

Representative Patch used in Landscape Assessment: Northern Section, Central West CMA



Northern Patch
Segment a
Segment b

EPURON

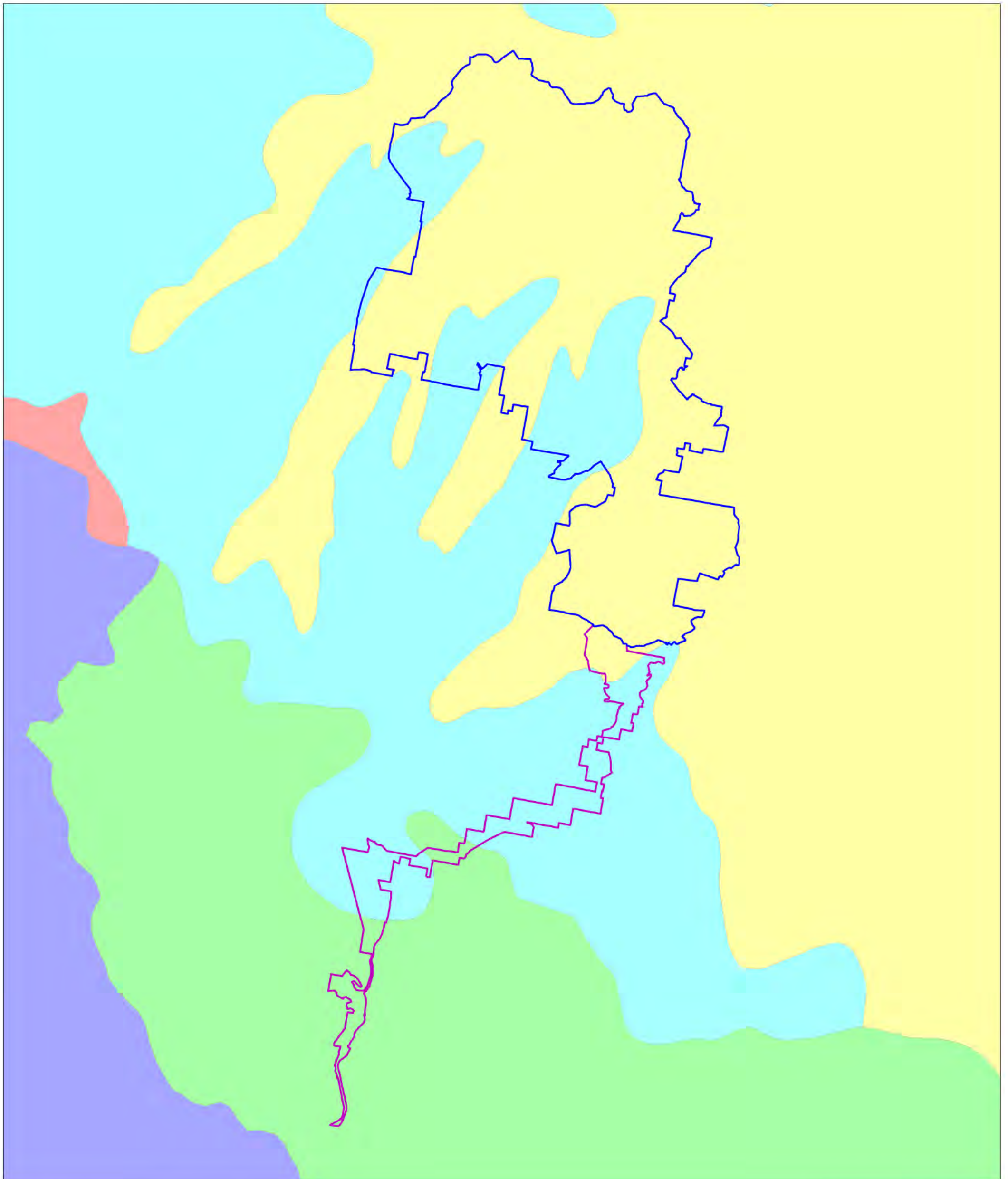


A3 @ 1:15,000

Project: Liverpool Range Wind Farm
Produced by: Virgil Robinson
Date: 3 February 2017
Projection: GDA94 MGA Zone 55



NSW Subregions Site Overview Map



Site perimeter		NSW Subregions	
	Wind Turbine Area		Inland Slopes
	Transmission Area		Kerrabee
			Liverpool Range
			Pilliga
			Talbragar Valley

