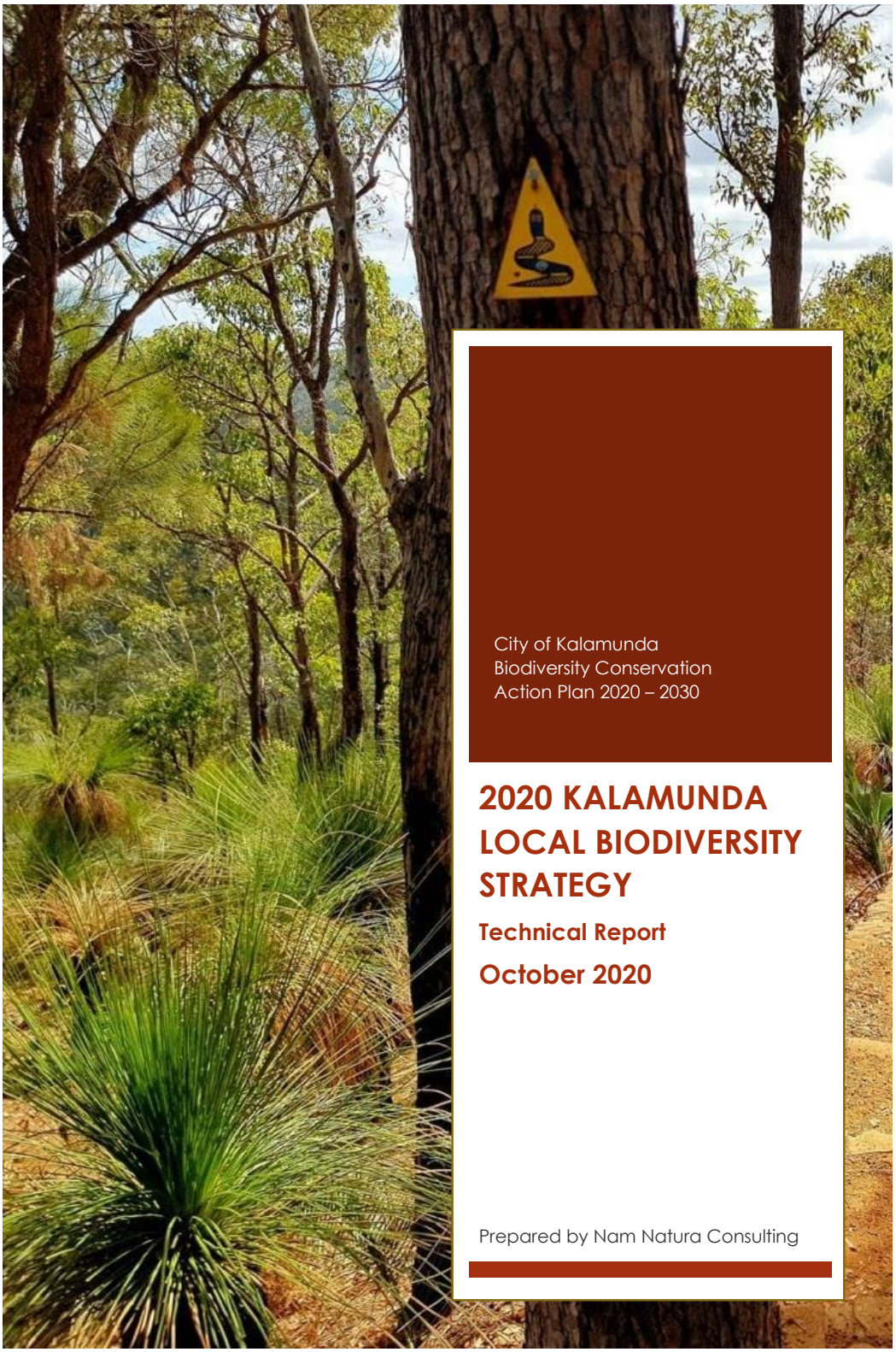
City of Kalamunda
Biodiversity Conservation
Action Plan 2020 – 2030
2020 KALAMUNDA LOCAL BIODIVERSITY STRATEGY
Technical Report
October 2020
Prepared by Nam Natura Consulting

Document Tracking

Item	Detail
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LIST OF APPENDICES

ABBREVIATIONS

2008 LBS	Shire of Kalamunda Local Biodiversity Strategy as adopted in October 2008
DBCA	Department of Biodiversity, Conservation and Attractions (current)
KEAC	Kalamunda Environmental Advisory Committee
EPP	Environmental Planning Policy
LPS 3	Local Planning Scheme No 3
PEC	Priority Ecological Community
TEC	Threatened Ecological Community
WALGA	Western Australian Local Government Association
WAPC	Western Australian Planning Commission

PURPOSE

The purpose of this report and its Appendices is to document the data and methodologies used to inform the revised City of Kalamunda Local Biodiversity Strategy.

1 INTRODUCTION – WHY HAVE A LOCAL BIODIVERSITY STRATEGY?

Biodiversity is the variety of all life forms —the different plants, animals and micro-organisms, the genes they contain, and the ecosystems they form. Biodiversity is usually considered at three levels: genetic diversity, species diversity and ecosystem diversity. The reasons why biodiversity conservation forms an important consideration in decision making go beyond the recognition of the great variety of unique or charismatic plants or animals. The interactions of these living entities, their contribution to functional values at the ecosystem level are well documented as being critical to human wellbeing.

Many aspects of biodiversity conservation are regulated via legislation. For example, the protection of rare or threatened plants, animals or plant (ecological) communities is regulated at both State and Federal government levels. Yet, key findings of the latest Australian State of the Environment (SOE) Report (2016) showed the number of threatened species and ecological communities continue to increase, also there was no evidence of decreased pressures on biodiversity and that the cumulative impacts of multiple pressures amplify the threats to biodiversity. While protection of biodiversity via a network of formal reserves forms an important component of biodiversity conservation, the SOE report found the current network of protected areas is not yet comprehensive, representative or adequate (Cresswell and Murphy, 2016). The 2016 SOE report also highlighted many activities that significantly contribute to biodiversity conservation but sit outside regulatory process, such as the significant contribution of citizen scientists to improving our understanding of biodiversity and the management of the numerous threatening processes, demonstrating the need for a multi-stakeholder approach to biodiversity conservation, including Local Government and communities.

Biodiversity conservation depends on a whole-of-community approach. While protection of representative natural areas via establishment of reserves can be legislated, the long-term viability of these protected features depends on adequate management and on the management of surrounding lands. A Local Biodiversity Strategy provides a process for assessing the significance of local natural areas in the broader landscape context, for identification of local conservation priorities and outlines a process for improving the conservation status of biodiversity by considering the local opportunities and protection constraints.

A Local Biodiversity Strategy that considers local biodiversity values in the regional context and is integrated into the local land use planning aids transparency and consistency in decision making.

The City of Kalamunda was one of three local governments piloting a local biodiversity conservation planning process developed via the Western Australian Local Government Association in 2004. When publishing its 2008 Local Biodiversity Strategy, the City was the first local government in Western Australia to adopt a strategy developed in accordance with the State Government endorsed methodology for biodiversity conservation planning at local level (Environmental Protection Authority 2008).

Review of the City's 2008 Local Biodiversity Strategy found the Strategy was not used effectively to support land use planning decisions or to increase the protection status of identified significant natural areas in the City. Since 2008, there was less than a 1% increase in formally protected areas recorded in the City (via conservation type Crown lands) and over 630 hectares of native vegetation lost (Appendix E).

The key achievements of the City included the establishment of a team dedicated to management of natural areas on its lands to support the growing number of community volunteers engaged in natural area management and publication of various resources and fact sheets on best practice bushland management including the Private Landholder Bushland Information Package (Shire of Kalamunda 2013).

Due to changes in legislation and policy frameworks relating to biodiversity as well as in the biodiversity status in the City, an update of the 2008 Local Biodiversity Strategy is warranted. The key changes include:

- Clarity about how the State government considers Local Biodiversity Strategies and local biodiversity conservation objectives;
- New State legislation; the *Biodiversity Conservation Act 2016* and changes to the *Environmental Protection Act 1986;*
- New threatened ecological communities listed by the Commonwealth and State governments;
- Changes in the strategic land use directions by the State;
- New land use planning policies; *Statement of Planning Policy No 2.8: Bushland Policy for the Perth Metropolitan Region (WAPC 2010)* and *State Planning Policy No. 3.7: Planning in Bushfire Prone Areas (2015);*
- Increase in the City's urban development footprint.

The City's Strategic Community Plan, *Kalamunda Advancing 2017 - 2027*, demonstrates the continued strong commitment to building the City's future while preserving its heritage, "a home in the forest" as expressed in the City's name[1]. "*Delivering environmental sustainability and maintaining the integrity of the natural environment*" is one of four priority areas of the City's Strategic Community Plan (City

[1] Kalamunda means 'a home in the forest', and the name comes from the words of the local Beeloo people that inhabited the area; with Cala meaning home or fire, hearth and Munda meaning forest (City of Kalamunda, 2017). Alternative explanation is that Munda is derived from the name of the Elder of the Beeloo clan of the Wadjuk Noongar people that lived in the area at the time of settlement (City of Kalamunda, 2019).

of Kalamunda, 2017). This provides for the development of the City's Local Environmental Strategy (LES) *(2019-2029)* which identifies actions in four key areas:

- The value of green space and natural areas
- Conserving natural resources
- Reducing waste
- Managing the impacts.

The Local Biodiversity Strategy will directly contribute to the actions identified in three of the four key areas of the *LES (2019-2029)*.

An update of the City's 2008 Local Biodiversity Strategy was also identified as a priority action in the City's *Environmental Land Use Planning Strategy*, adopted in July 2019.

1.1 BENEFITS OF CONSERVING BIODIVERSITY LOCALLY

The local community values the natural environment highly, with 97% of respondents in the City's 2017 and 2019 community surveys saying that the City's bushland, trees and natural vegetation are important and 96% wanting to see the integrity of the local natural environment protected and enhanced (City of Kalamunda, 2019). This strong local desire for environmental protection is well supported by scientific research into the benefits of investment into environmental protection, including community health and wellbeing, cultural identity, economic activity, moderation of climate or diseases, greater resilience and future research opportunities.

Simialrly, 'clean and green' products are highly valued by the community and the ability to deliver these via agriculture, forestry, tourism or product development depends on the continuation of ecosystem services supporting the natural landscape where such clean and green products can be produced (Commonwealth of Australia, 2019).

Management of natural resources provide for a range of local job opportunities, including employment of Aboriginal people whether in knowledge sharing or direct on-ground management. The value of Noongar knowledge of traditional land management practices to the conservation of biodiversity in the South West of Western Australia is getting greater recognition (e.g. DBCA's Aboriginal Ranger Program or the City of Swan Indigenous Trainee Program).

There is also growing evidence of higher restorative benefits to human health and wellbeing when easy access is available to diverse green spaces as opposed to the simplified environments maintained in landscaped parks with a limited number of plant species (e.g. Wood et al 2018). The mental health benefits of therapies that include contacts with nature, meaningful activities or working with animals are the basis of 'care farms', practices that provide health, social and educational services (https://www.carefarm.org.au/).

Having a clear plan for local biodiversity conservation is important to meeting local community expectations, maintaining the sense of place and connection to country for Noongar people but also providing opportunities to use the varied ecosystem services supporting community wellbeing, economic prosperity and sustainability.

1.2 LEGISLATION AND POLICY SUPPORTING BIODIVERSITY CONSERVATION

National Context

At the national level, *Australia's Strategy for Nature 2019-2030* (Commonwealth of Australia 2019) provides the overarching guiding national framework for biodiversity conservation. This is the latest update of *The National Strategy for the Conservation of Australia's Biological Diversity, developed in 1996 in response to Australia becoming the signatory to the United Nation's Convention on Biological Diversity*.

The "Australia's Strategy for Nature 2019-2030" takes a new approach, seeking to incorporate adaptation, resilience and natural resource management across the landscape, including cities and rural environment. This Strategy has three focus areas:

- Connect all Australians with nature
- Care for nature in all its diversity
- Share and build knowledge.

It's objectives are linked to Aichi Targets, set in 2010 in Nagoya at the Conference of Parties to the Convention on Biological Diversity and Sustainable Development Goals, set out by the United Nations. To monitor how each State contributes to Australia's progress in meeting its Strategy for Nature goals and international commitments, the Commonwealth government set up an on-line portal, Australia's Nature Hub.

Western Australian Context

The City's Environmental Land Use Planning Strategy (2019) lists the current legislation and policies providing for environmental protection. Table 1 gives an overview of key statutory mechanisms and policy support for biodiversity conservation. The Environmental Protection Authority (EPA) and the Western Australian Planning Commission (WAPC) provide guidance on how to address environmental issues in land use planning via environmental factor guidelines, guidance statements, environmental and State planning policies.

In Western Australia, the *Biodiversity Conservation Act 2016* is the principal legislation for protection of the State's plants, animals and ecological communities. In addition to providing for the listing of the threatened species and communities, it also provides for the registration of 'critical habitat'[2], listing of threatening processes, increased penalties for unauthorised taking of species, introduced penalties for

[2] Habitat critical to the survival of a threatened species or ecological community can be listed and placed on public register. Critical habitat will normally be identified in recovery plans. The Biodiversity Conservation Act 2016 provides for habitat conservation notice under some circumstances, with a Notification on Land title.

unauthorised modifications of threatened ecological communities and for failing to report threatened species or communities found in surveys. The Act introduced a new 'Biodiversity Conservation Covenant' which must be registered on the Land Title, providing for long-term protection of biodiversity conservation efforts on private land.

TABLE 1: SUMMARY OF KEY LEGISLATION AND POLICY RELEVANT TO BIODIVERSITY CONSERVATION

Statutory mechanisms/Legislation	Key strategic and policy documents
Commonwealth	
Environmental Protection and Biodiversity Conservation Act 1999	• Australia's Strategy for Nature 2019-2030
Western Australia	
Biodiversity Conservation Act 2016 and Biodiversity Conservation Regulations 2018 ***Environmental Protection Act 1986 and the related Environmental Protection (Clearing of Native Vegetation) Regulations 2004*** ***Biosecurity and Agriculture Management Act 2007*** ***Conservation and Land Management Act 1984***	• *Environmental Protection Bulletin No 20: Protection of naturally vegetated areas through planning and development* (EPA, 2013) • *EPA Guidance Statement No. 33: Environmental Guidance for Planning and Development* (EPA, 2008) • EPA Factor Guidelines: Flora & Vegetation, Terrestrial Fauna, Hydrological Processes, Inland waters environmental quality • *Environmental Protection Bulletin No. 1 – Environmental Offsets-Biodiversity*
Planning and Development Act 2005 and Planning and Development (Local Planning Schemes) Regulations 2015	• *Statement of Planning Policy No. 2: Environment and Natural Resources Policy* (SPP2) (WAPC 2003) • *Statement of Planning Policy No 2.8: Bushland Policy for the Perth Metropolitan Region (WAPC 2010)* • Statement of Planning Policy 2.5: Rural Planning (2016) • Statement of Planning Policy 3.7: Planning in Bushfire Prone Areas (2017)

Native vegetation and wetlands are protected via the provisions of the *Environmental Protection Act 1986* and the associated Native Vegetation Clearing Regulations 2004. Under the Act clearing of native vegetation is not permitted unless authorised or is for an exempt purpose. There are two types of exemptions: clearing authorised under statutory processes defined in the Schedule 6 of the Act and clearing for low impact land management practices defined in the Environmental Protection (Clearing of Native Vegetation) Regulations 2004. Clearing exemptions under the Regulations do not apply in areas classified as 'Environmentally Sensitive Areas'.[3]

[3] Areas classified as Environmentally Sensitive Areas can be viewed here https://www.der.wa.gov.au/images/documents/your-environment/native-vegetation/Fact_sheets/fs24-clearing-regs_ESAs.pdf

The State's *Planning and Development Act 2005,* Schedule 7- Matters which may be dealt with by planning scheme, establishes biodiversity as a valid planning consideration, incorporating provisions for its preservation and conservation, including:

"The conservation of the natural environment of the scheme area, including the protection of natural resources, the preservation of trees, vegetation and other flora and fauna, and the maintenance of ecological processes and genetic diversity."

Local planning schemes, the key statutory mechanism available to local government for control of land use and development are made under Part 5 of the *Planning and Development Act 2005*. The provisions of a local planning scheme are determined via a local planning strategy which sets out the long-term planning direction, guides the way the scheme changes over time and provides justification for land use categories in the scheme. Thus, a local planning strategy and the local planning scheme provide the most effective mechanisms for integrating local biodiversity conservation objectives into local decisions (WAPC 2011).

To provide further guidance on specific matters of the scheme, local planning policies can be prepared by local government. Adoption and implementation of this local biodiversity strategy will provide the adequate background information on biodiversity to inform the City's local planning framework.

There are two key State government documents that outline the expectations for how biodiversity is considered in land use planning.

Environmental Protection Bulletin No 20: Protection of naturally vegetated areas through planning and development (EPA, 2013) EPA's expectations for consideration of naturally vegetated areas in the design of urban and peri-urban development at all stages of land use planning are outlined in this Bulletin, including design guidelines for planning and development proposals. It outlines the matters related to the protection of natural areas that are most appropriately addressed at the different land use planning stages, ranging from regional planning strategies and frameworks to local planning strategies, schemes and subdivision or development plans.

The Bulletin No. 20 complements the *EPA Guidance Statement No. 33: Environmental Guidance for Planning and Development* (EPA, 2008) which outlines the EPA's broad principles for maintaining and protecting native terrestrial vegetation and flora, the EPA's objectives for biodiversity conservation, flora and fauna, and lists the natural areas that the EPA considers are of high conservation significance, including critical environmental assets and high value environmental value assets. These criteria form the basis for local natural area prioritisation, used in this local biodiversity strategy.

The need to protect 'locally significant natural areas' or natural areas that are not protected via the State's processes has been formally recognised since 2000 (Government of Western Australia 2000a, EPA, 2008, WAPC 2010).

State Planning Policy 2.8 *Bushland Policy for the Perth Metropolitan Region* (WAPC 2010) includes policy measures for 'local bushland' which provide for the preparation of local biodiversity strategies by local government. For the local

biodiversity strategy objectives to be recognised by the State, they need to prepared in accordance with an endorsed methodology, in consultation with relevant stakeholders and be integrated into a local planning strategy and scheme and thus be formally considered by the WAPC. The local planning strategy provides the rationale and justification for future zonings and policies at the local level that are aimed at the protection of significant biodiversity assets identified for protection via Council endorsed local bushland protection strategy.

Local Strategic and Planning Context

The hierarchy of the City's strategic and statutory documents guiding land use and land management decisions is outlined in Figure 1.

Following development of the City's Strategic Community Plan 2017-2027, several key strategic documents supporting the update of the City's 2008 Local Biodiversity Strategy were adopted by Council. These include:

- Environmental Land Use Planning Strategy (July 2019), and
- Kalamunda Clean and Green: Local Environment Strategy 2019-2029.

Both documents cover a broader range of environmental issues, many of which have direct or indirect impact on the City's biodiversity assets. The Local Biodiversity Strategy focuses on biodiversity conservation priorities within a scope described in section 1.3 of this document.

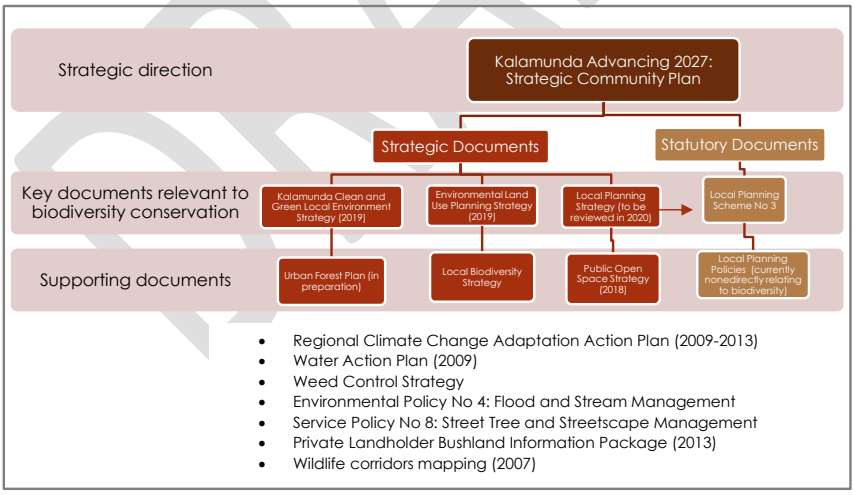

FIGURE 1: SUMMARY OF CURRENT STRATEGIC AND STATUTORY DOCUMENTS PROVIDING SUPPORT FOR BIODIVERSITY CONSERVATION IN THE CITY OF KALAMUNDA.

The City's Local Planning Scheme includes the following support for biodiversity conservation:

- 1.6 (d) to make provisions for the conservation of objects and places of natural, historic, scientific and cultural significance;
- 1.6 (e) to preserve and enhance the natural environment whilst managing further development; and indirectly
- 1.6 (c) to assist in the protection of regional forest, water catchment, recreational and other resources.

Three of the scheme's land use zones include objectives for vegetation retention, rehabilitation, preservation of natural ecosystems or conservation of indigenous flora and fauna. These objectives relate to the following zones:

- Rural Conservation, with preferred minimum lot size being 12 hectares with a possibility of reduction to 6 hectares;
- Rural Landscape Interest, with minimum lot size set at 6 hectares;
- Residential Bushland which facilitates residential development on lots with the minimum size of 500 square meters.

Development requirements for the Special Rural Zone and the Rural Composite Zone also include requirements for vegetation retention, provision of fauna habitat and wetland basin enhancements. In addition, in all rural type zones, vegetation clearing is permitted only if approved under relevant State legislation, regulations and guidelines (Section 5.18 of the LPS No 3).

There is no guidance provided on what is a viable natural ecosystem referred to in the provisions of the Rural Conservation Zone or how a balance between bushfire hazard reduction and the maintenance of viable ecosystems might be achieved on small blocks. While the scheme supports the possibility of requiring environmental studies to be undertaken to support development application, it is unclear when vegetation, flora and fauna studies are required and to what standard.

Environmental Conditions provided for in section 5.6 of the local planning scheme are limited to those set out following an assessment under the *Environmental Protection Act 1986,* and to date, include requirements for drainage and nutrient management plans, soil and groundwater contamination remediation plans and a groundwater abstraction plan.

Opportunities for increasing provisions for biodiversity consideration and protection via the City's land use planning tools include:

- an introduction of a local conservation reserve classification into the local planning scheme, supported by a local planning policy;
- strengthening the development requirements to improve the habitat value of the retained natural areas;
- adoption of a local planning policies that will outline the City's expectations of when and what type of environmental studies will be required, identify the biodiversity conservation priorities in the City, define criteria for local conservation reserves;
- Integrating local biodiversity objectives including the biodiversity conservation priorities mapping into the City's updated local planning strategy.

1.3 LOCAL BIODIVERSITY STRATEGY SCOPE

Development of this local biodiversity strategy follows the State government endorsed methodology for local biodiversity conservation planning, including the following:

- An overview of biodiversity assets retained in a local government area and identifies local conservation priorities in the context of current regulatory requirements, regional status and recognised principles of biodiversity conservation (see Box 1);
- Focus on 'Local Natural Areas';
- A spatial analysis to identify high conservation value areas, assess opportunities and constraints to protection and map conservation priorities.

The Strategy seeks to identify least cost opportunities for improving the protection status and condition of local natural areas and facilitate engagement with relevant stakeholders.

For the purposes of the City's 2020 Local Biodiversity Strategy, **Local Natural Areas** are defined as natural areas that exist:

- outside Bush Forever Areas that are reserved as Parks and Recreation in the Metropolitan Region Scheme, except for lands identified by the City as 'City's LNAs';
- outside Regional Parks, except for lands identified by the City as 'City's LNAs';
- outside lands managed by the Department of Biodiversity, Conservation and Attractions.

Natural areas are areas that contain native species or communities in a relatively natural state and hence contain biodiversity. Natural areas can be areas of native vegetation, vegetated or open water bodies, waterways, springs, rock outcrops, bare ground, caves, costal dunes or cliffs. Parkland cleared areas, isolated trees in cleared settings, oval and turfed areas are not included in the definition of natural areas (Del Marco *et al.* 2004).

Of the total of 23,552 hectares native vegetation remaining in the City of Kalamunda (2020), 2,445 hectares or 10% of the remaining native vegetation is classified as Local Natural Areas (Table 2).

TABLE 2: 2020 NATIVE VEGETATION DISTRIBUTION BY ADMINISTRATIVE PLANNING CATEGORIES.

Administrative Planning Category	Area of mapped vegetation* (hectares)	% of Total
Total City Area	32,375	100
Urban/Non-vegetated area	8,823	27.3%
2020 Native vegetation extent*	23,552	72.7%
Total Protection:	9,247	28.5%
• Protection via City managed reserves and Conservation Covenants	35.6	
• Bush Forever – managed for conservation	56.0	
• DBCA lands managed for conservation	9,159.9	
Bush Forever without formal protection	232.3	

Regional Parks (includes lands managed by the State and Local Government)	700.43	
DBCA State Forest	10,803	
DBCA Other lands	119	
Local Natural Areas	**2,445.4**	**10%****

*Based on combined mapping of 2020 native vegetation extent (DPIRD, 2020) and City's LNAs (June 2020, excluding areas mapped as completely degraded.
**Percentage of native vegetation extent remaining not the total City area.
See Map 1 in Appendix C for the mapping of Local Natural Areas in the City of Kalamunda.

Box 1: Biodiversity Conservation Principles

- **Prevent exponential loss of species and ecosystem failure by retaining at least 30% of the pre-European extent of each ecological community**
- **Protect regionally significant and locally significant natural areas**
- **Biodiversity is best conserved in-situ - protect remaining before revegetating**
- **Regeneration is a higher priority than revegetation**
- **Prioritise protection and management of highest biodiversity areas**
- **Involve the community in helping to conserve biodiversity**
- **Biodiversity values must be made transparent in decision-making processes**
- **Site-specific field survey is essential to understand biodiversity values**
- **Natural area conservation is a legitimate land use.**

Local Government Biodiversity Planning Guidelines (Del Marco et al 2004)

Definitions of key concepts/terms used in this document:

In the context of this Strategy, conservation, protection and retention of natural areas are defined as follows:

Conservation: In relation to biodiversity, conservation is the protection, maintenance, management, sustainable use, restoration and improvement of the natural environment (Australian Government 2010).

Protection: Areas considered to be protected in perpetuity are those natural areas that are secured for conservation either as

- Public lands vested for conservation purpose (e.g. nature conservation)
- Indigenous Protected Areas
- Private and public lands where the biodiversity values are secure for conservation under planning scheme provisions, or covenanting (Australian Government 2010).

Retention: is all the processes ensuring natural areas are retained but not necessarily afforded protection to ensure their continued existence and viability (Del Marco *et al.* 2004).

Regional context for the retention and protection status of vegetation types is based on the Interim Biogeographic Regionalisation for Australia (IBRA) sub-region boundaries (Figure 2). There are two IBRA sub-regions overlapping in the City of Kalamunda:

- Swan Coastal Plain
- Northern Jarrah Forest.

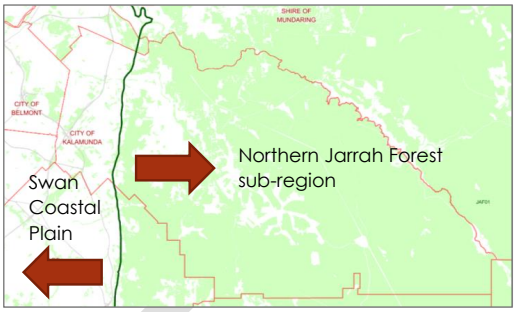

FIGURE 2: IBRA SUB-REGIONS OVERLAYING THE CITY OF KALAMUNDA AND 2020 NATIVE VEGETATION EXTENT.

Local status is based on a local government administrative area.

2 BIODIVERSITY ASSETS

The City of Kalamunda lies in a unique part of the world for biodiversity which has been recognised internationally by Conservation International[4]. It is estimated that one third of all known Australian plant species were recorded in the southwest of Western Australia and still new species are being discovered at a rate not seen in other regions with similar climates.

However, the designation of this region as "global biodiversity hotspot" not only recognises the presence of the large number of plants that do not grow anywhere

[4] Conservation International, a non-profit environmental organisation based in Washington DC, identified 36 biodiversity hotspots around the world. Southwest of Western Australia is one of them

else in the world, but also acknowledges that these species are threatened by loss of habitat.

Two distinct bioregions meet in the City, each represented by different landscapes, supporting different plant communities and habitats:

- Swan Coastal Plain (IBRA Sub-region Swan Coastal Plain SCP1), covers 13% of the City area and includes the eastern parts of the Plain; Pinjarra Plain and the Foothills
- Jarrah Forest (IBRA sub-region Northern Jarrah Forest JF1), covers 87% of the City areas and includes Darling Scarp and Darling Plateau.

The biodiversity of these two distinct bioregions have been impacted very differently in the City of Kalamunda with native vegetation on the Swan Coastal Plain portion of the City being reduced to the critical threshold of 10% of its pre-clearing status (Figure 3).

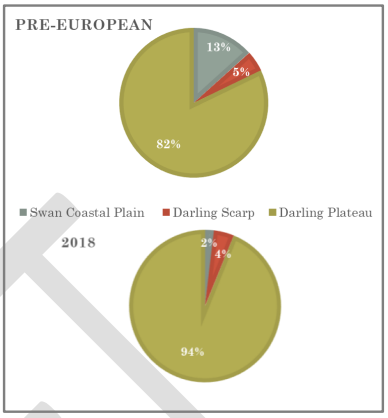

FIGURE 3: CHANGES IN VEGETATION DISTRIBUTION BY MAJOR LANDSCAPE UNITS IN THE CITY OF KALAMUNDA.

2.1 VEGETATION, THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

Native vegetation mapping is the main surrogate mapping layer used when assessing biodiversity. For the purposes of local biodiversity conservation planning in the Perth region, vegetation complex[5] mapping is used to describe the diversity of representative vegetation.

There are 14 vegetation complexes mapped in the City of Kalamunda; four are representative of the Swan Coastal Plain landforms, one of the Darling Scarp and nine of the uplands and valleys of the Darling Plateau. Three of these, Swan, Guildford and Swamp, are represented with less than 100 hectares and three vegetation complexes, Cooke, Swamp and Yarragil 2 were not affected by clearing. Characteristics of these vegetation complexes are described in Appendix B and shown in Map 2, Appendix C. Table 3 provides an overview of the current retention and protection status of vegetation complexes in the City.

[5] Vegetation complexes are based on the pattern of vegetation at a regional scale as they reflect the underlying determining factors of landforms, soils and climate (Del Marco et al 2004)

TABLE 3: 2020 NATIVE VEGETATION EXTENT AND PROTECTION STATUS IN THE CITY OF KALAMUNDA.

Vegetation complex/Retention and protection status at the regional level	Pre-European extent (ha)	Current extent (ha)*	% of pre-European extent retained in the City	% of the Pre-European extent protected in the City**
Swan Coastal Plain IBRA subregion				
<10 % remaining in the bioregion				
Forrestfield	1,924	220.7	11.5	2
Guildford	78	8.7	11.2	0
Swan	2	1.7	85	66
<30% remains and <10% protected in the bioregion				
Southern River	2,317	230.3	9.9	1
Jarrah Forest IBRA subregion				
At risk of being reduced to <30% retention and <15% protected in the bioregion				
Darling Scarp	1462	1002.2	68.5	35
<15% protected in the bioregion				
Cooke	274	274	100	65
Dwellingup 2	13,410	10,983.8	81.9	30
Murray 2	3,591	3,368	93.8	31
Yarragil 1	4,479	3,229.8	72.1	26
Yarragil 2	489	486.3	99.4	0
Vegetation complexes retained or protected at levels above the listed thresholds				
Helena 1	407	382.4	93.9	25
Helena 2	1,888	1,561.9	82.7	57
Murray 1	1,997	1,636.9	82	53
Swamp	56	56	100	0
Total in the City:	**32,375**	**23,443**	**72.4**	**29**

*Current extent is based on combined datasets of 2020 native vegetation extent (DIPRG, 2020) and City's LNAs (2020), excluding City's LNAs mapped as Completely Degraded
**Local protection includes vegetation in DBCA managed lands for conservation, Crown reserves vested in the City of Kalamunda with conservation purpose and within a conservation covenant.

There are significant differences in vegetation distribution across the City (Figures 2 & 3). Less than 10% of the pre-European extent of vegetation remains on the Swan Coastal Plain portion of the City while vegetation of the Jarrah Forest bioregion is well retained.

Most vegetation complexes in the City are well represented on lands providing protection but there are five vegetation complexes not protected locally and four

Box 2: Thresholds for vegetation retention and protection
In Western Australia, the regulatory processes require retention of at least 30% of the original extent of each ecological community. This threshold is widely recognised as the minimal level needed to prevent exponential loss of species and to maintain natural process. Where less than 10% of the original ecological community remains, that community is considered threatened.

In the Jarrah Forest bioregion, under the Regional Forest Agreement process, a minimum of 1500 hectares or 15% was set as a criterion for protection of forest ecosystems (ANZECC/MCFFA 1997). This has since been adopted by the EPA and in the Forest Management Plan 2014-2023 that inform the establishment of new formal and informal conservation reserves in the forest ecosystems.

These thresholds inform the conservation priorities at the bioregion and local levels.

of these are also not adequately protected across the bioregions: Forrestfield, Guildford, Southern River and Yarragil 2 vegetation complex. Increasing the protection status of these vegetation complexes where within the scope of the City's influence is one of the Local Biodiversity Strategy's objectives.

When assessing the representation of vegetation complexes within thresholds considered by the regulatory processes (Box 2), it is important to consider the limitations of the available vegetation mapping datasets (Appendix A, notes).

The list of priority vegetation complexes for increased protection in the City of Kalamunda (Table 4) was determined using the following criteria:

- geographical distribution
- retention and protection status at the bioregion and local levels
- extent within Local Natural Areas.

TABLE 4: PRIORITY VEGETATION COMPLEXES FOR INCREASED PROTECTION IN THE CITY OF KALAMUNDA.

Vegetation complex	Geographical significance	Retention & Protection status	Local Natural Area (LNA)(ha); area within City managed Crown reserves
Forrestfield	91-100% of pre-European extent mapped within Perth and Peel Scheme Regions	< 10% retained in bioregion and locally	129ha as LNA; 38ha in Crown reserves vested in the City
Southern River		<30% retained and <10% protected in bioregion; and <10% retained locally	42.5ha as LNA; 92ha in Crown reserves vested in the City (including Bush Forever Areas)
Darling Scarp	60-90% of pre-European extent mapped within Perth and Peel Scheme Regions	At risk of falling under 30% at bioregion level* and <15% protected in bioregion	108ha as LNA; 12ha in Crown reserves vested in the City

Vegetation complex	Geographical significance	Retention & Protection status	Local Natural Area (LNA)(ha); area within City managed Crown reserves
Dwellingup 2	60-90% of pre-European extent mapped within Perth and Peel Scheme Regions The most widespread vegetation complex in the City – 41% of the City area (pre-European extent)	<15% protected in bioregion	1080ha as LNA; 170ha in Crown reserves vested in the City
Murray 2		<15% protected in bioregion	12.23ha as LNA
Yarragil 1		<15% protected in bioregion	341.32ha as LNA; 32ha in Crown reserves vested in the City
Yarragil 2		<15% protected in bioregion;	65.88ha as LNA; On lands zoned Rural Conservation

Guildford and Swamp vegetation complexes that are not protected locally are retained on lands not classified as Local Natural Areas and their protection within the City of Kalamunda is subject to State government decisions.

While the vegetation complexes of the Jarrah Forest bioregion are well retained and significant portions are protected in conservation reserves, the plant communities in Jarrah Forest are under threat from the impacts of dieback (https://dieback.net.au/mapping/) and high risk of altered fire regimes. Dieback or fire do not remove native vegetation completely, but if not managed appropriately they can significantly change the vegetation structure and plant compositions, potentially resulting in the loss of habitat for native fauna and the loss of plant diversity. Therefore, opportunities to protect natural areas representative of any vegetation complex in good condition should be used to increase the long-term viability of natural areas across the City.

THREATENED ECOLOGICAL COMMUNITIES

Ecological communities are naturally occurring biological assemblages that occur in a particular type of habitat. In Western Australia, the *Biodiversity Conservation Act 2016* (BC Act) provides for the statutory listing of threatened ecological communities (TEC) which cannot be modified without authorisation. Significant penalties (up to $500,000) are prescribed where a TEC is modified without authorisation.

Seven threatened ecological communities mapped in the City are listed under the BC Act and six of these are also listed under the Commonwealth's *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act in Table 5).

