types was carried out using PATN software (Belbin 2013). The analysis was completed using data from all 19 survey quadrats. Taxa that were alien were removed from the dataset, and the analysis was conducted using the 149 remaining taxa. The analysis was undertaken using the density code values from the quadrat occurrence records. A two-step association measure was used to classify flora taxa into 13 groups.

A further analysis was done using these groups, which were then refined by removing taxa with Kruskall Wallis values (KW values) lower than 1.0. This resulted in 14 taxa being removed from the analysis. The final association of sites used the Agglomerative Hierarchical Fusion classification strategy, the Flexible UPGMA classification technique and the Bray and Curtis association measure, with beta of -0.1, producing 6 groups of sites. PATN results are presented in section 4.2.5.1 and Figure 4.1.

3.2.5.2 Personnel and licensing

The personnel involved in the field survey, data entry and analysis, and the preparation of this report are listed in Table 3.3. The field survey was conducted under was conducted under Flora Taking (Biological Assessment) Licences FB62000183, FB6200067-3, and FB62000331 pursuant to Regulation 62 of the *Biodiversity Conservation Regulations 2018.* As part of the license conditions, a list of flora and fauna species recorded in the survey will be forwarded to the DBCA.

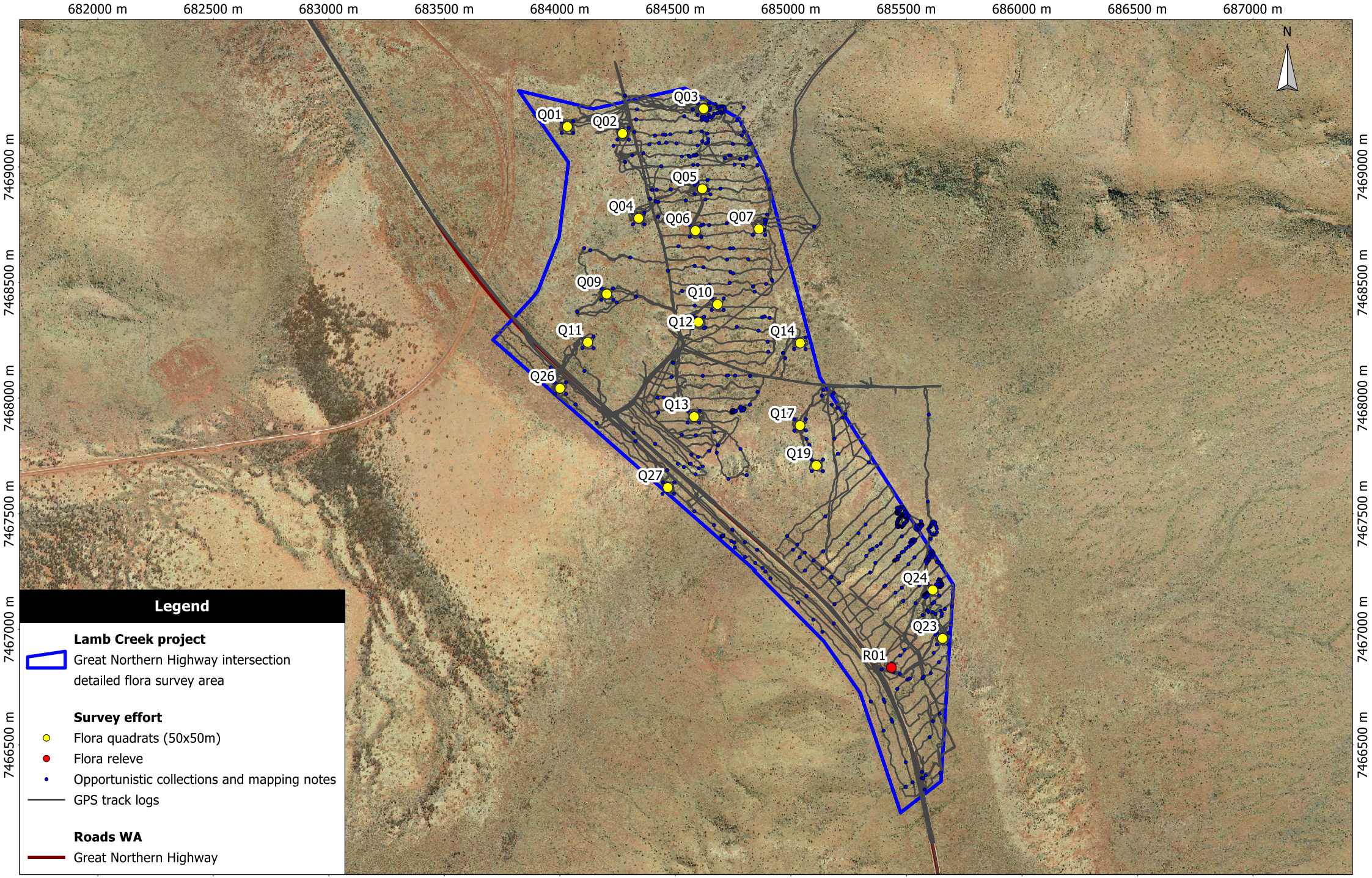
Table 3.3 Personnel

Name	Position	Field work	Taxonomy	Analysis	Reporting
Kate George	Principal Environmental Scientist				•
Marieke Weerheim	Senior Environmental Scientist			•	•
Sharnya Thomson-Yates[1]	Senior Botanist Botanical Taxonomist	•	•		
Linda Dalgliesh[2]	Senior Botanist	•			
Joshua Gilovitz[3]	Senior Botanist Senior Data Analyst	•		•	

Footnotes: 1 = License number FB62000183; 2 = License number FB6200067-3; 3 = License number FB62000331.

3.2.6 Nomenclature and conservation listing

Flora taxonomy and nomenclature follows FloraBase (Western Australian Herbarium 1998). FloraBase was also accessed to verify conservation codes, distribution records, habitat requirements, and flowering times. Conservation codes cited in this report are as per detailed Appendix I. Note that the conservation codes on FloraBase are the most up to date, whereas the DBCA Threatened (Declared Rare) and Priority Flora List (DBCA 2018) was last updated on 5 December 2018.



Rapallo environmental

Mineral Resources Limited
Lamb Creek Project

Lamb Creek Iron Ore Project
Great Northern Highway intersection
detailed flora survey (May 2021)

Original Size: A4 Scale: 1:20,000
Datum: MGA94 Zone 50
0 800 m

Figure 3.2

Survey effort

4 Results and Discussion

4.1 Desktop results

The desktop study returned 800 vouchered vascular plant taxa (species and sub species) within 40 kilometres of the survey area, representing 252 genera and 79 families. Conservation significant flora, weeds, and conservation significant vegetation are discussed in sections 4.1.1, 4.1.2, and 4.1.3.

4.1.1 Conservation significant flora

The desktop study found 86 significant vascular flora taxa from within 60 kilometres of the Lamb Creek project area. An assessment was completed to estimate the likelihood of occurrence within the Great Northern Highway intersection area for each of these conservation taxa. Desktop results are summarised in Table 4.1 and complete search results and likelihood ranking presented in Appendix II.

Note that the likelihood scores presented in this report are different from those presented in the targeted report (Rapallo 2021), because the latter considered the Lamb Creek project as a whole, while the GNHI survey area covered a small subset of this area containing far fewer habitats. This led to a down-grading of likelihood scores for all taxa for which the GNHI survey area did not contain habitat.

Table 4.1 Summary of Lamb Creek desktop results for conservation significant taxa

Likelihood ranking	Status[1]						Total taxa
	VU[2]	CR[3]	P1	P2	P3	P4	
Confirmed	1			1	2	1	**5**
Likely to occur			1	1	3		**5**
May potentially occur				1			**1**
Unlikely to occur		1	7	11	32	6	**57**
Highly unlikely to occur			5	4	9		**18**
Grand Total	**1**	**1**	**13**	**18**	**46**	**7**	**86**

Footnotes:
1. P = Priority (administered by DBCA; Biodiversity Conservation Act 2016 (BC Act)), VU = Vulnerable, CR = Critically Endangered.
2. Listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and BC Act,
3. Listed BC Act only. Refer to Appendix I for detailed explanation of conservation codes.

Two species listed as vulnerable and critically endangered were returned via the threatened and priority flora database search (DBCA 2021a) and the protected matters search (AWE 2021).

- *Thryptomene wittweri* listed as vulnerable under the BC Act and EPBC Act was assessed as unlikely to occur due to habitat requirements and distance of records from the survey area (>20 kilometres). This species is not discussed further in this report.
- *Seringia exastia* listed as critically endangered under the BC Act is. However, this taxon is only listed as a result of a taxonomic revision and is likely to be delisted (section 4.2.2.

Most records were DBCA listed priority flora taxa and the greater majority (87%) were ranked as unlikely to highly unlikely to occur within the survey area (Appendix II). These taxa are not discussed further in this report. Five conservation significant taxa were confirmed to occur within the Great Northern Highway intersection area during the targeted flora survey (section 4.2.2). Conservation significant taxa recorded

in the Lamb Creek project area are discussed in detail in the targeted survey report (Rapallo 2021), with the discussion not repeated in this report.

4.1.2 Introduced flora (weeds)

4.1.2.1 Weed classification in Western Australia

The *Biosecurity and Agriculture Management Act 2007* (BAM Act) categorises the weeds of Western Australia into four main classifications:

- Declared Pests (under Section 22 of the Act);
- Permitted (under Section 11 of the Act);
- Prohibited (under Section 12 of the Act); and
- Permitted requiring a permit (Section 73, BAM Regulations 2013).

Under the BAM Act all declared plant pests are placed in one of three categories:

- C1 (Exclusion) — Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State;
- C2 (Eradication) — Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still feasible; and
- C3 (Management) — Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size.

Fifteen introduced taxa have been identified by DBCA as 'Priority Alerts' for the Pilbara region, including **Azadirachta indica, *Calotropis procera, *Chloris gayana, *Clitoria ternatea, *Cryptostegia grandiflora, *Cylindropuntia spp., *Euphorbia tirucalli, *Jatropha gossypifolia, *Lantana camara, *Moringa oleifera, *Ricinus communis, *Schinus molle var. areira, *Vachellia nilotica, *Washingtonia robusta and *Xanthium strumarium* (DPaW 2014). None of these taxa were recorded during the survey.

4.1.2.2 Weeds identified in the desktop study

The desktop study identified forty-nine introduced taxa from the vicinity of the survey area, as presented in Appendix III. The greater majority of weeds recorded in the desktop were listed as Permitted – s11, with one weed (**Argemone mexicana*) listed as Declared Pest (Prohibited) – s12 category C2 (Eradication) under the *Biosecurity and Agriculture Management Act 2007* (DAFWA 2021).

No Weeds of National Significance (WONS) were returned from the desktop search (Centre for Invasive Species Solutions 2021).

4.1.3 Conservation significant vegetation

The survey area is not located within a known TEC or PEC. The nearest known PEC is subtype 2 of the Coolibah-Lignum Flats vegetation community, with the edge of the buffer zone located less than five kilometres south of the survey area (DBCA 2021b) as shown in Figure 3.1.

The Coolibah-Lignum Flats vegetation complex is described as: Woodland or forest of *Eucalyptus victrix* (coolibah) over thicket of *Duma florulenta* (lignum) on red clays in run-on zones. Associated species include *Eriachne benthamii*, *Themeda triandra*, *Aristida latifolia*, *Eulalia aurea* and *Acacia aneura* (DBCA 2021d).

Three sub-types have been identified, of which sub-type 2 occurs near the project with the edge of the buffer zone less than five kilometres from the southern edge of the survey area (Figure 3.1).

1. Coolibah and mulga (*Acacia aneura*) woodland over lignum and tussock grasses on clay plains (Coondewanna Flats and Wanna Munna Flats) – Priority 3
2. Coolibah woodlands over lignum (*Duma florulenta*) over swamp wandiree (Lake Robinson is the only known occurrence) – Priority 1
3. Coolibah woodland over lignum and silky browntop (*Eulalia aurea*); two occurrences known on Mt Bruce Flats – Priority 1

A detailed flora and vegetation survey of the Lamb Creek project completed in 2012 (Rapallo 2012) concluded that the Coolibah-Lignum Flats PEC is unlikely to occur in the survey area because neither Coolibah (*E. victrix*) nor lignum species were recorded.

Onshore (2013b) reviewed vegetation mapping within Coodewanna Flats and Lake Robinson and confirmed fine-scale mapping for the two sub-types of the Coolibah-lignum Flats. Onshore (2013b) concluded that the Priority 1 sub-type 2 lies at the lowest point of the Coondewanna Flats associated with Lake Robinson, and the Priority 3(i) sub-type 1 occurs on alluvial flats (Coondewanna Flats) around Lake Robinson, to the south and found that the Great Northern Highway divides the PEC to the west from the MAC Development Envelope MAC. Based on the Onshore (2013b) mapping, the PEC occurs ca. 12 kilometres to the south of the survey area.

4.2 Field survey results

4.2.1 Flora taxa recorded during the survey

The survey recorded 187 flora taxa from 35 different families, as presented in Appendix IV. These included 178 native taxa and nine introduced taxa (weeds: section 4.2.3). The most well-represented families were Poaceae (40 taxa), Fabaceae (37 taxa), and Malvaceae (16 taxa).

Of the 187 flora taxa recorded, 26 taxa (14%) were annuals, 18 (10%) were annual or short-lived perennial, 131 (70%) were perennials. Twelve taxa (6%) did not have life cycle information available. The full list of taxa is presented in Appendix IV.

Five conservation significant flora taxa were recorded from the Great Northern Highway intersection area during the targeted. These are discussed in detail in Rapallo (2021) and briefly described in section 4.2.2.

A list of quadrat locations is presented in Appendix V and quadrat data is provided in Appendix VI.

4.2.2 Conservation significant flora

Five conservation significant flora taxa were recorded from the Great Northern Highway intersection area during both the detailed and targeted survey, as listed in Table 4.2. Conservation significant flora are described and mapped in detail in the targeted flora survey report (Rapallo 2021).

The desktop study identified eleven conservation significant flora taxa that were considered likely or highly likely to occur in the survey area, based on proximity of records and availability of habitats in the survey area (section 4.1.1, Appendix II).

The vegetation types of the survey area (section 4.2.5) all comprised varieties of acacia and/or mulga (*Acacia aptaneura*) woodland over either spinifex (*Triodia* spp.), mixed tussock grasses, or a combination thereof, located on a flat or gently sloping plain. The limited habitat information provided for the conservation significant taxa identified in the desktop did not allow a distinction in likelihood scores between the vegetation types recorded within the GNHI survey area. Hence, the likelihood assessment presented in Appendix II refers to the survey area as a whole.

Table 4.2 Conservation significant flora taxa recorded during the survey

Taxon	Conservation status	Locations recorded per vegetation type							
		A	B	C	D	E	F	X	O
Aristida lazaridis	Priority 2	9	28	38	196			1	31
Rhagodia sp. Hamersley (M. Trudgen 17794)	Priority 3		4	11					
Goodenia nuda	Priority 4				1				
Seringia exastia	Critically Endangered							2	
Euphorbia aff. *ferdinandi*	Potentially undescribed			3	1				

The most commonly recorded conservation significant taxon was *Aristida lazaridis* (Priority 2) which is species of grass recorded throughout vegetation types A and D. Numbers in Table 4.2 above refer to the number of locations this grass was recorded in 2021, not the total number of plants.

Seringia exastia is only listed as a results of a taxonomic revision, which merged a common and a restricted species. DBCA communications (24/08/2021) confirmed that the species is "considered common and widespread" and likely to be delisted in the future.

4.2.3 Introduced flora taxa (weeds)

Nine introduced flora taxa (weeds) were recorded during the survey, these are listed in Table 4.3 below. The weeds were recorded in five of the six vegetation types identified during the survey, as well as from disturbed areas and outside of the survey area. The greater majority of weed records were from vegetation type B which occurred on a gently sloping drainage plain intersected by minor creek lines.

Table 4.3 Weeds recorded during the survey

Taxon	WAOL status	Locations recorded per vegetation type							
		A	B	C	D	E	F	X	O
**Aerva javanica*	Permitted - s11		1						
**Bidens bipinnata*	Permitted - s11	1	6	2	6			1	
**Stylosanthes hamata*	Permitted - s11				1				
**Malvastrum americanum*	Permitted - s11		11	2				2	
**Cenchrus ciliaris*	Permitted - s11	1	25	1		1		1	1
**Cenchrus setiger*	Permitted - s11		10	1					1
**Melinis repens*	Permitted - s11	1							
**Portulaca oleracea*	Permitted - s11	1	2	5	1				
**Solanum lasiophyllum*	Permitted - s11	1	3	2					

The most frequently recorded weed was **Cenchrus ciliaris* (buffel grass) which was recorded from three quadrats as well as opportunistically across the survey area from four different vegetation types. Vegetation types A, B, and C were the most heavily affected, especially type B which supported seven different weed species recorded from a total of 58 locations.

4.2.4 Flora of other significance

Flora species, subspecies, varieties, hybrids, and ecotypes may be considered significant for reasons other than listing as a Threatened or Priority flora taxon. This may include, but is not limited to, range extensions, keystone species, relic status, local endemism and anomalous features (EPA 2004). Based on these features, *Euphorbia* aff. *ferdinandi* recorded during the survey may be considered flora of "other" significance, as it represents a potentially undescribed species with unknown and potentially restricted distribution range. This taxon is discussed in Rapallo (2021).

4.2.5 Vegetation of the survey area

The vegetation across the survey area generally comprised low open woodland to isolated trees dominated by mulga (*Acacia aptaneura*) or other acacia species, over an understorey of either spinifex, tussock grasses, or a combination thereof, on a flat to gently sloping clay-loam plain. The dominant spinifex species was *Triodia pungens*, however patches dominated by *Triodia wiseana* occurred throughout the southern part of the survey area, with some patches large enough to be mapped.

The vegetation of the survey area has been affected by fire, as visible on the ground during the survey, and supported by NAFI data which maps the entire survey area as having been burnt in 2015 (NAFI 2021). Disturbance notes taken during the survey indicated that fire killed between 5% and 90% of (tall) shrubs and trees in the area. Comparison of vegetation data recorded in 2012 over a subset of the current survey area , as well as direct field observations noting many burnt trees and shrubs, strongly indicate that the 2015 fire has altered vegetation structure and composition of the survey area. This was further supported by comparison of vegetation structure and boundaries visible on the ground, with those shown on the available aerial photographs of the survey aera, which were taken pre-fire (2009 and 2013).

The absence of a recent aerial photograph presented a limitation with respect to both survey planning and vegetation mapping, as the vegetation visible on the aerials no longer reflected the actual vegetation on the ground. Vegetation mapping therefore relied heavily on field notes, photographs, and associated GPS coordinates.

Vegetation condition across the survey area varied from Very Good to Degraded (EPA 2016a: Table 2), with the greater majority of the quadrats ranked as Good (Appendix VI).

4.2.5.1 PATN classification of quadrats

The PATN analysis results in six quadrat groups, as presented in Figure 4.1. The grouping derived by PATN aligned well with manual classification of the sites, as outlined in Table 4.4. PATN groups 5 and 6 were manually combined into vegetation type D, based on floristic composition, land form, and site photos.

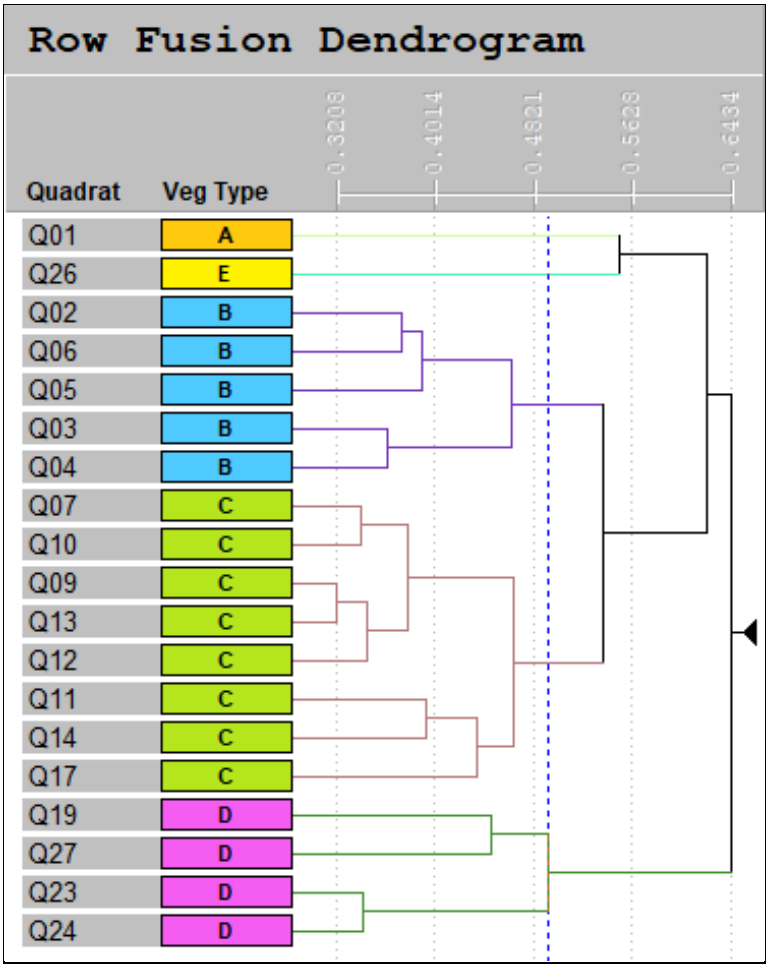


Figure 4.1 PATN dendrogram

Table 4.4 Comparison of PATN results with manual classification of vegetation types

PATN group	Vegetation types	Sites
1	Vegetation type A	Q01
2	Vegetation type E	Q26
3	Vegetation type B	Q02, Q03, Q04, Q05, Q06
4	Vegetation type C	Q07, Q09, Q10, Q11, Q12, Q13, Q14, Q17
5	Vegetation type D	Q19, Q27
6	Vegetation type D	Q23, Q24
n/a	Vegetation type F	R01

4.2.5.2 Vegetation types

Six vegetation types were mapped and described across the survey area, as summarised in Table 4.5 and mapped in Figure 4.2. The vegetation types of the survey area are described in detail in Table 4.6.

The vegetation types across the survey area were assessed as having moderate significance, based on criteria outlined in Appendix VII. This ranking was primarily due to the Priority 2 listed grass *Aristida lazaridis*, which was recorded in high numbers across the survey area, especially in vegetation type D, and also in types C, B, and A. Refer to Rapallo (Rapallo 2021) for further details on *Aristida lazaridis* populations within the survey area.

Table 4.5 Summary of vegetation types

Code	Vegetation type	Landform	Area (ha)
A	Low open *Eucalyptus gamophylla* woodland over *Triodia melvillei and T. pungens* on stony plain	Stony plain	39 ha
B	Mulga and acacia low open woodland over open tussock grassland on gently sloping (drainage) plain with variable rock cover	Gently sloping clay-loam plain with minor drainage channels and surface drainage	49 ha
C	Mulga and acacia low open woodland over open spinifex and tussock grassland on flat plain with medium rock cover	Clay-loam plain	84 ha
D	Mulga, *Hakea lorea*, and *Eucalyptus xerothermica* low open woodland over closed tussock grassland on gently sloping clay-loam plain (no rocks)	Gently sloping clay-loam plain without rocks	51 ha
E	Low mulga woodland over sparse understorey on stony plain	Flat stony plain	9 ha
F	*Triodia wiseana* hummock grassland with emergent shrubs and low trees on gently sloping stony plain	Gently sloping stony plain	4 ha
X	(not a vegetation type)	Disturbed / cleared / road	20 ha

Table 4.6 Vegetation types of the survey area

Type	Vegetation description	Photo
A	**Low open *Eucalyptus gamophylla* woodland over *Triodia melvillei* and *T. pungens* on stony plain** Description: *Eucalyptus gamophylla* (mallee) and *Corymbia deserticola* subsp. *deserticola* low open woodland; over *Acacia pruinocarpa*, *A. ancistrocarpa*, *A. atkinsiana* sparse shrubland; over isolated low shrubs; over isolated dwarf shrubs; over *Ptilotus calostachyus*, *Ptilotus obovatus*, *Trichodesma zeylanicum* var. *zeylanicum* sparse forbland; over *Triodia melvillei* and *Triodia pungens* sparse hummock grassland. Extent and landform: This vegetation type covers 38 hectares (15%) of the survey area. It occurs in the north-western part of the survey area, and along the Great Northern Highway. Vegetation type A falls primarily within the Boolgeeda land system. It occurs on a flat stony plain over a red-brown clay-loam plain. Rock cover is high, at approximately 90%. Quadrats: Q05 Vegetation condition: Good Disturbances: Tracks, clearing, recent fire, weeds Conservation significant flora: *Aristida lazaridis* (P2) Weeds: **Bidens bipinnata*, **Cenchrus ciliaris*, **Melinis repens*, **Portulaca oleracea*, **Solanum lasiophyllum* Significance: Local, Moderate	 **Site Q01** (Condition: Good)

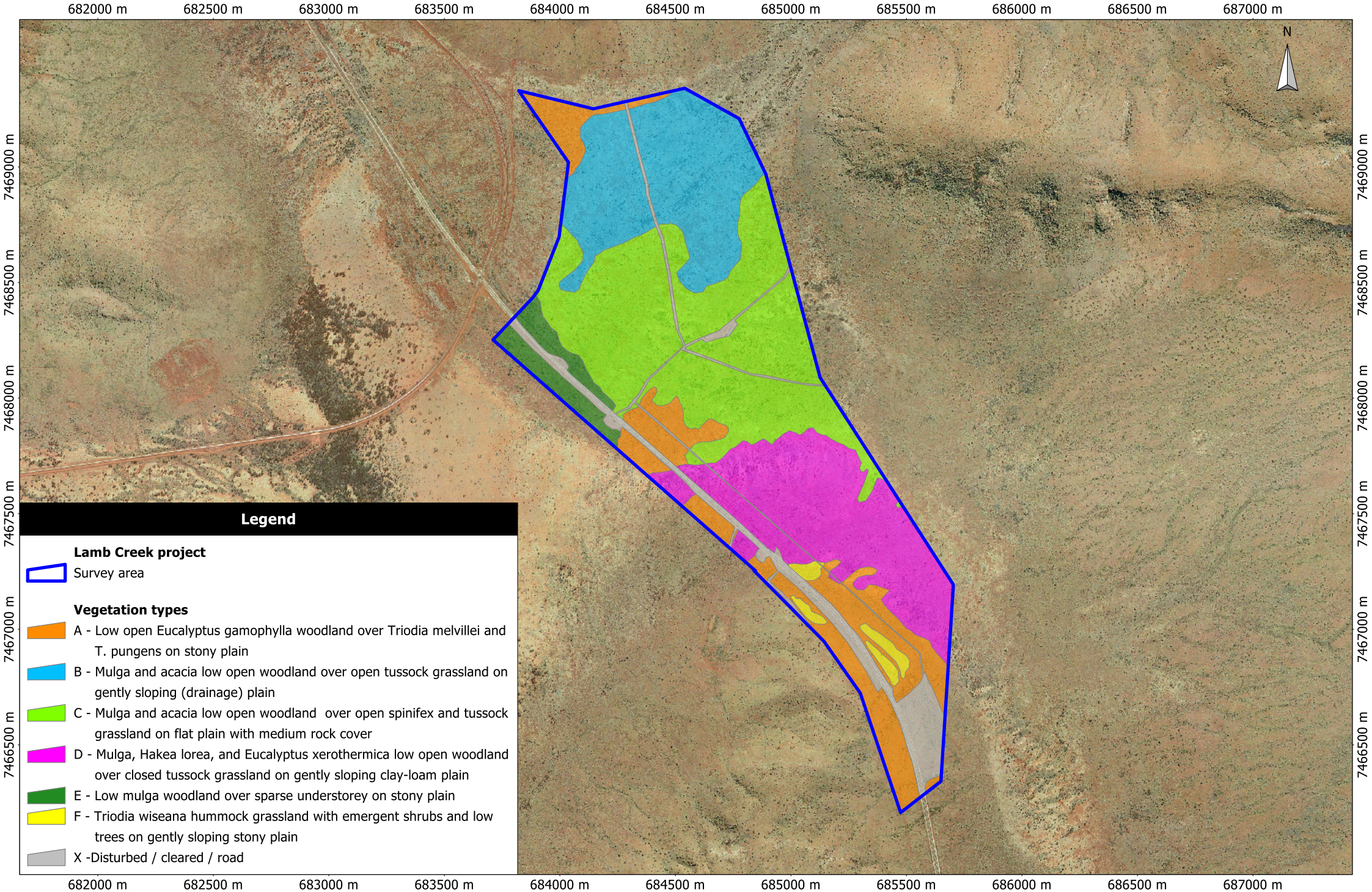
Type	Vegetation description	Photo
B	**Mulga and acacia low open woodland over open tussock grassland on gently sloping (drainage) plain with variable rock cover** Description: *Acacia aptaneura* and *A. pruinocarpa* low open woodland; over sparse tall shrubland including *Eremophila longifolia* and *Santalum lanceolatum*; over mixed isolated shrubs to sparse shrubland; over isolated forbs to open forbland dominated by *Pterocaulon sphacelatum*, *Ptilotus obovatus*, and *Arivela viscosa*; over sparse to medium-dense tussock grassland dominated by *Aristida inaequiglumis*, *A. contorta* and *Themeda triandra*. Extent and landform: Covers 49 hectares (19%) of the survey area. It occurs in the north of the survey area, on flat to gently sloping drainage plain, within the Boolgeeda land system. It is intersected by minor drainage lines, with mulga vegetation becoming denser along drainage lines. Soils are red-brown clay loam with generally low rock cover (2-10%) but with some areas of very high rock cover (90%). Quadrats: Q02, Q03, Q04, Q05, Q06 Vegetation condition: Good to Degraded Disturbances: Fire has killed on average 50% of trees and tall shrubs. Weeds. Conservation significant flora: *Aristida lazaridis* (P2), *Rhagodia* sp. Hamersley (P3) Weeds: **Aerva javanica*, **Bidens bipinnata*, **Malvastrum americanum*, **Cenchrus ciliaris*, **Cenchrus setiger*, **Portulaca oleracea*, **Solanum lasiophyllum*. Significance: Local, Moderate	 **Site Q04** (Condition: Good)  **Site Q05** (Condition: Good)

Type	Vegetation description	Photo
C	**Mulga and acacia low open woodland over open spinifex and tussock grassland on flat plain with medium rock cover** Description: *Acacia aptaneura*, *A. pruinocarpa* low open woodland with occasional *Corymbia deserticola*; over isolated tall shrubs to sparse tall shrubland dominated by *Hakea lorea* subsp. *lorea*, *Acacia elachantha*, *A. aptaneura*, *A. pruinocarpa*, *Santalum lanceolatum*; over isolated medium to dwarf shrubs; over sparse forbland dominated by *Pterocaulon sphacelatum*, *Arivela viscosa*, *Ptilotus obovatus*; over *Triodia pungens* and *T. melvillei* open hummock grassland, with *Themeda triandra*, *Aristida inaequiglumis*, and *A. contorta* open tussock grassland. Extent and landform: The most common vegetation type, covering 84 hectares (33%) of the survey area. Flat clay-loam plain with medium (10-60%) rock cover. This vegetation type occurs primarily in the Boolgeeda land system, with a minor extent in the Wannamunna land system. Quadrats: Q07, Q09, Q10, Q11, Q12, Q13, Q14, Q17 Vegetation condition: Good (one quadrat rated Very Good) Disturbances: Fire has killed 10-50% of tall shrubs and trees. Conservation significant flora: *Aristida lazaridis* (P2), *Rhagodia* sp. Hamersley (P3) *Euphorbia* aff. *ferdinandi* (potentially undescribed) Weeds: **Bidens bipinnata*, **Malvastrum americanum*, **Cenchrus ciliaris*, **Cenchrus setiger*, **Portulaca oleracea*, **Solanum lasiophyllum* Significance: Local, Moderate	 **Site Q07** (Condition: Good)  **Site Q17** (Condition: Good)

Type	Vegetation description	Photo
D	**Mulga, *Hakea lorea*, and *Eucalyptus xerothermica* low open woodland over closed tussock grassland on gently sloping clay-loam plain (no rocks)** Description: Low open woodland of *Acacia aptaneura*, *Hakea lorea* subsp. *lorea*, and *Eucalyptus xerothermica*; over isolated tall to dwarf shrubs; over sparse forbland to isolated forbs dominated by *Pterocaulon sphacelatum*; over closed tussock grassland dominated by *Themeda triandra*, with *Aristida inaequiglumis* and *A. contorta*. Extent and landform: Covers 51 hectares (20%) of the survey area, occurring only within the Wannamunna land system, with vegetation boundaries closely matching the land system boundaries. Flat clay-loam plain without rocks. Quadrats: Q19, Q23, Q24, Q27 Vegetation condition: Good Disturbances: Fire has killed on average 50% of trees and tall shrubs. Conservation significant flora: *Aristida lazaridis* (P2), *Goodenia nuda* (P4), *Euphorbia* aff. *ferdinandi* (potentially undescribed. Weeds: **Bidens bipinnata*, **Portulaca oleracea*, **Stylosanthes hamata* Significance: Local, Moderate	 **Site Q19** (Condition: Good)  **Site Q23** (Condition: Good)

Type	Vegetation description	Photo
E	**Low mulga woodland over sparse understorey on stony plain** Description: *Acacia aptaneura* low mulga woodland; over *Acacia pachyacra* and *A. ?sibirica* sparse shrubland; over isolated dwarf shrubs; over isolated forbs and ferns; over *Digitaria ammophila*, *Chrysopogon fallax*, *Aristida inaequiglumis* sparse tussock grassland. Extent and landform: Covers 9 hectares (4% of the survey area). Flat stony plain with high (90%) rock cover on red-brown clay loam. Occurs in the western part of the survey area, along the Great Northern Highway, within the Boolgeeda land system. Quadrats: Q26 Vegetation condition: Good Disturbances: Fire, some evidence of clearing Conservation significant flora: None Weeds: **Cenchrus ciliaris* Significance: Negligible	 **Site Q26** (Condition: Good)
F	***Triodia wiseana* hummock grassland with emergent shrubs and low trees on gently sloping stony plain** Description: *Corymbia hamersleyana* and *Corymbia deserticola* subsp. *deserticola* isolated low trees; over isolated tall shrubs; over *Acacia ancistrocarpa* and mixed *Acacia* spp. sparse shrubland; over isolated dwarf shrubs; over isolated forbs; over *Triodia wiseana* hummock grassland. Extent and landform: Occurs across in patches throughout the survey area on a gentle sloping stony plain with high (80%) rock cover. Patches large enough to map cover a combined area of 4 hectares (1%) of the survey area, but the actual extent is greater than this. Quadrats: None. Represented only by relevé R01. Vegetation condition: Good Disturbances: Fire, berms, rubbish from highway, intersected by cleared areas. Conservation significant flora: None (patches too small) Weeds: None (patches too small) GDV indicator species: None Significance: Negligible	 **Site R01** (Condition: Good)

Type	Vegetation description	Photo
X	**Disturbed / cleared / road** Description: this is not a vegetation type. It includes roads, completely cleared or heavily disturbed areas, and areas with regrowth or revegetation of native species. It covers 20 hectares (8%) of the survey area. Conservation significant flora: *Seringia exastia* (CR), *Aristida lazaridis* (P2) Weeds: **Bidens bipinnata*, **Malvastrum americanum*, **Cenchrus ciliaris*	(no photo)
Vegetation Types were ranked for significance (High, Moderate, Low or Very Low) according to the criteria in Appendix VII		



Rapallo environmental

Mineral Resources Limited
Lamb Creek Project

Lamb Creek Iron Ore Project
Great Northern Highway intersection
detailed flora survey (May 2021)

Original Size: A4 Scale: 1:20,000
Datum: MGA94 Zone 50
0 800 m

Figure 4.2

Vegetation types recorded in the survey area

4.2.6 Listed conservation significant vegetation

None of the vegetation types listed Table 4.5 and described in Table 4.6 aligned with listed PEC for the Pilbara region (DBCA 2021d). Neither Coolibah nor species of lignum were recorded in the survey area, supporting supports conclusions from (Rapallo 2012) and the desktop (section 4.1.3) that the Coolibah-Lignum flats PEC does not intersect the survey area.

4.2.7 Locally significant vegetation

Vegetation may be of significance for reasons other than a listing as a TEC or a PEC. This may include, although is not limited to, scarcity, combination of species, role as a refuge, restricted distribution and vegetation extent being below a threshold level (EPA 2004).

Local significance can be determined where a vegetation type is confined to a specialised habitat and/or landform that is not common in the local area or the vegetation types are supporting conservation significant species or groundwater dependent species.

Vegetation types retaining less than 30% of their pre-European extent generally experience accelerated species loss at an ecosystem level (EPA 2000) and are regarded as being 'vulnerable', while vegetation types retaining less than 10% of their original extent are regarded as being 'endangered' (EPA 2000, 2016b, Shepherd *et al.* 2002, DER 2014a).

The Hamersley 18 and Hamersley 82 vegetation system-associations intersected by the survey still have close to 100% of their original extent remaining, and would be considered 'least concern' (DER 2014a).

No vegetation considered to provide refugia for flora taxa (for example, vegetation associated with gorges or seepage areas), or otherwise providing an important function required to maintain ecological integrity of a significant ecosystem (as defined by EPA 2016a) was recorded in the survey area.

4.2.7.1 Mulga Vegetation on Floodplains

Mulga (species in the *Acacia aneura* complex) is widespread across arid and semi-arid regions of Western Australia, covering approximately 37 percent of the surface area of Western Australia (Fox 1980). Grove-intergrove Mulga communities of the eastern Hamersley range are considered as "ecosystems at risk" by (Kendrick 2001) because it is thought that sensitivity to disturbance is greatest at the northern limit mulga's distribution (Fox 1980), related to the dominant summer rainfall pattern of the Pilbara (Fox 1980, Kendrick 2001, Maslin & Reid 2012).

Kendrick (2001) lists a number of 'ecosystems at risk' including grove/inter-grove mulga of the eastern Hamersley range, and 'valley floor mulga' within the Hamersley IBRA subregion. Given the lack of detail provided by Kendrick, it is not possible to determine if the mulga vegetation at Lamb Creek match the mulga ecosystems at risk. However, vegetation types B, C, D and E (Table 4.6) do contain *Acacia aptaneura* as dominant upper storey on stony or clay plains and floodplains, which matches the broad description of 'valley floor mulga'.

Regionally, (Biota 2014) consider "valley floor mulga" to extend over a range of approximately 350 kilometres through the southern half of the Pilbara (Biota, unpublished data, cited in Biota 2014) and Onshore (2017) conclude that mulga vegetation of *Acacia catenulata* subsp. *occidentalis* and *Acacia aptaneura* that aligns with valley floor mulga' on the MAC Development Envelope is common on plains between Newman and Roy Hill (approximate range 150 kilometres).

Onshore (2017) concluded that seven other vegetation associations within BHP Billiton Iron Ore's consolidated vegetation mapping database support *Acacia catenulata* subsp. o*ccidentalis* and *Acacia aptaneura* as dominant upper storey components, and are considered to be closely affiliated with the mulga communities recorded on the lower stony plains of the MAC development area. As such Onshore (2017) does not considered the mulga communities within the MAC Development Area to be locally endemic or unique.

Neither the vegetation association nor related ecosystem of "valley floor mulga" has been nominated as a PEC by DBCA since identified as an ecosystem at risk by Kendrick (2001b) suggesting a low level of perceived conservation significance.

4.2.7.2 Vegetation supporting conservation significant species

Irrespective of whether the vegetation types of the survey area align with mulga vegetation as identified by (Kendrick (2001b) (section 4.2.7.1), vegetation types A, B, C and D are considered locally significant due to supporting the Priority 2 listed grass *Aristida lazaridis*, as well as other conservation significant species. For further information on conservation listed species refer to Rapallo (Rapallo 2021). Vegetation types A, B, C, and D are regarded as moderate significance, and types E and F as negligible significance, based on the criteria presented in Appendix VII,

4.2.8 Watercourses and groundwater dependent vegetation

No groundwater dependent taxa were recorded during the survey.

4.3 Survey adequacy and limitations

4.3.1 Level of assessment and survey timing

The flora survey was conducted in accordance with EPA (2016a) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment*, and conformed to requirements for a single-season detailed flora survey.

Survey level and timing were as per client request. Survey timing was primarily aimed to intercept the flowering period of several conservation significant taxa identified in the desktop and recorded during previous surveys of the Lamb Creek project. The survey period of May 2021 aligned with the recommended timing for vegetation surveys in the Eremaean Botanical Province, and fell within the primary survey period (EPA 2016a).

4.3.2 Survey completeness

To provide an indication of survey completeness of the detailed flora survey, the software program EstimateS (Version 9.1.0) (Colwell 2013) was used to generate species accumulation curves and to calculate predicted species richness. Species accumulation curves represent a theoretical model of the relationship between survey effort and species accumulation: as the number of quadrats increases, the accumulation of flora taxa decreases until the curve reaches an asymptote (Gotelli & Colwell 2011).

Since models can only be generated from data collected through systematic methods, the species accumulation curve and predicted species richness could only be calculated from quadrat data. Analyses were conducted on presence-absence data from the quadrats (152 taxa from 19 quadrats), using the default settings, with the following exceptions:

- Accumulations (runs) were randomised 1,000 times without replacement.
- Upper abundance limit for rare or infrequent species was set to 5.

The species accumulation curve is presented in Figure 4.3, plotting number of flora taxa (y-axis) against the number of quadrats surveyed (x-axis). Observed species richness is presented as a sample-based rarefaction curve, computing the mean expected number of flora taxa (S(est)) over all possible combinations of 1, 2, and up to 19 quadrats (Colwell *et al.* 2012). Predicted species richness was calculated by taking the average of the estimators ICE, Chao 2, Jackknife 1, and Jackknife 2.

Predicted species richness was 185 taxa, which indicates that 82% of the (estimated) total flora taxa present in the survey area were recorded in the quadrats. This is reflected in the species accumulation curve, which after 19 quadrats is approaching an asymptote (Figure 4.3).

Opportunistic collections and relevé data yielded an additional 35 taxa not recorded in quadrats, hence the actual number of taxa recorded (187 taxa) exceeds the predicted total. Since predicted species richness calculated by EstimateS is based on quadrat data, and cannot take into account opportunistic and relevé records, the predicted number of 185 taxa appeared to be a slight underestimation of the actual species richness in the survey area.

The fact that 19% of the taxa recorded during the survey were from opportunistic collections rather than quadrats supports the observation that not all vegetation types of the survey area were adequately sampled (see Table 4.4, and section 4.3.3 and 4.3.4), with types A and E only represented by a single quadrat, and type F only sampled by a single relevé.

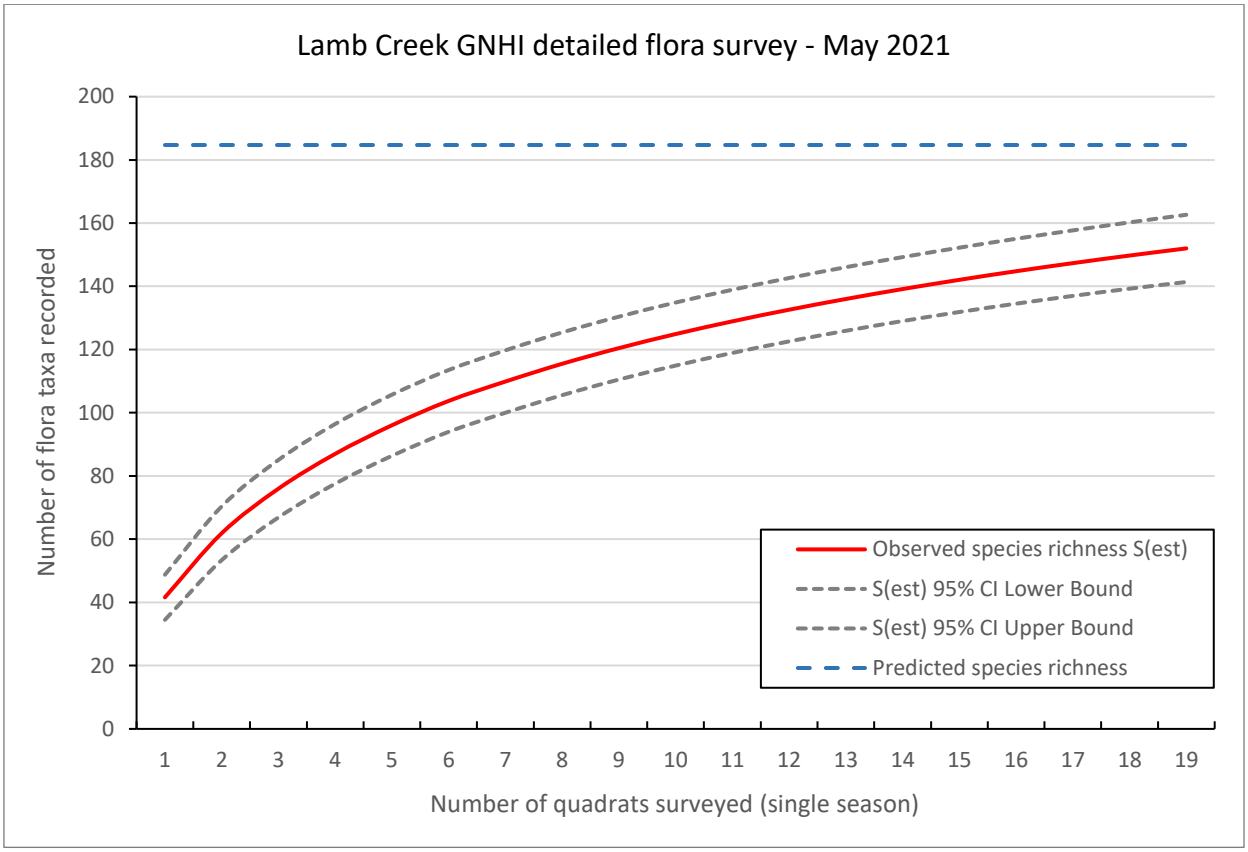


Figure 4.3 Species accumulation curve based on presence-absence quadrat data

In summary, although the survey effort appeared to have been adequate to sample the flora species richness present in the survey area at the time of survey, additional quadrats are expected to improve vegetation type classification and mapping.

4.3.3 Assessment against EPA technical guidance

The detailed flora and vegetation survey was conducted in accordance with Environmental Protection Authority (EPA) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* and aligned with criteria for a detailed flora survey (EPA 2016a). An assessment of the survey against EPA criteria for detailed flora and vegetation surveys, and for quadrat sampling, is provided in Table 4.7.

Table 4.7 Assessment of the survey against EPA technical guidance

EPA (2016a) criteria for detailed flora surveys	Survey met EPA criterion	Details
Surveys should be conducted during optimal survey timing for the botanical province.	Yes	The survey was completed in May 2021 which in the Pilbara is the post-wet season and is the primary survey season for the Eremaean botanical province.
Adequate survey may necessitate multiple sampling events in the same season or in different seasons.	No	The survey was completed during a single season. Additional surveys during the supplementary survey period (after winter rainfall) are likely to yield additional taxa.
Where desktop results indicate that there is insufficient local and regional	Yes	Sufficient local and regional information is available.

