



Silverton Wind Farm

Barrier Range Dragon Management Plan

FINAL REPORT

Prepared for GE Renewable Energy

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1 Introduction

1.1 Background

The Silverton Wind Farm is located approximately 5 kilometres north of Silverton and 25 kilometres northwest of Broken Hill in the far west of NSW (Figure 1). The Silverton Wind Farm was approved by the then Minister for Planning in May 2009. The Wind Farm was declared to be a critical infrastructure project under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), as an energy generating development with the capacity to generate at least 250MW.

Project and Concept Approval was approved in May 2009, pursuant to Part 3A of the EP&A Act. Further modification (Modification 3) was then approved in December 2016 in accordance with Clause 8J (8) of the *Environmental Planning and Assessment Regulation 2000* and the transitional arrangements of the EP&A Act. Approval was granted for the modifications to the project approval (08_022 MOD 3) and concept approval (08_0022MOD2) subject to the conditions set out in the instrument of approval (Notice of Modification Project Approval 08_022 under the *Environment Planning and Assessment Act 1979*). The detailed project history and compliance with conditions of consent is outlined in the Silverton Wind Farm Biodiversity Adaptive Management Plan BAMP (Biosis 2018a).

Condition 18(c) of the Project Approval requires that prior to the commencement of construction, the Proponent must prepare a Biodiversity Management Plan for the project, which includes a Barrier Range Dragon Management Plan for the site. This plan has been developed to satisfy that condition, and as applicable at the time of preparing the plan, Statement of Commitments (2009) 26 and 29 for the operational phase of the wind farm.

This plan has been developed in consultation with:

- Department of Planning and Environment
- Office of Environment and Heritage

In the processes of planning for Silverton Wind Farm and investigations of Barrier Range Dragons and their habitat at the site, up to and including MOD 3 in 2016, a number of 'hotspots' for the species were identified. The concept was that particular management aimed at maintaining the population of Barrier Range Dragons would be focussed on identified hotspots. The current plan has been prepared in response to the final, 'as-built' design of the wind farm and has been further informed by surveys, detailed here, that detected and documented the species at multiple locations and allowed for characterisation of habitat for the species across the site. Management actions in the current plan remain similar to those intended to be applied to hotspots, particularly in respect of traffic management. This plan has identified multiple zones of roadside habitat where traffic management will apply and these supersede the previously allocated hotspots.

1.2 Purpose

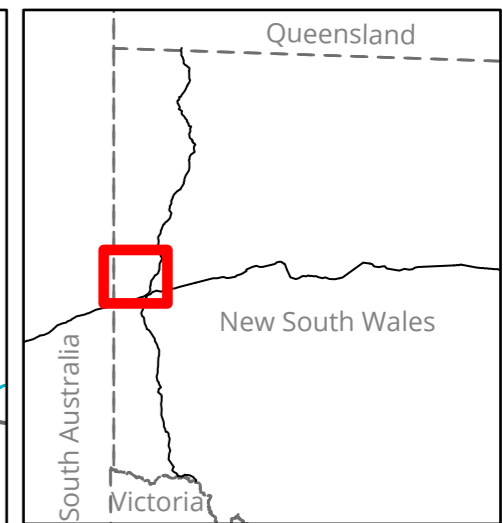
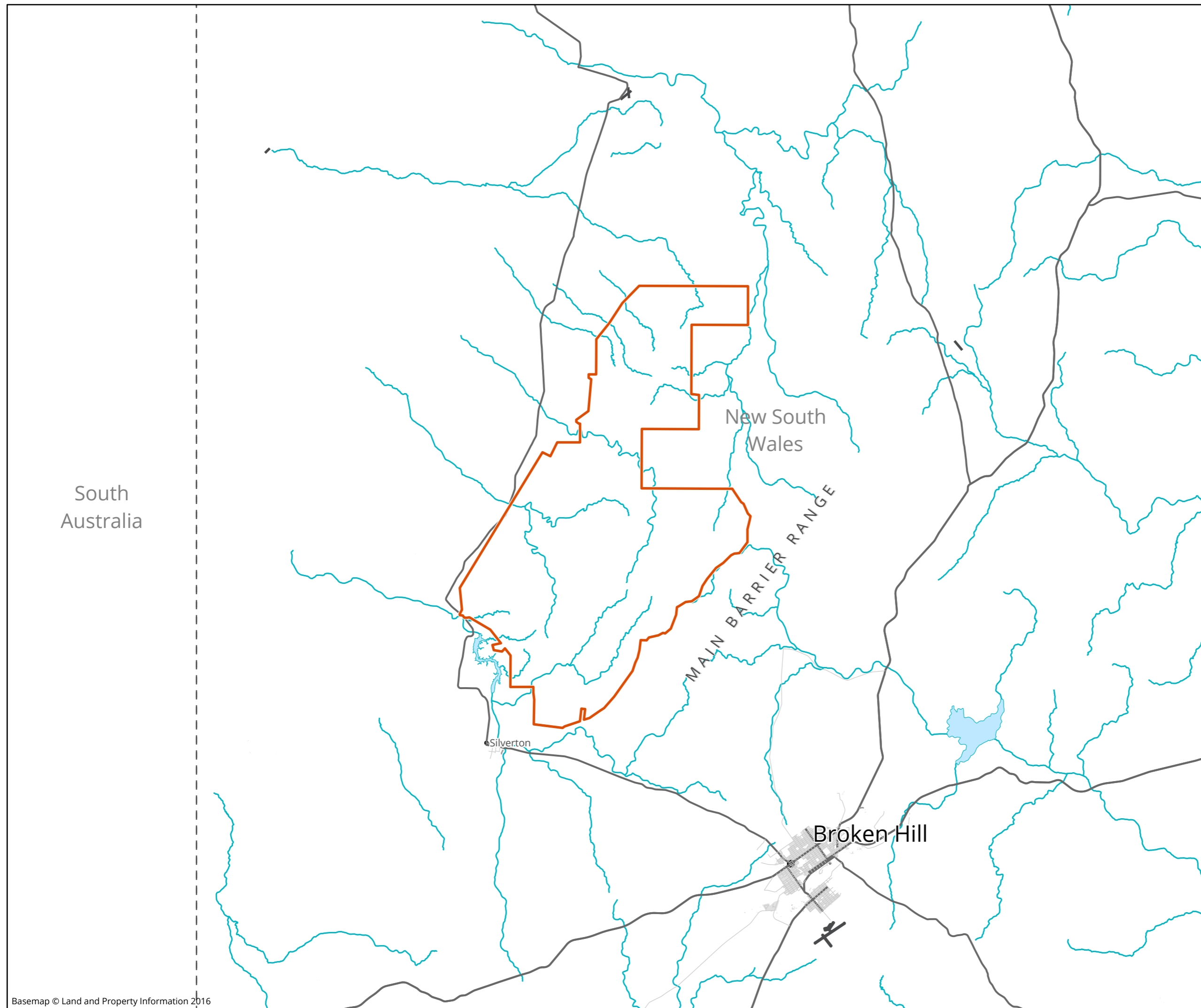
This document provides an overview of the management of Barrier Range Dragons across the Silverton Wind Farm. It was developed by a suitably qualified expert (Ian Smales, Principal Zoologist, Biosis) and provides a description of the species and its habitat and of possible effects of development and operation of Silverton Wind Farm on those values. Specific management measures to be undertaken by the wind farm to protect existing populations and to enhance conservation of the species are provided. Details of survey design and methods and of baseline surveys undertaken in early 2018 are included. These form the basis for future

monitoring in accordance with the Biodiversity Adaptive Management Plan (Biosis 2018a). Annual monitoring and reporting will be followed by a review of the management approach after the initial three year period., particularly to ensure there is a net gain in the conservation value of PGSW, Management actions will be revised following each annual monitoring period to continually improve on-ground management and ecological outcomes evaluate performance of management actions and to inform potential adaptive management responses.

1.3 Relationship to other plans

The specific management actions, monitoring and adaptive management responses in relation to Barrier Range Dragon management are described in the implementation section of the BAMP (Biosis 2018a). The overarching BAMP provides a cohesive document that details the methods, actions, monitoring and reporting identified for the Goat Management Plan (Biosis 2018b), Porcupine Grass Sparse Woodland Recovery Plan (Biosis 2018c), Barrier Range Dragon Management Plan (this document) and Vegetation Management Plan (Biosis 2018d), into one cohesive implementation document. This allows for an integrated approach to on-ground monitoring and management of biodiversity at the Silverton Wind Farm site.

This Barrier Range Dragon Management Plan is to be read in conjunction with the BAMP.



Legend


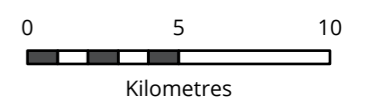
 Study area

Figure 1 - Location of the study area



Scale: 1:1:250,000@ A3
Coordinate System: GDA 1994 MGA Zone 54



Matter: 26380
Checked by RW, drawn by: ARL
Last edited by: alongmire on 04 September 2018
Location: P:\26300s\26380\Mapping\26380_PGSW_GMP

2 Barrier Range Dragon

The Barrier Range Dragon *Ctenophorus mirrityana* was recently described as a separate species from the Tawny Rock Dragon *Ctenophorus decresii* (McLean et al. 2013), and is currently documented from four sites in western New South Wales, including the Silverton Wind Farm (Sass & Swan 2010). The species is associated with rocky habitats such as outcrops, gorges, escarpments, rock spoils and scattered rock aggregates (Sass and Swan 2010; McLean et al. 2013).

The Barrier Range Dragon is listed as endangered under the NSW *Biodiversity Conservation Act 2016*. It is not currently listed under provisions of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Plates 1 and 2 show adult male and female Barrier Range Dragons photographed at Silverton Wind Farm.

2.1 Barrier Range Dragon conservation

A targeted strategy for managing this species has been developed under the Saving Our Species program administered by the Office of Environment and Heritage (OEH). OEH has established two management sites where conservation activities need to take place to ensure the conservation of this species. These are at Mutawintji National Park and Purnamoota (OEH 2018). Recent surveys have located some additional Barrier Range Dragon populations in the Broken Hill region (Marc Irvin OEH pers. comm. January 2018).

The Office of Environment and Heritage has identified the following threatening processes and activities to assist conservation of the Barrier Range Dragon (OEH 2017).

2.1.1 Threatening processes

- Habitat degradation by livestock and rabbits, particularly during drought, may decrease populations and impede dispersal.
- Predation by cats can impact upon local populations.
- Too frequent fire; risk of multiple burns within 20 years.
- Habitat degradation by goats through browsing on vegetation and disturbance to rock habitat, including pollution of key crevice habitat by scats.
- Inappropriate land management practices and/or change in land use on leasehold properties due to economic incentive.
- This species is threatened by fox predation.

2.1.2 Activities identified to assist the species

- Control vertebrate pest populations, e.g. foxes, cats, goats and rabbits.
- Reduce or exclude grazing in some areas to allow regeneration of vegetation.
- Retain understorey shrubs.
- Maintain exfoliating and soil surface rocks.