Priority ecological communities are ecological communities for which there is not enough information available to list them as threatened. There are two priority ecological communities listed in the City of Kalamunda, classified as

- P3 – Poorly known ecological communities;
- P4 – Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.

TABLE 5: THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES MAPPED IN THE CITY OF KALAMUNDA (DBCA 2020)

Ecological Community	Conservation status		Indicative mapping in the City* (DBCA 2020)
	Commonwealth (EPBC Act)	State (BC Act 2016)	
Banksia Dominated Woodlands of the Swan Coastal Plain	Endangered	P3	435.9ha
Banksia attenuata woodlands over species rich dense shrublands (floristic community type 20a as originally described in Gibson et al. (1994))	Endangered	Endangered	107.2ha
Corymbia calophylla - Kingia australis woodlands on heavy soils, Swan Coastal Plain (floristic community type 3a as originally described in Gibson et al. (1994))	Endangered	Critically Endangered	10.97 ha
Banksia attenuata and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain (floristic community type 20b as originally described in Gibson et al. (1994))	Endangered	Endangered	9.578 ha
Shrublands and woodlands of the eastern side of the Swan Coastal Plain (floristic community type 20c as originally described in in Gibson et al. (1994))	Endangered	Critically Endangered	1.088 ha
Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands, Swan Coastal Plain (floristic community type 3c as originally described in in Gibson et al. (19	Endangered	Critically Endangered	1.088 ha
Central Northern Darling Scarp Granite Shrubland Community		P4	552 ha

Ecological Community	Conservation status		Indicative mapping in the City* (DBCA 2020)
	Commonwealth (EPBC Act)	State (BC Act 2016)	
Southern wet shrublands, Swan Coastal Plain (floristic community type 2 as originally described in Gibson et al. (1994))		Endangered	5.358 ha
Shrublands on dry clay flats (floristic community type 10a as originally described in Gibson et al. (1994))	Critically Endangered	Endangered	0.4137 ha

*The actual extent needs to be confirmed via targeted surveys.

The mapping of threatened and priority ecological communities provided by DBCA (March 2020) identifies the majority of vegetation remaining on the Swan Coastal Plain portion of the City as a threatened ecological community. The type of ecological community needs to be confirmed via targeted field studies. In the City, about 1% of the Central Northern Darling Scarp Granite Shrubland Community (P4) is outside DBCA managed lands.

2.2 CONSERVATION SIGNIFICANCE PLANTS - THREATENED AND PRIORITY FLORA

Since the adoption of the City's first Local Biodiversity Strategy (2009), several new species of threatened and priority plants were recorded in the City. Tables 6 and 7 show the changes in the listing of threatened and priority flora in the City of Kalamunda since 2008.

'The area of a typical Perth garden (mainly grass) would have once grown around 50 species of native plants.'

Weller 2009

The lists include three new threatened and 33 priority plants recorded in the City. Three threatened flora species that were considered in 2008 likely to occur in the City have since been recorded.

Nearly a quarter (48 reserves) of the natural area reserves managed by the City of Kalamunda retain threatened and priority plants.

DBCA's *NatureMap* (January 2020) lists 984 indigenous and 222 naturalised (weed) plant species' records for the City of Kalamunda.

FIGURE 4: *Drosera glanduligera*, WHISTLEPIPE GULLY, LESMURDIE.

Recent studies of carnivorous plants in the southwest of Western Australia showed that this region has 4.5 times higher diversity of carnivorous plants than any other comparable region, with parts of the City being highly significant for these plants. Over 90% of these species are endemic to the region and nearly half of the carnivorous plants described in the southwest of Western Australia were recorded in an area described as Yule Brook region[6] (Cross, A.T., 2019). This and other similar studies (Nge, F., 2019) demonstrate that focusing only on species listed as threatened or priority by legislation does not adequately describe the conservation significance of natural areas.

TABLE 6: LIST OF THREATENED FLORA FOR THE CITY OF KALAMUNDA (DBCA, 2020)

Key: CR – Critically Endangered, En – Endangered, Vu – Vulnerable

Species listed as known to occur in the	Conservation Code		Change since 2008
	EPBC Act	State	
Acacia anomala	Vu	Vu	No change
Acacia aphylla	Vu	Vu	No change
Anthocercis gracilis	Vu	Vu	No change
Austrostipa bronwenae	En	En	New
Banksia mimica	En	Vu	Name change (previously known as *Dryandra mimica*)
Conospermum undulatum	Vu	Vu	No change
Darwinia apiculata	En	En	No change
Diuris drummondii	Vu	Vu	In 2008, listed as **likely** to occur
Diuris purdiei	En	En	New
Grevillea thelemanniana	CR	CR	New, in 2008 listed as P4
Lepidosperma rostratum	En	En	In 2008, listed as **likely** to occur
Macarthuria keigheryi	En	En	No change
Scholtzia sp. Bickley (W.H. Loaring s.n. PERTH 06165184)		Extinct	No change
Thelymitra stellata	En	En	In 2008, listed as **likely** to occur
Eremophila glabra subsp chlorella	En	En	New

[6] Yule Brook region – bushland areas along Yule Brook, from Lesmurdie Falls to Canning River, including some of the most diverse plant communities on the Swan Coastal Plain such as Greater Brixton Street Wetlands and Hartfield Park.

Species listed as <u>may or likely to occur</u> in the City by the Protected Matters Search Tool*	**Status under EPBC Act 1999**	**State Conservation Code**	**Change since 2008**
Andersonia gracilis	En	Vu	No change
Calytrix breviseta subsp. breviseta	En	CR	No change
Chamelaucium sp. Gingin (N.G. Marchant 6)	En	Vu	New
Diplolaena andrewsii	En	En	New
Diuris micrantha	Vu	Vu	New
Drakea elastica	En	CR	New
Drakea micrantha	Vu	En	New
Elocharis keigheryi	Vu	Vu	New
Eucalyptus x balanites	En	CR	New
Goodenia arthrotricha	En	En	New
Grevillea curviloba subsp incurva	En	En	New
Lasiopetalum pterocarpum	En	CR	No change
Lepidosperma rostratum	En	EN	New
Synaphea sp Fairbridge Farm (D.Papenfus 696)	CR	CR	New
Thelymitra dedmaniarum	En	CR	New
Tribonanthes purpurea	Vu	Vu	New
Verticordia fimbrilepis subsp. fimbrilepis	En	Vu	New

*Protected Matters Search Tool helps to identify matters of national environmental significance, protected under the provisions of the Commonwealth legislation, the *Environmental Protection and Biodiversity Conservation Act 1999*.

TABLE 7: PRIORITY FLORA LISTED AS KNOWN TO OCCUR IN THE CITY OF KALAMUNDA (DBCA, 2020)

Species listed as <u>known</u> to occur in the City (DBCA, 2020)	**Priority Rank**	**Change since 2008**
Acacia horridula	3	New
Acacia oncinophylla subsp. oncinophylla	3	New
Acacia oncinophylla subsp. patulifolia	4	New
Andersonia sp. Blepharifolia (F. & J. Hort 1919)	2	New
Asteridea gracilis	3	New
Banksia pteridifolia subsp. vernalis	3	New
Beaufortia purpurea	3	New
Boronia humifusa	1	New
Boronia tenuis	4	No change
Bossiaea modesta	2	New
Byblis gigantea	3	New
Cyanicula ixioides subsp. ixioides	4	New
Grevillea manglesii subsp. dissectifolia	3	New
Grevillea pimeleoides	4	New
Haemodorum loratum	3	No change
Halgania corymbosa	3	New

Species listed as known to occur in the City (DBCA, 2020)	Priority Rank	Change since 2008
Hydrocotyle striata	1	New
Isopogon drummondii	3	No change
Jacksonia gracillima	3	New
Lasiopetalum bracteatum	4	New
Lasiopetalum glutinosum subsp. glutinosum	3	New
Melaleuca viminalis	2	New
Ornduffia submersa	4	New
Paracaleana sp. Laterite (G. Brockman GBB 3571)	2	New
Pimelea rara	4	No change
Pithocarpa corymbulosa	3	No change
Platysace ramosissima	3	New
Schoenus pennisetis	3	New
Senecio gilbertii	1	New
Senecio leucoglossus	4	New
Sporobolus blakei	3	New
Stackhousia sp. Red-blotched corolla (A. Markey 911)	3	New
Stylidium striatum	4	No change
Styphelia filifolia	3	New
Thelymitra magnifica	1	No change
Thysanotus anceps	3	New
Thysanotus glaucus	4	New
Verticordia lindleyi subsp. lindleyi	4	New

2.3 FUNGI

There are many more fungi in Australia than plants. It is estimated only about 10% of Australia's fungi have been discovered and named. Yet, fungi play significant roles in bushland ecosystem as they transport, store, release and recycle nutrients.

Many plants such as Eucalypts, wattles and orchids depend on the beneficial partnerships with fungi called mycorrhizal associations. Due to the very small size of their seeds, germinating orchids are dependent on fungi for nutrients, especially the leafless orchids. Different types of mycorrhizal associations have been documented for common plants in the Yule Brook area (Davison et al 2019).

The fruiting bodies of fungi provide food and habitat for many animals, including invertebrates and mammals. Several species of truffle and fungus eating marsupials contribute to dispersal of fungi playing an important role in maintaining ecosystem functions. These include the locally recorded woylies (*Bettongia penicillata*) and quenda (*Isoodon fusciventer*) which seek out fungi seasonally (Davison et al 2019).

DBCA's records (January 2020) show 52 records of fungi in the City, including two Priority 3 species of fungi, one carrying the City's name; *Amanita kalamundae* or Kalamunda Lepidella.

Building the knowledge base on local fungi will improve the understanding of ecosystem health and inform future management.

2.4 CONSERVATION SIGNIFICANCE ANIMALS – THREATENED AND PRIORITY FAUNA

Current records (DBCA, January 2020) list 407 native species and 13 introduced species of fauna in the City. Thirteen require special protection. Five new priority fauna were recorded in the City since 2008.

Tables 8 and 9 show the changes in the listing of threatened and priority fauna in the City of Kalamunda since 2008.

TABLE 8. SPECIALLY PROTECTED FAUNA LIST, CITY OF KALAMUNDA

Key: CR – Critically Endangered; En- Endangered, Vu – vulnerable, MI – Migratory species, OS- other specially protected species

Species listed as known to occur in the City (DBCA, 2020)[7]	**Status under EPBC Act 1999**	**State Conservation Code**	**Change since 2008**
Bettongia penicillata ogilbyi (woylie, brush tailed bettong)	En	CR	Listed as Priority 5
Calyptorhynchus banksii naso (forest red-tailed black cockatoo)	Vu	Vu	No change
Calyptorhynchus baudinii (Baudin's cockatoo)	En	En	No change
Calyptorhynchus latirostris (Carnaby's cockatoo)	En	En	No change
Dasyurus geoffroii (chuditch, western quoll)	Vu	Vu	No change
Falco peregrinus (peregrine falcon)		Os	No change
Phascogale tapoatafa wambenger (south-western brush-tailed phascogale)		CR	No change
Setonix brachyurus (quokka)	Vu	Vu	No change
Tringa nebularia (common greenshank)		MI	New

[7] In 2008, *Morelia spilota imbricate* (carpet python) was listed as Schedule 4 species under the Wildlife Conservation Act 1956 and as known to occur in the City. The current fauna list for the City includes the species with no ranking under the Biodiversity Conservation Act 2016 which replaced the Wildlife Conservation Act 1956.

Species listed as <u>known</u> to occur in the City (DBCA, 2020)[7]	**Status under EPBC Act 1999**	**State Conservation Code**	**Change since 2008**
Westralunio carteri (Carter's freshwater mussel)	Vu	Vu	New
Species listed as <u>known to occur</u> in the City by the Protected Matters Search Tool but not listed by the DBCA	**Status under EPBC Act 1999**	**State Conservation Code**	**Change since 2008**
Actitis hypoleucos (common sandpiper)		MI	New
Ardea alba (great egret, white egret)		MI	No change
Sternula nereis nereis (Australian fairy tern)	Vu	Vu	New
Species listed as <u>may or likely to occur</u> in the City by the Protected Matters Search Tool or DBCA NatureMap	**Status under EPBC Act 1999**	**State Conservation Code**	**Change since 2008**
*Apus pacificus (*fork-tailed swift*)*	MI	MI	No change
*Ardea ibis (*cattle egret*)*	MI	MI	No change
Calidris acuminate (sharp-tailed sandpiper)	MI	MI	New
*Calidris ferruginea (*curlew sandpiper)	CR	MI	New
*Calidris melanotos (*pectoral sandpiper)	MI	MI	New
*Merops ornatus (*rainbow bee-eater)	MI	MI	Listed as known to occur
*Motacilla cinereal (*grey wagtail*)*	MI	MI	New
*Numenius madagascariensis (*eastern curlew*)*	CR	MI	New
*Pandion haliaetus (*osprey*)*	MI	MI	New
Rostratula benghalensis (painted snipe)	EN	MI	New
Thinornis rubricollis (hooded plover)	MI	MI	New
Pseudocheirus occidentalis (western ringtail possum)	CR	CR	New
Botaurus poiciloptilus (Australasian bittern)	En	En	New
Leipoa ocellata (mallefowl)	Vu	Vu	New
Rostratula australis (Australian painted snipe)	En		New
Myrmecobius fasciatus (numbat)	Vu	En	No change

TABLE 9: PRIORITY FAUNA LIST, CITY OF KALAMUNDA.

Species listed as <u>known</u> to occur in the City (DBCA, 2020)	**Priority Rank**	**Change since 2008**
Kawaniphila pachomai (grey vernal katydid (southwest)	1	New
Acanthophis antarcticus (southern death adder)	3	New
Idiosoma sigillatum (Swan Coastal Plain shield-backed trapdoor spider)	3	New

Species listed as known to occur in the City (DBCA, 2020)	**Priority Rank**	**Change since 2008**
Neelaps calonotos (black striped snake)	3	New
Ctenotus delli (Dell's skink, Darling Range southwest ctenotus)	4	No change
Hydromys chrysogaster (water-rat, rakali)	4	No change
Isoodon fusciventer (quenda, southwestern brown bandicoot)	4	Changed Priority (P5)
Notamacropus Irma (western brush wallaby)	4	Name change
Oxyura australis (blue-billed duck)	4	New

A good account of what animals might have lived across the City is provided by Bradshaw, D. (2019) who states that 26 species of mammals were known to have lived in the area stretching from Lesmurdie Falls to Brixton Steer Wetlands (Bush Forever Area 387) and lists 10 as considered to be present:

- Brushtail possum (*Trichosurus vulpecula*)
- Brush wallaby (*Notamacropus Irma*)
- Bush rat (*Rattus fuscipes*)
- Echidna (*Tachyglossus aculeatus*)
- Grey-bellied dunnart (*Sminthopsis griseoventer*)
- Grey kangaroo (*Macropus fuliginosus*)
- Honey possum (*Tarsipes rostratus*)
- Chuditch (*Dasyurus geoffroi*)
- Southern brown bandicoot or quenda (*Isoodon fusciventer*)
- Western pygmy possum (*Cercatetus concinnus*).

The City's diverse landscape is reflected in the variety of reptiles found in the City. Several reptile species are restricted to granite outcrops like the Stone gecko (*Diplodactylus granariensis*), Stimson's Python (*Antaresia stimsoni*) or the Ornate dragon (*Ctenophorus ornatus*). There are also several species of reptiles that are associated with the lateritic soils of the forest and have nearly identical species on the coastal plain, like *Lerista distinguenda* which lives on the escarpment and nearly identical *Lerista elegans* which is found on the Swan Coastal Plain (Bamford, M. 2019).

Similar differences between the forest and the coastal plain are recorded in frogs. One of the largest of the southwest of Western Australia, the Hooting frog (*Heleioporus barycragus*) occupies the forested part of the City but on the Swan Coastal Plain it is replaced with the Moaning frog (*Heleioporus* eyerei) and Sandplain frog (*Heleioporus psammophilus*). Maintaining the patterns of flooding and drying of wetlands is critical to retaining the diversity of frogs, reptiles and other animals that are dependent on water. Alteration of natural flooding patterns results in the loss of species like the Moaning Frog or Gunther's Toadlet as they rely on specific water levels during their life cycle (Bamford, M, 2019).

The fauna habitat provided by native vegetation in the City of Kalamunda is recognised as globally significant by BirdLife Australia which identify parts of the City vegetation as 'Key Biodiversity Areas' (KBA)[8].

KBAs identify the most important places for nature, using birds as an indicator of the presence and diversity of wildlife. There are two KBAs mapped within the City (Figure 5); Mundaring-Kalamunda Important Biodiversity Area (IBA) covers a large part of the Jarrah Forest vegetation types and Araluen-Wundong IBA extends into the City along its southern boundary.

These KBAs overlap with known breeding and roosting sites for the iconic Carnaby's black cockatoos, species which are endemic to the south-west of Western Australia, and are listed as 'fauna that is rare or likely to become extinct' under the Western Australian *Biodiversity Conservation Act 2016* and listed as 'Endangered' under the *Environmental Protection and Biodiversity Conservation Act 1999* (Figure 5). Most of the remaining vegetation is mapped as potential feeding habitat for Carnaby's black cockatoos (DBCA, 2018).

In the context of the Perth region, large vegetated natural areas in the City are also important for a number of bird species that have declined or were lost from more urbanised parts of the Metropolitan area such as the Western Spinebill, Scarlet Robin, Golden Whistler and Western Yellow Robin (Davis et al, 2013, Davis, R.A. & Douglas, T.K., 2019).

[8] Based on the Global Standard for the Identification of Key Biodiversity Areas (IUCN 2016), to qualify as a global KBA, a site must meet one or more of 11 criteria in the following categories:

- Threatened biodiversity
- Geographically restricted biodiversity
- Ecological integrity
- Biological processes
- Irreplaceability.

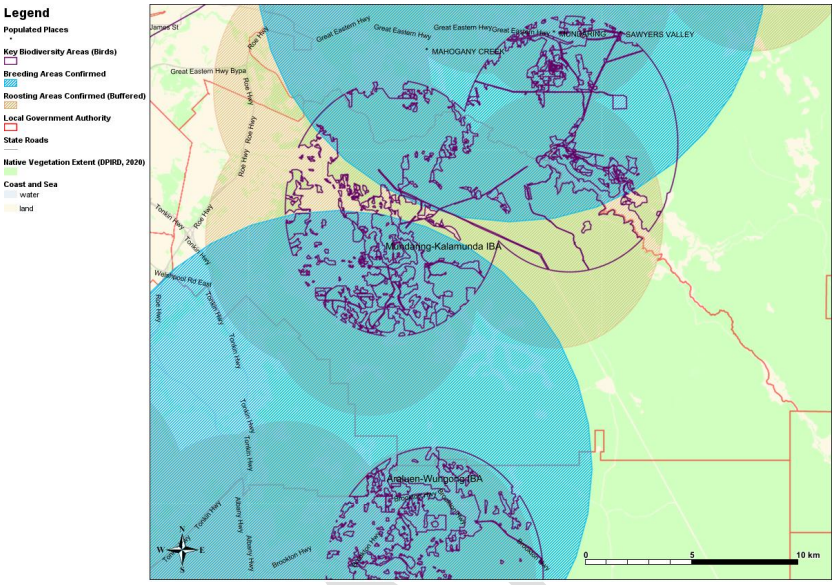

FIGURE 5: KEY BIODIVERSITY AREA FOR BIRDS AS MAPPED BY BIRDLIFE AUSTRALIA (2016) AND KNOWN BREEDING AND ROOSTING SITES FOR CARNABY'S BLACK COCKATOOS (2018) IN THE CITY OF KALAMUNDA.

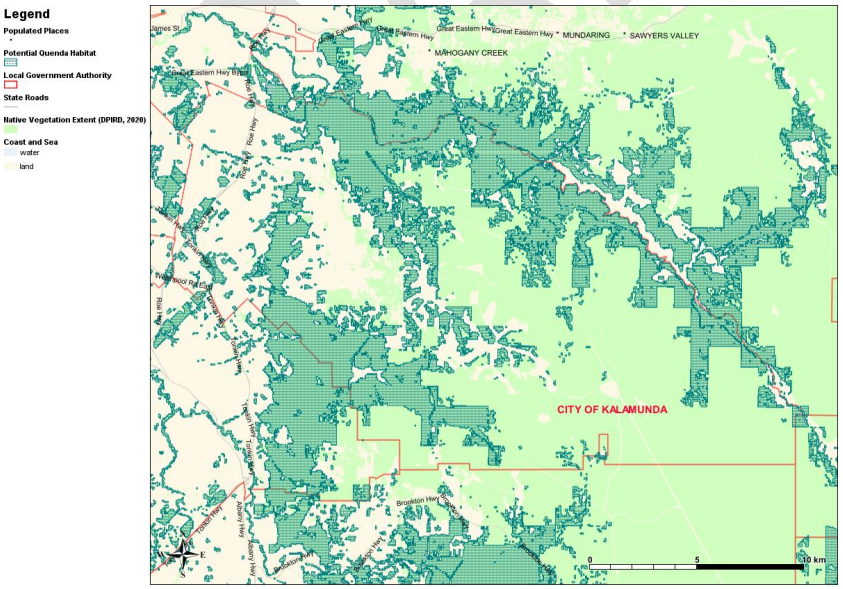

FIGURE 6: POTENTIAL HABITAT MAPPING FOR QUENDA (DPAW, 2013).

Significant areas of remnant vegetation in the City are also mapped as potential habitat for Priority 4 species, Quenda (*Isoodon fusciventer),* another animal endemic to the south west of Western Australia (Figure 6). *This* small marsupial plays an important role in maintaining ecosystem process in natural areas. While digging for food, quenda overturn large amounts of soil and ground litter, influencing water infiltration and nutrient recycling (Valentine el al 2018).

2.4 WETLANDS AND WATERWAYS

Maintenance of healthy waterways and sensitive management of drainage through the landscape is critical to maintaining the diversity of aquatic ecosystems and water dependent terrestrial ecosystems (Map 3, Appendix C). In some parts of the City, waterways or drains provide the only opportunity to improve connectivity between natural areas.

The City's Environmental Land Use Planning Strategy (2019) sets out specific approaches and actions for protection and enhancement of waterways, wetlands and groundwater to ensure the sustainable use and management of water resources in the City (Strategy for Water 6.1 and 6.4).

Figure 7 shows the mapped Conservation Category and Resource Enhancement wetlands in the City that are mostly undeveloped. Swan Coastal Plain wetland mapping is based on landforms and water permanence (Hill *et al* 1996). This mapping was used to further classify wetlands, according to condition and conservation values, into the following management categories:

- Conservation Category Wetlands (CCW) – wetlands for which the appropriate management regime has the objective of preserving their natural attributes and functions. Examples of wetlands in this category on City managed lands include Hartfield Park and reserve R52090. The remaining CCWs are on lands managed by other State agencies or the Commonwealth.
- Resource Enhancement Wetlands (REW) – wetlands for which appropriate management objective should be restoration and enhancement of natural attributes and values. Within City managed lands, examples of wetlands in this category include the wetland in Hartfield Park, reserve R47767 and the lower sections of Poison Gully. Other larger examples include wetlands in Bush Forever Areas 123 and 319.
- Multiple Use Wetlands – wetlands are most appropriately managed for their use and development in the context of water, town and environmental planning. Most wetlands in this category have been modified or replaced with residential development.

Increasing the protection status of Conservation Category and Resource Enhancement wetlands in the City of Kalamunda is one of the objectives of this biodiversity strategy.

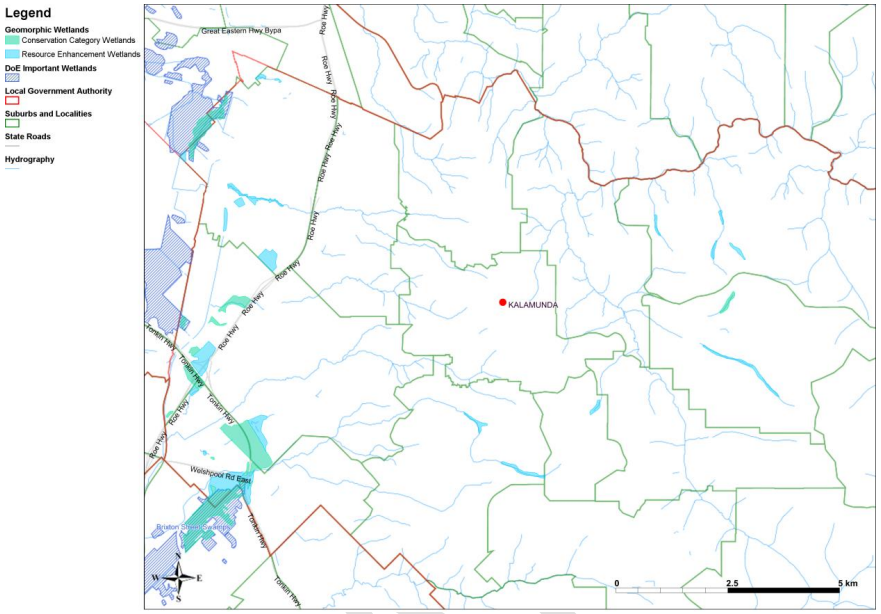

FIGURE 7: MOSTLY VEGETATED CONSERVATION CATEGORY AND RESOURCE ENHANCEMENT WETLANDS AND NATIONALLY LISTED IMPORTANT WETLANDS.

The importance of retaining vegetation along watercourses is recognised by the State (Environmental Protection Authority, 2008) and clearing of riparian vegetation is one of the 10 key considerations in applications for native vegetation clearing under the provisions of the *Environmental Protection Act 1986*. Native vegetation along waterways provides habitat, moderates water temperature, filters water entering the waterway and prevents erosion.

Several waterways in the City provide the best opportunity for connectivity between high conservation value areas including Poison Gully, Woodlupine Brook, Crumpet Creek and Yule Brook. The importance of Yule Brook as a connector of highly diverse plant communities was recognised in a proposal for a new regional park, presented to the State government in April 2018 by the Beeliar Group – Professors for Environmental Responsibility. The proposed 'Yule Brook Regional Park' consists of bushland along Yule Brook and Crystal Brook from Lesmurdie Falls to Canning River, including bushland and wetlands of Hartfield Park and Greater Brixton Street wetlands (Lambers, H., 2019).

The City's waterways contribute to catchments of two major rivers of the Swan Coastal Plain, the Swan and Canning rivers. The Piesse Brook catchment covers the largest part of the City area and contributes to the Swan River catchment. The Yule Brook catchment is the second largest in the City and contributes to the Canning River. In 2011, a report on 10 year monitoring of water quality at the lower end of the Yule Brook catchment found that of the monitored catchments, Yule Brook

contributed the second-highest nitrogen and phosphorus loads to the Canning River (Department of Water, 2011). A more recent report into water quality within the Yule Brook catchment concluded that a 25% reduction in nitrogen is required to meet targets set in the Swan Canning Water Quality Improvement Plan (Government of Western Australia 2016). These findings show the need to continue restoration of riparian vegetation within highly modified sections of the water catchments and change of practices identified as the greatest contributors to increased nutrient loads in water catchments such as filtered sewage from residential areas adjoining the main watercourses such as the Yule Brook.

3 THREATS TO BIODIVERSITY

The following section gives an overview of the factors that threaten biodiversity in the City of Kalamunda, including current and proposed responses. The proposed responses are further described in Section 4 of this document.

Threat	Causes	Impacts	Current responses	Proposed additional responses
Habitat fragmentation due to land clearing and loss of biodiversity	Continued vegetation loss and fragmentation of vegetation due to clearing for urban, industrial and infrastructure development but also in response to changed requirements for bushfire risk management.	• Loss of habitat and plants, many of which cannot be preserved elsewhere • Loss of ecosystem services provided by the plants and animals such as pollination or control of nutrient run-off • Loss of dispersal by native species • Loss of water quality within water catchments • Land degradation (erosion, soil acidification) • Loss of economic opportunities dependant on high quality natural areas • Decreased resilience of protected areas to other threatening processes	Utilising the provisions of the regulatory process to manage land use. The City's 2019 Local Environmental Strategy includes an action to develop a plan to link green spaces though the landscape	• Prioritise local natural areas for protection and retention • Identify opportunities for facilitating species dispersal and providing alternative habitat • Increase provisions of the local regulatory processes to increase natural retention and protection • Increase protection of retained natural areas via changes to land tenure • Develop, adopt and provide guidance to landholders on best practice bushfire risk management for plant communities represented in the City.
Introduced plants (weeds)	Weeds or introduced plants that replace native vegetation and thus reduce habitat and change the natural plant	• Loss of habitat and plants, many of which cannot be preserved elsewhere • Loss of biodiversity • Changed ecosystem functions	Implementation of weed control in accordance of City's priorities. Grab-a-gladdie initiative	• Update and distribute information for private landholders on best practice natural area management

Threat	Causes	Impacts	Current responses	Proposed additional responses
	community compositions.	• Diminishing economic viability of agriculture, tourism or bushland restoration programs	Support for community volunteers undertaking weed control in selected reserves Control of landscaping practices via development approval processes Community education via publication of *Plants Out of Place* booklet The City's 2019 Local Environmental Strategy includes an action to review and update the City's Weed Control Strategy	
Feral animals preying on native animals and reducing habitat (loss of nesting hollows)	Feral animals, including 17 Declared Pests and domestic cats	• Predation by foxes and cats is the major contributor to the loss of small mammals but also native birds and lizards • Loss of nesting hollows to the more aggressive introduced birds and feral bees • Competition for declining food sources • Land degradation via soil disturbance and erosion	Pest management via development approval processes Provision of information on pest control via the City's website Targeted feral animal control	• Work with EMRC and DBCA on coordinated feral animal control • Develop and release educational messaging on responsible cat ownership and property management to discourage feral animals • Investigate opportunities to declare cat-free-zones

Threat	Causes	Impacts	Current responses	Proposed additional responses
			The City's 2019 Local Environmental Strategy includes an action to develop a strategic approach to the control of feral animals in the City	• Update and distribute information for private landholders on best practice natural area management
Land clearing, modification of watercourses, land fill and over-use of fertilisers	Altered hydrological regime, erosion and water quality	• Loss of habitat and biodiversity • Loss of water quality within water catchments • Land degradation (erosion, soil acidification) • Loss of economic opportunities dependant on high quality natural areas • Decreased resilience of protected areas to other threatening processes	Adoption of catchment management strategies to guide land use and development in the City's public drinking water supply catchments Working with relevant State Government agencies to integrate wetlands into developments Supporting the managed Aquifer Recharge project (Hartfield Park) The City's 2019 Local Environmental Strategy includes an action to develop catchment management plans to	• Adoption of local planning policy for wetlands and waterways • Guidance for private landholders on best practice management of waterways and their buffers • Restoration of native vegetation along priority waterways, drains and drainage basins • Participation in the Eastern Hills Catchment Management Program or other regional catchment management initiative

Threat	Causes	Impacts	Current responses	Proposed additional responses
			inform surface water management and to develop a Local Planning Policy for waterways' protection.	
Arson and lack of consideration of ecological community needs in timing of bushfire risk mitigation measures	Altered fire regimes	• Loss of biodiversity due to changes to plant community structures and lost opportunities for species dispersal in fragmented landscapes • Loss of foraging opportunities • Increased risk of weed introduction, abundance and spread • Increased risk of predation by feral animals • Loss of economic opportunities dependent upon high quality natural areas	The City provide a fuel load measuring kit and guidelines to landowners on minimising bushfire risk on their properties without affecting the vegetation on adjoining lands The City's 2019 Local Environmental Strategy includes an action to determine ecological fire requirements and to develop fire and biodiversity conservation procedures for the management of City reserves.	• Use the local natural area prioritisation to inform land use planning, avoiding further subdivisions in high conservation value areas • Develop an adaptive weed control program to facilitate post-fire management of conservation areas • Adopt an emergency wildlife care strategy to facilitate effective response to major bushfires • Set up a fire frequency and extent monitoring database
Introduced plant diseases	Plant pathogens such as *Phytophthora. cinnamomi, P. multivora, P. nicotianae*	• Loss of biodiversity due to changes to plant community structures and loss of habitat (e.g. nectivorous birds are at high risk of significant decline due to spread of dieback)	Dieback warning signage at selected City managed reserves	• Adopt dieback hygiene procedures for all City operations (e.g. roadworks, infrastructure development and maintenance • Update and distribute information for private

Threat	Causes	Impacts	Current responses	Proposed additional responses
			Pest management via development approval processes Provision of information on dieback via the City's website The City's 2019 Local Environmental Strategy includes an action to map of City's LNA's for Phytopthora species.	landholders on best practice natural area management
Degradation of natural areas	Incompatible use of natural areas by people (e.g. rubbish dumping, off-track access, vandalism)	• Loss of biodiversity due to changes to plant community structures and loss of habitat • Increased risk of spread of plant diseases and weeds • Loss of economic opportunities dependent upon high quality natural areas	Support to community volunteers involved in management of bushland reserves Fencing and signage in selected reserves Clean up areas when observed or reported	• Adopt a plan for adequate fencing and signage for all high conservation value reserves • Update and distribute information for private landholders on best practice natural area management • Engage broader community to become stewards of local bushland and report activities threatening biodiversity values.

All the threats identified above further exacerbate the vulnerability of natural areas and the species that inhabit them to impacts of climate change. Impacts such as increased temperatures and decreased rainfall are expected to result in shifts of species

distributions. To increase the resilience of the unique biodiversity, multiple approaches are required. These include the establishment of ecological linkages to facilitate the movement of mobile species and managing threats to sites that provide refugia to highly specialised species, adapted to unique local conditions such as those found on granite outcrops or some types of wetlands.

4 LOCAL BIODIVERSITY CONSERVATION VISION AND OBJECTIVES

Vision

The City of Kalamunda and its community will protect, manage and value the local biodiversity to ensure lasting legacy for future generations.

To achieve the adopted vision, five key objectives have been identified which can be linked to specific actions and deliverables. In implementing the Local Biodiversity Strategy, the City of Kalamunda seeks to achieve the following objectives:

4.1. *To increase the protection **status of priority natural areas in the City**, including on Local Government managed or owned lands, and on private land;*
4.2. *To appropriately manage local natural areas **to reduce threats,** considering the identified local biodiversity conservation priorities**;***
4.3. *To increase the viability and resilience of natural areas by **establishing buffers and ecological linkages**; considering the impacts of climate change;*
4.4. *To integrate biodiversity considerations across all areas of City's business and operations;*
4.5. *To achieve long term community engagement in biodiversity management.*

5 IMPLEMENTATION

5.1 IDENTIFYING HIGH CONSERVATION VALUE AREAS

5.1.1 PRIORITISATION OF LOCAL NATURAL AREAS

The purpose of the prioritisation process is to identify natural areas where multiple biodiversity conservation values overlap as they can provide a good opportunity to meet conservation needs for multiple species or ecosystems.

While retention of natural areas should be facilitated where feasible, there are natural areas (high priority LNAs) which should be formally protected via adequate mechanisms to ensure their long-term land tenure security and management to prevent degradation.

The prioritisation process adopted in this document follows the main principles of the State government endorsed methodology developed via the Perth Biodiversity Project (Del Marco et al 2004) and utilises the advances in mapping and prioritisation techniques used effectively by others since the City's first Local Biodiversity Strategy.

Prioritisation considers two types of criteria:

1. Supported by legislation and policy (Environmental Protection Act 1986, Biodiversity Conservation Act 2016 and the EPA Guidance Statement No 33), that define the regional conservation significance criteria in the following categories:
   - Representation
   - Rarity
   - Diversity
   - Wetland, streamline, estuarine, coastal vegetation
   - Maintenance of ecological functions (patch size & connectivity).

2. Supported by best practice local biodiversity conservation as outlined in the Local Government Biodiversity Planning Guidelines (Del Marco et al 2004), providing for consideration of locally significant vegetation and local ecological linkages.

Each of the prioritisation criteria can be represented with mapping. For the purposes of this analysis, 'vegetation' is defined as the combined layer of the 2020 native vegetation extent (DPIRD, 2020) and the City's LNA[9] areas (City of Kalamunda, April 2020). LNA areas mapped by the City as being Completely Degraded were removed from the City's LNA dataset for this analysis. The list of criteria and datasets used as surrogates to represent each criteria are listed in Table 10.

All vegetated areas are scored in accordance to the number of criteria being represented within that area. Two types of scores were used:

1. A simple presence or absence score, where 1 is added for each criteria being represented within a vegetated area and 0 for an absence;
2. Weighted score – the purpose of the weighting being applied to selected criteria is to highlight vegetation where the representative values are protected by legislation. For example, if two areas meet the same number of criteria, they will be assigned the same score. If one of these areas also includes a record of threatened flora and the other includes a record of Priority flora, the area with the threatened flora will be scored higher because instead of a count of 1, a score of 4 is given to vegetation within a buffer of threatened species record and a score of 3 is given to vegetation within a buffer of a priority species.

