Environmental Land Use Planning Strategy

Prepared by City of Kalamunda

July 2019

Document	Author
Version 2 – Post advertising modifications	Strategic Planning

CONTENTS

1.0 INTRODUCTION

The City of Kalamunda (the City) contains a high proportion of natural areas and remnant vegetation as compared to other Local Governments in Western Australia. This so called 'green infrastructure' informs the distinctive character of the area and is an asset that requires protection, preservation and management. Maintaining a balance between social and economic development and the protection and improvement of the natural environment is imperative as the City grows and develops.

This Environmental Land Use Planning Strategy provides:

- A breakdown of the local environmental context such as climate, flora and fauna, and geography;
- Outlines key strategic planning directions;
- Considers potential environmental impacts of major projects; and
- Provides a consolidated summary of strategies to ensure the active improvement, protection and enhancement of the natural environment.

Strategies are derived from the local environmental context and data that identify the key areas of action to support the vision and values of the City's Kalamunda Advancing 2027 Strategic Community Plan. The strategies are based on comprehensive research and analysis, supported with key performance indicators to ensure the actions are relevant, realistic and measurable.

This Environmental Land Use Planning Strategy is prepared in accordance with the *Planning and Development Act 2005* and the Local Planning Manual as required by the Western Australian Planning Commission (WAPC). Strategies recommended as part of this Environmental Land Use Planning Strategy form part of a broader Local Planning Strategy which incorporates other key areas including housing, industry, public open space and agricultural and rural areas.

1.1 Goal

To compile a comprehensive report on the status of current natural environmental factors and influences in the City, and develop strategies to enhance and improve biodiversity and promote sustainable planning practises which are sensitive and complementary to the existing natural ecosystem.

1.2 Objectives

- To manage natural resources, land use, and development proposals to maintain the health and viability of geological soil systems in coordination with other ecosystem functions.
- To adapt to predicted climate change effects, and maintain and improve the safety of residents from bushfire events.
- Protect and enhance waterways, wetlands and the groundwater and ensure sustainable use and management of water resources.
- To preserve, enhance, connect and rehabilitate natural areas and protect biodiversity values.
- To improve the connectivity of existing green spaces and maintain and enhance urban soil, air and water quality.
- Identify and protect natural areas of Aboriginal cultural significance and local heritage value.

2.0 PLANNING CONTEXT

2.1 State Planning Strategy 2050

The State Planning Strategy provides the strategic context for planning and development decisions throughout the State. The State Planning Strategy guides development of local planning strategy and provides a framework by which Government can plans for the State's physical and social infrastructure, environment, food security, land availability, economic development, housing accessibility, security, education and training.

2.2 Perth and Peel Green Growth Plan for 3.5 million (draft)

The draft *Perth and Peel Green Growth Plan for 3.5 million* is a State Government strategic document developed by the WAPC incorporating recommendations from the Environmental Protection Authority's (EPA) *Interim strategic advice on Perth and Peel @ 3.5 million: Environmental Impacts Risks and Remedies* released August 2015.

The draft *Perth and Peel Green Growth Plan for 3.5 million* aims to support a projected 70% population growth with clearing of only 3% of the Coastal Plain and clearing of less than 1% on the Darling Scarp. Over 30 years, the objectives will be delivered through implementing a series of Action Plans. The Strategic Conservation Plan (Action Plan H) includes 170,000 hectares of new and expanded conservation reserves that, once endorsed, will equate to approximately a 50% increase in the area of conservation reserves in the Perth and Peel region.

The City aims to incorporate targets identified in the Perth and Peel Growth Plan at 3.5 million by supporting high quality infill development and confining greenfield developments particularly on the Darling Scarp and Swan Coastal Plain. Green field development describes the release and development of land not previously urbanised, whereas infill development relates to increasing and developing land that is already urbanised. The City contains existing conservation reserves and areas identified for Phase 1 additional conservation reserves and Phase 2 conservation reserves.

The draft *Perth and Peel Green Growth Plan for 3.5 million* was suspended as of June 2018 pending a six-month further review by an independent panel. The review will address ongoing costs, risks, and benefits of adopting the plan.

2.3 Perth and Peel @ 3.5million

Perth and Peel @ 3.5million outlines what the Perth Metropolitan Region could look like in the future, how our current lifestyle can be maintained and how to realistically accommodate a substantially increased population. The document identifies four planning and infrastructure frameworks for subregions within the Perth Metropolitan Area and provides guidance on sustainable development over the next three decades. The City of Kalamunda falls within the North-East subregion.

2.4 North-East Subregional Planning Framework

This framework sets out proposals to:

- achieve a more consolidated urban form and development;
- meet long-term housing requirements;
- strengthen key activity centres and employment nodes to meet the future needs of industry, commerce and the community;

- identify requirements for key community and social infrastructure such as those required for health and tertiary education;
- provide transport linkages that connect people with key centres of activity and employment, and access to areas beyond the Perth and Peel regions;
- facilitate and support a future regional transportation network and facilitate the provision of service infrastructure;
- identify sites to meet the growing requirements for regional sport and recreation facilities;
- protect areas with regional conservation, environmental or landscape value;
- establish the elements and functions of the green network in supporting an active and healthy community;
- encourage and guide increased connectivity between areas of open space or conservation through an integrated green network;
- protect areas with basic raw materials for timely extraction;
- provide ongoing consideration of water supply and protection of public drinking water source areas;
- retain land for rural and agricultural purposes; and
- guide the staging and sequencing of future urban development.

2.5 Local Planning Manual

Provides guidance to local government outlining the purpose of local planning strategies and schemes. The local planning strategy is the framework for local planning and the strategic basis for local planning schemes. The Environmental Land Use Planning Strategy will set out the objectives for future planning and development with particular emphasis on the environment. The Strategy will inform and support the development of the overall Local Planning Strategy.

2.6 Summary of Existing Legislation, Policies and Plans

All proposed development must give regard to relevant legislation, local planning schemes, policies and plans to ensure consistency with Commonwealth and State targets. Relevant legislation relating to environmental protection and development is summarised in Table 1 and 2.

Table 1. Table Summary of relevant Commonwealth and State Legislation

Legislation	Description
Commonwealth of Australia	
Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act)	Provides for protection of the environment and biodiversity conservation at a Federal level.
Australian Heritage Council Act 2003	Registered areas of valuable cultural and natural heritage
Western Australia	
Environmental Protection Act 1986	Outlines development and strategic documents which require referral to the Environmental Protection Authority.
Biodiversity Conservation Act 2016	Replaces the Wildlife Conservation Act 1950. Relates to the management threatened flora, fauna and ecological communities.
Planning and Development Act 2005	Is the primary piece of legislation governing development and subdivision of land in Western Australia.

Biosecurity and Agricultural Management Act 2007 (BAM Act)	Provides for the protection of agricultural and related resources through the management, control and prevention of pests, weeds and diseases.
Land Administration Act 1997 (LAA)	To repeal the Land Act 1933 and consolidate and reform the law in regards to Crown land, compulsory acquisition of land and related matters.
Rights in Water and Irrigation Act 1914	Provides for the rights in regards to the regulation, management, use and protection of water resources, irrigation schemes and related matters.
Contaminated Sites Act 2003	Identifies, records, manages and remediates contamination. Under the Act, known or suspected contaminated sites must be reported to the Department of Water and Environmental Regulation (DWER), investigated and, if necessary, cleaned up.
Biosecurity and Agricultural Management Act 2007 (BAM Act)	Provides for the protection of agricultural and related resources through the management, control and prevention of pests, weeds and diseases.
Land Administration Act 1997 (LAA)	To repeal the Land Act 1933 and consolidate and reform the law in regards to Crown land, compulsory acquisition of land and related matters.
Rights in Water and Irrigation Act 1914	Provides for the rights in regards to the regulation, management, use and protection of water resources, irrigation schemes and related matters.
Contaminated Sites Act 2003	Identifies, records, manages and remediates contamination. Under the Act, known or suspected contaminated sites must be reported to the Department of Water and Environmental Regulation (DWER), investigated and, if necessary, cleaned up.
Metropolitan Region Scheme	The Metropolitan Region Scheme (MRS) is a large town planning scheme for land use in the Perth metropolitan area.

Table 2. Table Summary of relevant Commonwealth and State Regulations

Regulations	Description
Commonwealth of Australia	
Environmental Protection and Biodiversity Conservation Regulations 2000	Supports the EPBC Act and outlines implementation procedures.
Western Australia	
Planning and Development (Local Planning Schemes) Regulations 2015	Supports the *Planning and Development Act 2005*. Prescribes the procedures by which local planning strategies, local planning

	schemes and amendments to local planning schemes must be prepared and adopted.
Environmental Protection (Clearing of Native Vegetation) Regulations 2004	Supports the *Environmental Protection Act 1986.* Addresses a number of matters relating to clearing native vegetation such as defining native vegetation, fees, data requirements, and circumstances where clearing is exempt from requiring a permit.
Contaminated Sites Regulations 2006	Prescribes the procedures for administering the *Contaminated Sites Act 2003.*

2.7 Policies and Plans

Commonwealth and State environmental legislation is supported with statutory planning policies and strategic plans to provide guidance to local government authorities and developers. For a summary list of relevant plans and policies which guide future development in Western Australia refer to Table 3.

Table 3. Table Summary of Relevant Commonwealth and State Policies and Plans

Policy, Code, Bulletin, Strategy	Description
Commonwealth of Australia	
EPBC Act Referral Guidelines for Three Threatened Black Cockatoo Species	Outlines actions and referrals when identified cockatoo habitat trees are proposed to be removed.
Western Australia	
Draft Perth and Peel Green Growth Plan for 3.5 million (Dec 2015)	EPA strategic advice prepared in collaboration with WAPC draft Perth and Peel @ 3.5million. A strategic conservation plan to be achieved over 30 years.
Design WA	Design WA replaces the R-Codes for R40-R80 multiple dwellings within mixed use development and activity centres.
Liveable Neighbourhoods	Best practice guidelines for designing liveable spaces.
SPP 2.0 Environment and Natural Resources Policy	A policy that defines the principles and considerations that represent good and responsible planning in terms of environment and natural resource issues within the framework of the State Planning Strategy. Supplemented by more detailed planning policies on particular natural resource matters.
SPP 2.4 Basic Raw Materials	A policy detailing the matters to be taken into account in considering zoning, subdivision and development applications impacting extractive industries.
SPP 2.7 Public Drinking Water Source	A policy to protect and manage public drinking water source areas from incompatible land uses and pollution.
SPP 2.8 Bushland Policy for the Perth Metropolitan Region	A policy to provide an implementation framework that will ensure bushland

	protection and management issues in the Perth Metropolitan Region are appropriately addressed and integrated with broader land use planning and decision-making.
SPP 2.9 Water Resources	Provides clarification and additional guidance to for consideration of water resources in land use planning strategy.
SPP 3.1 Residential Design Codes	State planning policy guiding residential development standards.
SPP 3.4 Natural Hazards and Disasters	A policy to inform and guide planning for natural disasters and minimising the adverse impacts of natural disasters on communities, the economy and the environment.
SPP 3.7 Planning in Bushfire Prone Areas	This policy directs how land use should address bushfire risk management in Western Australia.
SPP 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning	This policy guides development and land use planning around railway lines and the state's major road transport corridors with consideration to the effects of noise levels.
Better Urban Water Management (2008)	Better Urban Water Management provides guidance on the implementation of SPP 2.9, facilitating better management of our urban water resources by ensuring an appropriate level of consideration is given to the total water cycle at each stage of the planning system.
Guidelines for Planning in Bushfire Prone Areas Version 1.3	Provides supporting information to assist in the interpretation of the objectives and policy measures outlined in SPP 3.7. They provide advice on how bushfire risk is to be addressed when planning, designing or assessing a planning proposal within a designated bushfire prone area.
Water Sensitive Urban Design in WA: an introduction	An information sheet outlining the objectives and mechanisms by which better urban water management outcomes can be achieved.
Acid Sulfate Soils Planning Guidelines	The guidelines outline the range of matters which need to be addressed at various stages of the planning process to ensure that the subdivision and development of land containing acid sulfate soils is planned and managed to avoid potential adverse impacts on the natural and built environment.

2.8 Local Context

Planning decisions in the City are guided by the Local Planning Scheme (the Scheme) which is given statutory power by the *Planning and Development Act 2005*. To support the provisions of the Scheme text local planning policies are developed to provide additional detail and clarification within a local context. The Scheme and local planning policies are supported by various plans and strategies developed to target key areas for revitalisation or improvement. For a summary of relevant local documents refer to Table 4.

Table 4. Relevant Local Environment Planning Documents

Document	Description
City of Kalamunda	
Local Planning Scheme No. 3	Outlines provisions for all zoned land throughout the City of Kalamunda.
Local Biodiversity Strategy 2008	A report prepared in 2008 as part of the Western Australian Local Government Association's Perth Biodiversity program. Outlined the current conservation considerations for the City and proposed strategies for future improved retention and enhancement of the City's natural environment.
Kalamunda Advancing – Strategic Community Plan 2017	Documents the community's main priorities, expectations and aspirations for the City of Kalamunda over a 10 year time period and includes implementation strategies
Regional Climate Change Adaptation Action Plan (2009-2013)	A plan outlining strategic objectives and recommendations for the Perth Eastern Region to adapt to predicted effects of climate change.
Water Action Plan (2009)	A management plan prepared by the City to provide strategic objectives and strategies to improve water efficiency.
Weed Control Strategy	Guides weed control activities in the City.
Local Housing Strategy 2014	Provides the City with a firm rationale for determining future housing needs, and recommends appropriate policy measures for the provision of a range of housing types and densities.
Waste Strategy 2013-2022	Guides waste management activities in the City.
Local Planning Policy	
P DEV 46 - Effluent Disposal from Ancillary Accommodation and Caretakers Dwellings in the Middle Helena Catchment Area	Provides for the management of effluent disposal to ensure proposals are compatible with the water catchment area.
P DEV - 47 Effluent Disposal from Agri-tourism Development in the Middle Helena Catchment Area	Provides for the management of effluent disposal to ensure larger scale tourism proposals are compatible with water catchment management.
ENV4 - Flood and Stream Management	Provides guidance and recommended buffers for areas prone to flooding or within close proximity of a waterway.

3.0 LOCAL PROFILE

3.1 Land Use Planning Context

The City of Kalamunda comprises of three distinct areas, the Darling Plateau, the Darling Scarp and the Swan Coastal Plain (refer Map 1- Topography). Development within the City has been strongly influenced by landform, focussing urban development in areas on the Swan Coastal Plain where there are fewer geological constraints to development.

The Swan Coastal Plain contains the majority of urban development around commercial activity centres in Maida Vale, Wattle Grove, Forrestfield, and High Wycombe. Industrial type land uses are concentrated to the west, close to the airport and future Forrestfield North train station. The Darling Scarp contains land uses compatible with semi-rural and residential type uses as a buffer to the more intensive conservation or agricultural and life-style areas in the rural hills Darling Plateau region. The Darling Scarp hills region refers to Kalamunda, Gooseberry Hill, Lesmurdie and Walliston which adjoin the rural areas on the Darling Plateau which includes Piesse Brook, Paulls Valley, Hacketts Gully, Bickley, Pickering Brook, Canning Mills, and Carmel. Map 1 depicts the Shire's topography showing a move from the low-lying foothills, steeply up the Darling Scarp onto the Darling Range approximately 400m above sea level to the east.

The City of Kalamunda and its community have a strong connection to the local environment and have identified environmental sustainability and maintaining the natural environment as a key priority through the development of the Strategic Community Plan (2017-2027). Connection to the local environment is also demonstrated through active ongoing community engagement in local environmental activities such as participation in one of the Local 'Friends of Groups' which look after local bushland areas. It is therefore important to identify key local environmental features and planning strategies to retain and manage the natural environment as the City grows and develops.

3.1.1 Major Land Use Planning Projects

The City of Kalamunda is experiencing significant growth and urban expansion. As the City grows, it is important to consider the impact of development on the environment, including but not limited to:

- Native vegetation;
- Fauna;
- Wetlands; and
- Waterways

Airport Expansion

The addition of a proposed new runway at Perth airport significantly affects nearby land use planning, due to impacts such as noise. Such effects may limit residential zoning densities, height of structures, and reflectivity of materials. Modification of the ANEF contours and noise provisions, and rezoning of land to be consistent with the future development of the airport expansion may be required. The City works closely with Perth Airport to assess proposals in close proximity, or deemed to influence any aspect of the daily management or future airport works. Generally development within proximity of Perth Airport is managed by the application of State Planning Policy 5.1 – Land use planning in vicinity of Perth Airport which uses the Australian Noise Exposure Forecast (ANEF) as the State adopted planning tool to guide development types and intensities. Perth Airport also considers alternative noise metrics such

as the N65 method or 'numbers above' N^% when undertaking land use planning to better reflect noise conditions residents experience.

The connection of the airport to the future Forrestfield North train station as part of the Metronet rail project will provide a vital link for the City between the airport and metropolitan activity centres and greatly improve the sustainable transport infrastructure available to local residents.

As part of the proposed development for the new runway Perth Airport is considering environmental offsets for *Conospermum undulatum* (Wavy Leaf Smokebush), which occurs within the Forrestfield North proposed conservation areas. The City considers this an opportunity for collaboration, particularly due to the proximity of the sites.

Forrestfield North

The $2 billion Forrestfield Airport Link project driven by the Federal and State Governments will deliver new rail service to three new stations - Belmont, Airport Central, and Forrestfield. The area surrounding the future Forrestfield North train station is designated to become a transit oriented development and key activity centre for the City providing a plethora of opportunities for the community.

The construction of Forrestfield North train station and subsequent structure plan precinct is a key strategic planning priority for the City. Bordered by Poison Gully Creek (local reserve), Roe Highway, and Berkshire Road the precinct contains some areas of high natural significance including two Bush Forever sites, managed local reserves and some environmentally sensitive areas (ESA's). Creating ecological linkages between existing green spaces and future identified public open space is an integral part of the proposed structure plan to increase the resilience and biodiversity of the protected natural areas. Access and amenity to green space for residents is also a key consideration as it improves attractiveness and liveability of precincts and provides important social and physical health benefits for residents.

The area is zoned Urban under the Metropolitan Region Scheme (MRS) and is in the process of being rezoned to Urban Development under the City's Local Planning Scheme No.3 (LPS3) to facilitate the urbanisation of the area. Local Structure Plans are required prior to subdivision and development within the Urban Development zone and are being prepared for the area. There are significant environmental challenges in protecting the ecological values of the area, particularly the conservation of existing Wavy-leaved Smokebush (*Conospermum undulatum*). Spring flora and fauna surveys were conducted in November 2016 to inform detailed planning.

The City has received advice from the Office of the Environmental Protection Authority (OEPA) through three statutory processes: the MRS amendment to rezone the area to Urban (MRS Amendment 1282/57 Forrestfield High Wycombe Precinct Stage 3); the Forrestfield North District Structure Plan and the LPS3 amendment to rezone the area to Urban Development (Local Planning Scheme Amendment No. 3 Amendment No.75 Forrestfield North Stages 2 & 3). This advice has indicated that detailed environmental assessment has been deferred to subsequent stages of the planning process. The Local Planning Scheme amendment includes provisions that enable the OEPA to provide advice and comments through the Local Structure Plan preparation and approval process. The City has subsequently progressed an MRS Amendment in conjunction with the endorsed Residential Precinct Local Structure Plan, which identifies the green link as Parks and Recreation, with the recommendation these areas be purchased by the State government, or through private offsets, and managed by the City.

Maida Vale South

An area south of Maida Vale and in the north-east area of Forrestfield has been identified as a possible area for strategic planning investigation for urban development by both the WAPC and City through various strategic planning documents. The majority of the land parcels are zoned Rural under the MRS and have been subject to rural and semi-agricultural type uses for many years. As such, much of the land may have already been cleared of endemic vegetation or degraded, though in some instances pockets of high quality vegetation may still exist and where practicable may be protected. Other aspects such as extension of sewer, natural waterways or wetlands, and geology will also influence the feasibility of future development in this area.

While the City is yet to receive any formal requests to amend LPS3 or to progress a structure plan for the area, the City is aware progression of the necessary technical studies and documents are well advanced. In this respect any future requests to amendment the MRS and/or LPS3 will need to be supported by appropriate flora and fauna surveys and a level of water monitoring and management investigations. In January 2019 the City received notification that MRS Amendment 1344/57 was under consideration by the WAPC which proposed an urban outcome in the Maida Vale South area. This MRS proposal was subsequently called in by the EPA to be formally assessed. The formal assessment includes the preparation of a Public Environmental Review and, if the proposal is to the satisfaction of the EPA, will then be considered and advertised by the WAPC.

Wattle Grove (Cell 9)

The continual development of Wattle Grove Cell 9 will provide a mixture of housing typologies to cater for a diverse demographic, and deliver vital social infrastructure such as schools, community facilities, mixed use developments and opportunities for tourism accommodation. These developments will be supported with interconnected public open space which links to an existing bush forever reserve to encourage the migration of local fauna and preservation of native flora.

Wattle Grove South

The WAPC's North-East Sub-Regional Planning Framework has identified Wattle Grove South as an urban expansion area, with a small portion identified as urban investigation. Development of the site for urban purposes represents the most efficient use of the land given the subject land's strategic location in close proximity to the urban front, the capacity of existing infrastructure and services, the future Forrestfield Train Station and nearby major arterial routes (e.g. Tonkin Highway).

Any future MRS or LPS3 rezoning will need to be supported by appropriate flora and fauna surveys and an appropriate level of water monitoring and management investigations. At the February 2019 Ordinary Council Meeting Council resolved to remove the option for general or light industrial uses from the investigation area and proceed as primarily residential. Further to this in April 2019 Council resolved to support further technical investigations. The City is in the process of undertaking community engagement over this area to determine the appropriate path forward for further planning and technical investigations including flora and fauna surveys.

Maddington Kenwick Strategic Employment Area (MKSEA)

In 1990 the State Planning Commission, now the WAPC released the planning strategy Metroplan which identified the area of land within the Maddington Kenwick area of Gosnells as a potential future industrial use. The City's adopted Local Planning Strategy 2010 also

recognised the area as potentially future industrial. The Maddington Kenwick Strategic Employment Area (MKSEA) refers to a region to the south-east of the City of Kalamunda boundary and related to a parcel of land to be rezoned from primarily rural lots to industrial. The area of MKSEA located within the City is bound by Welshpool Road East to the north-east and Tonkin Highway to the east. North of Welshpool Road East is the residential area of Wattle Grove. Some properties east of Coldwell Road and adjacent to Brook Road abut Yule Brook and nearby Greater Brixton Street Wetland complex. The City relies on advice from key State Government agencies such as the Department of Water and Environmental Regulation, Department of Biodiversity, Conservation and Attractions and the Environmental Protection Authority with regard to environmental impacts of any MRS rezoning or development in the area. Further detailed environmental studies are required to be completed to determine the appropriate MRS and LPS3 zoning outcome for properties east of Coldwell Road and adjacent to Brook Road. Directly south, east and west of the site is within the boundaries of the City of Gosnells. The MKSEA area is currently under development.

Hills Rural and Pickering Brook

Rural agricultural activities in the Darling Scarp and Darling Plateau are an important contributor to the Perth metropolitan food bowl. Priority agricultural areas are to be protected and supported through strategic and statutory planning mechanisms so residents and visitors to the Perth metropolitan region can enjoy continued access to fresh locally grown produce into the future. Currently the activity centre of Pickering Brook is under investigation to address some bushfire access considerations for safety, to review the current zoning and identify opportunities to support agricultural tourism. In October 2018 the City received correspondence from the DPLH announcing the formation of a working group to support a Taskforce to develop a sustainability and tourism strategy for Pickering Brook and the surrounding area. The City will provide recommendations and formulate appropriate actions subject to the findings of the Taskforce as part of the Rural Strategy, including data to inform Priority Agricultural Land and a review of current zoning.

