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Main Roads Western Australia

**Galvans Gorge to Barnett Gorge
(SLK 286.5 - 324.1)**

Targeted Flora Survey

August 2009



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Executive Summary

Main Roads Western Australia (Main Roads) is currently planning to commence road formation and drainage improvements along approximately 37 km of the Gibb River Road (SLK 286.5 – 324.1) (the Project).

A Preliminary Environmental Impact Assessment (PEIA) undertaken for the Project by GHD in April 2009 concluded that the clearing of native vegetation required for the Project was potentially at variance under the *Environmental Protection Act (1986)* to Clearing Principle (c), due to the potential occurrence of Rare and Priority flora in the Project Study Area.

Main Roads commissioned GHD Pty Ltd (GHD) to undertake a targeted flora survey for the Project, to determine if the planned clearing will impact on significant flora. This report provides the results of the targeted flora survey and outlines the potential impact of the Project on known and recorded significant flora species.

Suitably experienced and qualified GHD Ecologists undertook a targeted flora survey in the Study Area from the 16th to the 20th June 2009, with reference to the Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia – Guidance Statement No. 51, EPA, Perth;

Based on the targeted flora survey results, the following conclusions are provided:

- » Two Priority 3 flora species, *Phyllanthus aridus* and *Alysicarpus major* were recorded within the Study Area.
- » Approximately 100 plants from 5 different locations were recorded during the survey of Priority 3 species *Alysicarpus major*.
- » A total of 6 plants from 5 different locations were recorded during the survey of Priority 3 species *Phyllanthus aridus*.
- » The recorded presence of *Phyllanthus aridus* (Priority 3) and *Alysicarpus major* (Priority 3) populations in the Survey Area constitutes 2.78% (one of 36 recorded populations; NatureMap, 2009) and 11.11% (one of 9 recorded populations, NatureMap, 2009) of the known populations from the State respectively.
- » Based on the known recorded populations of these species in the Kimberley (and Pilbara Bioregions, clearing of vegetation for the Project is not considered to significantly impact on the continued existence of these species.

Based on the results of the targeted flora survey, the following recommendations are provided:

- » GHD recommends that in order to assist in gaining the necessary environmental approvals for clearing within the Project Area, the locations of *Phyllanthus aridus* and *Alysicarpus major* are avoided (where possible) by excluding them from development design; and



- » It is recommended that Main Roads liaise with the DEC with regards to the recorded presence of the two Priority 3 species, *Phyllanthus aridus* and *Alysicarpus major* within the Study Area.



1. Introduction

1.1 Background

Main Roads Western Australia (Main Roads) is currently planning to commence road formation and drainage improvements along approximately 37 km of the Gibb River Road (SLK 286.5 – 324.1) (the Project).

The Project location is indicated in Figure 1, Appendix A.

The proposed road formation and drainage improvements require the sourcing of gravel and other fill materials. Eight material areas have been identified as suitable areas from which to extract road-building materials for the proposed Project. These areas will be investigated to locate naturally occurring gravel material suitable for the Project works.

The Gibb River Road is a predominantly gravel road that was originally built to provide road access to remote Kimberley stations. It runs approximately 650 km between Derby and intersects with the Great Northern Highway between Wyndham and Kununurra. The proposed work will:

- » improve the road condition,
- » provide increased serviceability,
- » reduce maintenance and freight costs; and
- » improve the level of serviceability to the local community.

A Preliminary Environmental Impact Assessment (PEIA) undertaken for the Project by GHD in April 2009 concluded that the clearing of native vegetation required for the Project was potentially at variance under the *Environmental Protection Act (1986)* to Clearing Principle (c), due to the potential occurrence of Rare and Priority flora in the Project Study Area.

1.2 Purpose and Scope of Survey

In accordance with Main Roads State-wide Clearing Permit CPS 818/4, Main Roads commissioned GHD to undertake a targeted flora survey for the Project, to determine if the planned clearing will impact on significant flora taxa.

This report provides the results of the targeted flora survey and outlines the potential impact of the Project on known and recorded significant flora species. The objective of the survey was to determine the numbers of Rare and/or Priority Flora species to be impacted by the proposal.

In addition, the report provides a more detailed assessment of the clearing with respect to Clearing Principle 'c'.

2. Methodology

2.1 Survey Area

Table 1 outlines the key features of the Project, which includes the following Survey Area that the targeted flora survey has been undertaken for:

- » A 100 m wide corridor on both the left hand side (LHS) and right hand side (RHS) of the Gibb River Road from SLK 286.5 - 324.1; and
- » Eight Material Investigation Areas.

The location and Survey Area extent for the road formation and drainage improvements, as well as each of the eight Material Investigation Areas are shown in Figure 2, Appendix A.

2.2 Conditions and Timing of Survey

The Kimberley Region has a tropical monsoon climate dominated by two seasons, referred to as the 'wet' and the 'dry', separated by short transitional periods. Hot, humid and high rainfall conditions characterise a wet season, extending over the months from November to April. The region receives around 90% of its rainfall during this season mainly from thunderstorms, monsoonal rain and occasionally, tropical cyclones. The dry season occurs from May to October as high pressure systems dominate the weather patterns with south easterly air flows from the interior bringing sunny days and cooler nights (Kimberley Development Commission, 2009).

The Environmental Protection Authority (EPA) Guidance Statement No. 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, indicates that the "flora and vegetation surveys should be conducted following the season which normally contributes the most rainfall in the bioregion". In the Kimberley Bioregion, this season equates to the beginning of the 'dry season'.

The survey was conducted at the beginning of the 'dry season', from the 16th to 20th June 2009. Weather conditions were mostly fine and warm and suitable for easy viewing of flora. The Project Area and road access was available, despite residual water from the 'wet season' was evident in floodway areas and creek crossings along the Gibb River Road.

The field survey was also conducted during the period when the majority of significant flora taxa known or likely to occur in the Project Area were present and / or flowering. This aspect of the field survey is considered to be exceedingly important as it enhances the likelihood of observing and recording significant taxa in the field.

Fire is recognised as one of the key threatening processes which can have a negative impact on biological diversity in the Kimberley Region. During the survey, a number of burnt areas (<1 yrs old) were noted within the Survey Area. These areas were essentially devoid of understorey vegetation and a detailed survey for the presence of significant flora species within these areas was therefore not possible.

2.3 Field Survey Methods

Suitably experienced and qualified GHD Ecologists undertook a targeted flora survey in the Study Area from the 16th to the 20th June 2009, with reference to the Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia – Guidance Statement No. 51, EPA, Perth;

The survey was undertaken according to the following process:

- » A search of the Department of Environment and Conservation's (DEC) Declared Rare and Priority Flora database and the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters Search Tool was undertaken to identify expected significant flora for the area (refer to Section 3.1);
- » 100m transects¹ on both the LHS and RHS of the Gibb River Road at approximately 1 km intervals (or where different vegetation and habitat was present) were undertaken for the entire length, from SLK 286.5 to SLK 324.1. A total of 40 transects along the alignment were undertaken. The transect locations are provided in Figure 3, Appendix A;
- » The riparian vegetation on both the LHS and RHS of Station Creek, Mt Barnett River and other floodway areas were also targeted for assessment within the 100 m corridor;
- » Within the Material Investigation Areas, the survey was conducted by traversing the area on foot. Survey effort was concentrated within habitats identified as potentially having Rare or Priority Flora species present, based on the preferred habitat and known distributions of significant flora taxa;
- » If suspected significant flora was found, particular attention was paid to the habitat, soil types and vegetation associations of any significant species recorded. These observations were then used to search for additional populations at likely locations in the Study Area;
- » A hand-held GPS (Garmin Etrex) was used to record the locations of all known and suspected significant flora. Accuracy of these locations were typically ± 5 m; and
- » Where field identification of plant taxa was not possible, specimens were collected in a systematic manner so that they could be later identified at the West Australian Herbarium by comparison with the reference collection and use of identification keys. Nomenclature of the species follows that of *FloraBase* (2009).

¹ For the purposes of this targeted flora survey, a **transect** is defined as a linear sampling line which delineates the area to be sampled, such that a general statement about the floristic composition and the species present at the location can be made.



Table 1 Key features of the Main Roads Project and Survey Area Extent

SLK /Area	Proposed Works	Survey Area	Proposed Clearing (ha)
Gibb River Road – SLK 286.5 to 324.1	Road formation and Drainage Improvements	A 100 m wide corridor on both the LHS and RHS of Gibb River Road from SLK 286.5 - 324.1.	Clearing will occur for: <ul style="list-style-type: none"> » Minor road widening; » A temporary side track; and » Establishment of offshoot drains.
Material Investigation Area 1	Source Material Area	Area 1 comprises approximately 24 ha. Located on the RHS of Gibb River Road.	Native vegetation will be cleared in areas where source material is identified.
Material Investigation Area 2	Source Material Area	Area 2 comprises approximately 356.1 ha. Located on the RHS of Gibb River Road.	Native vegetation will be cleared in areas where source material is identified.
Material Investigation Area 3	Source Material Area	Area 3 comprises approximately 27 ha. Located on the LHS of Gibb River Road.	Native vegetation will be cleared in areas where source material is identified.
Material Investigation Area 4	Source Material Area	Area 4 comprises approximately 93.1 ha. Located on the RHS of Gibb River Road.	Native vegetation will be cleared in areas where source material is identified.
Material Investigation Area 5	Source Material Area	Area 5 comprises approximately 74.1 ha. Located on the LHS of Gibb River Road.	Native vegetation will be cleared in areas where source material is identified.
Material Investigation Area 6	Source Material Area	Area 6 comprises approximately 101.5 ha. Located on the LHS of Gibb River Road.	Native vegetation will be cleared in areas where source material is identified.
Material Investigation Area 7	Source Material Area	Area 7 comprises approximately 128.2 ha. Located on the LHS of Gibb River Road.	Native vegetation will be cleared in areas where source material is identified.
Material Investigation Area 8	Source Material Area	Area 8 comprises approximately 33.6 ha. Located on the RHS of Gibb River Road.	Native vegetation will be cleared in areas where source material is identified.

3. Results

3.1 Desktop Assessment Results

An *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)* Protected Matters Search was undertaken for the Study Area. No flora species of conservation significance are known to occur, or considered to have habitat, in the search area.

A search was also undertaken through the DEC's Threatened Flora Databases (ref #: 37-0309) and NatureMap (Department of Environment and Conservation, 2009a) for species of Declared Rare and Priority Flora located within the vicinity of the Study Area. One Declared Rare Flora (DRF) and 29 Priority Flora species were identified from the DEC search area.

Descriptions of those species recorded from these searches and an indication of the likely occurrence in the Study Area is provided in Table 6, Appendix A. Of the One DRF and 29 Priority Flora species identified, only three of the Priority species were identified as highly likely to occur in the Study Area when comparing known preferred habitat and distribution with the vegetation and soil types recorded from the field survey.

Nine of the significant flora taxa identified from the search area were considered to have a medium chance of occurring in the Study Area as preferred habitat was known from the vicinity of the Study Area. Sixteen of the significant flora taxa identified were considered highly unlikely to occur in the Study Area, due to lack of preferred habitat. Two of the significant flora taxa identified were rated as unknown. These two taxa are non-vascular species (bryophytes – i.e. mosses). Non-vascular taxa were not included in the field survey.

The recorded locations of significant flora species are presented in Figure 4, Appendix A. None of the significant flora species from the DEC database search are located within the boundaries of the Study Area.