Plate 1 Female Barrier Range Dragon



Plate 2 Male Barrier Range Dragon

3 Barrier Range Dragon at Silverton

Early investigations of Barrier Range Dragon (then referred to as Tawny Rock Dragon) were carried out in 2008 by NGH Environmental to inform planning and impact assessment for Silverton Wind Farm as then proposed (NGH Environmental 2008). The wind farm design has been substantially altered since then and many locations investigated by NGH are no longer within the layout of the current development and conversely, many areas now within the layout were not investigated by NGH. They documented the species at multiple locations within the then wind farm study area and provided an analysis of habitats where the species was present and where it was absent. The majority of their sightings of the Barrier Range Dragon were on aggregations of rocks and in almost all cases were along the main ridge systems where their transect searches were concentrated. Nonetheless, more recent surveys in the Broken Hill region have found that the species does inhabit rocky environments into valleys, albeit at lower densities than on ridge-tops (Marc Irvin OEH pers. comm. January 2018).

NGH Environmental (2008) were able to show that key factors determining habitat where Barrier Range Dragons were present were percentage cover of exposed rock outcropping and percentage cover of rocks between 251-500 mm in size. The most important contributors to of habitat quality were levels of herbivore grazing and degradation of rock crevices. Degradation of crevices was due to accumulation of goat dung.

3.1 Survey for Barrier Range Dragon 2018

Surveys were undertaken in February 2018 to obtain current information about Barrier Range Dragons at Silverton Wind Farm site. Full details of the survey design and methods are set out here because surveys are intended to be replicated in future to monitor possible effects of both the operational wind farm on the species, and the effects of management measures to be implemented on behalf of the species (see Sections 4 and 5, below). Results of the 2018 surveys provide information about the current status of the Barrier Range Dragon population at the site and are documented here to provide a baseline against which to compare results of future monitoring.

The design of the survey used a sampling approach intended to obtain a good characterisation of habitat used by the species rather than an attempt to survey all potential habitat across the site. Survey sites were purposely selected to be close to and/or to include the locations of turbine hardstands, roads and underground power transmission alignments for the purpose to monitoring effects of the wind farm infrastructure on the species. As a consequence the survey sites were primarily close to or included ridge-tops, although at a number of sites habitat up to approximately 200 metres downslope from ridge crests was surveyed.

The survey design was chosen to provide a regime that can be readily applied at a selected sample of sites and that facilitates replicate counts to be made. This design will permit direct comparison of results of annual surveys into the future. Surveys in 2008 (NGH Environmental 2008) used a different design that was suited to its intended purpose of determining the presence of Barrier Range Dragons across the broader landscape of the area then under consideration for the wind farm.

In addition to records of the species collected during formal surveys at selected sites, all incidental observations of Barrier Range Dragons outside of survey sites were noted and their GPS locations were recorded. Results of the survey and of opportunistic records of the species at locations outside of survey sites provides a sound basis to determination of what constitutes suitable habitat for the species more broadly at the wind farm site.

3.1.1 Survey methods

The survey was undertaken between 19 and 23 February 2018, inclusive. Late summer was chosen as the species is active and individuals can be readily observed.

A total of 16 survey sites were selected during an initial on-site inspection. Sites were chosen to represent a sample of the following:

1. Natural rock outcrops with a complex of exposed bedrocks and loose fractured boulders of varying sizes that offered multiple potential basking and refuge microsites.
2. A mixture of naturally outcropping rocks and rocks that have been artificially moved, aggregated or turned out of the ground during wind farm construction.
3. Entirely artificial aggregations of rocks such as batters of roads and turbine hardstands created during wind farm construction.

All sites were adjacent to wind farm roads both for ease of access and to permit monitoring of the potential effects of roads on the species. The GPS location of each survey site was recorded for the purposes of future monitoring. The locations of all survey sites are shown on maps in Appendix 1. GPS co-ordinates for each site are listed in Table 1.

Table 1 GPS co-ordinates of Barrier Range Dragon survey sites

Site	Easting	Northing
1	530627	6489369
2	530787	6489085
3	529747	6488968
4	531089	6487956
5	530858	6487848
6	531418	6487346
7	531188	6486984
8	531093	6486731
9	529399	6485563
10	528220	6484368
11	528262	6483465
12	522865	6483628
13	522797	6483931
14	522797	6483976
15	522058	6481599
16	523980	6482600

Thirteen survey sites were outside of the Area 7 Goat Fence and three were inside it (see also Biosis 2018b). The dominant vegetation community within the Area 7 Goat Fence is Porcupine Grass Sparse Woodland Community. Goat density is planned to be managed within the fenced area with a view to protecting that community. A small number of survey sites for Barrier Range Dragons were chosen within that area to permit the effects of goat management on the species to be monitored.

The basic habitat type (according to the three types of rocky environments outlined above) and whether they are inside or outside of the Goat Fence are set out in Table 2, below. In addition, the presence and abundance

of goat scats was documented for each site. This was not quantified but was recorded as a relative and qualitative value (low / medium / high) allowing comparison between survey sites.

Table 2 Habitat characteristics of 16 survey sites

Site	Location	Rocky habitat type	Presence & relative abundance of goat scats
1	Outside Goat Fence	B	Low
2	Outside Goat Fence	A	Low
3	Outside Goat Fence	A	Medium
4	Outside Goat Fence	A	Low
5	Outside Goat Fence	C	Not present
6	Outside Goat Fence	A	Low
7	Outside Goat Fence	B	Low
8	Outside Goat Fence	A	Low
9	Outside Goat Fence	B	Low
10	Outside Goat Fence	B	Low
11	Outside Goat Fence	B	Low
12	Inside Goat Fence	B	Low
13	Inside Goat Fence	B	Low
14	Inside Goat Fence	B	Low
15	Outside Goat Fence	B	Low
16	Outside Goat Fence	A	High

The following metadata was recorded for each survey:

- Air temperature
- Humidity
- Average wind speed
- Percentage cloud cover
- Time of survey start and finish

Surveys of Barrier Range Dragons at selected sites took the form of standardised timed counts of dragons. Each survey was carried out by two experienced herpetologists. Each count was for 25 minutes (50 person-minutes). For safety reasons the two team members remained within visual distance of each other during counts, but each took a separate random path such that they were not likely to observe the same individual Barrier Range Dragons. During the surveys, observers paused frequently and used binoculars to scan habitat for dragons. The survey design using timed random meander was chosen rather than using defined area surveys because the habitat for the species was not continuous at all sites and because, while all habitat could be scanned from a distance, at some sites it was precipitous and too dangerous to access directly.

During five days of surveys each site was surveyed on four occasions. This permitted the mean number of dragons observed at each site over the duration of the entire survey to be determined. The timing of counts at each site was varied and all sites were counted during morning and afternoon. Surveys were not commenced during the hottest part of the day between 1300 and 1500 hrs when surface temperatures of many rocks exceeded 50°C and it was evident that dragons were less active and less observable.

In each count the total number of adult Barrier Range Dragons of each sex and the number of juveniles, were documented. Adult males and females are readily distinguished on the basis of very different colouration. Juveniles were distinguished from adults based on their smaller size.

3.1.2 Survey results

Weather conditions during the week of surveys were ideal for observing Barrier Range Dragons, which were active throughout all but the hottest, early afternoon parts of each day. Air temperatures during surveys ranged from 26 to 38 degrees C. Sunny conditions prevailed during the majority of most counts, with cloud cover of up to 100 percent on a very few occasions.

The results of all surveys are shown in Table 3. Barrier Range Dragons were detected at all 16 survey sites and on 53 of the 64 survey counts. The value of undertaking multiple counts is demonstrated by the fact that no dragons were observed on at least one of four counts at each of eleven sites, but they were recorded during other counts at the same sites. Overall, there was little variation in numbers of dragons detected between sites. The greatest number of dragons were recorded at sites 1, 9, 10 and 15, but these sites also had the greatest range between minimum and maximum numbers of dragons detected between counts.

The majority of dragons were observed basking on rocks and a smaller number were detected sheltering in rock crevices. While a few Barrier Range Dragons were observed on large bedrocks, it appeared that they generally prefer to use scree of jumbled and broken rocks, often around the edges and immediately downslope of outcropping bedrocks, rather than bedrocks themselves. In this respect, results of the survey concur with the finding of NGH Environmental (2008) that percentage cover of rocks between 251-500 mm in size was important for the species.

The mean and range of the number of individuals observed at each site are also shown in Table 3. These values provide a baseline against which to compare results of future surveys during operation of Silverton Wind Farm. Overall, the numbers of dragons observed during 'am' (surveys that commenced prior to 1200 hrs) and 'pm' (surveys that commenced after 1500 hrs) did not differ substantially.

Overall, the density of dragons varied little and there was no obvious indication of substantial differences in numbers of dragons according to the three basic habitat types; sites with different values for goat scats; and, sites within and outside of the Goat Fence. Sites where the highest numbers of dragons were recorded (sites 1, 9, 10 and 15) all included a mixture of natural and artificially moved rock (i.e. were recorded as habitat type B). It should be noted that the maximum number of Barrier Range Dragons recorded in any one count is the measure most likely to reflect the absolute number of individuals inhabiting the site, albeit that it should not be taken as a true census. The mean number has been calculated and is shown in Table 3 for the primary purpose of comparison with results of surveys in future years.

The relative abundance of goat scats at the sites surveyed was recorded as 'low' or 'not present' at all but two sites (sites 3 and 16). We note that while goat scats were present at all sites, except site 5, their density was very variable over any given rock outcrop and we were not able to determine whether any relationship might exist between specific locations where dragons were found and locations of goat scats. In addition, at many locations scats of Euros *Macropus robustus* were also present and variable in their densities. There was no apparent correlation between documented levels of goat scats and numbers of Barrier Range Dragons.

The combined results of all counts at all sites include records of 71 adult male and 75 adult female Barrier Range Dragons. As each site was surveyed four times it is very likely that these totals include multiple records of some individuals. The records may not represent the true adult sex ratio of the species as females are more cryptically coloured than males and they may have been less readily observed. The survey method was not designed to counter any potential biases in records of males and females.

Seven juvenile Barrier Range Dragons were observed. They demonstrate that the species had successfully bred during the preceding spring/summer months. At site four a juvenile Barrier Range Dragon was observed eating the small yellow flowers of the introduced Paddy Melon *Cucumis myriocarpus*.

3.1.3 Incidental records

The locations of incidental records of the species obtained during February 2018 are shown on maps in Appendix 1.

Table 3 Results of February 2018 survey for Barrier Range Dragons at Silverton Wind Farm

Results of timed Barrier Range Dragon counts at selected survey sites													
Site	19-Feb		20-Feb		21-Feb		22-Feb		23-Feb		BRD observed per count		
	am	pm	am	pm	am	pm	am	pm	am	pm	Mean	Min	Max
1	3		8			2				0	3.3	0	8
2	2		3			2			0		1.8	0	3
3			6			4		1	2		3.3	1	6
4			4		6			0	3		3.3	0	6
5			1		2			0	3		1.5	0	3
6				0			2		1	1	1.0	0	2
7				1			0		2	0	0.8	0	2
8			3			2	2			1	2.0	1	3
9			7			11	3			5	6.5	3	11
10			10			3	6			1	5.0	1	10
11			0		2			4		1	1.8	0	4
12				0			3	2	1		1.5	0	3
13		0			2		2			1	1.3	0	2
14		3			3		0		3		2.3	0	3
15		4			2		7		2		3.8	2	7
16					3		1	0	0		1.0	0	3
Mean BRD observed per count	2.5	2.3	4.7	0.3	2.9	4.0	2.6	1.2	1.6	1.3			

Surveys for Barrier Range Dragons in 2018, reported here, found the species was considerably more widespread at the site than it was found to be by NHG Environmental (2008). It is possibly that the difference was due to the 2008 surveys being carried out toward the end of the millennial drought and because vehicle access around the site was considerably easier during 2018 following construction of roads for the wind farm.

