

Appendix G:

Boree Plains Offset Report





Offset Report on Cristal Mining Australia's Boree Plains Property



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Cover Image: Flower heads of Orange Immortelle (*Waitzia acuminata*), an iconic and common everlasting daisy present within Spinifex-Mallee dunes and sandplains on the Boree Plains property in October 2016.

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1.0 INTRODUCTION

1.1 Purpose and Rationale of this Report

This summary report provides a rapid flora assessment and desk-top fauna assessment of land at Cristal Mining Australia's Boree Plains property, with the sole purpose of identifying a possible offset area for remnant vegetation that would be lost as a result of the proposed Hatfield West Gravel Pit Project. A number of constraints were placed upon the authors and consequently a number of assumptions were made in order to refine the search area. These include:

- 1) The land must not be included within the proposed Private Conservation Reserve for the Atlas-Campaspe Mines;
- 2) The land must be on the Boree Plains property (directive of Cristal who own this property);
- 3) The survey should be conducted on land not botanically surveyed by AMBS (2013);
- 4) The land should target a possible offset area totaling a minimum of 716 Ha – the area proposed by the proponent of the Hatfield West Gravel Pit Project as a conservation offset;
- 5) The land should contain at least 430 Ha of Belah-Rosewood Woodland and any Sandhill Pine Woodland, if possible;
- 6) The search should target high quality Sandhill Pine Woodland and Yarran Shrubland, the two endangered ecological communities that would be lost from the proposed Hatfield West Gravel Pit Project area, if these plant communities exist at Boree Plains;
- 7) The survey should include targeted searches for any of the 30 TSC or EPBC listed threatened plant taxa considered under the 'Likelihood of Occurrence' assessment included within the concurrent EIS Flora investigation conducted by Sluiter and Allen (2016), especially with respect to Mossgiel Daisy (*Brachyscome papillosa*).
- 8) The potential offset identified should conserve habitat for Corben's Long-eared Bat (*Nyctophilus corbeni*) which is known to occur within Belah-Rosewood Woodlands at the proposed gravel pit Subject Sites (GHD 2017).

1.2 Authority to Conduct this Study

The Principal Investigator and primary author of this report is Dr. Ian Sluiter from Ogyris Ecological Research. Dr. Sluiter was assisted in the field by Ogyris P/L staff member Geoffrey Allen. Ian Sluiter and Geoffrey Allen work on ecological projects in New South Wales pursuant to OEH National Parks and Wildlife Scientific Licence Number SL101035. The fauna information has been summarized by Alex Holmes of GHD (Mildura), based on the AMBS (2013) study of the Atlas-Campaspe Mineral Sands Project and adjacent Boree Plains Conservation Offset area.

1.3 Location of the Study Area

Figure 1 shows the broad location of the Boree Plains property, including the Atlas-Campaspe Mines and Private Conservation Offset area designated as part of that development. Also included are surrounding properties including the eastern side of Mungo National Park and parts of the Carawatha, Wampo and Iona properties. This study was conducted entirely on the Boree Plains property, explicitly to the east and north of land included within the AMBS (2013) study. Figure 2 shows the land on which this study was based. Four main areas were assessed and these have been shown on Figure 2 as Area 1, 2,3 and 4.

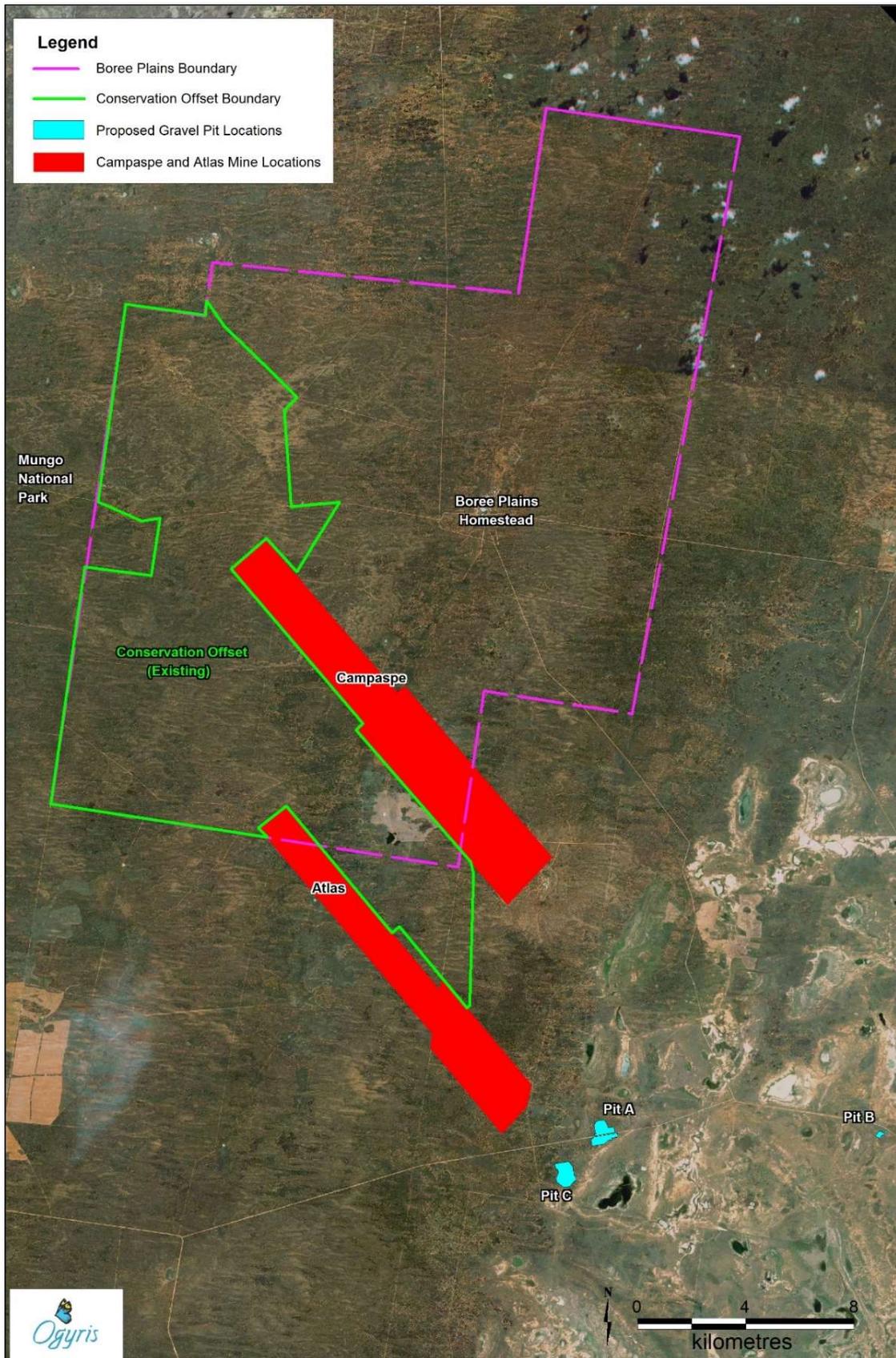


Figure 1: Location of the Boree Plains Offset Study showing the juxtaposition north and east of Mungo National Park, the designated Atlas-Campaspe Private Conservation Offset, the Atlas-Campaspe ML as well as the proposed Hatfield West gravel pit locations.

