SUMMARY OF FLORA AND VEGETATION VALUES ON HUNTLY AND LAREGO AREAS

ALCOA OF AUSTRALIA

WA

Prepared By

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Prepared For

Alcoa of Australia Limited

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LIST OF ABBREVIATIONS

BAM Act:	*Biosecurity and Agriculture Management Act 2007* (WA)
BC Act:	*Biodiversity Conservation Act 2016* (WA)
BOM:	Bureau of Meteorology
DBCA:	Department of Biodiversity, Conservation and Attractions
DCCEEW:	Department of Climate Change, Energy, the Environment and Water
DPIRD:	Department of Primary Industries and Regional Development
EP Act:	*Environmental Protection Act 1986* (WA)
EPA:	Environmental Protection Authority
EPBC Act:	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
MATTISKE:	Mattiske Consulting Pty Ltd
IBRA:	Interim Biogeographical Regionalisation for Australia
PEC:	Priority ecological community
RFA:	Regional Forest Agreement
TEC:	Threatened ecological community
WAH:	Western Australian Herbarium (PERTH)

EXECUTIVE SUMMARY

Alcoa of Australia Limited's (Alcoa) Western Australia (WA mining operations comprise the Huntly and Willowdale bauxite mines, within the northern Jarrah Forest (NJF) IBRA subregion, Mining Lease 1SA) ML1SA; Figure 1.

Alcoa has approval to mine within ML1SA for the Huntly and Willowdale bauxite mines, subject to submitting annual five-year mine pans and associated environmental management plans known as the Mining and Management Programs (MMP).

The following is a summary of the work completed by E.M. Mattiske and Associates (pre 1994) and Mattiske Consulting Pty. Ltd. (Mattiske Consulting post 1994) for Alcoa of Australia Limited on the respective areas for the Huntly and Willowdale ERD Development 2024.

The Huntly North (O'Neil, Myara and McCoy), Huntly South (Huntly, Del Park, White and Holyoake regions) and Willowdale (Larego and Orion survey areas) lie within the Northern Jarrah Forest subregion of the Southwest Botanical Province. The geology of the region comprises lateritic duricrust, with drainage lines and occasional granite hills. The Northern Jarrah Forest subregion is characterised by Jarrah (*Eucalyptus marginata*) forest on ironstone gravels and Marri-Wandoo (*Corymbia calophylla* - *Eucalyptus wandoo*) woodlands on loamy soils, with sclerophyll understoreys. The vegetation of the region has been extensively studied, and has been described in a series of vegetation complexes of the Darling System.

Survey Effort

Due to the survey effort the surveys spanned over multiple months in different years. As indicated for the respective areas, it is apparent that the amount of survey (even prior to the EPA Guidance Statement in 2016b) well exceeded the standards of the earlier period of survey work between 1980's and 1996.

The work has been undertaken over multiple seasons and as the perennial species and landforms and soils are critical to the classification of the site-vegetation types there has been more than enough data to assess the site-vegetation types. In recent years since the delineation of the conservation values of flora species and communities a greater emphasis has been placed on these particular values with baseline flora and vegetation studies, targeted searches and multiple research projects associated with plots and transects over multiple years.

Flora

The flora in the southwest forests includes some 3500 taxa and as such in most historical and recent surveys in the northern Jarrah Forest ranges from 300 to 750 taxa per survey area. In recent decades there has been a growing emphasis on restricted or threatened flora species or those species that may threatened the occurrence of other species. This report concentrates on the conservation significant species and the weed species.

The data collected to date on the threatened and priority flora includes records from Mattiske Consulting since 1980's, Eco Logical (2024) intensive and targeted flora studies in proposed clearance areas in the Willowdale areas in the spring of 2023, *Ecologia* (2024) and Biologic (2024) intensive and targeted flora studies in Huntly-Myara proposed clearance areas in the spring months of 2023.

The early work of Mattiske was undertaken when the native flora species were defined as threatened or priority and as such many of the earlier records have not been included in this report for the Huntly South area as the data is not in a format that can rapidly integrated into this report. The data is available and is intended to be integrated in 2025 into a combined data set. The latter is not a small task as many of the surveys were undertaken prior to current software types.

In summarizing the key potential conservation flora, it is important to recognize that the current practice of radial searches tend to bring in potential species that do not occur in the northern Jarrah Forest, let alone the specific areas as summarized for this report.

The recent works by Mattiske in the Huntly and Willowdale areas have been summarized in relation to coverage of threatened and priority flora species, weeds and site-vegetation types. Mattiske (1985 to 2023 has recorded some ten Priority flora species within the respective areas, namely potentially *Hibbertia ?ambita* (P1), *Hibbertia hortiorum* (P1), *Acacia horridula* (P3), *Conospermum scaposum* (P3), *Grevillea dissectifolia* (P3), *Thysanotus anceps* (P3),*Grevillea pimeleoides* (P4), *Lasiopetalum cardiophyllum* (P4), *Stylidium ireneae* (P4) and *Senecio leucoglossus* (P4), During this period many species have also changed names by specialists and also conservation status so there is an ongoing need to update datasets. An example of the latter is the revision of the *Hibbertia commutata* group by Thiele (2019) which was split into 27 taxa including Priority species. Such gaps in part have been addressed through the recent additional targeted work in 2023.

Eco Logical (2024) preclearance surveys were undertaken in spring 2023 and as a result no threatened flora species and three Priority flora species were recorded in the Willowdale areas. The three Priority flora species included *Netrostylis* sp. Nannup (P.A. Jurjevich 1133) (P1), *Grevillea prominens* (P3) and *Senecio leucoglossus* (P4).

Ecologia (2024) database searches identified 58 significant plant taxa within 20 km of the survey area (excluding records from the Swan Coastal Plain). Only three significant flora species were recorded in the field surveys including *Tetratheca phoenix* (P2), *Senecio leucoglossus* (P4) and *Stylidium ireneae* (P4). No threatened flora species were recorded in the targeted survey areas.

Biologic (2024) databases searches identified 72 significant plant taxa within the 20km of the survey area. Only four significant flora species were recorded in field surveys including *Acacia horridula* (P3), *Thysanotus anceps* (P3), *Senecio leucoglossus* (P4) and *Stylidium ireneae* (P4). No threatened flora species were recorded in the targeted survey areas.

Mattiske (2024) database searches identified the potential for 12 threatened flora species and 37 priority flora species to occur in the O'Neil Transport Corridor survey area. Of the threatened flora species, all were considered to have a very low potential of occurring in the O'Neil Transport survey area due to the lack of suitable habitat and also know distributions away from the survey area. A total of 2 priority flora species (*Hibbertia hortiorum* P1 and *Senecio leucoglossus* P4) were recorded in the O'Neil Transport Corridor survey area. The *Hibbertia hortiorum* appeared relatively regularly and in part reflected the recent split of *Hibbertia commutata* into multiple species by Kevin Thiele (2019).

Vegetation

Investigations by Diels (1906), Loneragan (1978), Beard (1979a, 1979b), Abbott and Loneragan (1986), Bell and Heddle (1989) and Dell and Havel (1989) reflect the depth of interest in the patterns of flora and vegetation in the south-west forests. The more regional broad scale mapping by Beard (1979a,1979b) in the northern Jarrah Forest was refined at a more detailed level by Heddle et al. (1980) and Mattiske and Havel (1998) through the expansion of the understanding of the key relationships of landforms and soils and plant species. The work by Heddle et al. (1980) and Mattiske and Havel (1998) led to regional mapping of vegetation complexes and ecological vegetation systems that were similar in approach to that utilized in the Regional Forest Agreement studies for Victorian and Tasmanian forests. A total of 35 site-vegetation types were defined and mapped in the survey areas and additional disturbance, cleared and rehabilitation areas. The site-vegetation types were defined on the basis of key species and site parameters as defined in Havel (1975a and 1975b) for the Jarrah Forest and as refined and developed by Mattiske over the last 40 years.

These site-vegetation types have been developed and based on the earlier work by Havel (1975a, 1975b) and more recently his Ph.D. Thesis (Havel 2000) where additional details were provided on the approach that is similar to other approaches globally where forests occur as continuums with several key species and a range of species that reflect subtle shifts in landforms, soils and soil moisture availability.

A total of 35 site-vegetation types were defined and mapped in the survey areas and additional disturbance, cleared and rehabilitation areas. The site-vegetation types were defined on the basis of key species and site parameters as defined in Havel (1975a and 1975b) for the Jarrah Forest and as refined and developed by Mattiske over the last 40 years.

Threatened and Priority Ecological Communities

During the earlier phases of the surveys no Threatened Ecological Communities (TECs) were listed on the survey areas on the Darling Ranges. Recently, it was recognized that the *Empodisma* peatland of southwestern Australia has the potential to occur in the swamps if peat is present. These would occur in the A or AC site-vegetation types. To date the suggested potential locations have not been assessed for the presence of peat; however *Empodisma gracillimum* has been recorded previously in a restricted area by the Mattiske team. This species is largely restricted to coastal areas in the southwest (WAH 1998-) and as such more work is required.

The desktop assessment highlighted several other potential TECs; however these are restricted to the Swan Coastal Plain or the Wheatbelt and as such do not extend into the Jarrah forest area on the Darling Ranges.

There are two priority ecological communities (PECs), as listed at State level by DBCA (2024b, 2024c) that occur within the Huntly North (Myara) survey area; only one of these is a botanical PEC.

The priority ecological communities that occur in the Huntly North survey area are:

- Granite communities of the northern Jarrah forest (P3)
    - Jarrahdale area – Monadnocks, Blue Rock; insufficient information to distinguish discrete community type/s (DBCA 2024b, 2024c).
- Litter Dependant Invertebrate Community of the northern Jarrah Forest (P2)
    - Chandler Block, Northern Jarrah Forest; insufficient evidence that this is a discrete community type (DBCA 2024b, 2024c).

There is a potential that the site-vegetation types associated with granite outcrops (site-vegetation types G and R), and the Cooke vegetation complex as defined by Mattiske and Havel (1998) may have affinities with the PEC.

The alignment of the communities with the DBCA defined PEC raises some issues due to the lack of consistent and detailed data on the granites. Alcoa is currently reviewing these values and this will be refined in conjunction with other data collected during surveys on the G and R site-vegetation types to assist in the refinement of the detail associated with this PEC. The location of the granite are associated with the G and R site-vegetation types as defined in the varying reports.

The significant issue that relates to the granites is the complexity of the structural and floristic components as they reflect varying depths or soil over the outcrop and as such vary from lithic complexes dominated by mosses and lichen species, through heath communities dominated by Proteaceae and Myrtaceae species to open woodlands of Jarrah-Marri or Wandoo over low shrubs on the fringes of the exposed granites.

All survey areas occur within the Regional Forest Agreement (RFA) area of the southwest forests DCCEEW (2024b) and as such were considered during the RFA process.

Groundwater Dependent Ecosystems

The potential groundwater dependent ecosystems were determined on the basis of the extent of the vegetation complexes (Murray 1, Murray 2, Yarragil 1, Yarragil 2, Swamp and Pindalup). The site-vegetation types associated with these vegetation complexes and as such are potential groundwater dependant ecosystems include A, AC, AD, AW, AY, C, CW, W, D, E, SW and PW.

In view of the extensive flora and vegetation studies in the northern Jarrah Forest subregion these vegetation complexes support species and site-vegetation types that prefer and occur on seasonally moister and wetter soils. This approach was considered to represent a precautionary approach in the absence of detailed groundwater level data at the time of selecting the potential groundwater dependent ecosystems at this juncture in the absence of site-vegetation type data.

Key indicator plant species that are generally accepted as indicators of moister soils and, hence, potential groundwater dependent ecosystems include – *Banksia littoralis, Hakea varia, Acacia divergens, Boronia molloyae, Thomasia paniculata, Astartea scoparia, Babingtonia camphorosmae, Eucalyptus patens, Hypocalymma angustifolium, Melaleuca preissiana, Melaleuca viminea* and *Taxandria linearifolia.*

Wetlands of International Importance (Ramsar)

The Peel-Yalgorup System, a listed Ramsar Wetland of International Importance, is located adjacent to the City of Mandurah and more than 40km from the nearest survey area on the Darling Ranges. The Peel-Yalgorup System consists of shallow estuaries, freshwater marshes and coastal saline lakes that include the Harvey Estuary, Peel Inlet, Lake McLarty, Lake Mealup and ten Yalgorup National Park wetlands (DCCEEW 2024f). The fringing vegetation is mainly samphire, rushes, sedges and paperbark communities. The Peel-Yalgorup System supports a wide variety of waterbirds, invertebrates and estuarine and marine fish and is considered the most important area for waterbirds in south-western Australia (DCCEEW 2024f). Whilst these potential values were recognized in the National database search (DCCEEW 2024f) these wetlands occur west of the survey areas.

Dieback Occurrence

The dieback data reflects the most up to date dieback interpretation data from both DBCA and Glevan Consulting for the survey areas. In the survey area the dieback infections are concentrated to the valleys systems. There may be some differences also in coverage and sampling in some of the survey areas.

Dieback as caused by *Phytophthora cinnamomi* influences species and communities in different ways and as such most impacts are concentrated around soils with more seasonal soil moisture levels. In recent studies, the presence of dieback has been taken into consideration in vegetation condition mapping.

Old Growth and Harvesting

Based on data from Department of Biodiversity, Conservation and Attractions, there is limited old growth forests occurring in these respective survey areas. This in part appears to reflect the proximity of historical logging and wood production activities near Jarrahdale and Dwellingup. The data as presented on the history of harvesting in the areas reflects the more recent logging in the pre-mining activities of Alcoa. Some of the valley areas have not been logged for some time and as such reflect the linear patterns of these systems and the differences in overstorey tree species.

1. INTRODUCTION

Mattiske Consulting Pty Ltd (Mattiske) was commissioned by Alcoa of Australia Ltd (Alcoa) to summarize survey efforts to date on flora and vegetation values in the Huntly North, Huntly South and Larego areas as covered by highlighted areas in Figure 1.

1.1 Environmental Legislation and Guidelines

The following key Commonwealth (Federal) legislation relevant to this desktop assessment is:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The following key Western Australian (state) legislation relevant to this assessment include:

- *Biodiversity Conservation Act 2016* (BC Act) and *Regulations* 2018;
- *Biodiversity and Agriculture Management Act 2007* (BAM Act); and
- *Environmental Protection Act 1986* (EP Act).

Further, key Western Australian Guidelines relevant to this assessment includes:

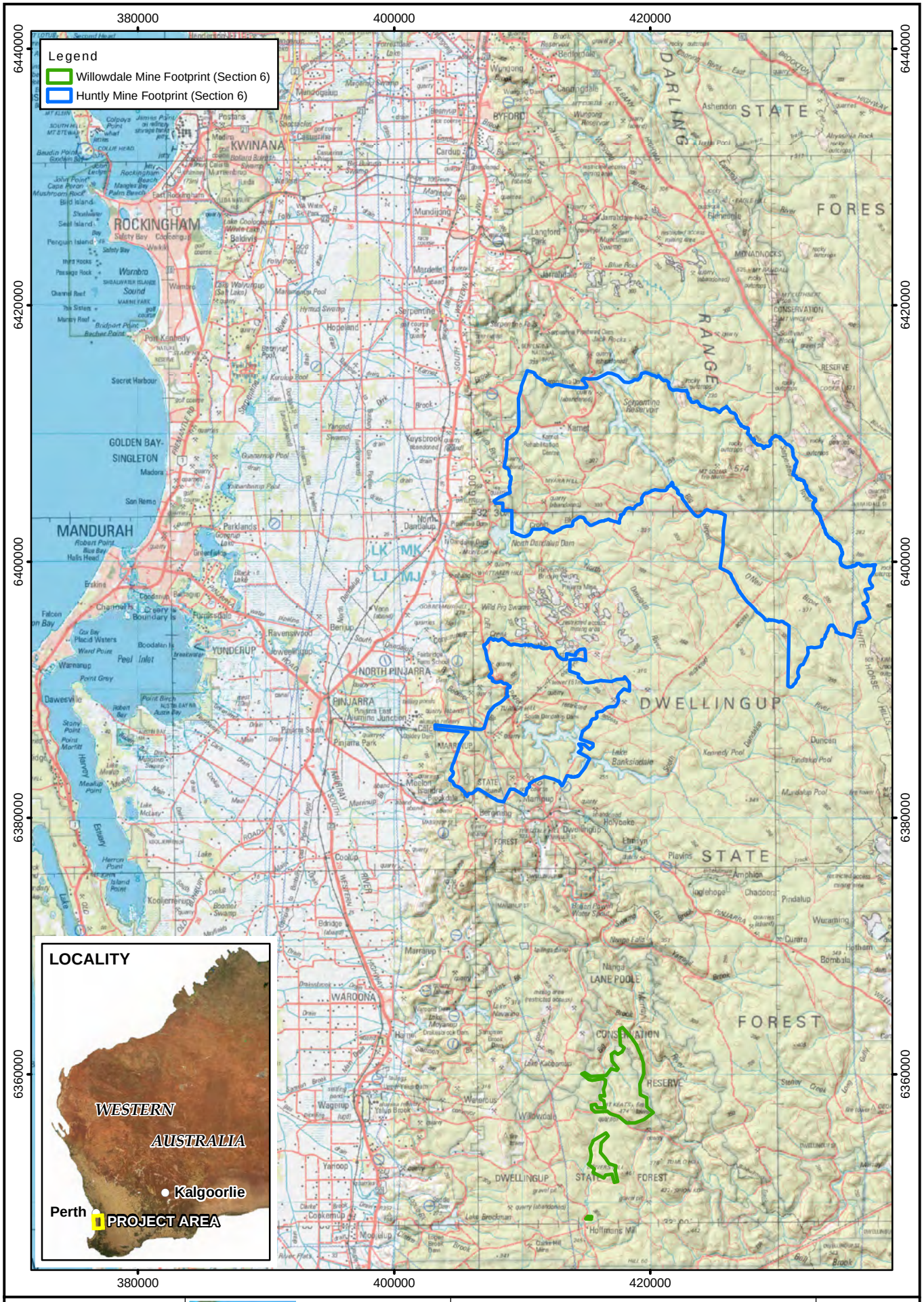
- Environmental Factor Guideline: Flora and Vegetation (Environmental Protection Authority [EPA] 2016a); and
- Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016b).

At this juncture it is important to recognize the extent of work undertaken over some 4 decades throughout the northern Jarrah forest by Dr Libby Mattiske and her team members. The work in the northern Jarrah forest commenced for Alcoa in the early 1980's and consequently significant field studies have been undertaken prior to the EPA Guidelines and Technical Guidance statements as releases by the EPA in (2016a and 2016b respectively).

As indicated in the following sections and by the summarizes in the following pages the earlier work exceeded many other projects undertaken in Western Australia at the time. This early work was supplemented by regional studies and assessments undertaken by Dr Mattiske Dr Havel through the 1975 Jarrah forest studies by Havel (1975a and 1975b), System 6 publications (Heddle et al., 1980) and the Regional Forest Agreement mapping Mattiske and Havel (1998) and the comprehensive Ph.D. thesis by Dr Havel (2000). The latter work enabled a comprehensive regional perspective with multiple scales of interpretation to place the detailed work into a regional context.

The latter does not down play the earlier work by authors such as Diels (1906), Lange (1960) and Beard (1979a, 1979b) and the mor recent work by Williams and Mitchell (2001).

Figure 1: Regional Context and Study Areas (note highlighted blue (Huntly North and Huntly South and highlighted green Willowdale areas)



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Date: September 2024 | Rev: A | A4

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Willowdale and Huntly Mine Footprints
Locality

Figure: **2**

2. OBJECTIVES

The objective of this assessment was to summarize the work undertaken to date on the respective areas as highlighted in Figure 2. At this juncture it should be recognized that the guidance statements of the EPA (2016a and 2016b) were introduced after a substantial amount of work had been undertaken in the northern Jarrah forest over some 40 years from the early 1980's to 2016.

The work undertaken for Alcoa prior to the 2016 achieved and would have met many of the current expectations of the EPA. Consequently, while the objective of this report to summarize the information was attempted it was not feasible to capture some of the expected data coverage in several weeks. Therefore it was not feasible to address all of the points raised in the initial review of the draft.

The scope of works (SoW) provided by Alcoa was to undertake a desktop assessment of the Huntly and Willowdale Mine Footprints (Section 6) areas (Study Area; Figure 1; 41,182 ha) and provide a desktop report that consolidates all completed Havel vegetation and targeted flora surveys to date including:

- Summary of surveys completed and survey timing
- Details on survey methodology
- Commentary on vegetation types and association with TECs/PECs, GDEs, and old growth forest.
- Commentary on local and regional distribution of vegetation types
- Commentary on distribution of conservation significant fauna recorded
- Likelihood of Occurrence Assessment of conservation significant flora

3. METHODS

An overview of the timing of the surveys is presented in Figure 3 which reflects the work undertaken for Alcoa on the respective areas between 1980's and 2023. Work is still currently underway in several areas on the ML1SA lease area. The main reports are summarized in the Reference List as attached.

In addition to the baseline flora and vegetation mapping projects (Figure 4), there has been substantial detailed transect and plot work associated with valley systems, creeklines, rehabilitation assessments and detailed studies on specific areas associated with direct and indirect impacts (e.g. Studies on vegetation near haul road crossings).

This report concentrates on the specific survey efforts associated with baseline flora and vegetation studies on the respective areas. The key point to make that since the beginning of the baseline work in the Alcoa lease areas the following minimum standard has been applied with at times additional work added to supplement this approach.

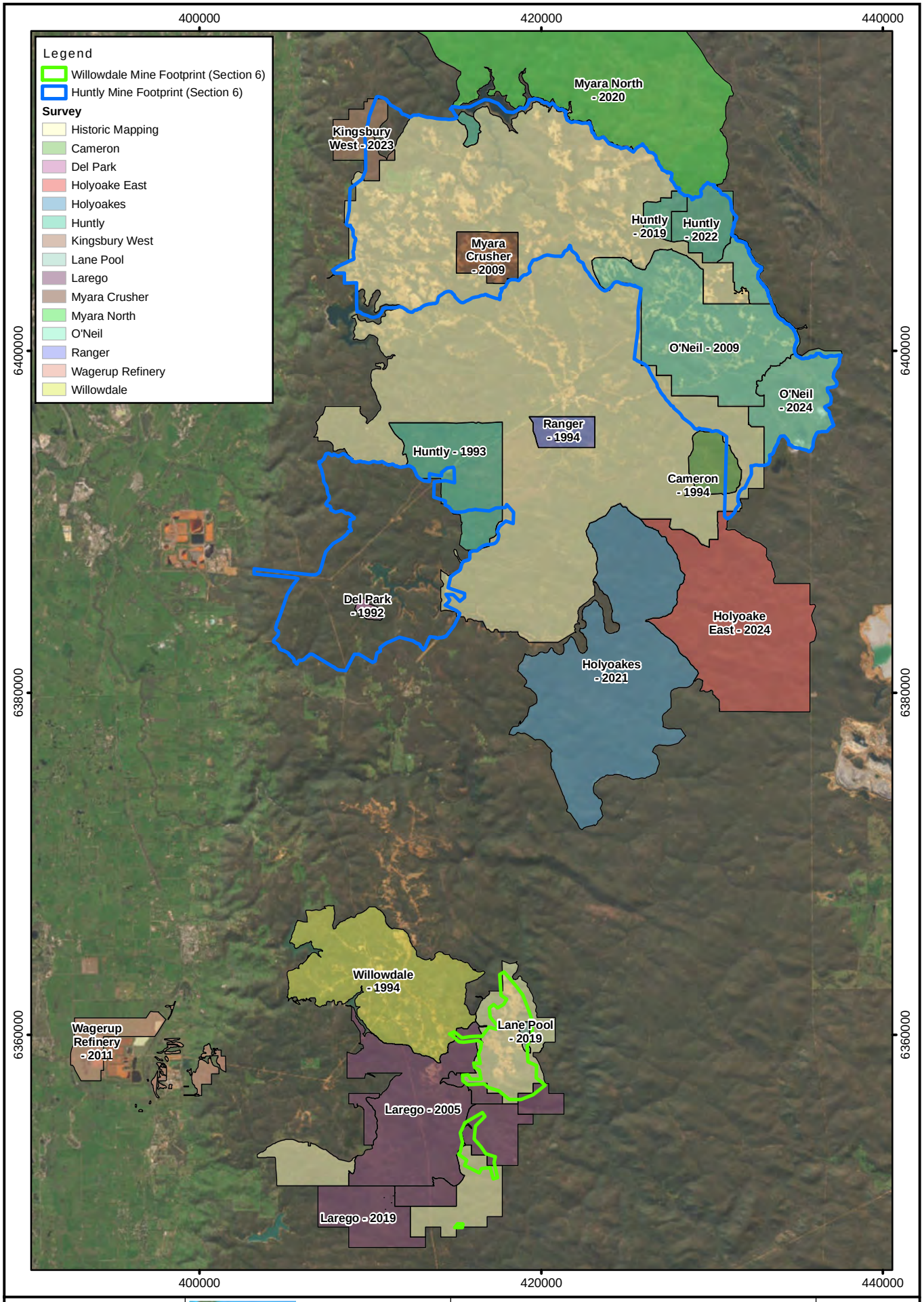
Initially, survey efforts were based on the following methodology and for consistency it has been continued
as the bare minimum in the respective survey areas.

3.1 Methodologies

Initially, the flora studies were based on detailed field collections and then using collections at the State Herbarium to confirm specimens. Databases such as Florabase (WAH1998-), NatureMap (DBCA 2007-) and Dandjoo (2022-) and the *EPBC Act* Protected Matters Search Tool (DCCEEW 2024b) were not available in the early phases of ecological studies in the southwest forests. In addition, the locational data for some species at the State Herbarium relied on notes rather than GPS equipment. Since the early period of recording many species have changed names or been split into multiple taxa by specialist taxonomists. This then entails a need for updating the names of species recorded. This shift in support databases and effort should be acknowledged in any review of work undertaken to date on Alcoa leases and in many other areas of the northern Jarrah forest.

Similarly, the definition and details on the conservation species at a State level was not readily available until the development of Florabase (1998-) and the Department of Biodiversity, Conservation and Attractions TPFL database of threatened and priority flora species. The conservation status at a federal level was similarly restricted initially and now is available more readily through databases managed by the Department of Climate Change, Energy, the Environment and Water. This shift in both datasets at the State and Federal levels over the last 4 decades reflects the increased prioritisation of these values.

In addition, historical documentation and vegetation mapping of the northern Jarrah forest area was initially undertaken at a very broad scale by Diels (1906) and Beard (1979a, 1979b). The detailed studies in the 1970's by Havel through the development of the site-vegetation types (Havel 1975a, 1975b) facilitated research into the definition of groupings within the continuum of the forested areas and also clearer understanding of the relationships between the underlying landforms, soils and site conditions with a range of key species and structural components.. This work was further developed in the late 1970's by Mattiske (nee Heddle) in conjunction with Loneragan and Havel (Heddle et al. 1980) during the System 6 studies of the northern Jarrah forest. In the 1990's further detailed studies during the Regional Forest agreement process the regional mapping of the vegetation complexes by Mattiske and Havel (1998) and Havel (2000) assisted in a further understanding of the vegetation values. As indicated the Pre-European vegetation datasets by Beard and more recent researchers provides a broad scale interpretation of the regional vegetation, whilst the vegetation complexes and the site-vegetation type mapping undertaken by Mattiske provides substantially greater detail on the vegetation values in the northern Jarrah forest.