3.1.4 Comparison with 2008 records

As noted above, the configuration of the wind farm has altered substantially since the time of surveys for the species carried out by NGH Environmental in 2008. As a consequence, some locations used for the 2018 survey did not coincide with locations searched in 2008. Table 4 provides site by site comparison between the two survey periods. As noted above, Barrier Range Dragons were detected at all 16 sites surveyed in 2018.

Comparison of maps provided in NGH Environmental (2008) indicate that ten sites surveyed in 2018 were covered by transect searches undertaken in 2008 and that Barrier Range Dragons were recorded in 2008 at, or in very close proximity to seven of the sites surveyed in 2018. Barrier Range Dragons were found in 2018 at three locations where they were not detected during the 2008 surveys. The difference in results between 2008 and 2018 may be due to actual changes in Barrier Range Dragon occupation of sites, but may equally be the result of different survey methods employed.

Table 4 Results of February 2018 survey for Barrier Range Dragons at Silverton Wind Farm

2018 survey site	Surveyed in 2008?	Barrier Range Dragons recorded in 2008?
1	Yes	Yes
2	Yes	Yes
3	Yes	No
4	Yes	Yes
5	Yes	No
6	Yes	No
7	No	No
8	Yes	Yes
9	No	No
10	Yes	Yes
11	Yes	Yes
12	No	No
13	No	No
14	Yes	Yes
15	No	No
16	No	No

3.2 Mapping of roadside habitat.

After completion of all surveys, habitat for Barrier Range Dragons immediately adjacent to all roads throughout the wind farm was mapped. On the basis of the preliminary results of the completed surveys, habitat was considered to exist adjacent to roads wherever there was the following combination of characters:

- Aggregations of rocks where a large proportion of rocks were between approximately 30 cm and one metre in diameter
- Aggregations were within approximately 20 metres of the edge of the road surface
- The aggregation consisted of at least 30 metres of continuous length beside the road

Habitat was considered to exist whether the rocks were natural outcrops and scree or had been placed artificially. All mapped roadside habitat is shown on maps in Appendix 1.

4 Threats to Barrier Range Dragon at Silverton

4.1 Existing threats

All of the processes identified by OEH (2017) as threatening the Barrier Range Dragon (see Section 2.1.1, above) are believed to exist or to have potential to have effects on the species in the area of Silverton Wind Farm. These are pre-existing processes and the construction and operation of the wind farm is not considered likely to influence their effects. Whilst that is the case, the presence and operation of the wind farm may introduce new, local effects (see Section 4.2). Management of the wind farm to mitigate any detrimental of the wind farm itself may include beneficial actions focussed on pre-existing, non-wind-farm effects.

4.1.1 Goats

NGH Environmental (2008) considered that grazing pressure and habitat degradation by goats was impacting on habitat for the Barrier Range Dragon at Silverton Wind Farm. Grazing pressure and trampling by goats does have detrimental impacts on vegetation cover and structure, and a resultant reduction in the quality and availability of microhabitat for ground-dwelling fauna and this is likely to include the Barrier Range Dragon. Grazing pressure may also alter trophic processes. For example, changes in floristics and vegetation structure along with changed abundance of woody debris may alter distribution, abundance and densities of invertebrate prey species for Barrier Range Dragons.

Goats were considered by NGH Environmental (2008) to have also been detrimental to Barrier Range Dragons as a result of their dung filling rock crevices, which may reduce the availability of this key resource for the species. The combined impacts of goat grazing pressure and scats filling rocky crevices is hypothesised as having contributed to a limited and patchy distribution of the Barrier Range Dragon in the area of Silverton Wind Farm (NGH Environmental 2008). *Competition and habitat degradation by feral goats* was listed in 2011 as a key threatening process under Schedule 3 of the *Threatened Species Conservation Act*. The final listing determination of the NSW Scientific Committee (OEH 2011) listed 20 threatened species at risk from this threatening process. These included the Tawny Rock Dragon (in reference to the subsequently described Barrier Range Dragon). Two other threatened reptile species known to occur at the Silverton Wind Farm, Mallee Slender Blue-tongue Lizard *Cyclodomorphus melanops elongatus* and Marble-faced Delma *Delma australis*, are also listed in this determination as being threatened by competition and habitat degradation of feral goats.

Surveys of Barrier Range Dragons in early 2018 did not detect measurable differences in dragon densities between sites considered to have high or low levels of goat dung. Where substantial amounts of dung (from both goats and Euros occurred it was over extremely small proportions of available rocks and rock crevices and it appeared to be unlikely that availability of crevices was a factor limiting abundance or distribution of Barrier Range Dragons

4.1.2 Fire

Inappropriate fire frequency, specifically risk of multiple burns within 20 years, has been identified as a potential threatening process for Barrier Range Dragon. Nonetheless, the rocky microhabitat preferred by the species can be expected to provide considerable protection from the immediate effects of most fires.

4.1.3 Feral predators

OEH (2017) identified both feral cats and Red Foxes as introduced predators that are likely to be having an impact on Barrier Range Dragons. This is certain to be the case although it has not been quantified and it may be that the species use of densely rocky environments with multiple refuge sites offers substantial protection from these predators.

4.2 Potential effects of Silverton Wind Farm on Barrier Range Dragon

4.2.1 Loss of habitat

Development of Silverton Wind Farm has included construction of roads both by widening of some pre-existing tracks and building of new roads, turbine hardstands and underground power transmission lines, some of which have entailed loss or disturbance of Barrier Range Dragon habitat. However, the natural habitat of the species is not continuous and any losses will have been confined to the scattered locations where appropriate microhabitats intersected with locations of wind farm earthworks.

4.2.2 Road traffic

It was noted by NGH Environmental (2008) that numbers of Barrier Range Dragons were observed in the vicinity of vehicular tracks in the study area. In all cases, individuals were recorded displaying or basking on rocks that had been pushed aside for the construction of the tracks. Such individuals were more commonly observed where the spoil consisted only of rocks and soil was absent. The 2018 surveys also detected many individuals on rocks alongside roads, including newly constructed roads and those on the alignment of previous tracks, but also on natural rock outcrops immediately adjacent to roads.

Barrier Range Dragons appear to be very strongly associated with rock screens that provide them with immediate refuge sites amongst rocks. Crossing open spaces places them at increased risk of predation, especially from birds and, in common with a range of reptiles with similar behavioural traits they are not likely to cross roads frequently. Nonetheless, Barrier Range Dragons that inhabit rocky roadsides are at some risk of mortality caused by vehicles when they do cross roads. New roads and routine vehicle movements due to operation of the wind farm are expected to have somewhat increased this risk.

5 Management & mitigation actions

Management measures designed to ensure persistence of the Barrier Range Dragon population at Silverton Wind Farm and/or to mitigate against potential impacts of the wind farm on it are set out below. The Silverton Wind Farm BAMP (Biosis 2018a) is a comprehensive document covering all management for biodiversity values and the measures set out here are also provided in the BAMP.

5.1 Habitat creation

NGH Environmental (2008) recommended the option of using rocks excavated for wind farm construction to create artificial rock piles of suitable structure to increase available habitat for Barrier Range Dragons at Silverton Wind Farm.

Survey for Barrier Range Dragons in early 2018 found adult individuals using numerous artificial rock structures created for the purposes of the wind farm. These included substantial rock batters built for downslopes of roads and turbine hardstands and areas where rocks had simply been turned out of the ground during construction of roads and handstands and in trenching for underground power transmission cables. While these were not built specifically for the purposes of creating habitat for Barrier Range Dragons, the fact that the species was found to be using these structures, sometimes within a few days or weeks of their creation, indicates that they have provided appropriately structured microenvironments for the species. The areas occupied by such artificial habitats have not been quantified, but they are substantial and it is quite plausible that they have effectively created at least as much habitat as has been lost.

As set out in Section 3.1.1, the design of annual surveys intentionally includes a sample of sites with artificially created rocky habitats (see Section 3.1.1). Annual monitoring of Barrier Range Dragons will determine whether the species continues to use artificially created rocky habitats into the future. As necessary, results of this aspect of monitoring will be used to determine any adaptive strategies that may be required to encourage on-going use of these microenvironments, such as any measures that may be required to maintain or improve their physical structure for the benefit of the species.

5.2 Traffic management

Low vehicle speed has been demonstrated to provide one of the most effective means to reduce mortality of wildlife on roads (e.g. Visintin et al. 2018; see also reviews in van der Ree et al. 2015). All roadside habitat for Barrier Range Dragons at Silverton Wind Farm was mapped in early 2018. It is not continuous and habitat does not exist beside substantial lengths of the roads. It is recommended that vehicle speed should be restricted to 25 km/h along all sections of road with roadside habitat for Barrier Range Dragons. For convenience, this speed restriction may be applied to cover a number of nearby road sections with mapped roadside habitat. Permanent speed restriction signs should be positioned at each end of relevant portions of the roads. The speed restrictions and the reason for them will be included in site inductions for all personnel driving at the site.

The annual monitoring program will inspect and review the condition of identified roadside habitat and results will be used to ensure that its physical structures are maintained in a condition suitable for use by Barrier Range Dragons.

5.3 Goat management

Goat numbers will be managed within the Area 7 Goat Fence with a specific objective of protecting and enhancing the Porcupine Grass Sparse Woodland Community within it. Specifics of goat management on behalf of other biodiversity values at the site are addressed in Biosis (2018a, b, c, d).

During the 2018 monitoring Barrier Range Dragons were found to inhabit surveyed sites within the Goat Fence area. Future monitoring of dragons at those sites will be used to ascertain whether their numbers or density alter in response to goat management. Results of this monitoring will be used to inform future management of goats. If numbers and density of Barrier Range Dragons are found to improve in response to reduced density of goats, then consideration will be given to the option of fencing relatively small goat exclusion plots around prime Barrier Range Dragon habitat patches elsewhere on the wind farm.

5.4 Fire

Wildfire represents a substantial risk for infrastructure of Silverton Wind Farm and the existence of the wind farm with permanent staff and equipment on-site is likely to add capacity to prevent or suppress wildfires. Overall, this is likely to reduce or limit the extent of wildfires that might otherwise impact on the population of Barrier Range Dragons.

If any sites used for monitoring of Barrier Range Dragons are burnt during the course of the monitoring program, that will be noted and the response of the species at such location post-fire, along with a comparison of burnt and unburnt survey locations, will be included in subsequent analyses and reporting. This will allow for an improved understanding of the species response to fire and results may be used to inform future adaptive management decisions.

5.5 Feral predator control

The potential effects of Red Foxes and feral cats as predators of Barrier Range Dragons is uncertain, but there is substantial evidence for their impacts on similar reptile species in the arid zone. Control of both foxes and cats at Silverton Wind Farm is only likely to benefit Barrier Range Dragons. All control measures will be carried out in accordance with NSW legislation, policy and strategies administered by the Department of Primary Industries and will entail collaboration with leaseholders.

The NSW Government gazetted the *Local Land Services (European Red Fox) Pest Control Order* in 2014, making foxes a declared pest species under the *Local Land Services Act 2013*. Under the Act all land managers in NSW, whether on public or private land, have an obligation to control declared pest species on their land, which includes foxes under the Pest Control Order.

At present, the density of feral predators at Silverton Wind Farm is not known. If feral predator control is undertaken during the Barrier Range Dragon monitoring program, the results of the monitoring may permit assessment of the response of dragons to feral predator control. Results of such analyses will then inform future adaptive management decisions.

