Jamisons Road, Boallia NatureMap report, conservation significant species

	Name ID	Species Name	Naturalised	Conservation Code	Endemic To Query Area
1	18102	Andersonia ferricola		P1	
2	32204	Banksia nivea subsp. uliginosa		T	
3	32046	Banksia squarrosa subsp. argillacea		T	
4	17804	Boronia tetragona		P3	
5	35796	Calothamnus quadrifidus subsp. teretifolius		P4	
6	35657	Chamelaucium sp. Yoongarillup (G.J. Keighery 3635)		P4	
7	3808	Daviesia elongata		T	
8	20510	Gastrolobium modestum		T	
9	14011	Grevillea brachystylis subsp. brachystylis		P3	
10	19414	Grevillea brachystylis subsp. grandis		T	
11	2190	Hakea oldfieldii		P3	
12	16522	Isopogon formosus subsp. dasylepis		P3	
13	16879	Lambertia rariflora subsp. rariflora		P4	
14	45084	Lasiopetalum laxiflorum		P3	
15	29492	Leucopogon sp. Busselton (D. Cooper 243)		P2	
16	13779	Loxocarya magna		P3	
17	37320	Loxocarya striata subsp. implexa		P1	
18	8163	Pithocarpa corymbulosa (Corymbose Pithocarpa)		P3	
19	4179	Pultenaea pinifolia		P3	
20	974	Schoenus benthamii		P3	
21	31872	Stylidium ferricola		P1	
22	16862	Synaphea petiolaris subsp. simplex		P3	
23	1334	Thysanotus glaucus		P4	
24	12448	Verticordia plumosa var. ananeotes		T	

Appendix 3. Definitions of Threatened and Priority List flora under the WC Act (DBCA, 2017a).

Conservation code	Category
T	Threatened flora is flora that has been declared to be 'likely to become extinct or is rare, or otherwise in need of special protection', pursuant to section 23F(2) of the *Wildlife Conservation Act 1950*. The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria (CR, EN, VU, EX). A species that is listed as Threatened and assessed as 'Critically Endangered' would therefore have its status written as T (CR).
P1	Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
P2	Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
P3	Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora', but are in need of further survey.
P4	Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

Appendix 4. Categories of Threatened Species under the EPBC Act (DotEE, 2017c).

Category	Definition
Extinct (Ex)	A native species is eligible to be included in the ***extinct*** category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild (ExW)	A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered (CE)	A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered (EN)	A native species is eligible to be included in the endangered category at a particular time if, at that time (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable (VU)	A native species is eligible to be included in the vulnerable category at a particular time if, at that time (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.
Conservation Dependent (CD)	A native species is eligible to be included in the conservation dependent category at a particular time if, at that time, the species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

Appendix 5. Vegetation condition scale (EPA, 2016).

Vegetation Condition	South West and Interzone Botanical Provinces
Pristine	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
Very Good	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees and shrubs.

Appendix 6. List of vascular flora found within the Survey Area at Lot 2626 Jamisons Road.

FAMILY	LATIN NAME	NATURALISED
Apiaceae	*Platysace tenuissima*	
Apiaceae	*Platysace filiformis*	
Apiaceae	*Xanthosia candida*	
Apiaceae	*Xanthosia huegelii*	
Araliaceae	*Trachymene pilosa*	
Asparagaceae	*Lomandra integra*	
Asparagaceae	*Lomandra purpurea*	
Asparagaceae	*Lomandra sericea*	
Asparagaceae	*Thysanotus arbuscula*	
Asparagaceae	*Thysanotus manglesianus*	
Asteraceae	*Cotula turbinata*	*
Asteraceae	*Hypochaeris glabra*	*
Asteraceae	*Ursinia anthemoides*	*
Asteraceae	*Lagenophora huegelii*	
Asteraceae	*Millotia tenuifolia*	
Asteraceae	*Senecio glomeratus*	
Asteraceae	*Sonchus oleraceus*	
Casuarinaceae	*Allocasuarina fraseriana*	
Celastraceae	*Stackhousia monogyna*	
Colchicaceae	*Burchardia congesta*	
Cyperaceae	*Lepidosperma pubisquameum*	
Cyperaceae	*Tetraria capillaris*	
Cyperaceae	*Tetraria octandra*	
Dasypogonaceae	*Kingia australis*	
Dilleniaceae	*Hibbertia amplexicaulis*	
Dilleniaceae	*Hibbertia glomerata*	
Droseraceae	*Drosera pallida*	
Droseraceae	*Drosera stolonifera*	
Droseraceae	*Drosera erythrorhiza*	
Euphorbiaceae	*Stachystemon virgatus*	
Fabaceae	*Lotus angustissimus*	*
Fabaceae	*Lotus subbiflorus*	*
Fabaceae	*Acacia extensa*	
Fabaceae	*Acacia nervosa*	
Fabaceae	*Acacia pulchella*	
Fabaceae	*Bossiaea ornata*	
Fabaceae	*Daviesia physodes*	
Fabaceae	*Daviesia preissii*	
Fabaceae	*Dillwynia laxiflora*	
Fabaceae	*Gompholobium knightianum*	
Fabaceae	*Gompholobium tomentosum*	
Fabaceae	*Hovea chorizemifolia*	

FAMILY	LATIN NAME	NATURALISED
Fabaceae	*Hovea trisperma*	
Fabaceae	*Isotropis cuneifolia*	
Fabaceae	*Kennedia coccinea*	
Fabaceae	*Sphaerolobium medium*	
Goodeniaceae	*Dampiera linearis*	
Goodeniaceae	*Lechenaultia biloba*	
Goodeniaceae	*Scaevola calliptera*	
Goodeniaceae	*Velleia trinervis*	
Haemodoraceae	*Conostylis aculeata*	
Haemodoraceae	*Haemodorum laxum*	
Haemodoraceae	*Haemodorum spicatum*	
Hemerocallidaceae	*Agrostocrinum hirsutum*	
Hemerocallidaceae	*Caesia micrantha*	
Iridaceae	*Patersonia occidentalis*	
Iridaceae	*Patersonia umbrosa* var. *xanthina*	
Loganiaceae	*Orianthera serpyllifolia* subsp. *angustifolia*	
Myrtaceae	*Eucalyptus marginata* subsp. *marginata*	
Myrtaceae	*Hypocalymma angustifolium*	
Orchidaceae	*Caladenia attingens*	
Orchidaceae	*Caladenia flava*	
Orchidaceae	*Cyanicula sericea*	
Orchidaceae	*Elythranthera brunonis*	
Orchidaceae	*Pheladenia deformis*	
Orchidaceae	*Pyrorchis nigricans*	
Orchidaceae	*Thelymitra crinita*	
Poaceae	*Amphipogon turbinatus*	
Poaceae	*Microlaena stipoides*	
Poaceae	*Neurachne alopecuroidea*	
Poaceae	*Rytidosperma setaceum*	
Poaceae	*Tetrarrhena laevis*	
Podocarpaceae	*Podocarpus drouynianus*	
Proteaceae	*Banksia grandis*	
Proteaceae	*Hakea amplexicaulis*	
Proteaceae	*Xylomelum occidentale*	
Restionaceae	*Desmocladus fasciculatus*	
Restionaceae	*Hypolaena exsulca*	
Rubiaceae	*Opercularia hispidula*	
Rutaceae	*Boronia spathulata*	
Stylidiaceae	*Levenhookia stipitata*	
Stylidiaceae	*Stylidium androsaceum*	
Stylidiaceae	*Stylidium barleei*	
Stylidiaceae	*Stylidium piliferum*	
Stylidiaceae	*Stylidium schoenoides*	
Thymelaeaceae	*Pimelea rosea*	

FAMILY	LATIN NAME	NATURALISED
Thymelaeaceae	*Pimelea spectabilis*	
Thymelaeaceae	*Pimelea sylvestris*	
Xanthorrhoeaceae	*Chamaescilla corymbosa*	
Xanthorrhoeaceae	*Xanthorrhoea gracilis*	
Xanthorrhoeaceae	*Xanthorrhoea preissii*	
Zamiaceae	*Macrozamia riedlei*	

Appendix 7. Quadrat species lists and descriptions.

Quadrat 1.

Grey-brown sand over laterite Easting: 341921.7 E Northing: 6259744.9 N

TAXON	COVER	TAXON	COVER
Acacia extensa	1	*Lagenophora huegelii*	1
Acacia pulchella	1	*Lechenaultia biloba*	1
Bossiaea ornata	1	*Lepidosperma pubisquameum*	1
Burchardia congesta	1	*Levenhookia stipitata*	1
Caesia micrantha	1	**Lotus subbiflorus*	1
Chamaescilla corymbosa	1	*Millotia tenuifolia*	1
Conostylis aculeata	1	*Opercularia hispidula*	4
Corymbia calophylla	3	*Patersonia umbrosa* var. *xanthina*	1
Cyanicula sericea	1	*Pimelea rosea*	1
Desmocladus fasciculatus	1	*Pimelea sylvestris*	1
Drosera erythrorhiza	1	**Sonchus oleraceus*	1
Drosera stolonifera	1	*Tetraria capillaris*	1
Eucalyptus marginata subsp. *marginata*	3	*Tetraria octandra*	1
Hakea amplexicaulis	1	*Tetrarrhena laevis*	2
Hovea chorizemifolia	1	*Thelymitra crinita*	1
**Hypochaeris glabra*	2	*Xanthosia candida*	4
Isotropis cuneifolius	1	*Xylomelum occidentale*	1

* denotes introduced species.

Quadrat 2

Grey-brown sand over laterite Easting: 341967.4 E Northing: 6259716.9 N

TAXON	COVER	TAXON	COVER
Acacia extensa	1	*Millotia tenuifolia*	2
Acacia pulchella	2	*Opercularia hispidula*	1
Caesia micrantha	1	*Patersonia umbrosa* var. *xanthina*	1
Caladenia flava	1	*Pimelea rosea*	1
Chamaescilla corymbosa	1	*Platysace filifolius*	1
Corymbia calophylla	3	*Stackhousia monogyna*	1
Daviesia physodes	1	*Tetraria capillaris*	1
Dillwynia laxiflora	3	*Thysanotus manglesianus*	1
Eucalyptus marginata subsp. *marginata*	3	**Ursinia anthemoides*	2
Hovea chorizemifolia	1	*Xanthosia huegelii*	1
Hypolaena exsulca	1	*Xylomelum occidentale*	1
Isotropis cuneifolius	1		
Lagenophora huegelii	2		
Lechenaultia biloba	1		
Lepidosperma pubisquameum	1		
Lomandra integra	1		

* denotes introduced species.

Quadrat 3.

Grey sand over laterite Easting: 342109.2 E Northing: 6259744.9 N

TAXON	COVER	TAXON	COVER
Allocasuarina fraseriana	3	*Logania serpyllifolia* subsp. *angustifolia*	1
Banksia grandis	1	*Lomandra sericea*	1
Caesia micrantha	1	*Millotia tenuifolia*	1
Caladenia flava	1	*Neurachne alopecuroidea*	1
Chamaescilla corymbosa	1	*Opercularia hispidula*	1
Corymbia calophylla	3	*Patersonia umbrosa* var. *xanthina*	3
**Cotula turbinata*	1	*Pimelea spectabilis*	1
Eucalyptus marginata subsp. *marginata*	3	*Platysace tenuissima*	1
Gompholobium knightianum	1	*Scaevola calliptera*	1
Hibbertia glomerata	2	*Stylidium androsaceum*	1
Hovea chorizemifolia	1	*Tetraria capillaris*	1
Hovea trisperma	1	*Thysanotus manglesianus*	1
**Hypochaeris glabra*	1	*Trachymene pilosa*	1
Hypolaena exsulca	2	**Ursinia anthemoides*	1
Lagenophora huegelii	1	*Xanthosia huegelii*	1
Lepidosperma pubisquameum	1	*Xylomelum occidentale*	1

* denotes introduced species.

Report of a Level 1 Flora and Vegetation Survey at Lots 2629 and 2699 Jamisons Road and a Portion of the Treeton State forest, Boallia.

Prepared for B & J Catalano Pty Ltd
December 2016

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Version	Origin	Review	Review date	Ecoedge release approval & purpose	Issue date
V1	M. Strang	R. Smith	23/12/2016		
V2	R. Smith	M. Strang	04/01/2016		
Final draft	M. Strang	P. Bennett (B&J Catalano)		M. Strang (to P. Bennett for review)	04/01/2016
Final					

Executive Summary

Ecoedge was engaged by B & J Catalano Pty Ltd in September 2016 to undertake a Level 1 Flora and Vegetation Survey of approximately 19.2 ha of remnant vegetation on Lots 2629 and 2699 Jamisons Road, Boallia, in the City of Busselton. The Level 1 survey included both a reconnaissance survey and a targeted rare flora survey. The assessment also included a rare flora survey over approximately 44.3 ha of remnant vegetation in the adjacent Treeton State forest block (State forest No. 32). The private property survey areas and State forest survey area together totalled 63.5 ha and, except where indicated otherwise, are referred to as the 'Survey Area'.

