Stage 3 Resleepering Project (Muchea) Flora, Vegetation and Fauna Survey

Arc Infrastructure Pty Ltd

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Abbreviations

Abbreviation	Description
Arc	Arc Infrastructure Pty Ltd
BAM Act	State Biosecurity and Agriculture Management Act 2007
BC Act	State Biodiversity Conservation Act 2016
BoM	Bureau of Meteorology
DAWE	Department of Agriculture, Water and the Environment
DBCA	Department of Biodiversity, Conservation and Attractions
DoEE	Department of the Environment and Energy
DPIRD	Department of Primary Industries and Regional Development
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
ELA	Eco Logical Australia
EP Act	Environment Protection Act 1986
EPA	Environmental Protection Authority
EPBC Act	Commonwealth Environment Protection and Biodiversity Conservation Act 1999
ESA	Environmentally Sensitive Area
ESSS	Endangered Species Scientific Subcommittee
FCT	Floristic Community Type
GDE	Groundwater Dependent Ecosystem
IBRA	Interim Biogeographic Regionalisation for Australia
PEC	Priority Ecological Community
PMST	Protected Matters Search Tool
TEC	Threatened Ecological Community
TSSC	Threatened Species Scientific Committee
WAH	Western Australian Herbarium
WAM	Western Australian Museum
WoNS	Weed of National Significance

Executive Summary

Eco Logical Australia was engaged by Arc Infrastructure Pty Ltd to undertake a Reconnaissance flora and vegetation survey and Basic fauna survey of proposed laydown areas and existing access tracks adjacent to the rail line running between Millendon Junction to Gingin, Western Australia. Surveys were required to identify the potential presence of conservation significant flora species, vegetation communities or fauna habitats in the survey areas prior to submission of an application for a Native Vegetation Clearing Permit.

The field survey was conducted from 4th to 7th October 2021 in accordance with the Environmental Protection Authority *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (2016) and the Environmental Protection Authority *Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (2020). Vegetation communities were described from 34 relevés established across seven proposed laydown and 18 proposed access track survey areas.

A total of 153 flora taxa (97 native and 56 introduced taxa) from 106 genera and 48 families were recorded from the 34 relevés (105 taxa) and from opportunistic collections (49 additional taxa). Individual flora species and assemblages recorded in the survey areas are considered to be typical of the local area and broader region. One Threatened flora species, *Grevillea curviloba*, listed as Endangered under both the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the State *Biodiversity Conservation Act 2016* (BC Act), was recorded within six access track survey areas. A total of 265 *Grevillea curviloba* individuals were recorded, 20 plants within relevés and the remainder recorded opportunistically. One individual of the Priority flora species, *Grevillea evanescens,* listed as Priority 1 by the Department of Biodiversity, Conservation and Attractions (DBCA), was recorded within an access track survey area. Following the field survey, six conservation significant flora species were assessed as having Potential to occur. A very high proportion (37%) of the total number of flora species recorded in the survey areas were introduced (weed) species. This was expected given the highly disturbed and fragmented nature of the vegetation of the survey areas. Four of the recorded weed species are listed as Declared Pests under the State *Biosecurity and Agriculture Management Act 2007:* Bridal Creeper (**Asparagus asparagoides*); Arum Lily (**Zantedeschia aethiopica*); One-leaf Cape Tulip (**Moraea flaccida*); and Paterson's Curse (**Echium plantagineum*). Bridal Creeper is also listed as a Weed of National Significance.

A total of eight broad vegetation communities, four comprising shrublands and four woodlands, were delineated and mapped within the survey areas. Cleared areas, including previously cleared vehicle access tracks and cleared areas adjacent to the rail line, covered approximately one-third (35.5%) of the survey areas. The BsppW vegetation community comprised floristic and structural characteristics associated with the *Banksia Woodlands of the Swan Coastal Plain* Threatened Ecological Community (TEC). The full four-stage assessment against key diagnostic characteristics for this TEC resulted in one 2.5 ha patch of vegetation within the survey areas being assessed as Likely to represent the Banksia Woodlands TEC. It is noted that this assessment is based on results from a reconnaissance level survey.

Following the field survey, four other TECs were assessed as having Potential to occur in the survey areas: *Clay Pans of the Swan Coastal Plain; Corymbia calophylla - Xanthorrhoea preissii woodlands and*

shrublands of the Swan Coastal Plain; Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain; and *Shrublands and Woodlands on Perth to Gingin ironstone (Perth to Gingin ironstone association) of the Swan Coastal Plain*. All TEC likelihood assessments were based on outcomes of a reconnaissance level survey and a such a precautionary approach was taken to likelihood scenarios. In order to confirm the presence/absence of potential TECs and determine potential sub-components of those TECs within the survey area a Detailed flora and vegetation survey would be required.

Vegetation condition within the survey areas was highly variable ranging from Completely Degraded to Very Good, with most of the intact native vegetation rated as Good or Degraded (33.9% and 33.6% of the vegetated area, respectively). Disturbances included large sections of clearing including rail lines and vehicle access tracks, high coverage of weed species and the presence of some highly invasive weeds, and minor rubbish.

A total of 47 vertebrate fauna species were recorded during the Basic fauna survey, comprising 37 birds, six mammals (four introduced species), three reptiles and one amphibian. The species recorded represent a snapshot of the fauna occurring within the survey area, and it is therefore likely that more species occur than were observed during the survey. Three Threatened fauna species were recorded during the field survey: Carnaby's Cockatoo (*Calyptorhynchus latirostris*, listed as Endangered under both the EPBC Act and BC Act); Baudin's Cockatoo (*Calyptorhynchus baudinii*, listed as Endangered under both the EPBC Act and the BC Act); and Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*, listed as Vulnerable under both the EPBC Act and the BC Act). No Priority fauna species as listed by DBCA were recorded within the survey area. Following the field survey, two species of the remaining 20 conservation significant fauna species identified from the desktop assessment were considered as having Potential to occur within the survey area: Douglas' Broad-headed Bee (*Hesperocolletes douglasi*, listed as Critically Endangered under the EPBC Act and the BC Act); and a short-tongued bee (*Leioproctus douglasiellus*, listed as Critically Endangered under the EPBC Act and Endangered under the EPBC Act).

A total of five fauna habitats were recorded within the survey area. Fauna habitats within the survey area are considered to provide suitable habitat for a number of terrestrial and avian fauna, with the habitats providing a mix of suitable vegetation, substrate and microhabitats suitable for a variety of fauna species. Majority of bird species recorded during the field survey are widespread and common species, including nectivores, insectivores and granivores. The most widespread fauna habitat was Mixed shrubland, which occurred across approximately half (49.4%) of the intact native vegetated area. Cleared areas covered approximately one-third of the survey area (35.5%). Field observations indicated that these areas are likely used by fauna for movement between vegetated areas.

For the purposes of a Reconnaissance flora and vegetation survey and Basic fauna survey adequate data were collected to define and assess the presence of flora, vegetation and fauna within the survey area.

1. Introduction

1.1. Project overview

Eco Logical Australia (ELA) was engaged by Arc Infrastructure Pty Ltd (Arc) to undertake an in-season Reconnaissance flora and vegetation survey and Basic fauna survey of proposed laydown areas and existing access tracks adjacent to the rail line running between Millendon Junction (23 km northeast of the Perth CBD) to Gingin (approximately 90 km north of Perth) in the northern Swan Coastal Plain, Western Australia (Figure 1). Ecological surveys were required to identify the potential presence of conservation significant flora species, vegetation communities or fauna habitats in the survey areas prior to submission of an application for a Native Vegetation Clearing Permit.

The project comprises seven proposed laydown survey areas with a total area of 3.20 ha, spaced along approximately 60 km of rail line, and 18 access track survey areas with a total length of 27.6 km, spaced along approximately 50 km of rail line.

It is noted that all findings and conclusions presented in the following report are based on results from a Reconnaissance Level flora survey and Basic Level Fauna survey, and as such further work may be required to confirm values.

1.2. Scope of Works

The purpose of this assessment was to provide information on the ecological values of the survey areas, in particular the presence of any conservation significant flora species or fauna habitats. The specific scope of works includes:

- A brief desktop assessment prior to commencing the field survey to identify conservation significant species and communities which have the potential to occur within the survey areas;
- A Reconnaissance flora and vegetation survey, undertaken in accordance with the Environmental Protection Authority (EPA) *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016); and
- A Basic fauna survey, undertaken in accordance with the EPA *Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA 2020).

1.3. Environmental setting

1.3.1. Bioregion

The Interim Biogeographic Regionalisation for Australia (IBRA) currently classifies 89 bioregions across Australia, based on a range of biotic and abiotic factors such as climate, vegetation, fauna, geology and landform (Thackway and Cresswell 1995; Department of Agriculture, Water and the Environment [DAWE] 2021a). These bioregions are currently further refined into 419 sub-regions representing more localised and homogenous geomorphological units in each bioregion (DAWE 2021a). IBRA divides Western Australia into 26 biogeographic regions and 53 subregions based on dominant landscape characteristics of climate, lithology, geology, landform and vegetation (DAWE 2021a).

The survey areas are located in the Swan Coastal Plain bioregion (SWA), with all survey areas except three located in the Perth (SWA02) subregion. The SWA02 subregion is described as a low lying coastal

plain, mainly covered with woodlands. Vegetation broadly comprises heath and/or Tuart woodlands on limestone, Banksia and Jarrah-Banksia woodlands on Quaternary marine dunes of various ages, Marri on colluvial and alluvials, and a complex series of seasonal wetlands (Mitchell et al. 2002). Survey areas LD05, LD06 and LD07 (Gingin) are located in the Dandaragan Plateau (SWA01) subregion, described as a plateau of marine sediments mantled by sands and laterites. The vegetation is characterised by Banksia low woodland, Jarrah - Marri woodland, Marri woodland, and by scrub-heaths on laterite pavement and on gravelly sandplains (Desmond 2001).

1.3.2. Climate

The Swan Coastal Plain IBRA regions experiences a warm, Mediterranean climate with hot dry summers and mild wet winters (Mitchell et al. 2002, Desmond 2001).

Based on climate data from the Bureau of Meteorology (BoM) Pearce RAAF weather station (station number 9053; rainfall data 2001 – 2021) located in the middle of the survey areas, the survey areas receive an annual average rainfall of 599 mm, with approximately half of the annual rainfall occurring during the months of June, July and August (BoM 2021a). Mean maximum air temperatures range from 18.3°C in July to 33.7°C in January, and mean minimum temperatures range from 8.0°C in July and August to 17.8°C in February (BoM 2021a).

In the nine months preceding the field survey (no data were recorded October-December 2020), Pearce RAAF weather station received a total of 629 mm of rainfall which is above the long-term average for the area for those months (535 mm). A total of 372 mm was recorded in the three months prior to the field survey, which is higher than the long-term average for the same period (287 mm).

1.3.3. Geology, landforms and soils

The Perth subregion soils and substrate are composed of colluvial and aeolian sands, alluvial river flats, and coastal limestone. Three phases of Quaternary marine sand dune development provide relief, with the youngest system, Quindalup, closest to the coast and the Spearwood and Bassendean systems further east (Mitchell et al. 2002). The Dandaragan Plateau subregion is bounded by the Derby and Dandaragan faults and comprises Cretaceous marine sediments mantled by sands and laterites (Desmond 2001).

Soil-landscape mapping prepared by the Department of Primary Industries and Regional Development (DPIRD), provides an inventory and condition survey of lands at a 1: 250,000 scale (DPIRD 2020a). The survey areas are situated within four soil-landscape systems (Table 1).

Table 1: Soil-landscape systems mapped in the survey areas (ref)

Survey Area	System Code	System Name	Landforms and Soils	Vegetation
LD05, LD06, LD07	222Da	Dandaragan	Subdued dissected lateritic plateau, undulating low hills and rises with narrow alluvial plains. Variable deep sands and sandy gravels plus minor earths, duplexes and clays.	Marri woodlands and shrublands.
AT18	222Cb	Coonambidgee	Footslopes of sand, on the western margin of the Dandaragan Plateau.	Low woodland and shrubland with occasional trees. Species include Banksia prionotes, low and

Survey Area	System Code	System Name	Landforms and Soils	Vegetation
				occasional stunted E. marginata with Adenanthos spp.
AT03-AT18, LD03, LD04	213Ya	Yanga	Poorly drained plain with pale sands and deep sandy duplex, wet, semi-wet and saline wet soils.	Banksia-pricklybark-marri-swamp sheoak-paperbark woodlands.
AT01, AT02, AT03, LD01, LD02	213Pj	Pinjarra	Swan Coastal Plain from Perth to Capel. Poorly drained coastal plain with variable alluvial and aeolian soils.	Variable vegetation includes Jarrah, marri, wandoo, paperbark sheoaks and rudis.

1.3.4. Regional vegetation

Vegetation type and extent have been mapped at a regional scale by Beard (1979) who categorised vegetation into broad vegetation associations. Based on this mapping at a scale of 1:250,000, DPIRD has compiled a list of vegetation extent and types across Western Australia (Shepherd et al. 2002).

Six vegetation associations occur across the project area (DPIRD 2020b; Table 2). Only one association, Bassendean 949, has more than half (56%) of its total pre-European extent remaining within the Perth subregion, while the other five vegetation associations each have less than one-quarter of their pre-European extents remaining in their subregions (DBCA 2019a).

Table 2: Beard (1979) Vegetation Associations in the survey areas (DPIRD 2020b)

Survey area	Vegetation association	Description	Pre-European extent in IBRA subregion (ha)	Current extent in IBRA subregion (ha)	% Remaining in IBRA subregion
LD05, LD06, LD07	Gingin 999	Jarrah, marri and wandoo Eucalyptus marginata, Corymbia calophylla, E. wandoo.	102,177	9,441	9.2
AT13-AT18, LD04	Pinjarra 1018	Woodland / Low woodland / Low forest or Woodland	13,946	2,418	17.3
AT17	Pinjarra 999	Jarrah, marri and wandoo Eucalyptus marginata, Corymbia calophylla, E. wandoo.	763	161	21.1
AT01-AT03, AT07-AT12, LD03	Pinjarra 4	Jarrah, marri and wandoo Eucalyptus marginata, Corymbia calophylla, E. wandoo.	13,108	1,922	14.7
AT03-AT06	Bassendean 949	Other acacia, banksia, peppermint, cypress pine, casuarina, York gum Acacia spp., Banksia spp., Agonis flexuosa, Callitris	184,476	104,129	56.5

Survey area	Vegetation association	Description	Pre-European extent in IBRA subregion (ha)	Current extent in IBRA subregion (ha)	% Remaining in IBRA subregion
		spp., Allocasuarina spp., Eucalyptus loxophleba.			
LD01, LD02	Pinjarra 1009	Jarrah, marri and wandoo Eucalyptus marginata, Corymbia calophylla, E. wandoo.	18,183	2,982	16.4

Vegetation within the Perth metropolitan area has been described by Heddle *et al.* (1980) as vegetation complexes. The survey areas are located within six vegetation complexes (Table 3). None of the complexes have more than half their Pre-European extent remaining within their respective geomorphological province, and five complexes have less than one-quarter remaining.

Table 3: System 6 vegetation complexes within the survey areas (DBCA 2019)

(Extent is with respect to geomorphological province: Dandaragan Plateau for the Gingin complex, Swan Coastal Plain for the other five complexes)

Survey area	Vegetation complex	System 6 code	Description	Pre-European extent (ha)	Current extent (ha)	% Remaining
LD05, LD06, LD07	Gingin	66	Open woodland of Corymbia calophylla with second storey of Banksia grandis and Nuytsia floribunda. Fringing woodland of Eucalyptus rudis - Melaleuca rhaphiophylla along streams.	7,113	823	11.6
AT03-AT18, LD03, LD04	Yanga	38	Predominantly a closed scrub of Melaleuca species and low open forest of Casuarina obesa on the flats subject to inundation. On drier sites the vegetation reflects the adjacent vegetation complexes of Bassendean and Coonambidgee.	26,176	4,269	16.31
AT16, AT17	Coonambidgee	31	Vegetation ranges from a low open forest and low woodland of Eucalyptus todtiana - Banksia attenuata – B. menziesii – B. ilicifolia with localised admixtures of B. prionotes to an open woodland of Corymbia calophylla - Banksia species.	6,272	2,851	45.5
AT06	Beermullah	36	Mixture of low open forest of Casuarina obesa and open woodland of Corymbia calophylla - Eucalyptus wandoo – E. marginata. Minor components include closed scrub of Melaleuca species and occurrence of Actinostrobus pyramidalis (Swamp Cypress).	6,707	447	6.7
AT01, AT02, LD01	Guildford	32	A mixture of open forest to tall open forest of Corymbia calophylla - Eucalyptus wandoo – E. marginata and woodland of E. wandoo (with	90,513	4,608	5.1

Survey area	Vegetation complex	System 6 code	Description	Pre-European extent (ha)	Current extent (ha)	% Remaining
			rare occurrences of E. lane-poolei). Minor components include E. rudis - Melaleuca rhaphiophylla.			
LD02	Swan	33	Fringing woodland of Eucalyptus rudis - Melaleuca rhaphiophylla with localised occurrence of low open forest of Casuarina obesa and M. cuticularis.	15,194	2,062	13.6

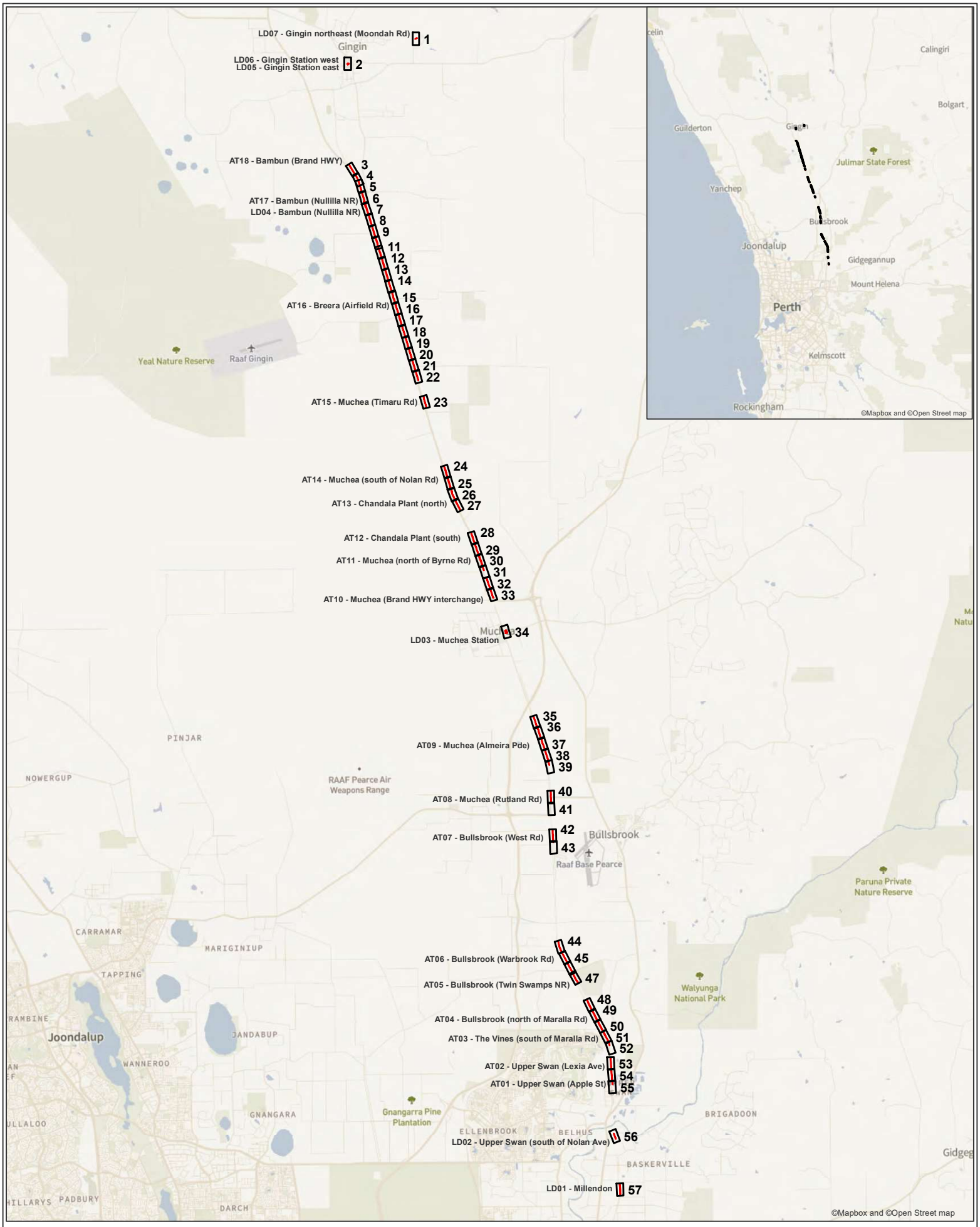
1.3.5. Hydrology

The survey areas fall within the Moore River (Gingin Brook sub-catchment) and Swan-Avon_Lower Swan (Ellen Brook, Upper Swan and Susannah Brook sub-catchments) catchments (DWER 2018a).

The survey areas lie within the Ellen Brook Floodplain and several un-named Aquatic Groundwater Dependent Ecosystems (GDEs) and several un-named Terrestrial GDEs (BoM 2021b).

1.3.6. Areas of conservation significance

Environmentally Sensitive Areas (ESAs) are defined in the Environmental Protection (Environmentally Sensitive Areas) Notice 2005 under s51B of the EP Act. ESAs include areas declared as World Heritage, included on the Register of the National Estate, defined wetlands, Bush Forever sites, vegetation containing rare (Threatened) flora and/or TECs. A total of 32 ESAs intersect the survey area (DWER 2020b). There are no DBCA legislated lands or Bush Forever sites overlapping the project area (DBCA 2021a). Ellen Brook Swamp System is listed on the Directory of Important Wetlands in Australia (DBCA 2018a). This wetland is located with Twin Swamps Nature Reserve. Survey area AT05 intersects Ellen Brook Swamp System, but not the Nature Reserve, along its western edge.



Project overview

Study Area

Map Frame

0 1.25 2.5 5

Kilometres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19686-RS Date: 2/12/2021

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2. Methodology

2.1. Brief desktop review

A brief desktop assessment prior to the field survey was undertaken to identify any potential conservation significant species (including Threatened and Priority flora and fauna) and communities which could potentially be present within the survey areas (see Appendix A for definitions).

Aerial photography for the survey areas was reviewed to identify extent of vegetation, relevant landscape matters and any other relevant issues where possible.

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters Search Tool (PMST) for Threatened species and communities listed under the EPBC Act (Department of Agriculture, Water and Environment [DAWE] 2021a) and the Department of Biodiversity, Conservation and Attractions (DBCA) and Western Australian Museum (WAM) NatureMap online database (DBCA 2007-2021) were used to search for information relating to conservation listed flora, fauna and ecological communities in order to inform the field survey. These searches were carried out using a buffer of 2 km around a continuous line joining all survey areas within the greater project area.

An assessment of the likelihood of occurrence of any Threatened and Priority flora and fauna was carried out using the criteria listed in Appendix B.

2.2. Field survey

2.2.1. Survey areas

The seven laydown survey areas were spaced from Gingin (LD07) to Millendon station (LD01) (

Table 4). Relevés were not completed in all laydown areas as there was not always a sufficient area of intact native vegetation in which to place a relevé. Photographs of each laydown survey area are presented in Appendix J: Survey Area Photographs.

The original access track survey areas comprised 18 sections from Bambun (Brand Hwy - AT18) to Upper Swan (Apple St – AT01), were 5 m wide and followed existing tracks. The access track survey areas were amended on 28th September 2021 to allow for alternative development areas. The amended areas were shifted laterally or widened in some places to a maximum of 30 m. They did not include all the original survey areas; in particular original access track survey areas AT18, AT15, AT08, AT06, AT05, AT01 were not included in the amended access track survey areas. The priority for the field survey was to cover the amended survey areas, and, where time allowed, adjacent parts of the original survey areas. Due to this prioritisation, not all portions of the original access track survey areas were surveyed. Naming conventions for the original access track survey areas were retained for the amended survey areas (Table 5). Relevés were not completed in all access tracks survey areas as there was not always a sufficient area of intact native vegetation in which to place a relevé. Photographs from the northern and southern ends of each access track survey area are presented in Appendix J: Survey Area Photographs.

Table 4: Laydown survey areas

Survey Area Name	Area (ha)	Location	Relevés
LD01	0.93	Millendon	ELA34
LD02	0.46	Upper Swan (south of Nolan Ave)	-
LD03	0.85	Muchea Station	ELA19
LD04	0.67	Bambun (Nullilla NR)	-
LD05	0.13	Gingin Station east	-
LD06	0.10	Gingin Station west	ELA01
LD07	0.07	Gingin northeast (Moondah Rd)	-

Table 5: Access track survey areas

Original Survey Area Name	Included in Amended Survey Area	Combined Length (m)	Location	Relevés
AT01	None	129	Upper Swan (Apple St)	-
AT02	Partial	1215	Upper Swan (Lexia Ave)	ELA32, ELA33
AT03	Partial	946	The Vines (south of Maralla Rd)	-
AT04	Partial	1754	Bullsbrook (north of Maralla Rd)	ELA28, ELA29, ELA30, ELA31
AT05	None	619	Bullsbrook (Twin Swamps NR)	ELA27
AT06	None	1791	Bullsbrook (Warbrook Rd)	ELA25, ELA26
AT07		580	Bullsbrook (West Rd)	ELA24
AT08	None	660	Muchea (Rutland Rd)	ELA23
AT09	Partial	2729	Muchea (Almeira Pde)	ELA20, ELA21
AT10	Partial	1086	Muchea (Brand Hwy interchange)	ELA16, ELA17, ELA18
AT11	Partial	944	Muchea (north of Byrne Rd)	ELA15
AT12	Partial	833	Chandala Plant (south)	ELA14
AT13	Partial	1037	Chandala Plant (north)	ELA13
AT14	Partial	1424	Muchea (south of Nolan Rd)	ELA10, ELA11, ELA12
AT15	None	627	Muchea (Timaru Rd)	ELA22
AT16	Partial	7011	Breera (Airfield Rd)	ELA05, ELA06, ELA07, ELA08, ELA09
AT17	Partial	3476	Bambun (Nullilla NR)	ELA02, ELA03, ELA04
AT18	None	889	Bambun (Brand Hwy)	-

2.2.2. Survey team and timing

The field survey was conducted by Emily Chetwin (Botanist) and Briana Wingfield (Ecologist) from 4th to 7th October 2021. The survey team's roles and licences are provided in Table 6. No licence was required for the Basic fauna survey.

Survey timing was consistent with EPA (2016) recommendations for undertaking primary flora and vegetation surveys in the South-west Botanical Province (i.e. Spring [September to November]). Total rainfall for the three months prior to the field survey at the Pearce RAAF weather station (#09053) was 372 mm, significantly higher than the long-term average (2001-2021) of 96 mm (Bureau of Meteorology 2021). The high rainfall resulted in long, narrow (5 m wide) pools of open water in several sections of the existing access tracks, making access to some parts of the survey areas impossible, although in most places vegetation could be observed from the accessible part of a survey area. Reproductive material was present on many species during this survey, enabling confident flora species identification.

Table 6: Survey team

Staff	Project role	Licence
Emily Chetwin	Project Manager; Field survey (flora and vegetation component); Reporting	Flora taking licence: FB62000026-3 Threatened Flora Licence: TFL-124-2021
Briana Wingfield	Field survey (flora, vegetation and fauna components); Reporting	Flora taking licence: FB62000316

2.2.3. Reconnaissance flora and vegetation survey

A Reconnaissance flora and vegetation survey was undertaken across the survey areas in accordance with EPA *Technical Guidance for flora and vegetation* (EPA 2016).

A total of 34 relevés of 5 m radius were established across the survey areas (Appendix M: Maps – Survey Effort). Dominant vegetation types were described with respect to dominant species, structure and overall condition. The following data were recorded within each relevé:

- Site details (site name, number, observer/s, date and location);
- Broad vegetation type survey based on an assessment of the dominant flora species for the three traditional strata (upper, mid and ground) and mapping extent; and
- Vegetation condition in accordance with the Keighery (1994) vegetation condition scale, as provided in the EPA Technical Guidance (EPA 2016).

Suitable habitat of the survey areas was searched to identify any conservation significant flora or vegetation communities potentially occurring, including:

- Threatened flora or Threatened Ecological Communities (TECs) listed under the EPBC Act;
- Threatened (Declared Rare) flora listed under the latest Western Australia Wildlife Conservation (Rare Flora) Notice under the BC Act;
- Priority Ecological Communities (PECs) endorsed by the Western Australian Minister for the Environment; and
- Priority flora listed by DBCA.

In addition, any encountered Declared Pests listed under the State *Biosecurity and Agriculture Management Act 2007* (BAM Act) or Weeds of National Significance (WoNS) were recorded and mapped.

Photographs were taken at the start and end of every access track survey area section to ensure that vegetation presence and accessibility were recorded at all entry points for the survey areas (Appendix J: Survey Area Photographs).

Survey methodology involved personnel walking meandering traverses across the survey areas, with all relevant vegetation types visited and areas of potential significant flora habitat traversed, with spacing dependent on factors including suitable habitat, disturbance (e.g. cleared areas), landform and survey area accessibility. Locations of survey traverses are presented in Appendix M: Maps – Survey Effort.

Flora species able to be identified in the field were recorded, and specimens of unfamiliar species were collected for later identification. All collections were assigned a unique collecting number. For conservation significant flora species identified in the field, the following was recorded:

- A colour photograph;
- GPS location;
- Population size estimate;
- Location of population boundaries;
- Associated habitat/landscape element;
- Time and date observed;
- Observer details; and
- A specimen suitable for use as a reference specimen (where appropriate).

2.2.3.1. Flora Identification and Nomenclature

Flora specimen identification was undertaken by ELA Botanist Daniel Brassington. Species identification utilised taxonomic literature and keys, and where required specimens were confirmed using the Western Australian Herbarium (WAH) collection. Where considered appropriate, specimens that meet WAH specimen lodgement requirements (e.g. Threatened and Priority Flora, range extensions) may be submitted along with Threatened and Priority Report forms to DBCA. Nomenclature used for the flora species within this report follows the WA Plant Census as available on *FloraBase* (WAH 1998-).

2.2.4. Basic fauna survey

The Basic fauna survey was conducted across the survey areas in accordance with EPA *Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment* (EPA 2020). The Basic fauna survey involved personnel walking transects through the survey areas, delineating and mapping fauna habitats and recording opportunistic sightings of fauna.

Fauna habitats were assessed for their ability to support and sustain populations of fauna, along with an assessment of the likelihood of occurrence of conservation significant fauna species. The habitat characteristics and fauna database records used in assessing likelihood of occurrence for fauna included:

- Vegetation type, structure and condition;
- Soil and landform type;

- Extent and connectivity of bushland;
- Fauna species habitat preferences;
- Proximity of conservation significant fauna records; and
- Signs of species presence.

Opportunistic recordings of fauna species were made at all times during the field survey. These included visual sightings of active fauna such as reptiles and birds; records of bird calls; and signs of species presence such as tracks, diggings, burrows, scats and any other signs of fauna activity.

Nomenclature used for the vertebrate fauna species within this report follows the WAM *Checklist of the Vertebrates of Western Australia* (WAM 2020).

2.3. Limitations

The EPA Technical Guidance documents (EPA 2016, 2020) recommend including a discussion of the constraints and limitations of the survey methods used. An assessment of potential limitations of this survey are summarised in Table 7 below. One potential limitation was identified, regarding background information.

Table 7: Survey limitations

Potential survey limitation	Impact on survey
Sources of information and availability of contextual information (i.e. pre-existing background versus new material).	**Potential limitation**. Broad-scale vegetation mapping at a scale of 1:1,000,000 was available. Land system mapping at a scale of 1:2,000,000 and soil and landform mapping was also available. Available information was sufficient to provide context at a broad scale; however, as no paid DBCA database searches were conducted, the mapped extent of significant communities and specific locations of significant flora and fauna were not known and therefore were considered a potential limitation, given the likely presence of a TEC within the survey areas.
Scope (i.e. what life forms, etc., were sampled).	**Not a limitation**. The survey requirement of a Reconnaissance flora and vegetation survey and a Basic fauna survey in accordance with relevant State and Federal legislation and EPA guidance documents was adequately met.
Proportion of flora collected and identified (based on sampling, timing and intensity).	**Not a limitation**. A Reconnaissance level survey records the dominant and abundant species, with little requirement for a comprehensive account of species richness. Data recorded were sufficient for this level of survey.
Completeness and further work which might be needed (i.e. was the relevant survey area fully surveyed).	**Not a limitation**. The survey area coverage met the requirements of a Reconnaissance level flora and vegetation survey and Basic fauna survey, as outlined in the scope of work. All parts of the laydown survey areas and the amended access track survey areas were surveyed.
Mapping reliability.	**Not a limitation**. Coverage of the survey areas was considered to be good. High quality aerial maps were used for both the survey and subsequent vegetation mapping. Some small portions of the survey areas were inaccessible due to open water; however, these portions could be adequately observed from areas adjacent, along with any contiguous vegetation immediately adjacent. In many places there were distinct boundaries between vegetation types in the survey areas, observable both in the field and on aerial maps, and hence mapped boundaries are considered accurate.
Timing, weather, season, cycle.	**Not a limitation**. The survey timing was consistent with the EPA recommendations for undertaking flora and vegetation surveys in the South-west Botanical Province (i.e. Spring [September to November]; EPA 2016). Rainfall in the three months prior to the field survey was above average; reproductive material was present on many species during this survey, enabling confident flora species identification.
Disturbances (fire, flood, accidental human intervention, etc.).	**Not a limitation**: Disturbances within the survey areas included previously cleared vehicle access tracks, clearing adjacent to the rail line and historical clearing within some of the laydown survey areas. In some places introduced flora species dominated the vegetation. These disturbances did not negatively impact the ability to meet objectives outlined in the scope of works.
Intensity (in retrospect, was the intensity adequate).	**Not a limitation**. The survey effort was appropriate for a Reconnaissance and Targeted level flora and vegetation survey and Basic fauna survey.
Resources (i.e. were there adequate resources to complete the survey to the required standard).	**Not a limitation**. The number of personnel conducting this field survey in the given time was adequate to undertake the required level of survey. Additional resources, including equipment available, additional support and personnel were adequate.

Potential survey limitation	Impact on survey
Access problems (i.e. ability to access survey area).	**Not a limitation**. All relevant areas within the survey areas were able to be accessed and surveyed.
Experience levels (e.g. degree of expertise in plant identification to taxon level).	**Not a limitation**. The personnel conducting this field survey were both suitably qualified to identify specimens, having multiple years of field experience in flora and fauna surveys across Western Australia.

3. Results

3.1. Desktop assessment

3.1.1. Flora summary

Prior to the field survey, 30 conservation significant flora species were identified as possibly occurring within the survey areas, based on the database searches undertaken in Section 2.1. Using the criteria outlined in Appendix B, prior to the field survey five of these species were assessed as being Likely to occur, ten as having the Potential to occur and 15 as being Unlikely to occur. The five species considered as Likely to occur were: *Darwinia foetida* (listed as Critically Endangered under the EPBC Act and Endangered under the BC Act); *Grevillea curviloba* (listed as Endangered under the EPBC Act and Critically Endangered under the BC Act); *Grevillea evanescens* (listed as P1 by DBCA); *Styphelia fililoba* (listed as P3 by DBCA); and *Stylidium longitubum* (listed as P4 by DBCA). The flora likelihood of occurrence assessment is presented in Appendix C: Conservation significant flora likelihood of occurrence assessment.

3.1.2. Fauna summary

Prior to the field survey, 23 species were identified as possible occurring within the survey areas, based on the database searches undertaken in Section 2.1. Using the criteria outlined in Appendix B, prior to the field survey three of these species were assessed as being Likely to occur, six as having the Potential to occur and 14 as being Unlikely to occur. The three species considered as Likely to occur were: Carnaby's Cockatoo (*Calyptorhynchus latirostris*; listed as Endangered under the EPBC Act and the BC Act), Baudin's Cockatoo (*Calyptorhynchus baudinii*; listed as Endangered under the EPBC Act and the BC Act) and Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*; listed as Vulnerable under the EPBC Act and the BC Act). The fauna likelihood of occurrence assessment is presented in Appendix D: Conservation significant fauna likelihood of occurrence assessment.

3.1.3. Ecological Communities summary

Seven TECs were identified by the database searches as possibly occurring in the survey areas. Prior to the field survey, one community, *Banksia Woodlands of the Swan Coastal Plain* (Banksia Woodlands TEC), listed as EN under the EPBC Act and as P3 by DBCA, was assessed as being Likely to occur within the survey areas. Five communities were considered as having Potential to occur within the survey areas, namely:

- *Clay Pans of the Swan Coastal Plain* (Clay Plans TEC), listed as CR under the EPBC Act and VU under the BC Act;
- *SCP3a - Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands of the Swan Coastal Plain* (*Corymbia calophylla - Xanthorrhoea preissii* TEC), listed as EN under the EPBC Act and CR under the BC Act;
- *Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain* (Muchea Limestone TEC), listed as EN under both the EPBC Act and the BC Act;
- *Shrublands and Woodlands on Perth to Gingin ironstone (Perth to Gingin ironstone association) of the Swan Coastal Plain* (Gingin ironstone TEC), listed as EN under the EPBC Act and CR under the BC Act; and

- *Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain* (Tuart Woodlands TEC), listed as CR under the EPBC Act and as P3 by DBCA.

One community, Assemblages of plants and invertebrate animals of tumulus (organic mound) springs of the Swan Coastal Plain, listed as EN under the EPBC Act and CR under the BC Act, was considered prior to the field survey as being Unlikely to occur. The ecological communities likelihood of occurrence assessment is presented in Appendix E: Conservation significant ecological communities likelihood of occurrence assessment.

3.2. Flora and vegetation survey

3.2.1. Flora overview

A total of 153 flora taxa (97 native and 56 introduced taxa) from 106 genera and 48 families were recorded across 34 relevés (105 taxa) and opportunistic collections (49 additional taxa). Families with the highest number of taxa were Myrtaceae (20 taxa), Fabaceae (17 taxa) and Proteaceae (16 taxa). *Banksia*, *Acacia* and *Eucalyptus* were the best represented genera throughout the survey areas with six, five and five taxa recorded, respectively. A full species list is provided in Appendix F: Flora species listand the flora species by relevé matrix is provided in Appendix G: Flora species matrix.

Although a Reconnaissance level flora and vegetation survey requires only the dominant and abundant species to be recorded within relevés, effort was made to record as many flora species within the survey areas as time permitted and hence species recorded opportunistically formed a high proportion of the overall number of species.

3.2.2. Conservation significant flora

One Threatened flora species, *Grevillea curviloba* (listed as EN under the EPBC Act and EN under the BC Act) was recorded during the field survey. *Grevillea curviloba* was previously listed as two subspecies, *G. curviloba* subsp. *curviloba* (listed as CR under the EPBC Act) and *G. curviloba* subsp. *incurva* (listed as EN under the EPBC Act), but the two subspecies are currently no longer recognised (Keighery et al. 2020). *Grevillea curviloba* had been identified prior to the field survey as Likely to occur in the survey areas. A total of 265 *Grevillea curviloba* plants were recorded across survey areas AT07, AT08, AT10, AT12, AT14 and AT15, with 20 plants recorded within five relevés and the remainder recorded opportunistically. Locations of *Grevillea curviloba* within each specific survey area are provided in Appendix H: Locations of Conservation Significant Floraand shown in Appendix N: Maps – Conservation significant flora species, Declared Pests and WoNS species, Vegetation communities, Vegetation condition and TEC locations.. A Threatened and Priority flora report form for this species will be submitted to DBCA following the completion of this project.

One Priority flora species, *Grevillea evanescens*, listed as P1 by DBCA, was recorded during the field survey. This species had been identified prior to the field survey as Likely to occur in the survey areas. One individual plant of *Grevillea evanescens* was recorded opportunistically at one location in survey area AT15 (Appendix H: Locations of Conservation Significant Flora, Appendix N: Maps – Conservation significant flora species, Declared Pests and WoNS species, Vegetation communities, Vegetation condition and TEC locations.). A Threatened and Priority flora report form for this species will be submitted to DBCA following the completion of this project.

Following the field survey, of the remaining 28 conservation significant flora species identified from the desktop assessment (Section 3.1.1, Appendix C: Conservation significant flora likelihood of occurrence assessment) as possibly occurring in the survey areas, none were considered Likely to occur within the survey areas, six were considered to have the Potential to occur, and 22 were assessed as being Unlikely to occur (Appendix C: Conservation significant flora likelihood of occurrence assessment). This assessment is based on availability of suitable habitat for the species, proximity to previous records and detectability of the species. Those considered to have Potential to occur are small or cryptic species that may not have been visible in dense vegetation, especially if not in flower.

3.2.3. Introduced flora

A total of 56 introduced (weed) species were recorded in the survey areas, with almost half of these species representing the Poaceae (11 taxa), Fabaceae (8 taxa) and Iridaceae (7 taxa) families. Four weed species are listed as Declared Pests under the BAM Act: Bridal Creeper (**Asparagus asparagoides*); Arum Lily (*Zantedeschia aethiopica); One-leaf Cape Tulip (**Moraea flaccida*); and Paterson's Curse (**Echium plantagineum*). Bridal Creeper is also listed as a WoNS.

3.2.4. Vegetation communities

Eight broad vegetation communities were delineated and mapped within the survey areas (Table 8, Appendix N: Maps – Conservation significant flora species, Declared Pests and WoNS species, Vegetation communities, Vegetation condition and TEC locations.). The most widespread intact vegetation community was *AsS*, *Acacia saligna* Shrubland, which covered 19.5% (6.1 ha) of the survey areas. Cleared areas, including previously cleared vehicle access tracks and cleared areas adjacent to the rail line, covered approximately one-third (35.5%; 11.2 ha) of the survey areas.

Vegetation communities were defined on the basis of relevé data and as such are broadly described using dominant flora species for each of upper, mid and lower strata, along with informal field observations and photographs, and aerial imagery.

Whilst much of the survey areas comprised previously cleared areas there were slivers of intact native vegetation present, often at the eastern side of the access track survey areas. These slivers of bushland were often bordered to the east (opposite side of the survey areas to the rail line) by cleared areas, e.g. pastoral land, roads and residential areas. Only occasionally was the intact native vegetation in the survey areas connected to bushland patches of any significant size immediately adjacent.

Table 8: Vegetation communities mapped in the survey areas

Photo	Vegetation type code	Description	Relevé/s	Survey Area	Total area (ha)	Proportion of the survey areas (%)
	AsS	*Acacia saligna* Shrubland	ELA12, ELA15, ELA20, ELA23, ELA24, ELA28	AT04, AT07, AT08, AT09, AT11, AT14	6.1	19.5
	AsppW	*Allocasuarina* spp. Woodland	-	LD04 & others from informal field observations	0.7	2.3
	BsspW	*Banksia* spp. Woodland	ELA10, ELA17, ELA18, ELA29, ELA30	AT04, AT10, AT14	3.2	10.2

Photo	Vegetation type code	Description	Relevé/s	Survey Area	Total area (ha)	Proportion of the survey areas (%)
	CcW	*Corymbia calophylla* Woodland	ELA01, ELA16, ELA19, ELA25, ELA31, ELA32, ELA34	AT02, AT04, AT06, AT10, LD01, LD03, LD06	3.5	11.1
	MmS	Mixed mid open Shrubland	ELA08	AT16	0.6	1.9
	MrW	*Melaleuca rhaphiophylla* Woodland	ELA02, ELA04, ELA05, ELA06, ELA07, ELA09, ELA13	AT13, AT16, AT17	2.2	6.9

Photo	Vegetation type code	Description	Relevé/s	Survey Area	Total area (ha)	Proportion of the survey areas (%)
	MtS	Mixed tall sparse Shrubland	ELA03, ELA11, ELA14, ELA22, ELA33	AT02, AT15, AT14, AT15, AT17	3.0	9.4
	MvS	*Melaleuca viminea* Shrubland	ELA21, ELA26, ELA27	AT05, AT06, AT09	0.3	1.0
				Cleared areas	11.2	35.5
				Not surveyed	**0.7**	**2.2**
				Total	**31.4**	**100.0**

3.2.5. Vegetation condition

The condition of intact native vegetation ranged from Very Good to Completely Degraded (Table 9, Appendix N: Maps – Conservation significant flora species, Declared Pests and WoNS species, Vegetation communities, Vegetation condition and TEC locations.), based on the Keighery (1994) vegetation condition scale provided in EPA (2016). Disturbances common to most of the survey areas included: introduced flora (weed) species, which many in places formed a dominant part of one of more strata; vehicle tracks (given the access tracks survey areas included existing tracks); and clearing (particularly adjacent to rail tracks).

Native vegetation within access track survey area AT15 had been burnt approximately 5 years ago, based on field observations; however, sufficient species were present to broadly describe vegetation communities.

Table 9: Vegetation condition recorded in the survey areas

Condition	Extent in the survey area (ha)	Proportion of survey areas (%)
Very Good	1.1	3.5
Good	6.6	21.2
Degraded	6.6	21.0
Completely Degraded	5.3	16.7
Cleared	11.2	35.5
Total	31.4	100.0

3.2.6. Conservation significant ecological communities

Following the field survey, one TEC, *Banksia Woodlands of the Swan Coastal Plain*, listed as Endangered under the EPBC Act and as P3 by DBCA, was identified by the desktop assessment as Likely to occur in the survey areas (section 3.2.6.1).

Following the field survey, four TECs listed under the EPBC Act identified by the desktop assessment as possibly occurring in the survey areas were assessed as having Potential to occur in the survey areas (sections 3.2.6.2, 3.2.6.3. 3.2.6.4, 3.2.6.5):

- Clay Pans of the Swan Coastal Plain (Clay Pans TEC);
- *Corymbia calophylla - Xanthorrhoea preissii* woodlands and shrublands of the Swan Coastal Plain (*Corymbia calophylla - Xanthorrhoea preissii* TEC);
- Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain (Muchea Limestone TEC); and
- Shrublands and Woodlands on Perth to Gingin ironstone (Perth to Gingin ironstone association) of the Swan Coastal Plain (Perth-Gingin ironstone TEC).

Following the field survey, two of the TECs identified by the desktop assessment as possibly occurring in the survey areas were assessed as Unlikely to occur or Does not Occur. These are: *Assemblages of plants and invertebrate animals of tumulus (organic mound) springs of the Swan Coastal Plain* (Tumulus Springs TEC); and *Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community* (Tuart Woodlands TEC) (sections 3.2.6.6, 3.2.6.7).

All TEC likelihood assessments are based on the outcomes of a reconnaissance level survey. In order to confirm the presence/absence of potential TECs within the survey areas a Detailed flora and vegetation survey would be required. As a result, ELA has taken a precautionary approach to likelihood scenarios.

3.2.6.1. Banksia Woodlands of the Swan Coastal Plain TEC

In order to determine if any vegetation within the survey areas forms part of the Banksia Woodlands TEC, ELA relevés and broad vegetation types were compared with key diagnostic characteristics for the TEC, as outlined in the Approved Conservation Advice (Department of the Environment and Energy [DoEE] 2016, Appendix K: Banksia Woodlands TEC Key diagnostic characteristics). To be considered as part of the Banksia Woodlands TEC a patch needs to meet at least the 'Good' condition category (DoEE 2016); therefore, areas of Degraded condition within the survey areas were not included in this assessment, except where they adjoined areas of Good or better condition. Several of these diagnostic characteristics were assessed for patches of vegetation community BsppW, including:

- **Location/landform**: the survey areas are located on the Swan Coastal Plain and occurs in one of the limited scenarios where alluvial, limestone and other lithic substrates are potentially juxtaposed with Bassendean and Spearwood sands.
- **Structure and composition**: vegetation within three patches of vegetation in the survey areas is dominated or co-dominated by *Banksia attenuata* and *B. menziesii*. Understorey includes sclerophyllous shrub species of varying height, and an herbaceous ground layer of mostly introduced forbs and grasses. Patch A is centred on relevé ELA10 within survey area AT14. Patch B is centred on relevé ELA17 within survey area AT10. Patch C is centred on relevés ELA29 and ELA30 within survey area AT04.
- **Condition thresholds**: the community was assessed and sampled in the highest condition representation available in the survey areas and was completed in the most appropriate season for the Swan Coastal Plain (i.e., spring).
- **Minimum patch size**: vegetation within Patch C in survey area AT04 meets the minimum patch size requirements, as it has 1.1 ha in Very Good condition (0.6 ha of which are inside the survey area). Patch C also includes 3.8 ha of vegetation in Degraded condition (1.9 ha inside the survey area). Patch A was in Good condition but was only 1.6 ha in area, below the required minimum size of 2 ha. Patch B was in Degraded condition and was not connected to vegetation in Good or better condition. Areas in Degraded condition are not considered part of the TEC, except where they are connected to patches in better condition.

One patch of vegetation within the survey areas, Patch C in survey area AT04, was assessed as Likely to represent the Banksia Woodlands TEC. Whilst there are vehicle tracks within this patch (shown in Appendix N: Maps – Conservation significant flora species, Declared Pests and WoNS species, Vegetation communities, Vegetation condition and TEC locations.), they are approximately only 5 m wide, therefore included in patch size calculations (DoEE 2016).

The location of conservation significant vegetation within the survey areas is presented in Appendix N: Maps – Conservation significant flora species, Declared Pests and WoNS species, Vegetation communities, Vegetation condition and TEC locations.. The full four-stage assessment against the key diagnostic characteristics for this TEC is presented in Appendix K: Banksia Woodlands TEC Key diagnostic characteristics. The condition thresholds that apply to the TEC, also apply to the PEC (DBCA 2021).

It is recognised that that this assessment is based on results from a reconnaissance level survey, and it is likely that a detailed flora and vegetation survey would be required to confirm presence/absence of the Banksia Woodlands TEC and furthermore determine potential sub-components (i.e., Floristic community types (FCTs); Gibson et al 1994).

3.2.6.2. Clay Pans of the Swan Coastal Plain TEC

In order to assess the likelihood of occurrence of the Clay Pans TEC within the survey areas, field observations, photographs, aerial imagery, ELA relevés and broad vegetation types were compared with the description of the TEC provided in the Listing Advice (Threatened Species Scientific Committee [TSSC] 2012) and summarised in Appendix E: Conservation significant ecological communities likelihood of occurrence assessment. For a vegetation patch to be considered part of the Clay Pans TEC, it must have a functioning hydrologic regime and be in at least Good condition. As the ecological community occurs in very localised locations that can be very small, there is no minimum patch size requirement.

Several inundated and damp, low-lying areas were observed in the survey areas. These areas were typically true wetlands (no heavy clay) and/or low-lying areas in degraded condition (high weed cover and no native species). Although typical clay pan characteristics were not obvious (e.g. grey clay soils, species rich heath), it is recognised that most of these patches were inundated at the time of survey. In addition, several species typically associated with Floristic Community Type 8 (FCT08) were also recorded; with this FCT being a recognised subcomponent of the Clay Pans TEC (see section 2.2.6.5). These factors, in conjunction with the close proximity of known records of the TEC have resulted in a Potential likelihood of occurrence rating.