5.6 Future habitat protection

Habitat for the species includes:

- Aggregations of rocks where a large proportion of rocks are between approximately 30 cm and one metre in diameter

- All natural rock outcrops and aggregations of loose rocks
- All artificially created aggregations of such rocks including, but not limited to, road and hardstand batters and roadside rock spoil.

In order to ensure that Barrier Range Dragons and their habitats are protected, future activities that entail earthworks or movement of rocks, including road maintenance and repair, erosion control and the like, must adhere to the following:

- All natural rock outcrops and structures must be kept strictly undisturbed and protected as 'no-go' zones during any construction or earthwork activities.
- Movements of artificially placed rocks within identified roadside Barrier Range Dragon habitat (Appendix 1) must be avoided unless absolutely necessary for road maintenance, safety, etc. Where absolutely necessary any such movements must be kept to the minimum and all rocks must be kept on the surface and aggregated in a formation similar to that prior to their movement.
- No soil or other material that might fill crevices between rocks or that might smother rocks is permitted to encroach on any habitat for the species.
- Remedial action must be undertaken in the event that erosion as a result of the presence of wind farm infrastructure causes sediment to fill or smother any Barrier Range Dragon habitat. If it is not physically possible to remove sediment, creation of additional artificial rock habitat may be required.

5.7 Site personnel awareness

All pre, during and post construction staff should be made aware of the significance of the Barrier Range Dragon in the wind farm area, through education and awareness and their obligations in regard to habitat for the species and road management zones.

The wind farm operator will provide all employees, contractors and site visitors with specific information about management actions on behalf of the species, including the obligations on all personnel in the course of site inductions and periodic information sessions.

6 Monitoring and adaptive management

Monitoring of the population of Barrier Range Dragons at Silverton Wind Farm will be vital to understanding of any effects of the operation wind farm on the species. It will also inform understanding of the on-going values of management actions to be implemented on behalf of the species. In turn, this will allow adaptive management to be based on good empirical evidence of responses by the species.

In order for results to be comparable and to determine the values of management actions, future monitoring will use the methodology and sites used in the 2018 surveys and set out in Section 3.1.1, above. Changes in numbers and distribution of Barrier Range Dragons as determined by the monitoring program, will provide the primary metrics of response by the species to the wind farm and to management measures set out in this plan. This will provide performance indicators as required by condition 18(c) of Notice of Modification Project Approval under the *Environment Planning and Assessment Act 1979*.

Future monitoring will be undertaken annually in late summer for the first three years of wind farm operation. Following monitoring in each year a report will be prepared and submitted to OEH. The report will compare the results of each year with the cumulative results from previous years and will particularly note any significant changes in numbers and distribution of Barrier Range Dragons. All efforts will be made to ascertain and report on the likely causes of any such changes. In particular, the response of dragons to identified threats and management measures (habitat creation; traffic management; goat management; fire; and, feral predation control see also Section 5) will be assessed on the basis of results of annual monitoring.

6.1 Adaptive management

At the conclusion of the first three years of monitoring, results of the investigations will be thoroughly reviewed to ascertain the status of the Barrier Range Dragon population and the nature of its responses to operation of the wind farm and to management actions set out in this plan. The review will be used to guide any potential adaptive management actions for the species. Requirements for any further monitoring will be considered in the light of results of the review.

Adaptive management, potentially including further monitoring, will be applied, as necessary to determine the effects of any significant new or altered management regime, such as a major campaign against feral predations or following fire within the wind farm site.

As noted in Section 5.1.3, monitoring of Barrier Range Dragons at sites within the Goat Fence area will provide the opportunity to ascertain whether the numbers or density of dragons alter in response to goat management. If they are found to improve, then consideration will be given to the option of fencing relatively small goat exclusion plots around prime Barrier Range Dragon habitat patches elsewhere on the wind farm.

7 Summary of management actions

A summary of management actions for Barrier Range Dragon conservation at Silverton Wind Farm is set out in Table 5, below.

Table5 Management actions, monitoring, responses and responsibility for Barrier Range Dragon conservation at Silverton Wind Farm

#	Management Action	Task / Performance Criteria	Measure / Target	Evidence of Completion	Responsibility	Timing
Baseline performance criteria						
1.5	Baseline Barrier Range Dragon monitoring	Baseline monitoring of the presence and abundance of the species and characterise habitat.	Complete baseline monitoring	Baseline monitoring report	GE/ Project Ecologist	Completed This report
1.6	Site inductions	Biodiversity information to be included as part of the site induction for all contract and subcontract staff working within the study area.	Biodiversity actions to be incorporated into site inductions as per BAMP	Induction sheets and associated support materials developed	GE operational staff/Project Ecologist	Initial site inductions conducted December 2018
1.9	Fire preparedness	Develop fire suppression guidelines	Fire suppression guidelines prepared in consultation with Project Ecologist, as per the BAMP.	Guidelines submitted	GE operational staff / Project Ecologist	In preparation, due February 2019
1.10	Feral predator control	Develop feral pest management program	Feral pest management program prepared in association with leaseholders	Pest management program submitted	GE operational staff / Project Ecologist / Leaseholders	March 2019
1.11	Traffic management	Designation of low vehicle speed areas	Permanent speed restriction signs positioned near BRD habitat	Signs in place	GE operational staff	January 2019

#	Management Action	Task / Performance Criteria	Measure / Target	Evidence of Completion	Responsibility	Timing
Ongoing performance criteria						
2.1	Site inductions	Biodiversity information to be included as part of the site inductions	Inductions completed for all contract and subcontract staff Staff aware of key vegetation values and issues as per BAMP	Signed induction sheets completed and submitted	GE operational staff	Ongoing
2.2	Maintain fencing to exclude feral goats	Work with leaseholder to ensure fences are maintained as required	Work with lease holder to ensure fences are maintained and any damage repaired within two weeks of notification. Fences maintained. Vegetation protected. If necessary, additional fencing should be implemented for areas of sensitive vegetation as required where restoration measures are impeded (e.g. by Feral Goat grazing pressure/trampling).	Inspection checklists submitted.	Leaseholders/ GE operational staff / fencing contractor	Fence lines to be inspected quarterly and documented via inspection checklist. New fences to be implemented as required
2.4	Feral goat exclusion	Goats excluded in PGSW area	No Feral Goats within the exclusion fencing from June to January unless cover of ephemeral flora species is greater than 40% <ul style="list-style-type: none"> Goat fenced closed All goats removed via trapped watering points Active mustering as required <p>If there is greater than 40 % ground cover of annual species, the lease holder will allow seed production to occur, and then reserves the right to utilise the vegetation</p>	Inspection report submitted.	Project Ecologist (monitoring) Silverton Industries (goat exclusion and mustering) GE Operational Staff	Surveillance monitoring of enclosure at monthly intervals

#	Management Action	Task / Performance Criteria	Measure / Target	Evidence of Completion	Responsibility	Timing
			<p>as feed. Goats will again be excluded when the cover of these annual species falls to less than 40 %.</p> <p>If monitoring shows signs of grazing pressure during exclusion period – initiate active on ground mustering to eliminate goats within PGSW area.</p>			
2.5	Ensure reduced stocking of feral goats	Feral Goat population within goat fence to be reduced	<p>Achieved maximum stocking rate of approximately 0.26 weaner goats per hectare (GMP Section 3.1 pg 10)</p> <ul style="list-style-type: none"> Active trapping at trapped watering points Initiate mustering when observed goat numbers exceed 100. 	<p>Surveillance monitoring of enclosure at monthly intervals</p> <p>Inspection report submitted.</p>	Silverton Industries	February to May (inclusive) each year
2.6	Feral Goat population monitoring	Collection of leaseholder population estimates	All four leaseholders contacted to gather baseline information about goat abundance and harvesting activities	Records from landowner discussions to be submitted	Project Ecologist or GE operational staff	Annually in line with spring survey
2.7	Feral Goat population monitoring	Scat counts in subplots as per BAMP	Decrease in goat scat abundance	Annual monitoring report	Project Ecologist	Annually in spring 2019-2021
2.18	Barrier Range Dragon Monitoring	Monitor presence and abundance of BRD.	<p>Compare the results of each year with the cumulative results from previous years.</p> <p>Note any significant changes in numbers and distribution of Barrier Range Dragon</p> <p>Annual monitoring of Barrier Range Dragon will assess</p>	<p>Annual monitoring report</p> <p>Monitoring of Barrier Range Dragons will be undertaken annually in late summer for the first three years of wind farm operation. Following monitoring in each year a</p>	Project Ecologist	Annually in late summer 2019-2021