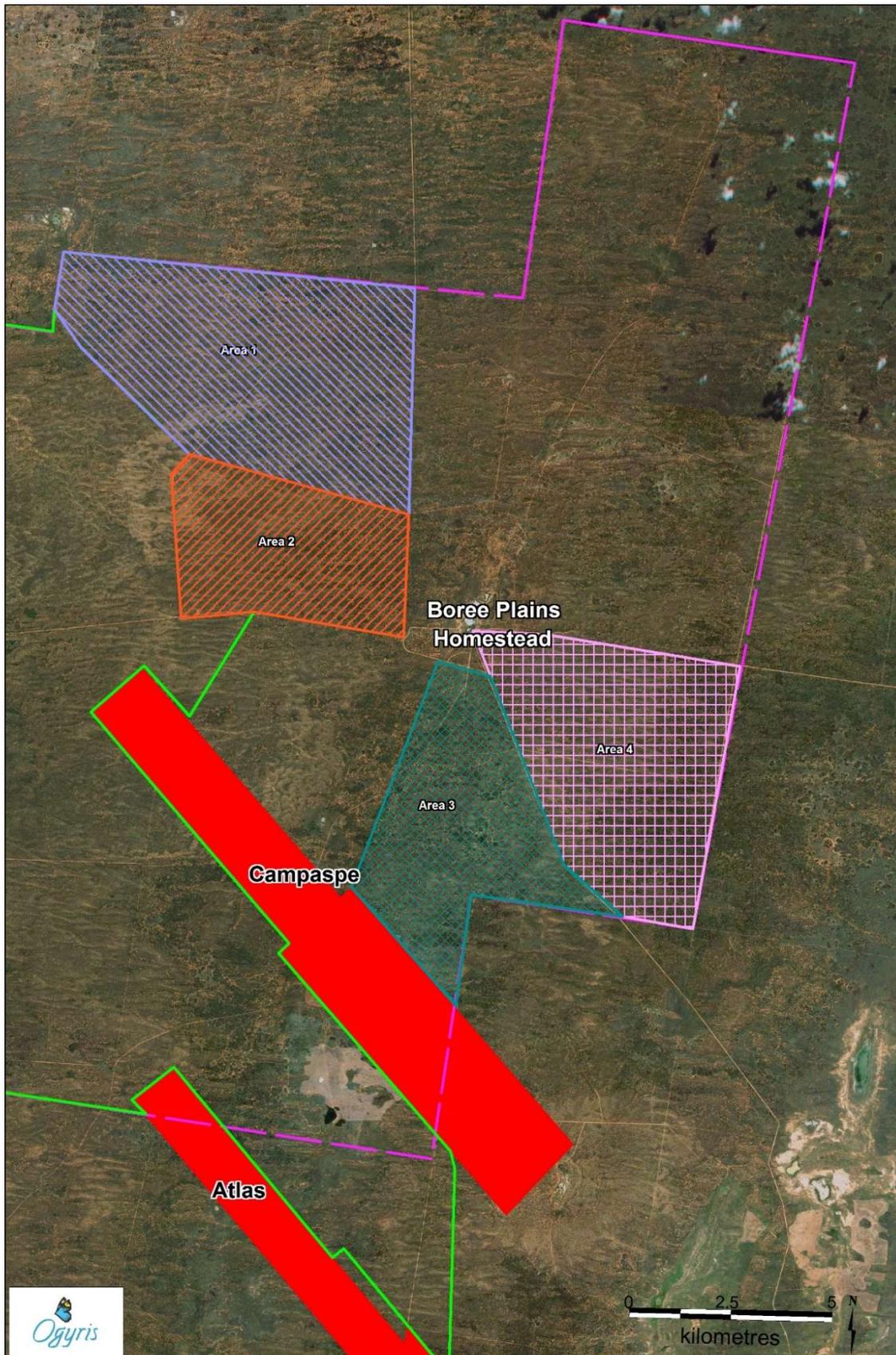


Figure 2: Boree Plains areas of interest in this study, which are to the north and east of any existing flora survey work conducted by AMBS (2013) as well as being outside of the designated Atlas-Campaspe Private Conservation Reserve.

2.0 METHODS

Timing of the Flora Survey Flora surveys associated with this study were conducted over 3 days between 26-28th October 2016.

Conditions of the Vegetation Survey The vegetation survey was conducted in optimal conditions for flora survey. In excess of 100 mm of precipitation in September 2016 ensured that the herbaceous groundflora layer was in peak condition.

Site Selection The constraints on site selection have been outlined in Section 1.1. Our study concentrated on areas with large expanses of Belah-Rosewood Woodlands in juxtaposition with other vegetation communities of interest from a threatened plant community and threatened plant conservation perspective. Quadrat survey site numbers were low due to time constraints, with their location shown in Figure 3. The location of all tracks driven as part of this study have also been shown.

Vegetation Description The vegetation quadrats measured 50 x 20 m (0.1 Ha). All species recorded in the (1,000m²) fixed area quadrats were allocated a cover-abundance scaling as outlined below:

- + = few individuals, with small cover
- 1 = numerous individuals but < 5% cover, or scattered individuals and cover to 5%
- 2 = 5-25% cover
- 3 = 25-50% cover
- 4 = 50-75% cover
- 5 = 75-100% cover

A structural assessment was also undertaken at a subset of the treed sites as well. This involved quantitatively describing the structural parameters that characterized the selected quadrat sites. Information was collected on tree, shrub and groundflora height and cover as well as the number of live trees and large shrubs in each 0.1 Ha area. The latter assessment facilitated a calculation of the density of trees and shrubs per hectare. The number of dead trees, fallen logs, tree hollows, bird nests, lizard burrows and spider holes were also counted.

Plant Nomenclature Botanical nomenclature used in this report follows the *Flora of New South Wales* (Harden 1990; 1991; 1992 and 1993), except where more recent taxonomic revisions as outlined on the Atlas of Living Australia (ALA 2016) apply.

Data Collection and Compliance Ian Sluiter and Geoffrey Allen, the two botanists that undertook the surveys, are licenced to undertake plant biodiversity assessments and ecological surveys under New South Wales *National Parks and Wildlife Act*, 1974 Scientific Licence number SL101035.

Data Curation All floristic data associated with this project was entered to the NSW BioNet on 6th April 2017, as per scientific license requirements.

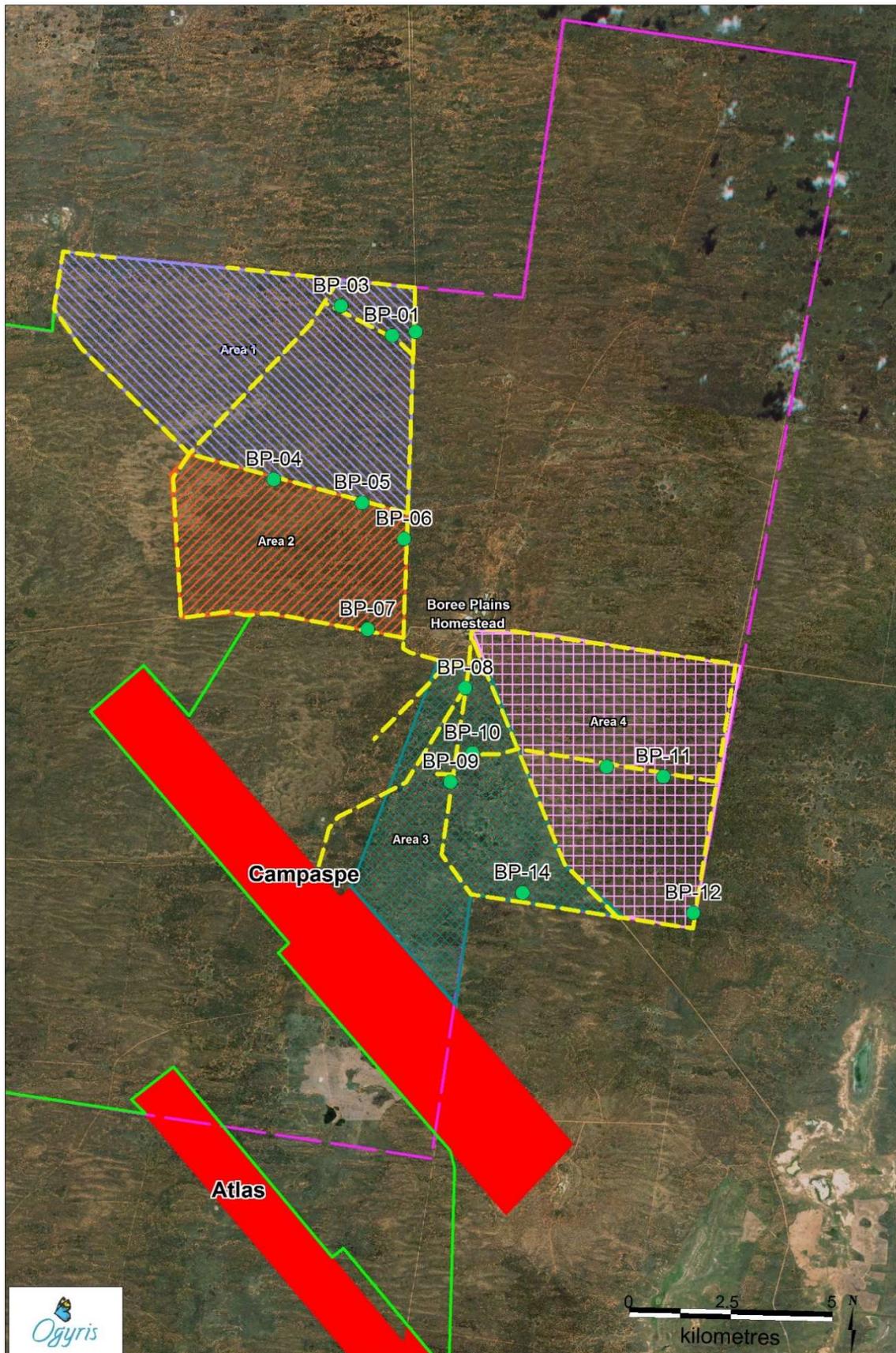


Figure 3: Map showing the location of all detailed quadrat sites assessed in this offset study. The tracks driven to locate these quadrats as well to ground truth vegetation community types has also been shown.

Vegetation Classification Plant community types were allocated to Benson *et al.* (2006) New South Wales vegetation communities.

Vegetation Mapping The vegetation map produced uses the same orthophotographic image used for Cristal's 2011 Atlas-Campaspe EIS study, combined with detailed 'ground truth' notes taken whilst at the sites. The mallee plant communities known as Spinifex-Mallee and Chenopod Sandplain Mallee have been combined, but in essence, the majority area is composed of the latter. The maps are necessarily broad in nature and divide the primary vegetation types. Any threatened plant communities found have also been mapped.