A total of ten patches that potentially require further investigation to confirm the presence/absence of the Clay Plans TEC are:

- relevé ELA04 in vegetation community MrW in survey area AT17;
- relevés ELA05, ELA06 and ELA09 in vegetation community MrW in survey area AT16;
- relevé ELA13 in vegetation community MrW in survey area AT13;
- relevé ELA26 in vegetation community MvS in survey area AT06;
- relevé ELA27 in vegetation community MvS in survey area AT05;
- relevés ELA28 and ELA31 in vegetation communities AsS and CcW in survey area AT04; and
- relevé ELA33 in vegetation community MtS in survey area AT02.

It is recognised that that this assessment is based on results from a reconnaissance level survey, and it is likely that a detailed flora and vegetation survey would be required to confirm presence/absence of the Clay Pans TEC and define potential sub-components (i.e., TECs as listed under the BC Act – SCP07, SCP08, SCP09, SCP10a and PECs listed by DBCA – *Claypans with mid dense shrublands of Melaleuca lateritia over herbs*).

3.2.6.3. Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands of the Swan Coastal Plain TEC

In order to assess the likelihood of occurrence of the *Corymbia calophylla - Xanthorrhoea preissii* TEC within the survey areas, field observations, ELA relevés and broad vegetation types were compared with the description of the TEC provided in the Approved Conservation Advice (DoEE 2017a) and summarised in Appendix E: Conservation significant ecological communities likelihood of occurrence assessment.

Critical habitat for the TEC is the heavy soils on which it occurs, the fresh superficial groundwater, and/ or surface water that may help sustain flora species in this community, and the catchment for this groundwater and surface water. Because of its very restricted distribution, no condition thresholds exist for this TEC (DoEE 2017a).

Several relevés comprised a dominant *Corymbia calophylla* woodland structure with *Xanthorrhoea preissii* present in the midstorey. None of the other 16 key flora species listed in the Approved Conservation Advice were recorded within those five relevés; the ground stratum was dominated by introduced species, particularly grasses. All five relevés occurred on moist dark brown-grey loam, sandy loam and sand and were in Good to Very Good condition.

Based on the dominant *Corymbia calophylla* woodland structure on moist, dark brown-grey loam, presence of *Xanthorrhoea preissii* in the mid stratum and proximity to known records a Potential likelihood of occurrence rating was assigned. A total of five vegetation patches that potentially require further investigation to confirm the presence/absence of the TEC are: ELA16 in survey area AT10, ELA19 in LD03, ELA20 in AT09, ELA25 in AT06 and ELA34 in LD01.

It is recognised that that this assessment is based on results from a reconnaissance level survey, and it is likely that a detailed flora and vegetation survey would be required to confirm presence/absence of the *Corymbia calophylla - Xanthorrhoea preissii* TEC and furthermore determine potential sub-components (i.e. Floristic community type FCT 3c; Gibson et al 1994).

3.2.6.4. Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain TEC

In order to assess the likelihood of occurrence of the Muchea Limestone TEC within the survey areas, field observations, ELA relevés and broad vegetation types were compared with the description of the TEC provided in the Approved Conservation Advice (DoEE 2017b) and summarised in Appendix E: Conservation significant ecological communities likelihood of occurrence assessment.

The habitat that is critical for survival of the ecological community is the area of occupancy of known occurrences; the substrate on which the community occurs, the fresh superficial groundwater and/or surface waters that help to sustain this community, and the local catchments for this ground/surface water. Because of its very restricted distribution, no condition thresholds exist for this TEC (DoEE 2017b).

Some known floristic characteristics of the Muchea Limestone TEC including *Grevillea curviloba* (T) and *Grevillea evanescens* (P1) (DoEE 2017b) were recorded in some parts of the survey areas. *Grevillea curviloba* (T) is known to grow over limestone at depth where the water table is high and is noted as associating with the Muchea Limestone TEC (TSSC 2016a). *Melaleuca viminea* shrublands form part of the typical vegetation of the TEC (DoEE 2017b), and in the current survey were present in some parts of the survey areas.

Based on the occurrence of known floristic characteristics, presence of one vegetation community typical of the TEC and proximity to known records, a Potential likelihood of occurrence rating was assigned. A total of eight vegetation patches that potentially require further investigation to confirm the presence/absence of the Muchea Limestone TEC are:

- Vegetation community MvS in survey area AT05;

- Vegetation community MvS in survey area AT06;
- Vegetation community MvS in survey area AT09;
- relevé ELA 18 and vegetation communities CcW and BsppW in survey area AT10;
- relevé ELA14 in vegetation community MtS in survey area AT12;
- relevés ELA10 and ELA12 in survey area AT14; and
- relevé ELA22 and vegetation community MtS in survey area AT15.

It is recognised that this assessment is based on results from a reconnaissance level survey, and it is likely that a detailed flora and vegetation survey would be required to confirm presence/absence of the Muchea Limestone TEC and furthermore provide data for Floristic Community Type analysis to aid the assessment (e.g. calcicole species in Muchea Limestone sites can be linked with floristic community types on Tamala Limestone in Spearwood dunes or floristic community type 18 shrublands on calcareous silts (DoEE 2017b)).

3.2.6.5. Shrublands and Woodlands on Perth to Gingin ironstone (Perth to Gingin ironstone association) of the Swan Coastal Plain TEC

In order to assess the likelihood of occurrence of the Perth-Gingin Ironstone TEC in the survey areas, field observations, ELA relevés and broad vegetation types were compared with the description of the TEC provided in the Listing Advice (Endangered Species Scientific Subcommittee [ESSS] 2000) and summarised in Appendix E: Conservation significant ecological communities likelihood of occurrence assessment.

Local hydrogeology is very important in determining the occurrence of this ecological community. Occurrences of the community are all located on the north Gnangara Mound shallow groundwater aquifer. Where it occurs, the height of the groundwater table is 60-70 m above sea level and there is a low point in topography adjacent to a peak in the water mound and adjacent to a flow channel in the groundwater mound. Ironstone soils are found in locally restricted areas within the mainly alluvial clays of the Guildford Formation (ESSS 2000). The Perth-Gingin Ironstone TEC is described as being located on seasonally inundated ironstone and heavy clay soils on the eastern side of the Swan Coastal Plain, and supporting a rich layer of herbaceous annuals under a sparse shrub layer (ESSS 2000).

Several species known to occur within the Perth-Gingin Ironstone TEC, namely *Acacia saligna, Grevillea curviloba* (T), *Jacksonia furcellata* and *Melaleuca viminea*, were recorded within several of the survey areas. Of note was the presence of *Grevillea curviloba* (T), as this species is known to grow over ironstone at depth where the water table is high and is noted as associating with the Perth-Gingin Ironstone Limestone TEC (TSSC 2016b).

Based on the occurrence of several key species (particularly *G. curviloba*), the location of a known occurrence of the TEC immediately adjacent to survey area AT16, a Potential likelihood of occurrence rating was assigned. A total of seven vegetation patches that potentially require further investigation to confirm the presence/absence of the Perth-Gingin Ironstone TEC are:

- relevés ELA29 and ELA 30 in survey area AT04;
- relevés ELA20 and ELA21 in survey area AT09;
- relevé ELA17 in survey area AT10;
- relevés ELA10 and ELA12 in survey area AT14;

- vegetation community MtS in survey area AT15;
- relevé ELA08 in survey area AT16; and
- relevé ELA03 in survey area AT17.

It is recognised that that this assessment is based on results from a reconnaissance level survey, and it is likely that a detailed flora and vegetation survey would be required to confirm presence/absence of the Muchea Limestone TEC and furthermore provide data for Floristic Community Type analysis to aid the assessment (i.e. floristic analyses of plots on this soil type link to 'herb rich shrublands in clay pans' (community type 8) as described by Gibson *et al*. (1994) - reflecting the clays in the soil (ESSS2000)).

3.2.6.6. Assemblages of plants and invertebrate animals of tumulus (organic mound) springs of the Swan Coastal Plain TEC

This community is restricted to areas of continuous discharge of groundwater at the junction of the Guildford Clays and the Bassendean sands. Mounds of peat accumulate at the surface, and ooze water from their whole surface or from discrete channels, thus providing a stable, permanently moist series of microhabitats. Whilst this TEC was originally distributed between Guildford and Muchea, intact vegetated tumulus springs are now only known at three locations (Appendix E: Conservation significant ecological communities likelihood of occurrence assessment).

Whilst some typical flora species (*Astartea* sp., *Banksia littoralis, Eucalyptus rudis, Lepidosperma* sp., *Melaleuca preissiana*) were recorded in the survey areas, the TEC has a very restricted, well known distribution. The aforementioned species are common and widespread in many wetland/dampland habitats across the Swan Coastal Plain. Characteristic habitat requirements (e.g., areas of raised peat with continuous groundwater discharge) were not recorded in the survey areas. Other key flora associated with this TEC (e.g., *Taxandria linearifolia* and *Cyclosorus interruptus*) were not recorded in the survey areas. Based on the lack of occurrence of characteristic habitat and key, distinctive flora species within the survey areas, and taking a precautionary approach, the Tumulus Springs TEC is Unlikely to occur within the survey areas.

3.2.6.7. Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain TEC

This ecological community occurs as woodlands or forests or other structural forms where the primary defining feature is the presence of *Eucalyptus gomphocephala* (Tuart) trees in the uppermost canopy layer. The ecological community is strongly associated with calcareous soils of the western part of the plain, including those very close to the coast. While it mainly occurs where soils are sandy and well drained, it can also occur in other areas such as on protected swales, saline and freshwater wetlands, close to river banks and on limestone slopes. Tuart woodlands and forests are most commonly found on the Spearwood dune systems, also occurring on the Quindalup dune systems and in some places also found on the Bassendean dune systems (Appendix E: Conservation significant ecological communities likelihood of occurrence assessment).

The survey areas are situated with the Yanga and Pinjarra soil-landscape systems on the eastern side of the Swan Coastal Plain, and no *Eucalyptus gomphocephala* trees were recorded within or adjacent to the survey areas; therefore, the Tuart Woodlands TEC Does not Occur within the survey areas.

3.3. Fauna survey

3.3.1. Fauna overview

A total of 47 vertebrate fauna species were recorded as occurring within the survey areas, comprising 37 birds, six mammals (four introduced species), three reptiles and one amphibian. A complete fauna list is presented in Appendix L: Fauna species list.

3.3.2. Conservation significant fauna

Three Threatened fauna species were recorded during the field survey; Carnaby's Cockatoo (*Calyptorhynchus latirostris*; listed as Endangered under EPBC Act and BC Act), Baudin's Cockatoo (*Calyptorhynchus baudinii*; listed as Endangered under the EPBC Act and the BC Act) and Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*; listed as Vulnerable under the EPBC Act and the BC Act). Carnaby's Cockatoo and Baudin's Cockatoo were heard flying near the survey areas and Forest Red-tailed Black Cockatoo and Carnaby's Cockatoo were observed via foraging evidence (Table 10, Appendix O: Maps – Black Cockatoo foraging evidence locations, Fauna habitats). A total of 17 flora species (two introduced species) were recorded within the survey areas that will provide suitable foraging resources for at least one of the black cockatoo species (DoEE 2017c, Department of Sustainability, Environment, Water, Population and Communities [DSEWPaC] 2012, Groom 2011, Johnstone et al. 2010).

No Priority fauna species as listed by DBCA were recorded within the survey areas.

Table 10: Forest Red-tailed Black Cockatoo and Carnaby's Cockatoo foraging evidence in the survey areas

Common name	Species name	Signs	Photo	Easting	Northing
Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Foraging evidence on Marri (*Corymbia calophylla*)		395889	6530973

Common name	Species name	Signs	Photo	Easting	Northing
Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Foraging evidence on Marri (*Corymbia calophylla*)		402956	6505557
Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Foraging evidence on Marri (*Corymbia calophylla*)		404391	6501187
Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Foraging evidence on Marri (*Corymbia calophylla*)	No photograph	408081	6480459
Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Foraging evidence on Marri (*Corymbia calophylla*)	No photograph	408064	6480666

Common name	Species name	Signs	Photo	Easting	Northing
Carnaby's Cockatoo	*Calyptorhynchus latirostris*	Foraging evidence on Banksia		407171	6487910

Following the field survey, two species of the remaining 20 conservation significant fauna species identified from the desktop assessment (see Section 3.1.2) were considered as having Potential to occur within the survey areas; Douglas' Broad-headed Bee (*Hesperocolletes douglasi*; listed as Critically Endangered under the EPBC Act and the BC Act) and a short-tongued bee (*Leioproctus douglasiellus*; listed as Critically Endangered under the EPBC Act and Endangered under the EPBC Act). The remaining 18 species were considered as being Unlikely to occur.

3.3.3. Introduced fauna

Four introduced fauna species were recorded within the survey areas, namely dog (*Canis familiaris familiaris*), cat (*Felis catus*), black rat (*Rattus rattus*) and Rabbit (*Oryctolagus cuniculus*). The black rat was observed and the other three species were observed from secondary signs (i.e., scats, tracks).

3.3.4. Fauna habitats

A total of five fauna habitats were recorded within the survey areas, covering approximately 64.5% (19.6 ha) of the survey area (Table 11, Appendix O: Maps – Black Cockatoo foraging evidence locations, Fauna habitats). Cleared areas, including previously cleared vehicle access tracks and cleared areas adjacent to the rail line, covered the majority (35.5%; 11.2 ha) of the survey areas.

As outlined in Section 3.2.5, the overall condition of the fauna habitats recorded varied from completely Cleared areas to areas of intact vegetation in Very Good condition.

Table 11: Fauna habitats within the survey areas

Fauna habitat	Extent in the survey areas (ha)	Proportion of survey areas (%)
Allocasuarina woodland	0.7	2.3
Mixed shrubland	9.7	30.8
Banksia woodland	3.2	10.2
Marri woodland	3.5	11.1
Melaleuca woodland/shrubland	2.5	8.0
Cleared	11.2	35.5
Total	**31.4**	**100.0**

The Forest Red-tailed Black Cockatoo and Carnaby's Cockatoo foraging evidence records (outlined in Table 10) occurred mostly in the Marri woodland fauna habitat and to a lesser extent in the Mixed shrubland and Banksia woodland habitats. The Marri woodland and Mixed shrubland fauna habitats are suitable foraging habitat for all three species of Black Cockatoo. The Allocasuarina woodland and Banksia woodland fauna habitats are suitable habitats for mainly Carnaby's Cockatoo. The Banksia woodland fauna habitat would be suitable for the two potential conservation significant bees outlined in Section 3.3.2.

4. Discussion

4.1. Flora

A total of 153 taxa (97 native and 56 introduced taxa) from 106 genera and 48 families were recorded across 34 relevés and opportunistic collections. Individual flora species and assemblages recorded in the survey areas are considered to be typical of the local area and broader region in general.

The threatened flora species *Grevillea curviloba*, listed as EN under the EPBC Act and EN under the BC Act, was recorded within the survey areas during the field survey (Plate 1). *Grevillea curviloba* is a prostrate, spreading to tall, erect shrub growing to 2.5 m from the Proteaceae family. It is known to grow in winter-wet grey sand and sandy loam over limestone at depth or over ironstone where the water table is high. It occurs with a suite of shrubs including *Acacia saligna, Melaleuca huegelii* and *M. systena* ms. It is noted as associating with both the Muchea Limestone TEC and the Perth-Gingin Ironstone TEC (TSSC 2016a, 2016b). *G. curviloba* had previously been recorded (until 2000) as: *G. curviloba* subsp. *curviloba* in five populations, two of which were in road or rail reserves, totalling 208 individuals in the Muchea-Bullsbrook area; and *G. curviloba* subsp. *incurva* in 17 populations, 12 of which were in road or rail reserves, totalling approximately 1100 plants between Muchea and Badgingarra TSSC 2016a, 2016b). Florabase (WAH 1998-) shows numerous records from 2010 onwards along the rail line between Bambun and The Vines. In the current survey, 265 individuals of *G. curviloba* were recorded on flats in grey to brown moist sand or sandy loam in vegetation communities AsS, BsppW, MmS and MtS, with the majority of the recorded plants (145 plants) in survey area AT15, within Mixed tall sparse Shrubland (community MtS) in Good condition.

Plate 1: *Grevillea curviloba* (T) ©ELA 2021.

The priority flora species *Grevillea evanescens*, listed as P1 by DBCA, was recorded within the survey areas during the field survey (

Plate 2). *Grevillea evanescens* is an erect, robust shrub growing to 4 m from the Proteaceae family. It is known to grow in winter-wet brown sand and sandy loam in *Allocasuarina, Banksia* and Eucalypt woodland, tall mixed shrubland, open heath (WAH 1998-). *G. evanescens* had previously been recorded in the rail reserve within survey area AT16 just south of Airfield Rd (2014), with two nearby older (1995, 2005) records approximately 1 km west of the rail line (WAH 1998-). In the current survey, one individual plant of *G. evanescens* was recorded in survey area AT15, within Mixed tall sparse Shrubland (community MtS) in Good condition.

Plate 2: Grevillea evanescens (P1) ©ELA 2021.

A very high proportion (37%) of the total number of flora species recorded in the survey areas were introduced (weed) species, with weedy grass species most prevalent (20% of all introduced species). The high proportion of weeds was expected given the highly disturbed and fragmented nature of the vegetation of the survey areas; much of the survey areas had previously been cleared, including the rail tracks, existing access tracks and roads and driveways crossing the rail tracks and survey areas. Vegetation patches within and adjacent to the survey areas usually comprised a narrow strip backed by pastoral land (in the northern survey areas) and residential areas (in the southern survey areas). The linear nature of the vegetation results in large edge effects and allows for easy spread of introduced species.

Four recorded weed species are listed as Declared Pests under the BAM Act: Bridal Creeper (*Asparagus asparagoides); Arum Lily (*Zantedeschia aethiopica); One-leaf Cape Tulip (*Moraea flaccida); and Paterson's Curse (*Echium plantagineum). Bridal Creeper is also listed as a WoNS. None of the four significant weed species have a listed Control or Keeping category (DPIRD 2021) and therefore no specific management of these species is required. Arum Lily and One-leaf Cape Tulip were the most widespread of the four significant weed species; many of the low, damp parts of existing access tracks and areas bordering pastoral land were populated by these species.

4.2. Vegetation

Eight broad vegetation communities, comprising four shrubland communities and four woodland communities, were delineated and mapped within the survey areas. Vegetation communities were defined on the basis of relevé data and as such are broadly described using dominant flora species for each of upper, mid and lower strata, along with informal field observations and photographs, and aerial imagery.

Following the field survey one TEC, *Banksia Woodlands of the Swan Coastal Plain*, was assessed as Likely to occur in the survey areas. Several of the key diagnostic characteristics of the Banksia Woodlands TEC listed in the Approved Conservation Advice for the TEC (DoEE 2016) were met by patches of vegetation community BsppW (Banksia species Woodland). The survey areas are located on the Swan Coastal Plain and occur in one of the limited scenarios where alluvial, limestone and other lithic substrates are likely juxtaposed with Bassendean and Spearwood sands. The structure of the community BsppW is a low open woodland, and the understorey includes sclerophyllous shrub species of varying height and an herbaceous ground layer of (mostly introduced) forbs and grasses. The canopy in three of the four mapped BsppW patches is dominated by various combinations of the key diagnostic species *Banksia attenuata, B. menziesii* and *B. ilicifolia*. One continuous patch of the BsspW vegetation community, located within survey area AT04, met condition and patch size thresholds. This patch is at least 4.9 ha in area (2.5 ha within the survey area), with 1.1 ha in Very Good condition (0.6 ha inside the survey area) and 3.8 ha in Degraded Condition (1.9 ha inside the survey area). The full four-stage assessment against the key diagnostic characteristics for this TEC resulted in a total of 2.5 ha of vegetation within the survey areas being assessed as Likely to represent the Banksia Woodlands TEC.

Four other TECs were assessed following the field survey as having Potential to occur in the survey areas. All TEC likelihood assessments were based on the outcomes of a reconnaissance level survey. In order to confirm the presence/absence of potential TECs and determine potential sub-components of those TECs within the survey areas a Detailed flora and vegetation survey would be required. As a result, ELA has taken a precautionary approach to identifying areas that may require further investigation.

The *Clay Pans of the Swan Coastal Plain* TEC has Potential to occur within the survey areas. Although typical clay pan characteristics were not obvious in the several damp, low-lying areas observed in the survey areas, it is recognised that most of these patches were inundated at the time of survey. The Clay Pans TEC has several subcomponents including Floristic Community Type 8, the Muchea Limestone TEC and the Perth-Gingin Limestone TEC (both which are assessed here as having the Potential to occur). These factors, in conjunction with have resulted in a Potential likelihood of occurrence rating. Based on the occurrence of areas of suitable habitat and vegetation, the Potential occurrence of subcomponents of the TEC and the close proximity of known records of the TEC, the Clay Pans TEC has the Potential to occur within the survey areas.

The *Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands of the Swan Coastal Plain* TEC has Potential to occur within the survey areas. Based on the occurrence of vegetation patches with a dominant *Corymbia calophylla* woodland structure with *Xanthorrhoea preissii* present in the midstorey at several locations within the survey areas, the soil type in those areas and proximity to known occurrences of the TEC, the *Corymbia calophylla - Xanthorrhoea preissii* TEC has the Potential to occur within the survey areas.

The *Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain* TEC has Potential to occur within the survey areas. Based on the occurrence of known floristic characteristics, in particular *Grevillea curviloba* (T), which is known to associate with this TEC, the presence of a vegetation community typical of the TEC (*Melaleuca viminea* shrublands) and proximity to known records, the Muchea Limestone TEC has the Potential to occur within the survey areas.

The *Shrublands and Woodlands on Perth to Gingin ironstone (Perth to Gingin ironstone association) of the Swan Coastal Plain* TEC has Potential to occur within the survey areas. Based on the occurrence of several key species, in particular *Grevillea curviloba* (T), which is known to associate with this TEC and the proximity of a known occurrence of the TEC, the Perth-Gingin Ironstone TEC has the Potential to occur within the survey areas.

The condition of intact native vegetation within the survey areas ranged from Very Good to Completely Degraded, based on the Keighery (1994) vegetation condition scale provided in EPA (2016). Cleared areas comprised most of the survey areas. Disturbances common to most of the survey areas included: introduced flora (weed) species, which many in places formed a dominant part of one of more strata; vehicle tracks (given the access tracks survey areas included existing tracks); and clearing (particularly adjacent to rail tracks).

4.3. Fauna

Fauna habitats within the survey areas are considered to provide suitable habitat for a number of terrestrial and avian fauna, with the habitats providing a mix of suitable vegetation, substrate and microhabitats suitable for a variety of fauna species. Majority of bird species recorded during the field survey are widespread and common species, including nectivores, insectivores and granivores. Cleared areas covered the majority of the survey areas. Field observations indicated that these areas are likely used by fauna for movement between vegetated areas.

Carnaby's Cockatoo and Baudin's Cockatoo were heard flying near the survey areas and Forest Red-tailed Black Cockatoo and Carnaby's Cockatoo were observed via foraging evidence. The survey areas overlap the northern extent of Baudin's Cockatoo and Forest Red-tailed Black Cockatoo range, and the known breeding range for Carnaby's Cockatoo (DSEWPaC 2012). Several flora species recorded within the survey areas will provide suitable foraging species for black cockatoos; namely *Banksia* spp. for Carnaby's Cockatoo, *Hakea* spp. for Carnaby's Cockatoo and Baudin's Cockatoo and Marri (*Corymbia calophylla*) and Jarrah (*Eucalyptus marginata*) for all three species of black cockatoo (DoEE 2017c, DSEWPaC 2012, Groom 2011, Johnstone et al. 2010). Marri and Jarrah also provide suitable breeding and roosting habitat for all three species of black cockatoo (DoEE 2017c, DSEWPaC 2012).

Following the field survey, two conservation significant fauna species were considered to have the Potential to occur within the survey areas; Douglas' Broad-headed Bee (*Hesperocolletes douglasi*; listed as Critically Endangered under the EPBC Act and the BC Act) and a short-tongued bee (*Leioproctus douglasiellus*; listed as Critically Endangered under the EPBC Act and Endangered under the EPBC Act). The Douglas' Broad-headed Bee is only known from two records, one on Rottnest Island and one north-east of Perth (DBCA 2007-2021). This species was considered extinct until a female was collected collected during 2015 in Banksia woodland on the western extremity of the RAAF Weapons Range east of Muchea (TSSC 2019). The short-tongued bee is only known from six records around Perth, one north-east of Perth (DBCA 2007-2021). This species is now thought to occur in three locations within the Perth metropolitan area ranging from Cannington to Forrestdale (DSEWPaC 2013). As both species occur in the 'species or species habitat may occur' (DAWE 2021b), these species cannot be discounted as potentially occurring in the survey areas.

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Appendix A: Framework for conservation significant flora and fauna ranking

CATEGORIES OF THREATENED SPECIES UNDER THE ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999 (EPBC ACT)

Threatened fauna and flora may be listed in any one of the following categories as defined in Section 179 of the EPBC Act. Species listed as 'conservation dependent' and 'extinct' are not Matters of National Environmental Significance and therefore do not trigger the EPBC Act.

Category	Definition
Extinct (EX)	There is no reasonable doubt that the last member of the species has died.
Extinct in the Wild (EW)	Taxa known to survive only in captivity or as a naturalised population well outside its past range; or taxa 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)	Taxa considered to be facing an extremely high risk of extinction in the wild.
Endangered (EN)	Taxa considered to be facing a very high risk of extinction in the wild.
Vulnerable (VU)	Taxa considered to be facing a high risk of extinction in the wild.
Near Threatened (NT)	Taxa has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
Least Concern (LC)	Taxa has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.
Data Deficient (DD)	There is inadequate information to make a direct, or indirect, assessment of taxa's risk extinction based on its distribution and/or population status.
Not Evaluated (NE)	Taxa has not yet been evaluated against the criteria.
Migratory (MI)	Not an IUCN category. Species are defined as migratory if they are listed in an international agreement approved by the Commonwealth Environment Minister, including: • the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animal) for which Australia is a range state; • the agreement between the Government of Australian and the Government of the People's Republic of China for the Protection of Migratory Birds and their environment (CAMBA); • the agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA); or • the agreement between Australia and the Republic of Korea to develop a bilateral migratory bird agreement similar to the JAMBA and CAMBA in respect to migratory bird conservation and provides a basis for collaboration on the protection of migratory shorebirds and their habitat (ROKAMBA).

CONSERVATION CODES FOR WESTERN AUSTRALIA FLORA AND FAUNA

The Wildlife Conservation (Specially Protected Fauna) Notice 2018 and the Wildlife Conservation (Rare Flora) Notice 2018 have been transitioned under regulations 170, 171 and 172 of the Biodiversity Conservation Regulations 2018 to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the *Biodiversity Conservation Act 2016*.

Specially protected fauna or flora are species which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such.

Threatened species (T)

Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the *Biodiversity Conservation Act 2016* (BC Act).

Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for Threatened Fauna.

Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3 of the Wildlife Conservation (Rare Flora) Notice 2018 for Threatened Flora.

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 as detailed below.

Category	Code	Description
Critically Endangered species	CR	Threatened species considered to be "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for critically endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for critically endangered flora.
Endangered species	EN	Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for endangered flora.

Category	Code	Description
Vulnerable species	VU	Threatened species considered to be "facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as vulnerable under section 19(1)© of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for vulnerable fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for vulnerable flora.

Extinct species

Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild, as follows:

Category	Code	Description
Extinct species	EX	Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.
Extinct in the wild species	EW	Species that "is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act). Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.

Specially protected species

Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.

Species that are listed as threatened species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.

Categories are detailed below.

Category	Code	Description
Migratory species	MI	Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act). Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species. Published as migratory birds protected under an international agreement under schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.
Species of special conservation interest (conservation dependent fauna)	CD	Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act). Published as conservation dependent fauna under schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.
Other specially protected species	OS	Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act). Published as other specially protected fauna under schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.

Priority species (P)

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

Category	Code	Definition
Priority 1	P1	Poorly-known species

Category	Code	Definition
		Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
Priority 2	P2	Poorly-known species Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
Priority 3	P3	Poorly-known species Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
Priority 4	P4	Rare, Near Threatened and other species in need of monitoring (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. © Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Appendix B: Likelihood of occurrence assessment criteria

	Criteria
Recorded	The species has previously been recorded within survey area from DBCA database search results and/or from previous surveys of the survey area, and/or the species has been confirmed through a current vouchered specimen at WA Herbarium.
Likely	The species has not previously been recorded from within the survey area. However, (to qualify requires one or more criteria to be met): the species has been recorded in close proximity to the survey area, and occurs in similar habitat to that which occurs within the survey area; core habitat and suitable landforms for the species occurs within the survey area either year-round or seasonally. In relation to fauna species, this could be that a host plant is seasonally present on site, or habitat features such as caves are present that may be used during particular times during its life cycle e.g. for breeding. In relation to both flora and fauna species, it may be there are seasonal wetlands present; and there is a medium to high probability that a species uses the survey area.
Potential	The species has not previously been recorded from within the survey area. However, (one or more criteria requires to be met): targeted surveys may locate the species based on records occurring in proximity to the survey area and suitable habitat occurring in the survey area; the survey area has been assessed as having potentially suitable habitat through habitat modelling; the species is known to be cryptic and may not have been detected despite extensive surveys; the species is highly mobile and has an extensive foraging range so may not have been detected during previous surveys; The species has been recorded in the survey area by a previous consultant survey or there is historic evidence of species occurrence within the survey area. However, (one or more criteria requires to be met): doubt remains over taxonomic identification, or the majority of habitat does not appear suitable (although presence cannot be ruled out due to factors such as species ecology or distribution); and coordinates are doubtful.
Unlikely	The species has been recorded locally through DBCA database searches. However, it has not been recorded within the survey area and it is unlikely to occur due to the site lacking critical habitat, having at best marginally suitable habitat, and/or being severely degraded it is unlikely to occur due to few historic record/s and no other current collections in the local area. The species has been recorded within the bioregion based on literature review but has not been recorded locally or within the survey area through DBCA database searches. The species has not been recorded in the survey area despite adequate survey efforts, such as a standardised methodology or targeted searching within potentially suitable habitat.
Does not occur (one or more criteria requires to be met).	The species is not known to occur within the IBRA bioregion based on current literature and distribution. The conspicuous species has not been recorded in the survey area despite adequate survey efforts at an appropriate time of year to detect the species within potentially suitable habitat. The survey area lacks important habitat for a species that has highly selective habitat requirements. The species has been historically recorded within survey area or locally; however, it is considered locally extinct due to significant habitat changes such as land clearing and/or introduced predators.

Appendix C: Conservation significant flora likelihood of occurrence assessment

Species	Conservation status		Source*	Description	Known habitat	Likelihood Rating	
	EPBC Act	BC Act / DBCA				Pre-Survey	Post survey
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	CR	CR	PMST	Dense, clumped shrub, to 0.3 m high, to 0.4 m wide. Fl. yellow, Sep-Oct.	Grey, clayey sand with lateritic pebbles in low woodland areas near winter-wet flats on the Pinjarra Plain.	**Unlikely** Nearest record ~30km S (2004). All other records further S. No suitable habitat likely in survey areas.	**Unlikely** No suitable habitat in the survey areas.
Darwinia foetida	CR	EN	PMST, NatureMap, Florabase	An erect or spreading shrub that grows to 0.7m high, often uses other shrubs for support.	Grey-white sand on swampy, seasonally wet sites. Previously recorded at 3 locations, all near the town of Muchea.	**Likely** All recent known occurrences very near survey areas (to 2015). Some suitable habitat likely present in survey areas.	**Unlikely** This shrub is of a size and distinctive appearance that it would have been observed if present. Targeted searches carried out near known records.
Caladenia huegelii	EN	CR	PMST, Florabase	Tuberous, perennial herb that grows from 0.25-0.6m high. Fl. green-cream-red, Sep-Oct.	Areas of mixed woodland of jarrah (Eucalyptus marginata), candlestick banksia (Banksia attenuata), holly banksia (B. ilicifolia) and firewood banksia (B. menziesii) with scattered sheoak (Allocasuarina fraseriana) and marri (Corymbia calophylla) over dense shrubs. Soil is usually deep grey-white sand usually	**Potential** Nearest record ~12km SW (2000). All other recent records further S. Some suitable habitat likely present in survey areas.	**Potential** Whilst not observed, the potential for this herb to occur and not be observed in thick vegetation if not in flower cannot be ruled out.

Species	Conservation status		Source*	Description	Known habitat	Likelihood Rating	
	EPBC Act	BC Act / DBCA				Pre-Survey	Post survey
					associated with the Bassendean sand-dune system. However, rare plants have been known to extend into the Spearwood system (in which calcareous yellow sands dominate) in some areas.		
Drakaea elastica	EN	CR	PMST, Florabase	Tuberous, perennial herb that is 0.12-0.3m high. Fl. red and green and yellow, Oct-Nov.	White sand over a dark sandy loam on low-lying damp areas near ephemeral lakes, or on slopes adjacent to winter wet depressions, swamps.	**Unlikely** Nearest recent record ~60km NW (1992). All other records even further S. Some suitable habitat likely present in survey areas.	**Unlikely** No recent nearby records.
Eucalyptus x *balanites*	EN	CR	PMST, Florabase	5m high mallee with rough flaky bark. Fl. White, Oct-Dec-Jan-Feb.	Light coloured sandy soils over laterite. Gently sloping heathlands; open mallee woodland over shrubland or heathland with emergent mallees.	**Unlikely** Nearest record ~40km S (2013). All other records even further N. Little suitable habitat likely present in survey areas.	**Unlikely** No suitable habitat in the survey areas.
Grevillea althoferorum subsp. *fragilis*	EN	CR	PMST	Bluish-green, compact, rounded, lignotuberous shrub 0.25-0.5 m high. Fl. Yellow-cream, Sep-Nov.	Base of Darling Scarp in Banksia woodland in greyish-yellow sand with gravel.	**Potential** Several records <3km in Bullsbrook NR (2014) & ~6km E just N of Muchea (2014).	**Unlikely** No suitable habitat in the survey areas.
Grevillea curviloba	EN	EN	PMST, NatureMap, Florabase	Fl. White-cream, Aug-Oct.	Grey sand, sandy loam in winter-wet heath.	**Likely**	**Recorded**

Species	Conservation status		Source*	Description	Known habitat	Likelihood Rating	
	EPBC Act	BC Act / DBCA				Pre-Survey	Post survey
						Many recent records (2010s) along the rail line between Bambun and The Vines.	
Thelymitra dedmaniarum	EN	CR	PMST	To 80cm high with broad-ovate acute leaf to 15cm long. Fl. Gold-bronze, Nov-Jan.	Within granite or dolerite outcrops often within Eucalyptus wandoo and E. accedens woodlands on red-brown sandy loam soil. Often associated with includes Acacia pulchella, Acacia saligna, Calothamnus quadrifidus, Melaleuca radula and Hakea lissocarpha.	**Unlikely** No known occurrences on SWA. No suitable habitat likely in survey areas.	**Unlikely** No suitable habitat in the survey areas.
Diplolaena andrewsii	EN	EN	PMST, Florabase	Erect shrub that grows 0.5-1m high. Fl. red, Jul-Oct.	Within granite outcrops and hillsides.	**Unlikely** No known occurrences on SWA. No suitable habitat likely in survey areas.	**Unlikely** No suitable habitat in the survey areas.
Diuris purdiei	EN	EN	PMST, Florabase	Tuberous, perennial herb 0.15-0.35m high. Fl. Yellow, Sep-Oct.	Sand to sandy clay soils, in areas subject to winter inundation, and amongst native sedges and dense heath with scattered emergent Melaleuca preissiana, Eucalyptus calophylla, E. marginata and Nuytsia floribunda.	**Unlikely** Nearest record in Midland (1920s and older). All other records further S.	**Unlikely** No recent nearby records.

Species	Conservation status		Source*	Description	Known habitat	Likelihood Rating	
	EPBC Act	BC Act / DBCA				Pre-Survey	Post survey
Grevillea christineae	EN	EN	PMST, Florabase	Erect wiry shrub that is 0.5-0.6m high. Fl. white-cream, Aug-Sep.	Clay loam, sandy clay, often moist.	**Potential** Nearest record ~4km E of survey areas (2007) at base of scarp. All other records further N. Some suitable habitat likely present in survey areas.	**Unlikely** This shrub is of a size and distinctive appearance that it would have been observed if present.
Thelymitra stellata	EN	EN	PMST	Tuberous, perennial, herb, 0.15-0.25 m. Fl. yellow & brown, Oct-Nov.	Eucalyptus marginata and Eucalyptus wandoo woodlands in gravelly loam amongst low heath and scrub. Sand, gravel, lateritic loam.	**Unlikely** Only one nearby record at Chittering ~10km E of rail line (1998). All other records N of Gingin or S of Perth. Some suitable habitat may be present in survey areas.	**Unlikely** No suitable habitat in the survey areas.
Andersonia gracilis	EN	VU	PMST, Florabase	Slender erect or open straggly shrub that is bettwen 0.1-0.5m high. Fl. White-pink-purple, Sep-Nov.	Seasonally damp, black sandy clay flats near or on the margins of swamps, often on duplex soils supporting low open heath vegetation with species such as Calothamnus hirsutus, Verticordia densiflora and Kunzea recurva over sedges.	**Unlikely** No records within 25km of survey areas. Some suitable habitat may be present in survey areas.	**Unlikely** No recent nearby records.
Chamelaucium lullfitzii	EN	VU	PMST, NatureMap, Florabase	Shrub 1-2m high, with many erect branches. Fl. White in terminal, leafy inflorescences, Sep-Dec.	Restricted to a very small area associated with the Gingin scarp, south of Gingin. Plants grow on	**Potential** All known recent occurrences (to 2008) in Breera Rd NR, ~3km E of survey areas. Some suitable	**Unlikely** This shrub is of a size and distinctive appearance that

Species	Conservation status		Source*	Description	Known habitat	Likelihood Rating	
	EPBC Act	BC Act / DBCA				Pre-Survey	Post survey
					white, grey, or yellow sands in low open banksia woodland.	habitat likely present in survey areas.	it would have been observed if present.
Acacia anomala	VU	VU	PMST, Florabase	Slender, rush-like shrub that is between 0.2-0.5m high. Fl. Yellow, Aug-Sep.	Lateritic soils and slopes.	**Unlikely** Records very near survey areas (1965 and older). No suitable habitat likely in survey areas.	**Unlikely** No suitable habitat in the survey areas.
Anigozanthos viridis subsp. *terraspectans*	VU	VU	PMST, Florabase	Rhizomatous, perennial herb that grows between 0.05-0.2m high. Fl. green/yellow-green, Aug-Sep.	Winter-wet depressions where it grows on grey sandy clay loam, or grey sand, in low post-fire regenerating heath. Associated with species such as Banksia leptophylla, Melaleuca spp., Verticordia densiflora, Conostylis spp. and sedges.	**Unlikely** Nearest record ~25km N (2002). Some suitable habitat may be present in survey areas.	**Unlikely** No recent nearby records.
Diuris drummondii	VU	VU	PMST, Florabase	A 0.5-1.05m high tuberous, perennial herb. Fl. yellow, Nov-Dec or Jan.	Low-lying depressions and swamps.	**Unlikely** Nearest record ~8km N of Gingin (2006) in a watercourse. No suitable habitat (open water) likely in survey areas. Other nearby records historical (1960s).	**Unlikely** No recent nearby records.
Diuris micrantha	VU	VU	PMST, Florabase	Tuberous, perennial herb 0.3-0.6m high. Fl. yellow and brown, Sep-Oct.	Small populations, on dark, grey to blackish, sandy clay-loam	**Unlikely** Nearest record S of Perth (1980s). All other records further S.	**Unlikely** No recent nearby records.

Species	Conservation status		Source*	Description	Known habitat	Likelihood Rating	
	EPBC Act	BC Act / DBCA				Pre-Survey	Post survey
					substrates in winter wet depressions or swamps.		
Eleocharis keigheryi	VU	VU	PMST, NatureMap, Florabase	Rhizomatous, clumped perennial and grass-like or a herb 0.4m high. Fl. green, Aug-Nov.	Grows in small clumps in a substrate of clay or sandy loam. Emergent in freshwater creeks, and transient waterbodies such as drainage lines and claypans in water to approximately 15 cm deep.	**Potential** Several records with 2km of rail line, from Bambun to Upper Swan (2000s). Some suitable habitat likely in survey areas.	**Potential** Whilst not observed, the potential for this small sedge to occur and not be observed in thick vegetation within seasonally inundated areas cannot be ruled out.
Ptychosema pusillum	VU	VU	PMST	Perennial, herb, mostly 0.05-0.1 m high. Fl. red & brown & yellow, Aug to Oct.	Known from 3 populations, all of which are located on private property. Two populations are located near Gingin, one population occurs adjacent to a paperbark swamp and the other is found throughout open vegetation and firebreaks. The 3rd population is near Reagans Ford on the upper slopes of a high sand ridge. Sand. Rises. Low, open woodland of Banksia attenuata, B. menziesii and Euc todtiana over scrub with Adenanthos	**Unlikely** Recent (2000s) records in Breera NR, ~4km E of rail line, but populations known to be restricted. Some suitable habitat may be present in survey areas.	**Unlikely** Populations known to be restricted.

Species	Conservation status		Source*	Description	Known habitat	Likelihood Rating	
	EPBC Act	BC Act / DBCA				Pre-Survey	Post survey
					cygnorum and Hibbertia hypericoides.		
Grevillea evanescens	-	P1	NatureMap	Shrubs, 2-4 m high. Fl. Red, Jul-Sep.	Flat seasonally wet areas. Brown sand and sandy loam.	**Likely** Nearest recent record in rail reserve in survey area just south of Airfield Rd (2014). Two other (historical) records ~1km W of rail line. Suitable habitat likely present.	**Recorded**
Leucopogon squarrosus subsp. *trigynus*	-	P2	NatureMap	Shrubs to c. 150 cm high and 120 cm wide, but usually smaller, single-stemmed at ground. Fl. White.	Recent collections have all been from an area to the west and south-west of Gingin where it is locally common in the Yeal Nature Reserve (Banksia woodland).	**Potential** Nearest recent record ~4km W just N of Muchea (2020). Two other (historical) records on rail line, other records further W.	**Unlikely** This shrub is of a size and distinctive appearance that it would have been observed if present.
Schoenus sp. Bullsbrook (J.J. Alford 915)	-	P2	NatureMap	Grass-like or herb (sedge), ca 0.15 m high. Fl. green-brown.	Grey peaty sand. Low-lying flats.	**Potential** Only one known record very near survey areas at Twin Swamps NR (1986). Suitable habitat likely present in survey areas.	**Potential** Whilst not observed, the potential for this small sedge to occur and not be observed in thick vegetation within seasonally wet areas cannot be ruled out.
Acacia drummondii subsp. *affinis*	-	P3	NatureMap, Florabase	Erect shrub that is between 0.3-1m high. Fl. Yellow, Jul-Aug.	Lateritic gravelly soils.	**Unlikely**	**Unlikely** No suitable habitat in the survey areas.

Species	Conservation status		Source*	Description	Known habitat	Likelihood Rating	
	EPBC Act	BC Act / DBCA				Pre-Survey	Post survey
						Records near survey areas (1972 and older). No suitable habitat likely in survey areas.	
Isotropis cuneifolia subsp. *glabra*	-	P3	NatureMap, Florabase	A prostrate to ascending, spreading perennial herb or shrub 0.05-0.15m high. Fl. yellow/orange and red, Sep.	Sand, clay loam. Winter-wet flats.	**Potential** Nearest record in Nullilla NR (2007) and historical records <5km from rail line from Gingin to Muchea. Suitable habitat may be present.	**Potential** Whilst not observed, the potential for this small herb to occur and not be observed in thick vegetation within seasonally wet areas, especially when not in flower cannot be ruled out.
Styphelia filifolia	-	P3	NatureMap	Erect shrubs to c. 90 cm high and 70 cm wide. Pendulous inflorescences, white, Mar-May. Mature fruit Jul-Oct.	Sandy soils of the coastal plain (with one known occurrence from the northern Darling Scarp), usually in Banksia or Jarrah woodland and in low-lying situations.	**Likely** Nearest record at Chandala NR ~2km E of rail line (2006). All other records older and/or further away. Suitable habitat likely present in survey areas.	**Unlikely** This shrub is of a size and distinctive appearance that it would have been observed if present.
Verticordia serrata var. *linearis*	-	P3	NatureMap	Shrub, to 1 m high, differs from other varieties in the linear acuminate leaves 6-20 mm long; cilia to 1.2 mm long. Fl. yellow, Sep-Oct.	White sand, gravel. Open woodland.	**Potential** Several occurrences very near survey area (1987). Suitable habitat likely present in survey areas.	**Unlikely** This shrub is of a size and distinctive appearance that it would have been observed if present.
Caladenia speciosa	-	P4	NatureMap, Florabase	Tuberous, perennial herb that grows from 0.35-0.6m high with a flower that is	White, grey or black sand.	**Potential** Record at Gingin (1988). Next nearest record ~17km NW of survey areas (2005). Some	**Potential** Whilst not observed, the potential for this herb to occur and not be observed

Species	Conservation status		Source*	Description	Known habitat	Likelihood Rating	
	EPBC Act	BC Act / DBCA				Pre-Survey	Post survey
				white-pink that can be seen from September to October		suitable habitat likely present in survey areas.	in thick vegetation if not in flower cannot be ruled out.
Ornduffia submersa	-	P4	NatureMap	Aquatic, extremely slender perennial, herb. Fl. white, Aug-Nov. Petals furry.	Water 60 cm deep with leaves and flowers floating on the surface.	**Unlikely** One recent (2014) record ~100m E of rail line in a creek at Muchea. No suitable habitat (open water) in the survey area.	**Unlikely** This herb is of a distinctive appearance that it would have been observed if present.
Stylidium longitubum	-	P4	NatureMap	Erect annual (ephemeral), herb, 0.05-0.12 m high. Fl. pink, Oct-Dec.	Sandy clay, clay. Seasonal wetlands.	**Likely** Nearest records on rail line at Gingin (1990s), Chandala NR ~3km E of rail line (2000s) and 500m E of rail line at Ellen Brook NR (2010s). Suitable habitat may be present.	**Potential** Whilst not observed, the potential for this small herb to occur and not be observed in thick vegetation within seasonally wet areas if not in flower cannot be ruled out.