The weighting was only applied to criteria that are also used by the City to rank bushland reserves managed by the City and the weighting numbers were determined by City staff.

[9] City's LNAs or City of Kalamunda Local Natural Areas (LNAs) are based on assessment by City staff. It does not include all the natural areas defined as 'Local Natural Areas' in the local biodiversity planning process (Del Marco *et al,* 2004). Criteria used by the City to select the City's LNAs are described in Appendix A.

TABLE 10: PRIORITISATION CRITERIA.

Key to a Priority Field in the on-line model	Perth Biodiversity Project Criteria (2012)	Spatial data (relevant to the City of Kalamunda)	Criteria score
P1_1	Recognised International, National, State or Regional Conservation Value but not already protected	Regional Parks	N = 0 Y = 3.5
		Bush Forever Sites	
		Informal Reserves (based on Forest Management Plan 2014-2023)	
		DBCA Conservation Covenants	
		Directory of Important Wetlands	
P1_2a	of an ecological community with only 1500 ha or 30% or less remaining and <10% protected (formal) in the IBRA sub-region (here we use <or=40%))	Vegetation extent by vegetation complexes: Forrestfield, Guildford, Southern River, Swan,	1
P1_2b	of an ecological community with only 1500 ha or 30% or less remaining in the IBRA sub-region (here we use <or=40%)	Vegetation extent by vegetation complexes: Forrestfield, Guildford, Southern River, Swan,	N = 0 Y = 3
P1_2c	of an ecological community with 90-100% of its original proportion of the original extent occurs within the study area	Pre-European extent of vegetation complexes in IBRA sub-region: Forrestfield, Helena 2	1
P1_2d	of an ecological community with 60-89% of its original proportion of the original extent occurs within the study area	Pre-European extent of vegetation complexes in IBRA sub-region: Guildford, Swan, Darling Scarp, Dwellingup D2, Helena 1	1
P1_3	large (greater than 20ha) natural areas	Remnant vegetation in patches greater than 20ha.	N = 0 Y = 2.5
P1_4	of an ecological community with only 1500 ha or 15% or less protected for conservation in the Jarrah Forest sub-region (use 20%)	Vegetation extent by vegetation complexes: Cooke, Darling Scarp, Dwelingup 2, Murray 2, Yarragil 1, Yarragil 2	N = 0 Y = 2.0
P1_5	of an ecological community with only 400 ha or 10% or less protected for conservation on the SCP portion of Perth and Peel	Vegetation extent by vegetation complexes: Forrestfield, Guildford, Southern River, Swan,	N = 0 Y = 2.0
	Rarity		
P3_1	of an ecological community with only 1500 ha or 10% remaining in the IBRA sub-region	Vegetation extent by vegetation complexes: Forrestfield, Guildford, Swan,	N = 0 Y = 4.0
P3_2	of an ecological community with only 400 ha or 10% or less remaining in the Bush Forever	Vegetation extent by vegetation complexes: Forrestfield, Guildford, Southern River, Swan,	N = 0 Y = 4.0
P3_3	contains a Threatened Ecological Community (TEC)	TEC boundaries and buffers (DBCA, March 2020)	N = 0 Y = 4.0
P3_4a P3_4b	contains a Priority Ecological Community (PEC) P1-3 or P4	PEC and buffers (DBCA, March 2020)	1

Key to a Priority Field in the on-line model	Perth Biodiversity Project Criteria (2012)	Spatial data (relevant to the City of Kalamunda)	Criteria score
P3_5 P3_5wh	contains Threatened Flora wh – presence of Herbarium data	Threatened Flora locations with 50m buffers (DBCA, March 2020)	N = 0 Y = 4.0
P3_7	Threatened and specially protected fauna	Threatened Fauna (CR, EN, VU, OS - Other Specially Protected) (DBCA, March 2020)	N = 0 Y = 4.0
P3_6 P3_6wh	contains Priority 1,2,3,4 Flora wh – presence of Herbarium data	Priority Flora with buffers (DBCA, March 2020)	N = 0 Y = 3.0
P3_8	Priority fauna	Priority 1,2, 3, 4 Fauna (DBCA, March 2020)	N = 0 Y = 3.0
P3_9a	significant habitat for significant fauna	Areas requiring investigation for Carnaby's cockatoo feeding habitat (Swan Coastal Plain)	N = 0 Y = 2.0
		Areas requiring investigation for Carnaby's cockatoo feeding habitat (Jarrah Forest)	N = 0 Y = 2.0
P3_9b		Carnaby's Cockatoo habitat - breeding sites (confirmed & possible) with 12 km buffer	N = 0 Y = 2.0
P3_9c		Carnaby's Cockatoo habitat - roosting sites (confirmed & unconfirmed) with 6 km buffer	N = 0 Y = 2.0
P3_10	contains other significant flora	Significant flora – Locally significant flora	N = 0 Y = 2.0
P3_11	or other significant fauna	Decliner Bird Species Potential Quenda habitat	N = 0 Y = 2.0
	Maintaining ecological processes or natural systems – connectivity		
P4_1	natural areas acting as stepping-stones in a regionally significant ecological link	Connectivity layer - current remnant vegetation that touches the Perth Metropolitan Region Regional Ecological Linkages	N = 0 Y = 1.0
	Protection of wetland, streamline and estuarine fringing vegetation and coastal vegetation		
P5_1	Remnant vegetation within Conservation Category Wetlands plus 50m buffer	Geomorphic wetland mapping (DBCA 2019)	N = 0 Y = 2.0
P5_1b	Remnant vegetation within Resource Enhancement Wetlands plus 50m buffer	Geomorphic wetland mapping (DBCA 2019)	N = 0 Y = 2.0
P5_3	riparian vegetation	riparian vegetation surrogate - hydro lines buffered and used to intersect with current remnant vegetation	N = 0 Y = 1.0
P5_4	floodplain area	floodplain areas with floodplain ecosystems	N = 0 Y = 1.0
	Representation – Local		
P6_1	of an ecological community with 10% or less remaining within Local Government area	Vegetation extent by vegetation complexes within each the City: Forrestfield, Southern River Complex, Guildford	N = 0 Y = 1.5

Key to a Priority Field in the on-line model	Perth Biodiversity Project Criteria (2012)	Spatial data (relevant to the City of Kalamunda)	Criteria score
P6_2	of an ecological community with 30% or less remaining within a Local Government area	Vegetation extent by vegetation complexes within the City: Forrestfield, Southern River Complex, Guildford	N = 0 Y = 1.0
P6_3	natural areas acting as stepping-stones in a locally significant ecological link	Local linkages – as described in section 5.1.2 of this report	N = 0 Y = 0.5

The final priority score is a simple sum of individual criteria scores, with higher numbers identifying natural areas with higher number of criteria being met (Figure 8).

The first column in Table 10 provides a reference to the mapping data displayed in LGmap, the online mapping portal enabling the viewing of mapping layers developed for this Strategy. The key in Table 10 can be used to identify the specific criteria contributing to the final score for any mapped vegetation. Instructions on viewing the Local Biodiversity Strategy mapping layers via LGmap are in Appendix G.

It is important to note that this dataset represents a snapshot in time. The mapping is based on known records of plants, animals or ecological communities as they were at the time of the analysis being undertaken (June 2020). Low prioritisation scores cannot be interpreted as those areas not containing significant biodiversity.

For most areas, specific surveys will be required to determine the biodiversity conservation values. Even in areas where records exist, it does not necessarily mean that those sites were subject to a comprehensive survey or that species not identified in an area in the past do not inhabit that area now. Any final decisions regarding protection or land use change need to be based on field assessments to confirm the indicative biodiversity values. Finally, specialist's advice is required to determine the significance of the known population of threatened plants or animals as the distribution of some threatened species can be very limited.

Despite this, the natural area prioritisation mapping provides an effective tool for strategically identifying areas with existing or potential high conservation values and informing future land use decisions. The methodology provides for assessment of local conservation priorities in the context of regional representation. The mapping can be replicated and updated as new data becomes available.

Natural area prioritisation represents the first step in identifying priority areas for protection and conservation in the City. Figure 8 shows all remaining native vegetation, including already protected areas. The ability to conserve 'Local Natural Areas' depends on further factors such as land tenure, existing land use commitments and opportunities to change current land uses to those that better conserve biodiversity. Section 5.2.1 describes the next steps in mapping the Local Natural Area Prioritisation for protection by assessing the opportunities provided by the current land use provisions.

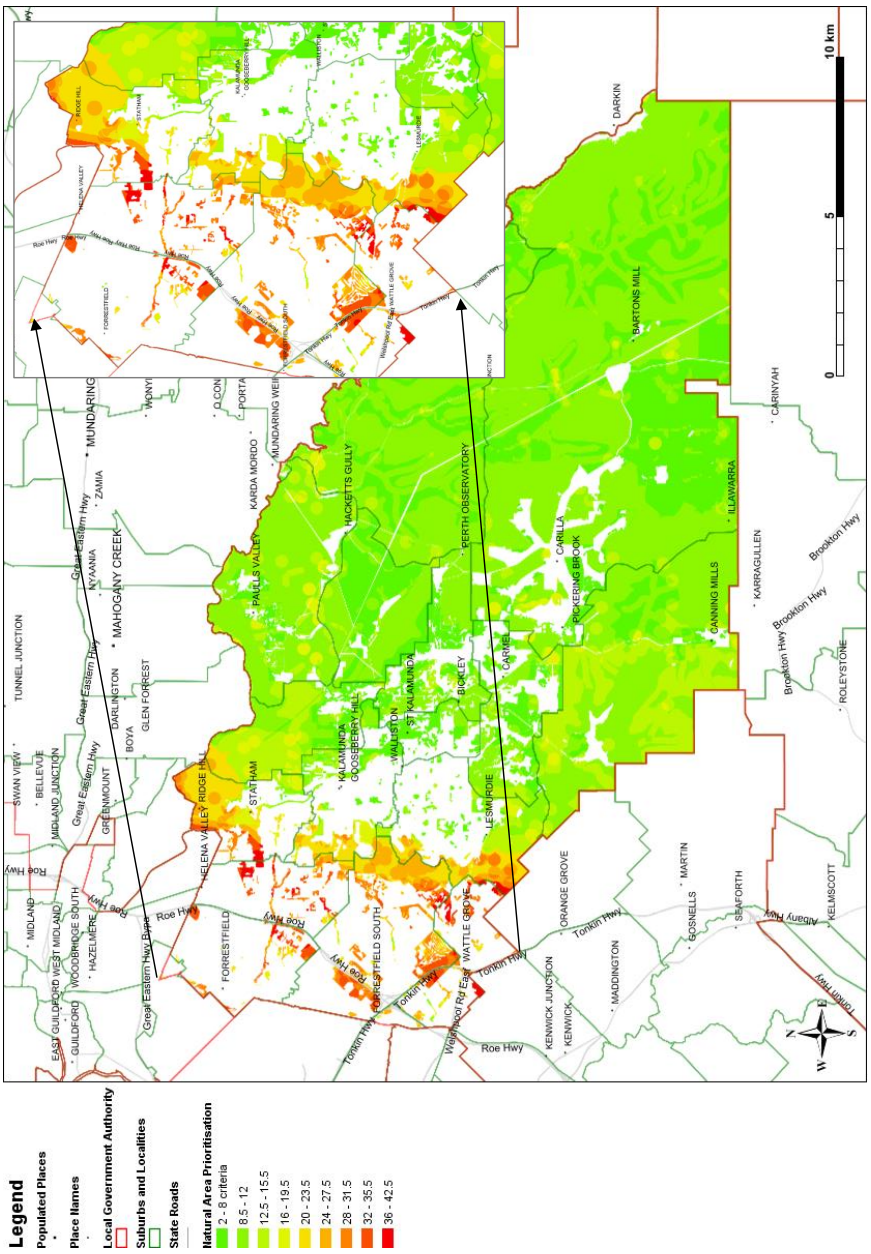

FIGURE 8: NATURAL AREA PRIORITISATION (2020) HIGHER NUMBERS IDENTIFY AREAS WITH MULTIPLE BIODIVERSITY VALUES.

5.1.2 ECOLOGICAL LINKAGES AND VEGETATION CONNECTIVITY

One of the main threats to biodiversity is habitat fragmentation. Improvement of ecosystem resilience and connectivity, expansion of the network of protected areas and protection of important refugia are recommended as priority management approaches to adaptation to the impacts of climate change (CSIRO 2014, Australian Government 2012a, EPA, 2008; Wilkins *et al,* 2006; Molloy *et al,* 2009). Therefore, one of the objectives of this Strategy is to provide a framework of increasing connectivity between natural areas in the City.

With isolation of vegetation patches, over time, the number of species being able to persist in those patches decreases. The viability of any natural area depends on its proximity to other natural areas, the quality of linkages or barriers in the landscape between them (Del Marco *et al* 2004, Davis and Brooker 2008, Molloy *et al* 2009

While the impacts of habitat fragmentation on fauna populations were documented to some degree, the effects of urbanisation on long term viability of plant communities is not well understood. A study by Ramalho (2012) into the effects of urbanisation on remnant Banksia woodlands in the Perth region showed that long term isolation of Banksia communities leads to changes in the species composition and plant community structure, recording nearly 50 percent reduction in species richness within small (1-5 ha) remnants that were isolated for 45 years or longer. This study also highlighted that these impacts of fragmentation will not be visible for some time and recommended focusing conservation efforts on areas that were recently fragmented and those without significant land-use legacies.

To increase the capacity of natural areas to retain biodiversity in fragmented urban landscapes and adapt to climate change, the recommended management responses include the following (Molloy *et al* 2009, Commonwealth of Australia 2010, CSIRO 2014):

- Provision of access to a greater number and diversity of resources
- Conservation of larger and more viable populations
- Ensuring species distribution in many populations to spread extinction risk associated with catastrophic events such as fires or drought
- Enabling species dispersal and migration; facilitating movement along corridors
- Provision of a more representative mosaic of habitat types and structures
- Facilitation of greater genetic variation within species
- Identification and management of refuges that buffer species from rapid change
- Increase the capacity of species and communities to persist through removal of threats and adapting to disturbances.

Establishment and maintenance of effective ecological linkages address many of the above recommendations.

Regional ecological linkages for the Perth region were mapped by the Perth Biodiversity Project in 2004. Since then, land use changes affected the feasibility of some regional linkages in parts of Perth. To test the feasibility of the Perth regional

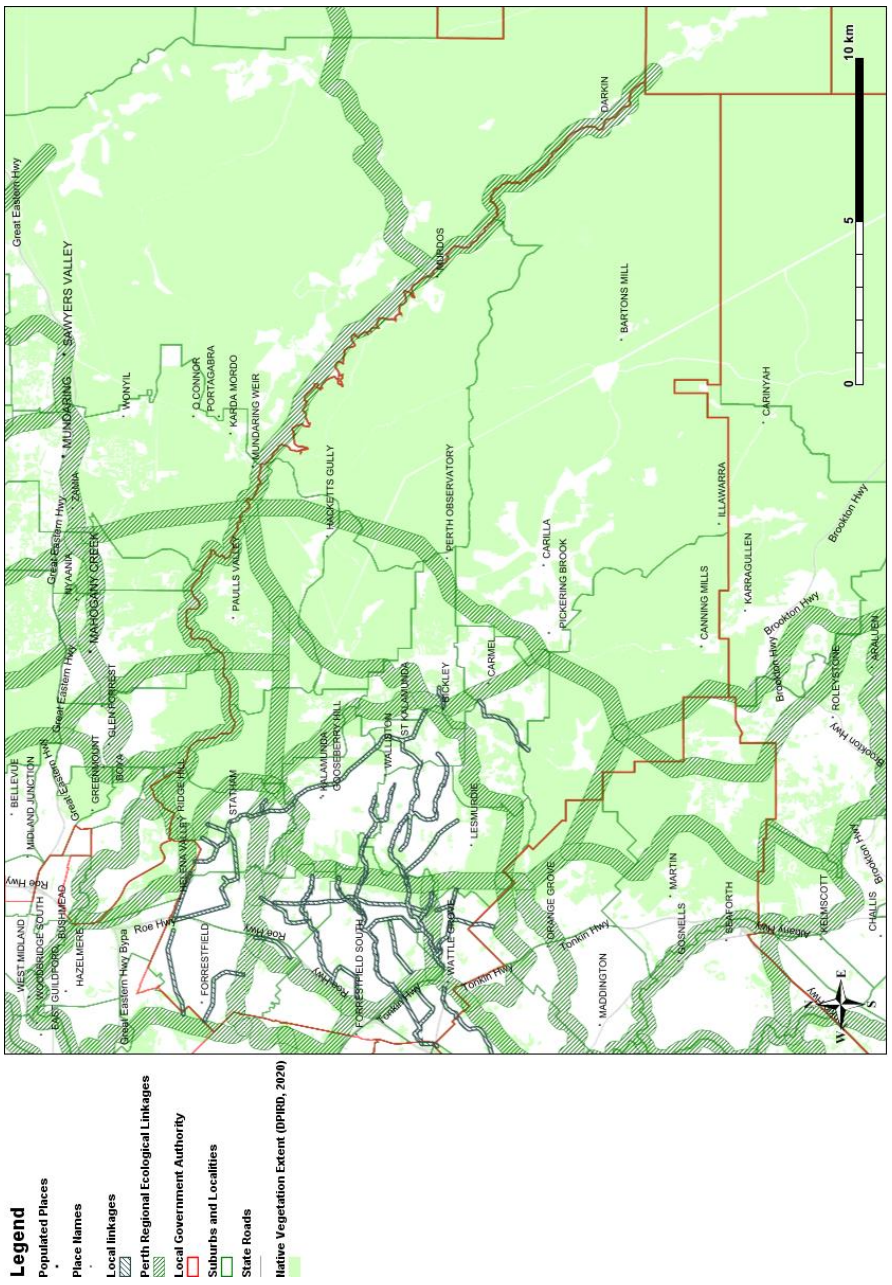

FIGURE 9: REGIONAL AND LOCAL ECOLOGICAL LINKAGES

ecological linkages in the City of Kalamunda and to identify feasible local linkages, vegetation connectivity modelling was undertaken.

Vegetation connectivity used the methodology developed by the Local Biodiversity Program (2012). The connectivity model considers the size, shape and the distance between vegetation patches and is described with three connectivity characteristics:

- Fragmentation
- Regional connectivity
- Connectivity Reach.

Connectivity Reach is an indicator of how large is a network of patches that any patch of vegetation is connected to. This measure helps to identify patches of vegetation that might be considered fragmented or unviable because of their shape (high area to perimeter ratio) but are very important due to their proximity to other patches that are interconnected. Narrow strips of vegetation retained along waterways are a good example of such remnants.

However, retaining only vegetation along waterways will not be enough to meet the needs of all species. Ecological linkages should include the major variations in plant communities and fauna habitat typical of the region. In the City of Kalamunda, the Darling Scarp forms a distinct feature and fauna and flora move primarily north-south within the Scarp habitat types. They use the adjoining Darling Plateau or the Swan Coastal Plain to a much lesser extent. Habitats typical of the top of the scarp should be linked to others at the top of the scarp and granite outcrops should be linked to other granite outcrops. On the Darling Plateau the habitat types are strongly influenced by topography and this should be reflected in the linkages.

Three vegetation connectivity scenarios were tested to:

- identify which protected areas might be at risk of becoming isolated due to future vegetation loss;
- assess the effectiveness of the proposed network of local ecological linkages;
- test the relevance of the regional ecological linkages mapped in 2004 by the Perth Biodiversity Project (Del Marco et al 2004).

When mapping Local Ecological Linkages, the following criteria were used (Figure 9):

- Support the Perth Regional Ecological Linkages as they remain relevant in the City of Kalamunda;
- Provide for connection between protected natural areas, City managed reserves proposed to be protected in this Local Biodiversity Strategy (see section 5.2), areas mapped as having very high conservation value (WALGA, 2019) and not within the regional linkages;
- Include areas with high Connectivity Reach values and with least cost opportunities for retention to act as stepping-stones within linkages. Examples include areas of native vegetation on public lands or freehold lands within land use categories supporting vegetation retention and areas where restoration of public lands will improve connectivity;

- Ensure the widest range of habitats or vegetation types are connected via the ecological linkages; including valleys, high points in the landscape, foothills and the top of the Scarp

Vegetation connectivity modelling scenarios are described in Appendix D.

The regional and local ecological linkages mapping will inform decisions on:

- priority vegetation for retention to maintain connectivity between already protected natural areas
- the identification of priority area for restoration or revegetation to reduce gaps in connectivity.

When considering how vegetation on rural lands contributes to connectivity, the importance of some non-indigenous plants like pecans or macadamias to native animals can be considered. It is important though to provide guidance to landowners on how these crops can be managed sustainably to meet the potentially conflicting needs (DBCA 2017).

5.2 TOWARDS LOCAL BIODIVERSITY CONSERVATION OBJECTIVES

Many types of human activities and decisions affect the outcomes for biodiversity at the local scale which then affects biodiversity outcomes on a regional scale. Therefore, biodiversity consideration needs to be integrated into all activities that affect it, including development approvals on private lands and management of community assets.

Figure 7 shows the tools that will be used to achieve each of the five Local Biodiversity Strategy objectives. Specific actions designed to contribute to the achievement of these objectives are listed in the Action Plan (See section 6 of this document).

To allow monitoring the effectiveness of the proposed implementation mechanisms and the levels of implementation, adoption of targets specific to each objective of the City's Local Biodiversity Strategy is recommended. Table 11 lists the recommended targets and references sections of this document which discuss how to achieve them.

TABLE 11: LOCAL BIODIVERSITY CONSERVATION TARGETS.

Local Biodiversity Strategy Objectives	Targets to be achieved by 2031	How to achieve them?
To increase the protection status of significant biodiversity in the City, including on	1.1 Formally protect at least additional 500 ha of native vegetation in the City, increasing the protection of at least 30% of the City's natural areas.	Implementing recommendations in Section 5.2.1, Table 12

Local Biodiversity Strategy Objectives	**Targets to be achieved by 2031**	**How to achieve them?**
local government managed or owned lands, and on private land.		
To appropriately manage local natural areas to reduce threats, considering the identified local biodiversity conservation priorities.	2.1 All local conservation reserves vested in the City are managed in accordance of an approved management plan	Develop and adopt a bushland management strategy for all City vested Local Natural Areas – see section 5.2.2
	2.2 Conservation signage is installed at all conservation reserves	
	2.3 Continuous decrease in weed cover and feral animal distribution is recorded in all conservation reserves managed by the City	
	2.4 No new dieback infestations are recorded within the City's conservation reserves	
To increase the viability and resilience of natural areas by establishing buffers and ecological linkages; considering the impacts of climate change.	3.1 Each high conservation value natural area is connected to at least three other significant natural areas through a network of ecological linkages	Implementation of protection and restoration of natural areas and replating of native vegetation within the regional and local ecological linkages – see Sections 5.2.2
	3.2 Revegetate at least 250 ha of degraded or cleared land using local species to increase the native vegetation cover in the Swan Coastal Plain portion of the City to at least 10% of its area or approximately 650 hectares	
	3.3 At least 50% increase in local tree species in streets and parks of Swan Coastal Plain portion of the City.	
To establish biodiversity consideration as standard across all areas for biodiversity conservation.	4.1. Local Biodiversity Strategy objectives are integrated into the City's land use planning tools	Integration into City's Local Planning Strategy, Local Planning Scheme and adoption of Local Planning Policies -See Section 5.2.1
	4.2 All staff use the City's environmental checklist procedures prior project planning and development.	Relevant to staff responsible for infrastructure projects' planning and delivery, City infrastructure and lands management - See Section 5.2.3
	4.2 All City staff and contractors working on City managed lands follow	See Section 5.2.3

Local Biodiversity Strategy Objectives	Targets to be achieved by 2031	How to achieve them?
	the best practice dieback and weed hygiene protocols	
To achieve long-term community engagement in local biodiversity management	5.1 All current community groups are active and actively participating in the management of natural areas in the City	See Section 5.2.1 and 5.2.4.
	5.2 At least 70% of native vegetation currently mapped on rural lands is retained	
	5.3 10% increase in participation in the City's environmental initiatives	

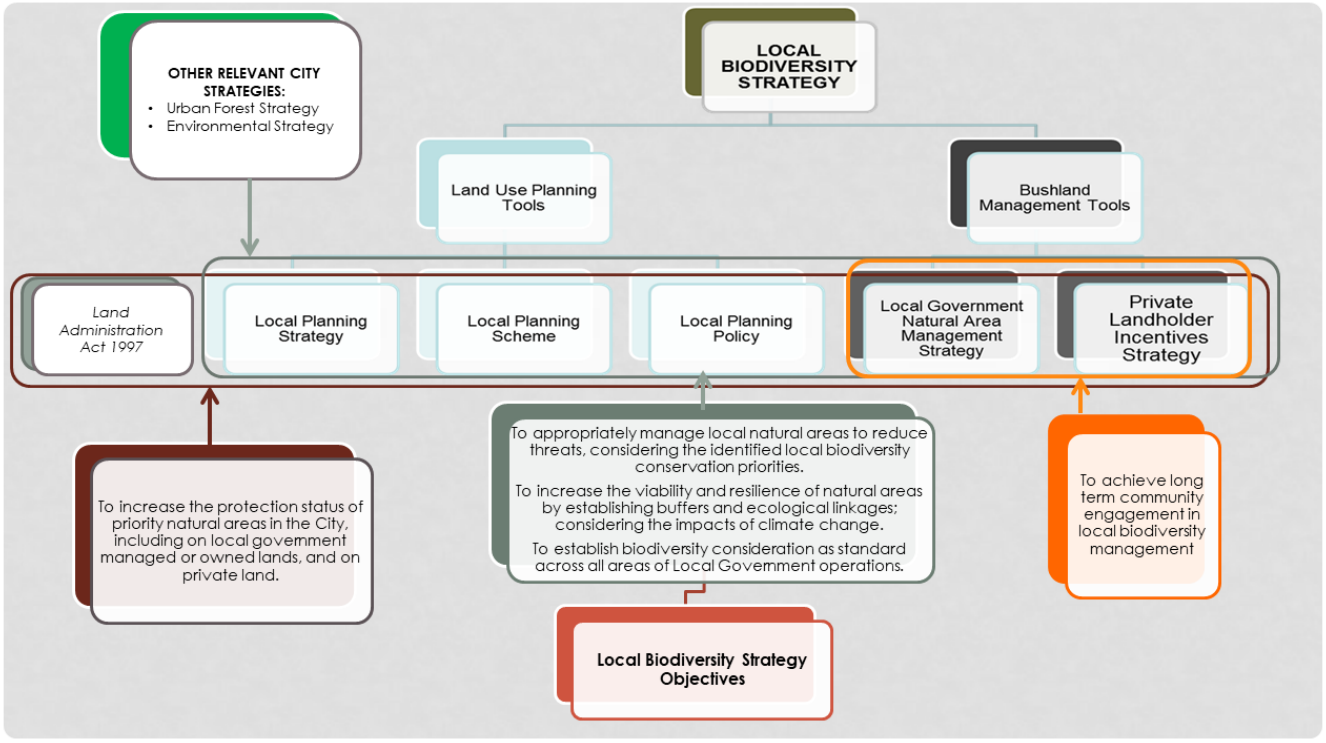

FIGURE 1: OVERVIEW OF LOCAL GOVERNMENT TOOLS TO MEET LOCAL BIODIVERSITY CONSERVATION OBJECTIVES.

5.2.1 Opportunities to increase protection and retention of local natural areas

Increasing the representation of biodiversity on lands that provide long-term protection via land tenure is one of the Strategy's key objectives. The scope of this document is to look at lands where the City has some level of influence or can determine the protection status of natural areas, the Local Natural Areas (LNAs).

When identifying the opportunities to increase the biodiversity protection status in LNAs, the existing provisions of the region and local land use planning schemes must be considered. Region and local planning scheme zones and reserves afford varied ability to retain and protect biodiversity. Figure 8 lists the land use categories in order of level of opportunity they provide for LNA retention and protection. To increase the remaining LNA protection status, additional policy or land tenure provisions are needed.

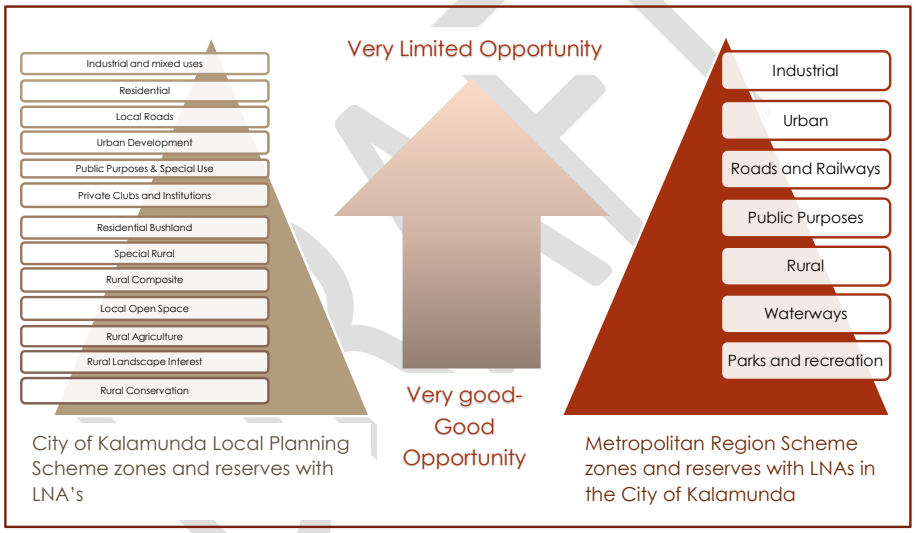

Figure 2: Provision of opportunities to retain local natural areas within land use categories in the City of Kalamunda.

Statistical analysis of native vegetation distribution across the Metropolitan Region Scheme (MRS) and local planning scheme's zones and reserves was undertaken (Tables A-10 and A-11 in Appendix A) to identify LNA distribution across land use categories. Comparison with the data published in the City's 2008 Local Biodiversity Strategy shows there was a significant shift of remnant vegetation from lands reserved as State Forest to lands reserved as Parks and Recreation in the MRS. In 2020, native vegetation reserved as Parks and Recreation increased by 7,046 hectares while vegetation mapped as State Forest decreased by 7,169 hectares. There is also less vegetation remaining on lands zoned Rural and more vegetation on lands zoned Industrial and Urban in the MRS.

While the increase in lands reserved for Parks and Recreation in the City is significant, the land tenure under the *Land Administration Act 1997* for these lands has not changed and thus no significant increase in formal protection of native vegetation in the City was recorded since 2008 (Table 2). In 2008, 9,492 hectares of native vegetation was considered protected, representing 29% of the City's area. This figure comprised all vegetation in Bush Forever Areas, including those on private lands and not formally protected and 9,185 hectares in DBCA lands managed for conservation. The 2020 vegetation extent mapping that is based on the combination of the DPIRD vegetation extent mapping and the City's LNA mapping shows 9,247 hectares protected, including 35.6 hectares consisting of City managed reserves for conservation and on private lands with a conservation covenant. This represents 28.5% of the City's area.

While the Parks and Recreation land use classification in the MRS covers DBCA lands managed for conservation, it also includes other public lands vested for purposes other than conservation and freehold lands that are yet to be ceded to the Crown. This MRS land use classification alone is not considered adequate at providing formal protection for native vegetation. There is an opportunity to improve the protection status of significant LNAs by changing the land tenure of LNAs reserved as Parks and Recreation in the MRS but not on Crown land or on Crown lands with vesting purpose other than conservation (see section 5.2.1.1. of this document).

The City of Kalamunda manages nine Crown reserves with vesting purpose listed as conservation or protection of flora (Table 12). However, four are classified as Local Open Space or Special Rural in the City's Local Planning Scheme No 3 (2020) which does not distinguish them from other areas designated for active recreational use and not all are recognised as 'biodiversity assets' in the City's Public Open Space Strategy (2018). To recognise the conservation values of these City managed reserves, introduction of a new local reserve classification into the City's Local Planning Scheme is proposed (see section 5.2.1.1. of this document).

Over 900 hectares of native vegetation remains on private land in land uses with objectives to protect vegetation, including LNAs zoned as Rural Conservation, Rural Landscape Interest and Residential Bushland (Table A-11 in Appendix A). While further development of these lands can be managed under the current local planning scheme provisions, the appropriate management of biodiversity is dependent on the landowner's capacity. To increase the certainty over the long-term conservation of biodiversity on these lands, landowners could enter into a covenanting agreement with an appropriate agency (DBCA or National Trust) which adds another level of protection and facilitates access to advice on best practice natural area management.

Not all vegetation on lands zoned Urban or Industrial in the MRS will be cleared as these lands are further classified in the local planning scheme and vegetation retention can be achieved via environmental conditions detailed through relevant regulatory processes or via Local/Public Open Space provisions. Currently there is more than 65 hectares of native vegetation in Local Open Space (Table A-11 in Appendix A). Opportunities to improve the protection status of high conservation LNAs within these land uses are discussed in section 5.2.1.1 of this document.

To achieve the 'protected' status of native vegetation, as defined by the local biodiversity conservation planning process, there are three mechanisms available:

- Creating a Crown reserve under the provisions of the *Land Administration Act 1997* and listing the vesting purpose or land use as Conservation;
- In the local planning scheme introducing land use categories with biodiversity protection objectives, such as Local Conservation Reserve[10] classification in addition to the existing Public Open Space, and Rural Conservation type zoning with a conservation covenant;
- Entering into a conservation covenant agreement with DBCA (lands owned freehold by the City).

How and when these mechanisms will be used depends on the current land use provision and land tenure or ownership. The Natural Area Prioritisation mapping (Figure 6) considers matters protected by legislation and helps to identify natural areas with significant biodiversity, using ecological and viability criteria. The next step is to identify and map opportunities for protecting the significant biodiversity across lands of varied tenure and land use.

5.2.1.1 BIODIVERSITY CONSERVATION PRIORITIES

To assist with identifying opportunities for protecting significant biodiversity in the City, another mapping layer was developed: Biodiversity Conservation Priority (BCP) mapping. The BCP mapping classifies Local Natural Areas into 11 categories, symbolised with letters of alphabet A to L. Table 12 describes each BCP category and makes recommendations on how to maximise protection and retention of vegetation mapped within each BCP category. Several of the BCP categories include lands where the City might have limited scope for influencing the final outcomes but for consistency, all Local Natural Areas were allocated to BCP category.

TABLE 12: BIODIVERSITY CONSERVATION PRIORITY CATEGORIES, AREA OF NATIVE VEGETATION MAPPED WITHIN EACH CATEGORY AND RECOMMENDED ACTIONS FOR CONSERVATION

LGmap Legend Symbol	Biodiversity conservation priorities and opportunities to protect Local Natural Areas	Area of vegetation (ha)	Recommended actions for conservation
A	Conservation Reserves managed by the City	27	• Those mapped as Local Open Space in the City's Local Planning Scheme, re-classify to 'Local Conservation Open Space or similar

[10] Exact name of the new local reserve classification to be determined via the review of the City's current Local Planning Scheme.

