Stratford Mining Complex Annual Biodiversity Report

FOR THE YEAR ENDING 31 DECEMBER 2019

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1 INTRODUCTION

The Stratford Mining Complex (**SMC**), located in the Northern part of the Gloucester Basin NSW, is approximately 10 kilometres south of Gloucester and is owned and operated by Stratford Coal Pty Ltd (**SCPL**), a fully owned subsidiary of Yancoal Australia Limited (**YAL**).

1.1 Scope

In accordance with the Stratford Extension Project Development Consent SSD-4966, the proponent (SCPL) is required in accordance with *Schedule 2, condition 39* to prepare and implement a Biodiversity Management Plan (BMP). This Plan must include:

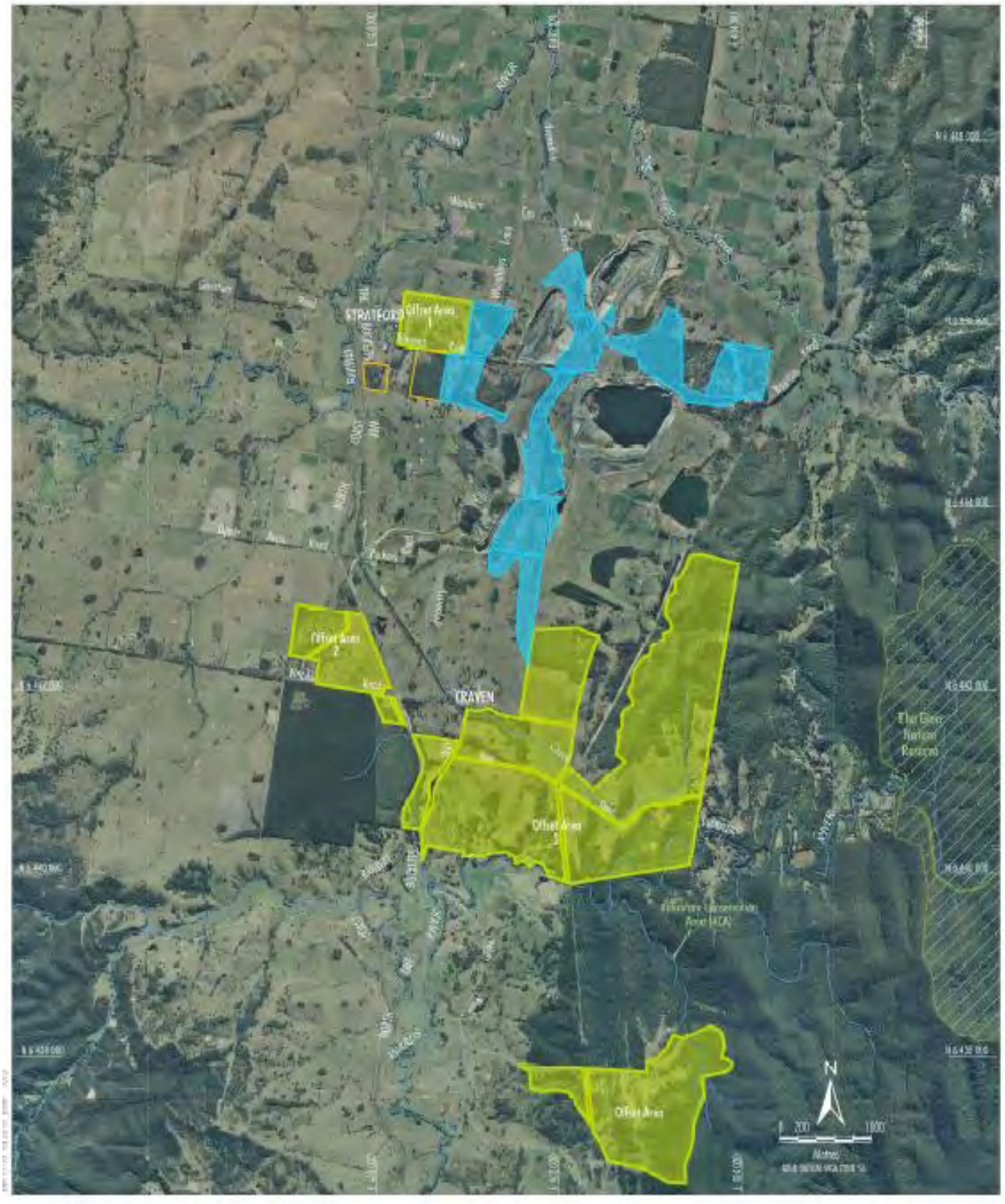
> *"a program to monitor and report on the effectiveness of the measures in the Biodiversity Management Plan, and progress against the detailed performance and completion criteria".*

The BMP was approved by the Department of Planning & Environment on 4 April 2018. This is the second Annual Biodiversity Report prepared for the Stratford Extension Project. This SMC Annual Biodiversity Report provides a review of the effectiveness of measures in the BMP for the annual year ending 31 December 2019 in accordance with Section 8.2.1 of the BMP. The scope of the review includes the Mining Lease areas, the Biodiversity Offset areas and the Biodiversity Enhancement area as indicated on Plan A.

This report (and associated Appendices) is included as an Appendix of the SMC Annual Review which is available on the Stratford Coal website www.stratfordcoal.com.au.

2 STATUS OF BMP PERFORMANCE CRITERIA

Performance criteria as prescribed in the BMP is presented in **Tables 1 to 9**. The performance criteria have been developed to meet the specific objectives for the areas described in Section 1.2 of the BMP. All performance criteria are linked to the management specifications listed in the BMP Section 4 and Section 5, and monitoring/reporting specifications in the BMP Section 7. The status of BMP performance criteria is provided in the subsequent sections of this report.



Plan A – BMP Figure 3

3 VEGETATION CLEARANCE PROTOCOL

3.1 Vegetation Clearance Report

Vegetation clearance is undertaken in accordance with the BMP Section 4.1 Vegetation Clearance Protocol. Prior to any clearance operations being undertaken a Clearing Plan is prepared, and pre-clearance surveys are undertaken.

During the 2019 reporting period, vegetation clearance was undertaken in advance of mining operations in the following areas:

- Stratford East Open Cut Stage 1
- Stratford East Haul Road
- Avon North Open Cut Stage 3.

The area of disturbance at the end of 2019 is shown in the SMC Annual Review 2019 Figure 3 (Appendix A).

Information obtained during the preparation of the Clearing Plans and the vegetation clearance activities (i.e. habitat features, hollows cleared and fauna observed) is used to determine the requirements for nest box replacement in the Biodiversity Offset and Enhancement Areas (refer to Section 9). A summary of the vegetation cleared including habitat features and tree hollows is included in Appendix C. During the 2019 reporting period a total of forty-two (42) habitat features and fourteen (14) tree hollows were removed.

3.2 Salvaged and Reused Material for Habitat Enhancement

Section 4.1.4 of the BMP requires salvaged material from vegetation clearance activities to be used for habitat enhancement within the rehabilitation, Biodiversity Offset areas and Biodiversity Enhancement Areas. Habitat features such as trunks, logs, large rocks, branches, stumps and roots are salvaged and relocated where practicable.

The areas cleared in advance of mining in 2019 as described in Section 3.1 where a mixture of previously cleared pasture and medium density woodland with habitat material available for salvage. In these areas, the cleared vegetation was managed as follows:

- Suitable trees and stumps were salvaged and stockpiled adjacent to the Avon North Open Cut for reuse.
- Suitable trees and stumps were salvaged and stockpiled adjacent to the Stratford East Box Cut.

4 MANAGING ACCESS, FENCING, GATES AND SIGNAGE

Managing access, fencing, gates and signage is undertaken in accordance with the BMP Section 5.1 and 5.2.

Table 1: Fencing, Gate and Signage Performance and Completion Criteria

Management Action	Performance Criteria			Completion Criteria
	Year 1 (January – December 2018)	Year 2 (January – December 2019)	Year 3 (January – December 2020)	
Review of fencing requirements for offset areas.	Review of fencing complete including development of mapping showing fence and gate types, redundant fences and fences to be retained.	-	-	-
Gate and fence installations	50% of gates and fences installed	Installation of gates and fences complete	-	Gate and fence installations complete. Livestock excluded.
Redundant fence removal	50% of redundant fencing removed	Redundant fences removed	-	No redundant fencing
Installation of signage	-	Installation of signage complete	-	Signage installed

Table 2: Access Track Performance and Completion Criteria

Management Action	Performance Criteria			Completion Criteria
	Year 1 (January – December 2018)	Year 2 (January – December 2019)	Year 3 (January – December 2020)	
Operational review and mapping to facilitate site access for offset management activities.	Operational review developed. Mapping complete	-	-	Operational review and mapping completed
Access track enhancement and maintenance	Enhancement of access tracks undertaken as identified in operational review.	Maintenance of access tracks annually	Maintenance of access tracks annually	-

Legend	Not commenced	In progress	Completed

The implementation of the BMP management measures continued in 2019. The BMP requires works to be undertaken to exclude livestock and control access to the Biodiversity Offset areas and Biodiversity Enhancement Areas.

Following the initial 2018 review of the existing fencing, gates and access tracks. Contractors were engaged to continue the removal of redundant fencing and install new fencing where required. Contractors were also engaged to maintain access tracks required for the ongoing management of the Biodiversity Areas. Fencing and access track work will continue during the next reporting period.

5 REVEGETATION MANAGEMENT

5.1 Seed Collection and Propagation

Seed collection and propagation is undertaken in accordance with the BMP Section 4.1.5 and 5.3.

Table 3: Seed Collection and Propagation Performance and Completion Criteria

Management Action	Performance Criteria			Completion Criteria
	Year 1 (January – December 2018)	Year 2 (January – December 2019)	Year 3 (January – December 2020)	
Develop seed collection species list	Species list developed over time.			-
Seed collection	Seed collection commenced	Seed collection to continue	Seed collection to continue	-
Seed propagation	-	Seed propagation commenced	Seed propagation to continue	-

Revegetation in the BMP Revegetation Areas (BMP Management Zone A) will continue via seed and tube-stock. Local endemic (adapted) species are preferentially used where a seed supply is available, however consideration will be given to the use of a high quality seed sourced further from the site as required.

During 2019 SCPL prepared a scope and schedule for the revegetation works to be implemented (further discussed in Section 5.2). The total volume of seed required was calculated based on the floral listings for the target communities in the BMP appendices. During 2019 seed collection was conducted on felled Forest Oak (*Allocasuarina torulosa*), the seed will be used in seeding and tube-stock propagation in the next reporting period.
Kleinfelder, Cumberland Seeds, Hunter Indigenous and Riverdene Nursery have been engaged to assist in the propagation of native plant species with tube-stock grown under controlled nursery conditions and delivered to site as required for revegetation works in the next reporting period.

5.2 Revegetation and Regeneration

Revegetation management is undertaken in accordance with the BMP Section 5.3 Revegetation Programme. The aim of revegetation is to establish a range of habitat niches including native canopy, and understorey. The Revegetation Area (Management Zone A) in the Biodiversity Areas will be revegetated to substantially increase the area of native vegetation in the area and maximise habitat diversity and a range of successional stages.

Table 4: Revegetation and Regeneration Performance and Completion Criteria

Management Action	Performance Criteria			Completion Criteria
	Year 1 (January – December 2018)	Year 2 (January – December 2019)	Year 3 (January – December 2020)	
Site Planning	Site inspection complete and advice received.	-	-	-
Map Revegetation Areas (Management Zone A) and identify target vegetation communities to establish	Mapping complete and target vegetation communities identified	-	-	-
Develop a species list for each target vegetation community	Species list developed	-	-	-

Develop application rates for seeds as well as planting densities for tube stock	Application rates developed	-	-	-
Implement revegetation schedule	Develop revegetation schedule	Implement revegetation schedule	Implement revegetation schedule	-
Revegetation Area (Management Zone A)	Commence revegetation works within the Revegetation Area (Management Zone A) (Figures 12a to 12c)	Continue revegetation works within the Revegetation Area (Management Zone A) (Figures 12a to 12c)	Continue revegetation works within the Revegetation Area (Management Zone A) (Figures 12a to 12c)	Vegetation established and provides suitable habitat for use by native fauna species.
Squirrel Glider Vegetation Pathways (Management Zone A1)	Commence planting *of* flora species which provide habitat for the Squirrel Glider within designated revegetation zones (Figures 12a to 12c)	Continue plantings of flora species which provide habitat for the Squirrel Glider	Continue plantings of flora species which provide habitat for the Squirrel Glider	Squirrel Glider vegetation pathways planted within the indicative area shown on Figures 12a to 12c, and provide connective habitat for the Squirrel Glider.
Allocasuarina spp. Plantings (Management Zone A2)	-	Commence planting of *Allocasuarina* spp. within designated revegetation zones (Figures 12a to 12c)	Complete *Allocasuarina* spp. plantings within Offset Area 3	*Allocasuarina* spp. plantings within the indicative area shown on Figures 12a to 12c, and provide foraging habitat for the Glossy Black-cockatoo
Coastal Floodplain Forest Revegetation (Management Zone A3)	-	-	Re-establishment of flora species characteristic of the Cabbage Gum open forest vegetation community	Improvement in condition of the riparian habitat along Avondale Creek within the indicative area shown on Figures 12a to 12c, as evidenced by monitoring data
Existing Remnant Vegetation (Management Zone B)	Inspection to be undertaken to monitor regeneration.	Inspection to be undertaken to monitor regeneration.	Inspection to be undertaken to monitor regeneration.	-
Power Line Corridor (Management Zone C)*	-N/A	-	-	-

Site Planning & Schedule

During 2019 SCPL prepared a scope and schedule for the revegetation works to be implemented. Kleinfelder have been engaged to assist with both the site planning and implementation of the revegetation works. The site planning included:

- Mapping of the priority revegetation areas to be completed in the following 2 years (Year 2 and Year 3).
- Calculation of seed and tube-stock requirements based on the indicative lists of flora species in the BMP appendices.

Plans showing areas proposed for revegetation in the Biodiversity Areas in 2020 are included in Appendix B.

Revegetation Implementation

Tube-stock for the Autumn 2019 revegetation work was divided into Two projects; Squirrel Glider Corridor and the Glen Road Offset Area. Revegetation ground preparation work was slashed by tractor to reduce the grass and woody weed biomass and then deep ripped (600-800mm) at a nominal 5m spacing. A total of 4000 canopy species and 3840 shrub species were planted into the Squirrel Glider Corridor and a total of 20558 canopy species and 8642 shrub species were planted into the Glen Road Offset Area during April and May 2019. Both areas were planted with species that reflected the Spotted Gum – Ironbark (Spotted Gum variant) woodland and Rough-Barked Apple – Red Gum Grassy Woodland (Cabbage Gum woodland variant) vegetation communities.

Plate 1 – Tube-stock planting in Glen Road South Offset Area

Tube-stock planting is scheduled to commence in March 2020. Details of the 2020 revegetation works will be included in the next annual biodiversity report.

Monitoring

Vegetation Monitoring was undertaken in 2019 to assess the effectiveness of revegetation in the Revegetation Area (Management Zone A) and to assess the natural regeneration in the Existing Remnant Vegetation Area (Management Zone B). The data gathered in 2019 will serve as a baseline to assess the success of the revegetation efforts. The full report can be found in Appendix D. Habitat and vegetation monitoring is discussed further in Section 11. Habitat and vegetation condition monitoring will continue to be undertaken annually to quantitatively measure the change in habitat and vegetation condition over time and to inform any ongoing maintenance requirements.

6 WEED CONTROL AND MONITORING

Weed control is undertaken in accordance with the BMP Section 4.4 and Section 5.6. The weed control program aims to manage weeds to minimise their impact on native flora and fauna

Table 5: Weed Management Performance and Completion Criteria

Management Action	Performance Criteria			Completion Criteria
	Year 1 (January – December 2018)	Year 2 (January – December 2019)	Year 3 (January – December 2020)	
Monitoring of weed location and density	Mapping of weed extent and density produced	-	-	-
Bi-annual weed inspections and recording	Inspections and records completed	Inspections and records completed	Inspections and records completed	-

Weed control/treatment program	Strategic weed control as required, recording on areas worked and implementation of recommendations	Priority weed infestations appropriately controlled and minimised as evidenced through monitoring data

The general procedure for controlling weed involves:

- Monitoring to identify locations and densities of priority weed;
- Identification of suitable control measures;
- Implementation of the selected control measure by a suitable qualified person;
- Follow-up inspections to evaluate effective of weed control.

Weed spraying activities are generally undertaken between the months of September and April each year. Physical management measures such as mechanical removal, slashing and/or back-burning can be undertaken at other times of the year as required.

A contractor is engaged at the SMC to undertake weed management activities on an ongoing basis. Weed spraying commenced in September 2019 and continued through spring and summer. The weed control activities in 2019 continued to target areas of known weed infestation. The key species targeted included blackberry, lantana, privet, wild tobacco and Giant Parramatta grass.

Weeds mapping is proposed to be undertaken during the next reporting period to assist in setting future management priorities and developing on-ground actions for weed control.

7 FERAL ANIMAL CONTROL AND MONITORING

Feral animal control is undertaken in accordance with the BMP Section 4.5 and Section 5.7. The objective of the feral animal control program is to manage feral animals to minimise their impact on native flora and fauna in the Biodiversity Offset and Biodiversity Enhancement Areas and/or their impact on agricultural production in other surrounding areas.

Table 6: Feral Animal Management Performance and Completion Criteria

Management Action	Performance Criteria			Completion Criteria
	Year 1 (January – December 2018)	Year 2 (January – December 2019)	Year 3 (January – December 2020)	
Abundance of feral animal species established	Initial study undertaken in the Biodiversity Offset Area and Biodiversity Enhancement Area.	-	-	-
Feral animal control and monitoring	-	Inspections and records completed	-	-
Feral animal control program	Feral animal control as required.			Feral animal numbers within offset areas minimised as evidenced through monitoring data

MDP Vertebrate Pest Management has been engaged by SCPL since 2016 to implement wild dog and fox control programs across property owned by SCPL including both the Stratford & Duralie Mining Leases and the Stratford & Duralie Biodiversity Offset Areas. During the reporting period two wild dog control programs were undertaken. The first was between **30 April 2019** to **14 May 2019** the 14-Day control program was productive and successful with a total of 4 wild dogs and 3 foxes trapped and shot. The second was between **15 October 2019** to **13 November 2019**. The program was productive and successful with a total of 6 wild dogs and 5 foxes trapped and Shot over the 30-Day control program.

Plate 2 – Wild Dog captured on camera

Wild dogs, foxes and wild cats will be targeted within the next reporting.

In accordance with the BMP Section 5.7 follow-up feral animal monitoring surveys would be undertake every two years. A feral animal survey of the Biodiversity Offset Area and Biodiversity Enhancement Area will be undertaken during the next reporting period.

8 BUSHFIRE PREVENTATION AND RISK MANAGEMENT

Bushfire management is undertaken in accordance with the BMP Section 4.7 and Section 5.9. The objective of bushfire management in the Biodiversity Areas is to prevent impacts from unplanned bushfire and to use fire to promote biodiversity.

Table 7: Bushfire Management Performance and Completion Criteria

Management Action	Performance Criteria			Completion Criteria
	Year 1 (January – December 2018)	Year 2 (January – December 2019)	Year 3 (January – December 2020)	
Mapping of Fire Breaks and Trails	Mapping complete	-	-	-
Monitoring of Fuel Loads	Inspections and records completed	Inspections and records completed	Inspections and records completed	-
Controlled Burning	-	Implement (if required)	Implement (if required)	Controlled burns implemented (where required)

Monitoring of fuel loads to evaluate bushfire risk and guide bushfire hazard reduction activities is undertaken in conjunction with the annual vegetation monitoring was conducted in February 2019. Further detail is included in Section 11.

Section 4.7 of the BMP states SCPL will:

- ensure that the development is suitably equipped to respond to any fires on site; and
- assist the Rural Fire Service (RFS), emergency services and National Parks and Wildlife Service as much as possible if there is a fire in the surrounding area.

During the 2019/2020 fire season the local RFS's accessed hydrants at the SMC site using water from the mine storage system to contain and fight fires in the region.

9 NEST BOX PROGRAMME

Nest box management is undertaken in accordance with the BMP Section 5.10. Nest boxes will be installed to provide habitat opportunities in the short to medium-term for a number of arboreal fauna species including the Squirrel Glider.

Table 8: Nest Box Program Performance and Completion Criteria

Management Action	Performance Criteria			Completion Criteria
	Year 1 (2018)	Year 2 (2019)	Year 3 (2020)	
Nest Boxes – Installation	Nest boxes installed for clearing activities	Installation continued as clearing progresses	Installation continued as clearing progresses	Nest boxes installed as required.
Nest Boxes – Monitoring and Reporting	Quarterly inspections undertaken – undertaken in Year 2	Annual inspection and records completed	Annual inspection and records completed	-
Nest Boxes – Maintenance	-	Maintenance or replacement as required	Maintenance or replacement as required	Nest boxes functioning as designed

The nest box programme consists of two main components to replace any tree hollows cleared prior to mining activities as described in Section 3:

- Suitable nest boxes for the Squirrel Glider will be installed at a ratio of least 3:1 for each tree hollow cleared suitable for the Squirrel Glider. Squirrel Glider nest boxes will have a small entrance hole (45-50 millimetres diameter) to exclude larger possums and birds.
- For tree hollows that provide habitat to arboreal fauna species (other than the Squirrel Glider), nest boxes will be installed at a minimum ratio of 1:1 (i.e. one nest box of appropriate size to replace one hollow of similar size and properties). These next boxes will be provided for birds, bats and arboreal mammals.

Nest boxes will be installed within the Biodiversity Offset Area and Biodiversity Enhancement Area in Existing Remnant Vegetation (Management Zone B) as well as the Revegetation Area (Management Zone A).

During the 2019 reporting period a total of Forty-Two (42) habitat features, Nine (9) tree hollows suitable for habitat for arboreal fauna species and Five (5) tree hollows suitable for the Squirrel Glider were removed (Appendix C). As such, Fifteen (15) Squirrel Glider specific nest boxes and Nine (9) other arboreal nest boxes for a total of Twenty-four (24) nest boxes were required to be replaced.

The current nest box program involves:

- Five (5) targeting Squirrel Glider *(Petaurus norfolcensis),* Installed December 2018.
- Twenty-Five (25) targeting Squirrel Glider *(Petaurus norfolcensis),* Installed May 2019
-

Sixty (60) Squirrel Glider and Eighteen (18) other arboreal nest boxes for other arboreal fauna are proposed to be installed in April 2020. Next Boxes will continue to be installed in accordance with the BMP.

Monitoring

In Accordance with section 5.10 of the BMP nest boxes will be monitored by suitably qualified personnel with quarterly inspections during the first year followed by annual inspections in spring. Monitoring details the nest box identification number, the tree species on which the box is installed, evidence of use and whether fauna was present. Details on each of the fauna species present within nest boxes is collected (sex, weight, length, breeding status and if it had been a new capture or recapture). Quarterly monitoring nest box was undertaken in July and October 2019.

A summary of results from the July 2019 report is provided below:

- Seven squirrel gliders were found occupying the nest boxes across the SMC during Stage 1 of the monitoring program. One (male) was found in nest box 29. Six squirrel gliders (three males and three females) were found in nest box 30. Six nest boxes showed signs of previous occupancy by vertebrates including leaf nests and scratching.

PLATE 1 FRESH GLIDER BOWL (BOX29) AFTER GLIDER WAS REMOVED

PLATE 2 SIX SQUIRREL GLIDERS (BOX30)

A summary of results from the October 2019 report is provided below:

- A single squirrel glider was found occupying the nest boxes across the SMC during Stage 2 of the monitoring program.

- Four of the five marine ply nest boxes showed signs of previous occupancy by vertebrates with fresh leaves shaped into glider bowls. This round of monitoring no new evidence of use was observed in most nest boxes.

PLATE 3 SQUIRREL GLIDER (BOX 6)

Quarterly monitoring is scheduled for January and April 2020. Annual monitoring will be completed following the April survey.

10 SQUIRREL GLIDER MANAGEMENT PLAN

In accordance with Condition 38(a), Schedule 3 of the Development Consent SSD-4966 the management of Squirrel Glider populations is undertaken in accordance with the Squirrel Glider Management Plan (SQMP). The SQMP was approved by the DP&E on 19 October 2018 and includes specific management measures in addition to those in the BMP. The SGMP has been prepared to facilitate the management of squirrel gliders at the SMC, Biodiversity Enhancement Areas and Biodiversity Offset Areas.

Squirrel Glider programs which commenced during the reporting period include the identification of the Squirrel Glider home ranges (SQMP 4.2), the tree hollow census and nest box program (SQMP Section 7) further details are found in section 10.1 and 10.2.

Programs proposed to commence in the next reporting period will include squirrel glider food resources (SQMP Section 6), and vegetation pathways (SQMP Section 8.1).

10.1 Squirrel Glider Home Range

Objectives outlined in Section 4 of the SGMP require measures to establish the home range size of squirrel glider colonies within SMC. This information will be used to guide the ongoing management of squirrel glider populations within the SMC Biodiversity Offset Areas and Biodiversity Enhancement Areas. This information will also define the study area for further programs including the census of suitable tree hollows, food resources surveys and habitat enhancement including nest box installations.

Kleinfelder Australia was commissioned by SCPL to conduct an initial targeted squirrel glider survey to establish the locations of any existing Squirrel Glider colonies within the potential habitat in the vicinity of SMC. This involved the use of baited remote cameras placed throughout the biodiversity offset and biodiversity enhancement areas. From the areas identified to contain squirrel gliders, radio-tracking was conducted to estimate the home range of the local population of squirrel gliders within these areas of the SMC.

Two radio tracking programs were conducted between January - April 2019 and July - September 2019 in the 2019 reporting period. The 2019 tracking programs consisted of trapping of the Squirrel Gliders, processing and collaring trapped squirrel gliders, radio tracking selected gliders, analysing and estimating home ranges for each radio-tracked squirrel glider. The findings of the initial survey and home range estimations with appropriate recommendations are provided in the 2019 SMC Squirrel Glider Colony & Home Range Report, Appendix E. the following is an extracted summary from the Squirrel Glider & Home Range Report:

> *"An initial targeted squirrel glider survey was undertaken to establish the locations of any existing Squirrel Glider colonies within the potential habitat in the vicinity of SMC. The initial survey was undertaken from 26 November to 17 December 2018 consisting of a total of 692 trap nights over 37 locations. Squirrel glider presence was confirmed at five locations. Four of these locations were determined as suitable areas to conduct home range surveys using radio-tracking.*

Radio-tracking was undertaken to examine spatial requirements and use, and den preferences. Radio-tracking was conducted in two periods of 40 nights and are subsequently referred to as seasons. A total of 36 squirrel gliders were captured, 19 gliders were fitted with radio collars and sufficient data points were obtained to allow home range estimates for 13 gliders.

Results of the radio-tracking study showed that the seasonal home range for squirrel gliders within the Stratford area in period 1 (Summer) was FK95% 3.9 ± 0.3. ha and MCP100% was 9.7 ± 1.6ha. The FK95% for period 2 (Winter) was 3.6 ± 0.3 and the MCP100% was 12.8 ± 2.1. There was no significant difference between periods (P = 0.366, F7,5 = 1.407). This study also identified areas within the impact area of the Avon North extension where squirrel gliders were denning and foraging.

Further studies in accordance with the Squirrel Glider Management Plan into the population dynamics of the squirrel glider within the Biodiversity Offset areas and Biodiversity Enhancement areas would be conducted to determine the impacts predators and habitat fragmentation are having on the local population. This will provide information on the effectiveness of the offset measures and habitat enhancement being implemented for the species."

PLATE 4 RADIO-TRANSMITTING COLLAR AND FINGERLING TAGS FITTED TO SQUIRREL GLIDER

PLATE 5SQUIRREL GLIDER DETECTED DURING REMOTE CAMERA SURVEY

PLATE 6 SQUIRREL GLIDER (SHARON) WITH YOUNG.

10.2 Tree Hollow Census

Condition 38(b), Schedule 3 of Development Consent SSD-4966 requires a census of suitable tree hollows in home ranges and offset areas suitable for Squirrel Gliders. A tree hollow census was undertaken within the home ranges identified by the radio tracking program (Section 10.1) to identify hollow bearing trees suitable for use as den sites by the Squirrel Glider.

An extracted summary of the census results from the 2019 Stratford Mining Complex Hollow-bearing Tree Census Report Appendix F:

"Radio-tracking and home range estimations was undertaken to comply with the requirement outlined in section 4.2 of the Squirrel Glider Management Plan (SGMP) (Stratford Coal 2018, Kleinfelder 2019). The areas identified to form part of a squirrel gliders home range were then used as study sites for the hollow-bearing tree census as required by Section 7.1 of the SGMP.

The hollow-bearing tree census identified and mapped 480 hollow-bearing trees which contained a combined total of 648 hollows. Attributes of available hollows and known den hollows were compared to investigate the hollow preferences of squirrel gliders. The results indicated that hollow entrance size (area and width of hollow opening) was the most important factors in determining whether a hollow would be selected as a den by a squirrel. Tree species was not a determining factor with seven species being used for dens. Stags and Eucalyptus siderophloia (Grey Ironbark) were the most commonly used den species.

Direct comparison of the density of hollow-bearing trees recorded in the biodiversity enhancement and offsets areas vegetation community benchmark data for the relevant vegetation type shows that the two major vegetation communities at the SMC were found to contain significantly lower densities of hollow-bearing trees.

Once the squirrel glider food resources have been mapped as outlined in section 6.1 of the SGMP, information provided in this report can be used to identify areas best suited for nest box installation. Nest boxes will be best situated in areas currently lacking tree hollows but have an adequate number of food resources."

11 BIODIVERSITY OFFSET MONITORING AND REPORTING

The Biodiversity Offset monitoring program is prescribed in the BMP Section 7. The program aims to monitor and report on the effectiveness of the BMP management measures and progress against the detailed performance and completion criteria.

Table 9: Monitoring Program – Biodiversity Offset Strategy

Monitoring Program	Relevant BMP Section	Frequency
Visual Monitoring	Section 7.1.1	Annual
Photo Monitoring	Section 7.1.2	Annually (spring)
Habitat and Vegetation Monitoring Program	Section 7.1.3	Annually (spring)
Fauna Monitoring Program	Section 7.1.4	Every three years
Weed Monitoring	Section 5.6	Biannually
Initial Feral Animal Study of the Biodiversity Offset Area and Biodiversity Enhancement Area	Section 5.7	Within 12 months of approval of the BMP
Feral Animal Monitoring	Section 5.7	Every two years
Nest Box Monitoring	Section 5.10	Quarterly for 12 months and then biannually

11.1 Habitat and Vegetation Condition Monitoring

Habitat and vegetation condition monitoring is undertaken to quantitatively measure the change in habitat and vegetation condition over time. The visual monitoring and photo monitoring programs are undertaken concurrently with the vegetation monitoring to provide additional information on the change of the Biodiversity Areas over time and inform maintenance requirements.

To monitor the effectiveness of revegetation in the Biodiversity Areas Kleinfelder was commissioned to undertake the baseline habitat and vegetation monitoring. The monitoring which was completed in February 2019 was the first survey in accordance with the Stratford Mining Complex (Stratford Extension Project) – Biodiversity Management Plan (BMP 2018) to provide baseline data for subsequent surveys of the revegetation progress against the project specific performance and completion criteria. This survey has been undertaken prior to the revegetation works commencing in the Biodiversity Offset areas.
An extracted summary of the survey results from the *2019 Stratford Mining Complex Biodiversity Offsets Flora Monitoring Report (Appendix D*).

> *"This report is the first monitoring event for the Stratford Offset Revegetation program and the results provides data immediately after the revegetation had commenced, although some smaller areas in the Biodiversity Enhancement Area (e.g. Q5) had been planted in previous years. The results show that the native vegetation in the Offsets areas is very sparse, especially canopy and midstorey strata even in those areas where natural recruitment is occurring. The Biodiversity Enhancement Areas generally recorded higher densities of native species in these strata. Both revegetation areas will have increased densities of native species as a result of the revegetation program."*

11.2 Fauna Monitoring

Monitoring of fauna usage within the Biodiversity Areas is conducted every three years to document the fauna species response to improvement in vegetation and habitat in the Biodiversity Areas and assess the performance in providing habitat for a range of vertebrate fauna. The surveys include an assessment of habitat complexity, species richness and abundance.

During 2019 AMBS Ecology & Heritage (AMBS) were engaged to undertake a fauna survey within the SMC Biodiversity Offset areas and Biodiversity Enhancement Areas (Appendix G).

> *"Targeted fauna surveys were undertaken at eight sites. Six sites within the Stratford Offset Areas and two sites within the Biodiversity Enhancement Area. Field surveys occurred during two weeks, from 23 to 27 September 2019 and 28 October to 2 November 2019. At each site survey techniques included pitfall traps, funnel traps, Elliott A traps, harp traps, ultrasonic call recording, spotlighting, diurnal bird surveys and reptile searches. In addition, targeted frog surveys were undertaken at four water sources, one located in the Biodiversity Enhancement Area and three in the Biodiversity Offset Area. Opportunistic observations of signs of fauna were noted throughout the field survey period, including during transit between surveys sites.*
>
> *A total of 167 species of vertebrate were recorded, comprising 11 frogs, 16 reptiles, 97 birds and 43 mammals, most of which were native. Six introduced species were recorded during the surveys, including the Red Fox (Vulpes vulpes), Feral Cat (Felis catus), Black Rat (Rattus rattus), European Rabbit (Oryctolagus cuniculus), European Brown Hare (Lepus europaeus) and Cattle (Bos taurus). This is a reasonable diversity of fauna considering extreme drought conditions throughout the year and the relatively short length of the survey.*
>
> *Twenty-two of the species detected are listed as threatened or migratory on the schedules of the BC Act and/or EPBC Act, including:*
>
> - *White-bellied Sea-eagle (Haliaeetus leucogaster)*
> - *Dusky Woodswallow (Artamus cyanopterus cyanopterus)*

- *Black-chinned Honeyeater (eastern subspecies) (Melithreptus gularis gularis)*
- *Black-faced Monarch (Monarcha melanopsis)*
- *Spectacled Monarch (Symposiachrus trivirgatus)*
- *Varied Sittella (Daphoenositta chrysoptera)*
- *Grey-crowned Babbler (eastern subspecies) (Pomatostomus temporalis temporalis)*
- *Black-necked Stork (Ephippiorhynchus asiaticus)*
- *Little Lorikeet (Glossopsitta pusilla)*
- *Yellow-bellied Sheathtail-bat (Saccolaimus flaviventris)*
- *Little Bent-winged Bat (Miniopterus australis)*
- *Large Bent-winged Bat (Miniopterus orianae oceanensis)*
- *Eastern Coastal Free-tailed Bat (Micronomus norfolkensis)*
- *Large-eared Pied Bat (Chalinolobus dwyeri)*
- *Southern Myotis (Myotis macropus)*
- *Greater Broad-nosed Bat (Scoteanax rueppellii)*
- *Brush-tailed Phascogale (Phascogale tapoatafa)*
- *Red-legged Pademelon (Thylogale stigmatica)*
- *Yellow-bellied Glider (Petaurus australis)*
- *Squirrel Glider (Petaurus norfolcensis)*
- *Koala (Phascolarctos cinereus)*
- *New Holland Mouse (Pseudomys novaehollandiae)*

The fauna surveys suggest the Stratford Offset and Biodiversity Enhancement Areas provide habitat for a range of native vertebrate fauna, including birds, mammals, reptiles and frogs. Two of the threatened species recorded, the Black-chinned Honeyeater and Red-legged Pademelon, have not previously been recorded at the Stratford Mining Complex."

PLATE 7 BRUSH-TAILED PHASCOGALE (PHASCOGALE TAPOATAFA)

PLATE 8 KOALA (PHASCOLARCTOS CINEREUS)

PLATE 9 RED-LEGGED PADEMELON (THYLOGALE STIGMATICA)

12 LONG TERM SECURITY AND CONSERVATION BOND

12.1 Long-term Security

In accordance with Condition 36, Schedule 3 of Development Consent SSD-4966, SCPL is required to make suitable arrangements for the long-term security of the Stratford Extension Project Biodiversity Offset Area. SCPL proposes to pursue the mechanisms available under section 88E(3) of the NSW Conveyancing Act, 1919, namely:

- Registration of a Positive Covenant under section 88E(3) of the NSW Conveyancing Act, 1919; and
- Registration of a Restriction on the Use of Land by a Prescribed Authority under section 88E(3) of the NSW Conveyancing Act, 1919.

To finalise securing the offset areas, the following actions were conducted:

- confirmation that the completed instruments are to the satisfaction of the Secretary;
- execution of the instruments by the prescribed authority (the DP&E);
- execution of the instruments by the three separate registered proprietors of the offset lands (i.e. Yancoal's subsidiary companies, CIM Stratford Pty Ltd; Stratford Coal Pty Ltd and Gloucester Coal Limited);
- lodgement of the executed instruments with NSW Land Registry Services (LRS) in accordance with LRS's dealing lodgement requirements;
- LRS assessment/review of the instruments to confirm the instruments are acceptable for registration; and
- if acceptable, registration of the instruments on the titles of the offset lands.

Copies of the executed Positive Covenants and registration of the instruments are provided in Appendix H.

12.2 Conservation Bond

In accordance with Condition 40, Schedule 3 of Development Consent SSD-4966, SCPL is required to lodge a Conservation Bond with the DP&E which covers the cost of implementing the Biodiversity Offset Strategy detailed in the BMP.

The conservation bond calculation was prepared by Kleinfelder and a verification of the costs was undertaken by Rider Levett Bucknall. The conservation bond calculation was submitted in January 2019 and subsequently approved by DP&E on 15 January 2019.

The Conservation Bond in the form of a bank guarantee was executed and lodged with DP&E on 8 February 2019.

13 COMMONWEALTH EPBC APPROVAL COMPLIANCE REPORTS

In accordance with Condition 10 of EPBC 2011/6176 for the Stratford Extension Project, by 31 March of each year after the commencement of the action, or as agreed with DoEE, SCPL is required to publish a report addressing compliance with the conditions of EPBC 2011/6176 during the previous calendar year, including implementation of any management documents as specified in the conditions of EPBC 2011/6176.

SCPL commenced the action approved under EPBC 2011/6176 on 4 April 2018. The first annual compliance report was submitted in March 2019. The 2020 compliance report was submitted on 9 April 2020.

Condition 10 also requires reporting on the implementation of the relevant management documents required in accordance with the conditions of EPBC 2011/6176. This SMC Annual Biodiversity Report provides a review of the implementation of the management measures in the BMP for the annual year ending 31 December 2019. This report is included as an Appendix of the SMC Annual Review.

14 APPENDICES

Appendix A: SMC Annual Review 2019 - Disturbance & Rehabilitation Areas Figure 3

Appendix B: Biodiversity Offset Area – Areas proposed for revegetation in 2020

Appendix C: SMC Vegetation Clearance & Nest Box Replacement Requirements 2019

Appendix D: Stratford Biodiversity Offset Flora Monitoring Report 2019

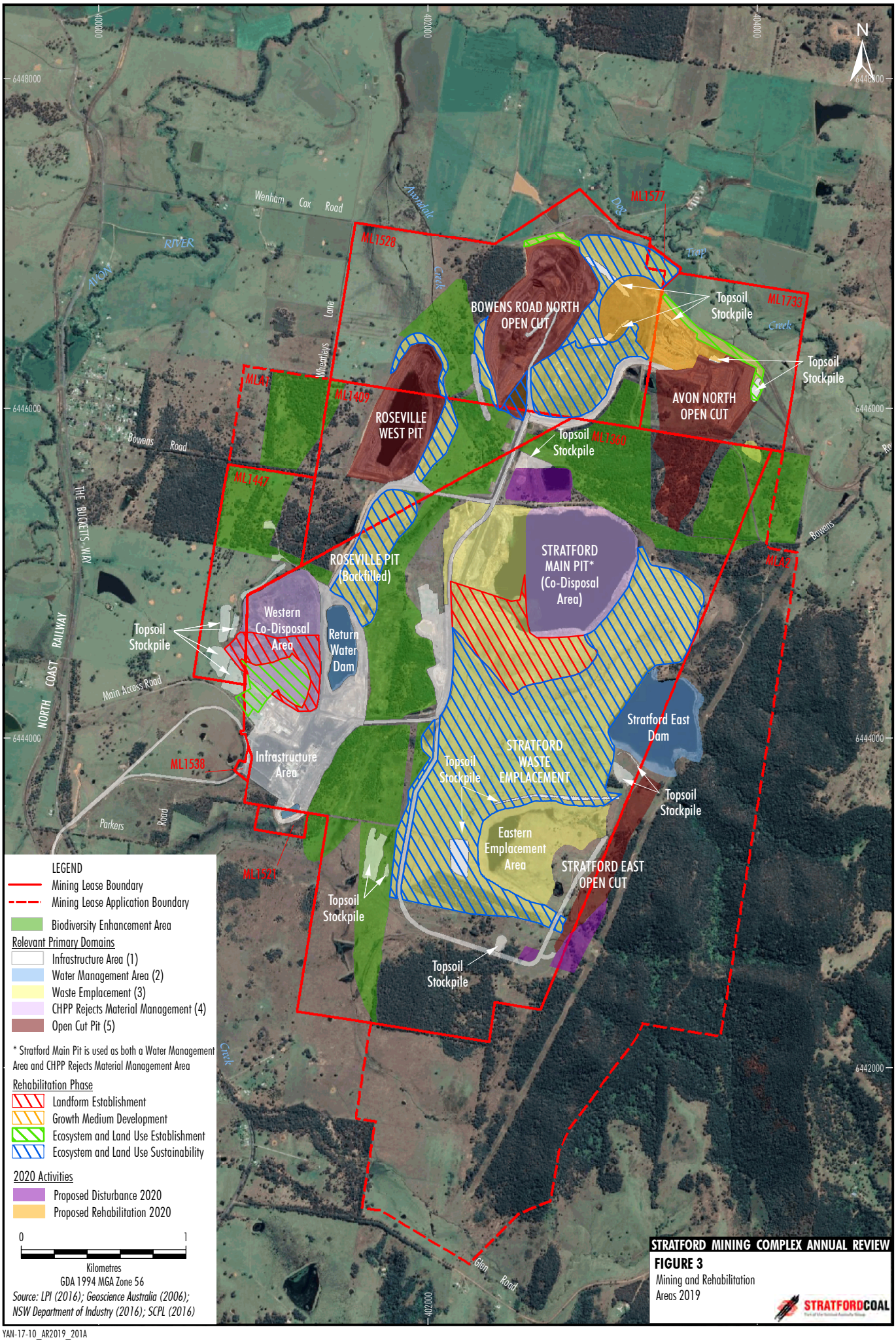
Appendix E: SMC 2019 Squirrel Glider Colony & Home Range Report

Appendix F: SMC Hollow-bearing Tree Census Report 2019

Appendix G: SMC Fauna Survey 2019

Appendix H: Executed Positive Covenants and Registration Notices

(Appendices available on request)



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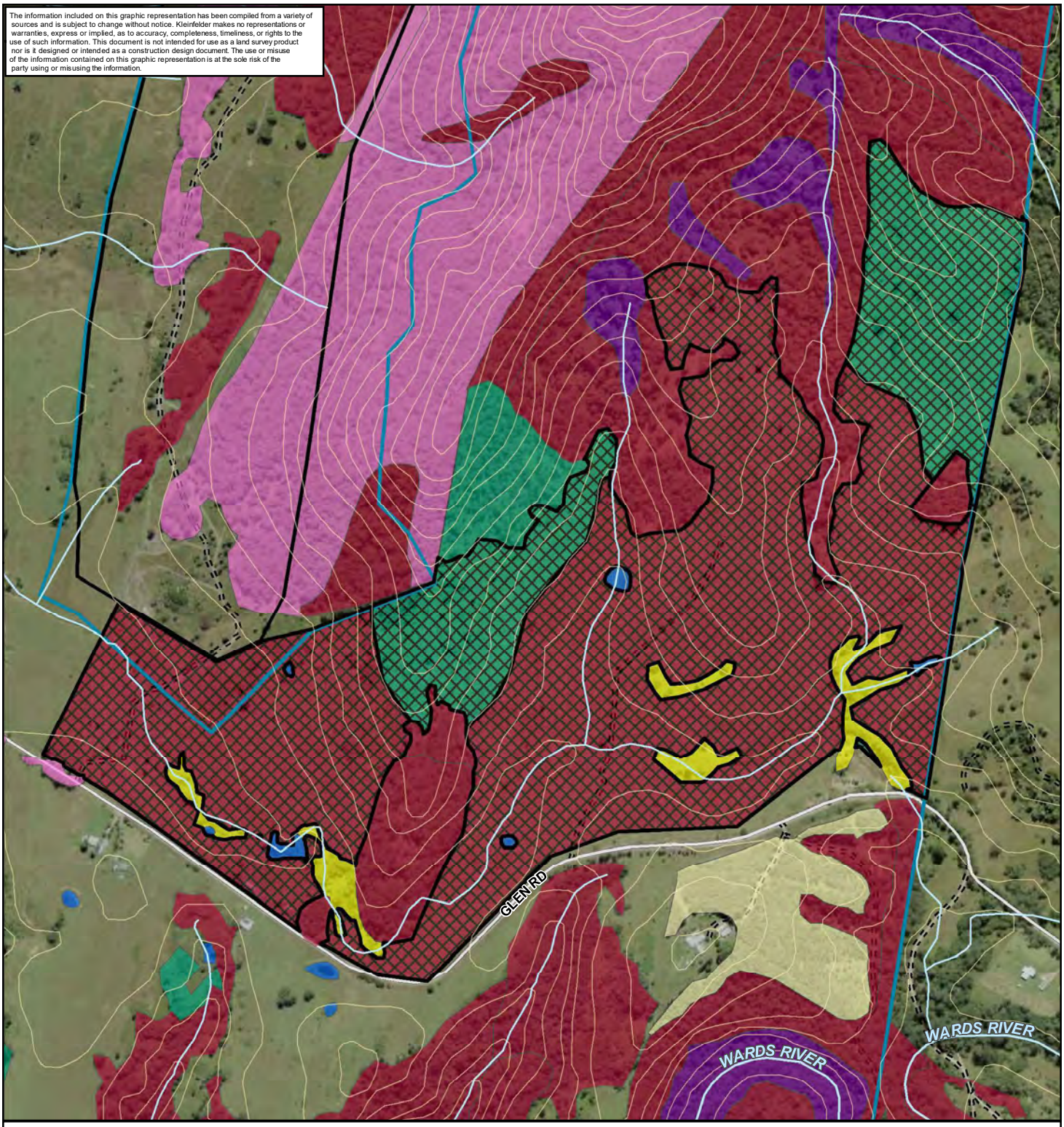

Legend

Proposed 2020 Offset Planting Area (79.1 ha)

- Veg Type 6: Tallowwood - Small-fruited Grey Gum dry grassy forest of the foothills of the North Coast (HU 644)
- Veg Type 9: Grey Box - Forest Red Gum - Grey Ironbark Open Forest of the Hinterland Ranges of the North Coast (HU 549)

Mapped Vegetation (Stratford EIS, 2012)

- Veg Type 5: Grey Gum-Tallowwood Spotted Gum Forest and Woodland
- Veg Type 6: Tallowwood - Small-fruited Grey Gum dry grassy forest of the foothills of the North Coast (HU 644)
- Veg Type 9: Grey Box - Forest Red Gum - Grey Ironbark Open Forest of the Hinterland Ranges of the North Coast (HU 549)
- Veg Type 10: Spotted Gum - Grey Ironbark - Dry Open Forest of the Lower Foothills of the Barrington Tops, North Coast (HU 630)
- Veg Type 12: Rough-barked Apple Grassy Open Forest on Valley Flats of the North Coast and Sydney Basin (HU 605)
- Eucalyptus plantation
- Dams

- Local Road
- Track
- Named Watercourse
- Unnamed Watercourse
- 10m Contours

Stratford Project Areas

- Development Footprint
- Offset Areas

Metres
0 50 100 200 300 400 500
N

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PROJECT REFERENCE: 2020 Planting
DATE DRAWN: 9/10/2019 11:02 Version 1
DRAWN BY: GJoyce
DATA SOURCE:
LPI - 2009

Proposed 2020 Offset Planting Areas

Stratford Coal
2020 Offset Planting

FIGURE:
1

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Stratford Mining Complex - Nest Box Replacement Requirements

**Note: Accounts for vegetation clearance post approval of the NSW Development Consent SSD-4966 i.e. 4 April 2018 (Commencement date)*

**Note: Jan 2019 to Dec 2019*

			Location		Tree Description					Habitat Features						Fauna Observed	
Area Cleared	Date cleared	Tree/ Feature #	Easting	Northing	Species	Health/ Isolation	Height (m)	DBH (m)	% Crown Cover	Total # Features	Total Tree Hollows	Feature	Feature Height	Dimensions Width (cm)	Dimensions Depth (m)	Species	Comments
Avon North Stage 3 (South of old Wenham Cox Road)		001	6445257	403499	*Stag*	S, M	15	0.5	-	1		LH	10	>20			
		002	6445374	403516	*Stag*	S, M	12	0.4	-	3		LH	8	>20			
		003	6445459	403601	*Grey Gum*	L,D	18	0.5	30	1		LH	10	10			Scratch Marks on one tree. This is a closely spaced group of 5 trees - will need to be treated as a single unit when cleared
		003			*Grey Gum*	L, D	18	0.6	30	1		LH	10	10			
		003			*Log*	-	-	-	-	1		Log hollow	-	>20			
	1/02/2019	004	6445545	403683	*Dam*	-	-	-	-	-		-	-	-		-	Dry at moment - may have been amphibian habitat
		005	6445712	403389	*Stag*	S, D	15	0.6	-	1	0	LH	15	>20			
		006	6445751	403310	*Log*	-	-	-	-	1		Log hollow	-	>20		Lge Skink	outside footprint
		007	6445766	403345	*Log*	-	-	-	-	1		Log hollow	-	>20			
		008	6445648	403761	*Log*	-	-	-	-	1		Log hollow	-	>20			
	1/02/2019	009	6445798	403458	*E. acmenoides*	L, M	20	0.6	30	1	1	LH	7	10			
	1/02/2019	010	6445809	403584	*Logs*	-	-	-	-	-	0	Log pile	-	-		Lge Skink	stockpile of old logs
	1/02/2019	011	6445798	403638	*Logs*	-	-	-	-	-	0	Log pile	-	-			stockpile of old logs
	1/02/2019	012	6445781	403719	*Logs*	-	-	-	-	-	0	Log pile	-	-			stockpile of old logs
	1/02/2019	013	6445758	403736	*Log*	-	-	-	-	1	0	Hollow	-	>20			
Flood Bunds - Main Pit & Avon North	31/05/2019	1			E. Moluccana	L, S	25	0.6	25	1	0	Nest	10	-			Nil
	31/05/2019	2			E. Tereticornis	L, S	25	0.6	25	1	1	LH	5	10			Nil. Small hollow. Glider
	31/05/2019	3			E. Tereticornis	L, S	25	0.5	10	2	1	CH	2	30			Nil. Large hollow.
	31/05/2019	4			E. Tereticornis	L, S	25	0.8	25	1	1	Fissure	15	30			Nil. Large hollow
	31/05/2019	5			E. Moluccana	L, S	25	0.7	20	3	1	LH, Nest	15	10			Nil. Small hollow. Glider
	31/05/2019	6			E. Moluccana	L, S	25	0.25	10	1	0	Nest	20	-			Nil
	31/05/2019	7			E. Moluccana	L, S	25	0.5	15	1	0	Nest	20	-			Nil
Stratford East Stage 1 - Box Cut & Waste Emplacement		1	6443739	403116	*A floribunda*	LM	10	0.4	40	1		MSH	1	5 to 20			
		2	6443696	403127	*A floribunda*	LM	20	0.5	40	1		N	18				
		3	6443698	403175	-	SM	10	0.5	-	1		CH	10	>20			
		4	6443710	403187	*C maculata*	LM	10	0.3	50	1		MSH	4	5 to 20			
		5	6443705	403186	*A floribunda*	LM	15	0.4	10	1		MSH	10	5 to 20			
		6	6443721	403152	*C maculata*	LM	20	0.4	40	1		N	18				
	12/09/2019	7	6443721	403334	*E punctata*	LI	20	0.6	40	2	2	LH	10	5		Nil	Scratches on trunk. Suitable for glider
		8	6443695	403439	*E acmeniodes*	LM	10	0.7	70	1		MSH	5	5 to 20			
		9	6443637	403410	*E punctata*	LI	30	1.1	60	2		LH	10 & 15	5			Plus Allocasuarina underneath
	12/09/2019	10	6443348	403168	*E acmenoides*	LD	20	0.8	30	1	1	F	8	5 to 20		Nil	Large hollow
	12/09/2019	11	6443457	402968	*A floribunda*	LM	18	0.5	30	0	0	LH	8			Nil	No confirmed hollows
	12/09/2019	12	6443478	402969	*A floribunda*	I	18	0.4	10	1	1	MSH	10	5 to 20		Nil	plus Allo for seeds. Suitable for glider
	12/09/2019	13	6443297	402929	*Stag*	DI	20	-	-	2	2	MSH	5	>20		Nil	1 x glider hollow. 1 x large hollow
	12/09/2019	14	6443259	402569	*Stag x 2*	DI	20	-	-	2	2	MSH	5 to 10	5 to 20		Nil	Possible Birds or bats habitat. 2 x small hollows
	12/09/2019	15	6443211	402773	*E punctata*	LI		1	70	1	1	MSH		5 to 20		Nil	1 x large hollow.
		16	6442846	402989	*E punctata*	LM	20	1				LH	3	5			scratches on tree
		17	6443235	403230	*Stag*	D	10							>20			large pipe
		18	6443590	403380	*Figtree*	LI	10	0.6	40	1		MSH	2	>20			Strangler fig
									Total	42	14	Minus log hollows, termite nests.					

Key

*Health: Live (L), Stag (S)

*Isolation: Isolated (I), Sparse (S), Moderate (M), Dense Forest (D)

*Diameter at Breast Height (DBH)

*Features: Main stem hollow (MSH), Residual hollow (RH), Crown hollow (CH), Limb hollow (LH), Fissure (F), Nest (N)

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2019 Stratford Mining Complex Biodiversity Offsets Flora Monitoring Report

Yancoal Pty Ltd

Stratford Coal Pty Ltd
3364 Buckett's Way, Stratford, NSW 2422

18 December 2019

2019 Stratford Mining Complex Biodiversity Offsets Flora Monitoring Report

Stratford Coal Pty Ltd

3364 Buckett's Way, Stratford, NSW 2422

Kleinfelder Document Number: NCA19R93495
Project No: 20193635

Prepared for:

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EXECUTIVE SUMMARY

The monitoring of the Stratford Mine Complex (SMC) vegetation communities and habitats located within the Biodiversity Enhancement Area and Biodiversity Offset Area was conducted in February 2019 and was the first survey in accordance with the Stratford Mining Complex (Stratford Extension Project) – Biodiversity Management Plan (BMP 2018) to provide baseline data for subsequent surveys of the revegetation progress against the project specific performance and completion criteria. This survey has been undertaken prior to the revegetation works commencing in the Biodiversity Offset areas.

The Revegetation Areas are to be revegetated to substantially increase the area of native vegetation in the area and maximise habitat diversity and a range of successional stages. Revegetation is to include a range of native canopy, understory and groundcovers consistent with the vegetation types identified for the Biodiversity Offsets as described in the BMP 2018.

Surveys were undertaken in accordance with sections 7.1.1 to 7.1.3 of the BMP. This assessment was conducted using a plot-based approach to measure the progression of the rehabilitation towards a self-sustaining ecosystem and included:

- *Visual monitoring of maintenance issues such as tracks/fire trails, fences and uncontrolled presence of livestock, signage, illegal access or vandalism, severe erosion that require remediation; and fuel loads/fire risk.*
- *Habitat and vegetation condition in Biodiversity Offset Areas; and Biodiversity Enhancement Area using sixteen 20m x 20m permanent quadrat. All flora species were recorded within the quadrats including their estimated cover and abundance.*
- *Photographic monitoring at sixteen permanent monitoring points.*

The monitoring quadrats within the Stratford Mining Complex offset areas have been established as follows. Five quadrats are located in remnant bushland (BMP Management Zone B) that was deemed to be in good condition (multi layered vegetation and low prevalence of exotic species) and are used in the scope of this Biodiversity Offset monitoring as reference sites to provide a benchmark to assess the success of the revegetation of the other eleven plots. The remaining plots are all located in revegetation areas (BMP Management Zone A) which consist of predominantly exotic pasture and scattered trees which have been previously cleared.

Three reference sites are located within the Spotted Gum – Grey Ironbark Dry Open Forest vegetation community and two reference sites are located within the Cabbage Gum Open Forest vegetation community. The reference sites will be used as a benchmark to assess the success of the revegetation program for their respective communities.

All reference sites are similar in condition, floral diversity and vegetation structure. Vegetation condition is good with a multi layered structure and a low prevalence of exotic species in all reference sites except Q6 (Cabbage Gum community reference site) that possesses a ground layer with approximately 30% exotic cover.

All Spotted Gum – Ironbark Forest revegetation monitoring quadrats (Management Zone A) consist of introduced pastures with varying diversity and cover of native plants. All three quadrats are dominated by exotic grasses such as Narrow-leafed Carpet Grass, Paspalum and Whisky Grass and native species cover less than 5% of the total area.

Two quadrats located within the Cabbage Gum vegetation community (Management Zone A3), Q5 and Q7 present aspects of regrowth with some Cabbage gum saplings and less incidence of exotic species in the ground layer. The other three revegetation monitoring quadrats consist of introduced pastures with varying diversity of native plants but in all three, native species cover less than 5% of the total area and exotic pasture species such as Narrow-leafed Carpet Grass, Paspalum and Whisky Grass are the most widespread species.

Management Zone A1 has been planted to establish a Squirrel Glider corridor between existing patches of remnant vegetation known to provide foraging habitat for the local population of Squirrel Gliders. Through the planting of native trees and shrubs from the Spotted Gum – Ironbark Dry Open Forest vegetation community, Squirrel Gliders will be able to move freely between foraging areas decreasing the risk posed by habitat fragmentation to the long-term viability and survival of the local population. One quadrat, Q11, is located within the Squirrel Glider Corridor and will serve as a monitoring location to assess the success of the revegetation program of the corridor. Q11 is mostly grassland and currently lacks structural complexity and is dominated by Couch and other exotic grasses

Two separate areas have been selected to enhance habitat for the Glossy black-cockatoo (Management Zone A2), a species listed as vulnerable in NSW under the BC Act 2016. Through the planting of Allocasuarina torulosa (Forest She-oak), one of the species' preferred feed tree, the area will be established as high quality foraging habitat. Two quadrats, Q10 and Q14, will be used to assess the success of the revegetation program. Quadrat 10 is a grassland

mostly composed of native grasses such as Kangaroo Grass and Blady Grass while Quadrat 14 is also grassland and presents a higher density of exotic cover.

This survey marks the first monitoring event of the Stratford Offsets and Biodiversity Enhancement Areas, occurring immediately after the revegetation program had commenced. As such it provides baseline data for the revegetation program. The results that canopy and midstorey species are very sparse in the Offsets Areas – even where natural recruitment has been occurring – while the Biodiversity Enhancement Areas are slightly denser. Native plant numbers will be increased in both areas as a result of the revegetation program.

Contents

Tables

Figures

Plates

Appendices

1. INTRODUCTION

Stratford Coal Pty Ltd (SCPL) is a wholly owned subsidiary of Yancoal Australia Ltd and operates the Stratford Mining Complex (SMC). The SMC is located between the small towns of Craven and Stratford on the Buckett's Way, approximately 100km north of Newcastle (**Figure 1**). The SMC consists of the several open pits and associated waste emplacements, coal handling plant, and other infrastructure.

On 29 May 2015, the NSW Planning Assessment Commission approved the Stratford Extension Project (SEP). The SEP provides for the continuation of mining and processing at the SMC for an additional 11 years. The SMC operates under two key approvals, NSW Development Consent (SSD-4966) and the Commonwealth Approval (EPBC 2011/6176). Both may be viewed at http://www.stratfordcoal.com.au.

In accordance with Condition 39(d), Schedule 3 of the Development Consent SSD-4966, the Stratford Mining Complex (Stratford Extension Project) – Biodiversity Management Plan (2018) has been prepared for the three-year period from the date of the BMP approval (between 2018 and 2020). The objective of this Biodiversity Management Plan (BMP) is to address relevant State and Commonwealth approval conditions and facilitate the management of biodiversity at the SMC, Biodiversity Enhancement Area and Biodiversity Offset Area. Section 5.3 of the BMP details the Revegetation Programme currently in progress in the Biodiversity Enhancement Area and Biodiversity Offset Area.

In accordance with Section 7 of the BMP, monitoring and assessment of the revegetation of the Offset Areas will be required to demonstrate the effectiveness of the rehabilitation techniques and track the progression towards achieving the performance and completion criteria of the Biodiversity Offset Strategy. This assessment will be conducted using a plot-based approach to measure the progression of the rehabilitation towards a self-sustaining ecosystem. The 2019 Offset Monitoring report is submitted to fulfil this requirement and will serve as baseline data for future monitoring events. This survey has been undertaken prior to the revegetation works commencing in the Biodiversity Offset areas

1.1 SCOPE AND RATIONALE

Kleinfelder Australia was commissioned by SCPL to conduct monitoring of the vegetation communities within the Biodiversity Enhancement Area and Biodiversity Offset Area in accordance with Section 7 of the BMP to ensure compliance with the above stated objectives. The 2019 monitoring event will serve as the baseline survey to assess the success of the revegetation work.

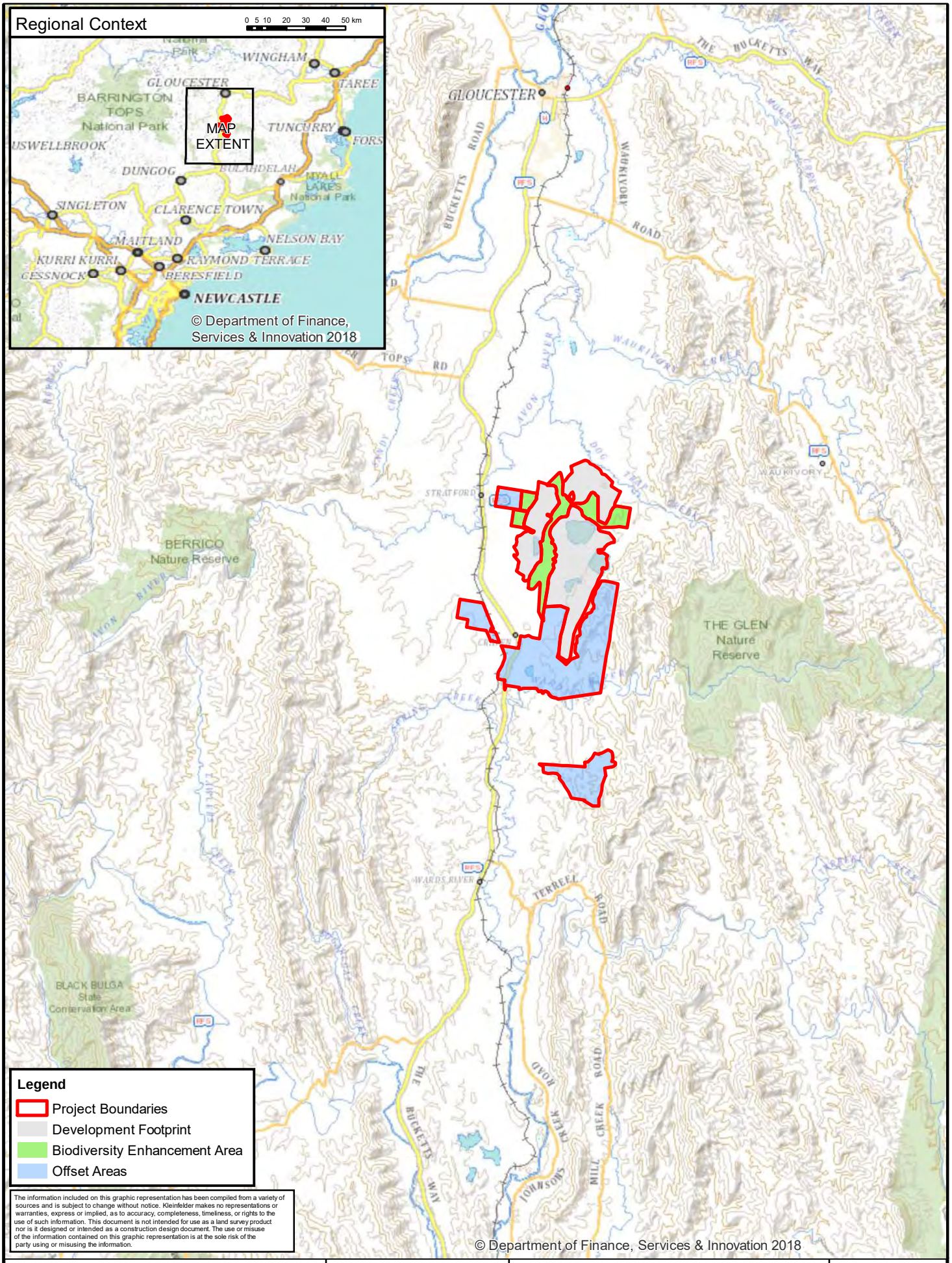
The Habitat and Vegetation Condition monitoring was conducted by Kleinfelder staff between the 25th and the 28th February 2019. The findings of the habitat and vegetation condition surveys and appropriate recommendations are provided in this report.

1.2 VEGETATION MANAGEMENT ZONES

The Revegetation Areas are to be revegetated to substantially increase the area of native vegetation in the area and maximise habitat diversity and a range of successional stages. Revegetation is to include a range of native canopy, understory and groundcovers consistent with the vegetation types identified for the Biodiversity Offsets as described in the BMP 2018 and summarised in **Table 1** taken form the BMP report itself. The prescribed species and management actions are detailed in the BMP.

Table 1: Summary of the different management zones within the Revegetation Areas of the Stratford Offsets and Biodiversity Enhancement Areas

Management Zones	Description	Description
A	Revegetation Area	The Revegetation Areas are areas of introduced pasture with scattered trees which will be revegetated to establish a range of habitat niches – including native canopy, understorey and groundcover. Revegetation Areas occur in the Biodiversity Offset Area and the Biodiversity Enhancement Area
	A1 - Squirrel Glider Vegetation Pathways	A sub-component of the Revegetation Area will be planted with species which will enhance the food resources and dispersal pathways for Squirrel Gliders. Squirrel Glider Vegetation Pathways occur in the Biodiversity Offsets Area (particularly in Offset Areas 1 and 3) and the Biodiversity Enhancement Area.
	A2 - *Allocasuarina* spp. Plantings	A sub-component of the Revegetation Area will be planted with *Allocasuarina* spp. tubestock for the Glossy-back Cockatoo. *Allocasuarina* spp. plantings will occur in the Biodiversity Offset Area.
	A3 – Coastal Floodplain Forest Revegetation	A sub-component of the Revegetation Area will be planted with flora species characteristic of the Cabbage Gum open forest vegetation community.
B	Existing Remnant Vegetation	Existing remnant vegetation within the Biodiversity Offset Area will be allowed to regenerate naturally.
C	Powerline Corridor	Woodland/forest will not be allowed to regenerate within the power line corridor within Offset Area 3.



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PROJECT REFERENCE: 20193635

DATE DRAWN: 23/04/2019 16:58 Version 1

DRAWN BY: BDeane

DATA SOURCE:
NSW DFSI - 2018

Locality

Stratford Coal Pty Ltd
Stratford Offset Monitoring
3364 Buckett's Way, Stratford, NSW 2422

FIGURE:

1

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2. METHODS

The methodology used for the monitoring of the Biodiversity Offset Strategy follows guidelines outlined in Section 7 of the BMP.

2.1 VISUAL MONITORING

The first component of the monitoring consists of an opportunistic and targeted inspection of the Biodiversity Offset Area to identify:

- Maintenance issues with tracks/fire trails;
- Maintenance issues with fences and uncontrolled presence of livestock;
- Maintenance issues with signage;
- Illegal access or vandalism
- Severe erosion that require remediation; and
- Fuel loads/fire risk.

Photographic evidence as well as GPS locations relating to the management issues mentioned above are provided in **Section 3**.

2.2 HABITAT AND VEGETATION CONDITION MONITORING

The second component of the monitoring consists in assessing the vegetation condition and habitat value at sixteen locations within five vegetation management units:

- Four Offset Areas; and
- One Biodiversity Enhancement Area.

At each location, a single 20m x 20m permanent quadrat, was established for data collection. Each quadrat was marked with four star pickets located at each corner; the co-ordinates of the south-west corner of each quadrat was recorded using a hand-held GPS unit. GPS locations of quadrats within each vegetation management units are presented as easting and northing in **Appendix 1** and mapped in **Figure 2**.

The data gathered during the habitat and vegetation monitoring is outlined in **Table 2**.

Table 2: Methodology for the collection of flora data for the Offsets Monitoring:

Parameter	Survey Requirement	Method
Species Name	Scientific and Common Name of each recorded species	20m x 20m quadrat
Stratum and layer	Stratum & layer in which each species occurs	
Growth Form	Growth form for each recorded species ***(at maturity)***	
Cover	Estimate the percentage foliage cover across the quad of each species rooted in or overhanging the quad. Cover should be estimated in decimals if less than 1% (0.1, 0.2, etc), or whole numbers up to 5% or the nearest 5% if greater than 5% cover.	
Abundance Rating	For species with cover less than or equal to 5%, count or estimate the number of individuals or shoots of each species with the quad at the following intervals: 1,2,3,4,5,6,7,8,9,10,20,50,100,500,1000,1500,2000 etc. Number above 20 are estimates only, and the recorded abundance is the upper end of class (i.e. 50 represents an estimated abundance of between 20 and 50). For species with cover greater than 5%, abundance estimates are not required but may be recorded if desired.	

Five quadrats are located in remnant bushland (Management Zone B) that was deemed to be in good condition (multi layered vegetation and low prevalence of exotic species) and are used in the scope of this Biodiversity Offset monitoring as reference sites to provide a benchmark to assess the success of the revegetation of the other eleven plots. The remaining plots are all located in revegetation areas (BMP Management Zone A and the which consist of predominantly exotic pasture and scattered trees which have been previously cleared. The quadrat location and vegetation type are outline in **Table 3**.

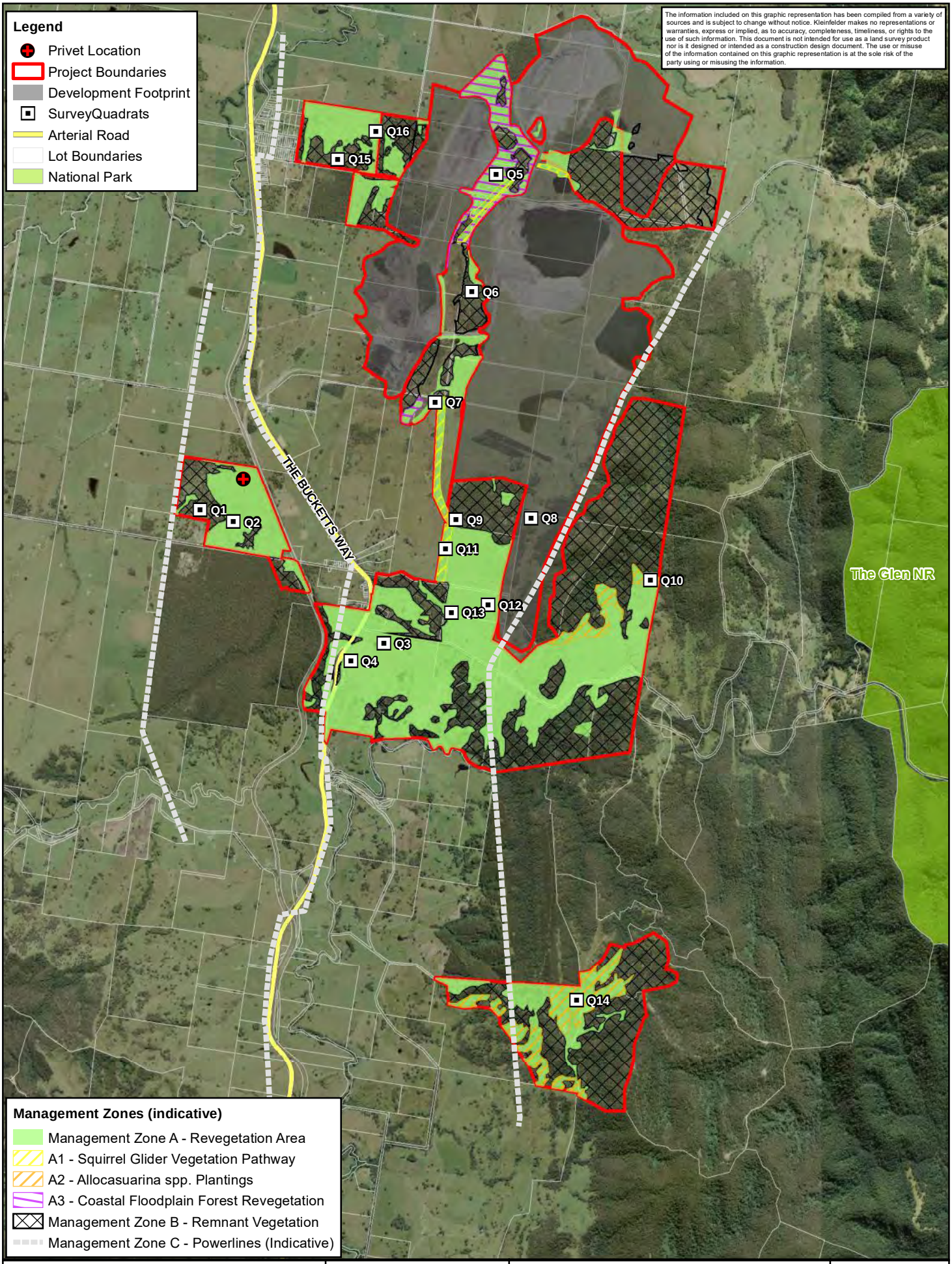
Table 3: Quadrat location and vegetation type

Management Zone	Vegetation Community	Offset Area/Location	No of Quadrats	Quadrat Designation	Type of Vegetation
A	Revegetation Areas – Spotted Gum – Grey Ironbark Dry Open Forest	Offset Area 2	1	Q2	Revegetation
		Offset Area 3	2	Q4 & Q12	Revegetation
	Revegetation Areas – Cabbage Gum Forest	Offset Area 1	1	Q16	Revegetation
A1	Squirrel Glider Corridor	Offset Area 3	1	Q11	Revegetation
A2	*Allocasuarina* spp. Plantings	Offset Areas 3 & 4	2	Q10 & Q14	Revegetation
A3	Cabbage Gum Open Forest	Biodiversity Enhancement Area	2	Q7 & Q5	Revegetation
		Offset Area 3	2	Q3 & Q13	Revegetation
B	Spotted Gum – Grey Ironbark Dry Open Forest	Offset Area 2	1	Q1	Remnant
		Offset Area 3	2	Q8 &Q9	Remnant
	Cabbage Gum Forest	Offset Area 1	1	Q15	Remnant
		Biodiversity Enhancement Area	1	Q6	Remnant
	Totals		**16**		**5 x Remnant 11 x Revegetation**

2.3 PHOTO MONITORING

Sixteen permanent photographic monitoring points have been established to provide a visual assessment of change in the Biodiversity Offset Area over time. Each photopoint has been installed at the south west corner of each quadrat. Four photos will be taken at each monitoring point in a clockwise direction (north, east, south and west). Additionally, four photographs will be taken at each of the star pickets looking toward the opposite picket, in both portrait and landscape view.

Photo monitoring will be undertaken annually and will coincide with the habitat and vegetation condition monitoring. Photos are provided in **Appendix 3**. Note that due to the large volume of photos, only one photo per quadrat will be provided in this report. The additional photos will be sent separately to SCPL.



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PROJECT REFERENCE: 20193635

DATE DRAWN: 2019/12/17 12:05Version 1

DRAWN BY: GJoyce

DATA SOURCE:
NSW DFSI - 2018
Stratford Coal - 2018

Flora Quadrat Monitoring

Stratford Coal Pty Ltd
Stratford Offset Monitoring
3364 Buckett's Way, Stratford, NSW 2422

FIGURE:
2

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3. MONITORING RESULTS

3.1 VISUAL MONITORING RESULTS

Recent works conducted by Stratford Coal Pty Ltd has resulted in few issues to be reported in the visual component of the offsets monitoring.

Tracks and maintenance, fencing and uncontrolled presence of livestock and signage and the fuel loads/risk have recently been addressed as part of the replanting program recently (at time writing) being undertaken. Any potential issues have been dealt with to ensure that the replanting program was able to be conducted and the plants were not subject to herbivory by livestock, while the fuel loads have been reduced by slashing in the replanting areas.

There were no severe erosion issues observed during the monitoring.

Instances of illegal access/vandalism have been dealt with through improved security of access gates i.e. heavier chains and improved locks.