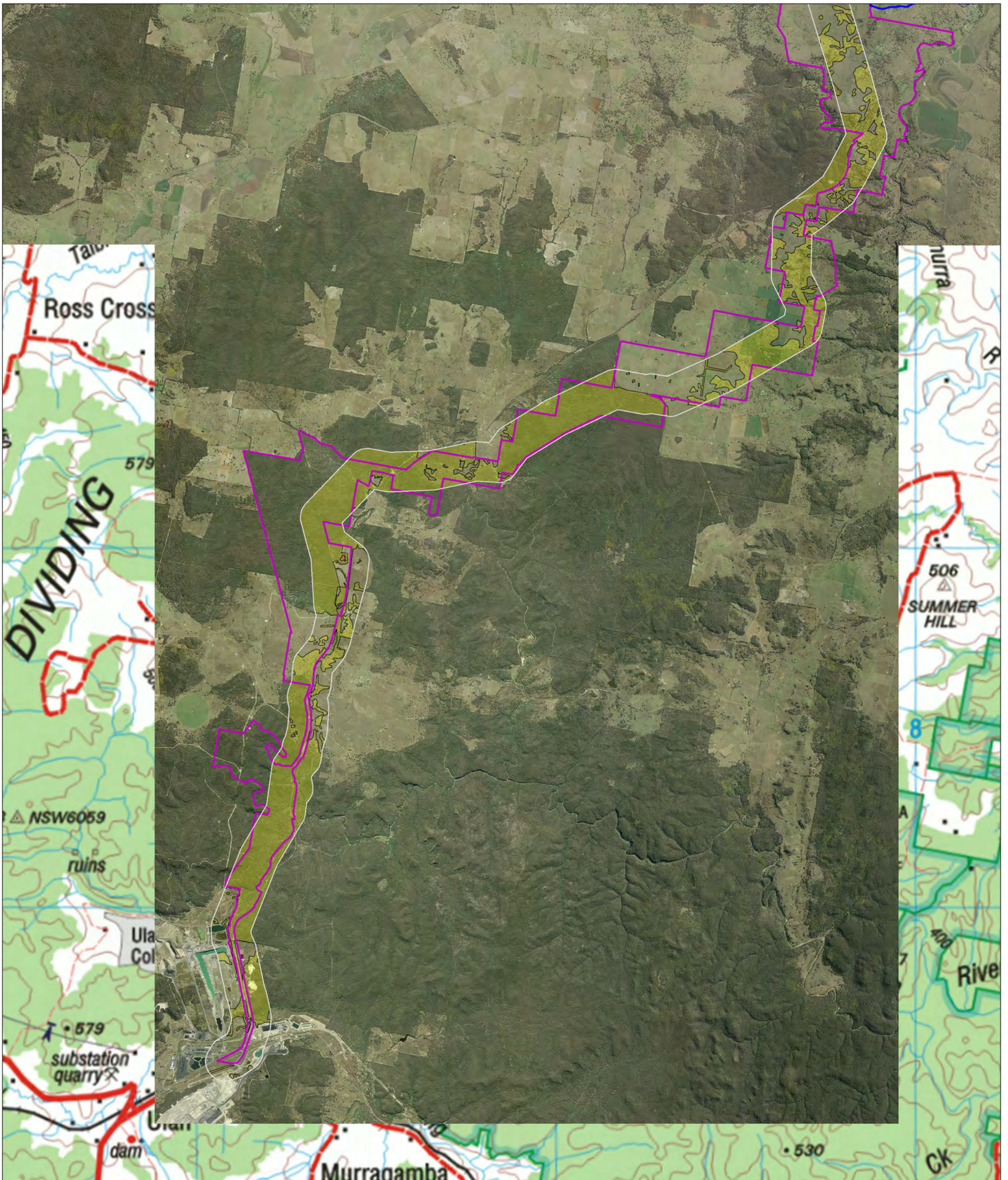
EPURON

0 3 6 9
Kilometers

A3 @ 1:220,000

Project: Liverpool Range Wind Farm
Produced by: Virgil Robinson
Date: 3 February 2017
Projection: GDA94 MGA Zone 55

Extent of Native Vegetation Southern Overview Map



- 550m infrastructure buffer
- Site perimeter
- Wind Turbine Area
- Transmission Area
- Additional data
- Native vegetation