Local Housing Strategy – Dual Density Zoning

Scheme Amendment 82 identifies key areas in Kalamunda, Forrestfield, and Maida Vale/High Wycombe for Dual Density zoning. The Dual Density zoning aims to increase residential infill around key activity centres and transport nodes to meet the objectives of Perth and Peel @ 3.5 million.

A property which has a Dual Density zoning may be eligible to subdivide and/or develop at a higher density, subject to applicants demonstrating they are able to meet design criteria outlined in a policy adopted with the Scheme amendment that addresses aspects such as;

- Dwelling mix (ie; single dwelling, grouped dwellings, multiple dwellings, aged or dependent persons dwelling)
- Design (such as two-storey dwellings)
- Provision of renewable energy
- Rainwater catchment and storage
- Greywater recycling
- Tree retention and high quality landscaping features

Environmental protection and high quality built form are key objectives of the Dual Density Policy.

Major Projects

All major projects will be influenced by the implementation of the sub-strategies identified in this Strategy. The intention is to guide future development with a stronger environmental focus to ensure valuable natural assets are protected and improved in synthesis with expansion of the built environment. By investigating opportunities, providing clearer guidelines, updating administrative procedures and contemporary data, as well as introducing new scheme provisions, policies, information sheets and masterplans, the role of planning can lead the way in implementing the City's vision of connecting communities and valuing nature, to create a clean green future together.

The City has identified a strategy to improve efficiency and reduce the waste produced as part of these administrative processes which is outlined below in Table 5.

Table 5. Strategy for major projects

Major Projects - Objective		
1. To reduce the levels of consumption and waste for improved environmental outcomes		
Strategy	**Action**	**Timeline**
1.1 Reduce waste and improve efficiency in the planning approvals process.	1.1.1 Implement online building and planning approval processes to reduce paper waste, provide transparency, and streamline approvals.	**Priority:** Medium **Timeframe:** 2-3 years **Partners:** WALGA **Indicator:** Online approvals and tracking are utilised for all development applications.

3.2 Physical Environment

3.2.1 Climate and Climate Change

The City experiences a dry Mediterranean climate featuring hot summers and mild wet winters. The City's elevation varies from 10–400 metres (33–1320 feet) above sea level, which means that higher parts of the region can be a few degrees cooler than Perth. This difference is less pronounced in summer as the City is less affected by the regular afternoon sea breeze due to its inland location. Due to their elevation the Darling Scarp and rural east areas are wetter than Perth with over 1,000 millimetres (39 in) of annual rainfall (www.kalamunda.wa.gov.au)

The City has been working in conjunction with the Eastern Metropolitan Regional Council (EMRC) to acknowledge likely changes to its climate and implement best practice recommendations from the Regional Climate Change Adaptation Action Plan (2013-2016).

Likely climate change factors identified to pose the most risk to the City of Kalamunda include;

- Increased drought and hot dry weather occurrences;
- Increased frequency and intensity of bushfires;
- Removal of vegetation and therefore reduction in biodiversity and ability of ecosystems to recover after disturbance;
- Changing water supply and rainfall patterns;
- Reduced air quality; and
- The urban heat island effect including heat retention and increased stormwater runoff from sealed surfaces.

The impacts of climate change are addressed through subsequent strategies and actions (Refer Part 5 – Strategies and Actions).

3.2.2 Geology and Landform

The natural environment is comprised of three distinctive landform types or geomorphic provinces, namely the Swan Coastal Plain, the Darling Scarp and the Darling Plateau.

Swan Coastal Plain

The Swan Coastal Plain extends westwards from the lower edge of the Darling Scarp is generally low relief terrain made up of alluvial, aeolian deposits, including the Guildford, Forrestfield and Southern river soil associations. In general, the soils become more fertile on the east of the Swan Coastal Plain in the zone of transition between the Swan Coastal Plain and the Darling Scarp, locally identified as the 'foothills'. Wetlands can be found in low lying areas upon the Swan Coastal Plain and their water levels are often interlinked to underground aquifers. Map 2 shows the composition of the bedrock, while Map 3 shows the composition of surface soil complexes throughout the City.

Darling Scarp

The Darling Scarp classification unit is characterised by moderately steep to very steep scarp hill slopes with shallow yellow-brownish earths and yellow duplex soils. Granite outcropping is common throughout this unit which occurs on the western portions of Gooseberry Hill, Kalamunda and Lesmurdie.

Darling Plateau

The Darling Plateau covers the majority of the City and is dominated by lateritic uplands and duritic gravels and sands which form a gently undulating surface. The topography ranges from 50m AHD (Australian Height Datum) on the westerly fringe of the deeply dissected Darling Scarp to 360m AHD on elevated ridges. From west to east, the soils include the Darling Scarp, Swan, Dwellingup, Yarragil, Helena, Murray and Cook associations.

The Darling Plateau is the dominant landform type, covering the majority of the total area of the City.

3.2.3 Soils

Geographically, Perth soils are ancient, highly weathered, and relatively infertile – a factor which contributes to the high botanical endemism that harks back to the Gondwana era. As such, many native plants have adapted special coping mechanisms such as proteoid roots, C4 photosynthesis, long tap roots, and hairy/sclerophyllous leaves, as well as intricate symbiotic relationships with animals and fungi to survive. Plant communities vary depending on soil type and as such the City contains a unique and diverse array of plant communities and distinctive ecosystems (refer Map 13 - Remnant Vegetation by Vegetation Complexes).

Soil associations in the City vary with landform as shown by Map 03 – Soil Complexes. Twelve soil associations occur within the City:

- Guildford – Flat alluvial plain, gravelly yellow and brown duplex soils with sand and loam topsoils
- Yanga – Deep/shallow grey siliceous sand overlaying clay
- Forrestfield – Dominated by gravelly and sandy soils. Occurrences of imperfectly drained and duplex soils

- Southern River – Sandplain, low dunes with intervening swamps, iron and humus podzols, peats and clays
- Darling Scarp - Shallow yellow-brownish earths and yellow duplex soils. Granite outcropping
- Myara – Variable duplex and gradient soils
- Balgobin – Variable duplex and gradient soils
- Dwellingup – Lateritic duricrust and shallow gravelly sands
- Yarragil – Yellow duplex soils to sands over mottled clay
- Murray – Yellow, red and brown gradient earths and yellow mottled duplex soils
- Helena – Yellow duplex soils, gradient earths and granite rock outcropping
- Cooke – Mantle laterite surface, contain granite rock outcrop and duplex soils

Soils types in the Darling Plateau are suited for agriculture and horticultural production and is one of the few remaining regions near metropolitan Perth that yields locally grown fresh produce (refer Map 3).

4.0 BACKGROUND REVIEW

4.1 Basic Raw Materials and Minerals

Some soil types are noted to contain a higher proportion of naturally occurring basic raw materials such as minerals, metals, sand, rock or clay identified for potential future extraction. Areas identified as containing Basic Raw Materials for future resource extraction are identified within the WAPC's State Planning Policy 2.4 – Basic Raw Materials (SPP2.4). An assessment of SPP2.4 identifies only one extraction area within the City (Figure 1 Resource Protection Map Showing Locations with Potential for Future Resource Extraction).

This area is located in Pickering Brook on land that is not zoned within LPS3 and is identified as State Forest under the MRS.

Additionally, high level assessments have also been undertaken by the Department of Mines, Industry Regulation and Safety to identify other resources that are located within the City. Updates to the Local Planning Scheme and MRS may be required if further areas are confirmed for resource extraction.

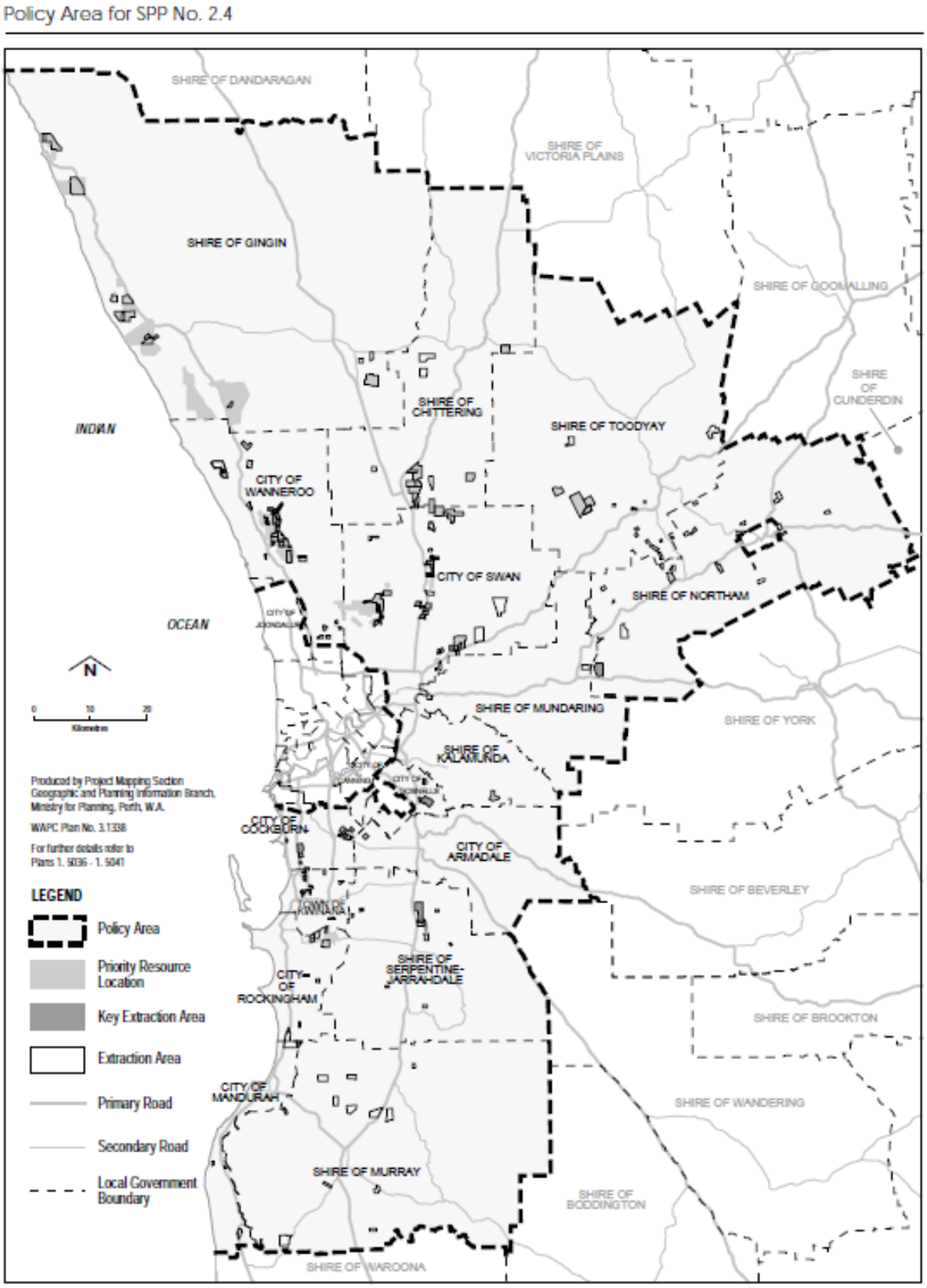


Figure 1. Resource Protection Map Showing Locations with Potential for Future Resource Extraction. (WAPC. Published 2000)

Table 6. Strategy for basic raw materials

Basic Raw Materials - Objective		
2. To manage natural resources, land use, and development proposals to maintain the health and viability of geological soil systems in coordination with other ecosystem functions.		
Strategy	**Action**	**Timeline**
2.1 Facilitate the extraction of basic raw materials, subject to appropriate safeguards to minimise any adverse impact on adjacent property or on the natural environmental resource.	2.1.1 Identify and map Basic Raw Materials areas which may be subject to future extraction and ensure current zoning is consistent with resource protection.	**Priority:** Low **Timeframe:** Ongoing **Partners:** Department of Mines, Industry Regulation and Safety **Indicator:** As necessary update scheme map to show amended zoning of identified Basic Raw Materials protection areas.

4.2 Energy Production

In May 2018 the WAPC released a Draft Position Statement for renewable energy facilities which aims to address key planning considerations for the location, siting and design of renewable energy facilities. Renewable energy facilities may include solar or wind, geothermal, biogas, ocean power or hydro-electric power. Any applications for such facilities should consider the environmental impact, ascertain visual and landscape impacts, noise and construction effects, public and aviation safety, cultural heritage and community consultation. Strategy 3.1 (refer Table 7) has therefore been developed to investigate where such facilities may be considered in the City, and provide acceptable design criteria.

Table 7. Strategy for basic raw materials

Energy Production - Objective		
3. To support clean energy production without adversely impacting on established residential, conservation or agricultural regions.		
Strategy	**Action**	**Timeline**
3.1 Improve and promote eco-friendly built form outcomes to reduce the footprint of urban development on the natural environment.	3.1.1 Investigate the preparation of a planning policy and, if necessary Scheme provisions, to promote and provide incentives for energy efficient built form and renewable energy options. As part of investigations consider methods to incentivise renewable energy for commercial and industrial developments.	**Priority:** Low **Timeframe:** 1-2 years **Partners:** Synergy, Western Power, Infrastructure WA, Federal Department of Environment and Energy **Indicator:** Recommendation made regarding criteria and objectives for implementation of renewable energy infrastructure within urban, commercial, industrial and rural zones.

	3.1.2 Investigate the preparation of a planning policy and, if necessary Scheme provisions, to address the large scale commercial generation of renewable energy eg; by way of solar or wind power; generally supportive of such proposals except where there are overwhelming amenity, safety or environmental concerns with a particular proposal.	**Priority:** Low **Timeframe:** 1-3 years **Partners:** Synergy, Western Power, Infrastructure WA, Federal Department of Environment and Energy **Indicator:** Recommendation made regarding local planning policy identifying criteria and objectives for implementation of renewable energy infrastructure within urban and rural zones.
	3.1.3 Investigate the potential for renewable energy project opportunities in the City.	**Priority:** Low **Timeframe:** 1-3 years **Partners:** Synergy, Western Power, Infrastructure WA, Federal Department of Environment and Energy **Indicator:** Recommendation made regarding sites which provide an opportunity to facilitate a renewable energy facility.

4.3 Acid Sulfate Soils

Acid Sulfate Soils (ASS) and Potential Acid Sulfate Soils (PASS) are naturally occurring soils, sediments or organic substrates (sometimes referred to as peat) which form under waterlogged conditions. These soils contain high levels of iron sulphides which are harmless when waterlogged, however, when dried and exposed to oxygen and water can react and produce iron compounds and sulphuric acid. The resulting acid can facilitate the release of heavy metals and other damaging compounds into the groundwater, surrounding waterways and environment.

Soils with a moderate to high PASS risk generally occur in interdunal swales, low-lying wetlands, backswamps, salt marshes, barrier estuaries, tidal flats and creeklines and are at risk of exposure due to falling groundwater tables and disturbance during high density development. Acid Sulfate Soils can be identified by the following characteristics;

Potential Acid Sulfate Soils:

- often have a pH close to neutral (6.5–7.5);
- contain unoxidised iron sulphides;
- are usually soft, sticky and saturated with water;
- are usually gel-like muds but can include wet sands and gravels; and
- have the potential to produce acid if exposed to oxygen.

Actual Acid Sulfate Soils:

- have a pH of less than 4;

- contain oxidised iron sulphides;
- vary in texture; and
- often contain jarosite (a yellow mottle produced as a by-product of the oxidation process).

The release of acid into the environment can affect the design life of concrete and metal infrastructure that has not been specifically designed to be acid resistant, may cause severe groundwater contamination and may affect aquatic life in wetlands that receive groundwater and stormwater discharge from the affected area.

Known areas for ASS have been identified in the City (refer Map 4 - Acid Sulfate Soils). The areas located on the swan coastal plain such as High Wycombe, Wattle Grove, Maida Vale and Forrestfield are identified as being largely low to moderate risk of ASS occurring with small pockets of high to moderate risk. Risk of ASS is taken into account when assessing strategic planning proposals and development applications. Some of the key areas known to contain ASS includes:

- Hatch Court, Stirling Crescent, Adelaide Street, and Croft Place
- Between Berkshire Road and Nardine Close, and;
- Along Yule Brook south and west of Hartfield Park.

As ASS become an issue when ground is disturbed and exposed to the air, significant investigation and management of areas identified is most important during subdivision and development. Conditions will therefore be applied to subdivision and development approvals subject to the satisfaction of the Department of Water and Environmental Regulation. Strategies to manage ASS are outlined in Table 8.

Table 8. Strategy for Acid Sulfate Soils

Acid Sulfate Soils - Objective		
4. To guide and manage development appropriate to the presence of acid sulfate soils.		
Strategy	**Action**	**Timeline**
4.1 Identify and map the presence of acid sulfate soils	4.1.1 Require management of acid sulfate soils as part of ongoing land development	**Priority:** Medium **Timeframe:** Ongoing **Partners:** DWER **Indicator:** Intramaps updated to show a warning where properties may be subject to exposing of Acid Sulfate Soils.

4.4 Contaminated Sites

The City contains a number of known contaminated sites. Historically the City of Kalamunda was considered the fringe of the metropolitan region and some sites were previously used for landfill. Some decommissioned landfill sites are located in areas identified for future urban growth, one of these sites is located on Brand Road in the future Forrestfield North development area. The City is currently undertaking detailed investigations to remediate and convert the site to a sports oval.

Sites that are publicly identifiable are published on the Department of Water and Environmental Regulation (DWER) website at www.der.wa.gov.au/your-environment/contaminated-sites. There are a number of sites are declared potentially contaminated and investigation is required however the location of these sites is not publicly available until the status is confirmed.

Where possible and practicable the remediation of contaminated sites is worthy of investigation. While the cost of remediation is often prohibitive, Brand Road in Forrestfield North has been identified as a site with potential for investigation to rehabilitation and repurpose. Other sites, such as a petrol station on Hale Road, Forrestfield, are known to be contaminated, however, remediation would only be required if a change of land use is proposed. Until that time, the classification 'Contaminated – restricted use' applies and current use of the site can continue.

Mapping undertaken as part of Strategy 5.1 (Table 9) is to be developed which can be used a resource for landowners and development services to be able to make informed decisions about future development areas and potential restrictions under the *Contaminated Sites Act 2003*. Mapping is publicly available through the City's online mapping system.

Table 9. Strategy for soil and geology

Soil and Geology - Objective		
5. To guide and manage development appropriate to the presence of contamination		
Strategy	**Action**	**Timeline**
5.1 Identify and map the presence of contaminated sites.	5.1.1 Consider contaminated sites classification as appropriate when assessing development applications and to provide comment on subdivision proposals	**Priority:** Medium **Timeframe:** Ongoing **Partners:** DWER **Indicator:** Intramaps updated to show a warning where properties may be subject to contamination.
5.2 Identify, rehabilitate and manage contaminated sites for health and safety, and potential future development.	5.2.1 Undertake detailed site investigations with an intention to remediate Brand Road landfill site for sporting fields as part of the Forrestfield North development.	**Priority:** Medium **Timeframe:** 1-2 years **Partners:** Strategic planning **Indicator:** Progress on investigations.

4.5 Bushfire Hazard

The Western Australian community has seen several catastrophic, devastating fires in recent years which as a result of hotter and dryer conditions due to climate change are anticipated to increase.

The Department of Fire and Emergency Services maintains a map of designated bushfire prone areas for the state of Western Australia. Due to a significant amount of remnant vegetation being retained in State Forests and National Parks, large areas in the City are designated as bushfire prone and are classified as having an extreme fire hazard level.

In line with State Planning Policy No. 3.7 Planning in Bushfire Prone Areas (SPP3.7) and the Planning in Bushfire Prone Areas Guidelines (WAPC, 2015), understanding of bushfire hazard for bushfire prone areas is necessary to inform the local planning strategy and allocate vulnerable and high-risk land uses away from areas of extreme bushfire risk. Map 5 shows the differing bushfire hazard levels throughout the City.

A Bushfire Hazard Level (BHL) assessment provides a 'broad brush' means of determining the potential intensity of a bushfire in a particular area. The BHL assessment is a pre-development decision-making tool used to inform the suitability of strategic planning proposals for future subdivision and development. Planning guidelines require that a BHL assessment should be undertaken for any area identified for intensification of land use in a strategic planning proposal where lot layout is not yet known. This is likely to impact on areas identified for urban development in Forrestfield, High Wycombe, Maida Vale and Wattle Grove and should be incorporated into ongoing planning for the area.

Removal of the Special Control Area to be consistent with the Planning and Development (Local Planning Schemes) Regulations 2015.

The City of Kalamunda Local Planning Scheme No.3 (LPS3) is currently subject to a Special Control Area provision for the identification of Bushfire Prone Areas. Since the adoption of the LPS3 the Planning and Development (Local Planning Schemes) Regulations 2015 were introduced. As the Scheme was not consistent with the new regulations, an omnibus amendment (Amendment 83) is to be introduced in 2019/2020 to update the Scheme and remove the additional requirements of the Special Control Area provisions to be consistent with State policy. Amendment 83 has been advertised and adopted by Council for final approval by the Minister.

The omnibus amendment to the Local Planning Scheme means a more streamlined planning approval process for residents and consistent local government approach to bushfire management that aligns with State policy.

Fire Regimes

The City adopts seasonal low-intensity managed burns to reduce fuels loads. Burning at low intensity in a mosaic type pattern gives vegetation a greater chance of recovery after fire and a slower rate of spread to be more easily controlled, and limited to targeted locations.