3.2 VEGETATION AND HABITAT MONITORING RESULTS

The results of the vegetation and habitat monitoring within the Biodiversity Offset Area and Biodiversity Enhancement Area are summarized in **Table 4**. The data gathered in 2019 will serve as a baseline to assess the success of the revegetation efforts initiated in autumn 2019. The detailed data from the 2019 monitoring survey of vegetation cover/abundance is provided in **Appendix 2**. Due to the large number of photos, only the photos taken from the south-west corner at each monitoring site are presented in this report (**Appendix 3**); the remaining photos have been provided as separate files with the report.

Table 4: Number of species present in each plot

Site	Vegetation Community	Vegetation Type	Quadrat Location	Number of species present within each plot by growth form
Q1	Spotted Gum – Grey Ironbark Dry Open Forest	Management Zone B -Remnant	Offset Area 1	The quadrat contained a total of 32 native plant species including: • 3 Tree species • 3 Shrub species • 14 Grass species • 7 Forb species • 1 Fern species • 4 Other species Additionally, 3 exotic plant species were present within the quadrat.
Q2	Spotted Gum – Grey Ironbark Dry Open Forest	Management Zone A - Revegetation	Offset Area 1	The quadrat contained a total of 12 native plant species including: • 0 Tree species • 1 Shrub species • 3 Grass species • 6 Forb species • 0 Fern species • 2 Other species Additionally, 8 exotic plant species were present within the quadrat including 1 Priority Weed for the Hunter, *Senecio madagascariensis*.
Q3	Cabbage Gum Open Forest	Management Zone A - Revegetation	Offset Area 3	The quadrat contained a total of 6 native plant species including: • 0 Tree species • 1 Shrub species • 3 Grass species • 2 Forb species • 0 Fern species • 0 Other species Additionally, 11 exotic plant species were present within the quadrat including 1 Priority Weed for the Hunter, *Senecio madagascariensis*.
Q4	Spotted Gum – Grey Ironbark Dry Open Forest	Management Zone A - Revegetation	Offset Area 3	The quadrat contained a total of 3 native plant species including: • 0 Tree species • 0 Shrub species

Site	Vegetation Community	Vegetation Type	Quadrat Location	Number of species present within each plot by growth form
				• 0 Grass species • 3 Forb species • 0 Fern species • 0 Other species Additionally, 12 exotic plant species were present within the quadrat including 1 Priority Weed for the Hunter, *Senecio madagascariensis*.
Q5	Cabbage Gum Open Forest	Management Zone A3 - Revegetation	Biodiversity Enhancement Area	The quadrat contained a total of 20 native plant species including: • 4 Tree species • 3 Shrub species • 3 Grass species • 8 Forb species • 0 Fern species • 2 Other species Additionally, 12 exotic plant species were present within the quadrat including 1 Priority Weed for the Hunter, *Senecio madagascariensis*.
Q6	Cabbage Gum Open Forest	Management Zone **B -** Remnant	Biodiversity Enhancement Area	The quadrat contained a total of 18 native plant species including: • 1 Tree species • 1 Shrub species • 5 Grass species • 8 Forb species • 0 Fern species • 3 Other species Additionally, 16 exotic plant species were present within the quadrat including 1 Priority Weed for the Hunter, *Senecio madagascariensis*.
Q7	Cabbage Gum Open Forest	Management Zone A1 – Squirrel Glider Corridor Revegetation	Biodiversity Enhancement Area	The quadrat contained a total of 11 native plant species including: • 1 Tree species • 0 Shrub species • 6 Grass species • 4 Forb species • 0 Fern species • 0 Other species Additionally, 11 exotic plant species were present within the quadrat.

Site	Vegetation Community	Vegetation Type	Quadrat Location	Number of species present within each plot by growth form
Q8	Spotted Gum – Grey Ironbark Dry Open Forest	Management Zone B - Remnant	Offset Area 3 (North)	The quadrat contained a total of 35 native plant species including: • 4 Tree species • 9 Shrub species • 13 Grass species • 6 Forb species • 0 Fern species • 3 Other species Additionally, 2 exotic plant species were present within the quadrat.
Q9	Spotted Gum – Grey Ironbark Dry Open Forest	Management Zone B - Remnant	Offset Area 3 (North)	The quadrat contained a total of 42 native plant species including: • 3 Tree species • 12 Shrub species • 10 Grass species • 11 Forb species • 0 Fern species • 6 Other species Additionally, 2 exotic plant species were present within the quadrat including 1 Priority Weed for the Hunter, Lantana camara.
Q10	*Allocasuarina torulosa* planting	Management Zone A2 - Revegetation	Offset Area 3	The quadrat contained a total of 12 native plant species including: • 0 Tree species • 1 Shrub species • 6 Grass species • 2 Forb species • 1 Fern species • 2 Other species Additionally, 15 exotic plant species were present within the quadrat including 1 Priority Weed for the Hunter, *Senecio madagascariensis*.
Q11	Spotted Gum – Grey Ironbark Dry Open Forest	Management Zone A1 – Revegetation	Offset Area 3	The quadrat contained a total of 7 native plant species including: • 0 Tree species • 1 Shrub species • 4 Grass species • 2 Forb species • 0 Fern species

Site	Vegetation Community	Vegetation Type	Quadrat Location	Number of species present within each plot by growth form
				• 0 Other species Additionally, 9 exotic plant species were present within the quadrat including 1 Priority Weed for the Hunter, *Senecio madagascariensis*.
Q12	Spotted Gum – Grey Ironbark Dry Open Forest	Management Zone A - Revegetation	Offset Area 3	The quadrat contained a total of 12 native plant species including: • 0 Tree species • 1 Shrub species • 7 Grass species • 2 Forb species • 2 Fern species • 0 Other species Additionally, 14 exotic plant species were present within the quadrat including 1 Priority Weed for the Hunter, *Senecio madagascariensis*.
Q13	Cabbage Gum Open Forest	Management Zone A - Revegetation	Offset Area 3	The quadrat contained a total of 3 native plant species including: • 0 Tree species • 0 Shrub species • 3 Grass species • 0 Forb species • 0 Fern species • 0 Other species Additionally, 13 exotic plant species were present within the quadrat.
Q14	*Allocasuarina torulosa* planting	Management Zone A1 – Revegetation	Offset Area 4	The quadrat contained a total of 12 native plant species including: • 0 Tree species • 0 Shrub species • 7 Grass species • 3 Forb species • 0 Fern species • 2 Other species Additionally, 17 exotic plant species were present within the quadrat including 1 Priority Weed for the Hunter, *Senecio madagascariensis*.
Q15	Cabbage Gum Open Forest	Management Zone B - Remnant	Offset Area 1	The quadrat contained a total of 44 native plant species including: • 4 Tree species • 6 Shrub species

Site	Vegetation Community	Vegetation Type	Quadrat Location	Number of species present within each plot by growth form
				• 15 Grass species • 16 Forb species • 1 Fern species • 2 Other species Additionally, 6 exotic plant species were present within the quadrat including 1 Priority Weed for the Hunter, *Sporobolus fertilis*.
Q16	Cabbage Gum Open Forest	Management Zone A - Revegetation	Offset Area 1	The quadrat contained a total of 15 native plant species including: • 0 Tree species • 2 Shrub species • 4 Grass species • 6 Forb species • 0 Fern species • 3 Other species Additionally, 8 exotic plant species were present within the quadrat including 2 Priority Weeds for the Hunter, *Senecio madagascariensis* and *Sporobolus fertilis*.

*Growth forms are based on the forms listed in the NSW Biodiversity Assessment Method (BAM).

3.3 PRIORITY WEEDS FOR THE HUNTER

Several species of exotic flora are present within the monitoring quadrats. **Appendix 2** provides a list of all exotic species present, listed by their growth form under the Biodiversity Assessment Method (BAM). This listing is more relevant to native vegetation than in the context of the revegetation of exotic pasture. The status of Priority Weeds listed by the NSW Department of Primary Industries (DPI) is more relevant to the threat posed by the exotic species to the revegetation of the offset areas. The following Priority Weeds for the Hunter region are present within the offset areas:

- *Lantana camara* (Lantana)
- *Senecio madagascariensis* (Fireweed)
- *Sporobolus fertilis* (Giant Parramatta Grass)

These species should be the focus of weed control measures due to their ability to impede the success of revegetation efforts as well as impacting surrounding bushland.

4. DISCUSSION

4.1 SPOTTED GUM – GREY IRONBARK DRY OPEN FOREST

4.1.1 Management Zone B Remnant Vegetation - Reference sites

Three reference sites are located within the Spotted Gum – Grey Ironbark Dry Open Forest vegetation community and will be used as a benchmark to assess the success of the revegetation program for that community. Q1 is located in Offset Area 2 while Q8 and Q9 are located in Offset Area 3 (**Figure 2**).

All three reference sites are similar in condition, floral diversity and vegetation structure. Vegetation condition is good with low prevalence of exotic species. Exotic species present include pasture grasses such as *Axonopus fissifolius* (Narrow-leafed Carpet Grass), *Paspalum dilatatum* and *Lantana camara* but cover less than 1% in each plot. The composition of the canopy layer varies between the three sites. While *Corymbia maculata* (Spotted Gum) is dominant in Q1 (**Plate 1**) and Q8 (**Plate 8**), it is absent from Q9 (**Plate 9**) where *Eucalyptus crebra* (Narrow-leaved Ironbark) and *Eucalyptus umbra* (Eucalyptus umbra) dominate. The shrub layer is sparse and consists of species such as *Pultenaea villosa* (Hairy Bush-pea), *Acacia ulicifolia* (Prickly Moses) and *Acacia implexa* (Hickory Wattle). The understorey is dominated by native grasses and groundcovers especially *Entolasia stricta* (Wiry Panic) and *Themeda triandra* (Kangaroo Grass) that combined, cover at least 15% in each plot. Other species present include *Lobelia purpurascens* (Whiteroot) and *Lagenophora stipitata* (Blue Bottle-daisy).

4.1.2 Management Zone A - Revegetation sites

Three monitoring quadrats have been established to assess the success of the Spotted Gum – Ironbark Dry Open Forest revegetation. Q2 is located within Offset Area 2 while Q4 and Q12 are located within Offset Area 3. Q11 has been established to monitor revegetation efforts that align with this vegetation community (**Figure 2**) and is located within the Squirrel Glider Vegetation Pathway which is discussed in **Section 4.3**.

All three quadrats consist of introduced pastures with varying diversity and surface cover of native plants. Q2 (**Plate 2**) has the highest cover of native flora (11.1% total) due to the presence within the quadrat of *Themeda triandra* (Kangaroo Grass) covering 10% of the total surface area. Q12 (**Plate 12**) and Q4 (**Plate 4**) have a total native cover of 7.9% and 0.3% respectively. Most native plants present in those quadrats are groundcovers including *Lobelia purpurascens* (Whiteroot), *Dichondra repens* (Kidney Weed) and *Goodenia paniculata* (Branched Goodenia). In all three quadrats, exotic pasture grasses such as *Axonopus fissifolius* (Narrow-leafed Carpet Grass) and *Paspalum dilatatum* are the most widespread species. Combined, they cover an estimated surface area of 80% in Q4 and 70% in Q12. In Q2, where *Andropogon virginicus* (Whisky Grass) is the dominant species covering 40% of the quadrat, *Axonopus fissifolius* (Narrow-leafed Carpet Grass) and *Paspalum dilatatum* only cover 45% of the total surface area.

4.2 CABBAGE GUM OPEN FOREST

4.2.1 Reference sites

Two reference sites are located within the Cabbage Gum Open Forest vegetation community and will be used as a benchmark to assess the success of the revegetation program for that community. Q6 is located in the Biodiversity Enhancement Corridor and Q15 is located in Offset Area 1 (**Figure 2**).

4.2.1.1 Biodiversity Enhancement Area – Remnant Vegetation

Q6 (**Plate 6**) presents good structural complexity with a multi-layered vegetation including a canopy cover of 50%, made entirely of *Eucalyptus amplifolia* (Cabbage Gum) and a midstorey of *Melaleuca linariifolia* (Flax-leaved Paperbark) covering 10% of the quadrat. The dominant native species present in the understorey is the vine *Parsonsia straminea* (Common Silkpod) covering an estimated area of 15% of the quadrat. Other native species occur in much lower density and include *Lobelia purpurascens* (Whiteroot), *Dichondra repens* (Kidney Weed) and *Polymeria calycina*. *Ligustrum sinense* (Small -leaved Privet) covers an estimated 5% of the midstorey layer and the understorey is dominated by exotic weeds such as *Chloris gayana* (Rhodes Grass) and *Sida rhombifolia* (Paddy's Lucerne) covering respectively 25% and 5% of the total surface area. Other exotic species also occur within the quadrat but in lower density

such as *Araujia sericifera* (Moth Vine), *Bidens pilosa* (Cobblers Pegs) and *Verbena bonariensis* (Purpletop).

4.2.1.2 Management Zone B – Remnant Vegetation

Q15 (**Plate 15**) possesses a more diverse canopy layer than Q6, however total canopy cover is similar. *Eucalyptus amplifolia* (Cabbage Gum), *Eucalyptus moluccana* (Grey Box) and *Eucalyptus eugenioides* (Thin-leaved Stringybark) are present within the quadrat and cover respectively 45%, 5% and 1% of the total canopy layer. The midstorey is sparse and not well established as species within that stratum are at the regrowth stage and include *Melaleuca nodosa* (Prickly-leaved Paperbark) and *Exocarpos cupressiformis* (Native Cherry) with a surface cover of 0.2% and 0.1% respectively. The dominant species within the shrub layer is *Leucopogon juniperinus* (Prickly Beard-heath) covering approximately 5% of that stratum. Other shrub species include *Acacia ulicifolia* (Prickly Moses), *Hibbertia riparia* (Erect Guinea-flower) and *Daviesia ulicifolia* (Gorse Bitter Pea). The dominant species within the ground layer are *Lomandra multiflora subsp. multiflora* (Many-flowered Mat-rush) and *Lomandra filiformis* (Wattle Mat-rush) covering respectively 5% and 3% of the total area of that stratum. Exotic species cover within the quadrat is only 0.7% and include *Axonopus* fissifolius (Narrow-leafed Carpet Grass), *Paspalum dilatatum* and *Sporobolus fertilis* (Giant Parramatta Grass).

4.2.2 Management Zone A - Revegetation Areas

Three monitoring quadrats have been established to assess the success of the Cabbage Gum Open Forest revegetation. Q3 and Q13 are located within the Offset Area 3. Q16 is located within the Offset Area 1 (**Figure 2**).

All three quadrats consist of introduced pastures with varying diversity of native plants but in all three, native species cover less than 5% of the total area (Q3 (**Plate 3**), Q13 (**Plate 13**) and Q16 (**Plate 16**) have a native species cover of 2.4%, 2.5% and 3.9% respectively). In all three quadrats, exotic pasture species such as *Axonopus fissifolius* (Narrow-leafed Carpet Grass), *Paspalum dilatatum* and *Andropogon virginicus* (Whisky Grass) are the most widespread species. Combined, they cover an estimated surface area of 95% in Q3 and 80% in Q16. In Q13, where *Andropogon virginicus* is absent, the other two species still cover 80% of the total surface area. Native groundcovers present among the exotic species include *Goodenia paniculata* (Branched Goodenia) and *Viola hederacea* (Ivy-leaved Violet).

4.2.3 Management Zone A3 Revegetation Areas

Two quadrats located within the Biodiversity Enhancement Corridor present aspects of regrowth.

Q5 (**Plate 5**) possesses fifteen *Eucalyptus amplifolia* (Cabbage Gum) saplings that cover approximately 0.5% of the quadrat. The ground layer is dominated by two species of native grasses, *Themeda triandra* (Kangaroo Grass) and *Imperata cylindrica* (Blady grass), that cover 25% and 30% of the total area respectively. The dominant exotic species are *Axonopus fissifolius* (Narrow-leafed Carpet Grass) and *Paspalum dilatatum* and combined, cover approximately 30% of the total area.

Q7 (**Plate 7**) Only has two canopy trees. These *Eucalyptus amplifolia* (Cabbage Gum) are more established than in Q5 and cover 5% of the total area. However, the ground layer is less diverse than in Q5 and dominated by exotic species especially *Paspalum dilatatum* covering an estimated 70% of the ground layer. *Andropogon virginicus* (Whisky Grass) is also present but less dense with a cover of 10%. The dominant native species is *Themeda triandra* (Kangaroo Grass) covering 10% of the quadrat.

NB – Q7 is situated at the northern most end of the Squirrel Glider Corridor and so may also be described under the following section.

4.3 MANAGEMENT ZONE A1 - SQUIRREL GLIDER CORRIDOR

This area has been selected to re-establish links between existing patches of vegetation known to provide foraging habitat for the local population of Squirrel Gliders. Through the planting of native trees and shrubs from the Spotted Gum – Ironbark Dry Open Forest vegetation community, Squirrel Gliders will be able to move freely between foraging areas decreasing the risk posed by habitat fragmentation to the long-term viability and survival of the local population. One quadrat, Q11, is located within the Squirrel Glider Corridor and will serve as a monitoring location to assess the success of the revegetation program of the corridor.

Q11 (**Plate 11**) lacks structural complexity and is dominated by *Cynodon dactylon* (Couch) covering 70% of the total area. Exotic species such as *Axonopus* fissifolius (Narrow-leafed Carpet Grass), *Paspalum dilatatum* and *Andropogon virginicus* (Whisky Grass) cover

approximately 25% of the quadrat. Scattered native grasses and groundcovers are also present including *Goodenia paniculata* (Branched Goodenia), *Juncus usitatus* and *Viola hederacea* (Ivy-leaved Violet).

4.4 MANAGEMENT ZONE A2 - *ALLOCASUARINA* SPP. PLANTING

Two separate areas have been selected to enhance habitat for the Glossy black-cockatoo, a species listed as vulnerable in NSW under the BC Act 2016. Through the planting of *Allocasuarina torulosa* (Forest She-oak), one of the species' preferred feed tree, the area will be established as high quality foraging habitat. Two quadrats, Q10 and Q14, respectively located within Offset Area 3 and Offset Area 4 will be used to assess the success of the revegetation program (**Figure 2**).

Quadrat 10 (**Plate 10**) is a grassland mostly composed of native grasses such as *Themeda australis* (Kangaroo Grass) and *Imperata cylindrica* (Blady Grass) and other native groundcovers. However, several exotic species are present within the quadrat including *Axonopus* fissifolius (Narrow-leafed Carpet Grass) *Paspalum dilatatum* and *Verbena rigida* (Veined Verbena) but cover less than 15% of the total area.

Quadrat 14 (**Plate 14**) presents a higher density of exotic cover with approximately 70% of the surface area colonized by weeds such as *Axonopus* fissifolius (Narrow-leafed Carpet Grass) and *Paspalum dilatatum*. The most dominant native species is *Imperata cylindrica* (Blady Grass) covering approximately 25% of the plot but other native grasses and groundcovers are also present including *Ischaemum australe*, *Entolasia stricta* (Wiry Panic) and *Cymbopogon refractus* (Barb Wired grass).

5. CONCLUSION

This report is the first monitoring event for the Stratford Offset Revegetation program and the results provides data immediately after the revegetation had commenced, although some smaller areas in the Biodiversity Enhancement Area (e.g. Q5) had been planted in previous years. The results show that the native vegetation in the Offsets areas is very sparse, especially canopy and midstorey strata even in those areas where natural recruitment is occurring. The Biodiversity Enhancement Areas generally recorded higher densities of native species in these strata. Both revegetation areas will have increased densities of native species as a result of the revegetation program.

6. REFERENCES

Monitoring of Landscape Function and Vegetation Structure of Rehabilitation Areas at the Stratford Coal Mine (2015) Report prepared by Greening Australia for Stratford Coal Pty Ltd.

Stratford Mining Complex Biodiversity Management Plan (2018) Report prepared by Stratford Coal Pty Ltd.

Stratford Mining Complex – Mining Operations Plan & Rehabilitation Management Plan (2018)

Tongway, D.J. and Ludwig, J.A. (2011). Restoring Disturbed Landscapes: Putting Principles into Practice. Island Press, Washington

The Royal Botanic Gardens and Domain Trust (2014), *PlantNET - The Plant Information Network System*, Version 2.0, The Royal Botanic Gardens and Domain Trust, Sydney, http://plantnet.rbgsyd.nsw.gov.au

APPENDIX 1. GPS LOCATIONS OF MONITORING QUADRATS

Table 5: GPS Locations of Monitoring Quadrats

Label	Easting	Northing	Longitude	Latitude
Q1	399296	6442419	151.93213	-32.15017
Q2	399617	6442303	151.93552	-32.15125
Q3	401069	6441130	151.95079	-32.16196
Q4	400749	6440960	151.94739	-32.16346
Q5	402150	6445659	151.96272	-32.1212
Q6	401917	6444524	151.96013	-32.13142
Q7	401565	6443458	151.95629	-32.141
Q8	402487	6442340	151.96595	-32.15117
Q9	401765	6442326	151.9583	-32.15123
Q10	403637	6441741	151.97808	-32.15667
Q11	401665	6442041	151.95721	-32.15379
Q12	402075	6441503	151.96149	-32.15868
Q13	401722	6441427	151.95775	-32.15934
Q14	402925	6437686	151.97013	-32.19319
Q15	400622	6445805	151.94654	-32.11975
Q16	400991	6446073	151.95048	-32.11737

APPENDIX 2. FLORA SPECIES LIST

Table 6: Flora species list Q1-Q5

Family	Scientific Name	Common Name	Stratum	Plot ID	Q1		Q2		Q3		Q4		Q5	
				BAM Growth Form / High Threat Weeds	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)
Acanthaceae	*Brunoniella australis*	Blue Trumpet	Groundcover	Forb (FG)										
Anthericaceae	*Arthropodium milleflorum*	Pale Vanilla-lily	Groundcover	Forb (FG)										
Anthericaceae	*Tricoryne elatior*	Yellow Autumn-lily	Groundcover	Forb (FG)									0.1	1
Apiaceae	*Centella asiatica*	Indian Pennywort	Groundcover	Forb (FG)										
Apiaceae	*Cyclospermum leptophyllum*	Slender Celery	Groundcover	Exotic										
Apocynaceae	*Araujia sericifera*	Moth Vine	Groundcover	Exotic										
Apocynaceae	*Gomphocarpus fruticosus*	Narrow-leaved Cotton Bush	Groundcover	Exotic									0.1	5
Apocynaceae	*Parsonsia straminea*	Common Silkpod	Groundcover	Other (OG)										
Asteraceae	*Aster subulatus*	Wild Aster	Groundcover	Exotic	0.1	5	0.1	10	0.5	200				
Asteraceae	*Bidens pilosa*	Cobblers Pegs	Groundcover	High Threat									0.1	20
Asteraceae	*Calotis lappulacea*	Yellow Burr-daisy	Groundcover	Forb (FG)										
Asteraceae	*Chrysocephalum apiculatum*	Yellow buttons	Groundcover	Forb (FG)							0.1	5		
Asteraceae	*Conyza bonariensis*	Flaxleaf Fleabane	Groundcover	Exotic			0.5	100	0.1	20	5	100	0.5	100
Asteraceae	*Conyza* spp.	Fleabane	Groundcover	Exotic							0.1	10		
Asteraceae	*Eclipta platyglossa*	-	Groundcover	Forb (FG)										
Asteraceae	*Euchiton sphaericus*	-	Groundcover	Forb (FG)										
Asteraceae	*Gamochaeta americana*	Cudweed	Groundcover	Exotic										
Asteraceae	*Hypochaeris glabra*	Smooth Catsear	Groundcover	Exotic										
Asteraceae	*Hypochaeris radicata*	Catsear	Groundcover	Exotic			0.5	100	0.1	50	0.1	100	0.2	50
Asteraceae	*Lagenophora stipitata*	Blue Bottle-daisy	Groundcover	Forb (FG)	0.1	5								
Asteraceae	*Onopordum acanthium*	Scotch Thistle	Groundcover	Exotic									0.1	5
Asteraceae	*Ozothamnus diosmifolius*	Rice flower	Groundcover	Shrub (SG)										
Asteraceae	**Senecio madagascariensis*	Fireweed	Groundcover	High Threat			0.1	20	0.1	30	0.1	50	0.5	50
Asteraceae	*Taraxacum officinale*	Dandelion	Groundcover	Exotic										
Asteraceae	*Cyanthillium cinereum var. cinereum*	Iron Weed	Groundcover	Forb (FG)									0.1	20
Bignoniaceae	*Pandorea pandorana*	Wonga wonga vine	Groundcover	Other (OG)										
Campanulaceae	*Wahlenbergia communis*	Tufted Bluebell	Groundcover	Forb (FG)										
Campanulaceae	*Lobelia purpurascens*	Whiteroot	Groundcover	Forb (FG)	0.1	30	0.1	20					0.1	20
Celastraceae	*Denhamia celastroides*	Orange Boxwood	Groundcover	Shrub (SG)										
Commelinaceae	*Commelina cyanea*	-	Groundcover	Forb (FG)	0.1	5								
Convolvulaceae	*Dichondra repens*	Kidney Weed	Groundcover	Forb (FG)	0.1	50	0.1	10					0.1	50
Convolvulaceae	*Polymeria calycina*	-	Groundcover	Other (OG)	0.1	1	0.1	10					0.1	10
Cyperaceae	*Carex longebrachiata*	-	Groundcover	Grass & grasslike (GG)										
Cyperaceae	*Cyperus brevifolius*	Mullumbimby Couch	Groundcover	Exotic							0.1	5		

Family	Scientific Name	Common Name	Stratum	Plot ID	Q1		Q2		Q3		Q4		Q5	
				BAM Growth Form / High Threat Weeds	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)
Cyperaceae	*Cyperus gracilis*	Slender Flat-sedge	Groundcover	Grass & grasslike (GG)	0.1	5			0.1	5				
Cyperaceae	*Cyperus polystachyos*	-	Groundcover	Grass & grasslike (GG)					0.5	100				
Cyperaceae	*Fimbristylis dichotoma*	Common Fringe-sedge	Groundcover	Grass & grasslike (GG)	0.1	20	0.1	20						
Cyperaceae	*Lepidosperma filiforme*	-	Groundcover	Grass & grasslike (GG)										
Cyperaceae	*Lepidosperma laterale*	-	Groundcover	Grass & grasslike (GG)	0.1	1								
Cyperaceae	*Schoenoplectus validus*	-	Groundcover	Grass & grasslike (GG)										
Dennstaedtiaceae	*Pteridium esculentum*	Common Bracken	Groundcover	Fern (EG)										
Dilleniaceae	*Hibbertia riparia*	Erect Guinea-flower	Groundcover	Shrub (SG)										
Dilleniaceae	*Hibbertia scandens*	Climbing guinea flower	Groundcover	Other (OG)										
Ericaceae	*Leucopogon juniperinus*	Prickly Beard-heath	Groundcover	Shrub (SG)										
Fabaceae (Faboideae)	*Daviesia ulicifolia*	Gorse Bitter Pea	Groundcover	Shrub (SG)					0.1	7				
Fabaceae (Faboideae)	*Desmodium brachypodum*	Large Tick-trefoil	Groundcover	Forb (FG)										
Fabaceae (Faboideae)	*Desmodium gunnii*	Slender tick trefoil	Groundcover	Forb (FG)										
Fabaceae (Faboideae)	*Desmodium rhytidophyllum*	-	Groundcover	Forb (FG)										
Fabaceae (Faboideae)	*Desmodium varians*	Slender tick trefoil	Groundcover	Other (OG)	0.1	30								
Fabaceae (Faboideae)	*Glycine clandestina*	-	Groundcover	Other (OG)	0.1	5								
Fabaceae (Faboideae)	*Glycine tabacina*	-	Groundcover	Other (OG)	0.1	10							0.1	1
Fabaceae (Faboideae)	*Hardenbergia violacea*	Purple Coral Pea	Groundcover	Other (OG)										
Fabaceae (Faboideae)	*Medicago* spp.	Medic	Groundcover	Exotic										
Fabaceae (Faboideae)	*Pultenaea villosa*	Hairy Bush-pea	Groundcover	Shrub (SG)	0.1	3	0.1	5						
Fabaceae (Faboideae)	*Trifolium repens*	White Clover	Groundcover	Exotic					0.1	10				
Fabaceae (Mimosoideae)	*Acacia falcata*	Hickory Wattle	Midstorey	Shrub (SG)										
Fabaceae (Mimosoideae)	*Acacia implexa*	Hickory Wattle	Midstorey	Shrub (SG)										
Fabaceae (Mimosoideae)	*Acacia longissima*	long-leaf Wattle	Midstorey	Shrub (SG)										
Fabaceae (Mimosoideae)	*Acacia ulicifolia*	Prickly Moses	Groundcover	Shrub (SG)	0.1	2							0.1	1
Gentianaceae	*Centaurium tenuiflorum*	-	Groundcover	Exotic										
Goodeniaceae	*Goodenia paniculata*	Branched Goodenia	Groundcover	Forb (FG)			0.1	10	1	500	0.1	50	0.2	100
Haloragaceae	*Gonocarpus teucrioides*	Raspwort	Groundcover	Forb (FG)									0.5	500
Juncaceae	*Juncus cognatus*	-	Groundcover	Exotic					0.1	20	0.1	0.1	0.1	1
Juncaceae	*Juncus usitatus*	-	Groundcover	Grass & grasslike (GG)										
Lauraceae	*Cassytha glabella*	-	Groundcover	Other (OG)										
Lomandraceae	*Lomandra filiformis*	Wattle Mat-rush	Groundcover	Grass & grasslike (GG)	0.1	2								
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush	Groundcover	Grass & grasslike (GG)										
Lomandraceae	*Lomandra multiflora subsp. multiflora*	Many-flowered Mat-rush	Groundcover	Grass & grasslike (GG)	0.1	10							0.1	1
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry	Groundcover	Other (OG)										
Malvaceae	*Sida rhombifolia*	Paddy's Lucerne	Groundcover	Exotic										
Meliaceae	*Melia azedarach*	White Cedar	Midstorey	Tree (TG)										

Family	Scientific Name	Common Name	Stratum	Plot ID	Q1		Q2		Q3		Q4		Q5	
				BAM Growth Form / High Threat Weeds	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush	Midstorey	Shrub (SG)									0.1	1
Myrtaceae	*Corymbia maculata*	Spotted Gum	Canopy	Tree (TG)	10	1								
Myrtaceae	*Eucalyptus amplifolia*	Cabbage Gum	Canopy	Tree (TG)									0.5	15
Myrtaceae	*Eucalyptus crebra*	Narrow-leaved Ironbark	Canopy	Tree (TG)									1	1
Myrtaceae	*Eucalyptus eugenioides*	Thin-leaved Stringybark	Canopy	Tree (TG)										
Myrtaceae	*Eucalyptus moluccana*	Grey Box	Canopy	Tree (TG)										
Myrtaceae	*Eucalyptus siderophloia*	Grey Ironbark	Canopy	Tree (TG)	50	20								
Myrtaceae	*Eucalyptus* spp.	-	Canopy	Tree (TG)									0.1	2
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum	Canopy	Tree (TG)									0.1	1
Myrtaceae	*Eucalyptus umbra*	Broad-leaved White Mahogany	Canopy	Tree (TG)	0	1								
Myrtaceae	*Leptospermum polygalifolium*	Tantoon	Midstorey	Shrub (SG)										
Myrtaceae	*Melaleuca decora*	-	Midstorey	Shrub (SG)										
Myrtaceae	*Melaleuca linariifolia*	Flax-leaved Paperbark	Midstorey	Shrub (SG)										
Myrtaceae	*Melaleuca nodosa*	Prickly-leaved Paperbark	Midstorey	Shrub (SG)										
Oleaceae	*Ligustrum sinense*	Small-leaved Privet	Midstorey	High Threat										
Oleaceae	*Notelaea longifolia*	Large Mock-olive	Midstorey	Tree (TG)										
Hypericaceae	Hypericum gramineum	Small St. John's Wort	Groundcover	Other (OG)			0.1	20						
Oxalidaceae	*Oxalis exilis*	-	Groundcover	Forb (FG)										
Oxalidaceae	*Oxalis perennans*	-	Groundcover	Forb (FG)	0.1	5	0.1	1			0.1	2	0.1	10
Phormiaceae	*Dianella caerulea*	Blue Flax-lily	Groundcover	Forb (FG)										
Phormiaceae	*Dianella caerulea var. caerulea*	Blue Flax-lily	Groundcover	Forb (FG)										
Phormiaceae	*Dianella revoluta var. revoluta*	-	Groundcover	Forb (FG)										
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush	Groundcover	Shrub (SG)	0.1	3								
Phyllanthaceae	*Phyllanthus hirtellus*	Thyme Spurge	Groundcover	Shrub (SG)										
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry	Groundcover	Other (OG)										
Plantaginaceae	*Plantago lanceolata*	Plantain	Groundcover	Exotic			0.1	20			0.1	20	0.2	50
Poaceae	*Andropogon virginicus*	Whisky Grass	Groundcover	High Threat			40	1000	15	200			2	100
Poaceae	*Aristida vagans*	Threeawn Speargrass	Groundcover	Grass & grasslike (GG)	15	500								
Poaceae	*Axonopus fissifolius*	Narrow-leafed Carpet Grass	Groundcover	High Threat	0.1	10	25	1000	60	2000	50	1500	10	1000
Poaceae	*Cenchrus clandestinum*	Kikuyu Grass	Groundcover	High Threat							0.5	50		
Poaceae	*Chloris gayana*	Rhodes Grass	Groundcover	High Threat										
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass	Groundcover	Grass & grasslike (GG)	20	500								
Poaceae	*Cynodon dactylon*	Couch	Groundcover	Grass & grasslike (GG)					0.5	100				
Poaceae	*Dichelachne micrantha*	Shorthair Plumegrass	Groundcover	Grass & grasslike (GG)										
Poaceae	*Echinopogon caespitosus*	Bushy Hedgehog-grass	Groundcover	Grass & grasslike (GG)										
Poaceae	*Echinopogon ovatus*	Forest Hedgehog Grass	Groundcover	Grass & grasslike (GG)	1	50								
Poaceae	*Entolasia marginata*	Bordered Panic	Groundcover	Grass & grasslike (GG)										
Poaceae	*Entolasia stricta*	Wiry Panic	Groundcover	Grass & grasslike (GG)	15	500								

Family	Scientific Name	Common Name	Stratum	Plot ID	Q1		Q2		Q3		Q4		Q5	
				BAM Growth Form / High Threat Weeds	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)
Poaceae	*Eragrostis brownii*	Brown's Lovegrass	Groundcover	Grass & grasslike (GG)			0.1	10						
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass	Groundcover	Grass & grasslike (GG)										
Poaceae	*Imperata cylindrica*	Blady Grass	Groundcover	Grass & grasslike (GG)	0.1	10							30	2000
Poaceae	*Ischaemum australe*	-	Groundcover	Grass & grasslike (GG)										
Poaceae	*Microlaena stipoides*	Weeping Grass	Groundcover	Grass & grasslike (GG)										
Poaceae	*Oplismenus aemulus*	Australian Basket Grass	Groundcover	Grass & grasslike (GG)	0.1	10								
Poaceae	*Oplismenus imbecillis*	Creeping Beard Grass	Groundcover	Grass & grasslike (GG)										
Poaceae	*Panicum effusum*	Hairy Panic	Groundcover	Grass & grasslike (GG)										
Poaceae	*Panicum simile*	Two-colour Panic	Groundcover	Grass & grasslike (GG)										
Poaceae	*Paspalidium distans*	-	Groundcover	Grass & grasslike (GG)	0.2	20								
Poaceae	*Paspalum dilatatum*	Paspalum	Groundcover	High Threat	0.2	20	20	1000	20	1000	30	1000	20	1000
Poaceae	*Poa labillardierei var. labillardierei*	Tussock	Groundcover	Grass & grasslike (GG)										
Poaceae	*Poa sieberiana*	-	Groundcover	Grass & grasslike (GG)	5	100								
Poaceae	*Rytidosperma longifolium*	Long-leaved Wallaby Grass	Groundcover	Grass & grasslike (GG)										
Poaceae	*Setaria parviflora*	-	Groundcover	Exotic										
Poaceae	*Setaria sphacelata*	South African Pigeon Grass	Groundcover	Exotic							0.1	5		
Poaceae	*Sporobolus africanus*	Parramatta Grass	Groundcover	Exotic										
Poaceae	**Sporobolus fertilis*	Giant Parramatta Grass	Groundcover	High Threat										
Poaceae	*Themeda triandra*	Kangaroo Grass	Groundcover	Grass & grasslike (GG)	25	500	10	500					25	1000
Poaceae	*Vulpia bromoides*	Squirrel Tail Fescue	Groundcover	Exotic					0.1	20				
Polygonaceae	*Rumex conglomeratus*	Clustered Dock	Groundcover	Exotic										
Proteaceae	*Persoonia linearis*	Narrow-leaved Geebung	Midstorey	Shrub (SG)										
Pteridaceae	*Cheilanthes sieberi subsp. sieberi*	Poison Rock Fern	Groundcover	Fern (EG)	0.2	50								
Ranunculaceae	*Clematis aristata*	Old Man's Beard	Groundcover	Other (OG)										
Rhamnaceae	*Alphitonia excelsa*	Red Ash	Midstorey	Tree (TG)	0.1	1								
Rubiaceae	*Opercularia diphylla*	-	Groundcover	Forb (FG)										
Santalaceae	*Exocarpos cupressiformis*	Native Cherry	Midstorey	Shrub (SG)										
Solanaceae	*Solanum mauritianum*	Wild Tobacco Bush	Midstorey	Exotic										
Solanaceae	*Solanum nigrum*	Black-berry Nightshade	Groundcover	Exotic										
Solanaceae	*Solanum prinophyllum*	Forest Nightshade	Groundcover	Forb (FG)	0.2	10								
Thymelaeaceae	*Pimelea linifolia*	Slender Rice Flower	Groundcover	Shrub (SG)									0.1	1
Verbenaceae	**Lantana camara*	Lantana	Groundcover	High Threat										
Verbenaceae	*Verbena bonariensis*	Purpletop	Groundcover	Exotic					0.1	10	1	50	2	100
Verbenaceae	*Verbena rigida*	Veined Verbena	Groundcover	Exotic										
Violaceae	*Viola betonicifolia*	Native Violet	Groundcover	Forb (FG)			0.1	5						
Violaceae	*Viola hederacea*	Ivy-leaved Violet	Groundcover	Forb (FG)	0.1	10	0.1	50	0.2	100			0.1	50

Table 7: Flora species list Q6-Q10

Family	Scientific Name	Common Name	Stratum	Plot ID	Q6		Q7		Q8		Q9		Q10	
				BAM Growth Form / High Threat Weeds	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)
Acanthaceae	*Brunoniella australis*	Blue Trumpet	Groundcover	Forb (FG)							0.1	50		
Anthericaceae	*Arthropodium milleflorum*	Pale Vanilla-lily	Groundcover	Forb (FG)							0.1	1		
Anthericaceae	*Tricoryne elatior*	Yellow Autumn-lily	Groundcover	Forb (FG)					0.1	2				
Apiaceae	*Centella asiatica*	Indian Pennywort	Groundcover	Forb (FG)										
Apiaceae	*Cyclospermum leptophyllum*	Slender Celery	Groundcover	Exotic									0.1	1
Apocynaceae	*Araujia sericifera*	Moth Vine	Groundcover	Exotic	0.5	5								
Apocynaceae	*Gomphocarpus fruticosus*	Narrow-leaved Cotton Bush	Groundcover	Exotic	0.1	5	0.2	2					0.1	1
Apocynaceae	*Parsonsia straminea*	Common Silkpod	Groundcover	Other (OG)	15	30					1	10		
Asteraceae	*Aster subulatus*	Wild Aster	Groundcover	Exotic			0.1	30			0.1	3		
Asteraceae	*Bidens pilosa*	Cobblers Pegs	Groundcover	High Threat	0.2	100								
Asteraceae	*Calotis lappulacea*	Yellow Burr-daisy	Groundcover	Forb (FG)							0.1	1		
Asteraceae	*Chrysocephalum apiculatum*	Yellow buttons	Groundcover	Forb (FG)										
Asteraceae	*Conyza bonariensis*	Flaxleaf Fleabane	Groundcover	Exotic	0.5	50	0.2	50					0.1	20
Asteraceae	*Conyza* spp.	Fleabane	Groundcover	Exotic										
Asteraceae	*Eclipta platyglossa*	-	Groundcover	Forb (FG)	0.1	5								
Asteraceae	*Euchiton sphaericus*	-	Groundcover	Forb (FG)									0.1	1
Asteraceae	*Gamochaeta americana*	Cudweed	Groundcover	Exotic									0.1	5
Asteraceae	*Hypochaeris glabra*	Smooth Catsear	Groundcover	Exotic			0.1	2						
Asteraceae	*Hypochaeris radicata*	Catsear	Groundcover	Exotic			0.1	20					0.1	10
Asteraceae	*Lagenophora stipitata*	Blue Bottle-daisy	Groundcover	Forb (FG)							0.1	1		
Asteraceae	*Onopordum acanthium*	Scotch Thistle	Groundcover	Exotic	0.1	5	0.1	10						
Asteraceae	*Ozothamnus diosmifolius*	Rice flower	Groundcover	Shrub (SG)							0.1	5		
Asteraceae	**Senecio madagascariensis*	Fireweed	Groundcover	High Threat	0.1	50							0.2	50
Asteraceae	*Taraxacum officinale*	Dandelion	Groundcover	Exotic										
Asteraceae	*Cyanthillium cinereum var. cinereum*	Iron Weed	Groundcover	Forb (FG)										
Bignoniaceae	*Pandorea pandorana*	Wonga wonga vine	Groundcover	Other (OG)	0.1	5								
Campanulaceae	*Wahlenbergia communis*	Tufted Bluebell	Groundcover	Forb (FG)										
Campanulaceae	*Lobelia purpurascens*	Whiteroot	Groundcover	Forb (FG)	0.1	50			0.1	20	0.1	50		
Celastraceae	*Denhamia celastroides*	Orange Boxwood	Groundcover	Shrub (SG)									0.1	3
Commelinaceae	*Commelina cyanea*	-	Groundcover	Forb (FG)										
Convolvulaceae	*Dichondra repens*	Kidney Weed	Groundcover	Forb (FG)	0.1	100	0.1	5			0.1	50		
Convolvulaceae	*Polymeria calycina*	-	Groundcover	Other (OG)	0.1	10					0.1	0.1		
Cyperaceae	*Carex longebrachiata*	-	Groundcover	Grass & grasslike (GG)			0.1	5						
Cyperaceae	*Cyperus brevifolius*	Mullumbimby Couch	Groundcover	Exotic										
Cyperaceae	*Cyperus gracilis*	Slender Flat-sedge	Groundcover	Grass & grasslike (GG)										
Cyperaceae	*Cyperus polystachyos*	-	Groundcover	Grass & grasslike (GG)									0.1	5
Cyperaceae	*Fimbristylis dichotoma*	Common Fringe-sedge	Groundcover	Grass & grasslike (GG)	0.1	50								
Cyperaceae	*Lepidosperma filiforme*	-	Groundcover	Grass & grasslike (GG)			0.1	20						

Family	Scientific Name	Common Name	Stratum	Plot ID	Q6		Q7		Q8		Q9		Q10	
				BAM Growth Form / High Threat Weeds	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)
Cyperaceae	*Lepidosperma laterale*	-	Groundcover	Grass & grasslike (GG)					0.1	1				
Cyperaceae	*Schoenoplectus validus*	-	Groundcover	Grass & grasslike (GG)			0.1	5						
Dennstaedtiaceae	*Pteridium esculentum*	Common Bracken	Groundcover	Fern (EG)										
Dilleniaceae	*Hibbertia riparia*	Erect Guinea-flower	Groundcover	Shrub (SG)										
Dilleniaceae	*Hibbertia scandens*	Climbing guinea flower	Groundcover	Other (OG)									0.1	2
Ericaceae	*Leucopogon juniperinus*	Prickly Beard-heath	Groundcover	Shrub (SG)					4	10	0.5	20		
Fabaceae (Faboideae)	*Daviesia ulicifolia*	Gorse Bitter Pea	Groundcover	Shrub (SG)					0.2	5				
Fabaceae (Faboideae)	*Desmodium brachypodum*	Large Tick-trefoil	Groundcover	Forb (FG)										
Fabaceae (Faboideae)	*Desmodium gunnii*	Slender tick trefoil	Groundcover	Forb (FG)	0.1	5					0.1	5		
Fabaceae (Faboideae)	*Desmodium rhytidophyllum*	-	Groundcover	Forb (FG)							0.1	20		
Fabaceae (Faboideae)	*Desmodium varians*	Slender tick trefoil	Groundcover	Other (OG)									0.1	5
Fabaceae (Faboideae)	*Glycine clandestina*	-	Groundcover	Other (OG)					0.1	5				
Fabaceae (Faboideae)	*Glycine tabacina*	-	Groundcover	Other (OG)							0.1	10		
Fabaceae (Faboideae)	*Hardenbergia violacea*	Purple Coral Pea	Groundcover	Other (OG)							0.1	5		
Fabaceae (Faboideae)	*Medicago* spp.	Medic	Groundcover	Exotic										
Fabaceae (Faboideae)	*Pultenaea villosa*	Hairy Bush-pea	Groundcover	Shrub (SG)					0.1	2	0.5	10		
Fabaceae (Faboideae)	*Trifolium repens*	White Clover	Groundcover	Exotic	0.1	5								
Fabaceae (Mimosoideae)	*Acacia falcata*	Hickory Wattle	Midstorey	Shrub (SG)							0.1	2		
Fabaceae (Mimosoideae)	*Acacia implexa*	Hickory Wattle	Midstorey	Shrub (SG)					5	10	2	10		
Fabaceae (Mimosoideae)	*Acacia longissima*	long-leaf Wattle	Midstorey	Shrub (SG)					4	10	5	10		
Fabaceae (Mimosoideae)	*Acacia ulicifolia*	Prickly Moses	Groundcover	Shrub (SG)					2	10	0.1	5		
Gentianaceae	*Centaurium tenuiflorum*	-	Groundcover	Exotic										
Goodeniaceae	*Goodenia paniculata*	Branched Goodenia	Groundcover	Forb (FG)	0.1	5	0.1	20	0.1	5	0.1	5		
Haloragaceae	*Gonocarpus teucrioides*	Raspwort	Groundcover	Forb (FG)			0.1	5	0.1	10				
Juncaceae	*Juncus cognatus*	-	Groundcover	Exotic									0.1	20
Juncaceae	*Juncus usitatus*	-	Groundcover	Grass & grasslike (GG)										
Lauraceae	*Cassytha glabella*	-	Groundcover	Other (OG)							0.1	5		
Lomandraceae	*Lomandra filiformis*	Wattle Mat-rush	Groundcover	Grass & grasslike (GG)					0.1	5	0.5	20		
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush	Groundcover	Grass & grasslike (GG)					20	20				
Lomandraceae	*Lomandra multiflora subsp. multiflora*	Many-flowered Mat-rush	Groundcover	Grass & grasslike (GG)					0.2	20	0.5	10	0.1	1
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry	Groundcover	Other (OG)					0.1	5				
Malvaceae	*Sida rhombifolia*	Paddy's Lucerne	Groundcover	Exotic	5	100								
Meliaceae	*Melia azedarach*	White Cedar	Midstorey	Tree (TG)										
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush	Midstorey	Shrub (SG)										
Myrtaceae	*Corymbia maculata*	Spotted Gum	Canopy	Tree (TG)					40	20				
Myrtaceae	*Eucalyptus amplifolia*	Cabbage Gum	Canopy	Tree (TG)	50	30	5	2						
Myrtaceae	*Eucalyptus crebra*	Narrow-leaved Ironbark	Canopy	Tree (TG)							40	2		

Family	Scientific Name	Common Name	Stratum	Plot ID	Q6		Q7		Q8		Q9		Q10	
				BAM Growth Form / High Threat Weeds	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)
Myrtaceae	*Eucalyptus eugenioides*	Thin-leaved Stringybark	Canopy	Tree (TG)					0.1	1				
Myrtaceae	*Eucalyptus moluccana*	Grey Box	Canopy	Tree (TG)										
Myrtaceae	*Eucalyptus siderophloia*	Grey Ironbark	Canopy	Tree (TG)					1	1				
Myrtaceae	*Eucalyptus* spp.	-	Canopy	Tree (TG)										
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum	Canopy	Tree (TG)					10	2				
Myrtaceae	*Eucalyptus umbra*	Broad-leaved White Mahogany	Canopy	Tree (TG)							40	10		
Myrtaceae	*Leptospermum polygalifolium*	Tantoon	Midstorey	Shrub (SG)					4	10				
Myrtaceae	*Melaleuca decora*	-	Midstorey	Shrub (SG)							1	1		
Myrtaceae	*Melaleuca linariifolia*	Flax-leaved Paperbark	Midstorey	Shrub (SG)	10	15					20	10		
Myrtaceae	*Melaleuca nodosa*	Prickly-leaved Paperbark	Midstorey	Shrub (SG)										
Oleaceae	*Ligustrum sinense*	Small-leaved Privet	Midstorey	High Threat	5	5								
Oleaceae	*Notelaea longifolia*	Large Mock-olive	Midstorey	Tree (TG)							0.1	1		
Hypericaceae	Hypericum gramineum	Small St. John's Wort	Groundcover	Other (OG)										
Oxalidaceae	*Oxalis exilis*	-	Groundcover	Forb (FG)										
Oxalidaceae	*Oxalis perennans*	-	Groundcover	Forb (FG)	0.1	50								
Phormiaceae	*Dianella caerulea*	Blue Flax-lily	Groundcover	Forb (FG)					0.1	10				
Phormiaceae	*Dianella caerulea var. caerulea*	Blue Flax-lily	Groundcover	Forb (FG)										
Phormiaceae	*Dianella revoluta var. revoluta*	-	Groundcover	Forb (FG)					0.1	1	0.1	5		
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush	Groundcover	Shrub (SG)					0.1	1	0.1	1		
Phyllanthaceae	*Phyllanthus hirtellus*	Thyme Spurge	Groundcover	Shrub (SG)							0.1	5		
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry	Groundcover	Other (OG)							0.1	10		
Plantaginaceae	*Plantago lanceolata*	Plantain	Groundcover	Exotic	0.5	50	0.5	1000					0.2	50
Poaceae	*Andropogon virginicus*	Whisky Grass	Groundcover	High Threat			10	1000					0.1	10
Poaceae	*Aristida vagans*	Threeawn Speargrass	Groundcover	Grass & grasslike (GG)					1	50	1	50		
Poaceae	*Axonopus fissifolius*	Narrow-leafed Carpet Grass	Groundcover	High Threat					0.1	5			10	500
Poaceae	*Cenchrus clandestinum*	Kikuyu Grass	Groundcover	High Threat										
Poaceae	*Chloris gayana*	Rhodes Grass	Groundcover	High Threat	25	500								
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass	Groundcover	Grass & grasslike (GG)										
Poaceae	*Cynodon dactylon*	Couch	Groundcover	Grass & grasslike (GG)	0.1	50								
Poaceae	*Dichelachne micrantha*	Shorthair Plumegrass	Groundcover	Grass & grasslike (GG)										
Poaceae	*Echinopogon caespitosus*	Bushy Hedgehog-grass	Groundcover	Grass & grasslike (GG)					1	100				
Poaceae	*Echinopogon ovatus*	Forest Hedgehog Grass	Groundcover	Grass & grasslike (GG)										
Poaceae	*Entolasia marginata*	Bordered Panic	Groundcover	Grass & grasslike (GG)	0.1	10								
Poaceae	*Entolasia stricta*	Wiry Panic	Groundcover	Grass & grasslike (GG)					10	500	10	500		
Poaceae	*Eragrostis brownii*	Brown's Lovegrass	Groundcover	Grass & grasslike (GG)					0.1	20	0.1	20	0.2	100
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass	Groundcover	Grass & grasslike (GG)			0.1	10						

Family	Scientific Name	Common Name	Stratum	Plot ID	Q6		Q7		Q8		Q9		Q10	
				BAM Growth Form / High Threat Weeds	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)
Poaceae	*Imperata cylindrica*	Blady Grass	Groundcover	Grass & grasslike (GG)			1	500	0.2	50	0.5	50	20	500
Poaceae	*Ischaemum australe*	-	Groundcover	Grass & grasslike (GG)										
Poaceae	*Microlaena stipoides*	Weeping Grass	Groundcover	Grass & grasslike (GG)					0.5	50				
Poaceae	*Oplismenus aemulus*	Australian Basket Grass	Groundcover	Grass & grasslike (GG)	0.1	10								
Poaceae	*Oplismenus imbecillis*	Creeping Beard Grass	Groundcover	Grass & grasslike (GG)	0.1	5								
Poaceae	*Panicum effusum*	Hairy Panic	Groundcover	Grass & grasslike (GG)									0.1	10
Poaceae	*Panicum simile*	Two-colour Panic	Groundcover	Grass & grasslike (GG)					0.2	50	1	50		
Poaceae	*Paspalidium distans*	-	Groundcover	Grass & grasslike (GG)										
Poaceae	*Paspalum dilatatum*	Paspalum	Groundcover	High Threat	1	50	70	2000	0.1	5			1	200
Poaceae	*Poa labillardierei var. labillardierei*	Tussock	Groundcover	Grass & grasslike (GG)							0.1	5		
Poaceae	*Poa sieberiana*	-	Groundcover	Grass & grasslike (GG)										
Poaceae	*Rytidosperma longifolium*	Long-leaved Wallaby Grass	Groundcover	Grass & grasslike (GG)					1	100	5	100		
Poaceae	*Setaria parviflora*	-	Groundcover	Exotic										
Poaceae	*Setaria sphacelata*	South African Pigeon Grass	Groundcover	Exotic	0.1	5							0.1	5
Poaceae	*Sporobolus africanus*	Parramatta Grass	Groundcover	Exotic									0.1	5
Poaceae	**Sporobolus fertilis*	Giant Parramatta Grass	Groundcover	High Threat										
Poaceae	*Themeda triandra*	Kangaroo Grass	Groundcover	Grass & grasslike (GG)			10	1000	15	500	5	100	65	2000
Poaceae	*Vulpia bromoides*	Squirrel Tail Fescue	Groundcover	Exotic			5	500						
Polygonaceae	*Rumex conglomeratus*	Clustered Dock	Groundcover	Exotic										
Proteaceae	*Persoonia linearis*	Narrow-leaved Geebung	Midstorey	Shrub (SG)					0.1	2				
Pteridaceae	*Cheilanthes sieberi subsp. sieberi*	Poison Rock Fern	Groundcover	Fern (EG)									0.1	20
Ranunculaceae	*Clematis aristata*	Old Man's Beard	Groundcover	Other (OG)					0.1	5				
Rhamnaceae	*Alphitonia excelsa*	Red Ash	Midstorey	Tree (TG)										
Rubiaceae	*Opercularia diphylla*	-	Groundcover	Forb (FG)							0.1	5		
Santalaceae	*Exocarpos cupressiformis*	Native Cherry	Midstorey	Shrub (SG)							0.1	4		
Solanaceae	*Solanum mauritianum*	Wild Tobacco Bush	Midstorey	Exotic	0.1	10								
Solanaceae	*Solanum nigrum*	Black-berry Nightshade	Groundcover	Exotic	0.1	5								
Solanaceae	*Solanum prinophyllum*	Forest Nightshade	Groundcover	Forb (FG)	0.2	10								
Thymelaeaceae	*Pimelea linifolia*	Slender Rice Flower	Groundcover	Shrub (SG)										
Verbenaceae	**Lantana camara*	Lantana	Groundcover	High Threat							0.1	0		
Verbenaceae	*Verbena bonariensis*	Purpletop	Groundcover	Exotic	0.5	50	0.5	20					0.1	2
Verbenaceae	*Verbena rigida*	Veined Verbena	Groundcover	Exotic									1	200
Violaceae	*Viola betonicifolia*	Native Violet	Groundcover	Forb (FG)	0.1	30								
Violaceae	*Viola hederacea*	Ivy-leaved Violet	Groundcover	Forb (FG)			0.1	20					0.1	10

Table 8: Flora species list Q11-Q16

Family	Scientific Name	Common Name	Stratum	Plot ID	Q11		Q12		Q13		Q14		Q15		Q16	
				BAM Growth Form / High Threat Weeds	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)
Acanthaceae	*Brunoniella australis*	Blue Trumpet	Groundcover	Forb (FG)									0.1	50		
Anthericaceae	*Arthropodium milleflorum*	Pale Vanilla-lily	Groundcover	Forb (FG)									0.1	10		
Anthericaceae	*Tricoryne elatior*	Yellow Autumn-lily	Groundcover	Forb (FG)									0.1	10		
Apiaceae	*Centella asiatica*	Indian Pennywort	Groundcover	Forb (FG)									0.1	5	0.1	5
Apiaceae	*Cyclospermum leptophyllum*	Slender Celery	Groundcover	Exotic			0.1	1			0.1	2				
Apocynaceae	*Araujia sericifera*	Moth Vine	Groundcover	Exotic												
Apocynaceae	*Gomphocarpus fruticosus*	Narrow-leaved Cotton Bush	Groundcover	Exotic												
Apocynaceae	*Parsonsia straminea*	Common Silkpod	Groundcover	Other (OG)												
Asteraceae	*Aster subulatus*	Wild Aster	Groundcover	Exotic	0.1	50			0.2	50						
Asteraceae	*Bidens pilosa*	Cobblers Pegs	Groundcover	High Threat												
Asteraceae	*Calotis lappulacea*	Yellow Burr-daisy	Groundcover	Forb (FG)									0.1	5		
Asteraceae	*Chrysocephalum apiculatum*	Yellow buttons	Groundcover	Forb (FG)												
Asteraceae	*Conyza bonariensis*	Flaxleaf Fleabane	Groundcover	Exotic	0.1	20			0.1	10	0.2	50				
Asteraceae	*Conyza* spp.	Fleabane	Groundcover	Exotic												
Asteraceae	*Eclipta platyglossa*	-	Groundcover	Forb (FG)												
Asteraceae	*Euchiton sphaericus*	-	Groundcover	Forb (FG)									0.1	10	0.1	5
Asteraceae	*Gamochaeta americana*	Cudweed	Groundcover	Exotic			0.1	20								
Asteraceae	*Hypochaeris glabra*	Smooth Catsear	Groundcover	Exotic	0.1	20										
Asteraceae	*Hypochaeris radicata*	Catsear	Groundcover	Exotic	0.1	50	0.1	20	0.1	20	0.1	20	0.1	5	0.1	50
Asteraceae	*Lagenophora stipitata*	Blue Bottle-daisy	Groundcover	Forb (FG)									0.1	5		
Asteraceae	*Onopordum acanthium*	Scotch Thistle	Groundcover	Exotic					0.1	1	0.1	5				
Asteraceae	*Ozothamnus diosmifolius*	Rice flower	Groundcover	Shrub (SG)												
Asteraceae	**Senecio madagascariensis*	Fireweed	Groundcover	High Threat	0.1	50	0.5	50			0.2	50			0.1	10
Asteraceae	*Taraxacum officinale*	Dandelion	Groundcover	Exotic			0.3	200			0.1	50			0.1	20
Asteraceae	*Cyanthillium cinereum var. cinereum*	Iron Weed	Groundcover	Forb (FG)									0.1	20		
Bignoniaceae	*Pandorea pandorana*	Wonga wonga vine	Groundcover	Other (OG)												
Campanulaceae	*Wahlenbergia communis*	Tufted Bluebell	Groundcover	Forb (FG)			0.1	5								
Campanulaceae	*Lobelia purpurascens*	Whiteroot	Groundcover	Forb (FG)									0.1	10		
Celastraceae	*Denhamia celastroides*	Orange Boxwood	Groundcover	Shrub (SG)												
Commelinaceae	*Commelina cyanea*	-	Groundcover	Forb (FG)												
Convolvulaceae	*Dichondra repens*	Kidney Weed	Groundcover	Forb (FG)							0.1	20	0.1	20	0.1	10
Convolvulaceae	*Polymeria calycina*	-	Groundcover	Other (OG)									0.1	10	0.1	50
Cyperaceae	*Carex longebrachiata*	-	Groundcover	Grass & grasslike (GG)			1	50	0.5	20	0.2	20	0.1	1		

Family	Scientific Name	Common Name	Stratum	Plot ID	Q11		Q12		Q13		Q14		Q15		Q16	
				BAM Growth Form / High Threat Weeds	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)
Cyperaceae	*Cyperus brevifolius*	Mullumbimby Couch	Groundcover	Exotic												
Cyperaceae	*Cyperus gracilis*	Slender Flat-sedge	Groundcover	Grass & grasslike (GG)			0.1	5					0.1	5		
Cyperaceae	*Cyperus polystachyos*	-	Groundcover	Grass & grasslike (GG)	0.1	20										
Cyperaceae	*Fimbristylis dichotoma*	Common Fringe-sedge	Groundcover	Grass & grasslike (GG)	0.1	5					0.1	20	0.1	1		
Cyperaceae	*Lepidosperma filiforme*	-	Groundcover	Grass & grasslike (GG)												
Cyperaceae	*Lepidosperma laterale*	-	Groundcover	Grass & grasslike (GG)												
Cyperaceae	*Schoenoplectus validus*	-	Groundcover	Grass & grasslike (GG)												
Dennstaedtiaceae	*Pteridium esculentum*	Common Bracken	Groundcover	Fern (EG)			0.5	20								
Dilleniaceae	*Hibbertia riparia*	Erect Guinea-flower	Groundcover	Shrub (SG)									0.5	10		
Dilleniaceae	*Hibbertia scandens*	Climbing guinea flower	Groundcover	Other (OG)												
Ericaceae	*Leucopogon juniperinus*	Prickly Beard-heath	Groundcover	Shrub (SG)									5	20		
Fabaceae (Faboideae)	*Daviesia ulicifolia*	Gorse Bitter Pea	Groundcover	Shrub (SG)									0.2	10	0.1	2
Fabaceae (Faboideae)	*Desmodium brachypodum*	Large Tick-trefoil	Groundcover	Forb (FG)									0.2	15	0.1	5
Fabaceae (Faboideae)	*Desmodium gunnii*	Slender tick trefoil	Groundcover	Forb (FG)												
Fabaceae (Faboideae)	*Desmodium rhytidophyllum*	-	Groundcover	Forb (FG)												
Fabaceae (Faboideae)	*Desmodium varians*	Slender tick trefoil	Groundcover	Other (OG)							0.1	1				
Fabaceae (Faboideae)	*Glycine clandestina*	-	Groundcover	Other (OG)									0.1	5		
Fabaceae (Faboideae)	*Glycine tabacina*	-	Groundcover	Other (OG)							0.1	1			0.1	5
Fabaceae (Faboideae)	*Hardenbergia violacea*	Purple Coral Pea	Groundcover	Other (OG)												
Fabaceae (Faboideae)	*Medicago* spp.	Medic	Groundcover	Exotic					0.2	50						
Fabaceae (Faboideae)	*Pultenaea villosa*	Hairy Bush-pea	Groundcover	Shrub (SG)												
Fabaceae (Faboideae)	*Trifolium repens*	White Clover	Groundcover	Exotic							0.1	5				
Fabaceae (Mimosoideae)	*Acacia falcata*	Hickory Wattle	Midstorey	Shrub (SG)												
Fabaceae (Mimosoideae)	*Acacia implexa*	Hickory Wattle	Midstorey	Shrub (SG)												
Fabaceae (Mimosoideae)	*Acacia longissima*	long-leaf Wattle	Midstorey	Shrub (SG)												
Fabaceae (Mimosoideae)	*Acacia ulicifolia*	Prickly Moses	Groundcover	Shrub (SG)			0.1	2					0.5	10	0.1	2
Gentianaceae	*Centaurium tenuiflorum*	-	Groundcover	Exotic					0.1	1						
Goodeniaceae	*Goodenia paniculata*	Branched Goodenia	Groundcover	Forb (FG)	0.2	50									0.2	40
Haloragaceae	*Gonocarpus teucrioides*	Raspwort	Groundcover	Forb (FG)												
Juncaceae	*Juncus cognatus*	-	Groundcover	Exotic	0.1	5										

Family	Scientific Name	Common Name	Stratum	Plot ID	Q11		Q12		Q13		Q14		Q15		Q16	
				BAM Growth Form / High Threat Weeds	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)
Juncaceae	*Juncus usitatus*	-	Groundcover	Grass & grasslike (GG)	0.5	100			1	50						
Lauraceae	*Cassytha glabella*	-	Groundcover	Other (OG)												
Lomandraceae	*Lomandra filiformis*	Wattle Mat-rush	Groundcover	Grass & grasslike (GG)									3	50		
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush	Groundcover	Grass & grasslike (GG)												
Lomandraceae	*Lomandra multiflora subsp. multiflora*	Many-flowered Mat-rush	Groundcover	Grass & grasslike (GG)									5	50	0.5	20
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry	Groundcover	Other (OG)												
Malvaceae	*Sida rhombifolia*	Paddy's Lucerne	Groundcover	Exotic			0.1	10			0.1	5				
Meliaceae	*Melia azedarach*	White Cedar	Midstorey	Tree (TG)									0.1	1		
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush	Midstorey	Shrub (SG)												
Myrtaceae	*Corymbia maculata*	Spotted Gum	Canopy	Tree (TG)												
Myrtaceae	*Eucalyptus amplifolia*	Cabbage Gum	Canopy	Tree (TG)									45	33		
Myrtaceae	*Eucalyptus crebra*	Narrow-leaved Ironbark	Canopy	Tree (TG)												
Myrtaceae	*Eucalyptus eugenioides*	Thin-leaved Stringybark	Canopy	Tree (TG)									1	3		
Myrtaceae	*Eucalyptus moluccana*	Grey Box	Canopy	Tree (TG)									5	3		
Myrtaceae	*Eucalyptus siderophloia*	Grey Ironbark	Canopy	Tree (TG)												
Myrtaceae	*Eucalyptus* spp.	-	Canopy	Tree (TG)												
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum	Canopy	Tree (TG)												
Myrtaceae	*Eucalyptus umbra*	Broad-leaved White Mahogany	Canopy	Tree (TG)												
Myrtaceae	*Leptospermum polygalifolium*	Tantoon	Midstorey	Shrub (SG)												
Myrtaceae	*Melaleuca decora*	-	Midstorey	Shrub (SG)												
Myrtaceae	*Melaleuca linariifolia*	Flax-leaved Paperbark	Midstorey	Shrub (SG)	0.5	1										
Myrtaceae	*Melaleuca nodosa*	Prickly-leaved Paperbark	Midstorey	Shrub (SG)									0.2	2		
Oleaceae	*Ligustrum sinense*	Small-leaved Privet	Midstorey	High Threat									0.2	3		
Oleaceae	*Notelaea longifolia*	Large Mock-olive	Midstorey	Tree (TG)												
Hypericaceae	Hypericum gramineum	Small St. John's Wort	Groundcover	Other (OG)											0.1	10
Oxalidaceae	*Oxalis exilis*	-	Groundcover	Forb (FG)									0.1	50		
Oxalidaceae	*Oxalis perennans*	-	Groundcover	Forb (FG)			0.1	20			0.1	2	0.1	10		
Phormiaceae	*Dianella caerulea*	Blue Flax-lily	Groundcover	Forb (FG)												
Phormiaceae	*Dianella caerulea var. caerulea*	Blue Flax-lily	Groundcover	Forb (FG)									0.1	5		
Phormiaceae	*Dianella revoluta var. revoluta*	-	Groundcover	Forb (FG)									0.1	5		
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush	Groundcover	Shrub (SG)												
Phyllanthaceae	*Phyllanthus hirtellus*	Thyme Spurge	Groundcover	Shrub (SG)												
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry	Groundcover	Other (OG)												
Plantaginaceae	*Plantago lanceolata*	Plantain	Groundcover	Exotic			0.5	50	0.1	20	0.2	50	0.1	5		

Family	Scientific Name	Common Name	Stratum	Plot ID	Q11		Q12		Q13		Q14		Q15		Q16	
				BAM Growth Form / High Threat Weeds	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)
Poaceae	*Andropogon virginicus*	Whisky Grass	Groundcover	High Threat	5	100	0.2	20			0.2	20			35	2000
Poaceae	*Aristida vagans*	Threeawn Speargrass	Groundcover	Grass & grasslike (GG)									0.1	20		
Poaceae	*Axonopus fissifolius*	Narrow-leafed Carpet Grass	Groundcover	High Threat	10	500	30	2000	45	2000	20	1000	0.1	10	10	500
Poaceae	*Cenchrus clandestinum*	Kikuyu Grass	Groundcover	High Threat			5	200	15	2000						
Poaceae	*Chloris gayana*	Rhodes Grass	Groundcover	High Threat												
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass	Groundcover	Grass & grasslike (GG)							0.2	20	5	30		
Poaceae	*Cynodon dactylon*	Couch	Groundcover	Grass & grasslike (GG)	70	200			1	20			0.2	30	2	100
Poaceae	*Dichelachne micrantha*	Shorthair Plumegrass	Groundcover	Grass & grasslike (GG)									0.1	20		
Poaceae	*Echinopogon caespitosus*	Bushy Hedgehog-grass	Groundcover	Grass & grasslike (GG)									0.1	20		
Poaceae	*Echinopogon ovatus*	Forest Hedgehog Grass	Groundcover	Grass & grasslike (GG)			0.1	20								
Poaceae	*Entolasia marginata*	Bordered Panic	Groundcover	Grass & grasslike (GG)												
Poaceae	*Entolasia stricta*	Wiry Panic	Groundcover	Grass & grasslike (GG)							0.1	10				
Poaceae	*Eragrostis brownii*	Brown's Lovegrass	Groundcover	Grass & grasslike (GG)			0.1	20					1	50		
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass	Groundcover	Grass & grasslike (GG)			5	500					0.5	20		
Poaceae	*Imperata cylindrica*	Blady Grass	Groundcover	Grass & grasslike (GG)							25	1000	1	50		
Poaceae	*Ischaemum australe*	-	Groundcover	Grass & grasslike (GG)			0.2	50			0.1	50	0.2	50		
Poaceae	*Microlaena stipoides*	Weeping Grass	Groundcover	Grass & grasslike (GG)			0.5	100								
Poaceae	*Oplismenus aemulus*	Australian Basket Grass	Groundcover	Grass & grasslike (GG)												
Poaceae	*Oplismenus imbecillis*	Creeping Beard Grass	Groundcover	Grass & grasslike (GG)												
Poaceae	*Panicum effusum*	Hairy Panic	Groundcover	Grass & grasslike (GG)												
Poaceae	*Panicum simile*	Two-colour Panic	Groundcover	Grass & grasslike (GG)												
Poaceae	*Paspalidium distans*	-	Groundcover	Grass & grasslike (GG)												
Poaceae	*Paspalum dilatatum*	Paspalum	Groundcover	High Threat	10	100	40	2000	35	2000	40	0	0.1	5	35	2000
Poaceae	*Poa labillardierei var. labillardierei*	Tussock	Groundcover	Grass & grasslike (GG)							2	50			0.1	1
Poaceae	*Poa sieberiana*	-	Groundcover	Grass & grasslike (GG)												
Poaceae	*Rytidosperma longifolium*	Long-leaved Wallaby Grass	Groundcover	Grass & grasslike (GG)												
Poaceae	*Setaria parviflora*	-	Groundcover	Exotic			5	200			5	500				
Poaceae	*Setaria sphacelata*	South African Pigeon Grass	Groundcover	Exotic							0.1	1				
Poaceae	*Sporobolus africanus*	Parramatta Grass	Groundcover	Exotic			10	500			0.2	20			10	500
Poaceae	**Sporobolus fertilis*	Giant Parramatta Grass	Groundcover	High Threat									0.1	5	0.1	2

Family	Scientific Name	Common Name	Stratum	Plot ID	Q11		Q12		Q13		Q14		Q15		Q16	
				BAM Growth Form / High Threat Weeds	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)	C (foliage cover) (%)	Ab (abundance rating)
Poaceae	*Themeda triandra*	Kangaroo Grass	Groundcover	Grass & grasslike (GG)									1	50	0.1	5
Poaceae	*Vulpia bromoides*	Squirrel Tail Fescue	Groundcover	Exotic					0.5	20						
Polygonaceae	*Rumex conglomeratus*	Clustered Dock	Groundcover	Exotic					0.1	5						
Proteaceae	*Persoonia linearis*	Narrow-leaved Geebung	Midstorey	Shrub (SG)												
Pteridaceae	*Cheilanthes sieberi subsp. sieberi*	Poison Rock Fern	Groundcover	Fern (EG)			0.1	5					0.1	50		
Ranunculaceae	*Clematis aristata*	Old Man's Beard	Groundcover	Other (OG)												
Rhamnaceae	*Alphitonia excelsa*	Red Ash	Midstorey	Tree (TG)												
Rubiaceae	*Opercularia diphylla*	-	Groundcover	Forb (FG)												
Santalaceae	*Exocarpos cupressiformis*	Native Cherry	Midstorey	Shrub (SG)									0.1	1		
Solanaceae	*Solanum mauritianum*	Wild Tobacco Bush	Midstorey	Exotic												
Solanaceae	*Solanum nigrum*	Black-berry Nightshade	Groundcover	Exotic												
Solanaceae	*Solanum prinophyllum*	Forest Nightshade	Groundcover	Forb (FG)									0.1	1		
Thymelaeaceae	*Pimelea linifolia*	Slender Rice Flower	Groundcover	Shrub (SG)												
Verbenaceae	**Lantana camara*	Lantana	Groundcover	High Threat												
Verbenaceae	*Verbena bonariensis*	Purpletop	Groundcover	Exotic			0.1	10	0.1	5	0.2	20				
Verbenaceae	*Verbena rigida*	Veined Verbena	Groundcover	Exotic							0.1	5				
Violaceae	*Viola betonicifolia*	Native Violet	Groundcover	Forb (FG)												
Violaceae	*Viola hederacea*	Ivy-leaved Violet	Groundcover	Forb (FG)	0.1	10					0.1	20			0.1	20

APPENDIX 3. MONITORING PHOTOGRAPHS

Plate 1: Spotted Gum Reference Site - Q1

Plate 2: Spotted Gum Revegetation Site - Q2

Plate 3: **Spotted Gum Revegetation Site - Q3**

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Plate 10: ***Allocasuarina*** **Planting Site - Q10**

Plate 11: **Squirrel Glider Corridor Revegetation Site - Q11**

Plate 12: **Spotted Gum Revegetation Site - Q12**

Plate 13: Cabbage Gum Revegetation Site - Q13

Plate 14: *Allocasuarina* Planting Site - Q14

Plate 15: Cabbage Gum Reference Site Q15

Plate 16: Cabbage Gum Revegetation Site - Q16

APPENDIX 4. STAFF CONTRIBUTIONS

The following staff were involved in the compilation of this report.

Name	Qualification	Title/Experience	Contribution
Gayle Joyce	BSc (Forestry) (Hons)	GIS Specialist	GIS and Mapping
Nigel Fisher	BSc (Hons) PhD	Restoration Ecologist	Fieldwork, Report Review
Yann Buissiere	BEnvMgt	Botanist	Fieldwork, Report Writing

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2019 Stratford Mining Complex Squirrel Glider Colony & Home Range Report

Yancoal Pty Ltd

Stratford Coal Pty Ltd
3364 Buckett's Way, Stratford, NSW 2422

14 April 2020

2019 Stratford Mining Complex Squirrel Glider Colony & Home Range Report

Stratford Coal Pty Ltd

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EXECUTIVE SUMMARY

Condition 38, Schedule 3 of Development Consent SSD-4966 requires the implementation of the Squirrel Glider Management Plan including measures to establish the home range of squirrel glider (Petaurus norfolcensis) colonies within Stratford Mining Complex (SMC) (Condition 38(a). This information will be used to guide the ongoing management of squirrel glider populations within the SMC Biodiversity Offset Areas and Biodiversity Enhancement Areas. This information will also define the study area for further programs including the census of suitable tree hollows, food resources surveys and habitat enhancement including nest box installations.

An initial targeted squirrel glider survey was undertaken to establish the locations of any existing Squirrel Glider colonies within the potential habitat in the vicinity of SMC. The initial survey was undertaken from 26 November to 17 December 2018 consisting of a total of 692 trap nights over 37 locations. Squirrel glider presence was confirmed at five locations. Four of these locations were determined as suitable areas to conduct home range surveys using radio-tracking.

Radio-tracking was undertaken to examine spatial requirements and use, and den preferences. Radio-tracking was conducted in two periods of 40 nights and are subsequently referred to as seasons. A total of 36 squirrel gliders were captured, 19 gliders were fitted with radio collars and sufficient data points were obtained to allow home range estimates for 13 gliders.

Results of the radio-tracking study showed that the seasonal home range for squirrel gliders within the Stratford area in period 1 (Summer) was FK95% 3.9 ± 0.3. ha and MCP100% was 9.7 ± 1.6ha. The FK95% for period 2 (Winter) was 3.6 ± 0.3 and the MCP100% was 12.8 ± 2.1. There was no significant difference between periods ($P = 0.366$, $F_{7,5} = 1.407$). This study also identified areas within the impact area of the Avon North extension where squirrel gliders were denning and foraging.

Further studies in accordance with the Squirrel Glider Management Plan into the population dynamics of the squirrel glider within the Biodiversity Offset areas and Biodiversity Enhancement areas would be conducted to determine the impacts predators and habitat fragmentation are having on the local population. This will provide information on the

effectiveness of the offset measures and habitat enhancement being implemented for the species.