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CAD Ref: a1992_F044_01

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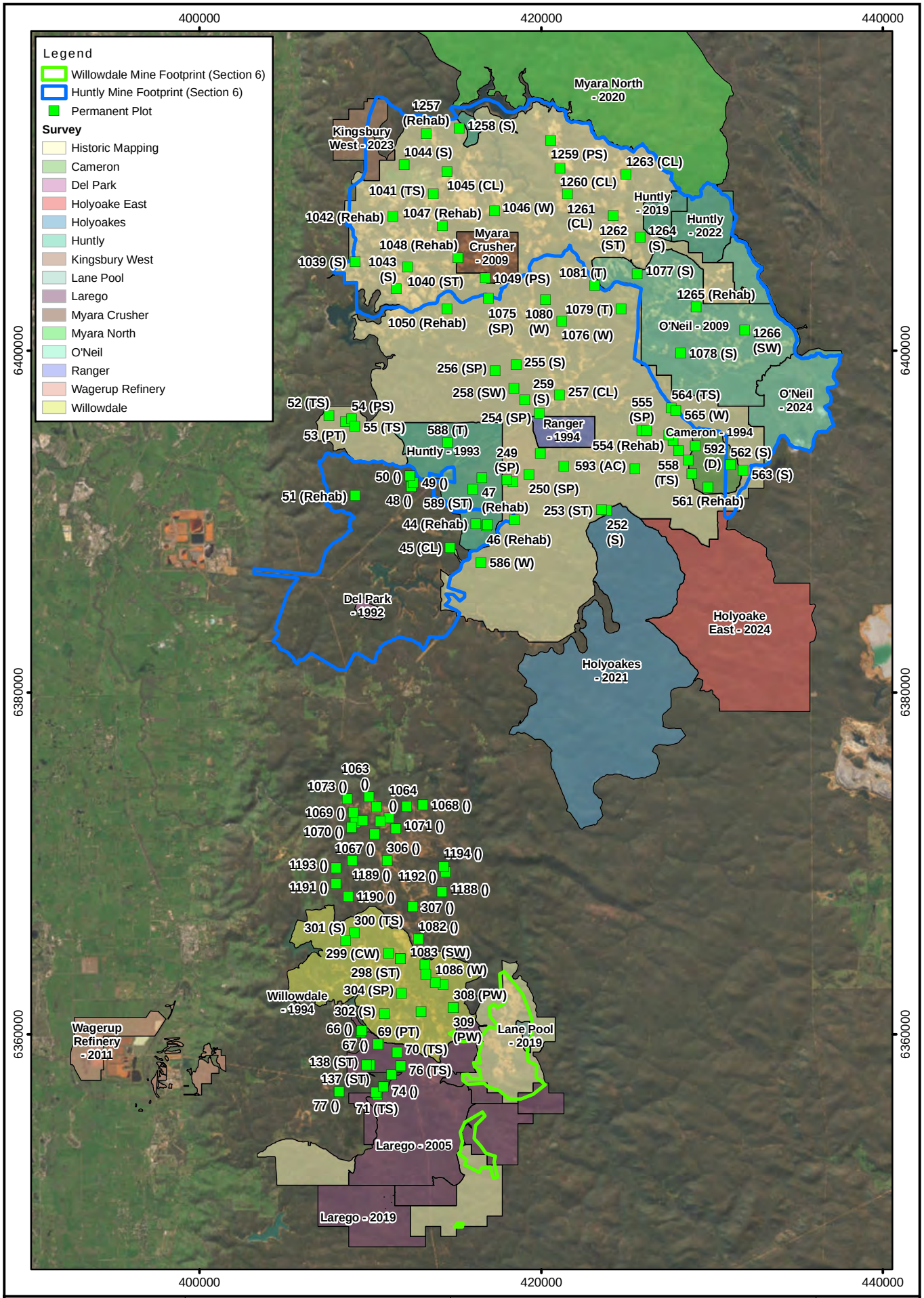
Willowdale and Huntly Mine Footprints
Survey Effort

Figure: **3**



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Willowdale and Huntly Mine Footprints
Survey Effort Permanent Plots

Figure: **4**

3.2 Site assessments

Sites were pre-designated using a grid system (minimum of 120m x 120m) overlaid on the survey area. These sites were initially located through transects based on foot traverses and refenced to Reference Trees (trees with codes on the lower trunks). It is only through the development of the GPS and IPAD and associated software as well as detailed aerial imagery that survey standards were improved in the northern Jarrah forest. The consistency of the 120m x 120m grid system was related to the Alcoa gridding system of 120m, 60m and 15m and as such provides a sound and consistent approach that predates all the EPA guidance statements (2016a and 2016b).

Additional opportunistic sites were surveyed when changes in the vegetation, representing communities which would otherwise have been missed, were encountered whilst walking between designated survey sites. Examples included additional sites near rapidly changing vegetation, landforms and soils such as on the fringes of the creeklines. Site data was used to define vegetation types for each survey site. This data was then used in combination with aerial imagery and field observations to map the vegetation of the survey area. Opportunistic collections of Threatened, Priority or Declared (plant) pests species were undertaken whilst walking between survey sites. In many instances some conservation species were not recognized or defined in earlier years, some were defined and then delisted by State and Federal agencies as more information was collated, some taxonomic studies refined species and taxon names and consequently distributions so the data each year requires auditing to check current currency (this applies to data collected even with the last 2 years).

The following information was recorded at each vegetation assessment site:

GPS location Easting, Northing and datum;
Soil types gravels, sandy-gravels, sandy-loam-gravels, sandy-loams, loams, clay-loams, clays and peat;
Topography ridge, upper slope, mid-slope, lower slope, valley floor and swamp;
Outcropping type – granite, laterite, dolerite, and quantity – few, moderate, numerous;
Logging history light, moderate or heavy, together with number of stumps within a 20 m radius;
Fire history years since last fire; and
Dieback occurrence *Phytophthora* spp. demarcation – field blazing, coloured flagging on trees, vegetation deaths, either old or recent.

Recent fire events (<3 years restricts vegetation assessments), dieback restricts coverage of species and recent logging raises safety issues in terms of access and difficulty of traversing areas efficiently.

At each site species were ranked according to the scale developed by Havel (1975a, 1975b). Tree and understorey species were assessed separately using the following method.

Tree species

Tree species (*Allocasuarina fraseriana, Banksia grandis, B. littoralis, B. seminuda, Corymbia calophylla, Eucalyptus marginata, E. megacarpa, E. patens, E. rudis, E. wandoo, Melaleuca preissiana, M. rhaphiophylla, Nuytsia floribunda, Persoonia elliptica, P. longifolia* and *Xylomelum occidentale*) were assessed within a 20 m radius from the observation point using the following scale:

0 absent;
1 one or two trees;
2 three to five trees;
3 more than five trees, but contributing less than one third of the total stand;
4 between one third and one half of the total stand; or
5 more than one half of the total stand.

Understorey species

Understorey species were assessed within a 5 m radius from the observation point using the following scale:

0 absent;
1 very rarely seen, only after a careful search;
2 present, observable, but in small numbers only;
3 common locally, but not uniform over the whole area;
4 common over the whole area; or
5 completely dominating the understorey.

The physiological stress was determined for each species within a 20 m radius from the observation point and ranked according to the following scale.

0 healthy, no evidence of stress;
1 odd plant showing signs of stress, not dead;
2 one or two dead plants, near death;
3 scattered stressed plants, (2-4) dead plants around survey site;
4 susceptible plants dying or dead (> 4 plants); or
5 “graveyard” death

During the more recent field survey, botanists had access to all relevant data in the Esri iOS application, Collector for ArcGIS on Apple iPads (provided and maintained by CAD Resources). Data layers accessible in the field included the development envelope, the boundaries of the survey area surrounding the proposed airstrip obstacle light and associated 10 m spaced search transect lines, locations of all known conservation significant flora from both historical and contemporary surveys, and aerial imagery supplied or acquired by CAD Resources.

The locations of any conservation significant flora were recorded with the Esri iOS application, Collector for ArcGIS. During the field survey botanists also had access to detailed data on all potential conservation significant species, which may potentially be encountered during the field survey. The State NatureMap (DBCA 2007-) and EPBC Act Protected Matters Search Tool (DCCEEW 2024b) databases have evolved and developed over these decades with constant needs for updating.

All plant specimens collected during the field surveys were dried and processed in accordance with the requirements of the Western Australian Herbarium (WAH 1998-). All plant specimens were identified through comparisons with pressed specimens housed at the WAH. Where appropriate, plant taxonomists with specialist skills were consulted. Nomenclature of the species recorded is in accordance with the WAH. As noted earlier there are taxonomic revision patterns that influence recordings and data is regularly checked for consistency with current nomenclature.

3.3 Data Analysis

Data analysis of recording sites was undertaken by reference to the interpretation of the presence of keystone species as developed and defined by Havel (1975a and 1975b) and as further developed by Mattiske over some 40 years of extensive vegetation mapping in the northern Jarrah forest. In addition, the position in the landscape, the type or landform and soils and the presence of granite outcrops were taken into consideration in the delineation of site-vegetation types. To enable integration with the surrounding vegetation mapping undertaken over these 40 years by Havel (1975b) and E. Mattiske and Associates (1985-1993) and Mattiske Consulting (2006-2024) the definition of the site-vegetation types were maintained with only slight changes to accommodate local variants.

3.4 Survey Effort

Due to the survey effort the surveys spanned over multiple months in different years. As indicated for the respective areas summarized on Figure 3 it is apparent that the amount of survey (even prior to the EPA Guidance Statement in 2016b) well exceeded the standards of the earlier period of survey work between 1980's and 1996. If one compares the survey effort in these decades with other assessments it is clearly apparent that the latter is supported by the following summary in Table 1. If one then calculates the number of person survey days undertaking 20 grid site assessments and associated searching for species over these areas then more than 2960 days of survey have been undertaken on these respective areas (this excludes the work on the plots and the multiple assessments of the Del Park former CSIRO catchment (Mattiske 1985, 1993). The work has been undertaken over multiple seasons and as the perennial species and landforms and soils are critical to the classification of the site-vegetation types there has been more than enough data to assess the site-vegetation types.

The survey effort to date has included (see Figure 3):

. More than 4,000 kilometres of foot transects which includes the mapping efforts and targeted searches within these respective areas and as such is supplemented by more extensive surveys in the wider northern Jarrah forest for a range of clients. This does not include the foot traverses by Ecologia Environment and Eco Logical Australia Pty Ltd;

. 27,990 recording sites on a grid system which varied slightly from 120m x 120m with some sites closer than this average and some slightly wider. This pattern of recording is consistent with previous ecological studies in the northern Jarrah forest for both Alcoa and other clients in nearby areas;

. Targeted searches of additional extreme sites that are variable within the Yarragil, Pindalup, Swamp and Cooke vegetation complexes;

. A total of 50 permanent plots have been established in the respective areas (Table1, Figure 4) and in the Myara and O'Neil areas detailed studies have been undertaken on the valley systems within the formerly recognised Cameron and Gordon catchments located within the O'Neil over decades of research both by staff of Alcoa and the Mattiske teams of botanists.

. Detailed and consistent data collection on position in the landscape, soils, flora, vegetation and vegetation condition; and

. Consistent interpretation in line with previous site-vegetation studies where there is a greater reliance on key indicator species and a series of site parameters. Such an approach differs from the EPA guidance statement, but if the latter was followed the dominance of some tree and understorey species in the analyses would lead to a less comprehensive delineation of biodiversity values and also be inconsistent with the approach adopted on all other Alcoa leases where detailed flora and vegetation studies have been undertaken in the past by the Mattiske team and site personnel.

A overview of the timing of the surveys is presented in Figure 3 which reflects the work undertaken for Alcoa on the respective areas between 1980's and 2023. In addition to the baseline flora and vegetation mapping projects, there has been substantial detailed transect and plot work associated with valley systems, creeklines, rehabilitation assessments and detailed studies on specific areas associated with direct and indirect impacts (e.g. Studies on vegetation near haul road crossings).

Initially, survey efforts were based on the following methodology and for consistency it has been continued as the bare minimum in the respective survey areas. Most site-vegetation type studies were undertaken over multiple seasons in different areas and details plot and transect work in spring months. As the site-vegetation type key indicators are perennial unless there were fires or dieback the seasonal efforts did not impact the interpretations of the communities.

Table 1: Summary of Survey Effort on these specific Huntly North, Huntly South and Willowdale Areas (does not include distance from plot and transect studies or targeted work)

Area	Survey Timing	Area (ha)	No. of Grid Sites	No. of Permanent Plots (excludes rehabilitation plots)	Traverses on Grid Systems and Targeted searches
Huntly Mine Footprint – North	Multiple seasons 1990 to1994, (plots and transects in spring), Multiple seasons in 2009, 2019, 2022, 2024	29322.979	19006	15 older and 30 new	>2800 km
Huntly Mine Footprint – South	Multiple seasons 1985, 1988, 1993 and pre-1993	9273.800	6,010	5 older	>900 km
Willowdale Mine Footprint	2005, March to July 2019	2136.062	2.974	0 in area, mostly west of area	>300km
TOTAL	1985 - 2024	41182.842	27990	50 (within the Huntly North, Huntly South and Willowdale areas)	>4000 km

Note: some of historical work on Huntly South in the 1980's and 1990's predated digital capture and as such is not included in the following summary. It is recognized that capture of the older work is required for Del Park CSIRO catchment (done twice) and remainder of Huntly South once in period from 1979 to 1993.

Targeted searches includes the detailed work by Mattiske, Biologic Environmental, *Ecologia* Environment and Eco Logical Australia Pty Ltd. Initially targeted searches were 120m apart transects and the over time the recent work has increased to 20m transect spacing in 2023/2024.

3.5 Survey Limitations

A general assessment was made of the surveys against a range of factors that may have limited the outcomes and conclusions of the surveys (Table 2).

Table 2: Summary of Potential Survey Limitations

Potential Survey Limitation	Impact on Survey
Sources of information and availability of contextual information (*i.e.* pre-existing background versus new material)	**Not a constraint:** Reference resources such as mapping by Havel 1975a and 1975b, Beard 1979, Heddle et al 1980, Mattiske and Havel 1998, previous vegetation mapping completed for Alcoa by E.M Mattiske and Associates (pre 1994) and Mattiske Consulting Pty Ltd (post 1994) together with online flora and vegetation information, has provided an appropriate level of information for the current survey.
Scope (*i.e.* what life forms, *etc.*, were sampled)	**Not a constraint:** Vascular flora, which were the focus of the present survey were thoroughly sampled on a grid pattern within the survey area and additional species were recorded during the surveys and in areas where more detailed studies were undertaken on transects and plots in a variety of landforms, soils, vegetation types.
Proportion of flora collected and identified (based on sampling, timing and intensity)	**Minor constraint:** The survey areas were sampled on a grid pattern. The botanists undertaking the field surveys have had extensive experience working with the flora of the Jarrah forest. Any flora which could not be identified in the field was collected for subsequent identification. In some instances the survey efforts were undertaken in several seasons and as such in many ways this assisted in the coverage of some annual species.
Mapping reliability	**Not a constraint:** The vegetation were assessed on a grid pattern within the survey area. This together with opportunistic survey sites will provide high quality data enabling the survey area to be mapped with a high level of confidence. The site-vegetation type interpretations rely on perennial species along with landforms and soil types so the types can be identified at any time the seasonal conditions are not a constraint.
Timing, weather, season, cycle	**Minor constraint:** The EPA (2016a) recommends that flora and vegetation surveys in the South – West Botanical Province be conducted in Spring (September-November). With regard to the conservation significant flora, the majority identified as potentially occurring within the survey area can be recorded out of season with the exception of some orchid species which do not flower as regularly and some *Drosera* species. In view the efforts spanning spring months as well on the various areas, this is considered to be a minor constraint.
Disturbances (fire flood, accidental human intervention, *etc*.)	**Minor constraint:** Survey efforts largely have been undertaken after 3 years since any fires in the forests. Therefore these have placed some constraint on mapping times, but as such this is considered to have been a minor constraint.
Access problems (*i.e.* ability to access survey area)	**Not a constraint:** Vehicle access was not restricted in the survey areas.
Experience levels (*e.g.* degree of expertise in plant identification to taxon level)	**Not a constraint:** All botanists had direct and recent experience working in the Jarrah Forest and working for Alcoa, and thus were familiar with the local flora and vegetation values. Dr Mattiske has more than 40 years of ecological experience in flora and vegetation studies in the southwest forests. The more experienced staff over many years have also contributed substantially to work in the southwest forests and as such many have had more than 5 years of experience in the forest areas.

4. KEY VALUES

The geology, soils and landforms all influence the occurrence of flora and vegetation of the area and are described in this section. Potential flora, including threatened, priority and introduced species are described, along with possible vegetation communities, and placed within a local and regional context.

4.1 DBCA Estate

The survey areas are situated in State Forest within ML1SA (Figure 5) in Huntly North and Huntly South areas and the Willowdale extends slightly from the State Forest into a Conservation Park and Lane Poole Reserve which have been declared since the initial work was undertaken. The northern area abuts and overlaps the survey area in Huntly North (this is a gap in coverage of the site-vegetation type mapping for the Huntly North areas, see section on site-vegetation types below).

4.2 Geology, Soils and Topography

The survey areas are situated within Beard's (1990) Northern Jarrah Forest subregion of the Southwest Province. The Northern Jarrah Forest subregion encompasses the area to the east of the Darling Scarp, overlying Archaean granite and metamorphic rocks of the Yilgarn Craton at an average elevation of 300 m (Beard 1990). The area is capped by extensive lateritic duricrust, dissected by drainage lines and broken by occasional granite hills. In the eastern section, the laterite becomes deeply dissected until it compresses isolated remnants. The duricrusted plateau of the Yilgarn Craton is characterised by lateritic gravels, consisting of 5 m or more of ironstone gravels in a yellow sandy matrix, and related lateritic podzolic soils with ironstone gravels in a sandy surface horizon. These overlay mottled yellow-brown clay subsoils and hard setting loamy soils, which become evident in the east (Beard 1990).

Furthermore, Western Australia is divided into twelve Systems, separated by natural and demographic boundaries (Department of Conservation and Environment 1980). The survey area lies within the Darling System (as known as System 6), which is further divided into provinces, with the survey area lying in The Darling Plateau province (Department of Conservation and Environment 1980).

The underlying geological units of The Darling Plateau province have been defined by Churchward and McArthur (1980), with three main landform and soil units occurring within the survey areas, these are:

Darling Scarp: Very steep slopes with shallow red and yellow earths and much rock outcrop.

Dwellingup: Gently undulating landscape with duricrust on ridges; sands and gravels in shallow depressions.

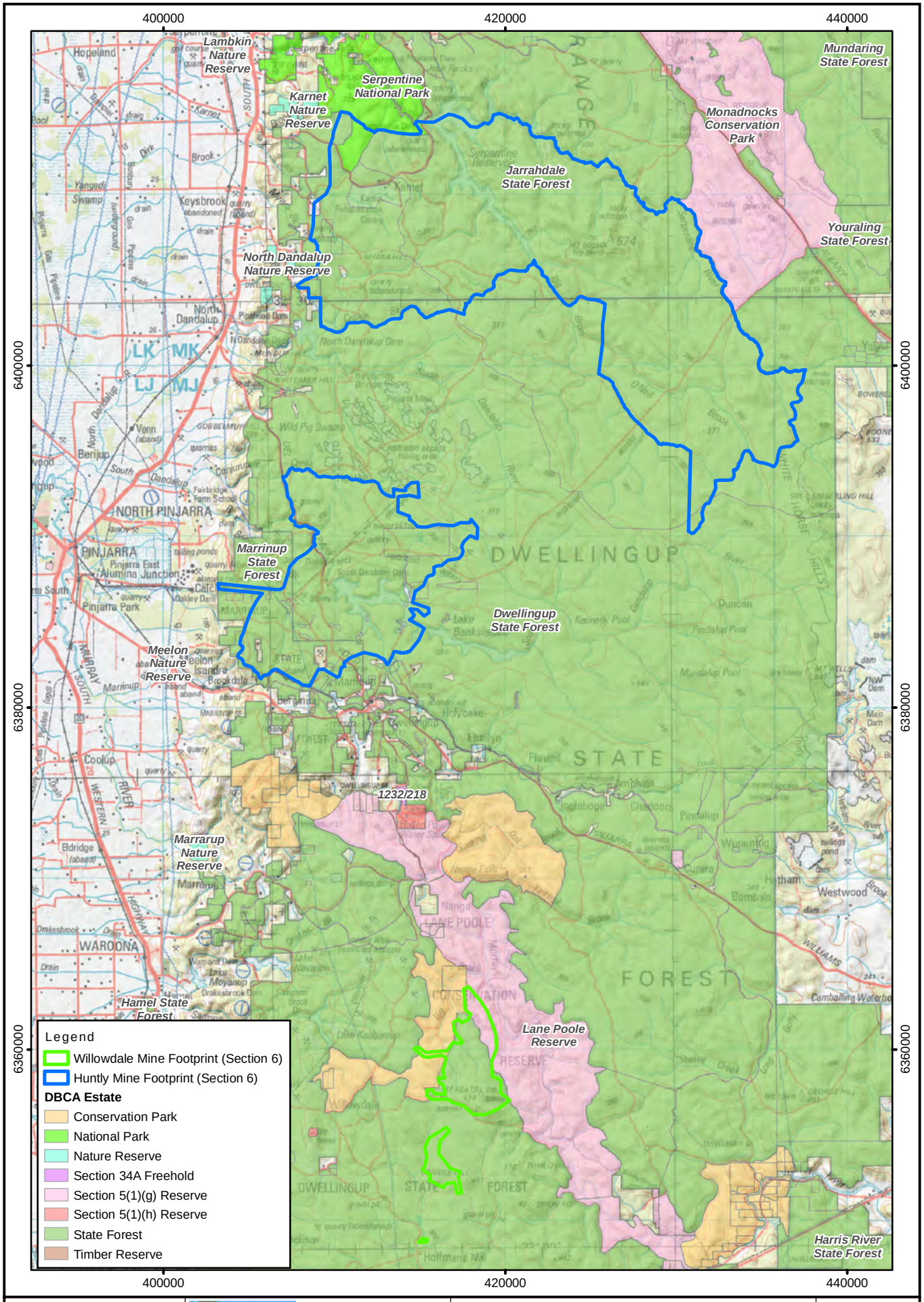
Helena: Very deeply incised valleys with steep rocky slopes and some shallow red or yellow earths.

Murray: Deeply incised valleys with red and yellow earths on slopes, narrow alluvial terraces.

Yarragil: Valleys of the western part of the plateau; sandy gravels on the slopes; orange earth in swampy floors.

Pindalup: Valleys of the central part of the plateau , gravelly duplex soils on slopes; some rock outcrop; grey sands, duplex yellow soils and orange earths in broad floors.

Cook: Hills rising above general plateau level ; mainly laterite but with some rock outcrop.



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Willowdale and Huntly Mine Footprints
DBCA Estates

Figure: **5**

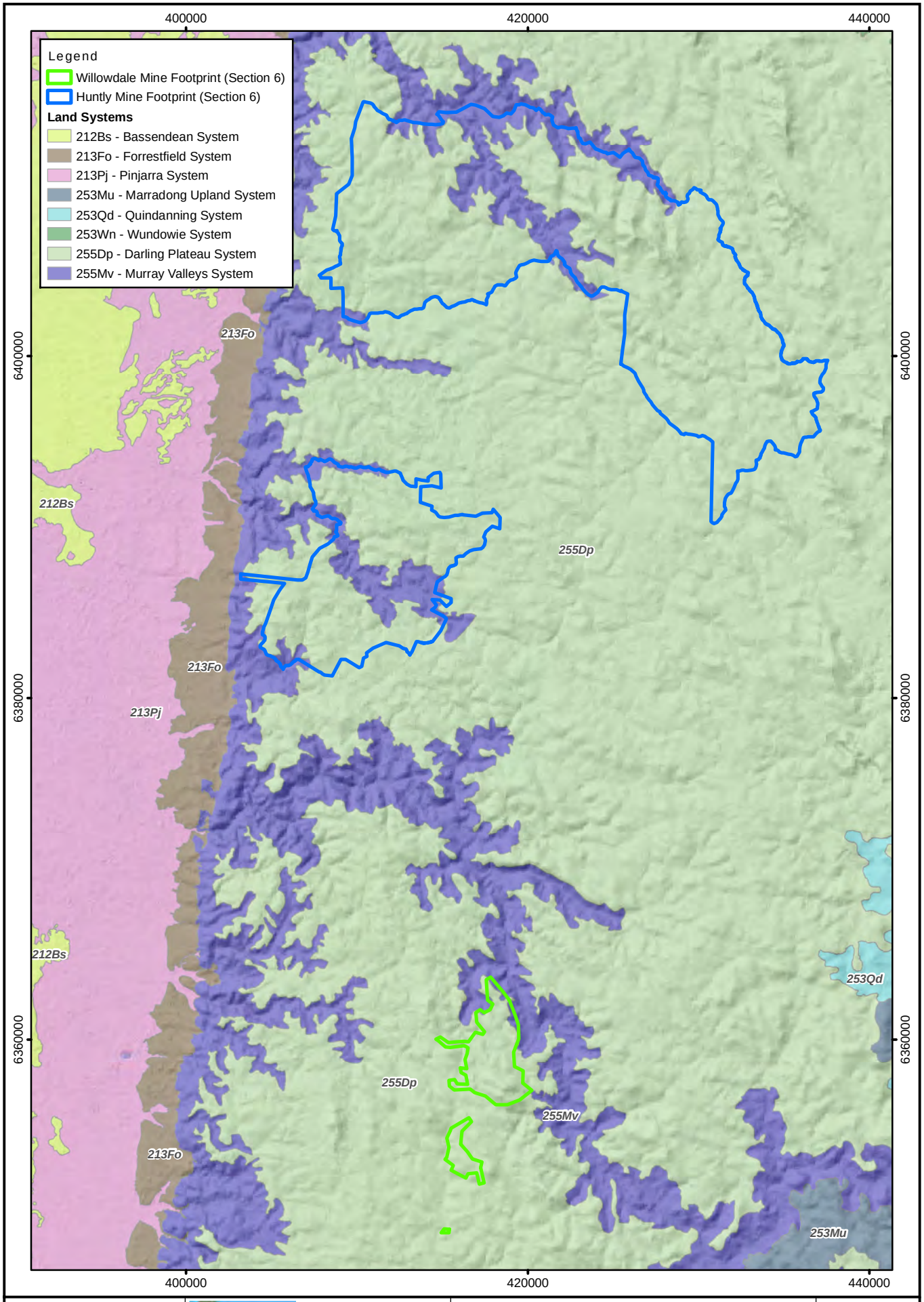
The Department of Primary Industries and Regional Development's (DPIRD) Land Systems present within the survey areas (Figure 6, Table 3) includes:

- **Darling Plateau System (255Dp):** Lateritic plateau. Duplex sandy gravels, loamy gravels and wet soils. Jarrah- marri-wandoo forest and woodland.

