1.6.3 Rural

Land to the north, north-east, east and south-east of the LSP site are surrounded by land zoned under the LPS No. 17 for “Landscape”, “Rural Residential” and “Rural” purposes. Bush Forever Site No. 86 is located in the north of the site.

1.6.4 RAAF Base Pearce

RAAF Base Pearce is located adjacent to the township of Bullsbrook.

RAAF Base Pearce’s primary role is pilot training for the Royal Australian Air Force, the Royal Australian Navy and the Republic of Singapore Air Force. It is the home base of:

- No. 2 Flying Training School
- No. 79 Squadron
- No. 25 (City of Perth) Squadron
- Defence Support and Reform Group – Pearce
- No. 453 Squadron Detachment Pearce (Air Traffic Control)
- No. 2 Expeditionary Health Squadron Detachment Pearce
- No. 3 Security Forces Squadron Detachment Pearce
- No. 7 Wing Australian Air Force cadets.

All the aircraft fly within a corridor known as a flight path. The Department of Defence operates Noise and Flight Path Monitoring Systems (NFPMS) to provide the community with information about aircraft noise associated with military operations at RAAF Base Pearce. The Defence Department’s Aircraft Noise Exposure Forecast (ANEF) maps and NFPMS show the entire Bullsbrook landholdings are located outside of the flight corridors noise contours (Figure D). The aircraft noise contours are contained to the western side of the Great Northern Highway.

1.7 Separation distances

Residential land uses are potentially sensitive to emissions from industrial land uses. Separation distances between Industrial and Sensitive Land Uses (EPA 2015) identifies generic separation distances, developed by the EPA, to determine buffers between sensitive land uses and industrial land uses.

1.7.1 Landfill site

The Class 1 inert landfill site was subject to the following DWER approvals:

- Class 1 inert landfill site that can accept a maximum of 200,000 tonnes per year of inert waste
- Crushing of building materials building waste up to 50,000 tonnes per year
- Solid waste depot up to 5,000 tonnes per year.

The landfill site was permanently closed in 2020. The operators of the landfill site are responsible for the remediation of the landfill site.

To date the indicative Bullsbrook residential development staging plan has maintained a 1,000 m separation distance from the landfill site as illustrated in Figure 1 and Figure D. However, with the closure of the landfill site in 2020, the WAPC is concurrently with this amendment LSP advancing the ‘lifting of Urban Deferment’ zoning which will facilitate development within the former 1,000 m separation buffer area.

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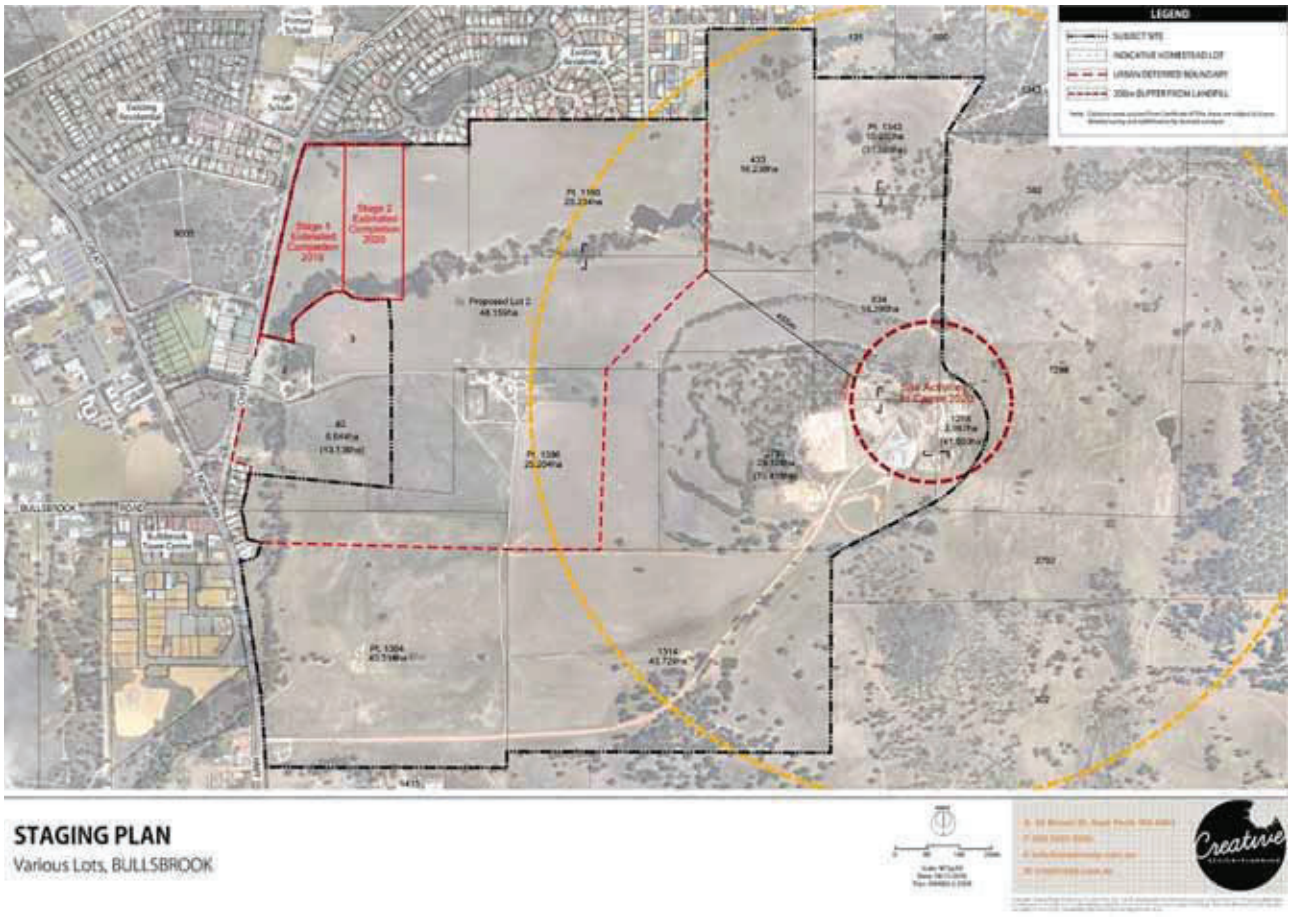


Figure 1: Bullsbrook development indicative staging plan and landfill buffer distance

1.7.2 Nursery

The generic separation distance from a nursery is 100 m (EPA 2015). Figure D shows that the buffer from the Swan Valley Nursery is located over a small portion of Lot 1354.

The generic buffer is primarily based on potential noise impacts. It is noted that since the nursery operations are enclosed within large greenhouse sheds, and is setback from the property boundary by approximately 20 m to 30 m.

Regarding the interface management, the structure plan has located commercial development and the District Open Space adjacent to the nursery site to manage the long-term interface. It should also be noted that land south of the LSP site (including the nursery) has been identified as future residential land in the Bullsbrook master plan.

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2 LEGISLATION AND REGULATION

2.1 Legislation and regulations

Urban development within the site will comply with environmental legislation and regulations. A summary of the key state and Commonwealth legislation and regulations is listed in Table 4.

Table 3: Key state and Commonwealth legislation and regulations

State legislation	
Aboriginal Heritage Act 1972	*Heritage of Western Australia Act 1950*
Conservation and Land Management Act 1984	*Land Administration Act 1997*
Conservation and Land Management Regulations 2002	*Planning and Development Act 2005*
Environmental Protection Act 1986	*Rights in Water and Irrigation Act 1914*
Contaminated Sites Act 2003	*Wildlife Conservation Act 1950*
Environment Protection Regulations 1987	Environmental Protection (Peel Inlet – Harvey Estuary) Policy 1992
Environmental Protection (Noise) Regulations 1997	
Commonwealth legislation	
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	Environment Protection and Biodiversity Conservation Regulations 2000

2.1.1 Applicable guidelines and standards

Development of the site is required to comply with applicable guidelines and standards developed by the EPA. These guidelines and standards assist proponents and the general public to understand the minimum requirements for the protection of elements of the environment that the EPA expects to be met during the assessment process.

Table 4 details the key EPA standards, guidelines and state planning policies relevant to the site.

Table 4: Applicable EPA standards, guidelines and state planning policies

EPA position statements
Position Statement No. 2: Environmental Protection of Native Vegetation in Western Australia
Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection
EPA Environmental Assessment Guidelines
Environmental Assessment Guideline No. 8: Environmental factors and objectives
Environmental Assessment Guideline No. 9: Application of significance framework in the environmental impact assessment process
EPA guidance statements
Guidance Statement No. 33: Environmental Guidelines for Planning and Development
Guidance Statement No. 41: Aboriginal Heritage Assessment
Guidance Statement No. 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia
Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia
State planning policies
State Planning Policy No. 3.7: Planning for Bushfire Risk Management
State Planning Policy 2.4: Basic Raw Materials

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2.2 Relevant planning and environmental policies and guidelines

2.2.1 Draft North-East Sub-regional Planning Framework – towards Perth and Peel@3.5million (WAPC 2015)

The Bullsbrook site is identified as an "Urban Expansion Area" in the Draft North-East Sub-regional Planning Framework (WAPC 2015). This Class of Action provides for existing, new and proposed urban development. This includes residential land uses and associated functions such as employment, education, retail, civic facilities, light industry and open space.

It is noted that the Environmental Protection Authority's (EPA) Interim Strategic Advice on the Perth and Peel@3.5million is supportive of the sub-regional planning framework proposed.

2.2.2 Draft Perth and Peel Green Growth Plan for 3.5 million

Figure 2 illustrates the draft Perth and Peel Green Growth Plan for 3.5 million mapping specifically noting the areas mapped as 'specific commitments" and "broad commitments and values".

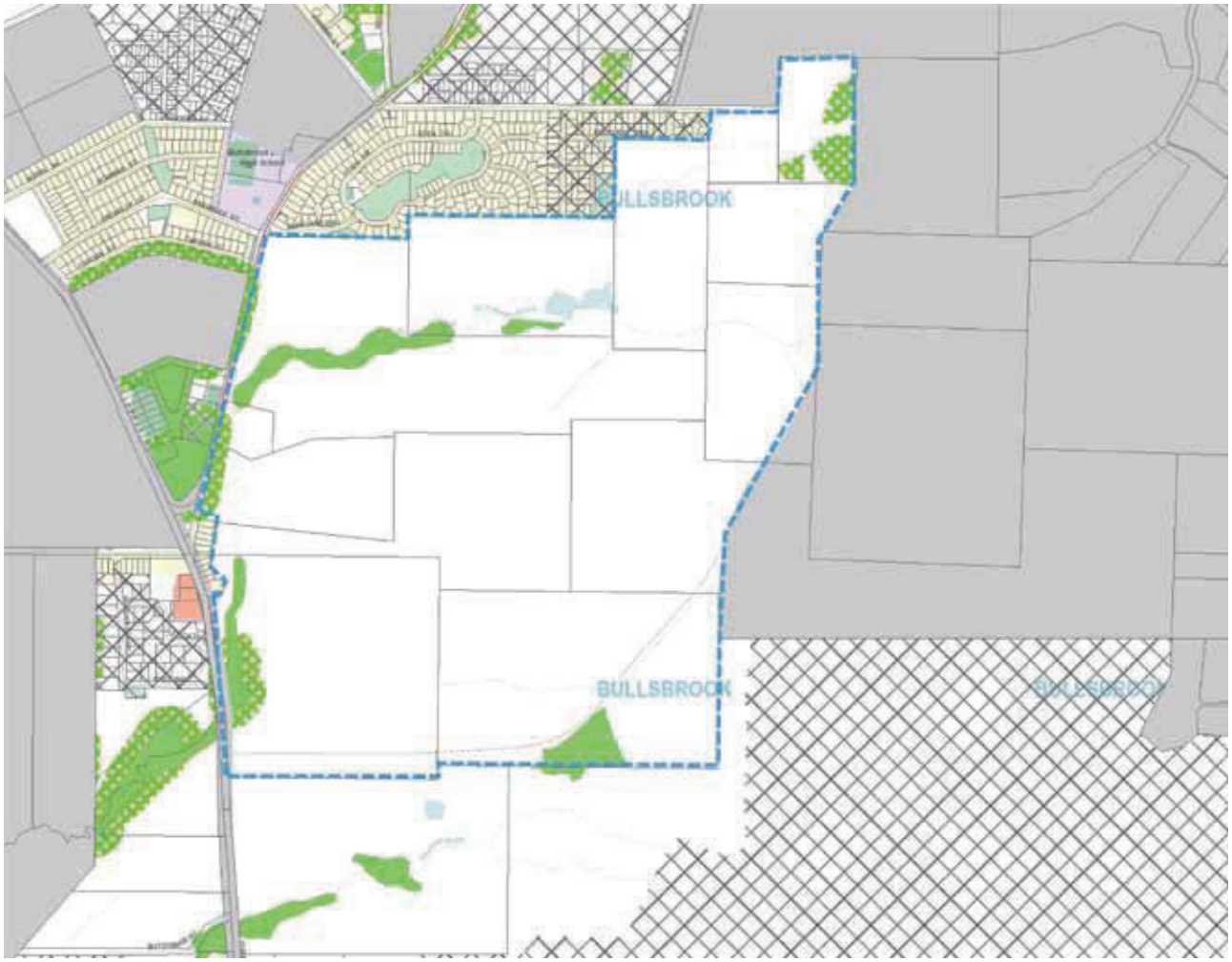


Figure 2: Draft Perth and Peel Green Growth Plan for 3.5 million spatial mapping of the Bullsbrook site

The LSP accommodates the 'specific commitment areas" as defined in the draft Perth and Peel Green Growth Plan for 3.5 million in particular the Ki-It Monger Brook and the stand of Guildford complex native vegetation on the southern boundary. This report outlines the key management measures to be undertaken at subdivision for the Ki-It Monger Brook and the stand of Guildford complex native vegetation.

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2.2.3 State Planning Policy 2.4 (SPP 2.4 Basic Raw Materials)

This policy sets out the matters which are to be considered and given effect to by the WAPC and local governments in considering zoning, subdivision and development applications for extractive industries.

The policy has identified a “basic raw materials key extraction area” within partial Lots 2792, 3 and 834. The Priority Resource Area is approximately 32.6 ha. The location of the “basic raw materials key extraction area” is shown in Figure 3.

Kaolinite clays had been excavated from the Bullsbrook site since 1980, with a void been formed in the southern side of the hill. In 2004, the EPA, the WAPC and the City of Swan approved clay extraction by Midland Brick. The void from the earlier Midland Brick clay excavation is currently being used as a Class 1 inert landfill site.

In 2004, the City of Swan approved an extractive industry licence and the WAPC approved a Development Application at the basic raw material resource location. The EPA assessed the clay excavation proposal in 2004 and determined the proposal to be “Not Assessed – Public Advice Given”.

Clay excavation ceased several years ago, however, geotechnical investigations has delineated a potential deposit of clay to the west. This deposit is within an area of approximately 1.4 ha, which has a significant volume of resource overburden which (if the clay is removed via excavation) will be stockpiled and potentially incorporated in the engineering fill to restore the land surface for future land use.

2.2.4 EPA Bulletin No. 20 (EPB No. 20) Protection of natural areas through planning and development

The Structure Plan will incorporate the objectives outlined in EPA Bulletin No. 20 (EPB No. 20) Protection of natural areas through planning and development (EPA 2013) outlined below.

2.2.4.1 Locate development on cleared land

The structure plan focuses on (in accordance with the master plan and the WAPC’s “Future Urban Expansion Area”) locating the development in historically cleared areas.

2.2.4.2 Minimising fire risk

Minimising development in naturally vegetated areas is highly compatible with minimising the risk of fire and its potential impacts on the community. A fire risk assessment report and management strategy will be undertaken in accordance with the Planning for Bushfire Protection Guidelines (WAPC and FESA 2010).

2.2.4.3 Protect large consolidated naturally vegetated areas

The largest extent of consolidated naturally vegetated areas on the site is located outside of the proposed future development area as outlined in the City’s master plan and the WAPC’s “Future Urban Expansion Area”. These large areas of remnant vegetation are located in the eastern Lots 857 (Bush Forever Site No. 86) and 1343 and along the scarp in Lots 1256, 6 and 1391. The structure plan will identify and plan for the retention of consolidated naturally vegetated areas.

The remnant vegetation along the Ki-It Monger Brook and pockets within the proposed future urban area as outlined in the LSP (Figure B).

2.2.4.4 Ecological linkages

Maintaining the ecological linkages along the Ki-It Monger Brook, which connects with the large naturally vegetated areas in the eastern portion of the site, will be established in the structure plan.

2.2.5 City of Swan Local Biodiversity Strategy

The City of Swan has one of the largest areas of natural environmental in the Perth Metropolitan area. The City in 2015 reviewed and updated its Local Biodiversity Strategy with the following goals:

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> Protection: The Goal is to formalise the long-term preservation of Local Natural Areas. This may be achieved through reservation, conservation covenant or inclusion in a conservation purpose zoning.
> Retention: The Goal is to use a variety of processes available to ensure the retention of natural areas to ensure its continued existence and viability
> (City of Swan 2015)

In relation to the Bullsbrook site, the City's Local Biodiversity Strategy identifies portions (i.e. the CCW and the Ki-It Monger Brook adjacent to the Great Northern Highway) as "Potential Significant Local Natural Areas". The Level 2 Vegetation and Flora Report survey concludes there are significant stands of *Eucalyptus rudis* within the Ki-It Monger Brook.

In accordance with the Local Biodiversity Strategy the vegetation in the Ki-It Monger Brook and the vegetation in the Brook (except for the creek road crossing) will be retained and managed after development, as outlined in the LSP (Figure B).

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3 EXISTING ENVIRONMENT

3.1 Biophysical factors

3.1.1 Topography

The site is located at the foothills of the Darling Scarp and is generally of high relief. The site ranges in elevation from approximately 120 metres Australian Height Datum (m AHD) in the east, where the laterised foothills begin down to approximately 50 m AHD to the south-west, where the relatively flat landscape of the Swan Coastal Plain commences (Figure E).

3.1.2 Environmental geology

Geological mapping (Gozzard 1982) indicates that the site is dominated by three main surficial geological units (Figure F):

- Msg – Silty Sands: The majority of the site is comprised of silty sand (Msg) that is described as strong brown, firm, friable and dispersive in parts. This unit occasionally has pebbly horizons with little matrix containing quartzite, quartz granite and laterite pebbles of colluvium origin.
- Sti – Siltstone: This is located on the eastern section of the site and is identified as white thinly bedded well laminated, fine-grained, with some large ferruginous concretions and laminae, which is occasionally micaeous.
- Mgs1 – Pebbly Silt: The south-western boundary of the site is dominated by pebbly silt associated with the Guildford Formation (Mgs1). This geological unit is described as strong brown silt with occasional coarse grained, laterite, quartz and heavily weathered granite pebbles with some fine to medium-grained quartz sand of alluvial origin.
- GR – Granite: Two small sections of the site on the eastern boundary have been mapped as granite, fine to coarse grained that ranges in composition from granodiorite to granite, with adamellite being the most common.

3.1.2.1 Site investigations

A geotechnical assessment was completed for the site by Galt Geotechnics (2014), which included the excavation of 79 test pits to depths of 0.6 m and 2.5 m as well as permeability testing. The main results from the Geotechnical Investigation include:

- Soil permeability ranged from 0.1 m/day to 6.8 m/day.
- Field tests indicated that there are potential acid sulfate soils (PASS) on the site.
- Galt (2014) identified three broad subsurface condition types including
  - Class S of slightly reactive clays
  - Class A mostly sand and rock
  - Class M of moderately reactive clay sites.

3.1.2.2 Acid sulfate soils

DWER broad-scale acid sulfate soil (ASS) risk mapping is based on surface geology mapping and provides a broad-scale indication of the risk of occurrence of ASS. The site has not been assigned an ASS risk rating and it is assumed there is a “low to no” known risk of ASS occurring within three metres of the natural soil surface (or deeper).

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3.1.3 Hydrology

3.1.3.1 Aquifers

The site is located within the Bandy Spring Sub-area of the Swan Groundwater Area and is managed under the Gnangara Groundwater Areas Allocation Plan (DoW 2009). The Bandy Spring Sub-area contains the Superficial aquifer and Fractured Rock West aquifer. A review of allocation limits identified that the Superficial aquifer was fully allocated. The Fractured Rock West aquifer is not expected to provide significant yields. The confined aquifers of the Swan Confined Groundwater sub-area (Leederville and Yarragadee North aquifers) extend beneath the western section of the site, which are also fully allocated.

Through consultation with Department of Water and Environmental Regulation (DWE) and the City of Swan, it was agreed that groundwater could be abstracted from the Superficial aquifer in the adjacent Cockman Bluff Sub-area and piped across the sub-area boundary to the development site to service its irrigation requirements. To support this, RPS has completed a drilling program and Level 2 Hydrogeological Assessment (RPS 2016).

The site is not located within a Public Drinking Water Source Protection area.

3.1.3.2 Groundwater levels

In September 2015, six monitoring bores (MB-1 to MB-6) were installed across the site. Drilling occurred to a depth of 18 mbgl (apart from MB-4 which was drilled to 11 mbgl). The locations of the bores are shown in Figure G.

During installation, only four of these bores encountered groundwater. At the time of installation, groundwater elevations ranged from approximately 76 m AHD at MW-3 down to approximately 30 m AHD at MB-1 (RPS 2016).

Groundwater levels were monitored from these bores and three other bores on the site (MW-1, MW-2 and MW-3) on two occasions in September and October 2015 and then again in November 2016. MB-3 and MB-4 were dry on all occasions, while the depth to water measured from the other bores ranged from 1.08 mbtoc (MW-1 November 2016) to 17.51 mbtoc (MB-1 November 2016). Groundwater levels monitored from the bores ranged from 30.49 m AHD (MB-1 November 2016) to 77.89 m AHD (MW-3 November 2016). Groundwater contours have been generated from the October monitoring event, ranging from 75 m AHD to 30 m AHD, as illustrated on Figure G.

3.1.3.3 Groundwater quality

Physico-chemical parameters were measured in the field as part of the three groundwater monitoring events, and samples were collected and sent to a NATA accredited laboratory to be analysed for a suite of nutrients as part of the September 2015 and November 2016 monitoring events.

pH ranged from acidic to slightly acidic, while uncompensated electrical conductivity ranged from 138 µS/cm (MW-2) to 2060 µS/cm (MB-1). Nutrient concentrations were found to be elevated, in particular total nitrogen (TN) and total phosphorus (TP). TN results ranged from below the laboratory limit of reporting (LoR) (MB-2) to 5.8 mg/L (MW-2), while TP results ranged from 0.03 mg/L (MW-1) to 17 mg/L (MB-1). Nine of the 12 groundwater samples had TN and TP concentrations above the ANZECC (2000) guidelines for lowland rivers in south-west Australia and eight of the TP results were also above the WQIP long term targets. Some of the results for NOx, NH4 and filterable reactive phosphorus were also above the ANZECC guidelines.

3.1.3.4 Surface water

The main hydrological feature of the site is the Ki-It Monger Brook, which flows east to west across the northern part of the site. It then runs along the south side of the site, before crossing under Great Northern Highway at the site's south-west corner, until it confluences with Ellen Brook approximately 2.3 km south-west of the site. A number of smaller drainage tributaries contribute to the Ki-It Monger Brook including a minor unnamed drainage course that traverses the southern section of the site and discharges into Ki-It Monger Brook near the site's south-west corner. The pre-development surface water features are illustrated in Figure H.

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The Ki-It Monger Brook has been considerably modified including the construction of dams and installation of culverts on the site which restrict flows, as well as the clearing of riparian vegetation. In particular, a major dam located in the centre of the site has a major impact on flows downstream, as flows only occur once the water level reaches the height of the culverts installed in the dam wall (RPS 2013a). The location of the dams and culverts installed across the area is shown in Figure 3.



Figure 3: Dam and culvert locations across the site

3.1.3.5 Flood levels of the Ki-It Monger Brook

RPS completed hydrological and hydraulic modelling to determine the flood levels and extent during a 1:100 Average Exceedance Probability (AEP) flood event of the Ki-It Monger Brook. The modelling identified that the 1% AEP flood was largely confined to the existing channel as shown in Figure I. Finished lot levels will be at least 0.5 m above the 1% AEP flood level of the Ki-It Monger Brook.

3.1.3.6 Ki-It Monger Brook foreshore area

As part of the District Water Management Strategy prepared for the site, the DWER highlighted the requirement for a desktop and on-site biophysical assessment and justification of the foreshore of the Ki-It Monger Brook in a foreshore area report. The foreshore area is defined as the land that adjoins or directly influences a waterway, the area of transition between the edge of the waterway and the furthest extent of riparian vegetation.

The determination of the Ki-It Monger Brook foreshore and buffer was based on the following:

5. Biophysical assessment which included:
    a. The CCW area of the Ki-It Monger Brook
    b. Remnant riparian vegetation (Level 2 vegetation and flora survey)
    c. Any valuable habitat areas
    d. Soil types, including identifying any soil types that historically may have supported riparian vegetation and erosion risk

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e. Heritage

6. Ki-It Monger Brook bank survey and site assessment
7. Stormwater flood modelling
8. Review of current and proposed land uses promoted in the LSP.

The foreshore assessment was also undertaken in accordance with Operational Policy 4.3: Identifying and establishing waterways foreshore areas (DoW 2012) and Determining Foreshore Reserves (Water and Rivers Commission 2001).

Table 5 summarises the findings of the foreshore and buffer assessment. Further details on the foreshore assessment are provided in the Bullsbrook LWMS.

Table 5: Foreshore assessment for the Ki-It Monger Brook

Biophysical criteria	Site considerations
Topography and landform	Ki-It Monger Brook has a strongly defined drainage channel. The topography of the site grades down towards the creekline on both sides of the Ki-It Monger Brook, as shown on Figure E. The elevation of the sites ranges from approximately 120 m AHD in the east to 50 m AHD in the south-west.
Soils	Environmental geology mapping (REF) has identified the majority of the Ki-It Monger Brook within the site to be underlain by silty sands (Msg), with the south western section of Ki-It Monger Brook underlain by pebbly silt (Mgs1) (Figure F). The definitions of these units are: • Msg – Silty Sands – is described as strong brown, firm, friable and dispersive in parts. This unit occasionally has pebbly horizons with little matrix containing quartzite, quartz granite and laterite pebbles of colluvium origin. • Mgs1 – Pebbly Silt – associated with the Guildford Formation. This geological unit is described as strong brown silt with occasional coarse grained, laterite, quartz and heavily weathered granite pebbles with some fine to medium-grained quartz sand of alluvial origin.
Floodway and flood plain	RPS has identified that the flooding for the 1% AEP is fully confined to the existing channel of the brook for most of the site, except for near the major dam. The area of flooding in the 1% AEP event for the Ki-It Monger Brook is shown in Figure I.
Riparian vegetation	The majority of the Guildford Complex is associated with the Ki-It Monger Brook. The remnant trees within the Ki-It Monger Brook will be retained through the establishment of the foreshore area, drainage retention and open space areas. A two-phase, Level 2 flora and vegetation assessment of the Bullsbrook site was conducted by Ecologia (2016). This survey identified the remnant riparian vegetation of Ki-It Monger Brook to be: • Er1: *Eucalyptus rudis* subsp. *rudis* low open forest, over mixed weed species dominated by **Avena barbata, *Lolium rigidum* and *Oxalis per-caprae* and other common species included *Corymbia calophylla, Gomphocarpus fruticosus, *Solanum linnaenum, *Brixa maxima, *Moraea flaccida* (Figure J). This vegetation unit was identified to be in a “Degraded” condition (on the Bush Forever scale), supporting no or very few native understorey plants, litter, high grazing levels and dominated by weeds (Figure L).
Habitat areas	The vegetation immediately outside of the creek channel has been historically cleared of native vegetation and the land used for agricultural purposes, and therefore does not provide significant habitat values. During the desktop search, no significant flora species were recorded or identified likely to occur along the creekline. During the site survey no *Commonwealth Environment Protection and Biodiversity Conservation (EPBC) 1999 Act* listed or *Wildlife Conservation Act 1950* listed Threatened flora, Priority flora or other flora species of significance were recorded in the study area, and thus Ki-It Monger Brook within the site boundary has not been identified to be required for the survival of such species.
Adjacent land use pressures	Residential housing is proposed to be developed around the foreshore reserve. Roads will be constructed to the north and south of the foreshore reserve as part of the development. Drainage basins will be installed in the POS surrounding the foreshore.
Heritage	A search of the Department of Aboriginal Affairs (DAA) Aboriginal Heritage Inquiry System (AHIS) database identified one registered site (AHIS ID 3525), which covers the extent of the site, in addition to one other heritage place, 22669 Bullya Spring, which is associated with mythological, natural features and as a water source. This heritage place is not located on the Ki-It Monger Brook (Figure N). A suitably qualified cultural heritage consultant will be appointed to investigate the extent of the site and undertake a cultural assessment of the mythological site.

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Biophysical criteria	Site considerations
Recreational amenity	Until recently, the site was used for grazing, with full animal access into the brook, with no public access. The LSP proposes to align areas of Public Open Space (which will be landscaped and used for drainage, pathways and recreational amenity, i.e. built form structure such as playgrounds, barbecue) adjacent to the core creek area. The Public Open Space areas and core creek area is shown in LSP – Figure B

3.1.3.7 Ki-It Monger Brook foreshore area definition

The foreshore area is defined as the land that adjoins or directly influences a waterway, the area of transition between the edge of the waterway and the furthest extent of riparian vegetation.

Based on the current biophysical condition of Ki-It Monger Brook within the site boundary, it is proposed to retain the foreshore area to the extent of the banks of the Ki-It Monger Brook for the majority of the site.

The width of the foreshore area will vary along its extent and at its widest points will be up to approximately 120 m associated with the major dam that will be retained on site, and the narrowest point will be approximately 10 m, incorporating both sides of the bank.

The proposed foreshore area has been overlaid on each of the figures attached at the rear of this report, to show that the proposed foreshore area contains (Figure I):

- All remnant riparian vegetation
- All habitat areas and landforms associated with Ki-It Monger Brook including the CCW UFI 12681 and the existing dams
- Flooding from the 1% AEP event.

The physical demarcation between Ki-It Monger Brook foreshore area and other areas of the development will include roads, dual use paths and fencing, in accordance with an approved Landscape Master Plan.

The proposed realignment of a portion of Chittering Road is within an existing (and cleared) road reserve and at the location of historically installed culverts.

3.1.3.8 Southern drainage line

There is an unnamed artificial agricultural drain that traverses the southern section of the site (Figure I). This mapped drainage line flows south from the major dam near the clay extraction site to two smaller dams, at which point the drainage line traverses west until it reaches Lot 1354. For minor storm events this drainage line then runs south, parallel to the gravel road through a small culvert under the access road for the clay extraction and landfill site and discharges to a dam south of the site boundary. Pre-development flood modelling undertaken using XPSWMM identified that in major events, this drainage line is likely to have insufficient capacity and be overtopped, resulting in sheet flow in a south-westerly direction over Lot 1354. This uncontrolled flow is likely to then be intercepted a small drain alongside the landfill access road, which flows into the neighbouring lot to the south via a culvert under the access road. As such, the agricultural drain does not form a tributary to the Ki-It Monger Brook. Further details of the pre-development flood modelling are included in the LWMS.

With the majority of the constructed agricultural drain being cleared of native vegetation, it has no or very limited ecological value. The Level 2 vegetation and flora survey mapped this agricultural drain area as being in a “completely degraded” condition (Ecologia 2016). There is no associated riparian vegetation, with only scattered marri (*Corymbia calophylla*) within an agricultural paddock. The LSP seeks to retain these marri trees, where practical, within road reserves.

Test pitting undertaken as part of the geotechnical investigation did not identify the soil type along this drainage line to be associated with a waterway and was consistent with other test pits. The section of the drainage line that runs across Lot 1314 is quite eroded.

Due to this drainage line being a constructed agricultural drain which is not a tributary of the Ki-It Monger Brook, the post-development drainage plan for this is to be a piped drainage system to open space areas, with bio-retention areas retaining and treating runoff from the first 15 mm rainfall event. Overland flow paths across Lot 1354 will be maintained utilising the road reserve.

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3.1.4 Wetlands

Hill et al. (1996) categorised wetlands occurring on the Swan Coastal Plain into levels of protection and management categories. Three management categories are recognised and are described below:

- Conservation Category Wetlands – are the highest priority wetlands that support high levels of attributes and functions and account for approximately 20 per cent of the wetlands. The management objectives are to preserve and protect existing conservation values.
- Resource Enhancement Wetlands – have been partly modified but still support substantial functions and attributes and the objective is to manage, restore and protect towards improving their conservation value.
- Multiple Use Wetlands – have few important ecological attributes and functions remaining and the use, development and management should be considered in the context of ecologically sustainable development. About 72% of wetlands have been degraded to the extent that they are not a priority for conservation.

There are two wetlands that occur within sections of the Ki-It Monger Brook; one is classified as a Conservation Category Wetland (CCW) (UFI 12681) and one is a Multiple Use Wetland which is likely to have few important ecological attributes and functions remaining (Figure H).

A botanical assessment was conducted detailing the spatial extent and characteristics of the wetlands within the Bullsbrook LSP site, in particular the CCW section of the Ki-It Monger Brook. Three relevés were sampled within the Conservation Category section, three were sampled in the Multiple Use section, and seven were sampled in areas along the Ki-It Monger Brook that have not been classified as wetland.

Ki-It Monger Brook occurs on the flat/plain for the majority of its length and extends into the drainage valley slopes in between the hills to the east. It is mapped as vegetation unit Er1: *Eucalyptus rudis* subsp*. rudis* low open forest over mixed *weed species dominated by **Avena barbata, *Lolium rigidum* and *Oxalis pes-caprae* other common species include *Corymbia calophylla, *Gomphocarpus fruticosus, *Solanum linnaeanum, *Briza maxima, *Moraea flaccida*.

There were no significant flora species recorded or likely to occur along Ki-It Monger Brook.

Both the CCW and MU wetlands within Ki-It Monger Brook had vegetation condition rated as “Degraded” with no or scattered native understorey plants, litter, high grazing levels and dominated by weeds (Plate 4 and Plate 5).

There were no differences in vegetation type, floristic composition, condition or values in the CCW section of the Ki-It Monger Brook, the Multiple Use section or the unclassified section.



Plate 4: Existing CCW environment

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Plate 5: Great Northern Highway culvert within the CCW

3.1.5 Vegetation

3.1.5.1 Regional vegetation

At a regional level, the majority of the remnant vegetation in the site is mapped as being the Guildford Complex, with small areas of Darling Scarp Complex and the Forrestfield Complex (Figure J). Descriptions of these vegetation complexes are summarised below:

- The Guildford Complex is described as a mixture of open forest to tall open forest of *Corymbia calophylla–Eucalyptus wandoo–E. marginata* and *woodland of E. Wandoo* (with rare occurrences of *E. Lane-poolei*). Minor components include *E. Rudis–Melaleuca rhaphiophylla*.
- The Forrestfield Complex is dominated by open forest of *C. Calophylla–E. Wandoo–E. Marginata* (on the heavier soils) to open forest of *E. Marginata–C. Calophylla, Allocasuarina fraseriana–Banksia* spp. (on the sandier soils). Fringing woodland of *E. Rudis* and *Melaleuca rhaphiophylla* are in gullies and watercourses.
- Darling Scarp Complex vegetation ranges from a low open woodland to lichens according to the depth of the soil. Woodland components chiefly *E. Wandoo,* with *E. laeliae* in the north, *E. haematoxylon* in the south, and *C. Calophylla* throughout the region.

Table 6 identifies the extent of these vegetation complexes remaining upon the Swan Coastal Plain / Perth Metropolitan Region and within the site.

Table 6: Native vegetation extents across the site

Vegetation complex	Swan Coastal Plain/Perth Metropolitan region (IBRA)		Remaining extent (ha)
	Original Pre-European extent (ha/%)	Remaining extent (ha/%)	Bullsbrook site boundary
Guildford	92,340 ha (100%)	4,936 ha (5.3%)	9.6
Forrestfield	21,210 (100%)	2,448 (11.5%)	0.05
Darling Scarp	35,512 (100%)	14,649 (41.3%)	64.8

Source: Perth and Peel@3.5million (EPA 2015)

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Coloured cells indicate vegetation complexes with approximately less than 10% of the original (pre-European) extent remaining (purple), less than 30% remaining (orange) and over 30% remaining (green). The 10% and 30% ecological thresholds are defined in national and state policies on native vegetation protection and biodiversity conservation (EPA, 2008; EPA, 2000).

The majority of the Guildford Complex is associated with the Ki-It Monger Brook. The remnant trees within the Ki-It Monger Brook will be retained through the establishment of setbacks, drainage retention and open space areas. The estimated 100-year ARI flood plain mapping provides the basis for development setbacks from the Ki-It Monger Brook and establishes the foreshore buffer area in accordance with the DWER Operational Policy 4.3: Identifying and establishing waterways foreshore areas (DoW 2012). This effectively ensures the trees in Kit-it Monger Brook are retained.

The remnant Guildford Complex is also located on the southern boundary of Lot 1314 will be retained through the LSP and managed through the subdivision and development process (Figure M).

3.1.5.2 Threatened ecological communities

No threatened ecological communities (TECs) have been identified within the Bullsbrook LSP site.

3.1.5.3 Remnant vegetation

A two-phase, Level 2 flora and vegetation assessment of the Bullsbrook site was conducted by Ecologia. A total of six quadrats and 27 relevés were sampled floristically. In addition, traverses to target flora of conservation significance, introduced flora and to provide opportunistic collections of taxa not recorded within the quadrats were conducted. A summary of the vegetation complexes is provided below.

The level 2 Bullsbrook Project Flora and Vegetation Assessment Report (Ecologia 2016) is provided in Appendix 1.