*Sources are PMST (DAWE 2021a); NatureMap (DBCA 2007-2021)

Appendix D: Conservation significant fauna likelihood of occurrence assessment

Species	Common name	Conservation status		Source*	Habitat	Likelihood Rating	
		EPBC Act	BC Act / DBCA			Pre-Survey	Post survey
Hesperocolletes douglasi	Douglas' Broad-headed Bee	CR	CR	PMST	Considered extinct until a female collected during 2015 in Banksia woodland on the western extremity of the RAAF Weapons Range east of Muchea. Banksia woodland.	**Potential** Occurs in the 'species or species habitat may occur' range (DAWE 2021c).	**Potential** Banksia woodland habitat occurs in the survey area
Pseudemydura umbrina	Western Swamp Tortoise	CR	CR	PMST, NatureMap	Habitat critical for the survival of this species includes land within the fox-proof fenced areas at Twin Swamps Nature Reserve and Ellen Brook Nature Reserve; all land within Mogumber Nature Reserve; land in which surface water catchments extend outside of the nature reserves; any land where wild populations are detected in the future; and land targeted for the introduction or reintroduction of this species.	**Unlikely** This species is only known from three locations. No suitable habitat present (i.e., wetland habitat).	**Unlikely**
Leioproctus douglasiellus	a short-tongued bee	CR	EN	PMST	In 2013 thought to occur in three locations within the Perth metropolitan area ranging from Cannington to Forrestdale.	**Potential** Occurs near the 'species or species habitat may occur' range (DAWE 2021c).	**Potential** Part of the survey area, Bullsbrook East, occurs within the species known range
Calidris ferruginea	Curlew Sandpiper	CR, MI	MI	PMST	Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They have also been occasionally recorded inland around ephemeral and permanent lakes, dams, waterholes and bore drains. sewage farms. They are also recorded inland, though less often,	**Unlikely** No suitable habitat present (i.e., wetland habitat).	**Unlikely**

Species	Common name	Conservation status		Source*	Habitat	Likelihood Rating	
		EPBC Act	BC Act / DBCA			Pre-Survey	Post survey
					including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand		
Numenius madagascariensis	Eastern Curlew	CR, MI	MI	PMST	Within Australia, the eastern curlew has a primarily coastal distribution. During the non-breeding season in Australia, the eastern curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass (Zosteraceae). Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. The birds are often recorded among saltmarsh and on mudflats fringed by mangroves, and sometimes within the mangroves.	**Unlikely** No suitable habitat present (i.e., coastal areas).	**Unlikely**
Botaurus poiciloptilus	Australasian Bittern	EN	EN	PMST	The Australasian Bittern occurs mainly in freshwater wetlands and, rarely, in estuaries or tidal wetlands. It favours wetlands with tall dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water.	**Unlikely** No suitable habitat present (i.e., wetland habitat).	**Unlikely**
Calyptorhynchus baudinii	Baudin's Cockatoo	EN	EN	PMST	Predominantly occurs in eucalypt forests, especially Jarrah, Marri and Karri forests. Foraging occurs at all levels of the forest (from canopy to the ground), often feeding in the understorey on proteaceous trees and shrubs, especially Banksias and in orchards.	**Likely** Overlaps the northern extent of the 'species likely to occur' range (DSEWPaC 2012).	**Recorded**
Calyptorhynchus latirostris	Carnaby's Cockatoo	EN	EN	PMST, NatureMap	Carnaby's Cockatoo is endemic to southwest WA with populations extending from the Murchison River to Esperance, and inland to Coorow, Kellerberrin and Lake Cronin. Foraging habitat for this species includes native shrubland, kwongan	**Likely**	**Recorded**

Species	Common name	Conservation status		Source*	Habitat	Likelihood Rating	
		EPBC Act	BC Act / DBCA			Pre-Survey	Post survey
					heathland and woodland dominated by proteaceous plant species including Banksia, Hakea and Grevillea, Eucalypt and Corymbia woodlands and pine plantations.	Overlaps the species known breeding range (DSEWPaC 2012).	
Galaxiella nigrostriata	Black-stripe Minnow	EN	EN	PMST	Lake Chandala (Muchea) is nothernmost known extent. Lives in ephemeral acidic peat wetlands, prefers sandy soils (more suited for burrowing). Shallow depth to groundwater to enable suitable soil mositure over dry period. Documented to consume micro-crustaceans, dipterans, and rotifers. May be sensitive to high temperatures and may be reliant on thermal stratification of wetlands (population north of Perth).	**Unlikely** No suitable habitat present (i.e., wetland habitat).	**Unlikely**
Rostratula australis	Australian Painted Snipe	EN	EN	PMST, NatureMap	The Australian Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum Muehlenbeckia or canegrass or sometimes tea-tree (Melaleuca).	**Unlikely** No suitable habitat present (i.e., wetland habitat).	**Unlikely**
Calyptorhynchus banksii naso	Forest Red-tailed Black-Cockatoo	VU	VU	PMST	Inhabits dense Jarrah, Karri and Marri forests which receive more than 600 mm average annual rainfall. Known to feed in more open agricultural areas and metropolitan Perth.	**Likely** Overlaps the northern extent of the 'species may occur' range (DSEWPaC 2012).	**Recorded**
Dasyurus geoffroii	Chuditch	VU	VU	PMST	Inhabits a variety of different habitat types including rocky outcrops, eucalypt forests and woodlands, sandy lowlands, beaches, shrubland, grasslands and deserts. Predominantly	**Unlikely** Occurs in the 'species or species habitat may occur' range (DAWE	**Unlikely**

Species	Common name	Conservation status		Source*	Habitat	Likelihood Rating	
		EPBC Act	BC Act / DBCA			Pre-Survey	Post survey
					though, rocky areas provide denning habitat and foraging is predominantly done within nearby grasslands and creek lines.	2021c). No suitable denning habitat present (i.e., rocky areas).	
Leipoa ocellata	Malleefowl	VU	VU	PMST	Occurs in scrubland and woodland dominated by mallee and wattle species. In Western Australia they are also found in some shrublands dominated by acacia, and occasionally in woodlands dominated by eucalypts such as Wandoo E. wandoo, Marri Corymbia calophylla and Mallet E. astringens.	**Potential** Occurs in the 'species or species habitat likely to occur' range (DAWE 2021c).	**Unlikely** No suitable habitat present
Westralunio carteri	Carter's Freshwater Mussel	VU	VU	PMST, NatureMap	Freshwater streams, rivers, reservoirs and lakes within 50-100 km of the coast, from Gingin Brook southward to the Kent River, Goodga River and Waychinicup River.	**Unlikely** No suitable habitat present (i.e., freshwater streams, rivers).	**Unlikely**
Actitis hypoleucos	Common Sandpiper	MI	MI	PMST	The species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats. Generally the species forages in shallow water and on bare soft mud at the edges of wetlands; often where obstacles project from substrate, e.g. rocks or mangrove roots.	**Unlikely** No suitable habitat present (i.e., wetland habitat).	**Unlikely**
Apus pacificus	Fork-tailed Swift	MI	MI	PMST	In Australia, they mostly occur over inland plains but sometimes above foothills or in coastal areas. They often occur over cliffs and beaches and also over islands and sometimes well out to sea. They also occur over settled areas, including towns, urban areas and cities. They mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh. They are also found at treeless grassland and sandplains covered with spinifex, open farmland and inland and coastal sand-dunes.	**Potential** This species can occupy a wide range of habitat types. This species does not breed in Australia and is almost exclusively aerial, including foraging.	**Unlikely** Unlikely to utilise the survey area

Species	Common name	Conservation status		Source*	Habitat	Likelihood Rating	
		EPBC Act	BC Act / DBCA			Pre-Survey	Post survey
Calidris acuminata	Sharp-tailed Sandpiper	MI	MI	PMST	In Australasia, the Sharp-tailed Sandpiper prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline saltlakes inland. They also occur in saltworks and sewage farms.	**Unlikely** No suitable habitat present (i.e., wetland habitat).	**Unlikely**
Calidris melanotos	Pectoral Sandpiper	MI	MI	PMST	In Australasia, the Pectoral Sandpiper prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands.	**Unlikely** No suitable habitat present (i.e., wetland habitat).	**Unlikely**
Motacilla cinerea	Grey Wagtail	MI	MI	PMST	This species inhabits fast-flowing mountain streams and rivers with riffles and exposed rocks or shoals, often in forested areas. It is also found in more lowland watercourses, even canals, where there are artificial waterfalls, weirs, millraces or lock gates. Outside of the breeding season it occupies a wider variety of habitats, including farmyards, sewage farms, forest tracks, tea estates and even town centres.	**Potential** This species can occupy a wide range of habitat types.	**Unlikely** Unlikely to utilise the survey area
Pandion haliaetus	Osprey	MI	MI	PMST	Eastern Ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. They are mostly found in coastal areas but occasionally travel inland along major rivers, particularly in northern Australia. They require extensive areas of open fresh, brackish or saline water for foraging. They frequent a variety of wetland habitats including inshore waters, reefs, bays, coastal cliffs, beaches, estuaries, mangrove swamps, broad rivers, reservoirs and large lakes and waterholes.	**Unlikely** No suitable habitat present (i.e., coastal areas).	**Unlikely**

Species	Common name	Conservation status		Source*	Habitat	Likelihood Rating	
		EPBC Act	BC Act / DBCA			Pre-Survey	Post survey
Plegadis falcinellus	Glossy Ibis	MI	MI	NatureMap	The Glossy Ibis' preferred habitat for foraging and breeding are fresh water marshes at the edges of lakes and rivers, lagoons, flood-plains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation. The species is occasionally found in coastal locations such as estuaries, deltas, saltmarshes and coastal lagoons.	**Unlikely** No suitable habitat present (i.e., wetland habitat).	**Unlikely**
Tringa nebularia	Common Greenshank	MI	MI	PMST, NatureMap	The Common Greenshank is found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity. It occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass. Habitats include embayments, harbours, river estuaries, deltas and lagoons and are recorded less often in round tidal pools, rock-flats and rock platforms.	**Unlikely** No suitable habitat present (i.e., wetland habitat).	**Unlikely**
Falco peregrinus	Peregrine Falcon	-	OS	NatureMap	The Peregrine Falcon is found in most habitats, from rainforests to the arid zone, and at most altitudes, from the coast to alpine areas. It requires abundant prey and secure nest sites, and prefers coastal and inland cliffs or open woodlands near water in trees with old rave or Wedge-tailed Eagle nests, and may even be found nesting on high city buildings	**Potential** This species can occupy a wide range of habitat types.	**Unlikely** Unlikely to utilise the survey area

*Sources are PMST (DAWE 2021a); NatureMap (DBCA 2007-2021).

Appendix E: Conservation significant ecological communities likelihood of occurrence assessment

Community	Conservation status		Habitat	Likelihood Rating	
	EPBC Act	BC Act / DBCA		Pre-Survey	Post survey
Assemblages of plants and invertebrate animals of tumulus (organic mound) springs of the Swan Coastal Plain	EN	CR	Habitat of this community is restricted to areas of continuous discharge of groundwater at the junction of the Guildford Clays and the Bassendean sands. Mounds of peat accumulate at the surface, and ooze water from their whole surface or from discrete channels, thus providing a stable, permanently moist series of microhabitats. Originally disributed between Guildford and Muchea, intact vegetated tumulus springs are now only known at three locations.	**Unlikely** PMST - Community known to occur within area. One occurrence immediately E of rail line ~800m N of AT06; distribution is well known and very restricted.	**Unlikely** Whilst some typical flora species (Astartea sp., Banksia littoralis, Eucalyptus rudis, Lepidosperma sp., Melaleuca preissiana) were recorded in the survey areas, the TEC has a very restricted, well known distribution. The aforementioned species are common and widespread in many wetland/dampland habitats across the SCP. Characteristic habitat requirements were not recorded, e.g. areas of raised peat with continuous groundwater discharge. Other key flora associated with this TEC were not recorded e.g. Taxandria linearifolia and Cyclosorus interruptus.
Banksia Woodlands of the Swan Coastal Plain ecological community	EN	P3	The ecological community is a woodland on the Swan Coastal Plain. A key diagnostic feature is a prominent tree layer of Banksia, with scattered eucalypts and other tree species often present among or emerging above the Banksia canopy. The understorey is a species rich mix of sclerophyllous shrubs, graminoids and forbs.	**Potential** PMST - Community likely to occur within area	**Likely** See Banksia Woodland TEC diagnostic (Appendix K).

Community	Conservation status		Habitat	Likelihood Rating	
	EPBC Act	BC Act / DBCA		Pre-Survey	Post survey
Clay Pans of the Swan Coastal Plain	CR	Several components: VU/EN	Occur where clay soils form an impermeable layer close to the landscape surface, and wetlands form that rely solely on rainfall to fill and then dry to impervious pans in summer. The ecological community generally occurs as a shrubland (less commonly as a low, open woodland) over a ground layer of geophytes, herbs and sedges which are characteristic of the wetter parts of the sites. There are no dominant species which characterise the entire ecological community. A distinctive feature of these clay pan wetlands is the suite of geophytes and annual flora that germinates, grows and flowers sequentially as these areas dry over summer. The clay pans have very high species richness and a number of local endemics.	**Potential** PMST - Community likely to occur within area. Five known occurrences within 2 km of the rail line between Gingin and Upper Swan.	**Potential** Several inundated and damp, low-lying areas were observed in the survey areas. These areas were typically true wetlands (no heavy clay) and/or low-lying areas in degraded condition (high weed cover and no native species). Although typical clay pan characteristics were not obvious (e.g. grey clay soils, species rich heath), it is recognised that most of these patches were inundated at the time of survey. In addition, several species typically associated with Floristic Community Type 8 (FCT08) were also recorded; with this FCT being a recognised subcomponent of the Clay Pans TEC (see section 2.2.6.5).
Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands of the Swan Coastal Plain	EN	CR	Located on heavy soils of the eastern side of the Swan Coastal Plain between Bullsbrook and Capel, with 29 occurrences known in 2017. Critical habitat is the heavy soils on which it occurs, the fresh superficial groundwater, and/ or surface water that may help sustain flora species in this community, and the catchment for this groundwater and surface water. Dominant species in the community are the trees Corymbia calophylla (marri), and occasionally Eucalyptus wandoo (wandoo); the shrubs Xanthorrhoea preissii, Acacia pulchella, Banksia dallanneyi, Gompholobium marginatum, and Hypocalymma angustifolium	**Potential** PMST - Community known to occur within area. One known occurrence ~300m E of AT02 in Ellen Brook Wildlife Sanctuary, but area between Sanctuary and survey area is cleared. Another ~1km E of AT07 at Bullsbrook RAAF base; area between airbase and survey area is cleared.	**Potential** Several relevés comprised a dominant Corymbia calophylla woodland structure with Xanthorrhoea preissii present in the midstorey. None of the other 16 key flora species listed in the Approved Conservation Advice were recorded within those five relevés; the ground stratum was dominated by introduced species, particularly grasses. All five relevés occurred on moist dark brown-grey loam, sandy loam and sand and were in Good to Very Good condition.

Community	Conservation status		Habitat	Likelihood Rating	
	EPBC Act	BC Act / DBCA		Pre-Survey	Post survey
			and the herbs Burchardia congesta, Cyathochaeta avenacea and Neurachne alopecuroidea.		
Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain	EN	EN	Occurs on the heavy soils of the eastern side of the Swan Coastal Plain. Known patches include wetland and well-drained habitats, in a variety of landforms (Tauss & Weston 2010). It is defined on the basis of rare limestone-influenced substrates. Where the best developed limestone occurs, near Gingin, the plant community is located on shallow black clay or sandy clay soils on limestone. As at April 2017 there are 16 known occurrences of the ecological community ranging from 0.06ha to 65ha. Some occurrences of the community are seasonally inundated.	**Potential** PMST - Community known to occur within area. Known occurrence ~1km E of AT07 at Bullsbrook RAAF base; area between airbase and survey area is cleared. Another ~150m SW of LD03; veg in survey area appears to have been previously cleared.	**Potential** Two of the nine typical and common native species, Grevillea curviloba (T) and Grevillea evanescens (P1), that occur in areas of the best developed limestone were present in some parts of the survey areas. In particular, *Grevillea curviloba* (T) is known to grow over limestone at depth where the water table is high and is noted as associating with the Muchea Limestone TEC. One of the nine calcicole species listed in the Approved Conservation Advice, Eremophila glabra, was recorded with the survey areas. Additionally, Melaleuca viminea shrublands have been recorded on Muchea limestone previously; in the current survey they were present in three survey areas and formed their own vegetation community, MvS.
Shrublands and Woodlands on Perth to Gingin ironstone (Perth to Gingin ironstone association) of the Swan Coastal Plain	EN	CR	Plant community located on seasonally inundated ironstone and heavy clay soils on the eastern side of the Swan Coastal Plain. The community supports a rich layer of herbaceous annuals under a sparse shrub layer. The ironstone soils are extremely restricted in distribution and are 97% cleared. Occurrences	**Likely** PMST - Community known to occur within area. Only known occurrence immediately adjacent to AT16 (Breera), in and around Timaru Nature Reserve.	**Potential** Four of the ten typical and common native species found in the Perth-Gingin Ironstone TEC, namely Acacia saligna, Grevillea curviloba (T), Jacksonia furcellata and Melaleuca viminea, were recorded within several of the survey

Community	Conservation status		Habitat	Likelihood Rating	
	EPBC Act	BC Act / DBCA		Pre-Survey	Post survey
			of the community are all located on the shallow groundwater aquifer, the north Gnangara Mound.		areas. Of note was the presence of Grevillea curviloba (T), as this species is known to grow over ironstone at depth where the water table is high and is noted as associating with the Perth-Gingin Ironstone Limestone TEC
Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community	CR	P3	The ecological community occurs as woodlands or forests or other structural forms where the primary defining feature is the presence of Eucalyptus gomphocephala (Tuart) trees in the uppermost canopy layer. The ecological community is strongly associated with calcareous soils of the western part of the plain, including those very close to the coast. While it mainly occurs where soils are sandy and well drained, it can also occur in other areas such as on protected swales, saline and freshwater wetlands, close to river banks and on limestone slopes. Tuart woodlands and forests are most commonly found on the Spearwood dune systems, also occurring on the Quindalup dune systems and in some places also found on the Bassendean dune systems.	**Potential** PMST - Community may occur within area	**Does not occur** The survey areas are situated with the Yanga and Pinjarra soil-landscape systems on the eastern side of the Swan Coastal Plain, and no Eucalyptus gomphocephala trees were recorded within or adjacent to the survey areas.

Appendix F: Flora species list

Family	Species	Conservation Status		Introduced Species Status
		EPBC Act	BC Act / DBCA	
Aizoaceae	**Carpobrotus edulis*			
Amaranthaceae	*Ptilotus polystachyus*			
Anacardiaceae	**Schinus* sp.			
Anarthriaceae	*Lyginia barbata*			
Apiaceae	**Eryngium pinnatifidum*			
Araceae	**Zantedeschia aethiopica*			*DP -s22(2)
Araceae	Araceae sp.			
Araliaceae	*Trachymene pilosa*			
Asparagaceae	**Asparagus asparagoides*			*DP -s22(2), WoNS
Asparagaceae	*Acanthocarpus canaliculatus*			
Asparagaceae	*Laxmannia grandiflora* subsp. *grandiflora*			
Asparagaceae	*Sowerbaea laxiflora*			
Asparagaceae	*Thysanotus dichotomus*			
Asparagaceae	*Thysanotus patersonii*			
Asphodelaceae	**Aloe* sp.			
Asteraceae	**Arctotheca calendula*			
Asteraceae	**Cotula coronopifolia*			
Asteraceae	**Hypochaeris radicata*			
Asteraceae	**Sonchus asper*			
Asteraceae	**Sonchus oleraceus*			
Asteraceae	**Ursinia anthemoides*			
Asteraceae	*Podolepis gracilis*			
Asteraceae	*Podotheca gnaphalioides*			
Asteraceae	Asteraceae sp.			
Boraginaceae	**Echium plantagineum*			*DP -s22(2)
Brassicaceae	**Raphanus raphanistrum*			
Campanulaceae	**Monopsis debilis*			
Campanulaceae	**Wahlenbergia capensis*			
Casuarinaceae	*Allocasuarina fraseriana*			
Casuarinaceae	*Allocasuarina huegeliana*			
Casuarinaceae	*Allocasuarina humilis*			
Casuarinaceae	*Allocasuarina* sp.			
Colchicaceae	*Burchardia bairdiae*			

Family	Species	Conservation Status		Introduced Species Status
		EPBC Act	BC Act / DBCA	
Colchicaceae	*Burchardia congesta*			
Crassulaceae	*Crassula colorata*			
Cyperaceae	**Cyperus tenellus*			
Cyperaceae	*Lepidosperma* sp.			
Cyperaceae	*Machaerina laxa*			
Cyperaceae	*Mesomelaena pseudostygia*			
Cyperaceae	Cyperaceae sp.			
Dasypogonaceae	*Dasypogon bromeliifolius*			
Droseraceae	*Drosera glanduligera*			
Ericaceae	*Conostephium pendulum*			
Fabaceae	*Acacia divergens*			
Fabaceae	**Acacia iteaphylla*			
Fabaceae	**Acacia longifolia*			
Fabaceae	*Acacia pulchella*			
Fabaceae	*Acacia saligna*			
Fabaceae	*Aotus gracillima*			
Fabaceae	**Chamaecytisus palmensis*			
Fabaceae	*Gompholobium preissii*			
Fabaceae	*Jacksonia furcellata*			
Fabaceae	*Jacksonia sternbergiana*			
Fabaceae	*Kennedia coccinea*			
Fabaceae	*Kennedia prostrata*			
Fabaceae	**Lotus subbiflorus*			
Fabaceae	**Lupinus cosentinii*			
Fabaceae	**Trifolium angustifolium* var. *angustifolium*			
Fabaceae	**Trifolium* sp.			
Fabaceae	**Vicia sativa*			
Geraniaceae	**Pelargonium capitatum*			
Goodeniaceae	*Dampiera coronata*			
Goodeniaceae	*Dampiera linearis*			
Haemodoraceae	*Anigozanthos manglesii*			
Haemodoraceae	*Anigozanthos viridis x manglesii*			
Haemodoraceae	*Conostylis aculeata*			
Haemodoraceae	*Conostylis candicans*			
Hemerocallidaceae	*Dianella revoluta*			

Family	Species	Conservation Status		Introduced Species Status
		EPBC Act	BC Act / DBCA	
Hemerocallidaceae	*Tricoryne tenella*			
Iridaceae	**Babiana angustifolia*			
Iridaceae	**Gladiolus caryophyllaceus*			
Iridaceae	**Moraea flaccida*			*DP -s22(2)
Iridaceae	*Patersonia occidentalis*			
Iridaceae	**Romulea rosea*			
Iridaceae	**Sparaxis bulbifera*			
Iridaceae	**Watsonia meriana*			
Iridaceae	**Watsonia meriana* var. *meriana*			
Juncaceae	**Juncus articulatus*			
Juncaceae	*Juncus pallidus*			
Juncaginaceae	*Triglochin calcitrapa*			
Lauraceae	*Cassytha* sp.			
Loranthaceae	*Nuytsia floribunda*			
Myrtaceae	*Astartea scoparia*			
Myrtaceae	**Callistemon* sp.			
Myrtaceae	**Chamelaucium uncinatum*			
Myrtaceae	*Corymbia calophylla*			
Myrtaceae	*Eucalyptus camaldulensis*			
Myrtaceae	*Eucalyptus marginata*			
Myrtaceae	*Eucalyptus rudis*			
Myrtaceae	*Eucalyptus* sp.			
Myrtaceae	**Eucalyptus* sp. (planted)			
Myrtaceae	*Hypocalymma angustifolium*			
Myrtaceae	*Kunzea glabrescens*			
Myrtaceae	*Kunzea micrantha*			
Myrtaceae	**Leptospermum laevigatum*			
Myrtaceae	*Melaleuca preissiana*			
Myrtaceae	*Melaleuca rhaphiophylla*			
Myrtaceae	*Melaleuca viminea*			
Myrtaceae	*Melaleuca* sp.			
Myrtaceae	*Regelia ciliata*			
Myrtaceae	*Verticordia densiflora*			
Myrtaceae	*Viminaria juncea*			
Orchidaceae	*Microtis media*			

Family	Species	Conservation Status		Introduced Species Status
		EPBC Act	BC Act / DBCA	
Oxalidaceae	**Oxalis pes-caprae*			
Oxalidaceae	**Oxalis purpurea*			
Papaveraceae	**Fumaria capreolata*			
Poaceae	**Bambusa* sp.			
Poaceae	**Briza maxima*			
Poaceae	**Briza minima*			
Poaceae	**Bromus diandrus*			
Poaceae	**Digitaria* sp.			
Poaceae	**Ehrharta calycina*			
Poaceae	**Ehrharta longiflora*			
Poaceae	**Eragrostis curvula*			
Poaceae	**Hyparrhenia hirta*			
Poaceae	**Lolium perenne*			
Poaceae	*Poaceae sp.			
Polygonaceae	**Rumex* sp.			
Primulaceae	**Lysimachia arvensis*			
Proteaceae	*Adenanthos cygnorum*			
Proteaceae	*Banksia attenuata*			
Proteaceae	*Banksia dallanneyi* subsp. *dallanneyi*			
Proteaceae	*Banksia illicifolia*			
Proteaceae	*Banksia littoralis*			
Proteaceae	*Banksia menziesii*			
Proteaceae	*Banksia telmatiaea*			
Proteaceae	*Grevillea curviloba*	EN	CR/EN	
Proteaceae	*Grevillea evanescens*	-	P1	
Proteaceae	*Grevillea vestita*			
Proteaceae	*Grevillea* sp.			
Proteaceae	*Hakea prostrata*			
Proteaceae	*Hakea varia*			
Proteaceae	*Petrophile linearis*			
Proteaceae	*Petrophile seminuda*			
Proteaceae	*Stirlingia latifolia*			
Restionaceae	*Desmocladus asper*			
Restionaceae	*Desmocladus flexuosus*			
Restionaceae	*Dielsia stenostachya*			

Family	Species	Conservation Status		Introduced Species Status
		EPBC Act	BC Act / DBCA	
Restionaceae	*Hypolaena exsulca*			
Restionaceae	*Hypolaena pubescens*			
Restionaceae	*Leptocarpus canus*			
Rubiaceae	*Opercularia vaginata*			
Sapindaceae	*Diplopeltis huegelii*			
Scrophulariaceae	**Dischisma capitatum*			
Scrophulariaceae	*Eremophila glabra*			
Solanaceae	**Solanum nigrum*			
Stylidiaceae	*Stylidium calcaratum*			
Stylidiaceae	*Stylidium rigidulum*			
Thymelaeaceae	*Pimelea argentea*			
Typhaceae	*Typha* sp.			
Xanthorrhoeaceae	*Xanthorrhoea gracilis*			
Xanthorrhoeaceae	*Xanthorrhoea preissii*			
Zamiaceae	*Macrozamia fraseri*			

Appendix G: Flora species matrix

Family	Species	AT01	AT02			AT03	AT04				AT05	AT06			AT07	AT08	AT09			AT10				AT11 & AT12			AT13		AT14			AT15	AT16					AT17				LD01	LD02	LD03	LD03	LD06
		oppo	ELA32	ELA33	oppo	oppo	ELA28	ELA29	ELA30	ELA31	oppo	ELA27	ELA25	ELA26	oppo	ELA24	oppo	ELA23	oppo	ELA20	ELA21	oppo	ELA16	ELA17	ELA18	oppo	ELA15	oppo	ELA14	ELA13	oppo	ELA10	ELA11	ELA12	oppo	ELA22	oppo	ELA05	ELA06	ELA07	ELA08	ELA09	oppo	ELA02	ELA03	ELA04	oppo	ELA34	oppo	oppo	ELA19	oppo	ELA01
Aizoaceae	*Carpobrotus edulis*							X							X							X		X	X																								
Amaranthaceae	*Ptilotus polystachyus*																										X																						
Anacardiaceae	*Schinus* sp.																																													X				
Anarthriaceae	*Lyginia barbata*									X																																								
Apiaceae	*Eryngium pinnatifidum*																				X																													
Araceae	*Zantedeschia aethiopica*																								X		X		X	X			X											X	X				
Araceae	Araceae sp.																																				X												
Araliaceae	*Trachymene pilosa*									X																																							
Asparagaceae	*Asparagus asparagoides*																X																X											X			X	X		
Asparagaceae	*Acanthocarpus canaliculatus*													X													X			X																			
Asparagaceae	*Laxmannia grandiflora subsp. grandiflora*									X																																							
Asparagaceae	*Sowerbaea laxiflora*																																		X														
Asparagaceae	*Thysanotus dichotomus*												X		X													X						X														
Asparagaceae	*Thysanotus patersonii*									X																										X													
Asphodelaceae	*Aloe sp.*																																													X				
Asteraceae	*Arctotheca calendula*	X			X	X				X				X	X		X		X	X							X						X	X		X												
Asteraceae	*Cotula coronopifolia*									X																			X							X													
Asteraceae	*Hypochaeris radicata*						X		X	X	X		X			X					X	X															X									X	X		
Asteraceae	*Sonchus asper*					X												X				X			X	X			X																	X	X		
Asteraceae	*Sonchus oleraceus*																																													X				
Asteraceae	*Ursinia anthemoides*					X			X	X	X		X		X												X		X				X	X	X	X	X									X		
Asteraceae	*Podolepis gracilis*																													X																			
Asteraceae	*Podotheca gnaphalioides*					X		X	X						X							X							X					X												X		
Asteraceae	Asteraceae sp.																																X																
Boraginaceae	*Echium plantagineum*				X																																												
Brassicaceae	*Raphanus raphanistrum*				X	X										X		X				X								X														X				
Campanulaceae	*Monopsis debilis*									X				X															X																X				
Campanulaceae	*Wahlenbergia capensis*					X		X								X					X						X					X				X									X				
Casuarinaceae	*Allocasuarina fraseriana*																																												X	X				
Casuarinaceae	*Allocasuarina huegeliana*																																			X													
Casuarinaceae	*Allocasuarina humilis*													X																																				
Casuarinaceae	*Allocasuarina* sp.																																				X									X				
Colchicaceae	*Burchardia bairdiae*																																																	
Colchicaceae	*Burchardia congesta*									X	X										X										X																			
Crassulaceae	*Crassula colorata*					X					X																					X																	X		
Cyperaceae	*Cyperus tenellus*										X				X			X				X					X		X					X															
Cyperaceae	*Lepidosperma* sp.																						X			X																								
Cyperaceae	*Machaerina laxa*																													X																				
Cyperaceae	*Mesomelaena pseudostygia*																																													X				

Family	Species	AT01	AT02			AT03	AT04				AT05	AT06			AT07		AT08		AT09			AT10				AT11 & AT12			AT13	AT14				AT15	AT16					AT17				LD01	LD02	LD03	LD03	LD06
		oppo	ELA32	ELA33	oppo	oppo	ELA28	ELA29	ELA30	ELA31	oppo	ELA27	ELA25	ELA26	oppo	ELA24	oppo	ELA23	oppo	ELA20	ELA21	oppo	ELA16	ELA17	ELA18	oppo	ELA15	oppo	ELA14	ELA13	oppo	ELA10	ELA11	ELA12	oppo	ELA22	oppo	ELA05	ELA06	ELA07	ELA08	ELA09	oppo	ELA02	ELA03	ELA04	oppo	ELA34	oppo	oppo	ELA19	oppo	ELA01
Cyperaceae	Cyperaceae sp.						X															X				X																								
Dasypogonaceae	*Dasypogon bromeliifolius*									X																																								
Droseraceae	*Drosera glanduligera*																				X									X																				
Ericaceae	*Conostephium pendulum*									X																																							
Fabaceae	*Acacia divergens*									X																																							
Fabaceae	**Acacia iteaphylla*				X																																												
Fabaceae	**Acacia longifolia*																																																X
Fabaceae	*Acacia pulchella*																																														X			
Fabaceae	*Acacia saligna*				X		X			X				X			X	X	X	X	X		X	X		X	X			X		X	X	X		X		X	X	X	X	X	X		X		X			X
Fabaceae	*Aotus gracillima*																																																
Fabaceae	**Chamaecytisus palmensis*																																																X
Fabaceae	*Gompholobium preissii*					X				X																																							
Fabaceae	*Jacksonia furcellata*					X			X	X	X				X		X			X		X							X		X			X	X								X	X		X			
Fabaceae	*Jacksonia sternbergiana*				X						X				X							X	X								X		X		X		X												
Fabaceae	*Kennedia coccinea*				X																																													
Fabaceae	*Kennedia prostrata*									X								X			X																									X	X		X		
Fabaceae	**Lotus subbiflorus*	X								X				X	X			X			X		X	X	X					X																			X
Fabaceae	**Lupinus cosentinii*				X	X				X		X			X	X					X		X	X		X		X							X		X									X			
Fabaceae	**Trifolium angustifolium* var. *angustifolium*	X																																															
Fabaceae	**Trifolium* sp.																				X																	X												
Fabaceae	**Vicia sativa*		X															X																															
Geraniaceae	**Pelargonium capitatum*					X			X		X						X	X							X																			X		X			
Goodeniaceae	*Dampiera coronata*																																																
Goodeniaceae	*Dampiera linearis*				X					X																		X																						
Haemodoraceae	*Anigozanthos manglesii*																														X	X			X														
Haemodoraceae	*Anigozanthos viridis x manglesii*																																X																
Haemodoraceae	*Conostylis aculeata*									X																																							
Haemodoraceae	*Conostylis candicans*																																X																
Hemerocallidaceae	*Dianella revoluta*				X																				X																								
Hemerocallidaceae	*Tricoryne tenella*																																			X													
Iridaceae	**Babiana angustifolia*																																																X
Iridaceae	**Gladiolus caryophyllaceus*					X		X	X				X		X					X		X										X															X			
Iridaceae	**Moraea flaccida*									X					X			X			X	X			X																					X	X			
Iridaceae	*Patersonia occidentalis*									X																																							
Iridaceae	**Romulea rosea*	X								X																				X																			
Iridaceae	**Sparaxis bulbifera*									X					X																																		
Iridaceae	**Watsonia meriana*	X	X	X	X	X								X		X	X		X				X	X		X	X																				X		X	
Iridaceae	**Watsonia meriana* var. *meriana*																																														X			
Juncaceae	**Juncus articulatus*																																			X													

Family	Species	AT01	AT02			AT03	AT04					AT05	AT06			AT07		AT08		AT09			AT10				AT11 & AT12			AT13		AT14				AT15		AT16						AT17				LD01		LD02	LD03		LD03		LD06
		oppo	ELA32	ELA33	oppo	oppo	ELA28	ELA29	ELA30	ELA31	oppo	ELA27	ELA25	ELA26	oppo	ELA24	oppo	ELA23	oppo	ELA20	ELA21	oppo	ELA16	ELA17	ELA18	oppo	ELA15	oppo	ELA14	ELA13	oppo	ELA10	ELA11	ELA12	oppo	ELA22	oppo	ELA05	ELA06	ELA07	ELA08	ELA09	oppo	ELA02	ELA03	ELA04	oppo	ELA34	oppo	oppo	ELA19	oppo	ELA01
Juncaceae	*Juncus pallidus*							X																																				X	X								
Juncaginaceae	*Triglochin calcitrapa*																																		X																	
Lauraceae	*Cassytha* sp.																																										X								
Loranthaceae	*Nuytsia floribunda*								X						X						X															X														X		
Myrtaceae	*Astartea scoparia*									X	X																													X					X							
Myrtaceae	**Callistemon* sp.																																															X				
Myrtaceae	**Chamelaucium uncinatum*																																															X				
Myrtaceae	*Corymbia calophylla*	X	X							X	X		X		X					X		X	X				X			X				X													X		X	X			X
Myrtaceae	*Eucalyptus camaldulensis*											X																																					X				
Myrtaceae	*Eucalyptus marginata*																																																	X			
Myrtaceae	*Eucalyptus rudis*																				X							X			X				X													X				
Myrtaceae	*Eucalyptus* sp.																																			X																	
Myrtaceae	**Eucalyptus* sp. (planted)				X																																												X	X			
Myrtaceae	*Hypocalymma angustifolium*										X																													X	X											
Myrtaceae	*Kunzea glabrescens*																																						X				X		X							
Myrtaceae	*Kunzea micrantha*			X																																																
Myrtaceae	**Leptospermum laevigatum*																																																	X			
Myrtaceae	*Melaleuca preissiana*																																								X											
Myrtaceae	*Melaleuca rhaphiophylla*																				X									X	X									X		X		X	X	X		X	X				
Myrtaceae	*Melaleuca viminea*								X	X	X	X		X							X	X				X											X																
Myrtaceae	*Melaleuca* sp.					X																															X																
Myrtaceae	*Regelia ciliata*						X				X				X																																						
Myrtaceae	*Verticordia densiflora*																																			X																
Myrtaceae	*Viminaria juncea*			X	X																											X				X													X			
Orchidaceae	*Microtis media*																																																			
Oxalidaceae	**Oxalis pes-caprae*																																																X	X			
Oxalidaceae	**Oxalis purpurea*										X																																									
Papaveraceae	**Fumaria capreolata*																																																		X			
Poaceae	**Bambusa sp.*				X																																															
Poaceae	**Briza maxima*	X		X	X		X			X				X	X						X	X	X				X		X			X			X	X				X							X				X
Poaceae	**Briza minima*														X													X		X			X		X	X											X				
Poaceae	**Bromus diandrus*				X										X							X	X		X	X		X		X										X						X				
Poaceae	**Digitaria* sp.																		X	X																																		
Poaceae	**Ehrharta calycina*	X			X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X					X		X			X		
Poaceae	**Ehrharta longiflora*											X				X	X	X	X		X																												X	X				
Poaceae	**Eragrostis curvula*	X	X	X		X	X		X		X	X	X			X	X	X	X	X	X	X		X	X		X		X				X	X		X	X			X					X		X	X				X
Poaceae	**Hyparrhenia hirta*	X	X	X																																													X				
Poaceae	**Lolium perenne*				X		X				X					X	X		X	X	X			X				X									X	X												X			
Poaceae	**Poaceae sp.*																																																			

Family	Species	AT01	AT02			AT03	AT04				AT05	AT06			AT07	AT08	AT09		AT10				AT11 & AT12			AT13	AT14				AT15		AT16					AT17				LD01		LD02	LD03		LD03		LD06
		oppo	ELA32	ELA33	oppo	oppo	ELA28	ELA29	ELA30	ELA31	oppo	ELA27	ELA25	ELA26	oppo	ELA24	oppo	ELA23	oppo	ELA20	ELA21	oppo	ELA16	ELA17	ELA18	oppo	ELA15	oppo	ELA14	ELA13	oppo	ELA10	ELA11	ELA12	oppo	ELA22	oppo	ELA05	ELA06	ELA07	ELA08	ELA09	oppo	ELA02	ELA03	ELA04	oppo	ELA34	oppo	oppo	ELA19	oppo	ELA01
Polygonaceae	*Rumex* sp.						X														X						X														X								
Primulaceae	*Lysimachia arvensis*	X			X												X							X											X														
Proteaceae	*Adenanthos cygnorum*					X		X																																									X	
Proteaceae	*Banksia attenuata*								X		X																				X																			
Proteaceae	*Banksia dallanneyi* subsp. *dallanneyi*																														X																			
Proteaceae	*Banksia illicifolia*								X																						X																			
Proteaceae	*Banksia littoralis*																								X	X			X																		X			
Proteaceae	*Banksia menziesii*							X			X		X		X									X																								X			
Proteaceae	*Banksia telmatiaea*																				X																													
Proteaceae	*Grevillea evanescens* (P1)																																			X														
Proteaceae	*Grevillea curviloba* (T)																								X	X		X	X		X																		
Proteaceae	*Grevillea vestita*			X	X																																													
Proteaceae	*Grevillea* sp.																																																X			
Proteaceae	*Hakea prostrata*			X	X																		X		X			X																						
Proteaceae	*Hakea varia*									X				X	X																						X														
Proteaceae	*Petrophile linearis*																														X																			
Proteaceae	*Petrophile seminuda*																																			X														
Proteaceae	*Stirlingia latifolia*														X																																			
Restionaceae	*Desmocladus asper*					X				X																																								
Restionaceae	*Desmocladus flexuosus*									X																																							
Restionaceae	*Dielsia stenostachya*																																																
Restionaceae	*Hypolaena exsulca*																														X																		
Restionaceae	*Hypolaena pubescens*									X					X																																		
Restionaceae	*Leptocarpus canus*			X						X				X	X											X																							
Rubiaceae	*Opercularia vaginata*																											X																					
Sapindaceae	*Diplopeltis huegelii*																									X																						
Scrophulariaceae	*Dischisma capitatum*								X				X			X																																	
Scrophulariaceae	*Eremophila glabra*																								X																								
Solanaceae	*Solanum nigrum*				X					X											X																									X					
Stylidiaceae	*Stylidium calcaratum*																											X		X						X	X											
Stylidiaceae	*Stylidium rigidulum*									X																																						
Thymelaeaceae	*Pimelea argentea*																											X																					
Typhaceae	*Typha* sp.					X				X																												X											
Xanthorrhoeaceae	*Xanthorrhoea gracilis*				X	X			X																																					X			
Xanthorrhoeaceae	*Xanthorrhoea preissii*	X		X									X		X			X		X		X		X		X		X			X		X	X		X						X			X	X	X		
Zamiaceae	*Macrozamia fraseri*					X		X			X				X																X																			

Appendix H: Locations of Conservation Significant Flora

EPBC Act	BC Act/DBCA	Species Name	Date	Survey Area	Relevé	Easting	Northing
EN	EN	*Grevillea curviloba*	5/10/2021	AT14	ELA10	400206	6512894
EN	EN	*Grevillea curviloba*	5/10/2021	AT14	ELA12	400458	6512040
EN	EN	*Grevillea curviloba*	5/10/2021	AT12	ELA14	401453	6509804
EN	EN	*Grevillea curviloba*	6/10/2021	AT10	ELA18	402350	6507154
EN	EN	*Grevillea curviloba*	6/10/2021	AT15	ELA22	399309	6515871
EN	EN	*Grevillea curviloba*	6/10/2021	AT15	oppo	399286	6515958
EN	EN	*Grevillea curviloba*	6/10/2021	AT15	oppo	399289	6515948
EN	EN	*Grevillea curviloba*	6/10/2021	AT15	oppo	399305	6515899
EN	EN	*Grevillea curviloba*	6/10/2021	AT15	oppo	399307	6515891
EN	EN	*Grevillea curviloba*	6/10/2021	AT15	oppo	399314	6515873
EN	EN	*Grevillea curviloba*	6/10/2021	AT15	oppo	399332	6515805
EN	EN	*Grevillea curviloba*	6/10/2021	AT15	oppo	399342	6515775
EN	EN	*Grevillea curviloba*	6/10/2021	AT15	oppo	399350	6515744
EN	EN	*Grevillea curviloba*	6/10/2021	AT15	oppo	399353	6515737
EN	EN	*Grevillea curviloba*	6/10/2021	AT15	oppo	399362	6515706
EN	EN	*Grevillea curviloba*	6/10/2021	AT10	oppo	402143	6507768
EN	EN	*Grevillea curviloba*	6/10/2021	AT10	oppo	402166	6507707
EN	EN	*Grevillea curviloba*	6/10/2021	AT10	oppo	402178	6507694
EN	EN	*Grevillea curviloba*	6/10/2021	AT10	oppo	402358	6507166
EN	EN	*Grevillea curviloba*	6/10/2021	AT10	oppo	402359	6507156
EN	EN	*Grevillea curviloba*	6/10/2021	AT10	oppo	402366	6507132
EN	EN	*Grevillea curviloba*	6/10/2021	AT15	oppo	399291	6515966
EN	EN	*Grevillea curviloba*	6/10/2021	AT15	oppo	399296	6515949
EN	EN	*Grevillea curviloba*	6/10/2021	AT15	oppo	399306	6515909
EN	EN	*Grevillea curviloba*	6/10/2021	AT15	oppo	399321	6515850
EN	EN	*Grevillea curviloba*	6/10/2021	AT15	oppo	399324	6515844
EN	EN	*Grevillea curviloba*	6/10/2021	AT15	oppo	399348	6515759
EN	EN	*Grevillea curviloba*	6/10/2021	AT15	oppo	399355	6515744
EN	EN	*Grevillea curviloba*	6/10/2021	AT15	oppo	399357	6515735
EN	EN	*Grevillea curviloba*	6/10/2021	AT15	oppo	399362	6515709
EN	EN	*Grevillea curviloba*	6/10/2021	AT15	oppo	399370	6515684
EN	EN	*Grevillea curviloba*	6/10/2021	AT08	oppo	404980	6498041
EN	EN	*Grevillea curviloba*	6/10/2021	AT07	oppo	405067	6496271

EPBC Act	BC Act/DBCA	Species Name	Date	Survey Area	Relevé	Easting	Northing
-	P1	*Grevillea evanescens*	6/10/2021	AT15	oppo	399339	6515791

Appendix I: Releve Data

Releve:	ELA01	Survey Area:	LD06
Date:	04/10/2021	**Location:**	UTM zone 50
Landform:	Slope	**Easting:**	395885
Soil colour:	Orange-brown	**Northing:**	6530971
Soil type:	Gravelly light clay	**Age since fire (yrs):**	20
Vegetation unit:	CcW	**Vegetation condition:**	Degraded

Releve:	ELA02	Survey Area:	AT17
Date:	04/10/2021	**Location:**	UTM zone 50
Landform:	Flat	**Easting:**	397156
Soil colour:	Grey	**Northing:**	6523029
Soil type:	Sand	**Age since fire (yrs):**	20
Vegetation unit:	MrW	**Vegetation condition:**	Completely Degraded

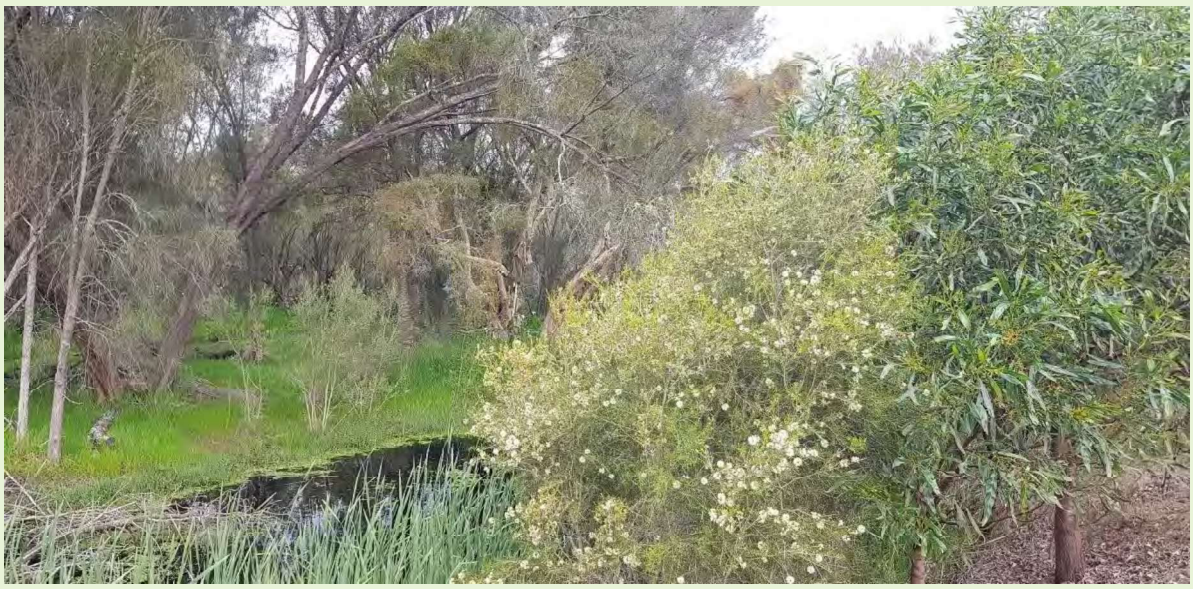
Releve:	ELA03	Survey Area:	AT17
Date:	04/10/2021	**Location:**	UTM zone 50
Landform:	Flat	**Easting:**	396996
Soil colour:	Brown	**Northing:**	6523564
Soil type:	Sand	**Age since fire (yrs):**	20
Vegetation unit:	MtS	**Vegetation condition:**	**Good**

No photo available

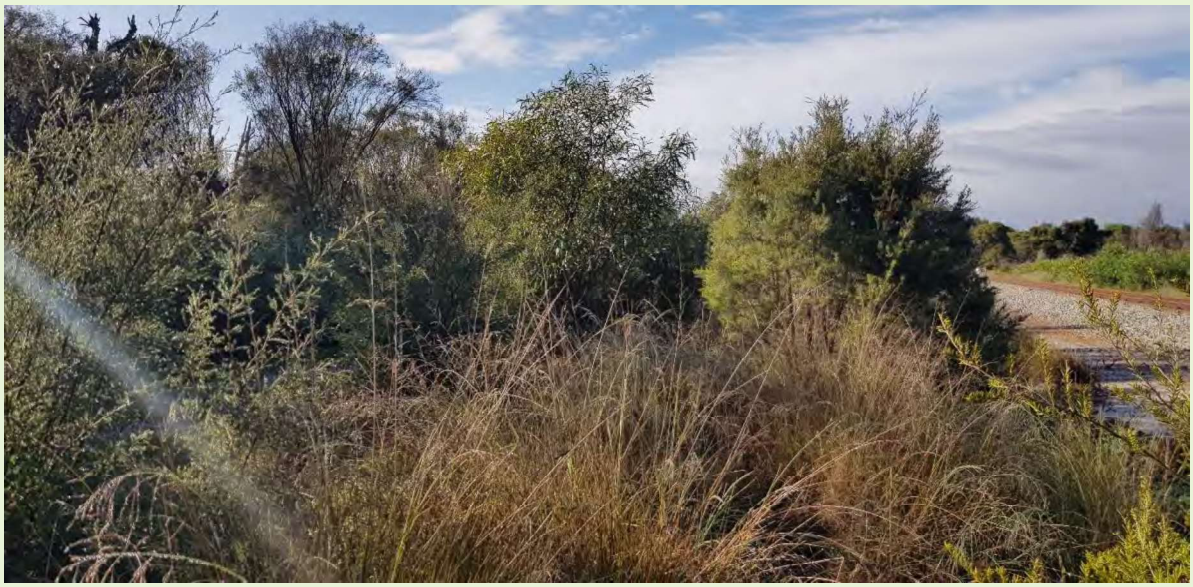
Releve:	ELA04	Survey Area:	AT17
Date:	04/10/2021	**Location:**	UTM zone 50
Landform:	Open depression	**Easting:**	396766
Soil colour:	Brown	**Northing:**	6524330
Soil type:	Sandy loam	**Age since fire (yrs):**	20
Vegetation unit:	MrW	**Vegetation condition:**	Good

Releve:	ELA05	Survey Area:	AT16
Date:	04/10/2021	**Location:**	UTM zone 50
Landform:	Flat	**Easting:**	397392
Soil colour:	Brown-grey	**Northing:**	6522286
Soil type:	Sand	**Age since fire (yrs):**	20
Vegetation unit:	MrW	**Vegetation condition:**	Good

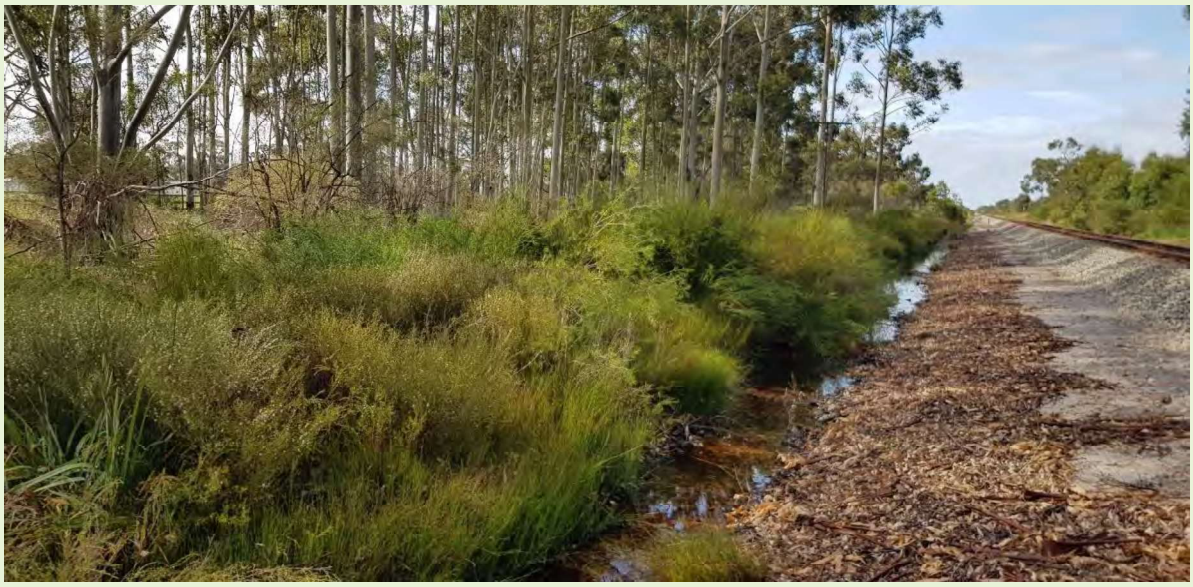
Releve:	ELA06	Survey Area:	AT16
Date:	04/10/2021	**Location:**	UTM zone 50
Landform:	Drainage line	**Easting:**	397717
Soil colour:	Brown	**Northing:**	6521145
Soil type:	Sandy loam	**Age since fire (yrs):**	20
Vegetation unit:	MrW	**Vegetation condition:**	Very Good



Releve:	ELA07	Survey Area:	AT16
Date:	05/10/2021	**Location:**	UTM zone 50
Landform:	Flat	**Easting:**	397995
Soil colour:	Dark brown	**Northing:**	6520225
Soil type:	Loamy sand	**Age since fire (yrs):**	20
Vegetation unit:	MrW	**Vegetation condition:**	Very Good



Releve:	ELA08	Survey Area:	AT16
Date:	05/10/2021	**Location:**	UTM zone 50
Landform:	Flat	**Easting:**	398421
Soil colour:	Brown	**Northing:**	6518826
Soil type:	Sandy loam	**Age since fire (yrs):**	20
Vegetation unit:	MmS	**Vegetation condition:**	Very Good



Releve:	ELA09	Survey Area:	AT16
Date:	05/10/2021	**Location:**	UTM zone 50
Landform:	Drainage line	**Easting:**	398898
Soil colour:	Dark brown	**Northing:**	6517237
Soil type:	Clayey sandy loam	**Age since fire (yrs):**	20
Vegetation unit:	MrW	**Vegetation condition:**	Good

Releve:	ELA10	Survey Area:	AT14
Date:	05/10/2021	Location:	UTM zone 50
Landform:	Flat	Easting:	400206
Soil colour:	Grey	Northing:	6512894
Soil type:	Sand	**Age since fire (yrs):**	1-10
Vegetation unit:	BsppW	Vegetation condition:	Good

Releve:	ELA11	Survey Area:	AT14
Date:	05/10/2021	**Location:**	UTM zone 50
Landform:	Flat	**Easting:**	400289
Soil colour:	Dark brown	**Northing:**	6512598
Soil type:	Loamy sand	**Age since fire (yrs):**	>20
Vegetation unit:	MtS	**Vegetation condition:**	Good