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1. INTRODUCTION

Stratford Coal Pty Ltd (SCPL) is a wholly owned subsidiary of Yancoal Australia Ltd and operates the Stratford Mining Complex (SMC). The SMC is located between the small towns of Craven and Stratford on the Buckett's Way, approximately 100km north of Newcastle (**Figure 1**).

On 29 May 2015, the NSW Planning Assessment Commission approved the Stratford Extension Project (SEP). The SEP provides for the continuation of mining and processing at the SMC for an additional 11 years. The SMC operates under two key approvals, NSW Development Consent (SSD-4966) and the Commonwealth Approval (EPBC 2011/6176). Both may be viewed at http://www.stratfordcoal.com.au.

In accordance with Condition 38(a), Schedule 3 of the Development Consent SSD-4966, the Stratford Mining Complex (Stratford Extension Project) – Squirrel Glider Management Plan (SGMP) (2018) has been prepared to facilitate the management of squirrel gliders at the SMC, Biodiversity Enhancement Areas and Biodiversity Offset Areas. The SGMP has been prepared for a three-year period between July 2018 and July 2021 and includes broader concepts for the longer term (6+ years). Objectives outlined in Section 4 of the SGMP require measures to establish the home range size of squirrel glider colonies within SMC. This information will be used to guide the ongoing management of squirrel glider populations within the SMC Biodiversity Offset Areas and Biodiversity Enhancement Areas. This information will also define the study area for further programs including the census of suitable tree hollows, food resources surveys and habitat enhancement including nest box installations to be undertaken in accordance with Condition 38, Schedule 3 of Development Consent SSD-4966 (SGMP).

1.1 SCOPE AND RATIONALE

Kleinfelder Australia was commissioned by SCPL to conduct an initial targeted squirrel glider survey to *establish the locations of any existing Squirrel Glider colonies within the potential habitat in the vicinity of SMC.* This involved the use of baited remote cameras placed throughout the biodiversity offset and biodiversity enhancement areas. From the areas identified to contain squirrel gliders, radio-tracking was conducted to estimate the home range of the local population of squirrel gliders within these areas of the SMC to

ensure compliance with the above stated objectives. The findings of the initial survey, home range estimation and appropriate recommendations are provided in this report.

2. METHODS

2.1 LITERATURE REVIEW

A literature review was conducted to gather information on previous home range estimates for the squirrel glider (*Petaurus norfolcensis*) and allow comparisons between studies. Legislation, policy and strategy relating to the conservation of threatened species also formed part of the literature review.

2.2 STUDY SITE

The study site is owned by Stratford Coal Pty Ltd (wholly owned subsidiary of Yancoal Australia Ltd) and is located in the Gloucester Basin approximately 100 km north of Newcastle and 11 km south of the township of Gloucester, NSW. The study site consists of the SMC biodiversity offset areas 1, 2 and 3 and a section of the biodiversity enhancement area located adjacent to the expanding Avon North open cut pit (**Figure 1**). No colonies were identified in Offset Area 4. The study site and area surrounding SMC are predominantly undulating agricultural land to the west, south and north. Some patches of woodland/forest exist within the landscape, varying in size and connectivity to large expanses of bushland. To the east of the study site lies a dry open forest that extends on a steeply undulating range running north - south.

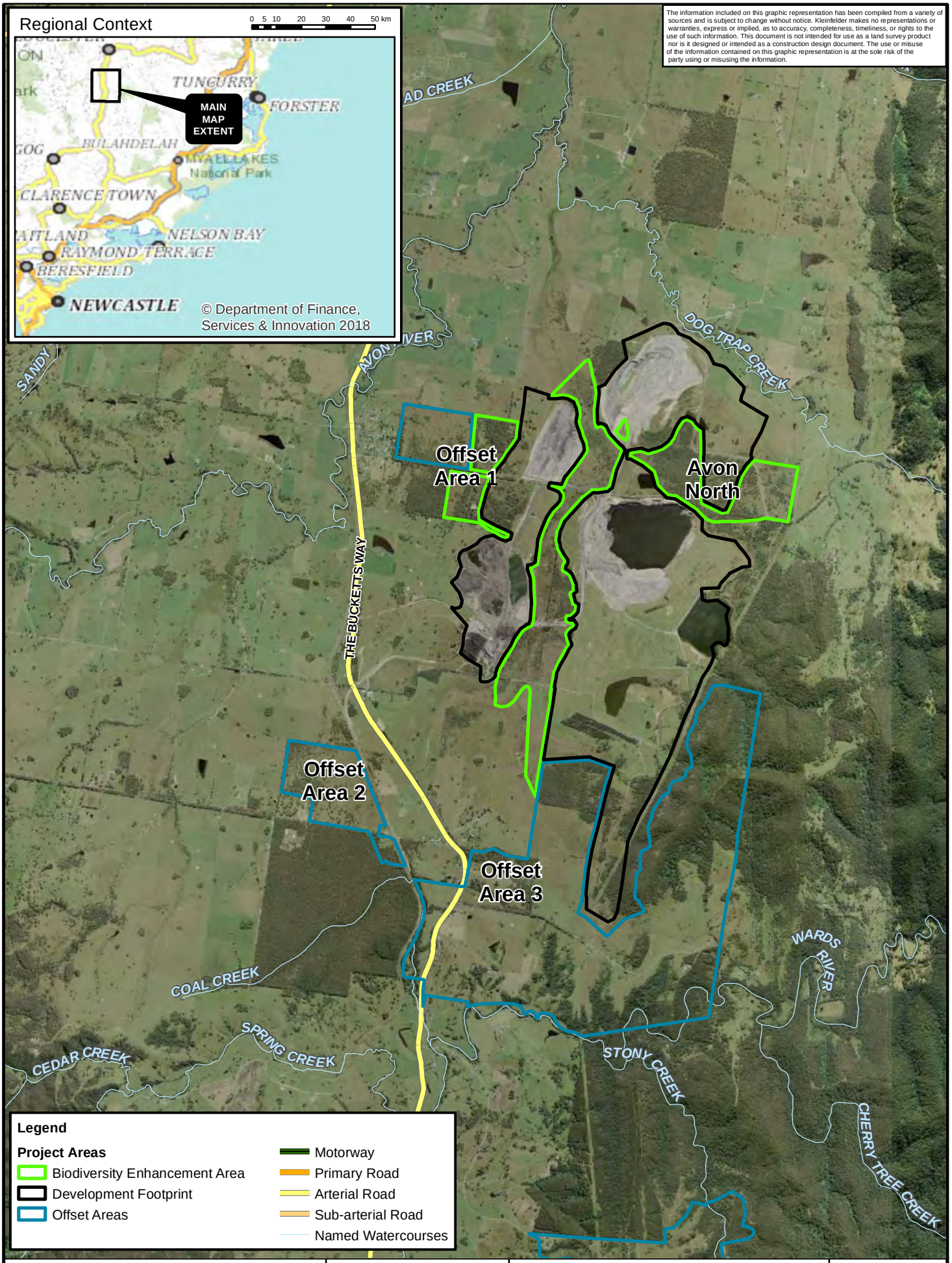
The biodiversity offset and enhancement areas are shown in **Figure 1** and comprise of the following vegetation types:

Offset Area 1 – 40 ha total. This area is comprised of: *Eucalyptus amplifolia* (Cabbage Gum) open forest or woodland on flats of the North Coast and New England Tablelands (7 ha), *Corymbia maculata* (Spotted Gum) - *Eucalyptus paniculata* (grey ironbark) dry open forest of the Barrington Tops, North Coast (9 ha) and exotic grassland (24 ha).

Offset Area 2 – 70 ha total. This area is comprised of: *Eucalyptus amplifolia* (Cabbage Gum) open forest or woodland on flats of the North Coast and New England Tablelands (3.5 ha), Spotted Gum – Grey Ironbark dry open forest of the Barrington Tops, North Coast (21 ha) and exotic grassland (45.5 ha).

Offset Area 3 (north and south) – 655 ha total. Of the total area approximately 85 ha was surveyed during this study. The main vegetation types include: Cabbage Gum open forest or woodland on flats of the North Coast and New England Tablelands (15.5 ha), Spotted Gum - Grey Ironbark dry open forest of the Barrington Tops, North Coast (12.5 ha) and exotic grassland (57 ha).

Biodiversity Enhancement Area (Avon North) - 110 ha. Avon North is comprised of: Cabbage Gum open forest or woodland on flats of the North Coast and New England Tablelands (19 ha), Spotted Gum - Grey Ironbark dry open forest of the Barrington Tops, North Coast (84 ha) and exotic grassland (7 ha).



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DRAWN BY: GJoyce

DATA SOURCE: NSW DFSI - 2019

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Locality

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FIGURE:

1

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2.3 INITIAL REMOTE CAMERA SURVEY

On 26 – 28 November 2018, 35 Reconyx Hyperfire™ remote cameras were installed throughout suitable squirrel glider habitat within SMC's Biodiversity Offset and Biodiversity Enhancement Areas (Kleinfelder 2019). Suitable habitat was determined by areas containing hollows and flowering gums known to be a food resource for squirrel gliders. The camera traps were in place for a total of 692 trap nights and set to take five images with no delay between trigger events. The cameras were installed on trees at a height of 2.5 – 3 m and aimed at a bait held in a tea infuser containing peanut butter, oats and honey (**Figure 2).** Honey-water was sprayed above the baits to a height of approximately 5 m to aid in attracting squirrel gliders (Goldingay 2018). A 30 cm wooden ruler was also installed next to the bait as a scale to aid in distinguishing squirrel gliders from sugar gliders. Baits were replaced on 5 and 6 December 2018 and honey-water resprayed. The cameras were left in place until the 16 - 17 December 2018.

During re-baiting, batteries were replaced, and SD cards were checked to identify areas where squirrel gliders had been detected. Two locations were found to have detected the presence of squirrel gliders at the time of re-baiting (RC19 and RC24), consequently, these cameras were repositioned to two new locations (RC19A and RC24A) to expand the area surveyed.

Figure 2: Remote camera trap and bait station used to detect squirrel glider presence.

2.4 ARBOREAL TRAPPING

Arboreal trapping was conducted over two discrete periods between January-April 2019 (Summer) and July-September 2019 (Winter) to capture squirrel gliders for radio-tracking and recapture for collar removal. Five trapping transects were established in areas containing squirrel gliders as identified by the remote camera survey and previous records. Each trapping transect consisted of 10 sheet metal box traps (45 x 15 x 15 cm, Elliott Type B) (Elliott Scientific Co., Victoria, Australia) spaced at approximately 100 m intervals. The traps were installed on trees identified to be within suitable habitat and with a diameter at breast height (DBH) of >30 cm. The traps were installed at a height of 3-4 m by hammering two metal pins into the trunk on which an aluminium platform made to slide onto to the pins was then attached (Plate 1). Dry leaves were placed in the back of the traps for bedding. A mixture of honey, oats and peanut butter was used as bait, which is commonly used for capturing many species of Australian mammal (Diete *et al*. 2016). Diluted honey water was sprayed using a two-litre handheld pressure sprayer to a height

Plate 1: **Arboreal Elliot type B trap installed on Platform (left). Diluted honey-water being sprayed on and above trap (right).**

of 3-4 m above the trap to attract squirrel gliders down from the treetops (Crane *et al*. 2008, Goldingay 2018).

When trapping to recapture and to remove collars from collared squirrel gliders, traps were placed in areas where gliders had been observed foraging and denning on previous nights/days. This likely reduced the amount of trapping effort needed to recapture collared gliders. The same trap type, method of attachment, bait and use of diluted honey water attractant remained unchanged.

Traps were checked from dawn each morning and any broken or soiled by other species were replaced with clean, functional traps. Captured gliders were transported to a nearby field station where a room had been prepared to hold gliders while measurements were taken, and collars attached. Measurements and collaring were conducted in the enclosed room to prevent gliders escaping; gliders could also be left for periods of time if they started to show signs of stress during the measuring and collaring process. Gliders were held until dusk where they were then released at their point of capture.

2.5 PROCESSING AND COLLARING

Squirrel gliders captured during the arboreal trapping phase were, weighed, measured, sexed, aged, named, and fitted with a uniquely numbered ear tag. Each glider was weighed by transferring them from the trap into a calico bag. PESOLA® 300-gram spring balance was then used to weigh each glider. Measurements were taken of the head-body and tail length using a flexible measuring tape. Ages were estimated using methods detailed in Suckling (1984). Signs of breeding such as, active scent glands on males and pouch young or stained, loose pouches on females were recorded. Uniquely numbered self-piercing fingerling tags (National Band and Tag Co., USA) were fitted to each captured squirrel glider's ear to aid in identification. Ear tags were attached using the applicator pliers designed for fitting fingerling tags. Lastly, squirrel gliders selected for radio-tracking were fitted with a SIRTRACK® single stage VHF transmitting collar (model V1C 118B) (**Plate 2**). Squirrel gliders were selected for tracking if they were adult and without young. One male and one female squirrel glider from each study site were preferred, however in Biodiversity Offset 2 only female gliders were captured during the trapping period.

2.6 RADIO-TRACKING

Radio-tracking was conducted over two periods to detect any variability in range size and use over different seasons. The first round was conducted in summer/autumn between 30 January 2019 and 3 April 2019. The second round was conducted in winter/spring between 7 July and 1 September 2019.

Plate 2: **Radio-transmitting collar (left). Radio-transmitting collar and fingerling tags fitted to squirrel glider (right).**

Released squirrel gliders fitted with radio-transmitters were tracked to dens during daylight hours between two to seven times per week and one to three times per night during the two radio-tracking periods. Individual gliders were tracked at differing times each night between 1900 – 0200 h to reduce systematic bias due to tracking routine. Each location point was recorded on an Ipad linked with a Garmin Glo® GPS for a more accurate GPS fix and included information such as tree species on which the glider was feeding, if the glider was sighted, glider ID and time.

ZoaTrack, an open source online software program, was used to spatially analyse squirrel glider locations obtained from trap captures and radio-tracking locations (Dwyer *et al.* 2015). The spatial analysis methods used to estimate squirrel glider seasonal home ranges were Minimum Convex Polygon (MCP) and Fixed Kernal (FK). The MCP100% estimate considers all the locations recorded for an individual glider and creates the smallest possible polygon that incorporates the location records. The FK estimate is a non-parametric method that utilises fixed kernel smoothing,

ignoring the temporal order whereby locations were obtained (Seaman and Powell 1996). The FK percentage refers to the boundary of the area which contains that volume of utilisation distribution. Typically 95% and 50% are used to estimate home range and core-area (Harris *et al.* 1990, Seaman and Powell 1996, Goldingay 2015, Dressler *et al*. 2016, Körtner *et al*. 2019). The use of these estimators allowed comparisons to previous studies of squirrel glider home range elsewhere within the geographical range of the species (**Table 1**). Maps of squirrel glider home ranges were created by exporting shape files from Zoatrack into ArcGIS® (Esri, California).

2.7 ASYMPTOTE ANALYSIS

In order to evaluate how the sample size of recorded locations influenced home range estimates an asymptote analysis was conducted. Asymptote analysis involves resampling groups of data in increasing increments and finding where the estimated home range values stabilise, typically 5-10% difference between successive groups is considered stable (Laver and Kelly 2008).

The asymptote analysis was completed by randomly resampling radio-tracking locations for sequential sets of locations from 10 to 40. Each set of locations contained 10 replicates for each individual. The resampled data were exported to Zoatrack and spatially analysed to provide estimates of MCP100% and FK95%. The seasonal home range size estimates for each sample was then averaged, and standard error calculated.

3. RESULTS

3.1 LITERATURE REVIEW

Burt (1943) defined the home range as the 'area traversed by the individual in its normal activities of food gathering, mating and caring for young. Occasional sallies outside the area, perhaps exploratory in nature, should not be considered as part of the home range'. *Powell et al*. (1997) suggested that this definition is vague as it does not provide a clear definition of what should be considered 'occasionally sallies'. As each individual animal's home range can be site specific, due to location and resource distribution, it is important to avoid generalising home range estimates for one species over its entire geographic range.

Knowledge of spatial and habitat requirements of the squirrel glider is important to managing its conservation, habitat retention and restoration (Goldingay *et al.* 2010). Several studies have investigated the home range size of squirrel gliders (**Table 1**), however, the methods of data collection and outcomes have varied and consequently conclusions have differed (Quin 1995, van der Ree and Bennett 2003, Sharpe and Goldingay 2007, Goldingay *et al*. 2010). The study by Quin (1995) used a grid trapping method to estimate the home range of squirrel gliders near Limeburners Creek, NSW. The mean home range estimate calculated during that study is significantly smaller compared to the present day/currently used method of using radio-telemetry (van der Ree and Bennett 2003, Sharpe and Goldingay 2007). Goldingay *et al.* (2010) emphasised that home range estimates are highly influenced by the methods employed and can vary throughout geographic regions and habitat types.

Table 1: **Summary of the squirrel glider's estimated home range size from previous studies throughout Australia. Methods used include: Minimum Convex Polygon (MCP), Fixed Kernel (FK), and Grid Cell.**

Location	Sex	Estimated home range (ha ± standard error)							References
		MCP 100%	FK 50%	FK 95%	HM 50%	HM 80%	HM 95%	Grid Cell 95%	
Limeburners Creek, NSW	Female	-	-	-	-	4.0 ± 0.7	-	-	Quin (1995)
	Male	-	-	-	-	3.7 ± 0.5	-	-	
	Combined	-	-	-	-	3.8 ± 0.4	-	-	
Euroa, VIC	Female	-	-	-	-	-	-	5.31*	van der Ree and Bennett (2003)
	Male	-	-	-	-	-	-	2.55*	
	Combined	-	-	-	-	-	-	3.93*	
Tea Gardens, NSW	Female	17.7 ± 5.0	1.8 ± 0.3	16.5 ± 5.1	1.2 ± 0.3	-	14.5 ± 5.5	-	Goldingay *et al.* (2010)
	Male	8.9 ± 1.4	1.7 ± 0.2	13.1 ± 0.6	0.3 ± 0.2	-	10.1 ± 1.1	-	
	Combined	13.3 ± 3.1	1.7 ± 0.1	4.6 ± 0.7	0.8 ± 0.3	-	12.3 ± 2.7	-	
Brisbane, QLD	Female	6.1 ± 2.0	0.9 ± 0.2	4.3 ± 1.1	0.2 ± 0.1		8.1 ± 5.2		
	Male	7.2 ± 2.5	0.9 ± 0.2	4.8 ± 0.9	0.2 ± 0.1		4.2 ± 2.0		
	Combined	6.7 ± 1.5	0.9 ± 0.1	4.6 ± 0.7	0.2 ± 0.1		6.2 ± 2.7		
South-east QLD	Combined	4.6 ± 1.9	1.5 ± 0.1	7.1 ± 0.4	-	-	-	-	Brearley *et al.* (2011)
	Mean	6.4 ± 0.4	1.0 ± 0.1	4.9 ± 0.2	0.2 ± 0.0	3.8 ± 0.2	6.2 ± 0.2	3.9 ± 1.5	

*Standard error not reported

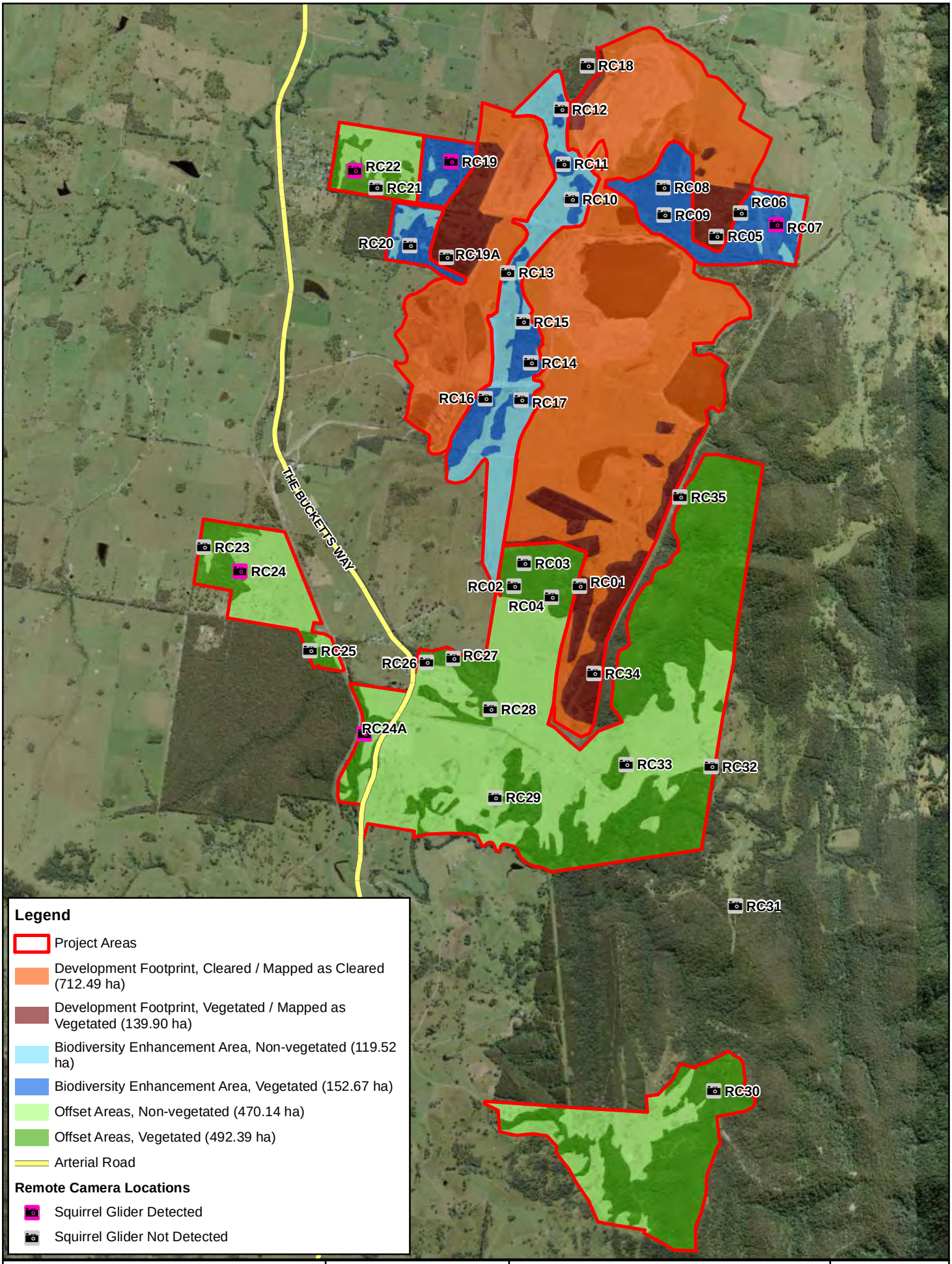
3.2 REMOTE CAMERA SURVEY

The remote camera trapping survey identified five locations where squirrel gliders were confirmed to be present (**Figure 3**). A total of 692 camera trap nights were conducted at 37 locations between 26 November and 17 December 2018. Four of the locations were determined to be suitable for arboreal trapping and radio-tracking (RC07, RC19, RC22, RC24). Location RC24A (**Figure 3**) was not selected as a study site due to the steep and hazardous terrain as well as not having permission to access the neighbouring property that likely formed part of that gliders home range in that area. Examples of photographed squirrel gliders are shown in **Plate 3** and **Plate 4**.

Opportunistic detections were also recorded and included; common brushtail possum (*Trichosurus vulpecula*) (nine locations), antechinus sp. (nine locations), sugar glider (*Petaurus breviceps*) (five locations) and vulnerably listed brush-tailed phascogale (*Phascogale tapoatafa*) (eight locations).

Plate 3: Squirrel glider detected at RC 19.

Plate 4: Squirrel glider detected at RC 24.



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DRAWN BY: GJoyce
DATA SOURCE:
NSW DFSI - 2017
Stratford Coal - 2018

Locations of Squirrel Glider Detection

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FIGURE:
3

3.3 ANIMAL CAPTURE AND COLLARING

A total of 36 squirrel gliders were captured during the arboreal trapping phase of the home range study - 19 females and 17 males; one squirrel glider (Sharon) had two dependant young (**Plate 5**). Of the 36 gliders captured, 10 individuals were fitted with radio-transmitting collars in each discrete tracking period (20 collars in total). In the first round of tracking conducted during summer/autumn between 30 January 2019 and 3 April 2019, seven gliders were successfully tracked. In the remaining three gliders the transmitters either failed or the gliders managed to remove the collar while denning.

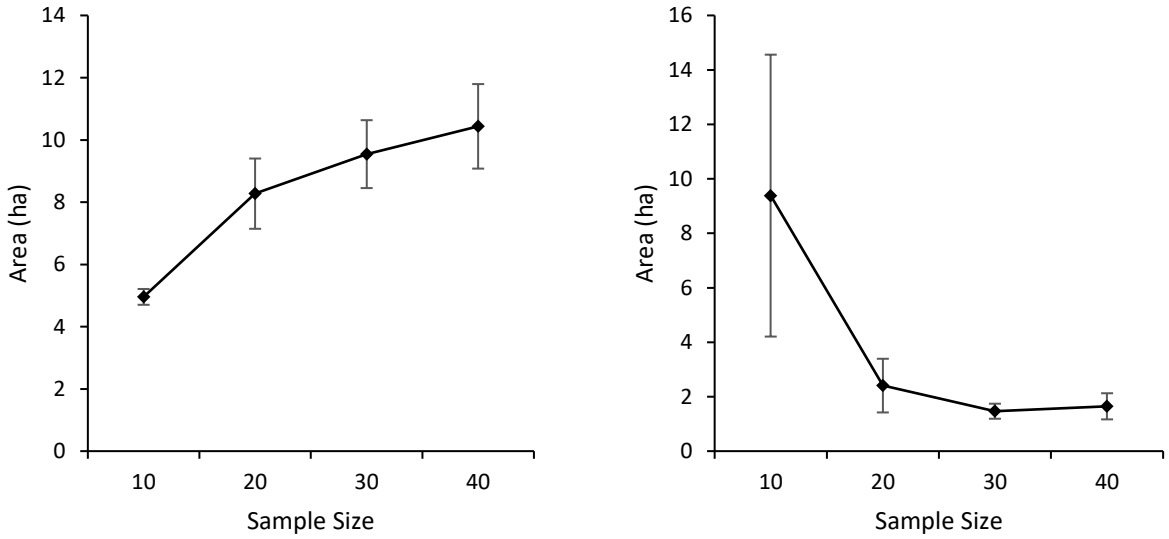
Plate 5: Squirrel glider (Sharon) with young.

During the second round of radio-tracking, conducted in winter/spring between 7 July and 1 September 2019, another 10 individuals were fitted with radio-transmitting collars. During this

period, a sufficient number of data points were gathered to estimate the seasonal home range of nine gliders. However, five gliders were not successfully tracked potentially due to transmitter failure or predation.

3.4 ASYMPTOTE ANALYSIS

An asymptote analysis was conducted for individuals tracked over both discrete tracking periods. **Figure 4(a)** shows the results of the MCP100% analysis, the trendline indicates that the home range sizes were increasing with the inclusion of additional locations. Results of the asymptote analysis for the FK95% estimate is shown in **Figure 4(b)** and indicates that the area estimation was stable beyond a sample size of 30 locations.



a) **b)**

Figure 4: Asymptote analysis of seasonal home range of MCP100% (a) and FK95% (b) estimates for three squirrel gliders tracked over both discrete tracking periods. Values are the mean (±se) six individuals.

3.5 HOME RANGE ESTIMATION

A regression analysis was undertaken to determine if the number of locations was influencing the size of the estimated home range (**Figure 5** and **Figure 6**). Results of the analysis showed no significant difference between estimated home range (both MCP100% and FK95%) and number of locations.

Mean seasonal home range (FK95%) was estimated for 13 squirrel gliders (**Figure 7**) that had at least 25 tracked locations, the round 1 FK95% was 3.9 ± 0.3. ha and MCP100% was 9.7ha ± 1.6ha. The FK95% for round two round 2 was 3.6 ± 0.3 and the MCP100% was 12.8 ± 2.1. There was no significant difference between rounds/seasons, sites or sexes as determined by a 3-factor ANOVA (P = 0.366, F7,5 = 1.407).

A summary of results is provided in **Table 2**. **Figure 8** to **Figure 16** show the estimated seasonal home range for each radio-tracked squirrel glider. **Figure 10** shows the presumed route of travel for Scarlet. Scarlet travelled approximately 5 km through a narrow strip of roadside vegetation in five nights before slipping loose of her collar whilst denning. All other gliders were generally observed foraging on flowering gums within 200 m of their den. Elsie was recorded 500 m from the area where she had normally been observed. This may have been an anomaly where she may have been looking for a mate, more foraging resources or defending her territory.

Table 2: **Results of squirrel glider radio-tracking and seasonal home range estimates from the current study. Three gliders (Rachel, Syril and Kate) were tracked during both periods**

Site ID	Glider ID	Sex	Age Category*	MCP100% (ha)	FK 95% (ha)	FK 50% (ha)	Tracking period (nights)	No. locations
Round 1								
Avon North	Emma	F	>3 years	7	2.6	0.4	52	52
Avon North	Eric	M	1-2 years	14.5	4.4	0.6	50	51
Offset 1	Rachel	F	>3 years	3.7	3.4	0.7	58	55
Offset 1	Russel	M	>3 years	7	5.8	1	57	56
Offset 2	Syril	F	2-3 years	9	4.6	0.8	57	56
Offset 3	Kate	F	1-2 years	13.1	3.7	0.6	35	40
Offset 3	Kevin	M	2-3 years	13.9	4.3	0.8	35	40
Mean ± standard error			Female (4)	8.1 ± 2.0	3.7 ± 0.4	0.7 ± 0.1	53 ± 2.3	54 ± 2.0
			Male (3)	11.8 ± 2.4	4.2 ± 0.2	0.7 ± 0.1	47 ± 6.5	49 ± 4.7
			All (7)	9.7 ± 1.6	3.9 ± 0.3	0.7 ± 0.1	51 ± 7.9	52 ± 6.0
Round 2								
Avon North	Eddy	M	>3 years	12.1	3.5	0.7	27	25
Avon North	Elsie	F	1-2 years	23.3	3.3	0.4	46	45
Avon North	Iris	F	1-2 years	3.5	2.3	0.5	29	29

Site ID	Glider ID	Sex	Age Category*	MCP100% (ha)	FK 95% (ha)	FK 50% (ha)	Tracking period (nights)	No. locations
Offset 1	Rachel	F	>3 years	12.8	3.3	0.4	45	45
Offset 1	Rodney	M	>3 years	7.6	3.7	0.6	38	42
Offset 1	Rupert*	M	1-2 years	5.2	0.9	0.2	14	11
Offset 2	Sharon	F	2-3 years	17.1	3.5	0.6	43	42
Offset 2	Syril	F	2-3 years	7.1	0.9	0.1	46	49
Offset 3	Kate	F	1-2 years	13.0	3.3	0.5	34	38
Offset 3	Kyle	M	1-2 years	18.8	6.5	1.1	45	49
Mean ± standard error			Female (6)	12.8 ± 2.9	3.4 ± 0.3	0.6 ± 0.1	41 ± 3.0	41 ± 2.9
			Male (3)	12.8 ± 3.3	4.1 ± 0.6	0.7 ± 0.1	37 ± 5.2	39 ± 7.1
			All (9)	12.8 ± 2.1	3.6 ± 0.3	0.6 ± 0.1	39 ± 2.8	40 ± 2.8

*Age category from adapted from Suckling (1984)

*Rupert excluded from analyses due to too few locations

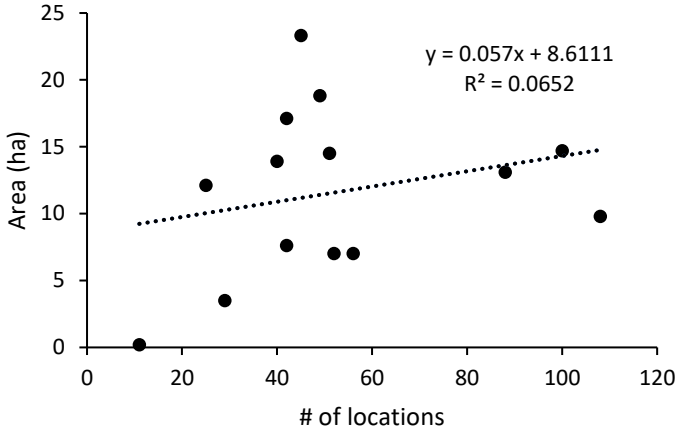


Figure 5: **Regression analysis of MCP100% area size estimation vs number of locations. No significant difference (P=0.374, F_{13}=0.837).**

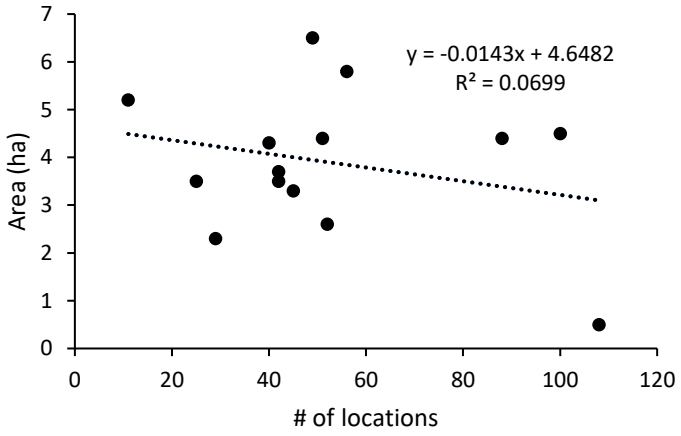
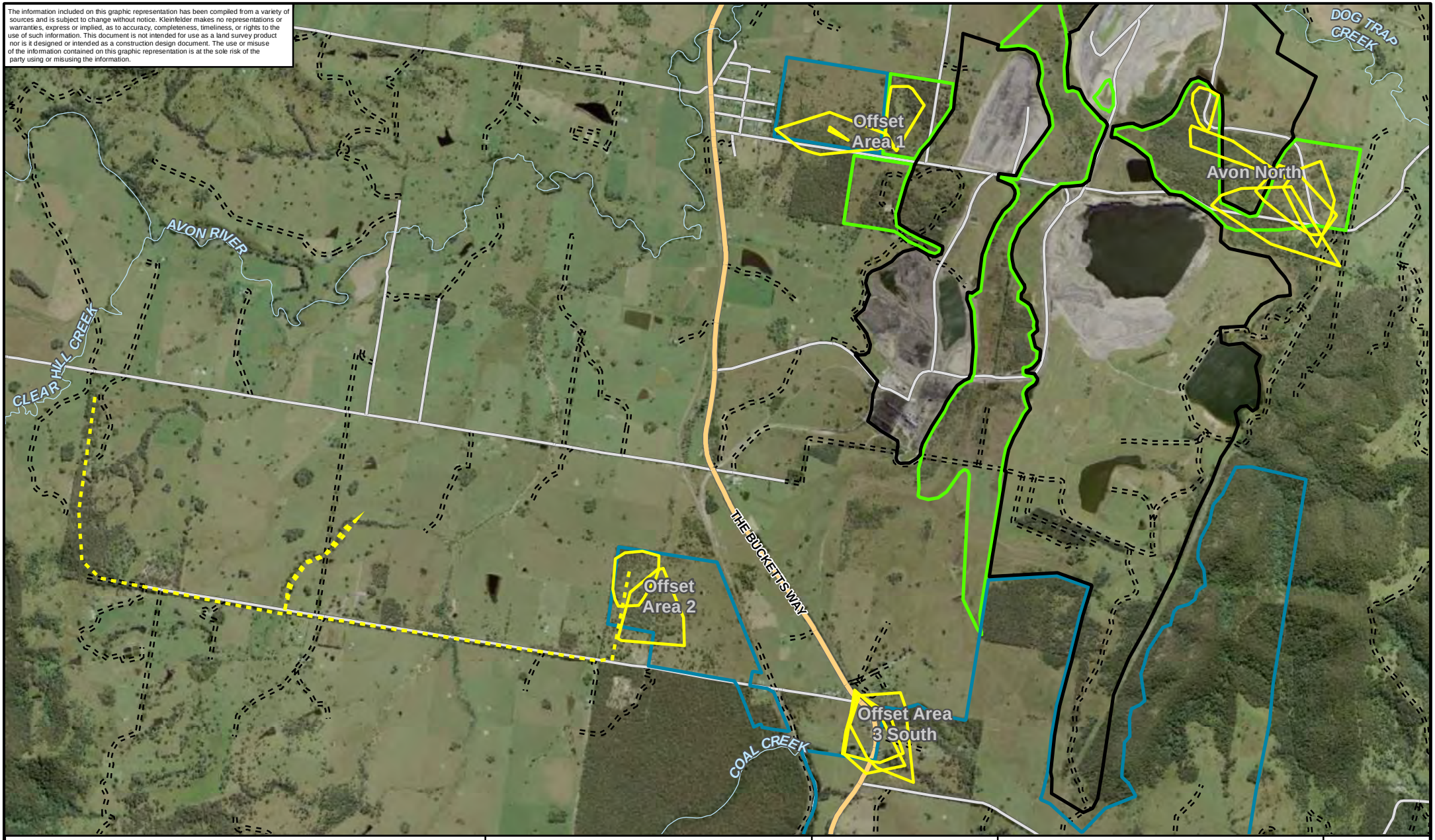


Figure 6: **Regression analysis of FK95% area size estimation vs number of locations. No significant difference (P=0.360, F_{13}=0.902).**



Legend

- Presumed Route of Travel (Scarlet)
- MCP 100 Home Range Areas
- Arterial Road
- Local Road
- Track
- Named Watercourses

Project Areas

- Biodiversity Enhancement Area
- Development Footprint
- Offset Areas

Kilometres

0 0.25 0.5 1 1.5 2

N

PROJECT REFERENCE: HONS

DATE DRAWN: 2019/11/20 10:37 Version 1

DRAWN BY: GJoyce

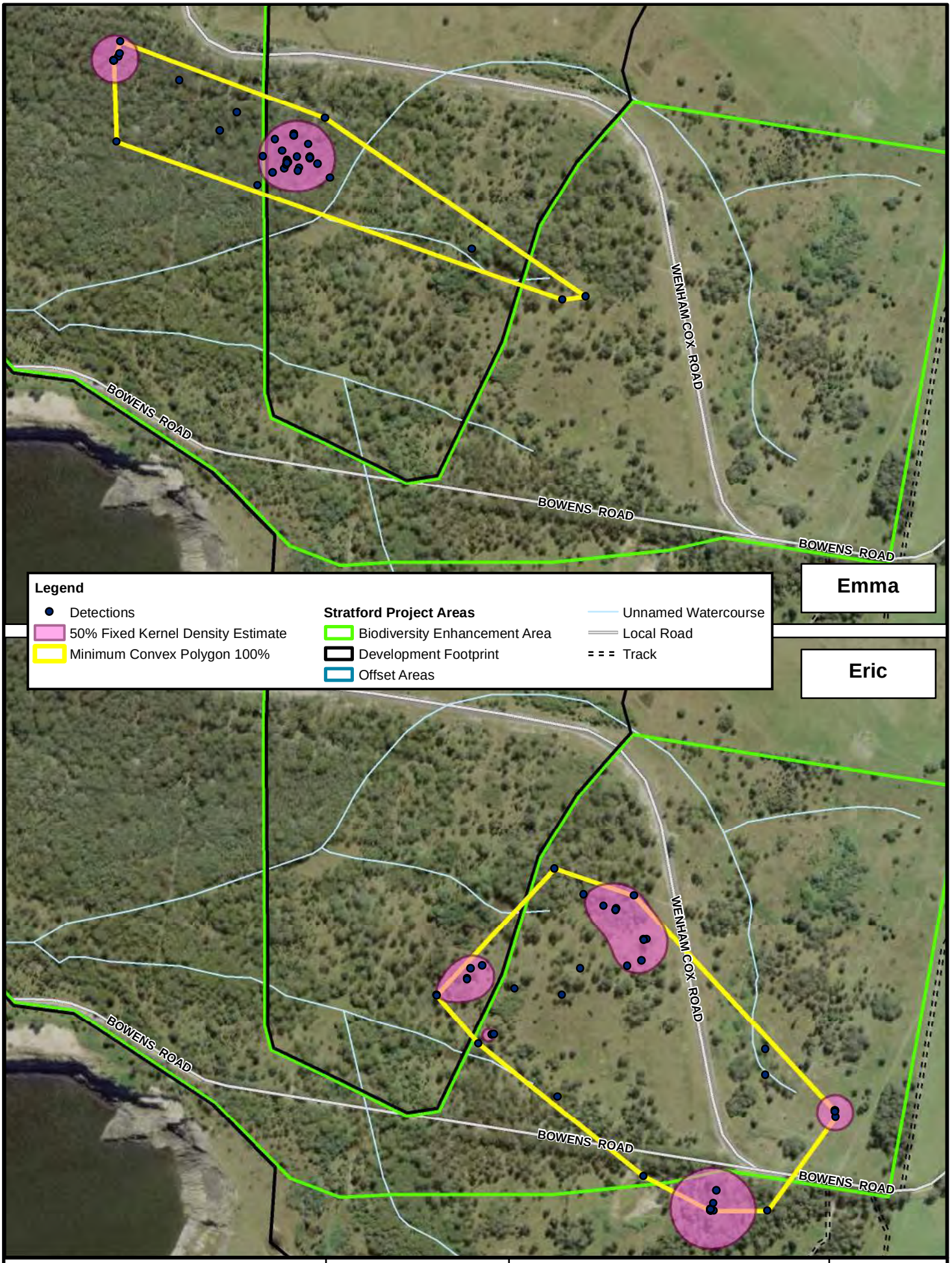
DATA SOURCE:
NSW DFSI - 2018
Kleinfelder - 2019

Locations of Radio-tracking and Seasonal Home Range Estimates

Squirrel glider (*Petaurus norfolcensis*) seasonal home range and den site characteristics within the Mid-north Coast of New South Wales.

FIGURE:

7



Metres
0 25 50 100 150 200 250

N

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DATE DRAWN: 2019/11/20 10:38 Version 2

DRAWN BY: GJoyce

DATA SOURCE:
NSW DFSI - 2019

Home Range (Round 1) - Emma & Eric in Avon North

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Squirrel Glider Seasonal Home Range Final Report

FIGURE:

8

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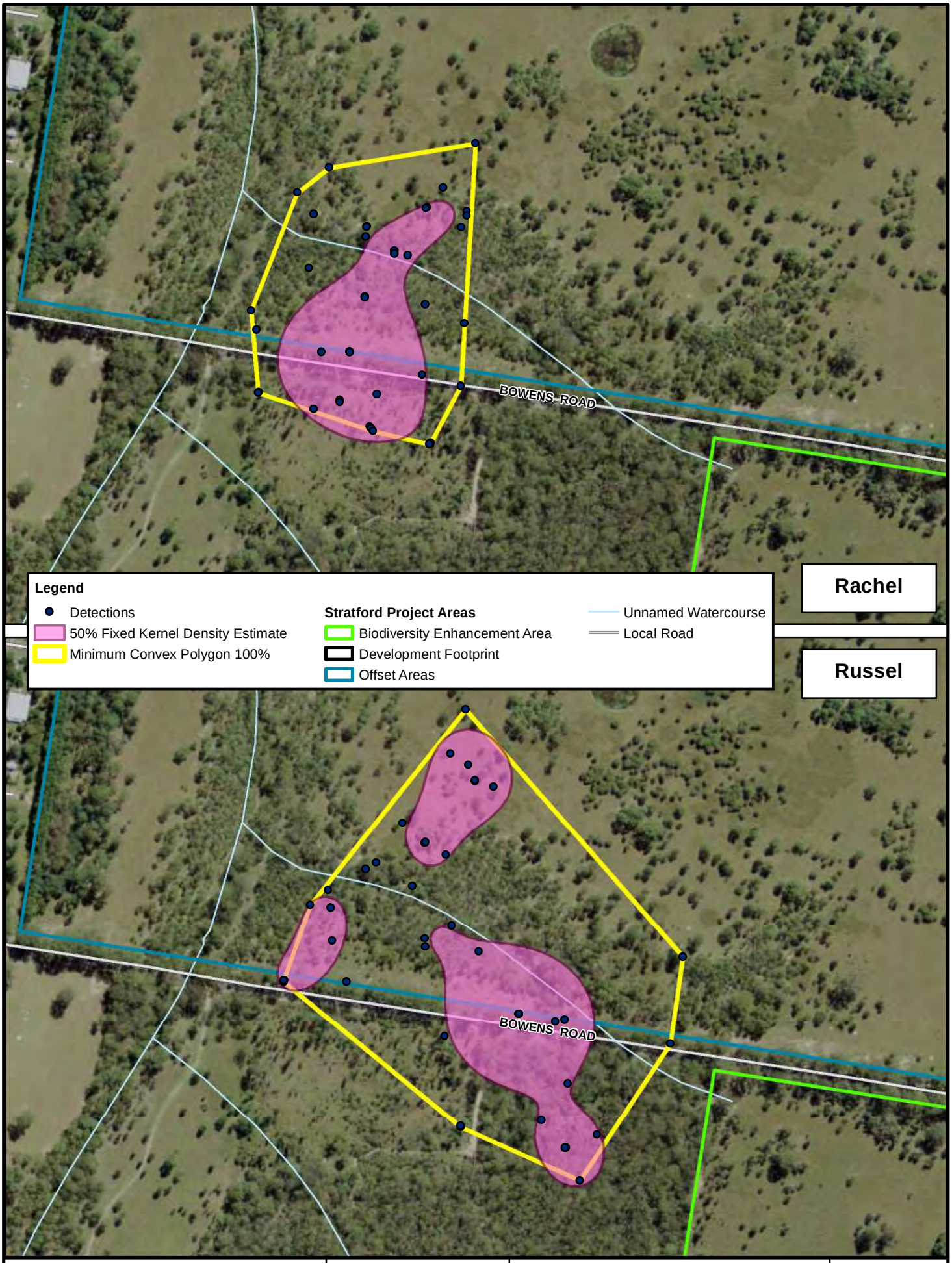

Metres
0 25 50 100 150 200
N

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DATE DRAWN: 2019/11/20 10:38 Version 2
DRAWN BY: GJoyce
DATA SOURCE: NSW DFSI - 2019

Home Range (Round 1) - Rachel & Russel in Offset Area 1

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Squirrel Glider Seasonal Home Range Final Report

FIGURE: 9

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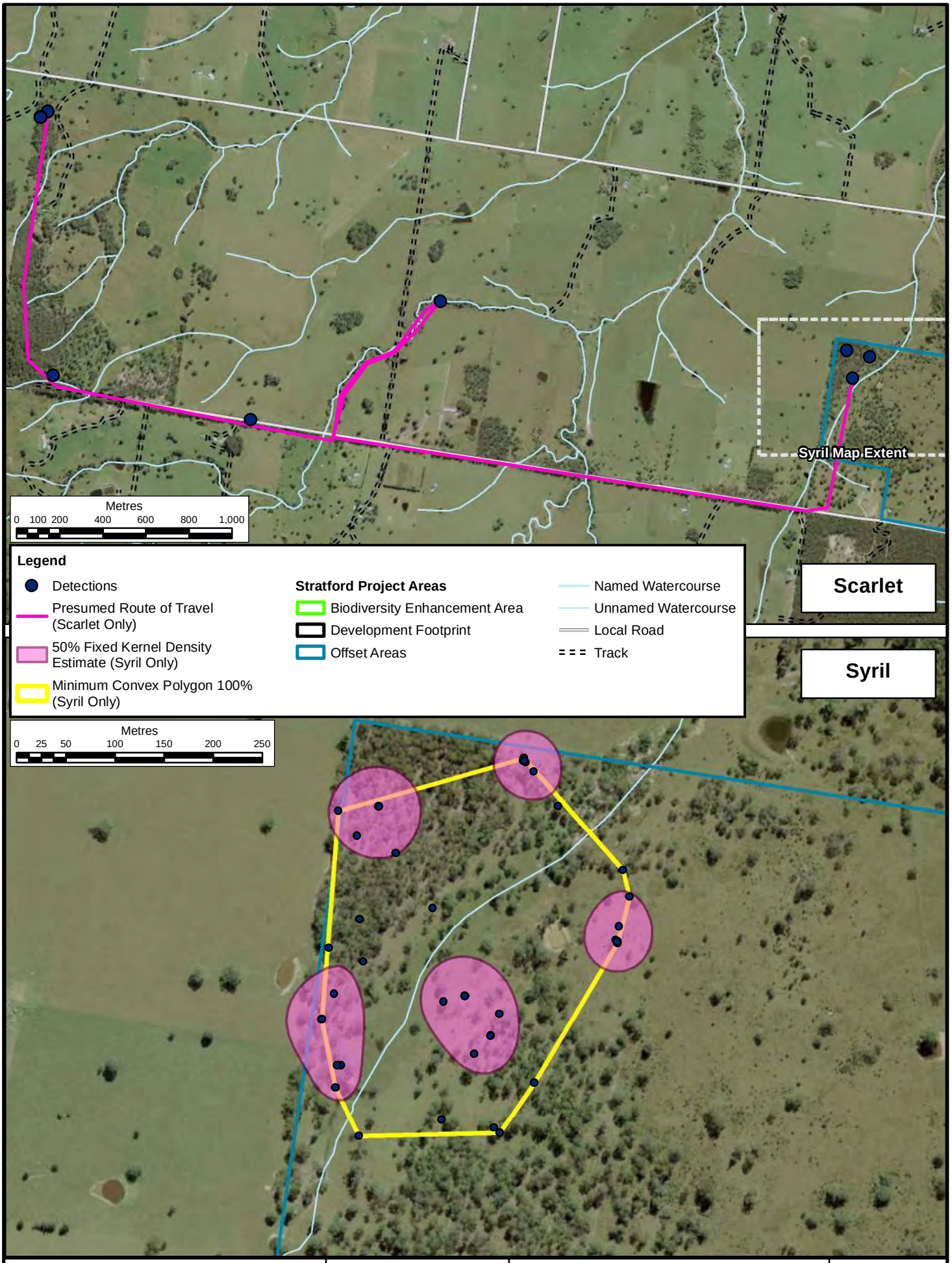

See each map frame for scale

N

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DATA SOURCE:
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Home Range (Round 1) - Scarlet & Syril in Offset Area 2

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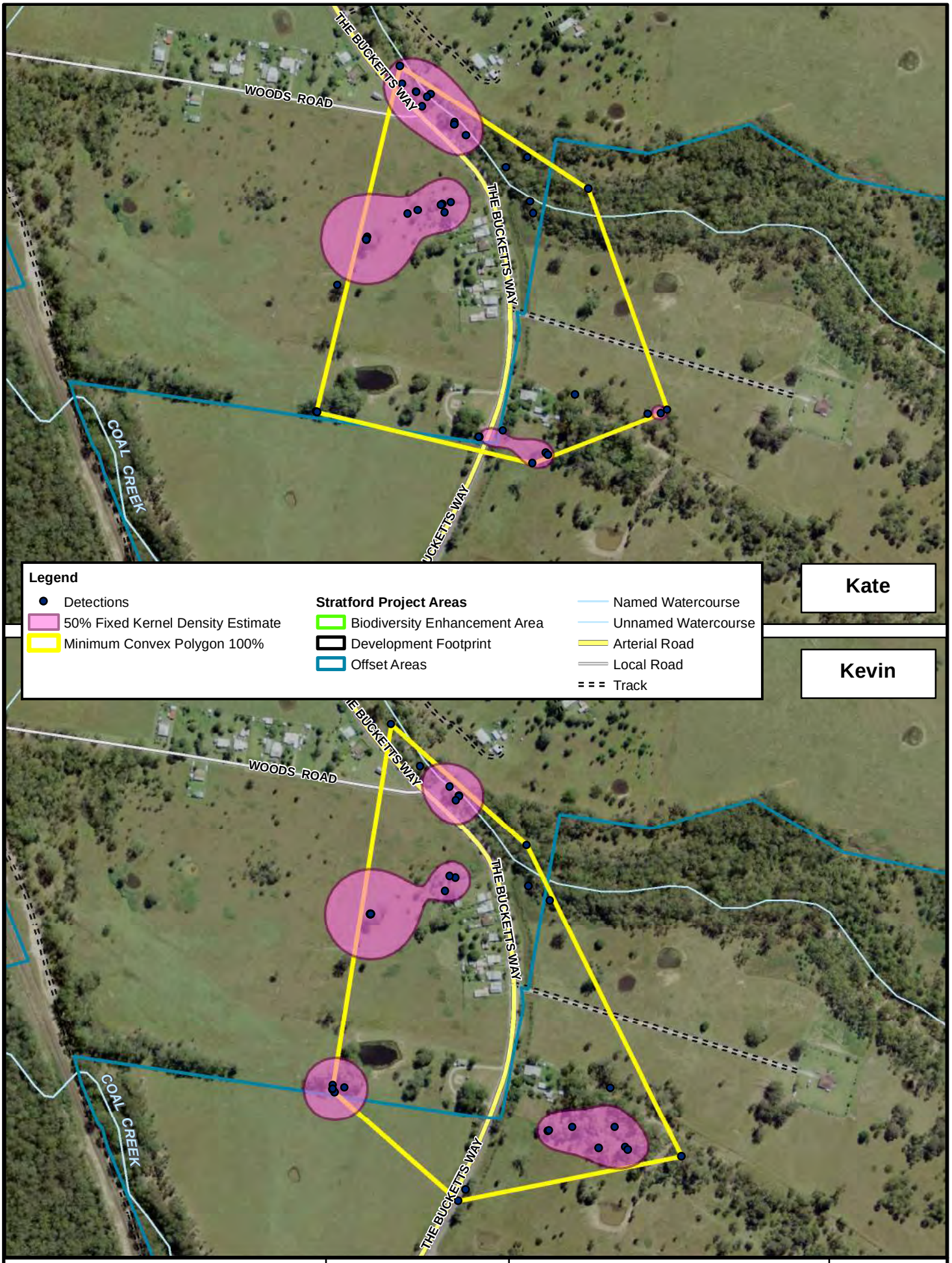
Squirrel Glider Seasonal Home Range Final Report

FIGURE:

10

L:\GIS FOLDER\00 CLIENT FILES\89351_StratfordCoal\20193431_StratfordSquirrelGliderTracking\Mapping\20193431_HomeRangeFINAL_Fig10_ScarletSyril.mxd



Legend

- Detections
- 50% Fixed Kernel Density Estimate
- Minimum Convex Polygon 100%

Stratford Project Areas

- Biodiversity Enhancement Area
- Development Footprint
- Offset Areas

- Named Watercourse
- Unnamed Watercourse
- Arterial Road
- Local Road
- Track

Metres
0 25 50 100 150 200 250

N

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DATA SOURCE:
NSW DFSI - 2019

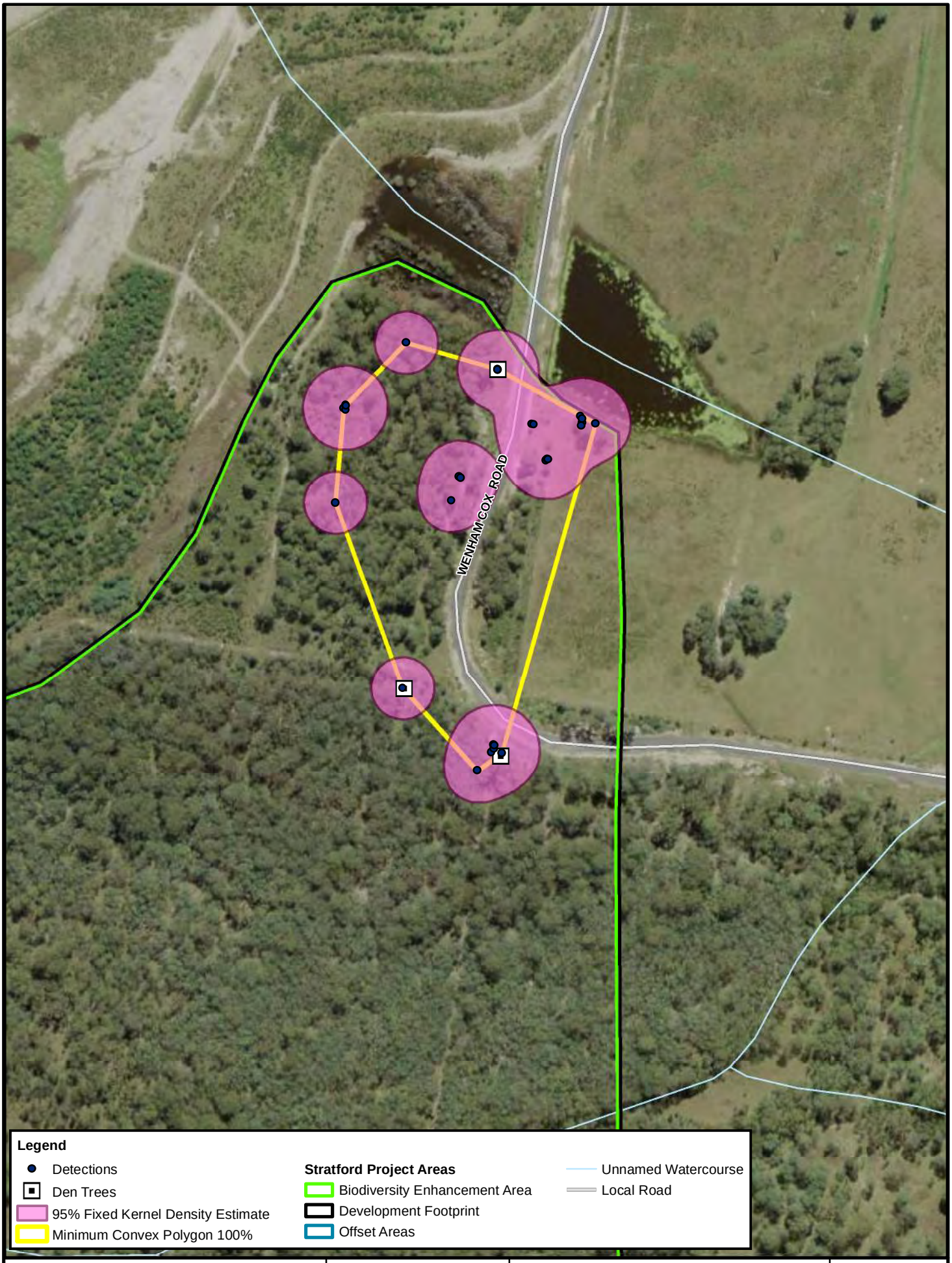
Home Range (Round 1) - Kate & Kevin in Offset Area 3

Stratford Coal Ltd
Squirrel Glider Seasonal Home Range Final Report

FIGURE:

11

L:\GIS FOLDER\00 CLIENT FILES\89351_StratfordCoal\20193431_StratfordSquirrelGliderTracking\Mapping\20193431_HomeRangeFINAL_Fig11_KateKevin.mxd



Legend

- Detections
- Den Trees
- 95% Fixed Kernel Density Estimate
- Minimum Convex Polygon 100%

Stratford Project Areas

- Biodiversity Enhancement Area
- Development Footprint
- Offset Areas

- Unnamed Watercourse
- Local Road

Metres
0 25 50 100 150 200
N

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DRAWN BY: GJoyce
DATA SOURCE: NSW DFSI - 2019

Home Range (Round 2) - Iris in Avon North

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Squirrel Glider Seasonal Home Range Final Report

FIGURE: 12

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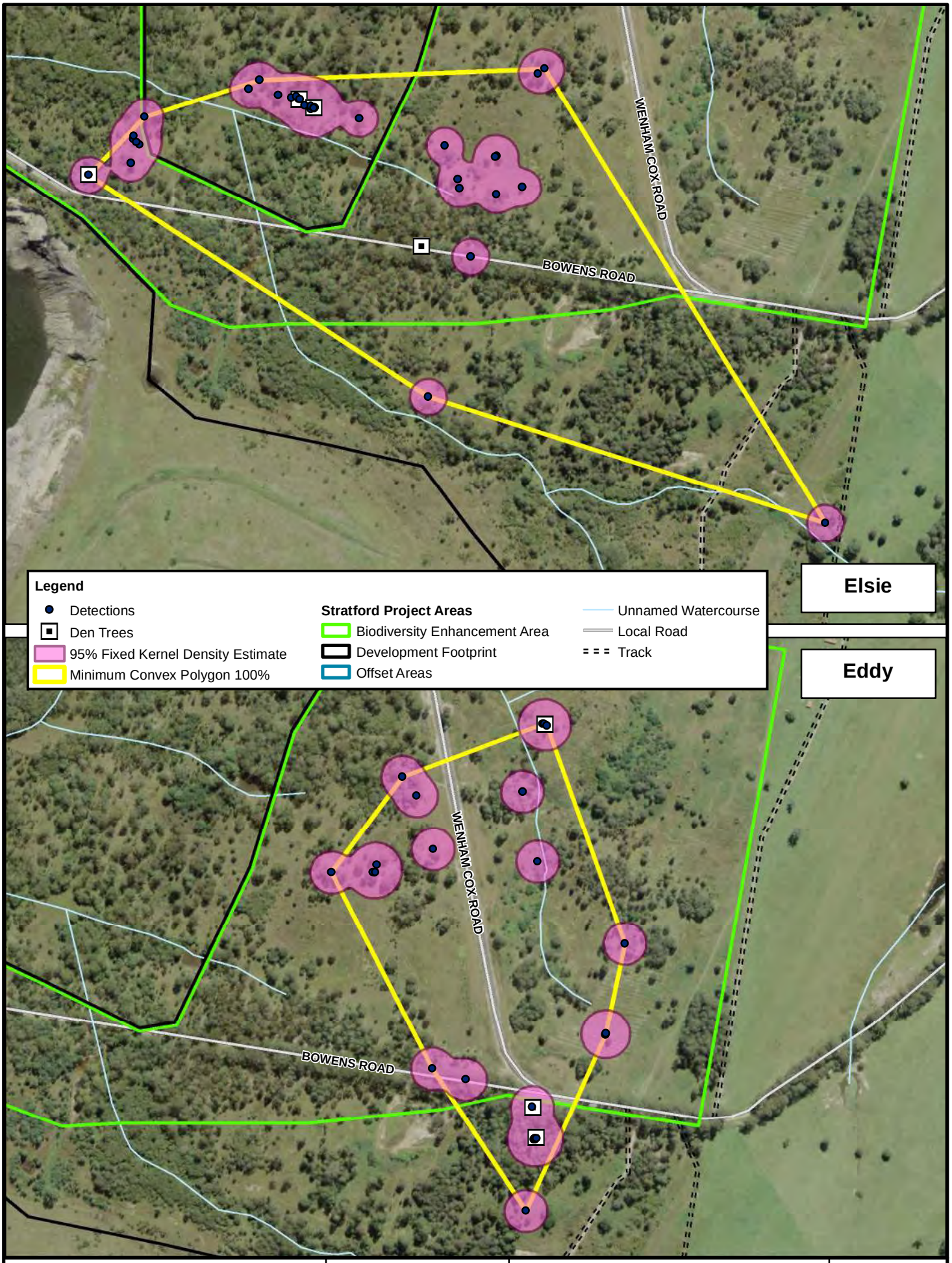

Metres
0 25 50 100 150 200 250

N

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DRAWN BY: GJoyce

DATA SOURCE:
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Home Range (Round 2) -
Elsie & Eddy in Avon North

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Squirrel Glider Seasonal Home Range Final Report

FIGURE:

13

L:\GIS FOLDER\00 CLIENT FILES\89351_StratfordCoal\20193431_StratfordSquirrelGliderTracking\Mapping\20193431_HomeRangeFINAL_Fig13_ElsieEddy.mxd

Metres (Rachel and Rodney)
0 25 50 100 150 200

N

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DRAWN BY: GJoyce

DATA SOURCE:
NSW DFSI - 2019

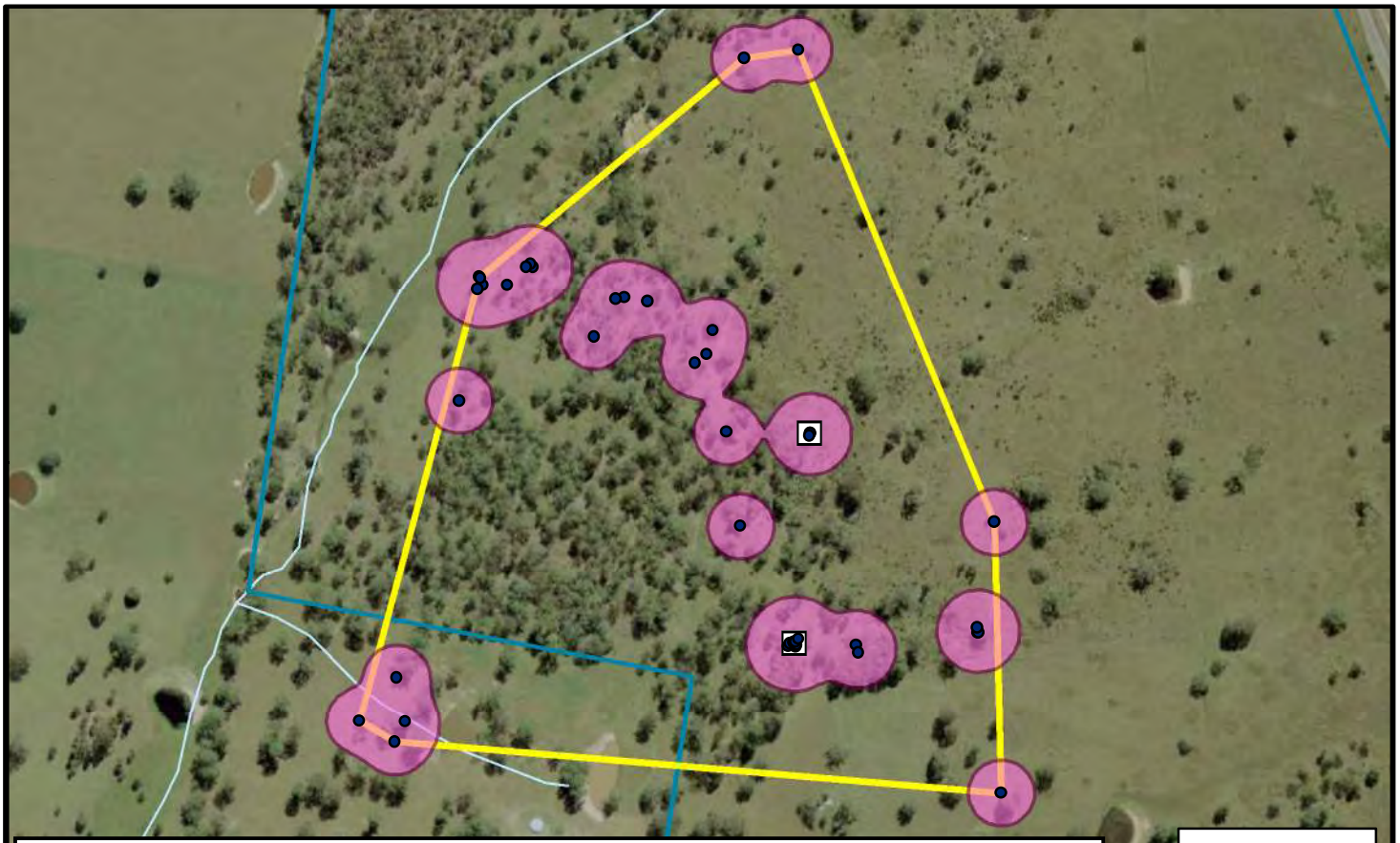
Home Range (Round 2) - Rachel, Rupert & Rodney in Offset Area 1

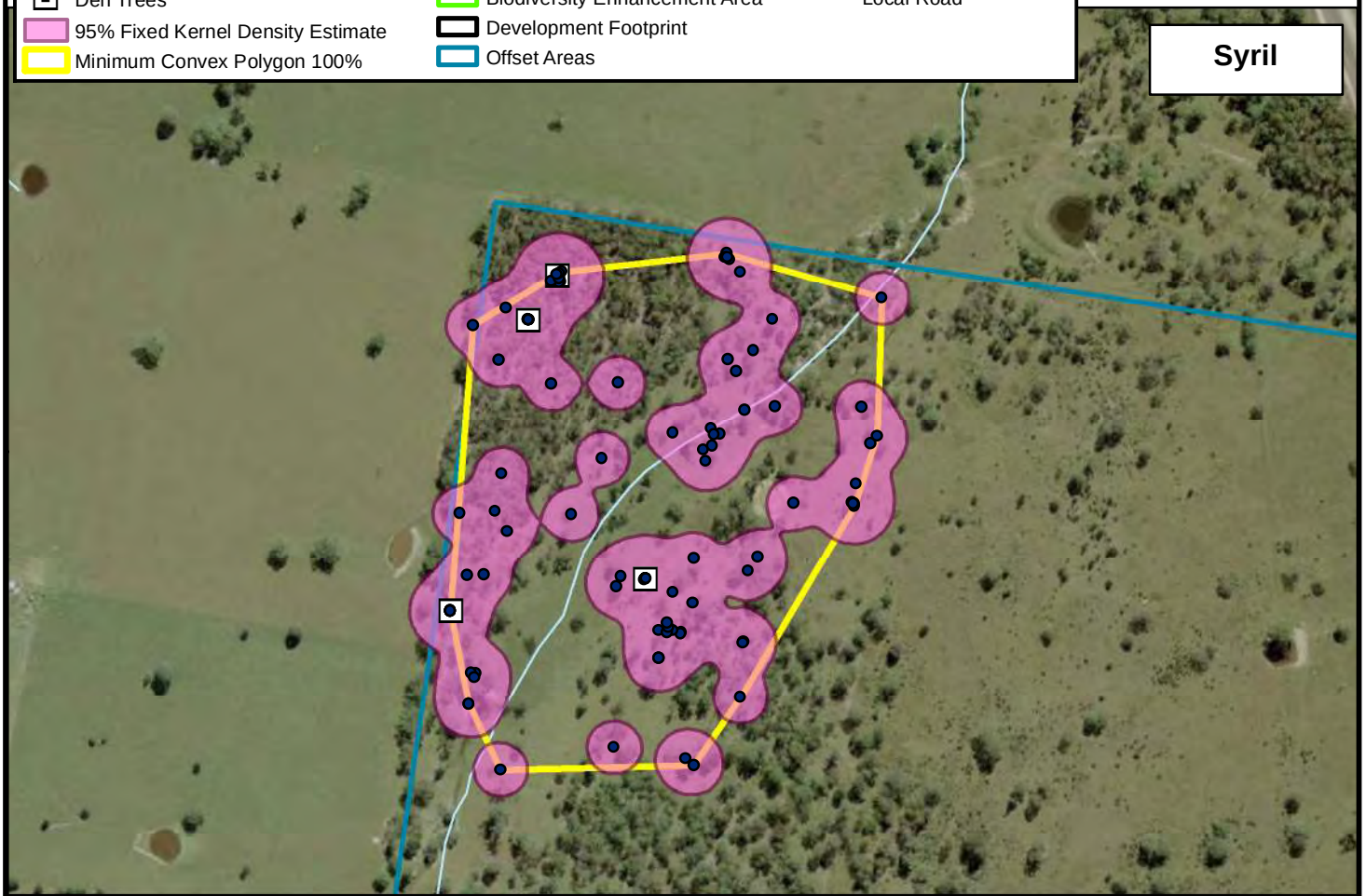
Stratford Coal Ltd
Squirrel Glider Seasonal Home Range Final Report

FIGURE:

14

L:\GIS FOLDER\00 CLIENT FILES\89351_StratfordCoal\20193431_StratfordSquirrelGliderTracking\Mapping\20193431_HomeRangeFINAL_Fig14_RachelRupertRodney.mxd





Legend

- Detections
- Den Trees
- 95% Fixed Kernel Density Estimate
- Minimum Convex Polygon 100%

Stratford Project Areas

- Biodiversity Enhancement Area
- Development Footprint
- Offset Areas

- Unnamed Watercourse
- Local Road

Sharon

Syril

Metres
0 25 50 100 150 200 250

N

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DATA SOURCE:
NSW DFSI - 2019

Home Range (Round 2) -
Sharon & Syril in Offset Area 2

Stratford Coal Ltd
Squirrel Glider Seasonal Home Range Final Report

FIGURE:

15

L:\GIS FOLDER\00 CLIENT FILES\89351_StratfordCoal\20193431_StratfordSquirrelGliderTracking\Mapping\20193431_HomeRangeFINAL_Fig15_SharonSyril.mxd

Legend

- Detections
- Den Trees
- 95% Fixed Kernel Density Estimate
- Minimum Convex Polygon 100%
- Named Watercourse
- Unnamed Watercourse
- Arterial Road
- Local Road
- Track

Stratford Project Areas

- Biodiversity Enhancement Area
- Development Footprint
- Offset Areas

Metres
0 25 50 100 150 200 250

N

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PROJECT REFERENCE: 20193431

DATE DRAWN: 2019/11/20 10:41 Version 3

DRAWN BY: GJoyce

DATA SOURCE:
NSW DFSI - 2019

Home Range (Round 2) - Kate & Kyle in Offset Area 3

Stratford Coal Ltd
Squirrel Glider Seasonal Home Range Final Report

FIGURE:

16

L:\GIS FOLDER\00 CLIENT FILES\89351_StratfordCoal\20193431_StratfordSquirrelGliderTracking\Mapping\20193431_HomeRangeFINAL_Fig16_KateKyle.mxd

3.6 PREDATION OF SQUIRREL GLIDERS DURING STUDY

During the study several gliders were preyed upon, most likely from a powerful owl that was frequently observed in close proximity (<100 m) to collared squirrel gliders (**Plate 6**). In support of this, one collar was also found next to a regurgitated owl pellet (**Plate 7** and **Plate 8**). The owl pellet was analysed in house and found to contain bones which matched the dimensions of squirrel glider bones as detailed in Triggs (2004).

Plate 6: **Powerful owl (*Ninox strenua*) observed within Avon North during radio-tracking.**

Plate 7: **Rupert's collar found next to regurgitated owl pellet that was found to contain squirrel glider bones.**

Plate 8: **Dissected owl pellet with bones corresponding dimensions to that of a squirrel glider.**

4. DISCUSSION

Global biodiversity has been rapidly declining over the past four decades, increasing the need to integrate biodiversity management and conservation into broad-scale land-use planning (Butchart *et al.* 2010, Hoffmann *et al*. 2011, Haddad *et al*. 2015). Identifying the most vulnerable species during the planning process allows measures to be implemented to avoid, mitigate or offset impacts to those species (Gardner 2018). Therefore, detailed knowledge of the ecology such as home range, breeding and foraging requirements of such species is needed to ensure these impacts are addressed appropriately (Beyer and Goldingay 2006, Goldingay *et al.* 2006, Taylor *et al.* 2011, Rogan and Lacher 2018). The current study has identified important areas and habitat elements for the squirrel glider (*Petaurus norfolcensis*) population within the vicinity of SMC.

4.1 REMOTE CAMERA SURVEY

Squirrel gliders were detected at 13.5% of locations surveyed during the remote camera survey. This was found to be an appropriate method to determine areas utilised by gliders, however, squirrel gliders were later confirmed present at some locations (RC26 – Biodiversity Offset 3, RC08 – Biodiversity Enhancement Area, RC09 - Biodiversity Enhancement Area and RC23 – Biodiversity Offset 2) not detected by cameras but identified during trapping.

No squirrel gliders were detected at RC10-RC16 in the Biodiversity Enhancement Area potentially due to the lack of habitat connectivity and lack of hollow-bearing trees. This section of the Biodiversity Enhancement area will eventually be linked to Offset area 3 south through plantings that have been undertaken in 2019 and will be completed in 2020.

4.2 SEASONAL HOME RANGE ESTIMATION

Seasonal home range estimates calculated during this study (MCP100% 11.3 ha ± 2.1 ha, FK95% 3.8 ha ± 0.3 ha) are similar to results reported in Goldingay *et al.* (2010). Goldingay *et al.* (2010) investigated that home range of squirrel gliders at Tea Gardens, NSW and Minnippi Parklands (Brisbane), Qld. The MCP100% estimated was 13.3 ha ± 3.1 ha and FK95% 4.6 ha ± 0.7 ha. This suggests the habitat quality may be lower in this part of the squirrel gliders' geographic range. MCP100% estimations from the Brisbane area (MCP100% 6.7 ha ± 1.5 ha) are almost half the size of estimations calculated for Tea Gardens (MCP100% 13.3 ha ± 3.1 ha) and the current study.

Trying to estimate the size of the home range of a species poses various challenges because individuals should ideally be tracked for a large part of the year to accurately characterise their home range areas (Goldingay 2015). This is difficult for squirrel gliders because the battery life of their radio-collars is approximately 6 months and collars may start to abrade their necks prior to that (R. Goldingay pers. comm.). Capturing gliders multiple times to remove and later reattach collars cannot be done with any reliability. For example, van der Ree and Bennett (2003) attempted this and could only re-collar 22% of 36 individuals. Their tracking periods per individual were on average 2.5 weeks in winter and spring but 5-6 weeks in summer and autumn.