Targeted Threatened Flora Searches For the first 2.5 days, targeted threatened flora searches were not specifically undertaken, but threatened plant taxa were searched for from quadrat survey sites and surrounds, as well as whilst driving around and through selected survey areas. On the 28th October 2016, four hours was set aside looking for four threatened plant species for which it emerged were likely candidates to be found in our search area. These included:

- **Vv** Mossgiel Daisy (*Brachyscome papillosa*)
- **Ee** Winged Peppergrass (*Lepidium monoplocoides*)
- **e** Bitter Quandong (*Santalum murrayanum*)
- **v** Cobar Greenhood (*Pterostylis cobarensis*)

The symbols listed above are conservation status symbols indicating:

E = Endangered in Australia (EPBC Act)

e = Endangered in NSW (TSC Act)

V = Vulnerable in Australia (EPBC Act)

v = Vulnerable in NSW (TSC Act)

Limitations Conditions across the Boree Plains survey area were ideal in late October 2016. The primary limitation of our survey was the amount of time allowed which restricted the number of detailed site descriptions as well as the chances of finding threatened plant species as well as threatened plant communities.

3.0 RESULTS

The Boree Plains property is divided into a number of management paddocks which have been given names by the previous owner. We have referred to the areas surveyed by the names (Areas 1, 2, 3 and 4) provided in Section 2.0 (Figure 3). The former owners paddock names are also mentioned.

3.1 Area 1 – Pattersons North Paddock

The Survey Area A Vegetation Map of Area 1 is shown as Figure 4. The area assessed was 3,960 Ha existing in the northern sector of Pattersons Paddock bounded by the Boree Plains-Gol Gol Road to the east, the Atlas-Campaspe Private Conservation Reserve to the west and the property boundary between Boree Plains and Gol Gol Station to the north. This area of land comprised the largest by area. The perimeter was mostly driven around this site, along with a southwest-northeast track which dissects the designated survey area from the proposed Private Conservation area to the northern boundary fence with the Gol Gol property.

Vegetation Communities Present Area 1 is dominated by Spinifex-Mallee and to a lesser extent Chenopod Sandplain Mallee which collectively comprises 2,730 Ha along with Belah-Rosewood Woodland which comprises 995 Ha. The diagonal track that dissects the survey area (see Figure 3) contained a large extent of Mandelman Land System comprised of Spinifex-Mallee vegetation growing on primarily siliceous dunes of irregular orientation. This vegetation is contiguous with similar vegetation in the Atlas-Campaspe Private Conservation Reserve. Also of note was the presence of ~16 Ha of Yarran Shrubland. This vegetation community straddles the Boree Plains-Gol Gol Road and merges ecotonally with Belah-Rosewood Woodland at its extremities. Areas of Open *Austrostipa* Grassland and shrublands composed of Slender-leaf Hopbush (*Dodonaea viscosa* subsp. *angustissima*) and Turpentine (*Eremophila sturti*) characterize the remaining land and comprise 119 Ha. Vegetation quadrat sites were surveyed from three locations only. The Belah-Rosewood Woodland in Area 1 was not as species diverse or as structurally complex as that found in Areas 2-4.

Threatened Plant Community Considerations The Area 1 site contains a significant sized patch of the EEC Yarran (*Acacia melvillei*) Shrubland. The plant community has been estimated at 16 Ha in size and was characterized by the most diverse suite of indigenous plants recorded during the offset study with 62 recorded from quadrats BP-01 (see Plate 1) and 69 recorded from quadrat BP-02 (Plate 2). Alien influence in terms of species diversity was moderately high with 10 and 12 species recorded respectively, and this also included the first record for NSW of the herbaceous alien weed Sprawling Marigold (*Oligocarpus calendulaceus*). This species was an uncommon component of this plant community but was recorded nowhere else in the Offset study. Monitoring of this weed species is advised with respect to the potential for further spread in western NSW. In general terms, however, weed species cover was low.

In terms of importance to nature conservation, the expanse of Yarran Shrubland present is possibly in the best condition seen by the lead author to date in the Western Division of NSW and is highly deserving of consideration for conserving as a stand-alone Private Conservation area. Area 1 did not contain any areas of Sandhill Pine Woodland which would enhance the prospects of this being selected as the potential offset broader site for the Hatfield West Gravel Pit Project.

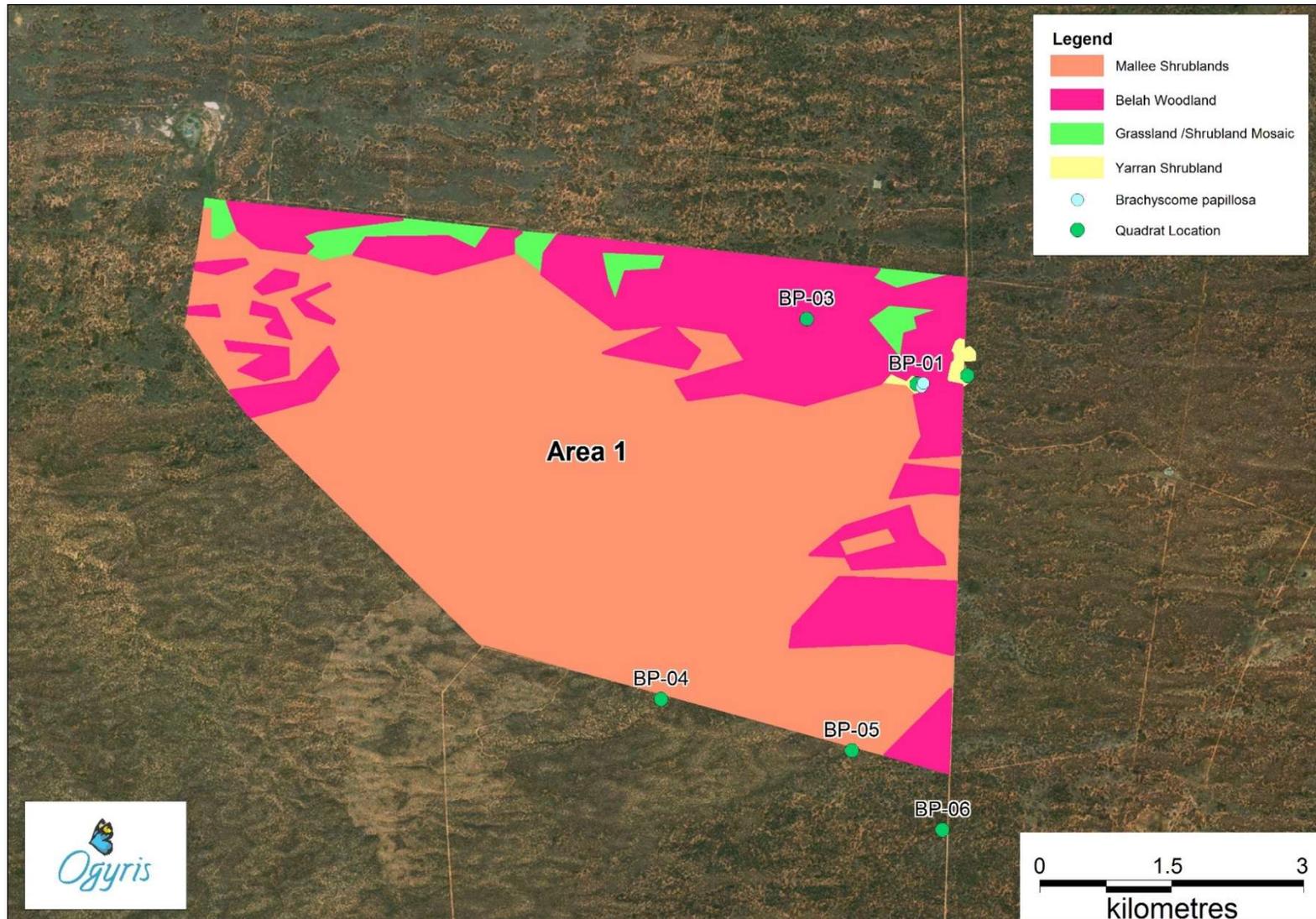


Figure 4: Boree Plains Area 1 potential offset location. The approximate extent of a Yarran Shrubland present has been indicated. This plant community contained the EPBC and TSC listed vulnerable species Mossgiel Daisy (*Brachyscome papillosa*).



Plate 1: Yarran Shrubland in Boree Plains Offset Study Area 1, at quadrat BP-01. This site contained 72 plant taxa of which only 10 were alien plants.



Plate 2: Yarran Shrubland in Boree Plains Offset Study Area 1, at quadrat BP-02. This site contained 81 plant taxa of which only 12 were alien plants.

Rare or Threatened Plant Considerations The most important plant species found in the Boree Plains Offset Study was Mossgiel Daisy (*Brachyscome papillosa*) which was found at two locations within the Yarran Shrubland in Area 1. The locations of this plant have been shown on Figure 4. Other plants of interest, all recorded from the Spinifex-Mallee in the Mandelman Land System component of the area included:

- *Daviesia ulicifolia* subsp. *ulicifolia* “a bizarre plant with very long leaves” (Neville Walsh, personal communication from MEL, 18 November 2016).
- *Logania nuda*
- *Bossiaea walkeri*

The Mandelman Land System Spinifex-Mallee part of Area 1 is a very strong candidate to contain a number of NSW TSC listed plant taxa. Some distinct possibilities include Harrow Wattle (*Acacia acanthoclada*), Bitter Quandong (*Santalum murrayanum*) and Pink Velvet-bush (*Lasiopetalum behrii*).