LGmap Legend Symbol	Biodiversity conservation priorities and opportunities to protect Local Natural Areas	Area of vegetation (ha)	Recommended actions for conservation
	(Table C-1 and Figure 4, Appendix C)		• Manage threats and restore degraded areas to extend habitat in accordance to a LNA management master plan
B	Proposed conservation reserves (See listed in Table C-2 and Figure 4, Appendix C)	420	• Consolidate adjoining reserves into a single reserve and seek change of vesting purpose or management order of the listed reserves to include conservation (through an application to Landgate under the *Land Administration Act 1997)* • In the City's Local Planning Scheme, re-classify to 'Conservation and Passive Recreation' local reserve • Manage threats and restore degraded areas to extend habitat in accordance to a strategic reserve management action plan
C	Bush Forever Areas outside State managed lands not reserved as Parks & Recreation in the Metropolitan Region Scheme (Figure 5, Appendix C)	10	• Seek protection of these natural areas through structure planning, including vegetation in good or better condition into adjoining existing or proposed conservation reserves (under the provisions of the *Land Administration Act 1997)* and by classifying them as 'Conservation and Passive Recreation' local reserve in the Local Planning Scheme No. 3
D	LNA reserved in MRS for Parks and Recreation but not on Crown Land (not in reserves designated under the *Land Administration Act 1997)* (Figure 6, Appendix C)	287	• Seek protection of High Conservation Value areas that overlap with City's LNAs, through formalisation of land tenure. Where feasible, ceding land to the Crown under the *Land Administration Act 1997* with vesting purpose conservation and passive recreation. In instances where these adjoin reserves in BCP B, consider consolidating the reserve boundary to form a single reserve with conservation purpose. • Manage threats and restore degraded areas to extend habitat in accordance to a strategic reserve management action plan • Formalise land tenure for all remaining City LNAs and manage threats to

LGmap Legend Symbol	Biodiversity conservation priorities and opportunities to protect Local Natural Areas	Area of vegetation (ha)	Recommended actions for conservation
			minimise risk of threats spreading into adjoining conservation reserves • For area not being mapped as City's LNAs, support formalisation of land tenure by the State (WAPC) and seek active management of these lands to minimise risk of threats impacting adjoining conservation reserves
E	LNA in Local Open Space and on Crown land (except Conservation reserves = Category A and Proposed conservation reserves=Category B) (Figure 7, Appendix C)	72	• Manage threats and restore degraded areas to extend habitat in accordance to a strategic reserve management action plan, with priority given to LNAs within ecological linkage
F	LNA in Local Open Space but not on Crown Land (not in reserves designated under the *Land Administration Act 1987*) (Figure 8, Appendix C)	11	There are several areas classified *Local Open Space* in the Local Planning Scheme No.3 that are not reserved under the *Land Administration Act 1997* and remain on freehold land. • For LNAs of high conservation value, seek formalisation of protection for these natural areas by ceding land to the Crown under the *Land Administration Act 1997* with vesting purpose conservation and passive recreation. In instances where these adjoin reserves in BCP B, consider consolidating the reserve boundary to form a single reserve with conservation purpose. • In the Local Planning Scheme No. 3, re-classify to 'Conservation and Passive Recreation' local reserve • Manage threats and restore degraded areas to extend habitat in accordance to a strategic reserve management action plan • For LNAs with degraded vegetation, but adjoining existing or proposed

LGmap Legend Symbol	Biodiversity conservation priorities and opportunities to protect Local Natural Areas	Area of vegetation (ha)	Recommended actions for conservation
			conservation reserves, seek formalisation of land tenure for these natural areas by ceding land to the Crown under the *Land Administration Act 1997* and develop a targeted revegetation plan to facilitate connectivity between adjoining conservation areas and along ecological linkages
G	LNA on Rural Conservation and Rural Landscape Interest zoned land on blocks larger than **12 hectares** (Figure 9, Appendix C)	341	• Seek to retain existing lot sizes • Any future development should be within the provisions of the Scheme and the proposed Local Planning Policy for Local Natural Area Conservation • Support landowners to manage retained natural areas for conservation
H	LNA on Rural Conservation and Rural Landscape Interest zoned land on blocks **6 -12 hectares** (Figure 9, Appendix C)	293	• No further reduction in lot sizes should be supported unless it is demonstrated that it can be achieved without clearing of Local Natural Areas and meeting the bushfire risk management requirements • Any future development should be within the provisions of the Scheme and the proposed Local Planning Policy for Local Natural Area Conservation • Support landowners to manage retained natural areas for conservation
I	LNA on varied rural lots (of any size) and on Rural Conservation and Rural Landscape Interest on blocks less than 6 hectares (Figure 9, Appendix C)	730	• Any future development/subdivision should be within the provisions of the Scheme and the proposed Local Planning Policy for Local Natural Area Conservation (e.g. High Conservation Value LNAs to be retained as Local Open Space for conservation) • Support landowners to manage retained natural areas for conservation
J	Areas allocated as future Local Open Space (Figure 8, Appendix C)	3.4	• Area to be retained as Local Open Space in a WAPC approved structure plan, as a condition of development • When implemented, classify the land as the proposed Conservation and

LGmap Legend Symbol	Biodiversity conservation priorities and opportunities to protect Local Natural Areas	Area of vegetation (ha)	Recommended actions for conservation
			passive recreation local reserve in the Local Planning Scheme No. 3. • Revise the strategic reserve management plan to incorporate the new LOS
K	LNA in all other City vested Crown reserves (not in Categories A, B & E) (Figure 10 in Appendix C)	150	• Review and amend the Local Planning Scheme zoning over lands not mapped as Parks and Recreation in the MRS** • Manage threats and restore degraded areas to extend habitat in accordance to a strategic reserve management action plan, with priority given to LNAs within ecological linkage
L	All other LNA (Figure 11 in Appendix C)	537	• On lands subject to structure planning, and no Environmental Conditions determined under environmental regulations, seek protection of High Conservation Value LNAs via Public Open Space allocation (according to the proposed Local Planning Policy for Local Natural Area Conservation)

5.2.1.2 INTEGRATING BIODIVERSITY CONSERVATION OBJECTIVES INTO LAND USE PLANNING

There are three key elements of the local land use planning framework that need to include adequate consideration of biodiversity to facilitate good environmental outcomes:

- Local Planning Strategy - provides for strategic consideration of local land use planning, considering the regional context and gives justification to local planning scheme land use categories. To integrate the Local Biodiversity Conservation objectives into land use planning, the City's Local Planning Strategy should include the Local Natural Area Prioritisation mapping (Figure 6), ecological linkages mapping and the Biodiversity Conservation Priorities mapping. The strategy should also include biodiversity conservation in its objectives and describe the local planning scheme provisions required to meet these objectives.

- Local Planning Scheme – provides a statutory mechanism for land use management by defining land use category objectives and development approval conditions. It is recommended that the City's Local Planning

Scheme be amended to include new local reserve classification e.g. Local Conservation Open Space and strengthen provisions for biodiversity during development approvals on lands identified as containing significant biodiversity.

- Local Planning Policies – provide for transparency in interpreting the local planning scheme provisions such as definitions 'significant vegetation'.

Other opportunities for improving biodiversity consideration in the City's Local Planning Scheme include:

- Amend general development control provisions to define requirements for landscaping using suitable local species (in accordance with a new local planning policy – see below), requirements for fauna friendly kerbing, requirements for conservation management plan and delineation of vegetation management zones on rural lands;
- Introduce a Special Control Area overlay to identify and recognise regional and local ecological linkages and their components;
- Review the Zoning Table to consider inclusion of uses that facilitate wider range of uses compatible with biodiversity retention and conservation.

Special Control Area

To afford formal recognition of the regional and local ecological linkages identified through the City (Figure 6), it is proposed the ecological linkages are shown in the local planning scheme as a Special Control Area (SCA). Provisions of the SCA Ecological linkages will apply in the addition to the provisions of the underlying zone or reserve and any general provisions of the Scheme.

The purpose of the SCA will be:

- To secure any native vegetation within ecological linkages from undue subdivision or development that will affect the connectivity value of that vegetation;
- To ensure land use and development is undertaken in a manner that maintains connectivity within the ecological linkage.

In dealing with an application for planning approval on land within ecological linkages, the City of Kalamunda will require the following (in addition to the standard development application requirements):

- Location of a dwelling and other infrastructure within a lot utilises already cleared lands, considers the extent of native vegetation on adjoining and lands within 500m along the linkage mapping;
- Any development demonstrates that fragmentation of remaining native vegetation is minimised;
- Fencing between adjoining lands with native vegetation provides for terrestrial fauna movement;
- Planting of native vegetation may be required to ensure re-establishment of connectivity affected by unavoidable clearing of native vegetation to facilitate allowable development;

- Any major road upgrade within an ecological linkage includes adequate information of local fauna potentially utilising natural areas on adjoining lands and provides for terrestrial fauna movements such as underpasses;
- Any new kerbing or upgrades of kerbing along streets and roads within ecological linkages should be sloped to allow terrestrial fauna crossing;
- Require a planning approval to remove native trees on private land within ecological linkages except where the tree is to be removed for:
    - Fire risk management purposes;
    - The tree is dead or dying and is posing risk to public safety;
    - Clearance for power lines, emergency access, emergency works by public authority;
    - Approved development.
- Redevelopment of existing residential, business or industrial lands within ecological linkages consider the location of landscaped areas in a way that helps to improve connectivity between green spaces within the ecological linkage;
- All landscaping on lands within ecological linkages uses local species.

It is recommended that the regional and local ecological linkages mapping is made available through the City's public Intramaps, to allow easy identification of properties within the SCA – Ecological Linkages.

Local Planning Policies

Development of local planning policies is recommended to provide additional guidelines assisting the City in making decisions under the scheme provisions and provide guidance to developers and community on how the City will be applying discretion in specific circumstances. While local planning policies are not endorsed by the WAPC, and do not form part of the scheme, the requirements of the policy can be upheld in the case of an appeal. To be effective, the local planning policy needs to be developed, adopted and implemented in accordance with standard procedures described in the Model Scheme Text, be consistent with State and regional policy and be applied with consistency.

It is proposed that two new local planning policies are adopted:

- Local planning policy guiding the creation of new Local Conservation Open Space reserves via the Local Planning Scheme. The policy will identify areas (BCP B) where this policy will apply, define the objectives, provide link to the local conservation target (adopted through the new local planning strategy), outline criteria for assessing the biodiversity values of new reserves created in the future as condition of future subdivisions, and define management standards for new local reserves before taking over its management. This need for a policy guiding future Public Open Space development was also identified as an action in the City's Local Environment Strategy (City of Kalamunda 2019).

- Local planning policy guiding development and landscaping within regional and local ecological linkages, identifying areas where this policy will apply (e.g. Special Control Area based on Figure 9), define objective, outline criteria for assessing remnant vegetation values as part of an ecological linkage, define species accepted by the City in landscaping, acceptable planting densities and landscaping structures to achieve water sensitive landscapes that also support local fauna movement. The policy will also define requirements for underpasses and other structures to be installed as part of the landscape to provide fauna habitat. Opportunities to integrate this policy with tree protection needs identified via the City's Urban Forest Strategy (2020).

These proposed Local Planning Policies are proposed in addition to the policies proposed to be actioned vie the implementation of the City's Clean and Green: Local Environment Strategy 2019-2029, including local planning policy for the protection of significant trees and vegetation on private property and policy to protect the environmental values of waterways. It is critical that the Local Planning Policy for retention and protection of trees and native vegetation (biodiversity) on private lands includes the Natural Area Prioritisation mapping (Figure 8) and all categories of Biodiversity Conservation Priorities mapping relating to private lands (Table 12, BCP G, H, I and L). The main purpose of this policy should be to provide guidance to land-owners and planners on how LNAs are to be considered in each of the land use zone categories.

Examples of best practice integration of biodiversity into local land use are available via WALGA website.

Update of the City's Public Open Space Strategy (2018)

In 2018, the City prepared a Public Open Space (POS) Strategy which evaluated the existing and future needs for active public open space. The POS Strategy classified POS into several categories, including 'Biodiversity Assets'. This category includes Local reserves zoned as Local Open Space in the City's Local Planning Scheme No 3 that were identified during the POS assessment as being for environmental protection purposes. While the primary purpose is the protection of environmental values, these POS area can provide for passive recreation such as walking or running.

The POS Strategy also identifies Local Open Space areas not classified as Biodiversity Assets but where provision of 'Nature Space' is the main use.

Comparison of the POS Strategy Biodiversity Assets mapping with the Natural Area Prioritisation mapping (Figure 8) identified several POS area that are not listed as Biodiversity Assets in the 2018 POS Strategy but retain native vegetation of high conservation value and POS areas that are mapped as Biodiversity Assets but no significant biodiversity conservation values were identified via the review of the City Local Biodiversity Strategy (Appendix E).

It is recommended that the City update the Biodiversity Asset POS mapping to integrate the findings of this strategy regarding the significance of POS to biodiversity conservation.

5.2.2 MANAGEMENT OF SIGNIFICANT BIODIVERSITY

5.2.2.1 CITY MANAGED LOCAL NATURAL AREAS

The City's Clean and Green: Local Environment Strategy 2019-2029 outlines numerous actions that will directly contribute to conservation of biodiversity and assist with meeting the local biodiversity conservation targets for protection and management of LNAs. Implementation of several of the Local Environment Strategy actions will be facilitated by this document.

The Local Biodiversity Strategy facilitates the prioritisation of City managed parks, reserves and other LNA for management and improvement, identifies opportunities for linking green spaces through the landscape, identifies priority water catchments and provides guide to what natural areas are significant in the City.

In addition to the specific actions listed in the City's Local Environment Strategy, the following additional recommendations are made:

- Develop, adopt and implement a bushland management master plan for all City managed Local Natural Areas;

- Secure and protect natural areas within mapped ecological linkages and undertake restoration of degraded areas to strengthen connectivity between protected areas within the regional and local ecological linkages.

The first step in prioritising City managed Local Natural Areas (City's LNAs) has been completed as part of the development of this document. The process for determining the City's LNA's (City of Kalamunda, April 2020) was based on the following:

1. A desktop assessment was undertaken by using the Fire Hazard Inspection areas (GIS layer FHI) as surrogates for Local Natural Areas (LNA's) as a starting point.
2. Discussion around what constitutes an LNA was undertaken with Manager Environment, Consultant and Environmental team staff.
3. LNA definition in Local Biodiversity Strategy referred to.
4. Definition: *A local natural area is any physical area containing endemic species or ecological communities in a relatively natural state and can therefore be described as having high biodiversity values. However, waterways and areas of remnant vegetation that offer values for sustaining biodiversity through ecological linking or buffering against threats are also included. Private property is currently not considered in the process as it is not under the direct control of LG. Road reserves are managed as road reserves*

and not LNA's. However, road reserves are mapped and classified according to roadside conservation committee protocols and can act as corridors and buffers.

5. Consultant redefined LNA's based on above parameters using aerial photography, knowledge of sites, discussion with City Officers and some initial site visits. Many Fire Hazard Inspection areas were determined to be highly modified parkland and not considered to be LNA's.
6. Further discussion was undertaken with City Officers and consideration of current planning processes, future plans, revegetation programs, potential future offset sites etc was taken into consideration in the final delineation of LNA's.
7. Many man made drainage basins were marked as LNA's due to their environmental value as water sources for wildlife, the ability for the Environment team to have an impact on the environmental amenity of these areas through planting programs, the proximity to other natural areas and the fact that these site will never be managed as anything but a drainage reserve (i.e. will not be made into parkland or "cleared".

The City of Kalamunda is responsible for the management of nearly 800 hectares of land across more than 300 Crown reserves and some unreserved[11] land. Only 12 of these Crown reserves are larger than 10 hectares and 65% is smaller than 1 hectare. Not all City managed reserves retain native vegetation. City's LNA mapping (2020) recorded native vegetation in 224 of the 315 reserves vested in the City for management purposes.

To inform management priorities on lands managed by the City, vegetation condition mapping was undertaken in 2019-2020 and this information was used to determine a viability score for these areas using the viability assessment methodology developed via WALGA's Perth Biodiversity Project (Del Marco et al 2004) (See Map 12 and Table C-3 in Appendix C).

The viability assessment formula considers the mapped area size, shape, perimeter to area ratio, vegetation condition and its distance from other protected or unprotected natural areas.
.
The highest possible viability score is 27.5, which would represent a large area of native vegetation in very good condition, in a remnant with a small edge to area ratio and well connected to other vegetated natural areas that are already protected. Such a remnant patch would be of highest priority for protection as it will require small initial investment to maintain its biodiversity values.

In the middle of the viability scores are areas with scores around 15, representing relatively large areas, with at least 50% of vegetation in good or better condition that are not part of a defined linkages but are near other natural areas. To maintain the biodiversity of these areas will require some investment but the likelihood of good outcomes in respect of improved ecosystem functions is high.

[11] Lands not classified as Crown reserve under the *Land Administration Act 1997*.

Small elongated patched, with high area to edge ration with degraded vegetation and isolated from other natural areas require significant active and on-going management to increase the ecosystem functions of these areas.

TABLE 13: DISTRIBUTION OF CITY'S LNAS BY VIABILITY ESTIMATE VALUES.

Viability score category	Number of City's LNAs in category	Percentage of the assessed total (238 LNAs)
<5	28	11.8%
5.01-10	126	53%
10.01-15	60	25%
15.01-20	23	9.7%
>20	1	0.5%

To identify the high priority City's LNA for protection and management, the viability estimate scores were combined with the 'Natural Areas Prioritisation' score (Figure 8) which are considering the ecological values of the area (Appendix E).

The total combined score values range from 54.7 to less then 5. Considering the total potential score estimate for the City's LNAs (62.6) and the distribution of ecological values and viability estimate, the City's highest priority LNAs were selected in the following categories (Appendix E and Figure 10):

- City LNAs with the combined score of over 40 (close to top 30% of the top scores)
- City LNAs with the combined score between 35 and 40
- City LNAs with the combined score less than 35 but the viability score over 15 (identifying larger reserves with vegetation mostly in good condition that based on the ecological criteria score relatively lower).

When developing the proposed LNA management master plan, the following should be considered:

- Natural Area Prioritisation mapping (Figure 8 and Appendix F)
- LNA viability mapping
- Type of threats (type of weeds, dieback, feral animals, rubbish dumping, high intensity use by people)
- Ecological linkages mapping
- Opportunities for community engagement (Friends Groups).

Approaches to various threats will be informed by the plans the City seeks to develop as identified in the Local Environment Strategy, including the an update of the City's weeds strategy, the development of a strategic feral animal control plan or the development of fire risk management measures that reflect the specific local plant community ecological requirements.

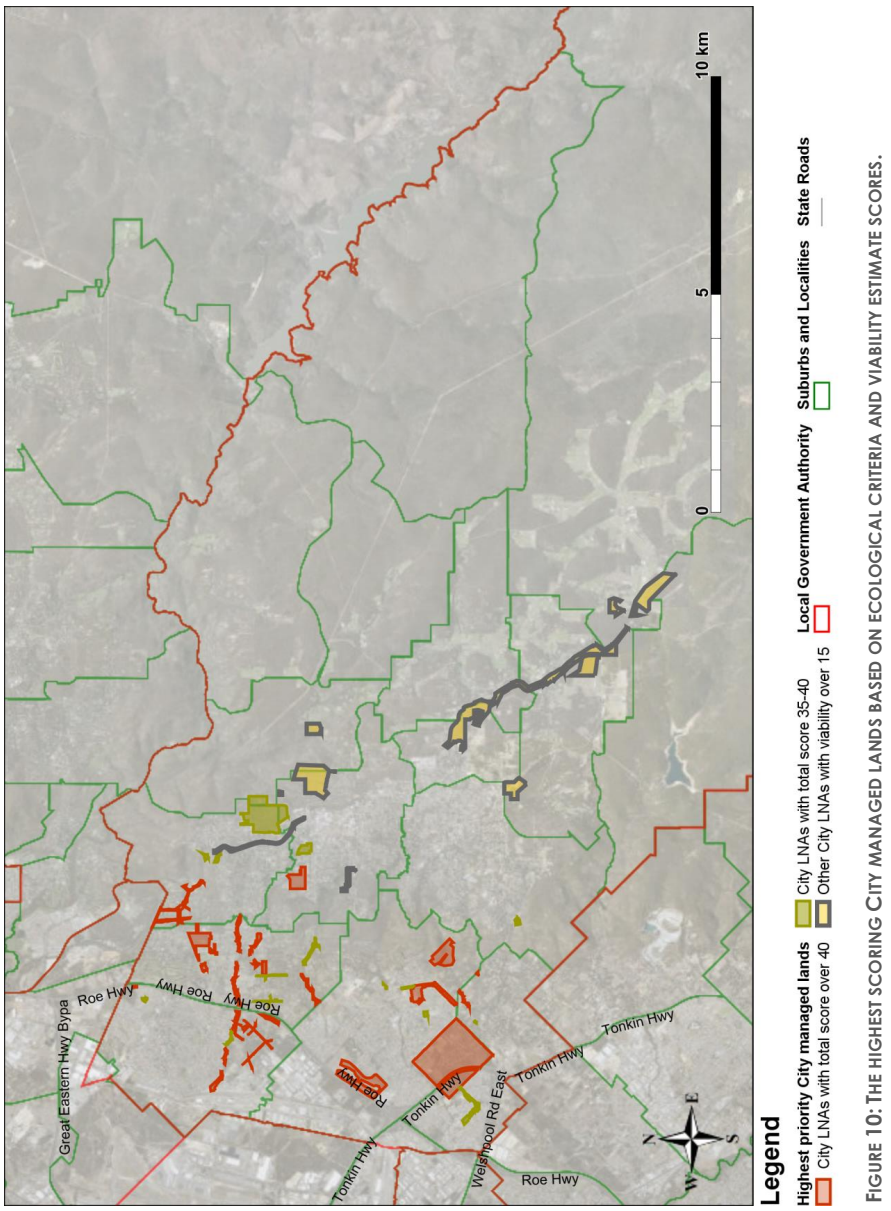

FIGURE 10: THE HIGHEST SCORING CITY MANAGED LANDS BASED ON ECOLOGICAL CRITERIA AND VIABILITY ESTIMATE SCORES.

5.2.2.2 MANAGEMENT OF BIODIVERSITY ON PRIVATE LAND

The City of Kalamunda developed several publications that provide useful information to residents on how to manage their own property to support biodiversity. Examples of these include the Private Landholder Bushland Information Package (2013) focusing on landowners of larger rural lots or the *Plants Out of Place* booklet which is relevant to all residents. Educational opportunities are available via the Bush Skills in The Hills programs run in partnerships with adjoining local governments. Supporting on-going activities that educate about the values of natural areas and what individuals can make to continue benefiting from these values is important. The following section includes some examples of activities that have been effective elsewhere and could be implemented by the City or in partnership with other stakeholders.

Of the 2,445 ha of native vegetation classified as Local Natural Areas in the City of Kalamunda, 62% is privately owned on rural zoned lands (See Table A-5 in Appendix A). Management of this vegetation in a way that supports biodiversity will significantly affect the biodiversity conservation outcomes. There are several ways in which landowners can be supported by the City in retaining biodiversity on their properties while meeting their expectations from land ownership:

- *Flexibility in land use provisions on rural lands that retain significant natural areas*
    - By extending the land use provisions to facilitate business opportunities that are compatible with natural area retention and sustainable management (e.g. 'CareFarms' that engage in bushland restoration or cooperatives like 'Round the Bend Conservation Cooperative' in Victoria)
    - By designing rural subdivisions with more flexible lot sizes to minimise the need for vegetation clearing while maximising lot yields (e.g. Shire of Mundaring in Chidlow, a rural subdivision has been developed where instead of the traditional 2ha lots, lost range from 1.3 ha to 3.5 ha and still maintaining the five- lot subdivision)

- *Advice to land owners on best practice bushland management and bush fire risk mitigation that minimises vegetation clearing and biodiversity loss on private land (*by providing site specific assessments by City's staff on a modest fee for service basis as provided by the Shire's of Serpentine-Jarrahdale or Mundaring).

It is recommended that the City surveys private landholders to collect information on the level of understanding of environmental management issues, barriers to retaining vegetation, the values of native vegetation on rural lots and the motivations for choosing to live on rural lands in the City. This information can then be used to tailor the any future incentives programs and environmental education programs.

In build-up areas, verges, public gardens, backyards or rooftops provide opportunities to grow local species that not only provide greenery but also support a range of native birds, insects and lizards. As not all native plants grow well in highly modified urban environments as exist on the Swan Coastal Plain portion of the City

or many residential and industrial areas, providing practical advice to landowners on suitable plant selection promotes and encourages their use.

The encourage participation in the City's 'Plants for Residents' program by residents with properties within the ecological linkages; the City's plants subsidy program could be extended to include the following features:

- garden consultation by adequately qualified specialist that will assist with plant selection and planting design to maximise the benefits of local plants while meeting the aesthetic requirements[12];
- Seek 'neighbourhood champions'
- Monitor and report to the community within target areas (ecological linkages) progress of transformation (e.g. % of properties with more than 60% of local species).

It is recommended that the City develops and implements an incentives program to encourage use of local species in private gardens, targeting private landholders within identified ecological linkages and within about 250m of conservation reserves.

Other activities that could be considered include:

- Hosting of practical gardening workshops focusing on growing local species
- Promoting open garden schemes and examples of public landscaping using local species
- In September (every 2-3 years), hosting gardening competitions.
- In partnerships with community groups or BirdLife Australia encourage monitoring of birds in private gardens.
-

In addition to the information resources the City already provides, it is recommended that the following additional information is developed:

- Responsible cat ownership (e.g. South West Group of local government's 'Happy at Home' campaign: http://www.southwestgroup.com.au/natural-resource-management/happyathome/)
- Wildlife care in emergencies such as fire (e.g. https://www.animalsaustralia.org/features/help-animals-wildlife-carers-vets-australia-bushfires.php)
- Responsible fertilise use (http://www.fertilisewise.com.au/) .

[12] Similar approach was used by the Sutherland Shire in New South Wales through their 'Greenweb' program. In 6 months, over 100 property inspections were held with residents wanting to take part in the program. This program was established in 2001 and is still being implemented by the Shire: http://www.sutherlandshire.nsw.gov.au/Outdoors/Environment/Plants-and-Bushland/Greenweb

5.2.3 INTEGRATION OF BIODIVERSITY CONSIDERATION INTO LOCAL GOVERNMENT BUSINESS

Update the Public Open Space Strategy to recognise the 'biodiversity assets' within lands vested in the City and identify underutilised Public Open Space with no biodiversity values as opportunities for land swap

Develop an internal governance process for all City operations and projects where activities have the potential to impact biodiversity including
Parks and reserves maintenance crews, infrastructure and roadside maintenance:

- All staff use the City's environmental checklist procedures (including checking of mapping)
- All City staff and contractors working on City managed lands follow the best practice dieback and weed hygiene protocols

5.2.4 COMMUNITY ENGAGEMENT

To effectively engage the local community and other land managers in the City, it is important to maintain consistent communication on the City's objectives for biodiversity conservation. This should be facilitated by:

- Including all Local Biodiversity Conservation mapping on the City's mapping information system available to all internal services, including planning, engineering and infrastructure maintenance.
- Including all Local Biodiversity Conservation mapping on the City's public mapping information system.
- Informing State agencies such as the Department of Planning, Lands and Heritage, Department of Water and Environmental Regulations, Department of Biodiversity, Conservation and Attractions about the City's the Local Biodiversity Strategy objectives and seek their support in implementation.
- Referring to the findings of the Local Biodiversity Strategy when providing comments on initiatives by State Agencies.
- Referring to the findings of the Local Biodiversity Strategy when providing comments on subdivision and scheme amendment proposals.
- Facilitating discussions with peak natural resource management groups such as Perth Region NRM, Eastern Metropolitan Regional Council, local friends groups or other not-for-profit organisations active in the City to develop potential partnerships that will support on-ground management on public and private lands and the re-vegetation programs.
- Facilitating discussions with local Aboriginal leaders to investigate opportunities for their involvement in promoting the cultural values of natural areas in the Shire.
- Engaging with local business groups and tourism operators to maximise the City's position as a destination for tourism (Bibbulmun Track, wildflowers, wellbeing stays and unique arts stays.

- Engaging with the active arts community to work on new ways of engaging the community in valuing
- Reporting to the local community at least every two years on progress with implementation.
- Including articles on biodiversity values in the City, prompts for actions in all City newsletters and at least once a month in the local newspaper.
- Maintaining the existing resources available to residents via the City's website.

There are 47 Friends Groups already active in the City (https://www.kalamunda.wa.gov.au/community/community-groups/friends-group Continued support to the volunteer community groups and active promotion and recognition of their bushland restoration and management activities in City should be a highest priority as the benefits of such partnerships are well recognised.

6 ACTION PLAN

Priority: High – complete by 2022-23
Medium – complete by 2023-2025
Low – complete by 2031

Action	Priority	Responsibility	(Key) Performance Indicator- provide justification for the proposed KPIs	Contributing to target
1 Integration into the land use planning framework				
1.1 Integrate Local Biodiversity Strategy objective, targets and mapping into the City's local planning strategy	High	Strategic and Regulatory Planning Services	WAPC endorses the City's local planning strategy with adequate provisions for local biodiversity (including mapping and targets)	4.1
1.2 Confirm the conservation values of the selected Land Administration Act 1997 reserves proposed for change of purpose, or change of classification of reserve to Conservation and Passive Recreation in the local planning scheme (BCP B)	High	City to engage adequately qualified consultant or City's Coordinator Conservation and Environment	All reserves assessed using the NAIA templates and report on recommendations for reserve purpose change made.	4.1
1.3 Scheme Amendment to change the classification of selected high conservation value reserves vested in the City to Conservation and Passive Recreation	High	Strategic and Regulatory Planning Services	All selected reserves with confirmed high conservation values classified for Conservation and Passive Recreation	4.1
1.4 Introduce a Special Control Area overlay for implementation of ecological linkages	High	Strategic and Regulatory Planning Services	Local Planning Scheme Amendment adopted by the Council and the WAPC	4.3

Action	Priority	Responsibility	(Key) Performance Indicator- provide justification for the proposed KPIs	Contributing to target
1.5 Develop a number of Local Planning Policy/Policies (see section 5.2.1.2)	High	Strategic and Regulatory Planning Services	Local Planning Policy adopted by the Council All new subdivisions and streetscape upgrades in accordance with the landscaping strategy (80% of plants used are local species) At least 70% of vegetation remaining in BCPs G,H, I retained	4.1
1.6 Implement recommendations for vegetation retention and protection on lands identifies as BCP L	Ongoing	Strategic and Regulatory Planning Services	Contribute to the achievement of 5% of pre-European vegetation extent protected and 10% native vegetation cover on the Swan Coastal Plain portion of the City	4.1
1.7 Update the 'Biodiversity Asset' mapping in the City's Public Open Space Strategy (2018)	High	Strategic and Regulatory Planning Services	The updated Biodiversity POS mapping being integrated into the City's Intramaps and used to inform land use planning	4.1
2 Local Government Natural Area Management				
2.1 Confirm the indicative ecological values, condition and management issues in all natural areas proposed to be managed for conservation	High	Environmental Services team or suitable consultant	All current and new natural areas assessed and prioritised according to ecological values and management issues	4.2 and 4.3
2.2 Develop a strategic 5 year management master plan for all conservation reserves	Medium	City to engage adequately qualified consultant Or in-house by the Conservation team	Strategic Management Plan adopted by the Council	4.2, 4.4 and 4.5
2.3 Develop and implement best-practice procedures for all City staff and contractors working and accessing	Medium-High	Coordinator Conservation and Environment /Engineering	Best practice procedures part of induction of new staff, part of contractual agreements for all works	4.2 and 4.4

Action	Priority	Responsibility	(Key) Performance Indicator- provide justification for the proposed KPIs	Contributing to target
natural areas and managing infrastructure assets		Services/Community Infrastructure	potentially within or near protected natural areas	
2.4 Develop and Implement the LNA reserve management master plan	Ongoing	Coordinator Conservation and Environment /Community Infrastructure	At least 80% of LNA reserves being actively managed by 2031	4.2, 4.4 and 4.5
2.5 Undertake periodic fauna monitoring and keep records of all incidental fauna observations for all natural areas.	Ongoing	Conservation and Environment Team	All viable natural areas will show current records of threatened and priority fauna where they would have occurred prior fragmentation	4.2 and 4.5
2.6 Report any new records to DPAW	Ongoing	Conservation and Environment Team	DPAW records of fauna in the City are up-to-date	4.1
2.7 Develop and implement a revegetation plan for all degraded lands within ecological linkages	Medium	Coordinator Conservation and Environment /Community Infrastructure	At least 50% of mapped degraded area in conservation reserves are revegetated by 2031 Significant progress has been achieved towards increasing native vegetation cover on the Swan Coastal Plain portion of the City.	4.3
2.8 Develop and implement a City-wide landscaping program (including public open space, compensation basins and streets)- overlapping with the City's Urban Forest Strategy	High	Coordinator Conservation and Environment /Engineering Services/Community Infrastructure/Development Services	By 2031, at least 50% of street and park trees are local species	4.3
3 Private landholder and community volunteers support				
3.1 Facilitate private landholder consultation to identify the most desirable	High	Coordinator Conservation and Environment	At least 20% of private landholders on rural zoned lands actively engaged in the survey	4.2

Action	Priority	Responsibility	(Key) Performance Indicator- provide justification for the proposed KPIs	Contributing to target
incentives for biodiversity conservation on private land		/Community Services		
3.2 Prepare and implement a private landholder incentives package to support biodiversity conservation on private rural lands.	Medium	City to engage adequately qualified consultant/ Coordinator Conservation and Environment	Private landholders incentive strategy adopted by the council At least 70% of native vegetation mapped on rural lands is retained in 2031	4.2
3.3 Deliver local plant subsidy scheme, targeting properties within ecological linkages	Medium	Conservation and Environment Team	60% of land owners within each linkage actively participated in the scheme	4.3
3.4 Support community volunteers and private landholders: • Information on management • Volunteer insurance • Free training • Promotion of bushcare activities • Volunteer recognition	Ongoing	Conservation and Environment Team	90% of the current community groups are active and actively participating in the management of natural areas in the City in 2031 Number of Friends Groups Grows at the rate of 2% per annum. Friend group membership grows by 5%/annum.	4.5
5 Communication and Local Government capacity building				
5.1 Integrate all Local Biodiversity Strategy mapping into the City's information system	High	Development Services	Mapping accessible to all City services	4.4
5.2 Develop an interactive portal for residents with information on how they can support biodiversity locally: • Responsible cat and dog ownership • Bee keeping • Nest boxes – birds, bats, insects	Medium	Coordinator Conservation and Environment /Corporate Services	10% annual increase of community activity on the portal	4.2, 4.3 and 4.5

Action	Priority	Responsibility	(Key) Performance Indicator- provide justification for the proposed KPIs	Contributing to target
• Sustainable landscaping – linked to ecological linkages • Wildlife care in bushfire emergencies • Map uptake of the implemented initiatives				
5.3 Facilitate discussions with local Aboriginal leaders to investigate opportunities for their involvement in promoting the cultural values of natural areas in the City	High	Community Services/ Coordinator Conservation and Environment		4.2, 4.4 and 4.5
5.4 Develop a monitoring and reporting schedule	High	Coordinator Conservation and Environment / Development Services/Corporate Services	Bi-annual report on progress with implementation of the Local Biodiversity Strategy and on the status of biodiversity in the Shire presented to the Council and the community	4.4 and 4.5
5.5 Undertake a review of the feasibility and effectiveness of the proposed implementation actions every 5 years.	Medium	Coordinator Conservation and Environment / Development Services	Results of the review with recommendations on further actions presented to the Council	4.4 and 4.5
5.6 Form partnerships with not-for-profit groups to facilitate reserve management and environmental education	Ongoing	Coordinator Conservation and Environment /Community Infrastructure	At least one long-term (5years) working partnership formed	4.2 and 4.3

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GLOSSARY

Adequate refers to how much of each ecosystem should be sampled to provide ecological viability and integrity of populations, species and ecological communities at a bioregional scale. The concept of adequacy incorporates ecological viability and resilience of ecosystems for individual protected areas and for the protected area system as a whole (National Reserve System Task Group, 2009).

Biodiversity Conservation Priority Areas classify natural areas according to opportunities to improve their formal protection in the City. It should be noted that it is not intended that all vegetation mapped within these areas and outside Crown land will be formally protected or all lands considered for restoration. They should be used to identify areas where any remaining vegetation and other natural areas are of conservation significance and their retention and protection should be a priority when determining future land use planning.

Bushland is land on which there is vegetation which is either a remainder of the natural vegetation of the land or, if altered, is still representative of the structure and floristics of the natural vegetation, and provides the necessary habitat for fauna (Bush Forever, Vol 1 & 2). 'Bushland' falls into the following condition classes: Pristine, Excellent, Very Good and Good (after Keighery 1994).

Comprehensive refers to the degree to which the full range of regional ecosystems recognisable at an appropriate scale within and across each IBRA bioregion is included within protected areas (National Reserve System Task Group, 2009).

Connectivity refers to the degree of connection between natural areas. Effectiveness will vary according to the type and mobility of different species.

Conservation: In relation to biodiversity, conservation is the protection, maintenance, management, sustainable use, restoration and improvement of the natural environment (Australian Government 2010).

Ecological community is a naturally occurring biological assemblage that occurs in a particular type of habitat. The scale at which ecological communities are defined will often depend on the level of detail in the information source, therefore, no particular scale is specified (Environmental Protection Authority 2003). The criteria in this document are based on using vegetation complexes as a means of interpreting ecological communities (except for threatened ecological communities).
Under the Environment Protection and Biodiversity Conservation Act 1999, ecological communities are similarly defined as assemblage of native species that:

- inhabits a particular natural area
- meets the additional criteria specified in the regulations made for the purposes of this definition.

Ecological linkages are non-contiguous natural areas that connect larger natural areas by forming stepping-stones that allow the movement over time of organisms between these larger areas.

Endemic refers to a species having a natural distribution confined to a particular geographical region.