EPA (2016a) criteria for detailed flora surveys	Survey met EPA criterion	Details
information, the survey must extend beyond the proposal area.		
Interpretation of vegetation boundaries and selection of sampling sites should be conducted with the use of aerial photography at 1:10,000 – 1:40,000 scale.	No	The aerial photograph available was of 1:80,000 scale and not recent enough to enable accurate interpretation of vegetation boundaries.
Quadrats should be placed at representative locations throughout the survey area considering landform, geology, elevation, slope, aspect, surface or groundwater expression, and soil type, as well vegetation structure, composition, and condition.	Yes	Quadrats were positioned at representative locations within preliminary vegetation types identified at the time of survey.
Quadrats should be positioned to avoid the boundary or transition zone between vegetation units and to minimise the influence of edge effects.	Yes	Quadrats were positioned away from vegetation boundaries.
Where possible, quadrats should be located in intact mature vegetation and in areas of best condition.	Yes	The entire survey area was affected by fire, and it was not possible to avoid these areas. Quadrats were positioned in the best quality representative areas within.
Survey design should consider disturbance events (such as fire)	Yes	Disturbances were present throughout the survey area and could not be avoided.
Quadrat size should be appropriate for the bioregion.	Yes	Quadrats were 50 by 50 metres, as is appropriate for the Pilbara.
The survey effort should be adequate to characterise the flora and vegetation within the survey area.	Partial	The species accumulation curve indicates that survey effort was adequate to sample the floristic diversity of the survey area, however additional quadrats are required to adequately describe and map vegetation types.
A minimum of three quadrats should be sampled in each vegetation unit. Quadrats within a widespread vegetation unit should be located to sample throughout its geographic range.	No	Six vegetation types were identified within the survey area. Of these, only three were sampled with three or more quadrats. Vegetation types A and E were sampled with a single quadrat only, while type F was only represented by a relevé. This occurred due to the quality and age of aerial photograph available to plan the survey.
Opportunistic collections, systematic transects and targeted inspections of potential habitat are required to verify that the survey area has been well characterised and important values identified.	Yes	Extensive opportunistic collections and mapping notes were taken during the detailed survey as well as the targeted survey.
Survey effort should be intensified in areas with unusual habitat or potential to provide habitat for conservation significant flora and or vegetation.	Yes	A targeted survey was completed to supplement the detailed survey results.

4.3.4 Survey limitations table

Table 4.8 Limitations of the targeted flora survey

Aspect	Limitation	Discussion
Availability of contextual information at a regional and local scale	No	Sufficient flora and vegetation information was available for the Hamersley subregion (of the Pilbara Bioregion) to place the survey area in a regional context. At a local scale, sufficient (publicly available) flora and vegetation surveys have been completed in the vicinity of the survey area. There has been a significant body of work completed at Mining Area C which is in close proximity to the Lamb Creek project.
Competency/experience of the team carrying out the survey, including experience in bioregion surveyed	No	The survey was completed by a team of senior botanists, each with between 10-20 years' experience completing flora and vegetation surveys throughout Western Australia. Sharnya Thomson-Yates is also an experienced botanical taxonomist.
Proportion of flora recorded and/or collected, any identification issues	No	There were no identification issues.
Was the appropriate area fully surveyed (effort and extent)	Partial	The entirety of the survey area was visited by the team. However, results of PATN analysis indicates that not all vegetation types were adequately sampled with at least three quadrats. The absence of a representative aerial photograph made it difficult to determine whether all vegetation types were adequately covered, and also limited vegetation mapping post-survey.
Access restrictions within the survey area	No	The entirety of the survey area was readily accessible by vehicle and on foot. There were no survey limitations due to access restrictions.
Survey timing, rainfall, season of survey	No	The field survey was completed in May 2021, which falls within the primary recommended timing for surveys in the Eremaean botanical province (EPA 2016a). The survey area experienced good rainfall over the months preceding both surveys, and this was reflected in the relatively high number of annuals and short-lived perennials present in the dataset, making up 23% of the dataset. Overall, survey timing was deemed to be appropriate for the survey area and the region.
Disturbances that may have affected the results of the survey (e.g. fire, flooding, clearing)	Yes	The survey area has been affected by a fire which burnt across the entirety of the survey area in 2015. No recent aerial photographs are available that show the current state of the survey area, and this limited both site selection before and during the field survey, and also the detail with which the vegetation boundaries could be mapped. Vegetation mapping relied heavily on mapping notes which did not always match vegetation boundaries visible on the aerial photographs which were taken in 2009 and 2013, pre-fire. The fire history of the survey area appears to have altered vegetation structure and composition of the vegetation types, which is supported by site photos and notes indicating between 5-90% of trees and tall shrubs had been killed by fire. The survey area was also affected by weeds, especially vegetation type B.

5 Conclusion

A single-season detailed flora and vegetation survey was completed across the Great Northern Highway intersection area of the Lamb Creek project over a period of six days, from 12 to 17 May 2021. The survey was completed in conjunction with a targeted conservation significant flora survey (Rapallo 2021). All preliminary vegetation types present in the survey area were visited and sampled through a total of 19 quadrats, one relevé, opportunistic collections, and mapping notes.

The detailed flora survey recorded 187 vascular flora taxa from 35 families, including 178 native species and nine introduced taxa. One Threatened flora taxon was recorded, *Seringia exastia*. This taxon is currently listed as Critically Endangered, but this ranking is due to a taxonomic revision. The DBCA (communications received 24/08/2021) considers the taxon common and widespread and likely to be delisted. Three Priority flora taxa were recorded, these were *Aristida lazaridis* (Priority 2), *Rhagodia* sp. Hamersley (Priority 3) and *Goodenia nuda* (Priority 4). One other taxon, *Euphorbia* aff. *ferdinandi*, is considered significant because it represents a potentially undescribed taxon.

The survey recorded nine weeds, none of which were Declared Pests. No Threatened or Priority Ecological Communities (TEC-PEC) were recorded from the survey area. None of the taxa recorded during the survey were indicative of groundwater dependent vegetation.

Six broad vegetation types were identified and mapped across the survey area. Vegetation types A, B, C and D were considered moderately significant because they supported populations of *Aristida lazaridis*. This further discussed in the Targeted report (Rapallo 2021).

The survey area was affected by a fire which burnt across the entire survey area in 2015. Vegetation condition ranged from Very Good to Degraded, with most quadrats ranked as Good. The main reason for this ranking was fire.

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7 Appendices

Number	Title
Appendix I	Conservation codes for Australian flora
Appendix II	Flora desktop results: Conservation significant flora and likelihood assessment
Appendix III	Flora desktop results: Introduced taxa (weeds)
Appendix IV	Taxa per vegetation type collected from the survey area
Appendix V	List of quadrat locations
Appendix VI	Quadrat Data
Appendix VII	Significance Assessment Criteria (Vegetation)

Appendix I Conservation codes for Australian flora

Threatened species under the Commonwealth EPBC Act

Threatened fauna and flora may be listed under Section 178 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) in any one of the following categories:

EX Extinct

EW Extinct in the wild

CR Critically endangered

EN Endangered

VU Vulnerable

CD Conservation dependent

Conservation codes for Western Australian flora under the Western Australian *Biodiversity Conservation Act 2016*

Threatened, Extinct and Specially Protected fauna or flora are species which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such.

The *Wildlife Conservation (Specially Protected Fauna) Notice 2018* and the *Wildlife Conservation (Rare Flora) Notice 2018* have been transitioned under regulations 170, 171 and 172 of the *Biodiversity Conservation Regulations 2018* to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the *Biodiversity Conservation Act 2016*.

Categories of Threatened, Extinct and Specially Protected fauna and flora are:

Threatened species

Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the *Biodiversity Conservation Act 2016* (BC Act).

Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3 of the *Wildlife Conservation (Rare Flora) Notice 2018* for Threatened Flora.

The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.

CR Critically endangered species

Threatened species considered to be "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines.

Published under **schedule 1** of the *Wildlife Conservation (Rare Flora) Notice 2018* for critically endangered flora.

EN Endangered species

Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under **schedule 2** of the the *Wildlife Conservation (Rare Flora) Notice 2018 for endangered flora*.

VU Vulnerable species

Threatened species considered to be "facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines.

Published under **schedule 3** of the *Wildlife Conservation (Rare Flora) Notice 2018* for vulnerable flora.

Priority species

Priority species are possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations. In this report, priority species are given the codes P1, P2, P3 and P4.

P1 Priority 1: Poorly-known species

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

P2 Priority 2: Poorly-known species

Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

P3 Priority 3: Poorly-known species

Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

P4 Priority 4: Rare, Near Threatened and other species in need of monitoring

(a) **Rare**. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands.

(b) **Near Threatened**. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent.

(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Appendix II Flora desktop results: Conservation significant flora and likelihood assessment

Taxon	Status	Growth Form	Habitat from DBCA database records	Habitat from FloraBase	Flowering period	Habitat present at in GNHI survey area?	Distance to survey area	Likelihood ranking
Acacia bromilowiana	P4	Tree or shrub to 12 m high	WAH and TPFL : High in landscape, Slope, cliff, gully, crest, summit , very steep	Red skeletal stony loam, orange-brown pebbly,gravel loam, laterite, banded ironstone, basalt. Rocky hills, breakaways, scree slopes, gorges, creek beds.	May, July, August	No	Within 20 km	Unlikely to occur
Acacia daweana	P3	Shrub from 0.3- 2m.	WAH: Gentle slopes, Along diffuse drainage area where it leaves low rocky hills. Low shrubland with Triodia basedowii, Acacia bivenosa, A. validinervia and A. maitlandii.	Stony red loamy soils. Low rocky rises, along drainage lines	July-October	Yes	Not within 20km	Unlikely to occur
Acacia effusa	P3	Low, dense, spreading, somewhat viscid shrub, 0.3-1 m high.	WAH: Scree, gentle slope, footslope, creeklines, low iron stone hill, stony plain base of hills , skeletal soils, red brown, Red brown clay loam.	Stony red loam. Scree slopes of low ranges.	May-August	No	Within 20 km	Unlikely to occur
Acacia subtiliformis	P3	Spindly, slender, erect shrub, to 3.5 m	WAH: Calcrete slope, rise, plain	On rocky calcrete plateau.	April-June	No	Within 20 km	Unlikely to occur
Adiantum capillus-veneris	P2	Perennial small herb from 0.1-0.2m. Frond 1-2 pinnate	WAH: In wet rocky crevices, associated with gorges or springs.	Moist sheleted sites in gorges and on cliff walls.	March, September	No	Not within 20km	Unlikely to occur
Amaranthus centralis	P3	Annual Herb	WAH: Tussock grassland of Themeda triandra, Eulalia aurea and Aristida inaequiglumis with open woodland of Eucalyptus victrix and Corymbia aspera over low open woodland of Corymbia aspera and Hakea lorea subsp. lorea over high open shrubland of Gossypium robi. Low in the landscape, alluvial flats, River banks, Mulga woodland[3]	no info	No info	Yes	Not within 20km	Unlikely to occur
Ampelopteris prolifera	P3	Perennial herb/fern to 4m	no info	Near water or in wet ground.	No info	No	Not within 20km	Unlikely to occur
Aristida jerichoensis var. subspinulifera	P3	Compactly tufted perennial, grass-like or herb, 0.3-0.8 m high	WAH: Plain or Flat, clay/loam. Often mulga woodlands or acacia shrublands over spinifex and/or tussock grassland.	Hardpan plains	May, July, September	Yes	Recorded elsewhere in Lamb Creek project	Likely to occur
Aristida lazaridis	P2	Tufted perennial, grass-like or herb, 0.4-1.5 m high.	WAH: Plain, clay /loam, drainage, slope; often mulga low open woodland with or without Eucalypts, over variety of shrubs and herbs, often over tussock grassland but sometimes with Triodia hummock grassland.	Sand or loam	April, May	Yes	Confirmed	Confirmed
Arthropodium vanleeuwenii	P2	Perennial herb 0.3 to nearly 1m.	WAH. Moderately steep facing slopes including banded and Brockman ironstone formations on red-brown, orange-brown loams and sandy loams. Low open woodland of Eucalyptus leucophloia subsp and Corymbia hamersleyana over hummock grassland of Triodia brizoides. Other tussock grassland species include Themeda triandra. Known from two small populations growing above 900 m on south-facing hillslopes of Brockman Iron Formation in the Pilbara bioregion of Western Australia. Associated vegetation includes Eucalyptus leucophloia subsp. leucophloia, Corymbia hamersleyana, Indigofera fractiflexa, Triodia spp. and Themeda triandra. Often found growing under the Triodia and occasionally under the Themeda, very rarely growing in the open. Flowering from mid- to late September. Fruiting from late September to mid-October[4]	No info	October	Yes but off footprint	Not within 20km	Unlikely to occur

Taxon	Status	Growth Form	Habitat from DBCA database records	Habitat from FloraBase	Flowering period	Habitat present at in GNHI survey area?	Distance to survey area	Likelihood ranking
Atriplex flabelliformis	P3	Monoecious, erect, rounded perennial, herb, to 0.35 m high.	WAH: Saline areas. Often salt tolerant shrublands, over low open heath.	Clay loam, loam. Saline flats or marshes.	No info	No	Not within 20km	Highly unlikely to occur
Barbula ehrenbergii	P1	Moss	Moss. Shaded moist environment on rock face 1.A species of hydric environments [2]	No info	No info	No	Not within 20km	Highly unlikely to occur
Calotis squamigera	P1	Procumbent annual, herb, to 0.21 m high.	WAH: Flat. Red brown loam clay, Stony plain with sandy loam soil. Low woodland of Acacia aptaneura, over open tussock grassland of Aristida contorta and Chrysopogon fallax with high open shrubland of Acacia synchronicia and Psydrax latifolia.	Pebbly loam	July	Yes	Not within 20km	Unlikely to occur
Cladium procerum	P2	Densely tufted perennial, grass-like or herb (sedge), 2 m high.	WAH: Major creeklines , Eucalyptus camaldulensis and Melaleuca argentea open woodland	Perennial pools	July, October, November	No	Not within 20km	Highly unlikely to occur
Dampiera anonyma	P3	Multi-stemmed perennial herb, 0.5 - 1m. Blue purple flower	WAH: Hillside; rocky red ironstone.	Skeletal red-brown gravelly soil over banded ironstone, basalt, shale and Jaspilite. Hills, summits and upper slopes (>1000m)	June, July, September	No	Not within 20km	Unlikely to occur
Dampiera metallorum	P3	Rounded, multi-stemmed perennial, herb, to 0.5 m high.	WAH: Summit of hill, high in landscape, steep slope, skeletal red gritty soil over massive banded ironstone.	Skeletal red-brown gravelly soil over banded ironstone. Steep slopes, summits of hills.	April-October	No	Not within 20km	Unlikely to occur
Dolichocarpa sp. Hamersley Station (A.A. Mitchell PRP 1479)	P3	no info	WAH: Cracking clay	Spreading annual herb to 10 cm tall, with blue flowers in March; occurs on cracking clay on flat to gently undulating plains with large surface rock	March, May, July	No	Within 20 km	Unlikely to occur
Dysphania congestiflora	P3	no info	WAH: Saline floodplain. Recorded from the western side of Fortescue Marsh from flats on the margin and towards the centre of seasonally inundated flood plains and lake beds, on saline, deep, light-medium to heavy clay soils. A single collection has also been recorded from the Lyndon River in close proximity to Lake Macleod [5]	No info	June, July	No	Not within 20km	Highly unlikely to occur
Eleocharis papillosa	P3	Annual, herb.	WAH: Claypan low dune/berm on eastern edge of wetland.	Red clay over granite, open clay flats. Claypans.	November	No	Not within 20km	Unlikely to occur
Eragrostis crateriformis	P3	Annual, grass-like or herb, 0.17-0.42 m high	WAH: Drainage area / floodplain.	Clayey loam or clay. Creek banks, depressions.	January-July	Yes	Not within 20km	Unlikely to occur
Eragrostis sp. Erect spikelets (P.K. Latz 2122)	P3	Erect perennial grass-like or herb to 0.3 m high	WAH: Near samphire flat. Associated species: Goodenia omeriana, G. forrestii, Cullen cinereum, Scaevola spinescens, Acacia tetragonophylla, A. victoriae. Associated species: Halosarcia spp., Eragrostis falcata (mostly as first year plants), Nicotiana sp., Swainsona sp., Angianthus sp. Low calcrete platforms/rises [12]	No info	No	No	Not within 20km	Highly unlikely to occur

Taxon	Status	Growth Form	Habitat from DBCA database records	Habitat from FloraBase	Flowering period	Habitat present at in GNHI survey area?	Distance to survey area	Likelihood ranking
Eragrostis sp. Mt Robinson (S. van Leeuwen 4109)	P1	Tussock-forming perennial, grass-like or herb, to 0.3 m high	WAH and TPFL: Open mallee shrubland; Summit of hill, steep western slopes. Skeletal gritty soil. Massive banded Brockman Iron Formation.	Red-brown skeletal soils, ironstone. Steep slopes, summits.	September	No	Not within 20km	Unlikely to occur
Eremophila magnifica subsp. magnifica	P4	Shrub, 0.5-1.5 m high.	WAH: High in landscape, steep slopes, summits, gullies, skeletal red gritty soil over massive banded ironstone of the Brockman Iron Formation.	Skeletal soils over ironstone. Rocky screes.	June-November	No	Within 20 km	Unlikely to occur
Eremophila magnifica subsp. velutina	P3	Shrub, 0.5-1.5 m high.	WAH: Summit of steep hill, high in landscape, steep slopes, rock screes and cliff faces, skeletal red stony soil over massive ironstone of the Brockman Iron Formation.	Skeletal soils over ironstone. Summits.	July-October	No	Not within 20km	Highly unlikely to occur
Eremophila pusilliflora	P2	Shrub to 0.5m	WAH: Low lying associated with drainage lines on red/brown clay loams and ironstone. Low open woodlands scattered with Corymbia hamersleyana and with Acacia aneura, A. inaequlatera, A. pyrifolia over hummock grasslands of T. wiseana, T. pungens and T. brizoides. TPFL: Low lying in valleys, gibber plains above drainage line with Goodenia over red clay loams. Open woodlands of Acacia aneura with Ptilotus exaltatus and Ptilotus helipteroides. Found on seasonally inundated alluvial plains between Turee Creek, Pingandy Creek and drainage systems leading into the Ashburton River, growing in red-brown sandy loam soils in open low shrubland with Acacia aneura, Ptilotus nobilis, Goodenia and Triodia species[6]	No info	April-September and after rainfall	Yes	Within 20 km	May potentially occur
Eremophila sp. Hamersley Range (K. Walker KW 136)	P3	no info	WAH: Rocky gullies and gorges. Steep rocky hill slopes and summits, high in the landscape	No info	June, August, September	No	Recorded elsewhere in Lamb Creek project	Unlikely to occur
Eremophila sp. West Angelas (S. van Leeuwen 4068)	P1	no info	WAH: TPFL Summits and slopes of hills, high in the landscape.	No info	August, September	Yes but off footprint, infrequently recorded ain locality	Not within 20km	Unlikely to occur
Eremophila spongiocarpa	P3	Compact, succulent-leaved shrub, to 1 m high.	WAH and TPFL: Saline , Alluvial margin of marsh. Edge of marsh, saline flats, broad plain, floodplain, claypan, Slope of linear dune.	Weakly saline alluvial plain on margins of marsh.	May, August, September	No	Not within 20km	Unlikely to occur
Eremophila youngii subsp. lepidota	P4	Dense, spreading shrub, (0.2-)1-3 m high.	WAH: Mulga woodland or acacia shrublands. Can grow near salt marshes in combination with Atriplex and other chenopods.	Stony red sandy loam. Flats plains, floodplains, sometimes semi-saline, clay flats.	January-March or August, September	Yes	Not within 20km	Unlikely to occur
Euphorbia australis var. glabra	P3	Prostrate herb, 10cm	WAH: Vegetation dominated by Acacia aptaneura. Acacia aff. aneura (long, flat, recurved; F. .MR 35.3), (Eucalyptus xerothermica) low woodland over *Malvastrum americanum, Sida aff. fibulifera low open shrubland over Sporobolus australasicus scattered bunch grasses. Associated Species: Acacia tetragonophylla. Broad, flat plain; calcrete platform to west and major creekline to east. Flat, red brown loam.	Prostrate annual herb. Typically occurs on cracking clay and clay plains	No	Yes	Not within 20km	Unlikely to occur
Euphorbia clementii	P3	Erect herb to 0.6m	TPFL; Sparse low woodland over Senna spp. moderately dense low shrubland over Triodia spp. and other grasses. Rock (Laterite) and red sand. Occasional Eucalyptus leucophloia. TPFL Taxon has been recorded on plains and outwash slopes, and in minor drainage lines or areas of sheet flow. This taxon is typically a fire-responder (and relatively short-lived) and can be observed in large numbers in recently burnt areas. [7]	Gravelly hillsides, stony grounds	May-July	Yes, would be obvious but as is a big post fire coloniser	Not within 20km	Unlikely to occur

Taxon	Status	Growth Form	Habitat from DBCA database records	Habitat from FloraBase	Flowering period	Habitat present at in GNHI survey area?	Distance to survey area	Likelihood ranking
Euphorbia inappendiculata var. inappendiculata	P2	small prostrate, much branched annual herb	Acacia aptaneura dominated vegetation. Flat, red brown loam. Recorded in cracking claypans of red sandy clay at Miralga Creek [7]	No info	No info	Yes, infrequently recorded	Not within 20km	Unlikely to occur
Euphorbia inappendiculata var. queenslandica	P2	prostrate annual herb	WAH: Tussock grassland of Astrebla elymoides, Chrysopogon fallax and Urochloa occidentalis var. occidentalis with open herbs of Polymeria longifolia, with high open shrubland of Acacia synchronicia. Cracking clay soil, Gilgai plain.	No info	No info	No	Not within 20km	Unlikely to occur
Euphorbia stevenii	P3	Succulent perennial herb from 0.1-0.5	Gently sloping area to gently undulating. Soils include: Red-brown cracking clay with scattered pebbles and cobbles on the surface. Occurs with many grasses including Astrebla sp, Themeda sp and Aristida sp.	Clay, sandy soils	June	Yes, infrequently recorded in locality	Not within 20km	Unlikely to occur
Fimbristylis sieberiana	P3	Shortly rhizomatous, tufted perennial, grass-like or herb (sedge), 0.25-0.6 m high.	WAH: Major drainage, edge of watercourse. With Eleocharis sp. Eucalyptus camaldulensis and Melaleuca argentea open woodland over Acacia pyrifolia var. pyrifolia; Acacia tumida var. pilbarensis and Clerodendrum tomentosum mid sparse shrubland over Cladium procerum and Cyperus vaginatus sedges and Cenchrus ciliaris. Woodland to forest of Eucalyptus camaldulensis and/or Melaleuca leucadendra and Acacia coriacea subsp. pendens over high shrubland.	Mud, skeletal soil pockets. Pool edges, sandstone cliffs.	May-August	No	Not within 20km	Unlikely to occur
Geijera salicifolia	P3	Tree from 1.5m-6m	WAH: Growing in flood area at base of gorge wall. Stony.	Skeletal soils, stony soils; Massive rock scree and gorges	September	No	Not within 20km	Unlikely to occur
Glycine falcata	P3	Mat-forming perennial, herb, to 0.2 m high	WAH: Sump, low in landscape. With Cullen and Vittadinia sp., Goodenia pascua and Bulbine pendula. Often low grassland or herbland with Acacia shrublands and hummock grassland, sometimes Eucalypts. Clay soils, cracking clays	Black clayey sand. Along drainage depressions in crabhole plains on river floodplains.		No	No	Within 20 km
Gompholobium karijini	P2	Low shrub growing to 70 cm tall, with coarsely fibrous, grey bark.	Eucalyptus leucophloia subsp. leucophloia over Triodia sp. Triodia hummock grassland with scattered shrubs and trees on ironstone gravel 9 Breakaway habitats and associated rocky slopes, the top edge of mesas, broadly rocky and rugged upland habitats, and incised gullies/ rocky gullies of the upland areas' and 'mesa top habitat consisting of hill top, mesa top, and broad rolling hill habitats. [10]	Typically occurs on rocky crests and slopes of hill	January, August-September	No	Not within 20km	Unlikely to occur
Goodenia lyrata	P3	Prostrate herb with lyrate leaves. Ephemeral	Broad drainage tract in hardpan plain. Mulga woodland. Mulga woodland or acacia shrublands, sometimes with E. victrix, over open shrubland, herbs.	Red sandy loam. Near claypan	May, August, October	No	Within 20 km	Unlikely to occur
Goodenia nuda	P4	Erect to ascending herb, to 0.5 m high.	WAH and TPFL : Variety of habitats	No info	March-August	Yes	Confirmed	Confirmed
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727)	P3	Open, erect annual or biennial, herb, to 0.2 m high.	WAH and TPFL : Variety of habitats with calcrete , Grassland on crabhole clay flats.	Red-brown clay soil, calcrete pebbles. Low undulating plain, swampy plains.	March-May and after rainfall	No	Within 20 km	Unlikely to occur
Grevillea saxicola	P3	Tall shrub or tree	WAH: High in landscape, steep and undulating terrain, skeletal red-brown gritty soil over massive banded ironstone of the Brockman Iron Formation. Mulga woodlands over shrublands with Eremophilas and other species, over Scaevola. No mention of Triodia. Skeletal red-brown sandy loam on steep slopes, rocky hills and ridges, usually growing with Mulga 10	No info	February, March	No	Not within 20km	Unlikely to occur
Gymnanthera cunninghamii	P3	Erect shrub, 1-2 m high.	WAH: South facing ironstone scree slope adjacent to Weeli Wolli Creek.	Sandy soils on islands in river and creek channels	Year-round	No, very scattered distribution.	Not within 20km	Unlikely to occur

Taxon	Status	Growth Form	Habitat from DBCA database records	Habitat from FloraBase	Flowering period	Habitat present at in GNHI survey area?	Distance to survey area	Likelihood ranking
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708)	P2	Shrub to 3m.	Gorges and Gullies associated with ironstone (inc: Brockman ironstone) outcroppings and boulders. Soils include Red-brown loams amongst boulders. Rocky ground high in the landscape. Gullies and gorges. [10]	No info	No info	No	Not within 20km	Highly unlikely to occur
Indigofera gilesii	P3	Shrub, to 1.5 m high.	WAH: Near summit of hill, high in landscape, skeletal red-brown stony soil over massive ironstone of the Brockman Iron Formation, Gorge / gully. Red brown skeletal. Continuous ironstone pebbles, Breakaway. Red dry soil.	Pebbly loam. Amongst boulders & outcrops, hills.	May, June, August	No	Within 20 km	Unlikely to occur
Indigofera ixocarpa	P2	Shrub to 1m	WAH: Dry creekline. Ironstone rocks and loamy soil	Skeletal red soils over massive ironstone	May, June, August	No	Not within 20km	Highly unlikely to occur
Iotasperma sessilifolium	P3	Erect herb	WAH: Sump, low in landscape, flat terrain, cracking red clay-loam.	Cracking clay, black loam. Edges of waterholes, plains.	September	No	Not within 20km	Highly unlikely to occur
Ipomoea racemigera	P2	Creeping annual, herb or climber.	WAH: Medium drainage line, fringing vegetation. Open forest of Eucalyptus camaldulensis and Melaleuca argentea	No info	June	No	Not within 20km	Unlikely to occur
Isotropis parviflora	P2	Shrub, 0.1 m high.	WAH: Stony plain, lower slopes, Hillcrest/upper slope.	Valley slope of ironstone plateaus, hill slopes and stony plains.	March-August	Yes	Within 20 km	Likely to occur
Kohautia australiensis	P2	Erect sparsely or much-branched annual, herb, 0.1-0.5 m high..	WAH: Calcrete plains, hills and rises	No info	March-May	No	Not within 20km	Unlikely to occur
Lepidium catapycnon	P4	Open, woody perennial, herb or shrub, 0.2-0.3 m high, stems zigzag.	Variety of vegetation types, typically with E. leucophloia over Acacias over Triodia. Strong habitat preference for steep upper breakaway slopes of mesa hills where it grows in skeletal light brown loam or sandy loam soils with a large proportion of loose rocks at the surface (50-100 percent) comprising a mixture of banded iron formation (BIF), banded chert and siltstone [11]	Skeletal soils. Hillsides.	May, June, August-November	No	Not within 20km	Unlikely to occur
Lindernia sp. Pilbara (M.N. Lyons & L. Lewis FV 1069)	P1	Annual or perennial herb, to 0.6 cm high	WAH: Claypan, low dune, edge of wetland.	No info	No info	No	Not within 20km	Unlikely to occur
Myriocephalus scalpellus	P1	Semi-erect herb, 0.03-0.08 m high.	WAH: At edge of claypan, In fringing vegetation.	Claypan	June	No	Not within 20km	Unlikely to occur
Nicotiana umbratica	P3	Erect, short-lived annual or perennial, herb, 0.3-0.7 m high. Fl. white, Apr to Jun. Shallow soils. Rocky outcrops.	no info	Shallow soils. Rocky outcrops.	April-June	No	Within 20km	Unlikely to occur
Olearia mucronata	P3	Densely branched, unpleasantly aromatic shrub (0.6-1m)	WAH: Steep upper slope, Soil: Red-brown scree boulders (ironstone), stones, base of south facing ironstone cliff, bordering a large scree slope.	Schistose hills along drainage channels	July-January	No	Not within 20km	Highly unlikely to occur
Oxalis sp. Pilbara (M.E. Trudgen 12725)	P2	Small annual herb to 10 cm tall. Leaves green above, purple below	WAH: Gorge, gully, cliff	No info	May, July	No	Not within 20km	Highly unlikely to occur

Taxon	Status	Growth Form	Habitat from DBCA database records	Habitat from FloraBase	Flowering period	Habitat present at in GNHI survey area?	Distance to survey area	Likelihood ranking
Pentalepis trichodesmoides subsp. Hispida	P2	Compact shrub to 1m	WAH: Summit of ridge, high in landscape, steep terrain, skeletal brown gritty soil over metabasaltic pillow lava, breccia; metatuff and minor cherts of the Bunjinah Formation, altitude ca. = 1020 m.	No info	August, September	No	Not within 20km	Unlikely to occur
Pilbara trudgenii	P3	Gnarled, aromatic shrub, to 1 m high.	WAH: Skeletal soil Summit, slopes, screes and cliffs. Brockman Iron Formation. With Eucalyptus leucophloia, E. gamophylla.	Skeletal, red stony soil over ironstone. Hill summits, steep slopes, screes, cliff faces.	July, September	No	Not within 20km	Highly unlikely to occur
Ptilotus mollis	P4	Compact, perennial shrub, to 0.5 m high, soft grey foliage.	WAH: Steep, rocky scree slope, laterite.	Stony hills and screes.	May, July, September	No	Not within 20km	Unlikely to occur
Rhagodia sp. Hamersley (M. Trudgen 17794)	P3	A spindly shrub growing to 2 m tall;	WAH: Mulga over mixed grassland. Emergent eucalypts and Triodia grassland. Very open mulga woodland over patchy mixed grasses. Floodplains, hardpan plains.	Red sandy clay loam plains and floodplains growing in association with Mulga (Acacia aneura)	March, May, September	Yes	Confirmed	Confirmed
Rhodanthe ascendens	P1	Ascending annual herb to 0.1m	WAH: Flat terrain, low in landscape, stony gibber with red cracking clay soils. Acacia aneura over Open Tussock Grass of Aristida spp.	Clay, roadside verge	August, September	Yes, infrequently collected	Not within 20km	Unlikely to occur
Rhynchosia bungarensis	P4	Compact, prostrate shrub, to 0.5 m high.	WAH: Creekline in a gorge	Pebbly, shingly coarse sand amongst boulders. Banks of flow line in the mouth of a gully in a valley wall.	November	No	Not within 20km	Unlikely to occur
Rostellularia adscendens var. latifolia	P3	Herb or shrub, 0.1-0.3 m high.	Acacia shrubland, sometimes with Eucalypts and Corymbias, over shrublands and herblands, over tussock grassland, or Triodia pungens hummock grassland.	Ironstone soils. Near creeks, rocky hills.	April, June, August	Yes	Confirmed	Confirmed
Samolus sp. Fortescue Marsh (A. Markey & R. Coppen FM 9702)	P1	Erect perennial herb, 0.3-1.0 m high	Margins of semi-permanent/permanent freshwater pools and the margins of samphire shrublands where creeks discharge freshwater following periods of high rainfall. [13]	No info	September	No	Not within 20km	Highly unlikely to occur
Scaevola sp. Hamersley Range basalts (S. van Leeuwen 3675)	P2	Shrub, to 1 m high	Steep slopes and screes. Growing in Regenerating Open Shrub Mallee of Eucalyptus kingsmillii and E. gamophylla over Dwarf Scrub C/D of Triumfetta sp, Corchorus sp, Hibiscus sp. and Acacia bivenosa over Open Hummock Grass of Triodia sp.	Skeletal, brown gritty soil over basalt. Summits of hills, steep hils.	July-August	No	Not within 20km	Unlikely to occur
Seringia exastia	CR	Shrub	Variety of mulga woodlands, sometimes with Eucalypts, over Acacia shrublands over Trioda pungens hummock grassland. Gully - washout. Red sand/laterite over sandstone.	No info	Year-round	Yes	Confirmed	Confirmed
Sida sp. Barlee Range (S. van Leeuwen 1642)	P3	Spreading shrub, to 0.5 m high.	WAH: Cliff line and scree slopes, gorge and steep gully	Skeletal red soils pockets. Steep slope.	August	No	Not within 20km	Highly unlikely to occur
Sida sp. Hammersley Range basalts (K. Newbey 10692)	P3	Herb or shrub to 0.15m	Plants growing amongst rocks along the south side of a small ironstone breakaway. Low open woodland over hummock grassland of Triodia sp.	No info	May, August, October	Possible, very little info, infrequently recorded at locality	Not within 20km	Unlikely to occur
Solanum kentrocaule	P3	Perennial shrub to 2.5m	WAH: Near summit of hill, high in landscape, skeletal red-brown stony soil over massive ironstone of the Brockman Iron Formation, steep slopes, steep gullies	No info	May, July, August	No	Not within 20km	Unlikely to occur
Stackhousia clementii	P3	Dense broom-like perennial, herb, to 0.45 m high.	Acacia shrubland, sometimes with E. victrix, over Acacia sclerosperma. WAH: Clay loam plains, drainage plains	Skeletal soils. Sandstone hills.	April, September		Not within 20km	Unlikely to occur

Taxon	Status	Growth Form	Habitat from DBCA database records	Habitat from FloraBase	Flowering period	Habitat present at in GNHI survey area?	Distance to survey area	Likelihood ranking
Streptoglossa sp. Cracking clays (S. van Leeuwen et a. PBS 7353)	P3	Multi stemmed annual herb	Cracking clay, Acacia aneura var. longicarpa high open shrubland over Rhagodia eremaea scattered shrubs over Aristida latifolia and Astrebla elymoides scattered tussock grasses. Acacia aneura var. longicarpa 3-5 m < 1-5%; Rhagodia eremaea 0.4-1.2 m < 1%; Aristida latifolia.	No info	June	No	Not within 20km	Unlikely to occur
Stylidium weeliwolli	P3	Annual, herb, 0.1-0.25 m high, throat appendages 4, rod-shaped.	WAH: In damp soil in rock clefts of river bed, permanent pools.	Damp soil in rock clefts of river bed, permanent pools, edge of water courses	July-October	No	Not within 20km	Unlikely to occur
Swainsona thompsoniana	P3	Prostrate annual herb to 10 cm high	WAH: Gently sloping area to gently undulating. Soil: Red-brown cracking clay with scattered pebbles and cobbles on the surface. Includes a flowline. Varies to areas of orange-brown cracking clay. Colluvial and alluvial gravels in fan or floodplain	No info	April, June, August	No	Not within 20km	Unlikely to occur
Synostemon hamersleyensis	P1	no info	WAH: Steep scree slope below banded iron formation cliff line with brown sandy loam soil. Steep hillslope, narrow gorge	No info	No info	No	Not within 20km	Highly unlikely to occur
Tecticornia globulifera	P1	no info	WAH: Saline flats and marsh with light medium clay soil.	No info	No info	No	Not within 20km	Highly unlikely to occur
Tecticornia medusa	P3	no info	WAH: Growing on the lake bed a few 100 metres from the shoreline. Red clayey sand., Claypan	No info	November	No	Not within 20km	Highly unlikely to occur
Tecticornia sp. Christmas Creek (K.A. Shepherd & T. Colmer et al. KS 1063)	P1	no info	Samphire flats.	No info	No info	No	Not within 20km	Highly unlikely to occur
Tetratheca fordiana	P2	Dwarf shrub; 0.3-0.4m	WAH: Vertical cliff faces amongst ironstone. Breakaways on Skeletal soils. Scattered low trees of Eucalyptus leucophloia, E. kingsmillii over scattered shrubs of Acacia hamersleyensis over open hummock grassland of Triodia epactia, Triodia wiseana and Triodia sp. Mt Ella (M.E. Trudgen 12739) with scattered tussock grasses of Eriachne mucronata.	Shale pocket amongst ironstone	April, May	No	Not within 20km	Unlikely to occur
Teucrium pilbaranum	P2	Upright shrub, 0.2 m high	WAH: High shrubland of Acacia sclerosperma, Acacia synchronicia, Eremophila longifolia and Acacia citrinoviridis over open herbs of Malvastrum americanum, Corchorus tridens and Cleome viscosa with low open woodland of Acacia citrinoviridis and Acacia aptaneura. Plain with brown clay loam soil.	Crab hole plain in a river floodplain, margin of calcrete table.	May, September	No	Not within 20km	Unlikely to occur
Themeda sp. Hamersley Station (M.E. Trudgen 11431)	P3	Tussocky perennial, grass-like or herb, 0.9-1.8 m high.	Variety of habitats including Mulga woodlands and mixed shrublands. Cracking clays, Red clay. Clay pan, grass plain.	Red clay. Clay pan, grass plain.	July-September	Yes	Within 20 km	Likely to occur
Thryptomene wittweri	VU	Spreading or rounded shrub from 0.5 - 1.5(2.1m)	WAH: Growing on tops of cliffs, ledges along cliff, in rock crevices and on boulder screes in shades southerly situations. Skeletal red stony soil. Ironstone. High in landscape, rocks on edge of cliff face and growing on face itself, S aspect, skeletal red-brown soil over massive banded ironstone of the Brockman Iron Formation, lots of rock and large sheets of ironstone on surface.	Skeletal red stony soils. Breakaways, stony creek beds.	April-August	No	Not within 20km	Unlikely to occur
Triodia basitricha	P3	no info	WAH Rehabilitation adjacent to Coondewanna airstrip, Mining Area C: Isolated Eucalyptus victrix and Corymbia hamersleyana, OR isolated Corymbia opaca trees over open to sparse Acacia aptaneura, A. bivenosa, A. pruinocarpa, and other shrubs, sometimes over Triodia, sometimes over low shrubs.	No info	No info	No	Within 20 km	Unlikely to occur

Taxon	Status	Growth Form	Habitat from DBCA database records	Habitat from FloraBase	Flowering period	Habitat present at in GNHI survey area?	Distance to survey area	Likelihood ranking
Triodia sp. Karijini (S. van Leeuwen 4111)	P1	no info	WAH: Triodia hummock grassland, variety of species including T. pungens, T. wiseana, often with emergent eucalypts and Corymbias, with Acacia shrublands. Very steep hillslope of grey silty loam.	No info	September	No	Within 20 km	Unlikely to occur
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	Perennial, grass-like or herb, 0.4 m high.	WAH: Rocky creeklines, often grows together with Triodia pungens. With E. leucophloia and C. hamersleyana.	Light orange-brown, pebbly loam. Amongst rocks & outcrops, gully slopes.	February, March, September	Yes	Within 20 km	Likely to occur
Vittadinia sp. Coondewanna Flats (S. van Leeuwen 4684)	P1	Annual daisy	WAH: Woodland to open forest of variety of mulga species and other acacias, OR shrubland of acacias and other species, sometimes with Eucalypts, over diverse shrubland, often over open Triodia grassland (T. pungens, T. melvillei). Plain, floodplain, drainage, sandy-clay loam,	No info	May, July, September	Yes	Within 20 km	Likely to occur
Xerochrysum boreale	P3	no info	WAH: Mulga, stony plain	No info	No info	Yes but rarely collected in locality	Not within 20km	Unlikely to occur

Appendix III Flora desktop results: Introduced taxa (weeds)

Family	Taxon	WAOL status	Total records
Amaranthaceae	**Aerva javanica*	Permitted s11	9
Apiaceae	**Cyclospermum leptophyllum*	Permitted s11	1
Arecaceae	**Phoenix dactylifera*	Permitted s11	1
Asteraceae	**Bidens bipinnata*	Permitted s11	34
Asteraceae	**Bidens subalternans var. simulans*	Not listed	1
Asteraceae	**Centaurea melitensis*	Permitted s11	1
Asteraceae	**Conyza bonariensis*	Permitted s11	2
Asteraceae	**Flaveria trinervia*	Permitted s11	12
Asteraceae	**Lactuca saligna*	Permitted s11	1
Asteraceae	**Lactuca serriola*	Permitted s11	2
Asteraceae	**Lactuca serriola forma serriola*	Permitted s11	2
Asteraceae	**Sonchus asper*	Permitted s11	1
Asteraceae	**Sonchus oleraceus*	Permitted s11	9
Asteraceae	**Symphyotrichum squamatum*	Permitted s11	1
Asteraceae	**Taraxacum khatoonae*	Permitted s11	1
Asteraceae	**Tridax procumbens*	Permitted s11	1
Brassicaceae	**Brassica rapa*	Permitted s11	1
Cucurbitaceae	**Citrullus amarus*	Permitted s11	1
Cucurbitaceae	**Citrullus colocynthis*	Permitted s11	3
Cucurbitaceae	**Citrullus lanatus*	Permitted s11	1
Cucurbitaceae	**Cucumis melo*	Permitted s11	4
Cucurbitaceae	**Cucumis myriocarpus*	Permitted s11	2
Cucurbitaceae	**Cucumis myriocarpus subsp. myriocarpus*	Permitted s11	1
Fabaceae	**Stylosanthes hamata*	Permitted s11	2
Fabaceae	**Vachellia farnesiana*	Permitted s11	14
Malvaceae	**Malvastrum americanum*	Permitted s11	26
Oxalidaceae	**Oxalis corniculata*	Permitted s11	1
Papaveraceae	**Argemone mexicana*	Declared Pest, Prohibited - s12 (C1 Prohibited)	1
Papaveraceae	**Argemone ochroleuca*	Permitted s11	6
Papaveraceae	**Argemone ochroleuca subsp. ochroleuca*	Permitted s11	3
Poaceae	**Cenchrus ciliaris*	Permitted s11	25
Poaceae	**Cenchrus echinatus*	Permitted s11	2
Poaceae	**Cenchrus setiger*	Permitted s11	5
Poaceae	**Chloris barbata*	Permitted s11	2

Family	Taxon	WAOL status	Total records
Poaceae	**Chloris virgata*	Permitted s11	22
Poaceae	**Cynodon dactylon*	Permitted s11	5
Poaceae	**Digitaria ciliaris*	Permitted s11	1
Poaceae	**Echinochloa colona*	Permitted s11	1
Poaceae	**Polypogon monspeliensis*	Permitted s11	1
Poaceae	**Rostraria cristata*	Permitted s11	1
Poaceae	**Setaria verticillata*	Permitted s11	18
Poaceae	**Sigesbeckia orientalis*	Permitted s11	12
Polygonaceae	**Rumex vesicarius*	Permitted s11	8
Portulacaceae	**Portulaca pilosa*	Permitted s11	3
Primulaceae	**Lysimachia arvensis*	Permitted s11	1
Solanaceae	**Datura leichhardtii*	Permitted s11	5
Solanaceae	**Datura leichhardtii subsp. leichhardtii*	Permitted s11	3
Solanaceae	**Solanum nigrum*	Permitted s11	3
Zygophyllaceae	**Tribulus terrestris*	Permitted s11	1

Appendix IV Taxa per vegetation type collected from the survey area

Family	Taxon name	Status	Vegetation type [1]						Other [2]	
			A	B	C	D	E	F	X	O
Amaranthaceae	**Aerva javanica*	Weed		X						
Amaranthaceae	*Alternanthera nana*			X	X	X	X			
Amaranthaceae	*Amaranthus cuspidifolius*			X						
Amaranthaceae	*Gomphrena canescens* subsp. *canescens*			X	X					
Amaranthaceae	*Ptilotus calostachyus*		X		X			X		
Amaranthaceae	*Ptilotus clementii*					X				
Amaranthaceae	*Ptilotus exaltatus*		X	X	X	X				
Amaranthaceae	*Ptilotus fusiformis*		X							
Amaranthaceae	*Ptilotus gaudichaudii*				X	X				
Amaranthaceae	*Ptilotus helipteroides*		X	X	X	X	X			
Amaranthaceae	*Ptilotus obovatus*		X	X	X	X	X			
Amaranthaceae	*Ptilotus rotundifolius*				X					
Asteraceae	**Bidens bipinnata*	Weed	X	X	X	X			X	
Asteraceae	*Chrysocephalum apiculatum* subsp. *pilbarense*				X					
Asteraceae	*Chrysocephalum gilesii*					X				
Asteraceae	*Peripleura virgata*				X					
Asteraceae	*Peripleura obovata*			X	X	X				X
Asteraceae	*Pterocaulon sphacelatum*			X	X	X				
Asteraceae	*Roebuckiella similis*		X							
Boraginaceae	*Capparis lasiantha*				X					
Boraginaceae	*Stenopetalum nutans*					X				
Boraginaceae	*Trichodesma zeylanicum* var. *zeylanicum*		X	X	X	X				
Brassicaceae	*Lepidium echinatum*				X					
Campanulaceae	*Wahlenbergia tumidifructa*		X							
Caryophyllaceae	*Polycarpaea corymbosa*		X	X	X					
Caryophyllaceae	*Polycarpaea holtzei*		X							
Celastraceae	*Stackhousia* sp. swollen gynophore (W.R. Barker 2041)							X		
Chenopodiaceae	*Dysphania kalpari*				X	X				
Chenopodiaceae	*Dysphania rhadinostachya* subsp. *inflata*			X	X	X				
Chenopodiaceae	*Maireana villosa*		X	X	X	X	X			
Chenopodiaceae	*Rhagodia eremaea*			X						

