Reconnaissance and Targeted Flora and Vegetation Survey at pt. Reserve 34343, Collie

Prepared for the Shire of Collie
November 2018

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Executive Summary

Ecoedge was engaged by the Shire of Collie (the Shire) in September of 2018 to undertake a Reconnaissance and Targeted flora survey across approximately 70 hectares of remnant bushland in two separate reserves located at Mininnup Pools approximately 1 and 2.5 kilometers south of the Collie Town Site (the 'Survey Area').

In a recently issued Economic Development Task Force Report, tourism was identified as a key industry sector for Collie, and one of the suggested initiatives was the development of a nature-based hub at Minninup Pool, linking with the Munda Biddi Trail and the Bibbulmun Track and featuring accommodation and activity options.

The purpose of the survey was to delineate key flora and vegetation values and their potential sensitivity to impact that may result from the proposed development.

Both Reconnaissance and Targeted surveys were required as part of the scope, in accordance with the Environmental Protection Authority's 'Technical Guidance' (Environmental Protection Authority, 2016).

The survey was conducted on 29 September and 9 October, 2018 in accordance with State and Commonwealth requirements for the bioregion and species and communities present, and the Environmental Protection Authority's 'Technical Guidance'.

A total of 198 vascular flora taxa were identified within the 70.45 ha[1] of remnant vegetation within the Survey Area, of which 14 were introduced or non-native species.

No Declared Pest Plants (DAFWA, 2018) were found within the Survey Area, however several significant environmental weeds were seen. The most widespread of these was the bulbous herb **Watsonia meriana* var. *bulbifera*. The small tree **Acacia dealbata* was observed in two locations and **Babiana angustifolia* in one.

Two species of Priority flora, *Synaphea hians* (P3) and *Grevillea ripicola* (P4) and one significant range extension species (*Stylidium scandens*) were found within the Survey Area.

Seven vegetation units dominated by native vegetation were recognised within the Survey Area. They range in structure from open forest through low open woodland, to tall shrubland, to low sedgeland. None of them resembles a recognised Threatened or Priority Ecological Community.

The vegetation in the Survey Area is mapped as the Muja (MJ) complex, of which 59.5% of the original areal extent remains. This is well above the Commonwealth government's retention target of 30%.

[1] Adjusted boundary to include all shoreline of the Collie River, but excluding the river itself.

Two regional ecological linkages cross the Survey Area, one forming a north-south link, and the other located in the south associated with the Collie River.

No Environmentally Sensitive Areas have been mapped within the Survey Area according to the DER database (DER, 2016).

Most (90%) of the Survey Area vegetation was rated as being in 'Very Good' or 'Excellent' condition.

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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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1 Introduction

Ecoedge was engaged by the Shire of Collie (the Shire) in September of 2018 to undertake a Reconnaissance and Targeted flora and vegetation survey across approximately 70 hectares (ha) of remnant bushland in two separate reserves located in the Minninup Pools area approximately 1 and 2.5 kilometers (km) south of the Collie Town Site (**Figure 1**).

In a recently issued Economic Development Task Force Report, tourism was identified as a key industry sector for Collie, and one of the suggested initiatives was the development of a nature-based hub at Minninup Pool, linking with the Munda Biddi Trail and the Bibbulmun Track and featuring accommodation and activity options. To facilitate the investigation of the viability of this suggestion, the Shire requires information about the flora, vegetation and fauna values of the site, and their potential sensitivities to impacts that may result from the proposed development.

The field survey was undertaken in accordance with the Environmental Protection Authority's (EPAs) Technical guidance (EPA, 2016), and the project brief supplied by Main Roads. This report compiles findings of the field survey.

1.1 Scope and Objectives

The purpose of the survey was to determine the flora and vegetation values onsite and their potential sensitivity to impacts from the proposed development.

The scope of works was defined by the Shire as:

- Document and map ecological values of the site including quality and extent;
- A description of the vegetation complex of the site;
- A description of the geology and soil types of the site;
- Known environmentally sensitive areas;
- Survey for threatened & priority listed flora within and immediately adjacent to the proposed development area;
- Survey for threatened fauna or habitat within and immediately adjacent to the proposed development area;
- Identify potential impacts to these ecological values from the proposed development;
- Outline appropriate measures to avoid, mitigate or offset potential impacts; and
- An assessment of the compatibility of a nature hub that includes accommodation and day use activities, given the results of the above assessments.

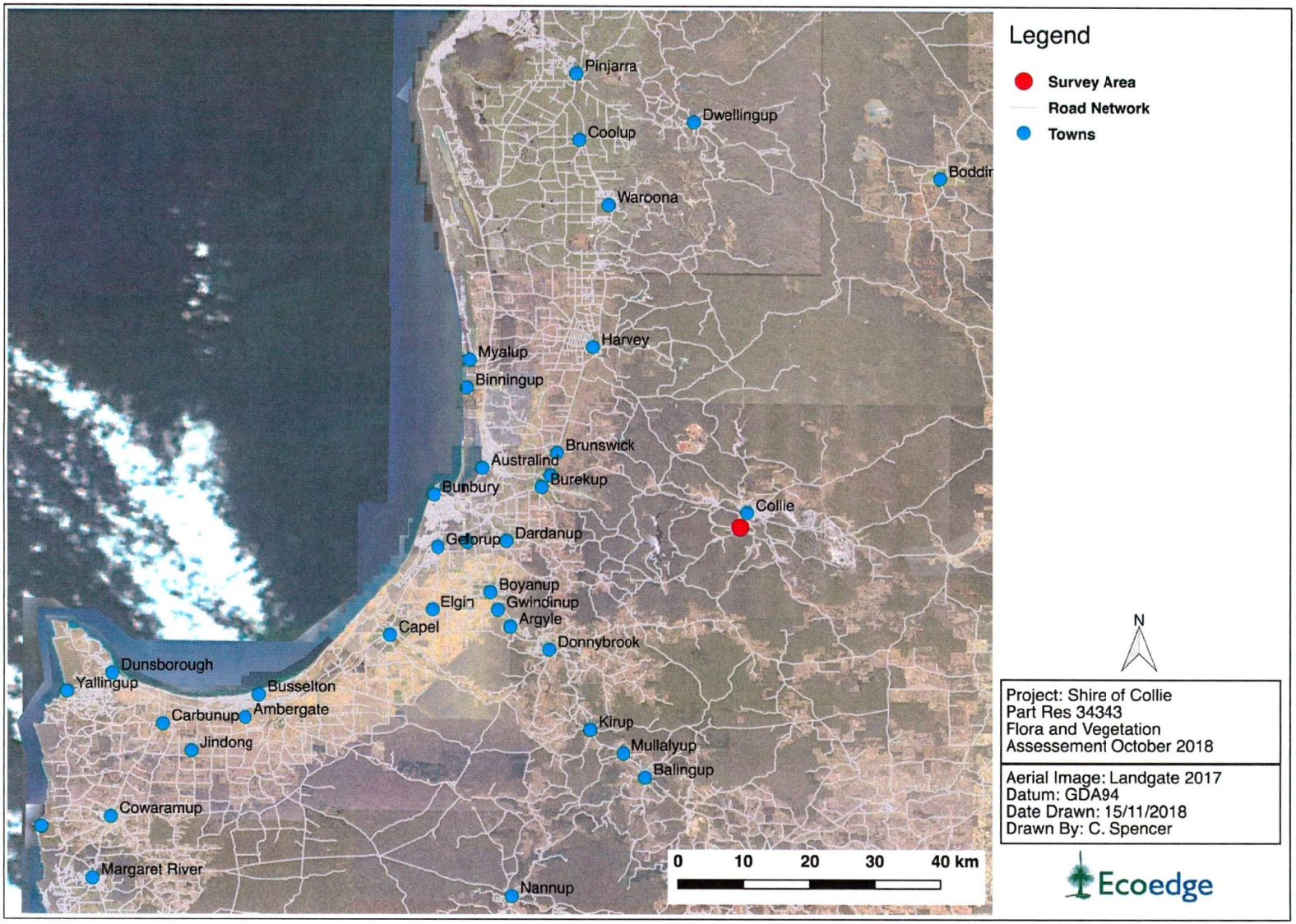

Figure 1. Map showing the Survey Area location.

To comply with the requested scope of works, the assessments included the following:

Desktop survey

- Identification of all vegetation and flora features and constraints in, and nearby the Survey Area, including presentation and review of data from the Department of the Environment and Energy's (DotEE's) Protected Matters Search Tool, the Department of Biodiversity, Conservation and Attractions' (DCBA's) NatureMap and FloraBase, and an extract from DBCA's Species & Communities Branch flora database; and
- Identification of significant flora, vegetation/ecological communities values and their potential sensitivity to impact.

Field survey

Implementation of a Reconnaissance and Targeted flora and vegetation assessment as per the requirements of EPA (2016). Specifically;

- verification / ground-truthing the desktop assessment findings through field surveys;
- vegetation community/type mapping;
- An assessment of the survey area's plant species diversity, composition, structure and weed cover;
- vegetation condition mapping using the EPA (2016) condition scale;
- a targeted survey for rare and priority flora based on desktop likelihood of occurrence and habitat availability. When populations are identified, survey and map extent of populations to determine number and habitat area for each population. Shapefiles shall be provided if required with point data indicating the number of plants identified at each point. If more than 100, the edges of the population boundary will be mapped. If the population extends outside the survey area, the survey will map the extent of the population. All Threatened flora will be mapped with a GPS; and
- identification of the location of any Weeds of National Significance or Declared Pests.

Report

A concise report detailing the methodology used in and findings of the biological survey, addressing the following:

- Environmental constraints via provision of environmental constraints maps using GIS mapping software (e.g. ArcMap) for flora, fauna, ecological communities, watercourse, wetlands, ESAs etc.;
- flora and vegetation biological aspects likely to require referral of the project to the EPA;
- Potential impacts on MNES as protected under the EPBC Act which are likely to require referral of the project to the Commonwealth DotEE.

