

Appendix K

A Review of the Flora and Vegetation and an Assessment of Groundwater Dependent Ecosystems

**A REVIEW OF THE FLORA AND VEGETATION
AND AN ASSESSMENT OF GROUNDWATER
DEPENDENT ECOSYSTEMS IN THE
PANORAMA PROJECT SURVEY AREA**

**Prepared for:
URS Australia Pty Ltd**

**On behalf of:
CBH Resources Ltd**

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1. SUMMARY

The flora and vegetation of the Panorama survey area is reviewed from Trudgen *et al.* (2002) and Trudgen (2006; 2007a; 2007b). As they stand, these reports are highly technical and specialist botanical documents, which are not easy for a non-scientific audience to understand. Mattiske Consulting Pty Ltd was commissioned by URS Australia Pty Ltd of behalf of CBH Resources Ltd to review and provide advice on the Trudgen *et al.* (2002) and Trudgen (2006; 2007a; 2007b) reports to facilitate a greater understanding of the flora and vegetation and to assist the Public Environmental Review of the proposed Panorama project.

1.1. Flora

A total of 514 plant taxa (including subspecies and varieties) from 161 genera and 58 plant families were recorded within the Panorama Project Survey Area. The most common families recorded included Poaceae (76 taxa), Papilionaceae (61 taxa), Malvaceae (46 taxa) and Mimosaceae (44 taxa). Ten introduced (exotic) species were recorded within the Panorama Project Survey Area (Appendix A). No Declared Plant species pursuant to section 37 of the *Agricultural and Related Resources Protection Act 1976* [WA] were recorded in the Panorama Project Survey Area.

No Declared Rare Flora species pursuant to Subsection 2 of Section 23F of the *Wildlife Conservation Act 1950* [WA] and listed by the Department of Environment and Conservation (2007a) were located during the survey.

No Endangered or Vulnerable taxa, pursuant to s179 of the *Environment Protection and Biodiversity Conservation Act 1999* [Commonwealth] were located during the survey.

Other species of conservation significance that may exist, but have not been recorded in the Panorama Project Survey Area include two Declared Rare Flora species, *Lepidium catapycnon* (R) and *Thryptomene wittweri* (R) according to the *Environment Protection and Biodiversity Conservation Act 1999* [Commonwealth] and eight Priority Flora species.

Seven Priority Flora species were recorded within or may occur within the Panorama Project Area: *Euphorbia clementii* (P2), *Gonocarpus ephemerus* (P2), *Olearia fluvialis* (P2), *Abutilon trudgenii* (ms) (P3), *Acacia glaucocaesia* (P3), *Gymnanthera cunninghamii* (P3) and *Ptilotus mollis* (P4).

Two new flora species were recorded within Panorama Project Survey Area: *Pityrodia* sp. Panorama and *Themeda* sp. Panorama. Only a few records of *Pityrodia* sp. Panorama were located within Panorama Project Survey Area and should therefore be treated as having a Declared Rare status until it can be investigated further. *Pityrodia* sp. Panorama is therefore considered by Trudgen *et al.* (2002) and Trudgen (2006; 2007b) to be the most conservation significant taxa within the Panorama Survey Project Area. Four locations of *Pityrodia* sp. Panorama occur within the Panorama Project footprint area. *Themeda* sp. Panorama was recorded at a range of sites, including ten sites in the Kangaroo Caves and Bernts areas. Therefore *Themeda* sp. Panorama appears to be less restricted than the *Pityrodia* sp. Panorama. Both of these taxa require further research into their taxonomic status and also conservation status.

Other flora species of conservation significance include five species that require further investigation and are possibly geographically restricted; nine species that require further investigation but are not geographically restricted and eleven species now with a wider distribution according to Trudgen (2006; 2007b). Of these species, seven occur within the Panorama Project footprint area.

1.2. Vegetation

Eighteen Vegetation Alliances in six Vegetation Formations were summarised from the detailed botanical surveys of the Panorama Project Survey Area (Trudgen *et al.* 2002). Thirteen of these were considered to be locally significant due to the presence of Priority Flora species, species of conservation significance or restricted occurrence in the wider Panorama Project Survey Area. No Threatened Ecological Communities (TEC) as defined by the *Environment Protection and Biodiversity Conservation Act 1999* [Commonwealth] were observed in the Panorama Project Survey Area. However, *Themeda* grasslands of the Pilbara Region are listed as a Vulnerable TEC according to the Department of Environment and Conservation's (2007b) TEC database. Whilst *Themeda* grasslands were not found within the Panorama Project Survey Area, these grasslands could potentially occur there and care should be taken where *Themeda* species, in particular *Themeda* sp. Panorama, are a dominant part of the vegetation.

In general, the vegetation of the Panorama Project Survey Area was categorised as “very good” or “excellent” in condition, except where directly impacted by the existing access road. There was one area of vegetation in “poor” to “very poor” condition along the access road which was infested with *Cenchrus ciliaris* (Buffel Grass).

1.3. Groundwater Dependent Ecosystems (GDE)

Two ecosystems in the Pilbara Region are recognised nationally as Groundwater Dependent Ecosystems (GDEs) (Sinclair Knight Merz, 2001). These are:

- Pilbara spring systems, which are entirely dependent on groundwater and have a high conservation value; and
- Pilbara river pool ecosystems, which are highly dependent on groundwater and have a moderate conservation value.

In general, the spring ecosystems and river pool ecosystems of the Pilbara are recognised as groundwater dependent ecosystems and are protected under state legislation according to the *Environmental Protection Act 1986* [WA] and the *Rights in Water and Irrigation Act 1914* [WA] (Water and Rivers Commission 2000; Sinclair Knight Merz 2001).

Mattiske conducted an assessment of the probability of groundwater dependence of the vegetation within the Panorama Project Survey Area. Vegetation Alliance 1a was rated as having a Very High probability of being a GDE and Vegetation Alliance 2a as having a High probability of being a GDE. All other Vegetation Alliances were rated with a low GDE probability. Locally within the Panorama Project Survey Area, Vegetation Alliance 1a and 2a could be potentially recognised as spring or river pool systems, given the location of these GDEs along flowlines and on lower slopes.

2. INTRODUCTION

In July 2007, URS Australia Pty Ltd commissioned Mattiske Consulting Pty Ltd on behalf of CBH Resources Ltd to review and provide advice on the Trudgen *et al.* (2002) and Trudgen (2006; 2007a; 2007b) reports of the Panorama Project Survey Area. Six detailed vegetation and flora surveys have been conducted for the proposed Project by M. E. Trudgen and Associates (Trudgen). These surveys comprised:

- April 2001 – General flora collection survey conducted with 81 quadrats established and recorded along the proposed access road and around the proposed mine and processing areas (including Kangaroo Caves and Bernts areas).
- October 2001 – Vegetation survey of the Project Area (including Kangaroo Caves and Bernts areas) and additional flora collections.
- April 2006 – Rare flora survey of the Project Area.
- May 2006 – Rare flora survey focussing on the proposed infrastructure locations and a vegetation survey of the previously proposed camp site.
- May 2007 – Vegetation and flora survey of new infrastructure areas, around the plant site, that were not covered by previous surveys.
- June 2007 – Vegetation and flora survey of new infrastructure areas, including the airstrip and camp that were not covered by previous surveys.

These reports are specialist botanical documents on the local flora and vegetation. The Panorama Project Survey Area is in the Pilbara region of Western Australia. It is situated approximately 160 kilometres south-south-east of Port Hedland and south-west of the Port Hedland - Marble Bar Road, to the west of the Shaw River.

3. BACKGROUND

3.1. Vegetation

Regionally, the Panorama Project Survey Area falls within the Fortescue Botanical District (Beard 1990). Trudgen *et al.* (2002) and Trudgen (2006; 2007a; 2007b) document in fine detail the flora and vegetation of the Panorama Project Survey Area. As they stand, these reports are highly technical documents and are not easy for a non-scientific audience to understand. The vegetation survey of the Panorama Project Survey Area involved both flora descriptions and vegetation mapping, in addition to floristic analysis using the PATN computer package; to enable comparison of the vegetation within the Survey Area with vegetation of other areas in the Fortescue Botanical District (Trudgen *et al.* 2002). Later reports provide further information and clarification on the flora and vegetation (Trudgen 2007; 2007a) and Trudgen (2007b) details information on additional areas (the proposed airstrip location and the NW extension) which were not included in the 2002 report. In summary, these reports document the flora and mapped vegetation units, detail the floristic analysis of the flora and associated communities and assess the conservation value of the flora and vegetation.

3.2. Rare and Priority Flora

Species of flora and fauna are defined as Rare or Priority conservation status where their populations are restricted geographically or threatened by local processes. The Department of Environment and Conservation (2007a) recognises these threats of extinction and consequently applies regulations towards population and species protection.

Rare Flora species are gazetted under subsection 2 of section 23F of the *Wildlife Conservation Act 1950* [WA] and therefore it is an offence to “take” or damage rare flora without Ministerial approval. Section 23F of the *Wildlife Conservation Act 1950* [WA] defines “to take” as “... to gather, pick, cut, pull up, destroy, dig up, remove or injure the flora to cause or permit the same to be done by any means.”

Priority Flora are under consideration for declaration as ‘Rare Flora’, but are in urgent need of further survey (Priority One to Three) or require monitoring every 5-10 years (Priority Four). Table 1 presents the definitions of Declared Rare and the four Priority ratings under the *Wildlife Conservation Act 1950* [WA] as extracted from Department of Environment and Conservation (2007a).

Table 1: Definition of Rare and Priority Flora Species (Department of Environment and Conservation 2007a)

Conservation Code	Category
R	Declared Rare Flora – Extant Taxa “Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection and have been gazetted as such.”
P1	Priority One – Poorly Known Taxa “Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat. Such taxa are under consideration for declaration as ‘rare flora’, but are in urgent need of further survey.”
P2	Priority Two – Poorly Known Taxa “Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as ‘rare flora’, but urgently need further survey.”
P3	Priority Three – Poorly Known Taxa “Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as ‘rare flora’ but need further survey.”
P4	Priority Four – Rare Taxa “Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.”

3.3. Threatened Flora Species and Ecological Communities

Threatened flora species are a matter of national environmental significance under the *Environment Protection and Biodiversity Conservation Act 1999* [Commonwealth]. A person must not take an action that has, will have, or is likely to have a significant impact on a listed threatened species or an ecological community, without approval from the Commonwealth Minister for the Environment and Water Resources. Table 2 presents the definitions of the categories of threatened species under the *Environment Protection and Biodiversity Conservation Act 1999* [Commonwealth].

Communities are described as ‘Threatened Ecological Communities’ (TEC’s) if they have been defined by the Western Australian Threatened Ecological Communities Scientific Advisory Committee and found to be Presumed Totally Destroyed (PD), Critically Endangered (CR), Endangered (EN) or Vulnerable (VU) (Department of Environment and Conservation 2007b). For further definitions of TEC categories and criteria refer to English and Blyth (1997, 1999). Some Western Australian TEC’s have also been listed as “Threatened Ecological Communities” under the *Environment Protection and Biodiversity Conservation Act 1999* [Commonwealth] (Department of the Environment and Water Resources 2007).

3.4. Vegetation Condition

Vegetation condition of communities in the Panorama Project Survey Area was assessed according to a condition scale from Trudgen (1988) (Table 3).

3.5. Local and Regional Significance

Flora or Vegetation may be locally or regionally significant in addition to statutory listings by the State or Federal Government.

In regards to Flora; species, subspecies, varieties, hybrids and ecotypes may be significant other than as Declared Rare Flora (DRF) or Priority Flora, for a variety of reasons, including:

- “ . a keystone role in a particular habitat for threatened species, or supporting large populations representing a significant proportion of the local regional population of a species;
- . relic status;
- . anomalous features that indicate a potential new discovery;
- . being representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- . the presence of restricted subspecies, varieties, or naturally occurring hybrids;
- . local endemism/a restricted distribution;
- . being poorly reserved” (Environmental Protection Authority 2004: 29 – 30).

Vegetation may be significant because the extent is below a threshold level and a range of other reasons, including:

- “ . scarcity;
- . unusual species;
- . novel combinations of species;
- . a role as a refuge;
- . a role as a key habitat for threatened species or large populations representing a significant proportion of the local to regional total population of a species;
- . being representative of the range of a unit (particularly, a good local and/or regional example of a unit in “prime” habitat, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- . a restricted distribution” (Environmental Protection Authority 2004: 30).

Vegetation communities are locally significant if they contain Priority Flora species or contain a range extension of a particular taxon outside of the normal distribution. They may also be locally significant if they are very restricted to one or two locations or occur as small isolated communities. In addition, vegetation communities that exhibit unusually high structural and species diversity are also locally significant (Matiske *pers. comm.*).

Vegetation communities are regionally significant where they are limited to specific landform types, are uncommon or restricted plant community types within the regional context, or support populations of Declared Rare Flora (Mattiske *pers. comm.*).

Determining the significance of flora and vegetation may be applied at various scales, for example, a vegetation community may be nationally significant and governed by statutory protection as well as being locally and regionally significant.

Table 2: Categories of Threatened Species (*Environment Protection and Biodiversity Conservation Act 1999* [Commonwealth])

Category Code	Category
Ex	Extinct A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
ExW	Extinct in the Wild A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
CE	Critically Endangered A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
E	Endangered A native species is eligible to be included in the endangered category at a particular time if, at that time (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
V	Vulnerable A native species is eligible to be included in the vulnerable category at a particular time if, at that time (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.
CD	Conservation Dependent A native species is eligible to be included in the conservation dependent category at a particular time if, at that time, the species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

Table 3: Vegetation Condition Scale from Trudgen (1988)

Condition Code	Category
E = Excellent	Pristine or nearly so, no obvious signs of damage caused by the activities of European man.
VG = Very Good	Some relatively slight signs of damage caused by the activities of European man. Eg. some signs of damage to tree trunks caused by repeated fire and the presence of some relatively non-aggressive weeds such as <i>Ursinia anthemoides</i> or <i>Briza</i> species, or occasional vehicle tracks.
G = Good	More obvious signs of damage caused by the activities of European man, including some obvious impact on the vegetation structure such as caused by low levels of grazing or by selective logging. Weeds as above, possibly plus some more aggressive ones.
P = Poor	Still retains basic vegetation structure or ability to regenerate to it after very obvious impacts of activities of European man such as grazing or partial clearing (chaining) or very frequent fires. Weeds as above, probably plus some more aggressive ones such as <i>Ehrharta</i> species.
VP = Very Poor	Severely impacted by grazing, fire, clearing or a combination of these activities. Scope for some regeneration but, not to a state approaching good condition without intensive management. Usually with a number of weed species including aggressive species.
D = Completely Degraded	Areas that are completely or almost completely without native species in the structure of their vegetation. Ie. Areas that are cleared or "parkland cleared" with their flora comprising weed or crop species with isolated native trees or shrubs.

3.6. Groundwater Dependent Ecosystems (GDEs)

Groundwater Dependent Ecosystems (GDEs) are ecosystems that depend on groundwater, which include:

- Aquifer and cave ecosystems where stygofauna reside;
- Ecosystems dependent on the surface expression of groundwater (such as baseflow rivers and streams, wetlands and some floodplains); and
- Ecosystems dependent on the subsurface presence of groundwater (Eamus *et al.* 2006).

Within a GDE, water use is likely to vary according to vegetation structure (ie tree water use versus shrub water use). The dependence of an ecosystem on groundwater may also be variable: infrequently utilised such as during plant establishment or in periods of drought; or continual dependence but facultative (ie species will utilise groundwater if present, but are not groundwater dependent for survival) (Eamus *et al.* 2006).

Key indicator species, such as *Melaleuca argentea* in the Daly River catchment in the Northern Territory (O'Grady *et al.* 2006) or *Banksia* sp. on the Swan Coastal Plain (Eamus *et al.* 2006), can be used to identify GDEs. However it has been shown that groundwater use varies according to the position in the landscape and trees at lower elevations closer to rivers are highly dependent compared to opportunistic groundwater use by trees at higher elevations (O'Grady *et al.* 2006).

The groundwater dependence of ecosystems is rated according to the depth to the water table:

0 – 10 m	Groundwater dependent
>10 m	Reduced dependence on groundwater
10 – 20 m	Possible groundwater dependence, although negligible
> 20 m	Groundwater dependence low (Eamus <i>et al.</i> 2006).

Due to the variability of groundwater use as mentioned above, the response of a GDE to groundwater drawdown will not be uniform. Hence determining the ecological water requirements (EWRs) and the subsequent statutory ecological water provisions (EWPs) according to the *Environmental Protection Act 1986* [WA] and the *Rights in Water and Irrigation Act 1914* [WA], necessary for the maintenance of the structure and function of GDEs is complex (Water and Rivers Commission 2000; Sinclair Knight Merz Pty Ltd 2001; Eamus and Froend 2006; Eamus *et al.* 2006).

Monitoring ecosystems over long-term periods are necessary to determine the impacts of lowering groundwater availability, prior to and during pumping. Monitoring can indicate if GDEs are more resilient than predicted or determine if the ecosystem condition falls below acceptable levels, and then EWPs can be adjusted where required. However, ecosystems may respond proportionally or show a threshold response to declining water availability. Often ecosystems do not respond immediately and the “lag” effects on ecosystem health may result in exponentially declining condition. Changes in understorey species and an increase in introduced (exotic) species may indicate disturbances in the short-term within GDEs. Whilst overstorey species tend to be more resilient to changes in groundwater levels and are good long-term indicators of GDEs.

In summary, to assess the impacts of altered groundwater levels as a result of EWPs set in Water Allocation Plans; monitoring should include an assessment of:

- species diversity;
- species cover and abundance;
- “weediness”;
- density of indicator species;
- community distribution (change in aerial extent);
- canopy health;
- water quality; and
- soil moisture (Eamus *et al.* 2006; Loomes *et al.* 2006; Water and Rivers Commission 2000).

4. OBJECTIVES

Mattiske Consulting Pty Ltd was commissioned by URS Australia Pty Ltd on behalf of CBH Resources Ltd to review and provide advice on the Trudgen *et al.* (2002) and Trudgen (2006; 2007a; 2007b) reports on the flora and vegetation of the Panorama Project Survey Area. The specific objectives of this report are to

- Review and simplify the flora and vegetation of the Panorama Project Survey Area for a Public Environment Review;
- Identify and assess potential Groundwater Dependent Ecosystems (GDEs) within the Panorama Project Survey Area; and
- Prepare a report on the findings.

5. METHODS

The results of Trudgen *et al.* (2002) and Trudgen (2006; 2007b) were crosschecked and combined to update the flora and vegetation results. In undertaking this review the authors of the Mattiske Consulting Pty Ltd report accept no responsibility for the previous work undertaken by Trudgen on the Panorama project area. The data and information as extracted is based on the reports and information as provided and any further re-interpretation of the vegetation and aerial photographs and the mapping units as defined by Trudgen (2007b). The potential impacts of clearing were assessed according to the project footprint as at the August 15th 2007.

5.1. Flora

All taxa were checked on the Department of Environment and Conservation (2007a) “Florabase” database to ensure listings were current, in particular for all Declared Rare and Priority Flora (see Table 1). Additionally, all introduced (exotic) species were checked on the Department of Agriculture and Food’s (2007) “Declared plants” database. Mattiske Consulting Pty Ltd has electronic access to the Department of Environment and Conservation (2007a) database through licensing and an annual fee payment.

A list of species recorded within the Panorama Project Survey Area in Trudgen *et al.* (2002) and Trudgen (2006; 2007b) was reviewed and updated according to the Department of Environment and Conservation (2007a) “Florabase” database. Several changes were made including updating name changes since 2002 and removal of now excluded flora species names. Flora species names with a collection or site number were treated as different taxa. If a species name had been misused for more than one species, the distributions of the flora species were checked to determine the species name used in this report. Flora species that were not found on the “Florabase” database (Department of Environment and Conservation 2007a) were included in Appendix A and treated as different taxa.

Fungi species, *Pisolithus tinctorius*, was listed in Appendix 9 of Trudgen (2007b), however it has been excluded from the count of taxa and Appendix A. *Convolvulus angustissimus* subsp. *angustissimus* was mentioned in Section 3.6 in Trudgen (2007b), however it was not in corresponding Appendix 7, or in Appendix 14. It has been included in the count of taxa and Appendix A. Several *Euphorbia* species were identified as *Euphorbia* sp. though it was unable to differentiate between these during the review of the flora collections.

The GPS locations of species of conservation significance within the Panorama Project Survey Area were compiled from Trudgen *et al.* (2002) and Trudgen (2006; 2007b) and updated where appropriate. Quadrat and releve site data given in Trudgen *et al.* (2002) and Trudgen (2006; 2007b) was used to check location data of species of conservation significance. If a species was recorded in any of the studies (Trudgen *et al.* 2002; Trudgen 2006; 2007a; 2007b), the site was recorded in the list of locations in the results.

5.2. Vegetation

The vegetation of the Panorama Project Survey Area was remapped utilising aerial photographs and a re-interpretation of the mapping units as defined by Trudgen *et al.* (2002) and Trudgen (2007b). Areas mapped in Trudgen *et al.* (2002) and Trudgen (2007b) were overlayed onto aerial photographs of the Panorama Project Survey Area. Vegetation Alliances were aligned to the underlying topography and vegetation and remapped using the vegetation codes from Trudgen *et al.* (2002) and Trudgen (2007b) in addition to knowledge of the Pilbara vegetation (Mattiske, *pers. comm.*).

The complexity of the vegetation communities was simplified. The ten Vegetation Formations and 52 Vegetation Alliances that were mapped in Trudgen *et al.* (2002) and Trudgen (2007b) were reduced to six Vegetation Formations and 18 Vegetation Alliances. This was conducted using both the results of the floristic analysis as conducted by Trudgen *et al.* (2002) and using standard vegetation mapping techniques as per Beard (1990). That is, further details on the habitats of Vegetation Alliances were added from the quadrat and releve descriptions. Vegetation Alliances were then grouped according to key species (floristic), structure and location in the landscape (habitat).