The primary objective of the survey was to determine whether there are any significant flora and/or vegetation values within the Survey Area, specifically in relation to the listed threatened (Declared Rare Flora (DRF)) species *Banksia squarrosa* subsp. *argillacea* and *Banksia nivea* subsp. *uliginosa*, and the Threatened Ecological Community (TEC) 'Shrublands on southern Swan Coastal Plain Ironstones'. The purpose of the rare flora survey in the adjoining Treeton forest block was to quantify the extent of populations of the aforementioned Threatened flora species.

The field survey was carried out by Russell Smith (Senior Botanist) on 11 October 2016 in accordance with the Environmental Protection Authority (EPA) and Department of Parks and Wildlife (DPaW) Technical Guide 2015.

Sixty-three taxa of vascular flora were identified within the private property, of which eight were introduced species. None of the introduced species are a declared Pest Plant under the under the *Biosecurity and Agriculture Management Act 2007*

It is estimated that within Lots 2629 and 2699, the population of the DRF *Banksia squarrosa* subsp. *argillacea* consists of approximately 3,728 individuals (+/-200), while there are approximately 22 individuals of the DRF *Banksia nivea* subsp. *uliginosa* (+/- 2). It is estimated that there are 6030 (+/- 500) individuals of *Banksia squarrosa* subsp. *argillacea* within the State forest, and approximately 1000 individuals of *Banksia nivea* subsp. *uliginosa* (+/- 200).

In addition to the two DRF *Banksias* mentioned above, four Priority list species were identified within the private property, these being: *Hakea oldfieldii*, *Isopogon formosus* subsp. *dasylepis*, *Loxocarya magna* (all P3) and *Calothamnus quadrifidus* subsp. *teretifolius* (P4). Of these, *H. oldfieldii*, *L. magna* and C. *quadrifidus* subsp. *teretifolius* were quite common within the shrubland on ironstone, while *I. formosus* subsp. *dasylepis* was restricted to the south-west corner of the private property.

Three vegetation units were recognised within the property, two of which are primarily comprised of shrubs, sedges and herbs (A1 and A2), and one that is a woodland or open forest unit (B).

Vegetation units A1 and A2 are similar, the main differences being the greater density of *B. squarrosa* subsp. *argillacea* in unit A1 (to the exclusion of many other species) and the more variable condition in unit A2, which ranges from scattered *Loxocarya magna* and *Calothamnus quadrifidus* subsp. *teretifolius* and native herbs and pasture species to tall shrubland in very good condition dominated by *Hakea oldfieldii*, *Calothamnus quadrifidus* subsp. *teretifolius* and *Banksia squarrosa* subsp. *argillacea*.

Vegetation unit B, which is dominated by Marri (*Corymbia calophylla*) trees is also quite variable in condition, ranging from very good to degraded (where understorey species are mainly pasture grasses).

Much of the remnant native vegetation on Lots 2699 and 2629 is consistent with it being an occurrence of the Critically Endangered TEC "Shrublands on southern Swan Coastal Plain Ironstones (Busselton area)" (SWAFCT10b). Vegetation unit A1 and portions of units A2 and B fit the description of this community. At total of 12.8 ha of vegetation consistent with belonging to this community occur on Lots 2699 and 2629 – this compares with approximately 16 ha in the adjacent State forest.

The condition of vegetation was quite variable within Lots 2629 and 2699 however, just over 60% was in Good or Very Good condition.

The Survey Area vegetation does not appear to have particular value with regard to regional ecological linkages.

All the Survey Area forms part of a designated Environmentally Sensitive Area and therefore has particular requirements regarding potential clearing under *the Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (Clearing Regulations*).

Contents

Table of Tables

Table of Figures

Statement of limitations

Reliance on Data

In the preparation of this report, Ecoedge has relied on data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report. Unless stated otherwise in the report, Ecoedge has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report are based in whole or in part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Ecoedge will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, unavailable, misrepresented or otherwise not fully disclosed to Ecoedge.

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The report has been prepared for the benefit of the Client and for no other party. Ecoedge assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including, without limitation, matters arising from any negligent act or omission of Ecoedge or for any loss or damage suffered by any other party relying on the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions, and should make their own enquiries and obtain independent advice in relation to such matters. Ecoedge will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

1 Introduction

Ecoedge was engaged by B & J Catalano Pty Ltd in September 2016 to undertake a Level 1 Flora and Vegetation Survey of approximately 19.2 ha of remnant vegetation on Lots 2629 and 2699 Jamisons Road, Boallia, in the City of Busselton. The Level 1 survey included both a reconnaissance survey and a targeted rare flora survey. The assessment also included a rare flora survey over approximately 44.3 ha of remnant vegetation in the adjacent Treeton State forest block (State forest No. 32). The private property survey areas and State forest survey area together will henceforth be referred to as the 'Survey Area'.

The field survey was carried out by Russell Smith (Senior Botanist) on 11 October 2016 and was undertaken in accordance with the Environmental Protection Authority (EPA) and Department of Parks and Wildlife (DPaW) Technical Guide 2015.

This report compiles findings of the field survey.

1.1 Scope and Objectives

The primary objective of the Level 1 flora and vegetation survey was to determine whether there are any significant flora and/or vegetation values within the Survey Area, specifically in relation to the listed threatened species *Banksia nivea* subsp. *uliginosa* and *Banksia squarrosa* subsp. *argillacea*, and the Threatened Ecological Community (TEC) 'Shrublands on southern Swan Coastal Plain Ironstones'. The purpose of the rare flora survey in the adjoining Treeton forest block was to quantify the extent of populations of the afore mentioned Threatened flora species.

The following are standard requirements for a Level 1 flora and vegetation survey under the new EPA and DPaW Technical Guide (2015):

- Review the documented flora and vegetation of significance, based on Department of Parks and Wildlife (DPaW) records (databases);
- Conduct a review of other literature to summarise the values of flora and vegetation significance in the Survey Area;
- Conduct a field assessment to:
    - identify the vascular flora species present;
    - determine the presence or absence of Declared Rare Flora (DRF), Priority or Significant Species;
    - assess conservation significance of vegetation and flora;
    - define and spatially map vegetation condition;
    - define and spatially map vegetation communities;
    - define and map threatened and priority ecological communities;

- determine whether the Survey Area are wholly or partly with an Environmentally Sensitive Area (ESA); and

- Prepare a report summarising findings
- Submit shapefiles of all field survey data

1.2 Previous Flora Surveys within the Local Area

To the Author's knowledge, no flora or vegetation assessments of vegetation within the Survey Area have been carried out, however, numerous surveys have been undertaken in the adjacent Treeton State forest. Based on correspondence B & J Catalano have received in 1999 from the then Departments of Conservation and Land Management and in 2003 from the then Department of Environment and Conservation (both now known as the Department of Parks and Wildlife), conservation values of the site are well known; it is known to contain an occurrence of the TEC 'Shrublands on southern Swan Coastal Plain Ironstones' (listed as a TEC in both State and Commonwealth legislation), and populations of the listed threatened flora *Banksia nivea* subsp. *uliginosa* and *Banksia squarrosa* subsp. *argillacea*, both of which are also listed as Threatened in both State and Commonwealth legislation.

Flora surveys, assessments and reviews have also been undertaken in nearby areas, although not all are publicly available and therefore could not be referenced. The most relevant and/or significant of those available that were referred to during the preparation of this report are listed below:

- Ecoedge (2014). Yoongarillup Level 2 Flora and Vegetation Survey Report, Rev. 03092014. Unpublished report prepared for Doral Mineral Sands.
- Mattiske Consulting Pty Ltd (2012). Flora and Vegetation Survey of Yoongarillup Resource Zone Survey Area. Unpublished report prepared for Doral Mineral Sands.
- Keighery, B.J., Keighery, G.J., Webb, A., Longman, V.M., Griffin E.A. (2008). A floristic survey of the Whicher Scarp. Department of Environment and Conservation, Perth.
- Meissner, R. and English, V. (2005). Shrubland association on southern Swan Coastal Plain ironstone (Busselton area) (southern ironstone association) interim recovery plan, 2005-2010. Dept. of Conservation & Land Management.

1.3 Biogeographic Region, Location and Site Description

The Survey Area is situated on the boundary between the Perth Coastal Plain (SWA2) sub-region of the Swan Coastal Plain biogeographic region, and the Southern Jarrah Forest (JF2) sub-region of the Jarrah Forest Bioregion as defined in the Interim Biogeographical Regionalisation for Australia (IBRA) (Australian Government, 2009). Approximately 95% of the Survey Area is mapped as being in the Southern Jarrah Forest (JF2) sub-region.

It is situated in the City of Busselton approximately 16 km south-southwest of the Busselton town site and 7.6 km southeast of Jindong (**Figure 1**), and covers a total area of 63.5 ha. The remnant vegetation on Lots 2629 and 2699 adjoins the Treeton State forest block at its southern boundary. Jamisons Road forms the north east and eastern boundary and it is bounded by cleared farmland adjoins on the north and west (**Figure 2**).

Elevation onsite is gently undulating and reflects the site's position in the landscape at the junction between the Swan Coastal Plain in the north and the Whicher Scarp in the south, gradually rising from 62 m above sea level (ASL) in the north to 72 m ASL in the south.

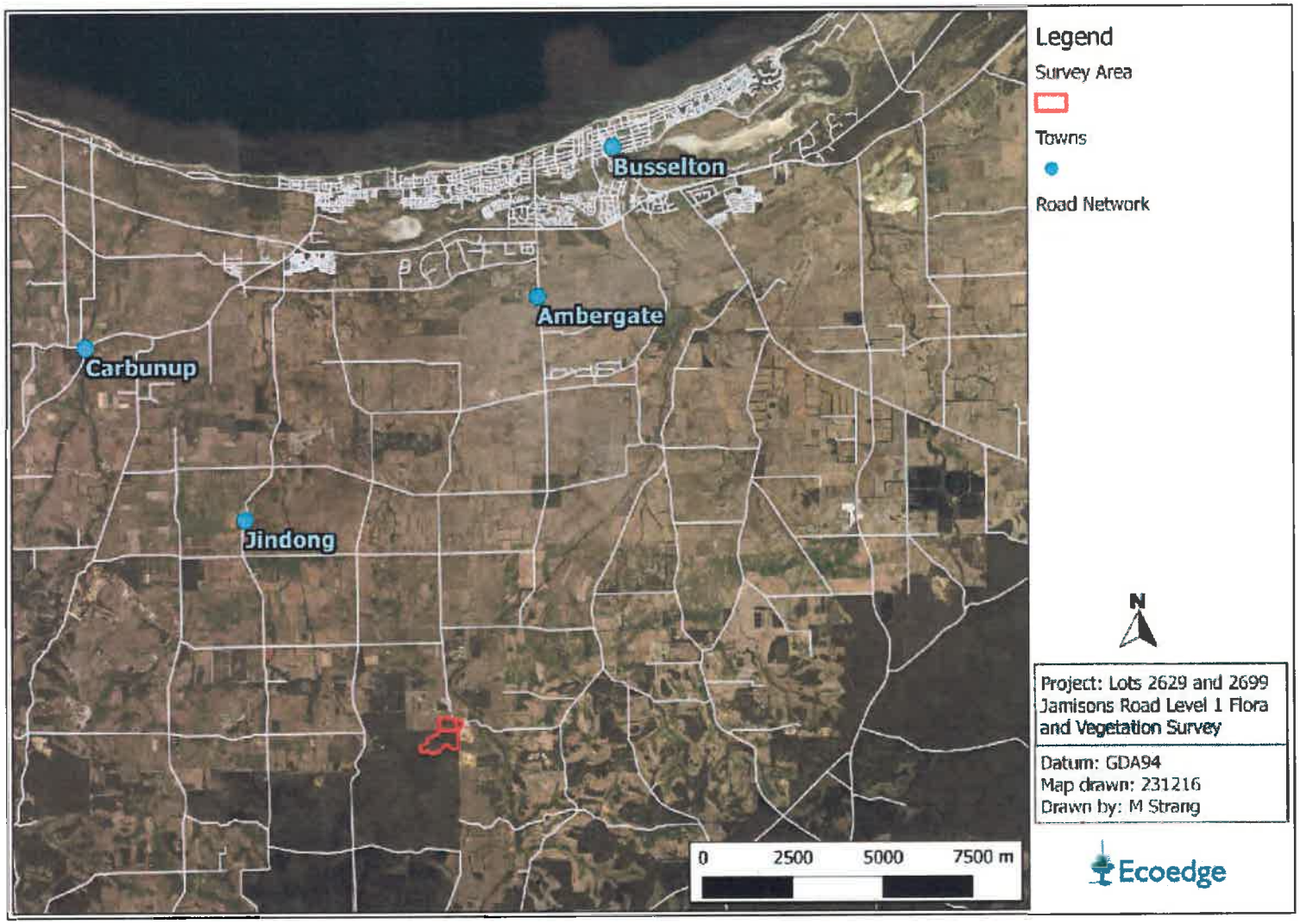

Figure 1. Aerial Photograph showing the location of the Survey Area.