- justification of decision as to whether a referral to DotEE is likely to be required in accordance with reference to relevant Commonwealth significant impact guidelines;

1.2 Biogeographic Region and Location

The Survey Area is situated within Southern Jarrah Forest JF02 sub-region of the Jarrah Forest biogeographic region, as defined in the Interim Biogeographical Regionalisation for Australia (IBRA) (Commonwealth of Australia, 2016). It comprises two remnant bushland areas situated approximately 1 and 2.5 km south of the Collie Town Site (**Figure 2**). The first and smaller reserve area is approximately 1 ha in size (excluding open water) and is located at the NE of the Collie Golf Course and on the west side of the Collie River East. It comprises mostly of cleared parkland with some remnant vegetation along the river bank. The second larger Survey Area, 'Minninup Pools', is approximately 69.4 ha in size and is located on the north bank of the Collie River East. It comprises mostly of native vegetation. Both survey areas are situated on Crown Land managed by the Shire.

1.3 Geology

Within the Southern Jarrah Forest biogeographical region, the Survey Area is situated on the Western Darling Range Zone (255) which is described as a moderately dissected lateritic plateau on granite with deeply incised valleys. It includes the Darling Scarp on the western margin. Soils are formed in laterite, lateritic colluvium and weathered in-situ granite and gneiss (Tille, 1996). Three soil landscape systems have been mapped for the Western Darling Range Zone; the Coalfields (255Cf), Darling Plateau (255Dp) and Lowden Valleys (255Lv) Systems, of which only the Coalfields system is represented within the Survey Area and described below:

Coalfields (255Cf) system: Gently undulating plain over coal basins, in the south of the Western Darling Range. Sandy gravel, deep sand and non-saline wet soils. The associated vegetation is Jarrah-marri-paperbark woodland, Tille (1996).

Based on the landscape position and characteristics, soil landscape systems have been separated into soil mapping units or phases, which are mapped at a finer scale than systems. Three soil mapping units were mapped for the Survey Area by Tille (1996); these are mapped in **Figure 3** and described in **Table 1**.

Table 1. Soil mapping units occurring within the Survey Area (Tille, 1996).

Soil Mapping Unit	Description
CfMU2	Duplex sandy gravels, Pale deep sands, Gravelly pale deep sands and Yellow deep sands.
CfMuf	Pale deep sands, Yellow deep sands, Duplex sandy gravels and Yellow sandy earths.
CfCF	Low lying poorly drained flats over coal measures. Soils are deep sands and wet soils.

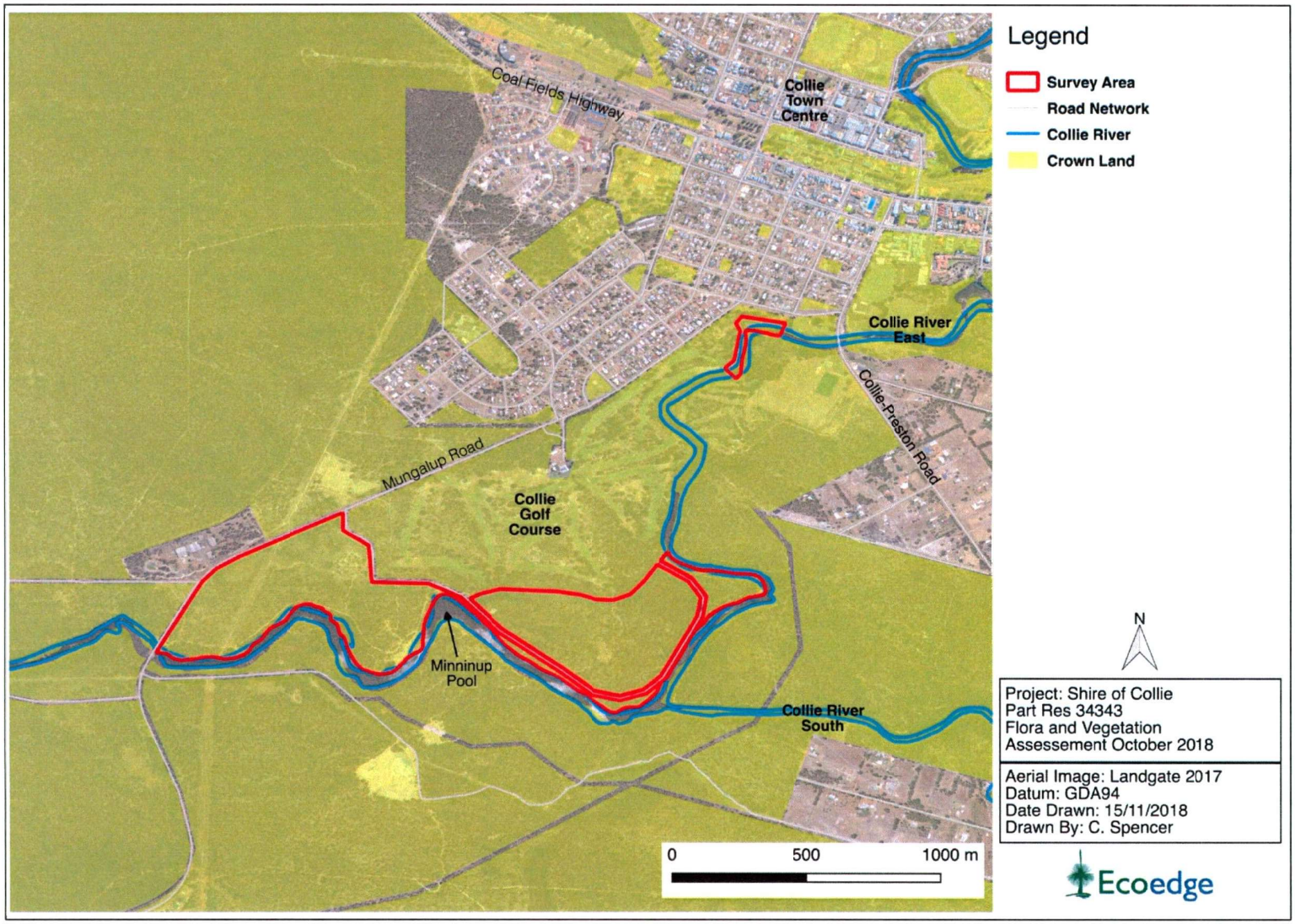

Figure 2. Survey Area showing surrounding land uses and geographical features.

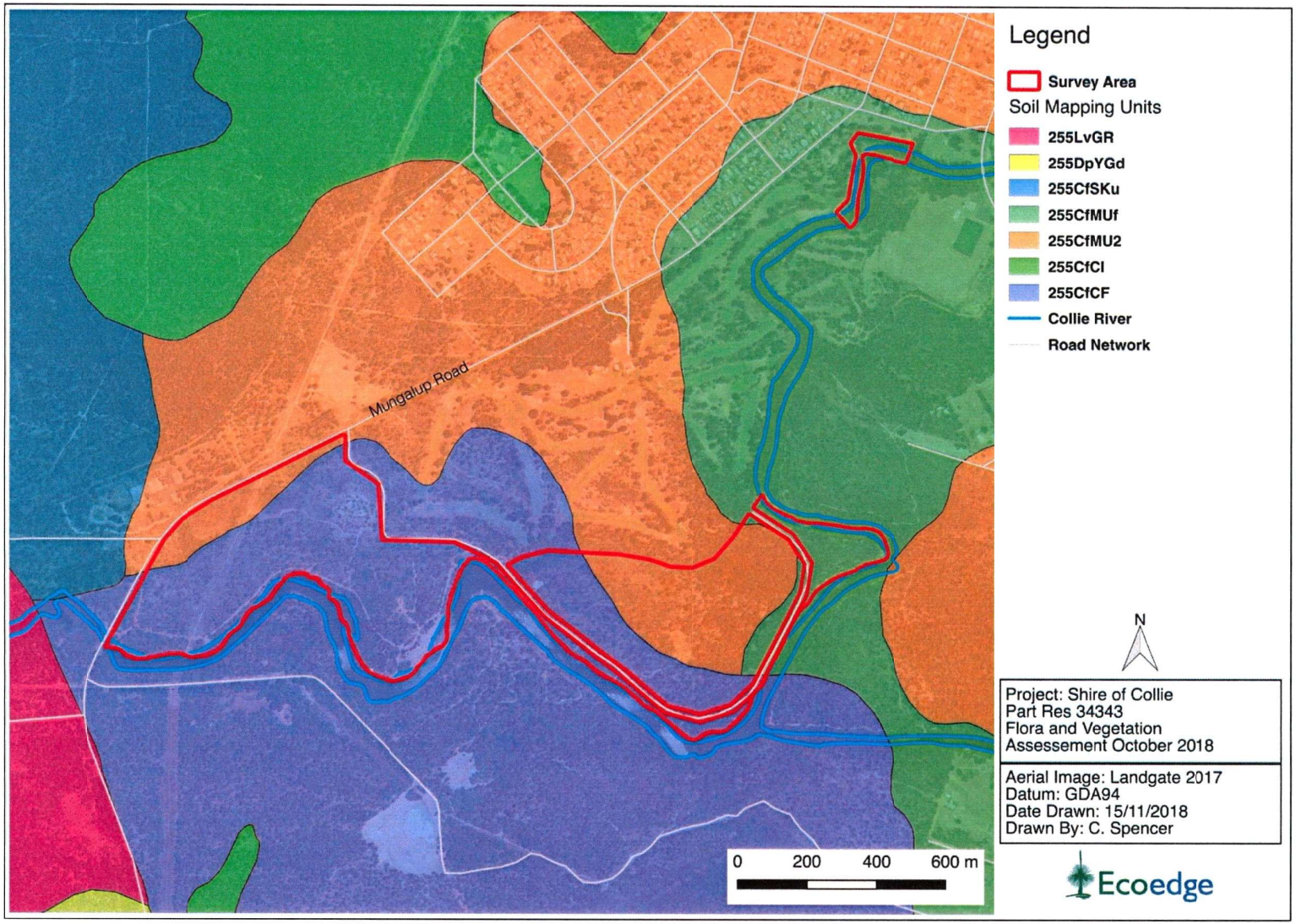

Figure 3. Soil mapping units mapped for the Survey Area Tille (1996).

1.4 Vegetation Description according to pre-European Mapping Datasets

The Survey Area covers approximately 71.2 ha and contains approximately 70.45 ha of remnant native vegetation.

1.4.1 Vegetation Complexes

In 2016, the then Department of Parks and Wildlife (DPaW) revised the datasets from the Darling Scarp and Plateau Regional Forest Agreement (RFA) mapping of Mattiske and Havel (1998) and the Swan Coastal Plain mapping of Heddle *et al.* (1980). The purpose of the revision was to fill data gaps and improve alignment and correlation between the two datasets (Webb, *et al.,* 2016).

