

Morley Activity Centre

Local Water Management Strategy

Prepared for the City of Bayswater

By Essential Environmental

March 2014



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SUMMARY

This local water management strategy has been prepared to support the development of the Morley Activity Centre Structure Plan. The Morley Activity Centre Structure Plan provides a framework for the redevelopment and vitalisation of the Morley Activity Centre.

The Morley Activity Centre area is an existing developed area with the Galleria commercial complex and Morley Bus Station located at its heart and surrounded by an existing commercial and light industrial area, which is in turn, surrounded by residential land. Also located within the Activity Centre are; the City of Bayswater administration centre, John Forrest Secondary College and Coventry Square Markets.

The proposed redevelopment of the Morley Activity Centre aims to increase the intensity and diversity of uses within the core area and enhance the public domain through provision of landscaping and community spaces, supported by further increases in residential density throughout the structure plan area.

The Morley Activity Centre Local Water Management Strategy proposes that the redevelopment of the area will achieve the following objectives:

- i. Improve water quality within the stormwater system while maintaining the flood protection and conveyance capacity of the drainage system.
- ii. Maximise opportunities for creation of living streams to improve water quality treatment and amenity outcomes.
- iii. Optimise water use efficiencies including for irrigation and increase water reuse.
- iv. Achieve water sensitive landscapes (both public and private realm) which incorporate water quality management and reflect the Western Australian climate.

These objectives are to be achieved through the implementation strategies and design criteria for stormwater and groundwater management; water resource use; and landscaping which have been developed in response to the proposed redevelopment and the local site conditions.

The environmental characteristics of the Morley Activity Centre area are similar to much of the Swan Coastal Plain, having flat topography, sandy soils and shallow groundwater. There are very few identified contaminated sites but existing commercial and light industrial land uses represent a risk to the water quality of groundwater and surface water systems. The Activity Centre is located within the catchment of the Bayswater Brook which has been identified as a priority catchment for water quality improvement.

The redevelopment of the Morley Activity Centre is relatively unconstrained by water resources as it is already largely developed and contains existing infrastructure in an already modified environment. There are several Water Corporation compensating basins where significant improvements to both aesthetic and environmental outcomes are possible.

Stormwater and groundwater management

Groundwater is shallow across the Activity Centre area and a combination of surface and subsurface drainage is used throughout the area to manage groundwater levels. The Activity Centre is served by a number of Water Corporation branch drains and compensating basins which are presented in Figure 5, namely:

- Browns Lake Branch Drain
 - Drake Way Compensating Basin (wet)

- Morley Branch Drain
 - Russell Street Compensating Basin (wet)
- Collier Road Branch Drain
 - Collier Road Compensating Basin (wet)
- Walter Road Branch Drain/Collier Rd Diversion Drain
- Light Street branch Drain
 - Peters Place Compensating Basin (dry)
- Johnsmith Street Branch Drain

The Water Corporation have identified a number of locations where flooding is predicted to occur within the Activity Centre and have proposed improvement options for future investigation. In summary these are:

- Brown's Lake East Branch Drain (and City of Bayswater system) at Barnett Court
 - Duplication or upgrade of pipework at Russell Street and Barnett Court
- Collier Road Compensating Basin and pumping station
 - Upgrade Collier Rd pumping station and enlarge Russell St compensating basin, or
 - Remove Collier Rd compensating basin, enlarge Russell St compensating basin and construct new compensating basin at Rudloc Reserve

Development proposals in these locations will need to consider the potential future need for these upgrades to be undertaken or make alternative provisions to ensure that the capacity of the main drains is sufficient to meet the conditions of the Water Corporations operating license.