3.2 Area 2 – Pattersons South Paddock

The Survey Area The survey area for Area 2 is shown on Figure 5. The area assessed was ~1,950 Ha existing in the southern sector of Pattersons Paddock bounded by the Boree Plains-Gol Gol Road to the east, the Atlas-Campaspe Private Conservation Reserve to the west and a track without a bordering fence line which separated Area 1 from Area 2. Only the perimeter was driven around this site.

Vegetation Communities Present Area 2 collectively contains approximately 1190 Ha of Spinifex-Mallee together with Chenopod Sandplain Mallee, of which the former plant community comprises the majority. The remaining area is comprised of Belah-Rosewood Woodland comprising approximately 760 Ha. Vegetation quadrat sites were surveyed from four locations from Area 2, including one elevated Spinifex-Mallee dune crest location (quadrat BP-04), a Chenopod Sandplain Mallee site (quadrat BP-05) and two Belah-Rosewood Woodland sites (quadrats BP-06 and BP-07). Plates 3 and 4 illustrate the vegetation at sites BP-05 and BP-06, respectively. In general terms, the vegetation of Area 2 was in very good condition with high indigenous plant diversity. The dune crest mallee site recording 51 indigenous plant taxa and only one alien plant taxon. The Mandelman Land System Spinifex-Mallee in this block was often characterized by Mallee Teatree (*Leptospermum coriaceum*) clad dunes which were present on spectacularly high dune crests where numerous species found nowhere else in the Offset study were present. Elsewhere, indigenous plant diversity was also high at > 40 species per 0.1 Ha quadrat. The Spinifex-Mallee in this block contains a Malleefowl (*Leipoa ocellata*) nest, although this appeared not to have been recently used.

Threatened Plant Community Considerations Sandhill Pine Woodland was not present in Area 2, although a small patch of Yarran Shrubland (< 5 Ha) was found.

Rare or Threatened Plant Considerations The Mandelman Land System Spinifex-Mallee part of Area 1 is a very strong candidate to contain a number of NSW TSC listed plant taxa. Some distinct possibilities include Harrow Wattle (*Acacia acanthoclada*), Bitter Quandong (*Santalum murrayanum*) and Pink Velvet-bush (*Lasiopetalum behrii*).

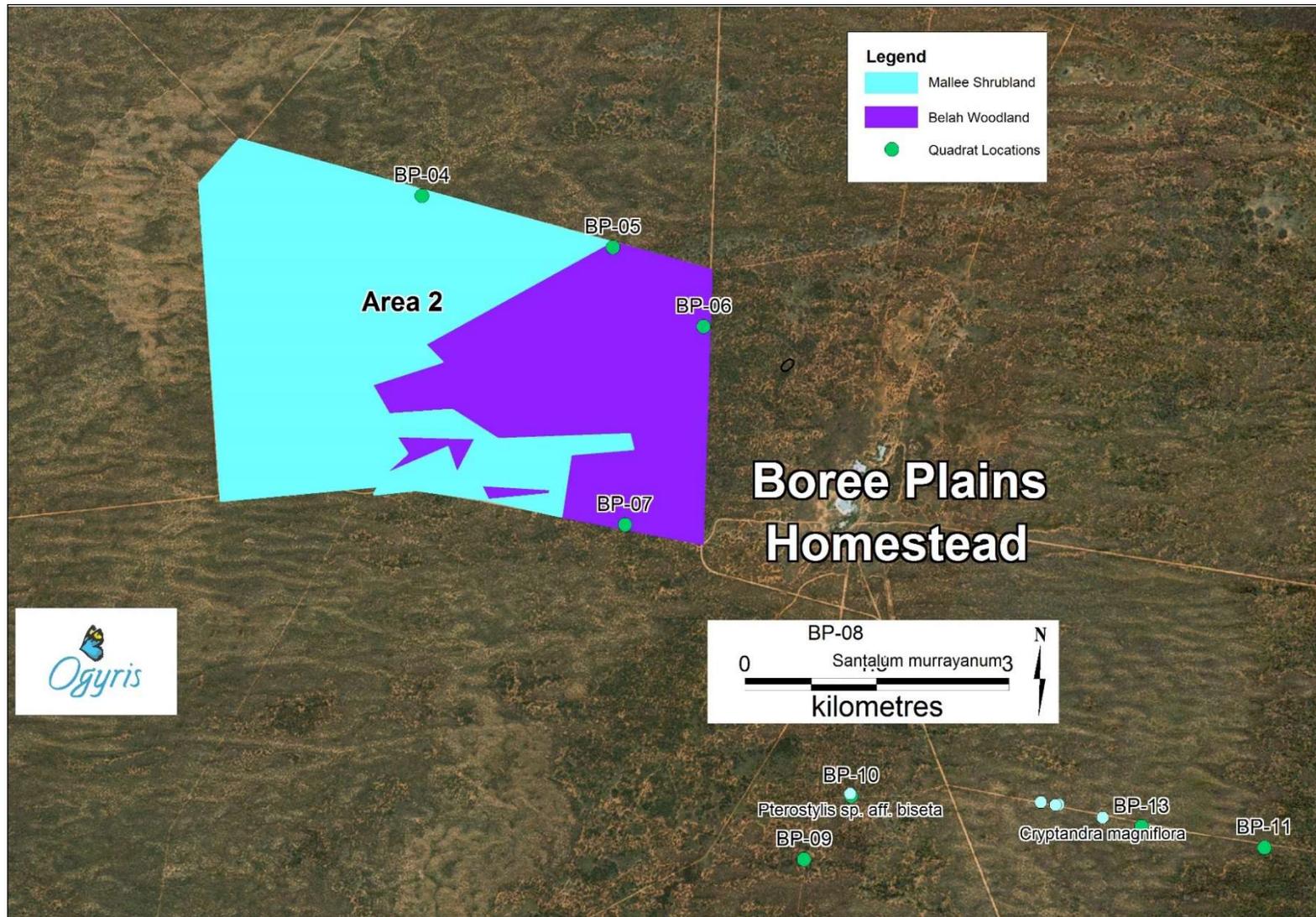


Figure 5: Boree Plains Area 2 potential offset location. This part of the Boree Plains property was dominated by Spinifex-Mallee, Chenopod Sandplain Mallee and Belah-Rosewood Woodland.



Plate 3: Chenopod Sandplain Mallee at quadrat site BP-05 in Area 2 of the Boree plains property. The vegetation was in good quality with 42 indigenous plant taxa and 4 alien plant taxa.



Plate 4: Belah-Rosewood Woodland at quadrat site BP-05 in Area 2 of the Boree plains property. The vegetation was in good quality with 45 indigenous plant taxa and 7 alien plant taxa.

3.3 Area 3 – Mildura and Balranald Southwest paddock

The Survey Area The survey area for Area 3 is shown on Figure 6. The area assessed was irregular in shape due to a shared boundary with the Campaspe ML as well as the location of internal property tracks. The area comprised 2,410 Ha bounded in the east and north by the Boree Plains-Gol Gol Road, to the south by the Carawatha-Boree Plains property boundary fence line as well as the Campaspe ML boundary, and to the west by an internal property track. A number of tracks and internal property fence lines facilitated access across a good proportion of this block.

Vegetation Communities Present The vegetation communities present were the most diverse of the four areas assessed. Spinifex-Mallee (see Plate 6) and Chenopod Sandplain Mallee collectively were the dominant plant communities comprising 1485 Ha, followed by Belah-Rosewood Woodland with 775 Ha (see Plate 6). Also present was a Pine Woodland, which in places was ecotonal with Belah-Rosewood Woodland (see Plate 7), and in others a distinctive community in its own right which we have tentatively assigned to Sandhill Pine Woodland. This Pine Woodland (see Plate 8), which occupied sizable tracts of land at the southern end of the Atlas ore body, was treated poorly in the AMBS (2013) study where it was lumped erroneously with Belah-Rosewood Woodland and not considered as a separate plant community.

Threatened Plant Community Considerations Area 3 contained ~ 145 Ha of Sandhill Pine Woodland of such quality, it was difficult to assign it to this plant community designation. Elsewhere within the Hatfield West area, Sandhill Pine Woodlands were in such poor condition through over-use for fence posts and over-grazing, it is difficult to imagine what something approaching a benchmark condition would actually look like. Although impacted by fire, storm damage from high winds and lightning, some cutting of stumps as well as grazing, the Sandhill Pine Woodlands in Area 3 and adjoining parts of the Carawatha property (also shown) were as good as the lead author has seen, including in better condition than all assessed in the southeast Australian assessment of Pine Woodlands and allied vegetation undertaken for the Australian National Parks and Wildlife study (Sluiter *et al.* 1993). Diversity was exceedingly high with 62 indigenous plant taxa, balanced by a moderately high weed component (8 species). The plant community also contained many indigenous species not recorded elsewhere within the Boree Plains Offset property study.

Unfortunately, however, no sizable areas of Yarran Shrubland were found.

