Biota Environmental Sciences

Nita Downs Irrigation Pivots Rare Flora Survey

Prepared for Forshaw Pastoral Company

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1.0 Background to the Study

Forshaw Pastoral Company (FPC) is seeking to establish a small-scale pivot irrigation development on Nita Downs Station, approximately 200 km southwest of Broome. The development is intended to comprise nine irrigation pivots, each 40 ha in size. Four pivots are located south and west of the homestead (Area A; pivots A1 to A4), while five are located in the north of the station (Area B; pivots PW1 to PW5) (see Figure 1.1, and Appendix 1 for more detail).

The purpose of the development is to provide an alternative source of feed for cattle on the station, particularly those that are currently grazing in a permanent spring area called Munro Springs. This wetland in the east of the station is considered to be of conservation value, and is being degraded through grazing and trampling. FPC has discussed the proposal with local Karajarri Traditional Owners, who are supportive of reducing the amount of grazing pressure in the area of the spring.

Following an initial application for a Purpose Permit to clear native vegetation over a slightly different area at Nita Downs, the Department of Environment Regulation (DER) provided a preliminary assessment, which identified that the proposed clearing may be at variance with some of the 10 clearing principles identified in Schedule 5 of the *Environmental Protection Act 1986*. These included:

(a) ***Native vegetation should not be cleared if it comprises a high level of biological diversity***
While this principle covers a range of different aspects of biodiversity, the concerns raised in the preliminary assessment were specifically in regards to the potential for the areas to support a number of Priority flora species.

(c) ***Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora***
This was raised in regards to the potential for the areas to support the Threatened species *Seringia exastia*.

Following this preliminary assessment, DER invited FPC to provide additional information addressing these issues. As a result, FPC commissioned Biota Environmental Sciences (Biota) to complete a survey for conservation significant flora in 2017. The purpose of this study was to provide additional background information to support assessment of an application for a Purpose Permit to clear vegetation in the area of the nine currently proposed pivots.

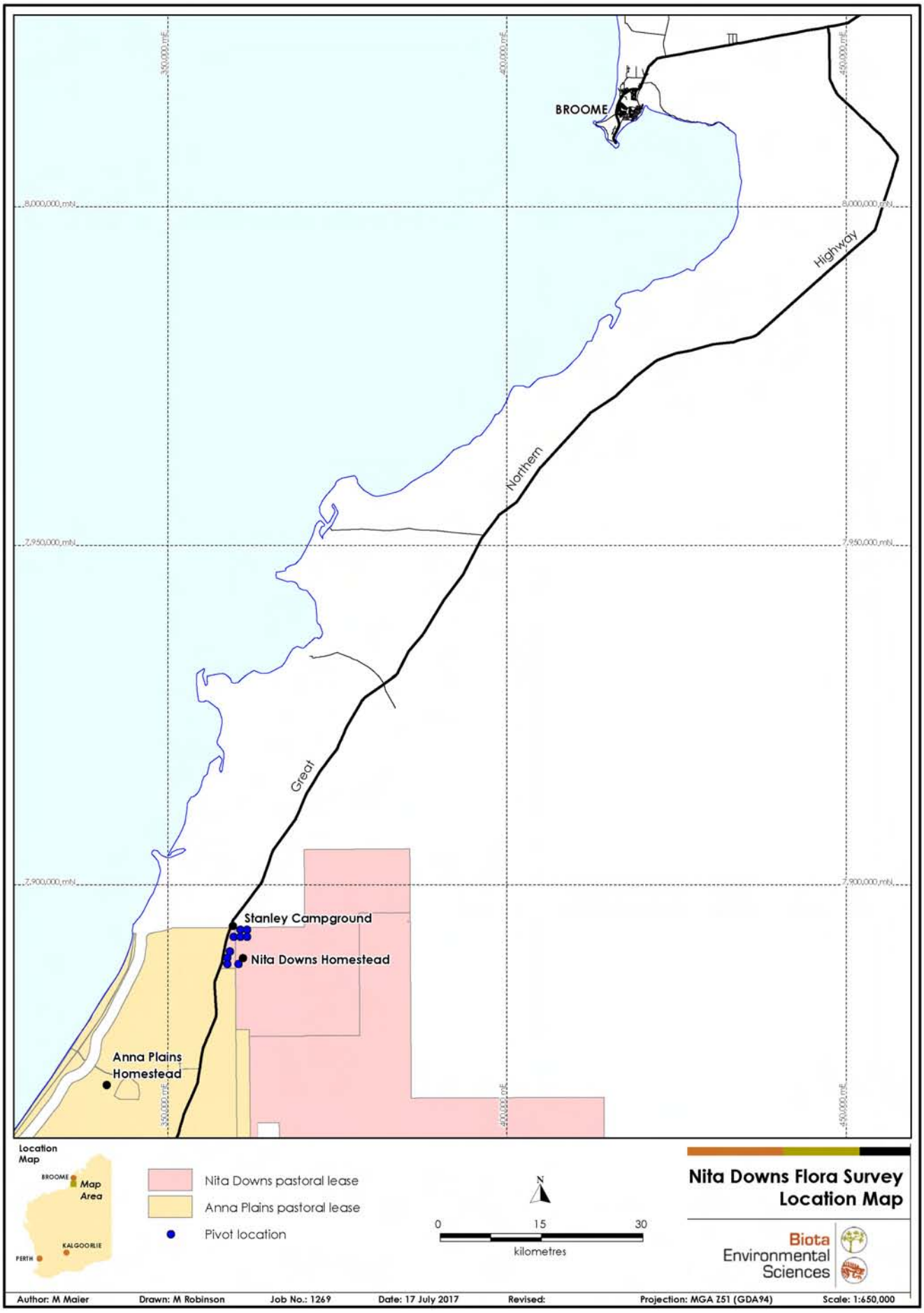

Figure 1.1: Location of the irrigation pivots on Nita Downs.

2.0 Methodology

2.1 Survey Team and Timing

The survey was undertaken from 5 to 9 June by Michi Maier, Principal Botanist with Biota. Michi has over 26 years of experience in conducting vegetation and flora surveys in the north of WA, including in the Kimberley region.

The timing of the survey was optimal, following substantial rainfall in the locality. To illustrate this, data were sourced from the closest Bureau of Meteorology weather recording station with reliable rainfall data (station number 3028 at Anna Plains, approximately 25 km southwest of the study area). Although closer to the coast, and therefore likely to experience slightly more rainfall, the data from this station would be indicative of the rainfall received at Nita Downs. Figure 2.1 shows the total monthly rainfall received at Anna Plains in the 12 months prior to the survey, compared to the long-term (1908-2017) median monthly rainfall. It is clear that the locality received considerably higher than the median rainfall from mid summer to late autumn (December 2016 to April 2017). The field survey was completed approximately 6 weeks after the last substantial rainfall event (56.0 mm on 16th April), which represents optimal timing.

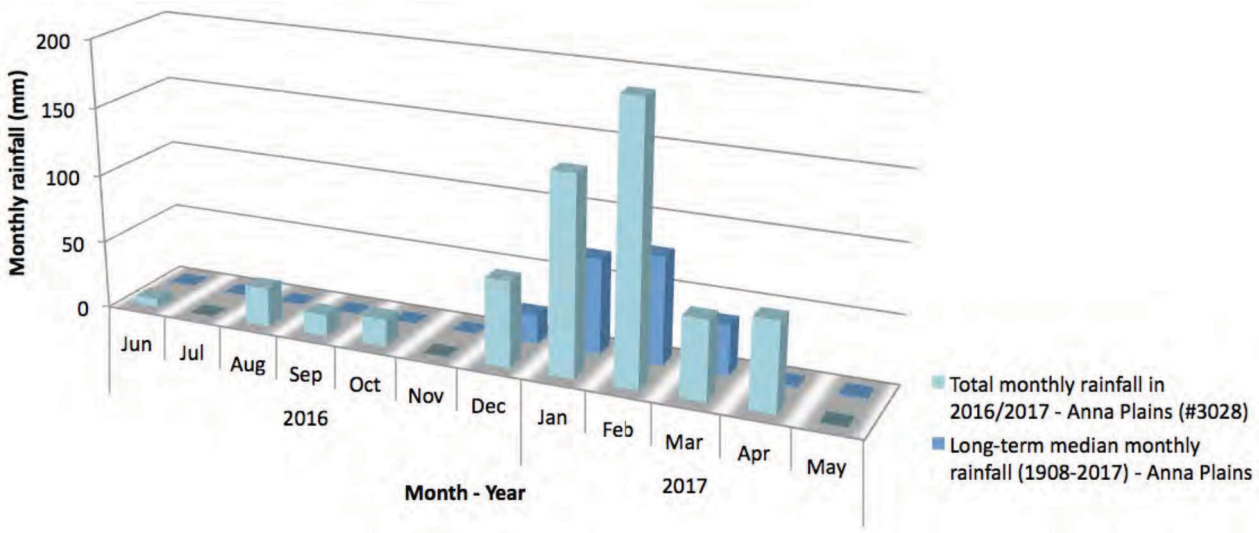

Figure 2.1: Total rainfall received at the Anna Plains weather recording station in the 12 months prior to the current survey, compared to the long-term median monthly rainfall.