According to the 1:50,000 Mapping of Vegetation Complexes in the South West Forest Region of Western Australia (Mattiske & Havel 1998) as updated by Webb *et al.* (2016), vegetation of the Survey Area was mapped as comprising the Muja (MJ) vegetation complex (**Figure 4**). The Muja complex is described as "Open woodland of *Melaleuca preissiana-Banksia littoralis-Banksia ilicifolia* with some *Eucalyptus patens* on moister sites, *Banksia* spp. on drier sites of valley floors in the subhumid zone".

1.4.2 Assessment of Remaining Extent against Pre-European Extent

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).

In its report on the Statewide Vegetation Statistics incorporating the CAR Reserve Analysis, the Government of Western Australia provides information on the pre-European and current extent of the ecological communities of Western Australia and reports on the status of the Comprehensive, Adequate and Representative (CAR) reserve system for WA (Government of Western Australia, 2017). This system is also based on the National retention targets of 30% overall. Only reserves managed by DBCA under the *Conservation and Land Management Act 1984* are considered for inclusion in the "CAR Reserve Analysis". **Table 2** lists the percentage remaining of Muja (MJ) vegetation complex and indicates that the Commonwealth 30% retention target is met.

Table 2. The Muja complex with regard to the Commonwealth retention target (Government of Western Australia, 2017).

Vegetation Complex	% Remaining of pre-European	Is the 30% Target Met?	% in DBCA Managed Lands*
Muja (MJ)	59.51	Yes	43.83

* Excludes Crown Freehold Department Interest Lands that are managed under Section 8(a) of the CALM Act.

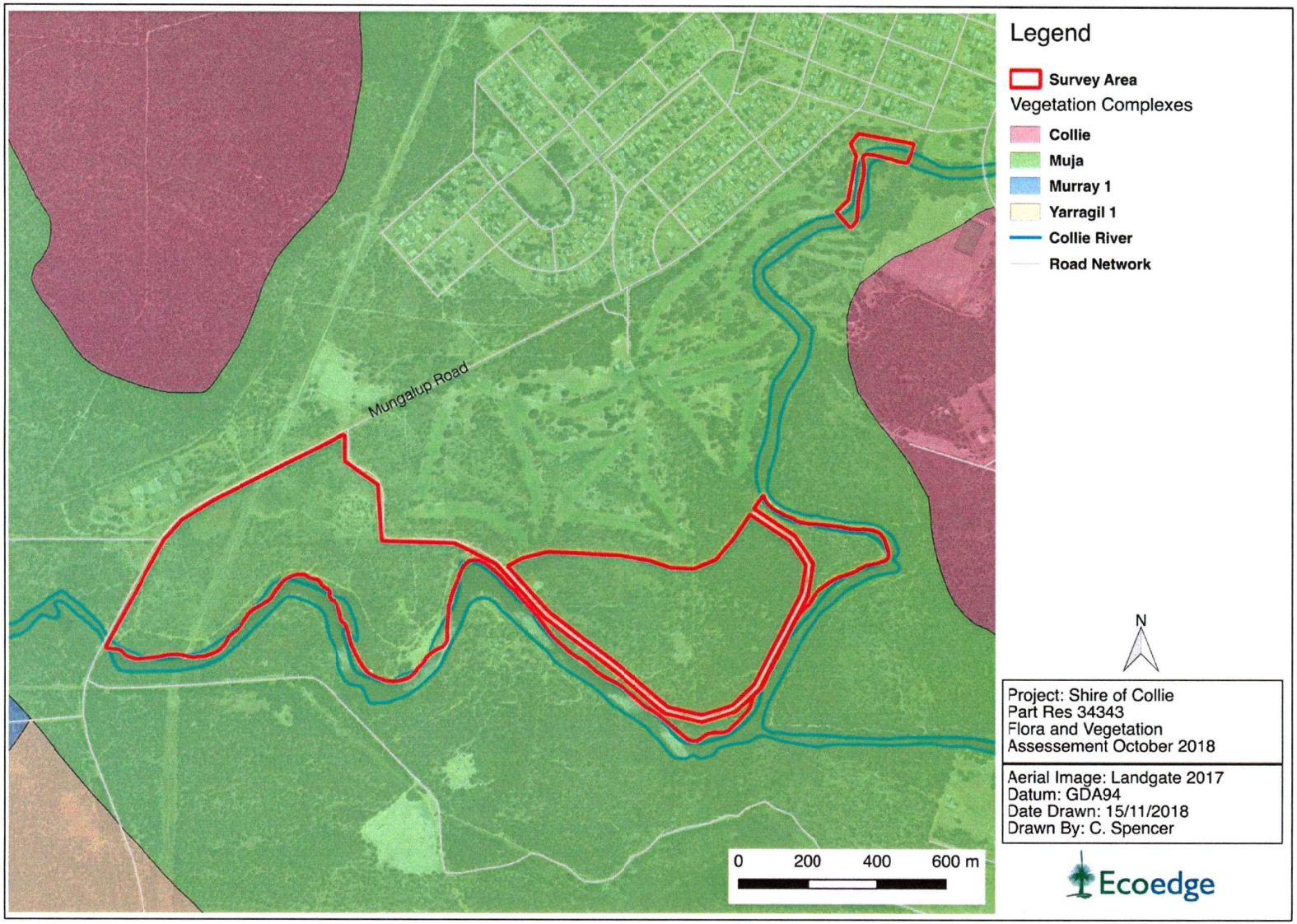

Figure 4. The Survey Area was mapped as comprising the Muja (MJ) complex (Webb *et al.*, 2016).

1.5 Threatened and Priority Ecological Communities

Ecological communities are defined by Western Australia's DBCA (previously DPaW and 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, 2013).

Through a non-statutory process, the Minister for Environment (Western Australia) may list communities that are considered to be at threat as either Threatened or Priority Ecological Communities. A Threatened Ecological Community (TEC) is one which is found to fit into one of the following categories; Presumed Totally Destroyed (PD), Critically Endangered (CE), Endangered (E) or Vulnerable (V) (DEC, 2013). Possible TECs that do not meet survey criteria are added to DBCA's Priority ecological community 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, 2013).

The current listing of TECs and PECs are specified in DPaW (2016) and DBCA (2017a).

TECs can also be listed under the Commonwealth EPBC Act (Department of the Environment and Energy (DotEE), 2017a; 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). These are defined in **Appendix 1** (DotEE, 2018a).

A Protected Matters Search report was generated to provide information regarding Matters of National Environmental Significance (MNES) known or potentially occurring within 10 km of the Survey Area (DotEE, 2018b **Appendix 2**), and the current DPaW and DBCA TEC and PEC listings were consulted (DPaW, 2016; DBCA, 2017a).

There are no Threatened or Priority Ecological Communities mapped within 10 km of the Survey Area.

1.6 Threatened and Priority Flora

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

Threatened Flora species are gazetted under Subsection 2 of Section 23F of the *Wildlife Conservation Act 1950* (WC Act)[2] and therefore it is an offence to "take" or damage rare flora without Ministerial approval. Section 6 of the WC Act 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 future declaration as "rare flora", dependent on more information. Species classified as Priority One to Three (referred to as P1, P2 and P3) are in need of further survey to determine their status, while Priority Four (P4) species require monitoring every 5-10 years. 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). **Appendix 3** presents the categories of Threatened and Priority Flora as defined by the WC Act (DPaW, 2017).

Under the EPBC Act, a species may be listed in one of six categories; the definitions of these categories are summarised in **Appendix 4** (DotEE, 2018c).

Threatened or Priority flora occurring within 10 km of the Survey Area generated from an extract from the DBCA databases (DBCA, 2018a and a NatureMap search (DBCA, 2018b) are listed in **Table 3.** Taxa listed under the EPBC Act (based on results of the Protected Matters Search Tool query (DotEE, 2018b) are noted. The results of the DBCA datasearch are mapped in **Figure 5.**

Some of the species listed in **Table 3** could 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.

[2] Transition to the *Biodiversity Conservation Act 2016* will commence in the near future. At the time of preparing this report, the WC Act 1950 was current in regards to the conservation of Threatened and Priority flora.

Table 3. Threatened and Priority flora known to occur within 10 km of the Survey Area (DBCA, 2018a, 2018b; DotEE, 2018b).

Species	Cons Status*	Flowering	Description and Habitat	Likelihood
Caladenia lodgeana	T (CE)	Oct	Tuberous, perennial, herb. Fl. whit. Black loam.	None
Caladenia leucochila	T (EN)	Sep-Oct	Tuberous, perennial herb, single leaf and one or two pale yellow to greenish cream and white flowers with dull red stripes. Only known from near Collie, sandy soil in open forest and scrub.	Moderate
Drakaea confluens	T (EN)	Oct-Nov	Tuberous, perennial, herb, 0.15-0.3 m high. Fl. red & brown & yellow. White-grey sand.	Low
Jacksonia velveta	T (EN)	Dec	Open, upright, sometimes sprawling shrub, to 1.9 m high. Fl. yellow-orange. Brown gravelly loam, dry grey sand, ironstone. Slight hillslopes, ridges.	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.	Low
Banksia sp. Boyup Brook (L.W. Sage LWS 2366)	P1	No info avail		Low
Caladenia validinervia	P1	Sep-Oct	Tuberous, perennial, herb, single erect, hairy leaf and up to three greenish to creamy white flowers with red stripes on the sepals and petals. Only known from an area between Rocky Gully and Collie. Grows in jarrah and marri woodland.	Moderate
Stylidium acuminatum subsp. *acuminatum*	P1	Oct-Dec/Jan	Rosetted perennial, herb, Leaves oblanceolate. Inflorescence racemose. Fl. yellow. Clayey sand over laterite. Hillslopes, ridges and valleys. Eucalypt forest, open woodland, Agonis shrubland.	Moderate
Juncus meianthus	P2	Nov-Jan	Tufted perennial, herb, 0.05-0.2 m high, to 0.4 m wide. Fl. brown. Black sand, sandy clay. Creeks, seepage areas.	Low
Leucopogon extremus	P2	Sep-Oct	Low spreading shrub to 40 cm high x 70 cm wide, corolla greenish white. Seasonally wet areas.	Low
Logania sylvicola	P2	Aug-Sep	Spreading, compact shrub to 40 cm x 50 cm. Inflorescence more or less pendant. Flowers cream. Mid slopes. Dry brown gravelly, sandy loam over laterite.	Moderate