EPURON

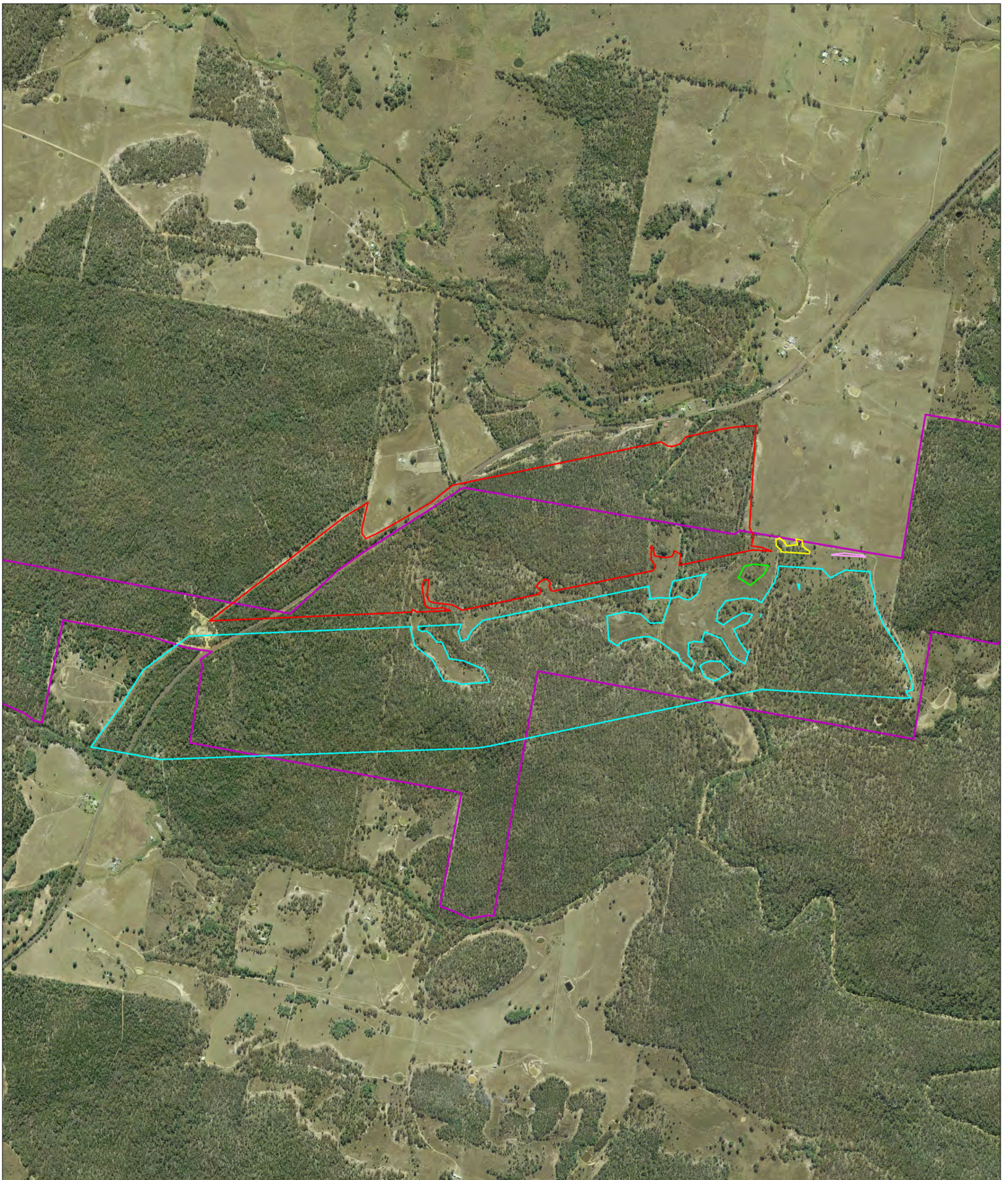


A3 @ 1:100,000

Project: Liverpool Range Wind Farm
 Produced by: Virgil Robinson
 Date: 7 February 2017
 Projection: GDA94 MGA Zone 55

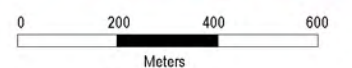


Representative Patch used in Landscape Assessment: Northern Section, Central West CMA



- Site perimeter
- Transmission Area
- Southern Patch
- Segment a
 - Segment b
 - Segment c
 - Segment d
 - Segment e