2.2 Survey Method

The target species for the survey comprised the nine species nominated by DER (2016) as potentially occurring in the study area, along with two other species, *Acacia glaucocaesia* and *Phyllanthus eremicus*, which have been recorded from the nearby Anna Plains station:

- *Seringia exastia* (Threatened);
- *Bonamia oblongifolia* (Priority 1);
- *Nicotiana heterantha* (Priority 1);
- *Tephrosia andrewsii* (Priority 1);
- *Acacia glaucocaesia* (Priority 3);
- *Lawrencia* sp. Anna Plains (N.T. Burbidge 1433) (Priority 3);
- *Phyllanthus eremicus* (Priority 3);
- *Pterocaulon intermedium* (Priority 3);
- *Seringia katatona* (Priority 3);

- *Terminalia kumpaja* (Priority 3); and
- *Tribulopis marliesiae* (Priority 3).

A search of the Department of Parks and Wildlife's NatureMap database on 4 June 2017 did not identify any records of other conservation significant flora species from within 40 km of Nita Downs homestead. However, given the relatively low level of survey work completed in the vicinity, other taxa known to occur in the broader region were also searched for (e.g. *Triodia caelestialis*, known from the vicinity of Port Smith, approximately 60 km north).

To search for conservation significant flora, each pivot area was systematically traversed on foot. The search area comprised the 40 ha pivot plus a buffer around this, for a total area of 50 ha per pivot (see Appendix 1). The original intention was to space the traverses at 100 m intervals in highly prospective habitats, and extend the spacing to a maximum of 200 m in degraded areas or unsuitable habitats. However, once in the field it was apparent that all of the pivots comprised suitable habitat for one or more of the target species, so all traverses were conducted at 100 m spacings (see Appendix 1 for track logs of the foot traverses).

To illustrate the habitat and vegetation of each pivot, photographs were taken from the boundary at each cardinal direction, looking towards the centre (Appendix 2). The broad vegetation type was also described for each pivot, and vegetation condition was assessed.

For any flora of conservation significance encountered, the following information was recorded:

- Location coordinates, using a hand-held GPS;
- Number of individuals (a count wherever possible, or an estimate for large populations);
- Habitat information, including landform, substrate, vegetation type and associated species; and
- Condition information (e.g. apparent health, reproductive status, etc).

Representative photographs were also taken.

It was intended that for any significant species found, searches would also be carried out beyond the pivot areas in order to evaluate the relative impact to the local population, however only limited such searches were possible in the time available.

2.3 Specimen Identifications

Voucher specimens were collected for all conservation significant flora species and for any species that could not be identified in the field (e.g. taxa that require microscopic examination to differentiate to species). Representative individuals of conservation significant species were also marked with flagging tape to allow the station owners to become familiar with these species.

Specimens were identified on return to Perth. Most were identified by Michi Maier, however assistance was sought from Dr Matt Barrett (Kimberley taxonomic specialist, Botanic Garden & Parks Authority) for problematic specimens and for confirmation of conservation significant flora species.

Vouchers will be submitted to the WA Herbarium for lodgement in accordance with the Herbarium's specimen acquisition policy, provided that the material is considered suitable. Threatened and Priority Flora Report Forms will be submitted to the Department of Parks and Wildlife for the conservation significant species recorded during the field survey.

2.4 Survey Limitations

While the survey gives a reliable indication of the flora species present in the pivot areas, the search traverses were spaced 100 m apart. Given the number of locations at which Priority flora were recorded, it is likely that additional plants are present in the intervening areas. It was also not possible to survey to an equivalent degree outside the pivot areas in the time available. This means it is not possible to quantify the extent of likely impact to the flora species recorded from the pivots with regards to the number of individuals; rather, an assessment has been made based on the amount of suitable habitat that can be inferred to occur in the vicinity.

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3.0 Results

3.1 Vegetation

The proposed development is located near the northern end of the Nita land system (see Payne and Schoknecht 2011), which has an area of 2,803 km^2 and extends from the northeastern edge of the Pilbara bioregion through to close to Bidyadanga. This land system is described as comprising sandplains supporting shrubby soft spinifex grasslands with occasional trees.

The vegetation types recorded from the pivots are summarised in Table 3.1, along with comments regarding vegetation condition. The typical habitat for all pivots comprised flat pindan sandplain with a substrate of orange-red sand overlying red sand, with some slightly more elevated areas in pivot PW4 in the northeastern section of Area B. No defined drainage areas were present.

The vegetation types were consistent with the Nita land system and typical of pindan sandplain vegetation in the locality, comprising open woodlands and shrublands over a ground storey of a hummock grassland (typically dominated by the soft spinifex *Triodia epactia*) with sparse to moderate amounts of tussock grasses (typically *Chrysopogon pallidus, Eriachne obtusa* and *Aristida* spp.). Photographs of each pivot are provided in Appendix 2.

The dominant trees in Area A comprised *Corymbia greeniana* and *C. zygophylla*, with lesser amounts of *C. flavescens* and *Bauhinia cunninghamii*. *Acacia drepanocarpa* was the dominant medium to tall shrub species in Area A, occurring with other species such as *A. colei* and occasional *A. sericophylla, A. tumida* var. *kulparn, Gardenia pyriformis* subsp. *keartlandii* and *Grevillea wickhamii* subsp. *macrodonta*. Some thickets of *Acacia monticola* were also recorded in pivots A1 to A3. The most common low shrubs recorded were *Chamaecrista symonii, Corchorus incanus* subsp. *incanus, Jacksonia aculeata, Sida* sp. Pindan (B.G. Thomson 3398), *Solanum dioicum* and *Waltheria indica*. Common herbs recorded through Area A included *Calandrinia strophiolata, Euphorbia vaccaria* subsp. *vaccaria, Polycarpaea corymbosa, Pterocaulon serrulatum, Ptilotus polystachyus* and *Trianthema pilosum*.

In Area B, *Corymbia zygophylla, C. greeniana* and *Bauhinia cunninghamii* were the dominant low trees, occurring with lesser amounts of *C. flavescens*. Tall shrubs were less abundant in Area B than in Area A, however thickets of *Acacia monticola* were again recorded. *Acacia drepanocarpa* was not as common in Area B as in Area A, except through the northeastern sections of pivots PW3 and PW4 and the western (recently burnt) section of PW1. The low shrubs recorded in Area A were again present in Area B, but were considerably less frequent in the latter area. The same herbaceous species recorded from Area A were common in Area B.

The vegetation over the majority of the pivots was in Very Good to Excellent condition. Vehicle tracks were present through some of the pivots, and there was a cleared area in the centre of A1 around a newly established bore. Cattle pads were evident in all pivots, and particularly in A4, however the only area of moderate to heavy grazing / trampling was at the western edge of PW3 where a bull appeared to be resident. Only three weed species were recorded, and these were present at a small number of locations. According to the Landgate Firewatch Map Service, the last fire through the area was in August 2014, when all of the northern pivots and pivots A3 and A4 in Area A were burnt.

