City of Busselton

Meelup Regional Park –
Ecological Bushfire Management Plan

V1.2: 13 May 2020

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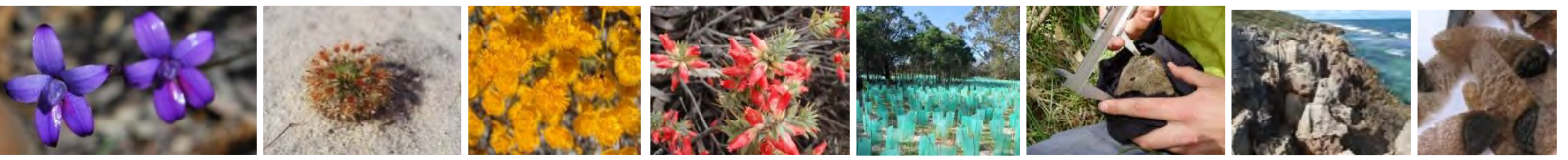

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D2	07 August 2019	Incorporate CoB and DBCA comments	SB	SH	Draft for client comment
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V1	17 March 2020	Incorporate CoB and DBCA comments, add TC information	SB	SH	Superseded
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Contents

1.0 Introduction

Natural Area Consulting Management Services (Natural Area) were engaged by the City of Busselton to review and update the Meelup Regional Park (Meelup) Fire Management Plan, produced in 2013. Due to the significant natural values and conservation significance of Meelup Regional Park, the development of an Ecological Fire Management Plan was considered necessary to ensure the required consideration and planning to protect and maintain biodiversity values balanced with fire protection measures.

Bushfires are a natural occurrence within Australian ecosystems and are a necessity in some instances as much of Australia's native vegetation has developed characteristics that promote the spread of fire that in turn encourages conditions (e.g. smoke and/or heat) needed for reproduction and/or germination of seeds. Vegetation characteristics that promote fire include flammable bark, dry coarse leaf litter and leaves that contain flammable oils (CSIRO, 2008). Consequently, residential areas in proximity to remnant native vegetation are at risk from bushfire impacts such as smoke and ember attack. To mitigate this risk the ecological processes and characteristics of native vegetation need to be understood and considered during management activities, hence the preparation of an ecological bushfire management plan.

The frequency and intensity of fires within a bushland area needs consideration as some species take longer to reach maturity after fire, before flowering and setting seed. For example, if fire occurs too frequently, then there is a risk of local plant extinctions as those species that take longer to flower and set seed may die out with other species adapted to more frequent fires becoming dominant, leading to a reduced flora diversity and changes in vegetation community composition. High intensity fires can lead to the death of flora and fauna species, with damage to the landscape such that regeneration may be significantly impaired. However, fire at a suitable temperature (intensity) and frequency in a manner that allows a patchy burn and creates vegetation with various ages (seral stages) will maximise the floristic structure and diversity of Meelup.

Bushfire management of local bushland areas, such as Meelup, predominantly involves controlling the intensity of fire through the removal of vegetative components that promote fire. Reduction in intensity (fire temperature) mean fires are more easily suppressed and extinguished. Reduction of the fire-fuel load, which is the amount of combustible material available during a fire, can be achieved through leaf litter removal, hazard reduction burns, and slashing and pruning of vegetation.

Consideration has been given to both the human and ecological values associated with Meelup when preparing this Ecological Bushfire Management Plan, the aims of which are to:

- protect lives and community assets from wildfires within Meelup and on neighbouring property
- maintain and enhance the biodiversity of Meelup
- consider and plan to protect the ecological values within Meelup when determining bushfire management strategies for the site, including any hazard reduction burns, addressing and avoiding/minimising impacts to the diversity of vegetation communities, threatened ecological communities (TECs), threatened and priority listed flora and fauna species
- increase knowledge of ecological fire regimes and incorporate that information into operational fire management of the Park

- reduce the risk and frequency of bushfire originating within Meelup due to accidental or intentional ignition as a result of human activities.

This report outlines:

- current site characteristics
- resources available for bushfire management
- site visit observations
- vegetation classification
- bushfire risk assessment
- bushfire management strategies and recommendations
- operational procedures.

1.1 Site Location

Meelup Regional Park occupies an area of approximately 577 ha along 11.5 km of coastline between Dunsborough in the south to Bunker Bay in the north (Figure 1). This bushfire management plan focuses on that portion of Meelup between Eagle Bay and Dunsborough, as the area north of Eagle Bay to Bunker Bay is primarily coastal foreshore reserve that does not require the same level of bushfire management as the remainder of the reserve.

1.2 Tenure and Management

Meelup Regional Park is an 'A' Class Reserve 12629 managed by the City of Busselton for the purpose of Conservation and Recreation. A formal Management Plan has been adopted by the Council and the Minister of Lands pursuant to section 49 of *the Land Administration Act 1997* (WA). The Park was formed from an amalgamation of six separate reserves in 1993 and currently comprises 16 lots. The management of the Park is supported by Council, City Officers and the Meelup Regional Park Working Group. At present, the Meelup Regional Park Working Group includes representatives from the City of Busselton and the community.

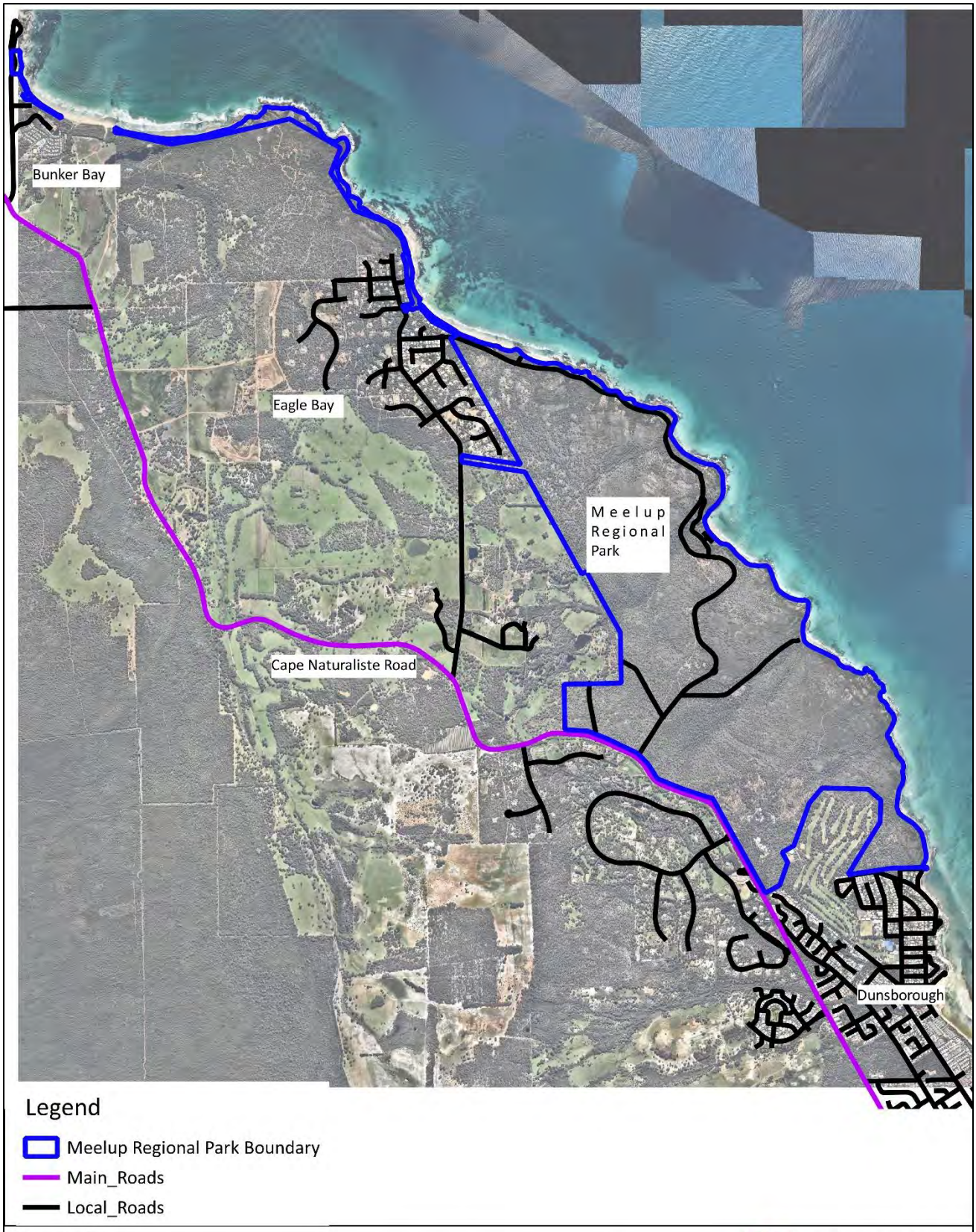

Figure 1:

Boundary, Meelup Regional Park

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Date: June 2019
Created by: Sue Brand
Image Source: NearMap, May 2019
Datum: GDA 94

2.0 Site Characteristics

2.1 Regional Context

According to Interim Biogeographical Regionalisation of Australia (IBRA) descriptions, Meelup Regional Park is located within the Jarrah Forest Bioregion, and which comprises two major divisions, namely the Jarrah Forest 1 (JF1 – Northern Jarrah Forest subregion) and Jarrah Forest 2 (JF2 – Southern Jarrah Forest subregion). Meelup Regional Park is located on the narrow north-west extension of the region within the JF2 subregion, which is broadly characterised as being a duricrusted plateau of the Yilgarn Craton, with dominant vegetation including Jarrah-Marri forest on laterite gravel, with Agonis shrublands on eluvial and alluvial deposits (Hearn, Williams, Comer, and Beecham, 2002).

2.2 Climate

The climate experienced in the area is Mediterranean, with dry, hot summers and cool, wet winters. According to the Bureau of Meteorology Cape Naturaliste, Station ID: 09519 (2019):

- average rainfall is 800.7 mm pa, with the majority falling between April and October
- average maximum temperature ranges from 16.4 ^{o}C in winter to 25.9 ^{o}C in summer, with the highest recorded maximum being 40.6 ^{o}C
- average minimum temperatures range from 10.1 ^{o}C in winter to 15.7 ^{o}C in summer, with the lowest recorded minimum being 3.7 ^{o}C
- predominant wind directions include easterlies and westerly and south westerlies throughout the year, with an average wind speed of 29.7 km/h and gusts of more than 100 km/h.

Note that summer weather conditions contribute to bushfire threat through mid-level disturbances bringing unstable atmospheric conditions from the north or north-west that result in thunderstorms and the potential for lightning strike as an ignition source.

2.3 Topography and Slope

Meelup Regional Park is located on the shores of Geographe Bay, rising from 0 m AHD up to 100 m AHD near Cape Naturaliste Road (Figure 2). Slope ranges from 0 – 5^{o} in some coastal locations, up to 20^{o} or more in creek lines and gullies, and near granite outcrops. Accordingly, the site has some particularly steep areas that mean access on foot and vehicle can be very difficult. The topography and slope will be a consideration during ongoing management and when responding to wildfires.

2.4 Geology and Soils

The geology of a location relates to its physical history, including the rocks of which it is composed and the change processes such as erosion, accretion, mountain building and soil formation over time that it is/has been undergoing. The local geology and soils determine the plant species that can be supported, along with the fauna species for which they provide habitat, and thus is the basis for the character of Meelup's biology and landscape.

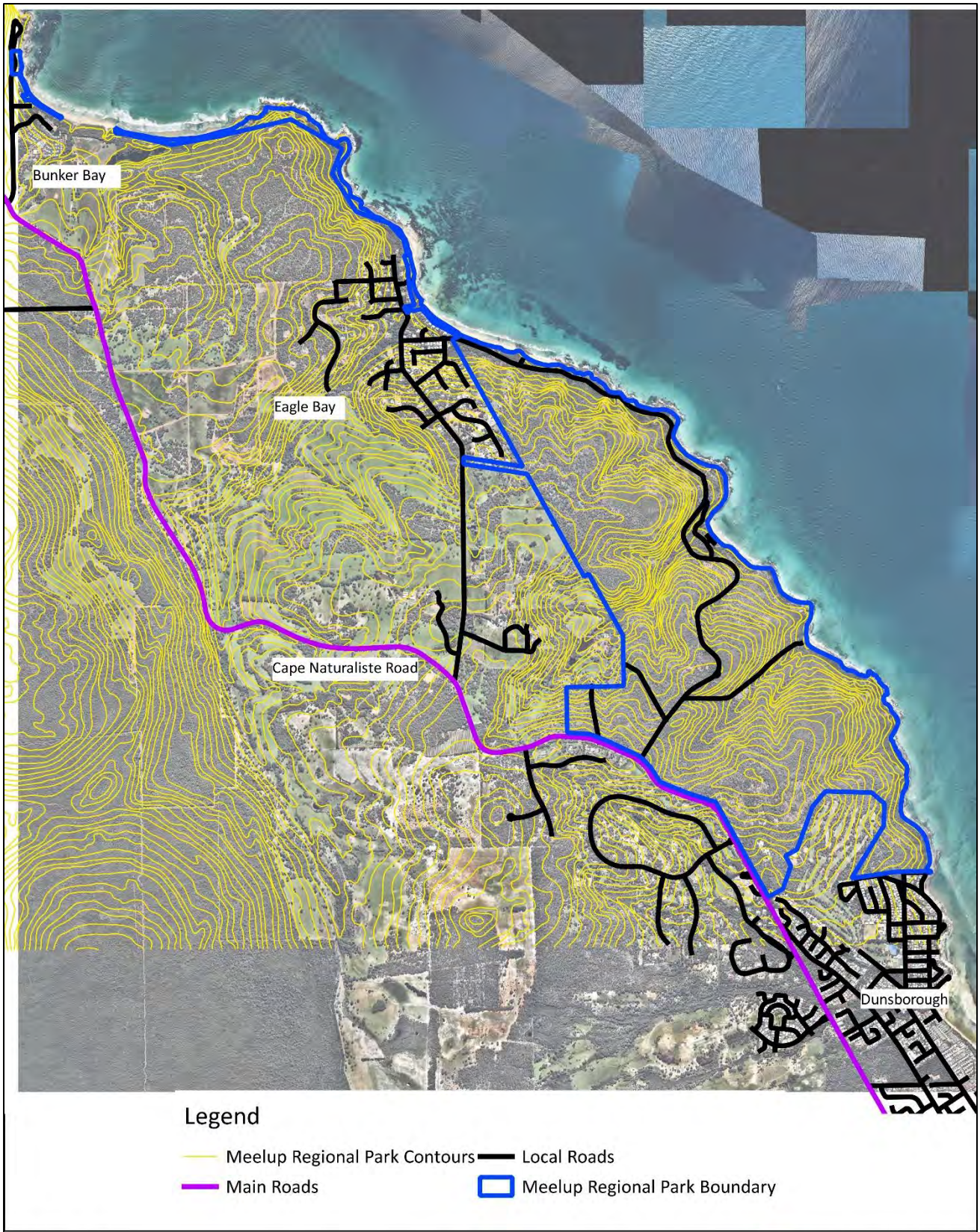

Figure 2:

Site Contours
Meelup Regional Park

Client: City of Busselton
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Image Source: NearMap, May 2019
Datum: GDA 94

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2.4.1 Geology

Meelup Regional Park is located west of the Dunsborough Fault, within the Leeuwin Complex. It provides the transition between the higher lands and rocky outcrops of the Leeuwin-Naturaliste Ridge to the west and the flat, sandy coastal plains to the east. The gneiss present within the Leeuwin Complex is metamorphic in origin, having been subjected to intense heat and pressure over a 600-million-year period between 530 – 1100 Ma ago (Smurthwaite, 2017 and 2019). Rocky outcrops associated with the gneiss are present in approximately 60% of the Park, including the coastal headland areas, hill crests, ridge slopes, stream beds, and escarpments. The second major rock type present within Meelup is laterite, which developed through weathering processes 25 – 40 Ma ago. Laterite is present in the northern, southern and western sections of the Park, with weathering over time resulting in clay soils, ferricrete duricrust, weathered bedrock and bedrock (Smurthwaite, 2019).

The rocky areas often have no or shallow soils, and thus influence the type of vegetation that occurs in their vicinity. Within Meelup, the gneiss is associated with the presence of landforms that are designated as granitic aprons and heath areas that are underlain by the gneiss. As several threatened and priority listed flora species and the threatened ecological community are located on these landforms, their presence needs to be considered when developing and implementing bushfire management strategies for the Park.

2.4.2 Soils

Soil landscape mapping activities carried out during the *Busselton, Margaret River and Augusta Land Capability Study* (Tille and Lantzke, 1990), determined that three soil landscape mapping systems are present within Meelup Regional Park (Table 1), with ten broad soil types associated with these (Department of Primary Industries and Regional Development, 2019a, b). Finer scale mapping of these soils was undertaken by Leonard (1991) and Smurthwaite (2017) (Table 2), with a simplified geology and soil map based on Smurthwaite's data provided in Figure 3).

Table 1: Soil Landscape systems of Meelup

Landscape Zone	Landscape System	Description
216	Cowaramup Uplands System	Lateritic plateau in the Leeuwin Zone. Sandy gravel, loamy gravel and grey sandy duplex. Jarrah-marri forest.
216	Gracetown Ridge System	Limestone ridge in the coastal edge of the Leeuwin Zone. Yellow deep sand and red deep sand. Coastal scrub, peppermint woodland and jarrah-marri-karri forest.
216	Wilyabrup Valleys System	Granitic valleys in the Leeuwin Zone. Loamy gravel, sandy gravel and loamy earth. Jarrah-marri-karri forest.

(Source: Department of Primary Industries and Regional Development, 2019a; Tille and Lantzke, 1990)

Table 2: Lithology and soils of Meelup Regional Park

Lithology	Name	Description	Material	Geology
S_1	Calcareous sand	White, fine – to coarse grained, sub-rounded quartz and shell debris; also, sub-rounded lithic pebbles	Unconsolidated	Safety Bay Sand mobile dunes
MSC_1	Clayey sandy silt	Pale brown, angular to rounded sand; low cohesion	Unconsolidated	Alluvium
GN	Gneiss	Medium-grained mesocratic gneiss	Rock	Gneiss
G_2	Gravel	Brown to reddish brown, ferruginous, pisolithic; occasionally cemented in a clay-silt matrix, moderately sorted	Unconsolidated	Laterite
Smg_4	Gravelly silty sand	Moderate brown to dark yellowish brown, fine to coarse grained, poorly sorted quartz with variable silt content	Unconsolidated	Alluvium
LA_1	Laterite	Massive and cemented, occasionally vesicular, up to 4 m in thickness; overlies mottled and/or palled clays, sometimes overlain by a ferruginous gravel set in a clay-sand matrix	Rock	Laterite
Ls_1	Limestone	Light, yellowish brown, fine to coarse grained, sub-angular to well-rounded quartz, with shell debris and a trace of feldspar, kankar at surface common	Rock	Tamala Limestone
S_6	Sand	Light grey, fine to coarse grained, angular to sub-rounded quartz with some feldspar; moderately sorted, loose	Unconsolidated	Colluvium
Sgm_2	Silty gravelly sands	Moderate brown to reddish brown, mottled, fine to coarse grained quartz; trace of feldspar, pisolithic gravels, variable silt content	Unconsolidated	Colluvium
Gsm_2	Silty sandy gravels	Moderate brown, mottled, pisolithic gravels and quartz; variable silt content, often thinly overlying gneiss (GN)	Unconsolidated	Colluvium

(Source: Leonard, 1991; Smurthwaite, 2017)

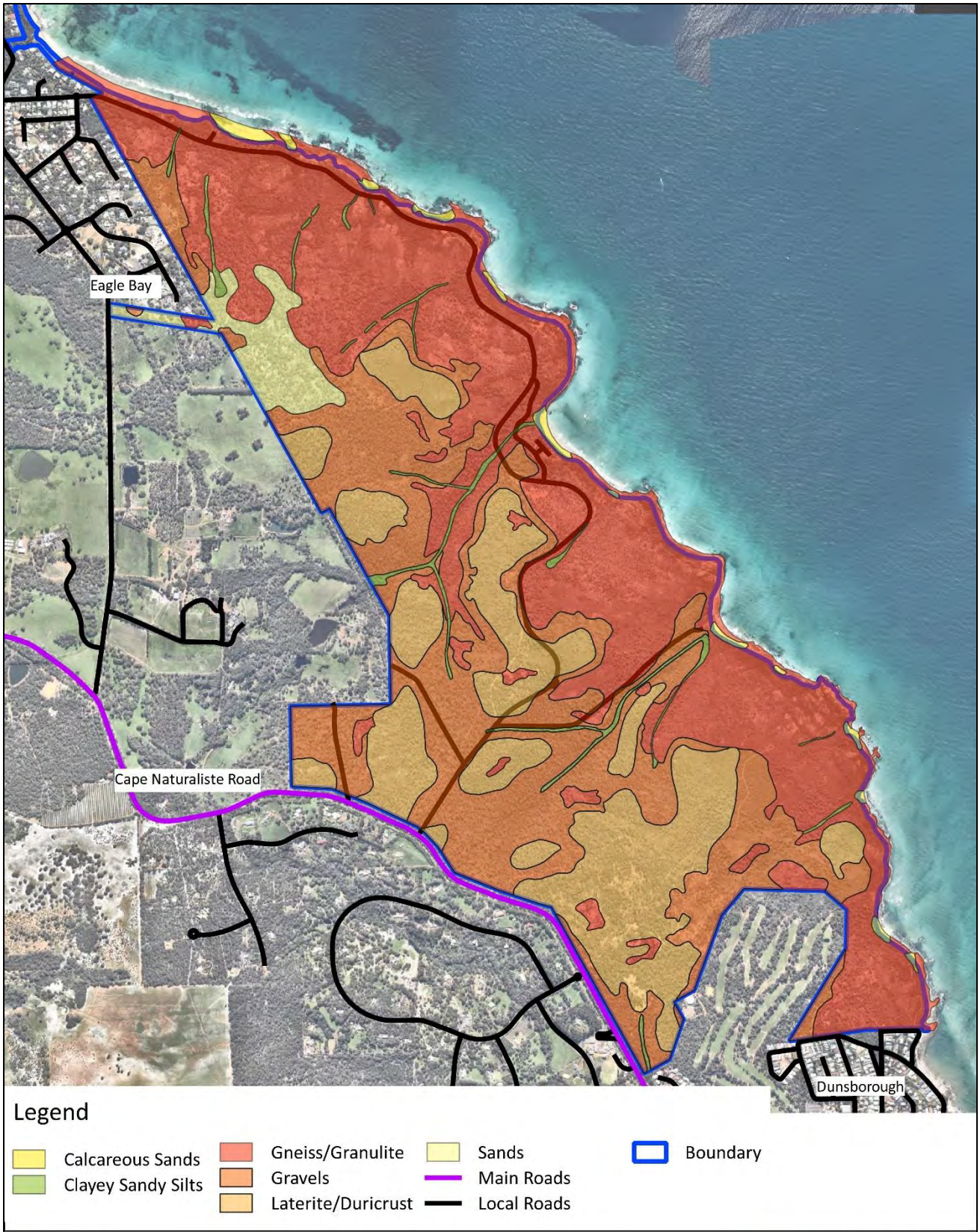

Figure 3:

Geology, after Smurthwaite 2017
Meelup Regional Park

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Date: July 2019
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Image Source: NearMap, May 2019
Datum: GDA 94

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2.5 Vegetation

The vegetation of an area is directly associated with its geology, aspect, climatic conditions and position within the landscape. The presence of rocky outcrops with shallow soils, as well as areas of deeper soils mean several vegetation complexes have been identified within Meelup Regional Park.

2.5.1 Vegetation Complexes

Mapping of vegetation complexes within the forested areas of the southwest of Western Australia according to their landform, soils and climate was undertaken by Mattiske and Havel in 1998, with a report documenting the mapping process finalised in 2000 (Havel and Mattiske, 2000). Five complexes were identified within Meelup (Table 3, Figure 4), with the dominant complex being the Wilyabrup (Wr) associated with the steep rocky slopes along the coastline.

2.5.2 Vegetation Associations

Vegetation association mapping was carried out by Webb (2013) during the Meelup flora and vegetation survey works, with each association showing a similar structure and dominant species in relation to the over, middle and understorey. Nine vegetation associations were indicated by Webb (Table 4, Figure 5).

Table 3: Meelup vegetation complexes as per Mattiske and Havel (1998 and 2000)

Complex	Description	Soils	Vegetation
Cowaramup (C2)	Associated with the mildly undulating uplands of the Margaret River Plateau north of Cowaramup	Gravely duplex soils and laterite outcrops	Open Forest of *Eucalyptus marginata* and *Corymbia calophylla*, over *Persoonia longifolia*, *Banksia grandis*, *Xylomelum occidentale*, with an understorey of shrubs and herbs including *Xanthorrhoea preissii*, *X. gracilis*, *Adenanthos barbiger*, *Hakea amplexicaulis*, *H. lissocarpha*, and *Daviesia incrassata*
Kilcarnup (KbE)	Associated with the exposed dunes in the near coastal areas of the Leeuwin Block	Lime rich sands with low water holding capacity	Shrubland of *Melaleuca huegelii*, *Pimelea ferruginea*, *Olearia axillaris*, *Spyridium globulosum*, *Acacia littorea*, with sedges *Lepidosperma gladiatum* and *Ficinia nodosa*
Wilyabrup (W2) and (Ww2)	Associated with riverine valleys incised into the Margaret River Plateau north of Cowaramup	Yellow duplex soils to red earths	Open Forest of *Corymbia calophylla* with a mixture of *Eucalyptus patens* on lower slopes and *E. marginata* on upper slopes, over *Hakea lasianthoides*, *Agonis flexuosa*, *Banksia grandis* and *Persoonia longifolia*, with an understorey that includes *Taxandria linearifolia*, *Mirbelia dilatata*, *Acacia alata*, *Astartea fascicularis* on the floor, with *Pteridium esculentum*, *Hovea elliptica*, *Leucopogon verticillatus*, *Macrozamia riedlei*, *Logania vaginalis* and *Opercularia hispidula* on the slopes
Wilyabrup (Wr)	Associated with steep rocky slopes of valleys incised into the Margaret River Plateau	Shallow duplex soils	Vegetation ranges from Lithic Complex, Herbfield through to Heath to Woodland of *Corymbia calophylla* with *Agonis flexuosa* and *Banksia grandis*, with shrubs and herbs consisting of *Hakea lissocarpha*, *H. trifurcata*, *Hibbertia hypericoides*, *Gastrolobium spinosum*, *Calothamnus sanguineus*, *Hypocalymma angustifolia*, *Hemigenia incana*, *Dodonaea ceratocarpa*, *Verticordia plumosa* and *Cryptandra arbutiflora*

Table 4: Meelup plant communities as per Webb (2013)

Community Name	Community Number	Description	Location
Banksia Woodland	3	Low Woodland to Low Open Forest, tress < 10 m, with foliage cover ranging from 10 – 70%; dominated by *Agonis flexuosa, Banksia attenuata*, *B. littoralis*, *Corymbia calophylla*, *Eucalyptus patens* and *Nuytsia floribunda* over a mixed shrub layer of *Acacia pulchella*, *Bossiaea eriocarpa*, *Gompholobium tomentosum*, *Jacksonia furcellata* and *Stirlingia latifolia*	Grey sandy soils associated with wetland features lower in the landscape
Calothamnus graniticus Closed Heath	5	Closed to Open Heath dominated by shrubs 1 – 2 m, 70 – 100% or 30 – 70% foliage cover; dominated by *Calothamnus graniticus* subsp. *graniticus*, with other shrubs including *Boronia tenuis*, *Commersonia cygnorum*, *Darwinia citriodora*, *Phyllanthus calycinus* and *Thryptomene saxicola*	Areas of massive exposed granite with pockets of shallow loam soils
Coastal Vegetation	9	Small areas of coastal vegetation on calcareous sands, along with a combination of the various Meelup vegetation associations, particularly the Calothamnus graniticus heath, the granitic apron, and the jarrah/marri forest, within the coastal fringe; the coastal vegetation on calcareous sands is dominated by *Acacia cochlearis*, *A. cyclops*, *Spyridium globulosum* open heath over *Lepidosperma gladiatum* sedgeland.	Calcareous sands, loamy soils
Creek Lines	8	Sedgeland dominated by *Lepidosperma tetraquetrum,* with associated species including *Melaleuca viminea*, *Agonis flexuosa*, *Acacia divergens*, *Hemigenia incana*, *Leucopogon hirsutus*, *Tremandra diffusa* and *Viminaria juncea*	Seasonal creek lines that maintain subsoil moisture, with loam soils
Granitic Apron	7	Low Shrubland < 1 m, with 10 – 30% foliage cover over a diverse range of annually renewed herbs; common taxa includes: *Melaleuca viminea*, *Babingtonia camphorosmae*, *Daviesia horrida*, *Thomasia foliosa*, *Aphelia cyperoides*, *Borya scirpoidea*, *Caladenia caesarea* subsp. *maritima*, *Cicendia filiformis* and *Podolepis lessonii*	Small deposits of clay overlying shallow granite that are saturated in winter months