- **Murray Valleys System (255Mv):** Western Darling Range from the Avon Valley to Harvey. Deeply incised valleys with Red loamy earths, shallow duplexes and rock outcrop and Jarrah-marri-wandoo forest and woodland

Table 3: Extent of Land Systems intersecting the Survey areas

and System	Mapping Unit	Total Extent (ha)	Total Area (ha)	Proportion of Current Extent (%)
Huntly North - Darling Plateau System	255Dp	820265.77	25178.89	3.07
Huntly North - Murray Valleys System	255Mv	132255.57	4144.09	3.13
Huntly South - Darling Plateau System	255Dp	820265.77	7622.73	0.93
Huntly South - Murray Valleys System	255Mv	132255.57	2101.07	1.59
Willowdale - Darling Plateau System	255Dp	820265.77	2028.96	0.25
Willowdale - Murray Valleys System	255Mv	132255.57	107.10	0.08



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Willowdale and Huntly Mine Footprints
Land Systems

Figure: **6**

4.3 Regional Vegetation

The survey area is situated within Beard's (1990) Northern Jarrah Forest subregion of the Southwest Province. The Northern Jarrah Forest subregion is characterised by Jarrah (*Eucalyptus marginata*) forest on ironstone gravels and Marri-Wandoo (*Corymbia calophylla* - *Eucalyptus wandoo*) woodlands on loamy soils, with sclerophyll understoreys. Dell and Havel (1989) broadly classified the Jarrah Forest as an open forest in its northern extent and as a tall forest in its southern extent. In lower rainfall areas towards the east trees decrease in size, forming woodlands or low forests. This dry sclerophyllous forest typically comprises a dominant *Eucalyptus marginata* and *Corymbia calophylla* overstorey, a mid-storey of *Allocasuarina fraseriana* (Sheoak), *Banksia grandis* (Bull Banksia), *Persoonia longifolia* (Snottygobble), *Persoonia elliptica* (Spreading Snottygobble), and a groundcover of woody shrubs with grass trees *Xanthorrhoea preissii*, *Kingia australis* and the cycad *Macrozamia riedlei* (Dell and Havel 1989).

The Pre-European vegetation system present within the survey areas (Figure 7, Table 4) includes:

1. **West Darling System**

   Vegetation Association 3.3: Mainly jarrah and marri *Eucalyptus marginata, Corymbia calophylla.*
   Vegetation Association 128: Bare areas; rock outcrops.

2. **West Darling System**

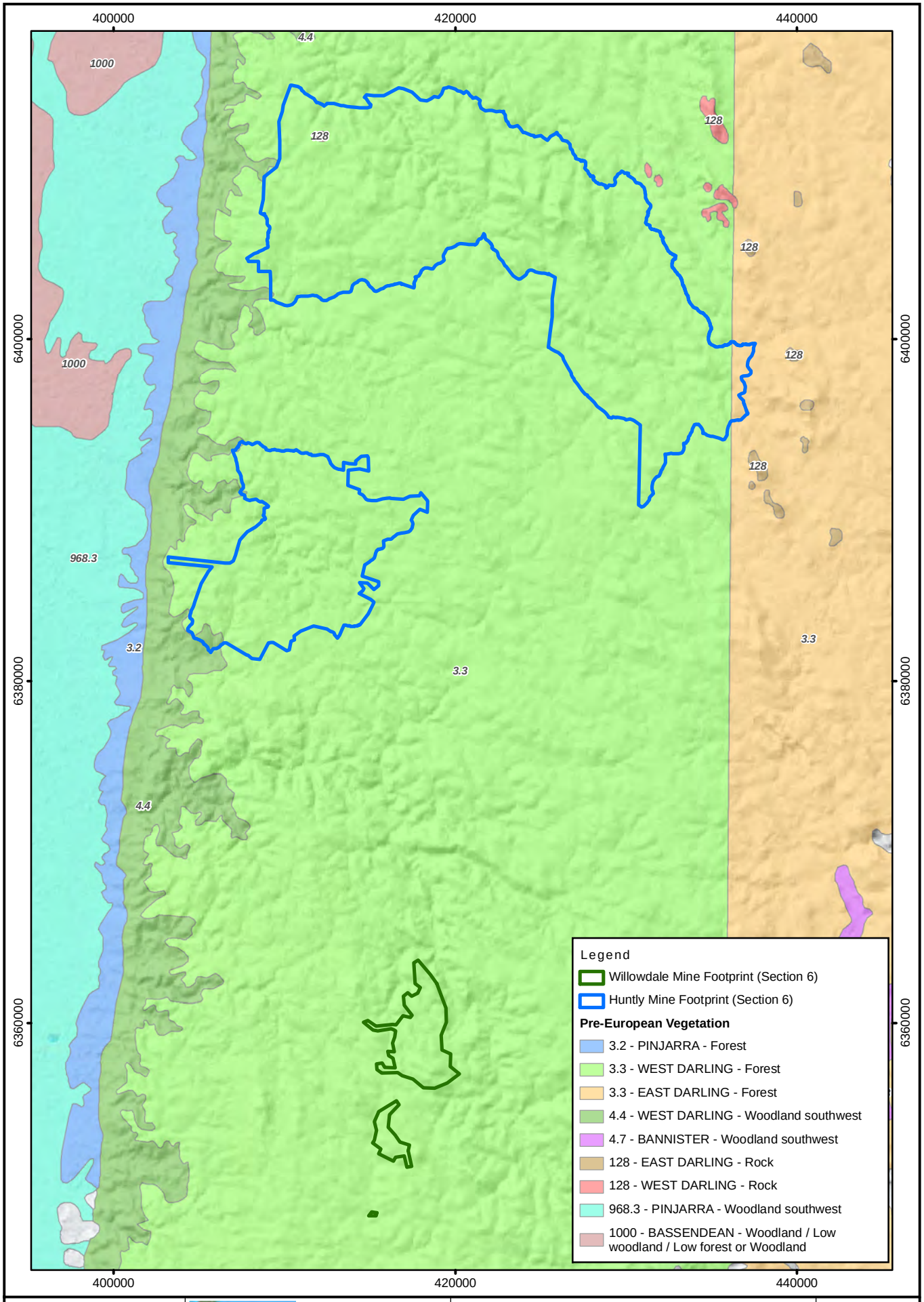
   Vegetation Association 4.4: Jarrah, marri and wandoo *Eucalyptus marginata, Corymbia calophylla, Eucalyptus. wandoo.*

3. **East Darling System**

Vegetation Association 3.3: Mainly jarrah and marri *Eucalyptus marginata, Corymbia calophylla*

Table 4: Extent of Pre-European Vegetation intersecting the Survey areas

Pre-European Vegetation	Mapping Unit	Total Extent (ha)	Total Area (ha)	Proportion of Current Extent (%)
Huntly North – West Darling	128	1449.098	27.82	1.92
Huntly North – East Darling	3.3	303349.645	398.87	0.13
Huntly North – West Darling	3.3	485225.883	28884.16	5.95
Huntly North – West Darling	4.4	52122.777	12.13	0.02
Huntly South – West Darling	3.3	485225.883	9571.67	1.97
Huntly South – West Darling	4.4	52122.777	152.13	0.29
Willowdale – West Darling	3.3	485225.883	2136.06	0.44



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Willowdale and Huntly Mine Footprints

Pre-European Vegetation

Figure: **7**

4.4 Vegetation Complexes

Heddle *et al.* (1980) and Mattiske and Havel (1998) described the dominant pre-European vegetation of the Darling System in a series of vegetation complexes (Regional Forest Agreement vegetation complexes) and determined how they relate to the landforms, soils and climatic conditions. Nine broad vegetation complexes occur in the survey areas (Figure 8, Table 5), these are:

Cooke (Ce): Mosaic of open forest of *Eucalyptus marginata* subsp. *marginata – Corymbia calophylla* (subhumid zone) and open forest of *Eucalyptus marginata* subsp*. thalassica – Corymbia calophylla* (semi-arid and arid zones) and on the deeper soils adjacent to outcrops closed heath of Myrtaceae-Proteaceae species and lithic complex on granite outcrops and associated soils in all climatic zones with some *Eucalyptus laeliae* (semi-arid), and *Allocasuarina huegeliana* and *Eucalyptus wandoo* (mainly semiarid to perarid zones).

Darling Scarp (DS2): Mosaic of open forest of *Eucalyptus marginata subsp. marginata – Corymbia calophylla*, with some admixtures with *Eucalyptus laeliae* in the north (subhumid zone) with woodland of *Eucalyptus wandoo* (subhumid and semiarid zones), low woodland of *Allocasuarina huegeliana* on shallow soils over granite outcrops, closed heath of Myrtaceae – Proteaceae species and lithic complex on or near granite outcrops in all climate zones.

Dwellingup 1 (D1): Open forest of *Eucalyptus marginata* subsp. *marginata - Corymbia calophylla* on lateritic uplands in mainly humid and subhumid zones.

Dwellingup 2 (D2): Open forest of *Eucalyptus marginata* subsp. *marginata - Corymbia calophylla* on lateritic uplands in subhumid and semiarid zones.

Dwellingup 4 (D4): Open forest of *Eucalyptus marginata* subsp. *marginata - Corymbia calophylla* on lateritic uplands in subhumid and semiarid zones.

Helena 1 (He1): Mosaic of open forest of C*orymbia calophylla – Eucalyptus patens - Eucalyptus marginata* subsp. *marginata* with some *Eucalyptus rudis* on the deeper soils ranging to closed heath and lithic complex on shallow soils associated with granite on steep slopes of valleys in humid and subhumid zones.

Murray 1 (My1): Open forest of *Eucalyptus marginata* subsp. *marginata - Corymbia calophylla - Eucalyptus patens* on valley slopes to woodland of *Eucalyptus rudis – Melaleuca rhaphiophylla* on the valley floors in humid and subhumid zones.

Pindalup (Pn): Open forest of *Eucalyptus marginata* subsp. *thalassica – Corymbia calophylla* on slopes and open woodland of *Eucalyptus wandoo* with some *Eucalyptus patens* on the lower slopes in semiarid and arid zones.

Yarragil 1 (Yg1): Open forest of *Eucalyptus marginata* subsp. *marginata - Corymbia calophylla* on slopes with mixtures of *Eucalyptus patens* and *Eucalyptus megacarpa* on the valley floors in humid and subhumid zones.

Yarragil 2 (Yg2): Open forest of *Eucalyptus marginata* subsp. *thalassica - Corymbia calophylla* on slopes, woodland of *Eucalyptus patens-Eucalyptus rudis* with *Hakea prostrata* and *Melaleuca viminea* on valley floors in subhumid and semiarid zones.

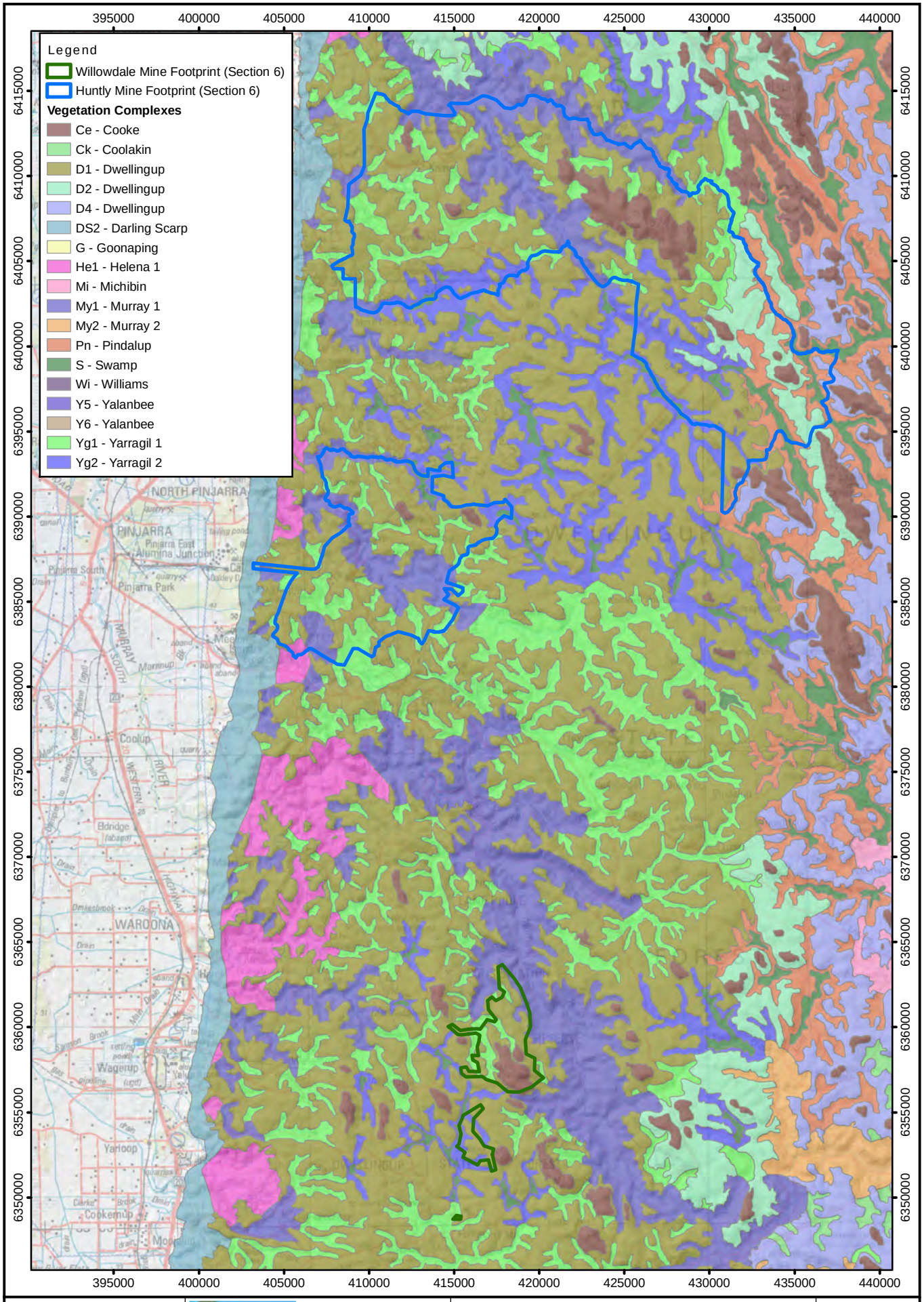
Swamp (S): Mosaic of open woodland of *Melaleuca preissiana – Banksia littoralis,* closed scrub of Myrtaceae spp., closed heath of Myrtaceae spp., and sedgelands of *Baumea* and *Leptocarpus* spp. On seasonally wet and moist sand, peat and clay soils on valley floors in all climatic zones.

More recently, the vegetation of Western Australia has been assigned to bioregions and subregions under the Interim Biogeographical Regionalisation for Australia (IBRA), with the survey area falling within the Northern Jarrah Forest subregion (JF1) of the Jarrah Forest (JAF) Region (DCCEEW 2024c). The vegetation of the Northern Jarrah Forest subregion consists of Jarrah – Marri forest, with Bullich and Blackbutt in the valleys to the west, grading to Wandoo and Marri woodlands to the east. Heath vegetation is the common understorey of forests and woodlands and occurs on granite rocks. The majority of the diversity between communities in this subregion occurs on lower slopes and near granite soils (Williams and Mitchell 2001).

Table 5: Extent of Vegetation Complexes intersecting the SurveyaAreas

Note: Total extent relies on data managed by DBCA for representation of vegetation complexes

Area (Blocks)	Vegetation Complex	Vegetation Code	Total Extent (ha)	Area of Intersection with the Huntly and Larego survey areas (ha)	Proportion of Current Extent (%)
Huntly North	Cooke	Ce	51872.103	2241.302	4.32
	Dwellingup 1	D1	297624.846	11950.490	4.01
	Dwellingup 2	D2	120755.000	2190.442	1.81
	Dwellingup 4	D4	187588.996	87.951	0.05
	Murray 1	My1	97562.811	4229.121	4.34
	Pindalup	Pn	236540.595	1472.212	0.62
	Swamp	S	76245.982	621.429	0.82
	Yarragil 1	Yg1	113828.123	4038.352	3.55
	Yarragil 2	Yg2	71234.370	2491.680	3.50
Huntly South	Cooke	Ce	51872.103	140.558	0.27
	Darling Scarp	DS2	45933.954	13.400	0.03
	Dwellingup 1	D1	297624.846	4708.344	1.58
	Helena 1	He1	22572.756	72.890	0.32
	Murray 1	My1	97562.811	2286.048	2.34
	Swamp, S	S	76245.982	131.005	0.17
	Yarragil 1	Yg1	113828.123	2041.258	1.79
	Yarragil 2	Yg2	71234.370	330.298	0.46
Willowdale	Cooke	Ce	51872.103	399.662	0.77
	Dwellingup 1	D1	120755.000	1127.142	0.93
	Murray 1	My1	97562.811	143.500	0.15
	Swamp	S	76245.982	12.214	0.02
	Yarragil 1	Yg1	113828.123	330.806	0.29
	Yarragil 2	Yg2	71234.370	122.738	0.17



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Willowdale and Huntly Mine Footprints

Vegetation Complexes

Figure:

8

4.5 Threatened and Priority Ecological Communities

During the earlier phases of the surveys no Threatened Ecological Communities (TECs) were listed on the survey areas on the Darling Ranges. Recently, it was recognized that the *Empodisma* peatland of southwestern Australia has the potential to occur in the swamps if peat is present. These would occur in the A or AC site-vegetation types. To date the suggested potential locations have not been assessed for the presence of peat; however *Empodisma gracillimum* has been recorded previously in a restricted area by the Mattiske team. This species is largely restricted to coastal areas in the southwest (WAH 1998-) and as such more work is required.

The desktop assessment highlighted several other potential TECs; however these are restricted to the Swan Coastal Plain or the Wheatbelt and as such do not extend into the Jarrah forest area on the Darling Ranges.

There are two priority ecological communities (PECs), as listed at State level by DBCA (2024b, 2024c) that occur within the Huntly North (Myara) survey area; only one of these is a botanical PEC.

The priority ecological communities that occur in the Huntly North survey area are:

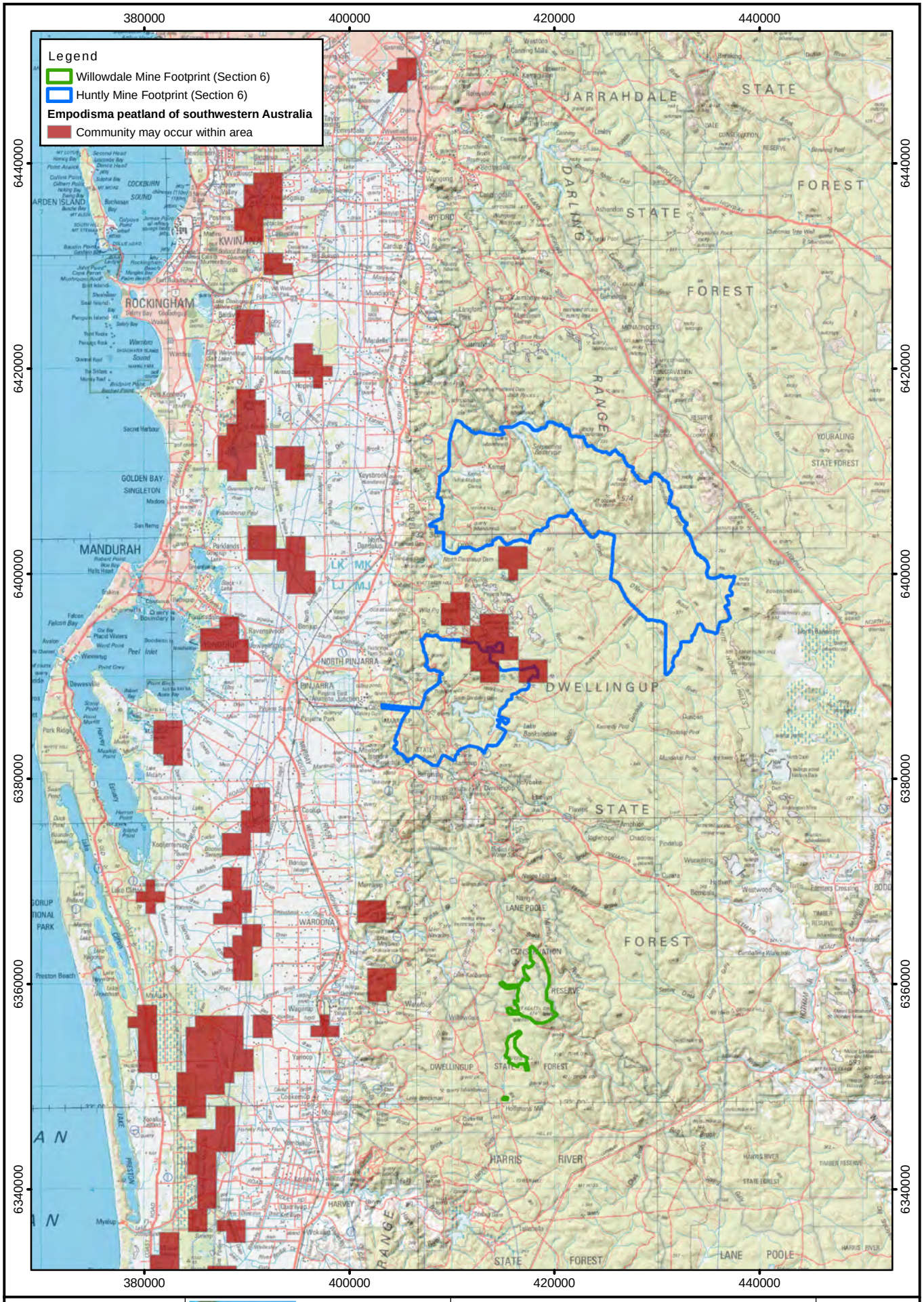
- Granite communities of the northern Jarrah forest (P3)
    - Jarrahdale area – Monadnocks, Blue Rock; insufficient information to distinguish discrete community type/s (DBCA 2024b, 2024c).
- Litter Dependant Invertebrate Community of the northern Jarrah Forest (P2)
    - Chandler Block, Northern Jarrah Forest; insufficient evidence that this is a discrete community type (DBCA 2024b, 2024c).

There is a potential that the site-vegetation types associated with granite outcrops (site-vegetation types G and R), and the Cooke vegetation complex as defined by Mattiske and Havel (1998) may have affinities with the PEC.

The alignment of the communities with the DBCA defined PEC raises some issues due to the lack of consistent and detailed data on the granites. Alcoa is currently reviewing these values and this will be refined in conjunction with other data collected during surveys on the G and R site-vegetation types to assist in the refinement of the detail associated with this PEC. The location of the granite areas is summarize on Figure 10 and as such these areas are associated with the G and R site-vegetation types as defined in the varying reports.

The significant issue that relates to the granites is the complexity of the structural and floristic components as they reflect varying depths or soil over the outcrop and as such vary from lithic complexes dominated by mosses and lichen species, through heath communities dominated by Proteaceae and Myrtaceae species to open woodlands of Jarrah-Marri or Wandoo over low shrubs on the fringes of the exposed granites.

All survey areas occur within the Regional Forest Agreement (RFA) area of the southwest forests DCCEEW (2024b) and as such were considered during the RFA process.



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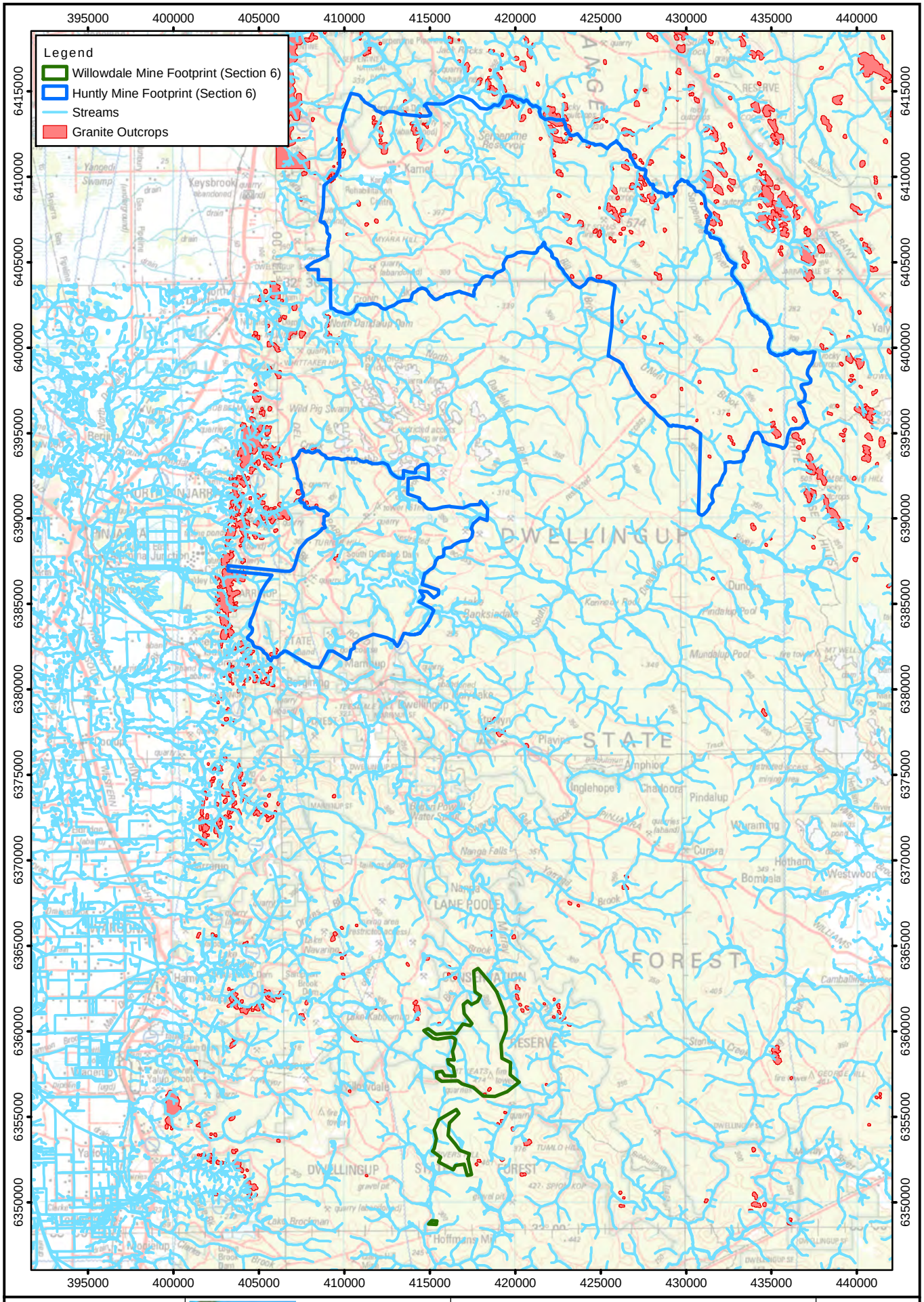
Willowdale and Huntly Mine Footprints
Potential Empodisma peatlands

Figure: **9**



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Willowdale and Huntly Mine Footprints

Granite Outrops and Streams

Figure:

10

4.6 Threatened and Priority Flora

In assessing threatened species there has been a tendency to rely on radial searches that at times can lead to the coverage of more potential conservation flora species than is relevant. An example of the latter is the potential inclusion of threatened species that are restricted to either the Darling Scarp or Swan Coastal Plain and that do not extend into the Darling Range of project areas on the Darling Range are excluded in this updated summary, namely:

Diuris drummondii (SCC – T, FCC - V) – Very Unlikely as mainly on Swan Coastal Plain and southern forest and southern Wheatbelt and restricted north of Brookton Highway in wet creek, swampy area

Diuris micrantha (SCC – T, FCC - V) - Unlikely as mainly on Swan Coastal Plain and Wheatbelt and restricted to lateritic soils near Byford

Diurus purdiei (SCC – T, FCC – E) – Unlikely as scattered collections along Swan Coastal Plain, furthest inland 20 km east of Armadale, as far south as Pinjarra and surrounds.