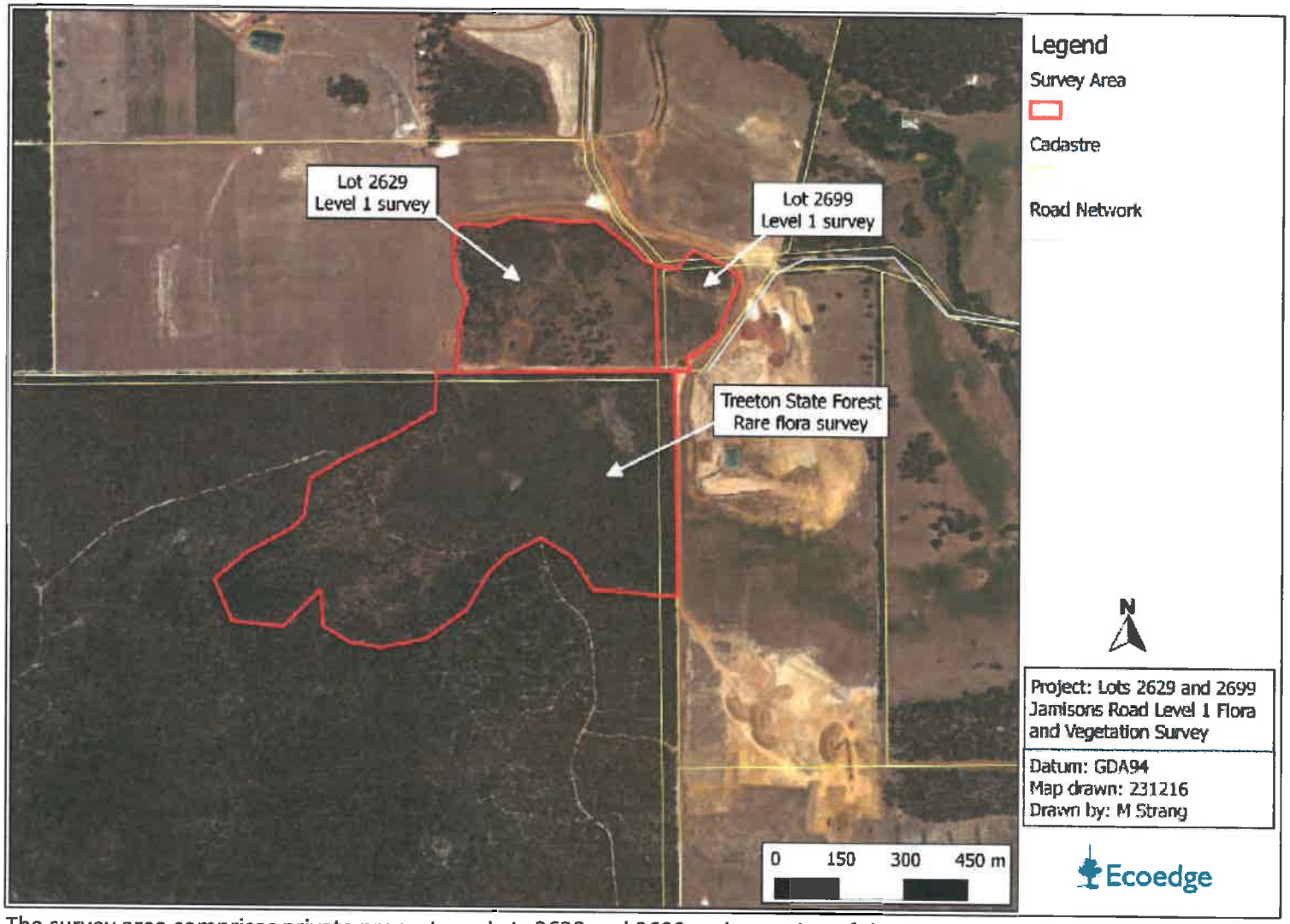

Figure 2. The survey area comprises private property on Lots 2629 and 2699 and a portion of the Treeton State forest block.

1.4 Geology

The Survey Area is situated on the Whicher Scarp, a sickle shape band of low hills thought to have formed as a result of marine erosion of the Perth Sedimentary Basin around two million years ago in the Pleistocene or late Tertiary period. Following ancient shorelines at the foot of the Whicher Scarp is the Yoganup Formation, a gently sloping shelf which contains localised concentrations of heavy minerals (Churchward and McArthur, 1980). The nature of its geology, landform and soils gives the Whicher Scarp affinities with the Swan Coastal Plain. The Survey Area is located on the 'Central Whicher Scarp', which is described by Keighery *et al.* (2008) as having moderate north facing slopes with areas of laterite capped rises and soils ranging from deep sands to sand, gravel, silt, clay and ironstone combinations.

The Survey Area is situated on the Whicher Scarp soil landscape system (214Ws) of Tille and Lantzke (1990), which is described as consisting of "....gentle lateritic slopes with gravels. These slopes form a low scarp which separates the Swan Coastal Plain and the Blackwood Plateau. This subsystem is similar to parts of the Cartis Land unit mapped by Churchward and McArthur (1980)."

Soil-landscape systems have been further divided into soil phases or mapping units; two occur in the Survey Area. These are mapped in **Figure 3** and are described in **Table 1.**

Table 1. Soil Mapping Units occurring within the Survey Area (Tille and Lantzke, 1990).

Soil Mapping Unit	Description
214WsYL1	Raised flats. Duplex sandy gravels, semi-wet soils, yellow deep sands and sandy earths and loamy gravels.
214WsYLw	Poorly drained depressions on the shelf surface. Soils are non-saline wet soils and grey-brown sands and loams.

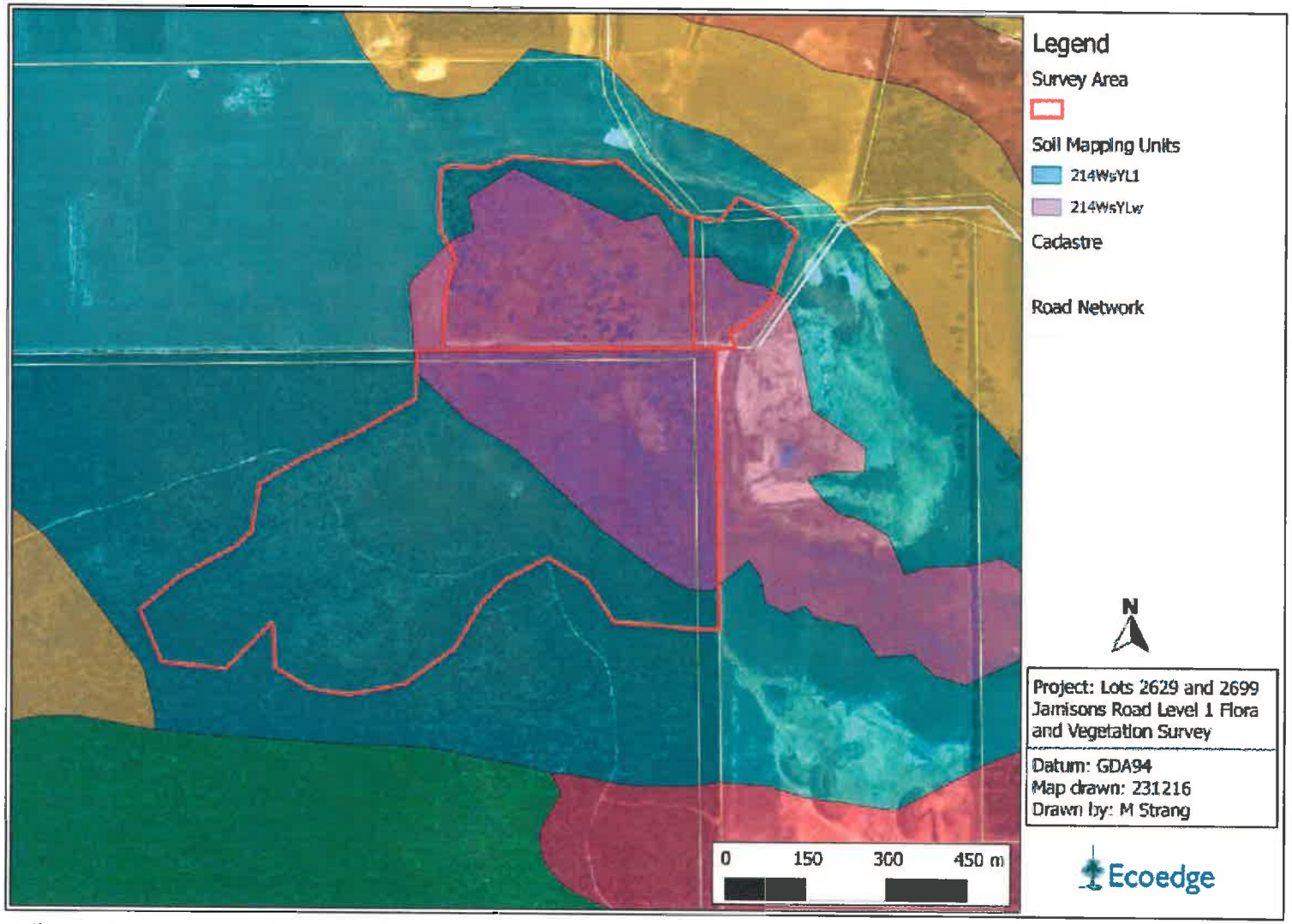

Figure 3. Soil mapping units occurring within the Survey Area.

1.5 Vegetation

Information presented in this section will relate only to the private property portion of the Survey Area. Lots 2629 and 2699 contain approximately 19.2 ha of remnant native vegetation.

A systematic survey of native vegetation in Western Australia was undertaken by J. S. Beard (along with others) during the 1970s, which described vegetation systems in the south-west of Western Australia at a scale of 1: 250,000. Beard's vegetation maps attempted to depict the vegetation as it might have been prior to European settlement in terms of type and extent (Beeston *et al.*, 2001). The Beard Vegetation Association dataset, also referred to as the pre-European native vegetation extent dataset, was digitised by Shepherd *et al.* (2002).

Beard vegetation associations have been described to a minimum standard of Level 3 'Broad Floristic Formation' for the National Vegetation Inventory System (NVIS) (state-wide to regional scale). Two Beard vegetation associations are mapped as occurring within the Survey Area; Association code 1181, which is described as 'Medium woodland, jarrah & *Eucalyptus (Corymbia) haematoxylon* (Whicher Ra.)', and Association 27 'Low woodland; paperbark (Melaleuca sp.)'.

Utilising the Regional Forest Agreement (RFA) mapping undertaken by Mattiske and Havel (1998), and the Swan Coastal Plain (SCP) mapping of Heddle *et al.* (1980), the South West Biodiversity Project (SWBP) Mapping and Information Installment 2 (Molloy *et al.*, 2007) provides mapping of vegetation complexes in the portion of the South West region not covered by either Heddle (1980) or Mattiske and Havel (1998).

As shown in **Figure 4**, vegetation within the Survey Area was mapped by the SWBP as supporting Yelverton Complex vegetation (**Table 2**).

Table 2. Description of Vegetation Complexes mapped as occurring within the Survey Area (Molloy *et al.*, 2007).

Vegetation Complex	Description
Yelverton (Yw)	Woodland of *Allocasuarina fraseriana-Nuytsia floribunda-Agonis flexuosa-Banksia attenuata* on slopes and open forest of *Corymbia calophylla-Eucalyptus patens-Eucalyptus marginata* subsp. *marginata* on the lower slopes and woodland of *Eucalyptus rudis-Melaleuca rhaphiophylla* on valley floors in the humid zone.
Yelverton (Y)	Woodland of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla-Allocasuarina fraseriana-Agonis flexuosa* and open woodland of *Corymbia calophylla* on low undulating uplands in the humid zone.