Community Name	Community Number	Description	Location
Granitic Heath	6	Shrubs < 1 m, 70 – 100% foliage cover, with the occasional tree; dominated by *Gastrolobium spinosum*, *Allocasuarina humilis* and *Dodonaea ceratocarpa*, with a range of species that are otherwise uncommon within Meelup, including *Astroloma pallida*, *Chorizema aciculare*, *Cryptandra arbutiflora*, *Grevillea trifida*, *Petrophile striata* and *Stachystemon virgatus*	Shallow lateritic and/or loamy soils over granite
Jarrah/Marri Forest – Laterite soils	1, 1b	Trees > 10 m, 30 – 70% foliage cover, dominated by *Corymbia calophylla*, *Eucalyptus marginata*, *Agonis flexuosa* and *Persoonia longifolia* over a mixed shrub layer that includes *Acacia pulchella*, *Banksia dallanneyi*, *Calothamnus sanguineus*, *Hakea amplexicaulis* and *Xanthorrhoea preissii*	Uplands and upper slopes on relatively deep lateritic gravelly loam, extending down into the mid to lower slopes
Jarrah/Marri Forest – Loam soils	2, 2b	Trees > 10 m, 30 – 70% foliage cover, dominated by *Corymbia calophylla*, *Eucalyptus marginata*, *Agonis flexuosa* and *Persoonia longifolia* over a mixed shrub layer that includes *Acacia pulchella*, *Banksia dallanneyi*, *Calothamnus sanguineus*, *Hakea amplexicaulis* and *Xanthorrhoea preissii*	Shady northern valley slopes of the Meelup Brook with sandy loam soils, extending down into the mid to lower slopes
Jarrah/Marri Woodland	4	Low, sparse, often multi-stemmed trees < 10 m with 10 – 30% foliage cover; dominated by *Banksia grandis*, *Corymbia calophylla*, *Eucalyptus marginata*, *Nuytsia floribunda* and *Persoonia longifolia* over a mixed shrub layer that includes *Acacia stenoptera*, *Allocasuarina humilis*, *Banksia dallanneyi*, *Grevillea quercifolia*, *Hibbertia cunninghamii* and *Melaleuca systena*	Shallow soils over granite and massive laterite

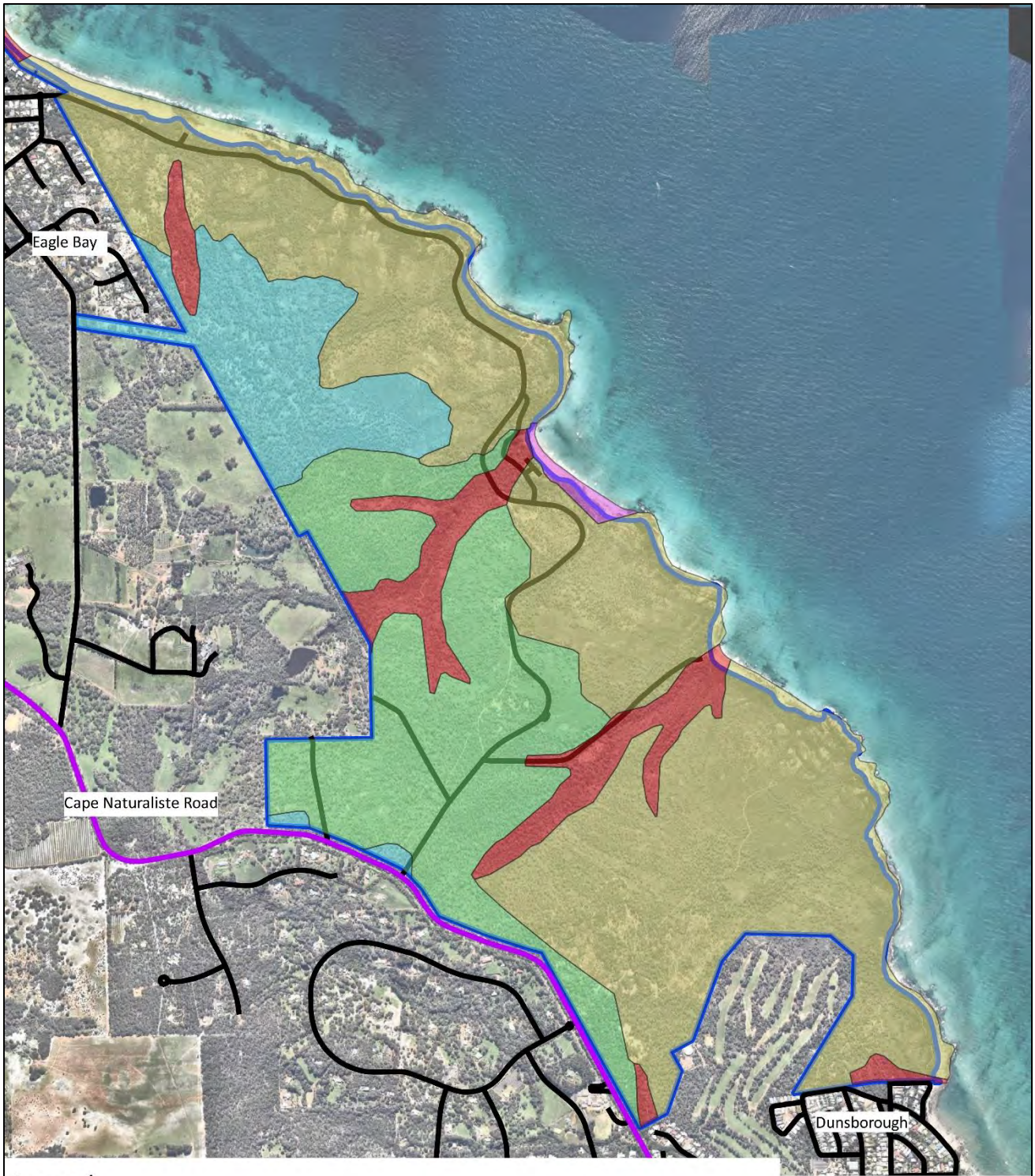

Figure 4:

Vegetation Complexes, after Mattiske and Havel, 1998
Meelup Regional Park

Client: City of Busselton
Date: July 2019
Created by: Sue Brand
Image Source: NearMap, May 2019
Datum: GDA 94

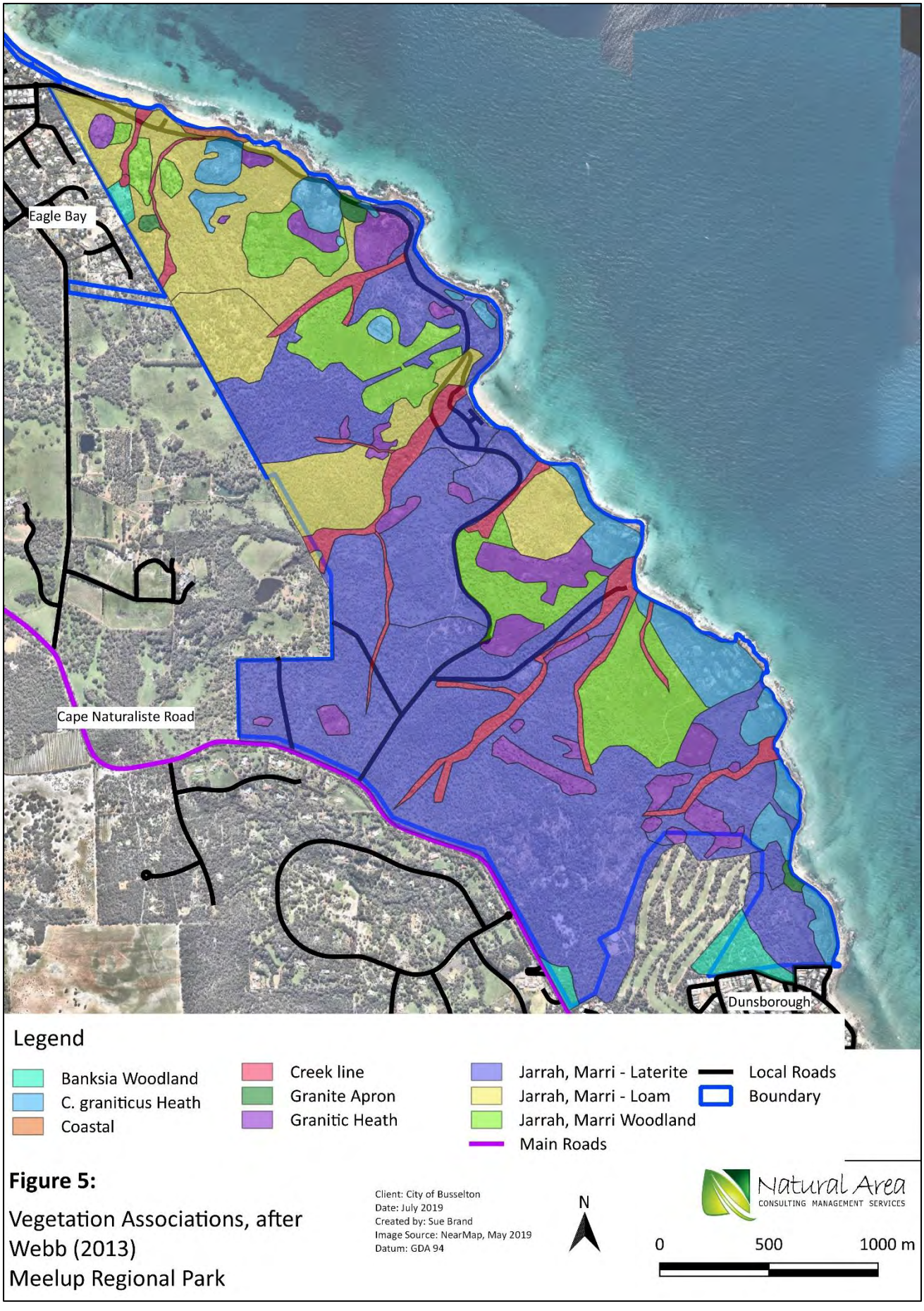

Figure 5:

Vegetation Associations, after Webb (2013)
Meelup Regional Park

2.6 Fauna

Meelup Regional Park supports a diverse array of fauna species. A Level 2 survey carried out by zoologists Shane Priddle (SW Environmental) and Greg Harewood (Zootopia Environmental Services) for NGH Environmental (2015) in spring 2014 confirmed the presence of 102 vertebrate fauna species, comprising:

- 19 mammals
- 17 reptiles
- 59 birds
- 7 amphibians.

Eight of the fauna species recorded were conservation significant, and included two priority listed species, four threatened species, and two migratory species; conservation significant species are discussed further in Section 2.7.

Fauna habitat was generally consistent with the vegetation associations identified by Webb (2013), with additional habitat types associated with wetland areas and creek lines. Several ecotones between treed and cleared areas, the presence of hollow-bearing trees, fallen trees, rocky outcrops and crevices, and seasonal pools and soaks. This variation in habitat contributes to the range of species recorded during the 2014 and previous surveys.

2.7 Environmental Values

Meelup Regional Park contains significant environmental values including landscape amenity, flora, fauna and ecological communities. Fire has the potential to impact on flora, fauna and ecological communities if it is:

- too intense, or the temperature high enough to kill plants so that they do not regenerate afterwards
- too frequent, with the burn interval not allowing slower growing/maturing species to reach maturity, flower, and set seed
- carried out during the fauna breeding season, when there is the potential for mothers and young to have difficulty escaping
- if it is too large, then animals will have no refuge.

Potential impacts include:

- injury or death of fauna
- local extinction of flora species and ecological communities
- 'shift' in flora and fauna species present due to declines of some species and/or communities, allowing others to fill ecological 'gaps'
- promote the growth of weed species, including those known to be flammable, such as Blowfly Grass (*Briza maxima*) and Wild Oat (*Avena barbata*) which dies back in summer leaving dead material that can readily ignite.

Thus, the presence of conservation significant species needs to be considered during ongoing bushfire management and wildfire response activities to ensure their continued presence over time within the reserve. There are several declared rare and priority listed flora, fauna and ecological communities (Table 5) that are listed under the *Biodiversity Conservation Act 2016* (WA) and/or the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth), and thus are considered conservation significant; an explanation of conservation codes is provided in Appendix 1.

Table 5: Conservation significant terrestrial species

Species Name	Common Name	Cons Code and Ranking (WA)	Cons Code (Cwlth)
Flora			
Acacia lateriticola var. Glabrous variant		P3	-
Boronia tenuis	Blue Boronia	P4	-
Caladenia busselliana	Bussell's Spider Orchid	T (Cr)	En
Caladenia caesarea subsp. maritima	Cape Spider Orchid	T (Cr)	En
Caladenia excelsa	Giant Spider Orchid	T (Cr)	En
Caladenia viridescens	Dunsborough Spider-orchid	T (Cr)	En
Calothamnus graniticus subsp. graniticus		P4	-
Eucalyptus x phylacis	Meelup Mallee	T (Cr)	En
Eucalyptus rudis subsp. cratyantha		P4	-
Eucalyptus virginea		P4	-
Meionectes tenuifolia		P3	-
Stylidium lowrieanum	Lowrie's Triggerplant	P3	-
Thelymitra variegata	Queen of Sheba	P2	-
Fauna			
Calyptorhynchus baudinii	Baudin's Black Cockatoo	T (En)	En
Calyptorhynchus banksia naso	Forest Red-tailed Black Cockatoo	T (Vu)	Vu
Calyptorhynchus latirostris	Carnaby's Cockatoo	T (En)	En
Falco peregrinus	Peregrine Falcon	OS	-
Falsistrellus mackenziei	False Pipistrelle	P4	-
Isoodon fusciventer	Southern Brown Bandicoot	P4	-
Merops ornatus	Rainbow Bee-eater	IA	IA
Ninox connivens connivens	Barking Owl	P3	-
Notamacropus irma	Western Brush Wallaby	P4	-
Phascogale tapoatafa wambenger	Southern Brush-tailed Phascogale	CD	-
Pseudocheirus occidentalis	Western Ringtail Possum	T (Cr)	Cr
Pandion haliaetus	Osprey	IA	IA
Ecological Communities			
Calothamnus graniticus heaths on south-west coastal granite (Meelup Granite)		T (Vu)	-

(Sources: Webb, 2013; DBCA, undated)

2.8 Social Values

Meelup Regional Park is popular with local residents and visitors to the area throughout the year, with social values including:

- Bush walking
- landscape and amenity values including rocky outcrops, riparian creek line areas and coastal rocky headlands and beaches
- bird watching

- wildflower appreciation
- photography
- picnics and other forms of recreation
- mountain bike riding.

This popularity means that while there is a safety risk to Park users if a fire ignites during everyday use, it is not feasible to close the park to the public on days when the fire danger rating is extreme or catastrophic due to its size and multiple points of entry to pedestrians and trail-bike riders (Figure 8).

2.9 Aboriginal Cultural Burning Practices

Meelup is a significant cultural site to the local Wadandi people. Consultation with representatives of the Wadandi provided an insight into the burning practices undertaken by traditional custodians. Burns are carried out during the season of Djeran, which coincides with the mid-late autumn (Figure 6). Before burns are undertaken, conditions need to be favourable, and include

- sufficient moisture to ensure the fire does not spread uncontrollably, which is typically after the first 'little' rains but before the 'large' (winter) rains set in
- wind is very low
- more humid days where the moisture in the air assists with controlling the spread of fire.

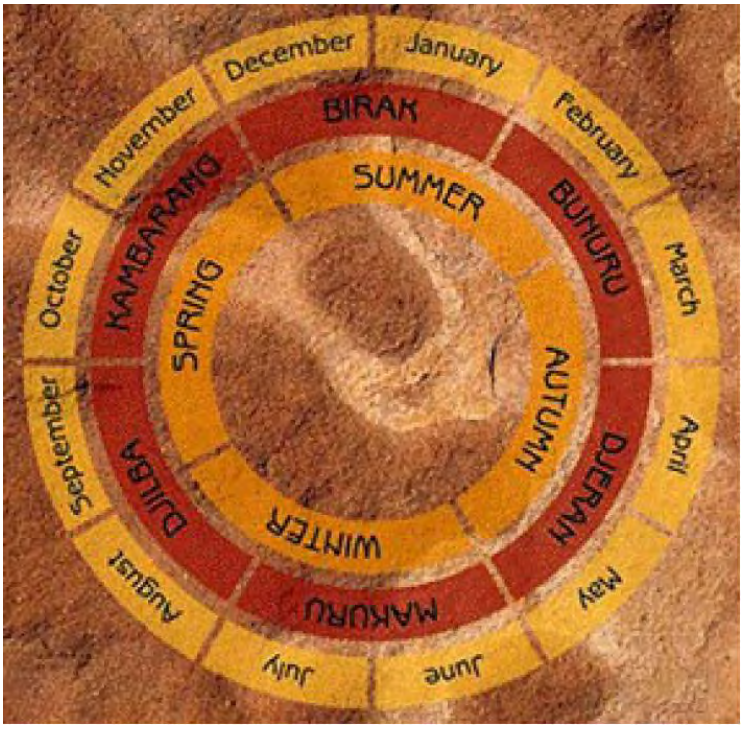

Figure 6: Six seasons of the Wadandi People (Source: Undalup Association, 2019)

When burns are carried out, the following are implemented:

- the area to be burnt is walked prior to the burn commencing
- burns are cool/cold (very low intensity), commencing at dusk when the sun left the sky, which also typically coincides with the time when daily winds settle
- the family group is involved with the burn, with an allocation of tasks

- the grass prons (needles) of the Balga (*Xanthorrhoea preissii*) is used as a drip torch to ignite the fire
- the family walks with the fire, using fronds of the Peppermint Tree (*Agonis flexuosa*) to beat out flames in areas where fire is to be excluded and to prevent flames and smoke getting into the canopy (flame height typically no more than 1 m above ground level)
- burn areas are limited.

These practices meant that:

- the burning season is short, with often a very narrow window of time when burns could be carried out safely without causing 'imbalance' within
- over time, the area was burnt progressively over time, not all at once
- smoke did not get into the tree canopy, meaning that respiration and photosynthesis processes can continue without interference
- a patchy mosaic of fuel was maintained, creating refuges for fauna, including invertebrate species
- animals within the canopy of trees were protected from smoke and flames
- catastrophic, high intensity fires were very unlikely.

2.9.1 Recommendations for Fire Management within Meelup

Based on the knowledge and information provided by the Wadandi representatives, the following are recommended to mimic traditional custodian burning practices:

- walk the site to determine the fire line of where the burning should be confined to
- undertake cool/cold burns during autumn, the time of year they would be carried out by traditional custodians
- burn at dusk when there is sufficient moisture and low winds
- walk with the fire and use appropriate tools, such as wet sacks or similar, to control fire path and flame height to prevent smoke reaching tree canopies and flames extending more than 1 m up tree trunks, or preventing the fire spreading into areas where it is not intended at the time
- continue to burn in random mosaics over several years, also considering the recommended burn frequency according to the ecological values present within Meelup
- maintain normal controls, such as fire trucks and similar, on site as a precautionary measure
- use traditional methods to protect areas such as granite outcrops, using fire to create a boundary/buffer around the area to be protected
- don't burn all the grass trees (Balga) at the same time.

3.0 Bushfire Resources

3.1 Water Supplies

Water supplies that can support fire suppression activities within Meelup Regional Park include:

- hydrants
- various bores and windmills
- dams.

All water points are signposted.

3.1.1 Hydrants

Hydrants that provide water under pressure are present within the Eagle Bay and Dunsborough townsites, and the Meelup Hills Estate. A hydrant is present on Sheens Road approximately 150 m north of Meelup Beach Road and another along the park boundary just south of Eagle Bay. (Figure 7)

3.1.2 Bores and Windmills

Several bores and windmills are available within the area surrounding Meelup Regional Park (Figure 7).

3.1.3 Tanks

Several tanks are available in the area surrounding Meelup Regional Park (Figure 7).

3.1.4 Dam

A dam of adequate size for the provision of firefighting water is present in Wise Winery Vineyard just east of the Meelup Regional Park boundary (54 Sheens Road). It is accessible via Sheens Road or via Eagle Bay Road further west (Figure 7).

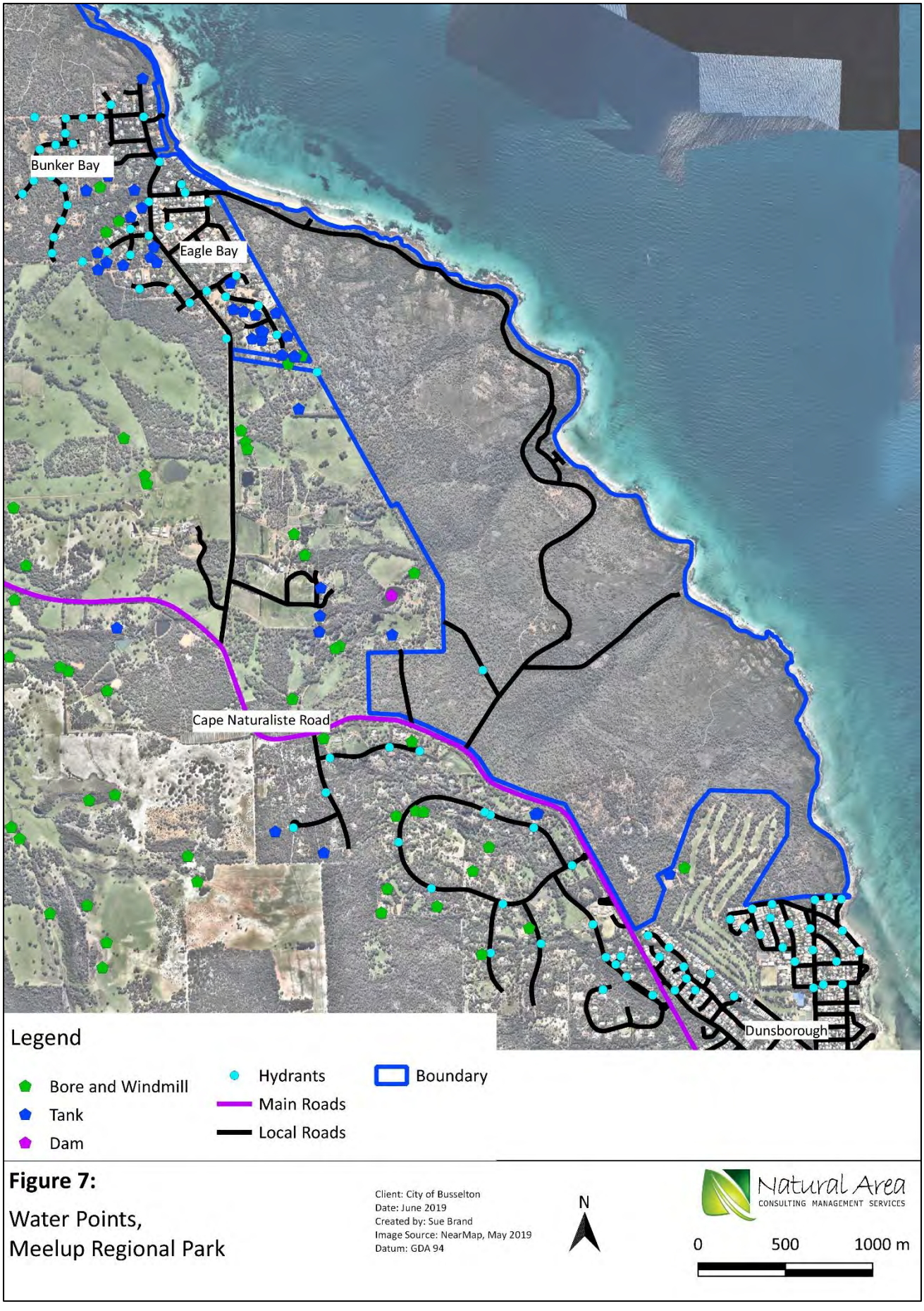

Figure 7:

Water Points,
Meelup Regional Park

Client: City of Busselton
Date: June 2019
Created by: Sue Brand
Image Source: NearMap, May 2019
Datum: GDA 94

3.2 Firebreaks

Trafficable firebreaks are present (Figure 8):

- along the western boundary of Meelup Regional Park, extending from Burton Road to end of the row of houses in Mercator Way in Eagle Bay (1)
- between Sheens Road and Meelup Beach (2)
- at the southern end of Eagle Bay in the vicinity of Lot 5125 Eagle Bay Road (3)
- as a 'loop' approximately 50 m east of the main firebreak; it extends from the southern houses in Mercator Way down to approximately 100 m north of the Lot 5125 boundary (4).

Firebreaks are gated and accessible using City of Busselton key number 56. No additional firebreaks are planned.

Roads in the northern portion of Dunsborough act as firebreaks between houses and Meelup, with access to the Water Corporation main tank for Dunsborough, the golf course and walking trails within Meelup east of the golf course also acting as alternative firebreaks. Additional alternative firebreaks (Figure 8) are present in the form of:

- bituminised local and main roads, including Eagle Bay – Meelup Road, Castle Rock Road, Sheens Road and Cape Naturaliste Road
- internal gravel local roads, such as Burton Road and the northern portion of Sheens Road
- internal walking tracks and bike trails
- Dunsborough Golf Course.

3.3 Fire Management Cells

Meelup Regional Park is divided into 11 fire management cells ranging in area from 18 – 110 ha, with no changes planned to the current boundaries. Three cells are divided into two components, with the 'B' cells (1B, 11B, 12B) being strategic buffers that are considered separately (Figure 9). Cell 5 was later amalgamated into Cell 6, hence its absence from discussion and mapping within this document.

The following were considered when cell boundaries were originally determined:

- sufficient cells to ensure the mosaic accounts for all major vegetation types
- basis of each cell is the main vegetation association
- each cell is large enough to be practical and to ensure post-burn seedlings are not over-grazed by kangaroos
- a burning cycle that included spring, autumn, and no-burn periods
- burning is avoided in areas with a steep northerly or north-westerly slope covered by heath or stunted jarrah communities due to difficulties carrying out burns safely
- some locations may be burnt less frequently or left out of the burning cycle according to their ecological and/or conservation significance
- presence of conservation significant flora, fauna, and ecological communities
- location of strategic firebreaks
- presence/absence of dieback.

The fire management cells contribute to hazard reduction burns in that they allow a mosaic approach to burning to be carried out across the reserve whilst also retaining older fuels that allow the continued ecological function of flora and vegetation. Burning is typically carried out in a portion of the cell rather than the entire cell, allowing a finer mosaic of fuels to be created that provides for the continued habitat, refuge areas and food sources for fauna species, particularly threatened species such as the Western Ringtail Possum.

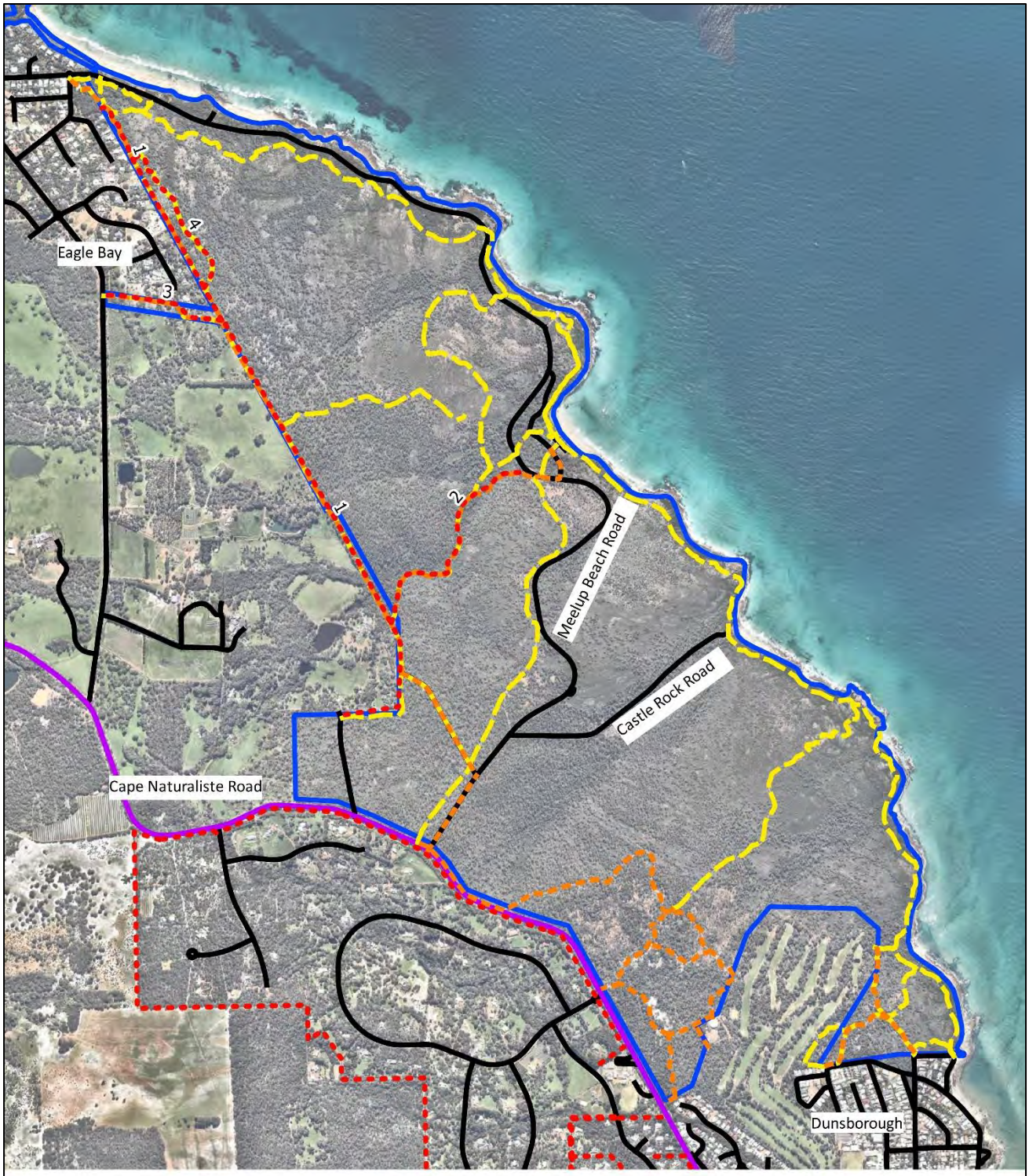

Figure 8:
Firebreaks and Trails
Meelup Regional Park and surrounds

Client: City of Busselton
Date: June 2019
Created by: Sue Brand
Image Source: NearMap, May 2019
Datum: GDA 94

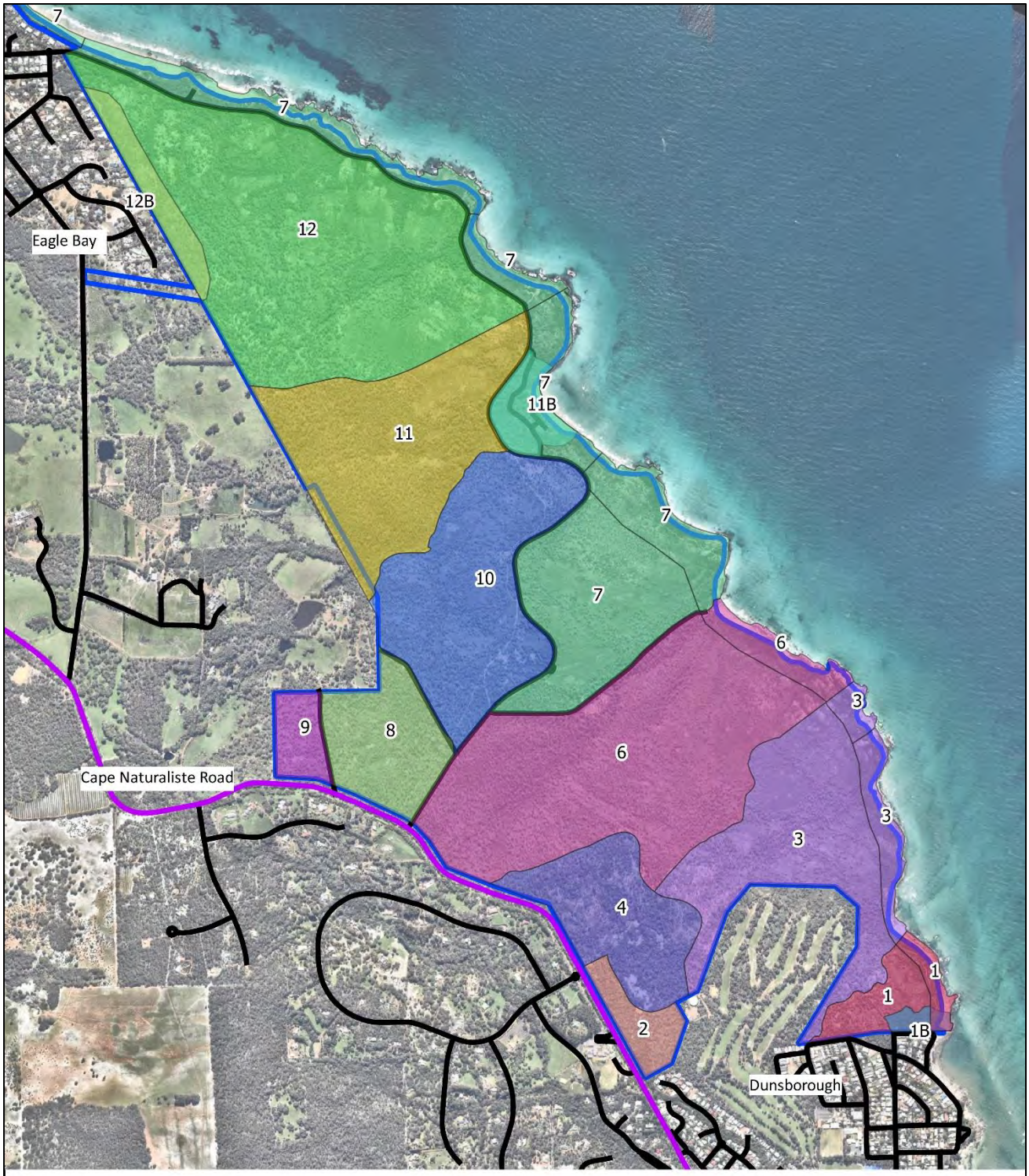

Figure 9:
Fire Management Cells, Meelup Regional Park

Client: City of Busselton
Date: June 2019
Created by: Sue Brand
Image Source: NearMap, May 2019
Datum: GDA 94

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3.4 Access and Egress

Access and egress from Meelup Regional Park is via the existing network of local and main roads, walking trails and firebreaks (Figure 8). No additional access is planned.