Family	Taxon name	Status	Vegetation type [1]						Other [2]	
			A	B	C	D	E	F	X	O
Chenopodiaceae	*Rhagodia* sp. Hamersley (M. Trudgen 17794)	Priority 3		X	X					
Chenopodiaceae	*Salsola australis*			X	X					
Chenopodiaceae	*Sclerolaena cornishiana*			X	X					
Cleomaceae	*Arivela viscosa*			X	X	X				
Convolvulaceae	*Convolvulus clementii*			X						
Convolvulaceae	*Duperreya commixta*		X	X	X	X	X			
Convolvulaceae	*Dysphania glomulifera* subsp. *eremaea*					X				
Convolvulaceae	*Evolvulus alsinoides* var. *villosicalyx*		X	X	X	X	X			
Cucurbitaceae	*Cucumis variabilis*			X	X	X				
Cyperaceae	*Bulbostylis barbata*					X				
Euphorbiaceae	*Euphorbia* aff. *ferdinandi*	Potentially undescribed			X	X				
Euphorbiaceae	*Euphorbia australis* var. *hispidula*		X							
Euphorbiaceae	*Euphorbia australis* var. *subtomentosa*			X	X					
Euphorbiaceae	*Euphorbia biconvexa*				X	X				
Euphorbiaceae	*Euphorbia coghlanii*			X						
Euphorbiaceae	*Euphorbia tannensis* subsp. *erem ophila*			X						
Fabaceae	**Stylosanthes hamata*	Weed			X	X				
Fabaceae	*Acacia ? aneura*							X		
Fabaceae	*Acacia ? sibirica*		X				X			
Fabaceae	*Acacia acradenia*				X					
Fabaceae	*Acacia adoxa* var. *adoxa*								X	
Fabaceae	*Acacia adsurgens*					X				
Fabaceae	*Acacia ancistrocarpa*		X					X		
Fabaceae	*Acacia aptaneura*		X	X	X	X	X			
Fabaceae	*Acacia atkinsiana*		X					X		
Fabaceae	*Acacia bivenosa*		X	X	X					
Fabaceae	*Acacia dictyophleba*		X		X	X		X		
Fabaceae	*Acacia elachantha*				X	X				
Fabaceae	*Acacia maitlandii*								X	
Fabaceae	*Acacia marramamba*							X		
Fabaceae	*Acacia minyura*									X
Fabaceae	*Acacia monticola*								X	

Family	Taxon name	Status	Vegetation type [1]						Other [2]	
			A	B	C	D	E	F	X	O
Fabaceae	*Acacia pachyacra*		X		X	X	X			X
Fabaceae	*Acacia pruinocarpa*		X	X	X	X				
Fabaceae	*Acacia pyrifolia* var. *pyrifolia*							X		
Fabaceae	*Acacia tenuissima*		X		X	X				
Fabaceae	*Acacia pachyacra*				X					
Fabaceae	*Acacia* sp.			X	X					
Fabaceae	*Cajanus marmoratus*			X						
Fabaceae	*Glycine canescens*				X					
Fabaceae	*Glycine* sp.			X	X					
Fabaceae	*Gompholobium oreophilum*		X							
Fabaceae	*Indigofera monophylla*								X	
Fabaceae	*Indigofera georgei*		X	X	X	X	X			
Fabaceae	*Isotropis iophyta*				X					X
Fabaceae	*Rhynchosia minima*			X						
Fabaceae	*Senna artemisioides* subsp. *x artemisioides*				X	X				
Fabaceae	*Senna artemisioides* subsp. *helmsii*			X	X					
Fabaceae	*Senna artemisioides* subsp. *oligophylla*		X	X	X					
Fabaceae	*Senna glutinosa* subsp. *glutinosa*		X							
Fabaceae	*Senna glutinosa* subsp. *X luerssenii*								X	
Fabaceae	*Senna notabilis*				X	X				X
Fabaceae	*Tephrosia* sp.				X				X	
Goodeniaceae	*Goodenia microptera*		X		X					
Goodeniaceae	*Goodenia nuda*	Priority 4				X				
Goodeniaceae	*Goodenia prostrata*			X	X	X				
Goodeniaceae	*Goodenia stellata*			X	X					
Goodeniaceae	*Scaevola parvifolia* subsp. *parvifolia*		X		X					
Gyrostemonaceae	*Codonocarpus* sp.					X				
Lamiaceae	*Clerodendrum floribundum* var. *angustifolium*					X				
Lamiaceae	*Teucrium teucriiflorum*					X				
Loranthaceae	*Lysiana murrayi*				X	X		X		
Malvaceae	**Malvastrum americanum*	Weed		X	X				X	
Malvaceae	*Abutilon fraseri*			X	X	X				

Family	Taxon name	Status	Vegetation type [1]						Other [2]	
			A	B	C	D	E	F	X	O
Malvaceae	*Abutilon lepidum*			X						
Malvaceae	*Abutilon macrum*			X	X					
Malvaceae	*Abutilon otocarpum*		X	X	X	X	X			
Malvaceae	*Androcalva luteiflora*			X						
Malvaceae	*Corchorus lasiocarpus* subsp. *parvus*								X	
Malvaceae	*Gossypium australe*		X							
Malvaceae	*Gossypium robinsonii*			X						
Malvaceae	*Melhania oblongifolia*			X						
Malvaceae	*Seringia exastia*	Critically Endangered							X	
Malvaceae	*Seringia velutina*							X		
Malvaceae	*Sida ? echinocarpa*			X						
Malvaceae	*Sida platycalyx*			X	X	X				
Malvaceae	*Sida* sp. *? L (A.M. Ashby 4202)*		X	X	X	X	X			
Malvaceae	*Sida* sp. spiciform panicles (E. Leyland s.n. 14/8/90)			X	X					
Montiaceae	*Calandrinia pumila*					X				
Myrtaceae	*Corymbia deserticola* subsp. *deserticola*		X		X			X		
Myrtaceae	*Corymbia hamersleyana*							X	X	
Myrtaceae	*Eucalyptus gamophylla*		X		X					
Myrtaceae	*Eucalyptus leucophloia* subsp. *leucophloia*		X							
Myrtaceae	*Eucalyptus xerothermica*					X				
Nyctaginaceae	*Boerhavia coccinea*			X	X	X				
Nyctaginaceae	*Boerhavia schomburgkiana*				X					
Oleaceae	*Jasminum didymum* subsp. *lineare*					X				
Phyllanthaceae	*Phyllanthus erwinii*				X					
Plantaginaceae	*Stemodia grossa*			X		X				
Poaceae	**Cenchrus ciliaris*	Weed	X	X	X		X		X	X
Poaceae	**Cenchrus setiger*	Weed		X	X					X
Poaceae	**Melinis repens*	Weed	X							
Poaceae	*Aristida contorta*		X	X	X	X	X			
Poaceae	*Aristida holathera* var. *holathera*		X		X	X				
Poaceae	*Aristida inaequiglumis*		X	X	X	X	X			
Poaceae	*Aristida lazaridis*	Priority 2	X	X	X	X			X	X

Family	Taxon name	Status	Vegetation type [1]						Other [2]	
			A	B	C	D	E	F	X	O
Poaceae	*Aristida obscura*						X			
Poaceae	*Aristida lazaridis*				X					
Poaceae	*Bothriochloa ewartiana*					X				
Poaceae	*Chrysopogon fallax*			X	X	X	X			
Poaceae	*Cymbopogon ambiguus*		X	X						
Poaceae	*Cymbopogon obtectus*		X		X	X				
Poaceae	*Dactyloctenium radulans*			X						
Poaceae	*Dichanthium sericeum* subsp. *humilius*		X			X				
Poaceae	*Digitaria ammophila*			X		X	X			
Poaceae	*Digitaria brownii*				X		X			
Poaceae	*Digitaria ctenantha*			X						
Poaceae	*Enneapogon caerulescens*		X	X	X		X			
Poaceae	*Enneapogon polyphyllus*		X	X	X	X	X			
Poaceae	*Enneapogon robustissimus*			X	X					
Poaceae	*Enneapogon lindleyanus*				X		X			
Poaceae	*Eragrostis cumingii*		X				X			
Poaceae	*Eragrostis eriopoda*		X	X						
Poaceae	*Eragrostis pergracilis*					X				
Poaceae	*Eriachne mucronata*			X	X					
Poaceae	*Eriachne pulchella* subsp. *pulchella*		X	X	X		X			
Poaceae	*Eulalia aurea*			X	X	X				
Poaceae	*Iseilema macratherum*					X	X			
Poaceae	*Panicum decompositum*		X	X	X	X	X			
Poaceae	*Paraneurachne muelleri*		X	X	X		X			
Poaceae	*Paspalidium rarum*				X	X				
Poaceae	*Perotis rara*			X	X	X	X			
Poaceae	*Schizachyrium fragile*		X	X	X		X			
Poaceae	*Sporobolus australasicus*			X	X		X			
Poaceae	*Themeda triandra*			X	X	X				
Poaceae	*Tragus australianus*			X						
Poaceae	*Triodia melvillei*		X		X	X	X			
Poaceae	*Triodia pungens*		X	X	X					
Poaceae	*Triodia wiseana*							X		
Polygalaceae	*Polygala glaucifolia*				X		X			

Family	Taxon name	Status	Vegetation type [1]						Other [2]	
			A	B	C	D	E	F	X	O
Portulacaceae	**Portulaca oleracea*	Weed	X	X	X	X				
Proteaceae	*Grevillea wickhamii* subsp. *hispidula*								X	
Proteaceae	*Hakea chordophylla*		X		X			X		
Proteaceae	*Hakea lorea* subsp. *lorea*			X	X	X				
Proteaceae	*Heliotropium inexplicitum*		X							
Proteaceae	*Hibiscus burtonii*		X	X	X	X	X			
Proteaceae	*Hibiscus coatesii*		X		X	X				
Proteaceae	*Hibiscus sturtii* var. *platychlamys*			X	X					
Pteridaceae	*Cheilanthes sieberi* subsp. *sieberi*				X	X	X			
Rubiaceae	*Psydrax latifolia*			X	X					
Rubiaceae	*Psydrax rigidula*				X					
Rubiaceae	*Psydrax suaveolens*					X				
Rubiaceae	*Spermacoce brachystema*					X				
Santalaceae	*Anthobolus leptomerioides*		X		X					
Santalaceae	*Santalum lanceolatum*			X	X	X				
Scrophulariaceae	*Eremophila forrestii* subsp. *forrestii*		X	X	X					
Scrophulariaceae	*Eremophila fraseri* subsp. *fraseri*		X							
Scrophulariaceae	*Eremophila lanceolata*					X				
Scrophulariaceae	*Eremophila latrobei* subsp. *filiformis*			X	X					
Scrophulariaceae	*Eremophila longifolia*			X	X	X				
Solanaceae	**Solanum lasiophyllum*	Weed	X	X	X					
Solanaceae	*Solanum ? horridum*				X					
Solanaceae	*Solanum ferocissimum*				X					
Zygophyllaceae	*Tribulus astrocarpus*						X			
Zygophyllaceae	*Tribulus macrocarpus*		X	X	X					
Zygophyllaceae	*Tribulus suberosus*								X	

Footnotes:

1: Vegetation types A to F.

2: X = Disturbed / cleared / revegetated areas; O = taxa recorded just outside the survey area boundaries

Appendix V List of quadrat locations

Site name	Site type	Vegetation type	Coordinates (MGA94 zone 50)	
			Easting	Northing
Q01	Quadrat (50x50m)	A	684032	7469174
Q02	Quadrat (50x50m)	B	684271	7469145
Q03	Quadrat (50x50m)	B	684622	7469252
Q04	Quadrat (50x50m)	B	684341	7468778
Q05	Quadrat (50x50m)	B	684617	7468905
Q06	Quadrat (50x50m)	B	684587	7468724
Q07	Quadrat (50x50m)	C	684861	7468732
Q09	Quadrat (50x50m)	C	684203	7468450
Q10	Quadrat (50x50m)	C	684682	7468406
Q11	Quadrat (50x50m)	C	684121	7468241
Q12	Quadrat (50x50m)	C	684599	7468329
Q13	Quadrat (50x50m)	C	684581	7467920
Q14	Quadrat (50x50m)	C	685040	7468238
Q17	Quadrat (50x50m)	C	685039	7467882
Q19	Quadrat (50x50m)	D	685110	7467709
Q23	Quadrat (50x50m)	D	685657	7466960
Q24	Quadrat (50x50m)	D	685614	7467170
Q26	Quadrat (50x50m)	E	684001	7468042
Q27	Quadrat (50x50m)	D	684467	7467613
R01	Relevé	F	685435	7466834

Appendix VI Quadrat Data

Site	Q01	Site photo
Date	14/05/21	 Flora_Quadrat/PhotoP5140012
Vegetation type	A - Low open Eucalyptus gamophylla woodland over Triodia melvillei and T. pungens on stony plain	
Landform	Plain	
Slope	Negligible	
Soil	Clay, Dark red/brown	
Rock type	Shale, Quartzite, Laterite	
Rock size	Up to 8cm	
Rock cover	90%	
Vegetation cover	10%	
Condition	Good	
Disturbances	Fire killed off 50% of shrubs >2m, Acacias, e.g. A. pruinocarpa	
Easting (MGA94 Zone 51)	684008	
Northing (MGA94 Zone 51)	7469197	
Vegetation description	*Eucalyptus gamophylla* (mallee) and *Corymbia deserticola* subsp. *deserticola* low open woodland; over *Acacia pruinocarpa*, *A. ancistrocarpa*, A. atkinsiana sparse shrubland; over isolated low shrubs; over isolated dwarf shrubs; over *Ptilotus calostachyus*, *Ptilotus obovatus*, *Trichodesma zeylanicum* var. zeylanicum sparse forbland; over *Triodia melvillei* and *Triodia* pungens sparse hummock grassland	

Taxon name	Growth form	Height (m)	Cover%
**Cenchrus ciliaris*	grass	0.3	0.1
**Portulaca oleracea*	herb	0.1	0.1
**Solanum lasiophyllum*	shrub	0.5	0.1
Abutilon otocarpum	shrub	0.3	0.1
Acacia ancistrocarpa	shrub	1.5	0.1
Acacia aptaneura	shrub	0.5	0.1
Acacia atkinsiana	shrub	1.5	0.1
Acacia dictyophleba	shrub	1.5	0.1
Acacia pruinocarpa	shrub	2	1
Acacia tenuissima	shrub	0.5	0.1
Anthobolus leptomerioides	shrub	0.8	0.1
Aristida contorta	grass	0.3	0.1
Aristida holathera var. holathera	grass	0.4	0.1
Aristida inaequiglumis	grass	0.5	0.1
Corymbia deserticola subsp. Deserticola	tree	7	0.1
Cymbopogon ambiguus	grass	0.4	0.1
Cymbopogon obtectus	grass	0.4	0.1
Duperreya commixta	creeper	n/a	0.1
Enneapogon caerulescens	grass	0.2	0.1
Enneapogon polyphyllus	grass	0.2	0.1
Eragrostis eriopoda	grass	0.4	0.1
Eremophila forrestii subsp. forrestii	shrub	1.2	0.1
Eremophila fraseri subsp. fraseri	shrub	0.5	0.1
Eriachne pulchella subsp. pulchella	grass	0.2	0.1
Eucalyptus gamophylla	mallee	4.5	1

Euphorbia australis var. hispidula	herb	0.1	0.1
Evolvulus alsinoides var. villosicalyx	herb	0.2	0.1
Goodenia microptera	herb	0.1	0.1
Heliotropium inexplicitum	herb	0.2	0.1
Hibiscus burtonii	shrub	0.3	0.1
Hibiscus coatesii	shrub	0.3	0.1
Indigofera georgei	shrub	0.4	0.1
Maireana villosa	shrub	0.2	0.1
Panicum decompositum	grass	0.5	0.1
Paraneurachne muelleri	grass	0.2	0.1
Polycarpaea corymbosa	herb	0.1	0.1
Ptilotus calostachyus	herb	0.8	0.1
Ptilotus exaltatus	herb	0.5	0.1
Ptilotus helipteroides	herb	0.2	0.1
Ptilotus obovatus	herb	0.4	0.1
Schizachyrium fragile	grass	0.1	0.1
Senna artemisioides subsp. oligophylla	shrub	0.3	0.1
Senna glutinosa subsp. glutinosa	shrub	0.5	0.1
Sida sp. ? L (A.M. Ashby 4202)	shrub	0.2	0.1
Tribulus macrocarpus	herb	0.1	0.1
Trichodesma zeylanicum var. zeylanicum	herb	0.4	0.1
Triodia melvillei	grass	0.5	2
Triodia pungens	grass	0.4	1

Site	Q02	Site photo
Date	14/5/21	 Flora_Quadrat/PhotoP5140012
Vegetation type	B - Mulga and acacia low open woodland over open tussock grassland on gently sloping (drainage) plain with variable rock cover	
Landform	Open woodland of Acacias over grasses + shrubs (Eremophila)	
Slope	Plain	
Soil	Negligible	
Rock type	Clay, Red brown	
Rock size	Quartzite, Laterite	
Rock cover	Up to 5cm	
Vegetation cover	5%	
Condition	Good	
Disturbances	Fire has killed 10% of shrubs >2m	
Easting (MGA94 Zone 51)	684249	
Northing (MGA94 Zone 51)	7469197	
Vegetation description	*Acacia aptaneura* (mulga) and *A. pruinocarpa* low open woodland; over *Eremophila longifolia*, *E. forrestii* subsp. *forrestii*, and *Acacia aptaneura* sparse tall shrubland; over *Eremophila latrobei* subsp. *filiformis* and *Santalum lanceolatum* sparse shrubland; over isolated low shrubs; over isolated dwarf shrubs; over *Pterocaulon sphacelatum* and *Ptilotus obovatus* sparse forbland; over *Aristida inaequiglumis*, *Aristida contorta*, and *Themeda triandra* open tussock grassland.	

Taxon name	Growth form	Height (m)	Cover%
Abutilon fraseri	shrub	0.3	0.1
Abutilon lepidum	herb	0.2	0.1
Abutilon otocarpum	shrub	0.3	0.1
Acacia aptaneura	tree	8	2
Acacia aptaneura	shrub	2.5	0.1
Acacia pruinocarpa	tree	4	1
Aristida contorta	grass	0.3	3
Aristida inaequiglumis	grass	0.4	4
Arivela viscosa	herb	0.8	0.1
Boerhavia coccinea	herb	0.1	0.1
Chrysopogon fallax	grass	0.6	0.1
Cucumis variabilis	creeper	n/a	0.1
Cymbopogon ambiguus	grass	0.8	0.1
Dactyloctenium radulans	grass	0.1	0.1
Digitaria ctenantha	grass	0.2	0.1
Duperreya commixta	creeper	n/a	0.1
Dysphania rhadinostachya subsp. inflata	herb	0.1	0.1
Enneapogon caerulescens	grass	0.2	0.1
Enneapogon polyphyllus	grass	0.2	0.1
Enneapogon robustissimus	grass	0.2	0.1
Eremophila forrestii subsp. forrestii	shrub	2.2	1
Eremophila latrobei subsp. filiformis	shrub	1.5	1
Eremophila longifolia	shrub	2.5	3
Eriachne mucronata	grass	0.3	0.1

Eulalia aurea	grass	0.1	0.1
Euphorbia coghlanii	herb	0.1	0.1
Evolvulus alsinoides var. villosicalyx	herb	0.1	0.1
Gomphrena canescens subsp. Canescens	herb	0.2	0.1
Hibiscus burtonii	shrub	0.6	0.1
Maireana villosa	shrub	0.1	0.1
Perotis rara	grass	0.1	0.1
Pterocaulon sphacelatum	herb	1	1
Ptilotus exaltatus	herb	0.2	0.1
Ptilotus helipteroides	herb	0.1	0.1
Ptilotus obovatus	herb	1	1
Rhynchosia minima	herb	0.3	0.1
Salsola australis	shrub	0.3	0.1
Santalum lanceolatum	shrub	2	0.1
Sclerolaena cornishiana	herb	0.2	0.1
Senna artemisioides subsp. helmsii	shrub	0.6	0.1
Senna artemisioides subsp. helmsii	shrub	0.6	0.1
Sida sp. ? L (A.M. Ashby 4202)	shrub	0.1	0.1
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)	shrub	0.9	0.1
Themeda triandra	grass	0.2	3
Tragus australianus	grass	0.1	0.1
Triodia pungens	grass	0.4	0.1

Site	Q03	Site photo
Date	14/05/21	 Flora_Quadrat/PhotoP5140010
Vegetation type	B - Mulga and acacia low open woodland over open tussock grassland on gently sloping (drainage) plain with variable rock cover	
Landform	Plain	
Slope	Negligible	
Soil	Clay, Red brown	
Rock type	Quartzite, laterite	
Rock size	<10cm	
Rock cover	2%	
Vegetation cover	80%	
Condition	Good	
Disturbances	Fire has killed 90% of shrubs over 3m (Old burnt stage to 6m)	
Easting (MGA94 Zone 51)	684598	
Northing (MGA94 Zone 51)	7469275	
Vegetation description	*Acacia pruinocarpa* low open woodland; over *Eremophila longifolia* and *Santalum lanceolatum* sparse tall shrubland; over *Acacia aptaneura* and *Acacia* spp. sparse shrubland; over isolated low shrubs; over isolated dwarf shrubs; over *Pterocaulon sphacelatum*, *Ptilotus obovatus*, *Arivela viscosa* open forbland; over *Aristida inaequiglumis*, *Themeda triandra*, *Aristida lazaridis* open tussock grassland.	

Taxon name	Growth form	Height (m)	Cover%
**Cenchrus setiger*	grass	0.5	0.1
**Malvastrum americanum*	herb	0.4	0.1
**Solanum lasiophyllum*	shrub	0.5	0.1
Abutilon macrum	shrub	0.3	0.1
Abutilon otocarpum	shrub	0.3	0.1
Acacia aptaneura	shrub	2	0.1
Acacia bivenosa	shrub	2	0.1
Acacia pruinocarpa	tree	5	1
Acacia sp.	shrub	2	1
Alternanthera nana	herb	0.2	0.1
Androcalva luteiflora	shrub	1.3	0.1
Aristida contorta	grass	0.3	0.1
Aristida inaequiglumis	grass	0.6	5
Aristida lazaridis	grass	0.8	0.1
Arivela viscosa	herb	0.5	0.1
Boerhavia coccinea	herb	0.1	0.1
Cajanus marmoratus	herb	0.1	0.1
Chrysopogon fallax	grass	0.5	0.1
Convolvulus clementii	creeper	n/a	0.1
Cucumis variabilis	creeper	n/a	0.1
Dactyloctenium radulans	grass	0.1	0.1
Duperreya commixta	creeper	n/a	0.1
Enneapogon polyphyllus	grass	0.3	0.1
Enneapogon robustissimus	grass	0.5	0.1

Eremophila longifolia	shrub	4	2
Euphorbia australis var. subtomentosa	herb	0.1	0.1
Euphorbia coghlanii	herb	0.2	0.1
Euphorbia tannensis subsp. eremophila	herb	0.2	0.1
Evolvulus alsinoides var. villosicalyx	herb	0.2	0.1
Glycine sp.	herb	0.4	0.1
Goodenia stellata	herb	0.1	0.1
Hibiscus sturtii var. platychlamys	shrub	0.3	0.1
Indigofera georgei	shrub	0.5	0.1
Maireana villosa	shrub	0.3	0.1
Melhania oblongifolia	shrub	0.4	0.1
Panicum decompositum	grass	0.5	0.1
Paraneurachne muelleri	grass	0.2	0.1
Perotis rara	grass	0.1	0.1
Pterocaulon sphacelatum	herb	0.7	20
Ptilotus exaltatus	herb	0.4	0.1
Ptilotus helipteroides	herb	0.4	0.1
Ptilotus obovatus	herb	0.6	0.1
Rhynchosia minima	creeper	n/a	0.1
Salsola australis	shrub	1.1	0.1
Santalum lanceolatum	shrub	2	0.1
Senna artemisioides subsp. oligophylla	shrub	0.3	0.1
Sida sp. ? L (A.M. Ashby 4202)	shrub	0.3	0.1
Sida sp. ? L (A.M. Ashby 4202)	shrub	0.3	0.1
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)	shrub	1	0.1
Themeda triandra	grass	0.4	4
Tribulus macrocarpus	herb	0.1	0.1
Trichodesma zeylanicum var. zeylanicum	herb	1.2	0.1

Site	Q04	Site photo
Date	14/05/21	 Flora_Quadrat/PhotoP5140022
Vegetation type	B - Mulga and acacia low open woodland over open tussock grassland on gently sloping (drainage) plain with variable rock cover	
Landform	Plain	
Slope	Very Slight	
Soil	Clay, Red brown	
Rock type	Quartzite, Shale	
Rock size	To 5cm	
Rock cover	10%	
Vegetation cover	85%	
Condition	Good	
Disturbances	Fire deaths 50% of shrubs >3m	
Easting (MGA94 Zone 51)	684314	
Northing (MGA94 Zone 51)	7468803	
Vegetation description	*Acacia aptaneura* isolated low trees; over *Acacia pruinocarpa*, *Santalum lanceolatum*, *Gossypium robinsonii* sparse tall shrubland; over isolated shrubs; over isolated low shrubs; over isolated dwarf shrubs; over *Pterocaulon sphacelatum*, *Arivela viscosa*; *Trichodesma zeylanicum* var. *zeylanicum* open forbland; over *Aristida inaequiglumis* and *Aristida contorta* tussock grassland.	

Taxon name	Growth form	Height (m)	Cover%
**Bidens bipinnata*	herb	0.4	0.1
**Malvastrum americanum*	herb	0.6	0.1
Abutilon fraseri	shrub	0.5	0.1
Abutilon otocarpum	shrub	0.4	0.1
Acacia aptaneura	tree	8	0.1
Acacia pruinocarpa	shrub	3	2
Alternanthera nana	herb	0.2	0.1
Amaranthus cuspidifolius	herb	0.2	0.1
Aristida contorta	grass	0.3	5
Aristida inaequiglumis	grass	0.5	60
Arivela viscosa	herb	1	0.1
Chrysopogon fallax	grass	0.7	0.1
Cucumis variabilis	creeper	n/a	0.1
Dactyloctenium radulans	grass	0.1	0.1
Duperreya commixta	creeper	n/a	0.1
Enneapogon polyphyllus	grass	0.3	0.1
Eragrostis eriopoda	grass	0.3	0.1
Glycine sp.	creeper	n/a	0.1
Gossypium robinsonii	shrub	4	0.1
Maireana villosa	shrub	0.4	0.1
Panicum decompositum	grass	0.5	0.1
Paraneurachne muelleri	grass	0.5	0.1
Perotis rara	grass	0.1	0.1
Psydrax latifolia	shrub	1	0.1
Pterocaulon sphacelatum	herb	0.9	15

Ptilotus exaltatus	grass	0.8	0.1
Ptilotus helipteroides	herb	0.1	0.1
Rhynchosia minima	creeper	n/a	0.1
Salsola australis	shrub	0.5	0.1
Santalum lanceolatum	tree	2	0.1
Senna artemisioides subsp. helmsii	shrub	1	0.1
Sida platycalyx	shrub	0.3	0.1
Sida sp. ? L (A.M. Ashby 4202)	shrub	0.1	0.1
Themeda triandra	grass	0.6	0.1
Tribulus macrocarpus	herb	0.1	0.1
Trichodesma zeylanicum var. zeylanicum	herb	1.5	0.1

Site	Q05	Site photo
Date	14/05/21	 Flora_Quadrat/PhotoP5140017
Vegetation type	B - Mulga and acacia low open woodland over open tussock grassland on gently sloping (drainage) plain with variable rock cover	
Landform	Drainage line on Plain	
Slope	Drains to south (200°)	
Soil	Clay	
Rock type	Quartzite, laterite	
Rock size	To 8cm	
Rock cover	2%	
Vegetation cover	60%	
Condition	Degraded	
Disturbances	Weeds, fire has killed some large trees, as well as shrubs >2m (5%)	
Easting (MGA94 Zone 51)	684684	
Northing (MGA94 Zone 51)	7468922	
Vegetation description	Acacia aptaneura low mulga woodland; over isolated shrubs; over isolated low shrubs; over isolated dwarf shrubs; over Pterocaulon sphacelatum, *Bidens bipinnata, *Malvastrum americanum open forbland; over Cenchrus ciliaris, Aristida contorta, A. inaequiglumis, Themeda triandra (56.2%) tussock grassland.	

Taxon name	Growth form	Height (m)	Cover%
**Bidens bipinnata*	herb	0.2	2
**Cenchrus ciliaris*	grass	1	40
**Malvastrum americanum*	herb	0.3	2
**Portulaca oleracea*	herb	0.1	0.1
**Solanum lasiophyllum*	shrub	0.3	0.1
Abutilon macrum	shrub	0.2	0.1
Abutilon otocarpum	shrub	0.3	0.1
Acacia aptaneura	tree	9	20
Alternanthera nana	herb	0.2	0.1
Aristida contorta	grass	0.3	8
Aristida inaequiglumis	grass	0.6	5
Arivela viscosa	herb	1	0.1
Boerhavia coccinea	herb	0.1	0.1
Chrysopogon fallax	grass	0.7	0.1
Cucumis variabilis	creeper	n/a	0.1
Digitaria ammophila	grass	0.2	0.1
Digitaria ctenantha	grass	0.1	0.1
Duperreya commixta	creeper	n/a	0.1
Dysphania rhadinostachya subsp. inflata	herb	0.1	0.1
Enneapogon caerulescens	grass	0.2	0.1
Enneapogon polyphyllus	grass	0.3	0.1
Eragrostis eriopoda	grass	0.2	0.1
Eremophila latrobei subsp. filiformis	shrub	1.5	0.1
Eriachne pulchella subsp. pulchella	grass	0.1	0.1
Euphorbia australis var. subtomentosa	herb	0.1	0.1

Evolvulus alsinoides var. villosicalyx	herb	0.1	0.1
Glycine sp.	Creeper	n/a	0.1
Goodenia prostrata	herb	0.01	0.1
Gossypium robinsonii	shrub	n/a	0.1
Maireana villosa	shrub	0.2	0.1
Melhania oblongifolia	shrub	0.3	0.1
Paraneurachne muelleri	grass	0.1	0.1
Perotis rara	grass	0.1	0.1
Polycarpaea corymbosa	herb	0.1	0.1
Pterocaulon sphacelatum	herb	0.5	5
Ptilotus exaltatus	grass	0.7	0.1
Ptilotus helipteroides	herb	0.2	0.1
Ptilotus obovatus	herb	0.5	0.1
Rhagodia eremaea	shrub	1	0.1
Rhagodia sp. Hamersley (M. Trudgen 17794)	shrub	2	0.1
Rhynchosia minima	creeper	0.3	0.1
Salsola australis	shrub	1	0.1
Schizachyrium fragile	grass	0.1	0.1
Senna artemisioides subsp. helmsii	shrub	0.6	0.1
Senna artemisioides subsp. oligophylla	shrub	0.4	0.1
Sida sp. ? L (A.M. Ashby 4202)	shrub	0.2	0.1
Sporobolus australasicus	herb	0.15	0.1
Stemodia grossa	herb	0.4	0.1
Themeda triandra	grass	0.9	2
Tragus australianus	grass	0.1	0.1
Tribulus macrocarpus	herb	0.1	0.1
Trichodesma zeylanicum var. zeylanicum	herb	1.5	0.1
Triodia pungens	grass	0.3	0.1

Site	Q06	Site photo
Date	14/05/21	 Flora_Quadrat/PhotoP5140020
Vegetation type	B - Mulga and acacia low open woodland over open tussock grassland on gently sloping (drainage) plain with variable rock cover	
Landform	Plain	
Slope	Negligible	
Soil	Clay, Red brown	
Rock type	Shale, quartzite, laterite	
Rock size	To 10cm	
Rock cover	95%	
Vegetation cover	6%	
Condition	Good	
Disturbances	Fire deaths of 50% of shrubs >2m	
Easting (MGA94 Zone 51)	684562	
Northing (MGA94 Zone 51)	7468748	
Vegetation description	*Acacia pruinocarpa* and *A. aptaneura* low open woodland; over *Hakea lorea* subsp. *lorea*, *Eremophila forrestii* subsp. *forrestii*, **Solanum lasiophyllum* isolated shrubs; over isolated low shrubs; over isolated dwarf shrubs; over isolated forbs; over *Aristida contorta*, *A. inaequiglumis*, *Themeda triandra* sparse tussock grassland.	

Taxon name	Growth form	Height (m)	Cover%
**Portulaca oleracea*	herb	0.1	0.1
**Solanum lasiophyllum*	shrub	1	0.1
Abutilon otocarpum	shrub	0.2	0.1
Acacia aptaneura	tree	4	1
Acacia pruinocarpa	tree	9	1
Aristida contorta	grass	0.2	6
Aristida inaequiglumis	grass	0.5	0.1
Boerhavia coccinea	herb	0.1	0.1
Cucumis variabilis	Creeper	n/a	0.1
Cymbopogon ambiguus	grass	1	0.1
Duperreya commixta	Creeper	1.2	0.1
Dysphania rhadinostachya subsp. inflata	herb	0.1	0.1
Enneapogon caerulescens	grass	0.2	0.1
Enneapogon polyphyllus	grass	0.3	0.1
Enneapogon robustissimus	grass	0.2	0.1
Eremophila forrestii subsp. forrestii	shrub	1.2	0.1
Goodenia prostrata	herb	0.01	0.1
Hakea lorea subsp. lorea	shrub	1.5	0.1
Hibiscus burtonii	shrub	0.3	0.1
Maireana villosa	shrub	0.5	0.1
Paraneurachne muelleri	grass	0.4	0.1
Perotis rara	grass	0.1	0.1
Pterocaulon sphacelatum	herb	1	0.1
Ptilotus exaltatus	grass	1	0.1
Ptilotus helipteroides	herb	0.2	0.1
Ptilotus obovatus	herb	0.9	0.1

Rhagodia eremaea	shrub	0.6	0.1
Salsola australis	shrub	1	0.1
Senna artemisioides subsp. helmsii	shrub	0.5	0.1
Sida ? echinocarpa	shrub	0.5	0.1
Stemodia grossa	herb	0.2	0.1
Themeda triandra	grass	0.7	0.1
Tribulus macrocarpus	herb	0.1	0.1
Triodia pungens	grass	0.6	0.1

Site	Q07	Site photo
Date	12/05/21	 Flora_Quadrat/PhotoP5120003
Vegetation type	C - Mulga and Acacia low open woodland over open spinifex and tussock grassland on flat plain with medium rock cover	
Landform	Plain	
Slope	N/A	
Soil	Clay, Dark red/black	
Rock type	Laterite	
Rock size	<10cm	
Rock cover	50%	
Vegetation cover	40%	
Condition	Very Good	
Disturbances	Fire >10 y.b.p	
Easting (MGA94 Zone 51)	684837	
Northing (MGA94 Zone 51)	7468759	
Vegetation description	Acacia pruinocarpa and Eucalyptus gamophylla low open woodland; over Acacia aptaneura, A. elachantha, and Santalum lanceolatum sparse tall shrubland; over isolated shrubs; over isolated low shrubs; over isolated dwarf shrubs; over Ptilotus obovatus, Pterocaulon sphacelatum, Arivela viscosa sparse forbland; over Aristida inaequiglumis, Themeda triandra, Triodia pungens, T. melvillei open grassland.	

Taxon name	Growth form	Height (m)	Cover%
**Portulaca oleracea*	herb	0.1	0.1
Abutilon otocarpum	shrub	0.4	0.1
Acacia aptaneura	shrub	4	2
Acacia dictyophleba	shrub	1.2	0.1
Acacia elachantha	shrub	4	0.1
Acacia pruinocarpa	tree	5	4
Acacia sp.	shrub	2	0.1
Alternanthera nana	herb	0.2	0.1
Aristida contorta	grass	0.1	0.1
Aristida inaequiglumis	grass	0.8	10
Arivela viscosa	herb	0.4	0.1
Boerhavia schomburgkiana	herb	0.2	0.1
Capparis lasiantha	shrub	1	0.1
Chrysopogon fallax	grass	0.3	0.1
Cucumis variabilis	Creeper	n/a	0.1
Duperreya commixta	Creeper	n/a	0.1
Enneapogon polyphyllus	grass	0.2	0.1
Enneapogon robustissimus	grass	0.5	0.1
Eremophila forrestii subsp. forrestii	shrub	2	0.1
Eriachne pulchella subsp. pulchella	grass	0.1	0.1
Eucalyptus gamophylla	tree	3	1
Evolvulus alsinoides var. villosicalyx	herb	0.1	0.1
Goodenia microptera	herb	0.1	0.1
Hakea chordophylla	shrub	2	0.1
Hibiscus burtonii	shrub	0.3	0.1

Hibiscus coatesii	shrub	0.3	0.1
Hibiscus sturtii var. platychlamys	shrub	0.2	0.1
Maireana villosa	shrub	0.2	0.1
Panicum decompositum	grass	0.5	0.1
Paraneurachne muelleri	grass	0.2	0.1
Perotis rara	grass	0.1	0.1
Polycarpaea corymbosa	herb	0.1	0.1
Psydrax latifolia	shrub	1.2	0.1
Pterocaulon sphacelatum	herb	0.7	0.1
Ptilotus exaltatus	herb	0.2	0.1
Ptilotus helipteroides	herb	0.2	0.1
Ptilotus obovatus	herb	1	1
Rhagodia sp. Hamersley (M. Trudgen 17794)	shrub	1.1	0.1
Salsola australis	shrub	0.1	0.1
Santalum lanceolatum	tree	3	0.1
Senna artemisioides subsp. helmsii	shrub	0.5	0.1
Sida platycalyx	shrub	0.3	0.1
Sida sp. ? L (A.M. Ashby 4202)	shrub	0.1	0.1
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)	herb	0.8	0.1
Themeda triandra	grass	0.8	10
Trichodesma zeylanicum var. zeylanicum	herb	1.1	0.1
Triodia pungens	grass	0.5	5

Site	Q09	Site photo
Date	17/05/21	 Flora_Quadrat/PhotoP5170080
Vegetation type	C - Mulga and Acacia low open woodland over open spinifex and tussock grassland on flat plain with medium rock cover	
Landform	Plain	
Slope	-	
Soil	Clay, Red brown	
Rock type	Quartzite + laterite fines	
Rock size	<10cm	
Rock cover	10%	
Vegetation cover	50%	
Condition	Good	
Disturbances	Fire deaths 20% of shrubs/trees >2m	
Easting (MGA94 Zone 51)	684181	
Northing (MGA94 Zone 51)	7468474	
Vegetation description	*Acacia aptaneura*, *A. pruinocarpa*, and *Corymbia deserticola* isolated low trees; over *Acacia dictyophleba* and *Santalum lanceolatum* isolated tall shrubs; over isolated shrubs; over isolated low shrubs; over isolated dwarf shrubs; over *Pterocaulon sphacelatum*, **Malvastrum americanum*, *Arivela viscosa* sparse forbland; *Triodia pungens*, *Aristida inaequiglumis* and *Themeda triandra* open grassland.	

Taxon name	Growth form	Height (m)	Cover%
**Malvastrum americanum*	herb	0.8	0.1
**Portulaca oleracea*	herb	0.1	0.1
**Stylosanthes hamata*	herb	0.3	0.1
Abutilon otocarpum	shrub	0.3	0.1
Acacia acradenia	shrub	1.5	0.1
Acacia aptaneura	tree	8	0.1
Acacia bivenosa	shrub	2	0.1
Acacia dictyophleba	shrub	2.5	0.1
Acacia elachantha	shrub	1.1	0.1
Acacia pachyacra	shrub	1.2	0.1
Acacia pruinocarpa	tree	6	0.1
Alternanthera nana	herb	0.2	0.1
Aristida contorta	grass	0.3	0.1
Aristida holathera var. holathera	grass	0.4	0.1
Aristida inaequiglumis	grass	0.4	3
Arivela viscosa	herb	0.7	0.1
Boerhavia coccinea	herb	0.2	0.1
Chrysopogon fallax	grass	0.5	0.1
Corymbia deserticola subsp. Deserticola	tree	3.2	0.1
Cucumis variabilis	Creeper	n/a	0.1
Cymbopogon obtectus	grass	1	0.1
Duperreya commixta	Creeper	n/a	0.1
Dysphania kalpari	herb	0.1	0.1
Enneapogon polyphyllus	grass	0.4	0.1
Enneapogon robustissimus	grass	0.5	0.1

Eremophila forrestii subsp. forrestii	shrub	1.2	0.1
Eremophila latrobei subsp. filiformis	shrub	1	0.1
Eremophila longifolia	shrub	1.2	0.1
Eulalia aurea	grass	0.7	0.1
Evolvulus alsinoides var. villosicalyx	herb	0.2	0.1
Goodenia microptera	herb	0.3	0.1
Hibiscus sturtii var. platychlamys	shrub	0.5	0.1
Maireana villosa	shrub	0.5	0.1
Panicum decompositum	grass	0.5	0.1
Paraneurachne muelleri	grass	0.5	0.1
Perotis rara	grass	0.1	0.1
Phyllanthus erwinii	shrub	0.1	0.1
Pterocaulon sphacelatum	herb	1	0.1
Ptilotus exaltatus	grass	0.6	0.1
Ptilotus helipteroides	herb	0.2	0.1
Ptilotus obovatus	herb	0.6	0.1
Santalum lanceolatum	tree	2	0.1
Senna notabilis	shrub	0.4	0.1
Sida sp. ? L (A.M. Ashby 4202)	shrub	0.2	0.1
Themeda triandra	grass	0.6	2
Trichodesma zeylanicum var. zeylanicum	herb	1.2	0.1
Triodia melvillei	grass	0.5	0.1
Triodia pungens	grass	0.5	4

Site	Q10	Site photo
Date	17/05/21	 Flora_Quadrat/PhotoP5170078
Vegetation type	C - Mulga and Acacia low open woodland over open spinifex and tussock grassland on flat plain with medium rock cover	
Landform	Plain	
Slope	-	
Soil	Clay, Red brown	
Rock type	Clay + Laterite fines	
Rock size	<8cm	
Rock cover	40%	
Vegetation cover	45%	
Condition	Good	
Disturbances	Fire killed 20% shrubs >2m	
Easting (MGA94 Zone 51)	684659	
Northing (MGA94 Zone 51)	7468432	
Vegetation description	*Acacia pruinocarpa*, *A. aptaneura*, *Corymbia deserticola* subsp. *deserticola* low open woodland; over isolated tall shrubs; over isolated shrubs; over sparse dwarf shrubs; over *Arivela viscosa*, *Pterocaulon sphacelatum*, *Ptilotus obovatus* isolated forbs; over *Triodia pungens*, *Aristida inaequiglumis*, *Themeda triandra* grassland.	

Taxon name	Growth form	Height (m)	Cover%
*Cenchrus ciliaris	grass	0.6	0.1
Abutilon otocarpum	shrub	0.2	0.1
Acacia aptaneura	tree	5	2
Acacia dictyophleba	shrub	2.5	0.1
Acacia pruinocarpa	tree	6	4
Aristida contorta	grass	0.3	0.1
Aristida holathera var. holathera	grass	0.3	0.1
Aristida inaequiglumis	grass	0.4	2
Arivela viscosa	herb	0.8	0.1
Chrysopogon fallax	grass	0.5	0.1
Corymbia deserticola subsp. Deserticola	tree	4	0.1
Cucumis variabilis	Creeper	n/a	0.1
Duperreya commixta	Creeper	n/a	0.1
Enneapogon caerulescens	grass	0.2	0.1
Enneapogon polyphyllus	grass	0.3	0.1
Eremophila forrestii subsp. forrestii	shrub	2	0.1
Eremophila latrobei subsp. filiformis	shrub	0.5	0.1
Eremophila longifolia	shrub	2.5	0.1
Eriachne pulchella subsp. pulchella	grass	0.1	0.1
Eulalia aurea	grass	1	0.1
Euphorbia australis var. subtomentosa	herb	0.2	0.1
Evolvulus alsinoides var. villosicalyx	herb	0.3	0.1
Hibiscus sturtii var. platychlamys	shrub	0.2	0.1
Maireana villosa	shrub	0.4	0.1
Panicum decompositum	grass	0.5	0.1
Paraneurachne muelleri	grass	0.4	0.1

Perotis rara	grass	0.1	0.1
Polycarpaea corymbosa	herb	0.2	0.1
Pterocaulon sphacelatum	herb	0.8	0.1
Ptilotus exaltatus	grass	0.3	0.1
Ptilotus obovatus	herb	0.4	0.1
Salsola australis	shrub	0.3	0.1
Schizachyrium fragile	grass	0.2	0.1
Sclerolaena cornishiana	herb	0.1	0.1
Senna artemisioides subsp. oligophylla	shrub	0.1	0.1
Sida platycalyx	shrub	0.3	0.1
Sida sp. ? L (A.M. Ashby 4202)	shrub	0.4	0.1
Themeda triandra	grass	0.5	2
Tribulus macrocarpus	herb	0.2	0.1
Triodia pungens	grass	0.5	40

Site	Q11	Site photo
Date	16/05/21	 Flora_Quadrat/PhotoP5160044
Vegetation type	C - Mulga and Acacia low open woodland over open spinifex and tussock grassland on flat plain with medium rock cover	
Landform	Plain	
Slope	Negligible	
Soil	Clay, Red brown	
Rock type	Quartzite	
Rock size	Up to 8cm	
Rock cover	20%	
Vegetation cover	20%	
Condition	Good	
Disturbances	Fire deaths Acacia >2m 50%	
Easting (MGA94 Zone 51)	684096	
Northing (MGA94 Zone 51)	7468226	
Vegetation description	*Acacia aptaneura* low open woodland; over *Acacia pruinocarpa* and *A. elachantha* isolated tall shrubs; over *Acacia dictyophleba*, *A. pachyacra*, *Psydrax latifolia* isolated shrubs; over isolated low shrubs; over isolated dwarf shrubs; over *Ptilotus calostachyus*, *Ptilotus obovatus*, *Evolvulus alsinoides* var. *villosicalyx* sparse forbland; over *Triodia melvillei*, *Aristida contorta*, *Themeda triandra* open grassland.	

Taxon name	Growth form	Height (m)	Cover%
Abutilon otocarpum	shrub	0.6	0.1
Acacia aptaneura	tree	7	5
Acacia dictyophleba	shrub	2	0.1
Acacia elachantha	shrub	2.5	0.1
Acacia pruinocarpa	shrub	2.5	0.1
Acacia pachyacra	shrub	1.2	0.1
Aristida contorta	grass	0.4	5
Aristida holathera var. holathera	grass	0.4	0.1
Arivela viscosa	herb	0.2	0.1
Cheilanthes sieberi subsp. sieberi	fern	0.2	0.1
Chrysopogon fallax	grass	0.5	0.1
Cucumis variabilis	Creeper	n/a	0.1
Duperreya commixta	Creeper	n/a	0.1
Dysphania kalpari	herb	0.1	0.1
Enneapogon polyphyllus	grass	0.2	0.1
Enneapogon robustissimus	grass	0.6	0.1
Eulalia aurea	grass	0.6	0.1
Euphorbia aff. ferdinandi	herb	0.1	0.1
Euphorbia biconvexa	herb	0.2	0.1
Evolvulus alsinoides var. villosicalyx	herb	0.3	0.1
Goodenia microptera	herb	0.2	0.1
Goodenia stellata	herb	0.1	0.1
Hibiscus burtonii	shrub	0.5	0.1
Hibiscus sturtii var. platychlamys	shrub	0.5	0.1
Indigofera georgei	shrub	0.8	0.1

Maireana villosa	shrub	0.3	0.1
Panicum decompositum	grass	0.3	0.1
Paraneurachne muelleri	grass	0.4	1
Paspalidium rarum	grass	0.2	0.1
Perotis rara	grass	0.1	0.1
Psydrax latifolia	shrub	1.8	0.1
Pterocaulon sphacelatum	herb	1.2	0.1
Ptilotus calostachyus	herb	0.8	0.1
Ptilotus exaltatus	grass	0.4	0.1
Ptilotus helipteroides	herb	0.2	0.1
Ptilotus obovatus	herb	0.5	0.1
Scaevola parvifolia subsp. parvifolia	shrub	0.4	0.1
Sclerolaena cornishiana	herb	0.1	0.1
Senna artemisioides subsp. oligophylla	shrub	0.3	0.1
Sida sp. ? L (A.M. Ashby 4202)	shrub	0.2	0.1
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)	shrub	1.2	0.1
Themeda triandra	grass	0.8	2
Triodia melvillei	grass	0.7	10

Site	Q12	Site photo
Date	17/05/21	 Flora_Quadrat/PhotoP5170076
Vegetation type	C - Mulga and Acacia low open woodland over open spinifex and tussock grassland on flat plain with medium rock cover	
Landform	Plain	
Slope	-	
Soil	Clay, Red brown	
Rock type	Quartzite	
Rock size	<5cm	
Rock cover	25%	
Vegetation cover	55%	
Condition	Good	
Disturbances	Fire deaths 10% Shrubs >2m	
Easting (MGA94 Zone 51)	684574	
Northing (MGA94 Zone 51)	7468353	
Vegetation description	*Acacia pruinocarpa*, *Eremophila longifolia*, *Hakea lorea* subsp. *lorea* open (5.2%) woodland; over *Acacia aptaneura* (0.1%) isolated tall shrubs; over *Acacia dictyophleba*, *Anthobolus leptomerioides*, *Salsola australis* (0.3%) shrubs; over *Abutilon macrum*, *Abutilon otocarpum*, *Hibiscus burtonii* (0.4%) low shrubs; over isolated dwarf shrubs; over *Pterocaulon sphacelatum*, *Arivela viscosa*, *Ptilotus calostachyus* sparse forbland; over *Themeda triandra*, *Eulalia aurea*, *Triodia pungens* and *T. melvillei* open grassland.	

