



**HASTINGS**  
Technology Metals Limited

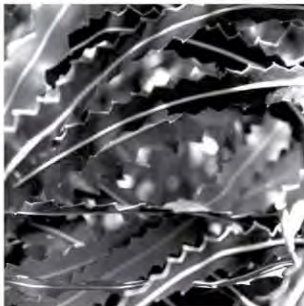
**APPENDIX 1-3**  
**Yangibana Flora and**  
**Vegetation Addendum**  
**Report**



# Yangibana Flora and Vegetation Addendum Report

Hastings Technology Metals Limited





**ecoscape**



---

**COPYRIGHT STATEMENT FOR:**  
**Yangibana Flora and Vegetation Addendum Report**  
**Our Reference: 11267-4326-19R final**  
**Copyright © 1987-2019**  
**Ecoscape (Australia) Pty Ltd**  
**ABN 70 070 128 675**

Except as permitted under the Copyright Act 1968 (Cth), the whole or any part of this document may not be reproduced by any process, electronic or otherwise, without the specific written permission of the copyright owner, Ecoscape (Australia) Pty Ltd. This includes microcopying, photocopying or recording of any parts of the report.

VERSION	AUTHOR	QA REVIEWER	APPROVED	DATE
Draft rev0	Lyn Atkins			5/04/2019
		Jared Nelson Principal Spatial Ecologist	Jared Nelson Principal Spatial Ecologist	
Final	Lyn Atkins			9/04/2019
		David Kaesehagen Managing Director	David Kaesehagen Managing Director	

**Direct all inquiries to:**  
**Ecoscape (Australia) Pty Ltd**  
**9 Stirling Highway • PO Box 50 NORTH FREMANTLE WA 6159**  
**Ph: (08) 9430 8955 Fax: (08) 9430 8977**

---

# TABLE OF CONTENTS

<b>Executive Summary</b> .....	<b>1</b>
<b>1 Introduction</b> .....	<b>3</b>
1.1 Background.....	3
1.2 Survey Requirements .....	3
1.2.1 Compliance .....	4
<b>2 Desktop Assessment</b> .....	<b>5</b>
<b>3 Methods</b> .....	<b>6</b>
3.1 Field Survey.....	6
3.2 Field Survey Methods .....	6
3.2.1 Floristic Quadrats.....	6
3.2.2 Vegetation Description and Classification.....	7
3.2.3 Vegetation Condition .....	7
3.2.4 Targeted Searches.....	7
3.3 Field survey timing.....	8
3.4 Statistical Analysis .....	9
<b>4 Results</b> .....	<b>11</b>
4.1 Vegetation.....	11
4.1.1 Floristic Analysis.....	13
4.2 Flora .....	14
4.2.1 Targeted Searches.....	14
<b>5 Discussion</b> .....	<b>17</b>
5.1 Vegetation Types.....	17
5.2 Flora .....	18
5.2.1 Priority Flora .....	18
5.2.2 Range Extension Species .....	19
<b>6 Conclusions</b> .....	<b>21</b>
<b>References</b> .....	<b>22</b>
<b>Maps</b> .....	<b>24</b>
<b>Appendix One Definitions and Criteria</b> .....	<b>38</b>
<b>Appendix Two Target Species</b> .....	<b>42</b>
<b>Appendix Three Quadrat Details</b> .....	<b>46</b>
<b>Appendix Four Floristic Analysis</b> .....	<b>65</b>
<b>Appendix Five Flora Inventory</b> .....	<b>69</b>

## FIGURES

Figure 1: Mean rainfall (Mount Phillips) and rainfall prior to the field survey (Cobra Airstrip) (Bureau of Meteorology 2019) .....	9
Figure 2: <i>NatureMap</i> (DPaW 2007-2019) search results.....	42

## TABLES

Table 1: Quadrat summaries .....	11
Table 2: Conservation codes for Western Australian flora and fauna (DBCA 2019) .....	38
Table 3: NVIS structural formation terminology, terrestrial vegetation (NVIS TWG 2017) .....	40
Table 4: NVIS height classes (NVIS TWG 2017) .....	41
Table 5: Vegetation Condition Scale for the South West and Interzone Botanical Provinces (EPA 2016b)..	41
Table 6: Conservation significant flora target species .....	43
Table 7: Range extension species targeted for survey .....	43
Table 8: Flora inventory (site x species) .....	69

## MAPS

Map 1: Quadrats and vegetation types of the Yangibana Project.....	25
Map 2: Conservation significant flora of the Yangibana Project .....	33

## PLATES

Plate 1: <i>Acacia curryana</i> .....	15
Plate 2: <i>Rhodanthe frenchii</i> .....	15
Plate 3: <i>Acacia atopa</i> .....	16
Plate 4: <i>Acacia atopa</i> .....	16

## EXECUTIVE SUMMARY

Hastings Technology Metals Ltd (Hastings) is seeking environmental approvals to develop its Yangibana Rare Earths Project in the Upper Gascoyne Region of Western Australia.

A number of flora and vegetation surveys have been conducted for this project; Ecologia Environment (Ecologia 2014) conducted a reconnaissance survey, Ecoscape (2015) conducted a two phase Level 2 survey and Eco Logical Australia (ELA 2018) conducted a reconnaissance and targeted flora survey within the area of the development envelope and beyond.

In 2019, during the environmental approvals process, the EPA identified that the 2015 Ecoscape survey did not meet current standards for flora and vegetation surveys i.e. it did not meet the requirements outlined in (EPA 2016b) *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment*, known as the Flora and Vegetation Technical Guidance, and requested additional works to bring the surveys into alignment with the current requirements. The additional surveys were required to establish and score additional floristic quadrats within vegetation types within the proposed development envelope that were under-represented, and conduct additional targeted searches for conservation significant flora species and species with range extensions that are known to occur within the proposed development envelope.

Ecoscape conducted the additional survey in March 2019 to meet the EPA requirements.

Nine additional floristic quadrats were established in the following vegetation types:

- **AaSaEs** (*Acacia aptaneura* low open woodland over *Senna artemisioides* subsp. *oligophylla* low sparse shrubland over *Eragrostis setifolia* and *Eragrostis tenellula* low tussock grassland). Two additional quadrats.
- **ApSgAc** (*Acacia pruinocarpa* and *Grevillea berryana* low open woodland over *Senna glutinosa* subsp. *x luerssenii* and *Eremophila phyllopoda* subsp. *obliqua* mid sparse shrubland over *Aristida contorta* and *Eriachne pulchella* subsp. *dominii* low grassland). One additional quadrat.
- **AtGc** (*Acacia tetragonophylla*, *Dodonaea petiolaris* and *Eremophila latrobei* subsp. *latrobei* mid open shrubland over *Gomphrena cunninghamii*, *Aristida contorta* and *Cymbopogon ambiguus* low open forbland/grassland). One additional quadrat.
- **EcBp** (*Eremophila cuneifolia* and *Scaevola spinescens* mid sparse shrubland over *Brachyachne prostrata* and *Sclerolaena eriacantha* low sparse grassland/chenopod shrubland). One additional quadrat.
- **Fs** (*Frankenia setosa*, *Sclerolaena medicaginoidea* and *Maireana georgei* low open shrubland). Two additional quadrats.
- **Mp** (*Maireana polypterygia*, *Lawrenzia densiflora* and *Eremophea spinosa* low open chenopod shrubland/forbland). One additional quadrat.

Floristic analysis identified that vegetation types **AaSaEs**, **AsFh**, **AtGc** and **Fs** are both floristic and structural vegetation types. However, vegetation types **EcBp** and **Mp** are local variations of the widespread **AxEcAc** vegetation type, and are described on the basis of structure and dominant species rather than floristics. Taking this into account, the following were considered to be significant:

- **AaSaEs**: 21.24% of the mapped occurrence is within the development envelope although none (0%) occurs within the disturbance footprint, and is habitat for *Goodenia berringbinensis* (P4) and prospective habitat for *Elacholoma* sp. Showy flowers (found in this vegetation type as well as **EcBp**, **EpAc** and **EvReMg** which also have minor clay depressions). However, it is likely to be more extensive than indicated by the mapping due to the small extents of some occurrences that are not mapped separately to the surrounding vegetation.
- **AtGc**: corresponds with small rocky outcrops with 35.39% mapped within the disturbance footprint and 67.39% within the development envelope. This vegetation type is habitat for *Acacia atopa* (P3).
- **Fs**: corresponds with sandy clay flats. None of this vegetation type occurs within the disturbance footprint, however 73.11% occurs within the development envelope.

Four priority flora species were identified during the field survey (data presented is from all surveys):

- *Acacia curryana* (P1): 6,048 individuals were recorded within the development envelope (61.82% of all recorded within the 2015 study area) with 1,647 of these within the disturbance footprint (16.84%). A further 1,443 individuals were recorded during regional surveys. Additional searches were not conducted within the broader study area during this survey (outside of the development envelope) and given this species does not favour any one vegetation type, it is expected that the number of individuals are also greater in areas outside of the development envelope.
- *Rhodanthe frenchii* (P2): 506 individuals were recorded within the development envelope (29.92%) of which 12 were recorded within the disturbance footprint (0.71%). This species has an approximately 200 km east-west and 280 km north-south distribution, and occurs in two bioregions.
- *Acacia atopa* (P3): at least 200 individuals were recorded within the development envelope (22.22%, within the ELA survey area but outside the targeted area of this survey) and a further 700+ individuals were recorded regionally. None occurred within the disturbance footprint.
- *Sporobolus blakei* (P3): 28 individuals were recorded from within the development envelope (4.02%) and none were recorded within the disturbance footprint. This species has an almost Australia-wide extent.

Two previously recorded range extension species were also recorded: *Abutilon malvifolium* and *Corchorus tridens*. Both were restricted to minor clay pans/depressions within the development envelope although none were within the disturbance footprint.

# 1 INTRODUCTION

## 1.1 BACKGROUND

Hastings Technology Metals Ltd (Hastings) is seeking environmental approvals to develop the Yangibana Rare Earths Project in the Upper Gascoyne Region of Western Australia.

In 2014 Ecologia Environment conducted a reconnaissance survey at the Yangibana tenement (Ecologia 2014) during which 12 floristic quadrats were established.

In 2015 Hastings appointed Ecoscape to conduct a Level 2 flora and vegetation survey of its 55,000 ha tenement, which was undertaken according to the Environmental Protection Authority (EPA) guidance that was current at the time of survey; *Guidance for the Assessment of Environmental Factors (in accordance with the Environmental Protection Act 1986) No. 51 - Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004), known as Guidance Statement 51 or GS51. According to GS51, two floristic quadrats were required per vegetation unit in order for the survey to be considered as adequate to describe the flora and vegetation of the study area.

Two phases of field survey were conducted in May and August 2015, resulting in the identification of 472 vascular flora species, including eight Priority Flora, 58 range extensions, one undescribed species and 24 introduced species from 103 floristic quadrats, and 20 vegetation types (Ecoscape 2015). However, due to having only a small extent of three of these vegetation types and due to identifying one vegetation unit as unique during floristic analysis (i.e. after the return from the field surveys), four vegetation types did not have the minimum number of quadrats recorded. At the time of survey, mine areas and the development footprint had not been finalised.

In 2017 Eco Logical Australia (ELA) was appointed to conduct a reconnaissance and targeted flora survey of the proposed access road disturbance footprint, occupying 2,000 ha (ELA 2018). ELA's study area was south of Ecoscape's study area. ELA recorded 38 relevés during its assessment, resulting in the identification of one Priority Flora species, and eight vegetation types, six of which were considered to have been previously recorded by Ecoscape.

In 2019, during the environmental approvals process, the EPA identified that the 2015 Ecoscape survey did not meet current standards for flora and vegetation surveys i.e. it did not meet the requirements outlined in (EPA 2016b) *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment*, known as the Flora and Vegetation Technical Guidance. According to the Flora and Vegetation Technical Guidance, three floristic quadrats are required to meet the requirements of a detailed survey, considered to be the equivalent of a Level 2 survey according to GS51. The EPA also required additional targeted conservation significant flora searches, and searches for range extension species in order to move forward with the approvals process.

This report outlines the results of the additional 2019 survey.

## 1.2 SURVEY REQUIREMENTS

On 11 March 2019, prior to commencing the field survey, Stephen Kern (Associate Environmental Scientist, Botanist, Ecoscape) and Dr Lara Jefferson (Environmental Manager, Hastings Technology Metals Limited) attended a meeting with the EPA Services Unit. As a result of this meeting the following was identified to meet the expectation of EPA Services Unit:

- establish and score at least eight floristic quadrats within vegetation types **AaSaEs**, **ApSgAc**, **AtGc**, **EcBp**, **Fs** and **Mp** (where there was sufficient extent) to meet the minimum requirement of three quadrats per vegetation unit, within the development envelope with consideration of other vegetation types outside the development envelope if time permits:
- conduct targeted searches for conservation significant flora species and species with range extensions and, where recorded, record extents, in:



- o drainage channels upstream and downstream of impact and non-impact areas (four potential sites around the TSF s and process plant and two potential sites near Yangibana West and North pits)
- o impact areas that have not already been surveyed (process plant area x1 and Yangibana West and North areas x2)
- o niche habitats (rocky outcrop areas x3)
- focus on species with significant range extensions and bioregional extensions (except those in the Pilbara with <200 km to nearest location)
- conduct floristic analysis using all available data, taking into consideration survey limitations i.e. not including annuals and using only presence/absence data.

Due to the poor seasonal conditions (lack of rainfall), the EPA Services Unit recognised that a number of species previously recorded are unlikely to be present, and thus do not require targeted searches. One species, *Elacholoma* sp. Showy flowers (C.P. Campbell 1762) (P1, although it was not conservation listed at the time of the 2015 survey), also did not require targeted survey as its habitat did not correspond with areas in the development footprint.

### 1.2.1 COMPLIANCE

The field survey and analysis was conducted according to the EPA (2016b) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment*.

The following were also taken into account:

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- Western Australian *Environmental Protection Act 1986* (EP Act)
- Western Australian *Biodiversity Conservation Act 2016* (BC Act)
- EPA (2016a) *Environmental Factor Guideline: Flora and Vegetation*.

## 2 DESKTOP ASSESSMENT

Except for an updated *NatureMap* conservation significant flora search (DPaW 2007-2019, accessed 05 March 2019), no new desktop assessment was required as this survey was undertaken to gather additional field data as directed by the EPA Services Unit.

# 3 METHODS

## 3.1 FIELD SURVEY

The field survey was conducted by Stephen Kern (Associate Environmental Scientist, Botanist, Flora Licence FB62000001) and Daniel Roberts (Environmental Scientist, Flora Licence FB62000005) during 12-17 March 2019 (4 days of field survey).

## 3.2 FIELD SURVEY METHODS

The methods utilised during the field survey followed those outlined in the Flora and Vegetation Technical Guidance (EPA 2016b). Conservation criteria used in this assessment are included in **Table 3** in **Appendix One**, noting that no flora or ecological communities listed for protection under the Commonwealth EPBC Act are known to occur in the vicinity of the study area, nor any Threatened Flora (TF) listed for protection under the Western Australian BC Act.

The field survey concentrated on specific areas within the development footprint, namely vegetation types that were represented by less than three quadrats within the development envelope and areas identified for targeted searches of conservation significant flora and species with range extensions.

Additional floristic quadrats were proposed to be recorded in the following Ecoscape (2015) vegetation types:

- **AaSaEs** (*Acacia aptaneura* low open woodland over *Senna artemisioides* subsp. *oligophylla* low sparse shrubland over *Eragrostis setifolia* and *Eragrostis tenellula* low tussock grassland): two additional quadrats
- **ApSgAc** (*Acacia pruinocarpa* and *Grevillea berryana* low open woodland over *Senna glutinosa* subsp. *x lueresenii* and *Eremophila phyllopoda* subsp. *obliqua* mid sparse shrubland over *Aristida contorta* and *Eriachne pulchella* subsp. *dominii* low grassland): one additional quadrat
- **AtGc** (*Acacia tetragonophylla*, *Dodonaea petiolaris* and *Eremophila latrobei* subsp. *latrobei* mid open shrubland over *Gomphrena cunninghamii*, *Aristida contorta* and *Cymbopogon ambiguus* low open forbland/grassland): one additional quadrat
- **EcBp** (*Eremophila cuneifolia* and *Scaevola spinescens* mid sparse shrubland over *Brachyachne prostrata* and *Sclerolaena eriacantha* low sparse grassland/chenopod shrubland): one additional quadrat
- **Fs** (*Frankenia setosa*, *Sclerolaena medicaginoidea* and *Maireana georgei* low open shrubland): two additional quadrats
- **Mp** (*Maireana polypterygia*, *Lawrencia densiflora* and *Eremophea spinosa* low open chenopod shrubland/forbland): one additional quadrat.

The above quadrats were recorded as planned, with one additional quadrat in vegetation type **AsFh** (*Acacia synchronicia* and *Eremophila cuneifolia* mid sparse shrubland over *Frankenia hispidula* and *Aristida contorta* low open shrubland/ grassland) that had only a very small extent.

Survey method details are outlined below.

### 3.2.1 FLORISTIC QUADRATS

Floristic quadrat ('quadrat') locations were selected using aerial photography, environmental values and field observations to represent the vegetation values existing at the site. The unmarked quadrats were 20 m x 20 m in dimension, as required according to the Flora and Vegetation Technical Guidance 2016. Where the vegetation consisted of a narrow linear corridor, quadrats were linear but of the same overall size i.e. 400 m<sup>2</sup>.

The following information was collected from within each quadrat:

- observer
- date
- quadrat/site number
- GPS location (GDA94) of the northwest corner

- digital photograph (spatially referenced with a reference number), taken from the northwest corner, looking diagonally across the quadrat
- soil type and colour
- topography
- list of flora species recorded with the average height and total cover within the quadrat for each species
- vegetation description (as per below)
- vegetation condition.

### 3.2.2 VEGETATION DESCRIPTION AND CLASSIFICATION

Vegetation was described from each of the quadrats using the height and estimated cover of dominant and characteristic species of each stratum based on the National Vegetation Information System, recorded at Level V (Executive Steering Committee for Australian Vegetation Information [ESCAVI] 2003) (**Table 4** and **Table 5** in **Appendix One**). Up to three species per stratum from each stratum (upper, mid and ground) were used to formulate vegetation descriptions for each quadrat and each vegetation type.

Vegetation type descriptions were created by combining quadrat descriptions and modifying, where necessary, based on the wider vegetation. Vegetation codes for these were formulated using the characteristic species of all strata within the vegetation type e.g. **AaSaEs** refers to *Acacia aptaneura* low open woodland over *Senna artemisioides* subsp. *oligophylla* low sparse shrubland over *Eragrostis setifolia* and *Eragrostis tenellula* low tussock grassland.

No additional vegetation type mapping was conducted during this survey, nor were mapped boundaries altered.

### 3.2.3 VEGETATION CONDITION

Vegetation condition was assessed at each quadrat using the Vegetation Condition Scale for the Eremaean Botanical Provinces (EPA 2016b) (**Table 6** in **Appendix One**).

No reassessment and re-mapping of vegetation condition was conducted, nor was the previous mapping altered.

### 3.2.4 TARGETED SEARCHES

Grid searches for significant flora (i.e. conservation significant flora and range extensions) at approximately 200 m-wide spacings were conducted in the areas known as Yangibana West and North, Plant and TSF. Drainage lines downstream and, for the Plant and TSF areas, upstream areas, were also searched as were rocky outcrops. Frasers and Bald Hill were examined at lower intensity. Significant flora species were also recorded if opportunistically observed outside of the development envelope.

#### 3.2.4.1 Conservation Significant Flora

Conservation significant flora identified during the 2015 desktop analysis as having potential to occur, as identified during the 2015 survey, and identified by a recent *NatureMap* (DPaW 2007-2019) search (included in **Appendix Two**) were targeted. The targeted species, described in **Table 7** in **Appendix Two**, were *Acacia curryana* (P1), *Isotropis forrestii* (P1), *Rhodanthe frenchii* (P2), *Gymnanthera cunninghamii* (P3), *Lawrencia* sp. Anna Plains (N.T. Burbidge 1433) (P3), *Maireana prosthochaeta* (P3) and *Sporobolus blakei* (P3).

However, annuals and short-lived perennials were not targeted during the survey due to the poor seasonal conditions, nor were species whose habitat was not represented within the development envelope and therefore were unlikely to be impacted by the proposed works. These species were *Elacholoma* sp. Showy flowers (C.P. Campbell 1762) (P1), *Acacia petricola* (P2), *Solanum octonum* (P2), *Wurmbea fluviatilis* (P2), *Goodenia berrinbinensis* (P4) and *Goodenia nuda* (P4).

The locations of all targeted taxa collected were recorded using a handheld GPS with the following data recorded:

- observer, date and time
- reproductive status and other features such as health of plants, percentage flowering and fruiting

- local abundance/population size and/or population boundary, including outside the development envelopes where possible
- landform
- brief vegetation community description
- representative photos of each species and habitat
- collection of representative specimens.

Two botanists conducted targeted searches for a period of two days (i.e. 10 hrs per day) representing a total of 40 hours spent conducting targeted searches during this survey, which is in addition to the approx. 3-4 days for phase 1 in 2015 (four personnel) and approx. 3-4 days for phase 2 in 2015 (two personnel; Ecoscape 2015).

An opportunistic observation of a conservation significant flora species not within the current targeted search area, but within the known development envelope, was also recorded.

#### 3.2.4.2 Flora Species Representing Range Extensions

Specific targeted searches for significant flora other than those listed as Threatened (TF) or Priority Flora (PF) are not required according to the Flora and Vegetation Technical Guidance (EPA 2016b).

However, the EPA Services Unit requested searches for significant flora identified during the earlier survey (Ecoscape 2015), specifically for species with range extensions of >200 km and bioregional extensions. The list of species with range extensions that met the EPA Services Unit criteria for targeted searches is included in **Table 8** in **Appendix Two** and listed below. The remaining species that were range extensions but did not meet the EPA Services Unit criteria for a targeted search are also listed in **Appendix Two**. Some species in **Table 8** were not targeted in the searches for the reasons that follow:

- annuals and short-lived perennials, due to the poor seasonal conditions
- species whose habitat did not correspond with that identified in the development envelope
- species with a wide-ranging extent where a range or bioregional extension (when taking the overall extent into consideration) was considered insignificant e.g. *Portulaca intraterranea* that has an almost Australia-wide distribution, but was not previously known from the Gascoyne bioregion within which the survey area is located (Atlas of Living Australia 2019, accessed 1 April 2019).