5.3. Groundwater Dependent Ecosystems (GDEs)

Groundwater Dependent Ecosystems (GDEs) within the Panorama Project Survey Area were identified according to likely groundwater dependent flora species (floristic), structure and position (habitat) of the Vegetation Alliance in the landscape. Key groundwater dependent flora species identified from Trudgen *et al.* (2002) in the Panorama Project Survey Area include *Eucalyptus camaldulensis*, *Eucalyptus victrix*, *Melaleuca linophylla*, *Melaleuca glomerata*, *Corymbia hamersleyana*, *Acacia tumida* var. *pilbarensis* and *Terminalia canescens*. Remapping of the vegetation and a site visit in August 2007 indicated that *Eucalyptus camaldulensis* and *Eucalyptus victrix* are the main groundwater dependent flora species and *Corymbia hamersleyana*, *Acacia tumida* var. *pilbarensis* and *Terminalia canescens* are more widespread in occurrence in the Panorama Project Survey Area.

The 18 Vegetation Alliances were rated according to their groundwater dependence:

- Very High: groundwater very important for maintenance of ecosystem;
- High: groundwater important for maintenance of ecosystem;
- Medium: groundwater may be important for maintenance of ecosystem; and
- Low: groundwater likely to be unimportant for maintenance of ecosystem.

6. RESULTS

6.1. Flora

A total of 514 plant taxa (including subspecies and varieties) from 161 genera and 58 plant families were recorded within the Panorama Project Survey Area (Appendix A). The most common families recorded included Poaceae (76 taxa), Papilionaceae (61 taxa), Malvaceae (46 taxa) and Mimosaceae (44 taxa). Of these, ten are introduced (exotic) species (Department of Environment and Conservation 2007). No Declared Plant species pursuant to section 37 of the *Agricultural and Related Resources Protection Act 1976* were recorded in the Project Area.

No Declared Rare Flora species, pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act 1950* [WA] and as listed by the Department of Environment and Conservation (2007) was located during the survey. No plant taxa pursuant to section 179 of the *Environment Protection and Biodiversity Conservation Act 1999* were located in the survey area.

Priority Flora species, new flora species and species of conservation significance, including species that require further investigation and are possibly geographically restricted, species that require further investigation but are not geographically restricted, and species now with a wider distribution according to Trudgen (2006; 2007b), are described in detail below (also see Appendix B and Figures 3a to 3c).

The GPS locations of species of Priority Flora species and flora species with conservation significance within the Panorama Project Survey Area are given in Appendix C.

6.2 Priority Flora Species

There are seven Priority Flora species recorded within the wider Panorama Project Survey Area (Appendices B and C). Of these species, six Priority Flora species are known to occur within or may occur within the Panorama Project Area.

Table 4: Priority Flora species known or possibly occurring in the Panorama Project Area.
SCC = State Conservation Code for Priority Flora Species, see Table 1 for explanation
(Department of Environment and Conservation 2007a)

Species	SCC	Comments
<i>Euphorbia clementii</i>	P2	This small annual herb was recorded in Vegetation Alliance 6a. A large population has been recorded adjacent to the Access Road and a scattered population was recorded in the vicinity of the proposed airstrip. This species was recorded outside the Project Area at five locations.
<i>Gonocarpus ephemerus</i>	P2	This species was recorded in Vegetation Alliance 6a adjacent to the Access Road. This species was recorded outside the Project Area at one location.
<i>Olearia fluvialis</i>	P2	This small perennial shrub was recorded at one location outside of the Project Area.
<i>Abutilon trudgenii</i> (ms)	P3	This species was recorded in Vegetation Alliance 13a in the TSF area and in communities 6a, 11a and 14a on the Access Road. This species was recorded at seven locations outside the proposed Project footprint area. Trudgen (2007b) comments that this species should be removed from the Priority Flora list.
<i>Gymnanthera cunninghamii</i>	P3	This species was collected from four locations outside of the Project Area and occurs at scattered locations in the Pilbara Region and two of the adjacent IBRA regions.
<i>Acacia glaucochaesia</i>	P3	This species was found in Vegetation Alliances 6a and 11a on the Access Road. This species was recorded outside the Project Area at eleven locations.
<i>Ptilotus mollis</i>	P4	This species was recorded in Vegetation Alliance 13a within the TSF area and at six locations outside of the Project Area.

6.3 New Flora Species

Two new flora species were recorded within Panorama Project Survey Area, *Pityrodia* sp. Panorama and *Themeda* sp. Panorama (Appendix B). Of these, *Pityrodia* sp. Panorama is considered the most important species of conservation significance within the Panorama Project Survey Area. This species appears to be rare within this area and should be reviewed as a Declared Rare by the Department of Environment and Conservation (2007a) (Trudgen *et al.* 2002; Trudgen 2006).

Two previously undescribed flora species were recorded within the wider survey area. These species are:

- *Pityrodia* sp. Panorama. This species was recorded at fifteen locations. Four of these locations occurred within Vegetation Alliances 5a, 6a and 9a in the proposed waste dumps and at two other proposed disturbance sites within the Project Area. This species appears to be rare within this area and Trudgen *et al.* (2002) and Trudgen (2006) suggested that this species is considered for classification as Declared Rare Flora.

- *Themeda* sp. Panorama. This species was recorded at ten locations in the Kangaroo Caves and Bernts areas to the south of the main Project Area.

If the project proceeds as proposed, both these species will not be impacted significantly by the proposed development. However these taxa require further research into their taxonomic status and also conservation status.

6.4 Species that require further investigation

A number of other flora species recorded within the wider survey area and are of interest because they:

- are classified as DRF or Priority Flora species and may occur within the Panorama Project Survey Area based on DEC database searches;
- may be geographically restricted, but require further investigation;
- may have conservation significance, but require further investigation; or
- are species that now have a wider distribution than previously recorded.

Of these species, the following occur within the proposed Project footprint. These species are:

- *Acacia* aff. *drepanocarpa* subsp. *drepanocarpa*. This species was recorded at seven locations. Five of these locations occurred within the proposed Project footprint area within Vegetation Alliances 11a and 13a. These locations occurred within the TSF and Evaporation Pond areas.
- *Acacia* sp. Barklys was recorded at four locations. All of these locations occurred within the Evaporation Pond area within the proposed Project footprint area within Vegetation Alliance 13a.
- *Cullen* aff. *lachnostachys* (MET 15, 154) was recorded at six locations, of which two occurred within the proposed Project footprint. This species occurred within Vegetation Alliance 5a (waste dump) and 11a (access road).
- *Sida* aff. *fibulifera* (PAN10-6) was recorded at one location within Vegetation Alliance 6a on the access road.
- *Tephrosia* aff. *supina* (HD88-4) was recorded at two locations. One of these locations was within Vegetation Alliance 6a on the access road and one was outside the proposed Project footprint.
- *Triodia angusta* (Shale form) was recorded at one location within Vegetation Alliance 6a in proposed disturbance areas within the proposed Project footprint.
- *Triumfetta* aff. *chaetocarpa* (Panorama form) was recorded at seven locations. Two of these locations occurred within Vegetation Alliances 6a (access road) and 13a (other proposed disturbance areas) of the Project footprint.

Acacia sp. (PAN M48), *Corchorus* aff. *walcottii* (H251-3), *Euphorbia* sp. (PAN5-15), *Mallotus ?dispersus* and *Rhynchosia* sp. King Bay were recorded in the wider survey area, but not in the proposed Project footprint area.

6.5 Species now with a wider distribution (Trudgen 2006)

As a result of the later survey by Trudgen (2006) there are eleven species of conservation significance according to Trudgen *et al.* (2002) which have a potentially wider distribution after further investigation (see Appendix B):

- *Corchorus* aff. *laniflorus* (PAN 76),
- *Corchorus* sp. Panorama,;
- *Eriachne* sp. Port Headland,
- *Indigofera monophylla* (PAN57-9),
- *Indigofera monophylla* (PAN58-17),
- *Indigofera monophylla* (PAN65-14),
- *Triodia angusta* (Panorama form),

- *Triodia angusta* (Shaw River form),
- *Triodia melvillei*,
- *Triumfetta* aff. *chaetocarpa* (PAN3/4), and
- *Vigna* sp. Harding Dam.

6.6 Potential Rare and Priority Species

Two Declared Rare Flora species, *Lepidium catapycnon* (R) and *Thryptomene wittweri* (R), were not recorded, but potentially occur within the Panorama Project Survey Area (see Appendix B) (Department of Conservation and Environment 2007a). These Declared Rare Flora species are also listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* [Commonwealth] (Department of the Environment and Water Resources 2007).

A description of these species is given below.

- *Lepidium catapycnon* (R), is a perennial, herb or shrub species, 0.2–0.3 m high that has white flower in October, and occurs on skeletal soils on hillsides (Department of Conservation and Environment 2007a). There are nine collections held at the Western Australian Herbarium from the Nullagine, Newman, Wittenoom and Hamersley Ranges areas (Department of Conservation and Environment 2007a).
- *Thryptomene wittweri* (R), a shrub species, 0.5–1.5 m high that has white and cream flowers from April to August, and occurs on skeletal red stony soils on breakaways and stony creek beds. There are ten collections held at Western Australian Herbarium from the Carnarvon Range, Karijini National Park, Mount Meharry, Mount Augustus and White Cliffs Station areas (Department of Conservation and Environment 2007a).

Ptilotus appendiculatus var. *minor* (P1), *Gomphrena pusilla* (P2), *Bulbostylis burbidgeae* (P3), *Fimbristylis sieberiana* (P3), *Goodenia nuda* (P3), *Goodenia pascua* (P3), *Hibiscus brachysiphonius* (P3) and *Phyllanthus aridus* (P3), were not recorded but potentially occur within the Panorama Project Survey Area. A description of these species is given below.

- *Ptilotus appendiculatus* var. *minor* (P1), is a perennial herb or shrub species that has only one record location according to the Western Australian Herbarium (Department of Conservation and Environment 2007a). This specimen occurred near Boodarie in the Pilbara (Department of Conservation and Environment 2007a).
- *Gomphrena pusilla* (P2) is an annual herb species to 0.2 m high with white flowers between March to June, and occurs on fine beach sand behind foredunes and on limestone (Department of Conservation and Environment 2007a). Five collections are held at the Western Australian Herbarium and were recorded in the Pilbara and Dampierland regions (Department of Conservation and Environment 2007a). As these habitat types do not occur within the Panorama Project Survey Area, it is unlikely that this species occurs there.
- *Bulbostylis burbidgeae* (P3), is a sedge species 0.03–0.25 m high with brown flower in March to August, and occurs on granitic soils and outcrops and at cliff bases (Department of Conservation and Environment 2007a). Nine collections are held at the Western Australian Herbarium and were recorded near Port Headland, Newman, the George Ranges, Mount Edgar Station and in the north Pilbara (Department of Conservation and Environment 2007a).

- *Fimbristylis sieberiana* (P3), is a sedge species 0.25–0.6 m high with brown flower from May to June, and occurs on mud and skeletal soil pockets, at pool edges and on sandstone cliffs (Department of Conservation and Environment 2007a). Fourteen collections are held at the Western Australian Herbarium and were recorded in the Great Sandy Desert, Pilbara, Central Kimberley, Dampierland and Ord-Victoria Plains regions (Department of Conservation and Environment 2007a).
- *Goodenia nuda* (P3), is a herb species to 0.5 m high with yellow flowers from April to August (Department of Conservation and Environment 2007a). Ten collections from the Pilbara region are held at the Western Australian Herbarium (Department of Conservation and Environment 2007a).
- *Goodenia pascua* (P3), is a herb species to 0.5 m high with yellow flowers from May to August, and occurs on red sandy soils and basaltic plains (Department of Conservation and Environment 2007a). Nine collections are held at the Western Australian Herbarium and were recorded in the Hamersley Range, Mount Brockman, Roebourne, Port Headland and Onslow areas (Department of Conservation and Environment 2007a).
- *Hibiscus brachysiphonius* (P3), is a perennial herb or shrub species 0.1–0.3 m high with pink flowers from August to October, and occurs on clay in creeklines and on clay flats (Department of Conservation and Environment 2007a). Fourteen collections are held at the Western Australian Herbarium and were recorded in the Exmouth Gulf, Newman, Paraburdoo and Hamersley Ranges areas (Department of Conservation and Environment 2007a).
- *Phyllanthus aridus* (P3), is a shrub species to 0.25 m high with cream and green flowers from May to June, and occurs on sandstone, gravel and red sand (Department of Conservation and Environment 2007a). Twenty collections are held at the Western Australian Herbarium and were recorded in the Great Sandy Desert, Pilbara, Central Kimberley, Dampierland, Northern Kimberley, Ord-Victoria Plains and Victoria Bonaparte regions (Department of Conservation and Environment 2007a).

6.7 Introduced (exotic) species

There are ten introduced (exotic) species recorded within the Panorama Project Survey Area. These are; **Cenchrus ciliaris* (Buffel Grass), **Cynodon dactylon* (Couch Grass), **Setaria verticillata* (Whorled Pigeon Grass), **Aerva javanica* (Kapok Bush), **Portulaca oleracea* (Purslane), **Argemone ochroleuca* (Mexican Poppy), **Vachellia farnesiana* (Mimosa Bush), **Ricinus communis* (Castor Oil Plant), **Solanum nigrum* (Black berry nightshade) and **Cucumis melo* subsp. *agrestis* (Ulcardo Melon) (Appendix A). Trudgen (2007a) also states that **Malvastrum americanum* (Spiked Malvastrum) may also be present in a flora survey is conducted in another season or after sufficient rain.

No Declared Plant species pursuant to section 37 of the *Agricultural and Related Resources Protection Act 1976* were recorded in the Panorama Project Survey Area (Department of Agriculture and Food 2007).

**Cenchrus ciliaris* (Buffel Grass) is a particularly invasive introduced (exotic) species that is now naturalised in many Pilbara habitats (Van Vreeswyk *et al.* 2004). The invasion of **Cenchrus ciliaris* (Buffel Grass) is a major concern for flora and ecosystem conservation of the Pilbara due to negative effects on biodiversity (Van Vreeswyk *et al.* 2004). **Cenchrus ciliaris* (Buffel Grass) was recorded at 38 locations within the Panorama Project Survey Area. **Cenchrus ciliaris* (Buffel Grass) is particularly invasive at 21 locations within the wider survey area.

6.8 Vegetation

A total of 18 Vegetation Alliances in six vegetation formations were noted within the Panorama Project Survey Area (Appendix D and Figures 1a to 1f).

Open Forest to Open Woodland: Flowlines

Vegetation Alliance 1a - Open forest to open woodland of *Eucalyptus camaldulensis*, *Melaleuca argentea* and *Eucalyptus victrix* with scattered tall shrubs of *Indigofera monophylla* over *Schoenus falcatus*, *Cyperus vaginatus* and *Triodia longiceps* sedgeland/grasslands in river beds.

Open Forest to Open Woodland: Other

Vegetation Alliance 2a - *Eucalyptus victrix* scattered trees to open woodland which may include *Melaleuca glomerata* and *Melaleuca linophylla* over open to closed scrub in creek beds and low slopes.

Vegetation Alliance 3a - *Corymbia aspera* scattered low trees to low open woodland in creek beds.

Vegetation Alliance 4a - *Acacia tumida* high shrubland to low open forest in creeklines.

Vegetation Alliance 5a - *Eucalyptus leucophloia* scattered low trees over patches of *Acacia* shrubs over hummock grasslands of *Triodia* species, including *T. brizoides*, *T. wiseana* and *T. epactia* on ridge slopes.

Vegetation Alliance 6a - *Corymbia hamersleyana* scattered low trees to low open woodland over tall shrubs to open shrubland of *Acacia* spp. and *Grevillea wickhamii* over hummock grasslands on creek banks, flood banks and distributing fans.

Vegetation Alliance 7a - *Corymbia zygomphylla* and *Corymbia hamersleyana* scattered low trees over hummock grasslands on sandplains.

Vegetation Alliance 8a - *Terminalia canescens* scattered low trees to low woodland on creek banks.

Vegetation Alliance 9a - *Atalaya hemiglauca*, *Acacia pruinocarpa*, *Ehretia saligna* var. *saligna*, *Acacia tumida*, *Eucalyptus ferriticola* subsp. *ferriticola* and *Ficus platypoda* scattered low trees over high open shrubland on steep, rocky gorge walls.

High Shrublands to Open Scrublands

Vegetation Alliance 10a - Shrubland to open scrubland of *Acacia* species including *A. tumida*, *A. acradenia* and *A. orthocarpa* over hummock grasslands on upper and steep slopes.

Vegetation Alliance 11a - Shrubland to closed scrubland of *Acacia* species, including *A. acradenia*, *A. pyrifolia* and *A. tumida* along small creeklines and on the adjacent parts of valley floors and distributing fans.

Vegetation Alliance 12a - *Acacia inaequilatera* scattered tall shrubs to high open shrubland over *Triodia brizoides* hummock grasslands on ridge slopes and low hills.

Vegetation Alliance 13a - *Acacia inaequilatera* scattered tall shrubs to high shrubland over *Triodia wiseana* hummock grasslands occurring mainly on gentle lower slopes.

Vegetation Alliance 14a - *Acacia ancistrocarpa* high open shrubland to open scrub.

Vegetation Alliance 15a - *Acacia trachycarpa* high open shrubland to high shrublands.

Low Shrublands to Low Open Heaths

Vegetation Alliance 16a - Low shrublands to low open heath on gentle slopes and undulating plains.

Hummock Grasslands

Vegetation Alliance 17a - Hummock grasslands on slopes and ridges.

Other Grasslands and Herblands

Vegetation Alliance 18a - Cracking clay alliance on gentle sloping plains and seasonal damplands.

6.9. Local and Regional Significance

Thirteen of the eighteen Vegetation Alliances recorded within the wider Panorama Project Survey Area are locally significant due to the presence of Priority Flora species, species of conservation significance or are restricted to isolated areas within the wider survey area. There are no regionally significant Vegetation Alliances within the Panorama Project Survey Area. Vegetation Alliances that are locally significant are listed in Appendix E and described below.

- **Vegetation Alliance 1a**

Vegetation Alliance 1a is classified as locally significant due its structure as a wetland area and the potential for habitat trees. *Schoenus falcatus*, which is uncommon in the Pilbara Region was recorded in this alliance. Vegetation Alliance 1a consists of an open forest to open woodland of *Eucalyptus camaldulensis*, *Melaleuca argentea* and *Eucalyptus victrix* with scattered tall shrubs of *Indigofera monophylla* over *Schoenus falcatus*, *Cyperus vaginatus* and *Triodia longiceps* sedgeland/grasslands in river beds.

- **Vegetation Alliance 2a**

Vegetation Alliance 2a is classified as locally significant due its structure as a wetland area and the potential for habitat trees. Vegetation Alliance 2a consists of an open forest to open woodland of *Eucalyptus victrix* which may include *Melaleuca glomerata* and *Melaleuca linophylla* over open to closed scrub in creek beds and low slopes.

- **Vegetation Alliance 3a**

Vegetation Alliance 3a is classified as locally significant as it is restricted to small areas along the access road, near the Marble Bar Road. Vegetation Alliance 3a consists of a woodland of *Corymbia aspera* scattered low trees to low open woodland in creek beds.

- **Vegetation Alliance 5a**

Vegetation Alliance 5a is classified as locally significant due to the occurrence of patches of species of conservation significance (including one occurrence of *Cullen* aff. *lachnostachys* (MET 15, 154) and two occurrences of *Pityrodia* sp. Panorama). Vegetation Alliance 5a consists of an open woodland of *Eucalyptus leucophloia* scattered low trees over patches of *Acacia* shrubs over hummock grasslands of *Triodia* species, including *T. brizoides*, *T. wiseana* and *T. epactia* on ridge slopes.

- **Vegetation Alliance 6a**

Vegetation Alliance 6a is classified as locally significant due to the occurrence of patches of Priority Flora and species of conservation significance (including three occurrences of *Abutilon trudgenii* (ms) (P3) one occurrence of *Acacia glaucoaesia* (P3), one occurrence of *Euphorbia clementii* (P2), two occurrences of *Gonocarpus ephemerus* (P2), one occurrence of *Pityrodia* sp. Panorama, one occurrence of *Sida* aff. *fibulifera* (PAN10-6), one occurrence of *Tephrosia* aff. *supina* (HD88-4), one occurrence of *Themeda augusta* (Shale form), eighteen occurrences of *Triodia* sp. Panorama and one occurrence of *Triumfetta* aff. *chaetocarpa* (Panorama form). Vegetation Alliance 6a consists of a low open woodland

of *Corymbia hamersleyana* over tall shrubs to open shrubland of *Acacia* spp. and *Grevillea wickhamii* over hummock grasslands on creek banks, flood banks and distributing fans.

- **Vegetation Alliance 7a**

Vegetation Alliance 7a is classified as locally significant due to the restricted occurrence of this alliance along the access road near the Marble Bar Road. Vegetation Alliance 7a consists of an open woodland of *Corymbia zygophylla* and *Corymbia hamersleyana* scattered low trees over hummock grasslands on sandplains.

- **Vegetation Alliance 8a**

Vegetation Alliance 8a is classified as locally significant due to the restricted occurrence of this alliance along the access road within the wider survey area. Vegetation Alliance 8a consists of an open woodland of *Terminalia canescens* scattered low trees to low woodland on creek banks.