4.6 Water

Perth experiences hot dry summers and the impacts are likely to make access to reliable sources of water imperative as periods of drought are predicted to extend and intensify. This is supported by the Perth-Peel Regional Water Plan (2010-2030) which reported a decline in rainfall has resulted in a 50% decrease in stream flows over the last century (refer Figure 2 and Figure 3)

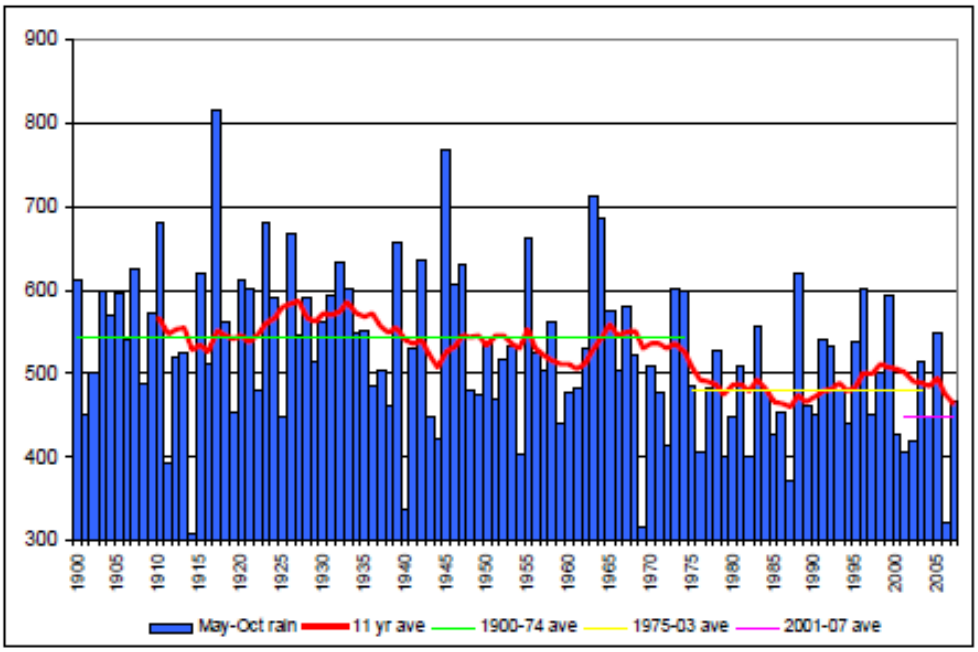


Figure 2. The decreasing trend in rainfall in May - Oct over the last 100 years. (Source: Draft Perth – Peel Regional Water Plan 2010-2030. Department of Water)

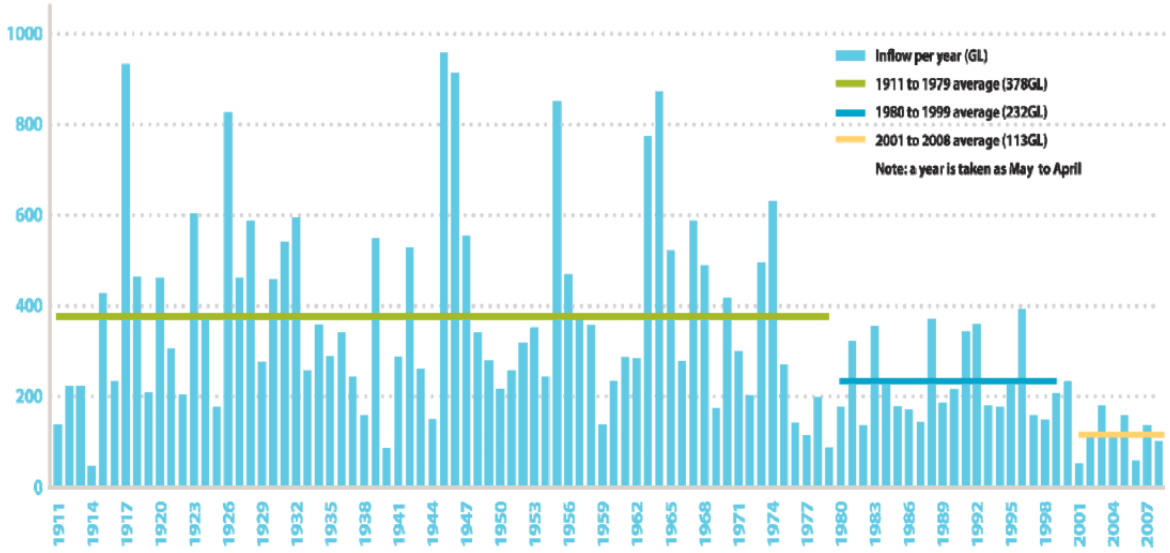


Figure 3. Annual streamflows into Perth dams (GL/y). (Source: Draft Perth and Peel Regional Water Plan 2010-2030. Department of Water).

4.6.1 Surface Water

There are two major water categories; surface water and subterranean water (or groundwater). Surface water describes water in the form of watercourses or stormwater surface runoff. As part of this strategy, the City has developed a Waterways and Water Catchments Map (refer Map 11) showing existing waterways and their tributaries. The Waterways and Water Catchments Map can be used as a tool in conjunction with local planning policies, and the Local Planning Scheme to identify when a proposal may affect an existing watercourse and catchment flows and nominate mitigation measures depending on the

hierarchy. Assessment through development applications can ensure surface water flows are not modified or obstructed and land uses are managed to maintain high water quality and protect life and property.

Key waterways in the City include:

- Helena River
- Poison Gully
- Crumpet Creek
- Woodlupine Brook
- Whistlepipe Gully
- Bickley Brook
- Piesse Gully
- Pickering Brook

These waterways feed into the larger Swan and Canning River Systems. Areas close to tributaries or within proximity to historical wetland areas, particularly on the costal plain, such as Maida Vale, High Wycombe or Forrestfield, may be subject to a high perched water table or seasonal inundation. Preparation of Map 8 - Waterlogging Risk Areas and Map 9 - Flood Risk Areas, shows areas in the City which may be more susceptible to flooding and subsequently any land uses these areas can be zoned, designed and managed in response to the geotechnical parameters.

To improve the assessment of development applications Strategy 6.1 was developed to identify known flood risk areas and ensure proposed developments are appropriately located so as not to cause damage to person or property and so natural water cycles remain uninhibited.

To help ensure the health and protection of its waterways, the City participates in the Eastern Hills Catchment Management Program (EHCMP); an award winning partnership program between the City of Kalamunda, the Shire of Mundaring, the City of Swan and the Eastern Metropolitan Regional Council (EMRC). The program aims to achieve a co-ordinated strategic approach to the restoration of land, bushland and creek lines. The EHCMP includes sampling and analysis of surface water quality, catchment planning activities and implementation of surface water restoration projects e.g. Booralie Way Reserve.

4.6.2 Catchment Management and Public Drinking Water Source Areas

The City contains eight water catchment areas (refer Map 11). The strategic importance of the Helena Pumpback Dam, the requirement to protect drinking water supply and the Swan River System and the community desire to protect the environmental values of the catchment particularly highlight the Middle Helena - Helena Pipehead as a significant area. The Middle Helena Catchment Area Land Use and Water Management Strategy has guided land use and development of this catchment and resulted in zoning in the MRS and local planning scheme that protect these values.

Areas around the same region as the water catchment may also be subject to Public Drinking Water Source Area's (PDWSA's levels P1-P3) as allocated by the Department of Water and Environmental Regulation (DWER) (Map 10: Public Drinking Water Source Protection Areas). Important public drinking water source areas (PDWSA) within the City, include the Middle Helena Catchment Area, Mundaring Weir Catchment Area, Victoria Reservoir Catchment Area and Canning River Catchment Area. Much of the public drinking water is reserved in National

Parks and State Forest, however, where a proposal on private land may have an effect on water quality the City works in collaboration with DWER, the Water Corporation and the WAPC to ensure compatibility of land uses. SPP 2.7 Public Drinking Water Source Protection guides zoning, subdivision and land use in public drinking water source areas and the DWER's Water Quality Protection Note No.25 Land use compatibility tables for Public Drinking Water Source Areas outlines appropriate land uses. Proposed land uses are also assessed against the Middle Helena Catchment Area Land Use and Water Management Strategy (2010). Development is also considered against State Planning Policy 2.9 – Water Resources which provides guidance for water sensitive design principles and water cycle management, including water supply, and efficiency, groundwater, stormwater, wastewater, flooding, water quality and water source protection, waterways and wetlands, consistent with the Better Urban Water Management framework.

Currently there are small disparities between mapped water catchment areas and public drinking water source areas in the City of Kalamunda which require updating. Strategy 6.2 has been developed to address this.

4.6.3 Wetlands

Permanent and seasonal wetlands on the Swan Coastal Plain provide ecologically important habitat for migratory birds as well as native flora and fauna. With reduced surface water inflow due to climate change effects and urbanisation, wetlands are more prone to drying out which can adversely affect the ecosystem composition.

Wetlands are defined as areas of seasonally, intermittently or permanently waterlogged or inundated land whether natural or otherwise, and includes a lake, swamp, marsh, spring, dampland, tidal flat or estuary. A wetland buffer is the designated area adjoining a wetland that is managed to protect the wetlands ecosystems health. The extent of wetlands in the City are shown in Map 7 - Wetlands, which are located primarily to the western aspect of the swan coastal plain. The Ramsar Convention on Wetlands is an intergovernmental treaty between national and international agencies which aims to protect worldwide networks of wetlands for the preservation of habitat for migratory fauna. In Western Australia there are three main management categories of wetland; Conservation Category wetland, Resource Enhancement and Multiple Use (refer Table 10).

Table 10. Table of Wetland Categories and Proposed Management Approaches

Management Category	Description	Retention and Management
Conservation Category Wetland	Subject to full environmental protection as it is identified as containing a high level of valuable ecological attributes and functions.	To be retained and protected in all instances. Proposals which may impact a conservation category wetland and their buffers are likely to be referred to the EPA for formal assessment.
Resource Enhancement Wetland	Wetlands that may have been partially modified or degraded but still support substantial ecological attributes and functions. These wetlands have the potential to be	All reasonable measures should be taken to protect resource enhancement wetlands and appropriate buffers. Must be retained in all proposals unless

	rehabilitated to reach Conservation category and remediation is encouraged.	it is demonstrated limited ecological value will be retained, and restoration is cost prohibitive **and** would contribute limited ecosystems functions and amenity.
Multiple Use Wetland	Wetlands with few important ecological attributes and functions remaining.	All reasonable measures should be taken to retain the wetlands hydrological function (including on-site water infiltration and flood detention), and where possible other ecosystem functions.

Where a development or subdivision application has potential to affect a category wetland the City works in cooperation with external agencies such as the EPA, DBCA Parks and Wildlife Services and DWER to preserve, remediate and manage remnant wetlands where possible.

4.6.4 Groundwater

Groundwater is water that is found below the earth's surface and is stored in the cracks and spaces in soil, sand and porous rocks. Most groundwater comes from rain that has infiltrated through the ground and has accumulated over many thousands of years. Soil, sand and rocks that are able to store and transmit useable quantities of groundwater are known as aquifers. Aquifers that are closest to the ground surface are called shallow or unconfined aquifers (their upper surface is the water table). There are also deeper, confined (sometimes called artesian) aquifers where the water is confined under pressure between impervious layers, like clay. These aquifers can be hundreds of metres thick. Map 6 – Groundwater and Surface Water shows the extent of groundwater in the City while Map 11 – Waterways and Water Catchments tracks the location of waterways and tributaries.

As the inflow to subterranean aquifers has decreased so has the inflow into groundwater resources causing the water table to lower. The lowering of the water table results in dependant wetlands that experience longer periods of dryness, making them more vulnerable to acidification, fires and fauna displacement. We are also largely dependent on groundwater as a drinking water source.

The City of Kalamunda has an amalgamated license to take groundwater to irrigate public open space within the Forrestfield, Wattle Grove, Maida Vale and High Wycombe localities. According to DWER groundwater resources in the area are fully allocated or close to fully allocated and further investigation into alternative non-potable water supplies, such as a groundwater recharge scheme, are encouraged.

Managed Aquifer Recharge Project

To counteract the lowering of the water table, trials to recharge the aquifer using stormwater and treated wastewater are underway. One example of a groundwater recharge scheme is the Managed Aquifer Recharge (MAR) Project at Hartfield Park which received the Innovating for Sustainability Award from the Australian Water Association WA in October 2017. The MAR project involves diverting and treating surface stormwater flows to recharge the subterranean aquifer for environmental benefits and to store the water for later abstraction. The project

relied on a synthesis of key factors such as the location of the groundwater aquifer, direction of stormwater flows, location of Hartfield Park recreation and conservation reserve, depth of the water table and location and depth of bores (see Figure 4).

The proposal involves three basins and one underground storage basin which feeds into the centralised MAR scheme at the City's public open space. It is estimated the three basins and underground storage have a combined volume of 2.9 ML, harvesting an estimated 121.3 ML/yr from a combined catchment of 17.24 ha. Harvesting from aquifer storage would be expected to occur over May- September, whereas from October-April stormwater could be harvested, treated and reused directly for irrigation at Hartfield Park.

In 2015 and 2017 a recharge trial was conducted to monitor the effectiveness of the proposal. The winter of 2015 was a near-record low-rainfall year, and due to the low rainfall and difficulties in commissioning the specialised equipment, the trial only partially achieved the objective of validating a full-scale ASR scheme. The early results, however, showed the stormwater quality to be of a high standard and generally free of contaminants, aquifer storage to be greater than previously estimated with no groundwater mounding observed in the superficial aquifer, and the risk of biological clogging to higher than anticipated.

Over the winter of 2017, a total volume of 10,670 kL of stormwater was recharged to the Leederville aquifer via Lakes Bore, at a flow rate averaging 5.75 L/s. Groundwater levels in the bore rose slightly over the three weeks of injection suggesting low levels of clogging. Biological clogging was adequately controlled with the implementation of an additional carbon filtration unit which reduced total organic carbon to levels of around 1.5 mg/L. The results from the pre-commissioning trials show the technology to be technically viable, and the scheme is likely to become fully operational (at Stage 4) with a dedicated injection bore designed to receive up to 230,000 kL planned for the near future. Results show the project is potentially capable of providing more than four times the volume of water originally sought.

It is anticipated the MAR trial report be provided the DWER for assessment with the intention of achieving a full operating scheme license.

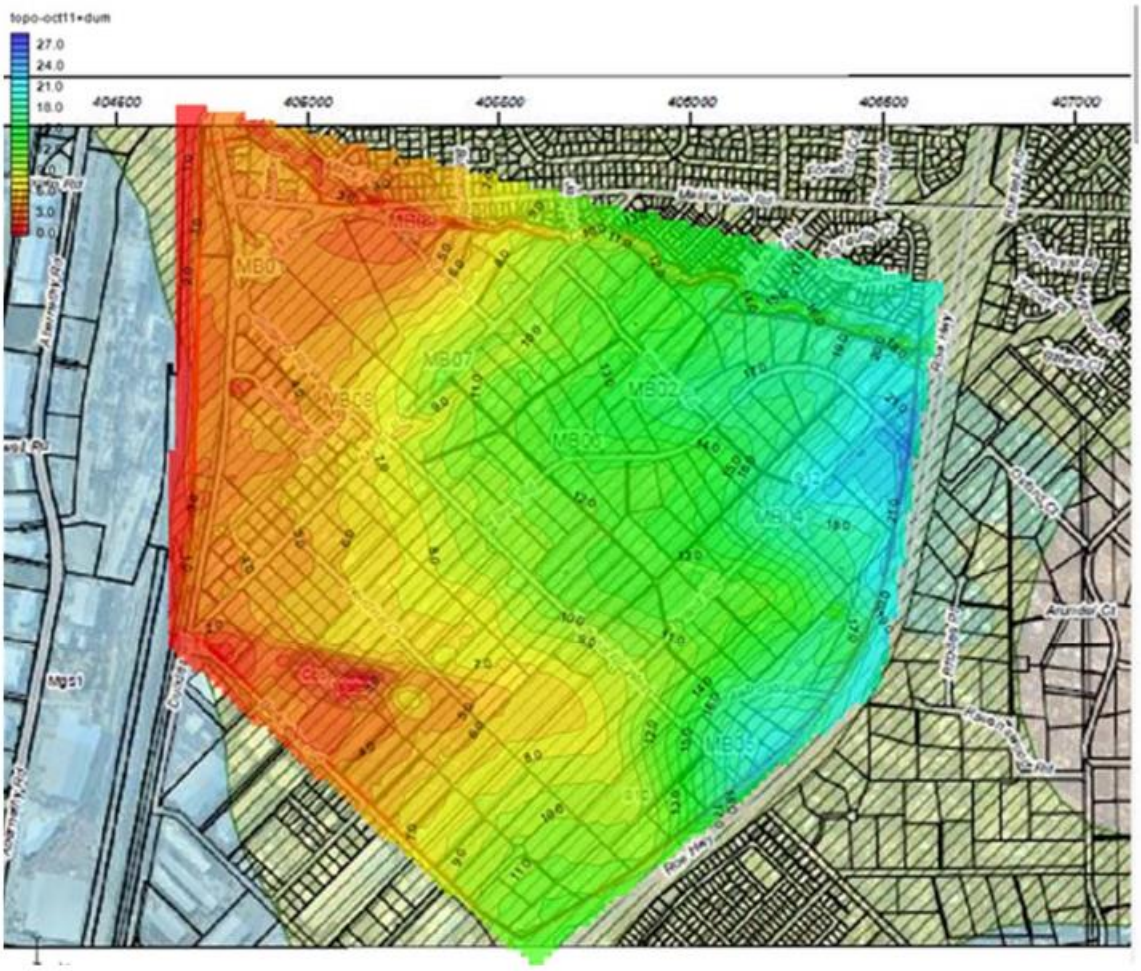


Figure 4. Depth to groundwater levels in the Managed Aquifer Recharge project area (Oct 2011)

Water Proofing Kalamunda

Since August 2004, the City has been involved in the Water Campaign coordinated by the ICLEI (International Council of Local Environmental Initiatives) to support water wise practices in the local community and in the Council's own operations. The Water Campaign includes five milestones. The Water Action Plan (Sept 2009) was completed in accordance with milestone three and the final milestone to review and evaluate the implementations actions was completed in October 2012.

The Kalamunda Achieving Corporate Business Plan (2010-2030) has identified a review and preparation of a new Water Action Plan as a key priority for the City. In the meantime, the City continually reviews and adopts water saving strategies implemented for City community facilities, administration offices and maintenance of nature reserves, as well as providing training and resources for the community. Annual water quality monitoring is undertaken by the City to obtain a 'snapshot' of the health of its waterways and the data collected is fed into the Department of Water's WIN database, which is publicly available.

4.6.5 Water Sensitive Urban Design

Where a new structure plan is proposed, the application is assessed to ensure a coordinated approach between stormwater management, rainwater catchment areas, drainage, and

irrigation of public open space. Assessments of landscaping plans at the subdivision and development phase and introduction of local planning policy, design guidelines, and information sheets are all mechanisms utilised by the City to promote water sensitive urban design principles.

Residents can incorporate water sensitive urban design principles in their developments by:

- locating structures outside nominated buffers to flood and stream management areas,
- minimising sealed surfaces such as concrete or paving to increase the areas for water infiltration into subterranean aquifers,
- planting drought tolerant native plant species,
- reducing the frequency of irrigation, or
- incorporating rain sensors on automated systems, rainwater harvesting, or greywater recycling.

SPP 2.9 Water Resources and the Better Urban Water Management Framework guides water management during each stage of the land use planning and development process. Local Planning Policy DEV54 Dual Density Design Guidelines supports the incorporation of water sensitive urban design principals in higher density developments. The preparation of any future local planning policy relating to wetlands and waterways should also give due consideration to the Managing the Floodplain Handbook (2017) developed by the National Flood Risk Advisory Group.

Table 11. Strategy for Water

Water - Objective		
6. To support water sensitive urban design initiatives and streamline administrative processes relating to key waterways, public drinking water source areas, and water catchment areas		
Strategy	**Action**	**Timeline**
6.1 Protect and enhance waterways, wetlands and the groundwater and ensure sustainable use and management of water resources.	6.1.1 Develop a local planning policy for waterways, flood prone areas (the floodway and flood fringe) and wetlands to protect the environmental value of the waterbody and provide parameters for development in susceptible areas. The local planning policy to include guidelines for management of stormwater prior to discharge into waterways, wetland areas or flood prone areas as well as establish minimum buffers. Stormwater management is to have due regard to the Department of Water and Environmental Regulation's	**Priority:** High **Timeframe:** 1-2 years **Partners:** Department of Water and Environmental Regulation, Environmental Services **Indicator:** Decision made to implement Flood Prone Areas Policy and/or recommend referral to the WAPC for endorsement.

	Stormwater Management Manual for Western Australia and Decision Process for Stormwater Management in WA, DBCA's Policy 49 – Planning for Stormwater Management Affecting the Swan Canning Development Control Area and Water Sensitive Urban Design principles.	
6.2 Investigate and develop opportunities to implement efficiencies in the City's groundwater management, stormwater aquifer recharge, and use.	6.2.1 Council to determine an amendment to the Local Planning Scheme map to rezone PDWSA's to be consistent with MRS water catchment zoning (with agreement from DWER and WAPC), and intramaps to be updated to reflect the changes.	**Priority:** Medium **Timeframe:** 1-2 years **Partners:** Department of Water and Environmental Regulation, WaterCorp, WAPC **Indicator:** Recommendations finalised and necessary amendments made to the Local Planning Scheme map.
6.3 Utilise Managed Aquifer Recharge (MAR) to secure sustainable water irrigation supply	6.3.1 Undertake investigations into the feasibility of a second MAR site within the City.	**Priority:** Low **Timeframe:** 2-4 years **Partners:** Department of Water and Environmental Regulation and WaterCorp **Indicator:** Preparation of the feasibility investigation.
6.4 Promote sustainable catchment management, based on the need to protect the quality of surface and groundwater from intensification of development, and provide equitable access to water resources for productive rural purposes.	6.4.1 Prepare a local planning policy outlining criteria to manage compatibility between rural and agri-tourism developments, taking into consideration protection of identified priority agricultural areas, rural conservation zones, protection of water catchment areas, PDWSA's, and watercourse hierarchy buffers.	**Priority:** Medium **Timeframe:** 1-2 years **Partners:** Department of Water and Environmental Regulation, WaterCorp, WAPC **Indicator:** Council adopts a local planning policy to guide intensity of agri-tourism development in rural areas when located in a water catchment or PDWS area.

4.7 Biodiversity

Garnett et al. (2017) noted that Australia has the highest rate of extinctions in the world which is the result of around 110 known species already extinct and 1,717 native species listed as endangered or threatened with extinction. ABC News (2016) reported that due to discrepancies in reporting Australia is more likely to be within the top four countries in the world with the highest extinction rates, only exceeded by the USA and French Polynesia and tied fourth with Mauritius. In total around 2,500 new Australian species are discovered and classified each year and an estimated 75% of species remain undiscovered (BBC News. 2018, ABC News[2]. 2014).

Conservation International (2017) classifies Perth within the Southwest Australia Ecoregion, a biodiversity hotspot consisting of a particularly high concentration and variety of native species found nowhere else in the world. Biodiversity hotspot classification means a region that contains at least 1,500 vascular (higher order) plants (>0.5% of the world's total) as endemics, and has lost at least 70% of the original vegetation (WWF. 2016). Attempting to recreate these unique ecosystems after clearing is essentially impossible, particularly as the plants can be recalcitrant and difficult to propagate.

The Southwest Ecoregion in WA (which includes the City of Kalamunda) is one of 34 globally recognised hotspots and contains 5 of Australia's 15 nationally recognised biodiversity hotspots as well as being one of only 5 Mediterranean-type ecosystems to be listed as significant (Commonwealth of Australia. 2017, Hales. 2014). The south-west region is unique, containing approximately a quarter of the nations flora species (approx. 8000), 75% of which are endemic (occur only in the south-west region), with approximately 2000 of these listed as threatened. Western Australia contains 43% of the nations threatened flora species, exceeding all other states and territories and 8% of the worlds threatened and rare flora species (exceeding figures recorded for most countries on earth). An estimated 10% of Perth's original wetlands remain (WA Museum. 2019, LPS Augusta-Margaret River. 2019).

Biodiversity is threatened by numerous processes, including:

- Clearing and fragmentation of natural vegetation
- Introduced plant and animal species
- Altered fire regimes
- Disease (phytophthora dieback); and
- Climate change

In recognition of its strong biodiversity values, the City developed a Local Biodiversity Strategy in collaboration with the Perth Biodiversity Project and by utilising the *Local Government Biodiversity Planning Guidelines for the Metropolitan Region* developed by the Western Australian Local Government Association (WALGA). The guidelines promote a four phase process with the final phase recommending review of the local planning scheme and application of Local Planning Policy for the protection of locally significant natural areas.

4.7.1 Benefits of Biodiversity

The retention of existing vegetation is vital to maintaining the health and resilience of the City's natural ecosystem. It is important to retain, maintain, and enhance biodiversity to minimise the "bottle-neck" effect where a decline in the number of individuals within a species causes a reduction in the genetic diversity and increases the chances of species extinction.