3.2 Field Survey Results

No Endangered or Vulnerable species pursuant to section 178 of the *Environment Protection and Biodiversity Conservation Act 1999* were located during the survey.

No plant taxa gazetted as Declared Rare pursuant to subsection 2 of section 23F of the *Wildlife Conservation Act (1950)* (Atkins, 2008) were located in the Survey Area.

Two Priority Flora species were located in the Survey Area, being:

- » *Phyllanthus aridus* (Priority 3); and
- » *Alysicarpus major* (Priority 3).

A discussion on each Priority flora species is provided in Sections 3.2.1 and 3.2.2.

3.2.1 *Phyllanthus aridus*

Phyllanthus aridus (Priority 3) is an erect, much-branched shrub, to 0.25 m high, flowering cream, green from May to June (Plate 1). They are known to occupy a habitat of sandstone, gravel and red sand (Department of Environment and Conservation, 2009b).



Plate 1 *Phyllanthus aridus* (P3) collection from Transect 3 (collection JF3797).

Within the Study Area, *Phyllanthus aridus* was recorded in areas of red loamy sands, and locations of red loamy sands with gravel. These soils were found in open plains, and on gentle slopes of low rises. The associated vegetation was typically an open eucalypt woodland over dense tussock grasslands (Plate 2, Plate 3).

These soil types and associated vegetation are common in the local area, and form the majority of the habitat surrounding the Barnett River, which is located between the sandstone plateaus of the Barnett Range to the south and the Packhorse Range to the north of the Study Area.



Plate 2 Typical Gibb River Road Vegetation observed in the Study Area.
Open Eucalypt woodland over dense tussock grassland.



Plate 3 Typical *Phyllanthus aridus* (P3) habitat observed in the Study Area.
Open Eucalypt woodland over dense tussock grassland.

The population number and location of *Phyllanthus aridus* within the Survey Area is provided in Table 2 and illustrated in Figure 4, Appendix A.

A total of 6 plants from 5 different locations were recorded during the survey.

During this survey, only individual, isolated plants were located. No plants were occurring in groups or small populations. The *Phyllanthus aridus* plants located during this survey are not considered to be significant in the local sense as there is a large area of identical, suitable habitat surrounding the Study Area that has not been examined.

Department of Environment and Conservation (2009a) identifies 36 records of *Phyllanthus aridus* in WA, both in the Pilbara and Kimberley Bioregions, occurring from Karratha in the west to Kalumburu in the east. This taxon is considered to be widespread, but is under-represented in Western Australian Herbarium collections.

Of note, during the identification process, the specimens collected within the Study Area matched the description of *Phyllanthus polycladus* and not that of *P. aridus* detailed in the Flora of the Kimberley Region (Wheeler, 1992). However, since the publication of Flora of the Kimberley, *P. polycladus* has been recognised as a taxonomic synonym as *Phyllanthus aridus*.

Table 2 Location and number of *Phyllanthus aridus* (P3) recorded within the Survey Area

Taxa	Cons Code	Easting*	Northing*	Location	Count
<i>Phyllanthus aridus</i>	P3	803431	8142460	Transect 3	1 plant
<i>Phyllanthus aridus</i>	P3	803514	8142566	Transect 3	1 plant
<i>Phyllanthus aridus</i>	P3	810345	8147557	Transect 12	1 plant
<i>Phyllanthus aridus</i>	P3	814533	8153016	Transect 20	1 plant
<i>Phyllanthus aridus</i>	P3	815916	8155683	Transect 22	1 plant
<i>Phyllanthus aridus</i>	P3	815594	8157487	Transect 26	1 plant

* Australian Geocentric 1994 (GDA94), Zone 51 K

3.2.2 *Alysicarpus major*

Alysicarpus major (P3) is a prostrate perennial pea, and is recognised as an herb, growing to 0.2 m high, with orange and red flowers, typically occurring in May. This species is described as prefers floodplain habitats (*FloraBase*, 2009), typically in disturbed areas.

Within the Study Area, *Alysicarpus major* was recorded growing on red sandy loam adjacent to Station Creek and along the edge of the Gibb River Road, and with a rocky to gravelly red loam below a low rocky ridge.

Associated vegetation is typically disturbed, particularly along the Gibb River Road, where it was recorded within the road maintenance zone. GHD considers that it is likely that the germination and presence of this species in the road maintenance zone is due to road maintenance activities (such as grading).

In the areas where this species was located away from the Gibb River Road, this taxon was recorded growing in vegetation disturbed by the preferential grazing activities of cattle. These areas were typically small areas of open grasslands occurring below low rocky ridges maintained by runoff from the rocky areas.

The population number and location of *Alysicarpus major* within the Survey Area is provided in Table 3 and illustrated in Figure 4, Appendix A. More than 100 plants from five different locations were recorded during the survey. This species was not flowering at the time of the survey, but was identified from fruit which remained abundant on the specimens.

The significance of this species in the local area is not certain. While there are no previous records for the area, the road maintenance activities that occur along the Gibb River Road are considered to assist in the maintenance of this species in the Study Area. It is considered likely that this species occurs in other areas along the Gibb River Road. Disturbance from the proposed Project is considered likely to impact on individuals of this species, but not affect the presence of this species in long-term. GHD considers that the proposed Project will enhance the presence of this species in the Study Area, by dint of the fact that the upgrade of the road and extraction of material from the Material Investigation Areas will provide an increased area of preferred habitat suitable for the germination and presence of this species.

Department of Environment and Conservation (2009a) identifies 9 records of *Alysicarpus major* in WA, from King Leopold Ranges to Kalumburu, within the Kimberley Bioregion.



Table 3 Location and number of *Alysicarpus major* (P3) recorded within the Survey Area

Taxa	Cons Code	Zone	Easting	Northing	Location	Count
<i>Alysicarpus major</i>	P3	51	811650	8148454	Transect 14 (adjacent to Station Creek)	>50
<i>Alysicarpus major</i>	P3	52	184354	8164034	Material Pit 6	25
<i>Alysicarpus major</i>	P3	52	185312	8164207	Material Pit 6	25
<i>Alysicarpus major</i>	P3	52	188651	8165185	Transect 39	10

* Australian Geocentric 1994 (GDA94), Zone 51 and 52 K

3.2.3 Other Priority Flora

One other Priority Flora species is considered highly likely to occur in the Study Area. *Minuria macrorhiza* (Priority 2) has suitable habitat in the vicinity of the Project Area, and two known locations (from WAHERB records) are within 1 km of the Study Area (one of which is 250 m north of Material Pit 3).

The site 250 m north of Material Pit 3 was searched and the species not located. Closer inspection of the records indicates that these two specimens were collected in June 1905 and May 1906 by W.V. Fitzgerald. The locality description is given as: "Isdell River near Mount Barnett Homestead".

The given locations are considered to have been applied to un-validated historical specimens by the WAHERB to give an indication of potential flora. As such, GHD does not believe these locations are correct. Isdell River is located further north and west of the Project Area.

3.2.4 Locally Significant Flora

All flora species identified during the survey are from within existing population ranges. As such, GHD does not consider the Study Area to support any additional flora species of conservation significance – such as species at the limit of known range or exhibiting an extension to the known range

Of note, is the collection of a specimen that is considered to have affinities to *Solanum dioicum* from the western end of the Study Area on Phillips Range, and is labelled in this report as *Solanum* aff. *dioicum*. Some confusion was found when identifying this taxon. The specimen collected JF3794 *Solanum* aff. *dioicum* was considered to be between *S. dioicum* and *S. petraeum* due to the specimen having leaves narrower than that described for *S. dioicum*.

However, Wheeler (1992) indicates that *Solanum dioicum* is a “very variable species belonging to a complex with *S. cunninghamii* and *S. petraeum* in which further studies are needed.” Wheeler (1992) further notes that “...all three species appear to intergrade.” As such, it is considered unlikely that this specimen has conservation significance.

To further any future studies on this complex, this specimen will be submitted to the Western Australian Herbarium.

The population number and location of *Solanum* aff. *dioicum* within the Study Area is provided in Table 4.

Table 4 Locally Significant Flora species recorded within the Study Area

Taxa	Easting*	Northing*	Location	Count
<i>Solanum</i> aff. <i>dioicum</i>	803798	8140424	Transect 1	9 plants on road formation
<i>Solanum</i> aff. <i>dioicum</i>	803744	8140419	Transect 1	15 plants on rocky hill side.

* Australian Geocentric 1994 (GDA94), Zone 51 K

4. Discussion

4.1 Native Vegetation Clearing

Flora species which are regarded as Priority Three Flora, are species which are known from several populations and are not believed to be under immediate threat; or known populations are considered to be large and either widespread or exist in protected areas. Despite Priority Flora not being protected under specific legislation, all flora species receive protection under the *Wildlife Conservation Act 1950* and as a consequence, native flora can not be cleared without a valid clearing permit.

The presence of Priority Flora populations is taken into account when the Department of Environment and Conservation assesses native vegetation clearing permit applications. GHD recommends that in order to assist in gaining the necessary environmental approvals for clearing within the Project Area, the locations of *Phyllanthus aridus* and *Alysicarpus major* are avoided (where possible) by excluding them from development design.

4.2 Potential Impact and Local and Regional Significance

The recorded presence of the *Phyllanthus aridus* (Priority 3) population and the *Alysicarpus major* (Priority 3) population in the Survey Area constitutes 2.78% (one of 36 recorded populations; Department of Environment and Conservation, 2009a) and 11.11% (one of 9 recorded populations, Department of Environment and Conservation, 2009a) of the known populations from the State respectively.

Based on the known populations of these two Priority species in the Kimberley region, clearing of vegetation for the Project is not considered to significantly impact upon the survival of the species, or result in the species being placed into a higher conservation category.

The local significance of these collections of Priority Flora is the first in the Study Area. However, habitat for these species is not considered to be limited in, or adjacent to the Study Area. GHD considers that, while individual plants may be impacted by the proposed Project, the long-term viability of the presence of these taxa in the local area will not be significantly altered. While the targeted flora survey was restricted to the boundary co-ordinates of the Study Area, *Phyllanthus aridus* and *Alysicarpus major* are expected to be common within the local area, due to the abundance of analogous habitat surrounding the Study Area.

4.3 Re-assessment Against 'Clearing Principle 'c''

The vegetation clearing required in the Study Area was previously assessed against the "Ten Clearing Principles", as outlined in the PEIA report (GHD, 2009), as potentially being at variance with Clearing Principle 'c'.

A re-assessment of the proposed Project against Clearing Principle 'c', as outlined in Schedule 5 of the *Environmental Protection Amendment Act 2003*, is provided as follows:

Clearing Principle (c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.