Eleocharis keigheryi (SCC – T, FCC - V) – Very Unlikely as restricted to seasonally wetter areas associated with creeks and clay pans. Mainly on wetter areas on Swan Coastal Plain and in Wheatbelt.

Grevillea flexuosa (SCC – T, FCC - V) – Very Unlikely as this species is restricted to areas north of Great Eastern Highway

Synaphea sp. Fairbridge Farm (D. Papenfus 696) (SCC – T, FCC - CE) - Very unlikely, restricted to Swan Coastal Plain

Synaphea sp. Pinjarra Plain (A.S. George 17182) (SCC – T, FCC – E) - Very unlikely, restricted to Swan Coastal Plain

Synaphea sp. Serpentine (G.R. Brand 103) (SCC – T, FCC - CE) - Very unlikely, restricted to Swan Coastal Plain

Synaphea stenoloba (SCC – T, FCC – E) - Very unlikely, restricted to Swan Coastal Plain

Verticordia plumosa var*. ananeotes* (SCC – T, FCC – E) - Very Unlikely - occurs on Darling Scarp, Swan Coastal Plain and southern Swan Coastal Plain near Bunbury

In addition, the following species have a low or low to moderate likelihood of occurring in either the Huntly North or Huntly South areas as they mainly on the fringes of the Albany Highway with the Monadnocks to the north-east of the Myara North survey area or west of both project areas on the Darling Scarp, Table 6 and Appendix B. It is worth noting that some of the species have changed conservation status in recent months (WA Herb 1998-). The results in Table 6 reflect the significance of the granite outcrops on the Darling Scarp, within the Monadnocks and the shallow occurrence of granite under some layers of laterite, loams and sands on the slopes north of Albany Highway for species such as *Verticordia fimbrilepis* subsp*. fimbrilepis.*

Note in defining the site-vegetation type codes the second letter is added to reflect some secondary influence (e.g. on the sandy-loam alluvial lower slopes of valleys which supports a range of site-vegetation types including the D site-vegetation type, when there are some influences of sub-surface outcropping the G letter is added after the D); thereby indicating a variation that relates to some species reflecting this shallow outcropping.

TABLE 6: Updated Review of Threatened and Priority Flora

Note: State (SCC; Department of Biodiversity, Conservation and Attractions 2024a, 2024c) and Federal (FCC; DCCEEW 2024a, 2024b) conservation code definitions. A range of species were included in the 20km radius desktop search and depending on location (based collections in State Herbarium - Florabase), previous records over some 40 years and updated searching on DBCA databases and also site conditions were ranked as likelihood of Low, Moderate or High. SVT Code – site-vegetation code based on Havel (1975a and 1975b) – Mattiske Consulting 2021 and 2024 and Vegetation Complexes (Mattiske and Havel 1998). Note Likelihood assessment reviewed on the basis of extended survey efforts and updated review of Florabase dataset.

Species	Family	SCC	FCC	Likelihood of Occurrence	20km Radius Search Vegetation complex outside Occurrence	Lateritic Soils on Uplands and Slopes	Granite Outcrops	Valley Systems and Swamps	Site-Vegetation Type SVTs) (Mattiske 2021, 2024)	Vegetation Complexes (Mattiske and Havel 1998)
Andersonia sp. Saxatilis (F. & J. Hort 3324)	Ericaceae	T	Not listed	Low	Been recorded in granite outcrop areas on the "G" site vegetation type in the Monadnocks area to the north of Albany Highway.		X		G	Cooke (Ce)
Anthocercis gracilis	Solanaceae	T	V	Low	Been recorded mainly on Darling Scarp, in isolated occurrences north of Albany Highway and eastward to Wheatbelt. Associated with open woodlands and heath communities on granite outcrops.		X		G and R	Cooke (Ce), Darling Scarp (DS2), Helena 1 (He1),
Lasiopetalum pterocarpum	Malvaceae	T	E	Low	Recorded on Darling Scarp, DS2, Murray 1, My1 and Helena 1, He1, so may extend to granite outcrops. Not in lateritic soils.		X		G and R	Cooke (Ce), Darling Scarp (DS2) Helena 1 (He1), Murray 1 (My1) (near granites for Murray 1 and Helena 1)
Morelotia australiensis R.L. Barrett and K.L. Wilson (formerly *Tetraria australiensis*)	Cyperaceae	T	V	Low-Moderate	Found along Swan Coastal Plain, north of Albany Highway in Monadnocks Reserve and near Bunbury on southern Swan Coastal Plain		X	X	G, R and D	Cooke (Ce), Yarragil 2 (Yg2) (broader valleys)
Verticordia fimbrilepis subsp. *fimbrilepis*	Myrtaceae	T	E	Low	Recorded in Jarrah Forest north of Albany Highway, Avon Wheatbelt (mainly near Pingelly, Narrogin an Katanning)		X	X	G, R and on shallow granites which may occur with some laterite on slopes (DG)	Cooke (Ce) (mainly north of Albany Highway - granite outcrops or near surface granite with some overlaying soils)

The recent works by Mattiske in the Huntly and Willowdale areas have been summarized in relation to coverage of threatened and priority flora species, weeds and site-vegetation types. Mattiske (1985 to 2023) has recorded some ten Priority flora species within the respective areas, namely potentially *Hibbertia ?ambita* (P1), *Hibbertia hortiorum* (P1), *Acacia horridula* (P3), *Conospermum scaposum* (P3), *Grevillea dissectifolia* (P3), *Thysanotus anceps* (P3),*Grevillea pimeleoides* (P4), *Lasiopetalum cardiophyllum* (P4), *Stylidium ireneae* (P4) and *Senecio leucoglossus* (P4), During this period many species have also changed names by specialists and also conservation status so there is an ongoing need to update datasets. An example of the latter is the revision of the *Hibbertia commutata* group by Thiele (2019) which was split into 27 taxa including Priority species. Such gaps in part have been addressed through the recent additional targeted work in 2023.

Eco Logical (2024) preclearance surveys were undertaken in spring 2023 and as a result no threatened flora species and three Priority flora species were recorded in the Willowdale areas. The three Priority flora species included *Netrostylis* sp. Nannup (P.A. Jurjevich 1133) (P1), *Grevillea prominens* (P3) and *Senecio leucoglossus* (P4).

Ecologia (2024) database searches identified 58 significant plant taxa within 20 km of the survey area (excluding records from the Swan Coastal Plain). Only three significant flora species were recorded in the field surveys including *Tetratheca phoenix* (P2), *Senecio leucoglossus* (P4) and *Stylidium ireneae* (P4). No threatened flora species were recorded in the targeted survey areas.

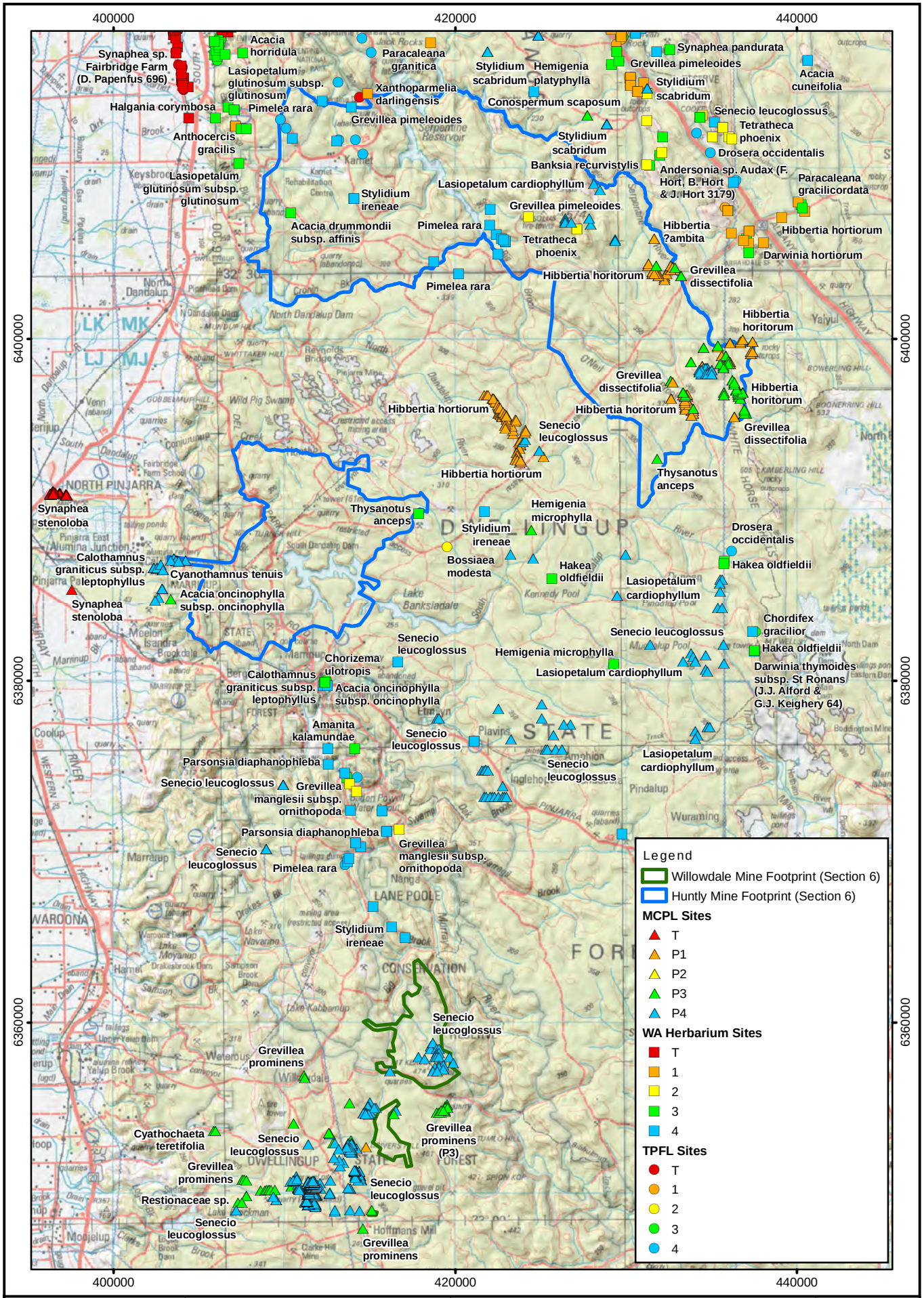
Biologic (2024) databases searches identified 72 significant plant taxa within the 20km of the survey area. Only four significant flora species were recorded in field surveys including *Acacia horridula* (P3), *Thysanotus anceps* (P3), *Senecio leucoglossus* (P4) and *Stylidium ireneae* (P4). No threatened flora species were recorded in the targeted survey areas.

Mattiske (2024) database searches identified the potential for 12 threatened flora species and 37 priority flora species to occur in the O'Neil Transport Corridor survey area. Of the threatened flora species, all were considered to have a very low potential of occurring in the O'Neil Transport survey area due to the lack of suitable habitat and also know distributions away from the survey area. A total of 2 priority flora species (*Hibbertia hortiorum* P1 and *Senecio leucoglossus* P4) were recorded in the O'Neil Transport Corridor survey area. The *Hibbertia hortiorum* appeared relatively regularly and in part reflected the recent split of *Hibbertia commutata* into multiple species by Kevin Thiele (2019).

The data from these survey efforts has been combined and integrated with previous records on Figure 11, Table 7 and Appendix B.

Table 7: Summary of Recorded Significant Flora in the respective areas of Huntly North, Huntly South, Willowdale (2 sub areas)

Conserv-ation Status	Threatened and Priority Flora	Site-Vegetation Type	Huntly North	Huntly South	Willowdale	Nearby but outside
P1	*Hibbertia ?ambita*	S	X			Mainly eastwards
P1	*Hibbertia hortiorum*	S, ST, T, TS, D, SW, DG, YG, AD, A, Y, R, AC, PT,	X			X
P1	*Netrostylis* sp. Nannup (P.A. Jurjevich 1133*)*	AC			X	X
P2	*Bossiaea modesta*	D				X
P2	*Tetratheca phoenix*		X			X
P3	*Acacia drummondii* subsp. *affinis*	D, PS, S				X
P3	*Acacia horridula*		X	X		X
P3	*Conospermum scaposum*	DA				X
P3	*Cyathochaeta teretifolia*	CW				X
P3	*Grevillea dissectifolia*	A, AC, AD, AY, D, DG, ST, S, G, YG	X			X
P3	*Grevillea prominens*	S, W, T, TS, PS, CW, AC			X	X
P3	*Hemigenia microphylla*	S				X
P3	*Thysanotus anceps*	SP	X	X		
P4	*Calothamnus graniticus* subsp. *leptophyllus*			X		Mainly Swan Coastal Plain
P4	*Cyanothamnus tenuis*			X		
P4	*Grevillea pimeleoides*	G1	X			
P4	*Lasiopetalum cardiophyllum*	D, P, PS, S, TS, DG, R	X			X
P4	*Senecio leucoglossus*	S, PS, T, TS, D, SP, PT, PW, , TP, P, SW	X		X	X
P4	*Stylidium ireneae*	AC	X	X		X
P4	*Stylidium scabridum*	CW, PS, P, D, S				X



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Willowdale and Huntley Mine Footprints
Threatened and Priority Flora

Figure: **11**

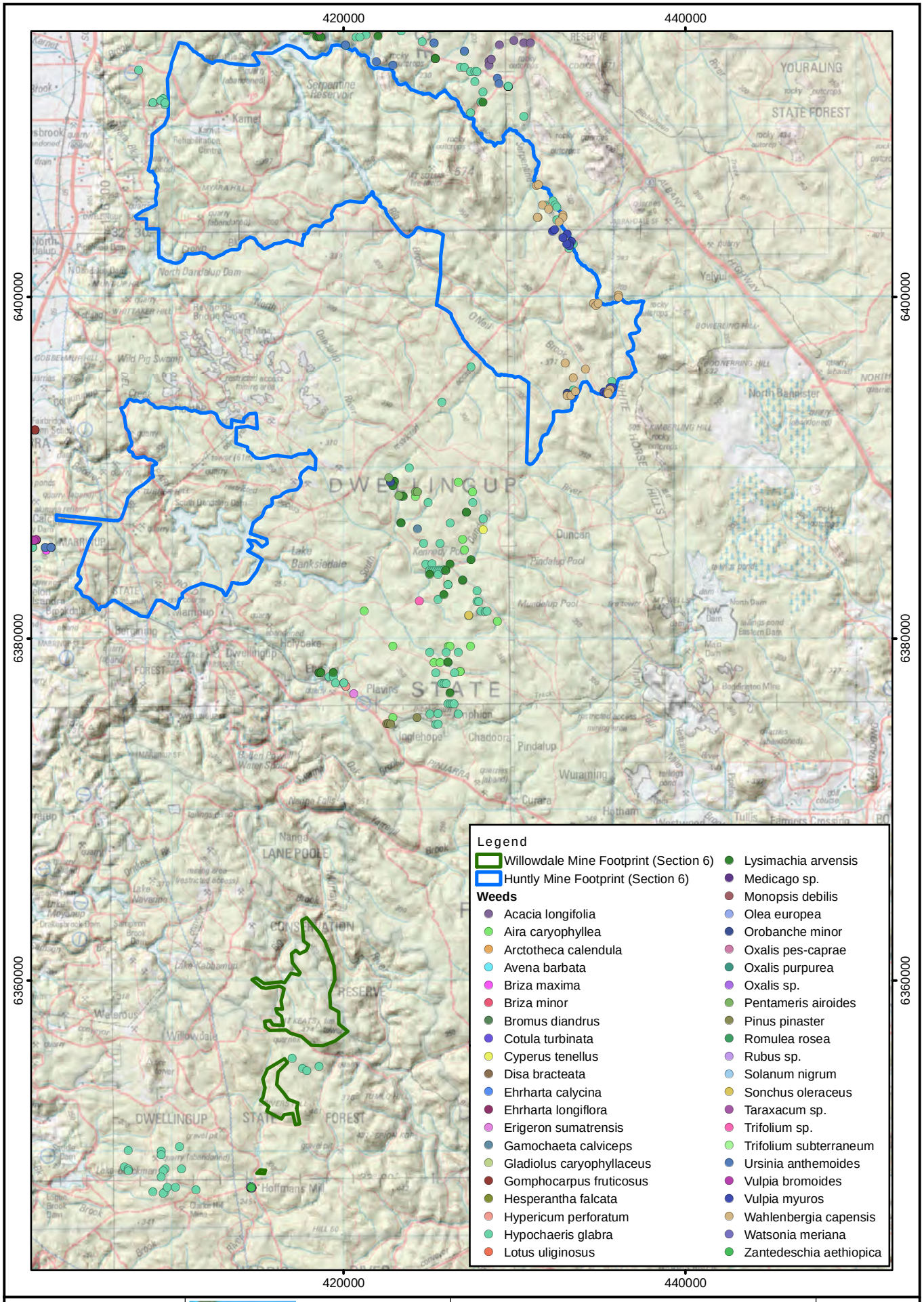
4.7 Introduced and Weed Species

A range of introduced species that have the potential to be recorded are summarized in Appendix C and others that have been recorded are summarized on Figure 12. As historical data sets are integrated the number of recorded locations of weeds is expected to increase, particularly near cleared, modified and disturbed areas. At this juncture it is important to recognize that many annual species do not persist over time in denser revegetation or forest areas.

In summary there is the potential for some 30 WONS weeds as listed under the EPBC Act 1999 by the Department of Climate Change, Energy, the Environment and Water (2024d) and 51 Declared weeds as listed under the BAM Act by the Department of Primary Industries and Regional Development (2024), Appendix C.

Many of these weeds occur primarily on agricultural holdings on the wider region and as such many are not expected to occur in the less disturbed forest areas. The main weeds in the Huntly and Willowdale areas included **Rubus* sp. (Blackberries), **Zantedeschia aethiopica* (Arum lily), **Watsonia meriana*, **Olea europea* (Olives), **Gomphocarpus fruticosus* and **Asparagus asparagoides* (Bridle creeper). Whilst others have been recorded these species appeared to pose the greatest threats in valley systems and forest areas near disturbed environments.

Many weeds have been recorded historically, the latter gaps on Figure 12 reflect the gaps in combining historical databases rather than their absence in the areas. Many weeds do not pose major threats to the community values as many are annuals and not aggressive.



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Willowdale and Huntly Mine Footprints

Weeds

Figure: **12**

4.8 Site-vegetation Types

A total of 35 site-vegetation types were defined and mapped in the survey areas and additional disturbance, cleared and rehabilitation areas, Table 8 and Figure 13. The site-vegetation types were defined on the basis of key species and site parameters as defined in Havel (1975a and 1975b) for the Jarrah forest and as refined and developed by Mattiske over the last 40 years.

Table 8: Summary of site-vegetation types as defined for the survey areas based on Havel (1975a and 1975b)

	SVT Code	Description	Huntly North (ha)	Huntly South (ha)	Willowdale (ha)
Swamps and Broad Valleys	A	Open Woodland of *Eucalyptus rudis – Melaleuca preissiana* - *Eucalyptus patens* - *Banksia littoralis* with dense stands of *Melaleuca viminea, Hakea varia, Taxandria linearifolia* and *Astartea scoparia* in understorey on broad swamps and water-courses.	113.19	1.307	
	AC	Open Woodland of *Eucalyptus rudis – Melaleuca preissiana* - *Eucalyptus patens* - *Banksia littoralis* with dense *Taxandria linearifolia* and *Astartea scoparia* in understorey on broad swamps and water-courses.	725.496	144.229	35.335
	AD	Low open woodland of *Eucalyptus rudis* and *Eucalyptus marginata* over *Banksia littoralis, Hakea prostrata* and *Pericalymma ellipticum* over low shrubs and herbs on leached sands over sandy-gravel on lower slopes.	31.652		
	AW	Low open woodland of *Eucalyptus patens* and *Melaleuca preissiana* over *Banksia littoralis, Hakea prostrata* and *Pericalymma ellipticum* over low shrubs and herbs on leached sands over sandy-gravel on lower slopes.	1.573		
	AX	Open Woodland *of Eucalyptus rudis – Melaleuca preissiana* with dense understorey of mixed *Melaleuca* species on clay soils in swamps.			
	AY	Open woodland of *Eucalyptus wandoo* over *Hakea varia, Hypocalymma angustifolium, Babingtonia camphorosmae* and *Gastrolobium calycinum* over herbs and sedges on clay-loams in seasonally wetter valley floors.	27.917		
	D	Open Forest of *Eucalyptus marginata -Corymbia calophylla – Eucalyptus patens - Alllocasuarina fraseriana - Hakea prostrata* on lower slopes with mixed low understorey species, including *Babingtonia camphorosmae, Daviesia decurrens, Davieisa preissii* and *Acacia extensa* on clay loams to gravelly clay-loams.	1586.830	10.110	29.483
	DA	Open Forest of *Eucalyptus marginata -Corymbia calophylla – Eucalyptus patens - Allocasuarina fraseriana - Hakea prostrata* on lower slopes with patches of *Melaleuca preissiana, Banksia littoralis* over mixed low understorey species, including *Babingtonia camphorosmae* and *Astartea scoparia* on clay loams to gravelly clay-loams.	32.729		
	DG	Open Forest of *Eucalyptus marginata -Corymbia calophylla – Eucalyptus patens - Allocasuarina fraseriana - Hakea prostrata* on lower slopes with mixed low understorey species, including *Grevillea bipinnatifida* and *Babingtonia camphorosmae,* on clay loams to gravelly clay-loams.	214.818		
	E	Open Forest to Woodland of *Eucalyptus marginata - Corymbia calophylla* with scattered understorey, including *Kingia australis, Mesomelaena tetragona* and *Babingtonia camphorosmae* on sandy gravels on lower slopes.	112.377		6.189

Table 8: Summary of site-vegetation types as defined for the survey areas based on Havel (1975a and 1975b) (continued)

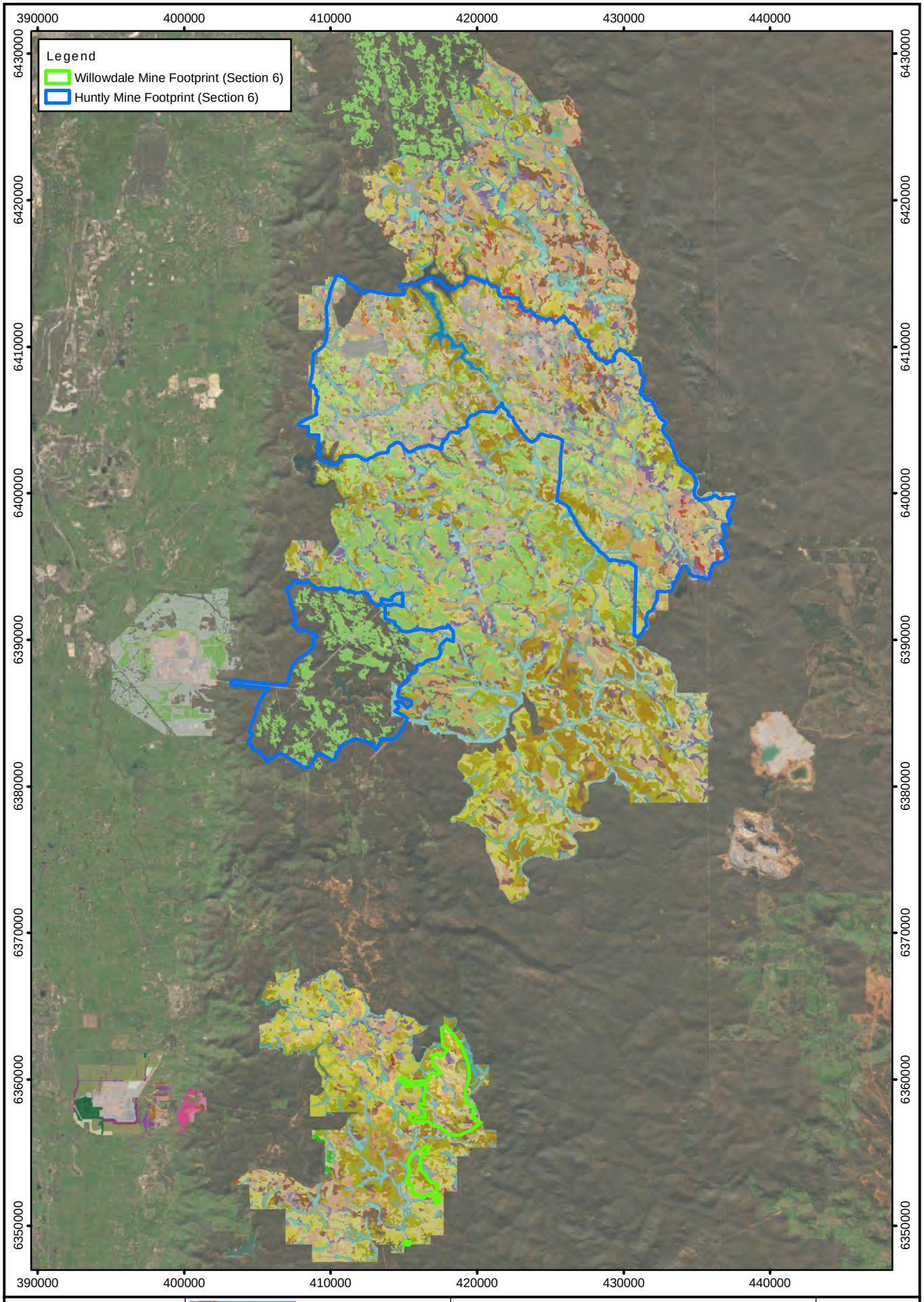
	SVT Code	Description	Huntly North (ha)	Huntly South (ha)	Willowdale (ha)
Valley Floors and Lower Slopes	C	Woodland to Open Forest of *Eucalyptus patens – Corymbia calophylla - Banksia littoralis* with dense *Taxandria linearifolia* and *Astartea scoparia* in understorey on creek-lines and water-courses.	7.423	29.691	-
	CW	Woodland to Open Forest of *Eucalyptus patens – Eucalyptus megacarpa - Corymbia calophylla - Banksia littoralis* with dense *Taxandria linearifolia* and *Astartea scoparia* in understorey on creek-lines and water-courses.	824.992	0.171	48.643
	CQ	Open Forest of *Eucalyptus patens – Corymbia calophylla - Banksia littoralis* with dense *Taxandria linearifolia, Tryamalium odoratissmum* subsp. *odoratissimum,* and *Astartea scoparia* in understorey on creek-lines and water-courses.			7.887
	W	Open Forest of *Eucalyptus megacarpa - Eucalyptus patens – Corymbia calophylla* on lower slopes with mixed low understorey species, including *Hypocalymma angustifolium* on seasonally moister sandy-loam gravelly soils.	989.000	70.727 (WD variant 1.361)	93.518
	Q	Open forest of *Eucalyptus marginata, Corymbia calophylla, Eucalyptus patens* over *Trymalium odoratissimum* subsp. *odoratissimum, Acacia extensa* and *Lysiandra calycina* on lower slopes on alluvial loam soils.	31.783	10.525	15.926
	Y	Open woodland of *Eucalyptus wandoo* over *Hypocalymma angustifolium* and *Babingtonia camphorosmae* over herbs and sedges on clay-loams on seasonally moister lower slopes.	6.917	-	-
	YG	Open woodland of *Eucalyptus wandoo* over *Hypocalymma angustifolium, Babingtonia camphorosmae, Grevillea bipinnatifida* and *Allocasuarina humilis* over herbs and sedges on clay-loams on seasonally moister lower slopes underlain by outcrops.	13.751	-	-
Slopes with seasonal soil moisture	SW	Open Forest of *Eucalyptus marginata - Corymbia calophylla – Banksia grandis* with scattered understorey, including *Adenanthos barbiger, Hypocalymma angustifolium* and *Styphelia tenuiflora* on seasonally moister sandy-gravelly soils.	933.077	36.549 (SW-D 0.215)	76.230
	PW	Open Forest of *Allocasuarina fraseriana - Eucalyptus marginata - Corymbia calophylla* with scattered understorey, including *Grevillea wilsonii, Adenanthos barbiger, Babingtonia camphorosmae* and *Hypocalymma angustifolium* on sandy gravels.	800.412	-	12.208
Shallow Outcrop Areas	R	Open Woodland of *Eucalyptus marginata - Corymbia calophylla* on fringes of granite outcrops or shallow soils.	526.005	-	0.816
	R/G	pen Woodland of *Eucalyptus marginata - Corymbia calophylla* with patches of Heath of Proteaceae – Myrtaceae species on fringes of granite outcrops or shallow soils.	6.152	-	-
	G	Mosaic of Open Woodland of *Eucalyptus marginata – Corymbia calophylla*, mixed Proteaceae – Myrtaceae heath and Lithic Complex associated with granite outcrops.	85.384	-	1.033
	G1	Mixed Proteaceae – Myrtaceae heath and Lithic Complex associated with granite outcrops.	393.948	-	-
	G2	Open Woodland of *Allocasuarina huegeliana* over shrubs and lithic complex and herbs	1.048	-	-