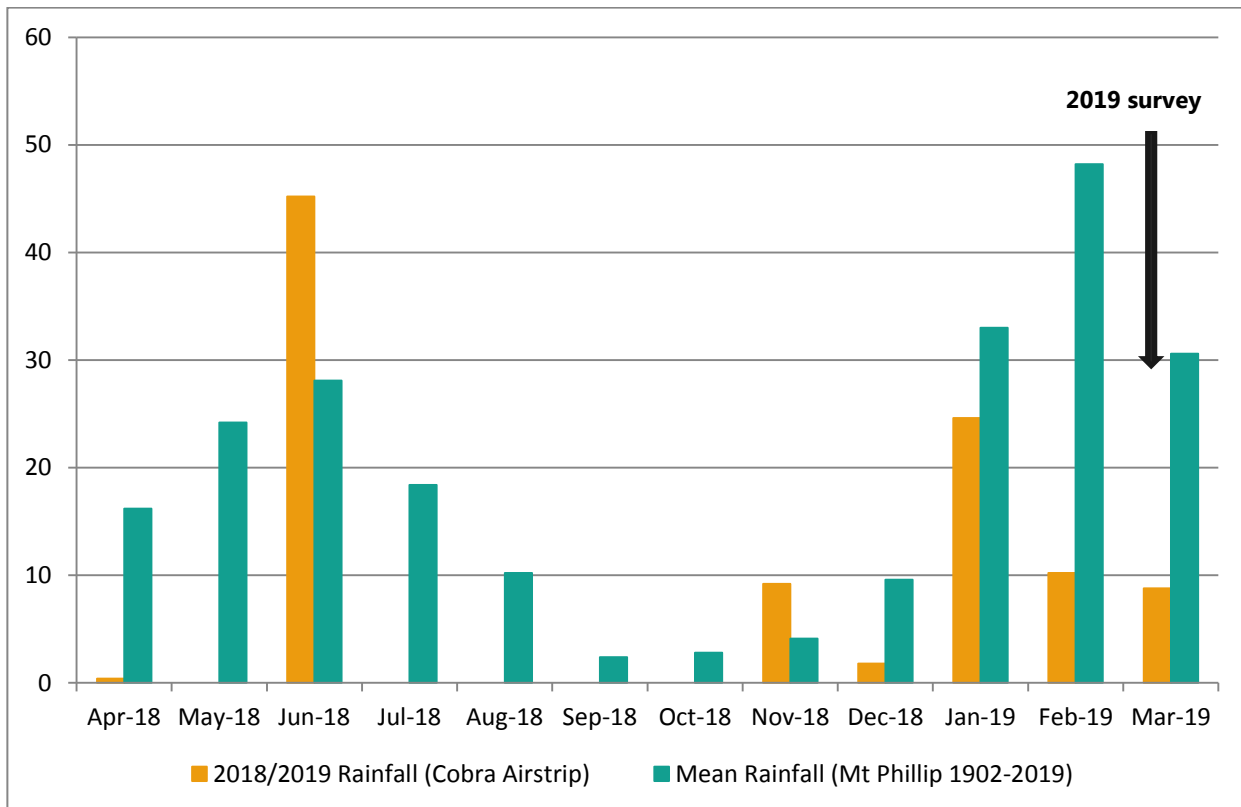
The species that were targeted in the searches were:

- *Acacia craspedocarpa*
- *Corchorus sidoides* subsp. *sidoides*
- *Dodonaea pinifolia*
- *Gymnanthera cunninghamii* (P3)
- *Hibiscus verdcourtii*
- *Melhaniania oblongifolia*
- *Sida* sp. Supplejack Station (T.S. Henshall 2345)
- *Sporobolus blakei* (P3)
- *Swainsona oroboides*
- *Urochloa subquadripara*.

Yangibana West and North, Plant and TSF were searched for these species as well as drainage lines downstream of these areas, upstream of the Plant and TSF areas, and rocky outcrops.

### 3.3 FIELD SURVEY TIMING

The field survey was conducted during March 2019. Whilst this was within the optimal period for a primary survey within the bioregion according to the Flora and Vegetation Technical Guidance (EPA 2016b), the rainfall prior to the field survey was significantly below the mean for this period (**Figure 1**).



**Figure 1: Mean rainfall (Mount Phillips) and rainfall prior to the field survey (Cobra Airstrip) (Bureau of Meteorology 2019)**

### 3.4 STATISTICAL ANALYSIS

PATN© software (Belbin & Collins 2006) was used to undertake statistical analysis to generate floristic groups using the data collected from the quadrats and relevés, in order to better understand local significance of floristic units. PATN analysis has been used for several local floristic analyses including Gibson *et al.* (1994) for the Swan Coastal Plain.

PATN is a multivariate analysis tool that generates estimates of association (resemblance, affinity, distance) between sets of objects described by a suite of variables (attributes), and classifies the objects into groups and condenses the information and displays the patterns in the data graphically. It offers a choice of data transformations prior to multivariate analysis.

Floristic groups, identified using a dendrogram output of the analysis, are used as a tool to inform vegetation type groups at various levels and scales.

For this project a variety of analyses were run including using the Bray Curtis similarity coefficient for rows (species) as this provides a good estimation of association for ecological applications (Belbin & Collins 2006) and, for columns (sites), Kulczynski coefficient to produce clusters of related objects (species); these are the floristic groups that are displayed as a dendrogram.

The analyses used presence-absence data as per EPA requirements for this project. The analysis using all species produced similar results to the analysis that excluded annual species. The analysis using data with all annuals and short-lived perennials excluded did not produce floristic groups that represented the vegetation types identified during the 2015 survey analysis.

Interpretation of these purely floristic groups into recognisable and mappable on-ground units is a tool used to identify broad vegetation types. Generally, quadrats that are closely floristically related on the dendrogram form identifiable vegetation units, however interpretation is frequently required for imperfect

results. Vegetation types are therefore determined as a combination of floristic analysis and on-ground interpretation using dominant and characteristic species.




# 4 RESULTS

## 4.1 VEGETATION





Nine floristic quadrats were established and scored during the field assessment as detailed in **Section 3.2**. Summaries of the quadrats, and within which vegetation type they were located, are provided in **Table 1** below. Complete quadrat data is presented in **Appendix Three**.



Quadrat representation within the vegetation types are shown on **Map 1**.

**Table 1: Quadrat summaries**

Quadrat	Vegetation description	Vegetation condition	Quadrat photograph
<b>AaSaEs:</b> <i>Acacia aptaneura</i> low open woodland over <i>Senna artemisioides</i> subsp. <i>oligophylla</i> low sparse shrubland over <i>Eragrostis setifolia</i> and <i>Eragrostis tenellula</i> low tussock grassland			
HY19110	U+ ^ ^ <i>Acacia citrinoviridis</i> , <i>Acacia tetragonophylla</i> , <i>Acacia aptaneura</i> ^tree\6\i; M ^ <i>Senna artemisioides</i> subsp. <i>oligophylla</i> , ^ <i>Eremophila cuneifolia</i> ^shrub\3\i; G ^ <i>Eragrostis setifolia</i> ^tussock grass\1\i	Very Good	
HY19111	U+ ^ <i>Acacia aptaneura</i> , ^ <i>Acacia synchronicia</i> ^tree\6\i; M ^ <i>Eremophila phyllopoda</i> ^shrub\3\i; G ^ ^ <i>Eragrostis setifolia</i> , <i>Marsilea hirsuta</i> , <i>Centipeda minima</i> subsp. <i>macrocephala</i> ^tussock grass, fern, forb\1\i	Very Good	
<b>ApSgAc:</b> <i>Acacia pruinocarpa</i> and <i>Grevillea berryana</i> low open woodland over <i>Senna glutinosa</i> subsp. <i>x luerssenii</i> and <i>Eremophila phyllopoda</i> subsp. <i>obliqua</i> mid sparse shrubland over <i>Aristida contorta</i> and <i>Eriachne pulchella</i> subsp. <i>dominii</i> low grassland			
HY19108	U ^ <i>Acacia pruinocarpa</i> , ^ <i>Grevillea berryana</i> ^tree\6\i; M+ ^ <i>Eremophila phyllopoda</i> , <i>Acacia kempeana</i> ^shrub\3\i; G ^ <i>Ptilotus obovatus</i> , ^ <i>Gomphrena kanisi</i> ^shrub\1\bi	Very Good	



Quadrat	Vegetation description	Vegetation condition	Quadrat photograph
<b>AsFh:</b> <i>Acacia synchronicia</i> and <i>Eremophila cuneifolia</i> mid sparse shrubland over <i>Frankenia hispidula</i> and <i>Aristida contorta</i> low open shrubland/grassland			
HY19112	U ^ <i>Acacia synchronicia</i> , ^ <i>Hakea preissii</i> ^ tree\6\r; M+ ^ <i>Eremophila cuneifolia</i> , ^ <i>Senna artemisioides</i> subsp. <i>oligophylla</i> ^ shrub\3\r; G ^ <i>Frankenia hispidula</i> , ^ <i>Sclerolaena cuneata</i> ^ shrub, chenopod shrub\1\r	Very Good	
<b>AtGc:</b> <i>Acacia tetragonophylla</i> , <i>Dodonaea petiolaris</i> and <i>Eremophila latrobei</i> subsp. <i>latrobei</i> mid open shrubland over <i>Gomphrena cunninghamii</i> , <i>Aristida contorta</i> and <i>Cymbopogon ambiguus</i> low open forbland/grassland			
HY19107	M+ ^ ^ <i>Eremophila exilifolia</i> , <i>Eremophila latrobei</i> subsp. <i>latrobei</i> , <i>Acacia tetragonophylla</i> ^ shrub\3\r; G ^ <i>Ptilotus obovatus</i> , ^ <i>Eriachne mucronata</i> ^ shrub, tussock grass\1\r	Very Good	
<b>EcBp:</b> <i>Eremophila cuneifolia</i> and <i>Scaevola spinescens</i> mid sparse shrubland over <i>Brachyachne prostrata</i> and <i>Sclerolaena eriacantha</i> low sparse grassland/chenopod shrubland			
HY19106	M+ ^ ^ <i>Eremophila cuneifolia</i> , <i>Acacia tetragonophylla</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> ^ shrub\3\r; G ^ <i>Eremophea spinosa</i> ^ chenopod shrub\1\r	Very Good	
<b>Fs:</b> <i>Frankenia setosa</i> , <i>Sclerolaena medicaginooides</i> and <i>Maireana georgei</i> low open shrubland			
HY19104	G+ ^ ^ <i>Frankenia setosa</i> , <i>Sclerolaena medicaginooides</i> , <i>Eragrostis dielsii</i> ^ shrub, chenopod shrub, tussock grass\1\r	Very Good	

Quadrat	Vegetation description	Vegetation condition	Quadrat photograph
HY19105	G+ ^ <i>Frankenia setosa</i> , ^ <i>Sclerolaena medicaginoides</i> ^shrub, chenopod shrub\1\r	Very Good	
<b>Mp:</b> <i>Maireana polypterygia</i> , <i>Lawrenzia densiflora</i> and <i>Eremophea spinosa</i> low open chenopod shrubland/forbland			
HY19109	M+ ^ ^ <i>Acacia synchronicia</i> , <i>Eremophila cuneifolia</i> , <i>Senna</i> sp. Meekatharra (E. Bailey 1-26) ^shrub\3\r; G ^ <i>Aristida contorta</i> ^tussock grass\1\r	Very Good	

#### 4.1.1 FLORISTIC ANALYSIS

Floristic analysis was conducted using presence-absence data from all surveys as described in **Section 3.4**. Three analyses were conducted: 1) All species included, 2) Excluding annuals, and 3) Excluding herbaceous species i.e. annuals, cormose and short-lived perennial species (as identified from descriptions on *FloraBase* (WAH 1998-2019). The resultant dendrograms indicated that the latter analysis showed the least groupings that correlated with the vegetation types, however, the first two analyses showed similar groupings and correlations. The analysis and resultant dendrogram using no annuals and presence-absence data was used as per EPA Services Unit instructions; the dendrogram is included in **Appendix Four**.

Each vegetation type that required additional quadrats is discussed in relation to the floristics as follows. Association coefficients closer to '0' indicate a closer floristic association than larger numbers i.e. the analysis produced a dissimilarity index. For the purposes of discussion in this report, association coefficients of 0.-0.2 are considered floristically very similar, 0.2-0.4 are considered floristically similar, 0.4-0.6 moderately similar, 0.6-0.8 distantly similar and >0.8 are not considered to be floristically similar. However, groupings within the dendrogram, even with little floristic similarity, can produce valid floristic units when they are separated from other groups i.e. are discrete.

**AaSaEs:** Two additional quadrats were surveyed (one existing quadrat by Ecoscape 2015); highlighted in pink in the dendrogram. The two new quadrats are moderately-distantly floristically similar, with association coefficients of 0.7124 for HY19110 and 0.6759 for HY19111 in association with HY15057, which is the only other quadrat considered to represent this vegetation type. However, the three quadrats are clustered together in a discrete group in the dendrogram, in supergroup 4, thus are considered to represent a valid floristic vegetation type.

**ApSgAc:** One additional quadrat was surveyed (two existing quadrats by Ecoscape 2015); highlighted in yellow in the dendrogram. The new quadrat (HY19108) is only distantly floristically similar to the two existing quadrats (HY15039 and HY14011; association coefficients of 0.7396 and 0.7500 respectively). However, a) the lack of grouping of the two existing quadrats within the dendrogram (they are all in different supergroups) and b) the upper stratum species in the quadrat that correspond with the upper stratum vegetation type

dominant species, indicate that this unit is likely to represent a structural vegetation type rather than a floristic vegetation type.

**AsFh:** No quadrats were specifically requested by the EPA for this vegetation type due to its limited extent, however, one additional quadrat was established and scored (one existing quadrat by Ecoscape 2015). The new quadrat (HY19112) and the existing quadrat (HY15103), highlighted in blue in the dendrogram, are closely grouped within the dendrogram and moderately floristically similar (association coefficient of 0.4833), both within supergroup 10.

**AtGc:** One additional quadrat was surveyed (two existing quadrats by Ecoscape 2015); highlighted in orange in the dendrogram. The new quadrat (HY19107) is moderately floristically similar to the existing quadrats (HY15094 and HY15102; association coefficients of 0.6291 and 0.6825 respectively). However, the quadrats are clustered together in the dendrogram within supergroup 7 indicating they are more similar to each other than other quadrats.

**EcBp:** One additional quadrat was surveyed (two existing quadrats by Ecoscape 2015); highlighted in green in the dendrogram. The new quadrat (HY19106) and existing quadrats (HY15077 and HY15089), whilst moderately floristically similar (association coefficients of 0.4982 and 0.6222 respectively) and occurring within the same supergroup (9), are largely within a broader and more widespread vegetation type characterised by *Acacia xiphophylla* (vegetation type **AxEcAc**). Vegetation type **EcBp** appears to be a localised variation of this widely occurring vegetation type, and separated from it based on dominant species rather than floristics.

**Fs:** Two additional quadrats were surveyed (one existing quadrat by Ecoscape 2015); highlighted in red in the dendrogram. The two new quadrats (HY19104 and HY19105) are floristically very similar to each other (association coefficient of 0.1964) and also similar to the existing quadrat (HY15085; association coefficients of 0.2895 and 0.3158 respectively). They group closely within the very small supergroup 10.

**Mp:** One additional quadrat was surveyed (two existing quadrats by Ecoscape 2015); highlighted in purple in the dendrogram. The new quadrat (HY19109) is moderately floristically similar to the existing quadrats (HY15036 and HY15088, with association coefficients of 0.5897 and 0.5556 respectively), and falls within the same supergroup (9). However, as for vegetation type **EcBp**, this vegetation type appears to be a localised variation of vegetation type **AxEcAc** that occurs widely within the region, and is separated based on dominant species.

#### Summary:

The new quadrats support earlier survey findings that indicate that vegetation types **AaSaEs**, **AsFh**, **AtGc** and **Fs** are both floristic and structural vegetation types. However, vegetation types **EcBp** and **Mp** are local variations of the widespread **AxEcAc** vegetation type, and are described on the basis of structure and dominant species rather than floristics.

## 4.2 FLORA

The flora inventory is presented in **Table 3** in **Appendix Five**.

Eighty three vascular flora taxa were recorded from the nine newly established floristic quadrats and targeted searches. Only one new species (i.e. not recorded during the previous surveys) was recorded: *Glinus lotoides* (Molluginaceae). It has no specific conservation significance.

### 4.2.1 TARGETED SEARCHES

#### 4.2.1.1 Conservation Significant Flora

Three of the targeted species as listed in **Section 3.2.4.1** were recorded, as below. Plants were considered to correspond with the development footprint if their GPS location was within 5 m of the boundary as this corresponds with GPS accuracy in most circumstances.

Locations of conservation significant flora from the current and previous surveys, with the surveyor's tracklog (search effort, for this survey), are shown on **Map 2**. Grid searches were conducted at the intensity outlined in **Section 3.2.4**.

### ***Acacia curryana* (P1)**

A total of 1,316 *Acacia curryana* (**Plate 1**) individuals were recorded within the development envelope during this survey. This species was also recorded along tracks outside the envelope; a further 100 individuals were recorded within the Ecoscape (2015) survey area, and 140 individuals outside this area, considered to be regional representatives. A total of 11,226 *Acacia curryana* individuals have been recorded over both the 2015 and 2019 Ecoscape surveys.

### ***Rhodanthe frenchii* (P2)**

One dead *Rhodanthe frenchii* plant (**Plate 2**) was recorded at a rock pile that was not within the development envelope, indicating that seasonal conditions and the timing of the survey were suboptimal to locate this species. The earlier surveys (Ecoscape 2015) identified 1,691 individuals of the species.



**Plate 1: *Acacia curryana***



**Plate 2: *Rhodanthe frenchii***

### ***Sporobolus blakei* (P3)**

A total of 26 *Sporobolus blakei* individuals were recorded during this survey from within the development envelope, and a further 5 from within the wider Ecoscape (2015) survey area. A total of 697 individuals of this species have been recorded during the 2015 and 2019 surveys.

### ***Acacia atopa* (P3)**

*Acacia atopa* (**Plate 3** and **Plate 4**) was not specifically targeted during this survey, however, it was recorded from a rocky hill within the development envelope (within ELA's survey area). At least 200 individual plants were recorded, and an additional 700+ recorded outside the survey area, considered to be regional representatives. It is considered that ELA's ApTSS vegetation type has been incorrectly attributed as being characterised by *Acacia paraneura*, whereas it should have been identified as *Acacia atopa*. The two species are vegetatively similar, and are distinguished by flower and fruit (pod) differences that may not have been present during the ELA survey.



Plate 3: *Acacia atopa*



Plate 4: *Acacia atopa*

#### 4.2.1.2 Significant Flora

*Abutilon malvifolium* and *Corchorus tridens* were recorded from within quadrats (indicated on **Map 2**). Both occurred within the development envelope, but not within the disturbance footprint. Both were within clay depressions in vegetation type **AaSaEs**.

Due to the poor seasonal conditions, survey timing and amount of livestock (and other) grazing resulting in a lack of available herbage, a significant amount of plant taxa could not be identified with certainty due to lack of reproductive and vegetative material, thus more may occur. The timing of the survey was a known limitation, however, many species listed in **Table 8** in **Appendix Two** have habitat preferences associated with drainage lines and creeks. This habitat type is extensive over the study area and beyond.

# 5 DISCUSSION

## 5.1 VEGETATION TYPES

Additional floristic quadrats were established and scored according to the EPA Services Unit requirements that a supplementary survey within the development envelope and disturbance footprint (that is proposed to be cleared) be conducted to meet the requirements of the Flora and Vegetation Technical Guidance (EPA 2016b).

Floristic analysis confirmed that vegetation types **AaSaEs**, **AsFh**, **AtGc** and **Fs** are both floristic and structural vegetation types.

Vegetation type **AaSaEs** occupies 9.45 ha within the development envelope, of which 0.32 ha occurs within the disturbance footprint (in the vicinity of the SipHon Well borefield). Overall, 44.49 ha was mapped within the broader Ecoscape (2015) study area. The disturbance footprint represents 0.72% of the mapped extent of this vegetation type, with the development envelope corresponding with 21.24% of the mapped extent. Given the location, Hastings has committed to avoiding impact to this vegetation type (pers. comm. Lara Jefferson, 8 April 2018). However, it is likely that this vegetation type, associated with minor clay depressions, occurs sparsely within the wider region, and has naturally small extents due to the small extents of its habitat. It is likely to be more common than indicated by its mapped extent as smaller occurrences would not be mapped separately at the scale that the surveys were conducted. However, given it is prospective habitat for flora species associated with clay depressions including *Elacholoma* sp. Showy flowers (C.P. Campbell 1762) (P1) and *Goodenia berringbinensis* (P4), is restricted in its extent and is a preferred location for pastoral grazing (referred to as 'crab holes' by the pastoralist) as these areas are the last to stay moist and support green grasses for fodder before becoming dry in the summer season and thus this vegetation type is at threat from pastoral land uses, and as a result, does hold some significance.

Vegetation type **AsFh** does not occur within the development envelope or disturbance footprint. It occupied 26.9 ha within the Ecoscape (2015) study area. It corresponded with a stony rise that, aside from slightly floristically different vegetation, was not significantly different from the surrounding area.

Vegetation type **AtGc** occupies 14.75 ha within the development envelope, of which 7.75 ha is within the disturbance footprint. Overall, 21.86 ha was mapped within the broader Ecoscape (2015) study area. The disturbance footprint represents 35.39% of the mapped extent of this vegetation type, with the development envelope corresponding with 67.35% of the mapped extent. This vegetation type corresponds with rocky outcrops and crests, thus, in this landscape, corresponds with habitat that has naturally small extents. *Acacia atopa* (P3) was observed in this habitat as well as vegetation type ApTSS (records of *Acacia paraneura* (ELA 2017) are likely to be *Acacia atopa*).

Vegetation type **Fs** occupies 20.91 ha within the development envelope, none of which is within the disturbance footprint. Overall 28.58 ha was mapped within the Ecoscape (2015) study area. The representation of **Fs** within the development envelope corresponds with 73.11% of the mapped extent of this vegetation type. It occurred on sandy clay flats, with the sandiness of the soil being uncommon in the region.

Floristic analysis identified vegetation types **EcBp** and **Mp** as not being floristic vegetation types.

Vegetation type **EcBp** occupies 66.76 ha within the development envelope, of which 3.61 ha is within the disturbance footprint. Overall, 1,062.63 ha was mapped within the Ecoscape (2015) study area. The disturbance footprint represents 0.34% of the mapped extent of this vegetation type, with the development envelope corresponding with 6.28% of the mapped extent. This vegetation type is considered to represent a local variation (with different dominant species) of the widespread **AxEcAc** vegetation type, which has a mapped extent of 8,079 ha over the study area and 1,714 ha mapped within the development envelope).

Vegetation type **Mp** occupies 113.21 ha within the development envelope, of which 2.28 ha is within the disturbance footprint. Overall, 279.12 ha was mapped within the Ecoscape (2015) study area. The

disturbance footprint represents 7.83% of the mapped extent of this vegetation type, with the development envelope corresponding with 40.56% of the mapped extent.

## 5.2 FLORA

### 5.2.1 PRIORITY FLORA

Targeted conservation significant flora searches were conducted within the areas specified by the EPA at approximately 200 m-wide spacing, and observations recorded when the target species were identified outside the search area.

The total recorded numbers of individuals from each of the recorded species, from both the current and 2015 surveys, are discussed below and summarised in **Table 2**.

**Table 2: Targeted species results summary**

Species	2015				2019				Grand Total
	DF	DE <sup>1</sup>	SA	RE	DF	DE <sup>1</sup>	SA	RE	
<b>Priority 1</b>									
<i>Acacia curryana</i>	1,034	3,085	3,635	1,303	613	1,316	100	140	11,226
<i>Elacholoma</i> sp. Showy flowers (C.P. Campbell 1762)			1,251						1251
<b>Priority 2</b>									
<i>Rhodanthe frenchii</i>	12	494	1,184				1		1691
<i>Solanum octonum</i>			14						14
<i>Wurmbea fluviatilis</i>		10	116						126
<b>Priority 2</b>									
<i>Acacia atopa</i>						200		700	900
<i>Gymnanthera cunninghamii</i>			5						5
<i>Sporobolus blakei</i>		2	664			26	5		697
<b>Priority 4</b>									
<i>Goodenia berringbinensis</i>			325	90					415
<i>Goodenia nuda</i>			1						1
<b>Range Extension</b>									
<i>Abutilon malvifolium</i>			1			3			4
<i>Corchorus tridens</i>		4	8	1		40	40		93

DF = Development Footprint; DE = Development Envelope (<sup>1</sup> the count within the DE does not include the DF population); SA = Ecoscape 2015 study area minus DE; RE = regional area i.e. outside the 2015 study area. Grand Total = DF + DE + SA + RE over the 2 years.

*Acacia curryana* (P1), *Rhodanthe frenchii* (P2), *Acacia atopa* (P3) and *Sporobolus blakei* (P3) were recorded during this survey. *Wurmbea fluviatilis* (P2) was not targeted during this survey as it would not have been detectable given the survey timing; it had previously been recorded from within the development envelope.

Other conservation significant flora species recorded during the Ecoscape (2015) survey (*Elacholoma* sp. Showy flowers (C.P. Campbell 1762), P1; *Solanum octonum*, P2; *Gymnanthera cunninghamii*, P3; and *Goodenia berringbinensis* and *Goodenia nuda*, both P4) have not been recorded from within the development envelope and are not anticipated to be impacted by the proposed mining activities.