Taxon name	Growth form	Height (m)	Cover%
Abutilon macrum	shrub	0.5	0.1
Abutilon otocarpum	shrub	0.6	0.1
Acacia aptaneura	shrub	3	0.1
Acacia dictyophleba	shrub	1.5	0.1
Acacia pruinocarpa	tree	7	5
Alternanthera nana	herb	0.4	0.1
Anthobolus leptomerioides	shrub	1	0.1
Aristida contorta	grass	0.3	1
Aristida holathera var. holathera	grass	0.5	0.1
Aristida inaequiglumis	grass	0.6	0.1
Aristida lazaridis	grass	0.3	0.1
Arivela viscosa	herb	1	0.1
Boerhavia coccinea	herb	0.1	0.1
Cheilanthes sieberi subsp. sieberi	fern	0.2	0.1
Chrysocephalum apiculatum subsp. pilbarense	grass	0.25	0.1
Chrysopogon fallax	grass	0.7	0.1
Cucumis variabilis	Creeper	n/a	0.1
Duperreya commixta	Creeper	n/a	0.1
Dysphania kalpari	herb	0.1	0.1
Enneapogon polyphyllus	grass	0.4	0.1
Enneapogon robustissimus	grass	0.5	0.1
Enneapogon lindleyanus	grass	0.3	0.1
Eremophila longifolia	shrub	6	0.1
Eulalia aurea	grass	0.5	10

Euphorbia australis var. subtomentosa	herb	0.1	0.1
Evolvulus alsinoides var. villosicalyx	herb	0.2	0.1
Glycine sp.	Creeper	n/a	0.1
Hakea lorea subsp. lorea	tree	5	0.1
Hibiscus burtonii	shrub	0.5	0.1
Maireana villosa	shrub	0.4	0.1
Panicum decompositum	grass	0.5	0.1
Paraneurachne muelleri	grass	0.5	0.1
Peripleura virgata	herb	0.3	0.1
Perotis rara	grass	0.1	0.1
Pterocaulon sphacelatum	herb	0.5	5
Ptilotus calostachyus	herb	0.8	0.1
Ptilotus exaltatus	grass	0.7	0.1
Ptilotus helipteroides	herb	0.2	0.1
Ptilotus obovatus	herb	1	0.1
Salsola australis	shrub	1	0.1
Senna notabilis	shrub	0.3	0.1
Sida sp. ? L (A.M. Ashby 4202)	shrub	0.2	0.1
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)	shrub	0.6	0.1
Themeda triandra	grass	0.5	20
Triodia pungens	grass	0.5	5

Site	Q13	Site photo
Date	17/05/21	 Flora_Quadrat/PhotoP5170082
Vegetation type	C - Mulga and Acacia low open woodland over open spinifex and tussock grassland on flat plain with medium rock cover	
Landform	Plain	
Slope	<2°	
Soil	Clay, Red brown	
Rock type	Quartzite + laterite fines	
Rock size	<10cm	
Rock cover	60%	
Vegetation cover	40%	
Condition	Good	
Disturbances	Fire deaths 50% trees + Shrubs >2m	
Easting (MGA94 Zone 51)	684555	
Northing (MGA94 Zone 51)	7467944	
Vegetation description	*Acacia aptaneura* low open mulga woodland; over *Acacia pruinocarpa*, *Hakea lorea* subsp. *lorea*, *Acacia elachantha* sparse tall shrubland; over isolated shrubs; over isolated low shrubs; over isolated dwarf shrubs; over *Pterocaulon sphacelatum*, *Arivela viscosa*, *Ptilotus obovatus* sparse forbland; over *Eulalia aurea*, *Aristida inaequiglumis*, and *Themeda triandra* tussock grassland.	

Taxon name	Growth form	Height (m)	Cover%
**Bidens bipinnata*	herb	0.2	0.1
**Cenchrus setiger*	grass	0.2	0.1
**Portulaca oleracea*	herb	0.1	0.1
**Solanum lasiophyllum*	shrub	0.2	0.1
Abutilon otocarpum	shrub	0.2	0.1
Acacia aptaneura	shrub	4	2
Acacia dictyophleba	shrub	1.5	0.1
Acacia elachantha	shrub	3	0.1
Acacia pachyacra	shrub	2	0.1
Acacia pruinocarpa	shrub	2.2	1
Alternanthera nana	herb	0.3	0.1
Aristida contorta	grass	0.3	1
Aristida inaequiglumis	grass	0.5	10
Aristida lazaridis	grass	0.5	0.1
Arivela viscosa	herb	0.6	0.1
Boerhavia coccinea	herb	0.2	0.1
Chrysopogon fallax	grass	0.3	0.1
Cucumis variabilis	Creeper	n/a	0.1
Digitaria brownii	grass	0.6	0.1
Duperreya commixta	Creeper	n/a	0.1
Dysphania rhadinostachya subsp. Inflata	herb	0.2	0.1
Enneapogon polyphyllus	grass	0.4	1
Enneapogon robustissimus	grass	0.5	0.1
Eremophila latrobei subsp. filiformis	shrub	1.1	0.1
Eremophila longifolia	shrub	1.2	0.1

Eriachne pulchella subsp. pulchella	grass	0.1	0.1
Eulalia aurea	grass	0.7	15
Euphorbia aff. ferdinandi	herb	0.1	0.1
Euphorbia biconvexa	shrub	0.1	0.1
Evolvulus alsinoides var. villosicalyx	herb	0.1	0.1
Hakea lorea subsp. lorea	tree	2	1
Hibiscus burtonii	shrub	0.8	0.1
Indigofera georgei	shrub	1.1	0.1
Maireana villosa	shrub	0.4	0.1
Panicum decompositum	grass	0.5	0.1
Paraneurachne muelleri	grass	0.1	0.1
Peripleura virgata	herb	0.3	0.1
Peripleura obovata	herb	0.3	0.1
Perotis rara	grass	0.1	0.1
Psydrax latifolia	shrub	0.7	0.1
Pterocaulon sphacelatum	herb	1	4
Ptilotus exaltatus	grass	0.5	0.1
Ptilotus helipteroides	herb	0.3	0.1
Ptilotus obovatus	herb	0.5	0.1
Senna artemisioides subsp. x artemisioides	shrub	1	0.1
Sida sp. ? L (A.M. Ashby 4202)	shrub	0.2	0.1
Solanum ? horridum	shrub	0.5	0.1
Sporobolus australasicus	herb	0.1	0.1
Themeda triandra	grass	0.6	5
Triodia melvillei	grass	0.6	1
Triodia pungens	grass	0.6	2

Site	Q14	Site photo
Date	16/05/21	 Flora_Quadrat/PhotoP5160058
Vegetation type	C - Mulga and Acacia low open woodland over open spinifex and tussock grassland on flat plain with medium rock cover	
Landform	Plain	
Slope	-	
Soil	Clay, Red brown	
Rock type	Quartzite, Shale	
Rock size	Up to 10cm	
Rock cover	45%	
Vegetation cover	25%	
Condition	Good	
Disturbances	Fire deaths 10% of shrubs >2m	
Easting (MGA94 Zone 51)	685014	
Northing (MGA94 Zone 51)	7468361	
Vegetation description	*Acacia acradenia* and *Acacia aptaneura* low open woodland; over *Acacia pruinocarpa*, *A. dictyophleba*, *Hakea lorea* subsp. *lorea* sparse tall shrubland; over isolated shrubs; over isolated low shrubs; over isolated dwarf shrubs; over *Pterocaulon sphacelatum*, *Goodenia microptera*, *Ptilotus exaltatus* sparse forbland; over *Triodia melvillei* open hummock grassland.	

Taxon name	Growth form	Height (m)	Cover%
**Bidens bipinnata*	herb	0.1	0.1
**Portulaca oleracea*	herb	0.1	0.1
**Solanum lasiophyllum*	shrub	0.5	0.1
Abutilon fraseri	shrub	0.3	0.1
Abutilon otocarpum	shrub	0.3	0.1
Acacia acradenia	tree	8	2
Acacia aptaneura	tree	6	2
Acacia dictyophleba	shrub	3	2
Acacia pruinocarpa	shrub	4	2
Alternanthera nana	herb	0.1	0.1
Anthobolus leptomerioides	shrub	1	0.1
Aristida contorta	grass	0.4	0.1
Aristida inaequiglumis	grass	0.5	0.1
Arivela viscosa	herb	0.1	0.1
Boerhavia coccinea	herb	0.1	0.1
Chrysopogon fallax	grass	0.6	0.1
Digitaria brownii	grass	0.5	0.1
Duperreya commixta	Creeper	n/a	0.1
Enneapogon polyphyllus	grass	0.3	0.1
Eriachne mucronata	grass	0.1	0.1
Eriachne pulchella subsp. pulchella	grass	0.1	0.1
Eulalia aurea	grass	0.9	0.1
Euphorbia aff. ferdinandi	herb	0.1	0.1
Evolvulus alsinoides var. villosicalyx	herb	0.2	0.1
Goodenia microptera	herb	0.3	0.1

Goodenia prostrata	herb	0.01	0.1
Hakea lorea subsp. lorea	tree	2.1	0.1
Hibiscus burtonii	shrub	0.5	0.1
Hibiscus sturtii var. platychlamys	shrub	0.5	0.1
Panicum decompositum	grass	0.5	0.1
Paraneurachne muelleri	grass	0.5	0.1
Polycarpaea corymbosa	herb	0.1	0.1
Polygala glaucifolia	herb	0.1	0.1
Psydrax latifolia	shrub	1	0.1
Psydrax rigidula	shrub	1	0.1
Pterocaulon sphacelatum	herb	0.3	0.1
Ptilotus exaltatus	herb	0.3	0.1
Ptilotus helipteroides	herb	0.3	0.1
Ptilotus obovatus	grass	0.4	0.1
Scaevola parvifolia subsp. parvifolia	shrub	0.3	0.1
Schizachyrium fragile	grass	0.2	0.1
Senna notabilis	shrub	0.1	0.1
Sida sp. ? L (A.M. Ashby 4202)	shrub	0.3	0.1
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)	shrub	1	0.1
Tephrosia sp.	shrub	0.4	0.1
Themeda triandra	grass	0.5	0.1
Triodia melvillei	grass	1	10

Site	Q17	Site photo
Date	16/05/21	 Flora_Quadrat/PhotoP5160051
Vegetation type	C - Mulga and Acacia low open woodland over open spinifex and tussock grassland on flat plain with medium rock cover	
Landform	Plain	
Slope	-	
Soil	Clay, Red brown	
Rock type	Quartzite + laterite fines	
Rock size	<5cm	
Rock cover	5%	
Vegetation cover	22%	
Condition	Good	
Disturbances	Fire death 5% of shrubs/trees over 2m	
Easting (MGA94 Zone 51)	685015	
Northing (MGA94 Zone 51)	7467909	
Vegetation description	*Acacia aptaneura* low open (mulga) woodland; over *Hakea lorea* subsp. *lorea*, *Acacia pachyacra* and *A. tenuissima* sparse tall shrubland; over isolated shrubs; over isolated low shrubs; over isolated dwarf shrubs; over *Ptilotus helipteroides*, *Pterocaulon sphacelatum*, *Ptilotus exaltatus* sparse forbland; over *Triodia melvillei*, *Aristida contorta, A. inaequiglumis* open grassland.	

Taxon name	Growth form	Height (m)	Cover%
**Portulaca oleracea*	herb	0.1	0.1
Abutilon otocarpum	shrub	0.2	0.1
Acacia aptaneura	tree	6	5
Acacia pachyacra	shrub	2.5	0.1
Acacia tenuissima	shrub	2.5	0.1
Anthobolus leptomerioides	shrub	1	0.1
Aristida contorta	grass	0.2	2
Aristida holathera var. holathera	grass	0.3	0.1
Aristida inaequiglumis	grass	0.5	2
Boerhavia coccinea	herb	0.1	0.1
Chrysopogon fallax	grass	0.6	0.1
Cymbopogon obtectus	grass	0.3	0.1
Digitaria brownii	grass	0.5	0.1
Duperreya commixta	Creeper	n/a	0.1
Dysphania kalpari	herb	0.1	0.1
Enneapogon polyphyllus	grass	0.3	0.1
Enneapogon robustissimus	grass	0.5	0.1
Eremophila latrobei subsp. filiformis	shrub	1.5	0.1
Eremophila longifolia	shrub	1.2	0.1
Eriachne pulchella subsp. pulchella	grass	0.1	0.1
Eulalia aurea	grass	0.6	0.1
Euphorbia biconvexa	shrub	0.1	0.1
Evolvulus alsinoides var. villosicalyx	herb	0.2	0.1
Gomphrena canescens subsp. Canescens	herb	0.2	0.1
Goodenia prostrata	herb	0.01	0.1

Hakea lorea subsp. lorea	tree	2	2
Hibiscus burtonii	shrub	1	0.1
Lysiana murrayi	Mistletoe	n/a	0.1
Maireana villosa	shrub	0.1	0.1
Perotis rara	grass	0.1	0.1
Polycarpaea corymbosa	herb	0.1	0.1
Pterocaulon sphacelatum	herb	0.8	0.1
Ptilotus exaltatus	herb	0.1	0.1
Ptilotus gaudichaudii	herb	0.2	0.1
Ptilotus helipteroides	herb	0.2	1
Ptilotus obovatus	grass	0.4	0.1
Rhagodia sp. Hamersley (M. Trudgen 17794)	shrub	1	0.1
Schizachyrium fragile	grass	0.1	0.1
Senna notabilis	shrub	0.1	0.1
Sida sp. ? L (A.M. Ashby 4202)	shrub	0.5	0.1
Solanum ferocissimum	herb	0.2	0.1
Themeda triandra	grass	0.5	0.1
Triodia melvillei	grass	0.5	10

Site	Q19	Site photo
Date	16/05/21	 Flora_Quadrat/PhotoP5160053
Vegetation type	D – Mulga, Hakea lorea, and Eucalyptus xerothermica low open woodland over closed tussock grassland on flat clay plain (no rocks)	
Landform	Plain	
Slope	-	
Soil	Clay, Red brown	
Rock type	-	
Rock size	-	
Rock cover	-	
Vegetation cover	80%	
Condition	Good	
Disturbances	Fire deaths of shrubs <1m about 20%	
Easting (MGA94 Zone 51)	685089	
Northing (MGA94 Zone 51)	7467734	
Vegetation description	*Acacia aptaneura*, *Hakea lorea* subsp. *lorea* low open woodland; over *Hakea lorea* subsp. *lorea* sparse tall shrubland; over isolated shrubs; over isolated dwarf shrubs; over *Pterocaulon sphacelatum*, **Bidens bipinnata*, *Euphorbia biconvexa* sparse forbland; over *Aristida inaequiglumis*, *Themeda triandra*, *Aristida contorta* tussock grassland.	

Taxon name	Growth form	Height (m)	Cover%
**Bidens bipinnata*	herb	0.3	0.1
Acacia aptaneura	tree	10	3
Acacia pachyacra	shrub	1.2	0.1
Alternanthera nana	herb	0.1	0.1
Aristida contorta	grass	0.2	2
Aristida holathera var. holathera	grass	0.2	0.1
Aristida inaequiglumis	grass	0.4	32
Boerhavia coccinea	herb	0.2	0.1
Cheilanthes sieberi subsp. sieberi	fern	0.2	0.1
Chrysopogon fallax	grass	0.5	0.1
Cucumis variabilis	Creeper	n/a	0.1
Digitaria ammophila	grass	0.2	0.1
Dysphania rhadinostachya subsp. Inflata	herb	0.1	0.1
Enneapogon polyphyllus	grass	0.4	0.1
Eremophila longifolia	shrub	1.2	0.1
Eulalia aurea	grass	0.4	0.1
Euphorbia biconvexa	herb	0.2	0.1
Goodenia prostrata	herb	0.01	0.1
Hakea lorea subsp. lorea	tree	3	2
Indigofera georgei	shrub	0.3	0.1
Lysiana murrayi	Mistletoe	n/a	0.1
Maireana villosa	shrub	0.3	0.1
Panicum decompositum	grass	0.5	0.1
Panicum decompositum	grass	0.1	0.1
Perotis rara	grass	0.1	0.1
Pterocaulon sphacelatum	herb	0.5	2

Ptilotus clementii	grass	0.3	0.1
Ptilotus obovatus	grass	0.5	0.1
Sida platycalyx	shrub	0.4	0.1
Sida sp. ? L (A.M. Ashby 4202)	shrub	0.4	0.1
Sida sp. ? L (A.M. Ashby 4202)	shrub	0.2	0.1
Teucrium teucriiflorum	shrub	0.4	0.1
Themeda triandra	grass	0.5	32
Themeda triandra	grass	0.5	0.1

Site	Q23	Site photo
Date	16/05/21	 Flora_Quadrat/PhotoP5160048
Vegetation type	D – Mulga, Hakea lorea, and Eucalyptus xerothermica low open woodland over closed tussock grassland on flat clay plain (no rocks)	
Landform	Almost indiscernible	
Slope	Clay, Red brown	
Soil	-	
Rock type	-	
Rock size	-	
Rock cover	95%	
Vegetation cover	Good	
Condition	Fire deaths of 25% of shrubs >2m	
Disturbances	685632	
Easting (MGA94 Zone 51)	7466984	
Northing (MGA94 Zone 51)	Plain	
Vegetation description	*Acacia aptaneura*, *Hakea lora* subsp. *lorea*, *Eucalyptus xerothermica* low open woodland; over isolated shrubs; over isolated low shrubs; over isolated dwarf shrubs; over *Trichodesma zeylanicum* var. *zeylanicum*, *Arivela viscosa*, *Pterocaulon sphacelatum* isolated forbs; over *Themeda triandra*, *Aristida inaequiglumis*, *Aristida contorta* closed tussock grassland.	

Taxon name	Growth form	Height (m)	Cover%
Abutilon otocarpum	shrub	0.5	0.1
Acacia aptaneura	tree	7	6
Acacia tenuissima	shrub	1.2	0.1
Alternanthera nana	herb	0.2	0.1
Aristida contorta	grass	0.4	2
Aristida inaequiglumis	grass	0.6	5
Aristida lazaridis	grass	0.5	0.1
Arivela viscosa	herb	1	0.1
Chrysocephalum gilesii	herb	0.3	0.1
Chrysopogon fallax	grass	0.7	0.1
Cucumis variabilis	creeper	n/a	0.1
Digitaria ammophila	grass	0.5	0.1
Duperreya commixta	Creeper	n/a	0.1
Dysphania kalpari	herb	0.2	0.1
Eremophila lanceolata	shrub	0.5	0.1
Eucalyptus xerothermica	tree	8	1
Eulalia aurea	grass	0.9	0.1
Evolvulus alsinoides var. villosicalyx	herb	0.1	0.1
Hakea lorea subsp. lorea	tree	4	2
Panicum decompositum	grass	0.6	0.1
Pterocaulon sphacelatum	herb	0.4	0.1
Ptilotus obovatus	grass	0.5	0.1
Sida platycalyx	shrub	0.5	0.1
Sida sp. ? L (A.M. Ashby 4202)	shrub	0.3	0.1
Stemodia grossa	herb	0.2	0.1

Themeda triandra	grass	0.6	85
Trichodesma zeylanicum var. zeylanicum	herb	1.5	0.1
Triodia melvillei	grass	0.5	0.1

Site	Q24	Site photo
Date	16/05/21	 Flora_Quadrat/PhotoP5160049
Vegetation type	D – Mulga, Hakea lorea, and Eucalyptus xerothermica low open woodland over closed tussock grassland on flat clay plain (no rocks)	
Landform	Plain	
Slope	Almost indiscernible	
Soil	Clay, Red brown	
Rock type	-	
Rock size	-	
Rock cover	-	
Vegetation cover	98%	
Condition	Good	
Disturbances	Fire deaths of 90% of shrubs _ trees >2m, Acacia regrowth <2m	
Easting (MGA94 Zone 51)	685593	
Northing (MGA94 Zone 51)	7467197	
Vegetation description	*Eucalyptus xerothermica* isolated low trees; over *Acacia dictyophleba*, *A. pachyacra*, *Clerodendrum floribundum* isolated tall shrubs; over isolated shrubs; over isolated low shrubs; over isolated dwarf shrubs; over isolated forbs; over *Themeda triandra* and *Aristida inaequiglumis* closed tussock grassland.	

Taxon name	Growth form	Height (m)	Cover%
Abutilon fraseri	shrub	0.4	0.1
Abutilon otocarpum	shrub	0.1	0.1
Acacia dictyophleba	shrub	2.5	0.1
Acacia elachantha	shrub	1.5	0.1
Acacia pachyacra	shrub	2.5	0.1
Acacia pruinocarpa	shrub	0.4	0.1
Alternanthera nana	creeper	n/a	0.1
Aristida contorta	grass	0.2	0.1
Aristida inaequiglumis	grass	0.5	15
Aristida lazaridis	grass	0.3	0.1
Arivela viscosa	herb	0.8	0.1
Chrysopogon fallax	grass	0.8	0.1
Clerodendrum floribundum var. angustifolium	shrub	2.3	0.1
Cucumis variabilis	creeper	2	0.1
Digitaria ammophila	grass	0.2	0.1
Duperreya commixta	creeper	n/a	0.1
Enneapogon polyphyllus	grass	0.5	0.1
Eremophila longifolia	shrub	2	0.1
Eucalyptus xerothermica	tree/mallee	9	0.1
Eulalia aurea	grass	0.7	0.1
Evolvulus alsinoides var. villosicalyx	herb	0.2	0.1
Hibiscus burtonii	shrub	0.6	0.1
Jasminum didymum subsp. lineare	Creeper	n/a	0.1
Pterocaulon sphacelatum	herb	1.1	0.1
Ptilotus obovatus	grass	0.5	0.1

Sida sp. ? L (A.M. Ashby 4202)	shrub	1	0.1
Sida sp. ? L (A.M. Ashby 4202)	shrub	0.4	0.1
Themeda triandra	grass	0.6	80
Themeda triandra	grass	0.6	0.1
Trichodesma zeylanicum var. zeylanicum	herb	1.2	0.1

Site	Q26	Site photo
Date	16/05/21	 Flora_Quadrat/PhotoP5160042
Vegetation type	E - Low mulga woodland over sparse understorey on stony plain	
Landform	Plain	
Slope	Negligible	
Soil	Clay, Red brown	
Rock type	Quartzite	
Rock size	Up to 8cm	
Rock cover	90%	
Vegetation cover	25%	
Condition	Good	
Disturbances	Some? Fire deaths (Logs on ground).	
Easting (MGA94 Zone 51)	683979	
Northing (MGA94 Zone 51)	7468067	
Vegetation description	*Acacia aptaneura* low mulga woodland; over *Acacia pachyacra* and *A. ?sibirica* sparse shrubland; over isolated dwarf shrubs; over isolated ferns; over isolated forbs; over *Digitaria ammophila*, *Chrysopogon fallax*, *Aristida inaequiglumis* sparse tussock grassland.	

Taxon name	Growth form	Height (m)	Cover%
Abutilon otocarpum	shrub	0.3	0.1
Acacia ? sibirica	shrub	1.2	2
Acacia aptaneura	tree	4	20
Acacia pachyacra	shrub	1.2	5
Alternanthera nana	herb	0.2	0.1
Aristida contorta	grass	0.1	0.1
Aristida inaequiglumis	grass	0.3	0.1
Aristida obscura	grass	0.1	0.1
Cheilanthes sieberi subsp. sieberi	fern	0.2	0.1
Chrysopogon fallax	grass	0.4	0.1
Digitaria ammophila	grass	0.5	0.1
Digitaria brownii	grass	0.3	0.1
Duperreya commixta	Creeper	n/a	0.1
Enneapogon caerulescens	grass	0.3	0.1
Enneapogon polyphyllus	grass	0.3	0.1
Enneapogon lindleyanus	grass	0.2	0.1
Eragrostis cumingii	grass	0.1	0.1
Eriachne pulchella subsp. pulchella	grass	0.1	0.1
Evolvulus alsinoides var. villosicalyx	herb	0.2	0.1
Hibiscus burtonii	shrub	0.3	0.1
Indigofera georgei	shrub	0.3	0.1
Iseilema macratherum	grass	0.2	0.1
Iseilema macratherum	grass	0.1	0.1
Maireana villosa	shrub	0.2	0.1
Panicum decompositum	grass	0.2	0.1
Paraneurachne muelleri	grass	0.2	0.1
Perotis rara	grass	0.1	0.1

Polygala glaucifolia	herb	0.1	0.1
Polygala glaucifolia	herb	0.1	0.1
Ptilotus helipteroides	herb	0.3	0.1
Ptilotus obovatus	herb	0.2	0.1
Schizachyrium fragile	grass	0.1	0.1
Sida sp. ? L (A.M. Ashby 4202)	shrub	0.3	0.1
Sporobolus australasicus	herb	1.3	0.1
Tribulus astrocarpus	herb	0.1	0.1
Triodia melvillei	grass	0.3	0.1

Site	Q27	Site photo
Date	16/05/21	 Flora_Quadrat/PhotoP5160040
Vegetation type	D – Mulga, Hakea lorea, and Eucalyptus xerothermica low open woodland over closed tussock grassland on flat clay plain (no rocks)	
Landform	Plain, next to GNH	
Slope	Negligible	
Soil	Clay, Red brown	
Rock type	-	
Rock size	-	
Rock cover	-	
Vegetation cover	80%	
Condition	Good	
Disturbances	Fire has killed 50% of trees/shrubs >2m Fence through quadrat	
Easting (MGA94 Zone 51)	684446	
Northing (MGA94 Zone 51)	7467636	
Vegetation description	*Hakea lorea* subsp. *lorea* low open woodland; over isolated shrubs; over isolated dwarf shrubs; over *Pterocaulon sphacelatum*, *Abutilon otocarpum*, *Ptilotus obovatus* sparse forbland; over *Themeda triandra*, *Aristida contorta*, *Aristida inaequiglumis*, *Enneapogon polyphyllus* closed tussock grassland.	

Taxon name	Growth form	Height (m)	Cover%
**Bidens bipinnata*	herb	0.1	0.1
**Portulaca oleracea*	herb	0.1	0.1
**Stylosanthes hamata*	herb	0.2	0.1
Abutilon otocarpum	herb	0.4	0.1
Acacia aptaneura	shrub	2	0.1
Alternanthera nana	herb	0.3	0.1
Aristida contorta	grass	0.2	20
Aristida inaequiglumis	grass	0.4	10
Arivela viscosa	herb	0.5	0.1
Bulbostylis barbata	sedge	0.05	0.1
Cheilanthes sieberi subsp. sieberi	fern	0.3	0.1
Chrysopogon fallax	grass	0.3	0.1
Cucumis variabilis	Creeper	n/a	0.1
Dichanthium sericeum subsp. Humilius	grass	0.2	0.1
Duperreya commixta	Creeper	n/a	0.1
Dysphania glomulifera subsp. eremaea	herb	0.1	0.1
Enneapogon polyphyllus	grass	0.4	10
Eragrostis pergracilis	grass	0.1	0.1
Euphorbia aff. ferdinandi	herb	0.1	0.1
Euphorbia biconvexa	herb	0.1	0.1
Evolvulus alsinoides var. villosicalyx	herb	0.2	0.1
Goodenia nuda	herb	0.3	0.1
Goodenia prostrata	herb	0.01	0.1
Hakea lorea subsp. lorea	tree	5	2
Hibiscus coatesii	shrub	0.2	0.1

Iseilema macratherum	grass	0.3	0.1
Panicum decompositum	grass	0.1	0.1
Paspalidium rarum	grass	0.2	0.1
Perotis rara	grass	0.1	0.1
Pterocaulon sphacelatum	herb	0.5	0.1
Ptilotus exaltatus	herb	0.5	0.1
Ptilotus gaudichaudii	herb	0.4	0.1
Ptilotus helipteroides	herb	0.4	0.1
Ptilotus obovatus	herb	0.4	0.1
Senna notabilis	shrub	0.1	0.1
Sida sp. ? L (A.M. Ashby 4202)	shrub	0.3	0.1
Spermacoce brachystema	herb	0.2	0.1
Stenopetalum nutans	herb	0.3	0.1
Themeda triandra	grass	0.3	40

Site	R01	Site photo
Date	17/05/21	
Vegetation type	F - Triodia wiseana hummock grassland with emergent shrubs and low trees on gently sloping stony plain	
Landform	Gentle slope, foothills	
Slope	2°	
Soil	Clay, Red brown	
Rock type	Quartzite	
Rock size	<5cm	
Rock cover	80%	
Vegetation cover	40%	
Condition	Good	
Disturbances	Droppers, berms, rubbish from Hwy.	
Easting (MGA94 Zone 51)	685435	
Northing (MGA94 Zone 51)	7466834	
Vegetation description	*Corymbia hamersleyana* and *Corymbia deserticola* subsp. *deserticola* isolated low trees; over isolated tall shrubs; over *Acacia ancistrocarpa* and mixed *Acacia* spp. sparse shrubland; over isolated dwarf shrubs; over isolated forbs; over *Triodia wiseana* hummock grassland	

Taxon name	Growth form	Height (m)	Cover%
Acacia ? aneura	shrub	1.5	0.1
Acacia ancistrocarpa	shrub	2	2
Acacia atkinsiana	shrub	1.5	1
Acacia dictyophleba	shrub	1.3	0.1
Acacia marramamba	shrub	2	0.1
Acacia pyrifolia var. pyrifolia	shrub	2	0.1
Corymbia deserticola subsp. Deserticola	tree	3	0.1
Corymbia hamersleyana	tree	6	0.1
Hakea chordophylla	shrub	2.2	0.1
Ptilotus calostachyus	herb	1	0.1
Seringia velutina	shrub	0.2	0.1
Stackhousia sp. swollen gynophore (W.R. Barker 2041)	herb	0.2	0.1
Triodia wiseana	grass	0.5	40

Appendix VII Significance Assessment Criteria (Vegetation)

Score	Criteria
High	Supports threatened flora species/ threatened ecological community listed under the EPBC Act and/ or BC Act or supports a: unique or regionally significant population of Priority 1 or Priority 2 species; a unique or regionally significant priority ecological community or occurs in association with a major river or creek system.
Moderate	Supports a population of priority 1, priority 2 flora species or an unlisted species that is restricted and warrants listing/ priority ecological community or occurs in association with a major river or creek system or supports a unique/ unusual floral assemblage not recognised by DBCA as a PEC.
Low	Supports a population of priority 3 or priority 4 species / priority ecological community or occurs in association with a medium ephemeral river or creek system with sensitive obligate phreatophytic vegetation or supports a unique/ unusual floral assemblage or disturbance sensitive communities such as mulga on sheet flow, or occurs in association with a unique/ unusual landform or refugia such as gorges, high ranges, outcrops or seepage areas not common in the IBRA subregion
Very Low	Vegetation and landform is widespread/common and does not solely support priority 3 or priority 4 flora species. May contain, presumed facultative phreatophytic vegetation species not in association with a river or creek system typically in association with un-incised drainage lines and flood plains.
Negligible	Vegetation and landform is widespread/common and does not support priority flora species. May contain presumed facultative phreatophytic vegetation.

LEVEL 2 FLORA AND VEGETATION SURVEY

OF

LAMB CREEK PROJECT AREA

FOR

PROCESS MINERALS INTERNATIONAL

JUNE 2012

Revision	Date	Prepared by	Reviewed By	Approved by
Draft A	01/05/12	M Weerheim	J Gilovitz	
Draft B	14/06/2012	J Gilovitz	J Fielder	J Fielder
Draft C	7/08/2012	J Fielder	C Jackson	C Jackson
FINAL	09/08/2012	J Fielder and C Jackson	C Jackson	C Jackson

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Table of Contents

Tables

Figures

Plates

Appendices

EXECUTIVE SUMMARY

Process Minerals International (PMI) proposes to develop a small iron ore mine with associated haul roads and infrastructure at Lamb Creek. The Lamb Creek project area is located approximately 130 kilometres (km) north-west of Newman in the East Pilbara Region of Western Australia, and is accessed via the Great Northern Highway.

A Level 2 flora and vegetation survey was completed in the approximately 20 km^2 survey area, comprising a desktop search and a single-phase comprehensive field survey from 27 March to 1 April 2012 by a team of three botanists. 46 survey quadrats were established.

A total of 230 species, from 110 genera and 42 families, were recorded during the survey of the Lamb Creek area, from 414 specimens collected. Of those, 209 were collected within survey quadrats; the rest were collected opportunistically.

No species of Threatened Flora (Declared Rare Flora) pursuant to the Western Australian *Wildlife Conservation Act* 1950, and no species listed as Threatened pursuant to the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* were recorded in the project area.

Three species of Priority Flora listed by DEC were recorded during the survey, comprising one Priority 1 species (*Brachyscome* sp. Wanna Munna Flats (S. van Leeuwen 4662)) and two Priority 2 species (*Aristida calycina* var. *calycina* and *Aristida lazaridis*). These taxa were found only in the far south-west of the survey area in the vicinity of the intersection of the proposed access/haul roads with the Great Northern Highway.

Five species of introduced flora were recorded in the survey area: *Bidens bipinnata* (Bipinnate Beggartick), *Cenchrus ciliaris* (Buffel Grass), *Chloris virgata* (Feathertop Rhodes Grass), *Malvastrum americanum* (Spiked Malvastrum), and *Portulaca oleracea* (Purslane).

None of these taxa were listed as Declared Plants by the WA Department of Agriculture and Food pursuant to section 37 of the *Agricultural and Related Resources Protection Act 1976* (Western Australia). None of these taxa were listed as Weeds of National Significance by the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC 2012).

Vegetation mapping was conducted by statistical analysis using the software PATN combined with field observations of vegetation boundaries and visual classification of aerial photography. The most widespread vegetation type was *Eucalyptus gamophylla* woodland over hummock grassland which was estimated to cover approximately 46% of the survey area.

Six main vegetation communities were recognised and mapped following field observations and statistical analysis of the field data.

No Threatened or Priority Ecological Communities listed by the DEC were recorded.

1. INTRODUCTION

1.1. PROJECT BACKGROUND

Process Minerals International (PMI) proposes to develop a small iron ore mine with associated haul roads and infrastructure at Lamb Creek. The Lamb Creek project area is located approximately 130 kilometres (km) north of Newman in the East Pilbara Region of Western Australia, and is accessed via the Great Northern Highway.

An overview of the tenements in which the project is located is presented in Table 1. The project is currently in the design phase; hence alternative locations for elements such as the accommodation facility appear in several tenements.

Table 1 Tenements in which the project area is located

Tenement	**Project Elements** (as per April 2012)	**Size**
M47/1468	Mining area	1201 ha
L47/635	Bore field, accommodation facility, pipeline, power line, taking water.	82 ha
L47/636	Bore field, accommodation facility, pipeline, power line, taking water.	64 ha
L47/637	Bore field, pipeline, power line, road, taking water.	149 ha
L47/638	Bore field, pipeline, power line, road, taking water.	30 ha
L47/639	Bore field, pipeline, power line, road, taking water.	276 ha
L47/640	Bore field, pipeline, power line, road, taking water.	156 ha
L47/641	Bore field, pipeline, power line, road, truck parking bay, taking water.	42 ha
E47/1238	Exploration licence including M47/1468	44 blocks
E47/1239	Pending: Currently held by Rio Tinto	64 blocks
Source: Tengraph and Mineral Titles Online (Department of Mines and Petroleum 2012)		

1.2. SCOPE AND OBJECTIVES OF THE SURVEY

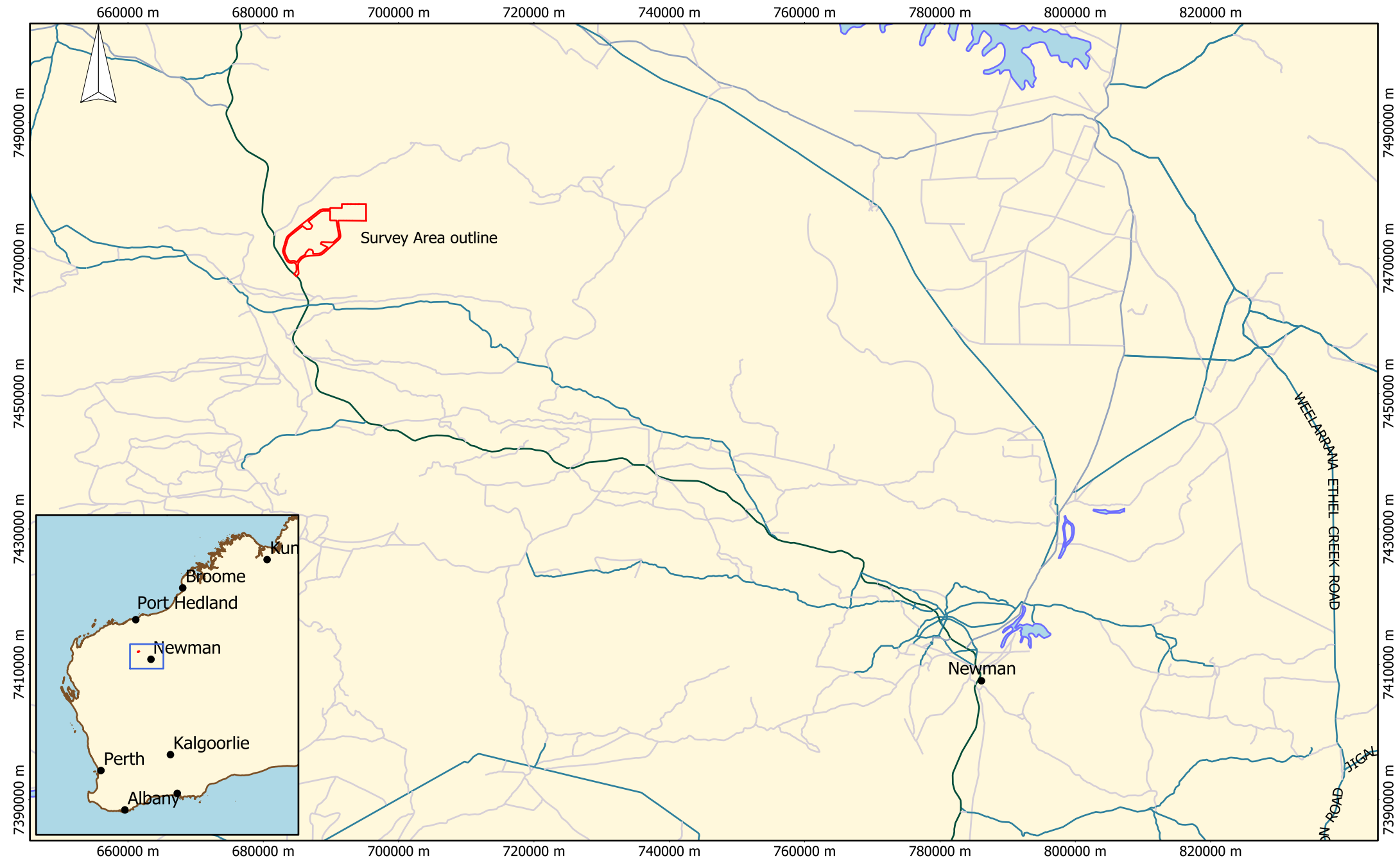
As part of the environmental approvals process, Rapallo conducted a single phase Level 2 flora and vegetation survey of the proposed Lamb Creek iron ore mine, two alternative haul road routes (120 metre buffer either side) and three alternative accommodation village sites. For the purpose of this report this area will hereafter be referred to as the "survey area" (Figure 1). The area surveyed comprised approximately 20 km^2, although the actual project footprint will be smaller.

The aims of the survey were to:

- characterise the flora and vegetation within the survey area;
- identify and map the vegetation communities;
- identify and map all Threatened and Priority Flora Species.

This information will be used to assist with environmental assessment of the project and, and to guide environmental management plans.

The flora and vegetation survey was designed according to Environmental Protection Authority (EPA) *Guidance Statement No. 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (2004). This guidance indicates that a project in the Pilbara region with an impact greater than 50 ha requires a Level 2 flora and vegetation survey.



Rapallo

Original Size: A4 Scale: 1:700,000
Datum: MGA94
0 30 km

Process Minerals International

Figure 1

Location of the Survey Area

1.3. LEGISLATION AND SURVEY GUIDANCE

1.3.1. COMMONWEALTH LEGISLATION AND CONSERVATION CATEGORIES

Native flora and ecological communities are protected at a federal level under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, defined as matters of national environmental significance. Under the EPBC Act, actions that have, or are likely to have, a significant impact on a matter of national environmental significance need to be referred to the Australian Government Minister for Sustainability, Environment, Water, Population and Communities (SEWPaC) for assessment and approval.

The EPBC Act protects Australia's native species and ecological communities by providing for identification and listing of threatened species and ecological communities. The conservation status of native species and communities is assessed by the Commonwealth Threatened Species Scientific Committee criteria outlined in the *EPBC Act 1999* and the *Environment Protection and Biodiversity Conservation Regulations 2000*.

The following categories of threatened flora are recognised: Extinct (EX), Critically Endangered (CR), Endangered (EN) and Vulnerable (VU).

Ecological communities are unique and naturally occurring groups of plants and animals. Their presence can be determined by factors such as soil type, position in the landscape, climate and water availability. The following categories of Threatened Ecological Communities are recognised: Critically Endangered (CR), Endangered (EN), and Vulnerable (VU).

1.3.2. WESTERN AUSTRALIAN LEGISLATION AND CONSERVATION CATEGORIES

At a state level, native flora and vegetation communities are protected under the *Wildlife Conservation Act 1950*, the *Western Australian Environmental Protection Act 1986* and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*.

Threatened and Priority Flora

All native vegetation in Western Australia is protected under the *Environmental Protection Act 1986* and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*. Under the Act and Regulations, clearing of native vegetation is prohibited unless a clearing permit is granted or the clearing is for a purpose defined under Regulation 5 as an exempt activity.

Flora that are threatened, rare or otherwise in need of protection, are protected under the *Wildlife Conservation Act 1950*. Threatened (Declared Rare) Flora species are listed under Schedule 1. Extinct flora are listed under Schedule 2. The species listed under Schedules 1 and 2 are published in the WA Government Gazette *Wildlife Conservation (Rare Flora) Notices*, the most recent dated 17 February 2012 (Western Australian Government 2012).

Threatened (Declared Rare) Flora listed on Schedule 1 are further ranked by the Department of Environment and Conservation (DEC) according to their level of threat using IUCN Red List criteria. The following categories of threatened flora are recognised: Critically Endangered (CR), Endangered (EN) and Vulnerable (VU).

The DEC also recognises Priority Flora, comprising taxa that have not yet been adequately surveyed to be listed as Threatened, but for which the DEC believes there is cause for concern. Priority flora listings can be found on the FloraBase website (Western Australian Herbarium 2012). Priority flora species recognised as having conservation significance and are given consideration when developments are

proposed within their distributions and known habitats. There are 5 levels of Priority flora: Priorities 1, 2 or 3 (not yet adequately surveyed), Priority 4 (rare, near threatened or in need of monitoring), and Priority 5 (conservation dependent) (Appendix 1).

Environmentally Sensitive Areas

Environmentally sensitive areas (ESAs) are protected under the *Environmental Protection (Clearing of Native Vegetation) Regulation 2004* and are listed for their environmental values at state or national levels. ESAs in Western Australia are listed in the *Environmental Protection (Environmentally Sensitive Areas) Notice 2005*. (Western Australian Government 2005). These include:

- Declared World Heritage property sites
- Bush Forever sites
- Defined wetlands and riparian vegetation within 50 metres of the wetland
- Area of vegetation within 50 metres of Declared Rare Flora
- Areas covered by Threatened Ecological Communities

Exemptions offered for clearing under Regulation 5 of the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* do not apply within an ESA.

Threatened and Priority Ecological Communities

An Ecological Community is defined by the DEC as a naturally occurring biological assemblage that occurs in a particular type of habitat. In Western Australia there is currently no legislation covering the conservation of Threatened Ecological Communities (TEC). However, TEC are indirectly protected under the *Environmental Protection Act 1986* and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* through protection of individual flora species. Under the Regulations TEC are defined as Environmentally Sensitive Areas, and therefore the exemptions from requiring a clearing permit do not apply in a TEC.

The DEC (2010) defines a Threatened Ecological Community as one that fits into one of the following categories: Presumed Totally Destroyed (PD), Critically Endangered (CR), Endangered (EN) and Vulnerable (VU).

Ecological communities that do not meet TEC criteria are listed on the Priority Ecological Community (PEC) list. Priorities 1, 2 and 3 are communities that are possibly threatened but not yet adequately surveyed. Priority 4 comprised communities that are in need of monitoring, and Priority 5 are communities that are conservation dependent (DEC 2010, 2012b).

1.3.3. National and Western Australian Weed Strategies

Invasive weeds are a serious threat to Australia's natural environment and can have major economic and social impacts, causing damage to natural landscapes, agricultural lands, waterways and coastal areas. A weed can either be an exotic (introduced) species, or a native species that colonises and ecosystem where it does not naturally occur (Commonwealth of Australia 2012a).

Federal Weeds of National Interest

The Federal government departments responsible for weed issues are SEWPaC and the Department of Agriculture, Fisheries and Forestry (DAFF). Weeds of national interest are published on one of several lists, with the nature of weeds and the national actions required determining on which list a species appears. The Federal lists are:

- Weeds of National Significance (WONS) – Published in the *Australian Weeds Strategy* (Commonwealth of Australia 2007) these 20 weeds are considered to be Australia's most significant environmental weeds;
- The National Environmental Alert List – 28 plant species in the early stages of establishment, which have the potential to become a significant threat to biodiversity if they are not managed;
- Sleeper weeds – Exotic plants that currently have established small populations but which have the potential to spread widely and affect agricultural or natural environments;
- Species targeted for national eradication under the Natural Resource Management Ministerial Council's National Cost-sharing Eradication Programme;
- Species targeted for biological control.