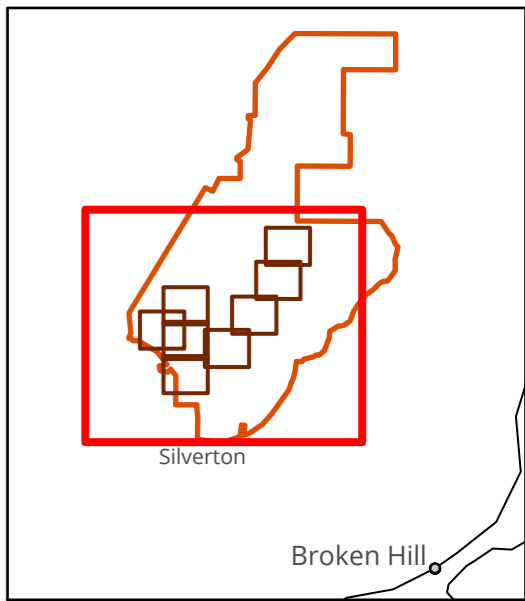
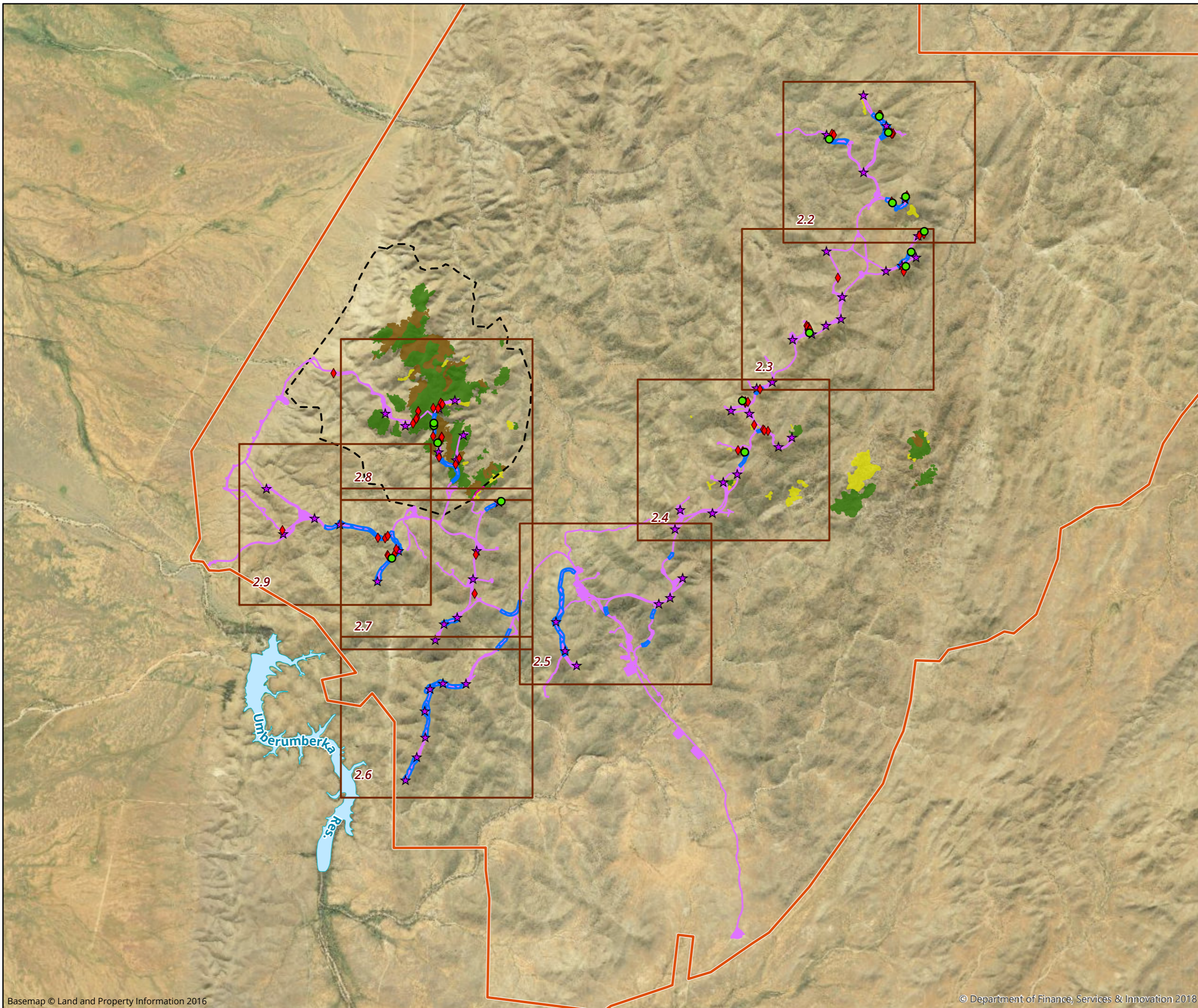
#	Management Action	Task / Performance Criteria	Measure / Target	Evidence of Completion	Responsibility	Timing
			<ul style="list-style-type: none"> any different response within Goat Fence and across remainder of wind farm assess any response if wildfire affects habitat 	report will be prepared and submitted to OEH. Option for further monitoring contingent on results of first three years		
2.19	Fire preparedness	Review fire preparedness Annual monitoring of Barrier Range Dragon will assess any response if wildfire affects habitat	Check fire response plans and equipment twice yearly	Inspection checklists submitted.	GE Operational Staff	September and January each year
2.21	Feral predator control	Implementation of feral pest management program	Feral pest management program implemented in association with leaseholders	Pest management works reports submitted.	GE operational staff / Leaseholders	Ongoing
2.22	Traffic management	Enforcement of low vehicle speed areas	Permanent 25 km/hr speed restriction signs positioned along all designated sections of road with roadside habitat for Barrier Range Dragons as mapped in Appendix 1	Signs in place Speeds enforced	GE operational staff	Ongoing
2.23	Creation of artificial habitat	Substantial artificial habitat has been created incidental to construction of the wind farm. No additional artificial habitat is considered to be required	Monitor usage as part of annual Barrier Range Dragon monitoring program	Annual monitoring report	Project Ecologist	Annually in late summer 2019-2021
2.24	BRD habitat protection	Any future construction, earthworks, road and other infrastructure maintenance	Monitoring to ensure any future earthworks and erosion do not impact upon Barrier Range Dragon habitat		GE operational staff / all relevant contractors	Ongoing when works required

#	Management Action	Task / Performance Criteria	Measure / Target	Evidence of Completion	Responsibility	Timing
		to ensure protection of habitat as per specifics set out in 5.1.6				
2.25	Review of BAMP	Comprehensive review of BAMP and supporting management plans	Review all monitoring data and assess the response of biodiversity values to modified site management. Update management recommendations as appropriate in consultation with OEH, particularly to ensure there is a net gain in the conservation value of PGSW,	Reviewed BAMP submitted	GE/ Project Ecologist	January 2022

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9 Appendix 1



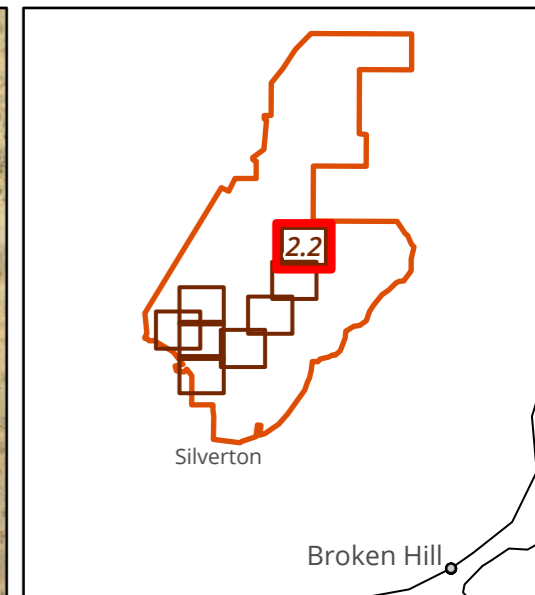
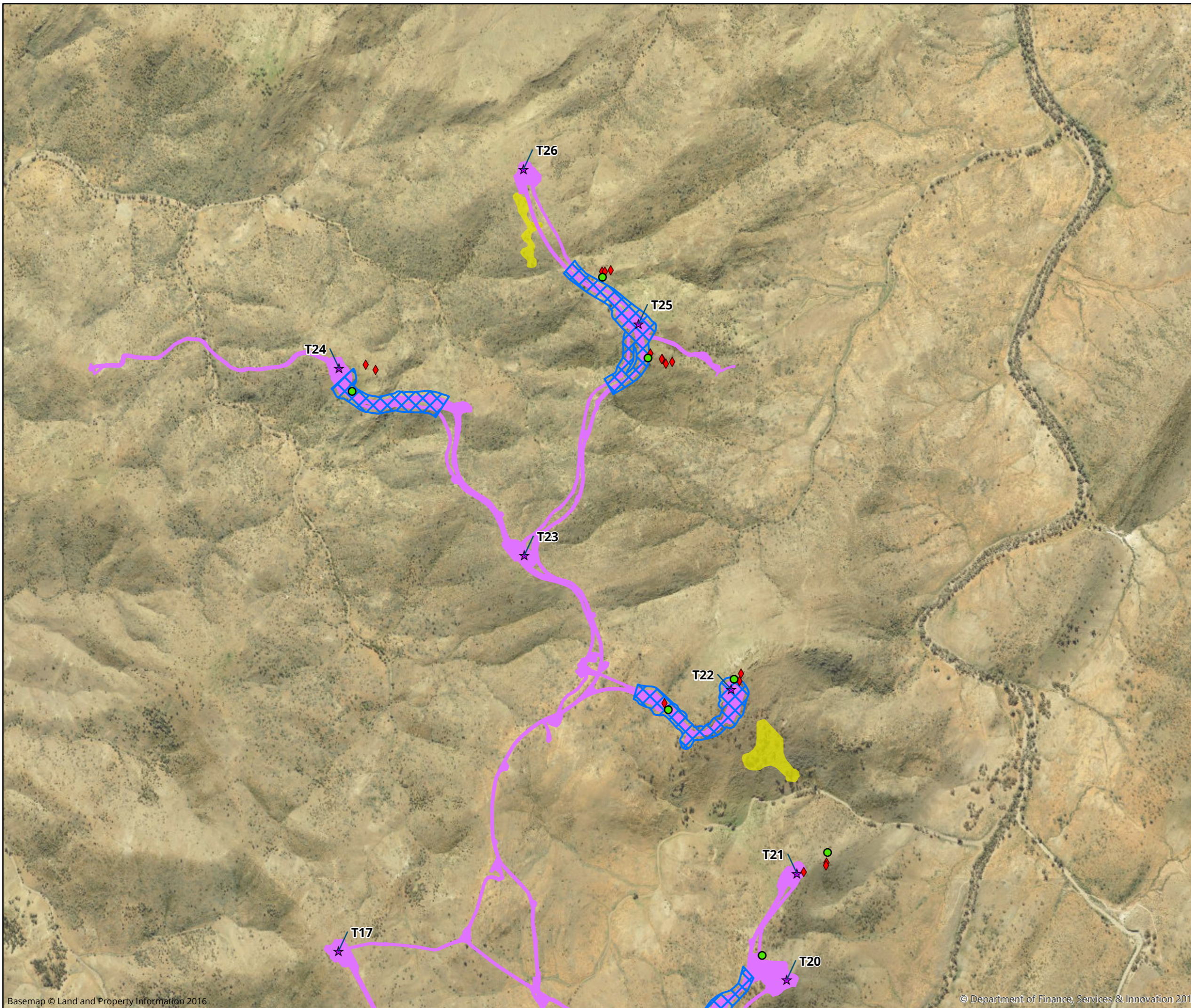
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 - Infrastructure
 - Pre-existing road
 - ★ Turbine
 - BRD survey site
 - ◆ Incidental BRD record
 - Roadside BRD habitat
- PGSW structural variants**
- Porcupine grass with eucalypts
 - Porcupine grass only
 - Eucalypts only