The Morley Activity Centre Local Water Management Strategy proposes to promote the enhancement of the stormwater management system through the potential creation of living streams in the following locations shown on Figure 6:

- Russell St Compensating Basin and open drain
- Vera St open drain
- Jakobsons Way open drain
- Rudloc Rd open drain
- Nora Hughes open drain

The creation of living streams in these locations can occur in isolation from any surrounding development however there are substantial opportunities for better outcomes to be achieved through integration with the planning process. It is therefore recommended that local development plans are prepared for these locations with supporting urban water management plans. The development of local development plans and urban water management plans for these sites should incorporate the following tasks:

- Undertake pre and post development modelling of the stormwater system to ensure run-off from future development scenarios is able to be adequately managed by the proposed stormwater system
- Design and construct identified living stream pathways, having consideration of existing infrastructure capacity requirements and delivery of Activity Centre objectives

Water resource use

Groundwater is used by the City for irrigation of public open space and water efficient landscape design and irrigation practices will be used to limit future public open space irrigation demand to current licensed volumes.

Because the study area is largely developed, there are extensive networks of all major services however it is possible that upgrades will be required to provide for the water and wastewater needs of the future population.

The existing development also means that widespread development of a fit-for-purpose water supply scheme is likely to be impractical. There are however, significant opportunities for industrial and commercial sites to incorporate rainwater tanks or greywater recycling systems on an individual basis and contribute to reducing the demand for potable water from the Water Corporation's integrated water supply system.

Implementation

As this area is an existing town centre and urban area, implementation of this local water management strategy will occur largely on an ad-hock basis, as development and redevelopment proposals are approved and constructed.

It is recommended that where Local Development Plans are prepared to guide subdivision, they are supported by an Urban Water Management Plan that provides further detailed designs and demonstrates how the objectives contained in this Strategy are to be achieved. Any subdivision and development should be in accordance with the objectives, strategies and design criteria contained in this Local Water Management Strategy and development will need to be consistent with any relevant design guidelines.

if not now...
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when?

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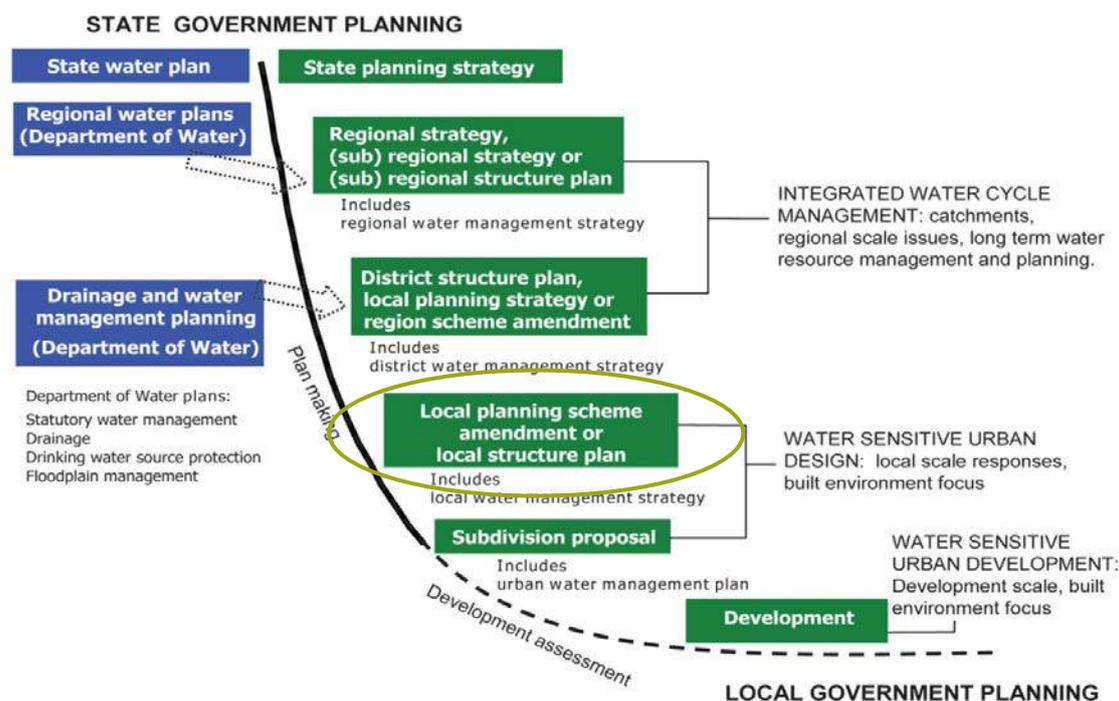
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1 INTRODUCTION