#### ***Acacia curryana* (P1)**

The total population of *Acacia curryana* recorded within the development envelope is 6,048 individuals, 1,647 of which are located within the disturbance footprint. This represents 61.82% in the development envelope and 16.84% in the disturbance footprint out of the total number recorded within the broader study area during both the 2015 and 2019 surveys (9,783 individuals). A further 1,443 individuals have been recorded during surveys as regional records i.e. outside the study area, indicating a potential 53.87% impact on this

species within the development envelope and 14.67% within the disturbance footprint. It is likely that a greater number of individuals occur within the study area in areas outside of the development envelope, and that its extent is greater in the region.

*Acacia curryana* is poorly collected with only six *FloraBase* (WAH 1998, accessed 5 April 2019) records and an approximately 100 km east-west and 50 km north-south distribution (*NatureMap*, DPaW 2007-2019, accessed 5 April 2019). However, it has been reported as occurring approximately 85 km south of the 2015 study area (Ecoscape 2015) thus its distribution is likely to be larger than indicated by *NatureMap*, and therefore impacts on the species' population is likely to be significantly less than the figures quoted above.

### ***Rhodanthe frenchii* (P2)**

The total population of *Rhodanthe frenchii* recorded within the development envelope is 506 individuals, of which 12 were recorded in 2015 from the disturbance footprint. This represents (respectively) 29.92% and 1.74% of the total number of individuals recorded during the 2015 and 2019 surveys (1,691), during which no individuals were recorded outside the study area.

*Rhodanthe frenchii* is poorly collected with only 11 *FloraBase* (WAH 1998, accessed 5 April 2019) records (18 *NatureMap* records that also include Threatened and Priority Flora Report Form records as well as vouchered specimens). It has an approximately 200 km east-west and 280 km north-south distribution, and occurs in two bioregions (*NatureMap*, DPaW 2007-2019, accessed 5 April 2019). Taking this species' extent into consideration, and that it is an annual species that is likely to have a fluctuating population depending on seasonal conditions and other factors including grazing intensity, it is unlikely that development of the proposed Project would have a significant impact on its population as a whole.

### ***Acacia atopa* (P3)**

At least 200 *Acacia atopa* plants were recorded from within the development envelope (within the ELA survey area) and a further 700+ plants recorded outside the 2015 study area i.e. regional records. None occurred within the disturbance footprint. Approximately 22.22% of the total recorded population occur within the development and are associated with vegetation types **AtGc** and **ApTSS**. Thus, it would be unlikely that this population would be affected by the proposed mine activities.

*Acacia atopa* is represented by 26 *FloraBase* (WAH 1998, accessed 5 April 2019) records from three bioregions and has an approximately 260 km east-west and 170 km north-south distribution (*NatureMap*, DPaW 2007-2019, accessed 5 April 2019). Impacts, if any, are unlikely to be significant on this species' population.

### ***Sporobolus blakei* (P3)**

There have been no *Sporobolus blakei* plants recorded from within the disturbance footprint. Over both the 2015 and 2019 surveys, 28 individuals have been recorded from within the development envelope and a further 669 individuals from the wider study area, representing 4.02% of the known local population.

Despite being represented by 10 *FloraBase* (WAH 1998, accessed 5 April 2019) records, *Sporobolus blakei* has an Australia-wide distribution and is represented by 277 *Atlas of Living Australia* (ALA 2019, accessed 5 April 2019) records from all mainland states except Victoria. Therefore, any impacts on this species' population from the proposed mining activities is likely to be insignificant.

## **5.2.2 RANGE EXTENSION SPECIES**

None of the range extension species that were identified for the targeted searches (listed in Section **3.2.4.2**) were found during specific searches of potential habitat.

However, *Abutilon malvifolium* and *Corchorus tridens* were recorded from within quadrats that corresponded with clay depressions in vegetation type **AaSaEs**. Only a small number of *Abutilon malvifolium* plants were recorded (one plant within one floristic quadrat, with only two recorded from the immediate vicinity), and few *Corchorus tridens* (10 plants within the quadrats and approximately 30 outside). Both species were restricted to within small clay pans, which were not much larger than single quadrat size.



The range extensions reported from the 2015 survey (Ecoscape 2015), and these, are likely due to the survey occurring in a previously unsurveyed area with no known nearby surveys, rather than representing true range extensions.

*Abutilon malvifolium* has an Australia-wide distribution, with 726 records listed on *Atlas of Living Australia* (ALA 2019, accessed 5 April 2019) from all mainland states except Victoria. *Corchorus tridens* has 436 ALA records and a northern Australia-wide distribution. The reported range extensions, when taking into consideration the population extents for these species, are not significant.

## 6 CONCLUSIONS

In summary, the following conclusions were made from the results of the survey:

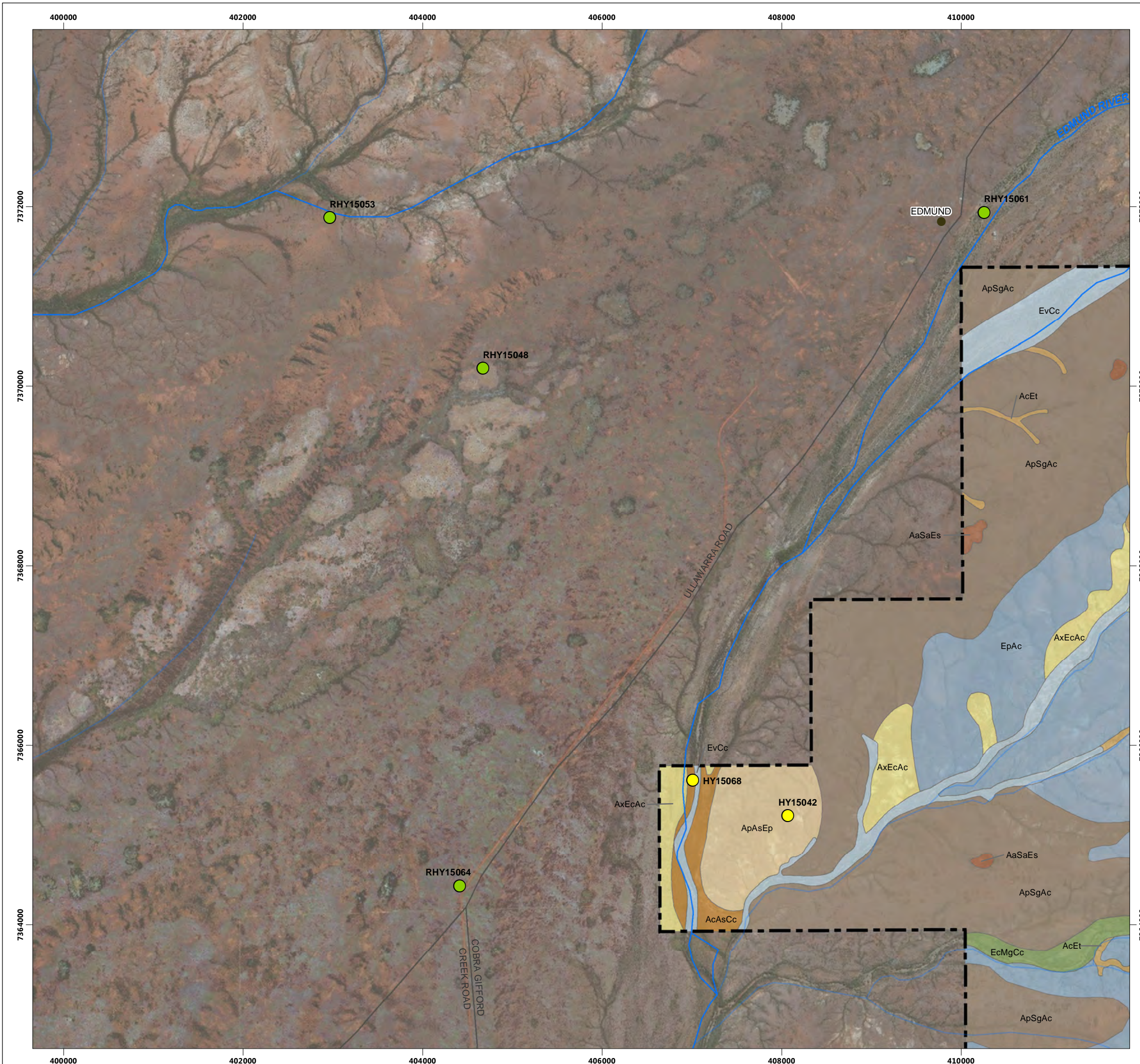
- vegetation type **AaSaEs** that corresponded with minor clay pans has up to 21.24% of the mapped occurrence within the development envelope), and is prospective habitat for conservation significant flora species (*Elacholoma* sp. Showy flowers (C.P. Campbell 1762) (P1) and *Goodenia berringbinensis* (P4)) although these species were previously also recorded within **EcBp**, **EpAc** and **EvReMg** vegetation types, and **AcEt**, **ArPc**, **EcBp** and **EpAc** vegetation types, respectively. However, the vegetation type is likely to be more extensive than indicated by the mapping due to the small extents of some occurrences that are not mapped separately to its surrounding vegetation. This vegetation type can be avoided from any direct impact due to its location: the track within the SipHon Well borefield can avoid direct impact to this vegetation type.
- vegetation type **AtGc** that corresponds with rocky hills with 35.39% mapped as occurring within the disturbance footprint and 67.39% within the development envelope. This vegetation type is habitat for a conservation significant flora *Acacia atopa* (P3), however, this species also occurs within **ApTSS** vegetation type, which has been mapped extensively outside of the development envelope.
- vegetation type **Fs** occurs on sandy clay flats. None corresponds with the disturbance footprint, even though 73.11% of this vegetation type occurs within the development envelope.
- *Acacia curryana* (P1) occurs within the development envelope and on vegetation types **AcAc**, **EcMgCc**, **EeAc** and **EpAc** that occur extensively outside of the development envelope. This species also has a wide regional distribution of at least 5,000 km<sup>2</sup> and occurs in an area with few known surveys, thus its extent and population are likely larger than currently recognised.
- The lack of rainfall during the summer season is likely the reason for the lack of species considered as range extensions and some conservation significant species found during this survey. Most of the species that represent range extensions have habitat associated with drainage lines, creeks and riparian habitats. This habitat type is extensive within the broader study area and regionally.
- The range extensions reported from the 2015 survey (Ecoscape 2015) are likely due to the survey occurring in a previously unsurveyed area with no known nearby surveys, rather than representing true range extensions.

## REFERENCES

- Atlas of Living Australia. 2019. *Atlas of Living Australia website*. Available from: <https://www.ala.org.au/>.
- Australian Government. *Environment Protection and Biodiversity Conservation Act 1999*.
- Belbin, L. & Collins, A. 2006. PATN Version 3.11. Blatant Fabrications Pty Ltd.
- Bureau of Meteorology. 2019. *Climate Data Online*. Available from: <http://www.bom.gov.au/climate/data/>.
- Department of Biodiversity Conservation and Attractions. 2019. *Conservation codes for Western Australian Flora and Fauna (3 January 2019)*. Available from: <https://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/Listings/Conservation%20code%20definitions.pdf>.
- Department of Parks and Wildlife. 2007. *NatureMap: Mapping Western Australia's Biodiversity*. Available from: <http://naturemap.dpaw.wa.gov.au>.
- Eco Logical Australia 2018, *Yangibana Rare Earths Project Flora and Fauna Survey*, Prepared for Hastings Technology Metals Limited.
- Ecologia Environment 2014, *Hastings Yangibana Site Visit Field Summary Report 17-20 November 2014*, Unpublished report for Hastings Rare Metals Ltd.
- Ecoscape (Australia) Pty Ltd 2015, *Yangibana Project Biological Assessment: Flora and Vegetation*, Unpublished report for Hastings Technology Metals Limited.
- Environmental Protection Authority 2004, *Guidance for the Assessment of Environmental Factors (in accordance with the Environmental Protection Act 1986) No. 51 - Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia*, EPA, Perth, Western Australia.
- Environmental Protection Authority. 2016a. *Environmental Factor Guideline: Flora and Vegetation*. Available from: [http://epa.wa.gov.au/sites/default/files/Policies\\_and\\_Guidance/Guideline-Flora-Vegetation-131216\\_4.pdf](http://epa.wa.gov.au/sites/default/files/Policies_and_Guidance/Guideline-Flora-Vegetation-131216_4.pdf).
- Environmental Protection Authority. 2016b. *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment*. Available from: <http://www.epa.wa.gov.au/policies-guidance/technical-guidance-flora-and-vegetation-surveys-environmental-impact-assessment>.
- Executive Steering Committee for Australian Vegetation Information. 2003. *Australian Vegetation Attribute Manual: National Vegetation Information System, Version 6.0*. Available from: <http://www.environment.gov.au/system/files/pages/06613354-b8a0-4a0e-801e-65b118a89a2f/files/vegetation-attribute-manual-6.pdf>.
- Gibson, N., Keighery, B., Keighery, G., Burbidge, A., & Lyons, M. 1994. *A Floristic Survey of the Southern Swan Coastal Plain* Perth, Department of Conservation and Land Management.
- Government of Western Australia. *Environmental Protection Act 1986*.
- Government of Western Australia. *Biodiversity Conservation Act 2016*.
- Maslin, B.R. 2014. Four new species of *Acacia* section *Juliflorae* (Fabaceae: Mimosoideae) from the arid zone in Western Australia. *Nuytsia*, vol. 24, pp. 193-205. Available from: <https://florabase.dpaw.wa.gov.au/science/nuytsia/721.pdf>
- NVIS Technical Working Group 2017, *Australian Vegetation Attribute Manual: National Vegetation Information System, Version 7.0*, Department of the Environment and Energy, Canberra.
- Walker, J. & Hopkins, M. 1990, "Vegetation," in *Australian Soil and Land Survey. Field Handbook.*, 2nd edn, R. McDonald et al. eds., Inkata Press, Melbourne.

Western Australian Herbarium. 1998. *FloraBase - the Western Australian Flora*. Department of Biodiversity, Conservation and Attractions. Available from: <https://florabase.dpaw.wa.gov.au/>.

# MAPS



**LEGEND**

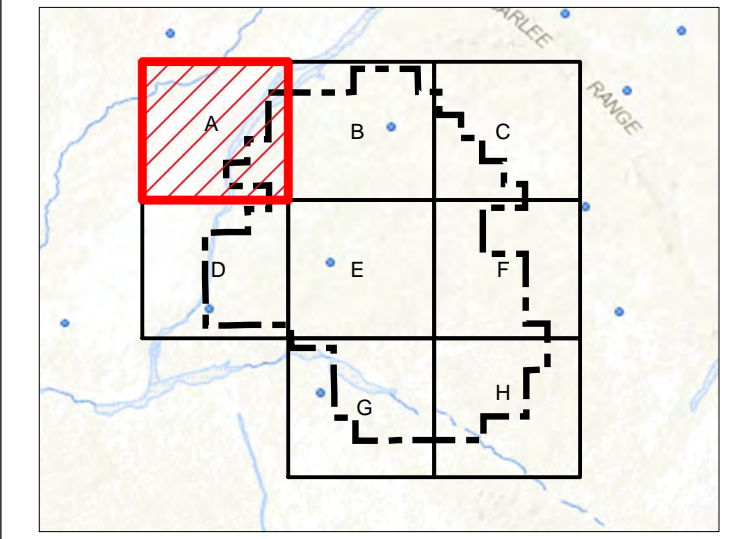
**Quadrats**

- Established 2015 (Yellow circle)
- Regional 2015 (Green circle)
- Homesteads (Black dot)
- Roads (Black line)
- Rivers (Blue line)
- Creeks (Light blue line)
- Biological Study Area (Dashed black line)

**Vegetation Types**

**Code**

- AaSaEs (Brown)
- AcAsCc (Orange)
- AcEt (Light orange)
- ApAsEp (Light yellow)
- ApSgAc (Dark brown)
- AxEcAc (Yellow)
- EcMgCc (Green)
- EpAc (Blue)
- EvCc (Light blue)



**DATASOURCES:**  
 SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AERGRID, IGN, AND THE GIS USER COMMUNITY

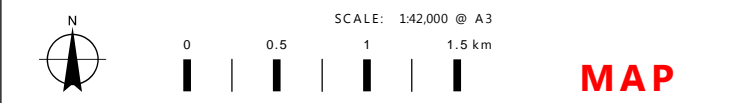


**QUADRATS AND VEGETATION TYPES OF THE YANGIBANA PROJECT**

**YANGIBANA RARE EARTHS PROJECT**

**CLIENT: HASTINGS**

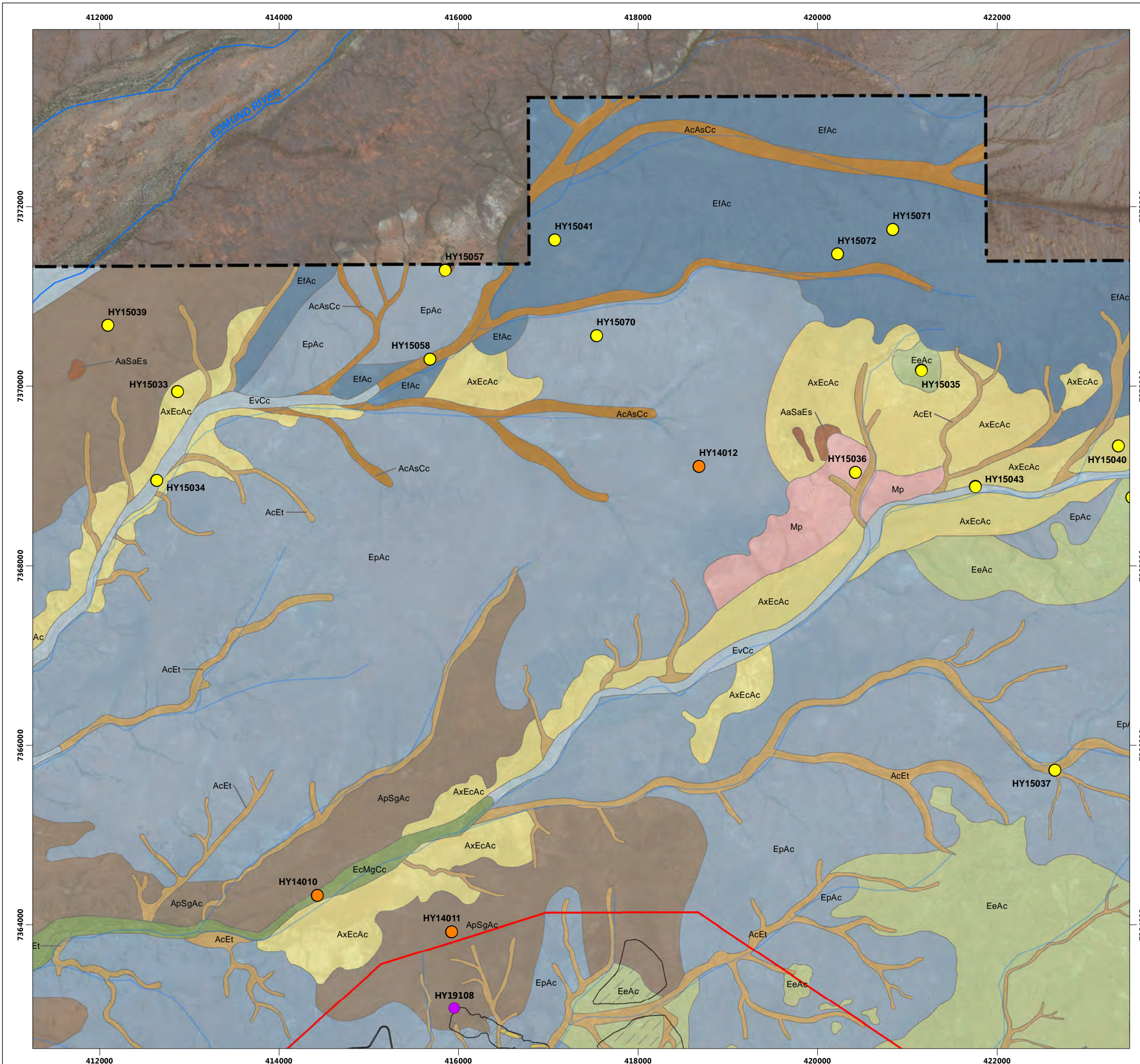
COORDINATE SYSTEM: GDA 1994 MGA ZONE 50  
 PROJECTION: TRANSVERSE MERCATOR  
 DATUM: GDA 1994  
 UNITS: METER



PROJECT NO: 4326-19

REV	AUTHOR	APPROVED	DATE
0	JN	SB	04/04/2019

**MAP**  
**1-A**



**LEGEND**

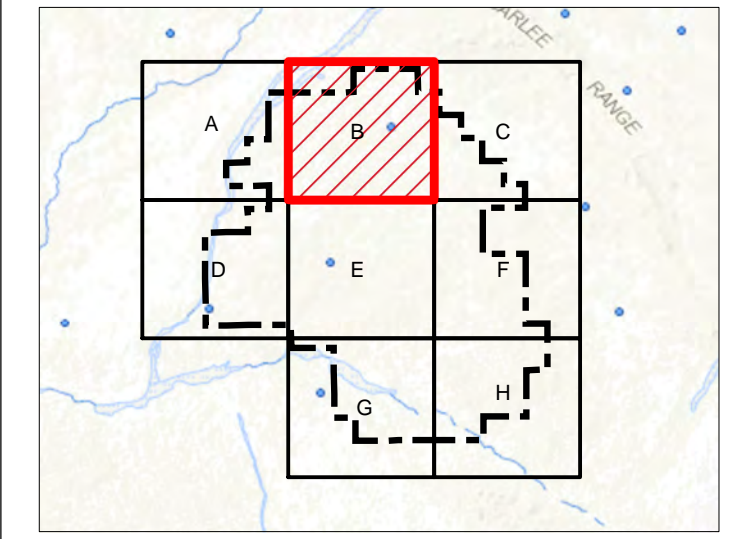
**Quadrats**

- Established 2014 (Orange circle)
- Established 2015 (Yellow circle)
- Established 2019 (Purple circle)
- Rivers (Blue line)
- Creeks (Light blue line)
- Biological Study Area (Dashed black line)
- Development Envelope (Red line)
- Disturbance Footprint (Hatched area)

**Vegetation Types**

**Code**

- AaSaEs
- AcAsCc
- AcEt
- ApSgAc
- AtGc
- AxEcAc
- EcMgCc
- EeAc
- EfAc
- EpAc
- EvCc
- Mp