Western Australian Declared and Environmental Weeds

In addition to the weeds of national interest, state and territory governments have their own lists of noxious weeds. In Western Australia, the principal legislation pertaining to weeds is the *Agriculture and Related Resources Protection Act 1976* (ARRPA).

The Department of Agriculture and Food has published a list of *Declared Plants* under the ARRPA (DAFWA 2011). There are five categories of declared plants defined under the ARRPA with the following management actions and aims associated with them:

Priority 1 – Prohibiting movement of plants and/or their seeds through the prevention of trade, sale or movement of plants into the State or that area of the State;

Priority 2 – Eradication of plants from the State or that area of the State;

Priority 3 – Controlling infestations by reducing area and/or density of infestation from the State or that area of the State;

Priority 4 – Preventing infestations spreading beyond existing boundaries of infestation; and

Priority 5 – Infestations must be controlled on public land or land under the control of a local government.

The DEC (previously Department of Conservation and Land Management, CALM) has published the *Environmental Weed Strategy for Western* Australia (CALM 1999). The strategy itself is still considered relevant but the *List of Environmental Weed Species of Actual and Potential Significance in WA* (Appendix 3 to the Strategy) is now out-dated (DEC 2012a).

More recently the DEC published a series of lists of Environmental Weeds in each of the DEC regions, based on workshops held between 2008 and 2010. These lists do not assign a single "priority" classification to each weed, but instead outline the relative threat in each region based on a number of criteria including their distribution, ecological impact and rate of dispersal. The DEC points out that at present these lists should be used as a guide only (DEC 2012a).

At the time of writing, FloraBase (WA Herbarium 2012) lists 1,358 taxa that may be considered weed species of actual or potential significance in Western Australia, of which 107 in the Pilbara region. These figures are subject to change as a result of ongoing changes to taxon nomenclature.

1.3.4. ENVIRONMENTAL PROTECTION AUTHORITY GUIDANCE

The Western Australian Environment Protection Authority (EPA) has produced a series of position statements and guidance statements to aid in assessing the environmental impacts of developments in Western Australia.

The following statements outline the minimum expectations of the EPA in regards to consideration of terrestrial flora and vegetation communities in an environmental impact assessment.

- *EPA Position Statement No. 2: Clearing of Native Vegetation, with Particular Reference to the Agricultural Area* (EPA 2000);
- *EPA Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002);
- *EPA Guidance Statement No. 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004).

Combined, these guidance and position statements provide general recommendations for consideration for planning environmental surveys, including the level of survey required, design and intensity factors, survey limitations and reporting criteria.

2. EXISTING ENVIRONMENT

2.1. BIOGEOGRAPHY

The survey area lies within the Hamersley (PIL3) subregion of the Pilbara Interim Biogeographic Regionalisation of Australia (IBRA) region (SEWPaC 2012a), covering the southern section of the Pilbara Craton (Kendrick 2002). The Hamersley subregion is a mountainous area of Proterozoic sedimentary ranges and plateaux, dissected by gorges of basalt, shale and dolerite (Kendrick 2002).

2.1.1. LAND SYSTEMS

The survey area traverses five different land systems within the Hamersley subregion, as described by Van Vreeswyk *et al*. (2004). These are:

- **Boolgeeda** – Stony lower slopes and stony plains and narrow drainage floors and channels, supporting hard and soft spinifex grasslands and mulga shrublands., level stony plains and narrow sub-parallel drainage floors, relief up to 20 m. Often occurs below hill systems such as Newman and Rocklea.
- **McKay** – Hills, ridges, plateaux remnants and minor breakaways of sedimentary and meta sedimentary rocks supporting hard spinifex grasslands; relief up to 100 m.
- **Newman** – Rugged high mountains, ridges and plateaux with near vertical escarpments of jaspilite, chert and shale, supporting hard spinifex grasslands; relief up to 400 m.
- **Platform** – Stony upper plains, dissected slopes and drainage floors, supporting hard spinifex grasslands. Erosional surfaces formed by partial dissection of the old tertiary surface. The gently inclined upper plains have extensive marginal dissection zones with gently inclined to steep slopes. Floors incised up to 30m with steep stable marginal slopes becoming wider downslope.
- **Wannamunna** – Hardpan plains and internal drainage tracts supporting mulga shrubland and woodlands, and occasionally eucalypt woodlands). Depositional surfaces, level hardpan wash plains subject to overland sheet flow. Broad internal drainage flats receiving run-on from adjacent hardpan surfaces; rare channelled tracts but moistly no organised through drainage; relief up to 5m.

The approximate area of each land system within the Pilbara region and within the survey area is presented in Table 2.

Table 2 Land systems of the survey area

Land System	Total area in Pilbara (km^2)	Area within survey area (km^2)	Percentage of total within survey area
Boolgeeda	7,748	11.58	0.15 %
McKay	4,202	0.44	0.01 %
Newman	14,580	2.77	0.02 %
Platform	1,570	1.98	0.12 %
Wannamunna	577	0.27	0.04 %

2.1.2. GEOLOGY

The survey area is located in the south-west corner of the Roy Hill 1:250,000 Geological Survey Sheet (SF50-12: Thorne & Tyler 1997). The geology of the survey area is generally defined by the assemblage of prehnite, pumpellyite, epidote, actinolite. Basement rocks comprise the early Proterozoic Brockman

Iron Formation and Weeli Wolli Formation. The Brockman Iron Formation consists of banded iron formation (BIF) and shale, while the Weeli Wolli formation consists of BIF separated by shale and siltstone bands, with younger dolerite sills that intersect the sedimentary sequence.

Regionally, the fresh basement rocks are typically overlain by weathered basement rocks which occur as lateritic and basal gravel and/or conglomerate deposits. These weathered deposits underlie early Tertiary Channel Iron Deposits (CID), which are the dominant economic-grade iron deposits in the region. The CID is typically overlain by younger alluvial and colluvial gravels and sediments (Thorne & Tyler 1997).

The survey geology comprises the following geological units (Thorne & Tyler 1997).

- **Brockman Iron Formation** (PLHB): banded iron-formation, chert, and pelite;
- **Quaternary Alluvium** (Qa): unconsolidated silt, sand, and gravel; in drainage channels and on adjacent floodplains;
- **Quaternary Alluvium and Colluvium** (Qw): red-brown sandy and clayey soil; on low slopes and sheetwash areas; and
- **Cainozoic Colluvium** (Czc): partly consolidated quartz and rock fragments in silt and sand matricx; old valley-fill deposits.

2.1.3. SOILS AND LANDFORMS

The survey area is located within the Fortescue botanical district of the Pilbara region (Beard 1990). This region is mountainous, with soils ranging from shallow, stony sandy loams along slopes, to cracking clays, stripped hardpans and calcareous loams along active waterways (Beard 1990).

The survey area is typical of the eastern Pilbara with rocky hills, small gorges, mostly seasonal watercourses and gravelly loam valleys. It is typified by hard red alkaline soils on plains, pediments and alluvial areas, while shallow, skeletal soils are common on ranges that rise to 1,250 m (Beard 1990). The southern part of eastern Pilbara region is characterised by earthy loams underlain by red-brown hardpan (Beard 1975; 1990).

The survey area has two distinct soil and landform assemblages. The majority of the potential haul road alignment and the edges of the mine tenement are characterised as landform unit Fa13. The central part of the mine tenement and small portion of the potential haul road alignment is characterised as landform unit Fb3. These are defined as follows (CSIRO Australia 2006–):

- **Fa13 –** Ranges of banded jaspilite and chert along with shales, dolomites, and iron ore formations with some areas of ferruginous duricrust as well as occasional narrow winding valley plains and steeply dissected pediments. This unit is largely associated with the Hamersley and Ophthalmia Ranges. The soils are frequently stony and shallow and there are extensive areas without soil cover: chief soils are shallow stony earthy loams (Um5.51) along with some (Uc5.11) soils on the steeper slopes. Associated are (Dr2.33, Dr2.32) soils on the limited areas of dissected pediments, while (Um5.52) and (Uf6.71) soils occur on the valley plains; and
- **Fb3** – High-level valley plains set in extensive areas of unit Fa13. There are extensive areas of pisolitic limonite deposits: principal soils are deep earthy loams (Um5.52) along with small areas of (Gn2.12) soils.

2.1.4. HYDROLOGY

Regional stream flow in the Pilbara is ephemeral, related to intense rainfall from with cyclonic activity or localised thunderstorms. Stream flow decays rapidly once rainfall has ceased. The drainage system upstream of the Fortescue Marsh has negligible base flow with stream flow and water table recharge following rainfall events (Van Vreeswyk *et al*. 2004).

The proposed mining area (tenement M47/1468) contains four minor non-perennial (type 2) watercourses. The southern proposed haul route option (L47/638, L47/639, L47/641) and two prospective accommodation areas (L47/635, L47/636) are crossed by eight minor non-perennial watercourses. Seven non-perennial watercourses cross the northern proposed haul road option (L47/637, L47/640) and the northern prospective accommodation area (E47/1329). No major or perennial drainage lines occur within or directly adjacent to the survey area (Commonwealth of Australia 2012b).

2.2. REGIONAL VEGETATION

The survey area is located in the Fortescue botanical district of the Pilbara region (Beard 1990), which forms part of the Eremaean Province. The Pilbara region receives a slightly higher than average rainfall than most of the Eremaean Province, due to the prevalence of cyclones off the coast, but this is not enough to modify the essentially desert appearance of the plant cover (Beard 1990).

The Fortescue district consists predominantly of tree and shrub steppe communities with *Eucalyptus* trees, *Acacia* shrubs and spinifex grasses including *Triodia pungens* and *T. wiseana* (Beard 1975). Mulga (*Acacia aneura*) occurs in valleys and short-grass plains may be present on alluvial soils (Beard 1990).

Vegetation of the Hamersley (PIL3) IBRA subregion is generally low Mulga woodland over bunch grasses on fine textured soils in the valleys with snappy gums (*Eucalyptus leucophloia*) over *Triodia brizoides* on skeletal soils of the ranges (Kendrick 2002). The mountain tops and gorges of the Hamersley subregion provide refugia for humidophile and/or fire intolerant flora, and support a diversity of range-restricted species (Kendrick 2002).

Beard (1975) mapped the area of the flora survey as Hamersley 82: hummock-grass (*Triodia wiseana*) steppe with irregularly scattered *Eucalyptus brevifolia* trees; and Hamersley 18: Low woodland of *Acacia aneura*.

Table 3 Beard (1975) vegetation areas of the Lamb Creek survey area

Beard (1970) vegetation type	Total area in WA (km^2)*	Area within survey area (km^2)	Percentage of total within survey area*
Hamersley 82	246,591.1	8.67	0.0035 %
Hamersley 18	29,209.1	12.01	0.0411 %

*Note: areas of vegetation types are taken from Shepherd *et al.* (2001). This document is now over ten years old, and significant vegetation clearing has taken place in the Pilbara region in the time since its publication. Area values given should be considered optimistic estimates rather than actual areas.

2.3. CLIMATE

The Pilbara region of Western Australia experiences an arid tropical climate with most rain falling during the hot summers between January and March (Beard 1990). Rainfall occurs in sporadic heavy rainfall events that occur during or immediately following cyclones. Cyclones develop off the north-west coast and often cross the coastline between Karratha and Port Hedland and move inland over the Fortescue Valley system towards Newman.

The closest Bureau of Meteorology (BOM) weather station to the survey area is at Newman Airport (station number 007176), located 130 km south-east of the survey area. This weather station has been recording rainfall data since 1971 and temperature data since 1996.

Data recorded at Newman Airport (Figure 2) shows a mean annual rainfall of 313.2 millimetres (mm). Mean monthly rainfall is highest in February at 77.3 mm, and lowest in September at 4.5 mm. The hottest month is January with a mean maximum temperature of 39.2°C and a mean minimum temperature of 23.9°C. The annual wind records from 9am and 3pm show a dominant easterly throughout the day, with the strongest winds recorded in the morning of up to 30 km/hour (BOM 2012).

Evaporation rates are not recorded at the Newman Airport Weather Station. However, evaporation in the Central Pilbara Region is estimated to be between 2000 mm and 3500 mm per annum, which is approximately ten times greater than annual rainfall (Gardiner 2003). This disparity maintains a typically arid landscape, with the exception of areas located in proximity to river systems and shallow groundwater resources.

The flora and vegetation survey of the survey area took place from 27 March to 1 April 2012. Rainfall in the three months preceding the survey was higher than average for the region, with a total of 307.8 mm recorded for the months of January to March 2012 combined, of which 239.4 was recorded in January 2012. Temperatures during the survey were generally warm during the day, ranging from 33.8 °C to 36.8 °C during the day, and mild at night, ranging from 22.1 °C to 25.2 °C (BOM 2012).

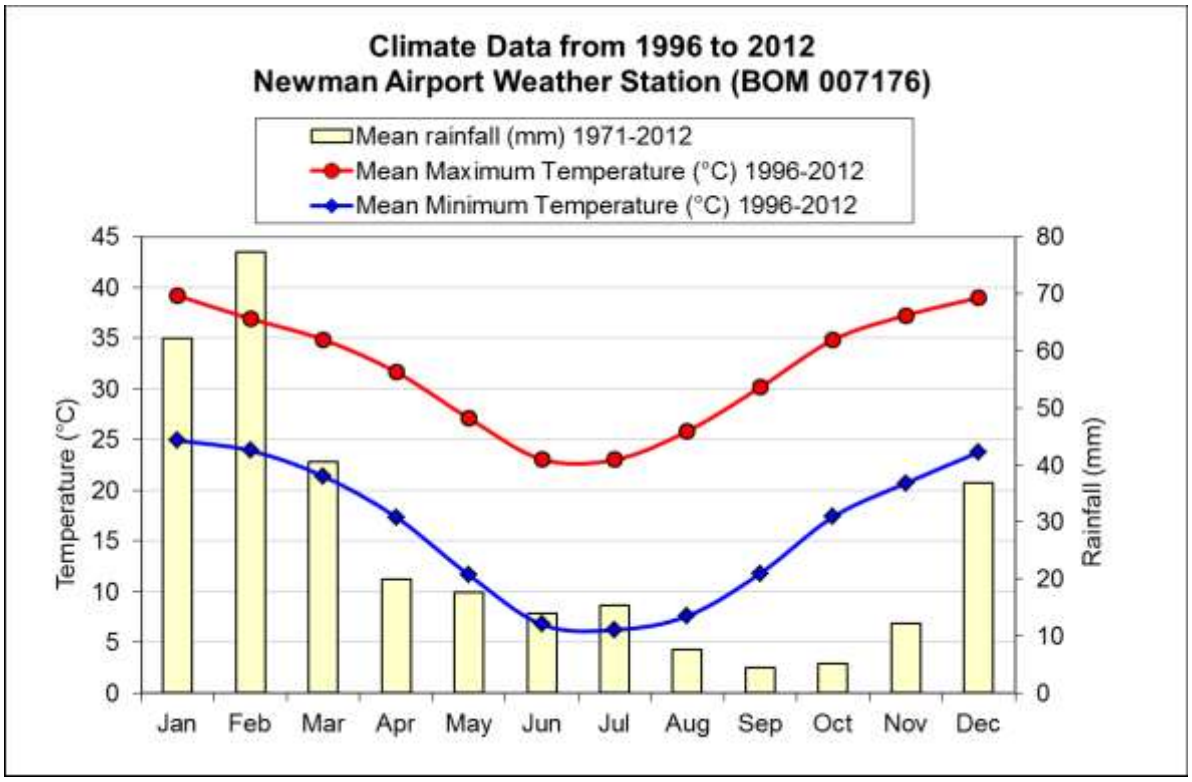


Figure 2 Newman Airport Weather Station – Average temperatures and rainfall

2.4. RESERVES AND ENVIRONMENTALLY SENSITIVE AREAS

Environmentally Sensitive Areas

The survey area is not situated within an ESA as defined under the Environmental Protection (Environmentally Sensitive Areas) Notice 2005 (Western Australian Government 2005).

There are no ESAs within 5 km of the survey area. The nearest Nationally Important Wetland is the Fortescue Marshes, located 52 km north of the survey area (SEWPaC 2012c).

Conservation Reserves

The survey area does not occur within a conservation reserve. The nearest nature reserves to the survey area (within a 100 km radius) are listed below (SEWPaC 2012c).

- Karijini National Park (DEC) – 26 km west of the survey area;
- Mungaroona Range National Park (DEC) – 52 km north of the survey area.

Threatened and Priority Ecological Communities

The project area is not located within a known TEC or PEC. The nearest known PEC is the Coolibah-Lignum Flats vegetation community, with the edge of the buffer zone located 6 km south of the survey area (DEC Threatened and Priority Communities database, search reference 35-0212EC).

The Coolibah-Lignum Flats vegetation complex is described as: Woodland or forest of *Eucalyptus victrix* (coolibah) over thicket of *Muehlenbeckia florulenta* (lignum) on red clays in run-on zones. Associated species include *Eriachne benthamii*, *Themeda triandra*, *Aristida latifolia*, *Eulalia aurea* and *Acacia aneura* (DEC 2012b). A series of sub-types have been identified:

- Coolibah and mulga (*Acacia aneura*) woodland over lignum and tussock grasses on clay plains (Coondewanna Flats and Wanna Munna Flats) – Priority 3
- Coolibah woodlands over lignum (*Muehlenbeckia florulenta*) over swamp wandiree; Lake Robinson is the only known occurrence – Priority 1
- Coolibah woodland over lignum and silky browntop (*Eulalia aurea*); two occurrences known on Mt Bruce Flats – Priority 3

3. METHODS

A Level 2 flora and vegetation survey was completed in the survey area, comprising a desktop search and a single-phase comprehensive field survey. Throughout this report taxonomy and taxonomic nomenclature follows the Western Australian Herbarium FloraBase website (Western Australian Herbarium 2012).

3.1. DESKTOP SEARCH

A desktop search was completed in preparation for the field survey, in order to provide a local context for the survey results, and to identify flora species and vegetation communities of conservation significance in the vicinity of the project area. The desktop search included a database search and a review of publically accessible literature and relevant survey reports within 100 km of the project area.

The database search included a combined search of the DEC Threatened (Declared Rare) and Priority Flora database, the WA Herbarium Specimen database, and the DEC Threatened and Priority Flora List (DEC reference number 38-0212FL); the NatureMap online search tool (DEC 2012); and the Protected Matters online search tool (SEWPaC 2012c) (Table 4).

Following completion of the field survey and taxonomic identifications, a follow-up database search was requested from the DEC (search reference number 04-0512FL) to obtain full details of all populations of the Priority species recorded during the survey in order to calculate the potential conservation impact of the project on these species (Table 4).

Table 4 Database Searches

Database Name	Latitude	Longitude	Search Area
DEC Threatened and Priority Flora database WA Herbarium database DEC Threatened and Priority Flora Species List	Search area based on shapefile of project area		40 km buffer around shapefile boundary
NatureMap	22°50’18” S	118°50’17” E	40 km buffer around coordinates
SEWPaC Protected Matters	22°53’28” S 22°50’28” S 22°47’44” S 22°50’20” S	118°48’09” E 118°47’16” E 118°58’05” E 118°51’54” E	10 km buffer around coordinates
DEC Species Specific search	Search carried out by species, not location		

Published literature and reports reviewed for the desktop search are listed in Table 5.

Table 5 Reports Reviewed for Desktop Study

Report Title	Distance from project area
Astron (2010a). *West Pilbara Iron Ore Project Reconciliation of Vegetation Descriptions and Associated Vegetation Mapping*. Unpublished report for API Management Pty Ltd.	25–30 km north-west
Astron (2010b). *Area C to Yandi flora and vegetation survey*. Unpublished report for BHP Billiton.	14 km north to 15 km east
Astron (2012) *Iron Valley Project Flora and Vegetation Survey*. Unpublished report for URS Australia Pty Ltd on behalf of Iron Ore Holdings Ltd.	48 km east north-east

Report Title	Distance from project area
Biota (2004). *Vegetation and flora survey of the proposed FMG stage A rail corridor*. Unpublished report for Fortescue Metals Group.	40 km east to 100 km north (only sites <100 km included in review)
Biota (2010). *Vegetation and flora surveys of the Oxbow and Junction South West deposits near Yandicoogina*. Unpublished report for Rio Tinto Pty Ltd.	35 km east
ENV (2008). *Rapid Growth Project 5: Jimblebar Junction to Yandi Junction Railway Reserve, Flora and Vegetation Assessment Report*. Unpublished report for BHP Billiton.	15 km north to 150 km south-east (only sites <100 km included)
Mattiske (2005). *Flora and vegetation on the Cloudbreak and White King leases*. Unpublished report prepared for Fortescue Metals Group Ltd.	85 km north-east
Mattiske (2008a). *Flora and Vegetation Survey of Exploration Tenement E47/1237 Phil's Creek Project area*. Unpublished report for URS Australia.	35 km east
Mattiske (2008b). *Flora and vegetation of the Hope Downs 4 mine infrastructure corridor*. Unpublished for Pilbara Iron.	30 km south-east
Rapallo (2012). *Level 2 flora and vegetation survey of Phil's Creek Haul Road*. Unpublished report for Process Minerals International.	30–45 km north-east

3.2. FIELD SURVEY

A single-phase Level 2 flora and vegetation survey was completed in the survey area from 27 March to 1 April 2012. The timing of the survey in autumn, following a period of significant rainfall or the region (section 2.3) is considered an appropriate time for conducting flora surveys in the Pilbara bioregion (EPA 2004). This is the time when the majority of plant species are flowering, fruiting and have foliage that allows identification, and provides the best opportunities for recording ephemeral or cryptic species.

The survey was completed by a team of three suitably qualified and experienced botanists. Geographic information system (GIS) data and aerial photography were used to demark the project area and to identify potential areas of interest. Survey areas were accessed by helicopter and were surveyed on foot.

The survey activities included:

- Flora quadrat surveys;
- Vegetation mapping;
- Opportunistic flora collections.

All specimens collected in the field were identified at the Western Australian Herbarium by Rapallo botanists, assisted by expert taxonomists where required (Table 7). Taxonomic identifications were completed using specialist texts, floral identification keys and comparisons with reference specimens held at the Western Australian Herbarium.

Specimens of conservation significant species, species found outside their normal range and other species of interest were lodged with the Western Australian Herbarium.

3.2.1. FLORA QUADRATS

Quadrat surveys involved a detailed and comprehensive search of a 50 by 50 m quadrat. Within each quadrat all flora taxa were recorded and specimens were collected of each species or subspecies when they were first encountered during the survey. Hence, specimens were collected for all taxa recorded in

the first quadrat, while specimen collection from subsequent quadrats only comprised taxa that had not been collected from previous quadrats unless considered possible to be different taxa. All species were thus collected at least once.

The following data were recorded for each quadrat:

- Location coordinates and elevation (on Garmin GPS units (MGA50, GDA94) and datasheet);
- Botanist name and Date – The name of the botanist involved in sampling the quadrat and the survey date;
- Species – all vascular plant species present, including introduced species were recorded;
- Percentage Foliar Cover – the percentage cover was estimated for each species within the quadrat;
- Height – the maximum height of each taxon was recorded;
- Soil and geology description including soil colour and type, and rock percentage cover, type, and size;
- Terrain and topography description;
- Vegetation condition - assessed in accordance to the Vegetation Condition Classification of Keighery 1994 – Appendix II);
- Vegetation Description - vegetation was described according to Aplin's (1979) modification of the vegetation classification system of Specht (1970) and the National Vegetation Invenotry System, Level 5 (Department of Environment and Heritage 2003 (Appendix V);
- Digital photographs of the quadrats were taken from different directions;

A total 46 of flora quadrats were established during the survey, with sites located in each of the five land systems within the project area. The number of sites (quadrats) per land system are listed in (Table 6) below and mapped in **Error! Reference source not found.**.

Table 6 Survey site established in each land system in the Lamb Creek survey area

Land system	Number of sites	Site names
Boolgeeda	14	LCF10, LCF11, LCF12, LCF14, LCF15, LCF21, LCF24, LCF26, LCF27, LCF35, LCF39, LCF40, LCF41, LCF42, LCF52
McKay	18	LCF05, LCF06, LCF16, LCF17, LCF18, LCF19, LCF20, LCF22, LCF23, LCF25, LCF28, LCF29, LCF30, LCF31, LCF32, LCF36, LCF37, LCF38
Newman	3	LCF01, LCF02, LCF43, LCF46
Platform	5	LCF03, LCF04, LCF07, LCF08, LCF09, LCF45
Wannamunna	2	LCF33, LCF34, LCF51

3.2.2. VEGETATION MAPPING

The boundaries of vegetation communities were established by ground-truthing the imagery of aerial photographs. Transition boundaries of vegetation communities were recorded manually on an aerial photograph of the project area, and waypointed with a GPS. Vegetation classification was carried out using the statistical analysis program PATN (Belbin 1989). Digital maps of vegetation communities were produced by Rapallo in a geographic information system (GIS) program using the results of the PATN analysis as a guide, with field-collected data serving to clarify and interpret the PATN results where required.

3.2.3. OPPORTUNISTIC FLORA COLLECTIONS

Opportunistic flora collections were made while traversing the project area between survey quadrats and during vegetation mapping. Opportunistic collections provide a valuable complement to the other collections and survey data, as they may be used to improve the botanical knowledge of the area.

Specimens were collected of all species that had not been recorded during the quadrat surveys. For each opportunistic collection, the following data were recorded: GPS location, density or numbers at location, growth form, and height of the plant. Digital photographs were taken where necessary for identification purposes and whenever a species was thought to be a conservation significant taxon.

3.3. STATISTICAL ANALYSIS

3.3.1. PATN ANALYSES

Survey sites were grouped into clusters of similar vegetation communities, based on the presence and density of the taxa recorded, by using the software program PATN v3.12 (Belbin 1989).

Analysis was done using Bray and Curtis association, a flexible UPGMA classification with a beta of -0.1, and seven final groups. Ordination was done using the default settings.

Kruskal-Wallis statistics were used to identify the taxa that were producing the most statistical noise; these taxa were then removed from the analysis. This process was repeated until the ordination stress values produced by the analysis were considered sufficiently low (ideally below 0.15). The Kruskal-Wallis values were then used to determine which species contributed most strongly to each vegetation group in order to describe the vegetation types.

3.3.2. ESTIMATES

The software program EstimateS (Windows Version 8.20) (Colwell 2006) was used to estimate survey completeness by generating species accumulation curves, and by calculating predicted total species richness. Analyses were conducted on presence-absence data from flora survey quadrats (46 quadrats, 214 taxa), using the default settings, with the following exceptions:

- Accumulations (runs) were randomised 10,000 times without replacement;
- Upper abundance limit for rare or infrequent species was set to 5;

The species accumulation curve was plotted as the number of species recorded (y-axis) against the number of flora quadrats surveyed (x-axis). Predicted species richness was calculated by taking the average of the estimators Jacknife 1, Jacknife 2 and Bootstrap.

Predicted species richness was compared with observed species richness, comprising all species recorded from quadrats (214 taxa), and with observed species richness comprising total number of species recorded during the survey, including opportunistic records (223 taxa).

3.4. SURVEY PERSONNEL AND LICENSING

The following people were involved with the survey and the preparation of this report:

Table 7 Personnel involved in the survey

Staff	Role	Flora License
Linda Dalgliesh	Botanist for Rapallo Environmental	SL009472
Joshua Gilovitz	Botanist for Rapallo Environmental	SL009605
Marieke Weerheim	Environmental Scientist for Rapallo Environmental	SL009964
Dr Eleanor Bennett	Taxonomist for Bennett Environmental Consulting	n/a
Sharnya Thompson	Consultant Taxonomist	n/a

Collection of specimens for the flora and vegetation survey was licensed under the Western Australian *Wildlife Conservation Act 1950* "Licence to take Flora for Scientific or Other Prescribed Purposes". As part of the license requirements, a copy of this report will be forwarded to the DEC.

3.5. SURVEY LIMITATIONS

The potential limitations of the survey, as outlined in EPA *Guidance Statement No. 51* (2004) are discussed in Table 8.

Table 8 Potential limitations and discussion of their relevance to the survey

Potential Limitation	Discussion
Sources of information and availability of contextual information (i.e. pre-existing background vs. new material)	Government database records were obtained for the area, although some of the species recorded in the field were not present in those data. Multiple similar flora surveys exist for surrounding areas, including one completed by Rapallo.
Scope (i.e. what life forms, etc., were sampled).	All vascular plant species were recorded when found in survey quadrats or encountered while traversing the area on foot.
Proportion of flora collected and identified (based on sampling, timing and intensity).	Statistical analysis shows that 86% of the predicted species richness was recorded during the survey, with a near-asymptotic species accumulation curve (Section 4.2.1). Specimen quality was high: of the 414 specimens collected, 96.4% could be identified to species or infraspecific level.
Completeness and further work which might be needed (e.g. was the relevant area fully surveyed).	The survey area is considered well sampled, with the exception of two areas within the main mining area that were poorly sampled. These areas are considered unlikely to contain different vegetation or species than those that were recorded throughout the rest of the survey area based on helicopter flyovers and satellite photographs.
Mapping reliability.	High quality satellite photographs of the area were available, and various other mapping resources (soils, geology, vegetation) were also available.
Timing, weather, season, cycle.	The survey was carried out in late March - early April, which is considered to be an appropriate time for the area. Rainfall was above average in the three months preceding the survey, and floristic diversity was high.

Potential Limitation	Discussion
Disturbances (fire, flood, accidental human intervention etc.).	The survey area occurs in an active pastoral lease, and some sites were noted as disturbed by cattle, as well as infrastructure associated with the pastoral lease and recent mineral exploration. Evidence of old (>5 years) fire was noted in some areas, however the majority of the survey area was relatively undisturbed and long unburnt.
Intensity (in retrospect, was the intensity adequate).	Statistical analysis demonstrates that survey intensity was adequate floristically; however more intensive sampling of some minor vegetation types may have resulted in more precise mapping.
Resources.	The field staff had adequate resources for the survey including reports of previous botanical surveys of the area, lists and information outlining all Declared Rare and Priority Flora, maps, GPS information supplied by the client, handheld GPS units, cameras, and the necessary equipment for botanical collection.
Experience levels (e.g. degree of expertise in plant identification to taxon level).	Herbarium identification was carried out by a combination of Rapallo staff and experienced external contractors (Eleanor Bennet and Sharnya Thomson). All specimen identifications were verified by a second botanist/taxonomist following initial identification.

4. RESULTS

4.1. DESKTOP SEARCH RESULTS

The combined review of databases, survey reports and published literature yielded a total of 68 taxa of conservation significant flora taxa previously recorded from within 100 km of the survey area. The majority of these (57 taxa) were recorded in the various databases, while an additional 11 taxa were recorded in previous surveys within 100 km of the survey area (Table 9).

Table 9 Number of conservation significant taxa recorded in databases and previous surveys

Conservation Status	Databases (within 40 km)	Survey reports (within 100 km)	Total taxa
Threatened (Declared Rare) Flora	2	1	2
Priority 1	11	2	11
Priority 2	14	3	15
Priority 3	26	12	34
Priority 4	4	5	6
Totals	**57**	**23**	**68**

Two species of Threatened (Declared Rare) flora were recorded within 40 km of the survey area. These were *Lepidium catapycnon* (Hamersley Lepidium) and *Thryptomene wittweri* (Mountain Thryptomene); both taxa are listed under the EPBC Act as Vulnerable, and listed under the Wildlife Conservation Act as Schedule 1 – rare or likely to become extinct.

In addition, 66 taxa listed by the DEC as Priority Flora were recorded in the desktop search; these comprised 11 Priority 1 species, 15 Priority 2 species, 34 Priority 3 species, and six Priority 4 species.

The complete list of conservation significant flora recorded in the desktop search is presented in Table 10. Please note that the DEC Threatened (Declared Rare) and Priority Flora database (TPFL) lists populations, and the WA Herbarium database (WAHerb) lists individual specimens. All other databases and reports listed in Table 10 represent presence or absence of a particular taxon within the search area.

Table 10 Desktop search results – Conservation significant flora taxa recorded within 100 km of the survey area

Taxon name and conservation status	Databases [1)]					Survey reports [2)]							
	TPFL	TPList	WAHerb	NatureMap	SEWPaC	A1	B1	B2	E	M1	M2	M3	R
Threatened (Declared Rare) Flora													
Lepidium catapycnon	17		1	1	1			1				1	
Thryptomene wittweri	2		4	1									
Priority 1													
Brachyscome sp. Wanna Munna Flats (S. van Leeuwen 4662)	1		2	1									
Brunonia sp. Long hairs (D.E. Symon 2440)			1	1									
Eragrostis sp. Mt Robinson (S. van Leeuwen 4109)	1		1	1									
Eremophila sp. West Angelas (S. van Leeuwen 4068)			1	1									
Eremophila spongiocarpa	1	1	1	1			1			1			
Grevillea sp. Turee (J. Bull & G. Hopkinson ONS JJ 01.01)				1									
Josephina sp. Marandoo (M.E. Trudgen 1554)	2	1	1	1			1						
Rhodanthe ascendens	1	1	1										
Tetratheca fordiana	1	1	1										
Teucrium pilbaranum		1	1	1									
Vittadinia sp. Coondewanna Flats (S. van Leeuwen 4684)			6	1									
Priority 2													
Adiantum capillus-veneris		1											
Aristida calycina var. *calycina*		1											
Aristida lazaridis		1											
Cladium procerum		1											
Eremophila forrestii subsp. Pingandy (M.E. Trudgen 2662)	1	1	3	1									
Euphorbia clementii	1			1									
Euphorbia sp. Mt Bruce flats (S. van Leeuwen 3861)		1											

Taxon name and conservation status	Databases [1]					Survey reports [2]							
	TPFL	TPList	WAHerb	NatureMap	SEWPaC	A1	B1	B2	E	M1	M2	M3	R
Indigofera ixocarpa		1											
Isotropis parviflora		1											
Oxalis sp. Pilbara (M.E. Trudgen 12725)		1	3	1									
Paspalidium retiglume							1						
Pilbara trudgenii	3		2	1									
Spartothamnella puberula	1	1	3	1									
Stylidium weeliwolli	1		4									1	
Vigna sp. Central (M.E. Trudgen 1626)		1				1							
Priority 3													
Abutilon trudgenii							1						
Acacia daweana	2	1	1										
Acacia effusa	4	1	2	1									
Acacia glaucocaesia						1							
Acacia subtiliformis	2	1	2	1									
Ampelopteris prolifera		1											
Atriplex flabelliformis		1											
Dampiera anonyma		1											
Dampiera metallorum	9	1	17	1									
Eremophila forrestii subsp. *viridis*												1	
Eremophila magnifica subsp. *velutina*	1		1										
Eriachne sp. Dampier Peninsula (K.F. Kenneally 5946)		1											
Euphorbia inappendiculata											1		
Euphorbia stevenii		1											
Fimbristylis sieberiana	1		1										
Glycine falcata	1	1	1	1									
Goodenia lyrata	3		2	1									

Taxon name and conservation status	Databases [1]					Survey reports [2]							
	TPFL	TPList	WAHerb	NatureMap	SEWPaC	A1	B1	B2	E	M1	M2	M3	R
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727)	4	1	3	1			1						
Indigofera gilesii subsp. *gilesii*	3	1	6	1									
Indigofera sp. Bungaroo Creek (S. van Leeuwen 4301)						1							
Iotasperma sessilifolium		1	1	1									
Nicotiana umbratica		1											
Oldenlandia sp. Hamersley Station (A.A. Mitchell PRP 1479)			2	1									
Olearia mucronata	2	1	1	1									
Owenia acidula						1							
Phyllanthus aridus		1											
Rhagodia sp. Hamersley (M Trudgen 17794)	3		3	1								1	1
Rostellularia adscendens var. *latifolia*			3	1					1	1			
Sida sp. Barlee Range (S. van Leeuwen 1642)			3	1									
Tecticornia medusa			1	1									
Terminalia supranitifolia						1							
Themeda sp. Hamersley Station (M.E. Trudgen 11431)		1	4	1			1			1			
Triodia sp. Mt Ella (M.E. Trudgen 12739)			7	1									
Triodia sp. Robe River (M.E. Trudgen et al. MET 12367)						1							
Priority 4													
Acacia bromilowiana	4	1	10	1		1							
Bulbostylis burbidgeae							1		1				
Eremophila magnifica subsp. *magnifica*			4	1									
Eremophila youngii subsp. *lepidota*										1		1	
Goodenia nuda	3		3	1		1		1	1				
Rhynchosia bungarensis			2	1		1							

Footnotes with Table 9

1) Databases: TPFL = DEC Threatened (Declared Rare) and Priority Flora database
TPList = DEC Threatened and Priority Flora List
WAHerb = Western Australian Herbarium Database
NatureMap = DEC Naturemap online search tool (DEC 2007–)
SEWPaC = Protected Matters online search tool (SEWPaC 2012c)

2) Survey reports: A1 = Astron (2010a)
A2 = Astron (2010b)
B1 = Biota (2004)
B2 = Biota (2010)
E = ENV (2008)
M1 = Mattiske (2005)
M2 = Mattiske (2008a)
M3 = Mattiske (2008b)
R = Rapallo (2012)

4.2. FIELD SURVEY RESULTS

4.2.1. FLORA TAXA RECORDED IN THE SURVEY

Summary Statistics

A total of 414 specimens were collected during the survey. Following taxonomic identification, these were found to represent 230 species or infraspecies. Of all specimens collected, 15 could not be identified to species level due to absence of suitable fruiting or flowering material. Specimens that could not be positively identified to species or subspecies level were only counted in the final species list if they were thought likely to represent a taxon that was not otherwise recorded. The total species list is presented in Appendix III.

The average number of flora taxa per survey quadrat was 25.83. This number is relatively high for surveys in the Pilbara area and was influenced by the presence of many annual / ephemeral species in at the sites, due to the survey being completed within three months following significant rainfall events, and also due to the presence of some extremely species-rich sites that increased the overall average.

Table 11 Summary statistics of taxa recorded in the survey area

Taxonomic level	Number of taxa	Most common taxa (number of species)
Family	42	Poaceae (41), Fabaceae (41), Malvaceae (26)
Genus	110	Acacia (23), Ptilotus (11), Senna (9)
Species	230	-

The average Keighery (1994) vegetation condition was 2.51 (excellent - very good). The most common disturbances observed were grazing by cattle, vehicle tracks and mineral exploration impact, and weeds.

Survey Completeness

The species richness estimators calculated with EstimateS indicate that 81% of the predicted number of flora taxa were recorded during the survey at Lamb Creek. This is reflected in the species accumulation curve, which approached an asymptote as the number of sites increased (Figure 3).

The predicted species richness was 264.9 based on the average of the estimators Jacknife 1, Jacknife 2 and Bootstrap, with observed species richness of 214 representing the number of species recorded from flora quadrats. Opportunistic flora collections made while walking between sites included another 16 species that had not been recorded in the quadrats. Hence, the total number of 230 flora species represents 86.8% of predicted species richness.

These figures suggest that increased survey effort, i.e. more flora quadrats, and/or more transects, may have produced a higher number of species recorded from the survey area. However, the fact that the accumulation curve reached a near-asymptote indicates that a large increase in the number of survey quadrats would have been required to reach a figure about 90% survey completeness. Furthermore, the fact that 93% of all taxa recorded during the survey were collected from the quadrat sites indicates that the sites were well placed within the survey area to sample all available vegetation types.

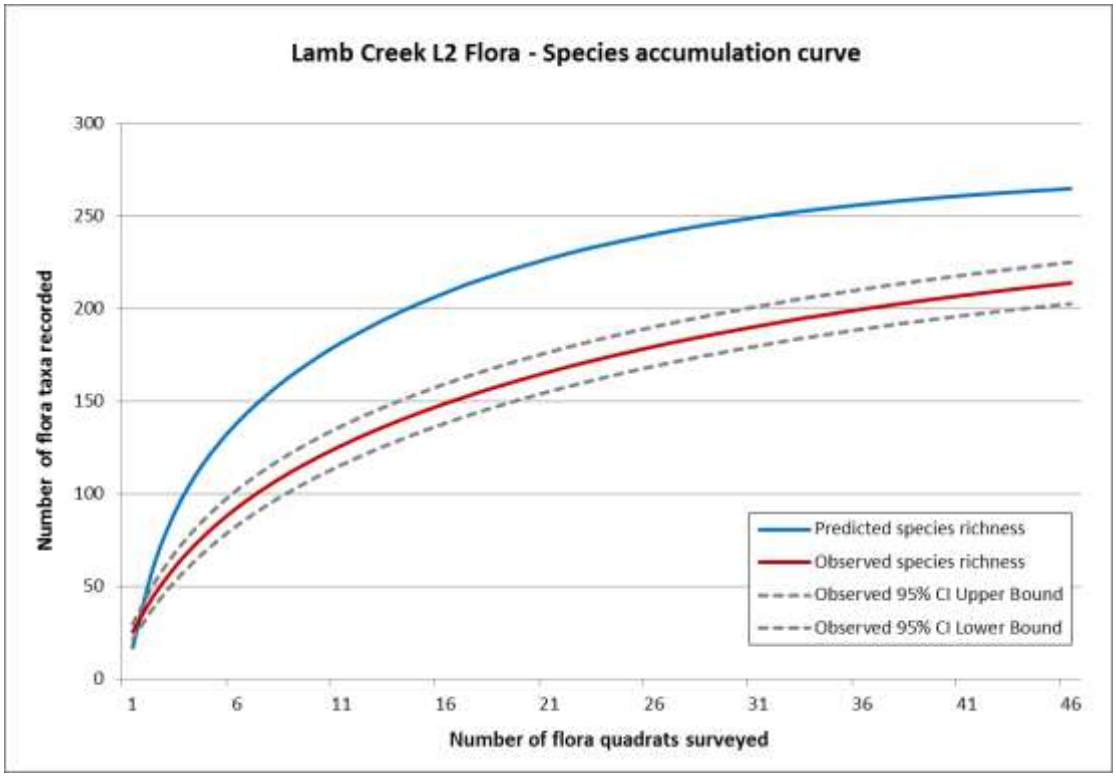


Figure 3 Species accumulation curve for the Lamb Creek L2 flora survey

4.2.2. CONSERVATION SIGNIFICANT TAXA

No species of Threatened Flora (Declared Rare Flora) pursuant to the Western Australian *Wildlife Conservation Act* 1950, and no species listed as Threatened pursuant to the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* were recorded in the survey area.

Three species of Priority Flora listed by DEC were recorded during the survey, comprising one Priority 1 species (*Brachyscome* sp. Wanna Munna Flats (S. van Leeuwen 4662)) and two Priority 2 species (*Aristida calycina* var. *calycina* and *Aristida lazaridis*). The locations of conservation significant flora taxa recorded in the survey area are presented in Figure 4; the coordinates of all these records are listed in Appendix IV.

Brachyscome sp. Wanna Munna Flats (S. van Leeuwen 4662) - Priority 1

This species is a small herb in the Asteraceae (daisy) family, with pink flowers and sharply divided leaves.

Brachyscome sp. Wanna Munna Flats (S. van Leeuwen 4662) was collected at LCF33, LCF51, and LCF34. Single plants or small numbers present at all sites. This species was recorded as occurring in small but consistent numbers throughout the area between these sites, at the far-western extent of the proposed haul road.

The species is known from ten collections in the WA Herbarium from an approximately 330 km wide south east - north west band, with the current survey area situated roughly in the centre. The nearest record is from 2006 and was 20km to the west of the collection made within the survey area. *Brachyscome* sp. Wanna Munna Flats (S. van Leeuwen 4662) is represented by two records in the TPFL database, which are both probably derived from WAHERB specimen records as they share dates and coordinates with WAHERB records.

A specimen of this species will be submitted to the WA Herbarium collection.

Aristida calycina var. *calycina* - Priority 2

Aristida calycina var. *calycina* is described as a loosely tufted perennial grass, 0.3-1.3 m high, with smooth lemma groove. It occurs on red earths, sands, and alluvial soils (Western Australian Herbarium 2012). Widespread throughout NSW and is present in several other Australian states (The Royal Botanic Gardens and Domain Trust 2012).

This species was collected at site LCF31, where only a single plant was recorded. The specimen did not match the description of the species exactly, however was very close to collection S. van Leeuwen PBS0466, and will be assumed to be *A. calycina* var. *calycina* for the purposes of this report.

This taxon is known in Western Australia from a single specimen at the Western Australian Herbarium (Sheet 04867599), and is not recorded in DEC's TPFL database. The existing WA Herbarium record was collected in 1996 and has coordinates placing it approximately 65 km away from our collection.

The specimen collected will be submitted to the Western Australian Herbarium collection.

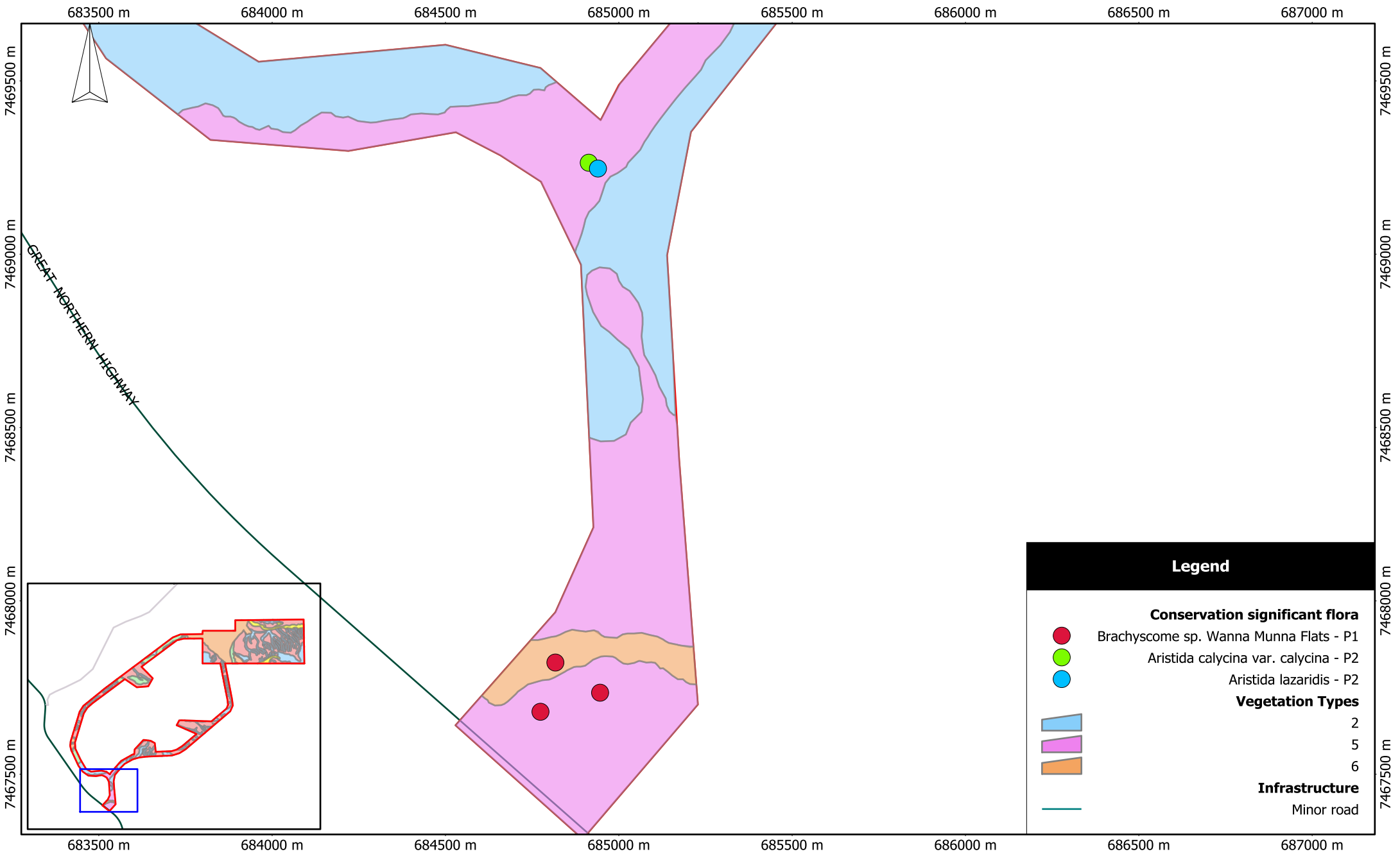
Aristida lazaridis - Priority 2

Aristida lazaridis is a tufted perennial grass, 0.4-1.5 m high, with green and purple flowers in April, occurring on sand or loam (Western Australian Herbarium 2012).