This local water management strategy has been prepared to support the development of the Morley Activity Centre Structure Plan. The Morley Activity Centre Structure Plan provides a framework for the redevelopment and vitalisation of the Morley Activity Centre.

Morley is identified as a strategic metropolitan centre under *State Planning Policy 4.2: Activity Centres for Perth and Peel* (Western Australian Government, 2010). Strategic metropolitan centres are the main regional activity centres. They are multipurpose centres that provide a diversity of uses. These centres provide the full range of economic and community services necessary for the communities in their catchments.

Although an activity centre structure plan is not specifically mentioned in *Better Urban Water Management* (WAPC, 2008a), much of the planning activity is at the local level. Thus a local water management strategy has been prepared to support the structure plan. The position of this strategy within the state government planning framework is defined in *Better Urban Water Management* (WAPC 2008a) and *Planning Bulletin No. 92, Urban Water Management* (WAPC 2008b) and is outlined in Figure 1.



Note: The above diagram depicts the optimal process. In situations where there is existing zoning and a lack of guiding information, a flexible approach to implementation may be required. This is at the discretion of the Western Australian Planning Commission on advice of the Department of Water.

Figure 1: Planning framework, integrating drainage planning with the land planning process (WAPC 2008)

In addition to *State Planning Policy 2.9: Water Resources* and *Better Urban Water Management* (WAPC 2008), the *Bayswater Brook Local Water Quality Improvement Plan* (SRT 2009), and *Bayswater Brook Action Plan* (BlueSands Environmental 2012) inform this plan's strategies and management principles.

2 PROPOSED DEVELOPMENT

This development involves the revitalisation of an existing urban activity centre which includes large commercial areas, some residential areas, two Water Corporation drainage compensating basins and a major public transport hub.

2.1 The strategy area

Located approximately 8 km north-east of the Centre of Perth in the City of Bayswater, the Morley Activity Centre (Figure 2) encompasses an area of approximately 220 Hectares.

At the heart of the Activity Centre is the exiting Galleria commercial complex and Morley Bus Station surrounded by an existing commercial and light industrial area. The light industrial area is largely bounded by Walter Road, Collier Road, Broun Avenue and Light Street, which is in turn surrounded by residential land. Also located within the Activity Centre are; the City of Bayswater administration centre, John Forrest Secondary College and Coventry Square Markets.

The boundary of the Activity Centre has been defined to include land that is generally within 800 m of the Bus Station. The Activity Centre is broadly encompassed by Coode Street, Light Street, Smith Street, Halvorson Road, Crimea Street and Broun Avenue.

The Activity Centre is located in an area of the Swan Coastal Plain historically scattered with interconnected watercourses and wetlands formed where natural undulations of the ground surface intersect the relatively shallow groundwater. Most of these wetlands have been lost through drainage and development, first as agricultural land and later for commercial, industrial and residential land uses. Those that remain have been formed into steep sided compensating basins and now form a part of the Water Corporation's main drainage system.

Aerial images taken in 1953 and 2013 (Plate 1) show how the Morley Activity Centre area has changed substantially in the past 60 years. The area has transformed from a largely undeveloped area with several large wetlands, evident as dark areas within the image, to its fully urbanised current state.