In summary, the vegetation types recorded from the pivot areas are typical for pindan sandplain in the locality. While generally in Very Good to Excellent condition, none of the vegetation types are considered to be of elevated conservation significance, and no Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs) occur within 20 km of the study area.

Table 3.1: Vegetation types and vegetation condition for the nine pivots surveyed at Nita Downs.

Pivot	Vegetation Type/s	Overall Condition
A1	*Corymbia greeniana, (C. zygophylla)* scattered low trees to low open woodland over *Acacia drepanocarpa* shrubland over *Triodia epactia* hummock grassland; patches of *Acacia monticola* thicket and open tussock grassland of *Aristida* spp.	Excellent to Very Good; occasional cattle pads present but no particular signs of grazing or weeds; patches burnt approximately 2 years ago.
A2	*Corymbia greeniana, (C. zygophylla)* scattered low trees to low open woodland over *Acacia drepanocarpa* shrubland over *Triodia epactia* hummock grassland; patches of *Acacia monticola* thicket and open tussock grassland of *Aristida* spp.	Excellent to Very Good; some cattle pads; remains of old corrugated iron water tanks.
A3	*Corymbia greeniana, Bauhinia cunninghamii* scattered low trees over *Acacia drepanocarpa* open heath over *Triodia epactia* hummock grassland with patches of open tussock grassland of *Aristida* spp. and *Chrysopogon pallidus*; with patches of *Acacia monticola* thicket.	Excellent to Very Good; some cattle pads.
A4	*Corymbia zygophylla, C. greeniana* scattered low trees over *Acacia colei* scattered tall shrubs over *Triodia epactia* hummock grassland.	Very Good; numerous cattle pads present but no particular signs of grazing or weeds; small patches in the west appear to have been burnt approximately 2 years ago.
PW1	*Corymbia greeniana, (Bauhinia cunninghamii)* scattered low trees to low open woodland over *Triodia epactia* hummock grassland with open tussock grassland of *Aristida* spp.; west side of track burnt relatively recently (~2-3 years ago) and has open shrubland of *Acacia drepanocarpa.*	Excellent to Very Good; difficult to assign a condition ranking to the section of this pivot west of the track as it has been burnt in the last 2 years.
PW2	*Corymbia greeniana, C. zygophylla, Bauhinia cunninghamii* scattered low trees to low open woodland over *Triodia epactia* hummock grassland with open tussock grassland of *Aristida* spp. and *Chrysopogon pallidus*; patches of *Acacia monticola* thicket.	Excellent to Very Good; cattle pads through area but no particular signs of grazing.
PW3	*Corymbia zygophylla, C. greeniana, Bauhinia cunninghamii* scattered low trees to low open woodland over *Triodia epactia* hummock grassland; patches of *Acacia monticola* thicket; northeastern section has *C. zygophylla* low open woodland over *Acacia drepanocarpa* open shrubland over *Triodia epactia* hummock grassland (burnt?).	Excellent to Very Good, except along western edge; condition ranked as Good in this area, as resident bull is grazing and trampling.
PW4	*Corymbia zygophylla, Bauhinia cunninghamii, (C. greeniana)* scattered low trees to low open woodland over *Triodia epactia* hummock grassland; with patches of *Acacia monticola* thicket, and an area of *Triodia schinzii* hummock grassland near the centre of the pivot; northeastern section has *C. zygophylla* low open woodland over *Acacia drepanocarpa* open shrubland over *Triodia epactia* hummock grassland (burnt?).	Excellent to Very Good; cattle pads through area but no particular signs of grazing.
PW5	*Corymbia zygophylla* low open woodland over *Triodia epactia* hummock grassland.	Excellent to Very Good; cattle pads through area but no particular signs of grazing; occasional camel scats also present.

3.2 Flora

A total of 125 native vascular flora species were recorded from the study area, belonging to 85 genera and 39 families (see Appendix 3). The survey timing was optimal for the flora survey; most plants were flowering or fruiting, providing suitable material for confident identification, and numerous annual species were present.

In general, the species recorded were typical of pindan vegetation in the locality. However, due to the relative lack of vouchering of specimens from the vicinity, some specimens fill gaps in the documented distributions of common species (e.g. *Triodia schinzii*), while others appear to be range extensions for poorly collected species (e.g. *Synostemon lissocarpus*).

3.2.1 Conservation Significant Flora Recorded During the Survey

Three flora species of conservation significance were recorded during the field survey; specimens of each species were confirmed by Dr Matt Barrett (Botanic Garden & Parks Authority). Locations are provided and mapped in Appendix 3, while each species is briefly described below.

- ***Phyllanthus eremicus*** **(Priority 3)**

This species is a woody subshrub growing to approximately 50 cm tall, with distinctive slightly peeling red-brown bark, oval leaves and round fruit (Plate 3.1) (see full description in Barrett and Telford 2015). *Phyllanthus eremicus* was found in all pivots except A4; it always occurred as scattered individuals but was more frequently recorded in the northern pivots. A total of 106 individuals were recorded at 69 locations inside the pivots, while a further 19 individuals were recorded from 8 locations during limited searches conducted outside the pivots. Virtually all of the individuals were fruiting at the time of survey.

On the basis of the data recorded, this species appears to be scattered but common within the pindan vegetation on Nita Downs station. Similar and contiguous habitat extends for several kilometres in all directions from the pivots, with the nearest other known population approximately 25 km southwest on Anna Plains station. Even assuming a very conservative estimate of the local suitable habitat, extending just 10 km east of the Great Northern Highway, there is over 11,500 ha of prospective habitat for *Phyllanthus eremicus* on Nita Downs. The proportion of suitable habitat in the locality that is encompassed by the pivots is therefore low (in the order of 4%). Given that the distribution of this species extends from the vicinity of Broome to Shay Gap, clearing for the proposed development would not be expected to impact the conservation status of this species.

Plate 3.1: ***Phyllanthus eremicus*****: growth form, bark and fruiting branchlet.**

- ***Seringia katatona* (Priority 3)**

This species is a low shrub, which has leaves with a fine felty indumentum on the upper and lower surfaces, and flowers with a calyx that is wider than long (Plate 3.2) (description in Wilkins and Whitlock 2015). Many members of this genus are believed to be clonal; where dense patches of shrubs occur, these may represent a single individual (one genotype), however this can only be confirmed through genetic analysis. *Seringia katatona* was found in all pivots except PW2 and PW5. At most of the locations in the study area, *S. katatona* occurred in only small numbers, however some larger stands were recorded. The largest comprised a stand of over 500 stems in PW3 and a stand of over 200 stems in PW4; three other stands of 50 or more stems were also recorded from PW3 (Plate 3.3). A total of 443 stems were recorded from approximately 25 locations inside the pivot areas, with a further 11 stems recorded just outside pivot A4 during limited searches outside the pivots. Most plants were healthy and flowering at the time of survey.

On the basis of the data recorded, it is likely that *Seringia katatona* occurs more broadly through pindan vegetation on Nita Downs at a similar density to that observed in the pivots (i.e. in localised patches ranging from a few stems to several hundred stems). There is abundant suitable and contiguous habitat in the vicinity, and a number of collections to the east of Nita Downs, the closest of which is approximately 25 km east of the study area. As for *Phyllanthus eremicus*, the pivot areas would comprise only a small amount (approximately 4%) of even the most conservative estimate of suitable habitat in the immediate vicinity. The distribution of *Seringia katatona* extends from approximately Broome to Nita Downs and over 250 km inland, and Wilkins and Whitlock (2015) note that "given the extent of unexplored suitable habitat among the known localities, the species is most likely not under threat…". Given this, clearing for the proposed development would not be expected to significantly impact this species.

Plate 3.2: ***Seringia katatona*: growth form, flowering branchlet and calyx.**

Plate 3.3: ***Seringia katatona* in pivot PW3: part of the population of 500+ stems (left) and 90 stems (right).**

- ***Tribulopis marliesiae*** **(Priority 3)**

This spreading herb has a perennial rootstock with corky bark, and compound leaves with up to four pairs of terete to very slightly compressed linear leaflets (Plate 3.4). A single individual was recorded outside the proposed clearing area, located between pivots PW3 and PW4. This specimen was immature and sterile (lacking flowering material), however the leaf characters match well with those of the Priority species (see Barrett and Barrett 2015).