Seven vegetation units were mapped in the larger Bullsbrook site (Figure K). The five vegetation units were associated with the agricultural land use and were either rated as either “Completely Degraded” (Unit Ab) or “Degraded” (Units CcAp, Er1, Er2 and EwCc):

- Ab (mixed weed species): Recorded in the areas which have been cleared for agriculture on the flats and lower hill slopes and mapped as 293.6 ha or 60.9% of the entire Bullsbrook site.
- Ccap (*Corymbia calophylla* low woodland, over +/- *Acacia pulchella* sparse low shrubland, over mixed weed species): Recorded on the hill tops and mid slopes which have not been completely cleared and mapped as 41.6 ha or 8.6% of the of the entire Bullsbrook site.
- Er1 (*Eucalyptus rudis* subsp. *Rudis* low open forest, over mixed weed species): Recorded along the Kit-Monger Brook and the drainage valley slopes in between the hills to the east of the project area and was mapped as 37.0 ha or 7.7% of the entire Bullsbrook site.
- Er2 (*Eucalyptus rudis* subsp. *Rudis* low open forest, over mixed weed species): Recorded as the strip of trees planted for stabilisation, rather than along the Ki-It Monger Brook and was therefore separated from Er1 and mapped as 4.2 ha or 0.9% of the entire Bullsbrook site.
- Ewcc (+/- *Eucalyptus wandoo* subsp. *Wandoo* and *Corymbia calophylla* open low woodland, over isolated **Solanum linnaeanum* mid-shrubs, over mixed weed species): Recorded on the mostly cleared hill slopes towards the eastern slopes and mapped as 17.4 ha or 3.6% of the entire Bullsbrook site. Note this vegetation complex is outside of the site.

Two units were classified as being in “Excellent” condition with disturbances limited to low density non-invasive weeds and common vehicle/animal tracks. These vegetation units are outside of the LSP and are not proposed to be the subject of future development.

3.1.5.4 Vegetation condition

The site has been used for agricultural purposes and the majority of the land has been classified as “Completely Degraded” (Ecologia, 2016). Stands of remnant vegetation and remnant vegetation associated with Ki-It Monger Brook have been classified as “Degraded”.

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The only vegetation in “Excellent Condition” is located outside of areas identified for future urban development (Figure L).

3.1.6 Flora

3.1.6.1 Priority flora species

A total of 102 vascular plant taxa were recorded from the study area. Of these, 44 (43.1%) are native and 58 (56.9%) are introduced species. No *Commonwealth Environment Protection and Biodiversity Conservation (EPBC) 1999 Act* listed or *Wildlife Conservation Act 1950* listed Threatened flora, Priority flora or other flora species of significance were recorded in the study area.

The literature review identified one Threatened flora taxon, *Acacia anomala* that has previously been recorded at three locations within the north-eastern portion of the Bullsbrook site (i.e. in Bush Forever Site No. 86). Based on historical land use, vegetation units mapped and condition, this species is considered likely to occur within the Bush Forever area in the east but not within the LSP site.

There were 60 weed species recorded, one of which is a Weed of National Significance (WONS) (*Asparagus asparagoides*) and one is a Declared Plant (*Zantedeschia aethiopica*).

3.1.7 Bush Forever Site No. 86

A dedicated 43 ha Bush Forever site occurs on the northern site boundary (within Lot 857). The Bush Forever site conserves regionally significant vegetation and fauna habitat including black cockatoo foraging and roosting habitat.

The vegetation includes *Eucalyptus accedens, E wandoo woodlands, Eucalyptus accedens, E wandoo, C. calophylla* and *E. marginata* Open Forest to woodland with *Allocasuarina humilis* and *Calytrix angulata* (Government of Western Australia 2000).

Figure J illustrates the location of Bush Forever Site No. 86.

Bush Forever Site No. 86 also provides an ecological link for remnant jarrah and marri vegetation within the adjacent Lot 1343 and the eastern scarp, Lots 1256 and 1391. This provides a significant fauna consolidated habitat and linkage. The Bush Forever site and remnant vegetation areas on the eastern scarp are outside of the LSP area and the City of Swan’s Bullsbrook Townsite Expansion Master Plan area.

3.2 Fauna

3.2.1 Habitat

The LSP site area exhibits a high level of disturbance from historic clearing of native vegetation and mostly comprises cleared agricultural paddocks (Figure A). Consequently, it is highly unlikely that these areas provide suitable habitat for significant fauna species.

Potential habitat that does remain within the site includes intermittent remnant native vegetation along the Ki-It Monger Brook, which has some habitat value for native fauna species. The creekline also allows for the movement of native fauna from the western portion of the site to areas of larger remnant vegetation to the east.

The remnant vegetation associated with Ki-It Monger Brook will be retained.

Consequently, through retention of Bush Forever Site No. 86 and vegetation within Ki-It Monger Brook, the majority of the limited existing habitat within the site will be retained (Figure L).

3.2.2 Significant fauna species

The Commonwealth Department of the Environment (DotE) website for matters of National Environmental Significance (NES) protected under the EPBC Act indicates a number of listed fauna species that may potentially utilise this habitat.

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Based on the fauna habitats remaining within the LSP site, the key species that could potentially be impacted through development of the site are listed below:

- Scattered stands, or individual *Eucalyptus rudis* trees within the creeklines
  - Forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*)
  - Carnaby's black cockatoo (*Calyptorhynchus latirostris*)
  - Baudin's black cockatoo (*Calyptorhynchus baudinii*)
- The banks of the seasonal creekline may support the following migratory bird species
  - Rainbow bee-eater (*Merops ornatus*) – migratory.

The proposed management and use of the Ki-It Monger Brook and water features on the site (dams) will replicate the pre-development conditions associated with both surface and groundwater availability to the existing vegetation. Therefore avifauna, in particular rainbow bee-eaters, can continue to utilise the brook area and the surrounding buffer after seasonal rain events.

Potential habitat on the site for black cockatoo species comprises poor foraging quality *Eucalyptus rudis* trees within the creekline and the occasional marri tree. These trees will be preserved in the Ki-It Monger Brook. As outlined previously, the location of the proposed brook / creek crossings (for road connections) will be selected to minimise the impacts to the existing mature trees within the brook.

Further fauna habitat on site, outside of the proposed future development areas, has been retained as Bush Forever Site No. 86, which links to large areas of remnant jarrah and marri vegetation within the adjacent Lot 1343 and the eastern scarp, Lots 1256 and 1391. This habitat comprises more intact vegetation structure and potentially provides fauna habitat for the Carnaby's black cockatoo (*Calyptorhynchus latirostris*) and Baudin's black cockatoo (*Calyptorhynchus baudinii*).

Future local structure planning for the site will respond to the objectives outlined in EPA Bulletin No. 20 (EPB No. 20) – Protection of natural areas through planning and development (EPA 2013).

3.3 Potential contamination

The DWER's Contaminated Sites Database indicated that no registered contaminated sites were recorded within the site or lands immediately surrounding the site.

3.3.1 Landfill

An operational landfill licensed by the DWER is located on Lot 2792 (Figure D).

The long-term land use as identified in the City of Swan's Bullsbrook Townsite Expansion Master Plan is for the landfill site to be rehabilitated for sequential land use in accordance with the LSP and future subdivision approvals. This sequential land use is promoted by the DWER in Best Practice Environmental Management Draft Sitting, Design, Operation and Rehabilitation of Landfills (DoE 2005).

The landfill permanently ceased operations in 2020, the landfill is now being rehabilitated, by the landfill operators, in accordance with DWER requirements.

3.4 Social surroundings

3.4.1 Heritage

3.4.1.1 Aboriginal heritage

A search of the Department of Aboriginal Affairs (DAA) Aboriginal Heritage Inquiry System (AHIS) database identified one registered Aboriginal site of mythological significance (AHIS ID 3583) in addition to eight heritage places (Figure N, Appendix 2).

Mythological site AHIS ID 3583 has been registered and meets the definition of a site, under Section 5 of the *Aboriginal Heritage Act 1972*; however data regarding the site is not available for public viewing until permission has been sought and granted from the appropriate traditional owner group.

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A suitably qualified cultural heritage consultant (Dr Edward McDonald) has been appointed to investigate the extent of the site and has undertaken a cultural assessment of the mythological site.

3.4.1.2 European heritage

A search of the State Heritage Office's database indicated there are no places listed on the Register of Heritage Places within the site.

3.4.2 Fire

Fire protection will be taken into consideration during all planning phases of land development (WAPC 2010), noting that the site is largely cleared.

The WAPC's Planning Guidelines: Planning for Bushfire Protection (WAPC 2010) outlines the range of matters that will be addressed at various stages of the planning process, to provide an appropriate level of protection to life and property from bushfires and avoid inappropriately located or designed land use, subdivision and development on land where a bushfire risk is identified.

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4 POTENTIAL IMPLICATIONS FOR DEVELOPMENT

This section details potential environmental impacts and proposes management measures to address the identified impact. Each environmental factor is addressed in the same format, using a series of four sub-headings as follows.

Environmental objective – states the EPA's objective for the identified environmental factor in accordance with EAG No. 8: Environmental factors and objectives (EPA 2013).

Applicable guidelines, standards and policies – the environmental factor is placed in context of the appropriate policy framework.

Potential impacts – describes the identified potential environmental impacts that might arise from the proposed development. This may take the form of impacts of the development on the environment, or constraints the environment might represent to realise the project successfully.

Based on the assessment of environmental and social factors undertaken above, potential impacts to the following factors are possible:

- Flora and vegetation
- Fauna habitat
- Hydrological processes
- Heritage
- Acid sulfate soils
- Bushfire risk.

Management response – details proposed environmental management responses to address the potential impacts.

4.1 Flora and vegetation

4.1.1 Environmental objective

To maintain representation, diversity, viability, and ecological function at the species, population and community level.

4.1.2 Applicable guidelines, standards and policies

- *Environment Protection and Biodiversity Conservation Act 1999*
- *Wildlife Conservation Act 1950*
- Position Statement No. 2: Environmental Protection of Native Vegetation in Western Australia (EPA 2000)
- City of Swan Local Biodiversity Strategy (2015).

4.1.3 Potential impacts

The site has been historical used for agriculture, and therefore has been largely cleared of native vegetation, with the majority of vegetation remaining comprising mixed weed species dominated by **Avena barbata*, **Lupinus cosentinii, *Bromus diandrus* and **Triticum aestivum* (Figure K).

The only remnant vegetation present within the site is illustrated in Figure M. Vegetation identified for retention is located within Ki-It Monger Brook and comprises *Eucalyptus rudis* subsp. *rudis* species.

Road crossing across the Ki-It Monger Brook will be required as shown in the LSP, which includes the realignment of Chittering Road through an existing (and cleared) road reserve. The Ki-It Monger Brook crossings will be kept to a minimum and located in areas which minimise the loss of trees within the creekline. Aside from the road crossing(s) the Ki-It Monger Brook vegetation is proposed to be preserved.

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The area of Guildford vegetation complex identified in the draft Perth–Peel Green Growth Strategy (Figures C and 13) will be retained and managed.

4.1.4 Management response

Flora and vegetation within the Kit-it Brook and remnant stands of vegetation location in the LSP site will be managed through the following:

1. An approved Ki-It Monger Brook Foreshore Management Plan was prepared and approved by the City of Swan in 2018. The Ki-It Monger Brook Foreshore Management Plan detail protocols, management actions and timing for commitments to mitigate potential impacts to the native vegetation within Ki-It Monger Brook during and post-construction, including:
    a. Delineation of areas to be retained
    b. Erosion and dust control during construction
    c. Proposed landscaping treatment
    d. Weeds management
    e. Access management
    f. The Ki-It Monger Brook Foreshore Management Plan also addresses the mapped wetland (CCW) portion of the Ki-It Monger Brook.
2. Remnant Vegetation Management Plan (Guildford complex on the southern border). This management plan will be underpinned by the following objectives:
    a. Retain and protect remnant vegetation areas identified in the future Local Structure Plan (e.g. control access, prevent rubbish dumping, weed control)
    b. Revegetate through resurfacing and replanting.

4.1.4.1 EPA Bulletin No. 20 (EPB No. 20) Protection of natural areas through planning and development

The future local structure plan for the site will respond to the objectives outlined in EPA Bulletin No. 20 (EPB No. 20) – Protection of natural areas through planning and development (EPA 2013), outlined below.

- Locate development on cleared land
    - The structure plan will focus on (in accordance with the master plan and the WAPC's "Future Urban Expansion Area") locating proposed future development in historically cleared areas. As mentioned previously, the majority of remnant vegetation within the site is restricted to Ki-It Monger Brook and will therefore be retained within the structure plan
- Minimising fire risk
    - Minimising development in naturally vegetated areas is highly compatible with minimising the risk of fire and its potential impacts on the community. A fire risk assessment report and management strategy will be undertaken in accordance with the Planning for Bushfire Protection Guidelines (WAPC and FESA 2010)
- Protect large consolidated naturally vegetated areas
    - The largest extent of consolidated naturally vegetated areas are located outside of the LSP, within Lots 857 (Bush Forever Site No. 86) and 1343 and along the scarp in Lots 1256 and 6 (Figure M). The majority of remnant vegetation within the site is restricted to Ki-It Monger Brook. The structure plan for the site addresses these areas of remnant vegetation along the Ki-It Monger Brook
- Ecological linkages
    - Maintaining the ecological linkages along the Ki-It Monger Brook, which connects with the large naturally vegetated areas in the eastern portion of the site, will be established in the structure plan.

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4.2 Fauna

4.2.1 Environmental objective

To maintain representation, diversity, viability and ecological function at the species, population and assemblage level.

4.2.2 Applicable guidelines, standards and policies

- *Environment Protection and Biodiversity Act 1999*.
- *Wildlife Conservation Act 1950*.
- Guidance Statement No 33: Environmental Guidance for Planning and Development.

4.2.3 Potential impact

Fauna habitat located within the LSP site is largely limited to *Eucalyptus rudis* subsp. *rudis* low open forest over mixed weed species along Ki-It Monger Brook. This vegetation also provides an ecological link through the site.

The vegetation associated with Ki-It Monger Brook will be retained and protected within the Structure Plan and future subdivision. Consequently, no significant fauna habitat or ecological linkages within the LSP site will be impacted through future development and most significant habitat within the site is proposed for retention.

Bush Forever Site No. 86 also provides an ecological link for remnant jarrah and marri vegetation within the adjacent Lot 1343 and the eastern scarp, Lots 1256 and 1391 (Figure M). This provides a significant fauna consolidated habitat and linkage.

4.2.4 Management response

The estimated 100-year ARI flood plain mapping provides the basis for development setbacks from the Ki-It Monger Brook and establishes the foreshore area in accordance with the DWER Operational Policy 4.3: Identifying and establishing waterways foreshore areas (DoW 2012).

The Ki-It Monger Brook Foreshore Management Plan details the protocols, management actions and timing for commitments to mitigate potential impacts to native vegetation providing significant fauna habitat.

4.3 Hydrological processes

4.3.1 Environmental objective

To maintain the hydrological regimes of groundwater and surface water so that existing and potential uses, including ecosystem maintenance are protected.

4.3.2 Applicable guidelines, standards and policies

- Better Urban Water Management (WAPC 2008).

4.3.3 Potential impacts

The key potential impacts identified include:

- Changes in hydrological regime as a result of changed landforms (from earthworks), which may alter natural flows and levels
- Discharge of stormwater may affect the quality of groundwater and surface water.

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4.3.4 Management response

In accordance with the WAPC Better Urban Water Management guidelines (WAPC 2008) the following water management actions will be undertaken at the appropriate planning stage:

- A Local Water Management Strategy (LWMS) was prepared to support the LSP and approved in 2018. The LWMS is consistent with the objectives of the DWMS (RPS 2016b).
- A Foreshore Area Report for the Ki-It Monger Brook to determine the foreshore area will be submitted with the LWMS.
- UWMPs will be prepared at the subdivision stage of development.

The LWMS has been prepared consistent with the DWMS. The LWMS will achieve integrated water management through the following design objectives:

- Water conservation and water use efficiency
  - Developments should aim to achieve a target of less than 100 kL per person per year, and where a non-drinking water source is available, should achieve a target of not more than 60 kL/person/yr.
  - Waterwise landscaping techniques should be employed in POS and irrigation should be restricted during the day.
- Stormwater management
  - The one year one hour ARI event should be retained at source through the use of retention (soakage) or stage devices.
  - Floodways are to be maintained with respect to their ecological value and current hydraulic capacity; and should be restored if required so they function as an ecological environment and a healthy watercourse.
  - Flood detention/storage areas shall be incorporated into POS and located outside defined floodways. Where the one year critical duration ARI event has already been retained (i.e. part of the initial losses), this volume does not need to be accommodated again in the detention/storage areas.
  - To reduce health risks from mosquitoes, retention and detention treatments should be designed to ensure that between the months of November to May, detained immobile stormwater is fully infiltrated within a time period not exceeding 96 hours.
  - Swales/vegetated bioretention systems are to be sized at a minimum of 2% of the constructed impervious area from which they receive run-off.
  - Residential development may not occur within floodways.
  - Minimum habitable floor levels shall be a minimum of 0.5 m above the 100 year ARI flood level in rivers or main drainage networks.
  - Minimum habitable floor levels shall be a minimum of 0.3 m above the 100 year ARI flood level in local drainage networks.
  - Defined major arterial roads should remain passable in the 100 year ARI event and minor roads passable in the 5 year ARI event.
- Groundwater management
  - Where a perched water table exists or the predicted maximum groundwater level is at or within 1.2 m of natural ground levels, measures should be implemented to ensure that adequate separation of building floor slabs from groundwater is achieved. This may include lowering the groundwater levels where possible, the importation of clean fill or installation of subsoil drainage.
  - Proposals to lower groundwater levels must demonstrate no or negligible impact on groundwater dependent ecosystems. In particular where subsoil drainage is proposed within the groundwater capture zones of wetlands, designs must be developed with consideration of ecological water requirements for groundwater dependent ecosystems.

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- Nutrient management
  - Where subsoil drainage is installed for groundwater level or soil moisture control, a treatment system (such as a swale or biofilter) at each subsoil drain outlet point will be required.
  - Clean fill imported onto the site is to have a capacity to reduce phosphorus export via soil leaching, while also meeting soil permeability and soil compaction criteria specified by the City of Swan.
  - Manage groundwater quality at pre-development (winter) concentrations and if possible, improve the quality of water leaving the development area to maintain and restore ecological systems in the catchment.
  - If the pollutant outputs of the development exceed catchment ambient conditions, the proponent shall achieve water quality improvements within the development area. If catchment ambient conditions have not been determined, the development should meet relevant water quality guidelines stimulated in ANZECC (2000).
  - Prior to the construction of flood detention/storage areas, phosphorus retention index testing (PRI) will be undertaken to measure the PRI of the soils. A PRI of less than 10 is considered low and will require amendment.
- Wetlands
  - Ecological water requirements will be determined by the proponent and will include the determination of hydrological buffers to wetlands to confirm where subsoil drainage is not suitable thus ensuring there is minimal impact on wetland water levels.

4.3.4.1 Wetlands

1. Ecological water requirements will be development by the proponent and will include the determination of hydrological buffers to wetlands to determine where subsoil drainage is not allowed so there is minimal impact on wetland water levels.
2. Urban Water Management Plan(s) will be prepared to support subdivision activities.
3. The Ki-It Monger Brook Foreshore Management Plan addresses the CCW area. The wetland interface management treatments and agreed through landscape plans have been approved by the City of Swan.
4. The estimated 100-year ARI flood plain mapping provides the basis for development setbacks from the Ki-It Monger Brook and establishes the foreshore buffer area in accordance with the DWER Operational Policy 4.3: Identifying and establishing waterways foreshore areas (DoW 2012).

4.4 Acid sulfate soils

4.4.1 Environmental objective

To maintain the quality of land and soils so that the environment values, both ecological and social, are protected.

4.4.2 Applicable guidelines, standards and policies

- Assessment Levels for Soil, Sediment and Water (Department of Environment and Conservation (DEC) 2010).
- Acid Sulfate Soils Guideline Series. Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes (DEC 2011).
- Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes (DEC 2013).

4.4.3 Potential impacts

ASS soils are stable when left undisturbed, however exposure to air during excavation or dewatering activities can set off a reaction resulting in acidity (sulfuric acid) being produced.

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The potential impacts relate to the potential for oxidation of excavated or in-situ ASS generating acidic conditions and possibly releasing metals into groundwater and the surrounding freshwater environment of Ki-It Monger Brook.

4.4.4 Management response

The final fill levels and engineering service excavation requirements will determine if an ASS investigation and an ASS and Dewatering Management Plan (ASSDMP) is required to be prepared prior to subdivision.

If required, the ASSDMP will outline the soil management measures, the groundwater and dewatering effluent monitoring measures and the contingency management measures required to minimise any environmental impacts to the satisfaction of the DWER.

4.5 Site contamination

4.5.1 Environmental objective

To ensure previous land uses within and surrounding the site, do not impact on future development of the site.

4.5.2 Applicable guidelines, standards and policies

- *Contaminated Sites Act 2003*.

4.5.3 Potential impact

The LSP site has been used for grazing and agricultural purposes and there is very little likelihood of any potential contamination over the majority of the site.

The Class 1 Landfill Site is located within the site on Lot 2792.

4.5.4 Management response

A 1,000 m buffer was maintained until the landfill closure in 2020 from any urban development.

The landfill ceased operations in 2020, the landfill is now being rehabilitated in accordance with DWER requirements.

4.6 Fire

4.6.1 Environmental objective

To reduce the risk of bushfire to people, property and infrastructure.

4.6.2 Applicable guidelines, standards and policies

- Australian Standard AS 3959:2009, Construction of Buildings in Bushfire-prone Areas (Standards Australia 2009)
- Guidelines for Planning in Bushfire Prone Areas (Department of Planning and WAPC 2015a)
- SPP 3.7: Planning for in Bushfire Prone Areas (Department of Planning and WAPC 2015b).

4.6.3 Potential impacts

Vegetation retained within Ki-It Monger Brook will present a risk to future residential development within the site.

Vegetation retained to the east of the site will also pose a potential risk to future development.

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4.6.4 Management response

In accordance WAPC guidelines, a Fire Management Plan will be required to be prepared at subdivision stage (WAPC, 2014).

4.7 Aboriginal heritage

4.7.1 Environmental objective

To ensure that historical and cultural associations are not adversely affected.

4.7.2 Applicable guidelines, standards and policies

- *Aboriginal Heritage Act 1972*
- Guidance Statement No. 41: Assessment of Aboriginal Heritage (EPA 2004b).

4.7.3 Potential impacts

Mythological site 3583 for the Ki-It Monger Brook is the only registered Aboriginal heritage site located within the site.

Other potential impacts of the proposed development on Aboriginal heritage sites are related primarily to direct disturbance of sites during including excavation and construction activities which may unearth or damage artefacts or other items of cultural Aboriginal significance.

4.7.4 Management response

- Consultation with the traditional owners has been undertaken by Amex on site.
- An application for approval to disturb the Aboriginal archaeological site under Section 18 of the *Aboriginal Heritage Act 1972* has been made.
- The Section 18 of the *Aboriginal Heritage Act 1972* application was approved in 2018.
- Be vigilant during earthworks and stop work immediately should any items be discovered.

4.7.5 Noise

A small section of the Bullsbrook LSP site in the north will abut the Great Northern Highway. This has potential noise implications for residential development. An appropriately qualified acoustic consultant has been engaged to prepare an acoustic assessment. This assessment will identify the noise impacts relevant to the site and any proposed treatment measures to be implemented as part of the future residential development.

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5 CONCLUSION

In the Executive summary, Table 1 details the following key environmental factors, potential impacts and proposed management response to the LSP for:

- Vegetation and flora
- Fauna
- Hydrology
- Contamination
- Acid sulfate soils
- Fire
- Aboriginal heritage.

This report concludes that through the implementation of the proposed management measures summarised below, the implementation of the structure plan through future subdivision and development will meet the EPA's and the City of Swan's environmental objectives.

- The landfill ceased operations in 2020, the landfill is now being rehabilitated in accordance with DWER requirements
- The Structure Plan has an approved LWMS.
- The structure plan provides an appropriate interface with the neighbouring herb nursery this includes locating the District Open Space and large commercial development at the boundary closest to the nursery.
- A Ki-It Monger Brook Foreshore Management Plan was prepared and approved by the City of Swan in 2018. The management plan commenced implementation in late 2018 to the satisfaction of the City.
- The approved Ki-It Monger Brook Foreshore Management Plan in inclusive of the wetland portion of the Ki-It Monger Brook.
- A Remnant Vegetation Management Plan will be prepared for the vegetation identified to be retained (outside of the Ki-It Monger Brook) on the southern boundary of the site.
- An Urban Water Management Plan(s) have been completed at each the subdivision stages to the satisfaction of the City of Swan.
- A Fire Management Plan will be prepared at subdivision stage in accordance WAPC guidelines.

The amendment(s) promoted the preparation and implementation of following key environmental management plans:

1. Ki-it Monger Brook Management Plan, which it is anticipated, will be a requirement of subdivision. The Ki-it Monger Brook FMP will appropriately detail the location of community facilities, open space areas, possible drainage areas and access pathways.
2. Remnant Vegetation Management Plan to outline management recommendations for the stand of remnant Guildford vegetation community located on the southern boundary of the site.
3. Wetland Management Plan for the Conservation Category Wetland (CCW) area and buffer will be prepared and implemented as a condition of subdivision.
4. Urban Water Management Plan(s).

Table 7 illustrates the status of the Kingsford development's environmental management framework.

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Table 7: Kingsford residential development environmental management status

Time frames	Key environmental
Undertaken for the MRS and LPS amendments	• Vegetation and flora assessment • Wetland assessment • Ki-It Monger Brook flood modelling / hydrology studies • Environmental Assessment Report • District Water Management Strategy (DWMS) – approved 2017
MRS and LPS amendment	• This Environmental Assessment Report
Local Structure Plan	• Local Water Management Strategy • Ki-It Monger Brook and wetland buffers associated the structure plan • Bushfire Management Plan
Subdivision and management plan approval status	• The following management plan have been prepared, approved and implemented: • Ki-it Monger Brook foreshore and wetland management plan – approved in 2018 • Ki-it Monger Brook – foreshore area report – approved as part of the LWMS in 2018 • Local Water Management Strategy – approved in 2018 • Hydrogeological Assessment Report – approved 2018 • Urban Water Management Plan(s) for approved subdivisions

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6 REFERENCES

City of Swan. 2015. Local Biodiversity Strategy. City of Swan, Western Australia.

Department of Water. 2009. Gnangara Groundwater Areas Allocation Plan. Government of Western Australia, Perth.

Ecologia. 2016. Bullsbrook Project, Flora & Vegetation Assessment. Prepared for RPS Group Pty Ltd.

Galt Geotechnics. 2014. Geotechnical Study – Various Lots Great Northern Highway Bullsbrook. Prepared for Mirvac.

GHD. 2012. Report for Bullsbrook Townsite Area, Regional Water Management Strategy.

RPS. 2013a. Estimate of Flood Levels and Extent of Flooding at Ki-It Monger Brook, Bullsbrook.

RPS. 2016a. Level 2 Hydrogeological Assessment, Vispo Holdings Pty Ltd's Bullsbrook Landholding.

RPS. 2016B. District Water Management Strategy, Bullsbrook Landholding. Prepared for Amex Corporation.

Swan Catchment Council. (2004). Swan Region Strategy for Natural Resource Management. Midland, Western Australia.

Water and Rivers Commission. (2001). Position Statement: Wetlands. Perth, Western Australia.

Western Australian Planning Commission. 2015a. State Planning Policy 3.7 Planning in Bushfire Prone Areas. Government of Western Australia, Perth.

Western Australian Planning Commission. 2015b. Guidelines for Planning in Bushfire Prone Areas. Government of Western Australia, Perth.

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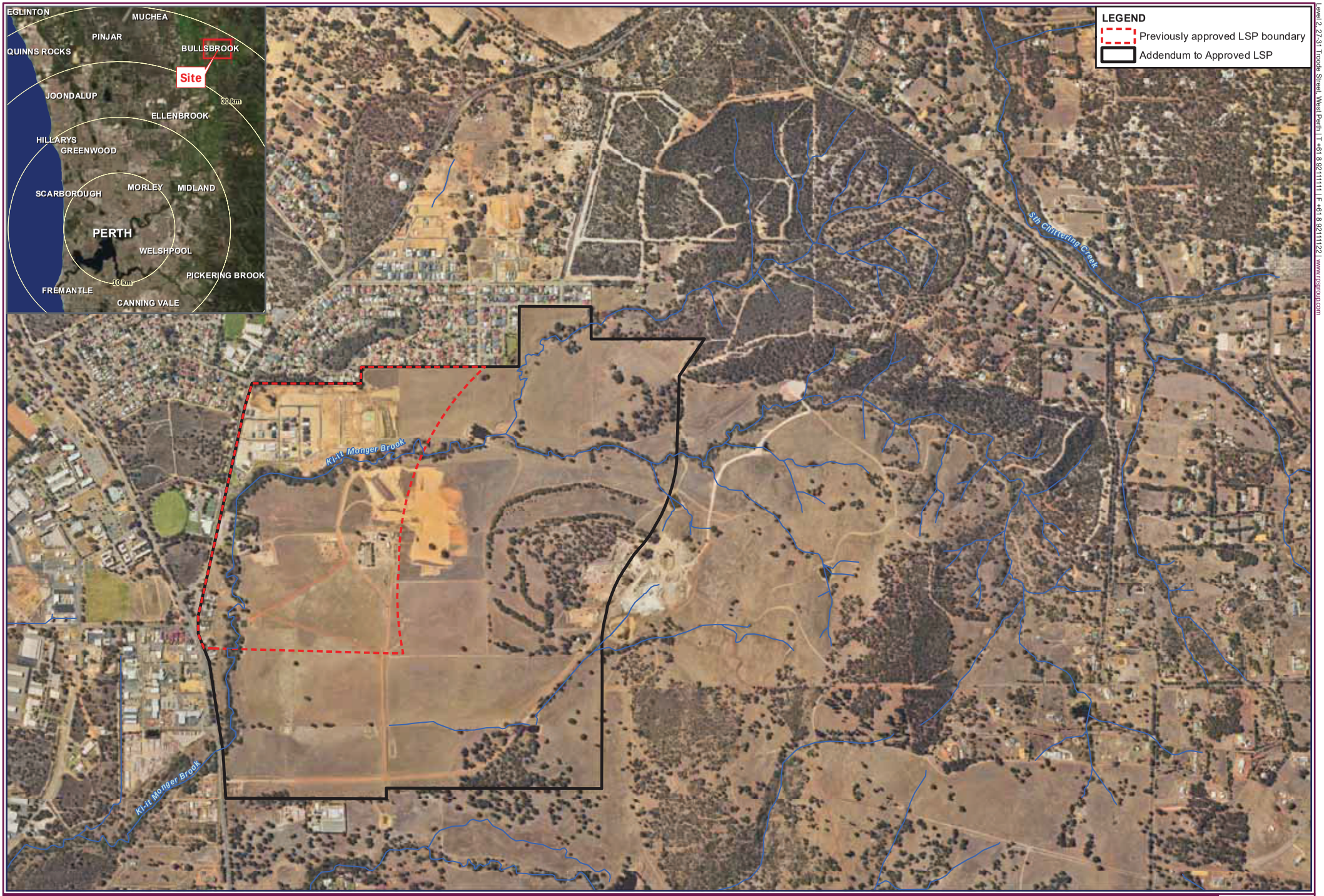


Figure A

Site location

GDA2020 MGA Zone 50
0 125 250 500 m

Project Number: L1519301
Date: 29.07.21
Scale: 1:12,500 @ A3
Created by: RL
Source: Cadastre - Landgate, 2020 Orthophoto - Landgate, Jan 2021

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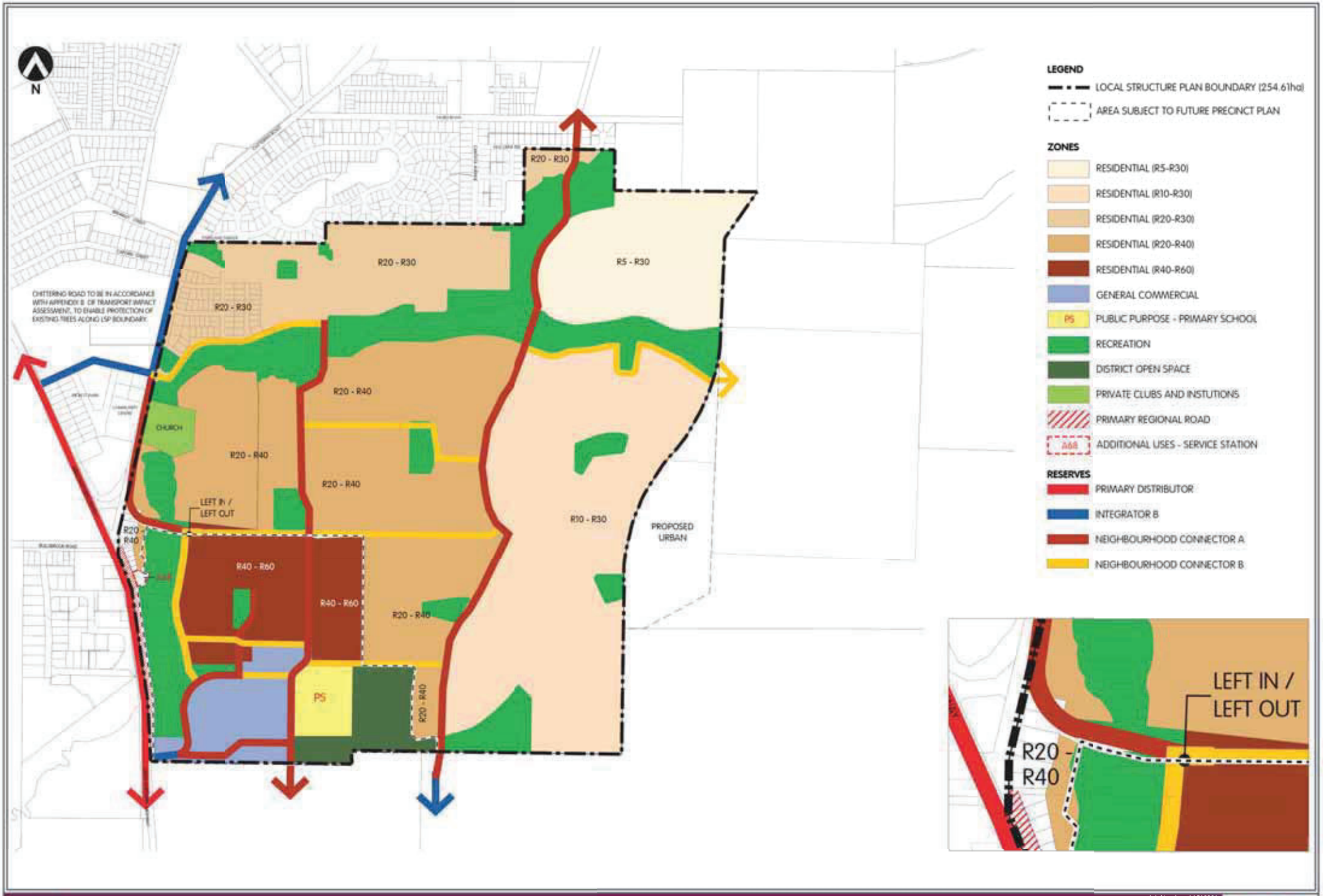


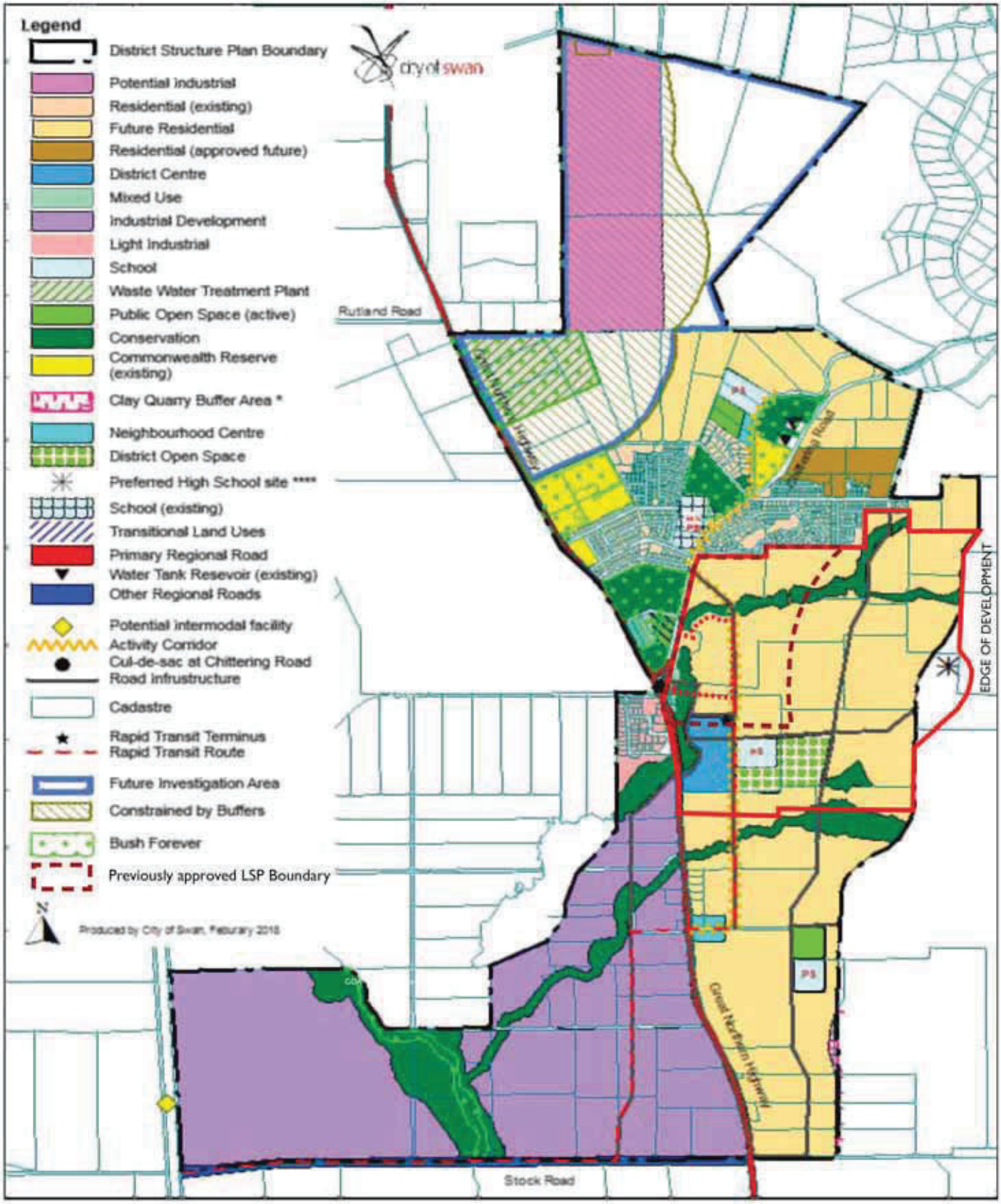
Figure B

Local structure plan

Job Number: L1519301
Date: 25.08.21
Scale: NTS @ A3
Created by: SN
Source: LSP - Roberts Day (AMX BUL RD1 107 RevW)

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Document Set ID: 8808819
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* The existing 500 metre clay quarry buffer may be reduced in the future, upon agreement of all relevant parties. This buffer is subject to detailed mapping.

