



**Jinidi**  
Detailed Flora and  
Vegetation Survey  
Interim Report: Dry-  
season

Technical Memorandum to BHP  
Western Australia Iron Ore Pty  
Ltd

10 January 2024

# 1 Introduction

## 1.1 Background

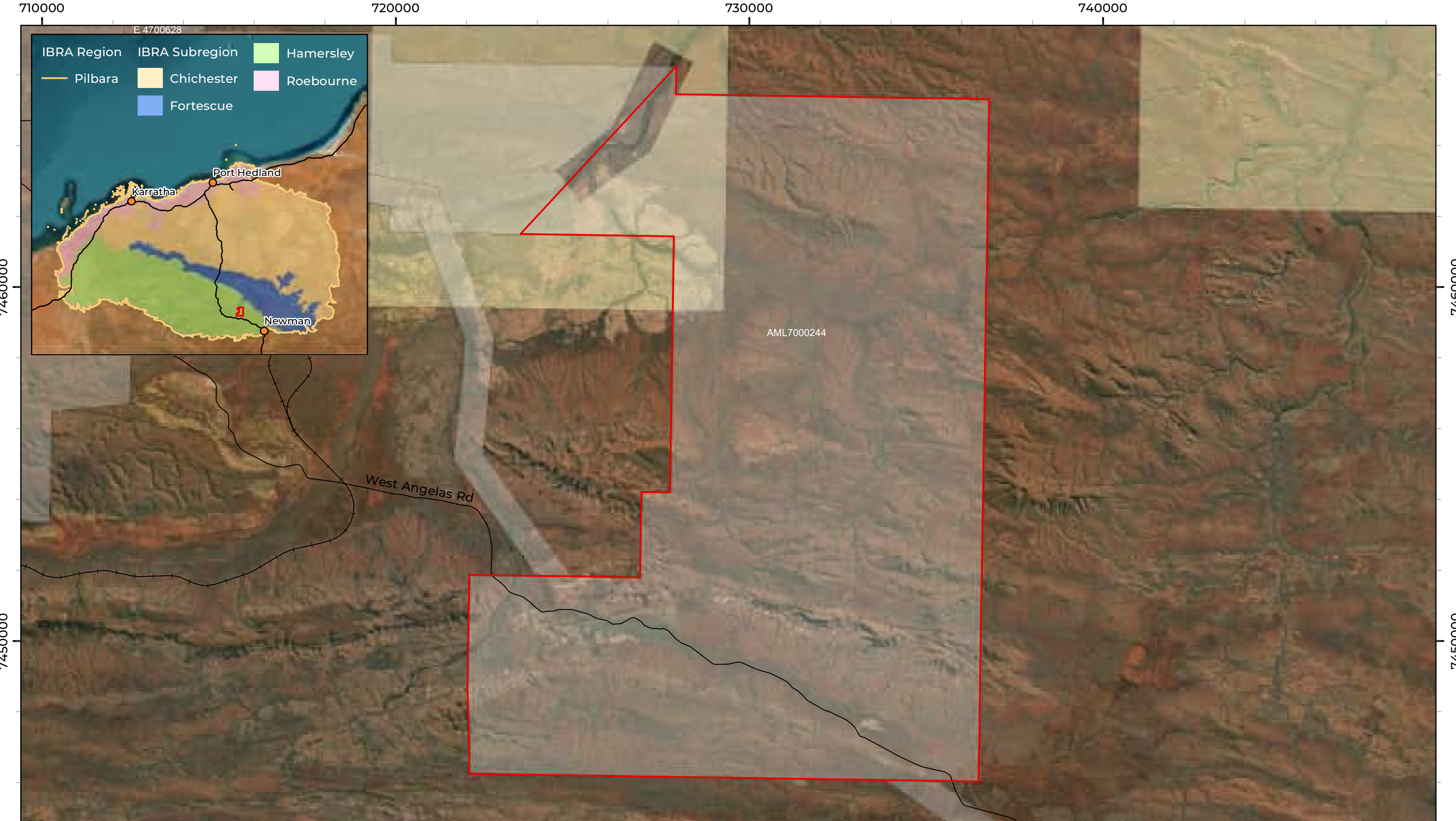
BHP Western Australia Iron Ore (BHP WAIO) is currently in the process of developing the Jinidi iron ore project, located in the Pilbara region of Western Australia, approximately 70 kilometres (km) northwest of Newman (Figure 1.1). BHP WAIO commissioned Biologic Environmental Survey Pty Ltd (Biologic) to undertake a two-season detailed flora and vegetation survey in the Jinidi project area (hereafter referred to as the Survey Area). The Survey Area is located approximately 50 kilometres (km) north-west of Newman and covers an area of 21,461.84 hectares (ha). The Survey Area comprises four sections (Figure 1.1):

- Jinidi;
- South Parmelia;
- North-East Corner; and
- Weeli Wolli Spring Priority Ecological Community (PEC).

This interim survey report highlights the preliminary results and findings from the 2023 dry-season survey trips detailed in Table 1.1. Following sampling in the 2024 wet-season (scheduled for March-April 2024), as a part of the full two-season detailed flora and vegetation survey, a consolidated report will be provided in the format listed in the scope of works.

Table 1.1: Summary of Jinidi dry-season survey details

Survey Trip	Survey Date	Survey Type	Timing)
Trip 1	12 <sup>th</sup> – 19 <sup>th</sup> September 2023	Detailed Flora and Vegetation Survey	Dry-season 2023
Trip 2	27 <sup>th</sup> October – 3 <sup>d</sup> November 2023	Detailed Flora and Vegetation Survey	Dry-season 2023



**LEGEND**

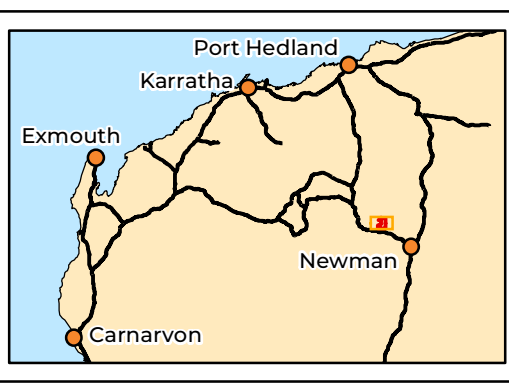
Survey Area
 Pastoral Station or Lease  
 Live Mining Tenement
 Marillana Station  
 Rail  
 Local Road

**Biologic**

Scale 1:100,000

0 1 2 3 4 Km

Coordinate System: GDA 1994 MGA Zone 50  
 Projection: Transverse Mercator  
 Datum: GDA 1994 Created 12/12/2023



**BHP WAIO**  
 Jinidi Detailed Flora  
 and Vegetation Survey

**Figure 1.1: Survey Area  
 and regional context**

## 2 Desktop Assessment

A desktop assessment, comprising database searches and a literature review, was undertaken prior to the field survey. The purpose of the desktop assessment is mainly to identify significant flora taxa and vegetation occurrence potential in relation to the Survey Area. Please note that this desktop assessment is preliminary only and may be adjusted in the final consolidated report.

### 2.1 Significant Flora

The desktop assessment identified 66 Priority listed flora (ten P1, eleven P2, thirty-eight P3, seven P4) occurring within or in the vicinity of the Survey Area. No Threatened flora taxa were identified by the desktop assessment. These taxa were then assessed against a decision matrix for their pre-survey likelihood of occurrence in the Survey Area (Table 2.1). Pre-survey likelihoods for taxa considered Confirmed, Highly Likely, Likely and Possible is presented in Table 2.2.

Table 2.1: Occurrence assessment decision matrix

Known Record's Proximity to the Survey Area	Habitat Categories within the Survey Area			
	Core/ Critical Habitat Present	Suitable Habitat Present/ within Known Distribution	Marginal Habitat Present/ Adjacent to Known Distribution	Not Present/ Outside of Known Distribution
<b>Within the Survey Area</b>	Confirmed	Confirmed	Confirmed	Confirmed
<b>Within &lt;5 km</b>	Highly Likely	Likely	Possible	Possible
<b>Within 5-15 km</b>	Likely	Possible	Possible	Unlikely
<b>Within 15-40 km</b>	Possible	Possible	Unlikely	Unlikely
<b>Greater than 40 km</b>	Possible	Unlikely	Unlikely	Highly Unlikely
<b>Taxa Considered Locally/Regionally Extinct</b>	Unlikely	Unlikely	Highly Unlikely	Highly Unlikely