4.3 MANAGEMENT IMPLICATIONS

Determining the seasonal home range of squirrel gliders within the area surrounding the expanding Stratford Mining Complex (SMC) is necessary to provide insights into how the species is utilising space and habitat elements. Knowing where squirrel gliders are, and what microhabitat elements they are using, allows management actions to be taken to reduce impacts on the species within the area and improve habitat through nest box installation and tree planting. The seasonal home range calculated during this study shows that gliders within the Stratford area use at least 11.3 ha ± 2.1 ha and mainly den and forage in within an area of 3.8 ha ± 0.3 ha.

From radio-tracking surveys conducted during the study, maps illustrating the areas used by squirrel gliders and estimates of seasonal home range size were produced. As several gliders (Emma, Eric, Iris, Eddy and Elsie) were observed within or adjacent to the impact area of the Avon North pit expansion, this information has been useful in identifying the most significant foraging and denning habitat for squirrel gliders in the area.

The mean seasonal home range calculated for the squirrel glider in the Stratford area in round 1 was FK95% 3.9 ha ± 0.3 ha and MCP100% 9.7 ha ± 1.6 ha. The FK95% for round two round 2 was 3.6 ha ± 0.3 ha and the MCP100% was 12.8 ha ± 2.1 ha. The FK95% estimate was shown to stabilise around 30 locations compared to the MCP100% estimator which was still unstable at 40 locations.

Important findings from this study indicate that the home range of squirrel gliders do not vary due to survey rounds/seasons, sites or sexes. The finding that home range size did not vary with season suggests that a variety of foraging habitat exists temporally in areas where squirrel gliders were radio-tracked.

It is important to note that the asymptote analysis was only conducted for the gliders that had >40 locations. This was needed to have a large enough sample size to allow resampling of data to conduct the asymptote analysis.

Further studies are required to be conducted concerning the population size of squirrel gliders within the Stratford area. All gliders captured during this study have been fitted with uniquely numbered tag, which should be continued during future trapping programs and nest box inspections to provide insights into the population dynamics and demography. As SMC are required to enhance habitat for the species, knowledge of the current population is needed to determine if enhancement activities are beneficial in the long-term. These baseline population estimates should be conducted prior to the corridor plantings reaching maturity.

4.4 OBSERVED LONG RANGE DISPERSAL

The ability of squirrel gliders to disperse through the landscape was particularly highlighted by one individual (Scarlet) who travelled approximately 5 km from the point of capture within five nights. There have been no published records of squirrel

gliders dispersing to this extent in such a short time frame through fragmented habitat. The closest published long range movement by a squirrel glider was by Crane *et al.* (2010), where a glider was reported to den in a tree 2,249 m away from the den used on the day previous. Crane *et al.* (2017) reported that 75% of squirrel glider nightly movements were within 300 m of their den tree. Sharpe and Goldingay (2007) reported that the maximum distance moved by female gliders was 1,043 ± 181 m. In the same study, the average long axis of squirrel glider home range was 482 ± 40 m. Findings from Sharpe and Goldingay (2007), Crane *et al.* (2017) and the seasonal home ranges calculated in this study suggest that Scarlet was dispersing rather than using the area as part of her home range. As few locations were recorded for Scarlet before she managed to slip free from the collar no home range estimates were calculated for her, hence her movements were omitted from **Table 2**.

4.5 IMPACTS OF LIGHT AND NOISE

Noise and lighting from the Avon North open cut pit appeared to have minimal impact upon denning and foraging behaviours. On several occasions one squirrel glider (Iris) was observed feeding in a flowering stringybark (*Eucalyptus umbra*) directly adjacent to the open cut pit and haul road, with the noise and light coming from haul trucks easily seen and heard. This was an unexpected finding as other studies have found a significant avoidance of light and noise by squirrel gliders (Francis *et al.* 2015). This is a particularly novel finding because flowering trees and denning habitat was available directly to the south of where Iris was sighted. This observation may suggest an adaptive behaviour to light and noise by squirrel gliders. However, this should not be overstated as the long-term effects of atypical light and noise on squirrel glider behaviours may manifest over time (Brearley *et al.* 2010). An alternate reason for Iris denning and feeding close to the mine is that the area to the south was already occupied by gliders that were defensive of their territory (R. Goldingay pers comm.).

4.6 SUGGESTIONS FOR FUTURE RESEARCH

Of the 19 squirrel gliders fitted with radio-transmitting collars during the study, five were suspected to be predated. While the mortality rate was unexpectedly high, further studies on population dynamics within the Stratford area need to be conducted to determine the impact of predation on the local squirrel glider population. It is possible that squirrel gliders fitted with collars are more susceptible to predation, however, this is extremely difficult to confirm as information on the predation rates of gliders without collars is generally unattainable. Comparison to GPS microchips could be considered to determine if collars were adversely affecting the gliders. These microchips were considered and then discarded in the early stages of planning of the project due to a number of factors including lack of positional accuracy when compared to collars, shorter battery life for duration of tracking and the additional stress to the animals with inserting microchips. However in the light of the mortality data, microchips may prove a viable option.

The squirrel gliders tracked during this study were likely predated by a powerful owl (*Ninox strenua*) which had been observed on multiple occasions near the Avon North pit and heard at the nearby township of Craven. Powerful Owls have been observed predating on squirrel gliders in other studies. Traill (1993) documented 40 squirrel gliders taken by a powerful owl over a 2.5 year period.

Introduced/non-native predators such as red fox (*Vulpes vulpes*) and feral cat (*Felis catus*) were observed within the Biodiversity Offset area and Biodiversity Enhancement areas. These species could also impact the local glider population. Further studies on the abundance and distribution of potential predators within these areas may assist in facilitating management actions aimed at reducing negative impacts of these species on local native fauna.

Additionally, several threatened species were recorded opportunistically during the remote camera survey and radio-tracking including; brush-tailed phascogale (*Phascogale tapoatafa*), powerful owl (*Ninox strenua*) and grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis*). As the brush-tailed phascogale was captured on multiple occasions during the survey period it may be possible to include this species in home range studies around SMC if any are planned in the future. This may provide insights into the impact mining has on this species in comparison to other arboreal hollow dependent mammals such as the squirrel glider.

4.7 CONCLUSIONS

The radio-tracking program undertaken on behalf of Stratford Coal identified the presence of squirrel glider colonies in the Avon North Biodiversity Enhancement Area and in Offset Areas 1, 2 and sections of Offset Area 3. These sightings confirmed previous work that had been undertaken and demonstrated that these areas contain sufficient foraging and denning resources to support sustainable glider populations. The mandated revegetation and expansion of the biodiversity enhancement and offsets areas will provide greater habitat for the squirrel glider colonies directly by the revegetation of land used for grazing but equally importantly provide corridors linking the colonies to each other to facilitate population flow and to wooded areas currently inaccessible to the gliders. Incidental sightings of other species such as the powerful owl and the brush-tailed phascogale highlight the importance of these offset areas and their ongoing maintenance and expansion.

5. REFERENCES

Beyer, G. L., and R. L. Goldingay. 2006. The value of nest boxes in the research and management of Australian hollow-using arboreal marsupials. Wildlife Research **33**:161-174.

Brearley, G., A. Bradley, S. Bell, and C. McAlpine. 2010. Influence of contrasting urban edges on the abundance of arboreal mammals: A study of squirrel gliders (*Petaurus norfolcensis*) in southeast Queensland, Australia. Biological Conservation **143**:60-71.

Brearley, G., A. Bradley, S. Bell, and C. McAlpine. 2011. Change in habitat resources and structure near urban edges and its influence on the squirrel glider (*Petaurus norfolcensis*) in southeast Queensland, Australia. Austral Ecology **36**:425-432.

Burt, W. H. 1943. Territoriality and Home Range Concepts as Applied to Mammals. Journal of Mammalogy **24**:346-352.

Butchart, S. H. M., M. Walpole, B. Collen, A. van Strien, J. P. W. Scharlemann, R. E. A. Almond, J. E. M. Baillie, B. Bomhard, C. Brown, J. Bruno, K. E. Carpenter, G. M. Carr, J. Chanson, A. M. Chenery, J. Csirke, N. C. Davidson, F. Dentener, M. Foster, A. Galli, J. N. Galloway, P. Genovesi, R. D. Gregory, M. Hockings, V. Kapos, J.-F. Lamarque, F. Leverington, J. Loh, M. A. McGeoch, L. McRae, A. Minasyan, M. H. Morcillo, T. E. E. Oldfield, D. Pauly, S. Quader, C. Revenga, J. R. Sauer, B. Skolnik, D. Spear, D. Stanwell-Smith, S. N. Stuart, A. Symes, M. Tierney, T. D. Tyrrell, J.-C. Vié, and R. Watson. 2010. Global Biodiversity: Indicators of Recent Declines. Science **328**:1164.

Crane, M. J., D. B. Lindenmayer, and S. C. Banks. 2017. Conserving and restoring endangered southern populations of the Squirrel Glider (*Petasurus norfolcensis*) in agricultural landscapes. Ecological Management & Restoration **18**:15-25.

Crane, M. J., D. B. Lindenmayer, and R. B. Cunningham. 2010. The use of den trees by the squirrel glider (*Petaurus norfolcensis*) in temperate Australian woodlands. Australian Journal of Zoology **58**:39-49.

Crane, M. J., M.-D. R. M., R. B. Cunningham, and D. B. Lindenmayer. 2008. The characteristics of den trees used by the squirrel glider (*Petasurus norfolcensis*) in temperate Australian woodlands. Wildlife Research **35**:663-675.

Diete, R. L., P. D. Meek, K. M. Dixon, C. R. Dickman, and L. K.-P. Leung. 2016. Best bait for your buck: bait preference for camera trapping north Australian mammals. Australian Journal of Zoology **63**:376-382.

Dressler, F., S. Ripperger, M. Hierold, T. Nowak, C. Eibel, B. Cassens, F. Mayer, K. Meyer-Wegener, and A. Kolpin. 2016. From radio telemetry to ultra-low-power sensor networks: tracking bats in the wild. IEEE Communications Magazine **54**:129-135.

Dwyer, R. G., C. Brooking, W. Brimblecombe, H. A. Campbell, J. Hunter, M. Watts, and C. E. Franklin. 2015. An open Web-based system for the analysis and sharing of animal tracking data. Animal Biotelemetry **3**:1.

Francis, M. J., P. G. Spooner, and A. Matthews. 2015. The influence of urban encroachment on squirrel gliders (*Petaurus norfolcensis*): effects of road density, light and noise pollution. Wildlife Research **42**:324-333.

Gardner, R. C. 2018. Avoid-Mitigate-Compensate Sequence: Wetland Conservation. Pages 869-872 *in* C. M. Finlayson, M. Everard, K. Irvine, R. J. McInnes, B. A. Middleton, A. A. van Dam, and N. C. Davidson, editors. The Wetland Book: I: Structure and Function, Management, and Methods. Springer Netherlands, Dordrecht.

Goldingay, R., D. Sharpe, and M. Dobson. 2010. Variation in the home-range size of the squirrel glider (*Petasurus norfolcensis*). Australian Mammalogy **32**:183-188.

Goldingay, R. L. 2015. A review of home-range studies on Australian terrestrial vertebrates: adequacy of studies, testing of hypotheses, and relevance to conservation and international studies. Australian Journal of Zoology **63**:136-146.

Goldingay, R. L. 2018. Population monitoring of an urban gliding mammal in eastern Australia. Australian Mammalogy **40**.

Goldingay, R. L., D. J. Sharpe, G. L. Beyer, and M. Dobson. 2006. Using ecological studies to understand the conservation needs of the squirrel glider in Brisbane's urban forest-remnants. Australian Mammalogy **28**:173-186.

Haddad, N. M., L. A. Brudvig, J. Clobert, K. F. Davies, A. Gonzalez, R. D. Holt, T. E. Lovejoy, J. O. Sexton, M. P. Austin, C. D. Collins, W. M. Cook, E. I. Damschen, R. M. Ewers, B. L. Foster, C. N. Jenkins, A. J. King, W. F. Laurance, D. J. Levey, C. R. Margules, B. A. Melbourne, A. O. Nicholls, J. L. Orrock, D.-X. Song, and J. R. Townshend. 2015. Habitat fragmentation and its lasting impact on Earth's ecosystems. Science Advances **1**:e1500052.

Harris, S., W. Cresswell, P. Forde, W. Trewhella, T. Woollard, and S. Wray. 1990. Home-range analysis using radio-tracking data–a review of problems and techniques particularly as applied to the study of mammals. Mammal review **20**:97-123.

Hoffmann, M., J. L. Belant, J. S. Chanson, N. A. Cox, J. Lamoreux, A. S. L. Rodrigues, J. Schipper, and S. N. Stuart. 2011. The changing fates of the world's mammals. Philosophical Transactions of the Royal Society B: Biological Sciences **366**:2598.

Kleinfelder. 2019. Initial Squirrel Glider survey as part of Stratford Coal's Squirrel Glider Management Plan.

Körtner, G., A. Trachtenberg, and F. Geiser. 2019. Does aridity affect spatial ecology? Scaling of home range size in small carnivorous marsupials. The Science of Nature **106**:42.

Laver, P. N., and M. J. Kelly. 2008. A Critical Review of Home Range Studies. The Journal of Wildlife Management **72**:290-298.

Powell, R. A., J. W. Zimmerman, and D. E. Seaman. 1997. Ecology and behaviour of North American black bears : home ranges, habitat, and social organization. Chapman & Hall, London; New York.

Quin, D. 1995. Population ecology of the squirrel glider (*Petaurus norfolcensis*) and the sugar glider (*P. breviceps*) (Maruspialia : Petauridae) at Limeburners Creek, on the central north coast of New South Wales Wildlife Research **22**:471-505.

Rogan, J. E., and T. E. Lacher. 2018. Impacts of Habitat Loss and Fragmentation on Terrestrial Biodiversity. Reference Module in Earth Systems and Environmental Sciences. Elsevier.

Seaman, D. E., and R. A. Powell. 1996. An Evaluation of the Accuracy of Kernel Density Estimators for Home Range Analysis. Ecology **77**:2075-2085.

Sharpe, D., and R. Goldingay. 2007. Home range of the australian squirrel glider, *Petaurus norfolcensis* (diprotodontia). Journal of Mammalogy **88**:1515-1522.

Suckling, G. C. 1984. Population Ecology of the Sugar Glider, Petaurus breviceps, in a System of Fragmented Habitats. Wildlife Research **11**:49-75.

Taylor, A. C., F. M. Walker, R. L. Goldingay, T. Ball, and R. van der Ree. 2011. Degree of landscape fragmentation influences genetic isolation among populations of a gliding mammal. PLOS ONE **6**:e26651-e26651.

Traill, B. 1993. The diet and movements of a pair of Powerful Owls *Ninox strenua* in dry eucalypt forest. Australian Raptor Studies'.(Ed. P. Olsen.) pp:155-159.

Triggs, B. 2004. Tracks, scats, and other traces : a field guide to Australian mammals / Barbara Triggs. Oxford University Press, South Melbourne, Vic.

van der Ree, R., and A. F. Bennett. 2003. Home range of the squirrel glider (*Petaurus norfolcensis*) in a network of remnant linear habitats. Journal of Zoology **259**:327-336.

APPENDIX 1. SQUIRREL GLIDER DETAILS

Table 1: Details of all gliders trapped during survey.

Number	Area	Name	Age Category	Sex M/F	Date of capture	Left Ear #	Right Ear #	Glider weight	HB	Tail
1	Offset 2	Syril	2-3 years	F	30/01/19	528	504	193	18	26
2	Offset 2	Scarlet	1-2 years	F	31/01/19	517	506	157	17.5	26
3	Offset 2	Stella	>3 years	F	31/01/19	526	527	211	20	26.5
4	Offset 2	Sharon	2-3 years	F	1/02/19	553	561	245	18	25
5	Offset 1	Ruby	2-3 years	F	2/02/19	538	556	220	20	23.5
6	Avon North	Eric	1-2 years	M	3/02/19	511	563	238	20	27
7	Avon North	Emma	1-2 years	F	4/02/19	542	516	161	17.5	26
8	Offset 1	Rachel	>3 years	F	4/02/19	502	560	165	20	25.5
9	Offset 2	Stuie	1-2 years	M	4/02/19	518	545	187	20	28
10	Offset 1	Rose	>3 years	F	5/02/19	501	521	170	19	26.5
11	Offset 1	Russel	>3 years	M	5/02/19	539	555	226	20.5	25.5
12	Offset 1	Rupert	1-2 years	M	6/02/19	508	579	167	18.5	25
13	Offset 3	Kate	1-2 years	F	7/02/19	544	551	248	21	26
14	Offset 2	Steve	1-2 years	M	7/02/19	576	533	130	17	27.5
15	Offset 3	Kevin	1-2 years	M	8/02/19	543	507	230	24	25.5
16	Offset 3	Kathleen	1-2 years	F	26/03/19	547	-	210	-	-
17	Offset 1	Ronald	>3 years	M	29/03/19	569	-	245	-	-
18	Offset 3	Kyle	1-2 years	M	30/03/19	550	-	220	-	-
19	Offset 1	Ralph	>3 years	M	2/04/19	599	-	241	-	-
20	Offset 1	Renee	1-2 years	F	4/04/19	597	-	172	-	-

Number	Area	Name	Age Category	Sex M/F	Date of capture	Left Ear #	Right Ear #	Glider weight	HB	Tail
21	Offset 1	Roxy	2-3 years	F	5/04/19	537	-	205	-	-
22	Offset 3	Kirsten	2-3 years	F	4/05/19	548	-	192	-	-
23	Offset 1	Robert	>3 years	M	4/05/19	519	-	285	-	-
24	Offset 2	Sterling	1-2 years	M	15/07/19	558	-	233	19	26
25	Offset 2	Suzy	1-2 years	F	15/07/19	549	-	178	21	27
26	Avon North	Elsie	1-2 years	F	19/07/19	571	522	173	18	23
27	Avon North	Eddy	>3 years	M	21/07/19	566	559	258	22	28
28	Avon North	Iris	1-2 years	F	21/07/19	580	582	180	17	24
29	Offset 1	Rebecca	1-2 years	F	24/07/19	552	-	173	19	24.5
30	Offset 1	Reece	>3 years	M	24/07/19	523	-	258	21	27
31	Offset 1	Roni	1-2 years	F	24/07/19	529	-	193	20	26
32	Offset 1	Ruban	1-2 years	M	24/07/19	534	-	203	19	25
33	Offset 1	Rihanna	1-2 years	F	24/07/19	595	-	228	18	25.5
34	Offset 1	Riley	2-3 years	M	24/07/19	515	-	232	17	25.5
35	Offset 1	Rodney	>3 years	M	24/07/19	505	581	238	19.5	25.5
36	Offset 2	Shane	>3 years	M	5/09/19	583	-	245	32	213

APPENDIX 2. STAFF CONTRIBUTIONS

The following staff were involved in the compilation of this report.

Name	Qualification	Title/Experience	Contribution
Luke O'Brien	BEnvSc&Mgmt	Ecologist	Fieldwork, Report writing
Mark Dean	BEnvSc&Mgt	Ecologist	Fieldwork
Ben Stewart	MMarSc&Mgt	Ecologist	Fieldwork
Gayle Joyce	BSc (Forestry) (Hons)	GIS Specialist	GIS and Mapping
Nigel Fisher	BSc (Hons) PhD	Restoration Ecologist	Project Management, Fieldwork, Report Review
Dan O'Brien	BEnvSc&Mgt (Hons)	Ecologist	Report Review

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2019 Stratford Mining Complex Hollow-bearing Tree Census Report

Yancoal Pty Ltd

Stratford Coal Pty Ltd
3364 Buckett's Way, Stratford, NSW 2422

17 December 2019

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EXECUTIVE SUMMARY

Condition 38(b), Schedule 3 of Development Consent SSD-4966 requires the implementation of a Squirrel Glider Management Plan which includes a census of suitable tree hollows in home ranges and biodiversity offset areas suitable for squirrel gliders (Petaurus norfolcensis). This information will be used to inform the installation of nest boxes within the Biodiversity Offset Areas and Biodiversity Enhancement Areas of Stratford Mining Complex (SMC).

Radio-tracking and home range estimations was undertaken to comply with the requirement outlined in section 4.2 of the Squirrel Glider Management Plan (SGMP) (Stratford Coal 2018, Kleinfelder 2019). The areas identified to form part of a squirrel gliders home range were then used as study sites for the hollow-bearing tree census as required by Section 7.1 of the SGMP.

The hollow-bearing tree census identified and mapped 480 hollow-bearing trees which contained a combined total of 648 hollows. Attributes of available hollows and known den hollows were compared to investigate the hollow preferences of squirrel gliders. The results indicated that hollow entrance size (area and width of hollow opening) was the most important factors in determining whether a hollow would be selected as a den by a squirrel glider (hollow opening $\chi^2 = 49.7$, $df = 1$, $p < 0.0001$, width of hollow opening $\chi^2 = 28.5$, $df = 1$, $p < 0.0001$). Tree species was not a determining factor with seven species being used for dens. Stags and Eucalyptus siderophloia (Grey Ironbark) (33% each) were the most commonly used den species.

Direct comparison of the density of hollow-bearing trees recorded in the biodiversity enhancement and offsets areas vegetation community benchmark data for the relevant vegetation type shows that the two major vegetation communities at the SMC were found to contain significantly lower densities of hollow-bearing trees. The Spotted Gum - Grey Ironbark dry open forest of the lower foothills of the Barrington Tops, North Coast benchmark data recorded a value of 12 hollow-bearing trees per hectare and the Cabbage Gum open forest or woodland on flats of the North Coast and New England Tablelands records 30 hollow-bearing trees per hectare. This compares with a maximum of 3.0 and 3.2 hollow-bearing trees per hectare respectively and usually fewer depending on the study area.

Once the squirrel glider food resources have been mapped as outlined in section 6.1 of the SGMP, information provided in this report can be used to identify areas best suited for nest

box installation. Nest boxes will be best situated in areas currently lacking tree hollows but have an adequate number of food resources.

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1. INTRODUCTION

Stratford Coal Pty Ltd (SCPL) is a wholly owned subsidiary of Yancoal Australia Ltd and operates the Stratford Mining Complex (SMC). The SMC is located between the small towns of Craven and Stratford on the Buckett's Way, approximately 100km north of Newcastle (**Figure 1**).

On 29 May 2015, the NSW Planning Assessment Commission approved the Stratford Extension Project (SEP). The SEP provides for the continuation of mining and processing at the SMC for an additional 11 years. The SMC operates under two key approvals, NSW Development Consent (SSD-4966) and the Commonwealth Approval (EPBC 2011/6176). Both may be viewed at http://www.stratfordcoal.com.au.

In accordance with Condition 38, Schedule 3 of the Development Consent SSD-4966, the Stratford Mining Complex (Stratford Extension Project) – Squirrel Glider Management Plan (SGMP) (2018) has been prepared to facilitate the management of squirrel gliders at the SMC, Biodiversity Enhancement Areas and Biodiversity Offset Areas. The SGMP has been prepared for a three-year period between July 2018 and July 2021 and includes broader concepts for the longer term (6+ years). Objectives outlined in section 7.1 of the SGMP requires a census of suitable tree hollows in home ranges identified by the radio-tracking program conducted by Kleinfelder (2019).

1.1 SCOPE AND RATIONALE

Kleinfelder Australia was commissioned by SCPL to conduct a hollow-bearing tree census within the Biodiversity Enhancement Area and Biodiversity Offset Area to ensure compliance with the above stated objectives. The ground-based hollow-bearing tree census was conducted in areas known to form part of the local squirrel glider populations home range. The findings of the hollow-bearing tree census and appropriate recommendations are provided in this report.

2. METHODS

2.1 LITERATURE REVIEW

A literature review was conducted to gather information concerning the use of tree-hollows by hollow-dependent fauna. Legislation, policy and strategy relating to the conservation of threatened species also formed part of the literature review.

2.2 STUDY SITE

The study site included the areas of known squirrel glider home ranges and consists of biodiversity offset areas 1, 2 and 3 and a section of the biodiversity enhancement area located adjacent to the expanding Avon North open cut pit (**Figure 1**). The study site and area surrounding SMC are predominantly undulating agricultural land to the west, south and north. Some patches of woodland/forest exist within the landscape, varying in size and connectivity to large expanses of bushland. To the east of the study site lies a dry open forest that extends on a steeply undulating range running north - south.

The biodiversity offset and enhancement areas are shown in **Figure 1.** The hollow tree census study site comprised the following vegetation types:

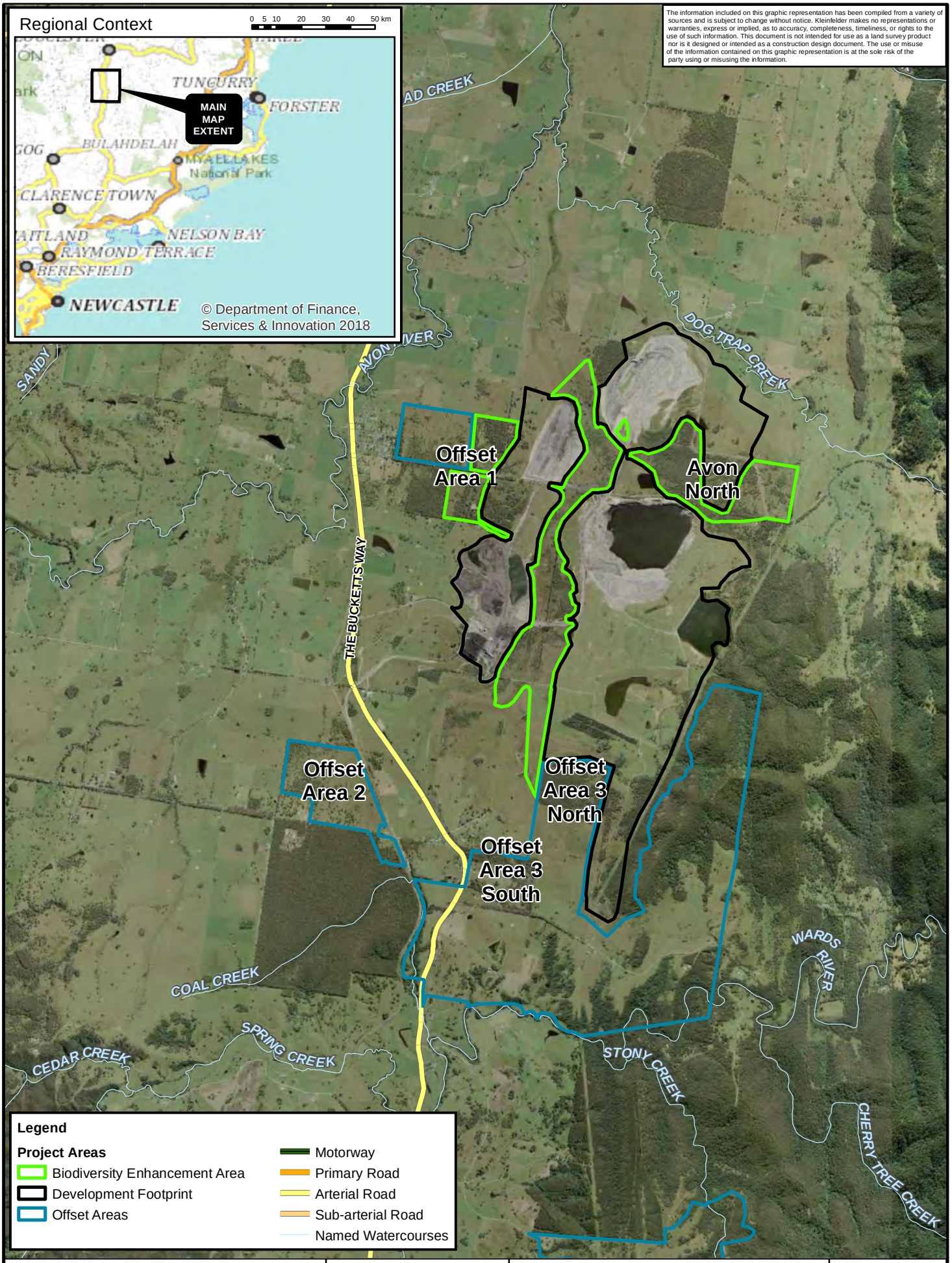
Biodiversity Enhancement Area (Avon North) 110 ha. Avon North is comprised of: Cabbage Gum open forest or woodland on flats of the North Coast and New England Tablelands (23 ha), Spotted Gum - Grey Ironbark dry open forest of the Barrington Tops, North Coast (84 ha) and exotic grassland (7 ha).

Offset Area 1 – 40 ha total. This area is comprised of: *Eucalyptus amplifolia* (Cabbage Gum) open forest or woodland on flats of the North Coast and New England Tablelands (HU526) (7 ha), *Corymbia maculata* (Spotted Gum) - *Eucalyptus paniculata* (grey ironbark) dry open forest of the Barrington Tops, North Coast (HU630) (9 ha) and exotic grassland (24 ha).

Offset Area 2 – 70 ha total. This area is comprised of: *Eucalyptus amplifolia* (Cabbage Gum) open forest or woodland on flats of the North Coast and New England Tablelands (3.5 ha),

Spotted Gum – Grey Ironbark dry open forest of the Barrington Tops, North Coast (21 ha) and exotic grassland (45.5 ha).

Offset Area 3 (north and south) – 655 ha total. Of the total area approximately 85 ha was surveyed during this study. The main vegetation types include: Cabbage Gum open forest or woodland on flats of the North Coast and New England Tablelands (15.5 ha), Spotted Gum - Grey Ironbark dry open forest of the Barrington Tops, North Coast (12.5 ha) and exotic grassland (57 ha).



PROJECT REFERENCE: 20200723

DATE DRAWN: 2019/11/22 15:40 Version 1

DRAWN BY: GJoyce

DATA SOURCE: NSW DFSI - 2019

Locality

Stratford Coal Ltd
Hollow-bearing Tree Census

FIGURE: 1

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2.3 ATTRIBUTES OF SQUIRREL GLIDER DEN TREES

As part of the radio-tracking survey conducted by Kleinfelder (2019), diurnal squirrel glider dens were located from one to seven times per week for each individual glider during two discrete tracking periods. The first tracking period was between 30 January 2019 and 3 April 2019, and the second tracking period was between 7 July and 1 September 2019.

Several attributes that may influence squirrel glider den selection were recorded to allow comparisons to other published studies. Recorded den attributes were similar to that of Crane *et al*. (2008), and included: location, tree species and DBH (Diameter at Breast Height), tree and den height, den opening length, width and aspect, den category. Den/hollow category was separated into three types according to the location or structure of the hollow within the tree: Branch hollow, trunk hollow, fissure/crack. Locations were recorded with an iPad® and Garmin-Glo®, tree and den height were measured using an inclinometer, den width and length were measured with a tape measure if accessible or estimated from the ground if inaccessible. Den aspect was taken with a compass and recorded as one of eight compass points or upright. Photographs were also taken of each identified den tree.

2.4 HOLLOW-BEARING TREE CENSUS

The hollow bearing tree census was conducted within known squirrel glider habitat, identified by previous records and locations recorded in Kleinfelder (2019). To ensure the study area was surveyed thoroughly transects spaced at 15 m intervals were overlaid on a satellite image of the Stratford area using ArcGIS® (Esri, California) and uploaded onto an iPad® linked with a Garmin-Glo®. Transects were then walked on foot along either the horizontal (east-west) or vertical (north-south) grid lines. Open areas of grass land containing isolated patches or singular trees were surveyed by targeting the isolated patches or singular trees instead of unnecessarily walking the grid lines.

Hollow-bearing tree attributes were observed from the ground and recorded on the iPad®. The attributes recorded for hollow-bearing trees were the same recorded for squirrel glider den trees listed in section 2.3. A hollow was recorded if it appeared to have a depth >10 cm and an opening > 2cm. Multiple logistic regression was used to compare attributes of known dens to available hollows.

3. RESULTS

3.1 DEN TREE IDENTIFICATION

A total of 29 den trees consisting of seven species were recorded during the two radio-tracking periods with three gliders occasionally sharing. The average number of dens used by each squirrel glider was 1.9 ± 0.2 (over an average of 46 ± 3.6 days). Dens in *Eucalyptus siderophloia* (Grey Ironbark) and stags (dead standing trees) were equally the most common tree species used by squirrel gliders for denning (*E. siderophloia* n = 11, 33% and stags n = 11, 33%). Other den trees included *Eucalyptus umbra* (Broad-leaved white mahogany) (n = 5, 15%), *Angophora floribunda* (Rough-barked Apple) (n = 2, 6%), *Eucalyptus moluccana* (Grey Box) (n = 2, 6%), *Eucalyptus amplifolia* (Cabbage Gum) (n = 1, 3%) and *Eucalyptus tereticornis* (Forest Red Gum) (n = 1, 3%). A summary of den tree attributes is detailed in **Table 1**. The most common aspect of known squirrel glider dens was upright (26%) followed by north-east (16%) (**Figure 2**).

Table 1: Summary of known den attributes and attributes of hollow bearing trees

Attribute	Mean ± Std Err	Range
known den tree attributes		
Tree Height (m)	18.8 ±1 .4	3 - 34
Den Height (m)	7.7 ± 1.1	1.2 - 28
Den opening width (cm)	6.2 ± 0.6	3 - 17
Den opening length (cm)	12.7 ± 3.4	4 - 100
Den opening area (cm²)	71.8 ± 17.3	18 - 500
DBH (cm)	63.6 ± 3.8	24 - 102
Dieback %	42.6 ± 7.9	0 - 100
Total no. of visible hollows	1.6 ± 0.2	1 - 3
hollow attributes gathered during hollow bearing tree census		
Hollow Height (m)	8.2 ± 0.2	1 - 25
Hollow opening width (cm)	13.7 ± 0.56	3 - 100
Hollow opening length (cm)	25.6 ± 2.0	3 - 400
Hollow opening area (cm²)	548.6 ± 56.6	12.7 - 3910
DBH (cm)	73.82 ± 1.4	10 - 200
Total no. of visible hollows	1.4 ± 0.9	1 - 8

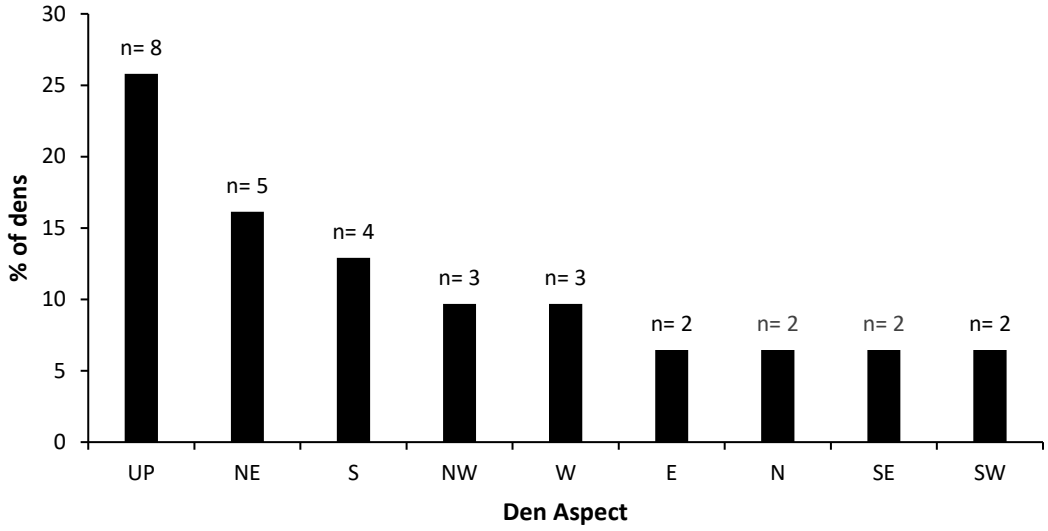


Figure 2: **Aspect of known dens chosen by individual squirrel gliders (n=31). X-axis labelled with each of eight compass points and UP representing hollows with a vertical aspect.**

3.2 HOLLOW BEARING TREE CENSUS

During the hollow bearing tree census a total of 480 hollow bearing trees were identified containing a total of 648 hollows (**Figure 6** - **Figure 10**). Hollows were found in 13 tree species including stags. Stags were the most common tree species to contain hollows (37%) followed by *Eucalyptus umbra* (Broad-leaved white mahogany) (25%) (**Figure 3**). A breakdown of the number of hollows, trees, presumed suitability for gliders and offsets area are detailed in **Table 2**.

3.2.1 Biodiversity Enhancement Area (Avon North)

From **Table 2** it can be seen that the Avon North area recorded the greatest number of hollows (276) and hollow-bearing trees (201). This area was the largest of the areas surveyed for hollows and therefore it is not an unexpected result. As part of the Avon North extension, 26 squirrel-glider (SG) suitable or possibly suitable and eight non SQ suitable hollows will be removed. There were four native woodland/forest communities plus derived grasslands identified in this area. The Smooth-barked Apple – White Stringybark woodland recorded the lowest density of hollows with 0.59 hollows/ha with only two trees containing two SG suitable

hollows (**Table 2**). The Cabbage Gum open forest recorded 68 hollow-bearing trees which contained 69 SG suitable hollows and 35 other hollows at a total density of 4.51 hollows/ha. The Grey Ironbark – Spotted Gum – Grey Box woodland recorded 90 hollow-bearing trees which contained 90 SG suitable and 23 other hollows at a total density of 3.3 hollows/ha. The Spotted Gum – Grey Ironbark open forest recorded 35 hollow-bearing trees which contained 35 SG suitable and eight other hollows. The derived grasslands and paddock trees had eight hollow-bearing trees with 10 SG suitable and two other hollows and were not included on the above density calculations.

3.2.1 Offset Area 1

This offset area recorded a total of 74 trees bearing 124 hollows (**Table 2**). These were distributed between two native woodland communities and two belts of planted trees (**Figure 6**). The Cabbage Gum open forest recorded 18 hollow-bearing trees which contained 28 SG suitable and three other hollows for a total density of 3.48 hollows/ha. The Grey Ironbark – Spotted Gum – Grey Box woodland recorded 38 hollow-bearing trees which had 48 SG suitable and one other hollow for a total density of 2.88 hollows/ha. The planted tree belts had three hollow-bearing trees with four SG suitable hollows at a density of 1.09 hollows/ha (**Table 2**). This offset area has a comparatively large number of trees (15) containing 33 hollows that were not included in the above density calculations. These trees and hollows were either in the derived grassland areas – paddock trees – or were in the adjacent roadside reserves.

3.2.2 Offset Area 2

Offset Area 2 recorded 59 trees bearing 76 hollows (**Table 2**). There were two native woodland communities mapped in this area (**Figure 8**). These were Grey Ironbark – Spotted Gum – Grey Box woodland with a hollow density of 2.23 hollows/ha and the Forest Red Gum – Broad-leaved Apple woodland 0.57 hollows/ha. A large proportion of this area is derived grassland and scattered paddock trees with nine trees and twelve hollows that were not included in the above density calculations.

3.2.3 Offset Area 3 North

Offset Area 3 North recorded a total of 84 hollow-bearing trees containing 103 hollows. There were two main native woodland/forest communities mapped in this area (**Figure 9**). The Grey Ironbark – Spotted Gum – Grey Box woodland recorded a total of 93 hollows (78 SG suitable and 15 others) at density of 4.00 hollows/ha. The Cabbage Gum open forest recorded a total 10 hollows (7 SG suitable and 3 others) at a density of 0.96 hollows/ha (**Table 2**). There were small areas within this offset that were either mapped as derived grassland or *Acacia* regeneration, but these minor areas did not contain hollow-bearing trees.

3.2.4 Offset Area 3 South

This offset area recorded a total of 62 hollow-bearing trees containing a total of 72 hollows (**Table 2**), situated in three vegetation communities. The Grey Ironbark – Spotted Gum – Grey Box woodland recorded 46 hollow-bearing trees with 54 SG suitable and four other hollows at a total density of 3.94 hollows/ha. The Cabbage Gun open forest recorded a total of 13 hollow-bearing trees with 13 SG suitable hollows and one other hollow at a total density of 1.33 hollows/ha. The derived grasslands recorded three trees with six hollows deemed SG suitable and one other hollow.

Table 2: Hollow-bearing tree and hollow density per hectare by vegetation community and biodiversity enhancement/offset area.

Offset/ Biodiversity Area	Vegetation Community	Area (ha)	Squirrel Glider Suitable Hollows			Density of SG Suitable Hollows (Hollows/ha)	Total Other Hollows	Density of Other Hollows (Hollows/ha)	Total Hollows	Density of all hollows (Hollows/ha)	Total Hollow-bearing trees	Density of Hollow-bearing Trees (Trees/ha)
			Definite	Possible	Total							
Biodiversity Enhancement Area (Avon North)	Cabbage Gum open forest or woodland on flats of the North Coast and New England Table Lands	23.0	23	46	69	3.0	35	1.5	104	4.5	68	3.0
	Grey Ironbark - Spotted Gum - Grey Box	34.3	47	43	90	2.6	23	0.7	113	3.3	88	2.6
	Smooth-barked Apple - White Stringybark Shrubby Forest	3.4	1	1	2	0.6	0	0.0	2	0.6	2	0.6
	Spotted Gum - Grey Ironbark dry open forest of the lower foothills of the Barrington Tops, Nth Coast	19.7	15	20	35	1.8	8	0.5	47	2.4	35	1.8
	Derived Grasslands/Paddock Trees		5	5	10		1		11		8	
	Totals	**80.4**	**91**	**115**	**206**		**67**		**273**		**201**	
Offset Area 1	Cabbage Gum open forest or woodland on flats of the North Coast and New England Table Lands	8.9	10	17	27	3.0	3	0.3	31	3.5	18	2.0
	Grey Ironbark - Spotted Gum - Grey Box	17.0	31	18	49	2.9	1	0.1	49	2.9	38	2.2
	Planted Trees	3.7	2	2	4	1.1	0	0.0	4	1.1	3	0.8
	Derived Grasslands/Outside Communities		16	16	32		1		33		15	
	Totals	**29.6**	**59**	**53**	**112**		**5**		**117**		**74**	
Offset Area 2	Grey Ironbark - Spotted Gum - Grey Box	17.1	21	34	55	3.2	7	0.4	62	3.6	48	2.8
	Cabbage Gum open forest or woodland on flats of the North Coast and New England Table Lands	3.5	1	1	2	0.6	0	0.0	2	0.6	2	0.6
	Derived Grasslands/Outside Communities		3	7	10		2		12		9	
	Totals	**20.6**	**25**	**42**	**67**		**9**		**76**		**59**	
Offset Area 3 (North)	Acacia Regeneration	0.3	0	0	0	0.0	0	0.0	0	0.0	0	
	Cabbage Gum open forest or woodland on flats of the North Coast and New England Table Lands	10.4	4	3	7	0.7	3	0.3	10	1.0	9	0.9
	Grey Ironbark - Spotted Gum - Grey Box	23.3	35	43	78	3.4	15	0.6	93	4.0	75	3.2
	Totals	**33.9**	**39**	**46**	**85**		**18**		**103**		**84**	
Offset Area 3 (South)	Cabbage Gum open forest or woodland on flats of the North Coast and New England Table Lands	10.5	4	9	13	1.2	1	0.1	14	1.3	13	1.2
	Grey Ironbark - Spotted Gum - Grey Box	14.7	17	37	54	3.7	4	0.3	58	3.9	46	3.1
	Derived Grasslands/Outside Communities		3	3	6		1		7		3	
	Totals	**25.2**	**24**	**49**	**73**		**6**		**79**		**62**	
Grand Totals			**238**	**305**	**543**		**105**		**648**		**480**	

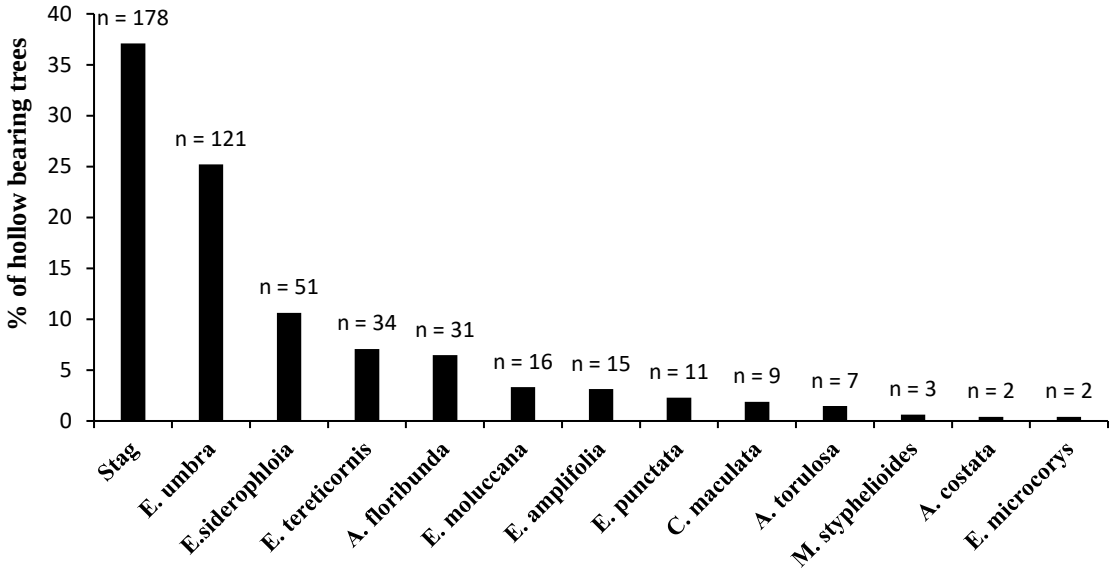


Figure 3: **Percentage of hollow bearing trees recorded grouped by species (total of 480 hollow bearing trees).**

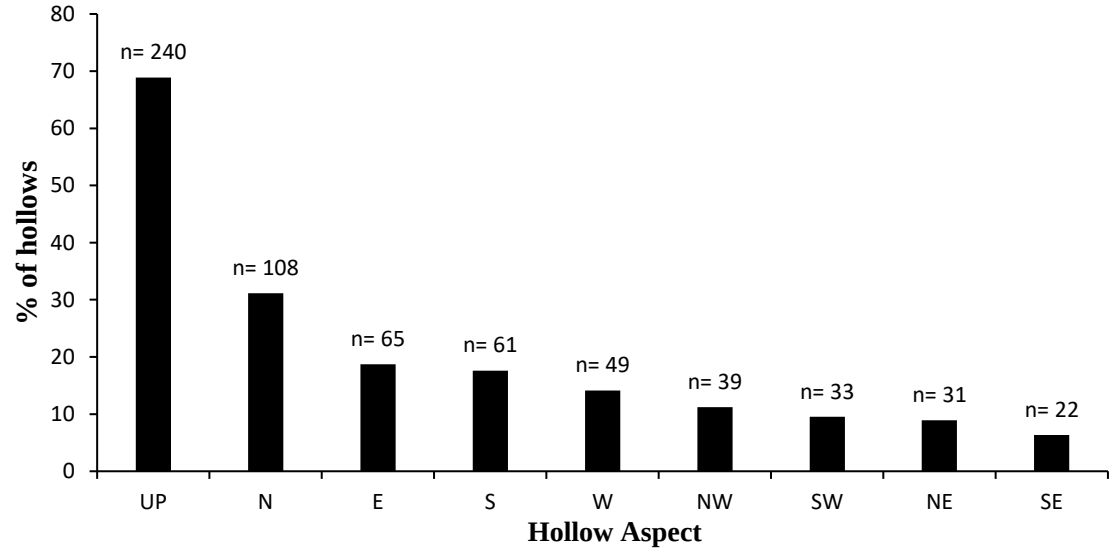
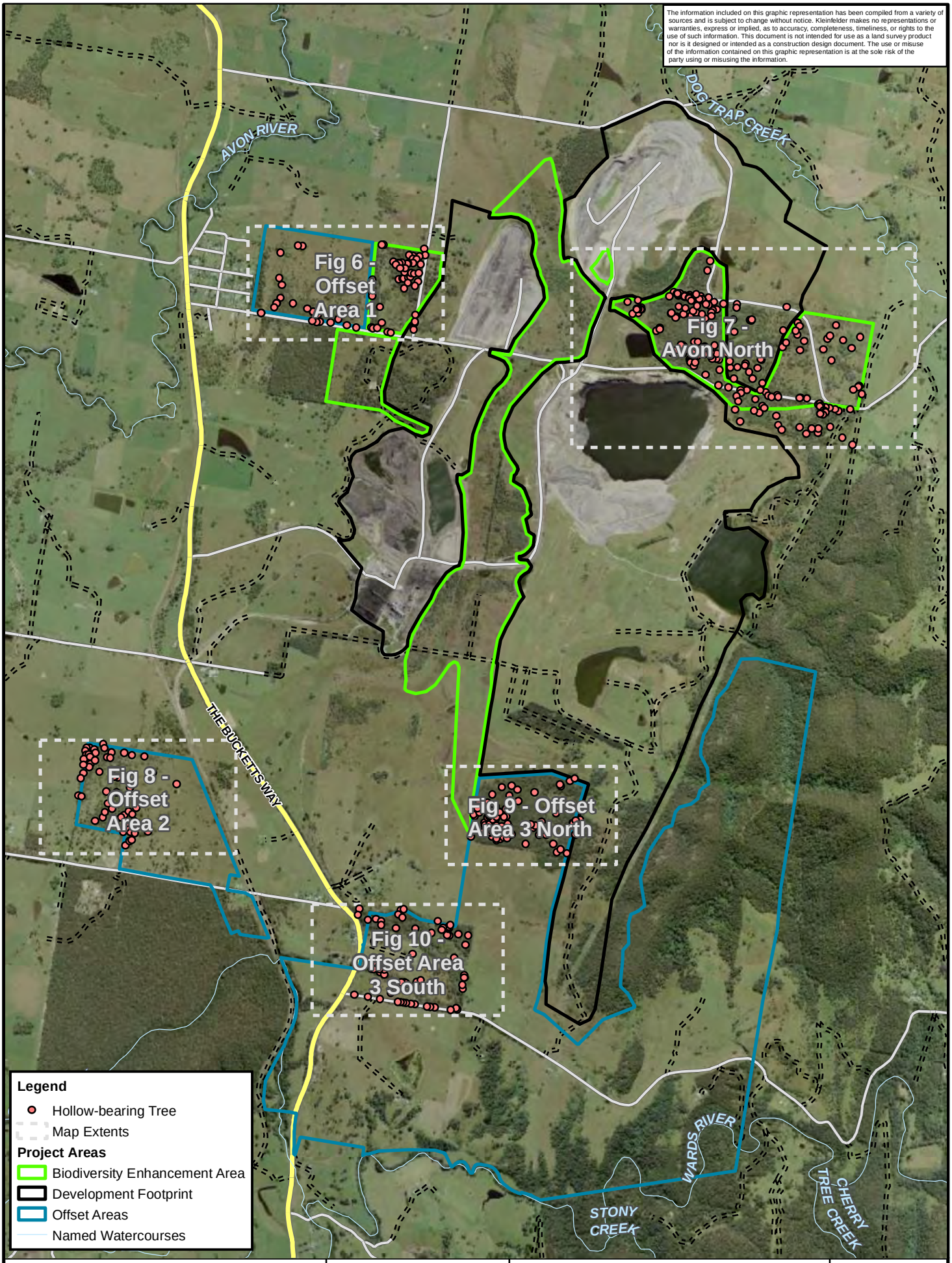


Figure 4: **Aspect of hollows identified during hollow bearing tree census (n= 648). X-axis labelled with each of eight compass points and UP representing hollows with a vertical aspect.**

3.3 PREFERRED DEN SELECTION

Multinomial logistic regression modelling indicated that two variables were having the most influence on den selection by squirrel gliders for the collected data. A significance level of 0.05 was used to identify the den attributes that most influenced the selection of a den by a squirrel glider. The variables found to be the most significant in predicting whether a hollow would be preferred by a squirrel glider were: width of hollow opening ($\chi^2 = 28.5$, df = 1, $P < 0.001$) and hollow category ($\chi^2 = 10.9$, df = 3, $P = 0.012$).



PROJECT REFERENCE: 20200723

DATE DRAWN: 2019/11/28 15:35 Version 2

DRAWN BY: GJoyce

DATA SOURCE: NSW DFSI - 2019

Hollow-bearing Tree Locations Overview

FIGURE: 5

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Squirrel Glider Seasonal Home Range Final Report

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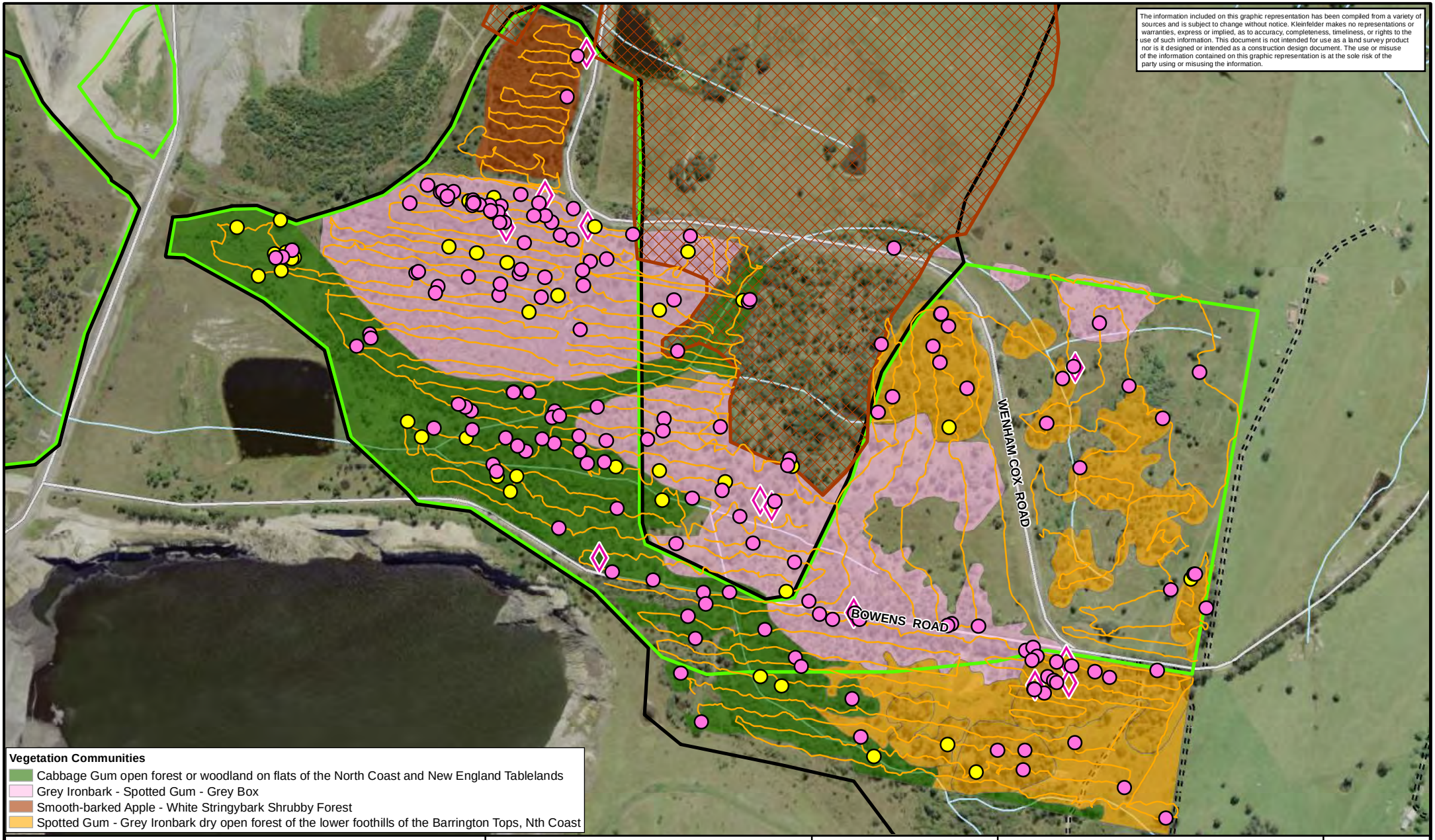

Vegetation Communities

- Cabbage Gum open forest or woodland on flats of the North Coast and New England Tablelands
- Grey Ironbark - Spotted Gum - Grey Box
- Smooth-barked Apple - White Stringybark Shrubby Forest
- Spotted Gum - Grey Ironbark dry open forest of the lower foothills of the Barrington Tops, Nth Coast

Legend

- Hollows Suitable for Squirrel Glider
- Hollows Unsuitable for Squirrel Glider
- Den Trees
- Hollow Census Search Lines
- Biodiversity Enhancement Area
- Development Footprint
- ClearedArea
- Named Watercourse
- Unnamed Watercourse
- Local Road
- Track

Metres
0 25 50 100 150 200 250

N

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NSW DFSI - 2019

Hollow-bearing Tree Locations - Avon North

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Hollow-bearing Tree Census

FIGURE:
6

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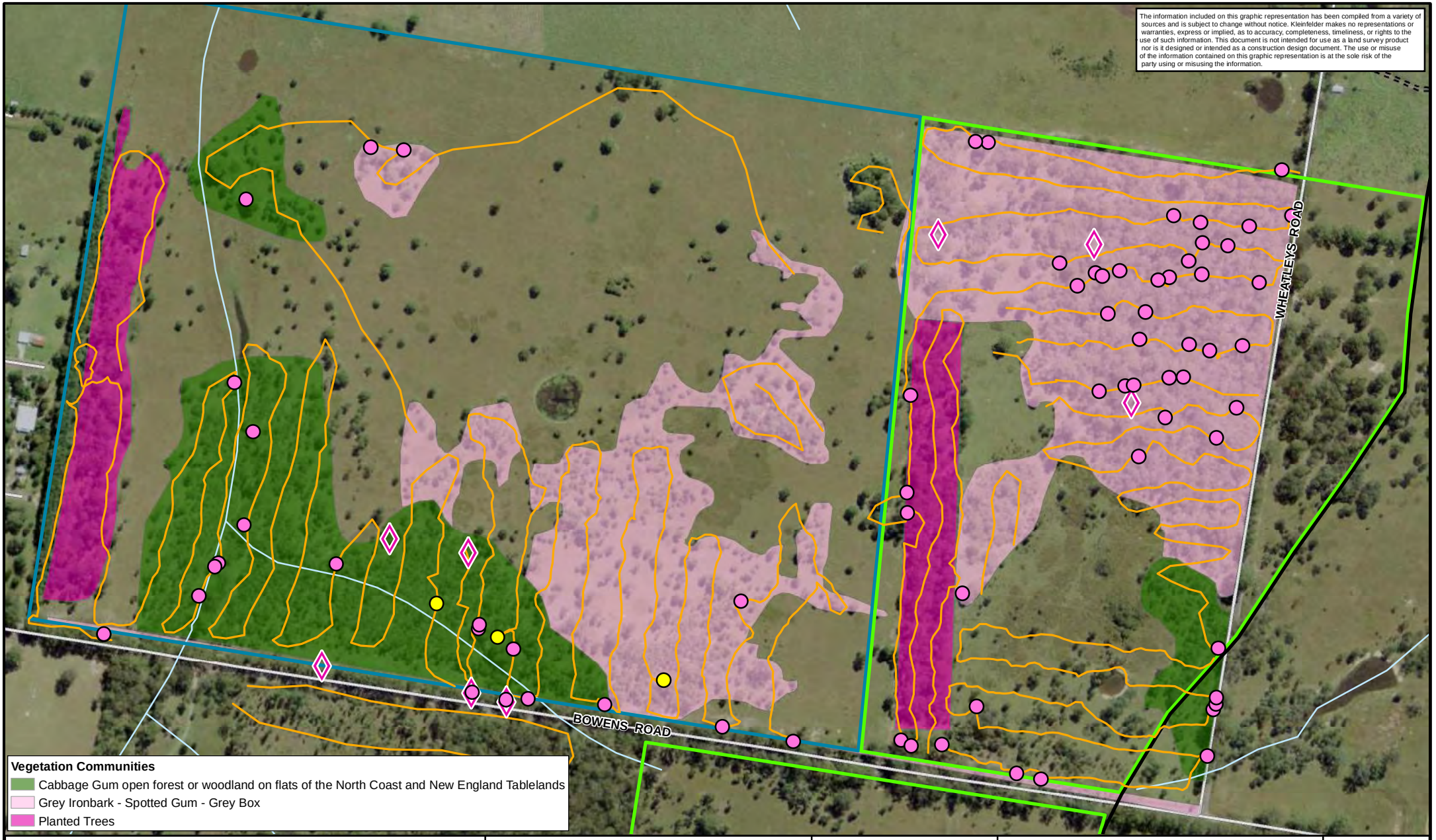

Legend

- Hollows Suitable for Squirrel Glider
- Hollows Unsuitable for Squirrel Glider
- Den Trees
- Hollow Census Search Lines
- Biodiversity Enhancement Area
- Development Footprint
- Offset Areas
- Unnamed Watercourse
- Local Road
- Track

Metres

0 25 50 100 150 200 250

N

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DATA SOURCE:
NSW DFSI - 2019

Hollow-bearing Tree Locations - Offset Area 1

Stratford Coal Ltd
Hollow-bearing Tree Census

FIGURE:

7

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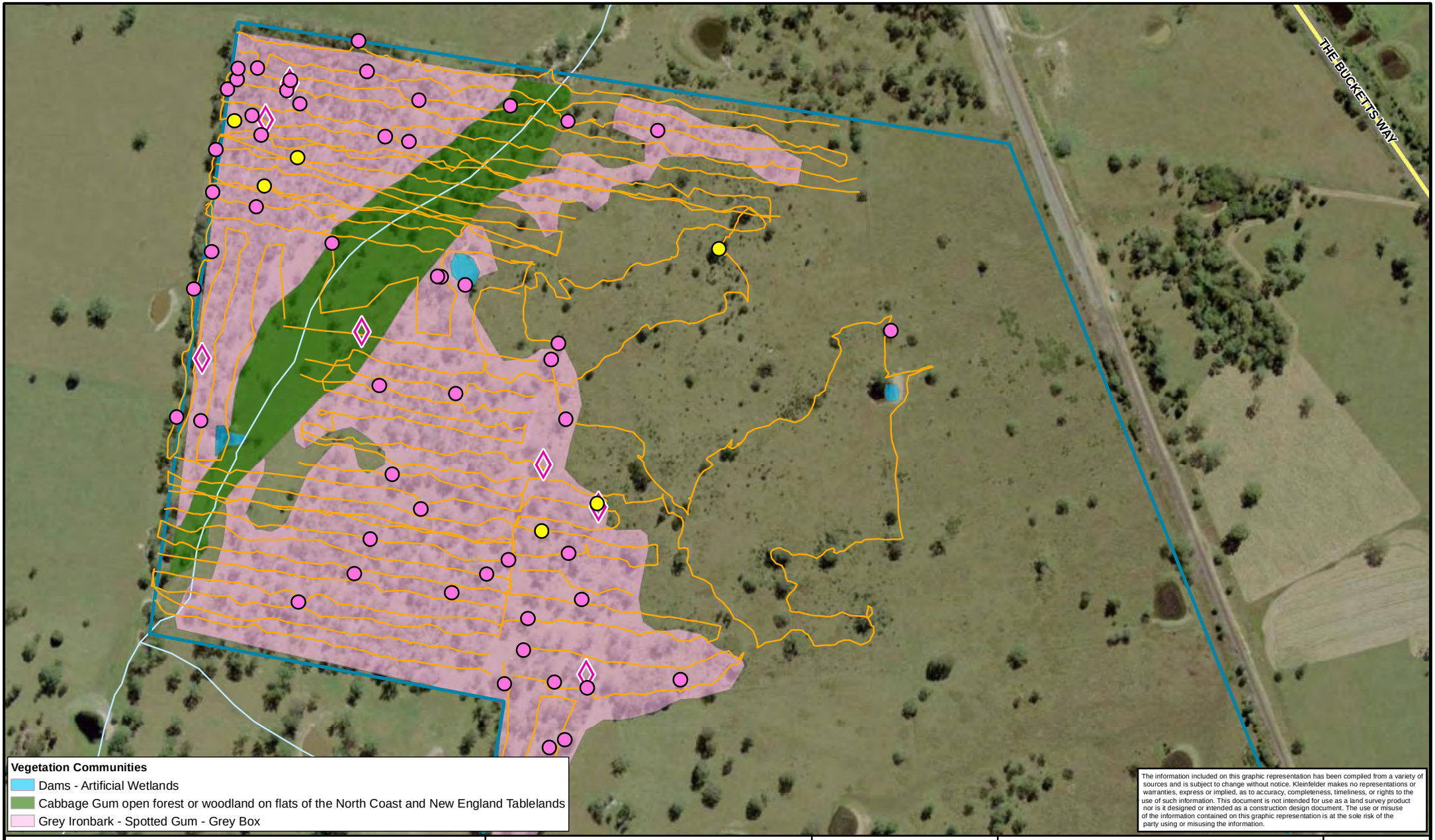

Legend

- Hollows Suitable for Squirrel Glider
- Hollows Unsuitable for Squirrel Glider
- Den Trees
- Hollow Census Search Lines
- Offset Areas
- Unnamed Watercourse
- Arterial Road
- Track

Metres

0 25 50 100 150 200 250

N

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DATA SOURCE:
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Hollow-bearing Tree Locations - Offset Area 2

Stratford Coal Ltd
Hollow-bearing Tree Census

FIGURE:

8

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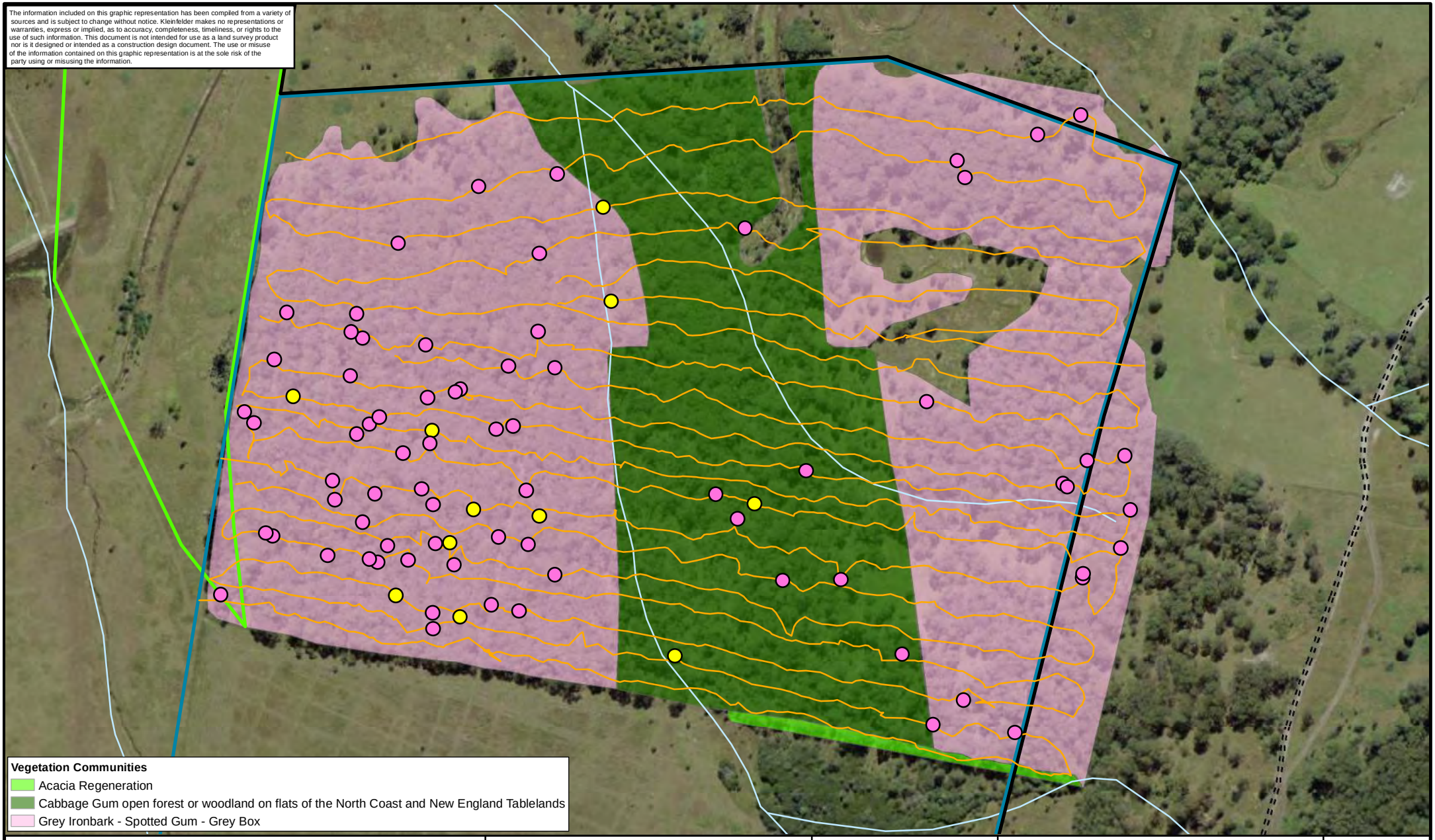

Legend

- Hollows Suitable for Squirrel Glider
- Hollows Unsuitable for Squirrel Glider
- Hollow Census Search Lines
- Biodiversity Enhancement Area
- Development Footprint
- Offset Areas
- Unnamed Watercourse
- Track

Metres
0 25 50 100 150 200

N

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NSW DFSI - 2019

Hollow-bearing Tree Locations - Offset Area 3 North

Stratford Coal Ltd
Hollow-bearing Tree Census

FIGURE:
9

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Legend

- Hollows Suitable for Squirrel Glider
- Hollows Unsuitable for Squirrel Glider
- Den Trees
- Hollow Census Search Lines
- Offset Areas
- Unnamed Watercourse
- Arterial Road
- Local Road
- Track

Metres

0 25 50 100 150 200 250

N

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NSW DFSI - 2019

Hollow-bearing Tree Locations - Offset Area 3 South

Stratford Coal Ltd
Hollow-bearing Tree Census

FIGURE:

10

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4. DISCUSSION

Due to the extensive land clearing that has taken place since European settlement (with approximately 40% of Australian forests cleared) hollow dependent fauna have been significantly impacted (Lindenmayer 2002, Brearley *et al*. 2011, Bradshaw 2012, Goldingay 2012, Lindenmayer *et al*. 2017a). More than 300 Australian fauna species utilise tree hollows, 75% of which are dependent on tree hollows for their survival (Gibbons and Lindenmayer 2002). Many hollow dependent fauna species (approximately 40 species) are listed as threatened under the *Biodiversity Conservation Act 2016.*

The current expansion of SCM will reduce available foraging, denning and breeding habitat for the local population of squirrel gliders and other hollow dependent fauna through vegetation clearing in the immediate mine path. Knowledge of the location of foraging areas and microhabitat elements such as tree hollows is paramount in conservation planning in areas impacted by habitat fragmentation (Ball 2007, Crane *et al*. 2010, Crane *et al*. 2017). The data gathered during this study has identified areas (such as Offset Area 3 – North) containing hollows that could potentially be utilised by squirrel gliders and other hollow dependant species. Having these data available while planning upcoming vegetation removal and nest box installations will be highly beneficial.

4.1 HOLLOW BEARING TREE CENSUS

The current study identified and mapped 480 hollow bearing trees which contained a combined total of 648 hollows (**Figure 6 – 10**). This information establishes a baseline for the number and distribution of hollows throughout the SCM biodiversity offset and biodiversity enhancement area and provides an estimated density of hollows for each vegetation community. Although whether the calculated hollow density is dependent on age and/or species type was not able to be determined from this survey. From this baseline, future management actions such as the installation of nest boxes can be placed in areas found to be deficient in hollows.

Ground-based hollow bearing tree surveys are often used to determine the density and size of hollows within an area (Harper *et al*. 2004, Davis *et al*. 2014, Treby and Castley 2015). These

surveys are often conducted as part of the development approvals process to quantify the number of hollows and determine the impacts their removal may have on the local hollow dependent fauna population (Brearley *et al*. 2010, Lindenmayer *et al*. 2017b).

There are several limitations that will affect the accuracy of ground-based hollow bearing tree surveys (Harper *et al*. 2004, Rayner *et al*. 2011). These include the height of the hollow, foliage and branch density, aspect of the hollow (if the hollow opening is vertical it may not be seen from the ground) and having a suitable vantage point to inspect the tree. Hollows become more difficult to detect and their opening size more difficult to estimate, when they are higher in the tree or if the trunk and branches are obscured from view by dense foliage. These factors combined can lead to an underestimation of the number of hollows. However, even with these limitations it has been shown that on average 82% of hollow bearing trees were identified during ground-based surveys (Harper *et al*. 2004). SMC has recognised these limitations and have implemented a policy of replacement of three nest boxes for every squirrel glider suitable hollow removed, and a one for one replacement of other hollows.

Other limitations of ground-based hollow bearing tree surveys include the difficulty in estimating the internal dimensions of a tree hollow (Rayner *et al*. 2011). Not knowing certain dimensions of hollows such as hollow depth can greatly reduce the ability of predicting whether the hollow is suitable for a fauna species (Koch *et al*. 2008). Several methods have been used to measure the internal dimensions of a tree hollow such as tree climbing and examining felled trees. However, these methods can often be time consuming, destructive, hazardous and expensive (Gibbons *et al*. 2000). The limitations of estimating the dimensions of hollows resulted in a high number of hollows classified as “possible” rather than “squirrel glider suitable”, but acting on instruction from SMC environmental staff, these hollows were grouped together in the final analysis.

In summary, ground-based surveys are not exact, but they can still provide an index of availability that may be consistent across areas. It’s possible that small hollows may be under-estimated more than large hollows (large hollows may have more obvious entrances with a depth of 10 cm) but small hollows are usually much more abundant than large hollows (e.g. Treby and Castley (2015)) so under estimation of these may have less serious consequences. Indeed, during the Squirrel Glider radio tracking program undertaken by Kleinfelder in 2019,

several gliders were tracked to trees where no obvious hollow was visible from the ground. Upon examination of the trees using ladders and climbing safety gear, small hollows were observed to be in the fork of trunks or large branches and not visible from ground level.

4.2 COMPARISON TO VEGETATION COMMUNITY BENCHMARK VALUES

This hollow-bearing tree density provides a measure of the current habitat condition and hollow availability within the study area, i.e. squirrel glider home ranges and offset areas. Vegetation community benchmark data provides values for the density of hollow-bearing trees that have been identified from surveys (NSW, DPIE 2017) (**Table 3**). Comparison of the benchmark values to the density of hollow bearing trees in **Table 2** shows that the vegetation communities within the biodiversity enhancement and offsets areas at the SMC are well below the benchmark values. For instance, the Spotted Gum – Grey Ironbark community at the SMC has recorded a maximum of 3.2 hollow-bearing trees per hectare in comparison to the benchmark value of 12 hollow-bearing trees per hectare. While the number of hollow-bearing does not directly correlate with the total number of hollows, with older trees and stags containing more hollows, 367 of the 480 hollow-bearing trees observed at the SMC only contained one observable hollow. The much lower number of hollow-bearing trees in the vegetation communities at the SMC indicates that these communities are relatively immature when compared to benchmark communities. This data strongly suggests that the loss of any hollows from the SMC vegetation areas as a result of the expansion of the mining operations will have an impact upon hollow-dependent fauna and therefore the replacement of hollows with suitable nest boxes would be highly beneficial.

Table 3: Benchmark data for numbers of hollow-bearing trees for recognised vegetation communities at the SMC

Vegetation Community Name	Vegetation Community ID	No. of Hollow Bearing trees per 50m x 20m Quad	Benchmark HBT Density (Trees/ha)	SMC Maximum HBT Density (Trees/ha)
Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast	HU630	1.2	12	3.2
Grey Ironbark - Spotted Gum - Grey Box (Variant of above vegetation community)	HU630	1.2	12	3.2
Cabbage Gum open forest or woodland on flats of the North Coast and New England Tablelands	HU526	3	30	3.0
Smooth-barked Apple - White Stringybark Shrubby Forest (nearest equivalent vegetation community)	HU641	1.5	15	0.6

4.3 HOLLOW USE

During this study squirrel gliders were observed using a smaller number of hollows on average compared to other studies. Crane *et al*. (2010) reported squirrel gliders using 2-13 dens (mean = 7 dens) over a period of 3.5 months. This range is much broader than the number of dens used in the current study (range 1-4 dens, mean = 1.9 ± 0.2 dens) over a similar study period (46 ± 3.6 days). In the current study, one squirrel glider (Elsie) was observed denning in a termite's nest on several occasions (**Plate 1**). Although uncommon, this has been observed previously at other locations (R. Goldingay pers. comm. 2019). This suggests that gliders can utilise areas of younger woodland vegetation, i.e. advanced re-growth rather than relying on old growth woodland and forests, but that sufficient suitable hollows may be a limiting factor in the offsets and biodiversity enhancement areas.