(c1)	Native vegetation should not be cleared if it is necessary for the continued <i>in situ</i> existence of populations of Declared Rare Flora under the <i>Wildlife Conservation Act 1950</i> .
Comment:	No Declared Rare Flora taxa were recorded during the targeted searches conducted from 16 th June to 20 th June 2009.
Assessment:	The clearing is not considered to be at variance with (c1) of Clearing Principle 'c'.
(c2)	Native vegetation should not be cleared if it is necessary for the continued <i>in situ</i> existence of other <u>significant flora</u> .
Comment:	<p>The proposed Project will result in clearing of two Priority 3 Flora species; <i>Phyllanthus aridus</i> and <i>Alysicarpus major</i>.</p> <p>Priority 3 Taxa (Poorly Known Taxa) 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 are in need of further survey.</p> <p><i>Phyllanthus aridus</i> is known from 36 recorded populations across at least two bioregions (Pilbara and Kimberley, Department of Environment and Conservation, 2009a), and <i>Alysicarpus major</i> is known from 9 recorded populations across the Kimberley bioregion (Department of Environment and Conservation, 2009a).</p> <p>Based on the known recorded populations of these species in the Kimberley bioregion, clearing of vegetation for the Project is not considered to significantly impact on the majority of the local or regionally known populations of these species.</p> <p>These collections of Priority Flora from the Study Area are the first in the local area; a result considered due to the paucity of flora surveys conducted in the local area. Habitat for these species is not considered to be limited in, or adjacent to the Study Area. GHD expects that any search undertaken for these taxa outside the Study Area will record these species in the wider local area. GHD considers that, while individual plants may be impacted by the proposed Project, the long-term viability of the presence of these taxa in the local area will not be altered.</p> <p>While the targeted flora survey was restricted to the boundary co-ordinates of the Study Area, <i>Phyllanthus aridus</i> and <i>Alysicarpus major</i> are expected to be common within the local area, due to the abundance of analogous habitat surrounding the Study Area.</p>



Assessment: The clearing is considered unlikely to be at variance with c2 of Clearing Principle 'c'.

(c3)	Native vegetation should not be cleared if it is necessary for the continued <i>in situ</i> existence of significant habitat for priority flora species published by the Department of Environment and Conservation
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Comment: Habitat for these two significant species is locally common in the Kimberley bioregion with 100% of the pre-European extents considered to be remaining in the Central Kimberley Interim Biogeographic Regionalisation for Australia (IBRA) region (GHD, 2009). Vegetation in the Study Area is therefore not considered necessary for the continued *in situ* existence of significant habitat for priority flora species.

Assessment: The clearing is not considered to be at variance with (c3) of Clearing Principle 'c'.

5. Conclusions and Recommendations

5.1 Conclusions

Based on the targeted flora survey results, the following conclusions are provided:

- » Two Priority 3 flora species, *Phyllanthus aridus* and *Alysicarpus major* were recorded within the Survey Area.
- » An estimated population of >100 plants from 5 different locations were recorded during the survey of Priority 3 species *Alysicarpus major*.
- » A total of 6 plants from 5 different locations were recorded during the survey of Priority 3 species *Phyllanthus aridus*.
- » The recorded presence of the *Phyllanthus aridus* (Priority 3) population and the *Alysicarpus major* (Priority 3) population in the Survey Area constitutes 2.78% (one of 36 recorded populations; NatureMap, 2009) and 11.11% (one of 9 recorded populations, NatureMap, 2009) of the known populations from the State respectively.
- » Based on the known recorded populations of these species in the Kimberley bioregion, clearing of vegetation for the Project is not considered to significantly impact on the continued existence of these species'.

5.2 Recommendations

Based on the results of the targeted flora survey, the following recommendations are provided:

- » GHD recommends that in order to assist in gaining the necessary environmental approvals for clearing within the Project Area, the locations of *Phyllanthus aridus* and *Alysicarpus major* are avoided (where possible) by excluding them from development design; and
- » It is recommended that Main Roads liaise with the DEC with regards to the recorded presence of the two Priority 3 species, *Phyllanthus aridus* and *Alysicarpus major* within the Study Area.



6. Limitations

6.1 Survey Limitations

The GHD field survey was carried out during only one season, and in one year. Complete surveys require multiple surveys, at different times of year, and over a period of a number of years, to enable full survey of all species present. Some flora species, such as annuals, are only available for collection at certain times of the year, and others are only identifiable at certain times (such as when they are flowering). Additionally, climatic and stochastic events (such as fire) may affect the presence of plant species. Species that have a very low abundance in the area are more difficult to locate, due to above factors.

The limitations for the survey are provided in Table 5.

6.2 Report Limitations

This report presents the results of a targeted flora survey, and desktop findings, prepared for the purpose of this commission. The data and advice provided herein relate only to the project described herein and must be reviewed by a competent scientist before being used for any other purpose. GHD accepts no responsibility for other use of the data.

Where reports, searches, any third party information and similar work have been performed and recorded by others the data is included and used in the form provided by others. The responsibility for the accuracy of such data remains with the issuing authority, not with GHD.

For these investigations GHD has conducted desktop data searches and a field survey. The conclusions of this report were based on the information gathered during these investigations and thus reflect the environment of the survey area at the time of survey. GHD accepts no responsibility for any variation in the flora present in the Study Area due to natural and seasonal variability.

Table 5 Limitations and constraints associated with the Study Area

Variable	Impact on Survey Outcomes
Date of Site assessment	16 th to 20 th June 2009
Access Problems	No access problems were encountered.
Experience levels	<p>The ecologists who executed these surveys were practitioners suitably qualified in their respective fields.</p> <p>Coordinating Ecologist: Joshua Foster (Senior Ecologist);</p> <p>Field Staff: Joshua Foster (Senior Ecologist), Melissa Scott (Ecologist);</p> <p>Taxonomy: Joshua Foster (Senior Ecologist)</p> <p>Data Interpretation: Joshua Foster (Senior Ecologist), Melissa Scott (Ecologist)</p>
Timing ² , weather, season.	<p>The Environmental Protection Authority (EPA) Guidance Statement No. 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, indicates that the “flora and vegetation surveys should be conducted following the season which normally contributes the most rainfall in the bioregion”. In the Kimberley, this season equates to the beginning of the dry season.</p> <p>The survey was undertaken in June 2009 which is inside the recommended survey timing.</p> <p>Flora composition changes over time, with flora species having specific growing periods, especially annuals and ephemerals (some plants lasting for a markedly brief time, some only a day or two). Therefore the results of future botanical surveys in this location may differ from the results of this survey.</p> <p>The recorded impact of fire within the Survey Area may affect the presence of some plant species.</p>
Completeness	<p>As the survey was conducted only once rather than several times over the course of a year some annual, ephemeral condition specific species may be present that were not recorded in the survey.</p> <p>Species that were insufficiently mature or dead were identified in the field to Genus or Family level only (where possible).</p>

² EPA Guidance Statement 51 (2004) stipulates that flora and vegetation surveys should be undertaken following the season that contributes the greatest rainfall in the region. In the Northern Province, this is after summer. In the Eremaean Province, rainfall is sporadic, and in the South-west Province the main rain is in winter, requiring surveys to be undertaken in spring. Short-term variances in normal weather patterns (e.g. drought) may necessitate supplementary survey work at other times of year or in later years to take into account temporal changes in diversity.



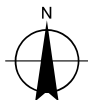
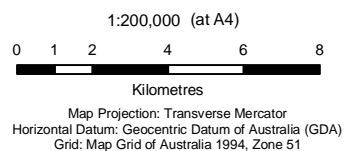
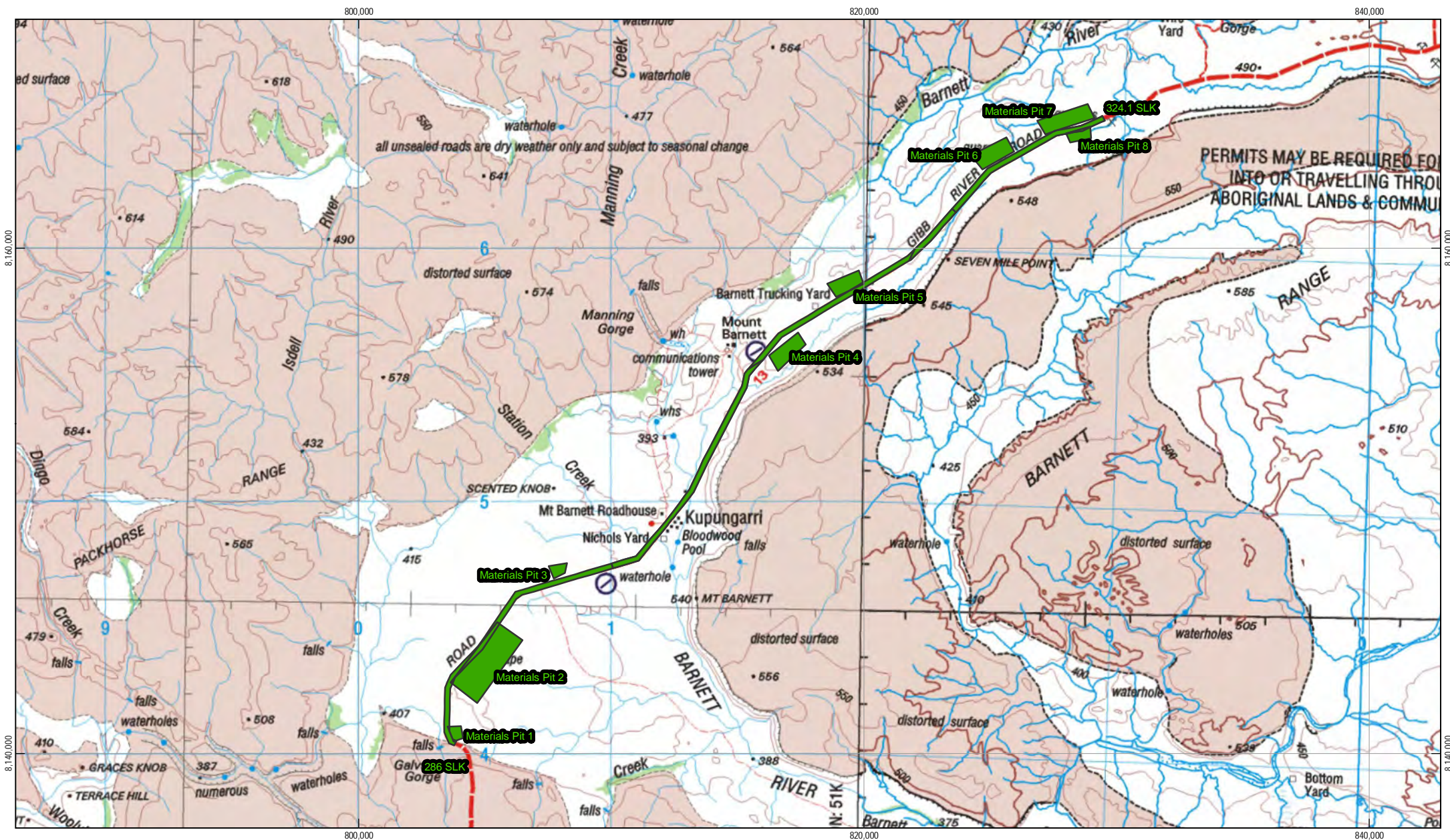
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- Wheeler, J.R. (ed) (1992). *Flora of the Kimberley Region*. Department of Conservation and Land Management, Como, Western Australia.



