City of Nedlands

Natural Areas Management Plan

2019–2024

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ACRONYMS AND ABBREVIATIONS

ACRONYM/ ABBREVIATION	DESCRIPTION
ARI	Average Recurrence Level
AHD	Australian Height Datum
BOM	Bureau of Meteorology
CALM	Department of Conservation and Land Management
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAFWA	Department of Agriculture and Food Western Australia
DBCA	Department of Biodiversity Conservation and Attractions
DEC	Department of Environment and Conservation
DFES	Department of Fire and Emergency Services
DPaW	Department of Parks and Wildlife
DPLH	Department of Planning, Lands and Heritage
DSEWPAC	Department of Sustainability, Environment, Water, Population and Communities
EPBC Act	Environmental Protection and Biodiversity Conservation Act
GPS	Global Positioning System
ha	Hectare
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
MCB	Metropolitan Cemeteries Board
PBP	Perth Biodiversity Project
PIRD	Department of Primary Industries and Regional Development
SRT	Swan River Trust
the City	City of Nedlands
WALGA	Western Australian Local Government Association
WESROC	Western Suburbs Regional Organisation of Councils

Cover photo: Carnaby's Black-Cockatoo
(Calyptorhynchus latirostris)

Contents

2. ACKNOWLEDGMENTS

The City of Nedlands would like to acknowledge the following organisations that contributed to the development of this Management Plan. There was a significant contribution made by the City of Nedlands community friends groups in terms of historical information, updating species lists and reviewing and developing natural area management actions. These groups included:

Friends of Allen Park Bushland Group
Friends of Hollywood Reserve
Friends of Point Resolution
Friends of Shenton Bushland
Swanbourne Coastal Alliance

Input of the following companies was also greatly appreciated:

Birdlife Australia
City of Nedlands Planning and Development, Leased Assets and Technical Services Departments
Ian Fordyce and Associates
Department of Defence (Environmental Department)
Perth Region NRM
Syrinx Environmental Pl
Technology One Limited

This Management Plan draws heavily from information compiled in previous management plans and assessments. These include:

Natural Areas Management Plan 2013-2018 (City of Nedlands, 2014)
Shenton Bushland Management Plan 2013-2018 (City of Nedlands, 2014)
Allen Park Management Plan 2013-2018 (City of Nedlands, 2014)
Hollywood Reserve Management Plan 2013-2018 (City of Nedlands, 2014)
Birdwood Parade Management Plan 2013-2018 (City of Nedlands, 2014)
Point Resolution Management Plan 2013-2018 (City of Nedlands, 2014)
Mount Claremont Oval Management Plan 2013-2018 (City of Nedlands, 2014)
Point Resolution Reserve Management Plan (Ecoscape, 1991)
Allen Park and Environs Management Plan 1996 (Ecoscape, 1996)
Shenton Bushland Management Plan 1996 (Ecoscape, 1996)
Hollywood Reserve Management Plan (APACE, 2001)
Nedlands Foreshore Bushland Reserves Management Plan 2003-2009 (Ecoscape, 2003)
Allen Park Management Plan 2005-2010 (Ecoscape, 2005)
Shenton Bushland Management Plan 2005-2010 (Ecoscape, 2005),
Hollywood Reserve Management Plan Review and Update (Tranen, 2007)
City of Nedlands Natural Area Initial Assessments (Orsini, 2008)

3. SUMMARY

The Natural Areas Management Plan 2019-2024 provides a framework for the conservation and restoration of the City's natural areas over the next five years. Seven Management Plans have been reviewed and updated including an overarching Management Plan and a further six focussed Management Plans for each natural area within the City. These Management Plans were developed by reviewing existing Management Plans in conjunction with the local community.

The key threats to the City's natural areas include environmental weeds, plant pathogens, feral animals, fire management, illegal dumping, access and climate change. The implementation of the City's Natural Area Management Plans will assist the City to:

- Improve public amenity through improvement of bushland condition and access
- Conserve biodiversity through the protection and enhancement of natural areas
- Maintain and enhance genetic diversity through the improvement of ecological corridors and habitat
- Improve the resilience of natural areas in the face of a changing climate
- Reduce bushfire risk through environmental weed control
- Receive grant funding assistance through development and implementation of management actions.

Table 1: Summary of Actions 2019-2024

Management Actions 2019-2024	
PLANNING CONTEXT	
1.	All six natural areas identified in this Management Plan that are managed by the City for conservation are considered "Special Protection Zones" regardless of the "Power to Lease" on Management Orders.
CLIMATE CHANGE	
2.	Implement actions identified in the Climate Change Local Adaptation Action Plan 2012-2017.
3.	Increase the resilience of natural areas by focussing on threats posed by environmental weeds, feral animals, illegal access and dumping, increased fire frequency, plant diseases and climate change.
4.	Accommodate adjustments to management practices to adapt to climate change. Use extreme events to monitor bushland areas for changes to assist with future plans for the area.
5.	Improve the resilience of natural areas through the creation and enhancement of ecological corridors by implementing the City's Greenways Policy.
6.	Keep informed about the latest climate change research and best practice for natural area adaptation techniques.
7.	Repair erosion using soft bioengineering techniques in preference to hard walling wherever possible.
8.	Implement revegetation in line with shifting water levels (surface and groundwater).
9.	Select local provenance species that are able to adapt to drying conditions and that assist in maintaining diversity as lack of diversity lowers habitat value

	and reduces the ability of the ecosystem to adapt to change.
10.	Encourage natural regeneration through weed control and rubbish removal as naturally regenerated species are more resilient.
11.	Improve revegetation success by using planting aids such as bentonite and water crystals and undertake watering during the first summer.
12.	Investigate options for wastewater/greywater treatment and reuse to supplement irrigation and other options to mitigate soil acidification.
MONITORING AND SURVEYS	
13.	Undertake weed mapping using Standard Operating Procedure SOP No: 22.1 (DEC, 2011) with the inclusion of actual cover every five years in spring.
14.	Undertake bushland condition mapping using the Keighery bushland condition scale every five years in spring.
15.	Continue to compile a comprehensive list of species present, including fungi.
REHABILITATION	
16.	Restoration should follow the three basic principles of the Bradley Method.
REVEGETATION	
17.	Develop rehabilitation plans for all sites to be intensively managed. These should include as a minimum the boundary of works, a planting list and native plants present that require protection.
18.	Only use plant species and forms of plants for rehabilitation if they would have naturally occurred at the sites.
19.	Prepare seed banks for all reserves for use in revegetation programs.
20.	For internal management purposes establish a monitoring program for indigenous species, with the location and abundance of species in very low abundance recorded.
21.	Document any locally occurring native species that are re-introduced to natural areas.
22.	Include large indigenous trees in annual planting programs.
23.	Incorporate all strata at the time of planting. Denser planting of herbs, sedges and rushes or smaller shrubs can be incorporated in the second or third year of revegetation.
24.	Where possible irrigate newly planted stock to ensure survival - generally between November and April.
25.	Create a detailed vegetation community map for each site with the specific species list for each zone based on the remnant vegetation in the area. Determine generic species abundance, cover and distribution per 100 m^2 and use this information to inform revegetation activities.
26.	Perform regular monitoring of revegetation and analyse success or otherwise of implemented works against site conditions including the climate variable.
WEED CONTROL	
27.	Use an integrated approach to weed control including herbicides, manual removal, modifying microclimates (in terms of shade, moisture etc) and biological controls (such as Bridal Creeper Leafhopper and the Rust, *Puccinia myrsiphylli*).
28.	Refer to the Department of Biodiversity, Conservation and Attractions (DBCA) Management Notes detailed on Florabase for target weeds species.
ASBESTOS	
29.	Asbestos if found in the bushland should be left alone and reported to the City.

30.	Develop asbestos management plans for the entire bushland sites of Allen Park and Shenton Bushland.
31.	Implement recommendations from asbestos management plans developed for Allen Park and Shenton Bushland.
PLANT PATHOGENS	
32.	Maintain hygiene protocols for Council operations and contractors within bushland reserves.
33.	Establish hygiene protocols for 'Friends of' group activities.
34.	Ensure that any soil or plant material used for bushland restoration is pathogen free.
35.	Minimise operations involving movement of soil, such as track construction and maintenance and carry out these operations under strict hygiene practices such as pressure cleaning machinery and vehicles.
36.	Ensure that nurseries contracted for revegetation programs are accredited by the Nursery and Garden Industry of Western Australia (NAISA) and are free of *Phytophthora*.
37.	When restoration work is undertaken begin in the reserves where *Phytophthora* has not been found and then proceed to other reserves.
38.	Ensure no soil or plant material is transferred between reserves or restoration sites by brushing excess soil off clothing, machinery and equipment, and sterilising with a 70% solution of methylated spirits.
39.	Ensure pruning equipment is sprayed with a 70% solution of methylated spirits (or similar) where plant pathogens are suspected or present.
40.	Ensure that any soil, mulch or plant material used for bushland restoration is certified pathogen-free according to Australian Standard AS4454 for Composts, Soil Conditioners and Mulches.
41.	Apply systemic and/or soil treatments (when funding is available) to vegetation that has tested positive to *plant pathogens* and surrounding vegetation, to prevent premature decline from pathogens and abiotic factors.
42.	Implement the Western Australian Dieback Signage System within bushland areas know to have *Phytophthora*.
FIRE MANAGEMENT	
43.	Fires bans should be instigated and maintained at all times.
44.	Reduce fuel loads through control of weeds such as Perennial Veldt Grass and manual fuel reduction techniques.
45.	Suppress and contain any wildfires as quickly as possible.
46.	Document fire history with the extent of fires mapped and dates and causes recorded.
47.	Control access into burnt areas as soon as possible after the fire. Access to any burnt areas should be limited to management vehicles only for the first six to twelve months.
48.	Monitor seed germination and regeneration of vegetation for two years following fire.
49.	Carry out an intensive weed control program after each fire and monitor weed and native species recolonisation to maximise native species establishment.
50.	Do not establish new tracks during firefighting operations.
51.	Provide a fire contingency fund in the natural areas budget for reactive weed management and tree pruning/removal following fires.
52.	Annually update Pre Fire Plans with DFES.

53.	Undertake maintenance of fire breaks and access points annually prior to 30th November.
54.	Undertake fuel load assessments and follow up fuel reduction techniques as required.
55.	Liaise with government agencies such as DFES and the DBCA to update and implement best practice fire risk methodology and guide the fuel load reduction program.
56.	Apply only coarse/chunky mulch or composted wood chips in landscaped areas as this form of mulch is less likely to ignite due to large particle size.
57.	In the event of restoration after fire events, apply assisted natural regeneration methodology first before planting tube stock revegetation (this is for areas that have *Good* to *Very Good* condition vegetation – *Degraded* areas will require tube stock revegetation).
ACCESS	
58.	Regularly prune along all paths to be retained.
59.	Maintain existing path networks and fencing.
60.	Install fencing between parkland and bushland/ecozone areas at Point Resolution and Birdwood Parade.
61.	Implement the City of Nedlands Natural Area Path Network Policy and Procedures.
62.	Undertake a geotechnical survey at Point Resolution and Birdwood Parade every five years.
63.	Continue to work with the Department of Defence to repair eroded pathways and fencing on Melon Hill.
64.	Investigate the installation of fencing along the Rugby Club and dog exercise ovals at Allen Park to reduce informal access.
65.	Undertake maintenance to beach fencing every 24 months.
66.	Install conservation fencing along Cleland Street at Mt Claremont Oval Bushland to reduce illegal access.
67.	Ensure ongoing revegetation along pathways to maintain good condition vegetation and prevent informal access.
68.	Install bollards on Sayer Street (adjacent to Defence Housing) to stop informal and illegal access.
COMMUNITY INVOLVEMENT	
69.	Continue to support the activities of bushland community groups by implementing the Bushland Friends Group Policy.
70.	Hold an annual event that brings all bushland community groups together rotating annually through different bushland areas.
71.	Provide assistance to help 'Friends of' groups remain sustainable through advertising and the volunteer referral centre.
FERAL ANIMALS	
72.	Continue to monitor and control feral animals using an integrated feral animal control program.
73.	Use baiting stations for feral rabbit control in preference to broad cast or trail baiting.
74.	Only undertake fumigation of fox warrens not rabbit warrens.
75.	Avoid using pavers or concrete slabs in natural areas which encourage Coastal Brown Ant infestations.

76.	Continue to control Coastal Brown Ants with maintenance of the Seaward Corridor undertaken biannually.
77.	Survey native and Coastal Brown Ant populations at Allen Park provided resources are available.
78.	Continue to work with other local governments and agencies to implement the regional feral animal control program.
79.	Minimise watering of bushland areas (where possible) to discourage Coastal Brown Ant infestations.
80.	Contribute to regional feral bird control programs.

4. INTRODUCTION

4.1 Purpose

This Management Plan outlines guiding information, strategies and management actions necessary to protect, enhance and restore natural areas and biodiversity within the City of Nedlands. Existing management plans have been reviewed and updated with actions provided for natural area management in the following natural areas:

Shenton Bushland
Allen Park Bushland
Point Resolution Bushland
Birdwood Parade
Hollywood Reserve
Mt Claremont Oval Bushland.

Smaller greenways exist within the City which fall under the City's Greenway Corridors Policy. These consist of small fragmented patches of urban bushland located in Mt Claremont and Swanbourne and along the River Foreshore and road reserves. Whilst these areas have not been directly addressed in this Management Plan the overarching management actions provided for rehabilitation, revegetation, feral animal control and weed control should be applied when restoration work is undertaken in these areas.

This Management Plan is intended to provide guidance to those involved in the management of the City's natural areas. This includes the Department of Defence (for Allen Park), Department of Health (for Shenton Bushland), City of Nedlands staff, volunteers and natural area friends groups.

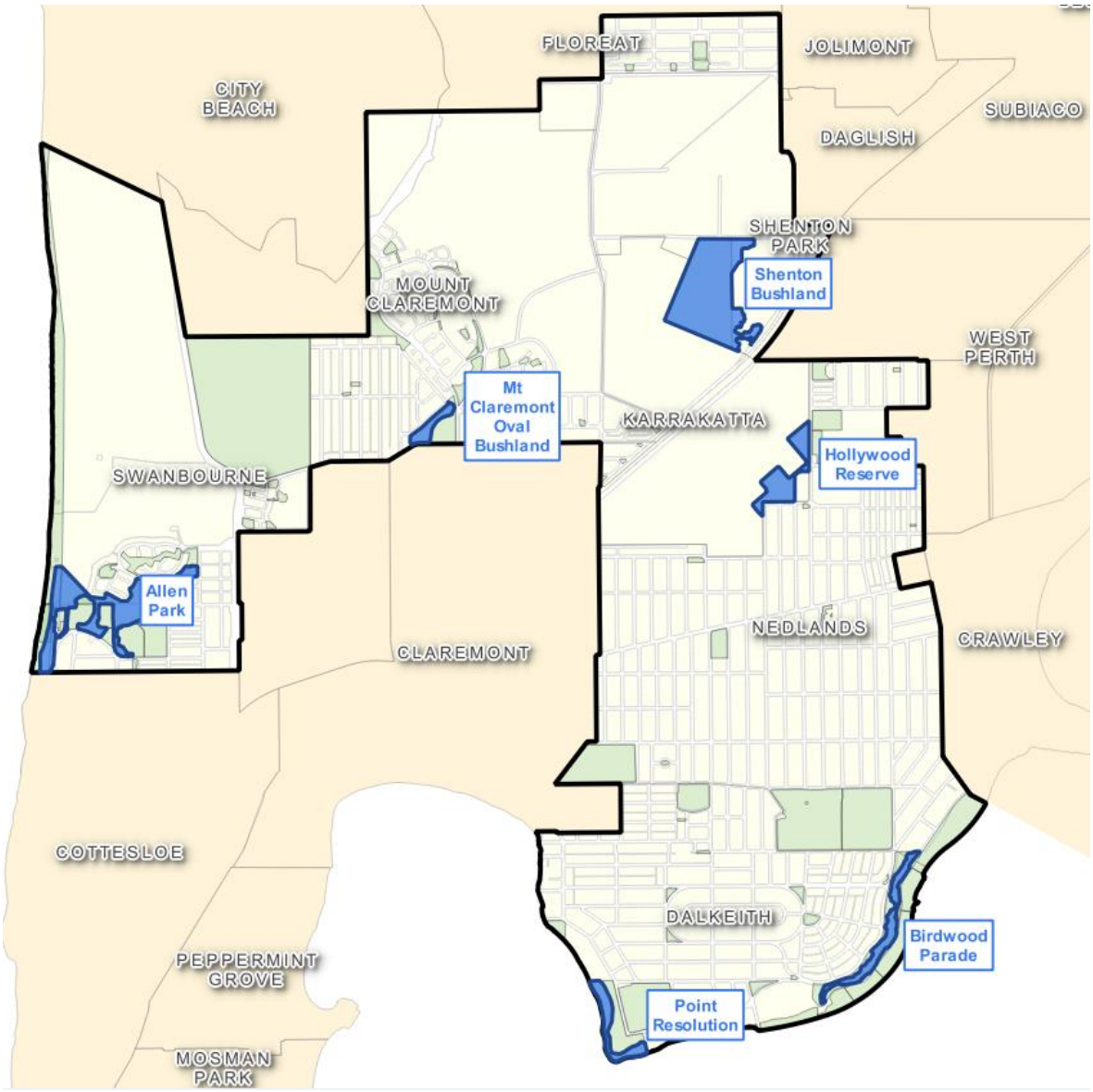
4.2 Natural Areas within the City of Nedlands

Natural areas can be areas of native vegetation, vegetated or open wetlands (lakes, swamps) or waterways (rivers, streams, creeks and estuaries - often referred to as channel wetlands), springs, rock outcrops, bare ground (generally sand or mud), caves, coastal dunes or cliffs (adapted from Environmental Protection Authority, 2003a (PBP and WALGA, 2004)).

The City has six natural areas which are all actively managed. They include coastal, riverine and inland natural areas which cover approximately 60 hectares (ha) as listed below:

- Shenton Bushland 24.57 ha located in Shenton Park (of which 3.46 ha is vested in the Department of Health and 0.11 ha Department of Education)
- Allen Park Bushland 18.9 ha located in Swanbourne (of which 2.9 ha is vested in the Department of Defence)
- Point Resolution Bushland 4 ha located in Dalkeith
- Birdwood Parade 5.7 ha located in Dalkeith
- Hollywood Reserve 6.41 ha located in Nedlands
- Mt Claremont Oval Bushland 2.21 ha located in Mt Claremont.

Figure 1: Location of Natural Areas within Nedlands



The City's natural areas provide a variety of environmental, social, recreational and cultural values for the local and wider community.

4.3 Threats to Natural Areas

The key threats to the City's natural areas include:

- Environmental weeds
- Plant pathogens
- Feral animals
- Fire
- Illegal dumping and access
- Climate Change.

5. PLANNING CONTEXT

5.1 Introduction

To ensure this Management Plan is consistent with other local, regional and national management initiatives, relevant documents, guidelines and policies have been reviewed with brief outlines of these documents provided below.

5.2 Vesting

Metropolitan Region Scheme (MRS) and Local Planning Scheme No. 2 (LPS No.2)

The majority of large natural areas are classed as Regional Reserves for the purpose of Parks and Recreation under the MRS. Where Reserved under the Local Planning Scheme they are classed as Local Reserves for the purpose of Recreation or Public Purposes.

Allen Park is classed as "Public Purposes" (limited to Defence owned land) and all other areas "Parks and Recreation" and under the MRS, it also carries a Recreation reserve under LPS No.2. Mt Claremont Oval Bushland carries a Recreation reserve under LPS No.2.

Local Planning Scheme No. 3 (LPS No.3)

Regional Reserves are unaffected by the introduction of LPS3. The Local Reserves remain reserved under LPS 3, however updated terminology has been applied. A portion of Allen Park, previously Recreation, is reserved for the purpose of "Environmental Conservation". Mt Claremont Oval was previously reserved as "Recreational", however it now carries a Recreation and "Public Open Space" designation.

Shenton Bushland

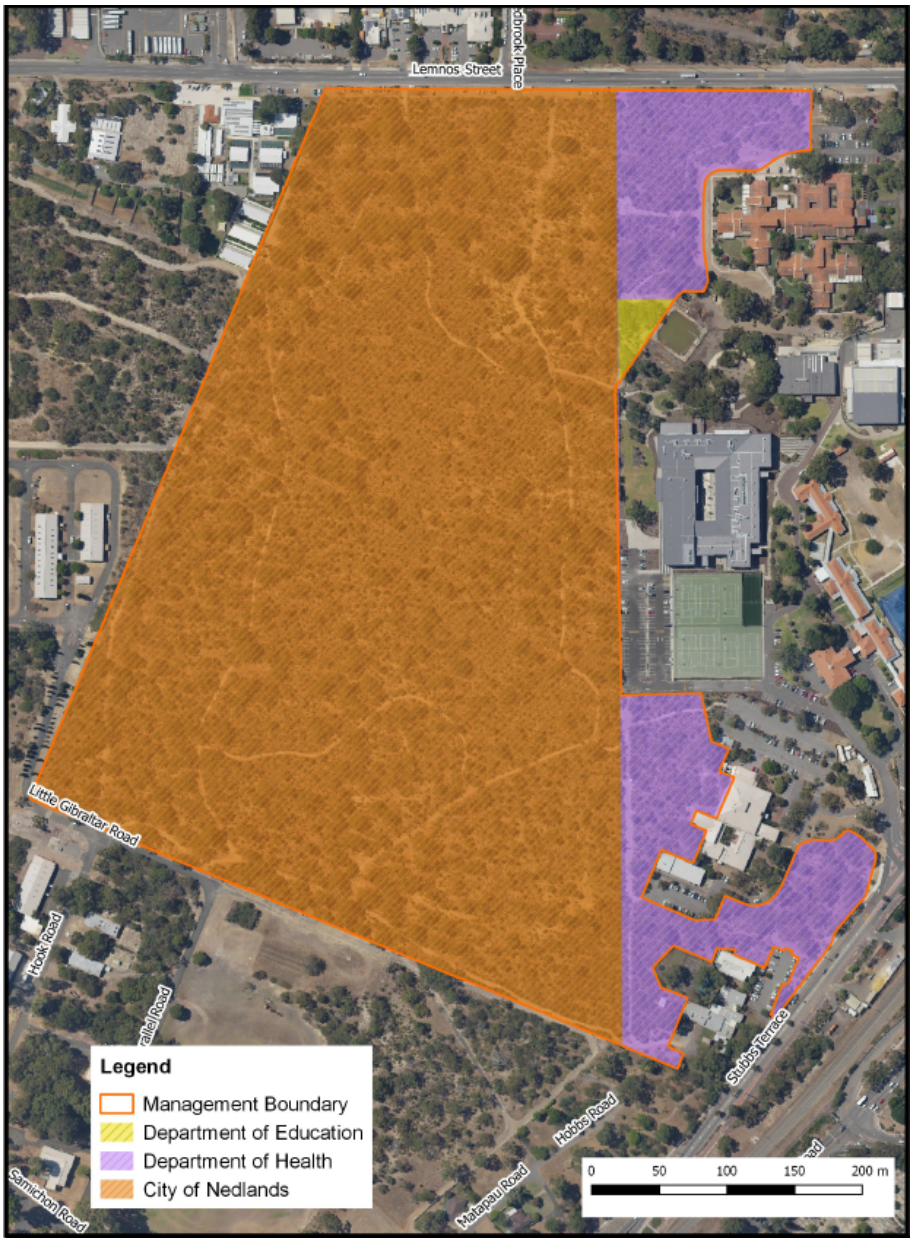
Shenton Bushland contains A Class Reserve 43161 vested in the City of Nedlands for "Conservation and Recreation" it covers an area of approximately 21 ha. Prior to 1993 this Reserve was vested with the State Government for "Health Purposes".