3.5 Firefighting Resources

Firefighting resources are available at local volunteer bushfire brigades (Table 6). First responders to fires in Meelup Regional Park will be from Dunsborough, Eagle Bay, Yallingup, Busselton, and private landowners. Additional support is available from brigades at Vasse, Sussex, Willyabrup and Metricup. Present within all firefighting vehicles are:

- a complete set of gate and valve box keys
- firefighting resources
- locations of internal tracks
- fire response plans for each cell.

Table 6: Firefighting resources

Brigade	Vehicle and Capability	No.	Volume (L)	Other
Dunsborough Volunteer Fire Rescue Service	4WD HSR	1	2000	
	Light tanker	1	600	
	Country pump	1	1000	
Dunsborough Volunteer Bushfire Brigade	4WD truck	2	3000	
	4WD light tanker	2	600	
Eagle Bay Volunteer Bushfire Brigade	4WD light tanker	2	600	
Yallingup Volunteer Bushfire Brigade – Rural	4WD truck 4/4	2	3000	
	4WD light tanker	1	600	
Yallingup Volunteer Bushfire Brigade – Coastal	4WD truck	2	3000	
	4WD light tanker	1	600	
City of Busselton Dunsborough Depot	Water tanker	2	10 000	
	Graders	4		
	Loaders	2		
Water bombers	Type 2 helicopter	2		Busselton
	Fixed wing	2		Bunbury
Private resources	Wise Winery unit	1		Private water tanks at Eagle Bay

If required, additional plant and equipment is available to assist with fire suppression activities from the City of Busselton and private road contractors; with requests for their deployment being directed to the Regional Duty Coordinator, as per the City's *Bushfire Control Manual*. As the City of Busselton and DBCA resources are some distance from Meelup Regional Park, they will be used as backup to the above when requested, provided they are not deployed elsewhere.

3.5.1 Backup Support

The City of Busselton maintains a list of privately-owned resources, such as trucks, loaders, and other firefighting equipment, that can assist with fire response activities as required. A copy of this information is provided to Fire Control Officers.

3.6 Strategic Buffers

A strategic buffer is a low-fuel zone of between 20 – 60 m created in locations of higher visitor use (cell 11B), or in proximity to residential areas (1B and 2 at the northern end of Dunsborough and 12B east of Eagle Bay) (Figure 9). While burning in these areas is at a higher frequency as a safety measure for human life and assets, it is necessary to ensure that conservation values are adequately considered when planning hazard reduction burns.

4.0 Site Visit Methodology

Sue Brand from Natural Area Consulting Management Services undertook a site-familiarisation visit to Meelup Regional Park on 23 May 2019. Various nodes within the reserve were walked via the internal access paths to review site characteristics and vegetation classes present, however, the entire park was not visited. Various site features were noted as observed to assist with the classification of the bushfire hazard level and development of the bushfire management plan.

4.1 Vegetation Assessment

The vegetation class and extent present within the reserve directly contributes to the associated fire risks. Vegetation class was inferred from the site visit and aerial imagery using descriptions provided in *AS 3959 – 2018 Construction of Buildings in Bushfire Prone Areas* (2018).

4.2 Bushfire Hazard Level

A bushfire hazard level assessment is a 'broad brush' assessment that assists with determining the potential intensity of bushfire according to the classified vegetation present as defined in AS 3959 – 2018, with outcomes informing bushfire management within the reserve.

4.3 Risk Assessments

Risk assessments were undertaken to determine the potential for fire within the reserve and the level of risk to nearby infrastructure and homes. The risk assessment involved a desktop fire hazard assessment and an on-ground field hazard assessment. The methodology for these evaluations were developed using information contained in *Planning for Bush Fire Protection Guidelines* V1.3 (DoPLH, WAPC and DFES, 2017) along with *AS/NZS ISO 31000:2009 Risk Management – Principles and Guidelines* and *Rural Urban Bush Fire Threat Analysis* (RUBTA) (FESA, 2003).

4.3.1 Fire Hazard Risk Assessment

The fire hazard assessment is a desktop survey that utilises aerial imagery, maps, database searches and other available information. This took into consideration several factors including risk of ignition, visitor use and fuel load. The outcome was a 'score' in the form of a hazard rating (low, medium, high or extreme). Fire management of the site was reviewed as part of the assessment process. This took into consideration ease of access, response time, water supply and resources available. The outcome was a 'score' (low, medium, high or extreme) with higher scores associated with potential or actual fire management deficiencies.

4.3.2 Field Fire Hazard Risk Assessment

The field fire hazard assessment was developed using information contained in *Planning for Bush Fire Protection Guidelines* (DoPLH, WAPC and DFES, 2017) along with *AS ISO 31000:2018 Risk Management – Guidelines* and *Rural Urban Bush Fire Threat Analysis* (RUBTA) (FESA, 2003). These assessments took into consideration environmental and human features including:

- vegetation classification
- site slope
- overhanging vegetation
- weed density

- presence of larger dead vegetation
- ecological values
- the distance to nearest fire station
- site access
- infrastructure.

Results of this assessment were used to formulate recommendations to reduce the fire hazard for properties and infrastructure.

4.4 Limitations

The observations represented the situation within Meelup Regional Park at the time of the visit in May 2019, noting that several limitations are associated with the assessment process including:

- vegetation characteristics may change at different times of the year (e.g.: annual death vs. perennial species)
- the site visit was limited to accessing several coastal tracks and roads within and adjacent to the reserve, particularly those near the coast.

As the works primarily depend on desktop and literature review activities, the site visit was sufficient to enable site familiarisation and contribute to Plan preparation.

5.0 Site Visit Outcomes

5.1 Vegetation Class

Assessment of the vegetation class as per AS 3959 – 2018 within Meelup Regional Park indicated the presence of five vegetation classes, namely Class A Forest, Class C Shrubland, Class D Scrub, low threat vegetation, and non-vegetated areas (Figure 15).

5.1.1 Class A Forest

Class A Forest is characterised by trees to 30 m, with a 30 – 70% foliage cover, typically dominated by Eucalypts, an understorey of sclerophyllous low trees or shrubs may be present (Figure 10). This vegetation class is present in the creek lines and on upland areas towards Cape Naturaliste Road.

Classification or Exclusion Clause: Class A Forest

Figure 10: Class A Forest

5.1.2 Class C Shrubland

Class C Shrubland is characterised by shrubs to 2 m with foliage cover > 30% (Figure 11). This vegetation class is found towards the coastal areas around the granite outcrops and areas with shallow soils.

Classification or Exclusion Clause: Class C Shrubland

Figure 11: Class C Shrubland

5.1.3 Class D Scrub

Class D Scrub is characterised by shrubs 2 – 6 m, with foliage cover > 30% (Figure 12). This vegetation class is found on deeper soils in and around the granite outcrops.

Classification or Exclusion Clause: Class D Scrub

Figure 12: Class D Scrub

5.1.4 Low-threat Vegetation

Low-threat vegetation is present in the form of turfed parkland areas around Meelup Beach (Figure 13). Trees present have higher canopies with the turfed understorey limiting the spread of fire in this area.

Classification or Exclusion Clause: Low-threat vegetation – exclusion clause 2.2.3.2 (f)

Figure 13: Low-threat vegetation

5.1.5 Non-Vegetated Areas

Non-vegetated areas include beaches, rocky outcrops, roads, parking areas, walk trails, and buildings within the Reserve (Figure 14).

Classification or Exclusion Clause: Non-vegetated areas – exclusion clause 2.2.3.2 (e)

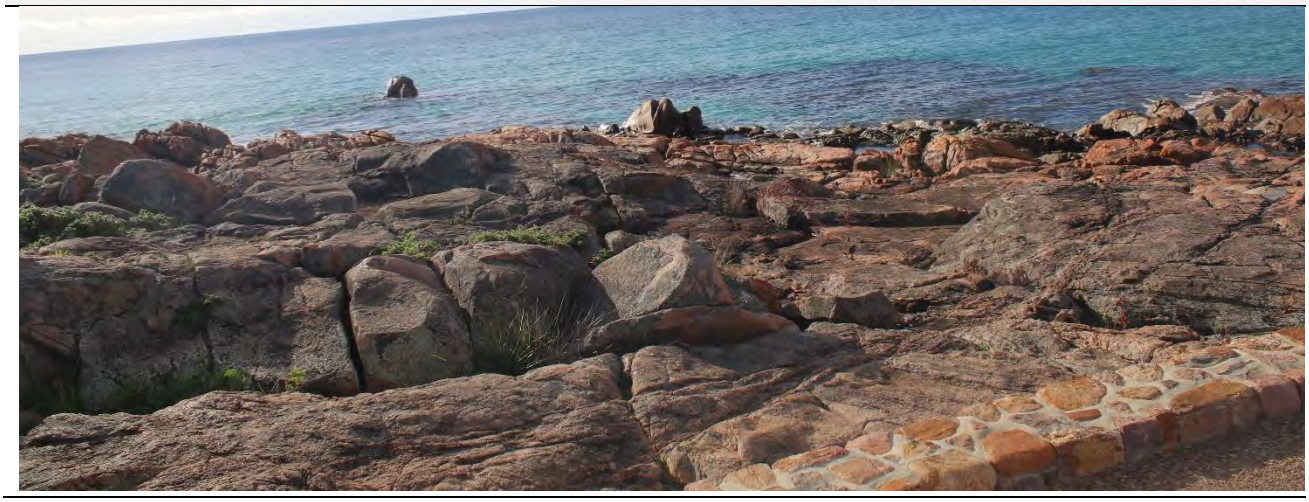


Figure 14: Non-vegetated areas

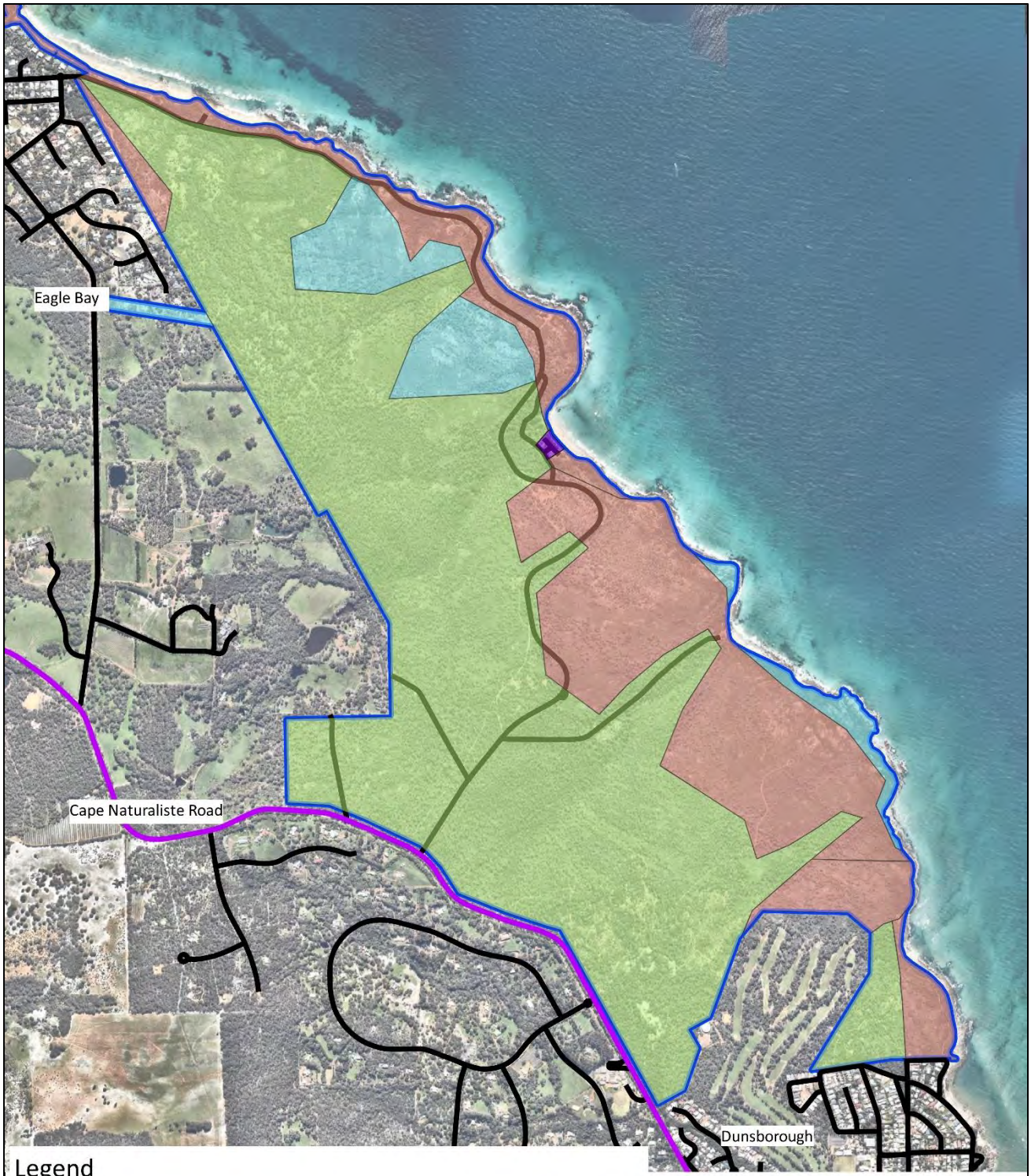


Figure 15:

Vegetation Classification as per AS 3959 - 2018, Meelup Regional Park

5.2 Bushfire Hazard Level

The site visit confirmed the presence of Class A Forest and Class D Scrub as defined by AS 3959 - 2018 within Meelup Regional Park, and according to the *Guidelines for Planning in Bushfire Prone Areas* (Department of Planning, Lands and Heritage, Department of Fire and Emergency Services, and the Western Australian Planning Commission, V1.3, 2017). These vegetation classes are considered to have an extreme hazard rating due to their vegetative form, litter build up over time, and their characteristics that promote fire. The Class C Shrubland has a moderate hazard rating, with the low-threat parkland areas within the reserve also having a moderate hazard rating due to their proximity to the bushland.

It is noted that:

- the housing and other land uses outside of the Park boundary will also have a moderate risk rating for 100 m from the edge of the bushland due to the potential of bushfire impacts such as smoke and ember attack; this risk rating will not influence current land uses, but may become relevant if changes to land use or renovations to existing properties trigger the requirements of *State Planning Policy 3.7 Planning in Bushfire Prone Areas*
- owners and occupiers of nearby properties are responsible for managing the fire risk within their property boundary, such as maintaining low fuel areas around their dwellings.

5.3 Fire-fuel Load

The fire-fuel load of a bushland area typically includes:

- surface fuel in the form of leaf litter and dry weedy grasses and herbs
- near surface fuel in the form of dead leaves, twigs and branches
- flammable vegetation.

It is noted that Smith (2003) indicates that a fuel load of 8 t/ha (tonnes per hectare) is preferred for bushland areas dominated by Jarrah and Marri, with this recommendation being based on the safety of fire response personnel during a bushfire event. However, a fuel load of 8 t/ha does not typically consider the ecological values of bushland areas and would mean the need to clear significant amounts of vegetation to achieve that rating. While a more realistic fuel load from an ecological perspective is around 10 – 15 t/ha on average, maintaining that needs to be balanced against human safety. Accordingly, areas of lower fuel loads can be interspersed with area of higher fuel loads to provide a mosaic of fuels that enable fauna to find refuge during hazard reduction burns and wildfires as well as to provide a range of vegetation ages that provide greater structural and habitat diversity (Burrows, 2008).

The fire-fuel load was not formally assessed during the site visit, with general observations noted. The fuel load appeared to be low overall, with some spot locations having slightly higher levels of leaf litter and twigs due to the presence of dead trees providing a concentration of dry material (Figure 16). These observations suggest that the hazard reduction burns and other fires within the reserve are effective in maintaining fuel loads to a level that provides a measure of safety for users and allows the continued ecological function of the flora, fauna and ecological communities present.

Figure 16: Localised build-up of leaf litter and other dead plant material

5.4 Fire History

Several wildfire and hazard reduction burn events have been recorded and mapped by the City of Busselton within Meelup since 2002, with the fire history prior to this time unknown. Fire callouts reported by the Department of Fire and Emergency Services indicates there have been five callouts within Meelup between 01 July 2014 and May 2019, with all being small and primarily associated with campfires or suspicious fires that affected less than a hectare. Table 7 provides a summary of years and cells in which fires have occurred since 2002, noting that in some cells, more than one fire occurred in a particular year. Figure 17 provides an indication of the fire history, with the most recent fire being shown for clarity; GIS data for Meelup includes data for all fires since 2002.

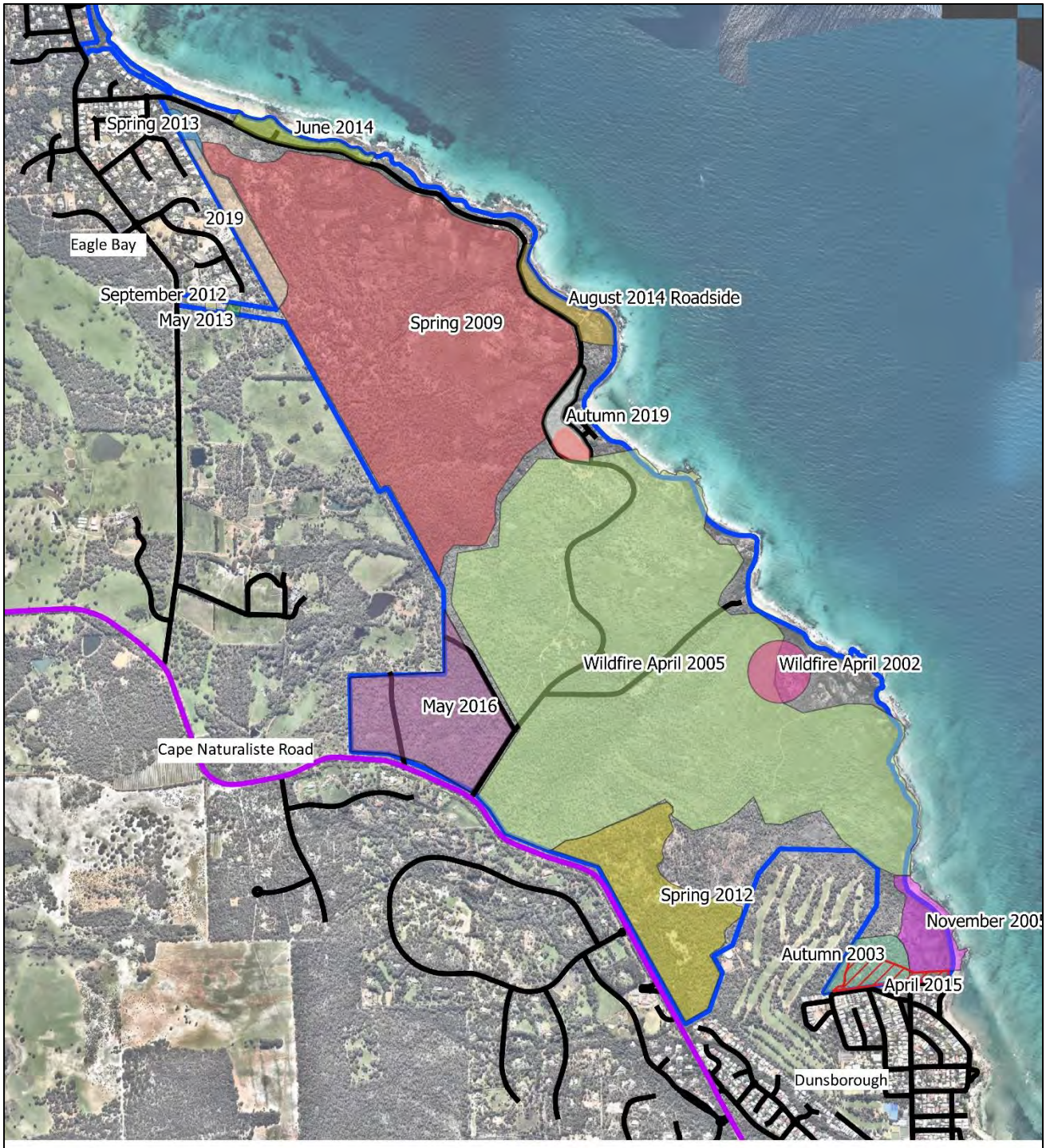
Fire history mapping provided by the City of Busselton (2019b) indicates that the recorded fires have occurred across the majority of the reserve between Eagle Bay and Dunsborough. Three areas have more than one fire recorded in the data provided (Table 7):

- a small area appears to have been burnt three times, once in January 2002, again in April 2002, and again in April 2005, or a three-year fire interval. The larger fire in January 2002 and the April 2005 fire also mean an area of around 20 ha that was burnt twice in three years. While not ideal, the outcomes of the flora and vegetation survey carried out by Webb in 2013 suggest there were no permanent impacts associated with the multiple fires. As it is now more than 14 years since burns, they will not influence future planned hazard reduction burns.
- An area of around 14 ha near Meelup Beach has been burnt in both 2013 and 2019, meaning a six-year fire interval, which is sooner than the preferred for the flora present within the locale. This will need to be considered when planning future hazard reduction burns to minimise the possibility of the area being burnt too frequently.

- An area has been burnt twice within a twelve-year period, which is acceptable from an ecological perspective based on the species present and known time to first flowering described by Burrows *et al*, 2007.

Table 7: Fire history by management cell

Management Cell	Recorded Burns																	
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
1		x		x														
1B			x											x				
2											x							
3	x			x														
4											x							
6	x			x														
7				x									x					
8	x		x												x			
9			x												x			
10	x			x														
11								x				x						x
11B						x												
12								x				x						
12B		x										x						x
Eagle Bay Sth											x	x						



Legend

- Autumn 2019
- August 2013
- Autumn 2003
- November 2005
- Spring 2009
- Spring 2012
- Spring 2013
- April 2002
- April 2005
- 2019
- April 2015
- August 2014
- June 2014
- May 2013
- May 2016
- September 2012
- Main Roads
- Local Roads
- Boundary

Figure 17:

Fire History 2002 - 2019,
Meelup Regional Park

Client: City of Busselton
Date: June 2019
Created by: Sue Brand
Image Source: NearMap, May 2019
Datum: GDA 94

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5.5 Risk Assessment

Risk assessments undertaken within Meelup Regional Park contributed to determining the likely risk bushfire poses to surrounding property and infrastructure.

5.5.1 Fire Hazard Assessment

The fire hazard assessment indicated that the fire hazard is 'high' (Table 8), suggesting that Council, DFES and community attention is required to assist with determining the appropriate fire management options; the nature of this risk means that it is unlikely to be reduced due to the nature and extent of vegetation present. The management assessment indicated that the risk is 'low' (Table 9) and can be managed through routine operations and procedures. The risks are a reflection of the vegetation class, topography and site characteristics present.

Table 8: Fire hazard assessment

Hazard Management	Yes	No	Score
Risk of ignition present	✓		1
Fuel load > standard intensity (i.e.: > 8 t/ha)	✓		1
Vegetation assessment area with fire hazard manageability	✓		1
Hazard reduction in < 80% of assessment zone		✓	
High visitor use	✓		1
Recent or proposed new residential or other developments		✓	
		Total	**4**
		Hazard Rating	**High**

Hazard rating: Extreme = 6, High = 4 – 5, Medium = 2 – 3, Low = 0 – 1

Table 9: Management assessment

Management Assessment	Yes	No	Score
Site access difficult or inaccessible	✓		
Response time > 30 minutes		✓	
Inadequate water supply		✓	
Inadequate resources		✓	
		Total	**1**
		Hazard Rating	**Low**

Hazard rating: Extreme = 4, High = 3, Medium = 2, Low = 1

5.5 2 Field Fire Hazard Assessment

Field assessment information for the reserve is provided in Table 10.

Table 10: Field fire hazard assessment

Risk Factor	Information to be recorded	Response
Vegetation type(s) and classes	Describe vegetation types and classes present within reserve (as per Table 2.3 AS 3959- 2009)	▪ Class A Forest ▪ Class C Shrubland ▪ Class D Scrub ▪ Low-threat vegetation subject to exclusion clause 2.2.3.2 (f) (*refer to Figure 15)*
Slope of land between vegetation and infrastructure	Calculate slope of land (as per AS 3959-2009)	Reserve slope rises from the coastline along Geographe Bay up towards Cape Naturaliste Road, thus is upslope within the reserve. Slope ranges from 0 – 5°, up to > 20° around creek lines and gullies.
Potential ignition sources	Describe	▪ Lightning ▪ Cigarette butts ▪ Unattended campfires ▪ Arson
Weeds	Describe species	Variable throughout reserve, with species including: ▪ Arum Lily ▪ Gladiolus ▪ Fumaria ▪ Kikuyu ▪ Flinders Range Wattle ▪ Olive ▪ Freesia ▪ Bridal Creeper ▪ Dolichos Pea ▪ Milkwort ▪ Broom ▪ Black Flag ▪ Watsonia ▪ Sydney Golden Wattle
	Density (approximate)	Variable
	Approximate area affected	Variable
Leaf litter	Approximate area	Variable, with higher densities in areas dominated by Jarrah, Marri and Tuart, decreasing in areas dominated by shrubs and Banksia
	Approximate depth	Not assessed
Fuel Load	Tonnes per hectare based on Visual Fuel Load Guide, (FESA,	Not assessed

Risk Factor	Information to be recorded	Response
	2012)	
Presence of larger dead vegetation	Describe	Dead and fallen shrubs, branches and trees
	Approximate area	Scattered throughout bushland
Ecological values	Significant flora, fauna and ecological communities	**Flora:** Eleven conservation significant species, including four threatened species, two priority four listed species and one priority three listed species **Fauna:** Eight conservation significant terrestrial species (five birds, three mammals), including four threatened species, two priority four listed species, one specially protection fauna and one subject to international agreement **Ecological Communities:** Two conservation significant ecological communities are present: *Calothamnus graniticus* heaths on south-west coastal granite (Vulnerable) and *Melaleuca lanceolata* forest, Leeuwin Naturaliste Ridge (Priority 2), with latter only present in the northern portion of the Reserve near Bunker Bay (*Refer Table 5, Section 2.5*)
Presence of rubbish material, such as broken glass	Location (approx.), describe	Small amounts of litter, mainly present in visitor nodes
Presence of human urban features	Types e.g.: playgrounds, homes	Playgrounds, parking areas, toilet blocks, barbecues in visitor nodes
	Location	Various
	Average distance from vegetation classes	Various
Fire hydrants	Locations	Hydrants in Eagle Bay to north and Dunsborough to south, one hydrant along Sheens Road just north of Meelup Beach Road
Other fire water sources	Describe	Water points include bore and windmills and tanks in various locations to the north, west and south of Meelup
Fire access tracks and similar	Locations	Throughout reserve, in good condition
	Accessibility (gates, locks, etc.)	Gates, locked with City of Busselton key

Risk Factor	Information to be recorded	Response
Fire station	Distance to nearest fire station	Eagle Bay Volunteer Bush Fire Brigade (response time approx. 25 min) Dunsborough Volunteer Bush Fire Brigade (response time approx. 35 min)
Fire Management Plan	Prepared (yes/no)	Yes – 2013 Fire Management Plan prepared by the City of Busselton
	Review date	This document will replace the 2013 FMP
Further new development in proximity to reserve proposed?	Yes/no	No
Roads accessible by emergency responders?	Yes/no	Yes – Roads and tracks accessible
Firebreak	Width	Trafficable
	Location	Western boundary of Meelup Regional Park North of Dunsborough East of Eagle Bay Internal roads within the reserve act as alternative firebreaks
Fire history known/approximated	Describe	Fire history, included hazard reduction burns, provided by City of Busselton. Most of the reserve has been burnt within the past 12 years
Proximity to sensitive premises	Describe, distance type, etc.	No schools, aged care facilities, hospitals or similar Eagle Bay townsite is to the west of Sheens Road and Dunsborough townsite to the south of the Reserve
Heritage or cultural values	Aboriginal, European or other heritage or cultural sites within the bushland area or nearby	No registered Aboriginal heritage sites, though Castle Rock is listed as 'other heritage place 4558' dues to the presence of artefacts/scatter (Aboriginal Heritage Inquiry System, 2019); this presence is unlikely to influence fire management within the reserve 'Other site 5854' Cape Naturaliste is present outside of Meelup Regional Park to the south-west of Cape Naturaliste Road, and is also associated with the presence of artefacts and scatter

6.0 Bushfire Management

Potential impacts associated with fire include:

- smoke damage
- ember attack
- proximity to flames
- injury to visitors and others
- fire moving from Meelup into Eagle Bay, Dunsborough, and/or other neighbouring properties
- changes to vegetation communities, species composition and diversity over time
- injury, death, local extinction of fauna and/or flora species.