Habitat is the natural environment of an organism or community, including all biotic (living) or abiotic (non-living) elements; a suitable place for an organism or community to live (Environmental Protection Authority 2004). This term can be applied at a range of scales (Environmental Protection Authority 2004). Vegetation can become a reasonable surrogate for outlining habitat when its main components, structure and associated landform are also described (Environmental Protection Authority 2004). Habitat can be occupied by an organism or community continuously, periodically or occasionally or can have once been occupied and still have the potential for organisms of that kind to be reintroduced (Williams et al 2001).

IBRA Bioregion or subregion as determined by the Interim Biogeographic Regionalisation for Australia (IBRA), is a region defined by a combination of biological, social and geographical criteria rather than geopolitical considerations; generally, a system of related, interconnected ecosystems. Region descriptions seek to describe the dominant landscape scale attributes of climate, lithology, geology, landforms and vegetation (Commonwealth of Australia 2010). A subregion is a subdivision of a bioregion which contains distinctive geomorphic units that closely align with land capability and development potential (Commonwealth of Australia 2010).

Local Natural Areas (LNAs) For the purposes of this document are defined as natural areas that exist:

- outside Bush Forever Areas that are reserved as Parks and Recreation in the Metropolitan Region Scheme,
- outside Regional Parks, except lands identified by the City as 'City's LNAs';
- outside lands managed by the Department of Biodiversity, Conservation and Attractions.

Native vegetation is indigenous aquatic or terrestrial vegetation. It does not include vegetation that was intentionally sown, planted or propagated unless that vegetation was sown, planted or propagated as required under the Environmental Protection Act 1986 or another written law; or that vegetation is of a class declared by regulation to be included in this definition. Native vegetation does not include dead vegetation unless that dead vegetation is of a class declared by regulation to be included in this definition. Native vegetation does include non-vascular plants (for example, mosses, fungi, algae) and marine plants (seagrass, macro algae [seaweed]). Native vegetation is more than trees and includes understorey and groundcover plants.

Natural area is used to describe an area that contains native species or communities in a relatively natural state and hence contains biodiversity. Natural areas can be areas of native vegetation, vegetated or open water bodies (lakes, swamps), or waterways (rivers, streams, creeks – often referred to as channel wetlands, estuaries), springs, rock outcrops, bare ground (generally sand or mud), caves, coastal dunes or cliffs (adapted from Environmental Protection Authority 2003). Note that natural areas exclude parkland cleared areas, isolated trees in cleared settings, ovals and turfed areas.
Protection: Areas considered to be protected in perpetuity are those natural areas that are secured for conservation either as

- Public lands vested for conservation purpose (e.g. nature conservation)

- Indigenous Protected Areas
- Private and public lands where the biodiversity values are secure for conservation under planning scheme provisions, or covenanting (Australian Government 2010).

Regionally significant bushland is a component of remnant vegetation that collectively aims to form a comprehensive, adequate and representative system of conservation areas (Environmental Protection Authority 2003). In order for bushland areas to fall into this category, they need to be part of the existing or proposed conservation system or to meet, in part or whole, a range of criteria which are outlined in Appendix 3 of Environmental Protection Authority (2003).

Representativeness: Comprehensiveness considered at a finer scale (IBRA subregion) and recognizes that regional variability within ecosystems is sampled within the reserve system. One way of achieving this is to aim to represent each regional ecosystem within each IBRA sub-region (National Reserve System Task Group, 2009).

Reserves are lands designated under the *Land Administration Act 1987*. They are areas of Crown land reserved for various public purposes, for example, parks, recreation, drainage or a range of public purposes. The reserve is identified by a number, for example, Reserve No. 12345. Reserves may be vested, leased or Crown Granted in Trust. Crown Reserves have varying levels of protection depending on the purpose of the reserve.

Retention is all the processes ensuring natural areas are retained but not necessarily afforded protection to ensure their continued existence and viability (Del Marco *et al.* 2004)

Vegetation complexes (as defined by Heddle, Loneragan & Havel 1980; Mattiske & Havel 1998 and updated by DBCA, 2016). Vegetation complexes are based on the pattern of vegetation at a regional scale as they reflect the underlying key determining factors of landforms, soils and climate. In the area covered by the Perth and Peel Regions, there was a reliance on the underlying landform and soils as defined and mapped by Churchward and McArthur (1980) and a major review of the forest climates by Gentilli (1989).

Viability (as in ecological viability) is the likelihood of long-term survival of a particular ecosystem or species.

2020 KALAMUNDA LOCAL BIODIVERSITY STRATEGY

APPENDICES

July 2020

Prepared for the City of Kalamunda
by Nam Natura Consulting

Document Tracking

Item	Detail
Project Name	Review and update of the City of Kalamunda Local Biodiversity Strategy
Client	City of Kalamunda
Prepared by	Renata Zelinova
Status	Draft
Version Number	1
Last saved on	

APPENDIX A: VEGETATION STATISTICS

Native vegetation mapping - Limitations and their implications on interpretation of the vegetation statistics

Vegetation extent mapping for Western Australia is maintained by the Department of Primary Industry and Regional Development (DPIRD). The mapping is based on aerial photo interpretation (February 2020 capture) at the scale of 1: 20,000.

The limitations of this dataset include the preferential mapping of treed landscapes, leading to mapping of parkland cleared or completely degraded areas as native vegetation, the inclusion of areas that are approved for clearing through relevant approval processes, inclusion of re-vegetation sites that do not represent the original native ecosystems or the vegetation extent mapping can exclude significant vegetation retained in small patches (less than 1 hectare).

This is evident when comparing the State's native vegetation mapping data, with the City's mapping of local natural areas. The City's mapping covers nearly 700 hectares, and in this document, it is referred to as City's LNAs.

The following criteria were used to define the City's LNA:

1. A desktop assessment was undertaken by using the Fire Hazard Inspection areas (GIS layer FHI) as surrogates for Local Natural Areas (LNA's) as a starting point.
2. Discussion around what constitutes an LNA was undertaken with Manager Environment, Consultant and Environmental team staff.
3. LNA definition in Local Biodiversity Strategy referred to.
4. Definition: *A local natural area is any physical area containing endemic species or ecological communities in a relatively natural state and can therefore be described as having high biodiversity values. However, waterways and areas of remnant vegetation that offer values for sustaining biodiversity through ecological linking or buffering against threats are also included. Private property is currently not considered in the process as it is not under the direct control of LG. Road reserves are managed as road reserves and not LNA's. However, road reserves are mapped and classified according to roadside conservation committee protocols and can act as corridors and buffers.*
5. Consultant redefined LNA's based on above parameters using aerial photography, knowledge of sites, discussion with City Officers and some initial site visits. Many Fire Hazard Inspection areas were determined to be highly modified parkland and not considered to be LNA's.
6. Further discussion was undertaken with City Officers and consideration of current planning processes, future plans, revegetation programs, potential future offset sites etc was taken into consideration in the final delineation of LNA's.

7. Many man made drainage basins were marked as LNA's due to their environmental value as water sources for wildlife, the ability for the Environment team to have an impact on the environmental amenity of these areas through planting programs, the proximity to other natural areas and the fact that these site will never be managed as anything but a drainage reserve (i.e. will not be made into parkland or "cleared").

The City mapped LNAs (April 2020) overlap with the State's native vegetation mapping in some areas but also identify native vegetation not captured by the State mapping, adding about 109 hectares of native vegetation to the total area of native vegetation remaining in the City (Table A-2).

The City's LNA mapping includes information on vegetation condition, identifying completely degraded areas within the State's native vegetation mapping. Figure 1 shows an example where the State's vegetation extent mapping overlaps with the City's LNA mapping which identifies significant areas as completely degraded.

FIGURE 1: AN EXAMPLE OF CITY'S LNA OVERLAPPING WITH NATIVE VEGETATION MAPPING USED AS SURROGATE IN LOCAL BIODIVERSITY CONSERVATION PLANNING.

Of the City LNAs, 58% is mapped as having vegetation in good of better condition (Table A-3).

Therefore, the statistics on native vegetation retention are considered an over-estimate of the native vegetation remaining on the ground. To allow for these data limitations, assessments of the local or regional vegetation retention and protection status against the accepted thresholds of 10%, 30% or 15% of their pre-European extent, the actual figures of 15%, 40% and 20% are used (Del Marco et al 2004). For example, even though the figures show that just over 11% of pre-European extent of

Forrestfield and Guildford vegetation complexes remain in the City (Table A-1), it can be assumed that less than 10% remain on-ground.

TABLE A-1: COMPARISON OF VEGETATION EXTENT DATA IN THE CITY OF KALAMUNDA BETWEEN 2007 AND 2020.

Vegetation Complex	Pre-European (ha)	Total Remnant (ha)	Local Retention (%)	Pre-European (ha)	Current Extent (ha)	Local Retention (%)
	2007 Status as published in the 2008 Local Biodiversity Strategy			2020 Status based on DPIRD 2020 data and DBCA (2016)*		
Swan Coastal Plain						
Forrestfield	1925	219	11.4	1924.4	220.7	11.5
Guildford	91	22.7	25.3	77.5	8.5	11.2
Southern River	2319	262	11.3	2317.0	230.3	9.9
Swan	33	32.6	98.8	2.0	1.7	84.6
Darling Scarp						
Darling Scarp	1420	980	69	1462.3	1002.2	68.5
Darling Plateau						
Cooke	274	274	100	274.3	274.2	100.0
Dwellingup 2	13407	11279	84.1	13410.2	10983.8	81.9
Helena 1	407	384	94.3	407.3	382.4	93.9
Helena 2	1879	1604	85.3	1887.5	1561.9	82.7
Murray 1	1997	1664	83.3	1997.2	1636.9	82.0
Murray 2	3578	3416	95.5	3591.1	3368.1	93.8
Swamp	56	56	100	56.0	56.0	100.0
Yarragil 1	4479	3395	75.8	4478.8	3229.8	72.1
Yarragil 2	489	489	100	489.0	486.3	99.4
Total:	32,354	24,077.3	74.4	32,374.6	23,443	72.4

*DPIRD 2020: Native vegetation extent (DPIRD-005) at data.wa.gov.au
DBCA 2016: Vegetation complexes -Swan Coastal Plain (DBCA-046) and Vegetation Complexes – South West Forest Region of WA (DBCA-047) at data.wa.gov.au

Note: Since 2007, two changes occurred that affect the vegetation statistics calculations:

- In 2010, the vegetation extend mapping methodology was modified, resulting in better data;
- In 2016, the vegetation complexes mapping for the Swan Coastal Plan and Jarrah Forest was amended to address the issue of two overlapping datasets:
    - Swan Coastal Plain Vegetation Complexes as updated by Webb et al (2016) – an updated mapping of the comprehensive coverage of the pre-European distribution of vegetation complexes considering the characteristic combinations of landforms, soils and rainfall along the Swan Coastal Plain south of Lancelin. The original mapping was prepared at the scale 1:250,000 by Heddle et al (1980) and the key changes to the original dataset within the City of Kalamunda include the consolidation of vegetation complex boundaries along the Darling Scarp interface.

    - Mapping of vegetation complexes in the South West forest region of Western Australia as updated by Webb et al (2016) – an updated version of the pre-European

distribution of vegetation complexes based on the 1:50,000 scale mapping undertaken by Mattiske & Havel (1998 & 2000). The key changes to the original dataset within the City of Kalamunda include the removal of overlaps with the Swan Coastal Plain vegetation complex mapping and introduction of a single scale mapping to landform boundaries within portions of the Darling Scarp.

Due to the 2016 updates of the pre-European vegetation complex mapping, several changes were made to the vegetation complex distribution in the City of Kalamunda. The most affected vegetation complexes are Swan complex for which the representation in the City was reduced from 33ha to 2ha mapped as originally occurring in the City, followed by Guildford vegetation complex, which was reduced from 91 ha to 77.5ha. The pre-European extent increased for Darling Scarp, Murray 2 and Helena 2 vegetation complexes (Table A-1).

TABLE A-2: ADDITIONAL VEGETATION MAPPED BY THE CITY OF KALAMUNDA (2020)

Vegetation complexes	2020 vegetation extent (DPIRD) with the City mapped LNAs* (Ha)	2020 vegetation extent (DPIRD) (Ha)	Additional vegetation mapped by the City as LNA (ha)
Forrestfield Complex	239.59	220.68	18.90
Guildford Complex	8.69	8.69	
Southern River Complex	263.06	230.33	32.73
Swan Complex	1.67	1.67	
Cooke, Ce	274.19	274.19	
Darling Scarp, DS2	1,005.96	1,002.23	3.73
Dwellingup, D2	11,032.29	10,983.75	48.54
Helena 1, He1	382.43	382.43	
Helena 2, He2	1,562.25	1,561.94	0.31
Murray 1, My1	1,636.58	1,636.88	
Murray 2, My2	3,368.11	3,368.11	
Swamp, S	55.95	55.95	
Yarragil 1, Yg1	3,234.89	3,229.84	5.05
Yarragil 2, Yg2	486.27	486.27	
Total	**23,551.92**	**23,442.95**	**108.97**

*City's LNAs mapped as Completely Degraded were not included in the total mapped vegetation.

TABLE A-3: VEGETATION CONDITION IN CITY MAPPED LNAS (CITY OF KALAMUNDA, 2020)

Excellent	Very Good	Good	Degraded	Completely Degraded	Total (698ha)
17%	24%	17%	16%	26%	100%

TABLE A-4: REGIONAL REPRESENTATION OF VEGETATION COMPLEXES OCCURRING THE CITY OF KALAMUNDA (DBCA, 2019).

Vegetation Complex	Pre-European extent in bioregion (ha)	2018 Extent in bioregion (ha)	Retention (% of pre-European extent)	Protection# (% of pre-European extent)
Swan Coastal Plain				
Forrestfield	22,812.92	2,803.36	12.29	1.58
Guildford	90,513.13	4,607.91	5.09	0.33
Southern River	58,781.48	10,832.18	18.43	1.37
Swan	15,194.13	2,062.03	13.57	0.82
Jarrah Forest				
Darling Scarp	32,448.29	13,586.40	41.87	7.67
Cooke	36,779.33	30,304.20	82.39	18.65
Dwellingup 2	86,128.33	71,055.96	82.50	19.31
Helena 1	15,889.99	12,010.31	75.58	29.97
Helena 2	16,339.34	12,984.83	79.47	30.12
Murray 1	68,695.18	52,296.01	76.13	25.66
Murray 2	59,317.10	40,952.07	69.04	15.89
Swamp	53,658.24	40,612.97	75.69	21.78
Yarragil 1	80,202.95	64,927.06	80.95	9.87
Yarragil 2	50,259.16	46,475.31	92.47	10.58

#Note: Protection consistent with the EPA definition of lands secure for conservation is National Parks, Nature Reserves, Conservation Parks and any other crown reserve that have "Conservation" as part of the reserve purpose. DBCA, 2019

LEGEND:

<10 % remaining in the bioregion
<30% remains and <10% protected in the bioregion
At risk of being reduced to <30% retention and <15% protected in the bioregion
<15% protected in the bioregion

TABLE A-5: 2020 NATIVE VEGETATION EXTENT* BY VEGETATION COMPLEXES AND METROPOLITAN REGION SCHEME LAND USE CATEGORIES IN THE CITY OF KALAMUNDA (IN HECTARES)

	Parks and recreation	Waterways	State forests	Public purposes - Commnwlth Government	Public purposes - high school	Public purposes - special uses	Public purposes - State Energy Commission	Other regional roads	Primary regional roads	Railways	Rural	Industrial	Urban	Total
Cooke, Ce	177.14		97.05											274.19
Darling Scarp, DS2	951.27							4.81			20.37		29.52	996.60
Dwellingup, D2	4505.64		5864.85		3.42		0.02	1.30			573.87		83.19	10947.22
Forrestfield Complex	74.99							0.87	3.61		115.37		44.74	209.26
Guildford Complex	7.91								0.27		0.32	0.19		8.47
Helena 1, He1	364.08										18.35			382.95
Helena 2, He2	1193.53		93.16								274.91		0.65	1550.19
Murray 1, My1	1090.02	0.77	384.16								161.54		0.09	1637.05
Murray 2, My2	1113.44		2242.85								11.82			3344.93
Southern River Complex	169.91			14.12		0.05	0.04	0.00	16.60	0.24	15.98	4.77	41.37	224.15
Swamp, S			20.52								35.43			55.95
Swan Complex	1.56										0.11			1.67
Yarragil 1, Yg1	1320.77		1711.67					0.88			181.17		20.41	3225.04
Yarragil 2, Yg2			384.36								101.91			486.27
Total	10970.26	**0.77**	10798.62	**14.12**	**3.42**	**0.05**	**0.06**	7.86	20.48	**0.41**	1511.13	**4.96**	219.96	**23343.92**
Total in 2007	3934.65	11.38	17967.01	16.48	4.05	0.04	0.12	7.62	29.84	0.40	1895.42	3.76	206.83	24081.10

*Based on DPIRD, 2020 vegetation extent mapping only. Does not include the additional vegetation mapped by the City.

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TABLE A-6: 2018 NATIVE VEGETATION EXTENT* BY VEGETATION COMPLEXES AND 2019 LOCAL PLANNING SCHEME LAND USE CATEGORIES (IN HECTARES).
Note: Lands reserved in the MRS are not classified further in the local planning scheme, so the total area of vegetation shown in this table is less than the total vegetation remaining in the City.

	Swan Coastal Plain				Jarrah Forest									
	Forrestfield Complex	Guildford Complex	Southern River Complex	Swan Complex	Darling Scarp DS2	DwellingupD2	Helena 1, He1	Helena 2, He2	Murray 1, My1	Murray 2, My2	Swamp, S	Yarragil Yg1	Yarragil Yg2	Total
General industry			1.10			0.41								1.50
Industrial development			0.04											0.04
Light industry			1.12											1.12
Mixed use			0.18		0.02									0.18
No zone			0.23			0.05						0.26		0.56
Special use	3.77													3.77
Other local roads				0.11	2.18									2.29
Private clubs and institutions	2.06				0.24	1.02						0.00		3.32
Public purposes			5.79			10.38						0.09		16.27
Rural agriculture						72.00	1.76	57.98	76.22	0.09		81.32		**289.39**
Rural composite	0.05		0.64											0.69
Rural conservation	0.25				0.19	287.31	16.78	132.48	66.25	9.25	35.41	55.37	101.90	**705.19**
Rural landscape interest						118.08		74.45	1.63	2.46		26.55		**223.18**
Special rural	91.86	0.32	12.69		16.11	46.28		0.82	9.40			5.88		183.37
Residential	4.04		0.05		14.95	23.28		0.07				13.17		55.55
Residential bushland						6.98			0.09			0.93		7.99
Urban development	9.65		11.65		0.44	0.31								**22.05**
Local open space	19.33		13.04		25.25	25.25		0.11				3.84		**64.65**
Total	131.01	0.32	46.53	0.11	37.21	591.34	18.55	265.91	153.59	12.31	35.41	187.42	101.90	1581.60

*Based on DPIRD, 2020 vegetation extent mapping only. Does not include the additional vegetation mapped by the City.

APPENDIX B: VEGETATION COMPLEX DESCRIPTIONS

VEGETATION COMPLEX DESCRIPTIONS

Abbreviations: E. = Eucalyptus; M. = Melaleuca; B. = Banksia; A. = Allocasuarina; C. = Casuarina; spp. = species

Swan Coastal Plain (Heddle, E.M., Loneragan, O.W. and Havel, J.J., 1980		
Ridge Hill Shelf	Forrestfield	Vegetation ranges from open forest of *E. calophylla-E. wandoo-E. marginata* to open forest of *E. marginata - E. calophylla – A. fraseriana – Banksia spp*. Fringing woodland of *E. rudis* in the gullies that dissect this landform.
Fluviatile deposits	Guildford	A mixture of open forest to tall open forest of *E. calophylla – E. wandoo – E. marginata* and woodland of *E. wandoo* (with rare occurrences of *E. lane-poolei*). Minor components include *E. rudis – M. rhaphiophylla*.
	Swan	Fringing woodland of *E. rudis-M. rhaphiophylla* with localised occurrence of low open forest of *C. obesa and M. cuticularis.*
Aeolian deposits	Southern River	Open woodland of *C. calophylla – E. marginata – Banksia spp*. with fringing woodland of *E. rudis – M. rhaphiophylla* along creek beds.
Jarrah Forest (Mattiske and Havel, 2000)		
Darling Plateau - Uplands	Darling Scarp	Mosaic of open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla*, with some admixtures with *Eucalyptus laeliae* in the north (subhumid zone), with occasional *Eucalyptus marginata* subsp. *elegantella* (mainly in subhumid zone) and *Corymbia haematoxylon* in the south (humid zone) on deeper soils adjacent to outcrops, woodland of *Eucalyptus wandoo* (subhumid and semiarid zones), low woodland of *Allocasuarina huegeliana* on shallow soils over granite outcrops, closed heath of Myrtaceae-Proteaceae species and lithic complex on or near granite outcrops in all climate zones.
	Cooke	Mosaic of open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla* (subhumid zone) and open forest of *Eucalyptus marginata* subsp. *thalassica-Corymbia calophylla* (semiarid and arid zones) and on deeper soils adjacent to outcrops, closed heath of Myrtaceae-Proteaceae species and lithic complex on granite rocks and associated soils in all climate zones, with some *Eucalyptus laeliae* (semiarid), and *Allocasuarina huegeliana* and *Eucalyptus wandoo* (mainly semiarid to perarid zones).
	Dwellingup 2	Open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla* on lateritic uplands in subhumid and semiarid zones.
Darling Plateau - Valleys	Helena 1	Mosaic of open forest of *Corymbia calophylla-Eucalyptus patens-Eucalyptus marginata* subsp. *marginata* with some *Eucalyptus rudis* on the deeper soils ranging to closed heath and lithic complex on shallow soils associated with granite on steep slopes of valleys in humid and subhumid zones.
	Helena 2	Mosaic of open forest of *Eucalyptus marginata* subsp. *thalassica-Corymbia calophylla* and woodland of *Eucalyptus wandoo* with some *Eucalyptus accedens* and *Eucalyptus rudis* on the deeper soils ranging to closed heaths and lithic complex

		on shallow soils associated with granite on steep slopes of valleys in semiarid and arid zones.
	Murray 1	Open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla-Eucalyptus patens* on valley slopes to woodland of *fs24 Eucalyptus rudis-Melaleuca rhaphiophylla* on the valley floors in humid and subhumid zones.
	Murray 2	Open forest of *Eucalyptus marginata* subsp. *thalassica-Corymbia calophylla-Eucalyptus patens* and woodland of *Eucalyptus wandoo* with some *Eucalyptus accedens* on valley slopes to woodland of *Eucalyptus rudis-Melaleuca rhaphiophylla* on the valley floors in semiarid and arid zones.
	Yarragil 1	Open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla* on slopes with mixtures of *Eucalyptus patens* and *Eucalyptus megacarpa* on the valley floors in humid and subhumid zones.
	Yarragil 2	Open forest of *Eucalyptus marginata* subsp. *thalassica-Corymbia calophylla* on slopes, woodland of *Eucalyptus patens-Eucalyptus rudis* with *Hakea prostrata* and *Melaleuca viminea* on valley floors in subhumid and semiarid zones.
Darling Plateau – Depressions and Swamps on Uplands	Swamp	Mosaic of low open woodland of *Melaleuca preissiana-Banksia littoralis,* closed scrub of Myrtaceae spp., closed heath of Myrtaceae spp. and sedge lands of *Baumea* and *Leptocarpus* spp. on seasonally wet or moist sand, peat and clay soils on valley floors in all climatic zones.

APPENDIX C: MAPS

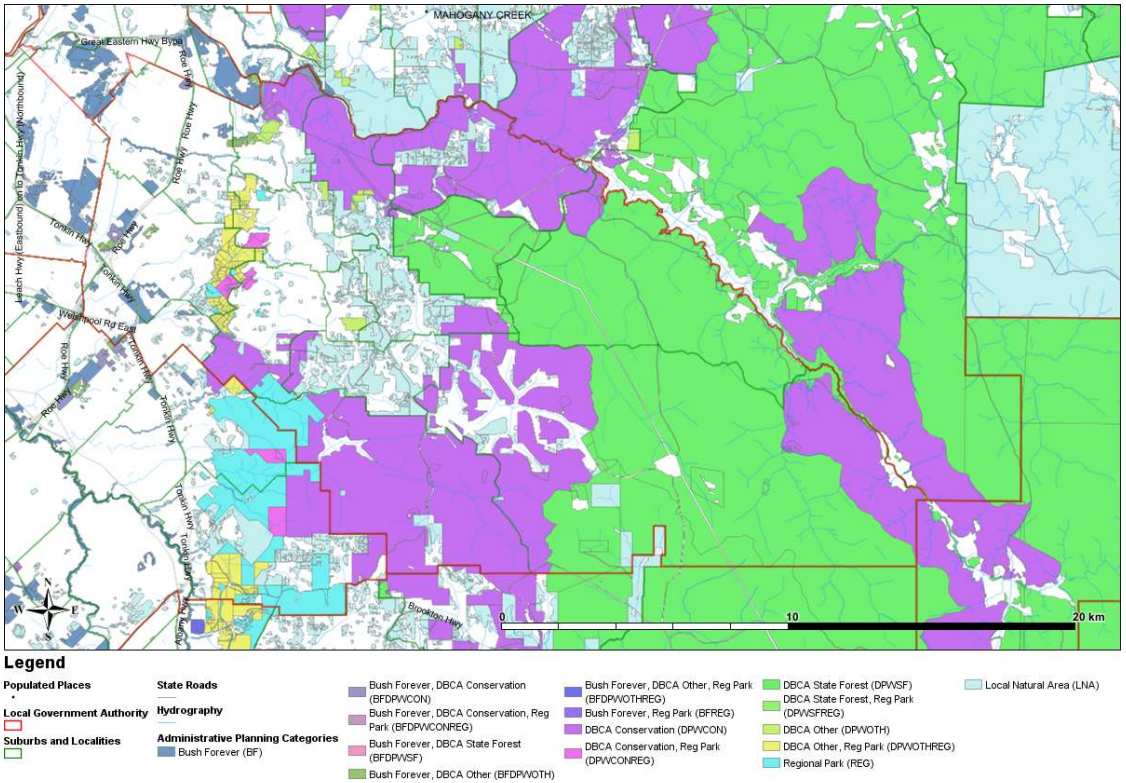

FIGURE 1: 2020 NATIVE VEGETATION EXTENT BY ADMINISTRATIVE PLANNING CATEGORIES.

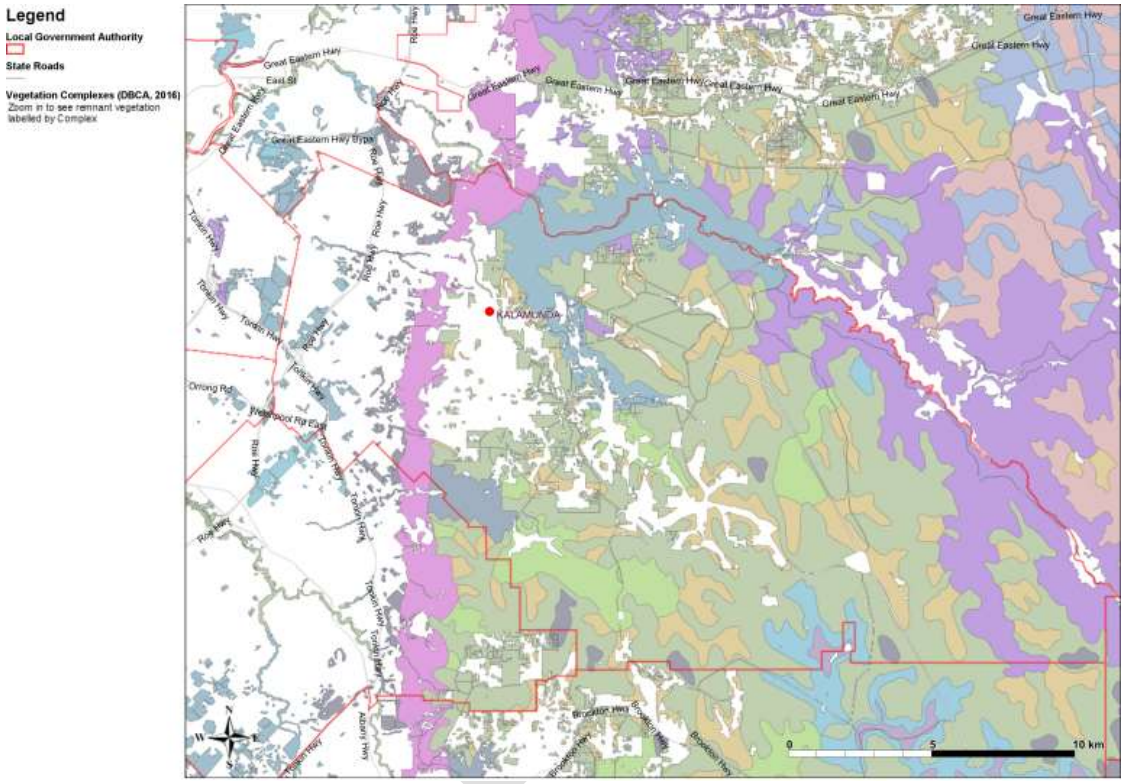

FIGURE 2: 2020 NATIVE VEGETATION EXTENT (DPIRD, 2020) BY VEGETATION COMPLEXES (DBCA, 2016).

2

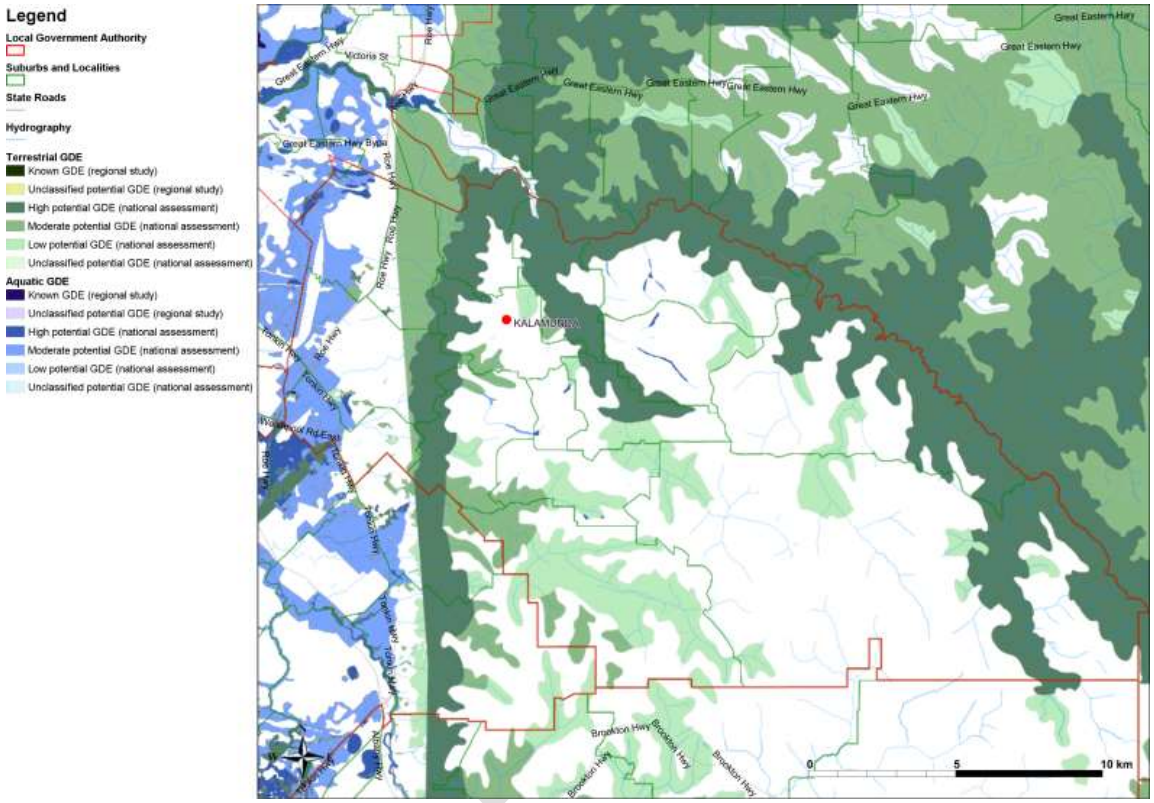

FIGURE 3: GROUNDWATER DEPENDENT ECOSYSTEMS (BUREAU OF METEOROLOGY, 2017)

3

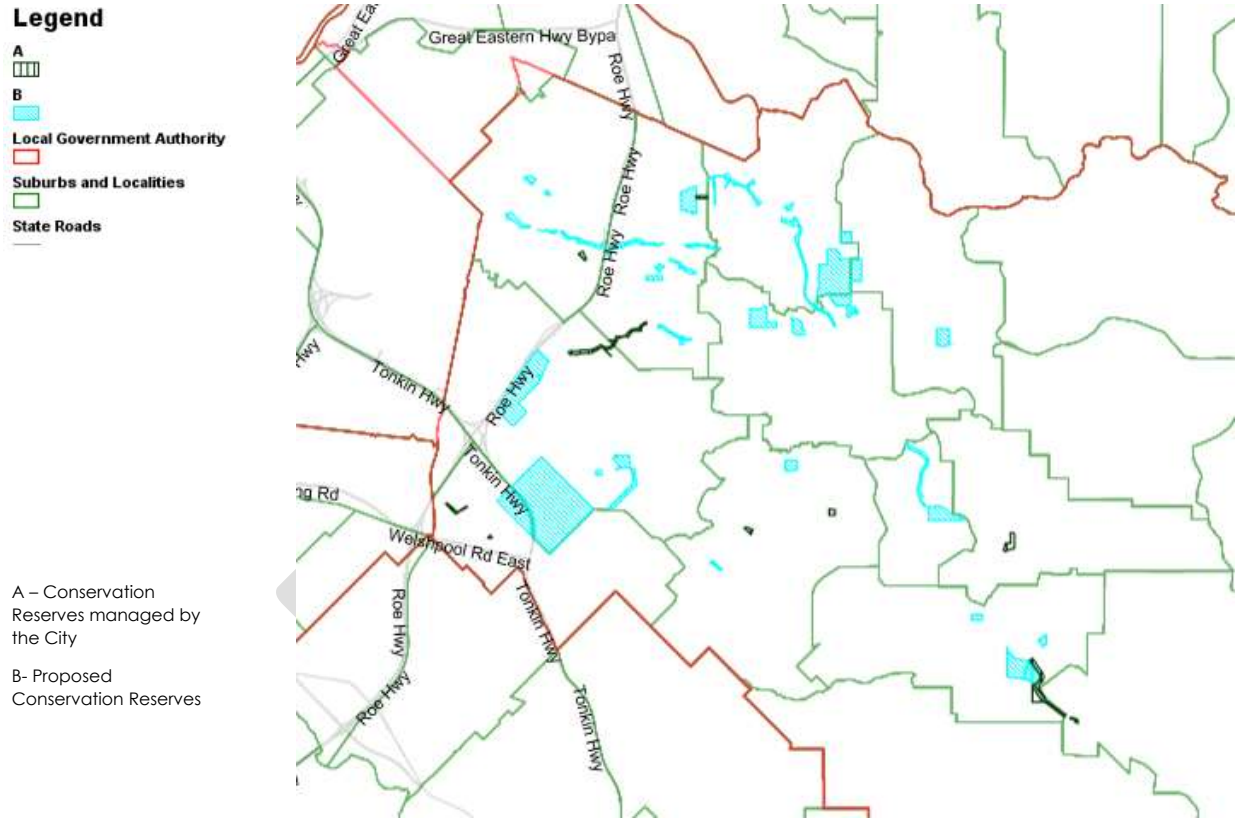

FIGURE 4: BIODIVERSITY CONSERVATION PRIORITY CATEGORIES A & B.

4

TABLE C-1: CITY MANAGED CONSERVATION RESERVES.

RESERVE NO	Current Purpose	Dwellingup, D2	Forrestfield Complex	Murray 1, My1	Southern River Complex	Yarragil 1, Yg1	Total area of vegetation mapped (ha)	TEC	Threatened or Priority Flora	LNA ID	Viability Score
R 27801	RECREATION AND CONSERVATION	6.97				3.09	10.06		Y	LNA-00039, LNA00191, LNA-00171	15.71, 17.67, 8.65
R 27817	NATURAL FLORA	0.96					0.96			LNA-00105	9.88
R 30898	CONSERVATION	1.74		2.03			3.78			LNA-00100	13.12
R 50763	CONSERVATION		1.04				1.04	Y	Y	LNA-00025	14.51
R 37650	Public Recreation, Conservation, Drainage		1.81		3.28		5.09	Y		LNA-00189 & LNA-00188	6.11-9.55
R 52090	Public Recreation & Conservation				0.08		0.08	Y		LNA-00083	8.04
R 48693	Public Recreation & Conservation				0.53					LNA-00081	6.82
R49122	Conservation Protection	0.96					0.96	Y	Y	LNA-00129	13.96
R 50011	Public Recreation & Conservation	0.87					0.87		Y	LNA-00091	12.06
Total		11.5	2.8	2.0	3.9	3.1	22.84				

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TABLE C-2: PROPOSED CONSERVATION RESERVES; RESERVES WITH MANAGEMENT RESPONSIBILITY VESTED IN THE CITY OF KALAMUNDA AND PROPOSED TO HAVE THEIR VESTING PURPOSE TO RECLASSIFIED TO INCLUDE CONSERVATION (UNDER THE PROVISIONS OF THE *LAND ADMINISTRATION ACT 1997*).

