GOVERNMENT OF
WESTERN AUSTRALIA

# CLEARING PERMIT

*Granted under section 51E of the Environmental Protection Act 1986*

| | |
|---|---|
| **Purpose Permit number:** | CPS 9475/1 |
| **Permit Holder:** | Commissioner of Main Roads Western Australia |
| **Duration of Permit:** | From 26 February 2022 to 26 February 2027 |

The permit holder is authorised to clear *native vegetation* subject to the following *conditions* of this permit.

## PART I – CLEARING AUTHORISED

### 1. Clearing authorised (purpose)

The permit holder is authorised to clear *native vegetation* for the purpose of Road upgrades to Marble Bar Road.

### 2. Land on which clearing is to be done

| | | |
|---|---|---|
| Marble Bar Road Reserve | (PIN: 11450438), | Nullagine |
| Marble Bar Road Reserve | (PIN: 11733777), | Nullagine |
| Marble Bar Road Reserve | (PIN: 11733778), | Nullagine |
| Marble Bar Road Reserve | (PIN: 11733779), | Nullagine |
| Marble Bar Road Reserve | (PIN: 11733780), | Nullagine |
| Marble Bar Road Reserve | (PIN: 11733781), | Nullagine |
| Marble Bar Road Reserve | (PIN: 11733782), | Nullagine |
| Marble Bar Road Reserve | (PIN: 11733783), | Nullagine |
| Marble Bar Road Reserve | (PIN: 11734470), | Nullagine |
| Marble Bar Road Reserve | (PIN: 11734863), | Nullagine |
| Marble Bar Road Reserve | (PIN: 11734864), | Nullagine |
| Marble Bar Road Reserve | (PIN: 11734865), | Nullagine |
| Marble Bar Road Reserve | (PIN: 11734866), | Nullagine |
| Marble Bar Road Reserve | (PIN: 11736120), | Nullagine |
| Marble Bar Road Reserve | (PIN: 11736121), | Nullagine |
| Marble Bar Road Reserve | (PIN: 11736122), | Nullagine |
| Marble Bar Road Reserve | (PIN: 11997700), | Nullagine |
| Bonney Downs-Hillside Rd | (PIN: 11734448), | Nullagine |
| Skull Springs Road Reserve | (PIN: 11450436), | Nullagine |
| Unnamed Road Reserve | (PIN: 11734450), | Nullagine |
| Lot 120 on Plan 91989 | | Nullagine |
| Lot 171 on Plan 213166 | | Nullagine |
| Lot 93 on Plan 220468 | | Nullagine |

| | | |
|---|---|---|
| De Grey Location 8 | | Nullagine |
| Crown Reserve | (R 11082), | Nullagine |
| Crown Reserve | (R 12347), | Nullagine |
| Crown Reserve | (R 12348), | Nullagine |
| Crown Reserve | (R 13687), | Nullagine |
| Crown Reserve | (R 13688), | Nullagine |
| Crown Reserve | (R 18938), | Nullagine |
| Crown Reserve | (R 2804), | Nullagine |
| Crown Reserve | (R 32645), | Nullagine |
| Crown Reserve | (R 3328), | Nullagine |
| Crown Reserve | (R 9700), | Nullagine |
| Pastoral Lease | (LPL N050430), | Nullagine |
| Unallocated Crown Land | (PIN: 957119), | Nullagine |
| Unallocated Crown Land | (PIN: 957121), | Nullagine |
| Unallocated Crown Land | (PIN: 957170), | Nullagine |
| Unallocated Crown Land | (PIN: 1012676), | Nullagine |
| Unallocated Crown Land | (PIN: 1114532), | Nullagine |

### 3. Clearing authorised

The permit holder must not clear more than 500 hectares of *native vegetation* within the area cross-hatched yellow in Figure 1 to Figure 4 of Schedule 1.

## PART II – MANAGEMENT CONDITIONS

### 4. Avoid, minimise, and reduce impacts and extent of clearing

In determining the *native vegetation* authorised to be cleared under this permit, the permit holder must apply the following principles, set out in descending order of preference:

(a) avoid the *clearing* of *native vegetation*;

(b) minimise the amount of *native vegetation* to be cleared; and

(c) reduce the impact of *clearing* on any environmental value.

### 5. Weed management

When undertaking any *clearing* authorised under this permit, the permit holder must take the following measures to minimise the risk of introduction and spread of *weeds*:

(a) clean earth-moving machinery of soil and vegetation prior to entering and leaving the area to be cleared;

(b) ensure that no known *weed*-affected soil, *mulch*, *fill*, or other material is brought into the area to be cleared; and

(c) restrict the movement of machines and other vehicles to the limits of the areas to be cleared.

### 6. Vegetation management - Watercourse and wetland surface flow

(a) Where practicable the permit holder shall avoid clearing *riparian vegetation.*

(b) Where a watercourse or wetland is to be impacted by clearing, the permit holder shall maintain the existing surface flow by use of culverts.

## 7. Directional clearing

The permit holder must conduct *clearing* activities in a slow, progressive manner towards adjacent *native vegetation,* to allow fauna to move into the closest adjacent *native vegetation* ahead of the *clearing* activity.

## 8. Fauna management – Pre-clearance surveys

(a) *Immediately prior* to undertaking any clearing authorised under this permit, the permit holder shall engage a *fauna specialist* to undertake clearance surveys within the areas cross-hatched red on Figure 1 to Figure 3 of Schedule 2 for the Greater Bilby (*Macrotis lagotis)* and Brush-tailed Mulgara *(Dasycercus blythi)*, including the identification and inspection of burrows, and determination of whether burrows are being utilised.

(b) Where evidence of recent burrow use is identified under condition 8(a) of this permit, the permit holder shall;
  (i) engage a *fauna specialist* to flag the location of the burrow/s showing signs of recent use;
  (ii) not clear within five metres of the flagged burrow/s;
  (iii) engage a *fauna specialist* to monitor with cameras, the flagged burrow/s for a maximum of five days, or until such time that Greater Bilbies or Brush-tailed Mulgara have been observed to independently move on from the burrow/s; and
  (iv) prior to clearing, engage a *fauna specialist* to re-inspect any flagged burrow/s for the presence of Greater Bilbies or Brush-tailed Mulgara.

(c) If Greater Bilbies or Brush-tailed Mulgara are identified utilising any flagged burrow/s under condition 8(b)(iv) of this permit and cannot be avoided in accordance with *condition* 4 of this permit, the permit holder shall engage a *fauna specialist* to remove and relocate the identified Greater Bilbies or Brush-tailed Mulgara to an area of suitable habitat, in accordance with a section 40 authorisation under the *Biodiversity Conservation Act 2016*.

(d) Where active Greater Bilby or Brush-tailed Mulgara burrows are identified under condition 8(a) of this permit, and/or Greater Bilbies or Brush-tailed Mulgara are relocated under condition 8(c) of this permit, the permit holder shall include the following in a report submitted to the *CEO* within two months of undertaking any *clearing* authorised under this permit:
  (i) The location of any active Greater Bilby or Brush-tailed Mulgara burrows identified, using a Global Positioning System (GPS) unit set to Geocentric Datum Australia 1994 (GDA94), expressing the geographical coordinates in Eastings and Northings or decimal degrees;
  (ii) a description of the camera monitoring measures undertaken under condition 8(b)(iii) of this Permit;
  (iii) the date and time of Greater Bilbies or Brush-tailed Mulgara are recorded as independently moving from a flagged burrow;
  (iv) the gender of each Greater Bilby captured under condition 8(c) of this Permit;
  (v) the location of any Greater Bilbies or Brush-tailed Mulgara, as referred to under condition 8(a) of this Permit, captured using a Global Positioning System (GPS) unit set to Geocentric Datum Australia 1994 (GDA94), expressing the geographical coordinates in Eastings and Northings or decimal degrees;

(vi) the date, time, vegetation type and weather conditions at each location where Greater Bilbies or Brush-tailed Mulgara are captured under condition 8(d)(v) of this permit;

(vii) the location of any Greater Bilbies or Brush-tailed Mulgara, identified in accordance with condition 8(a) of this permit, relocated using a Global Positioning System (GPS) unit set to Geocentric Datum Australia 1994 (GDA94), expressing the geographical coordinates in Eastings and Northings or decimal degrees;

(viii) the date, time, vegetation type and weather conditions at each location where Greater Bilbies or Brush-tailed Mulgara are relocated under condition 8(c) of this permit;

(ix) the name of the *fauna specialist* that relocated fauna under condition 8(c) of this permit; and

(x) a copy of the fauna licence authorising the relocation of fauna under condition 8(c) of this permit.

## PART III - RECORD KEEPING AND REPORTING

### 9. Records that must be kept

The permit holder must maintain records relating to the listed relevant matters in accordance with the specifications detailed in Table 1.

**Table 1: Records that must be kept**

| No. | Relevant matter | Specifications |
|---|---|---|
| 1. | In relation to the authorised *clearing* activities generally | (a) the species composition, structure, and density of the cleared area;<br>(b) the location where the *clearing* occurred, recorded using a Global Positioning System (GPS) unit set to Geocentric Datum Australia 1994 (GDA94), expressing the geographical coordinates in Eastings and Northings;<br>(c) the date that the area was cleared;<br>(d) the size of the area cleared (in hectares);<br>(e) actions taken to avoid, minimise, and reduce the impacts and extent of *clearing* in accordance with *condition* 4 of this permit;<br>(f) the locations, species, and numbers of *priority flora* taxa within the cleared area; and<br>(g) actions taken to minimise the risk of the introduction and spread of *weeds* in accordance with *condition* 5 of this permit. |
| 2. | In relation to fauna management pursuant to *condition* 8 | (a) results of the pre-clearance surveys undertaken in accordance with *condition* 8 of this permit; and<br>(b) a copy of the *fauna specialist's* report. |

## 10. Reporting

(a) The permit holder must provide to the *CEO* on or before 30 June of each year, a written report:
  (i) of records required under condition 9 of this permit; and
  (ii) concerning activities done by the permit holder under this permit between 1 January to 31 December of the preceding calendar year.

(b) If no clearing authorised under this permit was undertaken between 1 January to 31 December of the preceding calendar year, a written report confirming that no clearing under this permit has been carried out, must be provided to the *CEO* on or before 30 June of each year.

(c) Prior to 26 November 2026, the permit holder must provide to the *CE*O a written report of records required under condition 9 of this permit where these records have not already been provided under condition 10(a) of this permit.

# DEFINITIONS

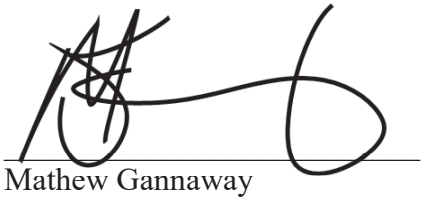
In this permit, the terms in Table  have the meanings defined.

**Table 2: Definitions**

| Term | Definition |
|---|---|
| *CEO* | Chief Executive Officer of the department responsible for the administration of the clearing provisions under the *Environmental Protection Act 1986*. |
| *clearing* | has the meaning given under section 3(1) of the EP Act. |
| *condition* | a condition to which this clearing permit is subject under section 51H of the EP Act. |
| *fauna specialist* | means a person who holds a tertiary qualification specialising in environmental science or equivalent, and has a minimum of 2 years work experience in fauna identification and surveys of fauna native to the region being inspected or surveyed, or who is approved by the *CEO* as a suitable fauna specialist for the bioregion, and who holds a valid fauna licence issued under the *Biodiversity Conservation Act 2016*. |
| *fill* | means material used to increase the ground level, or to fill a depression. |
| *department* | means the department established under section 35 of the *Public Sector Management Act 1994* (WA) and designated as responsible for the administration of the EP Act, which includes Part V Division 3. |
| *EP Act* | *Environmental Protection Act 1986* (WA) |
| *immediately prior* | Means the pre-clearance surveys must be undertaken within seven (7) days prior to *clearing* by a qualified *fauna specialist* |
| *mulch* | means the use of organic matter, wood chips or rocks to slow the movement of water across the soil surface and to reduce evaporation. |
| *native vegetation* | has the meaning given under section 3(1) and section 51A of the EP Act. |
| *priority flora* | means those plant taxa described as priority flora classes 1, 2, 3, or 4 in the Department of Biodiversity, Conservation and Attractions Threatened and Priority Flora List for Western Australia (as amended from time to time). |
| *riparian vegetation* | has the meaning given to it in Regulation 3 of the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*; |

| Term | Definition |
|---|---|
| *suitable habitat* | means habitat known to support the Greater Bilby (*Macrotis lagotis)* and Brush-tailed Mulgara *(Dasycercus blythi)* within the known current distribution of the species. |
| *watercourse* | has the meaning given to it in section 3 of the *Rights in Water and Irrigation Act 1914.* |
| *weeds* | means any plant –<br>(a) that is a declared pest under section 22 of the *Biosecurity and Agriculture Management Act 2007*; or<br>(b) published in a Department of Biodiversity, Conservation and Attractions species-led ecological impact and invasiveness ranking summary, regardless of ranking; or<br>(c) not indigenous to the area concerned. |

**END OF CONDITIONS**



Mathew Gannaway
A/SENIOR MANAGER
NATIVE VEGETATION REGULATION

*Officer delegated under Section 20*
*of the Environmental Protection Act 1986*

2 February 2022

# Schedule 1

The boundary of the areas cross-hatched yellow authorised to be cleared are shown in the maps below (Figure 1 to Figure 4).

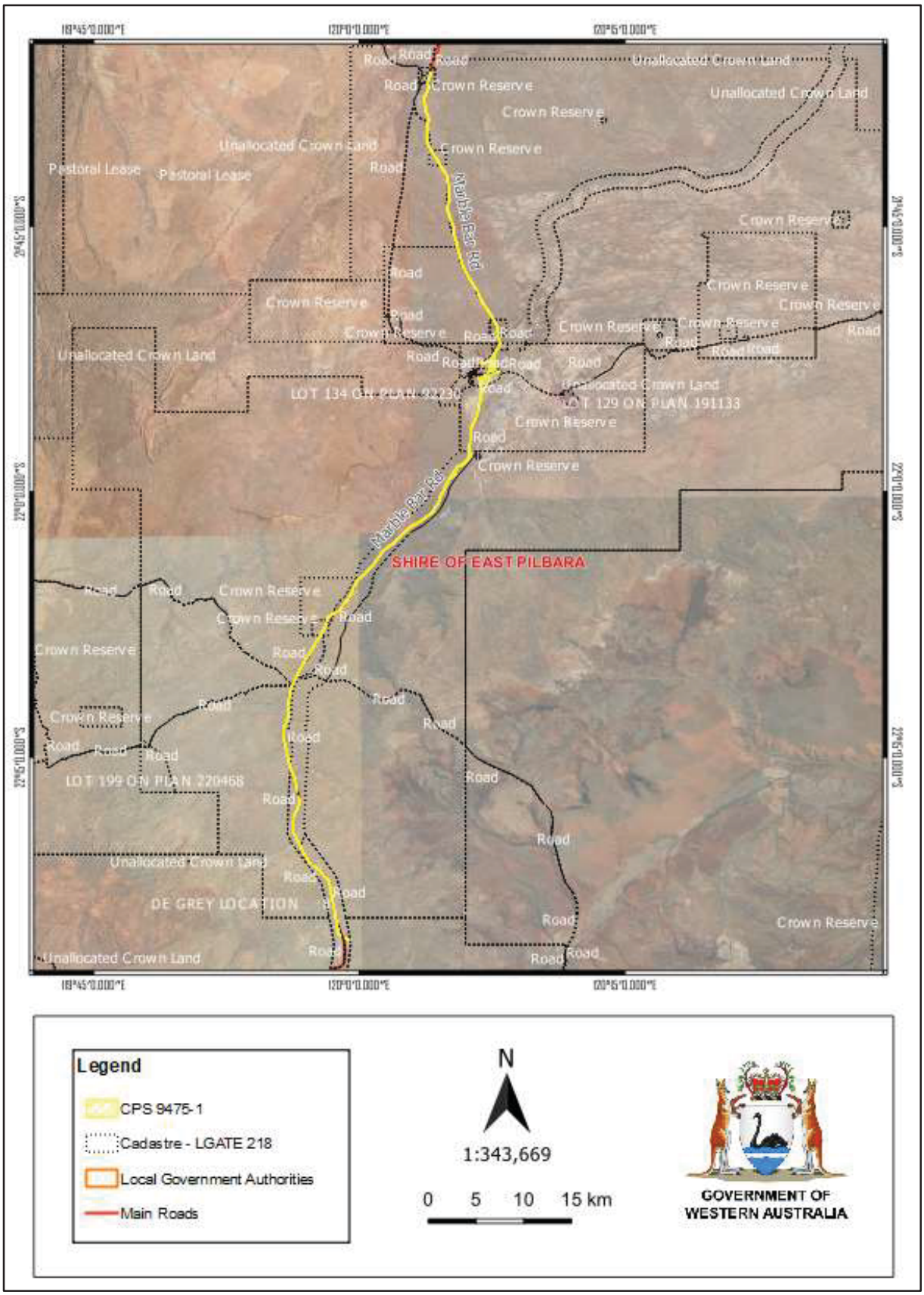



**Figure 1: Map (total) of the boundary of the areas within which *clearing* may occur**

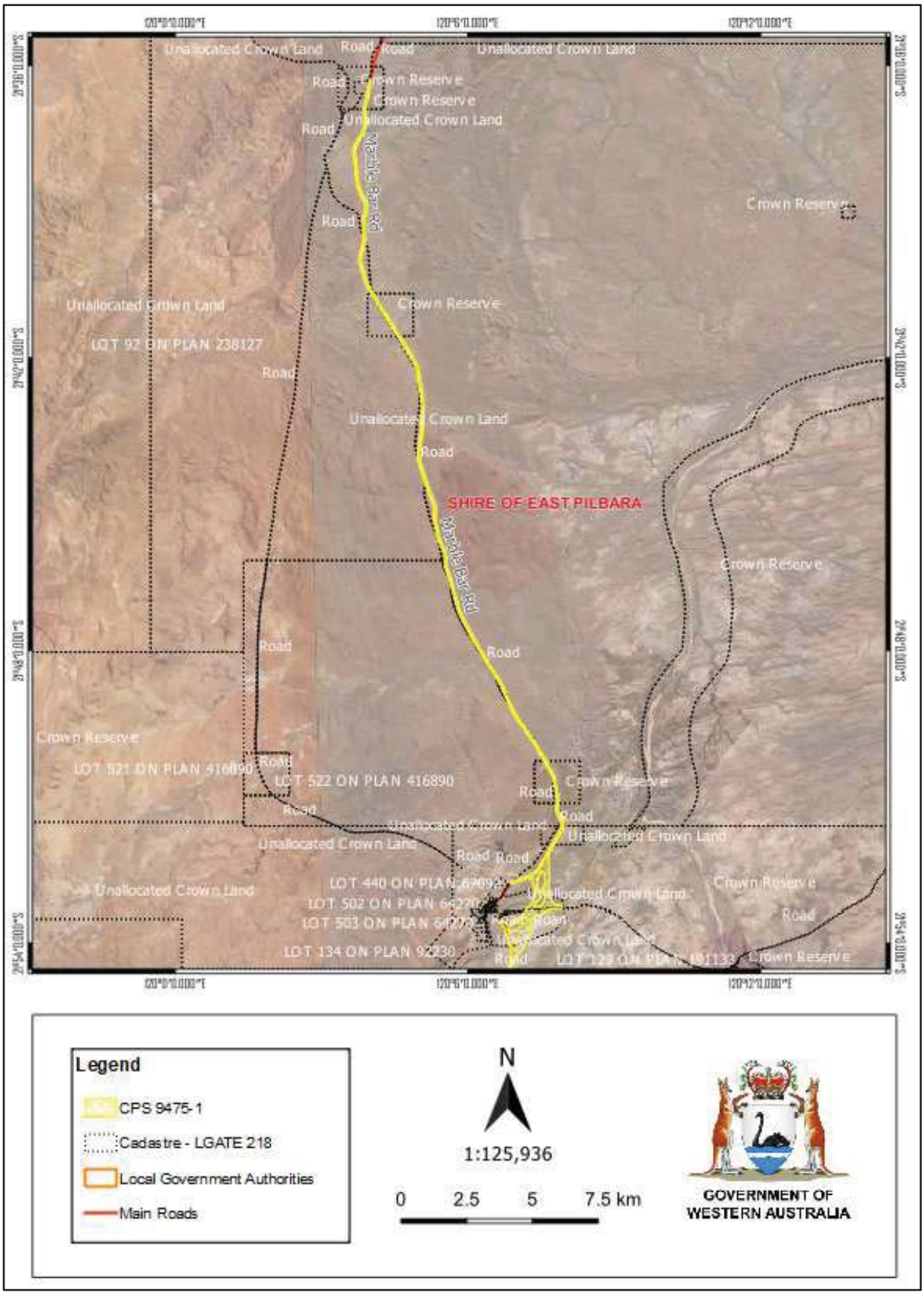



**Figure 2: Map (A) of the boundary of the areas within which *clearing* may occur**

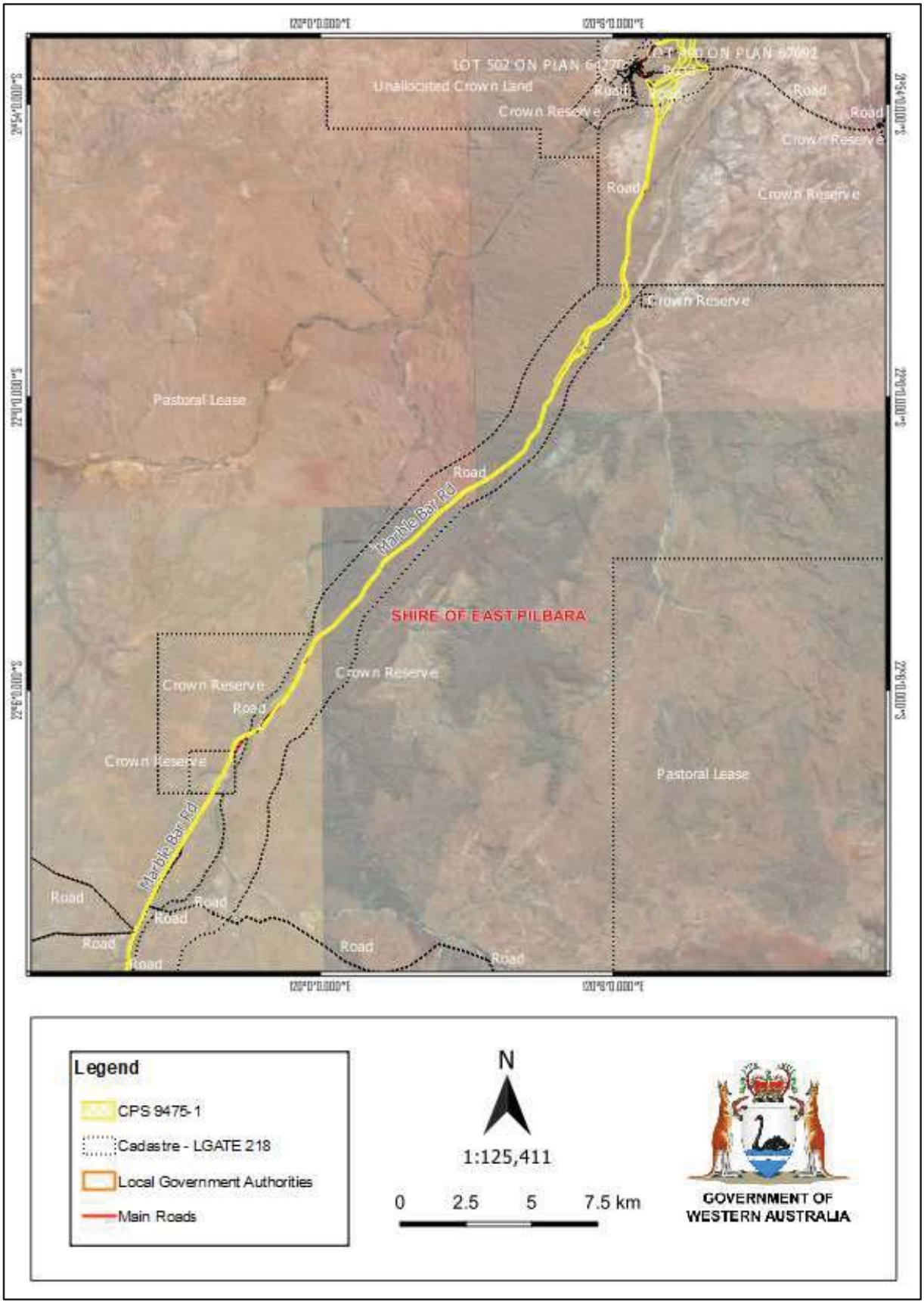



**Figure 3: Map (B) of the boundary of the areas within which *clearing* may occur**

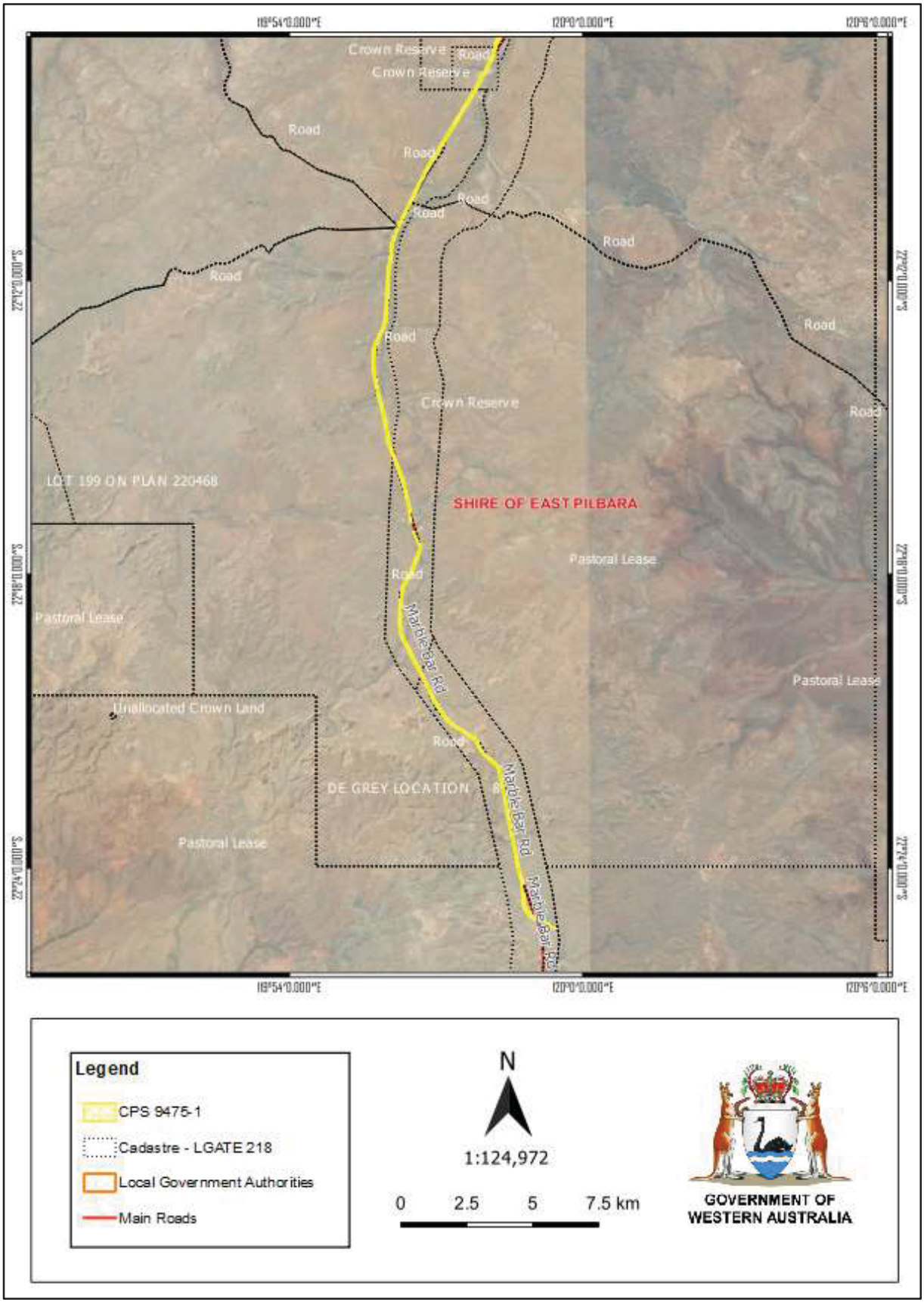



**Figure 4: Map (C) of the boundary of the areas within which *clearing* may occur**

# Schedule 2

The boundaries of the areas cross-hatched red where permit *conditions* apply are shown in the maps below (Figure 1 to Figure 3).