Table 2.2: Assessment of occurrence within the Survey Area pre-survey

Taxon	Status	Description	Approximate Distance from Survey Area
<b>Confirmed</b>			
<i>Acacia subtiliformis</i>	P3	Spindly, slender, erect shrub, to 3.5 m high, phyllodes green, new growth slightly viscid, resinous, aromatic; inflorescence in heads to 6 mm diameter; peduncles red. Fl. yellow, Jun. On rocky calcrete plateau.	Within
<i>Fimbristylis sieberiana</i>	P3	Shortly rhizomatous, tufted perennial, grass-like or herb (sedge), 0.25-0.6 m high. Fl. brown, May to Jun. Mud, skeletal soil pockets. Pool edges, sandstone cliffs.	Within
<i>Goodenia</i> sp. East Pilbara (A.A. Mitchell PRP 727)	P3	Open, erect annual or biennial, herb, to 0.2 m high. Fl. yellow. Red-brown clay soil, calcrete pebbles. Low undulating plain, swampy plains.	Within
<i>Grevillea saxicola</i>	P3	Tree or shrub, to 8 m high, rough bark on trunks and stems. Fl. creamy white. Skeletal red brown sandy loam with ironstone pebble cover. Rocky gully, drainage lines, steep cliff, low rocky hills.	Within
<i>Gymnanthera cunninghamii</i>	P3	Erect shrub, 1-2 m high. Fl. cream-yellow-green, Jan to Dec. Sandy soils.	Within
<i>Indigofera gilesii</i>	P3	Shrub, to 1.5 m high. Fl. purple-pink, May or Aug. Pebbly loam. Amongst boulders & outcrops, hills.	Within
<i>Isotropis parviflora</i>	P3	Shrub, 0.1 m high. Fl. white/pink, Mar. Valley slope of ironstone plateau.	Within
<i>Rostellularia adscendens</i> var. <i>latifolia</i>	P3	Herb or shrub, 0.1-0.3 m high. Fl. blue-purple-violet, Apr to May. Ironstone soils. Near creeks, rocky hills.	Within
<i>Stylidium weeliwoolli</i>	P3	Annual, herb, 0.1-0.25 m high, throat appendages 4, rod-shaped. Fl. pink & red, Aug to Sep. Gritty sand soil, sandy clay. Edge of watercourses.	Within
<i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739)	P3	Perennial, grass-like or herb, 0.4 m high. Light orange-brown, pebbly loam. Amongst rocks & outcrops, gully slopes.	Within
<i>Lepidium catapycnon</i>	P4	Open, woody perennial, herb or shrub, 0.2-0.3 m high, stems zigzag. Fl. white, Oct. Skeletal soils. Hillsides.	Within
<b>Highly Likely</b>			
<i>Aristida lazaridis</i>	P2	Tufted perennial, grass-like or herb, 0.4-1.5 m high. Fl. green/purple, Apr. Sand or loam.	0.9 km S
<i>Cladium procerum</i>	P2	Densely tufted perennial, grass-like or herb (sedge), 2 m high. Fl. Nov (?). Perennial pools.	0.3 km N
<i>Eremophila naaykensis</i>	P3	Erect shrub, 1-3 m high. Fl. White/pale blue. Red brown sandy clay loam. Upper slopes, gullies, gorges.	0.2 km WNW
<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794)	P3	Tall spindly shrub, 1.5-4 m high. Fl. yellow. Red brown sandy loam or clay, ironstone plain. Undulating plains, floodplain.	0.4 km WNW
<b>Likely</b>			
<i>Hibiscus</i> sp. Gurinbidy Range (M.E. Trudgen MET 15708)	P2	Erect slender shrub, 1-3 m high. Fl. pale purple. Loamy skeletal soils. Gorge with ironstone outcropping, gullies, drainage line.	5.5 km W

Taxon	Status	Description	Approximate Distance from Survey Area
<b>Possible</b>			
<i>Eremophila</i> sp. West Angelas (S. van Leeuwen 4068)	P2	Spindly shrub, 0.4-3 m high. Skeletal brown-red soil or loam. Hill slopes and summits.	18.1 km SSE
<i>Ipomoea racemigera</i>	P2	Creeping annual, herb or climber. Fl. white.	27.7 km NW
<i>Oxalis</i> sp. Pilbara (M.E. Trudgen 12725)	P2	Annual herb, 0.1-0.3 m high. Fl. Yellow. Brown sandy loam or clay. Gorge, ironstone outcrops, gully, shaded areas, creeklines.	8.7 km SSE
<i>Amaranthus centralis</i>	P3	Annual herb, decumbent or erect to 0.6 m high. Grows in red sand in ephemeral watercourses, sandy to clayey loam on riverbanks and edges of permanent pools in eucalypt lined channels, or acacia shrubland	16.9 km NW
<i>Aristida jerichoensis</i> var. <i>subspinulifera</i>	P3	Compactly tufted perennial, grass-like or herb, 0.3-0.8 m high, lemma groove muricate. Hardpan plains.	1.6 km S
<i>Dampiera metallorum</i>	P3	Rounded, multistemmed perennial, herb, to 0.5 m high. Fl. blue, Apr or Jun to Oct. Skeletal red-brown gravelly soil over banded ironstone. Steep slopes, summits of hills.	17.8 km S
<i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431)	P3	Tussocky perennial, grass-like or herb, 0.9-1.8 m high. Fl. Aug. Red clay. Clay pan, grass plain.	10.2 km S
<i>Vittadinia</i> sp. Coondewanna Flats (S. van Leeuwen 4684)	P3	Erect annual herb, 0.3-1 m high. Fl. cream, Mar-May, Jul-Sept. Red-brown sandy loam. Drainage areas, floodplains, flat and/or stony plains.	11.9 km S
<i>Acacia bromilowiana</i>	P4	Tree or shrub, to 12 m high, bark dark grey, fibrous; inflorescence in spikes. Fl. yellow/pink, Jul to Aug. Red skeletal stony loam, orange-brown pebbly, gravel loam, laterite, banded ironstone, basalt. Rocky hills, breakaways, scree slopes, gorges, creek beds.	7.6 km WSW
<i>Eremophila magnifica</i> subsp. <i>magnifica</i>	P4	Shrub, 0.5-1.5 m high. Fl. blue, Aug to Nov. Skeletal soils over ironstone. Rocky screes.	6.5 km WNW
<i>Ptilotus mollis</i>	P4	Compact, perennial shrub, to 0.5 m high, soft grey foliage. Fl. white/pink, May or Sep. Stony hills and screes.	7.2 km SW
<i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642)	P4	Spreading shrub, to 0.5 m high. Fl. yellow, Aug. Skeletal red soils pockets. Steep slope.	8.6 km E

## 2.2 Significant Vegetation

The desktop assessment identified eight PECs in the vicinity of the Survey Area (Table 2.3). No TECS were identified by the desktop assessment.

One priority 1 PEC; 'Weeli Wolli Spring Community', overlaps the Survey Area at the northwest corner. This PEC and its' riparian vegetation is currently being monitored by Biologic as part of a separate program for BHP WAIO using a combination of 100 m<sup>2</sup> understorey quadrats and tree health measuring parameters (Biologic, 2023a). Three of the remaining seven PECs are represented by Land Systems van Vreeswyk *et al.* (2004), none of



which intersect the Survey Area. The remaining four PECs represent communities that are unlikely to occur in the Survey Area based on revision of aerial imagery.

Table 2.3: Significant Ecological Communities in the vicinity of the Survey Area

PEC name	Description	Proximity to Survey Area
Weeli Wolli Spring Community (Priority 1)	Weeli Wolli Spring's riparian woodland and forest associations are unusual as a consequence of composition of the understorey. The sedge and herbfield communities that fringe many of the pools and associated water bodies along the main channels of Weeli Wolli Creek have not been recorded from any other wetland site in the Pilbara. The spring and creekline are also noted for their relatively high diversity of stygofauna and this is probably attributed to the large-scale calcrete and alluvial aquifer system associated with the creek. The valley of Weeli Wolli Spring also supports a very rich microbat assemblage including a threatened species.	<b>Within</b> (NW corner of Survey Area)
Kumina Land System (Priority 3)	-	5.5 km E
Riparian flora and plant communities of springs and river pools with high water permanence of the Pilbara Region (Priority 2)	The community includes flora with restricted distributions or populations that are highly disjunct or are major range extensions from northern and eastern Australia. These include <i>Imperata cylindrica</i> , <i>Cladium procerum</i> , <i>Schoenus falcatus</i> and <i>Fimbristylis sieberiana</i> (P3). In the Pilbara these taxa are almost exclusively restricted to the riparian zones of permanent wetlands with high soil moisture maintained by groundwater flows. Occurrences are disjunct with sites typically associated with groundwater discharge in gorge and valley wetlands that are often coupled with significant shading.	8.1 km E
Vegetation of sand dunes of the Hamersley Range/Fortescue Valley (Priority 3)	These red linear iron-rich sand dunes lie on the Divide Land system at the junction of the Hamersley Range and Fortescue Valley, between Kalgan Creek and the low hills to the west. A small number are vegetated with <i>Acacia dictyophleba</i> scattered tall shrubs over <i>Crotalaria cunninghamii</i> , <i>Trichodesma zeylanicum</i> var. <i>grandiflorum</i> open shrubland. They are regionally rare, small and fragile and highly susceptible to threatening processes.	21.1 km NNE
Coolibah-lignum flats: <i>Eucalyptus victrix</i> over lignum community in Pilbara (Priority 1)	Woodland or forest of <i>Eucalyptus victrix</i> (coolibah) over thicket of <i>Duma florulenta</i> (lignum) on red clays in run-on zones. Associated species include <i>Eriachne benthamii</i> , <i>Themeda triandra</i> , <i>Aristida latifolia</i> , <i>Eulalia aurea</i> and <i>Acacia aneura</i> .	32.9 km W
West Angelas Cracking-Clays (Priority 1)	Open tussock grasslands of <i>Astrebla pectinata</i> , <i>A. elymoides</i> , <i>Aristida latifolia</i> , in combination with low scattered shrubs of <i>Sida fibulifera</i> , on basalt (Jerrinah	34.9 km WSW

PEC name	Description	Proximity to Survey Area
	formation) derived cracking-clay loam depressions and flowlines. Occurs throughout the central and eastern Hamersley Range from near Tom Price east to Newman.	
Fortescue Marsh (Martuyitha) - Marsh Land System (Priority 1)	-	37.1 km N
Narbung Land System (Priority 3)	-	45.1 km NE



## 3 Field Survey

### 3.1 Methods

#### 3.1.1 Survey Timing & Personnel

The 2023 dry-season surveys were completed over two fieldtrips outlined in Table 1.1. Ground conditions observed during the survey were expectedly dry (with limited representation of annual or ephemeral taxa) as only 8.8 mm of rain was recorded between May 1<sup>st</sup> 2023 and the start date of the survey (September 12<sup>th</sup> 2023). Additionally, no rainfall was recorded during or between the dry-season survey period. However, these conditions are adequate to complete supplementary (dry-season) sampling, as primary sampling (wet-season) is scheduled to occur in March-April 2024 (EPA, 2016b).