Tribulopis marliesiae has been recorded from the vicinity of Pardoo Roadhouse to Roebuck Plains station and inland over 250 km to the east, with the closest location approximately 12 km south on Anna Plains station.

Plate 3.4: ***Tribulopis marliesiae*****: close-up of leaf material.**

3.2.2 Likelihood of Other Conservation Significant Flora Occurring in the Study Area

With regards to the other flora species of conservation significance potentially occurring at Nita Downs, no individuals were recorded of any of the possible species and none are considered likely to occur in the pivot areas:

- *Seringia exastia* (Threatened) is known from coastal dune swales in the Broome locality and from relict desert dune swales approximately 140 km south; the closest known population to the study area is over 50 km east. While the current survey was completed during the flowering period for this species, all of the material collected from the study area was confirmed as being the Priority 3 species *S. katatona*.
- *Bonamia oblongifolia* (Priority 1) is a prostrate herb known from a few very widely spaced locations in the Dampierland and Great Sandy Desert bioregions. There are no known populations within 100 km of Nita Downs. While other members of the Convolvulaceae family were recorded from the pivot areas (*Bonamia linearis, Evolvulus alsinoides* and *Polymeria lanata*), no specimens with sessile leaves corresponding to *Bonamia oblongifolia* were collected.
- *Nicotiana heterantha* (Priority 1) is a short-lived herb that typically grows on heavy soils in seasonally wet areas. Although there is a nearby record from approximately 17 km southwest on Anna Plains station, this collection was from a watercourse / wash and was growing in association with *Melaleuca acacioides*. There is no suitable drainage habitat for this species in any of the pivot areas.
- *Tephrosia andrewii* (Priority 1) is a low shrub occurring in pindan vegetation in two main areas, located approximately 85 km north and 50 km south of the study area. The northern population was inspected during the field survey; the shrubs were found to be in good condition, with the robust and hairy leaves distinctive and easy to spot in the field. While a number of *Tephrosia* species were recorded during the field survey, these did not include *T. andrewii*.

- *Acacia glaucocaesia* (Priority 3) is widespread through the Pilbara bioregion, and there is also a record from approximately 40 km southwest of the study area on Anna Plains station. While several *Acacia* species were recorded from the pivot areas, *A. glaucocaesia* was not recorded.
- *Lawrencia* sp. Anna Plains (N.T. Burbidge 1433) (Priority 3) is known from a number of locations in the western section of Anna Plains station in the Dampierland bioregion, with a disjunct record from the Gascoyne bioregion. The closest population is approximately 15 km west of the study area. All of the records from the Dampierland bioregion are from seasonal watercourses in semi-saline areas. There is no suitable habitat for this species in any of the pivots.
- *Pterocaulon intermedium* (Priority 3) is a perennial herb to low shrub, somewhat similar in appearance to *P. sphacelatum*. While *Pterocaulon sphacelatum* was confirmed from pivots in Area A and the more robust *P. serrulatum* was common in both areas, no specimens of *P. intermedium* were collected. *Pterocaulon intermedium* is widespread from the northern Kimberley to the Pilbara. The closest record is 18 km southwest of the study area on Anna Plains station; this location appears to be in pindan habitat but fringing saline areas.
- *Terminalia kumpaja* (Priority 3) is a low tree growing from the vicinity of Sandfire Roadhouse through to Broome. The closest record of this species is from a watercourse approximately 25 km southwest of the study area on Anna Plains station, and most other records appear similarly associated with seasonally inundated areas. No *Terminalia* trees were recorded during the field survey.

3.2.3 Introduced Flora

While introduced flora (weeds) were not a specific target for the survey, species were documented when encountered to contribute to the assessment of vegetation condition. Only three weed species were recorded, all at low frequency (see Appendix 4):

- **Aerva javanica* (Kapok Bush) was recorded as individual plants in pivots A1 and A2. This low shrub is a common weed from Shark Bay to the Kimberley. It can be invasive and form dense infestations, particularly in sandy coastal soils and disturbed areas, however there is no indication that this species currently represents an issue for Nita Downs.
- **Citrullus colocynthis* (Colocynth) was recorded as a single plant in pivot A3. This introduced melon grows throughout WA and is not a significant environmental weed.
- **Stylosanthes hamata* (Verano Stylo) is a perennial herb to low shrub with yellow pea flowers and distinctive beaked fruit. Ten plants were recorded growing on the verge of a track in pivot A1 and a single plant was recorded from pivot PW3. This species has been recorded from Exmouth to the Kimberley. Although introduced as a fodder species, Verano Stylo is considered an environmental weed.

4.0 Summary and Conclusions

Three flora species of conservation significance were recorded during the field survey.

The Priority 3 species *Phyllanthus eremicus* and *Seringia katatona* were recorded relatively frequently from the pivot areas. It was not possible to complete an equivalent amount of searches outside the study area in the time available. However, given the frequency at which both species were recorded, and the fact that suitable habitat is widespread and contiguous beyond the pivot areas, these two species can be inferred to occur at similar densities through the remainder of the pindan vegetation on Nita Downs and in the vicinity. The pivot areas encompass only approximately 4% of the local extent of suitable habitat (using the most conservative estimate). When considered together with the relatively broad documented distribution of both species and the wider extent of the Nita land system, the clearing proposed for the current development would be very unlikely to impact the conservation status of these species.

A third Priority 3 species, *Tribulopis marliesiae*, was recorded outside the proposed clearing areas, between pivots PW3 and PW4. Only one individual was recorded, and this location will not be cleared by the proposed development.

It is considered unlikely that any other flora species of conservation significance occur within the nine pivot areas.

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5.0 Glossary

Biota	Biota Environmental Sciences.
Calyx	The outer whorl of a flower, made up of the sepals, which protects the inner whorl of petals; in the genus *Seringia*, the sepals are coloured, petal-like structures, while the true petals are inconspicuous.
DER	WA Department of Environment Regulation.
FPC	Forshaw Pastoral Company.
Indumentum	Covering of hairs.
Pindan	Used to describe both the arid red sandplain country of the southwest Kimberley region and the vegetation communities commonly associated with it. Pindan vegetation is typically dominated by scattered eucalypts (particularly bloodwoods, *Corymbia* species), a variable cover of wattles (*Acacia* species), and an understorey of spinifex and/or tussock grasses.