Reserve No	LNA ID	Prioritisation score	LNA Viability Score#	Forrestfield	Southern River	Darling Scarp 2	Dwellingup 2	Yarragil 1	Helena 2	Total vegetation (ha)	TEC	Threatened or Priority Flora	Threatened or Priority Fauna	Comments
R 14088	LNA-00129	38.5	13.96*	11.90						11.90	TEC	Y		2008 mapping indicates high confidence infection by dieback
R 15470	LNA-00122	9	14.48				2.07			2.07				
R 16922	LNA-00049	19	17.37*				4.67	1.09	2.19	7.95	PEC			
R 17098	LNA-00084	36	9.98-18.61		124.82					124.82	TEC	3 species	Y	2008 mapping indicates high confidence infection by dieback
R 17343	LNA-00026	14.5	17.54						7.60	7.60				
R 17358	LNA-00123	4	14.95					1.91		1.91				
R 22502	LNA-00031	36	12.21	2.43						2.43	TEC	2 species	Y	No FCT listed in NAIA
R 23040	LNA-00047	17.5	14.68				4.04			4.04			Y	
R 23383	LNA-00069	9.5	10.51				2.59	0.63		3.22				2008 mapping indicates high confidence infection by dieback
R 24130	LNA-00053	14.5	10.15				0.29	2.09		2.37		Y		
R 24948	LNA-00112	18	13.55			0.66				0.66				
R 25393	LNA-00112	18	13.55			0.16				0.16				
R 27154	LNA-00049	18	17.37*				44.91	0.57		45.48		Y	Y	
R 27566	LNA-00085	32	7.97	0.86						0.86	TEC	Y		
R 27792	LNA-00204 & LNA-00037	36.5	9.84 & 8.00	0.21						0.21	TEC			

Reserve No	LNA ID	Prioritisation score	LNA Viability Score#	Forrestfield	Southern River	Darling Scarp 2	Dwellingup 2	Yarragil 1	Helena 2	Total vegetation (ha)	TEC	Threatened or Priority Flora	Threatened or Priority Fauna	Comments
R 27799	LNA-00045, LNA-00212 & LNA-00017	21.5	6.61-19.36, 15.50 & 18.27			0.58	6.87			7.45			Y	
R 27800	LNA-00062	8	9.83				6.56			6.56				2008 mapping indicates high confidence infection by dieback
R 28735	LNA-00018 & LNA-00017	25	14.69 & 18.37			1.99				1.99			Y	
R 30924	LNA-00191	5.5	17.14				11.49			11.49				2008 mapping indicates high confidence infection by dieback
R 31954	LNA-00030	33.5	11.57	1.06						1.06	TEC?			No FCT listed in NAIA
R 32230	LNA-00034	36	11.59	0.42						0.42	TEC	Y		
R 32613	LNA-00029 & LNA-00033	33	10.15 & 11.37	2.65						2.65	TEC			
R 33433	LNA-00034	36	11.59	0.95						0.95	TEC			
R 34364	LNA-00064	28	11.98	4.00						4.00	TEC			2008 mapping indicates high confidence infection by dieback
R 34600	LNA-00064	29.5	9.67	5.80						5.80	TEC			
R 35209	LNA-00034	32	11.21	0.90						0.90	TEC			
R 35412	LNA-00052	22	13.32			1.28	4.07			5.35			Y	

Reserve No	LNA ID	Prioritisation score	LNA Viability Score#	Forrestfield	Southern River	Darling Scarp 2	Dwellingup 2	Yarragil 1	Helena 2	Total vegetation (ha)	TEC	Threatened or Priority Flora	Threatened or Priority Fauna	Comments
R 36492	LNA-00127, LNA-00021 & LNA-00022	40.5	10.68, 10.94 & 11.80	2.16	3.04					5.20	TEC		Y	
R 37218	LNA-00050	32.5	5.73	2.78						2.78	TEC	Y		
R 37219	LNA-00013, LNA-00014 & LNA-00015	35		5.14		0.66				5.80	TEC			
R 38489	LNA-00129	35	13.96*	0.25						0.25	TEC			
R 39218	LNA-00010	23	9.78		2.12					2.12	TEC			2008 mapping indicates high confidence infection by dieback
R 40228	LNA-00011	33	12.11		3.55					3.55	TEC	Y		
R 40947	LNA-00034	32	11.21	0.11						0.11	TEC			
R 41156	LNA-00190 & LNA-00195	29.5	17.27 & 9.87		29.60					29.60	TEC	Y	Y	
R41731	LNA-00138	15.5?	8.14		0.26						TEC	Y		
R 45989	LNA-00023	29.5	11.28	1.62						1.62	TEC			
R 48084	LNA-00024 & LNA-00037	29.5	10.82 & 9.85	1.95						1.95	TEC			
R 9093	LNA-00051	24	17.10			4.90	8.33			13.23			Y	2008 mapping indicates high confidence infection by dieback

Reserve No	LNA ID	Prioritisation score	LNA Viability Score#	Forrestfield	Southern River	Darling Scarp 2	Dwellingup 2	Yarragil 1	Helena 2	Total vegetation (ha)	TEC	Threatened or Priority Flora	Threatened or Priority Fauna	Comments
R 9311	LNA-00124	10.5	23.10				7.74	9.93		17.67				2008 mapping indicates high confidence infection by dieback
Total				45.17	163.40	10.23	103.63	16.23	9.79	348.44				

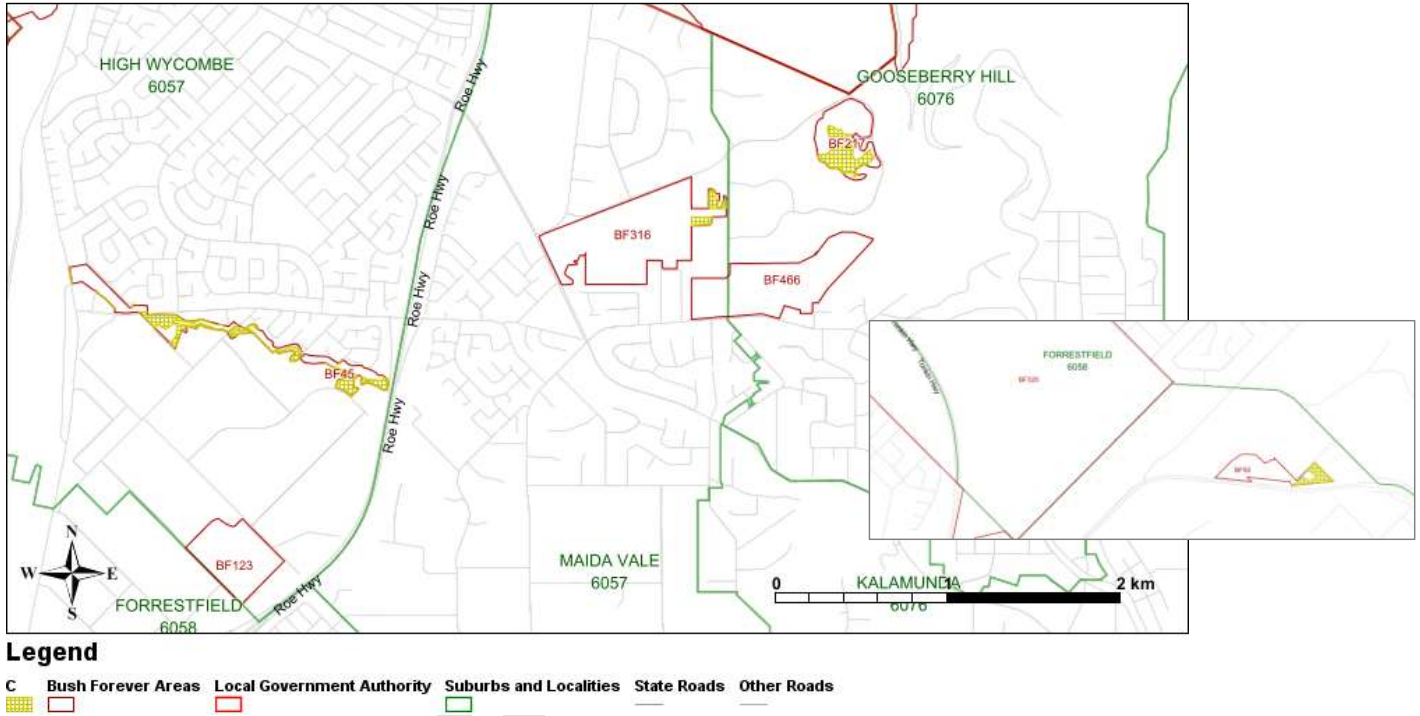

FIGURE 5: BIODIVERSITY CONSERVATION PRIORITY CATEGORY C – BUSH FOREVER AREAS OUTSIDE STATE MANAGED LANDS AND NOT RESERVED AS PARKS &RECREATION IN THE METROPOLITAN REGION SCHEME.

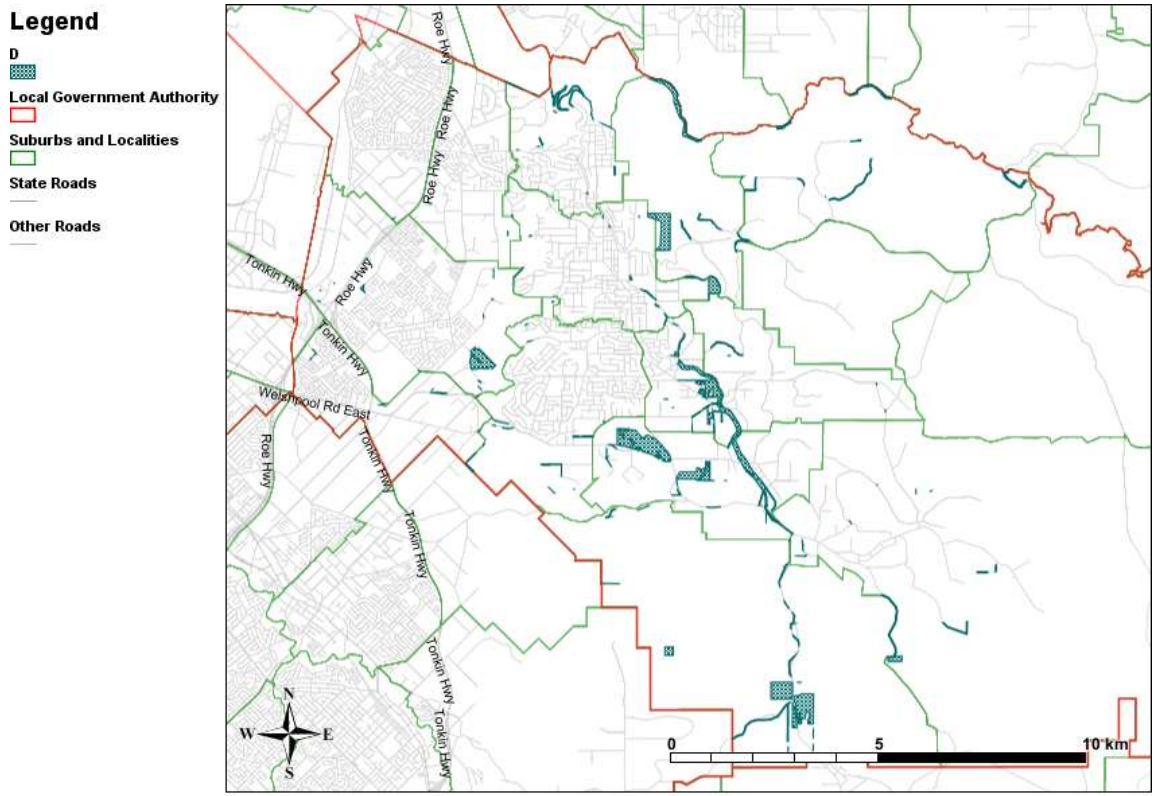

FIGURE 6: BIODIVERSITY CONSERVATION PRIORITY CATEGORY D - LOCAL NATURAL AREAS RESERVED IN MRS FOR PARKS & RECREATION BUT NOT ON CROWN LAND

11

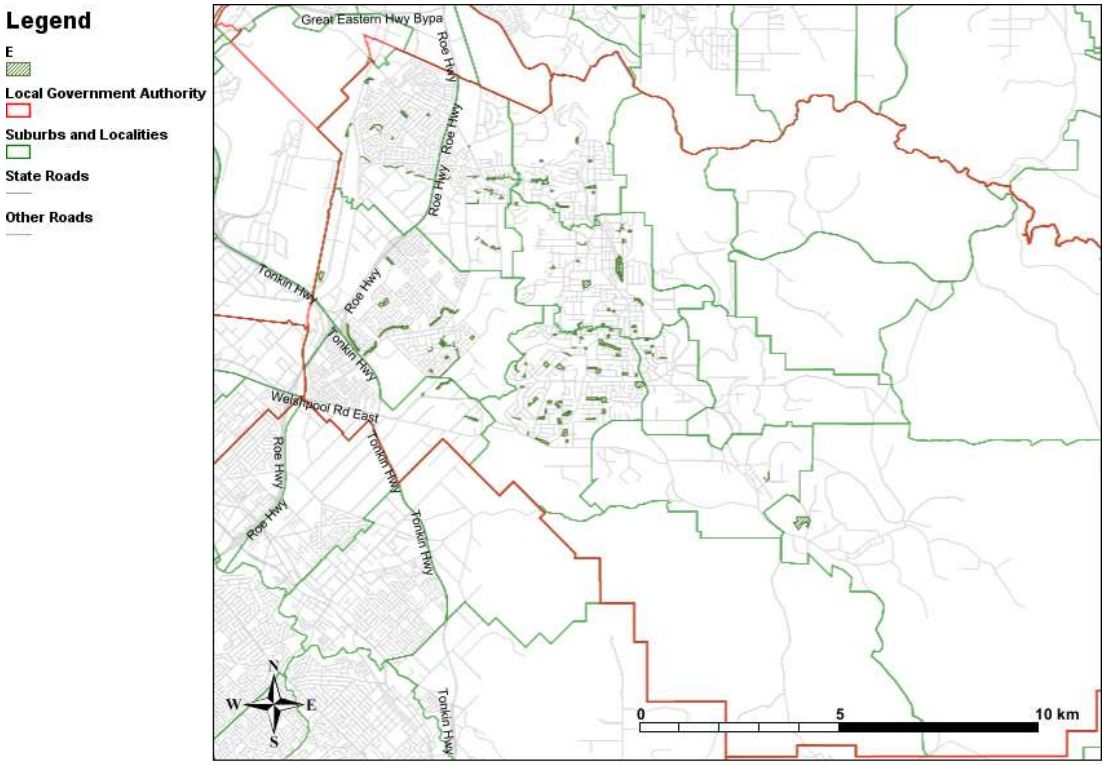

FIGURE 7: BIODIVERSITY CONSERVATION PRIORITY CATEGORY E - LOCAL NATURAL AREA IN LOCAL OPEN SPACE AND ON CROWN LAND (EXCEPT THOSE IN CATEGORY A AND B)

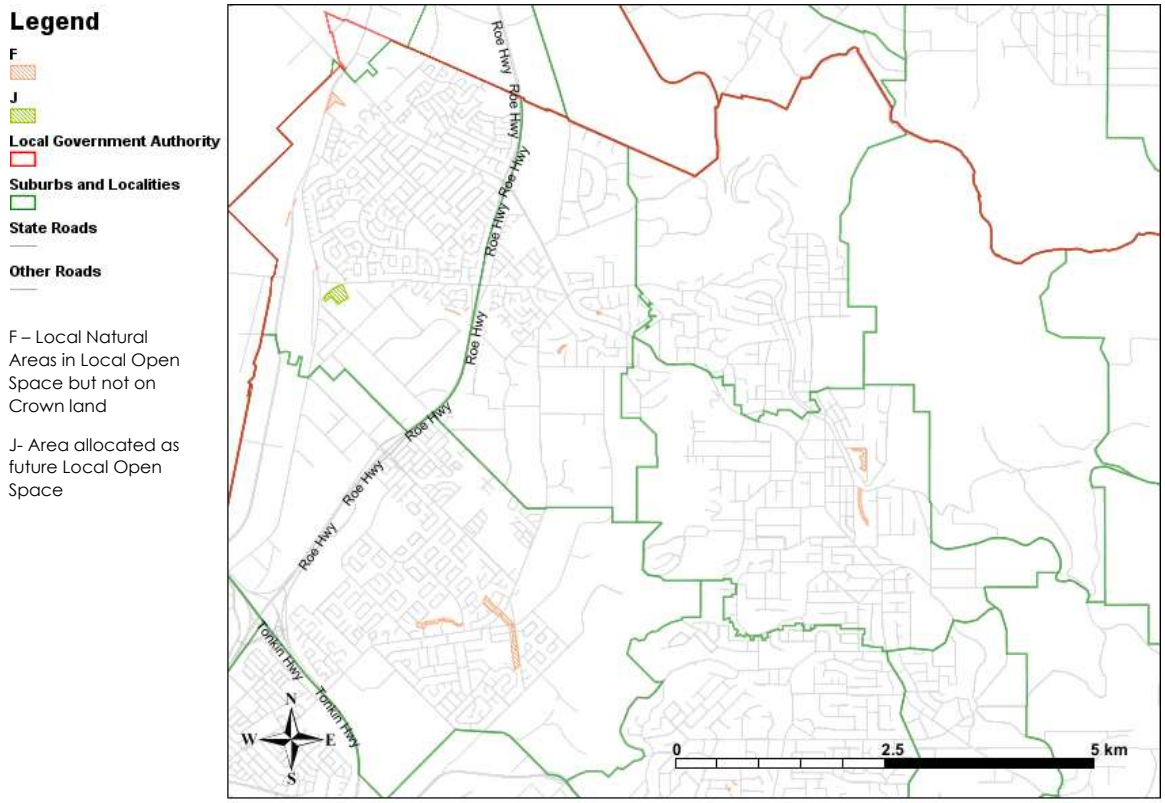

FIGURE 8: BIODIVERSITY CONSERVATION PRIORITY CATEGORY F & J

13

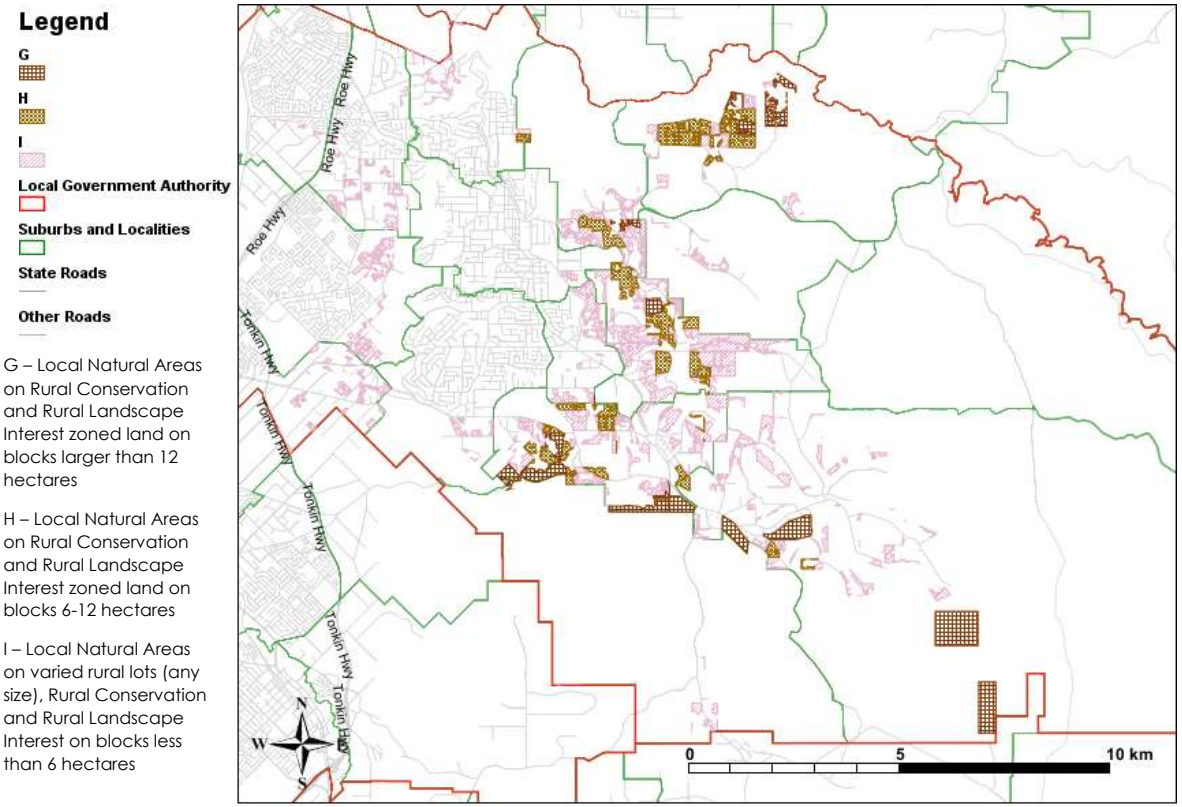

FIGURE 9: BIODIVERSITY CONSERVATION PRIORITY G, H & I

14

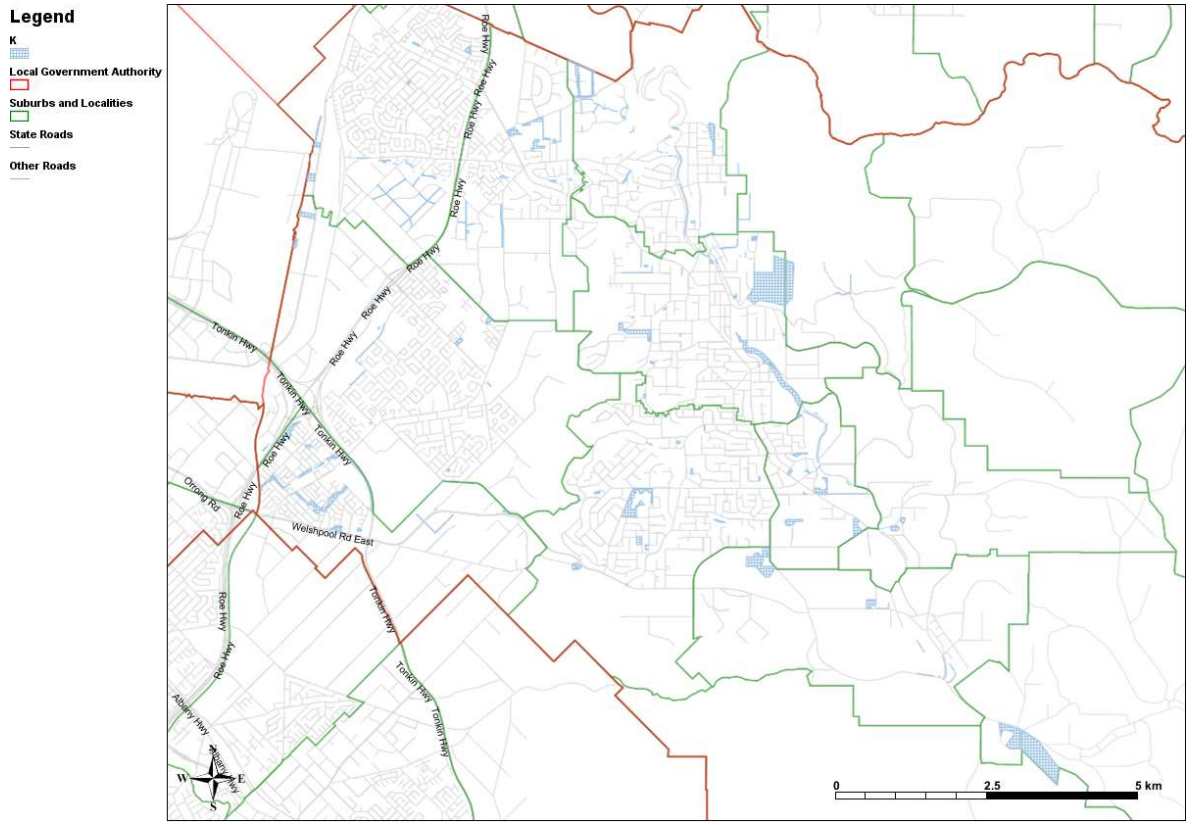

FIGURE 10: BIODIVERSITY CONSERVATION PRIORITY K: LOCAL NATURAL AREAS IN ALL OTHER CITY VESTED CROWN RESERVES AND NOT IN BCP A, B, E.

15

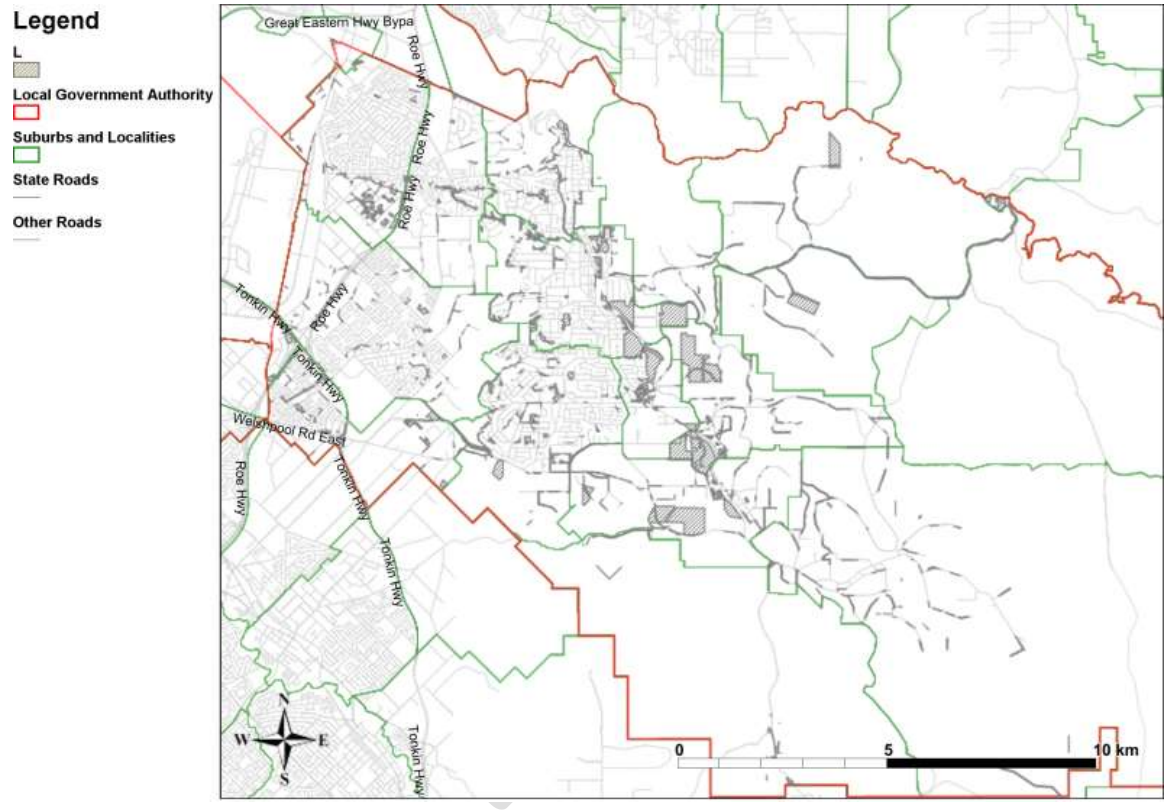

FIGURE 11: BIODIVERSITY CONSERVATION PRIORITY L: ALL OTHER LOCAL NATURAL AREAS

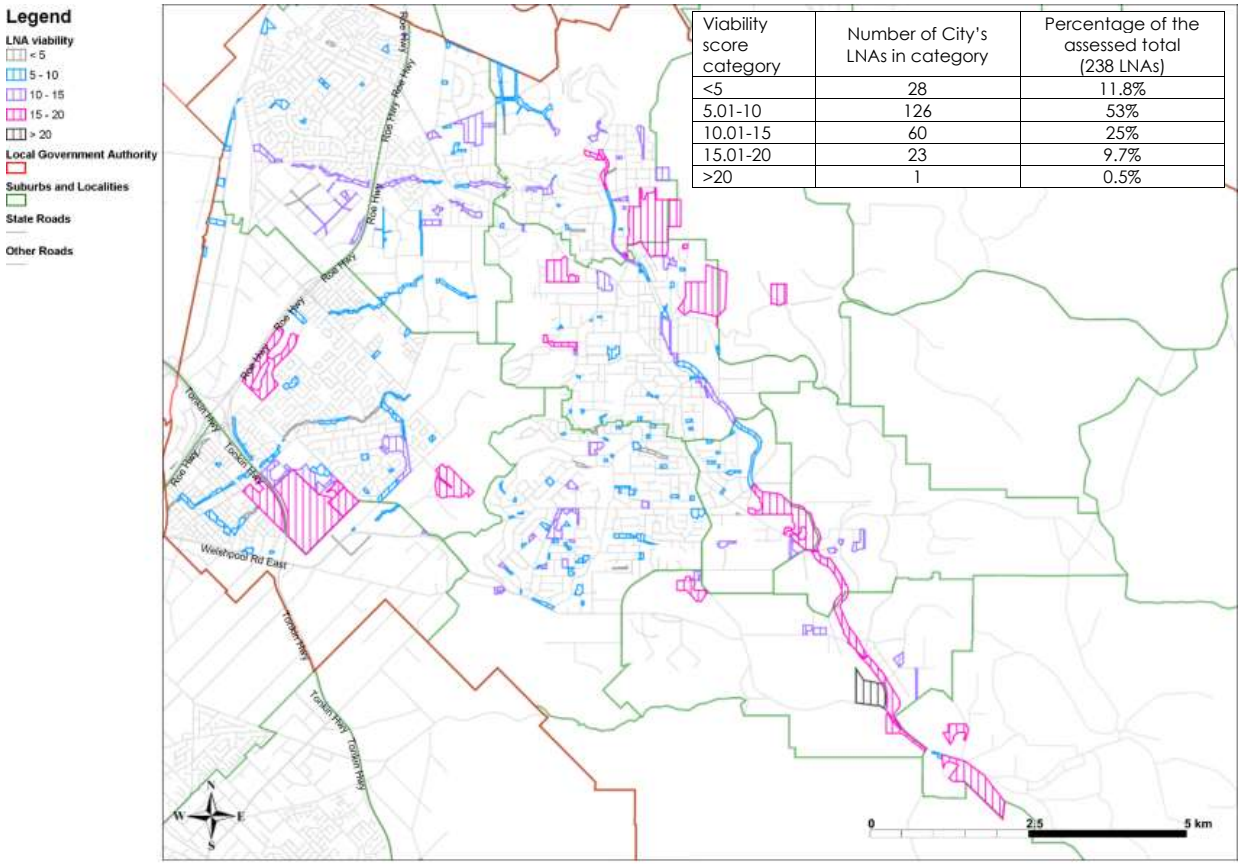

FIGURE 12: CITY MAPPED LNAS BY VIABILITY SCORE AND DISTRIBUTION OF LNAS BY VIABILITY SCORE CATEGORIES. SEE TABLE C-3 FOR THE VIABILITY CRITERIA.

TABLE C-3: LOCAL NATURAL AREA VIABILITY ASSESSMENT CRITERIA (DEL MARCO ET AL 2004)

Viability scores were determined by City staff and are based on desktop assessment for size, shape, perimeter to area ratio and connectivity. Vegetation condition mapping was undertaken by a consultant in 2019-2020.

VIABILITY ESTIMATE		
Viability Factor	**Category**	**Score**
Size	Greater than 20 ha	5
	Greater than 10 ha less than 20 ha	4
	Greater than 4 ha less than 10 ha	3
	Greater than 1 ha less than 4 ha	2
	Less than 1 ha	1
Shape	Circle, square or squat rectangle	3.5
	Oval, rectangle or symmetrical triangle	3
	Irregular shape with few indentations	2.5
	Irregular shape with many indentations	2
	Long thin shape with large proportion of area greater than 50 m wide	1.5
	Long thin shape with large proportion of area less than 50 m wide	1
Perimeter to area ratio	Less than 0.01	4
	Greater than 0.01 less than 0.02	3
	Greater than 0.02 less than 0.04	2
	Greater than 0.04	1
Vegetation condition (Keighery 1994)	Pristine 10 x % = (e.g of 90%-10 x .9=9) 9	
	Excellent 8 x % =	
	Very Good 6 x % =	
	Good 4 x % =	
	Degraded 2 x % =(e.g of 10%-2 x 0.1=0.2) 0.2	
	Completely Degraded 0 x % =	
	Calculated Score	9.2
Connectivity	**A.** Forms part of a Regional Ecological Linkage and is contiguous with a protected natural area greater than 4ha	5
	B. Not part of a Regional Ecological Linkage but contiguous with a protected natural area greater than 4ha	4.5
	C. Forms part of a Regional Ecological Linkage and is within 500 m of more than 4 protected natural areas having an area greater than 4 ha	4
	D. Not part of a Regional Ecological Linkage but within 500 m of more than 4 protected natural areas having an area greater than 4 ha	3.5
	E. Forms part of a Regional Ecological Linkage and is within 500 m of 3 or 4 protected natural areas having an area greater than 4 ha	3
	F. Not part of a Regional Ecological Linkage but within 500 m of 3 or 4 protected natural areas having an area greater than 4 ha	2.5
	G. Forms part of a Regional Ecological Linkage and is within 500 m of 2 protected natural areas having an area greater than 4 ha	2
	H. Not part of a Regional Ecological Linkage but within 500 m of 2 protected natural areas having an area greater than 4 ha	1.5
	I. Forms part of a Regional Ecological Linkage and is within 500 m of 1 protected natural area having an area greater than 4 ha	1
	J. Not part of a Regional Ecological Linkage but within 500 m of 1 protected natural area having an area greater than 4 ha	0.5
	K. Forms part of a Regional Ecological Linkage but is not within 500 m of any protected natural areas having an area greater than 4 ha	0.25
TOTAL SCORE (Viability Estimate)		

APPENDIX D: VEGETATION CONNECTIVITY MODELLING

Connectivity Scenarios

There were two objectives for the connectivity analysis. The first objective was to demonstrate the impacts of further vegetation clearing in the City on the connectivity and fragmentation levels of protected areas. The second objective was to test the effectiveness of the proposed local network of linkages on improving the connectivity values within protected areas and areas proposed to be protected via the implementation of the local biodiversity strategy.

Three connectivity descriptors or measures were developed through the Perth Biodiversity Project (Oh 2012) to assess the level of connectivity between patches of remnant vegetation.

The connectivity analysis consisted of an application of three connectivity measures to three scenarios of vegetation distribution patterns across the City of Kalamunda and within an 8 km buffer outside the City's boundary.

These three connectivity descriptors are based on methodology developed through the Perth Biodiversity Project (Oh 2012), and describe the various aspects of connectivity:

- **'Regional Connectivity'** is a measure for a patch and a network to which it belongs in how the network deviates from the "ideal" shape of a well-connected network (a circle). The higher the value of the Regional Connectivity measure, the larger is the patches' connected network.
- **'Connectivity Reach'** is a measure of the size of the connected network to which a patch belongs, not considering the pattern of the network. Higher values indicate patches which are part of larger connected networks than patches with smaller 'Reach' values.
- **'Fragmentation'** is a measure for a patch and its immediate surrounds and how this local network deviates from the ideal circle. Thin, small patches not closely bordering large patches are considered highly fragmented and large compact patches are considered least fragmented.

A **'patch'** was defined as a mapped contiguous unit of vegetation, based on the combine layer of the 2020 native vegetation extent mapping (DPIRD 2020) and the City's LNAs.

These three connectivity measures were applied to three defined vegetation distribution scenarios within the study area and its buffer:

Scenario 1: 2020 native vegetation extent (DPIRD) and vegetation within City mapped LNAs (without areas mapped as completely degraded)

Scenario 2: Only vegetation and City mapped LNA (except completely degraded) in the following land categories:

- DBCA lands managed for conservation (National Parks, Nature Reserves, Conservation Parks, Section 5 (1)(g) reserves (DBCA 2019)
- Regional Parks (DBCA 2019)
- Bush Forever in Parks & Recreation reserves in the MRS (DPLH 2020)
- Crown (Landgate 2018) reserves that include conservation, flora/fauna protection, natural flora as vesting purpose and are not managed by DBCA (e.g. all the City's conservation purpose reserves: R37650, R48693, R52090, R27817, R27801, R50011, R30898, R50763, R49122).