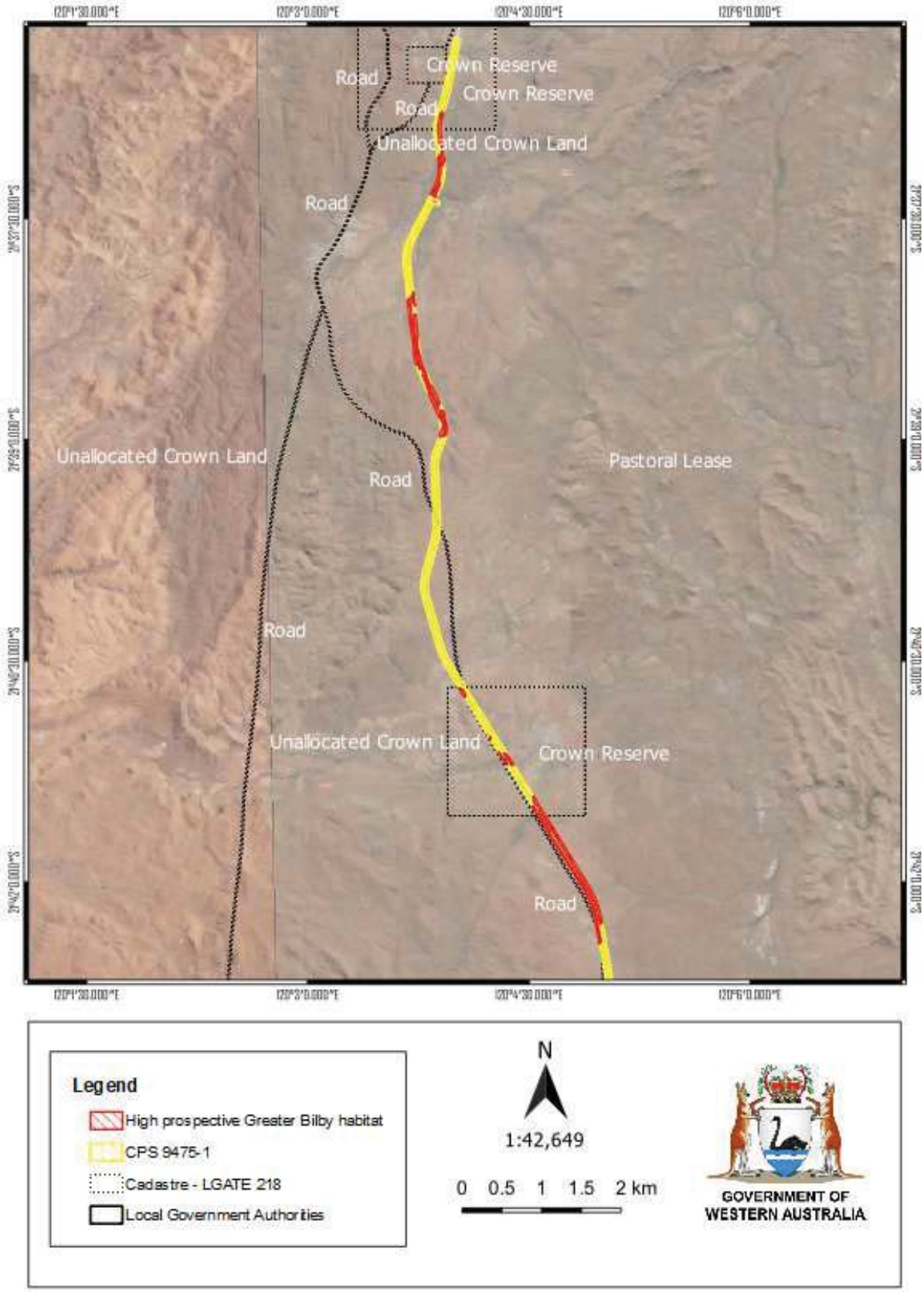



**Figure 1: Map (A)** of the boundary of the areas where permit *conditions* apply

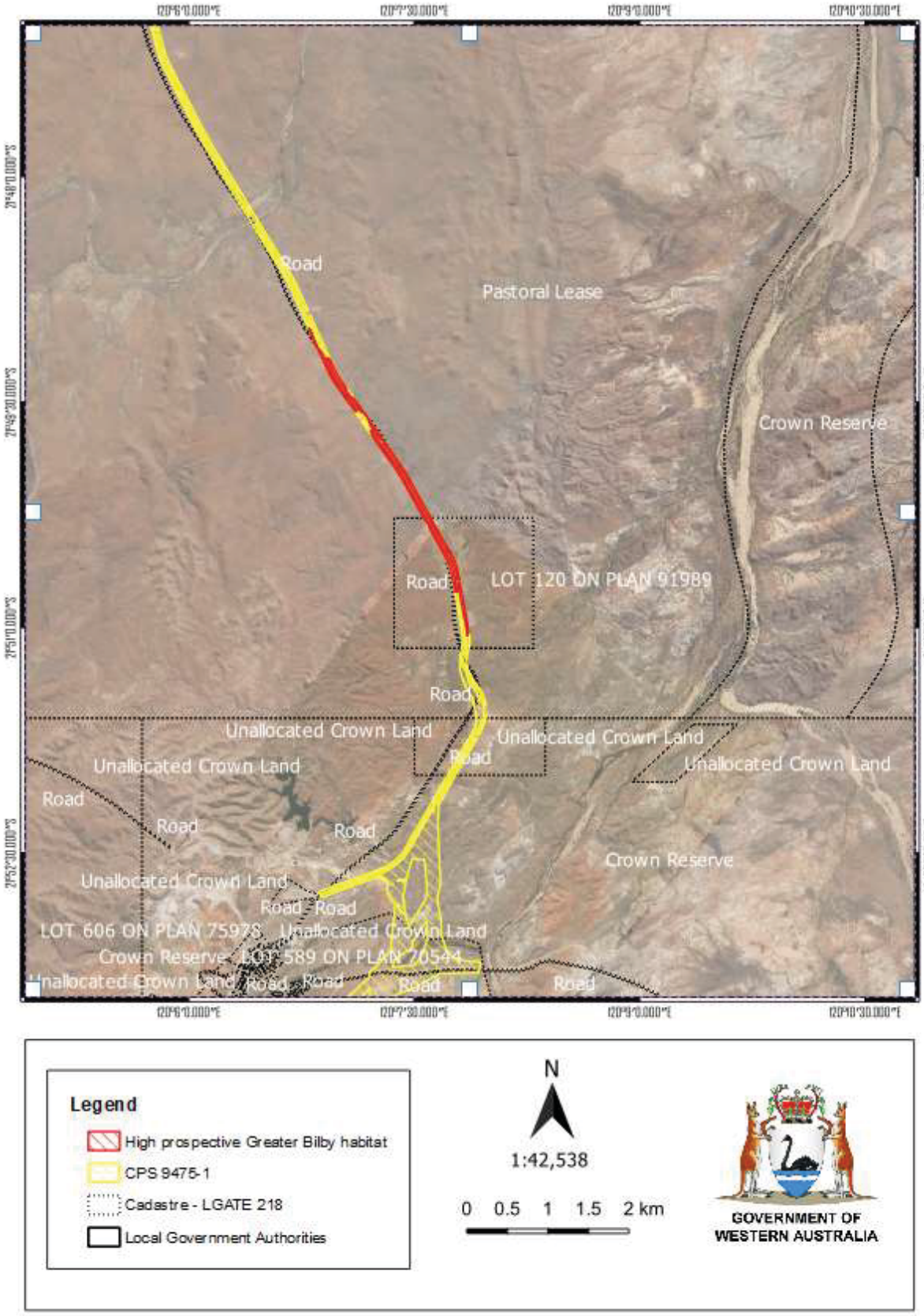



**Figure 2: Map (B)** of the boundary of the areas where permit *conditions* apply

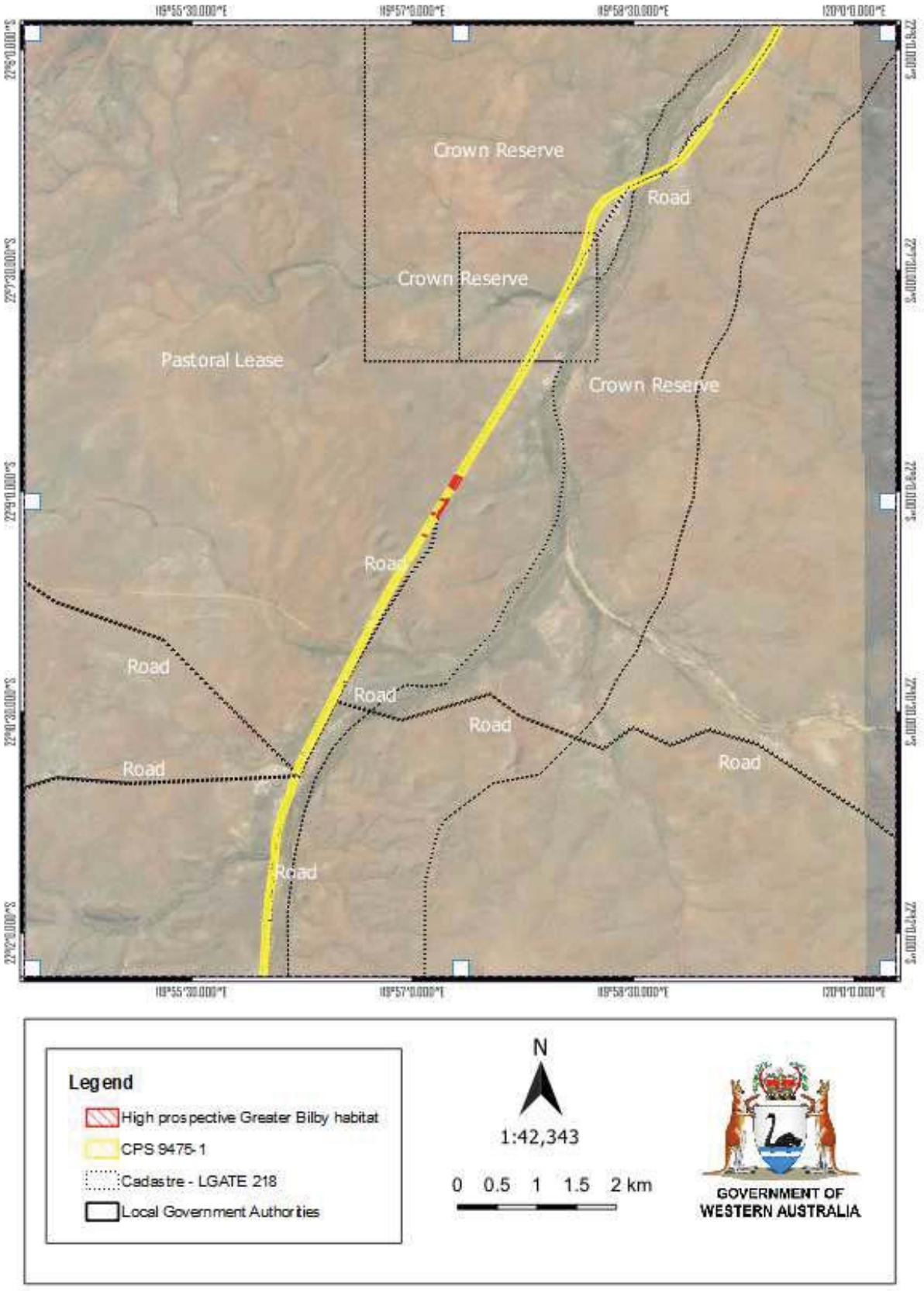



**Figure 3: Map (C)** of the boundary of the areas where permit *conditions* apply

Government of Western Australia
Department of Water and Environmental Regulation

# Clearing Permit Decision Report

## 1. Application details and outcome

### 1.1. Permit application details

| | |
|---|---|
| **Permit number:** | CPS 9475/1 |
| **Permit type:** | Purpose permit |
| **Applicant name:** | Main Roads Western Australia |
| **Application received:** | 21 October 2021 |
| **Application area:** | 500 hectares |
| **Purpose of clearing:** | Road upgrades |
| **Method of clearing:** | Mechanical clearing |
| **Properties:** | Various properties in the locality of Nullagine<br>Marble Bar Road Reserve PIN: 11450438<br>Marble Bar Road Reserve PIN: 11733777<br>Marble Bar Road Reserve PIN: 11733778<br>Marble Bar Road Reserve PIN: 11733779<br>Marble Bar Road Reserve PIN: 11733780<br>Marble Bar Road Reserve PIN: 11733781<br>Marble Bar Road Reserve PIN: 11733782<br>Marble Bar Road Reserve PIN: 11733783<br>Marble Bar Road Reserve PIN: 11734470<br>Marble Bar Road Reserve PIN: 11734863<br>Marble Bar Road Reserve PIN: 11734864<br>Marble Bar Road Reserve PIN: 11734865<br>Marble Bar Road Reserve PIN: 11734866<br>Marble Bar Road Reserve PIN: 11736120<br>Marble Bar Road Reserve PIN: 11736121<br>Marble Bar Road Reserve PIN: 11736122<br>Marble Bar Road Reserve PIN: 11997700<br>Bonney Downs-Hillside Road PIN: 11734448<br>Skull Springs Road Reserve PIN: 11450436<br>Unnamed Road Reserve PIN: 11734450<br>Lot 120 on Plan 91989<br>Lot 171 on Plan 213166<br>Lot 93 on Plan 220468<br>De Grey Location 8<br>Crown Reserve R 11082<br>Crown Reserve R 12347<br>Crown Reserve R 12348<br>Crown Reserve R 13687<br>Crown Reserve R 13688<br>Crown Reserve R 18938<br>Crown Reserve R 2804<br>Crown Reserve R 32645<br>Crown Reserve R 3328<br>Crown Reserve R 9700<br>Pastoral Lease (LPL N050430)<br>Unallocated Crown Lands |
| **LGA area:** | Shire of East Pilbara |
| **Locality:** | Nullagine |

## 1.2. Description of clearing activities

As part of the Marble Bar Road Upgrades Project, Main Roads Western Australia (Main Roads) propose to clear up to 500 hectares of native vegetation within a 755 hectare application area distributed across over 230 separate areas immediately adjacent to the existing Marble Bar Road for a length of approximately 100 kilometres in the locality of Nullagine in the Shire of East Pilbara. The purpose of the proposed clearing is to support road upgrades to this section of the Marble Bar Road, including sealing the currently unsealed road and constructing the Nullagine township bypass to facilitate hauling with improved safety.

## 1.3. Decision on application and key considerations

| | |
|---|---|
| **Decision:** | Granted |
| **Decision date:** | 02 February 2022 |
| **Decision area:** | Up to 500 hectares of native vegetation as depicted in Section 1.5 (Figures 1 to 4). |

## 1.4. Reasons for decision

This clearing permit application was submitted, accepted, assessed and determined in accordance with sections 51E and 51O of the *Environmental Protection Act 1986* (EP Act). The Department of Water and Environmental Regulation (DWER) advertised the application and one submission was received. Consideration of matters raised in the public submission is summarised in Appendix B.

In making this decision, the Delegated Officer had regard for the site characteristics (Appendix C), relevant datasets (Appendix K2), the results of relevant flora, vegetation and fauna surveys (Appendix A), the clearing principles set out in Schedule 5 of the EP Act (Appendix E; Section 3.2), and any other matters considered relevant to the assessment (Section 3.3). The Delegated Officer also took into consideration the purpose of the clearing to upgrade and seal a public road to improve community safety including the diversion of heavy vehicles around the Nullagine townsite.

The assessment identified that the proposed clearing will:

- impact two Priority Ecological Communities (PECs) known to occur within the application area;
- impact Priority flora taxa known to occur within the application area;
- impact native vegetation associated with watercourses known to occur within the application area;
- increase the risk of weeds impacting native vegetation, fauna habitat, and riparian vegetation directly adjacent to the application area; and
- potentially impact fauna of conservation significance utilising the application area at the time of clearing.

The Delegated Officer noted that PECs and Priority flora will be impacted by the proposed clearing. It is considered that the loss of the vegetation associated with the PECs and Priority flora as a result of the clearing will not impact the conservation status of the communities and taxa present, and will not significantly impact their local or regional occurrence. After consideration of the available information, as well as the applicants avoidance and minimisation measures (Section 3.1), The Delegated Officer determined that with appropriate management conditions, the proposed clearing is not likely to lead to an unacceptable risk to the environment. The Delegated Officer decided to grant a clearing permit subject to conditions to:

- avoid, minimise and reduce the impacts and extent of clearing;
- implement weed control measures to minimise the risk of introduction and spread of weeds into adjacent native vegetation;
- avoid clearing riparian vegetation where practicable;
- where a watercourse is impacted, maintain the existing surface flow by use of appropriate culverts;
- undertake slow, progressive, one directional clearing to allow terrestrial fauna to move into adjacent habitat ahead of the clearing activity; and
- undertake pre-clearance surveys for the Greater Bilby and Brush-tailed Mulgara by qualified personnel, and implement appropriate relocation programs if and when required.

## 1.5. Site maps

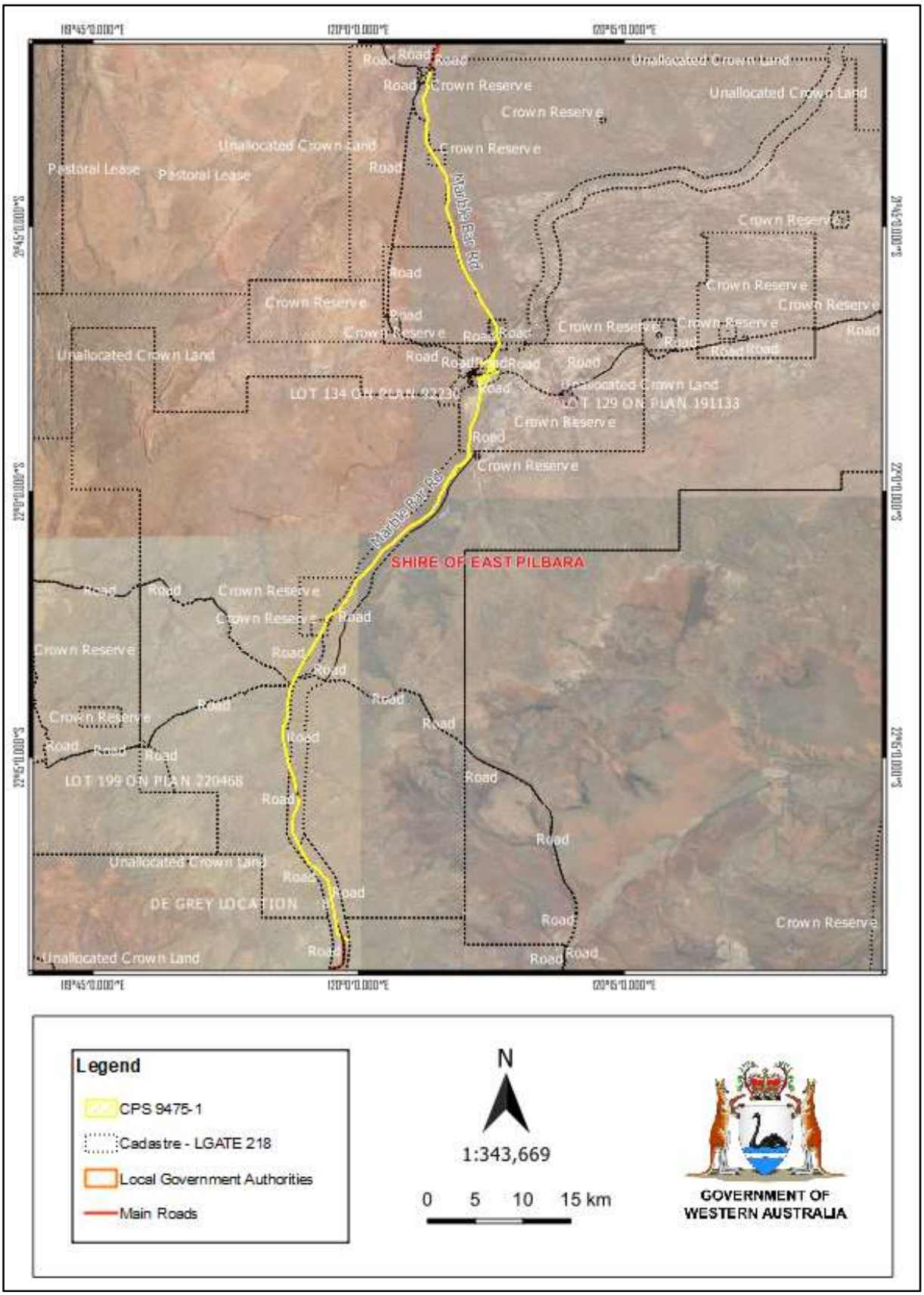



**Figure 1: Map (total) of the application area. The areas crosshatched yellow indicate the areas authorised to be cleared under the granted clearing permit.**

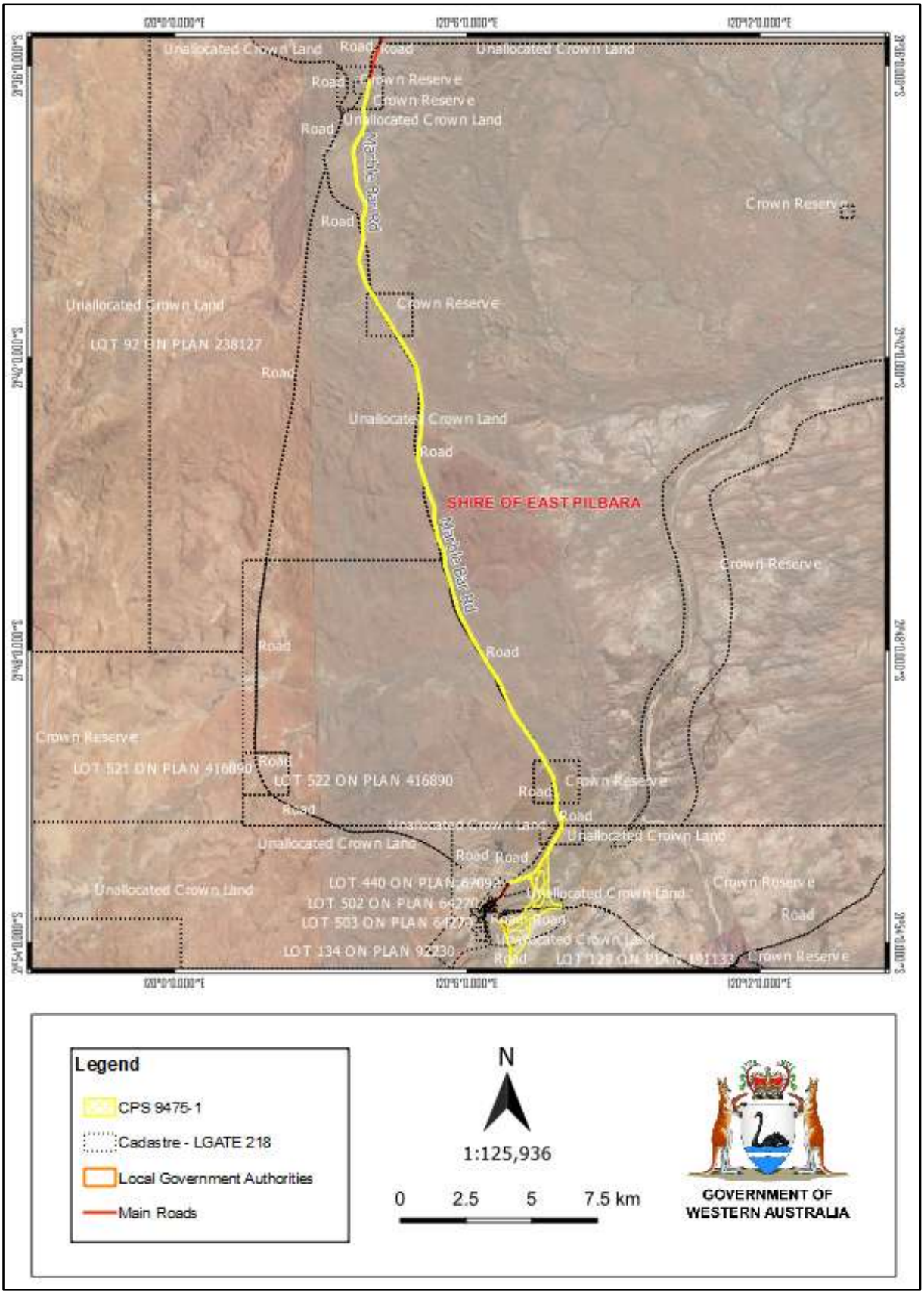



**Figure 2: Map (A) of the application area. The areas crosshatched yellow indicate the areas authorised to be cleared under the granted clearing permit.**

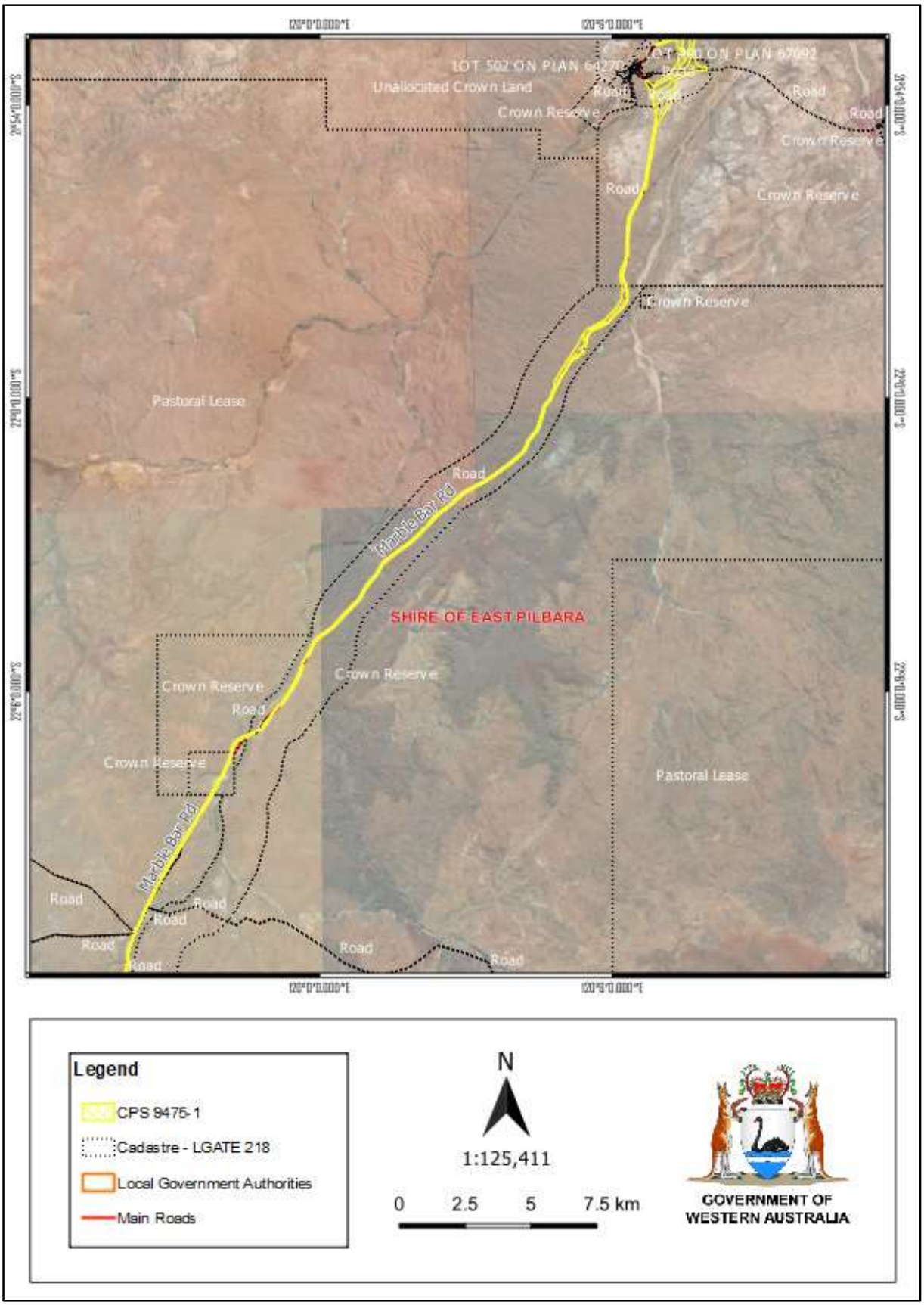



**Figure 3: Map (B) of the application area. The areas crosshatched yellow indicate the areas authorised to be cleared under the granted clearing permit.**

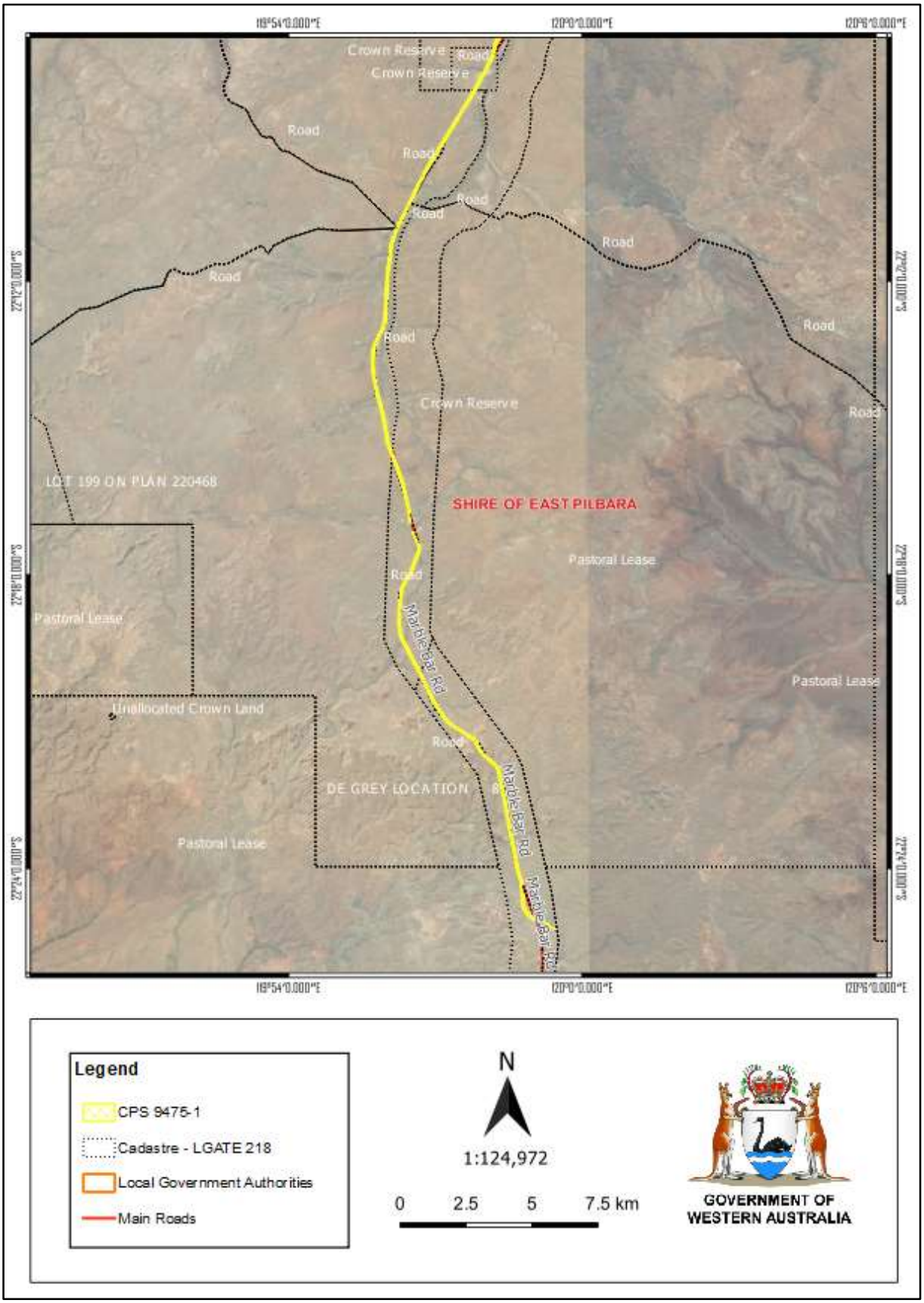



**Figure 4: Map (C) of the application area. The areas crosshatched yellow indicate the areas authorised to be cleared under the granted clearing permit.**

## 2. Legislative context

The clearing of native vegetation in Western Australia is regulated under the EP Act and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* (Clearing Regulations).

In addition to the matters considered in accordance with section 51O of the EP Act (Section 1.3), the Delegated Officer has also had regard to the objects and principles under section 4A of the EP Act, particularly:

- the precautionary principle
- the principle of intergenerational equity
- the principle of the conservation of biological diversity and ecological integrity

Other legislation of relevance for this assessment include:

- *Biosecurity and Agriculture Management Act 2007* (WA) (BAM Act)
- *Biodiversity Conservation Act 2016* (WA) (BC Act)
- *Biosecurity and Agriculture Management Act 2007* (BAM Act)
- *Contaminated Sites Act 2003* (CS Act)
- *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act)
- *Rights in Water and Irrigation Act 1914* (RIWI Act)

The key guidance documents which inform this assessment are:

- *A guide to the assessment of applications to clear native vegetation* (December 2013)
- *Procedure: Native vegetation clearing permits* (DWER October 2019)
- Technical guidance – Flora and vegetation surveys for environmental impact assessment (EPA 2016)
- Technical guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020)

## 3. Detailed assessment of application

### 3.1. Avoidance and mitigation measures

Evidence was submitted by the applicant demonstrating reasonable efforts to avoid and minimise potential impacts of the proposed clearing on environmental values.

The applicant has advised that no feasible alternatives that do not involve the clearing of native vegetation have been identified. To upgrade the Mable Bar Road to a safe level, clearing of native vegetation is required (Main Roads 2021). Factors influencing the avoidance and minimisation of the clearing impacts include the requirement to widen corners but avoid moving utilities, to increase road safety through improvement of sight lines, and to utilise the existing alignment as much as possible.

The design and management measures identified and considered by the applicant to avoid and minimise the impacts of clearing are provided below (Main Roads 2021).

**Steepen batter slopes:**
Due to the traffic volumes, vehicle type and posted speeds these batters cannot be changed significantly.

**Installation of safety barriers:**
Safety barriers are to be utilised, however the design has not progressed to that stage yet.

**Alignment to one side of the existing road:**
Not applicable as the whole alignment needs upgrading.

**Alternative alignment to follow existing road or to preferentially locate within pasture or degraded areas:**
Wherever possible the existing alignment has been utilised.

**Installation of kerbing:**
Kerbing has been considered and implemented in the design wherever possible, however, large amounts of storm water makes kerbing limited in effectiveness.

**Simplification of design to reduce number of lanes and/or the complexity of intersections:**
Only necessary intersections at towns and mine sites are being constructed.

**Preferential use of existing cleared areas for access tracks, construction storage and stockpiling:**
Temporary clearing will be avoided as the site office, materials storage areas, construction vehicles / machinery and access tracks will be located on previously disturbed or cleared areas.