Surveying was undertaken over a total of 112 person days by 11 Biologic personnel (Table 3.1). Senior Botanist Samuel Coultas led the fieldtrips, with the support of Principle Botanist Carmel Winton, Senior Botanist Kelby Jennings and Botanists Emma Marsh, Eva Karikis, Ryan Woodhouse and Grace Taylor and Field Technicians David Symons, Sammy Alatas and April Slater.

Table 3.1: Project team and licencing

Biologic Personnel	Project Involvement	Licencing	Experience
<b>Principal Botanists</b>			
Clinton van den Bergh	<ul style="list-style-type: none"> <li>Overall Project support</li> <li>Survey &amp; project design</li> <li>QA/QC</li> </ul>	-	17 yrs
Sam Coultas	<ul style="list-style-type: none"> <li>Project Manager</li> <li>Overall project lead</li> <li>Field team leader</li> <li>Reporting</li> <li>Vegetation mapping</li> <li>Data &amp; statistical analysis</li> <li>QA/QC</li> <li>Taxonomic support.</li> <li>Field Survey: Detailed PhI: 12 Sep – 19 Sep 2023 Detailed PhI: 27 Oct – 3 Nov 2023</li> </ul>	FB62000017-3 TFL 2223-0028	11 yrs
Carmel Winton	<ul style="list-style-type: none"> <li>Specimen identifications</li> <li>Field Survey: Detailed PhI: 12 Sep – 19 Sep 2023</li> </ul>	FB62000593 TFL 134B-2021	14 yrs
<b>Senior Botanists</b>			

Biologic Personnel	Project Involvement	Licencing	Experience
Kelby Jennings	<ul style="list-style-type: none"> <li>Field Survey: Detailed Ph1: 12 Sep – 19 Sep 2023</li> </ul>	FB62000486	11 yrs
Dr. Rachel Meissner	<ul style="list-style-type: none"> <li>Specimen identification lead</li> </ul>	-	26 yrs
<b>Botanists</b>			
Emalyn Loudon	<ul style="list-style-type: none"> <li>Field Survey: Detailed Ph1: 12 Sep – 19 Sep 2023</li> </ul>	-	7 yrs
Emma Marsh	<ul style="list-style-type: none"> <li>Reporting &amp; data support</li> <li>Specimen identifications.</li> <li>Field survey: Detailed Ph1: 12 Sep – 19 Sep 2023 Detailed Ph1: 27 Oct – 3 Nov 2023</li> </ul>	FB62000233-4	4 yrs
Ryan Woodhouse	<ul style="list-style-type: none"> <li>Reporting &amp; data support</li> <li>Specimen identifications.</li> <li>Field survey: Detailed Ph1: 12 Sep – 19 Sep 2023 Detailed Ph1: 27 Oct – 3 Nov 2023</li> </ul>	FB62000459	3 yrs
April Slater	<ul style="list-style-type: none"> <li>Field Survey: Detailed Ph1: 12 Sep – 19 Sep 2023</li> </ul>	-	2 yrs
David Symons	<ul style="list-style-type: none"> <li>Field survey: Detailed Ph1: 12 Sep – 19 Sep 2023 Detailed Ph1: 27 Oct – 3 Nov 2023</li> </ul>	-	10+ yrs
Sammy Alatas	<ul style="list-style-type: none"> <li>Field survey: Detailed Ph1: 12 Sep – 19 Sep 2023 Detailed Ph1: 27 Oct – 3 Nov 2023</li> </ul>	-	1 yr

### 3.1.2 Detailed Flora and Vegetation Survey

The assessment was conducted in line with relevant state guidelines, including:

- EPA (2016a) *Environmental factor guideline – flora and vegetation*;
- EPA (2016b) *Technical guidance: Flora and vegetation surveys for Environmental Impact Assessment*;
- EPA (2018) *Environmental factor guideline: Inland waters*; and
- EPA (2020) *Statement of environmental principles, factors and objectives*.

A combination of quadrats, relevés, vegetation mapping notes, meandering traverses, and opportunistic sampling was employed during the field survey to assess the flora and vegetation values in the Survey Area. These survey techniques are described in Table 3.2. The Survey Area was accessed by vehicle (access tracks, drill lines), by helicopter (in remote and/or difficult terrain), and by foot (traversing through the Survey Area).

Floristic data was collected from 212 sites during the dry-season field surveys; a total of 181 quadrats and 31 relevés were sampled and supplemented with an additional seven vegetation mapping notes.

Table 3.2: Field survey techniques

Approach	Description
<p>Quadrat</p>	<p>A comprehensive and replicable survey technique for gathering information during a detailed flora and vegetation assessment. A clearly defined area of set proportions, giving a consistent assessment of flora and vegetation across the Survey Area.</p> <p>Each quadrat represented a vegetation type and each vegetation type was represented by a minimum of three quadrat sites where practicable.</p> <p>Information collected at each quadrat included:</p> <ul style="list-style-type: none"> <li>• Site code, date, location, botanists recording data;</li> <li>• One photograph (as a minimum), from the NW corner of the site;</li> <li>• Vegetation condition and disturbances (including fire history);</li> <li>• Landform including: slope, soil, rock type, aspect;</li> <li>• Flora and vegetation information; dominant cover, structure and species count where necessary; and</li> <li>• Comprehensive recording of every species within the quadrat boundary (50 m x 50 m for a botanical survey in the Pilbara bioregion).</li> </ul>
<p>Relevé</p>	<p>Relevés are an unbounded, lower intensity survey technique utilised in a detailed survey to:</p> <ul style="list-style-type: none"> <li>• Support vegetation mapping;</li> <li>• Support the survey effort and sampling intensity;</li> <li>• Provide assessment where quadrats are too dangerous to set up (such as steep gorges or embankments); or</li> <li>• Provide assessment where the landform does not support adequate area for a detailed quadrat.</li> </ul> <p>Information collected at each relevé is the same as that of a quadrat site, excluding some detail within the landform category and the comprehensive collection of every species, their heights and percentage foliage cover within the quadrat boundary.</p>
<p>Vegetation Mapping Note</p>	<p>Mapping notes were used to ground-truth existing vegetation mapping and significant flora locations. They are a lower intensity, unbounded, survey technique. Information collected at each mapping note may vary in detail depending upon what is present and needed for that site. The following was recorded as a minimum:</p> <ul style="list-style-type: none"> <li>• Location coordinates;</li> <li>• Representative photograph; and</li> <li>• Brief description of the feature/s being mapped (e.g., landscape, vegetation, species composition)</li> </ul>

Approach	Description
Traverse/Meandering Traverse	A traverse is an unmarked route along which data is collected. Traverses are useful for identifying the boundaries and characteristics of vegetation types, selecting sites for detailed survey, and targeting significant flora or vegetation. Information recorded along a traverse during this assessment was the same as a mapping note, with the addition of noting vegetation changes and relationships between vegetation and substrate.
Opportunistic (Supplementary) Sampling	Flora and vegetation not recorded through other sampling methods were opportunistically sampled as encountered in the survey. Opportunistic sampling also included recording locations of significant, introduced (weed) and unknown species.

Prior to field mobilisation, personnel familiarised themselves with existing mapping and current disturbance layers using a combination of historical reports, aerial imagery, geological surface data, contour mapping and specialist knowledge of Pilbara vegetation communities. Site selection for flora sampling sites and targeted search areas (suitable habitat for significant flora) were determined prior to mobilisation through study of satellite imagery and data, to cover the range of land systems, geologies and superficial differences in vegetation across the Survey Area. Additionally, the significant flora and vegetation identified in the desktop was reviewed. Field personnel familiarised themselves with photographs, reference samples (for taxa) and descriptions prior to mobilisation.