Shenton Bushland also contains C Class Reserves 20074 and 53001 which are vested with the Department of Health for "Health Purposes – Hospital and Allied Purposes". Reserves 20074 and 53001 cover an area of approximately 8 ha of which approximately 3.46 ha consists of bushland. A 1 ha portion of Reserve 20074 that was previously vested with the Department of Health was transferred to the Department of Education in 2016 for the development of additional school buildings at Shenton College. Following the land transfer the Health Department owned bushland was then split into two Reserves (20074 and 53001).

The remaining 3.46 ha of bushland located on Reserves 20074 and 53001 is cooperatively managed between the City of Nedlands, the Friends of Shenton Bushland and the Department of Health. Memorandums of Understanding (MOUs) between the City and the Department of Health have been in place since 2013. These MOUs outline the Department of Health's financial contribution towards natural area management on Reserves 20074 and 53001, the current MOU is due to be reviewed in 2022. A small area of bushland (0.11 ha) is also owned by the Department of Education on the north eastern edge of the Shenton College site. This small portion of bushland is located outside the school boundary fencing and is

vested for “School” purposes. Shenton Bushland vesting is detailed in Figure 2 below.

Figure 2: Vesting Shenton Bushland



Allen Park

The bushland in Allen Park covers an area of 18.9 ha. Allen Park consists of a number of A and C Class reserves, which are primarily vested in the City of Nedlands for “Recreation”, “Parks and Recreation” or “Drainage” (refer to Table 2). Under current vesting the City of Nedlands has the “Power to Lease” on Reserves 19283, 7804 and 19349 which all are A Class reserves.

Lot 1 (which contains Bush Forever Site 315) is Freehold land owned by the City. It is actively managed in conjunction with the Swanbourne Coastal Alliance. Lot 1 has received significant funding through the Western Australian Planning Commission’s Coastwest Program.

The northern 2.9 ha portion (Melon Hill) is owned by the Commonwealth of Australia and vested with the Department of Defence for "Public Purposes". The Department of Defence, the City of Nedlands and the Friends of Allen Park have cooperatively managed this section of Allen Park since 1994. Allen Park (including Defence owned land) has received significant funding through the Natural Heritage Trust, Lotterywest and the Western Australian Local Government Association (WALGA) Perth Biodiversity Project over the years. The Friends of Allen Park do not distinguish between the different vesting arrangements in terms of on ground works.

Table 2: Vesting Allen Park Bushland

Reserve Number(s)	Vesting	Class
Reserve 19283 Part of Boobook Sector, bushland between Sayer Street including Tom Fricker and Mayo cottages.	"Parklands and Recreation". Contains "Power to Lease" for any term not exceeding 21 years subject to Minister for Lands.	Class A
Reserve 19349 Part of South Melon Hill.	Vested for "Recreation" Contains "Power to Lease" subject to consent from Minister for Lands.	Class A
Reserve 23729 Primary dunes along Marine Parade to Lot 1	Vested for "Recreation"	Class C
Lot 149 (9 Sayer Street) Reserve 19842	Vested for "Parklands and Recreation"	Class C
Reserve 27250 Primary dunes north from Cafe to Campbell Barracks including part of Bush forever Site 315.	Vested for "Recreation"	Class A
Lot 1 on Diagram 24967 includes part of Bush Forever Site 315	Registered Proprietor – City of Nedlands	Freehold land
Lot 131 91 Wood Street	Registered Proprietor – City of Nedlands	Freehold land
Lot 301 on DP22248 North Melon Hill and Seaward Corridor	Registered proprietor – Commonwealth of Australia	Freehold land
Reserve 7804 Odern Crescent, Flyash Hill, Friends of Allen Park, Tom Collins and Mattie Furphy Cottages and part of South Melon Hill.	Vested for "Parks and Recreation" Contains "Power to Lease" subject to consent from Minister for Lands.	Class A
Lot 1003 Reserve 47253 Boobook Sector and Jones Park	Vested for Drainage	Class C
Lot 353 The Walkway between Sayer and Wood Street	Proposed Vesting for "Recreation"	A Class

Figure 3: Land Ownership and Vesting Allen Park Bushland

Hollywood Reserve

Hollywood Reserve is vested in the City of Nedlands as A Class Reserve 32545 for "Gardens and Parks" it covers an area of 6.41 ha.

Birdwood Parade

The Bushland at Birdwood Parade covers an area of approximately 5.7 ha. Birdwood Parade is vested in the City of Nedlands as A Class Reserve 1624 for "Parks and Recreation". Currently, the City of Nedlands has the "Power to Lease" on Reserve 1624. Birdwood Parade falls within the Department of Biodiversity, Conservation and Attractions DBCA Development Control Area. The DBCA provides advice, considers and makes recommendations on development and land use applications that affect the Development Control Area.

Figure 4: DBCA Development Control Area Birdwood Parade

Point Resolution

The bushland at Point Resolution covers an area of approximately 4 ha. Point Resolution is vested in the City of Nedlands as A Class Reserve 17391 for “Parks and Recreation”. The City of Nedlands has the “Power to Lease” on Reserve 17391. Like Birdwood Parade, Point Resolution also falls within the DBCA Development Control Area. The DBCA provides advice, considers and makes recommendations on development and land use applications that affect the Development Control Area.

Figure 5: DBCA Development Control Area Point Resolution

Mt Claremont Oval Bushland Reserve

Mt Claremont Oval Bushland covers an area of approximately 2.21 ha. Mt Claremont Oval Bushland is vested in the City of Nedlands as A Class Reserve 26102 for “Parks and Recreation”. The City of Nedlands has the “Power to Lease” on Reserve 26102.

Whilst many of the City’s six natural areas contain the “Power to Lease” on their management orders they are all highly valued for their conservation attributes. Therefore, their management boundaries are considered “Special Protection Zones” regardless of the “Power to Lease” on their Management Orders

5.3 Local Government Context

City of Nedlands Strategic Community Plan 2018-2028

This plan builds on the Strategic Community Plan 2013-2023. It represents the communities long term vision, values, aspirations and priorities for the City of Nedlands over a ten year (plus) period.

The Strategic Community Plan refers to “Great Natural and Built Environment” this relates to:

- A vision that “Our city will be environmentally sensitive, beautiful and inclusive place”.

- That our values include “We protect our enhanced, engaging community spaces, heritage, the natural environment”.
- That our priorities include “Retaining Remnant Bushland and Cultural Heritage”.

Retaining Remnant Bushland and Cultural Heritage was identified as Strategic Priority 4. Several key actions were identified in the plan to contribute to retaining remnant bushland and cultural heritage as a strategic priority they are listed below:

- Revegetate remnant bushland areas
- Develop greenway corridors
- Undertake tree planting in public areas
- Restore coastal and estuarine areas
- Maintain parks and other green spaces
- Provide a mechanism for buildings and places of heritage significance to be protected
- Allocate funds to enhance the City in the areas of art, heritage etc
- Maintain City-owned art works and heritage assets
- Enforce existing heritage provisions in planning scheme.

Allen Park Masterplan 2017

The Allen Park Master Plan provides a long-term planning framework for the sustainable development of the Allen Park Precinct. Long term concept plans were developed to maximise opportunities for active and passive recreation for the whole community. Concepts identified that will affect the bushland areas at Allen Park include the conversion of part of Swanbourne Beach oval and the overflow car park behind the Rugby Club to bushland and possible expansion of the tennis courts along Clement Street removing vegetation in the Odern Crescent Sector.

Strategic Asset Management Strategy 2013-2023 (currently under review)

This strategy provides direction for the development of asset management plans for the major asset classes within the City and forms part of the City’s fulfilment to the Integrated Planning and Reporting Framework, implemented by the State Government’s Local Government Reform Program.

City of Nedlands Urban Forest Strategy 2018-2023

The Urban Forest Strategy 2018-2023 outlines the City's vision and priorities for a green and thriving urban forest. The urban forest is the collection of green spaces, trees and other vegetation that grow within the urban area. It provides a range of social, environmental and economic benefits that enriches quality of life such as providing shade, reducing surface temperatures and contributing to a visually appealing streetscape. Implementation of the City’s natural area Management Plans assists in meeting the City’s urban forest strategy priorities.

Corporate Business Plan 2013-2017

The Corporate Business Plan was developed and adopted to deliver the 2023 Community Strategic Plan. The Strategic Community plan highlighted the community’s focus on improving the knowledge of asset condition and implementing a pro-active asset management program.

Greenways Policy

The aim of the City's Greenways Policy is to link natural and built environments to provide for greater biodiversity and sustainability. The City of Nedlands' Greenways Policy was approved in 2001 following public consultation with residents. The Greenways Policy identifies land where action can be taken to enhance local and regional ecological corridors by connecting natural areas, parklands and verges.

All the City of Nedlands' natural areas managed for conservation and restoration are considered local greenways along with small fragmented bushland remnants in Mt Claremont, Swanbourne and the river foreshore. Allen Park, Birdwood Parade, Point Resolution and Shenton Bushland form part of regional greenways along with some of the small fragmented bushland remnants in Mt Claremont, Swanbourne and the river foreshore.

Community Friends Group Policy

The City of Nedlands aims to work collaboratively with residents who are prepared to form a Community Friends Group to assist in natural area management and/or wildlife protection within the City. This policy outlines the process by which Community Friends Groups assist in the care of natural areas and wildlife within the City.

Illegal Clearing of Vegetation Policy

This policy outlines how the City of Nedlands will respond to illegally removed vegetation from its parks and reserves. The purpose of this policy is to discourage unauthorised removal of vegetation through the use of signage and prosecution. This policy also encourages community members to report illegal damage to vegetation on public land.

Natural Area Path Network Policy

This policy outlines how the City of Nedlands will upgrade the natural area path network within the City to an acceptable standard in accordance with Australian Standards (where possible). The path upgrade process will be in accordance with fire protection strategies, integrate a hierarchy of paths for pedestrians and cyclists and meet its obligations under the Disability Access and Inclusion Plan (where possible) in consultation with bushland community groups .

City of Nedlands Natural Area Management Plans 1980-2018

Several natural area Management Plans have been developed for the City of Nedlands to guide restoration and protection of the City's natural areas. They include:

- Natural Areas Management Plan 2013-2018 (City of Nedlands, 2014)
- Shenton Bushland Management Plan 2013-2018 (City of Nedlands, 2014)
- Allen Park Management Plan 2013-2018 (City of Nedlands, 2014)
- Hollywood Reserve Management Plan 2013-2018 (City of Nedlands, 2014)
- Birdwood Parade Management Plan 2013-2018 (City of Nedlands, 2014)
- Point Resolution Management Plan 2013-2018 (City of Nedlands, 2014)
- Mount Claremont Oval Management Plan 2013-2018 (City of Nedlands, 2014)
- Allen Park and Environs Management Plans (Ecoscape, 1996) and reviewed plan 2005-2010

- Shenton Bushland Management Plan (Ecoscape, 1996) and reviewed plan 2005-2010
- Foreshore Bushland Reserves Management Plan 2003-2009 (Ecoscape, 2003)
- Phytophthora Dieback Management Plan (City of Nedlands, 2008)
- Natural Area Initial Assessments (Orsini, 2008)
- Management of Phytophthora Dieback at Shenton Bushland (Zuvela, 2002)
- Birdwood Parade Management Plan (Bunny, 1993)
- Point Resolution Management Plan (Ecoscape, 1991)
- Point Resolution Management Plan (Ecoscape, 1991)
- Nedlands Foreshore Plan (Ralph Stanton Planners, 1983).

Municipal Heritage Inventory for the City of Nedlands (October 2018)
The Municipal Heritage Inventory identifies and describes historical places within the City with cultural heritage significance. It also provides details which describe why each listed property or place is special.

It identifies a number of significant sites within Birdwood Parade Reserve (adjacent to bushland) including the: Dalkeith/Nedlands Foreshore, Sunset Hospital and Gallop House.

The entire Point Resolution Reserve is a significant site along with Shenton Bushland and the adjacent Irwin Barracks Magazine and Lemnos Hospital and Pine Trees.

Areas identified as significant sites also include Karrakatta Cemetery, Commonwealth War Cemetery and Tom Collins Group (Tom Collins House, Mattie Furphy House, Mayo House and Friends of Allen Park Cottage).

City of Nedlands Heritage List (Dec 2017)
Under the Planning and Development (Local Planning Schemes) Regulations 2015 – Schedule 2 Deemed Provisions, a local government must establish and maintain a Heritage List to identify places within the Scheme area that are of cultural heritage significance and worthy of built heritage conservation. Parade The heritage list identifies significant heritage sites within or adjacent to the City's natural areas to be Gallop House, Sunset Hospital, the War Memorial, the Allen Park Cottages and Shenton Park Rehabilitation Hospital.

Western Suburbs Greening Plan (Western Suburbs Regional Organisation of Councils – Ecoscape, 2002)
The Greening Plan sets out a framework to maintain and enhance linkages between open space, parks and recreational areas and bushland areas to enhance the ecological processes and the amenity of the Western Suburbs. The foredunes in Allen Park are identified as part of the 'Coastal Link' Regional Greenway and the remainder of Allen Park as an area for securing part of the greenway network. Shenton Bushland and Hollywood Reserve are part of the regional greenway linking Kings Park to Bold Park. Point Resolution and Birdwood Parade are identified as part of a regional river foreshore link from Kings Park to Fremantle. Mt Claremont Oval Bushland forms part of a greenway linking Bold Park and Lake Claremont.

Foreshore Management Plan for the Swan River Estuary in the Western Suburbs of Perth 2016
This long term foreshore Management Plan undertook a detailed vulnerability assessment and identified actions for each local government area. The aim the of the plan is to assist local governments plan for foreshore structure maintenance, renewal and capital works over a range of timescales to reduce the reliance on reactive management.

5.4 State Government Context

Aboriginal Heritage Act 1972
This Act makes provisions on behalf of the community for the preservation of places and objects used by or traditional to the original inhabitants of Australia or their descendants.

There are no registered significant sites in any of the City's natural areas. However, the entire Swan River is a registered site and there are "Other Significant Heritage Places" to the north of Point Resolution, close to Mt Claremont Oval Bushland and possibly four in the surrounding area of Shenton Bushland. Significant sites, regardless of whether they are they are registered or not, are protected under the Aboriginal Heritage Act, 1972.

Biosecurity and Agriculture Management Act 2007 (BAM Act)
The purpose of the BAM Act is to prevent new animal and plant pests and diseases from entering Western Australia, as well as managing the impact and spread of pests already present. The Act also governs the safe management and use of agricultural and veterinary chemicals and products.

Cat Act 2011
The Cat Act makes provisions for the control and management of cats and encourages the responsible ownership of cats.

Bushfires Act 1954
This Act makes provisions for prevention, control and extinguishment of bush fires and diminishing the dangers resulting from bush fires.

Conservation Reserves for Western Australia – System 6 (Department of Conservation and Environment, 1983)
The System 6 Conservation Reserve System developed by the Department of Conservation and Environment (1983) was the precursor of the Bush Forever Policy. Point Resolution Reserve and the foredunes at Allen Park were included in the System 6 Conservation Reserve System.

Perth and Peel @ 3.5 Million and Central Metropolitan Perth sub-regional Strategy
This overarching document builds on the vision laid down in Directions 2031 and Beyond and provides a link across the four sub-regional land use planning and infrastructure frameworks that define the Perth and Peel spatial plan for the next 30 years.

The frameworks adhere to the principles detailed in Directions 2031 and Beyond. They are recognised under the State Planning Framework (State Planning Policy No.

1) and are to be taken into account when preparing and reviewing strategies, policies and plans. They provide clear, definitive direction and guidance to government agencies and local governments on land use, land development, environmental protection, infrastructure investment and the delivery of physical and social infrastructure.

The vision for Perth and Peel is - a great, connected city that is globally competitive and technologically advanced; that is sustainable, resilient and respects its natural assets and heritage that maximises the use of new and existing infrastructure; that offers a mix of housing and lifestyle choices; and that respects and acknowledges the regions' sensitive natural environments and their respective ecosystems.

The Central Metropolitan Perth sub-regional strategy recognises the size and complexity of strategic planning for the metropolitan area. A sub-regional strategy provides the opportunity to provide guidance at the local level.

A strategic priority of these documents that directly relates to this Plan is to:

"Protect our natural and built environments and scarce resources; respond to social change and optimise the land use and transport conditions that create vibrant, accessible, healthy and adaptable communities."

This priority recognises the importance of strategic planning integrating the key environmental principles of environmental protections, natural resource management and sustainability.

Heritage of Western Australia Act 1990

Tom Collins and Mattie Furphy House at Allen Park and Gallop House at Birdwood Parade are listed on the State Register of Heritage Places.

The State Register of Heritage Places was established by the Heritage of Western Australia Act 1990 to ensure that places are recognised for their value and importance to the State and to promote their conservation into the future.

The Register is managed by the Heritage Council of Western Australia with the assistance of the State Heritage Office. Entry in the State Register means that any changes or works proposed for the place need to be referred, usually by the responsible local government, to the Heritage Council for advice.

National Trust of Australia (W.A) Act 1964

The Register includes places such as natural precincts, landscapes, buildings and cemeteries which the Trust determines as having heritage significance and being worthy of conservation. Listing by the National Trust W.A is as an authoritative statement of the heritage significance of a particular location and is not legally binding on the landowner.

State Planning Policy 2.8

State Planning Policy 2.8 – Bushland Policy for the Perth Metropolitan Region was prepared under the *Planning and Development* Act 2005. This is a strategic policy

guiding State and local planning systems. One of the key initiatives of this policy is the listing of properties under the State planning requirements of the 'Bush Forever' Policy.

Western Australian Planning Commission Bush Forever Policy 2000
The Bush Forever Policy replaces the Conservation Reserve System 6 recommendations as a blueprint for conservation of bushland of regional significance in the Perth Metropolitan Region. Bush Forever was prepared by the Department of Environmental Protection, Ministry for Planning, CALM and the Water and Rivers Commission and was endorsed by Cabinet and supported by the Environmental Protection Authority as the principle mechanism to identify and protect regionally significant bushland in the Perth Metropolitan Region.

The City has three Bush Forever Sites. These include:

- Shenton Bushland - Site 218
- Allen Park - Site 315 (north-western most portion – including Lot 1)
- Point Resolution - Site 221.

Biodiversity Conservation Act 2016
The Biodiversity Conservation Act and associated regulations replaced the outdated Wildlife Conservation Act 1950 and the Sandalwood Act 1929 in January 2019.

The Biodiversity Conservation Act provides the legislation relating to conservation and protection of flora and fauna. Six fauna species that are listed as "*Specially Protected"* under the Biodiversity Conservation Act are known to utilise the City's natural areas. They include Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) which are listed as Schedule 2 (*Endangered*), Forest Red-tailed Black-Cockatoos (*Calyptorhynchus banksii naso*) which are listed as Schedule 3 (*Vulnerable*) and the Grey Plover (*Pluvialis squatorola*), Common Sandpiper (*Actitis hypoleucos*), Common Greenshank (*Tringa nebalaria*) and Caspian Tern (*Hydropogne caspia*) which are listed as Schedule 5 *(Migratory).*

Four plant species that are listed as "*Specially Protected"* under the Biodiversity Conservation Act are known to occur within the City's natural areas. These include *Chamelaucium sp.* Gingin and *Acacia denticulosa (*Sandpaper Wattle) which are listed as Schedule 3 *(Vulnerable)* and *Eucalyptus crucis* subsp*. Crucis (*Southern Cross Silver Mallee) and *Grevillea curviloba subsp. Incurve* which are listed as Schedule 2 *(Endangered*). All four "*Specially Protected"* flora species have historically been planted in Hollywood Reserve and are located outside of their normal range.

Swan and Canning Rivers Management Act 2006
The Swan and Canning Rivers Management Act 2006 established the area covered by the Swan Canning Riverpark and sets out guidelines for government, industry and the community to work together to protect the Swan and Canning river systems.

5.5 Federal Government Context

Australia's Biodiversity Conservation Strategy 2010-2030
This Strategy provides the framework for the conservation of Australia's biodiversity.

Environmental Protection and Biodiversity Conservation Act, 1999 (EPBC Act)

The EPBC Act enables the Australian Government to protect matters of national environmental significance. The Threatened Ecological Community "*Banksia Woodlands of the Swan Coastal Plain*" exist at Shenton Bushland. Other areas this Threatened Ecological Community may exist include Birdwood Parade and Hollywood Reserve. None of the City's bushland areas have been assessed in accordance with the EPBC Act *Approved Conservation Advice.* Currently "*Tuart Woodlands and Forests of the Swan Coastal Plain*" are being assessed as a *Critically Endangered* Ecological Community. If this listing is approved then parts of Allen Park will be recognised as *Critically Endangered* under Federal Legislation.

Four flora species listed under the EPBC Act occur in the City's natural areas. These include *Acacia denticulosa (*Sandpaper wattle) and *Eucalyptus crucis* subsp*. Crucis (*Southern Cross Silver Mallee) which are listed as *Vulnerable* and *Chamelaucium sp*. Gingin and *Grevillea curviloba subsp. Incurve* which are listed as *Endangered*. All four species have historically been planted in Hollywood Reserve outside of their normal range.

Seven bird species that occur in the City's natural areas are listed under the EPBC Act. These include the Carnaby's Black-Cockatoo *(Calyptorhynchus latirostris)* which is listed as *Endangered, the* Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii)* which is listed as *Vulnerable*, the Rainbow Bee-eater *(Merops ornatus)*, which is listed as *Marine*; and the Grey Plover (*Pluvialis squatorola*), the Common Sandpiper (*Actitis hypoleucos*), the Common Greenshank (*Tringa nebalaria*) and the Caspian Tern (*Hydropogne caspia*) which are listed as *Marine* and *Migratory* species.

The City of Nedlands has four confirmed Carnaby's Black-Cockatoo roosting sites they include:

- Adelma Rd Dalkeith (NEDDALR003)
- Hollywood Hospital Site Nedlands (NEDNEDR001)
- Edward and Archdeacon Streets, Nedlands (R002)
- Birdwood Parade, Dalkeith (NEDDALR002).

There is one unconfirmed roost site near Melvista Avenue and Mountjoy Road, Dalkeith (NEDDALR004). There are also areas included in the roosting buffer of adjacent roosting sites located on the boundary of Nedlands, they include:

- Rear Trinity College, Crawley (NEDNEDR003)
- Perry Lakes, Floreat.

Carnaby's regularly forage in all the City's natural areas. A flock of Forest Red-tailed Black-Cockatoos also roost on University of Western Australia owned land near McGillivray Oval. Forest Red-tailed Black-Cockatoos are regularly seen foraging in Shenton Bushland, Hollywood Reserve and Allen Park. Rainbow Bee-eaters migrate annually in summer to Perth from parts of northern Australia, Papua New Guinea and some Indonesian Islands. They nest in Perth's sandy soils and have been found in Shenton Bushland, Allen Park, Birdwood Parade and Point Resolution.

Regional Weed Control Strategy (Department of Defence, 2006)

The Department of Defence manages land adjacent to Shenton Bushland and within Allen Park. This strategy identifies the role of individual landholders, including the Department of Defence as needing to:

- Understand that weeds are an important factor in land degradation
- Allocate sufficient resources to manage weeds to a practical level
- Detect and report new weed occurrences
- Understand land use activities and the cause/effect relationships which apply to weed problems
- Integrate economic and environmental values in the management of weed problems on their land
- Co-operate with and, where relevant, plan weed management activities jointly with neighbours; and support and promote sustainable production practices to minimise the development of weed problems
- Support and promote sustainable operational practices to minimise the development of weed problems.

As a public land manager, the Department of Defence has a role to:

- Participate in local and regional weed management programs
- Provide the community with information on weed management issues
- Participate in the development of codes and policies which will reduce the impact of weeds.

As both a landholder and land manager, the Department of Defence should recognise that effective weed management can only be achieved through a coordinated approach involving all levels of government, industry, community and individual landholders.