Species	Cons Status*	Flowering	Description and Habitat	Likelihood
Millotia tenuifolia var. laevis	P2	Sep-Oct	Ascending to erect annual, herb, 0.02-0.1 m high. Fl. yellow. Granite or laterite soils.	Moderate
Sphaerolobium benetectum	P2	Oct-Nov	Slender, caespitose shrub, 0.2-1 m high, to 0.45 m wide. Fl. pink & red & yellow. White gravelly sandy clay, sandy loam, granite, laterite. Ridges, swamps, undulating rises.	Moderate
Thysanotus unicupensis	P2		Erect perennial dwarf shrub, height to 15 cm, width to 11 cm; flowers purple. Jarrah - Marri forest	Moderate
Adenanthos cygnorum subsp. *chamaephyton*	P3	Jul-Jan	Prostrate, mat-forming, non-lignotuberous shrub, to 0.3 m high. Fl. white, cream, pink, green. Grey sand, lateritic gravel.	Moderate
Calytrix pulchella	P3	Aug-Nov	Shrub, 0.3-0.7(-1) m high. Fl. pink. Grey or white sand over laterite. Ridges, flats.	Moderate
Eryngium sp. Ferox (G.J. Keighery 16034)	P3	Nov	Erect, open tuberous, herb, 0.1–0.3 m high. Fl. green. Grey to brown loamy to sandy clay, brown cracking clay. Winter-wet flats, swamps, dried claypans, ridges.	Low
Grevillea prominens	P3	Sep-Oct	Spreading shrub, 0.5–1.7 m high, 0.3-1 m wide. Fl. cream, white. Gravelly loam. Along creeklines	Low
Lomandra whicherensis	P3	Nov-Dec	Tufted rhizomatous herb 20 cm high x 30 cm wide. Flowers yellow with purple stripe. Jarrah-marri forest, lateritic soils, sandy clay.	Low
Stylidium rhipidium	P3	Oct-Nov	Slender annual, herb, ca 0.05 m high. Fl. white. Sandy soils. Wet creek flats, swamps, granite outcrops.	Moderate
Synaphea decumbens	P3	Sep-Oct	Decumbent shrub. Fl. yellow. Sand over laterite.	Moderate
Synaphea hians	P3	Jul-Nov	Prostrate or decumbent shrub, 0.15-0.6 m high, to 1 m wide. Fl. Yellow. Sandy soils. Rises.	Moderate
Tetratheca parvifolia	P3	Oct	Small shrub, 0.2-0.3 m high. Fl. pink. Jarrah, woodland, wandoo woodland, gravelly soils.	Moderate
Stylidium lepidum	P3	Oct-Nov	Spreading, rosetted perennial, herb, ca 0.05 m high, forming densely packed colonies. Fl. pink, orange. Gravelly sand or loam, clay. Winter-wet depressions.	Moderate
Acacia cuneifolia	P4	Jul-Oct	Erect or straggly shrub, 1-3 m high. Fl. yellow. Sand, clay or loam over	Low

Species	Cons Status*	Flowering	Description and Habitat	Likelihood
			granite. Granite outcrops & hills, rocky watercourses.	
Acacia semitrullata	P4	May-Oct	Slender, erect, pungent shrub, (0.1-)0.2-0.7(-1.5) m high. Fl. cream, white. White/grey sand, sometimes over laterite, clay. Sandplains, swampy areas.	Moderate
Calothamnus graniticus subsp. *leptophyllus*	P4	Jun-Aug	Erect, multi-stemmed shrub, 1-2 m high. Fl. red. Clay over granite, lateritic soils. Hillsides.	Low
Eucalyptus rudis subsp. *cratyantha*	P4	Jul-Sep	Tree, 5-20 m high, bark rough, box-type. Fl. white. Loam. Flats, hillsides.	Moderate
Grevillea ripicola	P4	Jan-Apr /Nov-Dec	Spreading, much-branched, non-lignotuberous shrub, 0.6-2(-3) m high, to 4 m wide. Fl. red, orange. Sandy clay, clay or gravelly loam. Swampy flats, granite outcrops, along watercourses.	High
Hypolaena robusta	P4	Sep-Oct	Dioecious rhizomatous, perennial, herb, ca 0.5 m high. White sand. Sandplains.	Moderate
Lasiopetalum cardiophyllum	P4	Aug-Jan	Erect, multi-stemmed shrub, 0.2–0.5 m high. Fl. pink. Lateritic gravelly soils, sandy clay. Flats, hillslopes.	Moderate
Pultenaea skinneri	P4	Jul-Sep	Slender shrub, 1-2 m high. Fl. yellow, orange, red. Sandy or clayey soils. Winter-wet depressions.	Moderate

Note: The WC Act Conservation Status is shown, EPBC Act status, where relevant, is in brackets.

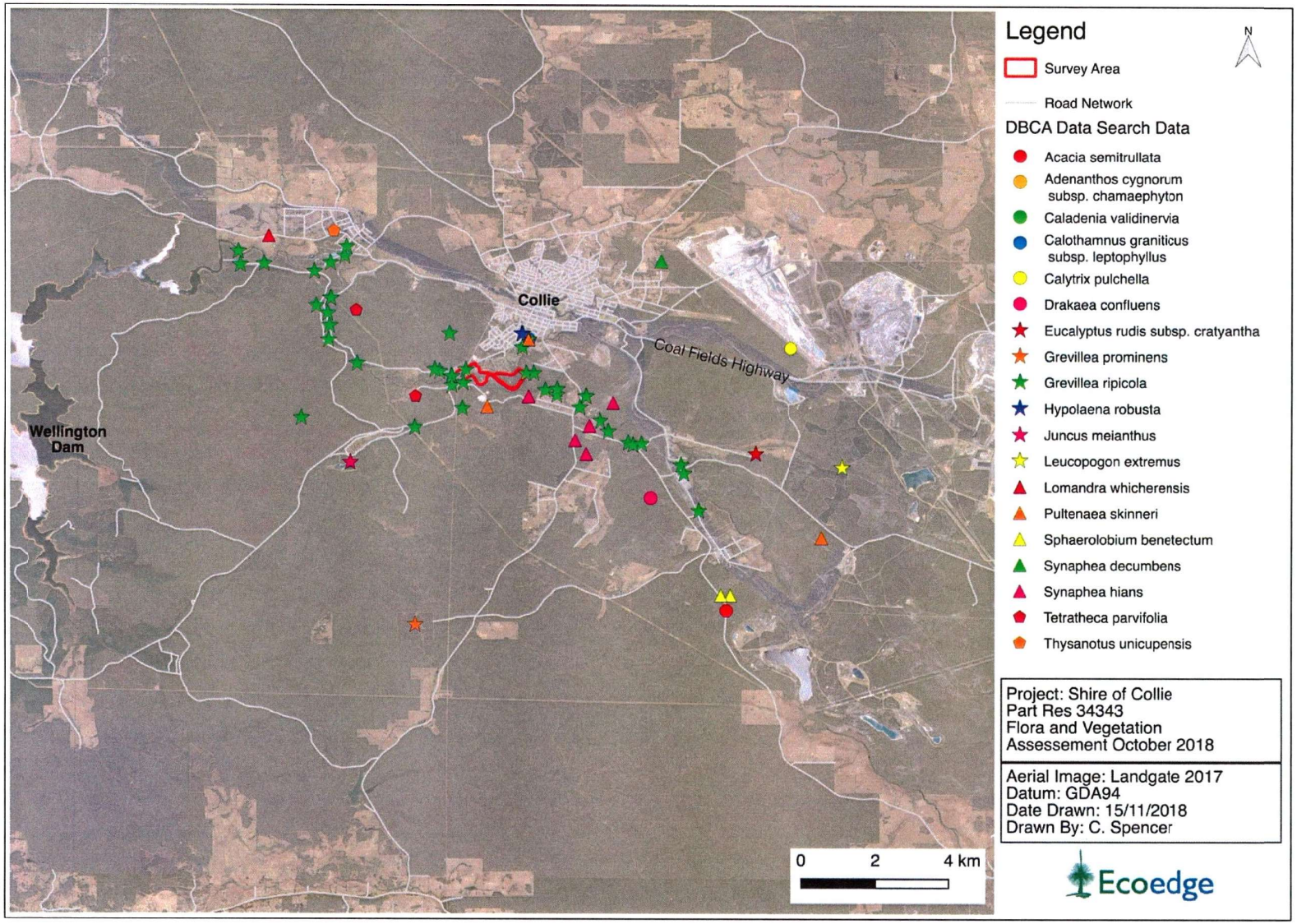

Figure 5. Known occurrences of Threatened and Priority flora within 10 km of the Survey Area (DBCA, 2018a).

1.7 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 **Table 4.** 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.

A north-south linkage axis line crosses through both Survey Areas and a second, associated with the Collie River, crosses and runs along the southern boundary of the larger Minninup Pools Survey Area.

As a result of the location of these axis lines, vegetation in the Survey Area is assigned proximity ratings of "1a" which is the highest rating, and indicates that the vegetation directly forms part of one or more regional ecological linkages (**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).

Table 4. 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

1.8 Environmentally Sensitive Areas

Environmentally Sensitive Areas (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 Threatened flora;
- Bush Forever sites; and
- Declared World Heritage property sites.