EPURON

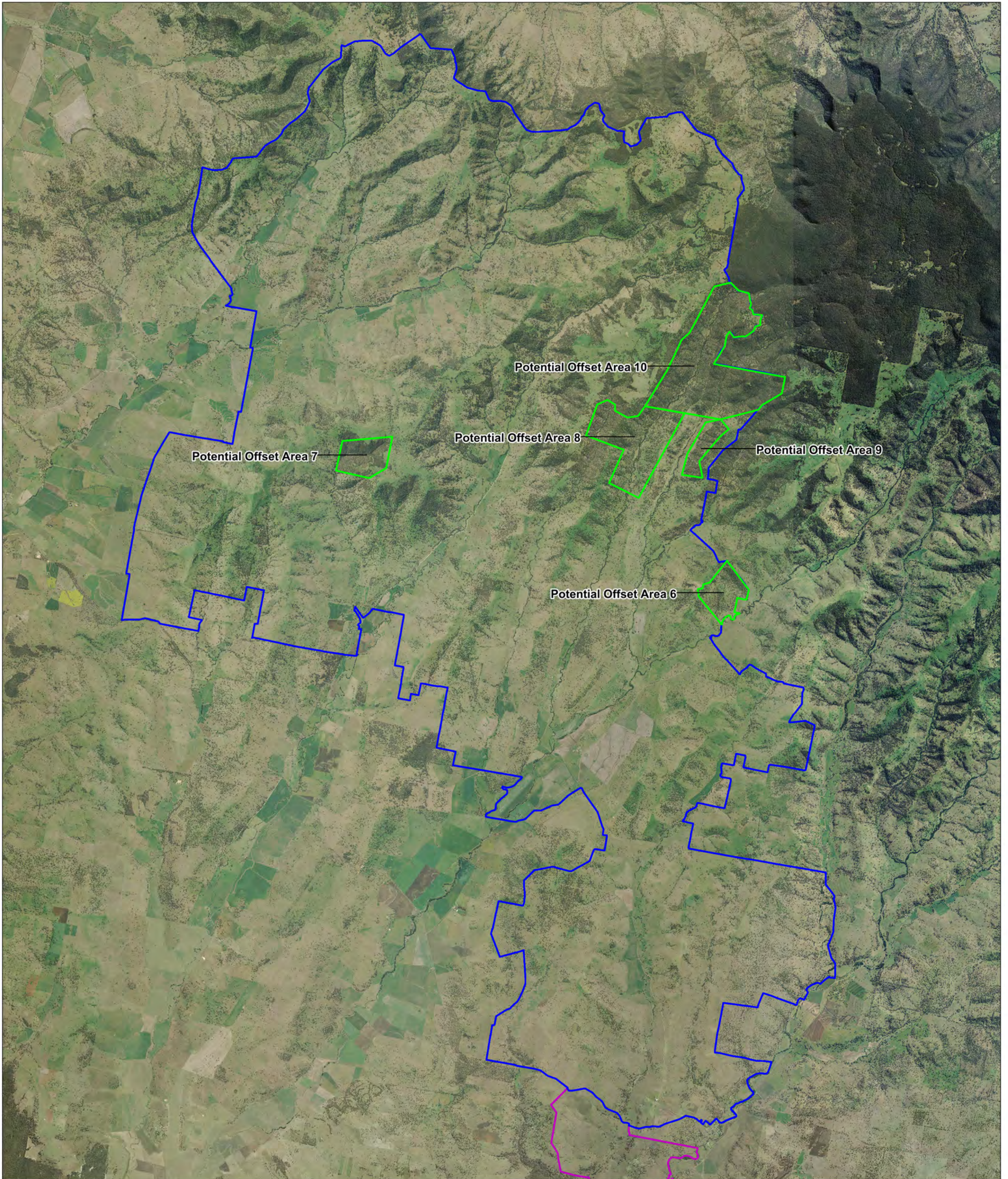


A3 @ 1:15,000

Project: Liverpool Range Wind Farm
Produced by: Virgil Robinson
Date: 3 February 2017
Projection: GDA94 MGA Zone 55