Figure 2.1
Barrier Range Dragon survey effort - overview

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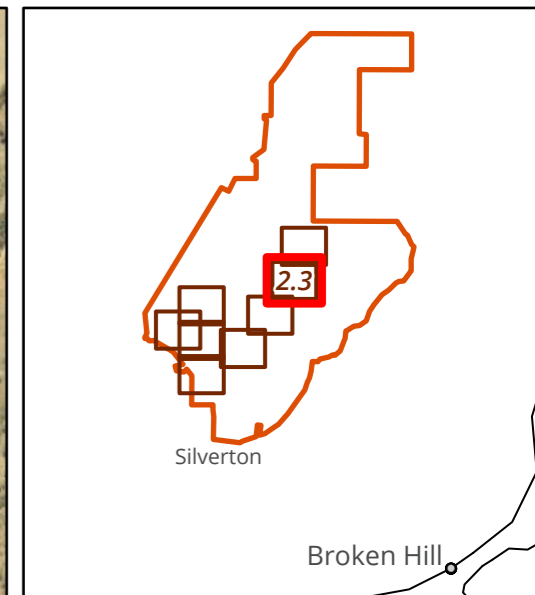
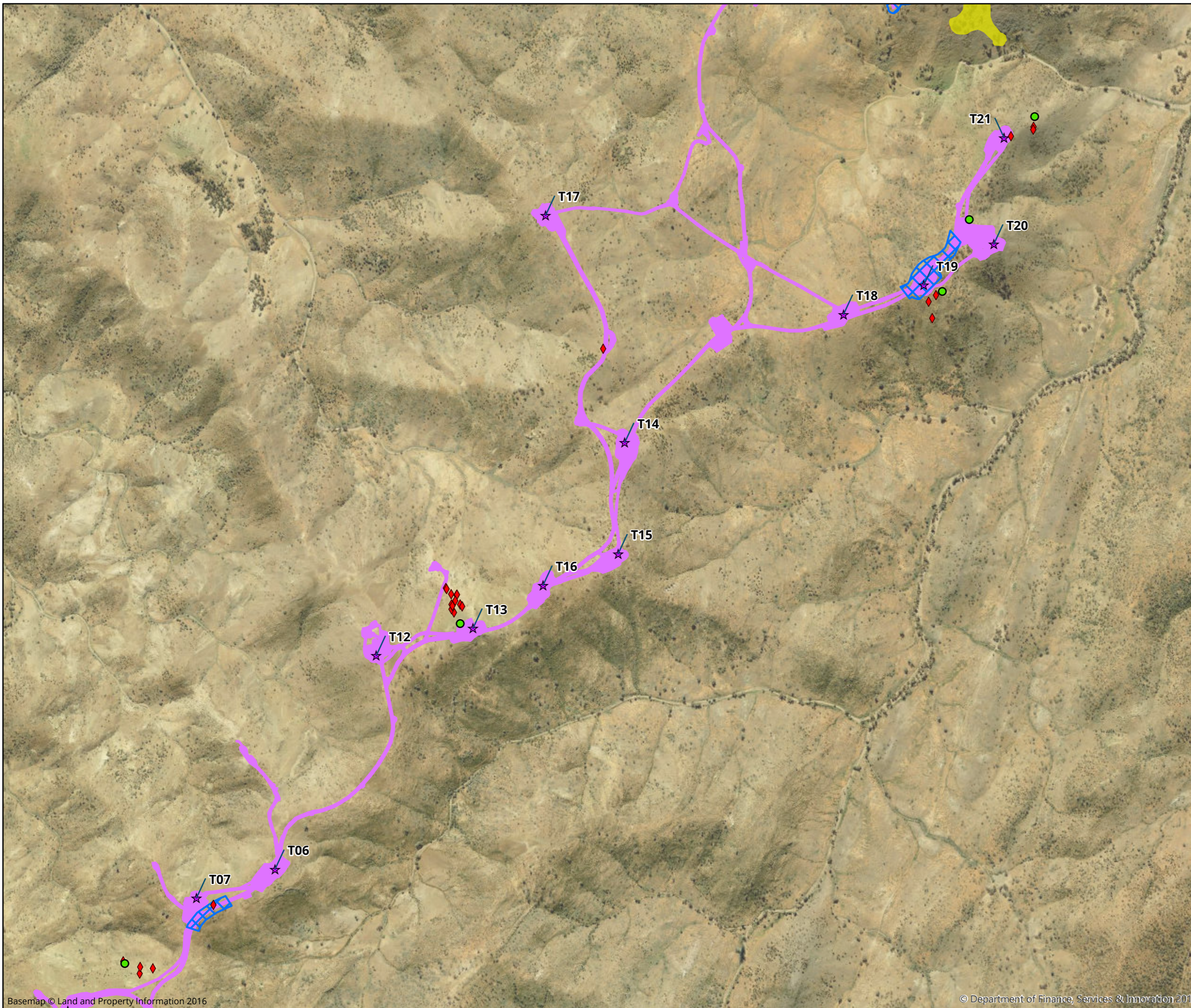
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Figure 2.2
Barrier Range Dragon survey effort

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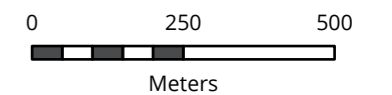
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 - BRD survey site
 - Incidental BRD record
 - Roadside BRD habitat
- PGSW structural variants**
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 - Porcupine grass only
 - Eucalypts only

Figure 2.3
Barrier Range Dragon survey effort

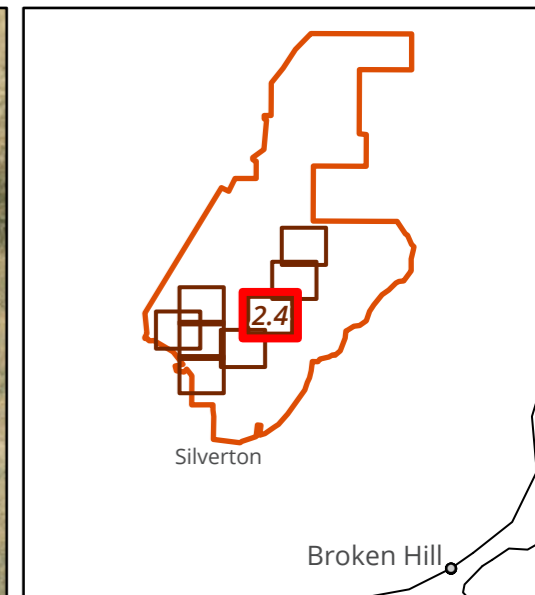
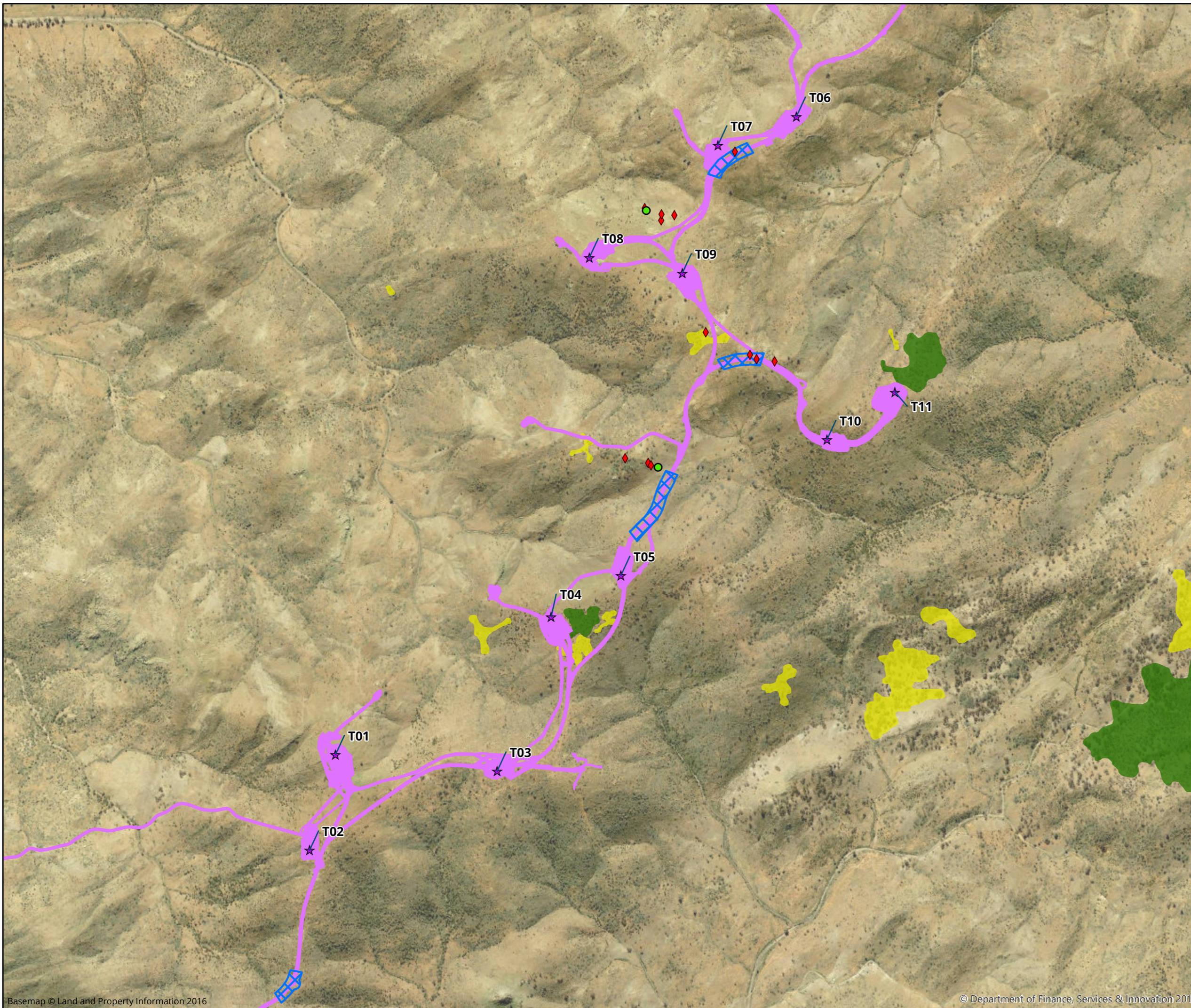


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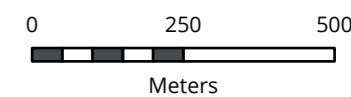
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 - BRD survey site
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Figure 2.4
Barrier Range Dragon survey effort

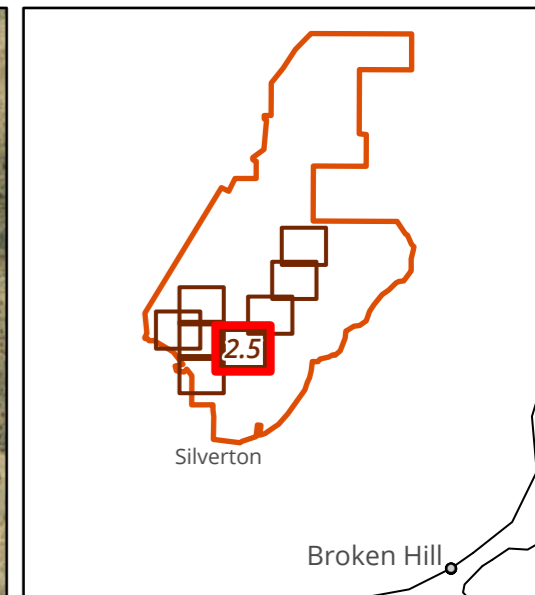
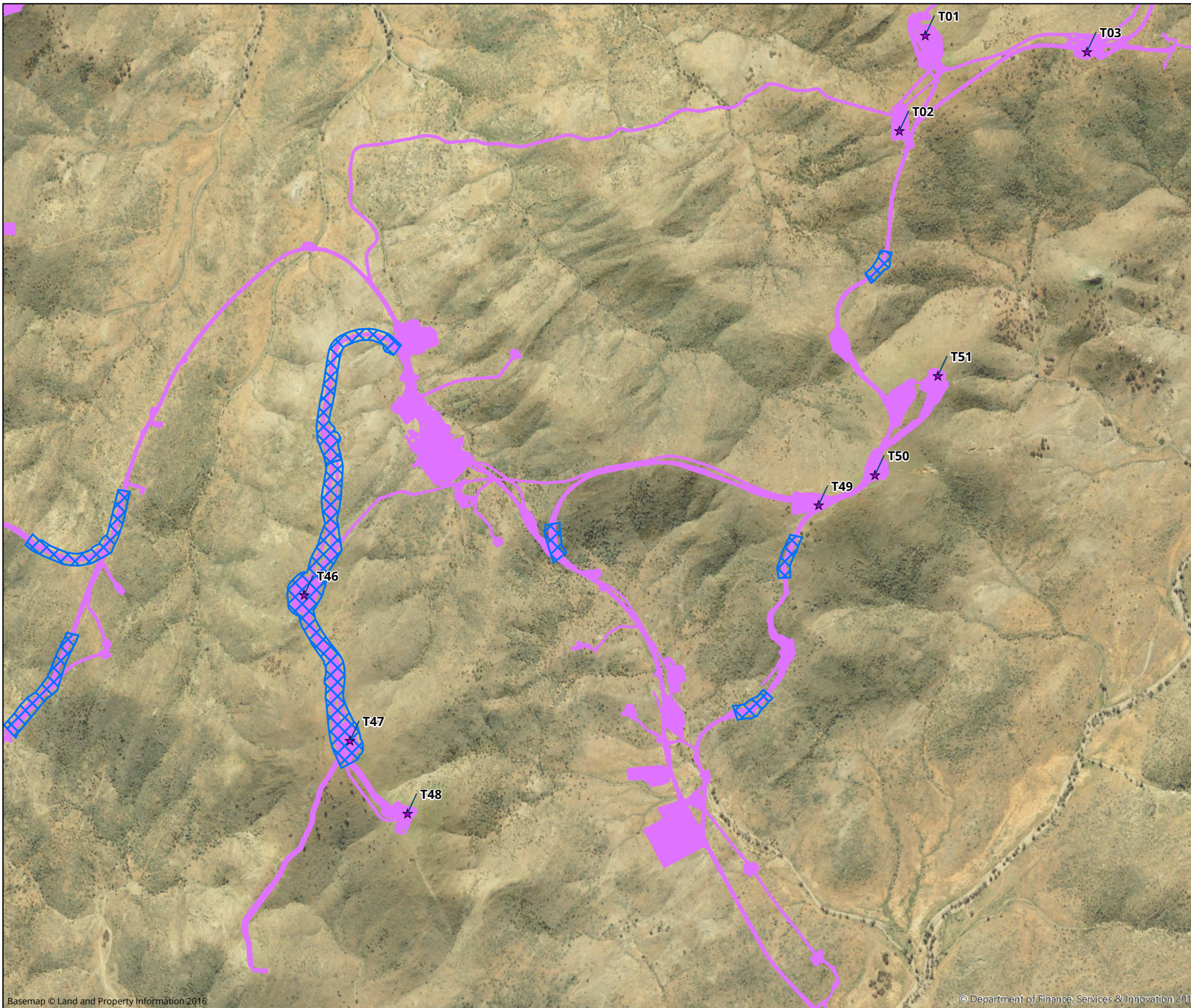