- **Vegetation Alliance 9a**

Vegetation Alliance 9a is classified as locally significant due to the presence of species of conservation significance (including one occurrence of *Pityrodia* sp. Panorama within the proposed waste dump areas). Vegetation Alliance 9a consists of an open low woodland of *Atalaya hemiglaucula*, *Acacia pruinocarpa*, *Ehretia saligna* var. *saligna*, *Acacia tumida*, *Eucalyptus ferriticola* subsp. *ferriticola* and *Ficus platypoda* scattered low trees over high open shrubland on steep, rocky gorge walls.

- **Vegetation Alliance 11a**

Vegetation Alliance 11a is classified as locally significant due to the presence of Priority Flora and species of conservation significance (including one occurrence of *Abutilon trudgenii* (ms) (P3), one occurrence of *Acacia* aff. *drepanocarpa* subsp. *drepanocarpa*, one occurrence of *Acacia glaucocaesia* (P3), one occurrence of *Cullen* aff. *lachnostachys* (MET 15, 154) and two occurrences of *Triodia* sp. Panorama). Vegetation Alliance 11a consists of a shrubland to closed scrubland of *Acacia* species, including *A. acradenia*, *A. pyrifolia* and *A. tumida* along small creeklines and on the adjacent parts of valley floors and distributing fans.

- **Vegetation Alliance 13a**

Vegetation Alliance 13a is classified as locally significant due to the presence of Priority Flora and species of conservation significance (including one occurrence of *Abutilon trudgenii* (ms) (P3), four occurrences of *Acacia* aff. *drepanocarpa* subsp. *drepanocarpa*, four occurrences of *Acacia* sp. Barklys, one occurrence of *Ptilotus mollis* (P4) and one occurrence of *Triumfetta* aff. *chaetocarpa* (Panorama form). Vegetation Alliance 13a consists of shrublands of *Acacia inaequilatera* scattered tall shrubs to high shrubland over *Triodia wiseana* hummock grasslands occurring mainly on gentle lower slopes.

- **Vegetation Alliance 14a**

Vegetation Alliance 14a is classified as locally significant due to the presence of Priority Flora (including one occurrence of *Abutilon trudgenii* (ms) (P3)). Vegetation Alliance 14a consists of shrublands of *Acacia ancistrocarpa* high open shrubland to open scrub.

- **Vegetation Alliance 16a**

Vegetation Alliance 16a is classified as locally significant due to the presence of Priority Flora (including two occurrences of *Ptilotus mollis* (P4)) and some areas of the Alliance are restricted to small areas of Shale ridges (including near the Kangaroo Caves area, which is outside the project area). Vegetation Alliance 16a consists of low shrublands to low open heath on gentle slopes and undulating plains.

- **Vegetation Alliance 18a**

Vegetation Alliance 18a is classified as locally significant due to the restricted occurrence of the alliance along the access road. Vegetation Alliance 18a consists of grasslands and herblands on cracking clay alliance on gentle sloping plains and seasonal damplands.

6.10 Threatened Ecological Communities (TECs)

No Threatened Ecological Communities (TECs) as defined by the *Environment Protection and Biodiversity Conservation Act 1999* [Commonwealth] were observed in the Panorama Project Survey Area.

However, *Themeda* grasslands of the Pilbara Region are listed as a Vulnerable Threatened Ecological Community according to the Department of Environment and Conservation's (2007b) Threatened Ecological Community's database. This category means that *Themeda* grasslands in the Pilbara region exists as largely "modified occurrences that are likely to be capable of being substantially restored or rehabilitated" (Department of Environment and Conservation 2007b).

Four *Themeda* species occur within the Panorama Project Survey Area: *Themeda* aff. *triandra* (MET 16,046), *Themeda avenacea*, *Themeda* sp. Panorama and *Themeda triandra* (Appendix A).

6.11 Condition of the Flora and Vegetation Communities

The vegetation of the Panorama Project Survey Area was generally "very good" or "excellent" in condition (see Table 3) (Trudgen *et al.* 2002). There was one area of vegetation in "poor" condition. Along the access road, approximately 42.85 km from the Marble Bar Road, quadrat PAN 032 (Vegetation Alliance 2) was assessed as being in "poor" to "very poor" condition with **Cenchrus ciliaris* (Buffel Grass) invasion. Trudgen *et al.* (2002) explains that the reduction in vegetation condition at this site is due to grazing of cattle and the associated introduction of **Cenchrus ciliaris* (Buffel Grass).

Some of the slopes of the gorge area were assessed to be in "good" condition but were burnt recently (Trudgen *et al.* 2002). The vegetation condition recorded at these sites was lowered because of the (then) recent fire. Most of the vegetation of the gorge area is in "very good" or "excellent" condition, except where it has been impacted by the access track.

Areas associated with mineral exploration were assessed as "completely degraded" due to creation of access tracks, camp sites, gridlines and drill pads. At these sites the vegetation has been completely removed and soil compaction and topsoil removal has inhibited rehabilitation. Other impacts include direct impacts from grazing cattle and camels, pastoral impacts such as increase in fire frequency to improve pasture and **Cenchrus ciliaris* (Buffel Grass) invasion (Trudgen *et al.* 2002, Trudgen 2006; Trudgen 2007b).

7. GROUNDWATER DEPENDENT ECOSYSTEMS (GDE)

7.1. Nationally recognised GDEs

Two ecosystems in the Pilbara Region are recognised nationally as Groundwater Dependent Ecosystems (GDEs) (Sinclair Knight Merz, 2001). These are:

- Pilbara spring systems, which are entirely dependent on groundwater and have a high conservation value; and
- Pilbara river pool ecosystems, which are highly dependent on groundwater and have a moderate conservation value.

Both GDEs list mining, water resources and agricultural as potential threats (Sinclair Knight Merz Pty Ltd 2001).

7.2. Panorama Project Survey Area: Potential GDEs

The GDE rating (from Low to Very High) of the 18 Vegetation Alliances within the Panorama Project Survey Area are given in Appendix D and Figures 2a to 2f. Besides Vegetation Alliances 1a and 2a, all other Vegetation Alliances were rated with a low GDE probability. Locally within the Panorama Project Survey Area, Vegetation Alliance 1a and 2a could be potentially recognised as spring or river pool systems, given the location of these GDEs along flowlines and on lower slopes.

Very High GDE Probability

Vegetation Alliance 1a in the Open Forest to Open Woodland: Flowlines Vegetation Formation was rated with a Very High GDE probability (Appendix D):

Vegetation Alliance 1a - Open forest to open woodland of *Eucalyptus camaldulensis*, *Melaleuca argentea* and *Eucalyptus victrix* with scattered tall shrubs of *Indigofera monophylla* over *Schoenus falcatus*, *Cyperus vaginatus* and *Triodia longiceps* sedgeland/grasslands in river beds.

High GDE Probability

Vegetation Alliance 2a in the Open Forest to Open Woodland: Other Vegetation Formation was rated with a High GDE probability (see Appendix D):

Vegetation Alliance 2a - *Eucalyptus victrix* scattered trees to open woodland which may include *Melaleuca glomerata* and *Melaleuca linophylla* over open to closed scrub in creek beds and low slopes.

8. DISCUSSION

8.1. Flora and Vegetation

The flora and vegetation of the Panorama Project Survey Area is complex and varies over small distances according to the geology and the range of habitats surveyed. In general, the flora and vegetation is typical of that in the Fortescue Botanical District. However, the Panorama Project Survey Area also contains some locally and regionally significant flora; including new, Priority Flora and other species of conservation significance.

Pityrodia sp. Panorama. This species was recorded at fifteen locations. Four of these locations occurred within Vegetation Alliances 5a, 6a and 9a in the proposed waste dumps and at two other proposed disturbance sites within the Project Area. This species appears to be rare within this area and Trudgen *et al.* (2002) and Trudgen (2006) have suggested that this species be considered for classification as DRF. The other new species - *Themeda* sp. Panorama was recorded at ten locations in the Kangaroo Caves and Bernts areas to the south of the main Project Area.

Seven current Priority Flora species were recorded within or may occur within the Panorama Project Area: *Euphorbia clementii* (P2), *Gonocarpus ephemerus* (P2), *Olearia fluvialis* (P2), *Abutilon trudgenii* (ms) (P3), *Acacia glaucochaesia* (P3), *Gymnanthera cunninghamii* (P3) and *Ptilotus mollis* (P4). Trudgen *et al.* (2002) comments that the conservation value of some of these Priority Flora species is low to moderate as they are not “genuinely uncommon”. Moreover, Trudgen (2007b) believes that *Abutilon trudgenii* (ms) (P3) should be removed from the Priority Flora species list. Despite this, *Abutilon trudgenii* (ms) (P3) and all Priority Flora species should be avoided wherever possible in any developments.

There are a number of other flora species recorded within the wider survey area and are of interest because they are classified as DRF or Priority Flora species and may occur within the Project Area based on DEC database searches; may be geographically restricted, but require further investigation; may have conservation significance, but require further investigation; or are species that now have a wider distribution than previously recorded. Some of these are recorded within the proposed Project footprint and may require further clarification.

Other conservation significant species that may exist, but have not been recorded in Panorama Project Survey Area, include two Declared Rare Flora species, *Lepidium catapycnon* (R) and *Thryptomene wittweri* (R) according to the *Environment Protection and Biodiversity Conservation Act 1999* [Commonwealth]. Further searches for Declared Rare Flora may confirm their presence or absence in the Panorama Project Survey Area.

Trudgen *et al.* (2002) mapped 52 Vegetation Alliances (or vegetation mapping units), reflecting the structural and floristic diversity. These vegetation mapping units were simplified to 18 Vegetation Alliances in the Panorama Project Survey Area by Mattiske (see Appendix D). Some of the Vegetation Alliances are locally significant.

No Threatened Ecological Communities (TEC) as defined by the *Environment Protection and Biodiversity Conservation Act 1999* [Commonwealth] were observed in the Panorama Project Survey Area. However, *Themeda* grasslands of the Pilbara Region are listed as a Vulnerable TEC according to the Department of Environment and Conservation's (2007b) TEC database. Whilst *Themeda* grasslands were not found within the Panorama Project Survey Area, these grasslands could potentially occur there and care should be taken where *Themeda* species, in particular *Themeda* sp. Panorama, are a dominant part of the local vegetation.

In general, the vegetation of the Panorama Project Survey Area can be classified as being “very good” or “excellent” in condition, except where directly impacted by the existing access road. There was one area of vegetation in “poor” to “very poor” condition along the access road which was infested with **Cenchrus ciliaris* (Buffel Grass).

8.2. GDEs

There is a suite of GDEs present within the Panorama Project Survey Area. In general, the spring ecosystems and river pool ecosystems of the Pilbara are recognised nationally and protected under state legislation according to the *Environmental Protection Act 1986* [WA] and the *Rights in Water and Irrigation Act 1914* [WA] (Water and Rivers Commission 2000; Sinclair Knight Merz 2001). Locally within the Panorama Project Survey Area; Vegetation Alliance 1a, rated with a Very High probability of being a GDE, and Vegetation Alliance 2a, rated with a High probability of being a GDE, could be potentially recognised as spring or river pool systems, given the location of these GDEs along flowlines and on lower slopes (see Appendix D). Given the groundwater dependence of these vegetation alliances, the EWRs need to be determined prior to any groundwater pumping. It is recommended that EWRs allow a buffer for groundwater drawdown given the likely large variability in ecosystem response.

Further site specific surveys are required to tightly constrain the findings reported herein. For example, determining the rooting depths of key flora species in GDEs can enable reliable determination of EWRs. Furthermore, determining seasonal changes in the depth to the watertable is important for long-term ecosystem function (see Eamus *et al.* 2006). Establishment of a detailed groundwater monitoring program prior to and during pumping is necessary to determine the impacts of altered groundwater levels on GDEs within the Panorama Project Survey Area. Additionally monitoring should include an assessment of: the abundance and distribution (especially in regard to indicator species but also in terms of aerial extent); character; and condition of GDEs to provide further detail reported herein (Eamus *et al.* 2006; Loomes *et al.* 2006; Water and Rivers Commission 2000).

9. LIST OF PERSONNEL

The following personnel of Mattiske Consulting Pty Ltd were involved in this project:

Principle Ecologist

Dr E.M. Mattiske

Senior Ecologist

Dr F. Itzstein-Davey

Botanists

Ms K. Rose

Ms F. De Wit

Mr C. Blackburn

Mr T. Sleight

10. ACKNOWLEDGEMENTS

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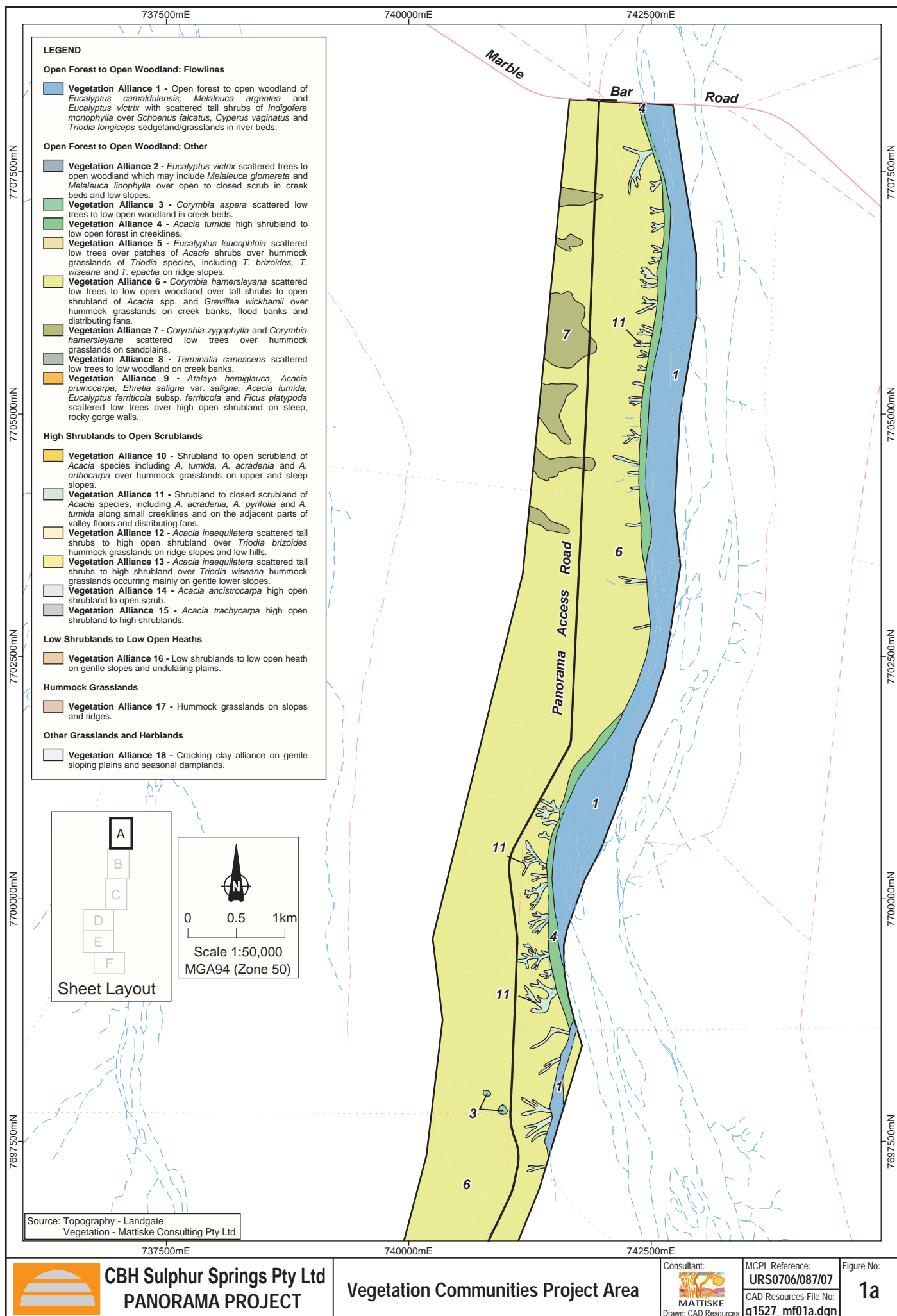
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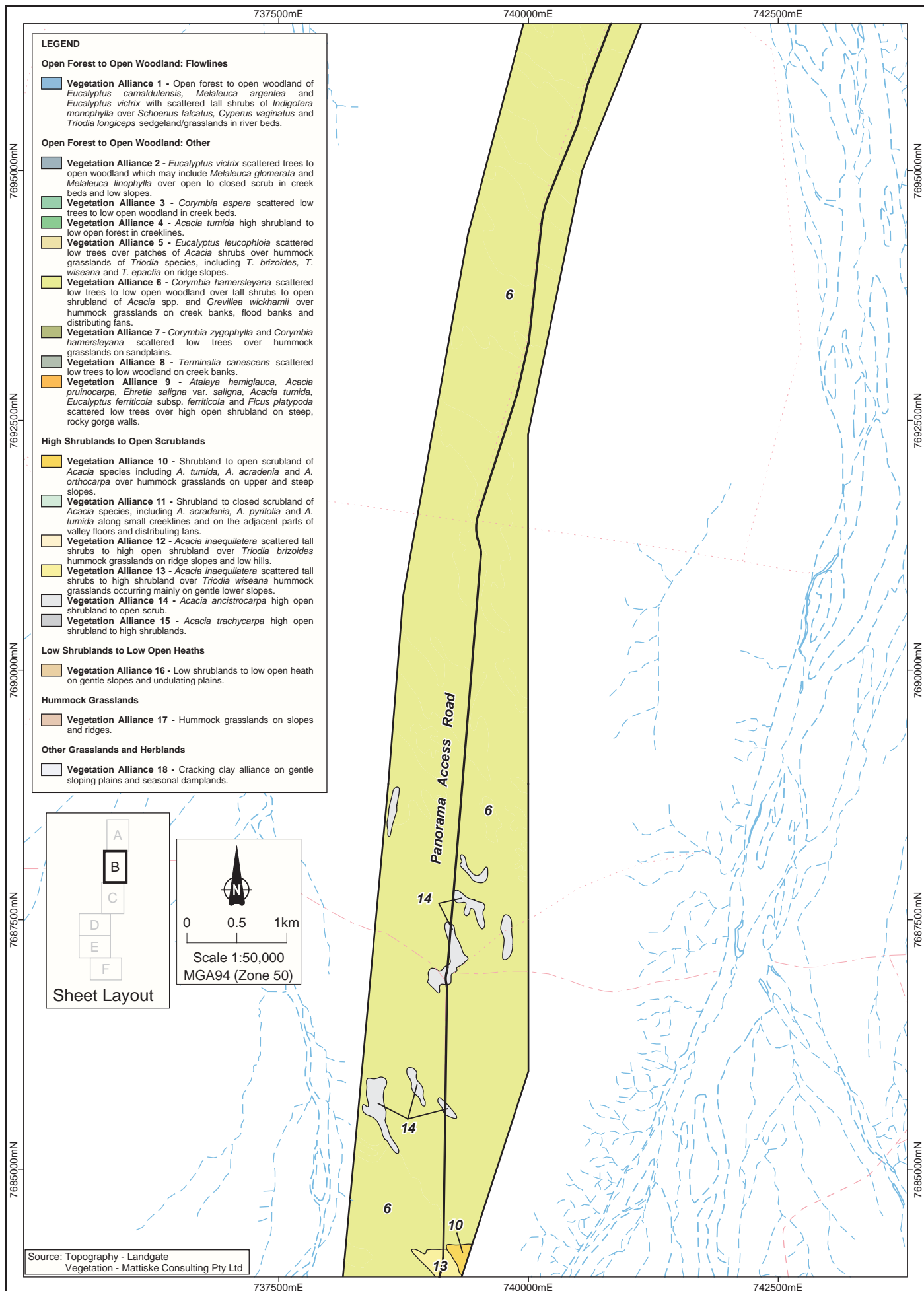
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1a