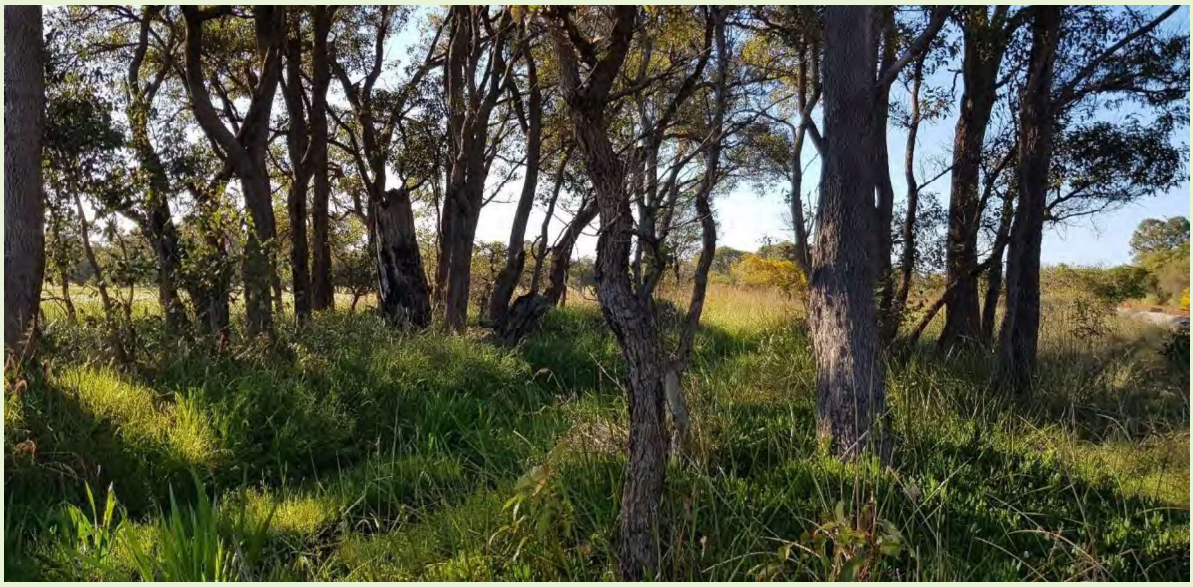
Releve:	ELA12	Survey Area:	AT14
Date:	05/10/2021	**Location:**	UTM zone 50
Landform:	Flat	**Easting:**	400458
Soil colour:	Brown	**Northing:**	6512040
Soil type:	Sand	**Age since fire (yrs):**	>20
Vegetation unit:	AsS	**Vegetation condition:**	Good

Releve:	ELA13	Survey Area:	AT13
Date:	05/10/2021	**Location:**	UTM zone 50
Landform:	Open depression	**Easting:**	400693
Soil colour:	Brown	**Northing:**	6511419
Soil type:	Sandy loam	**Age since fire (yrs):**	>20
Vegetation unit:	MrW	**Vegetation condition:**	Good

Releve:	ELA14	Survey Area:	AT12
Date:	05/10/2021	Location:	UTM zone 50
Landform:	Flat	Easting:	401453
Soil colour:	Grey	Northing:	6509804
Soil type:	Sand	Age since fire (yrs):	>20
Vegetation unit:	MtS	Vegetation condition:	Good

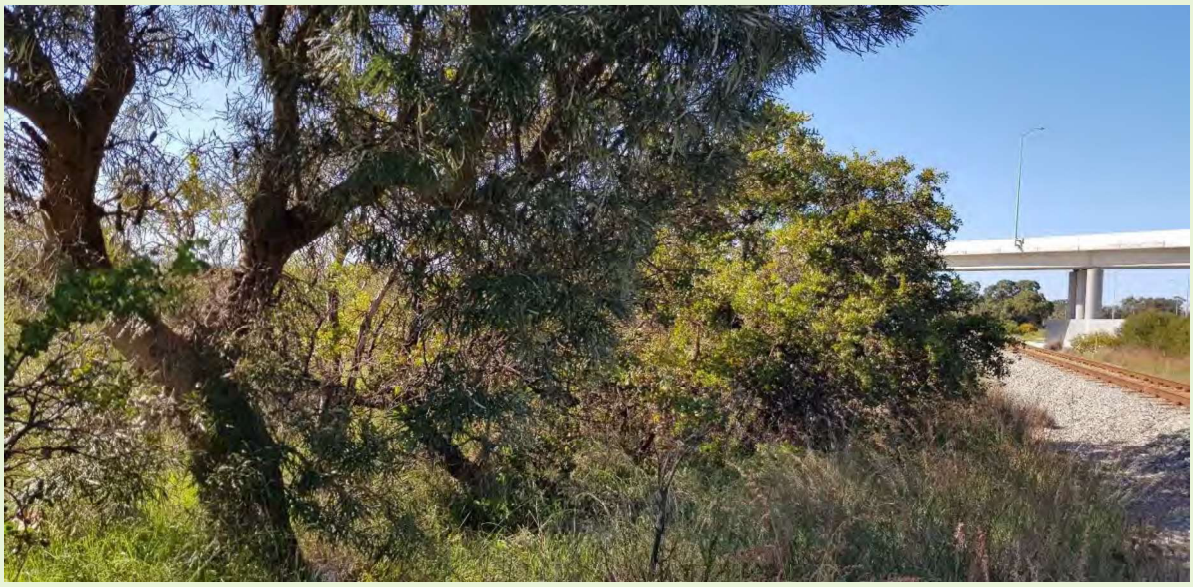
Releve:	ELA15	Survey Area:	AT11
Date:	05/10/2021	Location:	UTM zone 50
Landform:	Flat	Easting:	401902
Soil colour:	Grey	Northing:	6508475
Soil type:	Sand	Age since fire (yrs):	>20
Vegetation unit:	AsS	Vegetation condition:	Degraded

Releve:	ELA16	Survey Area:	AT10
Date:	06/10/2021	Location:	UTM zone 50
Landform:	Flat	Easting:	402119
Soil colour:	Dark brown	Northing:	6507850
Soil type:	Loam	Age since fire (yrs):	>20
Vegetation unit:	CcW	Vegetation condition:	Very Good



Releve:	ELA17	Survey Area:	AT10
Date:	06/10/2021	Location:	UTM zone 50
Landform:	Flat	Easting:	402298
Soil colour:	Brown	Northing:	6507318
Soil type:	Sand	Age since fire (yrs):	>20
Vegetation unit:	BsppW	Vegetation condition:	Very Good

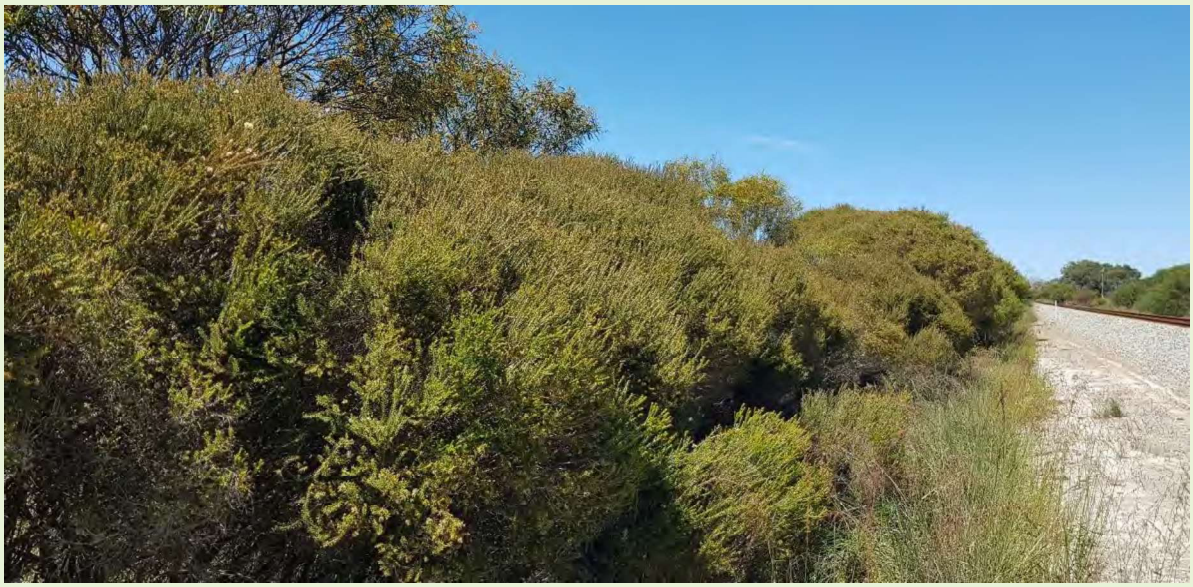
Releve:	ELA18	Survey Area:	AT10
Date:	06/10/2021	Location:	UTM zone 50
Landform:	Flat	Easting:	402350
Soil colour:	Grey	Northing:	6507154
Soil type:	Sandy loam	Age since fire (yrs):	>20
Vegetation unit:	BsppW	Vegetation condition:	Good



Releve:	ELA19	Survey Area:	LD03
Date:	06/10/2021	Location:	UTM zone 50
Landform:	Flat	Easting:	402964
Soil colour:	Grey	Northing:	6505550
Soil type:	Sand	Age since fire (yrs):	>20
Vegetation unit:	CcW	Vegetation condition:	Good

Releve:	ELA20	Survey Area:	AT09
Date:	06/10/2021	Location:	UTM zone 50
Landform:	Flat	Easting:	404397
Soil colour:	Brown	Northing:	6501180
Soil type:	Sandy loam	Age since fire (yrs):	>20
Vegetation unit:	AsS	Vegetation condition:	Good

Releve:	ELA21	Survey Area:	AT09
Date:	06/10/2021	Location:	UTM zone 50
Landform:	Flat	Easting:	404422
Soil colour:	Grey	Northing:	6501055
Soil type:	Sand	Age since fire (yrs):	>20
Vegetation unit:	MvS	Vegetation condition:	Good



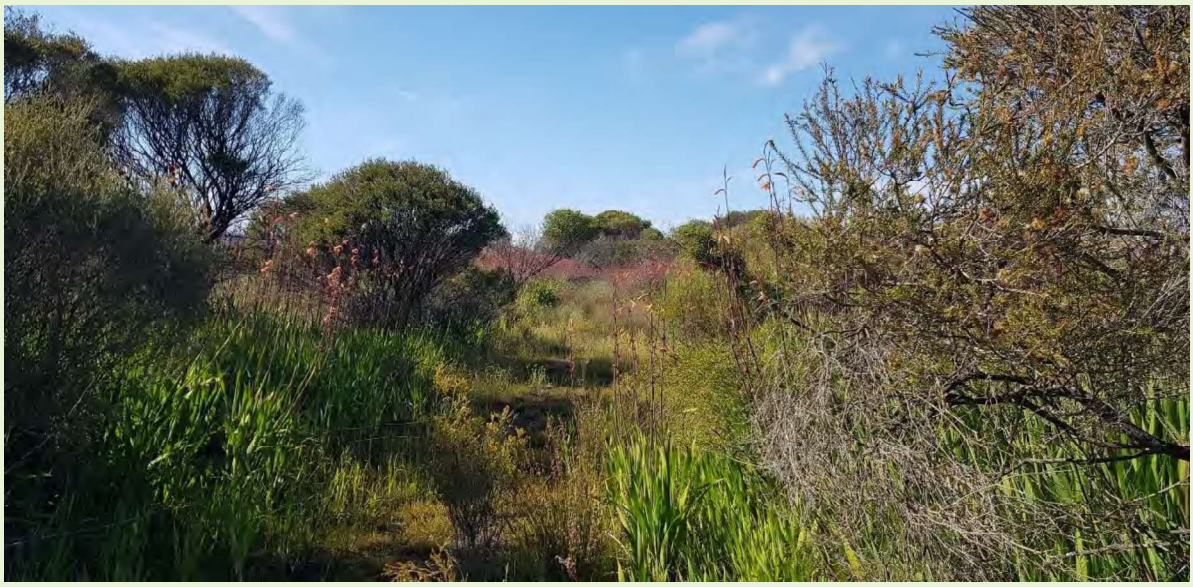
Releve:	ELA22	Survey Area:	AT15
Date:	06/10/2021	Location:	UTM zone 50
Landform:	Flat	Easting:	399309
Soil colour:	Brown	Northing:	6515871
Soil type:	Sandy loam	Age since fire (yrs):	>20
Vegetation unit:	MtS	Vegetation condition:	Good

Releve:	ELA23	Survey Area:	AT08
Date:	06/10/2021	Location:	UTM zone 50
Landform:	Flat	Easting:	404967
Soil colour:	Brown	Northing:	6498282
Soil type:	Sandy loam	Age since fire (yrs):	>20
Vegetation unit:	AsS	Vegetation condition:	Degraded

Releve:	ELA24	Survey Area:	AT07
Date:	06/10/2021	Location:	UTM zone 50
Landform:	Flat	Easting:	405058
Soil colour:	Brown	Northing:	6496424
Soil type:	Sand	Age since fire (yrs):	>20
Vegetation unit:	AsS	Vegetation condition:	Completely Degraded

Releve:	ELA25	Survey Area:	AT06
Date:	07/10/2021	Location:	UTM zone 50
Landform:	Flat	Easting:	405308
Soil colour:	Grey	Northing:	6491625
Soil type:	Sand	Age since fire (yrs):	>20
Vegetation unit:	CcW	Vegetation condition:	Very Good

Releve:	ELA26	Survey Area:	AT06
Date:	07/10/2021	Location:	UTM zone 50
Landform:	Open depression	Easting:	405679
Soil colour:	Brown	Northing:	6490773
Soil type:	Sand	Age since fire (yrs):	>20
Vegetation unit:	MvS	Vegetation condition:	Good

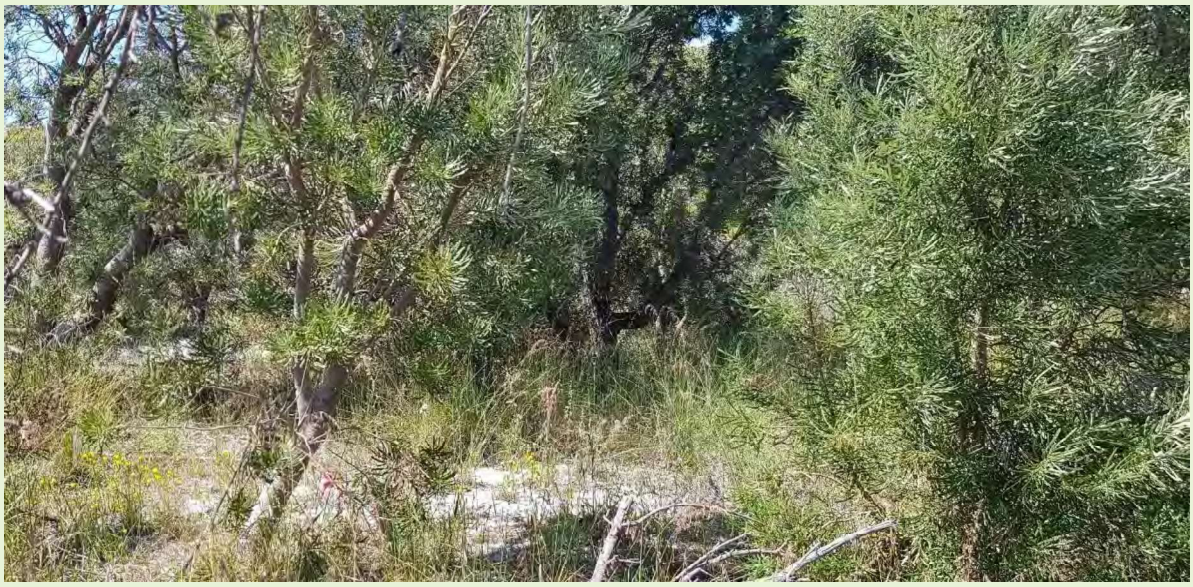


Releve:	ELA27	Survey Area:	AT05
Date:	07/10/2021	**Location:**	UTM zone 50
Landform:	Open depression	**Easting:**	406096
Soil colour:	Grey	**Northing:**	6489968
Soil type:	Sand	**Age since fire (yrs):**	>20
Vegetation unit:	MvS	**Vegetation condition:**	Good

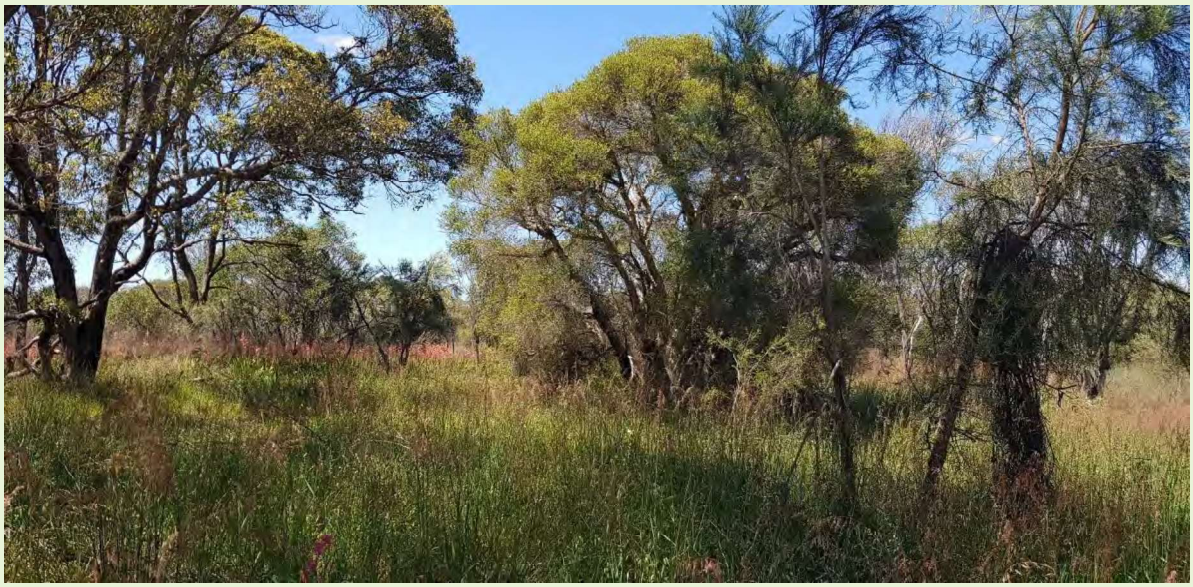
Releve:	ELA28	Survey Area:	AT04
Date:	07/10/2021	**Location:**	UTM zone 50
Landform:	Drainage line	**Easting:**	406658
Soil colour:	Brown	**Northing:**	6488874
Soil type:	Sand	**Age since fire (yrs):**	>20
Vegetation unit:	AsS	**Vegetation condition:**	Good

Releve:	ELA29	Survey Area:	AT04
Date:	07/10/2021	Location:	UTM zone 50
Landform:	Flat (local upland)	Easting:	406773
Soil colour:	Grey	Northing:	6488664
Soil type:	Sand	Age since fire (yrs):	1-10
Vegetation unit:	BsspW	Vegetation condition:	Degraded

Releve:	ELA30	Survey Area:	AT04
Date:	07/10/2021	Location:	UTM zone 50
Landform:	Slope	Easting:	406978
Soil colour:	Grey-brown	Northing:	6488278
Soil type:	Sand	Age since fire (yrs):	>20
Vegetation unit:	BsppW	Vegetation condition:	Very Good



Releve:	ELA31	Survey Area:	AT04
Date:	07/10/2021	**Location:**	UTM zone 50
Landform:	Open depression	**Easting:**	407040
Soil colour:	Dark brown	**Northing:**	6488154
Soil type:	Loamy sand	**Age since fire (yrs):**	>20
Vegetation unit:	CcW	**Vegetation condition:**	Good



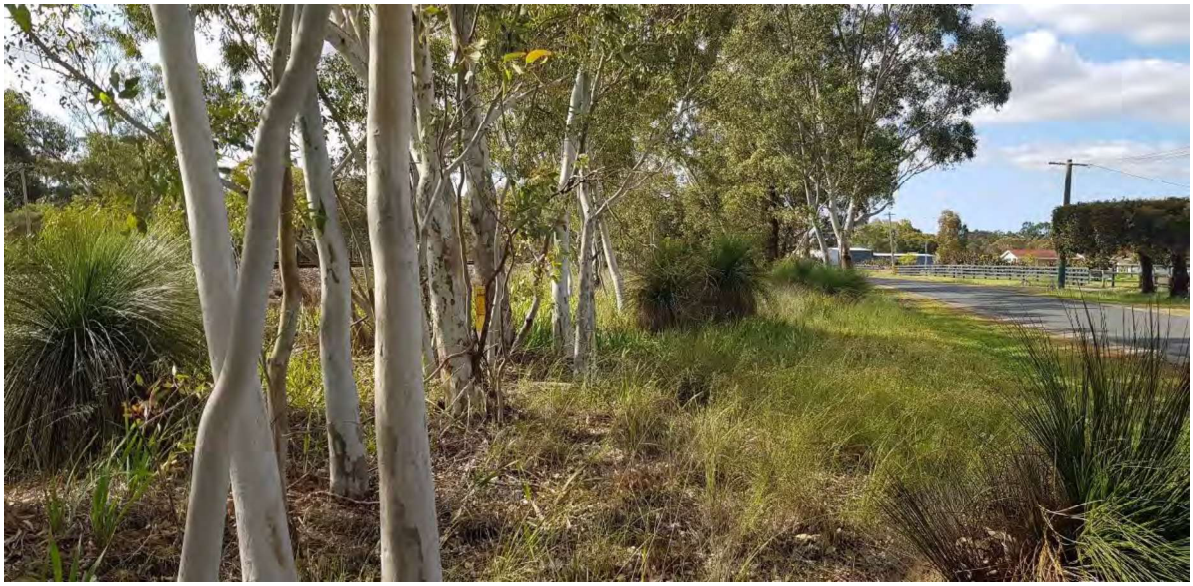
Releve:	ELA32	Survey Area:	AT02
Date:	07/10/2021	**Location:**	UTM zone 50
Landform:	Open depression	**Easting:**	407657
Soil colour:	Brown	**Northing:**	6486213
Soil type:	Clay loam	**Age since fire (yrs):**	>20
Vegetation unit:	CcW	**Vegetation condition:**	Degraded

Releve:	ELA33	Survey Area:	AT02
Date:	07/10/2021	Location:	UTM zone 50
Landform:	Open depression	Easting:	407664
Soil colour:	Brown	Northing:	6486082
Soil type:	Clay loam	Age since fire (yrs):	>20
Vegetation unit:	MtS	Vegetation condition:	Good

Releve:	ELA34	Survey Area:	LD01
Date:	07/10/2021	Location:	UTM zone 50
Landform:	Flat	Easting:	408078
Soil colour:	Dark brown	Northing:	6480461
Soil type:	Sandy loam	Age since fire (yrs):	>20
Vegetation unit:	CcW	Vegetation condition:	Good

Appendix J: Survey Area Photographs

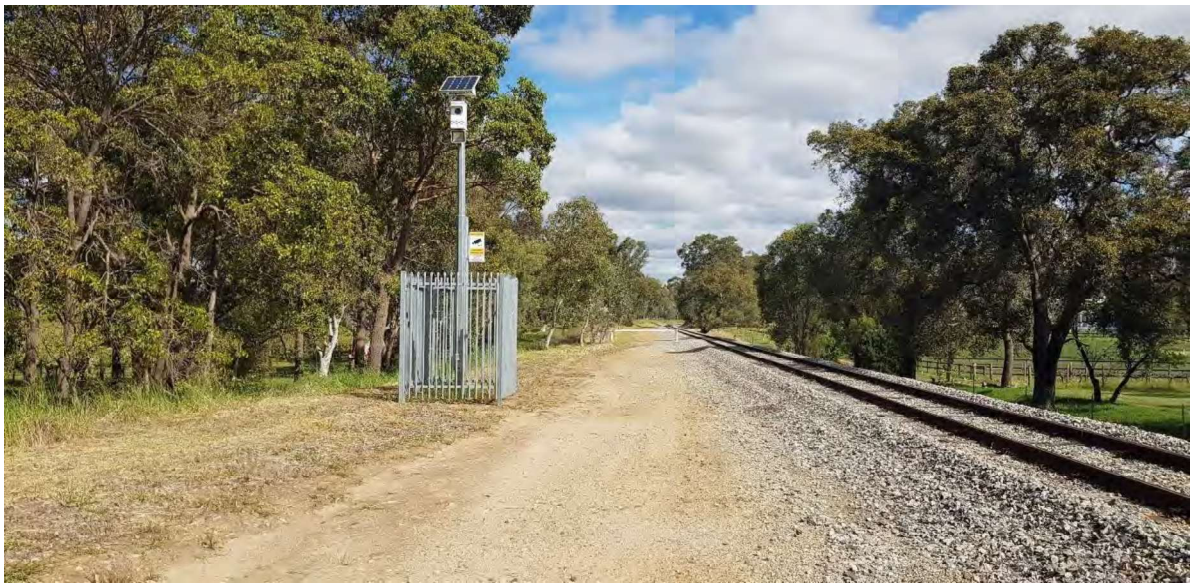
Survey Area: LD01 (from South end)



Survey Area: LD01 (from North end)

Survey Area: LD02 (from South end)

Survey Area: LD02 (from North end)



Survey Area: LD03 (from centre looking southeast)

Survey Area: LD04 (from South end)

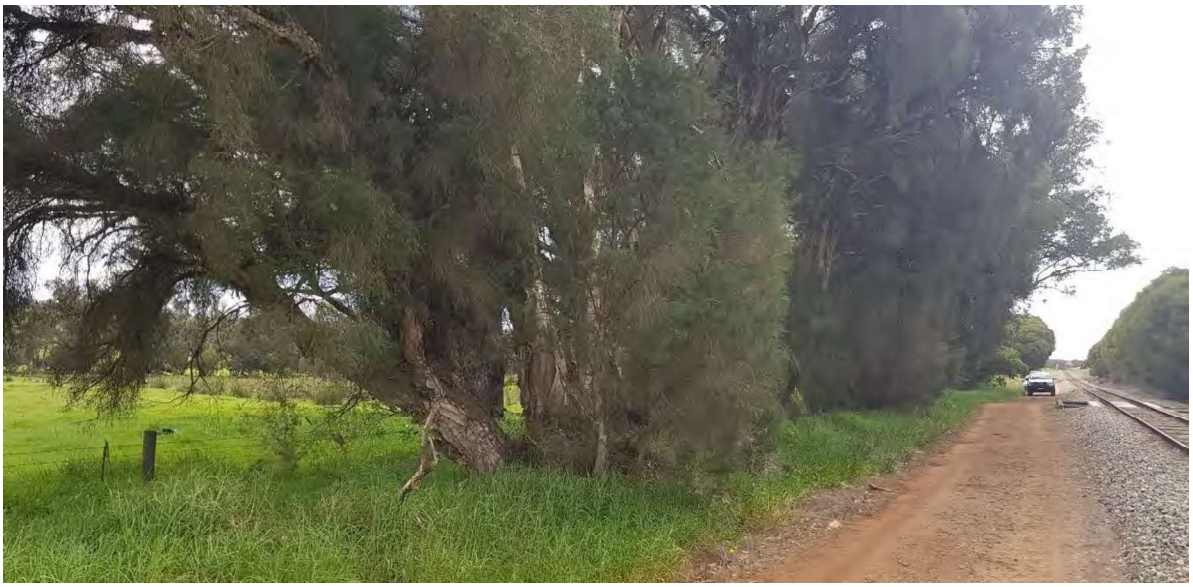
Survey Area: LD04 (from North end)

Survey Area: LD05 (from North end)

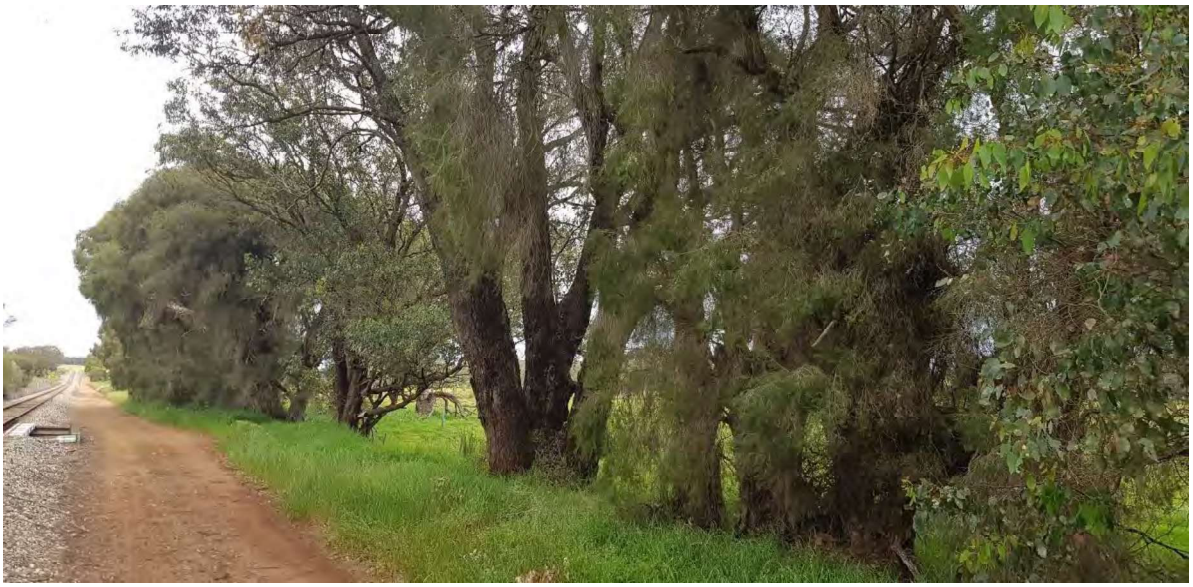
Survey Area: LD06 (from South end)

Survey Area: LD06 (from North end)

Survey Area: LD07 (from South end)



Survey Area: LD07 (from North end)



Survey Area: AT01 (from South end)

Survey Area: AT01 (from North end – Apple St)

Survey Area: AT02 (from South end – Apple St)

Survey Area: AT02 (from North end)

Survey Area: AT03 (from South end)

Survey Area: AT03 (from North end – Maralla Rd)

Survey Area: AT04 (from South end – Maralla Rd)

Survey Area: AT04 (from North end)

Survey Area: AT05 (South end)

Survey Area: AT05 (from North end – Warbrook Rd)

Survey Area: AT06 (from South end – Warbrook Rd)

Survey Area: AT06 (from North end – near Cunningham Rd)

Survey Area: AT07 (South of West Rd crossing)

Survey Area: AT07 (North of West Rd crossing)

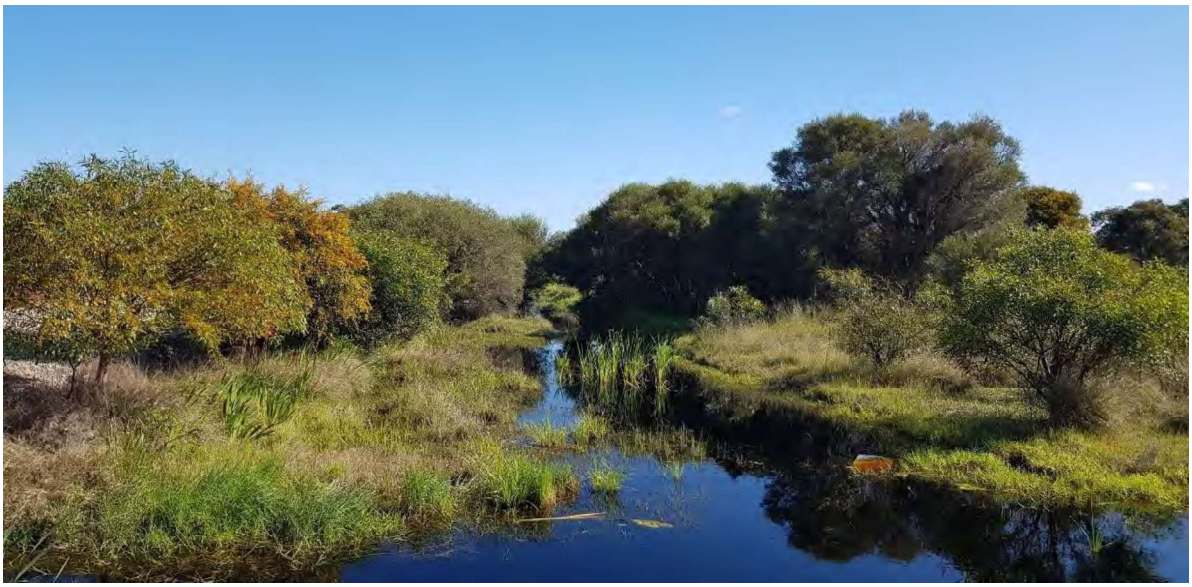
Survey Area: AT08 (from South end)

Survey Area: AT08 (from North end)

Survey Area: AT09 (from South end)

Survey Area: AT09 (from North end)

Survey Area: AT10 (from South end – Brand Hwy/Granary Dr intersection)



Survey Area: AT10 (from North end)

Survey Area: AT11 (from near North end)

Survey Area: AT12 (from South end)

Survey Area: AT12 (from North end)

Survey Area: AT13 (from South end)

Survey Area: AT13 (from near North end)

Survey Area: AT14 (from near South end)

Survey Area: AT14 (from North end)

Survey Area: AT15 (from South end)

Survey Area: AT15 (from North end)

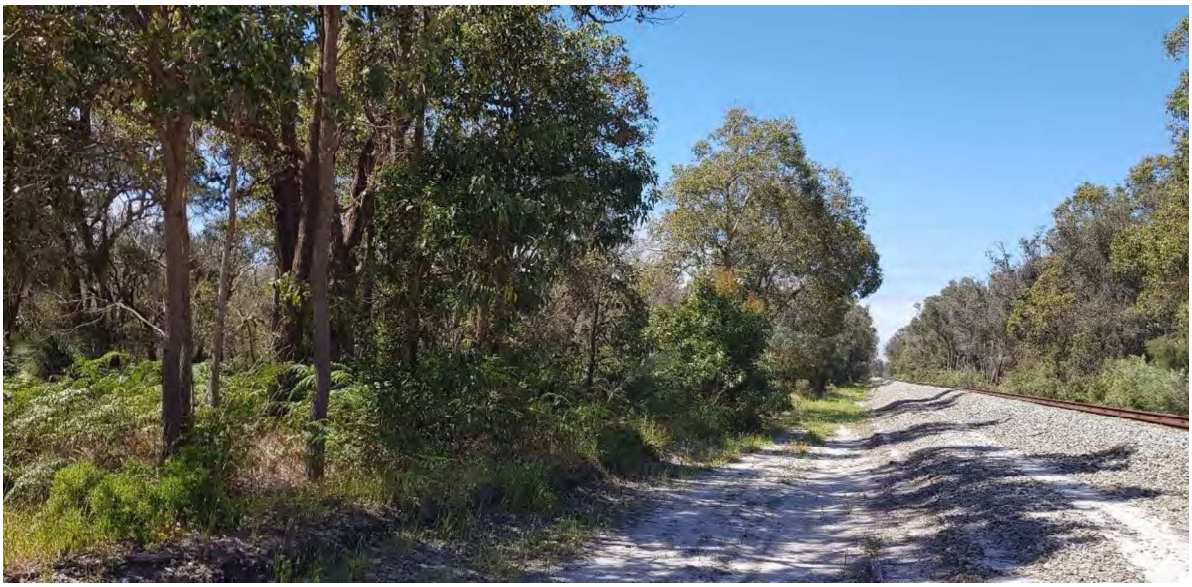
Survey Area: AT16 (from South end)

Survey Area: AT16 (from near North end)

Survey Area: AT17 (from South end)

Survey Area: AT17 (from North end)

Survey Area: AT18 (from North end)



Appendix K: Banksia Woodlands TEC Key diagnostic characteristics

Step	Key diagnostic characteristics	Outcome
1	**Location and physical environment** The Banksia Woodlands ecological community primarily occurs in the Swan Coastal Plain IBRA bioregion	The survey areas are located on the Swan Coastal Plain.
	Soil and landform The *Banksia* Woodlands: • typically occurs on well drained, low nutrient soils on sandplain landforms, particularly deep Bassendean and Spearwood sands and occasionally on Quindalup sands; • is also common on sandy colluvium and aeolian sands of the Ridge Hill Shelf, Whicher Scarp and Dandaragan Plateau; and • also occurs in limited scenarios where alluvial, limestone and other lithic substrates are juxtaposed with Bassendean and Spearwood sands.	The survey areas AT03-AT17 and LD03-LD07 are located in the Yanga soil-landscape system and survey areas AT01-AT02 and LD01-LD02 in the Pinjarra soil-landscape system, both of which are located between the Bassendean Dune System to the west and the Darling Scarp to the east. The survey areas are located on the Swan Coastal Plain and occur in one of the limited scenarios where alluvial, limestone and other lithic substrates are juxtaposed with Bassendean and Spearwood sands.

	Structure
	The structure of the Banksia Woodlands is a low woodland to forest with these features:
	• A distinctive upper sclerophyllous layer of low trees* (occasionally large shrubs more than 2 m tall), typically dominated or co-dominated by one or more of the *Banksia* species identified under composition
	• Emergent trees of medium or tall (>10 m) height *Eucalyptus* or *Allocasuarina* species may sometimes be present above the Banksia canopy
	• An often highly species-rich understorey that consists of:
	  ○ A layer of sclerophyllous shrubs of various heights; and,
	  ○ A herbaceous ground layer of cord rushes, sedges and perennial and ephemeral forbs, that sometimes includes grasses. The development of a ground layer may vary depending on the density of the shrub layer and disturbance history.
		There is one vegetation community which conforms to this structure:
		BsppW: *Banksia* species low open woodland. Understorey includes sclerophyllous shrub species of varying height, and an herbaceous ground layer of mostly introduced forbs and grasses.

	Composition	The canopy in three of the four mapped BsppW patches is dominated by various combinations of the key diagnostic species:

Step	Key diagnostic characteristics	Outcome
	• The canopy is most commonly dominated or co-dominated by *Banksia attenuata* (candlestick banksia, slender banksia) and/or *B. menziesii* (firewood banksia). Other Banksia species that dominate in some examples of the ecological community are *B. prionotes* (acorn banksia) or *B. ilicifolia* (holly-leaved banksia); and • The patch must include at least one of the following diagnostic species: ○ *Banksia attenuata* (candlestick banksia) ○ *Banksia menziesii* (firewood banksia) ○ *Banksia prionotes* (acorn banksia) ○ *Banksia ilicifolia* (holly-leaved banksia). • If present, the emergent tree layer often includes *Corymbia calophylla* (marri), *E. marginata* (jarrah), or less commonly *Eucalyptus gomphocephala* (tuart); and • Other trees of a medium height that may be present, and may be codominant with the Banksia species across a patch, include *Eucalyptus todtiana* (blackbutt, pricklybark), *Nuytsia floribunda* (Western Australian Christmas tree), *Allocasuarina fraseriana* (western sheoak), *Callitris arenaria* (sandplain cypress), *Callitris pyramidalis* (swamp cypress) and *Xylomelum occidentale* (woody pear); and • The understorey typically contains a high to very high diversity of shrub and herb species that often vary from patch to patch*** • Contra-indicators: ○ Patches clearly dominated by *Banksia littoralis* are not part of the Banksia Woodlands ecological community but indicates a different, dampland community is present. ○ Patches clearly dominated by *Banksia burdettii* are not part of the Banksia Woodlands ecological community but indicates a tall shrubland and not the Banksia Woodlands ecological community. ○ FCT 20c – Eastern shrublands and woodlands, corresponds with a separate EPBC ecological community listing, Shrublands and Woodlands of the eastern Swan	A. The patch around relevé ELA10 has a canopy of *Banksia attenuata* and *B. illicifolia* with cover 5%; B. The patch around relevé ELA17 has a canopy of *Banksia menziesii* with cover 10%; and C. The patch around relevés ELA29 and ELA30 has a canopy of *Banksia attenuata, B. illicifolia* and *B. menziesii* with cover up to 40%. The emergent layer includes *Nutysia floribunda* and *Corymbia calophylla,* but these are not dominant or co-dominant. The community has a high diversity of shrubs and herb species, although the majority are introduced species. The high proportion of weed species is reflected in the condition rating for the three patches (see Minimum Patch Size below). The contra-indicator species *Banksia* littoralis was co-dominant in one patch of the Banksia Woodland vegetation community BsppW; this patch was not considered to have any possibility of representing the TEC. *Banksia burdettii* was not recorded.

Step	Key diagnostic characteristics	Outcome
	Coastal Plain. Occurrences of this FCT should be considered under that separate listing.	
2	**Condition thresholds** • Assessments of a patch should initially be centered on the area of highest native floristic diversity and/or cover, i.e. the best condition area of the patch. • Consideration must be given to the timing of surveys and recent disturbance. Ideally surveys should be undertaken in spring with two sampling periods to capture early and late flowering species. • The surrounding context of a patch must also be taken into account when considering factors that add to the importance of a patch that meets the condition thresholds. • Certain vegetation components of the Banksia Woodlands ecological community merit consideration as critical elements to protect. Three components are recognised as threatened in their own right in WA and, as such, are priorities for protection; refer to Table 1 in the Approved Conservation Advice (TSSC 2016). • A relevant expert (e.g. ecological consultant, local NRM or environment agency) may be useful to help identify the ecological community and its condition.	The community was assessed and sampled in the highest condition representation available in each patch in the survey areas. The survey was completed in spring, which is the most appropriate season to survey on the Swan Coastal Plain. Affinity of parts of the mapped community BSppW with components (Floristic Community Types) of the Banksia Woodlands ecological community could not be assessed using Reconnaissance level survey data.
3	**Minimum patch size** Minimum patch sizes apply for consideration of a patch as part of the listed ecological community for EPBC Act referral, assessment and compliance purposes. Where patches meet different levels of condition, different minimum patch sizes apply: • 'Pristine' – no minimum patch size applies • 'Excellent' – 0.5 ha or 5,000 m2 (e.g. 50 m x 100 m) • 'Very Good' – 1 ha or 10,000 m2 (e.g. 100 m x 100 m) • 'Good' – 2 ha or 20,000 m2 (e.g. 200 m x 100 m). Note: To be considered as part of the EPBC Act ecological community, a patch should meet at least the Good Condition category. However, it is recognised that a single patch of this TEC may be degraded to some degree but still contributes to the overall function of the ecological community (DotEE 2016); areas of Degraded condition within the survey area were included in this assessment as they serve as linkages between patches in Good or better condition.	There are three continuous patches of Banksia woodland within the survey areas that meet the criteria above. These are: Patch A: is 1.60 ha in area and is in Good condition. It is centred on relevé ELA10 within survey area AT14. Given its size and condition, and that it is not connected to a larger patch of Banksia Woodland, the patch can be considered Unlikely to form part of the 'Banksia Woodlands' TEC. Patch B: is 2.2 ha in area has a condition rating of Degraded. It is centred on relevé ELA17 within survey area AT10. This patch is contiguous with the Banksia woodland mapped at relevé ELA18 immediately to the south. However, the canopy of the woodland at ELA18 is comprised of *Banksia littoralis*, which is not a key diagnostic species (and hence the Banksia woodland at ELA18 does meet the criteria for the TEC). Given its size, condition, and lack of connectivity to patches forming part of the TEC, the patch at ELA17 can be considered Unlikely to form part of the 'Banksia Woodlands' TEC.

Step	Key diagnostic characteristics	Outcome
		Patch C: is minimum 4.9 ha in area (2.5 ha inside the survey area), with 1.1 ha in Very Good (0.6 ha inside the survey area) and 3.8 ha in Degraded condition (1.9 ha inside the survey area). It is centred on relevés ELA29 (in the Very Good condition portion) and ELA30 (in the Degraded condition portion) within survey area AT04. Whilst Degraded patches are not in their own right considered to represent the TEC, the Degraded vegetation within this patch was connected to vegetation in better condition and is therefore considered to represent the TEC. Given its size and condition, and that it may be connected to a larger patch of Banksia Woodland, the patch can be considered Likely to form part of the 'Banksia Woodlands' TEC.
4	**Further information to assist in determining the presence of the ecological community and significant impacts** • The landscape position of the patch, including its position relative to surrounding vegetation also influences how important it is in the broader landscape. For example, if it enables movement of native fauna or plant material or supports other ecological processes • A patch is a discrete and mostly continuous area of the ecological community. A patch may include small-scale (<30 m) variations, gaps and disturbances, such as tracks, paths or breaks. Where there is a break in native vegetation cover, from the edge of the tree canopy of 30 m or more (e.g. due to permanent artificial structures, wide roads or other barriers; or due to water bodies typically more than 30m wide) then the gap typically indicates that separate patches are present. • Variation in canopy cover, quality or condition of vegetation across a patch should not initially be considered to be evidence of multiple patches. Patches can be spatially variable and are often characterised by one or more areas within a patch that meet the key diagnostic characteristics and condition threshold criteria amongst areas of lower condition. Average canopy cover and quality across the broadest area that meets the general description of the ecological community should be used initially in determining overall canopy cover and vegetation condition. Also note any areas that are either significantly higher or lower in quality, gaps in canopy cover and the condition categories that would apply across different parts of the site respectively. Where the average canopy cover or quality falls below the minimum thresholds, the next largest area or areas that meet key diagnostics (including	A total of 2.5 ha of vegetation within the survey areas was assessed as Likely to represent the Banksia Woodlands of the Swan Coastal Plain ecological community (TEC).

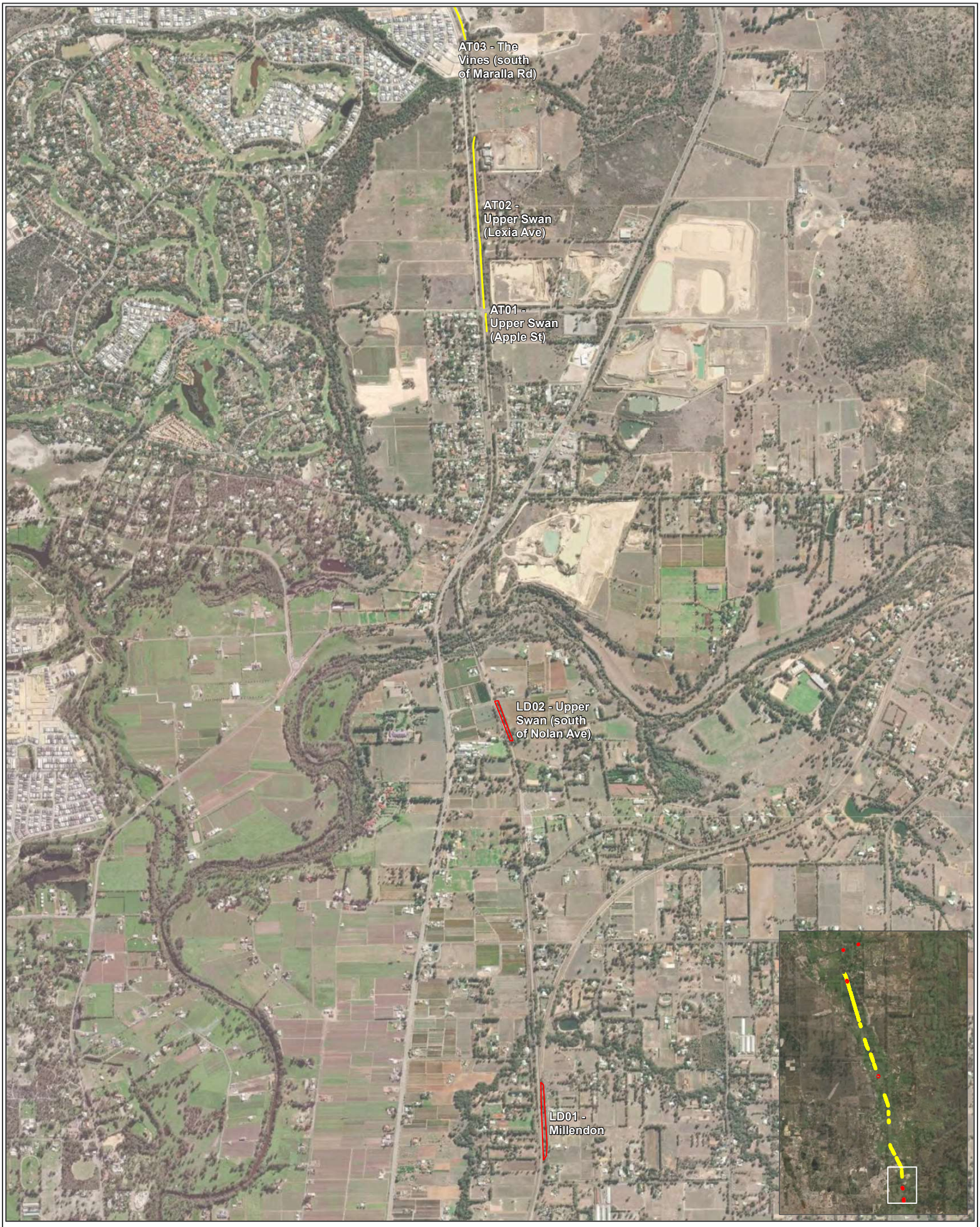
Step	Key diagnostic characteristics	Outcome
	minimum canopy cover requirements) and minimum condition thresholds should be specified and protected. This may result in multiple patches being identified within the overall area first considered. • A buffer zone is a contiguous area immediately adjacent to a patch of the ecological community that is important for protecting its integrity. The purpose of the buffer zone is to help protect and manage the national threatened ecological community. The edges of a patch are considered particularly susceptible to disturbance and the presence of a buffer zone is intended to act as a barrier to further direct disturbance. • The recommended minimum buffer zone for the ecological community is 20–50 m from the outer edge of a patch, and the appropriate size depends on the nature of the buffer and local context (e.g. slope). A larger buffer zone should be applied, where practical, to protect patches that are of particularly high conservation value, or if patches are down slope of drainage lines or a source of nutrient enrichment, or groundwater drawdown.	