5.6 International Union for Conservation of Nature (IUCN)

The IUCN Red List of Threatened Species provides taxonomic, conservation status and distribution information on plants and animals that have undergone an extinction risk assessment using the IUCN Red List Categories and Criteria. The Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) is IUCN Red Listed species as 'Endangered'. Carnaby's Black-Cockatoos forage in all of the City's Natural Areas. The native plant *Jacksonia sericea* is also IUCN Red Listed as 'Endangered'. *Jacksonia sericea* occur in Shenton Bushland, Hollywood Reserve and Point Resolution.

Management Actions 2019-2024	
1.	All six natural areas identified in this Management Plan that are managed by the City for conservation are considered "Special Protection Zones" regardless of the "Power to Lease" on Management Orders.

6. PHYSICAL ENVIRONMENT

6.1 Climate

The climate of the City of Nedlands is typically Mediterranean, with mild wet winters and long hot dry summers. The rainfall is moderate and highly seasonal with an average of approximately 733 mm most of which occurs between May and September (Perth Metro weather station, BOM, 2018). The maximum rainfall is usually recorded in the month of July, with an average of around 145 mm. The mean maximum temperatures range from 31 °C in February to a mild 18°C in July, while mean minimum temperatures range from 1618 °C in February to 8°C in July. Evaporation generally exceeds the rainfall for eight to nine months of the year from September through to May. The winds in Nedlands are strongest during the summer months with strong easterly winds in the morning, swinging to strong south–westerly winds in the afternoons. In the winter months the winds are generally much lighter except for strong westerly and north–westerly winds associated with rain–bearing depressions.

6.2 Climate Change

Background

The Earth's climate has changed over the last century and it has the potential to adversely affect the environment, communities and the economy. Local, state and federal governments have recognised the need to work together to adapt and reduce their contribution to the impacts of climate change.

The latest report on the State of the Climate – 2018 (CSIRO and BOM, 2018) indicates that Australia's climate has warmed just over 1°C since 1910, and the frequency of extreme weather has changed, with more extreme heat and reduction in rainfall for southern Australia. For the southwest, April to October rainfall has decreased significantly with May – July rainfall having decreased by around 20 per cent since 1970 (CSIRO and BOM, 2018). In addition to the above, warming and acidification of the oceans, as well as an increase in sea level rise are also reported. These changes are on par with the observed variations in global climate (IPCC) (2014, 2018).

The future forecasts from both national and international studies and modelling (IPCC, 2014, 2018 and CSIRO and BOM, 2018) suggest:

- Further increases in temperature (both air and oceans) with global temperature increases likely to reach 1.5°C between 2030 and 2052 (IPCC, 2018)
- Increased number of hot days and fewer cool extremes
- Extended fire season with more extreme fire weather
- Further increases in sea levels and acidification
- Changes in rainfall patterns.

For southern Australia, a decrease in rainfall and extended drought periods with reductions in streamflow are predicted; alongside an increase in intense heavy rainfall events.

Swan River and the Indian Ocean

In general, the water levels in the Swan River and the Indian Ocean vary due to seasonal and inter-annual fluctuations in climate (El Niño/Southern Oscillation or

ENSO), tides and storm surges. While each fluctuation is of similar scale with height increases between 0.2 to 0.5 m (SRT, 2007), changes in climate can severely affect these levels and the overall health and biodiversity of the water bodies particularly the Swan River.

Some of the effects climate change already has and will continue to have on the Swan River are:

- Reduced rainfall contributing to low streamflow and freshwater input from both surface and groundwater inflows
- Increased water levels due to sea level rise
- Increased flooding due to intense heavy rainfall events in combination with sea level rise and natural variations in climate
- Changes in water quality resulting in salinity, elevated water temperature and nutrient loading (from sediments)
- Changes in flora and fauna assemblages associated with the Swan River and the Indian Ocean foreshore
- Erosion of lower foreshore (or primary and secondary dunes) undercutting or overtopping of banks and loss
- Loss of infrastructure (recreational, servicing and housing).

The changes in sea level rise as a result of climate change have been recently analysed with respect to the new 100 year ARI (Average Recurrence Interval) flood levels for development in the Swan and Caning River floodplains (Department of Water (DoW) and (URS, 2013). The levels presented below include the maximum water level for the area of the river next to Point Resolution including the mean sea level rise wind set up. The wind set up refers to the effect of the wind on tide levels during storm surges (i.e. elevation in the direction towards which the wind is blowing).

100 year ARI “Present Day”	1.47 mAHD (Australian Height Datum)
100 year ARI Future (2110)	2.26 mAHD

This rise in potential flooding, although likely to be infrequent, has the capacity to impact foreshore vegetation negatively and limit revegetation opportunities.

Impacts on Biodiversity

Climate change poses a significant threat to the City’s natural areas. The predicted warmer and drier conditions are expected to have an impact on survival and persistence of native flora and fauna. This is likely to result with changes in the structure and composition of vegetation and fauna communities (e.g. opportunistic exotic species may replace native species or dominance of certain native species may increase causing shift in diversity).

The condition of remnant bushland is likely to decline, and the protection of vulnerable foreshore areas is likely to be impacted further by the increasing mean sea level, storm surges, decrease in streamflow and groundwater levels, and changes in water chemistry (e.g. salinity). Revegetation programs will become an ongoing challenge and restoration programs will need to adapt to ensure plant survival.

While facing climate change is continuing, adaptation and mitigation strategies are increasingly used to manage climate change effects. The City's actions are in line with the current trends as outlined in the in the Australian Biodiversity Conservation Strategy 2010-2030 (NRMMC, 2010). One of the key actions is to build ecosystem resilience so it can adapt to changes and disturbances and disturbances resulting from climate change. Maintaining natural areas and creating ecological linkages is the most effective strategy to build resilience and provide for species migration and protection.

Undertaking ongoing natural area management activities will also build ecosystem resilience by reducing existing threats to natural areas such as feral animals and environmental weeds and by increasing the connectivity and protection of fragmented landscapes. Maintaining a comprehensive, adequate and representative reserve system is the best way to secure the habitats of vulnerable species (DEWHA 2009).

Some of the key documents outlining climate change actions for City of Nedlands are listed below:

Relevant Documents

Carbon Inventory and Management Report Baseline year 2010/2011
This report summarised the findings from a baseline inventory that was completed by the City and recommended actions towards a Carbon Management Plan. This inventory has measured the baseline year for the City of Nedlands' carbon emissions, and aims to develop carbon mitigating actions by the City. The footprint measured was 2504.46 tonnes of carbon dioxide equivalent emissions for the 2010/2011 financial year.

WESROC Regional Climate Change Adaptation Action Plan 2010-2011
Coastal Zone Management developed a Climate Change Risk Assessment and Adaptation Plan for WESROC in 2010. This Plan outlines actions that are to be completed on a local and regional basis.

City of Nedlands Climate Change Local Adaptation Action Plan 2012-2017
This Local Adaptation Plan accompanies the WESROC Regional Climate Change Adaptation Action Plan 2010-2011 developed by Coastal Zone Management. It identifies adaptive actions for the City over a 20 year period across all divisions within the City.

The following actions for natural areas have been compiled from the Climate Change Local Adaptation Action Plan 2012-2017 and are listed below:

Table 3: Natural Area Actions from the Climate Change Local Adaptation Action Plan 2012-2017

ACTIONS	
1.	Work with Natural Area Friends Groups on Climate Change strengthening activities such as monitoring, adaptation work and raising community awareness.

2.	Develop partnerships with agencies to enhance and respond to Climate Change such as the Swan River Trust and Department of Planning, Lands and Heritage (DPLH).
3.	Continue to implement the WESROC Greening Plan and Greenway Corridors Policy to create ecological corridors and protect natural areas.
4.	Review management plans, policies and strategies to incorporate climate change impacts and adaptation measures.
5.	Protect natural areas through ongoing management programs such as feral animal and environmental weed management programs.
6.	Enhance coastal and estuarine foreshore protection management.
7.	Undertake vulnerability assessments for coastal and estuarine areas.
8.	Under take geotechnical surveys at required locations.
9.	Enhance the resilience of natural areas through the creation and enhancement of ecological corridors and implementing the City's Greenways Policy.
10.	Develop coastal and/or estuarine monitoring programs in conjunction with the state and federal government.

Management Actions 2019-2024	
1.	Implement actions identified in the Climate Change Local Adaptation Action Plan 2012-2017.
2.	Increase the resilience of natural areas by focussing on threats posed by environmental weeds, feral animals, illegal access and dumping, increased fire frequency, plant diseases and climate change.
3.	Accommodate adjustments to management practices to adapt to climate change. Use extreme events to monitor bushland areas for changes to assist with future plans for the area.
4.	Improve the resilience of natural areas through the creation and enhancement of ecological corridors by implementing the City's Greenways Policy.
5.	Keep informed about the latest climate change research and best practice for natural area adaptation techniques.
6.	Repair erosion using soft bioengineering techniques in preference to hard walling wherever possible.
7.	Implement revegetation in line with shifting water levels (surface and groundwater).
8.	Select local provenance species that are able to adapt to drying conditions and that assist in maintaining diversity as lack of diversity lowers habitat value and reduces the ability of the ecosystem to adapt to change.
9.	Encourage natural regeneration through weed control and rubbish removal as naturally regenerated species are more resilient.
10.	Improve revegetation success by using planting aids such as bentonite and water crystals and undertake watering during the first summer.
11.	Investigate options for wastewater/greywater treatment and reuse to supplement irrigation and other options to mitigate soil acidification.

6.3 Geology, Soils and Geomorphology

Geology

Almost the entire City of Nedlands area, and most of the Natural Areas described in the City of Nedlands Natural Area Management Plans 2019-2024, are underlain by Quaternary Tamala Limestone or by the sand derived from it. These two distinctive geological units together make up Spearwood Dunes.

The Tamala Limestone is typically light yellowish brown. It is variably sandy, variably well-lithified, contains trace amounts of shell debris, and is clearly of wind-blown origin. The sand derived from eroding Tamala Limestone outcrops, sometimes referred to informally as 'Spearwood Sand', is pale or olive yellow, and moderately well sorted. It consists of well-rounded to sub-angular, fine- to coarse-grained quartz, with trace feldspar. It is residual in origin.

A younger unit, the Safety Bay Sand, forms discontinuous patches along the Perth coast. It is best developed south of Fremantle, especially in the Rockingham-Warnbro Sound area. In the City of Nedlands area, an irregular tongue extends nearly 3 km inland from the Swanbourne shoreline almost as far as Challenge Stadium. The Safety Bay Sand is not a single massive unit, but is made up of white, fine - to medium-grained, immature, calcareous sands, which typically consist of sub-rounded quartz grains with abundant shell debris.

The Safety Bay Sand forms the Quindalup Dune System, a geomorphological feature discussed in the following section. The most detailed description of the surface geology of the Perth urban area is the map published by the Geological Survey of Western Australia (Gozzard 1986).

Geomorphology

Geomorphology is the study of landforms and the processes that shape them. There is general agreement in Western Australia that particular combinations of landforms and soils are consistently associated with particular vegetation types. It is this generalisation that underlies the concept of the 'vegetation complex' (e.g. Heddle *et al.* 1980) discussed in a later section of this Management Plan.

The City of Nedlands occupies a small part of the Swan Coastal Plain, a geologically modern landscape feature along the western margin of the southern Australian continent. In the Perth area, the Swan Coastal Plain is a series of sand dunes and interdune swamps, aligned approximately north-south, parallel to the present coastline. Three groups of dunes in particular are recognised locally as 'geomorphological systems' or 'landscape systems' (McArthur & Bettenay 1960) – from west to east (with increasing age and maturity), Quindalup, Spearwood and Bassendean Dunes. Churchwood & McArthur (1980) proposed a more-detailed scheme in which they further subdivided the simple landscape systems of McArthur & Bettenay into 'geomorphological units', and their scheme has been adopted in many later studies, for example Perth's Bushplan (1998), Bush Forever (2000) and previous management plans developed for City of Nedlands natural areas (e.g. Ecoscape (1996)).

For the City of Nedlands area, Churchwood & McArthur recognised two distinct geomorphological units in what had previously been known simply as the

‘Spearwood Dunes’ - Cottesloe in the west; Karrakatta in the central and eastern section. These units are probably better known by their informal names – ‘Cottesloe Dunes’ and ‘Karrakatta Dunes’.

As stated earlier, the Quindalup Dunes are the geomorphological equivalent of the Safety Bay Sand, which is represented in the City of Nedlands area by an irregular tongue of white sand extending about 2.8 km inland from the Defence Department beachfront at Swanbourne. The Mt Claremont Oval Bushland is excavated from an edge of this tongue, and, although very little of the original landscape remains at this site, high ground near the western boundary is probably a preserved remnant of Quindalup Dunes. Previous management plans developed for Allen Park stated Allen Park included a small section of Quindalup Dunes. This claim, however, is not consistent with earlier mapping, e.g. Heddle *et al.* (1980), Gozzard (1986), or with recent observations (Ian Fordyce, pers. Comm. 2014).

Other minor geomorphological features represented in the City of Nedlands are described below. Since they are not strictly part of any of the City’s natural areas, they are not considered further in this Management Plan.

- River floodplain along the Nedlands foreshore below Birdwood Parade. This area has been substantially engineered and the original landscape obscured. However, by analogy with alluvial remnants at Pelican Point and small stretches along the Dalkeith foreshore, it is likely that the original material was a white, well-sorted, medium-grained sand of sub angular quartz and feldspar grains with abundant shell fragments.
- Interdune marshland. Small marshlands are preserved at Kilgour Park (Aberdare Road adjacent to Queen Elizabeth II Hospital) and Mason Gardens (corner of Melvista Avenue and Vincent Road, Dalkeith). Both areas are now grassy parklands, with highly modified soils and vegetation.

Soils

There has been some confusion about soil nomenclature on the Swan Coastal Plain, because various authors have introduced different terms, or applied existing terms in different ways. The information described in the 2013-2018 and 2019-2024 Management Plans use the simplified, nomenclatural system of Bolland (1998), as summarised on the Department of Agriculture and Food website.

In the City of Nedlands area, natural soils associated with the major geomorphological units are:

- Spearwood Dunes: pale to olive yellow sand, occasionally becoming loamy in depressions. Thin and skeletal over limestone outcrops.
- Quindalup Dunes: pale calcareous sand with rare, thin patches of light yellow and light grey loamy sand.

Many soil profiles in the City of Nedlands area, even in some of the Natural Areas discussed in this Management Plan, have been altered to some extent. In some cases, the native soil has been removed, buried or replaced entirely.

6.4 Regional Classification of Vegetation Complex Heddle et al (1980)

Heddle et al (1980) grouped vegetation types into vegetation complexes on the basis of patterns in soils and landforms in medium to large areas. This regional scale mapping shows the City of Nedlands natural areas are classified as having two different vegetation complexes which include:

- Cottesloe Complex – Central and South
- Karrakatta Complex – Central and South.

The Commonwealth Government has recognised the need to retain 30 percent (%) of each vegetation community in order to maintain species diversity within an ecological community. In order to meet this national objective the 30% threshold has been set as the target for Biodiversity Conservation. According to the Perth Biodiversity Project Remnant Vegetation Extent by Vegetation Complexes (2010) currently both the Cottesloe Complex – Central and South and the Karrakatta Complex – Central and South fall below the 30% threshold.

Karrakatta Complex – Central and South

Shenton Bushland, Hollywood Reserve, Birdwood Parade, Point Resolution and Mt Claremont Oval Bushland are located within the area mapped by Heddle et al. (1980) as the Karrakatta Complex – Central and South. This Complex is characteristic of the Karrakatta soil association and occurs as a narrow belt approximately 5 km wide, 2 to 3 km from the coastline. The vegetation in this Complex is predominately open-forest of Tuart-Jarrah-Marri and woodland of Jarrah and Banksia species. Tuart is dominant on the western side of the Complex, particularly on hills and ridges, where limestone is nearer the surface. Jarrah replaces Tuart on deeper sands, and Marri occurs on localised moister sites.

Cottesloe Complex – Central and South

Allen Park is located within the area mapped by Heddle et al. (1980) as the Cottesloe Complex – Central and South. The vegetation in this Complex is characterised by a mosaic of woodland of Tuart-Jarrah and Marri with closed heath on the limestone outcrops.

6.5 Floristic Community Types (FCTs) – Gibson 1994

Floristic Community Types classify native vegetation into groups of plant species that tend to co-occur together in small to medium areas. They are a more recent and detailed form of vegetation classification to that of vegetation complexes. In order to identify the FCTs across the Swan Coastal Plain 509, 100 square meter plots were surveyed. however not all geographical or geomorphological areas could be sampled through this process. Following the analysis of the 509 plots four ‘super groups’ were distinguished which were then further divided into 43 floristic community types.

All the City’s natural areas belong to Super Group 4 – Uplands Centred on Spearwood and Quindalup Dunes. Super Group 4 contains 11 FTCs including 24, 25, 26 (a & b), 27, 28, 29 (a & b), 30 (a, b & c). The only reserve within Nedlands where the FCT has been inferred is Shenton Bushland as detailed in Bush Forever 2000. Point Resolution, another Bush Forever Site was not inferred as containing a specific FCT through Bush Forever which is likely a result of it being considered highly degraded in the Bush Forever Site description.

6.6 Rare and Priority Flora and Fauna

Threatened and Priority flora and fauna found in the City's natural areas are listed in Table 4, 5 and 6 below. Table 5 includes priority flora that are not local provenance species which have been planted outside their natural range, these species are all limited to Hollywood Reserve.

Table 4: Local Provenance Rare and Priority Flora found in the City of Nedlands

Species	Common Name	State Listing Biodiversity Conservation Act	International Listing (IUCN)	Natural Area
Dodonaea hackettiana	Hackett's Hopbush	Priority 4		Hollywood Reserve, Birdwood Parade and Shenton Bushland (one specimen)
Jacksonia sericea	Waldjumi	Priority 4	Red Listed as Endangered	Shenton Bushland, Hollywood Reserve, Point Resolution
Isopogon drummondii		Priority 3		Hollywood Reserve

Table 5: Non-Provenance Rare and Priority Flora found in the City of Nedlands Natural Areas

Species	Common Name	State Listing Biodiversity Conservation Act	Federal Listing EPBC Act	International Listing (IUCN)	Natural Area
Acacia denticulosa	Sandpaper Wattle	Vulnerable	Vulnerable		Hollywood Reserve
Chamelaucium sp. Gingin		Vulnerable	Endangered		Hollywood Reserve
Eucalyptus crucis subsp. *Crucis*	(Southern Cross) Silver Mallee	Endangered	Vulnerable		Hollywood Reserve
Grevillea curviloba		Endangered			Hollywood Reserve
Banksia lullfitzii		Priority 3			Hollywood Reserve
Melaleuca coccinea	Goldfields Bottlebrush	Priority 3			Hollywood Reserve
Calothamnus rupestris	Mouse Ears	Priority 4			Hollywood Reserve
Eucalyptus kruseana subsp. *kruseana*	Bookleaf Mallee	Priority 4			Hollywood Reserve
Grevillea olivacea	Olive Grevillea	Priority 4			Hollywood Reserve

Table 6: Rare and Priority Fauna found in the City of Nedlands

Species	Common Name	State Listing Biodiversity Conservation Act	Federal Listing EPBC Act	International Listing IUCN	Natural Area
Calyptorhynchus banksii naso	Forest Red-tailed Black-Cockatoo	Vulnerable	Vulnerable		Shenton Bushland, Allen Park and Hollywood Reserve.
Calyptorhynchus latirostris	Carnaby's Black-Cockatoo	Endangered	Endangered	Endangered	All 6 natural areas
Merops ornatus	Rainbow Bee-eater		Marine		Allen Park, Shenton Bushland, Point Resolution, Hollywood Reserve and Birdwood Parade.
Actitis hypoleucos	Common Sandpiper	Migratory	Migratory and Marine		Point Resolution
Pluvialis squatarola	Grey Plover	Migratory	Migratory and Marine		Point Resolution
Tringa nebularia	Common Greenshank	Migratory	Migratory and Marine		Point Resolution
Hydroprogne caspia	Caspian Tern	Migratory	Migratory and Marine		Point Resolution
Synemon gratiosa	Graceful Sunmoth	Priority 4			Shenton Bushland

7. MONITORING AND SURVEYS

7.1 Weed and Bushland Condition Mapping History

Prior to the development of the 2013-2018 Management Plan bushland condition and weeds were mapped using different methods and cover classes. For example some reserves were mapped using the Kaeshagen Scale (1995) and others using the Keighery Scale (1994), both which utilise different criteria for assessing bushland condition. Likewise, weed mapping used various cover classes therefore, it was difficult to make an accurate quantitative assessment prior to 2013.

In order to address this in 2013 and 2018 the mapping of bushland condition and weeds was standardised. Bushland condition was mapped by adapting the Keighery Scale (1994) and weeds were mapped using the Department of Environment and Conservation (DEC) Standard Operating Procedure SOP 22.1. *Techniques for Mapping Weed Distribution and Cover in Bushland and Wetlands.*

In 2013 and 2018 both bushland condition and weeds were also mapped by dividing each natural area into 20 x 20 m polygons. Dividing each natural area into 20 x 20 m polygons was considered the most efficient way of mapping large areas. The recording of data in 20 x 20 m polygons also allowed for a systematic, measurable and repeatable means of collecting data overtime. Where each 20 x 20 m polygon represents an individual numbered grid unit with a GPS coordinate where specific information relating to each polygon was recorded via field notes.

Further information on weed and bushland condition mapping survey methods is detailed below.

7.2 Weed Mapping

Background

Weed mapping is required for the effective development of priorities for weed control. Weed mapping assists with:

- Identifying the distribution and abundance of priority weed species in order to develop management actions
- Measuring the success of weed management programs
- Providing records.

Survey Method

Weed mapping undertaken for the 2013-2018 and 2019-2024 Management Plan was carried out using specifications developed from the DEC Standard Operating Procedure - SOP 22.1 *Techniques for Mapping Weed Distribution and Cover in Bushland and Wetlands*. These procedures were developed in order to address the subjectivity that can be encountered when different people undertake mapping. In order to address this subjectivity the DEC developed the below listed broad cover classes:

- Individual plants (mapped as GPS points) – this was limited to mapping of woody weeds
- Less than 5%
- 6-75%
- 76-100%.

Using SOP 22.1 for the weed mapping undertaken in spring 2013 and 2018 addressed the subjectivity involved in mapping weed cover. However, in order to refine weed management for the 2019-2024 Management Plan actual cover was also mapped in 2018. These cover classes included:

- Less than 1%
- 2-5%
- 6-10%
- 11-20%
- 21-30%
- Then 9% increments until 100%.

The purpose of additionally mapping actual cover in 2018 was to allow for more refined and focussed management and reporting of weed management. Whilst the broad cover classes assisted with standardising the mapping process, addressing issues with subjectivity; and identifying focus areas and actions the cover classes did not reflect weed management programs success or failures. For example, if a weed species was mapped as 6-75% in the 2013-2018 Management Plan it may have undergone a significant reduction after five years of management however it had the potential to still be mapped in the same cover class for the 2019-2024 management plan. Furthermore, the City has undertaken long term management of some species such as Perennial Veldt Grass which was primarily mapped as less than 5% in 2013. However, in reality the cover of Perennial Veldt grass is now less than 1% in some reserves and it would have still been mapped as less than 5% in 2018 if the broad cover classes were used in isolation.

Figure 6: Specifications for weed mapping (summarised from SOP 22.1 (DEC, 2011) with the inclusion of actual cover mapped in 2018)

1. Data Recording Methods

- Weeds are to be captured using a Global Positioning System (GPS).
- The data file should contain a minimum set of attribute data for each species.
- The data should be captured using the datum of GDA94 either in geographic, coordinates (latitude, longitude); or projected in UTM (zones).
- All data needs to be recorded or transferred into electronic format compatible with a computer mapping system or GIS (e.g. ArcGIS or DECGIS Geographic Information System).