Appendix A

Figures



LEGEND

Study Area - GHD - 20090401

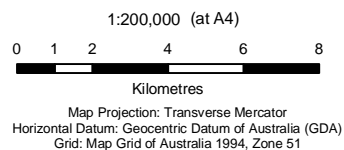
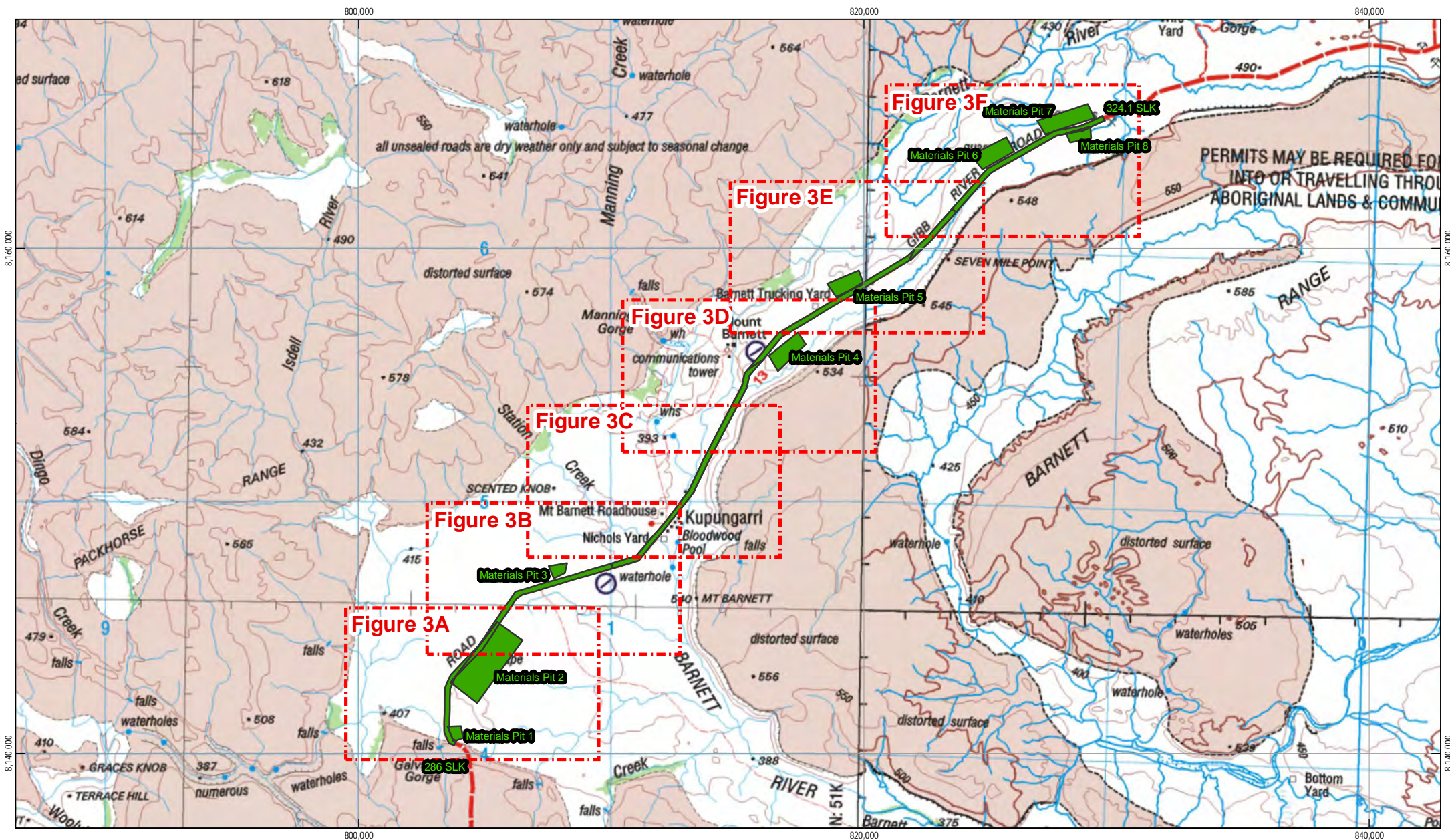


Main Roads WA
Galvans Gorge to Barnett Gorge
Targeted Flora Survey

Job Number	61-24012
Revision	0
Date	15 JUL 2009

Survey Area Extent

Figure 2



LEGEND

Study Area - GHD - 20090401



Main Roads WA
Galvans Gorge to Barnett Gorge
Targeted Flora Survey

Job Number | 61-24012
Revision | 0
Date | 15 JUL 2009

Survey Transects

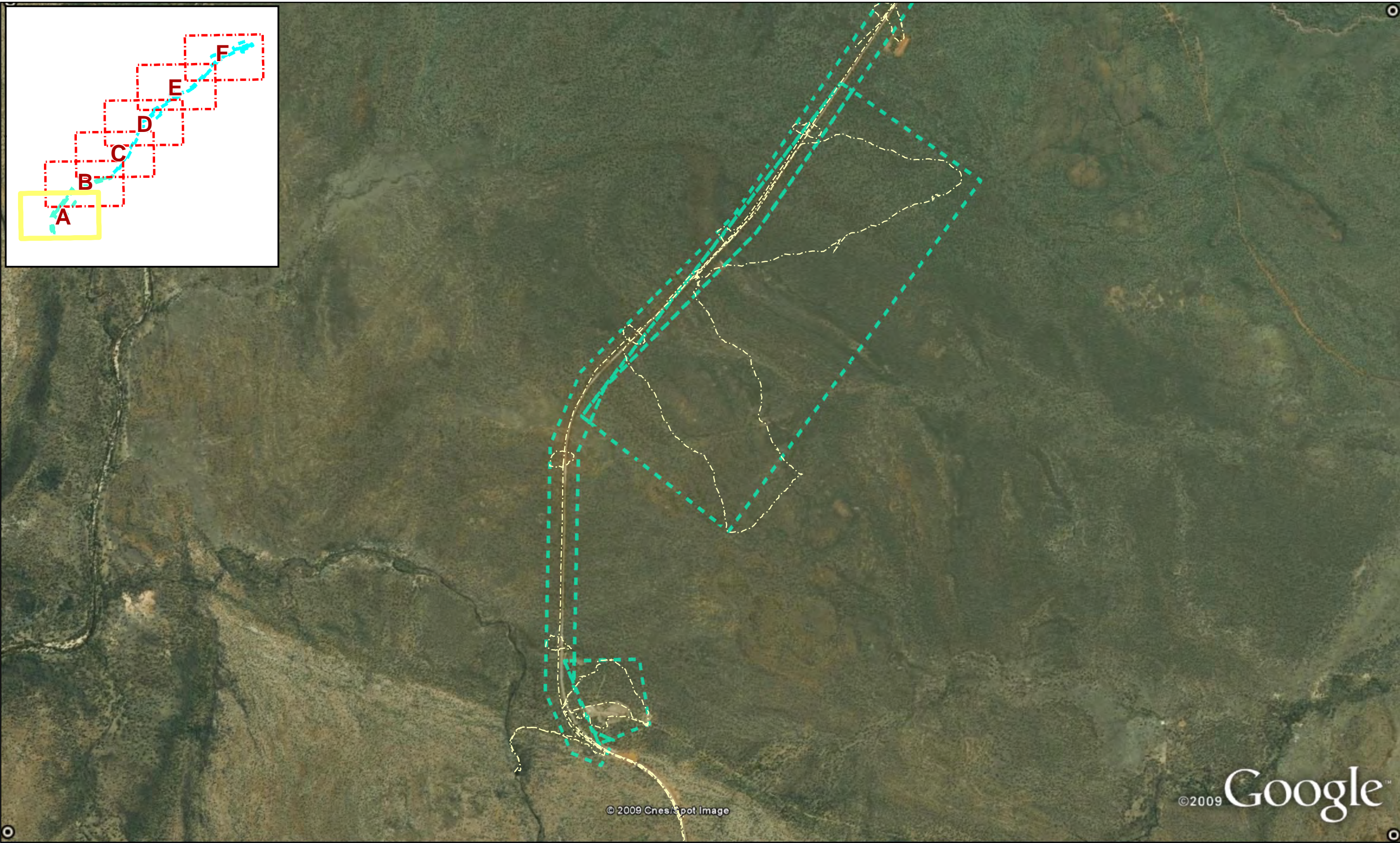
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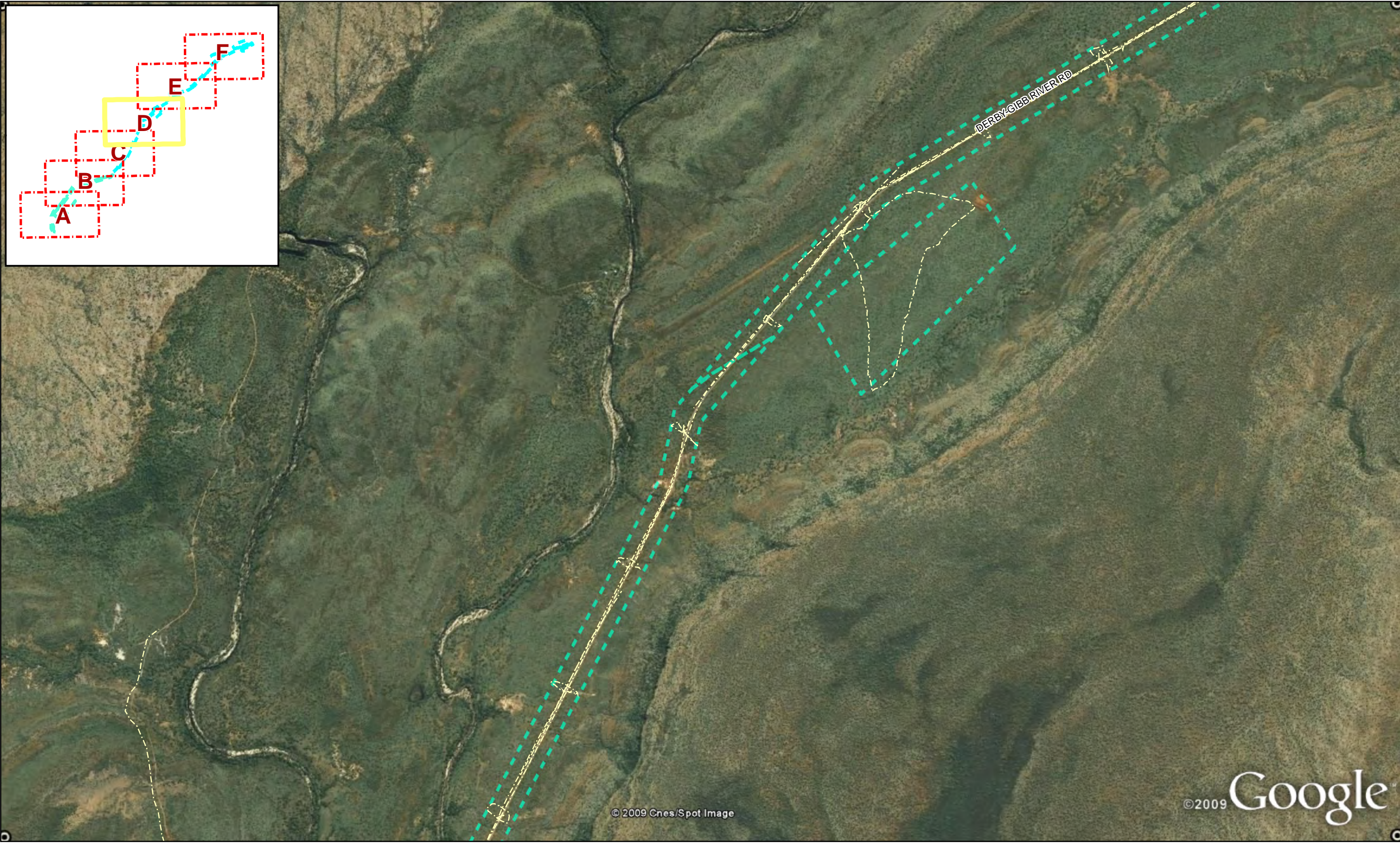
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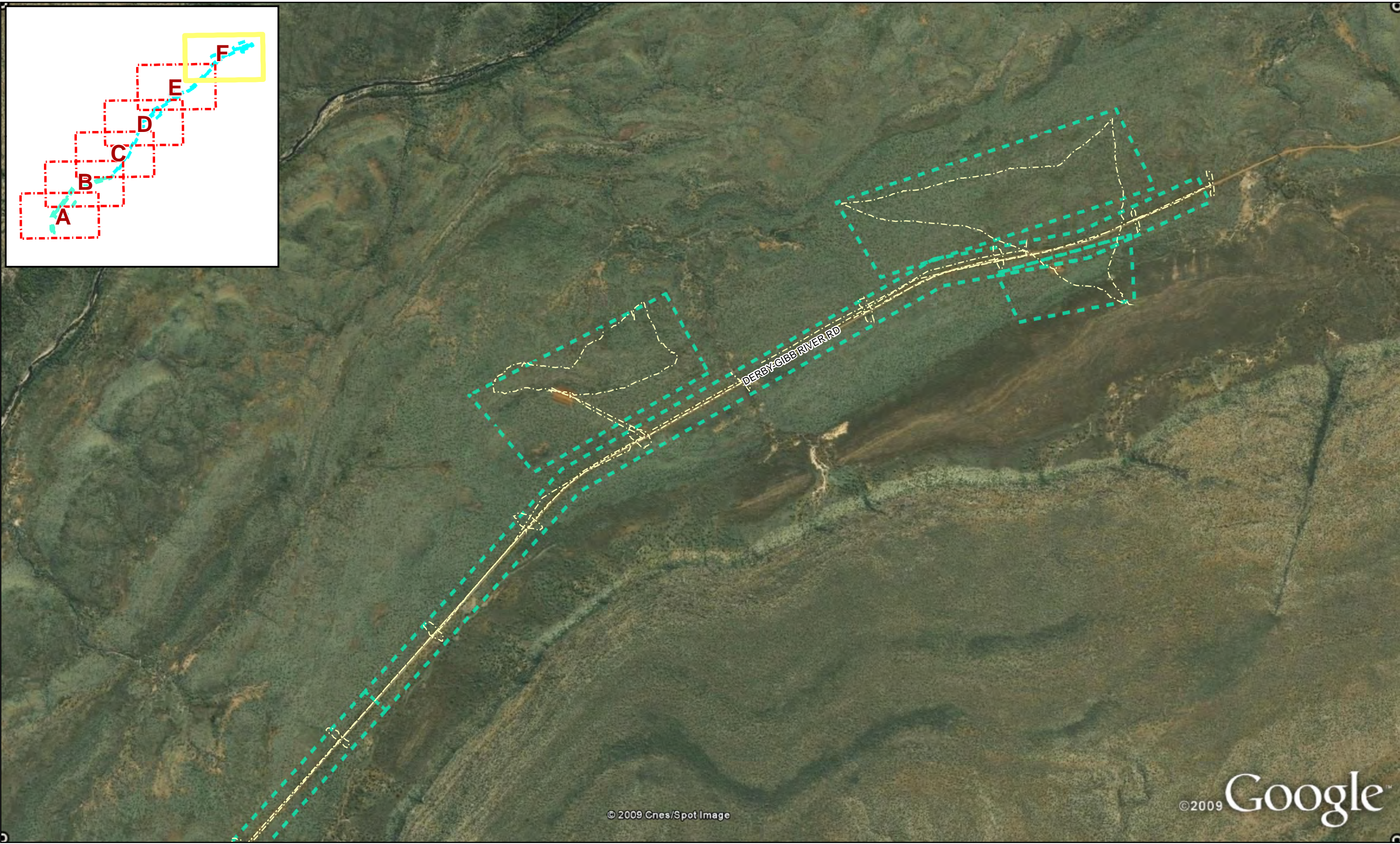