** Transitional land uses are required along the western edge of the Great Northern Highway (refer Section 3.1.2 of the Bullsbrook Townsite District Structure Plan report).

*** The location, design and size of the DOS is to be refined through the local structure planning stage.

**** In the event that an additional high school site is required, its siting and location should be determined prior to supporting the first major structure plan. Refer to Section 3.6.1 of the Bullsbrook Townsite District Structure Plan report.

Figure C

City of Swan - Bullsbrook Masterplan (2013)

Job Number: L151930
Date: 29.07.21
Scale: NTS @ A3
Created by: NL
Source: Masterplan - City of Swan, Feb 2018

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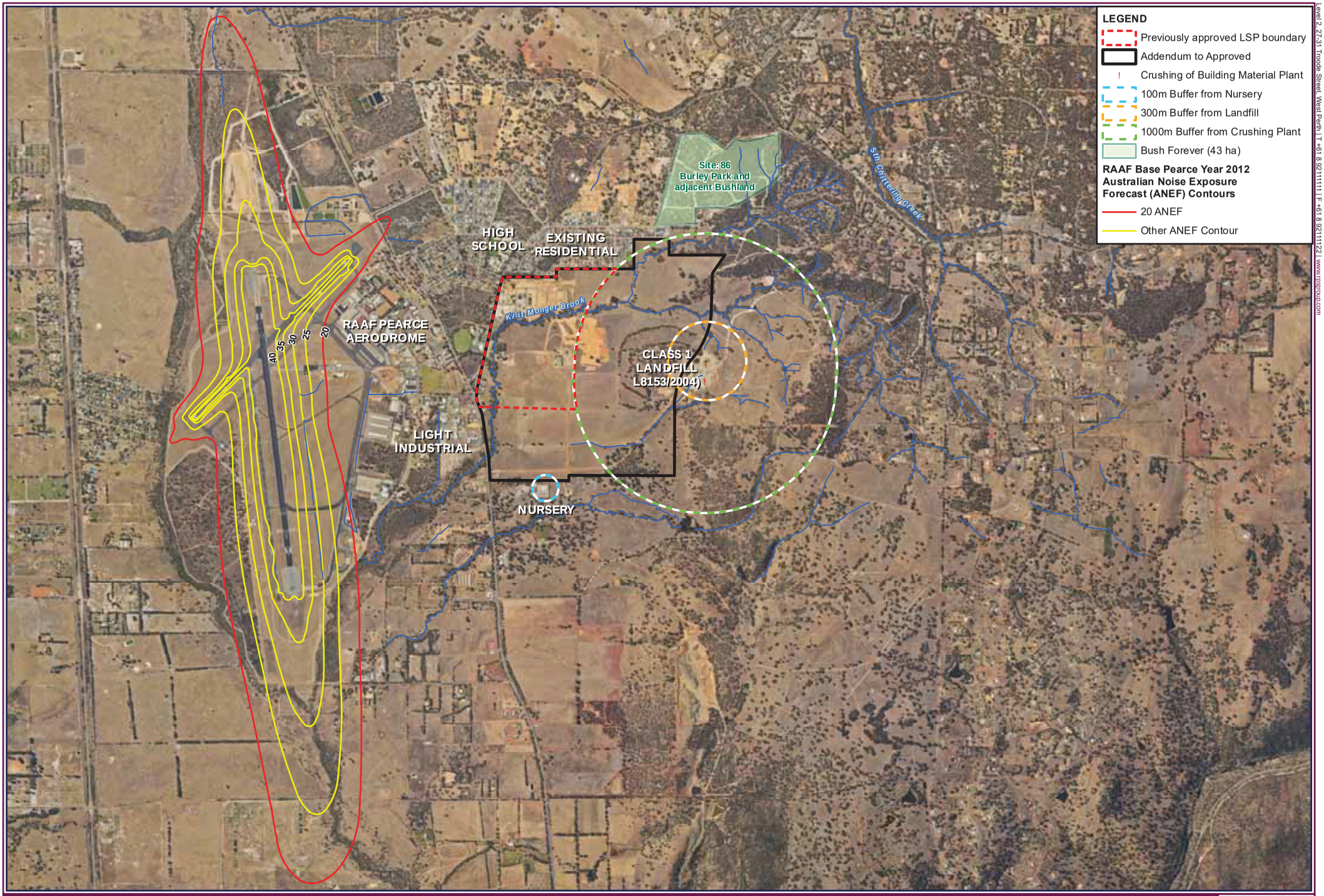


Figure D

Surrounding land use

GDA2020 MGA Zone 50
0 250 500 1,000 m

Project Number: L1519301
Date: 29.07.21
Scale: 1:25,500 @ A3
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Source: Cadastre - Landgate, 2020 Orthophoto - Landgate, Jan 2021

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Figure E

Topography

GDA2020 MGA Zone 50

0 100 200 400 m

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Date: 29.07.21
Scale: 1:8,000 @ A3
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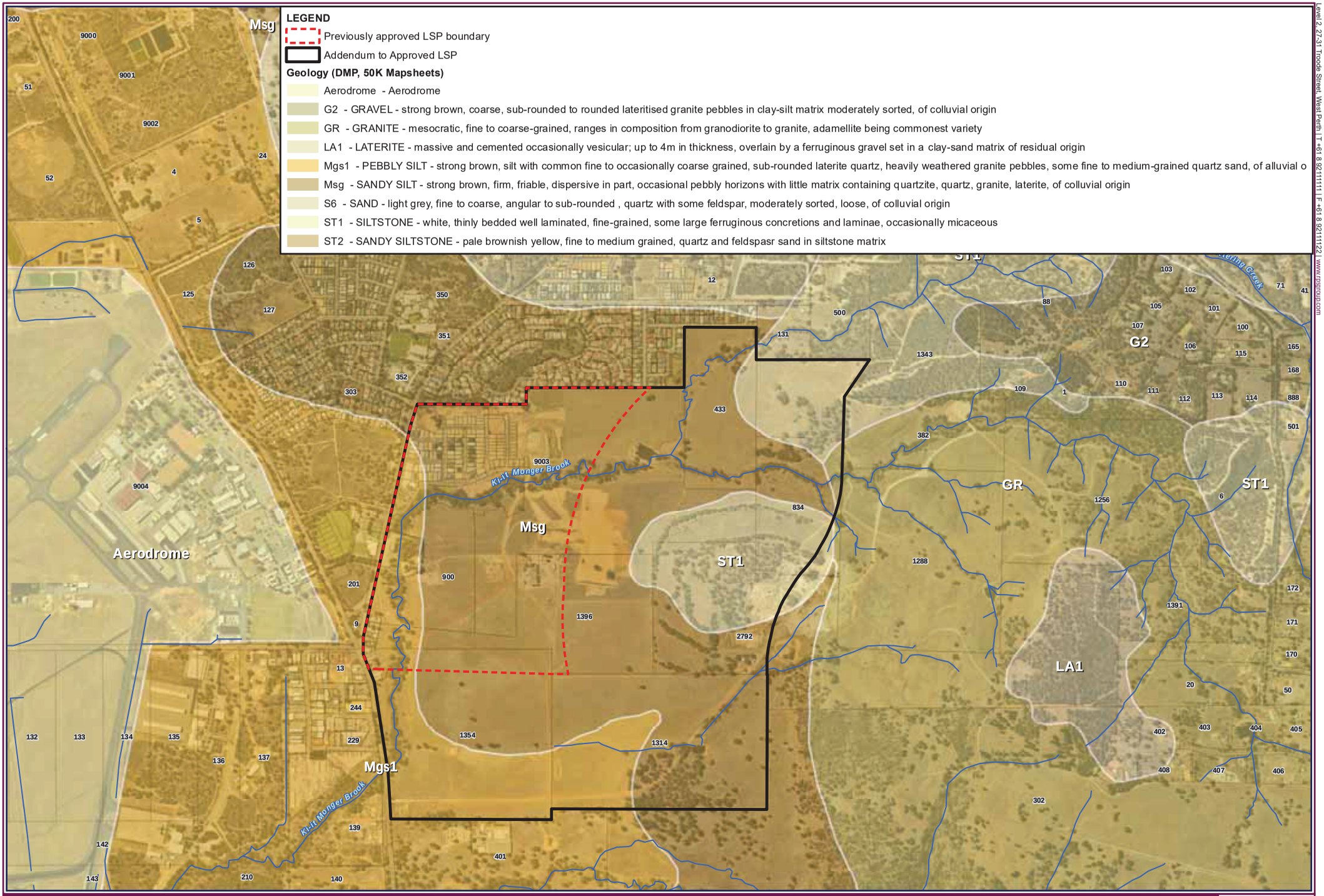


Figure F

Geology

Project Number: L1519301
Date: 29.07.21
Scale: 1:12,500 @ A3
Created by: RL
Source: Cadastre - Landgate, 2020 Orthophoto - Landgate, Jan 2021

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Document Set ID: 5115943
Version: 7, Version Date: 11/12/2024



Figure G

GW contours and bores

GDA2020 MGA Zone 50
0 100 200 400 m

Project Number: L1519301
Date: 29.07.21
Scale: 1:8,000 @ A3
Created by: RL
Source: Cadastre - Landgate, 2020 Orthophoto - Landgate, Jan 2021

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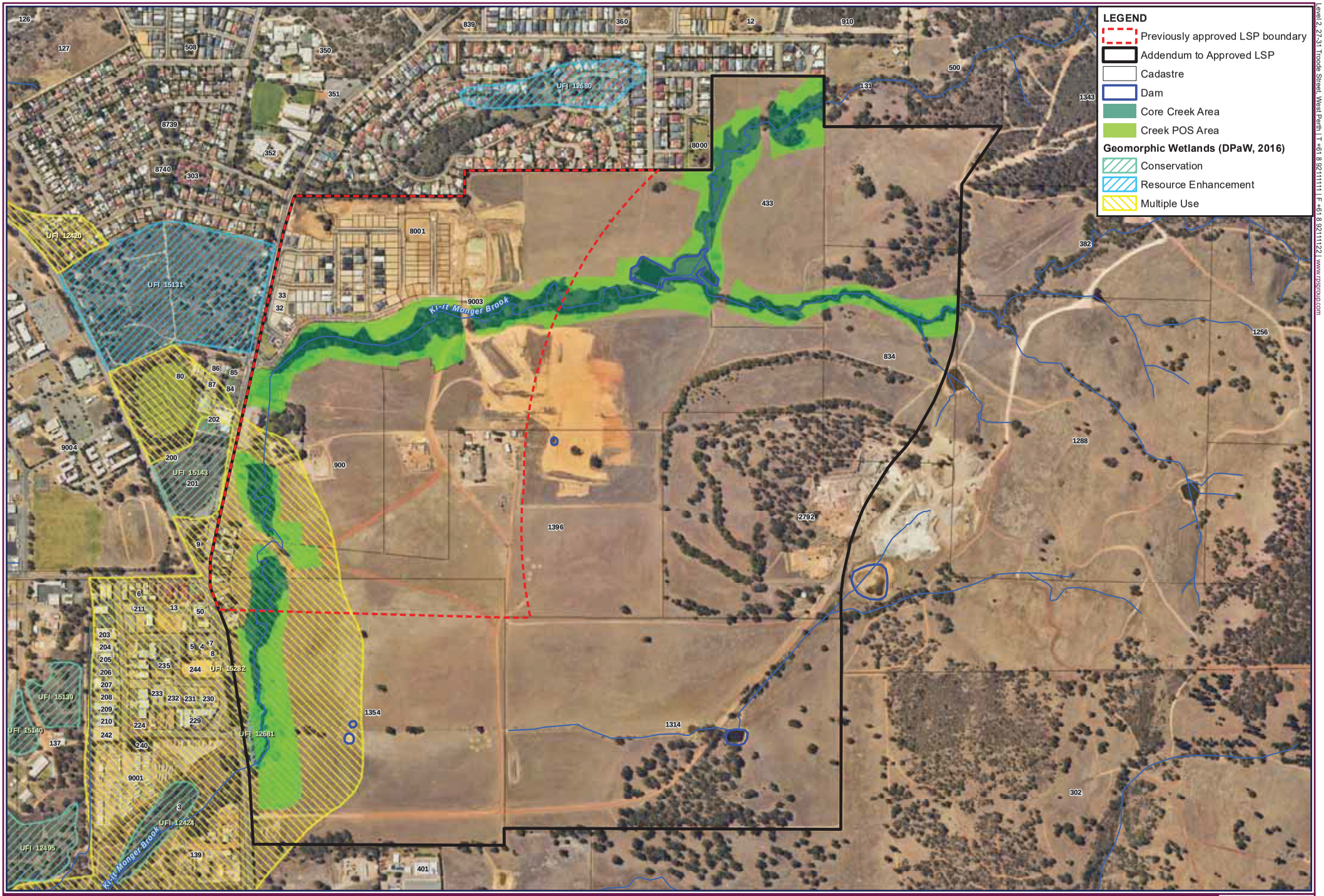


Figure H

Wetlands mapping and habitat area

GDA2020 MGA Zone 50
0 100 200 400 m

Project Number: L1519301
Date: 29.07.21
Scale: 1:8,000 @ A3
Created by: RL
Source: Cadastre - Landgate, 2020 Orthophoto - Landgate, Jan 2021

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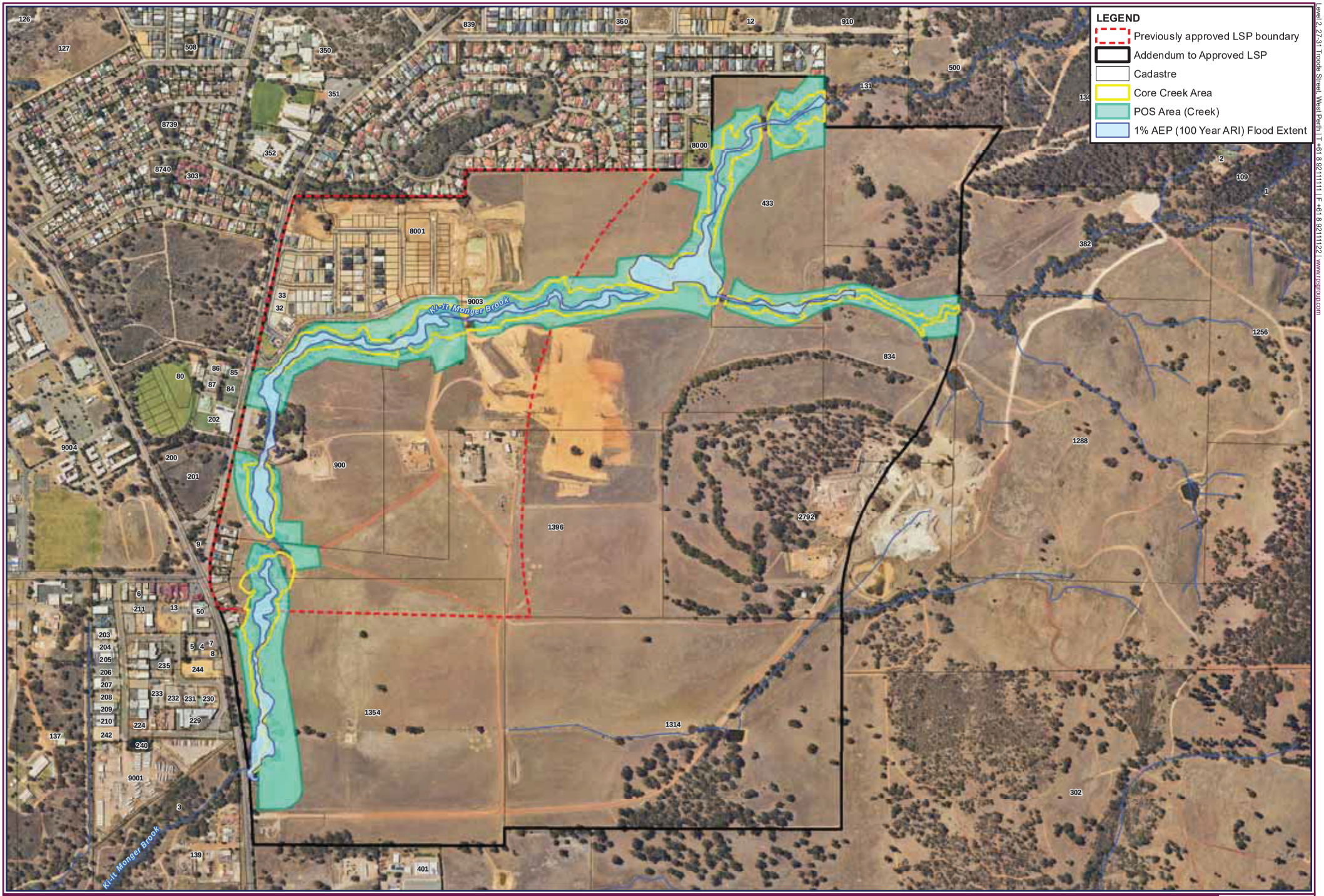


Figure I

1% AEP (100 year ARI) flood extent

GDA2020 MGA Zone 50
0 100 200 400 m

Project Number: L1519301
Date: 29.07.21
Scale: 1:8,000 @ A3
Created by: RL
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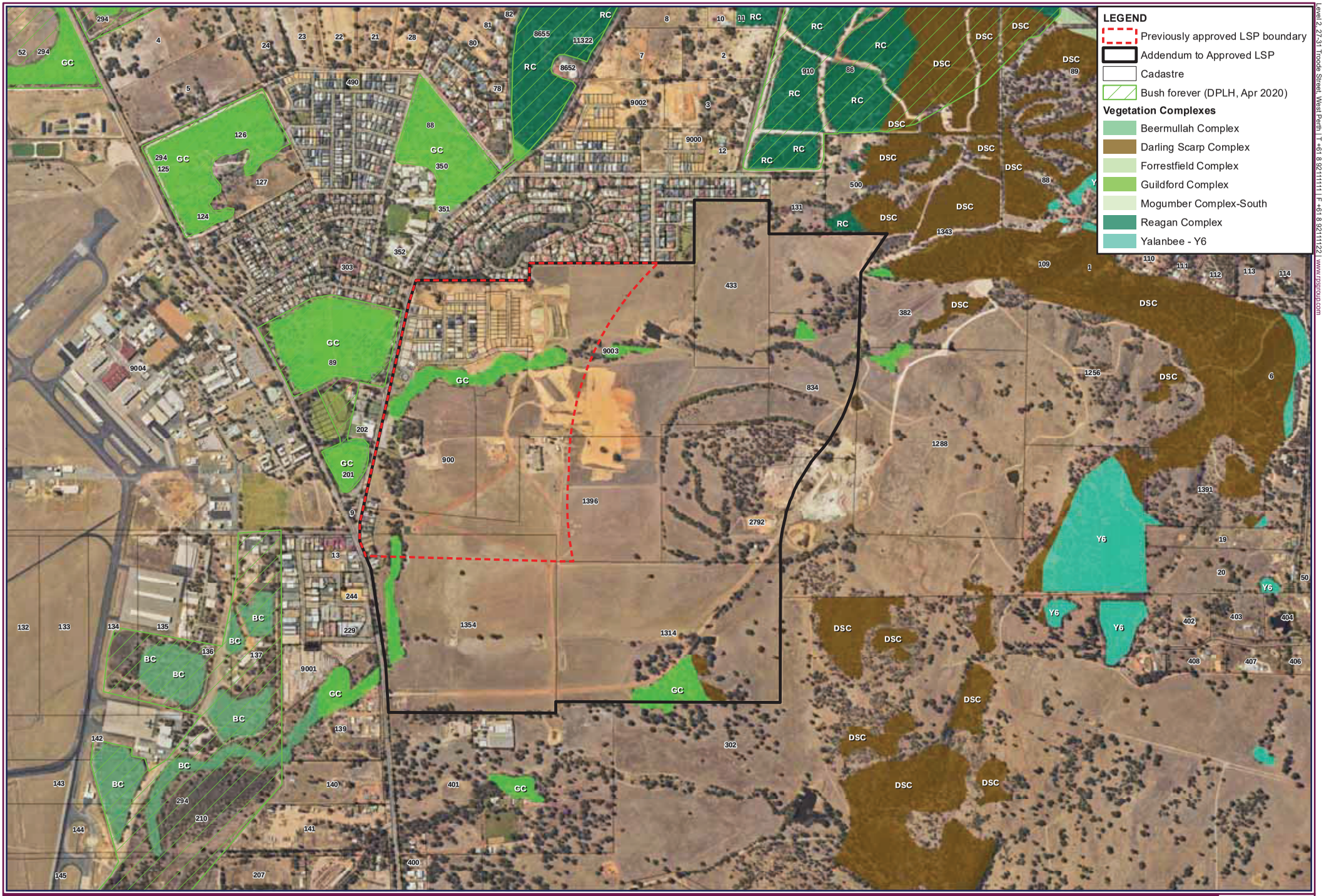


Figure J

Vegetation Complexes

Project Number: L1519301
Date: 29.07.21
Scale: 1:12,000 @ A3
Created by: RL
Source: Cadastre - Landgate, 2020 Orthophoto - Landgate, Jan 2021

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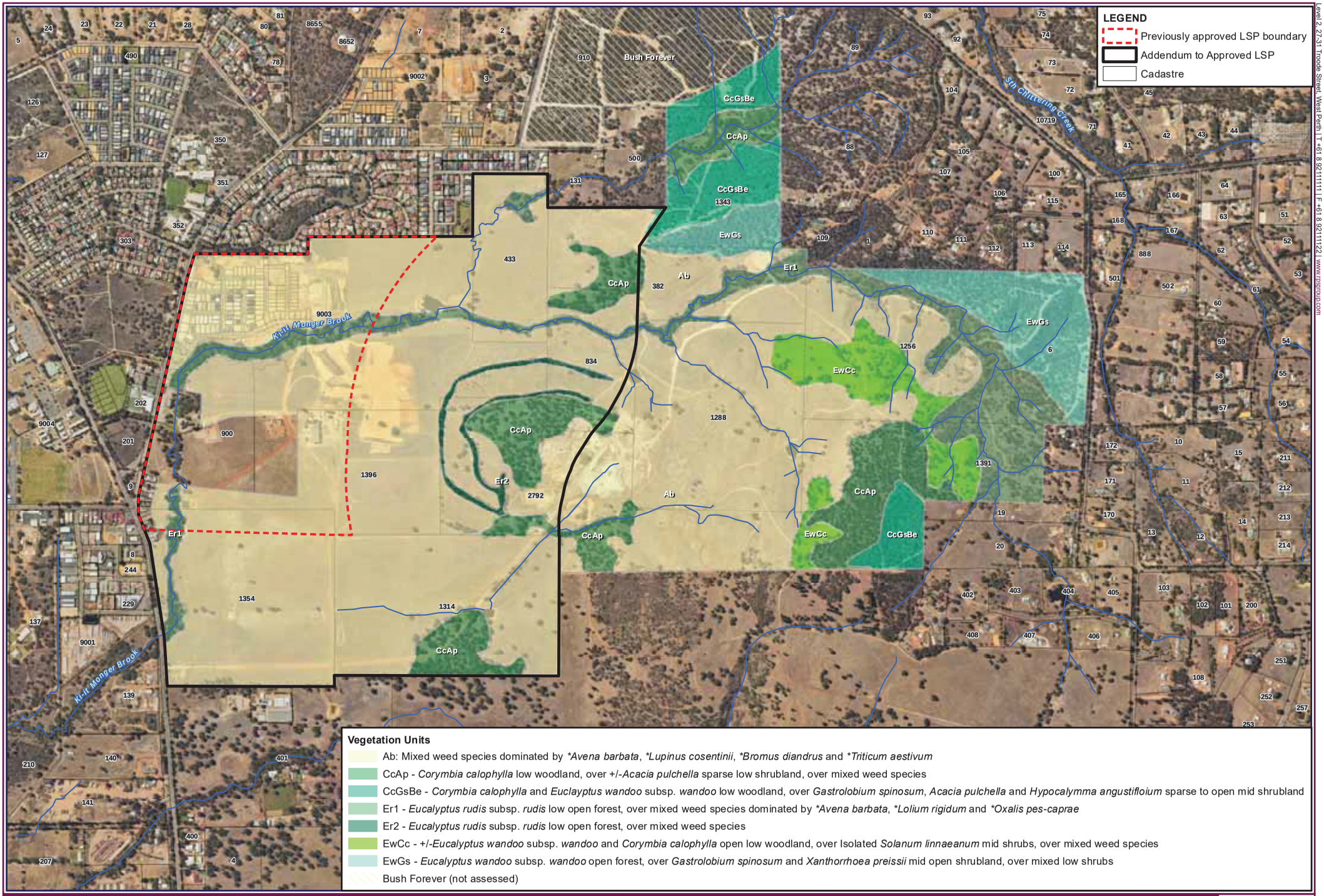


Figure K

Vegetation Units

GDA2020 MGA Zone 50
0 125 250 500 m

Project Number: L1519301
Date: 29.07.21
Scale: 1:12,000 @ A3
Created by: RL
Source: Cadastre - Landgate, 2020 Orthophoto - Landgate, Jan 2021

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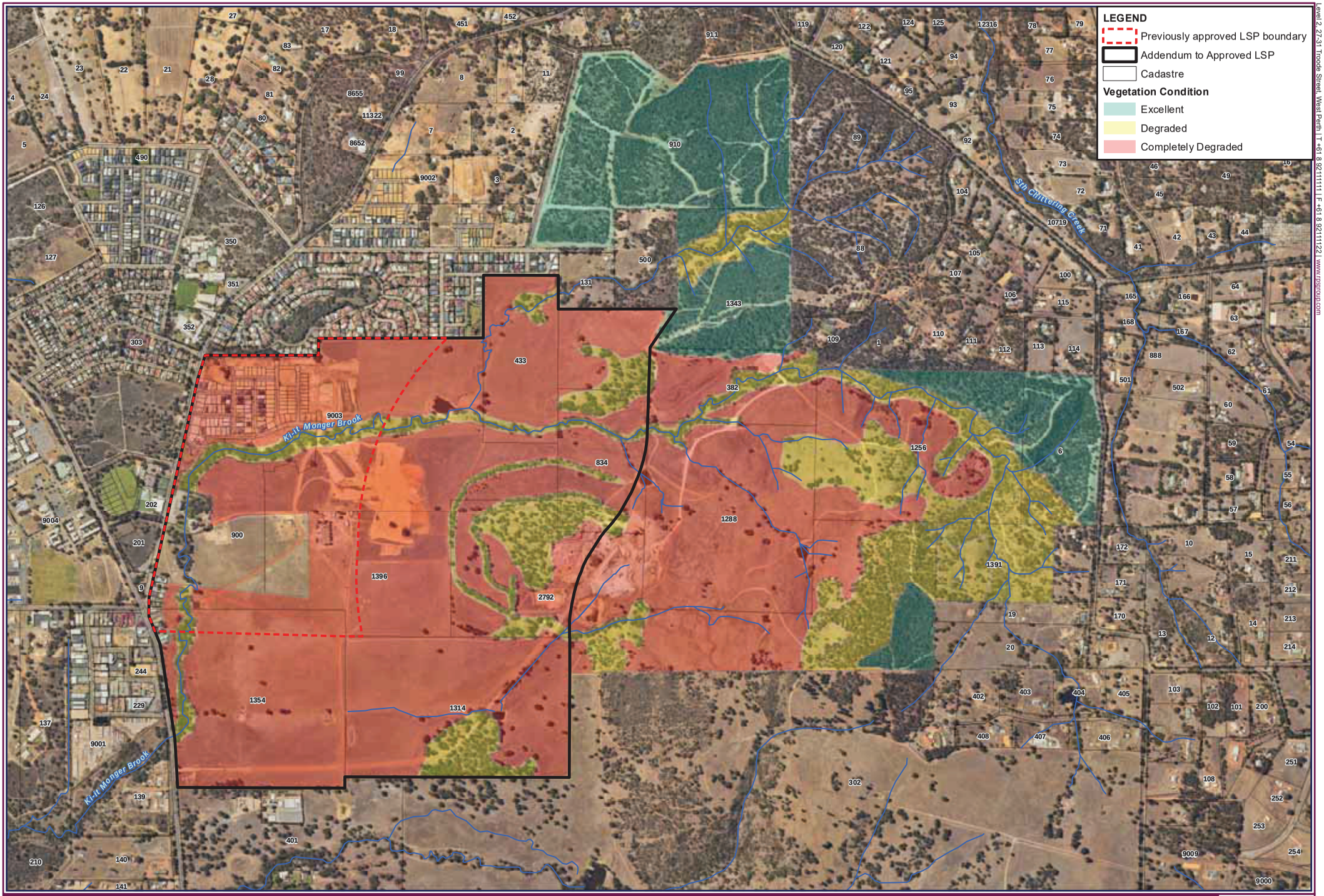


Figure L

Vegetation condition

GDA2020 MGA Zone 50
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Project Number: L1519301
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Created by: RL
Source: Cadastre - Landgate, 2020 Orthophoto - Landgate, Jan 2021

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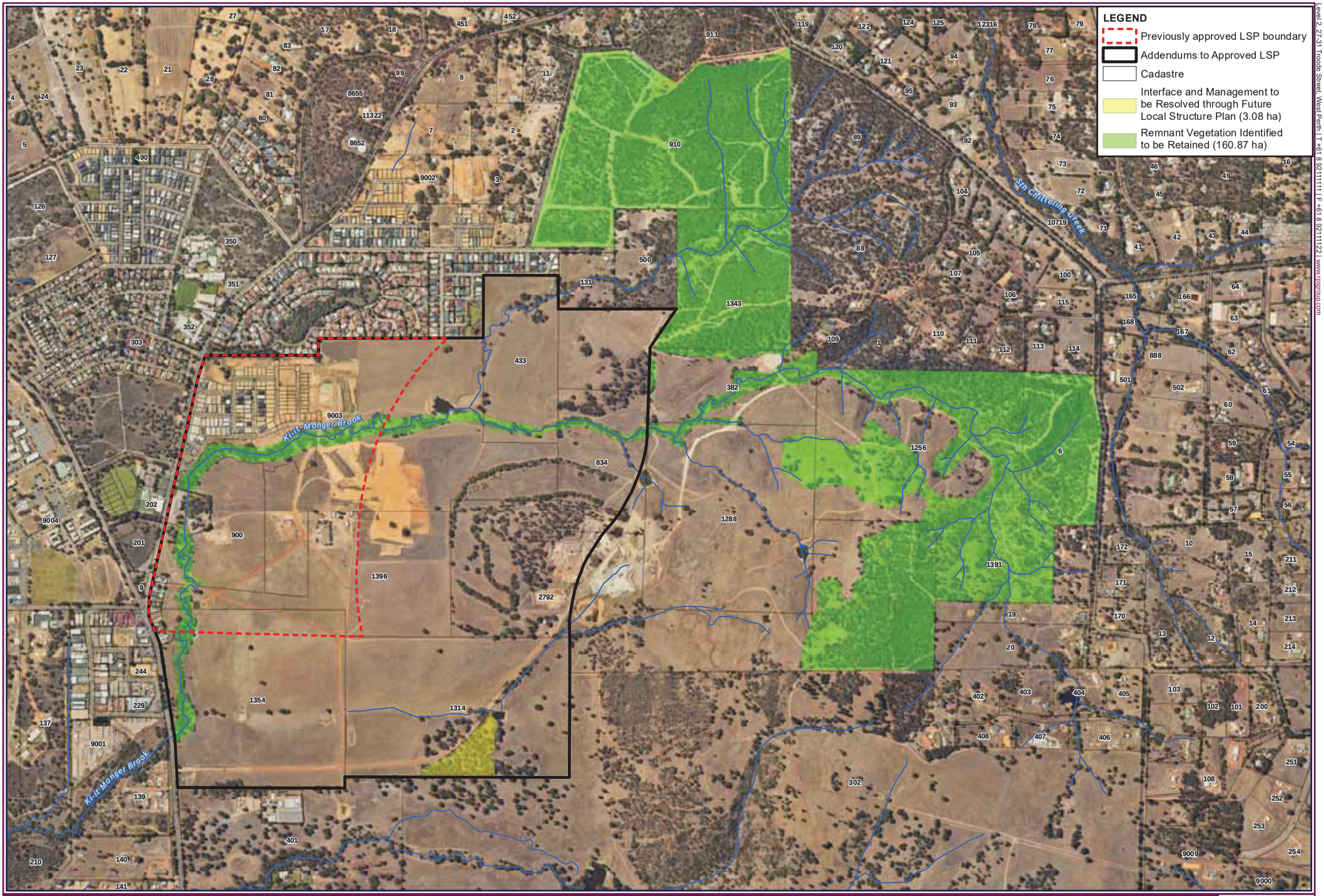


Figure M

Remnant Vegetation

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Created by: RL
Source: Cadastre - Landgate, 2020 Orthophoto - Landgate, Jan 2021

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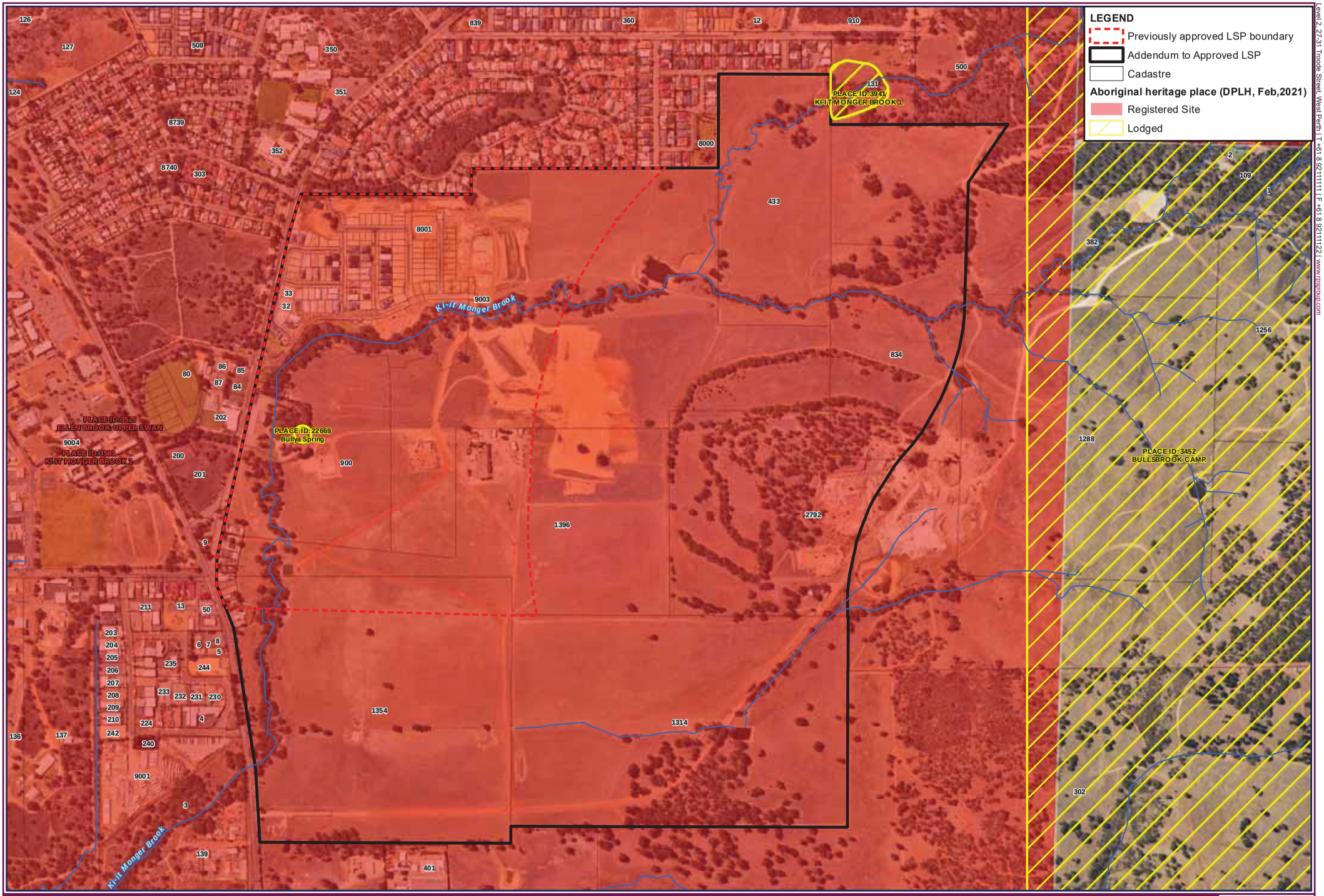


Figure N

Aboriginal heritage

Project Number: L1519301
Date: 29.07.21
Scale: 1:8,000 @ A3
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Source: Cadastre - Landgate, 2020 Orthophoto - Landgate, Jan 2021

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Appendix A
Bullsbrook Project Flora & Vegetation Assessment



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ACRONYMS

BAM Act	*Biosecurity and Agriculture Management Act 2007*
BOM	Bureau of Meteorology
CALM	Department of Conservation and Land Management (now DPaW)
DAFWA	Department of Agriculture and Food Western Australia
DEC	Department of Environment and Conservation (now DPaW)
DoE	Department of Environment
DoW	Department of Water
DPaW	Department of Parks and Wildlife (formerly DEC)
DSEWPaC	Department of the Sustainability, Environment, Water, Population and Communities
ESA	Environmentally Sensitive Area
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESCAVI	Executive Steering Committee for Australian Vegetation Information
IBRA	Interim Biogeographic Regionalisation for Australia
NVIS	National Vegetation Information System
PEC	Priority Ecological Community
RPS	RPS Group Pty Ltd
TEC	Threatened Ecological Community
TPFL	Threatened and Priority flora Database
TPList	Threatened and Priority flora List
WAHERB	Western Australian Herbarium
WAOL	Western Australian Organism List
WONS	Weeds of National Significance
WC Act	*Wildlife Conservation Act 1950*

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EXECUTIVE SUMMARY

Introduction

RPS Group Pty Ltd (RPS) is providing environmental and planning services for an area of 'Rural'-zoned land, immediately east of the Bullsbrook townsite and 35 km north-east of Perth, which consists of 15 Lots (or portions of) totalling 249 ha in area (the Development area). The landholding has been identified by the Western Australian Planning Authority (WAPC) as an area of future urban expansion. RPS requires an understanding of the status of the remnant vegetation, wetlands and flora, including Threatened and Priority flora, within the 482 ha Project area (the Project area). The northern portion of the Project area includes a Bush Forever site (Burley Park and Adjacent Bushland, Bullsbrook) that is not intended to be developed, and was therefore not surveyed during this assessment. Excluding the Bush Forever site, the total area (the study area) surveyed, which includes Lot 382 and portions of Lots 1288 and 2792 is 439 ha (the 'study area').