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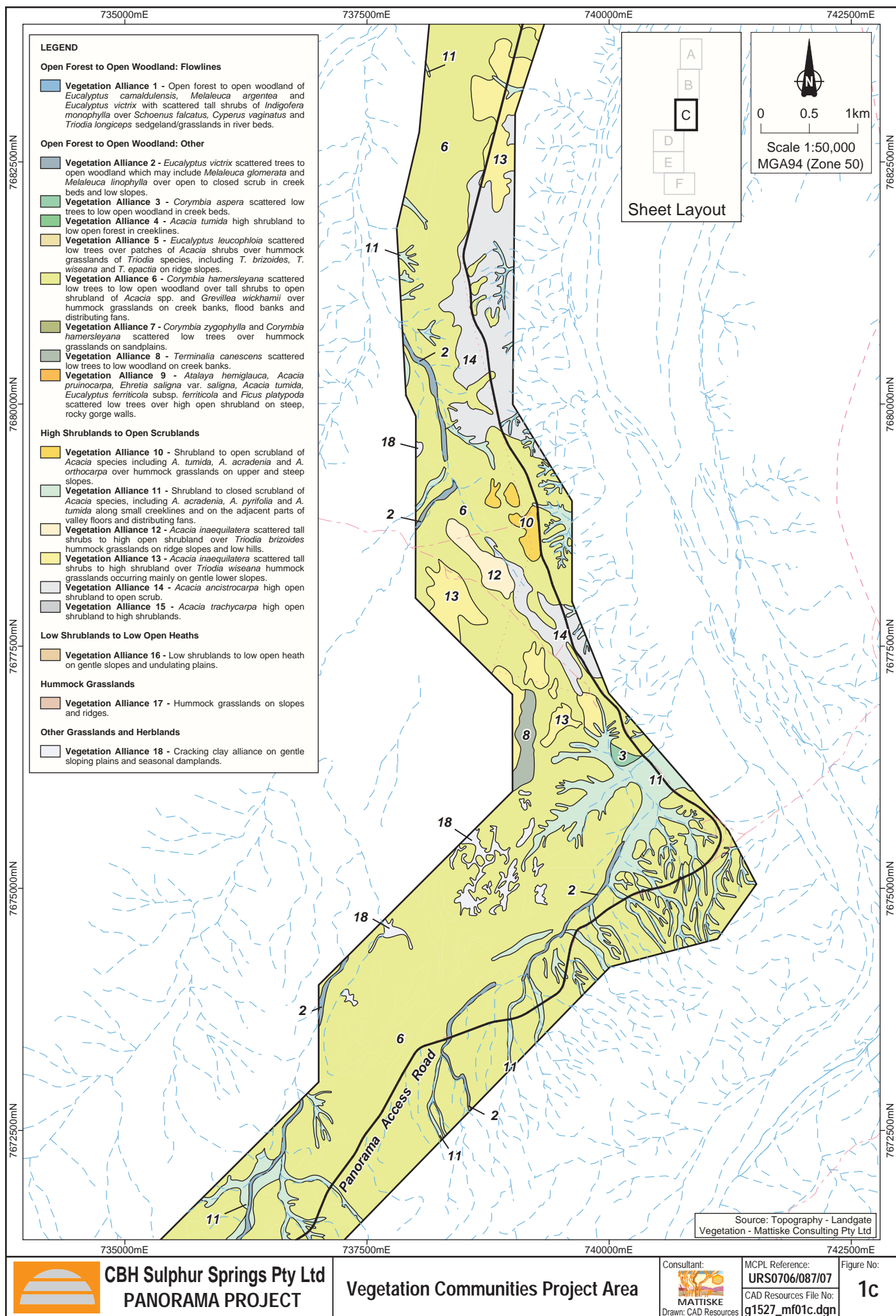
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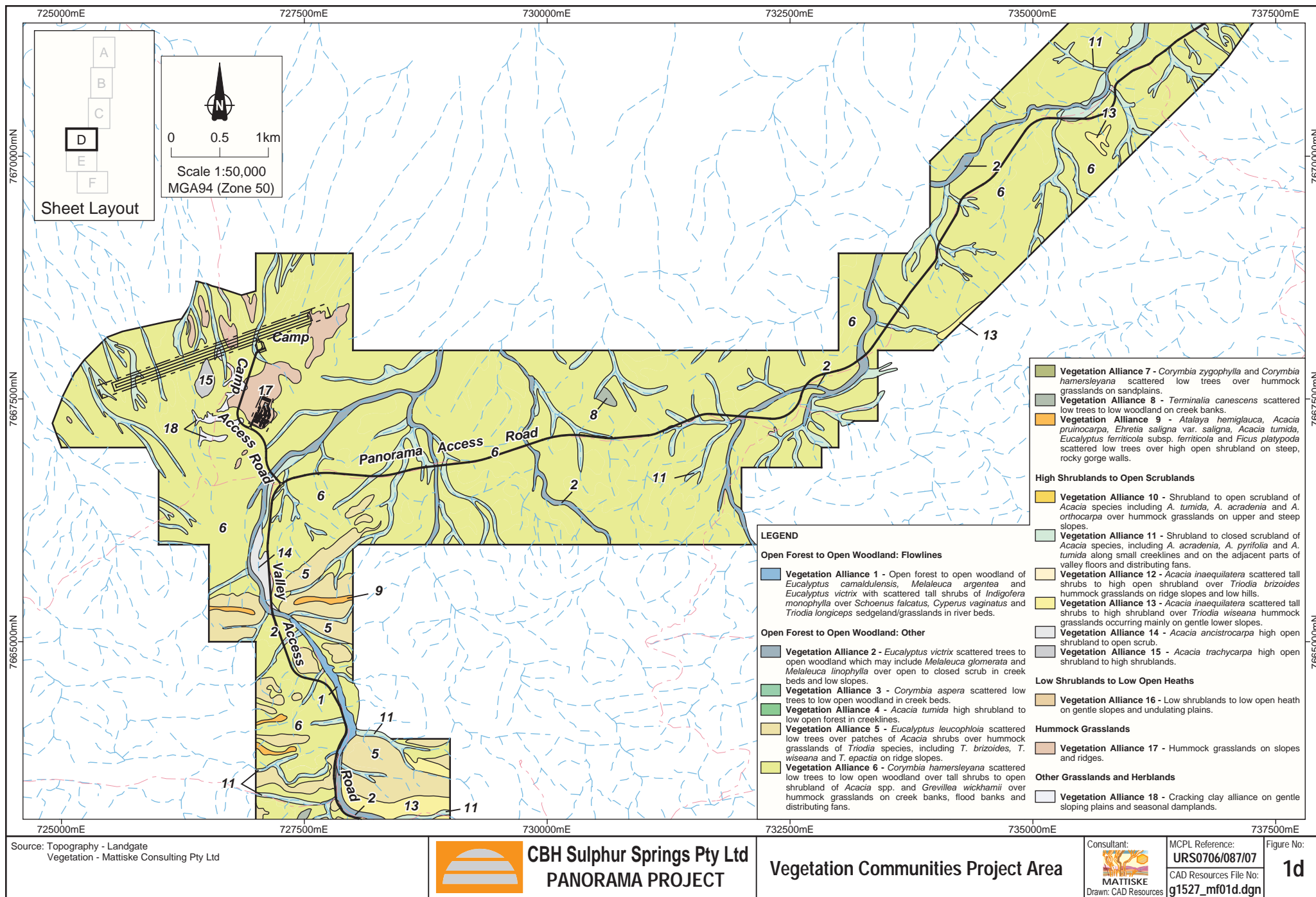


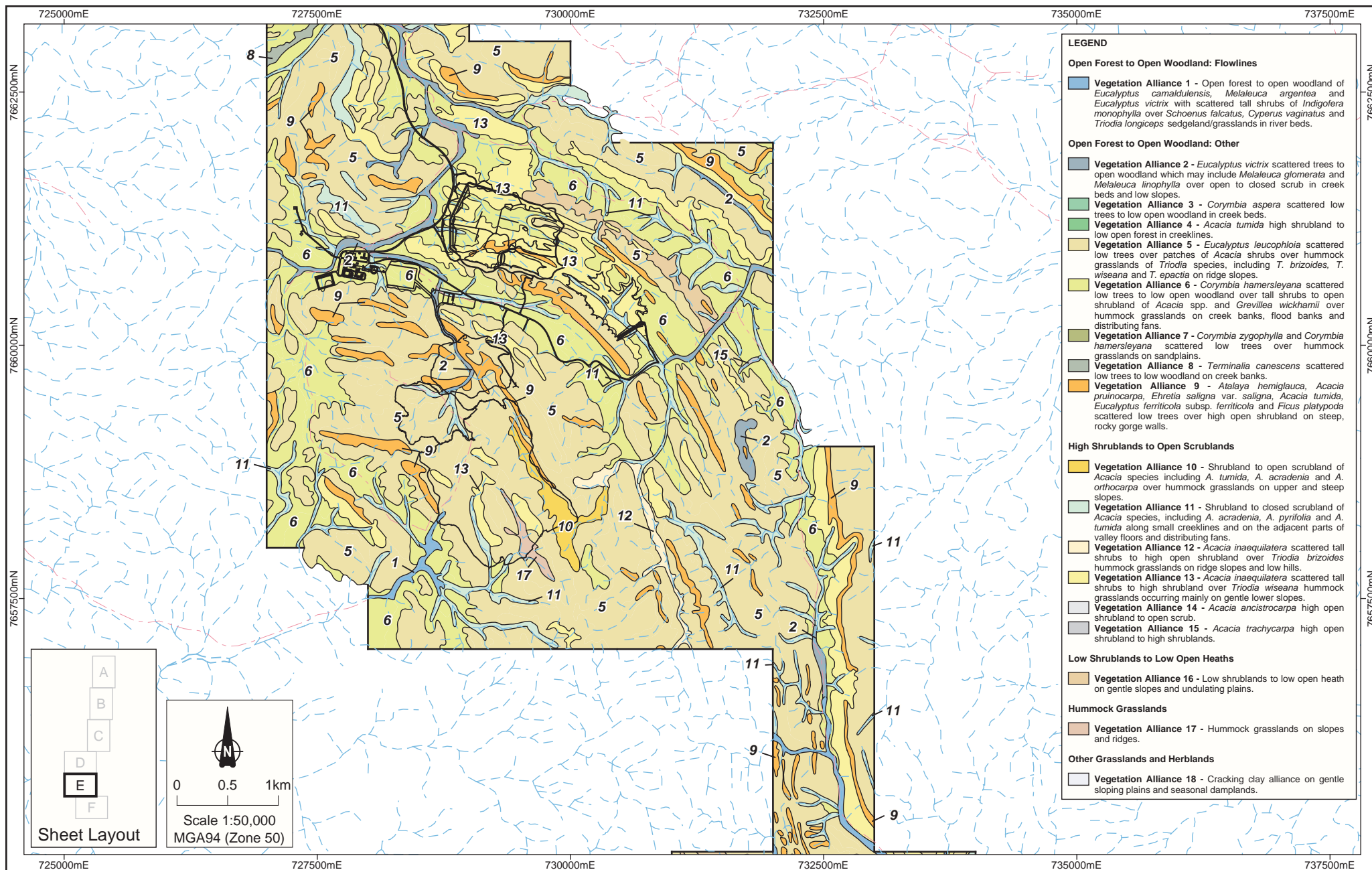
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Vegetation - Matiske Consulting Pty Ltd



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PANORAMA PROJECT

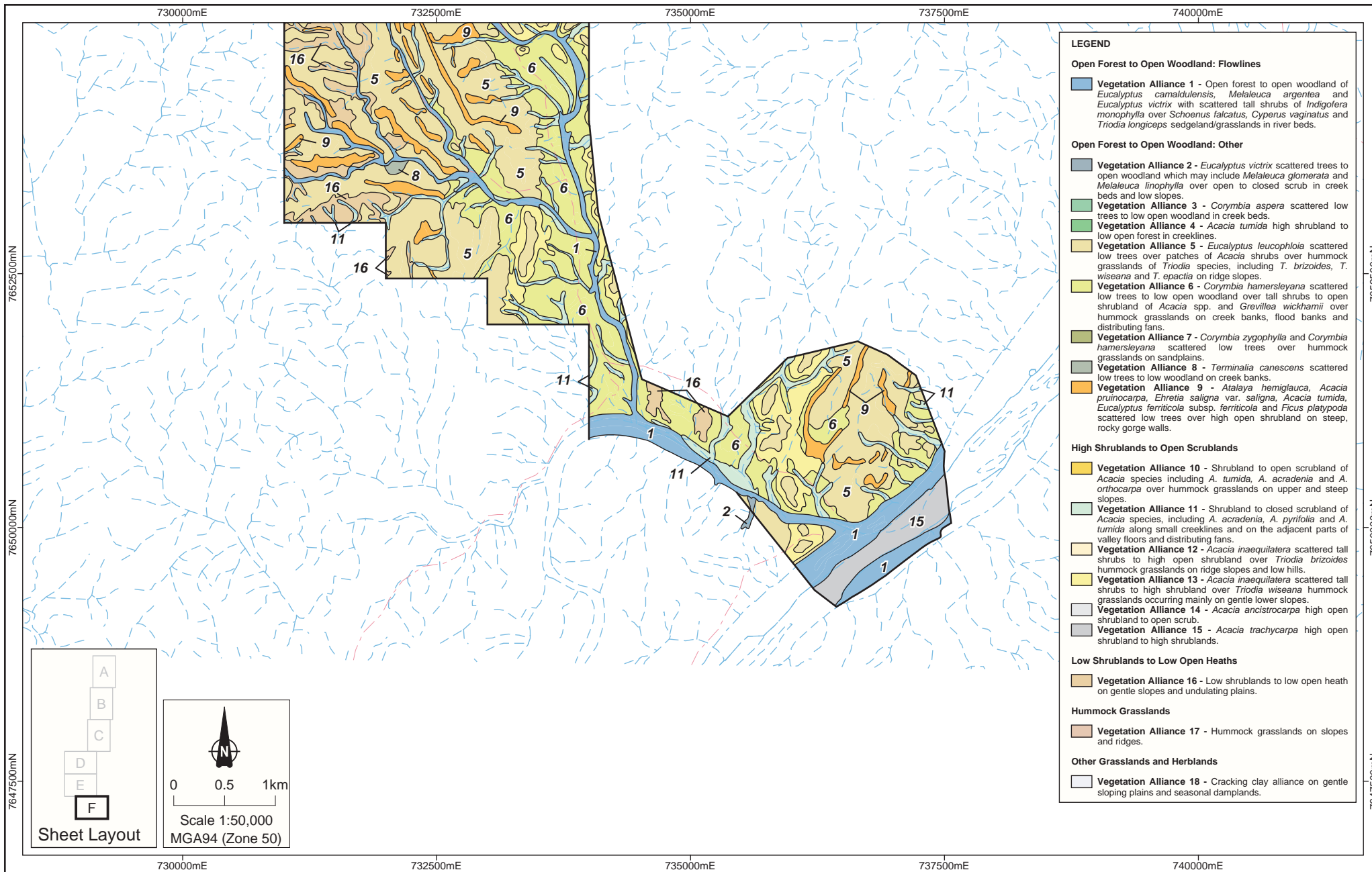
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MATTISKE
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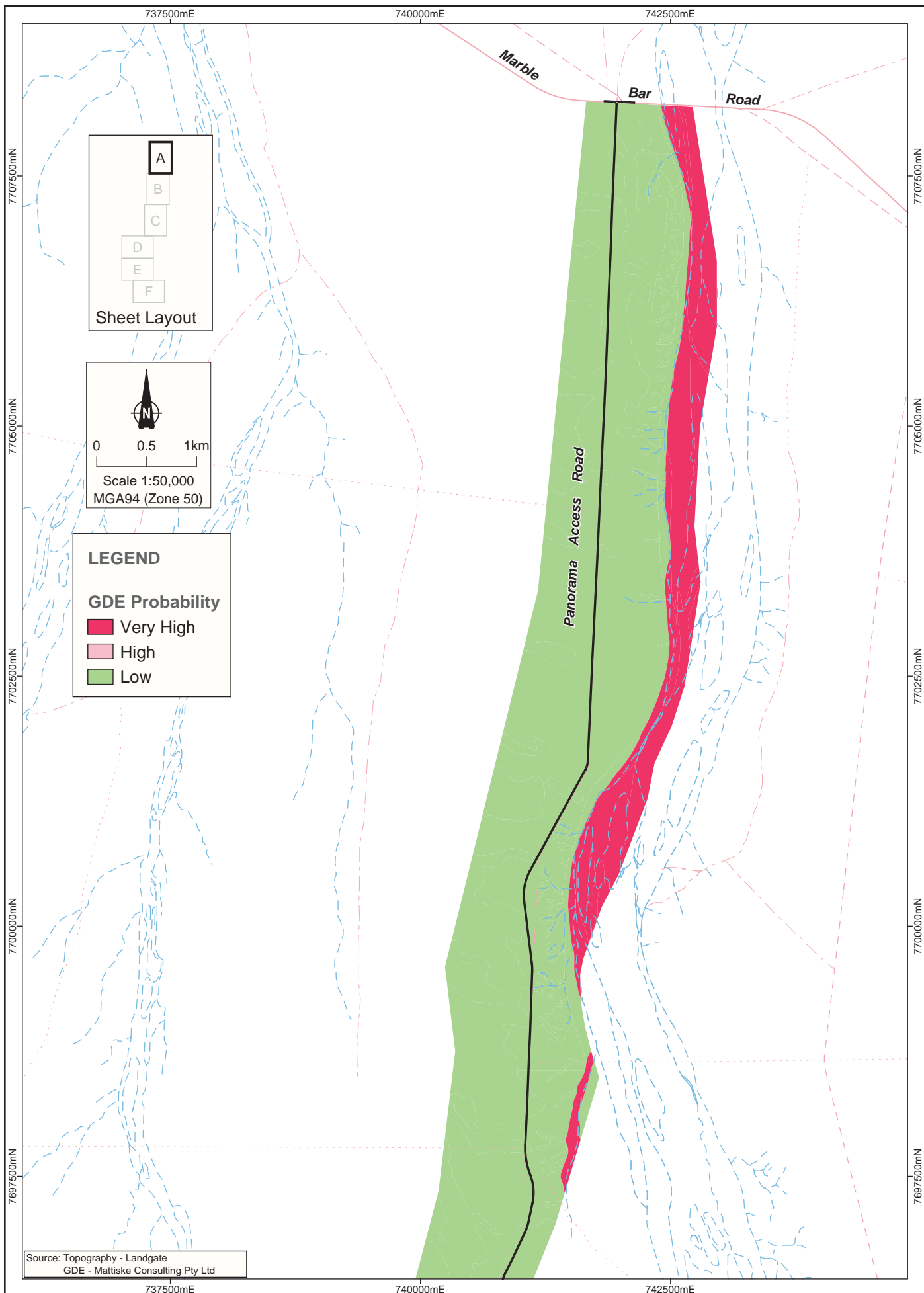
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Groundwater Dependent Ecosystems

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Drawn: CAD Resources

MCPL Reference:
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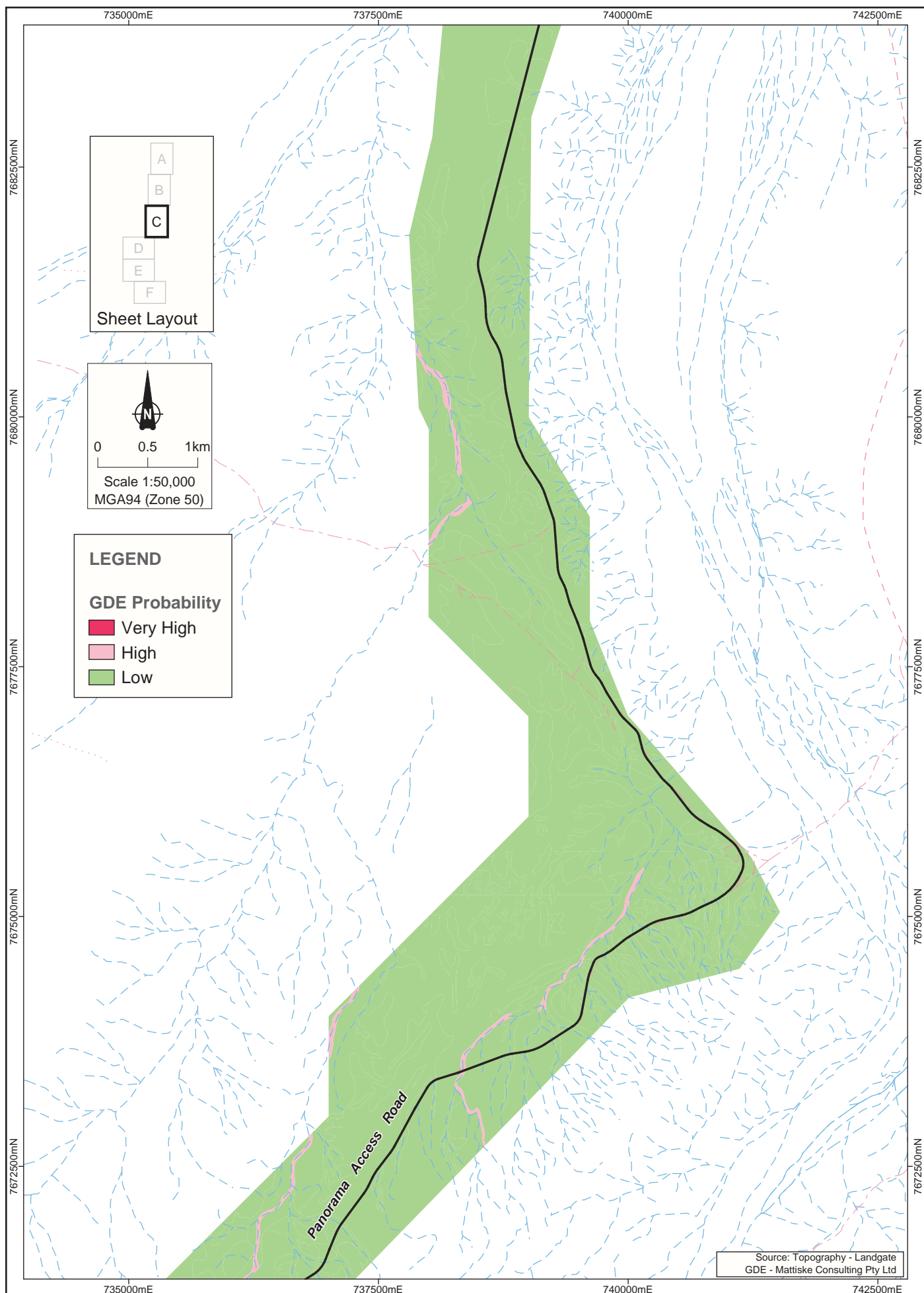
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Groundwater Dependent Ecosystems