Retention and improvement of natural vegetation produces many desirable outcomes including but not limited to;

- biodiversity and preservation of supportive ecosystems for flora and fauna
- increased amenity from an established urban canopy
- climate regulation and shelter from extreme heat, wind, rain and other weather events
- stormwater retention on-site and mitigation of run-off
- hydrological cycles including groundwater recharge, watershed protection and buffering against extreme events
- nutrient storage and cycling and erosion management
- soil pollutant breakdown and absorption
- improved air quality through dust mitigation and phytoremediation of noxious gases
- insulation and noise mitigation buffer

Further social benefits include;

- potential increase in property value within proximity to natural green spaces
- environmental tourism opportunities
- open space for recreation and outdoor events
- food production and medicinal or industrial applications
- cultural identity
- preservation of Indigenous natural heritage and culture
- scientific understanding of natural systems and how to rehabilitate degraded systems

4.7.2 Vegetation

Vegetation within the City can be grouped into three distinctive landform types; the Darling Plateau, Darling Scarp and Swan Coastal Plain. The distinctive landform types influence the vegetation types supported and referred to as vegetation complexes. Map 13 shows the composition of vegetation complexes throughout the City, while Map 12 shows the vegetation composition prior to European settlement.

Some vegetation complexes identified as having regional significance were identified through State Planning Policy 2.8: Bushland Policy for the Perth Metropolitan Region, introduced in 2000, which provides a policy and implementation framework that aims to protect remnant bushland throughout the Perth Metropolitan Region, commonly known as Bush Forever. The City of Kalamunda contains 17 Bush Forever Sites (refer to Map 14 – Remanent Vegetation by Admin Planning Categories), which in total amount to 490.56 ha of reserves identified as having regional environmental significance.

4.7.3 Rare and Threatened Species and Ecological Communities

The City contains a diverse array of endemic flora, fauna and ecological communities which have important ecological functions, and sometimes national or even global significance. Significant flora species are protected under both State and Commonwealth legislation. Any activities that are deemed to have a substantial impact on flora species that are recognised by the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) or the *Biodiversity Conservation Act 2016* (BC Act) and *Biodiversity Conservation Regulations 2018* (BC Regulations) can trigger referral to the Department of Water and Environmental Regulation and/or the Environmental Protection Authority (EPA). State Planning Policy 2.8 also has a presumption against clearing of rare species and ecological communities.

Significant flora in Western Australia that are protected under the WC Act are listed as Threatened (Declared Rare) flora. Also the Department of Biodiversity, Conservation and

Attractions (DBCA) which consists of Parks and Wildlife Services (PaW), produces a supplementary list of Priority Flora, these being species that are not considered Threatened under the WC Act but for which PaW feels there is a cause for concern. Such taxa need further survey and evaluation of conservation status before consideration can be given to declaration as threatened flora. As such these species have no special legislative protection, but their assessment of the conservation status of an area.

An ecological community is a naturally occurring group of plants, animals and other organisms interacting in a unique habitat. The complex range of interactions between the component species provides an important level of biological diversity in addition to genetics and species. The WC Act does not currently protect for ecological communities, however, the Minister for Environment may currently list an ecological community as being threatened through a non-statutory process if the community is presumed to be totally destroyed or at risk of becoming totally destroyed.

The *Biodiversity Conservation Act 2016* will provide for the statutory listing of threatened ecological communities (TECs) by the Minister when the relevant Parts of the Act are proclaimed following the preparation of enabling Regulations. The new legislation also describes statutory processes for preparing recovery plans for TECs, the registration of their critical habitat, and penalties for unauthorised modification of TECs.

The City of Kalamunda supports a number of threatened flora and fauna species and ecological communities listed under the EPBC Act and WC Act and a number of supplementary priority species.

There are 22 species listed as rare or likely to become extinct, including 13 flora and 9 fauna species. A further 38 flora species, 12 priority fauna species and one species of fungi have priority status.

Threatened Ecological Communities include:

- Banksia Woodlands of the Swan Coastal Plain ecological community (listed as Endangered, likely to occur in the City)
- Clay Pans of the Swan Coastal Plain (listed as Critically Endangered, likely to occur in the City)
- *Corymbia calophylla - Kingia australis* woodlands on heavy soils of the Swan Coastal Plain (listed as Endangered, known to occur in the City)
- Shrublands and Woodlands of the eastern Swan Coastal Plain (listed as Endangered, known to occur in the City)
  Protected Matters Report created April 2018

The City works in collaboration with DWER and the EPA to refer development and subdivision applications which may impact identified TEC's, rare or threatened flora, or be within habitat for listed fauna in accordance with the *Environmental Protection Act 1986* and *Environmental Protection and Biodiversity Conservation Act 1999*. Where it is reasonably suspected a proposal may affect protected flora, fauna or an ecological community, applicants are required to undertake a flora and fauna survey and provide a report outlining potential occurrence or impacts. Map 15 shows environmentally sensitive areas in the City known to contain rare, threatened or protected flora or fauna.

4.7.4 Ecological Linkages

Habitat fragmentation has many detrimental impacts including:

- Reduced habitat and isolation of individual species
- Interference with the ability of populations to disperse and recolonise areas after disturbance such as fire or senescence
- Decreasing population size below the threshold where it can be self-sustaining through reproduction
- Magnification of the negative impacts of surrounding land uses also known as 'edge effects' (Kalamunda Local Biodiversity Strategy. 2008)

Edge effects describe the effects on isolated vegetation resulting from higher exposure to solar radiation and wind gusts resulting in drier soil and air, increased fluctuations in microclimate including temperature, moisture and water levels, and easier access through fragmented landscapes for pathogens transported by animal and human movement. Where adjoining residential or agricultural land isolated vegetation may be subject to increased deposition of nitrogen and other fertilisers as well as pesticides and pollutants (Sapsford *et al*. 2017).

The accumulated effect of genetic isolation and edge effects can exacerbate the decline of protected parks and reserves despite their protection and zoning as an important natural asset. Identifying opportunities to link existing green spaces with future public open space, wetland reserves, watercourse buffers, and private open space to create ecological linkages will improve the health and resilience of important vegetation complexes.

When considering ecological linkages, internationally important areas are identified through reserves protected under the *Environment Protection and Biodiversity Conservation Act 1999*. Regional linkages identified were incorporated into the Kalamunda Local Biodiversity Strategy 2008 (refer Map 16: Ecological Linkages). The next stage of identifying and implementing ecological linkages involves adoption of guidelines or a local planning policy to guide development where it is proposed to be within an identified ecological linkage (refer Map 16) Efforts to maintain and improve connectivity between parks, reserves, public open space, nature strips and private gardens should be encouraged where feasible.

4.7.5 Bushfire and Biodiversity

Longer hotter summers increase the risk of bushfire. The City will continue to adhere to best practice for bushfire management, both for strategic planning proposals and statutory development applications and work in close collaboration with the Department of Fire and Emergency Services, the Fire Protection Authority, the Department of Planning, Lands and Heritage and landowners to promote education and community preparedness. Bushfire risk and hazard level is shown on Map 05.

The City of Kalamunda is bound by the Bushfires Act 1954 to manage all aspects of the lands it owns and has been allocated to be managed, which equates to approximately 300ha of Bush reserves. Historically, the reserve hazard reduction burns have been predominately a protection solution for life, property and community assets, with only a moderate consideration for environmental issues, or for a long term approach to a changing climate. The challenge is to manage the balance between maintaining the fuel at an acceptable level, (between 8 to 10 tonnes per hectare) and the long term biodiversity impacts of too frequent a fire burn regime and endemic weed invasion.

Reserves should be looked at from a broader strategic perspective that included several factors. On City managed lands, the City performs proactive fire mitigation works through numerous processes including inspections, hazard reduction burning, spraying of invasive weeds and slashing that are focussed on implementing an effective, risk based planning land use to preserve life and reduce the impact of fire on property and infrastructure. An annual program of inspecting all reserves within the city is performed by the Fire Mitigation Crew prior to the restricted burn seasons. From this review, works are allocated to other areas of Parks & Environment for review in preparation for the annual fire season as well being used by the City's Fire Mitigation Crew for its annual works program.

Maintaining a balance between bushfire prevention and protection, and biodiversity is an area that must be addressed on individual merit. In some cases, interpretation of the legislation has caused unnecessary clearing of native vegetation on private land that could have been alternatively managed at reasonable fuel levels to comply with bushfire requirements. As such the City is endeavouring to provide education and resources to best inform residents of their options when it comes to protecting lives and assets, and ensuring the environment is reasonably managed.

Clearing for the purposes of fire mitigation shall only be conducted on private property when a permit or notice is obtained from a City of Kalamunda Fire Control Officer in conjunction with the *Bush Fires Act 1954.* Land owned by the State of Western Australia or other government departments must obtain the relevant authorisation from the Department of Fire and Emergency Services or Department of Biodiversity, Conservation and Attraction.

Clearing for bushfire is limited by the boundaries of the property and is not to impact on environmental management of neighbouring conservation estate or reserves, remnant vegetation, foreshore reserves, revegetation areas or waterway and wetland buffers.

Objective 5.4 of State Planning Policy 3.7 aims to:

> 5.4 Achieve an appropriate balance between bushfire risk management measures and, biodiversity conservation values, environmental protection and biodiversity management and landscape amenity, with consideration of the potential impacts of climate change.

In implementing policy objective 5.4, planning assessments should consider existing planning policies and publications such as SPP 2.8 Bushland Policy for the Perth Metropolitan Region. The application may be refused if the value of the vegetation is high and the landowner/proponent proposes achieving an acceptable bushfire risk level through vegetation clearing without consideration and inclusion of other management measures.

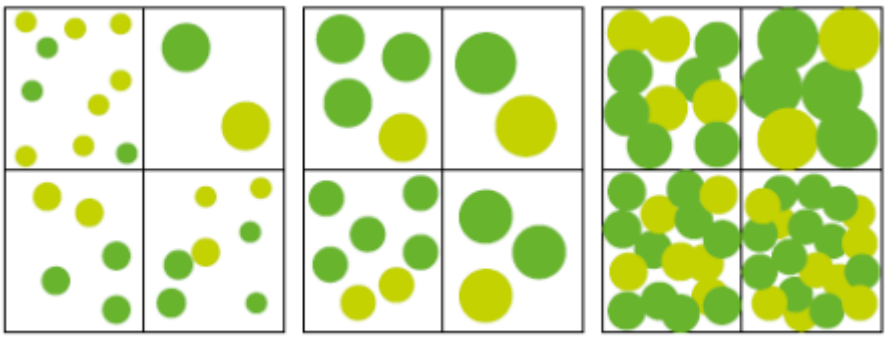
Some of the suggested ways to manage vegetation to mitigate bushfire impact without clearing include:

- removal of all dead flammable material
- trimming and pruning vegetation to reduce fire travelling from ground level to second level shrubs and into the tree canopy
- removing large swathes of leaf litter to reduce the available fuel load to an average of two tonnes per hectare (2t/ha) – the City provide a fuel load measuring kit available from the Community Safety Team or Administration counter.
- siting and designing a proposed building envelope to comply with recommended separation distances to a level of BAL-29 or lower
- maintaining an asset protection zone (APZ)
- maintaining grass in accordance with the City's Fire Hazard Reduction Notice.
- maintaining a sufficient fire break around the property perimeter for Fire and Emergency Services vehicle access

Additionally, residents are required to comply with all current requirements outlined in the City of Kalamunda Fire Hazard Reduction Notice, issued annually under the authority of the *Bush Fires Act 1954*.

Vegetation management only within an approved Asset Protection Zone (APZ) should include:

Trees (> 5 metres in height): trunks at maturity should be a minimum distance of 6 metres from all elevations of the building, branches at maturity should not be within 2 meters of the building, lower branches should be removed to a minimum height of 2 metres above the ground and or surface vegetation, canopy cover should be less than 15% with tree canopies at maturity well spread to at least 5 metres apart as to not form a continuous canopy. Diagram below represents tree canopy cover at maturity.



Shrubs (0.5 metres to 5 metres in height): should not be located under trees or within 3 metres of buildings, should not be planted in clumps greater than 5m^2 in area, clumps of shrubs should be separated from each other and any exposed window or door by at least 10 metres. Shrubs greater than 5 metres in height are to be treated as trees.

Ground covers (<0.5 metres in height): can be planted under trees but must be properly maintained to remove dead plant material and any parts within 2 metres of a structure, but 3 metres from windows or doors if greater than 100 mm in height. Ground covers greater than 0.5 metres in height are to be treated as shrubs.

Grass: should be managed to the requirements of the City's Fire Hazard Reduction Notice.

Clearing to comply with an approved asset protection zone (APZ) can adversely affect the retention of native vegetation. Where the loss of vegetation is not acceptable or causes conflict with landscape or environmental objectives, reducing lot yield may be necessary. Unnecessary or excessive clearing that is not in accordance with an approved APZ shall be required to adhere to the Local Planning Scheme.

In many cases, compliance with bushfire legislation and guidelines conflicts with preservation and protection of valuable biodiversity and natural habitat. One strategy to provide greater clarity and guidance to landowners includes development of a local planning policy which outlines performance objectives for reducing fuel loads in bushfire prone areas, which is to be delivered in conjunction with community education programs and supporting information sheets. Assessment of the potential impact of the bushfire legislation and guidelines on local biodiversity should be undertaken in the next review of the Local Biodiversity Strategy.

Table 12. Strategy for Bushfire

Bushfire - Objective		
1. To preserve, enhance, connect and rehabilitate natural areas and protect biodiversity values.		
Strategy	**Action**	**Timeline**
7.1 Where there is a conflict between bushfire guidelines and existing biodiversity values provide appropriate design alternatives to maintain effective ecosystem functions and resident safety.	7.2.1 Develop criteria within a vegetation protection local planning policy to outline performance objectives where biodiversity is seen to conflict with bushfire management requirements, with regard to State Planning Policy and guidelines.	**Priority:** High **Timeframe:** 1-2 years **Partners:** DFES. WAPC **Indicator:** Bushfire and biodiversity criteria incorporated as part of a vegetation protection policy.
7.2 Review the Biodiversity Strategy to consider any conflicts between biodiversity protection and the new bushfire requirements.	7.3.1 Prepare an updated Local Biodiversity Strategy to assess risk to biodiversity through implementation of the bushfire regulations and determine appropriate planning mechanisms for balancing biodiversity protection and protection of life and property.	**Priority:** High **Timeframe:** 1-2 years **Partners:** DFES. WAPC **Indicator:** Local Biodiversity Strategy updated and implemented.

4.7.6 Natural Resource Management: State Forest and National Parks

The City of Kalamunda adjoins three State Forests which account for 11, 417 ha with six National Parks amounting to 9,311 ha and two Regional Parks amounting to 837 ha. The sum total equates to approximately 66% of the City consisting of state forest, national park and regional park reserves. Notably the Kalamunda town centre also contains a termination point

for the Bibbulmun track, a renowned 1000km trail stretching to Albany on the south-west coast. The City provides continual protection of these nature reserves by maintaining the reserve status through strategic zoning and communication with external agencies, such as the Department of Biodiversity, Conservation and Attractions and the Environmental Protection Authority, where it is reasonably suspected they may be impacted by a nearby proposal. Land uses surrounding these areas are assessed to ensure compatibility with the conservation and reserve status of the City's natural assets.

Due to the protection of such high quality natural areas, Kalamunda has become a hub for outdoor activities such as walking, hiking and cycling where locals and visitors alike can enjoy the numerous trails, biodiversity and wildlife. The City works in conjunction with the State Government, and Federal Government agencies where necessary to maintain and manage these natural assets to provide conservation protection, eco-tourism opportunities and delivers infrastructure to support the use of public parks and trails.

4.7.7 Threats to Biodiversity

Weeds

Weeds are species of plants not originating from the local area that, due to their inherent characteristics, have become prolific and invasive. While some weedy species are increasingly being studied for their beneficial contribution to urban biodiversity and referred to as "spontaneous vegetation," some species can have significant direct effects on the economic viability of agricultural areas, tourism hotspots, conservation and rehabilitation programs and infrastructure. Commonly referred to as 'plants out of place,' species prone to weediness are listed to educate landowners, correctly identify species, and prioritise management actions.

Some plant species are so invasive that they are a national priority to rededicate. In WA the Department of Agriculture and Food Western Australia (DAFWA) regulates weeds under the *Biosecurity and Agriculture Management Act 2007* which lists weeds of national significance.

There are approximately 197 weed species known to occur within the City. The top 10 priority weeds listed in the City of Kalamunda Weed Control Strategy include:

- *Asparagus asparagoides* – Bridal creeper*
- *Cortaderia selloana* – Pampas grass
- *Eragrostis curvula* – African love Grass
- Freesia aff. *Leichtinii* – Freesia
- *Homeria flaccida* – One Leaf Cape Tulip
- *Hyparrhenia hirta* – Tambookie Gras
- *Leptospermum laevigatum* – Victorian (Coast) Tea Tree
- *Watsonia bulbilifera* – Watsonia
- *Rubus spp*. – Blackberry*
- *Echium plantagineum* – Paterson's Curse

* also listed as a weed of national significance

Landscaping plans are generally required by the City to be lodged with a development application. The landscaping plan identifies existing vegetation and shows what vegetation is to be retained and/or removed and proposed plantings. The City assesses the landscaping plan as part of the development approval to ensure activities and plantings do not contain listed weeds or plants prone to invasiveness which may become garden escapees and infiltrate nearby local nature reserves (thereby reducing local biodiversity).

Pests

Pests are vertebrate or invertebrate animals that negatively affect the natural environment, agriculture or our lifestyle. Pests include mostly exotic animals that were introduced accidentally or deliberately but, in certain situations, can include native animals. Known pests are included on the Western Australian Organism List (WAOL).

The prevalence and characteristics of known pests is considered when assessing development applications to ensure activities do not exacerbate environmental circumstances. Pest control may include remediation or revegetation activities, management of surface water, fencing of sensitive areas, crop rotation, effluent containment and disposal, stormwater filtration and drainage, or compliance with an approved management plan.

Feral animals are introduced animals that disrupt the natural local food chain hierarchy by competing with native animals for food and habitat, predation, disturb or erode native vegetation or soil stability, or pose a biosecurity risk with the introduction of associated pests and diseases.

Feral animals in the City include, but are not limited to:

- House cat (*Felis catus*);
- Red Foxes (*Vulpes vulpes*);
- European Honey Bees (*Apis mellifera*);
- Black Rats (*Rattus rattus*);
- European Rabbits (*Oryctolagus cuniculus)*;
- Rainbow Lorikeets (*Trichoglossus moluccanus*);
- European House Borers(*Hylotrupes bajulus*);

4.8 Sustainable Urban Design

4.8.1 Urban Heat Island Effect

The 'urban heat island effect' (UHI) is a term used to describe the capture and retention of ambient heat in urban areas which is amplified by the removal of vegetation and building materials. The UHI effect has been demonstrated to affect physical health through heat stress and exposure, modified microclimate patterns, exacerbated edge effects, plant flowering cycles, and animal breeding patterns and food availability.

Reduction of the UHI effect can be achieved through the concerted effort to retain vegetation, plant new vegetation, incorporate skyrise greenery (such as green roofs, green walls, vines and climbers, or permanent planter boxes) into built form, minimise sealed or impermeable surfaces, apply water sensitive design principles, use construction materials which have low heat retention and non-reflective materials such as wood or light coloured roofing, and reduction in energy consumption and subsequently greenhouse emissions (Brokenshire. 2017). Addressing the urban heat island effect consequently also improves liveability, amenity and biodiversity.

4.8.2 Public and Private Tree Protection

Research has shown up to 30% of species listed on the Environmental Protection and Biodiversity Conservation list of threatened species have been known to occur in urban areas (CAUL. 2017). Urban areas include vegetation that can be categorised into two broad

categories, public and private. Public natural areas include bush forever sites, protected reserves and local open space, as well as vegetation within road reserves and street trees. Private open space consists of vegetation within zoned privately-owned lots.

4.8.3 Street Trees

In 2016, the Street Tree and Streetscape Management Policy was adopted by Council. This procedural policy outlines the circumstances where removal of a street tree may be justified and offers options for replanting or offset where no alternative option exists. Street tree protection is particularly relevant to development applications where existing crossovers are proposed to be moved, or new crossovers installed.

Road verges create opportunities for continuous and converging tree canopies providing linkages between existing Public Open Space and natural Reserves. Through strategic planning, road verges can provide long linear connections between larger natural areas, in addition to providing linkages and buffers between public and privately-owned land. For example, key roads which link existing natural reserves can be identified and these areas may be subject to double-row tree plantings of native species to act as a wildlife corridor and promote connectivity. It is important to consider ongoing infrastructure upgrades and maintenance when planting road reserves to ensure infrastructure is not damaged by tree growth and to ensure the trees in turn are not damaged by future works.

4.8.4 Urban Forest

Both public and private natural areas contribute to the broader Kalamunda 'urban forest'. Vegetation on privately owned lots contributes considerably to the character, amenity and environmental health of an area. A study undertaken by the University of Melbourne published in May 2017 used random point sampling to measure urban canopy cover and found that while there was an overall increase in tree canopy cover, in some areas the concurrent removal of trees within private lots caused an overall net decrease (Kaspar *et al*. 2017). This indicates that while increasing canopy cover in the public realm is effective, the unrestricted removal of trees within private lots may be countering the benefits of increasing canopy cover. This supports the Urban Forest of Perth and Peel Statistical Report (2009) which states trees on private lots are at the greatest risk of development pressures as there is limited protection of existing trees under statutory policies.

The 'Statistical Report – The Urban Canopy Cover of Perth and Peel' published by DPLH and CSIRO in February 2019 reported on urban canopy cover on lots developed or redeveloped between the years 2009 and 2016, which is summarised as follows:

- Kalamunda 26% loss
- Maida Vale 22% loss
- High Wycombe 71% loss
- Forrestfield 65% loss
- Wattle Grove 25% loss
- Gooseberry Hill 21% loss
- Lesmurdie 15% loss
- Walliston 1% increase
- Paulls Valley 78% increase
- Piesse Brook 35% increase
- Bickley 31% increase
- Carmel 42% increase

These statistics show developed rural areas are generally increasing in canopy cover or remaining the same, while developed urban areas are incurring significant canopy loss. The relative canopy cover compared to other Local Government Areas is shown in Figure 5, extracted from the PlanWA online mapping data.