Table 8: Summary of site-vegetation types as defined for the survey areas based on Havel (1975a and 1975b) (continued)

	SVT Code	Description	Huntly North (ha)	Huntly South (ha)	Willowdale (ha)
Slopes and Ridges - Sandy Loam Gravels	P	Open Forest of *Allocasuarina fraseriana - Eucalyptus marginata - Corymbia calophylla* with scattered understorey, including *Grevillea wilsonii* and *Adenanthos barbiger* and low shrubs, herbs and sedges on sandy gravels.	361.201	-	3.657
	PG	Open Forest of *Allocasuarina fraseriana - Eucalyptus marginata - Corymbia calophylla* with scattered understorey, including *Grevillea bipinnatifida* and *Adenanthos barbiger* and low shrubs, herbs and sedges on sandy gravels.	0.308	-	-
	PT	Open Forest of *Allocasuarina fraseriana - Eucalyptus marginata - Corymbia calophylla - Banksia grandis* with scattered understorey, including *Adenanthos barbiger, Leucopogon verticillatus, Pteridium esculentum* and *Bossiaea aquifolium* subsp. *aquifolium* on sandy-loam gravels.	47.299	21.189	68.940
	PS	Open Forest of *Allocasuarina fraseriana - Eucalyptus marginata - Corymbia calophylla - Banksia grandis* with scattered understorey, including *Adenanthos barbiger, Leucopogon capitellatus* on gravels and sandy gravels.	3598.863	-	218.152
	SP	Open Forest of *Allocasuarina fraseriana - Eucalyptus marginata - Corymbia calophylla - Banksia grandis* with scattered understorey, including *Adenanthos barbiger, Grevillea wilsonii* and *Leucopogon capitellatus* on sandy-gravels to gravelly soils.	873.875	20.200 (SP-D 8.819)	51.139
	S	Open Forest of *Eucalyptus marginata - Banksia grandis – Allocasuarina fraseriana* with scattered understorey, including *Adenanthos barbiger, Leucopogon capitellatus* and *Styphelia tenuiflora* on gravels and sandy-gravels.	6119.405	42.478	626.454
	ST	Open Forest of *Eucalyptus marginata - Corymbia calophylla* with scattered understorey, including *Leucopogon capitellatus, Leucopogon verticillatus, Pteridium esculentum, Lasiopetalum floribundum* and *Styphelia tenuiflora* on sandy-gravelly soils.	770.420	103.122	139.473
	TS	Open Forest of *Eucalyptus marginata - Corymbia calophylla – Banksia grandis* with scattered understorey, including *Leucopogon verticillatus, Pteridium esculentum, Clematis pubescens* and *Bossiaea aquifolium* subsp. *aquifolium* on sandy-loam gravelly to gravelly soils.	2052.175	19.653	538.870
	T	Open Forest of *Eucalyptus marginata - Corymbia calophylla* with scattered understorey, including *Leucopogon verticillatus, Pteridium esculentum, Clematis pubescens* and *Bossiaea aquifolium* subsp. *aquifolium* on sandy-loam gravelly soils.	736.985	34.771	136.338
	TP	Open Forest of *Allocasuarina fraseriana - Eucalyptus marginata - Corymbia calophylla* with scattered understorey, including *Clematis pubescens*, *Adenanthos barbiger, Leucopogon verticillatus, Pteridium esculentum* and *Bossiaea aquifolium* subsp. *aquifolium* on sandy-loam gravels.	15.162	-	10.776
	Z	Open forest of *Eucalyptus marginata* and *Corymbia calophylla* over *Macrozamia riedlei, Xanthorrhoea preissii, Hakea lissocarpha* and *Lysiandra calycina* on sandy-loam to sandy-loam gravel soils on slopes.	12.788	-	-
	Total		**22054.96**	**509.534**	**2121.067**

Table 8: Summary of site-vegetation types as defined for the survey areas based on Havel (1975a and 1975b) (continued)

	SVT Code	Description	Huntly North (ha)	Huntly South (ha)	Willowdale (ha)
Other Areas	DAM	Dam	329.023	-	-
	CL	Cleared Areas	3555.738	-	-
	CL Other	Cleared Areas	365.445	161.459	-
	Rehab	Rehabilitation Areas	2198.135	2926.133	-
	Other	Other Areas	819.764	6080.999	14.996
	Total		**7268.105**	**9168.591**	**14.996**



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Willowdale and Huntly Mine Footprints

Site-Vegetation Type Mapping

Figure:

13

4.9 Groundwater Dependant Ecosystems

The potential groundwater dependent ecosystems were determined on the basis of the extent of the vegetation complexes (Murray 1, Murray 2, Yarragil 1, Yarragil 2, Swamp and Pindalup). The site-vegetation types associated with these vegetation complexes and as such are potential groundwater dependant ecosystems include A, AC, AD, AW, AY, C, CW, W, D, E, SW and PW.

In view of the extensive flora and vegetation studies in the northern Jarrah forest subregion these vegetation complexes support species and site-vegetation types that prefer and occur on seasonally moister and wetter soils. This approach was considered to represent a precautionary approach in the absence of detailed groundwater level data at the time of selecting the potential groundwater dependent ecosystems at this juncture in the absence of site-vegetation type data.

Key indicator plant species that are generally accepted as indicators of moister soils and, hence, potential groundwater dependent ecosystems include – *Banksia littoralis, Hakea varia, Acacia divergens, Boronia molloyae, Thomasia paniculata, Astartea scoparia, Babingtonia camphorosmae, Eucalyptus patens, Hypocalymma angustifolium, Melaleuca preissiana, Melaleuca viminea* and *Taxandria linearifolia.*

4.10 Wetlands of International Importance (Ramsar)

The Peel-Yalgorup System, a listed Ramsar Wetland of International Importance, is located adjacent to the City of Mandurah and more than 40km from the nearest survey area on the Darling Ranges. The Peel-Yalgorup System consists of shallow estuaries, freshwater marshes and coastal saline lakes that include the Harvey Estuary, Peel Inlet, Lake McLarty, Lake Mealup and ten Yalgorup National Park wetlands (DCCEEW 2024f). The fringing vegetation is mainly samphire, rushes, sedges and paperbark communities. The Peel-Yalgorup System supports a wide variety of waterbirds, invertebrates and estuarine and marine fish and is considered the most important area for waterbirds in south-western Australia (DCCEEW 2024f). Whilst these potential values were recognized in the National database search (DCCEEW 2024f) these wetlands occur west of the survey areas.

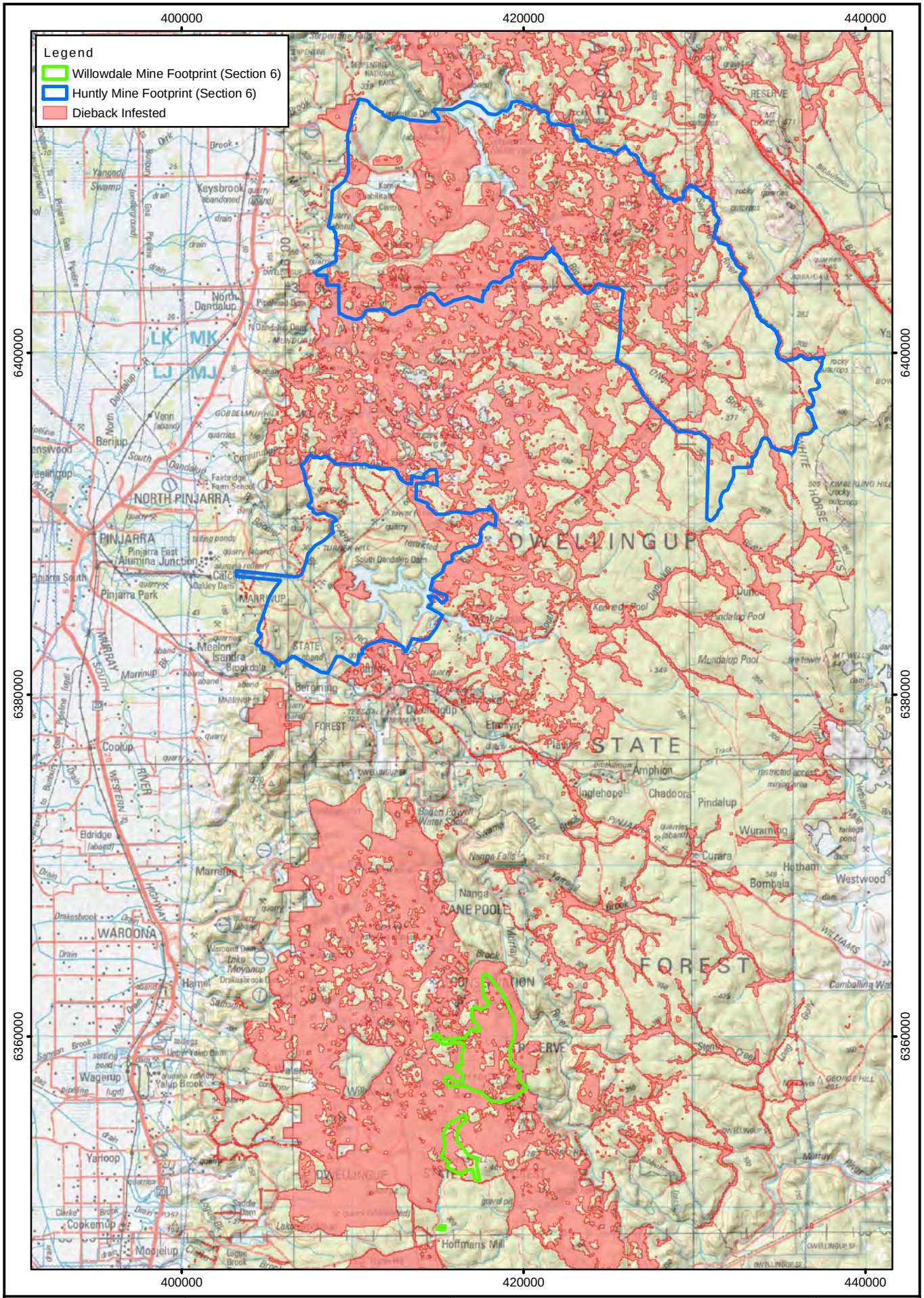
4.11 Review of Dieback Occurrence

The dieback data as shown on Figure 14 reflects the most up to date dieback interpretation data from both DBCA and Glevan Consulting for the survey areas. In the survey area the dieback infections are concentrated to the valleys systems. There may be some differences also in coverage and sampling in some of the survey areas.

4.12 Old Growth and Harvesting

Based on data from Department of Biodiversity, Conservation and Attractions, there is limited old growth forests occurring in these respective areas (Figure 15). This in part appears to reflect the proximity of historical logging and wood production activities near Jarrahdale and Dwellingup.

The data as presented on the history of harvesting in the area reflects the more recent logging in the pre-mining activities of Alcoa (Figure 16). Some of the valley areas have not been logged for some time and as such reflect the linear patterns of these systems and the differences in overstorey tree species.



N

0 2 4 km

Scale: 1:300,000
MGA94 (Zone 50)

CAD Ref: a1992_F044_11

Date: September 2024 | Rev: A | A4

Mattiske Consulting Pty Ltd
28 Central Road, Kalamunda WA 6076 ~ Tel: 9257 1625 ~ Fax: 9257 1640

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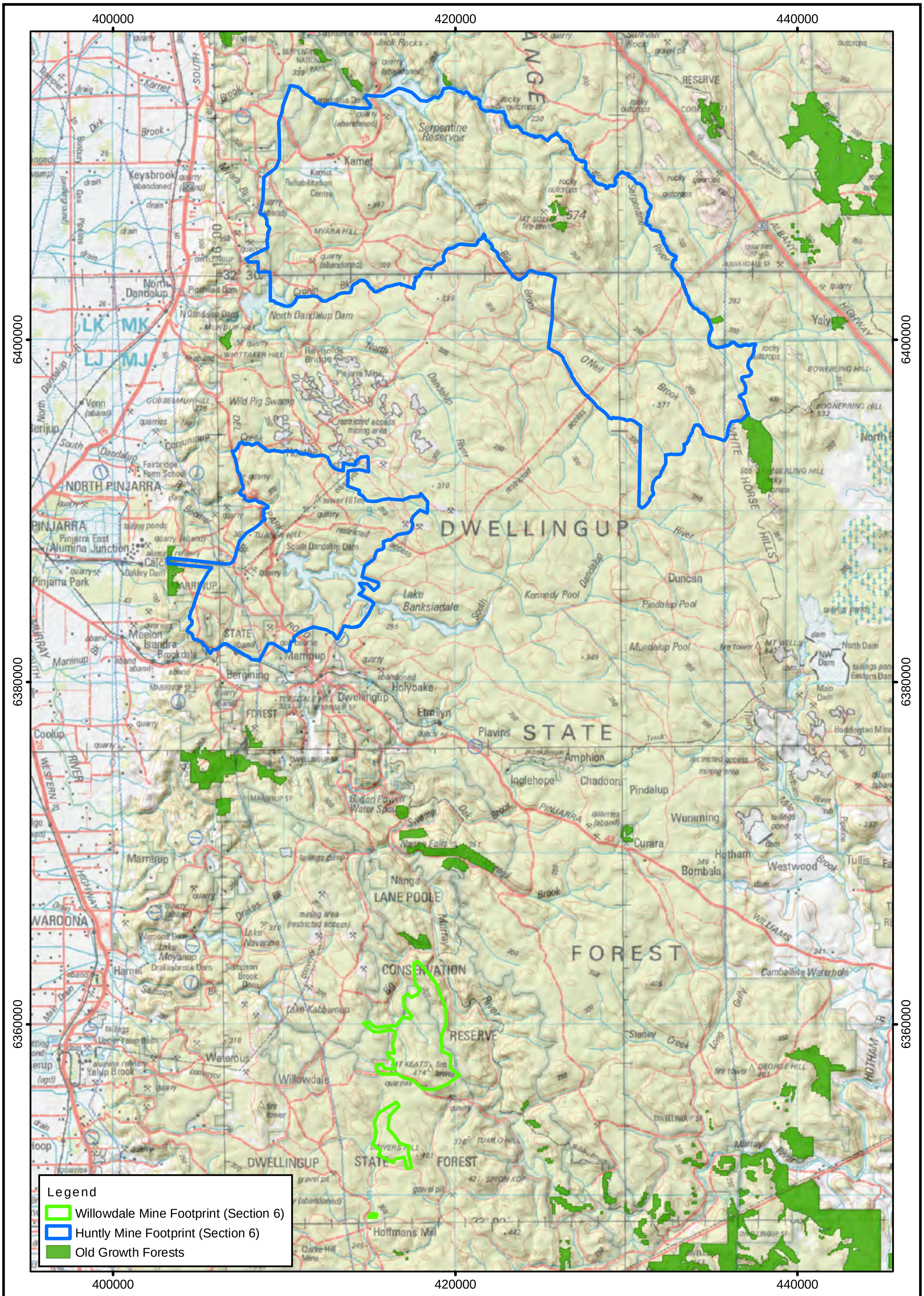
Tel: (08) 9246 3242 ~ Fax (08) 9246 3202

Willowdale and Huntly Mine Footprints
Dieback

Figure:
14



N

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Scale: 1:300,000
MGA94 (Zone 50)

CAD Ref: a1992_F044_10

Date: September 2024 | Rev: A | A4

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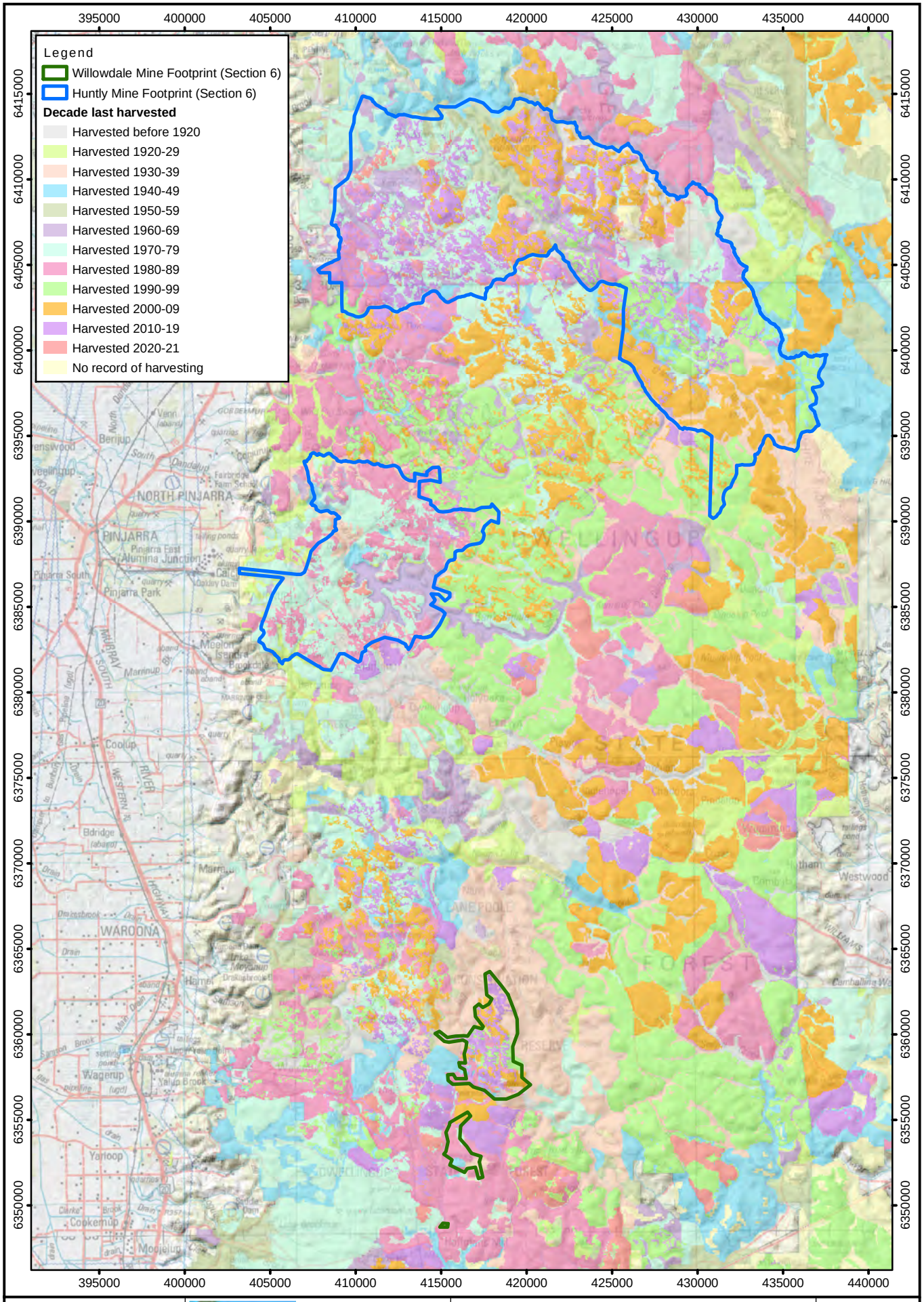
Willowdale and Huntly Mine Footprints

Old Growth Forest

Figure:

15



N

0 2,300 4,600 m

Scale: 1:300,000
MGA94 (Zone 50)

CAD Ref: a1992_F044_12

Date: September 2024 | Rev: A | A4

Mattiske Consulting Pty Ltd
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Willowdale and Huntly Mine Footprints
Harvested Year

Figure:
16

5. DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

Various databases were used to identify the possible occurrence of flora (including introduced, threatened and priority taxa) and threatened and priority ecological communities within the survey areas. Historical documentation of the floristics and vegetation mapping of the region, along with results of previous flora and vegetation surveys in the nearby areas, were reviewed again in 2024 in line with some changes in nomenclature.

The survey areas lie within the Northern Jarrah Forest subregion of the Southwest Botanical Province. The geology of the region comprises lateritic duricrust, with drainage lines and occasional granite hills. The Northern Jarrah Forest subregion is characterised by Jarrah (*Eucalyptus marginata*) forest on ironstone gravels and Marri-Wandoo (*Corymbia calophylla* - *Eucalyptus wandoo*) woodlands on loamy soils, with sclerophyll understoreys. The vegetation of the region has been extensively studied, and has been described in a series of vegetation complexes of the Darling System (Heddle *et al.* 1980; Mattiske and Havel (1998).

Survey Effort

Due to the survey effort the surveys spanned over multiple months in different years. As indicated for the respective areas summarized it is apparent that the amount of survey (even prior to the EPA Guidance Statement in 2016b) well exceeded the standards of the earlier period of survey work between 1980's and 1996. Since this time the efforts by Alcoa employees and a range of consultants has increased markedly. This report is only a small subset of the effort over >40 years.

At times, there is a debate about when survey work should be undertaken, however as indicated by reviewing the data for species on Florabase (WAH 1998-) it is evident that many species growth, flower and fruit in multiple seasons and the emphasis on spring surveys are influenced by variations in seasonal conditions and also the variations in regeneration and growth patterns of many species.

The earlier work of Havel (1975a and 1975b) in particular developed a system that was reliant on mainly perennial species and landforms and soils so that seasonal condition for vegetation mapping were less critical in the classification of the site-vegetation types.

In recent years since the delineation of the conservation values of flora species and communities a greater emphasis has been placed on these particular values with baseline flora and vegetation studies, targeted searches and multiple research projects associated with plots and transects over multiple years.

Flora

Surveys in the northern Jarrah forest ranges from 300 to 750 taxa per survey area. In recent decades there has been a growing emphasis on restricted or threatened flora species or those species that may threatened the occurrence of other species. This report concentrates on the conservation significant species and the weed species.

The data collected to date on the threatened and priority flora includes records from Mattiske Consulting since 1980's, Eco Logical (2024) intensive and targeted flora studies in proposed clearance areas in the Willowdale areas in spring 2023, *Ecologia* (2024) and Biologic (2024) intensive and targeted flora studies in Huntly-Myara proposed clearance areas in the spring months of 2023.

The early work of Mattiske was undertaken when the native flora species were defined as threatened or priority and as such many of the earlier records have not been included in this report for the Huntly South area as the data is not in a format that can rapidly integrated into this report. The data is available

and is intended to be integrated in 2025 into a combined data set. The latter is not a small task as many of the surveys were undertaken prior to current software types.

In summarizing the key potential conservation flora, it is important to recognize that the current practice of radial searches tend to bring in potential species that do not occur in the northern Jarrah forest, let alone the specific areas as summarized for this report. This was the case for some of the reporting on different areas as the radial searches covered species that occurred in the northern sections of the Jarrah forest, the Darling Scarp and the Swan Coastal Plain.

The recent works by Mattiske in the Huntly and Willowdale areas have been summarized in relation to coverage of threatened and priority flora species, weeds and site-vegetation types. Mattiske (1985 to 2023 has recorded some ten Priority flora species within the respective areas, namely potentially *Hibbertia ?ambita* (P1), *Hibbertia hortiorum* (P1), *Acacia horridula* (P3), *Conospermum scaposum* (P3), *Grevillea dissectifolia* (P3), *Thysanotus anceps* (P3),*Grevillea pimeleoides* (P4), *Lasiopetalum cardiophyllum* (P4), *Stylidium ireneae* (P4) and *Senecio leucoglossus* (P4), During this period many species have also changed names by specialists and also conservation status so there is an ongoing need to update datasets. An example of the latter is the revision of the *Hibbertia commutata* group by Thiele (2019) which was split into 27 taxa including Priority species. Such gaps in part have been addressed through the recent additional targeted work in 2023.

Eco Logical (2024) preclearance surveys were undertaken in spring 2023 and as a result no threatened flora species and three Priority flora species were recorded in the Willowdale areas. The three Priority flora species included *Netrostylis* sp. Nannup (P.A. Jurjevich 1133) (P1), *Grevillea prominens* (P3) and *Senecio leucoglossus* (P4).

Ecologia (2024) database searches identified 58 significant plant taxa within 20 km of the survey area (excluding records from the Swan Coastal Plain). Only three significant flora species were recorded in the field surveys including *Tetratheca phoenix* (P2), *Senecio leucoglossus* (P4) and *Stylidium ireneae* (P4). No threatened flora species were recorded in the targeted survey areas.

Biologic (2024) databases searches identified 72 significant plant taxa within the 20km of the survey area. Only four significant flora species were recorded in field surveys including *Acacia horridula* (P3), *Thysanotus anceps* (P3), *Senecio leucoglossus* (P4) and *Stylidium ireneae* (P4). No threatened flora species were recorded in the targeted survey areas.