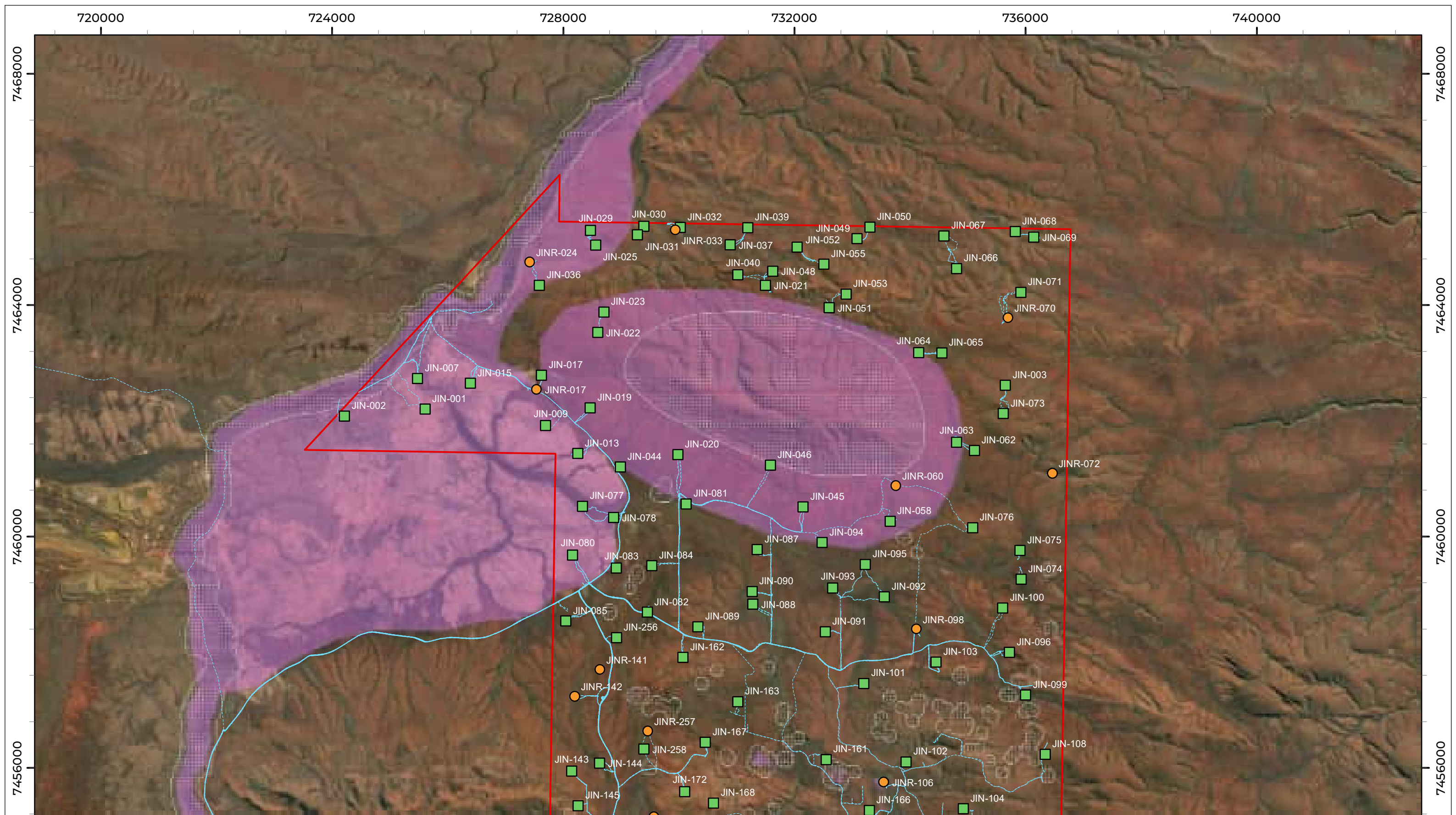
If significant taxa were identified, a GPS coordinate of the individual was taken when occurring in isolation, or a central GPS coordinate was taken for a small population (central coordinate with an approximate 20 m radius). Information collected at each location comprised:

- Number of individuals, for a small population;
- Condition and reproductive status of the plants in each population;
- Photographs and description of vegetation habitat;
- Broad information on vegetation type and condition; and
- Coordinates of each plant (if few) or the extent of the population (if many) using a GPS.

Specimens of significant taxa were identified at the Western Australian Herbarium (WAH) by Biologic botanists, with additional support from WAH taxonomists where appropriate (e.g., formal identification). These specimens will be vouchered at the WAH, where requested or required. Threatened and Priority Flora Report Forms will be provided to the Department of Biodiversity, Conservation and Attractions' (DBCA) Parks and Wildlife Division (Parks and Wildlife), as required under the flora collecting permits for conservation significant listed flora taxa.


### 3.1.3 Flora Identification

The nomenclature used for taxa referred to in this report is consistent with the Western Australian Herbarium's plant census, provided through Florabase (WAH, 1998-) and is current at the time of report preparation. Specimens were identified by Dr. Rachel Meissner, Senior Botanists Samuel Coultas and Carmel Winton and Botanists Emma Marsh and Ryan Woodhouse using the appropriate taxonomic keys, the WAH reference herbarium and research collection, and, where required, relevant taxonomic experts at the WAH.



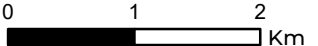
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Study Area	Heritage Exclusion Zone	Sampling Type
Initial	Revised	Quadrat
		Relevé
		Traverse

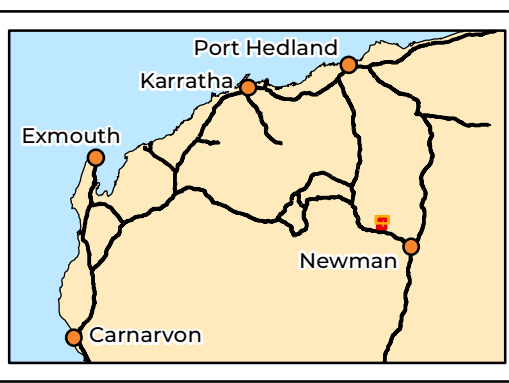


**Biologic**

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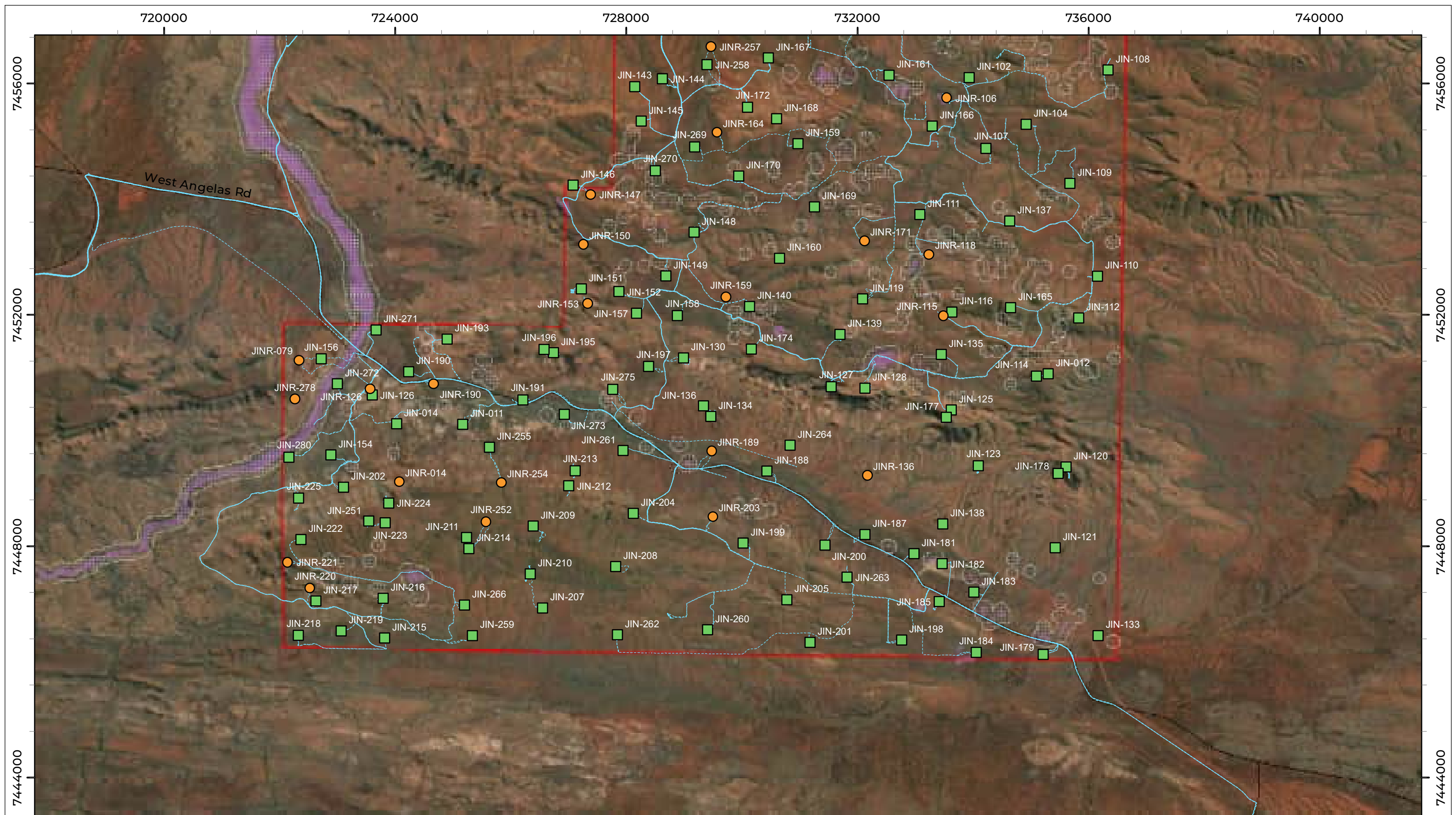
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**Figure 3.1: Sample sites and traverses**





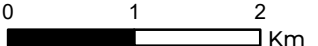
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Study Area	Heritage Exclusion Zone	<b>Sampling Type</b>
Rail	Initial	Quadrat
Local Road	Revised	Relevé
		Traverse

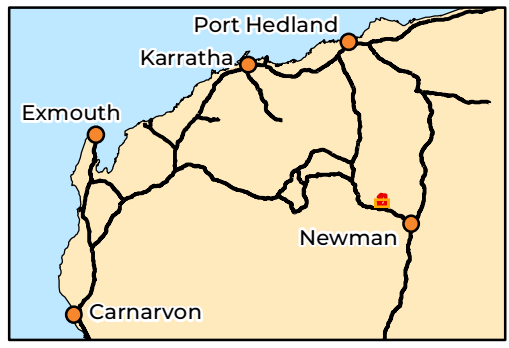


**Biologic**

Scale 1:60,000



Coordinate System: GDA 1994 MGA Zone 50  
 Projection: Transverse Mercator  
 Datum: GDA 1994    Created 10/01/2024



**BHP WAIO**  
**Jindi Detailed Flora and Vegetation Survey**

**Figure 3.1: Sample sites and traverses**



## 3.2 Results & Discussion

### 3.2.1 Significant Flora

The preliminary results from the dry-season field surveys identified 15 significant flora species from the Survey Area, consisting of two Priority 2 taxa, eleven Priority 3 taxa and two Priority 4 taxa (Table 3.3, Figure 3.2). Detailed descriptions of these taxa and their habitat within the Survey Area are listed in Table 3.4.