Appendix L: Fauna species list

Species	Common name	Sign
**Canis familiaris familiaris*	Dog	Tracks/scats
**Felis catus*	Cat	Tracks
**Rattus rattus*	Black Rat	Observed
Anas superciliosa	Pacific Black Duck	Observed/heard
Anthochaera carunculata	Red Wattlebird	Observed
Artamus cinereus	Black-faced Woodswallow	Observed/heard
Barnardius zonarius	Australian Ringneck	Observed/heard
Cacatua sanguinea	Little Corella	Observed/heard
Calamanthus campestris	Rufous Fieldwren	Heard
Calyptorhynchus banksii subsp. *naso*	Forest Red-tailed Black Cockatoo	Foraging evidence
Calyptorhynchus baudinii	Baudin's Cockatoo	Heard
Calyptorhynchus latirostris	Carnaby's Cockatoo	Heard, foraging evidence
Chelodina oblonga	Oblong Turtle	Observed
Chenonetta jubata	Australian Wood Duck	Observed
Cincloramphus mathewsi	Rufous Songlark	Observed/heard
Corvus coronoides	Australian Raven	Observed/heard
Coturnix pectoralis	Stubble Quail	Observed
Cracticus nigrogularis	Pied Butcherbird	Observed
Cracticus tibicen	Australian Magpie	Observed/heard
Crinia glauerti	Clicking Frog	Heard
Dacelo novaeguineae	Laughing Kookaburra	Heard
Dromaius novaehollandiae	Emu	Observed
Egretta novaehollandiae	White-faced Heron	Observed
Gavicalis virescens	Singing Honeyeater	Observed/heard
Grallina cyanoleuca	Magpie-lark	Observed/heard
Ixobrychus dubius	Australian Little Bittern	Observed
Lichmera indistincta	Brown Honeyeater	Observed/heard
Macropus fuliginosus melanops	Western Grey Kangaroo	Observed
Malurus splendens	Splendid Fairywren	Observed/heard
Manorina flavigula	Yellow-throated Miner	Heard
Merops ornatus	Rainbow Bee-eater	Observed/heard
Notechis scutatus	Tiger Snake	Observed
Nycticorax caledonicus	Nankeen Night Heron	Observed
Ocyphaps lophotes	Crested Pigeon	Observed

Species	Common name	Sign
**Oryctolagus cuniculus*	Rabbit	Scats/tracks/diggings
Osphranter robustus erubescens	Euro	Observed/scats
Phylidonyris novaehollandiae	New Holland Honeyeater	Observed/heard
Podargus strigoides	Tawny Frogmouth	Heard
Poodytes gramineus	Little Grassbird	Observed
Pseudonaja affinis	Dugite	Observed
Purpureicephalus spurius	Red-capped Parrot	Observed
Rhipidura albiscapa	Grey Fantail	Observed/heard
Rhipidura leucophrys	Willie Wagtail	Observed
Smicrornis brevirostris	Weebill	Observed/heard
Threskiornis molucca	Australian White Ibis	Observed
Threskiornis spinicollis	Straw-necked Ibis	Observed
Todiramphus sanctus	Sacred Kingfisher	Observed/heard

Appendix M: Maps – Survey Effort



Field map: Arc Muchea - Page 1 of 8

Access track
Laydown area

0 200 400 800
Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19686-OK Date: 23/09/2021

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Field map: Arc Muchea - Page 2 of 8

Access track
Laydown area

0 200 400 800
Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19686-OK Date: 23/09/2021

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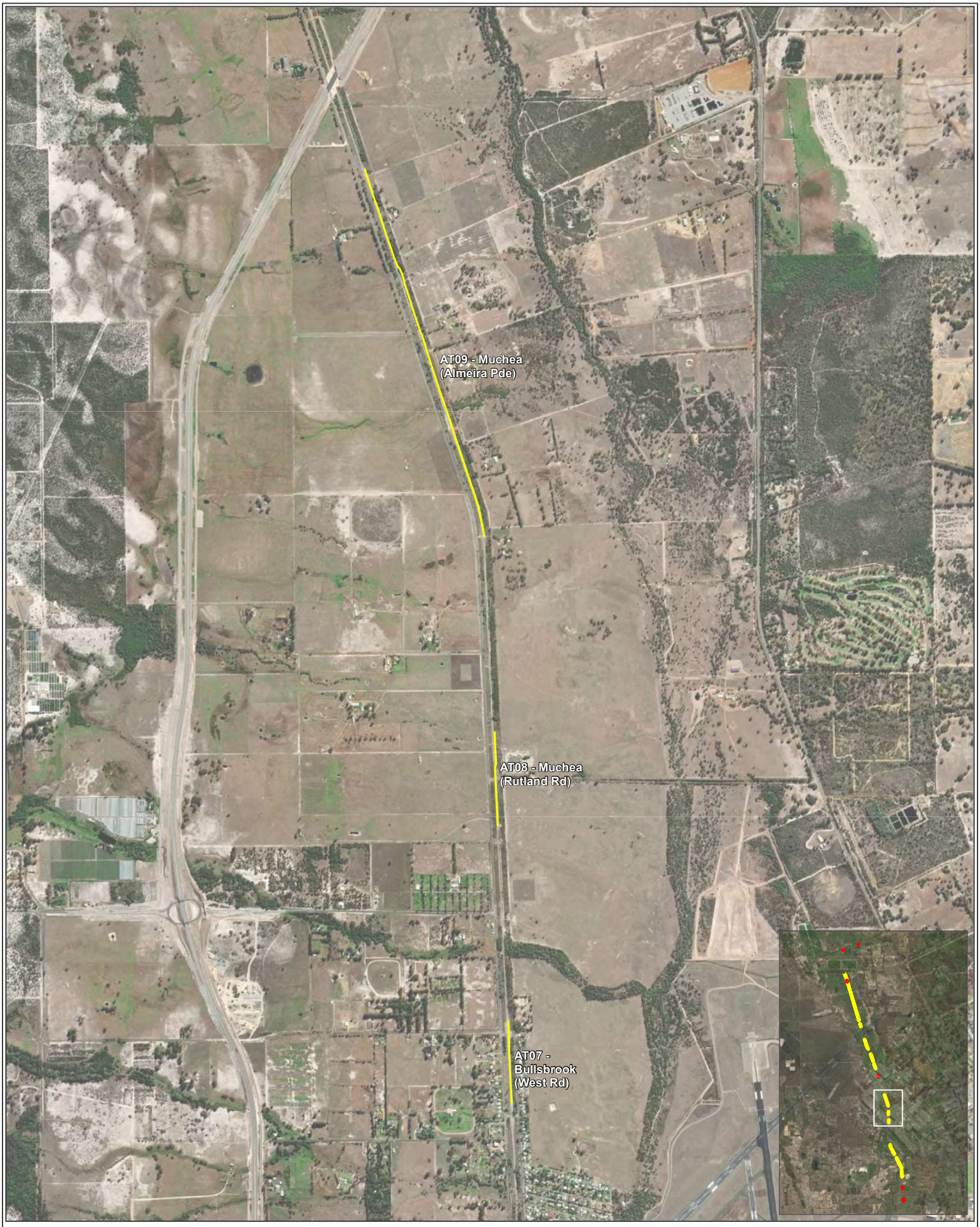

Field map: Arc Muchea - Page 3 of 8

Access track
Laydown area

0 200 400 800
Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19686-OK Date: 23/09/2021

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Field map: Arc Muchea - Page 4 of 8

Access track
Laydown area

0 200 400 800
Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19686-OK Date: 23/09/2021

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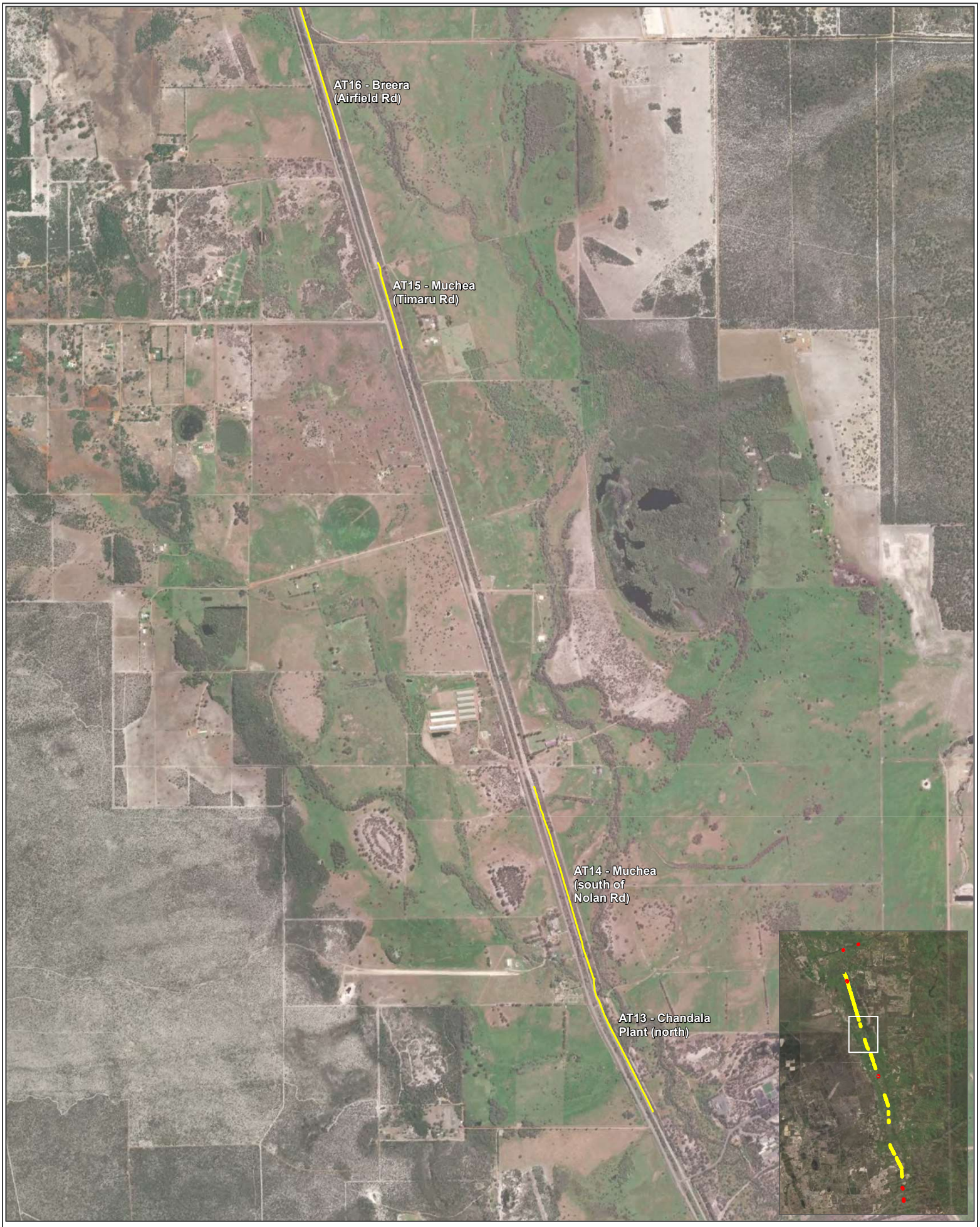

Field map: Arc Muchea - Page 5 of 8

Access track
Laydown area

0 200 400 800
Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19686-OK Date: 23/09/2021

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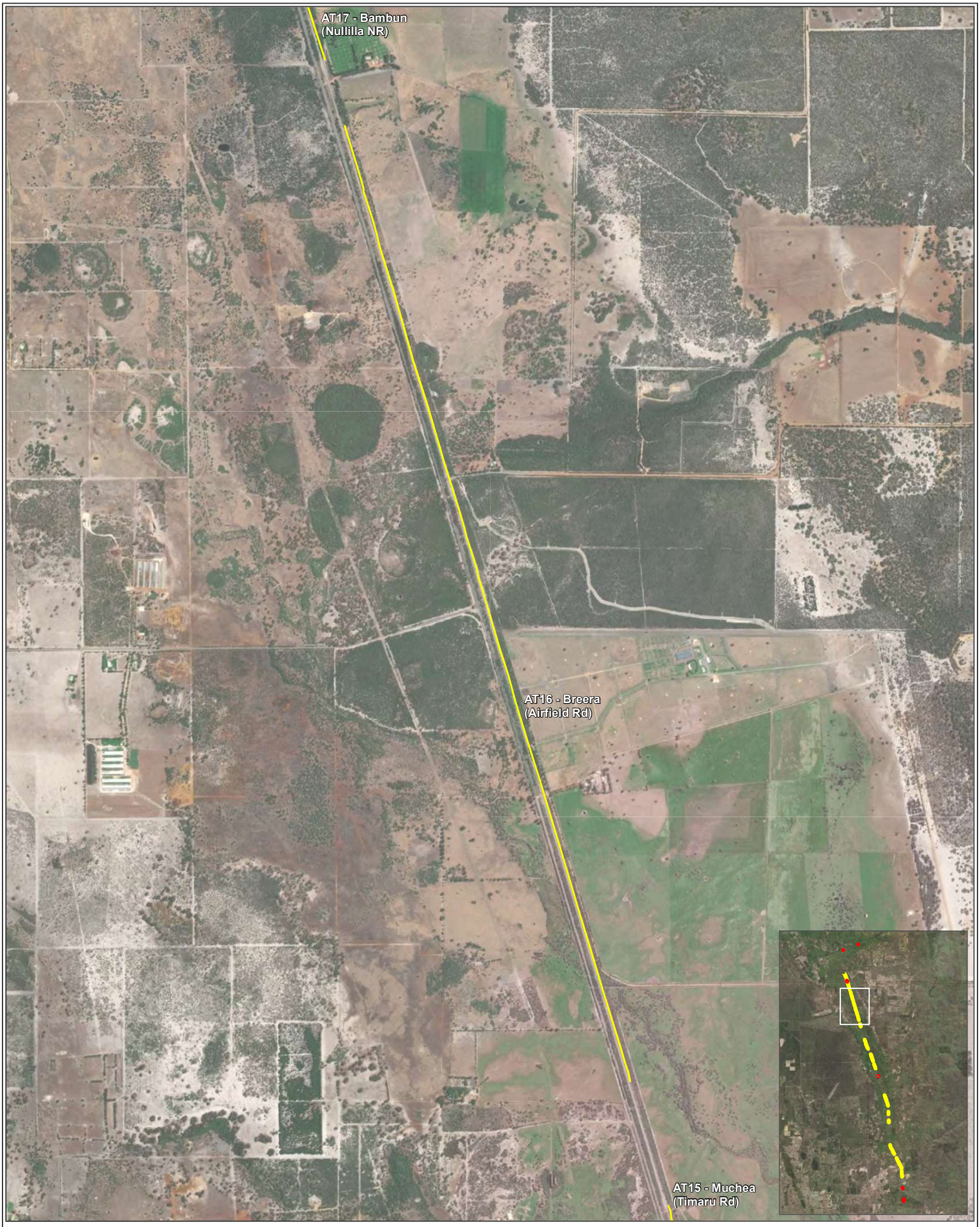

Field map: Arc Muchea - Page 6 of 8

Access track
Laydown area

0 200 400 800
Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19686-OK Date: 23/09/2021

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Field map: Arc Muchea - Page 7 of 8

Access track
Laydown area

0 200 400 800
Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19686-OK Date: 23/09/2021

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Field map: Arc Muchea - Page 8 of 8

Access track
Laydown area

0 200 400 800
Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19686-OK Date: 23/09/2021

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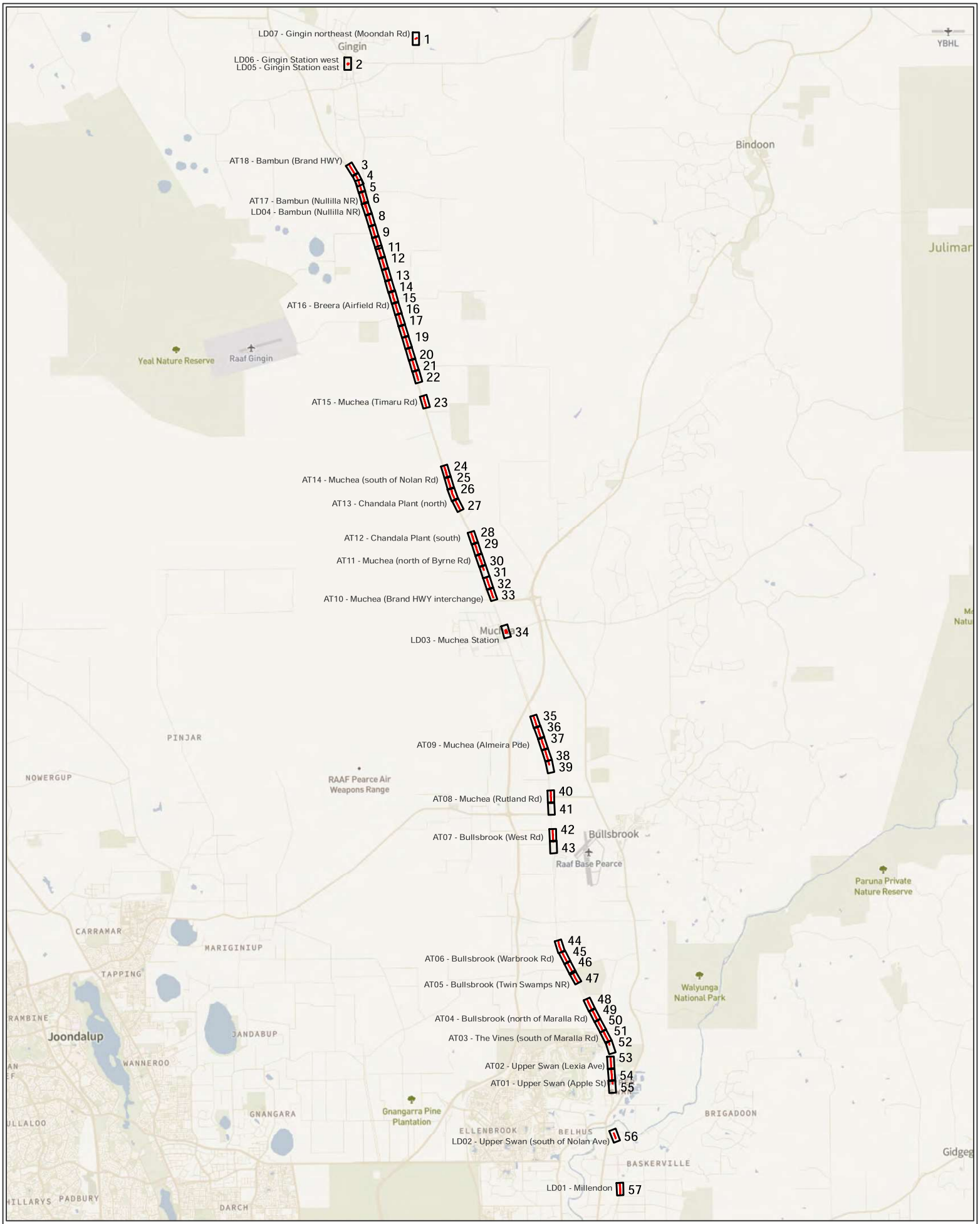
Appendix N: Maps – Conservation significant flora species, Declared Pests and WoNS species, Vegetation communities, Vegetation condition and TEC locations.



Index To Maps

Map Frame

Study Area

0 1.25 2.5 5

Kilometres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19686-RS Date: 1/12/2021

N

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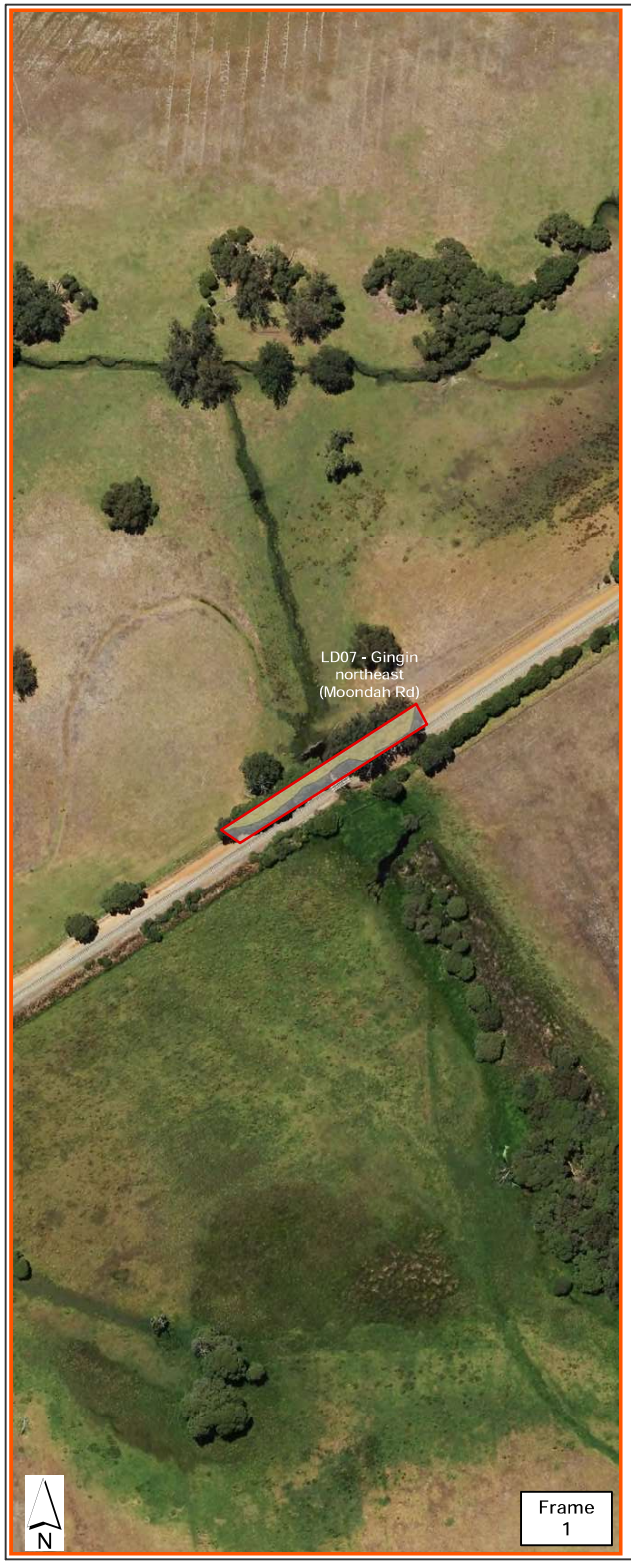

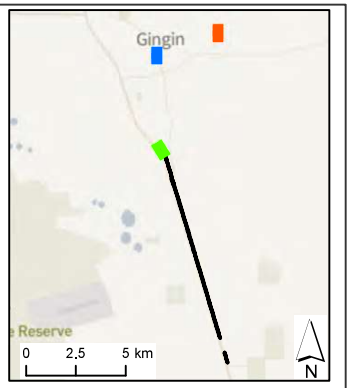

Vegetation

- Study Area

Conservation significant flora

- Grevillea curviloba
- Grevillea evanescens

Introduced Flora

- Declared Pest
- Declared Pest, WoNS
- TECs

Vegetation Community, Condition

- Acacia saligna Shrubland, Good
- Acacia saligna Shrubland, Degraded
- Acacia saligna Shrubland, Completely Degraded
- Allocasuarina spp. Woodland, Good
- Allocasuarina spp. Woodland, Degraded
- Allocasuarina spp. Woodland, Completely Degraded
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- Banksia spp. Woodland, Degraded
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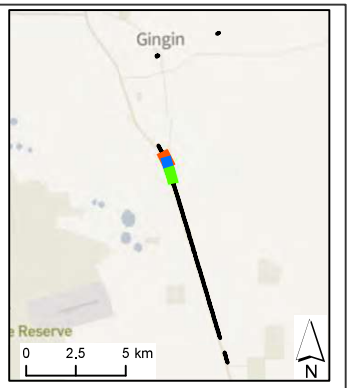
- Melaleuca rhaphiophylla Woodland, Good
- Melaleuca rhaphiophylla Woodland, Degraded
- Melaleuca rhaphiophylla Woodland, Completely Degraded
- Melaleuca viminea Shrubland, Good
- Melaleuca viminea Shrubland, Completely Degraded
- Mixed mid open Shrubland, Very Good
- Mixed mid open Shrubland, Good
- Mixed mid open Shrubland, Completely Degraded
- Mixed tall sparse Shrubland, Good
- Mixed tall sparse Shrubland, Degraded
- Cleared,
- No Survey,

0 25 50 100
Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19686-RS Date: 1/12/2021

ecological AUSTRALIA
A TETRA TECH COMPANY



Vegetation

- Study Area

Conservation significant flora

- Grevillea curviloba
- Grevillea evanescens

Introduced Flora

- Declared Pest
- Declared Pest, WoNS
- TECs

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- Cleared,
- No Survey,

0 25 50 100
Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19686-RS Date: 1/12/2021

ecological AUSTRALIA
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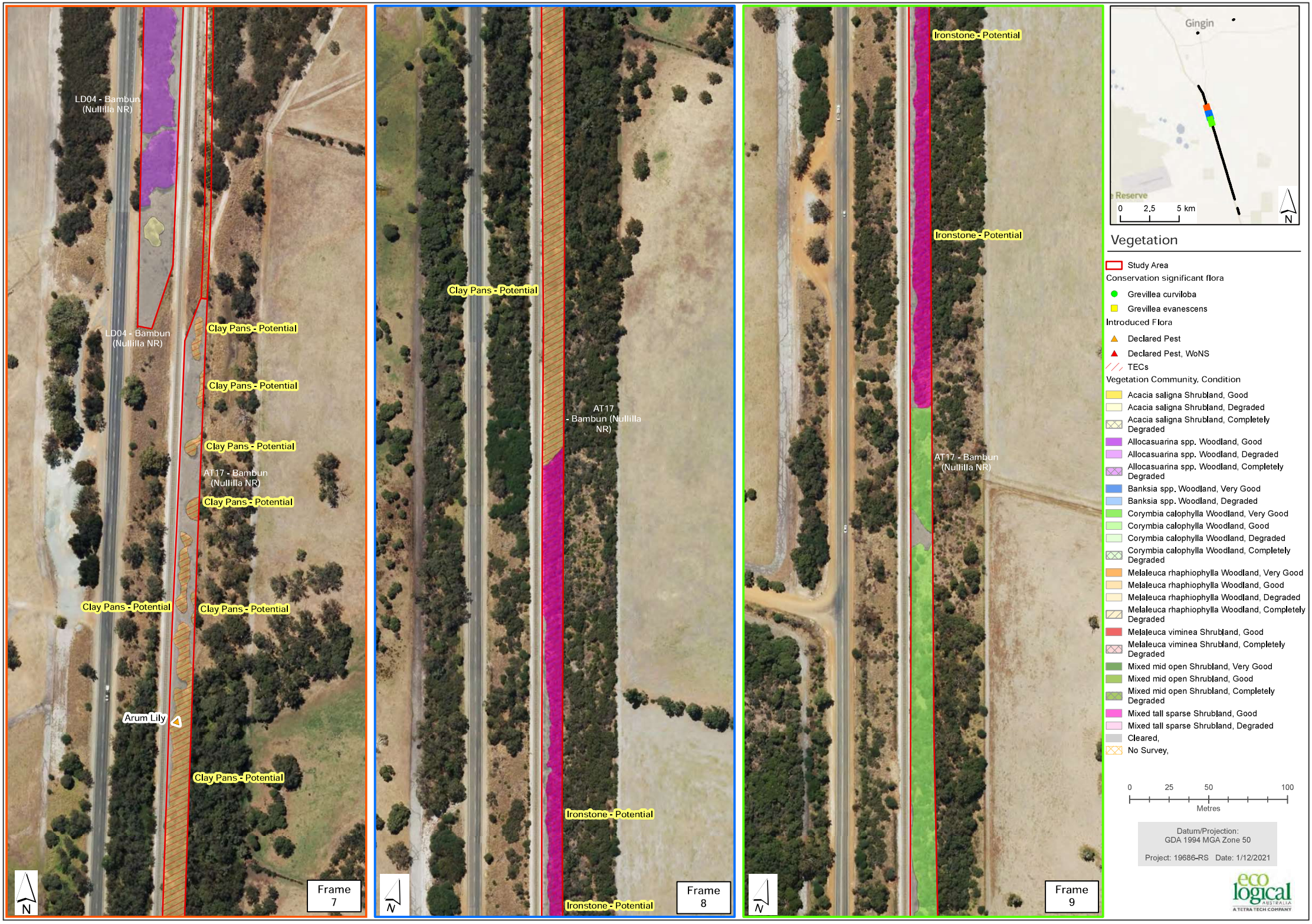
LD04 - Bambun (Nullilla NR)
LD04 - Bambun (Nullilla NR)
Clay Pans - Potential
Clay Pans - Potential
Clay Pans - Potential
AT17 - Bambun (Nullilla NR)
Clay Pans - Potential
Clay Pans - Potential
Clay Pans - Potential
Arum Lily
Clay Pans - Potential
N
Frame 7
Clay Pans - Potential
AT17 - Bambun (Nullilla NR)
Ironstone - Potential
Ironstone - Potential
N
Frame 8
Ironstone - Potential
Ironstone - Potential
AT17 - Bambun (Nullilla NR)
N
Frame 9
Gingin
Reserve
0 2.5 5 km
N
Vegetation
Study Area
Conservation significant flora
Grevillea curviloba
Grevillea evanescens
Introduced Flora
Declared Pest
Declared Pest, WoNS
TECs
Vegetation Community, Condition
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Acacia saligna Shrubland, Degraded
Acacia saligna Shrubland, Completely Degraded
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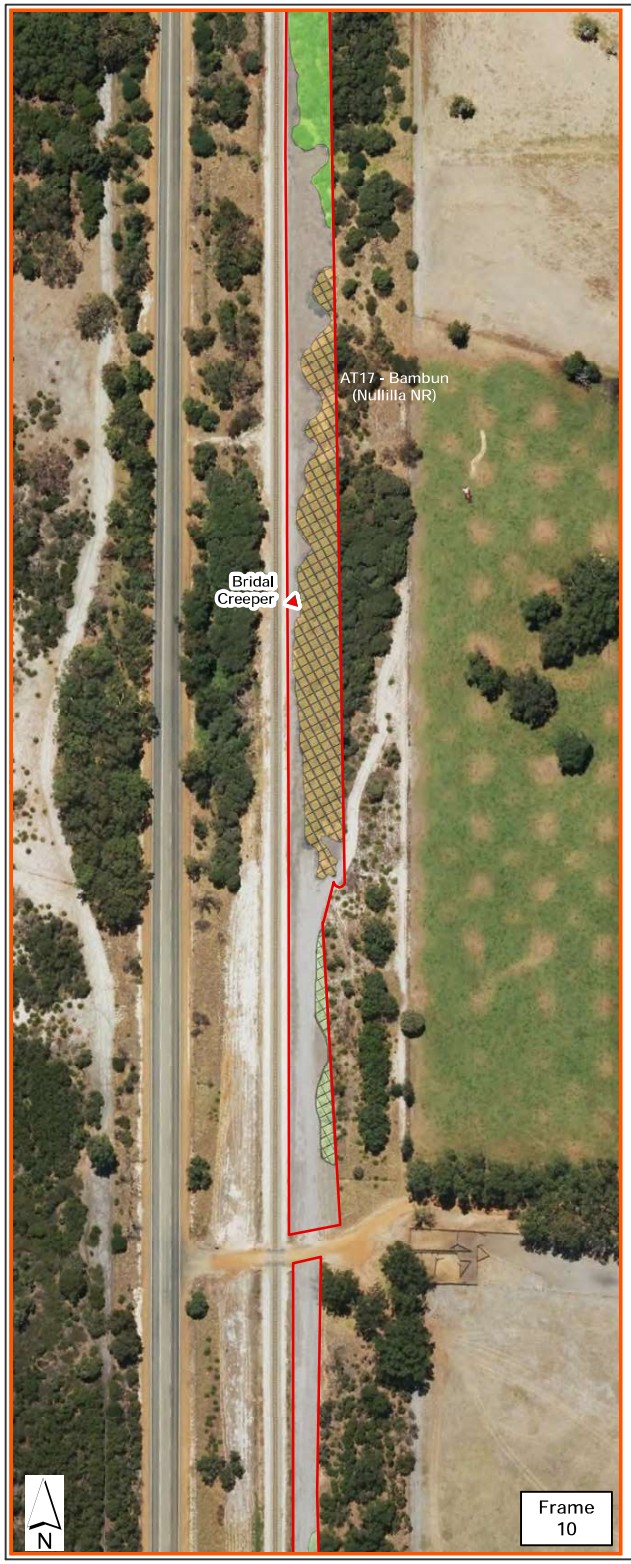
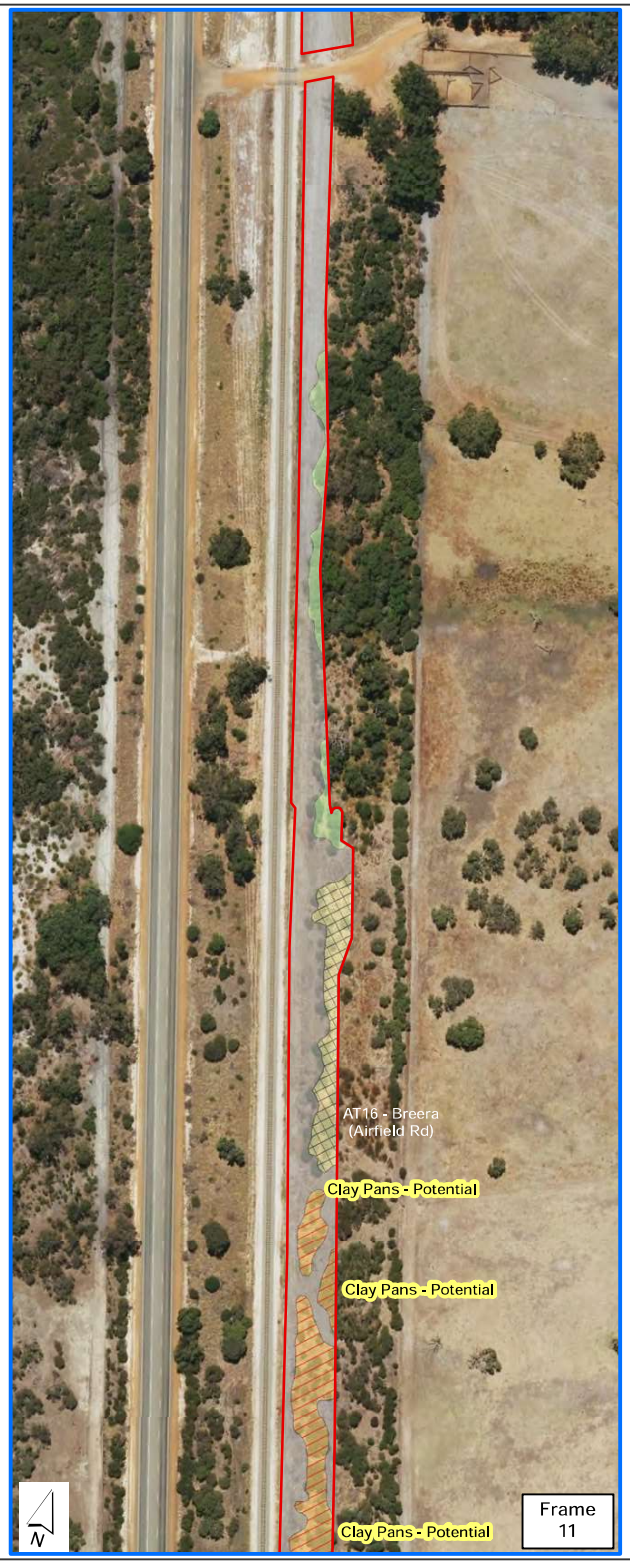
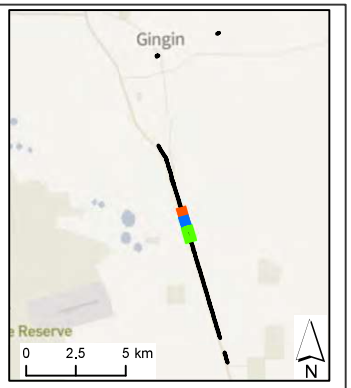
Mixed mid open Shrubland, Good
Mixed mid open Shrubland, Completely Degraded
Mixed tall sparse Shrubland, Good
Mixed tall sparse Shrubland, Degraded
Cleared,
No Survey,
0 25 50 100
Metres
Datum/Projection:
GDA 1994 MGA Zone 50
Project: 19686-RS Date: 1/12/2021
eco logical AUSTRALIA A TETRA TECH COMPANY







Vegetation

- Study Area

Conservation significant flora

- Grevillea curviloba
- Grevillea evanescens

Introduced Flora

- Declared Pest
- Declared Pest, WoNS
- TECs

Vegetation Community, Condition

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- Cleared,
- No Survey,

0 25 50 100
Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19686-RS Date: 1/12/2021

eco logical AUSTRALIA
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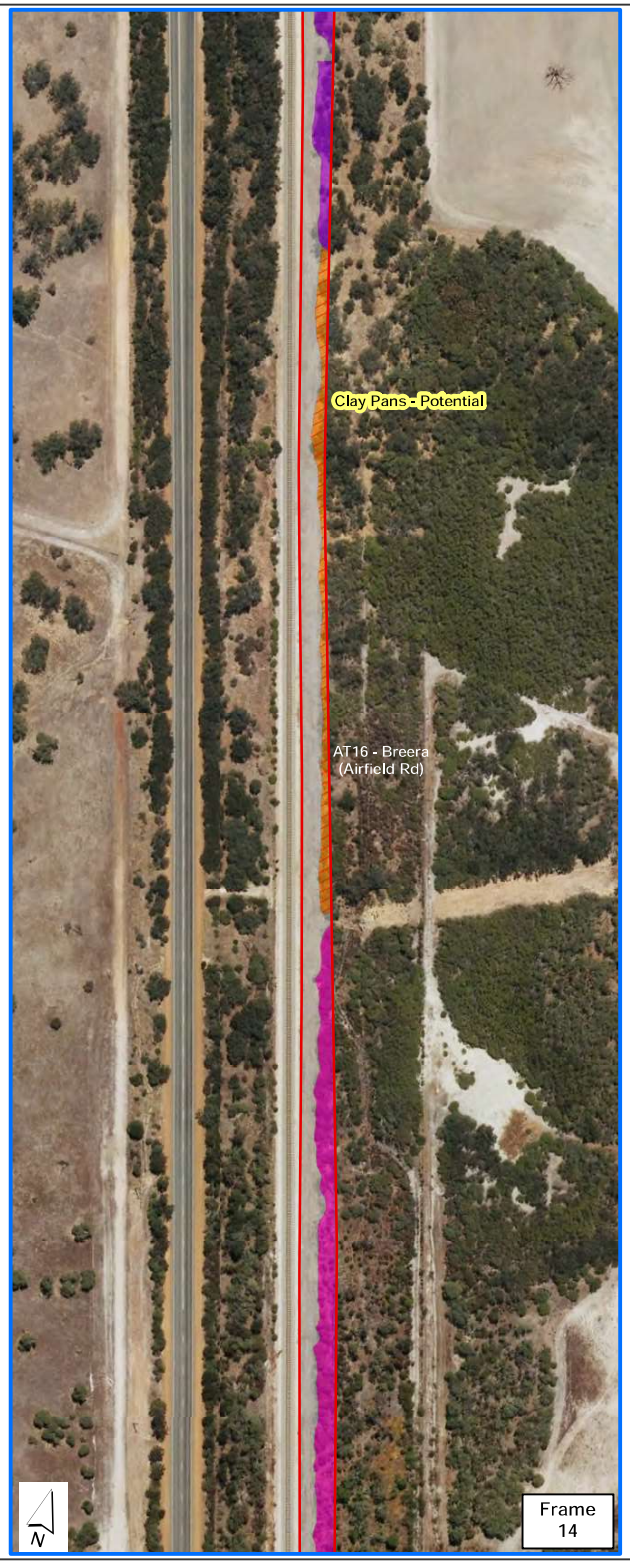

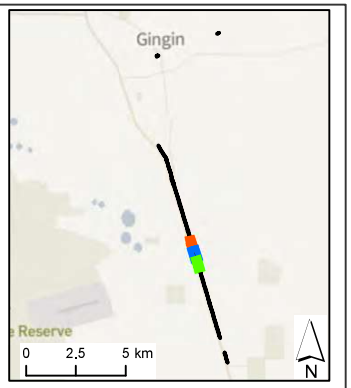

Vegetation

- Study Area

Conservation significant flora

- Grevillea curviloba
- Grevillea evanescens

Introduced Flora

- Declared Pest
- Declared Pest, WoNS
- TECs

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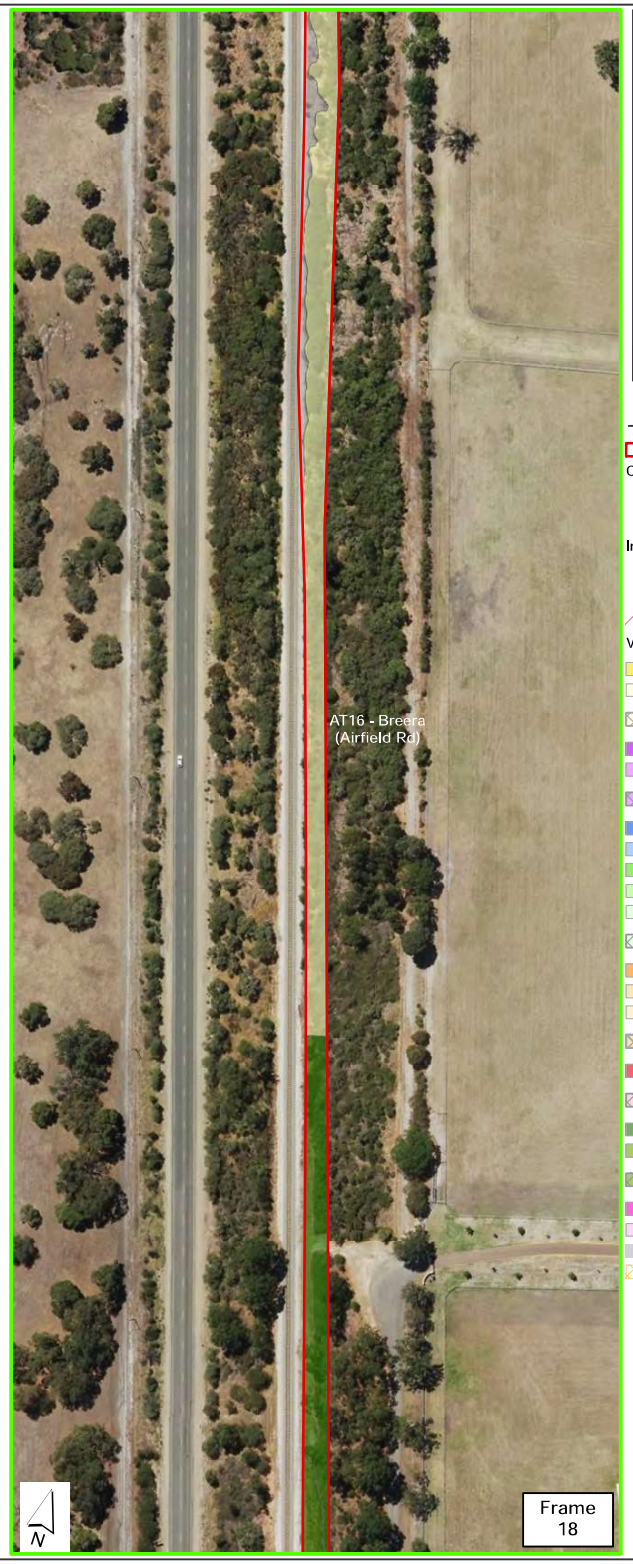
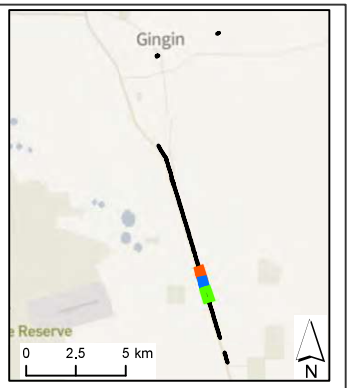
0 25 50 100
Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19686-RS Date: 1/12/2021

eco logical AUSTRALIA
A TETRA TECH COMPANY





Vegetation

- Study Area

Conservation significant flora

- Grevillea curviloba
- Grevillea evanescens

Introduced Flora

- Declared Pest
- Declared Pest, WoNS
- TECs

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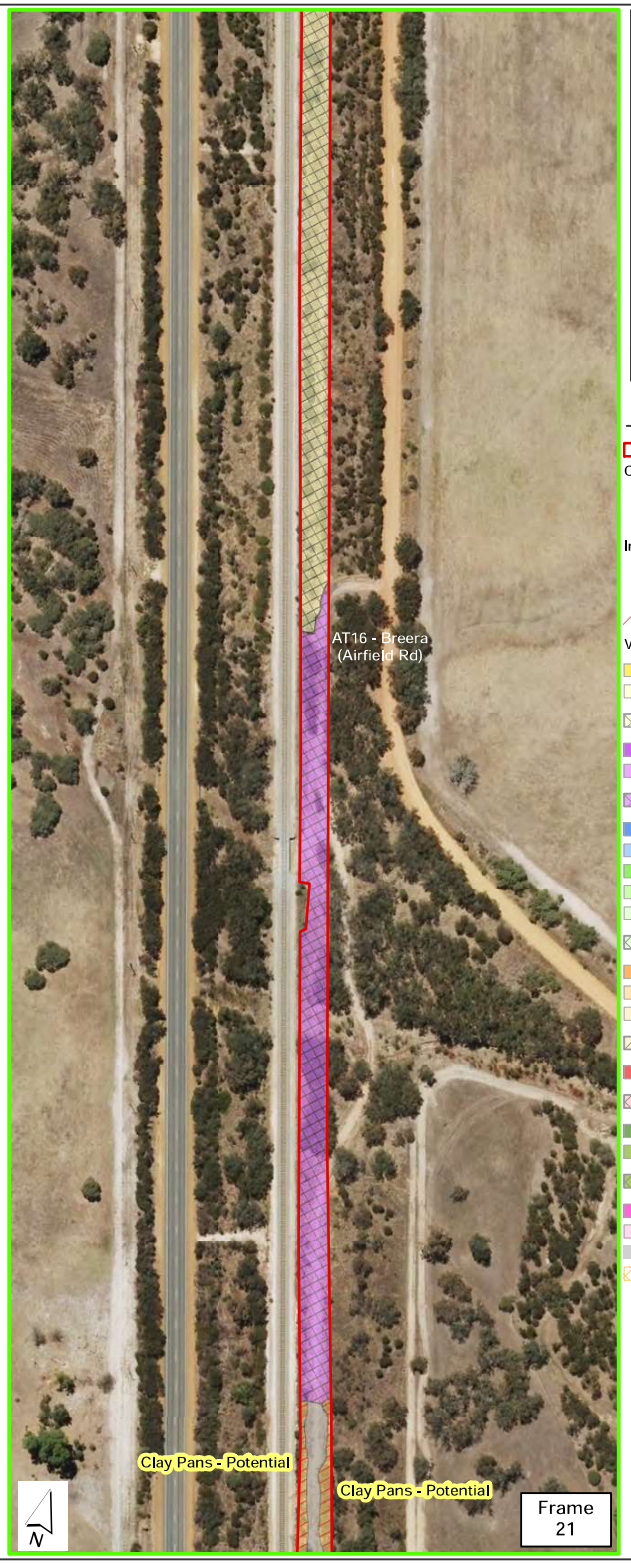
- Mixed tall sparse Shrubland, Degraded
- Cleared,
- No Survey,

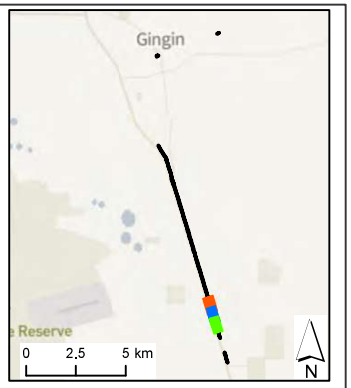
0 25 50 100
Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19686-RS Date: 1/12/2021

eco logical AUSTRALIA
A TETRA TECH COMPANY





Vegetation

- Study Area

Conservation significant flora

- Grevillea curviloba
- Grevillea evanescens

Introduced Flora

- Declared Pest
- Declared Pest, WoNS
- TECs

Vegetation Community, Condition

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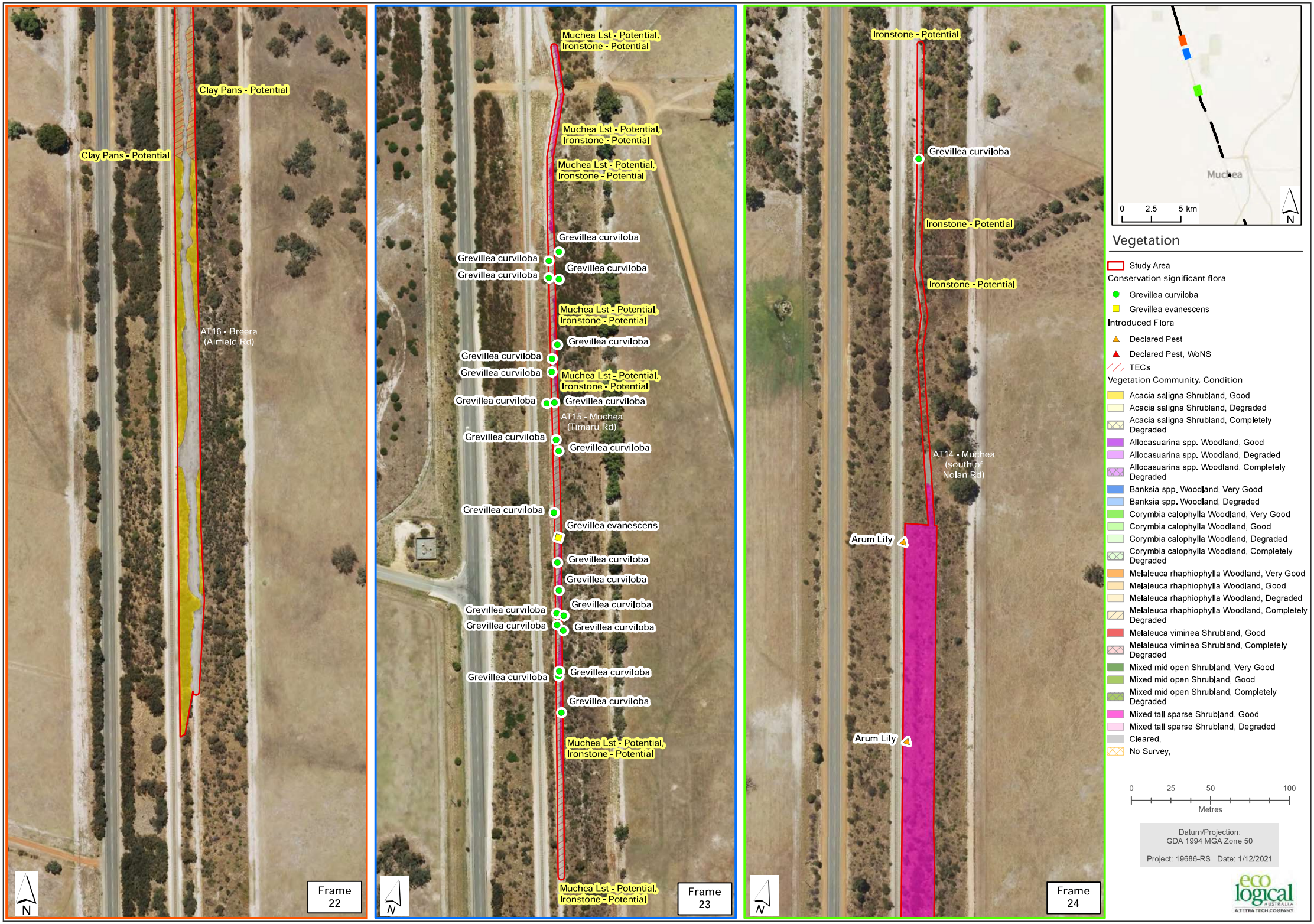
- Cleared,
- No Survey,