4.4 PREFERRED DEN SITES

The current study found that hollow entrance size (area) was the most important factor in determining whether a hollow would be selected as a den by a squirrel glider. Gliders at Avon North favoured hollows with a mean entrance size of 6.85 ± 0.9 cm. This finding is consistent with published studies (Traill and Lill 1997, Beyer *et al*. 2008, Ball *et al*. 2011). Beyer *et al*. (2008) found a preference for entrance sizes of 3-5 cm though observed use of entrances up to 12 cm. Traill and Lill (1997) found mean entrance size of 3.7 cm with entrances up to only 6.4 cm used. Squirrel glider dens were recorded in seven species of trees (if "stags" are counted as a species) while hollows were identified in 13 species. These observations provide further evidence that tree species is not a significant factor considered by squirrel gliders when selecting a den. Beyer *et al*. (2008) concluded that tree species does not influence squirrel glider den selection, rather disproportionate use of a tree species or dead trees only reflects hollow presence in those trees. Similar conclusions were also reported in Ball *et al*. (2011).

Plate 1: Elsie denning in a termite nest on Grey Ironbark (*Eucalyptus siderophloia*).

4.5 SUGGESTIONS FOR FURTHER RESEARCH

Long-term hollow availability

This study provides a baseline for the number and spatial distribution of hollows within the offsets and biodiversity areas of SCM. This offers an opportunity to assess the rate of attrition over a decadal timescale to determine if the number off hollows are increasing or decreasing within these areas. This may be used to determine how effective the offset measures have been in conserving hollow dependent fauna. Beyer *et al*. reported an annual loss of 3% of den trees over periods of 3-10 yrs. Such data are important for understanding the dynamics of hollow availability which may need active management.

Artificial hollow design

Another approach to increasing the availability of hollows would be to create hollows by either chain sawing (carved) or drilling into live trees (Rueegger 2017). Several studies have found that creating hollows in trees can lead to a variety of species utilising them (Ellis 2018, Griffiths *et al*. 2018). Further research could be conducted within the Stratford area to test whether these types of hollows are preferred over nest boxes. Their durability and cost/benefits could be compared to nest boxes. Other aspects that could be researched are the design of chain-sawn or drilled hollows to tailor them to better suit target species.

More Accurate Determination of Hollow Occurrence

Given the limitations ground based surveys, a more accurate survey of hollows could be undertaken by a quadrat-based survey where each individual tree is climbed, and hollows observed and counted. This would also allow measurements of hollows to be taken and evidence of usage collected to verify ground-based surveys and allow a more accurate comparison to the vegetation community benchmark data.

Further Observations of Squirrel Glider Occurrence

Observations by cameras located in other offset areas would provide further data for continued preservation of the glider populations at SMC. For instance, Offset Area 3 to the east of the Stratford East Expansion has the potential to be suitable habitat.

5. CONCLUSION

Hollow dependent fauna are threatened due to habitat fragmentation and the loss of tree hollows used for denning and breeding (Ball 2007, Crane *et al*. 2017, Rogan and Lacher 2018). As land continues to be developed, conservation strategies need to be developed to support populations of threatened species.

When compared to the benchmark values for the relevant vegetation communities, the number of hollow-bearing trees (and by inference the number of hollows) is much lower at the SMC. This is not unexpected given that a substantial portion of the vegetation is advanced re-growth with the area having been logged and cleared in the past (M. Plain, *pers. comm.)*. Of the two main communities surveyed, the Spotted Gum – Grey Ironbark appears to be in better habitat condition having approximately 2.8 to 3.0 hollow-bearing trees per hectare compared to the benchmark of 12. The Cabbage Gum open forest has the potential to have up to 30 hollow-bearing trees per hectare, but in the SMC only records a high of 3.0 trees per hectare in the Avon North biodiversity enhancement area, with much lower densities of trees and hollows in the remaining areas. This suggests that the alluvial flat country where this community grows may have been preferentially cleared and/or logged and will take longer to recover and improve in condition.

The results of this study show that in the vicinity of the SMC the squirrel glider population is utilising foraging and denning habitat that will be cleared as part of the Avon north open cut pit extension. To mitigate the loss of denning habitat nest boxes will be installed in SMC biodiversity offsets and biodiversity enhancement areas to provide additional denning resources that meet the requirements of squirrel gliders. The hollow bearing tree census that was completed within this study along with the planned mapping of squirrel glider food resources (Stratford Coal 2018) will be used to guide where future nest boxes are located. Additional foraging habitat will be supplemented by tree planting in cleared areas, which will provide further habitat connectivity and potentially in time denning opportunities.

During the course the Squirrel Glider habitat management work undertaken by Kleinfelder, it was hypothesized that suitable hollows appeared to be a limiting resource with observations of gliders denning in hollows that were near to the ground and in termite nests. The findings from this survey lend weight to that hypothesis and emphasize the

need to replace any hollows lost to clearing for the facilitation of the mining operations. In this regard, the current SMC policy of a 3:1 replacement of hollows with nest boxes and the instruction to treat all possible hollows as “squirrel glider suitable” will help to enhance the habitat quality of the offsets areas.

A baseline of the quantity and spatial arrangement of available hollows within SCM biodiversity offset and biodiversity enhancement has been provided by this hollow tree census. This information may be used in future studies to determine if there has been a net loss or gain of hollows within the areas of SCM.

6. REFERENCES

Ball, T. 2007. The ecology and management of the squirrel glider (Petaurus norfolcensis) in a fragmented landscape, central Queensland.*in* T. Ball, editor.

Ball, T., R. L. Goldingay, and J. Wake. 2011. Den trees, hollow-bearing trees and nest boxes: management of squirrel glider () nest sites in tropical Australian woodland. Australian Mammalogy **33**:106-116.

Beyer, G. L., R. L. Goldingay, and D. J. Sharpe. 2008. The characteristics of squirrel glider (*Petaurus norfolcensis*) den trees in subtropical Australia. Australian Journal of Zoology **56**:13-21.

Bradshaw, C. J. A. 2012. Little left to lose: deforestation and forest degradation in Australia since European colonization. Journal of Plant Ecology **5**:109-120.

Brearley, G., A. Bradley, S. Bell, and C. McAlpine. 2010. Influence of contrasting urban edges on the abundance of arboreal mammals: A study of squirrel gliders (Petaurus norfolcensis) in southeast Queensland, Australia. Biological Conservation **143**:60-71.

Brearley, G., A. Bradley, S. Bell, and C. McAlpine. 2011. Change in habitat resources and structure near urban edges and its influence on the squirrel glider (Petaurus norfolcensis) in southeast Queensland, Australia. Austral Ecology **36**:425-432.

Crane, M. J., D. B. Lindenmayer, and S. C. Banks. 2017. Conserving and restoring endangered southern populations of the Squirrel Glider (*Petasurus norfolcensis*) in agricultural landscapes. Ecological Management & Restoration **18**:15-25.

Crane, M. J., D. B. Lindenmayer, and R. B. Cunningham. 2010. The use of den trees by the squirrel glider (*Petaurus norfolcensis*) in temperate Australian woodlands. Australian Journal of Zoology **58**:39-49.

Crane, M. J., M.-D. R. M., R. B. Cunningham, and D. B. Lindenmayer. 2008. The characteristics of den trees used by the squirrel glider (*Petasurus norfolcensis*) in temperate Australian woodlands. Wildlife Research **35**:663-675.

Davis, A., R. E. Major, and C. E. Taylor. 2014. Distribution of tree-hollows and hollow preferences by parrots in an urban landscape. Emu - Austral Ornithology **114**:295-303.

Ellis, M. 2018. The presence of heartwood decay, a precursor to hollow formation, within Eucalyptus camaldulensis in relation to stem size. Ecological Management & Restoration **19**.

Gibbons, P., D. B. Lindenmayer, S. C. Barry, and M. T. Tanton. 2000. Hollow formation in eucalypts from temperate forests in southeastern Australia. Pacific Conservation Biology **6**:218-228.

Gibbons, P., and D. B. Lindenmayer. 2002. Tree hollows and wildlife conservation in Australia. CSIRO Publishing, Collingwood, Vic.

Goldingay, R. L. 2012. Characteristics of tree hollows used by Australian arboreal and scansorial mammals. Australian Journal of Zoology **59**:277-294.

Griffiths, S., P. Lentini, K. Semmens, S. Watson, L. Lumsden, and K. Robert. 2018. Chainsaw-carved cavities better mimic the thermal properties of natural tree hollows than nest boxes and log hollows. Forests **9**:235.

Harper, M. J., M. A. McCarthy, R. Van Der Ree, and J. C. Fox. 2004. Overcoming bias in ground-based surveys of hollow-bearing trees using double-sampling. Forest Ecology and Management **190**:291-300.

Kleinfelder. 2019. Stratford Mining Complex Squirrel Glider Radio-tracking Program. Report prepared for Stratford Coal.

Koch, A., S. Munks, and D. Driscoll. 2008. The use of hollow-bearing trees by vertebrate fauna in wet and dry Eucalyptus obliqua forest, Tasmania. Wildlife Research **35**:727-746.

Lindenmayer, D. 2002. Gliders of Australia : a natural history / David Lindenmayer. UNSW Press, Sydney, N.S.W.

Lindenmayer, D., W. Blanchard, D. Blair, L. McBurney, and S. Banks. 2017a. Relationships between tree size and occupancy by cavity-dependent arboreal marsupials. Forest Ecology and Management **391**:221-229.

Lindenmayer, D. B., M. Crane, M. C. Evans, M. Maron, P. Gibbons, S. Bekessy, and W. Blanchard. 2017b. The anatomy of a failed offset. Biological Conservation **210**:286-292.

NSW Department of Planning, Industry and Environment, 2017 Vegetation Condition Benchmarks https://www.environment.nsw.gov.au/projects/biometric-dataset.htm

Rayner, L., M. Ellis, and J. E. Taylor. 2011. Double sampling to assess the accuracy of ground-based surveys of tree hollows in eucalypt woodlands. Austral Ecology **36**:252-260.

Rogan, J. E., and T. E. Lacher. 2018. Impacts of Habitat Loss and Fragmentation on Terrestrial Biodiversity. Reference Module in Earth Systems and Environmental Sciences. Elsevier.

Rueegger, N. 2017. Artificial tree hollow creation for cavity-using wildlife – Trialling an alternative method to that of nest boxes. Forest Ecology and Management **405**:404-412.

Stratford Coal. 2018. Stratford Mining Complex (Stratford Extension Project) - Squirrel Glider Management Plan.

Traill, B., and A. Lill. 1997. Use of tree hollows by two sympatric gliding possums, the Squirrel Glider, *Petaurus norfolcensis*, and the Sugar Glider, *P. breviceps*. Australian Mammalogy **20**:79-88

Treby, D. L., and J. G. Castley. 2015. Distribution and abundance of hollow-bearing trees in urban forest fragments. Urban Forestry & Urban Greening **14**:655-663.

APPENDIX 1. ATTRIBUTES OF SQUIRREL GLIDER DENS

Table 1: Attributes of squirrel glider den trees found by radio-tracking at SMC.

Den Tree Number	Squirrel Glider Name	Tree Species	Tree Height (m)	DBH (cm)	Den Height (m)	Den Opening Width (cm)	Den Opening Length (cm)	Den Aspect	Den Type	Total Visible Hollows	Dieback	Site	Latitude	Longitude
1	Eddy	Eucalyptus umbra	16	45	1.5	10	10	N	Trunk	1	20	Avon North	-32.12174576	151.9828898
2	Eddy	Eucalyptus siderophloia	34	67	28	10	10	UP	Branch	3	60	Avon North	-32.12596595	151.9826891
3	Eddy	Eucalyptus tereticornis	29	80	20	10	10	SE	Branch	3	5	Avon North	-32.12629546	151.9827276
4	Elsie	Eucalyptus siderophloia	22	54	3	5	5	NW	Termite nest	0	5	Avon North	-32.12371257	151.9777146
5	Elsie	Eucalyptus umbra	10	45	2.5	5	5	UP	Trunk	1	0	Avon North	-32.1244272	151.9747892
6	Elsie	Stag	3	90	2	10	5	S	Trunk	1	100	Avon North	-32.12524781	151.9790905
7	Emma	Angophora floribunda	14.5	65	13.5	4.5	5	S	Branch	1	50	Avon North	-32.11964489	151.9732585
8	Eric	Angophora floribunda	10.5	49	7	5	100	E	Fissure	2	25	Avon North	-32.12632185	151.9821557
9	Iris	Eucalyptus umbra	32	76	10	4	5	E	Trunk	1	0	Avon North	-32.11715048	151.9746533
10	Iris	Eucalyptus umbra	21	68	8	5	8	NW	Branch	1	10	Avon North	-32.14918387	151.9333886
11	Rachel	Eucalyptus moluccana	30	83	11	5	10	W	Branch	5	5	Offset 1	-32.12062858	151.9469029
12	Rachel	Eucalyptus moluccana	26	75	9	5	8	S	Branch	2	5	Offset 1	-32.12031445	151.9451161
13	Rodney	Eucalyptus amplifolia	16	67	2.9	17	9	UP	Trunk	1	0	Offset 1	-32.11680919	151.9511339
14	Rodney	Stag	15	32	2.7	3	6	UP	Trunk	1	100	Offset 1	-32.11690034	151.9526452
15	Rupert	Stag	14	52	8	5	5	SE	Trunk	1	100	Offset 1	-32.11939503	151.9465449
16	Rupert	Stag	15	45	4	5	5	NE	Trunk	3	100	Offset 1	-32.11927364	151.9457833
17	Russel & Rachel	Stag	22	82	9	5	5	NE	Branch	2	100	Offset 1	-32.1205519	151.946562
18	Sharon	Eucalyptus siderophloia	20	78	8	10	4	Up	Trunk	1	10	Offset 2	-32.14953454	151.9339174
19	Sharon	Stag	15	48	3.5	6	6	S	Branch	1	100	Offset 2	-32.15090638	151.9337827
20	Stella	Eucalyptus siderophloia	22	94	1.4	4	6	NE	Trunk	1	0	Offset 2	-32.14918387	151.9333886
21	Syril	Eucalyptus siderophloia	28	70	4	3	6	W	Trunk	2	90	Offset 2	-32.14603333	151.9309795
22	Syril	Stag	4	24	4	7	7	Up	Trunk	1	100	Offset 2	-32.14633164	151.9307422
23	Syril	Stag	10	31	10	9	9	Up	Trunk	1	100	Offset 2	-32.14807944	151.9316486
24	Syril	Eucalyptus siderophloia	20	44	1.2	4	8	W	Trunk	1	5	Offset 2	-32.14828496	151.9301093
25	Kate & Kevin	Eucalyptus siderophloia	26	102	20	7	5	SW	Branch	2	5	Offset 3 South	-32.1569038	151.9476418
26	Kyle	Eucalyptus siderophloia	27	92	10	4	40	NW	Branch	3	5	Offset 3 South	-32.1569038	151.9476418
27	Kyle & Kate	Eucalyptus siderophloia	20	96	2	4	5	N	Trunk	1	5	Offset 3 South	-32.15641663	151.950003
28	Scarlet	Eucalyptus umbra	12	47	5.1	5	30	NE	Fissure	2	30	Offsite	-32.1487476	151.9016366
29	Scarlet	Stag	12	45	11	4	30	Up	Fissure	1	100	Offsite	-32.13598347	151.8914544

APPENDIX 2. STAFF CONTRIBUTIONS

The following staff were involved in the compilation of this report.

Name	Qualification	Title/Experience	Contribution
Luke O'Brien	BEnvSc&Mgmt	Ecologist	Fieldwork, Report writing
Mark Dean	BEnvSc&Mgt	Ecologist	Fieldwork
Ben Stewart	MMarSc&Mgt	Ecologist	Fieldwork
Gayle Joyce	BSc (Forestry) (Hons)	GIS Specialist	GIS and Mapping
Nigel Fisher	BSc (Hons) PhD	Restoration Ecologist	Fieldwork, Report Review
Dan O'Brien	BEnvSc&Mgt (Hons)	Ecologist	Report Review

Stratford Coal Mine: Fauna Surveys of the Offset and Biodiversity Enhancement Areas, Spring 2019

Prepared by AMBS Ecology & Heritage
for Stratford Coal Pty Ltd

Final Report

April 2020

AMBS Reference: 19676

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1 Introduction

Stratford Coal Pty Ltd (SCPL), a subsidiary of Yancoal Australia Ltd (Yancoal), operates the Stratford Mining Complex (SMC). The SMC is located in the Gloucester Valley, New South Wales (NSW), approximately 10 kilometres (km) south of Gloucester (Figure 1.1). SMC began production in 1995 and mining operations continued until 2014 when mining activities were suspended. The coal handling and preparation plant continued to operate during the suspension of mining activities, processing coal from the nearby Duralie Coal Mine.

The Stratford Extension Project was granted State and Federal approval in 2015 and has commenced operations early 2018. The Project Approval for the initial SMC included requirements to undertake periodic fauna monitoring, the requirements of which are described in the SMC Mining Operations & Rehabilitation Management Plan (MOP) (Yancoal 2018a) and the Stratford Coal Mine Biodiversity Management Plan (BMP (Yancoal 2018b)). For Spring 2019, Yancoal required fauna surveys to be undertaken in the following areas:

- Stratford Offset Areas; and
- Stratford Biodiversity Enhancement Areas.

This report presents the methods and results of the vertebrate fauna surveys undertaken in the Stratford Mine Biodiversity Offset and Biodiversity Enhancement Areas.

1.1 Characteristics of the Survey Areas

A detailed description of the existing environment has been provided in previous fauna surveys. Past fauna surveys in the area include frog surveys (SCPL, 1994; Murray, 1994; Mount King Ecological Surveys, 2001), general fauna surveys (Mount King Ecological Surveys, 2001), reptile surveys (SCPL, 1994; Mount King Ecological Surveys, 2001), bird surveys (AGC Woodward-Clyde, 1994; Mount King Ecological Surveys, 2001), bat surveys (Hoye and Finney, 1994; Hoye, 1998; Richards, 2001) and targeted threatened fauna surveys (Australian Museum Business Services 2011). AMBS Ecology and Heritage (AMBS) conducted fauna survey in the Stratford Mine Rehabilitation Areas in 2018 (AMBS 2018).

Historic and current land use in the vicinity of the SMC is dominated by agricultural production (primarily grazing for beef production) and mining (Yancoal 2018a). Remnant vegetation is generally located along ridgelines and watercourses, and in isolated patches within the cleared landscape (Yancoal 2018a). Vegetation in the offset areas is predominately re-growth, with large sections dominated by dry sclerophyll forest and grassy woodlands, including spotted gum – grey ironbark dry sclerophyll forest, grey box – forest red gum – grey ironbark forest, and cabbage gum woodland (Yancoal 2018b). Wet sclerophyll forest is less common, but habitat types present include grey gum – tallowwood – spotted gum forest, and tallowwood – brush box – sydney blue glum moist forest (Yancoal 2018b).

The Biodiversity Enhancement Areas are restricted to the alluvial flats, and are dominated predominantly by two habitat types, including spotted gum – grey ironbark dry sclerophyll forest, and cabbage gum woodland (Yancoal 2018b).

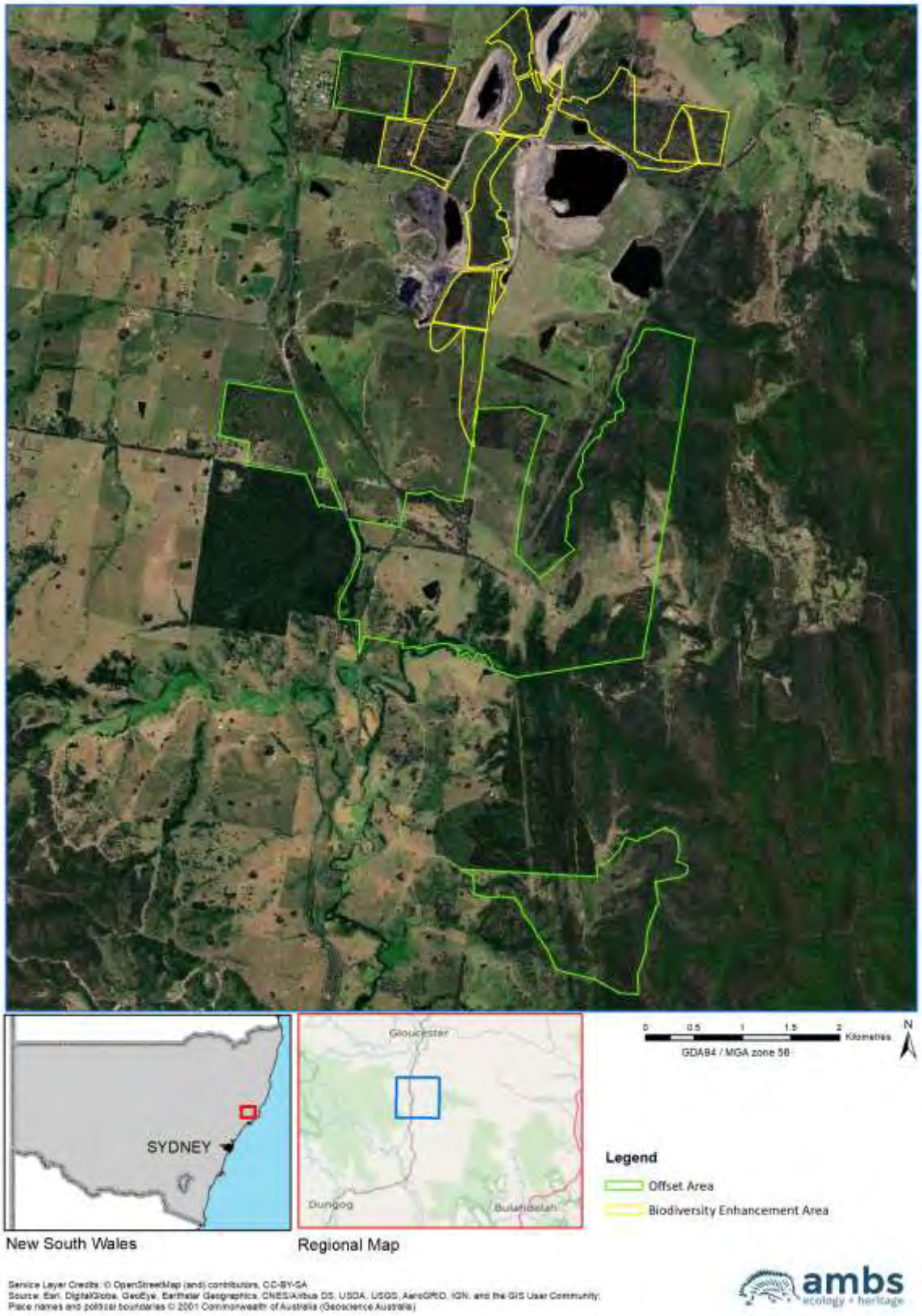


Figure 1.1 Location of the study area

1.2 Scope and Objectives

The scope was to undertake vertebrate fauna surveys in the Stratford Mine Biodiversity Offset and Biodiversity Enhancement Areas, in accordance with the SMC Mining Operations & Rehabilitation Management Plan Section 8.2 (Yancoal 2018a) and the Stratford BMP (Yancoal 2018b).

The objectives of the surveys were to sample the range of dominant fauna habitats present in the Biodiversity Offset and Biodiversity Enhancement Areas and provide a report documenting the methods and results. Survey sites were located to maximise the detection of vertebrate fauna that are utilising the habitats.

The methods are presented in Section 2 of this report. The results, including documentation of threatened species records, are provided in Section 3. A discussion of the results is provided in Section 4. A full list of vertebrate species recorded during the surveys is provided in Appendix A, fauna survey locations are provided in Appendix B, and Standard Survey Site data is provided in Appendix C.

1.3 Project Team

Fauna survey work was undertaken by Mark Semeniuk, Henry Cook, Narawan Williams and Alice Si. Identification of ultrasonic microbat calls was undertaken by Narawan Williams. Camera images were analysed by Ulrike Kloecker and Alice Si. This report was prepared by Ulrike Kloecker and Mark Semeniuk.

2 Methods

2.1 Field Surveys

Field surveys occurred during two weeks, from 23 to 27 September 2019 and 28 October to 2 November 2019. The first survey week predominantly involved survey site selection, installation of pitfall traps and remote camera deployment. Remote cameras were collected during the second survey week.

Eight survey sites were distributed throughout the survey area with two sites located within Biodiversity Enhancement Areas and six sites within Biodiversity Offset Areas. At each site survey techniques included pitfall traps, funnel traps, Elliott A traps, harp traps, ultrasonic call recording, spotlighting, diurnal bird surveys and reptile searches. In addition, targeted frog surveys were undertaken at four water sources, one located in the Biodiversity Enhancement Area and three in the Biodiversity Offset Area. Opportunistic observations of signs of fauna were noted throughout the field survey period, including during transit between surveys sites.

Survey site locations are shown in Figure 2.1 and summarised in Appendix B.

Pitfall traps

The standard survey technique for each site was six pitfall traps deployed for four nights (i.e. 24 pitfall trap nights total). Traps were checked each morning within three hours of dawn. Each pit was a 20-litre bucket spaced approximately 5 metres apart, with a 40m drift fence. Rocks, leaf litter or sticks were provided as cover for any trapped animals. Coopex was used as required to deter ants. The pitfall traps were deployed at one site in the Biodiversity Offset Areas during the first survey week, and at all other sites during the second survey week.

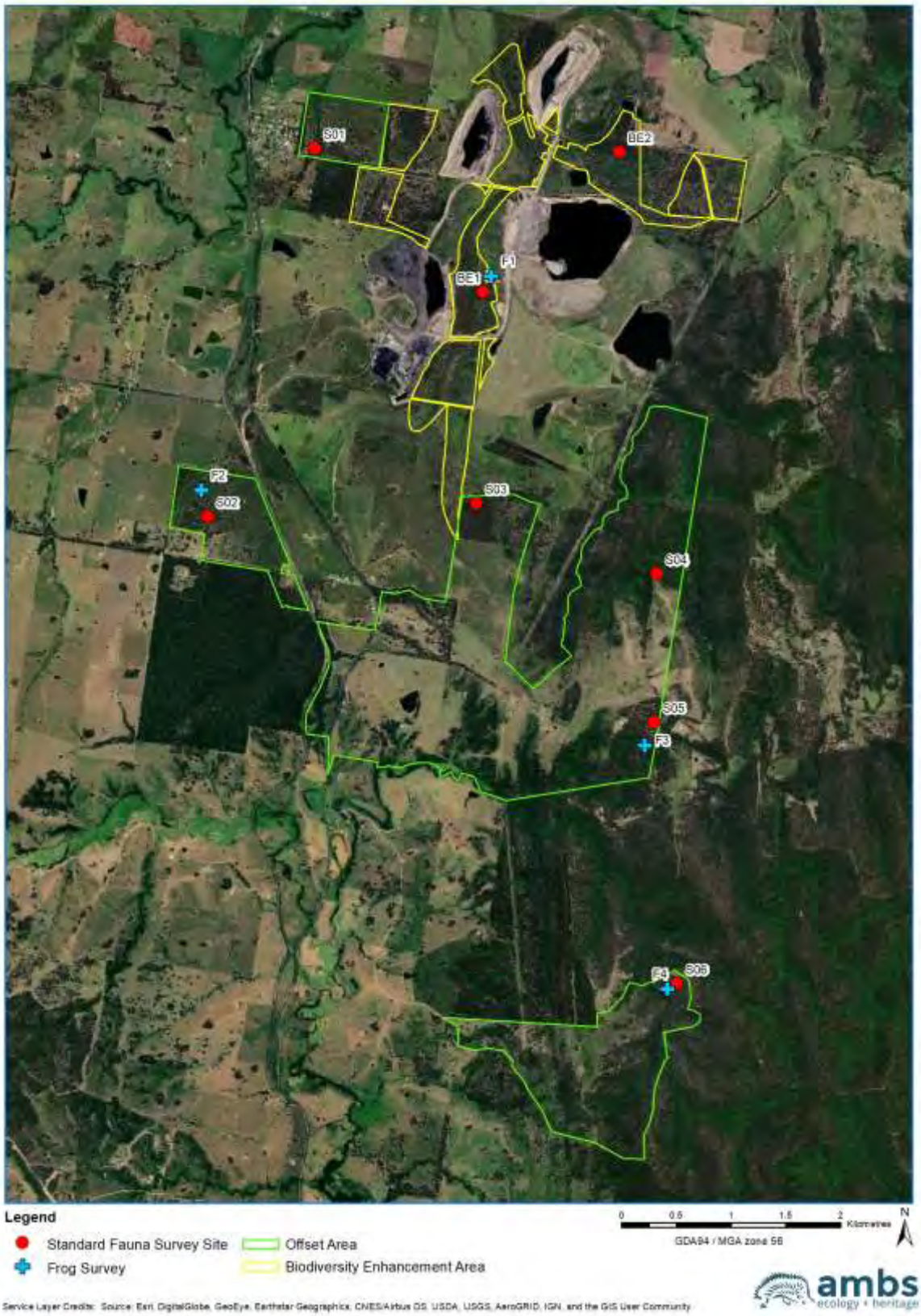


Figure 2.1 Location of fauna survey sites

Funnel traps

The standard survey technique for each site was four funnel traps deployed for four nights (i.e. 16 funnel trap nights total). Funnel traps were placed in pairs approximately 5m from each end of the pitfall trap drift fence. Traps were checked each morning within three hours of dawn. Coopex was used as required to deter ants. The funnel traps were deployed at one site in the Biodiversity Offset Areas during the first survey week, and at all other sites during the second survey week.

Elliott A traps

The standard survey technique for each site was 25 Elliott A Traps (on ground) deployed for 4 nights (i.e. 100 Elliott trap nights total). Traps were checked each morning within three hours of dawn. Each trap contained universal bait (peanut butter, rolled oats and honey) and cotton wool, and was placed in a plastic bag. Spacing between traps was 10m. Coopex was used as required to deter ants. The Elliott traps were deployed at one site in the Biodiversity Offset Areas during the first survey week, and at all other sites during the second survey week.

Harp Traps

The standard survey technique for each site was two harp traps deployed for two nights (i.e. four harp trap nights per site in total). Traps were checked each morning within three hours of dawn. Any captured microbats were placed in a calico bag, identified, and released at dusk the same day. The harp traps were deployed at one site in the Biodiversity Offset Areas during the first survey week, and at all other sites during the second survey week.

Ultrasonic Call Recording (Anabat)

The standard survey technique for each site was two Anabat Express units deployed for two nights. Each unit was set to the automatic 'night only' recording mode. The Anabat Express units were deployed at one site in the Biodiversity Offset Areas during the first survey week, and at all other sites during the second survey week.

Spotlighting

At each survey site, spotlighting was undertaken on two nights (non-consecutive when possible). The survey involved two people actively searching the length of the Elliott trap transect (approximately 250m), and identifying vertebrate fauna observed within 40 m of either side. Each survey was performed for 60 person-minutes. Spotlighting was undertaken at one site in the Biodiversity Offset Areas during the first survey week, all other sites were surveyed during the second survey week.

Diurnal Bird Survey

At each survey site, diurnal bird surveys were undertaken on two separate mornings within three hours of dawn. Each survey was undertaken for 20 minutes and involved the surveyor slowly walking the Elliott trap transect and identifying all birds observed or heard within and outside of a two-hectare area. Diurnal Bird Surveys were undertaken at one site in the Biodiversity Offset Areas during the first survey week, all other sites were surveyed during the second survey week.

Reptile Search

At each survey site, active searches of potential reptile habitats were undertaken. At each site two 30 person-minute searches (i.e. a total of 60 person-minutes per site in total) were undertaken on different days. Reptile Searches were undertaken at one site in the Biodiversity Offset Areas during the first survey week, all other sites were surveyed during the second survey week.

Camera Traps

At each survey site, two remote cameras (Scout Guard) were deployed and left in-situ for a minimum of 14 days and nights. One camera was baited with universal bait and one was baited with a tin of sardines. The bait was placed approximately 2-3 m from the camera. Cameras were programmed to record three images each time they were triggered.

Frog Survey

Targeted surveys were undertaken for frogs at four sites with suitable habitat. The survey involved two people spotlighting along the edge of the dam/creekline for 15 mins (30 person-minutes) and listening for calling individuals.

2.2 Limitations

Limitations or modifications to the surveys included:

- Surveys at SO1 were undertaken during the first survey week, and the remaining seven sites were surveyed during the second week. Conditions for fauna detection may have been slightly different.
- One remote camera at each of sites SO1, SO3 and SO6 recorded images for less than 14 days due to the memory card filling up with images of swaying vegetation.
- The air was smoky from widespread bushfires along the east coast at most sites during all surveys in October.
- The surveys were undertaken during a period in which much of Australia, including the study area, were experiencing drought conditions.

2.3 Climate

Rainfall, temperature and moon phase data for the study area during the survey period are provided in Table 2.1. Rainfall and temperature data were sourced from a weather station located at the SCM, while moon phase data was obtained from the Bureau of Meteorology (2020).

Weather conditions during the survey period were warm during the day and cold at night during the September field trip. During the second week of fieldwork at the end of October/beginning of November it was generally hot during the day and warm at night. The conditions during the active survey period were generally dry. Between the two field trips approximately 41 mm of rain fell over two days in October and provided some water for dams and creek lines.

The surveys were undertaken during an extremely dry year in the Gloucester Valley. A weather station located approximately two kilometres south-west of the Stratford Mine Site in the township of Craven (BOM weather station No. 060042), recorded an annual rainfall of 533.6 mm in 2019, the lowest annual rainfall recorded since this weather station was established in 1961 and roughly half of the mean annual rainfall for Craven of 1038.5 mm. The survey months September to November had very little rainfall, with approximately 10-20 mm occurring during each month.

Table 2.1 Climate data during the survey period

Date	Rainfall (mm)	Temp min (°C)	Temp max (°C)	Moon Phase
23/09/2019	-	10.8	26.4	Waxing Crescent
24/09/2019	-	4.2	24.0	FIRST QUARTER
25/09/2019	-	3.3	22.3	Waxing Gibbous
26/09/2019	-	6.1	22.3	Waxing Gibbous
27/09/2019	-	7.5	25.0	Waxing Gibbous
28/09/2019	0.2	5.6	28.5	Waxing Gibbous
29/09/2019	-	6.6	27.1	Waxing Gibbous
30/09/2019	-	8.9	25.3	Waxing Gibbous
1/10/2019	0.2	11.2	23.6	Waxing Gibbous
2/10/2019	-	8.3	24.7	FULL MOON
3/10/2019	-	7.5	26.4	Waning Gibbous
4/10/2019	-	9.7	29.7	Waning Gibbous
5/10/2019	-	15.6	34.0	Waning Gibbous
6/10/2019	2.6	13.9	21.7	Waning Gibbous
7/10/2019	-	15.1	30.1	Waning Gibbous
8/10/2019	-	12.6	33.4	Waning Gibbous
9/10/2019	-	11.3	30.1	Waning Gibbous
10/10/2019	-	5.0	20.6	THIRD QUARTER
11/10/2019	-	4.9	19.8	Waning Crescent
12/10/2019	21.8	8.9	22.5	Waning Crescent
13/10/2019	18.8	9.8	14.9	Waning Crescent
14/10/2019	-	8.4	19.9	Waning Crescent
15/10/2019	-	10.9	27.5	Waning Crescent
16/10/2019	-	11.7	32.2	Waning Crescent
17/10/2019	3.8	15	33.8	NEW MOON
18/10/2019	0.2	9.2	33.1	Waxing Crescent
19/10/2019	-	4.8	26.2	Waxing Crescent
20/10/2019	0.8	10.3	30.0	Waxing Crescent
21/10/2019	-	6.5	24.3	Waxing Crescent
22/10/2019	-	6.2	27.2	Waxing Crescent
23/10/2019	-	8.8	28.7	Waxing Crescent
24/10/2019	-	15.5	32.0	FIRST QUARTER
25/10/2019	-	14.5	33.6	Waxing Gibbous
26/10/2019	-	19.3	36.4	Waxing Gibbous
27/10/2019	-	9.6	35.5	Waxing Gibbous
28/10/2019	-	6.9	27.5	Waxing Gibbous
29/10/2019	-	9.2	26.6	Waxing Gibbous
30/10/2019	-	13.1	30.5	Waxing Gibbous
31/10/2019	-	12.3	31.7	Waxing Gibbous
01/11/2019	-	11.5	33.0	Full moon
02/11/2019	-	15.5	33.3	Waning Gibbous

2.4 Nomenclature

The nomenclature of all threatened species follows the Threatened Species Profiles provided on the threatened species website of the Office of Environment and Heritage (OEH 2020). For non-threatened species the following applies: the nomenclature of frog species follows the Reptiles and Amphibians of Australia (Cogger 2014) and reptile species follows the Complete Guide to Reptiles of Australia (Wilson and Swan 2017). Mammal species nomenclature follows the Field Companion to the Mammals of Australia (Van Dyck *et al.* 2013) with the exception of the free-tail bat genus Mormopterus which follows Reardon *et al.* (2014). Bird species nomenclature follows the BirdLife Australia Working List of Australian Birds (Birdlife Australia 2017).

3 Results

The following sections in the body of this report provide a brief summary of the survey results and records of threatened species made during the survey. The data recorded are provided in the Appendices to this report:

- Appendix A: Fauna species list
- Appendix B: Fauna survey site locations
- Appendix C: Standard fauna survey site data

3.1 Fauna Recorded

A total of 167 species of vertebrate were recorded, comprising 11 frogs, 16 reptiles, 97 birds and 43 mammals (Appendix A), most of which were native. Twenty-two of the species detected are listed as threatened on the schedules of the *Biodiversity Conservation Act 2016* (BC Act) and/or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Six introduced species were recorded during the surveys, including the Red Fox (*Vulpes vulpes*), Cat (*Felis catus*), Black Rat (*Rattus rattus*), European Rabbit (*Oryctolagus cuniculus*), Brown Hare (*Lepus europaeus*) and Cattle (*Bos taurus*).

A summary of the number of native species recorded at each survey site is provided in Figures 3.1 and 3.2. The data excludes exotic species and opportunistic records.

Figure 3.1 Native bird and mammal species recorded at each survey site excluding opportunistic records

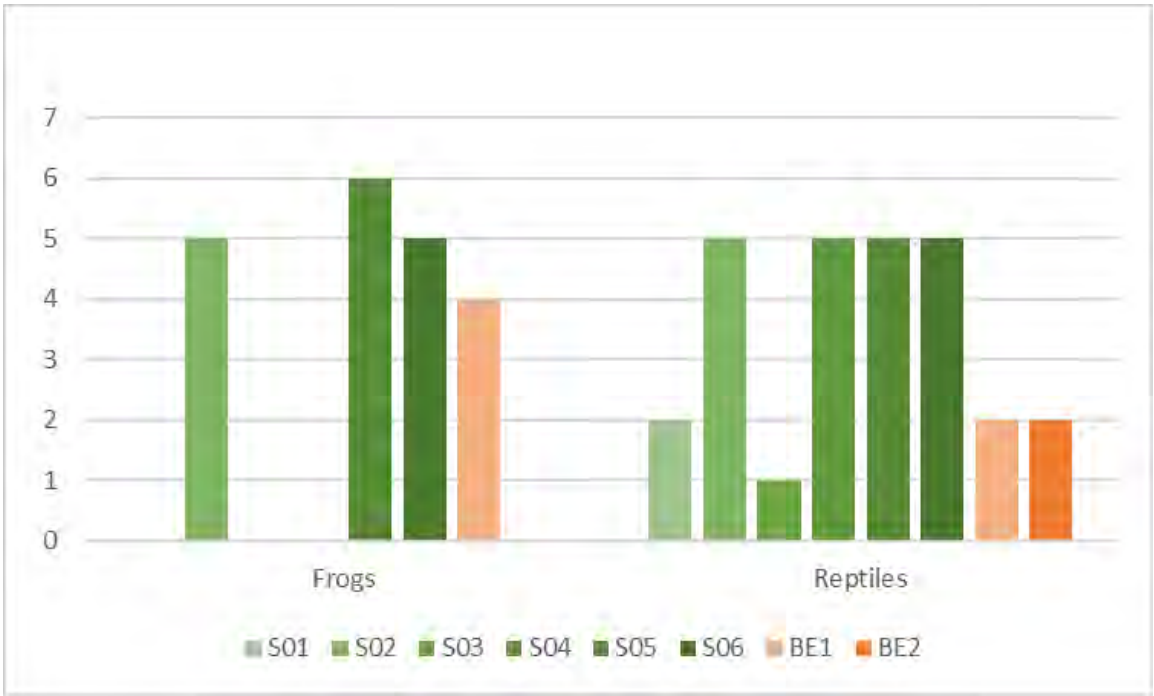


Figure 3.2 Native frog and reptile species recorded at each survey site excluding opportunistic records

3.2 Threatened and Migratory Fauna

Twenty-two of the species detected during the surveys are listed as threatened or migratory on the schedules of the BC Act and/or EPBC Act (Table 3.1). Two of the threatened species recorded, the Black-chinned Honeyeater (*Melithreptus gularis gularis*) and Red-legged Pademelon (*Thylogale stigmatica*), have not previously been recorded at the Stratford Mining Complex.

Threatened and migratory fauna recorded are listed in Table 3.1 and the locations of the records are shown in Figure 3.3. Descriptions of sightings for each species are provided below.

Table 3.1 Threatened and migratory fauna recorded during Spring 2019

Common Name	Scientific name	Conservation Status[1]		Areas Recorded[2]	
		BC Act	EPBC Act	SO	BE
Birds					
White-bellied Sea-eagle	*Haliaeetus leucogaster*	V	-	-	✓
Dusky Woodswallow	*Artamus cyanopterus cyanopterus*	V	-	✓	✓
Black-chinned Honeyeater (eastern subspecies)	*Melithreptus gularis gularis*	V	-	✓	-
Black-faced Monarch	*Monarcha melanopsis*	-	M	✓	-
Spectacled Monarch	*Symposiachrus trivirgatus*	-	M	✓	-
Varied Sittella	*Daphoenositta chrysoptera*	V	-	✓	✓
Grey-crowned Babbler (eastern subspecies)	*Pomatostomus temporalis temporalis*	V	-	✓	-
Black-necked Stork^	*Ephippiorhynchus asiaticus*	E	-	-	-
Little Lorikeet	*Glossopsitta pusilla*	V	-	✓	-
Mammals					
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	V	-	✓	-
Little Bent-winged Bat	*Miniopterus australis*	V	-	✓	✓
Large Bent-winged Bat	*Miniopterus orianae oceanensis*	V	-	✓	-
Eastern Coastal Free-tailed Bat	*Micronomus norfolkensis*	V	-	✓	✓
Large-eared Pied Bat	*Chalinolobus dwyeri*	V	V	✓	✓*
Southern Myotis	*Myotis macropus*	V	-	✓	✓
Greater Broad-nosed Bat	*Scoteanax rueppellii*	V	-	✓	-
Brush-tailed Phascogale	*Phascogale tapoatafa*	V	-	✓	✓
Red-legged Pademelon	*Thylogale stigmatica*	V	-	✓	-
Yellow-bellied Glider	*Petaurus australis*	V	-	✓	-
Squirrel Glider	*Petaurus norfolcensis*	V	-	✓	-
Koala	*Phascolarctos cinereus*	V	V	✓	-
New Holland Mouse	*Pseudomys novaehollandiae*	-	V	-	✓

Notes:
[1] Threatened or migratory fauna species status listed under the Biodiversity Conservation Act (BC Act) and/or Environment Protection and Biodiversity Conservation Act (EPBC Act) (current as of 20 March 2020).
[2] SO= Stratford Offset Area, BE= Biodiversity Enhancement Area
* probable record only
^ Recorded in surrounds of study area

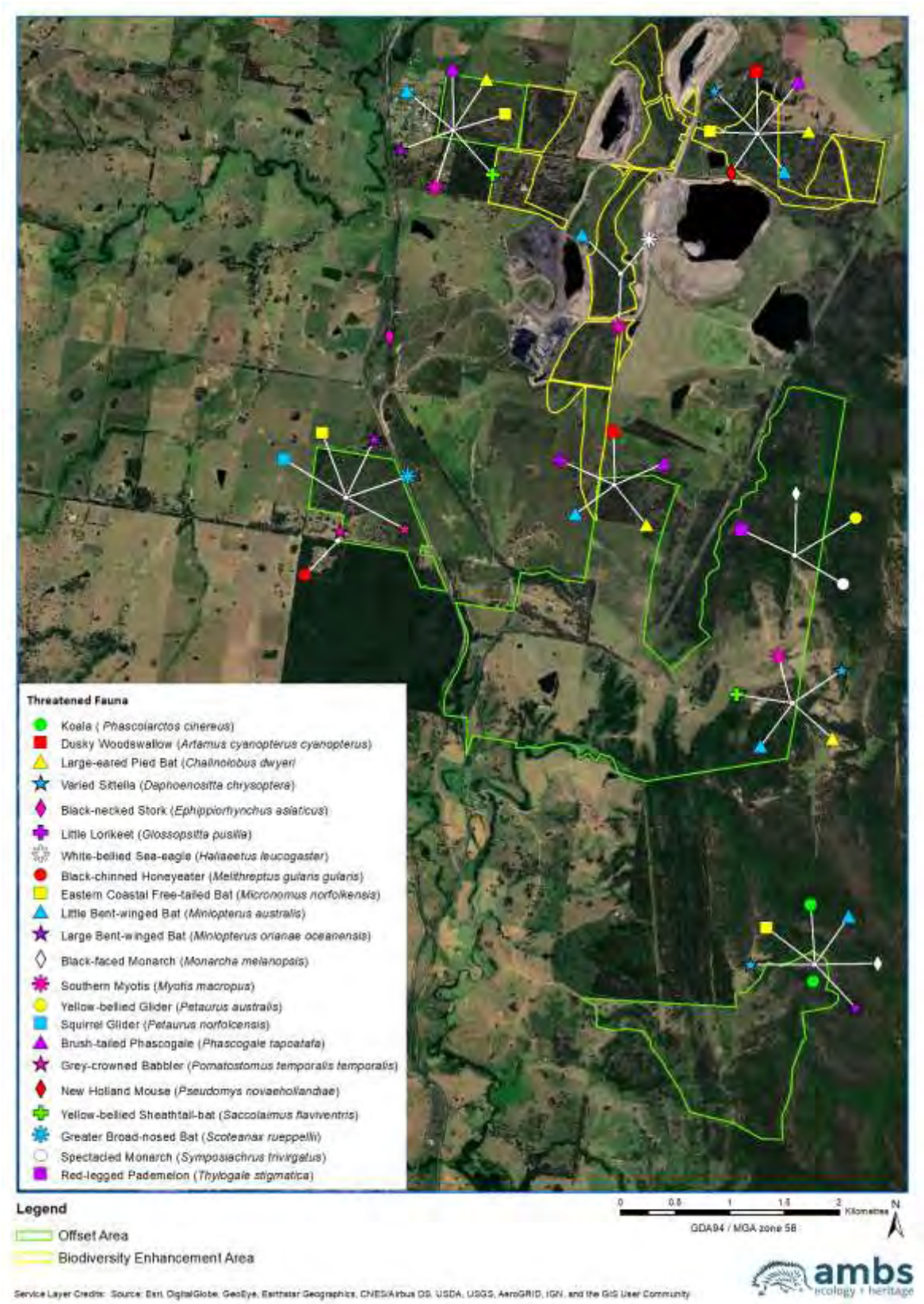


Figure 3.3 Threatened and migratory fauna recorded during the surveys

White-bellied Sea-eagle (Haliaeetus leucogaster)
There was one record of the White-bellied Sea-eagle. Two individuals were heard calling during a diurnal bird survey and a nest was found just inside the tree line near BE1. The nest was in good condition and likely recently built. However, no scraps of food or fresh scats were present under the nest. The pair of White-bellied Sea-eagles was likely preparing for breeding or the nest already contained eggs.

Dusky Woodswallow (Artamus cyanopterus cyanopterus)
The Dusky Woodswallow was recorded on five occasions at two sites during diurnal bird surveys. At SO3 the species was breeding; two nests were found, one contained chicks, the other eggs. At least six adult Dusky Woodswallows were observed and heard while flying over the site. One adult was seen feeding chicks in the nest. Two individuals were observed at BE2.

Black-chinned Honeyeater (Melithreptus gularis gularis)
There was one record of the Black-chinned Honeyeater during the surveys. One individual of the species was heard calling opportunistically along Woods Road at the gate into SO2.

Black-faced Monarch (Monarcha melanopsis)
The Black-faced Monarch was recorded three times during diurnal bird surveys. Calls of at least three individuals of this species were heard at SO4 and one individual was heard calling at SO6.

Spectacled Monarch (Symposiachrus trivirgatus)
There were two records of the Spectacled Monarch during the surveys. On two occasions one individual was heard calling at SO4 during diurnal bird surveys.

Varied Sittella (Daphoenositta chrysoptera)
There were five records of the Varied Sittella during the surveys. At least four individuals were observed or heard at BE2 either during diurnal bird surveys or opportunistically. Two individuals were observed during diurnal bird surveys at sites S05 and SO6.

Grey-crowned Babbler (eastern subspecies) (Pomatostomus temporalis temporalis)
There were two records or the Grey-crowned Babbler. An old, unused nest was found at SO2 during a diurnal bird survey and two individuals were observed opportunistically on Wood Road at the gate to SO2.

Black-necked Stork (Ephippiorhynchus asiaticus)
There was one record of the Black-necked Stork during the surveys. One individual of the species was observed opportunistically when travelling along The Bucketts Way about 1.2 km west of the SMC Office.

Little Lorikeet (Glossopsitta pusilla)
There was one record of the Little Lorikeet during the surveys. Two individuals were heard during a diurnal bird survey at SO3.

Yellow-bellied Sheathtail-bat (Saccolaimus flaviventris)
The Yellow-bellied Sheathtail-bat was recorded at two sites during the surveys. Definite calls of this species were found during Anabat call analysis at SO1 and probable calls at SO5.

Little Bent-winged Bat (Miniopterus australis)
The Little Bent-winged Bat was recorded at six sites during the surveys (BE1, BE2, SO1, SO3, SO5 and SO6). All records were from Anabat call analysis.

Large Bent-winged Bat (Miniopterus orianae oceanensis)
The Large Bent-winged Bat was recorded at three sites during the surveys. Definite calls of this species were found during Anabat call analysis at SO2 and SO6 and probable calls at SO1.

Eastern Coastal Freetail-bat (Micronomus norfolkensis)
The Eastern Freetail-bat was recorded at four sites during the surveys (BE2, SO1, SO2 and SO6). All records were from Anabat call analysis.

Large-eared Pied Bat (Chalinolobus dwyeri)
The Large-eared Pied Bat was recorded at four sites during the surveys. Definite calls of this species were found during Anabat call analysis at SO1 and probable calls at BE2, SO3 and SO5.

Southern Myotis (Myotis macropus)
The Southern Myotis was recorded at three sites during the surveys (BE1, SO1 and SO5). Definite calls of this species were found during Anabat call analysis at SO1 and SO5. The Anabat units at SO1 were positioned along an ephemeral drainage line which was dry at the time and at SO5 at the edge of the Wards River which was carrying water at the time of survey. At BE1 probable calls were found on an Anabat positioned next to a water-filled dam.

Greater Broad-nosed Bat (Scoteanax rueppellii)
The Greater Broad-nosed Bat was recorded at one site during the surveys, at SO2. The record was from Anabat call analysis.

Brush-tailed Phascogale (Phascogale tapoatafa)
The Brush-tailed Phascogale was recorded at three sites during the surveys (BE2, SO1 and SO3). At least one individual was recorded with remote monitoring cameras at each of the three sites.

Red-legged Pademelon (Thylogale stigmatica)
The Red-legged Pademelon was recorded at one site during the surveys (SO4). One adult male was recorded with remote monitoring cameras.

Yellow-bellied Glider (Petaurus australis)
There was one record of the Yellow-bellied Glider during the surveys. One individual was heard calling during spotlighting surveys at SO4.

Squirrel Glider (Petaurus norfolcensis)
There was one record of the Squirrel Glider during the surveys. One individual with an ear tag was seen during spotlighting surveys at SO2.

Koala (Phascolarctos cinereus)
There were two records of the Koala during the surveys, both at SO6. One individual was recorded with remote monitoring cameras and three scats were found opportunistically.

New Holland Mouse (Pseudomys novaehollandiae)
There was one record of the New Holland Mouse during the surveys. One male adult was captured during Elliott trapping at BE2.

Plate 1 Koala on remote camera image

Plate 2 Red-legged Pademelon on remote camera image

Plate 3 Brush-tailed Phascogale on remote camera image

Plate 4 Short-eared Brushtail Possum on remote camera image

3.3 Fauna Habitats

The survey conditions during the first week were warm and dry, however the rainfall which occurred prior to the second survey week improved the conditions for the detection of some fauna. Waterbodies and depressions were at least partially filled with water and frog calling activity was recorded at some sites (e.g. dam near BE1 and SO2, river south of SO5). Important resources such as flowering eucalyptus were uncommon. A few Stringybark were flowering at SO1 and SO3, and some eucalypts at BE2.

4 Discussion

4.1 Comparison with previous fauna surveys

A total of 167 species of vertebrate were recorded, comprising 11 frogs, 16 reptiles, 97 birds and 43 mammals, most of which were native. This is a reasonable diversity of fauna considering extreme drought conditions throughout the year and the relatively short length of the survey (i.e. 10 days), which was undertaken during one season. It is expected that the number of species recorded within the study area will increase with better weather and vegetation condition, as well as over time if additional fauna surveys are undertaken.

Australian Museum Business Services (2012) reported a total of 289 fauna species have been recorded within the SMC or surrounds since 1994. AMBS (2018) recorded a total of 104 species of vertebrate fauna, including 8 frogs, 10 reptiles, 56 birds and 30 mammals, most of which were native. In total, those studies documented 30 threatened or migratory species listed under the BC Act and/or EPBC Act that have been recorded within the SMC or surrounds. Threatened or migratory fauna recorded during the current study that have not been recorded at the SMC previously include the:

- Black-chinned Honeyeater (*Melithreptus gularis gularis*); and
- Red-legged Pademelon (*Thylogale stigmatica*)

4.2 Fauna usage in the Offset and Biodiversity Enhancement Areas

The fauna surveys suggest the Stratford Offset and Biodiversity Enhancement Areas provide foraging resources for a range of native vertebrate fauna, including birds, mammals, reptiles and frogs. This includes at least twenty-two species listed as threatened or migratory under BC Act and/or EPBC Act. For example, the Brush-tailed Phascogale was recorded on a remote monitoring camera in the Biodiversity Enhancement Area, Red-legged Pademelon in the Offset Area, and threatened microbats were identified from Anabat recordings.

Signs of nesting were observed for five bird species recorded during the surveys, including the White-bellied Sea-eagle, Dusky Woodswallow, Grey-crowned Babbler, Noisy Friarbird and Sacred Kingfisher. Observations of pregnant, lactating or juvenile animals during the surveys included reptiles (e.g. Lace Monitor) and mammals (e.g. Brown Antechinus, Common Brushtail Possum, Eastern Grey Kangaroo, Red-necked Pademelon, and microbats). It is likely the study area provides breeding habitat for many more of the native species recorded during the surveys. However, resources such as hollow-bearing trees, which are an important breeding component for some species, are still scarce or patchy in some locations in the study area.

4.3 Significance of the results and expected trends

The number of bird, mammal, reptile and frog species recorded at survey sites in the Stratford Offset and Biodiversity Enhancement Areas (Figure 3.1 and 3.2) is encouraging, particularly given the relatively young age of the vegetation in parts of the study area.

The number of bird and mammal species at the Biodiversity Enhancement sites was high in comparison to the Offset sites (Figure 3.1). The number of bird species recorded ranged from 16-28 and the average was 23.6 species per site. Amongst the Offset sites SO1 had noticeably smaller bird diversity compared to the other sites, which is likely due to the very young age of the vegetation and lack of structural diversity at this site. Site BE2 had the highest number of bird species of all the sites. The mammal diversity across all sites ranges from 12 to 21 species per site, with an average of 16.4 species. Site SO4 had the lowest mammal diversity and BE2 had the highest. Site BE2 contains forest habitat in good condition and with the structural diversity. The site contains old growth trees, good ground cover/shelter habitat, and fallen logs.

Differences in bird and mammal diversity are likely due to differences in a range of factors, including the structural diversity of the forest, abundance of old growth trees, fallen logs, abundance of roosting and nesting cavities, and habitat connectivity within the landscape.

The number of reptile and frog species at the Biodiversity Enhancement sites was low in comparison to some of the Offset sites (Figure 3.2). Frogs are dependent on water and this wasn't present at all standard fauna sites. However, where frog surveys were undertaken (at locations with water), the number of frog species recorded between sites was similar. The greater number of reptile species recorded at offset sites SO4, SO5 and SO6 may be due to the connectivity of these sites with other areas of habitat in the landscape, while SO2 contained several piles of woody debris, which can provide good reptile habitat.

Future monitoring of fauna within the Stratford Offset and Biodiversity Enhancement Areas may provide more information on species diversity and abundance trends.

5 Conclusion

Targeted fauna surveys were undertaken at six sites within the Stratfor Offset Areas and two sites within the Stratford Biodiversity Enhancement Area from 23 to 27 September 2019 and 28 October to 2 November 2019. At each site survey techniques included pitfall traps, funnel traps, Elliott A traps, harp traps, ultrasonic call recording, spotlighting, diurnal bird surveys and reptile searches. Opportunistic observations of signs of fauna were noted throughout the field survey period, including travel to and during transit between surveys sites.

A total of 167 species of vertebrate were recorded, comprising 11 frogs, 16 reptiles, 97 birds and 43 mammals (Appendix A), most of which were native. Six introduced species were recorded during the surveys, including the Red Fox (*Vulpes vulpes*), Cat (*Felis catus*), Black Rat (*Rattus rattus*), European Rabbit (*Oryctolagus cuniculus*), Brown Hare (*Lepus europaeus*) and Cattle (*Bos taurus*).

Twenty-two of the species detected are listed as threatened or migratory on the schedules of the BC Act and/or EPBC Act, including:

- White-bellied Sea-eagle (*Haliaeetus leucogaster*)
- Dusky Woodswallow (*Artamus cyanopterus cyanopterus*)
- Black-chinned Honeyeater (eastern subspecies) (*Melithreptus gularis gularis*)
- Black-faced Monarch (*Monarcha melanopsis*)
- Spectacled Monarch (*Symposiachrus trivirgatus*)
- Varied Sittella (*Daphoenositta chrysoptera*)
- Grey-crowned Babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*)
- Black-necked Stork (*Ephippiorhynchus asiaticus*)
- Little Lorikeet (*Glossopsitta pusilla*)
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)
- Little Bent-winged Bat (*Miniopterus australis*)
- Large Bent-winged Bat (*Miniopterus orianae oceanensis*)
- Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*)
- Large-eared Pied Bat (*Chalinolobus dwyeri*)
- Southern Myotis (*Myotis macropus*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Brush-tailed Phascogale (*Phascogale tapoatafa*)
- Red-legged Pademelon (*Thylogale stigmatica*)
- Yellow-bellied Glider (*Petaurus australis*)
- Squirrel Glider (*Petaurus norfolcensis*)
- Koala (*Phascolarctos cinereus*)
- New Holland Mouse (*Pseudomys novaehollandiae*)

All threatened species except the Black-necked Stork were recorded within either the Offset or the Biodiversity Enhancement Areas. Two of these species, the Black-chinned Honeyeater and the Red-legged Pademelon, have been recorded for the first time during dedicated fauna surveys for the SMC.

The fauna surveys suggest the Stratford Offset and Biodiversity Enhancement areas provide foraging and breeding habitat for a range of native vertebrate fauna, including birds, mammals, reptiles and frogs.

Bibliography

AGC Woodward-Clyde (1994). Avifauna. Attachment A8.3 of Appendix 8.2 of Stratford Coal (1994) *Stratford Coal Project Environmental Impact Statement.*

AMBS Ecology & Heritage (2017). Invasive animal study of the Stratford Coal Mining Lease, Gloucester Valley. Consultancy report to Stratford Coal Pty Ltd.

AMBS Ecology & Heritage (2018). Stratford Coal Mine: Fauna Surveys of the Mine Rehabilitation Areas, February 2018. Consultancy report to Stratford Coal Pty Ltd.

Australian Museum Business Services (2011). Stratford Surrounds Baseline Fauna Surveys. Report prepared for Gloucester Coal Pty Ltd by Australian Museum Business Services.

Birdlife Australia (2017). BirdLife Australia Working List of Australian Birds Version 2.1. https://www.birdlife.org.au/conservation/science/taxonomy

BOM (2020). Australian Bureau of Meteorology Website: http://www.bom.gov.au/. Accessed: 04/03/2020.

Cogger, H. (2014). Reptiles and Amphibians of Australia. Seventh edition, published by CSIRO Publishing.

Hoye, G.A. (1998). 1998 Summer Survey of Bats at the Stratford Open Cut Coal Mine, Stratford, New South Wales. In Richards, G.C. (2001) *An Assessment of the Bat Fauna at the proposed Bowens Road North Project, via Stratford, New South Wales.* Appendix FC of Stratford Coal (2001) *Bowens Road North Project Environmental Impact Statement.*

Hoye, G.A. and Finney, D. (1994). *Report on a Survey of the Bat Fauna of an Area Proposed for Open Cut Coal Mining Near Stratford, New South Wales.* Attachment 8.2-B Bat Survey (1994) of Appendix 8.2.

Mount King Ecological Surveys (2001). Bowens Road North Project, Stratford Fauna Survey and Assessment. Appendix FA of Stratford Coal (2001) *Bowens Road North Project Environmental Impact Statement.*

Murray, M. (1994). Survey of Frog Species at proposed Mine Stratford, Near Gloucester. Attachment A8.2-A Amphibian Survey (1994) of Appendix 8.2.

OEH (2020). Office of Environment and Heritage Threatened Species App – Profiles. Website: https://www.environment.nsw.gov.au/threatenedspeciesapp/. Accessed: 04/03/2020.

Reardon, T.B., McKenzie, N.L., Cooper, S.J.B., Appleton, B., Carthew, S. and Adams, M. (2014). A molecular and morphological investigation of species boundaries and phylogenetic relationships in Australian free-tailed bats Mormopterus (Chiroptera: Molossidae). *Australian Journal of Zoology*, 62: 109-136.

Richards, G.C. (2001). An Assessment of the Bat Fauna at the proposed Bowens Road North Project, via Stratford, New South Wales. Appendix FC of Stratford Coal (2001) Bowens Road North Project Environmental Impact Statement.

Stratford Coal Pty Ltd (1994). Terrestrial Fauna. Appendix 8.2 of Stratford Coal Pty Ltd (1994) Stratford Coal Project Environmental Impact Statement.

Van Dyck, S., Gynther, I. and Baker, A. (2013). Field Companion to Mammals of Australia. Published by New Holland.

Wilson & Swan (2017). A complete guide to reptiles of Australia. Fifth Edition. Reed New Holland Publishers.

Yancoal (2018a). Stratford Mining Complex Mining Operations and Rehabilitation Management Plan, 1 March 2018 to 1 March 2021. Version 1, March 2018.

Yancoal (2018b). Stratford Mining Complex (Stratford Extension Project) Biodiversity Management Plan. Version 2, October 2018.

Appendix A: Fauna recorded during the surveys

Class	Order	Family	Scientific name	Common Name	Individuals Observed	No. Observations	Ground Size	
							Min	Max
Amphibia	Anura	Hylidae	*Litoria fallax*	Eastern Dwarf Tree Frog	563	10	1	200
			Litoria latopalmata	Broad-palmed Frog	90	7	9	17
			Litoria peronii	Peron's Tree Frog	73	8	1	20
			Litoria tyleri	Tyler's Tree Frog	15	6	2	4
			Litoria wilcoxii	Wilcox's Frog	11	5	1	4
		Limnodynastidae	*Adelotus brevis*	Tusked Frog	18	7	1	4
			Limnodynastes peronii	Brown-striped Frog	1	1	1	1
			Limnodynastes tasmaniensis	Spotted Grass Frog	1	1	1	1
		Myobatrachidae	*Crinia signifera*	Common Eastern Froglet	14	4	1	5
			Uperoleia fusca	Dusky Toadlet	2	2	1	1
			Uperoleia laevigata	Smooth Toadlet	7	4	1	4
Reptilia	Squamata	Agamidae	*Intellagama lesueurii*	Water Dragon	5	5	1	1
			Pogona barbata	Common Bearded Dragon	6	6	1	1
		Elapidae	*Cryptophis nigrescens*	Eastern Small-eyed Snake	1	1	1	1
			Demansia psammophis	Yellow-faced Whipsnake	2	2	1	1
			Hemiaspis signata	Black-bellied Swamp Snake	2	2	1	1
			Pseudechis porphyriacus	Red-bellied Black Snake	1	1	1	1
		Scincidae	*Bellatorias major*	Land Mullet	1	1	1	1
			Calyptotis ruficauda	Red-tailed Calyptotis	1	1	1	1
			Ctenotus robustus	Eastern Striped Ctenotus	2	2	1	1
			Egernia mcpheei	Eastern Crevice-skink	1	1	1	1
			Eulamprus quoyii	Eastern Water Skink	1	1	1	1
			Lampropholis amicula	Friendly Sunskink	7	3	1	3
			Lampropholis delicata	Garden Skink	8	3	1	6
			Saiphos equalis	Three-toed Skink	7	3	1	4
		Typhlopidae	*Anilios nigrescens*	Blackish Blind Snake	1	1	1	1
		Varanidae	*Varanus varius*	Lace Monitor	47	46	1	2
Aves	Accipitriformes	Accipitridae	*Accipiter cirrocephalus*	Collared Sparrowhawk	1	1	1	1
			Elanus axillaris	Black-shouldered Kite	1	1	1	1
			Haliaeetus leucogaster	White-bellied Sea-eagle #	2	1	2	2
			Haliastur sphenurus	Whistling Kite	2	1	2	2
	Anseriformes	Anatidae	*Anas superciliosa*	Pacific Black Duck	1	1	1	1

Class	Order	Family	Scientific name	Common Name	Individuals Observed	No. Observations	Ground Size	
							Min	Max
			Chenonetta jubata	Australian Wood Duck	2	1	2	2
	Caprimulgiformes	Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar	8	7	1	2
		Eurostopodidae	*Eurostopodus mystacalis*	White-throated Nightjar	3	3	1	1
		Podargidae	*Podargus strigoides*	Tawny Frogmouth	4	3	1	2
	Charadriiformes	Charadriidae	*Elseyornis melanops*	Black-fronted Dotterel	2	1	2	2
			Vanellus miles	Masked Lapwing	3	2	1	2
		Turnicidae	*Turnix varius*	Painted Button-quail	2	1	2	2
	Columbiformes	Columbidae	*Geopelia humeralis*	Bar-shouldered Dove	1	1	1	1
			Leucosarcia melanoleuca	Wonga Pigeon	12	12	1	1
			Macropygia phasianella	Brown Cuckoo-dove	4	1	4	4
	Coraciiformes	Alcedinidae	*Ceyx azureus*	Azure Kingfisher	1	1	1	1
			Dacelo novaeguineae	Laughing Kookaburra	10	5	1	4
			Todiramphus sanctus	Sacred Kingfisher	13	6	1	4
		Coraciidae	*Eurystomus orientalis*	Dollarbird	1	1	1	1
		Meropidae	*Merops ornatus*	Rainbow Bee-eater	1	1	1	1
	Cuculiformes	Centropodidae	*Centropus phasianinus*	Pheasant Coucal	2	2	1	1
		Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo	1	1	1	1
			Cacomantis variolosus	Brush Cuckoo	5	5	1	1
			Chalcites basalis	Horsfield's Bronze-Cuckoo	1	1	1	1
			Chalcites lucidus	Shining Bronze-Cuckoo	3	3	1	1
			Heteroscenes pallidus	Pallid Cuckoo	4	4	1	1
			Scythrops novaehollandiae	Channel-billed Cuckoo	2	2	1	1
	Galliformes	Megapodiidae	*Alectura lathami*	Australian Brush-turkey	1	1	1	1
	Passeriformes	Acanthizidae	*Acanthiza lineata*	Striated Thornbill	26	6	2	6
			Acanthiza nana	Yellow Thornbill	36	10	1	12
			Acanthiza pusilla	Brown Thornbill	9	6	1	2
			Acanthiza reguloides	Buff-rumped Thornbill	3	2	1	2
			Gerygone mouki	Brown Gerygone	4	3	1	2
			Gerygone olivacea	White-throated Gerygone	21	13	1	3
			Sericornis frontalis	White-browed Scrubwren	2	1	2	2
			Sericornis magnirostra	Large-billed Scrubwren	3	1	3	3
		Artamidae	*Artamus cyanopterus cyanopterus*	Dusky Woodswallow #Babb	15	5	1	6
			Cracticus nigrogularis	Pied Butcherbird	6	5	1	2
			Cracticus torquatus	Grey Butcherbird	3	2	1	2
			Gymnorhina tibicen	Australian Magpie	23	21	1	2
			Strepera graculina	Pied Currawong	5	4	1	2

Class	Order	Family	Scientific name	Common Name	Individuals Observed	No. Observations	Ground Size	
							Min	Max
		Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	9	8	1	2
			Coracina papuensis	White-bellied Cuckoo-shrike	2	2	1	1
			Edolisoma tenuirostris	Cicadabird	2	2	1	1
		Climacteridae	*Cormobates leucophaea*	White-throated Treecreeper	13	10	1	2
		Corvidae	*Corvus coronoides*	Australian Raven	10	8	1	3
			Corvus orru	Torresian Crow	4	2	1	3
		Dicaeidae	*Dicaeum hirundinaceum*	Mistletoebird	5	5	1	1
		Estrildidae	*Neochmia temporalis*	Red-browed Finch	35	1	35	35
		Falcunculidae	*Falcunculus frontatus*	Crested Shrike-tit	3	3	1	1
		Maluridae	*Malurus cyaneus*	Superb Fairy-wren	26	9	1	7
			Malurus lamberti	Variegated Fairy-wren	9	4	1	4
		Meliphagidae	*Acanthorhynchus tenuirostris*	Eastern Spinebill	3	3	1	1
			Anthochaera carunculata	Red Wattlebird	4	2	2	2
			Anthochaera chrysoptera	Little Wattlebird	1	1	1	1
			Caligavis chrysops	Yellow-faced Honeyeater	86	18	1	12
			Manorina melanocephala	Noisy Miner	24	5	3	7
			Manorina melanophrys	Bell Miner	150	2	50	100
			Meliphaga lewinii	Lewin's Honeyeater	15	9	1	3
			Melithreptus brevirostris	Brown-headed Honeyeater	8	3	1	6
			Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies) #	1	1	1	1
			Melithreptus lunatus	White-naped Honeyeater	39	5	2	13
			Myzomela sanguinolenta	Scarlet Honeyeater	17	10	1	4
			Philemon corniculatus	Noisy Friarbird	22	10	1	6
			Ptilotula fusca	Fuscous Honeyeater	6	2	2	4
		Menuridae	*Menura novaehollandiae*	Superb Lyrebird	1	1	1	1
		Monarchidae	*Grallina cyanoleuca*	Magpie-lark	10	7	1	2
			Monarcha melanopsis	Black-faced Monarch #	5	3	1	3
			Myiagra rubecula	Leaden Flycatcher	23	9	1	4
			Symposiachrus trivirgatus	Spectacled Monarch #	2	2	1	1
		Motacillidae	*Anthus novaeseelandiae*	Australasian Pipit	3	1	3	3
		Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella #	14	5	2	4
		Oriolidae	*Oriolus sagittatus*	Olive-backed Oriole	9	6	1	2
		Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush	9	6	1	2
			Pachycephala pectoralis	Golden Whistler	10	10	1	1
			Pachycephala rufiventris	Rufous Whistler	58	19	1	8

Class	Order	Family	Scientific name	Common Name	Individuals Observed	No. Observations	Ground Size	
							Min	Max
		Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote	9	3	1	4
			Pardalotus striatus	Striated Pardalote	6	3	1	3
		Petroicidae	*Eopsaltria australis*	Eastern Yellow Robin	14	10	1	4
			Petroica rosea	Rose Robin	2	1	2	2
		Pomatostomidae	*Pomatostomus temporalis temporalis*	Grey-crowned Babbler (eastern subspecies) #	3	2	1	2
		Psophodidae	*Psophodes olivaceus*	Eastern Whipbird	8	5	1	2
		Ptilonorhynchidae	*Ailuroedus crassirostris*	Green Catbird	2	2	1	1
			Ptilonorhynchus violaceus	Satin Bowerbird	8	3	1	6
		Rhipiduridae	*Rhipidura fuliginosa*	Grey Fantail	34	16	1	4
			Rhipidura leucophrys	Willie Wagtail	3	3	1	1
		Zosteropidae	*Zosterops lateralis*	Silvereye	2	1	2	2
	Pelecaniformes	Ardeidae	*Ardea pacifica*	White-necked Heron	1	1	1	1
		Ciconiidae	*Ephippiorhynchus asiaticus*	Black-necked Stork #	1	1	1	1
	Psittaciformes	Cacatuidae	*Zanda funereus*	Yellow-tailed Black-cockatoo	1	1	1	1
		Psittaculidae	*Alisterus scapularis*	Australian King-parrot	3	1	3	3
			Glossopsitta pusilla	Little Lorikeet #	2	1	2	2
			Platycercus elegans	Crimson Rosella	25	7	1	8
			Platycercus eximius	Eastern Rosella	5	3	1	3
			Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet	1	1	1	1
			Trichoglossus moluccanus	Rainbow Lorikeet	9	4	1	4
	Strigiformes	Tytonidae	*Tyto alba*	Barn Owl	1	1	1	1
Mammalia	Artiodactyla	Bovidae	*Bos taurus*	Cattle	2	2	1	1
	Carnivora	Canidae	*Canis lupus dingo*	Dingo/Wild Dog	1	1	1	1
			Vulpes vulpes	Red Fox *	16	16	1	1
		Felidae	*Felis catus*	Cat *	3	3	1	1
	Chiroptera	Emballonuridae	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat #	2	2	1	1
		Miniopteridae	*Miniopterus australis*	Little Bent-winged Bat #	6	6	1	1
			Miniopterus orianae oceanensis	Large Bent-winged Bat #	3	3	1	1
		Molossidae	*Austronomus australis*	White-striped Free-tailed Bat	14	13	1	2
			Micronomus norfolkensis	Eastern Coastal Free-tailed Bat #	4	4	1	1
			Mormopterus (Ozimops) ridei	Eastern free-tailed bat	6	6	1	1
		Rhinolophidae	*Rhinolophus megaphyllus*	Eastern Horseshoe Bat	7	7	1	1
		Vespertilionidae	*Chalinolobus dwyeri*	Large-eared Pied Bat #	4	4	1	1
			Chalinolobus gouldii	Gould's Wattled Bat	5	5	1	1
			Chalinolobus morio	Chocolate Wattled Bat	10	9	1	2

Class	Order	Family	Scientific name	Common Name	Individuals Observed	No. Observations	Ground Size	
							Min	Max
			Myotis macropus	Southern Myotis #	3	3	1	1
			Nyctophilus geoffroyi	Lesser Long-eared Bat	17	7	1	3
			Nyctophilus gouldi	Gould's Long-eared Bat	13	7	1	6
			Scoteanax rueppellii	Greater Broad-nosed Bat #	1	1	1	1
			Scotorepens orion	Eastern Broad-nosed Bat	5	5	1	1
			Vespadelus pumilus	Eastern Forest Bat	25	16	1	9
			Vespadelus vulturnus	Little Forest Bat	40	23	1	5
	Dasyuromorphia	Dasyuridae	*Antechinus stuartii*	Brown Antechinus	18	13	1	3
			Phascogale tapoatafa	Brush-tailed Phascogale #	3	3	1	1
			Sminthopsis murina	Common Dunnart	1	1	1	1
	Diprotodonta	Macropodidae	*Macropus giganteus*	Eastern Grey Kangaroo	12	10	1	2
			Macropus rufogriseus	Red-necked Wallaby	16	11	1	3
			Thylogale stigmatica	Red-legged Pademelon #	3	1	3	3
			Thylogale thetis	Red-necked Pademelon	4	3	1	2
			Wallabia bicolor	Swamp Wallaby	1	1	1	1
		Petauridae	*Petaurus australis*	Yellow-bellied Glider #	1	1	1	1
			Petaurus breviceps	Sugar Glider	1	1	1	1
			Petaurus norfolcensis	Squirrel Glider #	1	1	1	1
		Phalangeridae	*Trichosurus caninus*	Short-eared Brushtail Possum	7	7	1	1
			Trichosurus vulpecula	Common Brushtail Possum	139	117	1	4
		Phascolarctidae	*Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)*	Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) #	4	2	1	3
		Pseudocheiridae	*Pseudocheirus peregrinus*	Common Ringtail Possum	3	1	3	3
	Lagomorpha	Leporidae	*Lepus europaeus*	European Brown Hare *	2	2	1	1
			Oryctolagus cuniculus	European Rabbit *	10	9	1	2
	Monotremata	Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna	7	7	1	1
	Peramelemorphia	Peramelidae	*Isoodon macrourus*	Northern Brown Bandicoot	7	7	1	1
			Perameles nasuta	Long-nosed Bandicoot	6	5	1	2
	Rodentia	Muridae	*Pseudomys novaehollandiae*	New Holland Mouse #	1	1	1	1
			Rattus rattus	Black Rat *	1	1	1	1

Notes:

* Indicates introduced species or livestock

# Indicates threatened and/or migratory species under the Biodiversity Conservation Act 2016/or Commonwealth Environment Protection and Biodiversity Conservation Act 1999

Appendix B: Fauna survey location co-ordinates

Note: GPS coordinates provided as UTM (GDA94, Zone 56).