Mattiske (2024) database searches identified the potential for 12 threatened flora species and 37 priority flora species to occur in the O'Neil Transport Corridor survey area. Of the threatened flora species, all were considered to have a very low potential of occurring in the O'Neil Transport survey area due to the lack of suitable habitat and also know distributions away from the survey area. A total of 2 priority flora species (*Hibbertia hortiorum* P1 and *Senecio leucoglossus* P4) were recorded in the O'Neil Transport Corridor survey area. The *Hibbertia hortiorum* appeared relatively regularly and in part reflected the recent split of *Hibbertia commutata* into multiple species by Kevin Thiele (2019).

Vegetation

Investigations by Diels (1906), Loneragan (1978), Beard (1979a, 1979b), Abbott and Loneragan (1986), Bell and Heddle (1989) and Dell and Havel (1989) reflect the depth of interest in the patterns of flora and vegetation in the south-west forests. The more regional broad scale mapping by Beard (1979a,1979b) in the northern Jarrah forest was refined at a more detailed level by Heddle et al. (1980) and Mattiske and Havel (1998) through the expansion of the understanding of the key relationships of landforms and soils and plant species. The work by Heddle et al. (1980) and Mattiske and Havel (1998) led to regional mapping of vegetation complexes and ecological vegetation systems that were similar in approach to that utilized in the Regional Forest Agreement studies for Victorian and Tasmanian forests. A total of 35 site-vegetation types were defined and mapped in the survey areas and additional

disturbance, cleared and rehabilitation areas. These site-vegetation types have been developed and based on the earlier work by Havel (1975a, 1975b) and more recently his Ph.D. Thesis (Havel 2000) where additional details were provided on the approach that is similar to other approaches globally where forests occur as continuums with several key species and a range of species that reflect subtle shifts in landforms, soils and soil moisture availability.

The development of the site-vegetation types and vegetation complexes by Havel and Mattiske has led to a means of addressing key species and communities that reflect particular site conditions and as such provide increased background information for management of the forests and also rehabilitation activities.

Threatened and Priority Ecological Communities

During the earlier phases of the surveys no Threatened Ecological Communities (TECs) were listed on the survey areas on the Darling Ranges. Recently, it was recognized that the *Empodisma* peatland of southwestern Australia has the potential to occur in the swamps if peat is present. These would occur in the A or AC site-vegetation types. To date the suggested potential locations have not been assessed for the presence of peat; however *Empodisma gracillimum* has been recorded previously in a restricted area by the Mattiske team. This species is largely restricted to coastal areas in the southwest (WAH 1998-) and as such more work is required.

The desktop assessment highlighted several other potential TECs; however these are restricted to the Swan Coastal Plain or the Wheatbelt and as such do not extend into the Jarrah forest area on the Darling Ranges.

There are two priority ecological communities (PECs), as listed at State level by DBCA (2024b, 2024c) that occur within the Huntly North (Myara) survey area; only one of these is a botanical PEC.

The priority ecological communities that occur in the Huntly North survey area are:

- Granite communities of the northern Jarrah forest (P3)
    - Jarrahdale area – Monadnocks, Blue Rock; insufficient information to distinguish discrete community type/s (DBCA 2024b, 2024c).
- Litter Dependant Invertebrate Community of the northern Jarrah Forest (P2)
    - Chandler Block, Northern Jarrah Forest; insufficient evidence that this is a discrete community type (DBCA 2024b, 2024c).

There is a potential that the site-vegetation types associated with granite outcrops (site-vegetation types G and R), and the Cooke vegetation complex as defined by Mattiske and Havel (1998) may have affinities with the PEC.

The alignment of the communities with the DBCA defined PEC raises some issues due to the lack of consistent and detailed data on the granites. Alcoa is currently reviewing these values and this will be refined in conjunction with other data collected during surveys on the G and R site-vegetation types to assist in the refinement of the detail associated with this PEC. The location of the granite areas is associated with the G and R site-vegetation types as defined in the varying reports.

The significant issue that relates to the granites is the complexity of the structural and floristic components as they reflect varying depths or soil over the outcrop and as such vary from lithic complexes dominated by mosses and lichen species, through heath communities dominated by Proteaceae and Myrtaceae species to open woodlands of Jarrah-Marri or Wandoo over low shrubs on the fringes of the exposed granites.

All survey areas occur within the Regional Forest Agreement (RFA) area of the southwest forests DCCEEW (2024b) and as such were considered during the RFA process.

Wetlands of International Importance (Ramsar)

The Peel-Yalgorup System, a listed Ramsar Wetland of International Importance, is located adjacent to the City of Mandurah and more than 40km from the nearest survey area on the Darling Ranges. The Peel-Yalgorup System consists of shallow estuaries, freshwater marshes and coastal saline lakes that include the Harvey Estuary, Peel Inlet, Lake McLarty, Lake Mealup and ten Yalgorup National Park wetlands (DCCEEW 2024f). The fringing vegetation is mainly samphire, rushes, sedges and paperbark communities. The Peel-Yalgorup System supports a wide variety of waterbirds, invertebrates and estuarine and marine fish and is considered the most important area for waterbirds in south-western Australia (DCCEEW 2024f). Whilst these potential values were recognized in the National database search (DCCEEW 2024f) these wetlands occur west of the survey areas.

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Based on data from Department of Biodiversity, Conservation and Attractions, there is limited old growth forests occurring in these respective areas. This in part appears to reflect the proximity of historical logging and wood production activities near Jarrahdale and Dwellingup.

The data as presented on the history of harvesting in the area reflects the historical clearing activities and more recent logging in the pre-mining activities of Alcoa. Some of the valley areas have not been logged for some time and as such reflect the linear patterns of these systems and the differences in overstorey tree species.

6. ACKNOWLEDGEMENTS

The authors would like to thank Alcoa of Australia Ltd for their assistance with this project.

7. PERSONNEL

The following Mattiske Consulting Pty Ltd personnel were mainly involved in this project:

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Mr L Rowles	Senior Botanist	Field Studies and Plant IDs	FB62000020-4,5
Mr A Pereira	Experienced Botanist	Data collection and Field Studies	FB62000035-4, 145-5
Mr D Rubick	Experienced Botanist	Data collection and Field Studies	FB62000328-2,3
Ms K Tribbeck	Experienced Botanist	Data collection and Field Studies	FB62000467, 2
Ms A Rowe	Experienced Botanist	Data collection and field studies	FB62000329-2,3
Ms JJ Werny	Botanist	Data collection and field studies	FB62000587
R Jones	Botanist	Data collation, reporting	N/A
J Wescombe	Botanist	Data collation, reporting	N/A

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APPENDIX A1: THREATENED AND PRIORITY FLORA DEFINITIONS

Under section 179 of the *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*), **threatened flora** are categorised as extinct, extinct in the wild, critically endangered, endangered, vulnerable and conservation dependent (Table A1.1).

Table A1.1 Federal definition of threatened flora species
Note: Adapted from section 179 of the *EPBC Act*.

CODE	CATEGORY	DEFINITION
Ex	**Extinct**	Species 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**	Species 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**	Species 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**	Species 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**	Species 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**	Species which at a particular time if, at that time, the species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

The *Biodiversity Conservation Act 2016 - WA* (*BC Act*) provides for (amongst other things) the protection of flora that is facing an extremely high risk of extinction in the wild in the immediate, near or medium-term future in Western Australia under Part 10 (Division 2).

Threatened flora are listed in the *Biodiversity Conservation (Listing of Native Species) (Flora) Order 2023*; Department of Biodiversity, Conservation and Attractions (DBCA) (DBCA 2023a), and are categorised under Division 1 (threatened species – critically endangered), Division 2 (threatened species - endangered), and Division 3 (threatened species – vulnerable)**.** A flora species is defined as **threatened flora** if it is facing an extremely high risk of extinction in the wild in the immediate, near or medium-term future, pursuant to sections 20, 21 and 22 of the *BC Act*. Threatened species are categorised as critically endangered, endangered, and vulnerable (Table A1.2).

Table A1.2 State definition of threatened flora species
Note: Adapted from *BC Act*

CODE	CATEGORY	DEFINITION
CR	**Critically endangered**	Species considered to be facing an extremely high risk of becoming extinct in the wild (listed under Schedule 1, Division 1 of the *Biodiversity Conservation (Listing of Native Species) (Flora) Order 2023*).
EN	**Endangered**	Species considered to be facing a very high risk of becoming extinct in the wild (listed under Schedule 1 Division 2 of the *Biodiversity Conservation (Listing of Native Species) (Flora) Order 2023*).
VU	**Vulnerable**	Species considered to be facing a high risk of becoming extinct in the wild (listed under Schedule 1 Division 3 of the *Biodiversity Conservation (Listing of Native Species) (Flora) Order 2023*).

Priority flora species are defined as "possibly threatened species that do not the criteria for listing under the BC Act because of insufficient survey or are otherwise data deficient" or species that are "adequately known, meet criteria for near threatened, or are rare but not threatened, or that have been recently removed from the threatened species list or are conservation dependent for other than taxonomic reasons" (DBCA 2023c). Priority species are not afforded the same level of protection under state or federal legislation as the listed Threatened species, however are considered significant under the Environmental Protection Authority's *Environmental Factor Guideline: Flora and Vegetation* (Environmental Protection Authority [EPA] 2016a). DBCA categorises priority flora into four categories: Priority 1; Priority 2, Priority 3 and Priority 4 (Table A1.3).

Table A1.3: State definition of priority flora species
Note: Adapted from DBCA (2023c).

CODE	CATEGORY	DEFINITION
P1	**Priority 1:** Poorly-known species	Known from one or a few locations (< 5) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation; or are otherwise under threat of habitat destruction or degradation. In urgent need of further survey.
P2	**Priority 2:** Poorly-known species	Known from one or a few locations (< 5). Some occurrences are on lands managed primarily for nature conservation. In urgent need of further survey.
P3	**Priority 3:** Poorly-known species	Known from several locations and the species does not appear to be under imminent threat; or from few but widespread locations with either a large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. In need of further survey.
P4	**Priority 4:** 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) Other -** Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

APPENDIX A2: THREATENED AND PRIORITY ECOLOGICAL COMMUNITY DEFINITIONS

Under section 181 of the *EPBC Act*, **threatened ecological communities** are categorised as critically endangered, endangered and vulnerable (Table A2.1).

Table A2.1 Federal definition of threatened ecological communities
Note: Adapted from section 181 and section 182 of the *EPBC Act*.

CATEGORY	DEFINITION
Critically Endangered	If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future.
Endangered	If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future.
Vulnerable	If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.

Threatened ecological communities (TECs) are listed in the *Biodiversity Conservation (Threatened Ecological Communities) Order 2023* (under Part 2, Division 2, of the *BC Act*; DBCA 2023d). An ecological community is defined as **threatened** if it is facing an extremely high risk of collapse in the immediate, near or medium-term future, pursuant to sections 28, 29 and 30 of the *BC Act*. Threatened ecological communities are categorised as critically endangered, endangered, and vulnerable (Table A2.2).

Table A2.2 State definition of threatened ecological communities
Note: Summarised from *BC Act* and DBCA 2023b

CODE	CATEGORY	DEFINITION
CO	**Collapsed ecological communities**	An ecological community is eligible for listing as a collapsed ecological community if either: **1.** there is no reasonable doubt that the last occurrence of the ecological community has collapsed; or **2.** the ecological community has been so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure
CR	**Critically Endangered**	An ecological community is eligible for listing as critically endangered if it is considered to be facing an extremely high risk of becoming eligible for listing as a collapsed ecological community in the immediate future when the best available evidence indicates that it meets **any** of the following criteria: **1.** The geographic distribution has been reduced by at least 80% or is less than 2000 km^2 for a single community **or** there are less than 2 areas of at least 100 km^2 **and** there is observed or inferred decline or threatening processes causing further decline; or **2.** Environmental degradation has occurred based on change in an abiotic or biotic variable affecting at least 80% of the extent of the ecological community **3.** Quantitative analysis that estimates the probability of ecological community collapse to be: at least 50% within 50 years.
EN	**Endangered**	An ecological community is eligible for listing in the category of endangered if it is considered to be facing a very high risk of becoming eligible for listing as a collapsed ecological community in the near future when the best available evidence indicates that it meets any of the following criteria: **1.** The geographic distribution has been reduced by, at least 50% or the geographic distribution is less than 20,000 km^2 for a single community **or** there are less than 20 areas of at least 100 km^2 **and** there is observed or inferred decline or threatening processes causing further decline; **2.** Environmental degradation has occurred based on change in an abiotic or biotic variable affecting either at least 50% of the extent of the ecological community; **3.** Quantitative analysis that estimates the probability of ecological community collapse to be: at least 20% within 50 years.
VU	**Vulnerable**	An ecological community is eligible for listing in the category of vulnerable at if it is considered to be facing a high risk of becoming eligible for listing as a collapsed ecological community in the medium-term future when the best available evidence indicates that it meets any of the following criteria: **1.** The geographic distribution has been reduced by, at least 30% or the geographic distribution is less than 50,000 km^2 for a single community **or** there are less than 50 areas of at least 100 km^2 **and** there is observed or inferred decline or threatening processes causing further decline; or **2.** Environmental degradation has occurred based on change in an abiotic or biotic variable affecting either at least 30% of the extent of the ecological community; or **3.** Quantitative analysis that estimates the probability of ecological community collapse to be at least 10% within 100 years.

Priority ecological communities (PECs) are defined as possible threatened ecological communities that do not meet the stringent survey criteria for the assessment of threatened ecological communities, and are listed by DBCA (2023b) in the *Priority Ecological Communities for Western Australia – Version 35 (19 June 2023)*. Similarly, to priority flora, PECs are not afforded legislative protection, however are considered significant under the EPA's (2016a) *Environmental Factor Guideline: Flora and Vegetation*. DBCA categorises PECs into five categories: Priority 1; Priority 2, Priority 3, Priority 4 and Priority 5 (Table A2.3).

Table A2.3 State definition of priority ecological communities
Note: Adapted from DBCA (2023c).

CODE	CATEGORY	DEFINITION
P1	**Priority 1** (Poorly known ecological communities)	Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤100 ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat or for which current threats exist. Communities may be included if they are 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 2** (Poorly known ecological communities)	Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200 ha). At least some occurrences are not under immediate threat (within approx. 10 yrs.) of destruction or degradation. Communities may be included if they are 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 3** (Poorly known ecological communities)	Communities may be included if they are 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. This category includes three sub-categories: (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. (ii) Communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat (within approx. 10 yrs.). (iii) Communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across their range from processes such as grazing by, inappropriate fire regimes, clearing, hydrological change, etc
P4	**Priority 4** (Ecological communities that are adequately known, rare but not threatened or that have been recently removed from the threatened list.)	Ecological communities that are adequately known and either rare but not threatened, near threatened, or have recently been removed from the threatened list. These communities require regular monitoring. (i) Rare: ecological communities known from few occurrences that are considered to have been adequately surveyed, and that are not currently threatened, but could be if present circumstances change. These communities are usually represented on conservation lands. (ii) Near threatened: ecological communities that are considered to have been adequately surveyed and that do not qualify as conservation dependent, but that are close to qualifying for a higher threat category. (iii) Ecological communities that have been removed from the list of threatened communities during the past five years.
P5	**Priority 5** (Conservation Dependent ecological communities)	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.

APPENDIX A3: CATEGORIES AND CONTROL MEASURES OF DECLARED PEST (PLANT) ORGANISMS IN WESTERN AUSTRALIA

Section 22 of Western Australia's *Biosecurity and Agriculture Management Act 2007* (*BAM Act*) makes provision for a plant taxon to be listed as a declared pest organism in respect to parts of, or the entire State. According to the *BAM Act*, a declared pest is defined as a prohibited organism (section 12), or an organism for which a declaration under section 22 (2) of the *BAM Act* is in force.

Under the *Biosecurity and Agriculture Management Regulations 2013* (WA), declared pest plants are placed in one of three control categories, C1 (exclusion), C2 (eradication) or C3 (management), which determines the measures of control which apply to the declared pest (Table A4.1). The current listing of declared pest organisms and their control category is through the Western Australian Organism List (Department of Primary Industries and Regional Development [DPIRD] 2023).

Table A3.1 Categories and control measures of declared pest (plant) organisms

Note: Adapted from *Biosecurity and Agriculture Management Regulations 2013*.

CONTROL CATEGORY	CONTROL MEASURES
C1 (Exclusion) '(a) Category 1 (C1) — Exclusion: if in the opinion of the Minister introduction of the declared pest into an area or part of an area for which it is declared should be prevented.' Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.	In relation to a category 1 declared pest, the owner or occupier of land in an area for which an organism is a declared pest or a person who is conducting an activity on the land must take such of the control measures specified in subregulation (1) as are reasonable and necessary to destroy, prevent or eradicate the declared pest.
C2 (Eradication) '(b) Category 2 (C2) — Eradication: if in the opinion of the Minister eradication of the declared pest from an area or part of an area for which it is declared is feasible.' Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.	In relation to a category 2 declared pest, the owner or occupier of land in an area for which an organism is a declared pest or a person who is conducting an activity on the land must take such of the control measures specified in subregulation (1) as are reasonable and necessary to destroy, prevent or eradicate the declared pest.
C3 (Management) '(c) Category 3 (C3) — Management: if in the opinion of the Minister eradication of the declared pest from an area or part of an area for which it is declared is not feasible but that it is necessary to: **(i)** alleviate the harmful impact of the declared pest in the area; or **(ii)** reduce the number or distribution of the declared pest in the area; or **(iii)** prevent or contain the spread of the declared pest in the area.' Pests will be assigned to this category if they are established in Western Australia 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.	In relation to a category 3 declared pest, the owner or occupier of land in an area for which an organism is a declared pest or a person who is conducting an activity on the land must take such of the control measures specified in subregulation (1) as are reasonable and necessary to: **(a)** alleviate the harmful impact of the declared pest in the area for which it is declared; or **(b)** reduce the number or distribution of the declared pest in the area for which it is declared; or **(c)** prevent or contain the spread of the declared pest in the area for which it is declared.

APPENDIX A4: OTHER DEFINITIONS

Environmentally sensitive areas

Environmentally sensitive areas are declared by the State Minister under section 51B of the *Environmental Protection Act 1986* (*EP Act*) and are listed in the *Environmental Protection (Environmentally Sensitive Areas) Notice 2005*, gazetted 8 April 2005. Specific environmentally sensitive areas relevant to this report include: a defined wetland and the area within 50 metres of the wetland; the area covered by vegetation within 50 metres of rare flora; the area covered by a threatened ecological community; a Bush Forever site – further areas and information are described in the *Environmental Protection (Environmentally Sensitive Areas) Notice 2005*.

Conservation significant flora

Under the *Environmental Factor Guideline: Flora and Vegetation* (Environmental Protection Authority 2016a), flora may be considered significant for a range of reasons, including, but not limited to the following:

- being identified as threatened or priority species;
- locally endemic or associated with a restricted habitat type (e.g. surface water or groundwater dependent ecosystems);
- new species or anomalous features that indicate a potential new species;
- representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- unusual species, including restricted subspecies, varieties or naturally occurring hybrids; or
- relictual status, being representative of taxonomic groups that no longer occur widely in the broader landscape.

Conservation significant vegetation

Under the *Environmental Factor Guideline: Flora and Vegetation* (Environmental Protection Authority 2016a), vegetation may be considered significant for a range of reasons, including, but not limited to the following:

- being identified as threatened or priority ecological communities;
- restricted distribution;
- degree of historical impact from threatening processes;
- a role as a refuge; or
- providing an important function required to maintain ecological integrity of a significant ecosystem.

APPENDIX A5: DEFINITION OF VEGETATION CONDITION SCALE FOR THE EREMAEAN AND NORTHERN BOTANICAL PROVINCES

Vegetation condition ratings relate to vegetation structure, level of disturbance at each structural layer and the ability of the vegetation unit to regenerate (Table A5.1). Vegetation condition provides complementary information for assessing the significance of potential impacts.

Table A5.1 Definition of vegetation condition categories

Note: Adapted from Trudgen (1988).

CATEGORY	DEFINITION
Excellent	Pristine or nearly so, no obvious sign of damage caused by human activities since European settlement.
Very Good	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks.
Good	More obvious signs of damage caused by human activity since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds.
Poor	Still retains basic vegetation structure or ability to regenerate after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds.
Degraded	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species present including very aggressive species.
Completely Degraded	Areas that are completely of almost completely without native species in the structure of their vegetation; i.e. areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs.

APPENDIX B: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE SURVEY AREAS

Note: Refer to Appendix A for State (SCC; WA Herb 1998-) and Federal (FCC; EPBC Act, DCCEEW 2024a, 2024b) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; ESP – Esperance Plains; GES – Geraldton Sandplains; JAF – Jarrah Forest; MAL – Mallee; SWA – Swan Coastal Plain; WAR – Warren. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Andersonia gracilis	Ericaceae	T	Vulnerable	Habit: Slender erect or open straggly shrub, 0.1-0.5(-1) m high. Flower colour: white-pink-purple Flowering period (indicated in green): J F M A M J J A **S O N** D Soils: White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps. IBRA Distribution: GES, SWA Florabase records: 29	**Very Low** Mainly outside survey areas in different bioregions
Andersonia sp. Saxatilis (F. & J. Hort 3324)	Ericaceae	T	-	Habit: Single-stemmed shrub to 0.6 m high. Flower colour: white-pink Flowering period (indicated in green): **J** F M A M J J A **S O** N D Soils: Dry, brown loam, clay over granite. Slope, outcrops, granite and laterite. IBRA Distribution: JAF Florabase records: 6	**Moderate** **M**ainly north near Modanocks and Albany Highway
Anthocercis gracilis	Solanaceae	T	Vulnerable	Habit: Erect, spindly shrub, to 0.6 (-1) m high. Flower colour: yellow-green Flowering period (indicated in green): J F M A M J J A **S O** N D Soils: Sandy or loamy soils. Granite outcrops. IBRA Distribution: AVW, JAF Florabase records: 29	**Very Low** Mainly on Darling Scarp and granites

APPENDIX B: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE SURVEY AREAS

Note: Refer to Appendix A for State (SCC; WA Herb 1998-) and Federal (FCC; EPBC Act, DCCEEW 2024a, 2024b) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; ESP – Esperance Plains; GES – Geraldton Sandplains; JAF – Jarrah Forest; MAL – Mallee; SWA – Swan Coastal Plain; WAR – Warren. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Banksia mimica	Proteaceae	T	Endangered	Habit: Prostrate, lignotuberous shrub, 0.15-0.4 m high. Flower colour: yellow-brown Flowering period (indicated in green): J F M A M J J A **S** **O** N D Soils: White or grey sand over laterite, sandy loam. IBRA Distribution: JAF, SWA Florabase records: 40	**Very Low** Occurs to the north on the SWA and south JAF
Caladenia huegelii	Orchidaceae	T	Endangered	Habit: Tuberous, perennial, herb, 0.25-0.6 m high. Flower colour: green & cream & red Flowering period (indicated in green): J F M A M J J A **S** **O** N D Soils: Grey or brown sand, clay loam. IBRA Distribution: JAF, SCP Florabase records: 43	**Very Low** Location outside species known range. Species not known within central part of northern Jarrah forest, but has been recorded on north-eastern sandy areas of northern Jarrah Forest.
Diuris drummondii	Orchidaceae	T	Vulnerable	Habit: Tuberous, perennial, herb, 0.5-1.05 m high. Flower colour: yellow Flowering period (indicated in green): **J** F M A M J J A S O **N** **D** Soils: Low-lying depressions, swamps IBRA Distribution: AVW, JAF, SWA, WAR Florabase records: 55	**Very Low** Dependent on suitable low-lying depressions/habitat conditions.

APPENDIX B: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE SURVEY AREAS

Note: Refer to Appendix A for State (SCC; WA Herb 1998-) and Federal (FCC; EPBC Act, DCCEEW 2024a, 2024b) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; ESP – Esperance Plains; GES – Geraldton Sandplains; JAF – Jarrah Forest; MAL – Mallee; SWA – Swan Coastal Plain; WAR – Warren. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Diuris micrantha	Orchidaceae	T	Vulnerable	Habit: Tuberous, perennial, herb, 0.3-0.6 m high. Flower colour: yellow & brown Flowering period (indicated in green): J F M A M J J A **S** **O** N D Soils: Brown loamy clay. Winter-wet swamps, in shallow water. IBRA Distribution: JAF, SWA Florabase records: 7	**Very Low** Mainly on Swan Coastal Plain and in Wheatbelt
Diuris purdiei	Orchidaceae	T	Endangered	Habit: Tuberous, perennial, herb, 0.15-0.35 m high. Flower colour: yellow Flowering period (indicated in green): J F M A M J J A **S** **O** N D Soils: Grey-black sand, moist. Winter-wet swamps. IBRA Distribution: JAF, SWA Florabase records: 2	**Very Low** Mainly on Swan Coastal Plain
Drakaea elastic	Orchidaceae	T	CR	Habit: Tuberous, perennial, herb, 0.12-0.3 m high. Flower colour: red, yellow & green Flowering period (indicated in green): J F M A M J J A S **O** **N** D Soils: White or grey sand. Low- lying situations adjoining winter- wet swamps. IBRA Distribution: SWA Florabase records: 18	**Very Low** One record listed in TPFL database as located within 10 km of survey area. Found adjacent to the SW Highway in dry sand. Occurs on the Swan Coastal Plain.
Drakaea micrantha	Orchidaceae	T	Vulnerable	Habit: Tuberous, perennial, herb, 0.15-0.3 m high. Flower colour: red & yellow Flowering period (indicated in green): J F M A M J J A **S** **O** N D Soils: White-grey sand. IBRA Distribution: JAF, SWA, WAR Florabase records: 49	**Very Low** Has not been recorded by DBCA or by MCPL previously within the survey area.