Rare or Threatened Plant Considerations The TSC listed endangered species Bitter Quandong (*Santalum murrayanum*) (see Plate 9) was found at the northern end of Area 3 in close proximity to the Boree Plains Homestead. The species was found in two locations, approximately 100m apart. A Greenhood orchid, “probably an unnamed member of the *Pterostylis. biseta* complex” (David Jones *personal communication* 17 November 2016), was also located (see Plate 10). This would appear to be a new species and is definitely not Cobar Greenhood (*Pterostylis cobarensis*), (Neville Walsh *personal communication* 17 November 2016). The location of these plant taxa in Area 3 is shown on Figure 8.

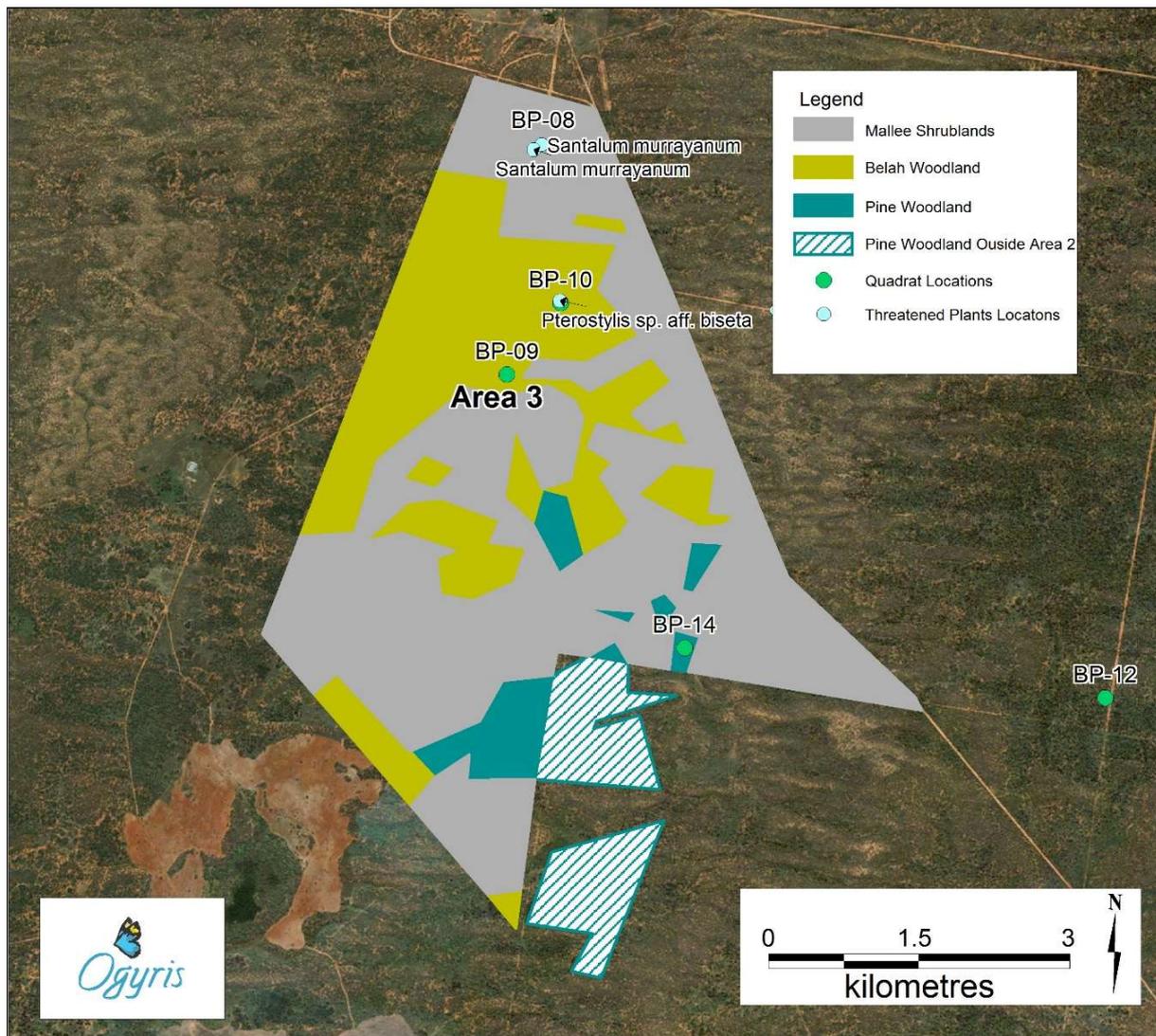


Figure 6: Boree Plains Area 3 potential offset location. This part of the Boree Plains property was characterized by a diverse mix of Spinifex-Mallee, Chenopod Sandplain Mallee, Belah-Rosewood Woodland, Sandhill Pine Woodland, Open Grassland and Hopbush-Turpentine Shrubland. The location of the TSC listed Bitter Quandong (*Santalum murrayanum*) and an undescribed Greenhood Orchid (*Pterostylis* sp. aff. *biseta*) have been shown. Extremely important areas of Pine Woodland have been shown on the adjoining Carawatha property as well.



Plate 5: Spinifex-Mallee at quadrat site BP-08 in Area 3 of the Boree plains property. The vegetation was in good quality with high indigenous plant diversity (47 taxa) and only 1 alien plant taxon. The TSC Act endangered species Bitter Quandong (*Santalum murrayanum*) was found at this location.



Plate 6: Belah-Rosewood Woodland at quadrat site BP-10 in Area 3 of the Boree plains property. The vegetation was in good quality with high indigenous plant diversity (37 taxa) and 2 alien plant taxa. An extremely rare Greenhood orchid was found at this location.



Plate 7: Belah-Rosewood Woodland containing White Cypress-pine (*Callitris glaucophylla*) at quadrat site BP-09 in Area 3 of the Boree plains property. The vegetation was in good quality with high indigenous plant diversity (50 taxa) and 8 alien plant taxa.



Plate 8: Sandhill Pine Woodland dominated by White Cypress-pine (*Callitris glaucophylla*) at quadrat site BP-14 in Area 3 of the Boree plains property. The vegetation was in good quality with high indigenous plant diversity (62 taxa). Alien plant diversity was also moderately high with 8 taxa.



Plate 9: The NSW endangered species Bitter Quandong (*Santalum murrayanum*) in Area 3 at the Boree Plains property. Two specimens were present ~100m apart.



Plate 10: Undescribed Greenhood Orchid (*Pterostylis* sp. aff. *biseta*), found in Belah-Rosewood Woodland in Area 3.

3.4 Area 4 – Balranald Paddock

The Survey Area The survey area for Area 4 is shown as a Vegetation Map on Figure 7. The area assessed was ~3,060 Ha existing in the Balranald Paddock to the east of the Boree Plains-Gol Gol Road and southeast of Boree Plains Homestead. The southern boundary borders the Carawatha property with the eastern border being the Boree Plains boundary fenceline.

Vegetation Communities Present The main vegetation communities present were Spinifex-Mallee (see Plate 11) and Chenopod Sandplain Mallee followed by Belah-Rosewood Woodland (see Plate 12). The Spinifex-Mallee was the dominant mallee plant community and comprised the overwhelming majority of the unit mapped as Mallee which totalled 1750 Ha. Belah-Rosewood Woodland in Area 4 comprised 1285 Ha. A small area of treeless vegetation near the Boree Plains Homestead comprised ~25 Ha.

Threatened Plant Community Considerations Area 4 contained no examples of either Sandhill Pine Woodland or Yarran Shrubland large enough to map.

Rare or Threatened Plant Considerations The TSC listed endangered species Bitter Quandong (*Santalum murrayanum*) and the undescribed Greenhood Orchid (*Pterostylis* sp. aff. *biseta*) found in Area 3, were also found in Area 4 as well. Also of interest from Area 4 was the occurrence of Mallee Cryptandra (*Cryptandra magniflora*). This species is known from only 6 previous collections in New South Wales, and none from within 50km of the Locality. Figure 10 is an Atlas of Living Australia map (ALA 2016) showing the distribution of Mallee Cryptandra in NSW and nearby VIC and SA. The species is not even listed on the NSW PlantNet website, but definitely occurs within NSW where it is present at Scotia Sanctuary in a private conservation area, and near Pooncarie, Ellerslie and Trentham Cliffs on leasehold land. Aside from the Scotia Sanctuary record, the other locations for Mallee Cryptandra in NSW suggest it is not recorded within a known NSW reserve or dedicated Private Conservation Agreement Area. Given the broad distances between populations across NSW distribution of this species, the poor reservation status and the low population numbers, Mallee Cryptandra would qualify as a threatened species in NSW.