The most recent Department of Environment Regulation (DER) mapping dataset (DER, 2016) showed that there are no ESA within ten kilometres of the Survey Area, with the closest located approximately 16.5 km north east of the site, as shown in **Figure 7.**

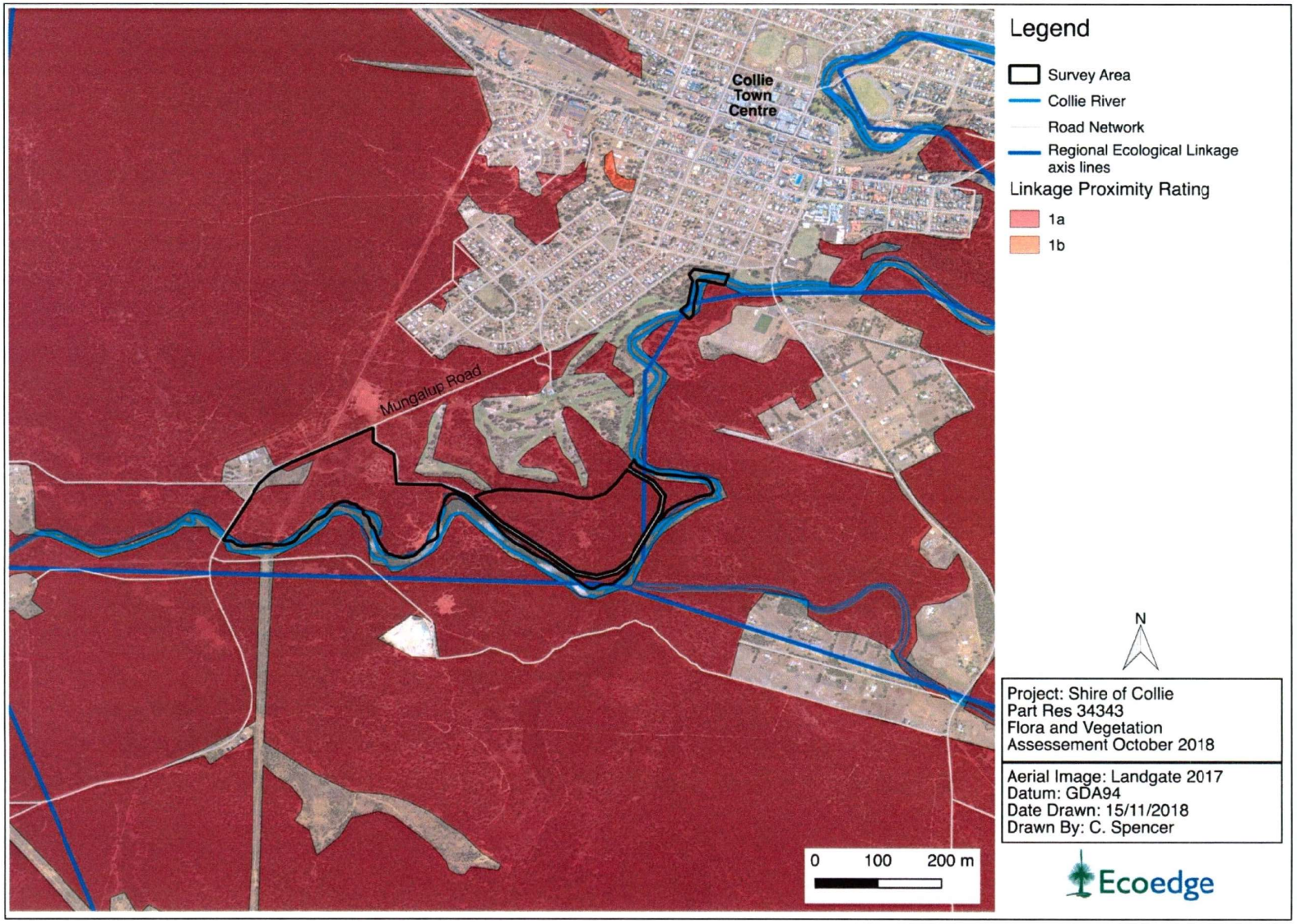

Figure 6. The Survey Area in relation to regional ecological linkages (Molloy *et al.*, 2009).

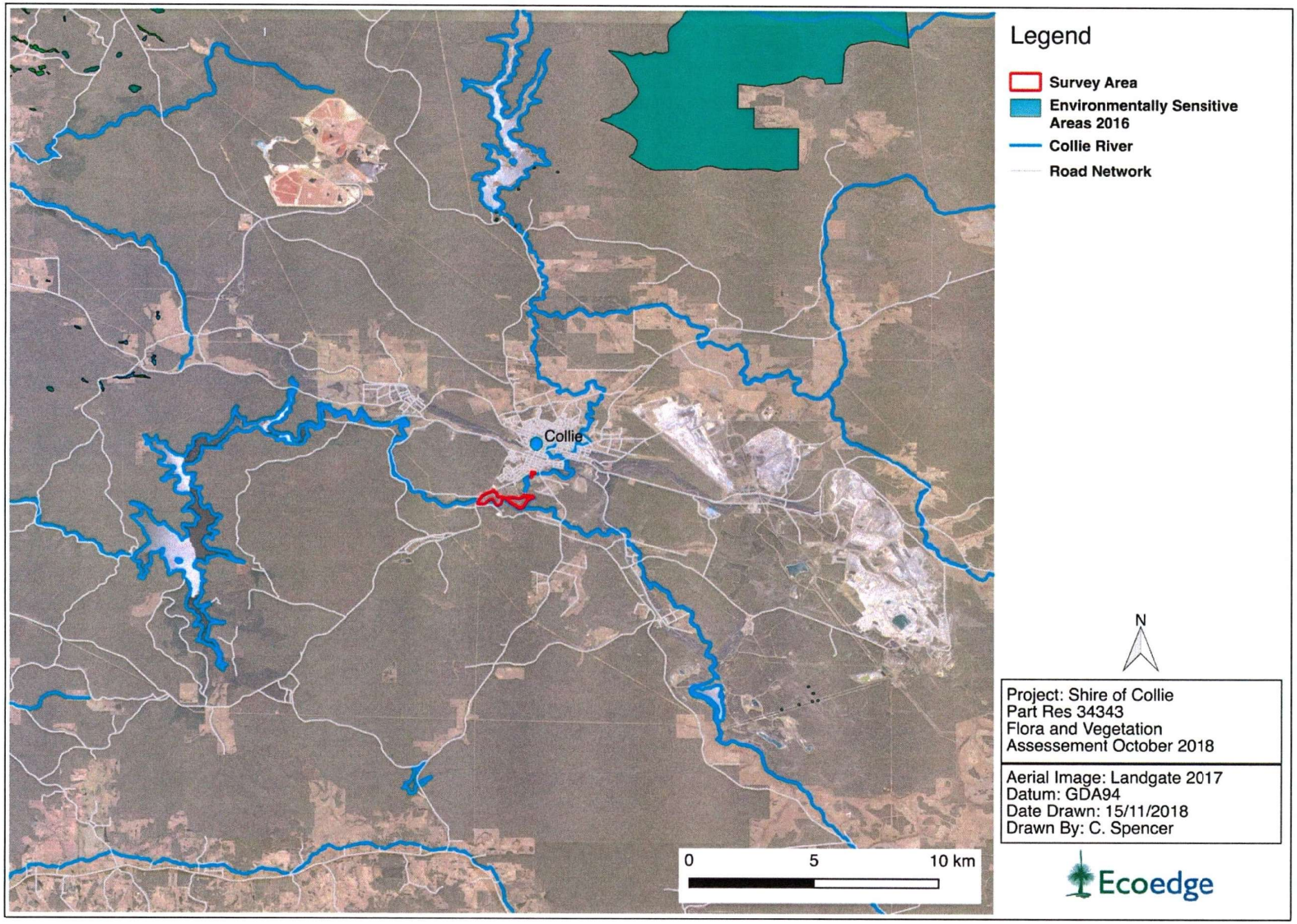

Figure 7. ESAs mapped within proximity to the Survey Area (DER, 2016).

2 Methods

2.1 Desktop Assessment

Prior to the field survey, a "desktop assessment" was carried out by downloading from the Threatened and Priority flora (TPFL) and W.A. Herbarium databases of records occurring within 10 km of the Survey Area (DBCA, 2018a). A NatureMap report was generated listing of all flora (including Threatened flora) occurring within 10 km of the Survey Area (DBCA, 2018b) (**Appendix 2**). A Protected Matters Search report was generated to provide information regarding Matters of National Environmental Significance (MNES) know or potentially occurring within 10 km of the Survey Area (DotEE, 2018) (**Appendix 2**). This data was used to establish the list of Threatened and Priority flora to target during the survey, as well as providing a list of what other plant taxa might be encountered during the survey.

2.2 Field Survey

The field survey was undertaken by Russell Smith (flora permit SL012218) and Colin Spencer (SL012460) on 29 September and 9 October 2018. The survey was carried out along transects about 40 m apart walked through the Survey Area. A comprehensive list of vascular flora species was compiled, and notes were taken of dominant species, vegetation condition and soil at more than 150 unmarked relevé survey sites. Taxonomy and conservation status were checked against the WA Herbarium database of names (DBCA, 2018c; 2018d). Taxa not able to be identified in the field were photographed for later determination.

Vegetation condition was assessed against the method the EPA (2016) (**Appendix 5**).

2.3 Survey Limitations

Potential limitations with regard to the assessment are addressed in **Table 5**.

Table 5. Limitations with regard to 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.
Proportion of flora identified	Negligible	The survey was conducted at the prime time for flowering in south west forests.
Climatic and seasonal effects	Minor	Rainfall during the winter season in the south-west of Western Australia was slightly below average to average. It did not appear to have significantly affected the flowering of annual or annually-renewed plants species.
Availability of contextual information	Minor	Regional scale vegetation surveys are available for the northern and southern Jarrah forest. However, there has been no sub-regional vegetation survey and there is no information available of the conservation status of particular vegetation types in the Collie Basin.
Completeness of the survey	Negligible	All of the survey area was easily accessed.
Skill and knowledge of the botanists	Negligible	The senior field botanist conducting the survey has had extensive experience in botanical surveys in south west Australia over a period of 25 years.

3 Results

3.1 Flora

A total of 198 vascular flora taxa were identified within the 70.45 ha[3] Survey Area (**Appendix 6**), of which 14 were introduced or non-native species.

3.2 Declared Weeds and Pest Plants

No Declared Pest Plants (DAFWA, 2018) were found within the Survey Area. However, several significant environmental weeds were seen. The most widespread of these was the bulbous herb **Watsonia meriana* var. *bulbifera*. The small tree **Acacia dealbata* was observed in two locations and **Babiana angustifolia* (another bulbous weed) in one. The locations of these environmental weeds are shown in **Figure 8**.

[3] Adjusted boundary to include all shoreline of the Collie River, but excluding the river itself.