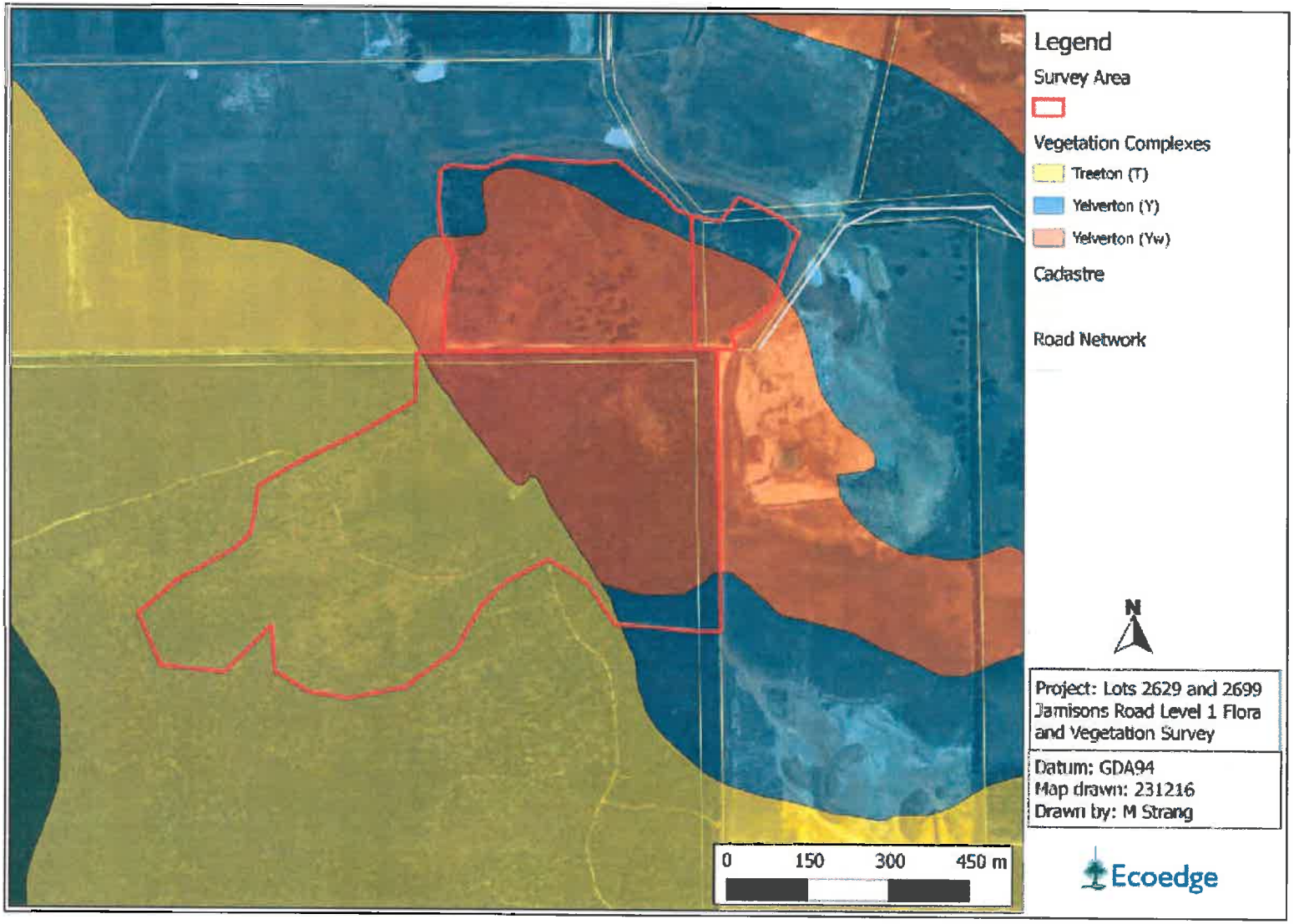

Figure 4. Vegetation complexes mapped by Heddle *et al.* (1980) as occurring within the Survey Area.

In 2001, the Commonwealth of Australia stated National Targets and Objectives for Biodiversity Conservation, which recognised that the retention of 30% or more of the pre-clearing extent of each ecological community was necessary if Australia's biological diversity was to be protected (Environment Australia, 2001). This level of recognition is in keeping with the targets set in the EPA's Position Statement on the 'Environmental protection of native vegetation in Western Australia: clearing of native vegetation, with particular reference to the agricultural area' (EPA, 2000). With regard to conservation status, the EPA has set a target of 15% of pre-European extent for each ecological community to be protected in a comprehensive, adequate and representative reserve system (EPA, 2006).

Table 3 lists the percentage remaining of each vegetation complex and the percentage of each vegetation complex in formal and formal plus informal reserves. It also lists whether each vegetation complex meets the Commonwealth's 30% target (Environment Australia, 2001) and the EPA's 15% target (EPA, 2006). As is evident in **Table 3**, the Yelverton (Y) Complex meets the Commonwealth target but not the EPA target, while the Yelverton (Yw) Complex meets neither target.

Table 3. Vegetation Complexes present in the Survey Area with regard to the EPA and Commonwealth retention targets (DEC, 2007).

Vegetation Complex	% Remaining of pre-European	Is the 30% Target Met?	% in Formal Reserves	% in Formal + All Informal Reserves	Is the 15% Target Met?
Yelverton (Yw)	26.5%	No	0.8%	8.7%	No
Yelverton (Y)	38.4%	Yes	3.1%	6.0%	No

1.5.1 Threatened and Priority Ecological Communities

Ecological communities are defined by Western Australia's Department of Parks and Wildlife (DPaW, previously the Department of Environment and Conservation (DEC)) as "...naturally occurring biological assemblages that occur in a particular type of habitat. They are the sum of species within an ecosystem and, as a whole, they provide many of the processes which support specific ecosystems and provide ecological services." (DEC, 2010).

A threatened ecological community (TEC) is one which is found to fit into one of the following categories; 'presumed totally destroyed', Critically Endangered (CE), Endangered (E) or Vulnerable (Vu) (DEC, 2010). Possible threatened ecological communities that do not meet survey criteria are added to DPaW's Priority Ecological Community (PEC) Lists under Priorities 1, 2 and 3 (referred to as P1, P2, P3). Ecological Communities that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4 (P4). These ecological

communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5 (P5) (DEC, 2010). The current listing of Threatened and Priority Ecological Communities is specified in DPaW, 2016a and 2016b. Threatened Ecological Communities can also be listed under the *EPBC Act* (Department of the Environment and Energy (DotEE), 2016a; Department of Environment, Water, Heritage and the Arts (DEWHA, 1999)).

There are three categories of TEC under the *EPBC Act*: Critically Endangered (CE), Endangered (E) and Vulnerable (V) (DotEE, 2016b). These are defined in **Table 4**.

Table 4. Categories of Threatened Ecological Communities under the *EPBC Act* (DotEE, 2016b).

Category	Definition
Critically endangered	If, at that time, an ecological community is facing an extremely high risk of extinction in the wild in the immediate future (indicative timeframe being the next 10 years).
Endangered	If, at that time, an ecological community is not critically endangered but is facing a very high risk of extinction in the wild in the near future (indicative timeframe being the next 20 years).
Vulnerable	If, at that time, an ecological, community is not critically endangered or endangered but is facing a high risk of extinction in the wild in the medium–term future (indicative timeframe being the next 50 years).

A Protected Matters Search Tool query for communities listed under the *EPBC Act* occurring within a 5 km radius of the Survey Area was undertaken (DotEE, 2015c, **Appendix 1**), and the current DPaW TEC and PEC listings were consulted (DPaW 2016a; 2016b).

Threatened or priority ecological communities known to occur or possibly occurring within 5 km of the Survey Area are listed in **Table 5**.

Table 5. Threatened and Priority Ecological Communities known to occur within 5 km of the Project Area (Gibson, *et al.* 1994; DPaW 2016d; DotEE, 2016c).

Community Name	Community Description	Status (WA)	Status (*EPBC Act*)
Shrublands on southern Swan Coastal Plain Ironstones (Busselton area) SCP10b	Rapidly drying clay flats, occurring on small areas of ironstone with thin skeletal soils in the Busselton area.	CR	EN
Banksia Woodlands of the Swan Coastal Plain			EN
Southern wet shrublands, Swan Coastal Plain SCP02	Shrublands or open low woodlands restricted to small remnants of Busselton. These occur on seasonally inundated sandy clay soils.	EN	
Corymbia calophylla woodlands on heavy soils of the southern Swan Coastal Plain SCP1b	Consists largely of *Eucalyptus* (*Corymbia*) *calophylla* forests and woodlands of bushland remnants on the plain south of Capel.	VU	
Corymbia haematoxylon - E. marginata woodlands on Whicher foothills ('community type 1a')	Community occurs along the northern edge of State Forest along the base of the Whicher Range and is composed of *Eucalyptus* (*Corymbia*) *haematoxylon – Corymbia calophylla - Eucalyptus marginata* forests and woodlands. Taxa virtually restricted to the type include *Acacia varia* subsp. *varia*, *Agonis grandiflora* and *Xanthosia pusilla*.	P3	
Central Whicher Scarp Mountain Marri woodland (Whicher Scarp woodlands of grey/white sands community A1)	Located on Whicher Scarp mid slopes. The taxa that identify the group include: *Ricinocarpos cyanescens*, *Hibbertia ferruginea*, *Platysace filiformis*, *Conospermum capitatum* subsp. *glabratum*, *Thysanotus arbuscula*, *Schoenus brevisetis*, *Phlebocarya filifolia*, *Leucopogon glabellus*, *Pimelea rosea* subsp. *rosea*, *Adenanthos obovatus*, *Stylidium carnosum* and *Gompholobium capitatum*.	P1*[1]	
Central Whicher Scarp Jarrah woodland (Whicher	Occurs on coloured sands on moderate to gentle slopes of the Central Whicher Scarp. The community has strong representation of a less common group of	P1*	

[1]* indicates Whicher Scarp Floristic Community Types (Keighery *et al.*, 2008)

Community Name	Community Description	Status (WA)	Status (*EPBC Act*)
Scarp woodlands of coloured sands and laterites community C1)	southern taxa including: *Podocarpus drouynianus, Loxocarya cinerea, Allocasuarina fraseriana, Drosera stolonifera, Amperea ericoides, Thysanotus triandrus, Cyathochaeta equitans, Hibbertia quadricolor, Comesperma calymega, Lepidosperma pubisquameum, Conospermum paniculatum, Acacia preissiana* and *Hybanthus debilissimus.*		
Swan Coastal Plain Paluslope Wetlands	These wetlands are very wet all year round and are associated with areas of groundwater seepage from the sandy low hills at the base of the Whicher Scarp. At times these wetlands are contiguous with areas of Pinjarra Plain wetlands, and the wetlands of the two landforms merge. Combinations of the following species are typically found in the type: *Melaleuca preissiana, Taxandria linearifolia, Taxandria fragrans, Melaleuca incana,* and *Cyathochaeta teretifolia*. Other species include: *Eucalyptus patens, Homalospermum firmum, Gahnia decomposita, Callistachys lanceolata, Hakea linearis, Melanostachya ustulata, Evandra aristata, Beaufortia sparsa, Callistemon glaucus* and *Pultenaea pinifolia*.	P1*	

1.5.2 Threatened and Priority Flora

Species of flora and fauna are defined as having Declared Rare (Threatened) or Priority conservation status where their populations are restricted geographically or threatened by local processes. The Department of Environment Regulation recognises these threats of extinction and consequently applies regulations towards population and species protection.

Declared Rare (Threatened) Flora species are gazetted under Subsection 2 of Section 23F of the *Wildlife Conservation Act 1950* (*WC Act*) and therefore it is an offence to 'take' or damage rare flora without Ministerial approval. Section 6 of the *WC Act* 1950 - 1980 defines 'to take' as "... to gather, pick, cut, pull up, destroy, dig up, remove or injure the flora or to cause or permit the same to be done by any means."

Priority Flora are under consideration for declaration as 'rare flora', but are in need of further survey (Priority One to Three) or require monitoring every 5-10 years (Priority Four).

Under the *WC Act*, Threatened Flora are ranked according to their level of threat using IUCN Red List categories and criteria of Extinct (EX), Critically Endangered (CE), Endangered (EN) or Vulnerable (VU). **Table 6** presents the categories of Declared Rare and Priority Flora as defined by the *WC Act* (DPaW 2015a).

Table 6. Definitions of Declared Rare and Priority List flora (DPaW, 2015a).

Conservation code	Category
T	Threatened flora is flora that has been declared to be 'likely to become extinct or is rare, or otherwise in need of special protection', pursuant to section 23F(2) of the *Wildlife Conservation Act 1950*. The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria (CR, EN, VU, EX). A species that is listed as Threatened and assessed as 'Critically Endangered' would therefore have its status written as T (CR).
P1	Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
P2	Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
P3	Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora', but are in need of further survey.
P4	Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

Under the *EPBC Act,* a species may be listed in one of six categories; the definitions of these categories are summarised in **Table 7** (DotEE, 2016d).

Table 7. Categories of Threatened Species under the *EPBC Act* (DotEE, 2016d).

Category	Definition
Extinct (Ex)	A native species is eligible to be included in the ***extinct*** category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild (ExW)	A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered (CE)	A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered (EN)	A native species is eligible to be included in the endangered category at a particular time if, at that time (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable (VU)	A native species is eligible to be included in the vulnerable category at a particular time if, at that time (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
Conservation Dependent (CD)	A native species is eligible to be included in the conservation dependent category at a particular time if, at that time, the species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

Threatened or Priority flora occurring within 5 km of the Survey Area generated from a DPaW NatureMap search (DPaW, 2016c) and the Protected Matters Search Tool report (DotEE, 2016c) are listed in **Table 8**.