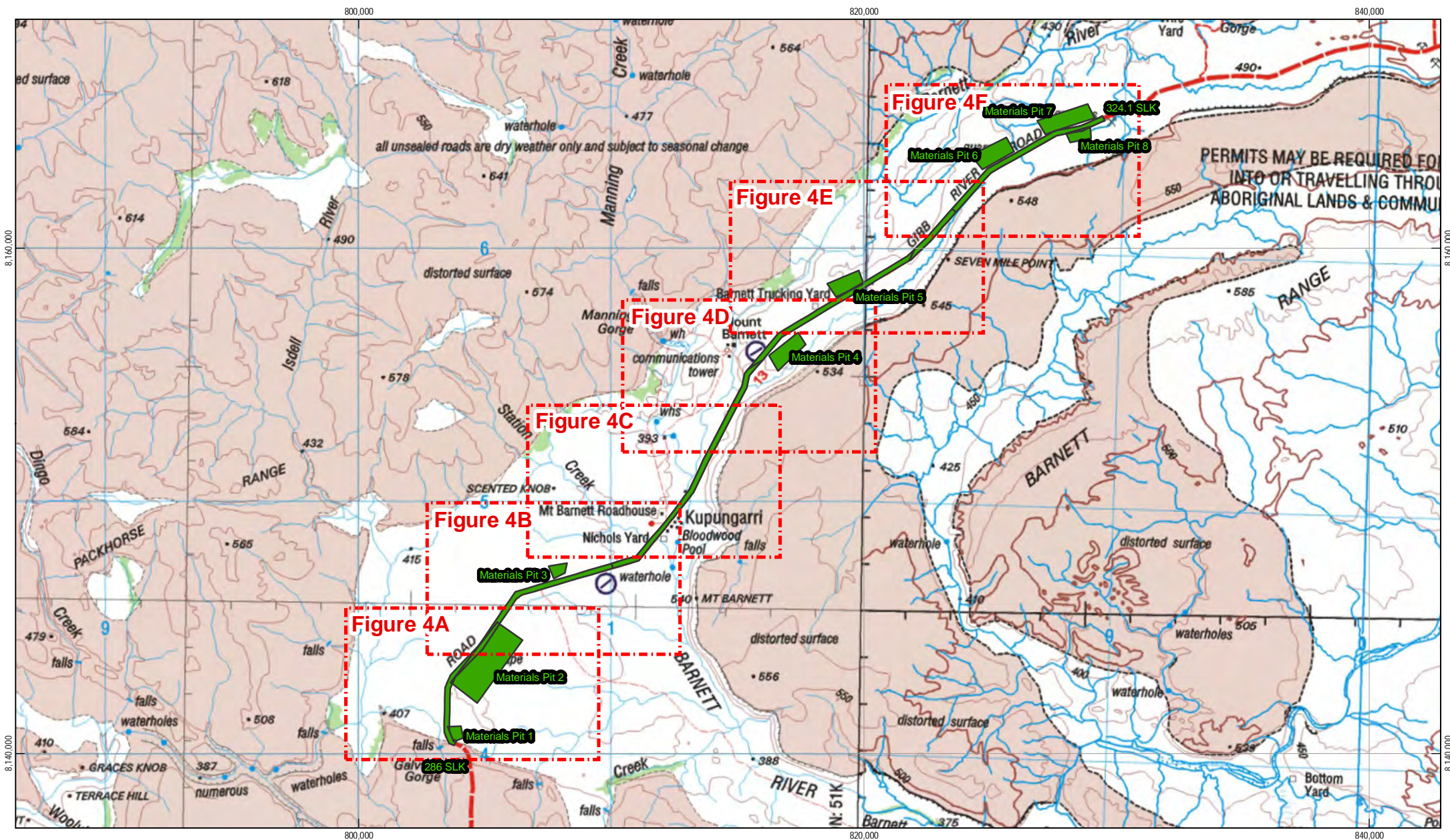










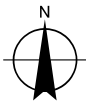


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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 51