Site	Equipment	Easting	Northing
BE1	Pitfall Traps	401912	6444519
BE1	Elliott Start	401944	6444323
BE1	Elliott End	401898	6444575
BE1	Camera 1	401874	6444567
BE1	Camera 2	401910	6444458
BE1	Anabat 1	401878	6444556
BE1	Anabat 2	401904	6444411
BE1	Harp Trap 1	401874	6444589
BE1	Harp Trap 2	401910	6444458
BE2	Pitfall Traps	403161	6445798
BE2	Elliott Start	403202	6446020
BE2	Elliott End	403153	6445777
BE2	Camera 1	403107	6445818
BE2	Camera 2	403194	6445810
BE2	Anabat 1	403174	6445790
BE2	Anabat 2	403126	6445816
BE2	Harp Trap 1	403071	6445845
BE2	Harp Trap 2	403166	6445816
SO1	Pitfall Traps	400378	6445827
SO1	Elliott Start	400613	6445777
SO1	Elliott End	400367	6445822
SO1	Camera 1	400423	6445898
SO1	Camera 2	400546	6445817
SO1	Anabat 1	400356	6445769
SO1	Anabat 2	400423	6445933
SO1	Harp Trap 1	400395	6445840
SO1	Harp Trap 2	400415	6445907
SO2	Pitfall Traps	399401	6442476
SO2	Elliott Start	399356	6442653
SO2	Elliott End	399469	6442396
SO2	Camera 1	399367	6442531
SO2	Camera 2	399367	6442531
SO2	Anabat 1	399429	6442464
SO2	Anabat 2	399325	6442713
SO2	Harp Trap 1	399423	6442448
SO2	Harp Trap 2	399402	6442581
SO3	Pitfall Traps	401853	6442593
SO3	Elliott Start	401840	6442332
SO3	Elliott End	401830	6442592
SO3	Camera 1	401838	6442590
SO3	Camera 2	401877	6442460
SO3	Anabat 1	401875	6442571
SO3	Anabat 2	401871	6442664
SO3	Harp Trap 1	401875	6442644
SO3	Harp Trap 2	401903	6442622
SO4	Pitfall Traps	403501	6441949
SO4	Elliott 1st Half-Start	403488	6441912
SO4	Elliott 1st Half-End	403434	6442060
SO4	Elliott 2nd Half-Start	403542	6442048
SO4	Elliott 2nd Half-End	403436	6441821
SO4	Camera 1	403440	6442042
SO4	Camera 2	403466	6441971
SO4	Anabat 1	403470	6441970
SO4	Anabat 2	403452	6442043
SO4	Harp Trap 1	403431	6442040

Site	Equipment	Easting	Northing
SO4	Harp Trap 2	403496	6441961
SO5	Pitfall Traps	403476	6440600
SO5	Elliott Start	403483	6440388
SO5	Elliott End	403505	6440631
SO5	Camera 1	403495	6440541
SO5	Camera 2	403451	6440405
SO5	Anabat 1	403445	6440668
SO5	Anabat 2	403372	6440390
SO5	Harp Trap 1	403406	6440376
SO5	Harp Trap 2	403471	6440648
SO6	Pitfall Traps	403681	6438214
SO6	Elliott Start	403681	6438000
SO6	Elliott End	403705	6438232
SO6	Camera 1	403623	6438235
SO6	Camera 2	403626	6438144
SO6	Anabat 1	403596	6437964
SO6	Anabat 2	403680	6438259
SO6	Harp Trap 1	403675	6438216
SO6	Harp Trap 2	403592	6438172
F1	Frog Survey	401990	6444664
F2	Frog Survey	399345	6442713
F3	Frog Survey	403389	6440385
F4	Frog Survey	403599	6438166

Appendix C: Species recorded at standard sites

Site	Class	Scientific name	Common Name	Bird Survey	Camera Traps	Elliott Traps-Ground	Frog-/Tadpole Search	Funnel Traps	Harp Traps	Pitfall Traps	Reptile Search	Spotlighting	Ultrasonic Call
BE1	Amphibia	*Litoria latopalmata*	Broad-palmed Frog				29						
		Litoria wilcoxii	Wilcox's Frog				3						
		Crinia signifera	Common Eastern Froglet				4						
		Uperoleia fusca	Dusky Toadlet							1			
	Reptilia	*Pogona barbata*	Common Bearded Dragon			1							
		Lampropholis sp.	unidentified Lampropholis								4		
	Aves	*Haliaeetus leucogaster*	White-bellied Sea-eagle	2									
		Aegotheles cristatus	Australian Owlet-nightjar									2	
		Podargus strigoides	Tawny Frogmouth									3	
		Todiramphus sanctus	Sacred Kingfisher	4									
		Eurystomus orientalis	Dollarbird	1									
		Acanthiza nana	Yellow Thornbill	5									
		Gerygone olivacea	White-throated Gerygone	5									
		Cracticus torquatus	Grey Butcherbird	1									
		Gymnorhina tibicen	Australian Magpie	2									
		Coracina novaehollandiae	Black-faced Cuckoo-shrike	2									
		Coracina papuensis	White-bellied Cuckoo-shrike	1									
		Malurus cyaneus	Superb Fairy-wren	9									
		Caligavis chrysops	Yellow-faced Honeyeater	8									
		Manorina melanocephala	Noisy Miner	8									
		Philemon corniculatus	Noisy Friarbird	12									
		Grallina cyanoleuca	Magpie-lark									1	
		Myiagra rubecula	Leaden Flycatcher	6									
		Oriolus sagittatus	Olive-backed Oriole	2									
		Pachycephala pectoralis	Golden Whistler	1									
		Pachycephala rufiventris	Rufous Whistler	7									
		Eopsaltria australis	Eastern Yellow Robin	2									
		Rhipidura fuliginosa	Grey Fantail	6									
		Zosterops lateralis	Silvereye	2									
		Platycercus elegans	Crimson Rosella	11									
		Trichoglossus moluccanus	Rainbow Lorikeet	2									
	Mammalia	*Vulpes vulpes*	Red Fox		2								

Site	Class	Scientific name	Common Name	Bird Survey	Camera Traps	Elliott Traps-Ground	Frog-/Tadpole Search	Funnel Traps	Harp Traps	Pitfall Traps	Reptile Search	Spotlighting	Ultrasonic Call
		Miniopterus australis	Little Bent-winged Bat										1
		Austronomus australis	White-striped Free-tailed Bat										1
		Mormopterus (Ozimops) ridei	Eastern free-tailed bat										1
		Rhinolophus megaphyllus	Eastern Horseshoe Bat										1
		Chalinolobus gouldii	Gould's Wattled Bat										1
		Chalinolobus morio	Chocolate Wattled Bat										1
		Myotis macropus	Southern Myotis										1^
		Nyctophilus geoffroyi	Lesser Long-eared Bat						3				
		Nyctophilus sp.	unidentified Nyctophilus										1
		Scotorepens orion	Eastern Broad-nosed Bat										1^
		Vespadelus pumilus	Eastern Forest Bat										1
		Vespadelus vulturnus	Little Forest Bat						6				
		Antechinus stuartii	Brown Antechinus			1							
		Macropus giganteus	Eastern Grey Kangaroo		2							2	
		Trichosurus vulpecula	Common Brushtail Possum		6							1	
		Tachyglossus aculeatus	Short-beaked Echidna		1								
BE2	Reptilia	*Hemiaspis signata*	Black-bellied Swamp Snake								1		
			unidentified skink								1		
		Varanus varius	Lace Monitor		4								
	Aves	*Accipiter cirrocephalus*	Collared Sparrowhawk									1	
		Leucosarcia melanoleuca	Wonga Pigeon		1								
		Todiramphus sanctus	Sacred Kingfisher	3									
		Cacomantis variolosus	Brush Cuckoo	1									
		Chalcites lucidus	Shining Bronze-Cuckoo	1									
		Heteroscenes pallidus	Pallid Cuckoo	1									
		Acanthiza lineata	Striated Thornbill	6									
		Acanthiza nana	Yellow Thornbill	6									
		Acanthiza pusilla	Brown Thornbill	2									
		Gerygone olivacea	White-throated Gerygone	3									
		Artamus cyanopterus cyanopterus	Dusky Woodswallow	2									
		Coracina novaehollandiae	Black-faced Cuckoo-shrike	1									
		Cormobates leucophaea	White-throated Treecreeper	3									
		Dicaeum hirundinaceum	Mistletoebird	1									
		Falcunculus frontatus	Crested Shrike-tit	1									
		Malurus cyaneus	Superb Fairy-wren	3									
		Malurus lamberti	Variegated Fairy-wren	2									

Site	Class	Scientific name	Common Name	Bird Survey	Camera Traps	Elliott Traps-Ground	Frog-/Tadpole Search	Funnel Traps	Harp Traps	Pitfall Traps	Reptile Search	Spotlighting	Ultrasonic Call
		Acanthorhynchus tenuirostris	Eastern Spinebill	1									
		Caligavis chrysops	Yellow-faced Honeyeater	9									
		Melithreptus brevirostris	Brown-headed Honeyeater	7									
		Myzomela sanguinolenta	Scarlet Honeyeater	2									
		Grallina cyanoleuca	Magpie-lark	2									
		Myiagra rubecula	Leaden Flycatcher	8									
		Daphoenositta chrysoptera	Varied Sittella	7									
		Pachycephala pectoralis	Golden Whistler	1									
		Pachycephala rufiventris	Rufous Whistler	13									
		Eopsaltria australis	Eastern Yellow Robin	2									
		Ptilonorhynchus violaceus	Satin Bowerbird	6									
		Rhipidura fuliginosa	Grey Fantail	7									
	Mammalia	*Vulpes vulpes*	Red Fox		3								
		Miniopterus australis	Little Bent-winged Bat										1
		Austronomus australis	White-striped Free-tailed Bat									1	1
		Micronomus norfolkensis	Eastern Coastal Free-tailed Bat										1
		Mormopterus (Ozimops) ridei	Eastern free-tailed bat										1
		Chalinolobus dwyeri	Large-eared Pied Bat										1^
		Chalinolobus gouldii	Gould's Wattled Bat										1
		Chalinolobus morio	Chocolate Wattled Bat						3				1
		Nyctophilus geoffroyi	Lesser Long-eared Bat						9				
		Nyctophilus gouldi	Gould's Long-eared Bat						1				
		Nyctophilus sp.	unidentified Nyctophilus										1
		Scotorepens orion	Eastern Broad-nosed Bat										1
		Vespadelus pumilus	Eastern Forest Bat						1				1
		Vespadelus vulturnus	Little Forest Bat						8				1
		Antechinus stuartii	Brown Antechinus			8							
		Phascogale tapoatafa	Brush-tailed Phascogale		1								
		Sminthopsis murina	Common Dunnart			1							
		Macropus giganteus	Eastern Grey Kangaroo		1								
		Macropus rufogriseus	Red-necked Wallaby		2								
		Trichosurus caninus	Short-eared Brushtail Possum		2								
		Trichosurus vulpecula	Common Brushtail Possum		14							5	
		Oryctolagus cuniculus	European Rabbit		6								
		Isoodon macrourus	Northern Brown Bandicoot		1								
		Pseudomys novaehollandiae	New Holland Mouse			1							

Site	Class	Scientific name	Common Name	Bird Survey	Camera Traps	Elliott Traps-Ground	Frog-/Tadpole Search	Funnel Traps	Harp Traps	Pitfall Traps	Reptile Search	Spotlighting	Ultrasonic Call
S01	Reptilia	*Lampropholis delicata*	Garden Skink								6		
		Varanus varius	Lace Monitor		1								
	Aves	*Macropygia phasianella*	Brown Cuckoo-dove	4									
		Acanthiza lineata	Striated Thornbill	2									
		Acanthiza nana	Yellow Thornbill	12									
		Acanthiza pusilla	Brown Thornbill	1									
		Acanthiza reguloides	Buff-rumped Thornbill	3									
		Gymnorhina tibicen	Australian Magpie		1								
		Coracina novaehollandiae	Black-faced Cuckoo-shrike	1									
		Malurus cyaneus	Superb Fairy-wren		4								
		Malurus lamberti	Variegated Fairy-wren	4									
		Anthochaera carunculata	Red Wattlebird	2									
		Caligavis chrysops	Yellow-faced Honeyeater	10									
		Philemon corniculatus	Noisy Friarbird	1									
		Pachycephala rufiventris	Rufous Whistler	1									
		Eopsaltria australis	Eastern Yellow Robin	2								1	
		Rhipidura fuliginosa	Grey Fantail	3									
		Platycercus elegans	Crimson Rosella	2									
	Mammalia	*Vulpes vulpes*	Red Fox		2							1	
		Felis catus	Cat		3								
		Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat										1
		Miniopterus australis	Little Bent-winged Bat										1
		Miniopterus orianae oceanensis	Large Bent-winged Bat										1^
		Austronomus australis	White-striped Free-tailed Bat										1
		Micronomus norfolkensis	Eastern Coastal Free-tailed Bat										1
		Mormopterus (Ozimops) ridei	Eastern free-tailed bat										1
		Rhinolophus megaphyllus	Eastern Horseshoe Bat										1
		Chalinolobus dwyeri	Large-eared Pied Bat										1
		Chalinolobus gouldii	Gould's Wattled Bat										1
		Chalinolobus morio	Chocolate Wattled Bat										1
		Myotis macropus	Southern Myotis										1
		Nyctophilus geoffroyi	Lesser Long-eared Bat						3				
		Nyctophilus sp.	unidentified Nyctophillus										1
		Vespadelus pumilus	Eastern Forest Bat										1
		Vespadelus vulturnus	Little Forest Bat						1				
		Antechinus stuartii	Brown Antechinus			3							

Site	Class	Scientific name	Common Name	Bird Survey	Camera Traps	Elliott Traps-Ground	Frog-/Tadpole Search	Funnel Traps	Harp Traps	Pitfall Traps	Reptile Search	Spotlighting	Ultrasonic Call
		Phascogale tapoatafa	Brush-tailed Phascogale		1								
		Macropus rufogriseus	Red-necked Wallaby		8							1	
		Trichosurus vulpecula	Common Brushtail Possum		15	1						4	
		Tachyglossus aculeatus	Short-beaked Echidna		1								
S02	Amphibia	*Litoria fallax*	Eastern Dwarf Tree Frog				200						
		Litoria latopalmata	Broad-palmed Frog				9						
		Litoria peronii	Peron's Tree Frog				15						
		Limnodynastes tasmaniensis	Spotted Grass Frog				1						
		Uperoleia fusca	Dusky Toadlet							1			
	Reptilia	*Intellagama lesueurii*	Water Dragon								1		
		Demansia psammophis	Yellow-faced Whipsnake							1			
		Hemiaspis signata	Black-bellied Swamp Snake				1						
		Ctenotus robustus	Eastern Striped Ctenotus							1	1		
		Lampropholis amicula	Friendly Sunskink					3		3			
	Aves	*Haliastur sphenurus*	Whistling Kite	2									
		Podargus strigoides	Tawny Frogmouth									1	
		Dacelo novaeguineae	Laughing Kookaburra		1								
		Heteroscenes pallidus	Pallid Cuckoo	1									
		Acanthiza lineata	Striated Thornbill	6									
		Acanthiza nana	Yellow Thornbill	1									
		Gerygone olivacea	White-throated Gerygone	6									
		Cracticus torquatus	Grey Butcherbird	2									
		Gymnorhina tibicen	Australian Magpie	3	4								
		Coracina novaehollandiae	Black-faced Cuckoo-shrike	2									
		Corvus sp.	unidentified Corvus		13								
		Malurus cyaneus	Superb Fairy-wren	7									
		Caligavis chrysops	Yellow-faced Honeyeater	22									
		Manorina melanocephala	Noisy Miner	13									
		Melithreptus brevirostris	Brown-headed Honeyeater	1									
		Melithreptus lunatus	White-naped Honeyeater	25									
		Philemon corniculatus	Noisy Friarbird	5									
		Grallina cyanoleuca	Magpie-lark	4									
		Myiagra rubecula	Leaden Flycatcher	6									
		Pachycephala rufiventris	Rufous Whistler	6									
		Pardalotus striatus	Striated Pardalote	5									
		Rhipidura fuliginosa	Grey Fantail	5									

Site	Class	Scientific name	Common Name	Bird Survey	Camera Traps	Elliott Traps-Ground	Frog-/Tadpole Search	Funnel Traps	Harp Traps	Pitfall Traps	Reptile Search	Spotlighting	Ultrasonic Call
		Rhipidura leucophrys	Willie Wagtail	1									
		Ardea pacifica	White-necked Heron	1									
		Platycercus elegans	Crimson Rosella	9									
		Platycercus eximius	Eastern Rosella	4									
	Mammalia	*Bos taurus*	Cattle		2								
		Vulpes vulpes	Red Fox		2							1	
		Miniopterus orianae oceanensis	Large Bent-winged Bat										1
		Austronomus australis	White-striped Free-tailed Bat									3	1
		Micronomus norfolkensis	Eastern Coastal Free-tailed Bat										1
		Mormopterus (Ozimops) ridei	Eastern free-tailed bat										1
		Rhinolophus megaphyllus	Eastern Horseshoe Bat										1
		Chalinolobus gouldii	Gould's Wattled Bat										1
		Chalinolobus morio	Chocolate Wattled Bat										1
		Nyctophilus geoffroyi	Lesser Long-eared Bat						1				
		Nyctophilus sp.	unidentified Nyctophilus										1
		Scoteanax rueppellii	Greater Broad-nosed Bat										1
		Vespadelus pumilus	Eastern Forest Bat										1
		Vespadelus vulturnus	Little Forest Bat										1
		Macropus giganteus	Eastern Grey Kangaroo		2								
		Petaurus breviceps	Sugar Glider									1	
		Petaurus norfolcensis	Squirrel Glider									1	
		Trichosurus vulpecula	Common Brushtail Possum		1							2	
		Lepus europaeus	European Brown Hare		2								
		Tachyglossus aculeatus	Short-beaked Echidna		1								
S03	Reptilia	*Egernia mcpheei*	Eastern Crevice-skink								1		
	Aves	*Leucosarcia melanoleuca*	Wonga Pigeon		1								
		Todiramphus sanctus	Sacred Kingfisher	6									
		Cacomantis variolosus	Brush Cuckoo	1									
		Acanthiza nana	Yellow Thornbill	4									
		Gerygone olivacea	White-throated Gerygone	1									
		Artamus cyanopterus cyanopterus	Dusky Woodswallow	7									
		Cormobates leucophaea	White-throated Treecreeper	3									
		Dicaeum hirundinaceum	Mistletoebird	1									
		Acanthorhynchus tenuirostris	Eastern Spinebill	1									
		Caligavis chrysops	Yellow-faced Honeyeater	14									
		Melithreptus lunatus	White-naped Honeyeater	4									

Site	Class	Scientific name	Common Name	Bird Survey	Camera Traps	Elliott Traps-Ground	Frog-/Tadpole Search	Funnel Traps	Harp Traps	Pitfall Traps	Reptile Search	Spotlighting	Ultrasonic Call
		Myzomela sanguinolenta	Scarlet Honeyeater	5									
		Ptilotula fusca	Fuscous Honeyeater	6									
		Myiagra rubecula	Leaden Flycatcher	1									
		Colluricincla harmonica	Grey Shrike-thrush	2									
		Pachycephala pectoralis	Golden Whistler	1									
		Pachycephala rufiventris	Rufous Whistler	14									
		Pardalotus punctatus	Spotted Pardalote	4									
		Rhipidura fuliginosa	Grey Fantail	2									
		Rhipidura leucophrys	Willie Wagtail	1									
		Glossopsitta pusilla	Little Lorikeet	2									
	Mammalia	*Canis lupus dingo*	Dingo/Wild Dog		1								
		Vulpes vulpes	Red Fox		1								
		Miniopterus australis	Little Bent-winged Bat										1
		Austronomus australis	White-striped Free-tailed Bat										1
		Rhinolophus megaphyllus	Eastern Horseshoe Bat										1
		Chalinolobus dwyeri	Large-eared Pied Bat										1^
		Chalinolobus morio	Chocolate Wattled Bat										1
		Nyctophilus geoffroyi	Lesser Long-eared Bat						1				
		Nyctophilus sp.	unidentified Nyctophilus										1
		Vespadelus pumilus	Eastern Forest Bat										1
		Vespadelus vulturnus	Little Forest Bat						2				1
		Antechinus stuartii	Brown Antechinus		1	5							
		Phascogale tapoatafa	Brush-tailed Phascogale		1								
		Macropus giganteus	Eastern Grey Kangaroo		1								
		Macropus rufogriseus	Red-necked Wallaby		1								
		Trichosurus vulpecula	Common Brushtail Possum		25								
S04	Reptilia	*Demansia psammophis*	Yellow-faced Whipsnake					1					
		Bellatorias major	Land Mullet		1								
		Calyptotis ruficauda	Red-tailed Calyptotis								1		
		Lampropholis delicata	Garden Skink							1			
		Saiphos equalis	Three-toed Skink								1		
	Aves	*Aegotheles cristatus*	Australian Owlet-nightjar									3	
		Eurostopodus mystacalis	White-throated Nightjar									1	
		Leucosarcia melanoleuca	Wonga Pigeon		1								
		Alectura lathami	Australian Brush-turkey		1								
		Acanthiza lineata	Striated Thornbill	6									

Site	Class	Scientific name	Common Name	Bird Survey	Camera Traps	Elliott Traps-Ground	Frog-/Tadpole Search	Funnel Traps	Harp Traps	Pitfall Traps	Reptile Search	Spotlighting	Ultrasonic Call
		Acanthiza pusilla	Brown Thornbill	2									
		Gerygone mouki	Brown Gerygone	1									
		Sericornis magnirostra	Large-billed Scrubwren	3									
		Cormobates leucophaea	White-throated Treecreeper	1									
		Falcunculus frontatus	Crested Shrike-tit	1									
		Caligavis chrysops	Yellow-faced Honeyeater	7									
		Meliphaga lewinii	Lewin's Honeyeater	5									
		Melithreptus lunatus	White-naped Honeyeater	10									
		Myzomela sanguinolenta	Scarlet Honeyeater	1									
		Philemon corniculatus	Noisy Friarbird									1	
		Monarcha melanopsis	Black-faced Monarch	4									
		Symposiachrus trivirgatus	Spectacled Monarch	1									
		Oriolus sagittatus	Olive-backed Oriole	1									
		Pachycephala pectoralis	Golden Whistler	1									
		Pachycephala rufiventris	Rufous Whistler	2									
		Pardalotus punctatus	Spotted Pardalote	4									
		Eopsaltria australis	Eastern Yellow Robin	4									
		Psophodes olivaceus	Eastern Whipbird	2									
		Ptilonorhynchus violaceus	Satin Bowerbird	1									
		Rhipidura fuliginosa	Grey Fantail	3									
	Mammalia	*Austronomus australis*	White-striped Free-tailed Bat										1
		Rhinolophus megaphyllus	Eastern Horseshoe Bat										1
		Nyctophilus gouldi	Gould's Long-eared Bat						1				
		Nyctophilus sp.	unidentified Nyctophilus										1
		Scotorepens orion	Eastern Broad-nosed Bat										1
		Vespadelus pumilus	Eastern Forest Bat										1
		Antechinus sp.	unidentified Antechinus		1								
		Thylogale thetis	Red-necked Pademelon		1								
		Trichosurus caninus	Short-eared Brushtail Possum		4								
		Trichosurus vulpecula	Common Brushtail Possum		1								
		Tachyglossus aculeatus	Short-beaked Echidna		1								
		Perameles nasuta	Long-nosed Bandicoot		1								
		Rattus sp.	unidentified Rattus		2								
S05	Amphibia	*Litoria fallax*	Eastern Dwarf Tree Frog				1						
		Litoria tyleri	Tyler's Tree Frog				4						
		Litoria wilcoxii	Wilcox's Frog				3						

Site	Class	Scientific name	Common Name	Bird Survey	Camera Traps	Elliott Traps-Ground	Frog-/Tadpole Search	Funnel Traps	Harp Traps	Pitfall Traps	Reptile Search	Spotlighting	Ultrasonic Call
		Adelotus brevis	Tusked Frog				8						
		Limnodynastes peronii	Brown-striped Frog				1						
		Uperoleia laevigata	Smooth Toadlet							1		1	
	Reptilia	*Intellagama lesueurii*	Water Dragon				1						
		Lampropholis delicata	Garden Skink							1			
		Lampropholis sp.	unidentified Lampropholis								1		
		Saiphos equalis	Three-toed Skink								4		
		Varanus varius	Lace Monitor		11								
	Aves	*Leucosarcia melanoleuca*	Wonga Pigeon		2								
		Dacelo novaeguineae	Laughing Kookaburra	4									
		Chalcites lucidus	Shining Bronze-Cuckoo	1									
		Acanthiza lineata	Striated Thornbill	2									
		Acanthiza nana	Yellow Thornbill	4									
		Acanthiza pusilla	Brown Thornbill	2									
		Gerygone olivacea	White-throated Gerygone	1									
		Sericornis frontalis	White-browed Scrubwren	2									
		Coracina novaehollandiae	Black-faced Cuckoo-shrike	1									
		Dicaeum hirundinaceum	Mistletoebird	2									
		Acanthorhynchus tenuirostris	Eastern Spinebill	1									
		Anthochaera carunculata	Red Wattlebird	2									
		Caligavis chrysops	Yellow-faced Honeyeater	8									
		Meliphaga lewinii	Lewin's Honeyeater	3									
		Myzomela sanguinolenta	Scarlet Honeyeater	3									
		Daphoenositta chrysoptera	Varied Sittella	2									
		Oriolus sagittatus	Olive-backed Oriole	2									
		Pachycephala pectoralis	Golden Whistler	2									
		Pachycephala rufiventris	Rufous Whistler	4									
		Pardalotus punctatus	Spotted Pardalote	1									
		Eopsaltria australis	Eastern Yellow Robin	1									
		Rhipidura fuliginosa	Grey Fantail	4									
	Mammalia	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat										1^
		Miniopterus australis	Little Bent-winged Bat										1
		Austronomus australis	White-striped Free-tailed Bat									1	1
		Mormopterus (Ozimops) ridei	Eastern free-tailed bat										1
		Rhinolophus megaphyllus	Eastern Horseshoe Bat										1
		Chalinolobus dwyeri	Large-eared Pied Bat										1^

Site	Class	Scientific name	Common Name	Bird Survey	Camera Traps	Elliott Traps-Ground	Frog-/Tadpole Search	Funnel Traps	Harp Traps	Pitfall Traps	Reptile Search	Spotlighting	Ultrasonic Call
		Chalinolobus morio	Chocolate Wattled Bat										1
		Myotis macropus	Southern Myotis										1
		Nyctophilus gouldi	Gould's Long-eared Bat									1	
		Nyctophilus sp.	unidentified Nyctophilus										1
		Scotorepens orion	Eastern Broad-nosed Bat										1^
		Vespadelus pumilus	Eastern Forest Bat						13				1
		Vespadelus vulturnus	Little Forest Bat						5			2	1
		Wallabia bicolor	Swamp Wallaby		1								
		Trichosurus caninus	Short-eared Brushtail Possum		1								
		Trichosurus vulpecula	Common Brushtail Possum		1		1						
		Pseudocheirus peregrinus	Common Ringtail Possum				3						
		Isoodon macrourus	Northern Brown Bandicoot		1								
		Perameles nasuta	Long-nosed Bandicoot									1	
S06	Amphibia	*Litoria fallax*	Eastern Dwarf Tree Frog				56				1		
		Litoria peronii	Peron's Tree Frog				13						
		Litoria tyleri	Tyler's Tree Frog				4						
		Litoria wilcoxii	Wilcox's Frog				1						
		Adelotus brevis	Tusked Frog				4						
	Reptilia	*Intellagama lesueurii*	Water Dragon				1				1		
		Pseudechis porphyriacus	Red-bellied Black Snake								1		
		Saiphos equalis	Three-toed Skink								2		
		Anilios nigrescens	Blackish Blind Snake							1			
		Varanus varius	Lace Monitor		8								
	Aves	*Cacomantis variolosus*	Brush Cuckoo	1									
		Scythrops novaehollandiae	Channel-billed Cuckoo	1									
		Acanthiza lineata	Striated Thornbill	4									
		Acanthiza nana	Yellow Thornbill	4									
		Acanthiza pusilla	Brown Thornbill	1									
		Gerygone mouki	Brown Gerygone	2									
		Gerygone olivacea	White-throated Gerygone	1									
		Edolisoma tenuirostris	Cicadabird	1									
		Cormobates leucophaea	White-throated Treecreeper	3									
		Dicaeum hirundinaceum	Mistletoebird	1									
		Malurus lamberti	Variegated Fairy-wren	3									
		Caligavis chrysops	Yellow-faced Honeyeater	5									
		Meliphaga lewinii	Lewin's Honeyeater	4									

Site	Class	Scientific name	Common Name	Bird Survey	Camera Traps	Elliott Traps-Ground	Frog-/Tadpole Search	Funnel Traps	Harp Traps	Pitfall Traps	Reptile Search	Spotlighting	Ultrasonic Call
		Myzomela sanguinolenta	Scarlet Honeyeater	3									
		Philemon corniculatus	Noisy Friarbird	1									
		Myiagra rubecula	Leaden Flycatcher	1									
		Daphoenositta chrysoptera	Varied Sittella	2									
		Oriolus sagittatus	Olive-backed Oriole	2									
		Colluricincla harmonica	Grey Shrike-thrush	1									
		Pachycephala pectoralis	Golden Whistler	1									
		Pachycephala rufiventris	Rufous Whistler	3									
		Rhipidura fuliginosa	Grey Fantail	3									
		Alisterus scapularis	Australian King-parrot	3									
		Platycercus elegans	Crimson Rosella	3									
		Tyto sp.	unidentified Tyto									1	
	Mammalia	*Miniopterus australis*	Little Bent-winged Bat										1
		Miniopterus orianae oceanensis	Large Bent-winged Bat										1
		Austronomus australis	White-striped Free-tailed Bat										1
		Micronomus norfolkensis	Eastern Coastal Free-tailed Bat										1
		Mormopterus (Ozimops) ridei	Eastern free-tailed bat										1
		Rhinolophus megaphyllus	Eastern Horseshoe Bat										1
		Chalinolobus gouldii	Gould's Wattled Bat										1^
		Chalinolobus morio	Chocolate Wattled Bat										1
		Nyctophilus gouldi	Gould's Long-eared Bat						10				
		Nyctophilus sp.	unidentified Nyctophilus										1
		Scotorepens orion	Eastern Broad-nosed Bat										1
		Vespadelus pumilus	Eastern Forest Bat						3				1
		Vespadelus vulturnus	Little Forest Bat						12				
		Trichosurus vulpecula	Common Brushtail Possum									1	
		Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)	Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory)		1								
		Tachyglossus aculeatus	Short-beaked Echidna		1								
		Isoodon macrourus	Northern Brown Bandicoot		2								
		Isoodon/Perameles sp.	unidentified Bandicoot		1							1	

^ Indicates “probable” record only.

Note regarding camera data: The number listed represents the sum of the maximum daily number of individuals recorded within a single camera image.

Note regarding ultrasonic call recording (Anabat) data: The numbers listed represent presence or absence of the species and are not indicative of abundance (i.e. 1 = species recorded, blank cell = species not recorded)

Form: 13PC
Release: 3·1

POSITIVE COVENANT

New South Wales

Section 88E(3) Conveyancing Act 1919

Leave this space clear. Affix additional pages to the top left-hand corner.

PRIVACY NOTE: Section 31B of the Real Property Act 1900 (RP Act) authorises the Registrar General to collect the information required by this form for the establishment and maintenance of the Real Property Act Register. Section 96B RP Act requires that the Register is made available to any person for search upon payment of a fee, if any.

(A) **TORRENS TITLE**

SEE ANNEXURE A

(B) **LODGED BY**

Document Collection Box	Name, Address or DX, Telephone, and Customer Account Number if any	CODE
599D	MinterEllison Customer Account: 123438S 1 Farrer Place Telephone: 02 9921 8888 Sydney NSW Reference: AEW:AIW:207001631	PC

(C) **REGISTERED PROPRIETOR**

Of the above land
GLOUCESTER COAL LTD ACN 008 881 712 and CIM STRATFORD PTY LIMITED ACN 070 387 914 as tenants in common

(D) **LESSEE MORTGAGEE or CHARGEE**

Of the above land agreeing to be bound by this positive covenant

Nature of Interest	Number of Instrument	Name
NOT APPLICABL	N.A.	N.A.

(E) **PRESCRIBED AUTHORITY**

Within the meaning of section 88E(1) of the Conveyancing Act 1919
Crown in right of the State of New South Wales, through its Department of Planning and Environment.

(F) The prescribed authority having imposed on the above land a positive covenant in the terms set out in annexure A hereto applies to have it recorded in the Register and certifies this application correct for the purposes of the Real Property Act 1900.

DATE

(G) **Execution by the prescribed authority**

I certify that an authorised officer of the prescribed authority who is personally known to me or as to whose identity I am otherwise satisfied signed this application in my presence.

Signature of witness:

Name of witness: SEE ANNEXURE B

Address of witness:

Signature of authorised officer:

Name of authorised officer: SEE ANNEXURE B

Position of authorised officer:

(G) **Execution by the registered proprietor**

Certified correct for the purposes of the Real Property Act 1900 and executed on behalf of the company named below by the authorised person(s) whose signature(s) appear(s) below pursuant to the authority specified.
Company:
Authority:

Signature of authorised person:

Name of authorised person: SEE ANNEXURE B
Office held:

Signature of authorised person:

Name of authorised person: SEE ANNEXURE B
Office held:

(H) **Consent of the N.A**

The N.A under N.A No. N.A., agrees to be bound by this positive covenant.

I certify that the above N.A who is personally known to me or as to whose identity I am otherwise satisfied signed this application in my presence.

Signature of witness:

Name of witness:

Address of witness:

Signature of N.A.

* *s117 RP Act requires that you must have known the signatory for more than 12 months or have sighted identifying documentation.*

Annexure A to Positive Covenant

A. Land burdened by Instrument

The Land burdened by this Instrument is identified as follows:

Area 1 biodiversity offset area (as depicted on Plan 1a attached at Annexure C)

- Lot 45 DP979859

Area 3 biodiversity offset area (as depicted on Plans 3a & 3f attached at Annexure C)

- Part of Lot 1 DP997092 (as shaded on the plans)
- Part of Lot 70 DP979859 (as shaded on the plans)
- Part of Lot 2 DP778861 (as shaded on the plans)
- Part of Lot 1 DP778861 (as shaded on the plans)

B. Interpretation

1.1 In this Instrument, unless the context clearly indicates otherwise, the following terms have the following meanings:

"**Department**" means the NSW Department of Planning and Environment.

"**Development**" has the same meaning as it has in the EP&A Act.

"**Instrument**" means this section 88E instrument.

"**Land**" means the land burdened by this Instrument.

"**Minister**" means the Minister administering the *Environmental Planning and Assessment Act 1979* (NSW).

"**Registered Proprietor**" means the person or entity recorded by the Registrar-General of New South Wales as the registered proprietor of the Land from time to time.

"**Secretary**" means the Secretary of the Department or other agency responsible to the Minister.

1.2 Unless the context clearly indicates otherwise, a reference in this Instrument to:

(a) the singular includes the plural and vice versa;

(b) any thing includes the whole and each part of that thing;

(c) legislation or a legislative provision includes regulations and other instruments made under the legislation, and any statutory amendment, consolidation, re-enactment or replacement of the same;

(d) a person includes a natural person, corporation, statutory corporation, partnership, the Crown or any other body, organisation or legal entity; and

(e) a requirement to do something includes a requirement to cause that thing to occur.

1.3 Headings are for convenience only and do not affect the interpretation of this Instrument.

C. Terms of Covenant

1. To the extent necessary to protect and conserve native vegetation and native fauna on the Land and facilitate revegetation and natural regeneration of native species, the Registered Proprietor must:

   (a) erect and maintain a stockproof fence on the boundaries of the Land, except in respect of any boundary which adjoins land reserved as a national park, state conservation area, or conservation area under the *National Parks and Wildlife Act 1974*, and for which the Secretary has given written approval to leave unfenced;

   (b) control weeds and feral pests on the Land, including compliance with the general biosecurity duty to control weeds under the *Biosecurity Act 2015* (NSW);

   (c) control vehicular access to the Land to minimise the potential for vehicle strike of native fauna;

   (d) carry out soil erosion prevention and management works on the Land; and

   (e) permit access to the Land by officers of the Department, authorised agents of the Department and relevant public authorities at all times for the purposes of monitoring compliance with this Instrument.

2. Nothing in this Instrument is to be construed as:

   (a) excusing or preventing the carrying out of Development or work required for the operation, maintenance or repair of infrastructure and easements existing as at the date this Instrument takes effect; or

   (b) excusing or derogating from any requirement to obtain any consent, approval, permit or licence under any applicable instrument or legislation or comply with any applicable legislation.

3. The Registered Proprietor must provide a copy of this Instrument and any relevant requirement of the Secretary to any transferee, lessee, licensee, mortgagee, or other successor in title.

4. The Registered Proprietor must, at its own cost, comply with the terms of this Instrument.

5. By written notice to the Registered Proprietor, the Secretary may, at any time, require the Registered Proprietor to attend to any matter and to carry out any such work required under clause C1 of this Instrument within such time as the Secretary may specify. The Registered Proprietor must comply with such notice at its cost and within the time specified.

6. If the Registered Proprietor fails to comply with the terms of any written notice given under clause 5 of this Instrument, any person authorised by the Secretary may enter the Land at any time with all necessary equipment and carry out any work which, in

its discretion, is required to ensure compliance with the notice or otherwise remedy any failure by the Registered Proprietor to observe its obligations under this Instrument. The Secretary may recover from the Registered Proprietor the costs associated with any such work, and may recover all expense incurred by the Secretary in doing so.

7. The Registered Proprietor must indemnify and keep indemnified the State of New South Wales from all claims and demands of every kind and from all liabilities which may arise in connection with the Registered Proprietor's failure to observe or comply with the terms of this Instrument.

8. The Registered Proprietor must maintain policies of insurance for public risk covering injury to person or property on the Land for an amount of not less than $20 million (or such other amount as the Secretary reasonably prescribes) arising out of any one single accident or event

9. All insurance policies held by the Registered Proprietor under clause 8 of this Instrument must note the Minister as an interested party as directed from time to time by the Secretary or any person authorised by the Secretary.

10. The Registered Proprietor must produce a certificate of currency for all insurance policies held under clause 8 of this Instrument to the Secretary or any person authorised by the Secretary for inspection within 5 business days of demand (provided that such demand is not made more often than once each year).

11. If any provision or part of any provision of this Instrument is or becomes void, invalid, or unenforceable for any reason, that provision or part may be severed from this Instrument and all other provisions or parts which are self-sustaining and capable of separate enforcement without regard to the void, invalid or unenforceable provision will be and continue to be valid and enforceable in accordance with their terms.

12. This Instrument is to remain in force in respect of the Land in perpetuity.

13. This Instrument may only be varied with the consent of the Secretary in accordance with section 88E(7) of the *Conveyancing Act 1919*.

Annexure B to Positive Covenant

Execution by the Prescribed Authority

I certify that I am an eligible witness and that an authorised officer of the lessee signed this dealing in my presence.

Signature of witness

NESTOR TSAMBOS

Name of witness

64 FRAMPTON AVENUE

Address of witness

MARRICKVILLE 2204

Certified correct for the purposes of the Real Property Act 1900 by the authorised officer named below.

Signature of authorised officer

MARCUS RAY

Authorised officer's name

GROUP DEPUTY SECRETARY

Authority of officer

Minister for Planning for and on behalf of the Crown in right of the State of New South Wales

Signing on behalf of

Execution by the Registered Proprietor

Certified correct for the purposes of the Real Property Act 1900 and executed on behalf of the corporation named below by the authorised person(s) whose signature(s) appear(s) below pursuant to the authority specified.

Corporation GLOUCESTER COAL LTD ACN 008 881 712

Authority section 127 of the *Corporations Act 2001* (Cth)

Signature of authorised person

Reinhold Schmidt

Name of authorised person

Director

Office held

Signature of authorised person

Lei Zhang

Name of authorised person

Director / Secretary

Office held

Certified correct for the purposes of the Real Property Act 1900 and executed on behalf of the corporation named below by the authorised person(s) whose signature(s) appear(s) below pursuant to the authority specified.

Corporation CIM STRATFORD PTY LTD ACN 070 387 914

Authority section 127 of the *Corporations Act 2001* (Cth)

Signature of authorised person

Reinhold Schmidt

Name of authorised person

Director

Office held

Signature of authorised person

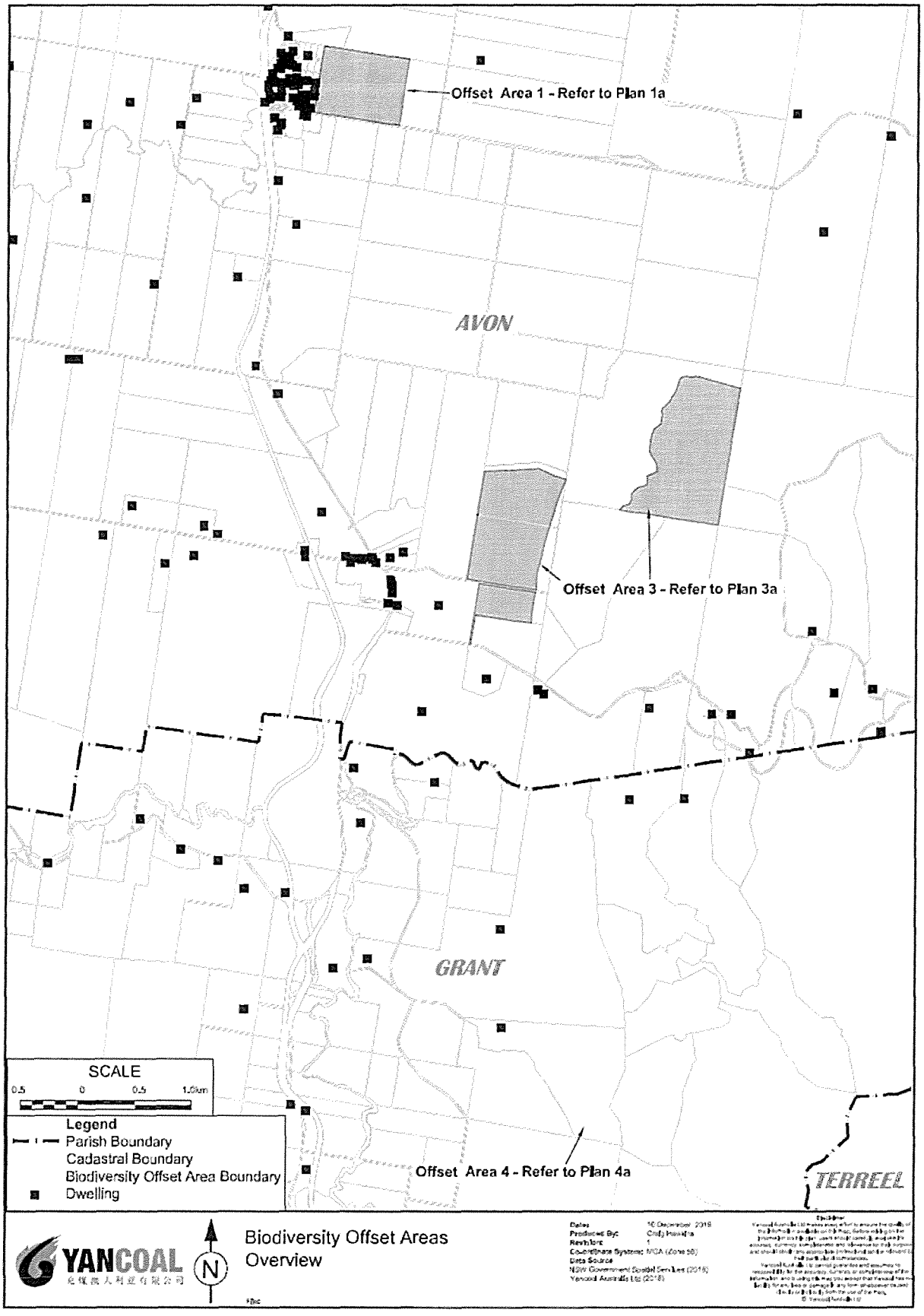
Lei Zhang

Name of authorised person

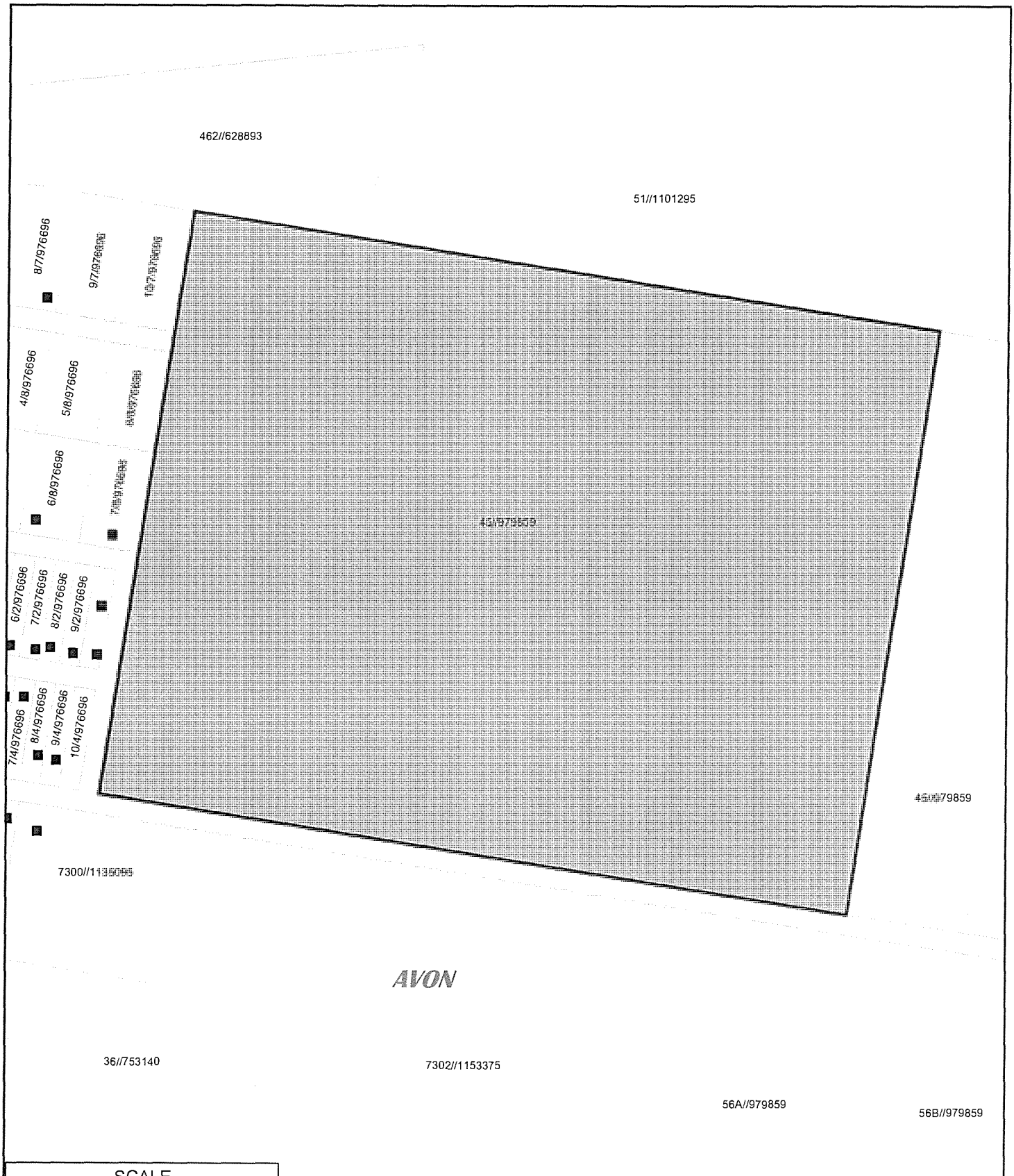
Director /Secretary

Office held

Annexure C to Positive Covenant



ME_160224228_2

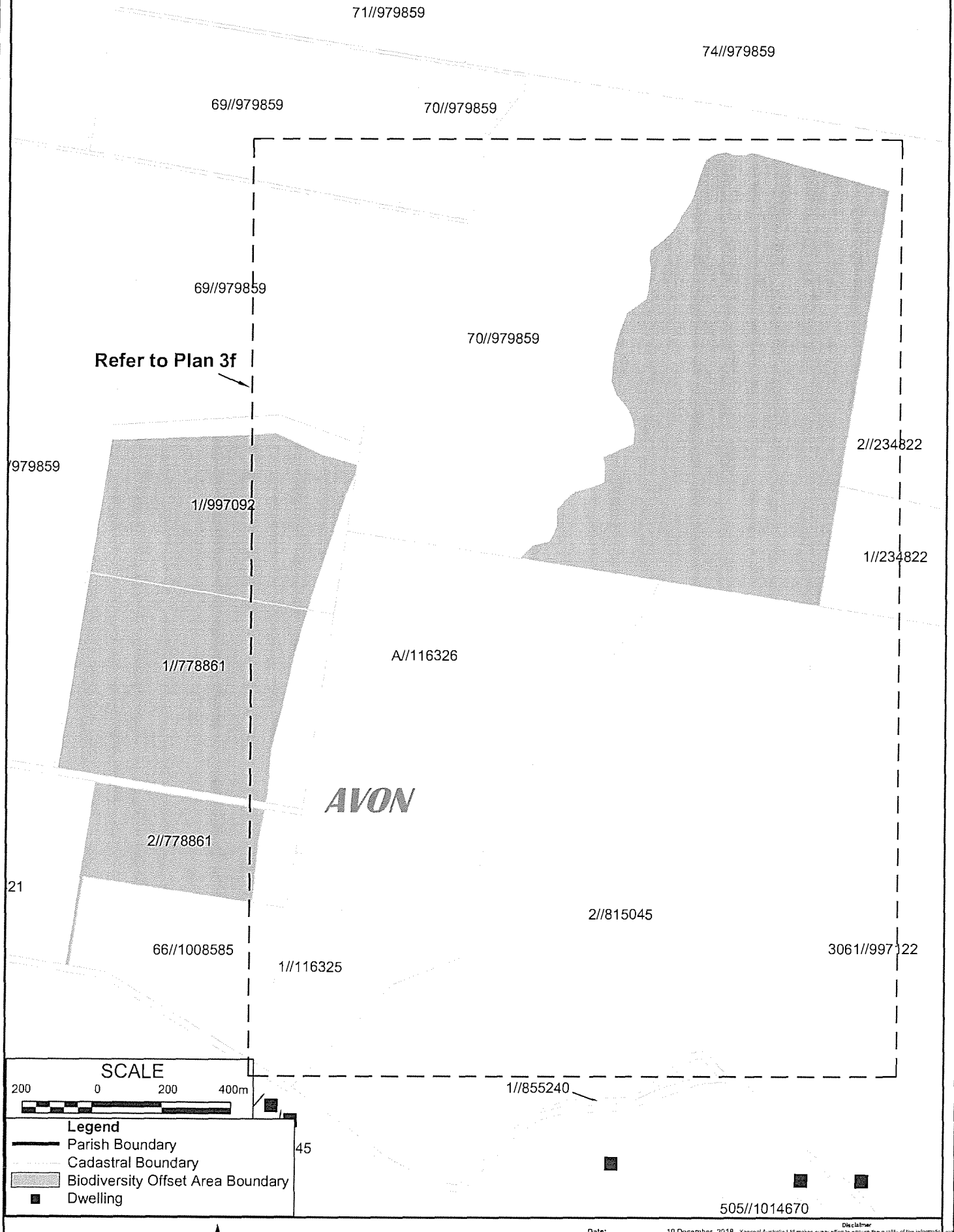


YANCOAL 兖煤澳大利亚有限公司

Plan 1a - Land Subject to Instrument "Area 1"

File:

Date: 10 December 2018
Produced By: Craig Hawkins
Revision: 1
Co-ordinate System: MGA (Zone 56)
Data Source
NSW Government Spatial Services (2018)
Yancoal Australia Ltd (2018)



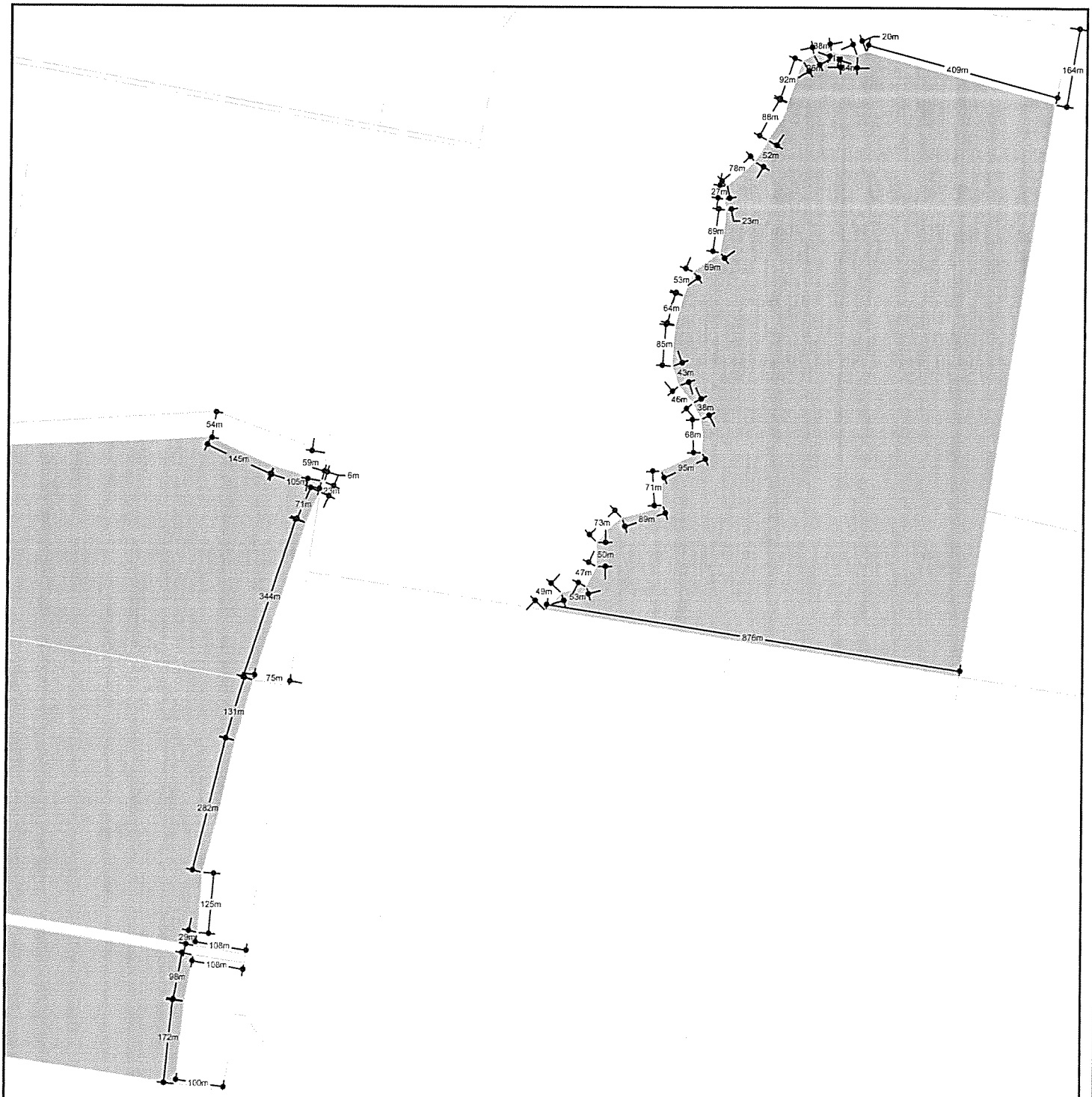
YANCOAL 克煤澳大利亚有限公司

Plan 3a - Land Subject to Instrument "Area 3"

Page 8 of 9

Date:	10 December 2018
Produced By:	Craig Hawkins
Revision:	1
Co-ordinate System:	MGA (Zone 56)
Data Source	NSW Government Spatial Services (2018) Yancoal Australia Ltd (2018)

File:



SCALE

125 0 125 250m

Legend

- Parish Boundary
- Cadastral Boundary
- Biodiversity Offset Area Boundary
- Dwelling

YANCOAL 兖煤澳大利亚有限公司

Plan 3f - Land Subject to Instrument "Area 3"

File:

Date: 10 December 2018
Produced By: Craig Hawkins
Revision: 1
Co-ordinate System: MGA (Zone 56)
Data Source
NSW Government Spatial Services (2018)
Yancoal Australia Ltd (2018)

MR RS

Form: 13PC
Release: 3·1

POSITIVE COVENANT

New South Wales

Section 88E(3) Conveyancing Act 1919

Leave this space clear. Affix additional pages to the top left-hand corner.

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(A) **TORRENS TITLE**

SEE ANNEXURE A

(B) **LODGED BY**

Document Collection Box	Name, Address or DX, Telephone, and Customer Account Number if any	CODE
599D	MinterEllison Customer Account: 123438S 1 Farrer Place Telephone: 02 9921 8888 Sydney NSW Reference: AEW:AIW:207001631	PC

(C) **REGISTERED PROPRIETOR**

Of the above land
GLOUCESTER COAL LTD ACN 008 881 712

(D) **LESSEE MORTGAGEE or CHARGEE**

Of the above land agreeing to be bound by this positive covenant

Nature of Interest	Number of Instrument	Name
NOT APPLICABL	N.A.	N.A.

(E) **PRESCRIBED AUTHORITY**

Within the meaning of section 88E(1) of the Conveyancing Act 1919
Crown in right of the State of New South Wales, through its Department of Planning and Environment.

(F) The prescribed authority having imposed on the above land a positive covenant in the terms set out in annexure A hereto applies to have it recorded in the Register and certifies this application correct for the purposes of the Real Property Act 1900.

DATE

(G) **Execution by the prescribed authority**

I certify that an authorised officer of the prescribed authority who is personally known to me or as to whose identity I am otherwise satisfied signed this application in my presence.

Signature of witness:

Name of witness: SEE ANNEXURE B

Address of witness:

Signature of authorised officer:

Name of authorised officer: SEE ANNEXURE B

Position of authorised officer:

(G) **Execution by the registered proprietor**

Certified correct for the purposes of the Real Property Act 1900 and executed on behalf of the company named below by the authorised person(s) whose signature(s) appear(s) below pursuant to the authority specified.
Company:
Authority:

Signature of authorised person:

Name of authorised person: SEE ANNEXURE B
Office held:

Signature of authorised person:

Name of authorised person: SEE ANNEXURE B
Office held:

(H) **Consent of the N.A**

The N.A under N.A No. N.A. , agrees to be bound by this positive covenant.

I certify that the above N.A who is personally known to me or as to whose identity I am otherwise satisfied signed this application in my presence.

Signature of witness:

Name of witness:

Address of witness:

Signature of N.A.

** s117 RP Act requires that you must have known the signatory for more than 12 months or have sighted identifying documentation.*

ML

Annexure A to Positive Covenant

A. Land burdened by Instrument

The Land burdened by this Instrument is identified as follows:

Area 2 biodiversity offset area (as depicted on Plan 2a attached at Annexure C)

- Lot 1 DP997290

Area 3 biodiversity offset area (as depicted on Plans 3a – 3d, 3f attached at Annexure C)

- Part of Lot A DP116326 (as shaded on the plans)
- Part of Lot 66 DP1008585 (as shaded on the plans)
- Part of Lot 1 DP116325 (as shaded on the plans)
- Part of Lot 2 DP737421 (as shaded on the plans)
- Part of Lot 1 DP998562 (as shaded on the plans)
- Part of Lot 2 DP1082739 (as shaded on the plans)
- Part of Lot 1 DP1082739 (as shaded on the plans)
- Lot 7 DP722748

Area 4 biodiversity offset area (as depicted on Plans 4a & 4b attached at Annexure C)

- Part of Lot 110 DP874013 (as shaded on the plans)
- Lot 506 DP1014670
- Lot 508 DP1014670

B. Interpretation

1.1 In this Instrument, unless the context clearly indicates otherwise, the following terms have the following meanings:

"**Department**" means the NSW Department of Planning and Environment.

"**Development**" has the same meaning as it has in the EP&A Act.

"**Instrument**" means this section 88E instrument.

"**Land**" means the land burdened by this Instrument.

"**Minister**" means the Minister administering the *Environmental Planning and Assessment Act 1979* (NSW).

"**Registered Proprietor**" means the person or entity recorded by the Registrar-General of New South Wales as the registered proprietor of the Land from time to time.

"**Secretary**" means the Secretary of the Department or other agency responsible to the Minister.

1.2 Unless the context clearly indicates otherwise, a reference in this Instrument to:

(a) the singular includes the plural and vice versa;

(b) any thing includes the whole and each part of that thing;

(c) legislation or a legislative provision includes regulations and other instruments made under the legislation, and any statutory amendment, consolidation, re-enactment or replacement of the same;

(d) a person includes a natural person, corporation, statutory corporation, partnership, the Crown or any other body, organisation or legal entity; and

(e) a requirement to do something includes a requirement to cause that thing to occur.

1.3 Headings are for convenience only and do not affect the interpretation of this Instrument.

C. Terms of Covenant

1. To the extent necessary to protect and conserve native vegetation and native fauna on the Land and facilitate revegetation and natural regeneration of native species, the Registered Proprietor must:

(a) erect and maintain a stockproof fence on the boundaries of the Land, except in respect of any boundary which adjoins land reserved as a national park, state conservation area, or conservation area under the *National Parks and Wildlife Act 1974*, and for which the Secretary has given written approval to leave unfenced;

(b) control weeds and feral pests on the Land, including compliance with the general biosecurity duty to control weeds under the *Biosecurity Act 2015* (NSW);

(c) control vehicular access to the Land to minimise the potential for vehicle strike of native fauna;

(d) carry out soil erosion prevention and management works on the Land; and

(e) permit access to the Land by officers of the Department, authorised agents of the Department and relevant public authorities at all times for the purposes of monitoring compliance with this Instrument.

2. Nothing in this Instrument is to be construed as:

(a) excusing or preventing the carrying out of Development or work required for the operation, maintenance or repair of infrastructure and easements existing as at the date this Instrument takes effect; or

(b) excusing or derogating from any requirement to obtain any consent, approval, permit or licence under any applicable instrument or legislation or comply with any applicable legislation.

3. The Registered Proprietor must provide a copy of this Instrument and any relevant requirement of the Secretary to any transferee, lessee, licensee, mortgagee, or other successor in title.

4. The Registered Proprietor must, at its own cost, comply with the terms of this Instrument.

5. By written notice to the Registered Proprietor, the Secretary may, at any time, require the Registered Proprietor to attend to any matter and to carry out any such work required under clause C1 of this Instrument within such time as the Secretary may specify. The Registered Proprietor must comply with such notice at its cost and within the time specified.

6. If the Registered Proprietor fails to comply with the terms of any written notice given under clause 5 of this Instrument, any person authorised by the Secretary may enter the Land at any time with all necessary equipment and carry out any work which, in its discretion, is required to ensure compliance with the notice or otherwise remedy any failure by the Registered Proprietor to observe its obligations under this Instrument. The Secretary may recover from the Registered Proprietor the costs associated with any such work, and may recover all expense incurred by the Secretary in doing so.

7. The Registered Proprietor must indemnify and keep indemnified the State of New South Wales from all claims and demands of every kind and from all liabilities which may arise in connection with the Registered Proprietor's failure to observe or comply with the terms of this Instrument.

8. The Registered Proprietor must maintain policies of insurance for public risk covering injury to person or property on the Land for an amount of not less than $20 million (or such other amount as the Secretary reasonably prescribes) arising out of any one single accident or event

9. All insurance policies held by the Registered Proprietor under clause 8 of this Instrument must note the Minister as an interested party as directed from time to time by the Secretary or any person authorised by the Secretary.

10. The Registered Proprietor must produce a certificate of currency for all insurance policies held under clause 8 of this Instrument to the Secretary or any person authorised by the Secretary for inspection within 5 business days of demand (provided that such demand is not made more often than once each year).

11. If any provision or part of any provision of this Instrument is or becomes void, invalid, or unenforceable for any reason, that provision or part may be severed from this Instrument and all other provisions or parts which are self-sustaining and capable of separate enforcement without regard to the void, invalid or unenforceable provision will be and continue to be valid and enforceable in accordance with their terms.

12. This Instrument is to remain in force in respect of the Land in perpetuity.

13. This Instrument may only be varied with the consent of the Secretary in accordance with section 88E(7) of the *Conveyancing Act 1919*.

Annexure B to Positive Covenant

Execution by the Prescribed Authority

I certify that I am an eligible witness and that an authorised officer of the lessee signed this dealing in my presence.

Signature of witness

NESTOR TSAMBOS

Name of witness

64 FRAMPTON AVENUE

Address of witness

MARRICKVILLE 2204

Certified correct for the purposes of the Real Property Act 1900 by the authorised officer named below.

Signature of authorised officer

MARCUS RAY

Authorised officer's name

GROUP DEPUTY SECRETARY

Authority of officer

Minister for Planning for and on behalf of the Crown in right of the State of New South Wales

Signing on behalf of

Execution by the Registered Proprietor

Certified correct for the purposes of the Real Property Act 1900 and executed on behalf of the corporation named below by the authorised person(s) whose signature(s) appear(s) below pursuant to the authority specified.

Corporation GLOUCESTER COAL LTD ACN 008 881 712

Authority section 127 of the *Corporations Act 2001* (Cth)

Signature of authorised person

Reinhold Schmidt

Name of authorised person

Director

Office held

Signature of authorised person

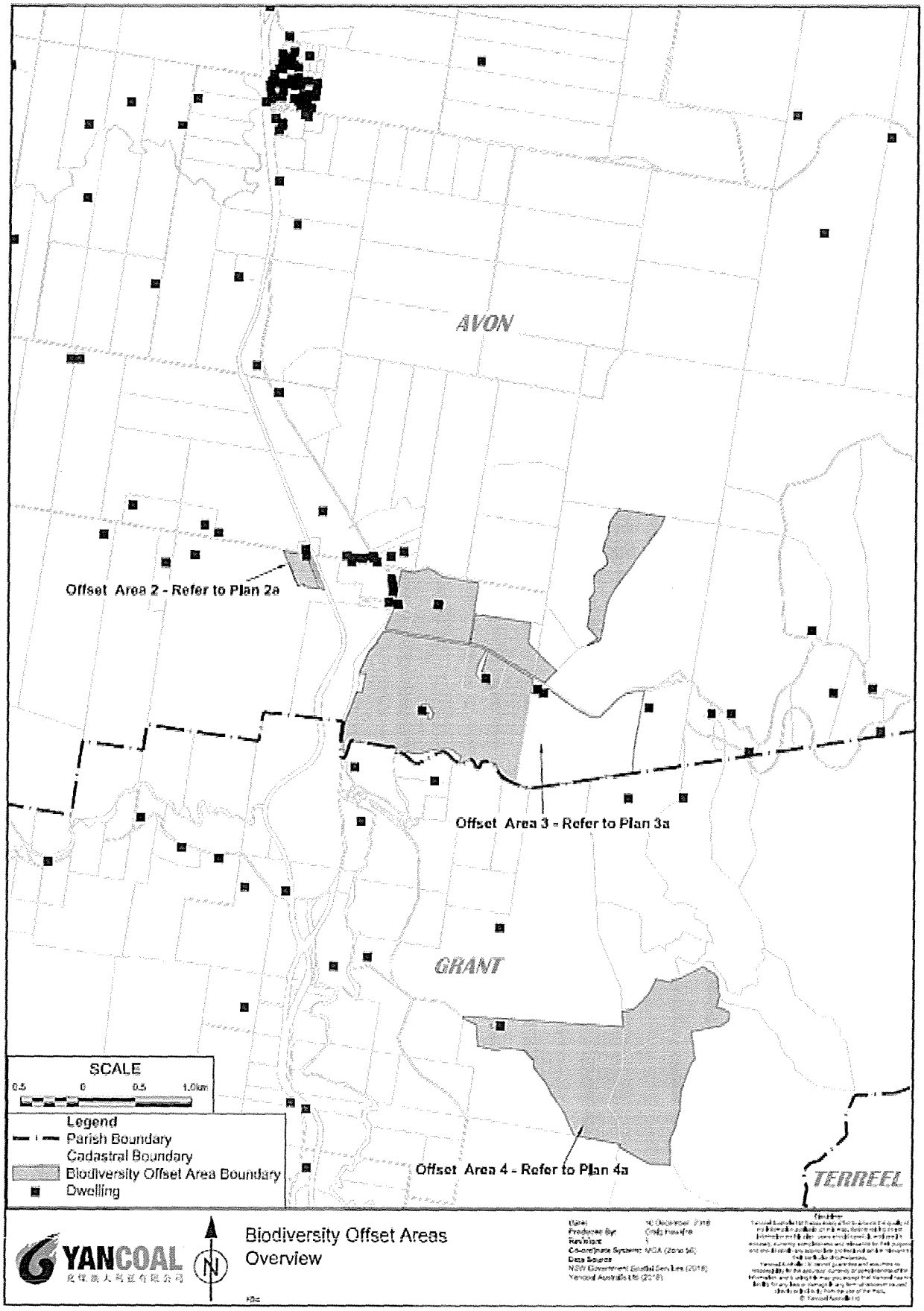
Lei Zhang

Name of authorised person

Director / Secretary

Office held

Annexure C to Positive Covenant



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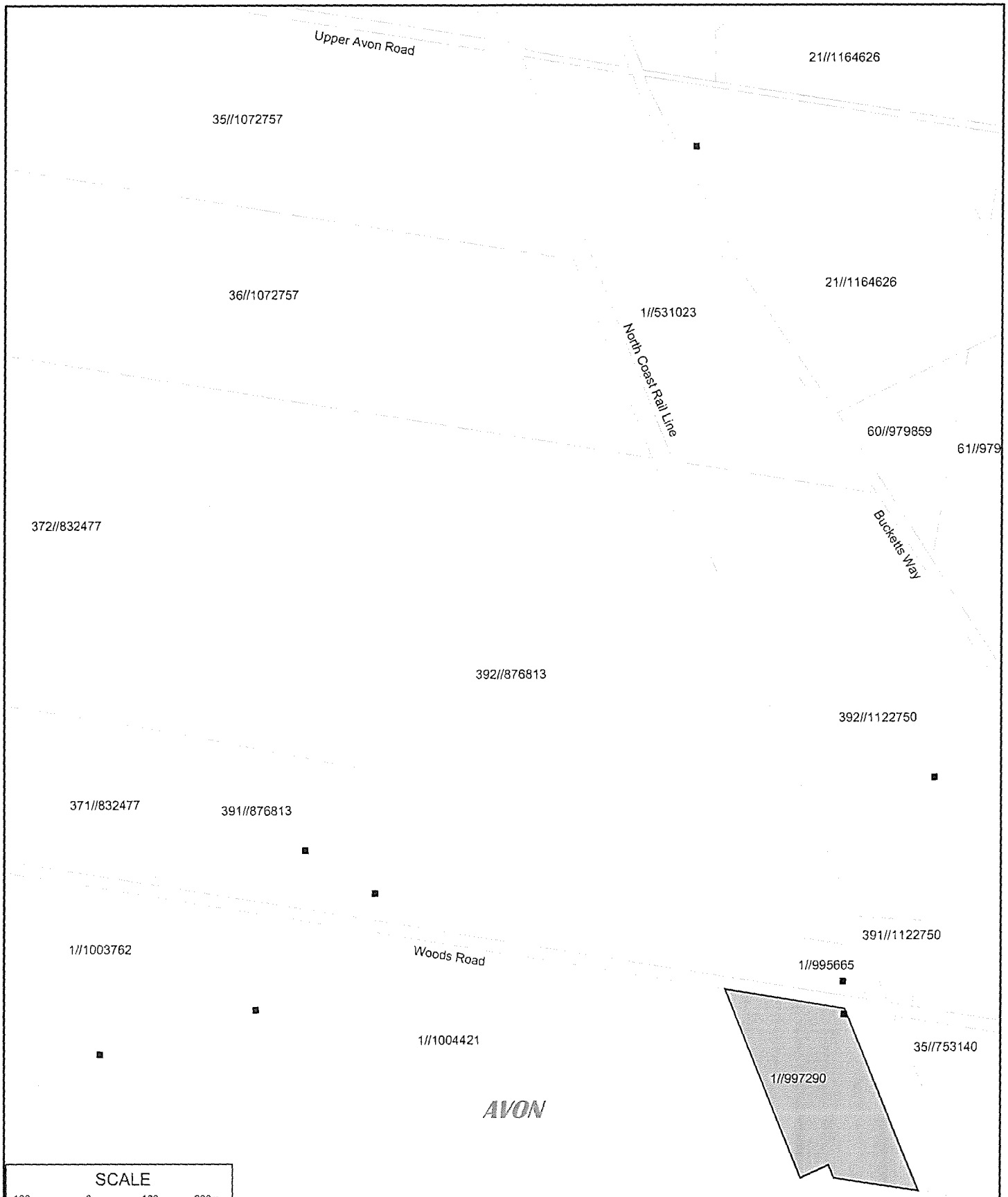

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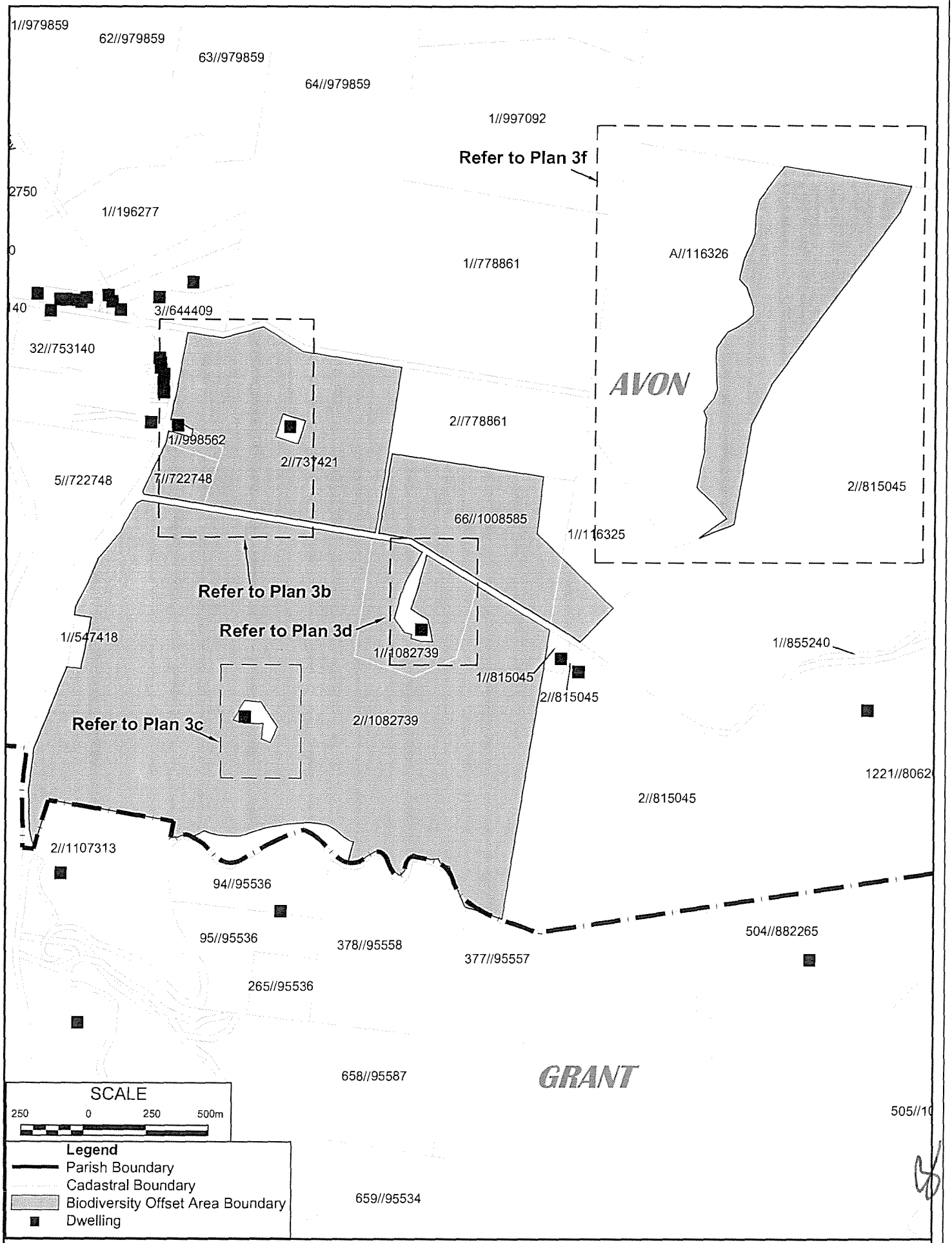
Plan 2a - Land Subject to Instrument "Area 2"

File:

Date: 14 December 2018
Produced By: Craig Hawkins
Revision: 1
Co-ordinate System: MGA (Zone 56)
Data Source
NSW Government Spatial Services (2018)
Yancoal Australia Ltd (2018)