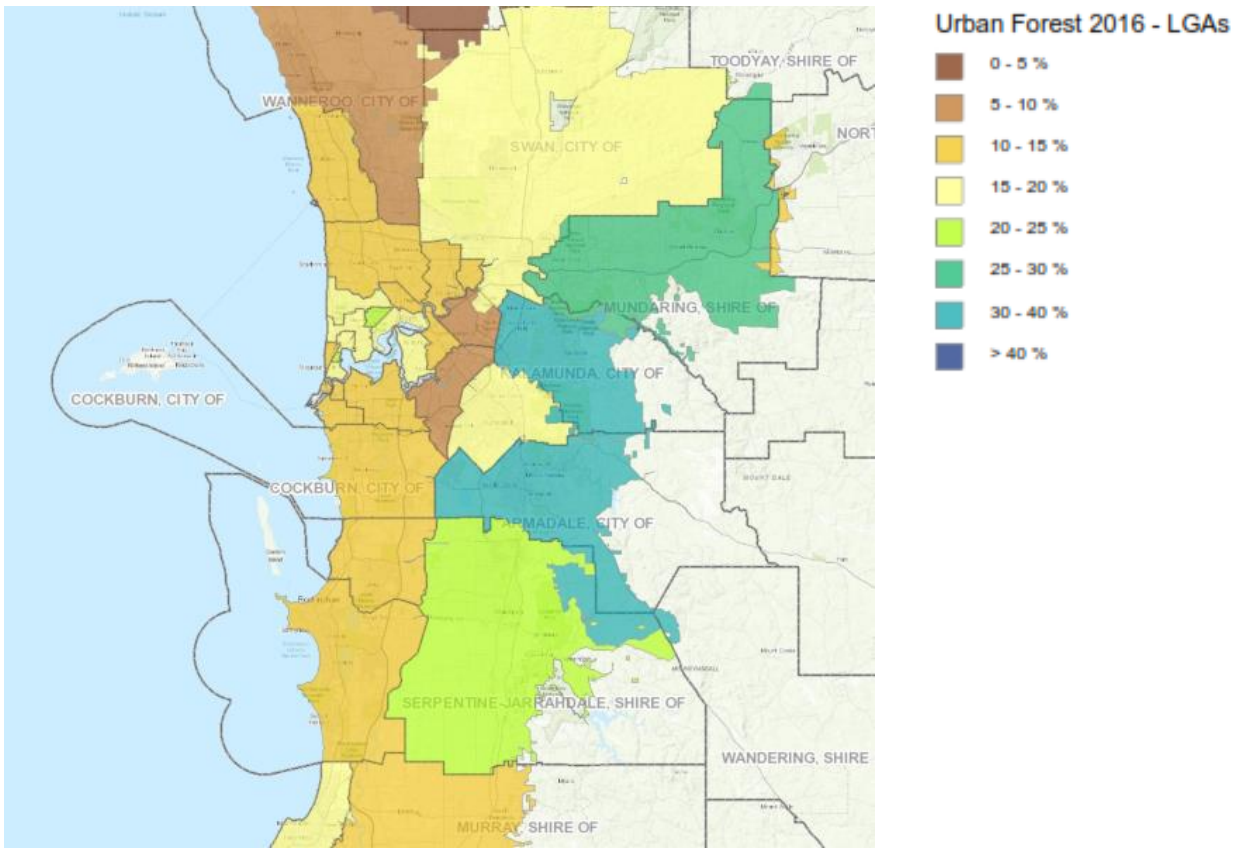


Figure 5. Map of Urban Canopy Cover in the City of Kalamunda (PlanWA. 2019)

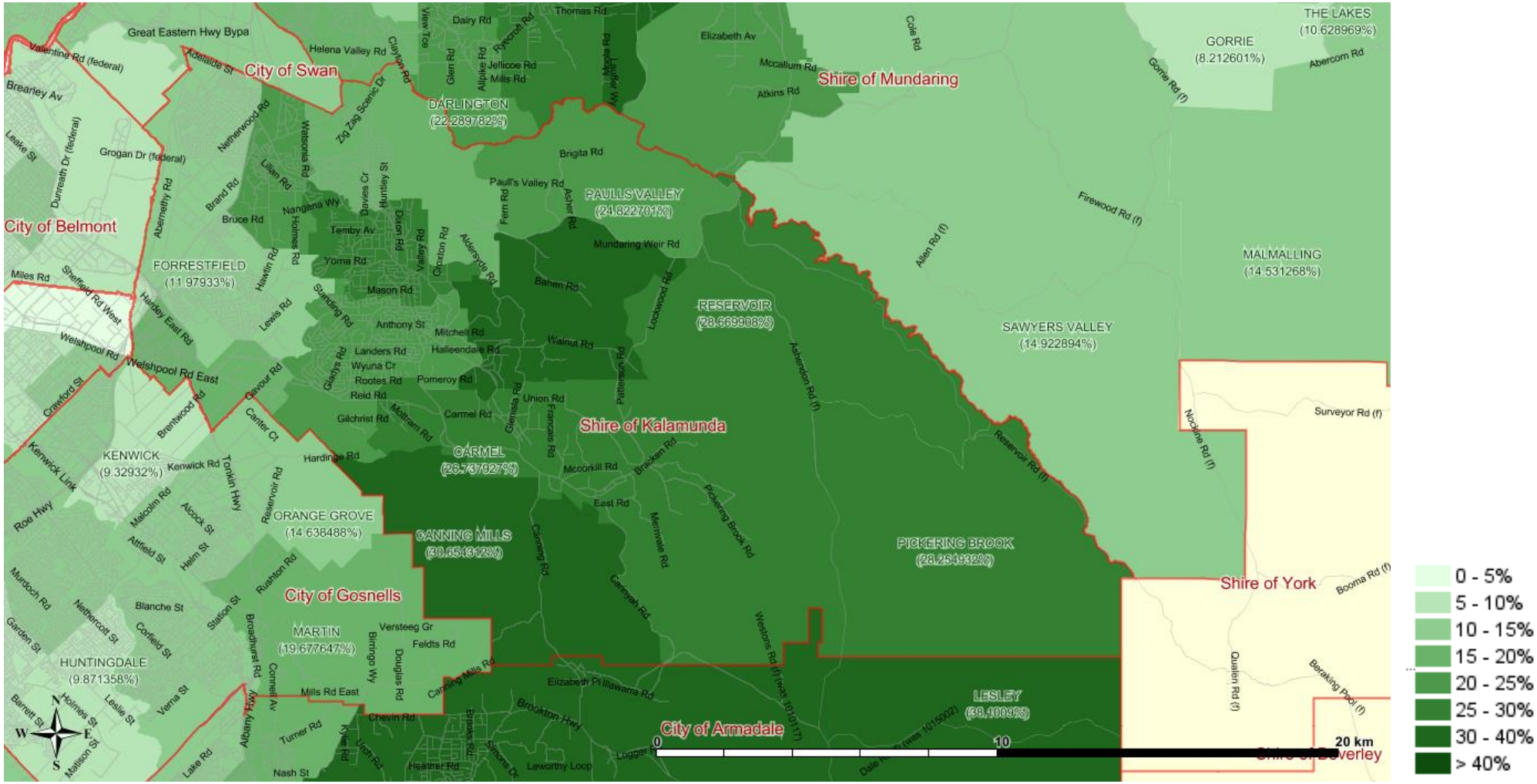


Figure 6. Percentage of Tree Canopy Cover throughout the City of Kalamunda (CSIRO & DoP. 2009) *Urban tree canopy cover measured using LiDAR data current as of 2009.

The WSATTG "Where Should All the Trees Go?" snapshot of Kalamunda is a report prepared by RMIT based on LiDAR data collected and reviewed in conjunction with 202020Vision. The report is based on data collected between March 2015 and December 2016 and showed the City of Kalamunda has relatively good urban tree canopy cover in comparison to other Perth metropolitan local governments, though the inclusion of State Forest and National Parks can result in skewed data. The WSATTG report showed 1.3% of the City was a hotspot with a land surface temperature above the mean average, which occurred in isolated spots primarily to the south west, areas majorly subject to industrial or medium density residential zoning.

Table 13. Comparison of urban canopy cover between the years 2011 and 2016

KEY STATISTICS	2011*	2016	
Tree Canopy Cover	62.8%	59.4%	3.4% Loss
Shrub Cover	4.8%	4.2%	0.6% Loss
Grass Cover	25.7%	28.5%	2.8% Gain
Hard Surface	6.7%	7.9%	1.2% Increase

As shown in Table 13 there has been an overall loss in tree canopy, and shrub cover and an increase in grass and hard surfaces which is consistent with most urban development. While vegetation on public land can be maintained, managed and replanted by the City it must be in conjunction with tree protection on private lots to reach and overall net increase in canopy cover.

There are various methods to protect trees on privately owned land. This includes:

- Local planning scheme provisions
- A local planning policy
- Significant tree register
- Land acquisition and resale with restrictive easements or covenants on the title
- Identification of Local Natural Areas (LNA's) and voluntary LNA reserve status
- Natural heritage protection
- Grants and external funding

Three of the above listed planning mechanisms have been identified to strengthen environmental protection within the City including a local planning policy, Local Natural Area identification and registration, and a Significant Tree Register. These mechanisms are to be implemented in conjunction with a Street Tree Masterplan (Strategy 8.2 – refer Table 14), and development of a staged planting program to plant areas already identified to have street trees in accordance with an adopted Local Development Plan, Outline Development Plan, or Local Structure Plan. As these strategies are introduced it is critical to monitor the community response to the changes, incorporate feedback and continually review the progress and community satisfaction . Streets identified through the Green Links Masterplan which can act as a link between existing reserves and public open space, can be incorporated into the Street Tree Masterplan, to be designed wider to contain a wider variety of native species to provide integrated wildlife and biodiversity corridors.

In addition strategy 8.2.4 was developed clarify the circumstances where a flora fauna survey is required prior to making a determination on a planning proposal to ensure a consistent approach and ensure decisions are well informed.

Table 14. Strategy for Biodiversity

Biodiversity - Objective		
8. To establish a sustainable urban environment.		
Strategy	**Action**	**Timeline**
8.1 Identify opportunities for linkages between existing green space	8.1.1 A Green Links Masterplan is to be prepared in conjunction with the Street Tree Masterplan and develop actions to improve linkages between existing nature reserves, POS, road reserves and local natural areas (LNA's).	**Priority:** High **Timeframe:** 1-2 years **Partners:** DBCA **Indicator:** The Green Links Masterplan and a staged planting schedule is implemented and periodically reviewed and improved.
	8.1.2 As part of the Green Links Masterplan investigate opportunities to incentivise residents to plant verges with native gardens to improve plant species diversity and habitat for local fauna. This includes: • Promoting native verge planting as part of the 'Plants for Residents' program. • Developing information brochures for residents within an identified Green Link and encouraging their participation and management of the verge. • Invite residents to participate in local street tree planting working bees to promote a sense of ownership and pride of place.	**Priority:** Medium **Timeframe:** 1-2 years **Partners:** DBCA **Indicator:** As part of the development and implementation of the Green Links Masterplan undertake community engagement to provide information and encourage residents to increase native planting on the verge.
8.2 Improve urban tree canopy cover to address urban heat island effect, WSUD principles and biodiversity linkages	8.2.1 Develop a Street Tree Masterplan, which analyses, identifies, and prioritises street tree plantings to improve Urban Forest canopy cover in conjunction with a	**Priority:** High **Timeframe:** 1-2 years **Partners: Indicator:** Street Tree Masterplan reviewed by Council and implemented to inform public plantings within the Green Links Masterplan.

	Green Links Masterplan by the year 2020.	
	8.2.2 Develop a Street Tree Masterplan which incorporates a staged planting program targeting key high risk areas first. The following areas were identified by 202020 Vision as being an opportunity for greening, which can be used as a basis for further investigation: • Corner of Abernethy Road and Kalamunda Road – commercial park home and industrial land uses. The border of City of Swan. • Corner of Reynolds Road and Tourmaline Gardens – a residential area currently R15 identified to have a Dual Density zone of R20/R30 • Corner of Arthur Road and Merlin Way – residential R20 area in Wattle Grove	**Priority:** High **Timeframe:** 1-2 years **Partners:** **Indicator:** Street Tree Masterplan incorporating staged planting programs reviwed by Council and actioned. Trees planted in accordance with the staged planting program to the satisfaction of the City of Kalamunda.
	8.2.3 Identify areas where street trees have not yet been planted in accordance with an approved structure plan or development application, and ensure compliance. Adopted LDP, or Structure plans include: • U2 ODP High Wycombe • Karingal Green • Lot 399 Sorensen Road • Cell 9 Wattle Grove Landscape Masterplan • Dundas Detailed Area Plan – Mixed Business Site. Lot 121 Worrell Ave, High Wycombe	**Priority:** High **Timeframe:** 1-2 years **Partners: Indicator:** Street trees are planted in accordance with the approved plan and maintained for a minimum period of 3 years and thereafter to the satisfaction of the City of Kalamunda.

	8.2.4 Prepare a local planning policy to address retention of significant trees on development sites.	**Priority:** High **Timeframe:** 2 years **Partners:** WAPC **Indicator:** Decision made whether to adopt a planning policy addressing significant trees on development sites.
	8.2.5 Investigate the implementation of a Natural Heritage Register as part of a Scheme amendment or local planning policy to register trees or local natural areas deemed to have a significant environmental, cultural or heritage value to the local community.	**Priority:** High **Timeframe:** 2 years **Partners:** WAPC/Minister for Planning **Indicator:** Decision made to determine the final scheme amendment or policy.
	8.2.6 Amend the Firebreak Notice to identify maximum widths and clearing parameters for the installations of firebreaks, to prevent unnecessary clearing of native vegetation. At the same time investigation into preparing an Information Sheet regarding clearing parameters for Asset Protection Zones can be undertaken and recommendations made.	**Priority:** High **Timeframe:** 1 year **Partners:** DFES **Indicator:** The Firebreak Notice is amended.
8.3 Protect vegetation outside of reserves, bush forever sites, or local natural areas for its ecological, aesthetic and amenity values.	8.3.1 Investigate a provision in the Local Planning Scheme which can require rehabilitation of land where an owner or occupier has caused or allowed land to be intensively cleared, managed or degraded resulting in adverse effects to adjoining or nearby land. The potential provision is to apply where environmental degradation has occurred as a result of non-compliance with a condition of planning	**Priority:** High **Timeframe:** 1 year **Partners:** WAPC/Minister for Planning **Indicator:** A decision made on the recommendations of the Local Natural Areas report.

	approval or in contravention of the Local Planning Scheme.	
	8.3.2 Prepare a report analysing the location and conservation or amenity value of existing local natural areas (LNA's- areas of vegetation worth conservation on private property). The report is to investigate opportunities to incentivise protection of LNA's through fiscal incentives, LPS3 provisions or a local planning policy and provide recommendations to Council.	**Priority:** Low **Timeframe:** 2-3 years **Partners:** Kalamunda Environmental Advisory Committee, Landowners, DBCA. **Indicator:** Council to review and provide a determination on the recommendations of the Local Natural Areas report.

4.9 Heritage

4.9.1 Indigenous Heritage

In June 2015, six identical Indigenous Land Use Agreements were formed across the South West by the Western Australian Government and, respectively, the Yued, Whadjuk People, Gnaala Karla Booja, Ballardong People, South West Boojarah, and Wagyl Kaip & Southern Noongar groups, and the South West Aboriginal Land and Sea Council.

In the City of Kalamunda the predominant group is the Whadjuk People. The City contains a 36 Aboriginal Heritage sites registered under the *Aboriginal Heritage Act 1972* including areas of cultural and mythological significance in addition to artefacts and locations where significant events occurred (refer Map 17 - Indigenous and Euopean Sites). There may be unlisted sites that are preserved under the Act regardless. Indigenous heritage is considered at the strategic planning stage when an area is identified for future development and taken into account by the assets maintenance team where applicable.

To increase knowledge and appreciation for local Indigenous heritage a report is to be prepared in accordance with Strategy 9.1 to gain understanding of site locations and procedures relating to development application referrals and recommendations.

4.9.2 Post European Heritage

In addition to the diverse array of registered Aboriginal Heritage Sites, cultural heritage places in Western Australia are recorded in many different heritage listings. Some of these listings give statutory protection to heritage places, through requirements for heritage-related approvals or referrals. Other listings are unofficial or quasi-official designations, often arising from local, community-based or thematic surveys.

The State Register provides statutory protection to preserve the State's cultural heritage. The State Register requires planning, building, demolitions and other applications affecting a place

in the State Register to be referred to the Heritage Council for advice. There are 17 places currently on the State's Register of Heritage Places located within the City of Kalamunda which are listed below and shown on Map 17: Indigenous and European Sites.

- Perth Observatory (WA State Govt Observatory)
- Carmel Primary School (fmr) (Heidelberg School, Scouts Meeting Hall)
- Victoria Reservoir (fmr)
- Weston Grave
- Statham's Quarry (City of Perth's Quarry, Darlington Range Quarries)
- Floriculture Nursery (fmr) (Asphodel, House and former Floriculture Nursery)
- Stirk Cottage
- Kalamunda Hotel
- Old Kalamunda Hotel
- Kalamunda Hotel and Original Kalamunda Hotel
- Lesmurdie House
- Paxwold Girl Guides Camp (Paxwold Girl Guides Association Memorial, Training Centre)
- St Swithun's Church
- St Brigid's College (St Andrews Convalescent Home, St Andrews School)
- Lesmurdie Group
- Barton's Mills Prison (ruins)
- Levi Wallis Cottage

Further recognition of local heritage is provided by the current Municipal Inventory (now called a Local Heritage Survey under the Heritage Act 2018) which lists 169 places and is the City's record of local heritage but does not provide statutory protection. Heritage places are recommended to be preserved or, if they can't, to be photographically recorded prior to demolition.

Further statutory protection could be provided to sites of local heritage significance through the development of a Heritage List for inclusion in the LPS3. It is unnecessary to include all sites listed on the Local Heritage Survey as this would create excessive restriction and requirements; it is more appropriate to only include the most significant sites on this list. This allows for the Local Heritage Survey to act as a general survey and store of information while the List records places that need the protection of additional planning controls. A review of the Local Heritage Survey would identify those sites (if any) requiring additional controls and also ensure all sites listed on the State Register are included.

4.9.3 Post European Environmental Heritage

A key area identified for environmental planning protection is the avenue of lemon scented gums (*Corymbia citriodora*) near the intersection of Lewis Road and Welshpool Road East, which further to public advocacy are requested to be given heritage value and protected from future development. Retention of the trees has been secured in the short-term, however, further heritage protection for these trees should be pursued to help ensure their long-term preservation. As the City does not have a heritage list the following options are available to protect the trees:

1. Create a heritage list and add the trees
2. Create a heritage area and prepare a Local Planning Policy relating to the trees
3. Create a Special Control Area through an amendment to the Local Planning Scheme

Each of these options propose differing levels of statutory protection however ultimately the Council will pass a resolution in accordance with Strategy 9.3 to determine how the trees will

be protected in the future. As part of Strategy 9.2 the City will also undertake future investigations into the development of a Significant Tree Register, as part of a Scheme amendment or local planning policy, to protect and preserve trees with significant environmental, cultural or heritage value to the local community.

Table 15. Indigenous Heritage and Post-Eurpoean Heritage Objectives

Aboriginal and Post-European Heritage - Objective		
9. Identify and protect natural areas of Aboriginal and Post-European settlement cultural significance and local heritage value.		
Strategy	**Action**	**Timeline**
9.1 Map sites of Aboriginal heritage significance that need to be considered in subdivision and development of urban and rural land	9.1.1 Review and prepare a report for sites of Aboriginal heritage significance and any recommended changes to zoning of such sites to ensure appropriate protection and preservation.	**Priority:** Medium **Timeframe:** 1-2 years **Partners:** DPLH. **Indicator:** Mapping updated to show sites of Aboriginal heritage significance and actions of the report implemented.
9.2 Provide increased statutory protection to locally significant heritage sites	9.2.1 Review Municipal Inventory (Local Heritage Survey) and if appropriate create a Heritage List for inclusion in Local Planning Scheme No.3, in particular considering the incorporation of significant natural assets.	**Priority:** Medium **Timeframe:** 1-2 years **Partners:** DPLH, Heritage Council **Indicator:** Updated Local heritage Survey, creation of Heritage List, amendment to Local Planning Scheme
9.3 Protect the avenue of trees near the intersection of Lewis Road and Welshpool Road East from future development.	9.3.1 Prepare a report for Council outlining the options to give the trees statutory protection.	**Priority:** High **Timeframe:** 1-3 months **Partners:** Western Australia Heritage Council **Indicator:** Council to pass a resolution to protect trees from future development.

5.0 STRATEGIES AND ACTIONS SUMMARY

Major Projects - Objective		
1. To reduce the levels of consumption and waste for improved environmental outcomes		
Strategy	**Action**	**Timeline**
1.1 Reduce waste and improve efficiency in the planning approvals process.	1.1.1 Implement online building and planning approval processes to reduce paper waste, provide transparency, and streamline approvals.	**Priority:** Medium **Timeframe:** 2-3 years **Partners:** WALGA **Indicator:** Online approvals and tracking are utilised for all development applications.
Basic Raw Materials - Objective		
2. To manage natural resources, land use, and development proposals to maintain the health and viability of geological soil systems in coordination with other ecosystem functions.		
Strategy	**Action**	**Timeline**
2.1 Facilitate the extraction of basic raw materials, subject to appropriate safeguards to minimise any adverse impact on adjacent property or on the natural environmental resource.	2.1.1 Identify and map Basic Raw Materials areas which may be subject to future extraction and ensure current zoning is consistent with resource protection.	**Priority:** Low **Timeframe:** Ongoing **Partners:** Department of Mines, Industry Regulation and Safety **Indicator:** As necessary update scheme map to show amended zoning of identified Basic Raw Materials protection areas.
Energy Production - Objective		
3. To support clean energy production without adversely impacting on established residential, conservation or agricultural regions.		
Strategy	**Action**	**Timeline**
3.1 Improve and promote eco-friendly built form outcomes to reduce the footprint of urban development on the natural environment.	3.1.1 Investigate the preparation of a planning policy and, if necessary Scheme provisions, to promote and provide incentives for energy efficient built form and renewable energy options. As part of investigations consider methods to incentivise renewable energy for commercial and industrial developments.	**Priority:** Low **Timeframe:** 1-2 years **Partners:** Synergy, Western Power, Infrastructure WA, Federal Department of Environment and Energy **Indicator:** Decision made to implement a local planning policy identifying criteria and objectives for implementation of renewable energy infrastructure within urban and rural zones.

	3.1.2 Investigate the preparation of a planning policy and, if necessary Scheme provisions, to address the large scale commercial generation of renewable energy eg; by way of solar or wind power; generally supportive of such proposals except where there are overwhelming amenity, safety or environmental concerns with a particular proposal.	**Priority:** Low **Timeframe:** 1-3 years **Partners:** Synergy, Western Power, Infrastructure WA, Federal Department of Environment and Energy **Indicator:** Recommendation made regarding local planning policy identifying criteria and objectives for implementation of renewable energy infrastructure within urban and rural zones.
	3.1.3 Investigate the potential for renewable energy project opportunities in the City.	**Priority:** Low **Timeframe:** 1-3 years **Partners:** Synergy, Western Power, Infrastructure WA, Federal Department of Environment and Energy **Indicator:** Recommendation made regarding sites which provide an opportunity to facilitate a renewable energy facility.
Acid Sulfate Soils - Objective		
4. To guide and manage development appropriate to the presence of acid sulfate soils.		
Strategy	**Action**	**Timeline**
4.1 Identify and map the presence of acid sulfate soils	4.1.1 Require management of acid sulfate soils as part of ongoing land development	**Priority:** Medium **Timeframe:** Ongoing **Partners:** DWER **Indicator:** Intramaps updated to show a warning where properties may be subject to exposing of Acid Sulfate Soils.
Soil and Geology - Objective		
5. To guide and manage development appropriate to the presence of contamination		
Strategy	**Action**	**Timeline**
5.1 Identify and map the presence of contaminated sites	5.1.1 Consider contaminated sites classification as appropriate when assessing development applications and to provide comment on subdivision proposals	**Priority:** Medium **Timeframe:** Ongoing **Partners:** DWER **Indicator:** Intramaps updated to show a warning

		where properties may be subject to contamination.
5.2 Identify, rehabilitate and manage contaminated sites for health and safety, and potential future development.	5.2.1 Undertake detailed site investigations with an intention to remediate Brand Road landfill site for sporting fields as part of the Forrestfield North development.	**Priority:** Medium **Timeframe:** 1-2 years **Partners:** Strategic planning **Indicator:** Progress on investigations.
Water - Objective		
6. To support water sensitive urban design initiatives and streamline administrative processes relating to key waterways, public drinking water source areas, and water catchment areas		
Strategy	**Action**	**Timeline**
6.1 Protect and enhance waterways, wetlands and the groundwater and ensure sustainable use and management of water resources.	6.1.1 Develop a local planning policy for waterways, flood prone areas (the floodway and flood fringe) and wetlands to protect the environmental value of the waterbody and provide parameters for development in susceptible areas. The local planning policy to include guidelines for management of stormwater prior to discharge into waterways, wetland areas or flood prone areas as well as establish minimum buffers. Stormwater management is to have due regard to the Department of Water and Environmental Regulation's Stormwater Management Manual for Western Australia and Decision Process for Stormwater Management in WA, DBCA's Policy 49 – Planning for Stormwater Management Affecting the Swan Canning Development Control Area and Water Sensitive Urban Design principles.	**Priority:** High **Timeframe:** 1-2 years **Partners:** Department of Water and Environmental Regulation, Environmental Services **Indicator:** Decision made to implement Flood Prone Areas Policy and/or recommend referral to the WAPC for endorsement.