Methodology

A two-phase, Level 2 flora and vegetation assessment of the study area was conducted. The initial Spring phase of the survey was conducted on 24 October 2014, while the second Autumn phase was conducted between 16 and 17 May 2016. A survey effort equivalent to four person days was expended in total across both phases. A total of six quadrats and 27 relevés were sampled floristically in the study area. In addition, traverses to target flora of conservation significance, introduced flora and to provide opportunistic collections of taxa not recorded within the quadrats were conducted.

Flora

A total of 102 vascular plant taxa were recorded from the study area. Of these, 44 (43.1%) are native and 58 (56.9%) are introduced species. No Commonwealth *Environment Protection and Biodiversity Conservation (EPBC) 1999* Act listed or Western Australian *Wildlife Conservation Act 1950* listed Threatened Flora, Priority flora or other flora species of significance were recorded in the study area.

The literature review identified one Threatened flora taxon, *Acacia anomala* that has previously been recorded at three locations within the Project area. This species is highly likely to occur within the remnant bush areas in the east of the Project area, though not within the Development area itself.

There were 60 weed species recorded, of which one is a Weed of National Significance (WONS) (*Asparagus asparagoides*) and one is a Declared Plant (*Zantedeschia aethiopica*).

Vegetation

Seven vegetation units were mapped in the study area, with five units occurring within the development area. Five were associated with the agricultural land use and were either rated as either 'Completely Degraded' (Unit Ab) or 'Degraded' (Units CcAp, Er1, Er2 and EwCc):

- Ab (Mixed weed species). Recorded in the areas which have been cleared for agriculture on the flats and lower hill slopes and mapped as 293.6 ha or 60.9% of the Project area
- CcAp (*Corymbia calophylla* low woodland, over +/-*Acacia pulchella* sparse low shrubland, over mixed weed species). Recorded on the hill tops and mid slopes which have not been completely cleared and mapped as 41.6 ha or 8.6% of the Project area.
- Er1 (*Eucalyptus rudis* subsp. *rudis* low open forest, over mixed weed species). Was recorded along the Kit-Monger Brook and the drainage valley slopes in between the hills to the east of the Project area and was mapped as 37.0 ha or 7.7% of the Project area.
- Er2 (*Eucalyptus rudis* subsp. *rudis* low open forest, over mixed weed species). Was recorded as the strip of trees planted for stabilisation, rather than along the creekline and was therefore separated from Er1 and mapped as 4.2 ha or 0.9% of the Project area.
- EwCc (+/-*Eucalyptus wandoo* subsp. *wandoo* and *Corymbia calophylla* open low woodland, over isolated **Solanum linnaeanum* mid shrubs, over mixed weed species). Recorded on the

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mostly cleared hill slopes towards the east of the Project area and mapped as 17.4 ha or 3.6% of the Project area.

Two units were classified as being in 'Excellent' condition with disturbances limited to low density non-invasive weeds and common vehicle/animal tracks:

- EwGs (*Eucalyptus wandoo* subsp. *wandoo* open forest, over *Gastrolobium spinosum* and *Xanthorrhoea preissii* mid open shrubland, over isolated mixed low shrubs). Recorded along the steep escarpment and valley walls and was mapped as 24.5 ha or 5.1% of the Project area.
- CcGsBe *(Corymbia calophylla and Eucalyptus wandoo subsp. wandoo low woodland, over Gastrolobium spinosum, Acacia pulchella* and *Hypocalymma angustifolium* sparse to open mid shrubland, over *Bossiaea eriocarpa* sparse low shrubland). Recorded on the hill tops and gentle mid and foot slopes of the Darling plateau 20.3 ha or 4.2% of this unit was mapped from the Project area, though only 0.21ha or 0.08% occurs within the proposed Development area

Both remnant vegetation units within the study area are considered significant as they are remnant units that are locally scarce, restricted in distribution and provide a role of refuge for flora. They provide potential suitable habitat for a Threatened flora species (*Acacia anomala*) and overlay two IBRA regions. However, none of vegetation unit EwGs and only 0.21ha of CcGsBe, occur with the proposed Development area

The CcGsBe unit supports a floristic suite that resembles the Endangered TEC: '*Corymbia calophylla – Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain'. Species common to both CcGsBe and this TEC include *Xanthorrhoea preissii*, *Eucalyptus wandoo, Acacia pulchella, Bossiaea eriocarpa, Hibbertia hypericoides, Hypocalymma angustifolium* and *Lepidosperma angustatum*.

The remnant vegetation in the study area corresponds with the Darling Scarp and Yalanbee Vegetation Complexes, which have 41.96% and 47.6%, respectively, of their pre-European extents remaining.

Wetland Assessment

The Ki-it Monger Brook is associated with vegetation unit Er1: *Eucalyptus rudis* subsp. *rudis* low open forest, over mixed weed species dominated by **Avena barbata, *Lolium rigidum* and *Oxalis pes-caprae* and other common species included: *Corymbia calophylla, *Gomphocarpus fruticosus, *Solanum linnaeanum, *Briza maxima, *Moraea flaccida.*

The entire length of the Ki-it Monger Brook, including the Conservation Category wetland section, was categorised as 'Degraded' supporting no or very few native understorey plants, litter, high grazing levels and was dominated by weeds. There were no significant differences in the vegetation structure, floristic composition, condition or values between the Conservation Category section of the Ki-it Monger Brook, the Multiple Use section and the un-classified section.

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1 INTRODUCTION

1.1 PROJECT BACKGROUND

RPS Group Pty Ltd (RPS) is delivering planning services for an area of 'Rural' zoned land immediately east of the Bullsbrook townsite, consisting of Lots 3, 1165, 1396, 433, 1354, 1314, 2792, 834, 1343, 382, 1288, 1391, 857, 6 and 1254. A significant portion of this land has been identified by the Western Australian Planning Authority (WAPC) as a "Future Urban Expansion" and for residential development in the City of Swan's draft Bullsbrook Townsite Expansion Master Plan. The proposed development area, referred to as the 'Development area' in this report, consists of 15 Lots (or portions of) totalling 249 ha. The Project area (482 ha) is located immediately east of the Bullsbrook townsite and approximately 35 km north-east of Perth within the City of Swan (Figure 1.1).

RPS requires an understanding of the status of the remnant vegetation, wetlands and flora, including Threatened and Priority flora, within the Project area to support future development of the site. The northern portion of the Project area form a portion (ie 43 ha) of the Burley Park and Adjacent Bushland Bush Forever site that will not be developed, and was therefore not surveyed in the field as part of this assessment. However, although occurring outside of the Project Area, Lot 382 and portions of Lots 1288 and 2792, were also surveyed Excluding the portion of the Bush Forever site, the total area surveyed for this flora and vegetation assessment is 439 ha and is referred to as the 'study area' in this report (Figure 1.1).

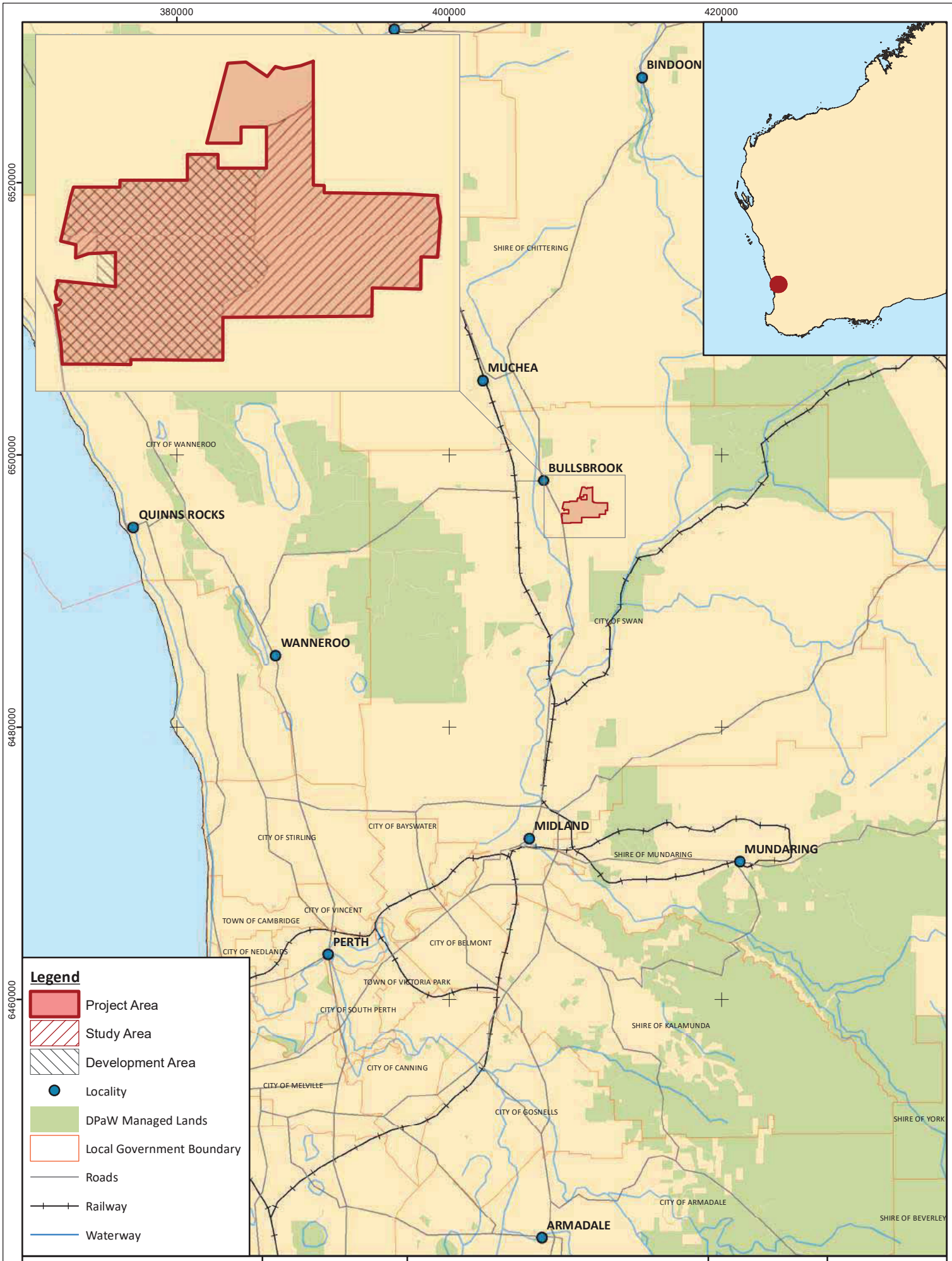
In order to assess the status of the remnant vegetation, RPS commissioned *ecologia* Environment (*ecologia*) to undertake a two-phase, Level 2 flora and vegetation assessment at the study area and as the study area is located on the Swan Coastal Plain, a wetland assessment was also conducted.

1.2 LEGISLATIVE FRAMEWORK

This assessment was undertaken as part of the WA Environmental Impact Assessment process. It considered the following government guidance documents:

- Position Statement 3: Terrestrial biological surveys as an element of biodiversity protection (EPA 2002a);
- Position Statement 4: Environmental protection of wetlands (EPA 2002b);
- Guidance Statement 51: Terrestrial flora and vegetation surveys for environmental impact assessment (EPA 2004d);
- A methodology for the evaluation of specific wetland types on the Swan Coastal Plain, Western Australia (DPaW 2013); and
- Technical Guide: Flora and vegetation surveys for environmental impact assessment (EPA & DEC 2015).

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1.3 SURVEY OBJECTIVES

The Environmental Protection Authority's (EPA) objectives with regard to the management of native flora and vegetation are to:

- Avoid adverse impacts on biological diversity comprising the different plants and the ecosystems they form, at the levels of genetic, species and ecosystem diversity;
- Maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities;
- Protect Threatened flora consistent with the provisions of the *Wildlife Conservation Act 1950*; and
- Protect other flora species of conservation significance.

The primary objective of this assessment is to provide sufficient information to the EPA to assess the impact of the proposed development on the flora and remnant vegetation of the study area, thereby ensuring that the EPA's objectives will be upheld.

Specifically providing:

- A review of background information (including existing environment review and database searches);
- An inventory of all flora species, including species of conservation significance and introduced species recorded;
- A map and detailed description of vegetation types (to National Vegetation Information Systems (NVIS) Level V: Association) occurring in the study area and an assessment of which vegetation units potentially represent TEC or PECs;
- A wetland assessment, associated with seasonal flowing creekline; Ki-it Monger Brook, in order to support any potential submissions to the Department of Parks and Wildlife (DPaW) for management classification;
- A map of the vegetation condition and discussion on the type of disturbances encountered; and
- A review of significance, including the conservation status, of species and vegetation recorded at the study area.

1.4 DEFINITIONS

1.4.1 Significant Flora

As described in EPA Guidance Statement 51 (EPA 2004b), flora may be considered conservation significant if it is:

- Declared Rare (Threatened, EPBC Act and/or WC Act, categories provided in Appendix A); or
- Priority flora (categories are provided in Appendix A).

Other reasons that flora may be significant include:

- Range extensions,
- Keystone species,
- Relic species,
- Potential novel or new species,
- Restricted subspecies, varieties or naturally occurring hybrids; and
- Local endemism and/or a restricted distribution.

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1.4.2 Introduced Flora

1.4.2.1 Weeds of National Significance

At a national level there are 32 weeds listed as Weeds of National Significance (WONS). *The Commonwealth National Weeds Strategy: A Strategic Approach to Weed Problems of National Significance* (2012b) describes broad goals and objectives to manage these weeds.

1.4.2.2 Declared Pests (Weeds)

The *Biosecurity and Agriculture Management Act 2007* (BAM Act) (Department of Agriculture and Food Western Australia; DAFWA 2007) seeks to prevent serious animal and plant pests and diseases from entering the State and becoming established, and to minimise the spread and impact of any that are already present.

The current Declared Pest, Western Australian Organism List (WAOL) was published in November 2015 (DAFWA 2013). The BAM Act categorises Declared Pests in one of three control categories; C1 Exclusion, C2 Eradication and C3 Management. These are described in Appendix A.

1.4.2.3 Environmental Weeds

A second and much more extensive categorisation of weeds has been developed by DPaW in the State Environmental Weed Strategy (Department of Conservation and Land Management (CALM) 1999). Weeds listed as Environmental Weeds are ranked into four control categories; Low, Mild, Moderate or High. These are described in Appendix A.

1.4.3 Significant Vegetation

As described in EPA Guidance Statement 51 (EPA 2004b), vegetation may be considered conservation significant if it is:

- Listed as a Threatened Ecological Community (TEC, categories provided in Appendix A); or
- The known post-European extent is below a threshold level.

Other reasons that vegetation may be significant include:

- Scarcity (based on likely distribution and landform type);
- Unusual species (based on other surveys conducted in the area);
- Novel combination of species (based on other surveys conducted in the area);
- A role as refuge (based on if the vegetation provides refuge for flora during any stress i.e. drought, fire etc. and can include gorges, phreatophytic species etc.);
- A role as a key habitat for threatened species or large populations representing a significant proportion of the local to regional total population of a species;
- Being representative of the range of a unit, at the extremes of range, recently discovered range extensions, outliers or isolated outliers of a main range; and
- A restricted distribution (based on other surveys conducted in the area).

In addition to that listed in Guidance Statement No. 51, vegetation is considered significant if it is:

- A state listed TEC or Priority Ecological Communities (PECs, categories provided in Appendix A).

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1.4.4 Number of Plants Estimates

When there was only a cover (percentage density) or a description available for records of significant flora or weeds, the number of plants was estimated from these covers or descriptions based on the information provided in Table 1.1.

Table 1.1: Number of plants estimated for records with only a cover or a description

Cover or description	No. of plants assumed for shrubs, herbs and trees	No. of plants assumed for grasses
No cover or number	1	1
Infrequent, not common, occasional, rare, scattered, sparse	1	1
Common, locally common, frequent	30	500
Abundant	50	1,000
<1% cover	1	1
1-2% cover	5	10
2-10 % cover	10	50
10-30 % cover	20	100
30-70 % cover	30	500
70-100 % cover	40	1,000

1.4.5 Criteria to Determine Likelihood of Occurrence

The criteria listed in Table 1.2 are used to determine the likelihood of occurrence of significant flora and vegetation (TEC/PECs) within the Project area as part of the literature review.

Table 1.2: Criteria used to assess the likelihood of occurrence of significant flora and vegetation

Likelihood	Criteria Significant Flora	Criteria TEC/PEC
Previously recorded	Taxon has previously been recorded in the Project area.	TEC/PEC (not including buffer) has previously been recorded in the Project area.
High	Due to the proximity of previous records (<5 km) or the presence of suitable habitat, the taxon is considered highly likely to occur within the Project area.	Due to the proximity of previous records (<5 km) or the presence of suitable habitat/geology, the TEC/PEC is considered highly likely to occur within the Project area.
Moderate	The habitat specificity of the taxon is broadly defined and habitat could possibly occur at the study area and there are records within 20 km of the Project area or there is insufficient information available to exclude the possibility of occurrence at the Project area.	The habitat specificity is broadly defined and habitat could possibly occur at the Project area, there are records within 20 km of the Project area or there is insufficient information available to exclude the possibility of occurrence at the Project area.
Low	The habitat specificity of the taxon is well defined from previous records and the habitat is considered unlikely to be present within the Project area; or there are no records within 20 km of the Project area.	The habitat specificity is well defined from previous records and the habitat is considered unlikely to be present within the Project area; or there are no records within 20 km of the Project area.

1.4.6 Managed Lands/Conservation Estate

The National Reserve System is a network of protected areas managed for conservation under international guidelines. The objective of placing areas of bushland into the Conservation Estate is to achieve and maintain a comprehensive, adequate and representative reserve system for Western Australia.

1.4.7 Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are areas that require special protection due to aspects such as landscape, wildlife of historical value and are declared under Section 51B of the *Environmental Protection Act 1986* (EP Act).

1.4.8 Bush Forever Sites

The Bush Forever strategy is a 10 year strategic plan that was published by the Western Australia Planning Commission. Bush Forever formally commenced in 2000 to protect approximately 51,200 ha of regionally significant bushland within approximately 290 Bush Forever sites across Western Australia.

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1.4.9 Geomorphic Wetlands

Wetlands are areas that are permanently, seasonally or intermittently inundated with water and can include lakes (permanently inundated basins), sumplands (seasonally inundated basins), damplands (seasonally waterlogged basins), playas (intermittently inundated basins), palusplains (seasonally waterlogged flats), barlkarras (intermittently inundated flats), paluslopes (seasonally waterlogged slopes) and palusmonts (seasonally waterlogged highlands) (Hill *et al.* 1996).

Hill *et al.* (1996) categorised wetlands occurring on the Swan Coastal Plain into levels of protection and management categories. Three management categories are recognised and are described below:

- *Conservation Category Wetlands:* are the highest priority wetlands that support high levels of attributes and functions and account for approximately 20 percent of the wetlands. The management objectives are to preserve and protect existing conservation values;
- *Resource Enhancement Wetlands:* have been partly modified but still support substantial functions and attributes and the objective is to manage, restore and protect towards improving their conservation value; and
- *Multiple Use Wetlands:* have few important ecological attributes and functions remaining and the use, development and management should be considered in the context of ecologically sustainable development. About 72% of wetlands have been degraded to the extent that they are not a priority for conservation.

Wetland mapping is available in the Geomorphic Wetlands Swan Coastal Plain dataset, which displays the location, boundary, classification (wetland type) and the management category.

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2 LITERATURE REVIEW

2.1 EXISTING ENVIRONMENT

2.1.1 Biogeographic Region

The Interim Biogeographic Regionalisation for Australia (IBRA) (Version 7) classifies the Australian continent into regions (bioregions) of similar geology, landform, vegetation, fauna and climate characteristics, and has currently 89 recognised regions (DSEWPaC 2012a). The Project area is located across the boundary of the Swan Coastal Plain and the Jarrah Forest IBRA regions (Figure 2.1).

The Swan Coastal Plain IBRA region is comprised of two subregions, the Swan Coastal Plain and the Dandaragan Plateau. The Project area straddles both of these subregions:

- The Dandaragan Plateau subregion is characterised by Cretaceous marine sediments and mantled by sands and laterites. 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).
- The Swan Coastal Plain subregion is characterised by a low lying coastal plain mainly covered by woodlands. Vegetation is dominated by *Banksia* or Tuart on sandy soils. *Casuarina obesa* is characteristics on outwash plains and Paperbark in swampy areas. In the east Jarrah woodland are seen on elevated plains (Mitchell *et al.* 2002).

The Jarrah Forest IBRA region is comprised of two subregions, the Northern Jarrah Forest and the Southern Jarrah Forest. The Project area is located in the Northern Jarrah Forest subregion:

- The Northern Jarrah Forest subregion is characterised by Jarrah-Marri Forest over lateritic gravel. Woodlands of Wandoo and Marri are seen on clayey soils in the east and in areas with Mesozoic sediment, Jarrah forests occur with a variety of other flora species (Williams and Mitchell 2001).

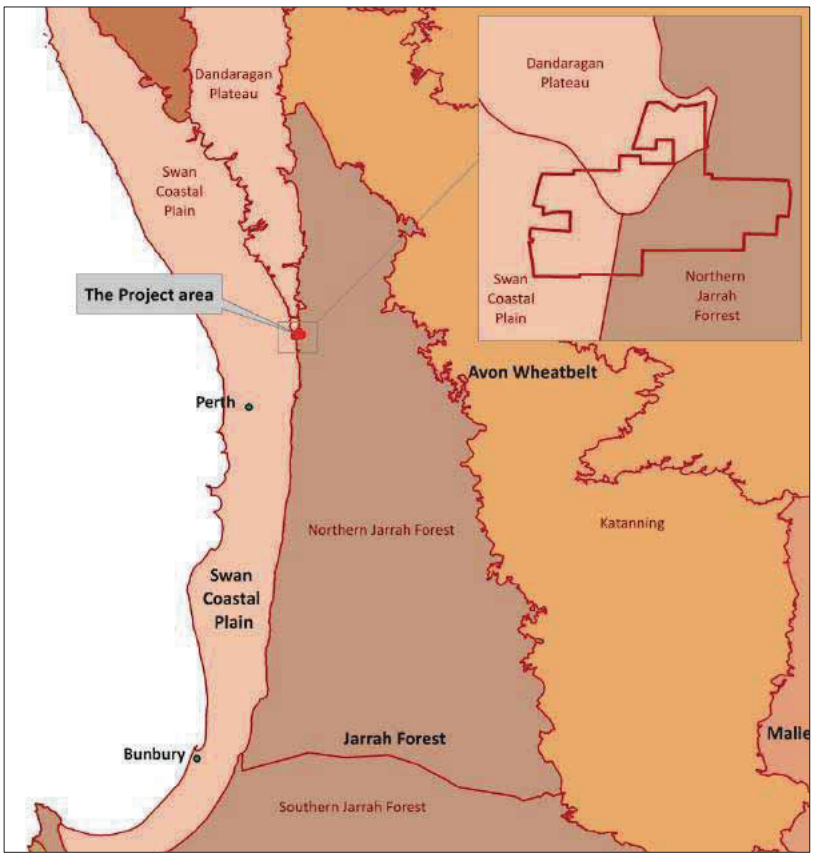


Figure 2.1: IBRA biogeographic regions and subregions of the Project area

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2.1.2 Climate

The Project area experiences a dry Mediterranean climate with a hot dry summer from December to March and a mild winter from June to August. Data from approximately 2 km south of the Project area (weather station Pearce RAAF; Bureau of Meteorology (BoM) station number 9053), indicate that the annual mean maximum temperature is 25.2°C and the mean minimum temperature is 12.2°C. The mean annual rainfall is 667.2 mm with the majority of rain falling between June to August (BoM 2016). Section 3.1.2 presents climate data for the Project area in more detail.

2.2 MANAGED AND SIGNIFICANT LANDS

2.2.1 DPaW Managed Lands

There are no DPaW managed lands within the Project area. The closest are Walyunga National Park located 2.5 km south, Bullsbrook Nature Reserve located 3.5 km north-west and conservation reserve 46564 located 2.5 km north of the Project area (Figure 2.2).

2.2.2 ESAs

A number of known ESAs occur at the Project area, including the bush forever site in the northern area and buffers surrounding the conservation category wetlands to the west (Figure 2.2 and Figure 2.3). TECs are present to the south-west of the Project area (Section 2.3.2.6).

2.2.3 Bush Forever

There is one Bush Forever Site (Site 86) located within the Project area, and three additional sites occurring within 1 km of the Project area (Table 2.1, Figure 2.2 and Figure 2.3). Vegetation complexes and structural units associated with these sites are described in Table 2.11, Section 2.3.2.4 (Department of Environmental Protection 2000).

Table 2.1: Bush Forever sites within or in close proximity to the Project area

Site	Name	Location
86	Burley Park and Adjacent Bushland, Bullsbrook	43 ha within northern portion of Project area
88	Ashton Road Bushland, Bullbrook	300 m north
89	Maroubra Avenue Bushland, Bullsbrook	Adjacent west
294	Pearce Aerodrome and Adjacent Bushland, Bullsbrook	100 m west

2.2.4 Wetlands

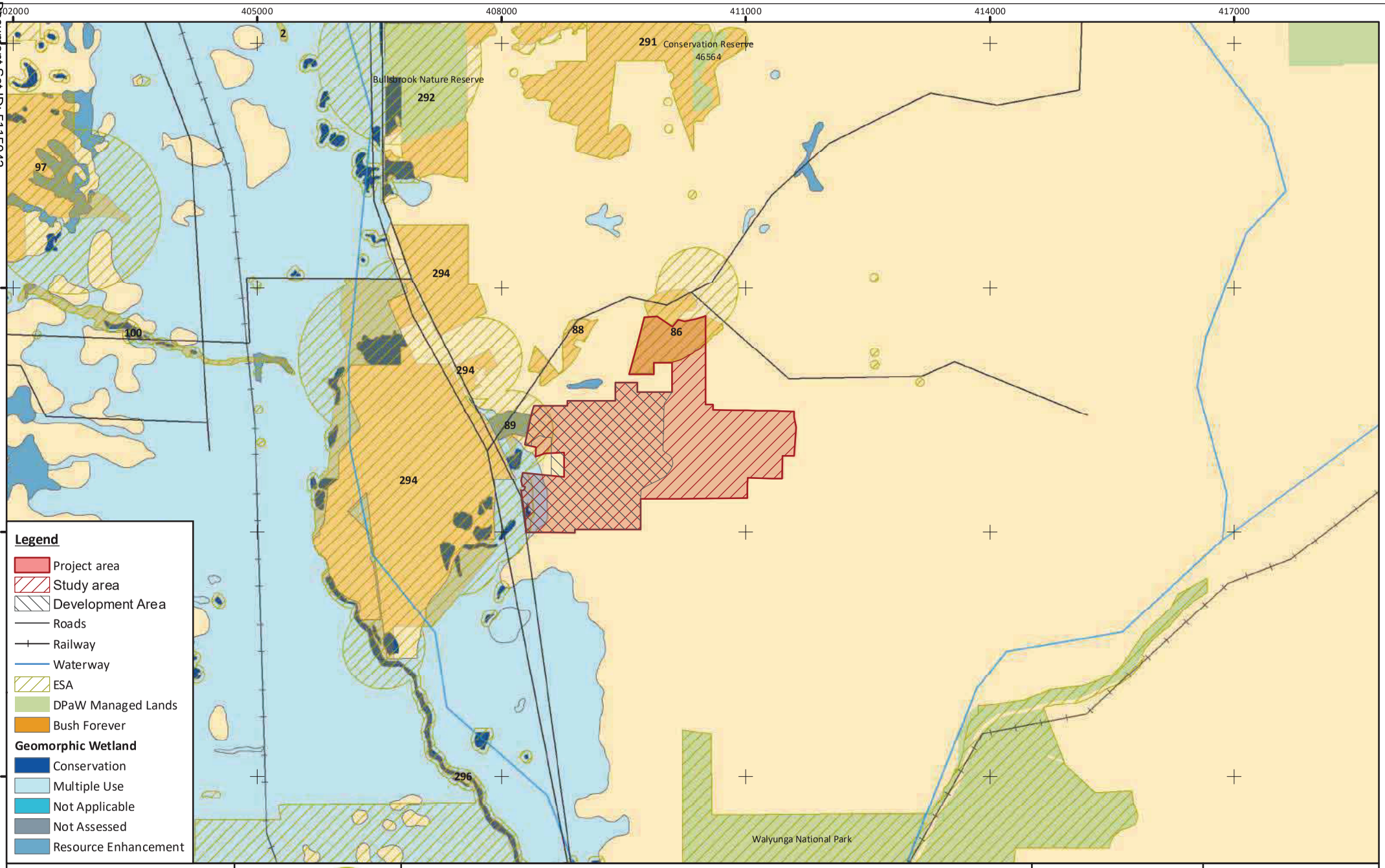
There are a number of geomorphic wetlands to the south-west of the Project area associated with the Ki-it Monger Brook. Two occur within the Project area; one is classified as a Conservation Category (Palusplain) Wetland (UFI 2691) which may support high levels of attributes and functions and one is a Multiple Use Palusplain Wetland which is likely to have few important ecological attributes and functions remaining (Table 2.2, Figure 2.3).

Table 2.2: Geomorphic wetlands occurring within the Project area

UFI	Wetland Name	Classification	Evaluation	Location
7577	n/a	Palusplain	Multiple Use	0.7 ha within south-west area of Project area
2691	n/a	Palusplain	Conservation	18.2 ha within south-west area of Project area

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0 1 2
Kilometres

Absolute Scale - 1:60,000

ecologia ENVIRONMENT

Managed and significant lands in the vicinity of the Project area

Figure: 2.2
Project ID: 1621

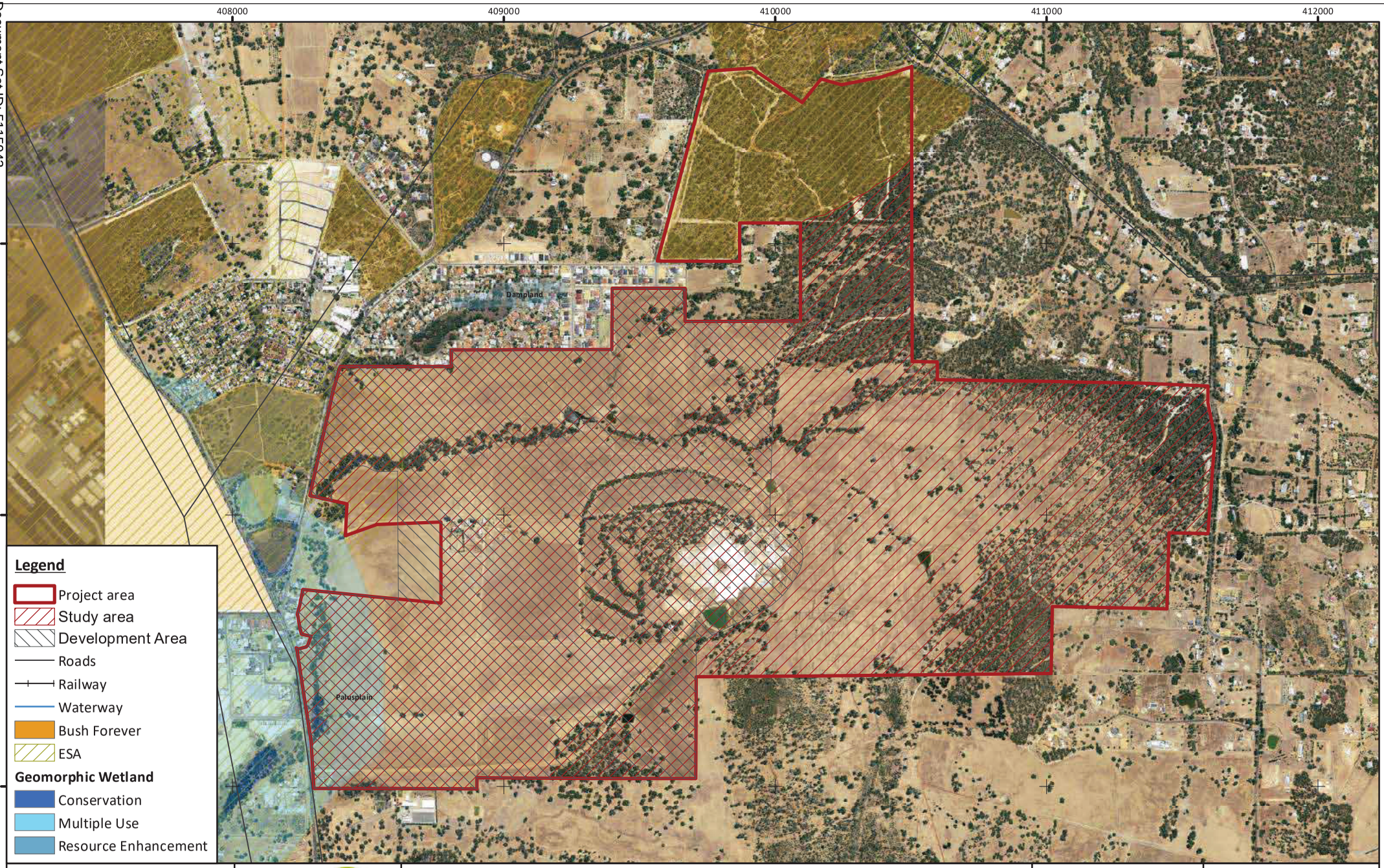
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Datum: GDA 1994

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Version: 7, Version Date: 11/12/2024



Geomorphic Wetlands, ESAs and Bush Forever sites at the Project area

Figure: 2.3
Project ID: 1621

Drawn: MY
Date: 29/06/2016

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

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Version: 1, Version Date: 10/10/2024

2.3 PREVIOUSLY KNOWN FLORA AND VEGETATION SURVEYS

A search of the databases listed in Table 2.3 was undertaken for the literature review, prior to the field surveys, to determine species and communities previously recorded in the vicinity or within the Project area.

Table 2.3: Flora and vegetation databases searched for the literature review

Database	Custodian	Search Details
EPBC Act Protected Matters Database	DoE	Records of EPBC Act significant species within 5 km of the Project area.
Threatened and Priority flora Database (TPFL)	DPaW	Records of significant flora within 5 km of the Project area (Search reference 38-1014FL).
Threatened and Priority flora List (TPList)	DPaW	Records of significant flora by place names within 5 km of the Project area (Search reference 38-1014FL).
Western Australian Herbarium Specimen Database (WAHERB)	DPaW	Records of significant flora within 5 km of the Project area (Search reference 38-1014FL).
Threatened and Priority Ecological Communities Database	DPaW	Records of TEC/PECs within 10 km of the Project area (Search reference 37-01014EC).
Nature Map	DPaW	All flora records within 3 km circle of the centre point of the Project area.

In addition surveys that encompassed the Project area, or have been conducted in the vicinity of the area and are publically available, were included in the literature review. These are listed in Table 2.4.

Table 2.4: Previous flora and vegetation assessments used for the literature review

Reference	Location	Description
Beard (1981) / Shepherd *et al.* (2001)	Encompassed Project area	Vegetation survey conducted by Beard across Western Australia (mapped at 1:1,000,000 for the Swan area). This mapping was subsequently reinterpreted to reflect the NVIS standards and digitised by Shepherd.
Heddle *et al.* (1980)	Encompassed Project area	Broad vegetation complexes based on vegetation in association with landforms and underlying geology.
Gibson *et al.* (1994)	Encompassed west section of Project area	Floristic community types in super groups were described for the Swan Coastal Plain.
(Chittering Landcare Centre 2008)	6 km west of Project area	Foreshore assessment, flora and fauna survey for three areas in the Lower Ellen Brook catchment.
360 Environmental (2012)	8 km south-west of Project area	Level 2 flora and vegetation survey for the North Ellenbrook Project area.
Emerge Associates (2013)	10 km north of Project area	Level 2 flora and vegetation survey for the PT Lot M1313 Great Northern Highway Project area.