Predominant winds at the time of any bushfires will determine the direction of spread and thus the potential for smoke and ember attack in surrounding areas, noting that fire travels faster uphill. The presence of fine fire fuels (thinner than a finger width), such as dry grass, leaves, twigs and loose bark, are a major contributor to the heat and speed of a fire. Management of these fuels is one means of limiting the spread of fire within the site and neighbouring areas that can be controlled by the City of Busselton, with the main management option for the Park being hazard reduction burns.

While fire management needs to consider the human values associated with Meelup, it is also necessary to consider the ecological and environmental values present and their response to fire. At a vegetation community level, fire is required at regular intervals to assist with the maintenance of floristic structure and diversity, with typical fire intervals ranging from 8 – 40 years on average, according to species and community types. At a species level, fire, or more typically the heat and/or smoke, is associated with seed release from tree canopies, germination of seed within the soil seed bank, and the re-sprouting of foliage after fire. A range of adaptations enable flora and fauna to cope with and survive in fire-prone environments. However, there will remain several species and/or communities that have a greater sensitivity to fire, and which will need to be factored into fire management strategies and activities to ensure their ongoing survival. Fauna species typically avoid fire by movement to refuge areas. This bushfire management plan considers both the human and the ecological aspects of fire within Meelup.

6.1 Ecological Values and Management

Key ecological values within Meelup include the presence of:

- the ecological community *Calothamnus graniticus* subsp. *graniticus* heaths on south-west coastal granite which is listed as vulnerable under the *Biodiversity Conservation Act 2016* (WA)
- various threatened and priority flora and fauna species listed under the *Biodiversity Conservation Act 2016* (WA) and/or the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth), or otherwise considered to be conservation significant
- fire sensitive ecosystems such as granitic vegetation and creek lines.

Table 11 provides a summary of conservation significant species and communities recorded within Meelup, along with the dominant vegetation association in which they were reported to the DBCA and/or the City of Busselton through various mechanisms. Accordingly, the aim of this table is to assist with the planning of hazard reduction burns and what conservation significant species and communities may be present based on

currently available information sources and should not be interpreted as representing the only locations or vegetation associations where a particular species may be found.

In order to maintain these values, consideration and early planning will be necessary to avoid or minimise impacts to these species and/or ecological communities. As a minimum, early consultation with the City of Busselton fire officers and environmental personnel, along with the DBCA will be necessary when planning for a hazard reduction burn. Other requirements may include the need for a spring flora survey in the planned burn area to support the legislative permitting processes (Sections 6.3 and/or 6.4) if outcomes of the proposed burn are likely to result in significant impacts to the population or community, the exclusion of nominated areas from the burn area, and specified burning seasons based on ecological information.

Key strategies relating to fire management in key populations and communities is provided in the following sections. Note that the strategies outlined for each value outlined will also contribute to the maintenance of habitat utilised by other species. In general, the projected burn frequencies for conservation significant species and communities are consistent with those recommended by Burrows, Wardell-Johnson and Ward (2007) on the basis of twice of twice the time to flowering after fire.

Table 11: Conservation significant species according to vegetation association in which they have been recorded

Species Name	Common Name	Cons Code (WA)	Cons Code (Cwlth)	Man. Cell	Vegetation Association/Community No.								
					BW	CGH	Coast	CL	GA	GH	JM Lt	JM Lm	JM Wd
					3	5	9	8	7	6	1	2	4
Flora													
Acacia lateriticola var. Glabrous variant		P3	-	6				x			x		
Boronia tenuis	Blue Boronia	P4	-	7, 12		x			x	x	x	x	x
Caladenia busselliana	Bussell's Spider Orchid	T (CR)	En	1	x								
Caladenia caesarea subsp. *maritima*	Cape Spider Orchid	T (CR)	En	3, 6, 7, 12		x			x	x			x
Caladenia excelsa	Giant Spider Orchid	T (CR)	En		x								
Caladenia viridescens	Dunsborough Spider-orchid	T (CR)	En	1, 2, 3, 6, 8	x	x					x		
Calothamnus graniticus subsp. *graniticus*		P4	-	3, 7		x	x		x	x			
Eucalyptus x phylacis	Meelup Mallee	T (CR)	En	7									x
Eucalyptus rudis subsp. *cratyantha*		P4	-	11				x				x	
Eucalyptus virginea		P4	-	7									x
Meionectes tenuifolia		P3	-	12					x				
Stylidium lowrieanum	Lowrie's Triggerplant	P3	-	12	x								
Fauna													
Calyptorhynchus baudinii	Baudin's Black Cockatoo	T (En)	En	1, 4, 7, 10, 11	x			x			x	x	

Species Name	Common Name	Cons Code (WA)	Cons Code (Cwlth)	Man. Cell	Vegetation Association/Community No.								
					BW	CGH	Coast	CL	GA	GH	JM Lt	JM Lm	JM Wd
					3	5	9	8	7	6	1	2	4
Calyptorhynchus banksia naso	Forest Red-tailed Black Cockatoo	T (Vu)	Vu	12		x							
Calyptorhynchus latirostris	Carnaby's Cockatoo	T (En)	En	7, 8, 12				x			x	x	
Falco peregrinus	Peregrine Falcon	OS	-	10							x		
Isoodon fusciventer	Southern Brown Bandicoot, Quenda	P4	-	1, 4, 6, 11, 12	x	x					x	x	
Notamacropus irma	Western Brush Wallaby	P4	-	7								x	
Pandion haliaetus	Osprey	IA	IA	3				x					
Pseudocheirus occidentalis	Western Ringtail Possum	T (Cr)	Cr	All except 9		x	x	x	x		x	x	x
Ecological Communities													
Calothamnus graniticus heaths on south-west coastal granite (Meelup Granites)		T (Vu)	-	1, 1B, 3, 6, 7, 10, 11, 11B, 12		x	x	x	x	x	x	x	x
Melaleuca lanceolata forest, Leeuwin Naturaliste Ridge*		P2	-	7									

(Sources: Webb, 2013; DBCA, undated; City of Busselton, 2019)

* This ecological community occurs only in the northern most portion of Meelup near Bunker Bay

6.1.1 *Calothamnus graniticus* Heaths on South-west Coastal Granite

Rocky outcrops with their shallow or absent soils, combined with the nature of the vegetation they support provide a natural barrier to fire spread under most conditions, in contrast to the presence of dense vegetation in the surrounding heath and forest areas. Vegetation associated with this community type includes fire intolerant species, thus acts as refuge to their continued survival. The *Calothamnus graniticus* subsp. *graniticus* heaths on south-west coastal granite ecological community (Meelup Granites) is listed as a vulnerable ecological community under the *Biodiversity Conservation Act* 2016 (WA); it is highly restricted, endemic to the Park, being found only in Meelup and near Sugar Load Rock. Accordingly, fire management activities need to consider its presence; its location in relation to the fire cells is provided in Figure 18.

According to Pryde (undated), this community:

- is dominated by the species *Calothamnus graniticus* subsp. *graniticus*, which is a one-sided bottle brush that grows to 3 m
- is located on a narrow band parallel of near-coastal rocky outcrops along the western shore of Geographe Bay
- is often present between boulders and on exposed slopes near headlands
- occupies approximately 40 ha
- is species rich; associated species include *Dodonaea ceratocarpa*; *Spyridium globulosum* (Basket Bush), *Viminaria juncea* (Swish Bush), along with several orchids and sundews, some of which are listed as declared rare under the *Biodiversity Conservation Act* 2016 (WA)
- includes plants that grow in the shallow soils and which are adapted to very wet and very dry periods according to seasonal conditions.

Fire management recommendations for granite outcrop communities (Department of Parks and Wildlife (DPaW), 2016a) include:

- no deliberate ignition during hazard reduction burns or fire suppression activities
- no physical disturbance of vegetation and soils (i.e.: no firebreak construction, vehicle access, and similar)
- avoid the use of foam, surfactants, or other chemical retardants on/in proximity to granite outcrops
- the minimum burn interval will be informed by the fire history for the location, time to flowering and reproductive maturity for species within the community, and risks to human, environmental, and other values if a burn is not carried out
- a burn interval of 15 up to a maximum of 45 years is recommended to assist with maintaining the floristic and structural diversity of the community; the burn interval is consistent with that recommended based on flora species present
- if a hazard reduction burn is required at any point, then a low intensity fire when conditions are mild and moist will limit the spread of fire within the community
- managing fire and fire-fuel loads in vegetation surrounding granite outcrops will reduce the potential for damage to granite outcrops from high intensity damaging fires and/or frequent fire regimes.

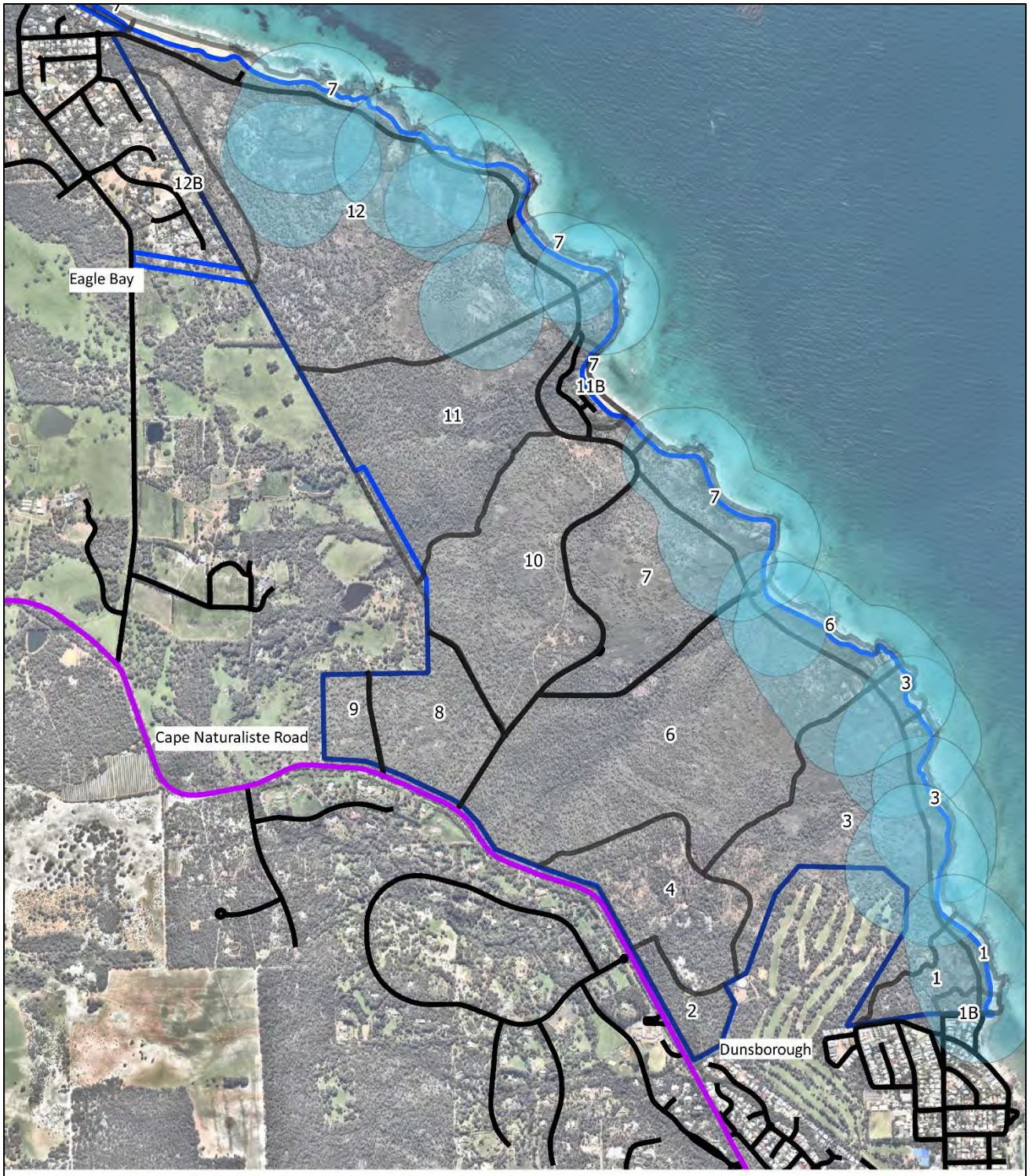

Figure 18:
Calothamnus graniticus Heath in Relation to Fire Cells
Meelup Regional Park

Client: City of Busselton
Date: June 2019
Created by: Sue Brand
Image Source: NearMap, May 2019
Datum: GDA 94

N

Natural Area
CONSULTING MANAGEMENT SERVICES

0 250 500 m

6.1.2 Geophyte Populations, including Orchids

Several of the threatened and priority listed flora species located with Meelup are orchids such as Caladenia, and which are perennial herbaceous plants known as geophytes due their having an underground storage organ that provides water, nutrients and carbohydrates to assist with survival in adverse conditions. Other genera within Meelup that include geophytic species are Burchardia, Caesia, Chamaescilla, Drosera, Sowerbaea, Thysanotus and Wurmbea.

According to the DPaW (2016b), the key to survival of geophytes after fire is the regime, which includes the sequence of fire events, the burn season, intensity, frequency, and patchiness of the fire. During the growing phase, plants can be killed by fire when there are above-ground parts or shoots in the upper soil area. The growing phase varies according to species; for example, several orchids show plant parts above the ground in winter, flowering in late winter/early spring, while others flower earlier in the year or later in spring. An overview of the effect of fire on geophytes at various lifecycle stages is provided in Table 12 (DPaW, 2016b).

Table 12: Effect of fire on geophytes at various reproductive cycle stages

Season, Time of Year	Lifecycle Stage	Likely Fire Effects
Mid-autumn (April – mid-May)	▪ No new shoot aboveground for most plants ▪ New shoot may be present in upper soil profile for some species ▪ Storage organ beginning to develop ▪ A few species flower at this time of year	▪ Unlikely to be life threatening for most species ▪ Fire may kill those species that have a new shoot in the upper soil layer, threatening development of the underground storage organ and thus overall survival of the plant
Late autumn – early spring (mid-May – mid-September)	▪ Active growth phase with above ground parts often visible ▪ Development of the new underground storage organ is progressing ▪ Several species begin to flower	▪ Plants may be killed or damaged as the underground storage organ is not sufficiently developed to ensure survival through the coming year
Mid-spring (mid-September – mid October)	▪ Flowering of many species ▪ New underground storage organ fully developed for some species ▪ For many species, storage organ is in the later development stages	▪ Aboveground plant parts, including flowers and seeds, may be destroyed ▪ For species with a well or fully developed storage organ, the plant is less likely to be killed or damaged ▪ Plants can survive fire, but will be weaker and less likely to flower the following year, depending on the development stage of the storage organ
(mid-October – mid-November)	▪ Flowering continues for many species ▪ Seed produced and released	▪ Aboveground parts may be destroyed, including flowers and seed

Season, Time of Year	Lifecycle Stage	Likely Fire Effects
	▪ Underground storage organ fully developed for most species	▪ Seed may be destroyed as it is short-lived and viable for up to 12 months in the soil seed bank ▪ Underground storage organ unlikely to be killed or damaged as it is fully developed ▪ Most plants will survive ▪ A mid-September burn can be considered on a species-by-species basis with specialist advice
Summer (mid-November to March)	▪ Dormant stage ▪ Aboveground parts have died back ▪ Underground storage organ fully developed	▪ Flowering and seed set complete for most species ▪ New underground storage organ fully developed ▪ Some species will respond favourably to fire by increasing in abundance and flowering prolifically the season after the fire

Fire management recommendations for geophyte populations (Department of Parks and Wildlife, 2016b) include:

- no deliberate ignition during hazard reduction burns or fire suppression activities
- no physical disturbance of vegetation and soils (i.e.: no firebreak construction, vehicle access, and similar)
- avoid the use of foam, surfactants, or other chemical retardants on/in proximity to granite outcrops, where geophytes often occur
- the minimum burn interval will be informed by the fire history for the location, time to flowering and reproductive maturity for species within the community, and risks to human, environmental, and other values if a burn is not carried out
- consideration needs to be given to the life-stage of the geophytes when planning hazard reduction burns:
  - burns are not recommended between mid-May – September when the majority of geophytes are actively growing and often flowering
  - burns in very early autumn (March – April) or late spring (mid-October – November) are recommended to avoid damage to aboveground parts and/or the underground storage unit; most plants will survive
  - burns between mid-November and March are unlikely to impact on populations as the plants are usually dormant; however, this should only occur if conditions allow for a burn to be undertaken safely
- burning regimes that encourage a range of post-fire seral stages are recommended as they encourage a greater diversity of geophytes

- where necessary, exclude rare species from hazard reduction burns if there is insufficient knowledge of their response to fire; such areas are likely to be small, representative of habitats that are less fire prone, and isolated within the landscape
- a burn interval of 15 up to a maximum of 45 years is recommended to assist with maintaining the floristic and structural diversity of the community; the 15-year burn interval is consistent with that recommended on the basis of flora species present
- if a hazard reduction burn is required at any point, then a burn under mild, moist spring or autumn conditions when there is a low fire danger rating is recommended
- if a hazard reduction burn is necessary between May – September, the burn should be patchy to allow the persistence of some unburnt locations to enable the survival of the populations
- where possible, the preservation of some large logs is recommended as they provide a refuge for some orchid species and their mycorrhizal fungi.

6.1.3 Western Ringtail Possum (*Pseudocheirus occidentalis*)

The Western Ringtail Possum (*Pseudocheirus occidentalis*) is a small weight range mammal that is listed as critically endangered under the *Biodiversity Conservation Act 2016* (WA) and the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) and is known from observations throughout Meelup Regional Park. This species often has a close association with the Peppermint (*Agonis flexuosa*) as a food source and as a location for drey (nest) construction. According to DPaW (2008), while breeding can occur year-round, it typically peaks around April – June and October – December, with mothers weaning offspring at around 5 – 6 months. It is during the breeding season and the time when pouch-young are being cared for that the possum is most vulnerable to disturbance from fires; populations are also at risk when fire intensity is high and results in greater damage and/or death of plant species and trees within the landscape, resulting in longer restoration times.

Fire management recommendations for the Western Ringtail Possum (Department of Parks and Wildlife, 2008) include:

- in areas known to have a higher density of Western Ringtail Possums, a population assessment should be carried out to identify the extent of those locations, and thus areas that may require a different treatment or exclusion from the burn
- an early spring burn prior to the completion of the jarrah leaf flush is recommended as this timing will enable the provision of a good-quality feeding source for animals to recover condition after winter, with re-sprouting after fire expected to be rapid and vigorous
- autumn fires are unlikely to result in the regeneration until spring, meaning a scarcity of some food sources
- autumn and summer fires are more likely to consume large portions of the understorey and overstorey, meaning a greater possibility of predation by foxes and feral cats, along with exposure to weather when mothers are still caring for their young
- where burning in autumn cannot be avoided, minimise the total area of the burn and retain many large unburnt patches of at least 1 – 5 ha
- predator control programs are recommended prior to and after a hazard reduction burn, with at least two fox baiting sessions occurring prior to the burn and post-burn baiting program implemented until the mid-over storey are largely recovered (i.e.: minimum 18 – months to three years post burn); cat control programs should complement fox control

- avoid intense fires that have the potential to cause the greatest impact to Western Ringtail Possum feeding and habitat trees (primarily the Peppermint, along with Marri and Jarrah)
- where hazard reduction burns are necessary within Western Ringtail Possum habitat, a low intensity burn with an average char height on mature jarrah trees should be limited to 2 m or less
- where possible, the skirts of grasstrees should be retained as possum habitat refuge, with at least four per hectare to be retained
- maintain the existing dense mid-storey vegetation where dreys are typically located
- a burn interval of > 20 years is recommended for the persistence of the Western Ringtail Possum
- a moderate – high intensity burn may be required every 30 – 50 years to allow regeneration of the denser mid-storey vegetation and to assist with the development of tree hollows that provide refuge for possums
- where these intervals mean an unacceptable risk, then it may be necessary to provide a mosaic of fuel ages in an area, with areas having a younger fuel-age (< 15 – 20 years) providing a lower-fuel buffer as a means of reducing the risk of wildfire; when deciding those areas to maintain with a younger fuel age (e.g.: upslope areas), the quality of the habitat and its suitability for sustaining the possum will need to be considered (e.g.: areas where riparian vegetation is present)
- where low-fuel age areas are installed, the high-quality habitat nearby for approx. 1 – 2 km should be maintained until the burnt areas have sufficiently recovered to provide habitat to sustain moderate possum populations (i.e.: minimum of 5 – 10 years)
- when primary habitat is to be burnt, it will be necessary to consider the suitability of adjacent habitat to provide a refuge for the Western Ringtail Possums
- no more than 50% of the primary habitat should be burnt, particularly where the possum population is isolated (> 2 – 5 km) from other known populations.

6.1.4 Black Cockatoos

There are three black cockatoo species listed as endangered under the *Biodiversity Conservation Act 2016* (WA) and the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth), namely the Carnaby's Cockatoo (*Calyptorhynchus latirostris*, En), the Forest Red-tailed Black Cockatoo (*Calyptorhynchus Banksia naso*, Vu) and the Baudin's Cockatoo (*Calyptorhynchus baudinii*, En), have been recorded in various locations throughout Meelup Regional Park. Remnant bushland areas containing Jarrah, Marri and Banksia species are often important feeding sources, with nesting occurring in large hollows in Eucalypts (minimum 10 cm diameter entrance, 19 cm internal diameter and 45 cm deep) (Whitford, 2001, in DPaW, 2009), noting that it can take at least 100 or more years for hollows of suitable size to develop. In order to protect black cockatoo populations, it is important to protect potential nesting sites, or large, old Eucalypts, along with suitable feeding habitat. A summary of key habitat requirements is provided in Table 13.

Table 13: Key habitat requirements for Black Cockatoos

Species	Food Source	Nesting Trees	Reproduction
Baudin's Cockatoo	▪ Primarily seeds of Marri, Banksia and Hakea ▪ Will also feed on fruit crops, particularly apple and pear, and beetle larvae	▪ Marri ▪ Wandoo ▪ Karri	▪ 1 egg, October ▪ Low reproduction rate, average 0.6 chicks per year ▪ Female incubates and broods the chick

Species	Food Source	Nesting Trees	Reproduction
	under the bark of live or dead trees		
Carnaby's Cockatoo	▪ Seeds of Banksia, Dryandra, Hakea, Eucalyptus, Grevillea ▪ Will also feed on Pine seeds, nectar of native plants and insects in the stems of flowers and fruits of Banksia and Dryandra	▪ Wandoo ▪ Salmon Gum	▪ 1 or 2 eggs, typically July to October ▪ Breeding success dependant on extensive heathland within 12 km of nesting site ▪ Female broods the chick, but later both parents will feed ▪ Juvenile dependent on parents until around 1 year ▪ Females reach sexual maturity around 4 – 5 years
Forest Red-tailed Black Cockatoo	▪ Seeds from Eucalypts, mainly Jarrah and Marri ▪ Will feed on seeds of Yarri, Albany Blackbutt, Karri, Sheoak, Snottygobble and Bull Banksia, along with Pine, Spotted Gum and White Cedar	▪ Marri ▪ Jarrah ▪ Karri	▪ 1 egg, October ▪ Incubation 29 – 31 days ▪ Female incubates and broods the chick

Source: DPaW, 2009

Fire management recommendations for Black Cockatoo populations (Department of Parks and Wildlife, 2009) include:

- ensuring fire regimes maintain a mosaic of cockatoo food sources of varying ages/seral stages, noting that the proximity of food sources for Carnaby's Cockatoos is closely linked to fledgling success
- where possible, avoiding fire during known breeding times, particularly with unfledged chicks in nests
- where possible, burn height should be less than 2 m on Jarrah and Marri to avoid fire resulting in canopy scorch and affecting any existing hollows and/or impacting on seeds within the canopy
- raking litter away from the trunk of nesting stags, veteran trees with hollows and mature trees that are likely to develop hollows in the future (i.e.: those that are larger than 80 cm in diameter)
- planned hazard reduction burns should be low intensity, fire grained and patchy, thus conducted under mild conditions that typically occur in late autumn or spring after rains
- moderate intensity hazard reduction burns at around 15 – 25-year intervals during late summer/early autumn will encourage regeneration of vegetation, and contribute to seed release and germination of food sources

- while it is recognised that high-intensity fires contribute to the creation of hollows used for nesting, these should be infrequent and limited in the area burned to avoid the destruction of feeding sources and existing nesting hollows.

6.1.5 Other Significant Flora

Significant flora includes species, subspecies and variants that may be significant for reasons other than Declared Rare or Priority listing; such as being endemic, relictual, a representation of species range (outliers, range end) and/or having anomalous features that may indicate a potential new discovery (EPA, 2016). Webb (2013) notes approximately 100 species that should be considered significant within Meelup Regional Park. The majority of these species are associated with granitic outcrops, which ranges from massive exposed rock to fugitive outcrops (Main, 1997). Microhabitats offered by granitic outcrops are considered to have provided refuge for flora typically adapted to wetter and drier conditions as the Australian climate fluctuated over millions of years of continental drift from cool moist to arid conditions (Hopper *et.al*, 1997).

Rather than propose fire management strategies for individual significant flora it is considered more appropriate to implement strategies for their preferred habitat, being granitic outcrops as outlined in Section 6.1.1. In the case of wildfire, the appropriate strategies will be (City of Busselton, 2019c):

- no machine disturbance within granite outcrops, it is preferable to let the habitat burn
- use only hand tools for direct attack
- where possible, utilise aerial support.

When planning hazard reduction burns in areas where significant flora species are present, it is recommended that the DBCA are consulted in the planning stages to ensure impacts are minimised.

6.1.6 Coastal Vegetation

Coastal vegetation is sensitive and is subject to harsh conditions from strong winds, thus burning could lead to issues with erosion and unauthorised visitor access/tracks. Coastal vegetation buffer areas should be left unburnt if possible.

6.1.7 Other Fauna Species

In addition to the threatened fauna species present within Meelup, the site supports more than 100 vertebrate fauna species (mammals, reptiles, birds and amphibians), and an unknown number of invertebrates. Species present include the Echidna (*Tachyglossus aculeatus*), the Southern Brown Bandicoot (*Isoodon fusciventer*), the Honey Possum (*Tarsipes rostratus*), and several bat species including the Gould's Wattled Bat (*Chalinolobus gouldii*) and the Southern Forest Bat (*Vespadelus regulus*). Adopting the mosaic burn approach within fire management cells recommended for the Western Ringtail Possum that provides for continued food and habitat during and after fire will be sufficient to ensure the continued presence of other fauna species present within the Reserve. General recommendations for small mammal species include:

- aim for low intensity burns to achieve a mosaic of burnt/unburnt habitats
- avoid burning riparian zones where possible
- avoid deliberate ignition of grass tree skirts
- protect habitat trees (containing hollows)
- post burn predator control is recommended whilst refuge areas recover.

6.2 Fire Fuel Load

While the recommended fuel load for remnant bushland is 8 t/ha to mitigate risk to emergency response personnel (Smith, 2003), maintaining bushland areas to a fuel load of 8 t/ha or less has a high likelihood of leading to a reduction of ecological and environmental values or change those values that are often the reason why people visit and enjoy local bushland reserves. In instances where the ecological values would be diminished by fuel load reduction works it is considered appropriate to balance these competing needs, thus it is recommended that:

- where practicable, the fire fuel load is maintained to an average of 15 t/ha to reflect the ecological and other values of the site
- the City continue to prioritise fuel load reduction activities in high-risk areas, such as adjacent to accessways, amenities, infrastructure, neighbouring property, Eagle Bay and Dunsborough, to reduce the risk of ignition, whilst maintaining higher fuel loads in less-accessible areas within the reserve
- a range of fire fuel load reduction methods are considered, such as hazard-reduction burns, chemical and manual weed control
- the City continue to map and document fire events, including accidental fires, arson and hazard reduction burns via the City's GIS system to inform ongoing management.