Table 8. List of Declared Rare and Priority List flora known to occur within 5 km of the Survey Area (DPaW, 2016c & 2016d; DotEE, 2016c).

Species	Cons Status*	Flowering	Habitat	Likelihood of Occurrence
Brachyscias verecundus	T (CE)		Annual (or ephemeral), herb, 0.012-0.022 m high, entirely glabrous. Fl. white/cream. In a moss sward. On a granite outcrop.	High
Caladenia procera	T (CE)	Sep-Oct	Tuberous, perennial, herb, 0.35-0.9 m high. Fl. yellow. Rich clay loam. Alluvial loamy flats, jarrah/marri/peppermint woodland, dense heath, sedges.	Moderate
Grevillea brachystylis subsp. *grandis*	T (CE)	Aug-Sep	Shrubs, 0.3–1 m high. Branchlets not glaucous. Leaves simple, 70–110 mm long overall. Flowers red, very irregular. Habitat amongst medium trees, or tall (sclerophyll) scrubland; in sand, or loam.	Moderate
Banksia nivea subsp. *uliginosa*	T (EN)	Aug-Sep	Dense, erect, non-lignotuberous shrub, 0.2–1.5 m high. Fl. yellow, brown. Sandy clay, gravel.	Very High
Caladenia hoffmanii	T (EN)	Aug-Oct	Tuberous, perennial, herb, 0.13-0.3 m high. Fl. green & yellow & red. Clay, loam, laterite, granite. Rocky outcrops and hillsides, ridges, swamps and gullies.	Moderate
Caladenia huegelii	T (EN)	Sep-Oct	Tuberous, perennial, herb, 0.25-0.6 m high. Fl. green, cream, red. Grey or brown sand, clay loam.	Moderate
Caladenia winfieldii	T (EN)	Oct-Nov	Tuberous, perennial, herb, 0.3-0.6 m high. Fl. pink. Grey-black sand, sandy loam. Winter-wet depressions, swamps.	Moderate
Darwinia whicherensis	T (EN)	Oct-Nov	Erect low shrub to 30 cm, flowers green, outer red. Winter-wet area of scrubland over shallow red clay over ironstone.	Moderate
Drakaea elastica	T (EN)	Oct-Nov	Tuberous, perennial, herb, 0.12-0.3 m high. Fl. red, green, yellow. White or grey sand. Low-lying situations adjoining winter-wet swamps.	Moderate
Eucalyptus phylacis	T (EN)	May	Mallee or tree, to 5 m high, bark rough & flaky on trunk. Fl. Cream. Laterite, loam over granite. Coastal areas.	None

Species	Cons Status*	Flowering	Habitat	Likelihood of Occurrence
Gastrolobium papilio	T (EN)	Oct-Dec	Tangled, clumped shrub, to 1.5 m high. Fl. cream-red. Sandy clay over ironstone and laterite. Flat plains.	Moderate
Lambertia echinata subsp. *occidentalis*	T (EN)	Feb/May-Jun/Oct	Prickly, much-branched, non-lignotuberous shrub, to 3 m high. Fl. yellow. White sandy soils over laterite, orange/brown-red clay over ironstone.	Moderate
Petrophile latericola	T (EN)	Nov	Multi-stemmed shrub, 0.4-1.5 m high. Fl. yellow. Red lateritic clay. Winter-wet flats.	High
Sphenotoma drummondii	T (EN)	Sep-Dec	Tufted shrub, 0.15-0.5 m high. Fl. white. Stony or shallow soils over granite or quartzite. Steep rocky slopes, crevices of rocks.	Moderate
Banksia squarrosa subsp. *argillacea*	T (VU)	Jun-Nov	Erect, open, non-lignotuberous shrub, 1.2–4 m high. Fl. yellow, Jun–Nov. White/grey sand, gravelly clay or loam. Winter-wet flats, clay flats.	Very High
Chamelaucium sp. S coastal plain (R.D.Royce 4872)	T (VU)	Oct-Dec	Winter-wet areas, loams and ironstone.	Moderate
Daviesia elongata subsp. *elongata*	T(VU)	Dec-Feb	Spreading shrub, 0.4–1 m high. Fl. yellow, orange, red. Sandy soils.	Moderate
Diuris micrantha	T (VU)	Sep-Oct	Tuberous, perennial, herb, 0.3–0.6 m high. Fl. yellow, brown. Brown loamy clay. Winter-wet swamps, in shallow water.	Moderate
Drakaea micrantha	T (VU)	Sep-Oct	Tuberous, perennial, herb, 0.15–0.3 m high. Fl. red, yellow. White-grey sand.	Moderate
Gastrolobium modestum	T (VU)	Sep-Nov	Prostrate to clumped shrub, to 0.5 m high. Fl. cream-green-pink. Shallow red clay-loam or grey sand, ironstone. Gullies and edges of flats.	Moderate
Tetraria australiensis	T (VU)	Nov-Dec	Rhizomatous, tufted perennial, grass-like or herb (sedge), to 1 m high. Fl. brown.	Moderate
Andersonia ferricola	P1	Oct	Shrub, 0.2-0.5 m high. Fl. purple. White sand or red-brown loam over ironstone. Seasonally wet flats.	Moderate
Loxocarya striata subsp. *implexa*	P1	Jul-Dec	Winter-wet flats.	Moderate

Species	Cons Status*	Flowering	Habitat	Likelihood of Occurrence
Stylidium ferricola	P1		Caespitose perennial, herb, 0.09-0.15 m high. Shallow red-brown clay loam over ironstone. Seasonally wet poorly-drained slopes.	Moderate
Leucopogon sp. Busselton (D. Cooper 243)	P2	Aug-Sep	Slender, erect shrub to 70 cm; flowers white. *Pericalymma ellipticum* wet scrubland, Marri-Jarrah woodland.	Moderate
Boronia tetragona	P3	Oct-Dec	Perennial, herb, 0.3–0.7 m high, leaves sessile, entire, with papillate margins, branches quadrangular, sepals ciliate. Fl. pink, red. Black/white sand, laterite, brown sandy loam. Winter-wet flats, swamps, open woodland.	Moderate
Grevillea brachystylis subsp. *brachystylis*	P3	Aug-Nov	Much-branched, prostrate or decumbent, non-lignotuberous shrub, 0.2-0.5 m high, to 3 m wide. Fl. red. Black sand, sandy clay. Swampy situations.	Moderate
Hakea oldfieldii	P3	Aug-Oct	Open, straggling shrub, up to 2.5 m high. Fl. white, cream, yellow. Red clay or sand over laterite. Seasonally wet flats.	High
Isopogon formosus subsp. *dasylepis*	P3	Jun-Dec	Low, bushy or slender, upright, non-lignotuberous shrub, 0.2–2 m high. Fl. pink, purple, red. Sand, sandy clay, gravelly sandy soils over laterite. Often swampy areas.	Moderate
Lasiopetalum laxiflorum	P3	Sep-Oct	Jarrah forest, lateritic soils.	Low
Loxocarya magna	P3	Sep-Nov	Rhizomatous, perennial, herb (sedge-like), 0.5-1.5 m high. Sand, loam, clay, ironstone. Seasonally inundated or damp habitats.	Very High
Pithocarpa corymbulosa	P3	Jan-Apr	Erect to scrambling perennial, herb, 0.5-1 m high. Fl. white. Gravelly or sandy loam. Amongst granite outcrops.	Moderate
Pultenaea pinifolia	P3	Oct-Nov	Erect, slender shrub, 1-3 m high. Fl. yellow, orange. Loam or clay. Floodplains, swampy areas.	Moderate
Schoenus benthamii	P3	Oct-Nov	Tufted perennial, grass-like or herb (sedge), 0.15-0.45 m high. Fl. brown. White, grey sand, sandy clay. Winter-wet flats, swamps.	Moderate
Synaphea petiolaris subsp. *simplex*	P3	Sep-Oct	Tufted shrub, 0.1–0.6 m high. Fl. yellow. Sandy soils. Flats, winter-wet areas.	Moderate

Species	Cons Status*	Flowering	Habitat	Likelihood of Occurrence
Calothamnus quadrifidus subsp. *teretifolius*	P4	Nov-Dec	Erect, compact, perennial shrub 1.7 m high x 1 m wide. Fl. Red. Seeds held. Fruit exposed.	High
Chamelaucium sp. Yoongarillup (G.J. Keighery 3635)	P4	Jul-Oct	Non-lignotuberous shrub, to 2.5 m high. Fl. cream, yellow. Jarrah-marri forest. Loams, sandy clays. Riverbanks, lower slopes, below laterite breakaways.	Moderate
Lambertia rariflora subsp. *rariflora*	P4	Feb-May	Small tree or shrub, to 7 m high. Fl. green, yellow. Red-brown clay soils, black organic loam, laterite. Near intermittent streams.	Moderate
Thysanotus glaucus	P4	Oct-Mar	Caespitose, glaucose perennial, herb, 0.1–0.2 m high. Fl. purple. White, grey or yellow sand, sandy gravel.	Moderate

Based on an assessment of their preferred habitats some of the species listed in **Table 8** could potentially occur within the Survey Area, based on an assessment of their preferred habitats. All species listed would have either been flowering at the time of survey or could be identified in the field without flowers.

1.6 Regional Ecological Linkages

Information for this section is taken from Molloy *et al.* (2009) and their report on the South West Regional Ecological Linkages (SWREL) Project.

Ecological linkages are defined as:

> *A series of (both contiguous and non-contiguous) patches which, by virtue of their proximity to each other, act as stepping stones of habitat which facilitate the maintenance of ecological processes and the movement of organisms within, and across, a landscape.*

Regional ecological linkages link protected patches of regional significance by retaining the best (condition) patches available as stepping stones for flora and fauna between regionally significant areas. This increases the long-term viability of all the constituent areas.

The SWREL report is the result of collaboration between the Western Australian Local Government Association's *South West Biodiversity Project* and the then Department of Environment and Conservation's *Swan Bioplan* to provide a tool for the identification of ecological linkages and guidance for the protection of linkages through planning policy documents.

Molloy *et al.* (2009) assessed and assigned 'proximity value ratings' to all patches of remnant native vegetation as a way of indicating their distance from the nearest regional ecological linkage axis line. These values are defined in **Figure 5.** Vegetation of the Survey Area is mapped as having a proximity value of 1b, which is the second highest category. It should be noted however, that the proximity value of a patch of remnant vegetation to an ecological linkage is not intended to replace the need to consider the other biodiversity conservation values of that patch of remnant vegetation.

Molloy *et al.* (2009) identify a regional ecological linkage axis line running approximately 460 m to the east of the Survey Area, associated with the Vasee River, and 1120 m to the west of the Survey Area, through the Treeton State Forest and adjacent vegetated private property (**Figure 6**).

While there is no statutory basis for regional ecological linkages identified through the SWREL project, the importance of ecological linkages have been recognised as an environmental policy consideration in EPA and Planning policy over the last decade (EPA, 2009 and references therein). In its statement regarding the SWREL Project, the EPA stated that even though Ecological Linkages are just one measure of the conservation values of a patch of remnant vegetation it expected that:

In preparing plans and proposals for development, consideration will be given to both the site-specific biodiversity conservation values of patches of native vegetation, as well as the landscape function and core linkage significance of a patch in supporting the maintenance of ecological linkage (EPA, 2009).

Figure 5. Linkage proximity rating values assigned to patches of remnant vegetation within a landscape (from Molloy et al., 2009).