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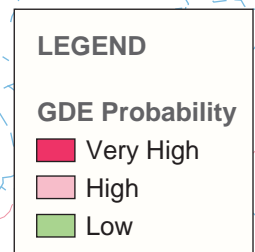
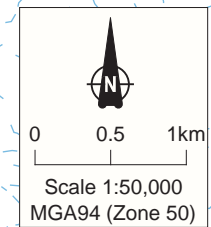
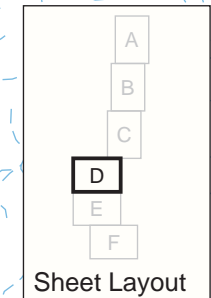
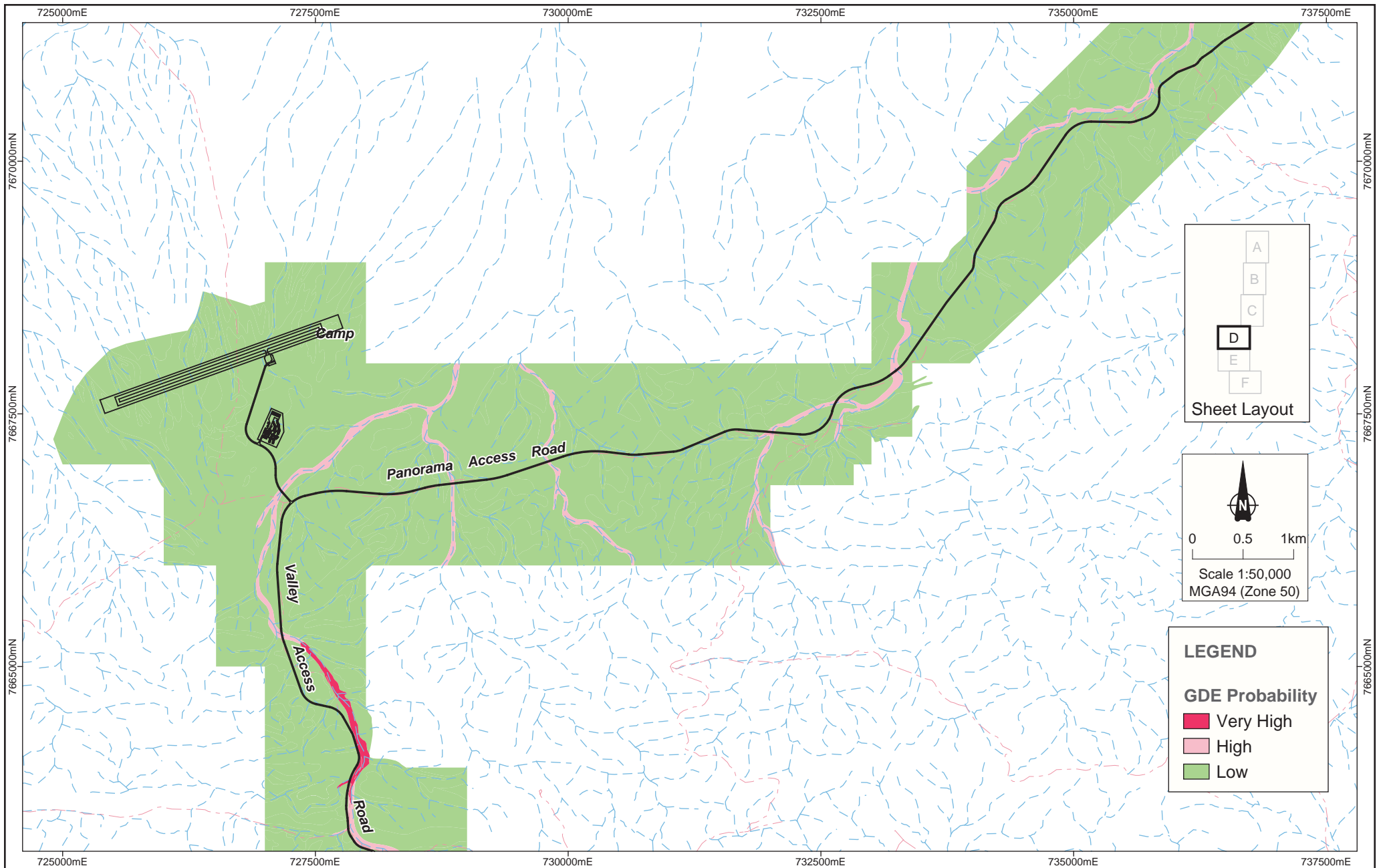
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Groundwater Dependent Ecosystems

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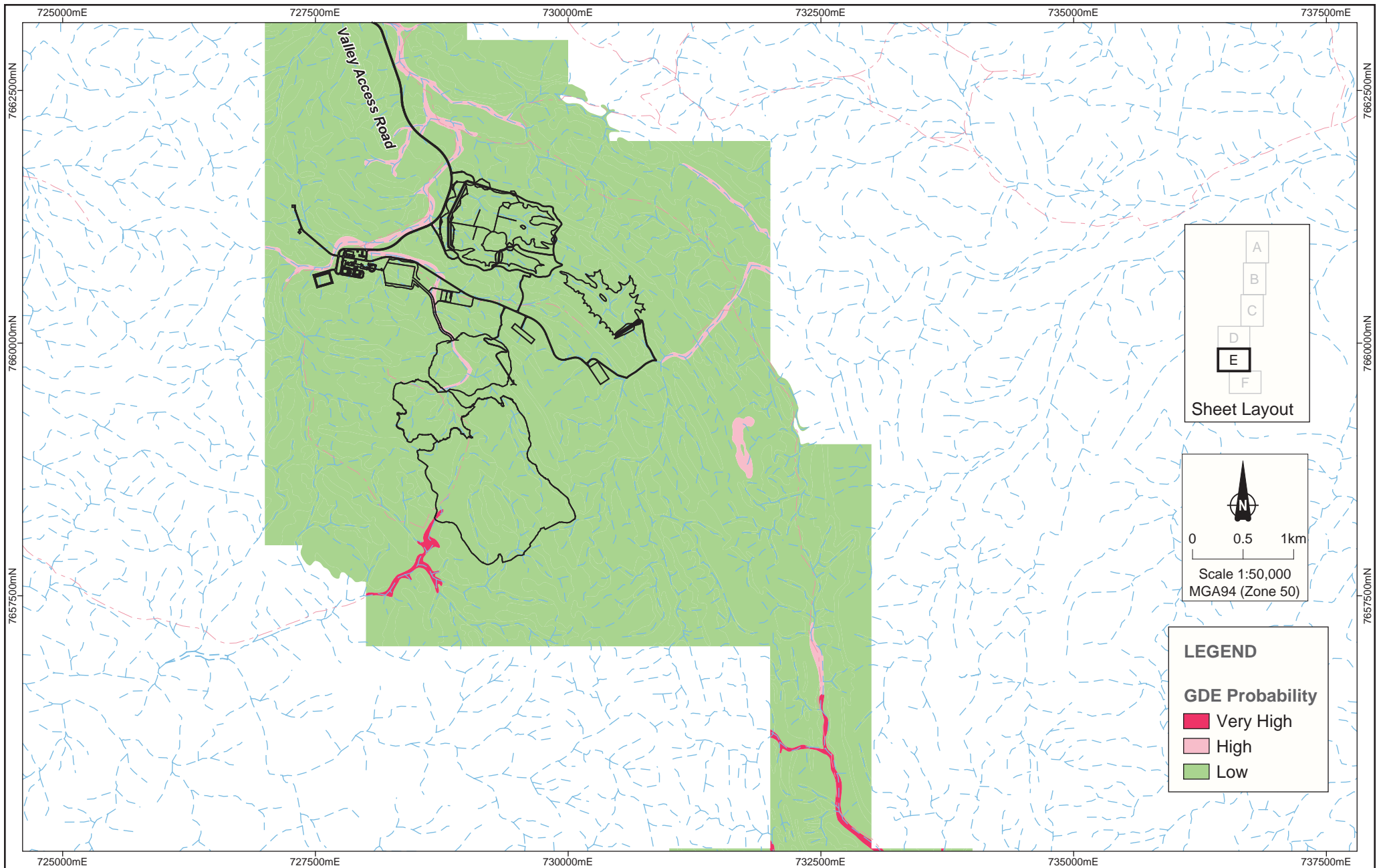
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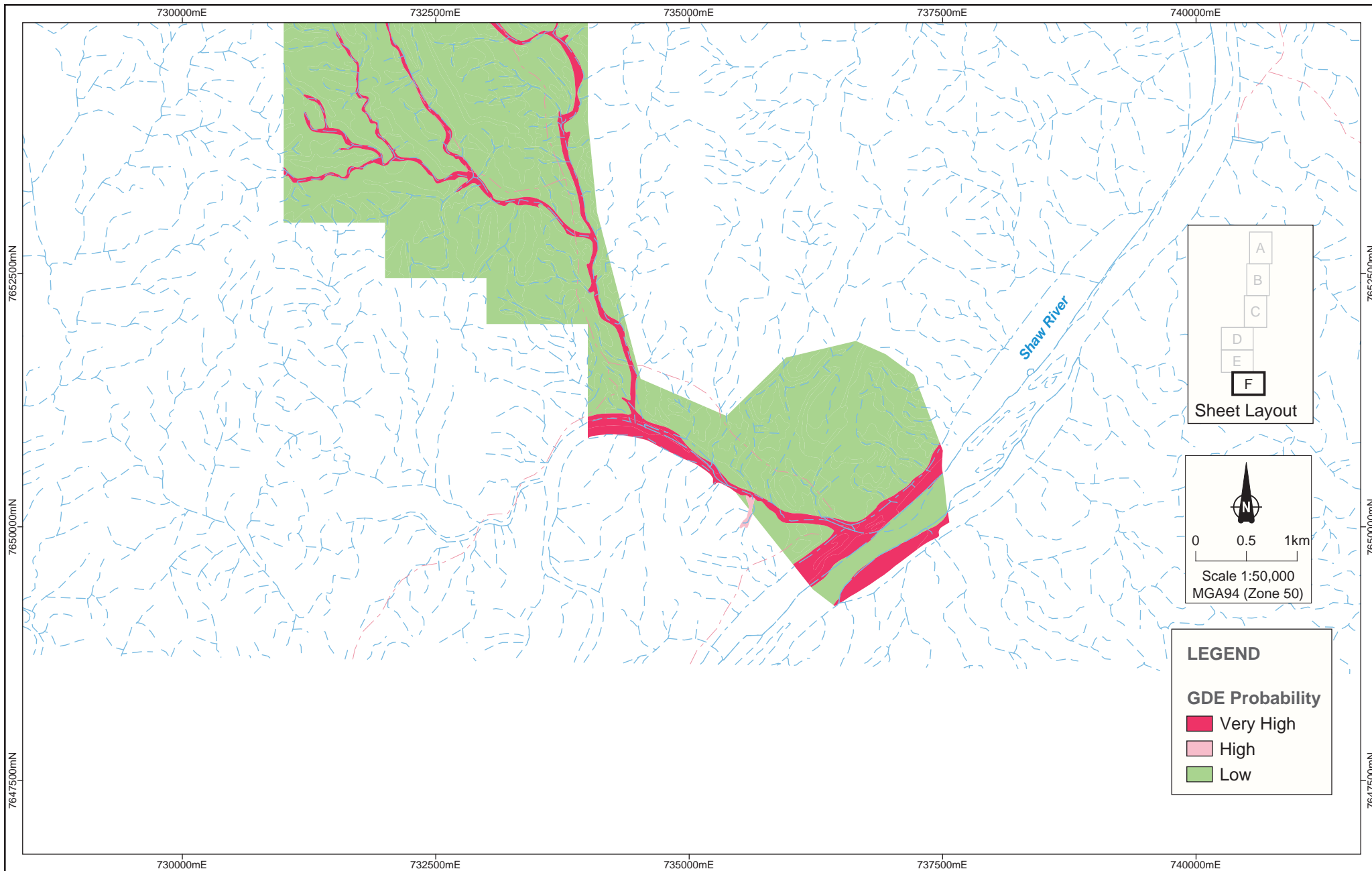
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Figure No:
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Source: Topography - Landgate
GDE - Mattiske Consulting Pty Ltd



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Groundwater Dependent Ecosystems

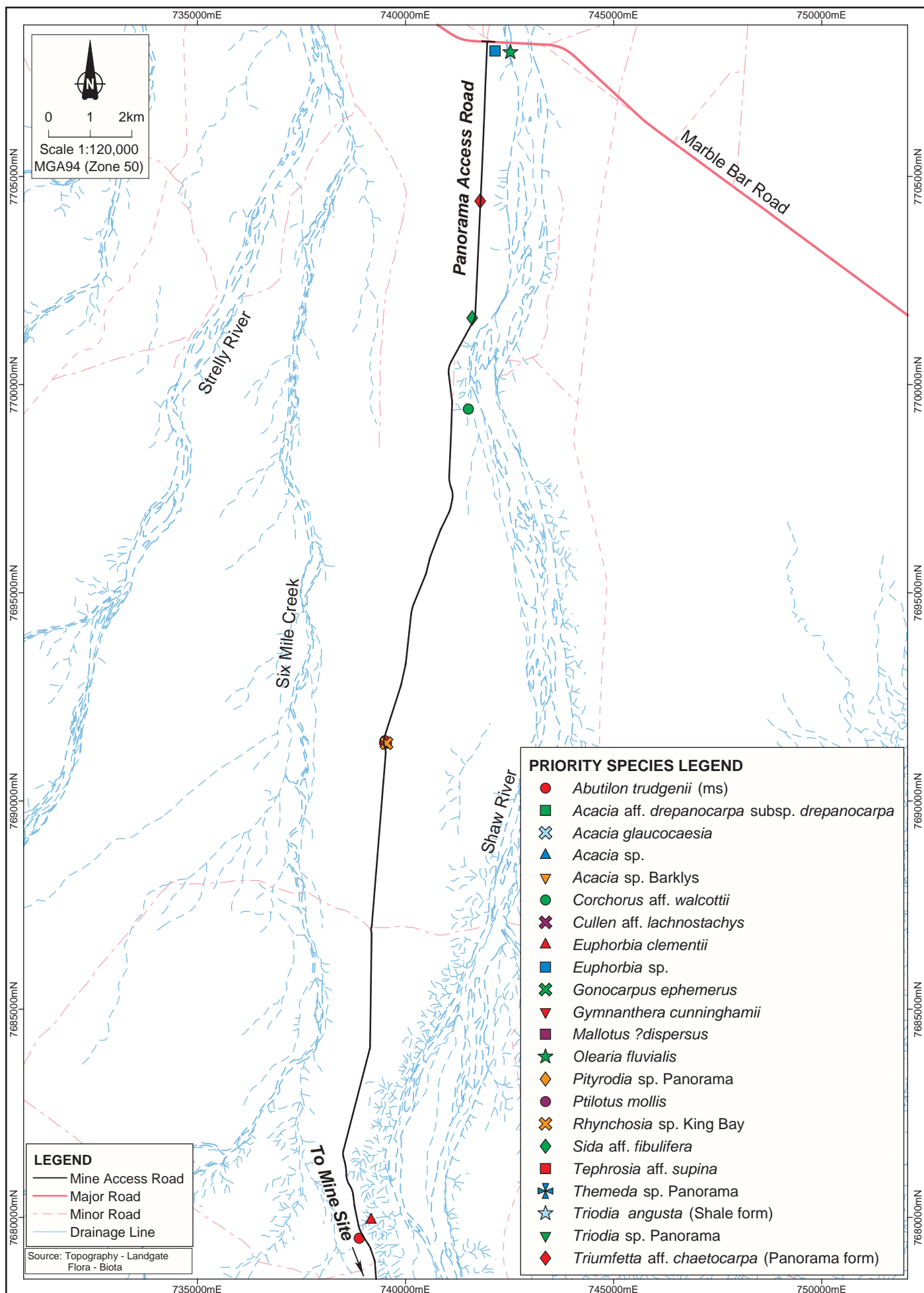
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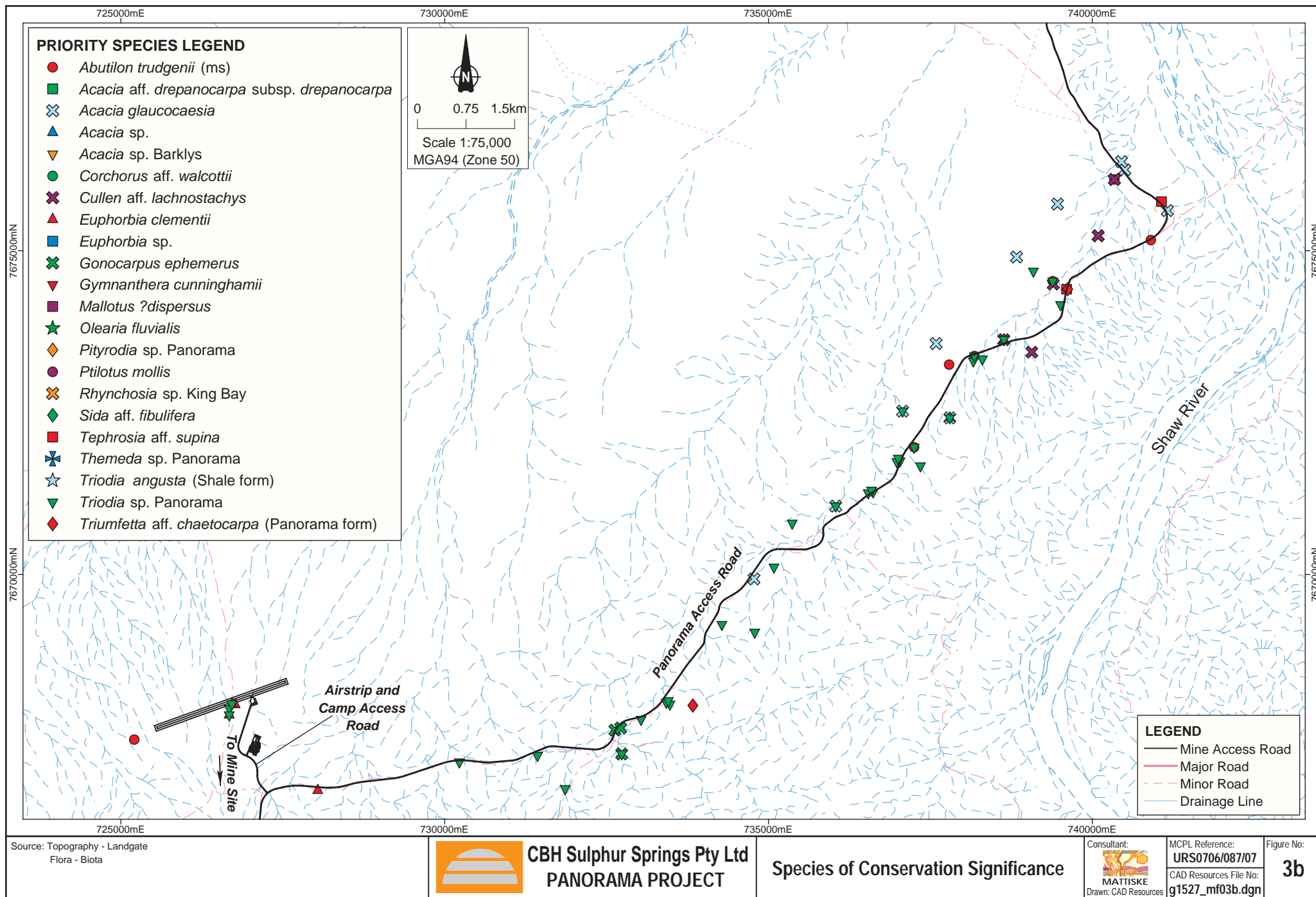
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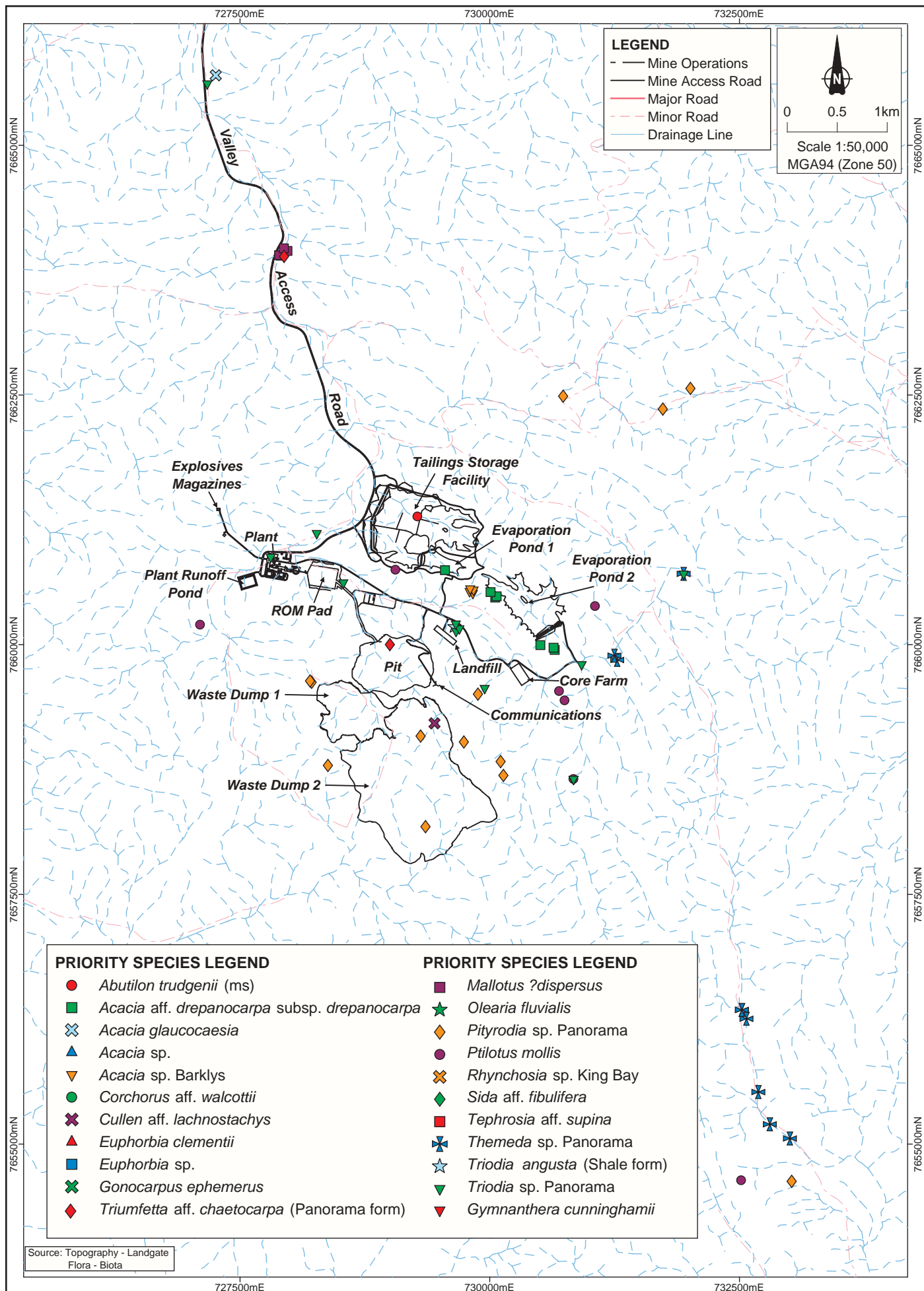
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Species of Conservation Significance