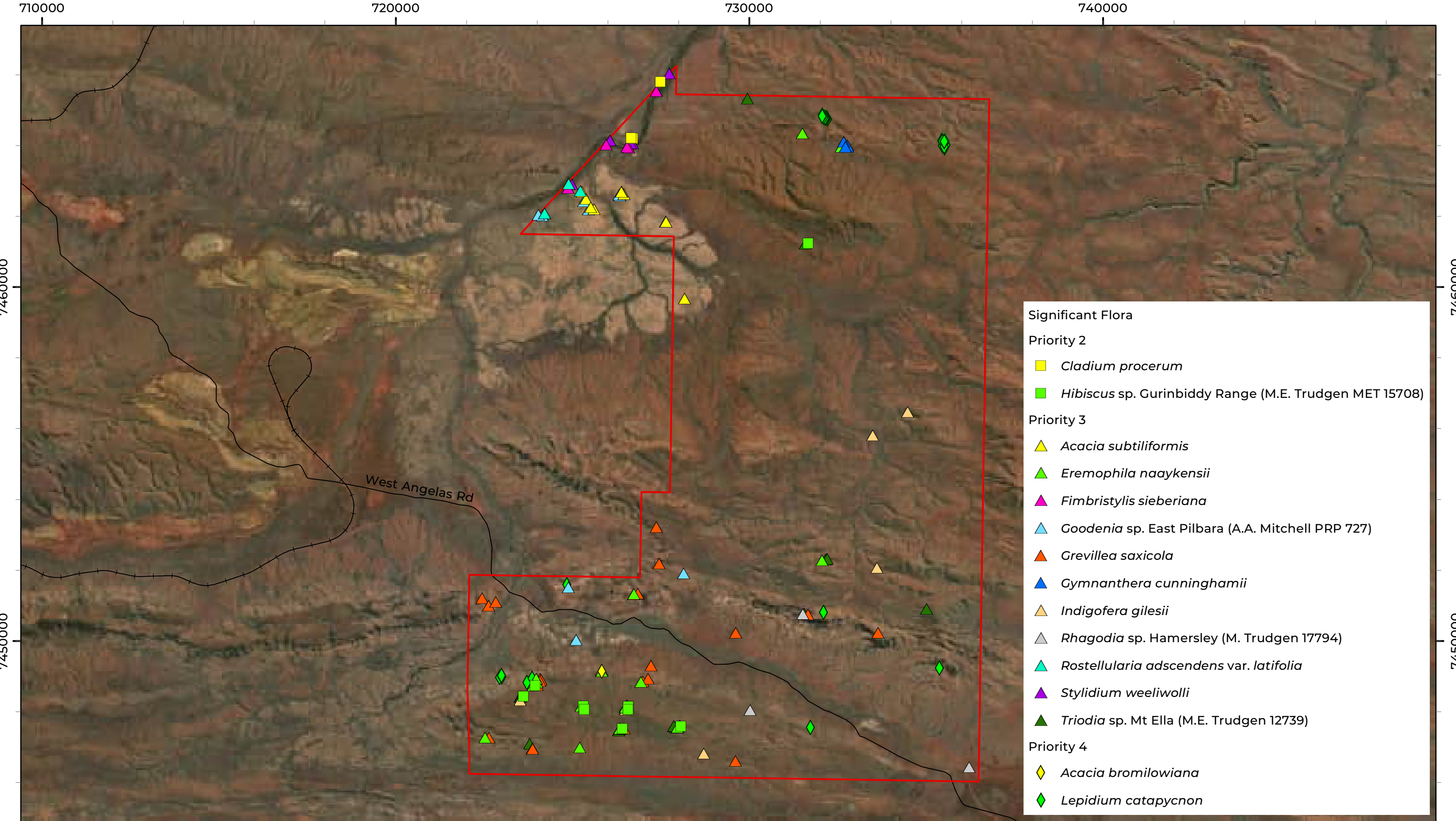
All taxa previously confirmed from the Survey Area pre-survey (Table 2.2), excluding *Isotropis parviflora* (P3), were recorded during the dry-season surveys. Dry-season conditions and access restrictions (to Kuthawarthayinha (Round Top Hill)) have likely limited the ability to re-confirm *I. parviflora* (P3) in the Survey Area thus far.

All significant flora taxa in Table 3.3 have been formally identified and confirmed by the Western Australian Herbarium (ACC/9536 (for taxa collected during Biologic's ongoing monitoring at Weeli Wolli Creek (Biologic, 2023a)), ACC/10604/E (taxa collected during this survey)).

**Table 3.3: Significant flora recorded in the Survey Area**

Taxon	Number of locations recorded	Number of individuals recorded
<i>Cladium procerum</i> (P2) <sup>^</sup>	3	300
<i>Hibiscus</i> sp. Gurinbiddy Range (M.E. Trudgen MET 15708) (P2)	12	325
<i>Acacia subtiliformis</i> (P3)	10	2,975
<i>Eremophila naaykensis</i> (P3)	19	784
<i>Fimbristylis sieberiana</i> (P3) <sup>^</sup>	5	900
<i>Goodenia</i> sp. East Pilbara (A.A. Mitchell PRP 727) (P3)	11	76
<i>Grevillea saxicola</i> (P3)	25	315
<i>Gymnanthera cunninghamii</i> (P3)	4	47
<i>Indigofera gilesii</i> (P3)	15	221
<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3)	3	3
<i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3)	3	26
<i>Stylidium weeliwollii</i> (P3) <sup>^</sup>	5	500
<i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739) (P3)	26	1,558
<i>Acacia bromilowiana</i> (P4)	1	25
<i>Lepidium catapycnon</i> (P4)	76	274

<sup>^</sup> Indicates species recorded during annual monitoring of trees and riparian flora for Weeli Wolli Creek monitoring (2021-23), the area of which intersects the Jinidi Survey Area.



**LEGEND**

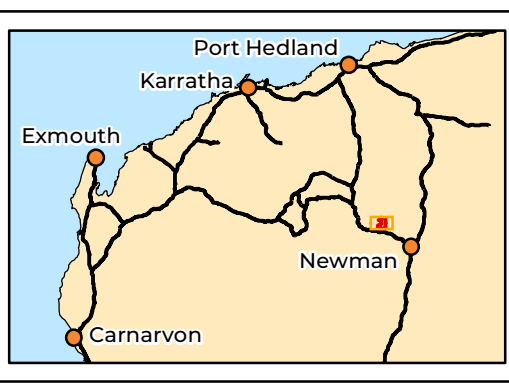
- Survey Area
- Rail
- Local Road

**Biologic**

Scale 1:100,000

0 1 2 3 4 Km




Coordinate System: GDA 1994 MGA Zone 50  
 Projection: Transverse Mercator  
 Datum: GDA 1994 Created 10/01/2024