6.2.1 Hazard Reduction Burns

A hazard reduction burn is the deliberate introduction of fire in a bushland location at a nominated frequency to reduce fire fuel loads in the form of leaf litter and other fine materials that have built up over time, with the aim of reducing potential high intensity fires in summer months that could result in environmental and human impacts to reserve users and nearby residents. Accordingly, hazard reduction burns tend to be carried out in spring or autumn to reduce the potential for the fire getting out of control.

Typically, hazard reduction burns in Jarrah/Marri forests are carried out when the fire fuel load reaches 8 tonnes per hectare (t/ha), which would require significant burning and clearing if it were to be applied at Meelup and would result ecosystem degradation and reduced ecological and environmental values. In order to maintain the ecological and environmental values of Meelup, an average fire fuel load of 15 t/ha is suggested as being more realistic, noting that there will be variable fuel loads and ages across the reserve as hazard reduction burns are carried out. This variability in fuel load and age contributes to the provision of refuges for fauna during and after burns, as well as allowing for patchiness or mosaic burning patterns that result in varied flora seral stages so that food sources or habitat is available despite the hazard reduction burn.

Advantages of hazard reduction burns include:

- reduces the potential for a catastrophic, high intensity burn during summer months that is potentially damaging to infrastructure and neighbouring properties
- 'mimics' nature in the sense that many Australian ecosystems require fire at some stage during their life cycle
- allows burning pattern that is patchy, ensuring fauna refuges and plants of varying ages and nutritional quality are available.

Disadvantages include:

- tend to be carried out in spring or autumn, rather than summer when most 'natural' Australian bushfires occur (usually the result of lightning)
- greater chance of impact on fauna in a bushland area as spring often coincides with breeding season, meaning young animals will not have the means of escape from a fire
- smoke and embers produced can impact on infrastructure, neighbouring property, road visibility and human health
- too frequent burning in an area can result in the inability of a plant to produce and set seed, resulting in the death of some species; it can also bring about a change in the species present within a particular ecosystem through local extinctions.

The nature of Meelup Regional Park and its proximity to townsites of Eagle Bay and Dunsborough mean that hazard reduction burns will remain a key bushfire management tool, with the frequency of fires being informed by:

- time since the area was last burnt (frequency in years) (accidental, arson, other)
- fire fuel load (t/ha)
- presence of sensitive flora, ecological communities and fauna populations, noting that two burn intervals across the reserve based on ecological features are suggested, namely a minimum 10-year fire interval for the majority of the reserve and a 16-year interval for those locations where *Melaleuca viminea* is present
- species response to fire, particularly months to flowering
- proximity to on and offsite assets, particularly the presence of neighbouring property
- DFES and/or City permit requirements.

6.2.2 Hazard Reduction Burn Intervals – Ecological Considerations

When hazard reduction burns are used as a management tool, Jarrah/Marri/Banksia Woodlands tend to be burnt every 8 – 12 years based on the flora species present and how quickly they produce seed after a fire, with the burn interval determined by multiplying the known period to first flowering after fire by two to ensure flora has sufficient time to mature and set seed between fires (Burrows, Wardell-Johnson and Ward, 2007).

Within Meelup Regional Park, the *Acacia alata* (Winged Wattle), *Melaleuca lateritia* (Robin Redbreast Bush), and *Melaleuca viminea* (Mohan) have a minimum 60 months (5 years) to first flowering, suggesting a minimum 10 year burning interval for hazard reduction burns in cells where they are located. With respect to the *Melaleuca viminea* (Mohan), Burrows *et al* (2007) indicates a minimum of 180 months (15 years) to peak flowering, suggesting that a burn period of less than this may impact on the longer term survival of this species within Meelup, with a minimum burn period of 16 years suggested to ensure peaking flowering is achieved (Table 14).

There are also several species that have a minimum of four years until first flowering, including *Eucalyptus marginata* (Jarrah) and *Corymbia calophylla* (Marri) indicating a minimum burn interval of 8 years for several species; for simplicity, a minimum burn interval of 10 years across the site (Table 14) with the exception of the *Melaleuca viminea* (Mohan) locations is recommended. The frequency and location of accidental and other fires within the reserve will also inform any burn interval.

Research carried out by Valentine, Reaveley, Fisher and Wilson (2012) in relation to reptiles found a greater diversity in banksia sites that had not been burnt for 16 years or more. Similarly, Valentine and Hobbs (2014) found that the density of Banksia trees, a key food source of the Carnaby's Cockatoo (*Calyptorhynchus latirostris*), and cone productivity of *Banksia attenuata* was greater with a fire free period of 10 – 30 years, with *Banksia menziesii* higher in locations that had not been burnt for 35 years or more. This is consistent with the minimum recommended burn period of 10 – 16 years for Meelup.

As human activity often results in increased fires due to accidental or deliberate ignition within remnant bushland areas, there is an increased risk of too frequent burning. Research at Kings Park bushland in relation to prescribed burns between 1931 and 1984 indicated that the frequent fires were facilitating the spread of Perennial Veldt Grass (*Ehrharta calycina*) (McChesney, 2016). As a result, hazard reduction burns ceased, and an integrated fire management approach adopted that includes:

- fuel reduction through weed control, particularly of the Perennial Veldt Grass
- regular firebreak maintenance
- undertaking targeted fuel reduction activities around key infrastructure
- rapid response and suppression.

Table 14: Recommended burning frequency by flora species within vegetation association

Vegetation Association	Key Species	Months to First Flowering (Years)	Months to Peak Flowering (Years)	Recommended Burn Interval (Years, min)
Banksia Woodland	▪ *Banksia attenuata* (Slender Banksia)	4		
	▪ *Corymbia calophylla* (Marri)	4		
	▪ *Eucalyptus marginata* (Jarrah)	4		10
	▪ *Eucalyptus patens* (Swan River Blackbutt)	4		
	▪ *Melaleuca viminea* (Mohan)*	5	15	
Calothamnus graniticus Heath	▪ *Corymbia calophylla* (Marri)	4		
	▪ *Hakea trifurcata* (Two-leaf Hakea)	4		10
	▪ *Hypocalymma angustifolium* (White Myrtle)	4		
Coastal	▪ *Corymbia calophylla* (Marri)	4		
	▪ *Hakea trifurcata* (Two-leaf Hakea)	4		16
	▪ *Melaleuca viminea* (Mohan)	5	15	
Creek line	▪ *Acacia alata* (Winged Wattle)	5		
	▪ *Corymbia calophylla* (Marri)	4		
	▪ *Eucalyptus patens* (Swan River Blackbutt)	4		10
	▪ *Hypocalymma angustifolium* (White Myrtle)	4		
	▪ *Melaleuca lateritia* (Robin Redbreast Bush)	5		
	▪ *Olearia paucidentata* (Autumn Scrub Daisy)	4		
Granite Apron	▪ *Corymbia calophylla* (Marri)	4		
	▪ *Eucalyptus patens* (Swan River Blackbutt)	4		16
	▪ *Hypocalymma angustifolium* (White Myrtle)	4		
	▪ *Melaleuca viminea* (Mohan)	5	15	
Granitic Heath	▪ *Allocasuarina microstachya*	4		
	▪ *Corymbia calophylla* (Marri)	4		10
	▪ *Eucalyptus marginata* (Jarrah)	4		

Vegetation Association	Key Species	Months to First Flowering (Years)	Months to Peak Flowering (Years)	Recommended Burn Interval (Years, min)
Jarrah, Marri Forest - Laterite	▪ *Acacia alata* (Winged Wattle) ▪ *Corymbia calophylla* (Marri) ▪ *Eucalyptus marginata* (Jarrah) ▪ *Hypocalymma angustifolium* (White Myrtle)	5 4 4 4		10
Jarrah, Marri Forest - Loam	▪ *Corymbia calophylla* (Marri)	4		10
Jarrah, Marri Woodland	▪ *Banksia attenuata* (Slender Banksia) ▪ *Corymbia calophylla* (Marri) ▪ *Eucalyptus marginata* (Jarrah) ▪ *Eucalyptus patens* (Swan River Blackbutt)	4 4 4 4		10

* While *Melaleuca viminea* is present in the Banksia Woodland, it is not representative of the area, thus its presence has not been considered when determining the nominal burn interval.

6.2.3 Recommended Burn Intervals

Based on the available information, as described above and in Section 6.1, burn intervals of 10 or 16 years are recommended for the Meelup vegetation associations (Table 15, Figure 19). These intervals consider the number of months to first flowering and peak flowering (Burrows *et al*, 2007), along with fire management advice provided by the DBCA in their Fire Management Notes (DBCA, 2008, 2009, 2016a and 2016b).

Table 15: recommended burn interval according to Meelup vegetation association

Vegetation Association	Minimum Recommended Burn Interval (Years)	Vegetation Association	Minimum Recommended Burn Interval (Years)
Banksia Woodland	10	Granitic Heath	16
Calothamnus graniticus Heath	16	Jarrah, Marri Forest - Laterite	10
Coastal	16	Jarrah, Marri Forest - Loam	10
Creek line	10	Jarrah, Marri Woodland	10
Granite Apron	16		

As outlined in Section 6.1.3, DPaW (2008) indicates that a burn interval of more than 20 years is recommended for the continued survival of the Western Ringtail Possum (*Pseudocheirus occidentalis*), thus the recommended burn interval for vegetation may need to be adjusted to accommodate the presence of fauna; where it is not possible to implement a burn interval of > 20 years, an interval of <15 – 20 years is acceptable. Accordingly, it is recommended burn intervals in areas with a high possum density are carried out at the minimum 20 year interval indicated by DPaW (2008), with a population assessment carried out in areas known to have a higher density of Western Ringtail Possum to identify the extent of those locations, and thus areas that may require a different treatment or exclusion from the burn.

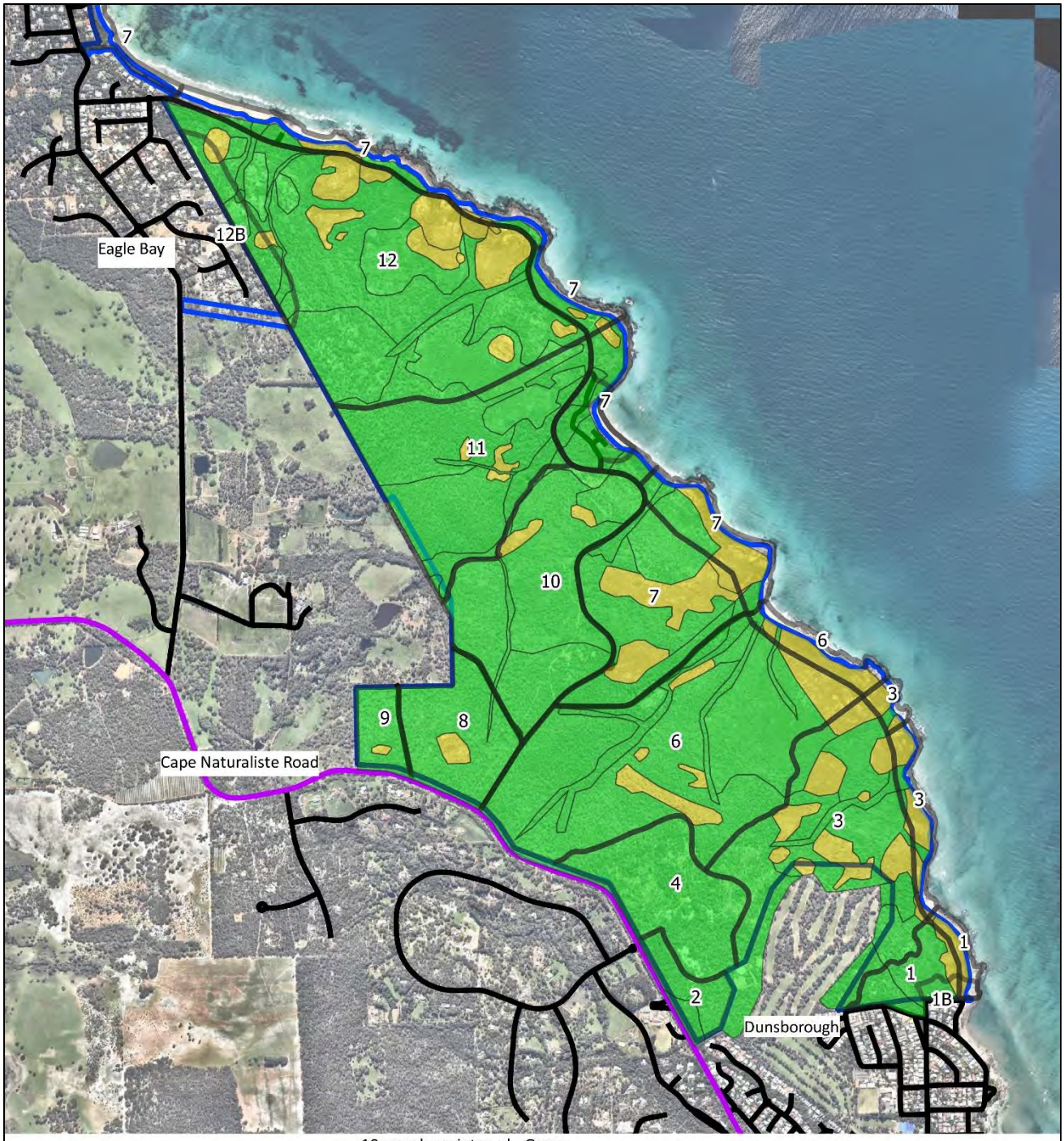

Figure 19:
Burn Interval by Vegeation Association and Fire Cells Meelup Regional Park

6.2.4 Hazard Reduction Burn Season

Due to their aim and nature, hazard reduction burns are typically carried out in autumn or spring, with the season alternating within management cells. As highlighted in Section 6.1, Fire Management Advice information prepared by DPaW (2008, 2009, 2016a, 2016b) provides information on the preferred burn season for nominated conservation significant species within Meelup (Table 16). It is apparent from this information that it introduces additional constraints that need to be considered during the planning process, and that it will not always be possible to avoid all burns at times when they are not recommended. Key to ensuring the continued survival of conservation significant species and communities will be to ensure burns are low-moderate intensity, patchy, and with refuge available for fauna that provides a continued food source with vegetation of varying ages, shelter, and protection from predators.

Table 16: Burn seasons according to conservation significant species

Organism/Community	Non-life-threatening Period(s)	Potentially Life-threatening Period(s)	Life-threatening Period(s)
Baudin's Cockatoo		▪ October	
Carnaby's Cockatoo		▪ July - October	
Geophytes	▪ Summer (mid-November to March)	▪ Mid-autumn (April – mid-May) ▪ Mid-spring (mid-October – mid-November)	▪ Late autumn – early spring (mid-May – mid-September)
Forest Red-tailed Black Cockatoo		▪ October	
Western Ringtail Possum	Early spring prior to the completion of jarrah leaf flush		Autumn and summer

Traditional custodians recommend that hazard reduction burns are carried out in autumn only (Section 2.9). Where this is not possible, an alternative burning cycle may include alternating spring and autumn burns followed by a no-burn period of 15 – 20 years according to the area in question.

6.2.5 Hazard Reduction Burn Patch Sizes

While Meelup Regional Park has had fire management cells delineated, the need to maintain ecological function to support plants, animals and communities mean that an entire cell will not be burnt at a single time. Fine scale burn mosaics within a vegetation association and/or management cell will provide fauna a refuge location, as well as flora of varied age that will provide a continued food source. Mosaics can be achieved through:

- controlling the intensity of the fire
- determining the most appropriate timing of the burn according to the life stage of species to be protected
- scheduling of burns to avoid the creation of broad areas of homogenous fuel ages

- offsetting adjacent burns by several seasons or years to provide a variety of fuel ages, habitat types and food resources
- hazard reduction burns may need to be adjusted/rescheduled in the event a wildfire occurs to create a landscape mosaic pattern
- burning when moisture levels are higher
- manually creating low-fuel zones around areas and/or individual trees to be protected.

6.3 Licences and Authorisations – *Biodiversity Conservation Act 2016* (WA)

At all times, there is a need to protect conservation significant flora, fauna and ecological communities during fire management activities. Depending on the works to be undertaken, if threatened (declared rare) flora, fauna and/or ecological communities listed under the *Biodiversity Conservation Act 2016* (WA) are likely to be impacted then an authorisation or licence (permit) issued by the Minister for Environment or their delegate may be required. Sufficient time will need to be allowed during planning activities to make application to the DBCA and have the authorisation in place ahead of planned fire management activities, with 4 – 6 weeks likely to be sufficient time.

6.3.1 Threatened Flora Authorisation

A Management Operation authorisation to take or disturb threatened flora will be required if direct or indirect impacts are likely, such as undertaking hazard reduction burns in areas that include populations of threatened flora. Early discussion with the DBCA officers is recommended, noting that one or more flora surveys to confirm the extent of the population(s) within the proposed impact area and its surrounds may be required to support the Authorisation application; several visits may be required to target species during their known flowering times.

6.3.2 Threatened Fauna Authorisation

While fire management activities will be planned to give appropriate consideration to the presence of threatened fauna species, an authorisation to 'take or disturb' threatened fauna listed under the *Biodiversity Conservation Act 2016* (WA) will be required for any activity that is likely to impact individuals or populations. Advice from DBCA officers is recommended, noting that fauna survey activities may be required to support any licence application.

6.3.3 Threatened Ecological Community Authorisation

An authorisation to modify a threatened ecological community may be required if fire management activities are likely to result in changes to the species composition and/or structure, or the destruction of the community (i.e.: a permanent modification). For ongoing fire management activities within Meelup, authorisation relating to threatened ecological communities is unlikely to be required at the current 10+ year hazard reduction burn cycle. However, if a more frequent burn regime is implemented, then authorisation may be required. Guidance material is available to enable landowners/managers undertake a self-assessment to gauge whether their proposed activity is like to result in a permanent change to the community (DBCA, 2019b), and thus the need for authorisation; advice should also be sought from DBCA officers. Note that flora and/or fauna surveys may be required to support authorisation applications.

6.3.4 Priority Listed Flora, Fauna and Ecological Communities

While a permit to 'take' flora during hazard reduction burns or other fire management activities on non-DBCA land is not technically required when 'taking' priority listed species, their presence needs to be considered from a fire management perspective, with any activities being undertaken in a manner that complements the conservation status of the species, such as protecting individuals or communities when maintaining firebreaks.

6.4 Permitting – EPBC Act 1999

With several species listed as threatened under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) such as black cockatoos and the Western Ringtail Possum utilising the site, a permit may be required from the Department of the Environment and Energy for hazard reduction burns and fire management activities if impacts are likely to be significant. A self-assessment using guidelines available from the DoEE (*1.1 Significant Impact Guidelines – Matters of National Environmental Significance*, Department of the Environment, 2013) can be used to determine if an activity is likely to be significant and if an approval is required. For example, a hazard reduction burn every 10 years that impacts a threatened orchid population and routine property maintenance activities, such as firebreak maintenance, are unlikely to require Commonwealth approval if carried out in accordance with state laws covering native vegetation is unlikely to be significant (Department of Environment and Energy, 2019, personal communication). In contrast, an intense burn through more than 1 ha of potential nesting trees with a diameter at breast height of more than 50 cm is likely to be significant, as could impacts to Western Ringtail Possum habitat; in these circumstances, DoEE approvals may be required.

Additional advice indicates the need to maintain prevailing fire regimes that do not disrupt the component species of the ecological community, including avoiding burning during flowering and nesting seasons, and the promotion of exotic species that increase the fire risk or increase impacts of other disturbances. If bushfire management activities are likely to result in a significant impact to threatened species, a referral to the DoEE will need to be submitted well ahead of time.

6.5 Weeds

The presence of weeds can contribute to fire fuel loads within a bushland area, with grassy weeds generally having the greatest potential to increase fuels. However, there are few, if any, grassy weeds within Meelup Regional Park, with recent environmental weed control activities focusing on the removal of Arum Lily (*Zantedeschia aethiopica*), a range of woody weeds, the Dolichos Pea (*Dipogon lignosus*), Watsonia sp., Thistle and Double Gee (Litoria Ecoservices, 2019). These weed types do not significantly increase the fire fuel load within Meelup, thus it is recommended that the City of Busselton:

- continue to undertake regular weed control within Meelup Regional Park to maintain the ecological values present within the reserve
- undertake post-fire event weed control activities to minimise competition from weeds after disturbance and allow new native emergents to establish.

6.6 Tracks and Access

Access throughout Meelup includes several roads, pedestrian tracks, and firebreaks, and those currently present adequate for fire control purposes. Some walking tracks have a continuous canopy over the track,

and which presents a potential safety issue in the event of a fire. If a proliferation of the pedestrian tracks occurs within the reserve, potential outcomes include loss of biodiversity, fragmentation of the landscape, and increased risk to visitors in the event of a fire. It is recommended that:

- no new firebreaks are created within the park
- rationalisation of any surplus pedestrian tracks is carried out via closure and allowed to regenerate or actively revegetated
- pedestrian tracks to be kept should be formalised to discourage users from creating informal tracks into the bushland, such as through the use of crushed limestone, clay, or other suitable means
- consideration is given to the pruning of canopy overhanging tracks due to the potential risk to park users in the event of a fire
- directional signage be installed on tracks and roads to inform park users and fire responders of distances to and locations of exits within the reserve, this will be particularly important in the event of a fire where the presence of smoke may reduce visibility.

6.7 Consultation and Liaison

The City of Busselton will continue to liaise with the DFES, the Dunsborough Volunteer Fire Brigade, the Eagle Bay Volunteer Fire Brigade, and the Department of Biodiversity Conservation and Attractions to undertake reviews of the fire response plan and access requirements within Meelup Regional Park. Regular consultation with neighbouring landowners on an ongoing basis will continue to occur.

6.8 Education

Education is a vital management tool in that information relating to various aspects of bushfire management can be provided to the wider community. This includes but is not limited to:

- the meaning of fire hazard ratings published by DFES, particularly those on very hot, dry days when the chances of a fire getting out of control are greater
- owner's responsibilities and other information relating to the protection of life and property
- expectations relating to asset protection zones around property (low-fuel areas aimed at providing a measure of protection in the event of a fire)
- advantages and disadvantages of hazard reduction burns
- management of ecological regimes to conserve biodiversity and minimising bushfire impacts to the community.

6.9 Revegetation

Revegetation activities have been carried out within Meelup Regional Park (City of Busselton, 2019, personal communication). It is recommended that revegetation continues to be carried out on an as required basis:

- in areas of degraded or non-existent native vegetation, where appropriate for the landscape and vegetation type present
- after the closure of unauthorised tracks to discourage continued usage.

6.10 Dieback

Dieback is a devastating fungal infection caused by species of Phytophthora, including *Phytophthora cinnamomi* and *Phytophthora multivora*. Dieback is present in several Meelup Regional Park locations (Figure 20), as mapped by Dieback Treatment Services (2017). The aim within Meelup is to keep its movement into

other areas at a minimum. Dieback spores are mobile in moist conditions, with infected soil having the potential to be moved on visitors' shoes and on vehicles moving between infected and uninfected areas of the reserve. Tracks are marked within an indicator of the dieback status. For vehicles, it is assumed that vehicles are clean on entry and are cleaned after fire response activities. The City of Busselton (2019a) has provided the following advice relating to dieback:

General Advice for Vehicle access into Meelup Regional Park for City staff and Contactors
Phytophthora dieback is an introduced disease that is a major threat to the biodiversity of south-west WA. It kills up to 40% of all native plants and occurs in areas receiving 400mm of rainfall per year or more. The movement of infected soil, plant material or water containing its spores, **particularly under warm, moist conditions**, will spread the disease into uninfected areas. To prevent the spread of the disease, **a critically important action is managing human access through and soil-disturbance activities within native vegetation**.

This list is designed for City employees and Contractors who have a need to access the Meelup Regional Park in vehicles and is adapted from a checklist created for the City of Busselton during a Phytophthora Management Workshop series held in the area, managed by the Busselton Dieback Working Group and funded by LotteryWest and the Shire of Busselton in 2011.

Vehicle Access Checklist	
1	**Check the disease status prior to the inspection** Meelup Regional Park has had Phytophthora Occurrence mapping conducted on a regular basis over the past 10 years or more. Many of the strategic firebreaks have been professionally mapped for *Phytophthora* occurrence with the appropriate signage placed in the field at the disease interface. Plan to visit the reserve under dry soil conditions and be sure to start the day with a clean vehicle and to stop, inspect and brush down/wash down your vehicle prior to entering areas designated as dieback free. Plan your trip to minimise the number of inspection clean down requirements.
2	**Plan fire control access prior to crisis situations** In key City reserves it is advisable to plan appropriate access routes that suit the various weather conditions that could be experienced during fire management activities based on *Phytophthora* status. Emphasis should be placed on minimising the frequency of vehicles crossing from infested vegetation into uninfested vegetation.
3	**Establish well drained pads for parking while filling appliances.** Feedback from recent workshops indicated the need for more control at water filling points used during fire control activities. As these areas tend to experience high volumes of traffic and rapidly become wet and sometimes boggy; the potential to transport *Phytophthora* spores from these sites throughout the operational area is high. Limestone pads could be installed with a focus on improved drainage to reduce the risk under these conditions.
4	**Be aware of and rectify tracks that pond water** Identify sections of tracks that have the potential to allow water to pond and rectify the drainage during dry soil conditions to reduce the risk of *Phytophthora* spread. Limestone or crushed stone should be used in preference to gravels in these situations as they are less likely to harbour

	Phytophthora. If these wet areas will present ongoing problems the installation of steel culverts should be considered as a more permanent solution.
5	**Ensure all vehicles have up to date *Phytophthora* mapping of all City reserves** This is an invaluable tool for planning around unexpected conditions such as summer rainfall events or waterlogged tracks to reduce the risk of inadvertently spreading *Phytophthora*.
6	**Ensure all vehicles have suitable clean down equipment** This can be as simple as stiff bristle brushes for dry soil removal or as technical as a high pressure wash down trailer to be used at pre- determined sites that are designed in line with current best practise wash down bays. See the image for an example of a simple battery operated clean down spray unit that is an effective hygiene tool when filled with *Phytoclean* at appropriate dilution rates. 
7	**Ensure all staff are aware of their responsibilities** Through regular discussions and training, supervisors need to be confident that all staff are familiar with hygiene requirements that are required when working in and around areas of uninfested vegetation. Dieback Working Group "Green Card Training" is one training package endorsed by DPaW that is tailored around the specific requirements of working in Phytophthora sensitive areas in a hygienic fashion.

Accordingly, it is recommended that:

- where possible, machinery and vehicles are clean on entry, as per the general advice prepared by the City
- the current Dieback Management Plan is utilised to prepare for fire management activities including proposed burns and firebreak maintenance to prevent the spread of dieback in the Park
- as dieback assessments are accurate for a specified time frame, updated information may be required ahead of any disturbance that could result in the spread of *Phytophthora* species.

6.11 Meelup Environmental Induction

The range of environmental values within Meelup Regional Park that could impacted during bushfire management activities and wildfire response mean that it is important for fire officers and volunteer fire fighters, site personnel, contractors, emergency responders and similar to be aware of those values and their location. Accordingly, it is recommended that relevant personnel are:

- informed of the values within the Reserve, including the nominal locations of fire-sensitive communities and vegetation associations present ahead of any planned hazard reduction burns;

some areas of DRF may be flagged on the ground, in consultation with DBCA, for exclusion for the fire

- vehicles to comply with General Advice for Vehicle Access into Meelup Regional Park for City Staff and Contractors; as a minimum, vehicles will need to be clean on entry and cleaned after being within a dieback area.

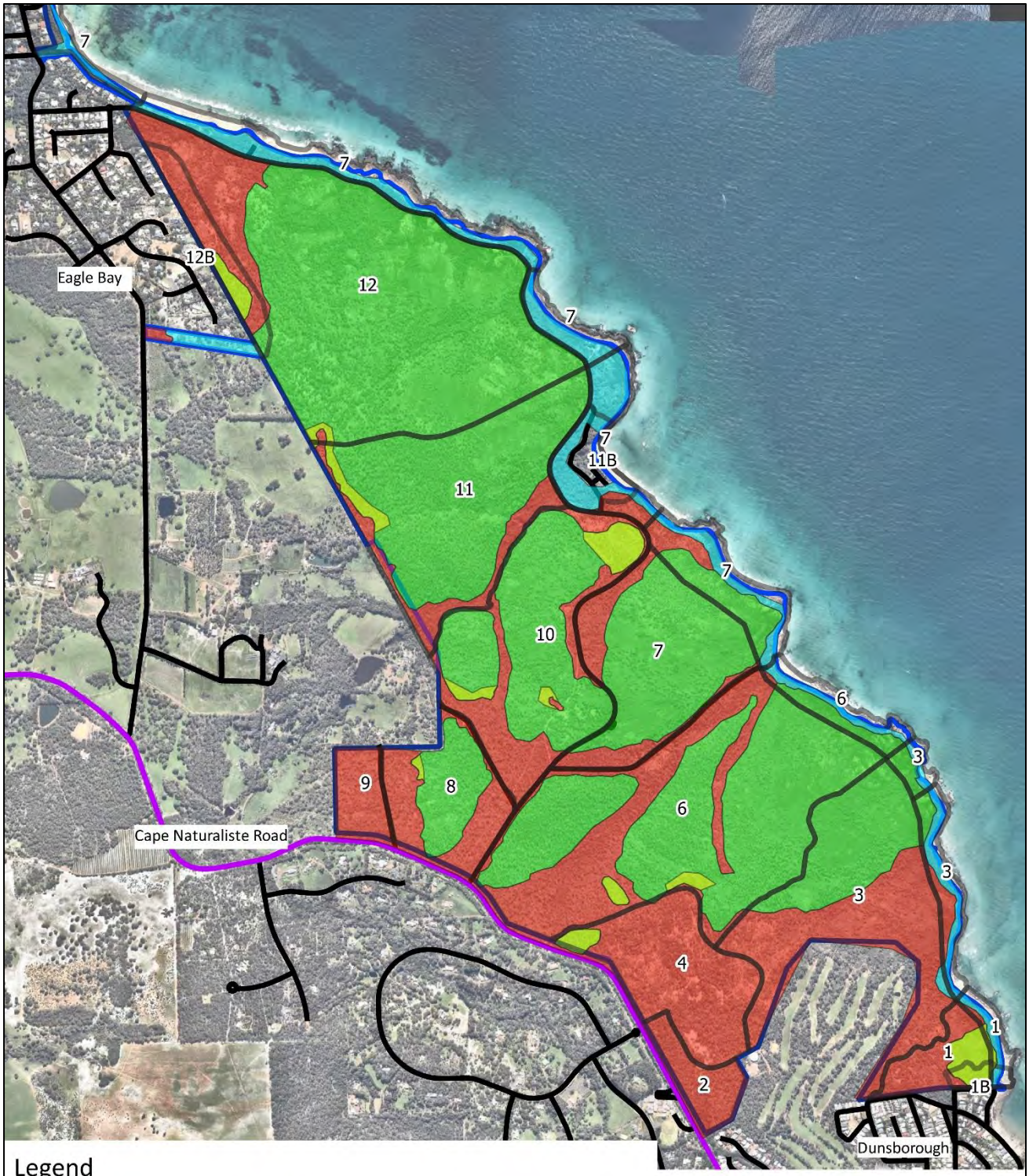

Figure 20:

Dieback Status, as at 2017
Meelup Regional Park

Client: City of Busselton
Date: June 2019
Created by: Sue Brand
Image Source: NearMap, May 2019
Datum: GDA 94

N

0 500 1000 m

Natural Area
CONSULTING MANAGEMENT SERVICES

6.12 Wildfire Response

Wildfires are those fires that are unplanned with ignition sources including arson, lightning or the escape of campfires or hazard reduction burns. Advance planning for this type of fire is limited, with response determined by the location, intensity and prevailing winds at the time of the fire. Meelup Regional Park is located within the area that is subject to the Capes Zone Response (DFES and DBCA, 2016) that operates during the peak bushfire risk period between 01 December and 31 March. During this period, an automatic multi-agency turnout applies within the bushland/urban interface zone, including the dispatch of:

- one appliance from each of the local government bush fire brigades
- one appliance from the nearest DFES station
- one appliance and DBCA staff member
- DFES staff member
- two helitaks and two fixed wing fire bombers.