LEGEND

Study Area - GHD - 20090401



Main Roads WA
Galvans Gorge to Barnett Gorge
Targeted Flora Survey

Job Number	61-24012
Revision	0
Date	15 JUL 2009

Significant Flora

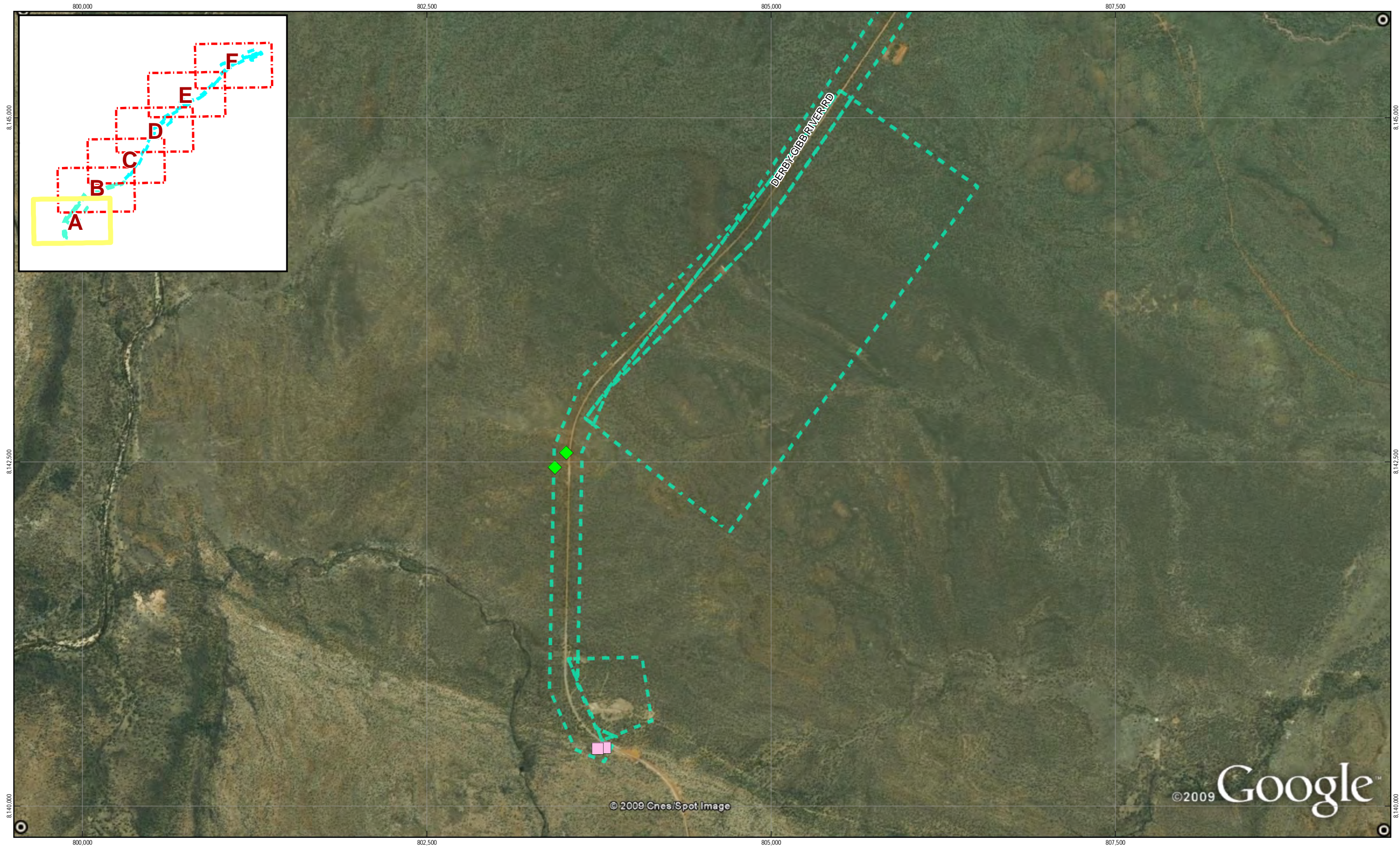
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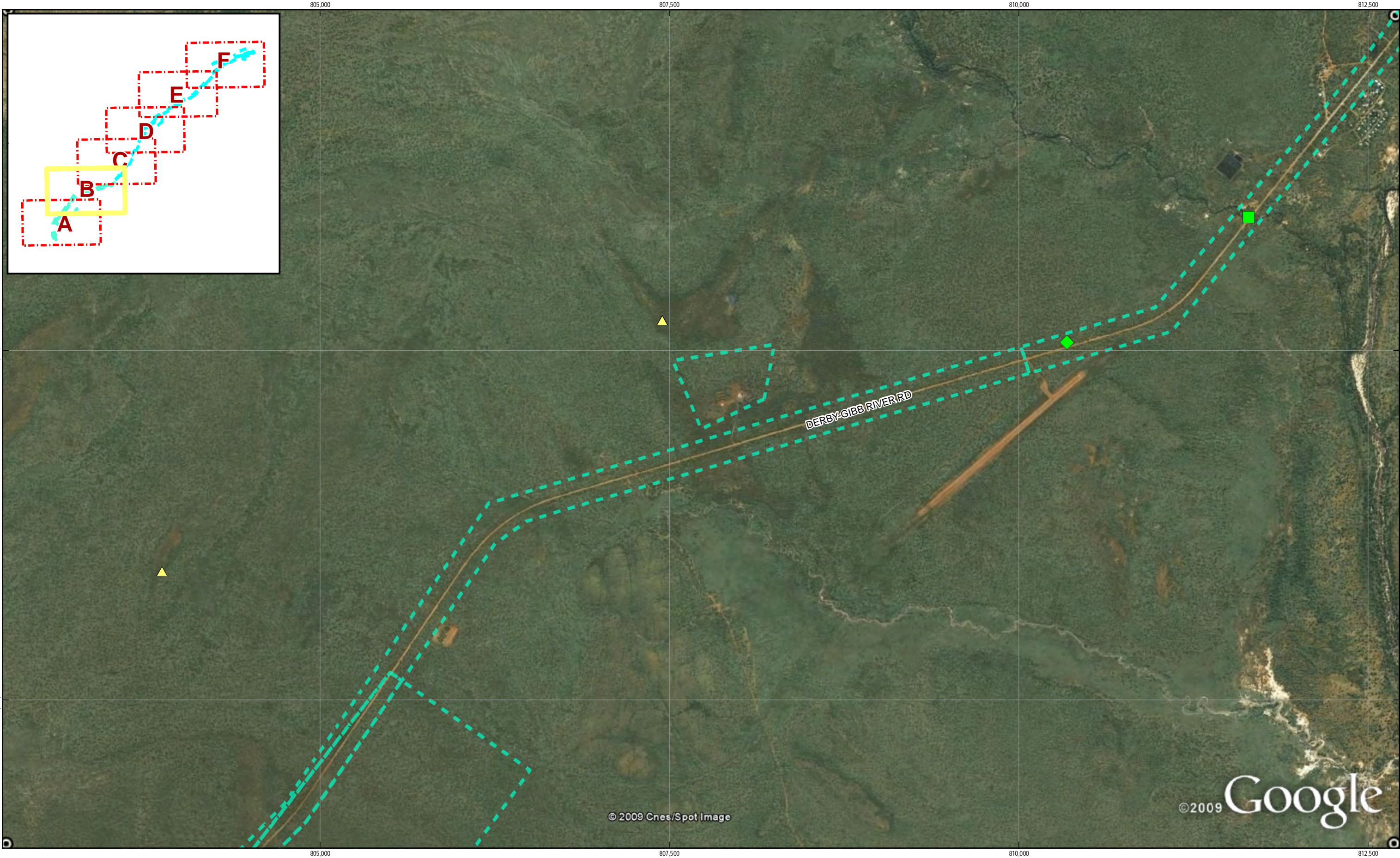
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Metres

Geographic Coordinate System

Horizontal Datum: Geocentric Datum of Australia 1994

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LEGEND

Road Reserve Study Area/Proposed Gravel Pits - GHD - 20090401

Threatened and Endangered Flora* - DEC - 20090319

- Rare
- Priority 1
- Priority 2

* DEC Search Ref 37-0309

Significant Flora - GHD - 20090619

- Priority 3
- Priority 4
- Alysicarpus major*
- Phyllanthus aridus*
- Solanum aff. dioicum*

Species of Interest - GHD - 20090619

CLIENTS | PEOPLE | PERFORMANCE

Main Roads WA

Galvans Gorge to Barnett Gorge

Targeted Flora Survey

Job Number 61-24012

Revision 0

Date 15 JUL 2009

Significant Flora

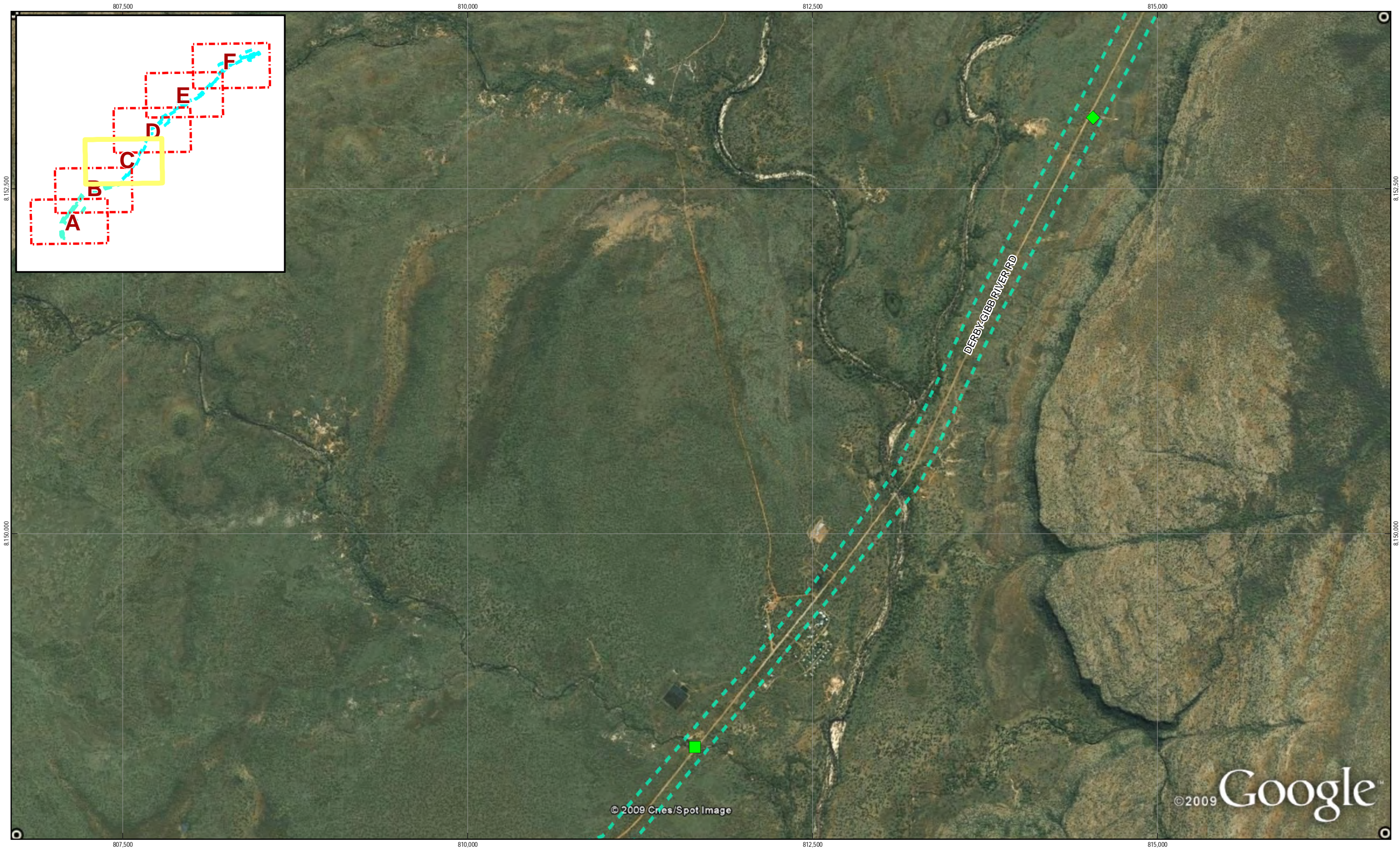
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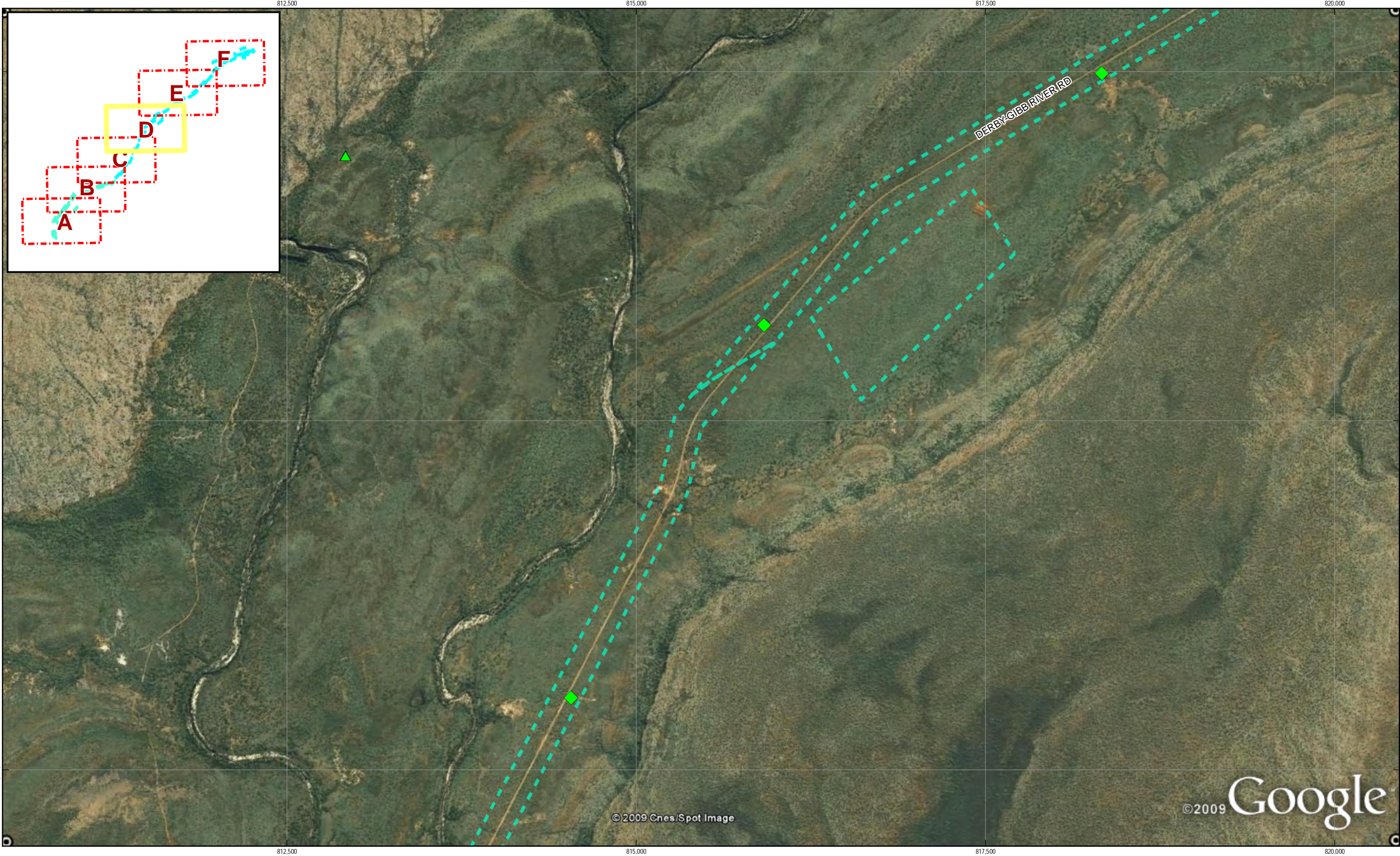
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Horizontal Datum: Geocentric Datum of Australia 1994