This species was record at site LCF31, where it was relatively abundant, with a density rated at 5-25%.

Aristida lazaridis is known from only two specimens at the WA Herbarium. One was collected in 2008, approximately 55 km to the east south east of our record, and the second was collected the same distance to the north west in 1996. The species is not recorded in DEC's TPFL database.

A specimen of *Aristida lazaridis* will be submitted to the WA Herbarium collection.



Rapallo

Original Size: A4 Scale: 1:14,000
Datum: MGA94
0 500 m

Process Minerals International

Figure 4

Conservation significant flora recorded in the survey area

4.2.3. WEEDS

Five species of introduced flora (weeds) were recorded in the survey area: *Bidens bipinnata* (Bipinnate Beggartick), *Cenchrus ciliaris* (Buffel Grass), *Chloris virgata* (Feathertop Rhodes Grass), *Malvastrum americanum* (Spiked Malvastrum), and *Portulaca oleracea* (Purslane).

None of these taxa were listed as Declared Plants by the WA Department of Agriculture and Food pursuant to section 37 of the *Agricultural and Related Resources Protection Act 1976* (Western Australia). None of these taxa were listed as Weeds of National Significance by the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC 2012).

Five weed species were recorded at nine locations in the Lamb Creek survey area (Figure 5, Figure 6). Weed species were more abundant at locations where evidence of cattle was noted. The site that contained the most weed species was LCF31, where four weed species were found.

Bidens bipinnata (Bipinnate Beggartick)

Bidens bipinnata is an erect annual herb, from 0.1-0.9 m high, with yellow flowers from March to September. It occurs on alluvium, clay, loam over sandstone, and limestone, along rivers and creeks, in coastal areas, and on rocky hillsides. It is widespread throughout the Pilbara and also occurs in other north-western WA regions (Western Australian Herbarium 2012).

Bidens bipinnata was the most commonly recorded weed species, found at nine sites in the survey area: LCF12, LCF15, LCF18, LCF20, LCF23, LCF31, LCF34, LCF37, LCF46.

Cenchrus ciliaris (Buffel Grass)

Cenchrus ciliaris is a tufted perennial grass to 1.5m in height, with purple seed-heads from February to October (Western Australian Herbarium 2012). The seeds of this weed are spread by wind, water, stock and machinery (Thorp and Wilson 1998-2012). Buffel Grass has become a major environmental weed of northern Australia, displacing native species, and carrying fire into areas where fire was not normally part of the ecosystem (Thorp and Wilson 1998-2012, Hussey *et al* 2007).

This species was observed at a single site, LCF23, in the current project.

Chloris virgata (Feathertop Rhodes Grass)

Chloris virgata is an annua grass, usually from 0.23-0.45 m high, with green-purple flowers from April to May or in September. It usually occurs on sand dunes. It occurs in many areas of WA and is common in the Pilbara region (Western Australian Herbarium 2012).

Chloris virgata was observed at a single site, LCF31, in the current project.

Malvastrum americanum (Spiked Malvastrum)

Malvastrum americanum is an erect perennial herb or shrub, from 0.5-1.3 m high. It has yellow-orange flowers in April to July. It occurs on orange, red, or yellow sands, gritty alluvial sand, black or brown clay, alluvial cracking clays, limestone, and calcrete, on stony ridges and hillsides, floodplains, and along drainage lines. It is widespread and common within the Pilbara and other north-western regions of WA (Western Australian Herbarium 2012).

Malvastrum americanum was recorded at site LCF31 in the survey area.

Portulaca oleracea (Purslane)

Portulaca oleracea is a succulent, prostrate to decumbent annual herb to 0.2 m high. It has yellow flowers from April to May, and occurs on clay loam and sand, often in disturbed sites. It has been recorded extensively in the Pilbara, and also occurs in many other regions of WA (WA Herbarium 2012).

In the survey area, *Portulaca oleracea* was recorded at sites LCF31 and LCF34.

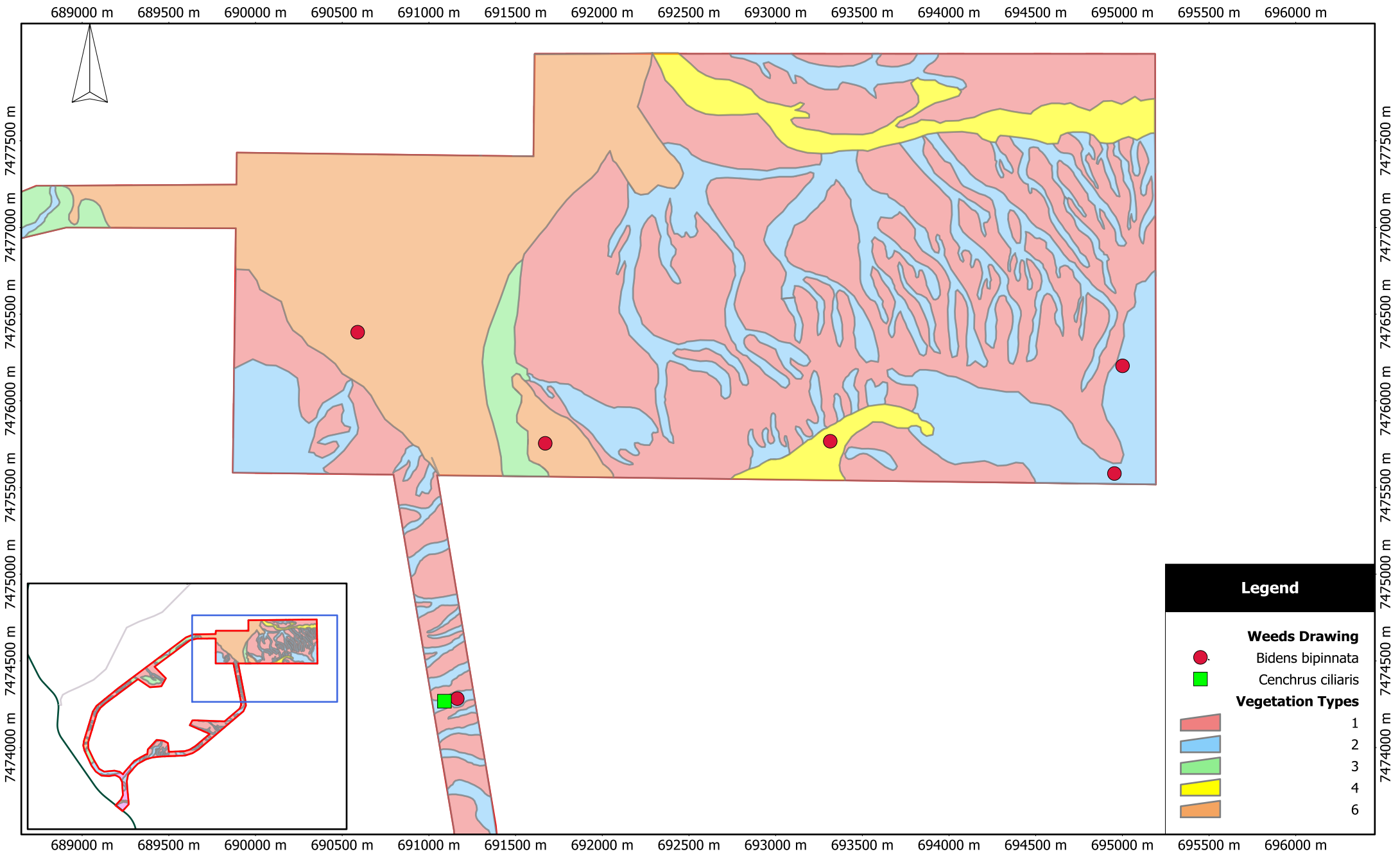


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Figure 5

Introduced flora species recorded in the survey area (1 of 2)

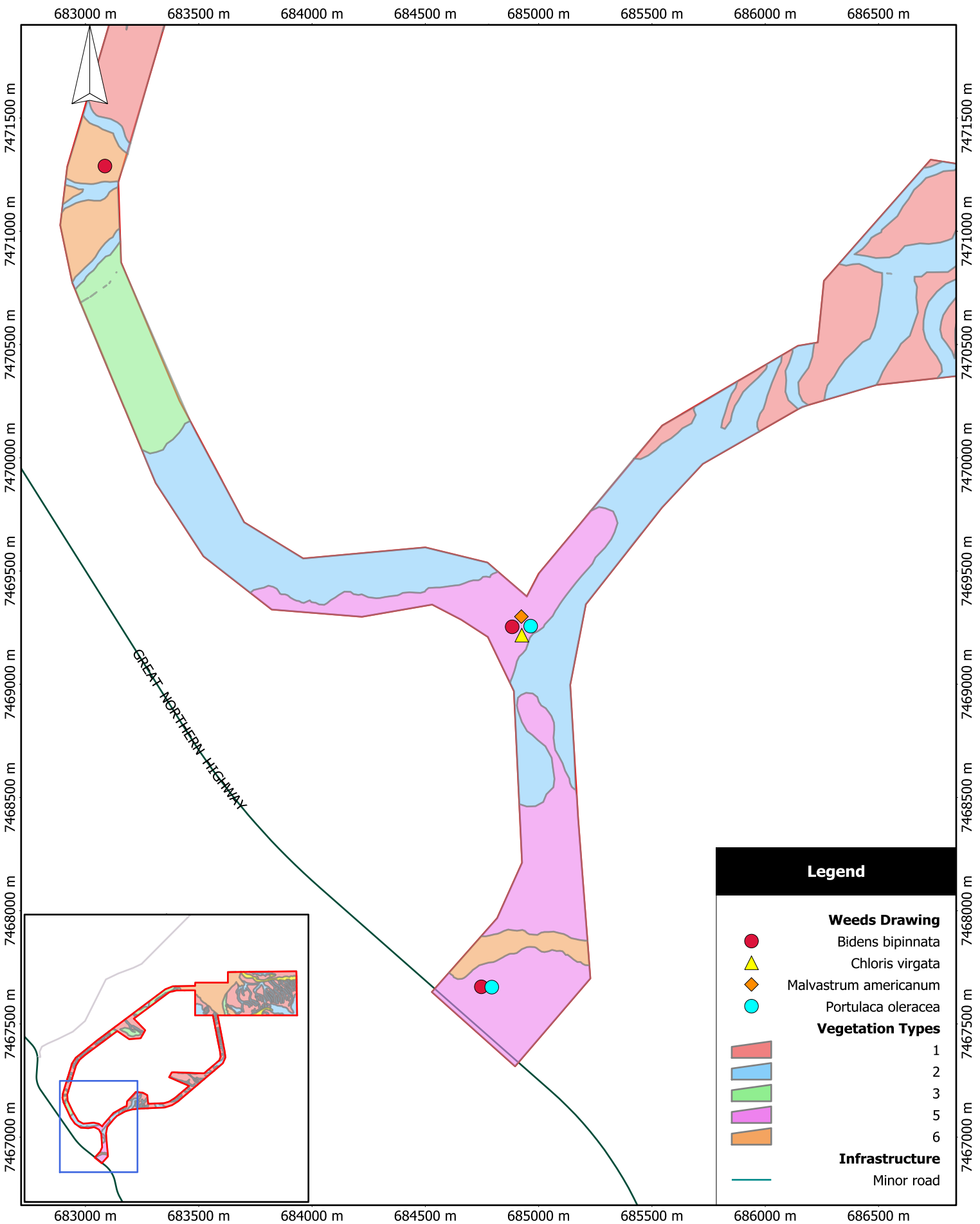

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Figure 6

Introduced flora species recorded in the survey area (2 of 2)

4.2.4. VEGETATION COMMUNITIES IN THE SURVEY AREA

Six vegetation communities were identified in the survey area. PATN analysis results were largely consistent with field mapping of vegetation communities, although they were partially manually adjusted to produce the final integrated results.

None of the vegetation communities in the survey area represented a TEC or PEC. The Coolibah-Lignum Flats vegetation complex PEC includes some species recorded in the survey, including 'mulga' (*Acacia aptaneura*, previously considered part of the *A. aneura* complex), however mulga was not found in association with *Eucalyptus victrix*, or with the species assemblage described in the PEC. *Eucalyptus victrix* was thought to be recorded at a single site, however due to lack of fruit was not able to be identified positively, and at that site it was not associated with any of the other species described in the Coolibah-Lignum Flats vegetation complex PEC.

PATN Dendrogram

Following analysis and evaluation, 110 species were selected for inclusion in the PATN analysis. This produced a dendrogram of seven vegetation types, with a stress value of 0.1686 (Figure 7). The quadrats assigned to one group, which consisted of two sites (LF12 and LCF32), were manually reassigned to other groups based on field observations, to produce six final groups.

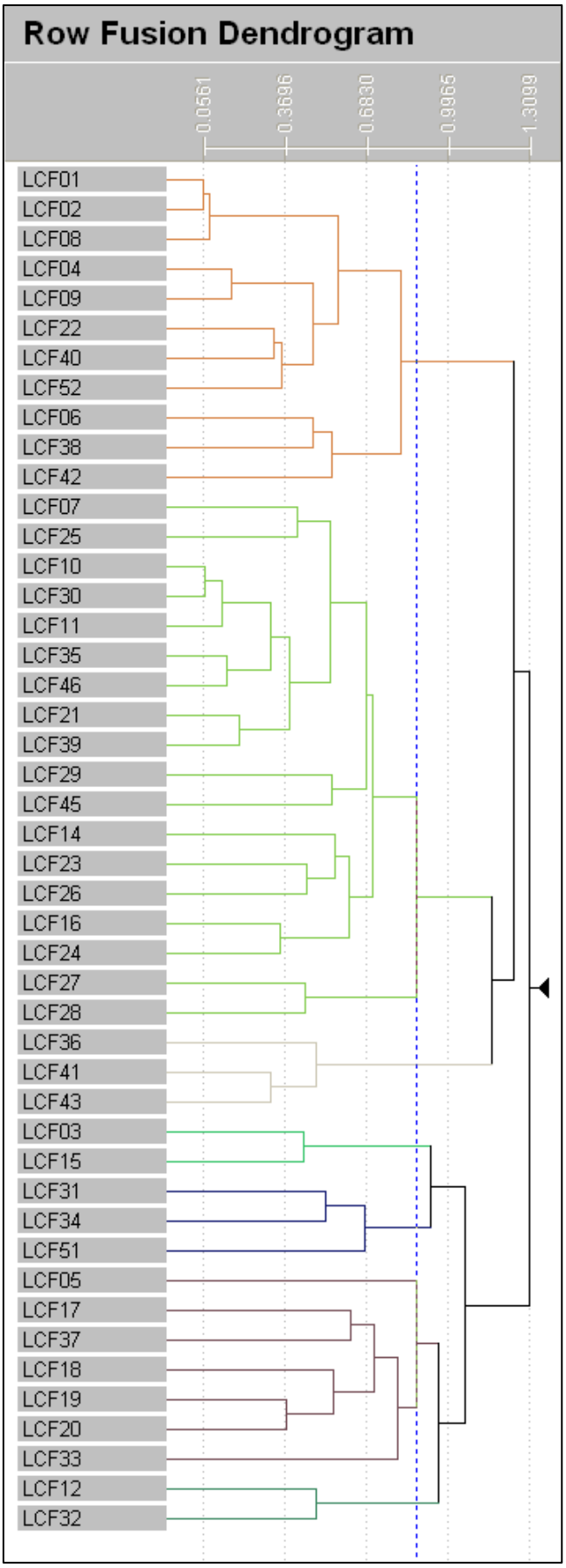

Figure 7 PATN dendrogram of analysis of survey quadrats

Vegetation Mapping

Based on field observations and PATN analysis, six main vegetation communities were recorded. The vegetation type occurring most widely across the survey area was *Eucalyptus gamophylla* woodland over hummock grassland (Table 1).

Table 1 Total and percentage area of each vegetation type recorded in the Lamb Creek survey area

Vegetation community	Total area (km^2) within survey area	Percentage of survey area
1. *Eucalyptus gamophylla* woodland over hummock grassland	9.57	46 %
2. *Eucalyptus leucophloia* subsp. *leucophloia* woodland over mixed shrubs over *Triodia wiseana* grassland	5.25	25 %
3. *Acacia* shrubland over hummock grassland	1.30	6 %
4. *Acacia tumida* var. *pilbarensis* scrub in creeklines	0.64	3 %
5. Wannamunna Mulga grove	0.66	3 %
6. *Acacia aptaneura* over hummock grassland	3.26	16 %
Totals	20.68	**100** %

The vegetation communities of the survey area are mapped in Figures 8, 9, 10, 11, 12 and 13 and described in detail in Table 13 below.

Table 13 Description of vegetation communities

Vegetation Community	Plate	Land System	Substrate	Description	Quadrats
1. *Eucalyptus gamophylla* woodland over hummock grassland	1	Boolgeeda, McKay, Newman, Platform	Clay loams with BIF and ironstone pebbles and gravel on open plains and gentle rises	*Eucalyptus gamophylla* low open woodland over *Acacia elachantha* or *Acacia hilliana*, *Senna glutinosa* subsp. *pruinosa* open shrubland over *Triodia brizoides*, *Triodia wiseana* hummock grassland.	LCF01, LCF02, LCF04, LCF06, LCF08, LCF09, LCF22, LCF38, LCF40, LCF42, LCF52
2. *Eucalyptus leucophloia* subsp. *leucophloia* woodland over mixed shrubs over *Triodia wiseana* grassland	2	Boolgeeda, Platform	Clays and clay loams with BIF and ironstone pebbles, cobbles, and sheetrock in gorges and rocky creeklines and on hillsides and breakaways	*Eucalyptus leucophloia* subsp. *leucophloia*, *Eucalyptus gamophylla* low open woodland over mixed species (typically *Gossypium robinsonii*, *Acacia hilliana*, *Grevillea wickhamii*, *Keraudrenia nephrosperma*) scattered shrubs over *Triodia wiseana* hummock grassland.	LCF07, LCF10, LCF11, LCF12, LCF14, LCF16, LCF21, LCF23, LCF24, LCF25, LCF26, LCF27, LCF28, LCF29, LCF30, LCF35, LCF39, LCF45

Vegetation Community	Plate	Land System	Substrate	Description	Quadrats
3. *Acacia* shrubland over hummock grassland	3	Boolgeeda, Newman	Sandy clay with ironstone gravel and pebbles on gentle slopes at bases of hills	*Acacia bivenosa* or *Acacia adsurgens* open shrubland over *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) , *Triodia wiseana* hummock grassland.	LCF36, LCF41, LCF43
4. *Acacia tumida* var. *pilbarensis* scrub in creeklines	4	Boolgeeda, Platform	Clay loam and sandy clay with laterite pebbles in drainage lines	*Acacia tumida* var. *pilbarensis* tall open scrub over *Themeda triandra* tussock grassland and *Triodia wiseana* open hummock grassland.	LCF03, LCF15
5. Wannamunna Mulga grove	5	Boolgeeda, Wannamunna	Sandy clay and clay on flat plains	*Acacia aptaneura* low woodland over *Themeda triandra*, *Cymbopogon ambiguus*, *Chrysopogon fallax* open tussock grassland.	LCF31, LCF32, LCF34, LCF51
6. *Acacia aptaneura* over hummock grassland	6	Boolgeeda, Wannamunna	Broad open drainage system through stony plains with clay soils	*Acacia aptaneura* and/or *Corymbia deserticola* low woodland over *Acacia elechantha* and mixed *Eremophila* species over *Triodia wiseana* very open hummock grassland	LCF17, LCF18, LCF19, LCF20, LCF33, LCF37

Type 1: *Eucalyptus gamophylla* woodland over hummock grassland

A widespread vegetation type within the survey area, and especially within the main mining tenement and western haul road areas of the project, occurring on open plains and gentle rises.

This vegetation type had a mean Keighery health rating of 2.667 (excellent-very good) with the main disturbance causes being grazing (cattle), vehicle tracks, and erosion.

No weed species or Priority flora species were observed in this vegetation type.

Plate 1 ***Eucalyptus gamophylla*** **woodland over hummock grassland vegetation type (site LCF09)**

Type 2: *Eucalyptus leucophloia* subsp. *leucophloia* woodland over *Triodia wiseana* hummock grassland

The most widespread vegetation type within the survey area occurring on rocky ridges, hillsides, rocky minor drainage lines, and gorges.

This vegetation type had a mean Keighery health rating of 2 (excellent) with the main disturbance causes being grazing (cattle) and weeds.

The weed species *Bidens bipinnata* and *Cenchrus ciliaris* were observed at three sites in this vegetation type. No Priority flora species were observed in this vegetation type.

Plate 2 ***Eucalyptus leucophloia* subsp. *leucophloia* woodland vegetation type (site LCF24)**

Type 3: *Acacia* shrubland over hummock grassland

This is a minor vegetation type within the survey area. It occurs at three sites along the western haul road section of the survey area and on rocky gentle slopes at the base of hills.

This vegetation type had a mean Keighery health rating of 1.667 (pristine - excellent) with the main disturbance causes being grazing (cattle) and vehicle tracks.

No weed species or priority flora species were observed in this vegetation type.

Plate 3 ***Acacia*** **shrubland over hummock grassland vegetation type (site LCF36)**

Type 4: *Acacia* shrubland over hummock grassland

A minor vegetation type within the survey area, occurring at only two sites in medium-sized creek lines.

This vegetation type had a mean Keighery health rating of 3 (very good) with the main disturbance causes being grazing (cattle) and weeds.

The weed species *Bidens bipinnata* was found at one site in this vegetation type. No Priority flora species were observed in this vegetation type.

Plate 4 ***Acacia tumida* var. *pilbarensis* scrub in creeklines vegetation type (site LCF03)**

Type 5: Wannamunna Mulga grove vegetation

This vegetation type occurred primarily in the Wannamunna land system and was recorded at four sites.

This vegetation type had a mean Keighery health rating of 3 (very good) with the main disturbance causes being weeds and grazing (cattle).

The weed species *Bidens bipinnata*, *Chloris virgata*, *Malvastrum americanum*, and *Portulaca oleracea* were found in this vegetation type. Priority flora species including *Aristida calycina* var. *calycina* (Priority 2), *Aristida lazaridis* (Priority 2), and *Brachyscome* sp. Wanna Munna Flats (S. van Leeuwen 4662) (Priority 1) were observed in three sites of this vegetation type.

Plate 5 Wannamunna mulga grove vegetation type (site LCF31)

Type 6: *Acacia aptaneura* over hummock grassland

This vegetation type was recorded at seven sites, throughout the extent of the survey area but particularly in the open plains at the western end of the main mining tenement area.

This vegetation type was the most highly disturbed of all types in the current survey, and had a mean Keighery health rating of 3.57 (very good-good) with the main disturbance causes being grazing (cattle), active mining exploration, and vehicle tracks.

The weed species *Bidens bipinnata* was found at three sites in this vegetation type. The Priority flora species *Brachyscome* sp. Wanna Munna Flats (S. van Leeuwen 4662) (Priority 1) was observed at one site in this vegetation type (LCF33).

Plate 6 ***Acacia aptaneura*** **over hummock grassland (site LCF18)**

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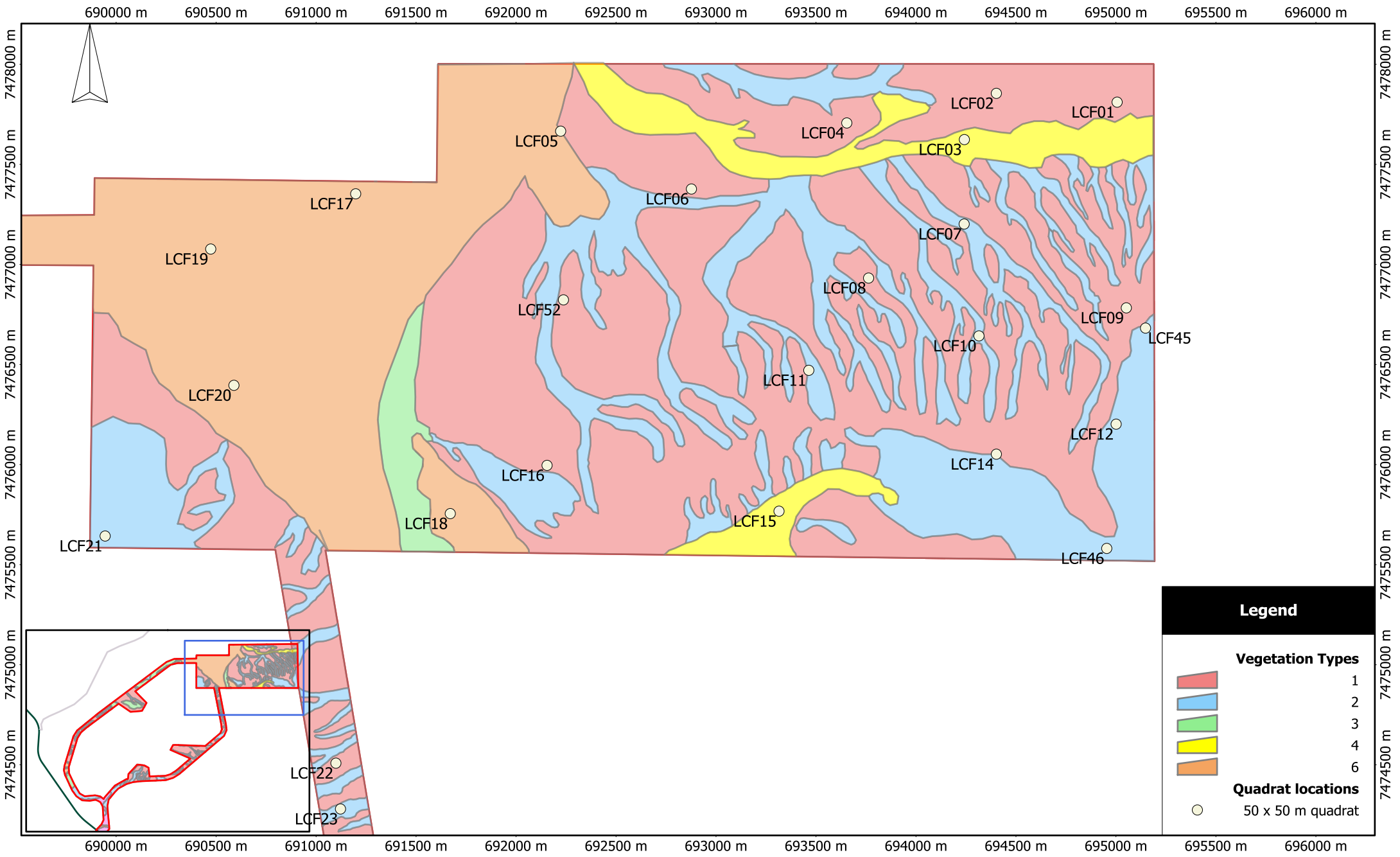

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Figure 8

Vegetation communities mapped in the survey area: Proposed mining area (1 of 6)

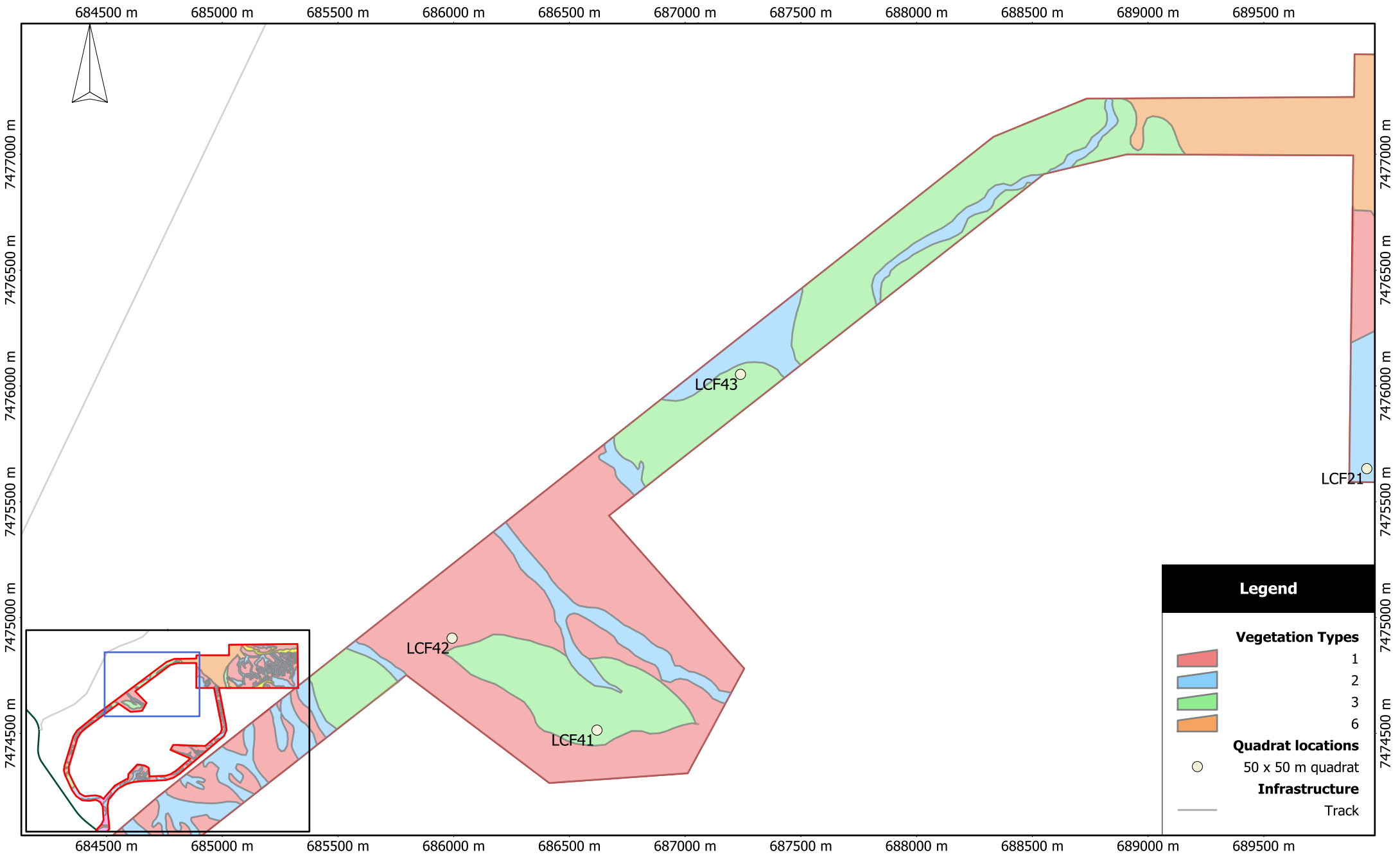

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Figure 9

Vegetation communities mapped in the survey area: Northern haul road (2 of 6)

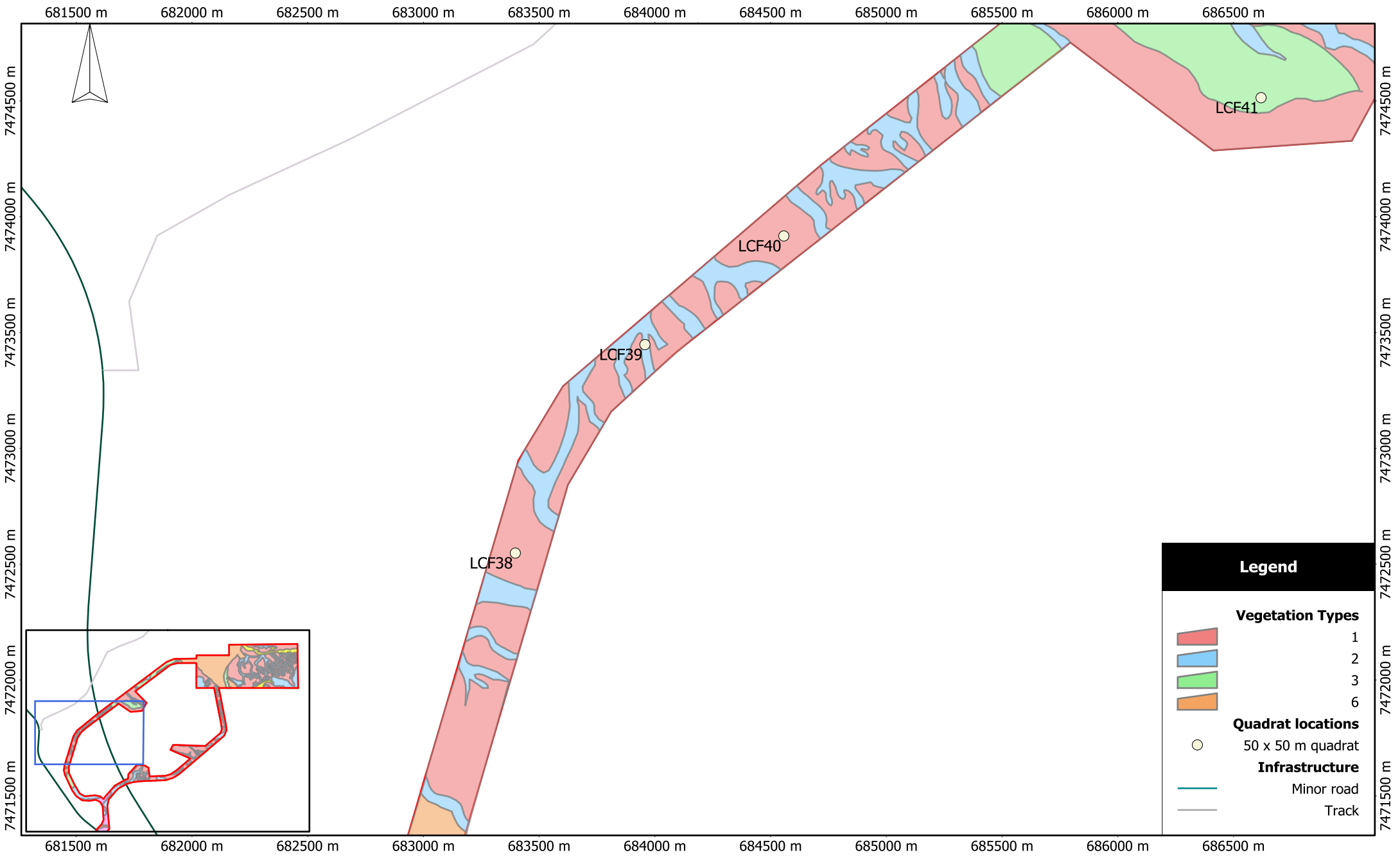

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Figure 10

Vegetation communities mapped in the survey area: Northern haul road (3 of 6)

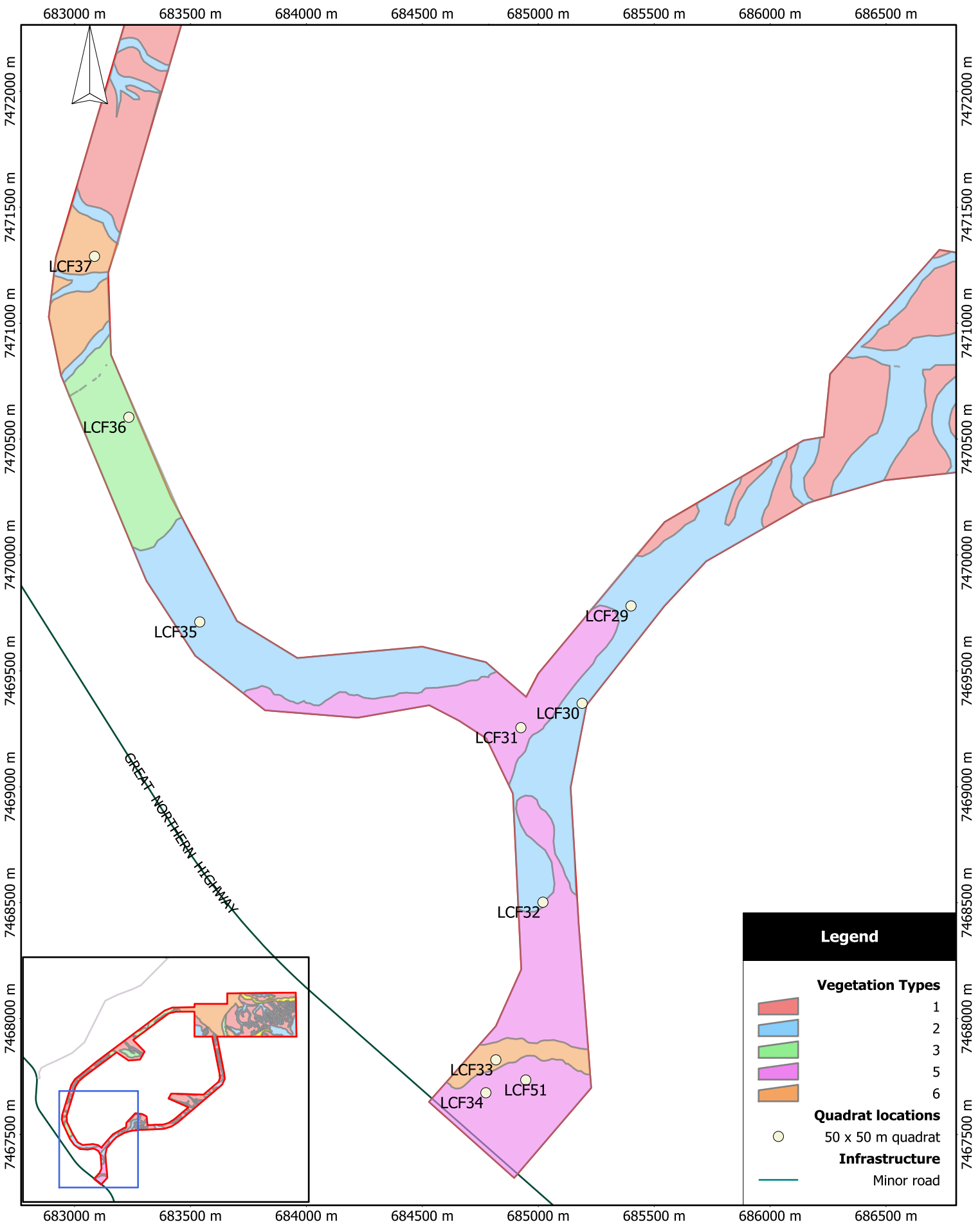

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Figure 11

Vegetation communities mapped in the survey area: Intersection (4 of 6)

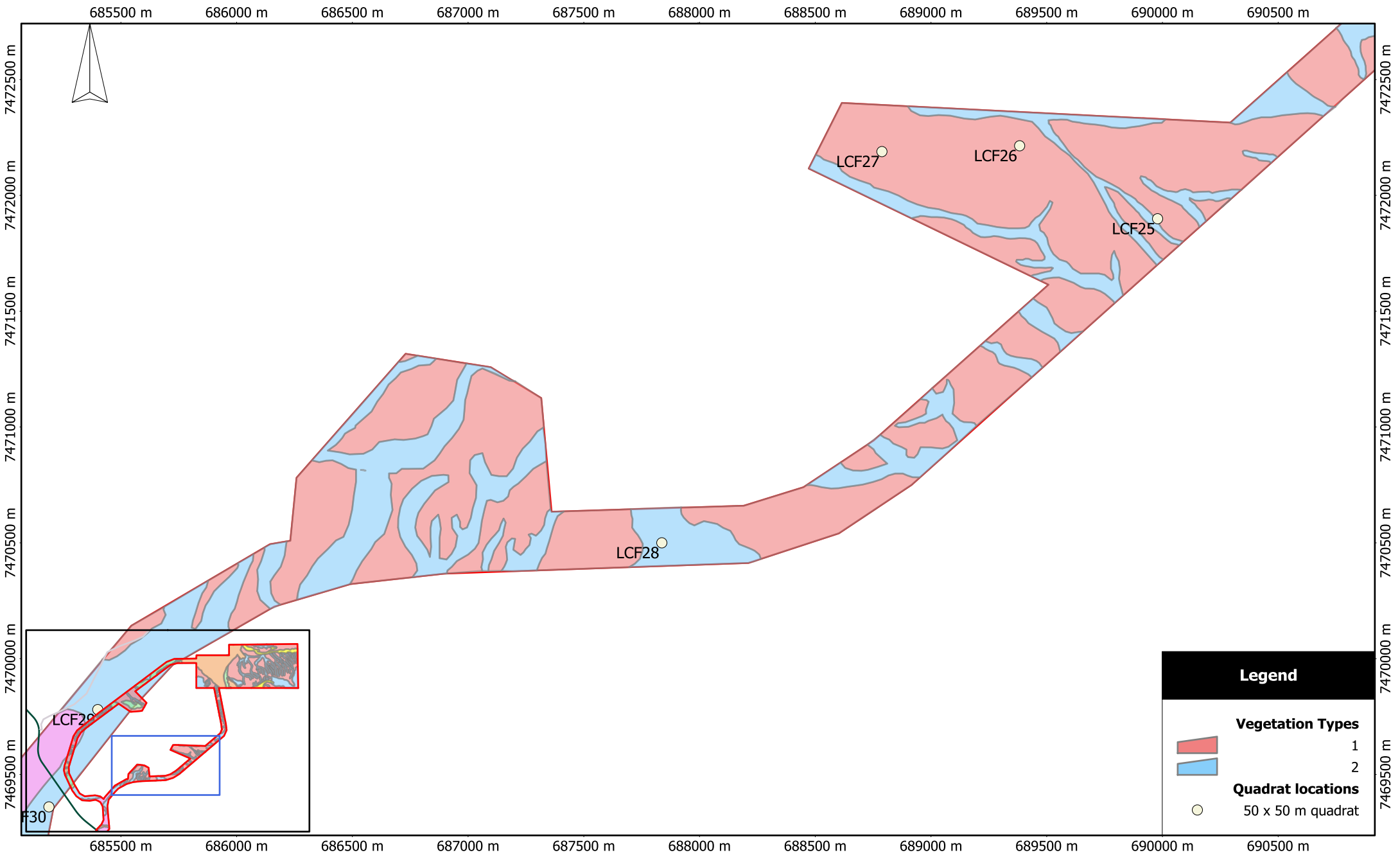

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Figure 12

Vegetation communities mapped in the survey area: Southern haul road (5 of 6)

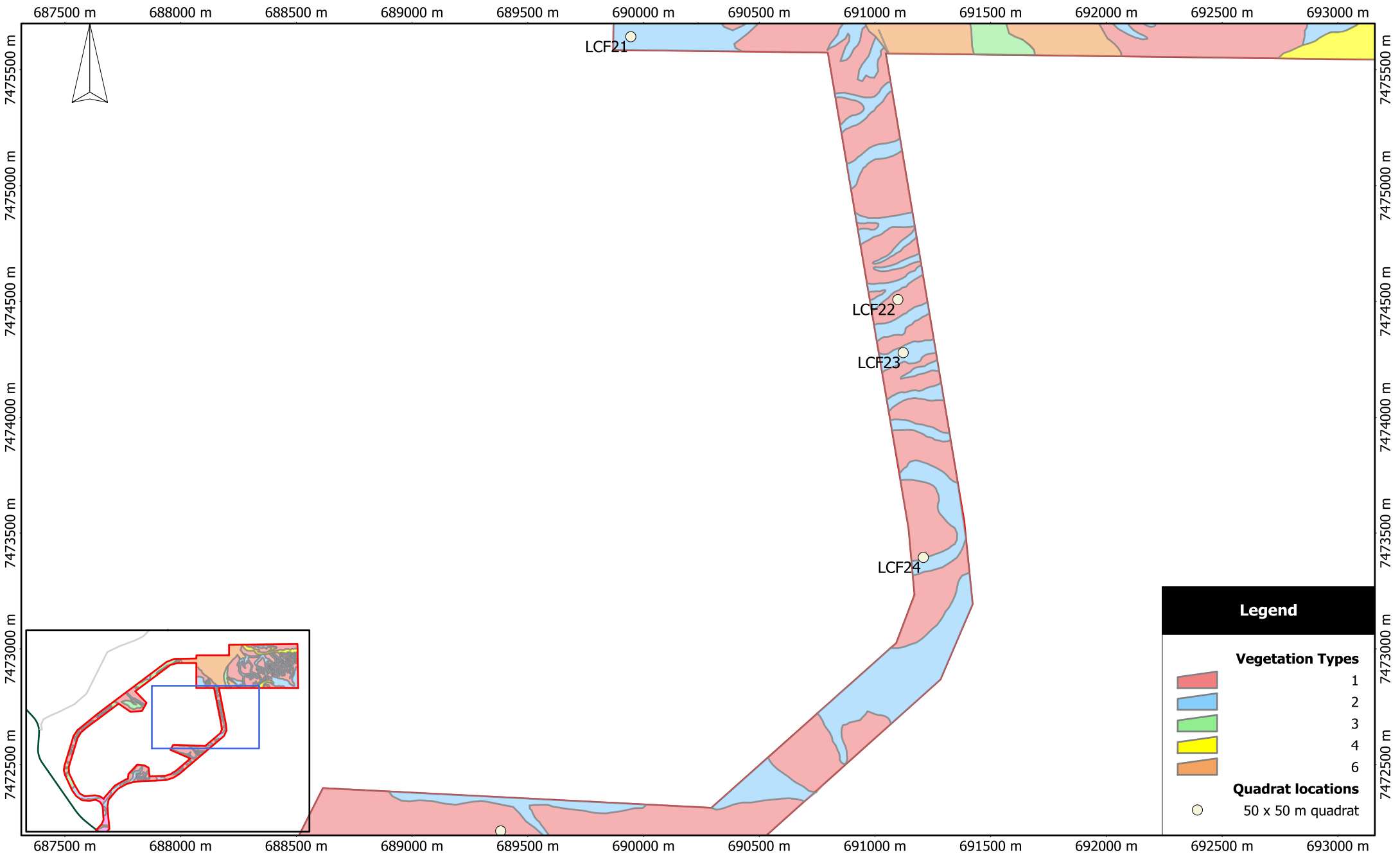

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Figure 13

Vegetation communities mapped in the survey area: Southern haul road (6 of 6)

5. DISCUSSION AND RECOMMENDATIONS

5.1. SUMMARY OF RESULTS

A total of 230 species, from 110 genera and 42 families, were recorded during the survey of the Lamb Creek area, from 414 specimens collected. Of those, 209 were collected within survey quadrats; the rest were collected opportunistically.