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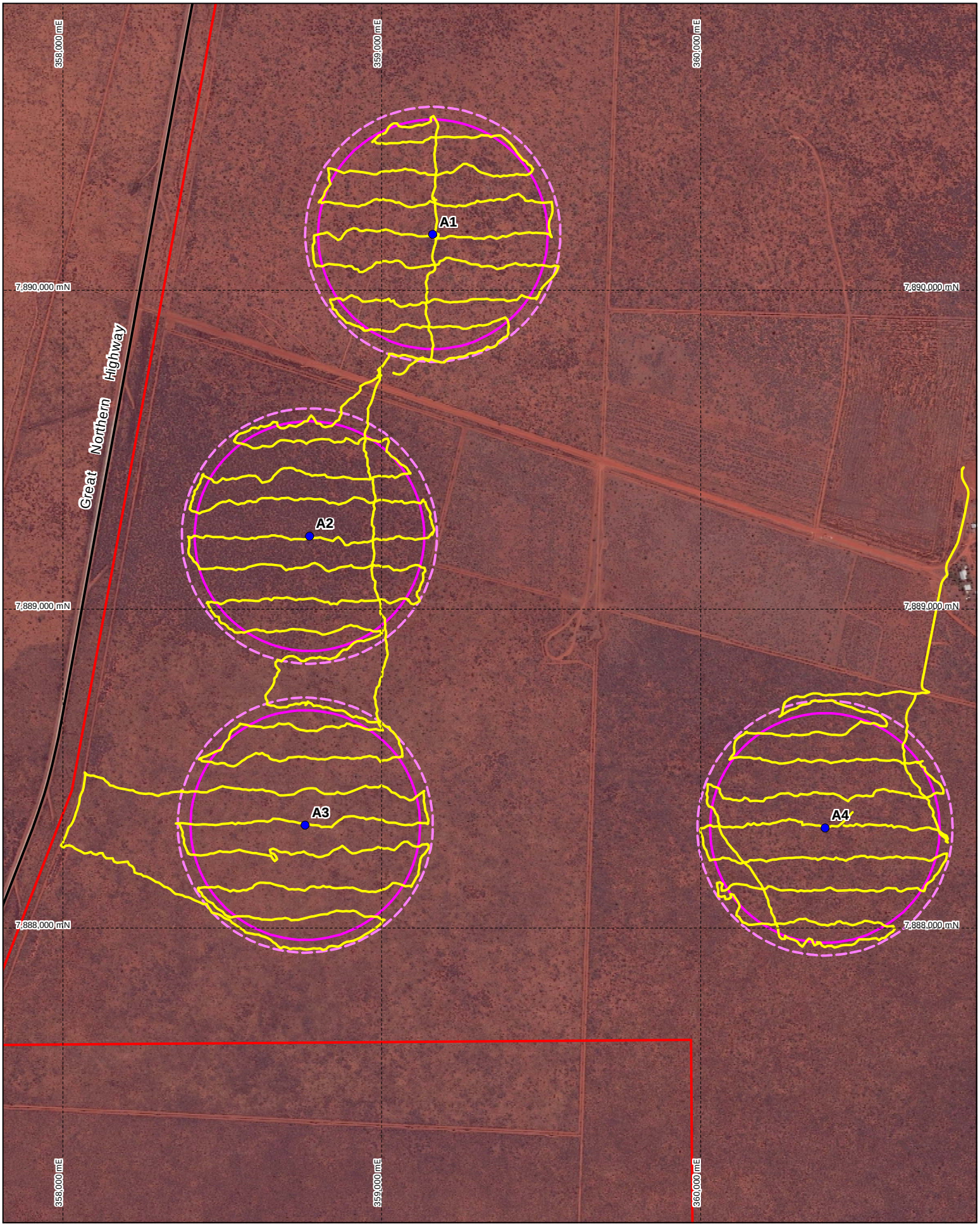
Appendix 1

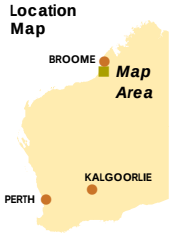
Locations of Pivots and Track Logs of Foot Traverses

Centre points of each pivot.

Pivot	Easting (WGS84, Zone 51 K)	Northing (WGS84, Zone 51 K)
A1	359159	7890174
A2	358773	7889229
A3	358760	7888322
A4	360390	7888314
PW1	359700	7892350
PW2	360700	7892350
PW3	360700	7893350
PW4	361700	7893350
PW5	361700	7892350



Location Map



Proposed pivot extent

Buffer area

Nita Downs pastoral lease

Foot traverse

Area A pivot location

N

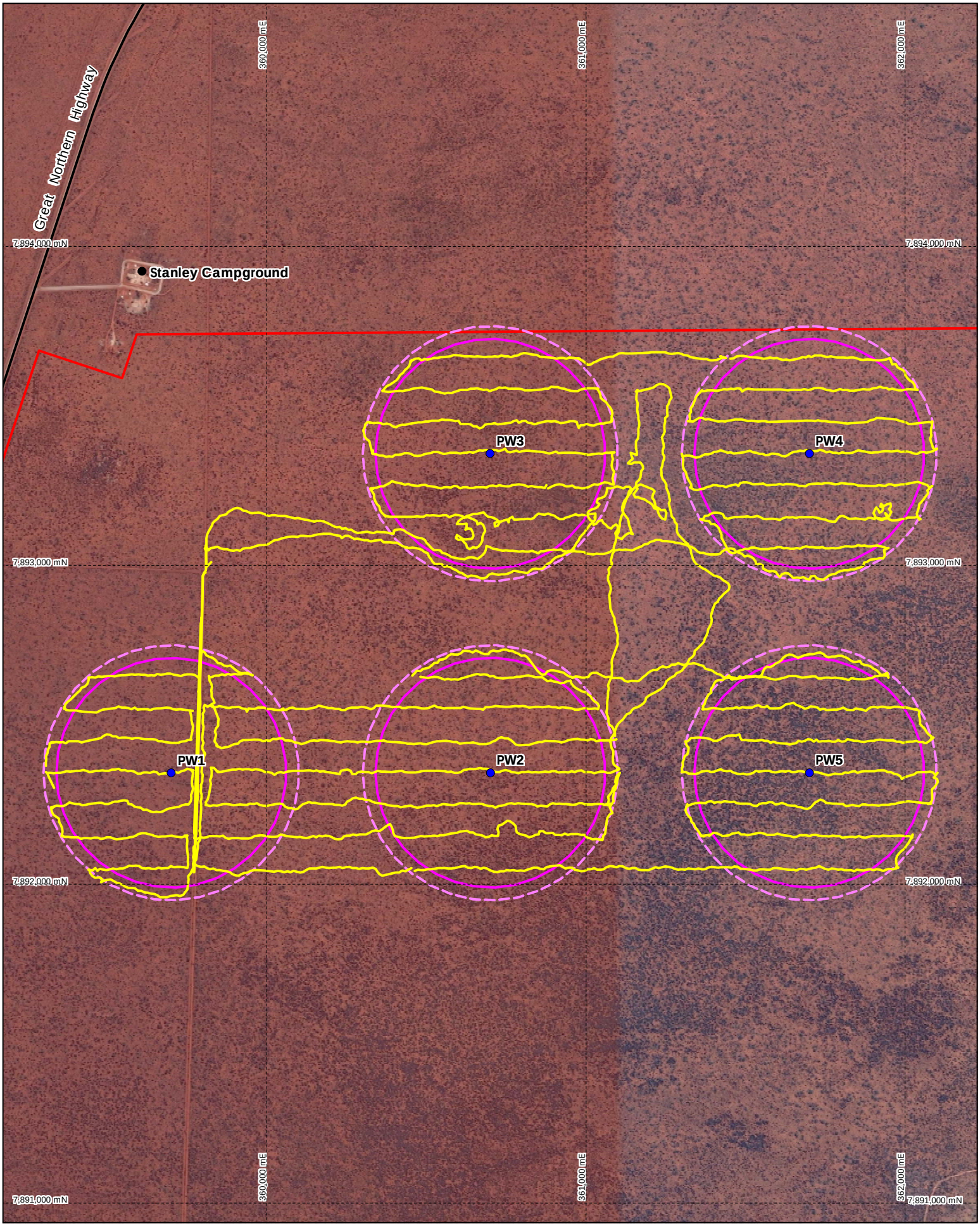
0 400 800

metres

Nita Downs Flora Survey
Foot Traverses Area A

Biota Environmental Sciences

Author: M Maier | Drawn: M Robinson | Job No.: 1269 | Date: 17 July 2017 | Revised: 21 July 2017 | Projection: MGA Z51 (GDA94) | Scale: 1:15,000



Location Map

BROOME
Map Area
KALGOORLIE
PERTH

Proposed pivot extent

Buffer area

Nita Downs pastoral lease

Foot traverse

Area A pivot location

N

0 400 800

metres

Nita Downs Flora Survey
Foot Traverses Area B

Biota Environmental Sciences

Author: M Maier | Drawn: M Robinson | Job No.: 1269 | Date: 17 July 2017 | Revised: 21 July 2017 | Projection: MGA Z51 (GDA94) | Scale: 1:15,000