2.3.1 Flora

There were 103 native flora species identified from the Nature Map database searches as occurring within 3 km of the centre point of the Project area. The most common native families were Fabaceae and Myrtaceae (8 taxa each) and Poaceae and Asparagaceae (7 taxa each) and the most common genera were *Stylidium* (5 taxa) and *Acacia*, *Hakea* and *Xanthorrhoea* (3 taxa each). A potential species list is provided in Appendix B. Additionally, 20 Threatened (Table 2.6) and 36 Priority flora taxa (Table 2.7) were recorded during the literature review and these are listed and discussed overleaf.

2.3.1.1 Species Richness

The species richness of the Level 2 flora and vegetation assessments conducted in the vicinity of the Project area are listed in Table 2.5.

Table 2.5: Species richness for surveys conducted in the vicinity of the Project area

Reference	Survey	Area (ha)	Description	Number of native species	Number of introduced species	Most common native families	Most common native genera
360 Environmental (2012)	Level 2 One phase	1,000	Most of the area surveyed were native bushland	181 (80.1%)	45 (19.9%)	Myrtaceae (16 taxa) Cyperaceae (8 taxa)	*Stylidium* (8 taxa) *Lomandra* (6 taxa)
Emerge Associates (2013)	Level 2 One phase	150	Most of the area surveyed was disturbed	72 (68%)	34 (32%)	Myrtaceae (21 taxa) Fabaceae (12 taxa)	*Eucalyptus* (9 taxa) *Melaleuca* (6 taxa)

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2.3.1.2 Threatened Flora

Six Threatened flora taxa have been previously recorded within 5 km of the Project area, of which one, *Acacia anomala,* has previously been recorded with four records (three locations) within the Project Area. Two Threatened flora taxa have a high likelihood of occurrence – *Grevillea curviloba* subsp*. curviloba* and *Grevillea curviloba* subsp*. incurva* – and the remaining three have a moderate or low likelihood of occurrence (Figure 2.4, Table 2.6).

In addition to these six taxa, 15 other Threatened flora taxa were recorded during the database searches or other surveys conducted in the area, but have no known locations from within 5 km of the Project area itself (Table 2.6).

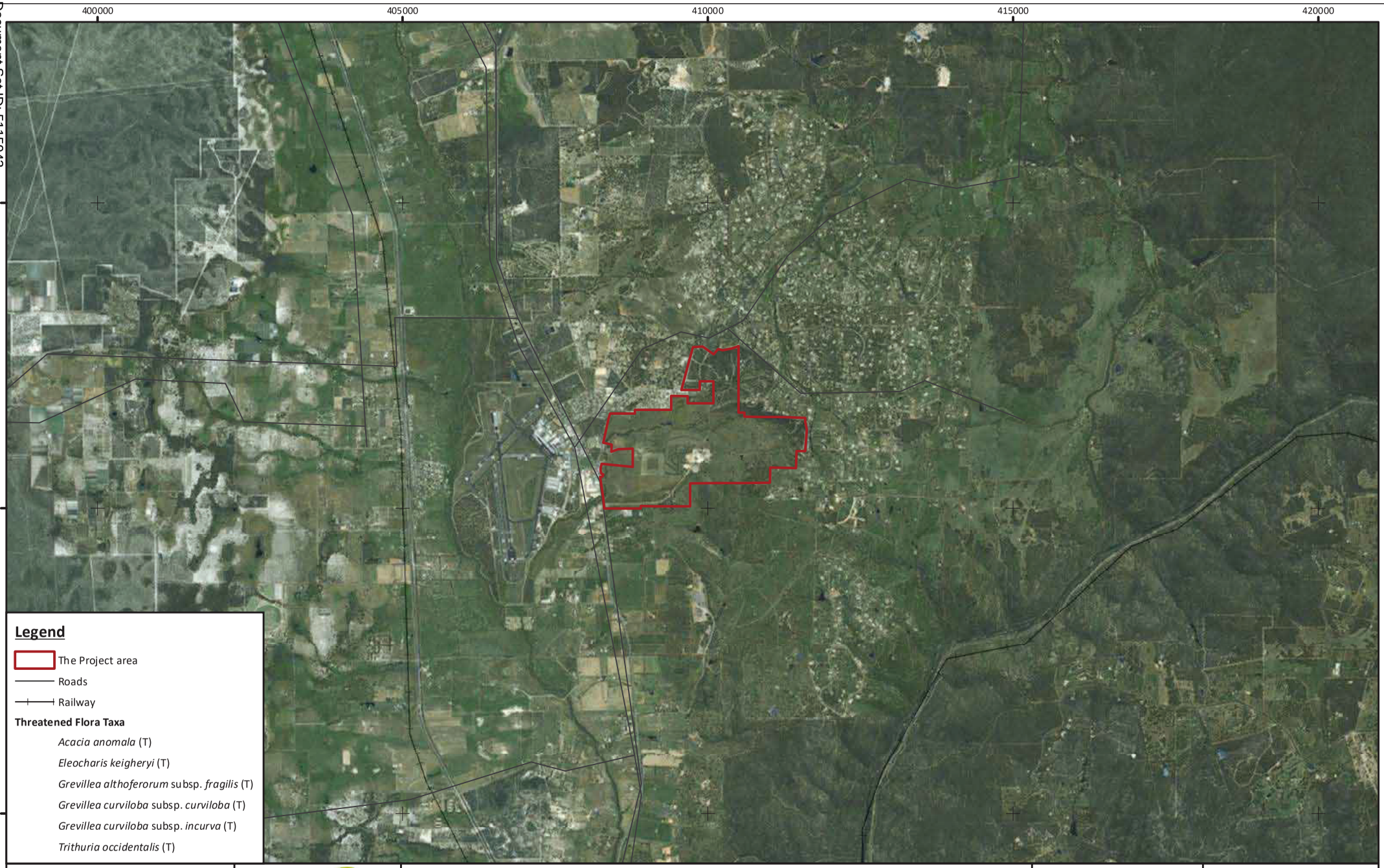
An assessment on the likelihood of the Threatened taxa occurring within the Project area was conducted (Table 2.6), using the criteria listed in Table 1.2.

Table 2.6: Threatened flora recorded during the literature review

Status	Taxa	Habitat	Distance from study area	Likelihood of occurrence at the Project area
Threatened	*Acacia anomala*	Lateritic soils. Slopes.	Recorded	Previously recorded (from Bush Forever Site 86)
Threatened	*Andersonia gracilis*	White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps.	> 5 km	Low
Threatened	*Anigozanthos viridis* subsp. *terraspectans*	Grey sand, clay loam. Winter-wet depressions.	> 5 km	Low
Threatened	*Caladenia huegelii*	Grey or brown sand, clay loam.	> 5 km	Low
Threatened	*Centrolepis caespitosa*	White sand, clay. Salt flats, wet areas.	> 5 km	Low
Threatened	*Chamelaucium* sp. Gingin (N.G.marchant 6)	Undulating plain. Yellow dry sand. Hillslopes.	> 5 km	Low
Threatened	*Conospermum densiflorum* subsp. *unicephalatum*	Clay soils. Low-lying areas.	> 5 km	Low
Threatened	*Darwinia foetida*	Grey sand. Winter wet areas. Poorly drained.	> 5 km	Low
Threatened	*Eleocharis keigheryi*	Clay, sandy loam. Emergent in freshwater: creeks, claypans.	2.3 km south-west	Moderate
Threatened	*Eucalyptus balanites*	Sandy soils with lateritic gravel.	> 5 km	Low
Threatened	*Eucalyptus leprophloia*	White or grey sand over laterite. Valley slopes.	> 5 km	Low
Threatened	*Grevillea althoferorum* subsp. *fragilis*	Undulating plain. Grey sand over yellow sand.	4.5 km north	Moderate
Threatened	*Grevillea christineae*	Valley slope outcrop. Brown sand / loam / clay over granite boulder.	> 5 km	Low
Threatened	*Grevillea corrugata*	Gravelly loam. Roadsides.	> 5 km	Low
Threatened	*Grevillea curviloba* subsp. *curviloba*	Grey sand. Winter-wet heath.	0.3 km north	High
Threatened	*Grevillea curviloba* subsp. *incurva*	Sand, sandy loam. Winter-wet heath.	0.3 km north	High
Threatened	*Grevillea flexuosa*	Red-brown sand with laterite & gravel, sand over granite. Ridgetop plateau & associated breakaways.	> 5 km	Low
Threatened	*Thelymitra dedmaniarum*	Granite.	> 5 km	Low
Threatened	*Thelymitra stellata*	Sand, gravel, lateritic loam.	> 5 km	Low
Threatened	*Trithuria occidentalis*	Muddy clay.	4.8 km south	Low

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2.3.1.3 Priority flora

Sixteen Priority flora taxa have been recorded within 5 km of the Project area (Figure 2.5), none of which have previously been recorded within the Project area itself. On the basis of the desktop assessment, two of these taxa; *Schoenus capillifolius* (P3) and *Stylidium longitubum* (P3) are considered to have a high likelihood of occurrence within the study area (Table 2.7), although this was not borne out from the field assessment results (Section 5.1).

In addition to these 16 taxa, 20 other Priority flora were identified from the database searches or other previous surveys in the vicinity, but are not known from within 5 km of the Project area (Table 2.7).

Table 2.7: Priority flora recorded during the literature review

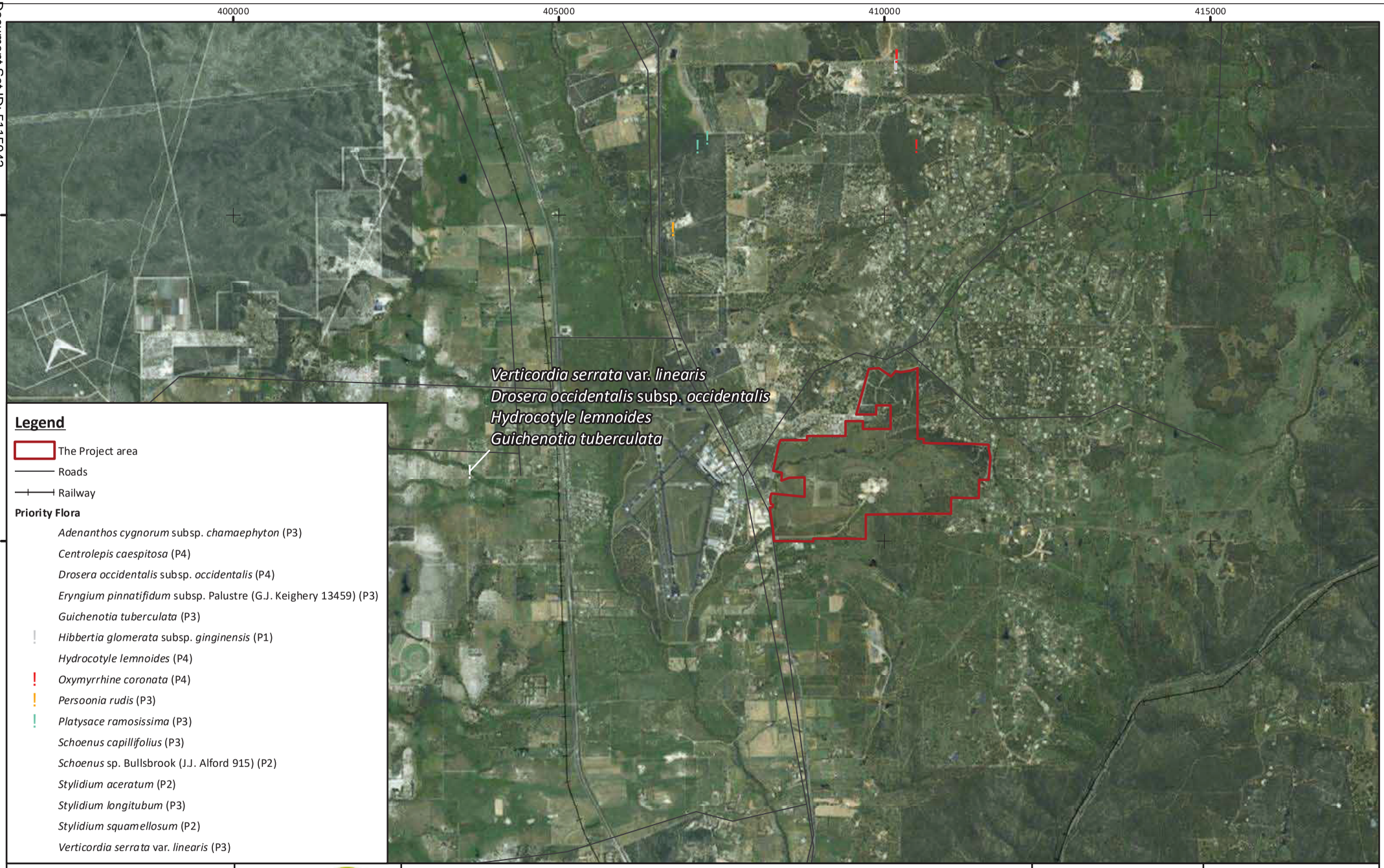
Status	Taxa	Habitat	Distance from study area	Likelihood of occurrence at the study area
Priority 1	*Drosera sewelliae*	Laterite & silica sand soils.	> 5 km	Low
	Gastrolobium crispatum	Yellow or brown sandy loam, red laterite soils. Steep gullies, slopes, ridges, breakaways.	> 5 km	Low
	Hibbertia glomerata subsp. *ginginensis*	Sand, brown clay, laterite. Near roadsides.	4.8 km north	Moderate
Priority 2	*Gastrolobium nudum*	Red-brown clay, brown loam, gravel, laterite, granite. Flats, slopes, hilltops, ridges, valleys, breakaways.	> 5 km	Low
	Grevillea candolleana	Laterite, lateritic loam. Hillsides.	> 5 km	Low
	Schoenus sp. Bullsbrook (J.J. Alford 915)	Low lying flat, grey peaty sand over clay.	4.8 km south	Low
	Stenanthemum sublineare	Littered white sand. Coastal plain.	> 5 km	Low
	Stylidium aceratum	Seasonal swamp; Black damp sand and sandy soils.	3.5 km north	Low
	Stylidium squamellosum	Brown to red-brown clay loam. Winter-wet habitats and depressions, open woodland, shrubland.	4.4 km north	Low
	Tetraria sp. Chandala (G.J. Keighery 17055)	Mound spring, black peaty sand. Swamps.	> 5 km	Low
Priority 3	*Acacia drummondii* subsp. *affinis*	Lateritic gravelly soils.	> 5 km	Low
	Acacia oncinophylla subsp. *oncinophylla*	Granitic soils, occasionally on laterite.	> 5 km	Low
	Adenanthos cygnorum subsp. *chamaephyton*	Grey sand, lateritic gravel.	4 km north	Low
	Chamaescilla gibsonii	Clay to sandy clay. Winter-wet flats, shallow water-filled claypans.	> 5 km	Low
	Cyathochaeta teretifolia	Grey sand, sandy clay. Swamps, creek edges.	> 5 km	Low
	Eryngium pinnatifidum subsp. Palustre (G.J. Keighery 13459)	Clay, sandy clay. Claypans, seasonally wet flats.	4.7 km north	Low
	Guichenotia tuberculata	Sand clay over laterite, sand.	4.6 km west	Moderate
	Haemodorum loratum	Grey or yellow sand, gravel.	> 5 km	Low
	Halgania corymbosa	Gravelly soils, soils over granite.	> 5 km	Low
	Meionectes tenuifolia	Sand or clay. Wetlands and Swamps.	> 5 km	Low
	Persoonia rudis	White, grey or yellow sand, often over laterite.	3.8 km north-west	Low
	Platysace ramosissima	Sandy soils.	4.6 km north-west	Low
	Schoenus capillifolius	Brown mud. Claypans – but see Section 5.1	0.6 km west	High
	Stylidium asteroideum	Shallow/flat drainage line with damp sand/loam/clay.	> 5 km	Low
	Stylidium longitubum	Sandy clay, clay. Seasonal wetlands – but see Section 5.1	0.7 km west	High
	Stylidium paludicola	Winter-wet flats; brown sandy-clay.	> 5 km	Low
	Stylidium trudgenii	Margins of winter-wet swamps, depressions. Grey sand, dark grey to black sandy peat.	> 5 km	Low
	Verticordia serrata var. *linearis*	White sand, gravel. Open woodland.	4.7 km west and north	Low
Priority 4	*Centrolepis caespitosa*	White sand, clay. Salt flats, wet areas.	0.7 km west	Moderate
	Darwinia pimelioides	Loam, sandy loam. Granite outcrops.	> 5 km	Low
	Drosera occidentalis subsp. *occidentalis*	Sandy and clayey soils. Swamps and wet depressions.	4.7 km west	Low
	Hydrocotyle lemnoides	Swamps.	4.6 km west	Low
	Oxymyrrhine coronata	Slope with dry laterite gravel and boulders.	3.5 km north	Low
	Synaphea grandis	Laterite.	> 5 km	Low
	Tripterococcus paniculatus	Grey, black or peaty sand. Winter-wet flats.	> 5 km	Low

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Status	Taxa	Habitat	Distance from study area	Likelihood of occurrence at the study area
	Verticordia lindleyi subsp. *lindleyi*	Sand, sandy clay. Winter-wet depressions.	> 5 km	Low

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2.3.1.4 Introduced Flora

Seventy-seven introduced plant species were recorded from the literature review as occurring in the vicinity of the Project area. Of these, seven were classified as WONS, one as a Declared Plant (for the whole of the state) and the remaining 69 as permitted environmental weeds. The WONS and declared weeds are listed below and the environmental weeds are listed in the potential species list in Appendix B.

- WONS: *Asparagus asparagoides* (Asparagus), *Chrysanthemoides monilifera* (Bitou Bush), *Genista* sp., *Lantana camara* (Lantana), *Lycium ferocissimum* (African Boxthorn), *Rubus fruticosus* aggregate (Blackberry) and *Salvinia molesta* (Salvinia).
- Declared (C3): *Zantedeschia aethiopica* (Arum Lily).

The percentage of introduced flora recorded from the two previous Level 2 flora and vegetation assessments undertaken in the vicinity of the Project area are listed in Table 2.5. Both surveys had expectedly high percentages of introduced species with 19.9% (360 Environmental 2012) and 32% (Emerge Associates 2013) of the total species recorded introduced.

2.3.2 Vegetation

2.3.2.1 Beard and Shepherd

Beard *et al.* mapped the vegetation of Western Australia over a series of maps from 1974 to 1981 and separated the state in various provinces and districts. The west of the Project area occurs within the Drummond Sub-district and the east occurs within the Dale Sub-district of the South-west Botanical Province. The Beard vegetation mapping was subsequently reinterpreted to reflect the National Vegetation Information System (NVIS) standards, revised taxonomy and was digitised by Shepherd *et al.* (2001). Two vegetation associations and one mosaic of these two associations were mapped within the Project area and are presented below in Table 2.8. Both of the associations are very widespread across Western Australia and have been mapped extensively in the south-west.

Table 2.8: Beard vegetation units mapped at the study area

Code	Description	Current Extent (ha)	Pre-European extent (ha)	Remaining (%)
3	Medium forest; Jarrah-Marri	1,860,865	2,707,678	68.7
4	Medium woodland; Marri & Wandoo	276,471	1,127,124	24.5
1020	Mosaic: 3/4	1,669	5,610	29.7

2.3.2.2 Heddle Vegetation Complexes

The vegetation of the Swan Coastal Plain has been mapped at a regional scale by Heddle *et al.* (1980) in correlation to the major geological units of Churchward and McArthur (1980). The Project area supports five vegetation complexes: Darling Scarp, Forrestfield, Guildford, Reagan and Yalanbee and these are presented in Table 2.9.

Table 2.9: Heddle vegetation complexes mapped at the study area

Complex	Landform	Vegetation	Area (ha) & description in Project area	Pre-European Extent (ha)	2015 extent (ha, %)
Darling Scarp Complex	Scarp	Vegetation ranges from a low open woodland to lichens according to the depth of the soil. Woodland components chiefly *E. wandoo*, with *E. laeliae* in the north, *E. haematoxylon* in the south, and *C. calophylla* throughout the region.	64.8 ha - associated with the steep slopes of the eastern side of the Project area. Generally in Good condition.	35,512	14,649 (41.3%)
Forrestfield Complex	Foothills	Dominated by open forest of *C. calophylla – E. wandoo – E. marginata* (on the heavier soils) to open forest of *E. marginata – C. calophylla*, *Allocasuarina fraseriana – Banksia* spp. (on the sandier soils). Fringing woodland of *E. rudis* and *Melaleuca rhaphiophylla* are in gullies and watercourses.	0.1 ha - a very small area mapped with a patch of Guildford complex on a Completely degraded area.	21,210	2,448 (11.5%)

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Complex	Landform	Vegetation	Area (ha) & description in Project area	Pre-European Extent (ha)	2015 extent (ha, %)
Guildford Complex	Pinjarra Plain	A mixture of open forest to tall open forest of *C. calophylla – E. wandoo – E. marginata* and woodland of *E. wandoo* (with minor components occurrences of E. lane-poolei). Minor components include *E. rudis* and *M. rhaphiophylla*.	9.6 ha - mostly associated with the Ki-Monger Brook that runs through the Project area as well as a small area in the southern area of the Project area.	92,340	4,936 (5.3%)
Reagan Complex	Gingin scarp	Vegetation ranges from low open woodland of *Banksia* species and *E. todtiana* to closed heath depending on the depth of the soil	23.0 ha - associated with the Bush Forever site in the northern section of the Project area. Not to be developed.	9,081	3,035 (33.4%)
Yalanbee	Darling Plateau	Open forest of *E. marginata – C. calophylla*	14.8 ha - associated with the hill top in the south-east of the Project area. Some areas are in Good condition, mostly is degraded.	199,021	93,351 (46.9%)

2.3.2.3 Gibson FTCs

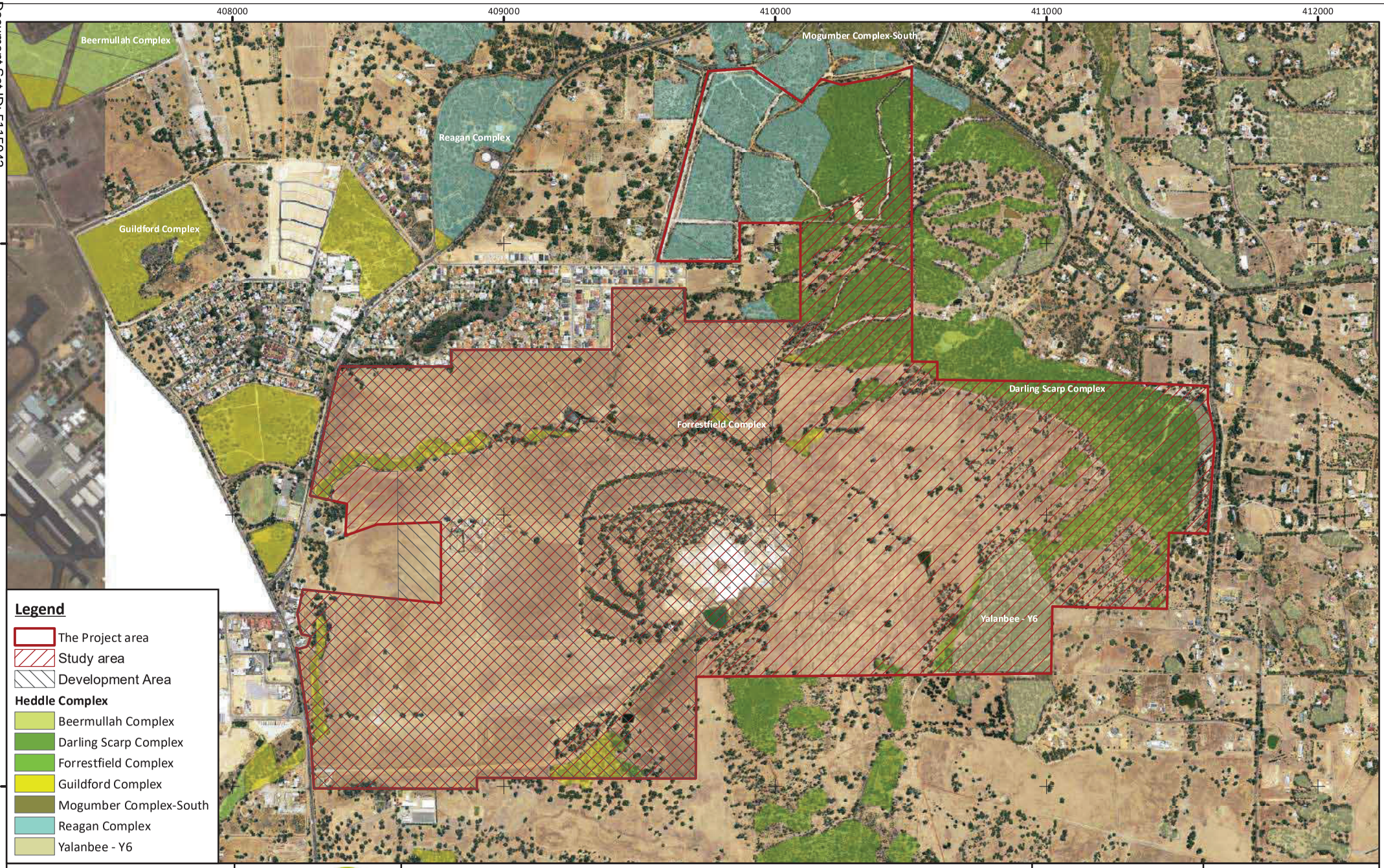
Gibson *et al.* (1994) florstically sampled 22 quadrats within 8 km of the Project area which were assigned to nine FTCs (Table 2.10). Four of these FTCs represent either TECs or PECs and are considered significant (Table 2.10, Table 2.14).

Table 2.10: FTCs recorded within 8 km of the Project area

FTC	Status	Description	Typical and common species
3c	TEC	*Eucalyptus calophylla – Xanthorrhoea preissii* woodlands and shrublands	*Eucalyptus calophylla, Xanthorrhoea preissii, *Briza maxima, Burchardia umbellata, Cyathochaeta avenacea, Neurachne alopecuroidea, *Romulea rosea, Acacia pulchella, Dryandra nivea, Gompholobium marginatum, Hypocalymma angustifolium, Caesia micrantha, Drosera menziesii subsp. penicillaris, *Hypochaeris glabra, Lepidosperma sp., Loxocarya flexuosa, Mesomelaena tetragona, Opercularia vaginata, Sowerbaea laxiflora, Stipa Pycnostachya, Tetraria octandra, Thysanotus manglesianus/patersonii.*
5	-	Mixed shrub damplands	**Hypochaeris glabra, Hypolaena exsulca* and *Siloxerus humifusus*, *Kunzea ericifolia*, *Pericalymma ellipticum, *Aira caryophyllea, *Briza maxima, *Briza minor, Caladenia flava, Mitrasacme paradoxa, Quinetia urvillei, Trachymene pilosa, *Ursinia anthemoides.*
6	-	Weed dominated wetland on heavy soils	**Hypochaeris glabra* and **Briza maxima*, *Hypocalymma angustifolium, *Ehrharta calycina, *Ehrharta longiflora, *Monadenia bracteata, *Romulea rosea*, **Ursinia anthemoides*.
7	TEC	Herb rich saline shrubland sin clay pans	**Briza minor, Centrolepis aristata* and *Philydrella pygmaea*, *Melaleuca viminea, Brachyscome bellidioides, *Briza maxima, Centrolepis polygyna, *Cicendia filiformis, Goodenia micrantha, *Hypochaeris glabra, Pogonolepis stricta, Polypompholyx multifida, Schoenus odontocarpus, Siloxerus humifusus, Thysanotus manglesianus/patersonii.*
11	-	Wet forests and woodlands	*Eucalyptus rudis, Astartea aff. fascicularis, *Briza maxima, Lepidosperma longitudinale, *Hypochaeris glabra.*
15	TEC – WC Act	Forests and woodlands of deep seasonal wetlands	*Melaleuca rhaphiophylla, Melaleuca teretifolia, Cotula coronopifolia, Crassula natans, *Cynodon dactylon, Isolepis producta, Lemna disperma, Triglochin procerum.*
21c	PEC	Low lying *Banksia attenuata* woodlands or shrublands	*Banksia attenuata, Banksia menziesii, Gompholobium tomentosum, Kunzea ericifolia, Leucopogon conostephioides, Petrophile linearis, Scholtzia involucrata, *Briza maxima, *Hypochaeris glabra, Lomandra caespitosa, Lyginia barbata, Thysanotus manglesianus/patersonii, Trachymene pilosa, Burchardia umbellata, Caladenia flava, Dasypogon bromeliifolius, Drosera erythrorhiza, Hypolaena exsulca, Lomandra hermaphrodita, Patersonia occidentalis, Stylidium brunonianum, Stylidium repens, *Ursinia anthemoides.*
23a	-	*Banksia attenuata – Banksia menziesii* woodlands	*Banksia attenuata, Banksia menziesii, Bossiaea eriocarpa, Gompholobium tomentosum, Leucopogon conostephioides, Petrophile linearis, Scholtzia involucrata, Adenanthos cygnorum, Calytrix flavescens, Conostephium pendulum, Eriostemon spicatus, Hibbertia hypericoides, Hibbertia subvaginata, Hovea trisperma, Xanthorrhoea preissii, Burchardia umbellata, Conostylis juncea, Dampiera linearis, Drosera erythrorhiza, *Hypochaeris glabra, Lomandra hermaphrodita, Lyginia barbata, Patersonia occidentalis, Schoenus curvifolius, Stylidium piliferum, Trachymene pilosa.*
28	-	Spearwood *Banksia attenuata* or *Banksia attenuata – Eucalyptus woodlands*	*Banksia attenuata, Hibbertia hypericoides, Xanthorrhoea preissii, Acacia pulchella var. pulchella, Conostephium pendulum, Gompholobium tomentosum, Petrophile linearis, Burchardia umbellata, Drosera erythrorhiza, Loxocarpa flexuosa, Mesomelaena pseudostygia, Trachymene pilosa.*

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2.3.2.4 Bush Forever site vegetation

Vegetation complexes and structural units associated with the four Bush Forever sites within, or in close proximity to, the Project area are provided in Table 2.11.

Table 2.11: Vegetation Complexes and structural units of Bush Forever sites within or in close proximity to the Project area

Site	Vegetation Complex and Structural Unit(s)
86	**Mogumber Complex – South (Dandaragan Plateau)** **Reagan Complex (Dandaragan Plateau**) Uplands: *Eucalyptus accedens* and *E. wandoo* Woodland*; Eucalyptus accedens, Corymbia calophylla* and *Eucalyptus marginata* Open Forest to Woodland; *Allocasuarina humilis* and *Calytrix angulata* Open Heath; *Corymbia calophylla* and *Eucalyptus marginata* Low Woodland to Low Open Forest*; Eucalyptus marginata* and *E. accedens* Woodland Wetlands: *Eucalyptus rudis and Corymbia calophylla* Woodland to Open Forest
88	**Reagan Complex (Dandaragan Plateau)** **Guildford Complex** Uplands: *Corymbia calophylla* and *E.marginata* Open Woodland; *Corymbia calophylla* and *E. wandoo* Woodland to Open Forest; *Eucalyptus marginata* Woodland; scattered *Corymbia calophylla* over *Banksia attenuata* and *B. menziesii* Low Woodland; mixed Open Low Heath
89	**Guildford Complex** Uplands: *Eucalyptus wandoo* Open Woodland Wetlands: *Eucalyptus wandoo* Open Woodland; *Hakea prostrata, Jacksona sternbergiana, Daviesia horrida* and *Xanthorrhoea preissii* Shrubland; *Hypoclaymma nhustifolium* Open Low Heath; Sedgeland, Herbland
294	**Reagan Complex (Dandaragan Plateau)** **Guildford Compex** **Yanga Complex** **Beermullah Complex** Uplands: *Banksia attenuata* and *B. menziesii* Woodland with scattered *Eucalyptus todtiana; Corymbia calophylla* Woodland; *Eucalyptus wandoo* Tall Woodland. Wetlands: *casuarina obesa* Woodland; *Acacia saligna* Low Woodland; Scattered *Eucalyptus wandoo* over *Xanthorrohea preissii, Acacia lasiocarpha* var. *bracteolata* and *Hycalymma angustifolium* Open Low Heath; *Kunzea* aff. *recurva* Shrubland; *Melaleuca rhaphiophylla* Low Woodland to Forest; *Viminaria juncea* Tall Shrubland; *Pericalymma* Open Heath; *Melaueca* species Tall Open Scrub; *Haklea trifurcata, Allocasruarina humilis* and *Xanthorrhoea preissii* Open Heath; *Borya scirpoidea* Herbland; Mixed Herbland and *Meeboldina coangustata* Closed Sedgeland

2.3.2.5 Vegetation from surveys conducted in the local area

360 Environmental (2012) statistically delineated fourteen vegetation units during a Level 2 flora and vegetation assessment within the remnant bushland in the North Ellenbrook survey area, 8 km south-west of the Project area (Table 2.12). Of these, two PECs are likely to be represented at this survey site: 'Swan Coastal Plain *Banksia attenuata-Banksia menziesii* woodlands' and 'Low lying *Banksia attenuata* woodlands or shrublands' NEQ4, NER8, NEQ14.

Table 2.12: Vegetation recorded at the North Ellenbrook survey area

Code	Description
	Banksia and Pricklybark woodlands on dune crests and slopes
BaBmEt	*Banksia attenuata, Banksia menziesii, Eucalyptus todtiana* low woodland over *Scholtzia involucrata* and *Beaufortia elegans* high shrublands over *Eremaea pauciflora* var. *pauciflora*, *Astroloma xerophyllum*, *Croninia kingiana* and *Leucopogon conostephioides* low shrublands.
Et	*Eucalyptus todtiana* low open woodland over *Adenanthos cygnorum* var. *cygnorum* scattered tall shrubs to high open shrubland over *Beaufortia elegans*, (*Verticordia nitens*) open heath and *Eremaea pauciflora* var. *pauciflora* low open shrubland
	Vegetation on the sandy parts of swales and flats
BaBmBi	*Banksia attenuata, Banksia ilicifolia, Banksia menziesii* low woodland over *Xanthorrhoea preissii, Xanthorrhoea brunonis* subsp. *brunonis* shrubland over *Calytrix flavescens, Conostephium pendulum, Adenanthos obovatus, Eremaea pauciflora* var. *pauciflora* low open shrublands over *Phlebocarya ciliata, Patersonia occidentalis, Dasypogon bromeliifolius* low herblands.
BeEp	*Beaufortia elegans* open heath over *Eremaea pauciflora* var. *pauciflora* low shrubland.
BiXp	*Banksia ilicifolia* scattered low trees over *Xanthorrhoea preissii* shrubland over *Eremaea pauciflora* var. *pauciflora*, *Melaleuca seriata* low shrublands over *Lyginia barbata, Alexgeorgea nitens* open sedgelands.
Cc	*Corymbia calophylla* woodland over *Xanthorrhoea preissii* scattered shrubs to open shrubland.
CcEm	*Eucalyptus marginata* subsp. *marginata*, *Corymbia calophylla* scattered trees over *Banksia ilicifolia, Banksia attenuata* scattered low trees to low open woodland (patches) over *Xanthorrhoea preissii* shrublands over *Hypocalymma angustifolium*

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Code	Description
	Banksia and Pricklybark woodlands on dune crests and slopes
	scattered low shrubs to low shrublands over *Hypolaena exsulca* open sedgelands.
EmBiXp	*Eucalyptus marginata* subsp. *marginata* scattered trees over *Banksia attenuata, Banksia ilicifolia, Nuytsia floribunda* scattered low trees over *Xanthorrhoea preissii* shrubland over *Dielsia stenostachya*, **Pentaschistis airoides* very open grassland/sedgeland.
	Dampland vegetation
Er	*Eucalyptus rudis* open forest over *Xanthorrhoea preissii, Astartea scoparia* high open shrubland over *Lepidosperma longitudinale, Dielsia stenostachya* open sedgeland.
Kg	*Kunzea glabrescens* closed scrub over *Aotus gracillima* open shrubland over *Schoenus efoliatus, Dielsia stenostachya* very open sedgeland.
Mp	*Melaleuca preissiana*, (*Banksia littoralis*) low closed forest over *Xanthorrhoea preissii* open shrubland, *Astartea scoparia* and *Cyathochaeta teretifolia, Dielsia stenostachya, Lepidosperma longitudinale* open sedgelands.
MpAs	*Melaleuca preissiana* low woodland over *Astartea scoparia* open heath over *Hypocalymma angustifolium* low open shrubland over *Dielsia stenostachya, Cyathochaeta teretifolia* sedgelands.
MpPeAs	*Melaleuca preissiana* low woodland over open shrubland over *Pericalymma ellipticum* var. *ellipticum*, *Astartea scoparia*, *Regelia inops, Xanthorrhoea preissii* shrublands and *Hypocalymma angustifolium* low shrublands.
MpRi	*Melaleuca preissiana* scattered low trees over *Regelia inops*, (*Xanthorrhoea preissii*) open to closed heath.