1a: with an edge touching or <100m from a linkage
1b: with an edge touching or <100m from a natural area selected in 1a
1c: with an edge touching or <100m from a natural area selected in 1b
2a: with an edge touching or <500m from a linkage
2b: with an edge touching or <500m from a natural area selected in 2a
2c: with an edge touching or <500m from a natural area selected in 2b
3a: with an edge touching or <1000m from a linkage
3b: with an edge touching or <1000m from a natural area selected in 3a
3c: with an edge touching or <1000m from a natural area selected in 3b

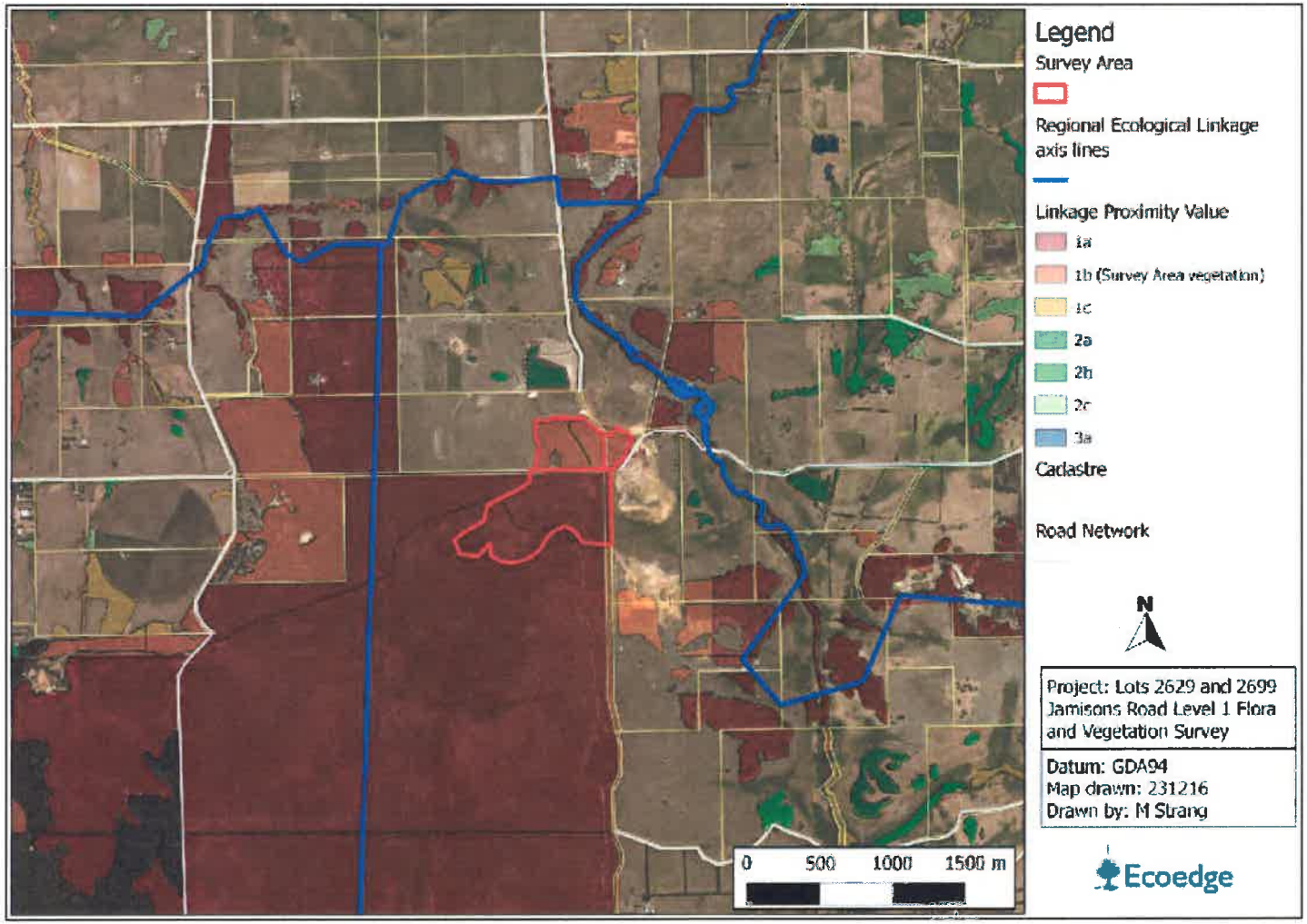

Figure 6. The Survey Area in relation to regional ecological linkages (Molloy et al., 2009).

1.7 Environmentally Sensitive Areas

Environmentally sensitive areas (ESAs) are declared by the Minister for Environment under section 51B of the *Environmental Protection Act 1986* (*EP Act*). ESAs are protected under the Environmental Protection (Clearing of Native Vegetation) Regulations 2004 and are selected for their environmental values at state or national levels (Government of Western Australia, 2005). They include;

- Defined wetlands and riparian vegetation within 50 m;
- Areas covered by Threatened Ecological Communities;
- Area of vegetation within 50 m of Declared Rare Flora;
- Bush Forever sites; and
- Declared World Heritage property sites.

According to the 2014 EPA database (EPA, 2014), the Survey Area forms part of an ESA (**Figure 7**), most likely associated with the known populations of the Threatened species *Banksia nivea* subsp. *uliginosa* and *Banksia squarrosa* subsp. *argillacea*, and the recognised occurrence of the TEC 'Shrublands on southern Swan Coastal Plain Ironstones'.

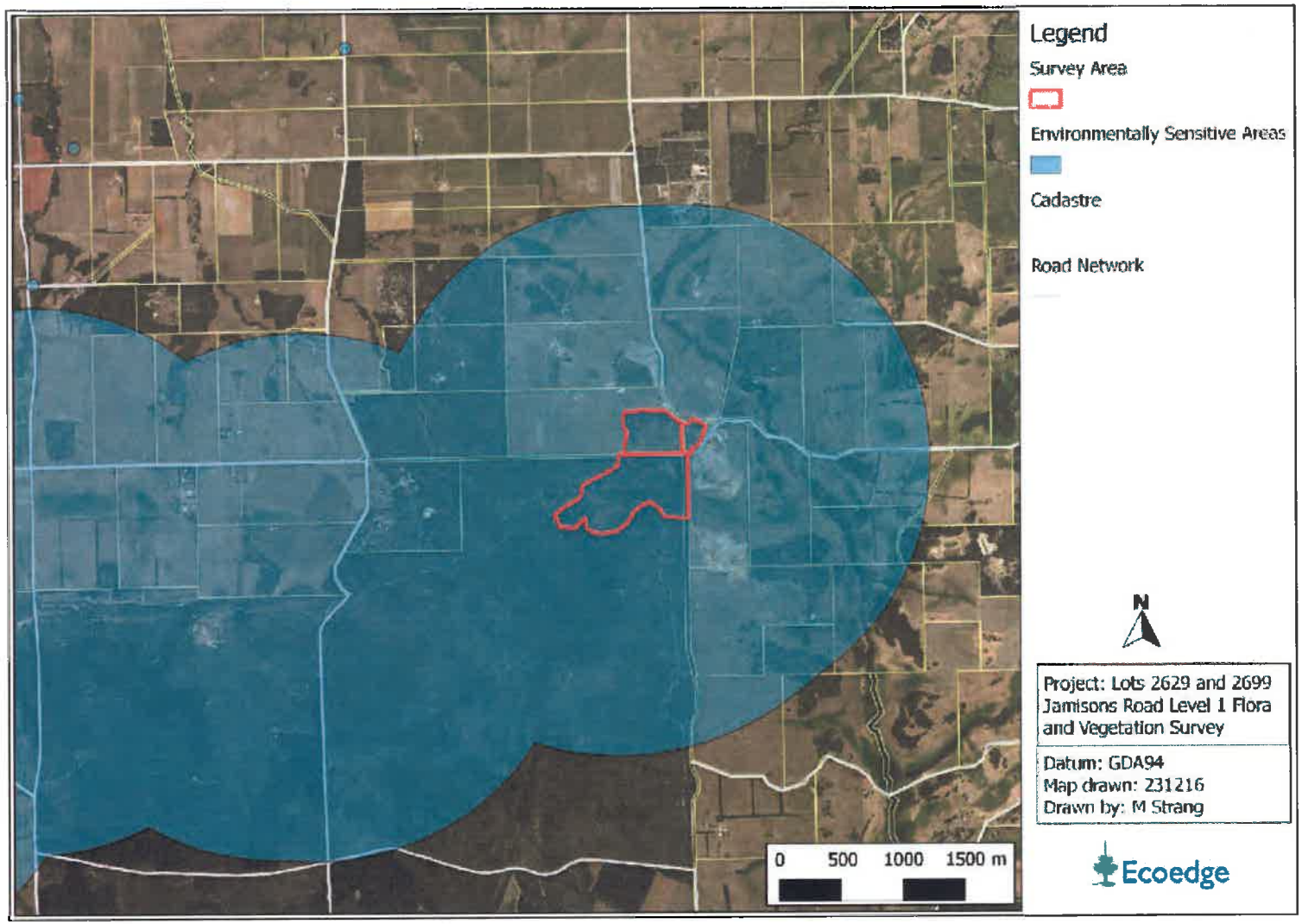

Figure 7. ESAs mapped around and near to the Survey Area.

2 Methods

2.1 Desktop survey

Prior to the field survey, a 'desktop survey' was carried out by downloading extracts from DPaW's and the Western Australian Museum's Rare and Priority flora databases (DPaW, 2016d, refer to **Section 1.5.2**), and from NatureMap (DPaW, 2016d) to produce a list of all flora (including rare flora) occurring within 5 km of the Survey Area. A Protected Matters Search Tool report was also generated, detailing all species listed under the *EPBC Act* known to occur, potentially occur or potentially have habitat occurring within 5 km of the Survey Area (DotEE, 2016c) (**Appendix 1**).

Vegetation condition was assessed using the categories of the EPA and DPaW (2015), which are defined in **Table 10**.

2.2 Field Survey

The field survey was carried out on 11 October 2016. One of the main tasks of the survey was to record the location and numbers of the DRF species *Banksia squarrosa* subsp. *argillacea* and *Banksia nivea* subsp. *uliginosa* – a combination of estimation based on capturing boundaries and estimating density, and also counting of individuals was employed.

Within the private property part of the Survey Area (lots 2629 and 2699 as well as the associated unmade road reserve), an estimate of the numbers of the two DRF taxa, *Banksia squarrosa* subsp. *argillacea* and B. *nivea* subsp. *uliginosa* was made by recording them on a GPS unit, either singly in the case of *B. nivea* subsp. *uliginosa*, or in groups of about seven for the much more numerous *B. squarrosa* subsp. *argillacea*. However, in the case of two particularly dense patches of *B. squarrosa* subsp. *argillacea,* the boundaries were captured and numbers estimated based on a count of individual within a 5 m x 15 m area.

The presence of other conservation significant species (Priority listed) was noted, although no attempt was made to estimate numbers. In addition, a list was made of non-conservation significant species, although because the survey was conducted in a single visit the list of taxa is not a full list of species for the private property.

Within the adjacent State forest, no attempt was made to count either of the DRF *Banksias* – instead the boundary of the ironstone vegetation where both were growing was logged on a GPS unit, or estimated from aerial photography where the vegetation was too thick to access. Then, based on a subsample method as described for the private property, an estimate of the number of individuals of both taxa was made.

Flora species that were not identified in the field were photographed for later identification. Taxonomy and conservation status of flora species was checked against DPaW databases (DPaW, 2016d and 2016e).

Notes were taken at 40 relevés within the private property of vegetation condition and dominant species. This, together with aerial photography, was used to map vegetation type and condition.

Table 9. Vegetation condition scale (EPA and DPaW, 2015).

Vegetation Condition	South West and Interzone Botanical Provinces
Pristine	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
Very Good	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees and shrubs.

2.3 Survey limitations

Potential limitations of the assessment are addressed in **Table 11**.

Table 10. Limitations of assessment adequacy and accuracy.

Aspect	Constraint	Comment
Scope	No	The survey scope was prepared in consultation with the client and was designed to comply with EPA requirements.
Accuracy of count	Minor	Within the time constraints of the survey.
Availability of contextual information	Minor	Comprehensive regional surveys of remnant vegetation have been carried out on the Swan Coastal Plain and Whicher Scarp.
Completeness of the survey	Negligible	Vegetation within the Survey Area was thoroughly searched on foot.
Skill and knowledge of the botanists	Negligible	The senior field botanist conducting the survey has had extensive experience in botanical survey in south west Australia over a period of 25 years.

3 Results

3.1 Flora

Sixty-three taxa of vascular flora were identified within the private property, of which eight were introduced species (**Appendix 2**). All of the introduced species were pasture species or common weeds of pasture and none are a declared Pest Plant under the under the *Biosecurity and Agriculture Management Act 2007* (Department of Agriculture and Food, 2007).

3.2 *Banksia squarrosa* subsp. *argillacea* and *B. nivea* subsp. *uliginosa*

Estimates of the numbers of *Banksia squarrosa* subsp. *argillacea* and B. *nivea* subsp. *uliginosa* on private property and State forest within the Survey Area are provided in **Table 11**. The accuracy of the estimate is greater for the private property than the State forest because the populations are more accessible. The extent of *Banksia squarrosa* subsp. *argillacea* within the Survey Area is shown in **Figure 8**, *B. nivea* subsp. *uliginosa* (together with other species of Priority flora) is shown in **Figure 9**.

Table 11. Estimates of the numbers of *Banksia squarrosa* subsp. *argillacea* and *B. nivea* subsp. *uliginosa* within the Survey Area.

Taxon	Private Property	State Forest
Banksia squarrosa subsp. *argillacea*	3,728 (+/- 200)	6,030 (+/= 500)
Banksia nivea subsp. *uliginosa*	22 (+/- 2)	1,000 (+/- 200)

Note: An estimate of the accuracy of the count is given in brackets.