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CAD Resources File No:
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Figure No:

3c

APPENDIX A: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE PANORAMA PROJECT SURVEY AREA

Note: * denotes introduced species; P1, P2, P3 and P4 denote - Priority Flora Species (DEC, 2007a)

FAMILY	SPECIES
ADIANTACEAE	<i>Cheilanthes austrotenuifolia</i> <i>Cheilanthes lasiophylla</i> <i>Cheilanthes sieberi</i>
MARSILEACEAE	<i>Marsilea hirsuta</i>
TYPHACEAE	<i>Typha domingensis</i>
POACEAE	<i>Aristida contorta</i> <i>Aristida holathera</i> var. <i>holathera</i> <i>Aristida holathera</i> var. <i>latifolia</i> <i>Aristida hygrometrica</i> <i>Aristida latifolia</i> <i>Aristida</i> sp. <i>Bothriochloa</i> sp. <i>Brachyachne convergens</i> <i>Brachyachne prostrata</i> * <i>Cenchrus ciliaris</i> <i>Chrysopogon fallax</i> <i>Cymbopogon ambiguus</i> <i>Cymbopogon obtectus</i> <i>Cymbopogon procerus</i> * <i>Cynodon dactylon</i> <i>Dactyloctenium radulans</i> <i>Dichanthium fecundum</i> <i>Dichanthium sericeum</i> subsp. <i>humilius</i> <i>Digitaria brownii</i> <i>Elytrophorus spicatus</i> <i>Enneapogon caeruleus</i> <i>Enneapogon caeruleus</i> var. <i>caeruleus</i> <i>Enneapogon lindleyanus</i> <i>Enneapogon</i> sp. <i>Eragrostis cumingii</i> <i>Eragrostis eriopoda</i> <i>Eragrostis ?leptocarpa</i> <i>Eragrostis olida</i> <i>Eragrostis tenellula</i> <i>Eragrostis xerophila</i> <i>Eriachne aristidea</i> <i>Eriachne benthamii</i> <i>Eriachne ciliata</i> <i>Eriachne</i> aff. <i>festucea</i> <i>Eriachne mucronata</i> (typical form) <i>Eriachne obtusa</i> <i>Eriachne</i> sp. Port Hedland <i>Eriachne pulchella</i> <i>Eriachne pulchella</i> subsp. <i>dominii</i> <i>Eriachne pulchella</i> subsp. <i>pulchella</i> <i>Eriachne tenuiculmis</i> <i>Eriachne</i> sp. aff. <i>festucea</i>

APPENDIX A: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE PANORAMA PROJECT SURVEY AREA

Note: * denotes introduced species; P1, P2, P3 and P4 denote - Priority Flora Species (DEC, 2007a)

FAMILY	SPECIES
POACEAE (continued)	<i>Eulalia aurea</i> <i>Heteropogon contortus</i> <i>Iseilema dolichotrichum</i> <i>Iseilema eremaeum</i> <i>Iseilema macratherum</i> <i>Leptochloa fusca</i> subsp. <i>fusca</i> <i>Panicum decompositum</i> <i>Paraneurachne muelleri</i> <i>Paspalidium clementii</i> <i>Paspalidium rarum</i> <i>Paspalidium tabulatum</i> (Whim Creek form) <i>Schizachyrium fragile</i> <i>Setaria dielsii</i> * <i>Setaria verticillata</i> <i>Sorghum plumosum</i> <i>Sporobolus actinocladus</i> <i>Sporobolus australasicus</i> <i>Themeda avenacea</i> <i>Themeda</i> sp. Panorama <i>Themeda triandra</i> <i>Themeda</i> aff. <i>triandra</i> (MET 16,046) <i>Triodia angusta</i> (Panorama form) <i>Triodia angusta</i> (Shale form) <i>Triodia angusta</i> (Shaw River form) <i>Triodia basedowii</i> <i>Triodia brizoides</i> <i>Triodia epactia</i> <i>Triodia lanigera</i> <i>Triodia longiceps</i> <i>Triodia melvillei</i> <i>Triodia</i> sp. Panorama <i>Triodia schinzii</i> <i>Triodia wiseana</i> <i>Triodia wiseana</i> var. <i>brevifolia</i> ? <i>Yakirra australiensis</i> var. <i>australiensis</i>
CYPERACEAE	<i>Bulbostylis barbata</i> <i>Cyperus cunninghamii</i> subsp. <i>cunninghamii</i> <i>Cyperus hesperius</i> <i>Cyperus iria</i> <i>Cyperus squarrosus</i> <i>Cyperus vaginatus</i> <i>Cyperus viscidulus</i> <i>Eleocharis atropurpurea</i> <i>Fimbristylis dichotoma</i> <i>Fimbristylis littoralis</i> <i>Fimbristylis microcarya</i> <i>Fimbristylis simulans</i> <i>Fimbristylis</i> sp. <i>Fuirena ciliaris</i>

**APPENDIX A: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE PANORAMA
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Note: * denotes introduced species; P1, P2, P3 and P4 denote - Priority Flora Species (DEC, 2007a)

FAMILY	SPECIES
CYPERACEAE (continued)	<i>Lipocarpha microcephala</i> <i>Schoenoplectus litoralis</i> <i>Schoenus falcatus</i>
MORACEAE	<i>Ficus brachypoda</i> <i>Ficus opposita</i> <i>Ficus opposita</i> var. <i>indecora</i> <i>Ficus platypoda</i> var. D
PROTEACEAE	<i>Grevillea pyramidalis</i> <i>Grevillea pyramidalis</i> subsp. <i>leucadendron</i> <i>Grevillea wickhamii</i> subsp. <i>aprica</i> <i>Grevillea wickhamii</i> subsp. <i>hispidula</i> <i>Hakea chordophylla</i> <i>Hakea lorea</i> subsp. <i>lorea</i>
SANTALACEAE	<i>Santalum lanceolatum</i> <i>Santalum spicatum</i>
LORANTHACEAE	<i>Lysiana casuarinae</i>
CHENOPODIACEAE	<i>Dysphania rhadinostachya</i> subsp. <i>rhadinostachya</i> <i>Dysphania sphaerosperma</i> <i>Salsola tragus</i> <i>Salsola tragus</i> var. <i>tragus</i> <i>Sclerolaena hostilis</i>
AMARANTHACEAE	* <i>Aerva javanica</i> <i>Alternanthera nana</i> <i>Alternanthera nodiflora</i> <i>Amaranthus</i> aff. <i>pallidiflorus</i> (WAS1127) <i>Amaranthus undulatus</i> <i>Amaranthus</i> sp. <i>Gomphrena canescens</i> <i>Gomphrena cunninghamii</i> <i>Gomphrena leptoclada</i> subsp. <i>leptoclada</i> <i>Ptilotus aervoides</i> <i>Ptilotus arthrolasius</i> <i>Ptilotus astrolasius</i> var. <i>astrolasius</i> <i>Ptilotus auriculifolius</i> <i>Ptilotus axillaris</i> <i>Ptilotus calostachyus</i> var. <i>calostachyus</i> <i>Ptilotus clementii</i> <i>Ptilotus exaltatus</i> var. <i>exaltatus</i> <i>Ptilotus fusiformis</i> <i>Ptilotus fusiformis</i> var. <i>fusiformis</i> <i>Ptilotus gaudichaudii</i> var. <i>gaudichaudii</i> <i>Ptilotus gomphrenoides</i> var. <i>gomphrenoides</i> <i>Ptilotus incanus</i> <i>Ptilotus incanus</i> var. <i>elongatus</i> <i>Ptilotus mollis</i> (P4) <i>Ptilotus murrayi</i> var. <i>murrayi</i>

APPENDIX A: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE PANORAMA PROJECT SURVEY AREA

Note: * denotes introduced species; P1, P2, P3 and P4 denote - Priority Flora Species (DEC, 2007a)

FAMILY	SPECIES
NYCTAGINACEAE	<i>Boerhavia burbridgeana</i> <i>Boerhavia coccinea</i> <i>Boerhavia gardneri</i> <i>Boerhavia repleta</i> <i>Boerhavia</i> sp. (M92-7)
GYROSTEMONACEAE	<i>Codonocarpus cotinifolius</i>
AIZOACEAE	<i>Trianthema</i> aff. <i>triquetra</i> (M3.35) <i>Trianthema oxycalyptra</i> var. <i>oxycalyptra</i> <i>Trianthema pilosa</i> <i>Trianthema triquetra</i> <i>Trianthema</i> sp.
MOLLUGINACEAE	<i>Mollugo molluginea</i>
PORTULACACEAE	<i>Calandrinia pumila</i> * <i>Portulaca oleracea</i>
CARYOPHYLLACEAE	<i>Polycarpaea corymbosa</i> var. <i>corymbosa</i> <i>Polycarpaea holtzei</i> <i>Polycarpaea involucreta</i> <i>Polycarpaea longiflora</i> <i>Polycarpaea longiflora</i> (Whim Creek form, WC147-7) <i>Polycarpaea longiflora</i> (White form, M13-7) <i>Polycarpaea</i> sp.
MENISPERMACEAE	<i>Tinospora smilacina</i>
LAURACEAE	<i>Cassytha capillaris</i>
PAPAVERACEAE	* <i>Argemone ochroleuca</i>
CAPPARACEAE	<i>Cleome uncifera</i> <i>Cleome uncifera</i> subsp. <i>uncifera</i> <i>Cleome viscosa</i>
BRASSICACEAE	<i>Lepidium pholidogynum</i>
MIMOSACEAE	<i>Acacia acradenia</i> <i>Acacia adoxa</i> var. <i>adoxo</i> <i>Acacia ampliceps</i> <i>Acacia ancistrocarpa</i> <i>Acacia arida</i> <i>Acacia</i> sp. <i>Barklys</i> <i>Acacia bivenosa</i> <i>Acacia colei</i> <i>Acacia coriacea</i> <i>Acacia coriacea</i> subsp. <i>pendens</i> <i>Acacia dictyophleba</i> <i>Acacia</i> aff. <i>drepanocarpa</i> subsp. <i>drepanocarpa</i> (BM:C16)

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Note: * denotes introduced species; P1, P2, P3 and P4 denote - Priority Flora Species (DEC, 2007a)

FAMILY	SPECIES
MIMOSACEAE (continued)	<i>Acacia elachantha</i> <i>Acacia ericifolia</i> <i>Acacia glaucocaesia</i> (P3) <i>Acacia hilliana</i> <i>Acacia holosericea</i> <i>Acacia inaequilatera</i> <i>Acacia maitlandii</i> <i>Acacia melileodora</i> <i>Acacia orthocarpa</i> <i>Acacia orthocarpa</i> (wispy form) <i>Acacia</i> sp. (PAN M48) <i>Acacia pruinocarpa</i> <i>Acacia ptychophylla</i> <i>Acacia pyrifolia</i> <i>Acacia pyrifolia</i> (slender, white) <i>Acacia sabulosa</i> <i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i> <i>Acacia sericophylla</i> <i>Acacia sphaerostachya</i> <i>Acacia spondylophylla</i> <i>Acacia stellaticeps</i> <i>Acacia synchronicia</i> <i>Acacia trachycarpa</i> <i>Acacia trachycarpa</i> x <i>tumida</i> var. <i>pilbarensis</i> <i>Acacia</i> ? <i>trachycarpa</i> (PAN12-4) <i>Acacia tumida</i> <i>Acacia tumida</i> var. <i>pilbarensis</i> <i>Acacia victoriae</i> <i>Acacia</i> sp. <i>Dichrostachys spicata</i> <i>Neptunia dimorphantha</i> * <i>Vachellia farnesiana</i>
CAESALPINIACEAE	<i>Cassia glaucifolia</i> x <i>glutinosa</i> <i>Cassia glutinosa</i> x <i>luerssenii</i> <i>Cassia</i> aff. <i>oligophylla</i> (BMor 152) <i>Cassia</i> 'symonii' <i>Cassia</i> sp. <i>Petalostylis labicheoides</i> <i>Senna artemisioides</i> subsp. <i>helmsii</i> <i>Senna artemisioides</i> subsp. <i>oligophylla</i> <i>Senna artemisioides</i> subsp. <i>oligophylla</i> (Panorama form) <i>Senna artemisioides</i> subsp. <i>oligophylla</i> x <i>helmsii</i> <i>Senna artemisioides</i> subsp. x <i>artemisioides</i> <i>Senna artemisioides</i> subsp. x <i>artemisioides</i> (Panorama form) <i>Senna</i> aff. <i>artemisioides</i> subsp. x <i>artemisioides</i> (thinly sericeous) <i>Senna glaucifolia</i> <i>Senna glutinosa</i> <i>Senna glutinosa</i> subsp. <i>charlesiana</i> <i>Senna glutinosa</i> subsp. <i>glutinosa</i> <i>Senna glutinosa</i> subsp. <i>luerssenii</i> <i>Senna glutinosa</i> subsp. x <i>luerssenii</i>

**APPENDIX A: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE PANORAMA
PROJECT SURVEY AREA**

Note: * denotes introduced species; P1, P2, P3 and P4 denote - Priority Flora Species (DEC, 2007a)

FAMILY	SPECIES
CAESALPINIACEAE (continued)	<i>Senna glutinosa</i> subsp. <i>pruinosa</i> <i>Senna notabilis</i> <i>Senna oligoclada</i> <i>Senna symonii</i> <i>Senna venusta</i> <i>Senna</i> sp.
PAPILIONACEAE	<i>Alysicarpus muelleri</i> <i>Cajanus cinereus</i> <i>Cajanus marmoratus</i> <i>Crotalaria cunninghamii</i> <i>Crotalaria dissitiflora</i> subsp. <i>benthamiana</i> <i>Crotalaria medicaginea</i> (Burrup form; B65-11) <i>Crotalaria medicaginea</i> <i>Crotalaria ramosissima</i> <i>Cullen lachnostachys</i> <i>Cullen</i> aff. <i>lachnostachys</i> (MET 15,154) <i>Cullen leucanthum</i> <i>Cullen leucochaïtes</i> <i>Cullen martinii</i> <i>Cullen pogonocarpum</i> <i>Cullen stipulaceum</i> <i>Desmodium filiforme</i> <i>Desmodium muelleri</i> <i>Indigastrum parviflorum</i> <i>Indigastrum parviflorum</i> (Whim Creek form; W138-3) <i>Indigofera colutea</i> <i>Indigofera linifolia</i> <i>Indigofera linnaei</i> <i>Indigofera monophylla</i> <i>Indigofera monophylla</i> (small calyx form) <i>Indigofera monophylla</i> (PAN20-2) <i>Indigofera monophylla</i> (PAN57-9) <i>Indigofera monophylla</i> (PAN58-17) <i>Indigofera monophylla</i> (PAN65-14) <i>Indigofera rugosa</i> <i>Indigofera trita</i> <i>Isotropis atropurpurea</i> <i>Rhynchosia</i> cf. <i>minima</i> <i>Rhynchosia minima</i> var. <i>australis</i> <i>Rhynchosia</i> sp. King Bay (B181-13) <i>Sesbania cannabina</i> <i>Sesbania formosa</i> <i>Swainsona formosa</i> <i>Templetonia hookeri</i> <i>Tephrosia bidwillii</i> <i>Tephrosia</i> aff. <i>bidwillii</i> (HD153-5) <i>Tephrosia</i> sp. B Kimberley Flora (C.A.Gardner 7300) <i>Tephrosia</i> sp. Bungaroo Creek (M.E.Trudgen 11601) <i>Tephrosia clelandii</i> ms <i>Tephrosia clementii</i> <i>Tephrosia</i> aff. <i>clementii</i> (11)

**APPENDIX A: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE PANORAMA
PROJECT SURVEY AREA**

Note: * denotes introduced species; P1, P2, P3 and P4 denote - Priority Flora Species (DEC, 2007a)

FAMILY	SPECIES
PAILIONACEAE (continued)	<i>Tephrosia rosea</i> var. <i>clementii</i> <i>Tephrosia rosea</i> var. <i>rosea</i> <i>Tephrosia</i> aff. <i>rosea</i> (HD292-37) <i>Tephrosia simplicifolia</i> <i>Tephrosia spechtii</i> <i>Tephrosia stipuligera</i> <i>Tephrosia supina</i> <i>Tephrosia</i> aff. <i>supina</i> <i>Tephrosia</i> aff. <i>supina</i> (HD205-10) <i>Tephrosia</i> aff. <i>supina</i> (HD237-23) <i>Tephrosia</i> aff. <i>supina</i> (HD88-4) <i>Tephrosia</i> aff. <i>supina</i> (MET 12,357) <i>Tephrosia</i> aff. <i>uniovulata</i> (HD76) <i>Tephrosia</i> sp. <i>Vigna lanceolata</i> var. <i>lanceolata</i> <i>Vigna</i> sp. Harding Dam (HD189-12) <i>Zornia chaetophora</i>
ZYGOPHYLLACEAE	<i>Tribulopsis angustifolia</i> <i>Tribulus hirsutus</i> <i>Tribulus platypterus</i> <i>Tribulus suberosus</i>
POLYGALACEAE	<i>Polygala</i> aff. <i>isingii</i> <i>Polygala linariifolia</i>
EUPHORBIACEAE	<i>Euphorbia australis</i> <i>Euphorbia</i> aff. <i>australis</i> <i>Euphorbia</i> aff. <i>australis</i> (B191) <i>Euphorbia biconvexa</i> <i>Euphorbia clementii</i> (P2) <i>Euphorbia coghlanii</i> <i>Euphorbia</i> aff. <i>drummondii</i> (HD195-16) <i>Euphorbia</i> aff. <i>drummondii</i> (MET 15,030) <i>Euphorbia</i> sp. (PAN1-14B) <i>Euphorbia</i> sp. (PAN5-15) <i>Euphorbia</i> sp. (site 1089) <i>Euphorbia tannensis</i> subsp. <i>eremophila</i> (Panorama form) <i>Euphorbia</i> sp. <i>Euphorbia wheeleri</i> <i>Flueggea virosa</i> subsp. <i>melanthesoides</i> <i>Leptopus decaisnei</i> <i>Leptopus decaisnei</i> var. <i>decaisnei</i> <i>Mallotus ?dispersus</i> <i>Phyllanthus erwinii</i> <i>Phyllanthus maderaspatensis</i> * <i>Ricinus communis</i>
SAPINDACEAE	<i>Atalaya hemiglauca</i> <i>Dodonaea coriacea</i>
RHAMNACEAE	<i>Ventilago viminalis</i>

**APPENDIX A: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE PANORAMA
PROJECT SURVEY AREA**

Note: * denotes introduced species; P1, P2, P3 and P4 denote - Priority Flora Species (DEC, 2007a)

FAMILY	SPECIES
TILIACEAE	<i>Corchorus</i> sp. A Kimberley Flora (K.F.Kenneally & B.P.M.Hyland 10421)
	<i>Corchorus</i> aff. <i>aestuans</i>
	<i>Corchorus elachocarpus</i>
	<i>Corchorus incanus</i>
	<i>Corchorus</i> aff. <i>laniflorus</i> (PAN 76)
	<i>Corchorus</i> aff. <i>laniflorus</i> (PAN 78)
	<i>Corchorus</i> sp. (M.E. Trudgen 21,247)
	<i>Corchorus</i> sp. Panorama
	<i>Corchorus parviflorus</i>
	<i>Corchorus</i> aff. <i>walcottii</i> (H251-3)
	<i>Corchorus</i> aff. <i>walcottii</i> (K.J. Atkins 570)
	<i>Corchorus</i> sp.
	<i>Triumfetta chaetocarpa</i>
	<i>Triumfetta</i> aff. <i>chaetocarpa</i> (PAN3/4)
	<i>Triumfetta</i> aff. <i>chaetocarpa</i> (Panorama form)
	<i>Triumfetta clementii</i>
	<i>Triumfetta maconochieana</i>
	<i>Triumfetta propinqua</i>
	<i>Triumfetta</i> sp.
MALVACEAE	<i>Abutilon dioicum</i>
	<i>Abutilon</i> aff. <i>dioicum</i> (HD72-14)
	<i>Abutilon</i> sp. aff. <i>dioicum</i>
	<i>Abutilon fraseri</i>
	<i>Abutilon</i> aff. <i>hannii</i>
	<i>Abutilon</i> aff. <i>hannii</i> (1)
	<i>Abutilon</i> aff. <i>hannii</i> (2)
	<i>Abutilon</i> aff. <i>lepidum</i> (1) (MET 15 352)
	<i>Abutilon</i> aff. <i>lepidum</i> (4)
	<i>Abutilon otocarpum</i>
	<i>Abutilon trudgenii</i> (P3)
	<i>Abutilon</i> sp.
	? <i>Abutilon</i> sp. (P62)
	? <i>Abutilon</i>
	<i>Gossypium australe</i> (Burrup Peninsula form)
	<i>Gossypium australe</i> (Whim Creek form)
	<i>Gossypium robinsonii</i>
	<i>Hibiscus brachychlaenus</i>
	<i>Hibiscus coatesii</i>
	<i>Hibiscus</i> aff. <i>coatesii</i>
	<i>Hibiscus</i> aff. <i>coatesii</i> (MET 15012)
	<i>Hibiscus</i> aff. <i>coatesii</i> (site 693)
	<i>Hibiscus goldsworthii</i>
	<i>Hibiscus leptocladus</i>
	<i>Hibiscus platychlamys</i>
	<i>Hibiscus</i> aff. <i>platychlamys</i> (site 1139)
	<i>Hibiscus sturtii</i> var. <i>campylochlamys</i>
	<i>Hibiscus sturtii</i> var. aff. <i>campylochlamys</i> (MET 15,957)
	<i>Hibiscus sturtii</i> var. aff. <i>campylochlamys</i> (site 1398)
	<i>Hibiscus sturtii</i> var. <i>platychlamys</i>
	<i>Hibiscus</i> sp.