APPENDIX B: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE SURVEY AREAS

Note: Refer to Appendix A for State (SCC; WA Herb 1998-) and Federal (FCC; EPBC Act, DCCEEW 2024a, 2024b) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; ESP – Esperance Plains; GES – Geraldton Sandplains; JAF – Jarrah Forest; MAL – Mallee; SWA – Swan Coastal Plain; WAR – Warren. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Drosera oreopodion	Droseraceae	T	-	Habit: Fibrous-rooted, rosetted perennial, herb, to 0.035 m high, to 0.015 m wide. Flower colour: White Flowering period (indicated in green): J F M A M J J A **S** **O** N D Soils: Clayey sand sometimes mixed with lateritic pebbles. IBRA Distribution: JAF, SWA Florabase records: 6	**Very Low** Recorded near Armadale and Albany Highway
Eleocharis keigheryi	Cyperaceae	T	Vulnerable	Habit: Rhizomatous, clumped perennial, grass-like or herb (sedge), to 0.4 m high. Flower colour: green Flowering period (indicated in green): J F M A M J J **A** **S** **O** **N** D Soils: Clay, sandy loam. Emergent in freshwater: creeks, claypans. IBRA Distribution: AVW, GES, JAF, SWA Florabase records: 56	**Very Low** Not been recorded by DBCA or by MCPL previously within the survey area. Mainly on Swan Coastal Plain and in Wheatbelt
Eucalyptus x *balanites*	Myrtaceae	T	Endangered	Habit: Mallee to 5 m high, bark rough, flaky. Flower colour: white Flowering period (indicated in green): **J** **F** M A M J J A S **O** **N** **D** Soils: Sandy soils with lateritic gravel. IBRA Distribution: GES, SWA Florabase records: 11	**Very Low** Has not been recorded by DBCA or by MCPL previously within the survey area. Distribution and soil type is not suitable

APPENDIX B: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE SURVEY AREAS

Note: Refer to Appendix A for State (SCC; WA Herb 1998-) and Federal (FCC; EPBC Act, DCCEEW 2024a, 2024b) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; ESP – Esperance Plains; GES – Geraldton Sandplains; JAF – Jarrah Forest; MAL – Mallee; SWA – Swan Coastal Plain; WAR – Warren. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Grevillea flexuosa	Proteaceae	T	Vulnerable	Habit: Irregular, few-branched, non-lignotuberous shrub, to 2 m high. Flower colour: creamy-yellow Flowering period (indicated in green): J F M A M J **J A S O** N D Soils: Red-brown sand with laterite & gravel, sand over granite. Ridgetop plateau & associated breakaways. IBRA Distribution: JAF Florabase records: 43	**Very Low** Not been recorded by DBCA or by MCPL previously within the survey area. Occurs north of Mundaring
Lasiopetalum pterocarpum	Malvaceae	T	Endangered	Habit: Open, multi-stemmed shrub (with distinctly winged fruit), to 1.2 m high. Flower colour: pink Flowering period (indicated in green): J F M A M J J **A S O N D** Soils: Dark red-brown loam or clayey sand over granite. On sloping banks near creeklines. IBRA Distribution: JAF Florabase records: 11	**Low** Has the potential to occur western areas of Darling Ranges near granites on steeper slopes.
Morelotia australiensis	Cyperaceae	T	Vulnerable	Habit: Rhizomatous, tufted perennial, grass-like or herb (sedge), to 1 m high. Flower colour: brown Flowering period (indicated in green): J F M A M J J A S O **N D** Soils: Sand, sandy loam. Flats, well-drained areas. IBRA Distribution: JAF, SWA Florabase records: 37	**Low** Not been recorded by DBCA or by MCPL previously within the survey area. Occurs on Swan Coastal Plain, been recorded northeast of sites.

APPENDIX B: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE SURVEY AREAS

Note: Refer to Appendix A for State (SCC; WA Herb 1998-) and Federal (FCC; EPBC Act, DCCEEW 2024a, 2024b) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; ESP – Esperance Plains; GES – Geraldton Sandplains; JAF – Jarrah Forest; MAL – Mallee; SWA – Swan Coastal Plain; WAR – Warren. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	Proteaceae	T	Critically Endangered	Habit: Dense, clumped shrub, to 0.3 m high, to 0.4 m wide. Flower colour: yellow Flowering period (indicated in green): J F M A M J J A S **O** N D Soils: Sandy with lateritic pebbles. Near winter-wet flats. IBRA Distribution: JAF, SWA Florabase records: 31	**Very Low** Not been recorded by DBCA or by MCPL previously within the survey area. Occurs on Swan Coastal Plain.
Synaphea sp. Pinjarra Plain (A.S. George 17182)	Proteaceae	T	Endangered	Habit: Erect, clumped shrub (sub-shrub), to 0.8 m high. Flower colour: yellow Flowering period (indicated in green): J F M A M J J A **S** **O** **N** D Soils: Grey sandy loam or clay, grey-brown clayey sand, brown clayey loam, laterite. Flats, seasonally wet areas, railroad reserves often with wet depressions or drains. IBRA Distribution: SWA Florabase records: 63	**Very Low** Not been recorded by DBCA or by MCPL previously within the survey area. Occurs on Swan Coastal Plain
Synaphea sp. Serpentine (G.R. Brand 103)	Proteaceae	T	Critically Endangered	Habit: Erect shrub 0.3-0.6 m high and to 0.5 m wide. Flower colour: yellow Flowering period (indicated in green): J F M A M J J A **S** **O** N D Soils: Sand, loamy sand, clay-loam, clay soil. Flats, gentle slope to wetland, seasonally wet areas. IBRA Distribution: SWA Florabase records: 36	**Very Low** Not been recorded by DBCA or by MCPL previously within the survey area. Occurs on Swan Coastal Plain

APPENDIX B: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE SURVEY AREAS

Note: Refer to Appendix A for State (SCC; WA Herb 1998-) and Federal (FCC; EPBC Act, DCCEEW 2024a, 2024b) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; ESP – Esperance Plains; GES – Geraldton Sandplains; JAF – Jarrah Forest; MAL – Mallee; SWA – Swan Coastal Plain; WAR – Warren. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Thelymitra dedmaniarum	Orchidaceae	T	Endangered	Habit: Tuberous, perennial, herb, to 0.8 m high. Flower colour: yellow Flowering period (indicated in green): **J F M A M J J A S O N D** Soils: Granite IBRA Distribution: JAF Florabase records: 4	**Very Low** Has not been recorded by DBCA or by MCPL previously within the survey area and occurs north of Mundaring
Thelymitra stellata	Orchidaceae	T	Endangered	Habit: Tuberous, perennial, herb, 0.15-0.25 m high. Flower colour: yellow & brown Flowering period (indicated in green): J F M A M J J A S **O N** D Soils: Sand, gravel, lateritic loam. IBRA Distribution: GES, JAF, SWA Florabase records: 20	**Very Low** Has not been recorded by DBCA or by MCPL previously within the survey area and occurs mainly north of Perth on sandplains
Verticordia fimbrilepis subsp. *fimbrilepis*	Myrtaceae	T	Endangered	Habit: Shrub, 0.3-0.7 m high. Flower colour: pink-white Flowering period (indicated in green): **J F M A M J J A S O N D** Soils: Gravelly or clayey soils. Flats, road verges. IBRA Distribution: AVW, JAF Florabase records: 39	**Very Low** Occurs mainly north of Albany Highway and in Wheatbelt
Verticordia plumosa var. *ananeotes*	Myrtaceae	T	Endangered	Habit: Erect, sparsely branched shrub, 0.3-0.5 m high. Flower colour: pink-purple/white Flowering period (indicated in green): J F M A M J J A S O **N D** Soils: Sandy loam. Seasonally inundated plains. IBRA Distribution: JAF, SWA Florabase records: 23	**Very Low** Not been recorded by DBCA or by MCPL previously within the survey area. Occurs on Swan Coastal Plain and Darling Scarp

APPENDIX B: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE SURVEY AREAS

Note: Refer to Appendix A for State (SCC; WA Herb 1998-) and Federal (FCC; EPBC Act, DCCEEW 2024a, 2024b) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; ESP – Esperance Plains; GES – Geraldton Sandplains; JAF – Jarrah Forest; MAL – Mallee; SWA – Swan Coastal Plain; WAR – Warren. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Anthotium sp. Darling Range (F. Hort & B. Hort 2431)	Goodeniaceae	P1	-	Habit: Prostrate, spreading perennial, herb, to 0.05 m high. Flower colour: pink/mauve/purple/blue Flowering period (indicated in green): J F M A M J J A S O **N** **D** Soils: Yellow, grey or brown clayey sand, loam. Slopes, low plains, drainage lines of swamp flats. IBRA Distribution: JAF Florabase records: 16	**Very Low** Been recorded north of Albany Highway, mainly near Brookton Highway.
Calytrix simplex subsp. *simplex*	Myrtaceae	P1	-	Habit: Shrub, ca 0.2 m high. Flower colour: purple Flowering period (indicated in green): J F M A M J J A S **O** **N** D Soils: Grey clay loam soil, red-brown gravelly loam. Flats and slopes on laterite, swamp. IBRA Distribution: JAF, SWA Florabase records: 5	**Very Low** Recorded on eastern fringes of the northern Jarrah forest and north of survey areas
Darwinia hortiorum	Myrtaceae	P1	-	Habit: Erect to spreading, densely branched shrub to 0.7 m high and 0.8 m wide. Flower colour: reddish-brown & green & yellow-red Flowering period (indicated in green): J F M A M J J A **S** **O** **N** **D** Soils: Shallow granitic soils, loam or loam/clay associated with laterite. Granite outcrops and drainage lines to granite outcrops. IBRA Distribution: JAF Florabase records: 8	**Moderate** Recorded on granites, mainly north-east of survey areas near Monadnocks

APPENDIX B: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE SURVEY AREAS

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Drosera paleacea	Droseraceae	P1		Habit: Fibrous-rooted, rosetted perennial, herb, to 0.03 m high, to 0.015 m wide. Flower colour: white-cream Flowering period (indicated in green): **J F** M A M J J A **S O N D** Soils: White sand, sandy clay. IBRA Distribution: AVW, WAR Florabase records: 16	**Very Low** Occurs on Swan Coastal Plain and southern coastal areas near Albany
Hemigenia rigida	Lamiaceae	P1	-	Habit: Upright or spreading shrub, 0.1-0.6 (-1) m high. Flower colour: blue-purple/violet Flowering period (indicated in green): **J F** M A M J J **A S O N D** Soils: Sandy soils, lateritic gravelly soils. Hillslopes, granite outcrops IBRA Distribution: AVW Florabase records: 4	**Very Low** In Wheatbelt, not in survey areas
Hibbertia acrotoma	Dilleniaceae	P1	-	Habit: Openly branched, spreading to prostrate shrub to 0.5m. Flower colour: yellow Flowering period (indicated in green): J F M A M J J **A S** O N D Soils: Loam soils over laterite or granite IBRA Distribution: JAF, SWA Florabase records: 7	**Very Low** Edge of Darling Scarp between Serpentine & Oakley Dam
Hibbertia ?ambita	Dilleniaceae	P1		Habit: Shrub Flower colour: Yellow Flowering period (indicated in green): J F M A M J J A **S O** N D Soils: Lateritic sandy loam. IBRA Distribution: JAF Florabase records: 17	**Low** Recorded in eastern sections of Huntly North, mainly east of survey areas

APPENDIX B: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE SURVEY AREAS

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Hibbertia hortiorum	Dilleniaceae	P1		Habit: Prostrate shrub Flower colour: Yellow Flowering period (indicated in green): **J F M A M J J A S O N D** Soils: Lateritic yellowish sandy loam. IBRA Distribution: JAF Florabase records: 12	**Moderate** Recorded in eastern sections of Huntly North
Hibbertia polyancistra	Dilleniaceae	P1	-	Habit: Erect shrub 0.3-0.45 (-0.6) m high. Flower colour: yellow Flowering period (indicated in green): **J F M A M J J A S O N D** Soils: Shallow soil over granite. IBRA Distribution: JAF Florabase records: 8	**Very Low** Occurs north-east of survey areas and on Blackwood Plateau
Levenhookia preissii	Stylidiaceae	P1	-	Habit: Annual (ephemeral), herb, 0.03-0.17 m high. Flower colour: pink-red Flowering period (indicated in green): **J F M A M J J A S O N D** Soils: Grey or black, peaty sand. Swamps. IBRA Distribution: SWA Florabase records: 14	**Very Low** Occurs on Coastal Plain from north of Perth to Augusta and then localised patch in southern forests
Netrostylis sp. Nannup (P.A. Jurjevich 1133)	Cyperaceae	P1	-	Habit: Perennial. Caespitose sedge 90 cm high. Flower colour: - Flowering period (indicated in green): **J F M A M J J A S O N D** Soils: Creek, valley floors. IBRA Distribution: JAF Florabase records: 6	**Moderate** Locally abundant to the NW and within 5 km of survey area (WA Herb). Findings associated with clay loam and dark grey soils in lowland areas.

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Paracaleana gracilicordata	Orchidaceae	P1	-	Habit: Perennial, herb, to 0.07 m high. Flower colour: green-yellow-purple Flowering period (indicated in green): J F M A M J J A S **O N** D Soils: Growing on moss mats, granite. Outcrops. IBRA Distribution: JAF Florabase records: 8	**Moderate** Recorded north and north-east of survey areas
Paracaleana granitica	Orchidaceae	P1	-	Habit: Perennial, herb, to 0.07 m high. Flower colour: green-purple Flowering period (indicated in green): J F M A M J J A S **O N D** Soils: Growing on moss mats, granite. Outcrops. IBRA Distribution: JAF Florabase records: 7	**High** **R**ecorded near Huntly North survey areas, mainly on granites
Senecio gilbertii	Asteraceae	P1	-	Habit: Erect, slender perennial, herb, to 1.5 m high. Flower colour: yellow Flowering period (indicated in green): J F M A M J J A **S O N** D Soils: Peaty sand. Swamps, slopes IBRA Distribution: AVW, JAF Florabase records: 10	**Very Low** Recorded north of Brookton Highway and in Wheatbelt
Synaphea odocoileops	Proteaceae	P1	-	Habit: Tufted, compact shrub, 0.2-0.5 m high. Flower colour: yellow Flowering period (indicated in green): J F M A M J J A S O N D Soils: Brown-orange loam & sandy clay, granite. Swamps, winter-wet areas. IBRA Distribution: SWA Florabase records: 22	**Very Low** Recorded on Swan Coastal Plain

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Banksia recurvistylis	Proteaceae	P2	-	Habit: Non-lignotuberous shrub to c. 2 m high and 3 m wide. Flower colour: pale yellow Flowering period (indicated in green): J F M A M J J A S O **N D** Soils: Shallow, lateritic soils associated with granite outcrops. IBRA Distribution: JAF Florabase records: 7	**Moderate** Recorded north and northeast of survey area
Bossiaea modesta	Fabaceae	P2	-	Habit: Slender, trailing & twining shrub. Flower colour: yellow & red Flowering period (indicated in green): J F M A M J J A S **O N D** Soils: Soils derived from granite. Damp areas close to stream. IBRA Distribution: JAF, SWA Florabase records: 22	**Moderate** Recorded mainly north of survey areas and outlier north of Dwellingup
Calectasia grandiflora	Dasypogonaceae	P2		Habit: Rhizomatous, perennial, herb (or undershrub), to 0.65 m high, without stilt roots. Flower colour: blue/purple Flowering period (indicated in green): **J J A S O N** D Soils: White, grey or yellow sand, sandy clay, gravel, laterite, granite. Swampy areas, rock outcrops, flats, slopes, ridges. IBRA Distribution: JAF, SWA Florabase records: 12	**Very Low** Mainly on Darling Scarp and Swan Coastal Plain

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Cardamine paucijuga	Brassicaceae	P2	-	Habit: Slender erect annual herb to 0.4m high. Flower colour: White Flowering period (indicated in green): J F M A M J J A **S** **O** N D Soils: In moist to dry habitats IBRA Distribution: SWA, WAR, JAF Florabase records: 10	**Very Low** Occurs on Swan Coastal Plain and in Southern Wheatbelt
Grevillea crowleyae	Proteaceae	P2	-	Habit: Dense & spreading shrub, 0.5-1.5 m high. Flower colour: - Flowering period (indicated in green): J F M A M J J **A** **S** **O** **N** D Soils: Loam. IBRA Distribution: JAF Florabase records: 9	**Very Low** Occurs East on fringes of Wheatbelt and in Wheatbelt
Grevillea ornithopoda	Proteaceae	P2	-	Habit: Spreading, virgate shrub, 1-3 (-5) m high, up to 3 m wide. Flower colour: cream-white Flowering period (indicated in green): J F M A **M** **J** **J** **A** **S** **O** **N** D Soils: Loam, loam over clay, sand, clay. Edge of river bank and creek, dunes IBRA Distribution: JAF, SWA Florabase records: 20	**Low Moderate** Within species range, recorded south, west and north of survey area.
Johnsonia pubescens subsp. *cygnorum*	Hemerocallidaceae	P2	-	Habit: Tufted, perennial, herb, 0.15-0.25 m high. Flower colour: white-green Flowering period (indicated in green): J F M A M J J A **S** O N D Soils: Grey-white-yellow sand. Flats, seasonally-wet sites. IBRA Distribution: SWA Florabase records: 12	**Very Low** Occurs on the Swan Coastal Plain

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Lepyrodia curvescens	Restionaceae	P2		Habit: Dioecious, shortly creeping, tufted rhizomatous, herb, 0.24-0.4 m high, rhizomes on surface or to 1 cm deep Flower colour: light-brown to mauve Flowering period (indicated in green): J F M A M J J A **S O N** D Soils: Sand, laterite. Seasonally inundated swampland. IBRA Distribution: SWA Florabase records: 20	**Very Low** Mainly on Swan Coastal Plain, northern sandplains and near Brookton Highway
Millotia tenuifolia var. *laevis*	Asteraceae	P2	-	Habit: Ascending to erect annual, herb, 0.02-0.1 m high. Flower colour: yellow Flowering period (indicated in green): J F M A M J J A **S O** N D Soils: Granite or laterite soils. IBRA Distribution: AVW, JAF, SWA Florabase records: 13	**Very Low** Mainly on Sawan Coastal Plain and in Wheatbelt
Schizaea rupestris	Schizaeaceae	P2	-	Habit: Rhizomatous, perennial, herb or grass-like or (fern), 0.1-0.2m high. Flower colour: - Flowering period (indicated in green): J F M A M J J A S O N D Soils: Sand. Gullies, creek banks, shaded moist rock faces. IBRA Distribution: ESP, JAF, WAR Florabase records: 13	**Moderate** Two records identified by WA herb and one record contained in the TFPL database. All occurring within 5 km N and S of the survey area. Findings are associated with clay loam and dark gravelly soils.

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Tetratheca phoenix	Elaeocarpaceae	P2	-	Habit: Few-branched shrub (subshrub), to 0.25 m high. Flower colour: dark pink-magenta Flowering period (indicated in green): J F M A M J J A **S** **O** N D Soils: Brown gravelly loam over granite. Mid to Upper slopes, near granite outcrops. IBRA Distribution: JAF Florabase records: 10	**Moderate** Near granite outcrops and mainly near Monadnocks
Acacia drummondii subsp. *affinis*	Fabaceae	P3	-	Habit: Erect shrub, 0.3-1 m high. Flower colour: yellow Flowering period (indicated in green): J F M A M J **J** **A** S O N D Soils: Lateritic gravelly soils. IBRA Distribution: AVW, JAF, SWA Florabase records: 37	**Low** Mainly on Coastal Plain and in Wheatbelt north-east of Perth
Acacia horridula	Fabaceae	P3	-	Habit: Harsh, slender, single-stemmed shrub, 0.3-0.6 (-1) m high. Flower colour: yellow Flowering period (indicated in green): J F M A **M** **J** **J** **A** S O N D Soils: Gravelly soils over granite, sand. Rocky hillslopes. IBRA Distribution: JAF, SWA Florabase records: 33	**Low** Mainly on Swan Coastal Plain and western edges of Darling Ranges with patch on eastern fringes of northern Jarrah forest

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Acacia oncinophylla subsp. *oncinophylla*	Fabaceae	P3	-	Habit: Shrub, 0.9-2.5 m high, 'minni-ritchi' bark, phyllodes mostly 8-13 cm long, 1-2 mm wide. Flower colour: yellow Flowering period (indicated in green): **J F M A M J J A S O N D** Soils: Granitic soils IBRA Distribution: AVW, JAF, SWA Florabase records: 42	**Low** Mainly on the western fringes of the Darling Ranges on granites
Actinotus repens	Apiaceae	P3	-	Habit: Prostrate perennial to 5 cm high, c. 20cm wide. Flower colour: white Flowering period (indicated in green): **J F M** A M J J A S O N D Soils: Coarse black peaty sand over clay. Creeklines, edges of water channels. IBRA Distribution: JAF, WAR Florabase records: 36	**Moderate** Mainly on southern forested areas. Located on the banks of a creekline containing *E. patens*, *E. megacarpa*, *T. linearifolia*, and *M. dilatata.* Near Willowdale
Adenanthos cygnorum subsp. chamaephyton	Proteaceae	P3	-	Habit: Prostrate, mat-forming, non-lignotuberous shrub, to 0.3 m high. Flower colour: white-cream-pink-green/green Flowering period (indicated in green): **J** F M A M **J J A S O N D** Soils: Grey sand, lateritic gravel. IBRA Distribution: AVW, JAF, SWA Florabase records: 21	**Low** Recorded mainly north of Brookton Highway, localised areas south of survey areas

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Andersonia sp. Audax (F. Hort, B. Hort & J. Hort 3179)	Ericaceae	P3	-	Habit: Shrub, to 1.1 m high and 1.1 m wide. Flower colour: white-cream/mauve-pink Flowering period (indicated in green): J F M A M J J A S **O** **N** D Soils: Loam, clay, sand, gravel. Granite, slopes and drainage lines. IBRA Distribution: JAF Florabase records: 22	**Moderate** Mainly north of Huntly North area and Albany Highway
Byblis gigantea	Byblidaceae	P3	-	Habit: Small, branched perennial, herb (or sub shrub), to 0.45 m high. Flower colour: pink-purple/white Flowering period (indicated in green): **J** F M A M J J A **S** **O** **N** **D** Soils: Sandy-peat swamps. Seasonally wet areas. IBRA Distribution: JAF, SWA Florabase records: 40	**Low** Mainly north of Albany Highway but patch southeast if Dwellingup
Conospermum scaposum	Proteaceae	P3		Habit: Erect shrub, 0.2-0.45(-0.75) m high. Flower colour: blue Flowering period (indicated in green): **J** **F** M A M J J A S **O** **N** **D** Soils: White-grey sand, sandy clay. Low swampy areas, road verges. IBRA Distribution: AVW, GES, JAF, SWA Florabase records: 46	**Low** Mainly north-east of survey areas, from northern sandplains to Wheatbelt

APPENDIX B: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE SURVEY AREAS

Note: Refer to Appendix A for State (SCC; WA Herb 1998-) and Federal (FCC; EPBC Act, DCCEEW 2024a, 2024b) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; ESP – Esperance Plains; GES – Geraldton Sandplains; JAF – Jarrah Forest; MAL – Mallee; SWA – Swan Coastal Plain; WAR – Warren. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Cyathochaeta teretifolia	Cyperaceae	P3	-	Habit: Rhizomatous, clumped, robust perennial, grass-like or herb (sedge), to 2.0 m high, to 1.0 m wide. Flower colour: brown Flowering period (indicated in green): **J** F M A M J J A **S** **O** **N** D Soils: Grey sand, sandy clay. Swamps, creek edges. IBRA Distribution: JAF, SWA, WAR Florabase records: 39	**Low to Moderate** Mainly on Coastal Plains, with few in creekline areas of forests
Grevillea dissectifolia (formerly known as *Grevillea manglesii* subsp. *dissectifolia)*	Proteaceae	P3	-	Habit: Spreading, virgate shrub, 1.5-3 (-5) m high, up to 33 m wide. Flower colour: white & red & brown Flowering period (indicated in green): J F M A M **J** J A **S** **O** **N** D Soils: Gravelly loam, moist. Roadsides. IBRA Distribution: JAF Florabase records: 27	**Moderate** Mainly north of the Albany Highway with some occurrences in valleys near survey areas
Grevillea prominens	Proteaceae	P3	-	Habit: Spreading shrub, 0.5-1.7m high, 0.3-1m wide. Flower colour: cream-white Flowering period (indicated in green): J F M A M J J A **S** **O** N D Soils: Gravelly loam, along creeklines. IBRA Distribution: JAF Florabase records: 9	**Moderate** Recorded previously by MCPL (2022). Three records with WAHerb and near survey areas
Hakea oldfieldii	Proteaceae	P3	-	Habit: Open straggling shrub up to 2.5m. Flower colour: white-cream to yellow Flowering period (indicated in green): J F M A M J J **A** **S** **O** N D Soils: Red clay or sand over laterite, seasonally wet flats IBRA Distribution: GES, SWA, AVW, JAF. MAL, ESP Florabase records: 66	**Low** Soil conditions less likely in survey area and occurs mainly south, southeast and east of survey area

APPENDIX B: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE SURVEY AREAS

Note: Refer to Appendix A for State (SCC; WA Herb 1998-) and Federal (FCC; EPBC Act, DCCEEW 2024a, 2024b) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; ESP – Esperance Plains; GES – Geraldton Sandplains; JAF – Jarrah Forest; MAL – Mallee; SWA – Swan Coastal Plain; WAR – Warren. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Halgania corymbosa	Boraginaceae	P3	-	Habit: Erect shrub, 0.35-1 m high. Flower colour: blue-purple Flowering period (indicated in green): J F M A M J J **A S O N** D Soils: Gravelly soils, soils over granite. IBRA Distribution: JAF, SWA Florabase records: 18	**Very Low** Mainly on fringes of northern Jarrah forest to north-west and north of survey areas with outliers near Bannister
Hemigenia microphylla	Lamiaceae	P3	-	Habit: Slender shrub, 0.4-1.8 m high. Flower colour: blue-purple Flowering period (indicated in green): J F M A M J J A **S O N D** Soils: Sandy clay, peaty clay, granite. Winter-wet depressions. IBRA Distribution: JAF, SWA, WAR Florabase records: 25	**Low** Mostly on Swan Coastal Plain and in southern forest and coastal areas
Isopogon autumnalis	Proteaceae	P3	-	Habit: Shrub 0.3-1 m high, commonly 0.5-1 m wide. Flower colour: pale yellow Flowering period (indicated in green): **J F M A M** J J A S O N D Soils: Sandy soils. IBRA Distribution: GES, JAF, SWA Florabase records: 59	**Very Low** Mostly on Swan Coastal Plain and northern sandplains
Lasiopetalum glutinosum subsp. *glutinosum*	Malvaceae	P3	-	Habit: Shrub to 0.8 m high. Flower colour: pink-purple Flowering period (indicated in green): J F M A M J J A **S O** N D Soils: Lateritic gravel and clay, clay loam, sandy clay over granite. Slopes, granite outcrops. IBRA Distribution: AVW, JAF, SWA Florabase records: 48	**Very Low** Mainly on Darling Scarp and areas north of survey areas

APPENDIX B: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE SURVEY AREAS

Note: Refer to Appendix A for State (SCC; WA Herb 1998-) and Federal (FCC; EPBC Act, DCCEEW 2024a, 2024b) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; ESP – Esperance Plains; GES – Geraldton Sandplains; JAF – Jarrah Forest; MAL – Mallee; SWA – Swan Coastal Plain; WAR – Warren. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Lepyrodia heleocharoides	Restionaceae	P3	-	Habit: Rhizomatous, slender, tufted perennial, herb (sedge-like), 0.15-0.25 m high. Flower colour: - Flowering period (indicated in green): J F M A M J J A S O N **D** Soils: Moist peaty sand. Dry or seasonally inundated heath or woodland, swamps. IBRA Distribution: JAF, SWA Florabase records: 20	**Very Low** Mainly on Darling Scarp or in southern areas of southwest forests
Meionectes tenuifolia	Haloragaceae	P3	-	Habit: Annual semi-aquatic herb, to 0.35 m high. Flower colour: orange-red-brown, green Flowering period (indicated in green): J F M A M J J A **S O N D** Soils: Grey sand or grey-brown clay, shallow soils. Seasonally inundated flat, edge of swamp. IBRA Distribution: JAF, SWA Florabase records: 24	**Very Low** Mainly on Darling Scarp, Swan Coastal Plain, north of Brookton Highway ad eastern fringes of forest
Netrostylis sp. Blackwood River (A.R. Annels 3043)	Cyperaceae	P3	-	Habit: Erect or spreading sedge to 1 m high. Flower colour: brown Flowering period (indicated in green): J F M A M J J A S O N D Soils: Shallow grey sandy soil, clay loam. Along edges of creeklines and inundated swamp. IBRA Distribution: ESP, JAF, SWA, WAR Florabase records: 16	**Moderate** WAHerb lists one record within 1 km of central survey point and found within creekline. Mostly in southern forest and coastal areas