**BHP WAIO**  
**Jinidi Detailed Flora and Vegetation Survey**




**Figure 3.2: Significant flora recorded in the Survey Area**

Table 3.4: Significant flora recorded in the Survey Area



Description	Habitat	Records from survey	Representative floristic material / habit and/or habitat
<b>Priority 2</b>			
<p><b><i>Cladium procerum</i></b></p> <p>A large, densely tufted, clumping perennial, grass-like sedge growing to 2 m, (WAH, 1998-). It produces numerous nodding inflorescences, but often reproduces by asexual bulbils on older inflorescences (Rio Tinto &amp; WAH, 2015).</p>	<p><i>Cladium procerum</i> is common across most of the coastal areas of eastern Australia (except for most of Cape York), with a few known records in East Timor, Papua New Guinea and New Caledonia internationally (ALA, 2023). However, it is extremely restricted and uncommon in Western Australia, with its 15 known records contained entirely within the Pilbara region, occurring sporadically from Weeli Wolli creek in the southeast, through to Karijini in the centre and to Millstream Chichester National Park in the northwest (WAH, 1998-). <i>Cladium procerum</i> (P2) is a key component of the 'Riparian flora and plant communities of springs and river pools with high water permanence of the Pilbara Region' (P2) PEC, and the 'Weeli Wolli Spring' (P1) PEC unique sedgeland floral assemblage (DBCA, 2022; van Leeuwen, 2009).</p>	<p>Records of <i>C. procerum</i> were located during Biologic's monitoring of Weeli Wolli Creek (Biologic, 2023a), part of which intersects the Jinidi Survey Area. Cover ranged from 0.1 to 7% (a total of 300 individuals) within three 100 m<sup>2</sup> monitoring quadrats (WWM-03, 05 and 06). This taxon was recorded fringing permanent waterbodies/perennial pools of Weeli Wolli Spring (Biologic, 2023b).</p>	
<p><b><i>Hibiscus</i> sp. Gurinbiddy Range (M.E. Trudgen MET 15708)</b></p> <p>A large, erect, often spindly perennial shrub growing up to 3 m tall (WAH, 1998-). It produces a large 5-petaled pale-mauve flowers with a magenta throat, typical of the genera (timing unknown) (WAH, 1998-). The stems, branchlets and leaves are conspicuously densely covered with rusty-brown, erect, stellate hairs, giving individuals a distinct woolly texture and rusty appearance (Rio Tinto &amp; WAH, 2015).</p>	<p><i>Hibiscus</i> sp. Gurinbiddy Range (M.E. Trudgen MET 15708) is known to occur in sheltered/ shaded rocky drainage lines, gullies and gorges, often below associated cliff-lines or rocky ridges of massive ironstone hills and mountain ranges across the southern Pilbara from Newman to Paraburdoo (Rio Tinto &amp; WAH, 2015; WAH, 1998-). There are currently 27 records for this species, each of which has a corresponding specimen held at WAH (WAH, 1998-).</p>	<p>325 individuals of <i>H. sp. Gurinbiddy Range</i> (M.E. Trudgen MET 15708) from 12 locations were recorded in the Survey Area by this survey. This taxon was recorded in rocky gullies and gorges associated with the two large hills in the northern and southwestern sections of the Survey Area high in the landscape.</p>	
<b>Priority 3</b>			
<p><b><i>Acacia subtiliformis</i></b></p> <p>A spindly, slender, single-stemmed, erect shrub, growing to 3.5 m in height (WAH, 1998-). The new growth of this species is slightly viscid, resinous, aromatic and produces yellow flowers in June (Maslin, 2018; WAH, 1998-).</p>	<p><i>Acacia subtiliformis</i> has been recorded in low, undulating country on calcareous rises adjacent to drainage lines and is known only from the Hamersley Range; specifically the Hancock and Ophthalmia Ranges (WAH, 1998-). There are currently 24 records for this species, each of which has a corresponding specimen held at WAH (WAH, 1998-).</p>	<p>2,975 individuals of <i>A. subtiliformis</i> from 10 locations were recorded in the Survey Area by this survey. This taxon is strongly linked to calcrete outcrops and plains located in the north-western section of the Survey Area.</p>	 <p>Image left from: Maslin (2018)</p>






Description	Habitat	Records from survey	Representative floristic material / habit and/or habitat
<p><b><i>Eremophila naaykensis</i></b></p> <p>An erect, usually dome-shaped, shrub growing to 3.5 m high (Curtis <i>et al.</i>, 2022; WAH, 1998-). It has fibrous, grey bark with short “velvety” hairy branchlets, pale grey-green leaves with a shiny silver appearance, and resinous young leaves. It produces white-cream to pale purple flowers typical of the genus from June to October (Curtis <i>et al.</i>, 2022; WAH, 1998-).</p>	<p><i>Eremophila naaykensis</i> typically occurs on a variety of rocky ironstone hillslope landforms, often forming a mid to tall shrub layer, particularly in gully / gorge situations (Curtis <i>et al.</i>, 2022; WAH, 1998-). There are currently 22 records for this taxon, confined to the Pilbara and Gascoyne regions (WAH, 1998-). Its distribution is quite restricted, occurring sporadically from Newman to Paraburdoo, extending north to central Karijini. However, observed frequency of individuals at locations can be extremely common, with numbers often in the hundreds in 50x50 m floristic sample sites.</p>	<p>765 individuals of <i>E. naaykensis</i> from 19 locations were recorded in the Survey Area. This taxon was recorded in rocky gullies, ridges, cliffs and on ironstone hills and summits mainly in the northern and south-western sections of the Survey Area.</p>	
<p><b><i>Fimbristylis sieberiana</i></b></p> <p>A shortly rhizomatous tufted perennial sedge which grows up to 1 m tall ((WAH, 1998-). It flowers between May and June, producing hairy glumes and a pale nut (Rio Tinto &amp; WAH, 2015).</p>	<p><i>Fimbristylis sieberiana</i> occurs across the northern parts of Western Australia, the Northern Territory and Queensland, with a few sporadic records known from inland freshwater lakes and creek systems in central South Australia and the Northern Territory, as well as subtropical Africa, and Asia (ALA, 2023). There are currently 29 records for this taxon in Western Australia, confined to the Pilbara and Kimberley regions (WAH, 1998-). This taxon is a key component of the ‘Riparian flora and plant communities of springs and river pools with high water permanence of the Pilbara Region’ (P2) PEC, and ‘Weeli Wolli Spring’ (P1) PEC unique sedgeland floral assemblage (DBCA, 2022; van Leeuwen, 2009)</p>	<p>Records of this taxon were located during Biologic’s monitoring of Weeli Wolli Creek (Biologic, 2023a), part of which intersects the Jinidi Survey Area. Covers ranged from 0.1 to 25% ( a total of 900 individuals) within five 100 m<sup>2</sup> monitoring quadrats (WWM-03, 05, 06, 19 and 22). This taxon was recorded in water-logged creek beds-in Weeli Wolli Spring (Biologic, 2023b).</p>	
<p><b><i>Goodenia</i> sp. East Pilbara (A.A. Mitchell PRP 727)</b></p> <p>An open, rosetted, erect annual or biennial herb to 0.2 m in height. This species produces small yellow flowers, with brown / maroon centres, in September (WAH, 1998-). Leaves are usually spatulate with entire margins, often with dentate margins on new growth, with an indumentum of sparse to dense simple long hairs.</p>	<p><i>Goodenia</i> sp. East Pilbara (A.A. Mitchell PRP 727) has been recorded exclusively from low undulating calcrete plains/ hills. This species is known to occur within the wider surrounds of the Hamersley Range. There are currently 53 records for this species, each of which has a corresponding specimen held at WAH (WAH, 1998-).</p>	<p>76 individuals of <i>G. sp. East Pilbara</i> (A.A. Mitchell PRP 727) from 11 locations were recorded in the Survey Area by this survey. This taxon is strongly linked to calcrete hills located in the north-western section of the Survey Area.</p>	

Description	Habitat	Records from survey	Representative floristic material / habit and/or habitat
<p><b><i>Grevillea saxicola</i></b></p> <p>An upright shrub or small tree with rough grey-black and terete to subterete leaves in cross section. This taxon grows to 7 m high and produces green/ cream flowers from late spring to early autumn (Rio Tinto &amp; WAH, 2015; WAH, 1998-)</p>	<p><i>Grevillea saxicola</i> is known from shaded and steep upper scree/ breakaway slopes and crests, often associated with banded ironstone formation outcropping (Rio Tinto &amp; WAH, 2015; WAH, 1998-). However, it has on occasion been found in mulga woodlands low in the landscape (Rio Tinto &amp; WAH, 2015; WAH, 1998-). This taxon is restricted to the southern Pilbara from 50 km west-north-west of Newman to 40 km east of Paraburdoo. There are currently 38 records for this species, each of which has a corresponding specimen held at WAH (WAH, 1998-).</p>	<p>315 individuals of <i>G. saxicola</i> from 25 locations were recorded in the Survey Area by this survey. This taxon was recorded in rocky ironstone gullies, ridges, steep upper slopes of south-facing cliffs as well as on ironstone hills and summits in the southern section of the Survey Area.</p>	
<p><b><i>Gymnanthera cunninghamii</i></b></p> <p>An erect, woody shrub growing to 2 m high with cylindrical, glabrous stems and shiny leaves. It releases a milky latex if cut, and is conspicuously lenticellate (Rio Tinto &amp; WAH, 2015). Leaves are simple and glabrous with a lanceolate to elliptic shape and an acute apex (Rio Tinto &amp; WAH, 2015). It produces small cream to green yellow flowers from January to December (Rio Tinto &amp; WAH, 2015).</p>	<p><i>Gymnanthera cunninghamii</i> has been recorded growing in the surrounding areas of permanent or semi-permanent watercourses in alluvial soils. This species is widespread throughout northern Australia, and is recorded sporadically in Western Australia, from the Gascoyne, Pilbara and Kimberley (Rio Tinto &amp; WAH, 2015). There are currently 40 records for this species, each of which has a corresponding specimen held at WAH (WAH, 1998-).</p>	<p>47 individuals of <i>G. cunninghamii</i> from four locations within a gorge were recorded in the northern section of the Survey Area. This gorge was deeply incised and likely supports seasonal surface water.</p>	
<p><b><i>Indigofera gilesii</i></b></p> <p>A sparsely branched, open shrub, growing up to 2 m high. Leaflets are grey with small, persistent stipules. Flowers are dull dark pink with a white centre, produced from June to October (WAH, 1998-).</p>	<p><i>Indigofera gilesii</i> is typically known from boulders, gullies and outcrops/ hills on skeletal soils associated with banded ironstone formations. It has most often been recorded from the south-eastern Pilbara around Newman, Giles and Rhodes Ridge, with sporadic records from the northern Gascoyne and Central Deserts (Western Australian and Northern Territory). There are currently 39 records for this species, each of which has a corresponding specimen held at WAH (WAH, 1998-).</p>	<p>221 individuals of <i>Indigofera gilesii</i> from 15 locations were recorded in rocky ironstone gullies and gorges of the Survey Area.</p>	