Scenario 3:

The results of the updated Scenario 2 plus vegetation in the following (Vegetation = City LNA (all vegetation condition classes) + DPIRD):

- Vegetation within or touching the Perth Regional and the proposed local linkages and is in lands reserved Parks and Recreation in the Metropolitan Region Scheme (DPLH 2020),
- Vegetation within or touching the Perth Regional and the proposed local linkages and in Local Open Space (LPS No 3),
- Vegetation within or touching the Perth Regional and the proposed local linkages and is on lands zoned Rural Conservation (City's LPS No 3),
- Vegetation within or touching the Perth Regional and the proposed local linkages and is on lands zoned Rural Landscape Interest (City's LPS No 3),
- Vegetation in Bush Forever sites except for Perth Airport (BF 386),
- Selected local roads with a 4 m inward buffer – representing planting along road verges,
- Potential planting areas within selected Local Open Space,
- Vegetation within proposed conservation reserves (Biodiversity Conservation Priorities, Category B),
- Vegetation within City LNAs on waterways (regardless whether on an ecological linkage or not),
- Vegetation in mapped as Fauna Zones and Informal Reserves in the Forest Management Plan 2014-2023,
- Vegetation on selected Rural Conservation lands,
- Vegetation within or touching the Perth Regional and the local linkages and in Crown reserves vested in the City of Kalamunda.

APPENDIX E: 2008 KALAMUNDA LOCAL BIODIVERSITY STRATEGY REVIEW REPORT

SUMMARY

This report summarises the findings of a review into the effectiveness of the 2008 LBS in increasing the protection of biodiversity in the City of Kalamunda. The key findings include:

- Since 2008, over 630 ha of native vegetation was cleared and this clearing occurred at a greater rate than clearing recorded between 2001 and 2005.
- Slight increase in formal protection at the local level has been recorded, with three new reserves with conservation purpose created since 2008, providing protection for additional 2.2ha of natural areas in the City of Kalamunda.
- A change of Crown reserve vesting purpose (under the provisions of the *Land Administration Act 1997*) was only used in three instances to protect threatened flora since 2008. It was not used to increase the protection of other biodiversity features or targeted vegetation complexes such as Forrestfield, Southern River, Darling Scarp, Yarragil 1, Dwellingup 2 or Helena 2. Some of these targeted vegetation complexes remain poorly protected at the regional level, including the Darling Scarp, Yarragil 1 and the vegetation complexes on the Swan Coastal Plain portion of the City.
- In 2020, 22.8ha is protected via conservation reserves vested in the City.
- Since 2008, new TECs were listed by the State and under the provisions of the Commonwealth legislation in the City. Some areas mapped as TEC have been cleared since 2008 while some will be retained via POS provisions of the LPS 3.
- Since 2008, surveys identified new threatened flora and fauna species as occurring in the City of Kalamunda.
- The City did not adopt any Local Planning Policies focusing on biodiversity protection.
- Recommendations on local planning scheme provisions amendments have not been implemented. However, structure planning has been utilised to retain natural areas containing TECs, threatened flora and to buffer a watercourse.
- Management of natural areas in reserves vested in the City is supported by increased number of Friends Groups, with numerous restoration projects being implemented.
- The City now employs four FTE equivalent staff that form a dedicated Environmental Services Unit.
- Key achievements in biodiversity management in the City include:
    - Dedicated team of staff with responsibility for natural areas

- Growing number of Friends Groups working with the City on managing and restoring the significant natural areas across the City
- Continued 'Plants for Residents' program to encourage use of native species by residents
- Publication of the *Private Landholder Bushland Information Package*
- Progress with strategic approach to management of reserves vested in the City.

1 INTRODUCTION AND METHODOLOGY

The purpose of this report is to summarise the progress against objectives and targets for biodiversity conservation, as adopted via the 2008 Kalamunda Local Biodiversity Strategy (2008 LBS) and outline new considerations in planning for biodiversity conservation. The Shire of Kalamunda was the first Local Government in Western Australia to adopt a Local Biodiversity Strategy that was consistent with a methodology endorsed by the State Government and detailed in the Local Government Biodiversity Planning Guidelines for the Perth Metropolitan Region (Del Marco *et al,* 2004).

Since the development of the Shire of Kalamunda's Local Biodiversity Strategy Discussion paper in 2006-2007, changes occurred in the classification of biodiversity assets on the Swan Coastal Plain, in land use and in the State's regulatory and policy framework.

The review is based on the following:

- Information, conservation targets and implementation actions published in the Shire of Kalamunda Local Biodiversity Strategy (2008) https://www.kalamunda.wa.gov.au/docs/default-source/strategies-plans/local-biodiversity-strategy.pdf?sfvrsn=8c074841_6
- Review of the City of Kalamunda Local Planning Scheme No 3 (2019)
- Review of Structure Plans and Outline Development Plans available on https://www.kalamunda.wa.gov.au/building-development/planning/plans
- Review of the City's Local Planning Policies
- Comparison of historical aerial photography with the latest aerial photography available via the City's *Intramaps*
- Analysis of vesting purpose of Crown reserves vested in the City of Kalamunda (using 2019 Crown Reserves (Landgate) data available via WALGA's LGmap)
- South West vegetation complex statistics published by the Department of Biodiversity, Conservation and Attractions, 2019 (https://catalogue.data.wa.gov.au/dataset/dbca)
- Flora and fauna species list generated via NatureMap https://naturemap.dbca.wa.gov.au/ and as provided by the Department of Biodiversity, Conservation and Attractions, April 2020
- Report on the Matters of National Environmental Significance generated via the Protected Matters Search Tool, https://www.environment.gov.au/epbc/protected-matters-search-tool

- Documents and information sources from the City of Kalamunda website and following discussions with the City's staff.

2 BIODIVERSITY FEATURE AND REPRESENTATION TARGETS

The 2008 LBS target's development followed the methodology detailed in the Local Government Biodiversity Planning Guidelines for the Perth Metropolitan Region (Del Marco *et al,* 2004). The biodiversity conservation targets were drafted by Shire staff and endorsed by a Steering Group set up to assist with the development of the Local Biodiversity Strategy. The Shire's Council adopted the Local Biodiversity Strategy with the proposed targets and implementation actions at its meeting in October 2008.

There are two types of biodiversity conservation targets:

- Biodiversity features targets seek to protect local natural areas that contain specific biodiversity features, including flora, fauna and ecological communities protected by provisions of the State and Commonwealth legislation;
- Representational targets seek to ensure that adequate representation of ecological communities occurring in a Local Government area is retained and protected; with vegetation complexes being used as surrogates for ecological communities.

2.1 BIODIVERSITY FEATURE TARGETS

The 2008 LBS listed seven Biodiversity Feature Targets. They are listed in Table 1 (wording of targets is consistent with those published in the 2008 LBS). The aim of this review is not to examine every site where vegetation was lost since 2008 but look at processes influencing outcomes for biodiversity conservation in the City of Kalamunda. In addition, information on the condition of mapped remnant vegetation is not readily available. As generally only vegetation in good or better condition is considered for protection, this information would help with the analysis of past decisions approving vegetation clearing but search and review of site-specific reports was beyond the scope of the 2008 LBS review.

Another important consideration is that the final decisions on developments with potential to affect native vegetation, threatened ecological community, threatened flora or fauna habitat are not made by Local Government but by the relevant regulators (assuming Local Government is not the proponent).

Comparison of vegetation extent data for 2005 which informed the 2008 LBS and the current data (Department of Biodiversity, Conservation and Attractions, 2019) shows that around 730 hectares of native vegetation were cleared across the City since 2005 (Appendix A), including over 90 hectares cleared on the Swan Coastal Plain

portion of the City within vegetation complexes associated with listed threatened ecological communities. The presence of a threatened ecological community is determined via field surveys.

TABLE 1: BIODIVERSITY FEATURE TARGETS ADOPTED VIA THE 2008 KALAMUNDA LOCAL BIODIVERSITY STRATEGY.

Threatened Ecological Communities (Federal and State)	*Retain and protect areas containing TECs (Threatened Ecological Communities) and where there is significant natural area remaining, protect buffers and the associated vegetation that is contiguous with these communities. Where practicable enhance these natural areas to maintain and improve biodiversity values.*
Declared Rare Flora (this includes all known species that are protected)	*Retain and protect natural areas containing DRF and, provide and protect a buffer to the natural area containing the DRF. Where practicable, enhance these natural areas to maintain and improve biodiversity values.*
Threatened and Specially Protected Fauna (Federal & State)	*Retain and protect natural areas containing significant populations of Threatened and Specially Protected Fauna and/or significant habitat for these fauna, where there is sufficient natural area remaining also protect a buffer to the natural area containing the Threatened and Specially Protected Fauna or their habitat. Where practicable, enhance these natural areas to maintain and improve biodiversity values.*
Priority species	Retain and protect natural areas containing substantial populations of Priority Flora and significant habitat for Priority Fauna. Where possible include a buffer and/or enhance these natural areas
Wetlands	*Retain and protect natural areas containing Environmental Protection Policy Lakes and Conservation Category Wetlands. All reasonable measures should be taken to minimise impacts on Resource Enhancement Wetlands and their buffers and the associated upland vegetation. Where practicable enhance natural areas containing wetlands to maintain and improve biodiversity values.*
Rivers, creeklines and other channel waterways	*Retain and protect riparian vegetation and upland vegetation in moderate or better condition associated with rivers. Creeklines, other channel waterways and floodplain areas. Retain sufficient buffer distance to maintain the ecological function of the watercourse. Where practicable, enhance natural areas containing waterways to maintain and improve biodiversity values.*
Ecological linkages	Retain and protect viable natural areas that occur within regional linkages and wildlife corridors. Where practicable enhance natural areas, which form linkages. Seek opportunities to add linkages to maintain and improve biodiversity values.

Review of the City's Local Planning Scheme No. 3 identified thirteen areas across the City where land use provisions changed after 2008, providing for higher intensity development with limited provisions for vegetation retention (Appendix B[1]).

[1] This is for internal use only, will not be part of the public document.

Threatened and priority ecological communities

Of the lands subject to land use change since 2008, four include native vegetation mapped as a threatened ecological community. While one of them, Forrestfield North Structure Plan, is yet to receive final approval by the WA Planning Commission, most of the vegetation mapped as *Banksia dominated woodlands of the Swan Coastal Plain* TEC (EPBC Act listed) is to be retained via Public Open Space provisions, with specific designation as 'Environmental Conservation'.

For two of the identified sites, specific conditions are set in the City's Local Planning Scheme No. 3:

- Development conditions (Schedule 11, LPS 3) on Structure Plan for Milner Road, High Wycombe (DA 2) set out a requirement to retain the mapped TEC and threatened flora within Public Open Space that will retain just over 3 ha of the TEC
- Table 4 in section 5.23 of LPS requires "the identification and protection of environmentally significant areas within the land through the provision of adequate buffers", on rezoned Urban to Light Industry lots on Stirling Crescent, Hatch Court and Kalamunda Road in High Wycombe.

One area where rural type land uses were changed to Special Use (Retirement village) do not provide for TEC retention, but include specific conditions to retain and protect the Crystal Brook and its foreshores. Since 2008, TEC loss occurred on lands reserved for roads, Parks and Recreation, zoned Light Industry and on private land[2].

Of the 54 reserves managed by the Shire in 2008 (Table 19, 2008 LBS), only three were listed as containing a TEC. A review of vesting purposes of Crown reserves vested in and managed by the City of Kalamunda show that the vesting purpose have not changed for any of the reserves containing TECs to include conservation and thus their protection status remains the same as in 2008.

However, the City actively manages the three reserves with mapped TECs: Maida Vale Reserve and the adjoining Bush Forever Site (R14088 & R40122), Hartfield Park (R17098) and Pioneer Park (R41156). All three reserves are reserved in the Metropolitan Region Scheme for Parks and Recreation with the Bush Forever overlay.

Threatened flora

To assess which areas subject to land use change since 2008 might have considered threatened flora, areas identified in Figure 1 were compared with the Threatened and priority flora records provided by the DBCA. This comparison identified two approved structure plan areas with threatened flora records, the Development approval for an Aged Residential Care Facility on Hybanthus Avenue & Lambertia Cr, High Wycombe and the Forrestfield North Structure Plan area. The Aged Care

[2] Possibly cleared illegally between 2015-2016 as no clearing permit registered in the DWER system and land is zoned Rural Composition.

facility has been approved by the City subject to approvals from DER and DBCA to remove the threatened flora. DBCA approved the removal of *Conospermum undulatum.* The Forrestfield North structure plan is yet to be finalised but the draft provides for the majority of threatened flora to be in areas designated as 'Environmental Conservation'.

There are numerous records of threatened flora on freehold land in lands zoned industrial, urban, rural or reserved for roads and public purposes. The revised Local Biodiversity Strategy investigate the opportunities to improve their protection.

Of the 54 crown reserves listed in the 2008 LBS, eight reserves were identified as containing threatened flora (Table 19 in 2008 LBS). According to the 2020 DBCA data, additional 12 reserves vested in the City of Kalamunda show records of threatened flora. Four of the 20 reserves with threatened flora include conservation in their vesting purpose: R49122, R50011, R50763 and R27801. Three of these were created or amended after the Shire of Kalamunda adopted its 2008 LBS.

Threatened and Specially Protected Fauna

The 2008 LBS listed 18 Threatened Fauna species that were either known to occur or may occur in the City and did not identify any of the City's 54 reserves as providing habitat for threated and specially protected fauna (Table 19, 2008 LBS). However, review of the 2020 DBCA data shows threatened and specially protected fauna records across Crown reserves vested in the City of Kalamunda, including several new species not identified in the 2008 LBS.

The review of the thirteen areas subject to land use change since 2008 did not identify specific conditions relating to protected fauna and their habitat protection, except the structure plan for Forrestfield North which provides for the retention of Banksia woodlands, habitat for threatened and priority fauna such as Carnaby's and Forest red-tailed black cockatoos and quenda.

The revised Local Biodiversity Strategy will address types of management actions recommended to support fauna in the City of Kalamunda.

Target for Priority Species

None of the thirteen areas approved for further development overlap with priority flora records.

Of the 54 reserves listed in the 2008 LBS, Table 19, only five were recorded to include Priority species. 2020 DBCA data shows Priority flora and fauna records across numerous Crown reserves vested in the City of Kalamunda.

Review of the Priority species list generated via DBCA's NatureMap includes new Priority species of flora and fauna not identified in the 2008 LBS, including 33 new Priority flora and 5 new Priority fauna. Priority ranking has changed for several species of flora and fauna.

Wetlands

The Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 was repealed in December 2016 and it is not clear from the 2008 LBS whether any EPP lakes were mapped in the Shire of Kalamunda at the time.

The 2008 LBS listed one Conservation Category Wetland (CCW) in a Shire managed reserve, in R41156 Pioneer Park. However, review of the mapping shows that the listing was not correctly allocated in Table 19, 2008 LBS as the CCW occurs in Hartfield Park (R17098). According to Table 19, four reserves contained a Resource Enhancement Wetland (REW).

Several vegetated areas mapped as CCW or REW remain in the City of Kalamunda outside Bush Forever Areas and outside reserves. Some are retained within major road reserves, a railway reserve, Perth Airport and lands zoned Urban and Industrial. Small REW on Stirling Crescent, High Wycombe was reclassified as its condition does not meet the criteria for REW (D. Lynch, personal comment). This reclassified REW extends into one of the City's area where land use changed since 2008 from Rural to Urban (MRS) and Light Industry (LPS 3) in High Wycombe.

One of these remaining REWs is proposed to be retained in Local Open Space within the Forrestfield North Structure Plan Area (2018).

Rivers, creeklines and other channel waterways

The 2008 LBS refers to a Flood and Stream Management Policy which was developed by the Shire to "*reduce negative ecological impacts on waterways*". This policy is not listed on the City's website among the City's current policies.

The City's LPS No 3 provides for protection of the Crystal Brook and its foreshore areas within one of the thirteen areas subject to land use change since 2008; the proposed retirement village on Gavour Road in Wattle Grove.

In 2008, there were eleven volunteer groups actively participating in managing the City's creeklines. Based on the City's website, five of these groups are no longer active, however, there are eight new groups listed, so in total the City is supporting 14 Friends Groups that are involved in the management of several waterways across the City (https://www.kalamunda.wa.gov.au/community/community-groups/friends-group) and the City was working with the Eastern Region Catchment Management Program to support landholders and volunteers in better environmental management within important water catchments (https://www.kalamunda.wa.gov.au/our-city/environment/programs/ercmp).

The City's ELUPS (2019) list the development of a "*local planning policy for waterways, flood prone areas and wetlands to protect the environmental value of the waterbody and provide parameters for development insusceptible areas*" (Action 6.1.1).

Ecological Linkages

The current review identified one example of public open space planning along a mapped regional ecological linkage. The Forrestfield North Residential Structure Plan which seeks to retain natural areas in close proximity and to facilitate connection between Bush Forever Areas 123 and 45. However, at the time of writing, this Structure Plan is still awaiting final WAPC approval.

The City's ELUPS (2019) identify preparation of a 'Green Links Masterplan' and a 'Street Tree Masterplan' as the priority action (Action 8.1.1). However, the 'Street Tree and Streetscape Management' policy, adopted in August 2019 does not refer to ecological linkages and it focuses on public landscape management to maintain the City's identity, contributing to improved resident's health and wellbeing.

2.2 Representational Targets

Vegetation in the City of Kalamunda is representative of 14 vegetation complexes, four associated with the Swan Coastal Plain, one of the Darling Scarp and nine associated with various landforms of the Darling Plateau. The representational targets consider vegetation remaining in areas classified as 'local natural areas'[3].

Table 2 shows the distribution of mapped native vegetation by land categories relevant to local biodiversity conservation planning, comparing data published in the 2008 LBS with the current data based on datasets available via www.data.wa.gov.au.

The key findings of this comparison show reduction of remaining native vegetation in the City by 2%, including within lands with conservation status and increase of native vegetation on lands classified as Local Natural Areas.

It is also interesting to note that the rate of vegetation clearing increased since 2008. The 2008 LBS noted that between 2001 and 2005, 59 ha of vegetation was removed in the Shire of Kalamunda, or 14.7ha a year over 4 years. This is a significantly lower rate to that recorded since, when over 730 ha of native vegetation was lost since 2008, representing 66.4 ha a year over 11 years.

Portion of the 630 ha vegetation loss can be attributed to the revised methodology for the State's vegetation extent mapping, implemented by the Department of Agriculture and Food (DAFWA) in 2010. The current vegetation extent mapping is more detailed than the 2005 vegetation extent mapping used to inform the 2008 LBS, with areas cleared for tracks and buildings removed where they were included in the 2005 mapping layer (Figures 1&2). However, vegetation has been cleared across the City to facilitate development (Figure 3).

[3] Local Natural Areas in the context of local biodiversity conservation planning are defined as natural areas that exist outside Bush Forever Sites, DBCA managed lands and Regional Parks.

TABLE 2: COMPARISON OF 2008 AND 2020 VEGETATION EXTENT STATISTICS FOR THE CITY OF KALAMUNDA.

Administrative Planning Category	2008 LBS statistics		2020 Statistics**	
	Area (ha)	% of total (percentage in brackets based on 32,375ha total area)	Area (ha)	% of total
Total Shire/City area	34,900*	100	32,375	100
Urban Area/non vegetated area	10,819	31	9,031	28
Total native vegetation	24,081	69 (74)	23,344	72
Total conservation	9,492	27.20 (29)	9,408	29
• Bush Forever	307	0.88	287	0.89
• DEC/DBCA Conservation lands	9,185	26.32	9,121	28.13
• Regional Parks	1,467	4.20	700	2.16
DBCA State Forest	11,011	31.55	10,771	33.22
DBCA Lands Other	N/A	N/A	32	0.09
Local Natural Areas	**2,110**	**6.05**	**2,433**	**7.5**

*The source of the 'Total Shire' figure of 34,900ha is not listed in the 2008 LBS. This figure is published on the City's website (https://www.kalamunda.wa.gov.au/our-city/about-kalamunda/demographics-statistics) however, it is not consistent with other current published information on the total area occupied by the City of Kalamunda. A comparison of the Local Government boundary in 2008 and 2019 did not show any changes that would account for the recorded difference. The pre-European vegetation complex mapping covers the whole City area, comprising 32,374.6ha. This figure is also consistent with figure based on Administrative Boundaries for Local Government as provided by Landgate.

**Source: WALGA, 2020: based on:

- 2019 Native vegetation extent, DPIRD-005
- 2019 Bush Forever 2000, DPLH-019
- 2017 DBCA Legislated Lands and Waters, DBCA-011
- 2017 Regional Parks, DBCA-026

FIGURE 1: COMPARISON OF THE 2018 VEGETATION EXTENT MAPPING (COLOURED FILL) WITH THE 2005 VEGETATION EXTENT MAPPING (RED OUTLINE) SHOWS EXAMPLES OF AREAS THAT WERE CLEARED IN 2005 BUT INCLUDED IN THE NATIVE VEGETATION EXTENT MAPPING IN 2005 BUT NOT IN 2018. AERIAL PHOTOGRAPHY UNDERLAY – 2019. SEE FIGURE 2 FOR COMPARISON WITH 2005 AERIAL PHOTOGRAPHY.

FIGURE 2: 2005 AERIAL PHOTOGRAPHY COVERING THE AREA SHOWN IN FIGURE 1 (SOURCE CITY OF KALAMUNDA INTRAMAPS).

There were two types of conservation targets set for the vegetation complexes in the 2008 LBS: general overarching targets and specific quantitative targets.

The general overarching targets were set for five vegetation complexes of the Darling Plateau as they were considered adequately protected locally, then for two of the Swan Coastal Plain vegetation complexes, Swan and Guildford vegetation complex, and for Cooke vegetation complex (Darling Plateau) of which less than 1ha remained in the Shire classified as 'local natural area'.

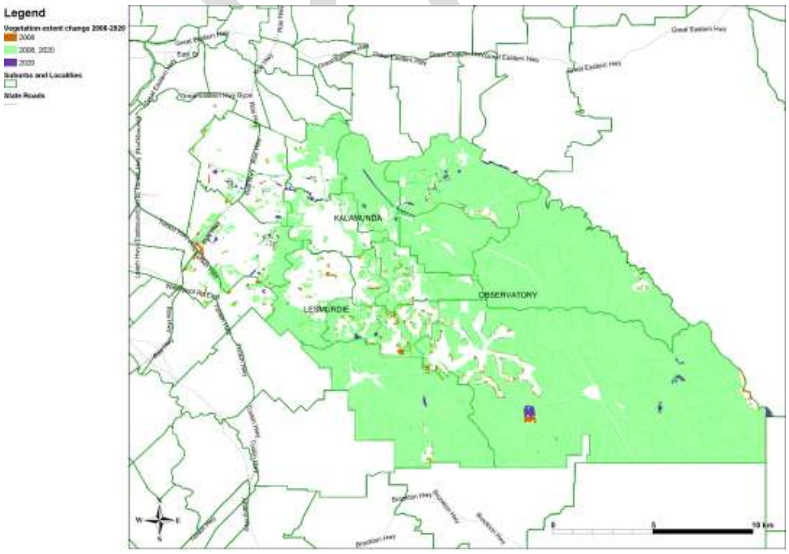

FIGURE 3: VEGETATION LOSS BETWEEN 2008 AND 2020

Target for the Guildford, Swan and Cooke vegetation complexes

'Retain existing protected areas of the Guildford, Swan and Cooke vegetation complexes by working cooperatively with DEC and other State government departments to ensure that identified threatening processes are addressed and the conservation of biodiversity values is maintained.'

While there were no changes to the retention status of the Cooke vegetation complex in the City of Kalamunda, native vegetation representative of the Guildford and Swan vegetation complexes decreased significantly. This is primarily due to the changes to the pre-European vegetation complex distribution following a mapping review by the Department of Parks and Wildlife in 2016 (Appendix A).

Local retention of the Swan vegetation complex remains like that prior the mapping changes at around 90%. Significant drop in local retention of the Guildford vegetation complex has been recorded, from 25% in 2007 to 11% in 2018 (Appendix A). While majority of the remaining Guildford complex is within lands reserved for Parks and Recreation in the MRS, and classified as Bush Forever Area 387, it is not within a reserve vested for conservation.

Target for the Helena 1, Helena 2, Murray 1, Murray 2 and Dwellingup 2 vegetation complexes

'Retain existing protected areas of the Helena 1, Helena 2, Murray 1, Murray 2 and Dwellingup 2 vegetation complexes and endeavour to protect additional natural areas in good to better condition that also meet additional criteria such as diversity, rarity and connectivity.'

The 2008 LBS listed 18 Crown reserves where the investigation of opportunities for increasing vegetation protection via changes to the reserve vesting purpose was recommended. Review of the current vesting purpose of these 18 reserves showed that no changes were made to their vesting purpose. One of the reserves (R27817) is vested for flora protection but the vesting purpose was set prior the 2008 LBS (Appendix C).

For all but one vegetation complex, Helena 1, vegetation extent decreased since the adoption of the 2008 LBS (Appendix A). All these vegetation complexes remain well represented locally and regionally; at over 80% of their original extent retained in the City of Kalamunda. Dwellingup 2 is the most represented vegetation complex in reserves managed by the City, with over 170 hectares or 48% of vegetation retained in City managed reserves.

For the remaining six vegetation complexes, specific quantitative targets were set:

Target for protection of the Forrestfield vegetation complex

> *'Retain and protect remaining areas of the Forrestfield vegetation complex original extent, in good or better condition within the Shire of Kalamunda. Formal protection will be increased by at least 10 hectares and preference*

should be given to retaining natural areas that also meet additional criteria such as diversity, rarity and connectivity.'

The 2008 LBS proposed several ways for meeting the adopted target for the Forrestfield vegetation complex:

1 Change of the vesting purpose of 5 reserves managed by the City, together containing 24.2ha of vegetation representative of the Forrestfield complex. Table 3 lists the 2008 LBS recommended reserves and provides an overview of their current status.

Two of the listed reserves form Bush Forever Area 316 and thus in the context of local biodiversity conservation planning were considered protected and should not have been included when identifying areas to protect. Two of the five listed reserves already include conservation as their vesting purpose and from the Crown reserve information this was their purpose prior to 2008. Finally, one of the listed reserves does not include vegetation representative of Forrestfield vegetation complex.

TABLE 3: LIST OF CITY OF KALAMUNDA MANAGED RESERVES WHERE CHANGING OF RESERVE VESTING PURPOSE WOULD INCREASE THE PROTECTION STATUS OF FORRESTFIELD VEGETATION COMPLEX.

Reserve Number	Name	Vesting Purpose	Reserve Area (ha)	2018 vegetation extent (ha)	Comments
22502	Norwood Reserve	Municipal purposes, Municipal depot site	2.47	1.33	
14088	Maida Vale & adjoining Bush Forever Site	Recreation	30.59	10.31	Part of BF 316
49122	Maida Vale & adjoining Bush Forever Site	Conservation Protection	1.026	0.96	Part of BF 316; Registered in 2007
37650	Crumpet Creek/Yongar Reserve	Public Recreation. Conservation and drainage	7.66	2.95	Forrestfield = 1.91ha, Southern River = 1.04ha; Original destination of the reserve in 1982, subject to 20A
39218	Fleming Reserve	Public Recreation	5.88	1.79	Vegetation here is classified as Southern River Complex, was classified as SRC in 2008 and also in the NAIA Template, thus error in the LBS

While the 2008 LBS recommendations for increased protection of the Forrestfield vegetation complex via reserve classification were not implemented, a new Crown reserve was created in 2010 to protect just under 1ha of vegetation representative of the Forrestfield vegetation complex and a population of threatened flora (R50763).

There 34 hectares of Forrestfield vegetation complex mapped across 31 reserves vested in the City of Kalamunda, with only 3.7 ha in reserves vested for conservation (R37650, Yongar Reserve; R50763 and R49122 Maida Vale Reserve). Additional 28 ha of Forrestfield vegetation complex could be protected by extending the vesting purpose of 14 City managed reserves (Appendix E).

2 The 2008 LBS also recommended that at least 5 ha of Forrestfield vegetation complex is protected via new public open space provisions within the Kewdale-Hazelmere Integrated Master Plan (KHIMP) urban development area. Review of the City's LPS shows that of the 23.27ha of Forrestfield vegetation complex remain in the KHIMP area, only 1.54ha is within Local Open Space and 6.45ha are on lands zoned Urban Development (Table 4). However, the Forrestfield North structure plan is awaiting final WAPC approval which provide for vegetation retention via local reserves proposed to be classified as 'Environmental Conservation'.

TABLE 4: DISTRIBUTION OF REMAINING VEGETATION REPRESENTATIVE OF FORRESTFIELD VEGETATION COMPLEX WITHIN THE CITY OF KALAMUNDA PORTION OF THE KHIMP.

Total remaining (KHIMP/Kalamunda only)	23.27 ha	Additional information
Parks & Recreation (MRS)- outside areas R34 & R35 of the KHIMP)	9.77 ha	Bush Forever 122 (R49079)
Road (MRS)	1.86 ha	Roe Hwy road reserve
Total remaining within areas R34 & R35 of the KHIMP	12.64 ha	See Appendix B
Parks & Recreation (MRS)- within areas R34 & R35 of the KHIMP)	2.25 ha	Bush Forever 123 & portion of 45 (R50763)
Local Open Space (LPS)	1.54 ha	Bush Forever 45 (R36492)
Urban development (LPS)	6.45 ha	
Special Rural (LPS)	1.31 ha	

MRS – Metropolitan Region Scheme (2019)
LPS - Local Planning Scheme No 3 (2019)

Finally, the 2008 LBS recommended to protect minimum 10 ha of Forrestfield vegetation complex by supporting conservation on private lands in Special Rural zone. While the LPS 3 provisions for Special Rural zone require consideration of native vegetation retention prior to subdivision, the zone provisions do not protect the vegetation. In 2019, nearly 92 ha of Forrestfield vegetation complex was mapped on lands zoned Special Rural in the City of Kalamunda (see Appendix A, Table A-4). To formally protect and conserve the remaining vegetation, new mechanisms are required and will be addressed via the updated Local Biodiversity Strategy.

Summary

- Since the adoption of the 2008 LBS, vegetation representative of the Forrestfield vegetation complex declined (locally and regionally).

- Local protection target of at least 15 ha of Forrestfield vegetation complex protected has not been achieved yet; with only 3.7 ha of Forrestfield vegetation complex retained in reserves vested for conservation.
- Additional 28 ha of Forrestfield vegetation complex could be protected by extending the vesting purpose of 14 City managed reserves.
- Opportunities still exist to increase the local protection of the Forrestfield vegetation complex (as indicated in the Forrestfield North Residential Structure Plan) but also on rural lands in Goosberry Hill, Maida Vale, Forrestfield and Wattle Grove.

Target for protection of the Southern River vegetation complex

'Retain and protect remaining areas of the Southern River vegetation complex original extent, in good or better condition within the Shire of Kalamunda. Formal protection will be increased by at least 7 hectares and preference should be given to retaining natural areas that also meet additional criteria such as diversity, rarity and connectivity.'

The 2008 LBS listed the following opportunities for additional protection of vegetation representative of the Southern River vegetation complex:

- At least 5ha within the KHIMP urban development area to be retained as public open space
- A minimum of 2ha via implementation of the proposed Private Landholder Conservation Strategy on lands zoned Special Rural.

While no formal protection has been achieved on privately owned rural lands, opportunities remain within lands zoned Urban Development within the KHIMP area and also elsewhere in the City.

Proposed Structure Plan for Forrestfield North provides for retention and potential protection of the Forrestfield and Southern River complexes. However, the proposed Structure Plan is subject to final approval by the WAPC.

Implementation of development conditions for Milne Rd, High Wycombe DA2 (Schedule 11 LPS No 3) require the retention of a TEC and threatened flora within public open space. The identified area is also representative of 2.63 ha of the Southern River vegetation complex.

Finally, there is over 80 ha of Southern River complex mapped within six City managed reserves currently vested for recreation. Changing or extending the current purpose to provide for conservation will increase the protection status of the Southern River complex in the City but also contribute to its improved protection status at the regional level.

One new reserve was created in 2016 with vesting purpose Public recreation and Conservation, retaining 0.04ha of Southern River complex vegetation.

Summary

- Since the adoption of the 2008 LBS, vegetation representative of the Southern River vegetation complex declined (locally and regionally).
- Local protection target of at least 7 ha has not been achieved yet.
- Opportunities exist to increase the local protection of the Southern River vegetation complex (as indicated in the Forrestfield North Structure Plan).
- Over 80 ha of Southern River complex is retained in six City managed reserve where extending the reserve's purpose to include conservation would increase the protection status of this vegetation complex.

Target for protection of the Darling Scarp vegetation complex

'Encourage retention of remaining areas of the Darling Scarp vegetation complex original extent in good or better condition within the Shire of Kalamunda. Formal protection will be increased within Shire reserves. Preference should be given to recognising the values of natural areas that meet additional criteria such as diversity, rarity and connectivity and provide a management buffer to the existing reserves.'

The 2008 LBS listed four crown reserves where the opportunity to increase protection of the Darling Scarp DS2 vegetation complex exists via change of reserve purpose to 'conservation' (Appendix C). These changes were not implemented yet.

There are only 13 City managed reserves that retain vegetation representative of Darling Scarp complex and only three retain more than 1 hectare of vegetation.

Summary

- At the bio-regional scale, Darling Scarp remains under- represented in lands with conservation purpose (less than 10%) and its extent reduced across the City.
- No increase in formal protection achieved as a result of LBS implementation.
- There are at least four City managed reserves where extending the reserve's purpose to conservation will improve the protection status of Darling Scarp complex.

Target for protection of the Yarragil 1 vegetation complex.

'Encourage retention of remaining areas of the Yarragil 1 vegetation complex in accordance with the local town planning scheme zonings and policies within the Shire of Kalamunda. Work cooperatively with DEC and other State government departments to ensure that identified threatening processes are addressed and the conservation of biodiversity values is maintained.'

The 2008 LBS listed two reserves managed by the City where changes to the reserve vesting purpose to include conservation would increase the formal protection status of Yarragil 1 in the City of Kalamunda (Appendix C). These proposed changes were not implemented yet.

Of the 341 hectares of Yarragil 1 vegetation complex classified as Local Natural Area, 31 hectares are retained in reserves managed by the City. There is an opportunity to increase the protection status of Yarragil 1 vegetation complex in the City via changing the vesting purpose of three reserves containing about 15 hectares of Yarragil 1: R9311, R16922 and R24130.

Summary

- Since the adoption of the 2008 LBS, vegetation representative of the Yarragil 1 vegetation complex declined locally.
- At the bio-regional scale, Yarragil 1 remains under- represented on lands with conservation purpose (less than 10%).
- No increase in formal protection of Yarragil 1 has been achieved as a result of LBS implementation.
- There is an opportunity to increase the protection status of Yarragil 1 via change of vesting purpose of three City managed reserves.

Target for protection of the Yarragil 2 and Swamp vegetation complexes.

'Encourage retention of remaining areas of the Yarragil 2 and Swamp vegetation complexes original extent in accordance with the local town planning scheme zonings and policies within the Shire of Kalamunda. Work cooperatively with DEC and other State government departments to ensure that identified threatening processes are addressed and the conservation of biodiversity values is maintained.'

The review of LPS No 3 did not identify any areas where change in land use affected vegetation representative of Yarragil 2 or Swamp vegetation complex. These vegetation complexes are not represented in reserves managed by the City or in lands providing formal protection within the City of Kalamunda. All remaining Local Natural Areas representative of Yarragil 2 and Swamp vegetation complexes are on freehold land, zoned Rural Conservation in LPS 3.