Emerge Associates (2013) delineated eight vegetation communities during a Level 2 flora and vegetation assessment at the Great Northern Highway survey area, 10 km north of the Project area (Table 2.13). Of these, BaBm is likely to represent the PEC 'Low lying *Banksia attenuata* woodlands or shrublands'

Table 2.13: Vegetation recorded at the Great Northern Highway survey area

Code	Description
	Banksia and Pricklybark woodlands on dune crests and slopes
BaBm	Open woodland of *Eucalyptus todtiana, Banksia attenuata* and *Banksia menziesii* over low open shrubland of *Eremaea pauciflora* var. *calyptra, Xanthorrhoea preissii* over open tussock grassland of **Ehrharta calycina* with *Dasypogon bromeliifolius* on grey sands.
MpJp	Open woodland of *Melaleuca preissiana* over open sedgeland of *Juncus pallidus* over grassland of **Cynodon dactylon* in saturated black loams with free-standing water at the surface.
MoJp	Tall open shrubland of *Melaleuca osullivanii* over open sedgeland of *Juncus pallidus* over closed forbland of **Cotula coronopifolia, *Briza maxima* and *Lotus subbiflorus* in saturated black loams.
Rehab	Rehab: Revegetated areas of mixed native and introduced *Eucalyptus* and *Melaleuca* species.
MpJa	Woodland of *Melaleuca preissiana* over sedgeland of **Juncus acutus* subsp. *acutus* over grassland of **Cynodon dactylon* in saturated black loams.
MpPg	Woodland of *Melaleuca preissiana* over mixed pasture grasses.
Pasture	Cleared pastures with isolated paddock trees.
MoCp	Tall shrubland of *Melaleuca osullivanii* over sparse rushland of *Dielsia stenostachya* over forbland of **Cotula coronopifolia*, *Angianthus preissianus* and **Hordeum hystrix* in damp grey/black sands.

Chittering Landcare Centre (2008) conducted a foreshore, flora and fauna assessment at three locations within the Lower Ellenbrook Catchment. Of these, Bingham Road is 2 km west, Muchea North Drain is 8 km north and Brand Highway is 11 km north of the Project area. The following was recorded:

- Brand Highway: *Melaleuca viminea* open low forest, over various weed species. This was categorised as in C3 condition with a high grazing levels, high levels of erosion, no understorey, evidence of a salt scald and tree death.
- Bingham Road: *Eucalyptus rudis* and/or *Acacia saligna* open low woodland. This was categorised as in C1 condition where the foreshore supports remnant trees over pasture or weeds.
- Muchea North Drain: *Melaleuca rhaphiophylla* scattered low trees, over pasture or weeds. This was categorised as in C1 condition where the foreshore supports healthy perennial vegetation, over a high weed infestation.

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2.3.2.6 TECS/PECS

Five EPBC Act and two WC Act-listed TECs occur within 10 km of the Project area (Figure 2.7, Table 2.14). Of these, three have buffers that intersect the Project area, however the boundaries of the TECs themselves do not occur within. On the basis of this desktop information and the criteria listed in Table 1.2 (see Table 2.14), two TECs were considered to have a 'High' likelihood of occurrence within the Project area based. However following analysis of the field data, only one of these TECs is potentially present in the study area (see Section 5.2 for discussion of possible TEC presence in the Bush Forever block in the Project area, to the north of the study area).

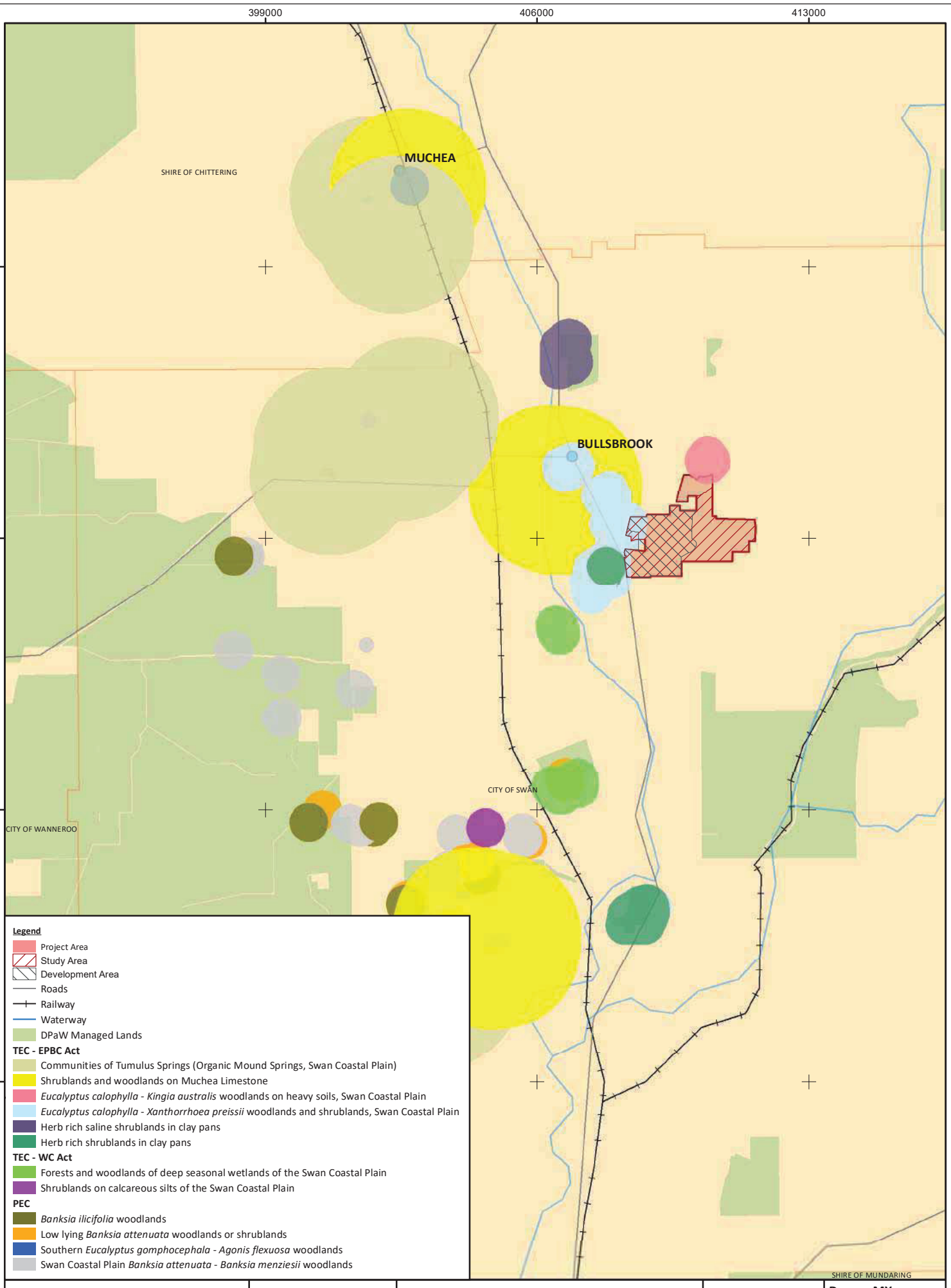
Four PECs occur within 10 km of the Project area (Figure 2.7, Table 2.14) of which none occur within. Three PECs have been given a 'Moderate' likelihood of occurrence within the Project area based on the criteria listed in Table 1.2.

Table 2.14: TECs and PECs occurring within 10 km of the Project area

Status	FCT	Name		Location	Likelihood of occurrence
TEC - EPBC Act					
Endangered (WC Act - CR)	Mounds Springs	Communities of Tumulus Springs (Organic Mound Springs, Swan Coastal Plain)		4 km north-west of Project area	Low – no likely habitat
Endangered (WC Act - EN)	Muchea limestone	Shrublands and woodlands on Muchea Limestone		Buffer intersects west of Project area	Low – no likely habitat
Endangered (WC Act - CR)	SCP3a	*Corymbia calophylla – Kingia australis* woodlands on heavy soils, Swan Coastal Plain – See Section 5.2		Buffer intersects north of Project area	High – possible habitat in the northern section of the Project area (outside of Development area), close proximity
Endangered (WC Act - CR)	SCP3c	*Corymbia calophylla – Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain – See Section 5.2		Buffer intersects west of Project area	High – possible habitat in the northern section of the Project area (outside of Development area) , close proximity
Critically endangered (WC Act - VU)	SCP07	Claypans of the Swan Coastal Plain, includes:	Herb rich saline shrubland in clay pans	4 km north-west of Project area	Low – no likely habitat
	SCP08		Herb rich shrublands in clay pans	Immediately west of Project area	Low – no likely habitat
TEC - WC Act					
Vulnerable	SCP15	Forests and woodlands of deep seasonal wetlands of the Swan Coastal Plain		1.6 km south-west of Project area	Low – no likely habitat
Vulnerable	SCP18	Shrublands on calcareous silts of the Swan Coastal Plain		7 km south-west of Project area	Low – no likely habitat
PECs					
Priority 3	SCP22	*Banksia ilicifolia* woodlands, Southern Swan Coastal Plain		8 km south-west of Project area	Moderate – habitat not well defined, records within 20 km
Priority 3	SCP21c	Low lying *Banksia attenuata* woodlands or shrublands		5 km south-west of Project area	Low – no likely habitat
Priority 3	SCP25	Southern *Eucalyptus gomphocephala-Agonis flexuosa* woodlands		10 km north-west of Project area	Moderate – habitat not well defined, records within 20 km
Priority 3	SCP23b	Swan Coastal Plain *Banksia attenuata – Banksia menziesii* woodlands		7 km south-west of Project area	Moderate – habitat not well defined, records within 20 km

Note: CR = Critically Endangered, EN = Endangered, VU = Vulnerable listing under the WC Act.

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3 METHODOLOGY

This flora and vegetation assessment was carried out in accordance with EPA Guidance for a Level 2 flora and vegetation survey and encompassed both a pre-field desktop assessment and a two phase field survey of the 439 ha study area (i.e. excluding the Bush Forever site, comprising the other 43 ha in the north of the 482 ha Project area). While the remnant vegetation present in the east of the study area was sampled as part of this assessment, effort was focused on the cleared areas in the west of the study area which are primary area that are proposed for future development.

3.1 FIELD SURVEY

3.1.1 Survey Timing

A two-phase, Level 2 flora and vegetation assessment was conducted in the study area. The initial (Spring) phase was conducted on 24 October 2014, and the second (Autumn) phase was conducted from 16 to 17 May 2016. A survey effort equivalent to four person days was expended undertaking the surveys.

3.1.2 Weather Preceding the Survey

Rainfall data are available from the RAAF Bureau of Meteorology (BoM) station 9053, directly adjacent to the study area from 1937 to 2016 (Figure 3.1) (BoM 2016). Rainfall for three months prior to the field surveys is discussed below:

- Phase 1: 246.9 mm was recorded in July to September, 60.4 mm less mm than the long-term average of 307.3 mm for the same period; and
- Phase 2: 171 mm was recorded in February to April, 107.2 mm more than the long-term average of 63.8 mm for the same period.

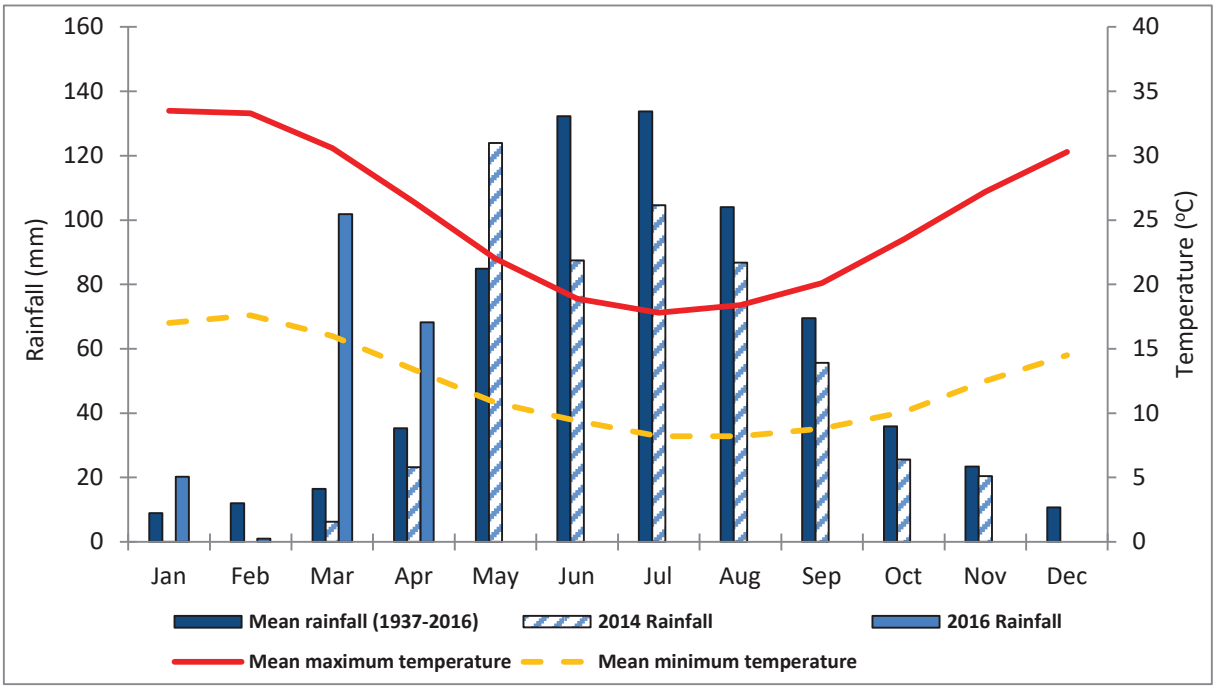


Figure 3.1: Climate data at Pearce RAAF BoM station (1937-2016)

3.1.3 Survey Techniques and Intensity

The survey was conducted using a combination of quadrats/relevés and traverses to delineate the vegetation units present, provide a floristic inventory and target significant flora, vegetation and introduced flora. Quadrat, releve and traverse locations were selected using a combination of aerial

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photography, topographic features, land systems and field observations in order to ensure capture of the diversity of vegetation and habitats present.

3.1.3.1 Quadrats and Releves

Quadrats were sampled in vegetation that was in '4 - Good' or better condition, and relevés were sampled when vegetation was in a '6 – Degraded or Poor' or '7 – Completely Degraded' condition.

A total of six quadrats (10 m x 10 m) and 27 relevés were established and sampled within the study area, six releves of which were sampled during both phases. Site information for each quadrat and relevé is presented in Appendix C and they are mapped on Figure 3.2.

The following parameters were recorded at each quadrat:

- All observed flora species and the average height, percentage cover (using the ranges cited by NVIS) and observable presence/absence of fruit/flowers for each;
- Vegetation structure (National Vegetation Information System (NVIS) Level V;
- Vegetation condition scale (Trudgen 1991), which is based on the criteria in Table XX;
- Estimated time since fire;
- GPS co-ordinates of all corners;
- Panorama digital photograph of the vegetation, taken from the north-west corner facing south-east;
- The landform element (morphological type, position and element type);
- The presence of rock outcrops (type and abundance);
- Soil type (colour, profile, field texture and surface type); and
- Slope and aspect.

Relevés also have the aforementioned data collected, however only the dominant flora species are recorded in a non-bounded, representative, 10 m x 10 m area.

3.1.3.2 Traverses

Traverses were conducted at the study area to allow a series of opportunistic observations to be recorded on the flora and vegetation of the study area. Parameters recorded during a traverse can include:

- A GPS track log, which includes the location and date of the traverse;
- Any significant or introduced flora taxa encountered, with an estimated number of plants;
- Any flora taxa encountered that have not yet been recorded within survey sites with an estimated number of plants;
- Notes on vegetation units: including extent, changes in dominant species etc.;
- Notes on vegetation condition: based on the criteria described by Trudgen (1991), shown in Appendix A, including condition rating and disturbance types; and
- Notes on fire history: including extent, fire age and intensity.

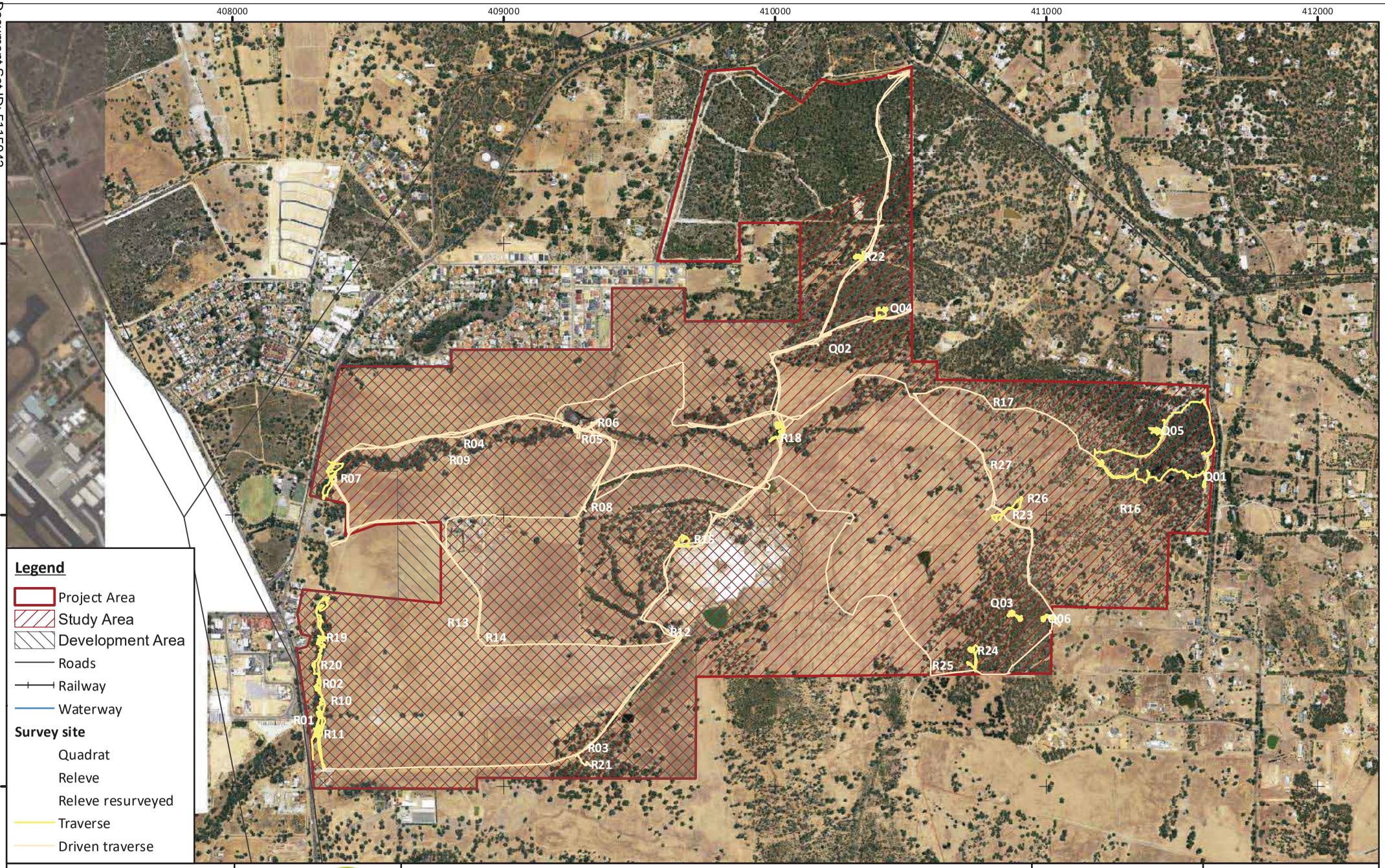
Driving traverses were also conducted and larger, more noticeable introduced flora species and significant flora were recorded. Traverses are mapped on Figure 3.2.

3.1.3.3 Targeted Significant Flora and Vegetation Traverses

Significant flora and vegetation identified during the literature review as potentially occurring were targeted by conducting traverses in habitats that have the potential to support them and in areas where they have previously been recorded. Additionally, habitats with intermittent and restricted distributions were searched during the survey and included the creek line and the steep western facing scarp.

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3.1.3.4 Wetland Assessment

An assessment was conducted detailing the spatial extent and characteristics of the wetlands at the study area, in particular the Conservation Category wetland section of the Ki-it Monger Brook. Three relevés were sampled within the Conservation Category section, three were sampled in the Multiple Use section and seven were sampled in areas along the Ki-it Monger Brook that have not been classified.

Notes were taken on key wetland characteristics including vegetation structure, floristic composition, soil type, soil moisture and topography to determine the attributes and functions of the wetland.

3.2 DATA INTERPRETATION AND ANALYSIS

3.2.1 Vegetation Mapping

Vegetation mapping is the delineation of plant communities or vegetation units based on distinctive characteristics that these communities share, such as the vegetation structure, dominant species and species composition. A combination of aerial photography, the vegetation unit grouping during statistical analysis (Section 3.2.1.1) and ground truthing was used to interpret the vegetation patterns of the study area and allow for the vegetation mapping.

Vegetation is described based on the National Vegetation Information System (NVIS) methodology (ESCAVI 2003), and is described to one hierarchical level (known as vegetation units):

- Broad floristic formation level (Level III) where the dominant growth form, crown cover, height and dominant land cover genus are described for the upper or most ecologically or structurally dominant stratum.

3.2.1.1 Statistical Analysis

Statistical analysis provides an objective means of defining vegetation units and provides insight into the hierarchical relationship between communities based on the degree of similarity in species composition and abundance.

Multivariate analysis was conducted using the site by species matrix data collected from the six quadrats and 27 relevés that were sampled during the field survey. In order to best align the vegetation analysis, the data from the species by site matrix was treated in that:

- Data was transformed to cover weighted;
- Taxa were removed from the data or grouped together if they could not be confidently identified to a consistent taxonomic level and there was a possibility of confusion with other similar taxa; and
- Annual taxa were removed.

This site by species matrix was then used to perform a cluster analysis to produce a dendrogram of dissimilarity between the quadrats. Cluster analysis was performed on the cover weighted site by species matrix using an association matrix of the Bray-Curtis coefficient with the multivariate program PATN^{TM}. The resultant dendrogram was used in the definition of hierarchy of vegetation assemblages. The site by species matrix used for the analysis is provided in Appendix D.

3.2.2 Taxonomy

Nomenclature of the species recorded follow the protocols of the West Australian Herbarium (Western Australian Herbarium 1998-2015).

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3.3 PROJECT TEAM

The flora and vegetation assessment described in this document was planned, coordinated and executed under the licences and by those summarised in Table 3.1.

Table 3.1: Project team and licences

Project Staff			
Name	**Qualification**	**Role**	**Project role**
Shaun Grein	B.Sc, Grad.Dip. Nat. Resources, MBA	Managing Director/Principal Environmental Scientist	Reporting, QA
Matthew Macdonald	PhD	Principal Ecologist	Quality control
Melissa Hay	Bsc (Hons)	Senior botanist	Field survey phase 2, reporting
Gaby Martinez	Bsc (Hons)	Ecologist	Field survey phase 1
Udani Sirisena	PhD	Botanist/taxonomist	Field survey phase 1, plant identifications
Andrew Craigie	PhD	Botanist/taxonomist	Plant identifications
Licences			
The flora and vegetation assessment described in this report was conducted under the authorisation of the following licences issued by DPaW:			
Name	**Licence Number**	**Licence**	
Udani Sirisena	SL 010 543	Licence to collect flora for scientific purposes	
Gaby Martinez	SL 010 974	Licence to collect flora for scientific purposes	
Melissa Hay	SL 011 068	Licence to collect flora for scientific purposes	

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4 RESULTS

4.1 FLORA

A total of 102 vascular plant taxa were recorded from the study area. Of these 44 (43.1%) were native and 58 (56.9%) were introduced. The composition of the flora of the study area is summarised in Table 4.1. A complete list of taxa recorded is included in Appendix E.

Table 4.1: Floristic information at the study area

Native or Introduced	Number of taxa recorded	Number annuals	Number of families	Number of genera	Number of families represented by a single taxon	Number of genera represented by a single taxon
Native	52	1	28	38	18	30
Introduced	59	36	25	46	18	35
Total	111	37	48	83	33	64

The families and genera represented by the greatest number of taxa, and the most frequently recorded species at the study area are listed in Table 4.2. The most species-rich native families were Fabaceae, Protoaceae and Myrtaceae, and *Hakea* and *Stylidum* were the most species-rich genera.

Table 4.2: Most commonly recorded families, genera and taxa

Native or Introduced	Most taxa per family	Most taxa per genus	Most frequently recorded taxa
Native	Fabaceae (9 taxa) Protoaceae (4 taxa) Myrtaceae (4 taxa)	*Acacia* (5 taxa) *Lepidosperma, Stylidium* (2 taxa)	*Eucalyptus rudis* subsp. *rudis* (19 records) *Eucalyptus wandoo* subsp. *wandoo* (14 records)
Introduced	Poaceae (19 taxa) Fabaceae (6 taxa) Asteraceae (6 taxa)	*Oxalis, Trifloium (3 taxa)* *Sonchous, Cyperus, Cenchrus, Avena, Ehrharta, Briza, Vulpia, Bromus, Solanum* (2 taxa)	**Avena barbata* (28 records) **Gomphocarpus fruticosus* (21 records)
Combined	Poaceae (21 taxa) Fabaceae (15 taxa) Asteraceae (6 taxa)	*Acacia* (6 taxa) *Oxalis, Lepidosperma, Stylidium, Hakea, Trifolium* (3 taxa)	**Avena barbata* (28 records) **Gomphocarpus fruticosus* (21 records)

4.1.1 Flora of Conservation Significance

No EPBC Act or WC Act-listed Threatened Flora, Priority flora or other flora of conservation significance were recorded within the study area.

4.1.2 Introduced Flora

Introduced species made up the dominant component of the species of the study area with 56.9% of all taxa recorded introduced. Sixty introduced flora species were recorded in the study area. Of these taxa, one was a WONS, one was a Declared Pest at the study area, four are Declared Pests but not for the area and the remaining 54 were environmental weeds. The weeds recorded in the study area are listed in Table 4.3, coordinates provided in Appendix F and they are mapped in Figure 4.1 to Figure 4.3.

Table 4.3: Introduced flora recorded from the study area

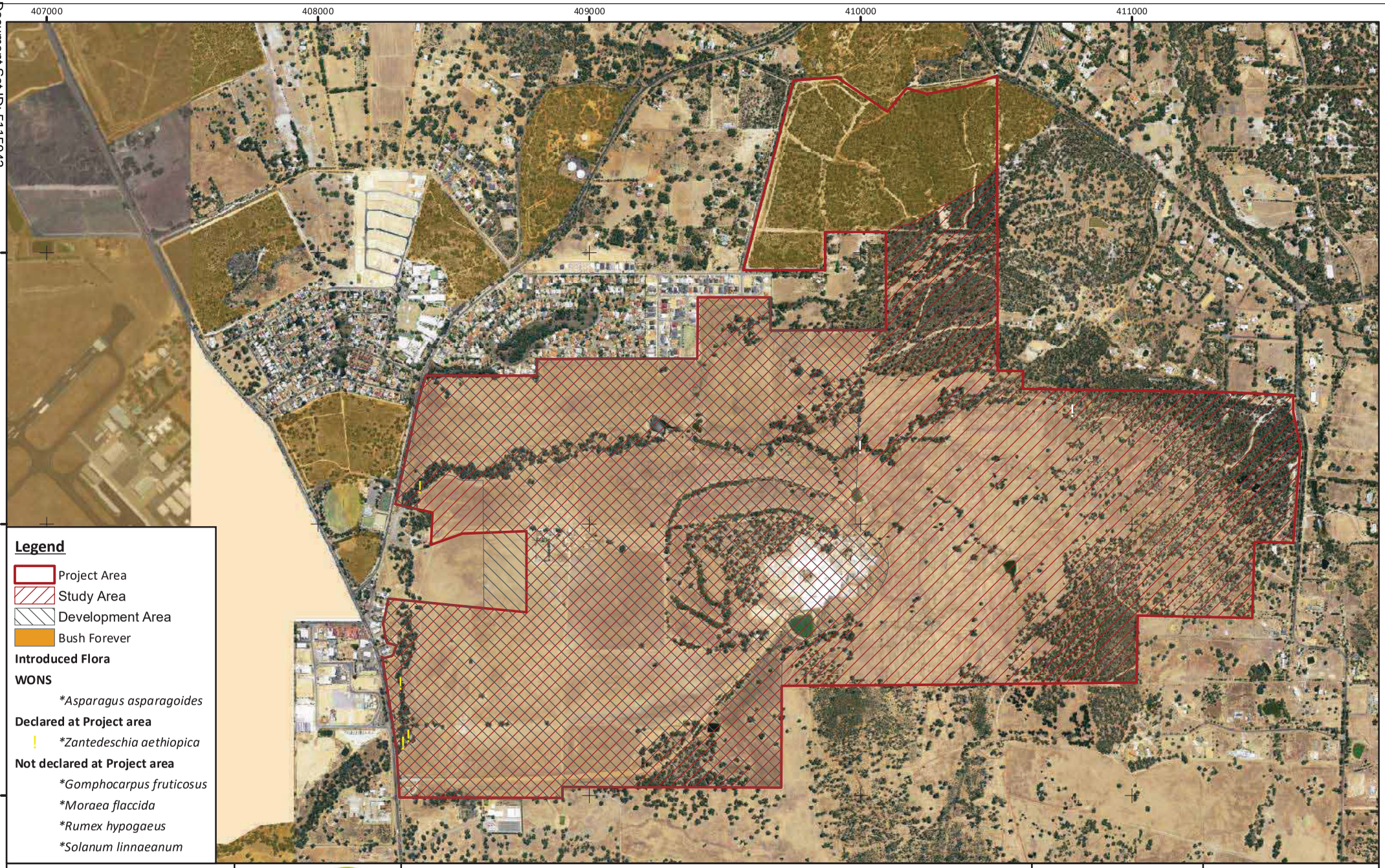
Taxon	Number of locations		# of plants
	Phase 1	Phase 2	
WONS			
**Asparagus asparagoides*	-	2	2
Declared - at the Project area			
**Zantedeschia aethiopica*	2	4	5
Declared – not at the Project area			
**Gomphocarpus fruticosus*	2	21	95
**Moraea flaccida*	3	16	196
**Rumex hypogaeus*	-	4	8
**Solanum linnaeanum*	2	17	886
Environmental			
**Acacia ?baileyana*	-	1	4
**Acacia podalyriifolia*	-	1	5
**Arctotheca calendula*	5	11	89
**Avena barbata*	13	21	17,294
**Avena fatua*	2	-	110

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Taxon	Number of locations		# of plants
	Phase 1	Phase 2	
**Babiana angustifolia*	1	-	3
**Bougainvillea glabra*	-	1	1
**Briza maxima*	9	-	241
**Briza minor*	5	-	23
**Bromus diandrus*	8	-	830
**Bromus hordeaceus*	4	-	152
**Cenchrus clandestinus*	1	-	1
**Cenchrus setaceus*	-	1	5
**Cynodon dactylon*	-	9	416
**Cyperus involucratus*	-	2	7
**Cyperus tenuiflorus*	-	1	1
**Digitaria ciliaris*	-	1	20
**Ehrharta calycina*	1	-	500
**Ehrharta longiflora*	2	-	11
**Eragrostis curvula*	-	2	25
**Erodium botrys*	-	1	100
**Fumaria capreolata*	1	-	5
**Hesperantha falcata*	5	-	18
**Hordeum leporinum*	8	-	300
**Hypochaeris glabra*	2	1	2
**Lolium rigidum*	9	9	582
**Lotus angustissimus*	2	-	25
**Lupinus cosentinii*	4	3	65
**Lysimachia arvensis*	2	3	27
**Melia azedarach*		1	1
**Monoculus monstrosus*	1	-	1
**Olea europaea* subsp. *europaea*	-	1	1
**Orobanche minor*	1	-	5
**Oxalis corniculata*	-	8	53
**Oxalis pes-caprae*	6	10	200
**Oxalis purpurea*	-	10	61
**Pentameris airoides*	2	1	120
**Raphanus raphanistrum*	2	5	24
**Ricinus communis*	-	1	5
**Schinus molle*	-	1	2
**Solanum nigrum*	-	4	18
**Sonchus asper*	1	-	1
**Sonchus oleraceus*	2	4	15
**Stachys arvensis*	1	4	9
**Trachyandra divaricata*	2	-	2
**Trifolium angustifolium* var. *angustifolium*	6	1	38
**Trifolium arvense* var. *arvense*	1	-	1
**Trifolium campestre* var. *campestre*	5	-	5
**Triticum aestivum*	2	-	1,001
**Tropaeolum majus*	-	1	1,000
**Typha ?orientalis*	-	1	100
**Ursinia anthemoides*	2	-	2
**Vulpia bromoides*	1	-	10
**Vulpia myuros*	2	-	11

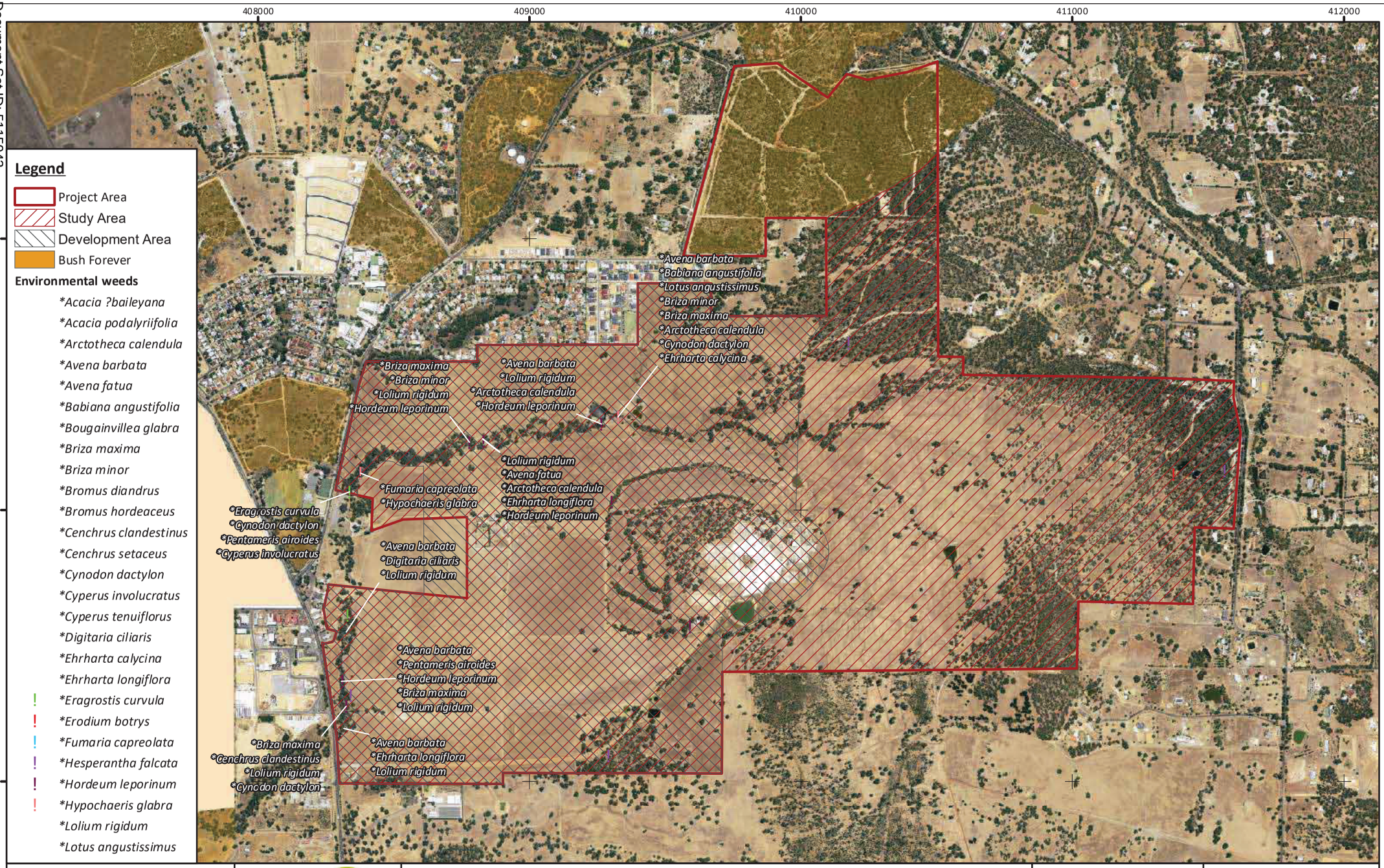
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Introduced flora - Environmental weeds Map A

Due to the the large number of weed taxa recorded relative to the scale of this map, this is indicative only. For the definitive point dataset of environmental weed locations, refer to Appendix F.