Description	Habitat	Records from survey	Representative floristic material / habit and/or habitat
<p><b><i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794)</b></p> <p>A wispy and often scrambling shrub with small lanceolate leaves (not aromatic, unlike that of the superficially similar and co-occurring species <i>Rhagodia eremaea</i>), growing up to 4 m tall. Branches of this taxon are slender; flowers are white in colour and fruits exist as clustered red drupelets (WAH, 1998-).</p>	<p><i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) is known mainly from mulga woodlands and shrublands on cracking clays, floodplains, hardpan plains and stony plains. Records of this taxon (75 records for this species held at WAH (WAH, 1998-)) are mainly restricted to the south-eastern Pilbara, with a few records known west of Karijini and one records known south of Newman at Kumarina..</p>	<p>Three individuals from three locations of <i>R. sp. Hamersley</i> (M. Trudgen 17794) were recorded in the southern section of the Survey Area. Two individuals were in rocky ironstone gullies, with the remainder from a sandy mulga plain/ floodplain.</p>	
<p><b><i>Rostellularia adscendens</i> var. <i>latifolia</i></b></p> <p>A small, spreading shrub with hairy leaves (hairs usually scattered evenly across surface), growing to 0.3 m in height (WAH, 1998-). It produces small blue-purple-violet flowers from April to May, which are covered by conspicuous bracts.</p>	<p>The <i>Rostellularia adscendens</i> group (containing seven varieties and two subspecies) is cosmopolitan, occurring in parts of eastern Africa, subtropical America and across most of southern Australasia (excluding New Zealand) (ALA, 2023). However, <i>R. var. latifolia</i> occurs exclusively in the Pilbara region of Western Australia, with its 43 known records occurring from Marble Bar to Paraburdoo (WAH, 1998-). This taxon has been recorded from a variety of habitats, preferring rocky dry creek beds of major drainage lines and gullies/ gorges</p>	<p>21 individuals from two locations of <i>R. adscendens</i> var. <i>latifolia</i> were recorded in the north-western section of the Survey Area in rocky (ironstone, calcrete) creeklines. Five individuals were also located during Biologic's monitoring of Weeli Wolli Creek (Biologic, 2023a), part of which intersects the Jinidi Survey Area., within vegetation monitoring quadrat WWM-25.</p>	
<p><b><i>Stylidium weeliwollii</i></b></p> <p>An annual herb growing to 0.25 m, producing small but characteristic pink trigger-plant flowers from August to September (WAH, 1998-). This taxon's nomenclature is derived from the first location it was collected from and observed at, Weeli Wolli Creek, which also represents the type-specimen location for this taxon (Wilson et al., 1998).</p>	<p><i>Stylidium weeliwollii</i> occurs exclusively in northern-central Western Australia, with its 29 known records restricted to the Pilbara and Gascoyne regions (WAH, 1998-). It occurs predominantly in sandy-clay soils, black mud and amongst precipitated rocky substrates along permanent watercourse edges and fringing permanently wet areas (WAH, 1998-). This taxon is a key component of the 'Weeli Wolli Spring' (P1) PEC unique herbland floral assemblage (DBCA, 2022; van Leeuwen, 2009).</p>	<p>Records of this taxon were located during Biologic's monitoring of Weeli Wolli Creek (Biologic, 2023a), part of which intersects the Jinidi Survey Area. A total of 500 individuals within five 100 m<sup>2</sup> monitoring quadrats (WWM-01, 05, 06, 19 and 22) occur within the Survey Area. This taxon was recorded fringing permanent waterbodies/ perennial pools of Weeli Wolli Spring (Biologic, 2023b)..</p>	



Description	Habitat	Records from survey	Representative floristic material / habit and/or habitat
<p><b><i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739)</b></p> <p>A resinous, perennial, hummock-forming grass growing to 0.6 m high and 1.5 m wide, producing flowers from May and August (WAH, 1998-). This taxon superficially resembles a number of resinous species in the soft <i>Triodia</i> group, but is readily distinguished by its' copiously resinous foliage, glabrous leaf sheath surfaces, narrowly lanceolate glumes and awned lemmas (Barrett &amp; Trudgen, 2018).</p>	<p><i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739) occurs on skeletal hillslopes, ridgelines, gullies and summits of massive ironstone ranges and mountains restricted to the south-eastern Pilbara between Newman (Jimblebar) and the eastern boundary of Karijini. Singular disjunct records of this taxon occur in the north-eastern Gascoyne (Angelo River proper) and Little Sandy Desert (Rudall River, Karlamilyi National Park) regions (WAH, 1998-). There are currently 40 records for this species, each of which has a corresponding specimen held at WAH (WAH, 1998-).</p>	<p>1,558 individuals of <i>T.</i> sp. Mt Ella (M.E. Trudgen 12739) from 26 locations were recorded in the Survey Area by this survey. This taxon was recorded in a range of habits including rocky ironstone gullies, ridges, steep upper slopes of cliffs as well as on ironstone hillslopes and crests and minor drainage lines.</p>	
<p><b>Priority 4</b></p>			
<p><b><i>Acacia bromilowiana</i></b></p> <p>A gnarled perennial tree or shrub, to 12 m high with dark grey bark and fibrous phyllodes (more or less glaucous &amp; slightly pruinose) (WAH, 1998-) This taxon flowers from July to August producing yellow/ pink racemose spiked inflorescences (Maslin, 2018).</p>	<p><i>Acacia bromilowiana</i> occurs on red skeletal stony loam, orange-brown pebble/ gravel loam, laterite, banded ironstone soils and is most commonly found on rocky hills, breakaways, scree slopes, gorges and creek beds (WAH, 1998-). It has 29 records on WAH, mainly hilltop populations in the Hamersley Range extending from Tom Price through Ophthalmia and Hancock Ranges to Newman, and also from Balfour Downs Station (Rio Tinto &amp; WAH, 2015).</p>	<p>25 individuals of <i>A. bromilowiana</i> from a single location were recorded in the Survey Area. by this survey. These individuals were found growing in a rocky ironstone north-facing gully in the south-western section of the Survey Area.</p>	 <p>Image left from: Maslin (2018)</p>
<p><b><i>Lepidium catapycnon</i></b></p> <p>An open, perennial shrub, growing to 0.8 m in height. It has distinctive zigzag stems with succulent, linear terete leaves. It produces white flowers in a dense terminal raceme and is known as a pioneer fire ephemeral, typically senescing as vegetation matures (WAH, 1998-).</p>	<p><i>Lepidium catapycnon</i> is endemic to the Pilbara region and is distributed primarily across the Hamersley Ranges from Tom Price east to Newman. It prefers steep and exposed rocky ironstone hill and scree slopes, particularly areas of recent burn and/or disturbance. There are currently 39 records for this species specimens of this taxon, each of which has a corresponding specimen held at WAH (WAH, 1998-)...</p>	<p>274 individuals of <i>Lepidium catapycnon</i> from 76 locations were recorded in the Survey Area by this survey. This taxon was recorded growing on steep rocky ironstone hill slopes and crests scattered across the entirety of the Survey Area.</p>	



### 3.2.2 Introduced Flora

The database searches and literature review conducted identified a total of 98 introduced flora taxa that occur or may potentially occur within the Jinidi Survey Area. Twenty-nine of the introduced species identified by the desktop assessment are classed as Weeds of National Significance (WoNS) and 48 as Declared Plant Pests (DPP).

During dry season surveying, eight introduced species were recorded: *\*Bidens bipinnata*, *\*Cenchrus ciliaris*, *\*Cenchrus setiger*, *\*Euphorbia hirta*, *\*Lactuca serriola*, *\*Malvastrum americanum*, *\*Sonchus oleraceus* and *\*Vachellia farnesiana* (Table 3.5). None of these species are recognised as a DPP or WoNS by DPIRD (2023).

The most abundant introduced species was *\*Cenchrus ciliaris* with 2916 individuals recorded from 21 locations. Introduced species were strongly associated with creeklines and water courses (e.g., Weeli Wolli) and areas of disturbance.

Table 3.5: Introduced flora recorded from the Survey Area

Family	Taxon	Number of individuals recorded	Number of locations recorded
Asteraceae	<i>*Bidens bipinnata</i>	60	5
	<i>*Lactuca serriola</i>	40	4
	<i>*Sonchus oleraceus</i>	30	3
Euphorbiaceae	<i>*Euphorbia hirta</i>	80	4
Fabaceae	<i>*Vachellia farnesiana</i>	17	4
Malvaceae	<i>*Malvastrum americanum</i>	45	2
Poaceae	<i>*Cenchrus ciliaris</i>	2,916	21
	<i>*Cenchrus setiger</i>	11	2

### 3.2.3 Significant Vegetation

Significant vegetation includes Threatened and Priority Ecological Communities (TECs, PECs), and may extend beyond conservation codes assigned by state and commonwealth governments (described as vegetation of “other” significance). Further sampling of the landforms/ broad vegetation types listed above will be required to definitively determine whether they constitute vegetation of significance. A comprehensive assessment of broad floristic formations and vegetation types within the Jinidi Survey Area will be presented in the final report, following completion of 2024 wet-season surveying.