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LEGEND

Road Reserve Study Area/Proposed Gravel Pits - GHD - 20090401

Threatened and Endangered Flora* - DEC - 20090319

Rare

Priority 1

Priority 2

Priority 3

Priority 4

* DEC Search Ref 37-0309

Significant Flora - GHD - 20090619

Alysicarpus major

Phyllanthus aridus

Species of Interest - GHD - 20090619

Solanum aff. *dioicum*

CLIENTS | PEOPLE | PERFORMANCE

Main Roads WA

Galvans Gorge to Barnett Gorge

Targeted Flora Survey

Job Number 61-24012

Revision 0

Date 16 JUL 2009

Significant Flora

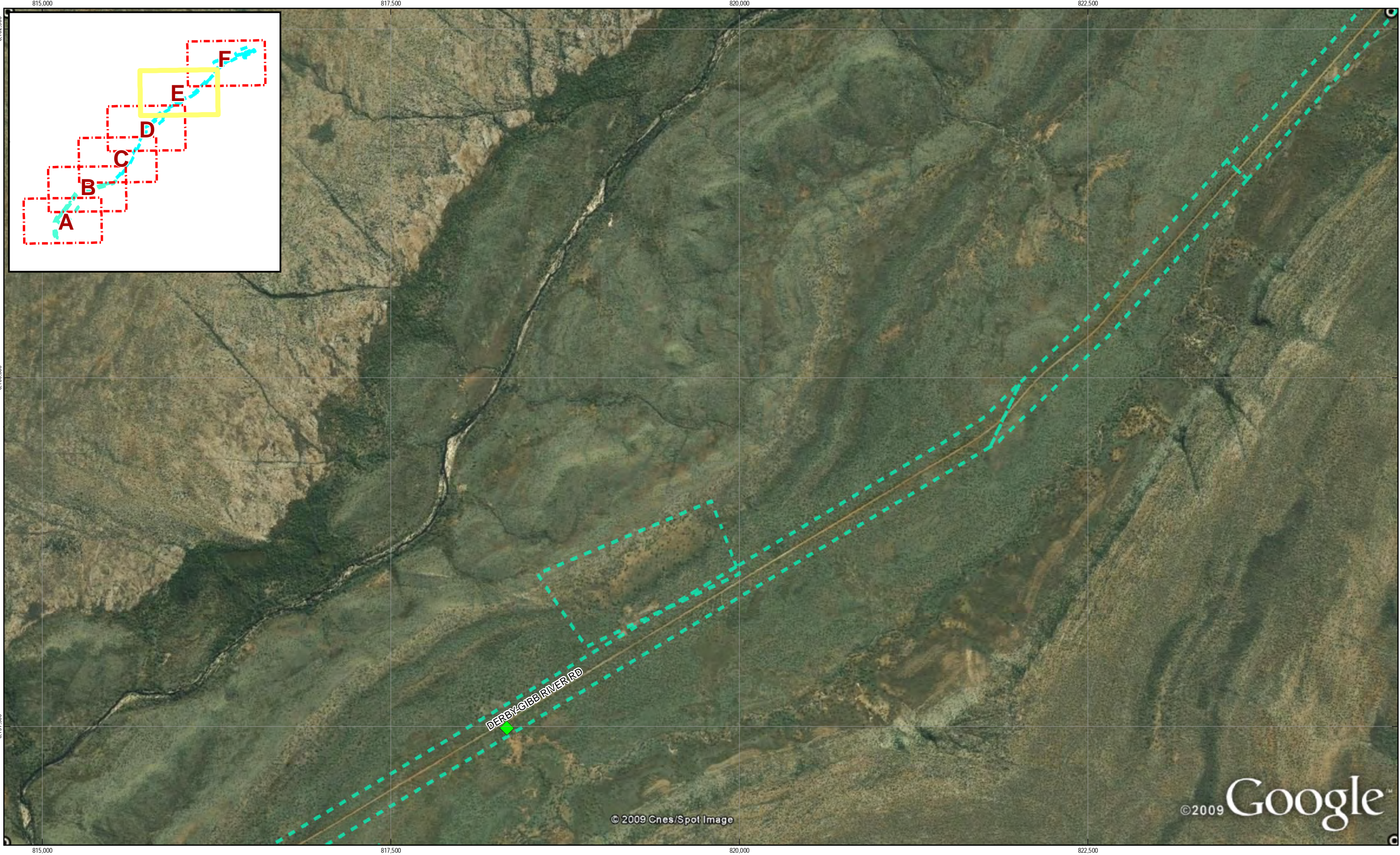
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Metres

Geographic Coordinate System

Horizontal Datum: Geocentric Datum of Australia 1994

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LEGEND

Road Reserve Study Area/Proposed Gravel Pits - GHD - 20090401

Threatened and Endangered Flora* - DEC - 20090319

Rare

Priority 1

Priority 2

Priority 3

Priority 4

* DEC Search Ref 37-0309

Significant Flora - GHD - 20090619

Alysicarpus major

Phyllanthus aridus

Species of Interest - GHD - 20090619

Solanum aff. dioicum

CLIENTS | PEOPLE | PERFORMANCE

Main Roads WA

Galvans Gorge to Barnett Gorge

Targeted Flora Survey

Job Number 61-24012

Revision 0

Date 16 JUL 2009

Significant Flora

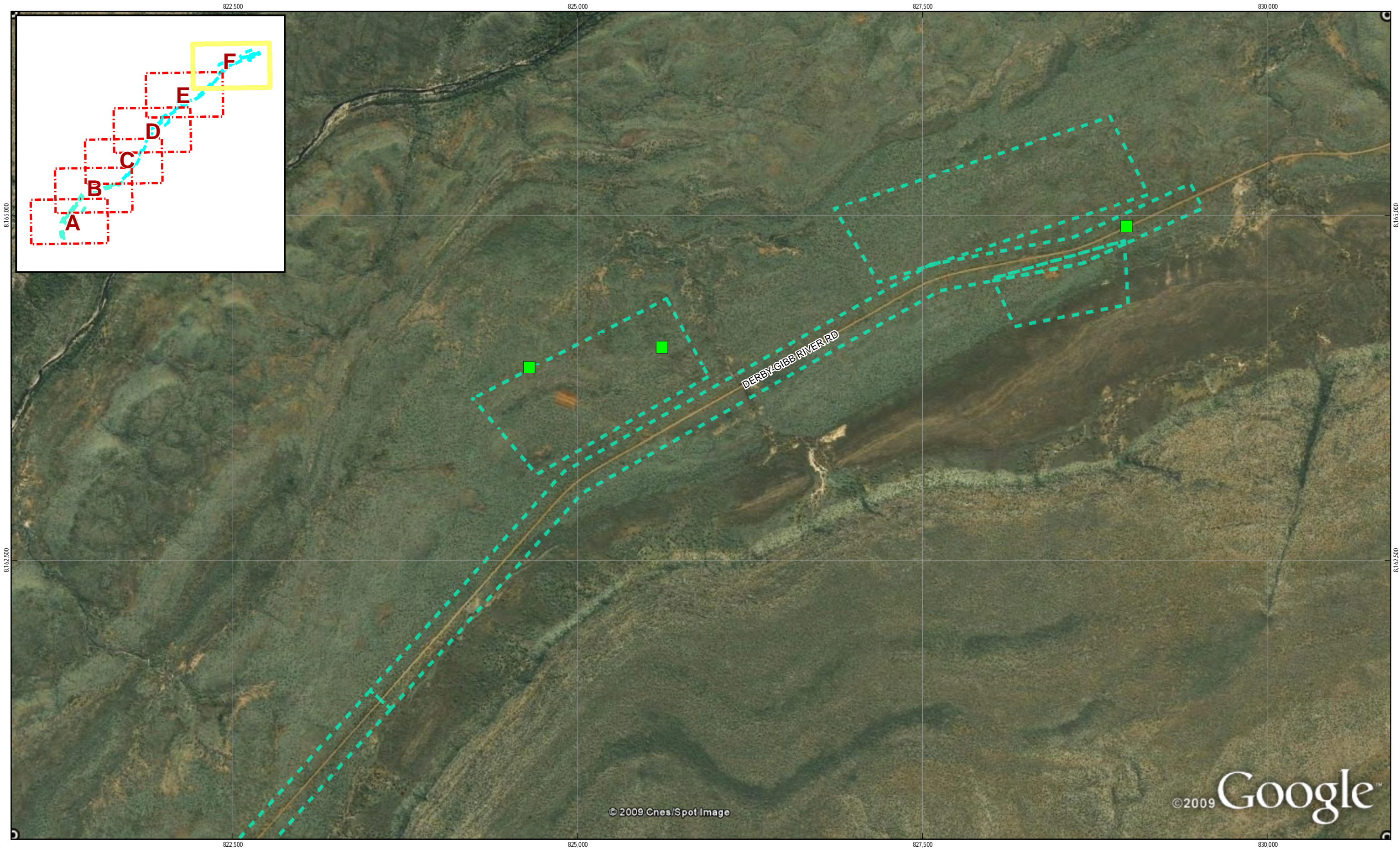
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Appendix B

Flora

Significant Flora Species



Table 6 Significant Flora Species identified in the Threatened Flora Database Search Results

Species	Conservation Code	Description ¹	Flowering Time ^{1&2}	Preferred Habitat ¹	Distribution ²	Data Source	Likelihood of Occurrence
<i>Acacia kimberleyensis</i>	Priority 2	Erect, more or less viscid shrub, to 1.5 m high. Fl. Yellow	Jun–Jul	Gullies, Rocky areas associated with sandstone plateaus	Packhorse Range, W Kimberley	WAHERB, NatureMap	Low Habitat not recorded in Study Area
<i>Acacia manipularis</i>	Priority 1	Low, spreading, viscid shrub, 0.75–1.2 m high. Fl. Yellow	Jul	Shale plateau	Mount House Station	WAHERB, DEFL	Low Habitat not recorded in Study Area
<i>Alysicarpus major</i>	Priority 3	Prostrate perennial, herb, to 0.2 m high. Fl. Orange, red	Apr, May	Floodplains	Drysdale River Stn, King Leopold Ranges, Sir Graham Moore Is., Secure Bay, Napier Downs	DR&PF List	High Habitat recorded in Study Area
<i>Boronia pauciflora</i>	Priority 3	Much-branched shrub, 0.4–1 m high, juvenile leaves sometimes trifoliate, mature leaves simple; sepals about the same size as petals. Fl. White, pink,	May, Jul	Sandy soils on sandstone. Rocky areas with spinifex.	King Leopold Range, Prince Regent River NR, Edkins Range	DR&PF List	Low Habitat not recorded in Study Area
<i>Cleome kenneallyi</i>	Priority 2	Perennial, herb, to 0.6 m high. Fl. Yellow	Jan–Feb	Sand dunes (beaches), Sandstone areas	Barnett River Gorge, c. 35 km WSW of Gibb River Station	WAHERB, DEFL, NatureMap	Low Habitat not recorded in Study Area