2. Mapping Procedure

- Maps are to be appropriately annotated (legend, title, site location, date and species mapped) and hard copy maps produced.
- Digital data for each species (including tables, shape files and metadata) are to be made available to the City on the completion of the mapping.
- Cover classes should represent:

BROAD COVER CLASSES	ACTUAL COVER CLASSES
Individual plants (limited to mapping woody weeds)	Less than 1%
Less than 5%	2-5%
6-75%	6-10%
76-100%	11-20%

	21-30%
	Then 9% increments until 100%

- Individual plants should be recorded as **points** (where each point represents an individual plant) in the following situations:
  - -weeds occurring as discrete individuals
  - -weeds occurring in low density and abundance
  - -weeds occurring in isolated or scattered population.

  This method was only used for mapping woody weeds.
- Weeds should be mapped as **polygons** using cover classes where they are common frequent or abundant in part of the site with no individual outliers.

7.3 Bushland Condition Mapping

Bushland condition is a measure of the degree to which vegetation has been degraded. This measure is based on the proportion of weeds and the degree to which structure (i.e. height and density of vegetation layers) have been modified. An understanding of the natural structure expected for the plant community is required to determine whether the structure has been altered. Bushland condition is useful in tracking large changes overtime and should continue to be measured each time this Management Plan is reviewed. This allows changes to be regularly monitored and recorded.

Prior to the development of the 2013-2018 Management Plans bushland condition was mapped interchangeably either using the Kaeshagan Scale (1995) or the Keighery Scale (1994). In order to standardise bushland condition monitoring for the development of the 2013-2018 and 2019-2024 Management Plans the Keighery Scale was used (refer to Figure 7 below).

Figure 7: Keighery (1994) Vegetation Condition Scale

Pristine Pristine or nearly so, no obvious signs of disturbance.
Excellent Vegetation structure intact; disturbance affecting individual species; weeds are non-aggressive species.
Very good Vegetation structure altered; obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires; the presence of some more aggressive weeds; dieback; logging; grazing.
Good Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires; the presence of some very aggressive weeds at high density; partial clearing; dieback; grazing.
Degraded Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without

intensive management. For example, disturbance to vegetation structure caused by very frequent fires; the presence of very aggressive weeds; partial clearing; dieback; grazing.
Completely Degraded The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

The condition of each natural area was assessed by dividing each reserve into 20 x 20 m polygons. Each 20 x 20 m polygon was provided a rating from *Very Good*, *Good, Degraded* to *Completely Degraded*. There were no areas considered to be Pristine or Excellent. The main disturbance factors that influenced the condition rating included fire, environmental weeds, selective removal of species (from plant pathogens, frequent fires, grazing and logging for example) and clearing.

At Shenton Bushland the bushland condition assessment was rated strictly on the basis of local native species present and applied the Keighery Scale as it was intended to be used. However in all other natural areas the Keighery Scale was adapted as these reserves were characterised in part by some historical non-indigenous plantings. Therefore to avoid assessing entire portions of these natural areas as *Degraded* or *Completely Degraded* they were not assessed strictly on the basis of local native species present (except the *Very Good* rated areas). The presence of non-indigenous plants did not reduce the condition rating unless they were considered invasive or if they were found in isolation with no other local native species present.

Generally accepted practice regarding assessment methodology of bushland condition has therefore been modified within this Management Plan for all reserves except Shenton Bushland. This is because labelling large areas as *Degraded* or *Very Degraded* even though they contained non-indigenous plants and had good vegetation cover and structure would not provide a benefit in determining management priorities for these areas, neither would it reflect the ecological value of these areas.

7.4 Flora and Fauna Surveys

Detailed flora and fauna lists have been compiled for:

- Shenton Bushland and Allen Park for the 1996, 2005 and 2014 Management Plans
- Birdwood Parade for the 2003 and 2014 Management Plans
- Point Resolution between 1953 and 1973 by A. Gardiner and for the 1991, 2003 and 2014 Management Plans
- Hollywood Reserve for the 2001, 2007 and 2014 Management Plans
- Mt Claremont Oval Bushland had weed lists compiled in 2006 for weed mapping and flora and fauna lists developed for the 2014 Management Plan.

New species recorded since these lists were compiled have been detailed in the relevant Management Plan for these natural areas.

Management Actions 2019-2024	
1.	Undertake weed mapping using Standard Operating Procedure SOP No: 22.1 (DEC, 2011) with the inclusion of actual cover every five years in spring.
2.	Undertake bushland condition mapping using the Keighery bushland condition scale every five years in spring.
3.	Continue to compile a comprehensive list of species present, including fungi.

8. PLAN FOR MANAGEMENT

8.1 Management Boundaries

Objectives

Management boundaries are required for effective communication in terms of locations within natural areas, and for the elimination of areas where management responsibilities, objectives or practices conflict.

The objectives of bushland boundaries are:

- To facilitate effective communication as to locations within the City
- To provide clear delineation between parkland, bushland and greenway/ecozones and their associated management practices
- To facilitate the development of specific management practices appropriate to the different landforms, vegetation types, levels of degradation and adjacent land uses
- To facilitate resource allocation to specific sites.

Background

External and internal bushland boundaries should generally be established for bushland sites. For management purposes it is important to distinguish between external boundaries such as parkland, bushland and greenway/ecozones. This has a number of benefits including the reduction of unkempt areas between bushland and lawn. Internal bushland boundaries should be subdivided into zones and sites. Zones form the basis of general management and are intended to facilitate the establishment of guidelines for managing areas of similar terrain, vegetation types and degradation, and establishing priorities at a broad scale across reserves. Sites are targeted areas for rehabilitation within zones. They demarcate the extent of areas where specific works such as planting occurs.

8.2 Rehabilitation

Objectives

The objectives for bushland rehabilitation are to:

- Minimise the impact of activities that could result in degradation to vegetation communities through the use of appropriate management strategies
- Improve the overall condition of vegetation communities
- Optimise use of resources by prioritising areas for rehabilitation.

Background

Ecological restoration involves restoring the vegetation and habitats through means of reinforcing and reinstating the system's ongoing natural regenerative processes. This involves reducing or eliminating disturbance factors, removal of inhibitors to natural regeneration such as weeds, and the reconstruction of the ecosystem in highly disturbed areas where the potential for natural regeneration has been markedly reduced or lost.

Bushland condition maps can be used as a tool for determining restoration strategies such as:

- Assisting natural regeneration in better condition bushland is often more cost effective and sustainable than reconstructing poor condition bushland.
- Weed control is generally most critical in the better condition bushland and replanting is usually only considered in degraded condition bushland.

Strategy

Prioritisation

The restoration of vegetation should aim to maintain the resilience of good condition areas while restoring disturbed areas of the site. Restoration work should follow three basic principles of bush regeneration, collectively known as the Bradley method. This method involves selective weeding around native species to decrease competition, increasing the size and number of native plants and gradually improving the condition of the bushland.

The underlying principles of this method are:

- Work from areas in good condition to areas in poor condition. Start regeneration work in areas with least disturbance to increase their resilience and then gradually work into areas with more weeds (more disturbance).
- Minimise disturbance while working (for example disturbance to soils and trampling of plants). This is important so that regeneration work does not create conditions suitable for weed invasion.
- Let the rate of natural regeneration determine rate of weed removal. This is important as over-weeding will leave large bare areas that can be reinvaded by more or different weeds.
- Assisted natural regeneration following the Bradley method should be undertaken in good condition bushland.

Performance Indicators

Bushland condition mapping can be used to measure the success of ecological restoration, as it can be used to demonstrate increases in areas of good condition, through improvements to the proportion of native species present, the structural integrity of the bushland and a decline in the number and/or level of disturbances present.

Improvement in bushland condition should also be used in determining when a restored site moves from a Reconstruction site to an Assisted Natural Regeneration Site (i.e. when the emphasis changes from replanting and weed control to weed control only).

Reconstruction

Reconstruction is often required in *Degraded* or *Completely Degraded* bushland areas as the exclusion of further disturbance will not lead to significant regeneration in these areas. Reconstruction will not generally produce an ecosystem as diverse as one that has regenerated itself. It requires very intensive resources over a long time frame and should not be attempted unless the resources and commitment are available to follow through to completion. Therefore, reconstruction should generally be undertaken at focus areas, the boundaries of which are clearly delineated.

8.3 Revegetation

Objectives

The objectives for revegetation are to:

- Reinstate indigenous flora and vegetation communities, using local provenance seed, where they have been disturbed and/or depleted.
- Ensure that vegetation communities are self-sustaining and are capable of natural regeneration.

Background

Revegetation includes planting seedlings and direct seeding sites where native species have been partially or wholly lost. Revegetation is required at sites that have been sufficiently degraded and where natural regeneration is insufficient to restore the area. When revegetation occurs weeds should not be inadvertently introduced to the site and only local provenance forms of plants should be used.

Nedlands bushland areas lie on very hydrophobic soils. Often when planting in July after significant winter rainfall some sites are totally dry below 1 cm of the top soil. This results in low seedling survival at sites planted even as early as mid-June if they cannot be watered. Watering is only possible for some locations due to availability of resources and also access for watering is an ongoing issue.

Direct Seeding

Direct seeding can be a useful technique in reconstruction areas where the level of weeds is low. However proper research should be undertaken to determine if this option will be successful at selected sites.

Seedling Planting

Native seedlings should be planted in late autumn and early winter to ensure good establishment from beneficial winter rains and should only be planted after initial winter rainfall has thoroughly moistened the soil. Seedling survival monitoring has demonstrated that sites which are planted early in the winter season (prior to mid-June) have the greatest success.

Seedlings which have grown beyond post-emergent stage (around four to nine months, depending on species growth rates) in tube stock (e.g. 75 x 75 x 100 mm or similar) are considered most suitable for planting. Mature stock, although less suitable, do provide an obvious statement to the general public that a regeneration programme is underway and are useful in some places. Native seedlings should include a range of ground, middle and upper strata species with a view to achieving the floristic and structural composition of the original vegetation community. Large indigenous trees should be included in annual planting programs to achieve a multi-aged population of indigenous trees across Nedlands natural areas.

Adequate ground preparation is important for good plant establishment. A small area approximately 50 cm in diameter should be cleared of weeds as thick layers of mulch can deny weed seeds access to light and thereby restrict their growth. Due to hygiene issues the use of mulch is not recommended within bushland areas and should only be used at focal sites (such as entry points). When mulch is used it should be certified pathogen-free according to Australian Standard AS4454 Composts, Soil Conditioners and Mulches. This will ensure that that it is not contaminated with weed seeds or disease. Plants should be well watered before planting and the planting should precede good wetting rains. Due to the hydrophobic soils encountered in Nedlands, watering plants on installation using a wetting agent can assist to improve seedling survival. This is however dependent on available resources and the accessibility of the site for water vehicles.

Plants should preferably be grown from fertile seeds or cuttings collected within the natural area they are being planted in, or surrounding areas of similar vegetation

type. It is important to retain the existing native plant communities that naturally occurred within bushland areas. Therefore, site specific species lists should be developed for all bushland areas (including different plant communities found within those bushlands). This will ensure that the natural plant communities within each bushland reserve in the City are conserved.

All propagated plants should be grown by accredited nurseries, preferably those specialising in contract growing of revegetation species. Generally no fertilisers should be used at the time of planting. Seedlings should not be staked for support (unless rabbits are found within the reserve) as free standing plants become more durable and strong. Care should also be taken to ensure that plants are not evenly spaced or planted in rows. Seedlings should be randomly clumped or spaced to achieve a natural effect.

Seed and Plant Material Collection

When seeds are collected, no more than one third of the available seed should be collected from any individual plant and numerous “parent” plants should be sourced for seed.

This avoids problems of:

- Inbreeding where too few “parents” are used and the seedlings produced lack vigour.
- Genetic pollution due to the introduction of dissimilar genetic material (from a different area) which can result in sterile plants or a form of a species not native to the site becoming rampant.

Shenton Bushland and Allen Park (excluding the coastal swale and foredune areas) have only ever used plants in revegetation activities that were propagated from seed collected within or adjacent to their reserves and this practice should be continued.

Other reserves such as Point Resolution, Birdwood Parade, Mt Claremont Oval Bushland, Hollywood Reserve and the coastal foredune and swale areas at Allen Park have all had plants used in revegetation activities propagated from seed collected from the wider Swan Coastal Plain or other reserves within Nedlands. Due to land clearance on the Swan Coastal Plain local seed is increasingly becoming harder to source and local nurseries have to source their seed from reserves further north and south of the Perth metropolitan area. Seed banks have therefore been developed for all natural areas so that the plants propagated are sourced from the local seed stock contained within these reserves.

The seed of some revegetation species are easily obtained from Nedlands’ natural areas, however sourcing material for all species is difficult. There is presently a dearth of information in the public domain with regard to the distances at which genetic variation becomes important for native species. The precautionary principle therefore needs to be adhered to by sourcing material as close to the City’s natural areas as possible, keeping good records and noting obvious morphological differences between plants occurring onsite and seedlings planted. The City should investigate the possibility of sourcing seed from nearby and sites such as Bold Park, Kings Park, Campbell and Irwin Barracks or other adjacent Council land.

When this principle cannot be adhered to, obtaining seeds or cuttings from sites far removed from the City's natural areas can sometimes be justified. Species with good dispersal capabilities (e.g. bird or wind dispersed) can be obtained from relatively large distances, while species with poor dispersal capabilities (insect dispersed, winged seeds or vegetative reproducing) must be sourced locally.

Tuart seeds for revegetation in Allen Park have previously been obtained from Ludlow Forest as well as within the Park (Shaw, cited in Ecoscape 2005). This was done because of the difficulty of obtaining local seed. In this instance sourcing Tuart seed from afield should not be a concern as '[a]part from the northerly disjunct populations [at Cervantes and Cowalla Road], gene flow, either by pollen or seed dispersal, appears to be sufficient to maintain a relatively homogeneous gene pool throughout the main range of the species' (Coates, Keighery & Broadhurst, cited in Ecoscape 2005).

Species Selection

Ideally the species used in revegetation would consist of the entire suite of plants that naturally occur within the natural area. This is not always possible as not all species can be propagated. There are also situations where certain species are favoured for planting because the can serve a specific management function such as restricting public access.

Documentation and Monitoring

It is important to collect and store data such as what, how and when actions were taken. Rehabilitation Plans should be prepared for all sites that are to be intensively managed. These need not be lengthy documents and should include as a minimum the boundary of works, a planting list and assets (including relatively rare plants) requiring special consideration.

Documenting rehabilitation work offers an opportunity to monitor and evaluate the rehabilitation work and to build on the knowledge base of the City and the wider community.

8.4 Environmental Weed Control

Background

Environmental Weeds are plants that establish themselves in natural ecosystems and modify natural processes, resulting in the decline of the ecosystem that they invade. Impacts on ecosystem function by environmental weeds include:

- Resource competition
- Prevention of native seedling recruitment
- Alteration to geomorphological processes, such as increased erosion
- Alteration of hydrological cycles
- Changes to soil nutrient status
- Alteration of fire regime, usually through increased fire frequency
- Displacement of native species (both flora and fauna)
- Reduction of species and genetic diversity
- Changes to the structure of vegetation communities, often by the removal of the shrub layer or native ground covers
- Acceleration of extinction rates.

The fire-weed cycle that is a primary cause of the degradation of bushland and loss of understorey species is particularly prevalent on the deep sands of the coastal plain. The shrubs, herbs and sedges are gradually replaced by weed species, notably grassy weeds as fire frequency increases. Grassy weeds have characteristics which enable them to respond quickly to fires which, in turn supports more frequent fire events, than many of the native perennial understorey shrubs. Some of the contributing factors to the fire-weed cycle are summarised below:

- Weed species are often advantaged by the increase of nutrients available immediately following a fire.
- Weed species, particularly grassy weed species, accumulate biomass rapidly, increasing fuel loads to levels that will sustain fires.
- High growth rates of weed species allows them to outcompete native species.
- Grassy weeds, and many other weed species, are able to set seed within a single year.
- Grassy fuels have a different structure to shrubby fuels. The grasses have a fine, evenly spread structure, compared with the more heterogeneous, discrete structure of native understorey shrubs. This affects fire behaviour and rate of spread, particularly in the initial stages of a fire.
- Native seeder species require time between fires not only to set seed but also to replenish their seed stocks. This may take several years. Therefore, frequent fires deplete seed stocks, rapidly eliminating these species from the species assemblage.
- Native resprouting species (i.e. species that have an underground lignotuber) can also succumb to frequent fires if fire recurs before the new growth has had time to harden.

Disturbances that contribute to the spread of weeds include:

- Clearing
- Trampling
- Off-road vehicles
- Increased fire frequency
- Rubbish dumping, including soil and garden waste
- Movement of weed seed
- Climate change that has the potential to change weed distribution.

Objectives

The objectives for environmental weed management are to:

- Identify and control existing weeds with the highest priority for control
- Prevent the introduction of additional weed species
- Undertake early intervention when new weeds become established
- Prevent further encroachment of weeds into bushland areas
- Minimise any detrimental effects of the weed control programme on the native biota
- Integrate the weed control programme in conjunction with bushland restoration programmes
- Manage issues in relation to herbicide resistance
- Long term commitment.

Weed Control Strategy

Weed control requires prioritisation. There are two forms of weed prioritisation which include site-based management species-based management. Weeds often require a combination of site-based and weed-based management.

Site-based Management

Site-based Management is based on focal points and is developed with consideration of:

- Specific biological values requiring protection (such as Priority or Declared Rare Flora)
- The extent of the infestations
- The level of degradation (the circumstances will determine whether the worst or best sites are the initial point of control)
- Site fragility (such as coastal sand dunes)
- Reducing causes of degradation such as access tracks or weed nodes
- Available resources.

Site–based weed control should be focused at sites where either:

- Intensive rehabilitation efforts are being undertaken
- Where weeds are contributing to an acceptable fuel load near vulnerable property
- There is low weed cover and in areas of good condition bushland.

Species-based Management

The prioritisation of weeds for control is critical given that:

- There is a high distribution and abundance of weed species across Nedlands natural areas
- The effectiveness of controls varies between species
- The methods and intensity of control vary between weed species
- The impact of weeds in terms of their ability to displace native plants varies between species and sites
- The removal of easily controllable weeds can facilitate the greater proliferation of more difficult to control weeds.

Consideration should be given to the management of weeds at different sites as some native species are considered weeds at particular reserves as they have been planted outside their natural range. For example, W.A Peppermints are considered a weed at Hollywood Reserve as they reproduce prolifically and if left unmanaged the Reserve would become a peppermint grove displacing locally occurring herbaceous species. However, W.A. Peppermints are native at Allen Park and Point Resolution and control of these species is not recommended in these reserves.

Integrated Weed Management.

The aim of integrated weed management is to use a combination of different techniques to maintain weed density and cover at manageable levels. Hand weeding is preferred over herbicide use however it is not suitable for all weeds (such as control of geophytes or grass weeds occurring across large areas). Hand weeding is also very costly and time consuming which would reduce the effectiveness of the City's natural area management program if it was undertaken in isolation to other weed control methods. Therefore, the City uses a combination of manual, chemical

and biological control methods in order to control environmental weeds in natural areas.

Using an integrated weed management program also assists addressing issues with herbicide resistance. Herbicide resistance is defined as the inherited ability of an individual plant to survive a herbicide application that would kill a normal population of the same species (DAFWA, 2019). Weeds that survive the herbicide application then go onto produce further resistant populations and if they are not removed by other means the weed population increasingly becomes resistant.

In 2014 herbicide resistance was discovered in the Annual Veldt Grass population at Hollywood Reserve following scientific testing of both Annual and Perennial Veldt Grass. Furthermore, in 2018 herbicide resistance in Perennial Veldt Grass, whilst not scientifically tested, has been assumed to be occurring at certain isolated areas across a few reserves including Shenton Bushland, Birdwood Parade and Point Resolution. In order to address herbicide resistance the City has modified its grass spraying program ensuring that at all reserves hand weeding of Perennial Veldt Grass (and annual grasses provided resources are available) occurs following completion of the annual grass control program .

Unfortunately there is no alternative control option available to address herbicide resistance in the Annual Veldt Grass population at Hollywood Reserve as it occurs in high density across an area greater than 3 ha. Furthermore, changing to an alternative herbicide was not appropriate without causing significant damage to native understory vegetation. For further information on the City's management of herbicide resistance please refer to the individual reserve Management Plans.

The City of Nedlands has contracts for bushland herbicide spraying. Only spot spraying of specific target weeds is undertaken in the City's natural areas. The contracts outline risk management, specifications for herbicide spraying, insurance and licence requirements. Contractors undertaking herbicide spraying are supervised by City staff. All contractors undertaking work in the City's natural areas have relevant Department of Health licences and undertake spraying in accordance with Department of Health *(Pesticides) Regulations 2011*.

8.5 Legislative Responsibilities

Legislative responsibilities in relation to environmental weed management have been identified at local, state and national levels.

Weeds of National Significance (WONS) – Commonwealth of Australia DSEWPAC 2012

Thirty-two Weeds of National Significance (WONS) were identified by Australian governments based on their invasiveness, potential for spread and environmental, social and economic impacts. A list of 20 WONS weeds was endorsed in 1999 and a further 12 were added in 2012.

WONS weeds include plants of concern in natural areas, waterways or agricultural land. The species that have been identified as WONS weeds were selected due to their level of invasiveness, potential to spread, and impact on socioeconomic and environmental assets (Commonwealth of Australia 2007). The WONS list includes

several weeds found in Western Australia, those found in Western Australia are detailed in Table 6 below.

Table 7: WONS Weeds in the City's Natural Areas

Species	Common Name	Natural Area
Asparagus asparagoides	Bridal Creeper	All 6 natural areas
Lantana camara	Common Lantana	Birdwood Parade
Lyceum ferocissimum	African Boxthorn	Allen Park, Mt Claremont Oval and Point Resolution
Opuntia stricta	Prickly Pear	Shenton Bushland (previously removed however resprouts occur from time to time)
Tamarix aphylla	Athel Pine	Allen Park

Biosecurity and Agriculture Management Act 2007 (BAM Act)

The purpose of the BAM Act is to:

- Prevent new animal and plant pests (vermin and weeds) and diseases from entering Western Australia.
- Manage the impact and spread of those pests already present in the State.
- Safely manage the use of agricultural and veterinary chemicals.
- Ensure that agricultural products are not contaminated by chemical residues.

The Western Australian Organism List (WAOL) details the status of Organisms have been classified as part of the enactment of the *Biosecurity and Agriculture Management Act 2007* (BAM Act). WAOL groups organisms into four main classifications:

- Declared pests (section 22)
- Permitted (section 11)
- Prohibited (section 12)
- Permitted Requiring a permit (73, BAM Regulations 2013).

Under the BAM Act declared pests can be assigned control categories including C1 (exclusion), C2 (eradication), C3 (management) and unassigned; or keeping categories *Prohibited Keeping*, *Restricted Keeping* or *Exempt Keeping*. WAOL listed species in the City of Nedlands are shown in Table 8.

Table 8: WAOL Listed Declared Weeds in the City's Natural Areas

Species	Common Name	Natural Area	WAOL Listing
Asparagus asparagoides	Bridal Creeper	All 6 natural areas	Exempt
Lantana camara	Common Lantana	Birdwood Parade	C3
Moraea flaccida	One-leaf Cape Tulip	Shenton Bushland, Hollywood Reserve	Exempt
Opuntia stricta	Common Prickly Pear	Shenton Bushland (resprouts)	C3
Tamarix aphylla	Athel Pine	Allen Park	Exempt
Zantedeschia aethiopica	Arum Lily	Allen Park	Exempt

The Environmental Weed Strategy for Western Australia 1999 (EWSWA)

The Environmental Weed Strategy for Western Australia (EWSWA) provided a basis for determining which weeds were most critical to control. The 3 characteristics used for determining the ratings for environmental weeds in the EWSWA strategy were invasiveness, distribution and environmental Impacts. The EWSWA strategy is still considered relevant however the ratings have been deemed too broad and were out of date.