**DATASOURCES:**  
 SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AERGRID, IGN, AND THE GIS USER COMMUNITY



**QUADRATS AND VEGETATION TYPES OF THE YANGIBANA PROJECT**

**YANGIBANA RARE EARTHS PROJECT**

**CLIENT: HASTINGS**

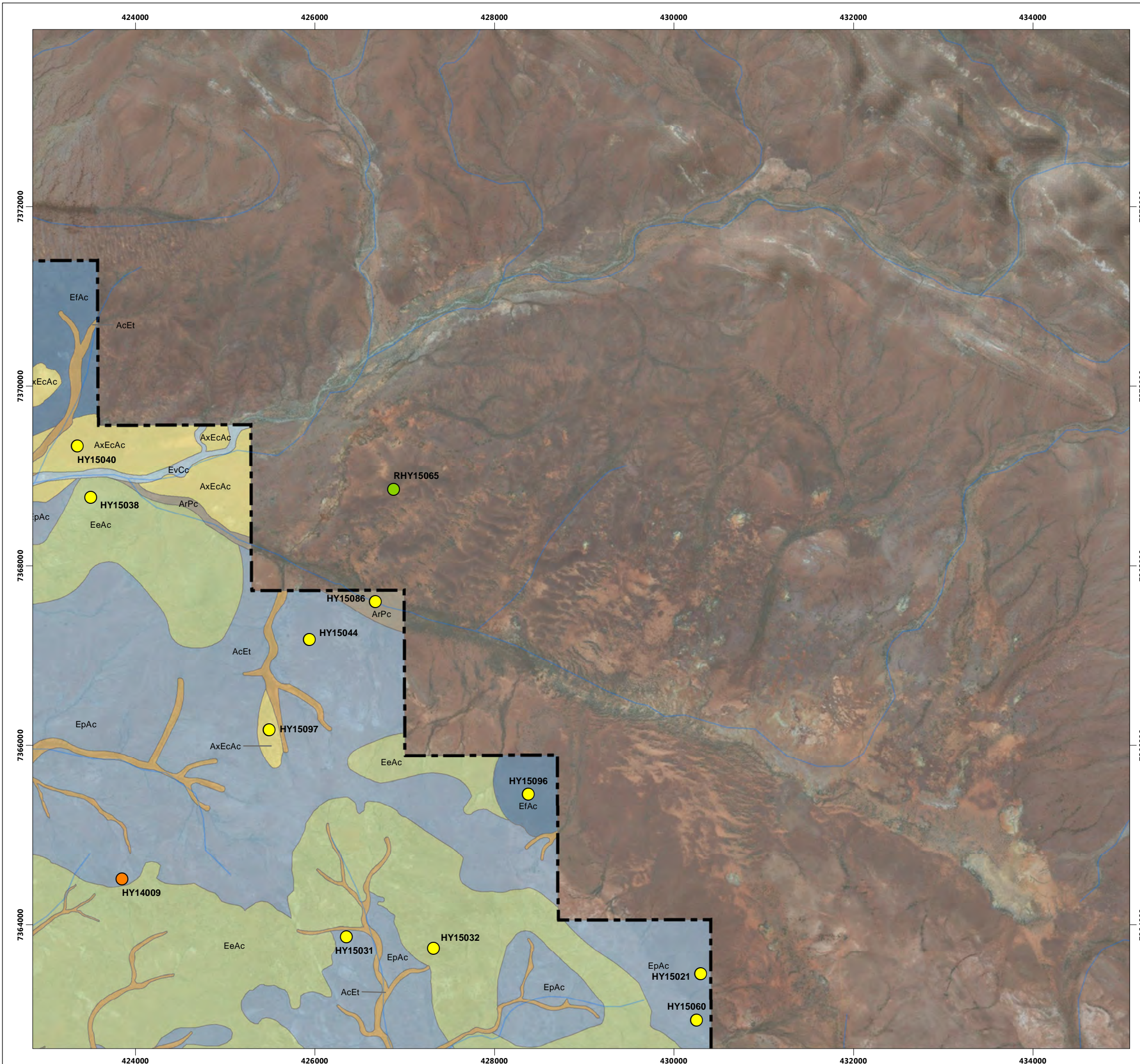
COORDINATE SYSTEM: GDA 1994 MGA ZONE 50  
 PROJECTION: TRANSVERSE MERCATOR  
 DATUM: GDA 1994  
 UNITS: METER



PROJECT NO: 4326-19

REV	AUTHOR	APPROVED	DATE
0	JN	SB	04/04/2019

**MAP 1-B**



**LEGEND**

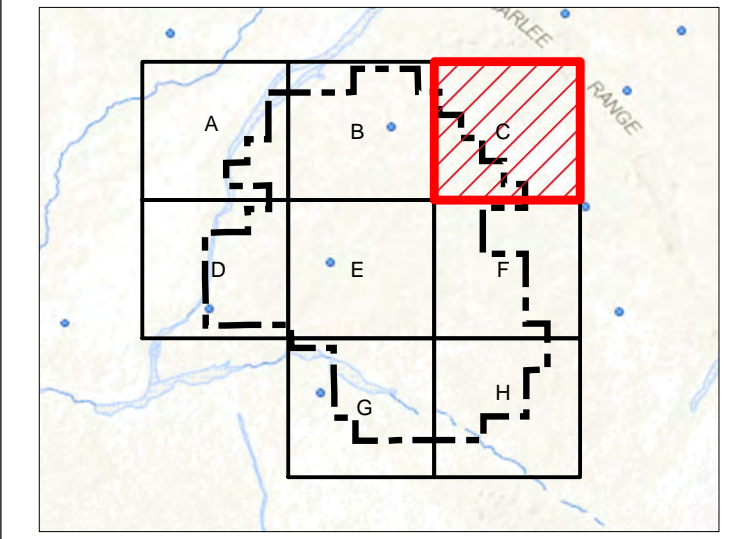
**Quadrats**

- Established 2014
- Established 2015
- Regional 2015
- Creeks
- Biological Study Area

**Vegetation Types**

**Code**

- AcEt
- ArPc
- AxEcAc
- EeAc
- EfAc
- EpAc
- EvCc



**DATASOURCES:**  
 SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AERGRID, IGN, AND THE GIS USER COMMUNITY



**QUADRATS AND VEGETATION TYPES OF THE YANGIBANA PROJECT**

**YANGIBANA RARE EARTHS PROJECT**

**CLIENT: HASTINGS**

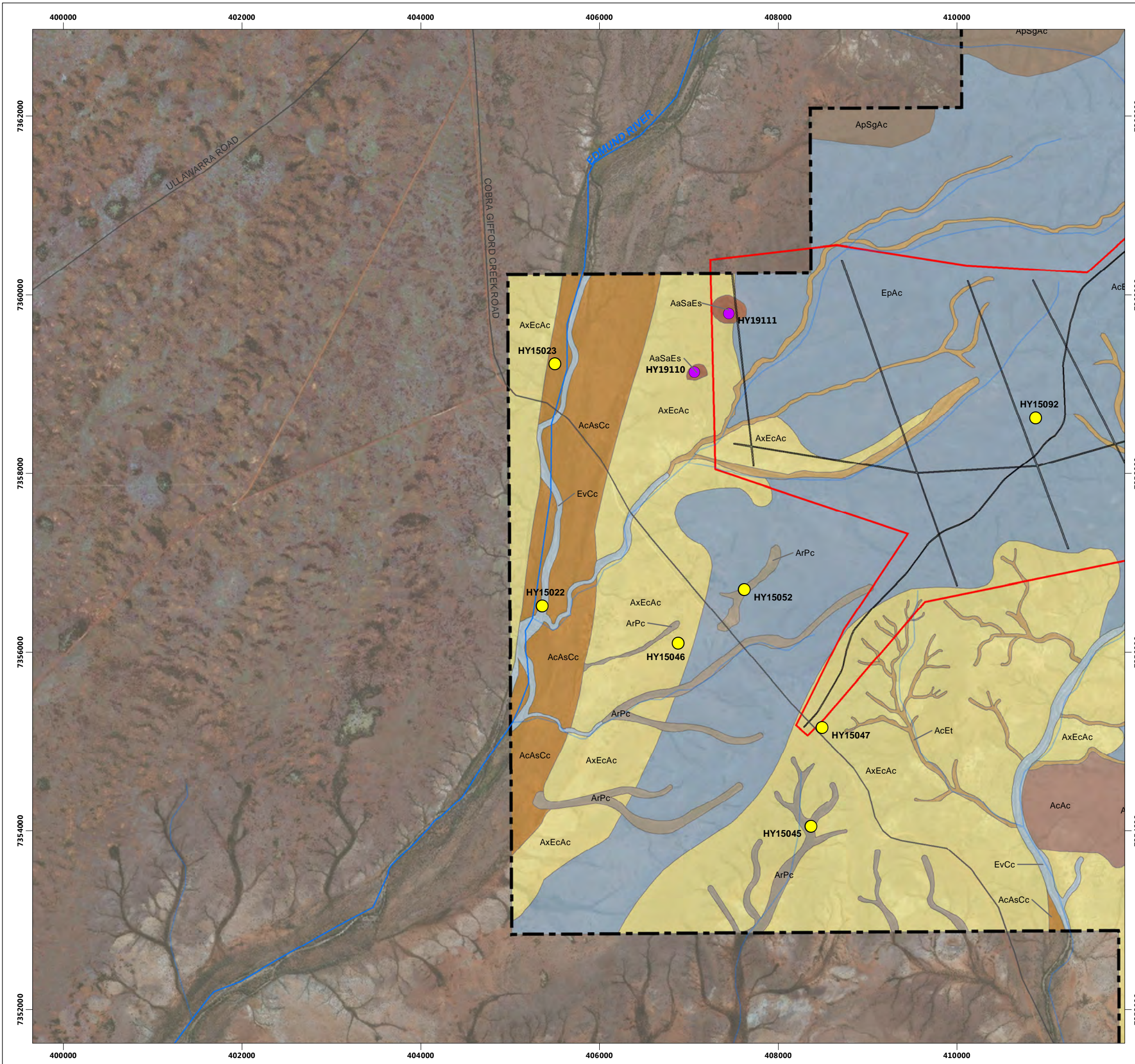
COORDINATE SYSTEM: GDA 1994 MGA ZONE 50  
 PROJECTION: TRANSVERSE MERCATOR  
 DATUM: GDA 1994  
 UNITS: METER



REV	AUTHOR	APPROVED	DATE
0	JN	SB	04/04/2019

**MAP**  
**1-C**





**LEGEND**

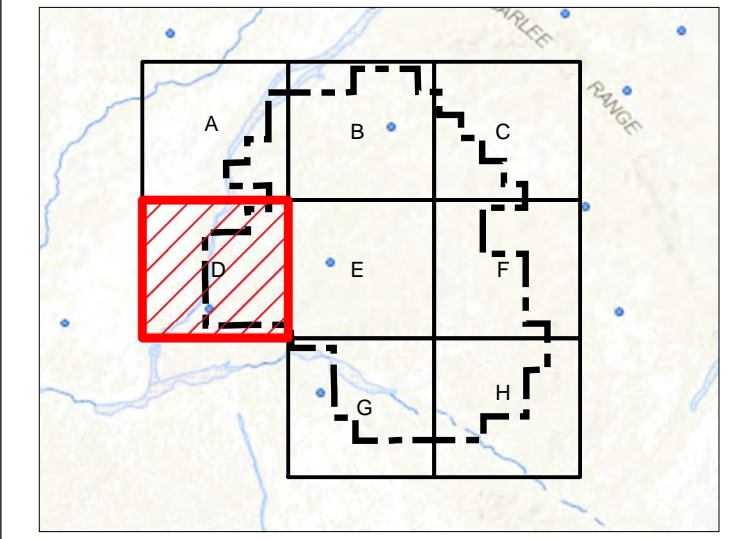
**Quadrats**

- Yellow circle: Established 2015
- Purple circle: Established 2019
- Black line: Roads
- Blue line: Rivers
- Light blue line: Creeks
- Dashed black line: Biological Study Area
- Red line: Development Envelope
- Hatched area: Disturbance Footprint

**Vegetation Types**

**Code**

- AaSaEs
- AcAc
- AcAsCc
- AcEt
- ApSgAc
- ArPc
- AxEcAc
- EpAc
- EvCc



**DATASOURCES:**  
 SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AERGRID, IGN, AND THE GIS USER COMMUNITY



**QUADRATS AND VEGETATION TYPES OF THE YANGIBANA PROJECT**

**YANGIBANA RARE EARTHS PROJECT**

**CLIENT: HASTINGS**

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50  
 PROJECTION: TRANSVERSE MERCATOR  
 DATUM: GDA 1994  
 UNITS: METER

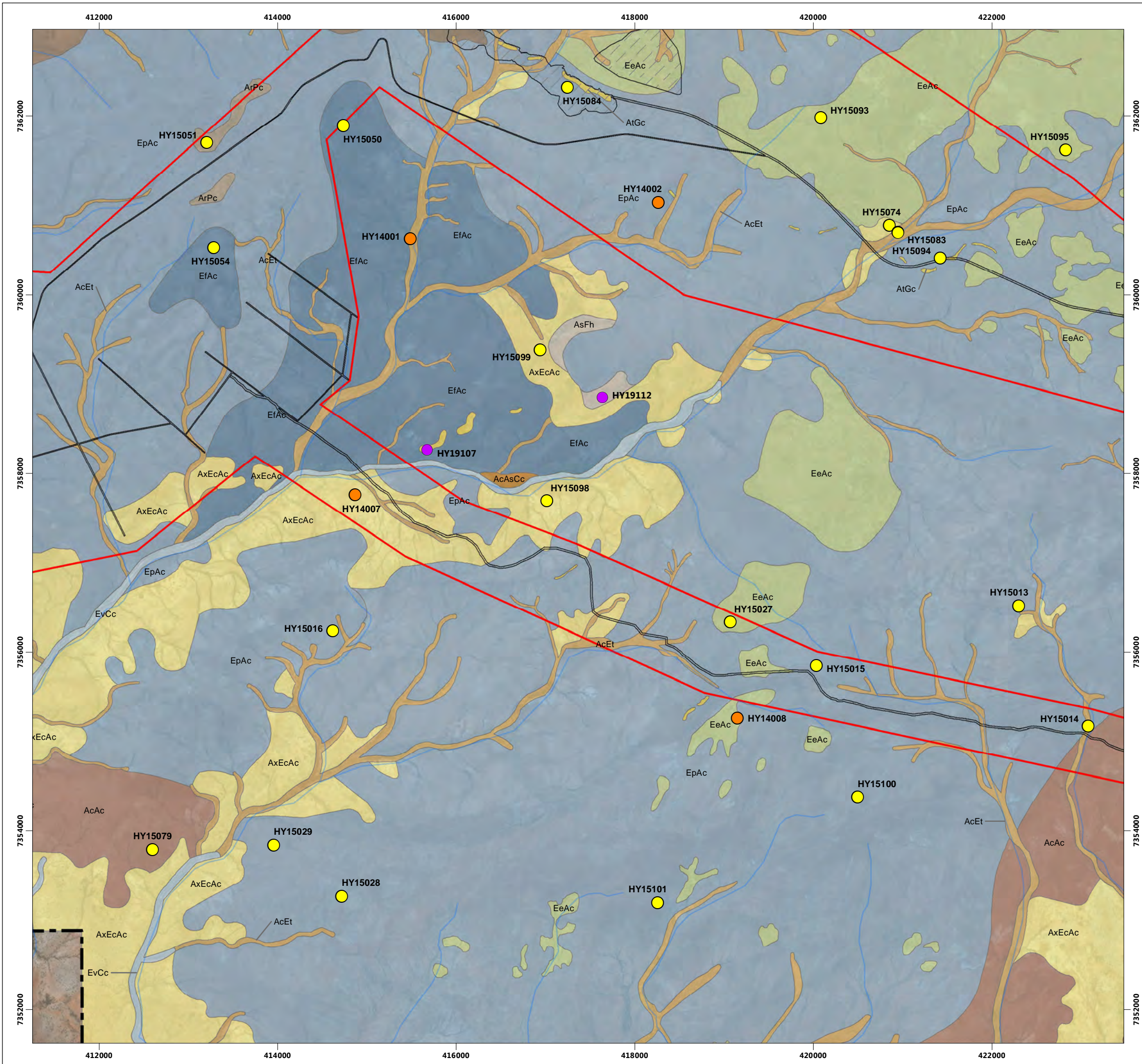
SCALE: 1:42,000 @ A3

0 0.5 1 1.5 km

PROJECT NO: 4326-19

REV	AUTHOR	APPROVED	DATE
0	JN	SB	04/04/2019

**MAP 1-D**



**LEGEND**

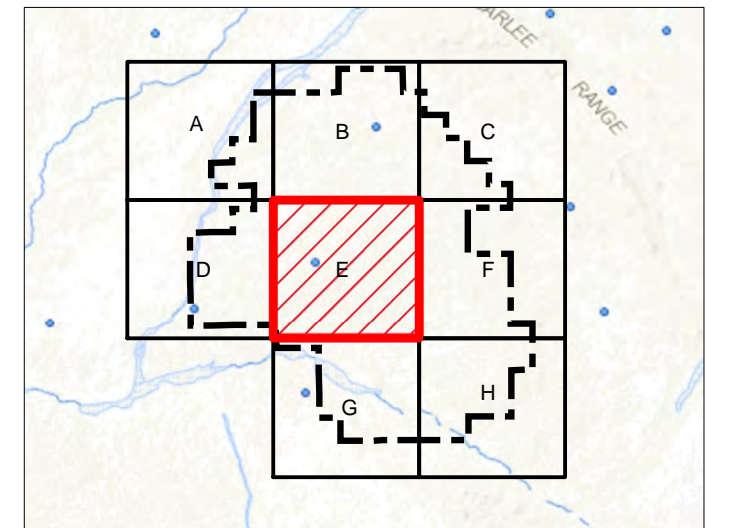
**Quadrats**

- Established 2014
- Established 2015
- Established 2019
- Creeks
- Biological Study Area
- Development Envelope
- Disturbance Footprint

**Vegetation Types**

**Code**

- AcAc
- AcAsCc
- AcEt
- ApSgAc
- ArPc
- AsFh
- AtGc
- AxEcAc
- EeAc
- EfAc
- EpAc
- EvCc



**DATASOURCES:**  
 SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AERGRID, IGN, AND THE GIS USER COMMUNITY

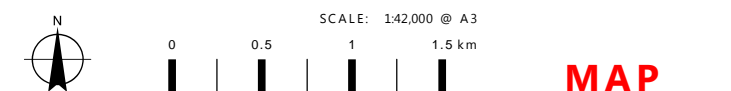


**QUADRATS AND VEGETATION TYPES OF THE YANGIBANA PROJECT**

**YANGIBANA RARE EARTHS PROJECT**

**CLIENT: HASTINGS**

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50  
 PROJECTION: TRANSVERSE MERCATOR  
 DATUM: GDA 1994  
 UNITS: METER

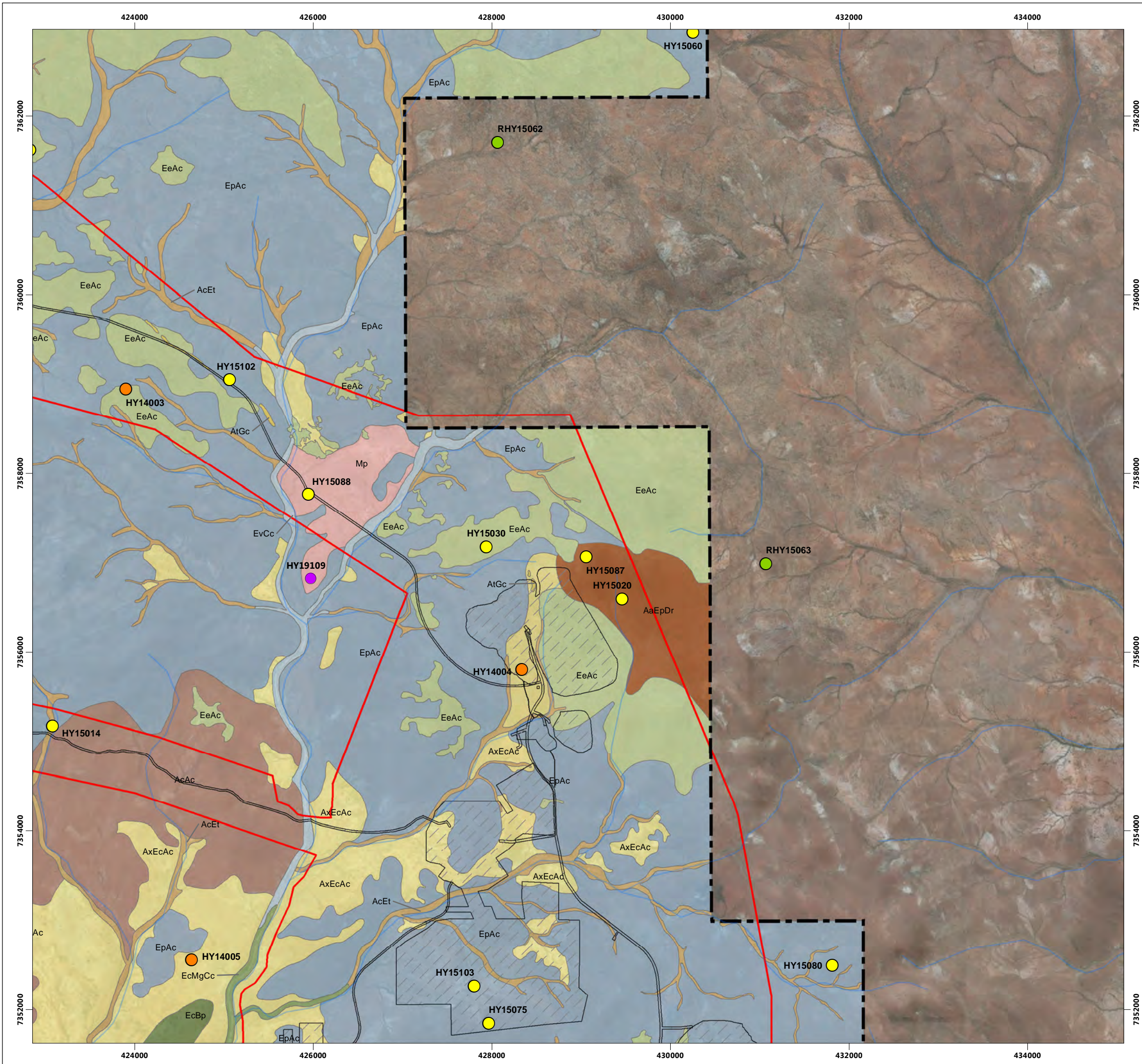


PROJECT NO: 4326-19

REV	AUTHOR	APPROVED	DATE
0	JN	SB	04/04/2019

**MAP**

**1 - E**



**LEGEND**

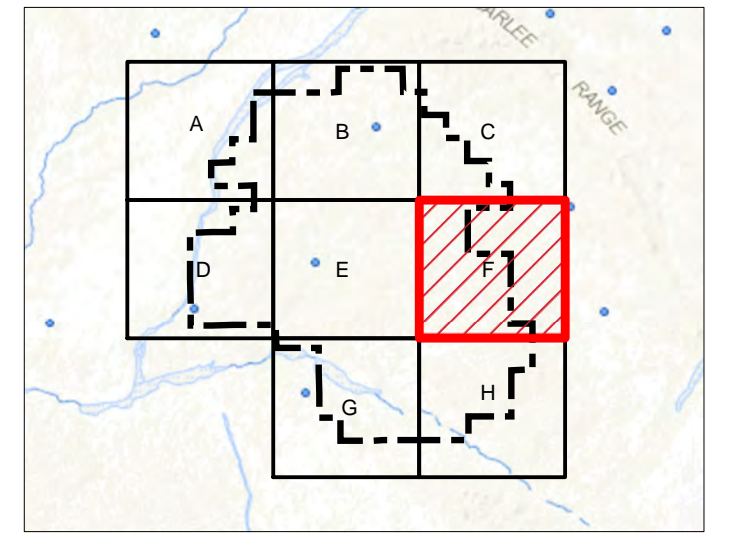
**Quadrats**

- Established 2014 (Orange dot)
- Established 2015 (Yellow dot)
- Regional 2015 (Green dot)
- Established 2019 (Purple dot)
- Creeks (Blue line)
- Biological Study Area (Black dashed line)
- Development Envelope (Red solid line)
- Disturbance Footprint (Hatched area)