Species	Conservation Code	Description ¹	Flowering Time ^{1&2}	Preferred Habitat ¹	Distribution ²	Data Source	Likelihood of Occurrence
<i>Erpodium coronatum</i> <i>var. australiense</i>	Priority 2	No description available – Note – Erpodiaceae taxa are typically epiphytic bryophytes (mosses)	-	Decaying wood matter	Entrance to Adcock Gorge, ca 2.5 miles E of Gibb River road at ca 15 miles N of the turnoff to Mount House Homestead, West Kimberleys	WAHERB, DEFL, NatureMap	Not known – non-vascular taxa were not examined during this project
<i>Eucalyptus fitzgeraldii</i>	Priority 2	Tree, 5–15 m high, bark rough, tessellated. Fl. White	Aug	Clay or clayey soils on basalt or dolerite. Rocky hillsides, plains	17.8 km W of river crossing at old Mount Elizabeth Homestead, SW flank of Lookout Hill, N of Beverley Springs, Central Kimberley; Beverley Springs Station, Lookout Hill, 9 km SE of camp at Merrys Road Creek crossing, Mount Elizabeth Station, Kimberley, Beverley Springs Station, West Kimberley	WAHERB, DEFL	Low Preferred habitat not recorded in Study Area (except plains)
<i>Eucalyptus mooreana</i>	Rare	Straggly tree (mallee), 2.5–4 m high, bark smooth. Fl. cream, white	May-Aug	Red sand over sandstone. Rocky steep slopes	King Leopold Range	DR&PF List	Low Habitat not recorded in Study Area
<i>Fimbristylis sieberiana</i>	Priority 3	Shortly rhizomatous, tufted perennial, grass-like or herb (sedge), 0.25–0.6 m high. Fl. Brown	May–Jun	Mud, skeletal soil pockets. Pool edges, sandstone cliffs	Hammersley Range, Millstream, Fitzroy Crossing, King Leopold Range, Halls Creek, Little Sandy Desert	DR&PF List	Low Habitat not recorded in Survey Area
<i>Glycine albicans</i>	Priority 2	Erect perennial, herb or shrub, 0.3–0.6 m high. Fl. white, purple, brown	Feb–Apr	Lateritic loam	Beverley Springs Station, West Kimberley, Near main workshop shed. 400 m W of Beverley Springs Station Homestead, W Kimberley	WAHERB, DEFL	Low Habitat not recorded in Study Area



Species	Conservation Code	Description ¹	Flowering Time ^{1&2}	Preferred Habitat ¹	Distribution ²	Data Source	Likelihood of Occurrence
<i>Goodenia byrnesii</i>	Priority 1	Prostrate to decumbent herb, stems to 30 cm. Fl. Yellow	Jan–Feb	Sand. Edge of creek	1.5 km SE of Beverley Springs Homestead,	WAHERB, DEFL	Medium Habitat recorded in Study Area
<i>Goodenia durackiana</i>	Priority 1	Erect, short-lived annual, herb, ca 0.3 m high. Fl. Yellow	Mar–May	Black clay. Grassland	Walgamungum Creek, 1.5 km ESE of Beverley Springs Station Homestead, West Kimberley	WAHERB, DEFL	Medium Habitat recorded in Study Area
<i>Goodenia psammophila</i> subsp. <i>psammophila</i>	Priority 3	Herb, to 0.5 m high. Fl. yellow, brown, purple	Jan–Jun	Sand over sandstone. Beside creek	13 km N of Beverley Springs Station homestead, Creek 7 km N of Beverley Springs Station Homestead, Kimberley,	WAHERB	Medium Habitat recorded in Study Area
<i>Goodenia psammophila</i> subsp. <i>hiddinsiana</i>	Priority 2	Erect annual, herb, to 0.45 m high. Fl. Yellow	Dec–Feb	Sand, sandstone. Flats, ridges, beside creeklines	0.5 km E of old Beverley Springs Homestead,	WAHERB, DEFL	Medium Habitat recorded in Study Area
<i>Grevillea adenotricha</i>	Priority 4	Shrub, to 2 m high. Fl. Red	May/Aug	Sandstone	Mount Elizabeth Station	WAHERB	Low Habitat not recorded in Study Area
<i>Grevillea miniata</i>	Priority 4	Spreading to erect shrub or tree, 1.8–5 m high. Fl. yellow, orange	Apr–Aug	Skeletal sandy soils or sandy loam over quartzite or sandstone. Cliffs or rocky slopes, sometimes along watercourses	Mt Leake, Hann River, King Leopold River, Bungle Bungle (Purnululu) NP	DR&PF List	Low Preferred habitat not recorded in Study Area – except along watercourses



Species	Conservation Code	Description ¹	Flowering Time ^{1&2}	Preferred Habitat ¹	Distribution ²	Data Source	Likelihood of Occurrence
<i>Minuria macrorhiza</i>	Priority 2	Erect perennial, herb, to 0.6 m high. Fl. white, purple, pink	Jan/May–Oct	Red clay or loam, laterite, bauxite. Sandstone gullies, exposed sheets basalt, among tumbled boulders, in grasslands	Beverley Springs homestead, Kimberley, Isdell River near Mount Barnett Homestead.	WAHERB, NatureMap	High Habitat recorded in Study Area
<i>Pentalepis</i> sp. Mt House (E.M. Bennett 1877)	Priority 1	Erect woody perennial, herb, 0.45–1 m high. Fl. Yellow	May	Sandstone	Lennard River Gorge, Fitzgerald Botanical District, 6 miles N Mount House Homestead	WAHERB, DEFL, NatureMap	Low Habitat not recorded in Study Area
<i>Phyllanthus aridus</i>	Priority 3	Erect, much-branched shrub, to 0.25 m high. Fl. cream, green	May–Jun	Sandstone, gravel, red sand	Near Beverley Springs Homestead Tank, Junction Pool on Plain Creek, 23 km W of the homestead, Walgamungun Creek, 1.5 km ESE of Beverley Springs Station Homestead, W. Kimberley	WAHERB, DEFL	High Habitat recorded in Study Area
<i>Pityrodia obliqua</i>	Priority 3	Erect shrub, 0.4–2 m high. Fl. pink, white	May–Jul	Sandstone or quartzite. Rocky faces in mountain ranges	King Leopold Range, Cockburn Range	DR&PF List	Low Habitat not recorded in Study Area
<i>Rhynchosia rostrata</i>	Priority 1	Erect shrub, 0.5–0.6 m high. Fl. Yellow	Jul	Stony ground	Barnett [River] Gorge, ca 250 km SW of Wyndham, York Sound, King Leopold Ranges, Drysdale River NP, Barnett Gorge	WAHERB, DEFL, DR&PF List, NatureMap	Low Habitat not recorded in Study Area
<i>Sauropus</i> sp. A Kimberley Flora (T.E.H. Aplin et al. 929)	Priority 2	Herb to 50 cm.	May ?	In sandy pockets in sandstone along creeklines	Barnett River Gorge, c. 25 km NE of Mount Barnett Homestead Botanical District: Fitzgerald	WAHERB, NatureMap	Low Habitat not recorded in Study Area



Species	Conservation Code	Description ¹	Flowering Time ^{1&2}	Preferred Habitat ¹	Distribution ²	Data Source	Likelihood of Occurrence
<i>Schoenus punctatus</i>	Priority 3	Shortly rhizomatous, tufted perennial, grass-like or herb (sedge), ca 0.6 m high. Fl. Brown	Aug	Watercourses	Isdell River near Mount Barnett homestead	WAHERB, NatureMap	Medium Habitat recorded in Study Area
<i>Solanum leopoldense</i>	Priority 3	Intricate, spreading shrub, 0.5–1 m high. Fl. blue, purple	May–Aug	Sandstone. Rocky gullies and creeklines	King Leopold Range, Buccaneer Archipelago	DR&PF List	Low Habitat not recorded in Study Area
<i>Stylidium costulatum</i>	Priority 3	Erect, tufted annual, herb, to 0.1(–0.2) m high. Fl. yellow, orange, red	Apr–Aug	Sandy or clayey soils. Creeks or seasonally wet areas	Coolabah Creek, Beverley Springs Station, NE verge of Brolga Swamp, 8 km SE of Beverley Springs Homestead, Mount Barnett Station	WAHERB, NatureMap	Medium Habitat recorded in Study Area
<i>Stylidium prophyllum</i>	Priority 3	Annual, herb, to 0.3 m high. Fl. Pink	May–Jun	Sandy, black silty or clayey sandy soils, loam. Seasonally wet floodway depressions & seepage areas	Between Beverley Springs airstrip and homestead on creek margin,	WAHERB	Medium Habitat recorded in Study Area
<i>Stylidium rubriscapum</i>	Priority 2	Sprawling annual, herb, 0.08–0.3 m high. Fl. pink, red	Jun–Sep	Sandy & clayey soils. Damp situations	12 miles NW of Mount Elizabeth Homestead on track to Panther Downs, Lake Gilbert, North of Beverley Springs Homestead, W Kimberley	WAHERB	Medium Habitat recorded in Study Area



Species	Conservation Code	Description ¹	Flowering Time ^{1&2}	Preferred Habitat ¹	Distribution ²	Data Source	Likelihood of Occurrence
<i>Triodia acutispicula</i>	Priority 3	Tussock-forming resinous perennial, grass-like or herb, 0.5–1.5 m high, lemma bi-textured, glabrous, with transverse demarcation, spikelet terete. Fl. cream, brown	Jan–Apr	Sandy soils. River levees, pindan plains, rocky hillslopes & outcrops	Charnley River Crossing, 55 km N of Beverley Springs	WAHERB	Low Habitat not recorded in Study Area
<i>Warnstorfia fluitans</i>	Priority 1	Semi-aquatic moss	–	–	Adcock Gorge	WAHERB, DEFL, NatureMap	Not known – non-vascular taxa were not examined during this project
<i>Whiteochloa</i> sp. Hann River (Aplin et al. 917)	Priority 1	Caespitose perennial or annual (?), grass-like or herb, ca 0.6 m high.	–	Creeklines, watercourses	Hann River Crossing, Gibb River Road, Fitzgerald Botanical district	WAHERB, DEFL	Medium Habitat recorded in Study Area

¹Data Source Department of Environment and Conservation (2009b) FloraBase accessed online at <http://florabase.calm.wa.gov.au/> on 07/04/2009

²Data Source Department of Environment and Conservation Declared Rare and Priority Flora List (6 October 2008).



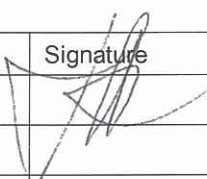
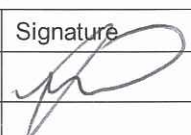
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