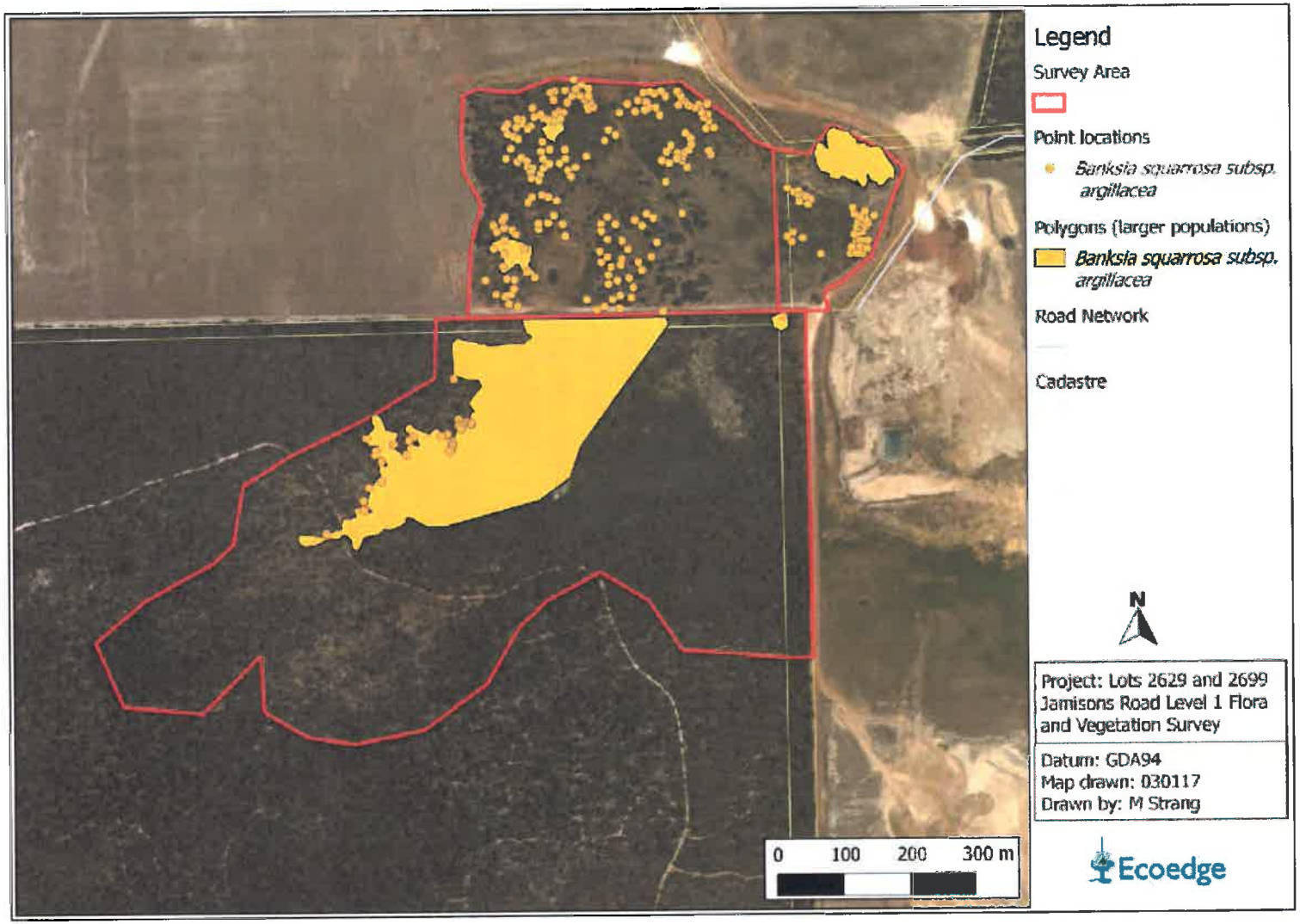

Figure 8. Location and extent of *Banksia squarrosa* subsp. *argillacea* within the Survey Area.

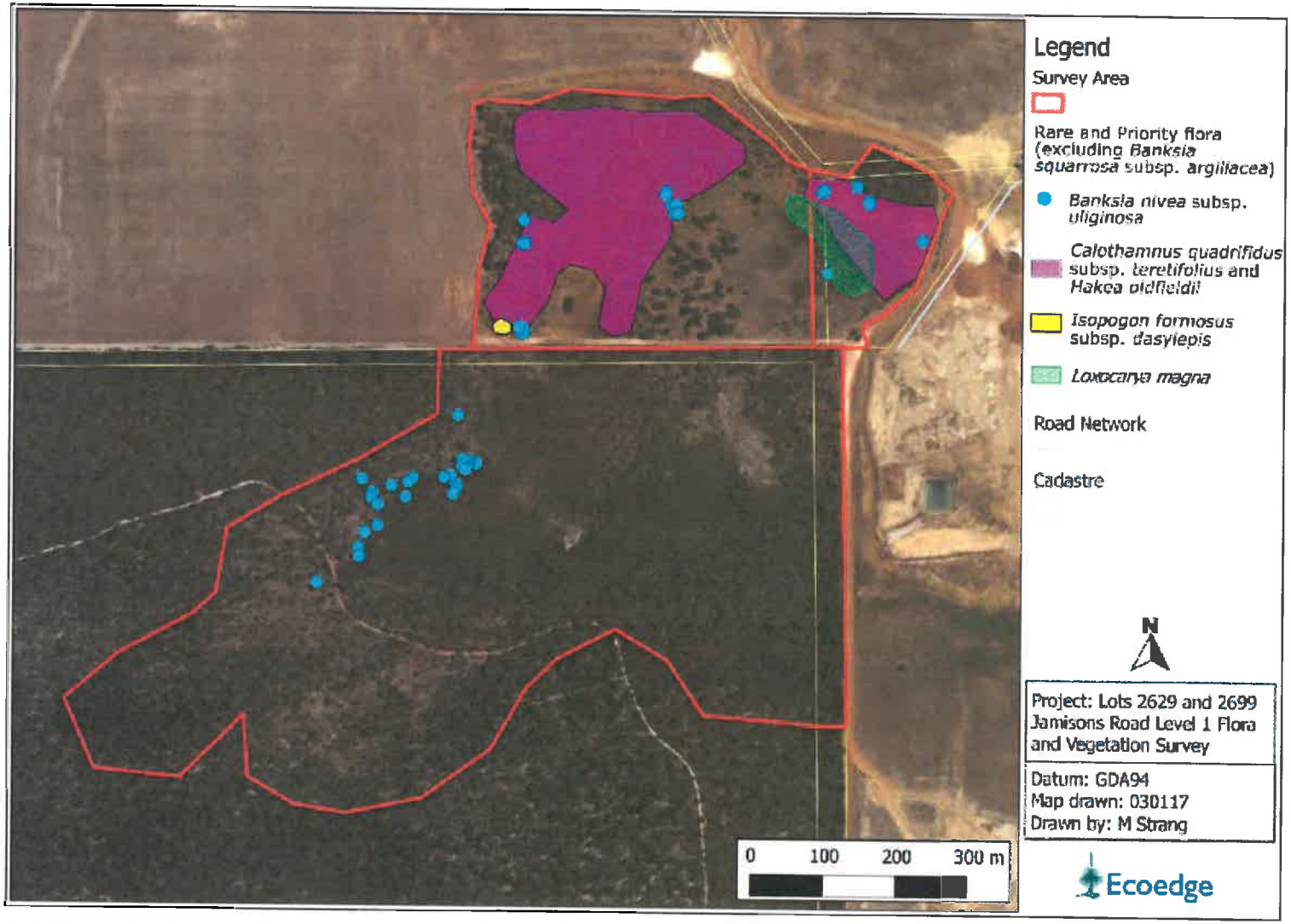

Figure 9. Location and extent of other rare and priority flora within the Survey Area.

3.3 Priority Flora

In addition to the two DRF *Banksias*, four Priority list species were identified within the private property, these being: *Hakea oldfieldii*, *Isopogon formosus* subsp. *dasylepis*, *Loxocarya magna* (all P3) and *Calothamnus quadrifidus* subsp. *teretifolius* (P4). Of the four, *H. oldfieldii*, *L. magna* and C. *quadrifidus* subsp. *teretifolius* were quite common within the shrubland on ironstone, while *I. formosus* subsp. *dasylepis* was restricted to the south-west corner of the private property (**Figure 9**).

3.4 Vegetation Types

3.4.1 Private Property (Lots 2629 and 2699)

Three vegetation units were recognised within the property, two of which are primarily comprised of shrubs, sedges and herbs, and one that is a woodland or open forest unit. Descriptions of each are given below, they are mapped in **Figure 10**, and photographs of the units are presented in **Appendix 3**.

> Unit A1. Tall shrubland of *Banksia squarrosa* subsp. *argillacea* with scattered emergent *Corymbia calophylla* low trees over open shrubland of *Hibbertia hypericoides*, *Pericalymma ellipticum* and open sedgeland of *Caustis dioica* and *Loxocarya magna* and low grassland of exotic species on ironstone.
>
> Unit A2. Tall open shrubland to open shrubland of *Hakea oldfieldii*, *Calothamnus quadrifidus* subsp. *teretifolius* and *Banksia squarrosa* subsp. *argillacea* with scattered emergent *Corymbia calophylla* low trees over scattered shrubs and sedges including *Caustis dioica* and *Loxocarya magna* and low grassland of exotic species on ironstone or shallow orange sand over ironstone.
>
> Unit B. Open forest or woodland of *Corymbia calophylla* over shrubland of Allocasuarina humilis, *Calothamnus quadrifidus* subsp. *teretifolius*, *Banksia squarrosa* subsp. *argillacea*, *Dillwynia laxiflora*, *Grevillea trifida*, *Hibbertia hypericoides*, *Melaleuca incana*, *M. viminea*, *Pericalymma ellipticum*, scattered sedges of *Caustis dioica* and *Loxocarya magna* (and in more open areas, pasture grasses on red-brown loam over ironstone.

Vegetation units A1 and A2 are similar, the main differences being the greater density of *B. squarrosa* subsp. *argillacea* in unit A1 (to the exclusion of many other species) and the more variable condition in unit A2, which ranges from scattered *Loxocarya magna* and *Calothamnus quadrifidus* subsp. *teretifolius* and native herbs and pasture species to tall shrubland in very good condition dominated by *Hakea oldfieldii*, *Calothamnus quadrifidus* subsp. *teretifolius* and *Banksia squarrosa* subsp. *argillacea*.

Vegetation unit B, which is dominated by Marri (*Corymbia calophylla*) trees is also quite variable in condition, ranging from very good to degraded (where understorey species are mainly pasture grasses).

3.4.2 State Forest

Vegetation type *per se* was not mapped in the State forest, however the boundary of the "Shrublands on southern Swan Coastal Plain Ironstones (Busselton area)" (Busselton Ironstone) TEC has been mapped (**Figure 11, Section 1.7**). The boundary delineation was mainly determined by the presence of species typical of this community, and the presence of sheet ironstone or shallow loam over ironstone. Approximately 16 ha of this threatened community was mapped in this survey within the State forest adjacent to Lots 2699 and 2629.

3.5 Vegetation Condition

Vegetation was quite variable within the private property (Lots 2629 and 2699) however, just over 60% was in Good or Very Good condition (**Table 12**, **Figure 12**). Degradation has been caused in the past through partial clearing and grazing, although some of the area previously subjected to physical disturbance (e.g. around the water-hole in the south west corner) has partially regenerated.

Table 12. Extent of vegetation within Lots 2629 and 2699 of the Survey Area in each condition class.