3 BIODIVERSITY CONSERVATION ACTIONS FOR CONSERVATION

Adopted implementation actions based on Table 11 in the 2008 Local Biodiversity Strategy:

Adopted implementation actions	Completion status
Endorse LBS including targets and action plan by: • Ensuring endorsement by Council, and • Working DPI, WAPC and DEC to gain State Government endorsement of the Strategy	Council endorsed the LBS in October 2008 On behalf of Local Government, WALGA via the Perth Biodiversity Project negotiated the State Government endorsement. In 2010, the WAPC committed to recognising local biodiversity conservation objectives adopted by Local Governments via endorsement of Local Planning Strategies that consider local biodiversity objectives and identify land use provisions to

	support these. Local Planning Strategies provide justification for Local Planning Scheme provisions that are the key statutory tool available to Local Government to protect natural areas. There are no other opportunities to seek formal endorsement of Local Biodiversity Strategies by the State.
Improve the protection and management of local reserves by: • Investigating the possibility of changing the vesting purpose of local reserves to recognise biodiversity conservation, • Forming a reserves management committee, • Developing a Reserves Masterplan	Change of vesting purpose of reserves listed in the 2008 LBS was not implemented. Of the 24 reserves created since 2008, three included 'conservation' as their vesting purpose. In 2020, the City managed 8 reserves with conservation as their vesting purpose. No reserves management committee has been established. The City is in the process of developing a process for prioritising reserve management. However, the City has implemented numerous restoration projects within reserves recognised as having significant conservation value. Some of the restoration projects were funded via offset requirements for native vegetation clearing in the City.
Develop supporting Local Planning Policies (LPP) to support decision making under the current local planning scheme, including: • Biodiversity Conservation LPP, and • Tree and Vegetation Preservation LPP.	The City does not have any LPPs with focus on environmental protection, except in August 2019, the City adopted the 'Street Tree and Streetscape Management Policy'. The scope of the policy is limited to City managed lands.
Protect existing natural areas in new urban areas by:	
• Protecting natural areas in public open space contributions of new developments, full ecological assessments should be conducted prior to structure planning	There is no systematic process set up to monitor whether vegetation is protected in all new areas being subdivided or developed. Generally, for subdivision proposals or development applications for sites including native vegetation, a flora and vegetation survey is required by the City. Key triggers for assessment are coverage of native vegetation, mapping indicating presence of TEC or PEC, DBCA or other agency advising it should be undertaken or where it is a condition of subdivision. Where high conservation values are identified, retention of these via POS is included in approval conditions. City's Parks staff approve the concept designs for new POS (City staff personal comment).
• Ensuring natural areas are protected as development the new areas takes place, i.e. by fencing during subdivision so the area is not cleared and undertaking spot checks to ensure builders rubble etc is not dumped in the reserve	
• Ensuring viable ecological areas are protected by requiring ecological assessment prior to development taking place;	
• Promoting tax concessions to developers for gifting of land.	No examples have been identified

Developing Private Land Conservation Strategy including: • Undertaking a survey of residents to determine initiatives that will be successful • The likely uptake of initiatives detailed in section 11.5 should be surveyed together with awareness of existing programs. • Following assessment of survey results the PLC Strategy can be developed. • Also include public opinion with regards to Environmental Levy in survey.	While the City did not conduct a survey of residents to determine which private landholder incentive initiatives were likely to be taken up, the City published a comprehensive *Private Landholder Bushland Information Package* in 2013.
Development of the Shire's Environmental Services including: • Full time Bush Regeneration Team	The City currently employs 4FTEs in Environmental Services
Other actions to reduce threats to biodiversity: • Undertake a trial to determine the success of planting verges with native species; • Investigate forming partnership with Main Roads WA to determine whether they could also be encouraged to plant local native species on the road verges they are responsible for.	The City provides information via its website on verge landscaping, residents can request a verge tree, or obtain free plants through the City's annual Plants for Residents program.
Purchase natural areas by: • Following completion of the Reserves Masterplan, sell reserves that serve no public or ecological function and use the revenue to purchase viable natural areas. • Utilising the public open space contribution • Liaising with DPI.	Since 2008, three new reserves were created via the provisions of the *Land Administration Act 1997* with vesting purpose including conservation and are managed by the City. In 2011, the City commissioned an audit of public open space availability, quality and needs across the City which informed the City's Public Open Space Strategy, completed in 2018. The POS strategy identifies some POS lands as 'Biodiversity Assets' and areas where "Nature' is listed as primary use. The environmental values assessment of POS focused on the quality and quantity of native vegetation, not the representation or type of ecological communities retained. The POS Strategy identifies numerous small parcels of land to be considered for transfer from POS to freehold but does not make recommendations on purchase of land to protect biodiversity.
Determine future of purchased natural areas: • Determine whether the purchased natural areas should become reserves or form the beginning of a revolving fund.	
Development of the Shire's Environmental Services including: • Environmental Reserves Officer • Environmental Planner	The City employs 4 FTEs in Environmental Services, including a Coordinator-Natural Areas, Environmental Projects Officer, Bushcare Officer and Environmental Friends Group Officer. Briefly, a role of Environmental Planner was created but not continued.

Implement Private Land Conservation Strategy.	The PLC Strategy was not developed.
Amend the Local Planning Scheme to support the protection of natural areas by: • Including protection of the environment in the objectives of the Special Rural Zone; • Requiring planning approval for removal of native vegetation; • Requiring full ecological assessment for all subdivision and development of rural land; • Allowing cluster development in rural land zonings.	Review of the Local Planning Scheme No shows that of the recommended amendments, only one is partially addressed via a subdivision condition for the Special Rural Zone. Section 5.9.1. e) iii & iv of LPS 3 seeks the retention of native vegetation and enhancement of basin wetlands as part of land capability analysis required prior subdivision. None of the other rural type zones include this provision.
Other: • Determine success of verge planting trial and continue program if appropriate; • Update weed strategy • Utilisation of PDA and/or GPS • Review of Wildlife Corridors Strategy • Investigate the appropriateness of joining/promoting a program such as CarbonSMART • If confirmation of public support has been gained introduce Environmental Levy.	The City continues running 'Plants for Residents, the support program for residents encouraging the use of native species in home gardens. The City's Weed Control Strategy (2002) is yet to be updated. Review of the Wildlife Corridors will be part of the Local Biodiversity Strategy update. The City did not undertake a survey of residents on feasible private landholder incentives, including the Environmental Levy. Other initiatives implemented by the City: • Support of Bush Skills for the Hills, workshops for volunteers and landholders delivered via EMRC. • Support for Friends Groups
Monitor and review:	
Track the progress and implementation of the Strategy so that progress and achievements can be reported to Council	No systematic reviews have been undertaken since the adoption of the Local Biodiversity Strategy in 2008. Structure planning has been utilised to retain natural areas containing TECs, threatened flora and to buffer a watercourse.
Review and update the LBS to ensure it remains up to date and any new mechanisms can be implemented	
Monitor and review the successfulness of the PLC strategy, adapt if necessary	
Review the effectiveness of the Local Planning Policies, adapt if necessary	
If land is rezoned, use structure planning to protect natural areas.	
Continue to update and review Strategies as required, e.g. Wildlife Corridor, Weed Strategy.	

APPENDIX F: CITY OF KALAMUNDA RESERVES PRIORITISATION

LNA_ID	LNA/Reserve name	Reserves	2020 Viability estimate	2020 Weighted Ecological Criteria Score (highest value)	Priority Rank (Ecological Criteria	2020 Total priority score	Priority Rank (Total scores)	Mapped as Biodiversity Asset in the City's 2019 POS Strategy	2020 LBS Conservation Priority Category
LNA-00086	Lower Lesmurdie Falls	Freehold	16.23	38.5	3	54.7	1	N/A-Not a POS	D
LNA-00084	Hartfield Reserve	R 17098	18.61	36.0	9	54.6	2	P&R	B
LNA-00025	Brae Rd Bridle trail	R 37320, R 50763, R 37662	14.51	39.0	2	53.5	3	part P&R	A+K
LNA-00129	Maida Vale Reserve	R 14088, R 38489, R 33262, R 49122, R38541	13.96	38.5	4	52.5	4	Only R38489	A+B+K
LNA-00188	Yongar Reserve	R 37650	9.55	39.5	1	49.0	5	Y	A
LNA-00127	Poison Gully Brae rd	R 37323, R 36492, R 35209, R 40947	11.80	37.0	5	48.8	6	Y	B
LNA-00190	Pioneer Park	R 41156, R 44545	17.27	31.5	25	48.8	7		B
LNA-00031	Norwood Reserve	R 22502	12.21	35.5	12	47.7	8	Y	B
LNA-00015	Kadina Brook Reserve	R 37219	13.10	34.5	13	47.6	9	N/A-Not a POS	B
LNA-00034	Poison Gully Meloway	R 32230, R 32108, R 33433, R 35209, R 40947, R 29519	11.59	36.0	10	47.6	10	Only R33433	B+E+K
LNA-00024	BF 45	R 48084	10.82	36.5	6	47.3	11	N/A-Not a POS	B
LNA-00037	Poison Gully-Maidavale/Hawtin rds	R 27792, R 48084	9.85	36.5	7	46.3	12	Y	B

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LNA-00116	Welshpool Rd (near BF50)	R 39253	12.69	33.5	14	46.2	13	N/A-Not a POS	K
LNA-00009	Quenda Creek-Kadina Brook Bridal Trail Reserve	R 37762	9.85	36.0	11	45.8	14	N/A-Not a POS	K
LNA-00185	Stewart Rd Bridal Trail	R 37323	11.73	33.5	15	45.2	15	Y	K
LNA-00011	Poison Gully West	R 40228	12.11	33.0	18	45.1	16	Y	B
LNA-00030	Millson Reserve	R 31954	11.57	33.5	16	45.1	17	Y	B
LNA-00204	Poison Gully-Lillian/Hawtin rds	R 27792	8.00	36.5	8	44.5	18	Y	B
LNA-00033	Poison Gully-Lillian/Cootamundra rds	R 32613	11.37	33.0	19	44.4	19		B
LNA-00221	Smokebush Reserve	Freehold	11.71	32.0	22	43.7	20	N/A-Not a POS	L
LNA-00021	Poison Gully-Milner rd	R 36492, R 48986	10.68	33.0	20	43.7	21	Y	B+K
LNA-00029	Poison Gully Booralie	R 32613	10.15	33.0	21	43.2	22		B
LNA-00064	Anderson Reserve	R 34600, R 34364, R 31348	11.98	31.0	28	43.0	23	Y	B
LNA-00117	Yule Brook Lewis Rd	R 35017	8.08	33.5	17	41.6	24	Y	E
LNA-00051	Brine Moran	R 9093, R 43458	17.10	24.0	49	41.1	25	P&R	B
LNA-00023	Poison Gully Myerson	R 45989	11.28	29.5	33	40.8	26	Y	B
LNA-00014	Quenda Creek reserve	R 37219	9.05	31.5	26	40.6	27	N/A-Not a POS	B
LNA-00202	Buttercup Drainage Sump	R 47222	10.00	30.5	29	40.5	28		K
LNA-00022	Poison Gully Springvale	R 36492, R 51230	10.94	29.0	35	39.9	29		B
LNA-00017	Quenda Creek Reserve	R 28735, R 27799	18.37	21.5	54	39.9	30	P&R	B
LNA-00018	Kalamatta Wy Reserve Reserve	R 28735	14.69	25.0	46	39.7	31	P&R	B

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LNA-00085	Edinburgh Rd reserve	R 27566	7.97	31.5	27	39.5	32	Y	B
LNA-00065	Woodlupine Brook -Preece crt	R 42353	6.45	32.0	23	38.5	33		E
LNA-00050	Crumpet Creek (Holmes rd)	R 37218	5.73	32.0	24	37.7	34	Y	B
LNA-00032	Hawtin Rd (Norwood)	R 40275	6.89	30.5	30	37.4	35		K
LNA-00119	Lions Lookout	R 49560	10.21	26.5	42	36.7	36		K+L
LNA-00083	Kalari Drive	R 52090, R 47767, R 48696	8.04	28.5	37	36.5	37		A+E+K
LNA-00118	Yule Brook-Lewis rd	R 28344	9.57	26.5	43	36.1	38	Y	E
LNA-00215	Oxfor crt Reserv (Bridal Trail)	R 42914, R 40245	5.90	30.0	31	35.9	39		K
LNA-00049	Ledger rd	R 27154, R 16922	17.37	18.5	63	35.9	40	P&R	B
LNA-00052	East Tce	R 35412	13.32	22.0	52	35.3	41	Y	B
LNA-00143	Alder Way easement, Forrestfield	Easement	7.24	28.0	39	35.2	42		F
LNA-00140	Gladys Newton Park	R 47320	5.16	30.0	32	35.2	43		K
LNA-00133	Woodlupine Brook -Stringbark Dr	R 34363	5.40	29.5	34	34.9	44		
LNA-00083	Kalari/Gillings	R 17098, R 52403, R 47767	8.80	26.0	45	34.8	45		
LNA-00218	Blackbutt Wy Reserve	R 35230	8.25	26.5	44	34.7	46		
LNA-00039	Canning Rd (Glenisla)	R 27801	15.71	19.0	62	34.7	47	P&R	A
LNA-00142	Jubillee Rd reserve	R 36344	5.61	29.0	36	34.6	48		
LNA-00124	Carmel Camping Ground	R 9311	23.10	10.5	99	33.6	49	P&R	B
LNA-00027	Jorgenson Park	R 51064, R 50554	17.18	15.5	75	32.7	50		K
LNA-00183	Woodlupine Brook-Cypress rd	R 33912	5.50	27.0	41	32.5	51		
LNA-00192	Yule Brook Drainage reserve	R 49714	4.00	28.5	38	32.5	52		

LNA_ID	LNA/Reserve name	Reserves	2020 Viability estimate	2020 Weighted Ecological Criteria Score (highest value)	Priority Rank (Ecological Criteria	2020 Total priority score	Priority Rank (Total scores)	Mapped as Biodiversity Asset in the City's 2019 POS Strategy	2020 LBS Conservation Priority Category
LNA-00063	Forrestfield Woodlupine	R 34250, R 38597, R 33912, R 32912	4.97	27.5	40	32.5	53		
LNA-00010	Fleming Reserve	R 39218	9.78	22.5	51	32.3	54		B
LNA-00047	Hill st Resreve	R 23040	14.68	17.5	67	32.2	55	P&R	B
LNA-00019	Lascelles Pde	R 36372	14.12	18.0	64	32.1	56		
LNA-00191	Old Railway Reserve-Union Rd-Canning Rd	R 9311, R 27801, R 30924, R 27800, R 17086	17.67	14.0	85	31.7	57	P&R	B, D, K, L
LNA-00112	Basildon Reserve	R 24948, R 25393	13.55	18.0	65	31.5	58	Y	B
LNA-00043	Poison Gully Zamia rd reserve	R 32291, R 27589	13.48	18.0	66	31.5	59		
LNA-00174	Hale Rd Easement	Easement	6.66	24.4	48	31.1	60		
LNA-00173	Nangana Wy Rd Reserve	Road reserve	13.43	17.5	68	30.9	61		
LNA-00132	Juniper Reserve	R 34706	9.12	21.5	55	30.6	62		
LNA-00003	Yorna/Alpine Rd	R 30142, R 29013	15.28	15.3	78	30.6	63		K
LNA-00189	Crumpet Creek-Sultana Rd East	R 37650	6.11	24.0	50	30.1	64		
LNA-00195	Crumpet Creek-Dawson Rd-Tonken Hwy	R 41156, R 41189	9.87	19.5	60	29.4	65		
LNA-00026	Schipp rd	R 17343	17.54	11.5	94	29.0	66	P&R	B
LNA-00081	Woodlupine Brook-The Promenade	R 48119, R 48404, R 48693	6.82	22.0	53	28.8	67		
LNA-00135	Chisolm cres Kewdale	R 44582	4.16	24.5	47	28.7	68		
LNA-00100	Broadway Rd	R 30898	13.12	15.0	79	28.1	69	Y	A
LNA-00182	8 Quartz Lane LOS	R 42866	6.00	21.5	56	27.5	70		
LNA-00044	The Boulevard Reserve	R 27946	11.05	16.0	70	27.0	71		
LNA-00099	Lawnbrrok rd east/First ave	R 39948	10.99	15.5	76	26.5	72		

LNA_ID	LNA/Reserve name	Reserves	2020 Viability estimate	2020 Weighted Ecological Criteria Score (highest value)	Priority Rank (Ecological Criteria	2020 Total priority score	Priority Rank (Total scores)	Mapped as Biodiversity Asset in the City's 2019 POS Strategy	2020 LBS Conservation Priority Category
LNA-00209	Josephine Cres LOS	R 28787	6.28	20.0	59	26.3	73		
LNA-00145	41 Neslon Cres Lesmurdie	R 32713	5.74	20.5	58	26.2	74		
LNA-00062	Railway Heritage Trail South ((Schmitt-Stanhope)	R 40367, R 17503, R 27800	10.86	15.0	80	25.9	75	only R17503, P&R	B
LNA-00101	Heidelberg Park	R 49077	17.32	8.5	110	25.8	76		K
LNA-00214	Pickering Brook Golf Course	R 52678	17.66	8.0	119	25.7	77	Y	K
LNA-00136	Lot 501 Maamba Rd	R 50985	6.00	19.5	61	25.5	78		
LNA-00042	GooseberryHill-obinson Rd rserve	R 32291	9.04	16.0	71	25.0	79		
LNA-00161	Chervil Bend Wattle Grove	R 51278, R 50762, R 49965, R 51668	3.50	21.5	57	25.0	80		
LNA-00212	Old Railway Reserve-Williams St-Browning Rd	R 27799	15.50	9.5	100	25.0	81	P&R	B
LNA-00038	George Spring Reserve	R 52678	16.38	8.5	111	24.9	82		E
LNA-00053	Crocus rd reserve	R 24130	10.15	14.5	82	24.6	83	Y	B
LNA-00091	Stirkwood res	R 50011	12.06	12.5	86	24.6	84	Y	A
LNA-00211	Sundew Rd Reserve	R 28430	8.50	16.0	72	24.5	85		
LNA-00056	Spring Rd North Reserve	R 33453	16.51	7.5	133	24.0	86		K
LNA-00002	Ray Owen Reserve	R 26127	11.97	12.0	91	24.0	87		
LNA-00040	Currawong Drive	R 33235	7.96	16.0	73	24.0	88		
LNA-00138	John Maclarty Park	R 41731	8.14	15.5	77	23.6	89		B
LNA-00098	AlanAnderson Park	R 37174	14.84	8.5	112	23.3	90		
LNA-00122	Marko Travicich Reserve	R 15470	14.48	8.5	113	23.0	91	Y	B
LNA-00054	Spring/Crocus rd Reserve	R 31065	8.01	14.5	83	22.5	92		

LNA_ID	LNA/Reserve name	Reserves	2020 Viability estimate	2020 Weighted Ecological Criteria Score (highest value)	Priority Rank (Ecological Criteria	2020 Total priority score	Priority Rank (Total scores)	Mapped as Biodiversity Asset in the City's 2019 POS Strategy	2020 LBS Conservation Priority Category
LNA-00157	Kadina Park	R 37452	10.48	12.0	92	22.5	93		
LNA-00045	RHT-Gooseberry Hil-Noel Rds	R 27799	12.98	9.5	101	22.5	94		
LNA-00144	16 Victory Place Lesmurdie	R 30186	7.67	14.5	84	22.2	95		
LNA-00123	Carmel Reserve	R 17358	14.95	7.0	139	21.9	96	Y	B
LNA-00126	Morton Rd Road Reserve	Road reserve	13.35	8.5	114	21.9	97		
LNA-00060	Bibbulmun terminus	R 28545, R 25574	9.33	12.5	87	21.8	98		
LNA-00199	13 Tindale RD Lesmurdie	R 33757	5.00	16.5	69	21.5	99		
LNA-00167	59 Huntley St Gooseberry Hil	R 29403	13.42	8.0	120	21.4	100		
LNA-00121	Old Carmel School site	R 8717	12.25	9.0	103	21.3	101		
LNA-00160	Bickley Recreation ground	R 17574	12.15	9.0	104	21.1	102		
LNA-00060	Railway Reserve	R 36023, R 28545, R 26843, R 22576	12.51	8.5	115	21.0	103		
LNA-00207	61 Ford Rd Lesmurdie	R 32119	5.00	16.0	74	21.0	104		
LNA-00082	Fennel Cres POS	R 46170	6.00	15.0	81	21.0	105		
LNA-00076	Lyndhurst/Stanhope Rd Reserve	R 17503	7.94	12.5	88	20.4	106		
LNA-00128	Markham Reserve	R 26063, R 36299	9.07	11.0	97	20.1	107		
LNA-00048	Old Railway Reserve Huntley-William Streets	R 27899	13.21	6.5	143	19.7	108		
LNA-00020	Toornart Ck reserve	R 26739	10.16	9.5	102	19.7	109		
LNA-00069	Eversden Reserve	R 23383	10.51	9.0	105	19.5	110		B
LNA-00168	1 Spring Rd Kalamunda	R 50055	6.64	12.5	89	19.1	111		
LNA-00110	Mary Drive Reserve	R 26557	10.83	8.0	121	18.8	112		
LNA-00059	Holly Way west	R 37699	7.18	11.5	95	18.7	113		

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LNA-00114	Lot 438 ,497 Kershaw Ave LOS	R 26754	10.68	8.0	122	18.7	114		
LNA-00149	3 Falls Rd Lesmurdie	R 29998	6.48	12.0	93	18.5	115		
LNA-00152	Wallis Park	R 45099	12.47	6.0	144	18.5	116		
LNA-00088	Hugh Sanderson Reserve	R 34183	10.46	8.0	123	18.5	117		
LNA-00090	Neil Tonkin Park	R 38569, R 50012, R 39706	6.80	11.0	98	17.8	118		
LNA-00148	Andrew St reserve	R 45007, R 35996, R 35663	9.48	8.0	124	17.5	119		
LNA-00216	Williams St Rd Reserve (Peoples ave)	Road reserve	4.98	12.5	90	17.5	120		
LNA-00153	Bill Shaw Reserve	R 32507	8.21	9.0	106	17.2	121		
LNA-00171	Old Railway Reserve Pickering Brook	R27801	8.65	8.5	116	17.1	122		A
LNA-00028	Mundaring Weir/Roach rd Reserves	R 28183	7.99	9.0	107	17.0	123		
LNA-00092	Trott Rd reserve	R 34076	7.99	9.0	108	17.0	124		
LNA-00067	Orange Valley Rd Drainage reserve	R 33340	5.48	11.5	96	17.0	125		
LNA-00066	Cabriatta Rd Reserve	Road reserve	9.44	7.5	134	16.9	126		
LNA-00105	Gladys Rd Reserve	R 27817	9.88	7.0	140	16.9	127	Y	A
LNA-00080	15 Lesmurdie Rd East Walliston	R 34394	9.52	7.2	138	16.7	128		
LNA-00070	Vernallen Wy Reserve	R 29107	8.56	8.0	125	16.6	129		
LNA-00223	Sanderson Rd Reserve	R 29873	11.06	5.5	146	16.6	130		
LNA-00104	Turner Park	R 25188, R 28624	8.53	8.0	126	16.5	131		
LNA-00055	Dixon Rd Reserve	R 31842	9.46	7.0	141	16.5	132		
LNA-00107	Over Ave Reserve	R 29041	11.40	5.0	148	16.4	133		
LNA-00150	Stone Rd Reserve	R 37395	7.30	9.0	109	16.3	134		
LNA-00113	52 Joyce St Lesmurdie	R 34809	7.76	8.0	127	15.8	135		

LNA_ID	LNA/Reserve name	Reserves	2020 Viability estimate	2020 Weighted Ecological Criteria Score (highest value)	Priority Rank (Ecological Criteria	2020 Total priority score	Priority Rank (Total scores)	Mapped as Biodiversity Asset in the City's 2019 POS Strategy	2020 LBS Conservation Priority Category
LNA-00164	Lawley Rd Reserve	R 31581	7.73	8.0	128	15.7	136		
LNA-00058	Headingly Rd reserve (adj Railway Heriatge Trail)	R 31117	7.18	8.5	117	15.7	137		
LNA-00072	Craydon Wy and Coral Rd Reserve	R 28860	7.51	8.0	129	15.5	138		
LNA-00075	Petunia St POS	R 36241	7.16	8.0	130	15.2	139		
LNA-00155	13 Petunia St Kalamunda	R 29132	7.00	8.0	131	15.0	140		
LNA-00094	Banksia Reserve LOS	R 34393	7.24	7.5	135	14.7	141		
LNA-00106	Pax Hill Reserve	R 30308, R 29189, R 29188, R 28268	7.63	7.0	142	14.6	142		
LNA-00073	Nangkita Rd Reserve	R 30693	9.55	5.0	149	14.6	143		
LNA-00151	Flora Tce Reserve	R 29757	6.77	7.5	136	14.3	144		
LNA-00087	Pagotto Park	R 26531	8.70	5.5	147	14.2	145		
LNA-00077	Currawong Cres Reserve	R 28858	9.17	5.0	150	14.2	146		
LNA-00169	Robert Rd Drainage Reserve	R 38952	6.00	8.0	132	14.0	147		
LNA-00068	Barbigal Place Reserve	R 34791	4.58	8.5	118	13.1	148		
LNA-00074	Elmwood Cres Reserve	R 30693	8.05	5.0	151	13.0	149		
LNA-00109	Godwin St Reserve	R 28212	7.74	5.0	152	12.7	150		
LNA-00093	Raymond Rd POS	R 28342	7.50	5.0	153	12.5	151		
LNA-00134	47 Lawnbrook Rd West Walliston	R 45157	7.41	5.0	154	12.4	152		
LNA-00158	Norma st Reserve	R 25425	7.40	5.0	155	12.4	153		
LNA-00089	Anthony Heslop Reserve	R 27730	7.06	5.0	156	12.1	154		
LNA-00071	Craydon Wy and Coral Rd Reserve	R 31447	7.02	5.0	157	12.0	155		

LNA_ID	LNA/Reserve name	Reserves	2020 Viability estimate	2020 Weighted Ecological Criteria Score (highest value)	Priority Rank (Ecological Criteria	2020 Total priority score	Priority Rank (Total scores)	Mapped as Biodiversity Asset in the City's 2019 POS Strategy	2020 LBS Conservation Priority Category
LNA-00200	Agnes Cl Reserve	R 29384, R 34192	4.50	7.5	137	12.0	156		
LNA-00154	Ryan Way Reserve	R 29947	6.98	5.0	158	12.0	157		
LNA-00120	15 Silverdale Rd Lesmurdie	R 25189	6.71	5.0	159	11.7	158		
LNA-00146	Mick Conti Park	R 35468	5.52	6.0	145	11.5	159		
LNA-00170	17 Norma St Walliston	R 31828	6.22	5.0	160	11.2	160		
LNA-00108	Granby St Reserve	R 28212	6.09	5.0	161	11.1	161		
LNA-00217	45 Halleendale Rd Walliston	R 44996	4.50	5.0	162	9.5	162		
LNA-00172	Mario Crt POS	R 41036	3.50	5.0	163	8.5	163		
LNA-00162	Redgum Reserve, Reynolds Rd-Tonkin Hwy	R 42573	8.50	0.0	164	8.5	164		
LNA-00177	865 Abernethy Rd Drainage Basin	R 47623	8.00	0.0	165	8.0	165		
LNA-00178	931 Abernethy Rd Drainage Basin	R 47622	8.00	0.0	166	8.0	166		
LNA-00197	11 Kaolunga Wy Lesmurdie LOS	R 31137	7.50	0.0	167	7.5	167		
LNA-00004	Ollie Worrell Reserve	R 43068	7.00	0.0	168	7.0	168		
LNA-00165	13 Taylor Rd Kalamunda	R 26610	6.50	0.0	169	6.5	169		
LNA-00187	Woodlupine Brrok-Hardy Rd East	R 49263	6.50	0.0	170	6.5	170		
LNA-00176	813 Abernethy Rd Drainage Basin	R 47624	6.00	0.0	173	6.0	171		
LNA-00179	987 Abernethy Rd Drainage Basin	R 48790, R 48788	6.00	0.0	174	6.0	172		
LNA-00174	Hale Rd Easement	R 19500	6.00	0.0	172	6.0	173		
LNA-00163	Redgum Reserve, Cravan Park-Reynolds Rd	R 43064, R 33912	6.00	0.0	171	6.0	174		
LNA-00181	Yule Brook Estate POS	R 47406	6.00	0.0	175	6.0	175		
LNA-00205	154 Midland Rd	Freehold	5.50	0.0	181	5.5	176		

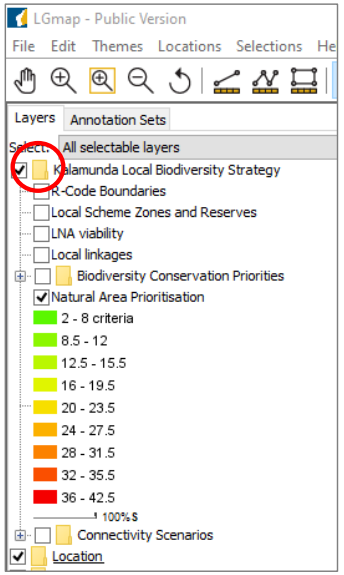
LNA_ID	LNA/Reserve name	Reserves	2020 Viability estimate	2020 Weighted Ecological Criteria Score (highest value)	Priority Rank (Ecological Criteria	2020 Total priority score	Priority Rank (Total scores)	Mapped as Biodiversity Asset in the City's 2019 POS Strategy	2020 LBS Conservation Priority Category
LNA-00194	28 Marri Cres Lesmurdie	R 25815	5.50	0.0	179	5.5	177		
LNA-00196	30 Nangkita wy Kalamunda	R 32277	5.50	0.0	180	5.5	178		
LNA-00139	Bandalong Way Park	R 30540	5.50	0.0	177	5.5	179		
LNA-00208	Beenup Pl Reserve	R 39684	5.50	0.0	182	5.5	180		
LNA-00210	Gunbar Wy LOS	R 28896	5.50	0.0	183	5.5	181		
LNA-00180	Lot 302 Abernathy Rd	R 48454	5.50	0.0	178	5.5	182		
LNA-00131	Wordsworth Reserve	R 27721	5.50	0.0	176	5.5	183	Y	
LNA-00111	26 Joyce Stree Lesmurdie	R 27972, R 27465	5.00	0.0	184	5.0	184	Y	
LNA-00147	Barbigal Place Reserve	R 33754	5.00	0.0	185	5.0	185	Y	
LNA-00220	Boodjera Rd Drainage basin	R 51191	5.00	0.0	188	5.0	186		
LNA-00203	Midland Rd Drainage sump	Drainage sump	5.00	0.0	186	5.0	187		
LNA-00206	Soverign Place LOS	R 35871, R 35958	5.00	0.0	187	5.0	188		
LNA-00222	Sultana Rd East Public Open Space	R 48778	5.00	0.0	189	5.0	189		
LNA-00137	Brae Rd Bridal Trail	R 37320, R 37272	4.76	0.0	190	4.8	190		
LNA-00201	Elmore Wy Park	R 47766	4.50	0.0	193	4.5	191		
LNA-00198	Seaton Park	R 33760, R 31137	4.50	0.0	192	4.5	192		
LNA-00175	Willow Lakes Estate POS	R 47590, R 50721	4.50	0.0	191	4.5	193		
LNA-00193	851 Welshpool Rd East	R 49714	4.00	0.0	196	4.0	194		
LNA-00156	Currawong Rd Reserve	R 33236	4.00	0.0	194	4.0	195		
LNA-00184	Milner Rd Bridal Trail	R 37272	4.00	0.0	195	4.0	196		
LNA-00013	Quenda Creek-Grange Cres-Frrant Cres	R 37219	3.00	0.0	197	3.0	197		

APPENDIX G: GUIDE TO USING LGMAP TO VIEW LOCAL BIODIVERSITY STRATEGY MAPPING

All the mapping layers are available for viewing via WALGA's LGmap portal which displays the Local Biodiversity Strategy (LBS) layers with other reference data, such as reserve boundaries, vegetation complex mapping, wetlands, significant fauna habitat, Perth regional ecological linkages, DBCA managed lands or Bush Forever Areas' boundaries. KEAC members are able to view these layers via the public version of LGmap, but this does not include all the datasets that informed the natural area prioritisation for the Local Biodiversity Strategy (e.g. threatened species and communities records).

To view the Local Biodiversity Strategy mapping analysis results, download the LGmap desktop application following the instructions on the following link: https://walga.asn.au/Policy-Advice-and-Advocacy/Environment/LGmap. (Under "Accessing LGmap" heading see options of Windows and Mac users). To login to the LBS project specific LGmap with the draft Local Biodiversity Strategy (LBS) layers, use the following login details:

Username: kalamundaLBSpub
Password: gumnut



In the menu bar, User Guide documents are available for download or viewing under 'Help'. It is recommended that you download the 'Tool Reference' document which lists descriptions for all LGmap tools/function buttons.

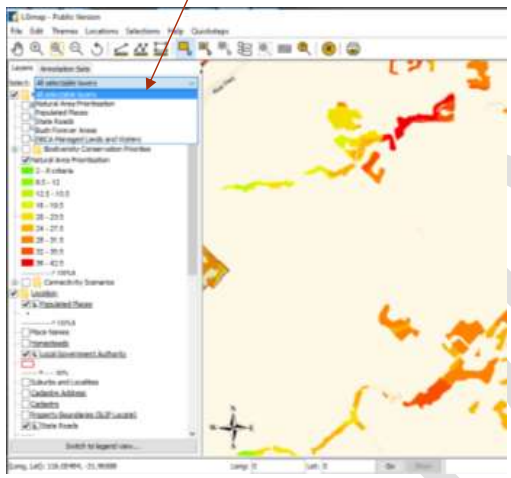
Under Layers, the LBS layers are located on top under the Kalamunda Local Biodiversity Strategy heading. Double click on the yellow rectangle next to the heading to open the folder with available datasets.

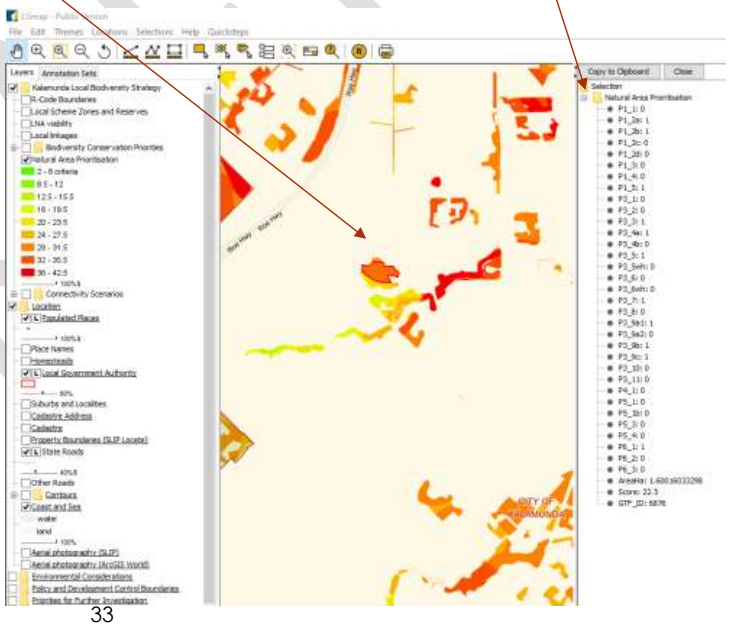
Activate the boxes next to any layer to turn the layer/s on and off. To enable viewing of multiple layers, use the slider under layers to adjust layer transparency to make overlaying data easier to read.

Any data heading that is underlined, is linked to an explanatory text that will open in a web browser. Check this information for description and data currency information of layers available under the other headings.

When comparing other LGmap data with the Kalamunda LBS Biodiversity Conservation Priorities, Natural Area Prioritisation and Connectivity scenarios, it is important to note that the Kalamunda LBS base layer for vegetation extent is using the combination of 2019 vegetation extent mapping by the Department of Primary Industries and Regional Development and the City's LNA mapping, excluding areas mapped as Completely Degraded by the City. All the other mapping layers in the Public LGmap are based on the 2018 vegetation extent mapping (due to be updated in July 2020).

Some of the available mapping layers can be interrogated using the LGmap Selection Tool. When activated, define which layer you want selected from the list in a drop-down menu. For a selected area, available information win be displayed in the Selected Features window.





To de-select, use the 'clear selected features' button.

LGmaps Annotation sets can be used to make notes or comments on the provided data, using the following steps:

1 Switch from Layers to Annotation Sets. Use the **New** button to create an annotation set, set a name such as "Missing vegetation" or "Questions", then choose the "General" option from the pop-up option.

2 Use any of the drawing tools to map the area you want to highlight. Use the computer mouse to draw an area, double clicking to finish the shape. This will open the Annotation Properties window where the created shapes display can be defined by name and colour. Press Ok and the description will appear in the Annotations legend.

3 Save your notes and comments. In the menu bar, go to **File/Save as** and create a LGmap project file (*.gpf). This file can be emailed to colleagues or to the City's LBS Project Manager: Dallas Lynch dallas.lynch@kalamunda.wa.gov.au .

Abbreviations used in the mapping layer descriptions:

DBCA	Department of Biodiversity, Conservation and Attractions (current)
DPIRD	Department of Primary Industry and Regional Development
DPLH	Department of Planning, Lands and Heritage
LNA	Local Natural Area
LPS 3	Local Planning Scheme No 3
PEC	Priority Ecological Community
TEC	Threatened Ecological Community
WAPC	Western Australian Planning Commission