Figure: 4.2
Project ID: 1621

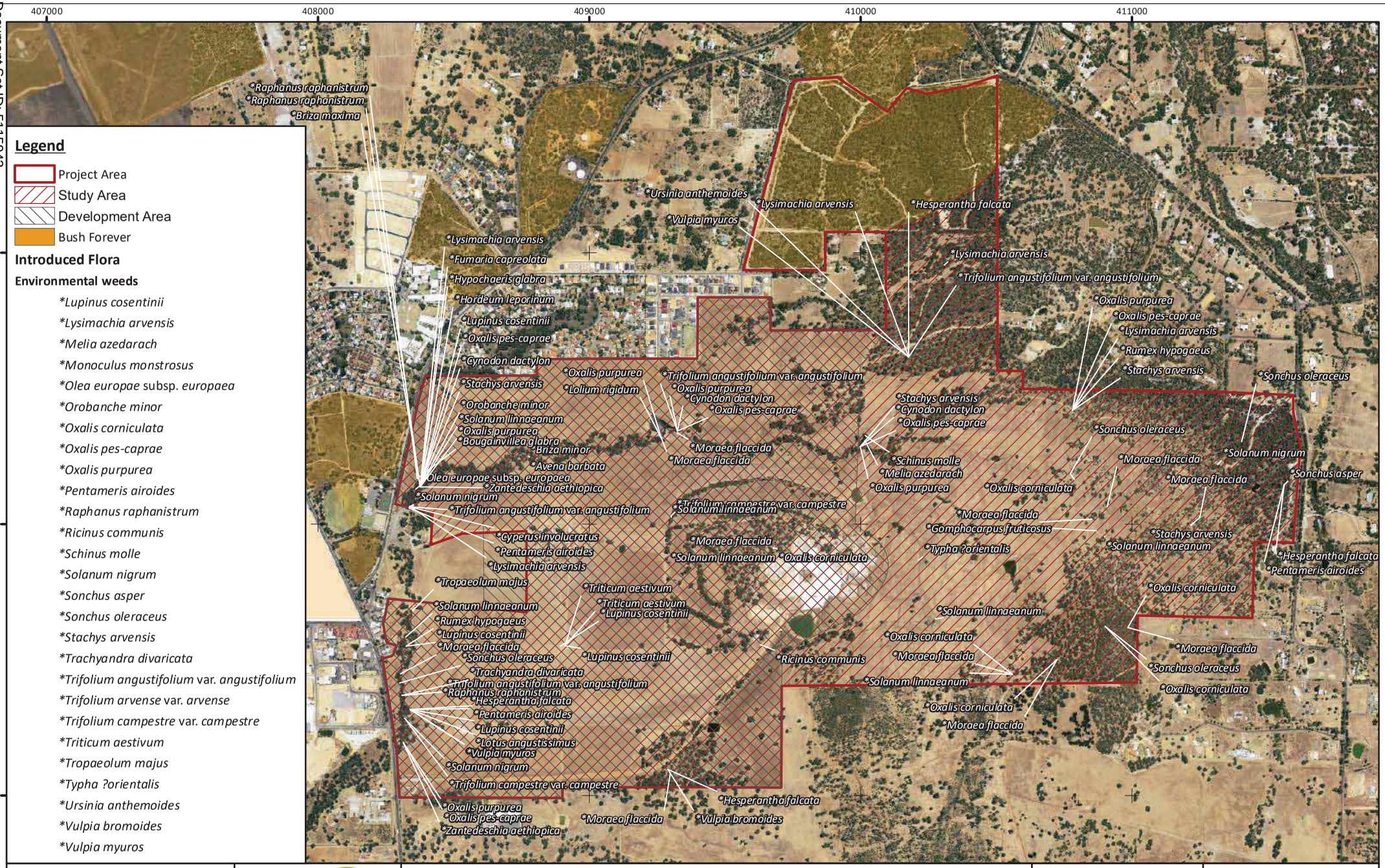
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Date: 29/06/2016

Coordinate System
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Projection: Transverse Mercator
Datum: GDA 1994

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Legend

- Project Area
- Study Area
- Development Area
- Bush Forever

Introduced Flora

Environmental weeds

- *Lupinus cosentinii
- *Lysimachia arvensis
- *Melia azedarach
- *Monoculus monstrosus
- *Olea europae* subsp. *europaea*
- *Orobanche minor
- *Oxalis corniculata
- *Oxalis pes-caprae
- *Oxalis purpurea
- *Pentameris airoides
- *Raphanus raphanistrum
- *Ricinus communis
- *Schinus molle
- *Solanum nigrum
- *Sonchus asper
- *Sonchus oleraceus
- *Stachys arvensis
- *Trachyandra divaricata
- *Trifolium angustifolium* var. *angustifolium*
- *Trifolium arvense* var. *arvense*
- *Trifolium campestre* var. *campestre*
- *Triticum aestivum
- *Tropaeolum majus
- *Typha ?orientalis
- *Ursinia anthemoides
- *Vulpia bromoides
- *Vulpia myuros

0 0.25 0.5
Kilometres

Absolute Scale - 1:18,000

ecologia ENVIRONMENT

Introduced flora - Environmental weeds Map B

Due to the the large number of weed taxa recorded relative to the scale of this map, this is indicative only. For the definitive point dataset of environmental weed locations, refer to Appendix F.

Figure: 4.3
Project ID: 1621

Drawn: MY
Date: 29/06/2016

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

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4.2 VEGETATION

Seven vegetation units were mapped from the study area, of which five occur within the Development area. These are described in Table 4.4, and include associated species and landforms, survey sites, mean species richness and condition. The dendrogram used to delineate the units, which also includes quadrats and releves representing additional vegetation units outside of the Development area, is shown in Figure 4.4 and mapping is provided in Figure 4.5.

Five vegetation units were associated with the agricultural land use:

- Ab (Mixed weed species). Recorded in the areas which have been cleared for agriculture on the flats and lower hill slopes and mapped as 213.36 ha or 85.42% of the Development area (NB: this vegetation unit is not represented in the dendrogram, as the releves only contained annual species).
- CcAp (*Corymbia calophylla* low woodland, over +/-*Acacia pulchella* sparse low shrubland, over mixed weed species). Recorded on the hill tops and mid slopes which have not been completely cleared and mapped as 20.3 ha or 8.12% of the Development area.
- Er1 (*Eucalyptus rudis* subsp. *rudis* low open forest, over mixed weed species). Was recorded along the Kit-Monger Brook and the drainage valley slopes in between the hills to the east of the Project area and was mapped as 11.7 ha or 4.69% of the Development area.
- Er2 (*Eucalyptus rudis* subsp. *rudis* low open forest, over mixed weed species). Was recorded as the strip of trees planted for stabilisation, rather than along the creekline and was therefore separated from Er1 and mapped as 4.24 ha or 1.7% of the Project area.
- EwCc (+/-*Eucalyptus wandoo* subsp. *wandoo* and *Corymbia calophylla* open low woodland, over isolated **Solanum linnaeanum* mid shrubs, over mixed weed species). Recorded on the mostly cleared hill slopes towards the east of the Project area and was not mapped within the Development area.

Two units were associated with remnant vegetation:

- EwGs (*Eucalyptus wandoo* subsp. *wandoo* open forest, over *Gastrolobium spinosum* and *Xanthorrhoea preissii* mid open shrubland, over isolated mixed low shrubs). Recorded along the steep escarpment and valley walls this unit was mapped from the central and northern portions of the Project area, though it was not mapped within the Development area.
- CcGsBe *(Corymbia calophylla* and *Eucalyptus wandoo* subsp*. wandoo* low woodland*,* over *Gastrolobium spinosum, Acacia pulchella* and *Hypocalymma angustifolium* sparse to open mid shrubland, over *Bossiaea eriocarpa* sparse low shrubland). Recorded on the hill tops and gentle mid and foot slopes of the Darling plateau with 0.21 ha or 0.08% mapped as occurring within the Development area.

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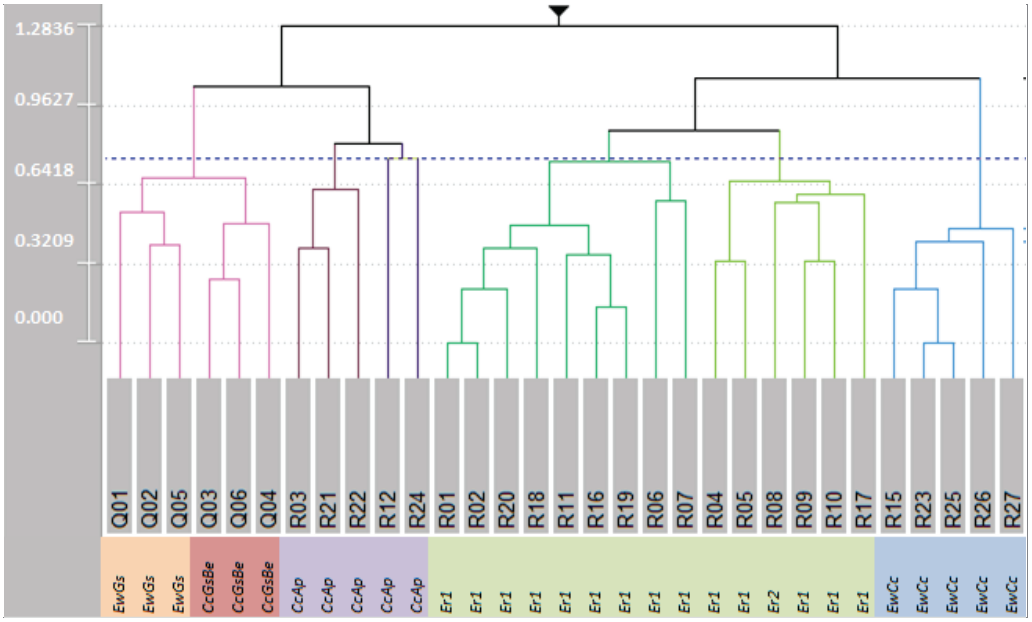


Figure 4.4: Dendrogram of vegetation units recorded

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Table 4.4: Vegetation units mapped from the study area

Unit	Description (NVIS Level VI)	Associated species	Area in study area, landform, sites and floristic details	Photograph
EwGs	*Eucalyptus wandoo* subsp. *wandoo* open forest, over *Gastrolobium spinosum* and *Xanthorrhoea preissii* mid open shrubland, over mixed low shrubs.	**Avena barbata* *Burchardia congesta* *Hakea lissocarpha* **Hesperantha falcata* *Hibbertia hypericoides* subsp. *hypericoides* *Hypocalymma angustifolium* *Neurachne alopecuroidea* *Thomasia foliosa* **Ursinia anthemoides*	**Landform**: Steep west or south-west facing scarp and valley edges brown-grey loamy sand, no or few lateritic rocks. **Area**: 24.5 ha of Project area **Sites**: Q01, Q02, Q05 **Mean total species richness:** 16.0 ± 4.0 **Mean perennial species richness:** 12.3 ± 3.1 **Mean weed species richness**: 4.7 ± 2.5 **Average condition:** 2-Excellent	
CcGsBe	*Corymbia calophylla* and *Eucalyptus wandoo* subsp. *wandoo* low woodland, over *Gastrolobium spinosum, Acacia pulchella* and *Hypocalymma angustifolium* sparse to open mid shrubland, over *Bossiaea eriocarpa* sparse low shrubland.	*Burchardia congesta* *Hakea lissocarpha* *Hibbertia commutata* *Lepidosperma leptostachyum* *Macrozamia riedlei* *Phyllanthus calycinus* *Trymalium odoratissimum* subsp. *odoratissimum* *Thysanotus patersonii* *Xanthorrhoea preissii*	**Landform**: Flat hill top, gentle mid slopes, brown-grey loamy sand, common lateritic rocks. **Area**: 0.21 ha (0.08%) of Development area **Sites**: Q03, Q04, Q06 **Mean total species richness:** 18.3 ± 2.5 **Mean perennial species richness:** 17.0 ± 1.7 **Mean weed species richness**: 1.7 ± 1.5 **Average condition:** 2-Excellent	

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Unit	Description (NVIS Level VI)	Associated species	Area in study area, landform, sites and floristic details	Photograph
CcAp	*Corymbia calophylla* low woodland, over +/-*Acacia pulchella* sparse low shrubland, over mixed weed species dominated by **Avena barbata* and **Lolium rigidum*	**Arctotheca calendula* **Avena barbata* **Briza maxima* *Hakea erinacea* *Hibbertia commutata* **Moraea flaccida* *Nuytsia floribunda*	**Landform**: Flat hill top, gentle mid slopes, brown-grey loamy sand, common lateritic rocks. **Area**: 20.27 ha (8.12%) of the Development area **Sites**: R03, R21, R22, R12, R24 **Mean total species richness:** 8.3 ± 2.3 **Mean perennial species richness:** 6.3 ± 0.6 **Mean weed species richness**: 2.7 ± 2.1 **Average condition:** 6 - Degraded	
Er1	*Eucalyptus rudis* subsp. *rudis* low open forest, over mixed weed species dominated by **Avena barbata, *Lolium rigidum* and **Oxalis pes-caprae*	**Arctotheca calendula* **Briza maxima* **Bromus diandrus* *Corymbia calophylla* **Cynodon dactylon* *Eucalyptus wandoo* subsp. *wandoo* **Gomphocarpus fruticosus* **Hordeum leporinum* *Juncus pallidus* **Moraea flaccida* **Oxalis purpurea*	**Landform**: Drainage line low hill slopes near drainage line. **Area**: 11.7 ha (4.69%) of the Development area **Sites**: R01, R02, R04, R05, R06, R07, R09, R10, R11, R16, R17, R18, R19, R20 **Mean total species richness:** 13.2 ± 5.1 **Mean perennial species richness:** 4.9 ± 2.8 **Mean weed species richness**: 10.9 ± 4.3 **Average condition:** 6 - Degraded	

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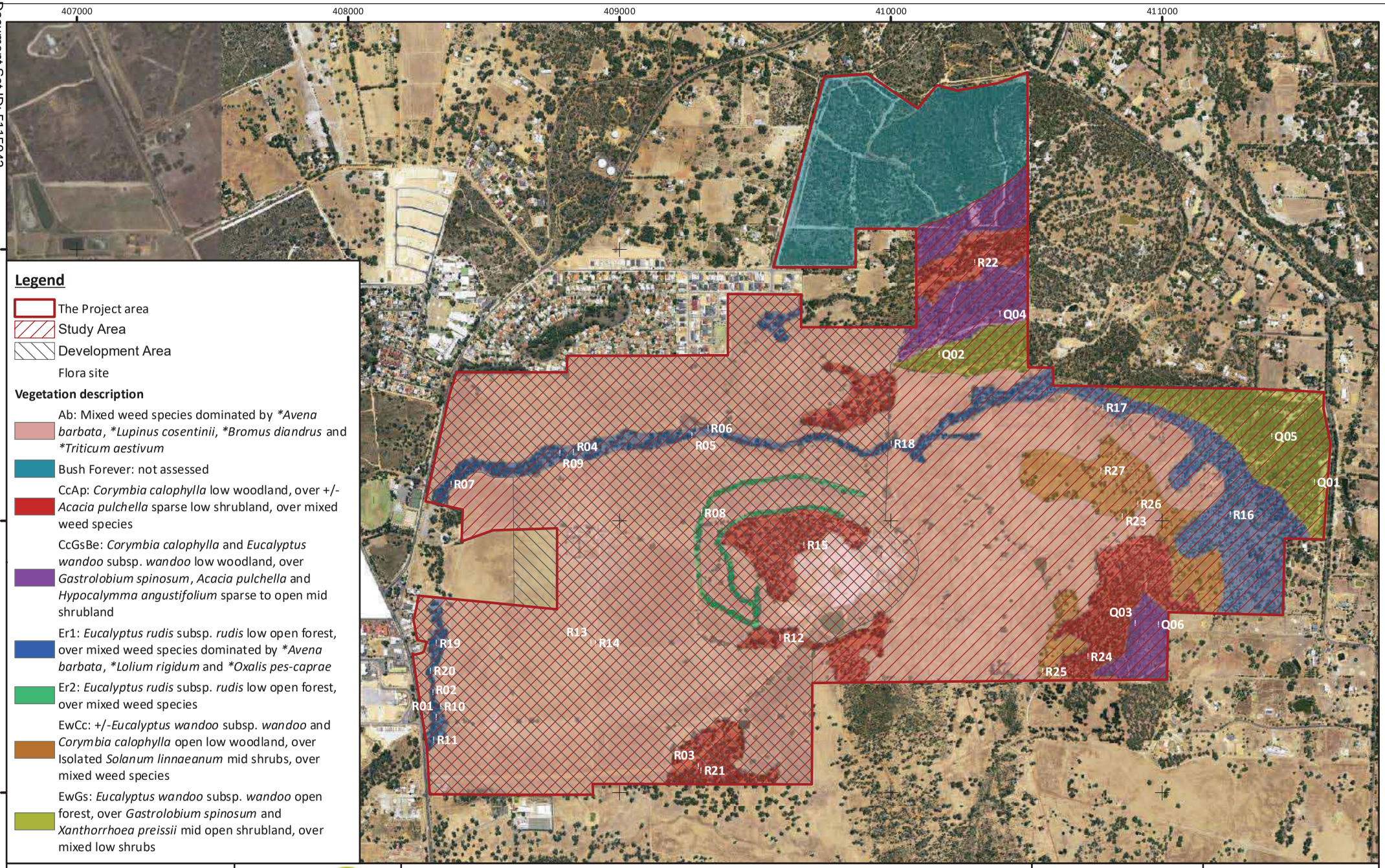
Unit	Description (NVIS Level VI)	Associated species	Area in study area, landform, sites and floristic details	Photograph
Er2	*Eucalyptus rudis* subsp. *rudis* low open forest, over mixed weed species dominated by **Avena barbata*	**Hordeum leporinum* **Lolium rigidum* **Solanum linnaeanum* **Trifolium campestre var. campestre*	**Landform**: Plantation strip on low hillslope **Area**: 4.24 ha (1.70%) of the Development area **Sites**: R08 **Total species richness:** 6 **Perennial species richness:** 2 **Weed species richness**: 5 **Average condition:** 6 - Degraded	
Ab	Mixed weed species dominated by **Avena barbata, *Lupinus cosentinii, *Bromus diandrus* and **Triticum aestivum*.	**Arctotheca calendula* **Trifolium angustifolium* var. *angustifolium* **Trifolium arvense* var. *arvense* **Trifolium campestre* var. *campestre*	**Landform**: Cleared pasture land. **Area**: 213.36 ha (85.42%) of the Development area **Sites**: R13, R14 **Mean total species richness:** 6.0 ± 0.0 **Mean perennial species richness:** 0 **Mean weed species richness**: 6.0 ± 0.0 **Average condition:** 7 – Completely Degraded	

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Legend

- The Project area
- Study Area
- Development Area
- Flora site

Vegetation description

- Ab: Mixed weed species dominated by **Avena barbata*, **Lupinus cosentinii*, **Bromus diandrus* and **Triticum aestivum*
- Bush Forever: not assessed
- CcAp: *Corymbia calophylla* low woodland, over +/- *Acacia pulchella* sparse low shrubland, over mixed weed species
- CcGsBe: *Corymbia calophylla* and *Eucalyptus wandoo* subsp. *wandoo* low woodland, over *Gastrolobium spinosum*, *Acacia pulchella* and *Hypocalymma angustifolium* sparse to open mid shrubland
- Er1: *Eucalyptus rudis* subsp. *rudis* low open forest, over mixed weed species dominated by **Avena barbata*, **Lolium rigidum* and **Oxalis pes-caprae*
- Er2: *Eucalyptus rudis* subsp. *rudis* low open forest, over mixed weed species
- EwCc: +/-*Eucalyptus wandoo* subsp. *wandoo* and *Corymbia calophylla* open low woodland, over Isolated *Solanum linnaeanum* mid shrubs, over mixed weed species
- EwGs: *Eucalyptus wandoo* subsp. *wandoo* open forest, over *Gastrolobium spinosum* and *Xanthorrhoea preissii* mid open shrubland, over mixed low shrubs

0 0.25 0.5
Kilometres

Absolute Scale - 1:18,000

ecologia ENVIRONMENT

Vegetation mapping at the study area

Figure: 4.5
Project ID: 1621

Drawn: MY
Date: 05/07/2016

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

A4

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4.2.1 Vegetation Condition

The majority of the Project area (81.6%) was characterised by high levels of disturbance and subsequently rated as 'Completely Degraded' or 'Degraded'. The remaining 18.3%, which was rated as 'Excellent', was associated with the remnant vegetation, including the Bush Forever site in the north of the Project area. A vegetation condition map is provided in Figure 4.7.

One vegetation unit – Ab – was rated as 'Completely Degraded' and mapped as covering 213.36 ha or 85.42% of the Development area (Figure 4.7). This was the parkland cleared for agriculture on the lower hill slopes and flats, containing no native species or perennials.

Four vegetation units were rated as 'Degraded' – CcAp, Er1, Er2 and EwCc – and were mapped as 36.22 ha or 14.50% of the Project area (Figure 4.7). These were areas on the higher and steeper hill slopes that had patches of native trees left un-cleared and along the Kit-Monger Brooke and were characterised by no or possibly scattered native understorey plants, litter, high grazing levels and domination by weeds. Trees were noticeably unhealthy in these areas, with upper foliage and branches often seen dead or dying (Figure 4.6).

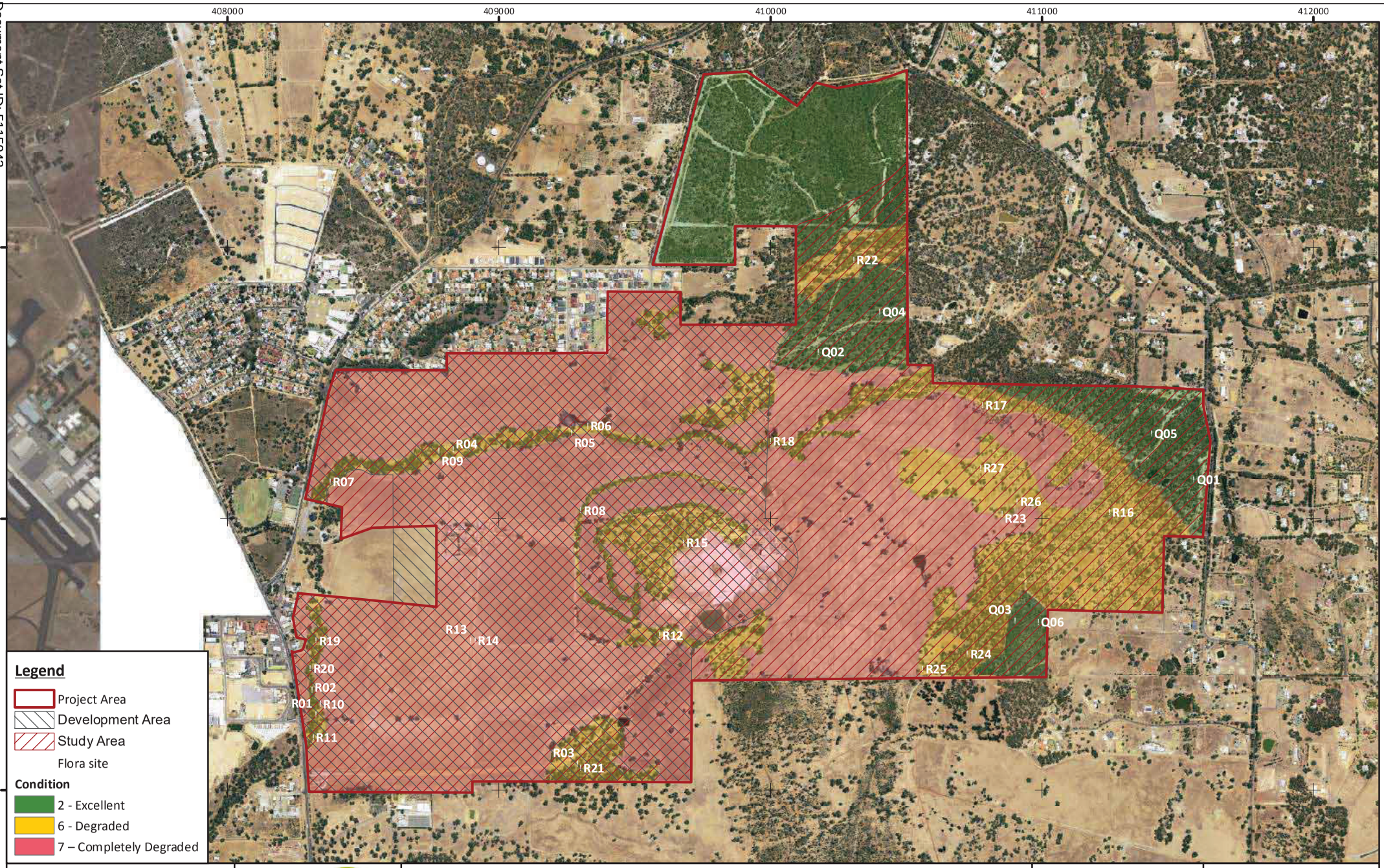
One vegetation unit was rated as 'Excellent' –CcGsBe – which was mapped as occurring over 0.21 ha or 0.08% in the north-eastern portion of the Development area (Figures 4.5 and 4.7) with more significant areas along the steep escarpment and valley walls, hill slopes and tops in the eastern portion of the Project area. Disturbances to this unit included a low density of non-invasive weeds and common vehicle/animal tracks. There were also trees that were noticeably unhealthy in these areas (Figure 4.6).



Figure 4.6: Tree health in unit EwCc (left) and CcGsBe (right)

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4.3 WETLAND ASSESSMENT

The section of the Ki-it Monger Brook within the Project area been been classified into two wetland management categories: Conservation and Multiple Use Category (Figure 2.3). The remainder of the Ki-it Monger Brook is unclassified.

The Brook occurrs on the flat/plain for the majority of its length, and extends into the drainage valley slopes in between the hills to the east of the Project area (Table 4.5). It is mapped as vegetation unit Er1: *Eucalyptus rudis* subsp. *rudis* low open forest, over mixed weed species dominated by **Avena barbata, *Lolium rigidum* and **Oxalis pes-caprae* throughout the whole Project area and other common species include; *Corymbia calophylla, *Gomphocarpus fruticosus, *Solanum linnaeanum, *Briza maxima, *Moraea flaccida.* The mean species richness of this vegetation unit is 13.2, of which the mean weed species richness is 10.9 and the mean perennial species richness is 4.9.

Its condition was rated as 'Degraded' with no or scattered native understorey plants, litter, high grazing levels and domination by weeds. Erosion was generally minor, however there were some areas with deep trenches cutting into the plain (Table 4.5).

There were no significant flora species recorded or likely to occur along the creekline. The WONS, **Asparagus asparagoides* was recorded within the unclassified section and the Declared Pest, **Zantedeschia aethiopica* was recorded within the Conservation, Multiple Use and Unclassified Categories (Figure 4.1).

The surface layer was characterised by common creek stones along the bed and a brown clay-loam along the banks. Small pools of water were observed commonly along the length of the creekline at no more than 30 cm deep (Table 4.5).

Table 4.5: Characteristics of the Kit-Monger Brook

Description	Photographs	
Conservation Category characteristics		
Multiple Use Category characteristics		

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Description	Photographs	
Unclassified wetland characteristics		
Litter and fencing in the Multiple Use Category section		
Bank erosion (left) and water pooling (Right) in the Multiple Use Category section		
Surface layer (right) and water pooling (Right) in the Conservation Category section		

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5 DISCUSSION

5.1 FLORA OF SIGNIFICANCE

No EPBC Act or WC Act-listed Threatened Flora, Priority flora or other flora of conservation significance were recorded in the study area during the current survey. All flora species recorded occurred within their known range and are well represented outside the study area.

One Threatened flora taxon, *Acacia anomala*, has previously been recorded at three locations in the Project area (Figure 2.4). These locations were visited for confirmation, but the taxon was not found. It is likely that the records to the east were not found because the exact location was not provided when conducting database searches, and therefore this taxon is still considered highly likely to occur within these areas. The record to the west that falls on the edge of the Ki-it-Monger Brook is likely to be a database location error, however, as this is a cleared paddock with no native species in the vicinity of the point.

Two Threatened flora taxa, *Grevillea curviloba* subsp*. curviloba* and *Grevillea curviloba* subsp*. incurva*, are considered to have a high likelihood of occurrence in the Project area. While these taxa are highly likely to occur within the Bush Forever site comprising the portion of the Project area to the north of the field study area, neither the study area nor the Development area contains any habitat that is likely to support these species.

Based on the desktop study data two Priority flora taxa, *Schoenus capillifolius* and *Stylidium longitubum,* were considered to have a high likelihood of occurrence in the Project area. Following the field survey, however, it is considered unlikely that they occur because the habitats that they could occur in are highly grazed and devoid of mostly all native understorey species.

5.2 VEGETATION OF SIGNIFICANCE

Both remnant vegetation units within the study area are considered significant. As they are remnant units they are scarce, restricted in distribution and provide a role of refuge for flora. They provide habitat for Threatened species (*Acacia anomala*), and are on an area that spans over two IBRA regions.

The remnant vegetation at the study area was mapped as the Darling Scarp and Yalanbee Vegetation Complexes (Heddle *et al,* 1980), which have 41.96% and 47.6%, respectively, of their pre-European extent remaining.

Based on the desktop study information, two Endangered TECs were considered to have a high likelihood of occurrence in the Project area. Following the field survey, *Corymbia calophylla – Kingia australis* woodlands on heavy soils, Swan Coastal Plain, was considered unlikely to occur in the study or Development area as *Kingia australis* was not recorded during the survey. However, both TEC's are highly likely to occur within the Bush Forever block in the north of the Project area.

Floristic correlation with the '*Corymbia calophylla – Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain' TEC were noted in the CcGsBe unit in the study area. While *Xanthorrhoea preissii* was not a dominant component of unit CcGsBe in the study area, it did occur at all three quadrats but at a low density. Other species common to both CcGsBe and the TEC include a co-dominance of *Eucalyptus wandoo, Acacia pulchella, Bossiaea eriocarpa, Hibbertia hypericoides, Hypocalymma angustifolium* and *Lepidosperma angustatum*. However, only a small portion (0.21 ha) of the CcGsBe unit was mapped within the proposed Development area.

The Conservation Category wetland section of the Ki-it Monger Brook was mapped as vegetation unit Er1: *Eucalyptus rudis* subsp. *rudis* low open forest, over mixed weed species and was classified as 'Degraded' with no or scattered native understorey plants, litter, high grazing levels and dominated by weeds. There were no differences in vegetation type, floristic composition, condition or values in

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the Conservation Category section of the Ki-it Monger Brook, the Multiple Use section or the un-classified section.

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5.3 FLORA AND VEGETATION SURVEY LIMITATIONS AND CONSTRAINTS

Limitations of the current survey are summarised in Table 5.1. The survey was undertaken focusing on the areas that are likely to be developed, and included the already disturbed areas throughout the Project area.

Table 5.1: Summary of survey limitations

Constraint	Relevant (yes/no)	Comment
Sources of information and availability of contextual information (i.e. pre-existing background versus new material)	No	Broad scale (1:1,000,000) vegetation mapping by Shepherd *et al* (2001), Beard (1981) and Heddle (1980) is available. The Floristic data from Gibson *et al.* (1994) are also available.
The scope (i.e. what life forms were sampled)	No	The vascular flora of the study area was sampled in accordance with Guidance Statement 51.
Proportion of flora collected and identified (based on sampling, timing and intensity)	No	52 native and 59 introduced species were recorded in the study area. Of these, 37 were annuals (33.3%). Higher sampling intensity in the remnant vegetation would be likely to increase the number of native species, but this area is unlikely to be developed; therefore, the survey intensity was focused on the areas that are proposed for development, and in these areas intensity is considered more than adequate.
Completeness and further work which might be needed (e.g. was the relevant area fully surveyed)	No	As the development is proposed to occur only within the areas already disturbed, the survey intensity is considered more than adequate. However, if the remnant bushland to the east of the Project area is to be proposed for development in future, exact locations of the Threatened flora taxa, *Acacia anomala* would need to be determined.
Mapping reliability	No	Good quality aerial imagery was available and the number and spatial distribution of quadrats was considered adequate for definition of vegetation within the study area.
Timing/weather/ season/ cycle	No	Two phases were surveyed in Spring and Autumn. While below average rainfall occurred before the Spring survey, above average rainfall occurred before the Autumn survey.
Disturbances (e.g. fire, flood, accidental human intervention)	No	There were no natural or human interventions that constrained the survey of the study area.
Intensity (in retrospect, was the intensity adequate?)	No	A two phase Level 2 survey over four person days was conducted at the study area. Considering the development is occurring in the already disturbed areas, this is considered more than adequate to assess the flora and vegetation at the study area.
Resources	No	A total of 4 person-days were expended.
Access issues	No	All parts of the study area were accessible by walking from existing vehicle tracks.
Experience levels (e.g. degree of expertise in plant identification to taxon level)	No	The senior botanist, who was responsible for planning, reporting and conducting the survey, has ten years' of experience conducting botanical surveys. The taxonomist(s) responsible for plant identifications has a Doctorate in botanical taxonomy and has completed identifications for many projects within WA.

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6 CONCLUSIONS

6.1 FLORA AND VEGETATION

The majority of the Project area was characterised by 'Completely Degraded' or 'Degraded' vegetation units. Land clearing, grazing, weed densities and litter were common disturbances. Sixty species of weeds recorded within the Project Area, of which one is a WONS (**Asparagus asparagoides*) and one is a Declared Plant (**Zantedeschia aethiopica*).

There were no conservation significant flora species recorded in the study area during the survey. Nonetheless, it is considered highly likely that the Threatened flora taxon *Acacia anomala* may occur in the two remnant vegetation units to the east of the Project area, and that *Grevillea curviloba* subsp*. curviloba* and *Grevillea curviloba* subsp*. incurva* may occur in the Bush Forever site (Site 89) in the north. However, given the small area (0.21 ha) of the CcGsBe unit mapped within the Development area, it is considered unlikely that either significant taxa occurs within this area.

Two remnant vegetation communities were mapped within the study area, though only a small portion of the CcGsBe unit occurs within the Development area. Both are considered significant, as they are scarce, restricted in distribution and provide a role of refuge for flora. They are likely to provide habitat for Threatened species (*Acacia anomala*), and are on an area that spans two IBRA regions. One of these remnant units (CcGsBe) contains similarities to the Endangered TEC: '*Corymbia calophylla – Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain'. Species common to both CcGsBe and this TEC include *Xanthorrhoea preissii*, *Eucalyptus wandoo, Acacia pulchella, Bossiaea eriocarpa, Hibbertia hypericoides, Hypocalymma angustifolium* and *Lepidosperma angustatum*.

The Conservation Category wetland section of the Ki-it Monger Brook was rated as 'Degraded' with no or scattered native understorey plants, litter, high grazing levels and domination by weeds. There was no difference in vegetation type, condition or values between the Conservation Category section of the Ki-it Monger Brook, the other Multiple Use section and the un-classified section.

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7 REFERENCES

360 Environmental. 2012. North Ellenbrook Level 2 Flora and Vegetation Survey. Prepared for Greg Rowe and Associates. July 2012.

Beard, J. S. 1981. Vegetation Survey of Western Australia: The Vegetation of the Swan Area. Map and Explanatory Memoirs, 1: 100,000 series. Vegmap Publications, Perth.

BoM. 2016. Bureau of Meteorology. Available at: http://www.bom.gov.au. Commonwealth of Australia, Canberra.

CALM. 1999. Environmental Weed Strategy for Western Australia. Department of Conservation and Land Management, Government of Western Australia, Western Australia.

Chittering Landcare Centre. 2008. Foreshore Assessment, Flora and Fauna Survey for the Drainage Nutrient Intervention Program (DNIP) in the Lower Ellen Brook Catchment. March 2008.

Churchward, H. M. and McArthur, W. M. 1980. Landforms and Soils of the Darling System. In: Atlas of Natural Resources, Darling System, Western Australia. Perth, Pinjarra and Collie Sheets. Department of Conservation and Environment, Western Australia.

DAFWA. 2007. Biosecurity and Agriculture Management Act 2007. As at 01 May 2013. Department of Agriculture and Food Western Australia. Government of Western Australia, South Perth.

DAFWA. 2013. Western Australian Organism List (WAOL) - Declared pest list. Available at http://www.biosecurity.wa.gov.au/organisms/export/PER-DP. Department of Agriculture and Food Western Australia. Government of Western Australia., South Perth.

Department of Environmental Protection. 2000. Bush Forever Volume 2: Directory of Bush Forever Sites. Western Australia, Department of Environment Protection, Perth.

Desmond, A. 2001. Swan Coastal Plain 1 (SWA1 - Dandaragan Plateau subregion). Department of Conservation and Land Management, Perth, Western Australia.

DPaW. 2013. A methodology for the evaluation of specific wetland types on the Swan Costal Plain, Western Australia. Department of Parks and Wildlife, August 2013.

DSEWPaC. 2012a. Interim Biogeographic Regionalisation for Australia (IBRA), Version 7. Australian Government Department of Sustainability, Environment, Water, Population and Communities.

DSEWPaC. 2012b. Weeds of National Significance (WONS). Department of Sustainability, Environment, Water, Population and Communities. Commonwealth of Australia. Available at: http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html.

Emerge Associates. 2013. Flora and vegetation report PT Lot M1313 Great Northern Highway Muchea. Prepared for Westbridge Property Group Pty Ltd. January 2013.

EPA. 2002a. Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection. . Environmental Protection Authority, Western Australia.

EPA. 2002b. Position Statement No. 4: Environmental Protection of Wetlands. Environmental Protection Authority. November 2004. Environmental Protection Authority, Western Australia.

EPA. 2004a. Environment Protection (Clearing of Native Vegetation) Regulations 2004. As at 17 April 2009. Environment Protection Authority. State Law Publisher, Western Australia.

EPA. 2004b. Guidance for the Assessment of Environmental Factors. Guidance Statement 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia. Environmental Protection Authority, Western Australia.

Document Set ID: 8106943
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EPA. 2004c. Guidance Statement No. 51: Guidance for the Assessment of Environmental Factors (in accordance with the Environmental Protection Act 1986). Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia. No. 51. June. Environmental Protection Authority, Western Australia.

EPA. 2004d. Terrestrial flora and vegetation surveys for environmental impact assessment in Western Australia. Guidance for the Assessment of Environmental Factors No. 51. Environmental Protection Authority, Western Australia.

EPA & DEC. 2015. Technical Guide - Flora and Vegetation Surveys for Environmental Impact Assessment. Technical Report of the Environmental Protection Authority and the Department of Parks and Wildlife (eds. K Freemen, G Stack, S Thomas, N Woolfrey), Perth, Western Australia.

ESCAVI. 2003. Australian Vegetation Attribute Manual: National Vegetation Information System (NVIS). Executive Steering Committee for Australian Vegetation Information System (ESCAVI), Australian Government Department of Environment and Heritage, Canberra.

Gibson, N., Keighery, B. J., Burbidge, A. H., and Lyons, M. N. 1994. A Floristic survey of the southern Swan Coastal Plain. Unpublished Report for the Australian Heritage Comission. Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.).

Heddle, E. M., Loneragan, O. W., and Havel, J. J. 1980. Vegetation complexes of the Darling System, Western Australia. Atlas of natural resources of the Darling System, Western Australia. Department of Environment and Conservation, Perth, Western Australia.

Hill, A. L., Semeniuk, C. A., Semeniuk, V., and Del Marco, A. 1996. Wetlands of the Swan Coastal Plain. Water and Rivers Commission, Perth.