**Vegetation Types**

**Code**

- AaEpDr
- AcAc
- AcEt
- AtGc
- AxEcAc
- EcBp
- EcMgCc
- EeAc
- EpAc
- EvCc
- Mp



**DATASOURCES:**  
 SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AERGRID, IGN, AND THE GIS USER COMMUNITY

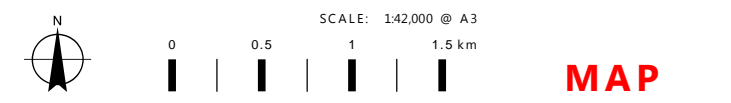


**QUADRATS AND VEGETATION TYPES OF THE YANGIBANA PROJECT**

**YANGIBANA RARE EARTHS PROJECT**

**CLIENT: HASTINGS**

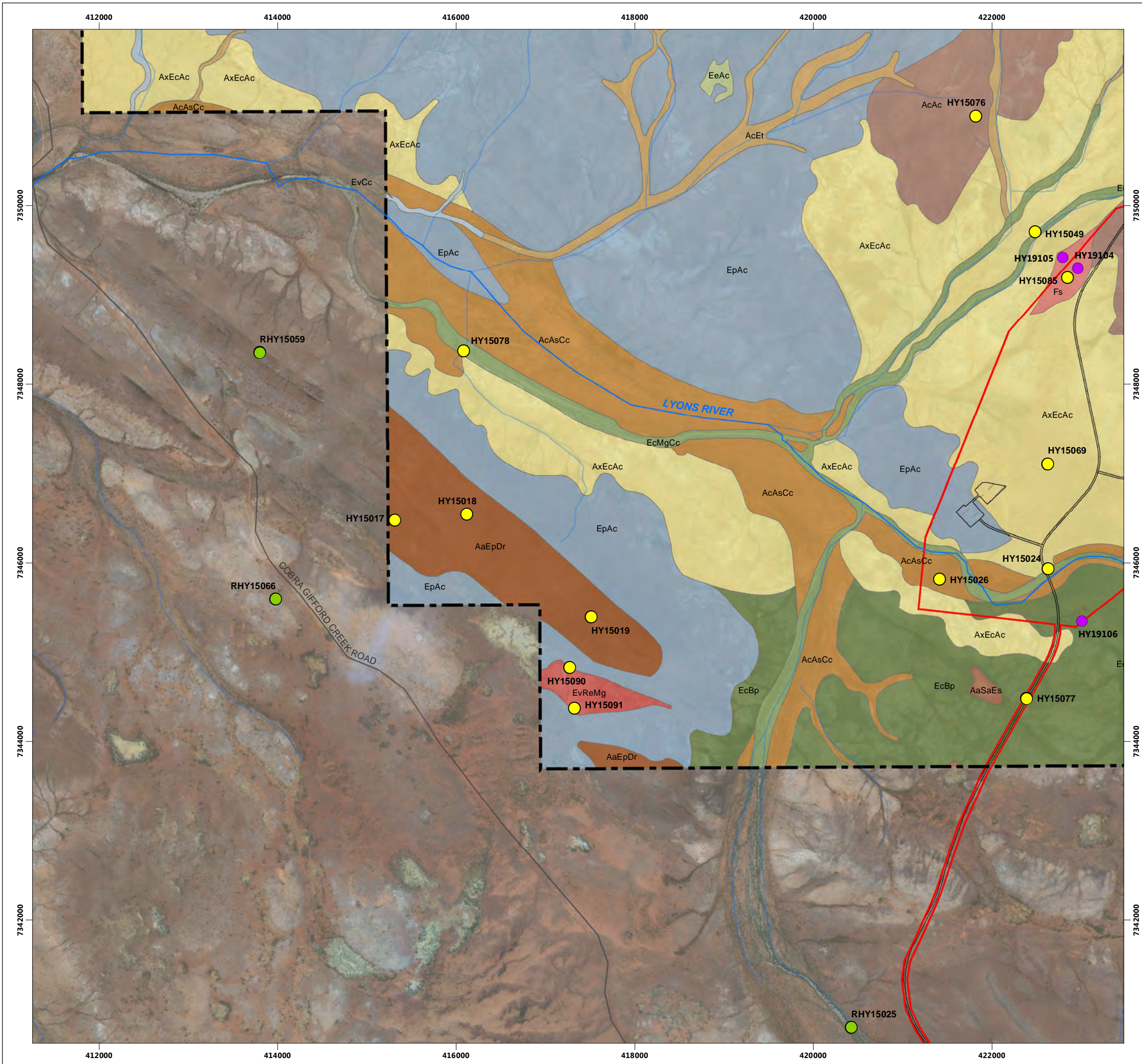
COORDINATE SYSTEM: GDA 1994 MGA ZONE 50  
 PROJECTION: TRANSVERSE MERCATOR  
 DATUM: GDA 1994  
 UNITS: METER



PROJECT NO: 4326-19

REV	AUTHOR	APPROVED	DATE
0	JN	SB	04/04/2019

**MAP**  
**1-F**



**LEGEND**

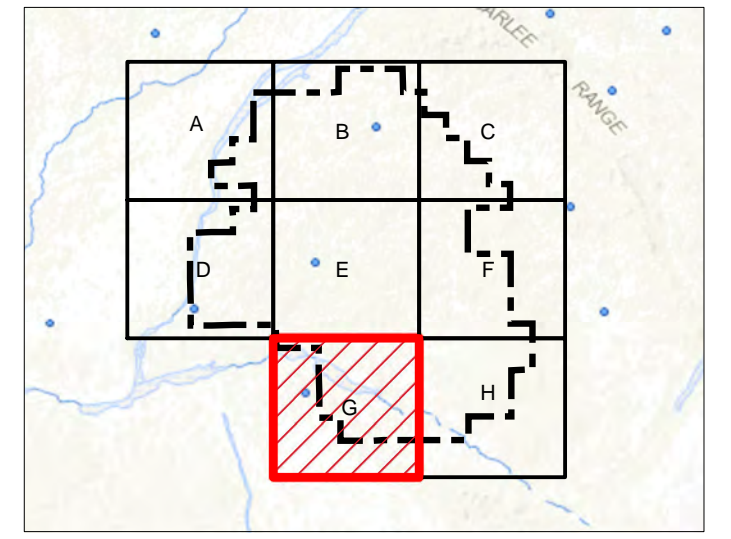
**Quadrats**

- Yellow circle: Established 2015
- Green circle: Regional 2015
- Purple circle: Established 2019
- Black line: Roads
- Blue line: Rivers
- Light blue line: Creeks
- Dashed black line: Biological Study Area
- Red line: Development Envelope
- Hatched area: Disturbance Footprint

**Vegetation Types**

**Code**

- AaEpDr
- AaSaEs
- AcAc
- AcAsCc
- AcEt
- AxEcAc
- EcBp
- EcMgCc
- EeAc
- EpAc
- EvCc
- EvReMg
- Fs



**DATASOURCES:**  
 SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AERGRID, IGN, AND THE GIS USER COMMUNITY



**QUADRATS AND VEGETATION TYPES OF THE YANGIBANA PROJECT**

**YANGIBANA RARE EARTHS PROJECT**

**CLIENT: HASTINGS**

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50  
 PROJECTION: TRANSVERSE MERCATOR  
 DATUM: GDA 1994  
 UNITS: METER

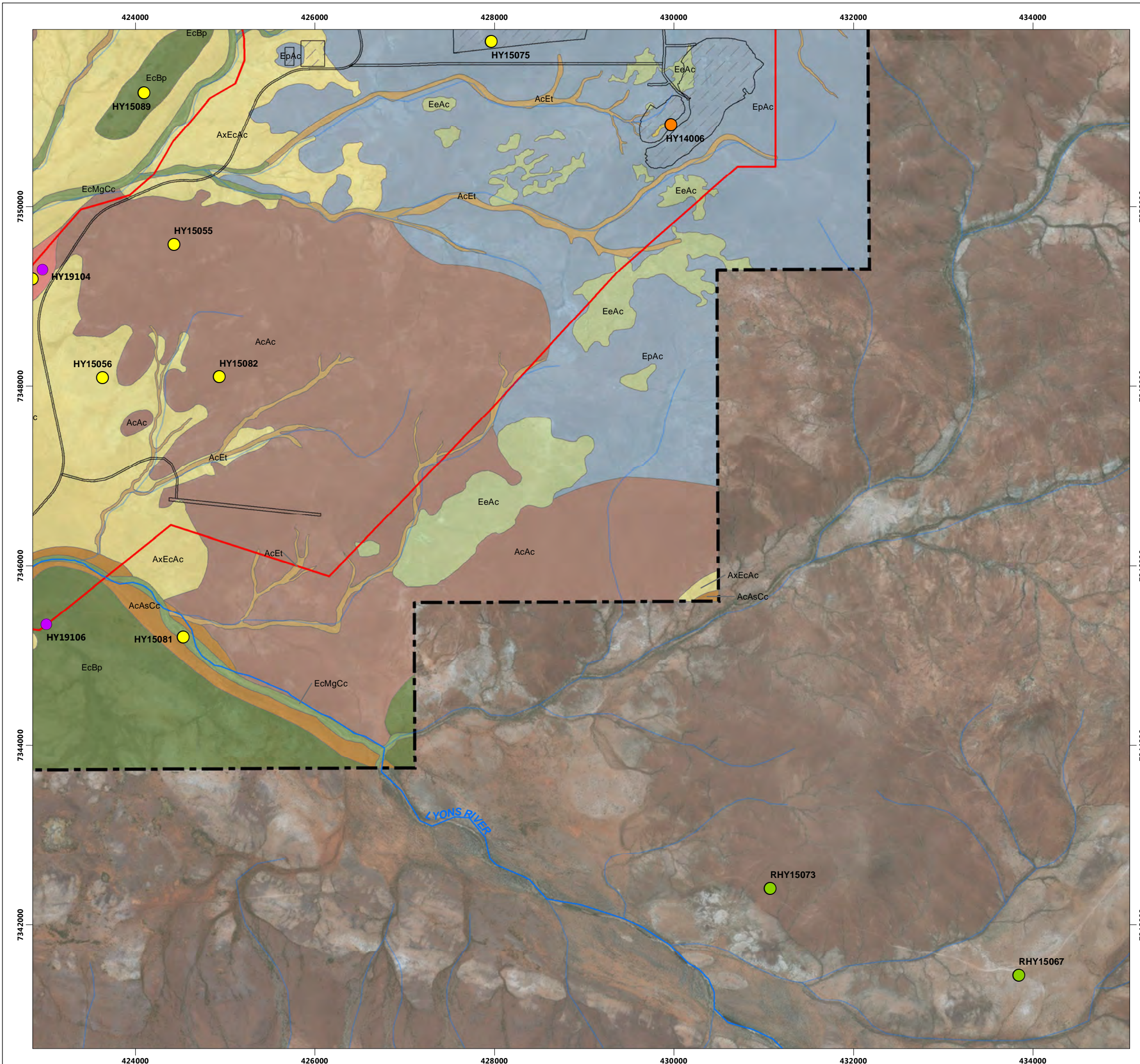
SCALE: 1:42,000 @ A3

0 0.5 1 1.5 km

PROJECT NO: 4326-19

REV	AUTHOR	APPROVED	DATE
0	JN	SB	04/04/2019

**MAP 1-G**



**LEGEND**

**Quadrats**

- Established 2014 (Orange dot)
- Established 2015 (Yellow dot)
- Regional 2015 (Green dot)
- Established 2019 (Purple dot)

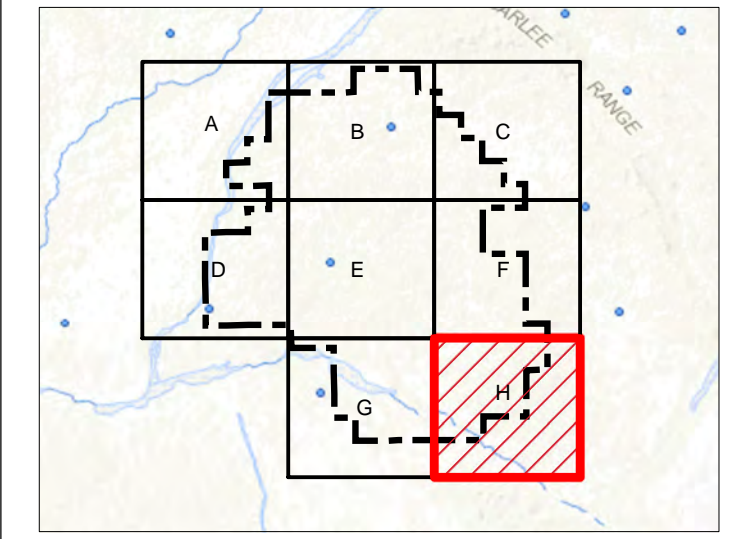
**Vegetation Types**

**Code**

- AcAc
- AcAsCc
- AcEt
- AtGc
- AxEcAc
- EcBp
- EcMgCc
- EeAc
- EpAc
- Fs

**Other Features:**

- Rivers (Blue line)
- Creeks (Light blue line)
- Biological Study Area (Dashed black line)
- Development Envelope (Red line)
- Disturbance Footprint (Hatched area)



**DATASOURCES:**  
 SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AERGRID, IGN, AND THE GIS USER COMMUNITY

**ecoscape**

**QUADRATS AND VEGETATION TYPES OF THE YANGIBANA PROJECT**

**YANGIBANA RARE EARTHS PROJECT**

**CLIENT: HASTINGS**

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50  
 PROJECTION: TRANSVERSE MERCATOR  
 DATUM: GDA 1994  
 UNITS: METER

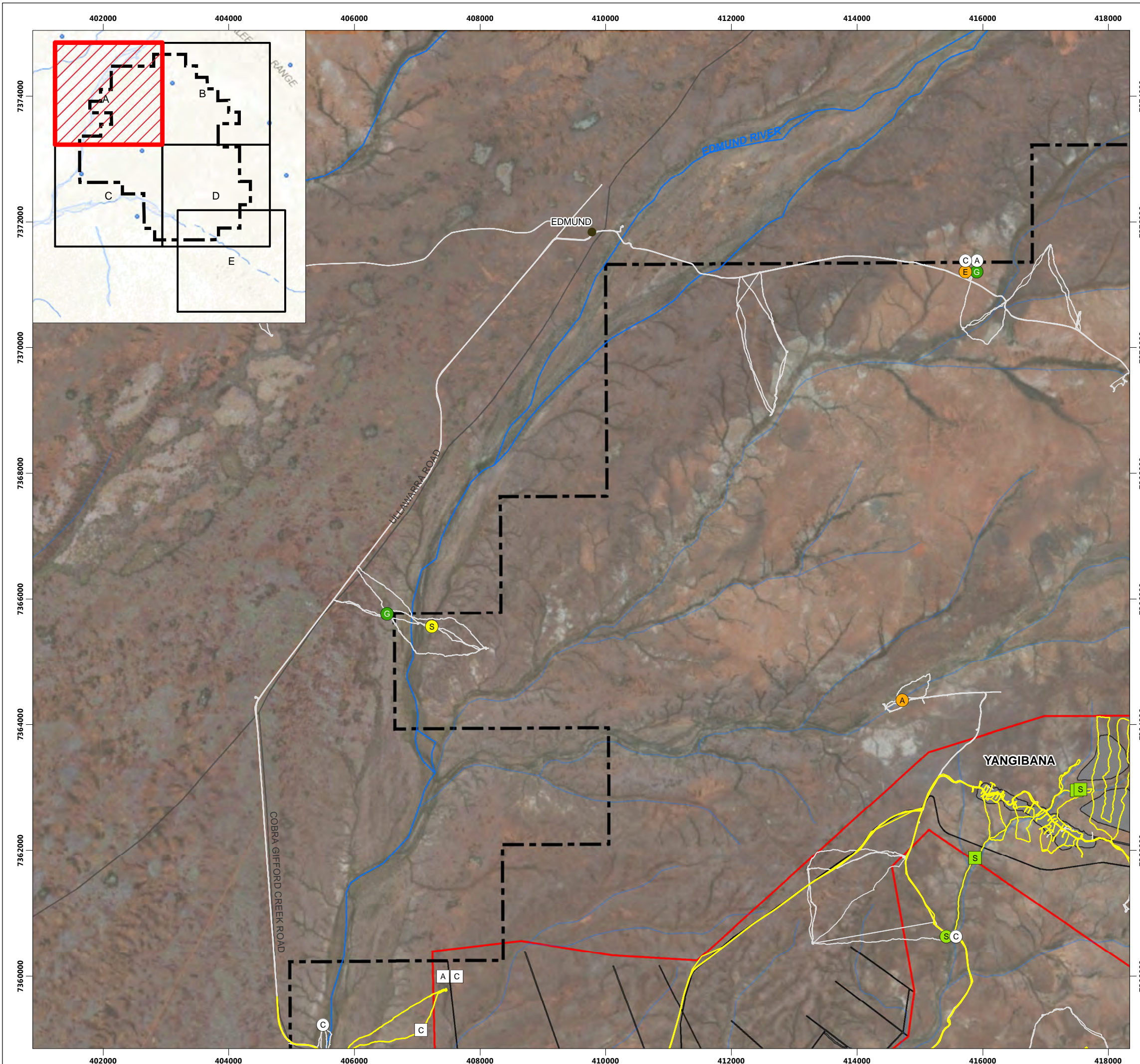
SCALE: 1:42,000 @ A3

0 0.5 1 1.5 km

PROJECT NO: 4326-19

REV	AUTHOR	APPROVED	DATE
0	JN	SB	04/04/2019

**MAP 1-H**



- LEGEND**
- Homesteads
  - Roads
  - Rivers
  - Creeks
  - 2015 Survey Tracks
  - 2019 Survey Tracks
  - ▭ Biological Study Area
  - ▭ Development Envelope
  - ▭ Disturbance Footprint
- 2015 Records**
- A Priority 1 (DBCA), *Acacia curryana*
  - E Priority 1 (DBCA), *Elacholoma* sp. Showy flowers (C.P. Campbell 1762)
  - R Priority 2 (DBCA), *Rhodanthe frenchii*
  - S Priority 2 (DBCA), *Solanum octonum*
  - W Priority 2 (DBCA), *Wurmbea fluviatilis*
  - G Priority 3 (DBCA), *Gymnanthera cunninghamii*
  - S Priority 3 (DBCA), *Sporobolus blakei*
  - G Priority 4 (DBCA), *Goodenia berringbinensis*
  - N Priority 4 (DBCA), *Goodenia nuda*
  - A Range Extension (Targeted), *Abutilon malvifolium*
  - C Range Extension (Targeted), *Corchorus tridens*
- 2019 Records**
- A Priority 1 (DBCA), *Acacia curryana*
  - R Priority 2 (DBCA), *Rhodanthe frenchii*
  - A Priority 3 (DBCA), *Acacia atopa*
  - S Priority 3 (DBCA), *Sporobolus blakei*
  - A Range Extension (Targeted), *Abutilon malvifolium*
  - C Range Extension (Targeted), *Corchorus tridens*

**DATASOURCES:**  
 SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGGRID, IGN, AND THE GIS USER COMMUNITY



**CONSERVATION SIGNIFICANT  
 FLORA OF THE YANGIBANA  
 PROJECT**

**YANGIBANA RARE  
 EARTHS PROJECT**

**CLIENT: HASTINGS**

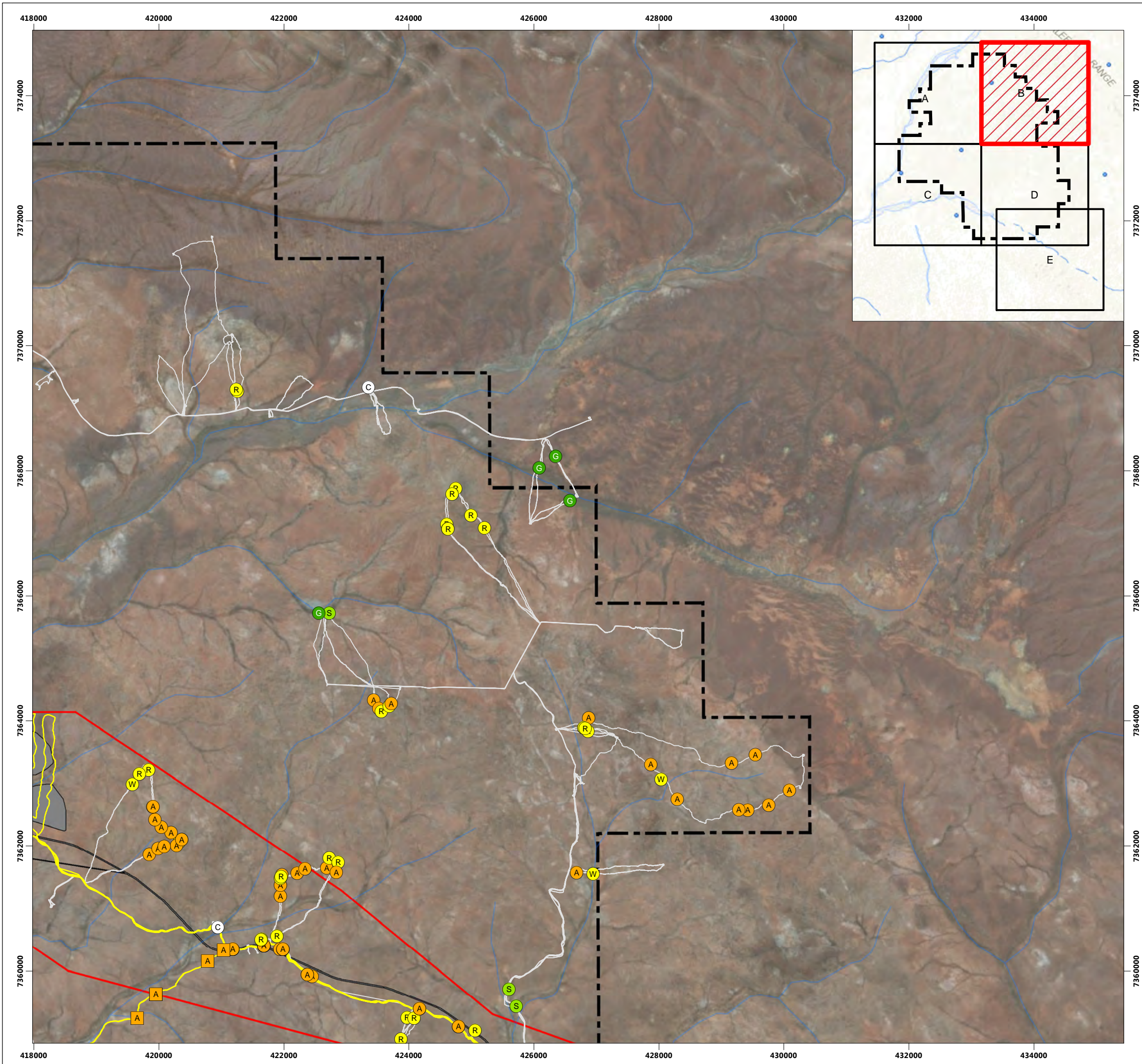
COORDINATE SYSTEM: GDA 1994 MGA ZONE 50  
 PROJECTION: TRANSVERSE MERCATOR  
 DATUM: GDA 1994  
 UNITS: METER

SCALE: 1:60,000 @ A3

PROJECT NO: 4326-19

REV	AUTHOR	APPROVED	DATE
0	JN	LA	09/04/2019

**MAP  
 2 - A**



- LEGEND**
- Creeks
  - 2015 Survey Tracks
  - 2019 Survey Tracks
  - Biological Study Area
  - Development Envelope
  - Disturbance Footprint
- 2015 Records**
- Priority 1 (DBC), *Acacia curryana*
  - Priority 1 (DBC), *Elacholoma* sp. Showy flowers (C.P. Campbell 1762)
  - Priority 2 (DBC), *Rhodanthe frenchii*
  - Priority 2 (DBC), *Solanum octonum*
  - Priority 2 (DBC), *Wurmbea fluviatilis*
  - Priority 3 (DBC), *Gymnanthera cunninghamii*
  - Priority 3 (DBC), *Sporobolus blakei*
  - Priority 4 (DBC), *Goodenia berringbinensis*
  - Priority 4 (DBC), *Goodenia nuda*
  - Range Extension (Targeted), *Abutilon malvifolium*
  - Range Extension (Targeted), *Corchorus tridens*
- 2019 Records**
- Priority 1 (DBC), *Acacia curryana*
  - Priority 2 (DBC), *Rhodanthe frenchii*
  - Priority 3 (DBC), *Acacia atopa*
  - Priority 3 (DBC), *Sporobolus blakei*
  - Range Extension (Targeted), *Abutilon malvifolium*
  - Range Extension (Targeted), *Corchorus tridens*