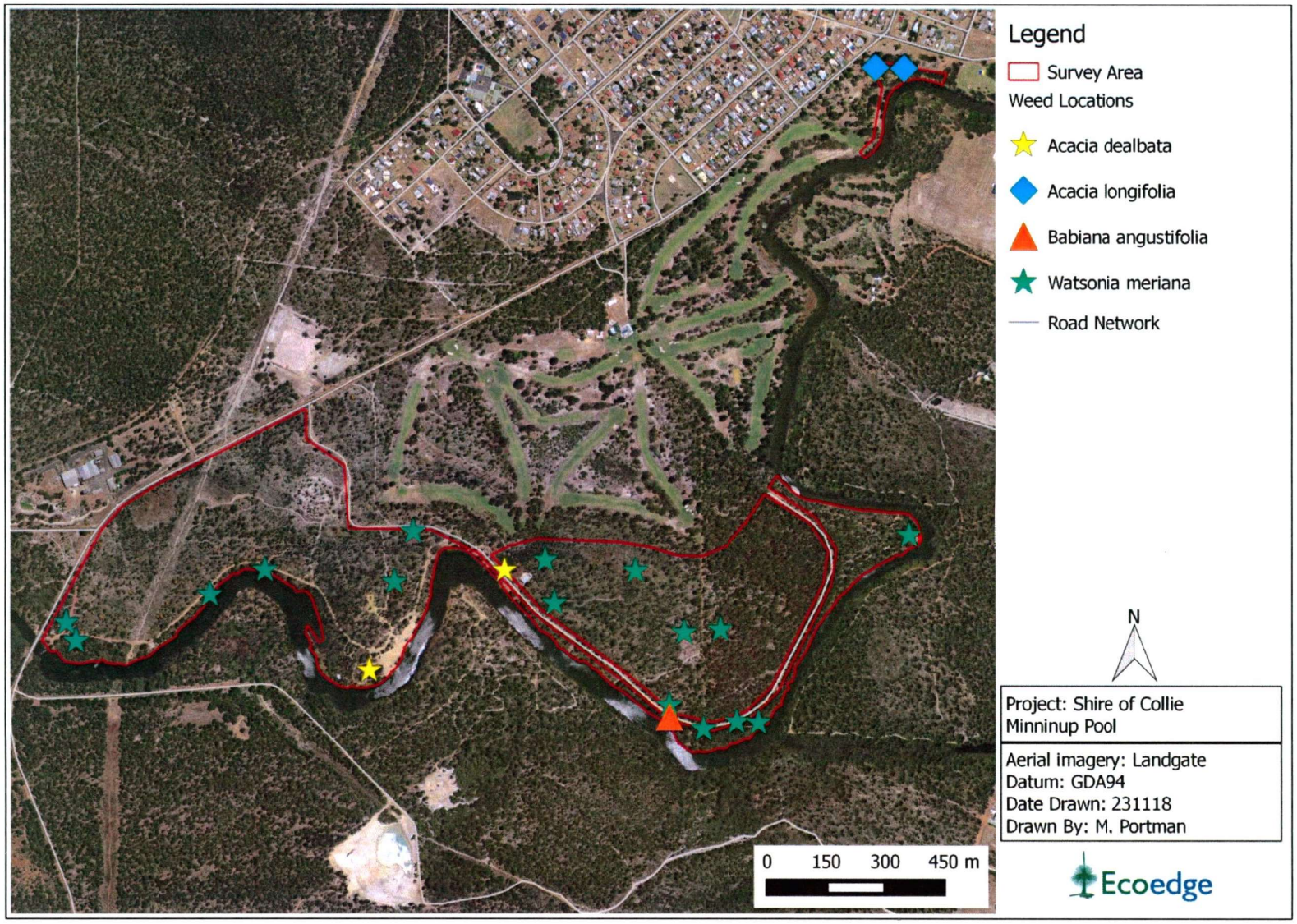

Figure 8. Location of conservation significant taxa within the Survey Area.

3.3 Priority Flora and Other Flora of Conservation Significance

Two species of Priority flora, *Synaphea hians* (P3) and *Grevillea ripicola* (P4) and one significant range extension species (*Stylidium scandens*) were found within the Survey Area (**Figure 9**). These are discussed below.

A completed Threatened and Priority Flora Reporting Form is included in **Appendix 7.**

3.3.1 Synaphea hians (P3)

Synaphea hians (**Figure 10**) was found growing at two locations within the Survey Area. It is distributed on the Swan Coastal Plain between Bunbury and Dunsborough, and on the Darling Plateau between Collie and Kojonup. There are also outlying populations on the Blackwood Plateau near Nannup and at Unicup east of Manjimup. There are 54 records for the species in DBCA databases. The populations on the coastal plain are at some risk through urban and infrastructure development.

3.3.2 Grevillea ripicola (P4)

Grevillea ripicola (**Figure 11**) was found along much of the riverbank within the Survey Area, usually on the narrow band of alluvial soils along the Collie River. It appears to be a disturbance opportunist and was found growing in other areas where machinery may have carried seed. The records in **Table 6**, below, only relate to part of the total occurrence in the Survey Area and it is estimated that several hundred plants occur there.

G. ripicola is mainly confined to a 15 km stretch of the valley of the Collie River, growing mostly with 50 m of the riverbank. There are a few outlying populations south-east of Donnybrook and near Greenbushes. It is represented by 56 records in DBCA databases, mostly representing populations within 10 km of Collie.

3.3.3 Stylidium scandens

Stylidium scandens (**Figure 12**) is a common species within its normal range along the south and south-west coasst between the Fitzgerald River National Park and Capel. Apart from one outlying population near Bannister the disjunct population found near the Collie River within the Survey Area is the furthest outlier from the main range of the species. Like the other outlying population at Bannister (Wege, 2010), the one within the Survey Area may display non-typical morphological characteristics and be important for study of variation within the species. Specimens were taken for lodgement at the W.A. Herbarium.

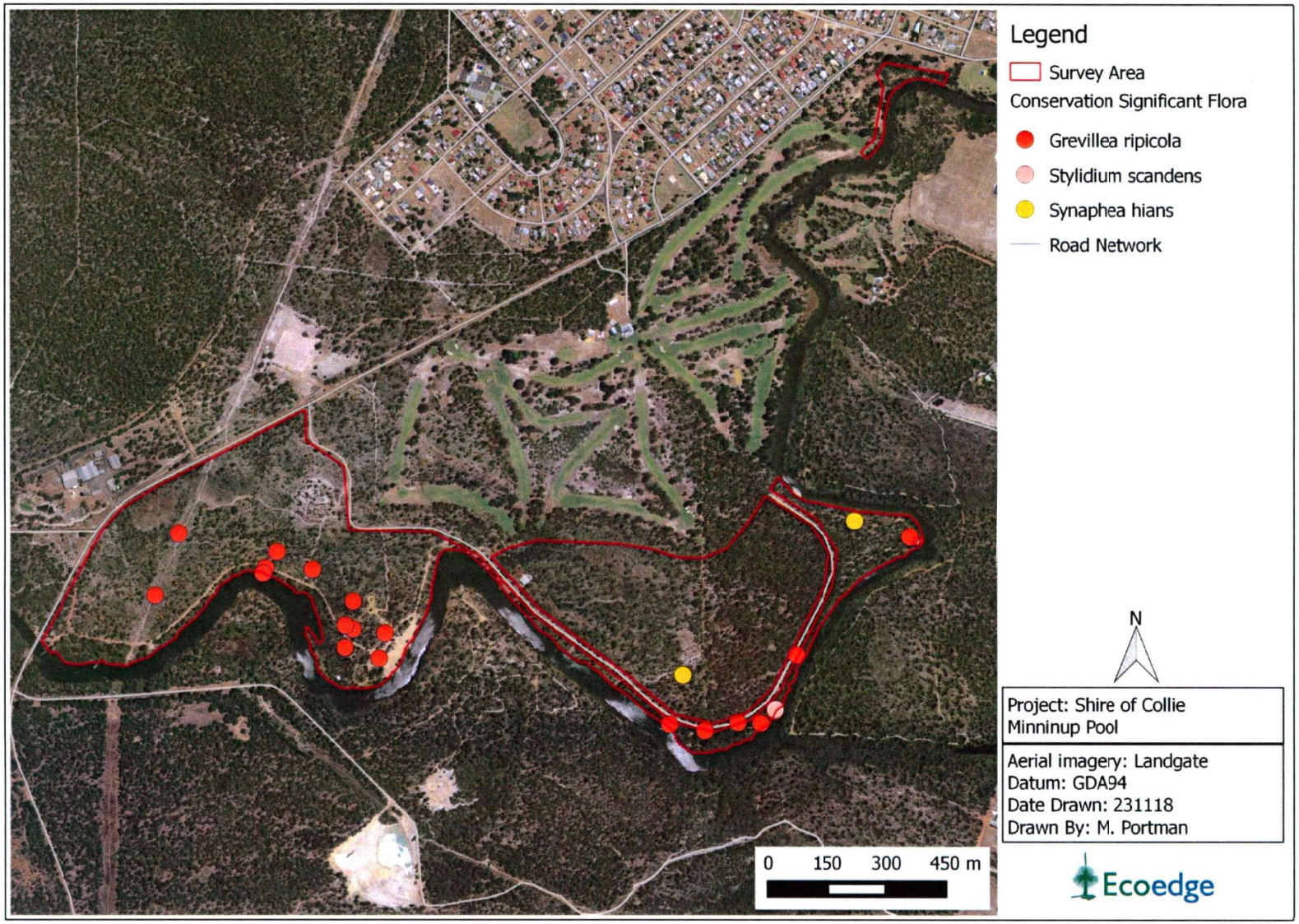

Figure 9. Location of conservation significant taxa within the Survey Area.

Table 6. Locations of Threatened and Priority flora and Conservation Significant taxa within the Survey Area.

Occurrence	Easting	Northing	Taxon	Cons. Code	No. Plants
1	420421.261	6306287.013	*Synaphea hians*	P3	3
2	420860.99	6306678.501	*Synaphea hians*	P3	3
1	420658.067	6306197.907	*Stylidium scandens*		5
1	419663.519	6306392.937	*Grevillea ripicola*	P4	5-10
2	420657.306	6306196.972	*Grevillea ripicola*	P4	5-10
3	419564.329	6306357.25	*Grevillea ripicola*	P4	5-10
4	419582.698	6306403.958	*Grevillea ripicola*	P4	5-10
5	419584.272	6306474.808	*Grevillea ripicola*	P4	5-10
6	419561.705	6306413.93	*Grevillea ripicola*	P4	5-10
7	419480.012	6306555.803	*Grevillea ripicola*	P4	5-10
8	420389.268	6306161.068	*Grevillea ripicola*	P4	5-10
9	419361.93	6306560.176	*Grevillea ripicola*	P4	5-10
10	419355.34	6306544.629	*Grevillea ripicola*	P4	5-10
11	419142.975	6306645.308	*Grevillea ripicola*	P4	5-10
12	419080.29	6306490.783	*Grevillea ripicola*	P4	5-10
13	420621.658	6306165.938	*Grevillea ripicola*	P4	5-10
14	420562.375	6306166.909	*Grevillea ripicola*	P4	5-10
15	420713.012	6306340.87	*Grevillea ripicola*	P4	5-10
16	421001.651	6306639.228	*Grevillea ripicola*	P4	5-10
17	420477.889	6306146.092	*Grevillea ripicola*	P4	5-10
18	420386.684	6306162.456	*Grevillea ripicola*	P4	5-10
19	420622.287	6306165.027	*Grevillea ripicola*	P4	5-10

Figure 10. *Synaphea hians*.