Condition	Area (ha)	%
Very Good	4.0	22.1
Good	6.9	38.2
Degraded	3.8	20.8
Completely Degraded	3.4	19.0
Total	**18.1**	**100.0**

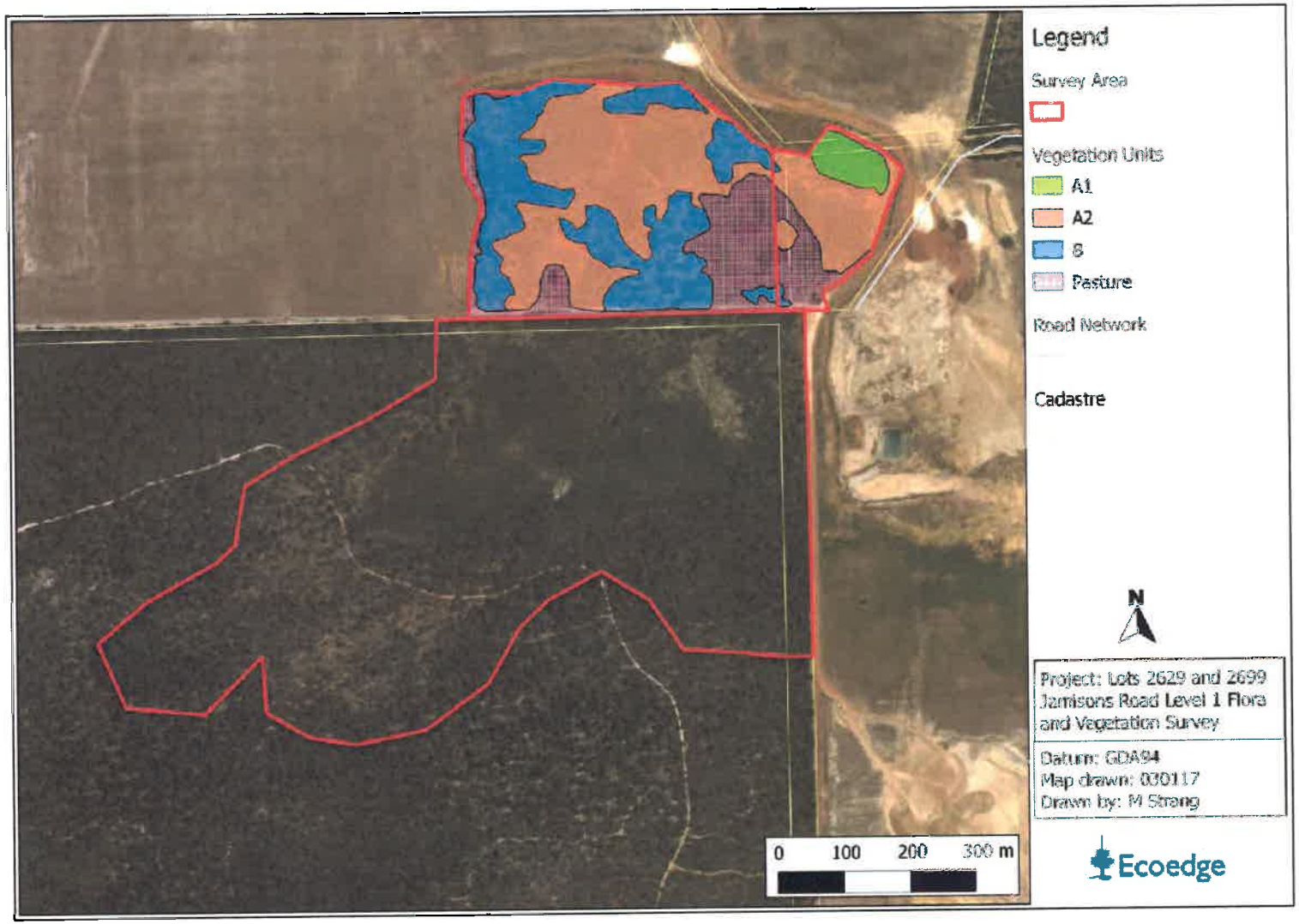

Figure 10. Vegetation units mapped within the private property portion of the Survey Area.

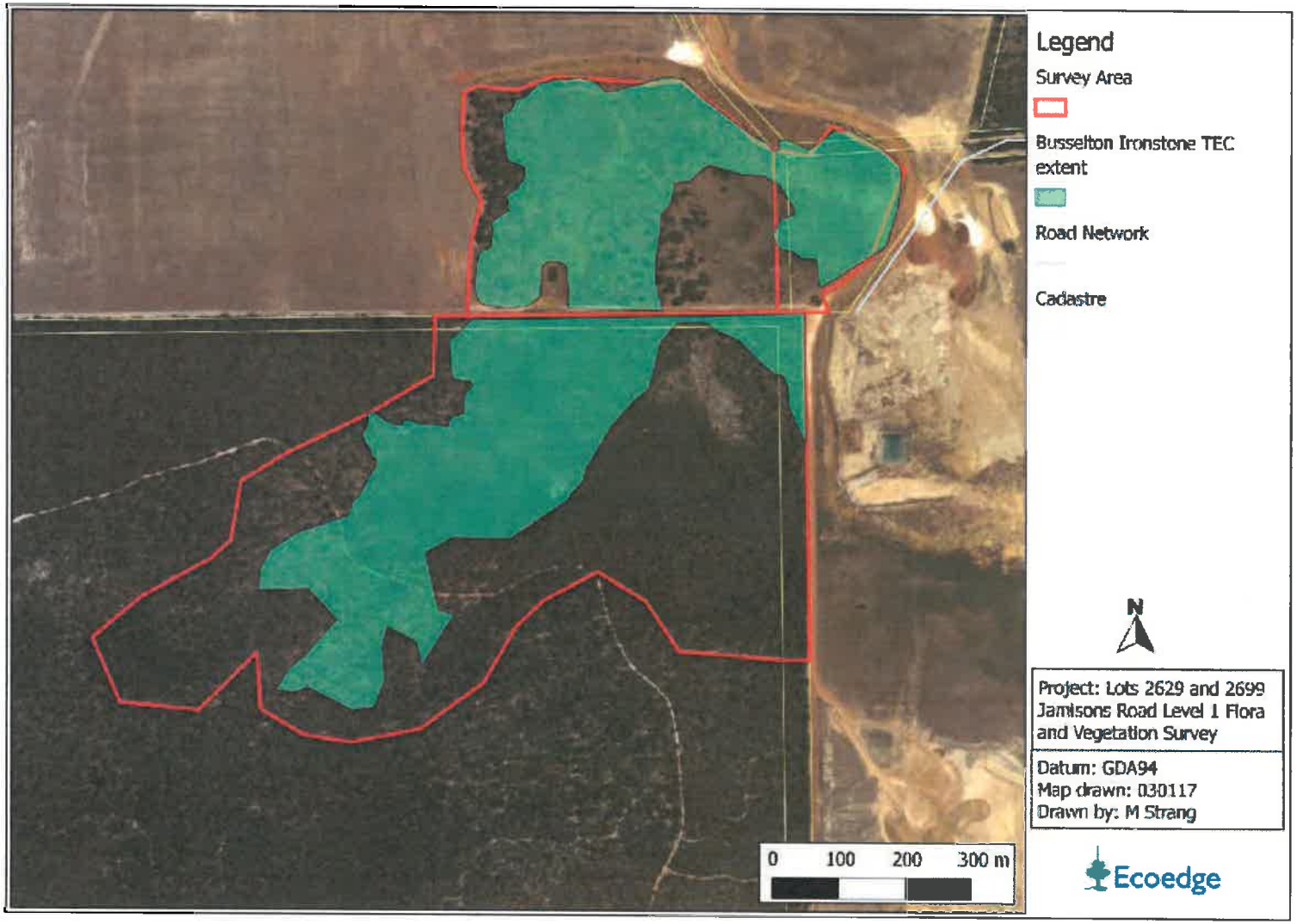

Figure 11. Extent of the "Shrublands on southern Swan Coastal Plain Ironstones (Busselton area)" (Busselton Ironstone) TEC within the Survey Area.

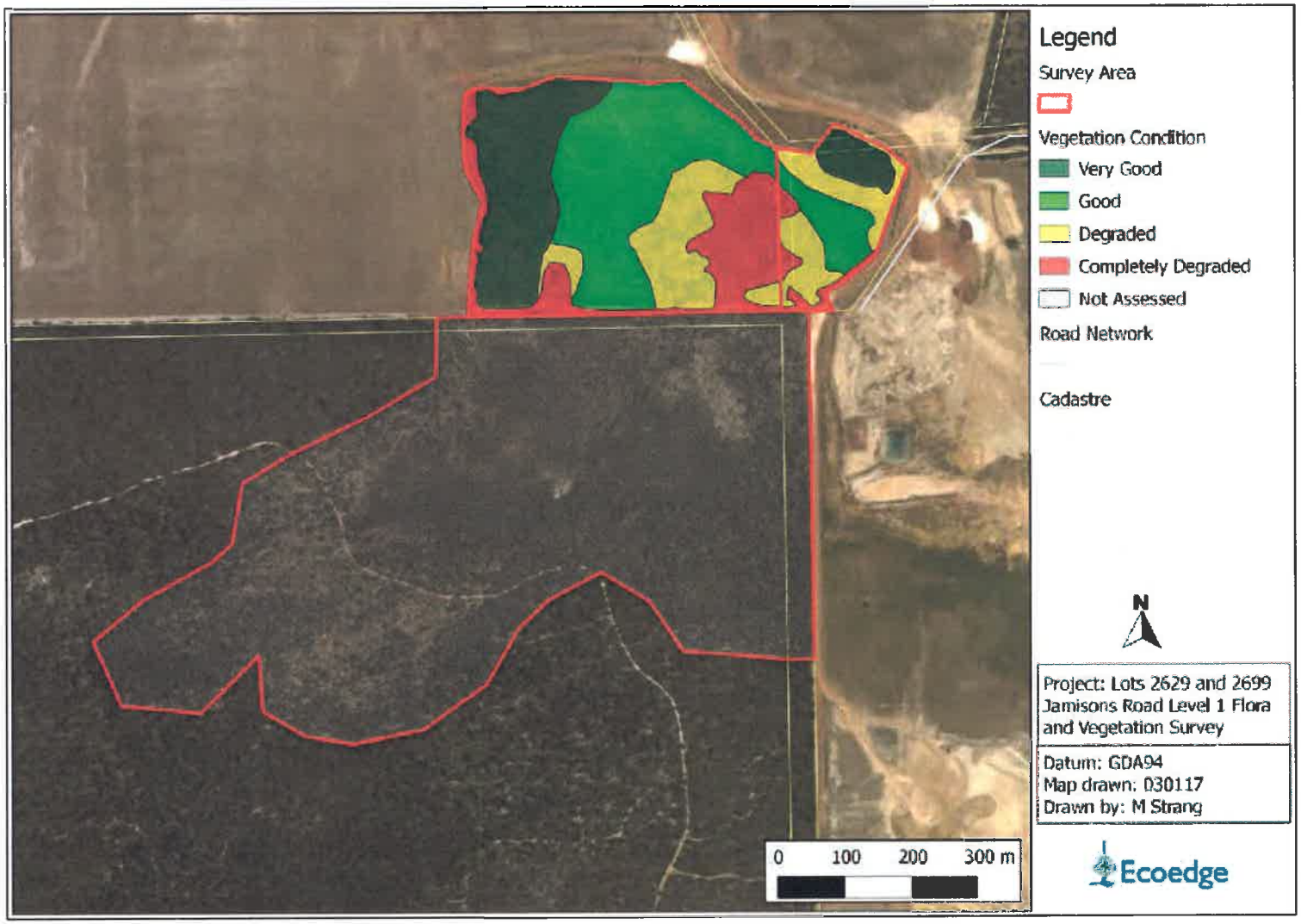

Figure 12. Condition of vegetation within the private property portion of the Survey Area.

4 Discussion and conclusions

4.1 Conservation Status of the Flora

Substantial populations of two threatened (DRF) taxa, *Banksia squarrosa* subsp. *argillacea* and *Banksia nivea* subsp. *uliginosa* occur within Lots 2699 and 2629. These species are protected under both State and Commonwealth legislation (**Table 6**, above). As can be seen from **Table 11** in **Section 3.3**, the sub-populations of these species on the private property (particularly in relation to *B. squarrosa* subsp. *argillacea*) form a substantial part of the total population of these species on both the private property and the adjacent State forest.

In addition, the Priority species *Hakea oldfieldii*, *Isopogon formosus* subsp. *dasylepis*, *Loxocarya magna* (all P3) and *Calothamnus quadrifidus* subsp. *teretifolius* (P4) all occur within the private property. *Hakea oldfieldii* and C. *quadrifidus* subsp. *teretifolius* are particularly numerous there. All of them are typical species of the Busselton Ironstone TEC.

4.2 Conservation Status of the Vegetation

Much of the remnant native vegetation on Lots 2699 and 2629 is consistent with it being an occurrence of the Critically Endangered TEC "Shrublands on southern Swan Coastal Plain Ironstones (Busselton area)" (SWAFCT10b). Vegetation unit A1 and portions of units A2 and B fit the description of this community (**Figure 10**). At total of 12.8 ha of vegetation consistent with belonging to this community occur on Lots 2699 and 2629 – this compares with approximately 16 ha in the adjacent State forest.

4.3 Regional ecological linkages

The Survey Area vegetation does not appear to have particular value with regard to regional ecological linkages.

4.4 Environmentally Sensitive Areas

As stated in **Section 1.7**, above, all the Survey Area forms part of an ESA, and therefore has particular requirements regarding potential clearing under *the Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (Clearing Regulations*).

5 Recommendations

It is recommended that because of its high conservation values, all of the vegetation in Lots 2699 and 2269 within the Survey Area is protected from further disturbance or damage through clearing or grazing.

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Appendix 1. Protected Matters Search Tool Report

Appendix 2. List of vascular flora found within Lots 2629 and 2699 of the Survey Area

Appendix 3. Photographs and Descriptions of Vegetation units mapped within Lots 2629 and 2699 of the Survey Area

Appendix 1. Protected Matters Search Tool Report