Wildfire response principals include:

- rapid and early direct attack to minimise the potential size and severity of fire
- immediate dispatch of water bombers (if available)
- direct attack with hand tools for small fires, if possible, utilising wet breaks and foam
- no machine disturbance to track fires through sensitive areas
- allow the area to burn out within existing boundaries rather than creating new breaks to track the fire; backburning from existing roads and tracks to contain the fire should be considered
- where possible, utilise aerial support
- where appropriate, use foam for suppression, avoiding creek lines, wetland areas, granite outcrops, and threatened flora and ecological community locations where possible.

Current information relating to Park environmental values, dieback status, access/egress, contingency measures, evacuation, no-ignition (back-burning) areas will be obtained and communicated to responders during the fire response briefing.

7.0 Operational Procedures

7.1 Operational Procedure – Hazard Reduction Burn

Given the significant conservation values of Meelup Regional Park, an operational procedure has been developed for planning hazard reduction burns.

No.	Activity	Y	N	NA
A	**Pre-burn Activities**			
1.	Induction for City fire officers and volunteer fire-fighter personnel on the details of the Meelup Regional Park Ecological Fire Plan- to update them on this new information, environmental assets, dieback management and any relevant procedures and management required. An induction should be undertaken each year depending on turnover of personnel.			
2.	Liaison with City environmental staff and a formal meeting with DBCA flora/fauna staff to discuss the proposed burn and receive input on strategies to minimise impacts on biodiversity values.			
3.	Consultation to be undertaken on any proposed burn with the Meelup Regional Park Working Group.			
B	**Planning for Future Burn Areas**			
1.	For areas to be burnt, review: ▪ burn history (period since last burnt) ▪ fire fuel loads ▪ risks to assets and infrastructure ▪ risks to environmental values, including: - vegetation associations - dieback status of the area - presence of conservation significant flora, fauna (particularly the Western Ringtail Possum), ecological communities; (generate maps with up-to-date information from City of Busselton GIS system) - the likely significance of impacts to Commonwealth listed species, and thus the need for EPBC Act approval (DoEE) - the need, if any, for DBCA authorisations or licences to 'take' threatened flora, fauna or modify ecological communities			
2.	If required, apply for: ▪ apply for DBCA authorisation(s) under the *Biodiversity Conservation Act 2016* (WA) (flora, fauna and/or ecological communities; minimum 4 – 6 weeks ahead of planned burn) ▪ DoEE approvals due to significant impacts to listed flora and/or fauna (minimum 3 months ahead of planned burn)			

No.	Activity	Y	N	NA
3.	Prepare the burn plan, allocating required personnel and resources, ensuring all personnel are aware of the locations of: ▪ conservation significant flora, fauna, and ecological communities (where possible, populations/individuals to be protected from impacts associated with activities) ▪ review of most recent dieback mapping to assess current dieback free and infested areas ▪ review planned access arrangements and dieback cleaning measures pre- and post-fire to prevent the spread of dieback ▪ water points ▪ tracks ▪ gates ▪ other			
4.	Identify and mark any habitat trees using flagging tape of a nominated colour in order to undertake pre-mop up to protect trees: ▪ trees that have a diameter at breast height of 50 cm ▪ trees that have hollows that can be utilised by birds or small mammals ▪ Peppermint trees that have possum dreys present ▪ Grass Trees to be retained during burning operations to provide refuge habitat for fauna, including the Western Ringtail Possum			
5.	Locations with *Melaleuca viminea* present: ▪ confirm if the area is to be burnt (16-year interval) or not (10-year interval) ▪ if the *M. viminea* is not to be burnt, confirm a suitable strategy to avoid this species, such as: - increase the burn rotation for the location/cell from 10 years to 16 years - avoiding direct ignition of the locations where *M. viminea* is present - undertaking the burn at a time when there is sufficient moisture differential to exclude the *M. viminea* - install a wet break prior to ignition to reduce the fire intensity in/around the *M. viminea*			
6.	Inform residents and key stakeholders of the planned burn (minimum 4, maximum 28 days prior to burn)			
7.	Advise park users of planned burn ahead of time (minimum 4 days) and tape off tracks to prevent entry			
C.	**Burn Activities**			
1.	Undertake burn briefing with all personnel, reviewing: ▪ OHS requirements ▪ environmental values and any related management measures required in burn area ▪ access/egress points			

No.	Activity	Y	N	NA
	▪ dieback 'clean on entry' requirements and post-burn cleaning requirement ▪ contingency measures ▪ evacuation requirements/fire safe areas for personnel ▪ requirement of no direct ignition of granitic heath fringing rocky outcrops ▪ no machinery or vehicle access in any vegetated areas or in the vicinity of granite outcrops and granitic apron ▪ if required, installation of barriers to restrict access ▪ no planned use of foam unless the burn escapes or risks escape; note that there are foam restriction areas in the vicinity of creek lines, water bodies, granite areas, threatened flora species ▪ minimise the use of foam around threatened orchid populations until the potential impact to mycorrhizal associations is determined			
2.	Implement burn in accordance with approved plan			
D.	**Post-burn Activities**			
1.	Undertake post-burn briefing will all personnel, including: ▪ what worked ▪ what didn't ▪ what could be done better next time			
2.	Update City records with details of: ▪ burn location ▪ area burnt ▪ indicative timing of next planned burn ▪ any other relevant observations			
3.	Check for any potentially dangerous trees/tree limbs that require lopping in public areas			
4.	Undertake post burn weed and pest animal control (rabbits, foxes)			

8.0 Recommendations

8.1 Aboriginal Cultural Burning Practices

Based on the knowledge and information provided by the Wadandi representatives, the following are recommended to mimic traditional custodian burning practices:

- walk the site to determine the fire line of where the burning should be confined to
- undertake cool/cold burns during autumn, the time of year they would be carried out by traditional custodians
- burn at dusk when there is sufficient moisture and low winds
- walk with the fire and use appropriate tools, such as wet sacks or similar, to control fire path and flame height to prevent smoke reaching tree canopies and flames extending more than 1 m up tree trunks, or preventing the fire spreading into areas where it is not intended at the time
- continue to burn in random mosaics over several years, also considering the recommended burn frequency according to the ecological values present within Meelup
- maintain normal controls, such as fire trucks and similar, on site as a precautionary measure
- use traditional methods to protect areas such as granite outcrops, using fire to create a boundary/buffer around the area to be protected
- don't burn all the grass trees (Balga) at the same time.

(Section 2.9)

8.2 *Calothamnus graniticus* Heaths on South-west Coastal Granite

Fire management recommendations for granite outcrop communities (Department of Parks and Wildlife (DPaW), 2016a) include:

- no deliberate ignition during hazard reduction burns or fire suppression activities
- no physical disturbance of vegetation and soils (i.e.: no firebreak construction, vehicle access, and similar)
- avoid the use of foam, surfactants, or other chemical retardants on/in proximity to granite outcrops
- the minimum burn interval will be informed by the fire history for the location, time to flowering and reproductive maturity for species within the community, and risks to human, environmental, and other values if a burn is not carried out
- a burn interval of 15 up to a maximum of 45 years is recommended to assist with maintaining the floristic and structural diversity of the community; the burn interval is consistent with that recommended based on flora species present
- if a hazard reduction burn is required at any point, then a low intensity fire when conditions are mild and moist will limit the spread of fire within the community
- managing fire and fire-fuel loads in vegetation surrounding granite outcrops will reduce the potential for damage to granite outcrops from high intensity damaging fires and/or frequent fire regimes.

(Section 6.1.1)

8.3 Geophyte Populations, including Orchids

Fire management recommendations for geophyte populations (Department of Parks and Wildlife, 2016b) include:

- no deliberate ignition during hazard reduction burns or fire suppression activities

- no physical disturbance of vegetation and soils (i.e.: no firebreak construction, vehicle access, and similar)
- avoid the use of foam, surfactants, or other chemical retardants on/in proximity to granite outcrops, where geophytes often occur
- the minimum burn interval will be informed by the fire history for the location, time to flowering and reproductive maturity for species within the community, and risks to human, environmental, and other values if a burn is not carried out
- consideration needs to be given to the life-stage of the geophytes when planning hazard reduction burns:
  - burns are not recommended between mid-May – September when the majority of geophytes are actively growing and often flowering
  - burns in very early autumn (March – April) or late spring (mid-October – November) are recommended to avoid damage to aboveground parts and/or the underground storage unit; most plants will survive
  - burns between mid-November and March are unlikely to impact on populations as the plants are usually dormant; however, this should only occur if conditions allow for a burn to be undertaken safely
- burning regimes that encourage a range of post-fire seral stages are recommended as they encourage a greater diversity of geophytes
- where necessary, exclude rare species from hazard reduction burns if there is insufficient knowledge of their response to fire; such areas are likely to be small, representative of habitats that are less fire prone, and isolated within the landscape
- a burn interval of 15 up to a maximum of 45 years is recommended to assist with maintaining the floristic and structural diversity of the community; the 15-year burn interval is consistent with that recommended on the basis of flora species present
- if a hazard reduction burn is required at any point, then a burn under mild, moist spring or autumn conditions when there is a low fire danger rating is recommended
- if a hazard reduction burn is necessary between May – September, the burn should be patchy to allow the persistence of some unburnt locations to enable the survival of the populations
- where possible, the preservation of some large logs is recommended as they provide a refuge for some orchid species and their mycorrhizal fungi.

(Section 6.1.2)

8.4 Western Ringtail Possum (*Pseudocheirus occidentalis*)

Fire management recommendations for the Western Ringtail Possum (Department of Parks and Wildlife, 2008) include:

- in areas known to have a higher density of Western Ringtail Possums, a population assessment should be carried out to identify the extent of those locations, and thus areas that may require a different treatment or exclusion from the burn
- an early spring burn prior to the completion of the jarrah leaf flush is recommended as this timing will enable the provision of a good-quality feeding source for animals to recover condition after winter, with re-sprouting after fire expected to be rapid and vigorous
- autumn fires are unlikely to result in the regeneration until spring, meaning a scarcity of some food sources

- autumn and summer fires are more likely to consume large portions of the understorey and overstorey, meaning a greater possibility of predation by foxes and feral cats, along with exposure to weather when mothers are still caring for their young
- where burning in autumn cannot be avoided, minimise the total area of the burn and retain many large unburnt patches of at least 1 – 5 ha
- predator control programs are recommended prior to and after a hazard reduction burn, with at least two fox baiting sessions occurring prior to the burn and post-burn baiting program implemented until the mid-over storey are largely recovered (i.e.: minimum 18 – months to three years post burn); cat control programs should complement fox control
- avoid intense fires that have the potential to cause the greatest impact to Western Ringtail Possum feeding and habitat trees (primarily the Peppermint, along with Marri and Jarrah)
- where hazard reduction burns are necessary within Western Ringtail Possum habitat, a low intensity burn with an average char height on mature jarrah trees should be limited to 2 m or less
- where possible, the skirts of grasstrees should be retained as possum habitat refuge, with at least four per hectare to be retained
- maintain the existing dense mid-storey vegetation where dreys are typically located
- a burn interval of > 20 years is recommended for the persistence of the Western Ringtail Possum
- a moderate – high intensity burn may be required every 30 – 50 years to allow regeneration of the denser mid-storey vegetation and to assist with the development of tree hollows that provide refuge for possums
- where these intervals mean an unacceptable risk, then it may be necessary to provide a mosaic of fuel ages in an area, with areas having a younger fuel-age (< 15 – 20 years) providing a lower-fuel buffer as a means of reducing the risk of wildfire; when deciding those areas to maintain with a younger fuel age (e.g.: upslope areas), the quality of the habitat and its suitability for sustaining the possum will need to be considered (e.g.: areas where riparian vegetation is present)
- where low-fuel age areas are installed, the high-quality habitat nearby for approx. 1 – 2 km should be maintained until the burnt areas have sufficiently recovered to provide habitat to sustain moderate possum populations (i.e.: minimum of 5 – 10 years)
- when primary habitat is to be burnt, it will be necessary to consider the suitability of adjacent habitat to provide a refuge for the Western Ringtail Possums
- no more than 50% of the primary habitat should be burnt, particularly where the possum population is isolated (> 2 – 5 km) from other known populations.

(Section 6.1.3)

8.5 Black Cockatoos

Fire management recommendations for Black Cockatoo populations (Department of Parks and Wildlife, 2009) include:

- ensuring fire regimes maintain a mosaic of cockatoo food sources of varying ages/seral stages, noting that the proximity of food sources for Carnaby's Cockatoos is closely linked to fledgling success
- where possible, avoiding fire during known breeding times, particularly with unfledged chicks in nests
- where possible, burn height should be less than 2 m on Jarrah and Marri to avoid fire resulting in canopy scorch and affecting any existing hollows and/or impacting on seeds within the canopy

- raking litter away from the trunk of nesting stags, veteran trees with hollows and mature trees that are likely to develop hollows in the future (i.e.: those that are larger than 80 cm in diameter)
- planned hazard reduction burns should be low intensity, fire grained and patchy, thus conducted under mild conditions that typically occur in late autumn or spring after rains
- moderate intensity hazard reduction burns at around 15 – 25-year intervals during late summer/early autumn will encourage regeneration of vegetation, and contribute to seed release and germination of food sources
- while it is recognised that high-intensity fires contribute to the creation of hollows used for nesting, these should be infrequent and limited in the area burned to avoid the destruction of feeding sources and existing nesting hollows.

(Section 6.1.4)

8.6 Other Significant Flora

Recommendations associated with the presence of significant flora species (City of Busselton, 2019c):

- no machine disturbance within granite outcrops, it is preferable to let the habitat burn
- use only hand tools for direct attack
- where possible, utilise aerial support.

When planning hazard reduction burns in areas where significant flora species are present, it is recommended that the DBCA are consulted in the planning stages to ensure impacts are minimised.
(Section 6.1.5)

8.7 Coastal Vegetation

It is recommended that coastal vegetation buffer areas are left unburnt if possible.
(Section 6.1.6)

8.8 Other Fauna Species

It is recommended that the mosaic burn approach within fire management cells for the Western Ringtail Possum is applied to maintain populations of other small mammals such as the Southern Brown Bandicoot (*Isoodon fusciventer*) and the Honey Possum (*Tarsipes rostratus*) (Section 8.4). General recommendations for small mammal species include:

- aim for low intensity burns to achieve a mosaic of burnt/unburnt habitats
- avoid burning riparian zones where possible
- avoid deliberate ignition of grass tree skirts
- protect habitat trees (containing hollows)
- post burn predator control is recommended whilst refuge areas recover.

(Section 6.1.7)

8.9 Fire Fuel Load

It is recommended that:

- where practicable, the fire fuel load is maintained to an average of 15 t/ha to reflect the ecological and other values of the site
- the City continue to prioritise fuel load reduction activities in high-risk areas, such as adjacent to accessways, amenities, infrastructure, neighbouring property, Eagle Bay and Dunsborough, to

reduce the risk of ignition, whilst maintaining higher fuel loads in less-accessible areas within the reserve
- a range of fire fuel load reduction methods are considered, such as hazard-reduction burns, chemical and manual weed control
- the City continue to map and document fire events, including accidental fires, arson and hazard reduction burns via the City's GIS system to inform ongoing management.

(Section 6.2)

8.10 Hazard Reduction Burns

It is recommended that the frequency of hazard reduction burns is informed by:

- time since the area was last burnt (frequency in years) (accidental, arson, other)
- fire fuel load (t/ha)
- presence of sensitive flora, ecological communities and fauna populations, noting that two burn intervals across the reserve based on ecological features are suggested, namely a minimum 10-year fire interval for the majority of the reserve and a 16-year interval for those locations where *Melaleuca viminea* is present
- species response to fire, particularly months to flowering
- proximity to on and offsite assets, particularly the presence of neighbouring property
- DFES and/or City permit requirements.

(Section 6.2.1)

8.11 Recommended Burn Intervals

Burn intervals of 10 or 16 years are recommended for the Meelup vegetation associations:

Vegetation Association	Minimum Recommended Burn Interval (Years)
Banksia Woodland	10
Calothamnus graniticus Heath	16
Coastal	16
Creek line	10
Granite Apron	16
Granitic Heath	16
Jarrah, Marri Forest - Laterite	10
Jarrah, Marri Forest - Loam	10
Jarrah, Marri Woodland	10

The recommended burn interval to ensure the continued existence of the Western Ringtail Possum and other small mammals is > 20 years (DPaW, 2008), thus the recommended burn interval for vegetation may need to be adjusted to accommodate the presence of fauna. It is also recommended that a population assessment is carried out in areas known to have a higher density of Western Ringtail Possum to identify the extent of those locations, and thus areas that may require a different treatment or exclusion from the burn. (Section 6.2.3)

8.12 Hazard Reduction Burn Season

Traditional custodians recommend that burns are carried out in mid-late autumn only (Section 2.9). Where that is not possible, an alternative burning cycle may include alternating spring and autumn burns followed by a no-burn period of 15 – 20 years according to the area in question and after giving consideration to aspects of flora and fauna biology to maximise the potential for their continued survival. (Section 6.2.4)

8.13 Hazard Reduction Burn Patch Size

It is recommended that an entire cell is not burnt during a single hazard reduction burn, with fine scale burn mosaics created through:

- controlling the intensity of the fire
- determining the most appropriate timing of the burn according to the life stage of species to be protected
- scheduling of burns to avoid the creation of broad areas of homogenous fuel ages
- offsetting adjacent burns by several seasons or years to provide a variety of fuel ages, habitat types and food resources
- hazard reduction burns may need to be adjusted/rescheduled in the event a wildfire occurs to create a landscape mosaic pattern
- burning when moisture levels are higher
- manually creating low-fuel zones around areas and/or individual trees to be protected.

(Section 6.2.5)

8.14 Permits, Licences and Authorisations

It is recommended that permits for 'taking' or impacting on threatened species or communities listed at State and/or Commonwealth level are applied for well ahead of the proposed activity (4 – 6 weeks for DBCA, 3 months for DoEE) to allow time for the permit to be processed ahead of the proposed activity.
(Sections 6.3 and 6.4)

8.15 Weeds

It is recommended that the City of Busselton:

- continue to undertake regular weed control within Meelup Regional Park to maintain the ecological values present within the reserve
- undertake post-fire event weed control activities to minimise competition from weeds after disturbance and allow new native emergents to establish.

(Section 6.5)

8.16 Tracks and Access

It is recommended that:

- no new firebreaks are created within the park
- rationalisation of any surplus pedestrian tracks is carried out via closure and allowed to regenerate or actively revegetated
- pedestrian tracks to be kept should be formalised to discourage users from creating informal tracks into the bushland, such as through the use of crushed limestone, clay, or other suitable means

- consideration is given to the pruning of canopy overhanging tracks due to the potential risk to park users in the event of a fire
- directional signage be installed on tracks and roads to inform park users and fire responders of distances to and locations of exits within the reserve, this will be particularly important in the event of a fire where the presence of smoke may reduce visibility.

(Section 6.6)

8.17 Revegetation

It is recommended that revegetation continues to be carried out on an as required basis:

- in areas of degraded or non-existent native vegetation, where appropriate for the landscape and vegetation type present
- after the closure of unauthorised tracks to discourage continued usage.

(Section 6.9)

8.18 Dieback

It is recommended that:

- where possible, machinery and vehicles are clean on entry, as per the general advice prepared by the City
- the current Dieback Management Plan is utilised to prepare for fire management activities including proposed burns and firebreak maintenance to prevent the spread of dieback in the Park
- as dieback assessments are accurate for a specified time frame, updated information may be required ahead of any disturbance that could result in the spread of *Phytophthora* species

(Section 6.10)

8.19 Meelup Environmental Induction

It is recommended that relevant personnel are:

- informed of the values within the Reserve, including the nominal locations of fire-sensitive communities and vegetation associations present ahead of any planned hazard reduction burns; some areas of DRF may be flagged on the ground, in consultation with DBCA, for exclusion for the fire
- vehicles to comply with General Advice for Vehicle Access into Meelup Regional Park for City Staff and Contractors; as a minimum, vehicles will need to be clean on entry and cleaned after being within a dieback area.

(Section 6.11)

8.20 Wildfire Response

Recommendations for responding to wildfires include:

- rapid and early direct attack to minimise the potential size and severity of fire
- immediate dispatch of water bombers (if available)
- direct attack with hand tools for small fires, if possible, utilising wet breaks and foam
- no machine disturbance to track fires through sensitive areas
- allow the area to burn out within existing boundaries rather than creating new breaks to track the fire; backburning from existing roads and tracks to contain the fire should be considered

- where possible, utilise aerial support
- where appropriate, use foam for suppression, avoiding creek lines, wetland areas, granite outcrops, and threatened flora and ecological community locations where possible.

(Section 6.12)

9.0 References

AS 3959 – 2018 Construction of Buildings in Bushfire Prone Areas, Standards Australia, Homebush Bay, New South Wales.

AS/NZS ISO 31000:2009 Risk Management – Principles and Guidelines, Standards Australia, Homebush Bay, New South Wales.

Biodiversity Conservation Act 2016 (WA)

Bureau of Meteorology, (2019), *Climate and Weather Data – Cape Naturaliste*, Retrieved July 2019 from http://www.bom.gov.au/climate/data/index.shtml?bookmark=200.

Burrows, N., (2008), Linking Fire Ecology and Fire Management in South-west Australian Forest Landscapes, in *Forest Ecology and Management* 255 (2008) 2394 – 2406.

Burrows, N., Wardell-Johnson, G., and Ward, B., (2007), Post-fire Juvenile Period of Plants in South-west Australia Forests and Implications for Fire Management, in *Journal of the Royal Society of Western Australia*, 91:163-174, 2008, also available https://naturemap.dpaw.wa.gov.au/Forms/Theme_PEA/post_fire_juvenile_periods_of_plants.pdf.

City of Busselton, (2019a), *Intramaps – Property Details*, accessed June 2019 via https://maps.busselton.wa.gov.au/IM80/default.htm.

City of Busselton, (2019b), personal communication.

City of Busselton, (2019c), *Threatened Species Response Plan*, Busselton, Western Australia

CSIRO, (2008), *Bushfire in Australia*, Retrieved from: http://www.csiro.au/en/Organisation–Structure/Divisions/Ecosystem–Sciences/BushfireInAustralia.aspx.

Department of Biodiversity, Conservation and Attractions, (2019a), *Conservation Codes for Western Australian plants and animals,* Retrieved January 2019 from: https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities.

Department of Biodiversity, Conservation and Attractions, (2019b), *Guidance Note – Modification of an Occurrence of a Threatened Ecological Community – Biodiversity Conservation Act 2016*, accessed August 2019 via: https://www.dpaw.wa.gov.au/images/documents/plants-animals/tecs/TEC_modification_guidance_note.pdf.

Department of Biodiversity, Conservation and Attractions, (undated), *Threatened Flora, Fauna and Ecological Community Database Searches*, personal communication to the City of Busselton.

Department of Fire and Emergency Services and Department of Biodiversity Conservation and Attractions, (2018), *Capes Zone Response – I-zone (Interface), O-zone (outer zone) Operational Protocols*, DFES and DBCA.

Department of Fire and Emergency Services, (2019), *Fire Callouts – Meelup Regional Park*, Personal communication.

Department of Parks and Wildlife, (2009), *Fire Management Information Note S10 – Black Cockatoos* V6.0, Department of Parks and Wildlife Fire Management Services Branch, Perth, Western Australia.

Department of Parks and Wildlife, (2016a), *Fire Management Information Note No E5 Granite Outcrops* V6.0, Department of Parks and Wildlife Fire Management Services Branch, Perth, Western Australia.

Department of Parks and Wildlife, (2106b), *Fire Management Information Note S11 – Geophytes* V6.2, Department of Parks and Wildlife Fire Management Services Branch, Perth, Western Australia.

Department of Parks and Wildlife, (2008), *Fire Management Information Note S8 – Western Ringtail Possum* V6.0, Department of Parks and Wildlife Fire Management Services Branch, Perth, Western Australia.

Department of Planning, Lands and Heritage, (2019), *Aboriginal Heritage Inquiry System*, accessed June 2019 via https://maps.daa.wa.gov.au/AHIS/.

Department of Planning, Lands and Heritage and Department of Fire and Emergency Services, (2017), *Guidelines for Planning in Bushfire Prone Areas – V1.3*, Western Australian Planning Commission, Perth, Western Australia. Also available World Wide Web via URL: https://www.planning.wa.gov.au/8194.aspx.

Department of Primary Industries and Regional Development, (2019a), *SLIP NRInfo Portal – Soil Landscape Mapping – Best Available*, Retrieved July 2019 from: https://maps.agric.wa.gov.au/nrm-info/.

Department of Primary Industries and Regional Development, (2019b), *SLIP NRInfo Portal – Soil Landscape Mapping – Systems*, Retrieved July 2019 from: https://maps.agric.wa.gov.au/nrm-info/.

Department of the Environment, (2013), *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance*, accessed June 2019 from http://www.environment.gov.au/epbc/publications/significant-impact-guidelines-11-matters-national-environmental-significance.

Department of the Environment and Energy, (2019), *Categories of Threatened Species*. Accessed January 2019 from: http://www.environment.gov.au/biodiversity/threatened/species.html.

Dieback Treatment Services, (2017), *Dieback Interpretation Report – Meelup Regional Park*, unpublished report prepared for the City of Busselton.

Environmental Protection Act 1986 (WA)

Environment Protection and Biodiversity Conservation Act 1999 (Cwlth)

Environmental Protection Authority (EPA), (2016), *Environmental Factor Guideline – Flora and Vegetation*, accessed March 2020 via https://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/Guideline-Flora-Vegetation-131216_4.pdf.

Havel, J., and Mattiske, E., (2000), Vegetation Mapping of South West Forest Region of Western Australia (part 5) – A Report for the Department of Conservation and Land Management, Perth, in Webb, A., (2013), *The Flora and Vegetation of the Meelup Reserve System – A Report for the Meelup Park Management Committee*, retrieved July 2019 from: http://meeluppark.com/park-management/publications.

Hearn, R., Williams, K., Comer, S., and Beecham, B., (2002), Jarrah Forest 2 (JF2 – Southern Jarrah Forest subregion), retrieved July 2019 from: https://www.dpaw.wa.gov.au/images/documents/about/science/projects/waaudit/jarrah_forest02_p382-405.pdf.

Hopper S.D, Brown A.P, Marchant N.G., (1997), Plants of Western Australian Granite Outcrop, in *Journal of the Royal Society of Western Australia* 80:141-158.

Land Administration Act 1997 (WA)

Leonard, E., (1991), *Environmental Geology Series – Yallingup*, accessed July 2019 via http://dmpbookshop.eruditetechnologies.com.au/category/environmental-geology.do.

Litoria Ecoservices, (2019), *Report on Meelup Regional Park Environmental Weed Control, Spring 2018 and Summer 2018/19*, unpublished report prepared for the City of Busselton.

Main, B.Y., (1997). Granite outcrops: A collective ecosystem, in *Journal of the Royal Society of Western Australia* 80:113-122.

Mattiske, E., and Havel, J., (1998), *Mapping – Vegetation Complexes – South West of Western Australia and Regional Forest Agreement (DBCA-047)*, retrieved July 2019 from https://nationalmap.gov.au/.

McChesney, C., (2016), An Adaptive Restoration Framework for the *Banksia* Woodlands of Kings Park and Bold Park, in Stevens, J., Rokich, D., Newton, V., Barrett, R., and Dixon, K., (2016) *Banksia Woodlands – A Restoration Guide for the Swan Coastal Plain*, UWA Publishing, University of Western Australia, Nedlands, Western Australia.

Mitchell, Williams and Desmond, (2002), Swan Coastal Plain 2 (SWA2 – Swan Coastal Plain subregion), accessed June 2019 via https://www.dpaw.wa.gov.au/images/documents/about/science/projects/waaudit/swan_coastal_plain02_p606-623.pdf.

Pryde, J., (undated), *Endangered – Meelup Granite Community*, Retrieved July 2019 via: https://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/tecs/Meelup_Granite_TEC.pdf.