Potential Offset Areas Northern Overview Map



Site perimeter

Wind Turbine Area

Transmission Area

Additional data

Potential Offset Area

EPURON

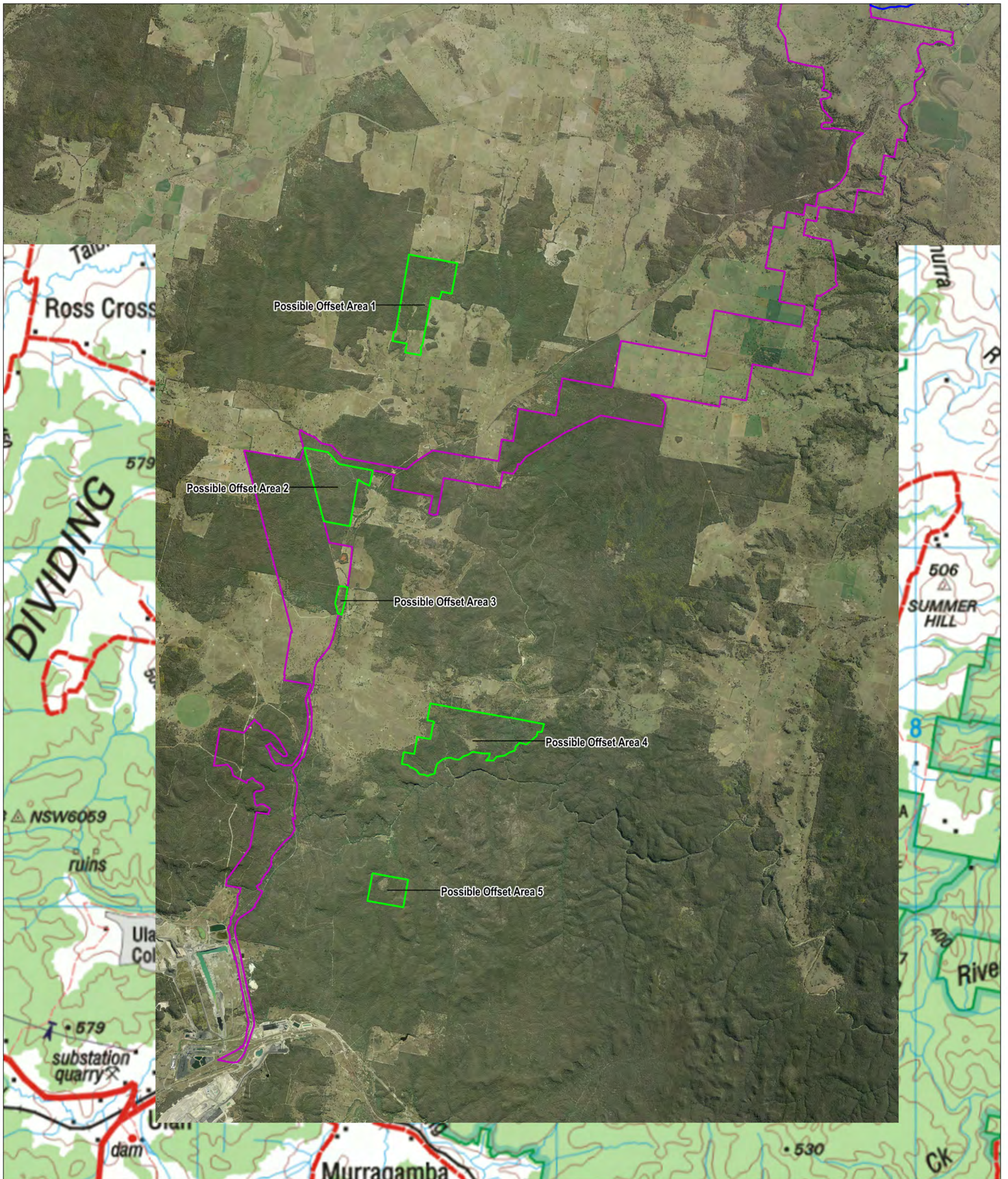


A3 @ 1:120,000

Project: Liverpool Range Wind Farm
Produced by: Virgil Robinson
Date: 3 February 2017
Projection: GDA94 MGA Zone 55



Potential Offset Areas Southern Overview Map



- Site perimeter
- Wind Turbine Area
- Transmission Area
- Additional data
- Potential Offset Area

EPURON



A3 @ 1:100,000

Project: Liverpool Range Wind Farm
Produced by: Virgil Robinson
Date: 3 February 2017
Projection: GDA94 MGA Zone 55



APPENDIX B BIODIVERSITY CREDIT REPORTS

BioBanking Credit Calculator

Ecosystem credits

Proposal ID : 0035/2016/4151MP
 Proposal name : Liverpool wind farm north
 Assessor name : Brooke Marshall
 Assessor accreditation number : 0035
 Tool version : v4.0
 Report created : 30/01/2017 12:38

Assessment circle name	Landsc ape score	Vegetation zone name	Vegetation type name	Condition	Red flag status	Management zone name	Management zone area	Current site value	Future site value	Loss in site value	Credit required for bio diversity	Credit required for TS	TS with highest credit requirement	Average species loss	Species TG Value	Final credit requirement for management zone
liverpool wind farm	20.50	CW180_Moderate/Good	River Oak - Rough-barked Apple - red gum - box riparian tall woodland (wetland) of the Brigalow Belt South Bioregion and Nandewar Bioregion	Moderate/Good	Yes	1	6.47	100.00	0.00	100.00	0	518	Masked Owl	100.00	3.00	518
liverpool wind farm	20.50	CW111_Moderate/Good	Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Moderate/Good	Yes	1	7.79	89.33	0.00	89.33	562	562	Powerful Owl	100.00	3.00	562
liverpool wind farm	20.50	CW304_Moderate/Good_Other	Silvertop Stringybark - Yellow Box +/- Nortons Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range, Brigalow Belt South Bioregion	Moderate/Good_Other	Yes	1	9.34	76.04	0.00	76.04	0	581	Powerful Owl	83.33	3.00	581
liverpool wind farm	20.50	CW322_Moderate/Good	White Box grass shrub hill woodland on clay to loam soils on volcanic and sedimentary hills in the southern Brigalow Belt South Bioregion	Moderate/Good	Yes	1	64.94	76.89	0.00	76.89	4,078	4,078	Powerful Owl	80.00	3.00	4,078
liverpool wind farm	20.50	CW304_Moderate/Good	Silvertop Stringybark - Yellow Box +/- Nortons Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range, Brigalow Belt South Bioregion	Moderate/Good	Yes	1	59.77	100.00	0.00	100.00	0	4,789	Powerful Owl	100.00	3.00	4,789
liverpool wind farm	20.50	CW303_Moderate/Good	Silvertop Stringybark - Forest Ribbon Gum very tall moist open forest on basalt plateau on the Liverpool Range, Brigalow Belt South Bioregion	Moderate/Good	Yes	1	1.05	100.00	0.00	100.00	0	0		0.00	0.00	32
liverpool wind farm	20.50	CW210_Moderate/Good	White Box - Red Stringybark shrubby woodlands on basalt slopes of the Nandewar Bioregion and Brigalow Belt South Bioregion	Moderate/Good	Yes	1	3.12	82.81	0.00	82.81	0	210	Masked Owl	94.44	3.00	210
liverpool wind farm	20.50	CW225_Moderate/Good	Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion	Moderate/Good	Yes	1	1.51	97.33	0.00	97.33	118	118	Masked Owl	94.44	3.00	118