Weed Prioritisation Process (DPaW 2013)

In 2008 in order to progress the EWSWA strategy and update the weed ratings the Weed Prioritisation Process for DPaW was undertaken. A species led prioritisation process was undertaken, that focussed on several natural resource management regions (NRM) including the Swan NRM region the ratings were reviewed again in 2016. Environmental weeds were assessed in order to identify the highest priority species. Through this process species with a high ecological impact and rapid invasiveness, high potential and current distribution and were not too difficult to control were considered a high priority for management.

City of Nedlands Priority Weeds for Management

The following list has been compiled from:

- Swan Region Weed Prioritisation Process (DPaW 2013)
- Swan Impact and Invasiveness Ratings (DBCA 2016)

- State and Federal weed lists
- Local knowledge from 'Friends of' groups that assisted with the development of a priority list for weeds to be mapped
- Their ability to contribute to fuel loads
- Their ability to be controlled without causing disturbance to natural areas.

Table 9: Priority Weeds in the City of Nedlands Natural Areas.

Species Name	Common Name	Other Ranking	DBCA 2016 Impact and Invasiveness Rating
Acacia iteaphylla	Flinders Range Wattle		High/Rapid
Arctotheca calendula	Capeweed		High/Rapid
Avena fatua	Wild Oat		High/Medium
Asparagus asparagoides	Bridal Creeper	WONS listed	High/Rapid
Babiana angustifolia	Baboon Flower		High/Rapid
Brassica tournefortii	Mediterranean Turnip		High/Rapid
Brachychiton populneus	Kurrajong		High/Medium
Cenchrus clandestinus	Kikuyu Grass		High/Slow
Cenchrus setaceus	Fountain Grass		High/Rapid
Centranthus macrosiphon	Pretty Betsy		High/Rapid
Chasmanthe floribunda	African Cornflag		High/Medium
Cynodon dactylon	Couch		High/Rapid
Ehrharta calycina	Perennial Veldt Grass		High/Rapid
Euphorbia paralias	Sea Spurge		Unknow/Medium
Euphorbia terracina	Geraldton Carnation Weed		High/Rapid
Ferraria crispa	Black Flag		High/Rapid
Ficus carica	Edible Fig		High/Medium
Freesia alba x leichtlinii	Freesia		High/Rapid
Fumaria capreolata	Climbing Fumitory		High/Rapid
Gladiolus angustus	Long Tubed Painted Lady		High/Unknown
Gladiolus undulatus	Wavy Gladiolus		High/Rapid
Ixia maculata	Yellow Ixia		High/Rapid
Lachenalia aloides	Soldiers		High/Unknown
Lachenalia bulbifera	Soldiers		High/Unknown
Lachenalia reflexa	Soldiers		High/Rapid

Lantana camara	Common Lantana	WONS listed	High/Medium
Leptospermum laevigatum	Coast Teatree		High/Rapid
Lupinus angustifolius	Narrowleaf Lupin		High/Medium
Lupinus cosentinii	Sandplain Lupin		High/Medium
Lycium ferocissimum	African Boxthorn	WONS listed	High/Medium
Moraea flaccida	One-leaf Cape Tulip	P1. Declared	High/Rapid
Olea europaea subsp. Europaea	Olive		High/Rapid
Oxalis pes-caprae	Soursob		High/Slow
Pelargonium capitatum	Rose Pelargonium		High/Rapid
Schinus terebinthifolia	Brazilian Pepper Tree		High/Medium
Sparaxis bulbifera	Sparaxis		High/Rapid
Stenotaphrum secundatum	Buffalo Grass		High/Slow
Tamarix aphylla	Athel Pine	WONS listed	High/Rapid
Watsonia meriana var. bulbillifera	Watsonia		High/Rapid

Table 10: Alert Weeds in the City of Nedlands

Species Name	Common Name	Notes
Acacia longifolia	Sydney Golden Wattle	Previously removed from Shenton Bushland and Point Resolution
Albuca flaccida	Albuca	Small infestation at Shenton Bushland Listed as an alert species on the Swan Impact and invasiveness Ratings 2016
Hyparrhenia hirta	Tambookie Grass	Found on west coast highway north of Allen Park
Retama raetam	White Broom	Found on west coast highway north of Allen Park
Verbesina encelioides	Golden Crownbeard	Listed as an alert species on the Swan Impact and Invasiveness Ratings 2016 Found on Health Department land adjacent to upgraded sewer work site near Lemnos St. Found at the entrance of the northern end of the upper car park at Swanbourne Dunes.

Each priority weed listed in Table 9 will be managed according to the management notes provided on the DBCA Florabase website refer to http://florabase.dpaw.wa.gov.au Appendix 1: Details the management strategy for all priority weeds in the City. A list of priority weeds has also been developed for each natural area which is detailed in the relevant Management Plan for these areas.

Management Actions 2019-2024	
REHABILITATION	
1.	Restoration should follow the three basic principles of the Bradley Method.
REVEGETATION	
2.	Develop Rehabilitation Plans for all sites to be intensively managed. These should include as a minimum the boundary of works, a planting list and native plants present that require protection.
3.	Only use plant species and forms of plants for rehabilitation if they would have naturally occurred at the sites.
4.	Prepare seed banks for all reserves for use in revegetation programs.
5.	For internal management purposes establish a monitoring program for indigenous species, with the location and abundance of species in very low abundance recorded.
6.	Document any locally occurring native species that are re-introduced to natural areas.
7.	Include large indigenous trees in annual planting programs.
8.	Incorporate all strata at the time of planting. Denser planting of herbs, sedges and rushes or smaller shrubs can be incorporated in the second or third year of revegetation.
9.	Where possible irrigate newly planted stock to ensure survival - generally between November and April.
10.	Create detailed vegetation community map for each site with the specific species list for each zone based on the remnant vegetation in the area. Determine generic species abundance, cover and distribution per 100 m2 and use this information to inform revegetation activities.
11.	Perform regular monitoring of revegetation and analyse success or otherwise of implemented works against site conditions including the climate variable.
WEED CONTROL	
12.	Use an integrated approach to weed control including herbicides, manual removal, modifying microclimates (in terms of shade, moisture etc) and biological controls (such as Bridal Creeper Leafhopper and the Rust, *Puccinia myrsiphylli*).
13.	Refer to the Department of Biodiversity, Conservation and Attractions (DBCA) Management Notes detailed on Florabase for target weeds species.

9. ASBESTOS MANAGEMENT

9.1 Background

Asbestos is a building material that was used widely between the 1940s to late 1980s. It was considered an excellent building product as it was durable, fire resistant and it had good insulation properties. However, after many years of use in the building industry in Western Australia, asbestos was found to pose health risks. If left untouched, asbestos poses no immediate danger. However, if asbestos products are broken or disturbed, they can release hazardous fibres. Asbestos contaminated material must only be handled by appropriately qualified and trained personnel.

The City has responsibility under Worksafe and Asbestos and Department of Health Regulations to investigate and manage any known asbestos contaminations on its land and to develop asbestos management plans for areas that require ongoing management.

9.2 Objectives

The objectives to manage asbestos within the City's bushland reserves include:

- To provide a safe working environment for staff and volunteers
- To provide safe recreational areas for the public
- To meet the requirements of the *Occupational Health and Safety Regulations 2007* and *Health (Asbestos) Regulations 1992*
- To protect and conserve bushland areas.

9.3 Asbestos Contaminations

There are a few bushland reserves within the City that have asbestos contaminations. Some of these require ongoing management and some consist of isolated dumped material that do not require ongoing management. They include:

Shenton Bushland

The entire bushland area at Shenton Bushland is classified as Contaminated Site 3628 - "*Contaminated Remediation Required*" by the Department of Water and Environmental Regulation under the Contaminated Sites Act 2003. This classification is largely due to historical waste disposal, which included quantities of household and commercial solid and liquid waste.

At Shenton Bushland the main asbestos contamination is located in an area called "The Barrens" and also some areas along the Lemnos Street front boundary which were historically used for landfill. Both friable and non-friable asbestos have been found in these locations. Asbestos fragments have also been found in various isolated locations across the bushland and the Lemnos Street front verge.

An amount of asbestos cement products was identified predominantly in "The Barrens" in the north-eastern corner of the site. The type and nature of asbestos material present is consistent with construction and demolition materials. Materials identified included:

- Asbestos sheeting
- Panelling and piping
- Woven asbestos material
- Asbestos rope such as fireplace or oven door seal.

Various consultant investigations have been completed for “The Barrens” (commencing in 2012) with progressive “hand based” remedial activities being implemented since that time. The site is being managed in accordance with the Department of Health – “Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated Sites in Western Australia 2009”.

Isolated asbestos piles and fragments have also been removed from Shenton Bushland several times over the years and further clean ups will be required into the future. The reason for this is because ongoing erosion occurs as the soil weathers and following rain events more fragments will become exposed on the surface.

As Shenton Bushland requires ongoing management an asbestos management plan needs to be developed for the entire bushland site.

Allen Park

A portion of the bushland and all of the playing fields at Allen Park are classed as Contaminated Site 3625 “*Possibly contaminated site - Investigation required*” by the Department of Water and Environmental Regulation under the Contaminated Sites Act 2003. This classification is largely due to the site being historically used for landfill which has the potential to cause contamination.

Asbestos contaminations (primarily bonded asbestos fragments) have been found in several locations at Allen Park. Some of these are contained within the boundary of Contaminated Site 3625 and some fall outside the boundary of the Site. These locations include:

- Sayer Street (in the area surrounding Lot 139)
- The Heritage Precinct Houses
- On the west side of the Associates Rugby Club Building
- The swale and old bowling greens
- The embankment behind the Shorehouse Restaurant
- Bushland areas adjacent to Marine Parade
- Various isolated locations in bushland areas including Department of Defence bushland.

The areas surrounding Lot 139 on Sayer Street; and the swale and old bowling green areas have had several remedial activities implemented over the years and they require ongoing management. The other areas where asbestos fragments have been located also require ongoing management. This is because as soil erosion occurs, following rain events, more fragments will become exposed on the surface.

As Allen Park requires ongoing management an asbestos management plan needs to be developed for the entire bushland site.

Isolated Dumped Fragments (All Bushland Reserves)

It should be noted that isolated fragments and/or fencing has been found dumped at all reserves. These are cleaned up as required by appropriately licenced contractors or trained City staff they do not require an asbestos management plan to be developed.

Management Actions 2019-2024	
1.	Asbestos if found in the bushland should be left alone and reported to the City.
2.	Develop asbestos management plans for the entire bushland sites of Allen Park and Shenton Bushland.
3.	Implement recommendations from asbestos management plans developed for Allen Park and Shenton Bushland.

10. PLANT PATHOGEN MANAGEMENT

10.1 Objectives

The objectives for plant pathogen management within the City's natural areas are to:

- Prevent the introduction of plant pathogens and prevent further spread of existing plant pathogens.
- Monitor vegetation for the presence of plant pathogens such as *Phytophthora sp*, *Armillaria, Quambalaria* coyrecup (cause of Marri canker) and other plant pathogens.

10.2 Background

Plant pathogens consist of organisms such as fungi, bacteria and viruses that cause plant diseases. Plant pathogens naturally occur within soil and plants, and are considered to be an important part of a natural functioning healthy ecosystem. However, some plant pathogens have been introduced to new areas through the movement of soil and vegetation. These pathogens may survive in the soil or within plant tissues for long periods without causing an outbreak of serious disease. Disease outbreaks occur if there are increases in the population of the pathogen, alteration to a more favourable environment, or increases in the vulnerability of the plant (as a result of stress caused by factors such as drought, water logging or mechanical damage to the trunk).

Following significant tree decline and death across Nedlands parks, natural areas and streetscapes in 2010, a broad disease survey was undertaken across eight reserves. The reserves surveyed included Point Resolution Reserve, Birdwood Parade, Shenton Bushland, Mt Claremont Oval Bushland, Allen Park, Hollywood Reserve, Mooro Park and Pine Tree Park. Approximately 100 samples were collected for testing for the presence of *Phytophthora* species along with the examination of a range of abiotic (non-living) and biotic (living) factors for their impact upon each tree. The survey focused on the three iconic endemic species of Tuart *(Eucalyptus gomphocephala*), Jarrah *(Eucalyptus marginata*) and Marri *(Corymbia calophylla*). Subsequently, 62 trees were treated with systemic implants to mitigate their decline and improve their health and resilience.

The key results found that six out of eight reserves surveyed tested positive for *Phytophthora* species, including *Phytophthora multivora*, *Phytophthora sp. ohioensis and Phytophthora aff. arenaria.* The two reserves that did not test positive for *Phytophthora* included Shenton Bushland and Pine Tree Park. In addition to isolating *Phytophthora* species other biotic and abiotic symptoms contributing to tree death and decline were identified as resulting from drought, nutrient deficiencies, fungal canker pathogens, stem boring insects and mechanical damage. The results for the City's natural areas are shown in Table 10 below.

Table 11: Results of Plant Pathogen Survey 2010.

Natural Area	*Phytophthora multivora*	*Phytophthora aff. arenaria*	*Phytophthora sp. ohioensis*	*Armillaria luteobubalina*	*Canker Disease*
Shenton Bushland					x
Allen Park	x		x (in carpark area)	Possible – not confirmed	x
Hollywood Reserve	x			Possible – not confirmed	x
Birdwood Parade	x	x		Possible – not confirmed	x
Point Resolution	x	x		x	
Mt Claremont Oval				x	

Following the broad disease survey undertaken in 2010 an additional plant pathogen called Armoured Scale (*Maskiella globosa)* has been impacting Tuart trees across a number of reserves. Furthermore, *Armillaria* has been confirmed at one location at Allen Park, with a further two locations at Allen Park unconfirmed. These *Armillaria* infected areas are suffering significant vegetation decline which is detailed further in the Allen Park Bushland Management Plan 2019-2024.

10.3 Pathogens and Diseases

Phytophthora Dieback

This disease is caused by the genus of water mould *Phytophthora*, a very well documented genus throughout the world limiting the production of many agricultural and forest crops. It is one of the most devastating pathogens of forests worldwide. The Latin name is derived from the Greek for “plant killer”. This group of organisms is incredibly well adapted to a wide range of environmental conditions, spreading rapidly in wet conditions via swimming zoospores, and surviving extended dry periods through thick walled chlamydospores or oospores. Most species within this genus cause disease of the roots, but some can cause severe disease of the lower and upper stems and foliage.

The most well-known of the *Phytophthora* species occurring in Australia is *P. cinnamomi.* This pathogen is a national and Western Australian (W.A.) state listed threat to biodiversity. More than 2000 native plant species are susceptible. The pathogen survives in soil and plant tissue and can readily be moved around the environment in these media. It is generally regarded as not commonly occurring on the calcareous sands of the coastal dunes, preferring soils of lower pH. This is only one of many species of *Phytophthora* that are now known to occur within WA.

Soil movement through human activities is perhaps the biggest factor contributing to the spread of *Phytophthora* species. Infected soil can be moved around on vehicles, bikes, footwear, animals and through construction and maintenance activities. Nurseries and infected stock are suspected of being one of the biggest sources of introduction of *Phytophthora* into new areas. *Phytophthora* may be moved through infected green waste mulch that has not been properly composted. Management of *Phytophthora cinnamomi* has been successful using a combination of hygiene and treatment of the host with chemicals such as phosphite. More recently, the use of a combination of novel systemic implants has shown promise for the suppression of the pathogen and improvement in crown condition.

Phytophthora multivora

This pathogen was recently described and has been widely found throughout the south west of WA. It is associated with a range of *Phytophthora* sensitive indicator species. However, it is the only *Phytophthora* species that has been found in association with declining Tuart along the Swan Coastal Plain. It appears to have a much greater tolerance of the higher pH soils of the Spearwood and Quindalup Dune Systems when compared to *P. cinnamomi*.

Phytophthora aff. arenaria

Morphologically this species is very similar to the recently described *P. arenaria*. According to DNA analysis however, it is slightly different and appears to be an undescribed species, new to science. Knowledge of this pathogen is therefore very limited and further research will be required to determine effective management strategies.

Phytophthora sp. ohioensis

According to DNA analysis *Phytophthora sp. ohioensis* that was isolated in the surveys undertaken in the City of Nedlands is an exact match with an undescribed species from overseas. Therefore it has been given the tentative name *Phytophthora*

sp. *ohioensis*. All that is known about this species is that it was isolated from oak forest soil in Ohio, USA. Knowledge of this pathogen is therefore very limited and further research will be required to determine effective management strategies.

Armillaria luteobubalina (Honey Fungus)
Armillaria, is a mushroom-producing parasitic soil borne fungus that causes collar and root rot of a wide variety of plants. It is native to W.A. and lives off both live and dead hosts. It occurs across many vegetation types and plant families and genera including those found on the Swan Coastal Plain. In natural areas it infects and kills trees that are over mature or have been weakened by some other factor, such as drought or lack of light, (Department of Environment and Conservation, 2013).

Armillaria does not survive in soil but spreads from a woody food source, such as a tree, stump or piece of infected root. As the root systems of many trees are in contact with each other the fungus is able to move to nearby healthy trees. Once it has infected the roots of a tree it reduces the function of plant roots which affects the internal structure of the tree, often resulting in a slow decline in health and eventually death. It can be found in conjunction with *Phytophthora,* and is thought to infect hosts through wounds or lesions induced by *Phytophthora. Armillaria* appears as a golden yellow fruiting body at the base of tree stumps around May to September. Other signs of the presence of *Armillaria* can include large inverted V shaped lesions at the base of trees, or white mycelial webs just beneath the bark. Trees that have been affected by *Armillaria* for some years can fail due to the decay of the large lateral roots or basal stem.

Unlike *Phytophthora*, movement of soil does not affect the spread of the *Armillaria*. However, its spread is thought to be favoured by disturbance, irrigation, and the use of diseased, untreated mulch and movement of plant material. Once established management is extremely difficult and expensive as it requires removing all infected stumps and roots from the site. No commercial fungicides or chemicals are currently known to control or eradicate this pathogen, although there has been some success in improving the crown health of diseased trees through systemic treatments.

Canker Diseases
Canker diseases on native W.A. trees are most commonly caused by fungal pathogens such as *Quambalaria coyrecup* (cause of Marri canker) or *Botryosphaeria.* They are largely air, splash or wind dispersed fungi that can affect a wide range of host species throughout south west WA. Occurrence of these pathogens is dependent on a combination of the availability of a susceptible host, the infective pathogen, and the ideal environmental conditions. Canker pathogens may either invade stem tissues and penetrate the bark layer, usually via a wound, or be present within the plant tissue as latent pathogens. Over-pruning of limbs, causing unnecessary wounding, can produce suitable infection sites for initiation and development of canker disease. Following the onset of suitable conditions, or a trigger stress event (e.g. hailstorm, drought), the canker pathogen may develop and cause small lesions known as ‘cankers’ beneath the bark of the minor or main stems. As cankers develop over time they may eventually girdle entire stems causing their death, and even cause tree mortality if severe. A good example is the marri canker pathogen, *Quambalaria coyrecup.* This pathogen also affects the red flowering gum and has been responsible for a widespread epidemic throughout south-west WA on

Marri, and the destruction of most of the trees that existed along Fraser Avenue in Kings Park prior to replacement with the now existent and resistant Lemon-Scented Gums. Canker pathogens can be responsible for serious limb failures of trees, causing damage to life and property, particularly throughout the urban area. Healthy trees not subjected to stress or wounds are unlikely to be severely affected. There is no large scale control method for canker pathogens, however, a combination of sound arboricultural practices and systemic treatments has recently shown some promising results.

Myrtle rust (*Puccinia psidii sensu lato*)
Myrtle rust is caused by the fungus *Puccinia psidii* which causes serious disease in plants in the Myrtaceae family. Myrtle rust is also referred to as Eucalyptus rust or guava rust it produces powdery orange-yellow or yellow spores on young leaves, flower buds, shoots and fruits. Whilst there are no confirmed reports of Myrtle rust in Western Australia, it has been placed on alert by the Department of Primary Industries and Regional Development (DPIRD) and suspected infestations should be reported to the DPRID.

Maskiella globosa (Armoured Scale)
In 2016 *Maskiella globosa* was located impacting a number of Tuart trees across several natural areas. This scale insect forms galls in the leaves and branches causing decline of the trees. There is little published literature on *Maskiella globosa* and treatment methods are still being researched. The City has engaged a consultant to apply systemic implants to several trees across a number of reserves between 2016 and 2018. Currently the results are being monitored and follow up treatments will be undertaken as required.

10.4 Management Strategies
The plant pathogens *Maskiella globosa*, *Phytophthora*, *Armillaria* and *Quambalaria coyrecup* have been identified within the study area. Other biotic and abiotic factors including drought stress, nutrient deficiencies, stem boring insects and mechanical damage have also been identified as contributing to the decline in health of vegetation and facilitating pathogen infection and development. Management of these pathogens should primarily focus on the prevention of their introduction into an area as once they are introduced they are extremely difficult to eradicate. Standard hygiene procedures that minimise the introduction and spread of infected soil or plant material should be implemented and maintained. In addition, maintaining the health of the existing population of flora is important to increase the resistance to any potential infection. For example, reducing pruning of canker-susceptible trees to limbs that are only deemed to be an unacceptable risk to life or property, avoiding over-irrigation in turfed areas, increasing the healthy microbial communities in the soil, or improving the nutrition of trees via systemic or soil treatments. If the pathogens are detected within an area, procedures should be implemented to systemically treat these trees to control the pathogens, ensure infested soil or plant material is not moved within or outside the site, and trees adjacent to infected trees are treated as a preventative to infection as this is always more effective than treated as a curative.

Management Actions 2019-2024	
1.	Maintain hygiene protocols for Council operations and contractors within bushland reserves.
2.	Establish hygiene protocols for Friends Group activities.
3.	Ensure that any soil or plant material used for bushland restoration is pathogen free.
4.	Minimise operations involving movement of soil, such as track construction and maintenance and carry out these operations under strict hygiene practices such as pressure cleaning machinery and vehicles.
5.	Ensure that nurseries contracted for revegetation programs are accredited by the Nursery and Garden Industry of Western Australia (NAISA) and are free of *Phytophthora*.
6.	When restoration work is undertaken begin in the reserves where *Phytophthora* has not been found and then proceed to other reserves.
7.	Ensure no soil or plant material is transferred between reserves or restoration sites by brushing excess soil off clothing, machinery and equipment, and sterilising with a 70% solution of methylated spirits.
8.	Ensure pruning equipment is sprayed with a 70% solution of methylated spirits (or similar) where plant pathogens are suspected or present.
9.	Ensure that any soil, mulch or plant material used for bushland restoration is certified pathogen-free according to Australian Standard AS4454 for Composts, Soil Conditioners and Mulches.
10.	Apply systemic and/or soil treatments (when funding is available) to vegetation that has tested positive to *plant pathogens* and surrounding vegetation, to prevent premature decline from pathogens and abiotic factors.
11.	Implement the Western Australian Dieback Signage System within bushland areas know to have *Phytophthora*.

11. FIRE MANAGEMENT

11.1 Ecological Impacts of Fire

Fire is a natural component of Swan Coastal Plain ecosystems with the majority of plants having developed fire-related adaptations. Many species have the ability to reproduce following fire by either resprouting from underground storage systems or utilising seed stored in the soil or seed material and are able to germinate with assistance from heat or smoke. Therefore, long term diversity and composition of native plants species is dependent on fire. However, the timing, frequency and intensity of fire regimes is a complex issue and frequent fires can be very damaging to species composition and the fauna it supports.