Smurthwaite, A., (2017), *Meelup Regional Park Environmental Geology*, personal communication to the City of Busselton.

Smurthwaite, A., (2019), Personal Communication.

Tille, P., Lantzke, N., (1990), Busselton, Margaret River, Augusta: Land Capability Study, accessed July 2019 via https://researchlibrary.agric.wa.gov.au/land_res/5/.

Undalup Association, (2019), *Undalup News Birak Issue, December 2019 – January 2020*, accessed March 2020 via https://7a7dce5f-55b7-4b12-bdc8-b1a1239c5fbe.filesusr.com/ugd/22ae6f_9aef86a94b834066b9fc49bc8a190740.pdf?index=true.

Valentine, L., Reaveley A., Johnson B., Fisher R., Wilson B., (2012), *Burning in Banksia Woodlands: How Does the Fire-free Period Influence Reptile Communities?* PLoS ONE 7(4): e34448, retrieved July 2019 via https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0034448.

Valentine, L., and Hobbs, R., (2014), Burning Questions for Black Cockatoos – Fire May Hold the Key to the Future of Carnaby's Cockatoo, in *Decision Point*, Issue #84/December 2014, retrieved July 2019 via http://decision-point.com.au/wp-content/uploads/2015/01/DPoint_84.pdf.

Webb, A., (2013), *The Flora and Vegetation of the Meelup Reserve System*, unpublished report prepared for the Meelup Park Management Committee, retrieved July 2019 via http://meeluppark.com/park-management/publications.

Whitford, K., (2001), Hollows in Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) tree: I. Hollow Sizes, Tree Attributes and Ages, *Forest Ecology and Management* 160 (1 – 3): 201-214; in Department of Parks and Wildlife, (2009), *Fire Management Information Note S10 – Black Cockatoos* V6.0, Department of Parks and Wildlife Fire Management Services Branch, Perth, Western Australia.

Appendix 1: Conservation Codes

Conservation codes are used to describe the status of species and ecological communities that are no longer common and under threat of extinction. Species and communities can be listed under state legislation and/or commonwealth legislation.

Western Australia

Conservation Code	Name	Description
T	Threatened	Flora and fauna listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the *Biodiversity Conservation Act 2016* (BC Act).
EX	Extinct species	Flora or fauna Species where "there is no reasonable doubt that the last member of the species has died", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).
EW	Extinct in the wild species	Species that "is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act).
MI	Migratory Species	Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act).
CD	Species of special conservation interest (conservation dependent fauna)	Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act).
OS	Specially Protected	Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).
Schedule 1 species that are ranked by the DBCA according to their level of threat using IUCN Red List criteria		
CR	Critically endangered	Species facing an extremely high risk of extinction in the wild in the immediate future
EN	Endangered	Species facing a very high risk of extinction in the wild in the near future

Conservation Code	Name	Description
VU	Vulnerable	Species considered to be facing a high risk of extinction in the wild in the medium-term future
Taxa that have not been adequately surveyed for listing under Schedule 1 or 2 of the Wildlife Protection Act are added to the Priority Lists under priorities 1, 2 or 3, according to the priority for further survey and evaluation of their conservation status.		
1	Priority One	Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey
2	Priority Two	Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
3	Priority Three	Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
4	Priority Four	(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Conservation Code	Name	Description
		Taxa that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

(Source: Department of Biodiversity Conservation and Attractions, 2019b)

Commonwealth

Category	Description
Critically Endangered	Taxa facing an extremely high risk of extinction in the wild in the immediate future
Endangered	Taxa facing a very high risk of extinction in the wild in the near future
Vulnerable	Taxa facing a high risk of extinction in the wild in the medium term

(Source: Department of the Environment and Energy, 2019)

Appendix 2: Meelup Flora Species Response to Fire

Notes:

- Species with 48 months (4 years) to first flowering = **orange**
- Species with 60 months (5 years) to first flowering = **green**
- Species with 180 months (15 years) to peak flowering = **blue**

Data sources:

- Burrows *et al*, 2007
- Webb, 2013

FAMILY	Scientific Name	Cons Code	Common Name	Response to Fire	Months to First Flowering	Months to Peak Flowering	Longevity	Banksia Woodland	CG Heath	Coastal	Creek Line	Granite Apron	Granitic Heath	J/M Forest	J/M Forest - Loam	J/M Woodland
Fabaceae	*Acacia alata*		Winged Wattle	02. 100% scorch kills, in soil seed storage	60		Perennial				x			x		x
Fabaceae	*Acacia cochlearis*		Rigid Wattle	02. 100% scorch kills, in soil seed storage	24		Perennial			x						
Fabaceae	*Acacia cyclops*		Coastal Wattle	02. 100% scorch kills, in soil seed storage	24		Perennial			x	x					
Fabaceae	*Acacia divergens*			02. 100% scorch kills, in soil seed storage	24		Perennial				x	x		x		
Fabaceae	*Acacia huegelii*							x								
Fabaceae	*Acacia lateriticola glabrous variant (B.R. Maslin 6765) PN*	P3						x			x			x		x
Fabaceae	*Acacia myrtifolia*			02. 100% scorch kills, in soil seed storage	21	48	Perennial	x						x		
Fabaceae	*Acacia nervosa*		Rib Wattle	02. 100% scorch kills, in soil seed storage	25	50	Perennial						x			x
Fabaceae	*Acacia obovata*			05. Survives 100% scorch, basal sprouts	19		Perennial							x		x
Fabaceae	*Acacia pulchella*		Prickly Moses	02. 100% scorch kills, in soil seed storage	24	48	Perennial	x	x	x	x		x	x	x	x
Fabaceae	*Acacia rostellifera*		Summer-scented Wattle	02. 100% scorch kills, in soil seed storage	36		Perennial			x						
Fabaceae	*Acacia saligna*		Orange Wattle	02. 100% scorch kills, in soil seed storage	36	48	Perennial			x	x					
Fabaceae	*Acacia saligna subsp. stolonifera*										x	x				
Fabaceae	*Acacia stenoptera*		Narrow Winged Wattle	02. 100% scorch kills, in soil seed storage	36		Perennial						x	x		x
Rosaceae	*Acaena echinata*		Sheep's Burr									x			x	
Asparagaceae	*Acanthocarpus preissii*			04. Survives 100% scorch, soil suckers	30		Perennial			x						
Proteaceae	*Adenanthos barbiger*			05. Survives 100% scorch, basal sprouts	24	48	Perennial	x						x		x
Proteaceae	*Adenanthos meisneri*			05. Survives 100% scorch, basal sprouts	36		Perennial	x								
Proteaceae	*Adenanthos sp. Whicher Range (G.J. Keighery 9736) PN*															x
Pteridaceae	*Adiantum aethiopicum*		Common Maidenhair								x				x	
Myrtaceae	*Agonis flexuosa*		Peppermint	05. Survives 100% scorch, basal sprouts	30		Perennial	x		x	x	x		x	x	x
Hemerocallidaceae	*Agrostocrinum hirsutum*							x			x	x	x	x		x
Casuarinaceae	*Allocasuarina fraseriana*		Sheoak	06. Survives 100% scorch, epicormics	36		Perennial									x
Casuarinaceae	*Allocasuarina humilis*		Dwarf Sheoak	05. Survives 100% scorch, basal sprouts	36		Perennial		x				x			x

FAMILY	Scientific Name	Cons Code	Common Name	Response to Fire	Months to First Flowering	Months to Peak Flowering	Longevity	Banksia Woodland	CG Heath	Coastal	Creek Line	Granite Apron	Granitic Heath	J/M Forest	J/M Forest - Loam	J/M Woodland
Casuarinaceae	*Allocasuarina microstachya*			05. Survives 100% scorch, basal sprouts	48		Perennial						x			
Poaceae	*Amphipogon amphipogonoides*			05. Survives 100% scorch, basal sprouts	12		Perennial									x
Poaceae	*Amphipogon laguroides*			04. Survives 100% scorch, soil suckers	12		Perennial	x								
Anarthriaceae	*Anarthria gracilis*															x
Ericaceae	*Andersonia caerulea*		Foxtails	08. Killed by 100% scorch (any 1,2,3)	24		Perennial						x			x
Ericaceae	*Andersonia micrantha*							x								
Haemodoraceae	*Anigozanthos flavidus*		Tall Kangaroo Paw	04. Survives 100% scorch, soil suckers	6		Perennial				x				x	
Haemodoraceae	*Anigozanthos humilis subsp. humilis*							x								
Haemodoraceae	*Anigozanthos manglesii*		Mangles Kangaroo Paw	04. Survives 100% scorch, soil suckers	12		Perennial	x								
Haemodoraceae	*Anigozanthos viridis*		Green Kangaroo Paw	04. Survives 100% scorch, soil suckers	36		Perennial					x				
Pteridaceae	*Anogramma leptophylla*		Annual Fern											x		
Solanaceae	*Anthocercis littorea*		Yellow Tailflower	04. Survives 100% scorch, soil suckers	18		Perennial			x						
Centrolepidaceae	*Aphelia cyperoides*			08. Killed by 100% scorch (any 1,2,3)	6		Annual	x			x	x		x		x
Apiaceae	*Apium prostratum*		Sea Celery							x						
Asteraceae	*Asteridea pulverulenta*		Common Bristle Daisy	08. Killed by 100% scorch (any 1,2,3)	12		Annual	x								
Ericaceae	*Astroloma ciliatum*		Candle Cranberry	05. Survives 100% scorch, basal sprouts	18		Perennial			x	x		x	x	x	x
Ericaceae	*Astroloma drummondii*			04. Survives 100% scorch, soil suckers	30		Perennial						x	x		x
Ericaceae	*Astroloma pallidum*		Kick Bush	04. Survives 100% scorch, soil suckers	24		Perennial		x		x	x	x	x		x
Chenopodiaceae	*Atriplex cinerea*		Grey Saltbush							x						
Chenopodiaceae	*Atriplex hypoleuca*									x						
Poaceae	*Austrostipa campylachne*			04. Survives 100% scorch, soil suckers	20		Perennial					x		x		
Poaceae	*Austrostipa compressa*			02. 100% scorch kills, in soil seed storage	6		Annual	x	x							
Poaceae	*Austrostipa flavescens*			02. 100% scorch kills, in soil seed storage	6		Perennial		x	x						
Poaceae	*Austrostipa macalpinei*			02. 100% scorch kills, in soil seed storage	12		Perennial								x	
Myrtaceae	*Babingtonia camphorosmae*		Camphor Myrtle									x				
Proteaceae	*Banksia attenuata*		Slender Banksia	06. Survives 100% scorch, epicormics	48		Perennial	x								
Proteaceae	*Banksia bipinnatifida*													x		x

FAMILY	Scientific Name	Cons Code	Common Name	Response to Fire	Months to First Flowering	Months to Peak Flowering	Longevity	Banksia Woodland	CG Heath	Coastal	Creek Line	Granite Apron	Granitic Heath	J/M Forest	J/M Forest - Loam	J/M Woodland
Proteaceae	*Banksia dallanneyi*		Couch Honeypot						x	x	x	x	x	x		x
Proteaceae	*Banksia grandis*		Bull Banksia	06. Survives 100% scorch, epicormics	24		Perennial	x	x				x			x
Proteaceae	*Banksia littoralis*		Swamp Banksia	06. Survives 100% scorch, epicormics	24		Perennial	x								
Cyperaceae	*Baumea juncea*		Bare Twigrush							x	x					
Cyperaceae	*Baumea rubiginosa*							^			x					
Euphorbiaceae	*Beyeria viscosa*		Pinkwood							x						
Pittosporaceae	*Billardiera fusiformis*		Australian Bluebell											x		
Pittosporaceae	*Billardiera floribunda*		White-flowered Billardiera	04. Survives 100% scorch, soil suckers	24		Perennial			x	x				x	x
Pittosporaceae	*Billardiera laxiflora*										x			x		x
Pittosporaceae	*Billardiera variifolia*													x		
Rutaceae	*Boronia dichotoma*													x		
Rutaceae	*Boronia tenuis*	P4	Blue Boronia						x			x	x		x	x
Boryaceae	*Borya scirpoidea*											x				x
Fabaceae	*Bossiaea eriocarpa*		Common Brown Pea	05. Survives 100% scorch, basal sprouts	12		Perennial	x								
Fabaceae	*Bossiaea linophylla*			02. 100% scorch kills, in soil seed storage	36	72	Perennial				x				x	
Fabaceae	*Bossiaea ornata*		Broad Leaved Brown Pea									x		x		x
Asteraceae	*Brachyscome iberidifolia*			03. 100% scorch kills, no seed storage	12		Perennial						x			
Poaceae	*Bromus arenarius*		Sand Brome									x				
Colchicaceae	*Burchardia congesta*		Milkmaids					x	x			x	x	x		x
Colchicaceae	*Burchardia multiflora*		Dwarf Burchardia	11. Geophyte (Survives 100% scorch)	12		Perennial		x		x					
Hemerocallidaceae	*Caesia micrantha*		Pale Grass-lily					x	x		X	x	x	x	x	x
Orchidaceae	*Caladenia attingens*							x							x	
Orchidaceae	*Caladenia caesarea subsp. maritima*	T										x	x			x
Orchidaceae	*Caladenia chapmanii*							x				x				x
Orchidaceae	*Caladenia excelsa*	T	Giant Spider Orchid					x								
Orchidaceae	*Caladenia ferruginea*		Rusty Spider Orchid	11. Geophyte (Survives 100% scorch)	9		Perennial		x							
Orchidaceae	*Caladenia flava*		Cowslip Orchid	11. Geophyte (Survives 100% scorch)	24		Perennial	x					x	x		
Orchidaceae	*Caladenia gardneri*															
Orchidaceae	*Caladenia longicauda subsp. clivicola*								x			x	x	x	x	x

FAMILY	Scientific Name	Cons Code	Common Name	Response to Fire	Months to First Flowering	Months to Peak Flowering	Longevity	Banksia Woodland	CG Heath	Coastal	Creek Line	Granite Apron	Granitic Heath	J/M Forest	J/M Forest - Loam	J/M Woodland
Orchidaceae	*Caladenia magniclavata*		Big Clubbed Spider Orchid	11. Geophyte (Survives 100% scorch)	9		Perennial						x			x
Orchidaceae	*Caladenia paludosa*							x								
Orchidaceae	*Caladenia reptans subsp. reptans*															
Orchidaceae	*Caladenia rhomboidiformis*															
Orchidaceae	*Caladenia thinicola*															x
Orchidaceae	*Caladenia viridescens*	T						x						x		
Portulacaceae	*Calandrinia granulifera*		Pygmy Purslane							x						
Cupressaceae	*Callitris acuminata*		Dwarf Cypress					x								
Myrtaceae	*Calothamnus graniticus subsp. graniticus*	P4							x			x	x			
Myrtaceae	*Calothamnus sanguineus*		Silky-leaved Blood flower	05. Survives 100% scorch, basal sprouts	36		Perennial	x		x		x	x	x	x	x
Myrtaceae	*Calytrix flavescens*		Summer Starflower	02. 100% scorch kills, in soil seed storage	30		Perennial	x								
Cyperaceae	*Carex preissii*									x						
Aizoaceae	*Carpobrotus virescens*		Coastal Pigface							x						
Lauraceae	*Cassytha glabella*		Tangled Dodder Laurel									x	x			x
Lauraceae	*Cassytha pomiformis*		Dodder Laurel								x		x			x
Lauraceae	*Cassytha racemosa*		Dodder Laurel	02. 100% scorch kills, in soil seed storage	24		Perennial					x		x		
Centrolepidaceae	*Centrolepis aristata*		Pointed Centrolepis					x	x			x	x	x		x
Centrolepidaceae	*Centrolepis drummondiana*							x	x		x	x		x		
Centrolepidaceae	*Centrolepis pilosa*								x							
Centrolepidaceae	*Centrolepis polygyna*		Wiry Centrolepis					^		x						
Asparagaceae	*Chamaescilla corymbosa*		Blue Squill	11. Geophyte (Survives 100% scorch)	7		Perennial	x	x			x	x	x	x	x
Pteridaceae	*Cheilanthes austrotenuifolia*			10. Ferns and allies (spores)			Perennial		x	x		x			x	
Pteridaceae	*Cheilanthes distans*		Bristly Cloak Fern						x				x			
Cyperaceae	*Chorizandra enodis*		Black Bristlerush								x	x				
Fabaceae	*Chorizema aciculare*		Needle-leaved Chorizema	05. Survives 100% scorch, basal sprouts	12		Perennial		x				x			x
Fabaceae	*Chorizema cordatum*							x							x	
Fabaceae	*Chorizema diversifolium*			02. 100% scorch kills, in soil seed storage	30		Perennial			x					x	
Fabaceae	*Chorizema nanum*														x	

FAMILY	Scientific Name	Cons Code	Common Name	Response to Fire	Months to First Flowering	Months to Peak Flowering	Longevity	Banksia Woodland	CG Heath	Coastal	Creek Line	Granite Apron	Granitic Heath	J/M Forest	J/M Forest - Loam	J/M Woodland
Fabaceae	*Chorizema reticulatum*												x			
Fabaceae	*Chorizema rhombeum*			02. 100% scorch kills, in soil seed storage	21		Perennial						x	x	x	x
Ranunculaceae	*Clematis pubescens*		Common Clematis	05. Survives 100% scorch, basal sprouts	32		Perennial				x				x	
Polygalaceae	*Comesperma ciliatum*								x				x	x		x
Polygalaceae	*Comesperma ciliatum (pink flw form)*												x			
Polygalaceae	*Comesperma confertum*												x		x	
Polygalaceae	*Comesperma integerrimum*												x			
Malvaceae	*Commersonia cygnorum*									x	x	x				
Proteaceae	*Conospermum capitatum subsp. glabratum*							x								
Haemodoraceae	*Conostylis aculeata*		Prickly Conostylis	05. Survives 100% scorch, basal sprouts	32		Perennial	x	x	x		x				
Haemodoraceae	*Conostylis setigera*		Bristly Cottonhead	02. 100% scorch kills, in soil seed storage	24		Perennial	x	x				x	x		x
Myrtaceae	*Corymbia calophylla*		Marri	06. Survives 100% scorch, epicormics	48		Perennial	x	x	x	x	x	x	x	x	x
Asteraceae	*Craspedia variabilis*											x		x		
Crassulaceae	*Crassula closiana*							x	x			x			x	x
Crassulaceae	*Crassula colorata*		Dense Stonecrop					x		x		x				
Crassulaceae	*Crassula decumbens*		Rufous Stonecrop					x			x					
Crassulaceae	*Crassula pedicellosa*											x				
Rhamnaceae	*Cryptandra arbutiflora var. tubulosa*							x	x	x		x	x			x
Orchidaceae	*Cyanicula gemmata*												x			x
Orchidaceae	*Cyanicula sericea*			11. Geophyte (Survives 100% scorch)	8		Perennial		x					x		
Cyperaceae	*Cyathochaeta avenacea*			05. Survives 100% scorch, basal sprouts	6		Perennial	x			x	x				
Orchidaceae	*Cyrtostylis huegelii*			11. Geophyte (Survives 100% scorch)	12		Perennial					x				
Goodeniaceae	*Dampiera coronata*		Wedge-leaved Dampiera												x	
Goodeniaceae	*Dampiera lindleyi*							x		x	x	x	x	x	x	
Goodeniaceae	*Dampiera linearis*		Common Dampiera	05. Survives 100% scorch, basal sprouts			Perennial	x					x	x		x
Goodeniaceae	*Dampiera trigona*		Angled-stem Dampiera								x					
Myrtaceae	*Darwinia citriodora*		Lemon-scented Darwinia	02. 100% scorch kills, in soil seed storage	35		Perennial		x	x	x	x	x		x	x

FAMILY	Scientific Name	Cons Code	Common Name	Response to Fire	Months to First Flowering	Months to Peak Flowering	Longevity	Banksia Woodland	CG Heath	Coastal	Creek Line	Granite Apron	Granitic Heath	J/M Forest	J/M Forest - Loam	J/M Woodland
Myrtaceae	*Darwinia vestita*		Pom-pom Darwinia	02. 100% scorch kills, in soil seed storage	36		Perennial						x			x
Dasypogonaceae	*Dasypogon bromeliifolius*		Pineapple Bush	07. Survives 100% scorch, large apical bud	6		Perennial	x								
Apiaceae	*Daucus glochidiatus*		Australian Carrot					x				x			x	
Fabaceae	*Daviesia cordata*		Bookleaf	04. Survives 100% scorch, soil suckers	24		Perennial		x							x
Fabaceae	*Daviesia decurrens*		Prickly Bitter-pea	05. Survives 100% scorch, basal sprouts	18		Perennial						x	x		x
Fabaceae	*Daviesia horrida*		Prickly Bitter-pea	04. Survives 100% scorch, soil suckers	24		Perennial		x	x		x	x	x		x
Fabaceae	*Daviesia incrassata*			05. Survives 100% scorch, basal sprouts	17		Perennial				x			x		x
Fabaceae	*Daviesia inflata*			05. Survives 100% scorch, basal sprouts	48		Perennial									x
Fabaceae	*Daviesia longifolia*			05. Survives 100% scorch, basal sprouts	20		Perennial						x			x
Fabaceae	*Daviesia preissii*			05. Survives 100% scorch, basal sprouts	30		Perennial				x			x		x
Restionaceae	*Desmocladus asper*											x				
Restionaceae	*Desmocladus fasciculatus*							x					x	x	x	x
Restionaceae	*Desmocladus flexuosus*												x			
Hemerocallidaceae	*Dianella brevicaulis*									x	x	x				
Poaceae	*Dichelachne crinita*		Longhair Plumegrass	04. Survives 100% scorch, soil suckers	30		Perennial	x								
Convolvulaceae	*Dichondra repens*		Kidney Weed								x					
Asparagaceae	*Dichopogon capillipes*			04. Survives 100% scorch, soil suckers			Perennial					x			x	
Asparagaceae	*Dichopogon preissii*										x					
Fabaceae	*Dillwynia laxiflora*								x				x			
Rutaceae	*Diplolaena dampieri*		Southern Diplolaena							x						
Orchidaceae	*Diuris sp. Dunsborough*							x			x			x		x
Sapindaceae	*Dodonaea ceratocarpa*			05. Survives 100% scorch, basal sprouts			Perennial		x	x	x	x	x		x	x
Sapindaceae	*Dodonaea pinifolia*												x			
Droseraceae	*Drosera bulbosa subsp. bulbosa*											x				
Droseraceae	*Drosera erythrorhiza*		Red Ink Sundew	11. Geophyte (Survives 100% scorch)	11		Perennial									
Droseraceae	*Drosera gigantea*		Giant Sundew	11. Geophyte (Survives 100% scorch)	10		Perennial				x	x				
Droseraceae	*Drosera glanduligera*		Pimpernel Sundew	11. Geophyte (Survives 100% scorch)	12		Perennial		x			x	x	x		x

FAMILY	Scientific Name	Cons Code	Common Name	Response to Fire	Months to First Flowering	Months to Peak Flowering	Longevity	Banksia Woodland	CG Heath	Coastal	Creek Line	Granite Apron	Granitic Heath	J/M Forest	J/M Forest - Loam	J/M Woodland
Droseraceae	*Drosera macrantha*		Bridal Rainbow	11. Geophyte (Survives 100% scorch)			Perennial	x				x				
Droseraceae	*Drosera menziesii subsp. menziesii*		Pink Rainbow	11. Geophyte (Survives 100% scorch)	6		Perennial	x					x			
Droseraceae	*Drosera pallida*		Pale Rainbow	11. Geophyte (Survives 100% scorch)	12		Perennial		x			x	x	x		x
Droseraceae	*Drosera stolonifera*		Leafy Sundew	11. Geophyte (Survives 100% scorch)	12		Perennial					x	x			
Droseraceae	*Drosera tubaestylis*											x				
Orchidaceae	*Elythranthera brunonis*		Purple Enamel Orchid	11. Geophyte (Survives 100% scorch)	24		Perennial	x	x				x	x		x
Orchidaceae	*Elythranthera emarginata*		Pink Enamel Orchid	11. Geophyte (Survives 100% scorch)	11		Perennial		x					x		
Chenopodiaceae	*Enchylaena tomentosa*		Barrier Saltbush							x						
Myrtaceae	*Eremaea pauciflora var. pauciflora*							x								
Orchidaceae	*Eriochilus dilatatus*		White Bunny Orchid	11. Geophyte (Survives 100% scorch)	12		Perennial	x	x	x			x	x	x	x
Geraniaceae	*Erodium crinitum*		Corkscrew									x				
Myrtaceae	*Eucalyptus marginata*		Jarrah	06. Survives 100% scorch, epicormics	48		Perennial	x					x	x		x
Myrtaceae	*Eucalyptus patens*		Swan River Blackbutt	06. Survives 100% scorch, epicormics	48		Perennial	x			x	x				
Myrtaceae	*Eucalyptus phylacis*	T	Meelup Mallee													x
Myrtaceae	*Eucalyptus rudis subsp. cratyantha*	P4									x				x	
Myrtaceae	*Eucalyptus virginea*	P4														x
Fabaceae	*Eutaxia myrtifolia*								x							
Santalaceae	*Exocarpos odoratus*		Scented Ballart	02. 100% scorch kills, in soil seed storage	24		Perennial					x				
Santalaceae	*Exocarpos sparteus*		Broom Ballart	02. 100% scorch kills, in soil seed storage	18		Perennial			x						
Cyperaceae	*Ficinia nodosa*		Knotted Club Rush							x						
Frankeniaceae	*Frankenia pauciflora*		Seaheath							x						
Fabaceae	*Gastrolobium praemorsum*										x	x				
Fabaceae	*Gastrolobium spinosum*		Prickly Poison	02. 100% scorch kills, in soil seed storage	36	72	Perennial						x			x
Fabaceae	*Gompholobium knightianum*			02. 100% scorch kills, in soil seed storage	21		Perennial		x				x	x		x
Fabaceae	*Gompholobium marginatum*			02. 100% scorch kills, in soil seed storage			Perennial	x	x			x	x	x	x	x
Fabaceae	*Gompholobium ovatum*			02. 100% scorch kills, in soil seed storage	31		Perennial							x		

FAMILY	Scientific Name	Cons Code	Common Name	Response to Fire	Months to First Flowering	Months to Peak Flowering	Longevity	Banksia Woodland	CG Heath	Coastal	Creek Line	Granite Apron	Granitic Heath	J/M Forest	J/M Forest - Loam	J/M Woodland
Fabaceae	*Gompholobium polymorphum*			02. 100% scorch kills, in soil seed storage	13		Perennial						x	x		x
Fabaceae	*Gompholobium preissii*			02. 100% scorch kills, in soil seed storage	21		Perennial						x	x		
Fabaceae	*Gompholobium tomentosum*		Hairy Yellow Pea	02. 100% scorch kills, in soil seed storage	31		Perennial	x					x	x		
Goodeniaceae	*Goodenia coerulea*			02. 100% scorch kills, in soil seed storage	24		Perennial						x	x		x
Goodeniaceae	*Goodenia eatoniana*			08. Killed by 100% scorch (any 1,2,3)	14		Perennial					x	x			
Goodeniaceae	*Goodenia micrantha*							x			x	x				
Plantaginaceae	*Gratiola pubescens*										x					
Proteaceae	*Grevillea quercifolia*		Oak-leaf Grevillea	05. Survives 100% scorch, basal sprouts	17		Perennial							x		x
Proteaceae	*Grevillea trifida*			05. Survives 100% scorch, basal sprouts	30		Perennial		x		x		x			x
Haemodoraceae	*Haemodorum discolor*			02. 100% scorch kills, in soil seed storage	12		Perennial	x	x				x	x	x	
Haemodoraceae	*Haemodorum laxum*			11. Geophyte (Survives 100% scorch)	6		Perennial						x			
Haemodoraceae	*Haemodorum simplex*			11. Geophyte (Survives 100% scorch)	8		Perennial			x		x				x
Proteaceae	*Hakea amplexicaulis*		Prickly Hakea	05. Survives 100% scorch, basal sprouts	30		Perennial							x	x	x
Proteaceae	*Hakea lissocarpha*		Honey Bush	05. Survives 100% scorch, basal sprouts	29		Perennial		x	x	x	x	x	x		x
Proteaceae	*Hakea prostrata*		Harsh Hakea	05. Survives 100% scorch, basal sprouts	36		Perennial			x						
Proteaceae	*Hakea trifurcata*		Two-leaf Hakea	01. 100% scorch kills, on plant seed storage	48		Perennial		x	x			x			x
Fabaceae	*Hardenbergia comptoniana*		Native Wisteria	05. Survives 100% scorch, basal sprouts	30		Perennial			x					x	
Lamiaceae	*Hemigenia incana*		Silky Hemigenia	02. 100% scorch kills, in soil seed storage	33		Perennial				x		x			
Lamiaceae	*Hemigenia rigida*													x		
Dilleniaceae	*Hibbertia commutata*			05. Survives 100% scorch, basal sprouts	32		Perennial							x		x
Dilleniaceae	*Hibbertia cuneiformis*		Cutleaf Hibbertia	05. Survives 100% scorch, basal sprouts	20		Perennial			x	x				x	
Dilleniaceae	*Hibbertia cunninghamii*			05. Survives 100% scorch, basal sprouts	24		Perennial		x	x	x	x	x	x	x	x
Dilleniaceae	*Hibbertia diamesogenos*							x		x		x	x	x		x
Dilleniaceae	*Hibbertia hypericoides*		Yellow Buttercups	05. Survives 100% scorch, basal sprouts	22		Perennial	x	x		x	x	x	x	x	x
Dilleniaceae	*Hibbertia polystachya*												x			
Dilleniaceae	*Hibbertia racemosa*		Stalked Guinea Flower	05. Survives 100% scorch, basal sprouts	29		Perennial	x							x	