**DATASOURCES:**  
 SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AERGRID, IGN, AND THE GIS USER COMMUNITY

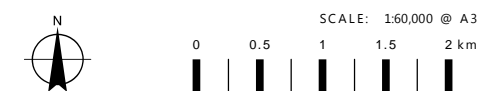


**CONSERVATION SIGNIFICANT  
 FLORA OF THE YANGIBANA  
 PROJECT**

**YANGIBANA RARE  
 EARTHS PROJECT**

**CLIENT: HASTINGS**

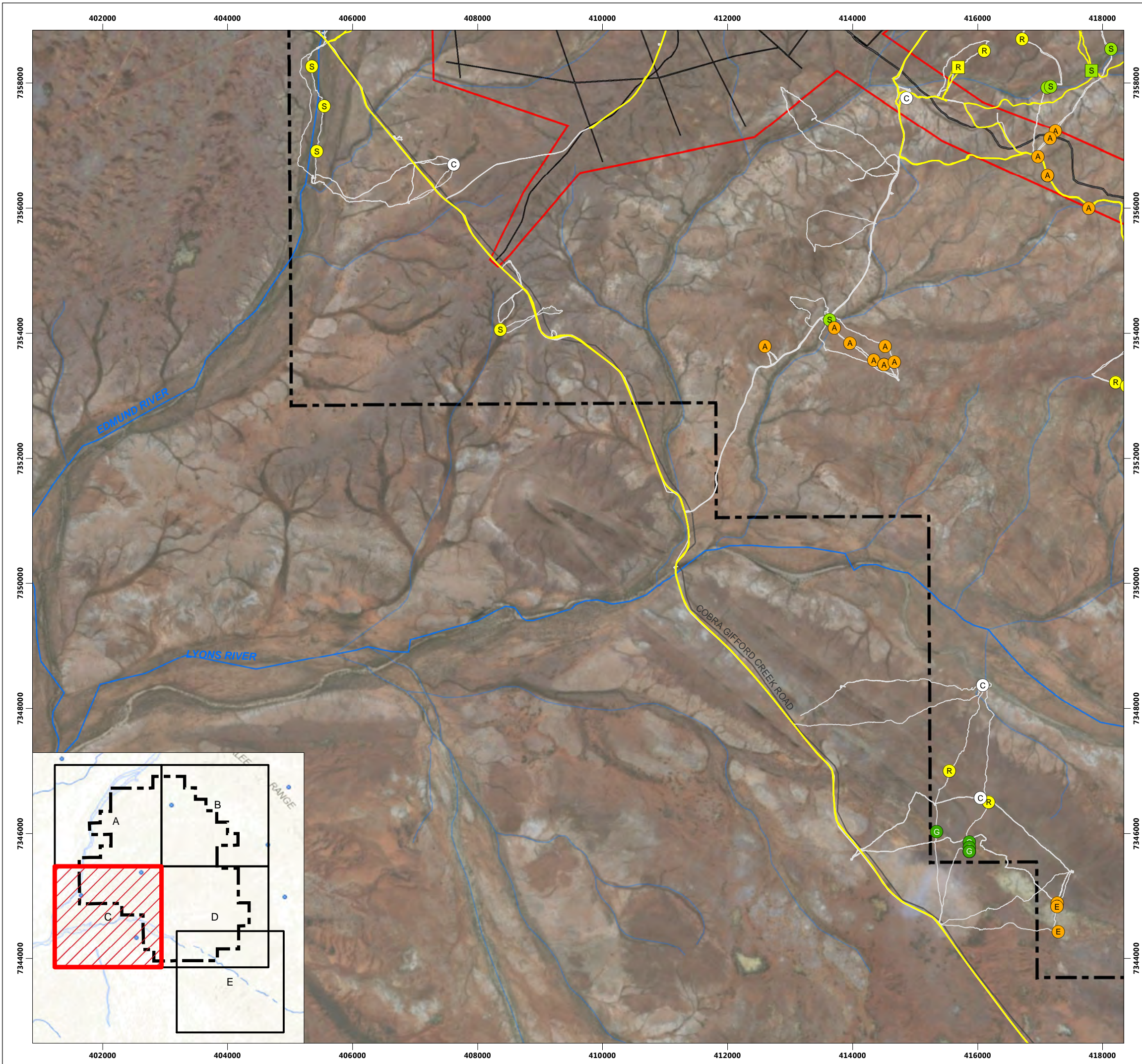
COORDINATE SYSTEM: GDA 1994 MGA ZONE 50  
 PROJECTION: TRANSVERSE MERCATOR  
 DATUM: GDA 1994  
 UNITS: METER



PROJECT NO: 4326-19

REV	AUTHOR	APPROVED	DATE
0	JN	LA	09/04/2019

**MAP  
 2 - B**



- LEGEND**
- Roads
  - Rivers
  - Creeks
  - 2015 Survey Tracks
  - 2019 Survey Tracks
  - ▭ Biological Study Area
  - ▭ Development Envelope
  - ▭ Disturbance Footprint
- 2015 Records**
- A Priority 1 (DBCA), *Acacia curryana*
  - E Priority 1 (DBCA), *Elacholoma* sp. Showy flowers (C.P. Campbell 1762)
  - R Priority 2 (DBCA), *Rhodanthe frenchii*
  - S Priority 2 (DBCA), *Solanum octonum*
  - W Priority 2 (DBCA), *Wurmbea fluviatilis*
  - G Priority 3 (DBCA), *Gymnanthera cunninghamii*
  - S Priority 3 (DBCA), *Sporobolus blakei*
  - G Priority 4 (DBCA), *Goodenia berringbinensis*
  - N Priority 4 (DBCA), *Goodenia nuda*
  - A Range Extension (Targeted), *Abutilon malvifolium*
  - C Range Extension (Targeted), *Corchorus tridens*
- 2019 Records**
- A Priority 1 (DBCA), *Acacia curryana*
  - R Priority 2 (DBCA), *Rhodanthe frenchii*
  - A Priority 3 (DBCA), *Acacia atopa*
  - S Priority 3 (DBCA), *Sporobolus blakei*
  - A Range Extension (Targeted), *Abutilon malvifolium*
  - C Range Extension (Targeted), *Corchorus tridens*

**DATASOURCES:**  
 SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRIID, IGN, AND THE GIS USER COMMUNITY

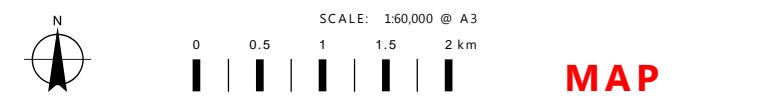


**CONSERVATION SIGNIFICANT  
 FLORA OF THE YANGIBANA  
 PROJECT**

**YANGIBANA RARE  
 EARTHS PROJECT**

**CLIENT: HASTINGS**

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50  
 PROJECTION: TRANSVERSE MERCATOR  
 DATUM: GDA 1994  
 UNITS: METER

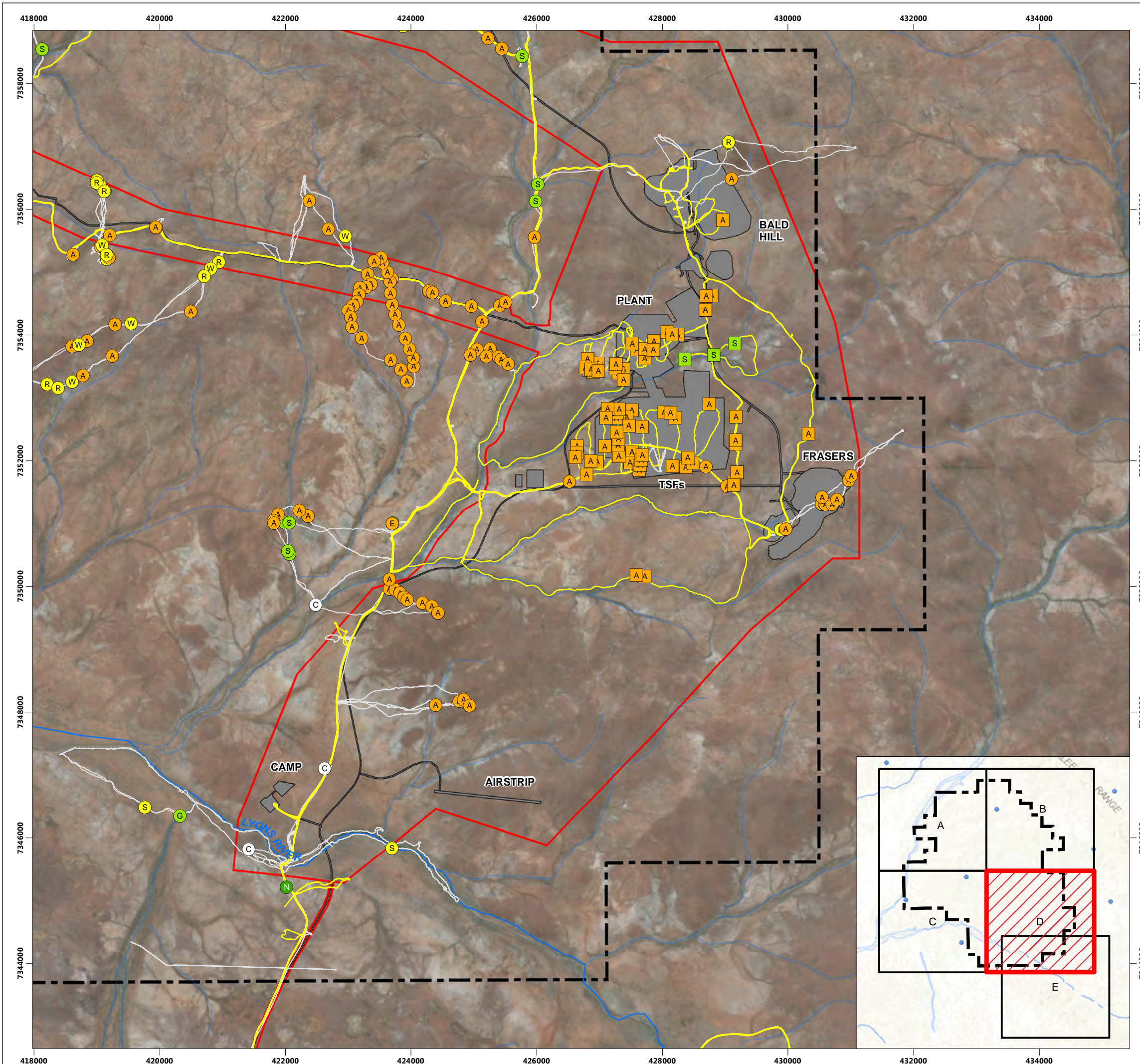


PROJECT NO: 4326-19

REV	AUTHOR	APPROVED	DATE
0	JN	LA	09/04/2019

**MAP  
 2 - C**





- LEGEND**
- Rivers
  - Creeks
  - 2015 Survey Tracks
  - 2019 Survey Tracks
  - Biological Study Area
  - Development Envelope
  - Disturbance Footprint
- 2015 Records**
- A Priority 1 (DBC), *Acacia curryana*
  - E Priority 1 (DBC), *Elacholoma* sp. Showy flowers (C.P. Campbell 1762)
  - R Priority 2 (DBC), *Rhodanthe frenchii*
  - S Priority 2 (DBC), *Solanum octonum*
  - W Priority 2 (DBC), *Wurmbea fluviatilis*
  - G Priority 3 (DBC), *Gymnanthera cunninghamii*
  - S Priority 3 (DBC), *Sporobolus blakei*
  - G Priority 4 (DBC), *Goodenia berringbinensis*
  - N Priority 4 (DBC), *Goodenia nuda*
  - A Range Extension (Targeted), *Abutilon malvifolium*
  - C Range Extension (Targeted), *Corchorus tridens*
- 2019 Records**
- A Priority 1 (DBC), *Acacia curryana*
  - R Priority 2 (DBC), *Rhodanthe frenchii*
  - A Priority 3 (DBC), *Acacia atopa*
  - S Priority 3 (DBC), *Sporobolus blakei*
  - A Range Extension (Targeted), *Abutilon malvifolium*
  - C Range Extension (Targeted), *Corchorus tridens*

**DATASOURCES:**  
 SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AERGRID, IGN, AND THE GIS USER COMMUNITY



**CONSERVATION SIGNIFICANT  
 FLORA OF THE YANGIBANA  
 PROJECT**

**YANGIBANA RARE  
 EARTHS PROJECT**

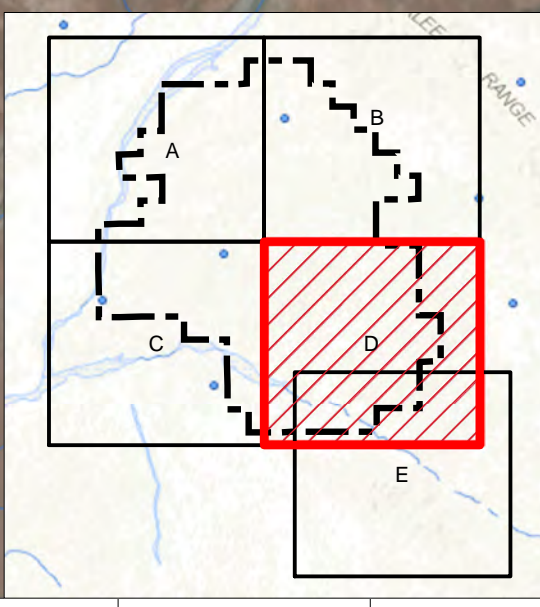
**CLIENT: HASTINGS**

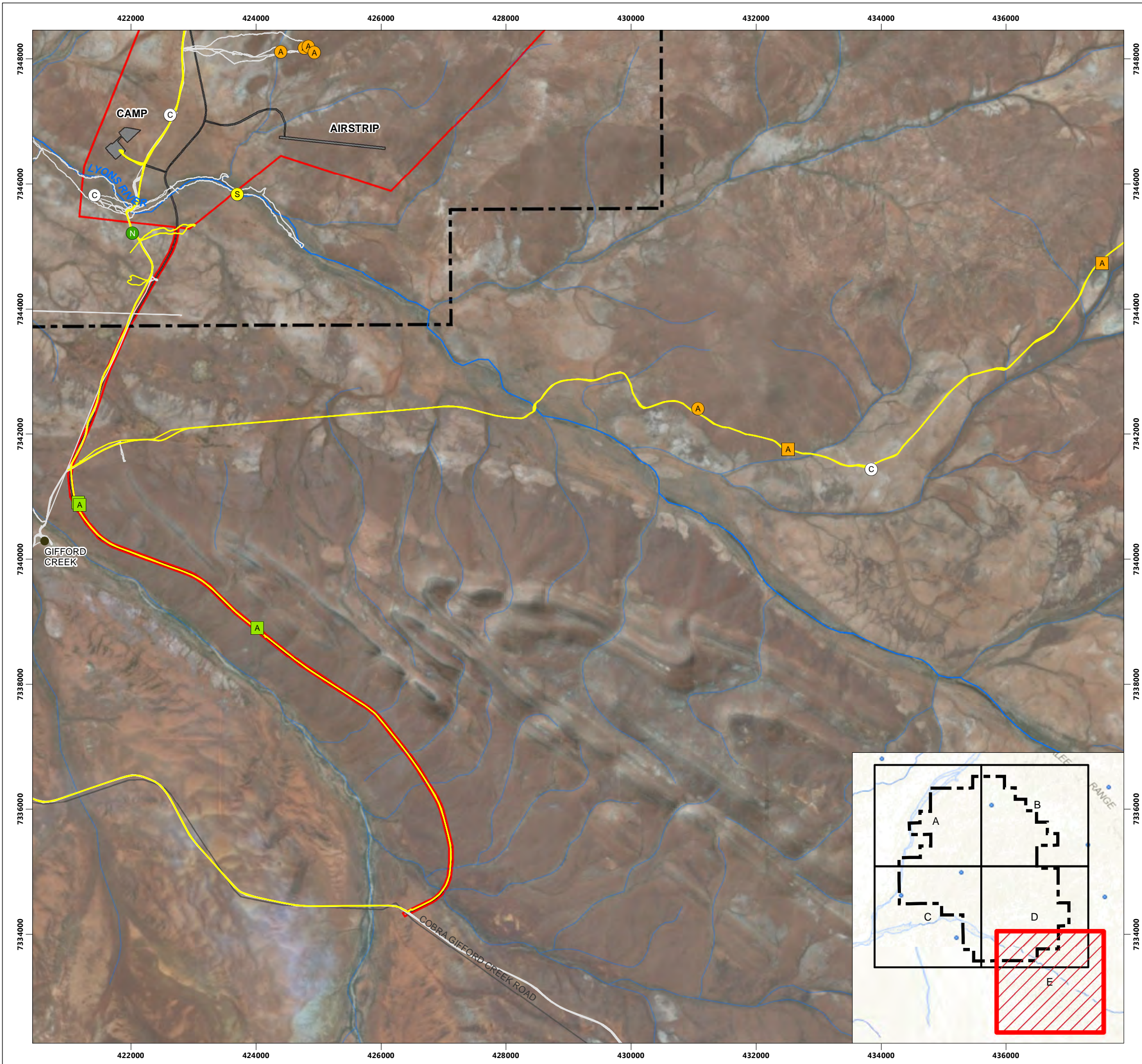
COORDINATE SYSTEM: GDA 1994 MGA ZONE 50  
 PROJECTION: TRANSVERSE MERCATOR  
 DATUM: GDA 1994  
 UNITS: METER

SCALE: 1:60,000 @ A3

REV	AUTHOR	APPROVED	DATE
0	JN	LA	09/04/2019

**MAP  
2-D**





- LEGEND**
- Homesteads
  - Roads
  - Rivers
  - Creeks
  - 2015 Survey Tracks
  - 2019 Survey Tracks
  - ▭ Biological Study Area
  - ▭ Development Envelope
  - ▭ Disturbance Footprint
- 2015 Records**
- A Priority 1 (DBCA), *Acacia curryana*
  - E Priority 1 (DBCA), *Elacholoma* sp. Showy flowers (C.P. Campbell 1762)
  - R Priority 2 (DBCA), *Rhodanthe frenchii*
  - S Priority 2 (DBCA), *Solanum octonum*
  - W Priority 2 (DBCA), *Wurmbea fluviatilis*
  - G Priority 3 (DBCA), *Gymnanthera cunninghamii*
  - S Priority 3 (DBCA), *Sporobolus blakei*
  - G Priority 4 (DBCA), *Goodenia berringbinensis*
  - N Priority 4 (DBCA), *Goodenia nuda*
  - A Range Extension (Targeted), *Abutilon malvifolium*
  - C Range Extension (Targeted), *Corchorus tridens*
- 2019 Records**
- A Priority 1 (DBCA), *Acacia curryana*
  - R Priority 2 (DBCA), *Rhodanthe frenchii*
  - A Priority 3 (DBCA), *Acacia atopa*
  - S Priority 3 (DBCA), *Sporobolus blakei*
  - A Range Extension (Targeted), *Abutilon malvifolium*
  - C Range Extension (Targeted), *Corchorus tridens*

**DATASOURCES:**  
 SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGGRID, IGN, AND THE GIS USER COMMUNITY



**CONSERVATION SIGNIFICANT  
 FLORA OF THE YANGIBANA  
 PROJECT**  
**YANGIBANA RARE  
 EARTHS PROJECT**  
 CLIENT: HASTINGS

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50  
 PROJECTION: TRANSVERSE MERCATOR  
 DATUM: GDA 1994  
 UNITS: METER

SCALE: 1:60,000 @ A3

PROJECT NO: 4326-19

REV	AUTHOR	APPROVED	DATE
0	JN	LA	09/04/2019

**MAP  
 2 - E**

# APPENDIX ONE

# DEFINITIONS AND CRITERIA

**Table 3: Conservation codes for Western Australian flora and fauna (DBCA 2019)**

Conservation Codes for Western Australian Flora and Fauna	
<p>Threatened, Extinct and Specially Protected fauna or flora<sup>1</sup> are species<sup>2</sup> which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such.</p> <p><b>The <i>Wildlife Conservation (Specially Protected Fauna) Notice 2018</i> and the <i>Wildlife Conservation (Rare Flora) Notice 2018</i> have been transitioned under regulations 170, 171 and 172 of the <i>Biodiversity Conservation Regulations 2018</i> to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the <i>Biodiversity Conservation Act 2016</i>.</b></p> <p>Categories of Threatened, Extinct and Specially Protected fauna and flora are:</p>	
<b>T</b>	<p><b>Threatened species</b></p> <p>Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the <i>Biodiversity Conservation Act 2016</i> (BC Act).</p> <p>Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3 of the <i>Wildlife Conservation (Specially Protected Fauna) Notice 2018</i> for Threatened Fauna.</p> <p>Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3 of the <i>Wildlife Conservation (Rare Flora) Notice 2018</i> for Threatened Flora.</p> <p>The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.</p>
<b>CR</b>	<p><b>Critically endangered species</b></p> <p>Threatened species considered to be "<i>facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines</i>".</p> <p>Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the <i>Wildlife Conservation (Specially Protected Fauna) Notice 2018</i> for critically endangered fauna or the <i>Wildlife Conservation (Rare Flora) Notice 2018</i> for critically endangered flora.</p>
<b>EN</b>	<p><b>Endangered species</b></p> <p>Threatened species considered to be "<i>facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines</i>".</p> <p>Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the <i>Wildlife Conservation (Specially Protected Fauna) Notice 2018</i> for endangered fauna or the <i>Wildlife Conservation (Rare Flora) Notice 2018</i> for endangered flora.</p>
<b>VU</b>	<p><b>Vulnerable species</b></p> <p>Threatened species considered to be "<i>facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines</i>".</p> <p>Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3 of the <i>Wildlife Conservation (Specially Protected Fauna) Notice 2018</i> for vulnerable fauna or the <i>Wildlife Conservation (Rare Flora) Notice 2018</i> for vulnerable flora.</p>
<p><b>Extinct species</b></p> <p>Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.</p>	
<b>EX</b>	<p><b>Extinct species</b></p> <p>Species where "<i>there is no reasonable doubt that the last member of the species has died</i>", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).</p> <p>Published as presumed extinct under schedule 4 of the <i>Wildlife Conservation (Specially Protected Fauna) Notice 2018</i> for extinct fauna or the <i>Wildlife Conservation (Rare Flora) Notice 2018</i> for extinct flora.</p>
<b>EW</b>	<p>Extinct in the wild species</p> <p>Species that "<i>is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form</i>", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act).</p> <p>Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.</p>
<p><b>Specially protected species</b></p> <p>Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.</p> <p>Species that are listed as threatened species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.</p>	

Conservation Codes for Western Australian Flora and Fauna	
<b>MI</b>	<p><b>Migratory species</b></p> <p>Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act).</p> <p>Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the <i>Convention on the Conservation of Migratory Species of Wild Animals</i> (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species.</p> <p>Published as migratory birds protected under an international agreement under schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.</p>
<b>CD</b>	<p><b>Species of special conservation interest (conservation dependent fauna)</b></p> <p>Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act).</p> <p>Published as conservation dependent fauna under schedule 6 of the <i>Wildlife Conservation (Specially Protected Fauna) Notice 2018</i>.</p>
<b>OS</b>	<p><b>Other specially protected species</b></p> <p>Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).</p> <p>Published as other specially protected fauna under schedule 7 of the <i>Wildlife Conservation (Specially Protected Fauna) Notice 2018</i>.</p>
<b>P</b>	<p><b>Priority species</b></p> <p>Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora.</p> <p>Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.</p> <p>Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.</p>
<b>1</b>	<p><b>Priority 1: Poorly-known species</b></p> <p>Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.</p>
<b>2</b>	<p><b>Priority 2: Poorly-known species</b></p> <p>Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.</p>
<b>3</b>	<p><b>Priority 3: Poorly-known species</b></p> <p>Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.</p>
<b>4</b>	<p><b>Priority 4: Rare, Near Threatened and other species in need of monitoring</b></p> <p>(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands.</p> <p>(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent.</p> <p>(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.</p>
<p><sup>1</sup> The definition of flora includes algae, fungi and lichens.</p> <p><sup>2</sup> Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).</p>	

Table 4: NVIS structural formation terminology, terrestrial vegetation (NVIS TWG 2017)

Cover characteristics								
Foliage cover *	70-100	30-70	10-30	<10	» 0 (scattered)	0-5 (clumped)	unknown	
Cover code	d	c	i	r	bi	bc	unknown	
Growth Form	Height Ranges (m)	Structural Formation Classes						
tree, palm	<10,10-30, >30	closed forest	open forest	woodland	open woodland	isolated trees	isolated clumps of trees	tree, palm
tree mallee	<3, <10, 10-30	closed mallee forest	open mallee forest	mallee woodland	open mallee woodland	isolated mallee trees	isolated clumps of mallee trees	tree mallee
shrub, cycad, grass-tree, tree-fern	<1,1-2,>2	closed shrubland	shrubland	open shrubland	sparse shrubland	isolated shrubs	isolated clumps of shrubs	shrub, cycad, grass-tree, tree-fern
mallee shrub	<3, <10, 10-30	closed mallee shrubland	mallee shrubland	open mallee shrubland	sparse mallee shrubland	isolated mallee shrubs	isolated clumps of mallee shrubs	mallee shrub
heath shrub	<1,1-2,>2	closed heathland	heathland	open heathland	sparse heathland	isolated heath shrubs	isolated clumps of heath shrubs	heath shrub
chenopod shrub	<1,1-2,>2	closed chenopod shrubland	chenopod shrubland	open chenopod shrubland	sparse chenopod shrubland	isolated chenopod shrubs	isolated clumps of chenopod shrubs	chenopod shrub
samphire shrub	<0.5,>0.5	closed samphire shrubland	samphire shrubland	open samphire shrubland	sparse samphire shrubland	isolated samphire shrubs	isolated clumps of samphire shrubs	samphire shrub
hummock grass	<2,>2	closed hummock grassland	hummock grassland	open hummock grassland	sparse hummock grassland	isolated hummock grasses	isolated clumps of hummock grasses	hummock grass
tussock grass	<0.5,>0.5	closed tussock grassland	tussock grassland	open tussock grassland	sparse tussock grassland	isolated tussock grasses	isolated clumps of tussock grasses	tussock grass
other grass	<0.5,>0.5	closed grassland	grassland	open grassland	sparse grassland	isolated grasses	isolated clumps of grasses	other grass
sedge	<0.5,>0.5	closed sedgeland	sedgeland	open sedgeland	sparse sedgeland	isolated sedges	isolated clumps of sedges	sedge
rush	<0.5,>0.5	closed rushland	rushland	open rushland	sparse rushland	isolated rushes	isolated clumps of rushes	rush
herb	<0.5,>0.5	closed herbland	herbland	open herbland	sparse herbland	isolated herbs	isolated clumps of herbs	herb
fern	<1,1-2,>2	closed fernland	fernland	open fernland	sparse fernland	isolated ferns	isolated clumps of ferns	fern
bryophyte	<0.5	closed bryophyte-land	bryophyte-land	open bryophyteland	sparse bryophyteland	isolated bryophytes	isolated clumps of bryophytes	bryophyte
lichen	<0.5	closed lichenland	lichenland	open lichenland	sparse lichenland	isolated lichens	isolated clumps of lichens	lichen
vine	<10,10-30, >30	closed vineland	vineland	open vineland	sparse vineland	isolated vines	isolated clumps of vines	vine

Table 5: NVIS height classes (NVIS TWG 2017)

Height		Growth form				
Height Class	Height Range (m)	Tree, vine (M & U), palm (single-stemmed)	Shrub, heath shrub, chenopod shrub, ferns, samphire shrub, cycad, tree-fern, grass-tree, palm (multi-stemmed)	Tree mallee, mallee shrub	Tussock grass, hummock grass, other grass, sedge, rush, forbs, vine (G)	Bryophyte, lichen, seagrass, aquatic
8	>30	tall	NA	NA	NA	NA
7	10-30	mid	NA	tall	NA	NA
6	<10	low	NA	mid	NA	NA
5	<3	NA	NA	low	NA	NA
4	>2	NA	tall	NA	tall	NA
3	1-2	NA	mid	NA	tall	NA
2	0.5-1	NA	low	NA	mid	tall
1	<0.5	NA	low	NA	low	low

Source: (based on Walker & Hopkins 1990)

Table 6: Vegetation Condition Scale for the South West and Interzone Botanical Provinces (EPA 2016b)

Condition rating	Description
Pristine	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
Very Good	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees and shrubs.