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Plan 3a - Land Subject to Instrument "Area 3"

Date:	10 December 2018
Produced By:	Craig Hawkins
Revision:	1
Co-ordinate System:	MGA (Zone 56)
Data Source	
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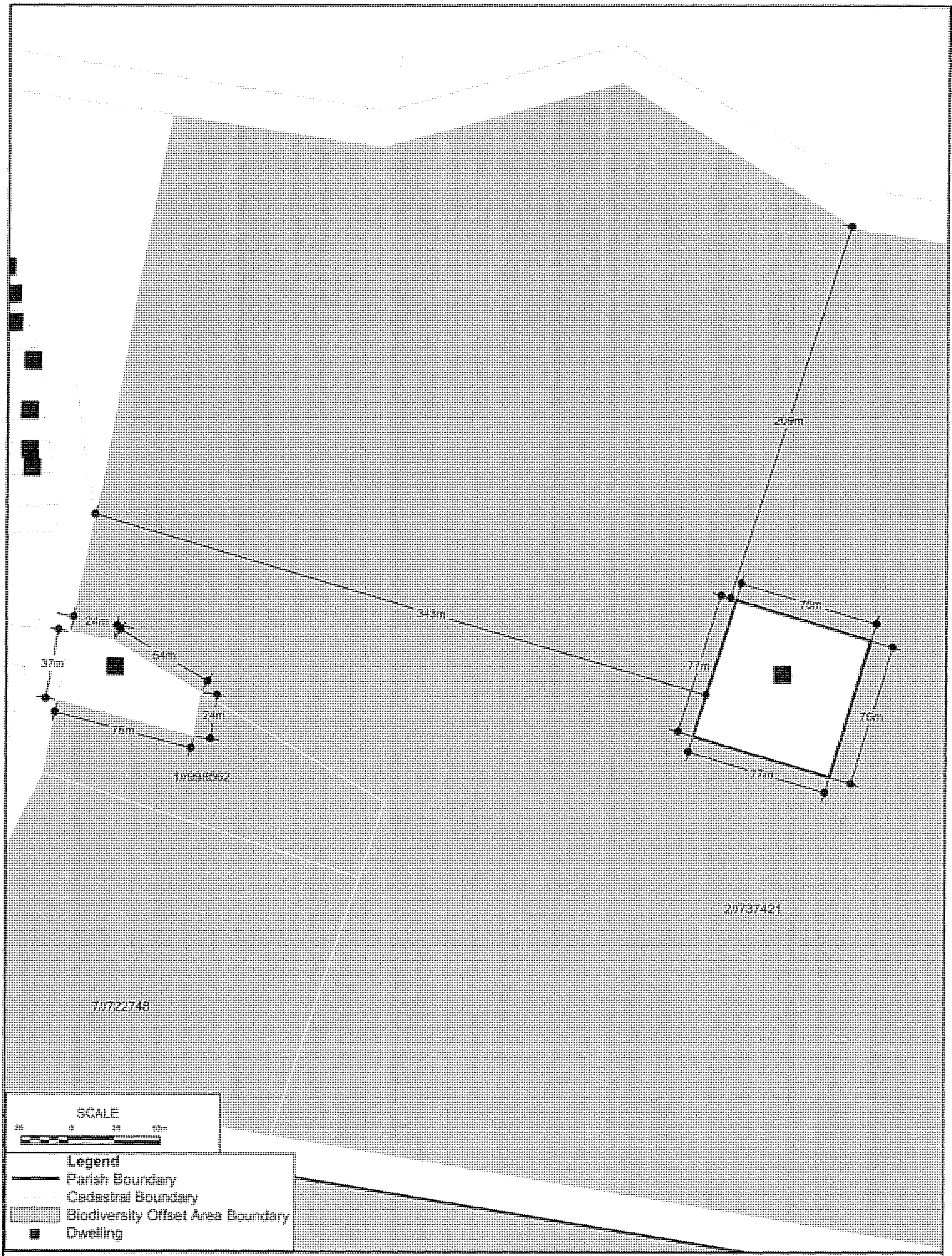

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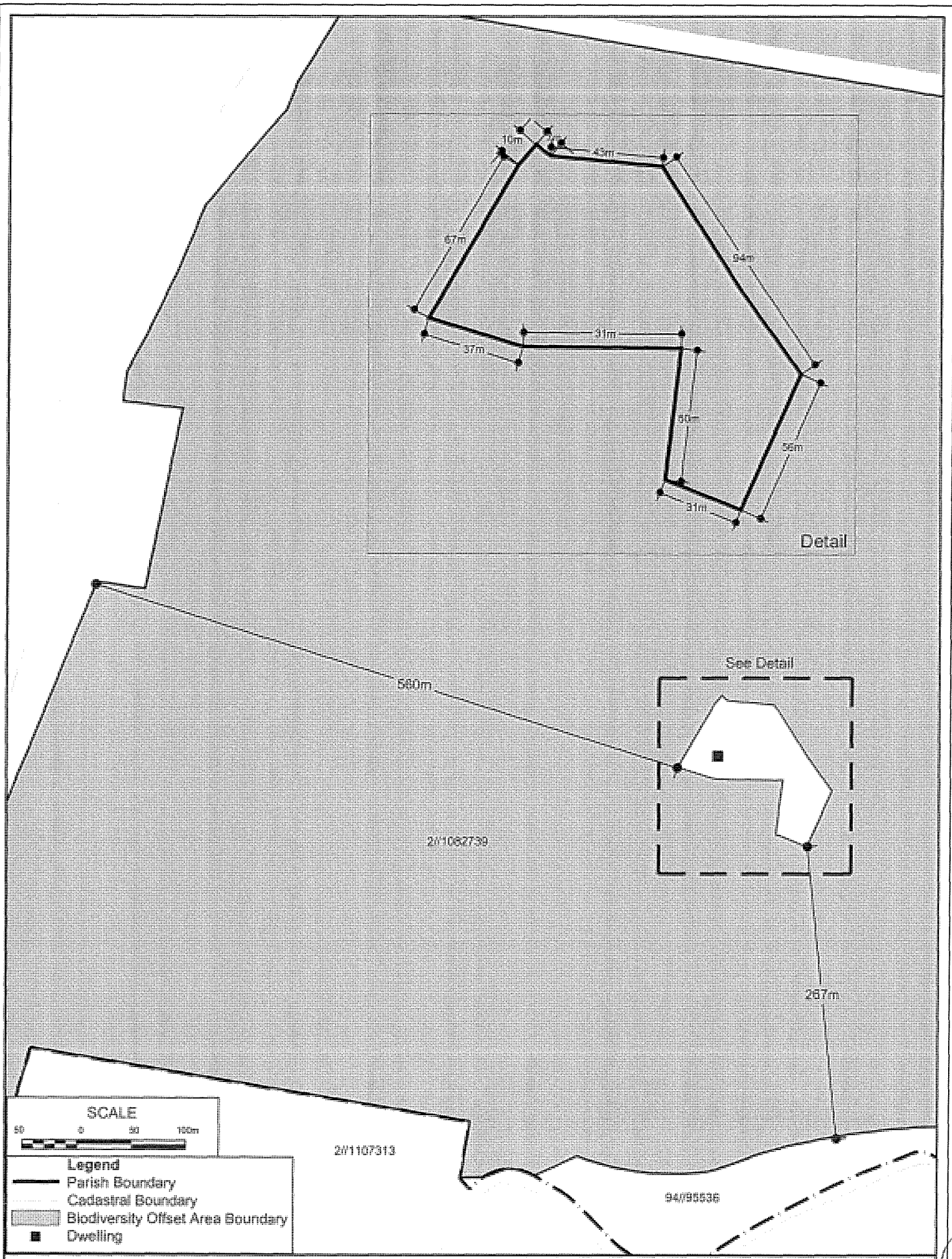
Plan 3b - Land Subject to Instrument "Area 3"

Date: 10 December 2018
Produced By: Craig Hawkins
Revision: 1
Co-ordinate System: MGA (Zone 56)
Data Source:
NSW Government Spatial Services (2018)
Yancoal Australia Ltd (2018)

Disclaimer



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Plan 3c - Land Subject to Instrument "Area 3"

Date: 19 December 2018
Produced By: Craig Hawkins
Revision: 1
Co-ordinate System: MGA (Zone 56)
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NSW Government Spatial Services (2018)
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MR

DS

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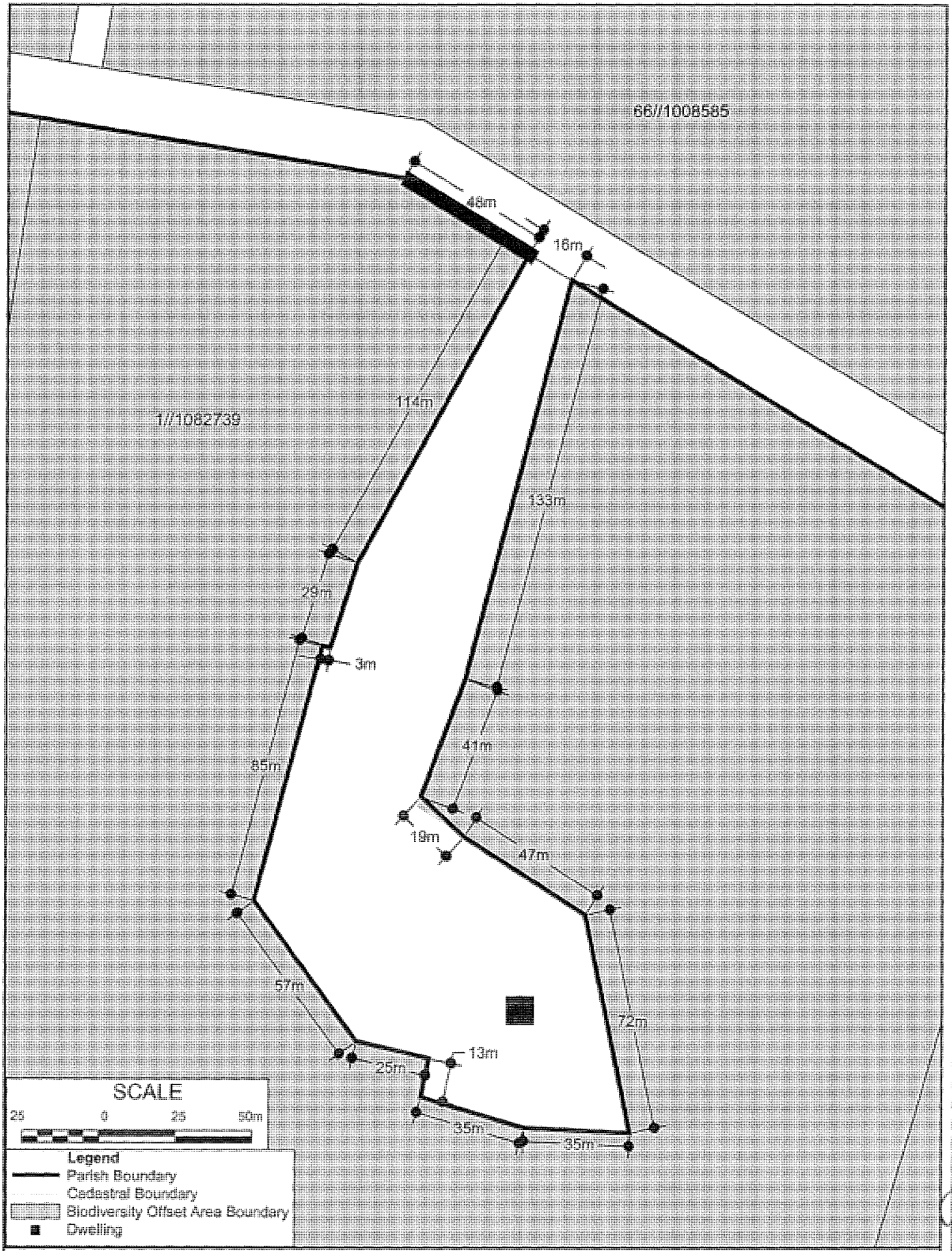

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Plan 3d - Land Subject to Instrument "Area 3"

Page 11 of 14

Date: 18 December 2018
Produced By: Craig Hamblin
Revision: 1
Coordinate System: MGA (Zone 56)
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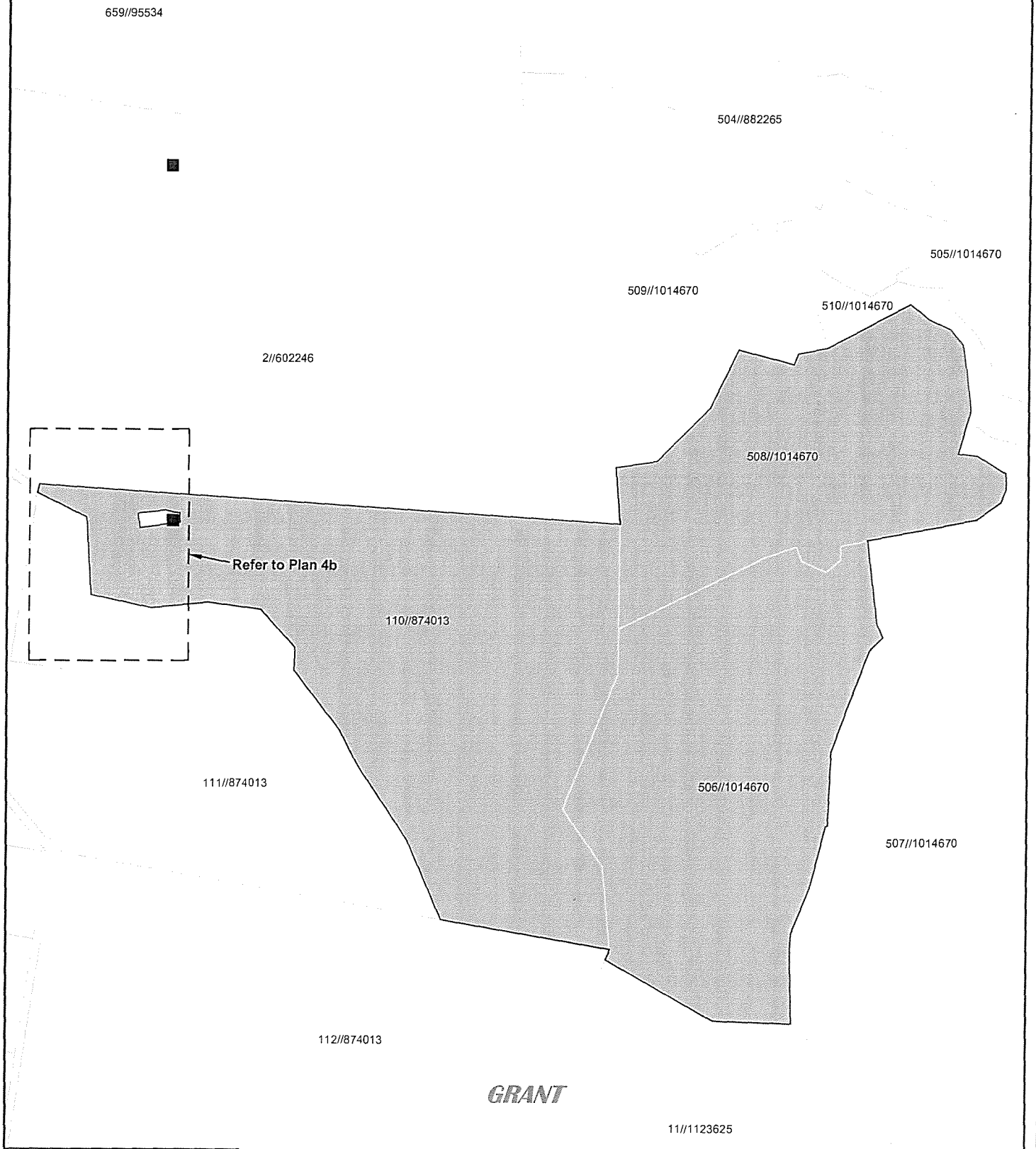
Plan 3f - Land Subject to Instrument "Area 3"

File:

Date: 10 December 2018
Produced By: Craig Hawkins
Revision: 1
Co-ordinate System: MGA (Zone 56)
Data Source
NSW Government Spatial Services (2018)
Yancoal Australia Ltd (2018)



SCALE

150 0 150 300m

Legend

- Parish Boundary
- Cadastral Boundary
- Biodiversity Offset Area Boundary
- Dwelling

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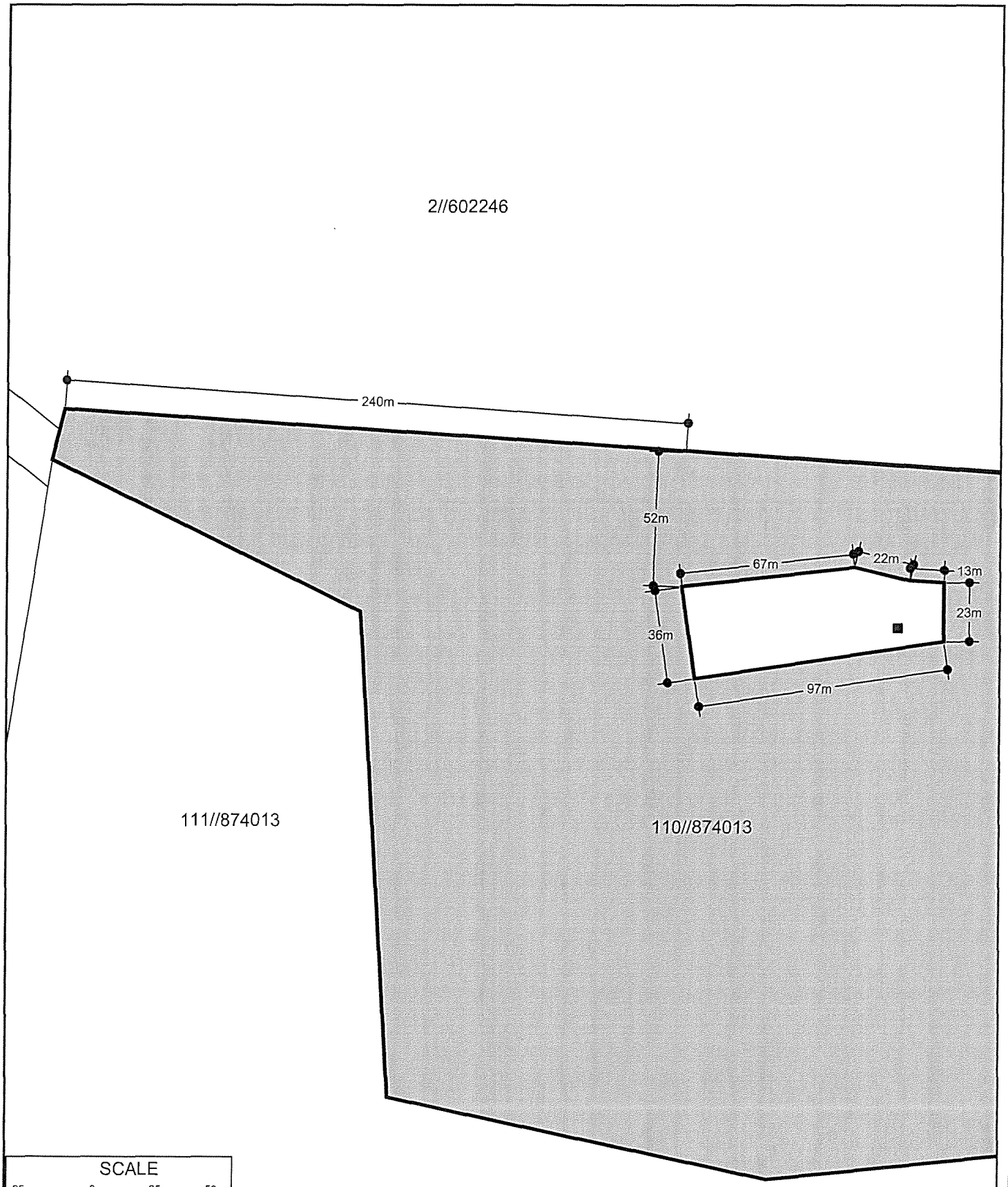
N

Plan 4a - Land Subject to Instrument "Area 4"

File:

Date: 10 December 2018
Produced By: Craig Hawkins
Revision: 1
Co-ordinate System: MGA (Zone 56)
Data Source
NSW Government Spatial Services (2018)
Yancoal Australia Ltd (2018)



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Plan 4b - Land Subject to Instrument "Area 4"

File:

Date: 10 December 2018
Produced By: Craig Hawkins
Revision: 1
Co-ordinate System: MGA (Zone 56)
Data Source
NSW Government Spatial Services (2018)
Yancoal Australia Ltd (2018)

Form: 13PC
Release: 3·1

POSITIVE COVENANT

New South Wales
Section 88E(3) Conveyancing Act 1919

Leave this space clear. Affix additional pages to the top left-hand corner.

PRIVACY NOTE: Section 31B of the Real Property Act 1900 (RP Act) authorises the Registrar General to collect the information required by this form for the establishment and maintenance of the Real Property Act Register. Section 96B RP Act requires that the Register is made available to any person for search upon payment of a fee, if any.

(A) **TORRENS TITLE**

SEE ANNEXURE A

(B) **LODGED BY**

Document Collection Box	Name, Address or DX, Telephone, and Customer Account Number if any	CODE
599D	MinterEllison Customer Account: 123438S 1 Farrer Place Telephone: 02 9921 8888 Sydney NSW Reference: AEW:AIW:207001631	PC

(C) **REGISTERED PROPRIETOR**

Of the above land
STRATFORD COAL PTY LIMITED ACN 064 016 164

(D) **LESSEE MORTGAGEE or CHARGEE**

Of the above land agreeing to be bound by this positive covenant

Nature of Interest	Number of Instrument	Name
NOT APPLICABL	N.A.	N.A.

(E) **PRESCRIBED AUTHORITY**

Within the meaning of section 88E(1) of the Conveyancing Act 1919
Crown in right of the State of New South Wales, through its Department of Planning and Environment.

(F) The prescribed authority having imposed on the above land a positive covenant in the terms set out in annexure A hereto applies to have it recorded in the Register and certifies this application correct for the purposes of the Real Property Act 1900.

DATE

(G) **Execution by the prescribed authority**

I certify that an authorised officer of the prescribed authority who is personally known to me or as to whose identity I am otherwise satisfied signed this application in my presence.

Signature of witness:

Name of witness: SEE ANNEXURE B

Address of witness:

Signature of authorised officer:

Name of authorised officer: SEE ANNEXURE B

Position of authorised officer:

(G) **Execution by the registered proprietor**

Certified correct for the purposes of the Real Property Act 1900 and executed on behalf of the company named below by the authorised person(s) whose signature(s) appear(s) below pursuant to the authority specified.
Company:
Authority:

Signature of authorised person:

Name of authorised person: SEE ANNEXURE B
Office held:

Signature of authorised person:

Name of authorised person: SEE ANNEXURE B
Office held:

(H) **Consent of the N.A**

The N.A under N.A No. N.A., agrees to be bound by this positive covenant.

I certify that the above N.A who is personally known to me or as to whose identity I am otherwise satisfied signed this application in my presence.

Signature of witness:

Name of witness:

Address of witness:

Signature of N.A.

* *s117 RP Act requires that you must have known the signatory for more than 12 months or have sighted identifying documentation.*

Annexure A to Positive Covenant

A. Land burdened by Instrument

The Land burdened by this Instrument is identified as follows:

Area 2 biodiversity offset area (as depicted on Plan 2a attached at Annexure C)

- Lot 392 DP876813

Area 3 biodiversity offset area (as depicted on Plans 3a, 3e & 3g attached at Annexure C)

- Part of Lot 1221 DP806209 (as shaded on the plans)
- Part of Lot 2 DP815045 (as shaded on the plans)
- Lot 5 DP722748
- Lot 1 DP855240

B. Interpretation

1.1 In this Instrument, unless the context clearly indicates otherwise, the following terms have the following meanings:

"**Department**" means the NSW Department of Planning and Environment.

"**Development**" has the same meaning as it has in the EP&A Act.

"**Instrument**" means this section 88E instrument.

"**Land**" means the land burdened by this Instrument.

"**Minister**" means the Minister administering the *Environmental Planning and Assessment Act 1979* (NSW).

"**Registered Proprietor**" means the person or entity recorded by the Registrar-General of New South Wales as the registered proprietor of the Land from time to time.

"**Secretary**" means the Secretary of the Department or other agency responsible to the Minister.

1.2 Unless the context clearly indicates otherwise, a reference in this Instrument to:

(a) the singular includes the plural and vice versa;

(b) any thing includes the whole and each part of that thing;

(c) legislation or a legislative provision includes regulations and other instruments made under the legislation, and any statutory amendment, consolidation, re-enactment or replacement of the same;

(d) a person includes a natural person, corporation, statutory corporation, partnership, the Crown or any other body, organisation or legal entity; and

(e) a requirement to do something includes a requirement to cause that thing to occur.

1.3 Headings are for convenience only and do not affect the interpretation of this Instrument.

C. Terms of Covenant

1. To the extent necessary to protect and conserve native vegetation and native fauna on the Land and facilitate revegetation and natural regeneration of native species, the Registered Proprietor must:

   (a) erect and maintain a stockproof fence on the boundaries of the Land, except in respect of any boundary which adjoins land reserved as a national park, state conservation area, or conservation area under the *National Parks and Wildlife Act 1974*, and for which the Secretary has given written approval to leave unfenced;

   (b) control weeds and feral pests on the Land, including compliance with the general biosecurity duty to control weeds under the *Biosecurity Act 2015* (NSW);

   (c) control vehicular access to the Land to minimise the potential for vehicle strike of native fauna;

   (d) carry out soil erosion prevention and management works on the Land; and

   (e) permit access to the Land by officers of the Department, authorised agents of the Department and relevant public authorities at all times for the purposes of monitoring compliance with this Instrument.

2. Nothing in this Instrument is to be construed as:

   (a) excusing or preventing the carrying out of Development or work required for the operation, maintenance or repair of infrastructure and easements existing as at the date this Instrument takes effect; or

   (b) excusing or derogating from any requirement to obtain any consent, approval, permit or licence under any applicable instrument or legislation or comply with any applicable legislation.

3. The Registered Proprietor must provide a copy of this Instrument and any relevant requirement of the Secretary to any transferee, lessee, licensee, mortgagee, or other successor in title.

4. The Registered Proprietor must, at its own cost, comply with the terms of this Instrument.

5. By written notice to the Registered Proprietor, the Secretary may, at any time, require the Registered Proprietor to attend to any matter and to carry out any such work required under clause C1 of this Instrument within such time as the Secretary may specify. The Registered Proprietor must comply with such notice at its cost and within the time specified.

6. If the Registered Proprietor fails to comply with the terms of any written notice given under clause 5 of this Instrument, any person authorised by the Secretary may enter the Land at any time with all necessary equipment and carry out any work which, in

its discretion, is required to ensure compliance with the notice or otherwise remedy any failure by the Registered Proprietor to observe its obligations under this Instrument. The Secretary may recover from the Registered Proprietor the costs associated with any such work, and may recover all expense incurred by the Secretary in doing so.

7. The Registered Proprietor must indemnify and keep indemnified the State of New South Wales from all claims and demands of every kind and from all liabilities which may arise in connection with the Registered Proprietor's failure to observe or comply with the terms of this Instrument.

8. The Registered Proprietor must maintain policies of insurance for public risk covering injury to person or property on the Land for an amount of not less than $20 million (or such other amount as the Secretary reasonably prescribes) arising out of any one single accident or event.

9. All insurance policies held by the Registered Proprietor under clause 8 of this Instrument must note the Minister as an interested party as directed from time to time by the Secretary or any person authorised by the Secretary.

10. The Registered Proprietor must produce a certificate of currency for all insurance policies held under clause 8 of this Instrument to the Secretary or any person authorised by the Secretary for inspection within 5 business days of demand (provided that such demand is not made more often than once each year).

11. If any provision or part of any provision of this Instrument is or becomes void, invalid, or unenforceable for any reason, that provision or part may be severed from this Instrument and all other provisions or parts which are self-sustaining and capable of separate enforcement without regard to the void, invalid or unenforceable provision will be and continue to be valid and enforceable in accordance with their terms.

12. This Instrument is to remain in force in respect of the Land in perpetuity.

13. This Instrument may only be varied with the consent of the Secretary in accordance with section 88E(7) of the *Conveyancing Act 1919*.

Annexure B to Positive Covenant

Execution by the Prescribed Authority

I certify that I am an eligible witness and that an authorised officer of the lessee signed this dealing in my presence.

Signature of witness

NESTOR TSAMBOS

Name of witness

64 FRAMPTON AVENUE

Address of witness

MARRICKVILLE 2204

Certified correct for the purposes of the Real Property Act 1900 by the authorised officer named below.

Signature of authorised officer

MARCUS RHY

Authorised officer's name

GROUP DEPUTY SECRETARY

Authority of officer

Minister for Planning for and on behalf of the Crown in right of the State of New South Wales

Signing on behalf of

Execution by the Registered Proprietor

Certified correct for the purposes of the Real Property Act 1900 and executed on behalf of the corporation named below by the authorised person(s) whose signature(s) appear(s) below pursuant to the authority specified.

Corporation STRATFORD COAL PTY LIMITED ACN 064 016 164

Authority section 127 of the *Corporations Act 2001* (Cth)

Signature of authorised person

Reinhold Schmidt

Name of authorised person

Director

Office held

Signature of authorised person

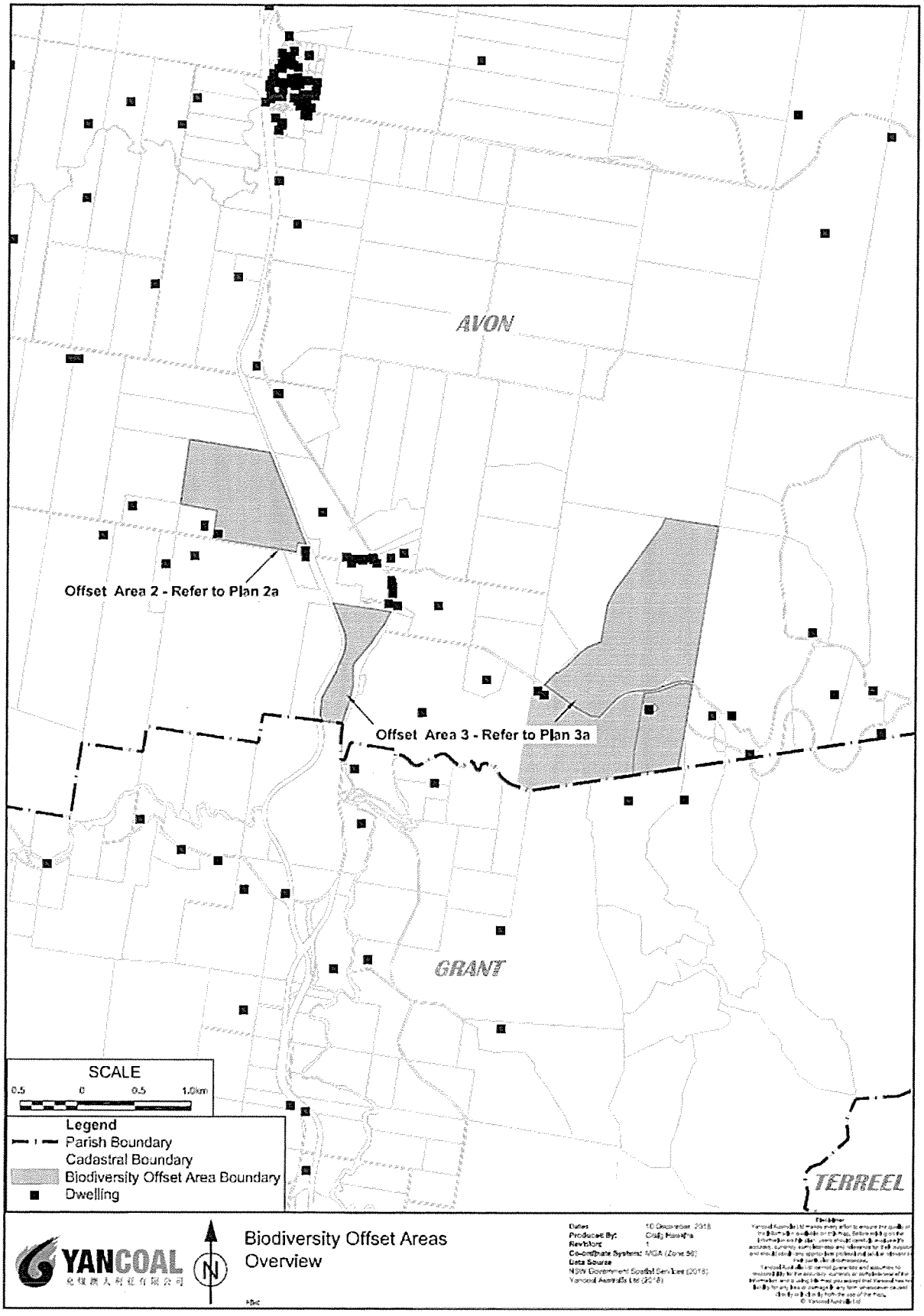
Lei Zhang

Name of authorised person

Director / Secretary

Office held

Annexure C to Positive Covenant



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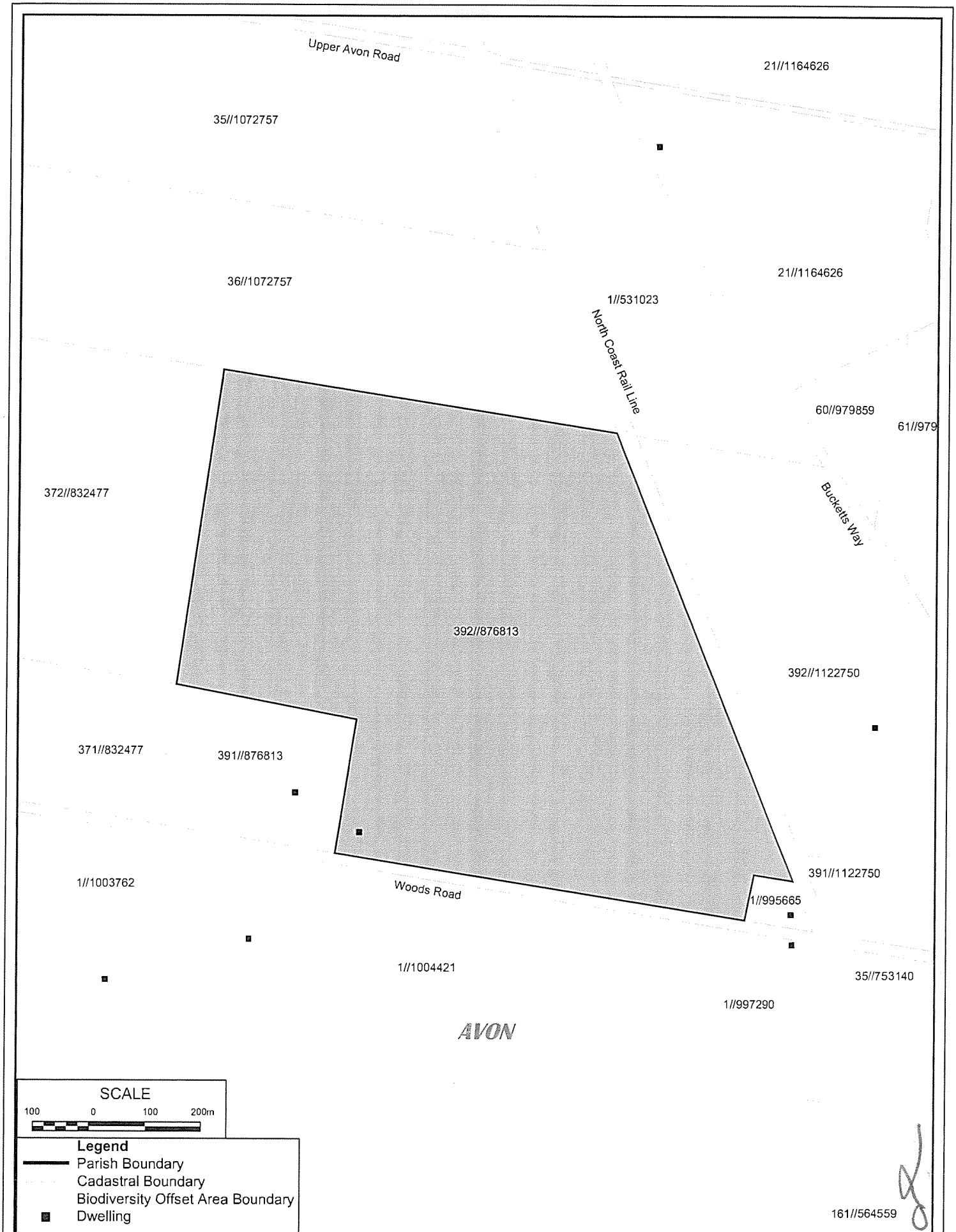

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N

Plan 2a - Land Subject to Instrument "Area 2"

File:

Date: 14 December 2018
Produced By: Craig Hawkins
Revision: 1
Co-ordinate System: MGA (Zone 56)
Data Source
NSW Government Spatial Services (2018)
Yancoal Australia Ltd (2018)

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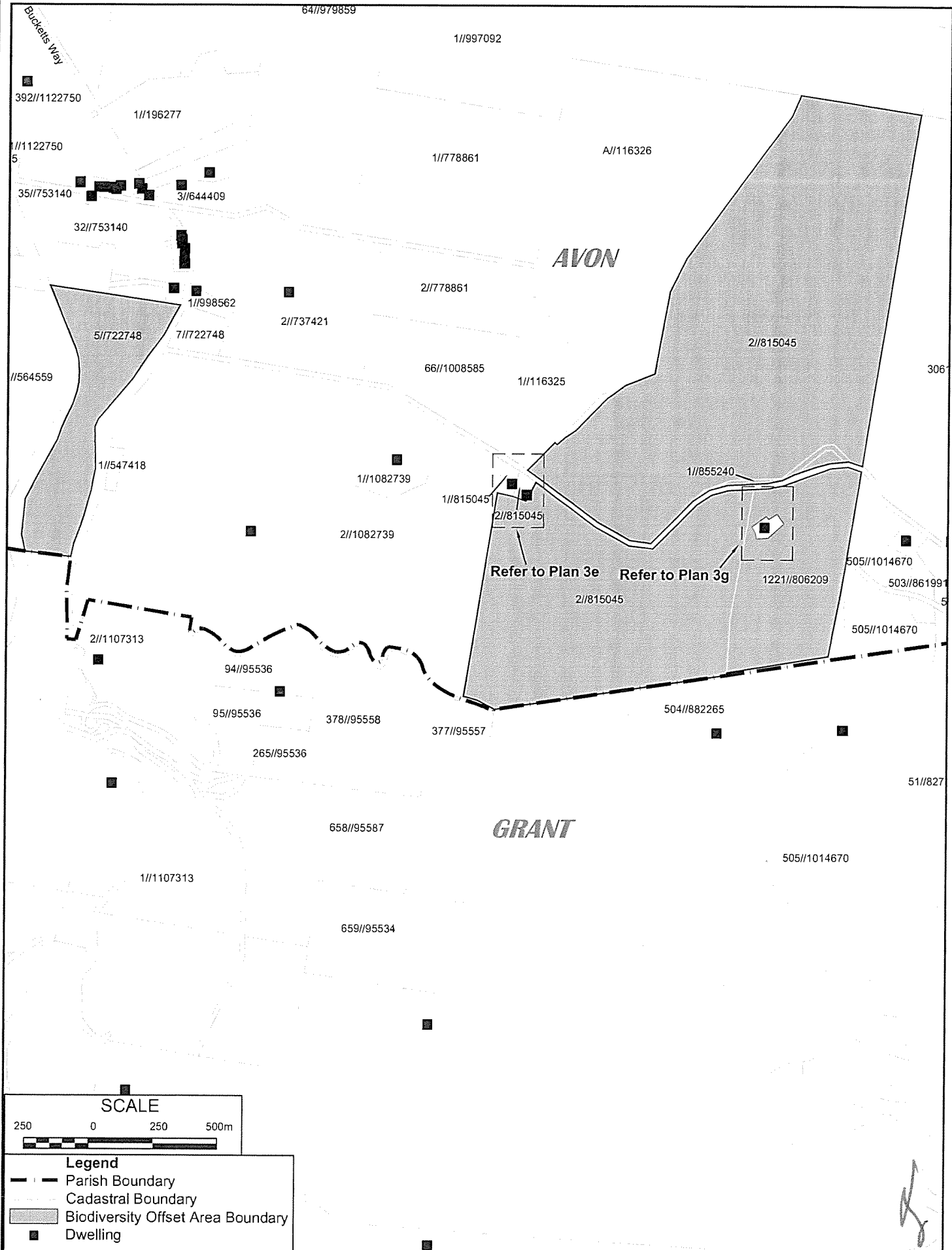

SCALE

250 0 250 500m

Legend

- Parish Boundary
- Cadastral Boundary
- Biodiversity Offset Area Boundary
- Dwelling

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N

Plan 3a - Land Subject to Instrument "Area 3"

File:

Date: 3 June 2019
Produced By: Craig Hawkins
Revision: 1
Co-ordinate System: MGA (Zone 56)
Data Source
NSW Government Spatial Services (2018)
Yancoal Australia Ltd (2018)

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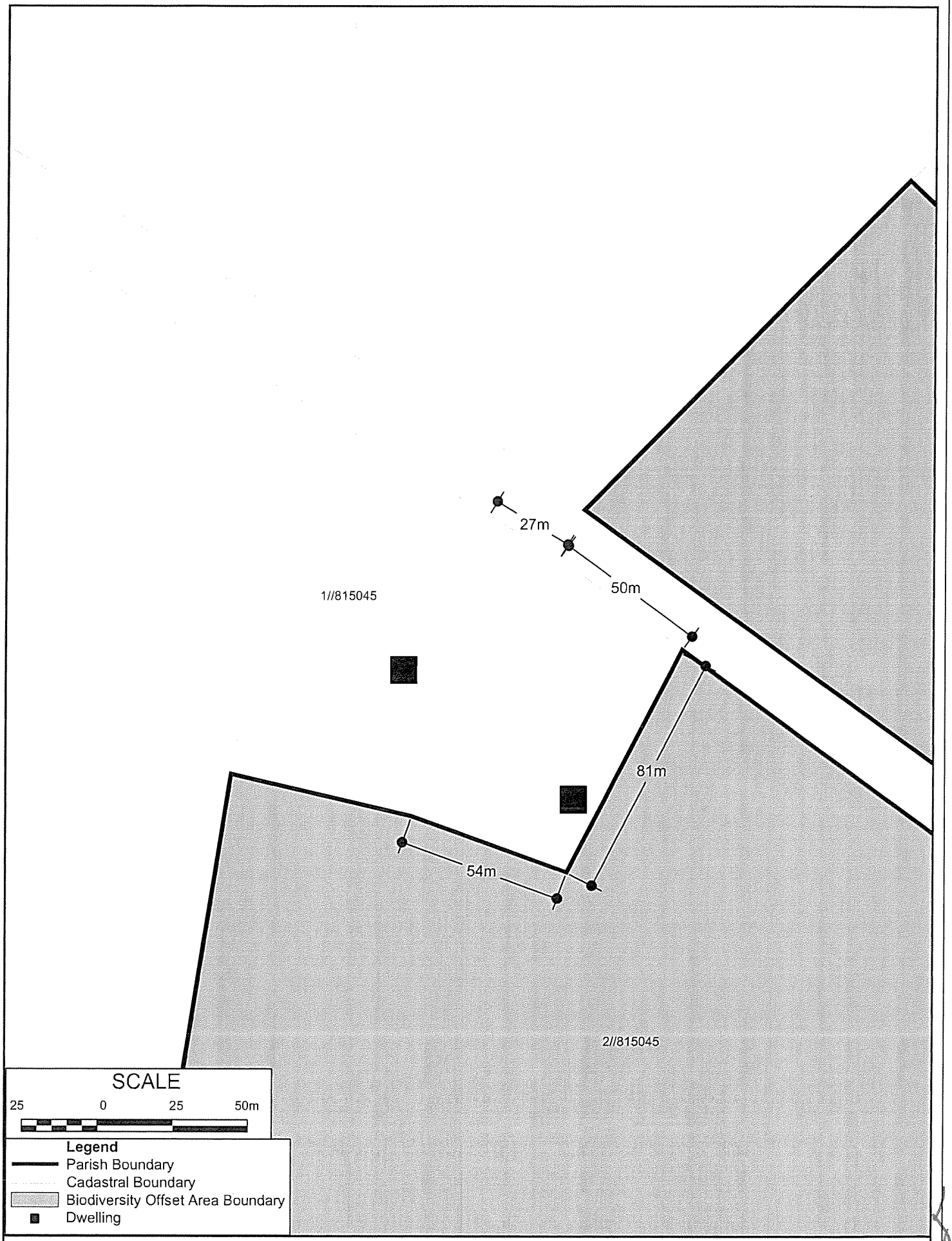

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Plan 3e - Land Subject to Instrument "Area 3"

Page 9 of 10

File:

Date: 14 December 2018
Produced By: Craig Hawkins
Revision: 1
Co-ordinate System: MGA (Zone 56)
Data Source
NSW Government Spatial Services (2018)
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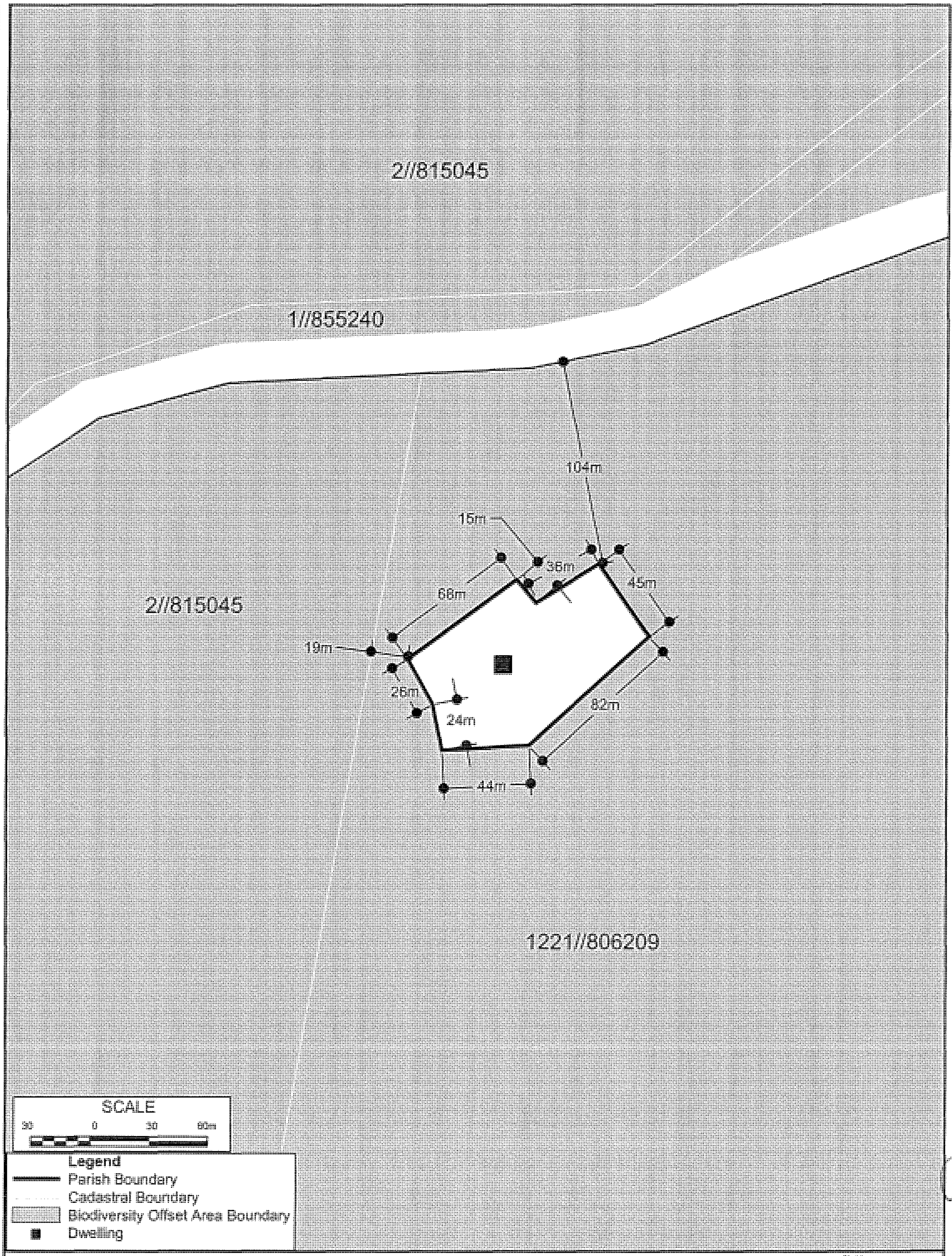

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Plan 3g - Land Subject to Instrument
"Area 3"

Date: 14 December 2018
Revision: 0
Coordinate System: MGA (Zone 56)
Data Source
NSW Government Spatial Services (2018)
Yancoal Australia Ltd (2018)

Disclaimer

MR

RS

Form: 13RPA
Release: 3·1

RESTRICTION ON THE USE OF LAND BY A PRESCRIBED AUTHORITY

New South Wales
Section 88E(3) Conveyancing Act 1919

Leave this space clear. Affix additional pages to the top left-hand corner.

PRIVACY NOTE: Section 31B of the Real Property Act 1900 (RP Act) authorises the Registrar General to collect the information required by this form for the establishment and maintenance of the Real Property Act Register. Section 96B RP Act requires that the Register is made available to any person for search upon payment of a fee, if any.

(A) **TORRENS TITLE**

SEE ANNEXURE A

(B) **LODGED BY**

Document Collection Box	Name, Address or DX, Telephone, and Customer Account Number if any	CODE
599D	MinterEllison Customer Account: 123438S 1 Farrer Place Telephone: 02 9921 8888 Sydney NSW Reference: AEW:AIW:207001631	RV

(C) **REGISTERED PROPRIETOR**

Of the above land
GLOUCESTER COAL LTD ACN 008 881 712 and CIM STRATFORD PTY LIMITED ACN 070 387 914 as tenants in common

(D) **LESSEE MORTGAGEE or CHARGEE**

Of the above land agreeing to be bound by this restriction

Nature of Interest	Number of Instrument	Name
NOT APPLICABLE	N.A.	N.A.

(E) **PRESCRIBED AUTHORITY**

Within the meaning of section 88E(1) of the Conveyancing Act 1919
Crown in right of the State of New South Wales, through its Department of Planning and Environment.

(F) The prescribed authority having imposed on the above land a restriction in the terms set out in annexure A hereto applies to have it recorded in the Register and certifies this application correct for the purposes of the Real Property Act 1900.

DATE

(G) I certify that an **authorised officer of the prescribed authority** who is personally known to me or as to whose identity I am otherwise satisfied signed this application in my presence.

Signature of witness:

Name of witness: SEE ANNEXURE B

Address of witness:

Signature of authorised officer:

Name of authorised officer: SEE ANNEXURE B

Position of authorised officer:

Certified correct for the purposes of the Real Property Act 1900 and executed on behalf of the company named below by the authorised person(s) whose signature(s) appear(s) below pursuant to the authority specified.
Company:
Authority:

Signature of authorised person:

Name of authorised person: SEE ANNEXURE B
Office held:

Signature of authorised person:

Name of authorised person: SEE ANNEXURE B
Office held:

(H) The N.A. under N.A. No. N.A. agrees to be bound by this restriction.
I certify that the N.A. ,who is personally known to me or as to whose identity I am otherwise satisfied, signed this application in my presence.

Signature of witness:

Name of witness:

Address of witness:

Signature of N.A.

* *s117 RP Act requires that you must have known the signatory for more than 12 months or have sighted identifying documentation.*

Annexure A to Restriction on Use of Land by a Prescribed Authority

A. Land burdened by Restriction

The Land burdened by this Instrument is identified as follows:

Area 1 biodiversity offset area (as depicted on Plan 1a attached at Annexure C)

- Lot 45 DP979859

Area 3 biodiversity offset area (as depicted on Plans 3a & 3f attached at Annexure C)

- Part of Lot 1 DP997092 (as shaded on the plans)
- Part of Lot 70 DP979859 (as shaded on the plans)
- Part of Lot 2 DP778861 (as shaded on the plans)
- Part of Lot 1 DP778861 (as shaded on the plans)

B. Interpretation

1.1 In this Instrument, unless the context clearly indicates otherwise, the following terms have the following meanings:

"**Approval**" means any of the following approvals as the case requires:

(a) Development Consent SSD-4966 granted by the Planning Assessment Commission on 29 May 2015 under Part 4 of the EP&A Act for the Stratford Extension Project as modified and as may be modified from time to time; and

(b) EPBC Approval EPBC 2011/6176 granted under Section 133 of the EPBC Act on 29 January 2016 for the Stratford Extension Project as may be modified from time to time;

"**Commonwealth Agency**" has the same meaning as it has in the EPBC Act.

"**Consent Authority**" has the same meaning as it has in the EP&A Act.

"**Department**" means the NSW Department of Planning and Environment.

"**Development**" has the same meaning as it has in the EP&A Act.

"**EECs**" means endangered ecological communities as defined in the *Biodiversity Conservation Act 2016* (NSW) and in the EPBC Act.

"**EP&A Act**" means the *Environmental Planning and Assessment Act 1979* (NSW).

"EPBC Act" means the *Environment Protection and Biodiversity Conservation Act 1999* (Cth).

"**Instrument**" means this section 88E instrument.

"**Land**" means the land burdened by this Instrument.

"**Minister**" means the Minister administering the *Environmental Planning and Assessment Act 1979* (NSW).

"**Registered Proprietor**" means the person or entity recorded by the Registrar-General of New South Wales as the registered proprietor of the Land from time to time.

"**Secretary**" means the Secretary of the Department or other agency responsible to the Minister.

"**Tenement**" means any of the following tenements and includes any modification or renewal of these tenements:

(a) Mining Lease 1733;

(b) Mining Lease 1360;

(c) Mining Lease 1409;

(d) Mining Lease 1447;

(e) Mining Lease 1521;

(f) Mining Lease 1528;

(g) Mining Lease 1538;

(h) Mining Lease 1577; and

(i) Mining Lease 1787.

1.2 Unless the context clearly indicates otherwise, a reference in this Instrument to:

(a) the singular includes the plural and vice versa;

(b) any thing includes the whole and each part of that thing;

(c) legislation or a legislative provision includes regulations and other instruments made under the legislation, and any statutory amendment, consolidation, re-enactment or replacement of the same;

(d) a person includes a natural person, corporation, statutory corporation, partnership, the Crown or any other body, organisation or legal entity; and

(e) a requirement not to do something includes a requirement to prevent that thing from occurring.

1.3 Headings are for convenience only and do not affect the interpretation of this Instrument.

C. Terms of restriction

1. Subject to clause 2 of this Instrument, no person, unless permitted to do so under the terms of an Approval or Tenement, is to:

(a) carry out any Development on the Land;

(b) destroy, damage, remove or harm any native flora or fauna in or on the Land;

(c) occupy, or allow any person to occupy the Land;

(d) allow livestock grazing on the Land;

(e) clear or cultivate the Land;

(f) interfere with any substance on the Land whether or not in or forming part of the Land;

(g) carry out any activity in or on the Land that threatens or might threaten, or may cause, or be likely to result in threat to, the viability of native flora or fauna on the Land;

(h) carry out any activity in or on the Land that threatens or might threaten, or may cause or be likely to result in threat to, the implementation of measures under a biodiversity management plan or a biodiversity offset management plan approved by a Consent Authority, Commonwealth Agency or the Secretary in respect of the Land; or

(i) carry out any activity in or on the Land that threatens or might threaten, or may cause or be likely to result in threat to, the viability of any EEC's on the Land.

2. To the extent that the carrying out of Development or other activity on the Land is necessary for the purpose of:

(a) implementing provisions of a biodiversity management plan or a biodiversity offset management plan approved by a Consent Authority, Commonwealth Agency or the Secretary in respect of the Land;

(b) complying with the conditions of any relevant Approval or Tenement;

(c) otherwise protecting and conserving native vegetation and native fauna on the Land and facilitating natural regeneration of native species on the Land,

the obligations in clause 1 of this Instrument do not prevent or restrict a Registered Proprietor or its authorised agents, contractors, employees, licensees, lessees and invitees from lawfully carrying out the following activities on the Land:

i. revegetation and regeneration works including establishment of canopy, understorey and ground cover species and collecting and propagating seed for the purposes of revegetation;

ii. introducing, installing or replacing hollow bearing habitat features and habitat resources;

iii. controlling weeds and feral pests;

iv. managing or preventing soil erosion;

v. carrying out bushfire management works under a management plan approved by NSW Rural Fire Service or as directed by NSW Rural Fire Service;

vi. destruction or removal of vegetation within 6 metres of the boundaries of the area of the Land to which this restriction applies, for the purpose of erecting or maintaining a fence along such boundaries;

vii. destruction or removal of vegetation where necessary for the purposes of maintaining an existing vehicular access track or creating a new vehicular access track but only up to 3 metres either side of the centre line of the track; and

viii. any other thing required to be done under a biodiversity management plan or biodiversity offset management plan approved by a Consent Authority, Commonwealth Agency or the Secretary in respect of the Land, including but not limited to, conducting surveys and undertaking monitoring, auditing and reporting activities. The Registered Proprietor must provide a copy of this Instrument to any lessee, licensee or mortgagee.

3. The Registered Proprietor must permit access to the Land by the Secretary or any person authorised by the Secretary and relevant public authorities at all times for the purposes of monitoring compliance with this Instrument.

4. The Registered Proprietor must, at its own cost, comply with the terms of this Instrument.

5. By written notice to the Registered Proprietor, the Secretary may, at any time, require the Registered Proprietor to attend to any matter and to carry out any such work pursuant to this Instrument within such time as the Secretary may specify. The Registered Proprietor must comply with such notice at its cost and within the time specified.

6. If the Registered Proprietor fails to comply with the terms of any written notice given under clause 5 of this Instrument, any person authorised by officers of the Department and authorised agents of the Department may enter the Land at any time with all necessary equipment and carry out any work which, in its discretion, is required to ensure compliance with the notice or otherwise remedy any failure by the Registered Proprietor to observe its obligations under this Instrument. The Department may recover from the Registered Proprietor the cost associated with carrying out any such work, and may recover all expense incurred by the Department in doing so.

7. The Registered Proprietor must indemnify and keep indemnified the State of New South Wales from all claims and demands of every kind and from all liabilities which may arise in connection with the Registered Proprietor's failure to observe or comply with the terms of this Instrument.

8. If any provision or part of any provision of this Instrument is or becomes void, invalid, or unenforceable for any reason, that provision or part may be severed from this Instrument and all other provisions or parts which are self-sustaining and capable of separate enforcement without regard to the void, invalid, or unenforceable provision will be and continue to be valid and enforceable in accordance with their terms.

9. Nothing in this Instrument is to be construed as:

(a) excusing or preventing the carrying out of Development or work required for the operation, maintenance or repair of infrastructure and easements existing as at the date this Instrument takes effect; or

(b) excusing or derogating from any requirement to obtain any consent, approval, permit or licence under any applicable instrument or legislation or comply with any applicable legislation.

10. This Instrument is to remain in force in respect of the Land in perpetuity.

11. This Instrument may only be varied with the consent of the Secretary in accordance with section 88E(7) of the *Conveyancing Act 1919*.

Annexure B to Restriction on Use of Land by a Prescribed Authority

Execution by the Prescribed Authority

I certify that I am an eligible witness and that an authorised officer of the lessee signed this dealing in my presence.

Signature of witness

NESTOR BAMBOS

Name of witness

64 FRAMPTON AVENUE

Address of witness

MARRICKVILLE 2204

Certified correct for the purposes of the Real Property Act 1900 by the authorised officer named below.

Signature of authorised officer

MARCUS RAY

Authorised officer's name

GROUP DEPUTY SECRETARY

Authority of officer

Minister for Planning for and on behalf of the Crown in right of the State of New South Wales

Signing on behalf of

Execution by the Registered Proprietor

Certified correct for the purposes of the Real Property Act 1900 and executed on behalf of the corporation named below by the authorised person(s) whose signature(s) appear(s) below pursuant to the authority specified.

Corporation GLOUCESTER COAL LTD ACN 008 881 712

Authority section 127 of the *Corporations Act 2001* (Cth)

Signature of authorised person

Reinhold Schmidt

Name of authorised person

Director

Office held

Signature of authorised person

Lei Zhang

Name of authorised person

Director / Secretary

Office held

Certified correct for the purposes of the Real Property Act 1900 and executed on behalf of the corporation named below by the authorised person(s) whose signature(s) appear(s) below pursuant to the authority specified.

Corporation CIM STRATFORD PTY LTD ACN 070 387 914

Authority section 127 of the *Corporations Act 2001* (Cth)

Signature of authorised person

Reinhold Schmidt

Name of authorised person

Director

Office held

Signature of authorised person

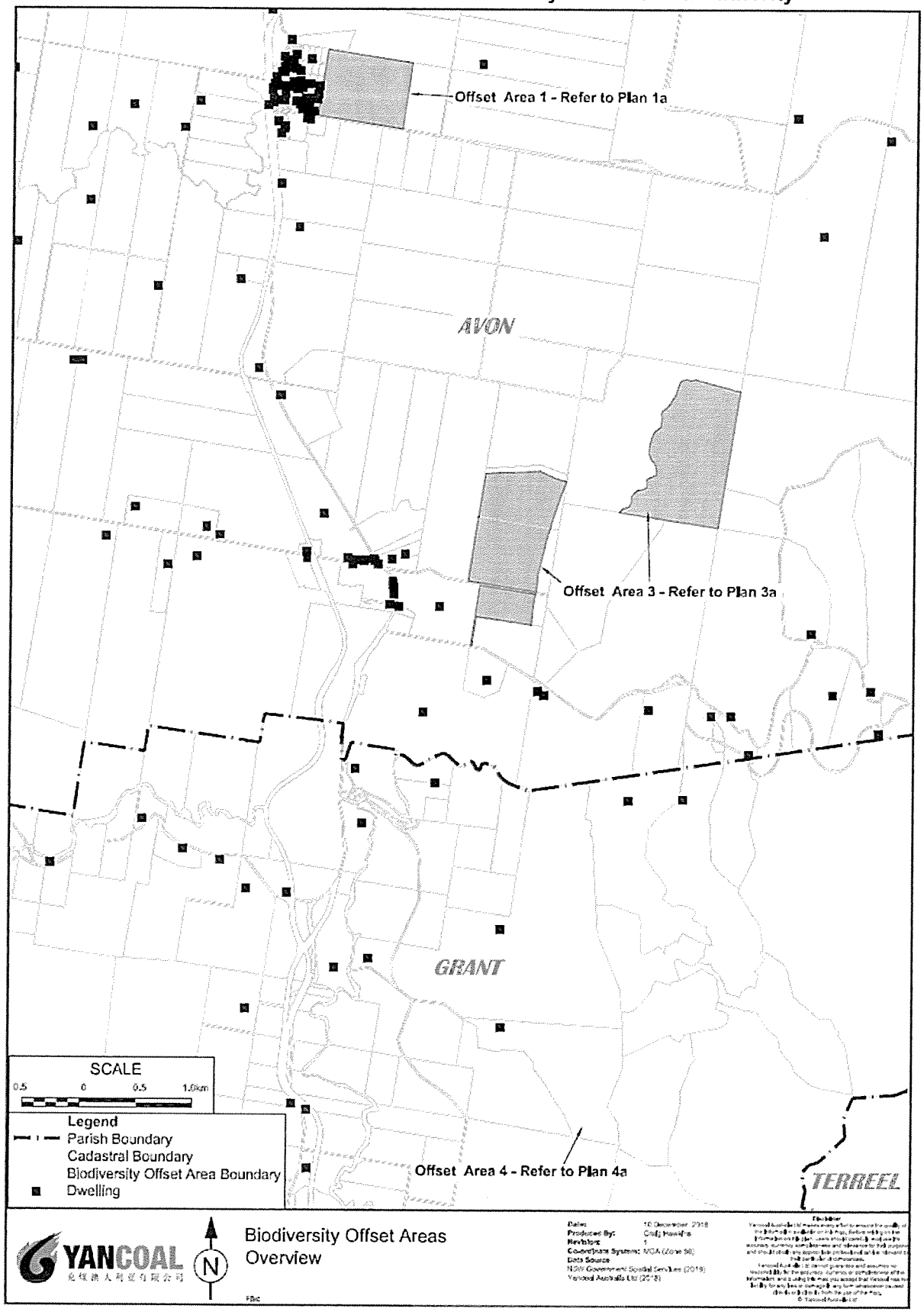
Lei Zhang

Name of authorised person

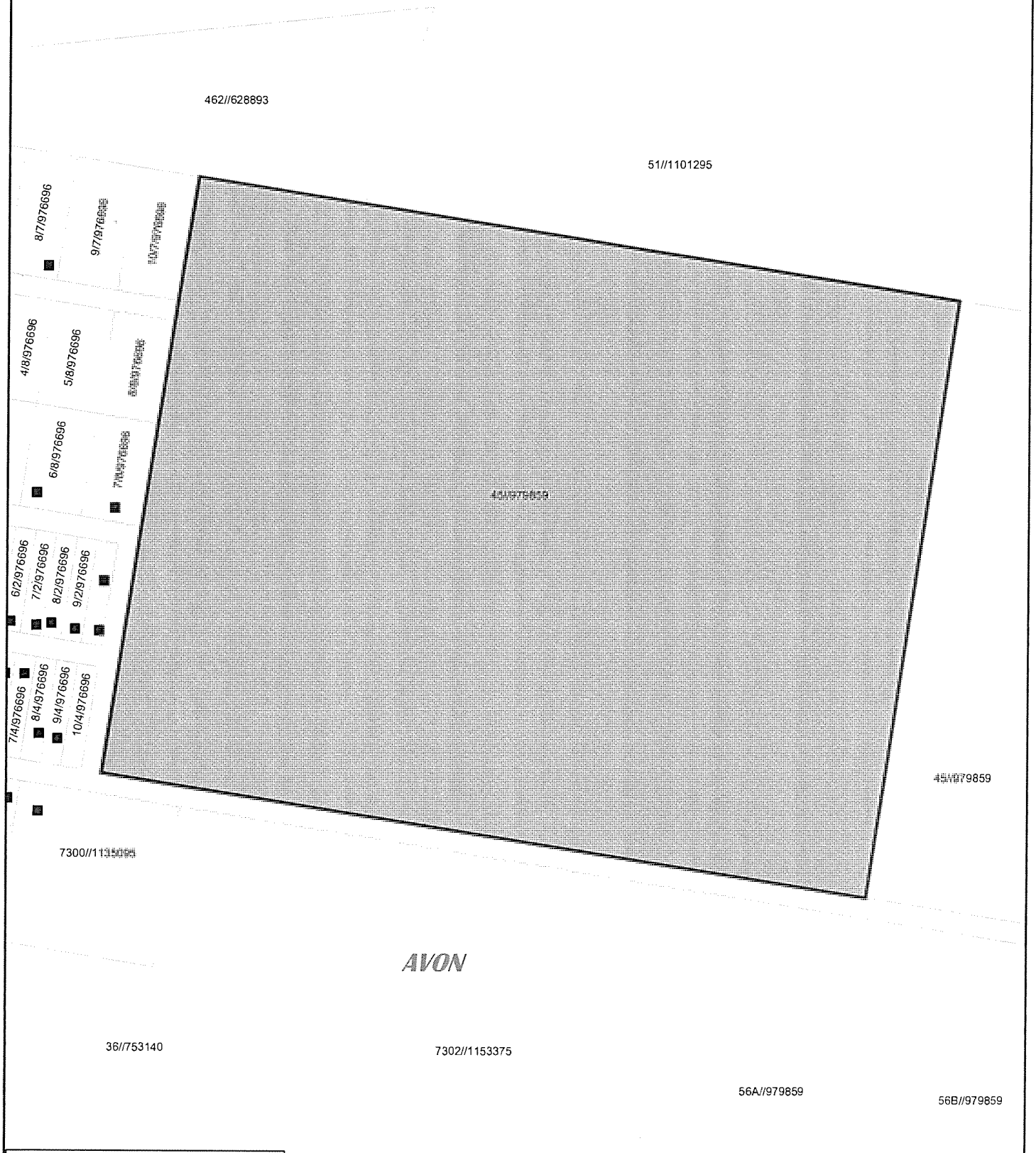
Director / Secretary

Office held

Annexure C to Restriction on Use of Land by a Prescribed Authority



ME_160224227_2

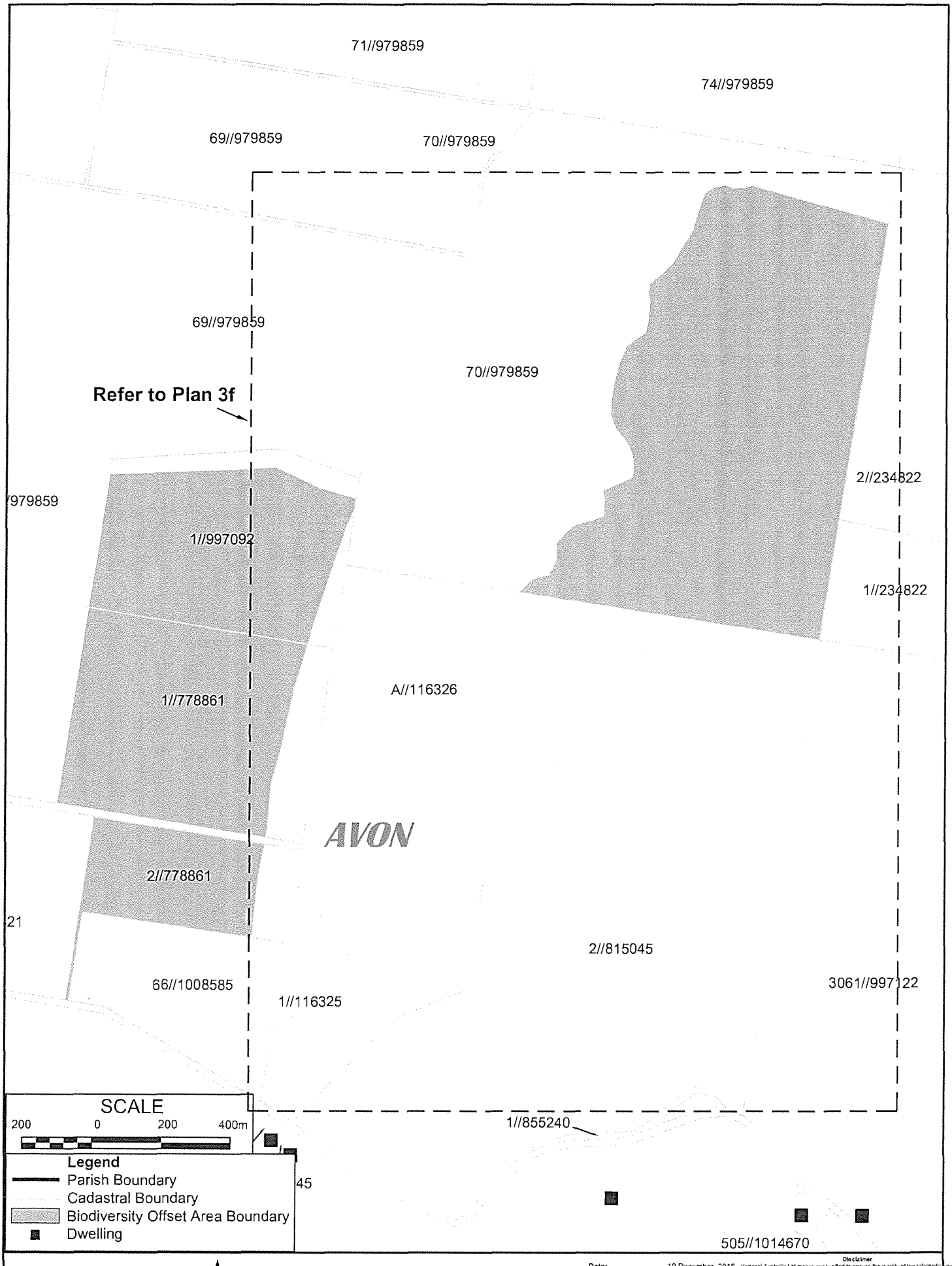


YANCOAL 克煤澳大利亚有限公司

Plan 1a - Land Subject to Instrument "Area 1"

File:

Date:	10 December 2018
Produced By:	Craig Hawkins
Revision:	1
Co-ordinate System:	MGA (Zone 56)
Data Source	NSW Government Spatial Services (2018) Yancoal Australia Ltd (2018)



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Plan 3a - Land Subject to Instrument "Area 3"

Page 10 of 11

File:

Date:	10 December 2018
Produced By:	Craig Hawkins
Revision:	1
Co-ordinate System:	MGA (Zone 56)
Data Source	NSW Government Spatial Services (2018) Yancoal Australia Ltd (2018)

SCALE

125 0 125 250m

Legend

- Parish Boundary
- Cadastral Boundary
- Biodiversity Offset Area Boundary
- Dwelling

YANCOAL 兖煤澳大利亚有限公司

Plan 3f - Land Subject to Instrument "Area 3"

File:

Date: 10 December 2018
Produced By: Craig Hawkins
Revision: 1
Co-ordinate System: MGA (Zone 56)
Data Source
NSW Government Spatial Services (2018)
Yancoal Australia Ltd (2018)

Form: 13RPA
Release: 3·1

RESTRICTION ON THE USE OF LAND BY A PRESCRIBED AUTHORITY

New South Wales
Section 88E(3) Conveyancing Act 1919

Leave this space clear. Affix additional pages to the top left-hand corner.

PRIVACY NOTE: Section 31B of the Real Property Act 1900 (RP Act) authorises the Registrar General to collect the information required by this form for the establishment and maintenance of the Real Property Act Register. Section 96B RP Act requires that the Register is made available to any person for search upon payment of a fee, if any.

(A) **TORRENS TITLE**

SEE ANNEXURE A

(B) **LODGED BY**

Document Collection Box	Name, Address or DX, Telephone, and Customer Account Number if any	CODE
599D	MinterEllison Customer Account: 123438S 1 Farrer Place Telephone: 02 9921 8888 Sydney NSW Reference: AEW:AIW:207001631	RV

(C) **REGISTERED PROPRIETOR**

Of the above land
GLOUCESTER COAL LTD ACN 008 881 712

(D) **LESSEE MORTGAGEE or CHARGEE**

Of the above land agreeing to be bound by this restriction

Nature of Interest	Number of Instrument	Name
NOT APPLICABLE	N.A.	N.A.

(E) **PRESCRIBED AUTHORITY**

Within the meaning of section 88E(1) of the Conveyancing Act 1919
Crown in right of the State of New South Wales, through its Department of Planning and Environment.

(F) The prescribed authority having imposed on the above land a restriction in the terms set out in annexure A hereto applies to have it recorded in the Register and certifies this application correct for the purposes of the Real Property Act 1900.

DATE

(G) I certify that an **authorised officer of the prescribed authority** who is personally known to me or as to whose identity I am otherwise satisfied signed this application in my presence.

Signature of witness:

Name of witness: SEE ANNEXURE B

Address of witness:

Signature of authorised officer:

Name of authorised officer: SEE ANNEXURE B

Position of authorised officer:

Certified correct for the purposes of the Real Property Act 1900 and executed on behalf of the company named below by the authorised person(s) whose signature(s) appear(s) below pursuant to the authority specified.
Company:
Authority:

Signature of authorised person:

Name of authorised person: SEE ANNEXURE B
Office held:

Signature of authorised person:

Name of authorised person: SEE ANNEXURE B
Office held:

(H) The N.A. under N.A. No. N.A. agrees to be bound by this restriction.
I certify that the N.A. ,who is personally known to me or as to whose identity I am otherwise satisfied, signed this application in my presence.

Signature of witness:

Name of witness:

Address of witness:

Signature of N.A.

** s117 RP Act requires that you must have known the signatory for more than 12 months or have sighted identifying documentation.*

A. Land burdened by Restriction

The Land burdened by this Instrument is identified as follows:

Area 2 biodiversity offset area (as depicted on Plan 2a attached at Annexure C)

- Lot 1 DP997290

Area 3 biodiversity offset area (as depicted on Plans 3a – 3d, 3f attached at Annexure C)

- Part of Lot A DP116326 (as shaded on the plans)
- Part of Lot 66 DP1008585 (as shaded on the plans)
- Part of Lot 1 DP116325 (as shaded on the plans)
- Part of Lot 2 DP737421 (as shaded on the plans)
- Part of Lot 1 DP998562 (as shaded on the plans)
- Part of Lot 2 DP1082739 (as shaded on the plans)
- Part of Lot 1 DP1082739 (as shaded on the plans)
- Lot 7 DP722748

Area 4 biodiversity offset area (as depicted on Plans 4a & 4b attached at Annexure C)

- Part of Lot 110 DP874013 (as shaded on the plans)
- Lot 506 DP1014670
- Lot 508 DP1014670

B. Interpretation

1.1 In this Instrument, unless the context clearly indicates otherwise, the following terms have the following meanings:

"**Approval**" means any of the following approvals as the case requires:

(a) Development Consent SSD-4966 granted by the Planning Assessment Commission on 29 May 2015 under Part 4 of the EP&A Act for the Stratford Extension Project as modified and as may be modified from time to time; and

(b) EPBC Approval EPBC 2011/6176 granted under Section 133 of the EPBC Act on 29 January 2016 for the Stratford Extension Project as may be modified from time to time;

"**Commonwealth Agency**" has the same meaning as it has in the EPBC Act.