#### 3.2.3.1 Weeli Wollli Spring (P1) PEC & GDV

The portion of Weeli Wollli Creek intersecting the north-western corner of the Survey Area represents the previously identified and mapped State listed Priority 1 ‘*Weeli Wollli Spring*’ ecological community. The spring is also considered a subregional significant wetland and an ecosystem at risk by Kendrick (2003) (risks: mining, dewatering, weeds, pastoralism and tourism). No sampling has occurred in Weeli Wollli Creek as part of this project due to heritage restrictions. If access is permitted for 2024 wet-season surveys, sampling will be required in Weeli Wollli Creek for survey coverage and adequacy as per EPA (2016b) guidance. However, less intensive survey is required in Weeli Wollli Creek as Biologic currently monitor riparian vegetation and tree health as part of a separate program for BHP WAIO (Biologic, 2023a)

This ecological community’s riparian woodland and forest associations are unusual as a consequence of composition of the understorey (van Leeuwen, 2009). The sedge and herbfield communities that fringe many of the pools and associated water bodies along the main channels of Weeli Wollli Creek have not been recorded from anywhere else in the Pilbara. Three significant flora taxa recorded in the Survey Area, *Cladium procerum* (P2), *Fimbristylis sieberiana* (P3) and *Stylidium weeliwolli* (P3), have only been recorded in the Weeli Wollli Creek portion of the Survey Area.

Hydrophytic/mesophytic flora and vegetation in this community represent groundwater dependent vegetation (GDV), which is closely linked to the groundwater aquifer and subject to significant impacts with changes to availability of groundwater. Additional expressions of landforms with the possibility of supporting groundwater dependant vegetation were observed during the dry-season sampling. However, additional sampling and analysis are required to determine other representations of GDV and associated landforms (drainages lines (minor, medium, major), floodplains etc.) across the Survey Area.

### 3.2.3.2 Mulga Dominated Vegetation, Mulga Groves and Overland Flow Dependant Ecosystems

Mulga is a large, variable and taxonomically complex group of plants allied to *Acacia aneura* that dominate significant areas of the vast Australian arid zone (Maslin *et al.*, 2012). The term Mulga is also used to describe vegetation communities in which these taxa predominate (Maslin *et al.*, 2012). The structure and patterning of mulga communities varies from dense, strongly banded groves through to open shrublands and woodlands across the landscape (Page & Grierson, 2010). Resulting wash from rainfall travels from and across the open overland sheet flow areas towards the banding Mulga groves. These groves act as a sink for nutrients and water to infiltrate the soil, supporting a diverse biota and refugia for a number of terrestrial flora and vertebrate and invertebrate fauna species. This overland phenomenon plays an important ecological function which is well documented (Dawson & Ahern, 1973; Saco *et al.*, 2007; Winkworth, 1973).

Small areas of mulga growing/banding have been observed scattered across the Survey Area during dry-season field surveys and are considered to support Overland Flow Dependant Ecosystems (sheet-flow). These communities also represent the “grove/inter-grove mulga, eastern Hamersley Range” Ecosystem at Risk, as defined by Kendrick (2003) (risks: weeds, pastoralism, hydrological changes).

Additional small areas supporting mulga woodlands and shrublands observed in the Survey Area may also represent other Ecosystems at Risk, as defined by Kendrick (2003), including “valley floor mulga” and “lower-slope mulga” (risks: weeds, pastoralism, hydrological changes). Further sampling and analysis is required to determine the extent of Mulga dominated vegetation within the Survey Area and to confirm its significance.

### 3.2.3.3 Calcrete Areas

Areas of restricted calcrete substrate are considered to have significant importance. Large-scale calcrete surface expressions are relatively uncommon across Western Australia and often act as refuge for significant flora species due to their unique soil composition. These substrates are also porous, giving rise to sub-surface aquifers and spring systems feeding important permanent surface water communities (e.g., Weeli Wolli Creek).

Dry-season fieldwork has indicated the presence of such geology and associated vegetation, predominantly in the northwest of the Survey Area adjacent Weeli Wolli creek, which supports two significant flora species: *Acacia subtiliformis* (P3) and *Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727) restricted to these areas. Further sampling and analysis are required to determine the extent of calcrete associated vegetation within the Survey Area and to confirm its local significance.

#### 3.2.3.4 Shaded Mulga Clifflines

Fairly unique and restricted expressions of ironstone steep cliffs and scree-slopes supporting relatively species poor Mulga communities (dominated by *Acacia catenulate*) occur in the Survey Area based on dry-season sampling. These occurrences, although not restricted exclusively to the local area (these have been observed occurring on Mt Robinson and The Governor further west), are not common in the area and support high densities of the significant taxon *Grevillea saxicola* (P3) (a dominant taxon in the upperstorey layer). These vegetation expressions are considered fairly unique as other slopes in the surrounding local and subregional area are dominated by hummock grasslands (*Triodia* spp.) rather than Mulga, suggesting a refugial relationship of the landform to supporting this vegetation (i.e., naturally fire suppressing). Mulga vegetation generally occurs low in the landscape in the Pilbara, occupying vast hardpan plains and floodplains in the surrounding area.

Instances of these landforms and associated vegetation were mainly observed in the south of the Survey Area (just north of the intersecting rail line running east-west). Further sampling and analysis are required to determine the extent of this vegetation within the Survey Area and to confirm its local significance.

#### 3.2.3.5 BIF Ranges and associated Gorges, Gullies and Cliffines

Two main large BIF range mountains/hills occur in the Survey Area: Kuthawarthayinha (+930 m above sea level (ASL)) in the north and South Parmelia (+910 m ASL) in the south. Additional smaller hills also occur in throughout the Survey Area. These landforms, particularly the hillcrests high in the landscape, and associated vegetation likely represent “hill-top floras of the Hamersley Range”, an Ecosystems at Risk, as defined by Kendrick (2003). Large mountain/hill tops often support unique vegetation types and significant flora taxa because of exposure, shading/protection, and altitude. However, these landforms are also at a high risk of frequent and intense fires and mining related pressures. Further sampling and analysis are required to determine the extent of this vegetation within the Survey Area and to confirm its local significance.

Deeply incised and shaded gorges, gullies, slopes and cliffines, associated with mountains/hills, were observed and sampled across the Survey Area. These areas act as refugia (shade, protection from fire, higher water capture etc.) for plant species, providing conducive habitat for a number of significant flora taxa in the Survey Area, including but not limited to *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708) (P2), *Eremophila naaykensis* (P3), *Grevillea saxicola* (P3), *Gymnanthera cunninghamii* (P3), *Indigofera gilesii* (P3), *Rostellularia adscendens* var. *latifolia* (P3), *Triodia* sp. Mt Ella (M.E. Trudgen 12739) (P3), *Acacia bromilowiana* (P4). Many of these shaded and protected gorges and gullies support

ephemeral sources of surface water for a variety of species. Further sampling and analysis are required to determine the extent of this vegetation within the Survey Area and to confirm its local significance.

Unfortunately, the best examples of BIF ranges and associated gorges, gullies and clifflines and associated vegetation occur within the restricted heritage area protecting access to Kuthawarthayinha and have not yet been visited and sampled. Unless access for botanical survey is permitted during 2024 wet-season surveys, these areas will remain unsurveyed for the entirety of the project.

### 3.3 Limitations & Constraints

#### 3.3.1 Dry-season Survey

No substantial limitations or constraints affected the dry season survey. The survey was led and completed by experienced personnel, the leader and manager of which has over 10 years completing surveys of this nature in the Pilbara bioregion. Numerous surveys of a similar nature have occurred both surrounding and intersecting the Survey Area, provide adequate contextual information for the desktop assessment and pre-field planning. The number of detailed floristic survey sites established across the Survey Area (181 quadrats), is considered adequate for a survey of this type and size, with respect to large tracts of restricted/inaccessible portions of the Survey Area. The season, as well as the pre and during-field conditions, were as expected for a dry season survey, with minimal representation of annual and ephemeral flora taxa and limited reproductive material present on most perennial taxa.

#### 3.3.2 Overall Two-season Survey

Access restrictions (e.g., heritage) experienced during dry-season sampling may impact overall (two-season detailed flora and vegetation survey) adequacy pending restriction of these areas during wet-season sampling. Restricted access did not allow for survey in large portions of the Survey Area, including, but not limited to, Kuthawarthayinha (Round Top Hill), Weeli Wollie Creek and tributaries, and various other sites deemed significant for a variety of reasons (sacred sites, water sources, archaeological sites etc.). At the time of survey, these restricted sites were strictly no entry, with no botanical sampling of any kind completed within these areas. The lack of survey within these areas could be considered a major limitation to survey adequacy.

To avoid this potential major limitation to the overall vegetation survey, Biologic recommends survey within these restricted areas where possible, with traditional owners present if necessary. Survey within these areas is critical for documenting additional environmental values that may be impacted (either directly or indirectly) by future

development in the Survey Area, as well as providing contextual knowledge for the surrounding local and regional area. Survey within these restricted areas can be completed with the lowest possible disturbances if necessary (foot traverses with no ground disturbance of any kind). If access to these areas is permitted for wet-season sampling or beyond, additional sampling will be required in these areas to adequately cover and survey the area as per government guidelines (EPA, 2016b, 2016c). Additional field visits may be required for any additional sampling of these areas (to be discussed with BHP WAIO).

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