6.2 Investigate and develop opportunities to implement efficiencies in the City's groundwater management, stormwater aquifer recharge, and use.	6.2.1 Council to determine an amendment to the Local Planning Scheme map to rezone PDWSA's to be consistent with MRS water catchment zoning (with agreement from DWER and WAPC), and intramaps to be updated to reflect the changes.	**Priority:** Medium **Timeframe:** 1-2 years **Partners:** Department of Water and Environmental Regulation, WaterCorp, WAPC **Indicator:** Recommendations finalised and necessary amendments made to the Local Planning Scheme map.
6.3 Utilise Managed Aquifer Recharge to secure sustainable water irrigation supply	6.3.1 Undertake investigations into the feasibility of a second MAR site within the City.	**Priority:** Low **Timeframe:** 2-4 years **Partners:** Department of Water and Environmental Regulation and WaterCorp **Indicator:** Preparation of the feasibility investigation.
6.4 Promote sustainable catchment management, based on the need to protect the quality of surface and groundwater from intensification of development, and provide equitable access to water resources for productive rural purposes.	6.4.1 Prepare a local planning policy outlining criteria to manage compatibility between rural and agri-tourism developments, taking into consideration protection of identified priority agricultural areas, rural conservation zones, protection of water catchment areas, PDWSA's, and watercourse hierarchy buffers	**Priority:** Medium **Timeframe:** 1-2 years **Partners:** Department of Water and Environmental Regulation, WaterCorp, WAPC **Indicator:** Council adopts a local planning policy to guide intensity of agri-tourism development in rural areas when located in a water catchment or PDWS area.
Bushfire - Objective		
7. To preserve, enhance, connect and rehabilitate natural areas and protect biodiversity values.		
Strategy	**Action**	**Timeline**
7.1 Where there is a conflict between bushfire guidelines and existing biodiversity values provide appropriate design alternatives to maintain effective ecosystem functions and resident safety.	7.2.1 Develop criteria within a vegetation protection local planning policy to outline performance objectives where biodiversity is seen to conflict with bushfire management requirements, with regard to State Planning Policy and guidelines.	**Priority:** High **Timeframe:** 1-2 years **Partners:** DFES. WAPC **Indicator:** Bushfire and biodiversity criteria incorporated as part of a vegetation protection policy.
7.2 Review the Biodiversity Strategy to consider any	7.3.1 Prepare an updated Local Biodiversity Strategy to	**Priority:** High **Timeframe:** 1-2 years

conflicts between biodiversity protection and the new bushfire requirements.	assess risk to biodiversity through implementation of the bushfire regulations and determine appropriate planning mechanisms for balancing biodiversity protection and protection of life and property.	**Partners:** DFES. WAPC **Indicator:** Local Biodiversity Strategy updated and implemented.
Biodiversity - Objective		
8. To establish a sustainable urban environment.		
Strategy	**Action**	**Timeline**
8.1 Identify opportunities for linkages between existing green space	8.1.1 A Green Links Masterplan is to be prepared in conjunction with the Street Tree Masterplan and develop actions to improve linkages between existing nature reserves, POS, road reserves and local natural areas (LNA's).	**Priority:** High **Timeframe:** 1-2 years **Partners:** DBCA **Indicator:** The Green Links Masterplan and a staged planting schedule is implemented and periodically reviewed and improved.
	8.1.2 As part of the Green Links Masterplan investigate opportunities to incentivise residents to plant verges with native gardens to improve plant species diversity and habitat for local fauna. This includes: • Promoting native verge planting as part of the 'Plants for Residents' program. • Developing information brochures for residents within an identified Green Link and encouraging their participation and management of the verge. • Invite residents to participate in local street tree planting working bees to promote a sense of ownership and pride of place.	**Priority:** Medium **Timeframe:** 1-2 years **Partners:** DBCA **Indicator:** As part of the development and implementation of the Green Links Masterplan undertake community engagement to provide information and encourage residents to increase native planting on the verge.

8.2 Improve urban tree canopy cover to address urban heat island effect, WSUD principles and biodiversity linkages	8.2.1 Develop a Street Tree Masterplan, which analyses, identifies, and prioritises street tree plantings to improve Urban Forest canopy cover in conjunction with a Green Links Masterplan by the year 2020.	**Priority:** High **Timeframe:** 1-2 years **Partners: Indicator:** Street Tree Masterplan reviewed by Council and implemented to inform public plantings within the Green Links Masterplan.
	8.2.2 Develop a Street Tree Masterplan which incorporates a staged planting program targeting key high risk areas first. The following areas were identified by 202020 Vision as being an opportunity for greening, which can be used as a basis for further investigation: • Corner of Abernethy Road and Kalamunda Road – commercial park home and industrial land uses. The border of City of Swan. • Corner of Reynolds Road and Tourmaline Gardens – a residential area currently R15 identified to have a Dual Density zone of R20/R30 • Corner of Arthur Road and Merlin Way – residential R20 area in Wattle Grove.	**Priority:** High **Timeframe:** 1-2 years **Partners:** **Indicator:** Street Tree Masterplan incorporating staged planting programs reviewed by Council and actioned. Trees planted in accordance with the staged planting program to the satisfaction of the City of Kalamunda.
	8.2.3 Identify areas where street trees have not yet been planted in accordance with an approved structure plan or development application, and ensure compliance. Adopted LDP, or Structure plans include: • U2 ODP High Wycombe • Karingal Green • Lot 399 Sorensen Road	**Priority:** High **Timeframe:** 1-2 years **Partners: Indicator:** Street trees are planted in accordance with the approved plan and maintained for a minimum period of 3 years and thereafter to the satisfaction of the City of Kalamunda.

	• Cell 9 Wattle Grove Landscape Masterplan • Dundas Detailed Area Plan – Mixed Business Site. Lot 121 Worrell Ave, High Wycombe.	
	8.2.4 Prepare a local planning policy to address retention of significant trees on development sites.	**Priority:** High **Timeframe:** 2 years **Partners:** WAPC **Indicator:** Decision made whether to adopt a planning policy addressing significant trees on development sites.
	8.2.5 Investigate the implementation of a Natural Heritage Register as part of a Scheme amendment or local planning policy to register trees or local natural areas deemed to have a significant environmental, cultural or heritage value to the local community.	**Priority:** High **Timeframe:** 2 years **Partners:** WAPC/Minister for Planning **Indicator:** Decision made to determine the final scheme amendment or policy.
	8.2.6 Amend the Firebreak Notice to identify maximum widths and clearing parameters for the installations of firebreaks, to prevent unnecessary clearing of native vegetation. At the same time investigate the preparation of an Information Sheet regarding clearing parameters for Asset Protection Zones and recommendations made.	**Priority:** High **Timeframe:** 1 year **Partners:** DFES **Indicator:** The Firebreak Notice is amended.
8.3 Protect vegetation outside of reserves, bush forever sites, or local natural areas for its ecological, aesthetic and amenity values.	8.3.1 Investigate a provision in the Local Planning Scheme which can require rehabilitation of land where an owner or occupier has caused or allowed land to be intensively cleared, managed or degraded resulting in adverse effects to adjoining or nearby land. The potential provision is to apply where	**Priority:** High **Timeframe:** 1 year **Partners:** WAPC/Minister for Planning **Indicator:** A decision made on the recommendations of the Local Natural Areas report.

	environmental degradation has occurred as a result of non-compliance with a condition of planning approval or in contravention of the Local Planning Scheme	
	8.3.2 Prepare a report analysing the location and conservation or amenity value of existing local natural areas (LNA's- areas of vegetation worth conservation on private property). The report is to investigate opportunities to incentivise protection of LNA's through fiscal incentives, LPS3 provisions or a local planning policy and provide recommendations to Council.	**Priority:** Low **Timeframe:** 2-3 years **Partners:** Kalamunda Environmental Advisory Committee, Landowners, DBCA. **Indicator:** Council to review and provide a determination on the recommendations of the Local Natural Areas report.
Aboriginal and Post-European Heritage - Objective		
9. Identify and protect natural areas of Aboriginal and Post-European settlement cultural significance and local heritage value.		
Strategy	**Action**	**Timeline**
9.1 Map sites of Aboriginal heritage significance that need to be considered in subdivision and development of urban and rural land	9.1.1 Review and prepare a report for sites of Aboriginal heritage significance and any recommended changes to zoning of such sites to ensure appropriate protection and preservation.	**Priority:** Medium **Timeframe:** 1-2 years **Partners:** DPLH. **Indicator:** Mapping updated to show sites of Aboriginal heritage significance and actions of the report implemented.
9.2 Provide increased statutory protection to locally significant heritage sites	9.2.1 Review Municipal Inventory and if appropriate create a Heritage List for inclusion in Local Planning Scheme No.3, in particular considering the incorporation of significant natural assets.	**Priority:** Medium **Timeframe:** 1-2 years **Partners:** DPLH, Heritage Council **Indicator:** Updated Municipal Inventory, creation of Heritage List, amendment to Local Planning Scheme
9.3 Protect the avenue of trees near the intersection of Lewis Road and Welshpool Road East from future development.	9.3.1 Prepare a report for Council outlining the options to give the trees statutory protection.	**Priority:** High **Timeframe:** 1-3 months **Partners:** Western Australia Heritage Council **Indicator:** Council to pass a resolution to protect trees from future development.

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7.0 DISCLAIMER

The City of Kalamunda's Environmental Land Use Planning Strategy (Strategy) has been developed for the purpose of being a "point in time" document with respect to, amongst other things, facilitate and manage growth and changes to the natural environment and ongoing development.

Without limiting the purpose of the Strategy, the City does not represent, warrant, undertake or guarantee that the contents of this Strategy will lead ot any particular outcome or result and the City reserves its rights to amend, vary or remove any and/or all of the contents of this Strategy, at its sole discretion, from time to time.

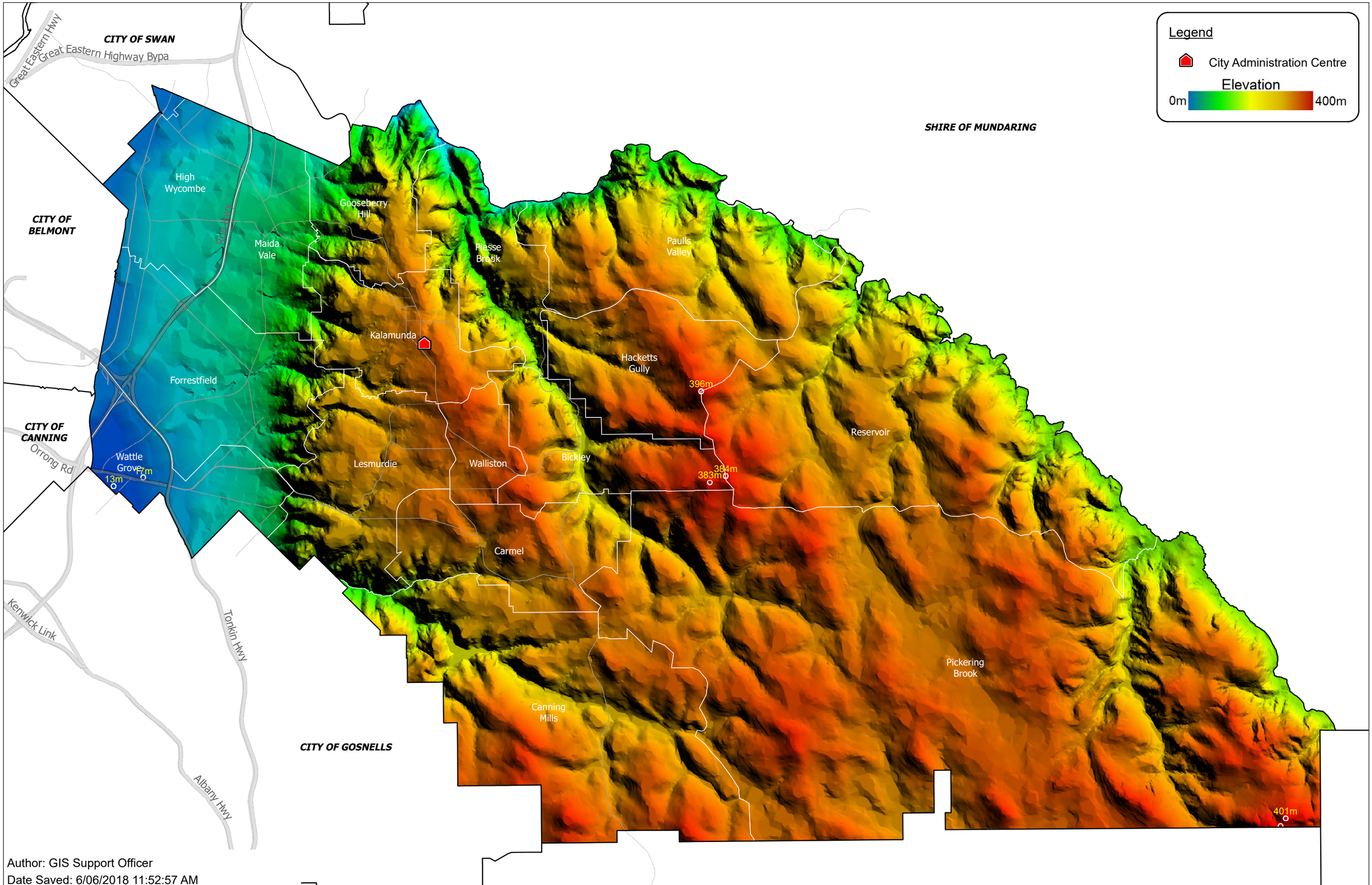
All areas contained within this Strategy are subject to further investigation by the City and any future use, direction, acquisition, transfer or development will be subject to consideration by Council, and/or the Department of Planning, Lands and Heritage.

The City shall not be liable for any losses that may result from any thirs parties use or relianc eon this document. Without limitation such losses shall include, but not be limited to, loss of profits, income, revenue, anticipated savings, contract expectation, commercial opportunities or goodwill.

The City shall not be liable for any reliance that any person, organisation, corporation, government authority, department, or entity of any kind, may place on the contents of this Strategy and the City does not guarantee the accuracy of the information herein.

This Strategy is based on City officer interpretation and the best information available to the City's officers at the point of time of the City's formulation.

7.1 Map 01: Topography



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Map 01: Topography

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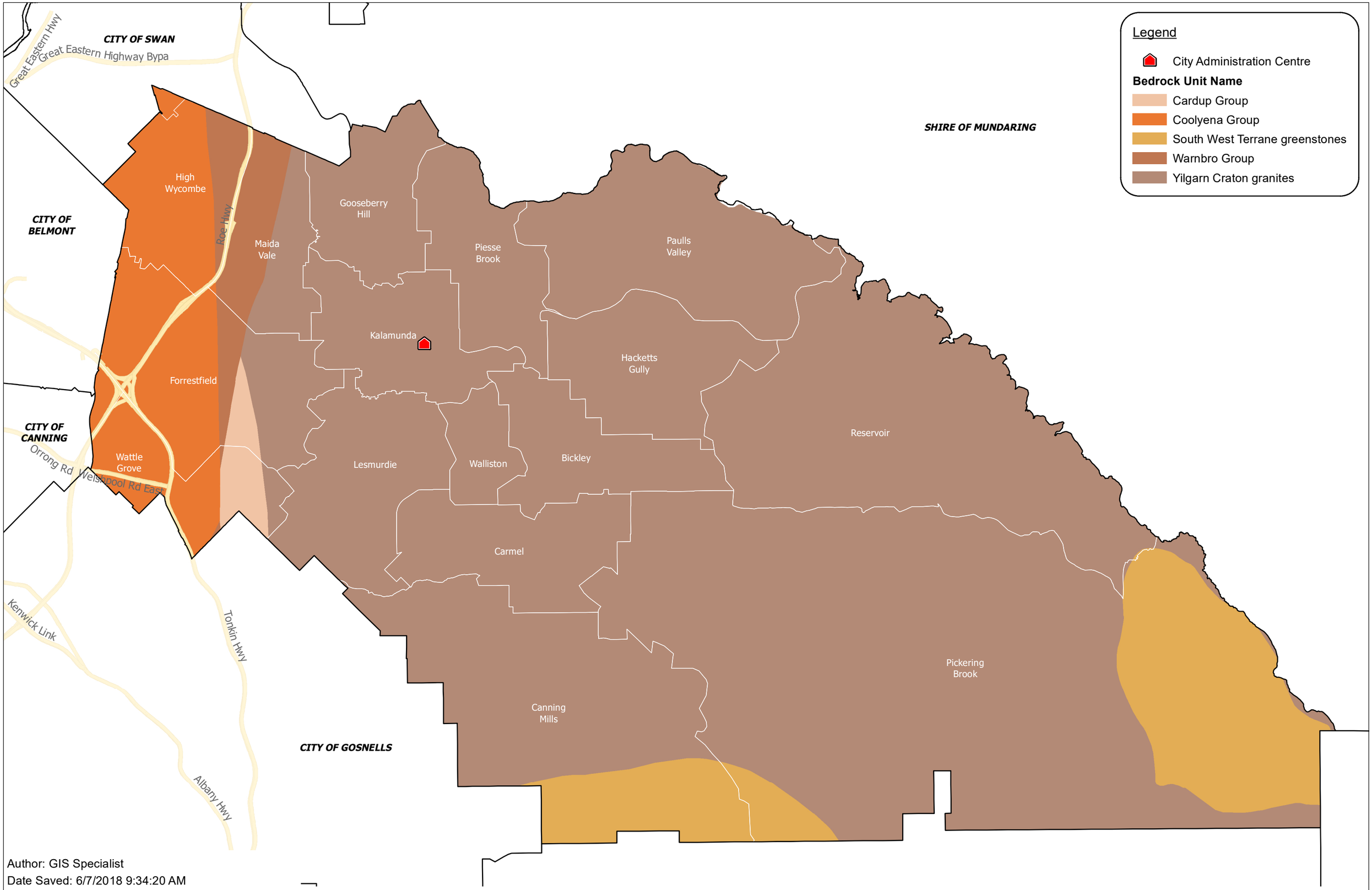
Scale at A3: 1:80,000

city of kalamunda

7.2 Map 02: Bedrock Geology



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Map 02: Bedrock Geology

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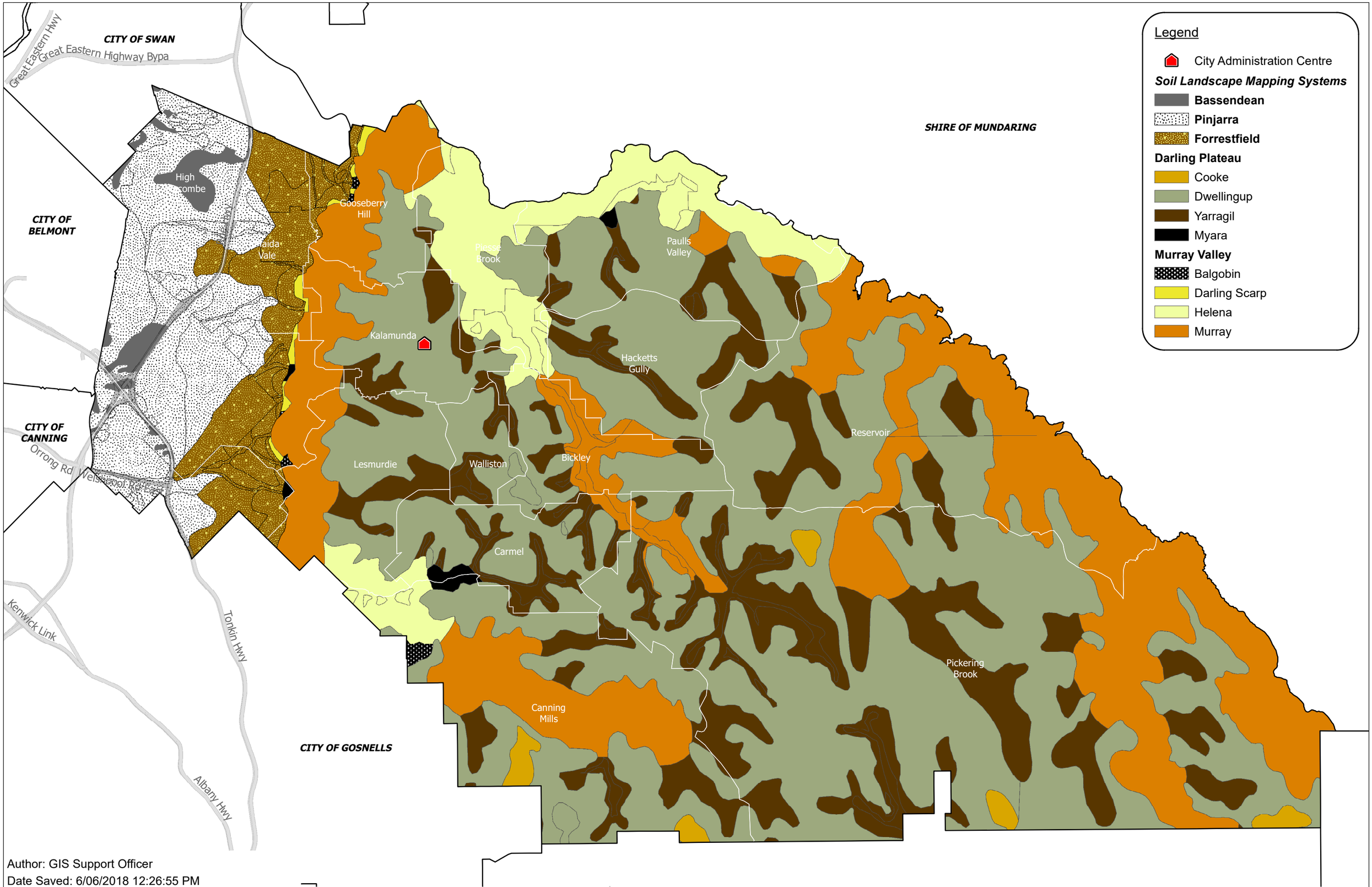
7.3 Map 03: Soil Complexes