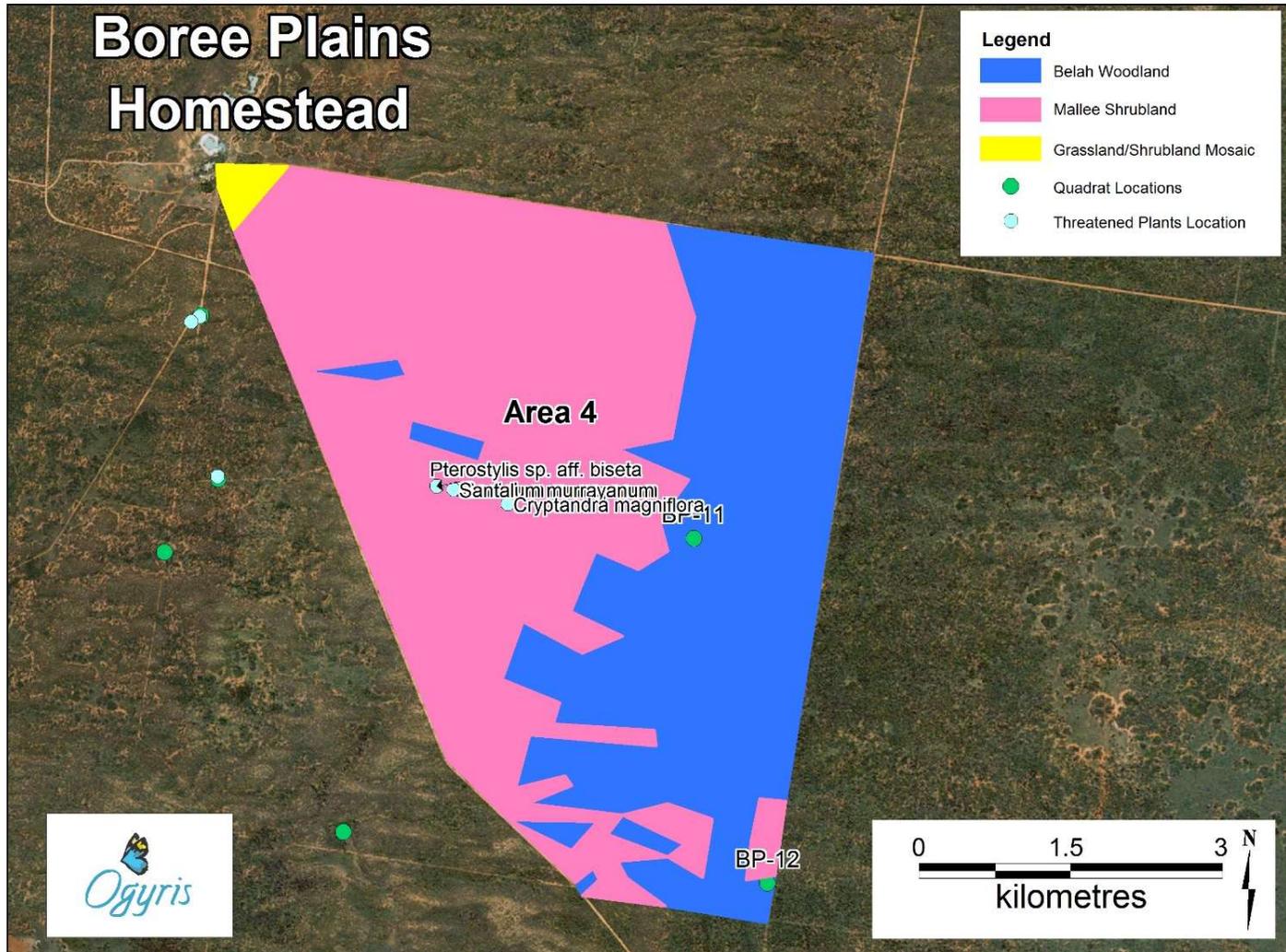


Figure 7: Boree Plains Area 4 potential offset location. This part of the Boree Plains property was dominated by Spinifex-Mallee and Belah-Rosewood Woodland. The location of the TSC listed Bitter Quandong (*Santalum murrayanum*) and an undescribed Greenhood Orchid (*Pterostylis* sp. aff. *biseta*) have been shown. The location for Mallee Cryptandra (*Cryptandra magniflora*), an unlisted but exceedingly rare plant in NSW has also been shown.



Plate 11: Spinifex-Mallee at quadrat site BP-13 in Area 4 of the Boree plains property. The vegetation was in good quality with high indigenous plant diversity (49 taxa) and only 1 alien plant taxon.



Plate 12: Belah-Rosewood Woodland at quadrat site BP-12 in Area 4 of the Boree plains property. The vegetation was in good quality with high indigenous plant diversity (46 taxa), although 8 alien plant taxa were also present. The unusual pale green climber at right of photograph is Gargaloo (*Parsonsia eucalyptophylla*).

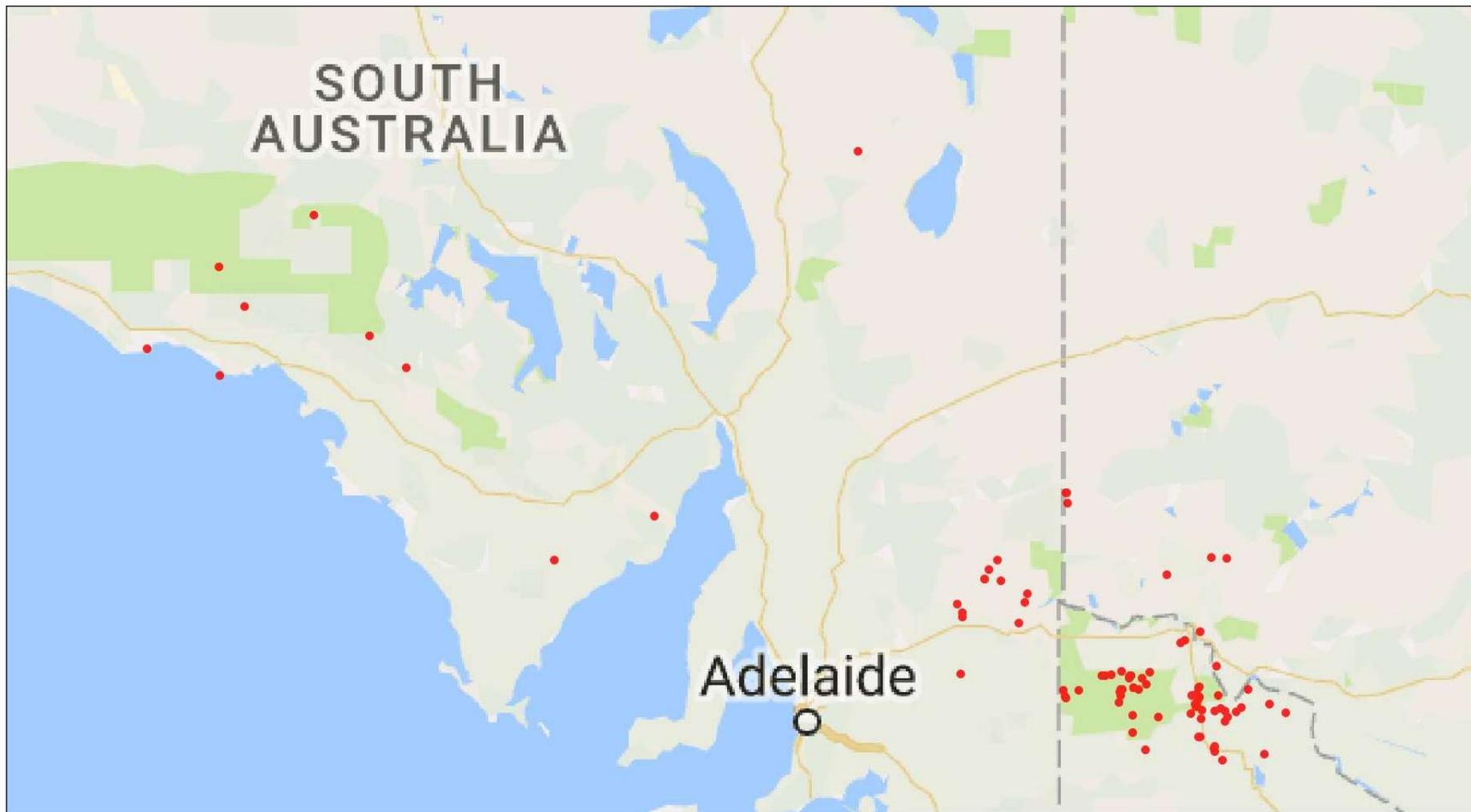


Figure 10: Atlas of Living Australia map showing the distribution of Mallee Cryptandra (*Cryptandra magniflora*) across Mallee Regions of southern Australia. This species is known from only six locations in NSW and is considered to be endangered and eligible for listing under the TSC Act

3.5 Fauna Considerations

Previous surveys in vicinity of proposed offset areas. A review of the previous Atlas-Campaspe Mineral Sands Project EIS Fauna Assessment (Australian Museum Business Services [AMBS] 2013) desktop assessment listed 55 fauna species listed as threatened under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and under the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), which included two frogs, six reptiles, 36 birds and 11 mammals. This included species that were previously recorded within a 20 km radius of the study area (Atlas of NSW Wildlife) and species predicted to occur with a 20 km radius of the study area by the Federal Protected Matters Search Tool (PMST). The previous EIS fauna surveys (AMBS 2013) recorded 219 fauna species across the broad study area (MCTR study area/offset area), including three frogs, 43 reptiles, 140 birds and 33 mammals. The AMBS 2013 surveys recorded a total of 28 threatened fauna species across the study area including four reptiles (all listed under TSC Act), 15 birds (all listed under TSC Act and three species also listed under the EPBC Act) and nine mammals (all listed under the TSC Act and one species listed under the EPBC Act).