Appendix 2

Photographs of Proposed Pivots

North

West

East

South

Pivot A1

North

West

East

South

Pivot A2

North

West

East

South

Pivot A3

North

West

East

South

Pivot A4

North

West

East

South

Pivot PW1

North

West

East

South

Pivot PW2

North

West

East

South

Pivot PW3

North

West

East

South

Pivot PW4

North

West

East

South

Pivot PW5

Appendix 3

Vascular Flora Species List

Family / Species	Status	Area A Pivots	Area B Pivots
Family: Aizoaceae			
Trianthema pilosum		✓	✓
Family: Amaranthaceae			
Achyranthes aspera		✓	✓
**Aerva javanica*	Weed	✓	
Amaranthus undulatus			✓
Ptilotus arthrolasius			✓
Ptilotus astrolasius		✓	✓
Ptilotus calostachyus		✓	✓
Ptilotus fusiformis		✓	
Ptilotus lanatus			✓
Ptilotus polystachyus		✓	✓
Family: Apocynaceae			
Carissa lanceolata		✓	✓
Cynanchum floribundum			✓
Marsdenia angustata			✓
Marsdenia viridiflora		✓	✓
Wrightia saligna			✓
Family: Araliaceae			
Trachymene oleracea subsp. *oleracea*		✓	
Family: Asteraceae			
Pterocaulon serrulatum		✓	✓
Pterocaulon sphacelatum		✓	
Family: Bignoniaceae			
Dolichandrone heterophylla		✓	✓
Family: Boraginaceae			
Ehretia saligna		✓	✓
Heliotropium leptaleum		✓	
Trichodesma zeylanicum		✓	✓
Family: Capparaceae			
Capparis umbonata		✓	✓
Family: Caryophyllaceae			
Polycarpaea corymbosa		✓	✓
Family: Cleomaceae			
Cleome uncifera subsp. *uncifera*		✓	✓
Family: Convolvulaceae			
Bonamia linearis		✓	✓
Evolvulus alsinoides var. *decumbens*		✓	✓
Polymeria lanata		✓	✓
Family: Cucurbitaceae			
**Citrullus colocynthis*	Weed	✓	
Cucumis variabilis		✓	✓
Family: Cyperaceae			
Bulbostylis barbata		✓	✓
Family: Euphorbiaceae			
Euphorbia coghlanii			✓

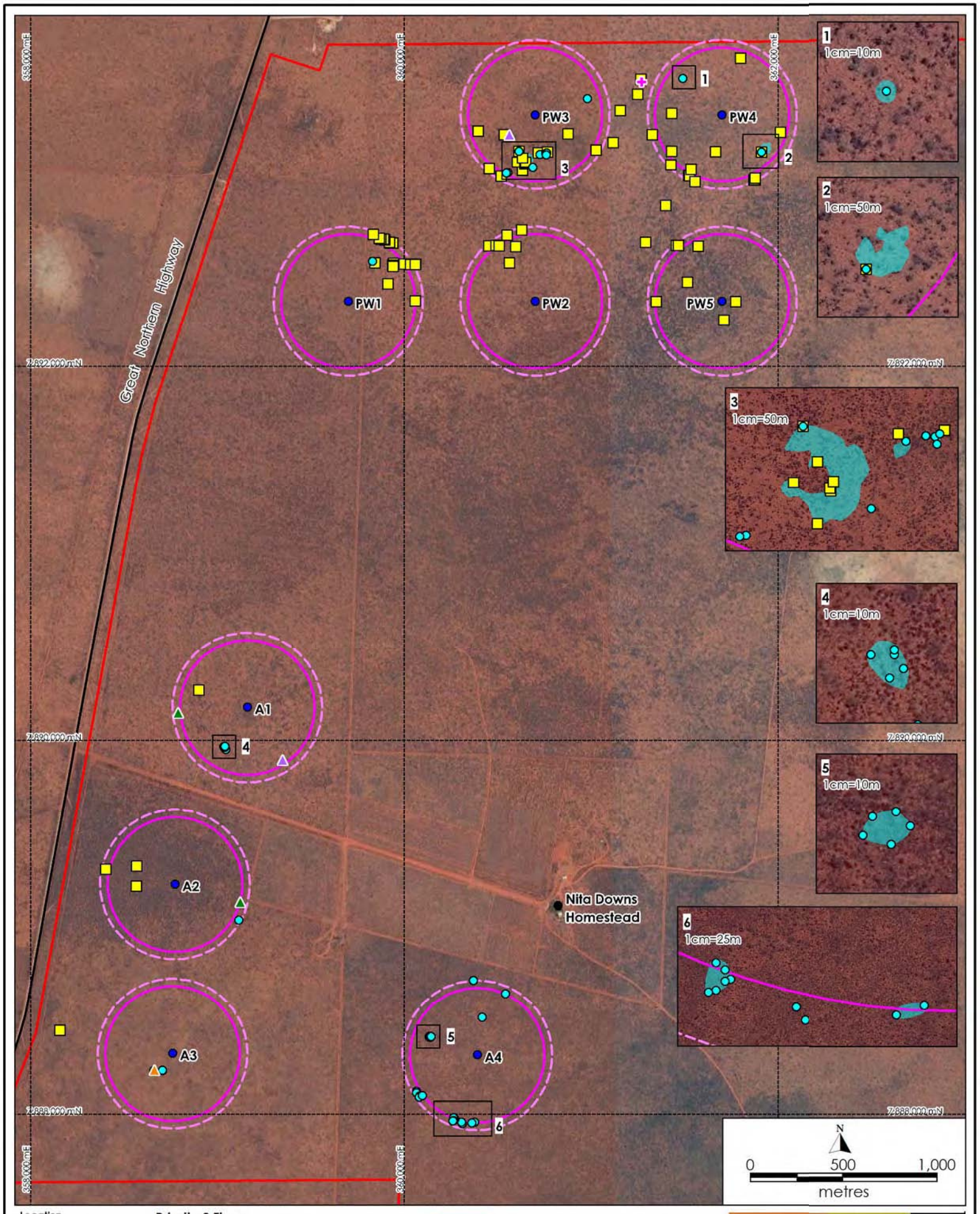
Family / Species	Status	Area A Pivots	Area B Pivots
Euphorbia psilosperma		✓	✓
Euphorbia vaccaria var. *vaccaria*		✓	✓
Family: Fabaceae			
Acacia ancistrocarpa		✓	✓
Acacia colei		✓	✓
Acacia drepanocarpa subsp. *drepanocarpa*		✓	✓
Acacia eriopoda		✓	
Acacia monticola		✓	✓
Acacia sericophylla		✓	✓
Acacia tumida var. *kulparn*		✓	✓
Bauhinia cunninghamii		✓	✓
Cajanus marmoratus		✓	✓
Chamaecrista symonii		✓	✓
Crotalaria ramosissima		✓	✓
Cullen martinii		✓	✓
Erythrophleum chlorostachys			✓
Indigofera colutea			✓
Indigofera linifolia		✓	✓
Indigofera linnaei		✓	✓
Indigofera monophylla		✓	✓
Jacksonia aculeata		✓	✓
Leptosema anomalum		✓	✓
Rhynchosia minima			✓
Senna costata		✓	✓
Senna goniodes			✓
Senna notabilis		✓	✓
**Stylosanthes hamata*	Weed	✓	✓
Tephrosia leptoclada		✓	✓
Tephrosia rosea var. *rosea*		✓	
Tephrosia sp. D Kimberley Flora (R.D. Royce 1848)			✓
Zornia chaetophora		✓	✓
Family: Goodeniaceae			
Brunonia australis var. A Kimberley Flora (K.F. Kenneally 5452)		✓	
Goodenia armitiana		✓	✓
Goodenia azurea			✓
Goodenia sepalosa var. *sepalosa*		✓	✓
Scaevola parvifolia subsp. *parvifolia*		✓	✓
Velleia panduriformis			✓
Family: Gyrostemonaceae			
Gyrostemon tepperi		✓	✓
Family: Hernandiaceae			
Gyrocarpus americanus subsp. *pachyphyllus*			✓
Family: Lamiaceae			
Cyanostegia cyanocalyx		✓	
Family: Lauraceae			
Cassytha capillaris		✓	✓
Family: Loranthaceae			
Lysiana spathulata subsp. *spathulata*		✓	✓