"**Consent Authority**" has the same meaning as it has in the EP&A Act.

"**Department**" means the NSW Department of Planning and Environment.

"**Development**" has the same meaning as it has in the EP&A Act.

"**EECs**" means endangered ecological communities as defined in the *Biodiversity Conservation Act 2016* (NSW) and in the EPBC Act.

"**EP&A Act**" means the *Environmental Planning and Assessment Act 1979* (NSW).

"**EPBC Act**" means the *Environment Protection and Biodiversity Conservation Act 1999* (Cth).

"**Instrument**" means this section 88E instrument.

"**Land**" means the land burdened by this Instrument.

"**Minister**" means the Minister administering the *Environmental Planning and Assessment Act 1979* (NSW).

"**Registered Proprietor**" means the person or entity recorded by the Registrar-General of New South Wales as the registered proprietor of the Land from time to time.

"**Secretary**" means the Secretary of the Department or other agency responsible to the Minister.

"**Tenement**" means any of the following tenements and includes any modification or renewal of these tenements:

(a) Mining Lease 1733;

(b) Mining Lease 1360;

(c) Mining Lease 1409;

(d) Mining Lease 1447;

(e) Mining Lease 1521;

(f) Mining Lease 1528;

(g) Mining Lease 1538;

(h) Mining Lease 1577; and

(i) Mining Lease 1787.

1.2 Unless the context clearly indicates otherwise, a reference in this Instrument to:

(a) the singular includes the plural and vice versa;

(b) any thing includes the whole and each part of that thing;

(c) legislation or a legislative provision includes regulations and other instruments made under the legislation, and any statutory amendment, consolidation, re-enactment or replacement of the same;

(d) a person includes a natural person, corporation, statutory corporation, partnership, the Crown or any other body, organisation or legal entity; and

(e) a requirement not to do something includes a requirement to prevent that thing from occurring.

1.3 Headings are for convenience only and do not affect the interpretation of this Instrument.

C. Terms of restriction

1. Subject to clause 2 of this Instrument, no person, unless permitted to do so under the terms of an Approval or Tenement, is to:

   (a) carry out any Development on the Land;

   (b) destroy, damage, remove or harm any native flora or fauna in or on the Land;

   (c) occupy, or allow any person to occupy the Land;

   (d) allow livestock grazing on the Land;

   (e) clear or cultivate the Land;

   (f) interfere with any substance on the Land whether or not in or forming part of the Land;

   (g) carry out any activity in or on the Land that threatens or might threaten, or may cause, or be likely to result in threat to, the viability of native flora or fauna on the Land;

   (h) carry out any activity in or on the Land that threatens or might threaten, or may cause or be likely to result in threat to, the implementation of measures under a biodiversity management plan or a biodiversity offset management plan approved by a Consent Authority, Commonwealth Agency or the Secretary in respect of the Land; or

   (i) carry out any activity in or on the Land that threatens or might threaten, or may cause or be likely to result in threat to, the viability of any EEC's on the Land.

2. To the extent that the carrying out of Development or other activity on the Land is necessary for the purpose of:

   (a) implementing provisions of a biodiversity management plan or a biodiversity offset management plan approved by a Consent Authority, Commonwealth Agency or the Secretary in respect of the Land;

   (b) complying with the conditions of any relevant Approval or Tenement;

   (c) otherwise protecting and conserving native vegetation and native fauna on the Land and facilitating natural regeneration of native species on the Land,

   the obligations in clause 1 of this Instrument do not prevent or restrict a Registered Proprietor or its authorised agents, contractors, employees, licensees, lessees and invitees from lawfully carrying out the following activities on the Land:

   i. revegetation and regeneration works including establishment of canopy, understorey and ground cover species and collecting and propagating seed for the purposes of revegetation;

   ii. introducing, installing or replacing hollow bearing habitat features and habitat resources;

iii. controlling weeds and feral pests;

iv. managing or preventing soil erosion;

v. carrying out bushfire management works under a management plan approved by NSW Rural Fire Service or as directed by NSW Rural Fire Service;

vi. destruction or removal of vegetation within 6 metres of the boundaries of the area of the Land to which this restriction applies, for the purpose of erecting or maintaining a fence along such boundaries;

vii. destruction or removal of vegetation where necessary for the purposes of maintaining an existing vehicular access track or creating a new vehicular access track but only up to 3 metres either side of the centre line of the track; and

viii. any other thing required to be done under a biodiversity management plan or biodiversity offset management plan approved by a Consent Authority, Commonwealth Agency or the Secretary in respect of the Land, including but not limited to, conducting surveys and undertaking monitoring, auditing and reporting activities. The Registered Proprietor must provide a copy of this Instrument to any lessee, licensee or mortgagee.

3. The Registered Proprietor must permit access to the Land by the Secretary or any person authorised by the Secretary and relevant public authorities at all times for the purposes of monitoring compliance with this Instrument.

4. The Registered Proprietor must, at its own cost, comply with the terms of this Instrument.

5. By written notice to the Registered Proprietor, the Secretary may, at any time, require the Registered Proprietor to attend to any matter and to carry out any such work pursuant to this Instrument within such time as the Secretary may specify. The Registered Proprietor must comply with such notice at its cost and within the time specified.

6. If the Registered Proprietor fails to comply with the terms of any written notice given under clause 5 of this Instrument, any person authorised by officers of the Department and authorised agents of the Department may enter the Land at any time with all necessary equipment and carry out any work which, in its discretion, is required to ensure compliance with the notice or otherwise remedy any failure by the Registered Proprietor to observe its obligations under this Instrument. The Department may recover from the Registered Proprietor the cost associated with carrying out any such work, and may recover all expense incurred by the Department in doing so.

7. The Registered Proprietor must indemnify and keep indemnified the State of New South Wales from all claims and demands of every kind and from all liabilities which may arise in connection with the Registered Proprietor's failure to observe or comply with the terms of this Instrument.

8. If any provision or part of any provision of this Instrument is or becomes void, invalid, or unenforceable for any reason, that provision or part may be severed from this Instrument and all other provisions or parts which are self-sustaining and capable of separate enforcement without regard to the void, invalid, or unenforceable provision will be and continue to be valid and enforceable in accordance with their terms.

9. Nothing in this Instrument is to be construed as:

(a) excusing or preventing the carrying out of Development or work required for the operation, maintenance or repair of infrastructure and easements existing as at the date this Instrument takes effect; or

(b) excusing or derogating from any requirement to obtain any consent, approval, permit or licence under any applicable instrument or legislation or comply with any applicable legislation.

10. This Instrument is to remain in force in respect of the Land in perpetuity.

11. This Instrument may only be varied with the consent of the Secretary in accordance with section 88E(7) of the *Conveyancing Act 1919*.

Annexure B to Restriction on Use of Land by a Prescribed Authority

Execution by the Prescribed Authority

I certify that I am an eligible witness and that an authorised officer of the lessee signed this dealing in my presence.

Signature of witness

NESTOR TSAMBOS

Name of witness

64 FRAMPTON AVENUE

Address of witness

MARRICKVILLE 2204

Certified correct for the purposes of the Real Property Act 1900 by the authorised officer named below

Signature of authorised officer

MARCUS BRAY

Authorised officer's name

GROUP DEPUTY SECRETARY

Authority of officer

Minister for Planning for and on behalf of the Crown in right of the State of New South Wales

Signing on behalf of

Execution by the Registered Proprietor

Certified correct for the purposes of the Real Property Act 1900 and executed on behalf of the corporation named below by the authorised person(s) whose signature(s) appear(s) below pursuant to the authority specified.

Corporation GLOUCESTER COAL LTD ACN 008 881 712

Authority section 127 of the *Corporations Act 2001* (Cth)

Signature of authorised person

Reinhold Schmidt

Name of authorised person

Director

Office held

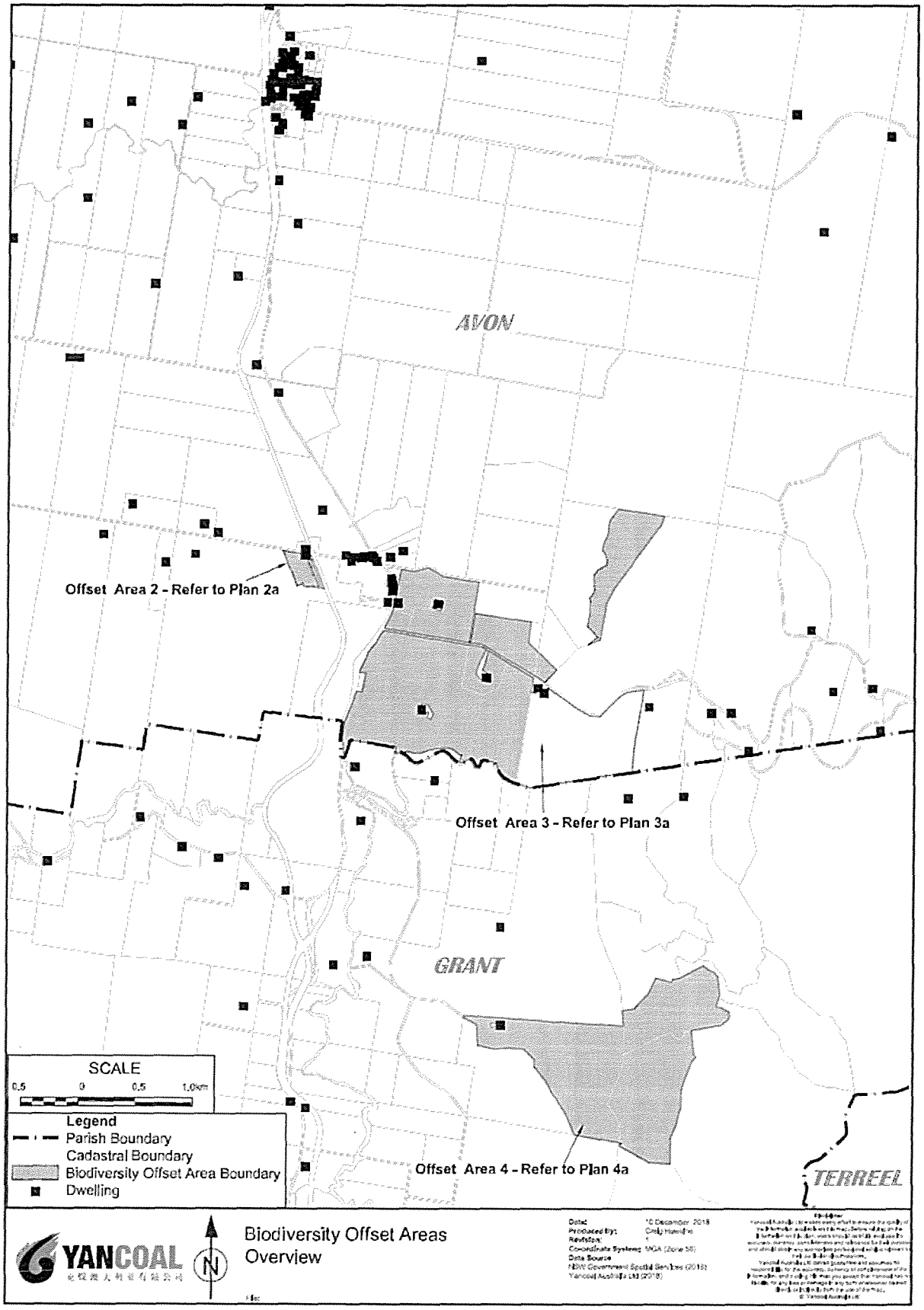
Signature of authorised person

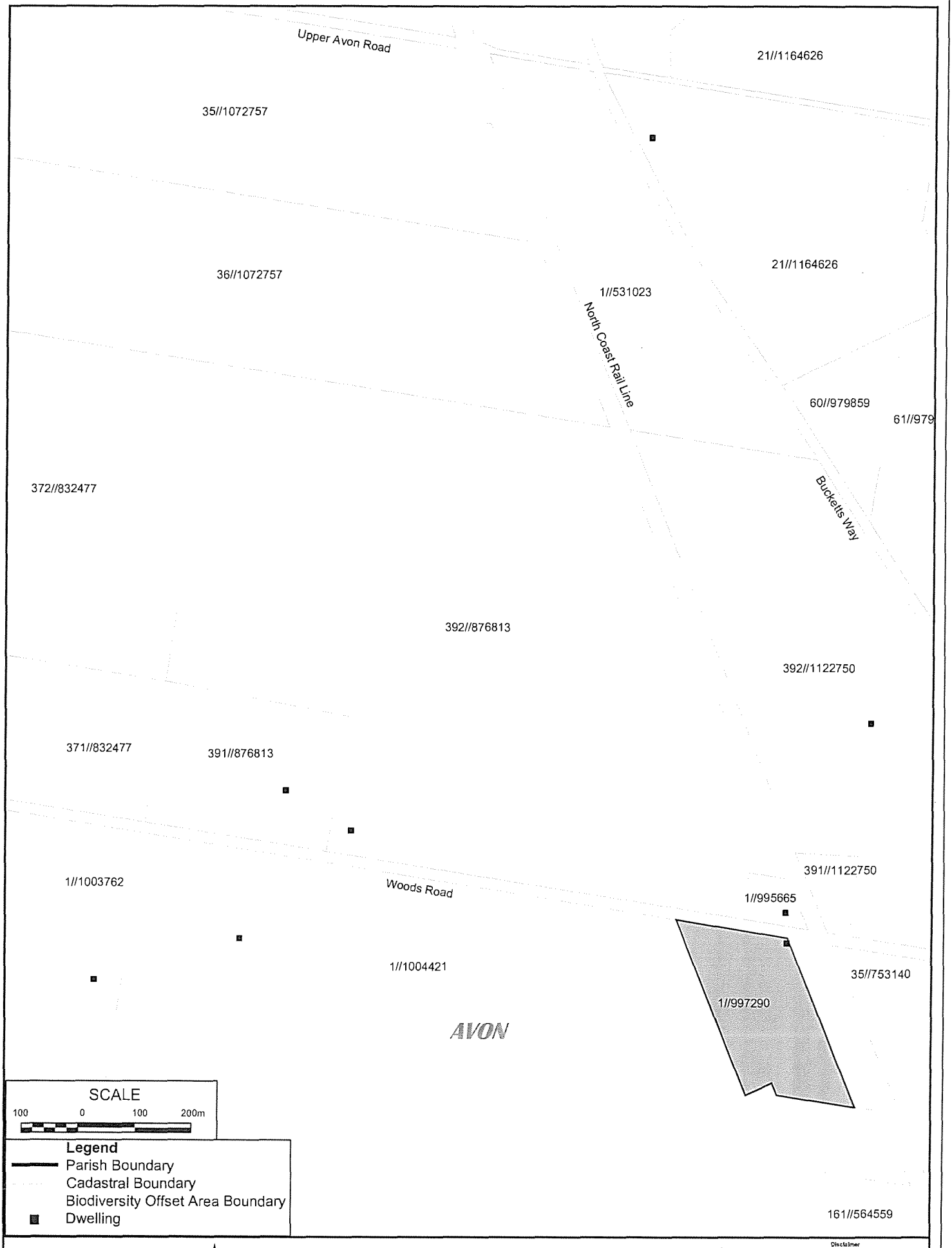
Lei Zhang

Name of authorised person

Director / Secretary

Office held


AVON
Offset Area 2 - Refer to Plan 2a
Offset Area 3 - Refer to Plan 3a
GRANT
Offset Area 4 - Refer to Plan 4a
TERREEL
SCALE
0.5 0 0.5 1.0km
Legend
Parish Boundary
Cadastral Boundary
Biodiversity Offset Area Boundary
Dwelling
YANCOAL
Biodiversity Offset Areas
Overview



YANCOAL 兖煤澳大利亚有限公司

N

Plan 2a - Land Subject to Instrument "Area 2"

File:

Date: 14 December 2018
Produced By: Craig Hawkins
Revision: 1
Co-ordinate System: MGA (Zone 56)
Data Source
NSW Government Spatial Services (2018)
Yancoal Australia Ltd (2018)

Disclaimer
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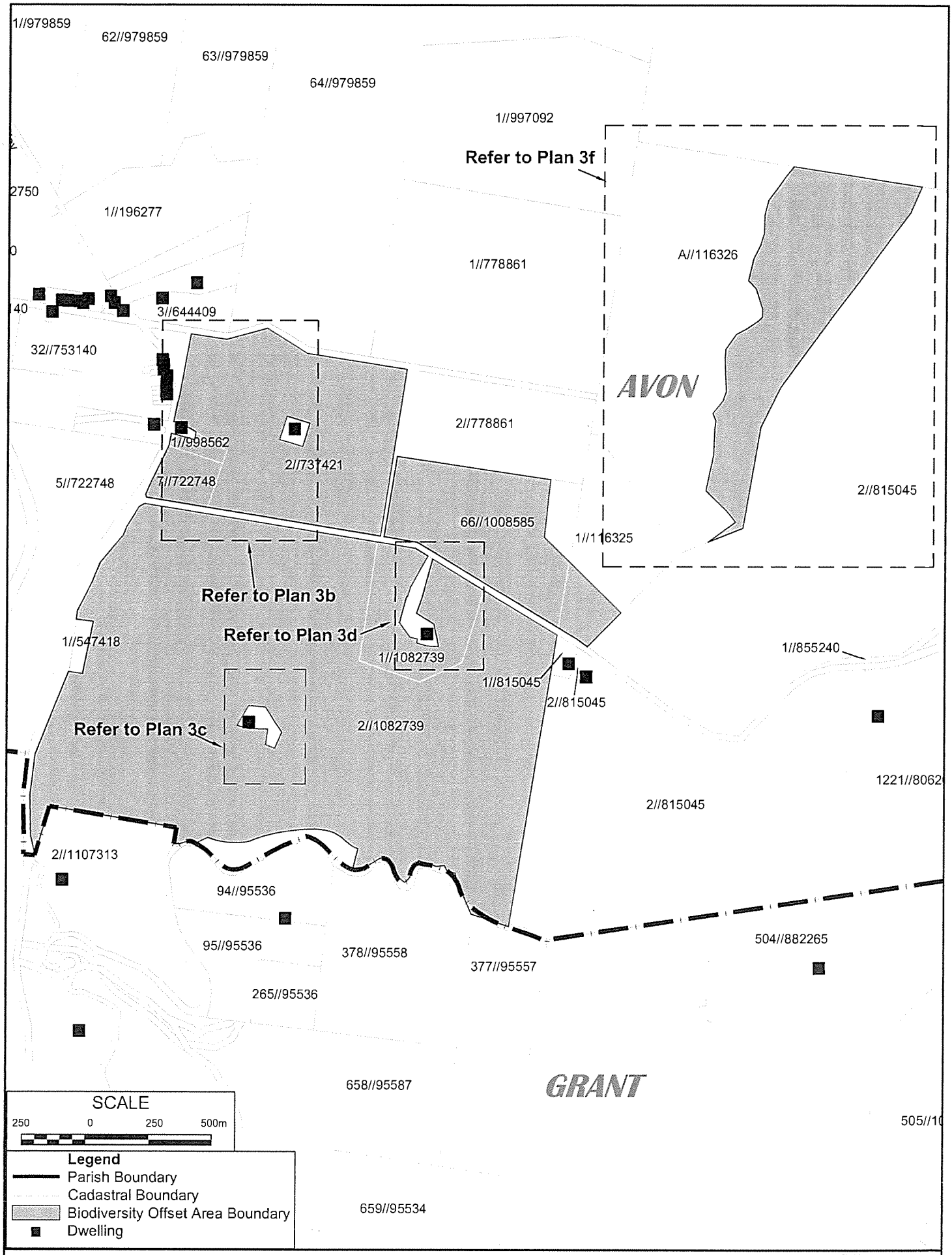

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N

Plan 3a - Land Subject to Instrument "Area 3"

File:

Date:	10 December 2018
Produced By:	Craig Hawkins
Revision:	1
Co-ordinate System:	MGA (Zone 56)
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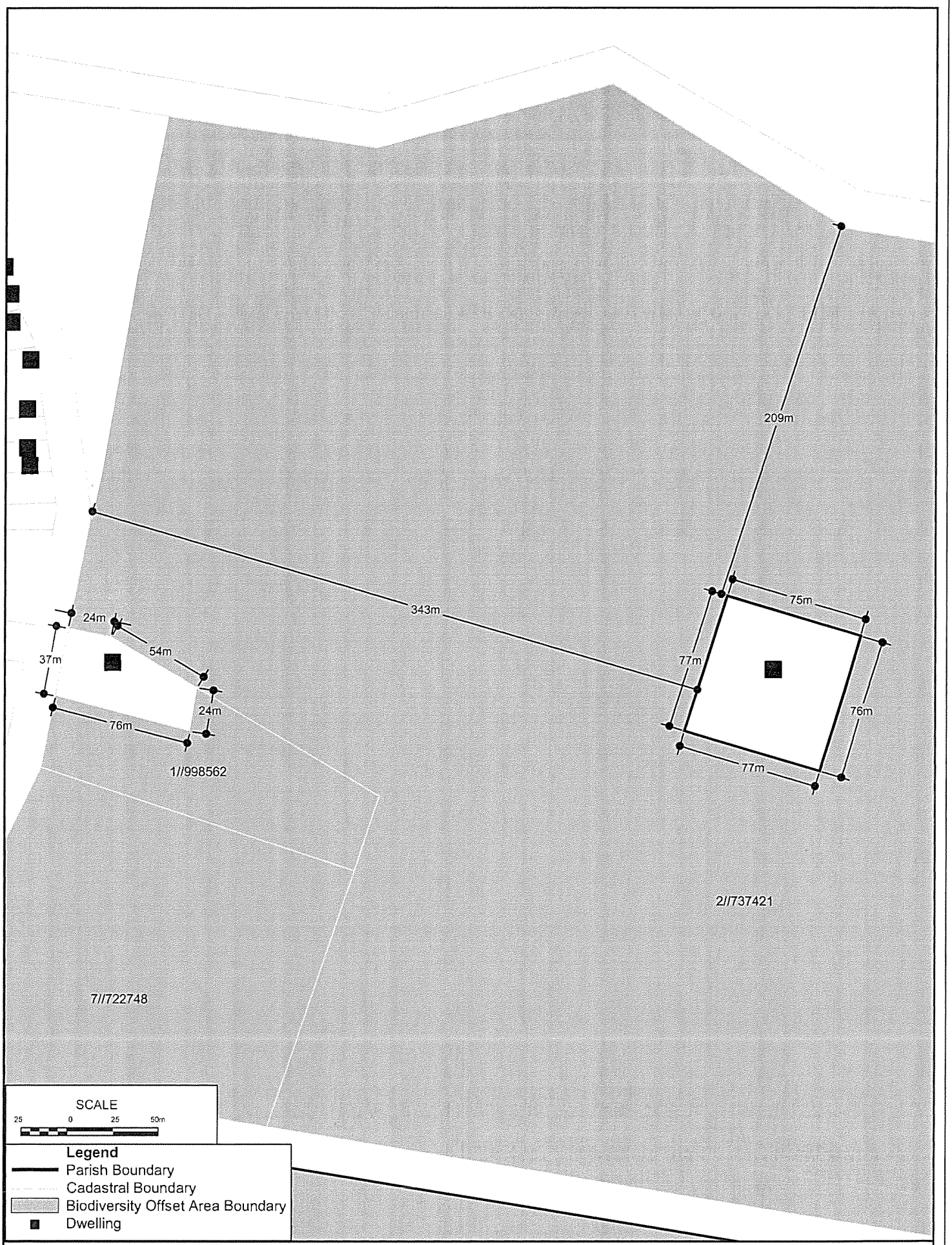
NSW Government Spatial Services (2018)	
Yancoal Australia Ltd (2018)	



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Plan 3b - Land Subject to Instrument "Area 3"

File:

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Produced By:	Craig Hawkins
Revision:	1
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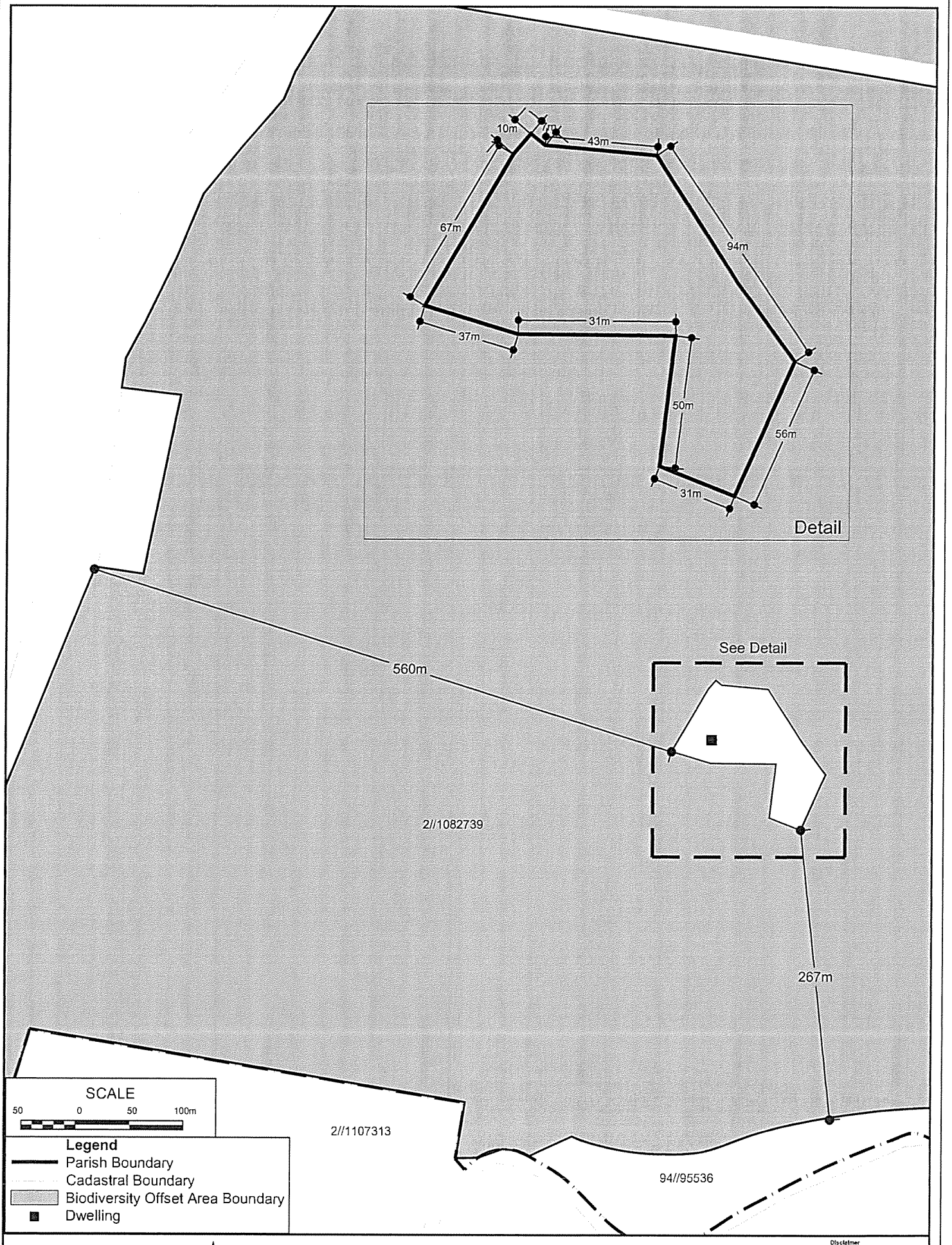
Yancoal Australia Ltd (2018)	



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Plan 3c - Land Subject to Instrument "Area 3"

Page 12 of 16

File:

Date: 10 December 2018
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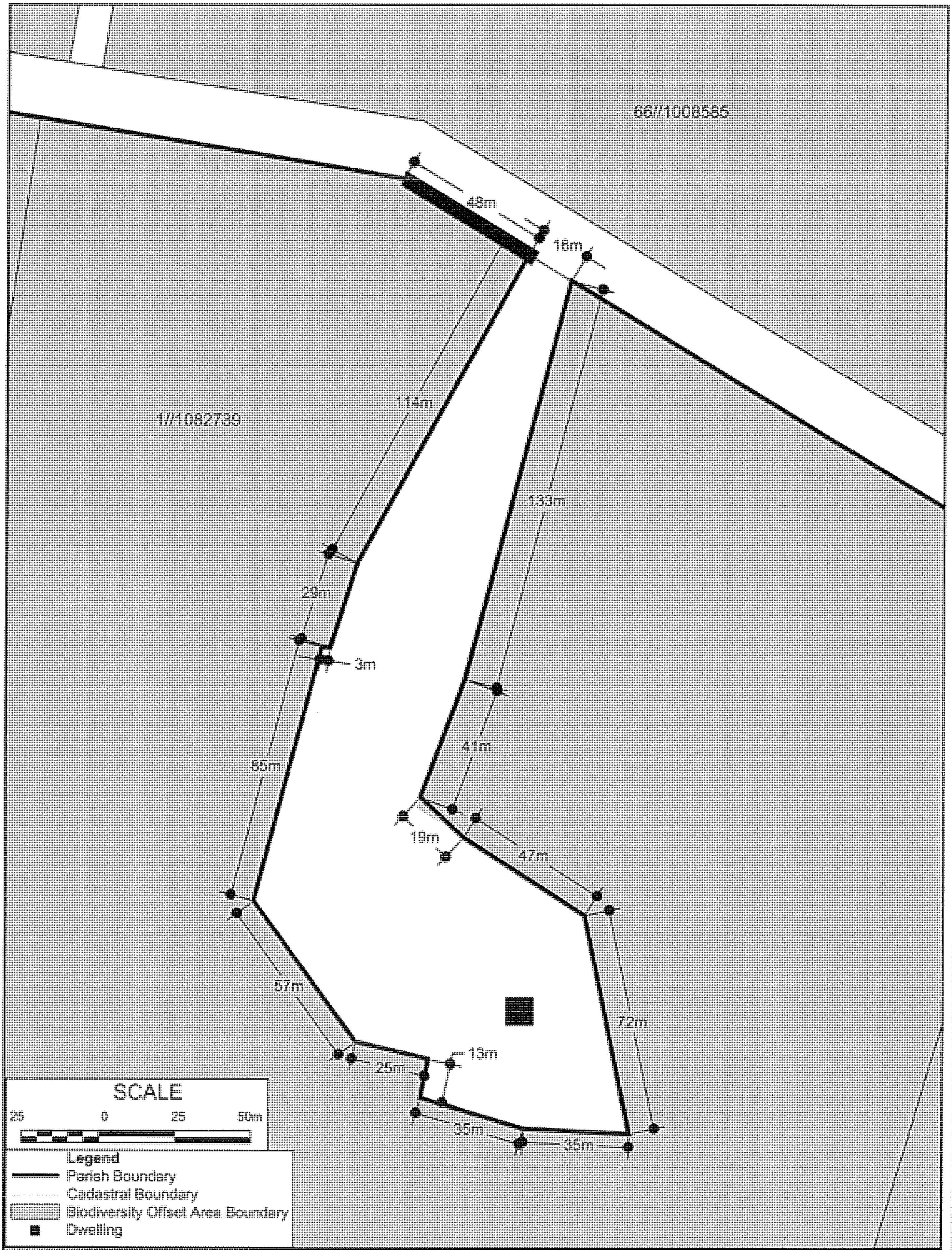
Revision: 1
Co-ordinate System: MGA (Zone 56)
Data Source
NSW Government Spatial Services (2018)
Yancoal Australia Ltd (2018)



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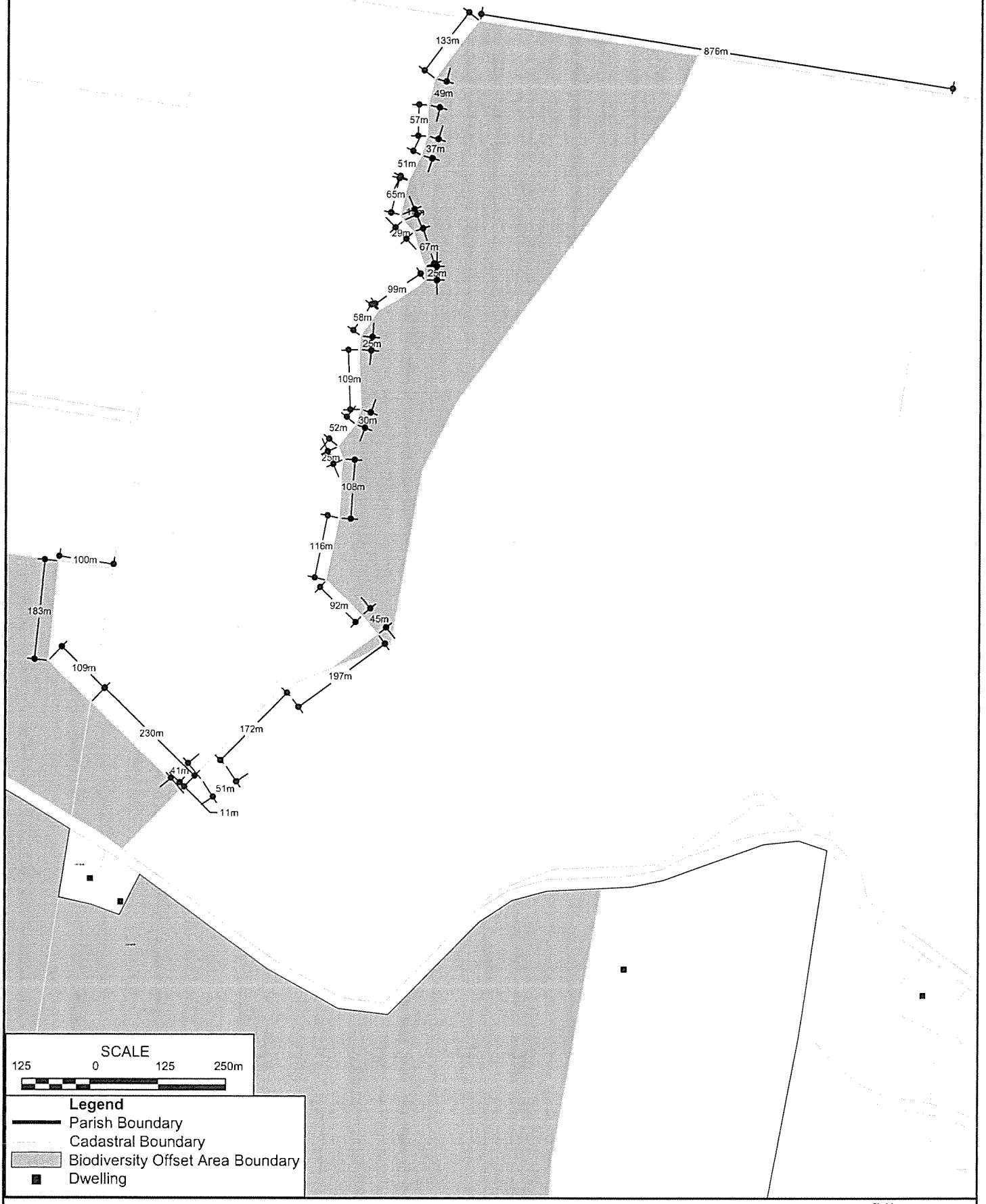
Plan 3d - Land Subject to Instrument
"Area 3"

File:

Date: 10 December 2018
Produced By: Craig Hawkins
Revision: 1
Co-ordinate System: MGA (Zone 56)
Data Source:
NSW Government Spatial Services (2018)
Yancoal Australia Ltd (2018)

Disclaimer:



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Plan 3f - Land Subject to Instrument "Area 3"

Date: 10 December 2018
Produced By: Craig Hawkins
Revision: 1
Co-ordinate System: MGA (Zone 56)
Data Source
NSW Government Spatial Services (2018)
Yancoal Australia Ltd (2018)

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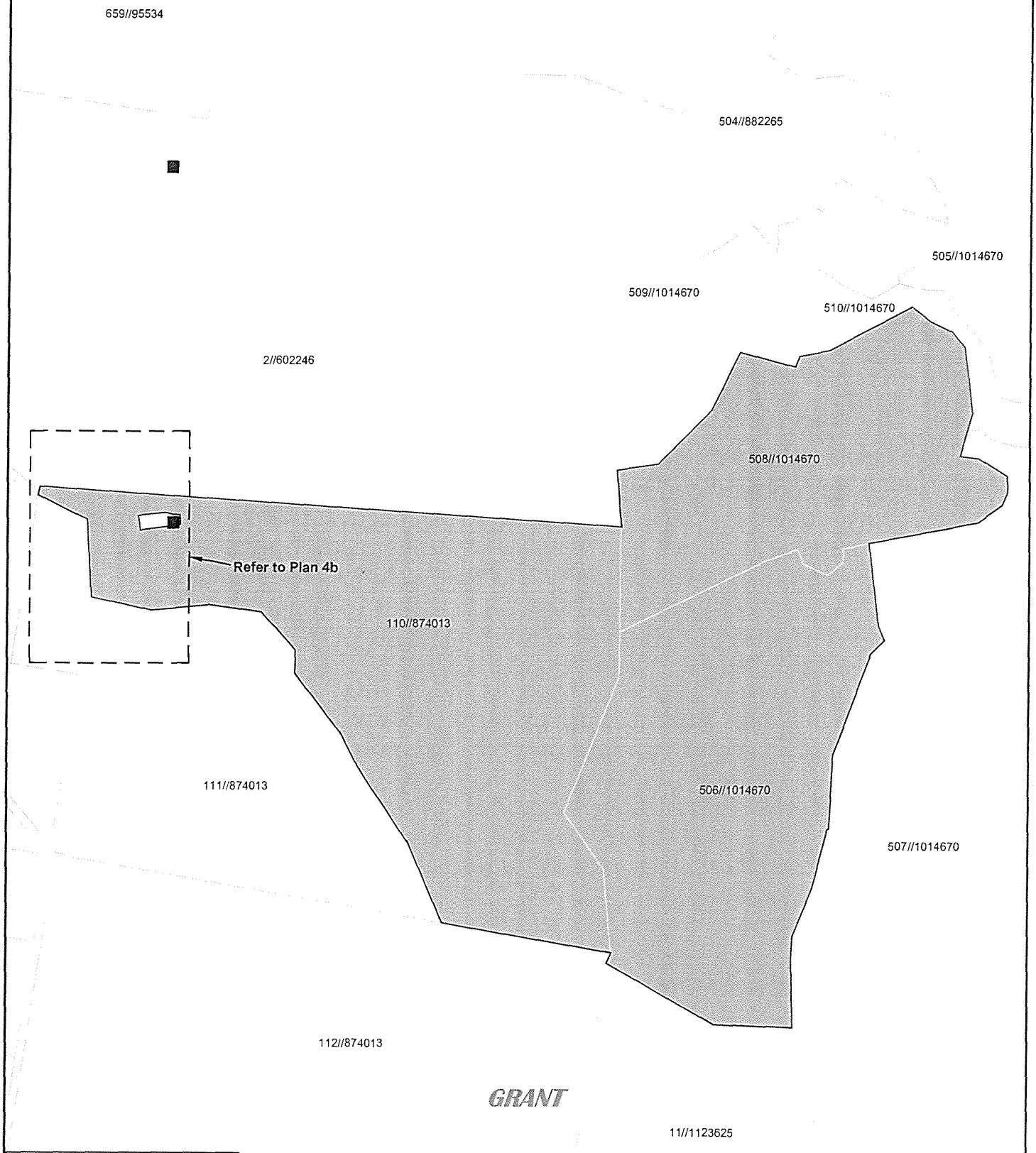

SCALE

150 0 150 300m

Legend

- Parish Boundary
- Cadastral Boundary
- Biodiversity Offset Area Boundary
- Dwelling

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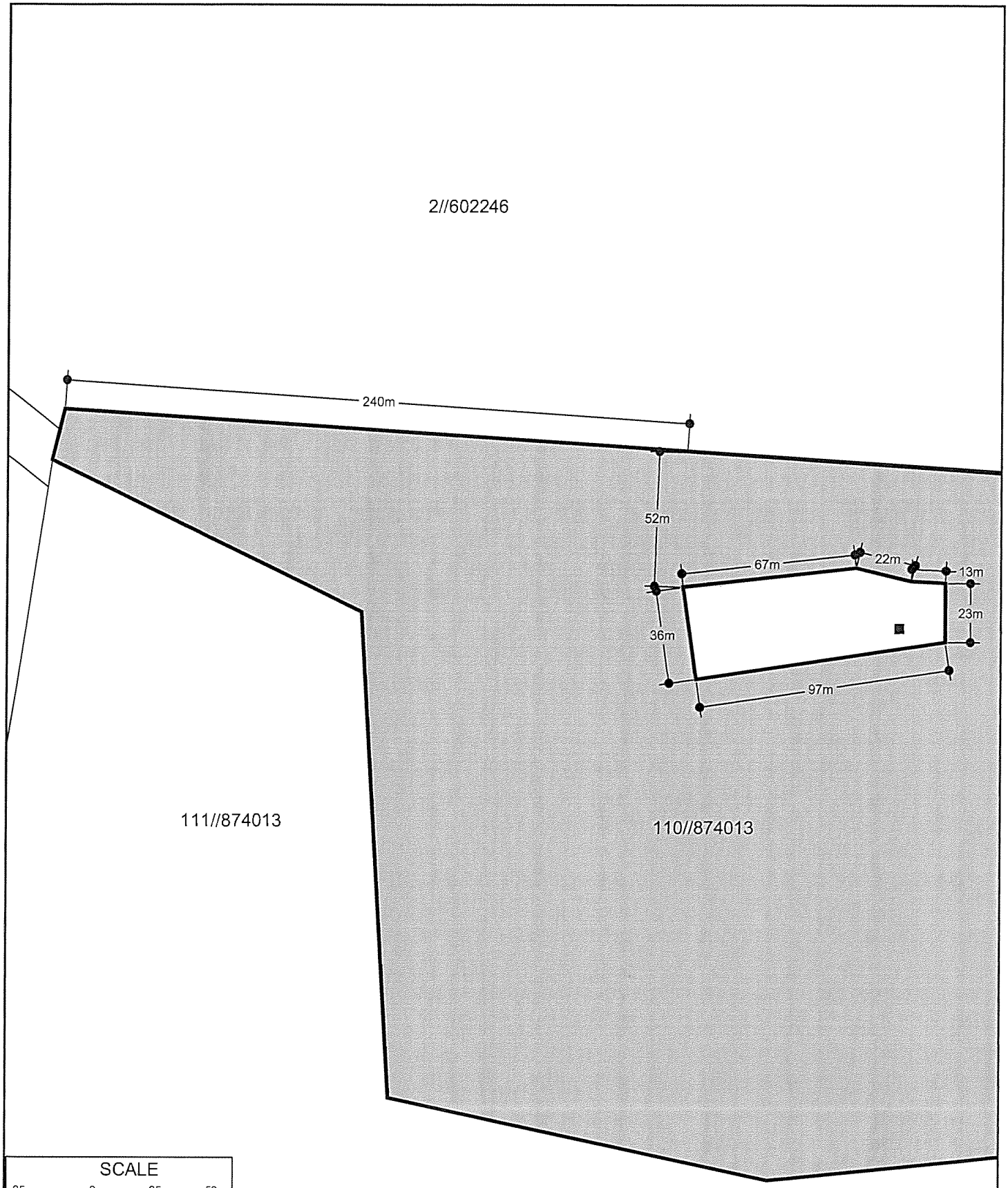
N

Plan 4a - Land Subject to Instrument "Area 4"

File:

Date: 10 December 2018
Produced By: Craig Hawkins
Revision: 1
Co-ordinate System: MGA (Zone 56)
Data Source
NSW Government Spatial Services (2018)
Yancoal Australia Ltd (2018)



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Plan 4b - Land Subject to Instrument "Area 4"

Date: 10 December 2018
Produced By: Craig Hawkins
Revision: 1
Co-ordinate System: MGA (Zone 56)
Data Source
NSW Government Spatial Services (2018)
Yancoal Australia Ltd (2018)

File:

ME

15

Form: 13RPA
Release: 3·1

RESTRICTION ON THE USE OF LAND BY A PRESCRIBED AUTHORITY

New South Wales
Section 88E(3) Conveyancing Act 1919

Leave this space clear. Affix additional pages to the top left-hand corner.

PRIVACY NOTE: Section 31B of the Real Property Act 1900 (RP Act) authorises the Registrar General to collect the information required by this form for the establishment and maintenance of the Real Property Act Register. Section 96B RP Act requires that the Register is made available to any person for search upon payment of a fee, if any.

(A) **TORRENS TITLE**

SEE ANNEXURE A

(B) **LODGED BY**

Document Collection Box	Name, Address or DX, Telephone, and Customer Account Number if any	CODE
599D	MinterEllison Customer Account: 123438S 1 Farrer Place Telephone: 02 9921 8888 Sydney NSW Reference: AEW:AIW:207001631	RV

(C) **REGISTERED PROPRIETOR**

Of the above land
STRATFORD COAL PTY LIMITED ACN 064 016 164

(D) **LESSEE MORTGAGEE or CHARGEE**

Of the above land agreeing to be bound by this restriction

Nature of Interest	Number of Instrument	Name
NOT APPLICABLE	N.A.	N.A.

(E) **PRESCRIBED AUTHORITY**

Within the meaning of section 88E(1) of the Conveyancing Act 1919
Crown in right of the State of New South Wales, through its Department of Planning and Environment.

(F) The prescribed authority having imposed on the above land a restriction in the terms set out in annexure A hereto applies to have it recorded in the Register and certifies this application correct for the purposes of the Real Property Act 1900.

DATE

(G) I certify that an **authorised officer of the prescribed authority** who is personally known to me or as to whose identity I am otherwise satisfied signed this application in my presence.

Signature of witness:

Name of witness: SEE ANNEXURE B

Address of witness:

Signature of authorised officer:

Name of authorised officer: SEE ANNEXURE B

Position of authorised officer:

Certified correct for the purposes of the Real Property Act 1900 and executed on behalf of the company named below by the authorised person(s) whose signature(s) appear(s) below pursuant to the authority specified.
Company:
Authority:

Signature of authorised person:

Name of authorised person: SEE ANNEXURE B
Office held:

Signature of authorised person:

Name of authorised person: SEE ANNEXURE B
Office held:

(H) The N.A. under N.A. No. N.A. agrees to be bound by this restriction.
I certify that the N.A. ,who is personally known to me or as to whose identity I am otherwise satisfied, signed this application in my presence.

Signature of witness:

Name of witness:

Address of witness:

Signature of N.A.

* *s117 RP Act requires that you must have known the signatory for more than 12 months or have sighted identifying documentation.*

Annexure A to Restriction on Use of Land by a Prescribed Authority

A. Land burdened by Restriction

The Land burdened by this Instrument is identified as follows:

Area 2 biodiversity offset area (as depicted on Plan 2a attached at Annexure C)

- Lot 392 DP876813

Area 3 biodiversity offset area (as depicted on Plans 3a, 3e & 3g attached at Annexure C)

- Part of Lot 1221 DP806209 (as shaded on the plans)
- Part of Lot 2 DP815045 (as shaded on the plans)
- Lot 5 DP722748
- Lot 1 DP855240

B. Interpretation

1.1 In this Instrument, unless the context clearly indicates otherwise, the following terms have the following meanings:

"**Approval**" means any of the following approvals as the case requires:

(a) Development Consent SSD-4966 granted by the Planning Assessment Commission on 29 May 2015 under Part 4 of the EP&A Act for the Stratford Extension Project as modified and as may be modified from time to time; and

(b) EPBC Approval EPBC 2011/6176 granted under Section 133 of the EPBC Act on 29 January 2016 for the Stratford Extension Project as may be modified from time to time;

"**Commonwealth Agency**" has the same meaning as it has in the EPBC Act.

"**Consent Authority**" has the same meaning as it has in the EP&A Act.

"**Department**" means the NSW Department of Planning and Environment.

"**Development**" has the same meaning as it has in the EP&A Act.

"**EECs**" means endangered ecological communities as defined in the *Biodiversity Conservation Act 2016* (NSW) and in the EPBC Act.

"**EP&A Act**" means the *Environmental Planning and Assessment Act 1979* (NSW).

"**EPBC Act**" means the *Environment Protection and Biodiversity Conservation Act 1999* (Cth).

"**Instrument**" means this section 88E instrument.

"**Land**" means the land burdened by this Instrument.

MR

"**Minister**" means the Minister administering the *Environmental Planning and Assessment Act 1979* (NSW).

"**Registered Proprietor**" means the person or entity recorded by the Registrar-General of New South Wales as the registered proprietor of the Land from time to time.

"**Secretary**" means the Secretary of the Department or other agency responsible to the Minister.

"**Tenement**" means any of the following tenements and includes any modification or renewal of these tenements:

(a) Mining Lease 1733;

(b) Mining Lease 1360;

(c) Mining Lease 1409;

(d) Mining Lease 1447;

(e) Mining Lease 1521;

(f) Mining Lease 1528;

(g) Mining Lease 1538;

(h) Mining Lease 1577; and

(i) Mining Lease 1787.

1.2 Unless the context clearly indicates otherwise, a reference in this Instrument to:

(a) the singular includes the plural and vice versa;

(b) any thing includes the whole and each part of that thing;

(c) legislation or a legislative provision includes regulations and other instruments made under the legislation, and any statutory amendment, consolidation, re-enactment or replacement of the same;

(d) a person includes a natural person, corporation, statutory corporation, partnership, the Crown or any other body, organisation or legal entity; and

(e) a requirement not to do something includes a requirement to prevent that thing from occurring.

1.3 Headings are for convenience only and do not affect the interpretation of this Instrument.

C. Terms of restriction

1. Subject to clause 2 of this Instrument, no person, unless permitted to do so under the terms of an Approval or Tenement, is to:

(a) carry out any Development on the Land;

(b) destroy, damage, remove or harm any native flora or fauna in or on the Land;

(c) occupy, or allow any person to occupy the Land;

(d) allow livestock grazing on the Land;

(e) clear or cultivate the Land;

(f) interfere with any substance on the Land whether or not in or forming part of the Land;

(g) carry out any activity in or on the Land that threatens or might threaten, or may cause, or be likely to result in threat to, the viability of native flora or fauna on the Land;

(h) carry out any activity in or on the Land that threatens or might threaten, or may cause or be likely to result in threat to, the implementation of measures under a biodiversity management plan or a biodiversity offset management plan approved by a Consent Authority, Commonwealth Agency or the Secretary in respect of the Land; or

(i) carry out any activity in or on the Land that threatens or might threaten, or may cause or be likely to result in threat to, the viability of any EEC's on the Land.

2. To the extent that the carrying out of Development or other activity on the Land is necessary for the purpose of:

(a) implementing provisions of a biodiversity management plan or a biodiversity offset management plan approved by a Consent Authority, Commonwealth Agency or the Secretary in respect of the Land;

(b) complying with the conditions of any relevant Approval or Tenement;

(c) otherwise protecting and conserving native vegetation and native fauna on the Land and facilitating natural regeneration of native species on the Land,

the obligations in clause 1 of this Instrument do not prevent or restrict a Registered Proprietor or its authorised agents, contractors, employees, licensees, lessees and invitees from lawfully carrying out the following activities on the Land:

i. revegetation and regeneration works including establishment of canopy, understorey and ground cover species and collecting and propagating seed for the purposes of revegetation;

ii. introducing, installing or replacing hollow bearing habitat features and habitat resources;

iii. controlling weeds and feral pests;

iv. managing or preventing soil erosion;

v. carrying out bushfire management works under a management plan approved by NSW Rural Fire Service or as directed by NSW Rural Fire Service;

vi. destruction or removal of vegetation within 6 metres of the boundaries of the area of the Land to which this restriction applies, for the purpose of erecting or maintaining a fence along such boundaries;

vii. destruction or removal of vegetation where necessary for the purposes of maintaining an existing vehicular access track or creating a new vehicular access track but only up to 3 metres either side of the centre line of the track; and

viii. any other thing required to be done under a biodiversity management plan or biodiversity offset management plan approved by a Consent Authority, Commonwealth Agency or the Secretary in respect of the Land, including but not limited to, conducting surveys and undertaking monitoring, auditing and reporting activities. The Registered Proprietor must provide a copy of this Instrument to any lessee, licensee or mortgagee.

3. The Registered Proprietor must permit access to the Land by the Secretary or any person authorised by the Secretary and relevant public authorities at all times for the purposes of monitoring compliance with this Instrument.

4. The Registered Proprietor must, at its own cost, comply with the terms of this Instrument.

5. By written notice to the Registered Proprietor, the Secretary may, at any time, require the Registered Proprietor to attend to any matter and to carry out any such work pursuant to this Instrument within such time as the Secretary may specify. The Registered Proprietor must comply with such notice at its cost and within the time specified.

6. If the Registered Proprietor fails to comply with the terms of any written notice given under clause 5 of this Instrument, any person authorised by officers of the Department and authorised agents of the Department may enter the Land at any time with all necessary equipment and carry out any work which, in its discretion, is required to ensure compliance with the notice or otherwise remedy any failure by the Registered Proprietor to observe its obligations under this Instrument. The Department may recover from the Registered Proprietor the cost associated with carrying out any such work, and may recover all expense incurred by the Department in doing so.

7. The Registered Proprietor must indemnify and keep indemnified the State of New South Wales from all claims and demands of every kind and from all liabilities which may arise in connection with the Registered Proprietor's failure to observe or comply with the terms of this Instrument.

8. If any provision or part of any provision of this Instrument is or becomes void, invalid, or unenforceable for any reason, that provision or part may be severed from this Instrument and all other provisions or parts which are self-sustaining and capable of separate enforcement without regard to the void, invalid, or unenforceable provision will be and continue to be valid and enforceable in accordance with their terms.

9. Nothing in this Instrument is to be construed as:

(a) excusing or preventing the carrying out of Development or work required for the operation, maintenance or repair of infrastructure and easements existing as at the date this Instrument takes effect; or

(b) excusing or derogating from any requirement to obtain any consent, approval, permit or licence under any applicable instrument or legislation or comply with any applicable legislation.

10. This Instrument is to remain in force in respect of the Land in perpetuity.

11. This Instrument may only be varied with the consent of the Secretary in accordance with section 88E(7) of the *Conveyancing Act 1919*.

Annexure B to Restriction on Use of Land by a Prescribed Authority

Execution by the Prescribed Authority

I certify that I am an eligible witness and that an authorised officer of the lessee signed this dealing in my presence.

Signature of witness

NESTOR TSAMBOS

Name of witness

64 FRAMPTON AVENUE

Address of witness

MARRICKVILLE 2204

Certified correct for the purposes of the Real Property Act 1900 by the authorised officer named below.

Signature of authorised officer

MARCUS RAY

Authorised officer's name

GROUP DEPUTY SECRETARY

Authority of officer

Minister for Planning for and on behalf of the Crown in right of the State of New South Wales

Signing on behalf of

Execution by the Registered Proprietor

Certified correct for the purposes of the Real Property Act 1900 and executed on behalf of the corporation named below by the authorised person(s) whose signature(s) appear(s) below pursuant to the authority specified.

Corporation STRATFORD COAL PTY LIMITED ACN 064 016 164

Authority section 127 of the *Corporations Act 2001* (Cth)

Signature of authorised person

Reinhold Schmidt

Name of authorised person

Director

Office held

Signature of authorised person

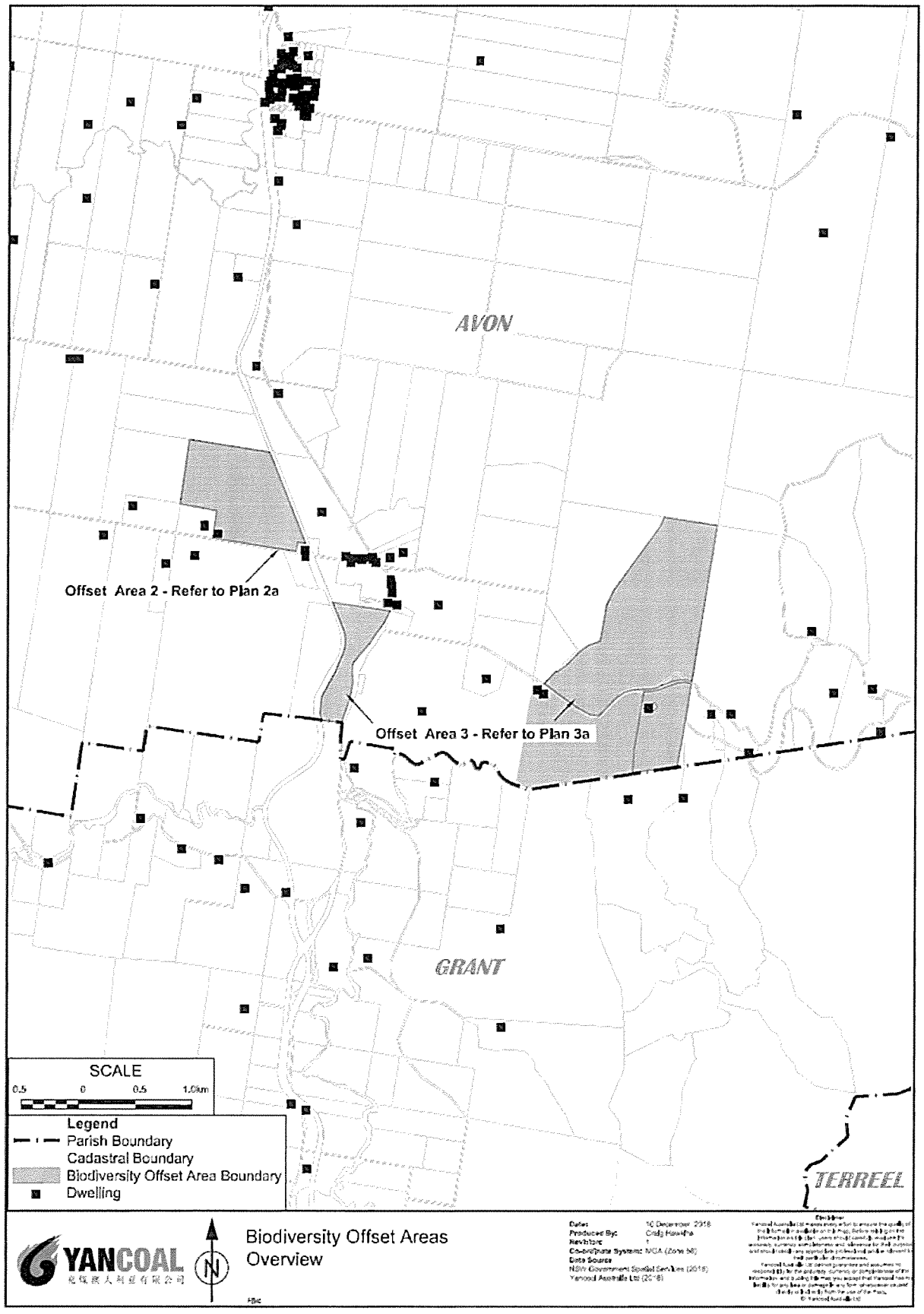
Lei Zhang

Name of authorised person

Director / Secretary

Office held

Annexure C to Restriction on Use of Land by a Prescribed Authority



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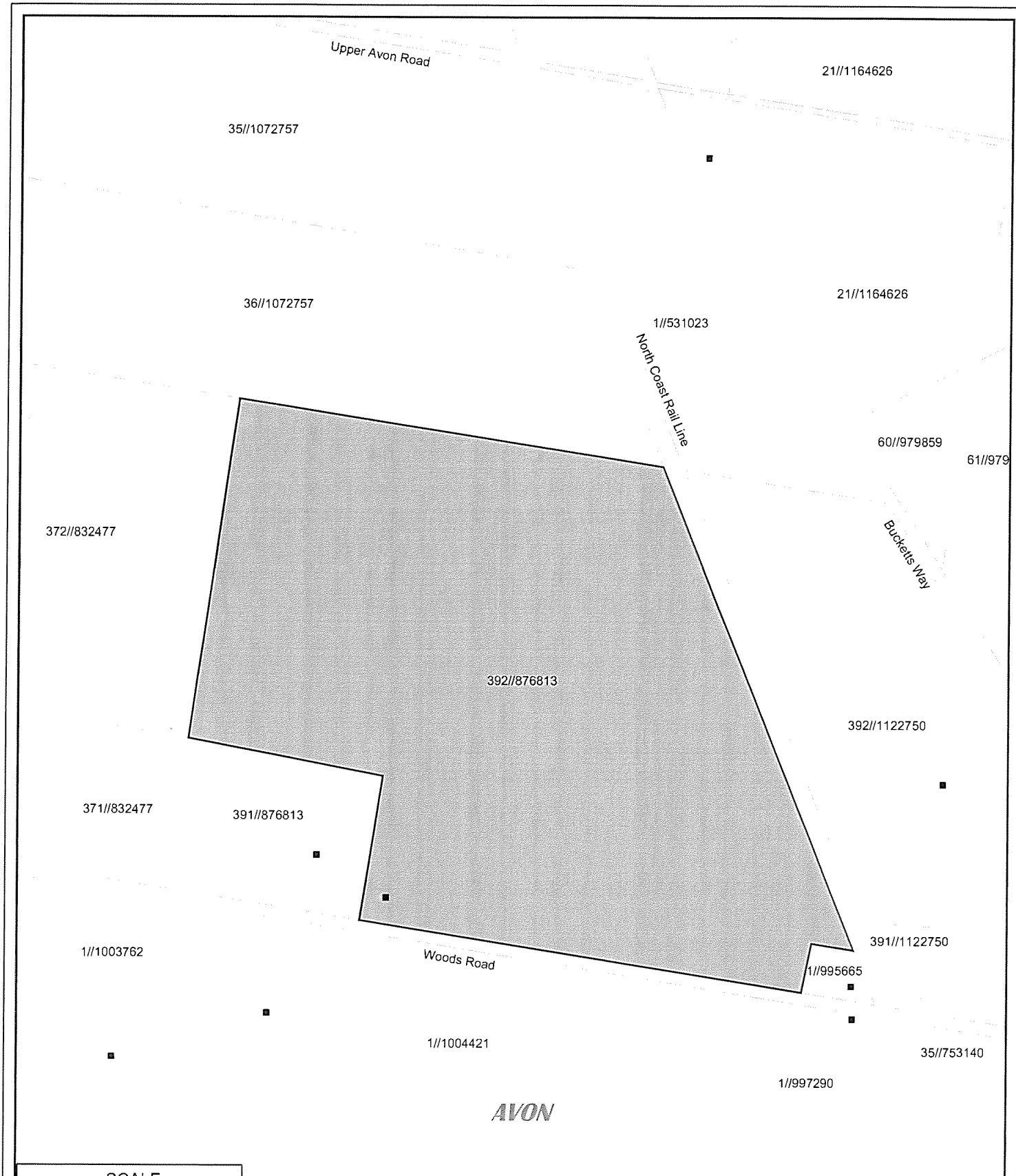

SCALE

100 0 100 200m

Legend

- Parish Boundary
- Cadastral Boundary
- Biodiversity Offset Area Boundary
- Dwelling

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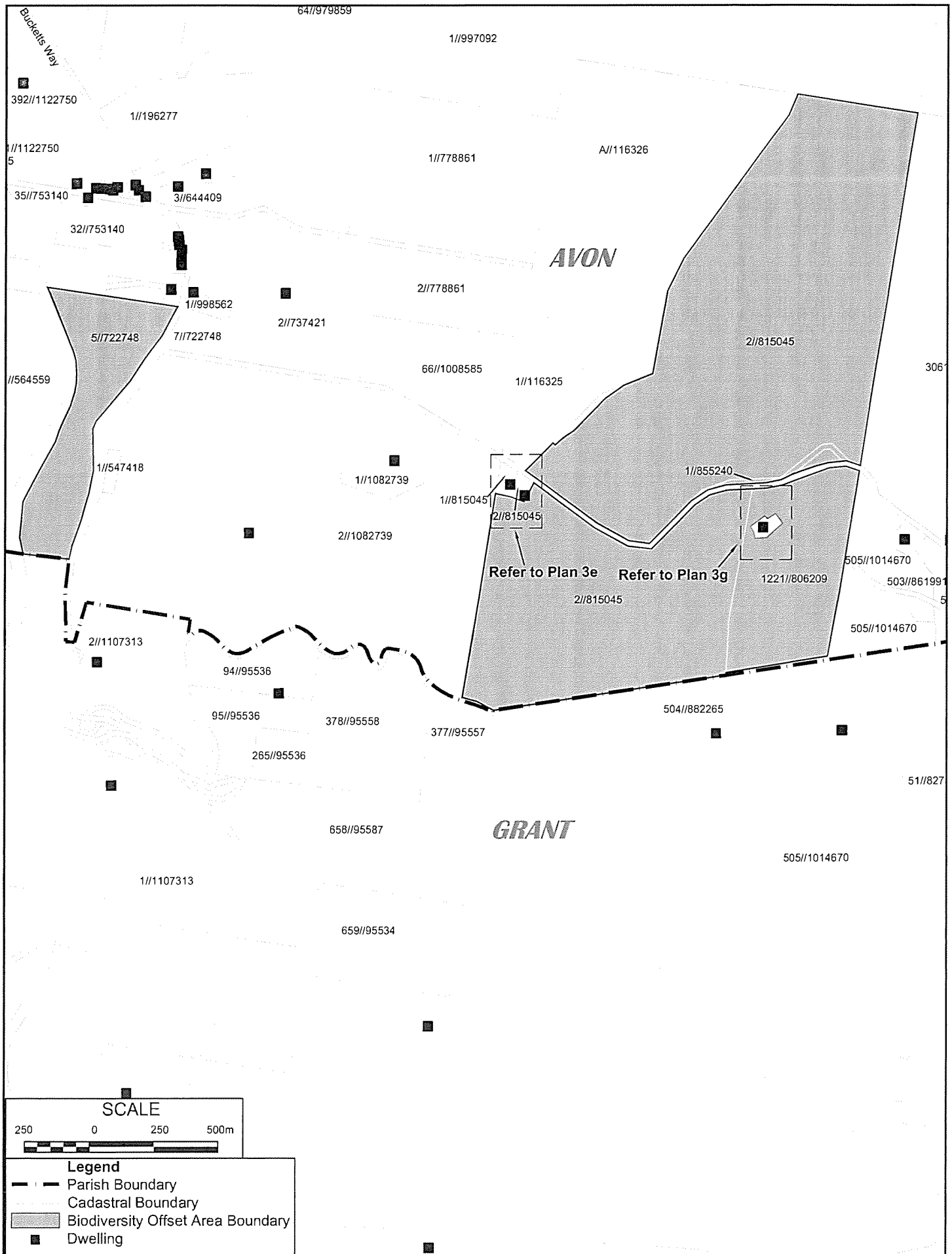
N

Plan 2a - Land Subject to Instrument "Area 2"

File:

Date: 14 December 2018
Produced By: Craig Hawkins
Revision: 1
Co-ordinate System: MGA (Zone 56)
Data Source
NSW Government Spatial Services (2018)
Yancoal Australia Ltd (2018)

B



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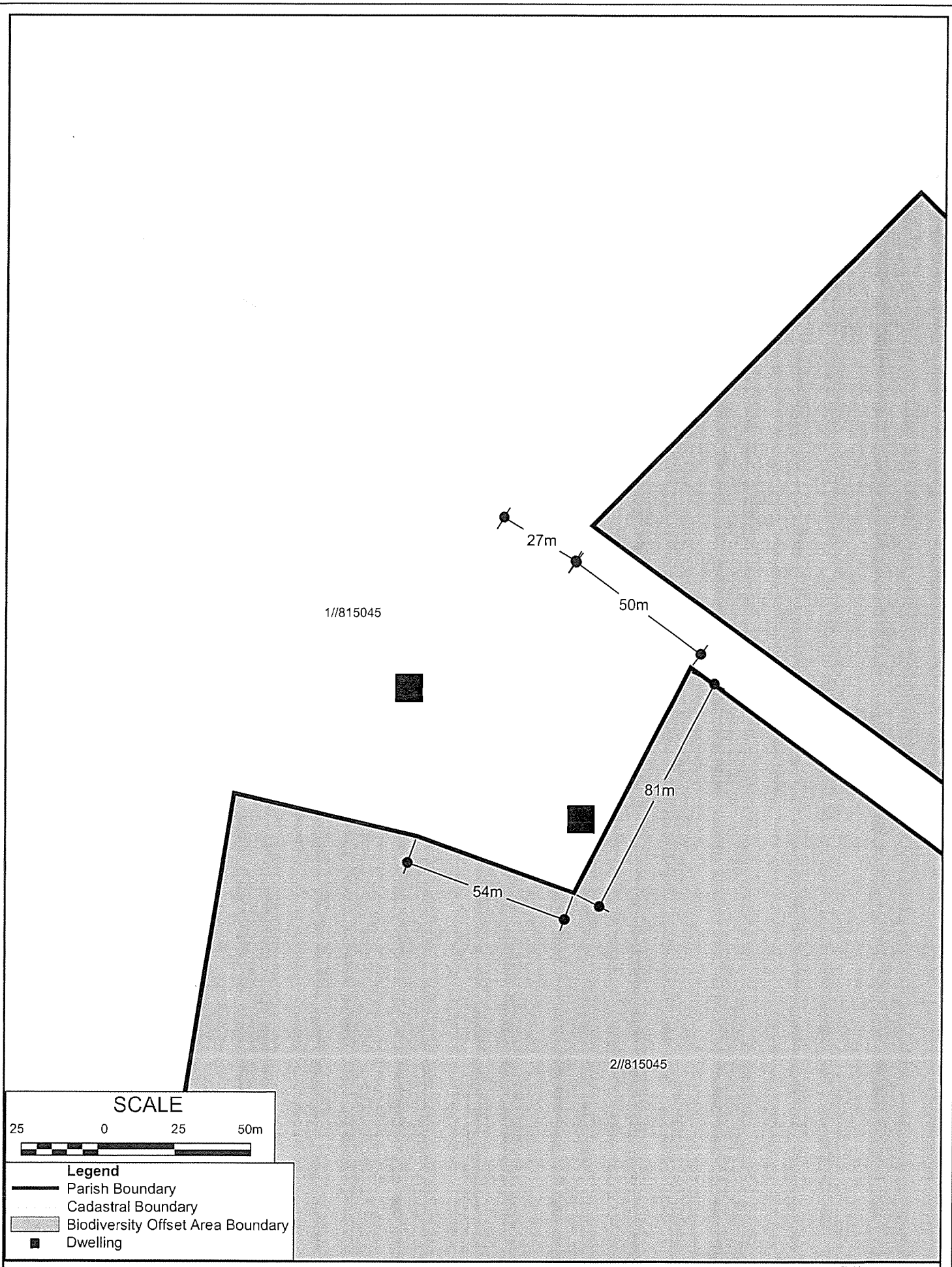
Plan 3a - Land Subject to Instrument "Area 3"

File:

Date:	3 June 2019
Produced By:	Craig Hawkins
Revision:	1
Co-ordinate System:	MGA (Zone 56)
Data Source	NSW Government Spatial Services (2018) Yancoal Australia Ltd (2016)



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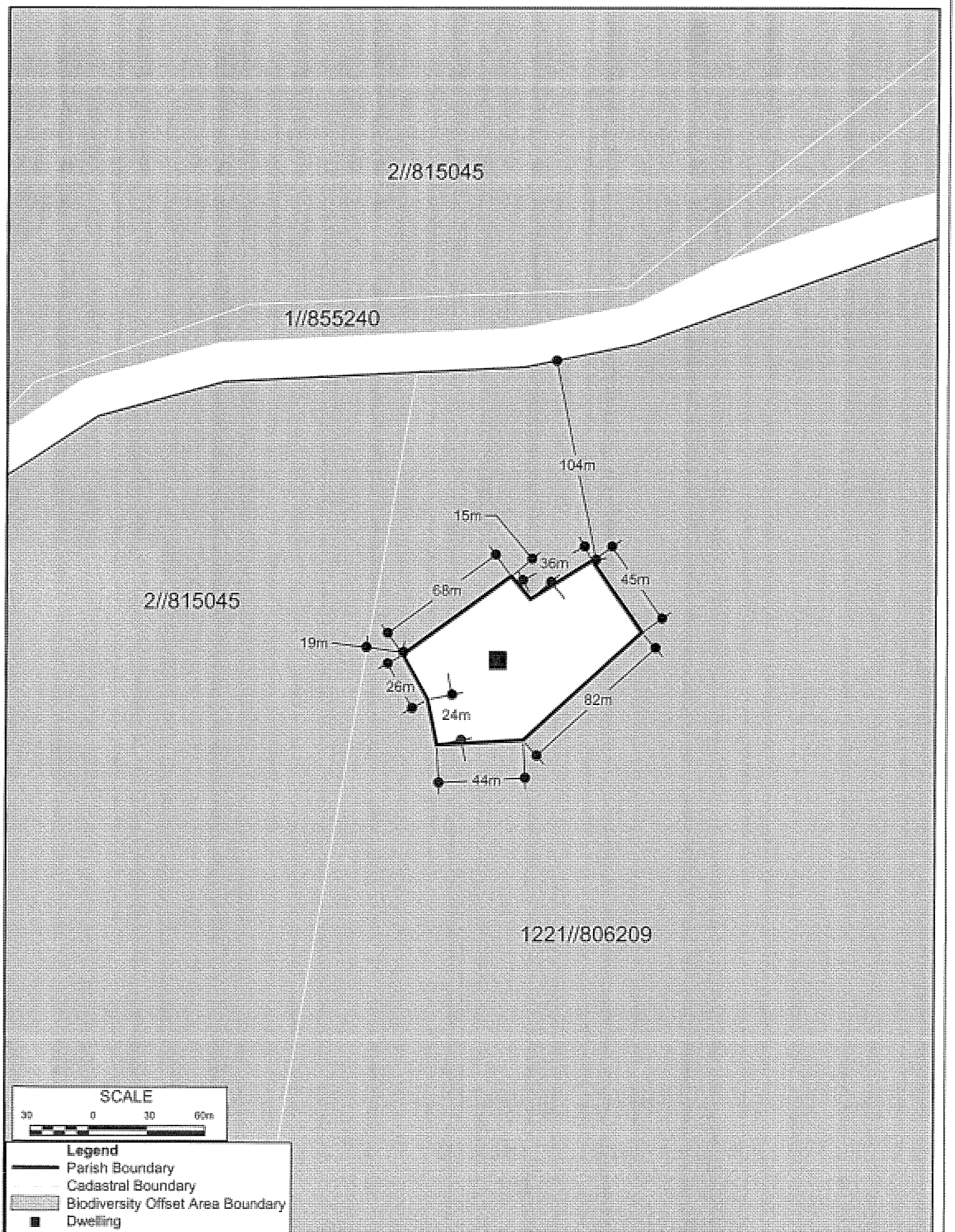
N

Plan 3e - Land Subject to Instrument "Area 3"

File:

Date: 14 December 2018
Produced By: Craig Hawkins
Revision: 1
Co-ordinate System: MGA (Zone 56)
Data Source
NSW Government Spatial Services (2018)
Yancoal Australia Ltd (2018)



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Plan 3g - Land Subject to Instrument "Area 3"

Page 12 of 12

Date: 14 December 2018
Produced By: Craig Hawkins
Revision: B
Co-ordinate System: MGA (Zone 56)
Data Source: NSW Government Spatial Services (2018); Yancoal Australia Ltd (2018)

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Sydney 2000

ABN: 23 519 493 925
GPO Box 15
Sydney NSW 2001
DX 17 SYDNEY
P: 02 8776 3575
W: www.nswlrs.com.au

Date: 15/10/2019

REGISTRATION NOTICE

THE UNDERMENTIONED DEALING(S) WERE REGISTERED/RECORDED ON 15/10/2019

DEALING NUMBERS: AP608002 PC
AP608003 RV

LODGMENT INVOICE NUMBER: D849306

YOUR REFERENCE: ABJACKS 1094966

TITLE REFERENCE	CT DIRECTION
1/1082739	N/A
1/116325	N/A
1/997290	N/A
1/998562	N/A
110/874013	N/A
2/1082739	N/A
2/737421	N/A
506/1014670	N/A
508/1014670	N/A
66/1008585	N/A
7/722748	N/A
A/116326	N/A

REGISTRAR GENERAL

Box : 599D

MINTER ELLISON .
Delivery Box 599D
Level 40 Governor Macquarie Tower,
Sydney 2000

ABN: 23 519 493 925
GPO Box 15
Sydney NSW 2001
DX 17 SYDNEY
P: 02 8776 3575
W: www.nswlrs.com.au

Date: 25/10/2019

REGISTRATION NOTICE

THE UNDERMENTIONED DEALING(S) WERE REGISTERED/RECORDED ON 25/10/2019

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AP571792 RV
AP571793 PC
AP571794 RV

LODGMENT INVOICE NUMBER: D830873

YOUR REFERENCE: 207001631 ABJ

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REGISTRAR GENERAL