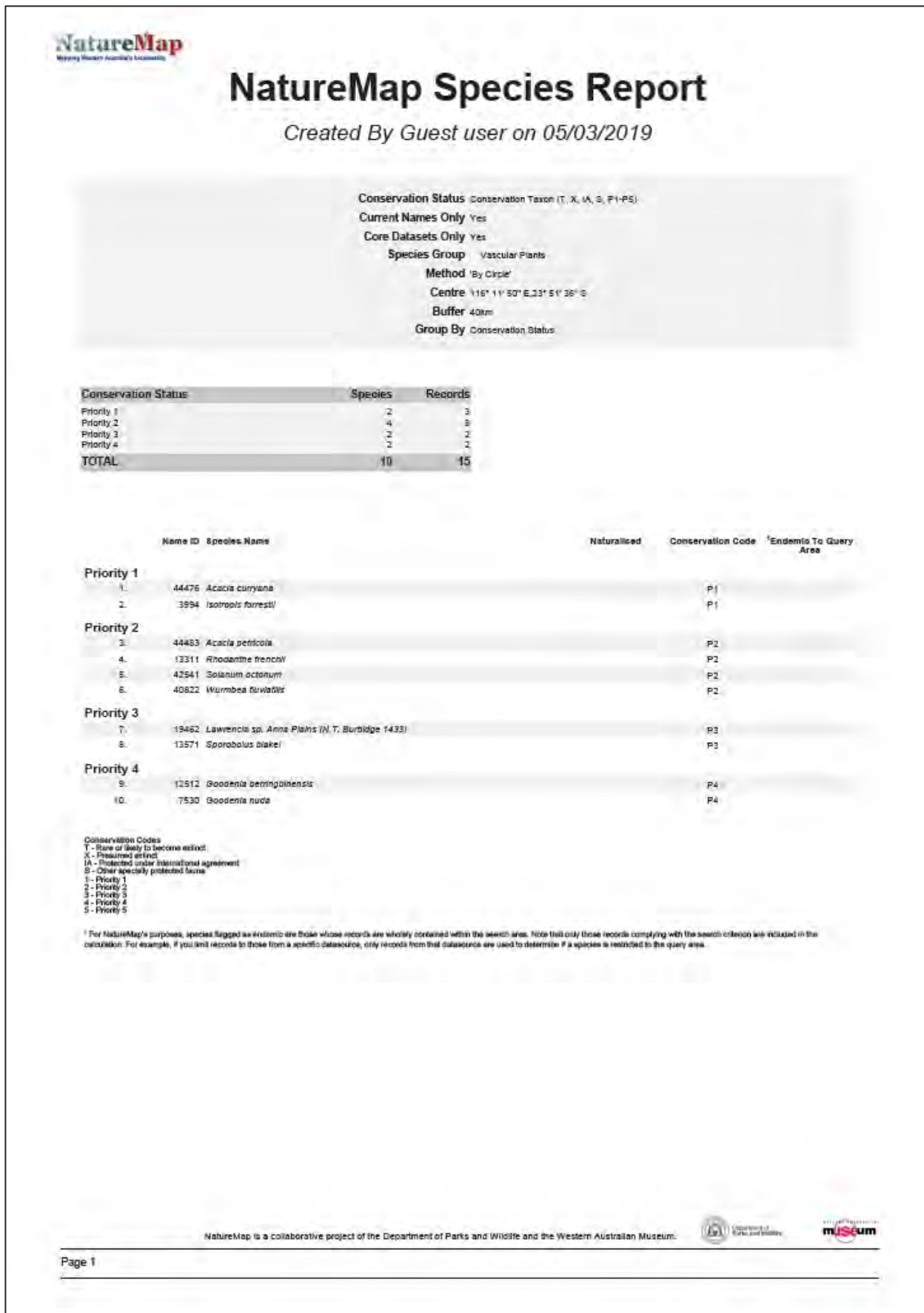


Figure 2: NatureMap (DPaW 2007-2019) search results

**Table 7: Conservation significant flora target species**

References: (1) *FloraBase* (WAH 1998), (2) Maslin (2014), (3) Ecoscape (2015)

Species/references	Description	Flowering	Soil	Landform/habitat	Associated vegetation
<b>P1</b>					
<i>Acacia curryana</i> (1, 2, 3)	Obconic or rounded spreading shrub 1.5-2.5 m high; stems and main branches contorted, small phyllodes	Unknown	Granite clay loam	Diffuse drainage channels	Dominant species
<i>Isotropis forrestii</i> (1)	Erect shrub to 1.5 m high. Yellow/orange/red flowers	Apr-Dec	Clay loam, alluvium	Drainage lines	<i>Eucalyptus camaldulensis</i>
<b>P2</b>					
<i>Rhodanthe frenchii</i> (1)	Erect annual herb to 0.35 m high, yellow flowers	Aug-Oct	Granite, sandstone, banded ironstone	Stony hills, river beds, outcrops, rocky gully	<i>Eremophila</i> spp., <i>Acacia</i> shrubland, <i>Eucalyptus camaldulensis</i>
<b>P3</b>					
<i>Gymnanthera cunninghamii</i> (1)	Erect shrub 1-2 m high, cream/yellow/green flowers	Jan-Dec	Sand	Drainage lines	<i>Eucalyptus camaldulensis</i> , <i>Eucalyptus victrix</i> , <i>Corymbia hamersleyana</i> , <i>Triodia</i> spp.
<i>Lawrenzia</i> sp. Anna Plains (N.T. Burbidge 1433)	Upright perennial herb to 0.8 m high. White flowers	Aug	Gravel	Flat	Mulga
<i>Maireana prosthocochaeta</i>	Open shrub with dense leaves to 0.6 m high.	Unknown	Laterite	Hills, saline areas	Mulga
<i>Sporobolus blakei</i> (1)	Tufted perennial grass 0.45-0.6 m high	Mar-Jul	Red sandy clay, loam	Creeks	<i>Acacia cyperophylla</i> woodland, <i>Acacia cuthbertsonii</i> shrubland

**Table 8: Range extension species targeted for survey**

Ecoscape (2015) should be viewed to decode the vegetation types.

Taxon	Type of record	Distance from nearest record	No. of locations within the study area	No. of WA Herbarium locations	Vegetation type	Likelihood of occurrence	Ecoscape comment
<i>Acacia craspedocarpa</i>	Range extension	260 km north of nearest known location within the Gascoyne IBRA region	1	134	Not recorded	Med	
<i>Corchorus sidoides</i> subsp. <i>sidoides</i>	Bioregional extension	220 km south of nearest known location in the Pilbara IBRA region	1	100	-	Med	
<i>Dodonaea pinifolia</i>	Range extension	270 km north of nearest known location in the Murchison IBRA region	1	322	Not recorded	Low	Unlikely to be detectable in current dry conditions
<i>Gymnanthera cunninghamii</i> (P3)	Range gap Bioregional extension	170 km of nearest known location in the Carnarvon IBRA region	1 plant	68	EcMgCc	Low	
<i>Hibiscus verdcourtii</i>	Bioregional extension	200 km southwest of nearest known location in the Pilbara IBRA region	1	14	EvReMg	Med	Unlikely to be detectable in current dry conditions
<i>Melhantha oblongifolia</i>	Bioregional extension	220 km south of nearest known location in the Pilbara IBRA region	5	302	AxEcAc, EcMgCc, ArPc	Med	



Taxon	Type of record	Distance from nearest record	No. of locations within the study area	No. of WA Herbarium locations	Vegetation type	Likelihood of occurrence	Ecoscape comment
<i>Sida</i> sp. Supplejack Station (T.S. Henshall 2345)	Bioregional extension	210 km southwest of nearest known location in the Pilbara IBRA region	1	10	Not recorded	Med	
<i>Sporobolus blakei</i> (P3)	Range gap	270 km of nearest known location in the Gascoyne IBRA region	8	15	AcEt, AxEcAc, EpAc, EvCc	Med	May not be detectable
<i>Swainsona oroboides</i>	Range extension	260 km northwest of nearest known location in the Gascoyne IBRA region	1	54	Not recorded	Med	Unlikely to be detectable in current dry conditions
<i>Urochloa subquadrifera</i>	Range extension	250 km west of nearest known location in the Gascoyne IBRA region	1	63	AcEt	Med	Annual; unlikely to be present in current dry conditions.

Species recorded by Ecoscape (2015) not targeted for searches:

- *Abutilon malvifolium*
- *Blumea tenella*
- *Bonamia media*
- *Bonamia pilbarensis*
- *Calotis porphyroglossa*
- *Corchorus tridens*
- *Cullen graveolens*
- *Elacholoma hornii*
- *Eremophila latrobei* subsp. *filiformis*
- *Eremophila platycalyx* subsp. *pardalota*
- *Eriochiton sclerolaenoides*
- *Euphorbia coghlanii*
- *Goodenia maideniana*
- *Hibiscus sturtii* var. *grandiflorus*
- *Hypericum gramineum*
- *Ipomoea coptica*
- *Ipomoea plebeia*
- *Ipomoea polymorpha*
- *Lysiana exocarpi*
- *Menkea sphaerocarpa*
- *Najas tenuifolia*
- *Notoleptopus decaisnei*
- *Oldenlandia galioides*
- *Podolepis kendallii*
- *Portulaca intraterranea*
- *Ptilotus auriculifolius*
- *Scaevola tomentosa* (note that this is likely to have been a misidentification in 2015)
- *Schoenoplectus laevis* (more recently known as *Schoenoplectiella laevis*)
- *Setaria surgens*
- *Sida* sp. verrucose glands (F.H. Mollemans 2423) (more recently known as *Sida* sp. L (A.M. Ashby 4202))
- *Sida spinosa*
- *Swainsona longipilosa*
- *Swainsona rotunda*
- *Triglochin hexagona*
- *Urochloa occidentalis* var. *ciliata*

- *Vigna lanceolata*
- *Vigna* sp. Hamersley Clay (A.A. Mitchell PRP 113)
- *Zygophyllum aurantiacum* subsp. *aurantiacum* (more recently known as *Roepera aurantiaca* Lindl. subsp. *aurantiaca*)
- *Zygophyllum eichleri* (more recently known as *Roepera eichleri* (R.M.Barker) Beier & Thulin).

## APPENDIX THREE

## QUADRAT DETAILS

## HY19104

**Staff** SOK                      **Date** 12/03/2019                      **Season** A  
**Revisit**  
**Type** Q 20 m x 20 m  
**Location**  
**MGA Zone** 50                      422962 mE                      7349298 mN                      **Lat.** -23.9663                      **Long.** 116.2428  
**Habitat** Flat  
**Aspect** N/A                      **Slope** N/A  
**Soil Type** Light red brown sandy loam  
**Rock Type** Quartz  
**Loose Rock** <2% cover ;                      6-20 mm in size                      **Litter** <1 % cover ; 0 cm in depth  
**Bare ground** 90% cover                      **Weeds** 0% cover  
**Vegetation** G+ ^^*Frankenia setosa*, *Sclerolaena medicaginooides*, *Eragrostis dielsii*^shrub, chenopod shrub, tussock grass\1\r  
**Veg. Condition** Very Good  
**Disturbance** Grazing  
**Fire Age** >10 years

## Notes



Species	WA Cons.	Height (m)	Cover (%)
<i>Aristida contorta</i>		0.1	<1
<i>Eragrostis dielsii</i>		0.1	1
<i>Frankenia hispidula</i>		0.3	<1
<i>Frankenia setosa</i>		0.4	7
<i>Gnephosis brevifolia</i>		0.1	<1
<i>Gomphrena kanisii</i>		0.2	<1
<i>Lepidium phlebopetalum</i>		0.1	<1

<i>Oldenlandia galioides</i>	0.1	<1
<i>Sclerolaena medicaginoidea</i>	0.5	1
<i>Trianthema triquetrum</i>	0.1	<1

---

## HY19105

**Staff** SOK                      **Date** 12/03/2019                      **Season** P  
**Revisit**  
**Type** Q 20 m x 20 m  
**Location**  
**MGA Zone** 50                      422794 mE                      7349417 mN                      **Lat.** -23.9652                      **Long.** 116.2411  
**Habitat** Flat  
**Aspect** N/A                      **Slope** N/A  
**Soil Type** Light red brown sandy loam  
**Rock Type** Nil  
**Loose Rock** 0% cover ;                      **Litter** <1 % cover ; 0 cm in depth  
**Bare ground** 85% cover                      **Weeds** 0% cover  
**Vegetation** G+ ^*Frankenia setosa*,^*Sclerolaena medicaginoidea*^shrub,chenopod shrub\1\r  
**Veg. Condition** Very Good  
**Disturbance** Grazing  
**Fire Age** >10 years

## Notes



Species	WA Cons.	Height (m)	Cover (%)
<i>Aristida contorta</i>		0.1	<1
<i>Eragrostis dielsii</i>		0.1	1
<i>Frankenia hispidula</i>		0.2	<1
<i>Frankenia setosa</i>		0.5	8
<i>Gnephosis brevifolia</i>		0.1	<1
<i>Gomphrena kanisii</i>		0.2	<1
<i>Sclerolaena medicaginoidea</i>		0.5	2

*Senna artemisioides* subsp. *oligophylla*

0.6

<1

---

## HY19106

**Staff** SOK                      **Date** 13/03/2019                      **Season** P  
**Revisit**  
**Type** Q 20 m x 20 m  
**Location**  
**MGA Zone** 50                      423007 mE                      7345348 mN                      **Lat.** -24.0020                      **Long.** 116.2430  
**Habitat** Flat  
**Aspect** N/A                      **Slope**  
**Soil Type** Red clay loam  
**Rock Type** Quartz, ironstone  
**Loose Rock** 20-50% cover ;                      6-20 mm in size                      **Litter** 1 % cover ; 0 cm in depth  
**Bare ground** 95% cover                      **Weeds** 0% cover  
**Vegetation** M+ ^*Eremophila cuneifolia*, *Acacia tetragonophylla*, *Senna artemisioides* subsp. *helmsii* ^shrub\3r; G ^*Eremophea spinosa* ^chenopod shrub\1r  
**Veg. Condition** Very Good  
**Disturbance** Grazing  
**Fire Age** >10 years

## Notes



Species	WA Cons.	Height (m)	Cover (%)
<i>Acacia cuthbertsonii</i> subsp. <i>cuthbertsonii</i>		0.6	<1
<i>Acacia synchronicia</i>		0.5	<1
<i>Acacia tetragonophylla</i>		1	<1
<i>Aristida contorta</i>		0.2	<1
<i>Brachyachne prostrata</i>		0.1	<1
<i>Enneapogon caerulescens</i>		0.2	<1
<i>Eremophea spinosa</i>		0.4	3



<i>Eremophila cuneifolia</i>	1	4
<i>Senna artemisioides</i> subsp. <i>helmsii</i>	1	1

---

## HY19107

**Staff** SOK                      **Date** 13/03/2019                      **Season** P  
**Revisit**  
**Type** Q 20 m x 20 m  
**Location**  
**MGA Zone** 50                      415676 mE                      7358262 mN                      **Lat.** -23.8850                      **Long.** 116.1717  
**Habitat** Crest  
**Aspect** NW                      **Slope** Moderate  
**Soil Type** Red brown loam  
**Rock Type** Chert  
**Loose Rock** 50-90% cover ; 60-200 mm in size                      **Litter** 1 % cover ; 0-1 cm in depth  
**Bare ground** 90% cover                      **Weeds** 0% cover  
**Vegetation** M+ ^Eremophila exilifolia,Eremophila latrobei subsp. latrobei,Acacia tetragonophylla^shrub\3\r;G  
^Ptilotus obovatus var. obovatus,^Eriachne mucronata^shrub,tussock grass\1\r  
**Veg. Condition** Very Good  
**Disturbance** Minimal, some grazing  
**Fire Age** >10 years

## Notes



Species	WA Cons.	Height (m)	Cover (%)
<i>Acacia aptaneura</i>		3	1
<i>Acacia tetragonophylla</i>		1.3	1
<i>Cheilanthes brownii</i>		0.2	<1
<i>Dodonaea petiolaris</i>		0.7	<1
<i>Eremophila exilifolia</i>		1.5	5
<i>Eremophila latrobei</i> subsp. <i>latrobei</i>		1.3	2
<i>Eremophila reticulata</i>		1	<1

<i>Eriachne mucronata</i>		0.3	3
<i>Gomphrena cunninghamii</i>		0.2	2
<i>Grevillea berryana</i>		0.5	<1
<i>Psydrax latifolia</i>		1	<1
<i>Ptilotus obovatus</i> var. <i>obovatus</i>		0.5	5
<i>Rhodanthe frenchii</i>	P 2	0.2	<1
<i>Solanum horridum</i>		0.2	<1
<i>Solanum lasiophyllum</i>		0.3	<1

---

## HY19108

**Staff** SOK                      **Date** 13/03/2019                      **Season** P  
**Revisit**  
**Type** Q 20 m x 20 m  
**Location** Stoney undulating plain  
**MGA Zone** 50                      415953 mE                      7363071 mN                      **Lat.** -23.8415                      **Long.** 116.1747  
**Habitat** Low undulating hills  
**Aspect** SE                      **Slope** Very Gentle  
**Soil Type** Clay Loam  
**Rock Type** Mixed  
**Loose Rock** 50-90% cover ; 20-60 mm in size                      **Litter** 2 % cover ; 0-1 cm in depth  
**Bare ground** 55% cover                      **Weeds** 0% cover  
**Vegetation** U ^*Acacia pruinocarpa*,^*Grevillea berryana*\tree\6\i;M+ ^*Eremophila phyllopoda*,*Acacia kempeana*\shrub\3\i;G ^*Ptilotus obovatus* var. *obovatus*,^*Gomphrena kanisii*\shrub\1\bi  
**Veg. Condition** Very Good  
**Disturbance** Minimal, some grazing  
**Fire Age** >10 years

## Notes



Species	WA Cons.	Height (m)	Cover (%)
<i>Acacia kempeana</i>		1.5	6
<i>Acacia pruinocarpa</i>		10	12
<i>Acacia ramulosa</i> var. <i>linophylla</i>		4	0.5
<i>Aristida contorta</i>		0.2	<1
<i>Eremophila phyllopoda</i>		1.5	12
<i>Eriachne pulchella</i>		0.4	<1
<i>Gomphrena kanisii</i>		0.1	<1

<i>Grevillea berryana</i>	4	5
<i>Hibiscus sturtii</i> var. <i>campylochlamys</i>	0.1	<1
<i>Ptilotus exaltatus</i>	0.4	<1
<i>Ptilotus obovatus</i> var. <i>obovatus</i>	0.1	<1
<i>Senna glutinosa</i> subsp. x <i>luerssenii</i>	0.6	<1
<i>Sida</i> sp. dark green fruits (S. van Leeuwen 2260)	0.1	<1
<i>Solanum lasiophyllum</i>	0.4	<1

---

## HY19109

**Staff** SOK                      **Date** 13/03/2019                      **Season** P  
**Revisit**  
**Type** Q 20 m x 20 m  
**Location**  
**MGA Zone** 50                      425969 mE                      7356826 mN                      **Lat.** -23.8985                      **Long.** 116.2727  
**Habitat** Flat  
**Aspect** N/A                      **Slope** N/A  
**Soil Type** Brown clay loam  
**Rock Type** Quartz  
**Loose Rock** 50-90% cover ; 20-60 mm in size                      **Litter** <1 % cover ; 0 cm in depth  
**Bare ground** 98% cover                      **Weeds** 0% cover  
**Vegetation** M+ ^Acacia synchronicia, Eremophila cuneifolia, Senna sp. Meekatharra (E. Bailey 1-26)  
 \shrub\3r;G ^Aristida contorta\1tussock grass\1r  
**Veg. Condition** Very Good  
**Disturbance** Grazing  
**Fire Age** >10 years

## Notes



Species	WA Cons.	Height (m)	Cover (%)
<i>Acacia synchronicia</i>		1	2
<i>Aristida contorta</i>		0.2	<1
<i>Brachyachne prostrata</i>		0.1	<1
<i>Enneapogon caerulescens</i>		0.2	<1
<i>Eremophila cuneifolia</i>		0.7	<1
<i>Portulaca intraterranea</i>		0.1	<1
<i>Ptilotus exaltatus</i>		0.4	<1

<i>Salsola australis</i>	0.1	<1
<i>Senna artemisioides</i> subsp. <i>helmsii</i>	0.6	<1
<i>Senna artemisioides</i> subsp. <i>oligophylla</i>	0.6	<1
<i>Senna</i> sp. Meekatharra (E. Bailey 1-26)	0.5	<1
<i>Trianthema triquetrum</i>	0.1	<1