**Drainage modification:**
Drainage modelling will bring the surface hydrology back to closer to natural models due to an increase in culvert installation.

Main Roads will avoid clearing native vegetation where possible. Where clearing cannot be avoided clearing will be kept to a minimum. The Clearing Assessment Report (CAR) provided by the applicant for the Marble Bar Road Upgrades Project (Main Roads 2021) includes an Environmental Management Plan (EMP) as Appendix A that has been developed to manage and minimise vegetation clearing impacts from proposed clearing. The applicant has advised (Main Roads 2022a) that the clearing proposed for the Marble Bar Road Upgrades Project is all permanent clearing, predominantly following the existing road. The proposed road upgrade utilises existing disturbed areas for all temporary construction requirements and the route follows the existing alignment wherever possible (Main Roads 2022a). Priority flora species have been avoided wherever possible (Section 3.2.1), and a large area to the east has been removed from the application area which encompasses a large portion of the Priority 1 *Solanum sp*. Mosquito Creek (A.A. Mitchell *et al.* AAM 10795) known habitat and records (Main Roads 2022a).

No clearing is proposed for laydowns and temporary construction needs, as these are all located within the final footprint or existing cleared areas. Due to the permanent nature of clearing no revegetation strategies are currently being considered. As the project progresses through the detailed design phase opportunities for refinement of the alignment and a reduction in total clearing will be investigated. Where the new alignment deviates from the existing road, redundant areas will be either handed over to local stakeholders where there is value (Main Roads 2022a), or they will be rehabilitated in accordance with Main Roads standard practices which involves ripping the old road surface (Main Roads 2022a). The intent is that redundant areas will be ripped to Main Roads standards, however further consultation will determine which areas of the existing roads are required to be left in place (Section 3.3). Rehabilitation of these redundant areas are not within the application area and are therefore not the subject of the CPS 9475/1 application (Main Roads 2022a). No further reduction in clearing has been identified at this stage of the project and no temporary clearing is proposed (Main Roads 2022a).

An Environmental Work Instruction (EWI) for clearing in potential Greater Bilby *(Macrotis lagotis)* habitat has been provided that includes pre-clearance surveys (Main Roads 2022b). Impacts of proposed clearing on significant flora and ecological communities are not considered significant in the local context, and no further mitigation measures have been proposed (Main Roads 2022a).

Main Roads (2022a) advised that impacts to surface water and groundwater will be minimised by incorporating all relevant water quality protection notes into the construction contract to ensure compliance and protection of Public Drinking Water Source Areas. Main Roads will not utilise any recycled road base or recycled drainage rock as defined in the Roads to Reuse Product Specification (Waste Authority 2021) (Main Roads 2022a) (Section 3.2.4).

## 3.2. Assessment of impacts on environmental values

The assessment against the clearing principles (Appendix E) identified that the impacts of the proposed clearing present a potential risk to the biological values of significant flora and ecological communities, significant fauna habitat, native vegetation associated with a watercourse, and land and water resources. The consideration of these impacts, and the extent to which they can be managed through conditions applied in line with sections 51H and 51I of the EP Act, is set out below.

Biological surveys referenced are described in Appendix A. The spatial scopes referenced are comprised of the:

- ‘application area’ of 755 hectares;
- ‘clearing area’ of 500 hectares;
- the ‘survey area’ based on biological surveys undertaken comprising a 100 metre wide corridor around Marble Bar Road (SLK 97 to SLK 179), plus a five kilometre extension at the southern end, and the Nullagine Bypass around the Nullagine townsite;
- a ‘contextual area’ based on a 500 metre buffer around the ‘survey area’; and
- the ‘local area’ based upon a 40 kilometre buffer around the ‘application area’.

### *3.2.1. Environmental value: biological values (significant ecological communities and flora) – Clearing Principle (a)*

Assessment: The Marble Bar Road upgrades primary biological survey was conducted in March 2020 by Biota Environmental Sciences (Biota 2021). A secondary targeted flora survey was conducted in April 2021 by Pilbara Environmental (Pilbara Environmental 2021). An additional survey has been utilised which covers some portions of the proposed Nullagine bypass by WoodGIS conducted in April 2019 (WoodGIS 2020).

Thirty-two vegetation units have been mapped over the application area (Biota 2021; WoodGIS 2020), and over 80 per cent of the native vegetation within the application area is in very good condition or better (Appendix C1).

Three significant ecological communities have been mapped locally within 40 kilometres of the application area (Table D1a; Appendix G1: Figure 1), with two mapped over the application area (Appendix G1: Figure 2):

- Four plant assemblages of the Wona Land System (previously 'Cracking clays of the Chichester and Mungaroona Range') (Wona Land System); and
- Stony saline clay plains of the Mosquito Land System (Mosquito Land System).

The Wona Land System is a Priority 1 PEC listed by the Department of Biodiversity, Conservation and Attractions (DBCA) and the Mosquito Land System is a Priority 3 PEC listed by the DBCA.

Three vegetation units mapped over the application area by Biota (2021) and WoodGIS (2020) correlate with the two PECs above (Appendix D: Tables D1a to Table D1c). One of the four plant assemblages of the Wona Land System PEC includes the cracking clays of the Chichester and Mungaroona Range and corresponds to the grassland/herbland areas of vegetation unit C1 (Biota 2021). Vegetation unit P1 (Biota 2021) and 4a (WoodGis 2020) corresponds with the stony saline clay plains of the Mosquito Land System.

Utilising the corresponding three vegetation units of Biota (2021) and WoodGIS (2020), the Wona Land System is mapped over 13.9 hectares of the application area (or 1.8 per cent) and the Mosquito Land System is mapped over 110.8 hectares of the application area (or 14.6 per cent).

Regionally, the Wona Land System has been recorded from 176 occurrences totalling 178,729 hectares, and occurs on tablelands throughout the Chichester Range in the Chichester-Millstream National Park, Mungaroona Range Nature Reserve and on adjacent pastoral leases (DBCA 2021). DBCA (2020) describes this assemblage as a "shrubless plain of stony gibber community occurs on the tablelands with very little vegetative cover during the dry season, however during the wet a suite of ephemerals/annuals and short-lived perennials emerge, many of which are poorly known and range-end taxa". Mapping of the community is based on broad scale land system mapping by Van Vreeswyk *et al*. (2004) and is approximate. The total area is likely to be much less (DBCA 2021). The community has been a focus for grazing and has been severely degraded by past land practices including heavy grazing, and development for mining and associated infrastructure and areas of the Wona Land System in good or better condition therefore have particularly high conservation significance (DBCA 2021). The condition of the vegetation over the application area is predominantly very good to excellent with very few weeds *(Cenchrus ciliaris* and *C. setiger* are present but individuals were scattered).

The Mosquito Land System has been recorded from eight occurrences totalling 164,314 hectares, and is largely restricted to the area east of Nullagine townsite. The community is threatened by preferential grazing (livestock and feral herbivores), clearing for mining and associated activity. The condition of the vegetation around Nullagine townsite (WoodGIS 2020 - 4a) is locally impacted by mining and grazing and generally degraded to completely degraded, with low plant cover and high levels of *Cenchrus ciliaris* and *C. setiger*. The condition of areas outside of the Nullagine townsite (Biota 2021 – vegetation unit P1) ranges from very good to excellent, with some minor disturbance from grazing.

Given the relatively limited extent of the proposed clearing (Table 1 below) it is likely that the impacts to the PECs will not be regionally significant, but may be locally significant particularly given the excellent condition of the vegetation along the road reserve. The penetration of weeds and altered hydrology have the potential to impact significant ecological communities adjacent to the proposed clearing (DBCA 2021).

**Table 1: Summary of Priority Ecological Communities identified over the application area**

| **Priority Ecological Community and status** | **Veg. unit** Biota (2021) and WoodGIS (2020) | **Application Area** | | **Survey Area and Contextual Area** | | **Percentage of Survey Area and Contextual Area potentially cleared (%)** | **Mapped within local area (40 km radius)** | **Percentage of local area potentially cleared (40 km radius) (%)** |
|---|---|---|---|---|---|---|---|---|
| | | Area (ha) | Per-cent (%) | Area (ha) | Per-cent (%) | | Area (ha) | |
| Wona Land System (P1) | C1 | 13.9 | 1.8 | 256 | 1.9 | **5.4%** | 15,701 | **0.089%** |
| Mosquito Land System (P3) | P1 and 4a | 110.8 | 14.6 | 638 | 4.5 | **17.4%** | 117,827 | **0.094%** |

Eight Priority flora taxa have been recorded from within the application area including; three Priority 1, two Priority 2, and three Priority 3 taxa (Biota 2021; Pilbara Environmental 2021; and WoodGIS 2020) (Appendix D: Tables D2a to D2d; Appendix G1: Figures 1 to 6 ). These eight taxa will be directly impacted by the proposed clearing (Table 2 below).

Surveys included a wider area than just the application area (that is, the combined survey area and contextual area) and locations and abundance information for the eight taxa recorded within the application area is also available from Threatened flora databases (TPFL and WAHerb data). Data available from the local area is summarised in Table 2 below (Appendix G1: Figure 1 to Figure 3).

**Table 2: Summary of known records of Priority flora taxa within 40 kilometres of the application area**

| Priority Taxon | Status | *Regional records | | *Survey records | | TOTAL | |
|---|---|---|---|---|---|---|---|
| | | Count | Locations | Count | Locations | Count | Locations |
| *Acacia aphanoclada* | P1 | 322 | 68 | 10,172 | 2,818 | 10,494 | 2,886 |
| *Solanum* sp. Mosquito Creek | P1 | 9 | 9 | 2,264 | 239 | 2,273 | 248 |
| *Atriplex spinulosa* | P1 | 73 | 18 | 158 | 104 | 231 | 122 |
| *Ipomoea racemigera* | P2 | | | 38 | 32 | 38 | 32 |
| *Euphorbia inappendiculata* var. *inappendiculata* | P2 | | | 131 | 21 | 131 | 21 |
| *Dolichocarpa* sp. Hamersley Station | P3 | | | 9,080 | 217 | 9,080 | 217 |
| *Eragrostis crateriformis* | P3 | 107 | 8 | 6 | 6 | 113 | 14 |
| *Rhagodia* sp. Hamersley (M. Trudgen 17794) | P3 | 15 | 11 | 23 | 17 | 38 | 28 |

***Regional records = TPFL and WAHerb data within the local area***
***Survey records = Biota (2021), Pilbara Environmental (2021), and WoodGIS (2020) data***

Utilising documented survey records an analysis of individuals (count) and locations potentially removed by the proposed clearing, and remaining within the local area, is provided in Table 3 below.

**Table 3: Summary of impacts to known records of Priority flora taxa identified over the application area**

| Priority Taxon recorded within application area | Status | Survey and contextual area | | Local area (40km radius) | |
|---|---|---|---|---|---|
| | | Percentage individuals lost due to proposed clearing (%) | Percentage locations lost due to proposed clearing (%) | Percentage individuals lost due to proposed clearing (%) | Percentage locations lost due to proposed clearing (%) |
| *Acacia aphanoclada* | P1 | 42 | 35 | 41 | 34 |
| *Solanum* sp. Mosquito Creek | P1 | 13 | 41 | 12 | 40 |
| *Atriplex spinulosa* | P1 | 8 | 10 | 5 | 8 |
| *Ipomoea racemigera* | P2 | 24 | 22 | 24 | 22 |
| *Euphorbia inappendiculata* var. *inappendiculata* | P2 | 1 | 5 | 1 | 5 |
| *Dolichocarpa* sp. Hamersley Station | P3 | 5 | 14 | 5 | 14 |
| *Eragrostis crateriformis* | P3 | 33 | 33 | 2 | 14 |
| *Rhagodia* sp. Hamersley (M. Trudgen 17794) | P3 | 30 | 35 | 18 | 21 |

Data includes the survey data of Biota (2021), Pilbara Environmental (2021), and WoodGIS (2020) as well as the TPFL and WAHerb database records. There are relatively few TPFL and WAHerb database records from the local area when compared to the survey data (Table 2), with just one TPFL and WAHerb database record within the application area (*Acacia aphanoclada),* reflecting little difference in impact comparisons between the survey and contextual area and the local area (Table 3).

In regard to the data available, 41 per cent of individuals and 34 per cent of locations of *Acacia aphanoclada* (P1) will be potentially removed as a consequence of proposed clearing. Approximately 40 per cent of locations of *Solanum* sp. Mosquito Creek will be potentially lost due to proposed clearing. Approximately 24 per cent of individuals and 22 per cent of locations of *Ipomoea racemigera* (P2) will be potentially removed, with percentages potentially lost for the remaining six taxa below 20 per cent for individuals and locations (apart from *Rhagodia* sp. Hamersley at 21 per cent of locations) (Table 3).

Apart from TPFL and WAHerb database records, additional local distribution and abundance information regarding the relevant Priority flora taxa is also available in the literature without specific location data and attributes being recorded or submitted. Extrapolating data from Biota (2021), Pilbara Environmental (2021), WoodGIS (2018),

WoodGIS (2020), and Waters (2017), Main Roads (2022a) assessed impacts to the local populations at less than one per cent for *Acacia aphanoclada* and *Atriplex spinulosa* and under ten per cent *Solanum* sp. Mosquito Creek (Appendix I).

***Acacia aphanoclada* (P1)** (Appendix D2: Table D2b, Table D2c; Appendix G2: Fig 4; Appendix G3: Fig 1;)

*Acacia aphanoclada* is a tall spindly shrub that has a relatively restricted distribution, with known records distributed over a range of 70 kilometres east-west and 40 kilometres north-south (DBCA 2021), being centred in the Mosquito Land System in the vicinity of Nullagine (Biota 2021). The species is known from nine confirmed sub-populations and approximately four locations (using the IUCN definition for location) (DBCA 2021).

Biota (2021), Pilbara Environmental (2021), and WoodGIS (2020) recorded *Acacia aphanoclada* within vegetation units D1, D5, H2, H3, H4, H5, H6, H8, P1, P4 within the application area and units 5a, 5b and 7a outside of the application area (Appendix G2: Figure 1; Figure 4). Assuming suitable habitat is limited to the above mentioned vegetation units, approximately six per cent of suitable habitat mapped within the survey area and contextual area occurs within the application area and potentially cleared.

Biota (2021), Pilbara Environmental (2021), and WoodGIS (2020) recorded more than 10,400 plants during surveys over the survey area and broader contextual area with the species 'widespread and abundant' in the Mosquito Land System. These surveys were predominantly linear and population extent was not recorded. Additional plants are likely to occur outside of the survey area and the true impact to this species is likely to be less than 41 per cent.

Additional records exist that do not have a population count (DBCA 2021). Over 21,220 individuals were recorded by WoodGIS (2018), with population estimates over the northern Mosquito Land System at 1,550,000 (WoodGIS 2018).

On the Mosquito Plain Land System, Pilbara Environmental (2021) recorded density estimates between 104 and 288 plants per hectare (Pilbara Environmental 2021). Extensive suitable habitat is known to be present outside mapped areas and the species would be expected to occur at similar densities in the surrounding areas (Pilbara Environmental 2021). Approximately 117,827 hectares of the Mosquito Land System has been mapped locally. The area of the Mosquito Land System mapped over the application area, and potentially cleared, represents approximately 0.09 percent of this local extent. Using an assumed conservative value of ten plants per hectare over the available local habitat, and an assumed conservative upper value of 288 plants per hectare (Pilbara Environmental 2021) within the application area, less than three per cent of the *Acacia aphanoclada* population would be potentially cleared.

***Solanum* sp. Mosquito Creek (P1)** (Appendix D2:Table D2b, Table D2c; Appendix G2: Fig 5; Appendix G3: Fig 1)

*Solanum* sp. Mosquito Creek (A.A. Mitchell *et al.* AAM 10795) is known from four locations (using the IUCN definition for location) over a restricted range of 25 kilometres east-west and 15 kilometres north-south (Appendix G3: Figure 1). Based on the available data (Table 3) impacts to the taxa may be significant at the regional and sub-population level (DBCA 2021). However, given the linear nature of the surveys completed, it is expected that populations extend beyond the survey area (DBCA 2021) and additional contextual information is available from literature.

Biota (2021) and Pilbara Environmental (2021) recorded *Solanum* sp. Mosquito Creek within vegetation units P1, P2 and H8 within the application area, with WoodGIS (2020) recording it in vegetation unit 2c within the application area (and vegetation units 2d and 2e outside of the application area). Assuming suitable habitat is limited to the above mentioned vegetation units, approximately 10.7 per cent of suitable habitat mapped within the survey area and contextual area occurs within the application area and potentially cleared.

The taxon is largely confined to, and abundant on, the Mosquito Land System (Pilbara Environmental 2021). Approximately 117,827 hectares of the Mosquito Land System has been mapped locally. The area of the Mosquito Land System mapped over the application area, and potentially cleared, represents approximately 0.09 percent of this local extent.

WoodGIS (2020) describe the taxa as an abundant local endemic species that is widespread on *Triodia longiceps* alluvial plains with densities very high in recently burnt areas, at approximately 6,533 plants per hectare when compared to unburnt sites at up to 156 plants per hectare. A similar trend was observed by Pilbara Environmental (2021) with the latter also recording the taxa mostly in disturbed habitats. A large area to the east of the application area has been avoided which encompasses a large portion of the *Solanum* sp. Mosquito Creek known habitat (Appendix I), and Main Roads (2022a) assessed impacts to local populations at under ten per cent (Appendix I). Based on the extensive areas of suitable habitat available in surrounding areas, the likelihood of densities being comparable in these surrounding areas, and the abundance of the species following fire, it is unlikely the proposed clearing will have a significant impact at the local or regional scale.

***Atriplex spinulosa* (P1)** (Appendix D2: Table D2b, Table D2c; Appendix G2: Fig 6; Appendix G3: Fig 1)

*Atriplex spinulosa* is known from four sub-populations (DBCA 2021) with the majority of records in the vicinity of the application area east of Nullagine over a range of approximately 65 kilometres east-west and 15 kilometres north-south (Appendix G3: Figure 1). There is a single record near Carnarvon from 2004, and another record from Indarra in the Wheatbelt from 1950, however it is considered unlikely that plants still persist at this location (DBCA 2021). As the species largely occurs over a restricted area, there is the potential for impacts to be significant to this species at a sub-population level as there may be additional indirect impacts such as potential penetration of weeds and altered hydrology (DBCA 2021).

*Atriplex spinulosa* was not recorded by Biota (2021), but was recorded in low numbers in the application area by Pilbara Environmental (2021) (six records) and WoodGIS (2020) (six records) (Appendix D2: Table D2b). Biota (2021) state that if present the species is unlikely to be abundant over the application area.

*Atriplex spinulosa* is common on the Mosquito Plain Land System (Pilbara Environmental 2021) with WoodGIS (2020) recording between 444 and 1,667 plants per hectare, and up to 30,500 plants per hectare recorded by WoodGIS (2018) at an average of 5,700 plants per hectare. Approximately 117,827 hectares of the Mosquito Plain Land System has been mapped in the local area of which up to 82 hectares may potentially be cleared; or 0.09 per cent of the available habitat in the local area. Main Roads (2022a) assessed impacts to local *Atriplex spinulosa* populations at under one per cent (Appendix I), and given the low number of records over the application area, and high densities recorded in surrounding areas, impacts are not likely to be significant. However, indirect impacts such as potential penetration of weeds and altered hydrology may impact adjacent local populations.

***Ipomoea racemigera* (P2)** (Appendix D2: Table D2b, Table D2c; Appendix G3: Fig 2)

*Ipomoea racemigera* occurs over a range of approximately 338 kilometres east-west and 180 kilometres north-south from six locations in Western Australia (using the IUCN definition for location) (DBCA 2021) (Appendix G3: Figure 2). It is also known from numerous records over a large range in the Northern Territory and Queensland, however, Western Australia's sub-populations are disjunct, may be different genetically, and exhibit different tolerances to environmental conditions. *Ipomoea racemigera* is an annual creeper recorded from seven locations in the application area and was recorded from creekline vegetation units D1, D2 and D4 (Biota 2021; Pilbara Environmental 2021). As the species is known to occur over a large range, the proposed clearing is unlikely to be significant to the conservation and persistence of the species (DBCA 2021). Due to the linear nature of proposed clearing, the proportion of drainage line and attendant floodplain habitat within the application area is minimal compared to the extent of habitats associated with drainage lines across the survey area, contextual area, and local area and direct impacts are unlikely to be significant. However, indirect impacts such as potential penetration of weeds and altered hydrology may impact adjacent local populations.

***Euphorbia inappendiculata* var. *inappendiculata* (P2)** (Appendix D2: Table D2b, Table D2c; Appendix G3: Fig 2)

*Euphorbia inappendiculata* is a small annual herb that was recorded in cracking clays (vegetation unit C1) at one location in the centre of the survey area by Pilbara Environmental (2021). Only 1.8 per cent of the mapped extend of this vegetation unit occurs within the application area (Appendix C: Table C1c). Of the 131 individuals recorded (Biota 2021; Pilbara Environmental 2021) only one individual was located with the application area. The potential loss of this individual will not have a significant impact on the local population of this species.

***Dolichocarpa sp*. Hamersley Station (P3)** (Appendix D2: Table D2b, Table D2c; Appendix G3: Fig 3)

*Dolichocarpa sp*. Hamersley Station (A.A. Mitchell PRP 1479) is distributed over a broad range of approximately 400 kilometres through the Pilbara (WAH 1998), but is restricted to heavy clay soils (Pilbara Environmental 2021). The current records are at the eastern edge of the known range (WAH 1998). This taxon was recorded as widespread by Pilbara Environmental (2021) across the cracking clay habitat (vegetation units C1 and P3) both within and outside the application area with a density estimate of 460 plants per hectare (Pilbara Environmental 2021). Utilising known records, impacts are assessed at five per cent for individuals and 14 per cent for locations (Table 3). There is a relative abundance of cracking clay habitat contiguous with, but outside the application area, that is highly likely to provide suitable habitat for this species in the local area (Pilbara Environmental 2021). Direct impacts are unlikely to be significant, however, indirect impacts such as potential penetration of weeds and altered hydrology may impact adjacent local populations.

***Eragrostis crateriformis* (P3)** (Appendix D2: Table D2b, Table D2c; Appendix G3: Fig 3)

Just two individuals of the annual grass *Eragrostis crateriformis* were recorded from within the application area. Utilising known records, impacts are two per cent for individuals and 14 per cent for locations (Table 3). The species has a range of approximately 2,000 km, extending from Yanrey Station near Onslow to the

inland Northern Territory, with most records being from the Pilbara bioregion (Biota 2021). The taxa was recorded from creeklines or associated floodplains (vegetation units D2, D4 and P4) and considering its widespread distribution, the proportion of drainage line and attendant floodplain habitat within the local area, and linear nature of proposed clearing, direct impacts are unlikely to be significant. However, local indirect impacts such as potential penetration of weeds and altered hydrology may impact adjacent populations.

***Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3)** (Appendix D2: Table D2b, Table D2c; Appendix G3: Fig 3)

*Rhagodia* sp. Hamersley (M. Trudgen 17794) occurs among Mulga (Acacia *aptaneura*) associated with clay substrates (vegetation units M1 and H7 - or D6 in the vicinity of M1) and this is considered the primary habitat for the taxon. The taxon is often restricted to the shade underneath the canopy of Mulga (Pilbara Environmental 2021). Seven individuals were recorded from the application area and an additional 31 outside of the application area. Utilising known records, impacts are assessed at 18 per cent for individuals and 21 per cent for locations (Table 3). Overall, there is limited suitable habitat for this species within the application area with the M1 and H7 vegetation units comprising less than five percent of the application area; with the Mulga (M1) vegetation just 0.5 per cent (Appendix C: Table C1c). Local impacts are not likely to be significant.

Six additional Priority flora taxa have been recorded within the vicinity of the application area (Appendix D: Table D2d) (Biota 2021; Pilbara Environmental 2021). Three of these taxa; *Paspalidium retiglume* (P2), *Nicotiana umbratical* (P3) and *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) (P3) were recorded within ten metres of the application area. Proposed clearing is unlikely to be significant to the conservation and persistence of these species, but indirect impacts such as potential penetration of weeds and altered hydrology may impact adjacent populations.

An additional two Priority flora taxa, *Iotasperma sessilifolium* (P3) and *Rostellularia adscendens* var. *latifolia* (P3) may occur over the application area but were not recorded (Biota 2021; Pilbara Environmental 2021) (Appendix D: Table D2e). If present, proposed clearing is unlikely to be significant due to the persistence of these two species, but indirect impacts such as potential penetration of weeds and altered hydrology may impact adjacent populations.

Twenty-five introduced flora species (that is, weeds) were recorded by Biota (2021) including three species declared under the BAM Act, as listed by the Agriculture and Food Division of the Department of Primary Industry and Regional Development (DPIRD 2020a); **Azadirachta indica* (Neem Tree), **Calotropis procera* (Calotrope) and **Tamarix aphylla* (Athel Tree). Indirect impacts of proposed clearing include the penetration of weeds into adjacent habitat, and altered hydrology that may impact adjacent PECs and adjacent Priority flora populations.

Design of the road upgrades has considered water run-off management in respect to the downstream impacts. Watercourses in the region are dry for most of the year, flowing only after significant rainfall events. Proposed clearing is linear in nature and predominantly along the existing road corridor. Appropriate drainage design and construction management of drainage at watercourse crossings to Australian Standards is unlikely to significantly alter the current surface water hydrology at watercourse crossings. The applicant has submitted that drainage modelling will either maintain the existing hydrology or reinstate the surface water hydrology closer to natural models due to an increase in culvert installation and roadside drainage (Main Roads 2021). Cleared areas will be replaced with hard road base. The proposed clearing of the Marble Bar roadside may cause some short-term surface water sedimentation during construction works, and altered hydrology in adjacent areas due to the installation of table drains. Surface water flow will be controlled by incorporating drainage management design and by implementing standard road construction methodologies for drainage control.

Conclusion: Based on the above assessment it is considered that proposed clearing will result in direct impacts to two PECs. Impacts are not considered significant at the local scale but weeds and altered hydrology have the potential to impact PECs immediately adjacent to the proposed clearing. Proposed clearing will also result in direct impacts to eight Priority flora taxa including three Priority 1 taxa, two Priority 2 taxa, and three Priority 3 taxa. When considering distribution and abundance information, additional to the robust data provided by surveys over the application area, survey area, and contextual area, impacts to Priority flora taxa are not considered significant at the local scale.

For the reasons set out above, and the avoidance and mitigation measures provided by the applicant (Section 3.1), it is considered that potential impacts of the proposed clearing on significant flora and adjacent habitat can be managed by implementing appropriate road design and construction to minimise alteration to surface hydrology, and implementing effective weed control actions.

Conditions: Risks of downstream sedimentation and alteration to surface hydrology can be managed by implementing appropriate drainage design and road construction methodologies. To address potential impacts of weed penetration into adjacent habitat the following management measure will be required as a condition on the clearing permit:

- Implement weed control measures to mitigate impacts to adjacent vegetation.

### *3.2.2. Environmental value: biological values (significant fauna) – Clearing Principle (b)*

Assessment: A vertebrate fauna survey was undertaken by Biota Environmental Sciences over the application area (Biota 2021). The background work considered a desktop study and literature review followed by field work during March 2020. The survey was undertaken over a survey area larger than the application area and also considered the surrounding contextual area, to inform the use or potential use of habitats in the survey area, and included a targeted Threatened fauna survey.

A total of 13 fauna habitat types were described and mapped over the application area by Biota (2021), and align broadly with the five landforms present (Appendix D: Table D3b). Percentages cleared within the contextual areas are provided in Appendix D: Table D3d**.**

The conservation-significant fauna species Pilbara Leaf-nosed Bat *(Rhinonicteris aurantia)* (VU) and Western Pebble-mound Mouse *(Pseudomys chapmani)* (P4) were recorded over the application area, and an additional three birds, three mammals and two reptiles were considered likely to occur (Biota 2021) (Table 4 below) (Appendix D: table D3a).

**Table 4: Fauna of conservation significance likely to occur over the application area**

| Common name | Scientific name | Status | Primary fauna habitat utilised |
|---|---|---|---|
| **Birds** | | | |
| Grey Falcon | *Falco hypoleucos* | VU | MDL |
| Peregrine Falcon | *Falco peregrinus* | OS | MDL |
| Fork-tailed Swift | *Apus pacificus* | MI | Aerial |
| **Mammals** | | | |
| Northern Quoll | *Dasyurus hallucatus* | EN | MB, MDL, RTG |
| Greater Bilby | *Macrotis lagotis* | VU | OS, GP, GSP, MDL |
| Pilbara Leaf-nosed Bat | *Rhinonicteris aurantia* (Pilbara) | VU | MDL |
| Ghost Bat | *Macroderma gigas* | VU | MDL |
| Western Pebble-mound Mouse | *Pseudomys chapmani* | P4 | HS |
| **Reptiles** | | | |
| Pilbara Olive Python | *Liasis olivaceus barroni* | VU | MB, MDL |
| Pin-striped Finesnout Ctenotus | *Ctenotus nigrilineatus* | P1 | HB |

All habitats present over the application area could be utilised for foraging and hunting by the Grey Falcon *(Falco hypoleucos)* and Peregrine Falcon *(Falco peregrinus)* with waterholes or other features attracting aggregations of birds or other prey likely to be particularly attractive. Breeding for both species typically takes place in taller trees such as large eucalypts along major drainage lines, or cliff ledges in rocky areas in the case of the Peregrine Falcon. Suitable breeding habitat occurs primarily within the contextual area, with smaller areas within the application area. No suitable cliff ledges occur over the application area, however, tall trees for breeding purposes occur along major drainage lines and associated tributaries, such as the Nullagine River and Cajuput Creek (fauna habitat MDL). Approximately 47 hectares of fauna habitat MDL has been mapped over the application area (6.2 per cent of the application area) representing potentially 4.7 per cent of this habitat within the combined survey and contextual areas (Table 5).

The Fork-tailed Swift *(Apus pacificus)* is a migratory species that in Australia is entirely aerial and may overfly the application area only.

All habitats present over the application area could be utilised for foraging and hunting by the Pilbara Leaf-nosed Bat *(Rhinonicteris aurantia)* and Ghost Bat *(Macroderma gigas)* but particularly waterholes and along major drainage lines and associated tributaries (fauna habitat MDL). Both species roost, and breed, within cave systems. No suitable caves occur within the application area for either species and roosting or breeding habitat is not present.

The Western Pebble-mound Mouse *(Pseudomys chapmani)* is commonly found on stony hillsides with hummock grasslands (van Dyck and Strahan 2008), and is known for the extensive mounds of small stones it constructs in habitat where pebble size is suitable. Suitable habitat is present over the application area particularly in the low rolling stony hills (fauna habitat HS), of which approximately 230 hectares has been mapped over the application area representing potentially 4.4 per cent of this habitat within the combined survey and contextual areas (Table 5).

The Northern Quoll *(Dasyurus hallucatus)* occurs predominantly in rocky habitat and often with gorges, breakaways and hills, with rugged rocky areas used for denning purposes, but can also occur along creek lines (van Dyck and

Strahan 2008) Capricorn and Newman land Systems (Appendix G4: Figure 1 and Figure 2). There is considerable habitat for this species in the survey and contextual area (>1,100 hectares), particularly along major drainage lines and surrounding rocky areas. Within the application area itself scree slopes (fauna habitat MB) and drainage lines (fauna habitats RTG and MDL) provide potential habitat representing 4.3 per cent of the mapped habitat within the combined survey and contextual areas.

Preferred habitat for the Pilbara Olive Python *(Liasis olivaceus barroni)* includes gorges, escarpments, rocky outcrops and water holes (Wilson and Swan 2010) where it may find suitable prey and suitable refuge. Rocky hills (fauna habitat MB) and major drainage lines (fauna habitat MDL) provide approximately 50 hectares of potential habitat representing potentially 4.2 per cent of habitat within the combined survey and contextual areas (Table 5).