APPENDIX B: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE SURVEY AREAS

Note: Refer to Appendix A for State (SCC; WA Herb 1998-) and Federal (FCC; EPBC Act, DCCEEW 2024a, 2024b) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; ESP – Esperance Plains; GES – Geraldton Sandplains; JAF – Jarrah Forest; MAL – Mallee; SWA – Swan Coastal Plain; WAR – Warren. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Petrophile filifolia subsp. *laxa*	Proteaceae	P3	-	Habit: Erect, spreading shrub, to 0.75 m high. Flower colour: cream Flowering period (indicated in green): **J F** M A M J J A S O **N D** Soils: White gritty sand, brown, red, yellow, white or grey sand, brown-yellow sandy clay. Winter-wet sites, flats, slopes, swamps, drainage lines. IBRA Distribution: JAF Florabase records: 18	**Very Low** Mainly northeast of Albany Highway
Pithocarpa corymbulosa	Asteraceae	P3	-	Habit: Erect to scrambling perennial, herb, 00.5-1 m high. Flower colour: white Flowering period (indicated in green): **J F M A** M J J A S O N D Soils: Gravelly or sandy loam. Amongst granite outcrops. IBRA Distribution: GES, JAF, SWA Florabase records: 22	**Very Low** Mainly on granites on Darling Scarp with outliers on northern sandplains
Stackhousia sp. Red-blotched corolla (A. Markey 911)	Celastraceae	P3	-	Habit: Erect herb or shrub, approximately 0.2 m high. Flower colour: cream-yellow Flowering period (indicated in green): J F M A M J J A **S O N** D Soils: Brown loamy sand, clayey sand over laterite, white sandy clay over granite, grey clay. Slopes. IBRA Distribution: AVW, GES, JAF Florabase records: 9	**Very Low** Mainly on Darling Scarp or in southern areas of southwest forests

APPENDIX B: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE SURVEY AREAS

Note: Refer to Appendix A for State (SCC; WA Herb 1998-) and Federal (FCC; EPBC Act, DCCEEW 2024a, 2024b) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; ESP – Esperance Plains; GES – Geraldton Sandplains; JAF – Jarrah Forest; MAL – Mallee; SWA – Swan Coastal Plain; WAR – Warren. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Synaphea pandurata	Proteaceae	P3	-	Habit: Clumped shrub (subshrub), 0.2-0.55 m high. Flower colour: yellow Flowering period (indicated in green): J F M **A** M **J** J A **S** **O** N **D** Soils: Yellow-grey, yellow-brown, yellow-red sands and sandy loams, dark brown loam, laterite gravel, granite. In undulating areas. IBRA Distribution: JAF Florabase records: 23	**Very Low** Mainly northeast of Albany Highway
Tetratheca pilifera	Elaeocarpaceae	P3	-	Habit: Spreading shrub, 0.1-0.3 m high. Flower colour: purple Flowering period (indicated in green): J F M A M J J **A** **S** **O** N D Soils: Gravelly soils. IBRA Distribution: JAF, SWA Florabase records: 35	**Very Low** MCPL (2019) recorded at one location and within 5 km of survey areas, mainly norther of Great Eastern Highway
Thysanotus anceps	Asparagaceae	P3	-	Habit: Rhizomatous, leafless perennial, herb, to 0.4 m high. Flower colour: purple Flowering period (indicated in green): J F M A M J J A S **O** **N** **D** Soils: White or grey sand, lateritic gravel, laterite. IBRA Distribution: GES, JAF, SWA Florabase records: 17	**Moderate** Mainly in northwest areas and Darling Scarp with outliers on northern sandplains

APPENDIX B: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE SURVEY AREAS

Note: Refer to Appendix A for State (SCC; WA Herb 1998-) and Federal (FCC; EPBC Act, DCCEEW 2024a, 2024b) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; ESP – Esperance Plains; GES – Geraldton Sandplains; JAF – Jarrah Forest; MAL – Mallee; SWA – Swan Coastal Plain; WAR – Warren. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Acacia cuneifolia	Fabaceae	P4	-	Habit: Erect or straggly shrub, 1-3 m high. Flower colour: yellow Flowering period (indicated in green): J F M A M J **J A S O** N D Soils: Sand, clay or loam over granite. Granite outcrops & hills, rocky watercourses. IBRA Distribution: AVW, JAF Florabase records: 41	**Very Low** Mainly northeast of Albany Highway and in Wheatbelt
Acacia oncinophylla subsp. *patulifolia*	Fabaceae	P4	-	Habit: Shrub, 0.5-2.5(-3) m high, 'minni-ritchi' bark, phyllodes 4-9 cm long, 3-6 mm wide. Flower colour: yellow Flowering period (indicated in green): J F M A M J J **A S O N D** Soils: Granitic soils, occasionally on laterite. IBRA Distribution: JAF, SWA Florabase records: 31	**Very** Recorded mainly to north and north-west on granites mainly.
Aponogeton hexatepalus	Aponogetonceae	P4	-	Habit: Rhizomatous or cormous, aquatic perennial, herb, leaves floating. Flower colour: green-white Flowering period (indicated in green): J F M A M J **J A S O** N D Soils: Mud. Freshwater: ponds, rivers, claypans. IBRA Distribution: JAF, SWA Florabase records: 30	**Very Low** Mainly on Swan Coastal Plain and southern forests.

APPENDIX B: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE SURVEY AREAS

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Caladenia speciosa	Orchidaceae	P4	-	Habit: Tuberous, perennial, herb, 0.35-0.6 m high. Flower colour: white-pink Flowering period (indicated in green): J F M A M J J A **S** **O** N D Soils: White, grey or black sand. IBRA Distribution: JAF, SWA Florabase records: 59	**Very Low** Mainly on Swan Coastal Plain with outlier north of Brookton Highway
Calothamnus graniticus subsp. *leptophyllus*	Myrtaceae	P4	-	Habit: Erect, multi-stemmed shrub, 1-2 m high. Flower colour: red Flowering period (indicated in green): J F M A M **J** **J** **A** S O N D Soils: Clay over granite, lateritic soils. Hillsides. IBRA Distribution: JAF, SWA Florabase records: 32	**Moderate** Nearby records within SWA and near survey areas
Chorizema ulotropis	Fabaceae	P4	-	Habit: Sprawling, open, semi-prostrate shrub, to 0.45 m high. Flower colour: orange-yellow Flowering period (indicated in green): J F M A M J **J** **A** **S** O N D Soils: Moist to dry soils, white sand with gravel, laterite, granite. Outcrops, winter damp to dry areas, flats. IBRA Distribution: ESP, JAF, MAL Florabase records: 24	**Low-Moderate** Mostly northeast of Albany Highway with several outliers in forest
Cyanothamnus tenuis	Rutaceae	P4	-	Habit: Procumbent or erect & slender shrub, 0.1-0.5 m high. Flower colour: white-pink Flowering period (indicated in green): J F M A M J J **A** **S** **O** **N** D Soils: Laterite, stony soils, granite. IBRA Distribution: JAF, SWA Florabase records: 44	**Moderate** Manly on western fringes of survey areas, with some outliers

APPENDIX B: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE SURVEY AREAS

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Drosera occidentalis	Droseraceae	P4	-	Habit: Fibrous-rooted, rosetted perennial, herb, to 0.025 m high. Flower colour: pink/white Flowering period (indicated in green): **J F M A M J J A S O N D** Soils: White/black sand over yellow clay, yellow sand, moist brown/grey clay/sand, peaty sand, sandy clay. Damp flats, flood plain. IBRA Distribution: JAF, SWA Florabase records: 18	**Low** Swan Coastal Plain and northeast mainly of survey areas
Eucalyptus x graniticola	Myrtaceae	P4	-	Habit: Mallee to 4 m, smooth bark. Flower colour: Stamens cream Flowering period (indicated in green): **S O** Soils: Granite soils. IBRA Distribution: JAF Florabase records: 6	**Low** WA Herb lists two records, both north of survey area and associated with granite.
Goodenia verreauxii	Goodeniaceae	P4	-	Habit: Perennial, herb, to 0.5 m high. Flower colour: yellow Flowering period (indicated in green): **J F N D** Soils: White/grey or yellow sand. Flats. IBRA Distribution: AVW, JAF Florabase records: 44	**Very Low** Occurs northeast of Brookton Highway and into Wheatbelt

APPENDIX B: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE SURVEY AREAS

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Grevillea pimeleoides	Proteaceae	P4	-	Habit: Non-lignotuberous shrub, 0.4-2.4 m high. Flower colour: yellow-orange Flowering period (indicated in green): J F M A **M** **J** **J** **A** **S** **O** **N** D Soils: Gravelly soils over granite. Rocky hillsides. IBRA Distribution: JAF Florabase records: 36	**Low** Mainly north of survey area and associated with granite.
Hemigenia platyphylla	Lamiaceae	P4	-	Habit: Spreading shrub, 0.2-1.5 m high. Flower colour: blue-purple Flowering period (indicated in green): J F M A M J J A **S** **O** **N** D Soils: Sandy & loamy soils. Granite rocks, slopes. IBRA Distribution: AVW, ESP, JAF, MAL Florabase records: 21	**Very Low** Mainly north of survey areas, in the Wheatbelt and southern coastal areas
Lasiopetalum cardiophyllum	Malvaceae	P4	-	Habit: Erect, multi-stemmed shrub, 0.2-0.5 m high. Flower colour: pink Flowering period (indicated in green): **J** F M A M J J **A** **S** **O** **N** **D** Soils: Lateritic gravelly soils, sandy clay. Flats, hillslopes. IBRA Distribution: AVW, JAF Florabase records: 34	**Low** Mainly on eastern fringes of Jarrah forest and in the Wheatbelt
Parsonsia diaphanophleba	Apocynaceae	P4	-	Habit: Woody climber, to 10 m high. Flower colour: white/cream & pink Flowering period (indicated in green): **J** **F** M **A** **M** **J** J A **S** O N D Soils: Alluvial soils. Along rivers. IBRA Distribution: JAF, SWA Florabase records: 28	**Low** Mainly Swan Coastal Plain with a few outliers in forest

APPENDIX B: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE SURVEY AREAS

Note: Refer to Appendix A for State (SCC; WA Herb 1998-) and Federal (FCC; EPBC Act, DCCEEW 2024a, 2024b) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; ESP – Esperance Plains; GES – Geraldton Sandplains; JAF – Jarrah Forest; MAL – Mallee; SWA – Swan Coastal Plain; WAR – Warren. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Pimelea rara	Thymelaeaceae	P4	-	Habit: Shrub, 0.2-0.35 m high. Flower colour: white Flowering period (indicated in green): **J** F M A M J **J** A S O N **D** Soils: Lateritic soils. IBRA Distribution: JAF Florabase records: 52	**High** Occurs near survey areas and norther of Brookton Highway
Senecio leucoglossus	Asteraceae	P4	-	Habit: Erect annual, herb, to 1.3 m high. Flower colour: white Flowering period (indicated in green): J F M A M J J **A S O N D** Soils: Gravelly lateritic or granitic soils. Granite outcrops, slopes. IBRA Distribution: JAF, SWA, WAR Florabase records: 44	**High** Occurs in local patches within survey areas
Stylidium ireneae	Stylidiaceae	P4	-	Habit: Lax perennial, herb, (0.06-) 0.1-0.28 m high. Flower colour: pink Flowering period (indicated in green): J F M A M J J A S **O N D** Soils: Sandy loam. Valleys near creek lines. IBRA Distribution: JAF, SWA, WAR Florabase records: 25	**Moderate-High** Extends from forest area to coastal plains and southern forests
Stylidium longitubum	Stylidiaceae	P4	-	Habit: Erect annual (ephemeral), herb, 0.05-0.12 m high. Flower colour: pink Flowering period (indicated in green): J F M A M J J A S **O N D** Soils: Sandy clay, clay. Seasonal wetlands. IBRA Distribution: GES, JAF, SWA Florabase records: 46	**Very Low** Mainly on coastal plains north and south of Perth

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
Stylidium scabridum	Stylidiaceae	P4	-	Habit: Perennial herb, 0.05-0.24 m high. Flower colour: pink Flowering period (indicated in green): J F M A M J J A S **O N D** Soils: Sands. IBRA Distribution: AVW, JAF Florabase records: 53	**Very Low** Mainly north of Albany Highway
Verticordia lindleyi subsp. *lindleyi*	Myrtaceae	P4	-	Habit: Erect shrub, 0.2-0.75 m high. Flower colour: pink Flowering period (indicated in green): **J** F M A **M** J J A S O **N D** Soils: Sand, sandy clay. Winter-wet depressions. IBRA Distribution: GES, JAF, SWA Florabase records: 83	**Very Low** Nearby records within Swan Coastal Plain. Grows on sand, sandy clay

APPENDIX C: SUMMARY OF INTRODUCED PLANT SPECIES WITH THE POTENTIAL TO OCCUR IN THE HUNTLY AND WILLOWDALE SURVEY AREAS

NOTE: The ecological impact and invasiveness rating of each taxon was assessed based on the South West Region database (DPaW, 2013; DBCA, 2024). The ecological impact of an introduced species is rated from low (L), medium (M), to high (H) disturbance. Invasiveness is an assessment of the rate of spread by that species throughout a system; from rapid (R) to slow (S). If species have deficiencies in knowledge, an unknown (U) is assigned. Desktop surveys were conducted by Biologic (2024) and Ecologia (2024) in 2023.

Family	Introduced species (*)	BAM act status	Ecological Impact	Invassivness	Biologic 2024	Ecologia 2024	Eco Logical 2024
Alismataceae	* *Sagittaria platyphylla*	Declared Pest - s22(2), WoNs	U	U		X	
Alliaceae	* *Allium neapolitanum*	Permitted - s11	U	U	X		
Apocynaceae	* *Calotropis procera*	Declared Pest - s22(2)	U	U		X	
Apocynaceae	* *Cryptostegia madagascariensis*	Declared Pest - s22(2)	U	U		X	
Apocynaceae	* *Gomphocarpus fruticosus*	Declared Pest - s22(2)	U	R	X	X	
Apocynaceae	* *Gomphocarpus physocarpus*	Permitted - s11	U	R	X		
Apocynaceae	* *Vinca major*	Permitted - s11	H	S	X		
Araceae	* *Pistia stratiotes*	Declared Pest - s22(2)	U	U		X	
Araceae	* *Zantedeschia aethiopica*	Declared Pest - s22(2)	H	M		X	X
Araliaceae	* *Hedera helix*	Permitted - s11	L	S	X		
Araliaceae	* *Hydrocotyle ranunculoides*	Declared Pest - s22(2)	U	U		X	
Asparagaceae	* *Asparagus asparagoides*	Declared Pest - s22(2), WoNs	H	R		X	
Asteraceae	* *Arctotheca calendula*	Permitted - s11	M	M	X		
Asteraceae	* *Chondrilla juncea*	Declared Pest - s22(2)	U	U		X	
Asteraceae	* *Cotula coronopifolia*	Permitted - s11	U	R	X		
Asteraceae	* *Cotula turbinata*	Permitted - s11	U	R	X		
Asteraceae	* *Erigeron sumatrensis*	Permitted - s11	U	U	X		
Asteraceae	* *Hypochaeris glabra*	Permitted - s11	M	R	X		
Asteraceae	* *Onopordum acaulon*	Declared Pest - s22(2)	L	S		X	
Asteraceae	* *Senecio diaschides*	Permitted - s11	U	U	X		
Asteraceae	* *Silybum marianum*	Declared Pest - s22(2)	U	M		X	
Asteraceae	* *Sonchus oleraceus*	Permitted - s11	M	R	X		
Asteraceae	* *Symphyotrichum squamatum*	Permitted - s11	U	R	X		
Asteraceae	* *Tolpis barbata*	Permitted - s11	U	R	X		
Asteraceae	* *Ursinia anthemoides*	Permitted - s11	U	R	X		
Asteraceae	* *Vellereophyton dealbatum*	Permitted - s11	M	R	X		
Asteraceae	* *Xanthium spinosum*	Declared Pest - s22(2)	U	U		X	
Asteraceae	* *Xanthium strumarium*	Declared Pest - s22(2)	U	U		X	
Bignoniaceae	* *Jacaranda mimosifolia*	Permitted - s11	U	U	X		
Boraginaceae	* *Echium plantagineum*	Declared Pest - s22(2)	L	M		X	
Cactaceae	* *Austrocylindropuntia cylindrica*	Declared Pest - s22(2), WoNs	U	U		X	
Cactaceae	* *Austrocylindropuntia subulata*	Declared Pest - s22(2), WoNs	U	U		X	
Cactaceae	* *Cylindropuntia fulgida*	Declared Pest - s22(2), WoNs	U	U		X	
Cactaceae	* *Cylindropuntia imbricata*	Declared Pest - s22(2), WoNs	U	U		X	
Cactaceae	* *Cylindropuntia kleiniae*	Declared Pest - s22(2), WoNs	U	U		X	
Cactaceae	* *Cylindropuntia pallida*	Declared Pest - s22(2), WoNs	U	U		X	

APPENDIX C: SUMMARY OF INTRODUCED PLANT SPECIES WITH THE POTENTIAL TO OCCUR IN THE HUNTLY AND WILLOWDALE SURVEY AREAS

NOTE: The ecological impact and invasiveness rating of each taxon was assessed based on the South West Region database (DPaW, 2013; DBCA, 2024). The ecological impact of an introduced species is rated from low (L), medium (M), to high (H) disturbance. Invasiveness is an assessment of the rate of spread by that species throughout a system; from rapid (R) to slow (S). If species have deficiencies in knowledge, an unknown (U) is assigned. Desktop surveys were conducted by Biologic (2024) and Ecologia (2024) in 2023.

Family	Introduced species (*)	BAM act status	Ecological Impact	Invassivness	Biologic 2024	Ecologia 2024	Eco Logical 2024
Cactaceae	* *Cylindropuntia tunicata*	Declared Pest - s22(2), WoNs	U	U		X	
Cactaceae	* *Opuntia elata*	Declared Pest - s22(2), WoNs	L	S		X	
Cactaceae	* *Opuntia elatior*	Declared Pest - s22(2), WoNs	L	S		X	
Cactaceae	* *Opuntia engelmannii*	Declared Pest - s22(2), WoNs	L	S		X	
Cactaceae	* *Opuntia microdasys*	Declared Pest - s22(2), WoNs	L	S		X	
Cactaceae	* *Opuntia monacantha*	Declared Pest - s22(2), WoNs	L	S		X	
Cactaceae	* *Opuntia polyacantha*	Declared Pest - s22(2), WoNs	L	S		X	
Cactaceae	* *Opuntia puberula*	Declared Pest - s22(2), WoNs	L	S		X	
Cactaceae	* *Opuntia stricta*	Declared Pest - s22(2), WoNs	L	S		X	
Cactaceae	* *Opuntia tomentosa*	Declared Pest - s22(2), WoNs	U	U		X	
Cannabaceae	* *Cannabis sativa*	Permitted, Requires Permit - r73	U	U	X		
Caprifoliaceae	* *Centranthus macrosiphon*	Permitted - s11	H	R	X		
Caprifoliaceae	* *Lonicera japonica*	Permitted - s11	U	S	X		
Caryophyllaceae	* *Moenchia erecta*	Permitted - s11	U	U	X		
Cyatheaceae	* *Sphaeropteris cooperi*	Permitted - s11	M	R	X		
Cyperaceae	* *Cyperus brevifolius*	Permitted - s11	H	M	X		
Cyperaceae	* *Cyperus tenellus*	Permitted - s11	U	R	X		
Euphorbiaceae	* *Jatropha gossypifolia*	Declared Pest - s22(2), WoNs	U	U		X	
Fabaceae	* *Acacia baileyana*	Permitted - s11	L	S	X		
Fabaceae	* *Acacia decurrens*	Permitted - s11	L	S	X		
Fabaceae	* *Acacia iteaphylla*	Permitted - s11	U	R	X		
Fabaceae	* *Acacia longifolia*	Permitted - s11	U	M	X		
Fabaceae	* *Acacia podalyriifolia*	Permitted - s11	L	S	X		
Fabaceae	* *Alhagi maurorum*	Declared Pest - s22(2)	U	U		X	
Fabaceae	* *Chamaecytisus palmensis*	Permitted - s11	H	R	X		
Fabaceae	* *Lathyrus tingitanus*	Permitted - s11	L	S	X		
Fabaceae	* *Lotus angustissimus*	Permitted - s11	U	R	X		
Fabaceae	* *Lotus subbiflorus*	Permitted - s11	U	R	X		
Fabaceae	* *Neltuma glandulosa × velutina*	Declared Pest - s22(2), WoNs	U	U		X	
Fabaceae	* *Parkinsonia aculeata*	Declared Pest - s22(2), WoNs	U	U		X	
Fabaceae	* *Senna alata*	Declared Pest - s22(2)	U	U		X	
Fabaceae	* *Senna obtusifolia*	Declared Pest - s22(2)	U	U		X	
Fabaceae	* *Trifolium campestre*	Permitted - s11	U	U	X		
Fabaceae	* *Trifolium dubium*	Permitted - s11	U	U	X		
Fabaceae	* *Trifolium hirtum*	Permitted - s11	U	U	X		
Fabaceae	* *Trifolium ligusticum*	Permitted - s11	U	U	X		

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Family	Introduced species (*)	BAM act status	Ecological Impact	Invassivness	Biologic 2024	Ecologia 2024	Eco Logical 2024
Fabaceae	* *Ulex europaeus*	Declared Pest - s22(2), WoNs	H	M		X	
Gentianaceae	* *Centaurium erythraea*	Permitted - s11	U	R	X		
Gentianaceae	* *Cicendia filiformis*	Permitted - s11	L	R	X		
Iridaceae	* *Chasmanthe floribunda*	Permitted - s11	H	S	X		
Iridaceae	* *Gladiolus caryophyllaceus*	Permitted - s11	U	U	X		
Iridaceae	* *Ixia polystachya*	Permitted - s11	L	M	X		
Iridaceae	* *Moraea flaccida*	Declared Pest - s22(2)	H	M		X	
Iridaceae	* *Moraea miniata*	Declared Pest - s22(2)	U	U		X	
Iridaceae	* *Romulea rosea*	Permitted - s11	H	U	X		
Iridaceae	* *Tritonia gladiolaris*	Permitted - s11	U	U	X		
Juncaceae	* *Juncus articulatus*	Permitted - s11	U	U	X		
Juncaceae	* *Juncus bufonius*	Permitted - s11	L	R	X		
Juncaceae	* *Juncus capitatus*	Permitted - s11	L	R	X		
Juncaceae	* *Juncus microcephalus*	Permitted - s11	L	R	X		
Linaceae	* *Linum trigynum*	Permitted - s11	L	U	X		
Orchidaceae	* *Disa bracteata*	Permitted - s11	U	R	X		
Orobanchaceae	* *Bellardia trixago*	Permitted - s11	U	R	X		
Orobanchaceae	* *Bellardia viscosa*	Permitted - s11	U	U	X		
Orobanchaceae	* *Orobanche minor*	Permitted - s11	U	R	X		
Orobanchaceae	* *Parentucellia latifolia*	Permitted - s11	U	R	X		
Papaveraceae	* *Fumaria capreolata*	Permitted - s11	M	U	X		
Passifloraceae	* *Passiflora filamentosa*	Permitted - s11	L	S	X		
Pittosporaceae	* *Pittosporum undulatum*	Permitted - s11	H	R	X		
Poaceae	* *Aira caryophyllea*	Permitted - s11	U	R	X		
Poaceae	* *Aira cupaniana*	Permitted - s11	U	R	X		
Poaceae	* *Aristida ramosa*	Permitted - s11	U	U	X		
Poaceae	* *Avena barbata*	Permitted - s11	H	R	X		
Poaceae	* *Brachypodium distachyon*	Permitted - s11	U	U	X		
Poaceae	* *Briza maxima*	Permitted - s11	U	R	X		
Poaceae	* *Briza minor*	Permitted - s11	U	R	X		
Poaceae	* *Bromus diandrus*	Permitted - s11	H	R	X		
Poaceae	* *Bromus hordeaceus*	Permitted - s11	H	R	X		
Poaceae	* *Digitaria sanguinalis*	Permitted - s11	L	R	X		
Poaceae	* *Ehrharta longiflora*	Permitted - s11	U	R	X		
Poaceae	* *Glyceria declinata*	Permitted - s11	M	R	X		
Poaceae	* *Lagurus ovatus*	Permitted - s11	U	M	X		

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Poaceae	* *Lolium perenne*	Permitted - s11	M	R	X		
Poaceae	* *Pentameris airoides*	Permitted - s11	U	U	X		
Poaceae	* *Vulpia bromoides*	Permitted - s11	U	R	X		
Poaceae	* *Vulpia myuros*	Permitted - s11	U	R	X		
Polygonaceae	* *Rumex acetosella*	Permitted - s11	U	U	X		
Primulaceae	* *Lysimachia arvensis*	Permitted - s11	U	R	X		
Rhamnaceae	* *Ziziphus mauritiana*	Declared Pest - s22(2)	U	U		X	
Rosaceae	* *Acaena echinata*	Permitted - s11	U	U	X		
Rosaceae	* *Prunus cerasifera*	Permitted - s11	L	S	X		
Rosaceae	* *Rubus anglocandicans*	Declared Pest - s22(2), WoNs	H	M	X	X	
Rosaceae	* *Rubus laudatus*	Declared Pest - s22(2), WoNs	H	M		X	
Rosaceae	* *Rubus rugosus*	Declared Pest - s22(2), WoNs	U	U		X	
Rosaceae	* *Rubus ulmifolius*	Declared Pest - s22(2), WoNs	H	M		X	
Rosaceae	* *Rubus x loganobaccus*	Permitted - s11	H	M	X		
Rosaceae	* *Rubus* sp.	Declared Pest - s22(2), WoNs	H	M			
Rubiaceae	* *Galium aparine*	Declared Pest - s22(2)	U	U		X	
Rubiaceae	* *Galium divaricatum*	Permitted - s11	L	U	X		
Rubiaceae	* *Galium spurium*	Declared Pest - s22(2)	U	U		X	
Salicaceae	* *Populus alba*	Permitted - s11	H	S	X		
Scrophulariaceae	* *Buddleja madagascariensis*	Permitted - s11	U	U	X		
Solanaceae	* *Solanum elaeagnifolium*	Declared Pest - s22(2), WoNs	U	U		X	
Solanaceae	* *Solanum linnaeanum*	Declared Pest - s22(2)	M	M		X	
Tamaricaceae	* *Tamarix aphylla*	Declared Pest - s22(2), WoNs	U	U		X	
Verbenaceae	* *Lantana camara*	Declared Pest - s22(2), WoNs	U	U		X	
Violaceae	* *Viola odorata*	Permitted - s11	L	S	X		
Zygophyllaceae	* *Tribulus terrestris*	Permitted - s11	U	U	X		