Assessment circle name	Landsc ape score	Vegetation zone name	Vegetation type name	Condition	Red flag status	Management zone name	Management zone area	Current site value	Future site value	Loss in site value	Credit required for bio diversity	Credit required for TS	TS with highest credit requirement	Average species loss	Species TG Value	Final credit requirement for management zone
liverpool wind farm	20.50	CW214_Moderate/Good	White Box - White Cypress Pine shrubby open forest of the Nandewar Bioregion and Brigalow Belt South Bioregion	Moderate/Good	Yes	1	0.36	73.96	0.00	73.96	0	22	Masked Owl	88.89	3.00	22

BioBanking Credit Calculator

Species credits

Proposal ID : 0035/2016/4151MP
Proposal name : Liverpool wind farm north
Assessor name : Brooke Marshall
Assessor accreditation number : 0035
Tool version : v4.0
Report created : 30/01/2017 12:38

Scientific name	Common name	Species TG value	Identified population?	Can Id. popn. be offset?	Area / number of loss	Negligible loss	Red flag status	Number of credits
Chalinolobus dwyeri	Large-eared Pied Bat	1.30	No		19.00	0.00	No	247
Miniopterus schreibersii subsp. oceanensis	Eastern Bentwing-bat	1.30	No		19.00	0.00	No	247
Petaurus norfolcensis	Squirrel Glider	2.20	No		19.00	0.00	No	418

BioBanking Credit Calculator

Ecosystem credits

Proposal ID : 0035/2017/4183MP
 Proposal name : Liverpool wind farm south
 Assessor name : Brooke Marshall
 Assessor accreditation number : 0035
 Tool version : v4.0
 Report created : 30/01/2017 12:56

Assessment circle name	Landsc ape score	Vegetation zone name	Vegetation type name	Condition	Red flag status	Management zone name	Management zone area	Current site value	Future site value	Loss in site value	Credit required for bio diversity	Credit required for TS	TS with highest credit requirement	Average species loss	Species TG Value	Final credit requirement for management zone
hunter	24.75	HU681_Moderate/Good	Blakely's Red Gum - Yellow Box grassy woodland of the New England Tableland Bioregion	Moderate/Good	Yes	1	3.55	91.67	0.00	91.67	266	266	Barking Owl	100.00	3.00	266
hunter	24.75	HU714_Moderate/Good	Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Moderate/Good	Yes	1	11.15	91.67	0.00	91.67	836	836	Barking Owl	100.00	3.00	836
hunter	24.75	HU690_Moderate/Good_Other	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley	Moderate/Good_Other	Yes	1	77.26	100.00	0.00	100.00	6,273	6,273	Barking Owl	100.00	3.00	6,273
hunter	24.75	HU682_Moderate/Good	Blue-leaved Ironbark - Black Cypress Pine shrubby sandstone open forest in the southern Brigalow Belt South Bioregion (including Goonoo)	Moderate/Good	Yes	1	3.30	89.33	0.00	89.33	0	242	Barking Owl	61.90	3.00	242
hunter	24.75	HU707_Moderate/Good	Red Ironbark - Black Cypress Pine - stringybark +/- Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong - Mendooran region, southern Brigalow Belt South Bioregion	Moderate/Good	Yes	1	31.51	98.00	0.00	98.00	0	2,511	Barking Owl	100.00	3.00	2,511
hunter	24.75	HU707_Moderate/Good_Other	Red Ironbark - Black Cypress Pine - stringybark +/- Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong - Mendooran region, southern Brigalow Belt South Bioregion	Moderate/Good_Other	Yes	1	1.20	86.67	0.00	86.67	0	85	Barking Owl	100.00	3.00	85
hunter	24.75	HU678_Moderate/Good	Black Cypress Pine - ironbark +/- Narrow-leaved Wattle low open forest mainly on Narrabeen Sandstone in the Upper Hunter region of the Sydney Basin Bioregion	Moderate/Good	Yes	1	10.32	100.00	0.00	100.00	0	838	Barking Owl	100.00	3.00	838