The Pin-striped Ctenotus skink *(Ctenotus nigrilineatus)* is a little-known species that has been recorded from several locations in the east Pilbara from spinifex plains in association with granite rocky outcrops and watercourses (Wilson and Swan 2017). It is known from the Nullagine region and has previously been recorded in close proximity. Areas of apparently suitable spinifex plain and volcanic boulder outcrop habitat exist within the application area (fauna habitat HB) with 57 hectares occurring over the application area representing potentially 4.3 per cent of habitat within the combined survey and contextual areas (Table 5).

**Table 5: Fauna habitat over contextual areas**

| Species | Primary landform and fauna habitat ID | | Application Area | | Survey Area | | Survey and Contextual Area | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Area (ha) | Per cent (%) | Area (ha) | Per cent (%) | Area (ha) | Per cent (%) | Per Cent pot. cleared |
| Grey Falcon | Drainage Lines | MDL | 47 | 6.2 | 153 | 6.6 | 998 | 7.4 | 4.7 |
| | | | | | | | | | |
| Peregrine Falcon | Drainage Lines | MDL | 47 | 6.2 | 153 | 6.6 | 998 | 7.4 | 4.7 |
| | | | | | | | | | |
| Northern Quoll | Hills and Mesas | MB | 2 | 0.3 | 6 | 0.3 | 155 | 1.1 | 1.2 |
| | Drainage Lines | MDL | 47 | 6.2 | 153 | 6.6 | 998 | 7.4 | 4.7 |
| | Drainage Lines | RTG | 2 | 0.3 | 5.6 | 0.2 | 30 | 0.2 | 7.1 |
| | | | | | | | | | |
| Pilbara Leaf-nosed Bat | Drainage Lines | MDL | 47 | 6.2 | 153 | 6.6 | 998 | 7.4 | 4.7 |
| | | | | | | | | | |
| Ghost Bat | Drainage Lines | MDL | 47 | 6.2 | 153 | 6.6 | 998 | 7.4 | 4.7 |
| | | | | | | | | | |
| Western Pebble-mound Mouse | Hills and Mesas | HS | 230 | 30.5 | 583 | 25.1 | 5,176 | 38.3 | 4.4 |
| | | | | | | | | | |
| Pilbara Olive Python | Hills and Mesas | MB | 2 | 0.3 | 6 | 0.3 | 155 | 1.1 | 1.2 |
| | Drainage Lines | MDL | 47 | 6.2 | 153 | 6.6 | 998 | 7.4 | 4.7 |
| | | | | | | | | | |
| Pin-striped Ctenotus | Hills and Mesas | HB | 57 | 7.6 | 149 | 6.4 | 1,331 | 9.8 | 4.3 |

The Greater Bilby (*Macrotis lagotis)* was not recorded by (Biota 2021), however, the species has previously been recorded in close proximity to the application area particularly in the River and Macroy Land Systems (Appendix G4: Figure 1 and Figure 2). Greater Bilbies are highly mobile species and known to move up to five kilometres between burrows on consecutive nights with an average home range of between 110 and 300 hectares around their burrow network (DBCA 2021). Bilbies are nomadic and often sparsely distributed across large areas and movement patterns and denning burrow locations change in response to rainfall and food availability. Therefore, a single survey may not detect bilby presence via primary or secondary signs (DBCA 2021). The application area is within close proximity to several recent and historic bilby records (Appendix G4: Figure 1 and Figure 2) and the application area is likely to support the species (DBCA 2021).

Prospective bilby habitat was described and mapped over the survey area by Biota (2021). Based on the presence of suitable food source plants and substrate within vegetation of an appropriate fire history age, a total of approximately 43 hectares of the application area (or 6 per cent) was classed as being High prospective bilby habitat by Biota (2021) (Appendix G4: Figure 3), with approximately 294 hectares (or 40 per cent) classed as Moderate

prospective bilby habitat (Table 6). The percentage of High prospective bilby habitat within the application area that was mapped across the combined survey and contextual area is approximately 14 per cent (with a total of 316 hectares mapped). The percentage of Moderate prospective bilby habitat within the application area that was mapped across the combined survey and contextual area is approximately 6 per cent (Table 6) (with a total of 5,232 hectares mapped) (Appendix D: Table D3e).

**Table 6: Greater Bilby habitat over contextual areas**

| Greater Bilby habitat quality | Application Area | | Survey Area and Contextual Area | | Percentage of Survey Area and Contextual Area potentially cleared (%) |
|---|---|---|---|---|---|
| | Area (ha) | Per-cent (%) | Area (ha) | Per-cent (%) | |
| High | 43 | 6 | 316 | 2 | 14% |
| Moderate | 294 | 39 | 5,232 | 36 | 6% |

The Priority 4 Brush-tailed Mulgara *(Dasycercus blythi)* can occur in similar habitats to the Greater Bilby but was not recorded over the survey area or contextual area during the survey of Biota (2021). Biota (2021) state that substrates across the majority of the survey area were relatively hard and stony and not optimal habitat for the species with areas of more suitable habitat occurring along the margins of drainage lines which were often degraded by cattle.

Conclusion: No caves providing permanent or semi-permanent day roosts or maternity roosts for the Ghost Bat (VU) or Pilbara Leaf-nosed Bat (VU) are likely to be located in the application area. The application area itself is not likely to include the rugged rocky areas used by Northern Quolls (EN) for denning purposes (Main Roads 2022a), and the applicant is not proposing to clear any Northern Quoll denning habitat (Main Roads 2021). Proposed clearing will not isolate any access to denning habitat as foraging habitat is widespread locally. Proposed clearing may impact fauna utilising the application area at the time of clearing. The likelihood of active nesting sites of the Grey Falcon (VU) or Peregrine Falcon (OS) being encountered over major drainage line crossings is very low. Similarly, the likelihood of the presence of the Northern Quoll or Pilbara Olive Python (VU) along major drainage lines or rocky hills, or the Pin-striped Ctenotus within volcanic boulder hills and outcrops at the time of proposed clearing is considered low. The Western Pebble-mound Mouse (P4) was recorded over the application area and mounds associated with this species may be present within the 230 hectares of hill slope habitat occurring, however, considering the linear nature of the proposed clearing, local and regional impacts are considered low. High prospective Greater Bilby habitat has been identified over the application area and individuals may be present within burrows at the time of proposed clearing. Pre-clearance surveys, with relocation of individuals if required, will mitigate impacts to individuals that may be present. The Brush-tailed Mulgara can occur in similar habitats to the Greater Bilby and also den in burrows. Pre-clearance surveys for the Greater Bilby should also consider the presence of Brush-tailed Mulgara. Twenty-five introduced flora species (that is, weeds) were recorded by Biota (2021) and indirect impacts of proposed clearing include the penetration of weeds into adjacent fauna habitat.

It is considered that the impacts of the proposed clearing on fauna of conservation significance can be managed by undertaking slow and directional clearing to allow fauna to move into adjacent vegetation, undertaking pre-clearance surveys, implementing relevant relocation programs if required, and taking steps to minimise the risk of the introduction and spread of weeds into adjacent fauna habitat.

DBCA (2021) advise that the proposed clearing may disturb or take fauna listed as Threatened under the BC Act and prior to clearing, an authorisation from the Minister for Environment under section 40 of the BC Act will be required for the Greater Bilby, Northern Quoll, Pilbara Olive Python and Night Parrot *(Pezoporus occidentalis)* (the latter due to proposed clearing located within 100 kilometres of a known record). Any section 40 authorisations under the BC Act are likely to impose additional conditions managed by the DBCA relating to impacts to individual Threatened fauna species at the time of clearing.

Conditions: To address the above impacts, the following management measures will be required as conditions on the clearing permit:

- Undertake slow, progressive, one directional clearing to allow terrestrial fauna to move into adjacent habitat ahead of the clearing activity.
- Undertake pre-clearance surveys for the Greater Bilby and Brush-tailed Mulgara by qualified personnel, and implement appropriate relocation programs if and when required.
- Implement weed control measures to minimise the risk of the introduction and spread of weeds into adjacent fauna habitat.

### *3.2.3. Environmental value: biological values (native vegetation associated with a watercourse) – Clearing Principle (f)*

Assessment: The application area bisects at least 12 designated rivers, watercourses, and adjacent floodplains (Appendix C: Table C1j) including the Nullagine River, Cajuput Creek, and major tributaries. Approximately 69 hectares of the application area, or approximately 9.2 per cent of the application area, is associated with the drainage lines landform (Appendix C: Table C1e) (Table 7 below). That is, Vegetation units D1, D2, D3, D4, D5, D6, D7, D8 (Biota 2021), and Vegetation units 1a, 2a, 2b, 4b (WoodGIS 2020).

**Table 7: Vegetation units associated with watercourses, mapped over the application area**

| Vegetation unit | | Area (ha) | Per cent (%) |
|---|---|---|---|
| D1 | *Eucalyptus camaldulensis, E. victrix* open forest over *Atalaya hemiglauca, Acacia coriacea* subsp. *Pendens* low open woodland over **Cenchrus spp*. tussock grassland. | 6.4 | 0.9 |
| D2 | *Eucalyptus victrix, (Acacia coriacea* subsp. *Pendens*) low open woodland over *Triodia longiceps* very open hummock grassland. | 2.3 | 0.3 |
| D3 | *Eucalyptus victrix, (Acacia coriacea* subsp. Pendens) low woodland over *Acacia trachycarpa* open shrubland over *Eriachne benthamii* open tussock grassland with *Triodia longiceps* very open hummock grassland. | 5 | 0.7 |
| D4 | *Eucalyptus victrix, (Acacia coriacea* subsp. *Pendens)* woodland over **Cenchrus ciliaris, *C. setiger, (Eriachne tenuiculmis, Chrysopogon fallax)* tussock grassland with *Cyperus vaginatus* scattered sedges. | 35.4 | 4.7 |
| D5 | *Corymbia hamersleyana* scattered low trees over *Acacia tumida* var. *pilbarensis, (A. trachycarpa)* tall open scrub over *Themeda triandra, Chrysopogon fallax* open tussock grassland with *Triodia epactia, (T. longiceps)* very open hummock grassland. | 12.2 | 1.6 |
| D6 | *Eucalyptus xerothermica* scattered low trees over *Grevillea wickhamii, Acacia ancistrocarpa, A. bivenosa* tall shrubland over **Cenchrus ciliaris, *C. setiger* open tussock grassland. | 1.9 | 0.2 |
| D7 | *Eucalyptus leucophloia* subsp. *Leucophloia, (E. xerothermica)* low open woodland over *Acacia colei, Acacia ancistrocarpa, A. bivenosa* tall shrubland over *Triodia longiceps* open hummock grassland. | 0.7 | 0.1 |
| 1a | *Eucalyptus camaldulensis, Melaleuca glomerata, Acacia coriacea* Woodland (Riverbeds and Banks) | 0.4 | 0.1 |
| 2a | **Vachellia farnesiana* Low Open Woodland over Cenchrus ciliaris Very Open Tussock-Tussock Grassland (Lower Terraces of Rivers) – *(Eucalyptus victrix, Acacia trachycarpa, Atalaya hemiglauca)* | 1.2 | 0.2 |
| 2b | **Vachellia farnesiana* Low Open Woodland over Cenchrus ciliaris Very Open Tussock-Tussock Grassland (Upper Terraces of Rivers) – (*Acacia sclerosperma, Atalaya hemiglauca, Hakea lorea)* | 2.9 | 0.4 |
| 4b | *Maireana melanocoma, Sclerolaena hostilis* Low Open Shrubland over *Triodia longiceps* Very Open Hummock Grassland (Creeks of Stony Plains) | 0.3 | 0 |
| **Total** | | **68.7** | **9.2** |

Drainage lines range in scale from major drainages such as the Nullagine River supporting riparian open River Red Gum forest (D1) through to minor flowlines with scattered open shrubland over spinifex (4b). There are no wetlands in the vicinity of the proposal area.

The area proposed to be cleared predominantly follows the existing road alignment that already crosses the watercourses. The road widening will result in direct impacts to native vegetation associated with at least 12 watercourses intersected by the application area. Removal of vegetation has potential to result in indirect impacts such as an increase in runoff and sediment loads during construction impacting downstream vegetation. Twenty-five introduced flora species were recorded by Biota (2021), including three species declared under the BAM Act, and proposed clearing has the potential to introduce or spread environmental weeds into adjacent riparian habitats.

Proposed clearing is linear in nature and predominantly along the existing road corridor and appropriate drainage design and construction management of drainage at watercourse crossings to Australian Standards is unlikely to significantly alter the current surface water hydrology at watercourse crossings.

Conclusion: Based on the above assessment, it is considered that clearing of native vegetation associated with a watercourse is unavoidable due to the direct clearing of native vegetation over watercourses required for road

widening. Impacts to riparian vegetation at the local scale are not considered significant however clearing of riparian vegetation should be minimised where practicable.

Proposed clearing may result in indirect impacts to native vegetation associated with a watercourse due to increased sedimentation during construction, altered hydrology, and penetration of weeds into adjacent riparian habitats. The adoption of standard environmental management procedures during construction will minimise the risk of sedimentation, and the applicant has submitted that drainage modelling will either maintain the existing hydrology or reinstate the surface water hydrology closer to natural models due to an increase in culvert installation and roadside drainage (Main Roads 2021). Weed control measures during construction will minimise the risk of introduction or spread of weed species into adjacent riparian habitats.

Conditions: Clearing of riparian vegetation should be minimised wherever practicable and weeds should be controlled to prevent degradation of adjacent riparian vegetation. The risks associated with downstream sedimentation and alteration to surface hydrology can be managed by implementing appropriate drainage design and road construction methodologies including the installation of culverts. To address potential impacts the following management measures will be required as a condition on the clearing permit:

- Avoid clearing riparian vegetation where practicable.
- Where a watercourse is to be impacted by clearing maintain the existing surface flow by use of culverts.
- Implement weed control measures to minimise the risk of introduction and spread of weeds into adjacent riparian native vegetation.

### *3.2.4. Environmental value: water resources – Clearing Principle (i)*

Assessment: The entire application area is located within the Pilbara Surface Water Area (UFI 54) and the Pilbara Groundwater Area (UFI 44) proclaimed under the RIWI Act. The area around Nullagine Township is located within a Public Drinking Water Source Area, consisting of two components: The Nullagine Water Reserve (Protection Area P1), and the Nullagine Water Reserve (Protection Area P3).

The application area bisects several (at least 12) designated rivers and watercourses (Appendix C: Table C1j) including the Nullagine River, Cajuput Creek, and major tributaries. No rivers proclaimed under the RIWI Act bisect the application area and there are no wetlands in the vicinity of the proposal area.

Main Roads have a groundwater licence to take water for the construction works associated with Marble Bar Road (GWL 179633) (DWER 2021b). An approved groundwater operating strategy is associated with licence GWL 179633 which outlines the management measures associated with the take of water.

DWER's North West Region (DWER 2021a) advise that during construction and operation activities, hydrocarbons, chemicals and potentially hazardous substances should be stored and disposed of in accordance with the DWER's guidelines and water quality protection notes (WQPN). As the application falls within proclaimed surface water and groundwater areas, best practice management measures outlined in relevant WQPN should be considered:

- WQPN 10: Contaminant spills – emergency response.
- WQPN 65: Toxic and hazardous substances – storage and use.
- WQPN 83: Infrastructure corridors near sensitive water resources.
- WQPN 84: Rehabilitation of disturbed land in Public Drinking Water Source Areas.

The area around Nullagine Township is located within a Public Drinking Water Source Area (DWER 2021b) and proposed clearing is also within a Wellhead Protection Zone (WHPZ) for the drinking water supply production bore within the Nullagine Water Reserve (DWER 2021b). Wellhead protection zones are defined in the immediate vicinity of drinking water abstraction points, as these areas are the most vulnerable to contamination.

Land use compatibility tables are available for Public Drinking Water Source Areas (DWER 2021d) and DWER's water source protection planning team (DWER 2021b) advise that in conformance with the tables, proposed clearing should not use recycled drainage rock within the Nullagine Water Reserve, or recycled road base in the P1 area or WHPZ within the Nullagine Water Reserve. DWER (2021b) also advise that, in addition to the WQPN above, clearing and proposed road works conforms with:

- WQPN 44: Roads near sensitive water resources
- WQPN 56: Tanks for fuel and chemical storage near sensitive water resources

The area proposed to be cleared is linear in nature and predominantly follows the existing road alignment that already crosses the watercourses. Removal of vegetation has potential to result in indirect impacts such as an increase in runoff and sediment loads during construction impacting watercourses downstream. Watercourses in the region are dry for most of the year, flowing after significant rainfall events. The design of the road upgrades has considered water run-off management in respect to the downstream impacts. Surface water flow will be controlled by incorporating drainage management design and by implementing standard road construction methodologies for drainage control. Standard roadwork processes include the installation of appropriate culverts and the applicant has

submitted that drainage modelling will either maintain the existing hydrology or reinstate the surface water hydrology closer to natural models due to an increase in culvert installation and roadside drainage (Main Roads 2021).

The North West Region (DWER 2021a) considers that proposed clearing is unlikely to impact on the water quality of the water resources provided clearing activities are undertaken with groundwater license conditions, relevant advice, and DWERs WQPN and guidelines. DWER's water source protection planning team (DWER 2021b) supports the application subject to the prohibition of the use of recycled drainage rock or recycled road base in particular areas, and conformance with relevant WQPNs.

Main Roads (2022a) have advised that impacts to surface water and groundwater will be minimised and all relevant WQPNs will be integrated into the construction contract to ensure compliance and protection of the Public Drinking Water Source Areas. Additionally, Main Roads (2022a) have advised that recycled road base or recycled drainage rock as defined in the Roads to Reuse Product Specification (Waste Authority 2021) will not be utilised.

Conclusion: Based on the above assessment it is considered that clearing as proposed is not likely to cause any deterioration in the quality of surface water or groundwater. Risks of downstream sedimentation and alteration to surface hydrology can be managed by implementing appropriate drainage design and road construction methodologies including the use of culverts, abiding by groundwater licence GWL179633 and the associated groundwater operating strategy, abiding by relevant WQPNs, and the avoidance of use of recycled drainage rock and recycled road base within specific areas.

Conditions: To address potential impacts the following management measure will be required as a condition on the clearing permit:

- Where a watercourse is to be impacted by clearing maintain the existing surface flow by use of culverts.

#### *3.2.5. Environmental value: land resources – Clearing Principle (g)*

Assessment: Eleven Land Systems are mapped over the application area (Table C1f) incorporating five land types (Table C1g) and seven Soil Types (Table C1h). Approximately 70 per cent of the application area consists of undulating hills and stony plains land types and approximately 30 per cent of the application area consists of plains and drainage lines land types.

Land Systems have been mapped and described in technical bulletins produced by the former Department of Agriculture (now the Department of Primary Industries and Regional Development) (van Vreeswyk *et al*. 2004). The majority of Land Systems (over 83 per cent of the application area) are not prone to erosion (Appendix C: Table C1i) (van Vreeswyk *et al.* 2004). However the susceptibility to erosion of the River Land System (approximately 3.8 per cent of the application area) is high or very high if vegetative cover is removed (van Vreeswyk et al. 2004). Most of the Mosquito Land System (approximately 10.8 per cent of the application area) has low susceptibility to erosion but drainage floors are moderately susceptible if vegetative cover is removed (van Vreeswyk *et al.* 2004). The Wona Land System (approximately 2.3 per cent of the application area) is not susceptible to erosion except if the stony mantle is removed, for example along tracks on sloping plains (van Vreeswyk *et al*. 2004).

Proposed clearing is linear in nature and largely adjacent to an existing road. Environmental management measures will be implemented and address erosion and other land degradation processes including strategies for drainage controls and wind and water erosion. With standard road construction methodologies in place, the proposed clearing is not expected to result in an increased risk of changes to pH, salinity, waterlogging or eutrophication (Phosphorus export), particularly in consideration of the final land use as a public road. It is not anticipated that the removal of vegetation will contribute to long term increased amounts of wind or water erosion in adjacent areas. Localised erosion can occur from roadworks in any of the land types (Table C1g), but particularly over the steep hills, steep stony hills, steep ranges, and low ranges incorporating the Fa14, Fa28, Fa29, and Gf1 soil types (Table C1h), as well as the River Land System.

Proposed clearing of the Marble Bar roadside may cause some short-term localised water and wind erosion. Soils will not be excavated at depth and groundwater will not be intersected, reducing the risk of exposing any acid sulphate soils. The cleared roadside area will be replaced with a hard road surface reducing the risk of wind erosion. Surface water flow will be controlled by incorporating drainage management design and by implementing standard road construction methodologies for drainage control. Surface water flows in the River Land System will be managed and controlled with the installation of appropriate culverts and the applicant has submitted that overall drainage modelling will either maintain the existing hydrology or reinstate the surface water hydrology closer to natural models due to an increase in culvert installation and roadside drainage features (Main Roads 2021).

A portion of the application area intersects Crown Reserve 2804 incorporating the Nullagine Landfill (also known as Nullagine Refuse Site) and the current Marble Bar road is within 50 metres of the landfill which is classified as 'possibly contaminated - investigation required' under the *Contaminated Sites Act 2003.*

DWER's contaminated sites science and planning team has advised that no soil or groundwater investigations have been carried out over the area, and the quality of soil and groundwater beneath the site are unknown (DWER 2021c). The science and planning team has no objection to the proposed clearing of native vegetation on Crown Reserve 2804 provided that an environmental management plan is prepared for any proposed works that might intersect Crown Reserve 2804 including management measures for possible interception of landfilled materials (DWER 2021c). Main Roads (2022a) has advised that whilst the application area intersects Reserve 2804, Main Roads technical guidance states that roads can not be built over geotechnically incompetent ground which includes landfills, as well as former landfills. Main Roads (2022a) has confirmed that the proposed clearing and construction will not disturb the landfill and operations will not interfere with any potential contamination. Main Roads has established a Community Reference Group (CRG) (Section 3.3) and stakeholder consultation with the Shire of East Pilbara is ongoing in relation to the Nullagine Landfill.

Conclusion: Given the location, final land use, surrounding landscape, and standard methodologies implemented for road construction it is unlikely that the proposed clearing will contribute to, or cause, appreciable land degradation and any impacts to surrounding landscapes, soils and drainage can be managed through avoidance, standard construction methodologies, and appropriate design.

Conditions: No land degradation management conditions required.

### 3.3. Relevant planning instruments and other matters

The application was advertised on the DWER website for a 21 day public comment period on 5 November 2021. One public submission was received in relation to this application (Appendix B).

Authority to assess land parcels required for the proposed clearing (Section 1.1) has been gained by the applicant under the *Main Roads Act 1930* or s185 of the *Land Administration Act 1997.*

Direct interest correspondence was sent to the Shire of East Pilbara, and relevant DWER contacts in regard to requirements under the RIWI Act, Public Drinking Water Source Areas and contaminated sites (Section 3.2.4; Section 3.2.5). Advice from DBCA was obtained in respect to PECs, Priority flora, and fauna of conservation significance (Section 3.2.1; Section 3.2.2).

The applicant has responsibilities under the BC Act and an authorisation from the Minister for Environment under section 40 of the BC Act will be required prior to the commencement of any clearing for the Threatened Greater Bilby, Northern Quoll, Pilbara Olive Python, and Night Parrot (Section 3.2.2).

The applicant has progressed discussions with stakeholders as part of the Marble Bar Road upgrades project development. Main Roads has established a Community Reference Group (CRG) whose membership consisted of the Shire of East Pilbara, Nullagine Residents, Roy Hill Holdings Pty Ltd (Roy Hill), Fortescue Metals Group Ltd (FMG), local pastoral station owners, Horizon Power, Millennium Minerals Limited (MML) and the Western Australian Police Force. A prioritisation model for redundant unsealed sections of the existing Marble Bar Road has been developed and endorsed with the CRG and presented to the Shire of East Pilbara. Consultation with Native Title groups is ongoing. The intent is that redundant areas will be ripped to Main Roads standards, however further consultation will determine which areas of the existing roads are required to be left in place.

The application area is located in Palyku People (WCD2021/003) and Palyku Part A (WCD2019/002) Native Title determination areas (south of Nullagine), and the Nyiyaparli People (WCD2018/008) determination area (southern section of the application area). The application area is also located within the boundaries of the Nyamal #1 (WAD20/2019) (northern section of the application area) and Palyku (WAD23/2019) (Nullagine area) registered Native Title Claim areas of interest.

Several Indigenous Land Use Agreements (ILUAs) intersect the application area including immediately south of Nullagine; the FMG - Palyku Land Access ILUA (WI2017/004), and in the southern section of the application area; Nyiyaparli People and BHP Billiton Comprehensive Agreement (WI2012/005), Nyiyaparli and BHP Billiton Comprehensive Agreement ILUA (WI2019/003), FMG-Nyiyaparli Land Access ILUA (WI2016/003), FMG - Nyiyaparli ILUA (WI2019/005), RTIO and Nyiyaparli ILUA (WI2012/007), and the RTIO and Nyiyaparli People ILUA (WI2020/001).

Over 100 Aboriginal Heritage Places have been identified within 40 kilometres of the application area with at least 23 Registered Aboriginal Heritage Places intersecting, or within close proximity to (within 50 metres), the application area (Appendix J). It is the Permit Holder's responsibility to comply with the *Aboriginal Heritage Act 1972* and to ensure that no Aboriginal sites of significance are damaged through the clearing process.

## Appendix A: Information provided by applicant and advice referenced

### Information provided by the applicant

| Supporting information provided for CPS 9475/1 | Description | Reference |
|---|---|---|
| Clearing Assessment Report (CAR) | A Clearing Assessment Report provided by Main Roads Western Australia for the Marble Bar Road upgrades including an Environmental Management Plan (EMP) as Appendix A. | Main Roads (2021) |
| Additional information provided by Main Roads Western Australia | Response provided by Main Roads Western Australia to a request for information from Department of Water and Environmental Regulation DWER. | Main Roads (2022a) |
| Main Roads Western Australia environmental work instruction | Main Roads Western Australia environmental work instruction for clearing in potential Greater Bilby habitat. | Main Roads (2022b) |
| **Biological reference** Flora, vegetation, and fauna survey report | The primary biological survey conducted over the Marble Bar road upgrade area (SLK 97 to SLK 179), consisting of a flora, vegetation and Level 1 fauna survey conducted in March 2020. | Biota (2021) |
| **Biological reference** Targeted flora survey report | A secondary targeted survey undertaken to assess the presence, extent and abundance of Priority flora over the application area conducted in April 2021. | Pilbara Environmental (2021) |
| **Biological reference** Flora and vegetation survey report | A flora and vegetation survey that covers some portions of the proposed Nullagine bypass conducted in April 2019. | WoodGIS (2020) |
| **Biological reference** Priority flora report | Updates to Priority flora data for surveys across Millennium Minerals Ltd's Nullagine mining tenements providing a basis for Priority flora impact assessments in the northern occurrence of the Mosquito Land System. | WoodGIS (2018) |
| **Biological reference** Vegetation survey report | A vegetation survey of 5,277 hectares covering Millennium Minerals Ltd's Nullagine mining tenements undertaken in April 2016 and 2017 by Plantecolgy Consulting and WoodGIS. | Waters (2017) |

### Relevant information referenced

| Information | Description | Reference |
|---|---|---|
| Advice regarding PECs, Priority flora, and fauna of conservation significance | Advice received from the Department of Biodiversity, Conservation and Attractions (DBCA) – Species and Communities Branch and Pilbara Region. | DBCA (2021) |
| Advice regarding requirements under the RIWI Act | Advice received from the Department of Water and Environmental Regulation (DWER) - North West Planning team | DWER (2021a) |
| Advice regarding Public Drinking Water Supply Areas | Advice received from the Department of Water and Environmental Regulation (DWER) - Water Source Protection Planning team. | DWER (2021b) |
| Advice regarding contaminated sites | Advice received from the Department of Water and Environmental Regulation (DWER) - Contaminated Sites; Science and Planning team. | DWER (2021c) |

## Appendix B: Details of public submissions

| Summary of comments | Consideration of comment |
|---|---|
| While not opposed to the project in principle, the submitter recommends that the clearing permit application CPS 9475/1 not be considered by DWER until rehabilitation works are included within the applicant's Environmental Management Plan. | The applicant has advised that the clearing proposed for the Marble Bar Road Upgrades Project is all permanent clearing predominantly following the existing road (Main Roads 2021; Main Roads 2022a). DWER has assessed the application as such with no revegetation or rehabilitation offered by the applicant as mitigation (Section 3.1). |
| Culverts and borrow-pits should be rehabilitated using topsoil from clearing activities associated with the realigned areas. | The applicant has advised that the clearing proposed for the Marble Bar Road Upgrades Project is all permanent clearing (Main Roads 2021). No temporary clearing is proposed. All construction needs and laydowns are located within the final design footprint or within existing cleared areas (Main Roads 2022a) (Section 3.1). |
| In several areas the design deviates from the existing road resulting in areas that are unlikely to regenerate unassisted. At the very least ripping of the old road surface should be undertaken. | In areas where the new Marble Bar road alignment deviates from the existing road redundant areas will be either handed over to local stakeholders via the CRG, or rehabilitated in accordance with standard practices which involves ripping the old road surface (Main Roads 2022a). The intent is that redundant areas will be ripped to Main Roads standards, however further consultation will determine which areas of the existing roads are required to be left in place (Main Roads 2022a). These areas are not included within the application area and are not the subject of the CPS 9475/1 application (Section 3.1; Section 3.3). |
| Rehabilitation would go some way towards offsetting the clearing required by the project. | The applicant has advised that as the design progresses, opportunities for a reduction in permanent clearing will be identified wherever possible. No further reduction in clearing can be identified at this stage and no temporary clearing is proposed. Should opportunities for rehabilitation arise it will be conducted in accordance with Main Roads standards. The intent is that redundant existing road areas will be ripped to Main Roads standards, however further consultation will determine which areas of the existing roads are required to be left in place (Main Roads 2022a). DWER has assessed the application as such with no revegetation or rehabilitation offered by the application as mitigation (Section 3.1; Section 3.3). No significant residual impacts have been identified by DWER that would require an offset be imposed. |

## Appendix C: Site characteristics

The information provided below describes the key characteristics of the area proposed to be cleared. This information was used to inform the assessment of the clearing against the Clearing Principles, contained in Appendix E. References include Main Roads (2021); Main Roads (2022a); Biota (2021); Pilbara Environmental (2021); and WoodGIS (2020). The spatial scopes referenced are comprised of the:

- 'application area' of 755 hectares with calculations based upon GIS data provided with IBSA packages.
- 'clearing area' of 500 hectares.
- The 'survey area' based on surveys undertaken comprising a 100 metre wide corridor around Marble Bar Road (SLK 97 to SLK 179), plus a 5 kilometre extension at the southern end, and the Nullagine bypass around the Nullagine townsite.
- A 'contextual area' based on a 500 metre buffer around the 'survey area'
- The 'local area' based upon a 40 kilometre buffer around the 'application area'

### C.1 Site characteristics

| Characteristic | Details |
|---|---|
| Local context | The application area consists of areas immediately adjacent to the existing Marble Bar Road for a length of approximately 100 kilometres in the locality of Nullagine in the Shire of East Pilbara. The proposed clearing is located within the Pilbara (PIL) bioregion of Thackway and Cresswell (1995), and the Chichester subregion. Spatial data indicates the local area (40 kilometre radius from the area proposed to be cleared) retains over 99 per cent of the original native vegetation cover. |
| Climate | The climate of the region is arid, with a low average rainfall of approximately 403.1 millimetres per year (BOM, 2021). Drainage lines in the area are dry for most of the year, only flowing briefly immediately following significant rainfall (BOM 2021). |
| Conservation areas | One conservation area managed by the Department of Biodiversity, Conservation and Attractions (DBCA) is located within 40 kilometres of the application area (Table C1a). |