0 25 50 100
Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19686-RS Date: 1/12/2021

eco logical AUSTRALIA
A TETRA TECH COMPANY


Clay Pans - Potential
Clay Pans - Potential
AT16 - Breera (Airfield Rd)
Frame 22
Muchea Lst - Potential, Ironstone - Potential
Muchea Lst - Potential, Ironstone - Potential
Muchea Lst - Potential, Ironstone - Potential
Grevillea curviloba
Grevillea curviloba
Grevillea curviloba
Grevillea curviloba
Muchea Lst - Potential, Ironstone - Potential
Grevillea curviloba
Grevillea curviloba
Grevillea curviloba
Muchea Lst - Potential, Ironstone - Potential
Grevillea curviloba
Grevillea curviloba
AT15 - Muchea (Timaru Rd)
Grevillea curviloba
Grevillea curviloba
Grevillea curviloba
Grevillea evanescens
Grevillea curviloba
Grevillea curviloba
Grevillea curviloba
Grevillea curviloba
Grevillea curviloba
Grevillea curviloba
Grevillea curviloba
Muchea Lst - Potential, Ironstone - Potential
Muchea Lst - Potential, Ironstone - Potential
Frame 23
Ironstone - Potential
Grevillea curviloba
Ironstone - Potential
Ironstone - Potential
AT14 - Muchea (south of Nolan Rd)
Arum Lily
Arum Lily
Frame 24
Muchea
0 2.5 5 km
N
Vegetation
Study Area
Conservation significant flora
Grevillea curviloba
Grevillea evanescens
Introduced Flora
Declared Pest
Declared Pest, WoNS
TECs
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Acacia saligna Shrubland, Completely Degraded
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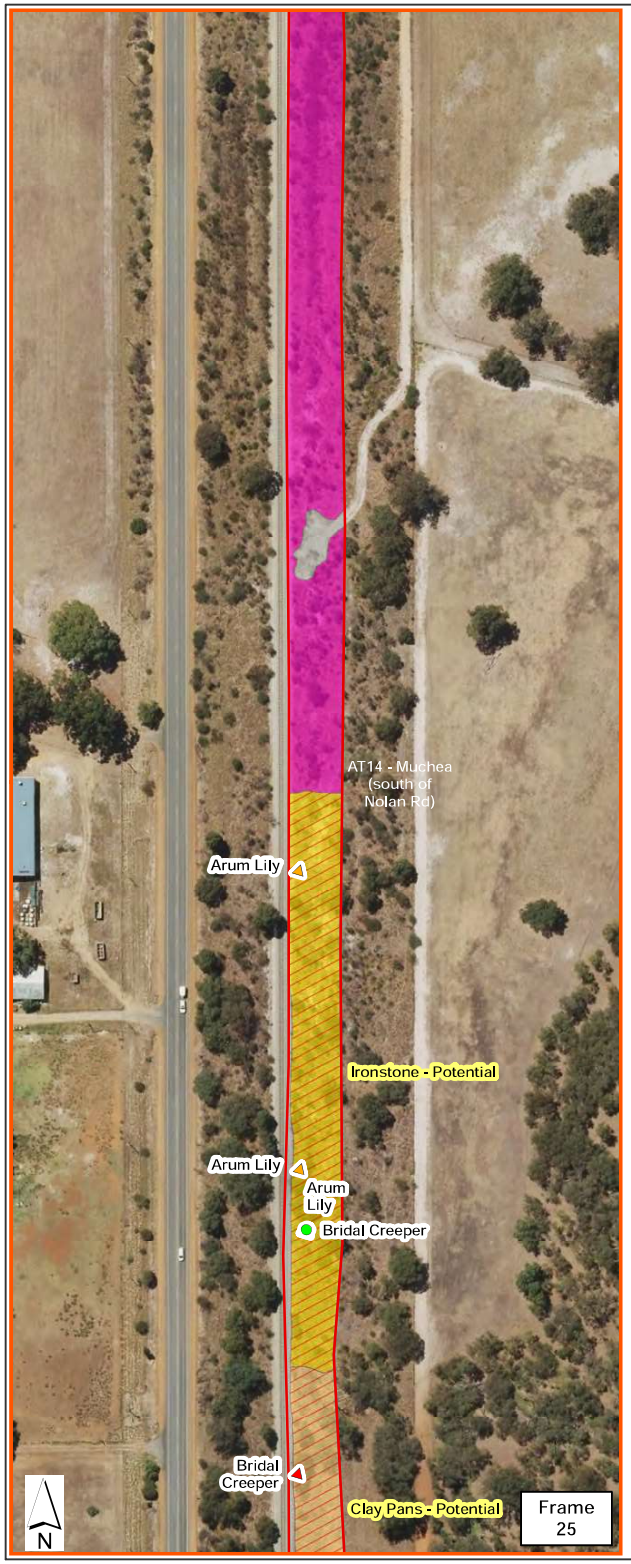
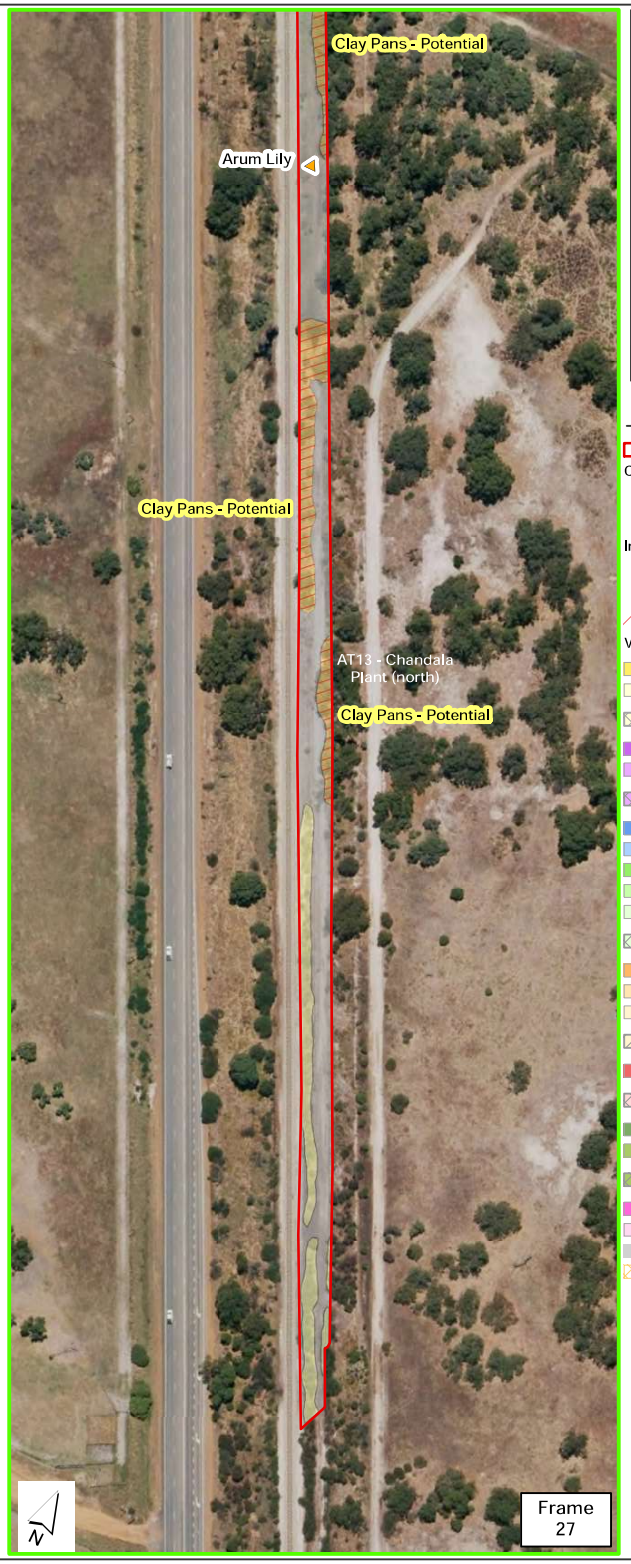
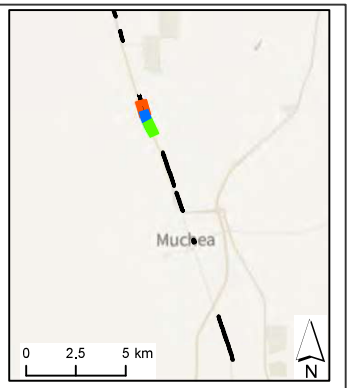
Mixed mid open Shrubland, Completely Degraded
Mixed tall sparse Shrubland, Good
Mixed tall sparse Shrubland, Degraded
Cleared,
No Survey,
0 25 50 100
Metres
Datum/Projection:
GDA 1994 MGA Zone 50
Project: 19686-RS Date: 1/12/2021
ecological AUSTRALIA
A TETRA TECH COMPANY







Vegetation

- Study Area

Conservation significant flora

- Grevillea curviloba
- Grevillea evanescens

Introduced Flora

- Declared Pest
- Declared Pest, WoNS
- TECs

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- Corymbia calophylla Woodland, Very Good
- Corymbia calophylla Woodland, Good
- Corymbia calophylla Woodland, Degraded
- Corymbia calophylla Woodland, Completely Degraded
- Melaleuca rhaphiophylla Woodland, Very Good
- Melaleuca rhaphiophylla Woodland, Good
- Melaleuca rhaphiophylla Woodland, Degraded
- Melaleuca rhaphiophylla Woodland, Completely Degraded
- Melaleuca viminea Shrubland, Good
- Melaleuca viminea Shrubland, Completely Degraded
- Mixed mid open Shrubland, Very Good
- Mixed mid open Shrubland, Good
- Mixed mid open Shrubland, Completely Degraded
- Mixed tall sparse Shrubland, Good
- Mixed tall sparse Shrubland, Degraded
- Cleared,
- No Survey,

0 25 50 100
Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19686-RS Date: 1/12/2021

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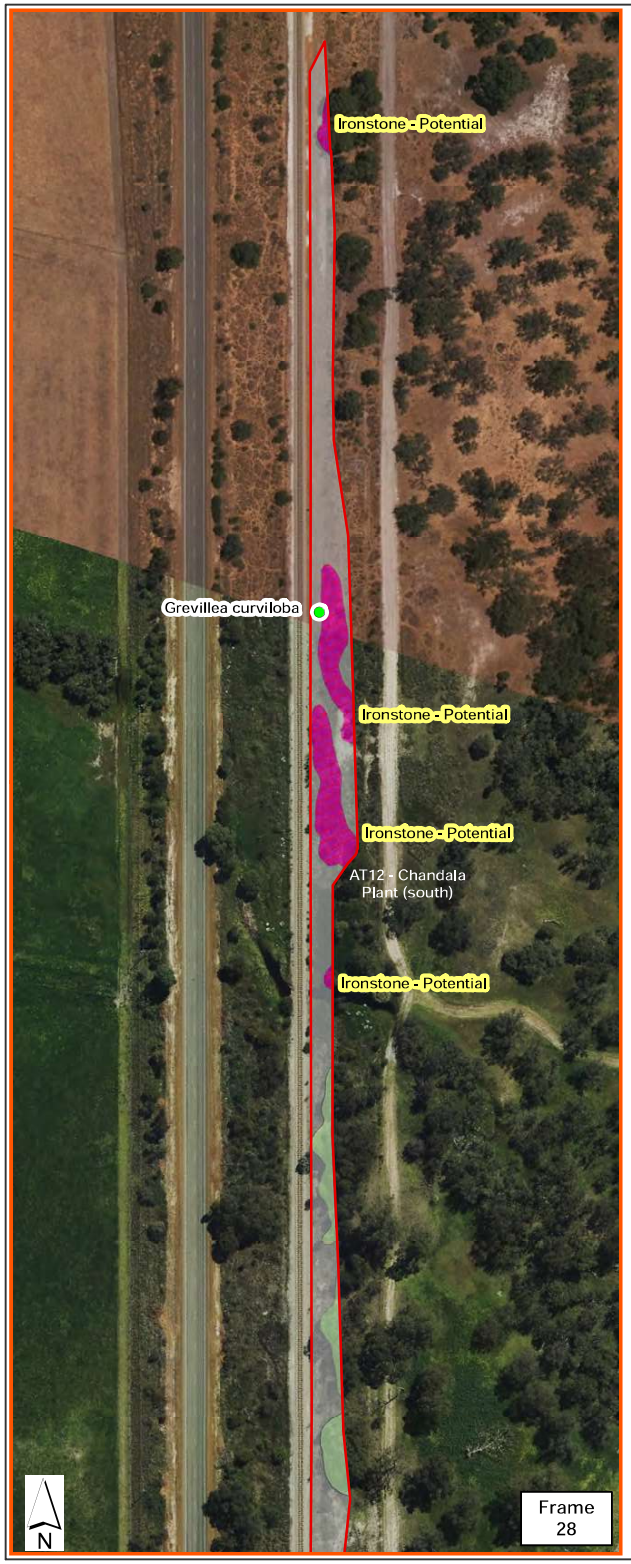

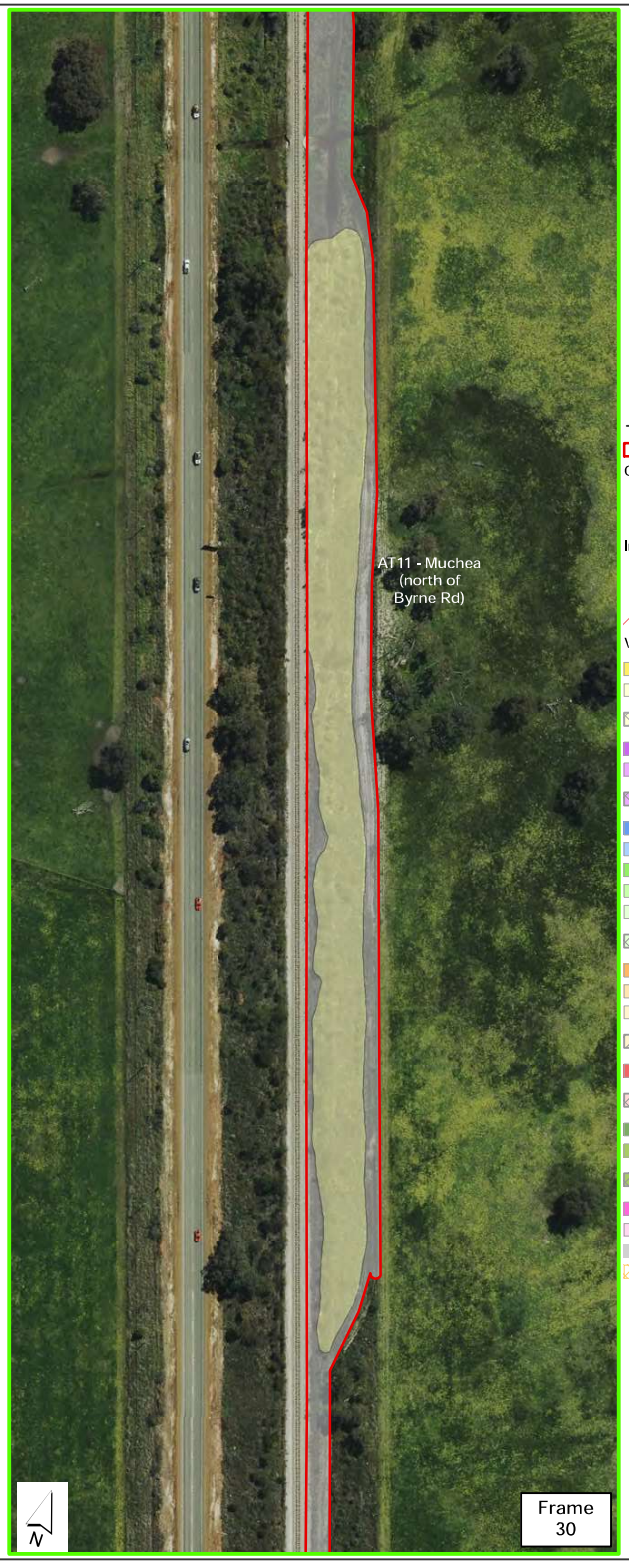

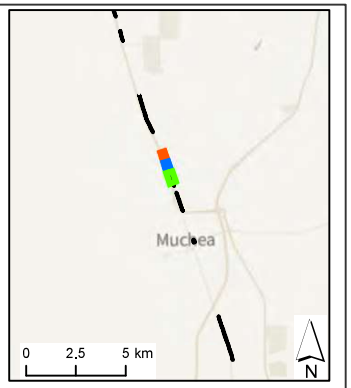

Vegetation

- Study Area

Conservation significant flora

- Grevillea curviloba
- Grevillea evanescens

Introduced Flora

- Declared Pest
- Declared Pest, WoNS
- TECs

Vegetation Community, Condition

- Acacia saligna Shrubland, Good
- Acacia saligna Shrubland, Degraded
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Metres

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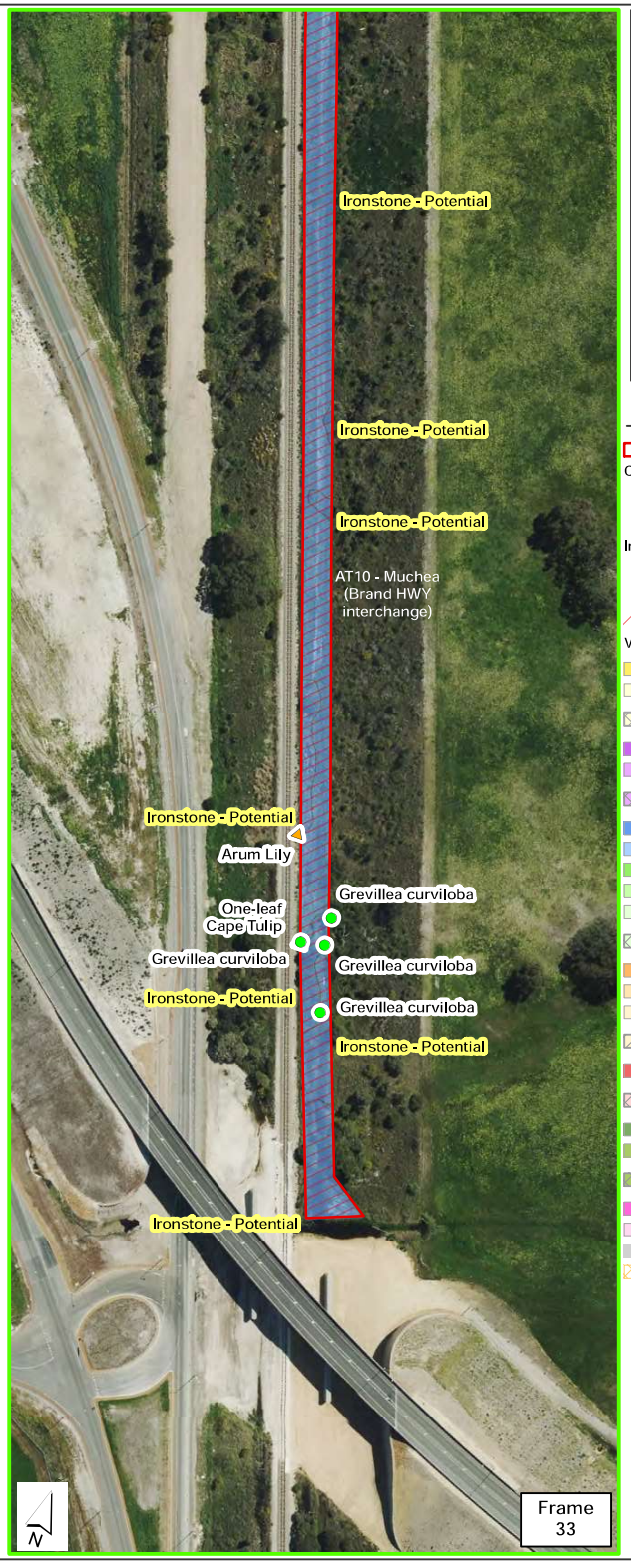
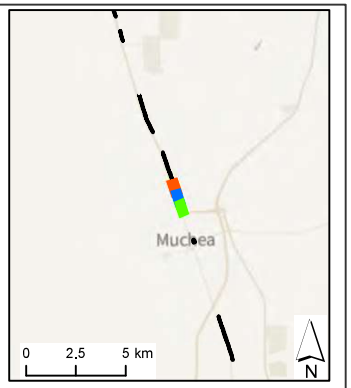
GDA 1994 MGA Zone 50

Project: 19686-RS Date: 1/12/2021

ecological AUSTRALIA A TETRA TECH COMPANY





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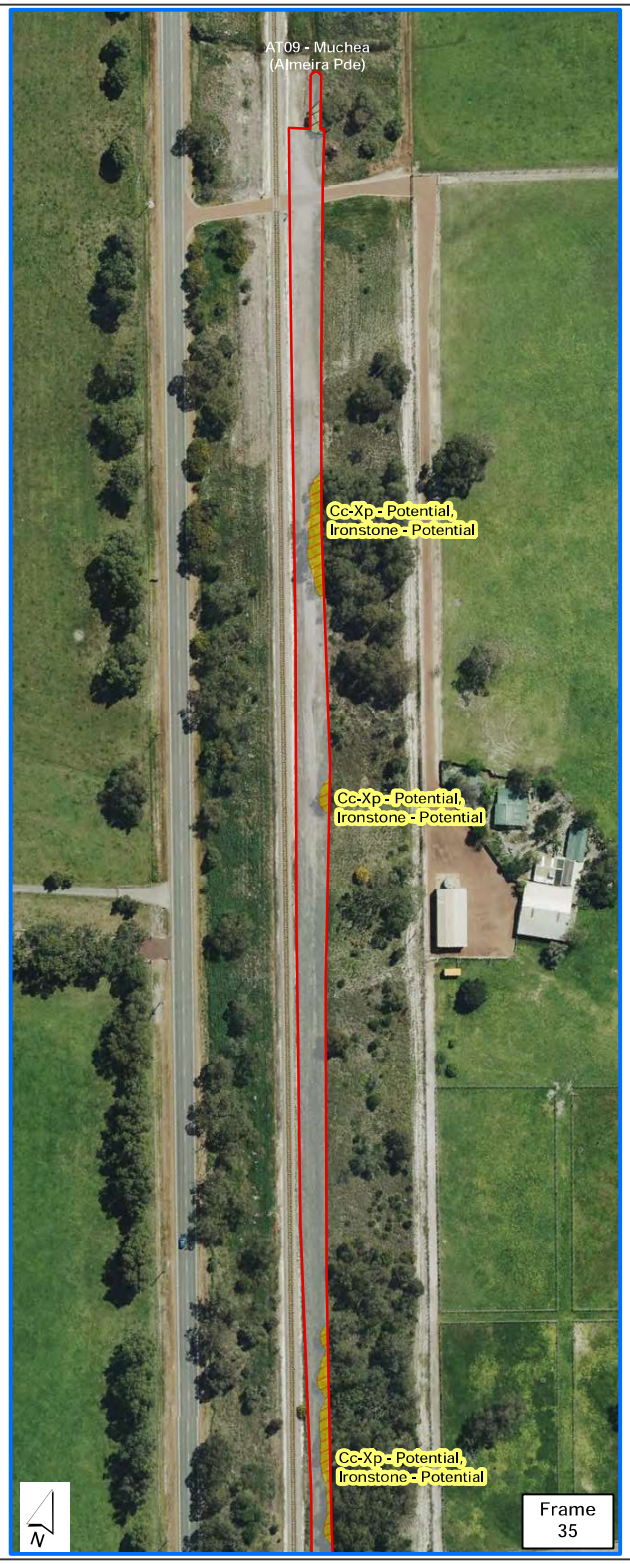

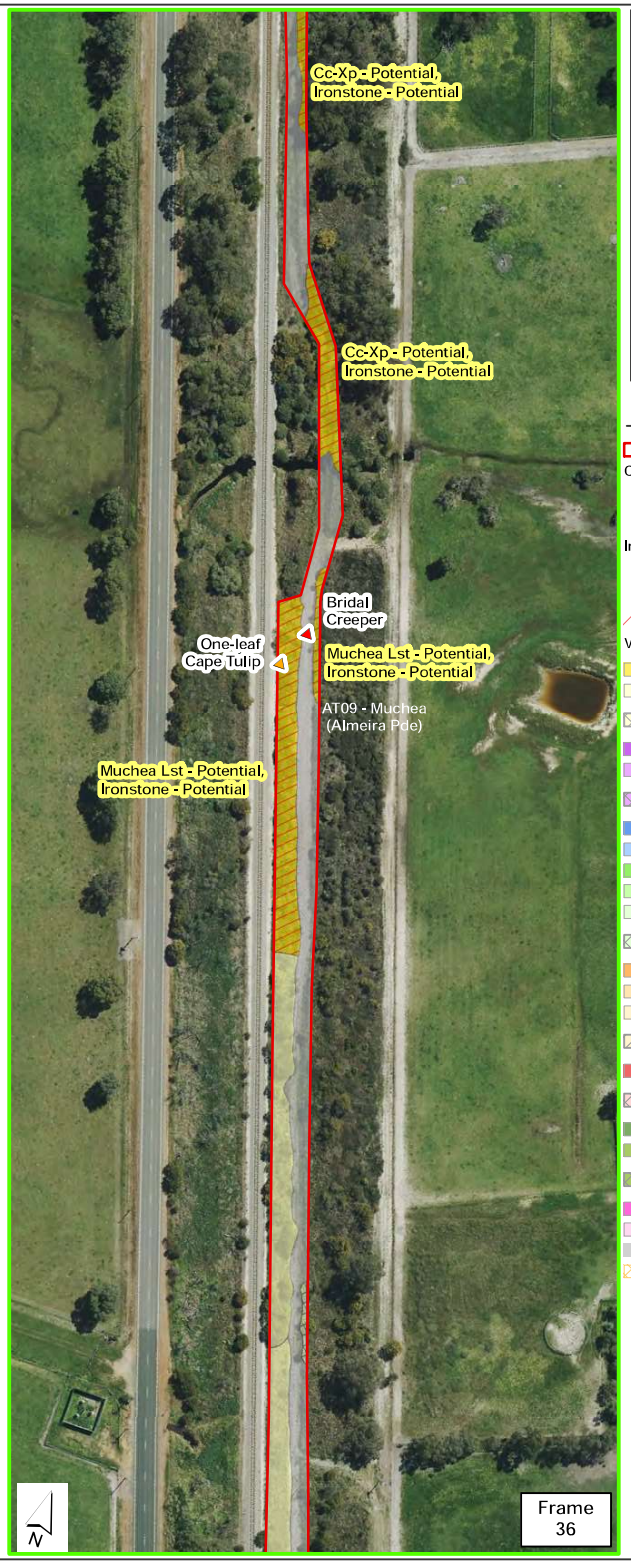

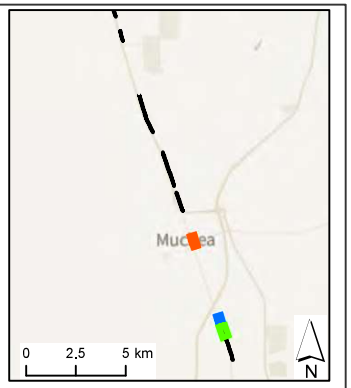

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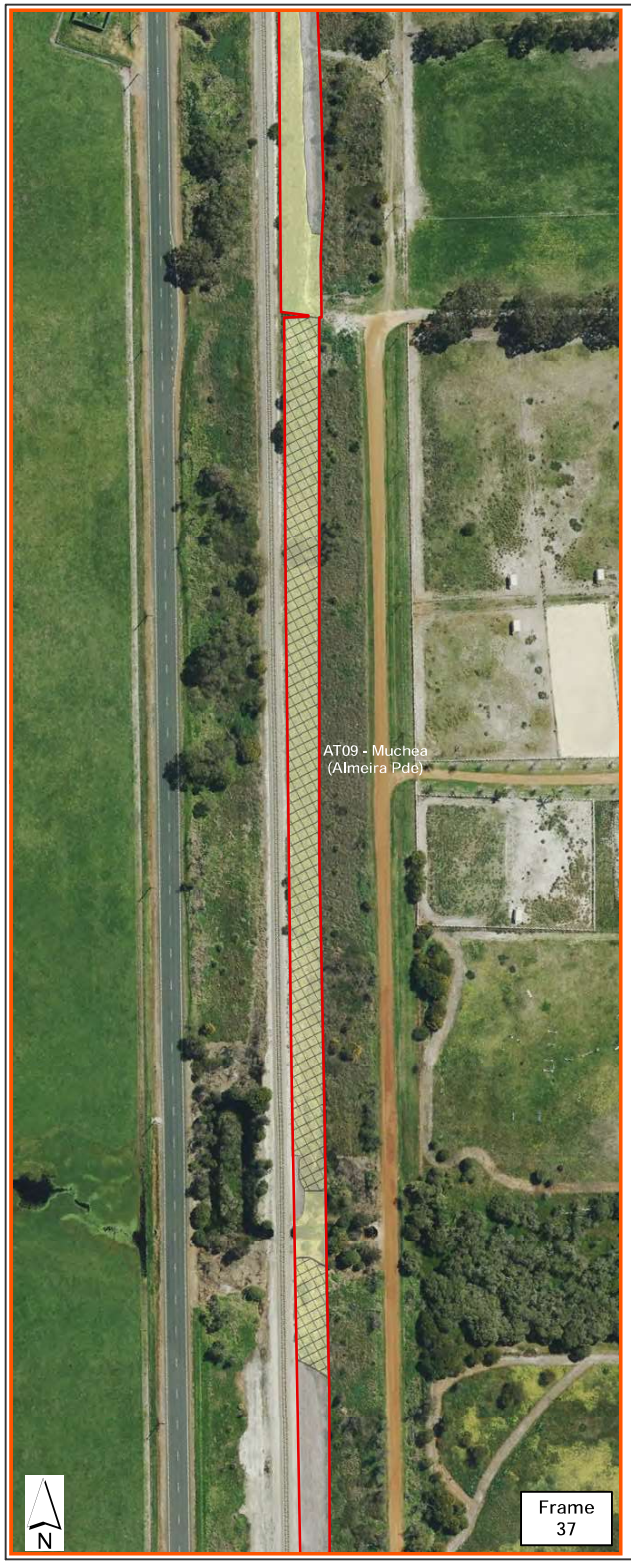

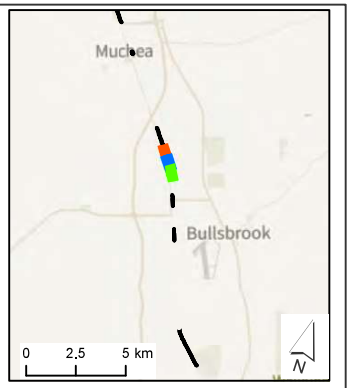

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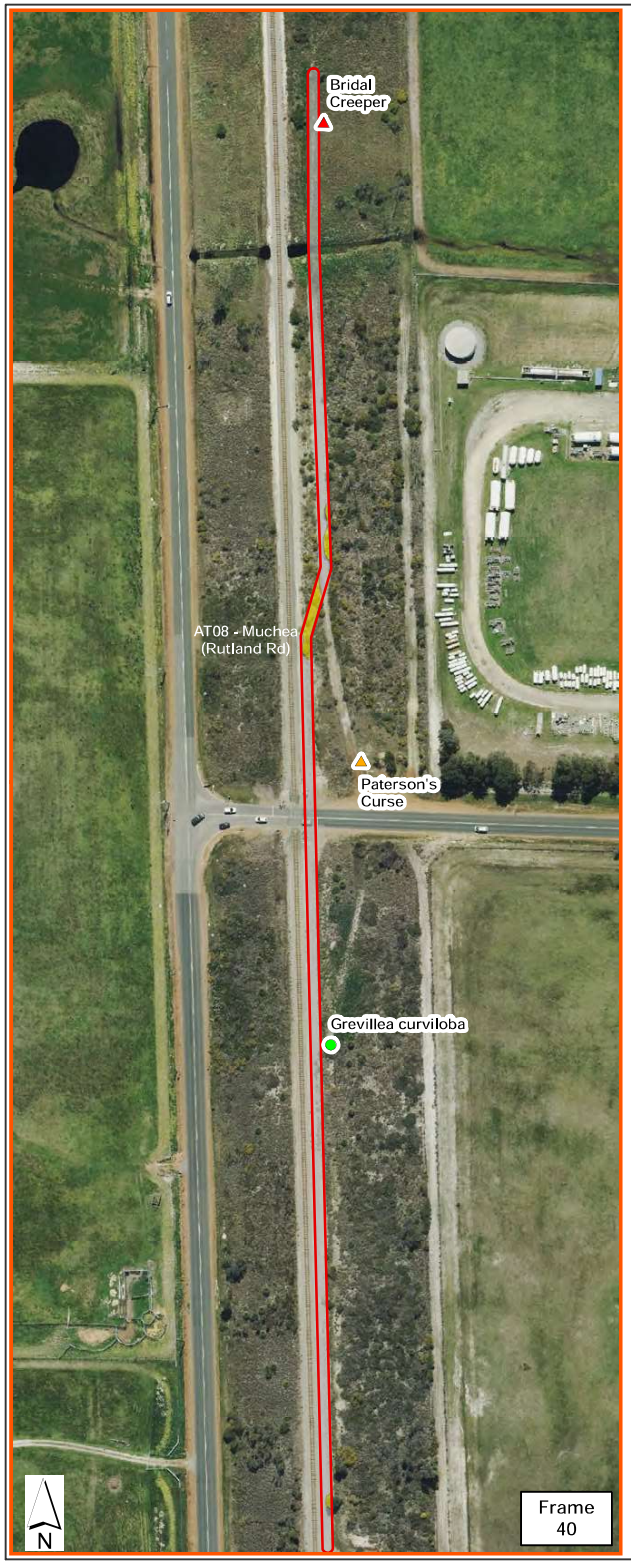

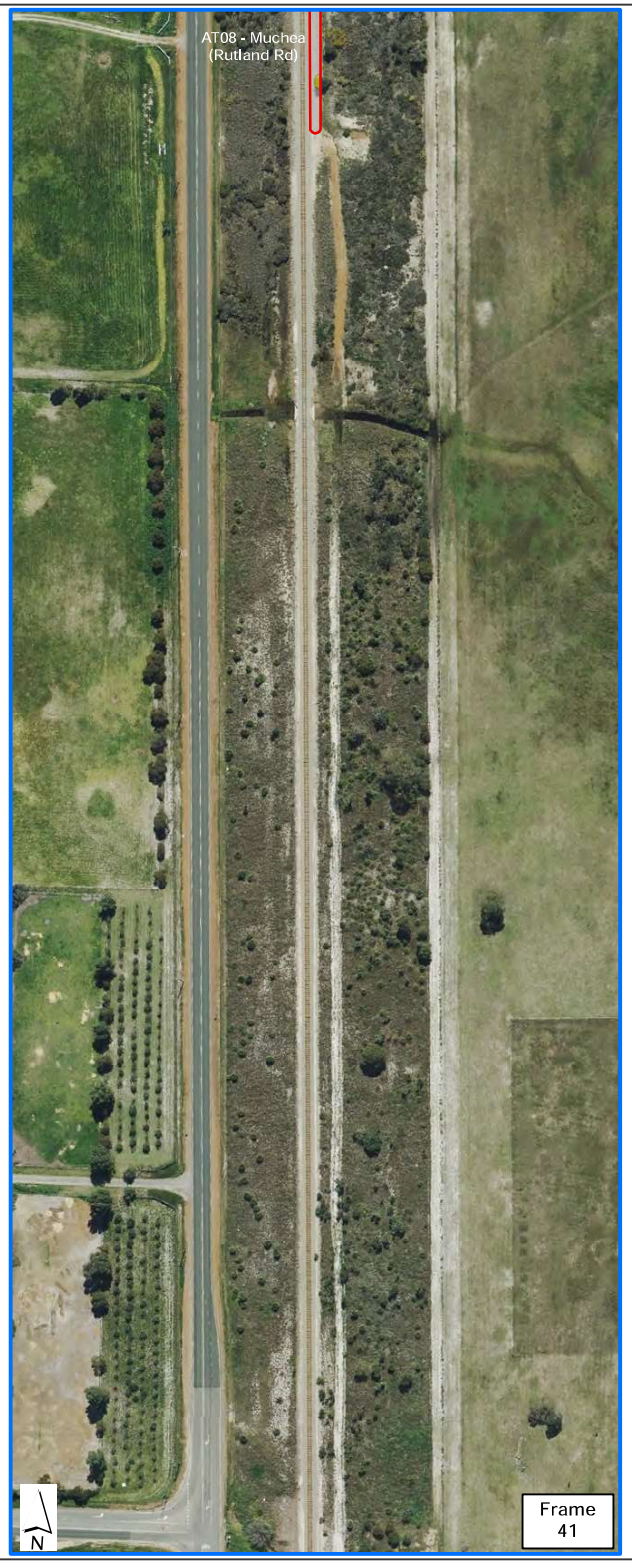

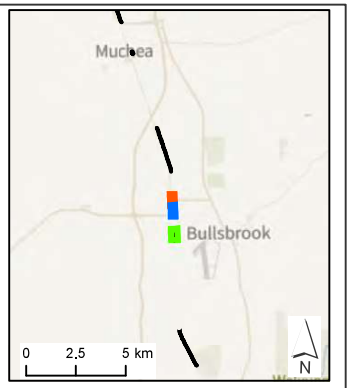

Vegetation

- Study Area

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eco logical AUSTRALIA
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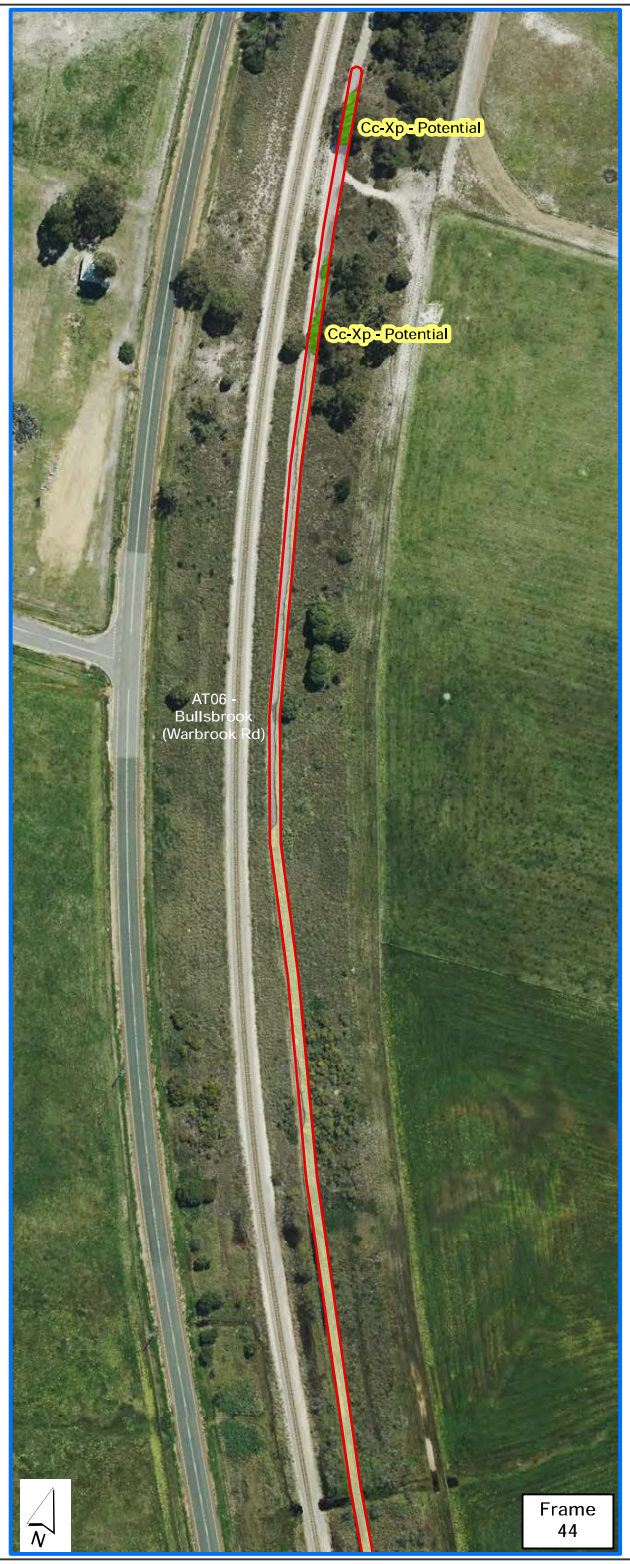

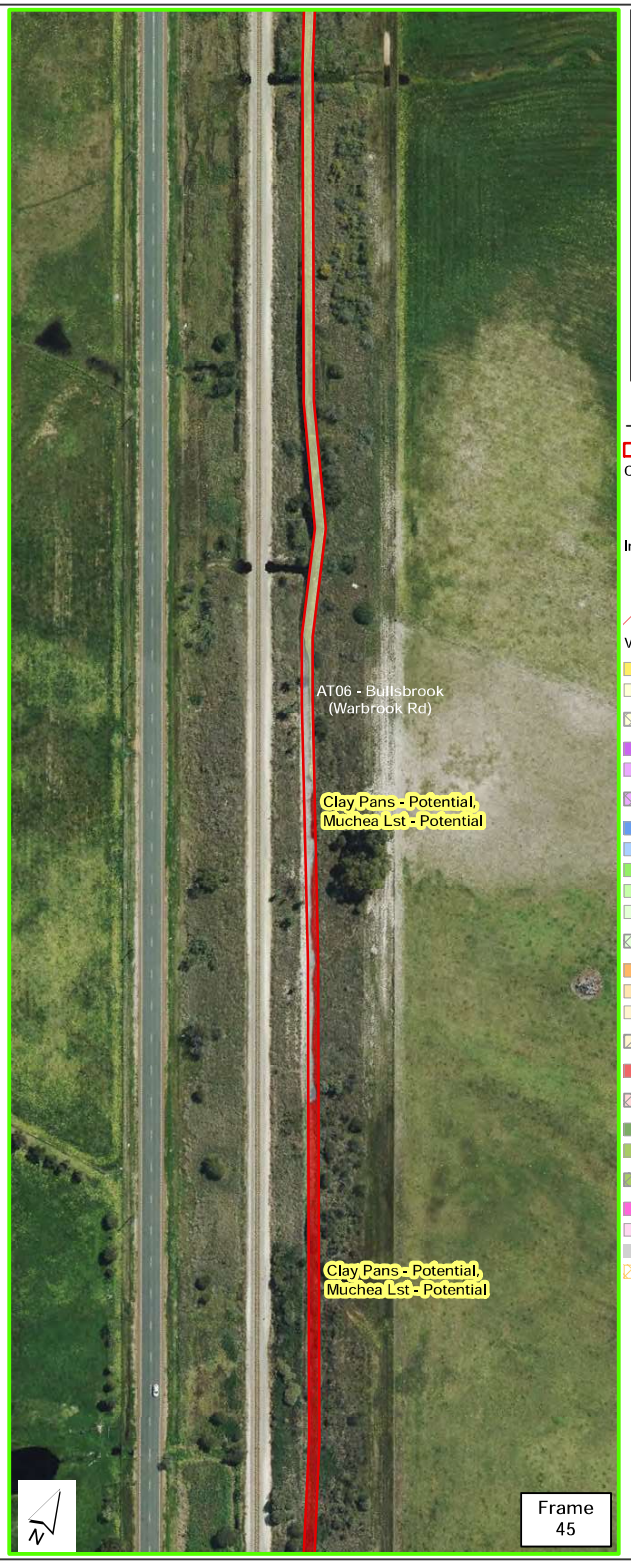

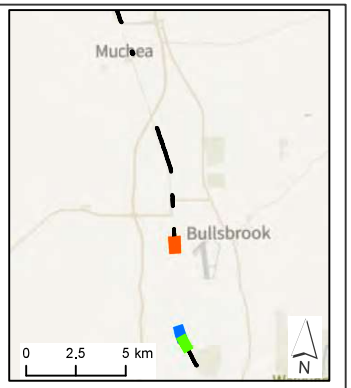

Vegetation

- Study Area

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- Grevillea curviloba
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0 25 50 100
Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19686-RS Date: 1/12/2021

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Clay Pans - Potential,
Muchea Lst - Potential
AT06 - Bullsbrook
(Warbrook Rd)
AT05 - Bullsbrook
(Twin Swamps NR)
N
Frame
46
AT05 - Bullsbrook
(Twin Swamps NR)
Clay Pans - Potential,
Muchea Lst - Potential
Frame
47
Clay Pans -
Potential
Clay Pans -
Potential
Clay Pans -
Potential
Clay Pans -
Potential
Clay Pans -
Potential
AT04 - Bullsbrook
(north of
Maralla Rd)
Banksia Woodland
- Likely
Frame
48
Bullsbrook
Walyung
National P
UPPER
SWAN
ELLENBROOK
BRIG
0
2.5
5 km
N
Vegetation
Study Area
Conservation significant flora
Grevillea curviloba
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Introduced Flora
Declared Pest
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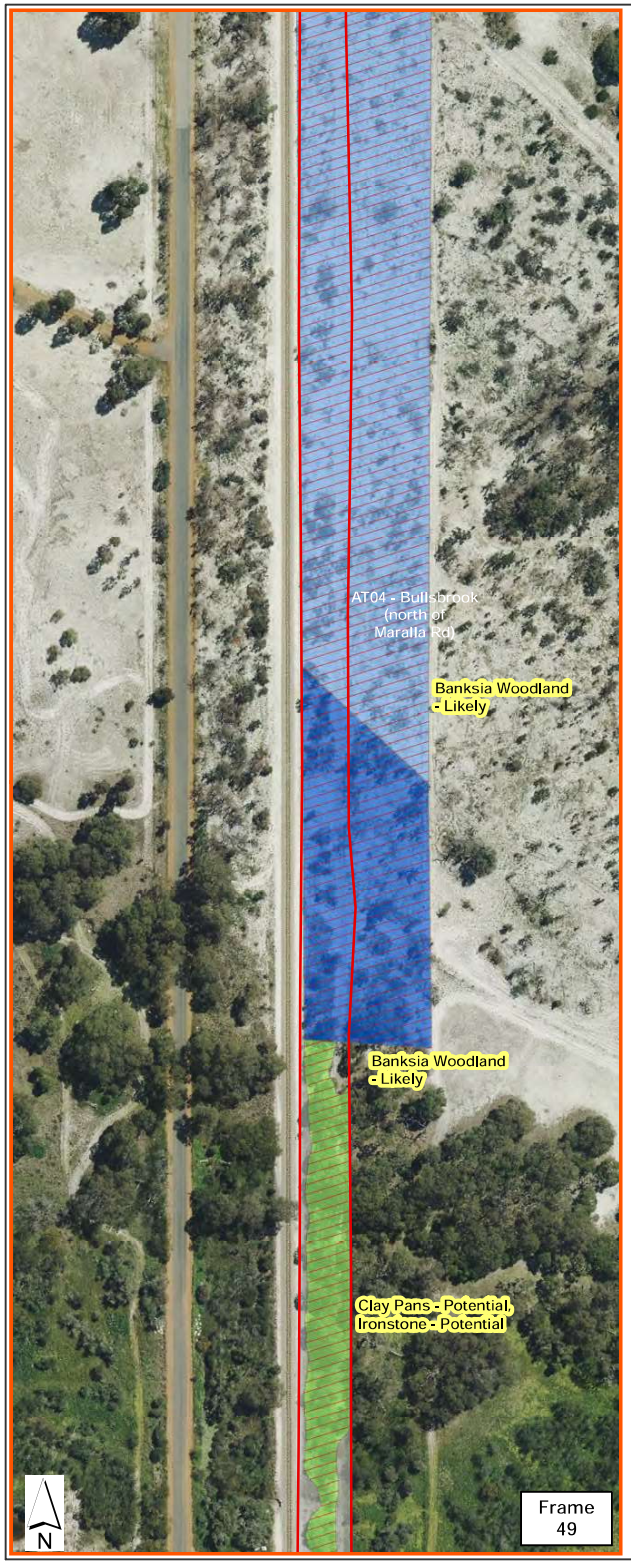
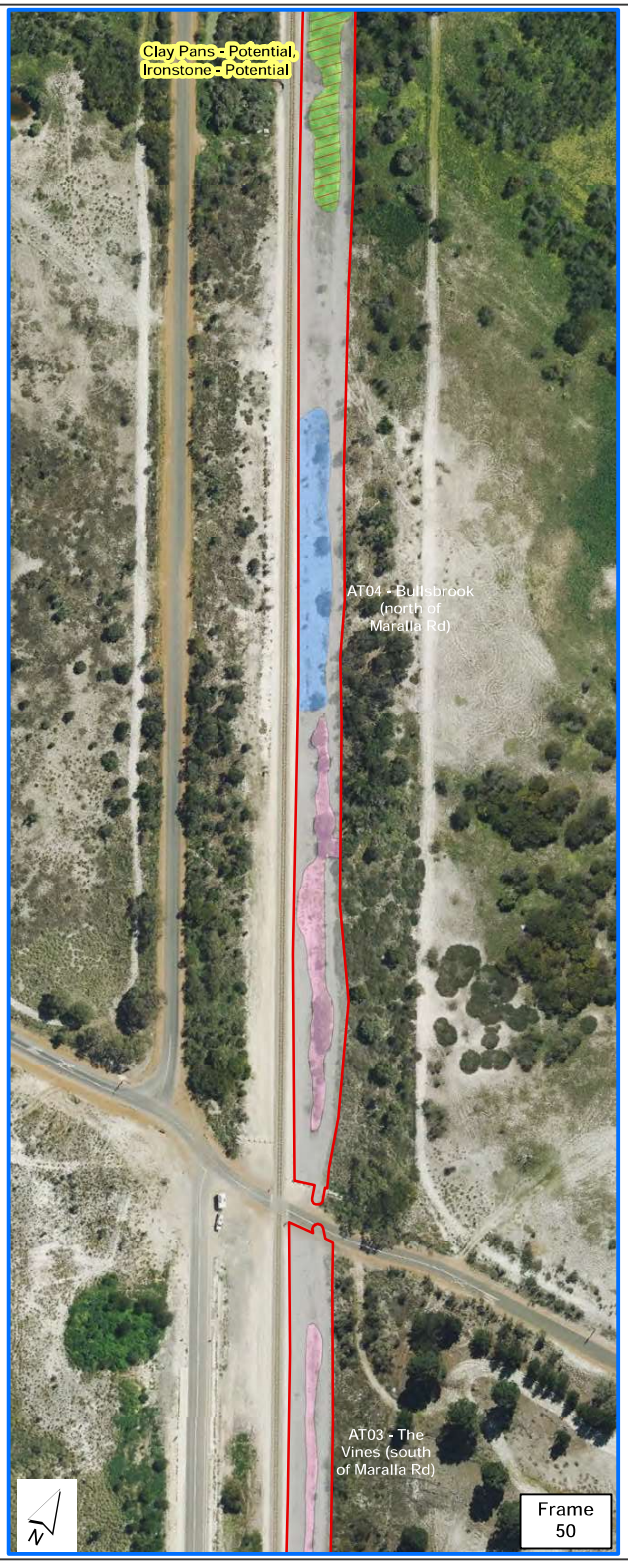
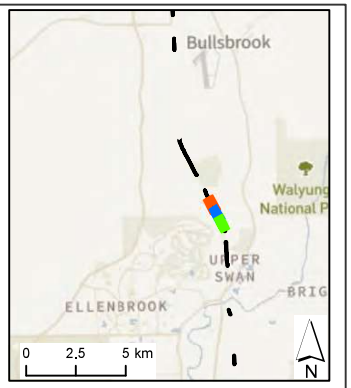
0
25
50
100
Metres
Datum/Projection:
GDA 1994 MGA Zone 50
Project: 19686-RS Date: 1/12/2021
ecological
AUSTRALIA
A TETRA TECH COMPANY