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FAMILY	SPECIES
MALVACEAE (continued)	<i>Sida</i> sp. A Kimberley Flora (P.A.Fryxell & L.A.Craven 3900) <i>Sida cardiophylla</i> <i>Sida clementii</i> <i>Sida echinocarpa</i> <i>Sida hackettiana</i> <i>Sida</i> aff. <i>fibulifera</i> <i>Sida</i> aff. <i>fibulifera</i> (PAN 10-6) ? <i>Sida</i> sp. (M58) <i>Sida pilbarensis</i> ms <i>Sida pilbarensis</i> ms (Ferruginous form) <i>Sida</i> aff. <i>pilbarensis</i> <i>Sida</i> aff. <i>Pilbarensis</i> (EOB46-01B) <i>Sida rohlenae</i> subsp. <i>rohlenae</i> <i>Sida spinosa</i> <i>Sida subarticulata</i> ms <i>Sida</i> sp. (?no match) ? <i>Sida</i> sp.
STERCULIACEAE	<i>Keraudrenia nephrosperma</i> <i>Keraudrenia velutina</i> subsp. <i>elliptica</i> ms <i>Melhania</i> sp. Burrup <i>Waltheria indica</i> <i>Waltheria virgata</i>
ELATINACEAE	<i>Bergia pedicellaris</i> <i>Bergia trimera</i>
VIOLACEAE	<i>Hybanthus aurantiacus</i>
THYMELAEACEAE	<i>Pimelea ammodendris</i>
LYTHRACEAE	<i>Ammannia auriculata</i> <i>Ammannia baccifera</i> <i>Rotala diandra</i>
COMBRETACEAE	<i>Terminalia canescens</i>
MYRTACEAE	<i>Corymbia ferriticola</i> subsp. <i>ferriticola</i> <i>Corymbia flavescens</i> <i>Corymbia hamersleyana</i> <i>Corymbia</i> sp. (PAN39-18) <i>Corymbia zygophylla</i> <i>Eucalyptus camaldulensis</i> var. <i>obtusata</i> <i>Eucalyptus leucophloia</i> <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> <i>Eucalyptus victrix</i> <i>Melaleuca argentea</i> <i>Melaleuca glomerata</i> <i>Melaleuca linophylla</i>
ONAGRACEAE	<i>Ludwigia perennis</i>

**APPENDIX A: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE PANORAMA
PROJECT SURVEY AREA**

Note: * denotes introduced species; P1, P2, P3 and P4 denote - Priority Flora Species (DEC, 2007a)

FAMILY	SPECIES
HALORAGACEAE	<i>Gonocarpus ephemerus</i> (P2) <i>Haloragis gossei</i>
APIACEAE	<i>Trachymene didiscoides</i> <i>Trachymene hemicarpa</i> <i>Trachymene oleracea</i> <i>Trachymene</i> aff. <i>oleracea</i> (B61)
LOGANIACEAE	<i>Mitrasacme connata</i>
APOCYNACEAE	<i>Carissa lanceolata</i>
ASCLEPIADACEAE	<i>Gymnanthera cunninghamii</i> (P3) <i>Marsdenia angustata</i> <i>Sarcostemma viminalis</i> subsp. <i>australe</i>
CONVOLVULACEAE	<i>Bonamia</i> sp. (HD94-6) <i>Bonamia linearis</i> <i>Bonamia media</i> var. <i>villosa</i> <i>Bonamia pannosa</i> <i>Bonamia rosea</i> <i>Bonamia</i> sp. <i>Convolvulus angustissimus</i> subsp. <i>angustissimus</i> <i>Convolvulus</i> sp. <i>Evolvulus alsinoides</i> var. <i>villosicalyx</i> <i>Ipomoea muelleri</i> <i>Operculina aequiseptala</i> <i>Polymeria ambigua</i> <i>Polymeria</i> aff. <i>ambigua</i> (PAN 26B-20) <i>Polymeria calycina</i> <i>Polymeria</i> aff. <i>calycina</i> <i>Polymeria</i> sp. (PAN1-16) <i>Polymeria</i> sp. (PAN4-14) <i>Polymeria</i> sp. <i>Porana commixta</i>
BORAGINACEAE	<i>Ehretia saligna</i> var. <i>saligna</i> <i>Heliotropium chrysocarpum</i> <i>Heliotropium cunninghamii</i> <i>Heliotropium</i> aff. <i>cunninghamii</i> (P65-12) <i>Heliotropium curassavicum</i> <i>Heliotropium heteranthum</i> <i>Heliotropium ovalifolium</i> <i>Heliotropium paniculatum</i> <i>Heliotropium skeleton</i> <i>Heliotropium tanythrix</i> <i>Heliotropium tenuifolium</i> <i>Heliotropium</i> sp. <i>Trichodesma zeylanicum</i> var. <i>zeylanicum</i>
VERBENACEAE	<i>Clerodendrum floribundum</i> var. <i>angustifolium</i> <i>Clerodendrum floribundum</i> var. <i>floribundum</i>

**APPENDIX A: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE PANORAMA
PROJECT SURVEY AREA**

Note: * denotes introduced species; P1, P2, P3 and P4 denote - Priority Flora Species (DEC, 2007a)

FAMILY	SPECIES
VERBENACEAE (continued)	<i>Clerodendrum tomentosum</i>
CHLOANTHACEAE	<i>Pityrodia</i> sp. <i>Panorama</i> (BMor 151)
SOLANACEAE	<i>Nicotiana benthamiana</i> <i>Solanum beaugleholei</i> <i>Solanum diversiflorum</i> <i>Solanum ellipticum</i> <i>Solanum ?ellipticum</i> <i>Solanum horridum</i> * <i>Solanum nigrum</i> <i>Solanum phlomoides</i>
SCROPHULARIACEAE	<i>Stemodia grossa</i> <i>Stemodia viscosa</i> <i>Striga curviflora</i>
BIGNONIACEAE	<i>Dolichandrone heterophylla</i>
RUBIACEAE	<i>Oldenlandia crouchiana</i> <i>Oldenlandia galioides</i> <i>Synaptantha tillaeacea</i> var. <i>tillaeacea</i>
CUCURBITACEAE	* <i>Cucumis melo</i> subsp. <i>agrestis</i> <i>Mukia maderaspatana</i> <i>Mukia</i> cf. <i>maderaspatana</i> <i>Mukia</i> sp. D Flora of Australia <i>Mukia</i> sp. <i>Panorama</i> <i>Trichosanthes cucumerina</i>
CAMPANULACEAE	<i>Wahlenbergia tumidifructa</i>
LOBELIACEAE	<i>Lobelia quadrangularis</i>
GOODENIACEAE	<i>Dampiera candicans</i> <i>Goodenia cusackiana</i> <i>Goodenia lamprosperma</i> <i>Goodenia microptera</i> <i>Goodenia muelleriana</i> <i>Goodenia ?muelleriana</i> <i>Goodenia stobbsiana</i> <i>Goodenia</i> sp. <i>Scaevola amblyanthera</i> var. <i>centralis</i> <i>Scaevola parvifolia</i> subsp. <i>pilbarae</i>
ASTERACEAE	<i>Centipeda minima</i> <i>Flaveria australasica</i> <i>Olearia fluvialis</i> (P2) <i>Pentalepis trichodesmoides</i> <i>Pluchea dentex</i> <i>Pluchea dunlopii</i> <i>Pluchea ferdinandi-muelleri</i>

**APPENDIX A: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE PANORAMA
PROJECT SURVEY AREA**

Note: * denotes introduced species; P1, P2, P3 and P4 denote - Priority Flora Species (DEC, 2007a)

FAMILY	SPECIES
ASTERACEAE (continued)	<i>Pluchea rubelliflora</i>
	<i>Pluchea tetranthera</i>
	<i>Pterocaulon</i> sp. (PAN1-47)
	<i>Pterocaulon serrulatum</i>
	<i>Pterocaulon sphacelatum</i>
	<i>Pterocaulon sphaeranthoides</i>
	<i>Pterocaulon sphaeranthoides</i> x <i>sphacelatum</i>
	<i>Rhodanthe margarethae</i>
	<i>Streptoglossa bubakii</i>
	<i>Streptoglossa decurrens</i>
	<i>Streptoglossa macrocephala</i>
	<i>Streptoglossa odora</i>
	<i>Streptoglossa</i> sp.
	<i>Vittadinia virgata</i>

**APPENDIX B: SUMMARY OF RECORDED AND POTENTIAL DECLARED RARE, PRIORITY
AND CONSERVATION SIGNIFICANT SPECIES RECORDED WITHIN THE
PANORAMA PROJECT SURVEY AREA**

SCC - State Conservation Codes (Department of Environment and Conservation 2007a)

FCC - Federal Conservation Codes (Environmental Protection and Biodiversity Conservation Act, 1999)

Family	Species	SCC	FCC
Priority Species Recorded in the Panorama Project Area			
AMARANTHACEAE	<i>Ptilotus mollis</i>	P4	
MIMOSACEAE	<i>Acacia glaucocaesia</i>	P3	
EUPHORBIACEAE	<i>Euphorbia clementii</i>	P2	
MALVACEAE	<i>Abutilon trudgenii</i> (ms)	P3	
HALORAGACEAE	<i>Gonocarpus ephemerus</i>	P2	
ASCLEPIADACEAE	<i>Gymnanthera cunninghamii</i>	P3	
ASTERACEAE	<i>Olearia fluvialis</i>	P2	
New Species Recorded in the Panorama Project Area			
POACEAE	<i>Themeda</i> sp. Panorama		
LAMIACEAE	<i>Pityrodia</i> sp. Panorama (BMor 151)		
Species that require further investigation and possibly geographically restricted			
POACEAE	<i>Triodia</i> sp. Panorama		
	<i>Triodia angusta</i> (Shale form)		
MIMOSACEAE	<i>Acacia</i> sp. Barklys		
EUPHORBIACEAE	<i>Mallotus</i> ?dispersus		
TILIACEAE	<i>Triumfetta</i> aff. <i>chaetocarpa</i> (Panorama form)		
Species that require further investigation			
MIMOSACEAE	<i>Acacia</i> aff. <i>drepanocarpa</i> subsp. <i>drepanocarpa</i>		
	<i>Acacia</i> sp. (PAN M48)		
PAPILIONACEAE	<i>Cullen</i> aff. <i>lachnostachys</i> (MET 15,154)		
	<i>Rhynchosia</i> sp. King Bay		
	<i>Tephrosia</i> aff. <i>supina</i> (HD88-4)		
EUPHORBIACEAE	<i>Euphorbia</i> sp. (PAN1-14B)		
	<i>Euphorbia</i> sp. (PAN5-15)		
TILIACEAE	<i>Corchorus</i> aff. <i>walcottii</i> (H251-3)		
MALVACEAE	<i>Sida</i> aff. <i>fibulifera</i> (PAN10-6)		

**APPENDIX B: SUMMARY OF RECORDED AND POTENTIAL DECLARED RARE, PRIORITY
AND CONSERVATION SIGNIFICANT SPECIES RECORDED WITHIN THE
PANORAMA PROJECT SURVEY AREA**

SCC - State Conservation Codes (Department of Environment and Conservation 2007a)

FCC - Federal Conservation Codes (Environmental Protection and Biodiversity Conservation Act, 1999)

Family	Species	SCC	FCC
Rare Species Potentially in the Panorama Project Area			
BRASSICACEAE	<i>Lepidium catapycnon</i>	R	Vulnerable
MYRTACEAE	<i>Thryptomene wittweri</i>	R	Vulnerable
Priority Species Potentially in the Panorama Project Area			
CYPERACEAE	<i>Bulbostylis burbidgeae</i>	P3	
	<i>Fimbristylis sieberiana</i>	P3	
AMARANTHACEAE	<i>Gomphrena pusilla</i>	P2	
	<i>Ptilotus appendiculatus</i> var. <i>minor</i>	P1	
EUPHORBIACEAE	<i>Phyllanthus aridus</i>	P3	
MALVACEAE	<i>Hibiscus brachysiphonius</i>	P3	
GOODENIACEAE	<i>Goodenia nuda</i>	P3	
	<i>Goodenia pascua</i>	P3	

**APPENDIX C: GPS LOCATIONS OF CONSERVATION SIGNIFICANT SPECIES RECORDED
WITHIN THE PANORAMA PROJECT SURVEY AREA**

Note: P1, P2, P3 and P4 denote - Priority Flora Species (DEC, 2007a).

All GPS locations are in the AMG projection, WGS84 datum and in zone 50k

Species	Easting	Northing	Project Disturbance Area	Project Area
Priority Species Recorded in the Panorama Project Area				
<i>Ptilotus mollis</i> (P4)	729055	7660749	TSF	13a
<i>Ptilotus mollis</i> (P4)	732516	7654639		
<i>Ptilotus mollis</i> (P4)	730839	7658653		
<i>Ptilotus mollis</i> (P4)	730750	7659443		
<i>Ptilotus mollis</i> (P4)	730692	7659536		
<i>Ptilotus mollis</i> (P4)	727100	7660200		
<i>Ptilotus mollis</i> (P4)	731055	7660387		
<i>Acacia glaucocaesia</i> (P3)	740342	7676101	Road	11a
<i>Acacia glaucocaesia</i> (P3)	734776	7669930	Road	6a
<i>Acacia glaucocaesia</i> (P3)	727257	7665700		
<i>Acacia glaucocaesia</i> (P3)	736039	7671056		
<i>Acacia glaucocaesia</i> (P3)	737800	7672418		
<i>Acacia glaucocaesia</i> (P3)	737071	7672523		
<i>Acacia glaucocaesia</i> (P3)	737588	7673567		
<i>Acacia glaucocaesia</i> (P3)	738831	7674903		
<i>Acacia glaucocaesia</i> (P3)	740091	7675231		
<i>Acacia glaucocaesia</i> (P3)	741158	7675620		
<i>Acacia glaucocaesia</i> (P3)	739463	7675721		
<i>Acacia glaucocaesia</i> (P3)	740503	7676251		
<i>Acacia glaucocaesia</i> (P3)	740451	7676376		
<i>Euphorbia clementii</i> (P2)	728040	7666664	Road	6a
<i>Euphorbia clementii</i> (P2)	726672	7667830		
<i>Euphorbia clementii</i> (P2)	726765	7667989		
<i>Euphorbia clementii</i> (P2)	726714	7668001		
<i>Euphorbia clementii</i> (P2)	738634	7673626		
<i>Euphorbia clementii</i> (P2)	739170	7679939		
<i>Abutilon trudgenii</i> (ms) (P3)	740342	7676101	Road	11a
<i>Abutilon trudgenii</i> (ms) (P3)	729276	7661285	TSF	13a
<i>Abutilon trudgenii</i> (ms) (P3)	738886	7679499	Road	14a
<i>Abutilon trudgenii</i> (ms) (P3)	737249	7671964	Road	6a
<i>Abutilon trudgenii</i> (ms) (P3)	738180	7673374	Road	6a
<i>Abutilon trudgenii</i> (ms) (P3)	740904	7675164	Road	6a
<i>Abutilon trudgenii</i> (ms) (P3)	725207	7667451		
<i>Abutilon trudgenii</i> (ms) (P3)	737789	7673242		
<i>Abutilon trudgenii</i> (ms) (P3)	739389	7674531		
<i>Abutilon trudgenii</i> (ms) (P3)	741069	7675759		
<i>Abutilon trudgenii</i> (ms) (P3)	739541	7691388		
<i>Abutilon trudgenii</i> (ms) (P3)	739493	7691397		
<i>Abutilon trudgenii</i> (ms) (P3)	739508	7691444		

**APPENDIX C: GPS LOCATIONS OF CONSERVATION SIGNIFICANT SPECIES RECORDED
WITHIN THE PANORAMA PROJECT SURVEY AREA**

Note: P1, P2, P3 and P4 denote - Priority Flora Species (DEC, 2007a).

All GPS locations are in the AMG projection, WGS84 datum and in zone 50k

Species	Easting	Northing	Project Disturbance Area	Project Area
Priority Species Recorded in the Panorama Project Area (continued)				
<i>Gonocarpus ephemerus</i> (P2)	732628	7667595	Road	6a
<i>Gonocarpus ephemerus</i> (P2)	732718	7667628	Road	6a
<i>Gonocarpus ephemerus</i> (P2)	732734	7667228		
<i>Gymnanthera cunninghamii</i> (P3)	736592	7650011		
<i>Gymnanthera cunninghamii</i> (P3)	736661	7650011		
<i>Gymnanthera cunninghamii</i> (P3)	736592	7650036		
<i>Gymnanthera cunninghamii</i> (P3)	736653	7650037		
<i>Olearia fluvialis</i> (P2)	742517	7707983		
New Species Recorded in the Panorama Project Area				
<i>Themeda</i> sp. Panorama	733005	7655055		
<i>Themeda</i> sp. Panorama	732804	7655197		
<i>Themeda</i> sp. Panorama	732689	7655520		
<i>Themeda</i> sp. Panorama	732541	7656061		
<i>Themeda</i> sp. Panorama	732570	7656254		
<i>Themeda</i> sp. Panorama	732524	7656342		
<i>Themeda</i> sp. Panorama	732524	7656342		
<i>Themeda</i> sp. Panorama	731276	7659847		
<i>Themeda</i> sp. Panorama	731248	7659889		
<i>Themeda</i> sp. Panorama	731941	7660708		
<i>Pityrodia</i> sp. Panorama	729741	7659025	Other	5a
<i>Pityrodia</i> sp. Panorama	728380	7658790	Waste Dumps	5a
<i>Pityrodia</i> sp. Panorama	729882	7659504	Other	6a
<i>Pityrodia</i> sp. Panorama	729308	7659084	Waste Dumps	9a
<i>Pityrodia</i> sp. Panorama	732326	7653399		
<i>Pityrodia</i> sp. Panorama	732282	7653420		
<i>Pityrodia</i> sp. Panorama	733023	7654626		
<i>Pityrodia</i> sp. Panorama	729357	7658177		
<i>Pityrodia</i> sp. Panorama	730137	7658690		
<i>Pityrodia</i> sp. Panorama	730109	7658829		
<i>Pityrodia</i> sp. Panorama	728217	7659623		
<i>Pityrodia</i> sp. Panorama	728201	7659636		
<i>Pityrodia</i> sp. Panorama	731733	7662358		
<i>Pityrodia</i> sp. Panorama	730735	7662487		
<i>Pityrodia</i> sp. Panorama	732009	7662565		

**APPENDIX C: GPS LOCATIONS OF CONSERVATION SIGNIFICANT SPECIES RECORDED
WITHIN THE PANORAMA PROJECT SURVEY AREA**

Note: P1, P2, P3 and P4 denote - Priority Flora Species (DEC, 2007a).

All GPS locations are in the AMG projection, WGS84 datum and in zone 50k

Species	Easting	Northing	Project Disturbance Area	Project Area
Species that require further investigation and possibly geographically restricted				
<i>Triodia</i> sp. Panorama	729663	7660135	Other	11a
<i>Triodia</i> sp. Panorama	737030	7671751	Road	11a
<i>Triodia</i> sp. Panorama	729949	7659563	Other	6a
<i>Triodia</i> sp. Panorama	729696	7660160	Other	6a
<i>Triodia</i> sp. Panorama	729660	7660208	Other	6a
<i>Triodia</i> sp. Panorama	731434	7667204	Road	6a
<i>Triodia</i> sp. Panorama	733032	7667760	Road	6a
<i>Triodia</i> sp. Panorama	733477	7667996	Road	6a
<i>Triodia</i> sp. Panorama	733421	7668024	Road	6a
<i>Triodia</i> sp. Panorama	733451	7668049	Road	6a
<i>Triodia</i> sp. Panorama	736540	7671259	Road	6a
<i>Triodia</i> sp. Panorama	736616	7671274	Road	6a
<i>Triodia</i> sp. Panorama	736592	7671300	Road	6a
<i>Triodia</i> sp. Panorama	736982	7671741	Road	6a
<i>Triodia</i> sp. Panorama	737005	7671794	Road	6a
<i>Triodia</i> sp. Panorama	737249	7671964	Road	6a
<i>Triodia</i> sp. Panorama	738163	7673296	Road	6a
<i>Triodia</i> sp. Panorama	738303	7673327	Road	6a
<i>Triodia</i> sp. Panorama	738180	7673374	Road	6a
<i>Triodia</i> sp. Panorama	739510	7674167	Road	6a
<i>Triodia</i> sp. Panorama	732125	7653619		
<i>Triodia</i> sp. Panorama	730839	7658653		
<i>Triodia</i> sp. Panorama	730839	7658653		
<i>Triodia</i> sp. Panorama	730920	7659801		
<i>Triodia</i> sp. Panorama	728534	7660620		
<i>Triodia</i> sp. Panorama	731941	7660708		
<i>Triodia</i> sp. Panorama	727807	7660877		
<i>Triodia</i> sp. Panorama	728268	7661114		
<i>Triodia</i> sp. Panorama	727172	7665616		
<i>Triodia</i> sp. Panorama	731860	7666691		
<i>Triodia</i> sp. Panorama	730226	7667103		
<i>Triodia</i> sp. Panorama	732734	7667228		
<i>Triodia</i> sp. Panorama	726672	7667830		
<i>Triodia</i> sp. Panorama	726674	7667928		
<i>Triodia</i> sp. Panorama	726714	7668001		
<i>Triodia</i> sp. Panorama	734787	7669107		
<i>Triodia</i> sp. Panorama	734280	7669226		
<i>Triodia</i> sp. Panorama	735084	7670113		
<i>Triodia</i> sp. Panorama	735366	7670791		
<i>Triodia</i> sp. Panorama	736039	7671056		
<i>Triodia</i> sp. Panorama	737346	7671676		
<i>Triodia</i> sp. Panorama	737800	7672418		
<i>Triodia</i> sp. Panorama	737071	7672523		
<i>Triodia</i> sp. Panorama	738634	7673626		
<i>Triodia</i> sp. Panorama	739389	7674531		
<i>Triodia</i> sp. Panorama	739090	7674684		

**APPENDIX C: GPS LOCATIONS OF CONSERVATION SIGNIFICANT SPECIES RECORDED
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Note: P1, P2, P3 and P4 denote - Priority Flora Species (DEC, 2007a).