**Table C1a: DBCA-managed lands within the local area**

| Description | Proximity (m) |
|---|---|
| Former leasehold proposed for conservation (ex Meentheena Pastoral Lease) | 22,055 |

| Vegetation description (regional) | The extent, type and status of native vegetation in Western Australia has been assessed by Shepherd *et al.* (2001) with three vegetation associations mapped over the application area (Table C1b). |
|---|---|

**Table C1b: Vegetation associations mapped over the application area.**

| | |
|---|---|
| **Veg Association:** | **173** |
| Veg Type: | 38 - Shrub-steppe |
| Description: | Hummock grasslands, shrub steppe; kanji over soft spinifex and *Triodia wiseana* on basalt |
| Landform: | Chichester Plateau; and Abydos Plain - Chichester |
| **Veg Association:** | **93** |
| Veg Type: | 38 - Shrub-steppe |
| Description: | Hummock grasslands, shrub steppe; kanji over soft spinifex |
| Landform: | Abydos Plain - Chichester |
| **Veg Association:** | **190** |
| Veg Type: | 39 - Sparse shrub-steppe |
| Description: | Hummock grasslands, shrub steppe; kanji over soft spinifex and *Triodia wiseana* on basalt |
| Landform: | Abydos Plain - Chichester |

| Characteristic | Details |
|---|---|
| Vegetation description (application area) | |

**Table C1c: Vegetation units mapped over the application area (Biota 2021; WoodGIS 2020)**

| Vegetation units mapped over the application area | | Area (ha) | Per cent (%) |
|---|---|---|---|
| C1 | *Triodia longiceps*, *T. epactia* open hummock grassland with patches of mixed herbland and annual grassland. | 13.9 | 1.8 |
| D1 | *Eucalyptus camaldulensis, E. victrix* open forest over *Atalaya hemiglauca, Acacia coriacea* subsp. *pendens* low open woodland over **Cenchrus* spp. tussock grassland. | 6.4 | 0.9 |
| D2 | *Eucalyptus victrix*, (*Acacia coriacea* subsp. *pendens*) low open woodland over *Triodia longiceps* very open hummock grassland. | 2.3 | 0.3 |
| D3 | *Eucalyptus victrix*, (*Acacia coriacea* subsp. *pendens*) low woodland over *Acacia trachycarpa* open shrubland over *Eriachne benthamii* open tussock grassland with *Triodia longiceps* very open hummock grassland. | 5 | 0.7 |
| D4 | *Eucalyptus victrix*, (*Acacia coriacea* subsp. *pendens*) woodland over **Cenchrus ciliaris*, **C. setiger*, (*Eriachne tenuiculmis, Chrysopogon fallax*) tussock grassland with *Cyperus vaginatus* scattered sedges. | 35.4 | 4.7 |
| D5 | *Corymbia hamersleyana* scattered low trees over *Acacia tumida* var. *pilbarensis*, (*A. trachycarpa*) tall open scrub over *Themeda triandra, Chrysopogon fallax* open tussock grassland with *Triodia epactia*, (*T. longiceps*) very open hummock grassland. | 12.2 | 1.6 |
| D6 | *Eucalyptus xerothermica* scattered low trees over *Grevillea wickhamii*, *Acacia ancistrocarpa*, *A. bivenosa* tall shrubland over **Cenchrus ciliaris*, **C. setiger* open tussock grassland. | 1.9 | 0.2 |
| D7 | *Eucalyptus leucophloia* subsp. *leucophloia*, (*E. xerothermica*) low open woodland over *Acacia colei*, *Acacia ancistrocarpa*, *A. bivenosa* tall shrubland over *Triodia longiceps* open hummock grassland. | 0.7 | 0.1 |
| D8 | **Cenchrus ciliaris*, **C. setiger* tussock grassland. | 3 | 0.4 |
| 1a | *Eucalyptus camaldulensis*, *Melaleuca glomerata*, *Acacia coriacea* Woodland (Riverbeds and Banks) | 0.4 | 0.1 |
| 2a | **Vachellia farnesiana* Low Open Woodland over **Cenchrus ciliaris* Very Open Tussock-Tussock Grassland (Lower Terraces of Rivers) - (*Eucalyptus victrix*, *Acacia trachycarpa*, *Atalaya hemiglauca*) | 1.2 | 0.2 |
| 2b | **Vachellia farnesiana* Low Open Woodland over **Cenchrus ciliaris* Very Open Tussock-Tussock Grassland (Upper Terraces of Rivers) - (*Acacia sclerosperma, Atalaya hemiglauca, Hakea lorea*) | 2.9 | 0.4 |
| 4b | *Maireana melanocoma*, *Sclerolaena hostilis* Low Open Shrubland over *Triodia longiceps* Very Open Hummock Grassland (Creeks of Stony Plains) | 0.3 | 0 |
| H1 | *Corymbia hamersleyana* scattered low trees over *Acacia bivenosa* scattered tall shrubs over *Triodia wiseana* hummock grassland. | 30.2 | 4 |
| H2 | *Corymbia hamersleyana* scattered low trees over *Acacia inaequilatera* scattered tall shrubs over *Triodia wiseana* hummock grassland. | 54.1 | 7.2 |
| H3 | *Acacia inaequilatera* tall open shrubland over *Triodia wiseana*, *T. epactia* hummock grassland. | 52.4 | 6.9 |
| H4 | *Triodia epactia* hummock grassland. | 26 | 3.4 |
| H5 | *Acacia orthocarpa* open shrubland over *Triodia epactia* hummock grassland. | 22.7 | 3 |
| H6 | *Acacia inaequilatera* scattered tall shrubs to tall open shrubland over *Triodia epactia* hummock grassland. | 157 | 20.8 |

| Characteristic | Details | | | |
|---|---|---|---|---|
| | H7 | *Triodia wiseana, T. scintillans* hummock grassland. | 21.8 | 2.9 |
| | H8 | *Triodia brizoides* hummock grassland. | 39.2 | 5.2 |
| | 5c | *Acacia aphanoclada* / *Acacia inaequilatera* Open Shrublands over *Triodia longiceps* Very Open Hummock Grassland (Slopes on Rises) | 0.3 | 0 |
| | 6a | *Acacia inaequilatera* Open Shrubland over Open Hummock Grassland (Plateaus on Rises) | 0.6 | 0.1 |
| | 8g | Scattered Low Trees of *Eucalyptus leucophloia* over *Acacia pyrifolia* Low Open Shrubland over Open Hummock Grassland (Creeks on Hills) | 0.5 | 0.1 |
| | P1 | *Acacia bivenosa* scattered tall shrubs over *Senna symonii* scattered shrubs over *Triodia longiceps* hummock grassland. | 108.3 | 14.3 |
| | P2 | *Triodia longiceps*, (*T. wiseana*) hummock grassland. | 78.5 | 10.4 |
| | P3 | *Triodia epactia* hummock grassland. | 12.6 | 1.7 |
| | P4 | *Acacia trachycarpa* open shrubland over *Triodia epactia*, *T. longiceps* hummock grassland. | 43.3 | 5.7 |
| | P5 | *Eucalyptus socialis* subsp. *eucentrica* low open mallee woodland over *Triodia wiseana*, (*T. longiceps*) open hummock grassland. | 6.8 | 0.9 |
| | 2c | **Vachellia farnesiana* Low Open Woodland over **Cenchrus ciliaris* Very Open Tussock-Tussock Grassland (Alluvial Plains) | 2.2 | 0.3 |
| | 4a | *Maireana melanocoma*, *Sclerolaena hostilis* Low Open Shrubland over *Triodia longiceps* Very Open Hummock Grassland (Stony Plains) | 2.5 | 0.3 |
| | M1 | *Acacia aptaneura* scattered low trees to low woodland over *Triodia longiceps*, *T. epactia* hummock grassland. | 3.4 | 0.5 |
| | N/A | Cleared | 6.4 | 0.8 |
| | | | **755** | **100** |

Vegetation condition (Appendix F)

**Table C1d: Vegetation condition over the application area (Biota 2021)**

| Condition | Application area | | Survey Area and Contextual Area | |
|---|---|---|---|---|
| | Area (ha) | Per cent | Area (ha) | Per cent |
| Excellent | 111 | 14.8 | 4,816 | 32.5 |
| Excellent to Very Good | 309 | 41.2 | 5,004 | 33.8 |
| Very Good | 194 | 25.8 | 2,627 | 17.8 |
| Good | 42 | 5.7 | 380 | 2.6 |
| Good to Poor | 5 | 0.7 | 110 | 0.7 |
| Poor | 29 | 3.9 | 715 | 4.8 |
| Very Poor | 7 | 0.9 | 237 | 1.6 |
| Very Poor to Very Good | 0 | 0.0 | 9 | 0.1 |
| Completely Degraded | 17 | 2.3 | 131 | 0.9 |
| Degraded | 24 | 3.2 | 51 | 0.4 |
| NA/NM | 17 | 2.2 | 721 | 4.9 |
| **TOTALS** | **755** | **100** | **14,801** | **100** |

| Characteristic | Details |
|---|---|
| Landforms | |

**Table C1e: Vegetation units grouped to landform mapped over the application area based on Biota(2021) and WoodGIS (2020)**

| Vegetation units grouped to landform | Area (ha) | Per cent (%) |
|---|---|---|
| Cracking Clays (C1) | 13.9 | 1.8 |
| Drainage lines (D1 to D8) (1a, 2a, 2b, 4b) | 71.7 | 9.6 |
| Hills (H1 to H8) (5c, 6a, 8g) | 404.8 | 53.6 |
| Plains (P1 to P5) (2c, 4a) | 254.2 | 33.6 |
| Mulga (M1) | 3.4 | 0.5 |
| Cleared | 6.4 | 0.8 |
| | **755** | **100** |

Land Systems

**Table C1f: Land Systems mapped over the application area**

| Land type | Land System | Description | Hectares | Per cent |
|---|---|---|---|---|
| Stony plains; Spinifex grasslands | Bonney Land System | Low rounded hills and undulating stony plains supporting soft spinifex grasslands. | 66 | 8.7 |
| | Mosquito Land System | Stony plains and prominent ridges of schist and other metamorphic rocks supporting shrubby hard spinifex grasslands. | 82 | 10.8 |
| | Taylor Land System | Stony plains and isolated low hills of sedimentary rocks supporting hard and soft spinifex shrubby grasslands. | 32 | 4.2 |
| Alluvial plains; Grassy woodlands and tussock grasslands | River Land System | Narrow, seasonally active flood plains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts sometimes with tussock grasses or spinifex. | 29 | 3.8 |
| Undulating plains with cracking clay soils; Tussock grasslands | Wona Land System | Basalt upland gilgai plains supporting Roebourne Plains grass and Mitchell grass tussock grasslands, minor hard spinifex grasslands or annual grasslands/herbfields. | 17 | 2.3 |
| Hills and ranges; Spinifex grasslands | Capricorn Land System | Rugged sandstone hills, ridges, stony footslopes and interfluves supporting low acacia shrublands or hard spinifex grasslands with scattered shrubs. | 88 | 11.7 |
| | Granitic Land System | Rugged granitic hills supporting shrubby hard and soft spinifex grasslands. | 72 | 9.5 |

| Characteristic | Details | | | | |
|---|---|---|---|---|---|
| | | McKay Land System | Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands with acacias and occasional eucalypts. | 129 | 17.1 |
| | | Newman Land System | Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands. | 8 | 1.1 |
| | | Rocklea Land System | Basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex and occasionally soft spinifex grasslands with scattered shrubs. | 205 | 27.1 |
| | Mesas, breakaways and stony plains; Spinifex grasslands | Robe Land System | Low plateaux, mesas and buttes of limonite supporting soft spinifex and occasionally hard spinifex grasslands. | 28 | 3.7 |
| | | | | **755** | **100** |

Land types

**Table C1g: Land types mapped over the application area**

| Land type | Vegetation | Hectares | Per cent |
|---|---|---|---|
| Stony plains | Spinifex grasslands | 179 | 24 |
| Cracking clays | Tussock grasslands | 17 | 2 |
| Drainage lines and floodplains | Grassy woodlands and tussock grasslands | 29 | 4 |
| Hills and ranges | Spinifex grasslands | 502 | 67 |
| Mesas, breakaways and stony plains | Spinifex grasslands | 28 | 4 |
| | | **755** | **100** |

Soils

**Table C1h: Soil units (Northcote *et al* 1960) mapped over the application area**

| Soil Unit | Description | Hectares | Per Cent |
|---|---|---|---|
| Fa14 | Steep hills and steeply dissected pediments on areas of banded jaspilite and chert along with shales, dolomite, and iron ore formations; some narrow winding valley plains: chief soils are shallow stony earthy loams (Um5.51) along with some (Uc5.11) soils on the steeper slopes. (Dr2.33, Dr2.32) soils which occur on the pediments are more extensive in this unit than in unit Fa13. (Um5.52) and (Uf6.71) soils occur on the valley plains | 28 | 4 |
| Fa28 | Steep hills and low ranges associated with various rocks including dolomite and some chert breccia; exposures of rock are extensive, and soils are shallow and stony: chief soils are shallow stony earthy loams (Um5.51). Other soils include shallow stony forms of (Dr2.32) | 202 | 26 |
| Fa29 | Steep stony hills and low ranges on highly folded quartzites, shales, and slates with extensive areas of rock exposures; small valley plains are included; soils are generally stony and shallow: chief soils are shallow stony earthy loams (Um5.51). Other soils include (Dr2.32), (Gn2.1), and (Uc5.11) | 145 | 19 |
| Gf1 | Steep ranges on basic lavas along with dolomites, tuff, banded iron formations, and dolerite dykes, with some | 0.2 | 0.03 |

| Characteristic | Details | | | | |
|---|---|---|---|---|---|
| | | narrow valley plains and high-level gently undulating areas of limited extent. The soils are generally shallow and stony and there are large areas without soil cover: chief soils are brown loams (Um6.23) along with significant areas of earthy loams (Um5.51). (Dr2.33) soils occur on lower slopes, with (Uf6.71) and (Ug5.37) on valley floors | | |
| | Mz25 | Plains associated with the Fortescue valley; there is a surface cover of stony gravels close to the ranges and hills: chief soils are acid red earths (Gn2.11) with some neutral red earths (Gn2.12); red-brown hardpan is absent. Associated are areas of calcareous earths (Gc) and loams (Um1) on calcrete (kunkar) and some hard red (Dr) soils around creek lines | 2 | 0.3 |
| | Oa11 | Dissected stony pediments and hills occurring at the foot of unit Gf1; some residuals of more resistant rocks occur as mesas. On deeply dissected areas lime is released from weathering of more basic rocks: chief soils are hard alkaline red soils (Dr2.13) and other (Dr) soils. There are also shallow (Um5.51) and (Uc) soils associated with rock outcrop; some cracking clays (Ug5.37) on pediments associated with basic rocks; and some shallow calcareous loam soils (Um1.2) | 292 | 38 |
| | Oc70 | Dissected pediments and low stony hills associated with cherts, jaspilites, and iron ore formations; much coarse surface gravel: the chief soils are hard alkaline red soils (Dr2.33) along with some (Dr2.32) and (Um5.52) soils | 105 | 14 |
| | | | **755** | **100** |
| Land degradation risk | Eleven Land Systems have been mapped over the application area (Table C1f) incorporating five land types (Table C1g) and seven Soil Types (Table C1h). Over 90 per cent of the application area consists of Spinifex grasslands associated with Hills and Ranges and Stony Plains land types (Table C1g). A portion of the application area intersects Crown Reserve 2804, the Nullagine Landfill which is classified as 'possibly contaminated - investigation required' under the *Contaminated Sites Act 2003.* Due to the large variety of landforms and soil types present various land degradation factors may be applicable including wind erosion, and water erosion over the hills and ranges land type and the River Land System. | | | | |

**Table C1i: Land Systems and land degradation comments (Van Vreeswyk *et al.* 2004)**

| Land type | Land System | Ha | Per cent | Comments (Van Vreeswyk *et al.* 2004) | |
|---|---|---|---|---|---|
| Stony plains; Spinifex grasslands | Bonney Land System | 66 | 8.7 | Not generally prone to grazing induced degradation or erosion | Soil erosion - nil 100%. |
| | Mosquito Land System | 82 | 10.8 | Most of the system has low susceptibility to erosion except for some drainage floors (unit 5) which are moderately susceptible if vegetative cover is lost. | Soil erosion - nil 97%, slight 1%, moderate 1%, severe 1%. |
| | Taylor Land System | 32 | 4.2 | Generally not susceptible to degradation or erosion. | Soil erosion - nil 100%. |
| Alluvial plains; Grassy woodlands and tussock grasslands | River Land System | 29 | 3.8 | Susceptibility to erosion is high or very high if vegetative cover is removed. | Soil erosion - nil 94%, slight 3%, minor 2%, moderate 1%. |

| Characteristic | Details | | | | | |
|---|---|---|---|---|---|---|
| | Undulating plains with cracking clay soils; Tussock grasslands | Wona Land System | 17 | 2.3 | The system is not susceptible to erosion except if the stony mantle is removed such as along tracks on sloping plains. | Soil erosion - nil 100% |
| | Hills and ranges; Spinifex grasslands | Capricorn Land System | 88 | 11.7 | Stoniness confers resistance to erosion. | Soil erosion - nil 100%. |
| | | Granitic Land System | 72 | 9.5 | Not susceptible to erosion. | Soil erosion - nil 91%, slight 1%, minor 5%, moderate 3%. |
| | | McKay Land System | 129 | 17.1 | Not prone to degradation or soil erosion. | Soil erosion - nil 99%, slight 1%. |
| | | Newman Land System | 8 | 1.1 | Erosional surfaces. | Soil erosion - nil 99%, minor 0.5%, moderate 0.5%. |
| | | Rocklea Land System | 205 | 27.1 | Very low erosion hazard. | Soil erosion - nil 100%. |
| | Mesas, breakaways and stony plains; Spinifex grasslands | Robe Land System | 28 | 3.7 | System is not generally susceptible to vegetation degradation or erosion. | Soil erosion - nil 100%. |

**Waterbodies**

The application area bisects several rivers, watercourses, and adjacent floodplains.

**Table C1j: Waterbodies intersecting the application area**

| Type of water | Description | Proximity (m) |
|---|---|---|
| Rivers | Nullagine River: Mainstream | 0 |
| | Cajuput Creek: Significant Stream | 0 |
| | Significant Stream | 0 |
| | Major Tributary | 0 |
| | Minor River | 0 |
| | Inundation Area | 0 |
| Watercourses | Watercourse: Major, non-perennial | 0 |
| | Watercourse: Minor, non-perennial | 0 |
| | Watercourse Bank: Non-perennial | 0 |
| Linear hydrography | Area Subject to Inundation | 0 |
| Geodata, Lakes | Watercourse_a | 0 |
| Hydrography, Lakes | Watercourse_a (medium scale 250k GA) | 0 |

**Hydrogeography**

The entire application area is located within the:

- Pilbara Surface Water Area (UFI 54) proclaimed under the RIWI Act
- Pilbara Groundwater Area (UFI 44) proclaimed under the RIWI Act

No RIWI Act rivers proclaimed under the RIWI Act bisect the application area

The area around Nullagine Township is located within a Public Drinking Water Source Area, consisting of two areas:

- Nullagine Water Reserve (Protection Area P1)
- Nullagine Water Reserve (Protection Area P3)

## C.2 Regional vegetation extent

| Table C2a: Regional vegetation extent | | | | | |
|---|---|---|---|---|---|
| **Factor** | **Pre-European extent (ha)** | **Current extent (ha)** | **Remaining (%)** | **Current extent in all DBCA managed land (ha)** | **Current extent in all DBCA managed land (%)** |
| **IBRA bioregion:** | | | | | |
| Pilbara (PIL) | 17,808,657 | 17,731,765 | 99.57 | 1,801,715 | 10.16 |
| **Vegetation Association** | | | | | |
| 173 (Shrub-steppe) | 1,753,104 | 1,748,261 | 99.72 | 238,705 | 13.65 |
| 93 (Shrub-steppe) | 3,044,293 | 3,040,639 | 99.88 | 59,537 | 1.96 |
| 190 (Sparse shrub-steppe) | 169,200 | 169,051 | 99.91 | No data | No data |
| **Remnant Vegetation** | | | | | |
| 40km radius | 1,361,518 | 1,358,250 | 99.76 | | |

## Appendix D: Ecosystem, flora and fauna analysis

The spatial scopes referenced are comprised of the:

- 'application area' with calculations based upon GIS data provided with IBSA packages
- The 'survey area' based on surveys undertaken comprising a 100 metre wide corridor around Marble Bar Road (SLK 97 to SLK 179), plus a 5 kilometre extension at the southern end, and the Nullagine bypass around the Nullagine townsite.
- A 'contextual area' based on a 500 metre buffer around the 'survey area'
- The 'local area' based upon a 40 kilometre buffer around the 'application area'

### D.1 Significant ecosystems

Three significant ecological communities have been mapped regionally within 40 kilometres of the application area (Table D1a below). The native vegetation of the application area is not representative of any Threatened Ecological Community (TEC).

**Table D1a: Significant ecological communities with 40 kilometres of the application area**

| Common ID | Common name | Status | Location |
|---|---|---|---|
| Fortescue Marsh | Fortescue Marsh (Marsh Land System) | Priority 1 | 16.5 km south of the application area. |
| Wona Land System | Four plant assemblages of the Wona Land System (previously 'Cracking clays of the Chichester and Mungaroona Range') | Priority 1 | To the east of, and mapped over the central portion of, the application area. |
| Mosquito Land System | Stony saline clay plains of the Mosquito Land System | Priority 3 | To the east and west, and mapped over the central portion of, the application area. |

Two vegetation units mapped over the application area correlate with significant ecological communities mapped within 40 kilometres of the application area (Tables D1b to D1e below).

**Table D1b: Significant ecological communities mapped over the application area**

| Common ID | Status | Veg. Ass. | Vegetation Unit | Area (ha) | Per cent of application area (%) | Cum. Area (ha) | Cum. Per cent of application area (%) |
|---|---|---|---|---|---|---|---|
| Wona Land System | Priority 1 | C1 | *Triodia longiceps, T. epactia* open hummock grassland with patches of mixed herbland and annual grassland. | 13.9 | 1.8 | 13.9 | 1.8 |
| Mosquito Land System | Priority 3 | P1 | *Acacia bivenosa* scattered tall shrubs over *Senna symonii* scattered shrubs over *Triodia longiceps* hummock grassland. | 108.3 | 14.3 | 110.8 | 14.6 |
| | | 4a | *Maireana melanocoma, Sclerolaena hostilis* Low Open Shrubland over *Triodia longiceps* Very Open Hummock Grassland. *Frankenia setosa* distinctive. (Stony Plains) | 2.5 | 0.3 | | |

| Table D1c: Significant vegetation units mapped over the survey and contextual areas, and the application area | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Common ID** | **Status** | **Veg. type.** | **Survey Area and Contextual Area** | | **Application Area** | | |
| | | | Area (ha) | Percentage (%) | Area (ha) | Percentage (%) | Area in application as percentage of Survey Area and Contextual Area (%) |
| Wona Land System | Priority 1 | C1 | 256 | 1.9 | 13.9 | 1.8 | 5.4 |
| Mosquito Land System | Priority 3 | P1 | 606 | 4.5 | 108.3 | 14.3 | 17.9 |
| Mosquito Land System | Priority 3 | 4a | 32.3 | 0.2 | 2.5 | 0.3 | 7.7 |

| Table D1d: Significant ecological communities mapped over the survey and contextual areas and application area | | | | | | |
|---|---|---|---|---|---|---|
| **Common ID** | **Status** | **Survey Area and Contextual Area** | | **Application Area** | | |
| | | Area (ha) | Percentage (%) | Area (ha) | Percentage (%) | Area in application as percentage of Survey Area and Contextual Area (%) |
| Wona Land System | Priority 1 | 256 | 1.9 | 13.9 | 1.8 | 5.4 |
| Mosquito Land System | Priority 3 | 638 | 4.7 | 110.8 | 14.6 | 25.6 |

| Table D1e: Areas of significant ecological communities mapped within 40km | | | | |
|---|---|---|---|---|
| **Common ID** | **Status** | **Total within 40km (ha)** | **Area within application area (ha)** | **Percentage within application area based on total within 40km (%)** |
| Wona Land System | Priority 1 | 15,701 | 13.9 | 0.089 |
| Mosquito Land System | Priority 3 | 117,827 | 110.8 | 0.094 |

The Priority 1 Wona Land System is known to cover areas to the west of the application area with approximately 0.09 per cent of the mapped area located within the application area.

The Priority 3 Mosquito Land System is known to cover an extensive area to the east of the application area with approximately 0.09 of the known extent falling within the development envelope (Biota 2021, WoodGIS 2020).

## D.2 Significant flora

### D.2.1 Threatened flora

One Threatened flora taxa, *Seringia exastia,* has been recorded approximately 20 kilometres south of the application area. This species was listed as Threatened (CR) when it was only known from a few locations in the vicinity of Broome. Taxonomically the widespread species *Seringia elliptica* has recently been incorporated into *Seringia exastia* (Binks *et al.* 2020). Given the much broader distribution of the resulting taxon, it is no longer considered to be of significance (Binks *et al.* 2020).

### D.2.2 Priority flora

Forty-five Priority flora taxa have been recorded within 40 kilometres of the application area including; 18 Priority 1, five Priority 2, seventeen Priority 3 and five Priority 4 (Table D2a).

Eight Priority flora taxa have been recorded within the application area itself including three Priority 1, two Priority 2, and three Priority 3 (Table D2b).

A further six Priority flora taxa have been recorded within the immediate vicinity with Biota (2021) considering that another two considered may occur but were not recorded (Table D2c).

**Table D2a: Priority flora recorded within 40 kilometres of the application area**

| Priority Taxon | Status | Regional locations | Closest record (km) |
|---|---|---|---|
| *Acacia aphanoclada* | P1 | 37 | *Recorded |
| *Acacia cyperophylla* var. *omearana* | P1 | 17 | *0.2 |
| *Acacia fecunda* | P1 | 12 | 9.6 |
| *Acacia* sp. Nullagine (B.R. Maslin 4955) | P1 | 1 | 8.8 |
| *Atriplex spinulosa* | P1 | 15 | *Recorded |
| *Calotis squamigera* | P1 | 2 | 23.0 |
| *Cochlospermum macnamarae* | P1 | 2 | 13.5 |
| *Eremophila pilosa* | P1 | 4 | 33.5 |
| *Fimbristylis* sp. Shay Gap (K.R. Newbey 10293) | P1 | 2 | 19.3 |
| *Helichrysum oligochaetum* | P1 | 1 | 36.5 |
| *Ptilotus wilsonii* | P1 | 2 | 1.0 |
| *Samolus* sp. Fortescue Marsh (A. Markey & R. Coppen FM 9702) | P1 | 10 | 19.1 |
| *Solanum* sp. Mosquito Creek (A.A. Mitchell et al. AAM 10795) | P1 | 9 | *Recorded |
| *Stemodia* sp. Battle Hill (A.L. Payne 1006) | P1 | 3 | 7.2 |
| *Tecticornia globulifera* | P1 | 1 | 33.7 |
| *Tecticornia* sp. Christmas Creek (K.A. Shepherd & T. Colmer *et al.* KS 1063) | P1 | 11 | 19.1 |
| *Themeda* sp. Panorama (J. Nelson et al. NS 102) | P1 | 1 | 35.0 |
| *Triodia veniciae* | P1 | 1 | 8.6 |
| *Cucumis* sp. Barrow Island (D.W. Goodall 1264) | P2 | 1 | 3.7 |
| *Euphorbia inappendiculata* var. *inappendiculata* | P2 | | *Recorded |
| *Indigofera ixocarpa* | P2 | 4 | 2.1 |
| *Ipomoea racemigera* | P2 | | *Recorded |
| *Paspalidium retiglume* | P2 | 1 | *0.01 |
| *Acacia levata* | P3 | 1 | 37.3 |
| *Atriplex flabelliformis* | P3 | 1 | 37.8 |
| *Dolichocarpa* sp. Hamersley Station (A.A. Mitchell PRP 1479) | P3 | | *Recorded |
| *Eleocharis papillosa* | P3 | 4 | 24.6 |
| *Eragrostis crateriformis* | P3 | 8 | *Recorded |
| *Eragrostis* sp. Erect spikelets (P.K. Latz 2122) | P3 | 1 | 17.2 |
| *Eremophila spongiocarpa* | P3 | 15 | 15.3 |
| *Eucalyptus rowleyi* | P3 | 9 | 9.4 |
| *Heliotropium murinum* | P3 | 3 | 30.8 |
| *Iotasperma sessilifolium* | P3 | 2 | 3.6 |
| *Nicotiana umbratica* | P3 | 1 | *0.01 |

| Table D2a: Priority flora recorded within 40 kilometres of the application area | | | |
|---|---|---|---|
| **Priority Taxon** | **Status** | **Regional locations** | **Closest record (km)** |
| *Rhagodia* sp. Hamersley (M. Trudgen 17794) | P3 | 11 | *Recorded |
| *Rostellularia adscendens* var. *latifolia* | P3 | 3 | 6.5 |
| *Swainsona thompsoniana* | P3 | 3 | *0.03 |
| *Tecticornia medusa* | P3 | 2 | 20.2 |
| *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) | P3 | 2 | *0.01 |
| *Triodia basitricha* | P3 | 1 | 36.2 |
| *Bulbostylis burbidgeae* | P4 | 2 | 31.9 |
| *Eremophila youngii* subsp. *lepidota* | P4 | 19 | 20.3 |
| *Goodenia nuda* | P4 | 8 | *0.01 |
| *Lepidium catapycnon* | P4 | 2 | 15.7 |
| *Ptilotus mollis* | P4 | 12 | 2.5 |

***Recorded = recorded within application area (see Table D2b below)***

***# : = recorded within the immediate vicinity of the application area (see Table D2c below)***

| Table D2b: Priority flora – Survey data | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Priority Taxon (8)** | **Status** | **Biota (2021)** | | **Pilbara Environ. (2021)** | | **WoodGIS (2020)** | | **TOTAL** | |
| | | **Count** | **Loc.** | **Count** | **Loc.** | **Count** | **Loc.** | **Count** | **Loc.** |
| *Acacia aphanoclada* | P1 | 3,703 | 942 | 1751 | 55 | 4,718 | 1,822 | 10,172 | 2,819 |
| *Solanum sp. Mosquito Creek* | P1 | 44 | 16 | 2,129 | 132 | 91 | 91 | 2,264 | 239 |
| *Atriplex spinulosa* | P1 | | | 84 | 30 | 74 | 74 | 158 | 104 |
| *Ipomoea racemigera* | P2 | 6 | 5 | 32 | 27 | | | 38 | 32 |
| *Euphorbia inappendiculata var. inappendiculata* | P2 | 2 | 2 | 129 | 19 | | | 131 | 21 |
| *Dolichocarpa* sp. Hamersley Station | P3 | | | 9080 | 217 | | | 9,080 | 217 |
| *Eragrostis crateriformis* | P3 | 6 | 6 | | | | | 6 | 6 |
| *Rhagodia sp. Hamersley (M. Trudgen 17794)* | P3 | 5 | 5 | 18 | 12 | | | 23 | 17 |

| Table D2c: Priority flora – Total records within the local area | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Priority Taxon** | **Status** | ***Regional records** | | ***Survey records** | | **TOTAL** | |
| | | **Count** | **Locations** | **Count** | **Locations** | **Count** | **Locations** |
| *Acacia aphanoclada* | P1 | 322 | 68 | 10,172 | 2,818 | 10,494 | 2,886 |
| *Solanum* sp. Mosquito Creek | P1 | 9 | 9 | 2,264 | 239 | 2,273 | 248 |
| *Atriplex spinulosa* | P1 | 73 | 18 | 158 | 104 | 231 | 122 |
| *Ipomoea racemigera* | P2 | | | 38 | 32 | 38 | 32 |
| *Euphorbia inappendiculata* var. *inappendiculata* | P2 | | | 131 | 21 | 131 | 21 |
| *Dolichocarpa* sp. Hamersley Station | P3 | | | 9,080 | 217 | 9,080 | 217 |
| *Eragrostis crateriformis* | P3 | 107 | 8 | 6 | 6 | 113 | 14 |
| *Rhagodia* sp. Hamersley (M. Trudgen 17794) | P3 | 15 | 11 | 23 | 17 | 38 | 28 |

***Regional records = TPFL and WAHerb data***

***Survey records = Biota (2021), Pilbara Environmental (2021), and WoodGIS (2020) data***

| Table D2d: Priority flora recorded within the immediate vicinity of the application area | | |
|---|---|---|
| **Priority Taxon (6)** | **Status** | **Closest location** |
| *Acacia cyperophylla* var. *omearana* | P1 | Within 180m |
| *Paspalidium retiglume* | P2 | Within 10m |

| Table D2d: Priority flora recorded within the immediate vicinity of the application area | | |
|---|---|---|
| **Priority Taxon (6)** | **Status** | **Closest location** |
| *Nicotiana umbratica* | P3 | Within 10m |
| *Swainsona thompsoniana* | P3 | Within 25m |
| *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) | P3 | Within 10m |
| *Goodenia nuda* | P4 | Within 12m |
| **Table D2e: Priority flora that may occur over the application area but were not recorded** | | |
| **Priority Taxon: May occur but not recorded (Biota 2021)** | **Status** | **Closest location** |
| *Iotasperma sessilifolium* | P3 | Within 3.5 km |
| *Rostellularia adscendens* var. *latifolia* | P3 | Within 6.3 km |

## D.3 Significant fauna

Twenty-five vertebrate fauna species of conservation significance have been identified from the local area consisting of 13 birds, 10 mammals and two reptiles (Table D3a).