Vegetation

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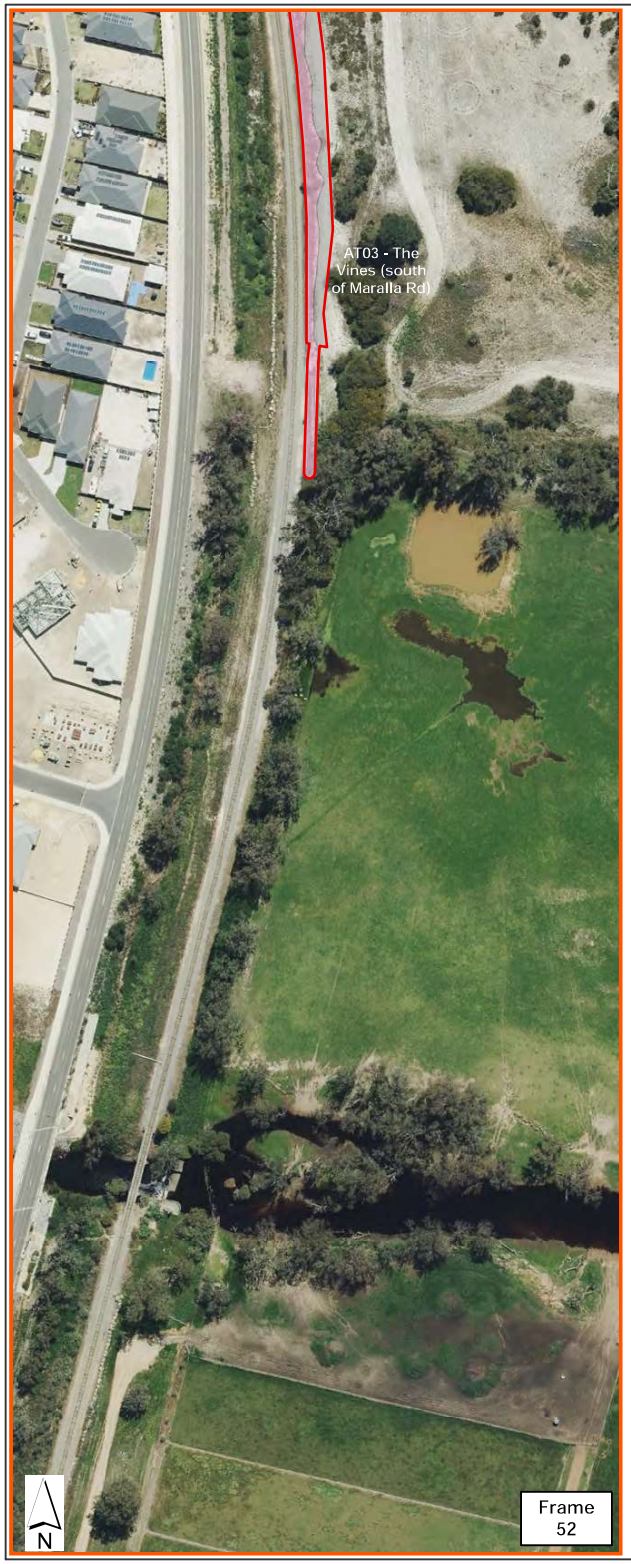

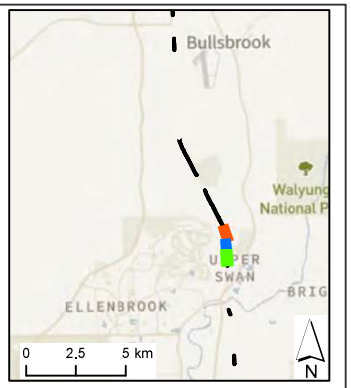

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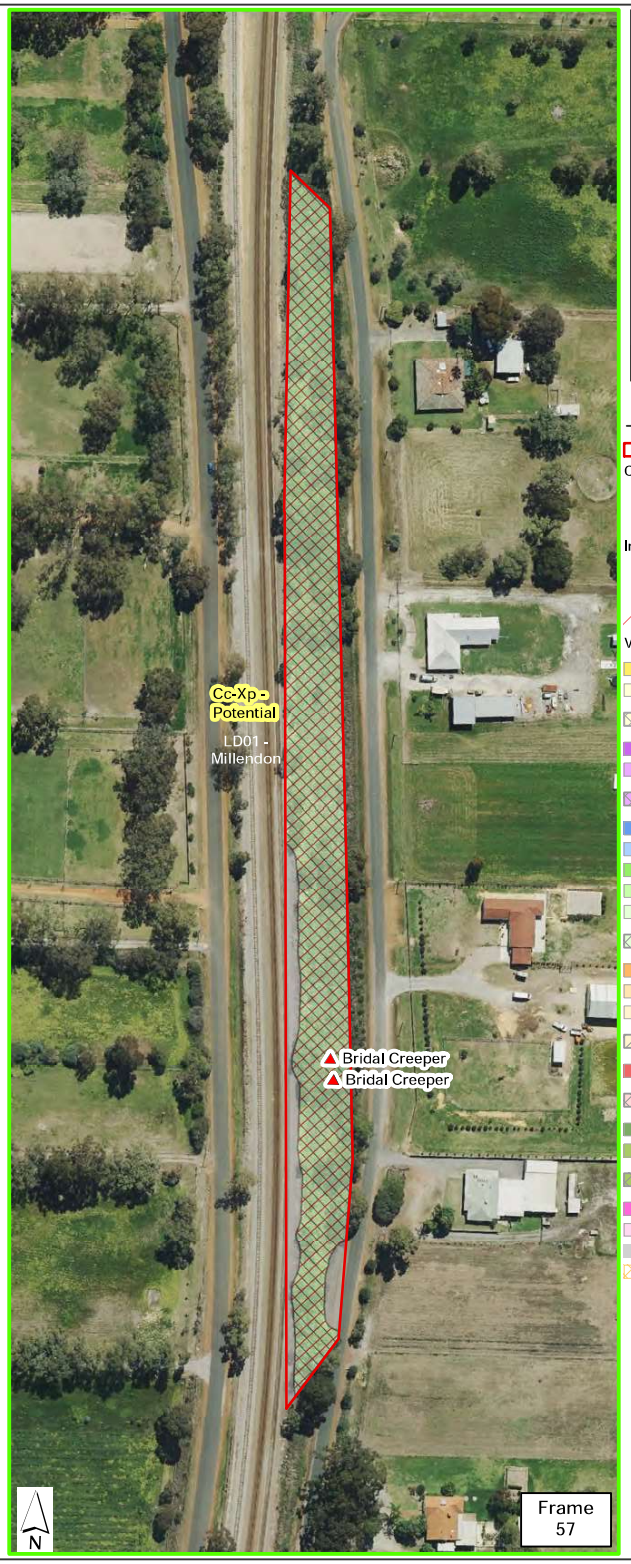

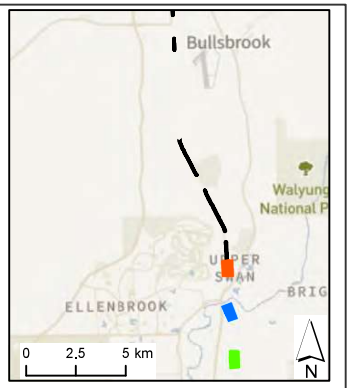

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- Mixed tall sparse Shrubland, Degraded
- Cleared,
- No Survey,

0 25 50 100
Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19686-RS Date: 1/12/2021

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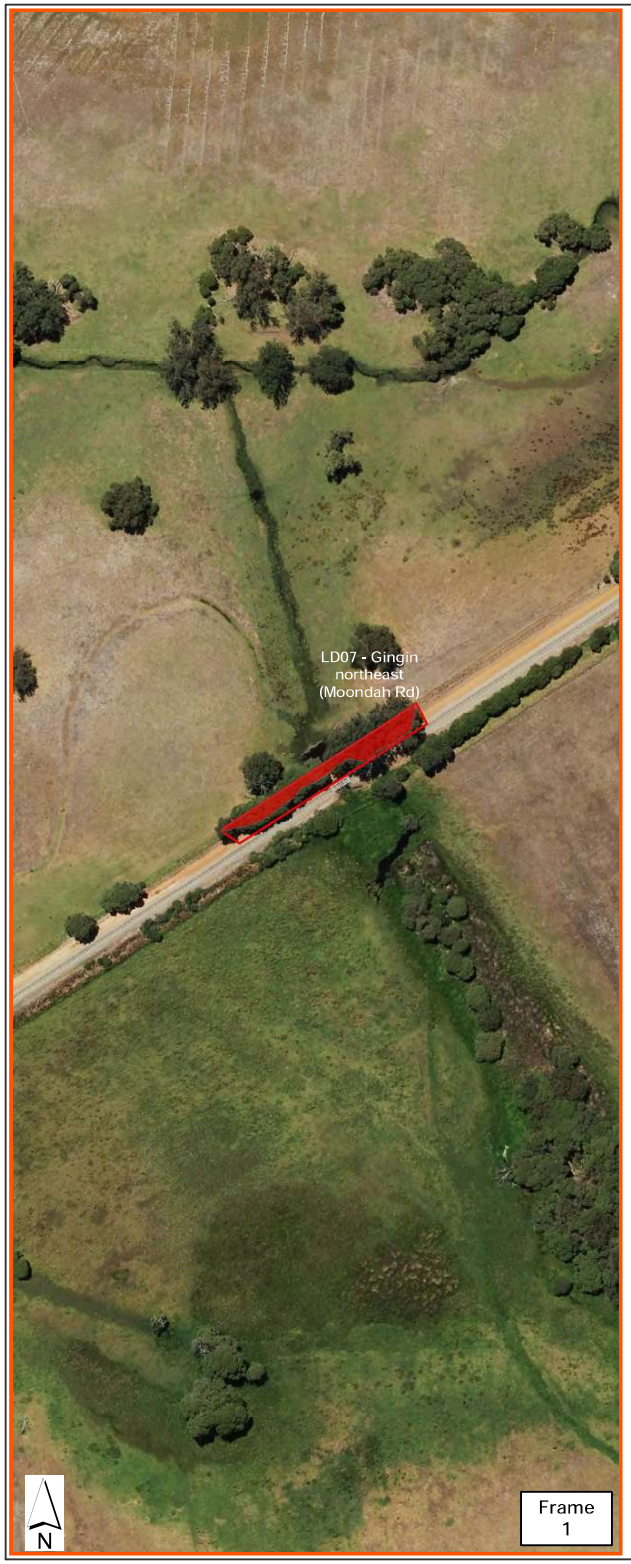
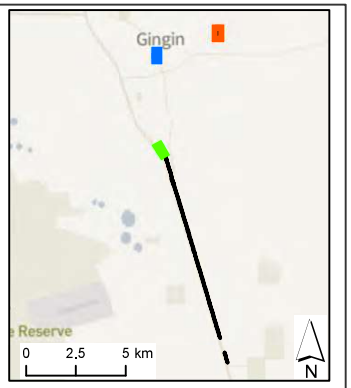
Appendix O: Maps – Black Cockatoo foraging evidence locations, Fauna habitats





Fauna

Study Area

Foraging evidence locations

- Carnaby's Cockatoo (Calyptorhynchus latirostris) foraging evidence
- Forest Red-tailed Black Cockatoo (Calyptorhynchus banksii naso) foraging evidence

Fauna Habitat

- Banksia woodland
- Marri woodland
- Melaleuca woodland/shrubland
- Mixed shrubland

0 25 50 100
Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19686-RS Date: 2/12/2021

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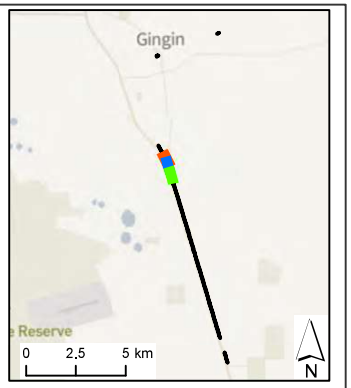

Fauna

Study Area

Foraging evidence locations

- Carnaby's Cockatoo (Calyptorhynchus latirostris) foraging evidence
- Forest Red-tailed Black Cockatoo (Calyptorhynchus banksii naso) foraging evidence

Fauna Habitat

- Allocasuarina woodland
- Banksia woodland
- Marri woodland
- Melaleuca woodland/shrubland
- Mixed shrubland

0 25 50 100
Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19686-RS Date: 2/12/2021

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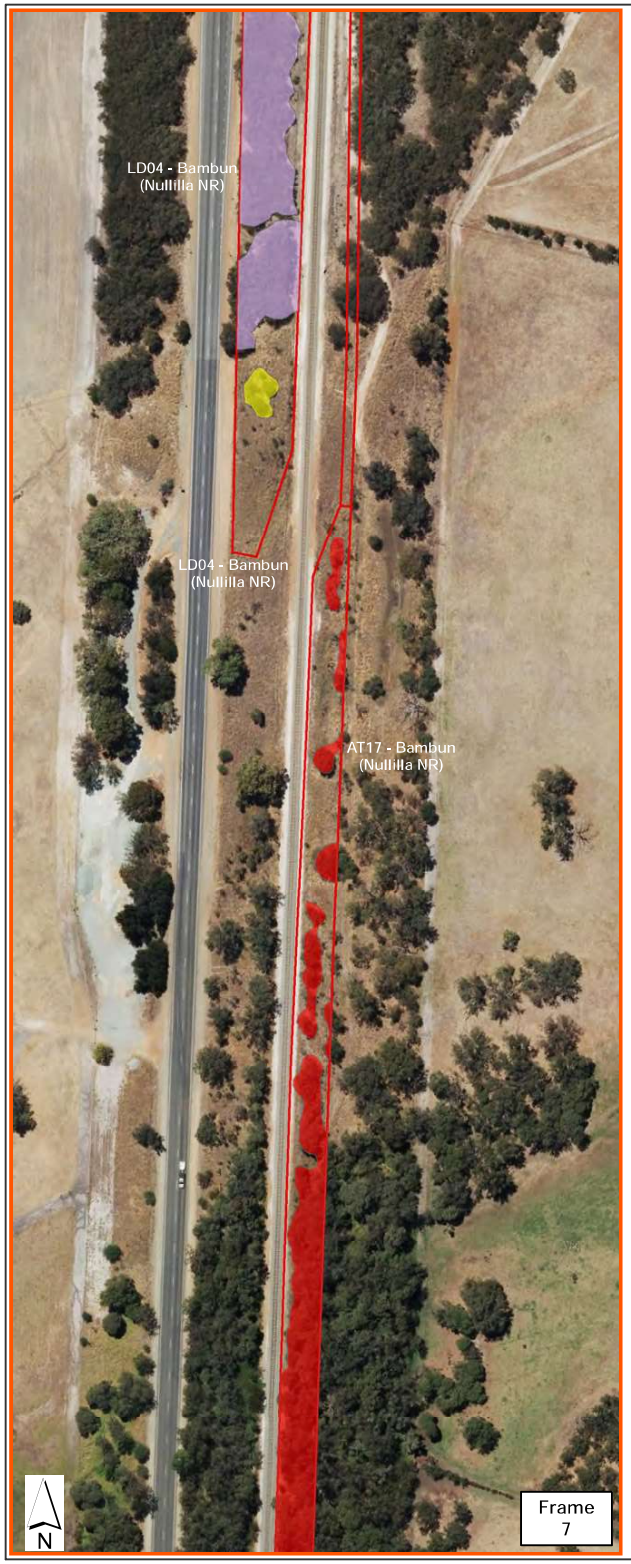

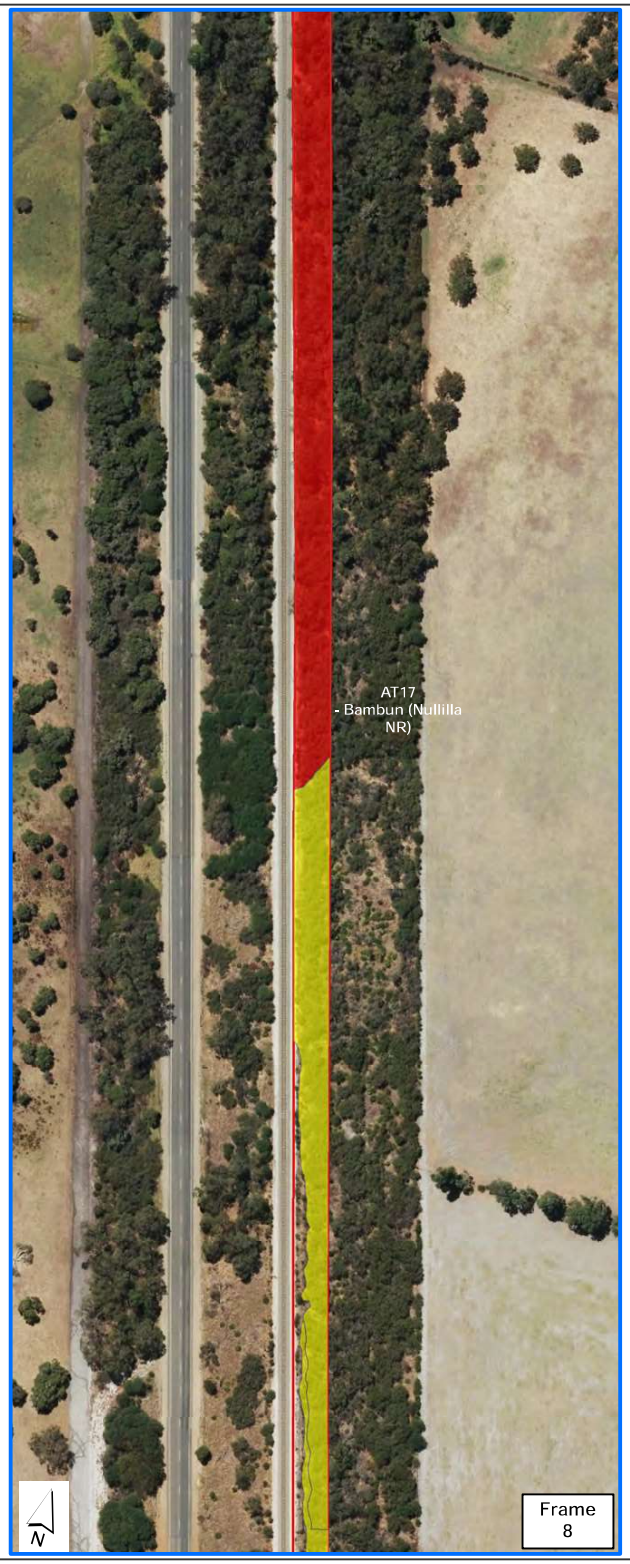

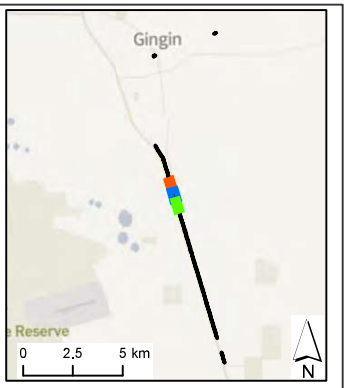

Fauna

Study Area

Foraging evidence locations

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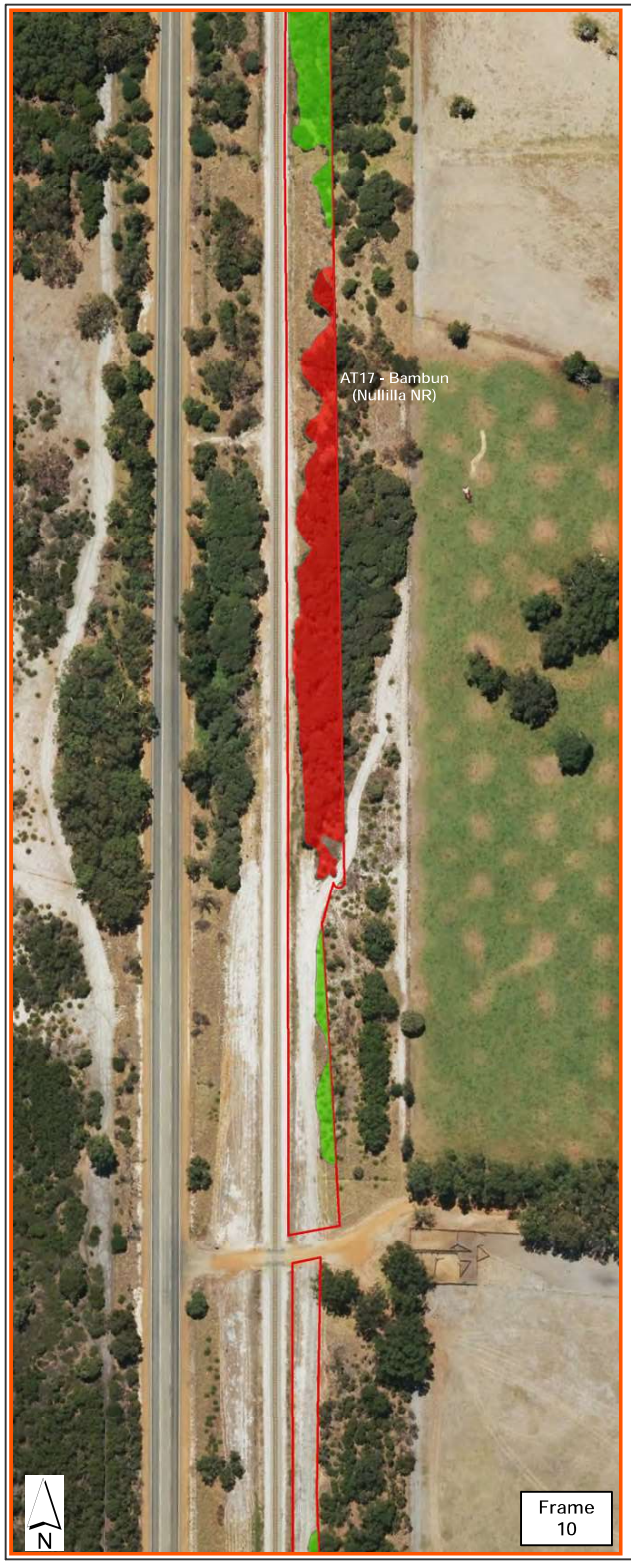

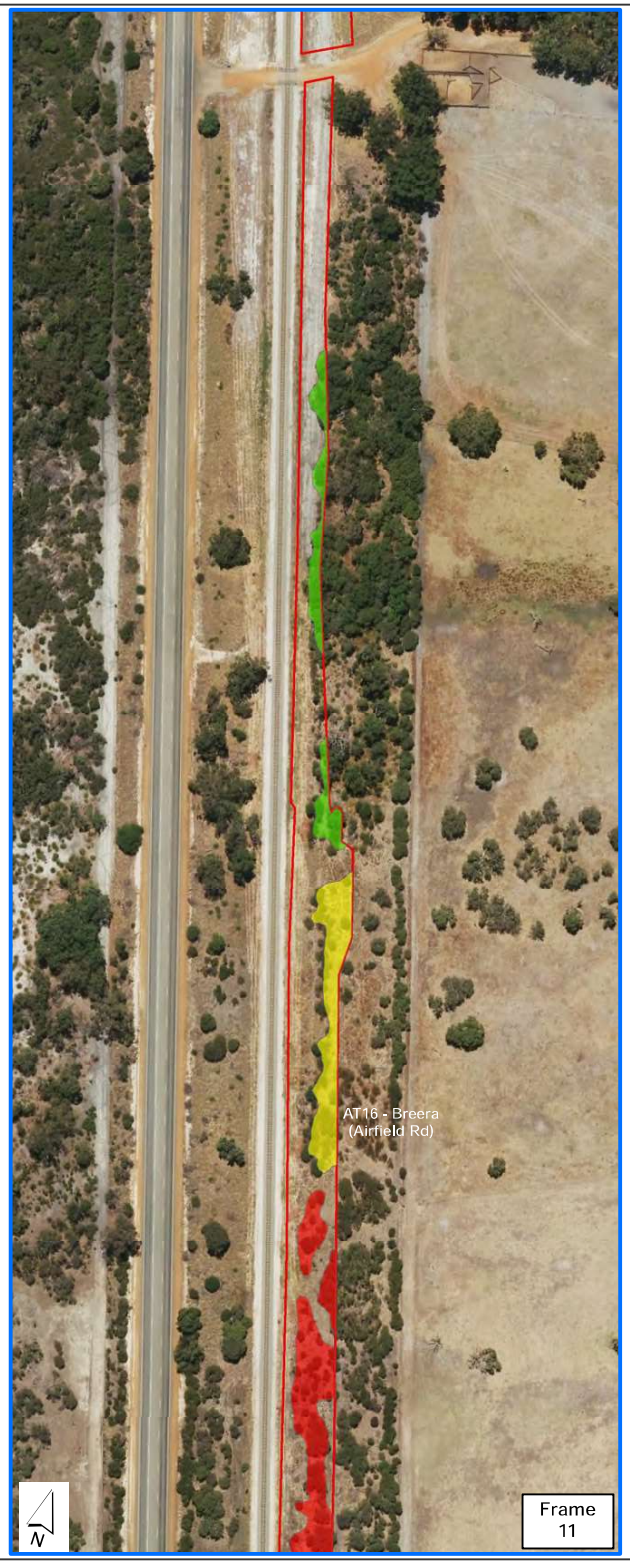

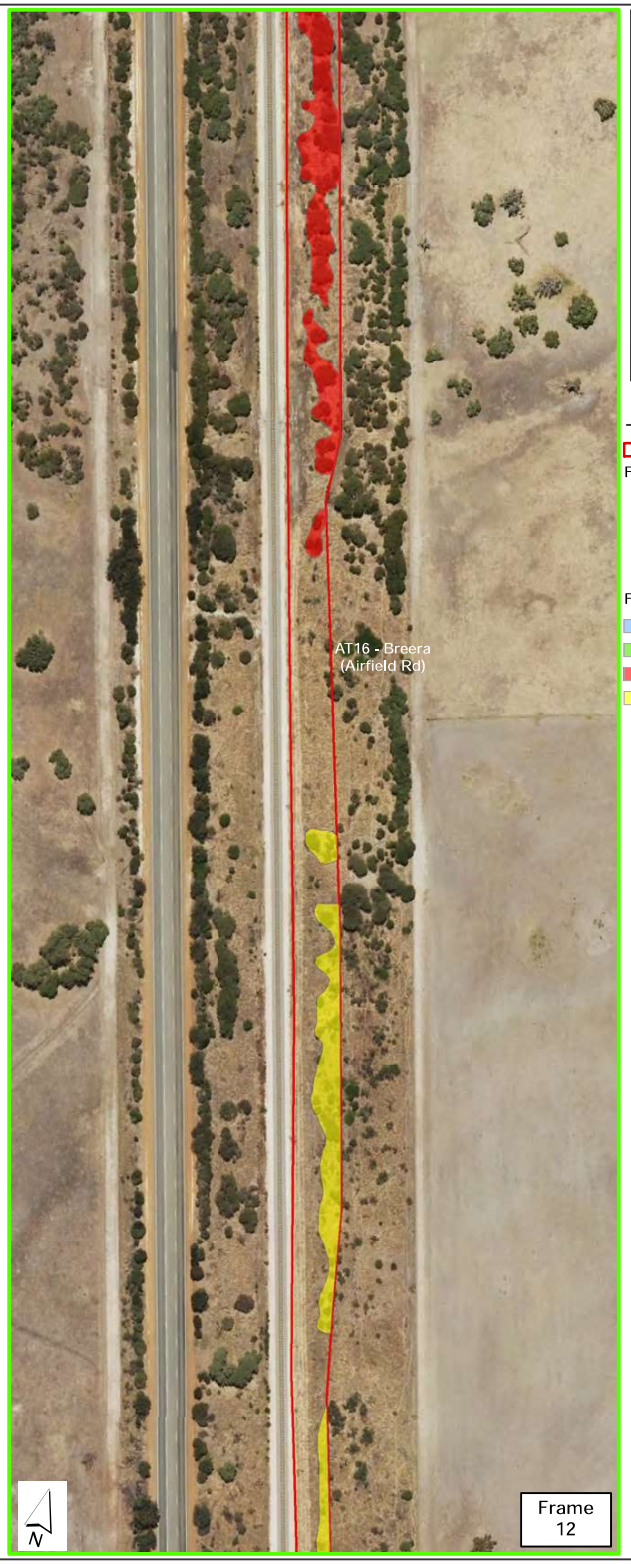

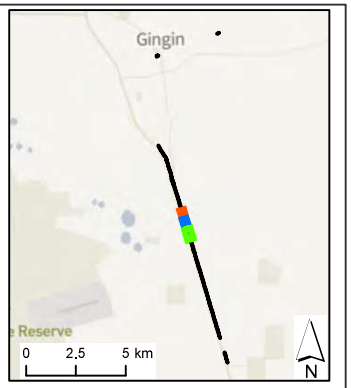

Fauna

Study Area

Foraging evidence locations

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Metres

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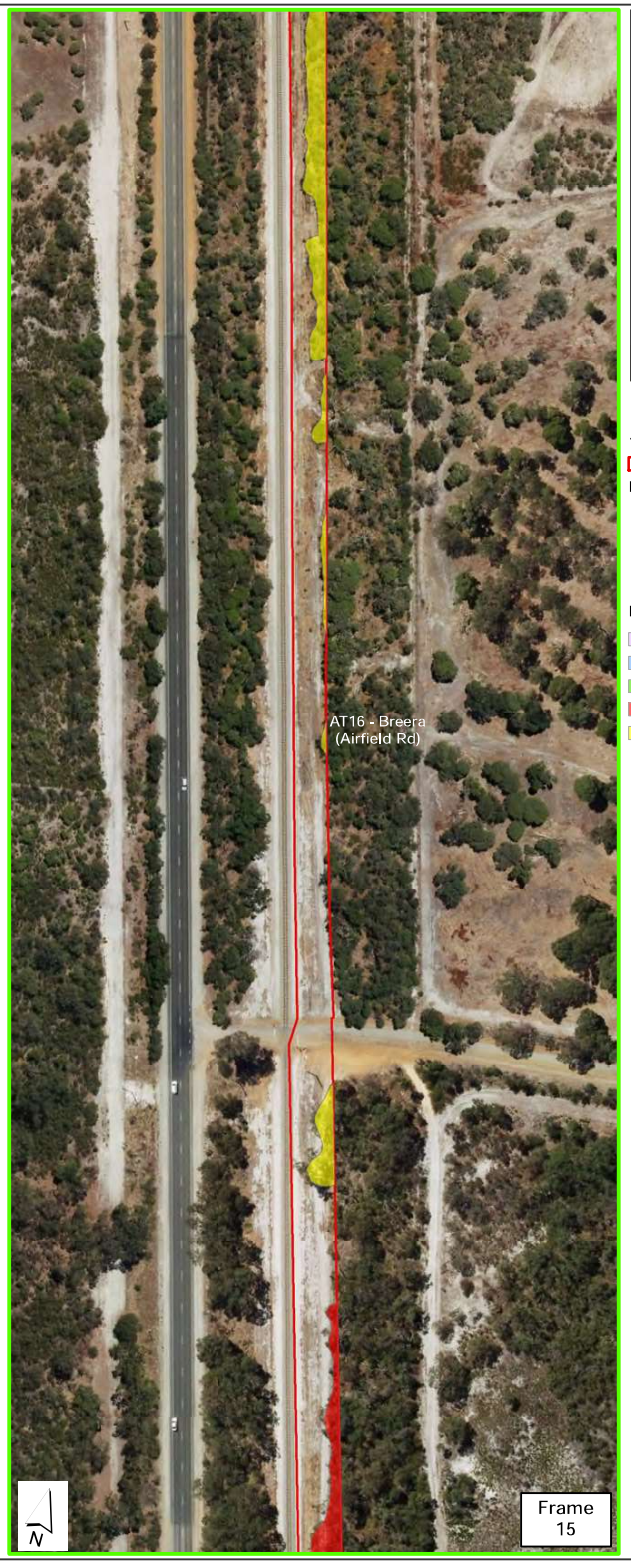

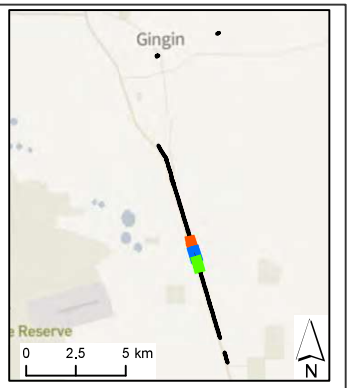

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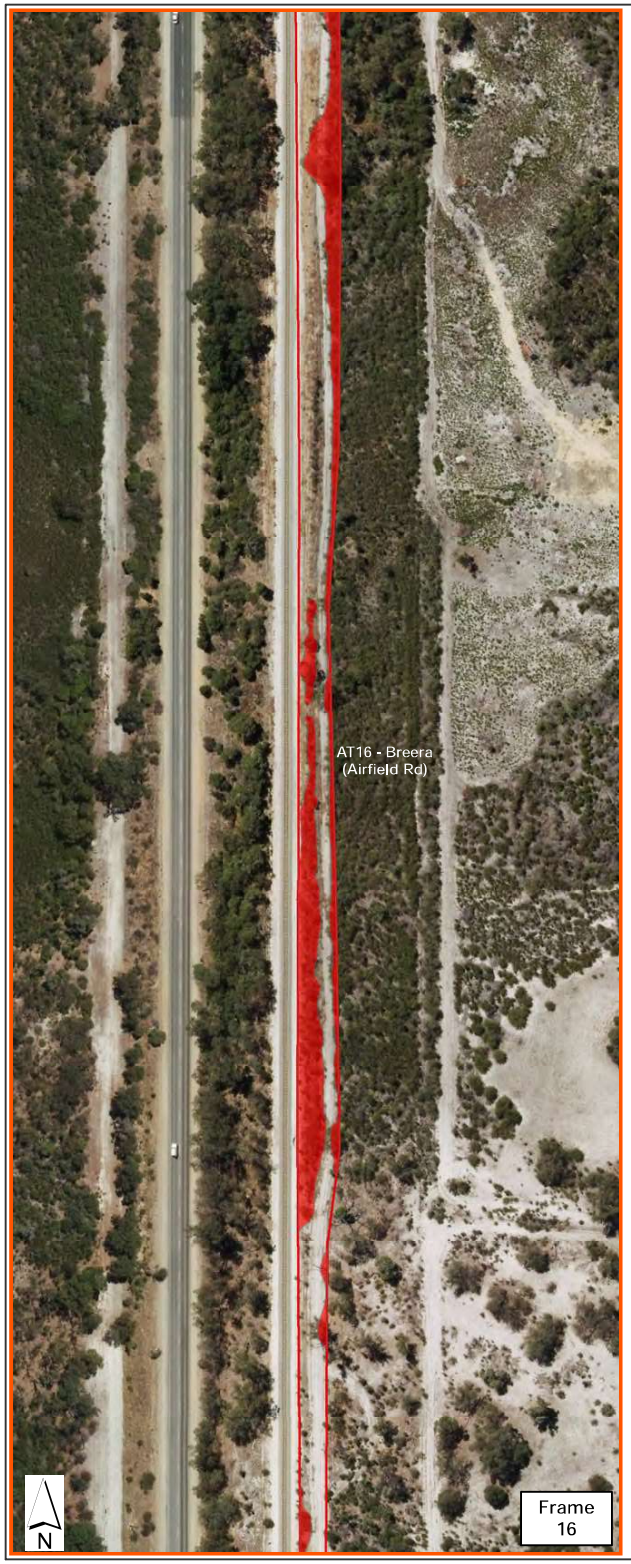

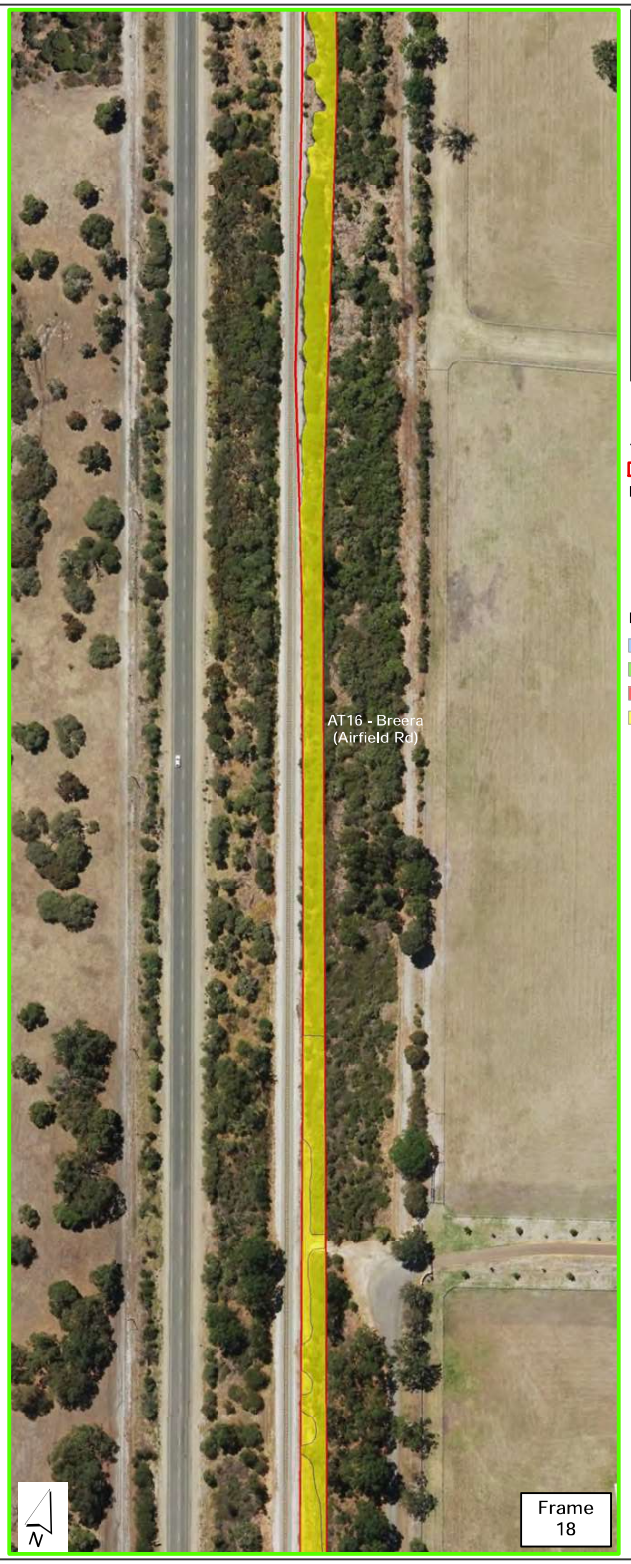

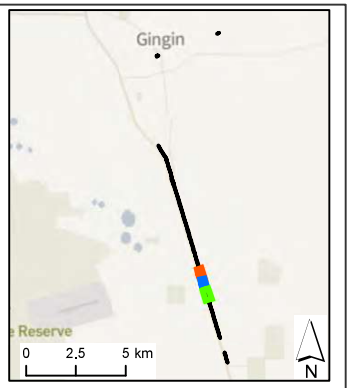

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Project: 19686-RS Date: 2/12/2021

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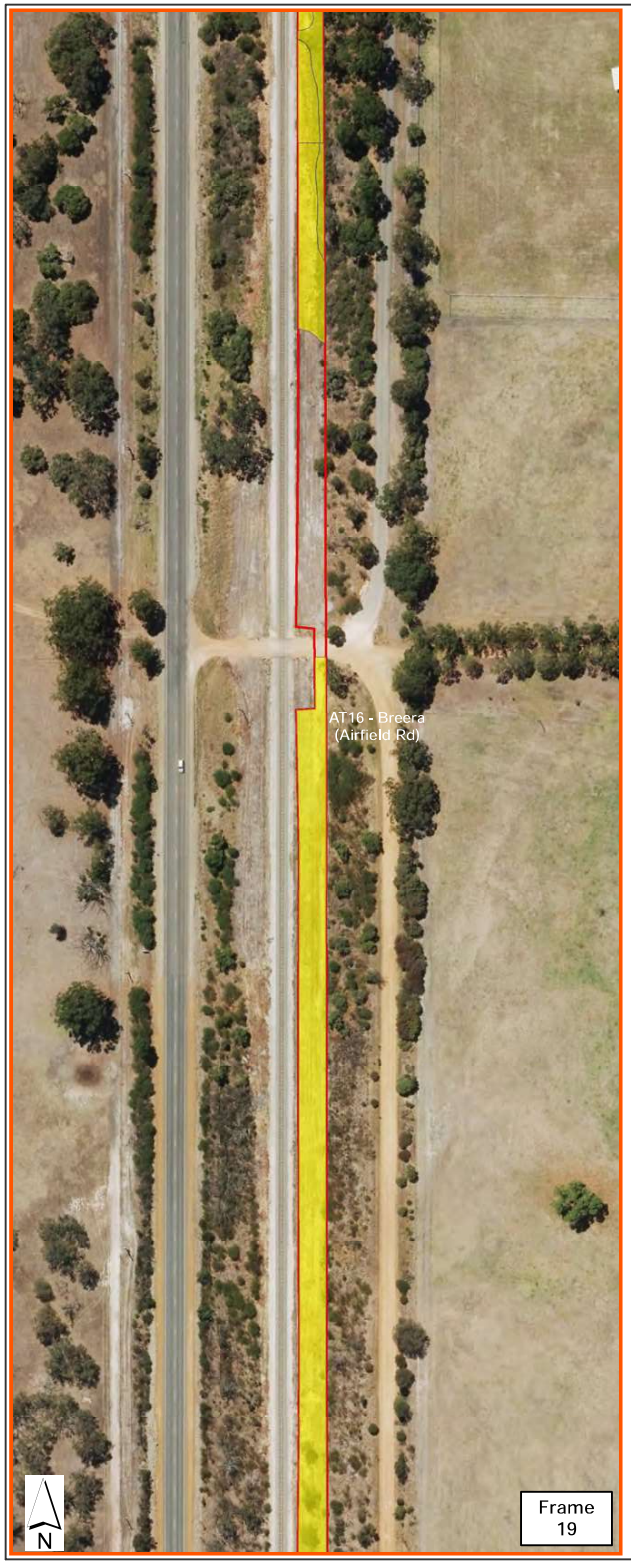

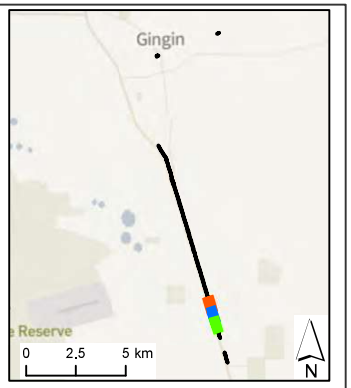

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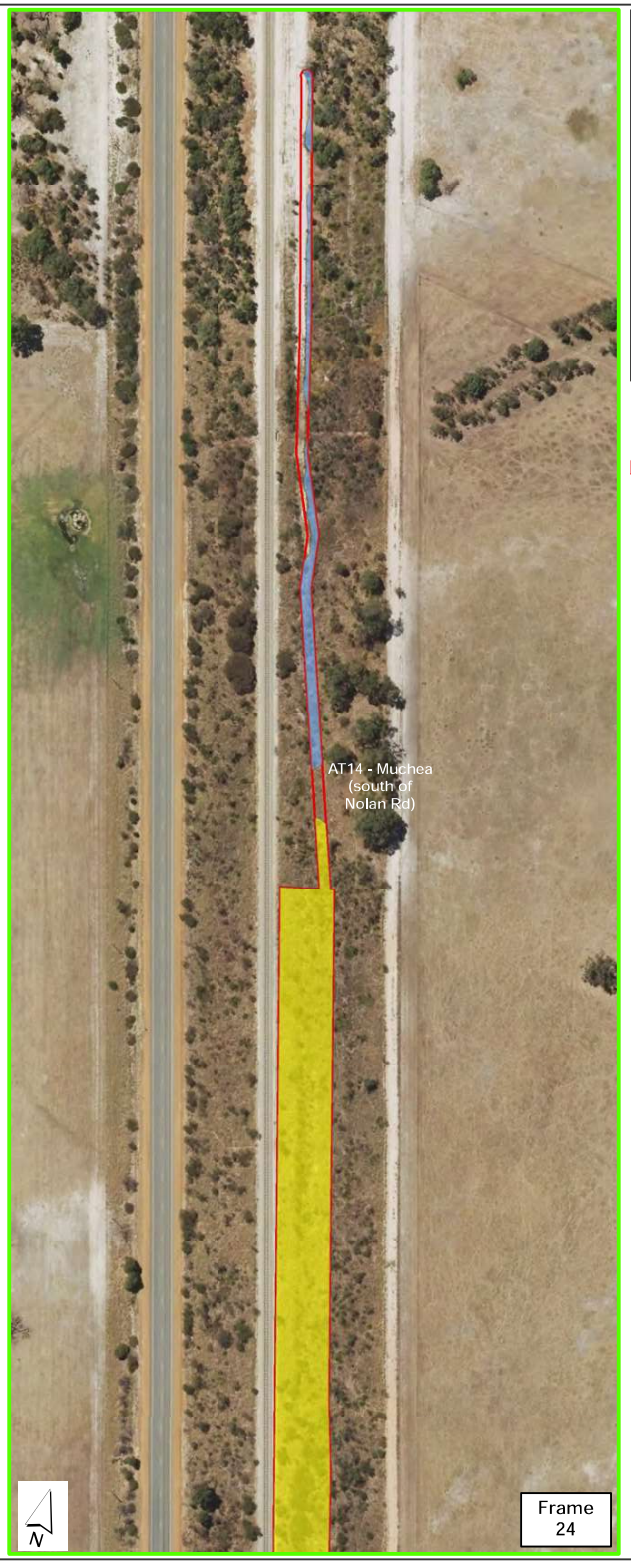

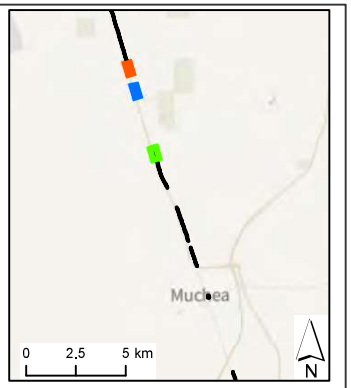

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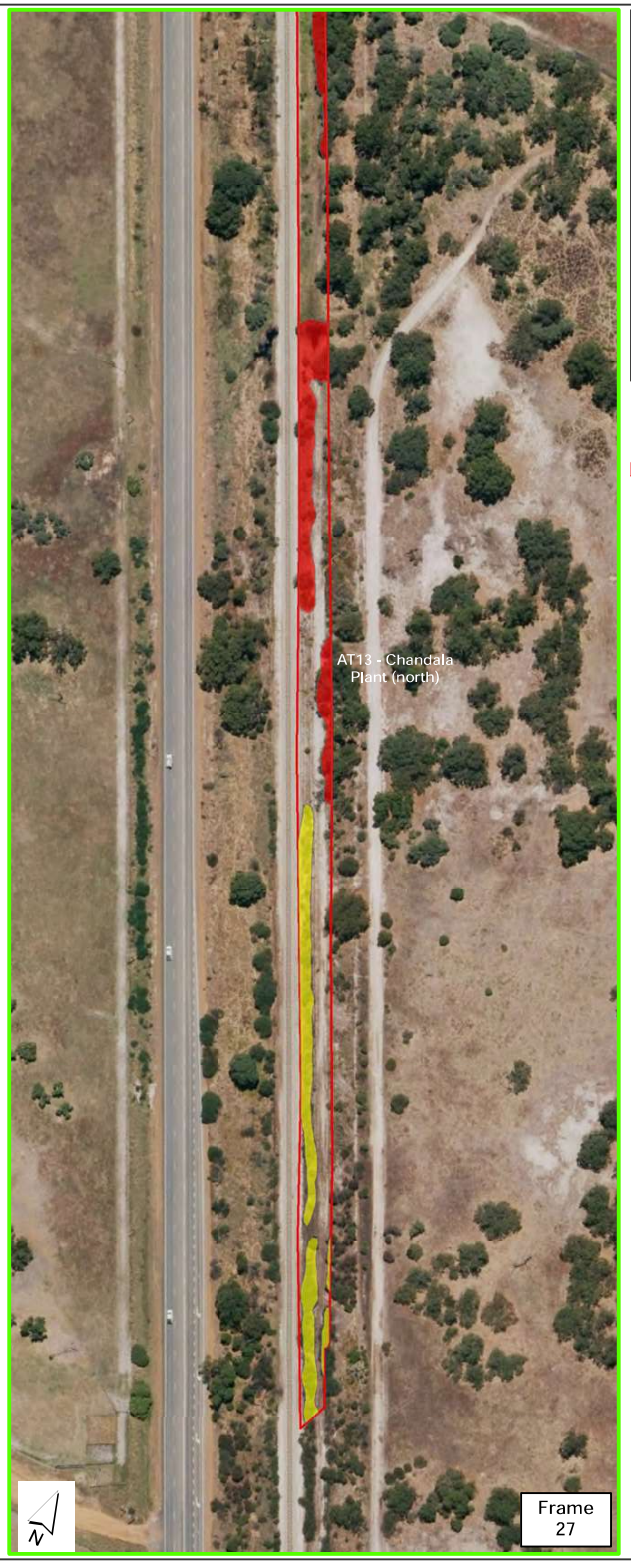