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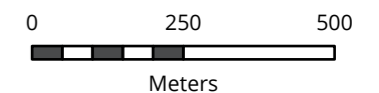
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- Study area
 - Infrastructure
 - Pre-existing road
 - Turbine
 - BRD survey site
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 - Roadside BRD habitat
- PGSW structural variants**
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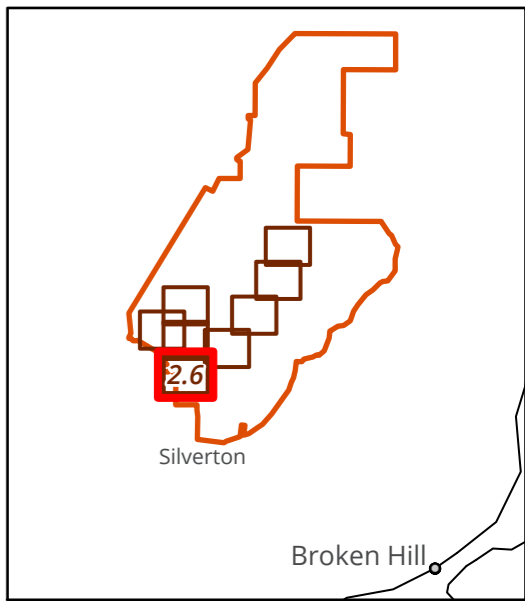
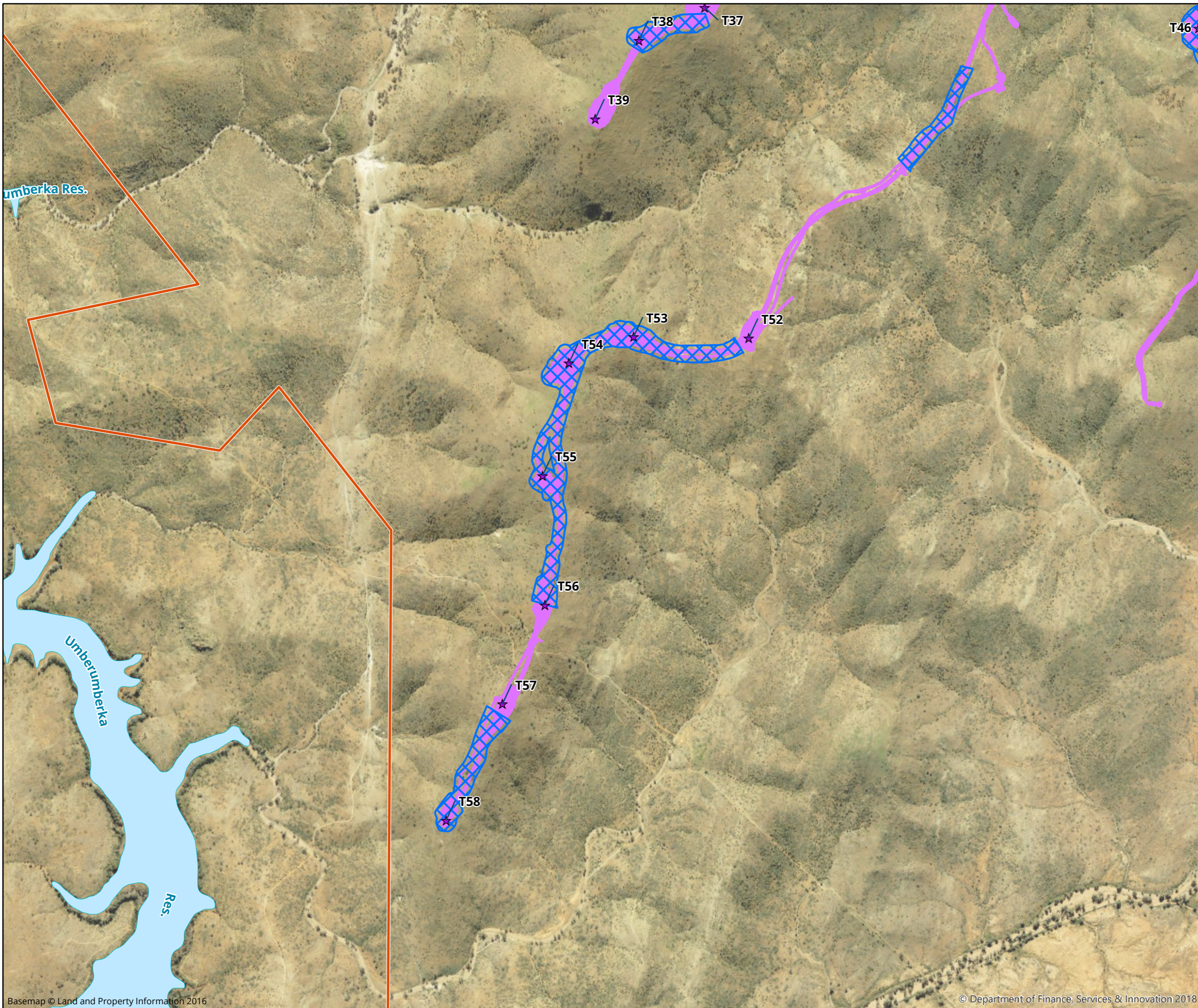
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Barrier Range Dragon survey effort



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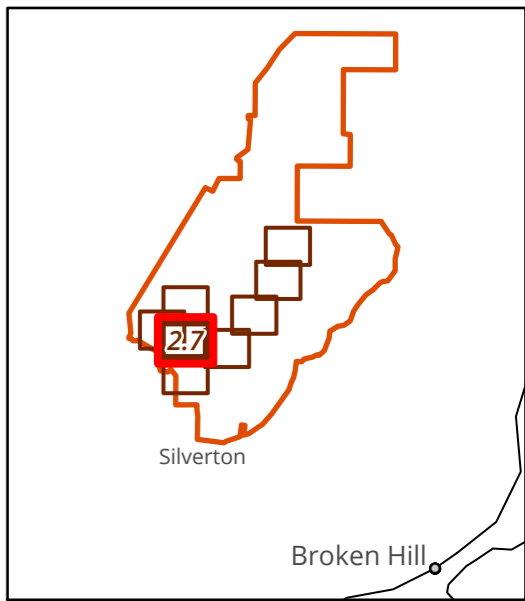
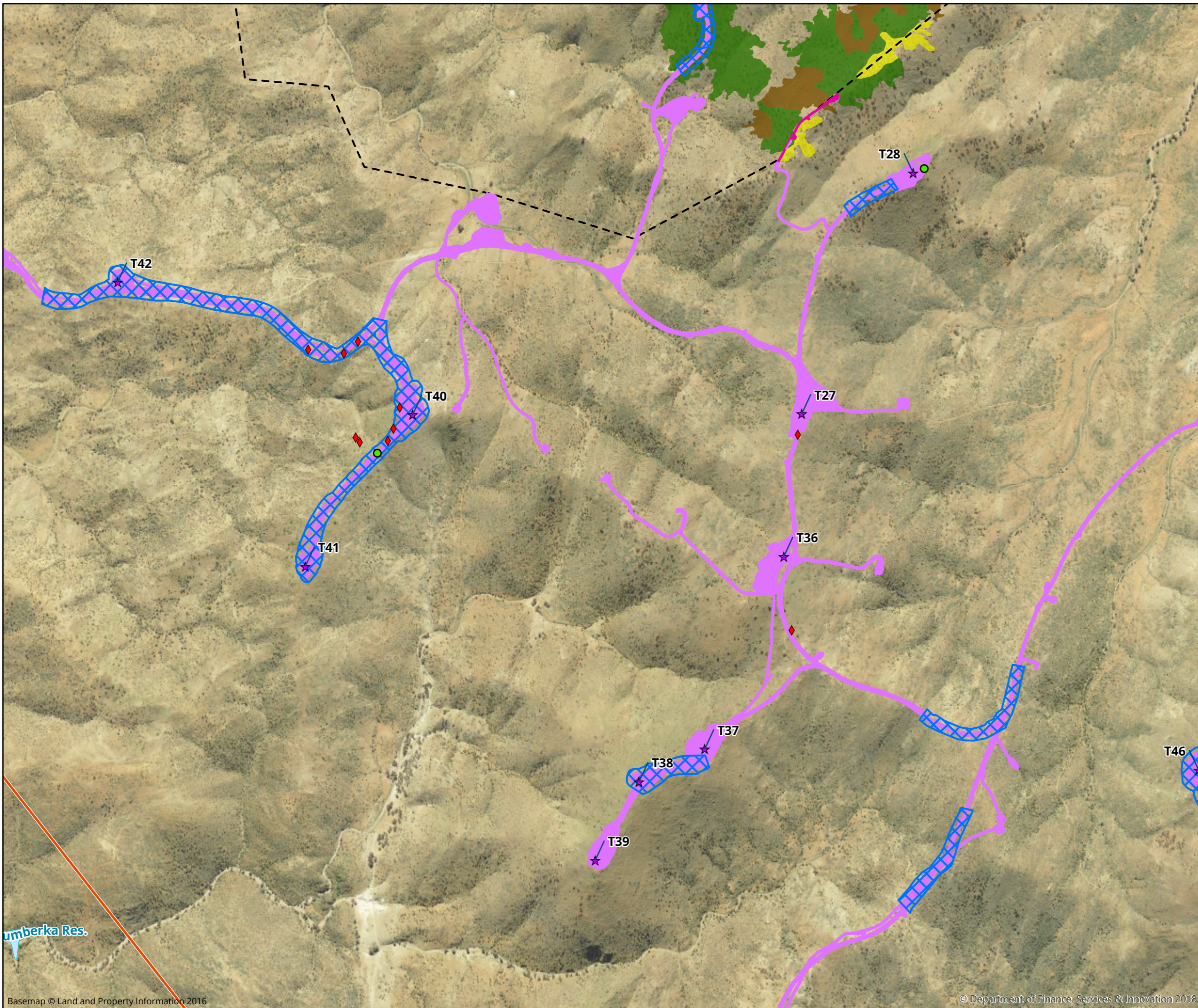
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 - Eucalypts only