**Table D3a: Conservation significant fauna species recorded within 40 kilometres of the application area**

| Common name | Scientific name | Status | Regional records | Closest record (km) | Comment |
|---|---|---|---|---|---|
| **Bird** | | | | | |
| Grey Falcon | *Falco hypoleucos* | VU | 7 | 0.2 | *Likely |
| Peregrine Falcon | *Falco peregrinus* | OS | 6 | 2.5 | Likely |
| Fork-tailed Swift | *Apus pacificus* | MI | 1 | 11.2 | Likely |
| Glossy Ibis | *Plegadis falcinellus* | MI | 1 | 19.4 | |
| Common Sandpiper | *Actitis hypoleucos* | MI | 1 | 19.4 | |
| Red-necked Stint | *Calidris ruficollis* | MI | 2 | 19.4 | |
| Oriental Plover | *Charadrius veredus* | MI | 2 | 24.7 | |
| Sharp-tailed Sandpiper | *Calidris acuminata* | MI | 3 | 0.2 | |
| Wood Sandpiper | *Tringa glareola* | MI | 7 | 0.2 | |
| Common Greenshank | *Tringa nebularia* | MI | 3 | 24.7 | |
| Marsh Sandpiper | *Tringa stagnatilis* | MI | 1 | 24.7 | |
| Gull-billed Tern | *Gelochelidon nilotica* | MI | 7 | 2.2 | |
| Caspian Tern | *Hydroprogne caspia* | MI | 1 | 19.1 | |
| **Mammals** | | | | | |
| Northern Quoll | *Dasyurus hallucatus* | EN | 59 | 0.01 | *Likely |
| Greater Bilby | *Macrotis lagotis* | VU | 96 | 0.2 | *Likely |
| Pilbara Leaf-nosed Bat | *Rhinonicteris aurantia (Pilbara)* | VU | 64 | 0.0 | *Recorded |
| Ghost Bat | *Macroderma gigas* | VU | 65 | 0.3 | *Likely |
| Brush-tailed Mulgara | *Dasycercus blythi* | P4 | 23 | 2.8 | |
| Mulgara | *Dasycercus sp.* | P4 | 2 | 5.3 | |
| Long-tailed Dunnart | *Sminthopsis longicaudata* | P4 | 7 | 16.2 | |
| Spectacled Hare-wallaby | *Lagorchestes conspicillatus leichardti* | P4 | 2 | 37.1 | |
| Northern Short-tailed Mouse | *Leggadina lakedownensis* | P4 | 18 | 20.5 | |
| Western Pebble-mound Mouse | *Pseudomys chapmani* | P4 | 73 | 0.2 | *Recorded |
| **Reptiles** | | | | | |
| Pilbara Olive Python | *Liasis olivaceus barroni* | VU | 7 | 5.8 | Likely |
| Pin-striped Finesnout Ctenotus | *Ctenotus nigrilineatus* | P1 | 39 | 2.0 | *Likely |

***Recorded = recorded within application area***

***Likely = recorded in very close proximity to application area***

| Table D3b: Fauna habitats over the application area | | | | |
|---|---|---|---|---|
| **Landform** | **ID** | **Fauna Habitat** | **Area (ha)** | **Percent (%)** |
| Cracking clays | CCP | Cracking clay plains | 14 | 1.8 |
| Plains | OS | Open shrubland/woodland on spinifex plains | 245 | 32.5 |
| | GP | Grassland plains | 10 | 1.3 |
| | GSP | Gravelly spinifex plains | 108 | 14.3 |
| | DG | Degraded grassland | 3 | 0.4 |
| Hills | HS | Low rolling stony hills | 230 | 30.5 |
| | MB | Mesa breakaways and scree slopes | 2 | 0.3 |
| | HB | Volcanic boulder hills and outcrops | 57 | 7.6 |
| Drainage lines | MDL | Major drainage lines and associated tributaries | 47 | 6.2 |
| | RTG | Rocky tributaries and gullies | 2 | 0.3 |
| | NR | Nullagine reservoir | 0.1 | 0.02 |
| | MFL | Minor flowlines | 15 | 1.9 |
| Mulga | MW | Mulga woodland plains and knolls | 3 | 0.5 |
| N/A | N/A | Other | 17 | 2 |

| Table D3c: Fauna habitats grouped by landform over the application area | | |
|---|---|---|
| **Landform (Fauna Habitat)** | **Area (ha)** | **Percent (%)** |
| Cracking clays | 14 | 2 |
| Plains | 367 | 49 |
| Hills | 289 | 38 |
| Drainage lines | 64 | 8 |
| Mulga | 3 | 0.5 |
| N/A | 17 | 2 |
| | **755** | **100** |

| Table D3d: Fauna habitat over contextual areas | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Landform** | **Fauna Habitat** | | **Application Area** | | **Survey Area and Contextual Area** | | **Percentage of Survey Area and Contextual Area potentially cleared (%)** |
| | | | Area (ha) | Per-cent (%) | Area (ha) | Per-cent (%) | |
| Hills and Mesas | HS | Low rolling stony hills | 230 | 30.5 | 5,176 | 38.3 | 4.4% |
| | MB | Mesa breakaways and scree slopes | 2 | 0.3 | 155 | 1.1 | 1.2% |
| | HB | Volcanic boulder hills and outcrops | 57 | 7.6 | 1,331 | 9.8 | 4.3% |
| Plains | GSP | Gravelly spinifex plains | 108 | 14.3 | 606 | 4.5 | 17.9% |
| | OS | Open shrubland/ woodland on spinifex | 245 | 32.5 | 3,736 | 27.6 | 6.6% |
| | CCP | Cracking clay plains | 14 | 1.8 | 256 | 1.9 | 5.4% |
| | GP | Grassland plains | 10 | 1.3 | 203 | 1.5 | 4.8% |
| | DG | Degraded grassland | 3 | 0.4 | 63 | 0.5 | 4.8% |
| Mulga | MW | Mulga woodland plains and knolls | 3 | 0.5 | 58 | 0.4 | 5.8% |

| Table D3d: Fauna habitat over contextual areas | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Landform** | **Fauna Habitat** | | **Application Area** | | **Survey Area and Contextual Area** | | **Percentage of Survey Area and Contextual Area potentially cleared (%)** |
| | | | Area (ha) | Per-cent (%) | Area (ha) | Per-cent (%) | |
| Drainage Lines | MDL | Major drainage lines and tributaries | 47 | 6.2 | 998 | 7.4 | 4.7% |
| | RTG | Rocky tributaries and gullies | 2 | 0.3 | 30 | 0.2 | 7.1% |
| | PW | Permanaent water holes | 0 | 0.0 | 0.2 | 0.0 | 0.0% |
| | MFL | Minor flowlines | 15 | 1.9 | 199 | 1.5 | 7.3% |
| Nullagine Resevoir | NR | Nullagine reservoir | 0.1 | 0.02 | 5 | 0.0 | 2.3% |
| | NA | Other | 17 | 2.3 | 699 | 5.2 | 2.4% |
| | | | **754** | | **13,516.2** | | |

## Appendix E: Assessment against the Clearing Principles

| Assessment against the Clearing Principles | Variance level | Is further consideration required? |
|---|---|---|
| **Environmental value: biological values** | | |
| Principle (a): *"Native vegetation should not be cleared if it comprises a high level of biodiversity."*<br>Assessment: Thirty-two vegetation units have been mapped over the application area (Biota 2021; WoodGIS 2020), and over 80 per cent of the vegetation is in very good condition or better (Appendix C: Table C1d). Three vegetation units (C1, P1 and 4a) represent two PECs; The cracking clays of the Chichester and Mungaroona Range of the Wona Land System (P1), and the stony saline clay plains of the Mosquito Land System (P3). Eight Priority flora taxa have been recorded within the application area including three Priority 1, two Priority 2, and three Priority 3 (Appendix D: Table D2b). A further six Priority flora taxa have been recorded within the immediate vicinity of the application area, with Biota (2021) considering that another two taxa may occur but were not recorded (Appendix D2). The conservation significant fauna species of Pilbara Leaf-nosed Bat *(Rhinonicteris aurantia)* (VU) and Western Pebble-mound Mouse *(Pseudomys chapmani)* (P4) were recorded over the application area, and an additional three birds, three mammals and two reptiles are considered likely to occur (Appendix D: Table D3a). | May be at variance | Yes<br>Section 3.2.1 |
| Principle (b): *"Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna."*<br>Assessment: A total of 13 fauna habitat types were described and mapped over the application area (Biota 2021) (Appendix D: Table D3b). Fauna habitat is available for the nine fauna species considered likely to occur. Fauna habitats align broadly with the landforms present, with further delineation of some isolated habitats that supported distinct fauna assemblages. In particular, high prospective Greater Bilby *(Macrotis lagotis)* (VU) habitat was identified and mapped within the application area. | May be at variance | Yes<br>Section 3.2.2 |
| Principle (c): *"Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, threatened flora."*<br>Assessment: *Seringia exastia* has been recorded approximately 20 kilometres south of the application area. This species was listed as Threatened (CR) when it was only known from a few locations in the vicinity of Broome. Taxonomically the widespread species *Seringia elliptica* has recently been incorporated into *Seringia exastia* (Binks *et al.* 2020). Given the much broader distribution of the resulting taxon, it is no longer considered to be of significance (Binks *et al.* 2020). The surveys of Biota (2021), Pilbara Environmental (2021) and WoodGIS (2020) did not record any Threatened flora occurring in the survey area. Biota (2021) undertook a likelihood of occurrence assessment and determined that no Threatened flora are expected to occur within the survey area. The application area is unlikely to include, or be necessary for, the continued existence of, Threatened flora. | Not at variance | No |
| Principle (d): *"Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community."*<br>Assessment: No Threatened Ecological Community (TECs) listed under the BC Act or the EPBC Act have been recorded from the application area. Only two TECs are listed for the Pilbara: the *Themeda grasslands on cracking clays (Hamersley Station, Pilbara)* (VU), and the *Ethel Gorge aquifer stygobiont community* (EN). Both of these TECs are restricted to the Hamersley subregion of the Pilbara Bioregion. The application area is located | Not at variance | No |

| Assessment against the Clearing Principles | Variance level | Is further consideration required? |
|---|---|---|
| within the Chichester subregion of the Pilbara Bioregion and would not occur over the habitats of the application area. The application area is unlikely to comprises the whole or a part of, or be necessary for, the maintenance of a TEC. | | |
| **Environmental values: significant remnant vegetation and conservation areas** | | |
| Principle (e): *"Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared."*<br>Assessment: The extend of the three regional native vegetation associations mapped over the application area (Appendix C1); Association173 (Shrub-steppe), Association 93 (Shrub-steppe), and Association 190 (Sparse shrub-steppe) is consistent with the national objectives and targets for biodiversity conservation in Australia (Commonwealth of Australia 2001) (Appendix C: Table C2a). Over 99 per cent remnant vegetation is retained in the local area of a 40 kilometre radius of the application area. Vegetation in the application area is not considered to be part of a significant ecological linkage in the local area. The application area does not support native vegetation considered significant as a remnant of native vegetation in an area that has been extensively cleared. | Not at variance | No |
| Principle (h): *"Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area."*<br>Assessment: No lands vested in the Western Australian Conservation and Parks Commission and managed by the DBCA are located within the local area. Former leasehold lands proposed for conservation and managed by the DBCA comprising the former Meentheena Pastoral Lease are located approximately 22.5 kilometres to the north-east of the application area. Additional former leasehold properties proposed for conservation (identified by the 2015 excision process) include the former Roy Hill Station; former Hillside Station; and former Marillana Station) and are located approximately 27 kilometres to the west of the application area. There are no mapped ecological linkages in the local area. Due to the separation distances above, the proposed clearing is unlikely to have an impact on the environmental values of any adjacent or nearby conservation areas. | Not at variance | No |
| **Environmental values: land and water resources** | | |
| Principle (f): *"Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland."*<br>Assessment: The application area bisects several designated rivers, watercourses, and adjacent floodplains (Appendix C: Table C1j). There are no wetlands in the vicinity of the application area (Biota 2021), however, the drainage line landform supports several vegetation units that are growing in, or in association with, an environment associated with a watercourse. | At variance | Yes<br>Section 3.2.3 |
| Principle (g): *"Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation."*<br>Assessment: Eleven Land Systems are mapped over the application area (Table C1f) incorporating five land types (Table C1g) and seven Soil Types (Table C1h). Over 90 per cent of the application area consists of Spinifex grasslands associated with Hills and Ranges and Stony Plains land types (Table C1g). With standard road construction methodologies in place proposed clearing is not expected to result in an increased risk of changes to pH, salinity, or eutrophication (Phosphorus export). The removal of native vegetation may contribute to increased amounts of wind or water erosion in adjacent areas from roadworks in any of the land types (Table C1g), but particularly over the hills and ranges land type. | May be at variance | Yes<br>Section 3.2.5 |

| Assessment against the Clearing Principles | Variance level | Is further consideration required? |
|---|---|---|
| Principle (i): *"Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water."*<br>Assessment: The application area bisects several (at least 12) designated rivers and watercourses (Appendix C: Table C1j) including the Nullagine River, Cajuput Creek, and major tributaries. The entire application area is located within the Pilbara Surface Water Area (UFI 54) and the Pilbara Groundwater Area (UFI 44) proclaimed under the RIWI Act. The area around Nullagine Township is located within a Public Drinking Water Source Area, consisting of two components: The Nullagine Water Reserve (Protection Area P1), and the Nullagine Water Reserve (Protection Area P3). In addition the proposed clearing is also within a Wellhead Protection Zone (WHPZ) for the drinking water supply production bore within Nullagine Water Reserve (DWER 2021b). | Not likely at variance | Yes<br>Section 3.2.4 |
| Principle (j): *"Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding."*<br>Assessment: The application area bisects several (at least 12) designated rivers and watercourses (Appendix C: Table C1j). Drainage lines in the area are dry for most of the year, only flowing briefly immediately following significant rainfall (BOM 2021). There are no permanent watercourses or waterbodies within the application area. Standard roadwork processes including the installation of appropriate culverts based on the drainage modelling ensure the natural hydrology is maintained, together with the linear clearing along an existing road, is unlikely to cause or exacerbate the incidence or intensity of flooding. | Not likely at variance | No |

## Appendix F: Vegetation condition rating scale

Vegetation condition is a rating given to a defined area of vegetation to categorise and rank disturbance related to human activities. The rating refers to the degree of change in the vegetation structure, density and species present in relation to undisturbed vegetation of the same type. The degree of disturbance impacts upon the vegetation's ability to regenerate. Disturbance at a site can be a cumulative effect from a number of interacting disturbance types.

**Table F1: Measuring vegetation condition for the Eremaean and Northern Botanical Provinces (Trudgen 1991)**

| Condition | Description |
|---|---|
| Excellent | Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement. |
| Very good | Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks. |
| Good | More obvious signs of damage caused by human activity since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds. |
| Poor | Still retains basic vegetation structure or ability to regenerate it after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds. |
| Very poor | Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species present including very aggressive species. |
| Completely degraded | Areas that are completely or almost completely without native species in the structure of their vegetation; i.e. areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs. |