Kendrick, P. and McKenzie, N. 2001. Pilbara 1 (PIL1 - Chichester subregion). A Biodiversity Audit of Western Australia's 53 Biogeographic Subregions. Department of Conservation and Land Management, Perth, Western Australia.

Mitchell, D., Williams, K., and Desmond, A. 2002. Swan Coastal Plain 2 (SWA2 - Swan Coastal Plain subregion). Department of Conservation and Land Management, Perth, Western Australia.

Shepherd, D. P., Beeston, G. R., and Hopkins, A. J. M. 2001. Native vegetation in Western Australia: Extent, type and status. Technical Report 249. Department of Agriculture, South Perth, Western Australia.

Trudgen, M. E. 1991. Vegetation Condition Scale. In: National Trust (WA) 1993 Urban Bushland Policy. National Trust of Australia (WA), Wildflower Society of WA (Inc.), and the Tree Society (Inc.), Perth, Western Australia.

Western Australian Herbarium. 1998-2015. FloraBase - The Western Australian Flora. Government of Western Australia Department of Parks and Wildlife. Available at: http://florabase.dpaw.wa.gov.au/.

Williams, K. and Mitchell, D. 2001. Jarrah Forest 1 (JF1 - Northern Jarrah Forest subregion). A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002. Department of Conservation and Land Management., Perth, Western Australia.

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APPENDIX A DEFINITIONS

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Threatened (WC Act) and Priority flora Categories

Code	Definition
T	**Threatened flora – (Declared Rare Flora – Extant)** Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection and have been gazetted as such (Schedule 1 under the *Wildlife Conservation Act 1950*).
X	**Presumed Extinct Flora (Declared Rare Flora - Extinct)** Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such Schedule 2 under the *Wildlife Conservation Act 1950*).
P1	**Priority One – Poorly Known Species** Species that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.
P2	**Priority Two – Poorly Known Species** Species that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.
P3	**Priority Three – Poorly Known Species** Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities 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 localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.
P4	**Priority Four – 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 do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
P5	**Priority Five - Conservation Dependent species** Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

Threatened flora (EPBC Act) Categories

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

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Definition of codes for Threatened Ecological Communities

Code	Definition
PD: Presumed Totally Destroyed	An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future. An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant
CR: Critically Endangered	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated. An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future.
EN: Endangered	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future. An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future.
VU: Vulnerable	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range. An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future.

Definition of codes for Priority Ecological Communities

Code	Definition
P1: Priority One	Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or Pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
P2: Priority Two	Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
P3: Priority Three	(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (ii) Communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (iii) Communities made up of large, and/or widespread occurrences that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.
P4: Priority Four	Ecological communities that are adequately known, Rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring. (a) Rare. Ecological communities known from few occurrences 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 communities are usually represented on conservation lands. (b) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (c) Ecological communities that have been removed from the list of threatened communities during the past five years.
P5: Priority Five	Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

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Control categories for Declared Pests (Weeds)

Declared plant category	Description
C1 - Exclusion	Pests assigned to this category are not established in WA and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2 - Eradication	Pests assigned to this category are present in WA in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
C3 - Management	Pests assigned to this category are established in WA but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.

Definition of codes for vegetation condition

Vegetation condition (EPA & DPaW 2015)	Vegetation condition (Keighery 1994)	Criteria
1	Pristine	Pristine or nearly so, no obvious sign of disturbance or damage caused by human activities.
2	Excellent	Vegetation structure intact; disturbance affecting individual species; weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
3	Very good	Vegetation structure altered; obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires; the presence of some more aggressive weeds; dieback; logging and grazing.
4	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires; the presence of some very aggressive weeds; partial clearing; dieback and grazing.
6	Degraded or Poor	Basic vegetation structure severely impacted by disturbance. Scope for regeneration by not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires; the presence of some very aggressive weeds at high density; partial clearing; dieback and grazing.
7	Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as “parkland cleared” with the flora comprising weed or crop species with isolated native trees or shrubs.

Categorisation of environmental weeds

Criteria	Description
Invasiveness	Ability to invade bushland in good to excellent condition or ability to invade waterways.
Distribution	Wide current or potential distribution including consideration of known history of widespread distribution elsewhere in the world.
Environmental impacts	Ability to change the structure, composition and function of ecosystems. In particular an ability to form single-species stands.
Category	**Scoring System**
High	A species which scores yes to all three of the above criteria. A rating of high indicates a species that should be prioritised for control and/or research.
Moderate	A species which scores yes for two of the above criteria. A rating of moderate indicates a species which should be monitored. Control or research should be directed to it if funds are available.
Mild	A species which scores yes to one of the criteria. A mild rating indicates monitoring or control if appropriate.
Low	A species which does not score yes for any of the criteria. A low rating indicates a low requirement for monitoring.

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APPENDIX B POTENTIAL SPECIES LIST

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Species recorded during the literature review			
Family	**Taxa**	**Family**	**Taxa**
Amaranthaceae	*Ptilotus drummondii var. drummondii*	Cyperaceae	*Schoenus nanus*
Apiaceae	*Daucus glochidiatus*	Cyperaceae	*Tetraria capillaris*
Apiaceae	*Eryngium pinnatifidum subsp. pinnatifidum*	Cyperaceae	*Tetraria octandra*
Apiaceae	*Homalosciadium homalocarpum*	Dilleniaceae	*Hibbertia commutata*
Apiaceae	*Xanthosia candida*	Dilleniaceae	*Hibbertia hypericoides*
Apiaceae	*Xanthosia huegelii*	Dioscoreaceae	*Dioscorea hastifolia*
Apocynaceae	**Gomphocarpus fruticosus* (Declared Pest - s22(2), C3 not for Project area)	Droseraceae	*Drosera erythrorhiza*
Araceae	**Zantedeschia aethiopica* (Declared Pest - s22(2), C3 whole of state)	Droseraceae	*Drosera macrantha*
Araliaceae	*Hydrocotyle callicarpa*	Elaeocarpaceae	*Tetratheca nuda*
Araliaceae	*Trachymene pilosa*	Ericaceae	*Leucopogon polymorphus*
Asparagaceae	**Asparagus asparagoides* (WONS)	Ericaceae	*Leucopogon pulchellus*
Asparagaceae	*Chamaescilla corymbosa*	Fabaceae	**Chamaecytisus palmensis*
Asparagaceae	*Dichopogon capillipes*	Fabaceae	**Genista sp.* (WONS)
Asparagaceae	*Laxmannia squarrosa*	Fabaceae	**Lotus subbiflorus*
Asparagaceae	*Lomandra nigricans*	Fabaceae	**Lupinus cosentinii*
Asparagaceae	*Sowerbaea laxiflora*	Fabaceae	**Ornithopus pinnatus*
Asparagaceae	*Thysanotus manglesianus*	Fabaceae	**Trifolium angustifolium*
Asparagaceae	*Thysanotus tenellus*	Fabaceae	**Trifolium arvense var. arvense*
Asteraceae	**Arctotheca calendula*	Fabaceae	**Trifolium cernuum*
Asteraceae	**Chrysanthemoides monilifera* (WONS)	Fabaceae	**Trifolium subterraneum*
Asteraceae	**Conyza bonariensis*	Fabaceae	*Acacia alata var. alata*
Asteraceae	**Conyza parva*	Fabaceae	*Acacia oncinophylla subsp. oncinophylla* (Priority 3)
Asteraceae	**Cotula coronopifolia*	Fabaceae	*Acacia pulchella var. pulchella*
Asteraceae	**Dittrichia graveolens*	Fabaceae	*Acacia saligna*
Asteraceae	**Hypochaeris glabra*	Fabaceae	*Bossiaea eriocarpa*
Asteraceae	**Lactuca serriola*	Fabaceae	*Bossiaea spinescens*
Asteraceae	**Sonchus asper*	Fabaceae	*Gastrolobium spinosum*
Asteraceae	**Sonchus oleraceus*	Fabaceae	*Gompholobium marginatum*
Asteraceae	**Ursinia anthemoides*	Fabaceae	*Templetonia drummondii*
Asteraceae	**Vellereophyton dealbatum*	Gentianaceae	**Centaurium erythraea*
Asteraceae	*Craspedia variabilis*	Goodeniaceae	*Scaevola glandulifera*
Asteraceae	*Lagenophora huegelii*	Haemodoraceae	*Conostylis setosa*
Asteraceae	*Quinetia urvillei*	Haemodoraceae	*Haemodorum discolor*
Asteraceae	*Trichocline spathulata*	Haemodoraceae	*Haemodorum simplex*
Boryaceae	*Borya sphaerocephala*	Haloragaceae	*Gonocarpus cordiger*
Campanulaceae	**Wahlenbergia capensis*	Hemerocallidaceae	*Caesia micrantha*
Campanulaceae	*Wahlenbergia preissii*	Hemerocallidaceae	*Tricoryne elatior*
Caryophyllaceae	**Minuartia mediterranea*	Iridaceae	**Gladiolus caryophyllaceus*
Celastraceae	*Stackhousia monogyna*	Iridaceae	**Moraea flaccida* (Declared Pest - s22(2), C3 not for Project area)
Centrolepidaceae	*Aphelia sp. Albany*	Iridaceae	**Romulea rosea*
Colchicaceae	*Burchardia congesta*	Iridaceae	**Watsonia sp.*
Cucurbitaceae	**Citrullus lanatus*	Iridaceae	*Patersonia juncea*
Cyperaceae	**Cyperus congestus*	Lamiaceae	*Hemigenia barbata*
Cyperaceae	**Isolepis marginata*	Lauraceae	*Cassytha pomiformis*
Cyperaceae	*Gahnia aristata*	Linaceae	**Linum trigynum*
Cyperaceae	*Lepidosperma leptostachyum*	Myrtaceae	**Leptospermum laevigatum*
Cyperaceae	*Schoenus grammatophyllus*	Myrtaceae	*Calothamnus quadrifidus*

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Species recorded during the literature review			
Family	**Taxa**	**Family**	**Taxa**
Myrtaceae	*Calothamnus sanguineus*	Poaceae	**Vulpia myuros forma myuros*
Myrtaceae	*Corymbia calophylla*	Poaceae	*Austrostipa campylachne*
Myrtaceae	*Eucalyptus accedens*	Poaceae	*Austrostipa elegantissima*
Myrtaceae	*Eucalyptus wandoo subsp. wandoo*	Poaceae	*Dichelachne crinita*
Myrtaceae	*Hypocalymma angustifolium*	Poaceae	*Microlaena stipoides*
Myrtaceae	*Leptospermum erubescens*	Poaceae	*Neurachne alopecuroidea*
Myrtaceae	*Melaleuca parviceps*	Poaceae	*Rytidosperma setaceum*
Oleaceae	**Olea europaea*	Poaceae	*Tetrarrhena laevis*
Onagraceae	**Oenothera glazioviana*	Polygalaceae	*Comesperma ciliatum*
Orchidaceae	**Disa bracteata*	Polygonaceae	**Rumex crispus*
Orchidaceae	*Caladenia longicauda subsp. longicauda*	Polygonaceae	**Rumex vesicarius*
Orchidaceae	*Caladenia marginata*	Polygonaceae	*Muehlenbeckia adpressa*
Orchidaceae	*Cyanicula sericea*	Primulaceae	**Lysimachia arvensis*
Orchidaceae	*Microtis media subsp. densiflora*	Proteaceae	*Grevillea pilulifera*
Orchidaceae	*Pterostylis vittata*	Proteaceae	*Hakea erinacea*
Orchidaceae	*Thelymitra crinita*	Proteaceae	*Hakea incrassata*
Orobanchaceae	**Bartsia trixago*	Proteaceae	*Hakea lissocarpha*
Oxalidaceae	*Oxalis perennans*	Proteaceae	*Isopogon asper*
Papaveraceae	**Fumaria capreolata*	Proteaceae	*Petrophile striata*
Phormiaceae	*Dianella revoluta var. divaricata*	Pteridaceae	*Cheilanthes austrotenuifolia*
Phyllanthaceae	*Phyllanthus calycinus*	Rhamnaceae	*Trymalium angustifolium*
Pinaceae	**Pinus pinaster*	Rosaceae	**Rubus fruticosus aggregate* (WONS)
Pinaceae	**Pinus radiata*	Rubiaceae	**Galium divaricatum*
Pittosporaceae	*Marianthus candidus*	Rutaceae	*Boronia ovata*
Plantaginaceae	**Kickxia elatine subsp. elatine*	Salviniaceae	**Salvinia molesta* (WONS)
Poaceae	**Aira caryophyllea*	Santalaceae	*Leptomeria cunninghamii*
Poaceae	**Avena barbata*	Solanaceae	**Lycium ferocissimum* (WONS)
Poaceae	**Avena fatua*	Solanaceae	**Solanum nigrum*
Poaceae	**Brachypodium distachyon*	Stylidiaceae	*Levenhookia pusilla*
Poaceae	**Briza maxima*	Stylidiaceae	*Stylidium amoenum*
Poaceae	**Briza minor*	Stylidiaceae	*Stylidium brunonianum*
Poaceae	**Bromus diandrus*	Stylidiaceae	*Stylidium bulbiferum*
Poaceae	**Cenchrus ciliaris*	Stylidiaceae	*Stylidium calcaratum*
Poaceae	**Cortaderia selloana*	Stylidiaceae	*Stylidium caricifolium*
Poaceae	**Cynodon dactylon*	Typhaceae	**Typha orientalis*
Poaceae	**Ehrharta brevifolia*	Verbenaceae	**Lantana camara* (WONS)
Poaceae	**Ehrharta calycina*	Verbenaceae	**Verbena sp.*
Poaceae	**Ehrharta longiflora*	Xanthorrhoeaceae	*Xanthorrhoea acanthostachya*
Poaceae	**Hordeum hystrix*	Xanthorrhoeaceae	*Xanthorrhoea gracilis*
Poaceae	**Lolium perenne*	Xanthorrhoeaceae	*Xanthorrhoea preissii*
Poaceae	**Lolium rigidum*	Zamiaceae	*Macrozamia riedlei*
Poaceae	**Pennisetum clandestinum*		
Poaceae	**Pentameris airoides*		
Poaceae	**Polypogon monspeliensis*		
Poaceae	**Urochloa mutica*		
Poaceae	**Vulpia bromoides*		

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APPENDIX C SITE DATA

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Site:	Q01		
Botanist:	Udani Sirisena	**Date:**	24/10/2014
Site type:	Quadrat (10x10m)	**NW corner (GDA94):**	50J 411560mE, 6496144mN
Habitat:	Hillslope (midslope, steep west-facing slope)		
Surface layer:	Brown sandy-clay loam, with no rocks		
Vegetation condition:	2 (Excellent, Keighery 1994)	**Fire history:**	No signs of fire
Disturbance types:	Weeds, animal tracks		

Phase 1

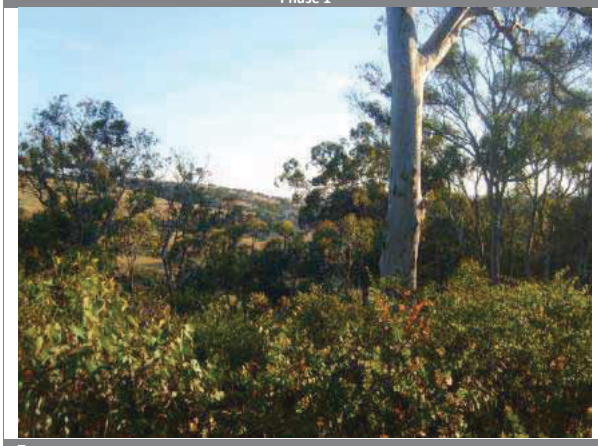


Taxa	Cover (%)		Stratum
	Phase 1	Phase 2	
Daucus glochidiatus	1		Herb
Dianella revoluta	1		Herb
Eucalyptus wandoo subsp. wandoo	70		Tree - low
Gastrolobium retusum	1		Herb
Gastrolobium spinosum	20		Shrub - low
Goodenia coerulea	0.1		Herb
Hakea lissocarpha	1		Shrub - low
Hesperantha falcata	1		Herb
Hibbertia hypericoides subsp. hypericoides	1		Shrub - low
Inadequate material	0.1		Herb
Isopogon sp.	1		Shrub - low
Monoculus monstrosus	1		Herb
Neurachne alopecuroidea	1		Tussock grass - low
Pentameris airoides	1		Tussock grass - low
Sonchus asper	1		Herb
Stylidium affine	1		Herb
Stylidium bulbiferum	0.1		Herb
Thomasia foliosa	1		Shrub - low
Thysanotus patersonii	0.1		Climber
Ursinia anthemoides	0.1		Herb
Xanthorrhoea preissii	2		Shrub - mid

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Site:	Q02		
Botanist:	Udani Sirisena	**Date:**	24/10/2014
Site type:	Quadrat (10x10m)	**NW corner (GDA94):**	50J 410176mE, 6496615mN
Habitat:	Hillslope (hilltop, moderate south facing slope)		
Surface layer:	Brown sandy-clay loam, with no rocks		
Vegetation condition:	2 (Excellent, Keighery 1994)	**Fire history:**	No signs of fire
Disturbance types:	Weeds, animal tracks		

Phase 1



Taxa	Cover (%) Phase 1	Cover (%) Phase 2	Stratum
Avena barbata	1		Tussock grass - low
Briza maxima	1		Tussock grass - low
Burchardia congesta	1		Herb
Eucalyptus wandoo subsp. wandoo	50		Tree - low
Gastrolobium spinosum	10		Shrub - mid
Hakea lissocarpha	1		Shrub - mid
Hesperantha falcata	1		Herb
Hypocalymma angustifolium	1		Shrub - mid
Inadequate material	1		Shrub - low
Lysimachia arvensis	1		Herb
Neurachne alopecuroidea	1		Tussock grass - low
Thomasia foliosa	1		Shrub - low
Trifolium angustifolium var. angustifolium	1		Herb
Ursinia anthemoides	1		Herb
Vulpia myuros	1		Tussock grass - low
Xanthorrhoea preissii	3		Shrub - mid
Xanthosia candida	1		Herb

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Site:	Q03		
Botanist:	Melissa Hay	**Date:**	17/05/2016
Site type:	Quadrat (10x10m)	**NW corner (GDA94):**	50J 410900mE, 6495623mN
Habitat:	Hillslope (midslope, gentle east facing slope)		
Surface layer:	Brown sandy-clay loam, with common pebbles, stones and boulders of laterite		
Vegetation condition:	2 (Excellent, Keighery 1994)	**Fire history:**	No signs of fire
Disturbance types:	Weeds, animal tracks		

Phase 2



Taxa	Cover (%)		Stratum
	Phase 1	Phase 2	
Acacia pulchella		5	Shrub - mid
Bossiaea eriocarpa		30	Shrub - low
Burchardia congesta		0.1	Herb
Corymbia calophylla		50	Tree - low
Eucalyptus wandoo subsp. wandoo		2	Tree - low
Gastrolobium spinosum		1	Shrub - mid
Hakea lissocarpha		0.1	Shrub - mid
Hibbertia commutata		0.1	Shrub - low
Hypocalymma angustifolium		5	Shrub - mid
Macrozamia riedlei		0.1	Shrub - low
Mesomelaena ?stygia subsp. stygia		5	Sedge - low
Oxalis corniculata		2	Herb
Phyllanthus calycinus		0.1	Shrub - low
Trymalium odoratissimum subsp. odoratissimum		0.1	Shrub - mid
Sonchus oleraceus		4	Herb
Stylidium repens		0.1	Herb
Xanthorrhoea preissii		3	Shrub - low
Xanthosia candida		0.1	Shrub - low

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Site:	Q04		
Botanist:	Melissa Hay	**Date:**	16/05/2016
Site type:	Quadrat (10x10m)	**NW corner (GDA94):**	50J 410401mE, 6496763mN
Habitat:	Hillslope (hilltop, gentle slope)		
Surface layer:	Brown sandy-clay loam, with few granite pebbles		
Vegetation condition:	2 (Excellent, Keighery 1994)	**Fire history:**	No signs of fire
Disturbance types:	Weeds, animal tracks		

Phase 2



Taxa	Cover (%)		Stratum
	Phase 1	Phase 2	
Acacia pulchella		5	Shrub - mid
Acacia ?applanata		0.1	Shrub - low
Burchardia congesta		0.1	Herb
Corymbia calophylla		2	Tree - low
Eucalyptus wandoo subsp. *wandoo*		15	Tree - low
Gastrolobium spinosum		80	Shrub - mid
Hibbertia commutata		0.1	Shrub - low
Hypocalymma angustifolium		0.1	Shrub - mid
Lepidosperma leptostachyum		0.1	Shrub - low
Lepidosperma squamatum		5	Sedge - low
Lasiopetalum floribundum		0.1	Shrub - low
Patersonia occidentalis		0.1	Sedge - low
Stylidium affine		0.1	Herb
Thomasia foliosa		0.1	Shrub - low
Thysanotus patersonii		0.1	Climber
Xanthorrhoea preissii		1	Shrub - low

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Site:	Q05		
Botanist:	Melissa Hay	**Date:**	16/05/2016
Site type:	Quadrat (10x10m)	**NW corner (GDA94):**	50J 411402mE, 6496313mN
Habitat:	Hillslope (midslope, steep west-facing slope)		
Surface layer:	Brown sandy-clay loam, with no rocks		
Vegetation condition:	2 (Excellent, Keighery 1994)	**Fire history:**	No signs of fire
Disturbance types:	Weeds, animal tracks		

Phase 2



Taxa	Cover (%)		Stratum
	Phase 1	Phase 2	
Avena barbata		5	Tussock grass - low
Exocarpos ?sparteus		0.1	Shrub - low
Burchardia congesta		0.1	Herb
Eucalyptus wandoo subsp. wandoo		70	Tree - low
Gastrolobium spinosum		20	Shrub - mid
Hakea undulata		0.1	Shrub - mid
Hibbertia hypericoides subsp. hypericoides		0.1	Shrub - low
Hypocalymma angustifolium		0.1	Shrub - mid
Lolium rigidum		0.1	Tussock grass - low
Thomasia foliosa		0.1	Shrub - low
Xanthorrhoea preissii		15	Shrub - mid
Xanthosia candida		0.1	Shrub - low

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Site:	Q06		
Botanist:	Melissa Hay	**Date:**	16/05/2016
Site type:	Quadrat (10x10m)	**NW corner (GDA94):**	50J 410985mE, 6495619mN
Habitat:	Hillslope (midslope, gentle east facing slope)		
Surface layer:	Brown sandy-clay loam, with no rocks		
Vegetation condition:	2 (Excellent, Keighery 1994)	**Fire history:**	No signs of fire
Disturbance types:	Weeds, animal tracks		

Phase 2



Taxa	Cover (%) Phase 1	Cover (%) Phase 2	Stratum
Acacia pulchella		5	Shrub - mid
Avena barbata		50	Tussock grass - low
Banksia sessilis var. sessilis		0.1	Shrub - tall
Bossiaea eriocarpa		20	Shrub - low
Burchardia congesta		0.1	Herb
Corymbia calophylla		20	Tree - low
Eucalyptus wandoo subsp. wandoo		10	Tree - low
Gastrolobium spinosum		5	Shrub - mid
Lasiopetalum floribundum		0.1	Shrub - low
Hakea lissocarpha		0.1	Shrub - mid
Hibbertia commutata		1	Shrub - low
Hypocalymma angustifolium		20	Shrub - mid
Lepidosperma leptostachyum		4	Shrub - low
Macrozamia riedlei		0.1	Shrub - low
Moraea flaccida		10	Herb
Oxalis corniculata		1	Herb
Phyllanthus calycinus		1	Shrub - low
Desmocladus flexuosus		2	Sedge - low
Trymalium odoratissimum subsp. odoratissimum		1	Shrub - mid
Thysanotus patersonii		0.1	Climber
Xanthorrhoea preissii		0.1	Shrub - low

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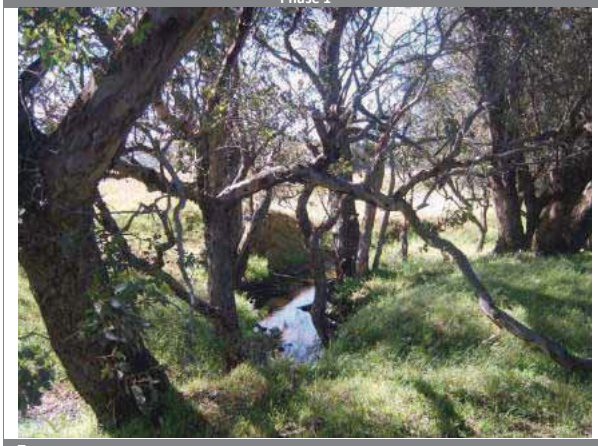
Site:	R01		
Botanist:	Udani Sirisena & Melissa Hay	**Date:**	24/10/2014 & 17/05/2016
Site type:	Releve	**NW corner (GDA94):**	50J 408324mE, 6495277mN
Habitat:	Drainage line on a plain		
Surface layer:	Brown-black sandy-clay loam on banks and bed		
Vegetation condition:	6 (Degraded, Keighery 1994)	**Fire history:**	No signs of fire
Disturbance types:	High level weeds, high level grazing, partial clearing, litter		

Phase 1	Phase 2
	

Taxa	Cover (%)		Stratum
	Phase 1	Phase 2	
Avena barbata	60	80	Tussock grass - low
Briza maxima	1		Tussock grass - low
Briza minor	0.1		Tussock grass - low
Bromus diandrus	5		Tussock grass - low
Cynodon dactylon		20	Tussock grass - low
Eucalyptus rudis subsp. *rudis*	50	50	Tree - low to mid
Gomphocarpus fruticosus	0.1	0.1	Shrub - mid
Hordeum leporinum	20		Tussock grass - low
Juncus pallidus	0.1	0.1	Rush - low
Lolium rigidum	5	5	Tussock grass - low
Moraea flaccida	0.1	10	Herb
Oxalis pes-caprae	5	30	Herb
Oxalis purpurea		10	Herb
Raphanus raphanistrum	0.1	0.1	Herb
Sonchus oleraceus	0.1		Herb
Trachyandra divaricata	0.1		Herb
Trifolium angustifolium var. *angustifolium*	5		Herb
Trifolium campestre var. *campestre*	1		Herb

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Site:	R02		
Botanist:	Udani Sirisena & Melissa Hay	**Date:**	24/10/2014 & 17/05/2016
Site type:	Releve	**NW corner (GDA94):**	50J 408310mE, 6495369mN
Habitat:	Drainage line on a plain		
Surface layer:	Brown-white sandy-clay loam on banks, with common pebbles of quartz and granite along drainage line		
Vegetation condition:	6 (Degraded, Keighery 1994)	**Fire history:**	No signs of fire
Disturbance types:	High level weeds, high level grazing, partial clearing, litter		

Phase 1	Phase 2
	

Taxa	Cover (%)		Stratum
	Phase 1	Phase 2	
Avena barbata	60	80	Tussock grass - low
Briza maxima	5		Tussock grass - low
Bromus diandrus	10		Tussock grass - low
Cynodon dactylon		3	Tussock grass - low
Eucalyptus rudis subsp. rudis	70	70	Tree - low
Gomphocarpus fruticosus	0.1	0.1	Shrub - mid
Hordeum leporinum	1		Tussock grass - low
Juncus pallidus	0.1	0.1	Rush - low
Lolium rigidum	10	3	Tussock grass - low
Moraea flaccida		0.1	Herb
Oxalis pes-caprae	1	20	Herb
Oxalis purpurea		1	Herb
Raphanus raphanistrum	0.1	0.1	Herb
Rumex hypogaeus		0.1	Herb
Sonchus oleraceus	1		Herb
Trachyandra divaricata	0.1		Herb
Trifolium angustifolium var. *angustifolium*	5		Herb

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Site:	R03		
Botanist:	Udani Sirisena	**Date:**	24/10/2014
Site type:	Releve	**NW corner (GDA94):**	50J 409289mE, 6495096mN
Habitat:	Hillslope (footslope, gentle west-facing slope)		
Surface layer:	Brown-white sandy-clay loam, with no rocks		
Vegetation condition:	6 (Degraded, Keighery 1994)	**Fire history:**	No signs of fire
Disturbance types:	High level weeds, high level grazing		

Phase 1



Taxa	Cover (%) Phase 1	Phase 2	Stratum
Acacia pulchella	2		Shrub - low
Avena barbata	20		Tussock grass - low
Briza maxima	5		Tussock grass - low
Bromus hordeaceus	5		Tussock grass - low
Corymbia calophylla	20		Tree - low
Hakea erinacea	0.1		Shrub - low
Hesperantha falcata	5		Herb
Hibbertia commutata	0.1		Shrub - low
Nuytsia floribunda	1		Shrub - tall
Vulpia bromoides	1		Tussock grass - low
Xanthorrhoea preissii	2		Shrub - low

Site:	R04		
Botanist:	Udani Sirisena	**Date:**	24/10/2014
Site type:	Releve	**NW corner (GDA94):**	50J 408829mE, 6496254mN
Habitat:	Drainage line on a plain		
Surface layer:	Brown-white sandy-clay loam on banks and bed		
Vegetation condition:	6 (Degraded, Keighery 1994)	**Fire history:**	No signs of fire
Disturbance types:	High level weeds, high level grazing, partial clearing, litter		

Phase 1



Taxa	Cover (%) Phase 1	Phase 2	Stratum
Arctotheca calendula	1		Herb
Avena fatua	10		Tussock grass - low
Avena barbata	70		Tussock grass - low
Bromus hordeaceus	10		Tussock grass - low
Ehrharta longiflora	1		Tussock grass - low
Eucalyptus rudis subsp. rudis	20		Tree - low
Eucalyptus wandoo subsp. wandoo	1		Tree - low
Hordeum leporinum	20		Tussock grass - low
Juncus pallidus	0.1		Rush - low
Lolium rigidum	10		Tussock grass - low

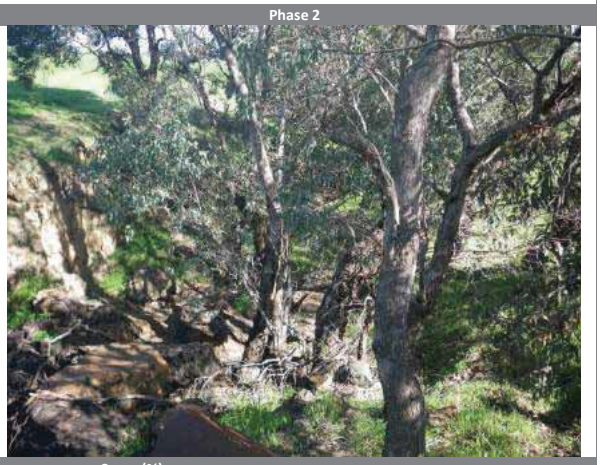
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Site:	R05		
Botanist:	Udani Sirisena & Melissa Hay	**Date:**	24/10/2014 & 17/05/2016
Site type:	Releve	**NW corner (GDA94):**	50J 409265mE, 6496316mN
Habitat:	Drainage line on a plain		
Surface layer:	Brown-white sandy-clay loam on banks and bed, with many boulders of granite		
Vegetation condition:	6 (Degraded, Keighery 1994)	**Fire history:**	No signs of fire
Disturbance types:	High level weeds, high level grazing, partial clearing, litter		

Phase 1



Phase 2



Taxa	Cover (%)		Stratum
	Phase 1	Phase 2	
Arctotheca calendula		0.1	Herb
Avena barbata	20	40	Tussock grass - low
Bromus diandrus	1		Tussock grass - low
Eucalyptus rudis subsp. rudis	60	60	Tree - low
Eucalyptus wandoo subsp. wandoo	10	10	Tree - low
Hordeum leporinum	1		Tussock grass - low
Lolium rigidum	1	0.1	Tussock grass - low
Moraea flaccida		5	Herb
Oxalis pes-caprae	1	5	Herb
Oxalis purpurea		1	Herb
Sonchus oleraceus		0.1	Herb
Stachys arvensis		0.1	Herb

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Site:	R06		
Botanist:	Udani Sirisena & Melissa Hay	**Date:**	24/10/2014 & 17/05/2016
Site type:	Releve	**NW corner (GDA94):**	50J 409325mE, 6496342mN
Habitat:	Plain - edge of dam		
Surface layer:	Brown-white sandy-clay loam on banks and bed		
Vegetation condition:	6 (Degraded, Keighery 1994)	**Fire history:**	No signs of fire
Disturbance types:	High level weeds, high level grazing, partial clearing, litter		

Phase 1



Phase 2



Taxa	Cover (%)		Stratum
	Phase 1	Phase 2	
Arctotheca calendula	2	2	Herb
Avena barbata	40	50	Tussock grass - low
Briza maxima	0.1		Tussock grass - low
Briza minor	0.1		Tussock grass - low
Bromus diandrus	20		Tussock grass - low
Corymbia calophylla	2	2	Tree - low
Cynodon dactylon		5	Tussock grass - low
Ehrharta calycina	30		Tussock grass - low
Eucalyptus rudis subsp. rudis	20	20	Tree - low to mid
Eucalyptus wandoo subsp. wandoo	10	10	Tree - low
Haemodorum laxum	0.1		Herb
Hesperantha falcata	2		Herb
Hypochaeris glabra	0.1		Herb
Inadequate material	0.1		Tussock grass - low
Inadequate material	0.1		Herb
Lolium rigidum	20	20	Tussock grass - low
Lotus angustissimus	2		Herb
Lupinus cosentinii	0.1		Herb
Moraea flaccida	0.1	8	Herb
Neurachne alopecuroidea	0.1		Tussock grass - low
Oxalis pes-caprae	2	10	Herb
Oxalis purpurea		2	Herb
Solanum linnaeanum	0.1		Shrub - mid
Trifolium angustifolium var. angustifolium	0.1		Herb
Trifolium campestre var. campestre	0.1		Herb

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Site:	R07		
Botanist:	Udani Sirisena & Melissa Hay	**Date:**	24/10/2014 & 17/05/2016
Site type:	Releve	**NW corner (GDA94):**	50J 408377mE, 6496136mN
Habitat:	Drainage line on a plain		
Surface layer:	Brown-white sandy-clay loam on banks and bed		
Vegetation condition:	6 (Degraded, Keighery 1994)	**Fire history:**	No signs of fire
Disturbance types:	High level weeds, high level grazing, partial clearing, litter		

Phase 1



Phase 2



Taxa	Cover (%)		Stratum
	Phase 1	Phase 2	
Avena barbata	40	70	Tussock grass - low
Briza maxima	5		Tussock grass - low
Corymbia calophylla	5	5	Tree - low
Cynodon dactylon		5	Tussock grass - low
Eucalyptus rudis subsp. rudis	40	40	Tree - low
Fumaria capreolata	2		Climber
Gastrolobium spinosum	0.1	0.1	Shrub - mid
Hakea lissocarpha	0.1	0.1	Shrub - low
Hordeum leporinum	5		Tussock grass - low
Hypochaeris glabra	2	0.1	Herb
Juncus pallidus	0.1	0.1	Rush - low
Lupinus cosentinii		0.1	Herb
Lysimachia arvensis	2		Herb
Orobanche minor	2		Herb
Oxalis pes-caprae	2	10	Herb
Oxalis purpurea		0.1	Herb
Raphanus raphanistrum		0.1	Herb
Solanum linnaeanum		0.1	Shrub - mid
Stachys arvensis	2		Herb
Zantedeschia aethiopica		0.1	Herb

Site:	R08		
Botanist:	Udani Sirisena	**Date:**	24/10/2014
Site type:	Releve	**NW corner (GDA94):**	50J 409301mE, 6496030mN
Habitat:	Hillslope (midslope, gentle west facing slope)		
Surface layer:	Brown sandy-clay loam, with no rocks		
Vegetation condition:	7 (Completely degraded, Keighery 1994)	**Fire history:**	No signs of fire
Disturbance types:	Re-vegetated strip with planted species, high level weeds, litter		

Phase 1



Taxa	Cover (%)		Stratum
	Phase 1	Phase 2	
Avena barbata	60		Tussock grass - low
Eucalyptus rudis subsp. rudis	80		Tree - low
Hordeum leporinum	1		Tussock grass - low
Lolium rigidum	1		Tussock grass - low
Solanum linnaeanum	0.1		Shrub - low
Trifolium campestre var. campestre	1		Herb

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Site:	R09		
Botanist:	Udani Sirisena	**Date:**	24/10/2014
Site type:	Releve	**NW corner (GDA94):**	50J 408778mE, 6496250mN
Habitat:	Drainage line on a plain		
Surface layer:	Brown-black sandy-clay loam on banks and bed		
Vegetation condition:	6 (Degraded, Keighery 1994)	**Fire history:**	No signs of fire
Disturbance types:	High level weeds, high level grazing, partial clearing, litter		

Phase 1



Taxa	Cover (%) Phase 1	Phase 2	Stratum
Avena barbata	60		Tussock grass - low
Briza maxima	1		Tussock grass - low
Briza minor	0.1		Tussock grass - low
Bromus diandrus	1		Tussock grass - low
Eucalyptus rudis subsp. rudis	80		Tree - low
Hordeum leporinum	1		Tussock grass - low
Lolium rigidum	1		Tussock grass - low
Trifolium campestre var. campestre	1		Herb

Site:	R10		
Botanist:	Udani Sirisena	**Date:**	24/10/2014
Site type:	Releve	**NW corner (GDA94):**	50J 408340mE, 6495317mN
Habitat:	Plain - cleared paddock		
Surface layer:	Brown sandy-clay loam, with no rocks		
Vegetation condition:	7 (Completely degraded, Keighery 1994)	**Fire history:**	No signs of fire
Disturbance types:	Parkland cleared		

Phase 1



Taxa	Cover (%) Phase 1	Phase 2	Stratum
Avena barbata	20		Tussock grass - low
Eucalyptus rudis subsp. rudis	0.1		Shrub - low
Hesperantha falcata	1		Herb
Lotus angustissimus	30		Herb
Lupinus cosentinii	50		Herb
Pentameris airoides	10		Tussock grass - low
Vulpia myuros	0.1		Tussock grass - low

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