All GPS locations are in the AMG projection, WGS84 datum and in zone 50k

Species	Easting	Northing	Project Disturbance Area	Project Area
Species that require further investigation and possibly geographically restricted (continued)				
<i>Triodia angusta</i> (Shale form)	729645	7660178	Other	6a
<i>Acacia</i> sp. Barklys	729831	7660514	EP2	13a
<i>Acacia</i> sp. Barklys	729798	7660533	EP2	13a
<i>Acacia</i> sp. Barklys	729838	7660548	EP2	13a
<i>Acacia</i> sp. Barklys	729804	7660560	EP2	13a
<i>Mallotus ?dispersus</i>	727907	7663894		
<i>Mallotus ?dispersus</i>	727891	7663899		
<i>Mallotus ?dispersus</i>	727975	7663942		
<i>Mallotus ?dispersus</i>	727939	7663968		
<i>Triumfetta</i> aff. <i>chaetocarpa</i> (Panorama form)	729000	7660000	Other	13a
<i>Triumfetta</i> aff. <i>chaetocarpa</i> (Panorama form)	739620	7674407	Road	6a
<i>Triumfetta</i> aff. <i>chaetocarpa</i> (Panorama form)	736384	7650836		
<i>Triumfetta</i> aff. <i>chaetocarpa</i> (Panorama form)	736462	7650954		
<i>Triumfetta</i> aff. <i>chaetocarpa</i> (Panorama form)	727941	7663887		
<i>Triumfetta</i> aff. <i>chaetocarpa</i> (Panorama form)	733832	7667975		
<i>Triumfetta</i> aff. <i>chaetocarpa</i> (Panorama form)	741792	7704409		
Species that require further investigation				
<i>Acacia</i> aff. <i>drepanocarpa</i> subsp. <i>drepanocarpa</i>	730507	7659995	EP2	11a
<i>Acacia</i> aff. <i>drepanocarpa</i> subsp. <i>drepanocarpa</i>	730055	7660471	EP2	13a
<i>Acacia</i> aff. <i>drepanocarpa</i> subsp. <i>drepanocarpa</i>	730069	7660484	EP2	13a
<i>Acacia</i> aff. <i>drepanocarpa</i> subsp. <i>drepanocarpa</i>	730008	7660526	EP2	13a
<i>Acacia</i> aff. <i>drepanocarpa</i> subsp. <i>drepanocarpa</i>	729552	7660745	TSF	13a
<i>Acacia</i> aff. <i>drepanocarpa</i> subsp. <i>drepanocarpa</i>	730650	7659947		
<i>Acacia</i> aff. <i>drepanocarpa</i> subsp. <i>drepanocarpa</i>	730639	7659969		
<i>Acacia</i> sp. (PAN M48)	737800	7672418		

**APPENDIX C: GPS LOCATIONS OF CONSERVATION SIGNIFICANT SPECIES RECORDED
WITHIN THE PANORAMA PROJECT SURVEY AREA**

Note: P1, P2, P3 and P4 denote - Priority Flora Species (DEC, 2007a).

All GPS locations are in the AMG projection, WGS84 datum and in zone 50k

Species	Easting	Northing	Project Disturbance Area	Project Area
<i>Cullen</i> aff. <i>lachnostachys</i> (MET 15,154)	740342	7676101	Road Waste Dumps	11a 5a
<i>Cullen</i> aff. <i>lachnostachys</i> (MET 15,154)	729447	7659212		
<i>Cullen</i> aff. <i>lachnostachys</i> (MET 15,154)	739066	7673434		
<i>Cullen</i> aff. <i>lachnostachys</i> (MET 15,154)	738634	7673626		
<i>Cullen</i> aff. <i>lachnostachys</i> (MET 15,154)	739397	7674485		
<i>Cullen</i> aff. <i>lachnostachys</i> (MET 15,154)	740091	7675231		
<i>Rhynchosia</i> sp. King Bay	739541	7691388		
Species that require further investigation (continued)				
<i>Tephrosia</i> aff. <i>supina</i> (HD88-4)	739602	7674407	Road	6a
<i>Tephrosia</i> aff. <i>supina</i> (HD88-4)	741069	7675759		
<i>Euphorbia</i> sp. (PAN1-14B)				
Species that require further investigation (continued)				
<i>Euphorbia</i> sp. (PAN5-15)	742149	7708015		
<i>Corchorus</i> aff. <i>walcottii</i> (H251-3)	741504	7699409		
<i>Sida</i> aff. <i>fibulifera</i> (PAN10-6)	741600	7701600	Road	6a

**APPENDIX D: SIMPLIFIED VEGETATION FORMATIONS AND ALLIANCES AND THEIR CORRESPONDING GROUNDWATER DEPENDENT ECOSYSTEM (GDE)
PROBABILTY IN THE PANORAMA PROJECT SURVEY AREA**

Vegetation Formation	Vegetation Alliance (Mattiske 2007)		Vegetation Alliances (Trudgen <i>et al.</i> 2002; Trudgen 2007b)		GDE probability			
	No.	Vegetation Alliance Description	No.	Vegetation Alliance	Low	Medium	High	Very High
Open Forest to Open Woodland - Flowlines	1a	Open forest to open woodland of <i>Eucalyptus camaldulensis</i> , <i>Melaleuca argentea</i> and <i>Eucalyptus victrix</i> with scattered tall shrubs of <i>Indigofera monophylla</i> over <i>Schoenus falcatus</i> , <i>Cyperus vaginatus</i> and <i>Triodia longiceps</i> sedgeland/grasslands in river beds	1	<i>Eucalyptus camaldulensis</i> var. <i>obtusa</i> open to closed forest				+
	1a		2	<i>Eucalyptus camaldulensis</i> , <i>Melaleuca argentea</i> and <i>Eucalyptus victrix</i> open forest over scattered tall shrubs of <i>Schoenus falcatus</i> , <i>Cyperus vaginatus</i> and <i>Triodia longiceps</i> sedgeland/grasslands				+
	1a		3	<i>Melaleuca argentea</i> low woodland to woodland				+
	1a		4	<i>Eucalyptus camaldulensis</i> var. <i>obtusa</i> open woodland to high open woodland in riverbeds (gravelly and sandy)				+
	1a		38	<i>Indigofera monophylla</i> low shrublands to low open heath on lower slopes and valley floor areas				+
Open Forest to Open Woodland - Other	2a	<i>Eucalyptus victrix</i> scattered trees to open woodland which may include <i>Melaleuca glomerata</i> and <i>Melaleuca linophylla</i> over open to closed scrub in creek beds and low slopes	5	<i>Eucalyptus victrix</i> scattered trees to open woodland over <i>Melaleuca glomerata</i> and <i>Melaleuca linophylla</i> over open to closed scrub in creek beds and low slopes			+	
	2a		11	<i>Eucalyptus victrix</i> scattered low trees to open woodland along major creeklines			+	
	3a	<i>Corymbia aspera</i> scattered low trees to low open woodland in creek beds	6	<i>Corymbia aspera</i> scattered low trees to low open woodland in creek beds	+			
	4a	<i>Acacia tumida</i> high shrubland to low open forest in creeklines	7	<i>Acacia tumida</i> high shrubland to low open forest in creeklines	+			
	5a	<i>Eucalyptus leucophloia</i> scattered low trees over patches of <i>Acacia</i> shrubs over hummock grasslands of <i>Triodia</i> species, including <i>T. brizoides</i> , <i>T. wiseana</i> and <i>T. epactia</i> on ridge slopes	8	<i>Eucalyptus leucophloia</i> scattered low trees over <i>Triodia brizoides</i> hummock grasslands on ridge slopes	+			
	5a		9	<i>Eucalyptus leucophloia</i> scattered low trees over <i>Triodia wiseana</i> hummock grasslands on ridge slopes	+			
	5a		10	<i>Eucalyptus leucophloia</i> scattered low trees over <i>Triodia epactia</i> hummock grasslands on ridge slopes	+			
	5a		28	<i>Acacia orthocarpa</i> shrubland to open scrub over hummock grasslands on steep slopes (gravelly and pebbly)	+			
	5a		34	<i>Acacia hilliana</i> low shrublands to low open heath on gentle slopes	+			

**APPENDIX D: SIMPLIFIED VEGETATION FORMATIONS AND ALLIANCES AND THEIR CORRESPONDING GROUNDWATER DEPENDENT ECOSYSTEM (GDE)
PROBABILTY IN THE PANORAMA PROJECT SURVEY AREA**

Vegetation Formation	Vegetation Alliance (Mattiske 2007)		Vegetation Alliances (Trudgen <i>et al.</i> 2002; Trudgen 2007b)		GDE probability			
	No.	Vegetation Alliance Description	No.	Vegetation Alliance	Low	Medium	High	Very High
Open Forest to Open Woodland - Other	5a	<i>Eucalyptus leucophloia</i> scattered low trees over patches of <i>Acacia</i> shrubs over hummock grasslands of <i>Triodia</i> species; including <i>T. brizoides</i> , <i>T. wiseana</i> and <i>T. epactia</i> on ridge slopes	35	<i>Acacia ptychophylla</i> low shrubland to low open heath on slopes on a low ridge	+			
	5a		40	<i>Triodia angusta</i> (Shaw River form) hummock grasslands on ridges	+			
	5a		44	(scattered tall shrubs over) <i>Triodia melvillei</i> hummock grasslands on	+			
	5a		46	<i>Triodia wiseana</i> hummock grasslands on mid slopes	+			
	5a		47	<i>Aristida holathera</i> var. <i>holathera</i> and <i>Triodia epactia</i> hummock grassland on sand dunes	+			
	6a	<i>Corymbia hamersleyana</i> scattered low trees to low open woodland over tall shrubs to open shrubland of <i>Acacia</i> spp. and <i>Grevillea wickhamii</i> over hummock grasslands on creek banks, flood banks and distributing fans	12	<i>Corymbia hamersleyana</i> scattered low trees to low open woodland over <i>Acacia acradenia</i> , <i>Cajanus cinereus</i> and <i>Petalostylis labicheoides</i> open scrublands on creek banks, flood banks and distributing fans	+			
	6a		13	<i>Corymbia hamersleyana</i> scattered low trees over <i>Triodia angusta</i> (Shaw River form) hummock grasslands on low slopes and creeks	+			
	6a		14	<i>Corymbia hamersleyana</i> scattered low trees over scattered tall shrubs to high open shrubland over <i>Triodia epactia</i> hummock grasslands on valley floor , lower slopes and distrubuting fans	+			
	6a		15	<i>Corymbia hamersleyana</i> low scattered trees over <i>Triodia wiseana</i> hummock grasslands on mid to lower slopes and valley floors	+			
	6a		27	<i>Grevillea wickhamii</i> subsp. <i>aprica</i> high open shrubland to high shrubland on gently undulating plains	+			
	6a		29	High shrublands over <i>Triodia schinzii</i> hummock grasslands on sandplains	+			
	6a		37	<i>Acacia stellaticeps</i> low shrubland to low open heath on undulating plains	+			

**APPENDIX D: SIMPLIFIED VEGETATION FORMATIONS AND ALLIANCES AND THEIR CORRESPONDING GROUNDWATER DEPENDENT ECOSYSTEM (GDE)
PROBABILTY IN THE PANORAMA PROJECT SURVEY AREA**

Vegetation Formation	Vegetation Alliance (Mattiske 2007)		Vegetation Alliances (Trudgen <i>et al.</i> 2002; Trudgen 2007b)		GDE probability			
	No.	Vegetation Alliance Description	No.	Vegetation Alliance	Low	Medium	High	Very High
Open Forest to Open Woodland - Other	7a	<i>Corymbia zygomphylla</i> and <i>Corymbia hamersleyana</i> scattered low trees over hummock grasslands on sandplains	16	<i>Corymbia zygomphylla</i> and <i>Corymbia hamersleyana</i> scattered low trees over hummock grasslands on sandplains	+			
	8a	<i>Terminalia canescens</i> scattered low trees to low woodland on creek banks	18	<i>Terminalia canescens</i> scattered low trees to low woodland on creek banks	+			
	9a	<i>Atalaya hemiglaucula</i> , <i>Acacia pruinocarpa</i> , <i>Ehretia saligna</i> var. <i>saligna</i> , <i>Acacia tumida</i> , <i>Eucalyptus ferriticola</i> subsp. <i>ferriticola</i> and <i>Ficus platypoda</i> scattered low trees over high open shrubland on steep, rocky gorge walls.	20	<i>Atalaya hemiglaucula</i> , <i>Acacia pruinocarpa</i> , <i>Ehretia saligna</i> var. <i>saligna</i> , <i>Acacia tumida</i> and <i>Ficus platypoda</i> scattered low trees over high open shrubland on steep, rocky gorge walls	+			
	9a		17	<i>Corymbia ferriticola</i> subsp. <i>ferriticola</i> scattered low trees to low open woodland on rocky breakaways	+			
	9a		19	<i>Acacia coriacea</i> subsp. <i>pendens</i> scattered low trees on rockpiles	+			
High Shrublands to Open Scrubs	10a	Shrubland to open scrubland of <i>Acacia</i> species including <i>A. tumida</i> , <i>A. acradenia</i> and <i>A. orthocarpa</i> over hummock grasslands on upper and steep slopes	21	<i>Acacia tumida</i> high shrubland to open scrub on upper slopes of ridges	+			
	10a		22	<i>Acacia acradenia</i> high shrubland to open scrub on ridge slopes	+			
	11a	Shrubland to closed scrubland of <i>Acacia</i> species, including <i>A. acradenia</i> , <i>A. pyrifolia</i> and <i>A. tumida</i> along small creeklines and on the adjacent parts of valley floors and distributing fans	23	<i>Acacia acradenia</i> shrubland to closed scrub along small creeklines and on the adjacent parts of valley floors and distributing fans	+			
	11a		24	<i>Acacia pyrifolia</i> high shrubland to open scrub on flowlines	+			
	11a		26	<i>Acacia tumida</i> high shrubland to open scrub over <i>Triodia lanigera</i> hummock grassland in creek beds	+			
	12a	<i>Acacia inaequilatera</i> scattered tall shrubs to high open shrubland over <i>Triodia brizoides</i> hummock grasslands on ridge slopes and low hills	30	<i>Acacia inaequilatera</i> scattered tall shrubs to high open shrubland over <i>Triodia brizoides</i> hummock grasslands on ridge slopes and low hills	+			

**APPENDIX D: SIMPLIFIED VEGETATION FORMATIONS AND ALLIANCES AND THEIR CORRESPONDING GROUNDWATER DEPENDENT ECOSYSTEM (GDE)
PROBABILTY IN THE PANORAMA PROJECT SURVEY AREA**

Vegetation Formation	Vegetation Alliance (Mattiske 2007)		Vegetation Alliances (Trudgen <i>et al.</i> 2002; Trudgen 2007b)		GDE probability			
	No.	Vegetation Alliance Description	No.	Vegetation Alliance	Low	Medium	High	Very High
High Shrublands to Open Scrubs	13a	<i>Acacia inaequilatera</i> scattered tall shrubs to high shrubland over <i>Triodia wiseana</i> hummock grasslands occurring mainly on gentle lower slopes.	31	<i>Acacia inaequilatera</i> scattered tall shrubs to high shrubland over <i>Triodia lanigera</i> hummock grassland on gentle slopes (gravelly and pebbly)	+			
	13a		32	<i>Acacia inaequilatera</i> scattered tall shrubs over <i>Triodia wiseana</i> hummock grasslands occurring mainly on the slopes of low rises and the colluvial spurs and lower slopes of high ridges	+			
	14a	<i>Acacia ancistrocarpa</i> high open shrubland to open scrub	25	<i>Acacia ancistrocarpa</i> high open shrubland to open scrub on very gentle lower slopes	+			
	15a	<i>Acacia trachycarpa</i> high open shrubland to high shrublands	33	<i>Acacia trachycarpa</i> high open shrubland to high shrublands	+			
Low Shrublands	16a	Low shrublands to low open heath on gentle slopes and undulating plain	36	<i>Acacia spondylophylla</i> low shrublands on mid to upper slopes	+			
	16a		39	<i>Corchorus</i> aff. <i>lanifloris</i> (PAN 76), <i>Dampiera candicans</i> and <i>Ptilotus mollis</i> low shrubland over <i>Triodia melvillei</i> and <i>Eriachne mucronata</i> (typical form) very open to open hummock grasslands on mid to upper slopes	+			
Hummock Grasslands	17a	Hummock grasslands on slopes and ridges	41	Other <i>Triodia brizoides</i> hummock grasslands on slopes and spurs of ridges and on low rises	+			
	17a		42	<i>Triodia epactia</i> hummock grasslands on sandplains and lower slopes of hills	+			
	17a		43	Other <i>Triodia lanigera</i> hummock grasslands on flat to gentle slopes	+			
	17a		45	(Scattered tall shrubs over) <i>Triodia</i> sp. Panorama hummock grasslands on flat to gentle slopes	+			

**APPENDIX D: SIMPLIFIED VEGETATION FORMATIONS AND ALLIANCES AND THEIR CORRESPONDING GROUNDWATER DEPENDENT ECOSYSTEM (GDE)
PROBABILTY IN THE PANORAMA PROJECT SURVEY AREA**

Vegetation Formation	Vegetation Alliance (Mattiske 2007)		Vegetation Alliances (Trudgen <i>et al.</i> 2002; Trudgen 2007b)		GDE probability			
	No.	Vegetation Alliance Description	No.	Vegetation Alliance	Low	Medium	High	Very High
Other Grasslands and Herblands	18a	Cracking clay alliance on gentle sloping plains and seasonal damplands	48	Cracking clay alliance on gentle sloping plains	+			
	18a		50	<i>Chrysopogon fallax</i> tussock grassland on cracking clay	+			
	18a		51	<i>Triodia</i> sp. Panorama grasslands on cracking clay (seasonal damplands)	+			
	18a		52	<i>Iseilema macrantherum</i> grasslands and herblands on cracking clay (seasonal damplands)	+			
	18a		49	* <i>Cenchrus ciliaris</i> tussock grassland along creek lines	+			

APPENDIX E: LOCAL AND REGIONAL SIGNIFICANCE OF VEGETATION ALLIANCES WITHIN THE PANORAMA PROJECT SURVEY AREA

Formation	Vegetation Alliance	Occurs within Project Footprint	Contains Priority Flora	Contains Conservation Significant Flora Species	Contains Dominant Conservation Significant Flora	Restricted Habitat	Locally Significant	Regionally Significant	Comments
OPEN FOREST - OPEN WOODLAND: FLOWLINES	1a	Access Road, Waste Dumps					X		Potential habitat trees for some species, includes some patches of <i>Schoenus falcatus</i> (which is uncommon)
OPEN FOREST - OPEN WOODLAND: OTHER	2a	Pit, Plant, Access Road, TSF					X		Potential habitat trees for some species
	3a	Access Road				X	X		Restricted occurrence in survey area, near Marble Bar Road
	4a								
	5a	Pit, Plant, Access Road, TSF, Waste Dumps		X	X		X		Presence of conservation species
	6a	Plant, Access Road, TSF, Waste Dumps	X	X	X		X		Presence of Priority species and conservation species
	7a	Access Road				X	X		Restricted occurrence in survey area
	8a					X	X		Restricted occurrence in survey area
	9a	Pit, TSF, Waste Dumps		X	X		X		Presence of conservation species

APPENDIX E: LOCAL AND REGIONAL SIGNIFICANCE OF VEGETATION ALLIANCES WITHIN THE PANORAMA PROJECT SURVEY AREA

Formation	Vegetation Alliance	Occurs within Project Footprint	Contains Priority Flora	Contains Conservation Significant Flora Species	Contains Dominant Conservation Significant Flora	Restricted Habitat	Locally Significant	Regionally Significant	Comments
HIGH SHRUBLANDS TO OPEN SCRUBS	10a	Access Road, Waste Dumps							
	11a	Pit, Plant, Access Road, TSF, Waste Dumps	X	X	X		X		Presence of Priority species and conservation species
	12a								
	13a	Pit, Access Road, TSF, Waste Dumps	X	X	X		X		Presence of Priority species and conservation species
	14a	Access Road	X		X		X		Presence of Priority species
	15a								
LOW SHRUBLANDS	16a	TSF				X	X		Presence of Priority species and can be restricted to small areas of shale ridges (Trudgen <i>et al.</i> 2002)
HUMMOCK GRASSLANDS	17a	Access Road, Waste Dumps							
OTHER GRASSLANDS AND HERBLANDS	18a					X	X		Restricted occurrence in survey area and supports range of grass species that are locally significant