---

## HY19110

**Staff** SOK                      **Date** 15/03/2019                      **Season** P  
**Revisit**  
**Type** Q 20 m x 20 m  
**Location**  
**MGA Zone** 50                      407060 mE                      7359136 mN                      **Lat.** -23.8766                      **Long.** 116.0871  
**Habitat** Clay depression  
**Aspect** N/A                      **Slope** N/A  
**Soil Type** Red brown clay  
**Rock Type** Ironstone, quartz  
**Loose Rock** <2% cover ;                      6-20 mm in size                      **Litter** 5 % cover ; 0-2 cm in depth  
**Bare ground** 85% cover                      **Weeds** 0% cover  
**Vegetation** U+ ^*Acacia citrinoviridis*,*Acacia tetragonophylla*,*Acacia aptaneura*^tree\6i;M ^*Senna artemisioides* subsp. *oligophylla*,^*Eremophila cuneifolia*^shrub\3r;G ^*Eragrostis setifolia*^tussock grass\1r  
**Veg. Condition** Very Good  
**Disturbance** Grazing  
**Fire Age** >10 years

## Notes



Species	WA Cons.	Height (m)	Cover (%)
<i>Acacia aptaneura</i>		5	2
<i>Acacia citrinoviridis</i>		7	10
<i>Acacia synchronicia</i>		0.8	<1
<i>Acacia tetragonophylla</i>		5	5
<i>Centipeda minima</i> subsp. <i>macrocephala</i>		0.1	<1
* <i>Citrullus amarus</i>		0.1	<1



---

<i>Corchorus tridens</i>	0.1	<1
<i>Duperreya commixta</i>	0.8	<1
<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>	0.3	<1
<i>Eragrostis setifolia</i>	0.2	5
<i>Eremophila cuneifolia</i>	1	1
<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>	0.1	<1
* <i>Malvastrum americanum</i>	0.4	<1
<i>Marsilea hirsuta</i>	0.1	<1
<i>Phyllanthus maderaspatensis</i>	0.3	<1
<i>Polymeria longifolia</i>	0.2	<1
<i>Ptilotus obovatus</i> var. <i>obovatus</i>	0.5	<1
<i>Scaevola spinescens</i>	0.5	<1
<i>Scaevola spinescens</i>	0.5	<1
<i>Senna artemisioides</i> subsp. <i>oligophylla</i>	1.5	2
<i>Solanum lasiophyllum</i>	0.3	<1
* <i>Vachellia farnesiana</i>	2	1

---

## HY19111

**Staff** SOK                      **Date** 15/03/2019                      **Season** P  
**Revisit**  
**Type** Q 20 m x 20 m  
**Location**  
**MGA Zone** 50                      407446 mE                      7359788 mN                      **Lat.** -23.8707                      **Long.** 116.0910  
**Habitat** Clay depression  
**Aspect** N/A                      **Slope** N/A  
**Soil Type** Red brown clay  
**Rock Type** Nil  
**Loose Rock** 0% cover ;                      **Litter** 2 % cover ; 0-1 cm in depth  
**Bare ground** 85% cover                      **Weeds** <1 % cover  
**Vegetation** U+ ^*Acacia aptaneura*,^*Acacia synchronicia*^tree\6i;M ^*Eremophila phyllopoda*^shrub\3r;G  
^*Eragrostis setifolia*,*Marsilea hirsuta*,*Centipeda minima* subsp. *macrocephala*^tussock grass,  
fern,forb\1i  
**Veg. Condition** Very Good  
**Disturbance** Grazing  
**Fire Age** >10 years

## Notes



Species	WA Cons.	Height (m)	Cover (%)
<i>Abutilon malvifolium</i>		0.1	<1
<i>Acacia aptaneura</i>		6	7
<i>Acacia kempeana</i>		3	3
<i>Acacia synchronicia</i>		4	3
<i>Acacia tetragonophylla</i>		4	3
<i>Aeschynomene indica</i>		0.3	<1

---

<i>Alternanthera denticulata</i>	0.1	<1
* <i>Bidens subalternans</i> var. <i>simulans</i>	0.2	<1
<i>Bulbostylis turbinata</i>	0.1	<1
<i>Centipeda minima</i> subsp. <i>macrocephala</i>	0.1	5
<i>Cleome viscosa</i>	0.2	<1
<i>Corchorus tridens</i>	0.1	<1
<i>Crotalaria medicaginea</i> var. <i>neglecta</i>	0.2	<1
<i>Dichanthium sericeum</i> subsp. <i>humilius</i>	0.2	<1
<i>Eragrostis setifolia</i>	0.3	5
<i>Eremophila phyllopoda</i>	1.5	2
<i>Glinus lotoides</i>	0.1	<1
<i>Goodenia</i> sp.	0.1	<1
<i>Haloragis trigonocarpa</i>	0.2	<1
<i>Ipomoea calobra</i>	2	<1
<i>Lotus cruentus</i>	0.1	<1
* <i>Malvastrum americanum</i>	0.3	<1
<i>Marsilea hirsuta</i>	0.1	10
<i>Phyllanthus maderaspatensis</i>	0.2	<1
<i>Psydrax latifolia</i>	2	<1
<i>Ptilotus gomphrenoides</i>	0.1	<1
<i>Solanum lasiophyllum</i>	0.4	<1
<i>Swainsona</i> sp.	0.3	<1

---

## HY19112

**Staff** SOK                      **Date** 16/03/2019                      **Season** P  
**Revisit**  
**Type** Q 20 m x 20 m  
**Location**  
**MGA Zone** 50                      417638 mE                      7358851 mN                      **Lat.** -23.8798                      **Long.** 116.1910  
**Habitat** Flat  
**Aspect** N/A                      **Slope** N/A  
**Soil Type** Red brown clay loam  
**Rock Type** Quartz  
**Loose Rock** 20-50% cover ;    20-60 mm in size                      **Litter** 3 % cover ; 0-1 cm in depth  
**Bare ground** 90% cover                      **Weeds** 0% cover  
**Vegetation** U ^*Acacia synchronicia*, ^*Hakea preissii* ^tree\6\r; M+ ^*Eremophila cuneifolia*, ^*Senna artemisioides* subsp. *oligophylla* ^shrub\3\r; G ^*Frankenia hispidula*, ^*Sclerolaena cuneata* ^shrub, chenopod shrub\1\r  
**Veg. Condition** Very Good  
**Disturbance** Grazing  
**Fire Age** >10 years

## Notes



Species	WA Cons.	Height (m)	Cover (%)
<i>Acacia synchronicia</i>		3	2
<i>Acacia tetragonophylla</i>		0.3	<1
<i>Aristida contorta</i>		0.2	<1
<i>Enteropogon ramosus</i>		0.3	<1
<i>Eragrostis xerophila</i>		0.1	<1
<i>Eremophila cuneifolia</i>		1	5

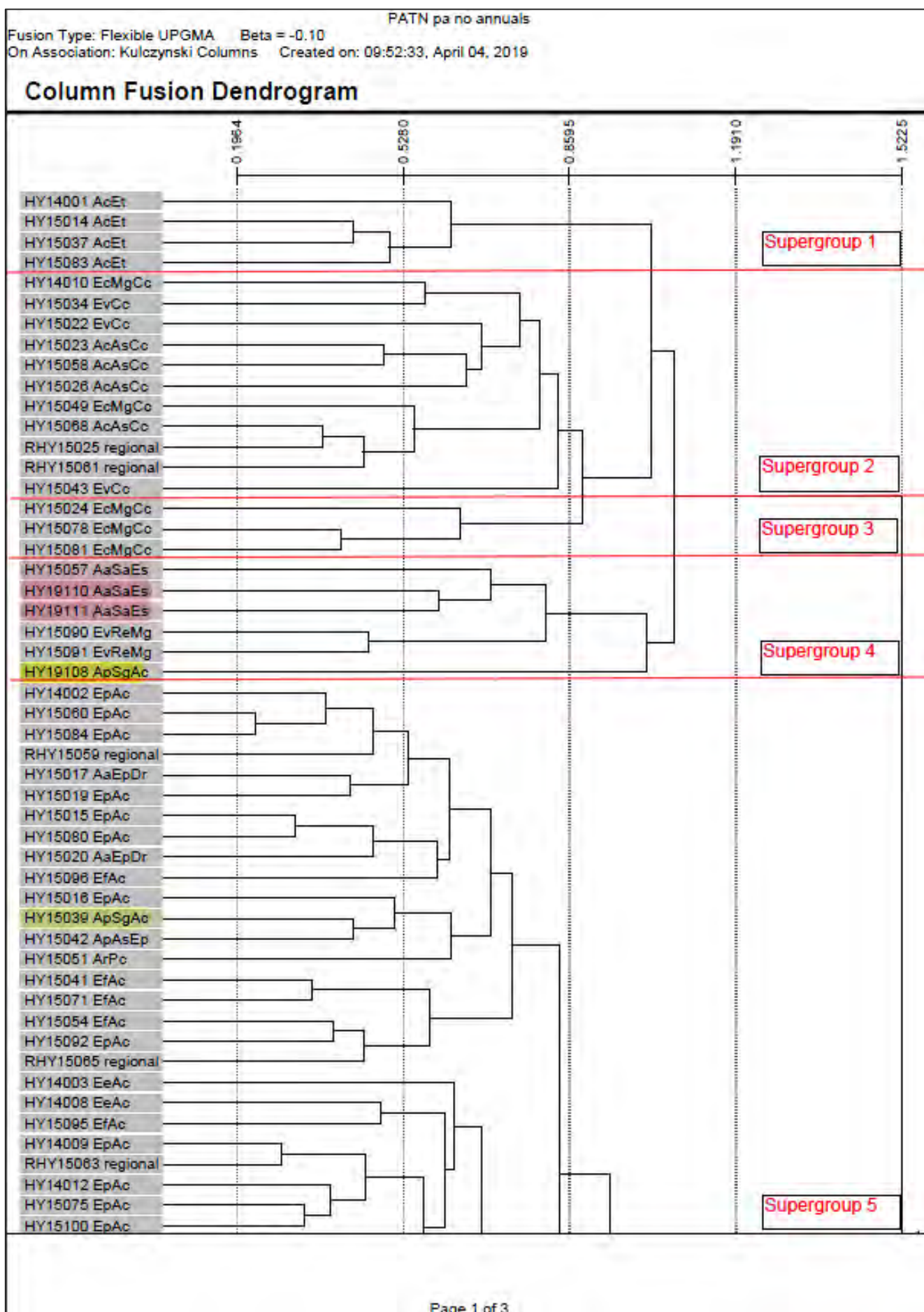
<i>Frankenia hispidula</i>	0.3	3
<i>Hakea preissii</i>	2	2
<i>Scaevola spinescens</i>	1	2
<i>Sclerolaena cuneata</i>	0.3	3
<i>Sclerolaena eriacantha</i>	0.1	<1
<i>Senna artemisioides</i> subsp. <i>oligophylla</i>	1	2
<i>Senna hamersleyensis</i>	0.2	<1
<i>Senna</i> sp. Meekatharra (E. Bailey 1-26)	1	<1
<i>Trianthema triquetrum</i>	0.1	<1

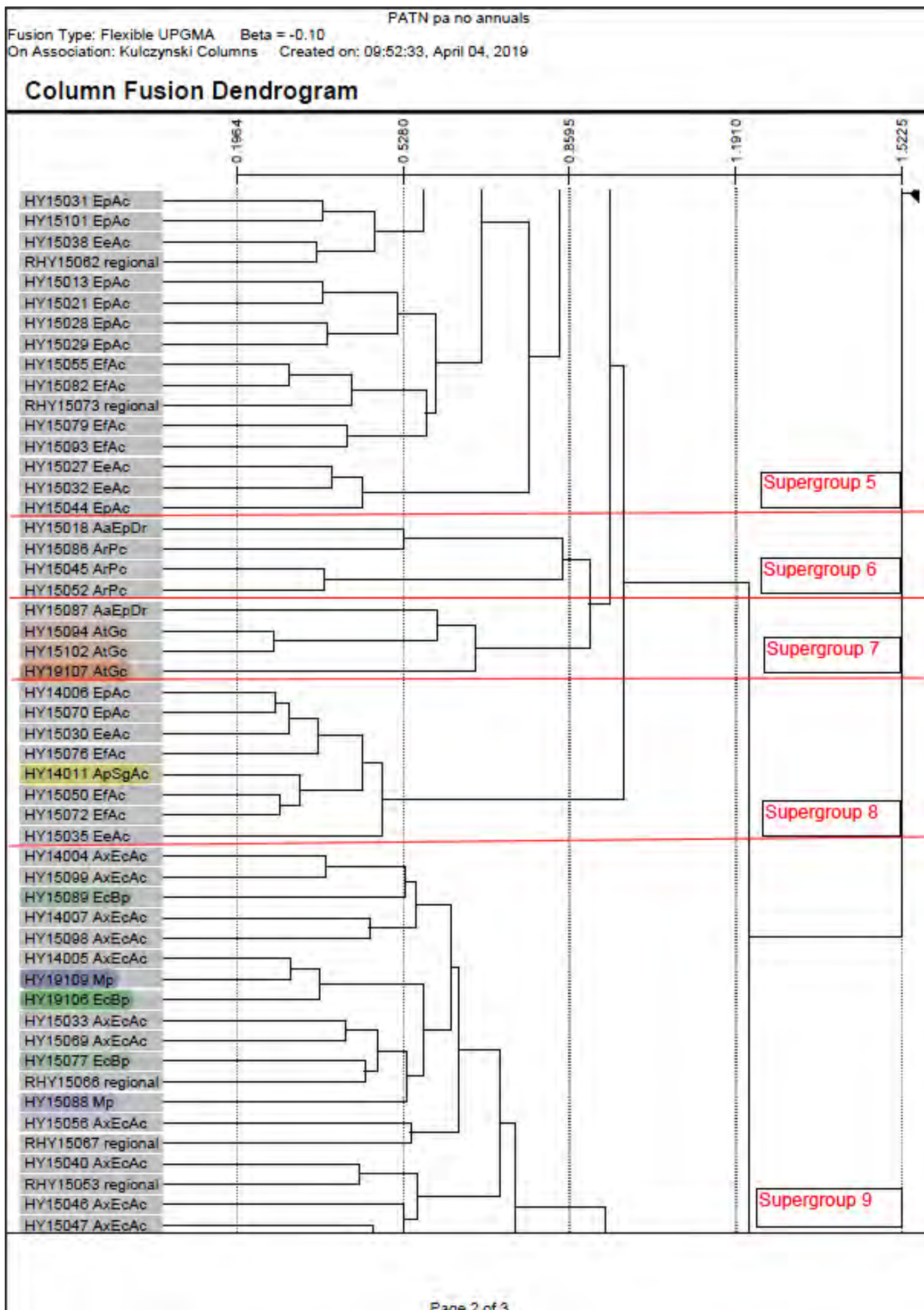
---

## **APPENDIX FOUR            FLORISTIC ANALYSIS**

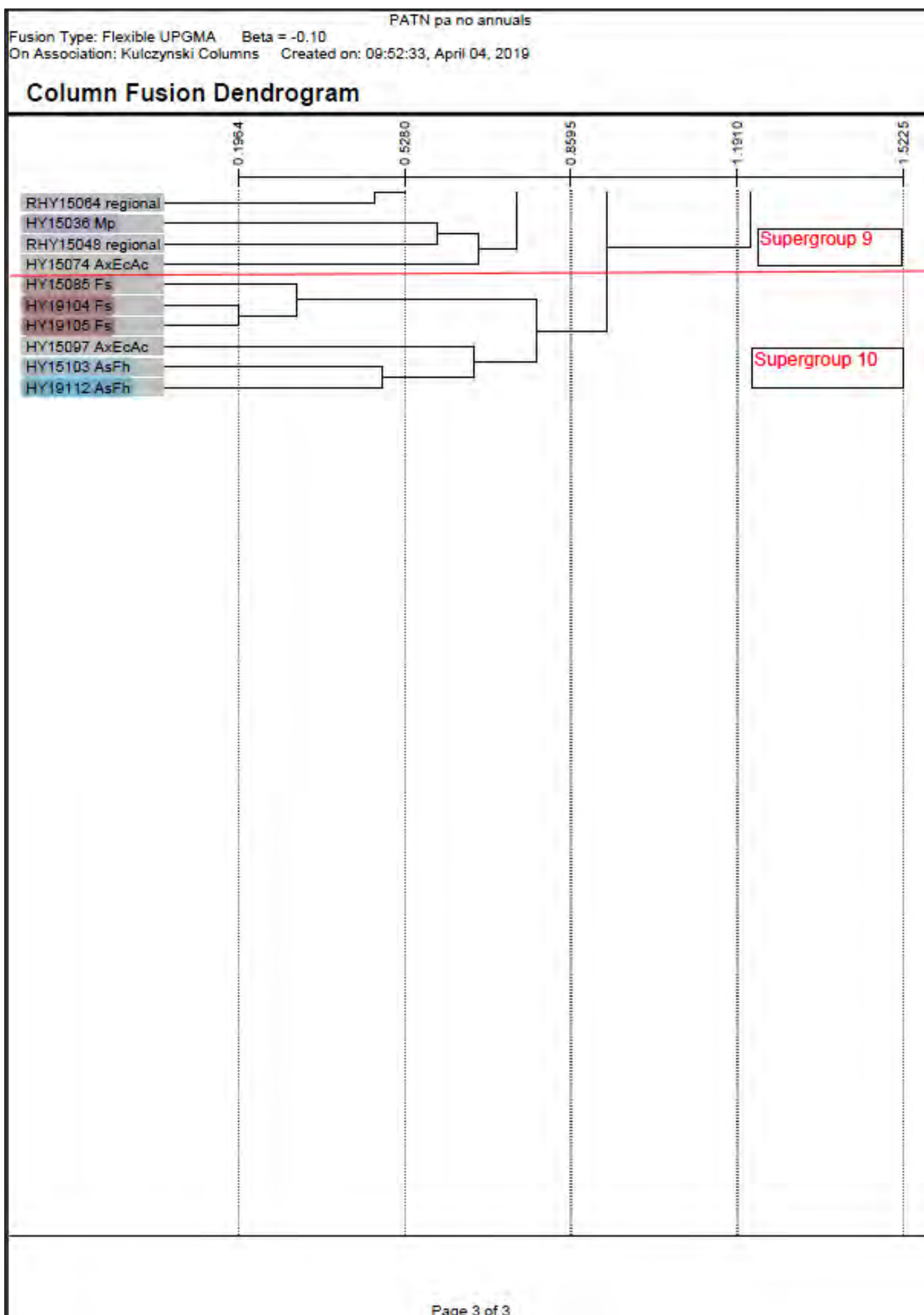
The floristic analysis dendrogram is included on the following pages.

The various colours highlight the vegetation types that were identified as requiring additional quadrats, with the darker hue of each colour indicating the new (2019) quadrats.









# APPENDIX FIVE

# FLORA INVENTORY

Table 9: Flora inventory (site x species)

Family	Species	Naturalised	Cons. code	HY19104	HY19105	HY19106	HY19107	HY19108	HY19109	HY19110	HY19111	HY19112	Targeted
Aizoaceae	<i>Trianthema triquetrum</i>			X					X			X	
Amaranthaceae	<i>Alternanthera denticulata</i>										X		
	<i>Gomphrena cunninghamii</i>						X						
	<i>Gomphrena kanisii</i>			X	X			X					
	<i>Ptilotus exaltatus</i>							X	X				
	<i>Ptilotus gomphrenoides</i>										X		
	<i>Ptilotus obovatus</i> var. <i>obovatus</i>						X	X		X			
Asteraceae	<i>Bidens subalternans</i> var. <i>simulans</i>	*									X		
	<i>Centipeda minima</i> subsp. <i>macrocephala</i>									X	X		
	<i>Gnephosis brevifolia</i>			X	X								
	<i>Rhodanthe frenchii</i>		P2				X						X
Brassicaceae	<i>Lepidium phlebopetalum</i>			X									
Chenopodiaceae	<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>									X			
	<i>Eremophea spinosa</i>					X							
	<i>Salsola australis</i>								X				
	<i>Sclerolaena cuneata</i>											X	
	<i>Sclerolaena eriacantha</i>											X	
	<i>Sclerolaena medicaginooides</i>			X	X								
Cleomaceae	<i>Cleome viscosa</i>										X		
Convolvulaceae	<i>Duperreya commixta</i>									X			
	<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>									X			
	<i>Ipomoea calobra</i>										X		
	<i>Polymeria longifolia</i>									X			
Cucurbitaceae	<i>Citrullus amarus</i>	*								X			
Cyperaceae	<i>Bulbostylis turbinata</i>										X		
Fabaceae	<i>Acacia aptaneura</i>						X			X	X		
	<i>Acacia citrinoviridis</i>									X			
	<i>Acacia curryana</i>		P1										X
	<i>Acacia cuthbertsonii</i> subsp. <i>cuthbertsonii</i>					X							
	<i>Acacia kempeana</i>							X			X		
	<i>Acacia pruinocarpa</i>							X					
	<i>Acacia ramulosa</i> var. <i>linophylla</i>							X					
	<i>Acacia synchronicia</i>					X			X	X	X	X	
	<i>Acacia tetragonophylla</i>					X	X			X	X	X	
	<i>Aeschynomene indica</i>										X		
	<i>Crotalaria medicaginea</i> var. <i>neglecta</i>										X		
	<i>Lotus cruentus</i>										X		
	<i>Senna artemisioides</i> subsp. <i>helmsii</i>					X			X				
	<i>Senna artemisioides</i> subsp. <i>oligophylla</i>				X				X	X		X	
	<i>Senna glutinosa</i> subsp. <i>x luerssenii</i>							X					

Family	Species	Naturalised	Cons. code	HY19104	HY19105	HY19106	HY19107	HY19108	HY19109	HY19110	HY19111	HY19112	Targeted
	<i>Senna hamersleyensis</i>											X	
	<i>Senna</i> sp. Meekatharra (E. Bailey 1-26)								X			X	
	<i>Swainsona</i> sp.										X		
	<i>Vachellia farnesiana</i>	*								X			
Frankeniaceae	<i>Frankenia hispidula</i>			X	X							X	
	<i>Frankenia setosa</i>			X	X								
Goodeniaceae	<i>Goodenia</i> sp.										X		
	<i>Scaevola spinescens</i>									X		X	
Haloragaceae	<i>Haloragis trigonocarpa</i>										X		
Malvaceae	<i>Abutilon malvifolium</i>										X		
	<i>Corchorus tridens</i>									X	X		
	<i>Hibiscus sturtii</i> var. <i>campylochlamys</i>							X					
	<i>Malvastrum americanum</i>	*								X	X		
	<i>Sida</i> sp. dark green fruits (S. van Leeuwen 2260)							X					
Marsileaceae	<i>Marsilea hirsuta</i>									X	X		
Molluginaceae	<i>Glinus lotoides</i>										X		
Phyllanthaceae	<i>Phyllanthus maderaspatensis</i>									X	X		
Poaceae	<i>Aristida contorta</i>			X	X	X		X	X			X	
	<i>Cynodon prostratus</i>					X			X				
	<i>Dichanthium sericeum</i> subsp. <i>humilius</i>										X		
	<i>Enneapogon caeruleus</i>					X			X				
	<i>Enteropogon ramosus</i>											X	
	<i>Eragrostis dielsii</i>			X	X								
	<i>Eragrostis setifolia</i>									X	X		
	<i>Eragrostis xerophila</i>											X	
	<i>Eriachne mucronata</i>						X						
	<i>Eriachne pulchella</i>							X					
	<i>Sporobolus blakei</i>		P3										X
Portulacaceae	<i>Portulaca intraterranea</i>								X				
Proteaceae	<i>Grevillea berryana</i>						X	X					
	<i>Hakea preissii</i>											X	
Pteridaceae	<i>Cheilanthes brownii</i>						X						
Rubiaceae	<i>Oldenlandia galioides</i>			X									
	<i>Psydrax latifolia</i>						X				X		
Sapindaceae	<i>Dodonaea petiolaris</i>						X						
Scrophulariaceae	<i>Eremophila cuneifolia</i>					X			X	X		X	
	<i>Eremophila exilifolia</i>						X						
	<i>Eremophila latrobei</i> subsp. <i>latrobei</i>						X						
	<i>Eremophila phyllopoda</i>							X			X		
	<i>Eremophila reticulata</i>						X						
Solanaceae	<i>Solanum horridum</i>						X						
	<i>Solanum lasiophyllum</i>						X	X		X	X		