Fragmented remnant urban bushland areas such as those found in Nedlands have had a history of frequent fires. This has had a devastating impact on the biodiversity values of these areas. Fire has the ability to modify bushland areas in the following ways:

- Promotion of weed growth especially grass weeds via increased light and nutrient availability after the fire and decreased competition from native seedlings
- Reduction of the natural regeneration potential of the bushland as recruiting seedlings die before they can set seed
- Alteration of floristic and fauna species composition
- Alteration of habitat requirements for fauna
- Threats to the viability of rare, endangered or geographically restricted species
- Threats to the viability of obligate seeder species (which are typically more sensitive to fire than lignotuberous species that can resprout following fire).

This is evident from the lack of a multi aged population of native trees in many of Nedlands natural areas such as Tuart (*Eucalyptus gomphocephala*), Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) which require several years in order to produce seed and therefore regenerate new populations. Another example is Rottnest Island Pines which require approximately fifteen years between fires to mature and produce adequate seed. They are easily killed by fires which have contributed to their population decline on the Swan Coastal Plain with most of their natural populations now restricted to Rottnest and Garden Islands.

Modified bushland environments where weeds form a significant part of understory increases the fire risk by creating the following conditions:

- Formation of a fine-textured fuel which is highly flammable
- Production of increased fuel loads in comparison to native plants
- Formation of a continuous fuel bed, increasing the rate of fire spread as natural vegetation structure is usually more open than dense grass weed infestations
- Creation of a very hot fire at ground level.

This leads to a “fire weed cycle” of increased weed growth leading to increased fire risk and thus increased fire intensity and frequency, which in turn leads to increased weed growth.

Given that the remaining remnant vegetation in the City's bushland areas is fragmented and often small, the extreme weather impacts as well as arson, further increase potential for fire and damage to the environment, property and people. As a result of extreme fire events in the state and nationally, the Western Australian government (Department of Planning,(now Department of Planning, Lands and Heritage) released a *Planning Policy 3.7, Planning in Bushfire Prone Areas* and corresponding guidelines in 2015 with the update to guidelines in 2017. These documents seek to guide landowners and land managers to conduct effective risk-based fire management planning for a variety of land uses.

11.2 Objectives

The fire management objectives for the City of Nedlands are:

- Protection of human life
- Protection of public and private property
- Fulfilment of obligations under fire legislation
- Reduction of the area, frequency and impact of fires
- Minimisation of the impacts of fire on air quality
- Protection of ecological integrity and biological values.

11.3 Responsibilities

Local governments are vested with responsibilities under the *Bush Fires Act 1954* in relation to the prevention, control and extinguishment of bushfires. The Department of Fire and Emergency Services (DFES) is responsible for fire extinguishment within DFES Gazetted Fire Districts such as Nedlands and provide education on hazard risk management to prevent, prepare for, respond to and recover from fire.

11.4 Current Management

The Department of Fire and Emergency Services has Fire Pre-Plans for all six natural areas. These plans were developed in conjunction with relevant stakeholders including the City of Nedlands and relevant 'Friends of' groups and are reviewed annually. These plans detail site information, ecological requirements, vulnerable property, risk management strategies and responsibilities; communications plan, hazards; and fire suppression strategies and tactics. In addition to the review and implementation of Fire Pre-Plans the City undertakes the following fire management practices:

- Maintenance of firebreaks prior to the 30th November annually
- Annual program to manually reduce fuel loads by removing fine fuels especially within asset protection zones
- Prescribed burning (where appropriate)
- Fuel load assessments to monitor fuel loads and respond accordingly.

In addition to the above management practices in 2013 the City undertook bushfire risk assessments in all of City's natural areas using Australian Standard AS 3959 (*Buildings in Bush Fire Prone Areas*) and ISO AS/NZ 31000-2009 (Risk Management - Principles and Guidelines). Whilst this was not a legislative requirement for the City and is only a requirement for developments occurring in bush fire prone areas. It was undertaken as a proactive measure by the City to assist in managing fire risk. As a result of these assessments several actions were identified and implemented for the City's natural areas and follow up maintenance has been scheduled (as required) in order to maintain these actions.

Fuel load assessments were undertaken for all natural areas in 2015 using methodology described within the DFES *Visual Fuel Load Guide for the Swan Coastal Plain and Darling Scarp* (DFES, 2015). Following these assessments a number of actions were undertaken to reduce fuel loads in areas of concern. Fuel load assessments were also undertaken at Shenton Bushland in 2017 and 2018 following prescribed burning undertaken that targeted grass trees. The 2015 fuel load assessments have assisted guiding the annual program to manually reduce fuel loads by removing fine fuels especially within asset protection zones.

11.5 Assets Requiring Protection

Key assets requiring protection are detailed below.

Shenton Bushland

- Grace Vaughn House
- Selby Older Adult Mental Health Service
- Shenton Dogs' Refuge
- Building on Irwin Barracks
- Child Care Centre Stubbs Terrace
- Designated "Conservation Zones"
- Remaining 26 Tuart (*Eucalyptus gomphocephala*) on site.

Allen Park

- The Heritage Precinct Houses
- Residences along Coast Rise, Sayer Street, Dune court, Island View Place, Horizon Court, Breeze Place and Wood Street
- The Western Power box on Jameson Street
- The Rugby Clubhouse
- Rottnest Island Pines (*Callitris preissii*) trees that are fire sensitive
- A number of species that are limited including, Broom Ballart (*Exocarpos sparteus*), Hairy Yellow Pea (*Gompholobium tomentosum*), Fanflower (*Scaevola thesioides)*, Coast Beard Heath (*Leucopogon parviflorus*) and Yellow Leschenaultia *(Leschenaultia linarioides)*.

Hollywood Reserve

- Office of the Australian War Graves
- Metropolitan Cemeteries Board depot
- Rottnest Island Pines that are fire sensitive.

Birdwood Parade

- Residence on the Avenue and the Esplanade
- Gallop House
- Rottnest Island Pines that are fire sensitive.

Point Resolution

- Residence at 68 Jutland Parade and 166 Victoria Avenue
- The three 100 year old Olive Trees that have historical significance
- Board walk
- Rottnest Island Pines that are fire sensitive.

Mt Claremont Oval Bushland

- Lisle Villages.

11.6 Strategy

Fire management within the City's natural areas consists of the following 3 core elements:

- Prevent fire (hazard reduction) remove the source of ignition e.g. reduce fuel load, remove equipment and materials that can spark the fire, increase public awareness
- Prepare for fire maintain firefighting equipment and emergency access ways
- Repair of fire damaged areas this usually involves revegetation and weed management.

Fire Prevention

The purpose of fire prevention is to reduce the frequency of ignitions, either accidental or deliberate, and minimise the extent of fires within the bushland. A further aim is to minimise adverse environmental impacts of any fires that do occur. Hazard reduction involves fuel and ignition reduction.

The control of weeds, particularly grasses such as Veldt Grass or African Lovegrass, the removal of excess leaf litter and dead vegetation is an effective way to reduce the fuel loads. A balance needs to be found as excess removal of leaf litter can contribute to other issues such as erosion and increased weed invasion.

The most effective manner in which fuel loads can be minimised throughout the bushland is to reduce the abundance of exotic perennial grasses (such as African Veldt Grass). Perennial grasses die back in summer whilst maintaining their root base of which provides fuel loading removal of perennial grasses will reduce fuel loading along with improving the native species composition of species that were out competed by perennial grass weeds.

Strategic or controlled burns in urban bushland such as those found in Nedlands are not recommended except where specific target species such as grass trees can be burnt to reduce fuel loads such as at Shenton Bushland. Broad scale strategic or controlled burns however, are found to be counterproductive. While occasional fires will not necessarily lead to the demise of species, regular and frequent fires lead to the increase of short-lived herbs and some grasses at the expense of other species.

Community education, access control (e.g. fencing), building standards for fire protection, planting of fire-retardant species and sparser planting arrangement can help reduce fire risks and fuel loads in addition to rubbish removal. To select fire retardant species, the naturally occurring species found in the bushland areas should be assessed using the online fire wise plants key www.cfa.vic.gov.au/plants. Although developed in Victoria, this key is relevant across Australia as it focuses on the plant properties rather than a species list. (e.g. small versus large leaf, dry versus succulent plant, stringy vs thick /coarse bark etc.).

Low fuel sites can also be created by spreading dead wood through the bushland to reduce high fuel loads in certain areas where vegetation has died or been burnt. This also assists in nutrient recycling and providing and maintaining habitat for fauna. Low

fuel areas also include firebreaks, tracks, roads, adjacent park land areas and carparks.

Fire Preparation

While fires are infrequent within Nedlands natural areas, it is worth noting that 48% of fires over a 50 year period in Kings Park are known to be due to arson and that large fires occur every 10 to 15 years during extreme conditions (Dixon, cited in Ecoscape 2005[2]). Fire suppression involves firefighting applications once a fire has started and taken hold.

Shenton Bushland and Hollywood Reserve fall under the jurisdiction of the Daglish Fire Station and Allen Park, Mt Claremont Oval, Birdwood Parade and Point Resolution with Claremont Fire Station.

Daglish Fire Station Contact Details

Street Address	221 Stubbs Terrace DAGLISH WA 6008
Telephone	+61 8 9381 1222

Claremont Fire Station Contact Details

Street Address	8 Congdon Street CLAREMONT WA 6010
Telephone	+61 8 9382 2222

Post-fire Recovery and Incident Analysis

Bushland areas are in a highly sensitive condition following fire. The soil is left bare and sensitive to erosion processes, such as from vehicle and pedestrian movements, heavy rain and wind. Following fires an initial assessment of the area should be undertaken to address informal access. Access control measures should be implemented as soon as possible and should be limited to management purposes for the first six to twelve months.

The site should be monitored for seed germination and resprouting vegetation and weed occurrences for a year following fire. Although regeneration should be adequate where access and weed control measures are implemented, additional direct seeding and tubestock replanting may need to be considered if regeneration is low. Following fire, weed species have an opportunity to increase in density and abundance. Weed control measures will need to be implemented if a fire occurs. The post-fire environment is susceptible to further damage, and weed control works should be undertaken at a time that will give the bushland the greatest chance of successful regeneration. Weed control should therefore be revised after each fire and the need for additional funds to maximise cost effective control of weeds such as Perennial Veldt Grass should be examined at this time.

Firefighting operations have the potential to cause mechanical damage through trampling of vegetation, water erosion and small scale clearing. This cannot be entirely avoided though should be minimised where possible. Trained bush regenerators should carry out reparation of mechanical damage. Post-fire incident analysis is an important facet of fire management which enables fire fighters and fire control authorities to review procedures, strategies and tactics and revise them in light of experience. All fires that occur within the park should be recorded. Information that should be compiled includes the date, season, time, cause of ignition, intensity and extent of the fire, fire control methods used and damage caused by the fire. This information can be used for long-term fire management planning.

DFES Pre Fire Plan

As mentioned above DFES have Fire Pre-Plans for all six natural areas which were developed in conjunction with relevant stakeholders including the City of Nedlands and relevant 'Friends of' groups and are reviewed annually. These plans detail: site information, ecological requirements, vulnerable property, risk management strategies and responsibilities; communications plan, hazards and fire suppression strategies and tactics.

Fire History

In the last five years uncontrolled fires covering an area of less than one hectare occurred at Point Resolution and Hollywood Reserve. The details are listed below.

Point Resolution fire history since 2013:

- An approximately 350 m^2 area of bushland on the edge of the parkland adjacent to the playground February 2017.

Hollywood Reserve fire history since 2013:

- Approx. 200 m^2 January 2015 in the northern section adjacent to the Metropolitan Cemeteries Board fence line.

Fire history maps have been detailed in the relevant Management Plan for these areas.

Management Actions 2019-2024	
1.	Fires bans should be instigated and maintained at all times.
2.	Reduce fuel loads through control of weeds such as Perennial Veldt Grass and manual fuel reduction techniques
3.	Suppress and contain any wildfires as quickly as possible.
4.	Document fire history with the extent of fires mapped and dates and causes recorded.
5.	Control access into burnt areas as soon as possible after the fire. Access to any burnt areas should be limited to management vehicles only for the first six to twelve months.
6.	Monitor seed germination and regeneration of vegetation for two years following fire.
7.	Carry out an intensive weed control program after each fire and monitor

	weed and native species recolonisation to maximise native species establishment.
8.	Do not establish new tracks during firefighting operations.
9.	Provide a fire contingency fund in the natural areas budget for reactive weed management and tree pruning/removal following fires.
10.	Annually update Pre Fire Plans with DFES.
11.	Undertake maintenance of fire breaks and access points annually prior to 30th November.
12.	Undertake fuel load assessments and follow up fuel reduction techniques as required.
13.	Liaise with government agencies such as DFES and the DBCA to update and implement best practice fire risk methodology and guide the fuel load reduction program.
14.	Apply only coarse/chunky mulch or composted wood chips in landscaped areas as this form of mulch is less likely to ignite due to large particle size.
15.	In the event of restoration after fire events, apply assisted natural regeneration methodology first before planting tube stock revegetation (this is for areas that have *Good* to *Very Good* condition vegetation – *Degraded* areas will require tube stock revegetation).

12. ACCESS

12.1 Objectives

The objectives for maintaining, rationalising and upgrading access within the City's natural areas is to:

- Protect natural areas
- Provide safe access for the public's use of natural areas
- Provide disability access (where possible)
- Provide access for Council works programs and firefighting.

These objectives need to be implemented with consideration to construction and maintenance costs minimising perimeter to area ratios for bushland (to avoid edge effects) and whether they facilitate public entry into unsafe areas (such as cliffs).

12.2 Background

Access is presently managed through paths, signs and fences.

Path Network

There is already an established path network in all natural areas which is considered adequate. These are shown in the map sections for each natural area in the relevant Management Plan. The path networks consist of different materials including crushed limestone, sand, concrete, boardwalks and bitumen.

The original paths through the majority of the City's natural areas were constructed of crushed limestone, which have deteriorated over time. In order to address deterioration of the pathways, the City developed the "Natural Area Path Network Policy". This policy outlines how the City of Nedlands will upgrade the natural area path network in accordance with Australian Standards (where possible). The most appropriate path material has been identified as red asphalt due to its durability and its aesthetics. The City's Corporate Business Plan and natural area path network forward works program outlines the funding requirements and program to upgrade all the City's natural area paths over a ten year period. Path upgrades are then scheduled into the City's five year capital works program and annual capital works budget. Currently path upgrades are complete for Allen Park, Mt Claremont Oval and Hollywood Reserve. The paths at Point Resolution are all complete except one small pathway in the northern part of the Reserve.

All six natural area path networks connect different sections of the Whadjuk Trails Network. The paths in Allen Park have had informal names used by the Friends of Allen Park over the years. Recently, through the Whadjuk trails project, their names have been formalised with Aboriginal names these can be viewed in the Allen Park Bushland Management Plan 2019-2024.

Signage

Signage aims to reduce issues with informal access and dumping in the City's natural areas and consists of Cliff Risk, Let it Grow, No Dumping, Whadjuk Trails and Bushland Restoration signage.

Birdwood Parade and Point Resolution Reserve both contain limestone outcrops and cliff areas. Geotechnical surveys are required every five years to assess the stability

of cliff areas. The most recent geotechnical survey was undertaken in 2015. Following this survey and recommendations contained within the geotechnical report the existing 'Cliff Risk' signage was upgraded and installed at additional locations to warn people and restrict access near cliffs and limestone outcrops. This signage was installed in 2016 and is compliant with the Australian Standard for safety signs.

Let it Grow, Bushland Restoration and No Dumping signage is also installed in many natural areas to encourage people to stay on pathways and not cause disturbance to bushland areas. Recently the City standardised its conservation signage by installing bollards with aluminium plates on them. These signs provide multiple messages for reserve users and assist with increasing awareness of environmental issues within individual reserves.

These standardised conservation signs are being installed in a different reserve each year. Currently Allen Park, Hollywood Reserve and Shenton Bushland have had these signs installed with Point Resolution, Birdwood Parade and Mt Claremont Oval Bushland to follow.

Whadjuk Trail signage has been installed in all six natural areas. This signage consists of small marine grade aluminium directional signage which is installed either onto bollards or into footpaths to guide people along sections of the trails. Whadjuk Trail signage also consists of interpretive signage which have information on them about Aboriginal and European history; and environmental education about different plants and animals found within each reserve. These signs are the responsibility of the City of Nedlands to maintain and replace as required.

Fences

Fencing bushland areas is one of the most effective ways to protect natural areas. Fencing provides clear delineation between parkland and bushland areas and their associated management practices. It also facilitates the development of specific management practices appropriate to the different land uses. Fencing within the City of Nedlands bushland areas consists of pine bollard and ring lock or three wires, chain mesh, limestone walls and bollards.

Shenton Bushland

The low limestone wall along the Lemnos Street front boundary lies on City of Nedlands owned land and it is the responsibility of the City of Nedlands to maintain. The internal ring lock fence on the southern part of the eastern boundary between the Department of Health and the City of Nedlands as well as the boundary fences along Irwin Army Barracks, Shenton College, Selby Adult Mental Health and the Dogs' Refuge Home are the responsibility of agencies other than the City of Nedlands.

Allen Park

The four types of fences at Allen Park include bollards, chainmesh, ring lock and fibre cement. Most of these fences are the responsibility of the City of Nedlands. The fibre cement fences along the boundary of Defence housing is the responsibility of the residences.

Hollywood Reserve
The fences at Hollywood Reserve consist of chain mesh and brick walls. The boundary chain mesh fence between the City of Nedlands and the Metropolitan Cemeteries Board (MCB) owned land is the responsibility of the MCB and the brick wall is the responsibility of the Office of the Australian War Graves all other fencing is the responsibility of the City of Nedlands.

Birdwood Parade
Fencing at Birdwood Parade is minimal and consists of ring lock fencing along the path near Gunners' Memorial and chain mesh fencing at the base of the limestone outcrops on The Esplanade. These fences are to be retained to restrict access to the limestone outcrops for safety reasons.

Point Resolution
There is ring lock fencing on one steep pathway at Point Resolution that assists pedestrians to keep to paths. There is also temporary fencing installed to protect Riverbank restoration sites on the western foreshore and embankment. This temporary fencing will remain in place until the vegetation has established.

Conservation fencing consisting of pine bollards and ring lock is being installed on the western edge of the new asphalt pathway in the parkland area. All grassed areas to the west of this new pathway are due to be converted to an ecozone in accordance with the Point Resolution Enviroscape Plan. As these areas are converted to ecozones, conservation fencing will be installed the entire length of the ecozone and will remain in place to delineate the bushland/ecozones from the parkland zones.

Mt Claremont Oval Bushland
There is currently pine and ring lock fencing along the southern part of the Reserve on the edge of the oval which is to be retained to restrict access to the Reserve from the playing fields. However there is no fencing on the Cleland Street boundary to the bushland this is resulting in informal access from various locations on Cleland Street.

13.3 Strategy

Path Network and Fences
Vegetation along path edges is easily degraded due greater disturbances encountered along the edges such as water runoff, light and trampling. Therefore it is important to ensure ongoing revegetation along pathways is undertaken to assist in maintaining good condition vegetation and prevent informal access paths.

Shenton Bushland
The fences and walls around Shenton Bushland are appropriate, as is the path network. Therefore the appropriate strategy is to maintain this infrastructure rather than construct, erect or remove components. The paths are eroding and require upgrading. They are scheduled to be upgraded in 2021/22 in accordance with natural area path network forward works program and the five year capital works program. Currently the majority of the limestone paths are 1.2 meters wide, when they are upgraded, they will be widened to a minimum of 2 meters.

Allen Park

Fencing within Allen Park is generally appropriate. There are some areas where informal access is occurring in the Odern Crescent and Flyash Hills Sectors. The City should investigate the installation of fencing along the Rugby Club playing fields (adjacent to the Odern Crescent sector) and the dog exercise area (adjacent to Flyash Hill) to reduce public access and trampling through these areas.

There is a 2m high wire boundary fence between the parts of Allen Park managed by the City of Nedlands and the Department of Defence. This fence should remain as it discourages the public from walking down the fragile dune slopes. Currently the footings on this fence are eroding in certain sections and require repositioning to stop the fence from falling down. As this fence belongs to the Department of Defence the City should work with the Department to progress the maintenance required to this fence.

Funding was received by the Western Australian Planning Commission's Coastwest Program to upgrade beach fencing to protect Swanbourne Dunes in 2010. This fencing requires maintenance every 24 months which involves lifting the fencing and removing sand build up off pathways. This will stop the fencing from becoming buried by sand dunes over time and increase its effectiveness to keep pedestrians on pathways.

The number and location of tracks within Allen Park is appropriate. Paths that have become eroded, unstable or overgrown expose the City of Nedlands and Department of Defence to risks with regards to public liability. All the City of Nedlands owned pathways were upgraded to red asphalt between 2012 and 2015 and are in good condition. One bitumen path between Sayer Street and Wood Street in the Heritage Precinct consists of black asphalt. This path was not upgraded as it was in good condition at the time of the path upgrades. When the red asphalt paths are upgraded in the future (which will consist of an overlay of red asphalt) this pathway should also be upgraded to red asphalt.

There are sections of the pathways on Defence owned land on Melon Hill which are eroded. The City has been working with the Department of Defence to address these issues and maintenance has been scheduled periodically by the Department of Defence to address these issues. The maintenance required is ongoing and ultimately the pathways require a full upgrade. This is hindered by available funding and therefore the City will continue to engage the Department of Defence to examine the status of these paths and request they undertake ongoing maintenance as required.

There is pedestrian traffic through the northern portion of the Coastal Foredune and Coastal Swale Sectors. Access through this area was restricted by fencing. The City has previously undertaken dense planting and brushing of this pathway. However the plants and brush were illegally removed and the fencing was continually damaged. It was therefore accepted that limiting access through this area was not achievable. As a result a small access point for pedestrians was provided for so that the fencing was not continually damaged

There is one location adjacent to the fire break along Sayer Street behind defence housing where there is potential for illegal access to occur. The City should investigate the installation of a bollard in this location.

Hollywood Reserve
The fences and path network at Hollywood Reserve are considered appropriate and rehabilitation has been completed on most informal tracks over recent years. The paths located in the southern section were upgraded in 2011 with the remainder of paths upgraded in 2018/19.

Birdwood Parade
The path network is considered appropriate at Birdwood Parade. The bushland already has a well-established path network. Interim stabilisation work (consisting of the installation of limestone retaining, spillways and curbing) was undertaken in 2012 with full path upgrades scheduled for completion in 2019/20 based on the current capital works program. Many informal tracks are being created at various locations between Birdwood Parade and The Esplanade and rehabilitation of these tracks is ongoing and difficult to manage. The formal paths should be retained, any informal tracks continue to be rehabilitated and the installation of conservation fencing between the parkland and the bushland areas should be investigated with priority on the Birdwood Parade side of the bushland.

A crushed limestone pathway was installed by the Department of Local Government, Sport and Cultural Industries (DLGSC) to link the Sunset Hospital Site to the City's pathway extending from Birdwood Parade to Tawarri Reception Centre. This has resulted in loose limestone washing debris onto the City's pathway causing maintenance issues. The City have collaborated with the DLGSC and they have agreed to upgrade this pathway to red asphalt.

Point Resolution
The bushland has a well-established path network and rehabilitation has been completed on most informal tracks over recent years. The formal tracks should be retained, and any informal tracks continue to be rehabilitated. Formalising access points onto the southern beach was undertaken as this area was restored through Riverbank funding received from the Department of Biodiversity, Conservation and Attractions. As a result there are now four access points along the southern foreshore area.

Two tracks in the south western part of the Reserve are used by fisherman, for access at high tide when access is not possible form the end of the path on the southern foreshore. One of the access points (adjacent to the boardwalk) was put forward as a funding request in the 2016/17 Council budget process. This request included design and construction costs to extend the boardwalk onto the beach at this location, however it was not approved by Council. Currently rehabilitation of these two areas is not achievable and these two tracks should be left as informal access points.