FAMILY	Scientific Name	Cons Code	Common Name	Response to Fire	Months to First Flowering	Months to Peak Flowering	Longevity	Banksia Woodland	CG Heath	Coastal	Creek Line	Granite Apron	Granitic Heath	J/M Forest	J/M Forest - Loam	J/M Woodland
Dilleniaceae	*Hibbertia spicata subsp. spicata*								x			x	x			
Apiaceae	*Homalosciadium homalocarpum*			02. 100% scorch kills, in soil seed storage	9		Annual	x			x	x			x	
Fabaceae	*Hovea chorizemifolia*		Holly-leaved Hovea	05. Survives 100% scorch, basal sprouts	29		Perennial	x					x	x		x
Fabaceae	*Hovea elliptica*		Tree Hovea	05. Survives 100% scorch, basal sprouts	18		Perennial				x				x	
Fabaceae	*Hovea pungens*		Devil's Pins	02. 100% scorch kills, in soil seed storage	36		Perennial	x								
Fabaceae	*Hovea trisperma*		Common Hovea	02. 100% scorch kills, in soil seed storage	42		Perennial					x	x	x		x
Asteraceae	*Hyalosperma demissum*											x				
Asteraceae	*Hyalosperma pusillum*							x								
Asteraceae	*Hyalosperma simplex*											x				
Violaceae	*Hybanthus calycinus*		Wild Violet													
Violaceae	*Hybanthus floribundus*				24		Perennial						x	x		x
Araliaceae	*Hydrocotyle alata*							^				x				
Araliaceae	*Hydrocotyle callicarpa*		Small Pennywort					x	x		x	x	x	x	x	x
Myrtaceae	*Hypocalymma angustifolium*		White Myrtle	04. Survives 100% scorch, soil suckers	48		Perennial		x		x	x	x	x		x
Myrtaceae	*Hypocalymma robustum*		Swan River Myrtle	05. Survives 100% scorch, basal sprouts	24		Perennial	x					x	x	x	x
Restionaceae	*Hypolaena exsulca*							x								
Hypoxidaceae	*Pauridia occidentalis*											x			x	
Hypoxidaceae	*Pauridia vaginata*		Yellow Star											x		
Cyperaceae	*Isolepis cernua*		Nodding Club-rush						x			x				
Campanulaceae	*Isotoma hypocrateriformis*		Woodbridge Poison	02. 100% scorch kills, in soil seed storage	12		Annual						x			x
Fabaceae	*Isotropis cuneifolia*		Granny Bonnets	05. Survives 100% scorch, basal sprouts	9		Perennial	x								
Fabaceae	*Jacksonia alata*												x			x
Fabaceae	*Jacksonia furcellata*		Grey Stinkwood		12		Perennial	x								
Hemerocallidaceae	*Johnsonia acaulis (Busselton form)*							x								
Hemerocallidaceae	*Johnsonia lupulina*		Hooded Lily	04. Survives 100% scorch, soil suckers	27		Perennial							x		
Juncaceae	*Juncus caespiticius*		Grassy Rush								x					
Juncaceae	*Juncus kraussii*		Sea Rush		33		Perennial			x						
Juncaceae	*Juncus pallidus*		Pale Rush								x					
Juncaceae	*Juncus planifolius*		Broadleaf Rush								x					
Fabaceae	*Kennedia carinata*			02. 100% scorch kills, in soil seed storage	32		Perennial	x	x					x	x	x

FAMILY	Scientific Name	Cons Code	Common Name	Response to Fire	Months to First Flowering	Months to Peak Flowering	Longevity	Banksia Woodland	CG Heath	Coastal	Creek Line	Granite Apron	Granitic Heath	J/M Forest	J/M Forest - Loam	J/M Woodland
Fabaceae	*Kennedia coccinea*		Coral Vine	02. 100% scorch kills, in soil seed storage	20		Perennial				x			x		
Dasypogonaceae	*Kingia australis*		Kingia	07. Survives 100% scorch, large apical bud	2		Perennial	x					x			x
Myrtaceae	*Kunzea glabrescens*		Spearwood											x		
Fabaceae	*Labichea punctata*		Lance-leaved Cassia	04. Survives 100% scorch, soil suckers	33		Perennial						x			x
Asteraceae	*Lagenophora huegelii*			09. Survives 100% scorch (any 4,5,6,7,11)	12		Perennial	x	x		x			x	x	x
Asparagaceae	*Laxmannia sessiliflora*		Nodding Lily	02. 100% scorch kills, in soil seed storage			Perennial		x			x	x			x
Goodeniaceae	*Lechenaultia biloba*		Blue Leschenaultia	04. Survives 100% scorch, soil suckers	24		Perennial						x			x
Cyperaceae	*Lepidosperma carphoides*		Black Rapier Sedge							x						
Cyperaceae	*Lepidosperma gladiatum*		Coast Sword-sedge	04. Survives 100% scorch, soil suckers	24		Perennial						x	x		x
Cyperaceae	*Lepidosperma leptostachyum*			04. Survives 100% scorch, soil suckers	24		Perennial				x	x				
Cyperaceae	*Lepidosperma longitudinale*		Pithy Sword-sedge	04. Survives 100% scorch, soil suckers	24		Perennial							x		
Cyperaceae	*Lepidosperma pubisquameum*										x					
Cyperaceae	*Lepidosperma squamatum*			04. Survives 100% scorch, soil suckers	24		Perennial		x	x	x		x	x	x	x
Cyperaceae	*Lepidosperma tetraquetrum*			04. Survives 100% scorch, soil suckers	22		Perennial				x					
Santalaceae	*Leptomeria cunninghamii*			02. 100% scorch kills, in soil seed storage	29		Perennial			x				x		x
Santalaceae	*Leptomeria squarrulosa*													x		
Asteraceae	*Leucophyta brownii*									x						
Ericaceae	*Leucopogon aff. cordatus*													x		
Ericaceae	*Leucopogon capitellatus*			04. Survives 100% scorch, soil suckers	29		Perennial					x		x	x	x
Ericaceae	*Leucopogon conostephioides*							x								
Ericaceae	*Leucopogon hirsutus*										x					
Ericaceae	*Leucopogon oxycedrus*			05. Survives 100% scorch, basal sprouts			Perennial	x								
Ericaceae	*Leucopogon parviflorus*		Coast Beard-heath	05. Survives 100% scorch, basal sprouts	30		Perennial			x						
Ericaceae	*Leucopogon propinquus*			04. Survives 100% scorch, soil suckers	27		Perennial	x			x	x			x	
Ericaceae	*Leucopogon tenuis*												x			x
Stylidiaceae	*Levenhookia pusilla*		Midget Stylewort	08. Killed by 100% scorch (any 1,2,3)	10		Annual	x	x			x	x	x	x	x

FAMILY	Scientific Name	Cons Code	Common Name	Response to Fire	Months to First Flowering	Months to Peak Flowering	Longevity	Banksia Woodland	CG Heath	Coastal	Creek Line	Granite Apron	Granitic Heath	J/M Forest	J/M Forest - Loam	J/M Woodland
Stylidiaceae	*Levenhookia stipitata*		Common Stylewort										x			x
Lindsaeaceae	*Lindsaea linearis*		Screw Fern				Perennial	x								x
Menyanthaceae	*Liparophyllum latifolium*										x					
Campanulaceae	*Lobelia anceps*		Angled Lobelia								x					
Campanulaceae	*Lobelia rhytidosperma*		Wrinkled-seeded Lobelia	08. Killed by 100% scorch (any 1,2,3)	12		Annual				x					
Campanulaceae	*Lobelia tenuior*		Slender Lobelia						x							x
Loganiaceae	*Orianthera serpyllifolia*			02. 100% scorch kills, in soil seed storage	24		Perennial							x		x
Loganiaceae	*Logania vaginalis*		White Spray	09. Survives 100% scorch (any 4,5,6,7,11)	20		Perennial				x				x	
Asparagaceae	*Lomandra caespitosa*		Tufted Mat Rush					x					x	x	x	x
Asparagaceae	*Lomandra hermaphrodita*										x				x	
Asparagaceae	*Lomandra integra*			05. Survives 100% scorch, basal sprouts	17		Perennial							x		
Asparagaceae	*Lomandra micrantha*		Small-flower Mat-rush					x	x		x	x	x	x	x	x
Asparagaceae	*Lomandra nigricans*			04. Survives 100% scorch, soil suckers	6		Perennial						x	x		x
Asparagaceae	*Lomandra pauciflora*			04. Survives 100% scorch, soil suckers	12		Perennial				x		x		x	
Asparagaceae	*Lomandra purpurea*		Purple Mat Rush	03. 100% scorch kills, no seed storage	12		Perennial							x		
Asparagaceae	*Lomandra sericea*		Silky Mat Rush									x	x	x		x
Asparagaceae	*Lomandra sonderi*			04. Survives 100% scorch, soil suckers	18		Perennial				x			x		x
Asparagaceae	*Lomandra suaveolens*			04. Survives 100% scorch, soil suckers	18		Perennial		x			x				x
Anarthriaceae	*Lyginia barbata*			05. Survives 100% scorch, basal sprouts	21		Perennial	x								
Orchidaceae	*Lyperanthus serratus*		Rattle Beak Orchid	11. Geophyte (Survives 100% scorch)	6		Perennial						x	x		x
Ericaceae	*Lysinema pentapetalum*							x					x			x
Zamiaceae	*Macrozamia riedlei*		Zamia	07. Survives 100% scorch, large apical bud	29		Perennial	x	x	x	x				x	
Pittosporaceae	*Marianthus tenuis*								x		x		x	x		x
Haloragaceae	*Meionectes tenuifolia*	3										x				
Myrtaceae	*Melaleuca incana subsp. incana*			01. 100% scorch kills, on plant seed storage	33		Perennial				x					
Myrtaceae	*Melaleuca lanceolata*		Rottnest Teatree		36		Perennial			x						
Myrtaceae	*Melaleuca lateritia*		Robin Redbreast Bush	05. Survives 100% scorch, basal sprouts	60		Perennial				x					

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Myrtaceae	*Melaleuca systena*								x			x	x			x
Myrtaceae	*Melaleuca thymoides*			05. Survives 100% scorch, basal sprouts	44		Perennial	x								
Myrtaceae	*Melaleuca trichophylla*			05. Survives 100% scorch, basal sprouts	36		Perennial	x								
Myrtaceae	*Melaleuca viminea*		Mohan	01. 100% scorch kills, on plant seed storage	60	180	Perennial	^		x		x				
Cyperaceae	*Mesomelaena graciliceps*															x
Cyperaceae	*Mesomelaena stygia*			04. Survives 100% scorch, soil suckers	18		Perennial						x			
Cyperaceae	*Mesomelaena tetragona*		Semaphore Sedge	04. Survives 100% scorch, soil suckers	22		Perennial					x	x	x		x
Poaceae	*Microlaena stipoides*		Weeping Grass	04. Survives 100% scorch, soil suckers	12		Perennial	x		x	x				x	
Orchidaceae	*Microtis media*											x				
Asteraceae	*Millotia myosotidifolia*			08. Killed by 100% scorch (any 1,2,3)	12		Annual		x	x			x			
Asteraceae	*Millotia tenuifolia*		Soft Millotia					x	x			x	x	x		x
Fabaceae	*Mirbelia dilatata*		Holly-leaved Mirbelia	02. 100% scorch kills, in soil seed storage	26		Perennial				x					
Euphorbiaceae	*Monotaxis occidentalis*													x		
Polygonaceae	*Muehlenbeckia adpressa*		Climbing Lignum	02. 100% scorch kills, in soil seed storage	30		Perennial			x						
Scrophulariaceae	*Myoporum caprarioides*		Slender Myoporum												x	
Scrophulariaceae	*Myoporum oppositifolium*		Twin-leaf Myoporum	02. 100% scorch kills, in soil seed storage	27		Perennial				x					
Poaceae	*Neurachne alopecuroidea*		Foxtail Mulga Grass	04. Survives 100% scorch, soil suckers	13		Perennial	x	x			x	x	x	x	x
Loranthaceae	*Nuytsia floribunda*		Christmas Tree	06. Survives 100% scorch, epicormics	24		Perennial	x	x				x			x
Asteraceae	*Olearia axillaris*		Coastal Daisybush	03. 100% scorch kills, no seed storage			Perennial			x						
Asteraceae	*Olearia paucidentata*		Autumn Scrub Daisy	08. Killed by 100% scorch (any 1,2,3)	48		Perennial				x					
Rubiaceae	*Opercularia apiciflora*							x				x	x	x		x
Rubiaceae	*Opercularia echinocephala*		Bristly Headed Stink Weed								x		x	x		x
Rubiaceae	*Opercularia hispidula*		Hispid Stinkweed	04. Survives 100% scorch, soil suckers	18		Perennial				x			x	x	
Rubiaceae	*Opercularia vaginata*		Dog Weed	02. 100% scorch kills, in soil seed storage	24		Perennial	x					x	x		x
Iridaceae	*Orthrosanthus laxus*		Morning 1ris								x					x
Oxalidaceae	*Oxalis perennans*									x	x	x			x	
Fabaceae	*Paraserianthes lophantha*		Albizia	02. 100% scorch kills, in soil seed storage	24		Perennial				x					

FAMILY	Scientific Name	Cons Code	Common Name	Response to Fire	Months to First Flowering	Months to Peak Flowering	Longevity	Banksia Woodland	CG Heath	Coastal	Creek Line	Granite Apron	Granitic Heath	J/M Forest	J/M Forest - Loam	J/M Woodland
Urticaceae	*Parietaria debilis*		Pellitory							x						
Iridaceae	*Patersonia babianoides*			04. Survives 100% scorch, soil suckers	7		Perennial						x	x		x
Iridaceae	*Patersonia juncea*		Rush Leaved Patersonia	04. Survives 100% scorch, soil suckers	12		Perennial	x	x		x	x	x			x
Iridaceae	*Patersonia occidentalis*		Purple Flag	02. 100% scorch kills, in soil seed storage	36		Perennial	x			x	x	x	x		x
Iridaceae	*Patersonia pygmaea*		Pygmy Patersonia	04. Survives 100% scorch, soil suckers	12		Perennial						x	x		x
Iridaceae	*Patersonia umbrosa*		Yellow Flags	04. Survives 100% scorch, soil suckers	36		Perennial				x			x		x
Geraniaceae	*Pelargonium littorale*			04. Survives 100% scorch, soil suckers	12		Perennial								x	
Apiaceae	*Pentapeltis peltigera*			04. Survives 100% scorch, soil suckers	9		Perennial							x		x
Proteaceae	*Persoonia longifolia*		Snottygobble	05. Survives 100% scorch, basal sprouts	24		Perennial	x			x			x	x	x
Proteaceae	*Petrophile striata*												x	x		x
Rutaceae	*Philotheca spicata*		Pepper and Salt					x					x	x		x
Philydraceae	*Philydrella drummondii*							x			x	x				x
Haemodoraceae	*Phlebocarya ciliata*			05. Survives 100% scorch, basal sprouts	18		Perennial	x								
Loganiaceae	*Phyllangium divergens*											x				
Loganiaceae	*Phyllangium paradoxum*											x				
Phyllanthaceae	*Phyllanthus calycinus*		False Boronia	04. Survives 100% scorch, soil suckers	24		Perennial	x	x	x	x	x	x		x	x
Thymelaeaceae	*Pimelea angustifolia*		Narrow-leaved Pimelea	02. 100% scorch kills, in soil seed storage	18		Perennial	x								
Thymelaeaceae	*Pimelea ferruginea*			02. 100% scorch kills, in soil seed storage	24		Perennial		x	x			x			
Thymelaeaceae	*Pimelea hispida*		Bristly Pimelea	02. 100% scorch kills, in soil seed storage	15		Perennial									
Thymelaeaceae	*Pimelea imbricata var. piligera*							x				x	x			
Thymelaeaceae	*Pimelea preissii*			04. Survives 100% scorch, soil suckers	21			x	x				x	x		x
Thymelaeaceae	*Pimelea rosea*		Rose Banjine					x				x	x		x	
Thymelaeaceae	*Pimelea suaveolens subsp. suaveolens*		Tall Mulla Mulla	05. Survives 100% scorch, basal sprouts	18		Perennial							x		
Pittosporaceae	*Pittosporum ligustrifolium*									x						
Apiaceae	*Platysace haplosciadia*												x			x
Apiaceae	*Platysace tenuissima*			02. 100% scorch kills, in soil seed storage	13		Perennial				x			x		x
Poaceae	*Poa poiformis*		Coastal Poa	09. Survives 100% scorch (any 4,5,6,7,11)	12		Perennial			x						

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Podocarpaceae	*Podocarpus drouynianus*		Wild Plum	05. Survives 100% scorch, basal sprouts	13		Perennial	x								
Asteraceae	*Podolepis lessonii*											x	x			
Asteraceae	*Podotheca angustifolia*		Sticky Longheads					x								
Phyllanthaceae	*Poranthera huegelii*													x		
Phyllanthaceae	*Poranthera microphylla*		Small Poranthera	02. 100% scorch kills, in soil seed storage	12		Annual		x			x			x	x
Orchidaceae	*Prasophyllum gracile*											x				
Orchidaceae	*Prasophyllum parvifolium*		Autumn Leek Orchid	01. 100% scorch kills, on plant seed storage	12		Perennial							x		x
Dennstaedtiaceae	*Pteridium esculentum*		Bracken	10. Ferns and allies (spores)			Perennial			x	x				x	
Asteraceae	*Pterochaeta paniculata*		Woolly Waitzia	02. 100% scorch kills, in soil seed storage	10		Annual						x			x
Orchidaceae	*Pterostylis aff. nana*		Snail Orchid										x			
Orchidaceae	*Pterostylis nana*		Snail Orchid											x		
Orchidaceae	*Pterostylis recurva*		Jug Orchid	11. Geophyte (Survives 100% scorch)	24		Perennial							x		
Amaranthaceae	*Ptilotus drummondii*		Narrowleaf Mulla Mulla	02. 100% scorch kills, in soil seed storage	12		Perennial			x						
Amaranthaceae	*Ptilotus manglesii*		Pom Poms	02. 100% scorch kills, in soil seed storage	3		Perennial	x						x		
Orchidaceae	*Pyrorchis nigricans*		Red beaks	11. Geophyte (Survives 100% scorch)	12		Perennial							x		
Asteraceae	*Quinetia urvillei*			02. 100% scorch kills, in soil seed storage	9		Annual	x	x			x		x		x
Ranunculaceae	*Ranunculus colonorum*		Common Buttercup	04. Survives 100% scorch, soil suckers			Perennial							x		
Chenopodiaceae	*Rhagodia baccata*		Berry Saltbush					x		x	x					
Asteraceae	*Rhodanthe citrina*			02. 100% scorch kills, in soil seed storage	12		Annual	x			x	x				
Asteraceae	*Rhodanthe corymbosa*								x							
Poaceae	*Rytidosperma setaceum*														x	x
Primulaceae	*Samolus junceus*			02. 100% scorch kills, in soil seed storage	33		Perennial				x					
Santalaceae	*Santalum acuminatum*		Quandong						x	x						
Chenopodiaceae	*Sarcocornia blackiana*									x						
Goodeniaceae	*Scaevola calliptera*			02. 100% scorch kills, in soil seed storage			Perennial							x	x	x
Goodeniaceae	*Scaevola crassifolia*		Thick-leaved Fan-flower	02. 100% scorch kills, in soil seed storage	3		Perennial			x						
Goodeniaceae	*Scaevola glandulifera*		Viscid Hand-flower								x		x	x		x
Goodeniaceae	*Scaevola microphylla*		Small-leaved Scaevola	04. Survives 100% scorch, soil suckers	12		Perennial				x	x				x

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Goodeniaceae	*Scaevola nitida*		Shining Fanflower							x						
Cyperaceae	*Schoenus asperocarpus*		Poison Sedge						x							x
Cyperaceae	*Schoenus aff. subflavus*		Yellow Bog-rush									x				
Cyperaceae	*Schoenus bifidus*							x				x				
Cyperaceae	*Schoenus clandestinus*										x		x			
Cyperaceae	*Schoenus curvifolius*			05. Survives 100% scorch, basal sprouts	24		Perennial	x								
Cyperaceae	*Schoenus elegans*										x	x				
Cyperaceae	*Schoenus nanus*		Tiny Bog Rush					x	x			x	x			x
Cyperaceae	*Schoenus obtusifolius*												x			
Cyperaceae	*Schoenus odontocarpus*										x	x				x
Cyperaceae	*Schoenus plumosus*							^				x				
Cyperaceae	*Schoenus sculptus*		Gimlet Bog-rush					x				x				
Cyperaceae	*Schoenus subbarbatus*		Bearded Bog-rush													x
Cyperaceae	*Schoenus sublateralis*												x			
Cyperaceae	*Schoenus unispiculatus*							x				x	x	x		x
Cyperaceae	*Schoenus variicellae*							x				x				
Selaginellaceae	*Selaginella gracillima*		Tiny Clubmoss					x				x		x		x
Asteraceae	*Senecio hispidulus*		Hispid Fireweed								x			x		x
Asteraceae	*Senecio pinnatifolius var. maritimus*		Coastal Groundsel							x						
Asteraceae	*Senecio quadridentatus*														x	
Asteraceae	*Siloxerus filifolius*			08. Killed by 100% scorch (any 1,2,3)	12		Annual	x					x			
Asteraceae	*Siloxerus multiflorus*											x				x
Solanaceae	*Solanum symonii*									x						
Asparagaceae	*Sowerbaea laxiflora*		Purple Tassels					x							x	
Fabaceae	*Sphaerolobium drummondii*													x		
Fabaceae	*Sphaerolobium medium*			02. 100% scorch kills, in soil seed storage	23		Perennial						x	x		x
Poaceae	*Spinifex hirsutus*		Hairy Spinifex							x						
Poaceae	*Sporobolus virginicus*		Marine Couch							x						
Rhamnaceae	*Spyridium globulosum*		Basket Bush	02. 100% scorch kills, in soil seed storage	6		Perennial	x		x	x	x		x	x	x
Euphorbiaceae	*Stachystemon virgatus*							x					x	x		x
Celastraceae	*Stackhousia monogyna*			08. Killed by 100% scorch (any 1,2,3)	12		Perennial	x					x	x		
Proteaceae	*Stirlingia latifolia*		Blueboy	02. 100% scorch kills, in soil seed storage	24		Perennial	x								

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Stylidiaceae	*Stylidium adnatum*		Common Beaked Triggerplant	02. 100% scorch kills, in soil seed storage	12		Perennial				x					
Stylidiaceae	*Stylidium affine*		Queen Triggerplant						x			x	x			
Stylidiaceae	*Stylidium amoenum*		Lovely Triggerplant	02. 100% scorch kills, in soil seed storage	9		Perennial						x	x		x
Stylidiaceae	*Stylidium calcaratum*		Book Triggerplant	02. 100% scorch kills, in soil seed storage	7		Ephemeral	x						x		x
Stylidiaceae	*Stylidium crassifolium*		Thick-leaved Triggerplant								x	x			x	
Stylidiaceae	*Stylidium diversifolium*		Touch-me-not	02. 100% scorch kills, in soil seed storage	12		Perennial	x								
Stylidiaceae	*Stylidium ecorne*		Foot Triggerplant							x						
Stylidiaceae	*Stylidium eriopodum*												x			x
Stylidiaceae	*Stylidium hesperium*							x								
Stylidiaceae	*Stylidium lowrieanum*							x								
Stylidiaceae	*Stylidium megacarpum*							x	x			x	x	x	x	
Stylidiaceae	*Stylidium petiolare*		Horn Triggerplant									x				x
Stylidiaceae	*Stylidium repens*		Matted Triggerplant	04. Survives 100% scorch, soil suckers	7		Perennial	x	x			x	x	x		x
Hemerocallidaceae	*Stypandra glauca*		Blind Grass	04. Survives 100% scorch, soil suckers	18		Perennial		x	x	x				x	
Ericaceae	*Styphelia tenuiflora*		Common Pinheath	04. Survives 100% scorch, soil suckers	29		Perennial	x			x		x	x		x
Proteaceae	*Synaphea gracillima*			04. Survives 100% scorch, soil suckers	22				x				x	x		x
Proteaceae	*Synaphea petiolaris*		Synaphea	05. Survives 100% scorch, basal sprouts	26		Perennial						x			x
Proteaceae	*Synaphea petiolaris* subsp. *triloba*															x
Myrtaceae	*Taxandria linearifolia*							^								
Fabaceae	*Templetonia retusa*		Cockies Tongues	02. 100% scorch kills, in soil seed storage	48		Perennial			x						
Cyperaceae	*Tetraria capillaris*		Hair Sedge								x		x	x		x
Cyperaceae	*Tetraria octandra*								x			x	x	x	x	x
Poaceae	*Tetrarrhena laevis*		Forrest Ricegrass	04. Survives 100% scorch, soil suckers	18		Perennial	x			x	x	x	x	x	x
Elaeocarpaceae	*Tetratheca setigera*			04. Survives 100% scorch, soil suckers	18		Perennial							x		x
Orchidaceae	*Thelymitra antennifera*		Vanilla Orchid	11. Geophyte (Survives 100% scorch)	12		Perennial		x			x				
Orchidaceae	*Thelymitra benthamiana*		Cinnamon Sun Orchid												x	

FAMILY	Scientific Name	Cons Code	Common Name	Response to Fire	Months to First Flowering	Months to Peak Flowering	Longevity	Banksia Woodland	CG Heath	Coastal	Creek Line	Granite Apron	Granitic Heath	J/M Forest	J/M Forest - Loam	J/M Woodland
Orchidaceae	*Thelymitra crinita*		Blue Lady Orchid	11. Geophyte (Survives 100% scorch)	6		Perennial					x	x	x	x	x
Orchidaceae	*Thelymitra macrophylla*			11. Geophyte (Survives 100% scorch)	12		Perennial				x					
Orchidaceae	*Thelymitra variegata*	P3	Queen of Sheba	11. Geophyte (Survives 100% scorch)	12		Perennial									
Orchidaceae	*Thelymitra villosa*		Custard Orchid	11. Geophyte (Survives 100% scorch)	12		Perennial									
Orchidaceae	*Thelymitra vulgaris*								x							
Poaceae	*Themeda triandra*									x						
Malvaceae	*Thomasia foliosa*											x	x	x	x	
Malvaceae	*Thomasia paniculata*			02. 100% scorch kills, in soil seed storage	24		Perennial									
Malvaceae	*Thomasia pauciflora*		Few Flowered Thomasia	02. 100% scorch kills, in soil seed storage	24		Perennial				x					
Malvaceae	*Thomasia rhynchocarpa*										x					
Myrtaceae	*Thryptomene saxicola*		Rock Thryptomene						x							
Asparagaceae	*Thysanotus gracilis*							x								
Asparagaceae	*Thysanotus manglesianus*		Fringed Lily	04. Survives 100% scorch, soil suckers	6		Perennial	x	x			x	x	x	x	
Asparagaceae	*Thysanotus multiflorus*		Many-flowered Fringe Lily	04. Survives 100% scorch, soil suckers	12		Perennial				x	x				x
Asparagaceae	*Thysanotus sparteus*			04. Survives 100% scorch, soil suckers	12		Perennial	x			x		x	x		x
Asparagaceae	*Thysanotus tenellus*			04. Survives 100% scorch, soil suckers	24		Perennial						x	x		x
Asparagaceae	*Thysanotus thyrsoideus*			02. 100% scorch kills, in soil seed storage			Perennial									x
Araliaceae	*Trachymene pilosa*		Native Parsnip	02. 100% scorch kills, in soil seed storage	12		Annual	x	x			x	x	x	x	x
Elaeocarpaceae	*Tremandra diffusa*			04. Survives 100% scorch, soil suckers	12		Perennial				x				x	
Elaeocarpaceae	*Tremandra stelligera*			02. 100% scorch kills, in soil seed storage	28		Perennial				x					
Haemodoraceae	*Tribonanthes australis*											x				
Asteraceae	*Trichocline spathulata*		Native Gerbera	04. Survives 100% scorch, soil suckers	9		Perennial		x				x	x		x
Hemerocallidaceae	*Tricoryne elatior*		Yellow Autumn Lily	02. 100% scorch kills, in soil seed storage	24		Perennial	x	x				x			x
Hemerocallidaceae	*Tricoryne humilis*			04. Survives 100% scorch, soil suckers	8		Perennial							x		
Juncaginaceae	*Triglochin trichophora*							^								
Haloragaceae	*Trihaloragis hexandra*										x					
Celastraceae	*Tripterococcus brunonis*		Winged Stackhousia	04. Survives 100% scorch, soil suckers	8		Perennial						x	x		x
Rhamnaceae	*Trymalium ledifolium*								x		x	x	x	x	x	x

FAMILY	Scientific Name	Cons Code	Common Name	Response to Fire	Months to First Flowering	Months to Peak Flowering	Longevity	Banksia Woodland	CG Heath	Coastal	Creek Line	Granite Apron	Granitic Heath	J/M Forest	J/M Forest - Loam	J/M Woodland
Lentibulariaceae	*Utricularia multifida*			02. 100% scorch kills, in soil seed storage	6		Annual	^								
Goodeniaceae	*Velleia trinervis*			02. 100% scorch kills, in soil seed storage	32		Perennial	x								
Myrtaceae	*Verticordia plumosa var. plumosa*											x	x			x
Fabaceae	*Viminaria juncea*		Swishbush							x	x	x	x		x	x
Campanulaceae	*Wahlenbergia gracilenta*		Annual Bluebell	02. 100% scorch kills, in soil seed storage	9		Annual	x	x				x	x	x	x
Colchicaceae	*Wurmbea monantha*			04. Survives 100% scorch, soil suckers	12		Perennial					x				
Colchicaceae	*Wurmbea tenella*		Eight Nancy						x							
Xanthorrhoeaceae	*Xanthorrhoea gracilis*		Graceful Grass Tree	07. Survives 100% scorch, large apical bud	9		Perennial	x				x	x	x		x
Xanthorrhoeaceae	*Xanthorrhoea preissii*		Grass tree	07. Survives 100% scorch, large apical bud	9		Perennial	x	x	x	x	x	x	x	x	x
Apiaceae	*Xanthosia candida*			02. 100% scorch kills, in soil seed storage	21		Perennial	x	x		x	x	x	x	x	x
Apiaceae	*Xanthosia ciliata*												x			x
Apiaceae	*Xanthosia huegelii*			05. Survives 100% scorch, basal sprouts	32		Perennial	x					x	x		x
Proteaceae	*Xylomelum occidentale*			06. Survives 100% scorch, epicormics	12		Perennial									x