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Map 03: Soil Complexes

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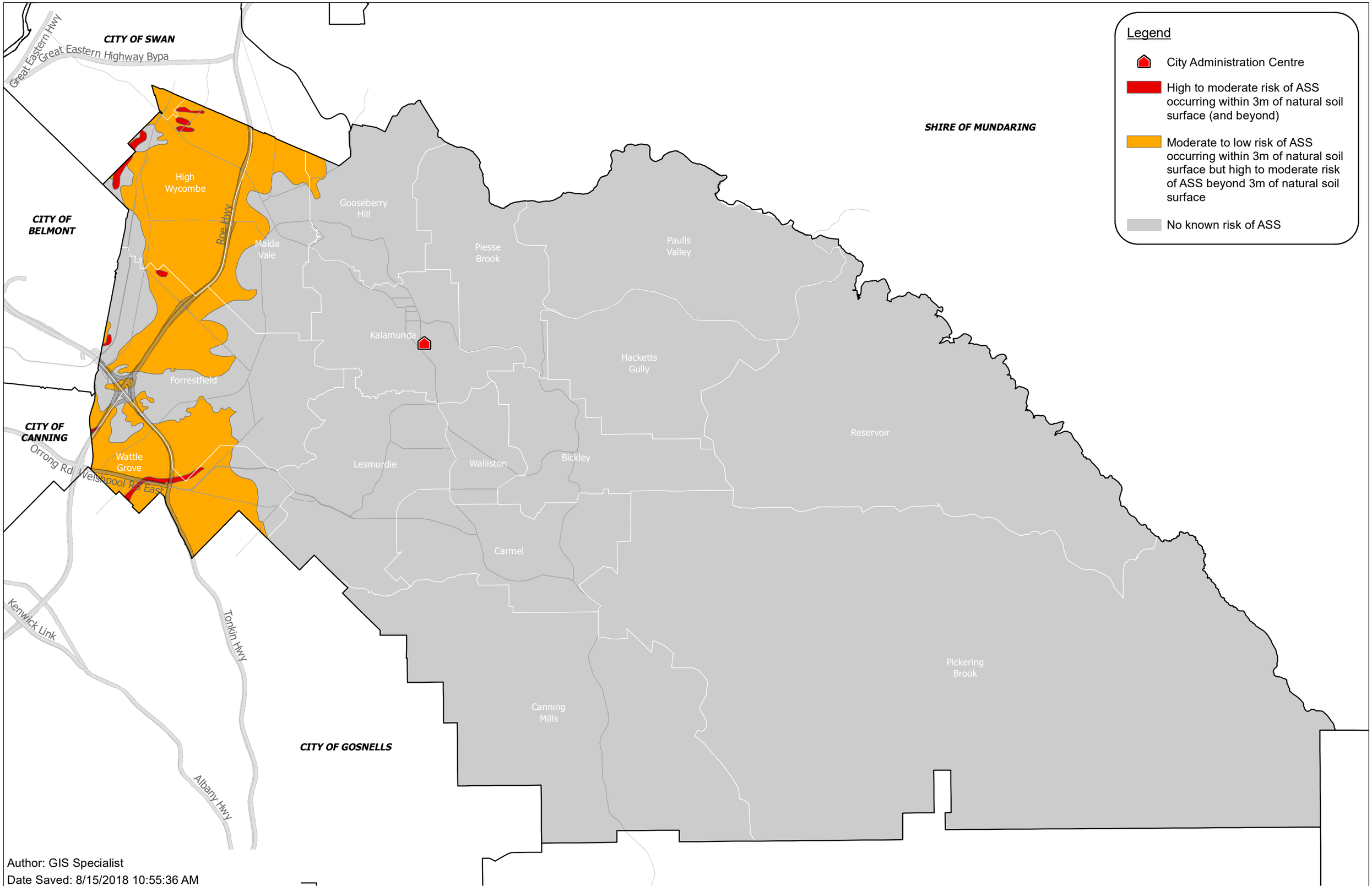
7.4 Map 04: Acid Sulfate Soils



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Map 04: Acid Sulphate Soils Risk Map

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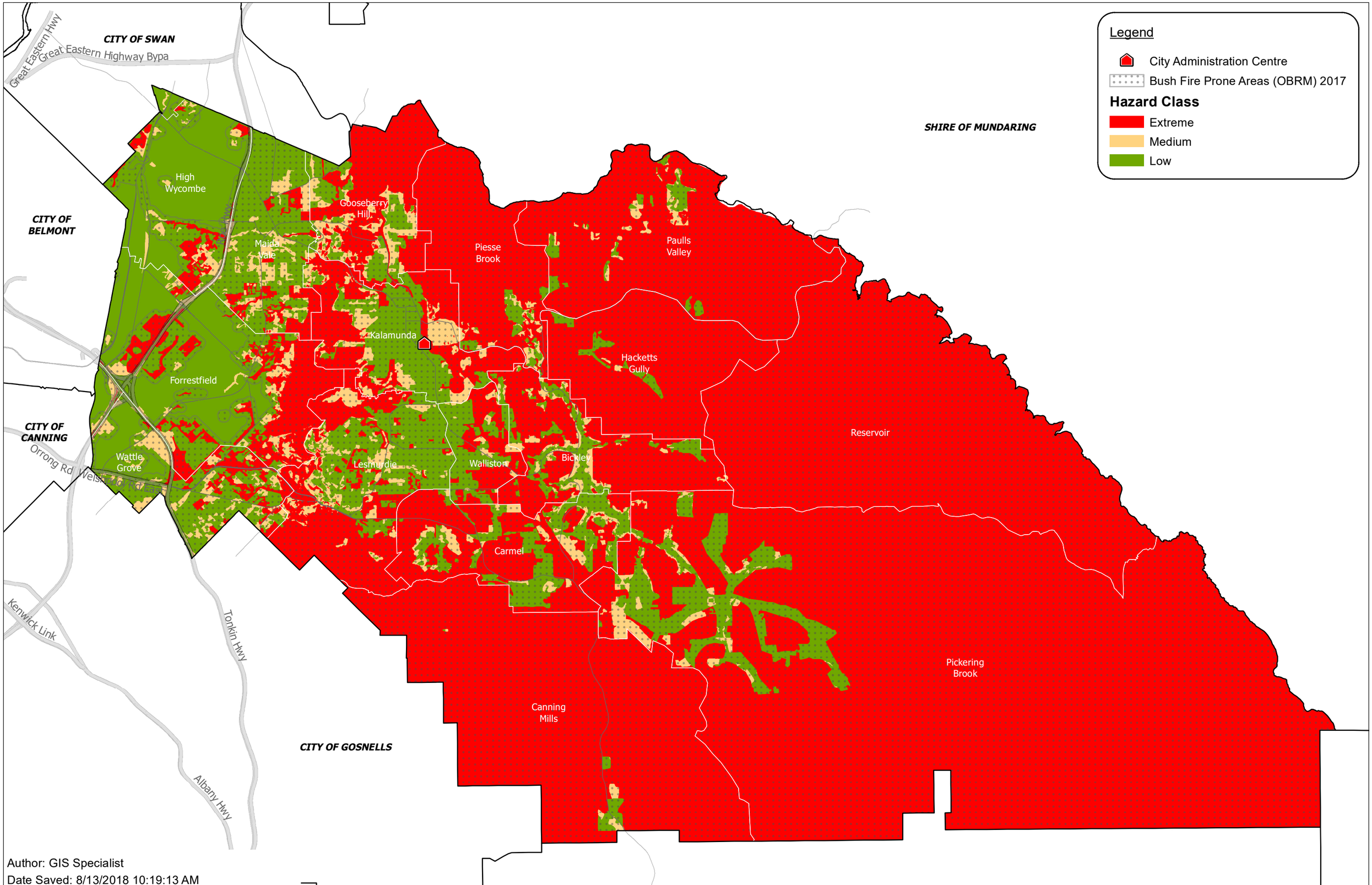
7.5 Map 05: Bushfire Hazard Risk Contour Map



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Map 05: Bushfire Hazard Risk Contour Map

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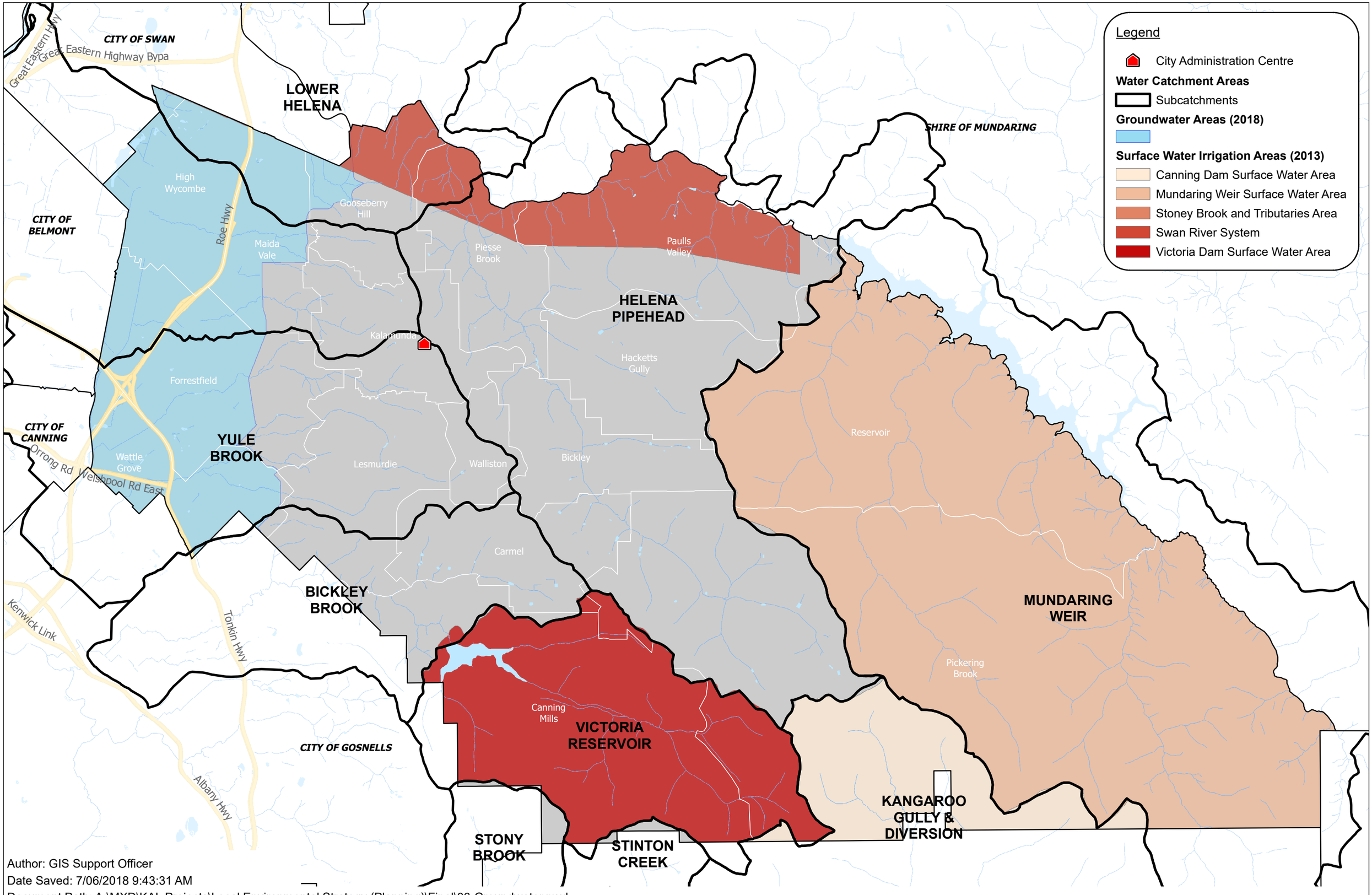
7.6 Map 06: Groundwater and Surface Water



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Map 06: Groundwater and Surface Water

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7.7 Map 07: Wetlands

The Geomorphic Wetlands dataset describes the wetlands of the Swan Coastal Plain representing two main aspects, physical classification and environmental evaluation.

The Development Control Area includes the waters of the Swan and Canning rivers and adjoining parks and recreation reservations. The process for development approvals. in and around the rivers depends on the location of the proposed development with respect to the Development Control Area. The DCA boundary is a gazetted boundary.

Legend

- City Administration Centre
- Directory of Important Wetlands in Australia - Western Australia (DBCA-045)
- Swan Canning Development Control Area (DCA)
- Waterways

Geomorphic Wetlands

- Conservation
- Resource Enhancement
- Multiple Use

Swan Canning Estuary
CITY OF SWAN
Palmer
Barracks, Guildford
Great Eastern Highway Bypa
Great Eastern Hwy
High Wycombe
Roe Hwy
CITY OF BELMONT
Maida Vale
Gooseberry Hill
Piesse Brook
Paulls Valley
SHIRE OF MUNDARING
Perth Airport Woodland Swamps
Kalamunda
Hacketts Gully
Forrestfield
CITY OF CANNING
Wattle Grove
Lesmurdie
Walliston
Bickley
Reservoir
Welshpool Rd East
Burton Street Swamps
Tonkin Hwy
Carmel
Kenwick Link
Pickering Brook
Canning Mills
CITY OF GOSNELLS
Albany Hwy

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Map 07: Wetlands

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Scale at A3: 1:80,000

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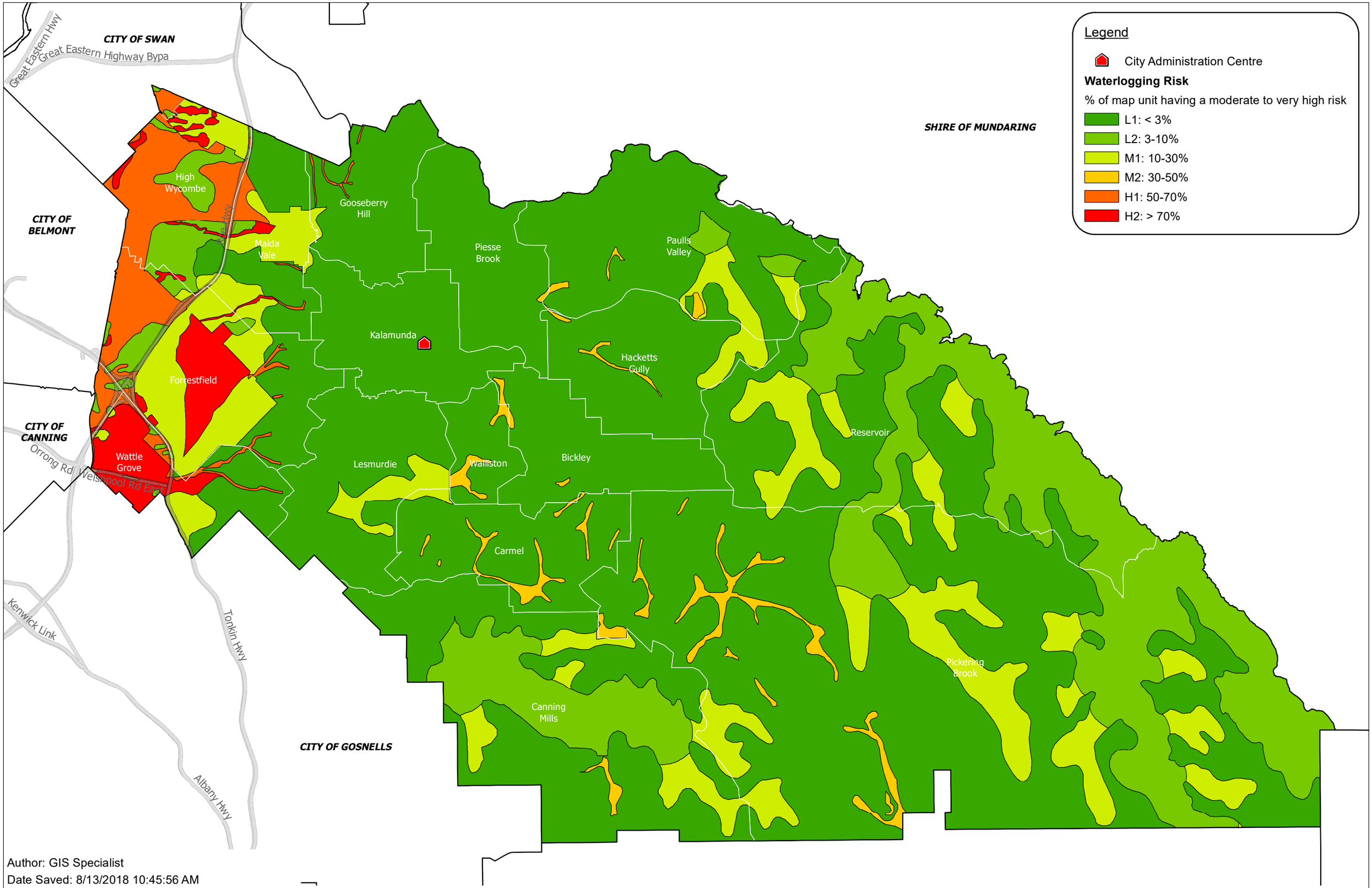
7.8 Map 08: Floodplains: Waterlogging Risk



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Map 08: Waterlogging Risk Areas

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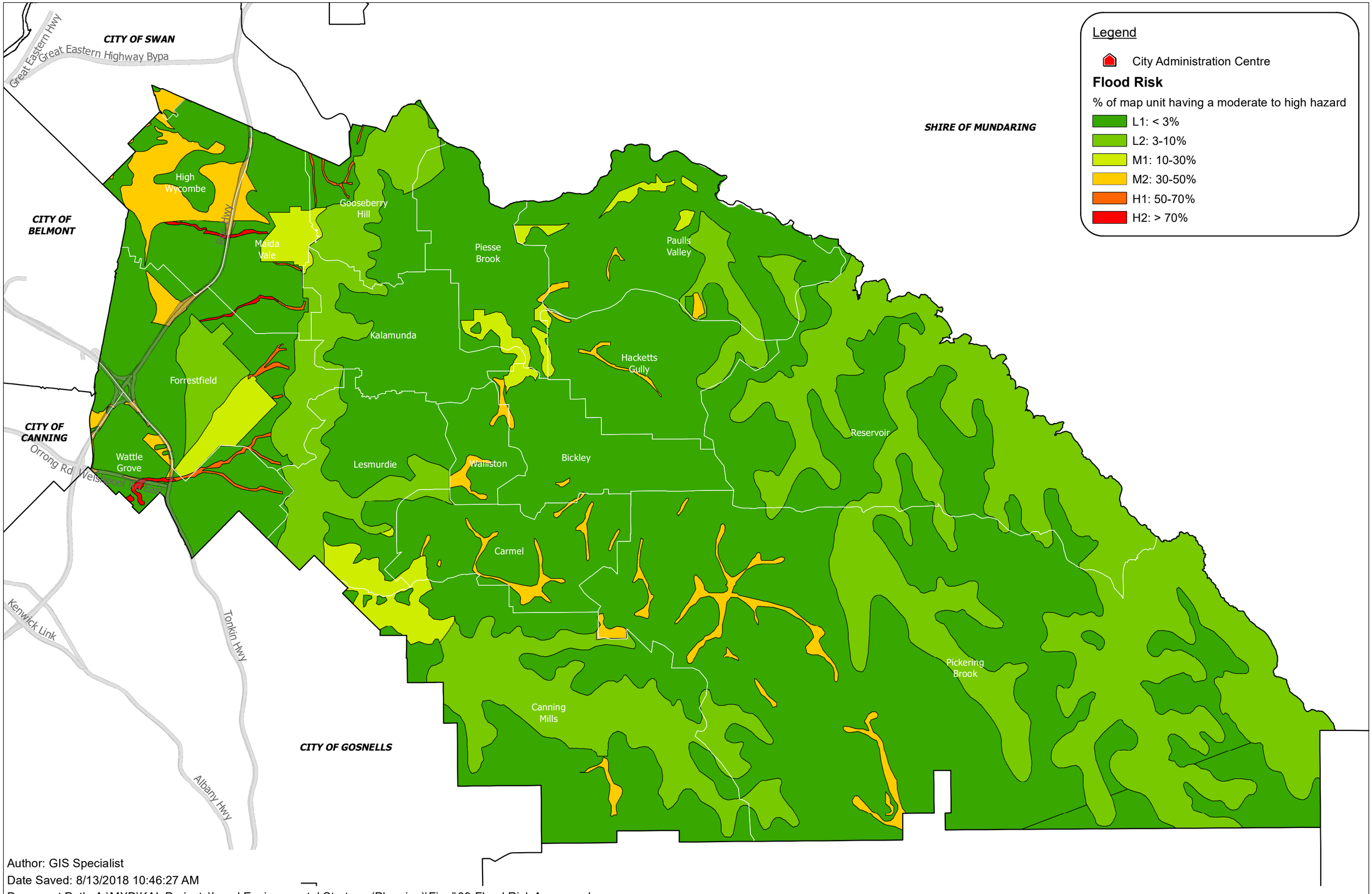
7.9 Map 09: Floodplains: Flood Risk