All pathways except one were upgraded in 2015/16. These works included formalising and stabilising the sand track adjacent to 68 Jutland Parade, undertaking repairs and maintenance to the boardwalk, upgrading one limestone pathway to

asphalt, upgrading one highly eroded vehicle sand track to an asphalt vehicle track; and upgrading one narrow bitumen pathway to red asphalt. There is one narrow asphalt track that requires upgrading in the northern section of the Reserve. This pathway is being put forward for upgrade in the 2019/20 capital works program.

Mt Claremont Oval Bushland

The number and location of paths within Mt Claremont Oval Bushland is appropriate. There is currently no fencing along the boundary on Cleland Street where informal access continues to be problematic. This is creating informal tracks through the bushland which is contributing to erosion and damage to native vegetation and revegetation programs. Furthermore in spring 2018 City staff witnessed a Shingleback Skink killed by a dog in the bushland area adjacent to Cleland Street. The City should investigate the installation of fencing to guide and control access through the bushland from Cleland Street. Interim stabilisation work (consisting of the installation of limestone retaining, spillways and curbing) was undertaken in 2012 with full path upgrades complete in 2017/18.

Management Actions 2019-2024	
1.	Regularly prune along all paths to be retained.
2.	Maintain existing path networks and fencing.
3.	Install fencing between parkland and bushland/ecozone areas at Point Resolution and Birdwood Parade.
4.	Implement the City of Nedlands Natural Area Path Network Policy and Procedures.
5.	Undertake a geotechnical survey at Point Resolution and Birdwood Parade every five years.
6.	Continue to work with the Department of Defence to repair eroded pathways and fencing on Melon Hill.
7.	Investigate the installation of fencing along the Rugby Club and dog exercise ovals at Allen Park to reduce informal access.
8.	Undertake maintenance to beach fencing every 24 months.
9.	Install conservation fencing along Cleland Street at Mt Claremont Oval Bushland to reduce illegal access.
10.	Ensure ongoing revegetation along pathways to maintain good condition vegetation and prevent informal access.
11.	Install bollards on Sayer Street (adjacent to Defence Housing) to stop informal and illegal access.

13. CULTURAL HERITAGE, INTERPRETATION & EDUCATION

13.1 Objectives

The objectives for cultural heritage, interpretation and education are to:

- Identify, encourage respect for, and preserve Aboriginal and European cultural heritage.
- Increase public knowledge of the environmental, local and regional significance of natural areas.
- Develop opportunities for recreation with minimal impact on the environment.
- Increase the level and quality of information available to the community on the flora, and fauna of the City's natural areas.
- Inform the local community on current and proposed management objectives and encourage public participation in the management of natural areas.
- Engender a spirit of care and sense of ownership for natural areas within the City; and sense of ownership amongst the community.

13.2 Whadjuk Trail Network

The Whadjuk Trail Network is a project that has been undertaken by WESROC Councils and natural area 'Friends of' groups in the Western Suburbs. The Whadjuk Trail Network consists of a series of walking trails that link all natural areas in the Western Suburbs. It has now extended beyond the Western Suburbs into the City of Stirling.

Currently six out of seven trails have been installed. Each trail has directional signage installed into footpaths and on signs and bollards along the trails. Interpretive signage has also been installed in parkland and bushland areas detailing the environmental, Aboriginal and European significance of each area the trail traverses.

This project has been a collaboration with all WESROC Councils, the City of Stirling, Fremantle and Perth, all natural area 'Friends of' groups in the Western Suburbs, Lotterywest and the South West Aboriginal Land and Sea Council.

13.3 Aboriginal Heritage

The Whadjuk tribe were one of over fourteen tribal groups that made up the Noongar people. The land occupied by the Mooro group of the Whadjuk tribe originally covered much of what is now the western and northern suburbs of Perth. Their area extended from the ocean in the west to the Swan River in the east and from Moore River in the north to the Swan Estuary to the South.

The leader of the Mooro group was a man called Yellagonga. Yellagonga apparently died in 1835 by drowning in the Swan River (Williams, cited in Ecoscape 2005[1]). It was estimated that in 1837 the population of the Mooro group was only 28 people which may reflect the collapse of Aboriginal society as a result of European occupation and influences. Other authorities have provided a higher population figure. N. Ogle in 1939 estimated that approximately 750 aboriginal people inhabited the present day metropolitan area (Seddon, cited in Ecoscape 2005[1]).

Wetlands in the Western Suburbs such as Perry Lakes, Lake Claremont (Butlers Swamp), Shenton Park Lake (Dysons Swamp) and Mabel Talbot Park (Jolimont Swamp) were important sources of food for Aboriginal people. These food resources

included turtles, mud fish and gilgies (O'Connor, cited in Ecoscape 2005[2]). Kings Park was an important ceremonial and dreaming area for Aboriginal males. According to Williams (cited in Ecoscape 2003) Aboriginal people called Point Resolution Mandyooranup or Mandyuranup which means place of Banksia, however it was not a preferred food gathering site due to its steep banks.

Despite their obvious food value, the exploitation of open shore marine molluscs does not appear to have been favoured by Aboriginal groups occupying the Swan Coastal Plain around Perth (Ecoscape 2005[1]). It is believed that wetlands to the east would have provided more opportunities to hunt and gather food than the coastal area in places such as Allen Park.

Aboriginal utilisation of area around Swanbourne for camping, hunting and gathering continued at least until the early 1950s and some Aboriginal children attended Swanbourne Primary School (Harris, 2013). According to the National Trust it is feasible that Allen Park provided a route between Lake Claremont and the flat limestone reefs off Swanbourne Beach and southwards (cited in Ecoscape 2005[1]).

Aboriginal Significant Sites in Nedlands Natural Areas

According to the Department of Planning, Lands and Heritage (DPLH) Aboriginal heritage inquiry system (accessed February 2019) the following sites are found within the vicinity of Shenton Bushland, Mt Claremont Oval Bushland and the river foreshore:

Registered significant sites in the vicinity include:

- ID3536 – Swan River (mythological significance)
- ID3762 – Lake Claremont (skeletal material, burial, camp, hunting place, water source)
- ID20178 – Bold Park – (mythological significance, historical, plant resource, camp, hunting place, lookout point).

There are a further nine sites listed as “Other Heritage Places” within the vicinity of Shenton Bushland, Mt Claremont Oval Bushland and the river foreshore. Other Heritage Places are either sites that have been assessed as not being an Aboriginal Site under the Act, are awaiting assessment or there is insufficient information to make a decision as to whether the Act applies. These sites include:

- ID3763 “Lemnos Street” is on the north side of Lemnos Street was once a camp which is now partly covered by buildings
- ID3549 “Shenton Park Scarred Tree” is a modified tree in Underwood Avenue Bushland which is now destroyed
- ID3764 “Fringecamp” is in the vicinity of Lake Jualbup and was a camp and water source
- ID4036 “Mengler Avenue” and contained artifacts and scatter
- ID4034 “Lisle Street” near Mt Claremont Oval Bushland contained artefacts/scatter
- ID3205 is located at Bishop Road Reserve and contains artifacts and scatter
- 3 sites (ID19934, ID19935 and ID19936) located in the vicinity of Underwood Avenue Bushland which consist of two camps, a meeting place and Jarrah trees.

For the preparation of the Allen Park Management Plan 2005-2010 Ecoscape researched collections in the City of Nedlands Library (Local Studies Collection), the Battye (State) Library and the Department of Indigenous Affairs Library collection. However no additional information was obtained for Allen Park.

The Mooro group of the Whadjuk tribe moved in response to seasonal availability of certain staple food items. They would have traversed all natural areas within the City to collect food, medicinal plants and hunt. Whilst no registered sites have been found to date in the City's natural areas there remains the possibility that evidence of Aboriginal activities could still be found and there may be significant sites within these areas that have not been registered.

13.4 European Heritage

Shenton Bushland

There are no historic buildings within Shenton bushland however the Prisoner of War (POW) Holding Compound at Karrakatta was located within the bushland. It was the first POW facility built in Western Australia to accommodate POWs. It was primarily used as a transit or holding depot for the movement of prisoners and was the main holding facility near Perth with up to 160 POWs and Australian Army personnel onsite. The facility was in constant use between 1942 and 1946 for the administration of POWs within the Perth metropolitan area, (Polis, cited in Ecoscape 2005[2]). There are photos in the City of Nedlands local studies collection of Italian POW's filling in the "hot pool" on the Dalkeith/Nedlands Foreshore. Considering this it is possible that POWs assisted with the reclamation work undertaken along the Esplanade and perhaps helped with the reclamation work along the Dalkeith/Nedlands Foreshore (Harris, 2013).

After 1946 the POW compound at Shenton Bushland was pulled down and the site was left to regenerate naturally. The only evidence of it today is the remains of gravel that was transported from Perth Hills to build the compound and a small patch of Blue Leschenaultia which was transferred with the gravel. Whilst there are no physical remains of the compound its location can be determined from aerial photos from the 1940s (Polis, cited in Ecoscape 2005[2]).

Allen Park

The existence of Allen Park is owed to Mr. John (Jack) Allen, the second longest serving Councillor in the City of Nedlands history. Mr. Allen was born in England, and having heard about Western Australia from army comrades, he decided to migrate and bought a home at 1 Reeve Street, Swanbourne in 1919. He initiated numerous tree planting programmes within the area as stated by his son:

> *"He also initiated a tree planting programme by means of an Arbor Day. As I recollect, on the Arbor Day local citizens including school children planted trees, some of which still remain - Peppermint, Rottnest Native Fir and Gums."*

From his first years on the board, Mr. Allen provided a strong driving force for the purchase of what is now Allen Park. He was particularly fascinated by the uniqueness of the vegetation of Melon Hill as is evidenced the recollection that:

"*I remember my father stating that the reason he went to a lot of trouble travelling far and wide with the expenditure of much time, getting people to sell their blocks which now make up the park, was the hill - commonly known as Melon Hill. The attractive bush covered hill caused him to make the effort when he moved to Swanbourne in 1919".*

In 1924/25 the Claremont Road Board bought 15 acres of the Langoulant Estate for a new sports ground. Langoulant was the first permanent resident who established a farm in the area in 1869 called 'Pleasant Valley', consisting of 40 acres of land (Williams, cited in Ecoscape 2005[1]). John Allen visited absent owners of some blocks, inducing them to sell. He helped dig the park's first well, which went down 12 feet. He also assisted in laying its first reticulation system.

In 1931 the Claremont Road Board secured parliamentary approval to alter 'Throssel Park Reserve' 7804 to 'Allen Park'. The boundaries of this Reserve were changed to allow the local authority to dispose of certain portions of it for residential purposes as they saw fit. In this way over 60 lots were sold, a portion of the original Reserve and money received was then spent further developing the area (Williams, cited in Ecoscape 2005[1]).

The author Joseph Furphy, who wrote under the pseudonym 'Tom Collins' also has substantial links with the Allen Park area. His house in Servetus Street was one of the earliest dwellings in the area. It is now located in the Allen Park Heritage Precinct and called "Tom Collins House". Joseph Furphy also designed and constructed a home for his son at the corner of Clement Street and Pine Close, overlooking Allen Park. This house has also been relocated next to Tom Collins House in the Heritage precinct and is call "Mattie Furphy House". Joseph Furphy was an avid observer of local natural history and the area now known as Allen Park is mentioned several times in his correspondence.

Until 1991, Melon Hill was part of the Coastal Defence System as a site for a concrete pillbox, now removed, dating from the Second World War. A cairn now stands on Melon Hill with this inscription on the plaque:

SWANBOURNE BATTERY (1936-1964)

This cairn commemorates the efforts of army coastal artillery and the vital role coastal batteries played in defending Australia's coastline from naval attacks. This site marks the location of a battery observation post built and operated on Melon Hill from 1938-1963. The post was used to support army coastal defences. Located 500 metres to the north, within the present day Campbell Barracks Swanbourne battery, was developed and operated by 6 Heavy Battery, Royal Australian Artillery, and formed the northern part of Perth's coastal defence system throughout World War II. The battery consisted of two six inch BL wire MK.VII guns as depicted on mounting central pivot MK.II and had a maximum range of 12 800 metres. The battery was never used in action and the facility was scrapped along with most of Perth's coastal defences in1963 (RK Glyde).

Allen Park Heritage Precinct

The Allen Park and Environs Management Plan (Ecoscape, 1996) designated a general area in the northeast corner of Allen Park as a Heritage Precinct. This recommendation was endorsed in the Swanbourne Local Area Plan which stated that *'[T]he Heritage Precinct in Allen Park is the only precinct in the metropolitan area dedicated to early urban life that has the potential to develop into a living cultural centre unique in Western Australia'* and was subsequently implemented.

Tom Collins House, Mattie Furphy House (built by Joseph Furphy for his son), Tom Fricker House, Mayo House (destroyed by fire) and the Friends of Allen Park Cottage are listed on the City's Municipal Heritage Inventory.

Conservation, Interpretation and Business Plans were developed for the Allen Park Heritage Precinct and between 2000 and 2007, the Heritage Precinct (Allen Park) Management Committee provided advice to the City of Nedlands Council on managing the precinct. The management committee no longer exists however the area surrounding the cottages is maintained through the City's Parks and Health and Compliance Departments.

Hollywood Reserve

Little of the European history of Hollywood Reserve is known however it was used as a farm for many years where dairy cattle grazed on the Reserve. During World War II soldiers staying at the nearby Hollywood Hospital were encouraged to cut down large trees as part of their rehabilitation therapy. Some of these felled trees are still visible today.

Birdwood Parade and Point Resolution

Both Point Resolution and Birdwood Reserve have had a long history of, quarrying, modification and tree planting. In 1890, John Forrest (Western Australia's first Premier) resolved to form a foreshore reserve from Beatrice Road in Freshwater Bay to Birdwood Parade (including Point Resolution) however this was not possible as part of the intended reserve had already been sold.

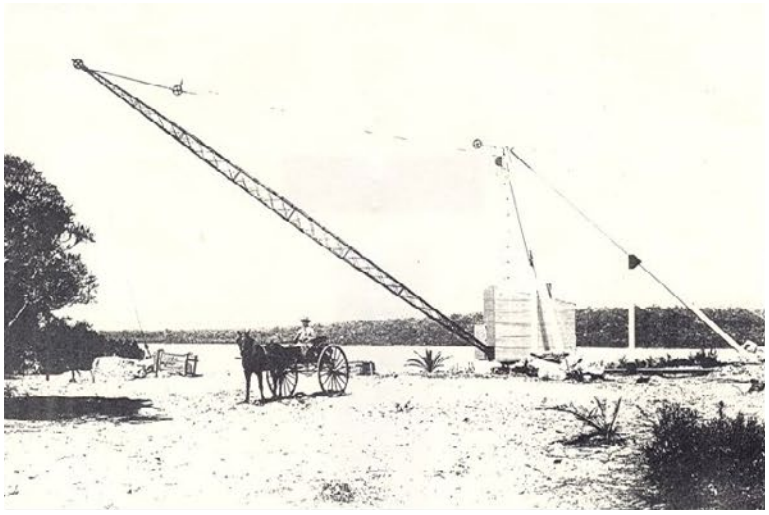
Point Resolution

Some early maps of the Swan River label Point Resolution as Point Brown who was the first Colonial Secretary. However, by 1896 the Admiralty Hydrographic Charts refer to it as Point Resolution. This name appears to predate these charts and the origin of the name may have been derived from Captain Cook's ship *Resolution*, although the compiler of the Admiralty Hydrographic Charts, Commander L.S. Lawson, also sailed on a Royal Navy vessel called *Resolution*, (Peet, cited in Ecoscape 2003).

Point Resolution experienced an extensive period of quarrying. During the 1850s convict labour was used to hoist the stone to the top of the scarp where it was trimmed before being used in government buildings, possibly including the Perth Goal and the Perth Boys' School. It was also used to construct the Perth – Fremantle Road which is now Stirling Highway (Harris, 2013).

By 1894 Alexander Mathieson was using a hand powered crane to bring the rock to the top of the scarp. Some of this rock was dressed on the high ground *'which to this*

day [1968]is so full of stone chips 50 yards back from the edge of the cliff as to render it very difficult to dig'. In 1904 Mr. Lakey began using a horse and jigger to bring the rock to the top of the scarp for the construction of Sunset Hospital and in 1908, Messrs. Briggs and Rowland used barges to cart stone from a jetty at Point Resolution for the surfacing of Broadway. (Peet, cited in Ecoscape 2003).
Figure 8: Hand powered crane at Point Resolution circa 1890 (Courtesy The West Australian)



The surfacing at Broadway was needed for the development of a new tram line (Harris, 2013). After 1908 when the new tram line took people to the Nedlands Baths, the term "Naughty Nedlands" was coined, people would hire yachts and stay at the beach overnight (Harris, 2013). The Hot Pool was formed in the 1920s from a burst pipe taking hot water to Sunset Hospital. Quarrying possibly ceased in about 1910 (Williams, cited in Ecoscape 2003) but the ruins of the two original convict stone cottages (one of which is shown in Figure 9) that were associated with the original quarrying still stood about 3 foot high in 1894, where a cluster of 'aloes' were growing (Hope, cited in Ecoscape 2003).

Figure 9: Convict Depot at Point Resolution circa 1890 (Courtesy The West Australian)

By about 1920 attempts were made to beautify the area (Peet, cited in Ecoscape 2003). Between World War I and II, White Beach (between Point Resolution and Bishop Road Reserve) was a popular venue for picnics and parties, to the extent that change sheds were erected (Williams, cited in Ecoscape 2003). A barbeque appears to have been built at the south end of White Beach (where the cliffs start) sometime in the 1920s, possibly by fishermen. This is shown in Figure 10.

Figure 10: Remains of Barbeque at Point Resolution

The stones for the barbeque most likely came from the cottage or shed near the quarry. A fishermen's cottage also existed just west of the present building line in Jutland Parade as late as 1948 (Anderson, cited in Ecoscape 2003).

Evidence of the history of Point Resolution has now largely been obscured because:

- The final remnants of the convict cottages may have been used to construct the barbecue in the 1920s. There are clues, such as old photographs (although the cliff faces may have subsequently altered by quarrying) and references to nearby 'aloes' (which may have been Agave), near where the convict cottages may have stood, however the exact location is unknown.
- The change sheds were demolished by the Nedlands Council in 1964 (Anderson, cited in Ecoscape 2003).
- The jetty at the tip of the point had deteriorated to one post by 1995 and is no longer present.
- A rock drilled with holes for securing barges carting stone has collapsed into the Swan River (Nedlands News, undated).

- The very large stones used to anchor the hand-powered cranes at the quarry were bulldozed off the top of the scarp in the 1960s Hope, (1968) and Peet (1995) as cited in Ecoscape 2003 noted several features, the exact history of which could not be determined.

There was a partially cemented stone structure just above the high water mark that may have been associated with the jetty and at the eastern end of the Reserve parallel rows of stones (possibly the remains of a landing ramp) were visible at low tide.

Birdwood Parade Reserve
At 21A Birdwood Parade, in the center of the bushland, Gallop House stands prominently as a rare example of a landmark colonial residence overlooking Melville Water.

Figure 11: Gallop House

The stone building was constructed in the 1870s by James Gallop and is now registered with the State Register of Heritage Places and National Heritage Trust. It is significant through its association with the family's instrumental in the development of Dalkeith and its strong association with farming in the early European settlement of the Swan River (Australian Heritage Commission, cited in Ecoscape 2003).

There were also several other buildings associated with farming within Birdwood Parade, little evidence of which remains. Their locations are shown in the Birdwood Parade section of this Management Plan. The main agricultural activity around Gallop House was table grape production (Morning Herald, cited in Ecoscape 2003) but other foods grown included apples, guavas, lemons, oranges, nectarines, pears,

pomegranates, quinces and peaches, bananas, melons, date palms. Even cotton bushes were planted (Morning Herald, 1905 & West Australian Daily, cited in Ecoscape 2003). In the City's Local Studies collection there are advertisements for "Gallops Cayenne Pepper" that won prizes at the Perth Royal Show (Harris, 2013).

The 20 acres of land on which the Gallop House gardens lay was level with the river and subject to seasonal flooding. To make the ground suitable it was raised by approximately a foot with sand obtained from the adjacent hillside. In order to obtain this 'red' sand a great mass of rock was cut from the hill. This rock was used to construct the Old Men's Home (Sunset Hospital) (West Australian Daily, cited in Ecoscape 2003). The 'Pinnacles' at the northern end of Birdwood Parade had earlier been quarried by the Armstrong's for Dalkeith Cottage and by the Gallops for its replacement Gallop House (Williams, cited in Ecoscape 2003). Sand around the 'Pinnacles' was mined by Snashells in the 1920s and 1930s. The Nedlands foreshore was then further extended by the reclamation of 17 acres of land west of the Nedlands jetty in the 1940s (West Australian, cited in Ecoscape 2003).

14. COMMUNITY INVOLVEMENT

14.1 Objectives

The objectives for community involvement are:

- To demonstrate sound environmental practices to the community
- To empower the community to provide and preserve the environment for future generations
- To document the management of the bushland.

14.2 Background

There are five bushland community groups within the City of Nedlands they include:

- The Friends of Shenton Bushland (FOSB)
- The Friends of Allen Park Bushland Group (FOAPBG)
- The Friends of Hollywood Reserve (FOHR)
- The Friends of Point Resolution (FOPR)
- The Swanbourne Coastal Alliance (SCA).

More detailed information relating to the history of the groups and contact details is provided in the relevant Management Plan for these areas.

City of Nedlands Community Friends Group Policy

The City of Nedlands aims to work collaboratively with residents who are prepared to form a Community Friends Group to assist in natural area management and/or wildlife protection within the City. This policy outlines the process by which Community Friends Groups assist in the care of natural areas and wildlife within the City.

City of Nedlands Strategic Community Plan 2018-2028

This plan builds on the Strategic Community Plan 2013-2023. It represents the communities long term vision, values, aspirations and priorities for the City of Nedlands over a ten year (plus) period.

The Strategic Community Plan refers to “Great Natural and Built Environment” and “Great Communities” this relates to:

- A vision that “Our city will be environmentally sensitive, beautiful and inclusive place”.
- That our values include “We protect our enhanced, engaging community spaces, heritage, the natural environment” and “We enjoy places, events and facilities that bring people together. We are inclusive and connected, caring and support volunteers.”
- That our priorities include “Retaining Remnant Bushland and Cultural Heritage”.

Retaining Remnant Bushland and Cultural Heritage was identified as Strategic Priority 4. Several key actions were identified in the plan to contribute to retaining remnant bushland and cultural heritage as a strategic priority they are listed on the next page:

- Revegetate remnant bushland areas
- Develop greenway corridors
- Undertake tree planting in public areas
- Restore coastal and estuarine areas
- Maintain parks and other green spaces
- Provide a mechanism for buildings and places of heritage significance to be protected
- Allocate funds to enhance the City in the areas of art, heritage etc
- Maintain City-owned art works and heritage assets
- Enforce existing heritage provisions in planning scheme.

The City also has an ongoing partnerships with Conservation Volunteers Australia and local School groups to undertake conservation work across all the City's reserves.

14.3 Strategy

Generally community-based groups should be encouraged to provide assistance with focused projects, such as specific sites or weeds within a reserve, while the City bears the burden of broader responsibilities (such as control of extensive weeds through spraying programs). Community projects need to be sufficiently focused such that visible results are obtainable for community education purposes. A sense of on-going ownership is also important and the development of specific rehabilitation sites can facilitate this, with the community group participating in follow-up weeding after planting the same site.

A recent challenge for community groups is retaining and recruiting new members. Some groups such as the FOAP, FOSB and FOHR have been in existence for approximately 20 years. In the 1990s these groups had large numbers of volunteers attending work sessions. However, the majority of these groups now only have a small core group of members in attendance and some founding members are currently less able to contribute to on ground activities as they were in the past.