Figure 2.6
Barrier Range Dragon survey effort

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- Study area
 - Goat fence
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 - Pre-existing road
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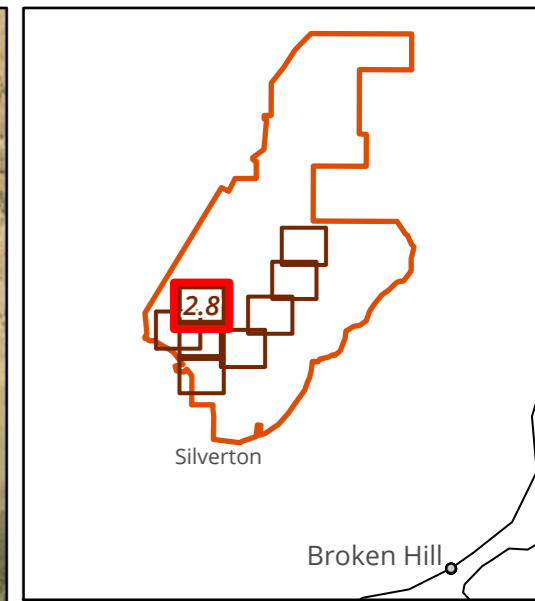
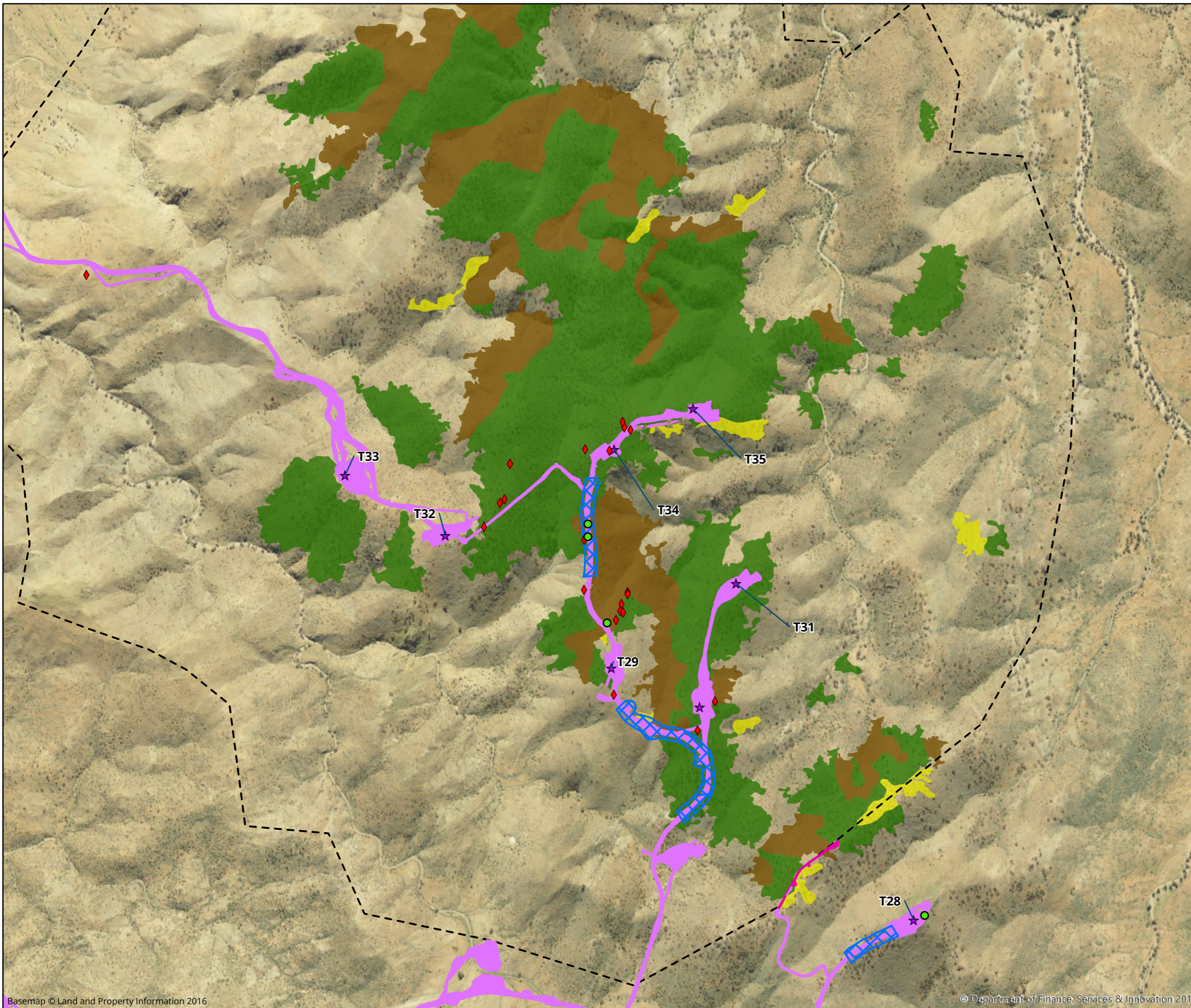
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Barrier Range Dragon survey effort

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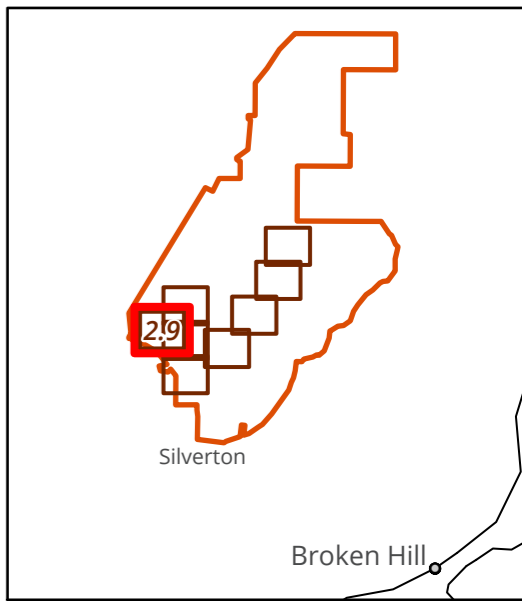
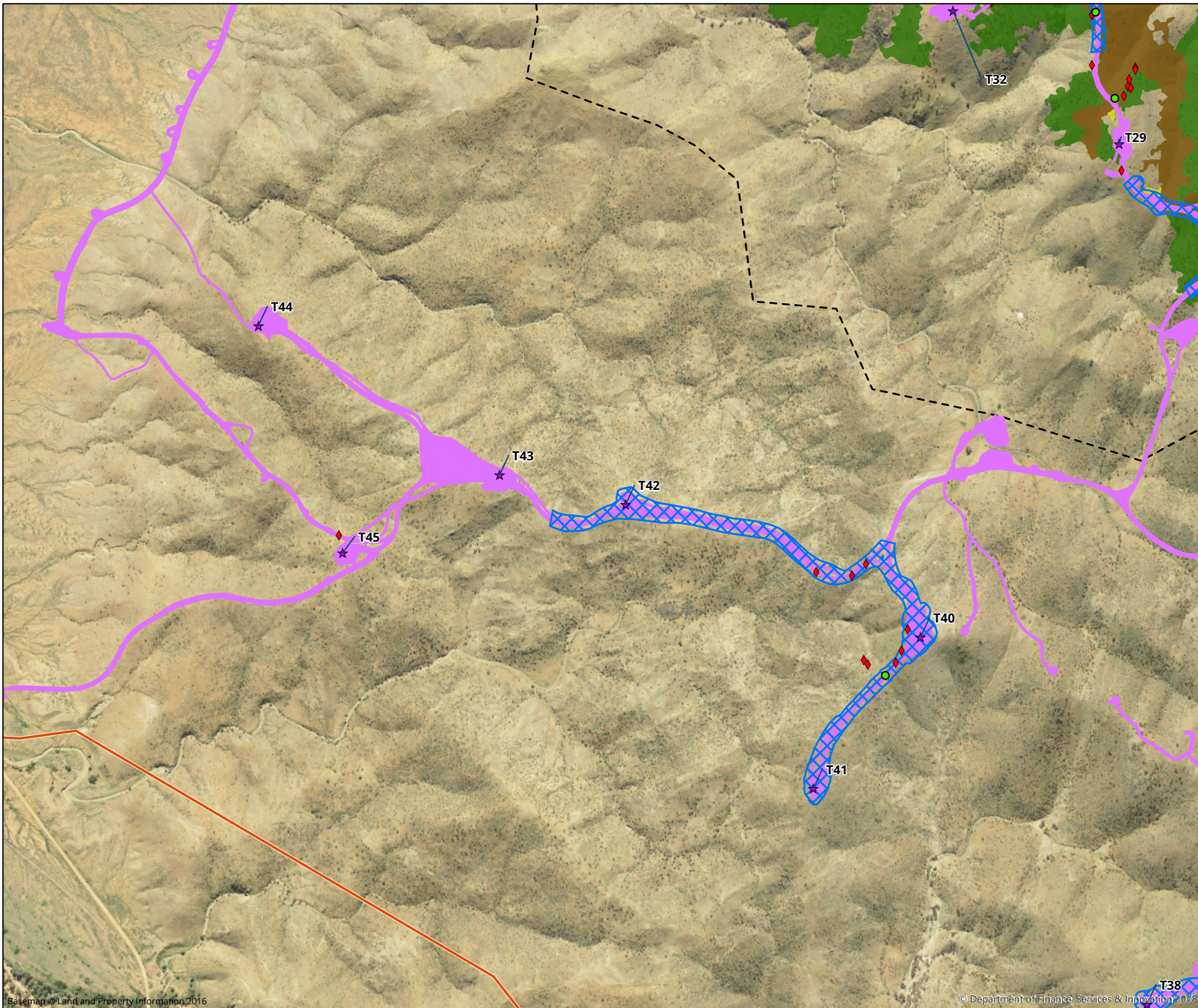
- Study area
- Goat fence
- Infrastructure
- Pre-existing road
- Turbine
- BRD survey site
- Incidental BRD record
- Roadside BRD habitat
- PGSW structural variants**
- Porcupine grass with eucalypts
- Porcupine grass only
- Eucalypts only

Figure 2.8
Barrier Range Dragon survey effort

0 250 500
Meters
Scale 1:12,500 @ A3
Coordinate System:
GDA 1994 MGA Zone 54

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Matter: 26380
Checked by RW, drawn by ARL
Last edited by jturner on 11 December 2018
Location:
\\Bio-data-01\bio-dfs\Matters\26380s\26380\Mapping\26380_BarrierRangeDragon



Legend

- Study area
- Goat fence
- Infrastructure
- Pre-existing road
- ★ Turbine
- BRD survey site
- ◆ Incidental BRD record
- Roadside BRD habitat

PGSW structural variants

- Porcupine grass with eucalypts
- Porcupine grass only
- Eucalypts only

Figure 2.9
Barrier Range Dragon survey effort

0 250 500
Meters
Scale 1:12,500 @ A3
Coordinate System:
GDA 1994 MGA Zone 54

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