Relevance of previous fauna records to current offset proposal. A fauna field study of the Hatfield West Gravel Pit sites (GHD 2017) recorded several threatened species including the TSC-listed Little Pied Bat (*Chalinolobus picatus*) and Inland Forest Bat (*Vespadelus baverstocki*), but also Corben's Long-eared Bat (*Nyctophilus corbeni*), which is both listed under the TSC and EPBC Acts. Additional species that were not recorded during the survey but have the potential to occur within the 'gravel pits' study area include Yellow-bellied Sheath-tail-bat (*Saccolaimus flaviventris*), Major Mitchell's Cockatoo (*Lophochroa leadbeateri*), White-fronted Chat (*Epthianura albifrons*), Hooded Robin (*Melanodryas cucullata*), Varied Sittella (*Daphoenositta chrysoptera*) and Gilbert's Whistler (*Pachycephala inornata*).

The AMBS 2013 surveys recorded each of these species across both the study area including the offset area for the Atlas-Campaspe Mine:

- Little Pied Bat – recorded from 21 locations within the proposed mine footprint and 12 locations within the proposed offset;
- Inland Forest Bat – recorded at 10 locations within the proposed mine footprint and nine locations within the proposed offset;
- Corben's Long-eared Bat – Recorded from eight locations within the proposed mine footprint and nine locations within the proposed offset;
- Yellow-bellied Sheath-tail-bat – Recorded in six locations within the proposed mine footprint and eight locations within the proposed offset area;
- Major Mitchell's Cockatoo – Recorded from 10 locations within the proposed mine footprint and 15 locations within the proposed offset;
- White-fronted Chat – Recorded from four locations within the proposed offset and one location within the proposed mine footprint.;
- Hooded Robin – Recorded from six locations within the proposed mine footprint, six records from the offset and four from surrounding habitat;
- Varied Sittella – Recorded from five locations within the proposed mine footprint and three within the proposed offset reserve; and
- Gilbert's Whistler – Recorded from two locations outside of the proposed mine footprint and one location within the proposed offset.

It is highly likely that Belah-Rosewood Woodland in the Boree Plains search areas surveyed would contain Corben's Long-eared bat, Little Pied Bat and Little Forest Bat due to proximity to known locations, as well as quality of habitat.

4.0 DISCUSSION

4.1 Boree Plains Vegetation Condition

The Boree Plains property (Western Lands Lease 2604 deposited in Plan 761603) is leased for the purposes of 'Pastoral and Recreational Hunting' and comprises 23,788 Ha which is rated to carry 1 Flock Sheep to 12.1 Ha. The property has until recently, been used solely for cattle grazing, but a recent change of ownership has seen the property transfer to the ownership of Cristal Mining Australia Ltd. with mining to occur at the Atlas-Campaspe Mines, whilst approximately 1/3 of the property will be conserved in perpetuity as a Private Conservation Reserve. The former owner leases the non-reserve section of the property where light grazing still occurs. Boree Plains contains large areas of Spinifex-Mallee vegetation which provides little fodder to stock. The property appears to have been lightly grazed which is evident from the condition of the vegetation which can be considered to be excellent in mallee areas and very good or excellent in most Belah Woodland areas. The influence of weeds is almost negligible in mallee vegetation with typically 1-2 species present only. Belah Woodlands carry a higher weed species compliment, typically 6-10 species, but weed cover is low. This contrasts with the Langleydale and Iona properties on which the Hatfield West Gravel Pit project is proposed to be based. At that location, 37 weed taxa were recorded in a little over 100 Ha of vegetation with problems weeds such as the Weed of National Significance in African Boxthorn (*Lycium ferocissimum*) common. In terms of a straight comparison of vegetation condition, the Boree Plains property is unequivocally in vastly superior condition to the land where the Hatfield West Gravel Pit Project is proposed to occur.

4.2 Targeting a Biodiversity Offset Package

The primary objective of any offset package should be to ensure that the biodiversity values impacted by the Hatfield West Gravel Pit Project would be enhanced in the long-term by the careful selection of an appropriate parcel of similar remnant vegetation within the Locality. The following benefits should be achieved through the application of the proposed offset strategy:

1. The addition of the managed offset areas to that already conserved within Crown and private ownership should enhance the conservation outcomes for the wider region.
2. Management of the offset sites for conservation should result in grazing pressures from feral animal species being significantly reduced and lead to improved biodiversity values.
3. The proposed offsets should contain similar vegetation types and fauna habitat to what occurs within the project area however the area of conserved vegetation will be increased.

4.3 Biodiversity Offset Options for Consideration

All Biodiversity Offset Options proposed and discussed below are shown on Figure 11. All are larger than the target area of 716 Ha proposed to offset the potential loss of vegetation at the Hatfield West gravel pit sites.

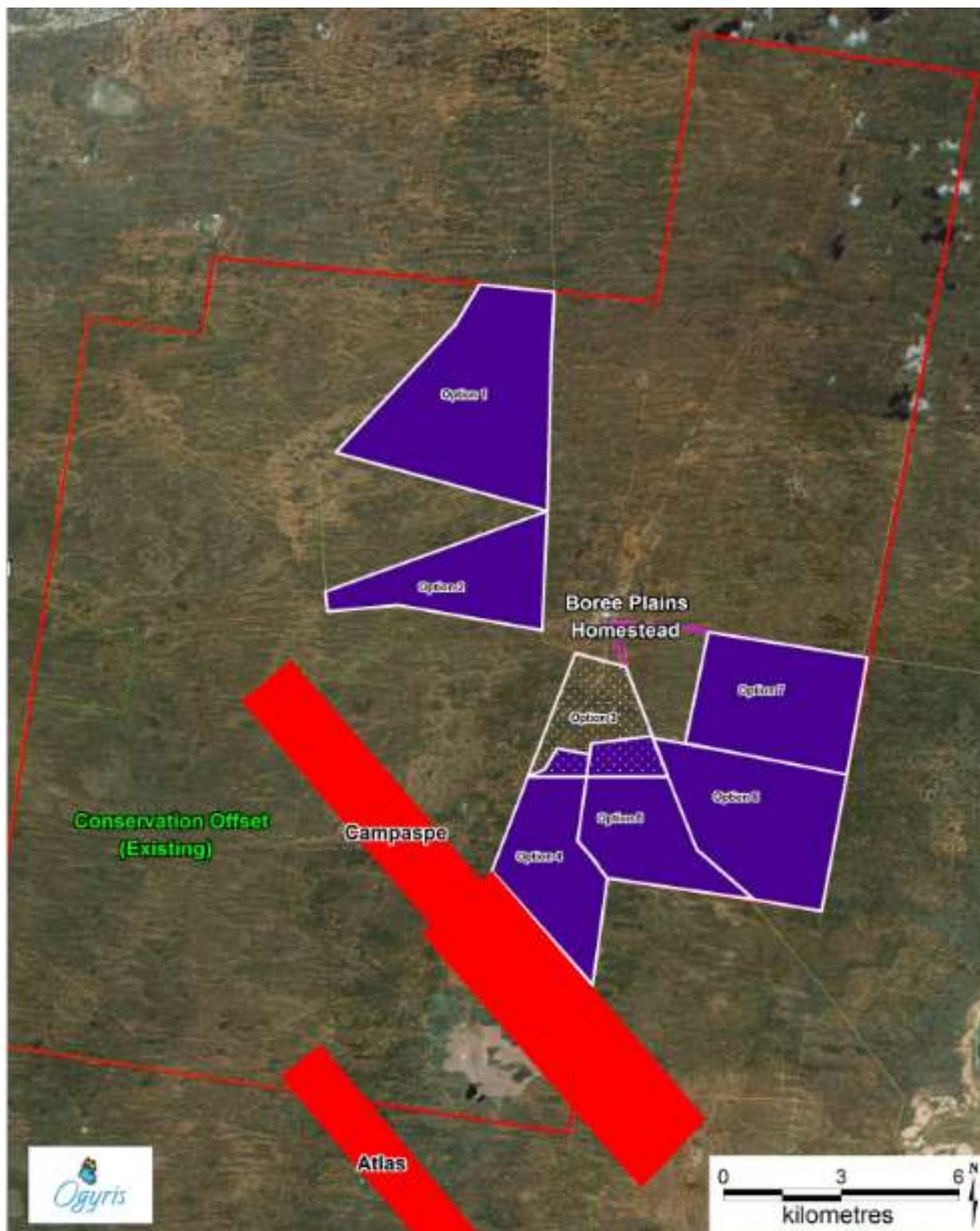


Figure 11: Biodiversity Offset Options (1-7) for consideration as land offsets for loss of the proposed Hatfield West Gravel Pits associated with Atlas-Campaspe MCTR road construction and maintenance.

Option 1 Area 1 – Approximately 1890 Ha at the Northern-most Part of Boree Plains

This option, would conserve an area greater than that proposed for clearance.