Assessment circle name	Landsc ape score	Vegetation zone name	Vegetation type name	Condition	Red flag status	Management zone name	Management zone area	Current site value	Future site value	Loss in site value	Credit required for bio diversity	Credit required for TS	TS with highest credit requirement	Average species loss	Species TG Value	Final credit requirement for management zone
hunter	24.75	HU713_Moderate/Good	Rough-barked Apple - Blakely's Red Gum - Narrow-leaved Stringybark +/- Grey Gum sandstone riparian grass fern open forest on in the southern Brigalow Belt South Bioregion and Upper Hunter region	Moderate/Good	Yes	1	30.04	100.00	0.00	100.00	0	2,439	Barking Owl	100.00	3.00	2,439
hunter	24.75	HU690_Moderate/Good	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley	Moderate/Good	Yes	1	36.16	100.00	0.00	100.00	2,936	2,936	Barking Owl	100.00	3.00	2,936
hunter	24.75	HU702_Moderate/Good	Narrow-leaved Ironbark- Black Cypress Pine - stringybark +/- Grey Gum +/- Narrow-leaved Wattle shrubby open forest on sandstone hills in the southern Brigalow Belt South Bioregion and Sydney Basin Bio	Moderate/Good	Yes	1	42.65	91.67	0.00	91.67	0	3,196	Barking Owl	100.00	3.00	3,196

BioBanking Credit Calculator

Species credits

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Scientific name	Common name	Species TG value	Identified population?	Can Id. popn. be offset?	Area / number of loss	Negligible loss	Red flag status	Number of credits
Swainsona sericea	Silky Swainson-pea	1.80	No		1.00	0.00	Yes	18
Calyptorhynchus lathami	Glossy Black-Cockatoo	1.80	No		19.00	0.00	No	342
Melithreptus gularis subsp. gularis	Black-chinned Honeyeater (eastern subspecies)	1.30	No		19.00	0.00	No	247
Ninox strenua	Powerful Owl	3.00	No		19.00	0.00	No	570
Nyctophilus corbeni	Corben's Long-eared Bat	2.10	No		19.00	0.00	No	399
Pomatostomus temporalis subsp. temporalis	Grey-crowned Babbler (eastern subspecies)	1.30	No		19.00	0.00	No	247
Stagonopleura guttata	Diamond Firetail	1.30	No		19.00	0.00	No	247
Tyto novaehollandiae	Masked Owl	3.00	No		19.00	0.00	No	570
Vespdelus troughtoni	Eastern Cave Bat	1.30	No		19.00	0.00	Yes	247

APPENDIX G AUTHOR QUALIFICATIONS

Brooke Marshall
Project Manager

Brooke has an honours degree in Natural Resources from the University of New England (UNE, 2004) where she specialised in wildlife management and ecosystem rehabilitation. Since joining nghenvironmental, Brooke has undertaken environmental impact assessment, biodiversity survey and assessment, environmental management documentation and community consultation.

Brooke has worked on large scale infrastructure projects and project managed the input of specialists, as required. She is a specialist in wind and solar farm environmental assessment and has prepared construction and operational environmental management documentation to over ten renewable energy projects. Brooke is an accredited Biobanking Assessor and Certified Environmental Practitioner.

Freya Gordon – lead author 2015 (work halted)
Senior Ecologist

Freya Gordon is a senior ecologist with extensive field experience. She holds a Bachelor of Science with Honours from Monash University, Melbourne. Projects she has managed and implemented include a microbat monitoring program for the Holbrook Bypass (RMS); a Squirrel Glider monitoring program for the Albury Bypass (Conneq); and multiple ecological assessments and constraints analyses for Stockland, RMS, Lake Coal, Epuron, and local councils. Freya has completed an Environmental Assessment for a Solar Farm in western NSW including a detailed investigation of the status of the Grey-crowned Babbler on the site and surrounding study area. Her work requires experience in Commonwealth and State environmental legislation, policies and standards. Prior to joining NGH Environmental she worked for the Institute of Wildlife Research, The University of Sydney, designing, managing and implementing survey programs for a range of species. She has managed large scale field programs in the Simpson Desert for the University of Sydney Desert Ecology Research Group.

Brenton von Takach Dukai - 2015 surveys
Ecologist

Brenton is a botanist and ecologist with NGH Environmental's biodiversity team, and performs flora and fauna assessments for a wide variety of projects. Brenton has been involved with developments ranging from large-scale wind farms and dam upgrades to minor road upgrades. He is familiar with a broad array of monitoring and survey techniques for both flora and fauna, and has conducted surveys in a number of biogeographic regions of NSW. As a result, he is familiar with many of the vegetation types and communities found throughout the state. Brenton's work requires knowledge of and experience in the management of threatened species and communities as well as a solid understanding of legislative requirements at both State and Commonwealth levels. Prior to joining nghenvironmental he worked for the *Australian Wetlands and Rivers Centre* at the University of NSW, conducting survey trips across Australia to undertake vegetation assessments and fauna trapping programs. He has been involved in fauna monitoring programs with OEH and radio tracking fauna for the Australian Wildlife Conservancy. Brenton is a very capable field ecologist with excellent reporting skills.