Figure 11. *Grevillea ripicola*.

Figure 12. *Stylidium scandens*.

3.4 Vegetation Units

Seven vegetation units were recognised within the Survey Area and are described in **Table 7**, below. In addition, there were two other mapping units comprising heavily disturbed areas, where there is little of original vegetation left, and areas that have been previously cleared (e.g. for gravel extraction) and have been replanted.

Photographs of each of the vegetation units are provided in **Appendix 8**. The extent (in hectares) of each vegetation unit within the Survey Area is provided in **Table 8**. The distribution of vegetation units is mapped in **Figure 13**.

Vegetation unit A, which is restricted to the western part of the Survey Area, forms a narrow strip (50-80 m wide) along the shoreline of the Collie River. It occurs on freer draining soil than unit B which abuts it to the north, and lacks wetland species such as *Banksia littoralis* and *Cyathochaeta avenacea*.

Vegetation units B and C are the most widely distributed in the Survey Area, with unit B being confined to the western part and unit C to the eastern part. The two units are similar in structure, being open forest to woodland dominated by Jarrah (*Eucalyptus marginata*), but unit B has more taxa characteristic of wetland vegetation, such as *Banksia littoralis* and *Melaleuca preissiana*. This is attributable to its clayier soils, with impeded drainage.

Vegetation unit D was Jarrah-dominated open forest confined to the lateritic gravels that occur in the easternmost portion of the Survey Area. It has a characteristic group of understorey taxa not found elsewhere in the Survey Area, such as *Banksia dallanneyi*, *Bossiaea ornata* and *Hakea lissocarpha*.

The structure of vegetation unit E varies from sedgeland, to shrubland to low open woodland (with emergent *Melaleuca preissiana*, *Eucalyptus patens* and *Banksia littoralis* low trees) and is situated on clayey soils with impeded drainage. It intergrades with vegetation unit B in the western part of the Survey Area.

Vegetation unit F is also a wetland, and appears to be formed on a natural spring. It is mostly in excellent condition. Vegetation units G and H (the latter of which is found on the small area of reserve 34343 at the corner of Crampton Street and Mungalup Road) are associated with alluvial loams near the bank of the Collie River.

Table 7. Descriptions of vegetation units mapped during the field survey.

Unit	Description
A	Open forest of *Eucalyptus marginata*, *Corymbia calophylla* (and occasionally *Allocasuarina fraseriana*, or *E. patens*), with the small trees *Persoonia longifolia* and *Xylomelum occidentale* over shrubland dominated by *Acacia extensa*, *A. pulchella*, (*Grevillea ripicola*), *Hypocalymma angustifolium*, *Kennedia coccinea*, *Macrozamia riedlei*, and *Xanthorrhoea brunonis* or *X. preissii* on sandy loam.
B	Open forest to woodland of *Eucalyptus marginata*, with in places the small trees *Banksia littoralis*, *Melaleuca preissiana* and *Nuytsia floribunda*) over shrubland dominated by *Acacia extensa*, *A. pulchella*, *Dasypogon bromeliifolius* and *Xanthorrhoea brunonis* over *Cyathochaeta avenacea* and *Lepidosperma squamatum* sedges on greyish sandy clay loams.
C	Open forest to woodland of *Eucalyptus marginata*, (*Allocasuarina fraseriana*) over *Banksia grandis* small trees over shrubland of *Acacia extensa*, *Adenanthos obovatus*, *Bossiaea eriocarpa*, *Gompholobium tomentosum*, *Macrozamia riedlei* and *Xanthorrhoea preissii* with scattered *Lepidosperma squamatum* sedges on sandy loam.
D	Open forest of *Eucalyptus marginata* (and occasionally *E. patens*) over *Xylomelum occidentale* low trees over shrubland of *Acacia extensa*, *Banksia dallanneyi*, *Bossiaea ornata*, (*Grevillea ripicola*), *Hakea lissocarpha*, *Hibbertia hypericoides*, *Hypocalymma angustifolium*, *Leucopogon propinquus*, *Macrozamia riedlei* and *Xanthorrhoea preissii* on lateritic gravel.
E	Open to very open woodland to closed or open shrubland of *Banksia littoralis* or *Melaleuca preissiana* (occasionally small *Eucalyptus patens*) over *Aotus gracillima*, *Astartea scoparia*, *Gastrolobium capitatum*, *Hakea ceratophylla*, *Hibbertia stellaris*, *Melaleuca lateritia* over sedgeland which may include *Cyathochaeta avenacea*, *Leptocarpus roycei*, and *Mesomelaena tetragona* on grey clay or sandy clay.
F	Tall closed shrubland/sedgeland of *Acacia divergens*, *Aotus gracillima*, *Astartea scoparia*, *Callistemon glaucus*, *Taxandria linearifolia* and *Cyathochaeta avenacea*, *Gahnia decomposita* on clay loam.

Unit	Description
G	Open forest of *Corymbia calophylla*, *Eucalyptus patens* and *E. rudis* with scattered *Banksia littoralis* and *Melaleuca preissiana* over a variable tall shrubland/shrubland that may include *Acacia extensa*, *A. pulchella*, *Astartea scoparia*, *Grevillea ripicola*, *Hakea lissocarpha*, *Hypocalymma angustifolium*, *Melaleuca viminea*, *Taxandria linearifolia* and *Xanthorrhoea brunonis* on loam.
H	Open forest of *Eucalyptus rudis* over tall shrubland of **Acacia longifolia*, *A. extensa*, *A. pulchella*, *Taxandria linearifolia* over *Lepidosperma effusum* and **Watsonia meriana* on loam.

Table 8. Area of each vegetation unit within the Survey Area.

Vegetation Unit	Area (ha)
A	3.61
B	20.95
C	19.16
D	9.9
E	7.39
F	1.1
G	3.33
H	0.4
Heavily disturbed	2.54
Planted	2.07
Total	**70.45**

3.5 Vegetation Condition

Most of the Survey Area (90%) was rated as being in 'Very Good' or 'Excellent' condition (**Table 9**). The 'Degraded' areas have been heavily disturbed in the past and are vegetated with a mixture of native and planted species. The distribution of vegetation condition across the Survey Area is shown in **Figure 14**.

Table 9. Summary of vegetation condition classes within the Survey Area.

Condition	Area (Ha)	%
Excellent	6.88	9.8
Very Good	56.56	80.3
Good	2.00	2.8
Degraded	2.66	3.8
Completely Degraded	2.35	3.3
Total	**70.45**	**100.0**

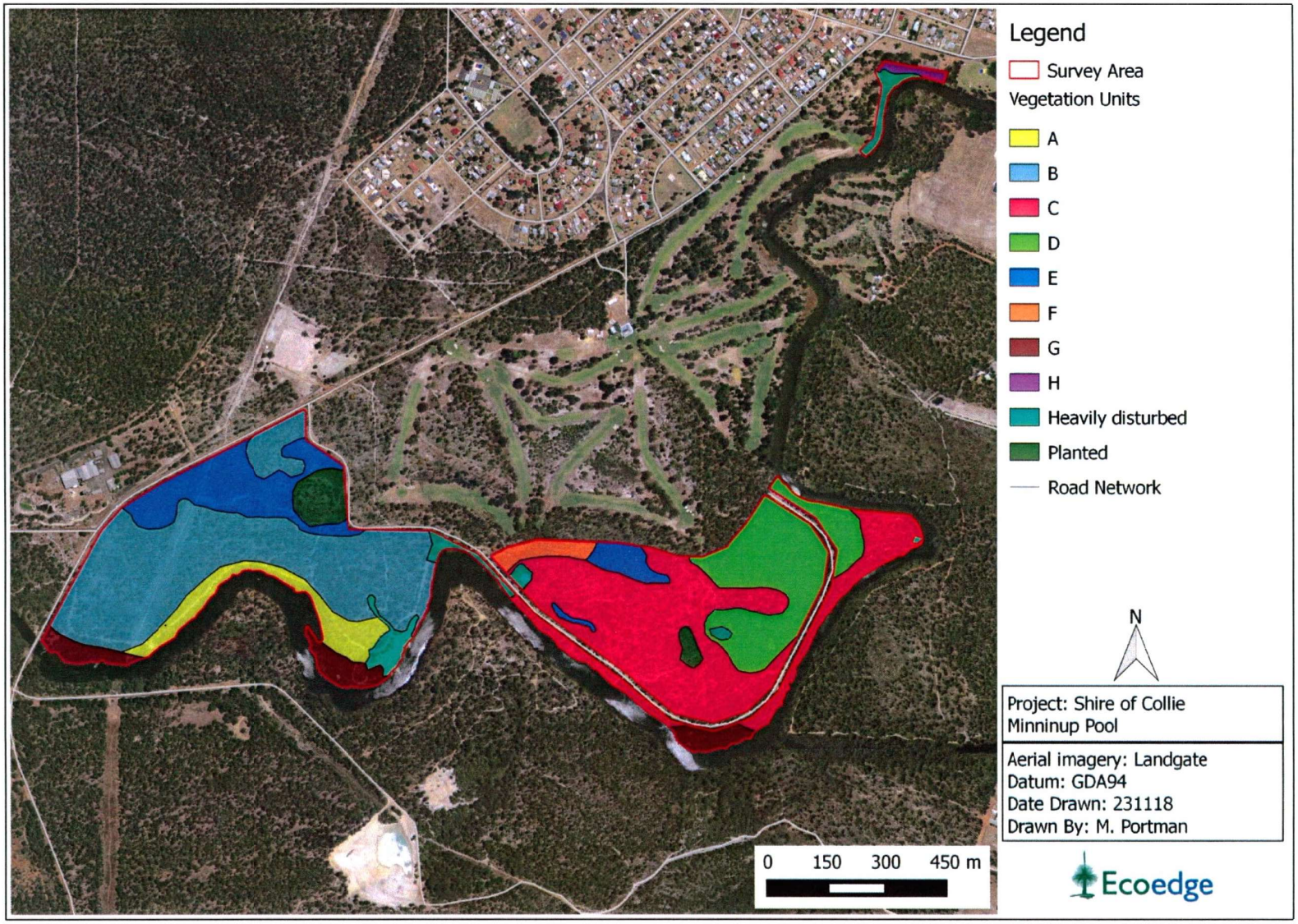

Figure 13. Vegetation units mapped within the Survey Area.