Advantages

- conserves known high quality Yarran Shrubland
- conserves known Mossgiel Daisy habitat
- conserves a significantly greater amount than the target area of Belah-Rosewood Woodland
- conserves Open Grassland-Shrubland Mosaic
- conserves a sizable area of Spinifex-Mallee on Mandelman Land System
- connects through narrow entrance with existing Atlas-Campaspe Conservation Area
- Requires no vegetation clearing for fenceline construction due to the alignment being along existing tracks.

Disadvantages

- Does not include Sandhill Pine Woodland.
- Does not include known TSC endangered plant Bitter Quandong, although the possibility is not precluded by including Spinifex-Mallee within the designated area.
- Requires over 18km of new Conservation Offset exclusion fencing.

Option 2 Area 2 – Approximately 900 Ha Northwest of Boree Plains Homestead

This option would conserve an area substantially greater than that proposed for clearance.

Advantages

- conserves greater (~590 Ha) than the target area (430 Ha) of Belah-Rosewood Woodland, of vastly superior quality.
- conserves a sizable area of Spinifex-Mallee on Mandelman Land System
- is contiguous with existing Atlas-Campaspe Conservation Area over a 2km shared boundary
- contains the greatest shared boundary with the Atlas-Campaspe Conservation Area
- minimal vegetation (~4 Ha) removed for fencing.
- conserves a small area of Yarran Shrubland.

Disadvantages

- Does not include known TSC endangered plant Bitter Quandong, although the possibility is not precluded by including Spinifex-Mallee within the designated area.
- Does not include Sandhill Pine Woodland.
- Is dominated by just three vegetation communities only (Belah-Rosewood, Spinifex-Mallee and Chenopod Sandplain Mallee)
- Requires 11km of new Conservation Offset exclusion fencing.

Option 3 Area 3 – Approximately 732 Ha South of Boree Plains Homestead

This area would conserve an area approximately the size of the target offset for the Hatfield West Gravel Pit Project.

Advantages

- conserves greater than the target area of Belah-Rosewood Woodland
- conserves a sizable area of Spinifex-Mallee
- conserves known locations for Bitter Quandong and the undescribed Greenhood Orchid species.

Disadvantages

- not contiguous with existing Atlas-Campaspe Conservation Area and would require approximately 11km of new Conservation Offset exclusion fencing
- Does not include Yarran Shrubland or Sandhill Pine Woodland
- Is dominated by just three vegetation communities only (Belah-Rosewood, Spinifex-Mallee and Chenopod Sandplain Mallee)

Option 4 Area 3 - 969 Ha Contiguous with Campaspe Mine

This area would conserve an area substantially greater than that proposed for clearance.

Advantages

- Contains Sandhill Pine Woodland
- Contains a sizable area of Spinifex-Mallee and Chenopod Sandplain Mallee
- would serve as an ecological re-colonization area for the Campaspe Mine, in the newly created rehabilitation landscape.
- minimal vegetation (~5 Ha) removed for fencing.

Disadvantages

- not contiguous with existing Atlas-Campaspe Conservation Area
- Would require over 16km of fencing, although only 11.5km would be new Conservation Offset exclusion fencing due to shared boundary with Campaspe
- Exists next to disturbed area within the Campaspe ML boundary
- Contains some disturbed areas around ground tanks and troughs.
- Dominated by Spinifex-Mallee and Chenopod Sandplain Mallee
- Has lower than the target area of Belah-Rosewood
- Does not contain Yarran Shrubland.
- Does not include known TSC endangered plant Bitter Quandong, although the possibility is not precluded by including Spinifex-Mallee within the designated area.

Option 5 Area 3 - 950 Ha

This area would conserve an area substantially greater than that proposed for clearance.

Advantages

- Contains Sandhill Pine Woodland
- Contains a sizable area of Spinifex-Mallee and Chenopod Sandplain Mallee
- Contains approximately the target area of Belah-Rosewood Woodland
- Minimal vegetation (~2 Ha) removed for fencing.

Disadvantages

- not contiguous with existing Atlas-Campaspe Conservation Area
- would require 16km of new Conservation Offset exclusion fencing
- Dominated by Spinifex-Mallee and Chenopod Sandplain Mallee
- Has lower than the target area of Belah-Rosewood
- Does not contain Yarran Shrubland
- Does not include known TSC endangered plant Bitter Quandong, although the possibility is not precluded by including Spinifex-Mallee within the designated area.

Option 6 Area 4 -1357 Ha of Balranald Paddock South

This area would conserve an area substantially greater than that proposed for clearance.

Advantages

- conserves greater than the target area of Belah-Rosewood Woodland
- conserves a sizable area of Spinifex-Mallee and Chenopod Sandplain Mallee
- conserves known locations for Bitter Quandong (*Santalum murrayanum*) and Mallee Cryptandra (*Cryptandra magniflora*)
- minimal vegetation (~3 Ha) removed for fencing.

Disadvantages

- not contiguous with existing Atlas-Campaspe Conservation Area
- would require 16km of new Conservation Offset exclusion fencing
- Does not contain Yarran Shrubland or Sandhill Pine Woodland

Option 7 Area 4 -1234 Ha of Balranald Paddock North

This area would conserve an area substantially greater than that proposed for clearance.

Advantages

- conserves greater than the target area of Belah-Rosewood Woodland
- conserves a sizable area of Spinifex-Mallee and Chenopod Sandplain Mallee
- conserves known locations for the un-named Greenhood orchid species and Mallee Cryptandra (*Cryptandra magniflora*)
- minimal vegetation (~3 Ha) removed for fencing.

Disadvantages

- not contiguous with existing Atlas-Campaspe Conservation Area
- would require 16km of new Conservation Offset exclusion fencing
- Does not contain Yarran Shrubland or Sandhill Pine Woodland

4.4 Habitat for Threatened Fauna

Given the prevalence of the threatened species outlined in Section 3.5 within both the proposed 15,830 Ha Atlas-Campaspe offset and surrounding habitats and presence of suitable habitat within the range of offset options presented above, it is expected that most, if not all, of these species will be adequately catered for by the offset options outlined. In particular, the EPBC-listed Corben's Long-eared Bat is known from nine locations within the Atlas-Campaspe

conservation offset and a total of 18 known locations within the broader Atlas-Campaspe study area. Along with the two new locations within the gravel pits study area (GHD 2017), 20 locations are known across the area. Only Option 4 of a total of 7 contains less than the target area of Belah-Rosewood Woodland and even this area still contains a sizable amount of this plant community. Indeed, it is expected that all of the proposed offsets contain, in varying proportions, high quality Belah-Rosewood Woodland (e.g. Area 1 contains 995 ha, Area 2 contains 590 ha, Area 3 contains 775 ha and Area 4 contains 1285 ha) that would address the habitat requirements of this species as well as the other TSC-listed threatened bats and woodland birds.

5.0 CONCLUSIONS

The Boree Plains pastoral property located at Hatfield West in the Balranald Shire Council LGA contains 23,788 Ha of remnant vegetation leased under Western Lands Lease to Cristal Mining Australia Ltd. Cristal Mining Australia Ltd. plan to develop a mineral sands mining precinct based at the property where two ore bodies known as Atlas and Campaspe will be developed over the next 20 years. A road known as the Atlas-Campaspe MCTR from the Atlas Mine will follow an existing alignment to the Hatfield township. This road will require a large volume of calcrete road base for a period of 25 + years in order to upgrade and maintain the MCTR. A large Biodiversity Offset of approximately 8,500 Ha has been set aside on the Boree Plains property, as well as small areas of surrounding properties, in order to offset the loss of remnant vegetation from both the Atlas and Campaspe Mines, as well as associated infrastructure. Three areas totaling 113.41 Ha and containing 108.78 Ha of remnant vegetation are proposed for clearance in order to extract the gravel resource required to maintain the MCTR. A parallel flora report on the Hatfield West Gravel Pit Project (Sluiter and Allen 2016) has estimated the potential Biodiversity Offset package required to compensate for the loss of this vegetation as a minimum of 716 Ha from within the Locality, preferably containing at least 430 Ha of Belah-Rosewood Woodland as well as a sizable area of Sandhill Pine Woodland of approximately 73 Ha, if this can be found.

A biodiversity assessment was conducted in late October 2016 on the Boree Plains property of vegetated areas not considered by AMBS (2013) for inclusion within the Atlas-Campaspe Biodiversity Offset area. This survey identified four areas as potential offset locations, from which seven options have been selected as potential offset sites for the Hatfield West Gravel Pit Project. All easily accommodate the target total conserved area of 716 Ha with six of the seven options also matching or increasing the target area of Belah-Rosewood Woodland. The occurrence of this plant community, in appreciably better condition than occurs at the Hatfield West Gravel Pit Subject Site, in all seven option packages would address the habitat requirements of Corben's Long-eared Bat as well as the other TSC-listed threatened bats and woodland birds known to occur in land immediately surrounding our study area. Only certain options, however, include Sandhill Pine Woodlands, but where these are not included, the selected options include other biodiversity benefits including NSW threatened plant species including Mossgiel Daisy (*Brachyscome papillosa*) and/or Bitter Quandong (*Santalum murrayanum*), or the threatened NSW plant community known as Yarran Shrubland.

6.0 REFERENCES

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