George Madani - 2015 surveys

Ecologist

George Madani is a freelance wildlife ecologist and has an extensive background in wildlife ecology with ten years of field survey skills and practical research and applied management experience. He has conducted fauna surveys and field studies across various regions and habitats in Australia. His work has taken him into remote areas as the Kimberley, Cape York, Simpson and Strzelecki Deserts as well across a range of temperate sclerophyll woodlands and rainforests along the East Coast and inland into the WA Goldfields, Victorian Mallee Country and rangelands of Western NSW. He has comprehensive knowledge of and experience with the identification, distribution, habitat and ecology of terrestrial vertebrate fauna, especially reptiles, amphibians and avifauna. George has a Masters in Wildlife Health and Population Management from the University of Sydney. He has worked with various State and Federal Government departments, universities, environmental consultancies and NGO's on projects ranging from wildlife monitoring, baseline inventory surveys to impact based assessments.

Bianca Heinze – lead author 2016

Ecologist

Bianca completed her Bachelor of Applied Science (Environmental Resource/Coastal Management) at Southern Cross University, Lismore in 2006. Bianca has been involved in a number of complex infrastructure projects in a range of biogeographic areas, including wind farms, highway realignments and power transmission alignments in New South Wales, South Australia and West Australia.

Bianca has been involved with over thirteen wind farm projects. Her involvement has been across various stages of the projects with a focus on flora and fauna issues. Her experience includes undertaking preliminary desktop investigations, field work and preparing Biodiversity Assessments for proposed wind farms, preparing environmental management sub-plans for approved wind farms and undertaking monitoring surveys at operational wind farms.

Bianca has experience in undertaking flora and fauna assessments associated with the development of linear infrastructure: these have varied in length and complexity from minor works up to major works. One project involved fauna habitat assessment along a proposed line approximately 300 kilometres in length, and with two route options. Bianca was the lead ecologist and author for this project.

As well as constraint and biodiversity assessments, Bianca has prepared Species Impact Statements and general environmental impact assessment including Review of Environmental Factors and Environmental Assessments. Assessments have been for a variety of proposals including municipal water treatment plants, power line upgrades, residential and commercial developments. Bianca has almost 10 years experience in conducting and participating in fauna surveys and monitoring including marine and terrestrial mammals, amphibians, reptiles, microbats and threatened species. Her particular area of interest is woodland birds. Bird surveys Bianca's skills in targeted threatened bird surveys include surveys for woodland diurnal birds and for owls. Her experience includes locating roost and nest sites of the vulnerable Powerful Owl *Ninox strenua* in inland and coastal environments, and utilising a range of bird survey techniques including area search and point counts to target birds such as Flame Robin *Petroica phoenicea*, Brown Treecreeper *Climacteris picumnus*, Speckled Warbler *Chthonicola sagittatus* and Superb Parrot *Polytelis swainsonii*. Mammal surveys Her practical skills in mammal trapping and handling extend from small and medium ground-dwelling mammals such as bush rats and potoroos through to medium arboreal species such as possums and gliders. She has experience in setting and checking tree-mounted Elliot and cage traps, as well as processing caught fauna.

Ryan Sims – 2016 surveys

Lead Ecologist

Ryan Sims is a consultant botanist and vegetation ecologist based in the Hunter who has 10 years botanical experience in Queensland and New South Wales. He has undertaken countless flora surveys, vegetation mapping and classification and threatened species searches for major projects in NSW. Ryan has a thorough understanding of NSW flora and demonstrated botanical field experience in the Hunter, Sydney Basin, Central West, Blue Mountains, and North Coast regions. Ryan has experience in both private consulting and local government. As a consultant, he has liaised with local, state and commonwealth government on development assessments. In local government, Ryan provided specialised botanical expertise for development and planning assessments and biodiversity conservation projects. Recently, Ryan completed a Masters at UNSW with David Keith. The study focused on grassy woodland restoration after livestock fencing. As such, Ryan has a very good understanding of grassy woodland dynamics. He is experienced in statistical analysis of floristic data, survey design, field survey techniques (including government standard methods i.e. Biometric and Biobanking), data analysis, and has a thorough understanding of environmental legislation. Ryan is also experienced in GIS mapping.

Calia Jones – 2016 surveys

Ecology technical assistant

Calia has a Bachelor degree in Wildlife and Conservation Biology from La Trobe University (LTU). Since starting with nghenvironmental in 2015, Calia has been a project officer on a wide range of projects including biodiversity assessments and assisting in solar and windfarm projects. She has had experience in the field assisting senior ecologists and undertaking simple assessments by herself. She also assists in writing documentation for a wide range of projects.