## Appendix G: Figures

### G.1 Significant ecosystems

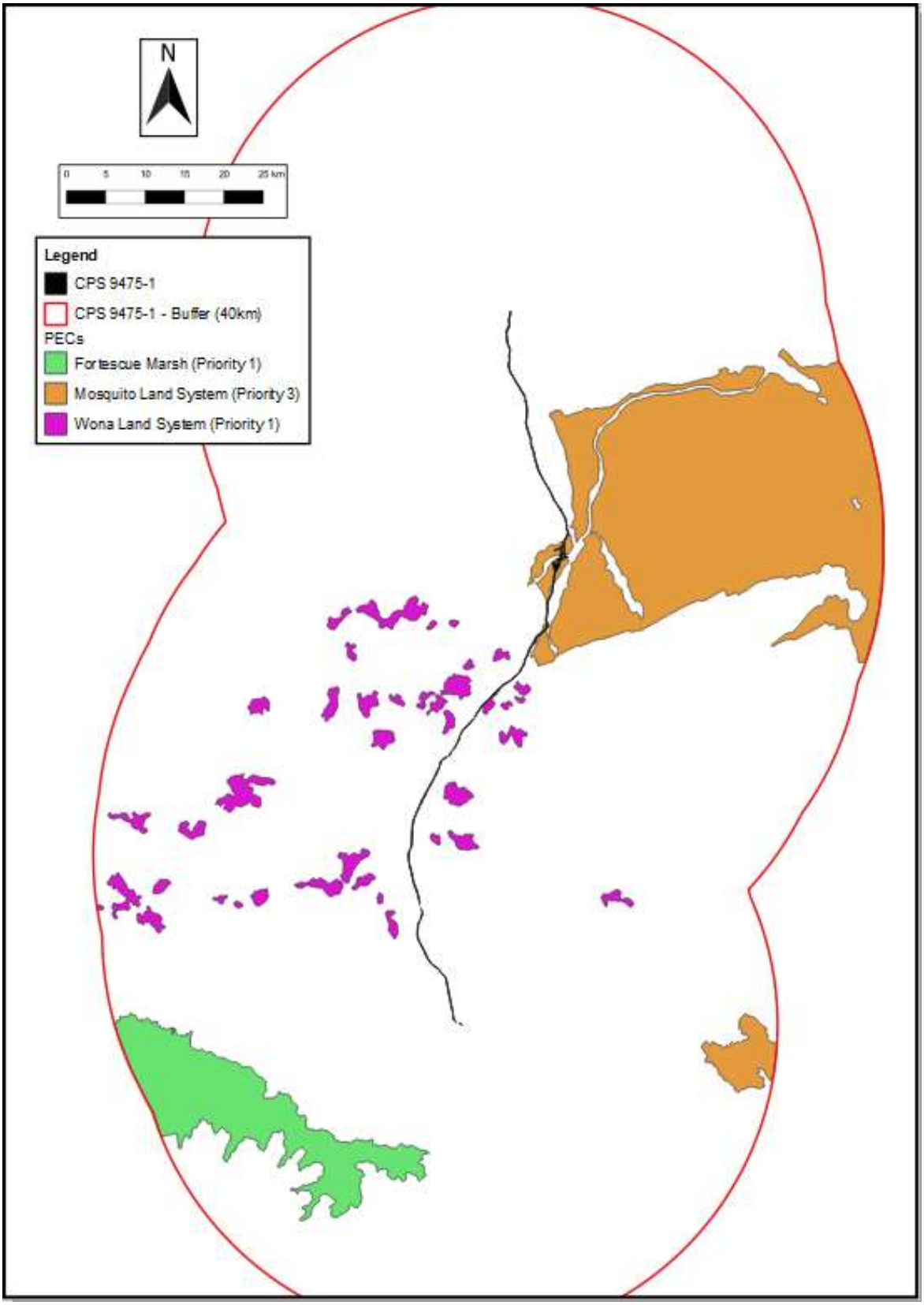



**Figure 1: Significant Ecological Communities within the local area**

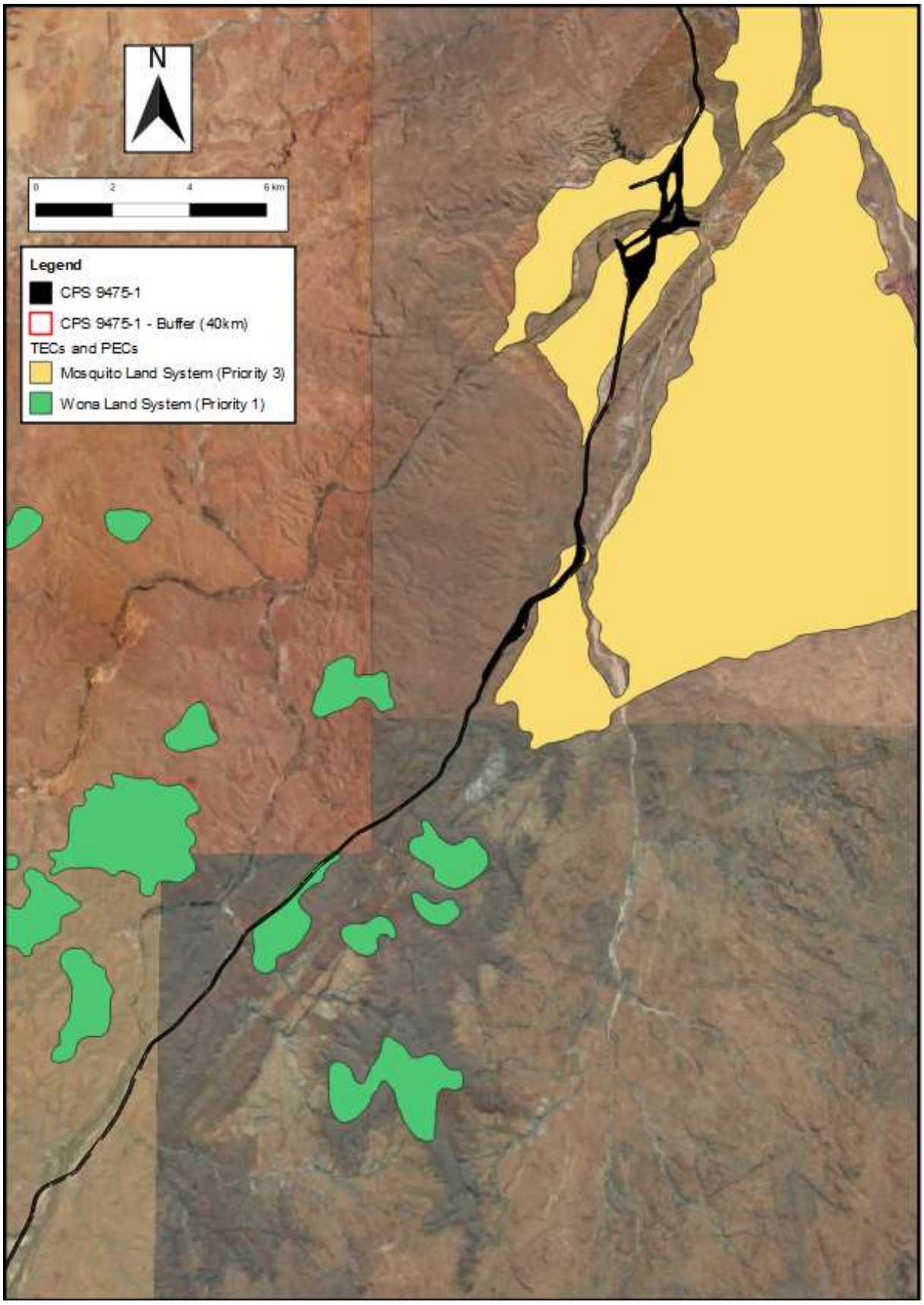



**Figure 2: Significant Ecological Communities mapped over the application area**

## G.2 Priority flora – Local area

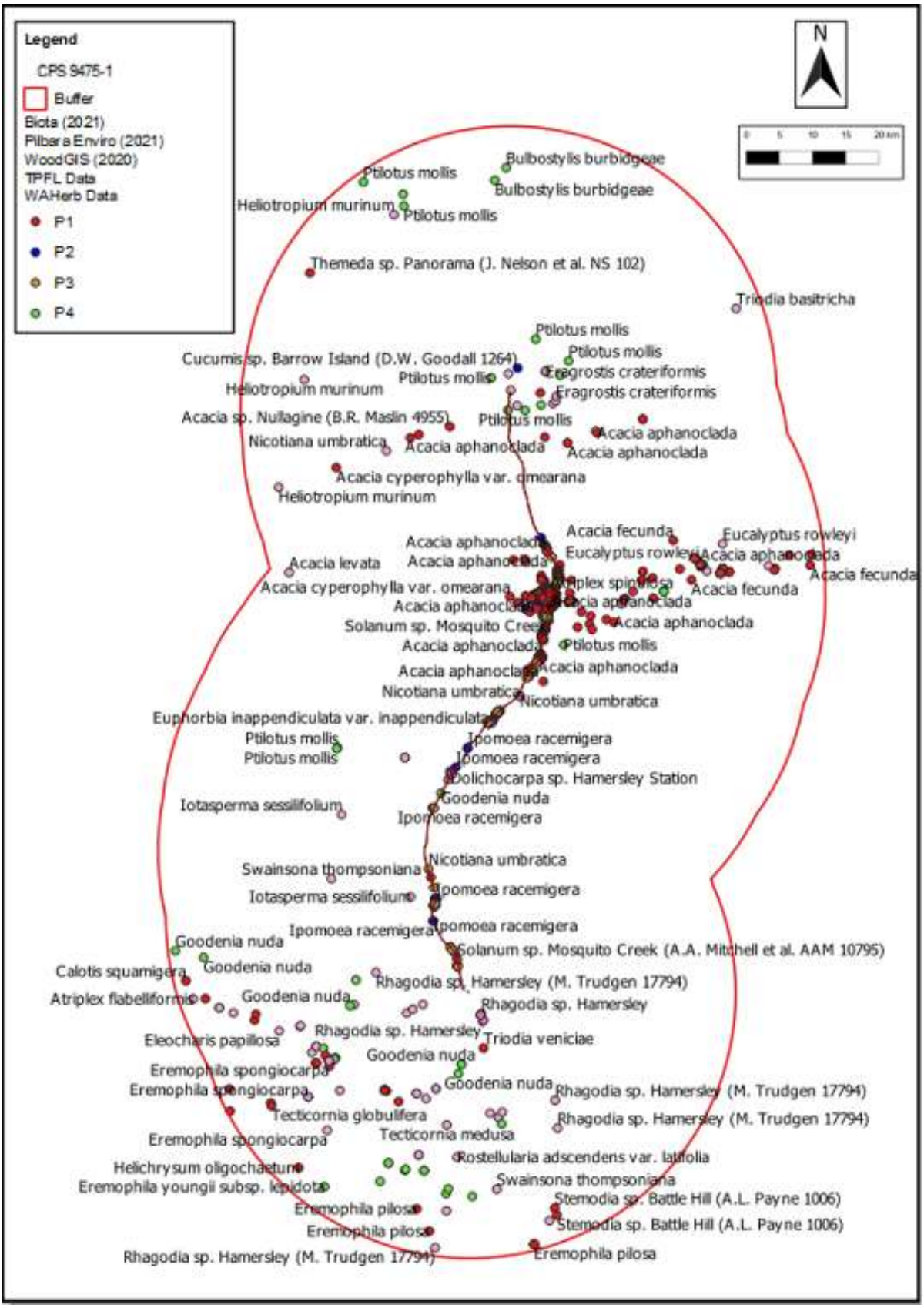



**Figure 1: Flora taxa of conservation significance recorded within the local area (all records)**

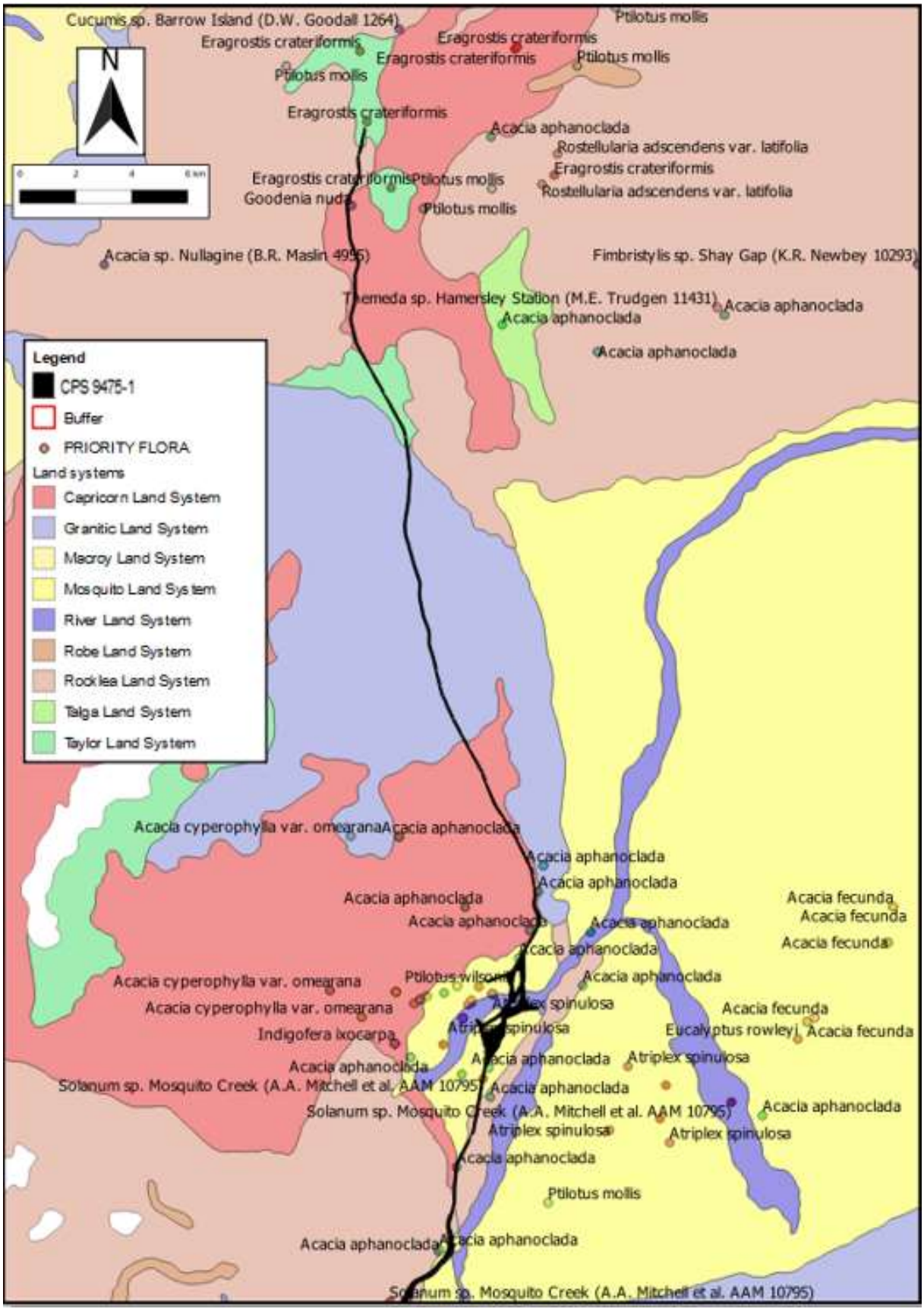



**Figure 2: Flora taxa of conservation significance (WAH; TPFL) recorded in the vicinity of the application area**

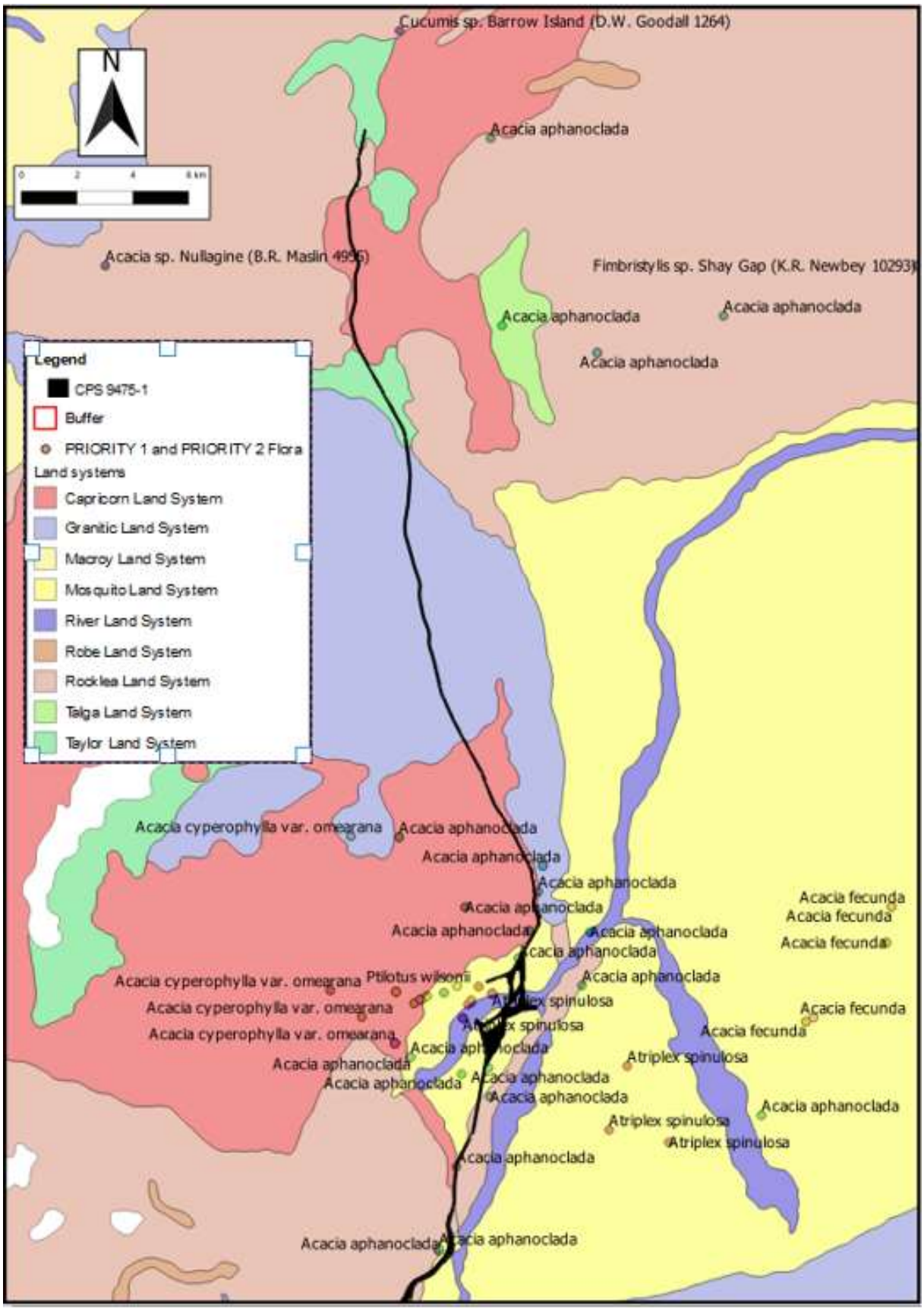



**Figure 3: Priority 1 and Priority 2 flora taxa (WAH; TPFL) recorded in the vicinity of the application area**

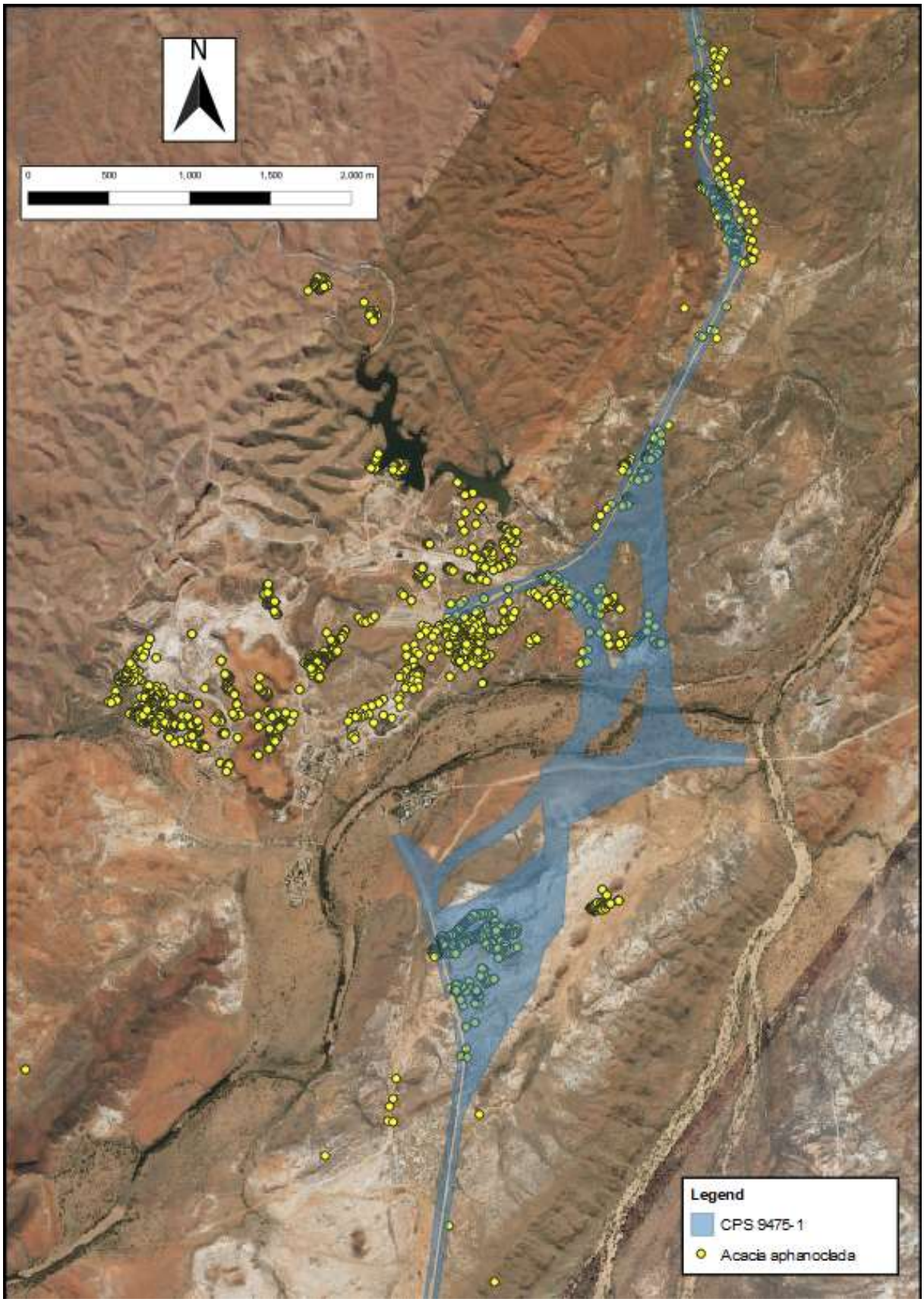



**Figure 4: *Acacia aphanoclada* (P1) records in the vicinity of the proposed Nullagine bypass (all records)**

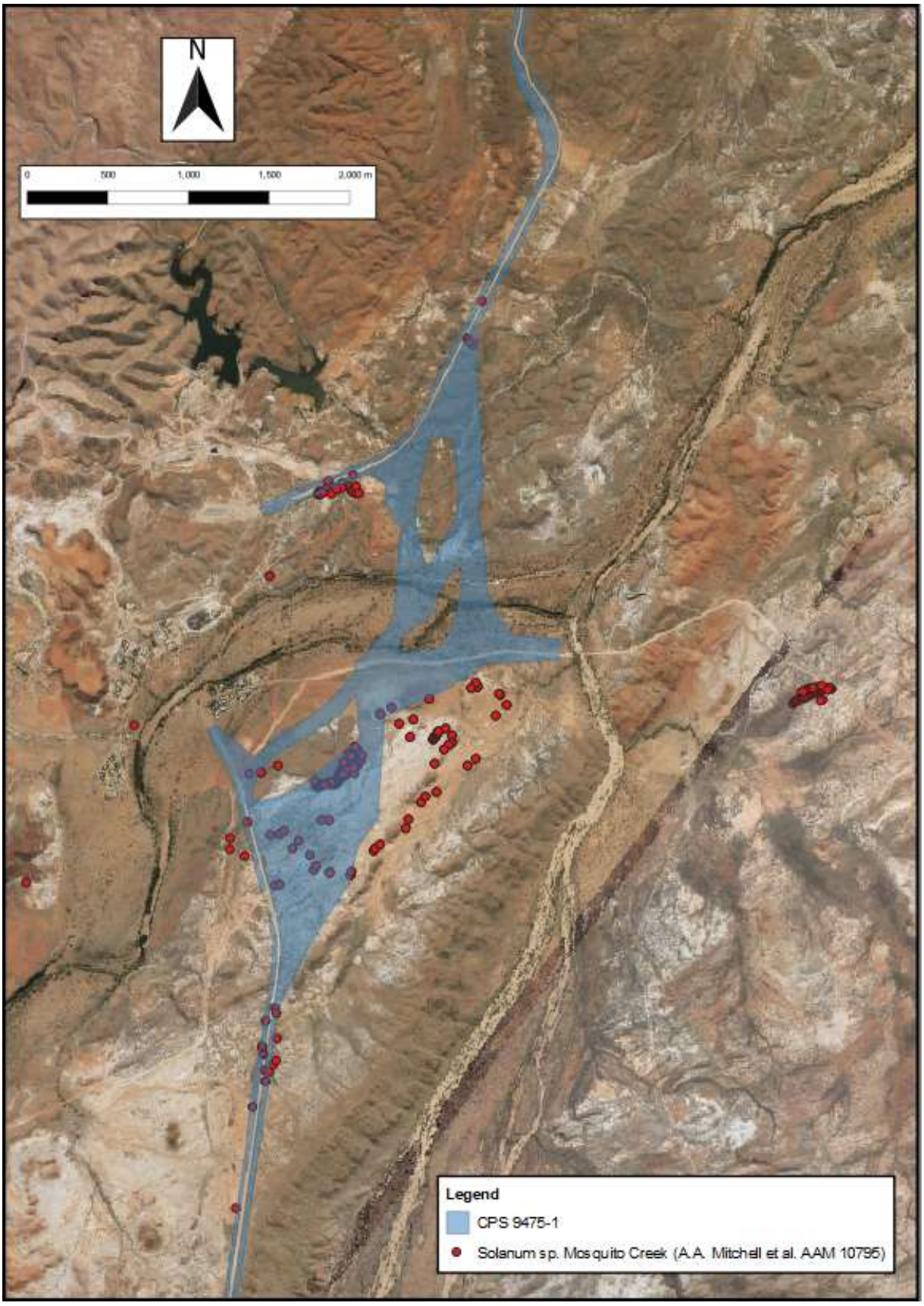



**Figure 5: *Solanum sp.* Mosquito Creek (P1) records in the vicinity of the proposed Nullagine bypass (all records)**

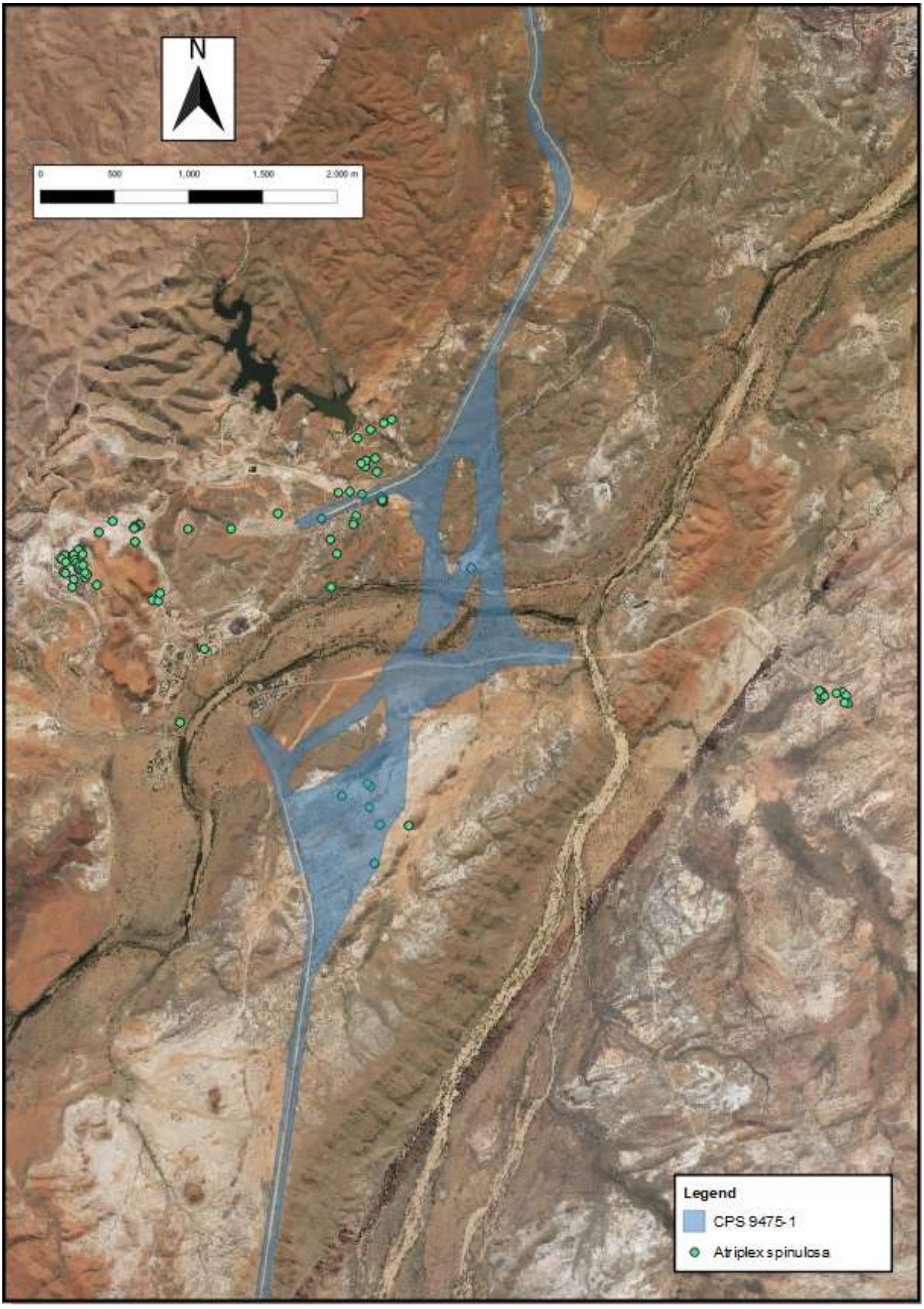
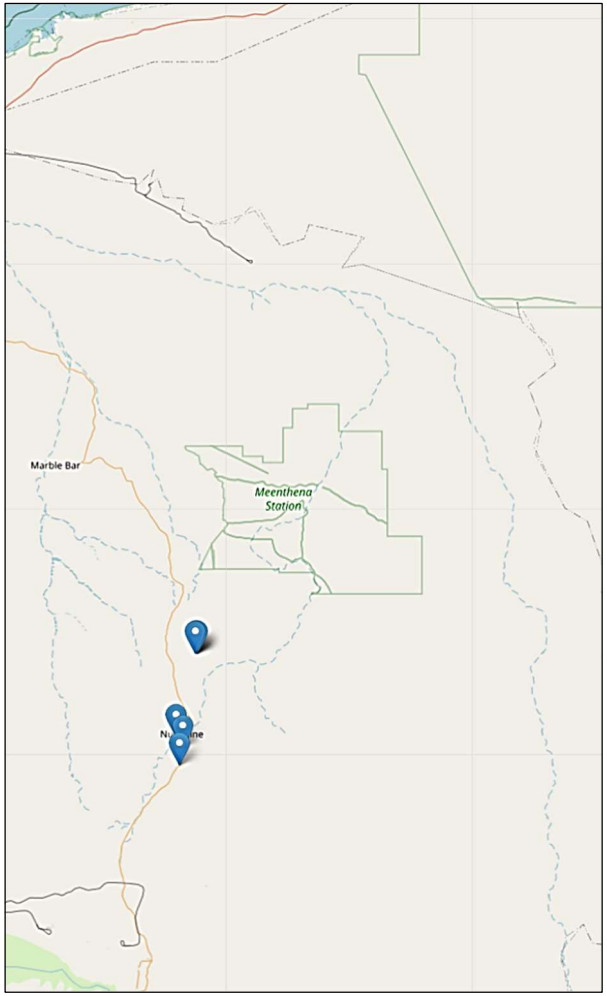


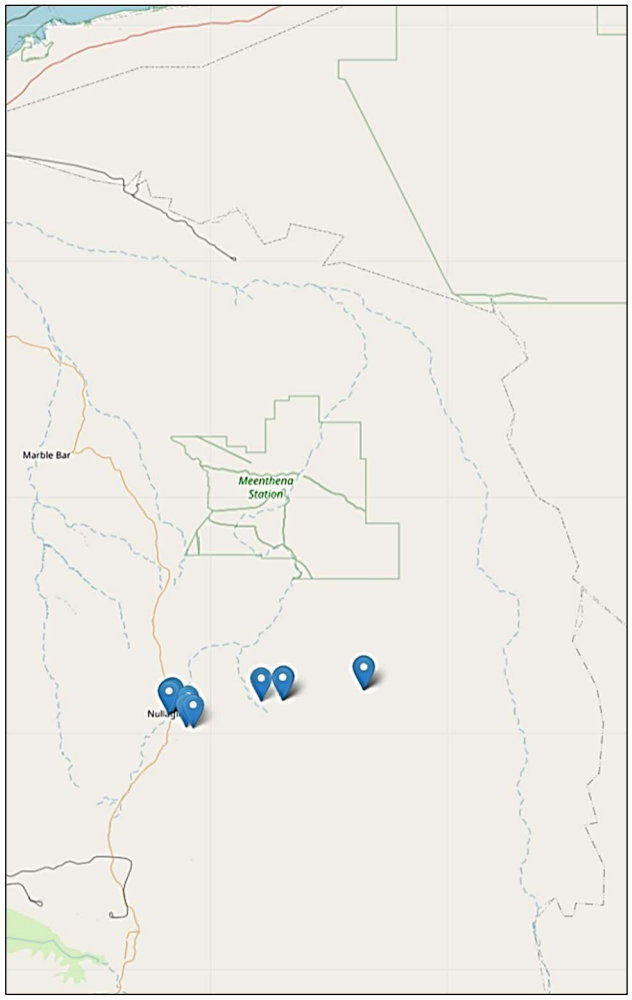

**Figure 6: *Atriplex spinulosa* (P1) records in the vicinity of the proposed Nullagine bypass (all records)**

## G.3 Priority flora - Regional (WAH 1998-)

***Acacia aphanoclada* (P1)**




***Solanum* sp. Mosquito Creek (A.A. Mitchell *et al.*) (P1)**




***Atriplex spinulosa* (P1)**

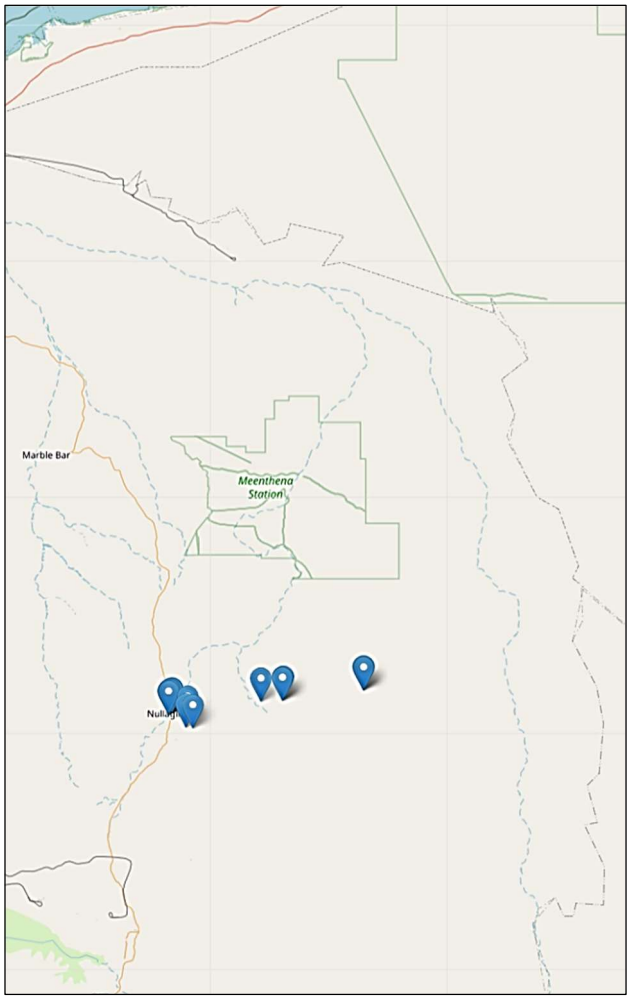



**Figure 1: Priority 1 flora distribution - Regional (WAH 1998-)**

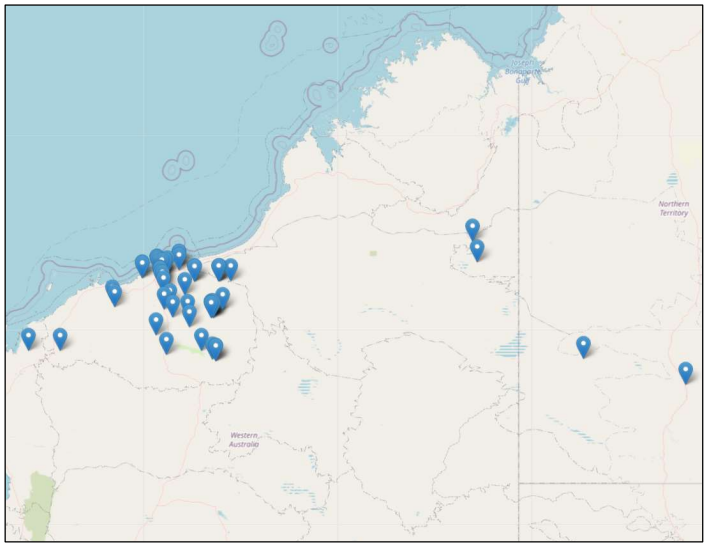
***Ipomoea racemigera*** **(P2)**


***Euphorbia inappendiculata*** **var.** ***inappendiculate*** **(P2)**


**Figure 2: Priority 2 flora distribution - Regional (WAH 1998-)**

***Dolichocarpa* sp. Hamersley Station (P3)**


***Eragrostis crateriformis* (P3)**




***Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3)**

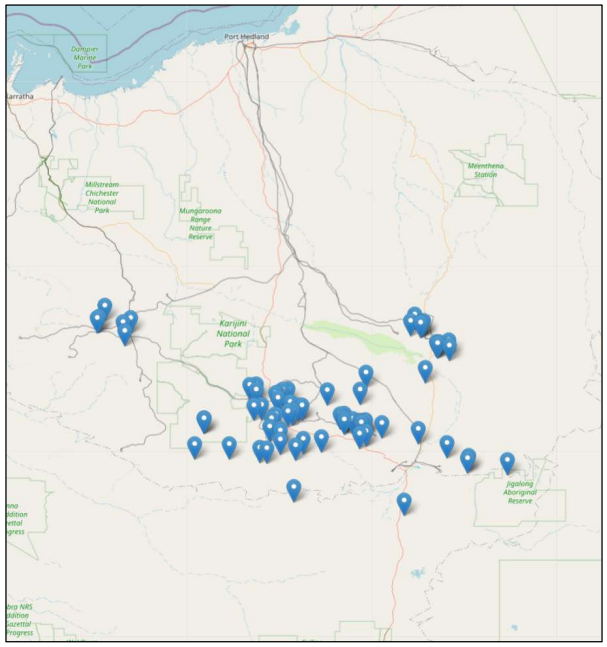



**Figure 3: Priority 3 flora distribution - Regional (WAH 1998-)**

## G.4 Significant fauna

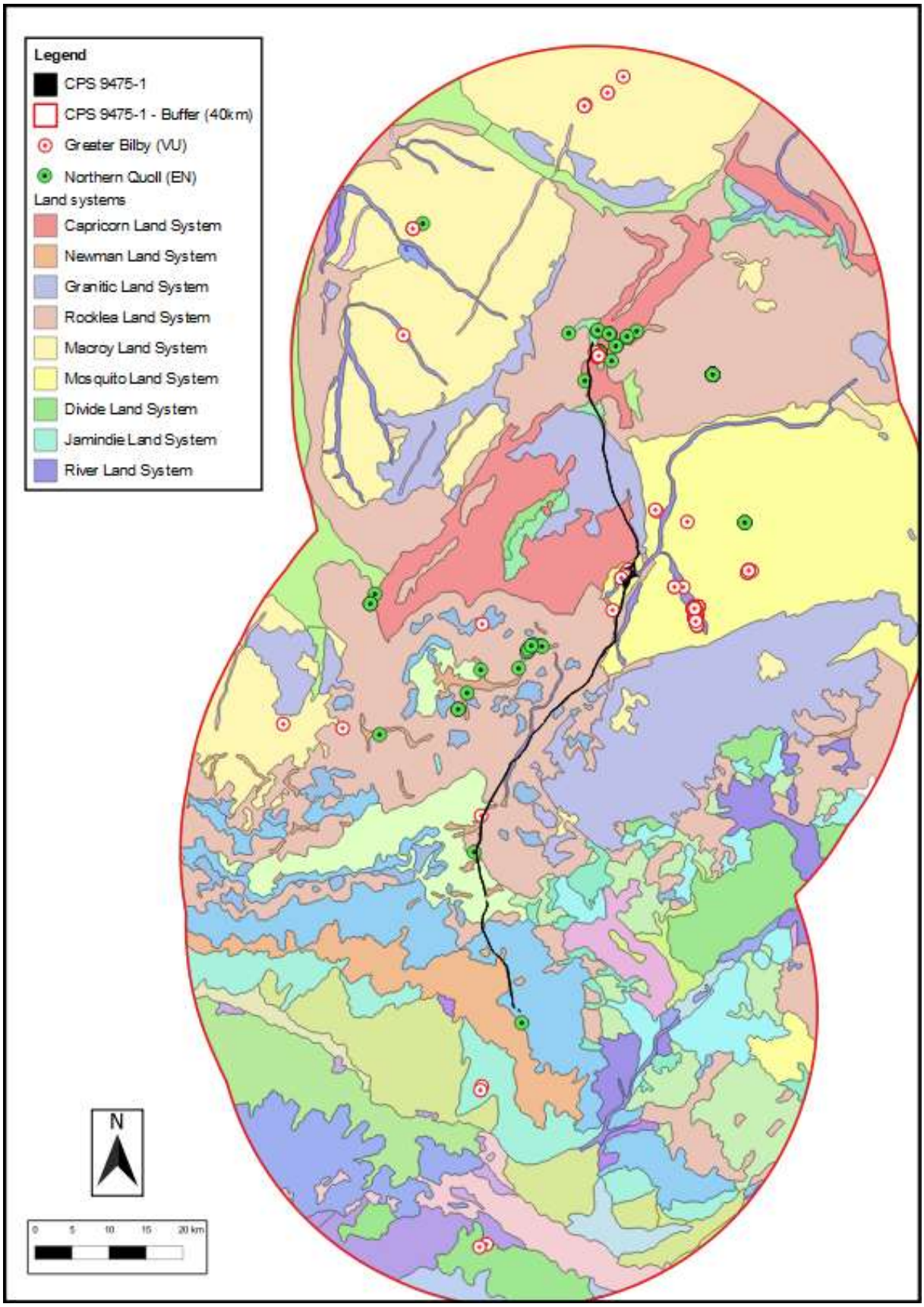



**Figure 1: Greater Bilby and Northern Quoll recorded within the local area (Threatened Fauna database)**

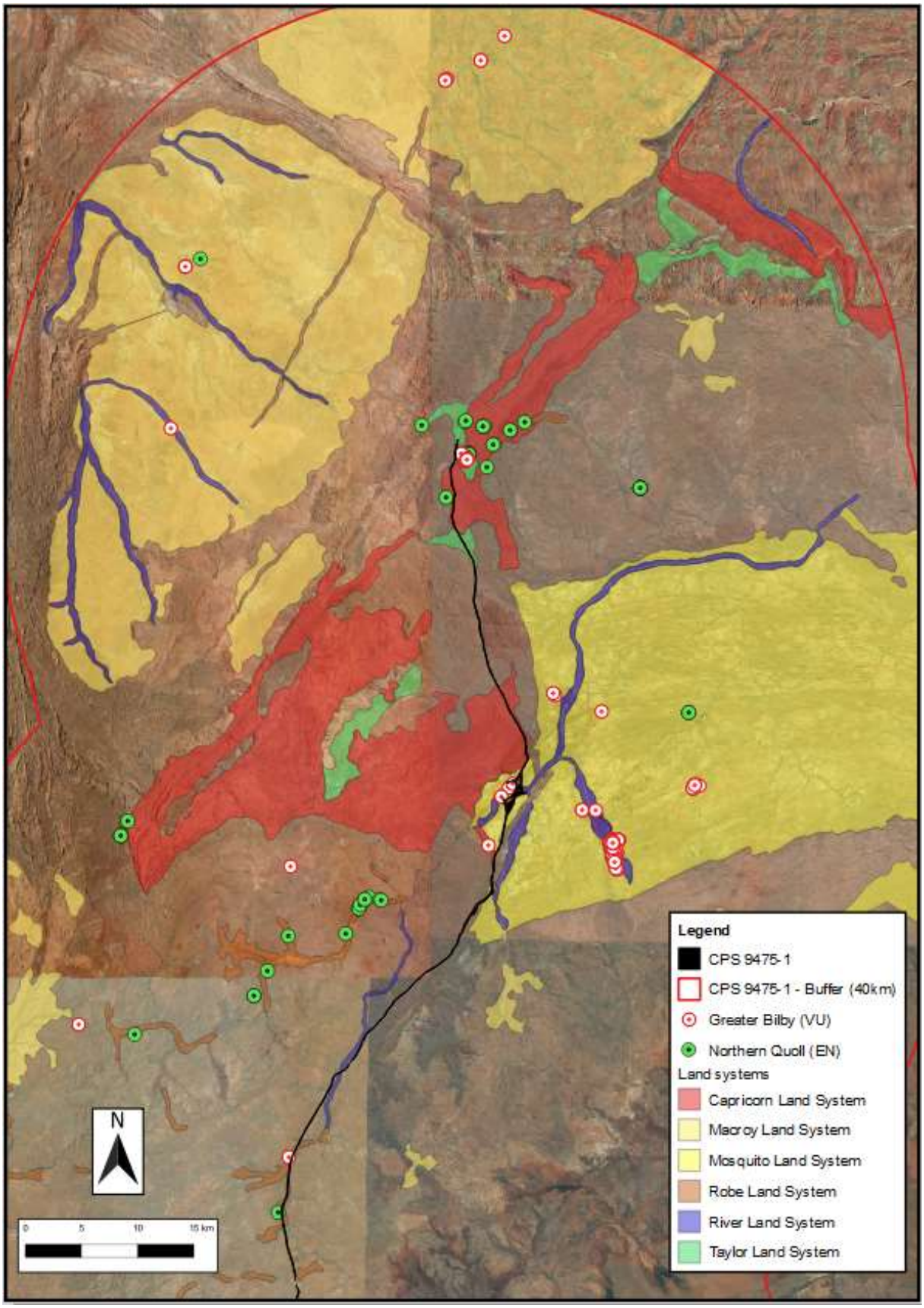



**Figure 2: Greater Bilby and Northern Quoll recorded in the vicinity of the application area (Threatened Fauna database)**