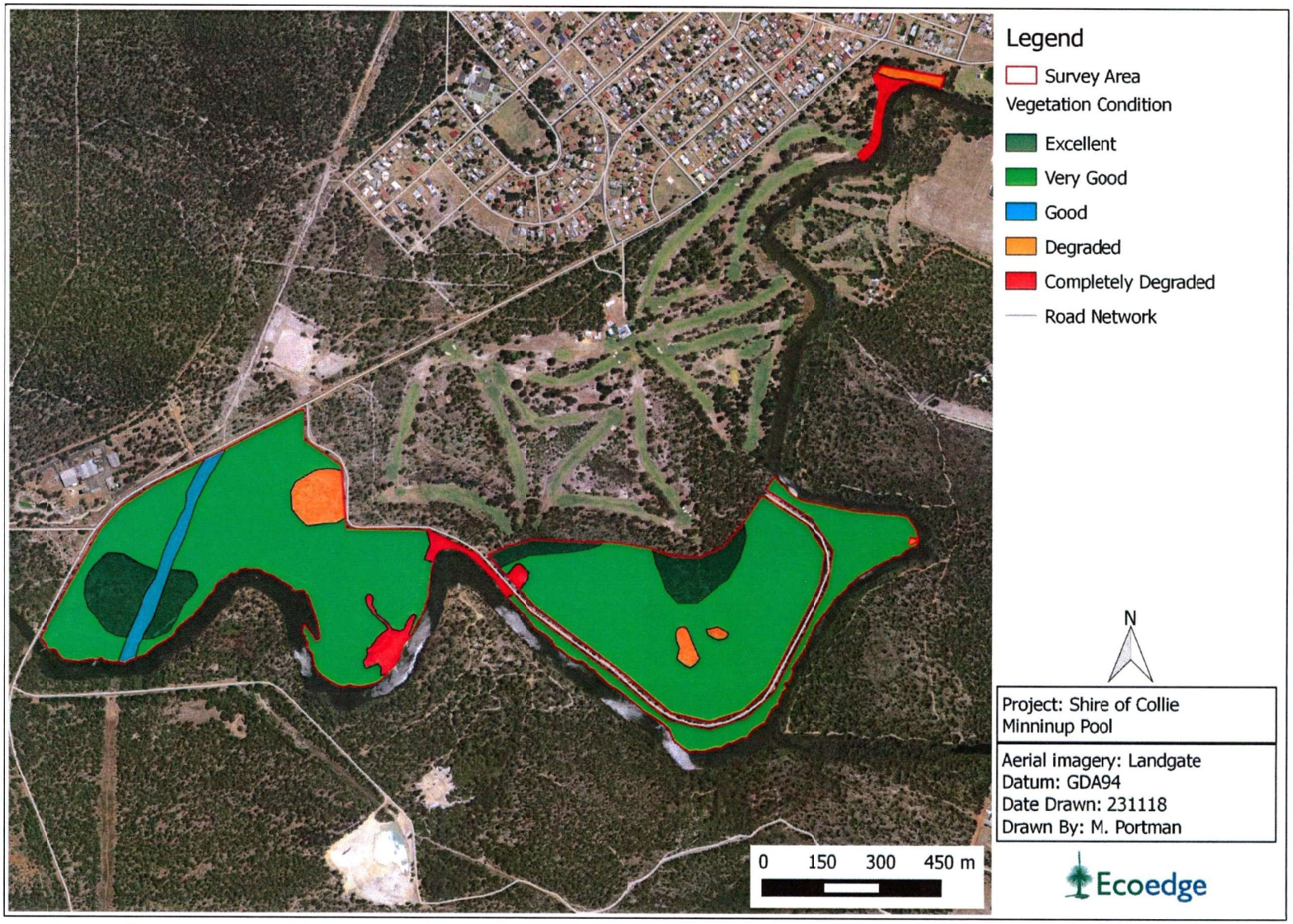

Figure 14. Condition of vegetation within the Survey Area.

4 Discussion

4.1 Conservation significance of the flora and vegetation

4.1.1 Flora

The Survey Area vegetation has a moderately high native plant diversity and contains two listed Priority species (*Synaphea hians* and *Grevillea ripicola*), as well as a highly disjunct population of *Stylidium scandens*. The population of *S. scandens* within the Survey Area, which is 50 km north of its normal range, may be important for studying variation in the species.

4.1.2 Vegetation

Seven vegetation units dominated by native vegetation were recognised within the Survey Area. They range in structure from open forest through low open woodland, to tall shrubland, to low sedgeland. There are no recognised Threatened or Priority Ecological Communities in the Collie Basin and none of the vegetation units within the Survey Area resembles any TEC or PEC. It is not possible to determine whether any of the Survey Area vegetation units is restricted or rare because there has been no comprehensive vegetation survey done in the Collie Basin.

The vegetation in the Survey Area is mapped as the Muja (MJ) complex, of which 59.5% of the original areal extent remains. This is well above the Commonwealth government's target of 30%.

Most (90%) vegetation within the Survey Area is in 'Very Good' or 'Excellent' condition, with only relatively small areas associated with car parking or previous gravel extraction being classified as 'Degraded' or 'Completely Degraded'.

Two regional ecological linkages cross the Survey Area, one forming a north-south link, and the other located in the south associated with the Collie River.

No Environmentally Sensitive Areas have been mapped within the Survey Area according to the DER database (DER, 2016).

4.2 Potential Impacts from the Proposed Nature Hub

Potential direct and indirect impacts of a proposed nature hub to be established within the Survey Area, which would potentially include a nature-based camping ground and visitor day use area, will be discussed below along with appropriate measures to avoid or mitigate these impacts.

There are two main types of negative impact to the native vegetation of the Survey Area, direct and indirect, that might arise from the proposed development.

Firstly, clearing of vegetation is an obvious potential direct impact on the Survey Area. It is desirable that these impacts be minimised by avoiding Threatened and Priority flora (including the disjunct population of *Stylidium scandens*) and by siting the campground or day-use area in a place that has already had significant disturbance.

Other direct negative impacts may be associated with new access tracks or roads built to facilitate use of the campground or day-use area. Again, it is desirable that these impacts be minimised by as much as practicable using already disturbed areas.

Indirect impacts on the vegetation of the Survey Area that may be associated with the proposed developments are the introduction of new weeds and plant diseases. It should be noted here that, particularly in areas already frequently used by visitors, there are substantial infestations of weeds, particularly **Watsonia meriana*. Disease caused by *Phytophthora* ('dieback') is probably present in the Survey Area, though its effects on plant health appear to be minor.

Another potential indirect negative impact of increased visitor use associated with the development of a nature hub is increased trampling of the vegetation by walkers. There are already some walking tracks through the Survey Area, and with appropriate construction methods and information boards and signs it is likely that trampling can be minimised.

Erosion of topsoil is another potential negative effect of increased visitation. There are already areas of bare, erodible soils adjacent to the river at near the Minninup Pool swimming beach. Construction of improved parking facilities would reduce the potential of further erosion in this area.

5 Recommendations

It is considered that development of a nature hub that includes accommodation and day use activities is compatible with protection of the nature conservation values identified by this assessment provided that the following recommendations are followed where practicable:

- That clearing of native vegetation required for the project is kept to a minimum.
- That where possible, any development is located in areas mapped as Degraded or Completely Degraded, so as to minimise impacts to the vegetation.
- That any development is specifically designed to minimise impacts to vegetation in Excellent and Very Good condition in particular, and to minimise impacts to the native vegetation in general.
- That any development is sited so as to minimise impacts on the conservation significant species *Synaphea hians*, *Grevillea ripicola* and in particular the population of *Stylidium scandens*.

- That any development takes into account access routes to desirable facilities (town, water, swimming holes, etc) for vehicles, pedestrians and bicycles, and is planned to minimise the creation of 'sheep tracks' and shortcuts.
- That the development design incorporates clearly defined and high quality access routes and paths to minimise trampling of vegetation.
- That regular maintenance is carried out within the areas surrounding the day-use and camping areas to keep weeds and other pests under control, and stop their spread into the bushland.
- Existing infestations of known environmental weeds should be eradicated or managed to substantially reduce their areas of occupancy. This will assist in minimising the spread of these species into currently uninfested bushland areas.
- A *Phytophthora* dieback assessment is carried out, and *Phytophthora* Management Plan is prepared for the area prior to any development.

6 Conclusions

A spring flora and vegetation survey of approximately 70 ha of part Reserve 34343 in the townsite of Collie recorded 184 native plant taxa and 14 introduced taxa.

Three conservation significant taxa were located, of which two are Priority-listed, and one is a significant range-extension.

No Declared Pest Plants were found within the Survey Area, however several significant environmental weeds are present.

Seven vegetation units dominated by native species were identified, none of which resemble any Threatened or Priority Ecological Communities.

Most (90%) of the Survey Area vegetation was rated as being in 'Very Good' or 'Excellent' condition.

Provided the design of the proposed development takes the values of the flora and vegetation into full consideration, and specifically aims to minimise impacts resulting from construction and the resulting increased use, and that sufficient ongoing management of any threats is implemented, it is possible that the proposed nature hub will not have significant impacts on the flora and vegetation in the Survey Area. There is substantial combined aesthetic and conservation value in this large tract of Excellent to Very Good vegetation remaining in such close proximity to the town.

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Appendix 1. Categories of Threatened Ecological Communities under the EPBC Act (DotEE, 2017a).

Appendix 2. Protected Matters Search Tool and NatureMap reports.

Appendix 3. Definitions of Threatened and Priority List flora (DBCA, 2017b).

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

Appendix 5. Vegetation Condition Scale (EPA, 2016).

Appendix 6. List of Vascular Flora found within the Survey Area.

Appendix 7. Completed Threatened and Priority Flora Reporting Form.

Appendix 8. Photographs of Vegetation Units mapped within the Survey Area.