Six main vegetation communities were recognised and mapped following field observations and statistical analysis of the field data.

5.1.1. CONSERVATION SIGNIFICANT SPECIES AND COMMUNITIES

No species of Threatened Flora (Declared Rare Flora) pursuant to the Western Australian *Wildlife Conservation Act* 1950, and no species listed as Threatened pursuant to the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* were recorded in the project area.

Three species of Priority Flora listed by DEC were recorded during the survey, comprising one Priority 1 species (*Brachyscome* sp. Wanna Munna Flats (S. van Leeuwen 4662)) and two Priority 2 species (*Aristida calycina* var. *calycina* and *Aristida lazaridis*).

Brachyscome sp. Wanna Munna Flats (S. van Leeuwen 4662), although listed as a Priority 1 taxon, is actually the most well-known of the three Priority flora species that were recorded in the Lamb Creek survey, having ten collections in the WA Herbarium, spanning across a relatively wide area. The population recorded in the Lamb Creek project appears to be a previously unknown one, as there are no corresponding records in any of the DEC flora databases. Conservation impact on this species of the proposed Lamb Creek project should be able to be minimised by relocation of the proposed access road to intersect with the Great Northern Highway at a more northern location, however further survey should be conducted to determine the extent of this population before any disturbance is undertaken as the occurrence of the species may not be exactly defined by the extent of the land system. Because *B.* sp. Wanna Munna Flats (S. van Leeuwen 4662) was observed to occur in small numbers, evenly spread across a wide area, and due to its ephemeral life cycle, it may be difficult to avoid disturbing the species if the proposed infrastructure cannot be relocated to outside of its known habitat.

Although ranked as lower Priority than *B.* sp. Wanna Munna Flats (S. van Leeuwen 4662), *Aristida calycina* var. *calycina* and *A. lazaridis* (both Priority 2 species) are less well-known in Western Australia. *Aristida calycina* var. *calycina* is only known from a single location in WA, approximately 65 km away from our record, and *A. lazaridis* is only known from two locations. As both of these species were found at the same single site only at Lamb Creek, avoiding conservation impacts entirely should be quite possible if proposed infrastructure is planned appropriately. Further survey should be conducted in the area to determine the full extent of these populations, particularly for *A. lazaridis*, which formed a dominant species in its stratum where it was recorded, and was probably widespread and common throughout the area of similar vegetation surrounding.

No Threatened or Priority Ecological Communities listed by the DEC were recorded.

Kendrick (2002) lists a number of 'ecosystems at risk' in the Hamersley IBRA subregion including some that have brief descriptions similar to vegetation types found in the survey area (for example 'Grove/inter-grove mulga, eastern Hamersley Range' and 'Valley floor Mulga'); however given the sparseness of these descriptions it is not possible to determine if the vegetation complexes recorded in fact match the ones described by Kendrick. These vegetation complexes are not formally listed as TECs or PECs and there is little further information available about them (Jill Pryde, pers. comm.). However, in the time elapsed since publication of the Biodiversity Audit of Western Australia's 53 biogeographical subregions, significant environmental change driven primarily by mining development has occurred in

the Pilbara, and Kendrick's (2002) estimations may now be poor indications of current conservation status. For this reason significant impact on these vegetation types (particularly the *Acacia aptaneura* complexes: vegetation types 5 and 6 in this document) should be avoided where possible.

5.1.2. WEEDS

Five species of introduced flora were recorded in the project area: *Bidens bipinnata* (Bipinnate Beggartick), *Cenchrus ciliaris* (Buffel Grass), *Chloris virgata* (Feathertop Rhodes Grass), *Malvastrum americanum* (Spiked Malvastrum), and *Portulaca oleracea* (Purslane). These species were located in a total of nine sites.

None of these taxa were listed as Declared Plants by the WA Department of Agriculture and Food pursuant to section 37 of the *Agricultural and Related Resources Protection Act 1976* (Western Australia), or as Weeds of National Significance by the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC 2012).

5.2. POTENTIAL PROJECT IMPACTS

As currently proposed, the project could impact on known habitat of the three Priority flora species observed in the Lamb Creek flora survey. The project also has the potential to impact on the 'at risk' ecological communities 'Grove/inter-grove mulga, eastern Hamersley Range' and 'Valley floor mulga' mentioned in Kendrick (2002). The project would also impact on the Wannamunna land system, a relatively uncommon land system with high conservation and pastoral value.

There is some risk of weed dispersal, particularly from the relatively weed-species rich south-west of the survey area to the relatively undisturbed main mining area.

5.3. RECOMMENDATIONS

1. Further targeted priority flora survey for *Brachyscome* sp. Wanna Munna Flats (S. van Leeuwen 4662), *Aristida calycina* var. *calycina*, and *Aristida lazaridis* should be conducted prior to disturbance to areas of the Wannamunna land system, and the associated nearby *Acacia aptaneura* groves where these taxa where recorded in the current survey.

2. Rapallo recommends avoiding impact on the Wannamunna land system vegetation where most of the Priority species where encountered.

3. If it remains necessary to impact the Wannamunna land system vegetation, consultation with the DEC is recommended before any works are undertaken.

4. A weed management program should be developed to reduce the spread of invasive plants before any further disturbance and/or clearing takes place. This should include washing down any vehicles travelling from weed-infested areas into non-infested areas.

5. Consultation with the DEC is recommended before any disturbance occurs in creek lines near watercourses in the areas of the proposed access roads in order to determine whether these areas are to be considered as wetland vegetation as specified under the *Environmental Protection Act 1986* (Section 51-O).

6. Access roads and other infrastructure should be planned to avoid disturbance to locations recorded to contain Priority Flora species including a minimum 50 m buffer around those locations is recommended. If disturbance cannot be avoided, consultation with the DEC is recommended before any clearing is undertaken

7. During project clearing, topsoil, branches and other vegetation debris should be stockpiled and returned directly to the disturbed areas for rehabilitation operations.

8. Windrows of topsoil, log debris and leaf litter formed during clearing should be retained.

9. Where possible ensure no ground engagements (the grader held blade up) when clearing or re-clearing the existing access tracks.

10. Ensure rapid rehabilitation of cleared areas such as laydown sites, access tracks and grid lines when they are no longer required.

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Appendices

Appendix I: State and Federal Conservation Codes

Conservation Listings under the Environment Protection and Conservation Act 1999 (EPBC Act)

Threatened fauna and flora may be listed in any one of the following categories as defined in Section 179 of the EPBC Act. Section 179 Categories of threatened species

Extinct

(1) A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.

Extinct in the Wild

(2) A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time:

(a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or

(b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.

Critically Endangered

(3) A native species is eligible to be included in the critically endangeredcategory at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.

Endangered

(4) A native species is eligible to be included in the endangered category at a particular time if, at that time:

(a) it is not critically endangered; and

(b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.

Vulnerable

(5) A native species is eligible to be included in the vulnerable category at a particular time if, at that time:

(a) it is not critically endangered or endangered; and

(b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.

Conservation Dependent

(6) A native species is eligible to be included in the conservation dependent category at a particular time if, at that time:

(a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or

(b) the following subparagraphs are satisfied:

(i) the species is a species of fish;

(ii) the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised;

(iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory;

(iv) cessation of the plan of management would adversely affect the conservation status of the species.

(7) In subsection (6): fish includes all species of bony fish, sharks, rays, crustaceans, molluscs and other marine organisms, but does not include marine mammals or marine reptiles.

Species listed as 'conservation dependent' and 'extinct' are not matters of national environmental significance and therefore do not trigger the EPBC Act.

Categories and definitions of Threatened Flora species under the *Wildlife Conservation Act (1950)* of Western Australia, taken directly from the DEC WA Herbarium website.

Under the *Wildlife Conservation Act(1950)* the Minister for the Environment may declare species of flora to be protected if they are considered to be in danger of extinction, rare or otherwise in need of special protection. Schedules 1 and 2 deal with those that are threatened and those that are presumed extinct, respectively.

T:Threatened Flora (Declared Rare Flora - Extant)

Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such (Schedule 1 under the *Wildlife Conservation Act 1950*).

Threatened Flora (Schedule 1) are further ranked by the Department according to their level of threat using IUCN Red List criteria:

- CR: Critically Endangered – considered to be facing an extremely high risk of extinction in the wild
- EN: Endangered – considered to be facing a very high risk of extinction in the wild
- VU: Vulnerable – considered to be facing a high risk of extinction in the wild.

X:Presumed Extinct Flora (Declared Rare Flora - Extinct)

Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such (Schedule 2 under the *Wildlife Conservation Act 1950*).

Species that have not yet been adequately surveyed to be listed under Schedule 1 or 2 are added to the Priority Flora List under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna. Species that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Conservation Dependent species are placed in Priority 5.

Priority One - Poorly Known Taxa

Species that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.

Priority Two - Poorly Known Taxa

Species that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.

Priority Three - Poorly Known Taxa

Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.

Priority Four – Rare, Near Threatened and other species in need of monitoring

- Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands.
- Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.
- Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Priority Five – Conservation Dependent species

Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

Definitions and criteria for presumed totally destroyed, critically endangered, endangered and vulnerable ecological communities, taken from DEC (2010).

THREATENED ECOLOGICAL COMMUNITIES

A **threatened ecological community** (TEC) is one which is found to fit into one of the following categories; "presumed totally destroyed", "critically endangered", "endangered" or "vulnerable".

Presumed Totally Destroyed (PD)

An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.

Critically Endangered (CR)

An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.

Endangered (EN)

An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.

Vulnerable (VU)

An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.

PRIORITY ECOLOGICAL COMMUNITIES

Possible threatened ecological communities that do not meet survey criteria or that are not adequately defined are added to the **Priority Ecological Community** List under priorities 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community, and evaluation of conservation status, so that consideration can be given to their declaration as threatened ecological communities. Ecological communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

Priority One: Poorly-known ecological communities

Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤ 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.

Priority Two: Poorly-known ecological communities

Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

Priority Three: Poorly known ecological communities

(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or:

(ii) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or;

(iii) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes.

Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

Priority Four: Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.

(i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands.

(ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.

(iii) Ecological communities that have been removed from the list of threatened communities during the past five years.

Priority Five: Conservation Dependent ecological communities

Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Appendix II: Vegetation condition scale (Keighery 1994)

Vegetation condition scale (Keighery, 1994)

Vegetation Condition	Definition
Pristine (1)	Pristine or nearly so, no obvious signs of disturbance.
Excellent (2)	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good (3)	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good (4)	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded (5)	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely Degraded (6)	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

Appendix III: List of Flora Species Recorded during the Survey

Family	LSS	Taxonomic Name
Lauraceae	80	*Cassytha capillaris*
Cyperaceae	156	*Bulbostylis barbata*
		Cyperus cunninghamii subsp. *cunninghamii*
		Eragrostis cumingii
		Eragrostis eriopoda
		Eragrostis pergracilis
		Eragrostis tenellula
		Fimbristylis dichotoma
		Fimbristylis simulans
Poaceae	163	*Amphipogon caricinus* subsp. *caricinus*
		Amphipogon sericeus
		Aristida calycina var. *calycina* **(P2)**
		Aristida contorta
		Aristida holathera
		Aristida inaequiglumis
		Aristida lazaridis **(P2)**
		**Cenchrus ciliaris*
		Chloris pectinata
		**Chloris virgata*
		Chrysopogon fallax
		Cymbopogon ambiguus
		Cymbopogon obtectus
		Dactyloctenium radulans
		Digitaria ctenantha
		Enneapogon caerulescens
		Enneapogon polyphyllus
		Enteropogon ramosus
		Eriachne aristidea
		Eriachne helmsii
		Eriachne obtusa
		Eriachne pulchella subsp. *pulchella*

Family	LSS	Taxonomic Name
		Eulalia aurea
		Iseilema membranaceum
		Paraneurachne muelleri
		Paspalidium basicladum
		Paspalidium rarum
		Paspalidium tabulatum
		Perotis rara
		Schizachyrium fragile
		Sporobolus australasicus
		Themeda triandra
		Tragus australianus
		Triodia sp. Shovelanna Hill (S. van Leeuwen 3835)
		Triodia brizoides
		Triodia wiseana
		Triraphis mollis
		Urochloa holosericea subsp. *velutina*
		Urochloa piligera
Menispermaceae	169	*Tinospora smilacina*
Proteaceae	175	*Grevillea stenobotrya*
		Grevillea wickhamii
		Grevillea wickhamii subsp. *hispidula*
		Hakea lorea
Zygophyllaceae	199	*Tribulopis angustifolia*
		Tribulus astrocarpus
		Tribulus hirsutus
		Tribulus platypterus
Fabaceae	201	*Acacia adoxa* var. *adoxa*
		Acacia adsurgens
		Acacia ancistrocarpa
		Acacia aptaneura
		Acacia arida

Family	LSS	Taxonomic Name
		Acacia bivenosa
		Acacia dictyophleba
		Acacia elachantha
		Acacia hilliana
		Acacia inaequilatera
		Acacia maitlandii
		Acacia marramamba
		Acacia minyura
		Acacia monticola
		Acacia pachyacra
		Acacia pruinocarpa
		Acacia pyrifolia var. *morrisonii*
		Acacia steedmanii subsp. *borealis*
		Acacia synchronicia
		Acacia tenuissima
		Acacia tumida var. *pilbarensis*
		Acacia xiphophylla
		Crotalaria medicaginea
		Gompholobium sp. Pilbara (NF Norris 908)
		Indigofera georgei
		Indigofera monophylla
		Rhynchosia minima
		Senna artemisioides subsp. *filifolia*
		Senna artemisioides subsp. *helmsii*
		Senna artemisioides subsp. *oligophylla*
		Senna artemisioides subsp. *sturtii*
		Senna ferraria
		Senna glutinosa subsp. *glutinosa*
		Senna glutinosa subsp. *pruinosa*
		Senna notabilis
		Senna venusta

Family	LSS	Taxonomic Name
		Tephrosia densa
		Tephrosia supina
Surianaceae	202	*Stylobasium spathulatum*
Polygalaceae	203	*Polygala isingii*
Moraceae	211	*Ficus brachypoda*
Cucurbitaceae	224	*Cucumis maderaspatanus*
Celastraceae	229	*Stackhousia intermedia*
Euphorbiaceae	242	*Euphorbia australis*
		Euphorbia biconvexa
		Euphorbia boophthona
		Euphorbia latrobei subsp. *filiformis*
		Euphorbia tannensis subsp. *eremophila*
Phyllanthaceae	247	*Phyllanthus maderaspatensis*
Violaceae	261	*Hybanthus aurantiacus*
Myrtaceae	281	*Corymbia ?opaca*
		Corymbia deserticola
		Corymbia hamersleyana
		Eucalyptus ?victrix
		Eucalyptus ?xerothermica
		Eucalyptus gamophylla
		Eucalyptus kingsmillii subsp. *kingsmillii*
		Eucalyptus leucophloia subsp. *leucophloia*
Sapindaceae	299	*Dodonaea coriacea*
		Dodonaea viscosa subsp. *mucronata*
Malvaceae	309	*Abutilon dioicum*
		Abutilon indicum
		Abutilon otocarpum
		Corchorus incanus subsp. *lithophilus*
		Corchorus lasiocarpus subsp. *lasiocarpus*
		Gossypium australe
		Gossypium robinsonii

Family	LSS	Taxonomic Name
		Hibiscus burtonii
		Hibiscus coatesii
		Hibiscus sturtii var. *campylochlamys*
		Hibiscus sturtii var. *platychlamys*
		Keraudrenia nephrosperma
		**Malvastrum americanum*
		Rulingia luteiflora
		Sida ?echinocarpa
		Sida ?sp. Spiciform panicles (E. Leyland s.n. 14/8/90)
		Sida ?sp. Supplejack Station (T.S. Henshall 2345)
		Sida arenicola
		Sida fibulifera
		Sida platycalyx
		Sida sp. Golden calyces glabrous (H.N. Foote 32)
		Sida sp. Pilbara (A.A. Mitchell PRP 1543)
		Sida sp. Tiny fruits (AA Mitchell PRP1152)
		Triumfetta maconochieana
Gyrostemonaceae	328	*Codonocarpus cotinifolius*
Capparaceae	330	*Capparis lasiantha*
		Capparis spinosa var. *nummularia*
Brassicaceae	332	*Cleome oxalidea*
		Cleome viscosa
		Lepidium echinatum
		Stenopetalum anfractum
		Stenopetalum pedicellare
Santalaceae	338	*Santalum lanceolatum*
Loranthaceae	339	*Amyema sanguinea* var. *sanguinea*
		Lysiana murrayi
Caryophyllaceae	355	*Polycarpaea corymbosa* var. *corymbosa*
		Polycarpaea holtzei
		Polycarpaea longiflora

Family	LSS	Taxonomic Name
Amaranthaceae	357	*Alternanthera nana*
		Gomphrena canescens subsp. *canescens*
		Gomphrena cunninghamii
		Ptilotus astrolasius
		Ptilotus calostachyus
		Ptilotus clementii
		Ptilotus exaltatus var. *exaltatus*
		Ptilotus fusiformis
		Ptilotus gaudichaudii var. *gaudichaudii*
		Ptilotus helipteroides
		Ptilotus macrocephalus
		Ptilotus obovatus subsp. *obovatus*
		Ptilotus polystachyus
		Ptilotus rotundifolius
Chenopodiaceae	358	*Dysphania glomulifera* subsp. *eremaea*
		Dysphania kalpari
		Dysphania rhadinostachya
		Enchylaena tomentosa
		Maireana villosa
		Rhagodia eremaea
		Salsola australis
		Sclerolaena cornishiana
Aizoaceae	364	*Trianthema glossostigma*
Nyctaginaceae	367	*Boerhavia gardneri*
Portulacaceae	374	*Calandrinia ptychosperma*
		**Portulaca oleracea*
Rubiaceae	409	*Oldenlandia crouchiana*
		Psydrax latifolia
Rubiaceae	409	*Psydrax rigidula*
Apocynaceae	413	*Cynanchum floribundum*
		Rhyncharrhena linearis

Family	LSS	Taxonomic Name
Boraginaceae	415	*Heliotropium tenuifolium*
		Trichodesma zeylanicum var. *zeylanicum*
Convolvulaceae	416	*Bonamia rosea*
		Convolvulus angustissimus subsp. *angustissimus*
		Duperreya commixta
		Evolvulus alsinoides var. *villosicalyx*
		Ipomoea polymorpha
Solanaceae	417	*Nicotiana occidentalis* subsp. *obliqua*
		Solanum ferocissimum
		Solanum lasiophyllum
		Solanum phlomoides
Oleaceae	423	*Jasminum didymum* subsp. *lineare*
Plantaginaceae	427	*Stemodia grossa*
		Stemodia viscosa
Scrophulariaceae	428	*Eremophila forrestii* subsp. *forrestii*
		Eremophila fraseri subsp. *fraseri*
		Eremophila lachnocalyx
		Eremophila longifolia
Lamiaceae	432	*Clerodendrum ?tomentosum*
		Clerodendrum floribundum var. *angustifolium*
		Newcastelia sp. Hamersley Range (S. van Leeuwen 4264)
		Spartothamnella teucriiflora
Goodeniaceae	458	*Dampiera candicans*
		Goodenia forrestii
		Goodenia microptera
		Goodenia muelleriana
		Goodenia prostrata
		Goodenia stobbsiana
		Scaevola browniana subsp. *browniana*
		Scaevola parvifolia subsp. *pilbarae*
Asteraceae	460	**Bidens bipinnata*

Family	LSS	Taxonomic Name
		Brachyscome sp. Wanna Munna Flats (S. van Leeuwen 4662) **(P1)**
		Pterocaulon serrulatum
		Rhodanthe floribunda
Araliaceae	472	*Trachymene oleracea*

Appendix IV: Coordinates of Conservation Significant Taxa recorded in the Project Area

Taxon name	Conservation status	Quadrat	Latitude	Longitude
Brachyscome sp. Wanna Munna Flats (S. van Leeuwen 4662)	P1	LCF33	-22.878188	118.801596
		LCF34	-22.879474	118.801194
		LCF51	-22.878959	118.802863
Aristida calycina var. *calycina*	P2	LCF31	-22.865242	118.802478
Aristida lazaridis	P2			

Appendix V: Vegetation Structural Classes

Vegetation Structural Classes – Specht (1970) as modified by Aplin (1979)

Stratum	Canopy Cover (%)				
	70-100%	30-70%	10-30%	2-10%	<2%
Trees >30m	Tall closed forest	Tall open forest	Tall woodland	Tall open woodland	Scattered tall trees
Trees 10-30m	Closed forest	Open forest	Woodland	Open woodland	Scattered trees
Trees <10m	Low closed forest	Low open forest	Low woodland	Low open woodland	Scattered low trees
Shrubs >2m	Tall closed scrub	Tall open scrub	Tall shrubland	Tall open shrubland	Scattered tall shrubs
Shrubs 1-2 m	Closed heath	Open heath	Shrubland	Open shrubland	Scattered shrubs
Shrubs <1 m	Low closed heath	Low open heath	Low shrubland	Low open shrubland	Scattered low shrubs
Hummock grasses	Closed hummock grassland	Hummock grassland	Open hummock grassland	Very open hummock grassland	Scattered hummock grasses
Grasses Sedges, Herbs	Closed tussock grassland/bunch grassland /sedgeland /herbland	Tussock grassland/ bunch grassland/ sedgeland/ herbland	Open tussock grassland / bunch grassland/ sedgeland / herbland	Very open tussock grassland / bunch grassland / sedgeland / herbland	Scattered tussock grasses / bunch grasses / sedges / herbs

Appendix VI: Flora Quadrat Survey Site Descriptions

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF01							
Botanist	Chid	**Date**	3/27/2012	**Site area**	Quadrat 50 x 50 m		
Location	50K		695006 **mE**	7477811 **mN**	**Elevation** 733 m		
Topography and Geology	Landform: Low plateau / flat hilltop Soil: red brown clay loam. Geology: 95% cover of laterite, ironstone gravel, pebbles.						
Veg Condition	2	**Disturbances**	catte	**Land System**	Newman		
Site Photo							
Vegetation	*Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Acacia hilliana* scattered low shrubs over *Triodia wiseana, Triodia brizoides* hummock grassland.						
Species	*Acacia adoxa* var. *adoxa* *Acacia ancistrocarpa* *Acacia hilliana* *Bulbostylis barbata* *Cassytha capillaris* *Dysphania rhadinostachya* *Eriachne obtusa* *Eucalyptus leucophloia* subsp. *leucophloia* *Goodenia microptera* *Goodenia stobbsiana* *Hakea lorea*			*Keraudrenia nephrosperma* *Polycarpaea holtzei* *Ptilotus calostachyus* *Ptilotus rotundifolius* *Santalum lanceolatum* *Senna glutinosa* subsp. *glutinosa* *Senna glutinosa* subsp. *pruinosa* *Solanum lasiophyllum* *Triodia brizoides* *Triodia wiseana*			

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF02					
Botanist	Linda	**Date**	3/27/2012	**Site area**	Quadrat 50 x 50 m
Location	50K		694402 **mE**	7477855 **mN**	**Elevation** 731 m
Topography and Geology	Landform: Rolling hills Aspect and Slope: variable. Soil: orange brown clay. Geology: 100% cover of BIF, laterite pebbles.				
Veg Condition	2	**Disturbances**	none	**Land System**	Newman
Site Photo					
Vegetation	*Eucalyptus leucophloia* subsp. *leucophloia, Corymbia* deserticola scattered low trees over *Triodia wiseana, Triodia brizoides* hummock grassland.				
Species	*Acacia adoxa* var. *adoxa* *Bulbostylis barbata* *Capparis lasiantha* *Cassytha capillaris* *Corymbia deserticola* *Dysphania rhadinostachya* *Eriachne helmsii* *Eucalyptus leucophloia* subsp. *leucophloia* *Euphorbia australis* *Goodenia microptera* *Goodenia stobbsiana*			*Hakea lorea* *Keraudrenia nephrosperma* *Polycarpaea holtzei* *Ptilotus calostachyus* *Ptilotus rotundifolius* *Senna glutinosa* subsp. *glutinosa* *Senna glutinosa* subsp. *pruinosa* *Solanum lasiophyllum* *Triodia brizoides* *Triodia wiseana*	

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF03							
Botanist	Chid	**Date**	3/27/2012	**Site area**	Quadrat 50 x 50 m		
Location	50K		694242 **mE**	7477624 **mN**	**Elevation** 726 m		
Topography and Geology	Landform: Creekline Soil: orange clay loam. Geology: 5% cover of laterite pebbles.						
Veg Condition	3	**Disturbances**	cattle, weeds	**Land System**	Platform		
Site Photo							
Vegetation	*Acacia tumida* var. *pilbarensis* tall closed scrub with *Duperreya commixta* creepers over *Themeda triandra* tussock grassland and *Triodia wiseana* open hummock grassland.						
Species	*Acacia tumida* var. *pilbarensis* *Clerodendrum floribundum* var. *angustifolium* *Corymbia hamersleyana* *Dodonaea viscosa* subsp. *mucronata* *Duperreya commixta* *Eriachne helmsii*			*Eucalyptus leucophloia* subsp. *leucophloia* *Keraudrenia nephrosperma* *Rulingia luteiflora* *Senna glutinosa* subsp. *pruinosa* *Themeda triandra* *Triodia wiseana*			

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF04							
Botanist	Chid	**Date**	3/27/2012	**Site area**	Quadrat 50 x 50 m		
Location	50K		693654 **mE**	7477707 **mN**	**Elevation** 719 m		
Topography and Geology	Landform: Flat low plateau / plain Soil: red brown clay loam. Geology: 95% cover of laterite, ironstone gravel, pebbles.						
Veg Condition	3	**Disturbances**	cattle, tracks nearby, weeds	**Land System**	Platform		
Site Photo							
Vegetation	*Eucalyptus gamophylla* scattered low trees over *Triodia brizoides, Triodia wiseana* hummock grassland.						
Species	*Acacia ancistrocarpa* *Acacia hilliana* *Acacia pruinocarpa* *Acacia tenuissima* *Amphipogon caricinus* subsp. *caricinus* *Aristida contorta* *Aristida holathera* *Bulbostylis barbata* *Dysphania rhadinostachya* *Enneapogon polyphyllus* *Eriachne helmsii* *Eucalyptus gamophylla* *Goodenia microptera*				*Goodenia stobbsiana* *Hakea lorea* *Indigofera monophylla* *Jasminum didymum* subsp. *lineare* *Keraudrenia nephrosperma* *Polycarpaea holtzei* *Ptilotus calostachyus* *Ptilotus obovatus* var. *obovatus* *Schizachyrium fragile* *Senna artemisioides* subsp. *oligophylla* *Solanum lasiophyllum* *Triodia brizoides* *Triodia wiseana*		

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF05						
Botanist	Linda	**Date**	3/28/2012	**Site area**	Quadrat 50 x 50 m	
Location	50K		692223 **mE**	7477666 **mN**	**Elevation** 699 m	
Topography and Geology	Landform: Flat low plateau / plain Aspect and Slope: flat Soil: red clay. Geology: 90% cover of laterite (colluvial) gravels.					
Veg Condition	3	**Disturbances**	grazing, weeds, signs of old fires	**Land System**	McKay	
Site Photo						
Vegetation	*Corymbia deserticola* scattered low trees over *Acacia elachantha* tall open shrubland over *Acacia hilliana, Acacia minyura, Senna artemisioides* subsp. *helmsii* low shrubland over *Eulalia aurea, Cymbopogon ambiguous* open tussock grassland and mixed scattered herbs.					

Species		
	Abutilon otocarpum	*Euphorbia biconvexa*
	Acacia aptaneura	*Evolvulus alsinoides* var. *villosicalyx*
	Acacia elachantha	*Gomphrena canescens* subsp. *canescens*
	Acacia elachantha	*Paspalidium rarum*
	Acacia minyura	*Perotis rara*
	Cassytha capillaris	*Ptilotus obovatus* subsp. *obovatus*
	Corymbia deserticola	*Rhynchosia minima*
	Cymbopogon ambiguus	*Senna artemisioides* subsp. *helmsii*
	Dysphania rhadinostachya	*Senna notabilis*
	Eremophila longifolia	*Sporobolus australasicus*
	Eulalia aurea	*Triodia wiseana*

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF06					
Botanist	Linda	**Date**	3/28/2012	**Site area**	Quadrat 50 x 50 m
Location	50K		692877 **mE**	7477377 **mN**	**Elevation** 722 m
Topography and Geology	Landform: Flat plain Soil: red clay. Geology: 90% cover of BIF colluvial fragments mostly <1cm, some 2-5%.				
Veg Condition	4	**Disturbances**	fire 1-2 years previous, old clearing, scrap piles, tracks (>3 years ago).	**Land System**	McKay
Site Photo					
Vegetation	*Corymbia deserticola* scattered low trees over *Acacia elachantha* shrubland over *Keraudrenia nephrosperma, Bonamia rosea, Senna artemisioides* subsp. *oligophylla* low open shrubland over *Triodia brizoides* very open hummock grassland.				
Species	*Abutilon dioicum* *Acacia ancistrocarpa* *Acacia elachantha* *Aristida contorta* *Bonamia rosea* *Corymbia deserticola* *Cymbopogon ambiguus* *Eucalyptus leucophloia* subsp. *leucophloia* *Evolvulus alsinoides* var. *villosicalyx* *Goodenia microptera* *Goodenia stobbsiana*			*Indigofera monophylla* *Keraudrenia nephrosperma* *Ptilotus calostachyus* *Senna artemisioides* subsp. *oligophylla* *Senna glutinosa* subsp. *glutinosa* *Senna notabilis* *Sida arenicola* *Sida sp. Pilbara (A.A. Mitchell PRP 1543)* *Trianthema glossostigma* *Triodia brizoides*	

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF07					
Botanist	Linda	**Date**	3/28/2012	**Site area**	Quadrat 50 x 50 m
Location	50K		694241 **mE**	7477202 **mN**	**Elevation** 710 m
Topography and Geology	Landform: Small dissected creekline through gently undulating country Soil: red clay. Geology: 100% cover of BIF cobbles.				
Veg Condition	2	**Disturbances**	none	**Land System**	Platform
Site Photo					
Vegetation	*Eucalyptus gamophylla* low woodland over *Acacia elachantha* tall shrubland over *Triodia wiseana* hummock grassland and *Hybanthus aurantiacus, Crotalaria medicaginea* scattered herbs.				
Species	*Acacia adoxa* var. *adoxa* *Acacia bivenosa* *Acacia elachantha* *Bulbostylis barbata* *Cassytha capillaris* *Corchorus lasiocarpus* subsp. *lasiocarpus* *Crotalaria medicaginea* *Cymbopogon ambiguus* *Enneapogon caerulescens* *Eucalyptus gamophylla* *Evolvulus alsinoides* var. *villosicalyx*		*Gossypium australe* *Hakea lorea* *Hybanthus aurantiacus* *Indigofera monophylla* *Paspalidium basicladum* *Perotis rara* *Rhynchosia minima* *Senna artemisioides* subsp. *oligophylla* *Tephrosia densa* *Triodia wiseana*		

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF08						
Botanist	Linda	**Date**	3/28/2012	**Site area**	Quadrat 50 x 50 m	
Location	50K		693763 **mE**	7476932 **mN**	**Elevation** 730 m	
Topography and Geology	Landform: Gently undulating plains with dissected minor drainage lines Aspect and Slope: W (270°) gentle <5%. Soil: red clay. Geology:90% cover of BIF 2-10 cm.					
Veg Condition	3	**Disturbances**	old tracks, clearing	**Land System**	Platform	
Site Photo						
Vegetation	*Corymbia deserticola* scattered low trees over *Triodia wiseana, Triodia brizoides* hummock grassland.					
Species	*Acacia adoxa* var. *adoxa* *Acacia hilliana* *Acacia elachantha* *Bulbostylis barbata* *Corymbia deserticola* *Dysphania rhadinostachya* *Eremophila longifolia* *Fimbristylis dichotoma* *Fimbristylis simulans* *Goodenia microptera*			*Goodenia stobbsiana* *Hakea lorea* *Ptilotus calostachyus* *Senna artemisioides* subsp. *oligophylla* *Senna glutinosa* subsp. *glutinosa* *Senna glutinosa* subsp. *pruinosa* *Solanum lasiophyllum* *Triodia brizoides* *Triodia wiseana*		

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF09					
Botanist	Chid	**Date**	3/28/2012	**Site area**	Quadrat 50 x 50 m
Location	50K		695052 **mE**	7476783 **mN**	**Elevation** 742 m
Topography and Geology	Landform: Gently sloping plain at foto of ridge. Dissected by deep gorges. Slope: very gentle. Soil: brown clay loam. Geology: 95% cover of ironstone (some BIF), granite pebbles, cobbles.				
Veg Condition	2	**Disturbances**	cattle, fire (old)	**Land System**	Platform
Site Photo					
Vegetation	*Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Acacia hilliana* low open shrubland over *Triodia brizoides, Triodia wiseana* hummock grassland.				
Species	*Acacia hilliana* *Acacia pruinocarpa* *Aristida holathera* *Aristida inaequiglumis* *Bulbostylis barbata* *Eremophila lachnocalyx* *Eucalyptus ?xerothermica* *Eucalyptus gamophylla* *Eucalyptus leucophloia* subsp. *leucophloia* *Fimbristylis dichotoma* *Goodenia microptera*			*Goodenia stobbsiana* *Grevillea wickhamii* *Hakea lorea* *Hibiscus sturtii* var. *campylochlamys* *Polycarpaea holtzei* *Schizachyrium fragile* *Senna artemisioides* subsp. *oligophylla* *Senna glutinosa* subsp. *glutinosa* *Triodia brizoides* *Triodia wiseana*	

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF10					
Botanist	Chid	**Date**	3/29/2012	**Site area**	Quadrat 50 x 50 m
Location	50K		694315 **mE**	7476643 **mN**	**Elevation** 733 m
Topography and Geology	Landform: Minor creekline in shallow valley bottom Slope: very gentle. Soil: brown sandy clay. Geology: 95% cover of granite, ironstone from pebbles to boulders.				
Veg Condition	2	**Disturbances**	tracks and drill pads nearby	**Land System**	Boolgeeda
Site Photo					
Vegetation	*Eucalyptus leucophloia* subsp. *leucophloia, Corymbia hamersleyana* scattered low trees over *Gossypium robinsonii* scattered shrubs over *Triodia wiseana* closed hummock grassland.				
Species	*Acacia adsurgens* *Acacia ancistrocarpa* *Acacia inaequilatera* *Corchorus lasiocarpus* subsp. *lasiocarpus* *Corymbia hamersleyana* *Cymbopogon ambiguus* *Enneapogon polyphyllus* *Eriachne helmsii* *Eucalyptus leucophloia* subsp.		*Leucophloia* *Fimbristylis dichotoma* *Gossypium robinsonii* *Hakea lorea* *Polycarpaea holtzei* *Rhynchosia minima* *Senna glutinosa* subsp. *glutinosa* *Senna glutinosa* subsp. *glutinosa* *Triodia wiseana*		

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF11					
Botanist	Chid	**Date**	3/29/2012	**Site area**	Quadrat 50 x 50 m
Location	50K		693464 **mE**	7476471 **mN**	**Elevation** 745 m
Topography and Geology	Landform: Sloping valley side leading down to creekline Aspect and Slope: East moderately inclined to steep. Soil: red brown clay loam. Geology: 95% cover of granite, ironstone pebbles, cobbles and boulders.				
Veg Condition	1	**Disturbances**	relatively recent fire.	**Land System**	Boolgeeda
Site Photo					
Vegetation	*Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Grevillea wickhamii* open shrubland over *Triodia wiseana* hummock grassland.				
Species	*Corymbia deserticola* *Eucalyptus leucophloia* subsp. *leucophloia* *Euphorbia biconvexa* *Goodenia stobbsiana* *Grevillea wickhamii*		*Polygala isingii* *Ptilotus calostachyus* *Schizachyrium fragile* *Senna glutinosa* subsp. *glutinosa* *Triodia wiseana*		

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF12					
Botanist	Chid	**Date**	3/28/2012	**Site area**	Quadrat 50 x 50 m
Location	50K		695001 **mE**	7476202 **mN**	**Elevation** 789 m
Topography and Geology	Landform: Deep gorge valley bottom Aspect and Slope: North gently inclined. Soil: red brown sandy clay. Geology: 95% cover of granite, BIF pebbles, stones, boulders, sheet.				
Veg Condition	2	**Disturbances**	cattle, weeds	**Land System**	Boolgeeda
Site Photo					
Vegetation	*Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Stylobasium spathulatum, Gossypium robinsonii* tall open shrubland over *Triodia wiseana* hummock grassland.				

Species	
Abutilon dioicum	*Gomphrena cunninghamii*
Abutilon indicum	*Gossypium robinsonii*
Acacia bivenosa	*Grevillea wickhamii*
Acacia inaequilatera	*Hakea lorea*
Acacia maitlandii	*Hibiscus coatesii*
Acacia synchronicia	*Paspalidium tabulatum*
**Bidens bipinnata*	*Pterocaulon serrulatum*
Capparis spinosa var. *nummularia*	*Salsola australis*
Corchorus lasiocarpus subsp. *lasiocarpus*	*Senna venusta*
Cymbopogon ambiguus	*Solanum phlomoides*
Dodonaea viscosa subsp. *mucronata*	*Stylobasium spathulatum*
Duperreya commixta	*Tinospora smilacina*
Eucalyptus leucophloia subsp. *leucophloia*	*Triodia wiseana*
Euphorbia biconvexa	

<table>
<tr><th colspan="6">Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF14</th></tr>
<tr><td>Botanist</td><td>Linda</td><td>Date</td><td>3/28/2012</td><td>Site area</td><td>Quadrat 50 x 50 m</td></tr>
<tr><td>Location</td><td colspan="2">50K</td><td>694402 mE</td><td>7476052 mN</td><td>Elevation 925 m</td></tr>
<tr><td>Topography and Geology</td><td colspan="5">Landform: Ridge top
Aspect and Slope: WSE (240°) gentle on ridge top <8%.
Soil: red clay.
Geology: 95% cover of BIF 5-10 cm.</td></tr>
<tr><td>Veg Condition</td><td>1</td><td>Disturbances</td><td>old fire (>5 years previous)</td><td>Land System</td><td>Boolgeeda</td></tr>
<tr><td>Site Photo</td><td colspan="5">  </td></tr>
<tr><td>Vegetation</td><td colspan="5">Eucalyptus leucophloia subsp. leucophloia, Eucalyptus gamophylla low open woodland over Triodia wiseana hummock grassland.</td></tr>
<tr><td>Species</td><td colspan="2">Eucalyptus gamophylla
Eucalyptus leucophloia subsp. leucophloia
Fimbristylis dichotoma
Goodenia microptera</td><td colspan="3">Goodenia stobbsiana
Senna glutinosa subsp. glutinosa
Solanum lasiophyllum
Triodia wiseana</td></tr>
</table>

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF15						
Botanist	Chid	**Date**	3/29/2012	**Site area**	Quadrat 50 x 50 m	
Location	50K		693315 **mE**	7475767 **mN**	**Elevation** 753 m	
Topography and Geology	Landform: Creekline within broad open drainage system surrounded by hills. Soil: brown sandy clay. Geology: 90% cover of ironstone pebbles, gravel, rocks.					
Veg Condition	3	**Disturbances**	cattle, weeds, clearing nearby (tracks and drill pads)	**Land System**	Boolgeeda	
Site Photo						
Vegetation	*Hakea lorea* scattered low trees over *Acacia tumida* var. *pilbarensis*, *Grevillea wickhamii, Acacia monticola* tall open scrub over *Gossypium robinsonii* and mixed species low open shrubland over *Themeda triandra, Eriachne helmsii* tussock grassland and *Triodia wiseana* open hummock grassland.					
Species	*Abutilon indicum* *Acacia inaequilatera* *Acacia monticola* *Acacia tumida* var. *pilbarensis* **Bidens bipinnata* *Boerhavia gardneri* *Bulbostylis barbata* *Cleome viscosa* *Corchorus incanus* subsp. *lithophilus* *Crotalaria medicaginea* *Cucumis maderaspatanus* *Dodonaea viscosa* subsp. *mucronata* *Dysphania rhadinostachya* *Eriachne helmsii* *Evolvulus alsinoides* var. *villosicalyx* *Gomphrena cunninghamii* *Gossypium robinsonii* *Grevillea wickhamii*			*Hakea lorea* *Hybanthus aurantiacus* *Indigofera monophylla* *Jasminum didymum* subsp. *lineare* *Paspalidium tabulatum* *Phyllanthus maderaspatensis* *Polycarpaea longiflora* *Pterocaulon serrulatum* *Ptilotus obovatus* subsp. *obovatus* *Rhagodia eremaea* *Rhynchosia minima* *Santalum lanceolatum* *Senna venusta* *Stylobasium spathulatum* *Tephrosia densa* *Themeda triandra* *Trichodesma zeylanicum* var. *zeylanicum* *Triodia wiseana*		

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF16					
Botanist	Linda	**Date**	3/29/2012	**Site area**	Quadrat 50 x 50 m
Location	50K		692155 **mE**	7475996 **mN**	**Elevation** 728 m
Topography and Geology	Landform: Gentle undulating country between breakaways Aspect and Slope: 210° gentle (5%). Soil: red clay. Geology:95% cover of BIF 5-30 cm.				
Veg Condition	2	**Disturbances**	none	**Land System**	McKay
Site Photo					
Vegetation	*Eucalyptus leucophloia* subsp. *leucophloia*, *Corymbia hamersleyana* scattered low trees over *Acacia inaequilatera* scattered tall shrubs over *Triodia wiseana, Triodia brizoides* hummock grassland.				
Species	*Acacia adoxa* var. *adoxa* *Acacia hilliana* *Acacia elachantha* *Acacia inaequilatera* *Bulbostylis barbata* *Corymbia hamersleyana* *Dysphania rhadinostachya* *Eucalyptus leucophloia* subsp. *leucophloia* *Fimbristylis dichotoma* *Goodenia microptera*			*Goodenia stobbsiana* *Hakea lorea* *Jasminum didymum* subsp. *lineare* *Polycarpaea corymbosa* var. *corymbosa* *Polycarpaea holtzei* *Ptilotus calostachyus* *Senna artemisioides* subsp. *helmsii* *Senna glutinosa* subsp. *glutinosa* *Solanum lasiophyllum* *Triodia brizoides* *Triodia wiseana*	

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF17						
Botanist	Linda	**Date**	3/29/2012	**Site area**	Quadrat 50 x 50 m	
Location	50K		691198 **mE**	7477353 **mN**	**Elevation** 695 m	
Topography and Geology	Landform: Flat plain Soil: red clay. Geology:70% cover of BIF 2-10 cm.					
Veg Condition	3	**Disturbances**	cattle grazing, trampling of vegetation, weeds, nutrification (dung)	**Land System**	McKay	
Site Photo						
Vegetation	*Corymbia ?opaca, Eucalyptus ?xerothermica, Corymbia ?hamersleyana* scattered low trees over *Eremophila longifolia, Eremophila fraseri* subsp. *fraseri* open shrubland over *Acacia hilliana, Senna* spp., *Indigofera monophylla* low open shrubland over *Triodia wiseana* very open hummock grassland					
Species	*Abutilon otocarpum* *Acacia aptaneura* *Acacia inaequilatera* *Acacia pruinocarpa* *Aristida contorta* *Aristida contorta* *Boerhavia gardneri* *Capparis lasiantha* *Cleome viscosa* *Cymbopogon ambiguus* *Dysphania rhadinostachya* *Enneapogon caerulescens* *Eremophila fraseri* subsp. *fraseri* *Eremophila longifolia* *Eucalyptus ?xerothermica* *Euphorbia latrobei* subsp. *filiformis* *Evolvulus alsinoides* var. *villosicalyx*			*Gomphrena canescens* subsp. *canescens* *Hibiscus burtonii* *Indigofera monophylla* *Jasminum didymum* subsp. *lineare* *Perotis rara* **Portulaca oleracea* *Ptilotus obovatus* subsp. *obovatus* *Salsola australis* *Senna artemisioides* subsp. *helmsii* *Senna artemisioides* subsp. *oligophylla* *Senna glutinosa* subsp. *glutinosa* *Senna notabilis* *Sida arenicola* *Solanum lasiophyllum* *Sporobolus australasicus* *Triodia wiseana*		

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF18					
Botanist	Linda	**Date**	3/29/2012	**Site area**	Quadrat 50 x 50 m
Location	50K		691671 **mE**	7475755 **mN**	**Elevation** 721 m
Topography and Geology	Landform: Flat plain Soil: red clay. Geology: 50% cover of BIF 0.5-5 cm.				
Veg Condition	4	**Disturbances**	exploration diggings, grazing, tracks	**Land System**	McKay
Site Photo					
Vegetation	*Acacia aptaneura, Grevillea stenobotrya* low open woodland *Senna artemisioides* subsp. *helmsii, Eremophila fraseri* subsp. *fraseri* open shrubland over mixed species scattered herbs and tussock grasses.				