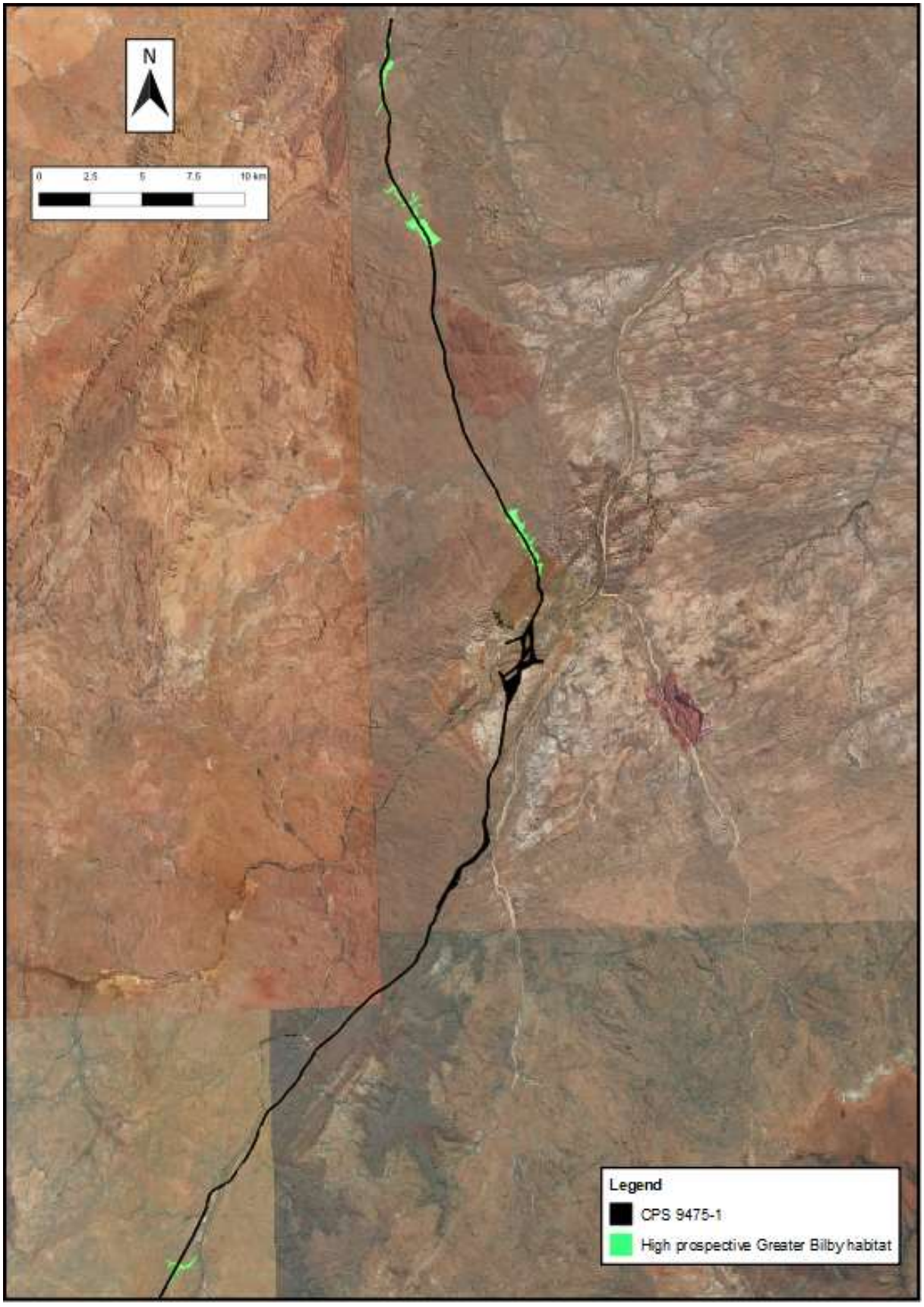



**Figure 3: Mapped 'High' prospective Greater Bilby habitat**

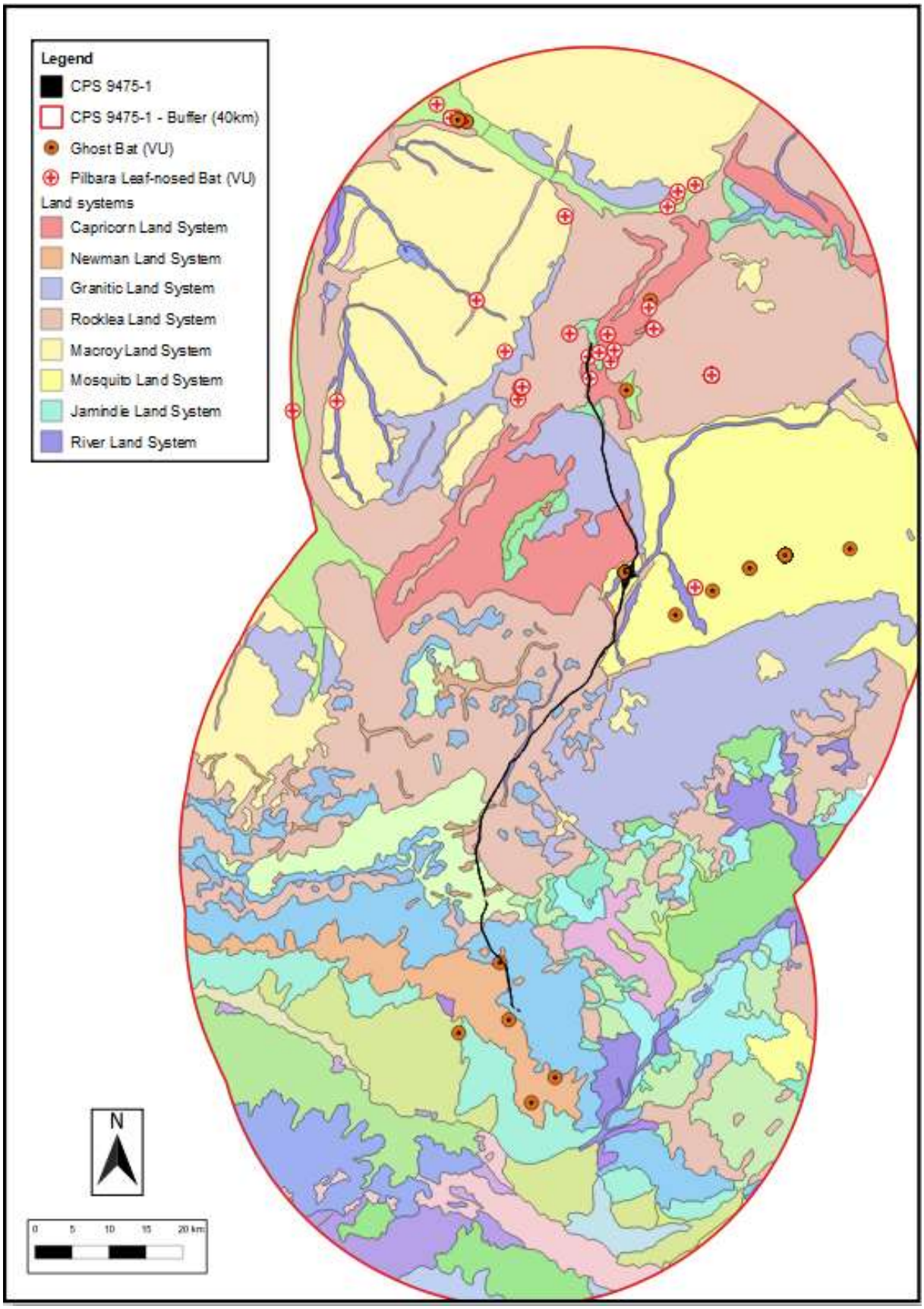



**Figure 4: Ghost Bat and Pilbara Leaf-nosed Bat recorded within the local area (Threatened Fauna database)**

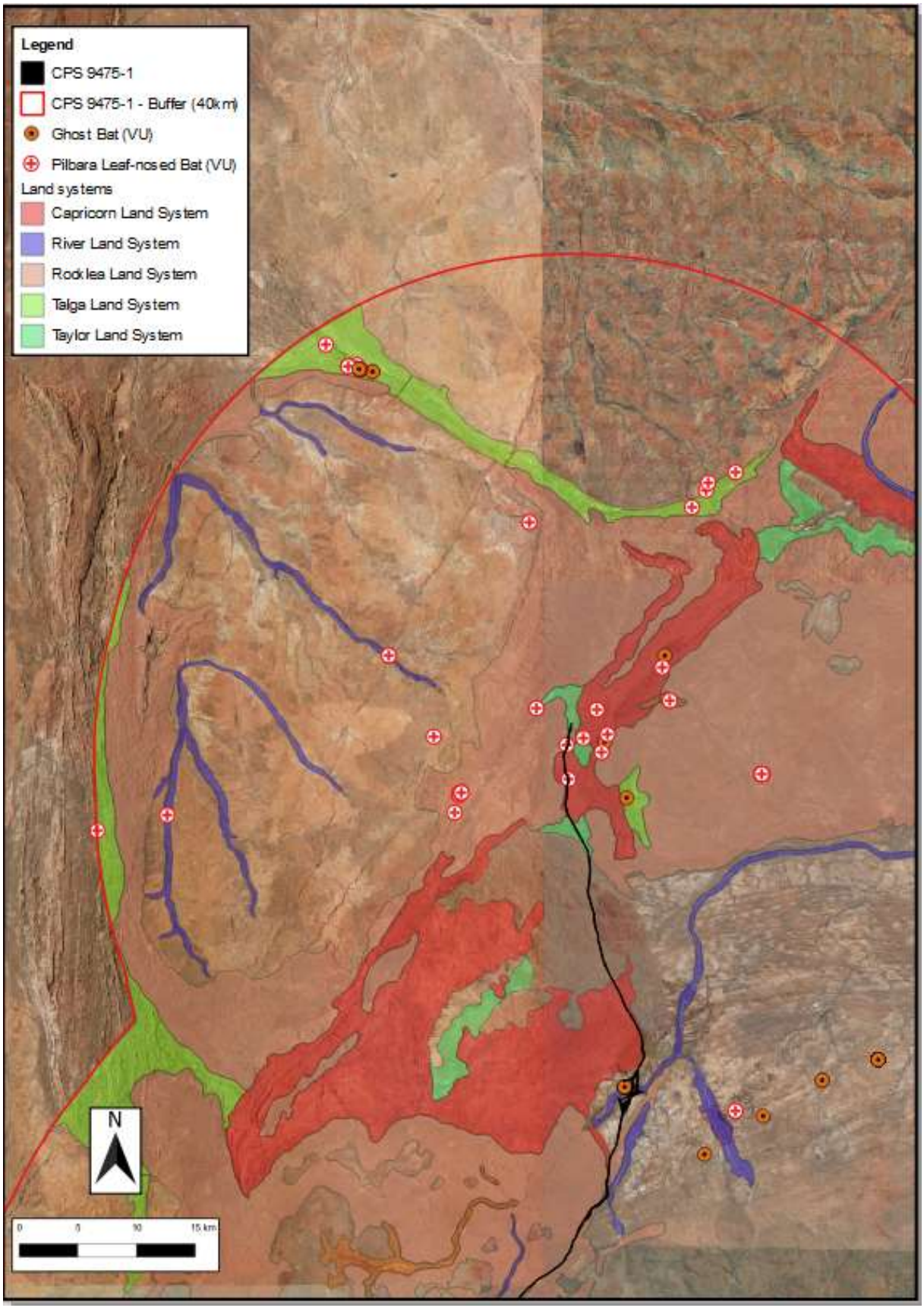



**Figure 5: Ghost Bat and Pilbara Leaf-nosed Bat records in the northern section of the application area (Threatened Fauna database)**

## Appendix H: Biological survey excerpts

### H.1 Vegetation (Biota 2021)

# 4.2 Vegetation Results

## 4.2.1 Overview

Reflecting its location along an existing road, the survey area generally traversed low-lying areas within the landscape, with larger hills typically outside the survey area in the contextual area. Almost one-fifth of the survey area had been cleared; the broad landforms and vegetation types through the remainder of the corridor comprised:

- Hills with boulder or stony substrates supporting spinifex hummock grasslands with a usually sparse overstorey of shrubs and trees; the hummock grassland was usually dominated by *Triodia wiseana* and/or *T. epactia*, sometimes with *T. brizoides* or *T. vanleeuwenii*, (Plate 4.1);
- Stony to gravelly plains supporting spinifex hummock grasslands, usually dominated by *Triodia longiceps* and *T. wiseana*, with a sparse to open cover of shrubs and trees (Plate 4.2);
- Clay plains supporting annual grasses and herbs, which ranged from a dense cover through to patches within open hummock grasslands of *Triodia longiceps* and *T. epactia* (Plate 4.3);
- Mulga (*Acacia aptaneura*) low woodland on plains and occasional rocky knolls (Plate 4.4); and
- Drainage lines, ranging in scale from major drainages (e.g. the Nullagine River) supporting riparian Eucalypt forests, through to minor flowlines with open scrub of mixed wattles and other shrub species (Plate 4.5).

Plate 4.1: Vegetation of hills with a boulder substrate (left), compared to a stony substrate (right).

Plate 4.2: Vegetation of gravelly / stony plains.

Plate 4.3: Vegetation of clay plains: with herbs and grasses dominating (left), and occurring in patches within an open hummock grassland (right).

Plate 4.4: Mulga woodland vegetation on plains (left) and knolls (right).

Plate 4.5: Vegetation of drainage lines: the Nullagine River (left), compared to a minor flowline (right).

## H.2 Significant communities and flora (Biota 2021)

# 5.1 Significant Communities

No TECs were identified in the survey area and none would be expected to occur, given the location of the area and the habitats and vegetation types present.

Two PECs were recorded in the survey area:

- Vegetation type P1 occurred around Nullagine and was equivalent to the "Stony saline plains of the Mosquito land system" PEC (Priority 3). A total of 130.8 ha was mapped in the survey area, which represented 21.6% of the extent in the local area.
- Vegetation type C1 appears to correspond to the "Cracking clays of the Chichester and Mungaroona Range" assemblage (Priority 1) of the "Four plant assemblages of the Wona land system" PEC. A total of 44.4 ha was mapped in the central section of the survey area, which comprised 17.3% of the mapped extent in the local area.

# 5.2 Significant Flora

No Threatened flora have been recorded from the survey area, and none are expected to occur.

A total of 14 Priority flora species have been recorded from the survey area, and it is considered that two additional species may occur (Table 5.1). The most significant of these are the records of the Priority 1 species *Acacia aphanoclada* and *Solanum* sp. Mosquito Creek (A.A. Mitchell et al. AAM 10795), both of which have relatively restricted distributions (less than 70 km at the widest point).

**Table 5.1: Significant flora recorded within the survey area, or assessed as having the potential to occur.**

| Species | Significance |
|---|---|
| **Recorded** | |
| *Acacia aphanoclada* | P1 |
| *Acacia cyperophylla* var. *omearana* | P1 |
| *Atriplex spinulosa* (historical records only) | P1 |
| *Solanum* sp. Mosquito Creek (A.A. Mitchell et al. AAM 10795) | P1 |
| *Euphorbia inappendiculata* var. *inappendiculata* | P2 |
| *Ipomoea racemigera* | P2 |
| *Paspalidium retiglume* | P2 |
| *Eragrostis crateriformis* | P3 |
| *Nicotiana umbratica* | P3 |
| *Oldenlandia* sp. Hamersley Station (A.A. Mitchell PRP 1479) | P3 |
| *Rhagodia* sp. Hamersley (M. Trudgen 17794) | P3 |
| *Swainsona thompsoniana* | P3 |
| *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) | P3 |
| *Goodenia nuda* | P4 |
| **May occur** | |
| *Iotasperma sessilifolium* | P3 |
| *Rostellularia adscendens* var. *latifolia* | P3 |

With respect to the species listed above, only the Priority 1 species are considered well documented with respect to their distribution in the survey area. Most of the other species are annual grasses or herbs, which are logistically impractical to fully survey, even under optimal conditions. For these species it is considered more appropriate to use habitat as a surrogate for populations when considering potential impacts. For most of the vegetation types mapped for this study, less than 25% of the local extent (i.e. the total mapped in the survey area and contextual area) occurs within the survey area. Exceptions comprise P4 (39% in the survey area), P5 (48%), D7 (32%) and D8 (29%). Only one of these units (P4) was associated with significant flora records, specifically the Priority 1 *Acacia aphanoclada* and Priority 4 *Goodenia nuda*, and these species were both recorded from other vegetation types.

## 5.3 Significant Fauna

Two species of significance, the Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia* Pilbara form; Vulnerable) and Western Pebble-mound Mouse (*Pseudomys chapmani*; Priority 4), were recorded with certainty from the survey area during the survey (Table 5.2).

A track that was likely attributable to Northern Quoll (*Dasyurus hallucatus*; Endangered) was also recorded within the survey area, and a Ghost Bat (*Macroderma gigas*; Vulnerable) was observed in close proximity to the contextual area; both species were considered likely to occur within the survey area. In addition, based on previous records from the region and an assessment of habitat within the survey and contextual areas, six other significant taxa were considered likely to occur, and a further seven may occur within the survey area (Table 5.2).

**Table 5.2: Significant fauna recorded within the survey area, or assessed as "likely to occur" or "may occur".**

| Species | Common Name | Significance † | |
|---|---|---|---|
| | | State | Federal |
| **Recorded** | | | |
| *Rhinonicteris aurantia* Pilbara form | Pilbara Leaf-nosed Bat | VU | VU |
| *Pseudomys chapmani* | Western Pebble-mound Mouse | P4 | - |
| **Likely to occur** | | | |
| *Dasyurus hallucatus* | Northern Quoll | EN | EN |
| *Macroderma gigas* | Ghost Bat | VU | VU |
| *Macrotis lagotis* | Bilby | VU | VU |
| *Liasis olivaceus barroni* | Pilbara Olive Python | VU | VU |
| *Falco hypoleucos* | Grey Falcon | VU | VU |
| *Apus pacificus* | Fork-tailed Swift | MI | MI |
| *Falco peregrinus* | Peregrine Falcon | OS | - |
| *Ctenotus nigrilineatus* | – | P1 | - |
| **May occur** | | | |
| *Pezoporus occidentalis* | Night Parrot | CR | EN |
| *Charadrius veredus* | Oriental Plover | MI | MI |
| *Anilios ganei* | – | P1 | - |
| *Dasycercus blythi* | Brush-tailed Mulgara | P4 | - |
| *Sminthopsis longicaudata* | Long-tailed Dunnart | P4 | - |
| *Lagorchestes conspicillatus leichardti* | Spectacled Hare-wallaby | P4 | - |
| *Leggadina lakedownensis* | Short-tailed Mouse | P4 | - |

† CR = Critically Endangered, EN = Endangered, VU = Vulnerable, MI = Migratory, OS = Other Specially Protected, P1 = Priority 1, P4 = Priority 4.

## Appendix I: Priority 1 flora analysis provided by applicant (Main Roads 2022a)

**Table I.1 - Priority 1 Flora Species recorded within the application area**

| Species | Species density estimate within Survey area (species/ ha)* | Total known habitat area for species (ha)** | Total habitat potentially cleared (ha) | Total estimated individuals potentially cleared | Total population estimate | Percentage population cleared (%) |
|---|---|---|---|---|---|---|
| *Acacia aphanoclada* | 206 | 182,636 | 199.70 | 41,076 | 37,565,942^^ | 0.11% |
| *Solanum* sp. Mosquito Creek | 1.33 | 2,091.17^ | 208.90 | 278 | 2,781 | 9.99% |
| *Atriplex spinulosa* | 5,700 | 182,636 | 199.70 | 1,138,290 | 1,041,025,200 | 0.11% |

***Species density estimate using density per hectare as calculated by Pilbara Environmental (2021). Plants are variable in the landscape but are common and widespread across their habitat types.***

****Acacia aphanoclada and Atriplex spinulosa are widespread across the Mosquito land system within the Chicester subregion, however, Solanum sp. Mosquito Creek is restricted to the drainage line around Nullagine and mapping is only available from Pilbara Environmental (2021).***

***^WoodGIS (2020) estimate up from 22- 6,533 plants/ha.***

***^^WoodGIS (2020) state there are likely Acacia aphanoclada 1,550,000 plants estimated from their survey alone.***

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A large gap to the east has been removed from the potential footprint which encompasses a large portion of the *Solanum* sp. Mosquito Creek known habitat (Figure 1). *Acacia aphanoclada* is also prolific around the Nullagine township and most of the mapped records will be avoided, and associated habitat will be avoided (Figure 2). The majority of the *Atriplex spinulosa* known locations are also currently being avoided (Figure 3).

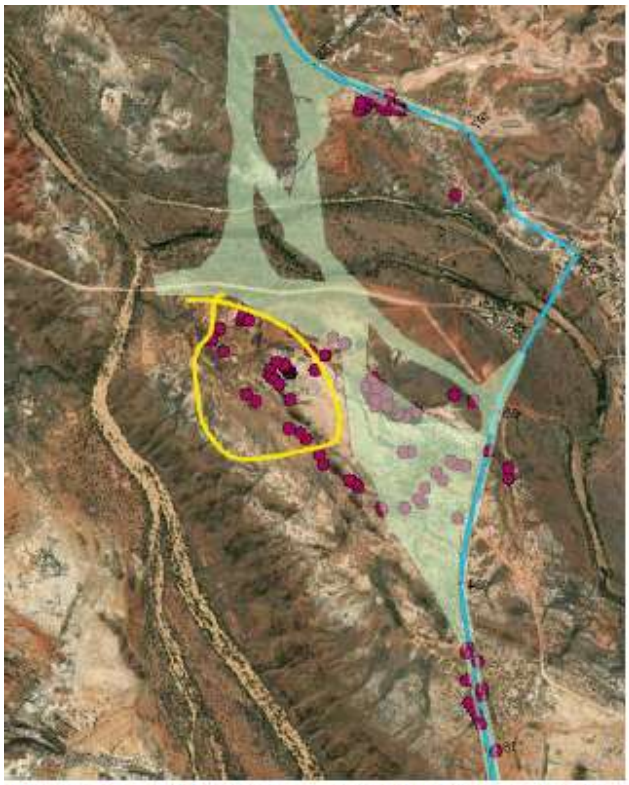

**Figure 1 - *Solanum* sp. Mosquito Creek records in and adjacent to the application area.**

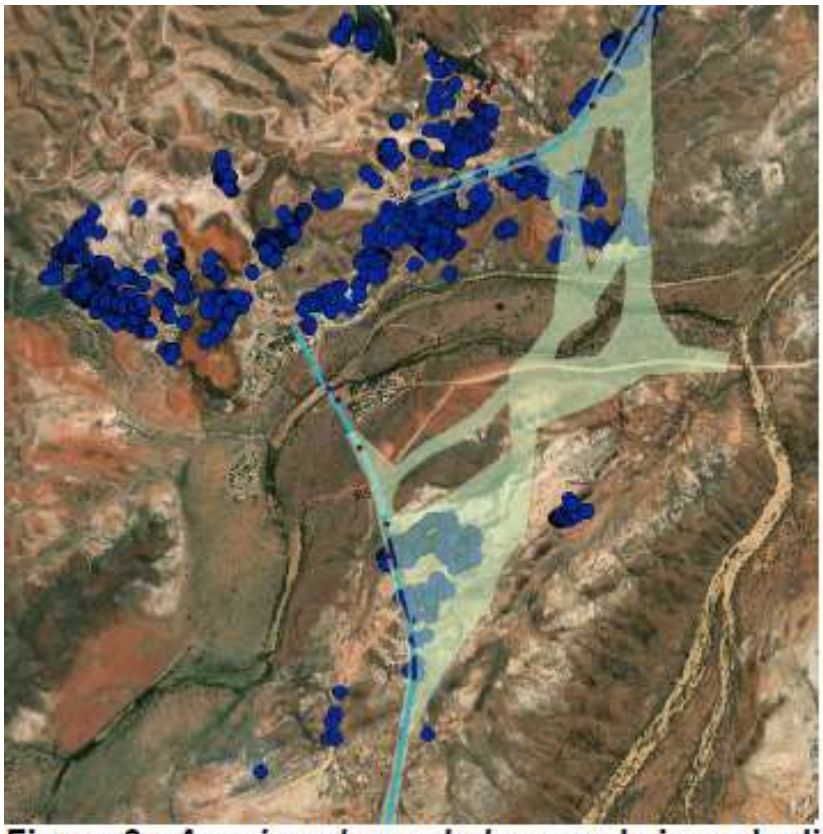

**Figure 2 - *Acacia aphanoclada* records in and adjacent to the application area.**

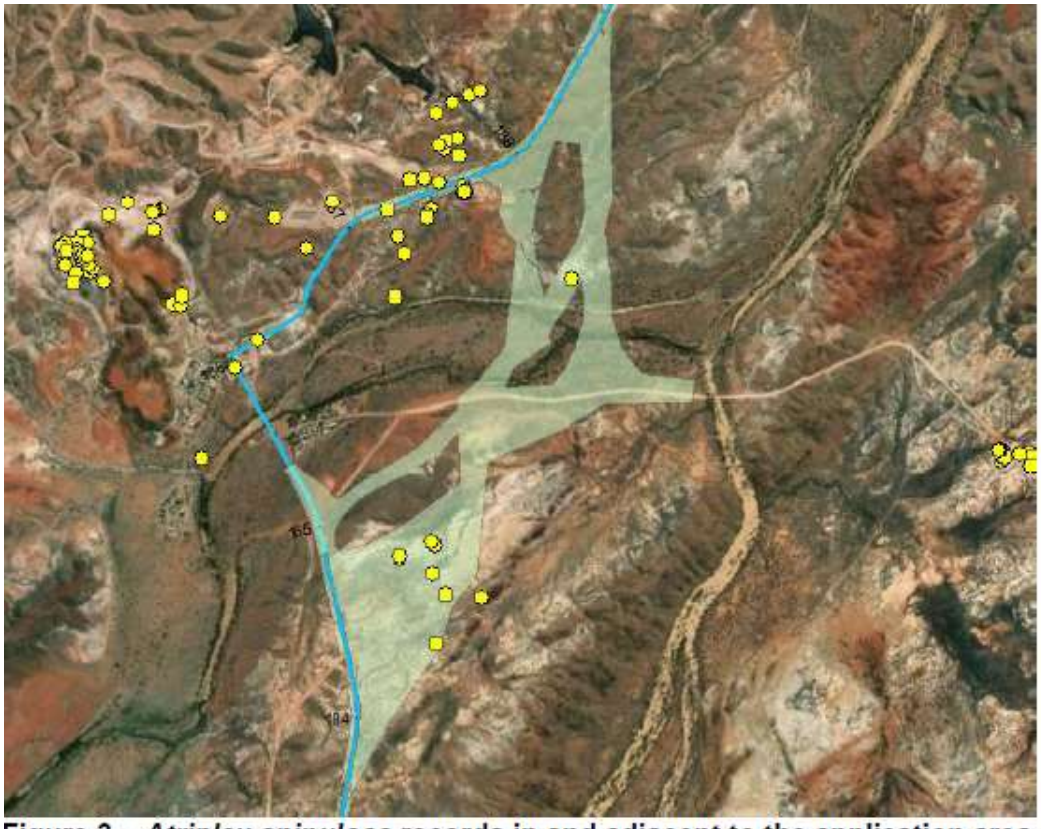

**Figure 3 – *Atriplex spinulosa* records in and adjacent to the application area.**

## Appendix J: Registered Heritage Places intersecting or in close proximity to the application area

| Name | Place ID |
|---|---|
| Nullagine Engraving 1 (3 Sites) | Place ID: 754 |
| MR_PAL_18_001 | Place ID: 37667 |
| MR_PAL_18_002 | Place ID: 37668 |
| Cajuput Spring Well. | Place ID: 11958 |
| Warlakanya | Place ID: 755 |
| MR16-006 | Place ID: 36955 |
| MR16-007 | Place ID: 36956 |
| Daylight Creek | Place ID: 18506 |
| HRC-Site-48 | Place ID: 30554 |
| BC 10-015 | Place ID: 28930 |
| Mankarlyirrkurra | Place ID: 11290 |
| Mankarlyirrkurra AS 4 | Place ID: 36993 |
| Mankarlyirrkurra AS 6 | Place ID: 36994 |
| Mankarlyirrkurra AS1 | Place ID: 36986 |
| Mankarlyirrkurra AS3 | Place ID: 36989 |
| Mankarlyirrkurra AS5 | Place ID: 36990 |
| Mankarlyirrkurra Iso1 | Place ID: 36996 |
| Mankarlyirrkurra Quarry 1 | Place ID: 36995 |
| Mankarlyirrkurra Quarry 2 | Place ID: 36997 |
| Mankarlyirrkurra Quarry 3 | Place ID: 36998 |
| Mankarlyirrkurra Quarry 4 | Place ID: 36999 |
| Mankarlyirrkurra Quarry 5 | Place ID: 36991 |
| Mankarlyirrkurra RS1 | Place ID: 36992 |

## Appendix K: References and databases

### K.1 References


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## K.2 GIS databases

Publicly available GIS Databases used (sourced from www.data.wa.gov.au):

- 10 Metre Contours (DPIRD-073)
- Aboriginal Heritage Places (DPLH-001)
- Aboriginal Heritage Places (DPLH-001)
- Cadastre (LGATE-218)
- Cadastre Address (LGATE-002)
- Contours (DPIRD-073)
- DBCA – Lands of Interest (DBCA-012)
- DBCA Legislated Lands and Waters (DBCA-011)
- Directory of Important Wetlands in Australia – Western Australia (DBCA-045)
- Environmentally Sensitive Areas (DWER-046)
- Flood Risk (DPIRD-007)

- Groundwater Salinity Statewide (DWER-026)
- Hydrography – Inland Waters – Waterlines
- Hydrological Zones of Western Australia (DPIRD-069)
- IBRA Vegetation Statistics
- Imagery
- Local Planning Scheme – Zones and Reserves (DPLH-071)
- Native Title (ILUA) (LGATE-067)
- Pre-European Vegetation Statistics
- Remnant Vegetation, All Areas
- Native Vegetation Extent (DPIRD-005)
- Public Drinking Water Source Areas (DWER-033)
- Ramsar Sites (DBCA-010)
- RIWI Act, Groundwater Areas (DWER-034)
- RIWI Act, Surface Water Areas and Irrigation Districts (DWER-037)
- Soil Landscape Land Quality – Flood Risk (DPIRD-007)
- Soil Landscape Land Quality – Phosphorus Export Risk (DPIRD-010)
- Soil Landscape Land Quality – Subsurface Acidification Risk (DPIRD-011)
- Soil Landscape Land Quality – Water Erosion Risk (DPIRD-013)
- Soil Landscape Land Quality – Water Repellence Risk (DPIRD-014)
- Soil Landscape Land Quality – Waterlogging Risk (DPIRD-015)
- Soil Landscape Land Quality – Wind Erosion Risk (DPIRD-016)
- Soil Landscape Mapping – Best Available
- Soil Landscape Mapping – Systems
- Wheatbelt Wetlands Stage 1 (DBCA-021)

Restricted GIS Databases used:

- Threatened Flora (TPFL)
- Threatened Flora (WAHerb)
- Threatened Fauna
- Threatened Ecological Communities and Priority Ecological Communities
- Threatened Ecological Communities and Priority Ecological Communities (Buffers)