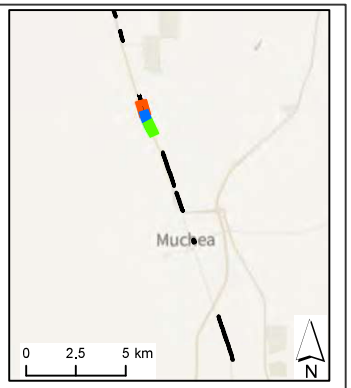

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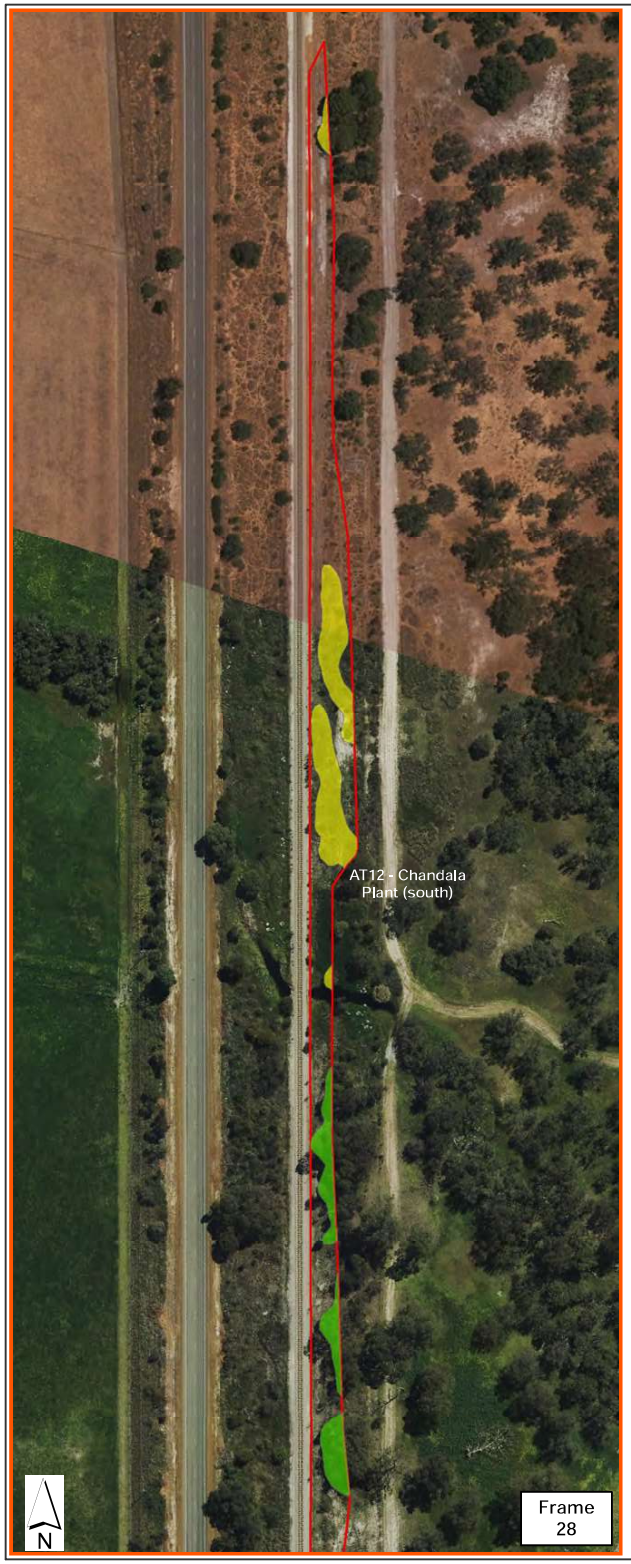

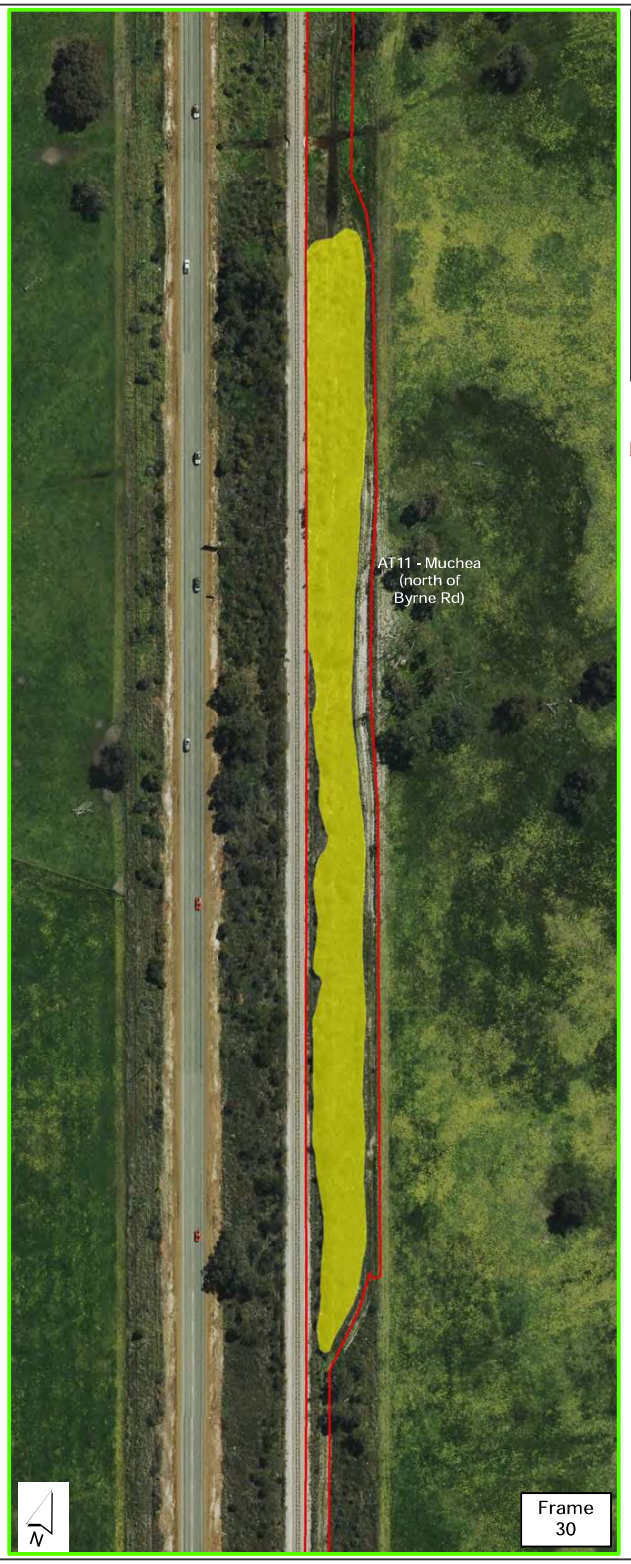

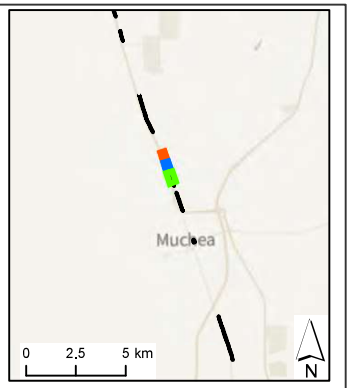

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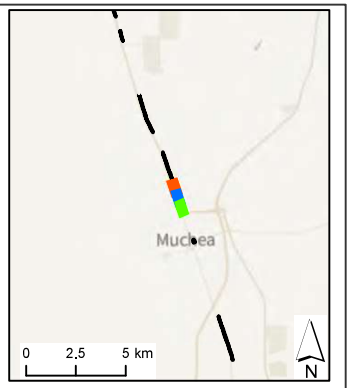

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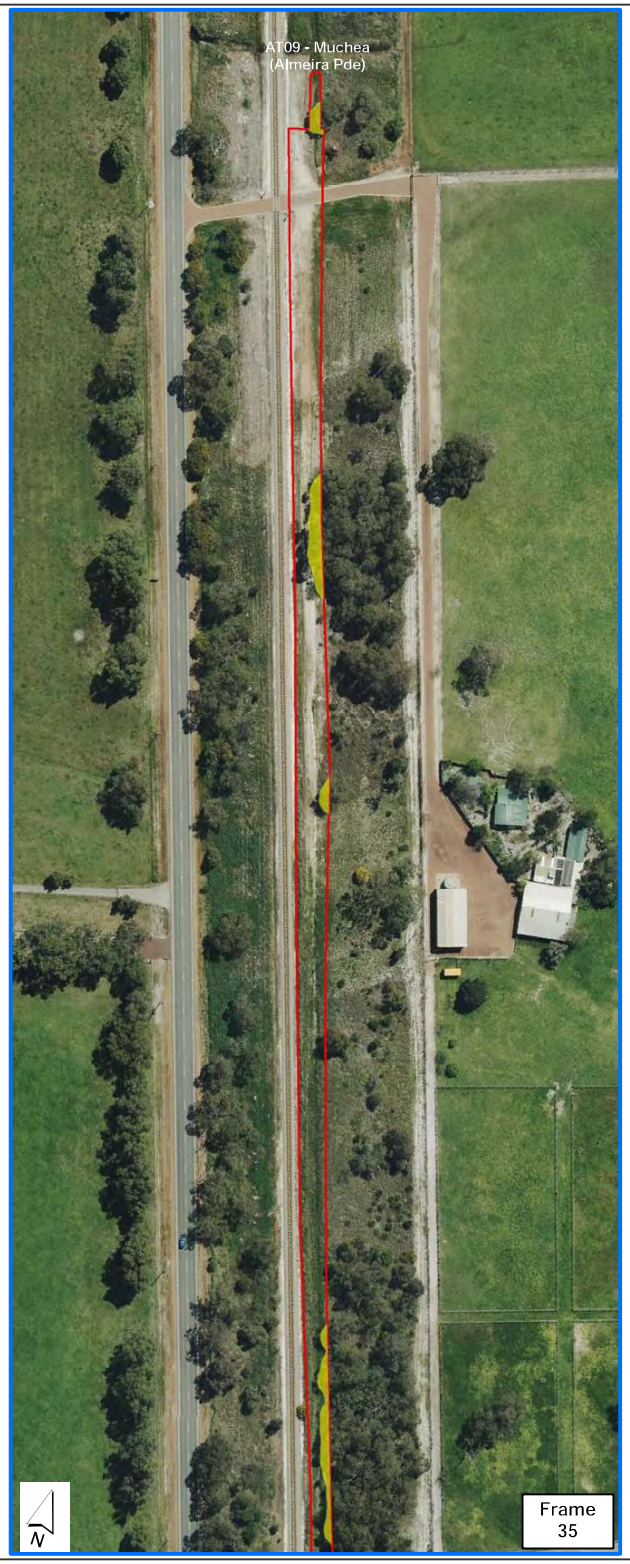

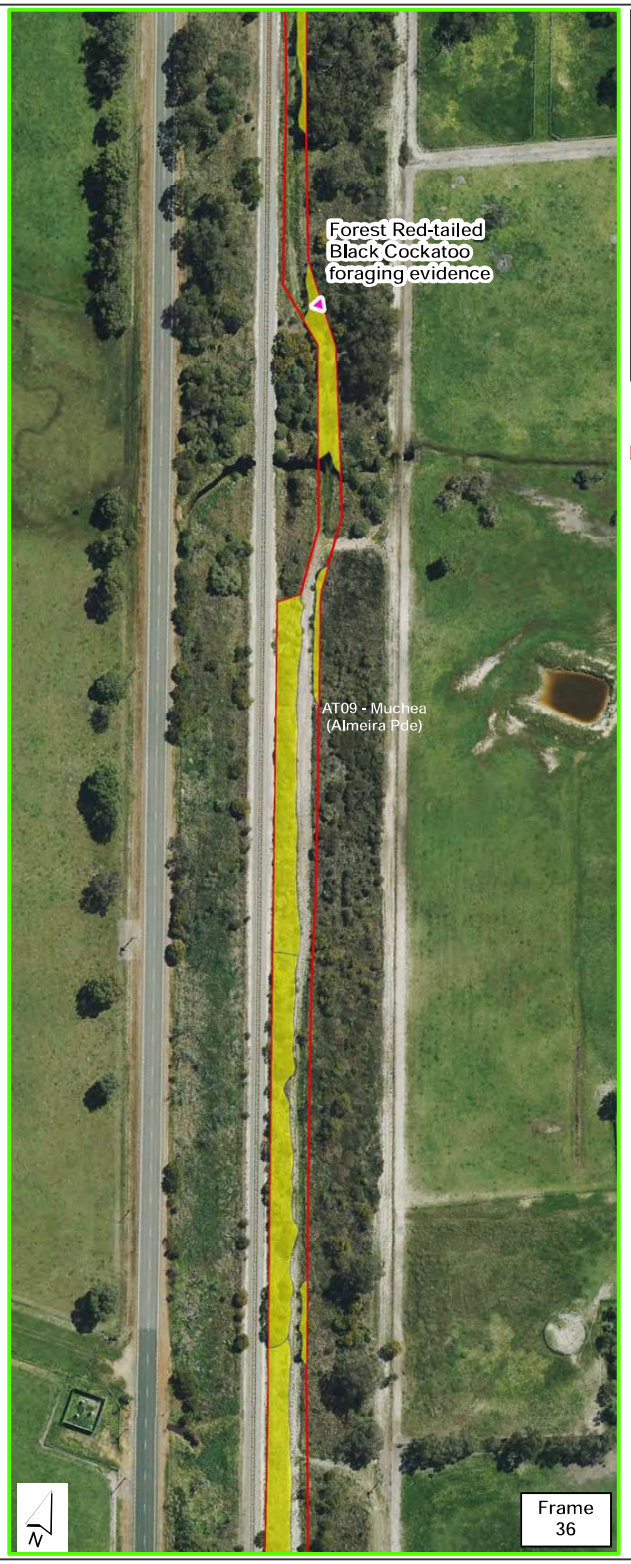

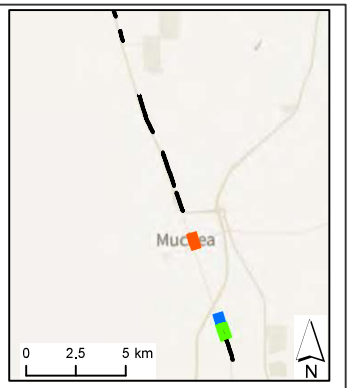

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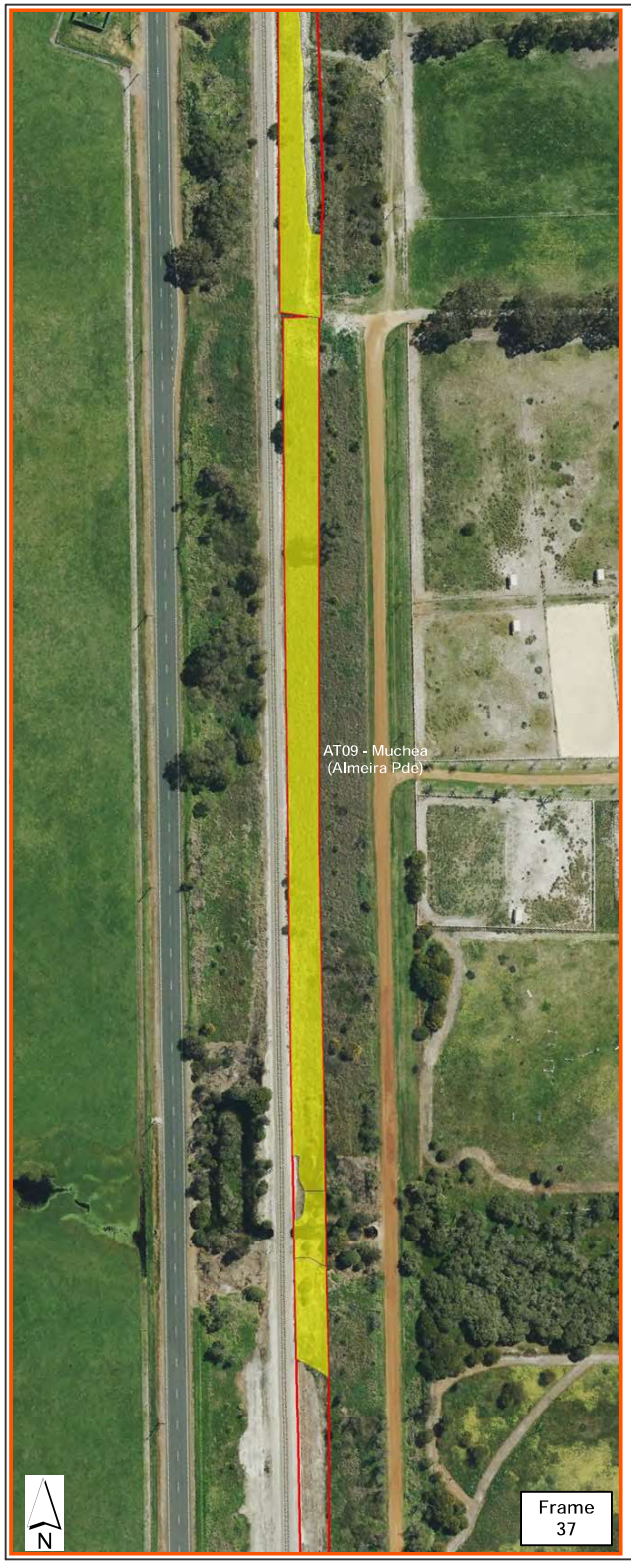

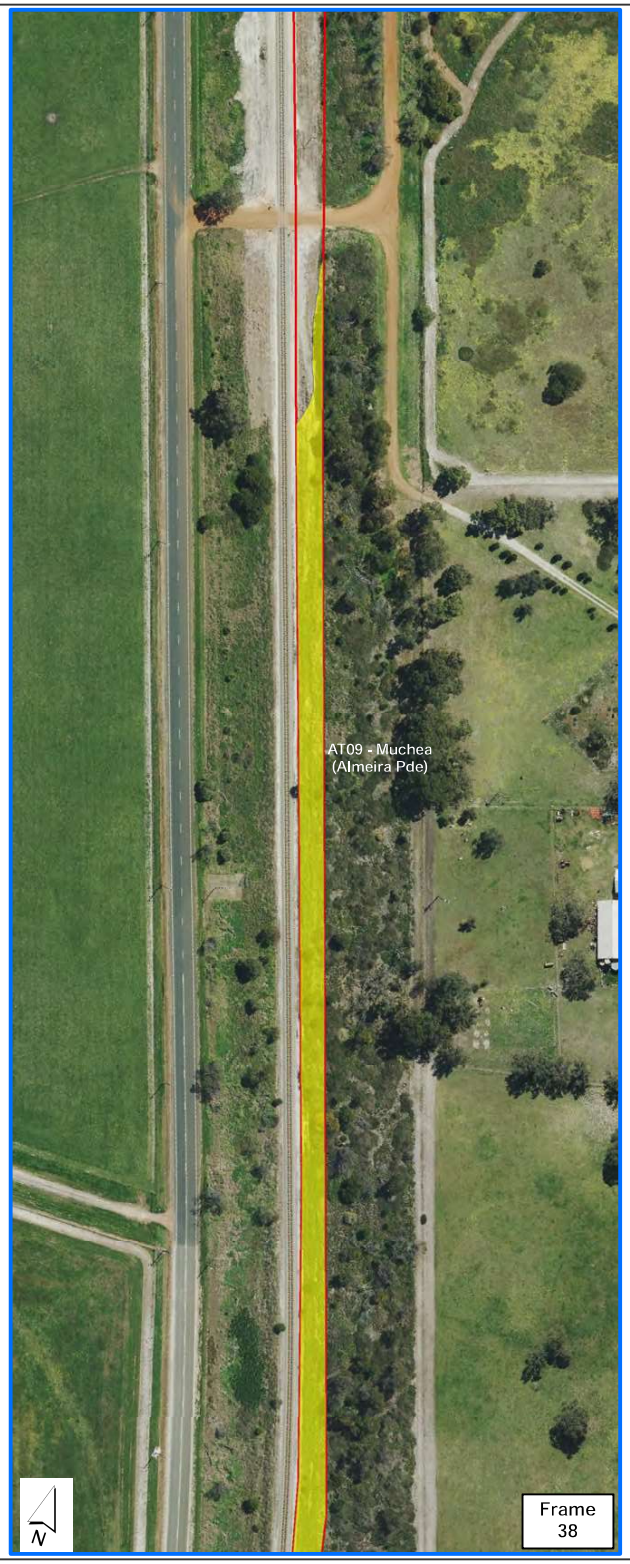

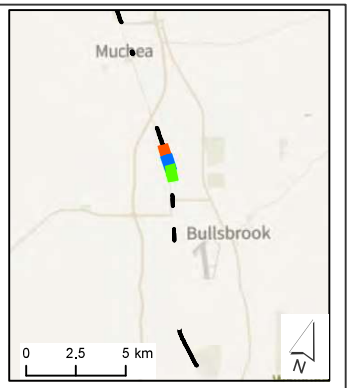

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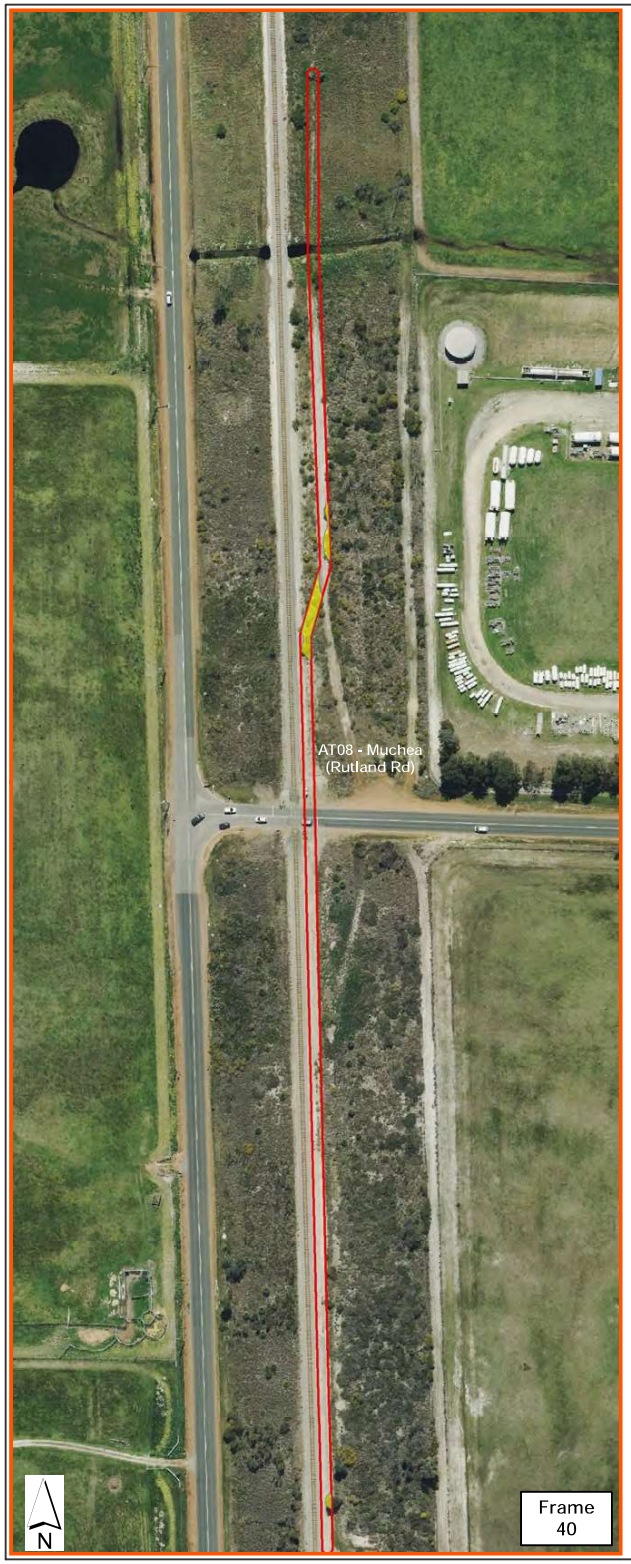

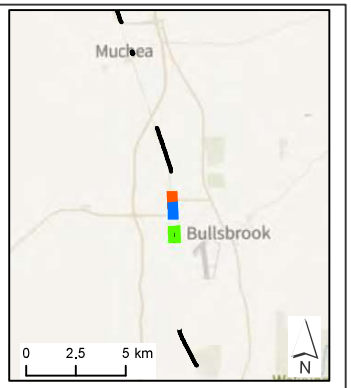

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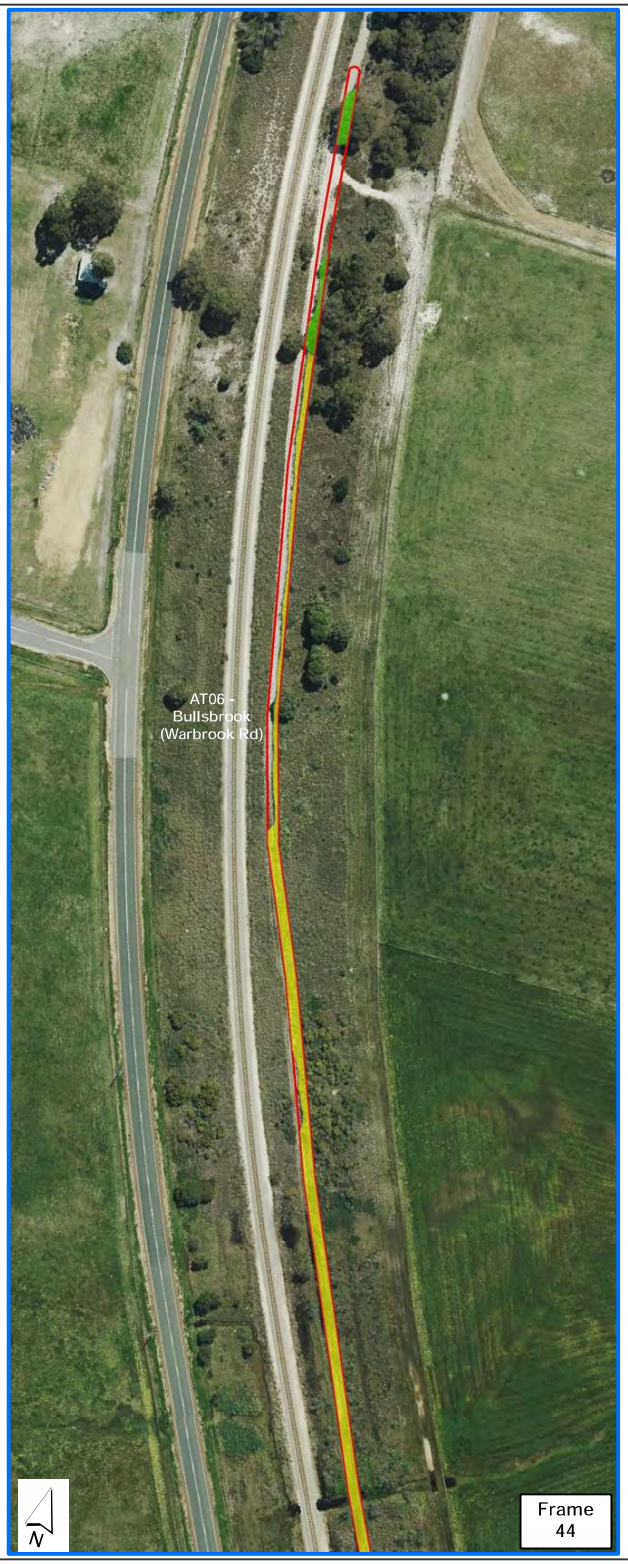

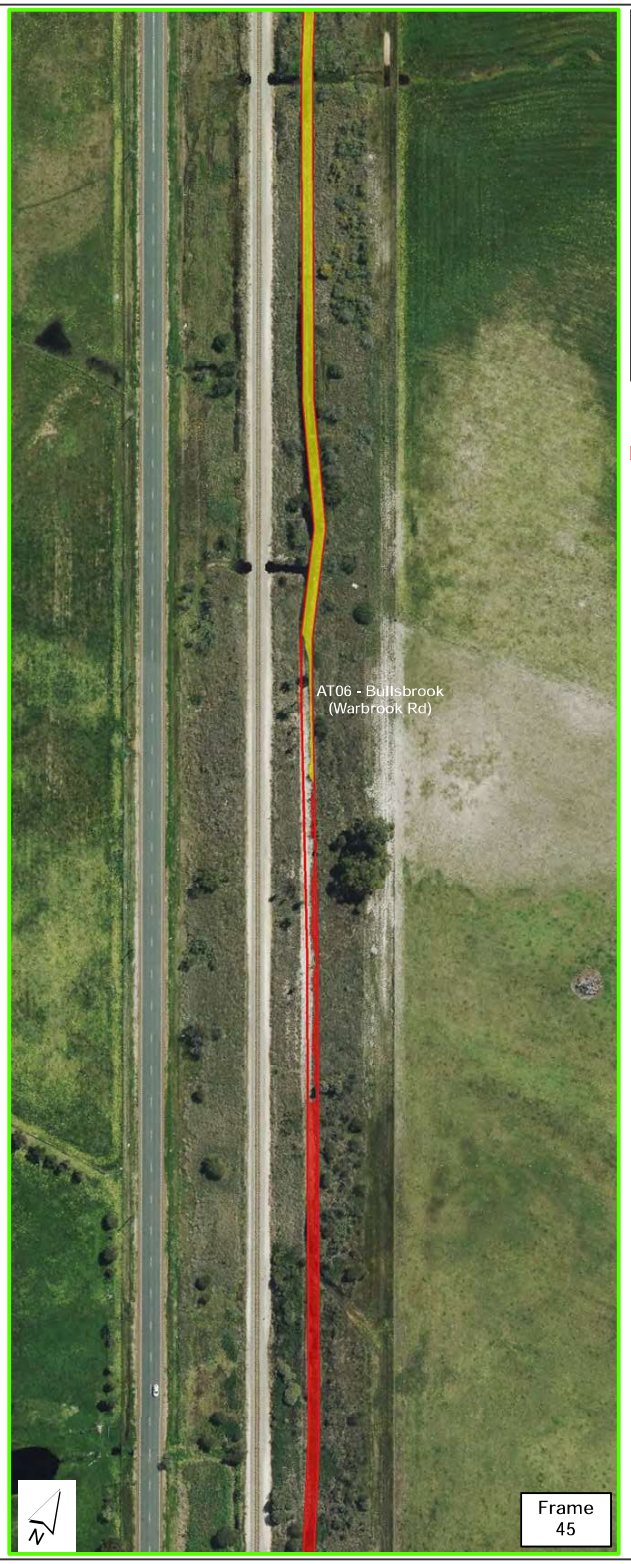

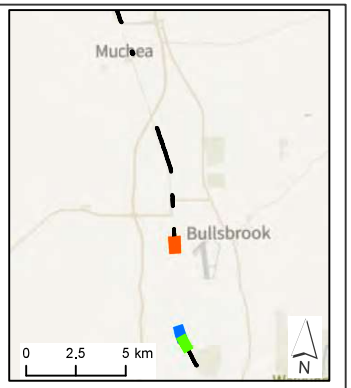

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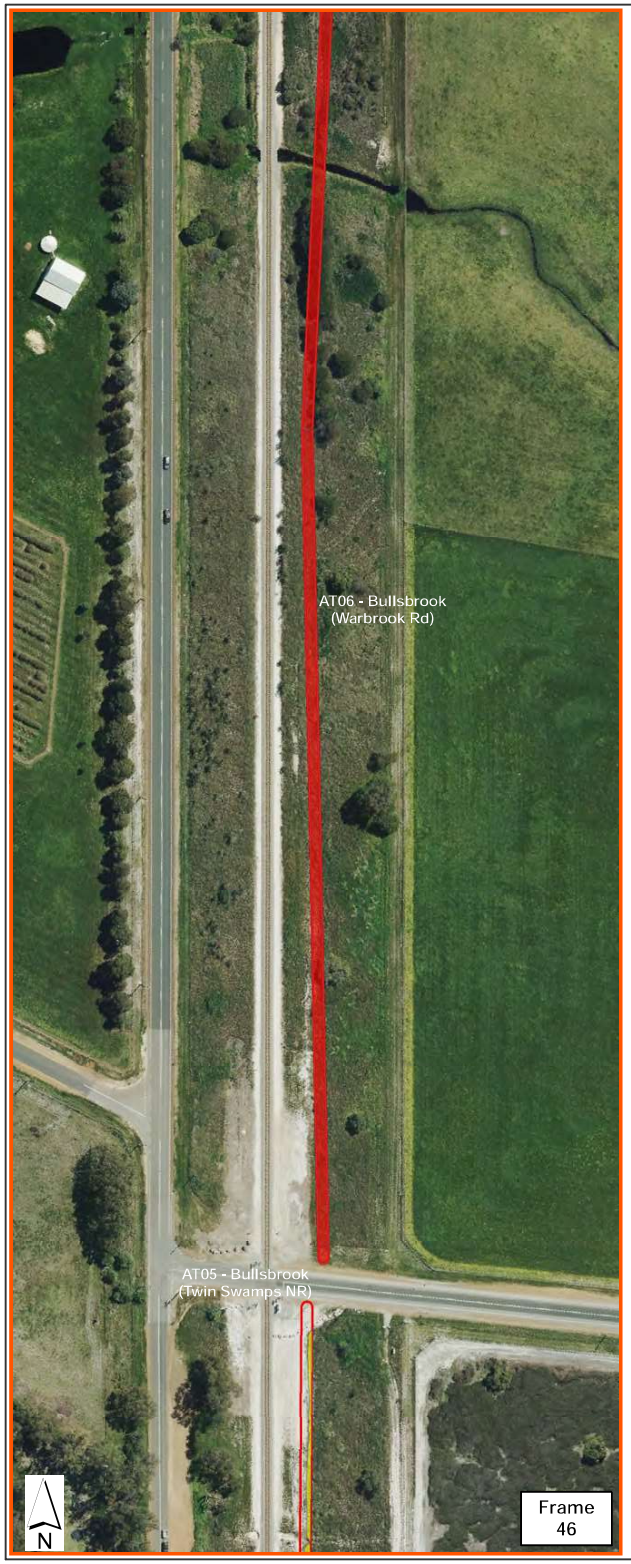

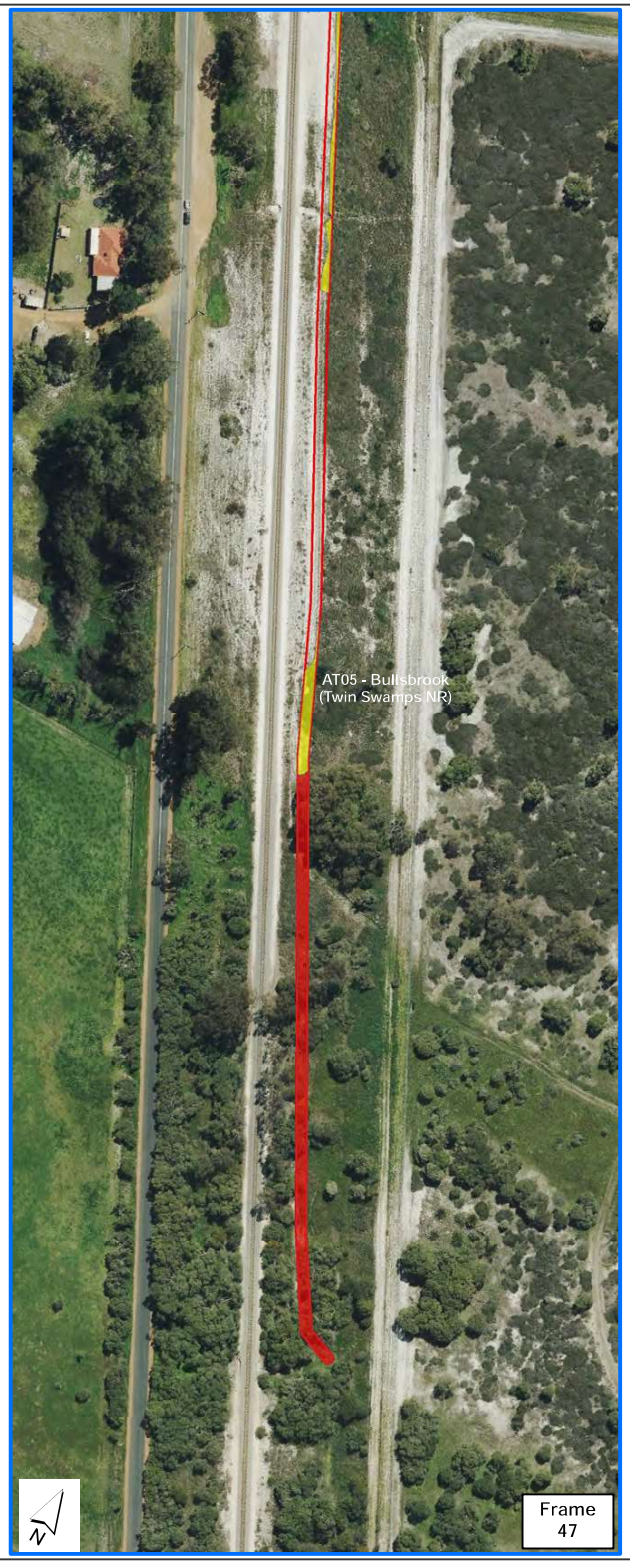

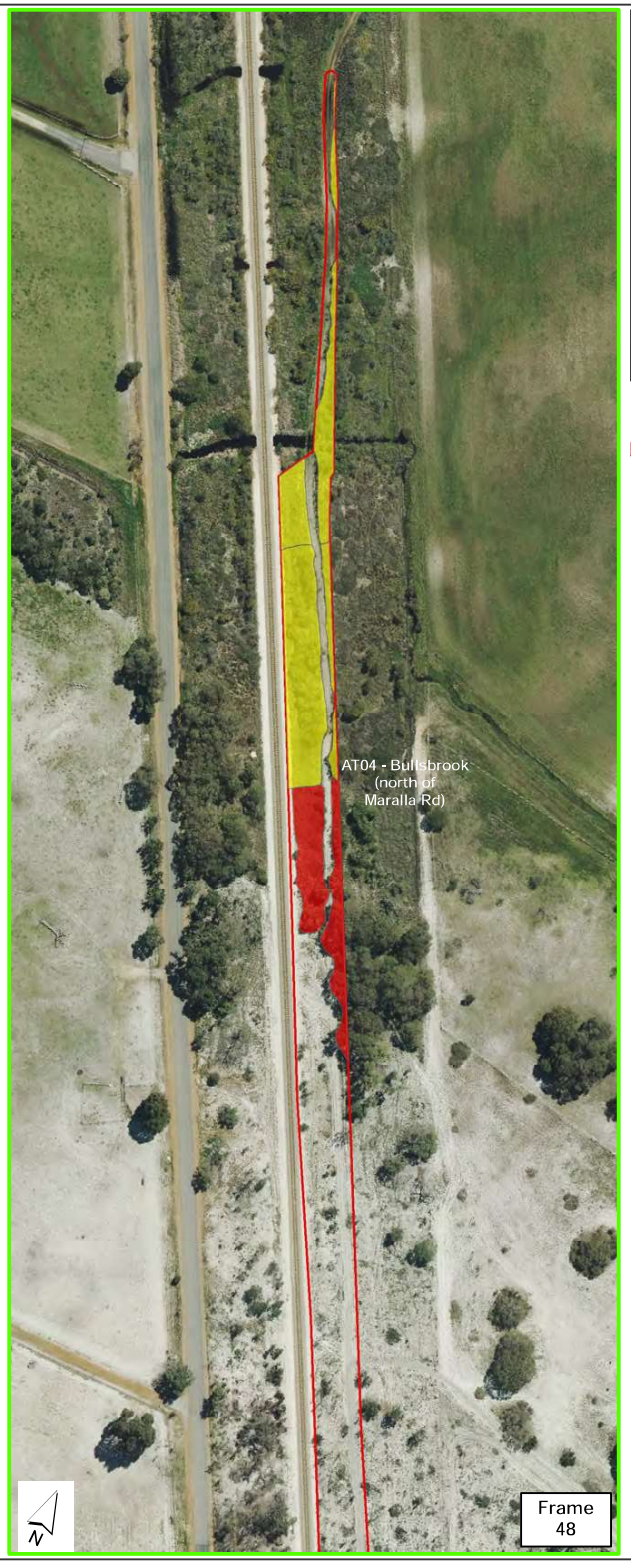

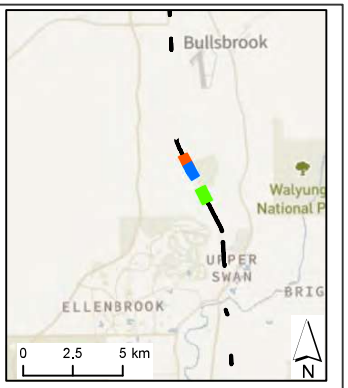

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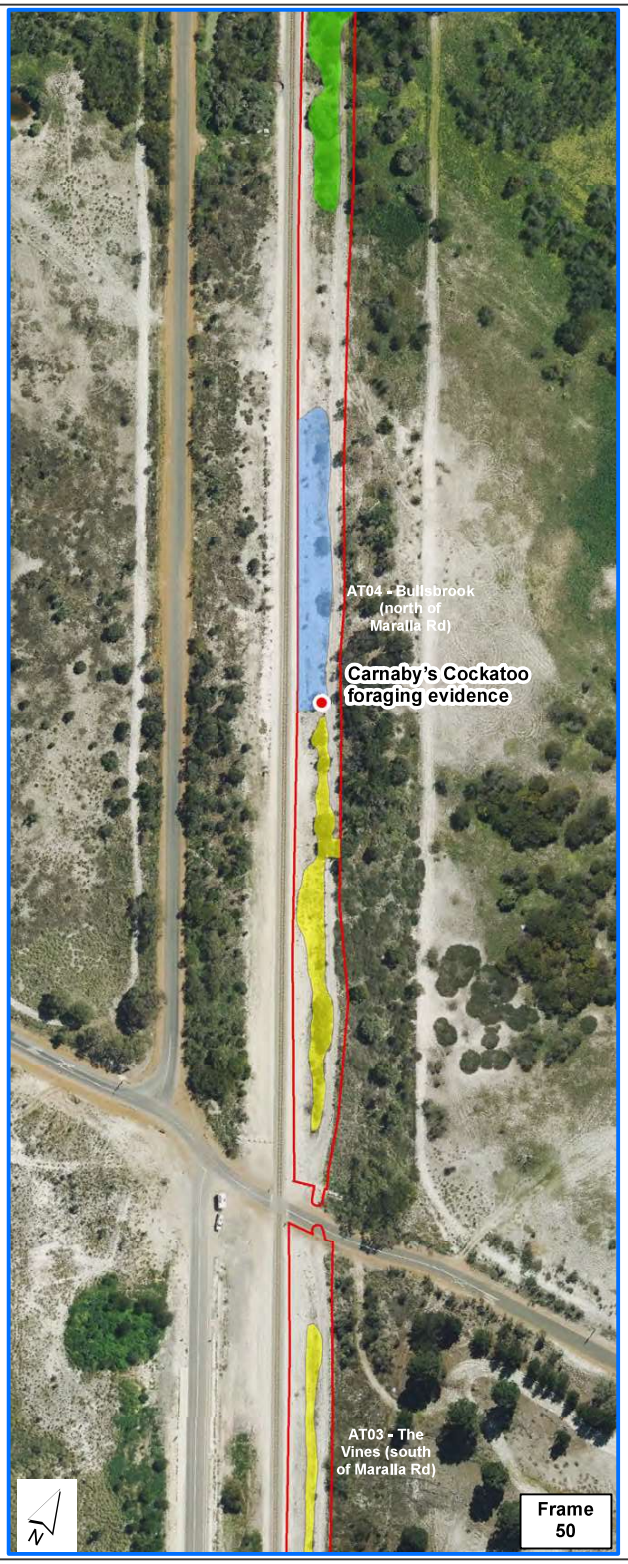

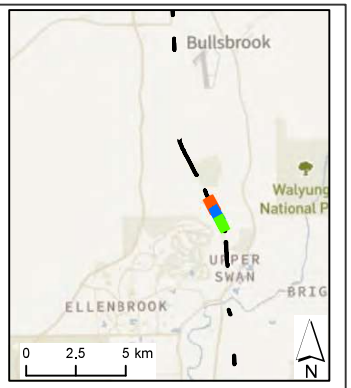

Fauna

Study Area

Foraging evidence locations

- Carnaby's Cockatoo (Calyptorhynchus latirostris) foraging evidence
- Forest Red-tailed Black Cockatoo (Calyptorhynchus banksii naso) foraging evidence

Fauna Habitat

- Banksia woodland
- Marri woodland
- Melaleuca woodland/shrubland
- Mixed shrubland

0 25 50 100
Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19686-RS Date: 2/12/2021

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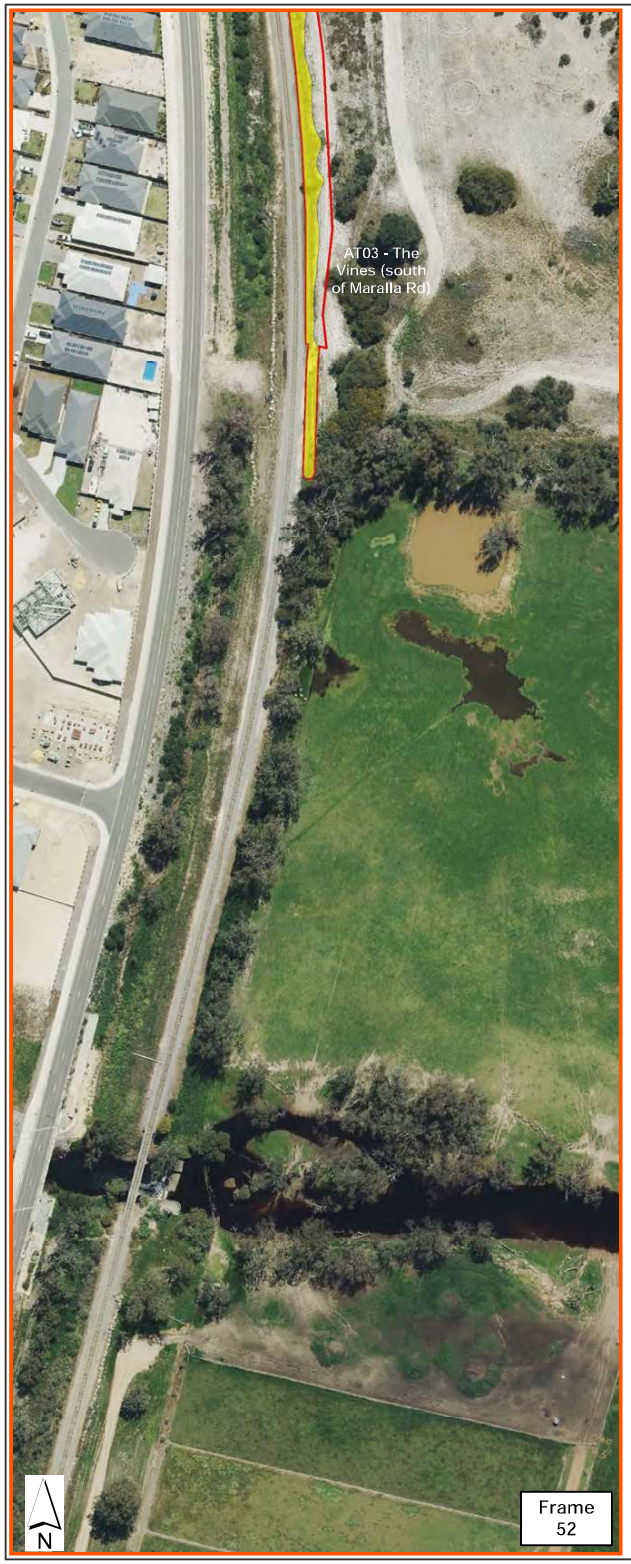

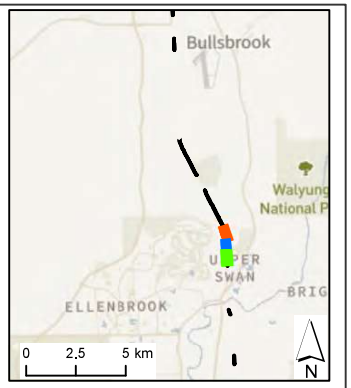

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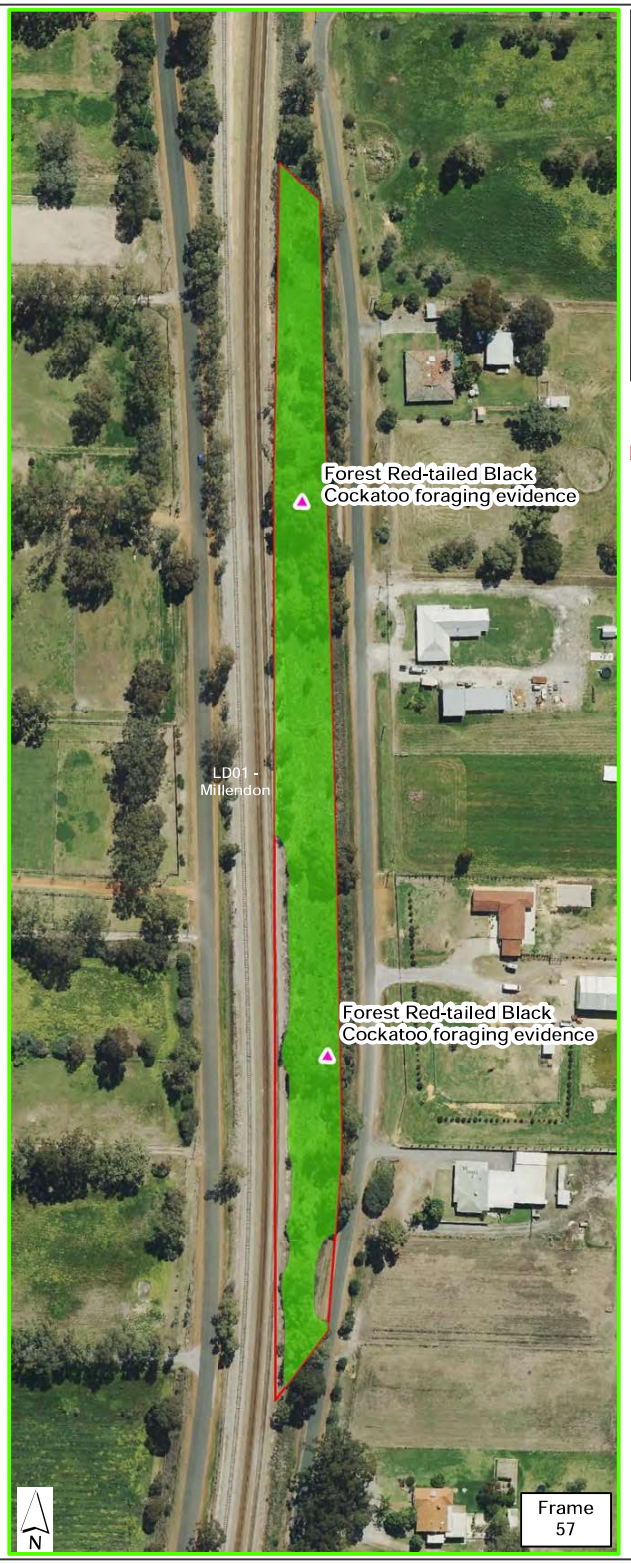

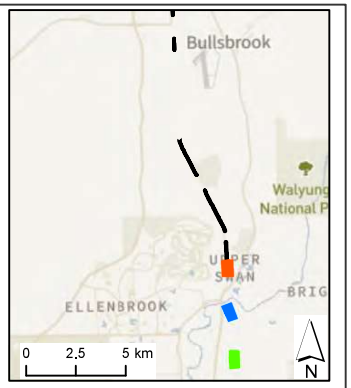

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