Family / Species	Status	Area A Pivots	Area B Pivots
Family: Malvaceae			
Abutilon otocarpum		✓	✓
Corchorus incanus subsp. *incanus*		✓	✓
Corchorus sidoides subsp. *sidoides*		✓	✓
Corchorus sidoides subsp. *vermicularis*		✓	✓
Gossypium australe			✓
Hibiscus leptocladus		✓	✓
Melhania oblongifolia		✓	
Seringia katatona	Priority 3	✓	✓
Sida arenicola		✓	✓
Sida rohlenae subsp. *occidentalis*		✓	✓
Sida sp. Pindan (B.G. Thomson 3398)		✓	✓
Waltheria indica		✓	✓
Family: Menispermaceae			
Tinospora smilacina		✓	✓
Family: Moraceae			
Ficus aculeata var. *indecora*		✓	✓
Family: Myrtaceae			
Calytrix carinata		✓	✓
Corymbia flavescens		✓	✓
Corymbia greeniana		✓	✓
Corymbia zygophylla		✓	✓
Family: Nyctaginaceae			
Boerhavia sp.		✓	✓
Family: Oleaceae			
Jasminum calcareum		✓	
Family: Phyllanthaceae			
Phyllanthus eremicus	Priority 3	✓	✓
Phyllanthus virgatus		✓	
Synostemon lissocarpus		✓	✓
Family: Poaceae			
Aristida holathera var. *holathera*		✓	✓
Aristida inaequiglumis		✓	✓
Chrysopogon pallidus		✓	✓
Digitaria brownii		✓	✓
Eragrostis eriopoda		✓	✓
Eriachne ciliata		✓	✓
Eriachne obtusa		✓	✓
Schizachyrium fragile			✓
Setaria surgens			✓
Sorghum plumosum		✓	✓
Triodia epactia		✓	✓
Triodia schinzii			✓
Yakirra australiensis var. *intermedia*		✓	✓
Family: Polygalaceae			
Polygala tepperi			✓
Family: Portulacaceae			
Calandrinia strophiolata		✓	✓

Family / Species	Status	Area A Pivots	Area B Pivots
Family: Proteaceae			
Grevillea pyramidalis		✓	✓
Grevillea refracta subsp. *refracta*		✓	
Grevillea wickhamii subsp. *macrodonta*		✓	✓
Hakea chordophylla		✓	
Hakea lorea subsp. *lorea*		✓	✓
Hakea macrocarpa		✓	✓
Persoonia falcata		✓	✓
Family: Rhamnaceae			
Ventilago viminalis			✓
Family: Rubiaceae			
Gardenia pyriformis subsp. *keartlandii*		✓	✓
Spermacoce occidentalis		✓	✓
Family: Sapindaceae			
Dodonaea coriacea		✓	
Dodonaea hispidula var. *arida*		✓	✓
Family: Solanaceae			
Solanum dioicum		✓	✓
Family: Thymelaeaceae			
Pimelea ammocharis		✓	
Family: Violaceae			
Hybanthus aurantiacus		✓	✓
Family: Zygophyllaceae			
Tribulopis angustifolia			✓
Tribulopis marliesiae	Priority 3		✓

Appendix 4

Locations of Priority Flora and Weeds



Location Map

Priority 3 Flora

- *Phyllanthus eremicus*
- *Seringia katatona*
- *Tribulopis marliesiae*

Introduced Flora

- **Aerva javanica*
- **Citrullus colocynthis*
- **Stylosanthes hamata*

- Extent of *Seringia katatona*
- Proposed pivot extent
- Buffer area
- Nita Downs pastoral lease
- Pivot location

Nita Downs Flora Survey Conservation Significant and Introduced Flora

Biota Environmental Sciences

Author: M Maier	Drawn: M Robinson	Job No.: 1269	Date: 17 July 2017	Revised: 21 July 2017	Projection: MGA Z51 (GDA94)	Scale: 1:25,000

Table 1: Priority flora recorded from the study area.

Species	Status	Pivot	Easting	Northing	Specimen	Abundance	Comments
Phyllanthus eremicus	Priority 3	A1	358900	7890266	A1-11	1	
Phyllanthus eremicus	Priority 3	A2	358402	7889309	A2-4	2	
Phyllanthus eremicus	Priority 3	A2	358567	7889327		3	
Phyllanthus eremicus	Priority 3	A2	358565	7889219		1	
Phyllanthus eremicus	Priority 3	A3	358157	7888445		4	In 1 x 1 m area
Phyllanthus eremicus	Priority 3	PW1	360058	7892352		1	
Phyllanthus eremicus	Priority 3	PW1	359912	7892443		1	
Phyllanthus eremicus	Priority 3	PW1	359922	7892662		1	
Phyllanthus eremicus	Priority 3	PW1	359937	7892661		2	Flagged for station owners
Phyllanthus eremicus	Priority 3	PW1	359921	7892665		1	
Phyllanthus eremicus	Priority 3	PW1	359895	7892678		1	
Phyllanthus eremicus	Priority 3	PW1	359889	7892682		1	
Phyllanthus eremicus	Priority 3	PW1	359874	7892682		2	
Phyllanthus eremicus	Priority 3	PW1	359865	7892686		1	
Phyllanthus eremicus	Priority 3	PW1	359833	7892708		3	
Phyllanthus eremicus	Priority 3	PW2	360628	7892730		1	
Phyllanthus eremicus	Priority 3	PW2	360550	7892704		1	Associated species: *Triodia epactia, Chrysopogon pallidus*
Phyllanthus eremicus	Priority 3	PW2	360453	7892647		2	
Phyllanthus eremicus	Priority 3	PW2	360490	7892649		2	Associated species: *Corymbia zygophylla, Triodia epactia*
Phyllanthus eremicus	Priority 3	PW2	360508	7892647		1	
Phyllanthus eremicus	Priority 3	PW2	360595	7892642		1	
Phyllanthus eremicus	Priority 3	PW2	360562	7892556		1	
Phyllanthus eremicus	Priority 3	PW2	360046	7892547		1	
Phyllanthus eremicus	Priority 3	PW2	360039	7892546		1	
Phyllanthus eremicus	Priority 3	PW2	360032	7892547		1	
Phyllanthus eremicus	Priority 3	PW2	359998	7892549		1	
Phyllanthus eremicus	Priority 3	PW2	359942	7892549		1	
Phyllanthus eremicus	Priority 3	PW2	359942	7892552		1	
Phyllanthus eremicus	Priority 3	PW2	359938	7892543		1	
Phyllanthus eremicus	Priority 3	PW2	359939	7892537		5	
Phyllanthus eremicus	Priority 3	PW2	359842	7892556		1	
Phyllanthus eremicus	Priority 3	PW3	360455	7893058		1	Associated species: *Bauhinia cunninghamii, Corymbia zygophylla, Triodia epactia*
Phyllanthus eremicus	Priority 3	PW3	360517	7893019		1	Associated species: *Bauhinia cunninghamii, Corymbia zygophylla, Triodia epactia*
Phyllanthus eremicus	Priority 3	PW3	360875	7893247		5	Associated species: *Acacia monticola, Triodia epactia*