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Map 09: Flood Risk Areas

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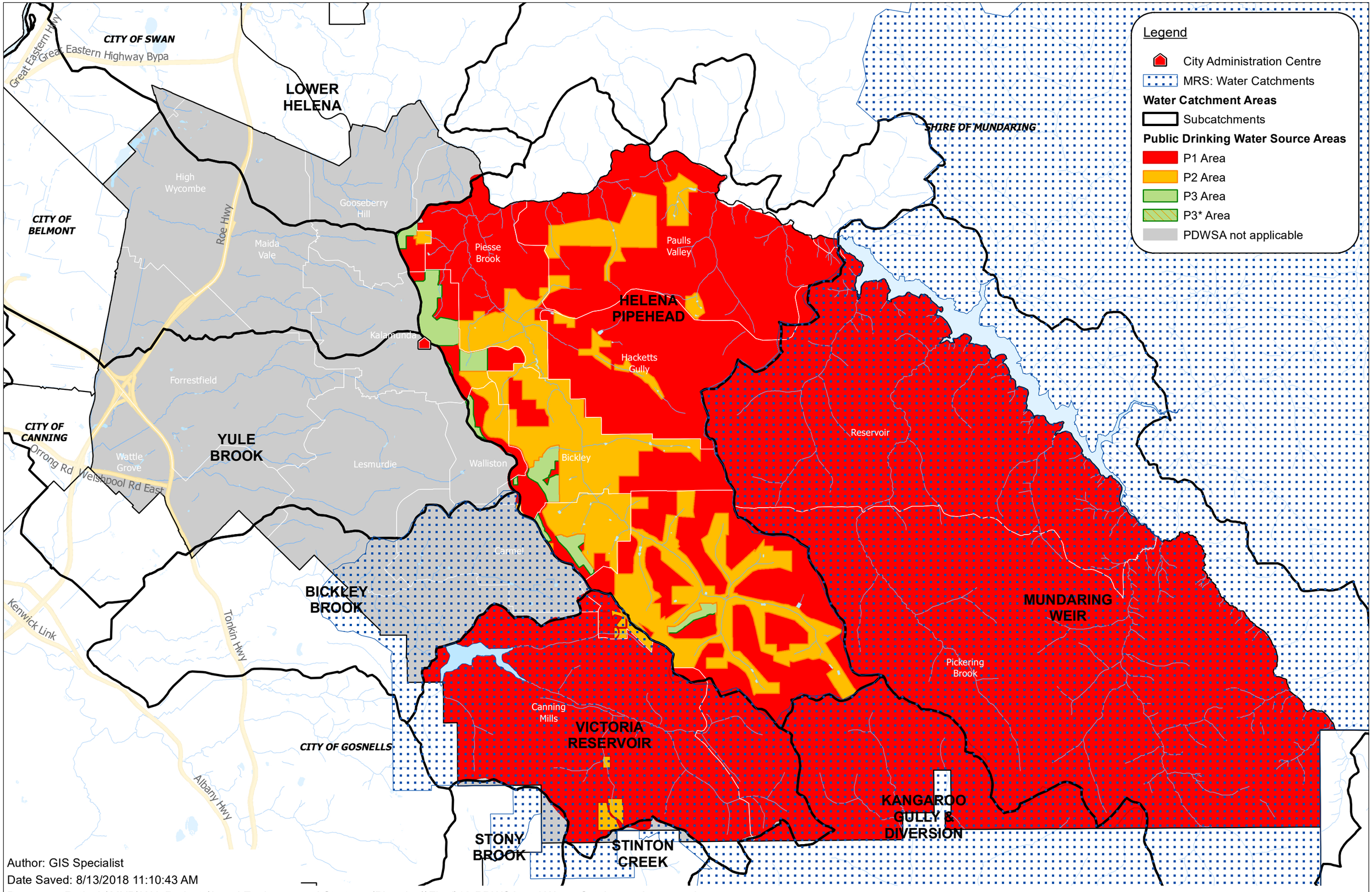
Scale at A3: 1:80,000

city of kalamunda

7.10 Map 10: Public Drinking Water Source Areas and Water Catchment Areas



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N W E S

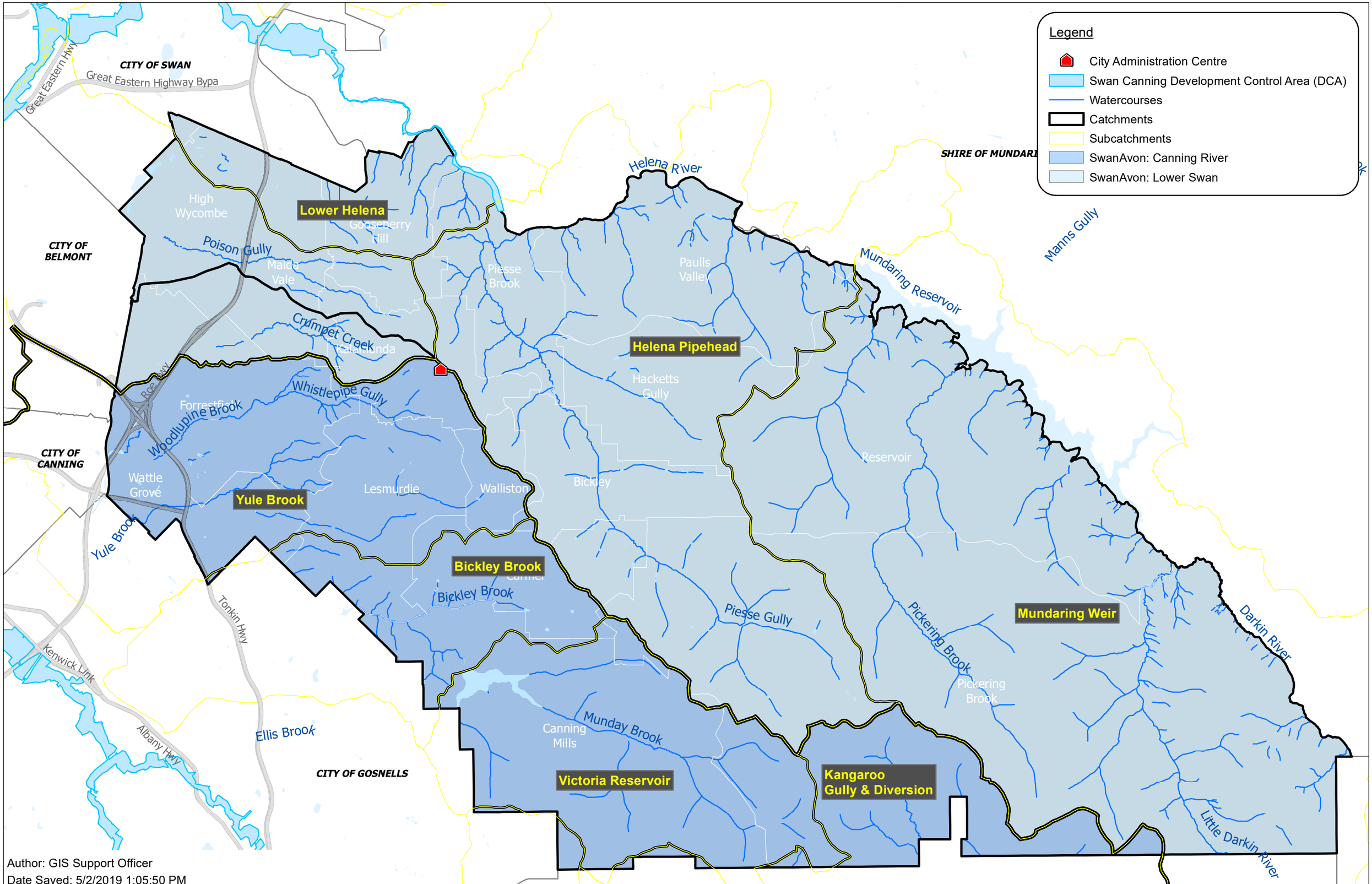
Map 10: Public Drinking Water Source Areas and Water Catchment Areas

0 1.25 2.5 5 Kilometers

Scale at A3: 1:80,000

city of kalamunda

7.11 Map 11: Waterways and Water Catchments



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Map 11: Waterways and Water Catchments

0 1.25 2.5 5 Kilometers

Scale at A3: 1:80,000

city of kalamunda

7.12 Map 12: Pre-European Vegetation

The pre-European vegetation mapping of Western Australia dataset is an output of a joint project between DAFWA and DEC.
It maps original natural vegetation presumed to have existed prior to European settlement in Western Australia.
Descriptions of each of the vegetation types can be found in the accompanying memoir.

Legend

3 City Administration Centre

Pre-European Vegetation

- Forest
- Low forest, woodland or low woodland with scattered trees
- Woodland / Low woodland / Low forest or Woodland
- Woodland southwest

CITY OF SWAN
Great Eastern Hwy
Great Eastern Highway Bypa
SHIRE OF MU
CITY OF BELMONT
Roe Hwy
High Wycombe
Maida Vale
Gooseberry Hill
Piesse Brook
Paulls Valley
Kalamunda
Hacketts Gully
Forrestfield
CITY OF CANNING
Orrong Rd
Welshpool Rd East
Wattle Grove
Lesmurdie
Walliston
Bickley
Reservoir
Carmel
Kenwick Link
Tonkin Hwy
Pickering Brook
Canning Mills
CITY OF GOSNELLS
Albany Hwy

Author: GIS Support Officer
Date Saved: 7/06/2018 12:45:24 PM
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Published as Beard, J. S., Beeston, G.R., Harvey, J.M., Hopkins, A. J. M. and Shepherd, D. P. 2013.
The vegetation of Western Australia at the 1:3,000,000 scale. Explanatory memoir.
Second edition. Conservation Science Western Australia 9: 1-152.

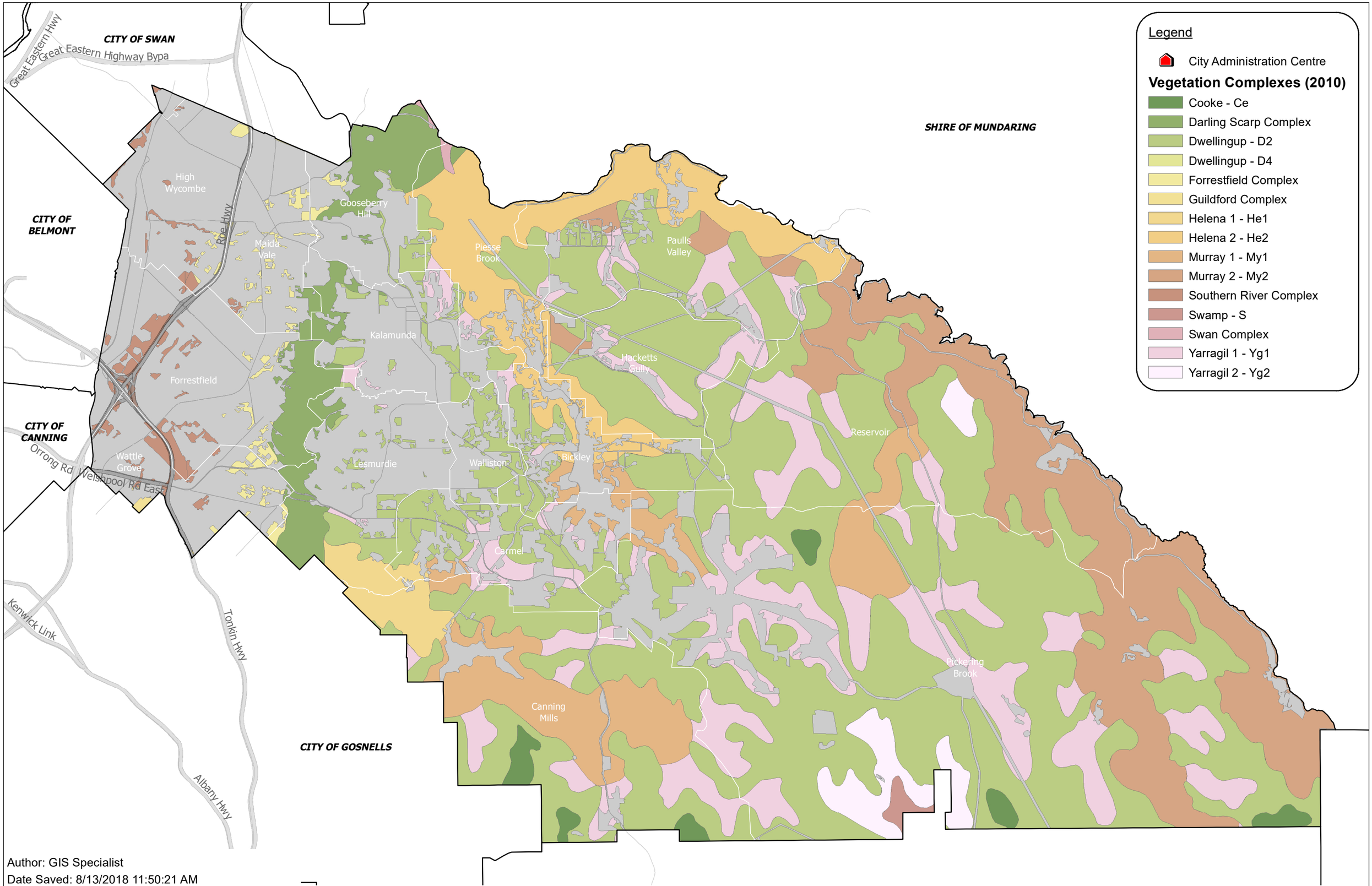
Map 12: Pre-European Vegetation

0 1.25 2.5 5 Kilometers

Scale at A3: 1:80,000

city of kalamunda

7.13 Map 13: Remnant Vegetation by Vegetation Complexes



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N W E S

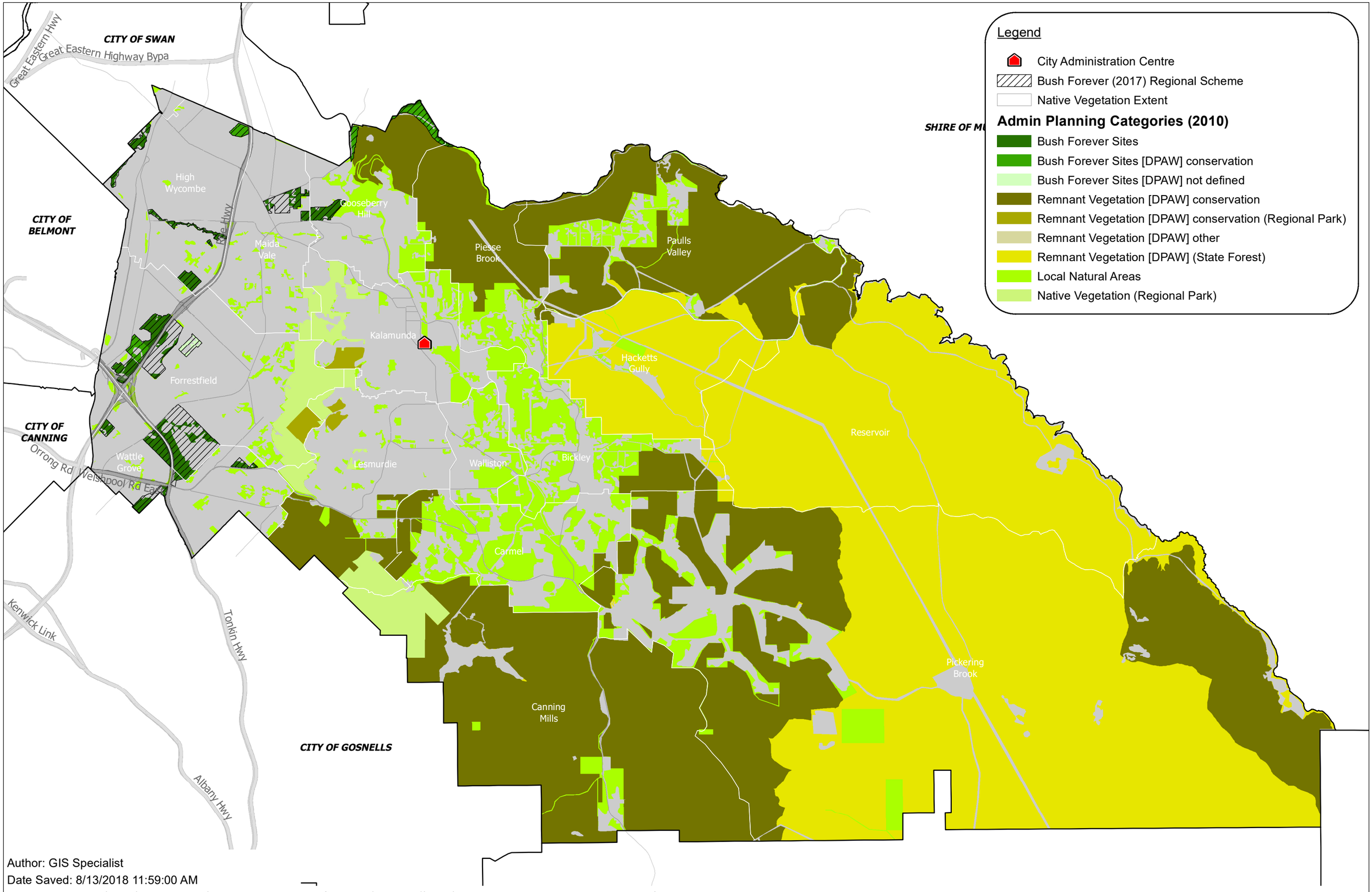
Map 13: Remnant Vegetation by Vegetation Complexes

0 1.25 2.5 5 Kilometers

Scale at A3: 1:80,000

city of kalamunda

7.14 Map 14: Remnant Vegetation by Planning Category



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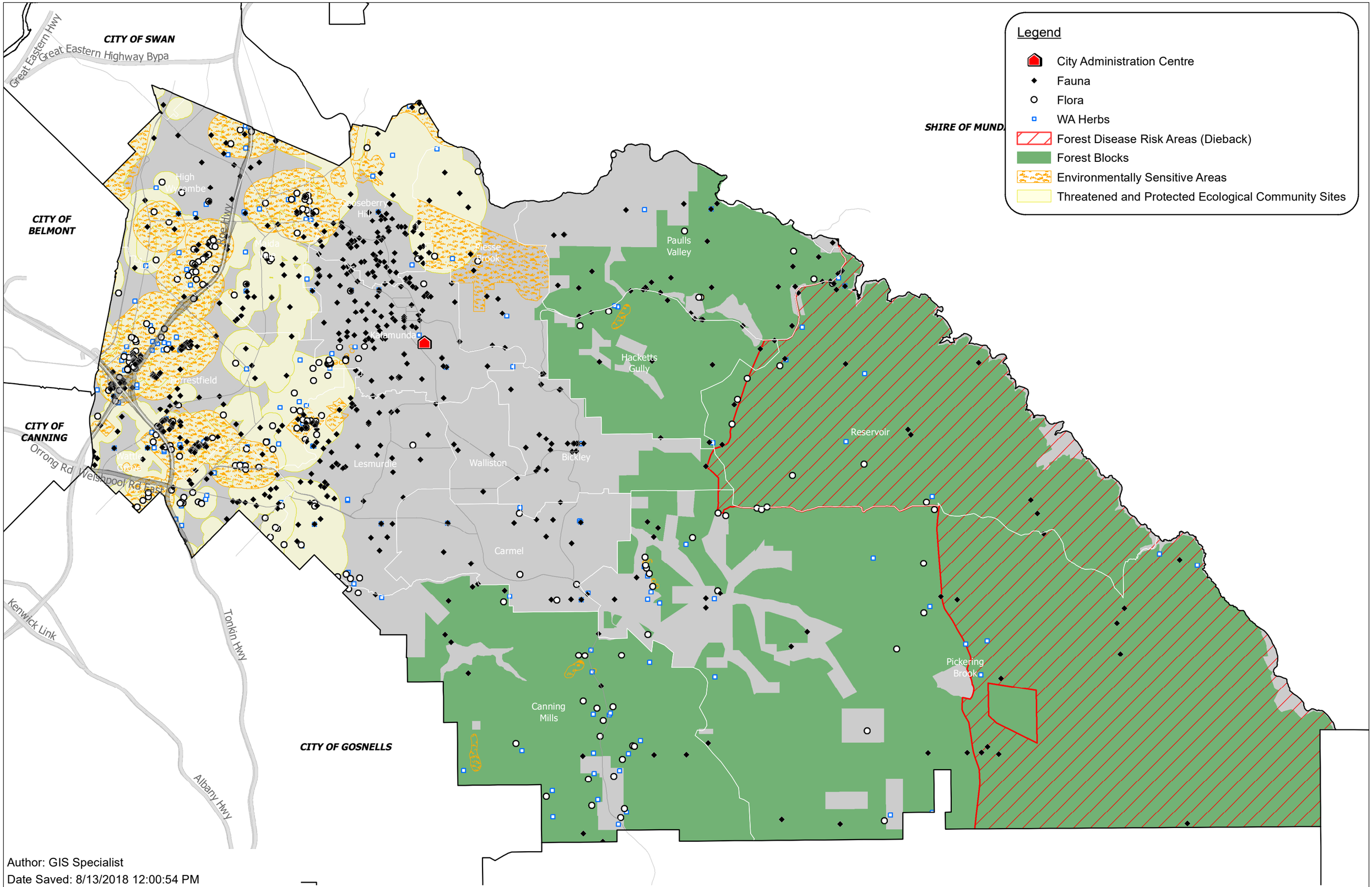
Map 14: Remnant Vegetation by Planning Category

Scale at A3: 1:80,000

0 1.25 2.5 5
Kilometers

city of kalamunda

7.15 Map 15: Protected Flora and Fauna Sites



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N W E S

Map 15: Protected Flora and Fauna Sites

0 1.25 2.5 5 Kilometers

Scale at A3: 1:80,000

city of kalamunda

7.16 Map 16: Ecological Linkages

Regional ecological linkages for the Perth Metropolitan Region were identified and mapped by the Perth Biodiversity Project in 2003

Legend
- City Administration Centre
- Regional Ecological Linkages
- Wildlife Corridors

CITY OF SWAN
SHIRE OF MUNDARING
CITY OF BELMONT
CITY OF CANNING
CITY OF GOSNELLS

Great Eastern Hwy
Great Eastern Highway Bypa
Orrong Rd
Welshpool Rd East
Kenwick Link
Tonkin Hwy
Albany Hwy
Roe Hwy

High Wycombe
Gooseberry Hill
Maida Vale
Piesse Brook
Paulls Valley
Kalamunda
Hacketts Gully
Forrestfield
Wattle Grove
Lesmurdie
Walliston
Bickley
Reservoir
Carmel
Pickering Brook
Canning Mills

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N W E S

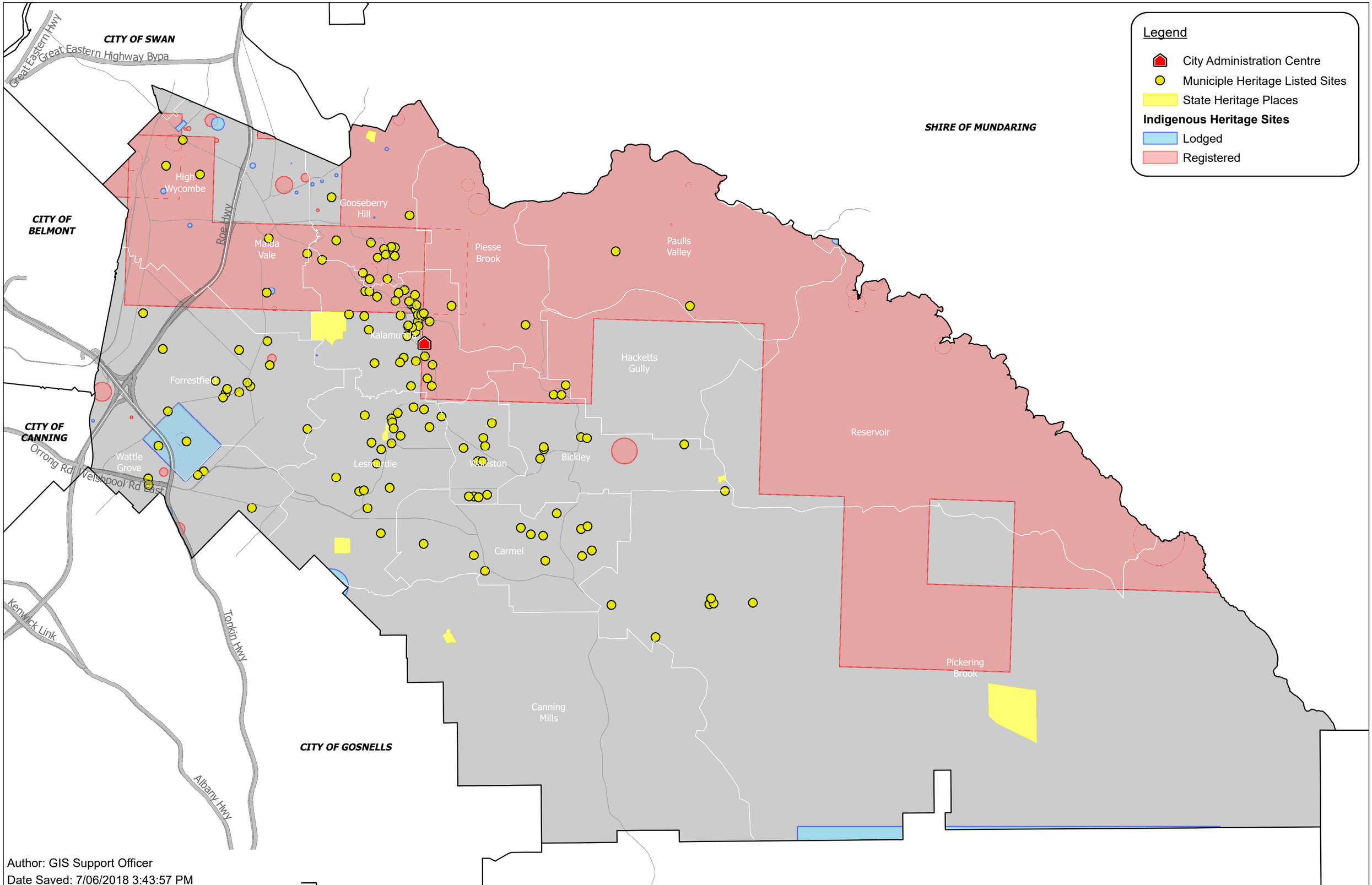
Map 16: Ecological Linkages (Perth Biodiversity Strategy)

0 1.25 2.5 5 Kilometers

Scale at A3: 1:80,000

city of kalamunda

7.17 Map 17: Indigenous and European Sites



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N W E S

Map 17: Indigenous and European Sites

0 1.25 2.5 5 Kilometers

Scale at A3: 1:80,000

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