Species	
Abutilon otocarpum *Acacia aptaneura* *Acacia aptaneura* *Acacia minyura* *Acacia pruinocarpa* *Aristida contorta* **Bidens bipinnata* *Boerhavia gardneri* *Cleome viscosa* *Cucumis maderaspatanus* *Dysphania rhadinostachya* *Eremophila fraseri* subsp. *fraseri* *Euphorbia latrobei* subsp. *filiformis* *Gomphrena canescens* subsp. *canescens* *Goodenia stobbsiana*	*Grevillea stenobotrya* *Hakea lorea* *Jasminum didymum* subsp. *lineare* *Perotis rara* **Portulaca oleracea* *Pterocaulon serrulatum* *Sclerolaena cornishiana* *Senna artemisioides* subsp. *helmsii* *Senna notabilis* *Sida* ?sp. Supplejack Station (T.S. Henshall 2345) *Sida arenicola* *Solanum lasiophyllum* *Tribulus astrocarpus*

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF19						
Botanist	Linda	**Date**	3/29/2012	**Site area**	Quadrat 50 x 50 m	
Location	50K		690473 **mE**	7477077 **mN**	**Elevation** 704 m	
Topography and Geology	Landform: Flat plain Soil: red clay. Geology: 90% cover of BIF 2-5 cm.					
Veg Condition	3	**Disturbances**	cattle grazing, old tracks, nutrification	**Land System**	McKay	
Site Photo						
Vegetation	*Corymbia deserticola* scattered low trees over *Acacia pruinocarpa* scattered tall shrubs over mixed species low scattered shrubs over *Triodia wiseana* very open hummock grassland and mixed species very open herbland.					
Species	*Abutilon otocarpum* *Acacia ancistrocarpa* *Acacia aptaneura* *Acacia pruinocarpa* *Aristida contorta* *Boerhavia gardneri* *Cleome viscosa* *Corymbia deserticola* *Cymbopogon obtectus* *Dodonaea viscosa* subsp. *mucronata* *Dysphania rhadinostachya* *Enneapogon caerulescens* *Eremophila fraseri* subsp. *fraseri* *Euphorbia latrobei* subsp. *filiformis* *Evolvulus alsinoides* var. *villosicalyx*			*Gomphrena cunninghamii* *Goodenia microptera* *Jasminum didymum* subsp. *lineare* *Perotis rara* *Psydrax rigidula* *Pterocaulon serrulatum* *Ptilotus helipteroides* *Ptilotus obovatus* subsp. *obovatus* *Senna artemisioides* subsp. *helmsii* *Senna glutinosa* subsp. *glutinosa* *Senna notabilis* *Solanum lasiophyllum* *Sporobolus australasicus* *Tribulus hirsutus* *Triodia wiseana*		

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF20					
Botanist	Linda	**Date**	3/29/2012	**Site area**	Quadrat 50 x 50 m
Location	50K		690589 **mE**	7476396 **mN**	**Elevation** 707 m
Topography and Geology	Landform: Flat plain. Soil: red clay. Geology: 10% cover of BIF pebbles and cobbles.				
Veg Condition	4	**Disturbances**	cattle and macropods grazing, tracks, trampled vegetation, nutrification (dung), weeds.	**Land System**	McKay
Site Photo					
Vegetation	*Corymbia deserticola, Acacia aptaneura* scattered low trees over *Dodonaea viscosa* subsp. *mucronata, Senna artemisioides* subsp. *helmsii, Sida* sp. Supplejack Station (T.S. Henshall 2345) open shrubland over *Triodia wiseana* scattered hummock grasses and mixed species very open herbland.				
Species	*Abutilon otocarpum* *Acacia aptaneura* *Acacia synchronicia* *Aristida contorta* **Bidens bipinnata* *Boerhavia gardneri* *Cleome viscosa* *Cleome viscosa* *Corymbia deserticola* *Cucumis maderaspatanus* *Cymbopogon ambiguus* *Dodonaea viscosa* subsp. *mucronata* *Dysphania rhadinostachya* *Eremophila fraseri* subsp. *fraseri*		*Gomphrena cunninghamii* *Jasminum didymum* subsp. *lineare* *Perotis rara* **Portulaca oleracea* *Pterocaulon serrulatum* *Ptilotus helipteroides* *Ptilotus obovatus* subsp. *obovatus* *Senna artemisioides* subsp. *helmsii* *Senna glutinosa* subsp. *glutinosa* *Senna notabilis* *Sida* ?sp. Supplejack Station (T.S. Henshall 2345) *Solanum lasiophyllum* *Stemodia viscosa*		

	Eremophila longifolia *Euphorbia latrobei* subsp. *filiformis* *Evolvulus alsinoides* var. *villosicalyx*	*Tribulus hirsutus* *Triodia wiseana*

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF21					
Botanist	Chid	**Date**	3/29/2012	**Site area**	Quadrat 50 x 50 m
Location	50K		689945 **mE**	7475643 **mN**	**Elevation** 838 m
Topography and Geology	Landform: Slope on side of large hill Aspect and Slope: NNW moderately inclined. Soil: light brown sandy clay. Geology: 95% cover of ironstone pebbles and cobbles, some sheet rock.				
Veg Condition	1	**Disturbances**	none	**Land System**	Boolgeeda
Site Photo					
Vegetation	*Corymbia hamersleyana, Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Grevillea wickhamii* tall open shrubland over *Triodia wiseana* open hummock grassland.				
Species	*Acacia inaequilatera* *Corchorus incanus* subsp. *lithophilus* *Corymbia hamersleyana* *Cymbopogon ambiguus* *Dampiera candicans* *Eriachne helmsii* *Eucalyptus leucophloia* subsp. *leucophloia* *Gossypium robinsonii* *Grevillea wickhamii*		*Hakea lorea* *Indigofera monophylla* *Ptilotus calostachyus* *Scaevola browniana* subsp. *browniana* *Senna artemisioides* subsp. *oligophylla* *Senna glutinosa* subsp. *glutinosa* *Solanum phlomoides* *Triodia wiseana*		

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF22					
Botanist	Chid	**Date**	3/29/2012	**Site area**	Quadrat 50 x 50 m
Location	50K		691099 **mE**	7474508 **mN**	**Elevation** 725 m
Topography and Geology	Landform: Flat plain Soil: orange brown sandy clay. Geology: 90% cover of ironstone pebbles.				
Veg Condition	2	**Disturbances**	cattle, vehicle tracks nearby	**Land System**	McKay
Site Photo					
Vegetation	*Eucalyptus gamophylla* low open woodland over *Acacia elachantha, A. synchronicia, A. xiphophylla* tall scattered shrubs over *Triodia brizoides, Triodia wiseana* open hummock grassland.				

Species	
Acacia adoxa var. *adoxa*	*Indigofera monophylla*
Acacia elachantha	*Ptilotus calostachyus*
Acacia synchronicia	*Ptilotus obovatus* subsp. *obovatus*
Acacia tenuissima	*Ptilotus rotundifolius*
Acacia xiphophylla	*Rhyncharrhena linearis*
Bulbostylis barbata	*Senna artemisioides* subsp. *oligophylla*
Capparis lasiantha	*Senna artemisioides* subsp. *sturtii*
Eucalyptus gamophylla	*Senna glutinosa* subsp. *glutinosa*
Gompholobium sp. Pilbara (NF Norris 908)	*Sida* sp. Pilbara (A.A. Mitchell PRP 1543)
Goodenia microptera	*Triodia brizoides*
Goodenia stobbsiana	*Triodia wiseana*
Grevillea wickhamii	

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF23						
Botanist	Chid	**Date**	3/29/2012	**Site area**	Quadrat 50 x 50 m	
Location	50K		691122 **mE**	7474279 **mN**	**Elevation** 728 m	
Topography and Geology	Landform: Broad creekline Slope: flat. Soil: orange brown fine sandy clay. Geology: 30% cover of ironstone pebbles, cobbles.					
Veg Condition	2	**Disturbances**	weeds, cattle	**Land System**	McKay	
Site Photo						
Vegetation	*Corymbia hamersleyana, Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Acacia monticola, Acacia pyrifolia* var. *morrisonii, Rulingia luteiflora* tall open scrub over *Triodia wiseana* very open hummock grassland.					
Species	*Acacia elachantha* *Acacia monticola* *Acacia pyrifolia* var. *morrisonii* *Acacia synchronicia* *Alternanthera nana* **Bidens bipinnata* *Boerhavia gardneri* **Cenchrus ciliaris* *Cleome viscosa* *Clerodendrum ?tomentosum* *Corymbia hamersleyana* *Cymbopogon ambiguus* *Digitaria ctenantha* *Dysphania rhadinostachya* *Enneapogon polyphyllus* *Eragrostis cumingii* *Eragrostis eriopoda* *Eucalyptus gamophylla* *Eucalyptus leucophloia* subsp. *leucophloia*				*Euphorbia tannensis* subsp. *eremophila* *Evolvulus alsinoides* var. *villosicalyx* *Gomphrena cunninghamii* *Gossypium robinsonii* *Grevillea wickhamii* subsp. *hispidula* *Hibiscus burtonii* *Hybanthus aurantiacus* *Indigofera monophylla* *Jasminum didymum* subsp. *lineare* *Paraneurachne muelleri* *Polycarpaea longiflora* *Rhyncharrhena linearis* *Rhynchosia minima* *Rulingia luteiflora* *Senna artemisioides* subsp. *oligophylla* *Tephrosia densa* *Themeda triandra* *Trachymene ?oleracea* *Triodia wiseana*	

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF24						
Botanist	Linda	**Date**	3/30/2012	**Site area**	Quadrat 50 x 50 m	
Location	50K		691209 **mE**	7473395 **mN**	**Elevation** 733 m	
Topography and Geology	Landform: Foothills of breakaway / ridge Aspect and Slope: East 105° moderately inclined. Soil: red clay. Geology: 95% cover of BIF gravels and pebbles.					
Veg Condition	2	**Disturbances**	grazing (cattle)	**Land System**	Boolgeeda	
Site Photo						
Vegetation	*Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Acacia hilliana, Senna artemisioides* subsp. *oligophylla , Senna glutinosa* subsp. *glutinosa* open shrubland *over Triodia wiseana, Triodia brizoides* hummock grassland.					
Species	*Acacia adoxa* var. *adoxa* *Acacia hilliana* *Acacia monticola* *Bulbostylis barbata* *Corchorus lasiocarpus* subsp. *lasiocarpus* *Eucalyptus leucophloia* subsp. *leucophloia* *Fimbristylis dichotoma* *Fimbristylis simulans* *Goodenia microptera* *Hakea lorea* *Polycarpaea holtzei*			*Ptilotus calostachyus* *Ptilotus rotundifolius* *Schizachyrium fragile* *Senna artemisioides* subsp. *oligophylla* *Senna glutinosa* subsp. *pruinosa* *Solanum lasiophyllum* *Trachymene oleracea* *Triodia brizoides* *Triodia wiseana* *Triumfetta maconochieana*		

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF25					
Botanist	Linda	**Date**	3/30/2012	**Site area**	Quadrat 50 x 50 m
Location	50K		689979 **mE**	7471899 **mN**	**Elevation** 757 m
Topography and Geology	Landform: Plain Soil: red clay. Geology: 80% cover of BIF gravels and pebbles.				
Veg Condition	3	**Disturbances**	grazing, fire approximately 3 years previously	**Land System**	McKay
Site Photo					
Vegetation	*Eucalyptus gamophylla* low woodland over *Keraudrenia nephrosperma* and mixed species low open shrubland over *Triodia wiseana, Triodia brizoides* hummock grassland.				
Species	*Acacia bivenosa* *Acacia elachantha* *Acacia inaequilatera* *Acacia tenuissima* *Aristida contorta* *Cymbopogon ambiguus* *Eucalyptus gamophylla* *Eucalyptus leucophloia* subsp. *leucophloia* *Goodenia stobbsiana* *Hakea lorea* *Indigofera monophylla* *Jasminum didymum* subsp. *lineare*			*Keraudrenia nephrosperma* *Ptilotus calostachyus* *Ptilotus rotundifolius* *Santalum lanceolatum* *Scaevola parvifolia* subsp. *pilbarae* *Senna artemisioides* subsp. *oligophylla* *Senna glutinosa* subsp. *glutinosa* *Senna glutinosa* subsp. *pruinosa* *Sida arenicola* *Solanum lasiophyllum* *Triodia brizoides* *Triodia wiseana*	

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF26					
Botanist	Chid	**Date**	3/30/2012	**Site area**	Quadrat 50 x 50 m
Location	50K		689383 **mE**	7472214 **mN**	**Elevation** 785 m
Topography and Geology	Landform: Stony hillside Aspect and Slope: ENE moderately inclined. Soil: orange brown clay loam. Geology: 90% cover of ironstone pebbles, cobbles, sheets.				
Veg Condition	2	**Disturbances**	none	**Land System**	Boolgeeda
Site Photo					
Vegetation	*Eucalyptus leucophloia* subsp. *leucophloia, Corymbia hamersleyana* scattered low trees over *Acacia hilliana* scattered low shrubs over *Triodia wiseana* open hummock grassland.				

Species	
Acacia adoxa var. *adoxa*	*Hakea lorea*
Acacia hilliana	*Hibiscus sturtii* var. *campylochlamys*
Acacia monticola	*Polycarpaea holtzei*
Acacia tenuissima	*Polycarpaea longiflora*
Aristida holathera	*Ptilotus astrolasius*
Bulbostylis barbata	*Ptilotus calostachyus*
Corchorus incanus subsp. *lithophilus*	*Ptilotus clementii*
Corymbia hamersleyana	*Ptilotus rotundifolius*
Dodonaea coriacea	*Scaevola browniana* subsp. *browniana*
Enneapogon polyphyllus	*Schizachyrium fragile*
Eremophila forrestii subsp. *forrestii*	*Senna artemisioides* subsp. *oligophylla*
Eriachne helmsii	*Senna glutinosa* subsp. *glutinosa*
Eriachne pulchella subsp. *pulchella*	*Sida ?echinocarpa*
Eucalyptus leucophloia subsp. *leucophloia*	*Sida* sp. Golden calyces glabrous (H.N. Foote 32)
Fimbristylis dichotoma	*Solanum lasiophyllum*
Gomphrena cunninghamii	*Triodia wiseana*
Goodenia microptera	*Urochloa holosericea* subsp. *velutina*
Goodenia stobbsiana	
Grevillea wickhamii	

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF27					
Botanist	Chid	**Date**	3/30/2012	**Site area**	Quadrat 50 x 50 m
Location	50K		688788 **mE**	7472189 **mN**	**Elevation** 828 m
Topography and Geology	Landform: Stony hillside Aspect: NE. Soil: pale brown fine clay. Geology: 95% cover of ironstone pebbles, cobbles.				
Veg Condition	1	**Disturbances**	none	**Land System**	Boolgeeda
Site Photo					
Vegetation	*Eucalyptus leucophloia* subsp. *leucophloia, Corymbia hamersleyana* scattered low trees over *Keraudrenia nephrosperma, Acacia hilliana* low shrubland over *Triodia wiseana* open hummock grassland and *Schizachyrium fragile* very open tussock grassland.				
Species	*Acacia adoxa* var. *adoxa* *Acacia hilliana* *Acacia tenuissima* *Amphipogon sericeus* *Aristida holathera* *Corchorus incanus* subsp. *lithophilus* *Corymbia hamersleyana* *Cymbopogon ambiguus* *Dampiera candicans* *Dodonaea coriacea* *Eriachne helmsii* *Eucalyptus leucophloia* subsp. *leucophloia*		*Goodenia microptera* *Hakea lorea* *Hibiscus sturtii* var. *campylochlamys* *Keraudrenia nephrosperma* *Ptilotus calostachyus* *Schizachyrium fragile* *Senna ferraria* *Sida* sp. Golden calyces glabrous (H.N. Foote 32) *Solanum lasiophyllum* *Triodia wiseana*		

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF28					
Botanist	Linda	**Date**	3/30/2012	**Site area**	Quadrat 50 x 50 m
Location	50K		687837 **mE**	7470500 **mN**	**Elevation** 777 m
Topography and Geology	Landform: Shallow wide drainage line on plain Aspect and Slope: S 200° gently inclined. Soil: red clay. Geology: 30% cover of BIF pebbles.				
Veg Condition	3	**Disturbances**	cattle grazing, erorion	**Land System**	McKay
Site Photo					
Vegetation	*Eucalyptus gamophylla, Corymbia hamersleyana* low woodland over *Acacia tenuissima, Acacia elachantha, Gossypium robinsonii* tall open shrubland over *Keraudrenia nephrosperma, Senna glutinosa* subsp. *pruinosa, Indigofera monophylla* low shrubland over *Triodia wiseana* open hummock grassland.				

Species	
Acacia adoxa var. *adoxa*	*Gossypium robinsonii*
Acacia aptaneura	*Hakea lorea*
Acacia bivenosa	*Indigofera monophylla*
Acacia elachantha	*Jasminum didymum* subsp. *lineare*
Acacia elachantha	*Keraudrenia nephrosperma*
Acacia steedmanii subsp. *borealis*	*Psydrax rigidula*
Acacia tenuissima	*Ptilotus calostachyus*
Aristida contorta	*Santalum lanceolatum*
Corymbia deserticola	*Scaevola parvifolia* subsp. *pilbarae*
Corymbia ?hamersleyana	*Senna artemisioides* subsp. *oligophylla*
Cymbopogon obtectus	*Senna glutinosa* subsp. *pruinosa*
Dodonaea viscosa subsp. *mucronata*	*Solanum lasiophyllum*
Eucalyptus gamophylla	*Trachymene oleracea*
Evolvulus alsinoides var. *villosicalyx*	*Triodia wiseana*
Goodenia stobbsiana	

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF29						
Botanist	Linda	**Date**	3/30/2012	**Site area**	Quadrat 50 x 50 m	
Location	50K		685400 **mE**	7469780 **mN**	**Elevation** 754 m	
Topography and Geology	Landform: Flat plain with large dissected drainage line in valley between two breakaways Soil: red clay. Geology: 30% cover of BIF gravels, pebbles and cobbles.					
Veg Condition	3	**Disturbances**	grazing, erosion, weeds	**Land System**	McKay	
Site Photo						
Vegetation	*Corymbia hamersleyana* scattered low trees over *Gossypium robinsonii, Acacia elachantha* tall open shrubland over *Triodia wiseana* hummock grassland and *Eulalia aurea, Eragrostis eriopoda* very open tussock grassland.					
Species	*Acacia elachantha* *Acacia maitlandii* *Alternanthera nana* *Aristida contorta* *Boerhavia gardneri* *Cleome viscosa* *Corymbia ?hamersleyana* *Cymbopogon ambiguus* *Dysphania rhadinostachya* *Eragrostis eriopoda* *Eucalyptus gamophylla* *Eulalia aurea* *Euphorbia biconvexa* *Evolvulus alsinoides* var. *villosicalyx* *Gomphrena canescens* subsp. *canescens* *Gomphrena cunninghamii* *Goodenia forrestii*			*Gossypium robinsonii* *Hybanthus aurantiacus* *Jasminum didymum* subsp. *lineare* *Keraudrenia nephrosperma* *Perotis rara* *Pterocaulon serrulatum* *Rhynchosia minima* *Rulingia luteiflora* *Rulingia luteiflora* *Santalum lanceolatum* *Scaevola parvifolia* subsp. *pilbarae* *Senna artemisioides* subsp. *oligophylla* *Tephrosia densa* *Tribulus hirsutus* *Triodia wiseana* *Triumfetta ?maconochieana*		

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF30					
Botanist	Chid	**Date**	3/30/2012	**Site area**	Quadrat 50 x 50 m
Location	50K		685189 **mE**	7469360 **mN**	**Elevation** 761 m
Topography and Geology	Landform: Stony hillside with rocky ledges and breakaways Aspect and Slope: NW moderately inclined. Soil: red brown sandy clay. Geology: 90% cover of pebbles, sheets, ledges.				
Veg Condition	0	**Disturbances**	?	**Land System**	McKay
Site Photo					
Vegetation	*Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Gossypium robinsonii* scattered shrubs over *Triodia wiseana* hummock grassland and *Cymbopogon ambiguus* scattered tussock grasses.				

Species	
Acacia dictyophleba	*Goodenia muelleriana*
Acacia inaequilatera	*Goodenia stobbsiana*
Aristida holathera	*Gossypium robinsonii*
Boerhavia gardneri	*Hakea lorea*
Bulbostylis barbata	*Paraneurachne muelleri*
Corchorus incanus subsp. *lithophilus*	*Polycarpaea holtzei*
Corymbia deserticola	*Ptilotus obovatus* subsp. *obovatus*
Corymbia hamersleyana	*Ptilotus rotundifolius*
Cucumis maderaspatanus	*Rhyncharrhena linearis*
Cymbopogon ambiguus	*Rhynchosia minima*
Eremophila forrestii subsp. *forrestii*	*Schizachyrium fragile*
Eriachne helmsii	*Senna glutinosa* subsp. *glutinosa*
Eriachne pulchella subsp. *pulchella*	*Sida ?echinocarpa*
Eucalyptus leucophloia subsp. *leucophloia*	*Themeda triandra*
Euphorbia biconvexa	*Triodia wiseana*
	Triumfetta maconochieana

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF31							
Botanist	Chid	**Date**	3/30/2012	**Site area**	Quadrat 50 x 50 m		
Location	50K		684925 **mE**	7469255 **mN**	**Elevation** 746 m		
Topography and Geology	Landform: Flat plain, open drainage area Soil: red sandy clay. Geology: 30% cover of ironstone gravel, pebbles.						
Veg Condition	3	**Disturbances**	weeds, cattle	**Land System**	McKay		
Site Photo							
Vegetation	*Acacia aptaneura* low open woodland over *Themeda triandra, Aristida lazaridis, Dactyloctenium radulans* open tussock grassland with *Nicotiana occidentalis* subsp. *obliqua, Salsola australis* open herbland.						
Species	*Bidens bipinnata* *Chloris virgata* **Malvastrum americanum* **Portulaca oleracea* *Abutilon otocarpum* *Acacia aptaneura* *Acacia pruinocarpa* *Aristida calycina* var. *calycina* *Aristida holathera* *Aristida lazaridis* *Boerhavia gardneri* *Capparis lasiantha* *Chrysopogon fallax* *Cleome viscosa* *Convolvulus angustissimus* subsp. *angustissimus* *Cucumis maderaspatanus* *Dactyloctenium radulans* *Dysphania rhadinostachya* *Enchylaena tomentosa* *Enneapogon polyphyllus* *Eremophila longifolia* *Euphorbia biconvexa*				*Evolvulus alsinoides* var. *villosicalyx* *Goodenia forrestii* *Hakea lorea* *Ipomoea polymorpha* *Iseilema membranaceum* *Nicotiana occidentalis* subsp. *obliqua* *Paspalidium rarum* *Pterocaulon serrulatum* *Ptilotus helipteroides* *Ptilotus macrocephalus* *Ptilotus obovatus* subsp. *obovatus* *Rhagodia eremaea* *Salsola australis* *Senna glutinosa* subsp. *pruinosa* *Sida* ?sp. Spiciform panicles (E. Leyland s.n. 14/8/90) *Sida fibulifera* *Tephrosia supina* *Themeda triandra* *Tragus australianus* *Triraphis mollis* *Urochloa piligera*		

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF32					
Botanist	Linda	**Date**	3/30/2012	**Site area**	Quadrat 50 x 50 m
Location	50K		685020 **mE**	7468502 **mN**	**Elevation** 737 m
Topography and Geology	Landform: Open flat plain Soil: red clay. Geology: 50% cover of BIF gravels and pebbles.				
Veg Condition	4	**Disturbances**	weeds, grazing, tracks	**Land System**	McKay
Site Photo					
Vegetation	*Acacia aptaneura* scattered low trees over *Cymbopogon ambiguus, Aristida contorta* closed tussock grassland and mixed species very open herbland.				

Species	
Abutilon otocarpum	*Evolvulus alsinoides* var. *villosicalyx*
Acacia aptaneura	*Gomphrena cunninghamii*
Acacia pruinocarpa	*Ipomoea polymorpha*
Aristida contorta	*Jasminum didymum* subsp. *lineare*
Aristida contorta	*Maireana villosa*
Boerhavia gardneri	*Perotis rara*
Cleome oxalidea	**Portulaca oleracea*
Cleome viscosa	*Pterocaulon serrulatum*
Cymbopogon ambiguus	*Ptilotus exaltatus* var. *exaltatus*
Cymbopogon obtectus	*Ptilotus helipteroides*
Dactyloctenium radulans	*Senna glutinosa* subsp. *glutinosa*
Dactyloctenium radulans	*Senna glutinosa* subsp. *pruinosa*
Dysphania rhadinostachya	*Senna notabilis*
Enneapogon caerulescens	*Sida arenicola*
Eremophila longifolia	*Solanum lasiophyllum*
Eulalia aurea	*Tephrosia supina*
Euphorbia biconvexa	*Triodia wiseana*
Euphorbia latrobei subsp. *filiformis*	

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF33					
Botanist	Linda	**Date**	3/31/2012	**Site area**	Quadrat 50 x 50 m
Location	50K		684817 **mE**	7467822 **mN**	**Elevation** 725 m
Topography and Geology	Landform: Flat open plain Soil: red clay. Geology: 20% cover of BIF gravels and pebbles.				
Veg Condition	5	**Disturbances**	weeds, grazing, erosion, trampling of vegetation	**Land System**	Wannamunna
Site Photo					
Vegetation	*Acacia dictyophleba, Acacia pachyacra* scattered shrubs over *Dysphania kalpari, Goodenia prostrata, Boerhavia gardneri* herbland with *Aristida contorta, Perotis rara* very open tussock grassland.				

Species	
Abutilon otocarpum *Acacia aptaneura* *Acacia dictyophleba* *Acacia pachyacra* *Aristida contorta* *Boerhavia gardneri* *Brachyscome* sp. Wanna Munna Flats (S. van Leeuwen 4662) *Cleome oxalidea* *Cleome viscosa* *Codonocarpus cotinifolius* *Dysphania kalpari* *Euphorbia biconvexa* *Evolvulus alsinoides* var. *villosicalyx* *Goodenia prostrata*	*Lepidium echinatum* *Paspalidium rarum* *Perotis rara* *Polycarpaea corymbosa* var. *corymbosa* **Portulaca oleracea* *Pterocaulon serrulatum* *Ptilotus exaltatus* var. *exaltatus* *Ptilotus helipteroides* *Ptilotus polystachyus* *Sclerolaena cornishiana* *Sida platycalyx* *Solanum lasiophyllum* *Tribulus hirsutus* *Triodia ?brizoides* *Triodia wiseana*

<table>
<tr><th colspan="6">Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF34</th></tr>
<tr><td>Botanist</td><td>Chid</td><td>Date</td><td>3/31/2012</td><td>Site area</td><td>Quadrat 50 x 50 m</td></tr>
<tr><td>Location</td><td colspan="2">50K</td><td>684774 mE</td><td>7467680 mN</td><td>Elevation 725 m</td></tr>
<tr><td>Topography and Geology</td><td colspan="5">Landform: Floodplain
Slope: level.
Soil: orange brown clay.
Geology: no rock outcrop or coarse fragments.</td></tr>
<tr><td>Veg Condition</td><td>2</td><td>Disturbances</td><td>weeds, cattle, roads nearby</td><td>Land System</td><td>Wannamunna</td></tr>
<tr><td>Site Photo</td><td colspan="5">  </td></tr>
<tr><td>Vegetation</td><td colspan="5">Acacia aptaneura low open forest over Eremophila longifolia scattered shrubs over Themeda triandra, Perotis rara tussock grassland and mixed species very open herbland.</td></tr>
<tr><td>Species</td><td colspan="2">Acacia aptaneura
Alternanthera nana
Aristida contorta
Bidens bipinnata
Boerhavia gardneri
Brachyscome sp. Wanna Munna Flats (S. van Leeuwen 4662)
Calandrinia ptychosperma
Chrysopogon fallax
Cleome viscosa
Cucumis maderaspatanus
Dactyloctenium radulans
Dysphania glomulifera subsp. eremaea
Dysphania rhadinostachya
Enchylaena tomentosa
Enteropogon ramosus
Eragrostis cumingii
Eragrostis pergracilis
Eragrostis tenellula
Eremophila longifolia</td><td colspan="3">Evolvulus alsinoides var. villosicalyx
Fimbristylis dichotoma
Goodenia prostrata
Indigofera georgei
Lepidium echinatum
Lysiana murrayi
Nicotiana occidentalis subsp. obliqua
Perotis rara
*Portulaca oleracea
Pterocaulon serrulatum
Ptilotus clementii
Ptilotus gaudichaudii var. gaudichaudii
Ptilotus obovatus subsp. obovatus
Rhyncharrhena linearis
Sida sp. Tiny fruits (AA Mitchell PRP1152)
Solanum ferocissimum
Spartothamnella teucriiflora
Stenopetalum anfractum
Stenopetalum pedicellare
Themeda triandra</td></tr>
</table>

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF35					
Botanist	Linda	**Date**	3/31/2012	**Site area**	Quadrat 50 x 50 m
Location	50K		683540 **mE**	7469711 **mN**	**Elevation** 738 m
Topography and Geology	Landform: Undulating plain around base of breakaway Aspect and Slope: 235° gently inclined. Soil: red clay. Geology: 80% cover of BIF pebbles and cobbles.				
Veg Condition	3	**Disturbances**	grazing	**Land System**	Boolgeeda
Site Photo					
Vegetation	*Eucalyptus leucophloia* subsp. *leucophloia, Eucalyptus gamophylla* scattered low trees over *Acacia bivenosa, Acacia elachantha* open shrubland over *Triodia wiseana* open hummock grassland.				

Species	
Acacia bivenosa	*Indigofera monophylla*
Acacia elachantha	*Jasminum didymum* subsp. *lineare*
Acacia pruinocarpa	*Perotis rara*
Aristida contorta	*Ptilotus calostachyus*
Cleome viscosa	*Ptilotus exaltatus* var. *exaltatus*
Cucumis maderaspatanus	*Ptilotus polystachyus*
Cymbopogon ambiguus	*Ptilotus rotundifolius*
Cymbopogon obtectus	*Schizachyrium fragile*
Eucalyptus gamophylla	*Senna artemisioides* subsp. *oligophylla*
Eucalyptus leucophloia subsp. *leucophloia*	*Senna glutinosa* subsp. *pruinosa*
Goodenia stobbsiana	*Solanum lasiophyllum*
Hakea lorea	*Triodia wiseana*

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF36						
Botanist	Chid	**Date**	3/31/2012	**Site area**	Quadrat 50 x 50 m	
Location	50K		683234 **mE**	7470594 **mN**	**Elevation** 749 m	
Topography and Geology	Landform: Gentle slope at base of hill Aspect and Slope: WSW gently inclined. Soil: orange fine sandy clay. Geology: 95% cover of ironstone pebbles and cobbles.					
Veg Condition	2	**Disturbances**	cattle, tracks nearby	**Land System**	McKay	
Site Photo						
Vegetation	*Keraudrenia nephrosperma, Acacia adsurgens, Acacia bivenosa* open shrubland over *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835), *Triodia wiseana* hummock grassland.					
Species	*Acacia adoxa* var. *adoxa* *Acacia adsurgens* *Acacia bivenosa* *Acacia dictyophleba* *Acacia maitlandii* *Bulbostylis barbata* *Cymbopogon ambiguus* *Eucalyptus leucophloia* subsp. *leucophloia*			*Hakea lorea* *Keraudrenia nephrosperma* *Ptilotus rotundifolius* *Schizachyrium fragile* *Senna artemisioides* subsp. *oligophylla* *Senna glutinosa* subsp. *glutinosa* *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) *Triodia wiseana*		

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF37						
Botanist	Chid	**Date**	3/31/2012	**Site area**	Quadrat 50 x 50 m	
Location	50K		683086 **mE**	7471288 **mN**	**Elevation** 747 m	
Topography and Geology	Landform: Flat plain Slope: very gently linclined. Soil: red fine sandy clay. Geology: ironstone pebbles and cobbles.					
Veg Condition	3	**Disturbances**	weeds, cattle	**Land System**	McKay	
Site Photo						
Vegetation	*Acacia aptaneura, Acacia inaequilatera* scattered low trees over *Eremophila longifolia*, *Senna artemisioides* subsp. *oligophylla* open shrubland over *Triodia wiseana* scattered hummock grasses and *Aristida inaequiglumis, Perotis rara* scattered tussock grasses.					
Species	*Abutilon otocarpum* *Acacia aptaneura* *Acacia inaequilatera* *Acacia marramamba* *Aristida contorta* *Aristida inaequiglumis* *Bidens bipinnata* *Cleome viscosa* *Corymbia deserticola* *Dysphania rhadinostachya* *Enneapogon polyphyllus* *Eragrostis cumingii* *Eremophila forrestii* subsp. *forrestii* *Eremophila longifolia* *Eriachne helmsii* *Evolvulus alsinoides* var. *villosicalyx* *Gomphrena canescens* subsp. *canescens* *Goodenia microptera*			*Gossypium australe* *Heliotropium tenuifolium* *Hibiscus sturtii* var. *platychlamys* *Perotis rara* *Psydrax latifolia* *Pterocaulon serrulatum* *Ptilotus helipteroides* *Ptilotus obovatus* subsp. *obovatus* *Rhyncharrhena linearis* *Senna artemisioides* subsp. *helmsii* *Senna artemisioides* subsp. *oligophylla* *Sida* ?sp. Spiciform panicles (E. Leyland s.n. 14/8/90) *Solanum phlomoides* *Sporobolus australasicus* *Tribulopis angustifolia* *Triodia wiseana*		

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF38						
Botanist	Linda	**Date**	3/31/2012	**Site area**	Quadrat 50 x 50 m	
Location	50K		683397 **mE**	7472548 **mN**	**Elevation** 741 m	
Topography and Geology	Landform: Flat open plain in-between rollin hills Soil: dark red clay. Geology: 40% cover of BIF, pisolite gravels up to 2 cm.					
Veg Condition	3	**Disturbances**	grazing, erosion	**Land System**	McKay	
Site Photo						
Vegetation	*Eucalyptus gamophylla* low open woodland over *Acacia ancistrocarpa, Acacia elachantha* tall open shrubland over mixed species open tussock grassland and *Triodia brizoides* very open hummock grassland.					

Species	
Acacia ancistrocarpa	*Keraudrenia nephrosperma*
Acacia elachantha	*Paraneurachne muelleri*
Aristida contorta	*Polycarpaea holtzei*
Cymbopogon obtectus	*Ptilotus calostachyus*
Dysphania rhadinostachya	*Ptilotus rotundifolius*
Eragrostis pergracilis	*Scaevola parvifolia* subsp. *pilbarae*
Eucalyptus gamophylla	*Schizachyrium fragile*
Eulalia aurea	*Senna artemisioides* subsp. *oligophylla*
Euphorbia biconvexa	*Senna glutinosa* subsp. *pruinosa*
Evolvulus alsinoides var. *villosicalyx*	*Senna notabilis*
Goodenia microptera	*Sida* sp. Pilbara (A.A. Mitchell PRP 1543)
Goodenia stobbsiana	*Solanum lasiophyllum*
Hibiscus coatesii	*Triodia ?brizoides*
Jasminum didymum subsp. *lineare*	

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF39					
Botanist	Chid	**Date**	4/1/2012	**Site area**	Quadrat 50 x 50 m
Location	50K		683957 **mE**	7473448 **mN**	**Elevation** 732 m
Topography and Geology	Landform: Narrow creekline on gentle slope at base of hill Aspect and Slope: NW gently inclined. Soil: red brown clay. Geology: 95% cover of ironstone, laterite gravel, pebbles, cobbles.				
Veg Condition	2	**Disturbances**	weeds, cattle	**Land System**	Boolgeeda
Site Photo					
Vegetation	*Corymbia hamersleyana* scattered low trees over *Grevillea wickhamii, Acacia inaequilatera* tall open shrubland over *Triodia wiseana, Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) hummock grassland.				
Species	*Acacia inaequilatera* *Acacia monticola* *Aristida holathera* *Clerodendrum ?tomentosum* *Corymbia hamersleyana* *Cymbopogon ambiguus* *Enneapogon polyphyllus* *Eragrostis eriopoda* *Eriachne helmsii* *Fimbristylis simulans* *Gompholobium sp. Pilbara (NF Norris 908)* *Gossypium robinsonii*			*Grevillea wickhamii* *Hybanthus aurantiacus* *Jasminum didymum* subsp. *lineare* *Keraudrenia nephrosperma* *Senna glutinosa* subsp. *glutinosa* *Senna venusta* *Solanum lasiophyllum* *Themeda triandra* *Triodia sp. Shovelanna Hill (S. van Leeuwen 3835)* *Triodia wiseana* *Urochloa piligera*	

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF40					
Botanist	Chid	**Date**	4/1/2012	**Site area**	Quadrat 50 x 50 m
Location	50K		684557 **mE**	7473917 **mN**	**Elevation** 728 m
Topography and Geology	Landform: Gently undulating plain at foot of breakaway, some small flat drainage lines Aspect and Slope: 280° gently inclined Soil: red clay. Geology:95% cover of BIF, chert, quartz pebbles and cobbles.				
Veg Condition	0	**Disturbances**	grazing, erosion, weeds	**Land System**	Boolgeeda
Site Photo					
Vegetation	*Eucalyptus leucophloia* subsp. *leucophloia, Eucalyptus gamophylla* scattered low trees over *Acacia elachantha, Acacia inaequilatera, Santalum lanceolatum* tall open shrubland over *Triodia brizoides, Triodia wiseana* hummock grassland.				

Species	
Acacia elachantha	*Polycarpaea holtzei*
Acacia inaequilatera	*Ptilotus calostachyus*
Aristida contorta	*Ptilotus obovatus* subsp. *obovatus*
Cleome viscosa	*Ptilotus rotundifolius*
Corymbia deserticola	*Santalum lanceolatum*
Eucalyptus gamophylla	*Schizachyrium fragile*
Eucalyptus leucophloia subsp. *leucophloia*	*Senna artemisioides* subsp. *oligophylla*
Fimbristylis simulans	*Senna glutinosa* subsp. *pruinosa*
Goodenia microptera	*Solanum lasiophyllum*
Lepidium echinatum	*Triodia ?brizoides*
Polycarpaea corymbosa var. *corymbosa*	*Triodia wiseana*

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF41					
Botanist	Chid	**Date**	4/1/2012	**Site area**	Quadrat 50 x 50 m
Location	50K		686619 **mE**	7474514 **mN**	**Elevation** 745 m
Topography and Geology	Landform: Gentle slope at foot of hill, minor drainage lines dissecting. Aspect and Slope: N gently to moderately inclined. Soil: red orange sandy clay. Geology: 95% cover of ironstone gravel, pebbles.				
Veg Condition	2	**Disturbances**	weeds	**Land System**	Boolgeeda
Site Photo					
Vegetation	*Acacia inaequilatera, Grevillea wickhamii* tall open shrubland over *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835), *Triodia wiseana* hummock grassland.				
Species	*Acacia adoxa* var. *adoxa* *Acacia adsurgens* *Acacia bivenosa* *Acacia dictyophleba* *Acacia elachantha* *Acacia inaequilatera* *Acacia tenuissima* *Acacia xiphophylla* *Aristida holathera* *Aristida inaequiglumis* *Bulbostylis barbata* *Corchorus incanus* subsp. *lithophilus* *Dampiera candicans* *Eriachne aristidea* *Eucalyptus leucophloia* subsp. *leucophloia*			*Gossypium robinsonii* *Grevillea wickhamii* *Hakea lorea* *Hibiscus sturtii* var. *campylochlamys* *Indigofera monophylla* *Paraneurachne muelleri* *Polycarpaea longiflora* *Ptilotus astrolasius* *Ptilotus calostachyus* *Scaevola parvifolia* subsp. *pilbarae* *Schizachyrium fragile* *Senna glutinosa* subsp. *glutinosa* *Senna glutinosa* subsp. *pruinosa* *Sida ?echinocarpa* *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) *Triodia wiseana*	
Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF42					

Botanist	Linda	**Date**	4/1/2012	**Site area**	Quadrat 50 x 50 m
Location	50K		685993 **mE**	7474911 **mN**	**Elevation** 712 m
Topography and Geology	Landform: Very gently undulating plain with dissected drainage lines and sheet flow. Aspect and Slope: 265° (W) gently inclined. Soil: red clay. Geology: 95% cover of BIF, chert, quartz gravels, pebbles and cobbles.				
Veg Condition	3	**Disturbances**	grazing, erosion	**Land System**	Boolgeeda
Site Photo					
Vegetation	*Corymbia ?hamersleyana, Eucalyptus gamophylla* scattered low trees over *Acacia elachantha, Grevillea wickhamii, Gossypium robinsonii* tall open shrubland over *Triodia brizoides, Triodia wiseana* open hummock grassland.				

Species	
Acacia aptaneura	*Keraudrenia nephrosperma*
Acacia elachantha	*Paraneurachne muelleri*
Acacia tenuissima	*Polycarpaea holtzei*
Aristida contorta	*Ptilotus astrolasius*
Corymbia ?hamersleyana	*Ptilotus calostachyus*
Cymbopogon ambiguus	*Ptilotus exaltatus* var. *exaltatus*
Cymbopogon obtectus	*Ptilotus rotundifolius*
Dodonaea viscosa subsp. *mucronata*	*Rhynchosia minima*
Eucalyptus gamophylla	*Scaevola parvifolia* subsp. *pilbarae*
Fimbristylis simulans	*Schizachyrium fragile*
Gossypium robinsonii	*Senna artemisioides* subsp. *oligophylla*
Grevillea wickhamii	*Senna glutinosa* subsp. *pruinosa*
Hibiscus sturtii var. *campylochlamys*	*Sida arenicola*
Hybanthus aurantiacus	*Solanum lasiophyllum*
Indigofera monophylla	*Tephrosia densa*
Jasminum didymum subsp. *lineare*	*Triodia ?brizoides*
	Triodia wiseana

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF43					
Botanist	Chid	**Date**	4/1/2012	**Site area**	Quadrat 50 x 50 m
Location	50K		687239 **mE**	7476050 **mN**	**Elevation** 724 m
Topography and Geology	Landform: Gentle slope at base of hill Aspect and Slope: NW gently inclined. Soil: red sandy clay. Geology: 95% cover of ironstone gravel, pebbles.				
Veg Condition	1	**Disturbances**	none	**Land System**	Newman
Site Photo					
Vegetation	*Corymbia deserticola* scattered low trees over *Acacia elachantha, Keraudrenia nephrosperma* low open shrubland over *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) open hummock grassland.				

Species	
Acacia adsurgens	*Hybanthus aurantiacus*
Acacia ancistrocarpa	*Indigofera monophylla*
Acacia elachantha	*Keraudrenia nephrosperma*
Acacia hilliana	*Oldenlandia crouchiana*
Amphipogon caricinus subsp. *caricinus*	*Polycarpaea holtzei*
Aristida holathera	*Ptilotus astrolasius*
Bulbostylis barbata	*Ptilotus calostachyus*
Corymbia deserticola	*Ptilotus rotundifolius*
Cymbopogon ambiguus	*Schizachyrium fragile*
Eriachne helmsii	*Senna artemisioides* subsp. *oligophylla*
Goodenia microptera	*Solanum lasiophyllum*
Goodenia stobbsiana	*Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835)
Heliotropium tenuifolium	
Hibiscus sturtii var. *campylochlamys*	

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF45					
Botanist	Chid	**Date**	3/28/2012	**Site area**	Quadrat 50 x 50 m
Location	50K		695148 **mE**	7476682 **mN**	**Elevation** 745 m
Topography and Geology	Landform: Creekline in gorge Aspect and Slope: N-S gully very gently inclined. Soil: dark orange-brown sandy clay. Geology: 95% cover of granite, BIF pebbles, stones, outcrops.				
Veg Condition	2	**Disturbances**	cattle	**Land System**	tba
Site Photo					
Vegetation	*Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Gossypium robinsonii, Acacia tumida* var. *pilbarensis* tall open shrubland over *Triodia wiseana* hummock grassland and *Cymbopogon ambiguus, Eriachne helmsii, Themeda triandra* very open tussock grassland.				

Species	
Abutilon indicum	*Paspalidium tabulatum*
Acacia bivenosa	*Phyllanthus maderaspatensis*
Acacia monticola	*Pterocaulon serrulatum*
Acacia tumida var. *pilbarensis*	*Ptilotus obovatus* subsp. *obovatus*
Clerodendrum ?tomentosum	*Rhynchosia minima*
Corchorus lasiocarpus subsp. *lasiocarpus*	*Senna glutinosa* subsp. *glutinosa*
Cucumis maderaspatanus	*Stemodia grossa*
Cymbopogon ambiguus	*Stemodia viscosa*
Eremophila lachnocalyx	*Stylobasium spathulatum*
Eriachne helmsii	*Themeda triandra*
Eucalyptus leucophloia subsp. *leucophloia*	*Trichodesma zeylanicum* var. *zeylanicum*
Euphorbia biconvexa	*Triodia wiseana*
Gossypium robinsonii	

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF46					
Botanist	Chid	**Date**	3/28/2012	**Site area**	Quadrat 50 x 50 m
Location	50K		694954 **mE**	7475581 **mN**	**Elevation** 1009 m
Topography and Geology	Landform: slope near top of very large ridge Aspect and Slope: North facing, gently to moderately inclined. Soil: brown clay. Geology: 95% cover of BIF, ironstone pebbles, cobbles, sheets.				
Veg Condition	2	**Disturbances**	weeds	**Land System**	tba
Site Photo					
Vegetation	*Eucalyptus leucophloia* subsp. *leucophloia, Eucalyptus* gamophylla low open woodland over *Triodia wiseana* hummock grassland.				
Species	*Acacia pruinocarpa* *Acacia tenuissima* *Bidens bipinnata* *Capparis spinosa* var. *nummularia* *Codonocarpus cotinifolius* *Corchorus lasiocarpus* subsp. *lasiocarpus* *Cymbopogon ambiguus* *Cynanchum floribundum* *Dodonaea viscosa* subsp. *mucronata* *Eriachne helmsii*			*Eucalyptus gamophylla* *Eucalyptus leucophloia* subsp. *leucophloia* *Newcastelia* sp. Hamersley Range (S. van Leeuwen 4264) *Polycarpaea holtzei* *Ptilotus obovatus* subsp. *obovatus* *Scaevola browniana* subsp. *browniana* *Solanum phlomoides* *Triodia wiseana*	

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF51					
Botanist	Linda	**Date**	3/31/2012	**Site area**	Quadrat 50 x 50 m
Location	50K		684946 **mE**	7467735 **mN**	**Elevation** 726 m
Topography and Geology	Landform: Flat plain Soil: red clay. Geology: no rock outcrop or coarse fragments				
Veg Condition	3	**Disturbances**	weeds, grazing	**Land System**	tba
Site Photo					
Vegetation	*Acacia aptaneura, Hakea lorea* low open woodland over *Goodenia prostrata, Dysphania kalpari, Sclerolaena cornishiana* very open herbland and *Cymbopogon ambiguus, Aristida contorta, Perotis rara* tussock grassland.				

Species	
Acacia aptaneura	*Hakea lorea*
Acacia dictyophleba	*Paspalidium rarum*
Alternanthera nana	*Perotis rara*
Aristida contorta	**Portulaca oleracea*
Boerhavia gardneri	*Pterocaulon serrulatum*
Brachyscome sp. Wanna Munna Flats (S. van Leeuwen 4662)	*Ptilotus gaudichaudii* var. *gaudichaudii*
Bulbostylis barbata	*Ptilotus helipteroides*
Cleome viscosa	*Ptilotus obovatus* subsp. *obovatus*
Cymbopogon ambiguus	*Ptilotus polystachyus*
Dactyloctenium radulans	*Ptilotus polystachyus*
Dysphania kalpari	*Rhodanthe floribunda*
Eragrostis pergracilis	*Sclerolaena cornishiana*
Euphorbia biconvexa	*Solanum lasiophyllum*
Evolvulus alsinoides var. *villosicalyx*	*Tribulus hirsutus*
Goodenia prostrata	

Lamb Creek Level 2 Flora and Vegetation Survey - Site LCF52					
Botanist	Linda	**Date**	4/1/2012	**Site area**	Quadrat 50 x 50 m
Location	50K		692237 **mE**	7476823 **mN**	**Elevation** 699 m
Topography and Geology	Landform: Flat plain Soil: red clay. Geology: 30% cover of BIF gravels, pebbles and cobbles.				
Veg Condition		**Disturbances**		**Land System**	tba
Site Photo					
Vegetation	*Acacia elachantha, Acacia inaequilatera, Grevillea wickhamii* scattered shrubs over *Triodia brizoides* open hummock grassland.				

Species

Abutilon dioicum
Abutilon otocarpum
Acacia ancistrocarpa
Acacia aptaneura
Acacia elachantha
Acacia inaequilatera
Alternanthera nana
Aristida contorta
Boerhavia gardneri
Dysphania rhadinostachya
Eremophila longifolia
Evolvulus alsinoides var. *villosicalyx*
Goodenia stobbsiana
Grevillea wickhamii
Hakea lorea
Hybanthus aurantiacus
Indigofera monophylla
Oldenlandia crouchiana
Paraneurachne muelleri
**Portulaca oleracea*
Ptilotus calostachyus
Ptilotus helipteroides
Ptilotus obovatus subsp. *obovatus*
Schizachyrium fragile
Senna artemisioides subsp. *oligophylla*
Senna glutinosa subsp. *glutinosa*
Senna notabilis
Sida ?sp. Supplejack Station (T.S. Henshall 2345)
Sida arenicola
Tragus australianus
Trianthema glossostigma
Triodia ?brizoides
Triodia wiseana

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