Species	Status	Pivot	Easting	Northing	Specimen	Abundance	Comments
Phyllanthus eremicus	Priority 3	PW3	360535	7893244		1	
Phyllanthus eremicus	Priority 3	PW3	360395	7893262		1	
Phyllanthus eremicus	Priority 3	PW3	360614	7893154		1	
Phyllanthus eremicus	Priority 3	PW3	360631	7893050		1	
Phyllanthus eremicus	Priority 3	PW3	360604	7893094		1	
Phyllanthus eremicus	Priority 3	PW3	360645	7893085		2	
Phyllanthus eremicus	Priority 3	PW3	360644	7893088		1	
Phyllanthus eremicus	Priority 3	PW3	360648	7893095		1	
Phyllanthus eremicus	Priority 3	PW3	360631	7893116		2	
Phyllanthus eremicus	Priority 3	PW3	360717	7893146		1	
Phyllanthus eremicus	Priority 3	PW3	360766	7893150		1	
Phyllanthus eremicus	Priority 3	PW3	361025	7893161		1	
Phyllanthus eremicus	Priority 3	PW4	361522	7893024		1	
Phyllanthus eremicus	Priority 3	PW4	361525	7893021		1	
Phyllanthus eremicus	Priority 3	PW4	361556	7892990		4	
Phyllanthus eremicus	Priority 3	PW4	361870	7892998		1	
Phyllanthus eremicus	Priority 3	PW4	361877	7892998		1	
Phyllanthus eremicus	Priority 3	PW4	361872	7892999		1	
Phyllanthus eremicus	Priority 3	PW4	361876	7893009		1	
Phyllanthus eremicus	Priority 3	PW4	361533	7893055		1	
Phyllanthus eremicus	Priority 3	PW4	361427	7893080		6	In 2 x 2 m area
Phyllanthus eremicus	Priority 3	PW4	361431	7893155		4	In 2 x 2 m area
Phyllanthus eremicus	Priority 3	PW4	361665	7893152		1	
Phyllanthus eremicus	Priority 3	PW4	361911	7893149		3	
Phyllanthus eremicus	Priority 3	PW4	362012	7893256		1	
Phyllanthus eremicus	Priority 3	PW4	361326	7893244		1	
Phyllanthus eremicus	Priority 3	PW4	361431	7893358		1	
Phyllanthus eremicus	Priority 3	PW4	361798	7893651		1	
Phyllanthus eremicus	Priority 3	PW5	361710	7892248		1	Associated species: *Corymbia zygophylla, Triodia epactia*
Phyllanthus eremicus	Priority 3	PW5	361774	7892347	PW5-2	1	Associated species: *Corymbia zygophylla, Acacia monticola, Triodia epactia, Chrysopogon pallidus*
Phyllanthus eremicus	Priority 3	PW5	361348	7892348		1	Associated species: *Corymbia zygophylla, Triodia epactia, Chrysopogon pallidus*
Phyllanthus eremicus	Priority 3	PW5	361514	7892451		1	Associated species: *Bauhinia cunninghamii, Corymbia zygophylla, Triodia epactia, Chrysopogon pallidus*
Phyllanthus eremicus	Priority 3	PW5	361455	7892649		1	Associated species: *Corymbia zygophylla, C. greeniana, Acacia monticola, Triodia epactia*
Phyllanthus eremicus	Priority 3	PW5	361466	7892648		3	

Species	Status	Pivot	Easting	Northing	Specimen	Abundance	Comments
Phyllanthus eremicus	Priority 3	PW5	361572	7892645		1	
Phyllanthus eremicus	Priority 3	Outside	360061	7892548		4	
Phyllanthus eremicus	Priority 3	Outside	360058	7892547		2	
Phyllanthus eremicus	Priority 3	Outside	361290	7892665		2	
Phyllanthus eremicus	Priority 3	Outside	361399	7892863		1	
Phyllanthus eremicus	Priority 3	Outside	361249	7893460		4	
Phyllanthus eremicus	Priority 3	Outside	361266	7893539		2	
Phyllanthus eremicus	Priority 3	Outside	361156	7893372		2	
Phyllanthus eremicus	Priority 3	Outside	361116	7893200		2	
Seringia katatona	Priority 3	A1	359044	7889951	A1-15	1	
Seringia katatona	Priority 3	A1	359038	7889961		1	Total of 14 in this polygon; with *Corymbia zygophylla, Acacia colei, Triodia epactia*
Seringia katatona	Priority 3	A1	359041	7889963		1	
Seringia katatona	Priority 3	A1	359039	7889966		1	
Seringia katatona	Priority 3	A1	359039	7889967		5	
Seringia katatona	Priority 3	A1	359034	7889966		6	
Seringia katatona	Priority 3	A2	359113	7889038	A2-6	1	
Seringia katatona	Priority 3	A3	358658	7888229	A3-3	12	In 4 x 4 m area. Associated species: *Corymbia greeniana, Acacia colei, Triodia epactia, Aristida* spp.
Seringia katatona	Priority 3	A3	358706	7888230	A3-4	13	In 3 x 3 m area
Seringia katatona	Priority 3	A3	358706	7888232		9	In 2 x 1 m area
Seringia katatona	Priority 3	A4	360065	7888119	A4-24	1	Associated species: *Corymbia zygophylla, Acacia drepanocarpa, Triodia epactia*
Seringia katatona	Priority 3	A4	360064	7888111		5	
Seringia katatona	Priority 3	A4	360081	7888094		10	In 5 x 4 m area
Seringia katatona	Priority 3	A4	360080	7888088		6	In 2 x 2 m area
Seringia katatona	Priority 3	A4	360096	7888097		2	In 1 x 1 m area
Seringia katatona	Priority 3	A4	360375	7887957	A4-25	5	In 10 x 2 m area
Seringia katatona	Priority 3	Outside	360360	7887952		11	From previous coordinate to here; these plants are outside pivot
Seringia katatona	Priority 3	A4	360311	7887949	A4-26	1	
Seringia katatona	Priority 3	A4	360306	7887956		1	
Seringia katatona	Priority 3	A4	360271	7887971		4	Total of 22 in this polygon
Seringia katatona	Priority 3	A4	360268	7887970		3	
Seringia katatona	Priority 3	A4	360268	7887976		1	
Seringia katatona	Priority 3	A4	360263	7887980		2	
Seringia katatona	Priority 3	A4	360263	7887965		10	
Seringia katatona	Priority 3	A4	360259	7887964		2	

Species	Status	Pivot	Easting	Northing	Specimen	Abundance	Comments
Seringia katatona	Priority 3	A4	360139	7888414	A4-27		
Seringia katatona	Priority 3	A4	360134	7888413			
Seringia katatona	Priority 3	A4	360132	7888409		38	Total of 38 in this polygon
Seringia katatona	Priority 3	A4	360138	7888407			
Seringia katatona	Priority 3	A4	360142	7888411			
Seringia katatona	Priority 3	A4	360417	7888516		2	
Seringia katatona	Priority 3	A4	360542	7888642	A4-28	6	In 2 x 2 m area
Seringia katatona	Priority 3	A4	360369	7888715	A4-29	1	
Seringia katatona	Priority 3	PW1	359830	7892564	PW1	35	In 5 x 5 m area at base of dead tree; flagged for station owners
Seringia katatona	Priority 3	PW3	360980	7893435		5	In 5 x 1 m area. Associated species: *Corymbia zygophylla, Acacia drepanocarpa, A. monticola, Triodia epactia, Chrysopogon pallidus*
Seringia katatona	Priority 3	PW3	360614	7893154		500+	Boundary track of this patch on GPS. Associated species: *Corymbia zygophylla, Bauhinia cunninghamii, Acacia monticola, Triodia epactia*
Seringia katatona	Priority 3	PW3	360725	7893138		90	In 20 x 20 m area. Associated species: *Corymbia zygophylla, Acacia monticola, Triodia epactia*
Seringia katatona	Priority 3	PW3	360746	7893144		8	In 5 x 2 m area
Seringia katatona	Priority 3	PW3	360756	7893143			
Seringia katatona	Priority 3	PW3	360761	7893146		50	50 stems in this ~triangular polygon.
Seringia katatona	Priority 3	PW3	360758	7893135			
Seringia katatona	Priority 3	PW3	360688	7893066		15	15 stems in 3 x 1 m area
Seringia katatona	Priority 3	PW3	360553	7893037		55	55 stems in this 10 x 3 m area
Seringia katatona	Priority 3	PW3	360546	7893036			
Seringia katatona	Priority 3	PW4	361911	7893149		200+	Boundary track of this patch on GPS. Associated species: *Corymbia zygophylla, Acacia drepanocarpa, Triodia epactia*
Seringia katatona	Priority 3	PW4	361490	7893544		35	In 5 x 5 m area. Associated species: *Corymbia zygophylla, Acacia drepanocarpa, A. monticola, Jacksonia aculeata, Triodia epactia, Chrysopogon pallidus, Eriachne obtusa*
Tribulopis marliesiae	Priority 3	Outside	361270	7893531		1	Only 1 plant seen. Outside pivots, between PW3 and PW4.

Table 2: Weed species recorded from the study area.

Species	Pivot	Easting	Northing	Specimen	Abundance	Comments
**Aerva javanica*	A1	358790	7890145		1	
**Aerva javanica*	A2	359123	7889133		1	
**Citrullus colocynthis*	A3	358663	7888235		1	
**Stylosanthes hamata*	A1	359348	7889897	A1-16	10	On verge of track
**Stylosanthes hamata*	PW3	360562	7893243		1	