The City has the opportunity to provide support to help these groups remain sustainable through assistance with recruitment of new volunteers through advertising, social media and the volunteer referral centre.

Ongoing partnerships should also continue with Conservation Volunteers Australia and local School groups.

Management Actions 2019-2024	
1.	Continue to support the activities of bushland community groups by implementing the Bushland Friends Group Policy.
2.	Hold an annual event that brings all bushland community groups together rotating annually through different bushland areas.
3.	Provide assistance to help friends groups remain sustainable through advertising and the volunteer referral centre.

15. FERAL ANIMALS

15.1 Objectives

The objective is to suppress feral animal numbers to:

- Minimise predation pressure on native animals by foxes and cats
- Minimise habitat loss from pressure by feral bees and Coastal Brown Ants
- Minimise grazing pressure on native plants and seedlings by rabbits.

15.2 Background

Feral animals are introduced animals that live in the wild and have negative impacts on native fauna either by predation or habitat displacement. The City of Nedlands has seven main introduced or feral animals that are known to cause an impact on natural areas. They include rabbits, foxes, cats, coastal brown ants, European honey bees and feral birds (such as Rainbow Lorikeets and Little and Long-billed Corellas').

A regional feral animal control program is being implemented by WESROC Councils in order to coordinate a cross boundary approach with the aim of increasing the effectiveness of feral animal control in the region. In 2016 WESROC undertook a feral animal monitoring programme. This baseline survey was undertaken over a 30 night period where 38 motion sensor cameras were installed across 26 parks and reserves. Over the study period, motion cameras captured brown rats on 188 occasions, cats on 73, rabbits on 37 and foxes on 5. A number of other introduced and native animals were also captured.

Whilst rats have not been found to directly impact the City natural areas they are found in significant numbers as confirmed in the regional feral animal monitoring program undertaken by WESROC.

Rabbits

Rabbits cause significant degradation to restoration sites and established vegetation. They can be particularly damaging to coastal environments where their populations tend to thrive. Rabbits are known to occur in four natural areas including Allen Park, Hollywood Reserve, Birdwood Parade and Point Resolution. In recent years they have not been sighted at Birdwood Parade. These natural areas all have access to reticulated lawn where rabbits feed and to bushland with sandy soils and shrubs where they establish burrows.

Foxes

Foxes are not uncommon in the Perth Metropolitan area they threaten natural areas by predating on native animals, especially birds. They have been sighted in the majority of Nedlands natural areas, as well as bushlands and wetlands of the wider Western Suburbs area with dens having been found in Allen Park, Point Resolution, Birdwood Parade and Shenton Bushland.

Coastal Brown Ants

Coastal Brown Ants (*Pheidole megacephala),* originally from southern Africa, are very aggressive and have the ability to displace native ant populations. They are usually only recorded in urban areas and coastal dune ecosystems disturbed by human impacts and associated deficient indigenous ant fauna (Vanderwoude, Lorry de Bruyn & House, cited in Ecoscape 2005[1]).

The 2005-2010 Allen Park Management Plan noted the following details regarding Coastal Brown Ant populations:

"Allen Park is only the second bushland site in Western Australia where Coastal Brown Ants (*Pheidole megacephala*) have been confirmed (Callan, 2004). This is significant given that this species is highly competitive and displace native ant populations."

Some further surveys for Coastal Brown Ants were undertaken at Bold Park in 2010, however no populations were found. This was considered interesting as the site at Bold Park that was surveyed was on the opposite side of the Road to the first of only two known populations of Coast Brown Ants (at Darren Park in Nedlands). No access to water at Bold Park is a possible factor contributing to this finding (Harris, 2013).

Cats

Feral cats have the potential to occur across all natural areas. The Cat Act 2011 which came into effect in November 2013 requires the identification, registration and sterilisation of domestic cats. The purpose of the legislation is to provide better management of the unwanted impacts of cats on the community and the environment, as well as encouraging responsible cat ownership.

The Cat Act 2011 gives local governments the power to administer and enforce the legislation. Once cats are six months of age they are required to be microchipped, sterilised and registered with the City. Cats are required to wear a collar and registration tag to ensure they can be easily identified and returned to their owner.

European Bees

European honey bees are found in all reserves mostly utilising hollows in large trees and stumps of Balga (grass trees). European honey bees compete with native insects and vertebrates for pollen and nectar along with establishing hives in tree hollows which reduces habitat and nesting opportunities for native birds and possums.

Introduced Birds

There are seven known introduced or feral birds recorded across Nedlands natural areas. These include:

- Rock Dove (*Columba livia)*
- Spotted Dove (*Streptopelia chinensis)*
- Laughing Dove (*Streptopelia senegalensis)*
- Rainbow Lorikeet (*Trichoglossus haematodus)*
- Laughing Kookaburra (*Dacelo novaeguineae)*
- Little and Long-billed Corellas' (*Cacatua sanguine and tenuirostris)*

Feral birds compete with native birds for foraging material and nesting hollows. Some also carry diseases which have the potential to infect native bird populations such as the Rainbow Lorikeets that carry Beak and Feather disease.

Invertebrates

One introduced non-resident moth (the Cabbage White Butterfly (*Pieris rapae*)) has been recorded in Shenton Bushland. Whilst it has not been recorded in other natural areas it is widespread in the Western Suburbs. Therefore in addition to Shenton Bushland it is likely to occur across many other natural areas within the City.

Cane Toads (*Rhinella marina*)

Cane Toads are native to south and central America and are highly invasive. They are a declared pest in Western Australia under the *Biosecurity and Agriculture Management Act 2007* (PIRD, 2019). They were introduced to Queensland in the 1930s and have spread from eastern Australian across the Northern Territory into Western Australia's Kimberley region.

Cane Toads are a serious threat to biodiversity as native species can be poisoned if they eat them. High risk species include snakes, goannas and lizards. Whilst isolated sightings of Cane Toads have been reported in the Perth region from time to time however there are no known established populations in Perth as yet. This may likely change in future and if this occurs the City will need to adapt its feral animal control program to include Cane Toads.

16.3 Strategy

Shooting feral animals is not considered appropriate for use in urban areas due to public safety issues. When contractors are engaged to undertake feral animal control the City ensures contractors have the appropriate licences and no feral animal control is undertaken where there is potential risk to pets, wildlife or the public.

The City uses an integrated feral animal control program which includes:

- Baiting rabbits (using baiting stations)
- Baiting coastal brown ants
- Virus release for rabbits
- Fumigation (only for foxes)
- Hive destruction.

Currently the City does not control feral birds or the Cabbage Butterfly.

Rabbits

Baiting

Feral rabbits are controlled using Pindone in bait stations (small enclosures for bait). The aim of this is to reduce potential risks to non-target species, although trail baiting has been found to be more effective and cost efficient in reducing rabbit numbers. Baiting is undertaken during summer when natural feed is scarcer which increases the success of the program. Baits are laid overnight to reduce potential off target damage to omnivorous skinks. Appropriate warning signage is installed at entry points and on the bait stations in accordance with label instructions.

When undertaking baiting using bait stations it is important to ensure that prior to any baits being laid no off target species are at risk such as Possums. This can be assisted by laying plain oats and ensuring rabbits are the only species eating the oats (which can be achieved by setting up cameras and surveying tracks and scats). Once it's confirmed rabbits are eating the plain oats only then should baits be laid.

Warren Fumigation and Destruction
Warren fumigation and destruction is not used in the City of Nedlands. The City has populations of Gould's Sand Monitors in five natural areas with four of these areas containing feral rabbits. As monitor lizards are known to use the burrows of rabbits and even predate on juvenile rabbits it is not considered appropriate to use warren fumigation or destruction as a rabbit control method due to the risk of off target damage to monitor lizard populations.

Fencing
Rabbit-proof fencing can provide a viable option for excluding rabbits from areas of high conservation value once they have been eliminated from the site. Twigg and Lowe 2003 (cited in Ecoscape 2005[1]) suggest that fencing can provide a better long-term and cost-effective solution to many rabbit problems in urban areas than baiting, despite the initial cost outlay for rabbit-proofing boundary fences.

Where such fencing is erected consideration also needs to be given to the possible effects on native animal species. There are no large native animals present that would be affected however, some reptiles such as Bobtails could be impeded by tightly knit fencing wire. Therefore, fencing with holes large enough for Bobtails to move through should be utilised when installing rabbit proof fencing.

Generally fencing is not a viable option for the City of Nedlands bushland reserves. This is due to the difficulty involved with removing all known rabbit populations from the areas they inhabit, followed by the initial cost outlay to install fencing and ongoing maintenance that would be required. However, rabbit proof fencing is being used for the greenway/ecozones being installed on the parkland areas at Point Resolution.

Tree guards
In the absence of fencing tree guards are effective in protecting seedlings in revegetation areas. However once the tree guards are removed the juvenile plants can then be open to predation by rabbits and therefore this method should not be used in isolation.

Virus Release
A number of biological controls have been introduced into Australia to control rabbits. These include the Rabbit Calicivirus Disease (RCD), Myxoma Virus (myxomatosis) and the Rabbit Haemorrhagic Disease Virus (RHD). In 2017 the City of Nedlands participated in the national release of a new strain of rabbit haemorrhagic disease virus (calicivirus) called RHDV1 K5. The virus was released at three sites Swanbourne Dunes, Point Resolution and Bishop Road Reserve.

Whilst useful in controlling overall rabbit numbers, the impact of virus release varies and none of these diseases will result in the complete elimination of rabbits. Therefore it is important to undertake an integrated approach to feral rabbit control.

Foxes
There are two options available to the City for fox control. One is the opportunistic fumigation of fox warrens when they are encountered. Unlike rabbit warrens it is

unlikely that foxes and monitor lizards would utilize the same warrens. It is also very easy to identify an active fox warren thereby eliminating concerns of off target damage. The second option is the use of soft jaw or cage traps undertaken by a licenced pest contractor with appropriate signage installed on site. This method is best undertaken in September to November when there is an influx of juvenile foxes in the region.

1080 is the only poison available that could be considered to control foxes however it cannot be used in urban areas. Shooting foxes is also not appropriate for use in urban areas due to public safety issues. Another option is the construction of exclusion fences however, due to the cost involved this is not appropriate for fragmented small urban bushland areas such as those found in the City of Nedlands.

Coastal Brown Ants

Habitat Modification

Water availability is the main limiting factor for Coastal Brown Ants (Heterick, Casella & Majer, cited in Ecoscape 2005[1]). Therefore any reticulation within bushland where Coastal Brown Ants are known to occur needs to be minimised in order to avoid encouraging further establishment. Concrete path materials also encourage Coastal Brown Ant infestations as they nest between pavers and under the edges of concrete paths.

Baiting

A study on the use of Amdro at a suburban residential site in Perth found that over a number of years the number of ant species increased from seven to twenty five (as native ants recolonised the site) and Coastal Brown Ant activity was reduced to almost zero (Heterick, Casella & Majer, cited in Ecoscape 2005[1]).

The use of Amdro baits has also been used successfully to control Coastal Brown Ants in Allen Park. Ongoing treatments are required to continue the success of removing Coastal Brown Ants and increasing the ability for native ants to recolonise. As there has been no recent monitoring of Coastal Brown Ant populations in Allen Park resurveying both native ant and Coastal Brown Ant populations should be undertaken provided resources are available. The City could engage a university research project to assist with resurveying native ant and Coastal Brown Ant populations at Allen Park.

Coastal Brown Ants have been noted as thriving on the bamboo stakes used in restoration activities. If the bamboo stakes are moved between sites then this activity could potentially increase their distributions as well as potentially transferring plant pathogens on soil to different sites. In order to address this the City changed its practices in regards to maintenance of green stock and reusing bamboo canes. All reserves use new bamboo canes each year or they are kept and reused on site within the same reserve.

European Bees

Annually in spring bee hives are GPS mapped and a contractor engaged to remove hives across all Nedlands bushland reserves.

Feral Birds

Currently the City does not undertake any control in relation to feral birds. Shooting feral birds is not appropriate for use in urban areas due to public safety concerns.

A regional feral bird control program targeting Little and Long-billed Corellas' and Rainbow Lorikeets was undertaken by the Department of Biodiversity, Conservation and Attractions (DBCA) between 2006 and 2013. In recent years the coordination of the control program was taken over by WALGA. The City should consider financially contributing to feral bird control programs as there are large roost sites in close proximity to the City's natural areas and both species are known to inhabit the City's bushland reserves. Nearby roost sites include the University of Western Australia's research station in Underwood Avenue (Rainbow Lorikeets) and Claremont Show Grounds (Long-billed Corellas). These roost sites most likely harbour birds that frequent Nedlands natural areas. One further strategy to assist with feral bird control is to remove dead palm fronds rom beneath date palm trees as these have been identified as significant nesting sites used by Rainbow Lorikeets in the metropolitan area.

Management Actions 2019-2024	
1.	Continue to monitor and control feral animals using an integrated feral animal control program.
2.	Use baiting stations for feral rabbit control in preference to broad cast or trail baiting.
3.	Only undertake fumigation of fox warrens not rabbit warrens.
4.	Avoid using pavers or concrete slabs in natural areas which encourage Coastal Brown Ant infestations.
5.	Continue to control Coastal Brown Ants with maintenance of the Seaward Corridor undertaken biannually.
6.	Survey native and Coastal Brown Ant populations at Allen Park provided resources are available.
7.	Continue to work with other local governments and agencies to implement the regional feral animal control program.
8.	Minimise watering of bushland areas (where possible) to discourage Coastal Brown Ant infestations.
9.	Contribute to regional feral bird control programs.

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Appendix 1 Priority Weed Management Notes (Compiled from WA Herbarium DBCA Florabase website)

Scientific Name	Common Name	Management Strategy	Timing (optimal)
Acacia iteaphylla	Flinders Range Wattle	Hand pull seedlings. Fell mature plants.	March - July
Arctotheca calendula	Cape Weed	Chip out small infestations, ensuring root is severed well below ground level to prevent re-sprouting from the crown. For large infestations apply Lontrel 6 ml/10 L (300 ml/ha) in early growth stages. Glyphosate at 0.2% will provide some selective control if the plants are young or at the budding stage, otherwise spot spraying glyphosate at 10 ml/L will control at all growth stages. A combination of chemical and physical control with follow up treatment provides optimal control.	June - Nov
Avena fatua	Wild Oat	Spray at 3-5 leaf stage with Fusilade Forte at 16 ml/10 L + wetting agent. Repeat treatment over following 2 years. Prevent seed production and seedbank inputs each year. In small infestations hand removal may be feasible.	August - November
Asparagus asparagoides	Bridal Creeper	Dig out juvenile seedlings in degraded areas. Spray 0.2 g metsulfuron methyl + Pulse in 15 L water (or 2.5 - 5g /ha + Pulse). Best results achieved when flowering. Biological control agents available such as the Leafhopper and the rust.	July - August
Babiana angustifolia		Spot spray metsulfuron methyl 0.2 g/15 L + Pulse or 2.5 - 5g/ha + Pulse. Apply just on flowering at corm exhaustion.	Aug - Sept
Brassica tournefortii	Mediterranean Turnip	Hand pull plants.	July - September
Brachychiton populneus	Kurrajong	Hand pull seedlings. For mature plants try stem injection with 50-100% glyphosate or apply 250 ml Access in 15 L of diesel to basal 50 cm of trunk (basal bark) or cut and paint with 50% glyphosate.	Sept - April
Cenchrus setaceus	Fountain Grass	Dig out small infestations, slash in winter and/or spray with 1% glyphosate + penetrant in spring to autumn. Follow up seedling control and treatment until regrowth ceases. Use unplanned fire events to effectively control any regrowth.	March – April and November - December
Centranthus macrosiphon	Pretty Betsy	Hand remove small populations. Spray metsulfuron methyl at 0.1 g/15 L (2 g/ha) + wetting agent.	August - September

Scientific Name	Common Name	Management Strategy	Timing (optimal)
Chasmanthe floribunda	African Cornflag	Dig out isolated plants. Spot spray glyphosate 1% + Pulse before flowering.	June - July
Cynodon dactylon	Couch	Spray Fusilade Forte at 8 ml/L + wetting agent when plants are small, or 1% glyphosate in late spring/summer and autumn when rhizomes are actively growing. In sensitive areas try painting runners or crowns with 50% glyphosate. Follow-up always required.	Nov - Feb
Ehrharta calycina	Perennial Veldt Grass	For small infestations, cut out plants ensuring crown removal. Do not slash. Alternatively spray with Fusilade Forte 13 ml/L or 3.3-6.6 L/ha + wetting agent on actively growing and unstressed plants. Use higher rate in dense undergrowth or on older less vigorous plants. Follow-up in subsequent years. Use unplanned fires to spray regrowth and seedlings within 4-6 weeks of germination.	June - Sept (herbicide). Nov - Feb (manual)
Euphorbia paralias	Sea Spurge	Hand pull plants.	Sept - Jan
Euphorbia terracina	Geraldton Carnation Weed	Hand pull plants.	June Nov
Ferraria crispa	Black Flag	Hand remove very small populations in degraded sites. Sift soil to find all corms. Spray 2,2 DPA 10 g/L + Pulse when flowering. In degraded sites try glyphosate 1% + metsulfuron methyl 0.2 g/15 L + Pulse.	August - September
Ficus carica	Common Fig	Hand remove seedlings. Stem inject with 50% glyphosate and foliar spray regrowth with 10% glyphosate. For stems less than 30 cm diameter apply 250 ml Access in 15 L of diesel to basal 50 cm of trunk (basal bark).	November - March
Freesia alba x leichtlinii	Freesia	Spot spray metsulfuron methyl 0.2 g/15 L + Pulse or 2.5-5 g/ha + Pulse. Apply just on flowering at corm exhaustion.	July - August
Fumaria capreolata	Whiteflower Fumitory	Hand remove seedlings in good bushland areas/restoration sites if resources available.	July – Sept

Scientific Name	Common Name	Management Strategy	Timing (optimal)
Gladiolus angustus	Long Tubed Painted Lady	Spot spray metsulfuron methyl 0.2 g/15 L + glyphosate 1% + Pulse in degraded sites.	July - August
Gladiolus undulatus	Wavy Gladiolus	Spot spray metsulfuron methyl 0.2 g/15 L + Pulse or 2.5-5 g/ha + Pulse. Herbicide application should be just on corm exhaustion. Physical removal can result in spread of cormels. Once the parent corm is killed cormels in the soil tend to lose dormancy and germinate.	July
Ixia maculata	Yellow Ixia	Spot spray metsulfuron methyl 0.2 g/15 L + Pulse or 2.5-5 g/ha + Pulse. Apply just on flowering at corm exhaustion.	July - September
Lachenalia aloides	Soldiers	Spot spray metsulfuron methyl 0.2 g/15 L + Pulse or 2.5-5 g/ha + Pulse. Apply just on flowering at corm exhaustion.	July - September
Lachenalia bulbifera	Soldiers	Spot spray metsulfuron methyl 0.2 g/15 L + Pulse or 2.5-5 g/ha + Pulse. Apply just on flowering at corm exhaustion. Physical removal can result in spread of bulbils.	August - September
Lachenalia reflexa	Soldiers	Spot spray metsulfuron methyl 0.2 g/15 L + Pulse (2.5g-5 g/ha).	June - August
Lantana camara	Common Lantana	Apply 250 ml Access in 15 L of diesel to base 50 cm of stems (basal bark) or foliar spray with 1.5% glyphosate.	March - May
Leptospermum laevigatum	Coast Teatree	Hand pull seedlings. Fell mature plants. Resprouting has been recorded in some areas. Where resprouting has been observed, apply 250 ml Access in 15 L of diesel to bottom 50 cm of trunk (basal bark).	July - October
Lupinus angustifolius	Narrowleaf Lupin	Hand remove scattered plants. Spray dense infestations with metsulfuron methyl 0.1 g/15 L (2-3 g/ha) + wetting agent or spot spray Lontrel 6 ml/10 L (300 ml/ha) + wetting agent to late flowering, this will prevent seed set.	July - September
Lupinus cosentinii	Sandplain Lupin	Hand remove scattered plants prior to flowering. Spray dense infestations with metsulfuron methyl 0.1g/15 L (2-3 g/ha) + wetting agent. Larger areas can be treated with more selective herbicides such as 200 g/ha Lontrel or 50 g/ha Logran (based on 500 L of water/ha). For spot spraying use 4 g Lontrel or 1 g Logran in 10 L of water + wetting agent. Glyphosate is relatively ineffective.	July - September

Scientific Name	Common Name	Management Strategy	Timing (optimal)
Lycium ferocissimum	African Boxthorn	Hand pull or dig out small seedlings ensuring removal of all roots. For mature plants cut and paint with 50% glyphosate and follow up treatment on regrowth or apply 250 ml Access in 15 L of diesel to basal 50 cm of stem (basal bark).	March - May and Sept - Nov
Moraea flaccida	One-leaf Cape Tulip	Spot spray metsulfuron methyl 0.2 g/15 L or chlorsulfuron 0.2 g/15 L + Pulse or 2.5-5 g/ha + Pulse or 2,2 DPA 55 g/10 L + Pulse. Apply just on flowering at corm exhaustion.	July - August
Olea europaea	Olive	Hand pull or dig out seedlings and small plants ensuring removal of all roots. For mature plants cut to base and paint 50% glyphosate or apply 250 ml Access in 15 L of diesel to base 50 cm of trunk (basal bark). Monitor sites for seedling recruitment.	March - May and October - December
Oxalis pes-caprae	Soursob	Spot spray metsulfuron methyl 0.2 g/15 L + Pulse, or 1% glyphosate. Apply at bulb exhaustion, generally just on flowering. Exercise care if manually removing as physical removal can result in spread of bulbils.	June - July
Pelargonium capitatum	Rose Pelargonium	Hand pull isolated plants taking care to remove the entire stem as it can reshoot from below ground level. Spot spray metsulfuron methyl 5 g/ha + Pulse. Easily controlled after fire.	June - October
Pennisetum clandestinum	Kikuyu Grass	Difficult to manually control as all rhizomes must be removed. Spray with 1% glyphosate or Fusilade Forte at 16mL/L + wetting agent. 2-3 sprays over a single growing season are often required. Use unplanned fire events to effectively control any regrowth.	November - January
Schinus terebinthifolia	Brazilian Pepper	Hand pull seedlings ensuring removal of all root material. Stem inject older plants using 50% glyphosate or basal bark with 250 ml Access in 15 L of diesel to bottom 50 cm of trunk during summer. Avoid root disturbance until trees are confirmed dead.	December - March
Sparaxis bulbifera	Sparaxis	Spot spray metsulfuron methyl 0.2 g/15 L + Pulse or 2.5-5 g/ha + Pulse. Apply just on flowering at corm exhaustion.	September
Stenotaphrum secundatum	Buffalo Grass	Spray with 1% glyphosate 2-3 times over a single growing season, or spray 13 ml/L Fusilade Forte + wetting agent. Do not spray after heavy frost. Solarisation over warmer months can be useful for small, isolated infestations.	November - May

Scientific Name	Common Name	Management Strategy	Timing (optimal)
Tamarix aphylla	Athel Pine	Inject 100% glyphosate into root crown. In pasture or degraded areas, manually removal all plant parts and follow up control any regrowth. In sensitive environments, cut stem to ground level, immediately paint with Access 17ml/L in diesel (using glyphosate with cut stump is ineffective). Where there is limited risk of off-target damage or impacts on waterways try foliar spray with triclopyr 600g/L at 1.7 to 10ml/L in water.	All year.
Watsonia meriana var. bulbillifera	Watsonia	Wipe individual leaves with glyphosate 10% or spray dense infestations 2,2-DPA 10 g/L + Pulse. Apply just as flower spikes emerge at corm exhaustion. 2,2-DPA at 5 g/L+ Pulse is also quite effective and is appropriate to use when particularly concerned about off-target damage, for example following fire when Watsonia is growing among germinating native seedlings and resprouting native shrubs.	September

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