Plate 1: Morley aerial images (Left 1953, Right 2013)

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Figure 2: Location plan



2.2 Existing Land use

The Morley Activity Centre is a highly modified urban centre with the majority of the area comprising the Galleria commercial complex, the Morley Bus Station public transport facilities and buildings, and light industrial area. A high school, the John Forrest Secondary College, and the City of Bayswater Administration Centre are located in the south of the study area. An area of active public open space is located to the north of the bus station, the Pat O'Hara Reserve. A number of smaller parks are located around the central shopping complex and bus station. The remaining area surrounding the bus station and community facilities comprises residential lots. Very little natural areas remain within the study area.

A broad scale assessment of the land use breakdown within the structure plan area is provided in Table 1.

Table 1: Current land use (Draft Morley Activity Centre Structure Plan)

Land use	Area (hectares)	Percentage
Commercial	55.2	25 %
Education/community/civic	19.6	9 %
Light Industry	17.5	8 %
Public Open Space/drainage	13.9	6 %
Residential	73.1	33 %
Road reserves	40.7	19 %
Total	219.9	100%

2.3 Planning process and approvals

The bulk of the study area is currently zoned 'central city area' under the metropolitan region scheme, with the remainder being zoned 'urban' or 'public purposes (High School)'. The Activity Centre includes land areas covered by the City of Bayswater's two town planning schemes. Town Planning Scheme No 23 encompasses the central commercial and light industrial core of the Activity Centre whilst surrounding residential areas are within the broader Town Planning Scheme No 24. Zones and reserves under the Metropolitan Region Scheme and both Town Planning Schemes are presented in Figure 3.

Morley is identified in the Department of Planning's *Directions 2031 and beyond* (2010a) as one of the 10 Strategic Metropolitan Activity Centres. The document highlights Morley's importance at a strategic level and provides a general framework as to its significance in comparison with other centres across the Perth metropolitan region.

Strategic Metropolitan Centres are expected to function as a multi-purpose hub "providing a mix of retail, office, community, entertainment residential and employment activities and are well connected by high frequency public transport" (WAPC: 2010a pg 35).

Statement of Planning Policy No 4.2 Activity Centres for Perth and Peel (WAPC 2010b) specifies broad planning requirements for the planning and development of new activity centres as well as the redevelopment and renewal of existing centres in Perth and Peel. It identifies distribution, function, broad land use and urban design criteria for activity centres, and establishes

objectives for coordination of land use and infrastructure planning as well as integration with public transport.

The redevelopment of the Morley Activity Centre is likely to occur over an extended duration, given that the area is largely developed, albeit with substantial pockets of vacant land. The development of an improved public open space network incorporating better urban water management will be critical to changing the character of the Activity Centre and promoting future urban renewal.

The existing drainage network through the study area is owned and managed by the Water Corporation and the City of Bayswater and discharges to the Swan River at the Eric Singleton Bird Sanctuary wetland approximately 4 km south-east of the Activity Centre. Modifications to this drainage system to provide better outcomes for the environment and community will need to be approved by the Water Corporation (for works on an within their drainage infrastructure) on advice from;

- Department of Water
- Swan River Trust – for works potentially impacting the Swan River and wetlands

2.4 Proposed land use

The proposed redevelopment of the Morley Activity Centre aims to increase the intensity and diversity of uses within the core area and enhance the public domain through provision of landscaping and community spaces, supported by further increases in residential density throughout the structure plan area. These changes have implications for the future water demand within the Activity Centre. Figure 3 presents a potential distribution of the land use precincts presented in Table 2 and Table 3 that have been applied in modelling of future water demands within the Activity Centre.

Table 2: Proposed land use precincts (Draft Morley Activity Centre Structure Plan)

Land use	Area (hectares)	Percentage
Central core	38.9	18 %
Outer core	18.2	8 %
Civic and education	18.2	8 %
Light Industry transition	19.0	9 %
Inner city residential	74.7	34 %
Public open space/drainage	10.2	5 %
Road reserves	40.7	18 %
Total	219.9	100%

Within the core areas of the Activity Centre the changes to the breakdown of commercial spaces presented in Table 3 are proposed.

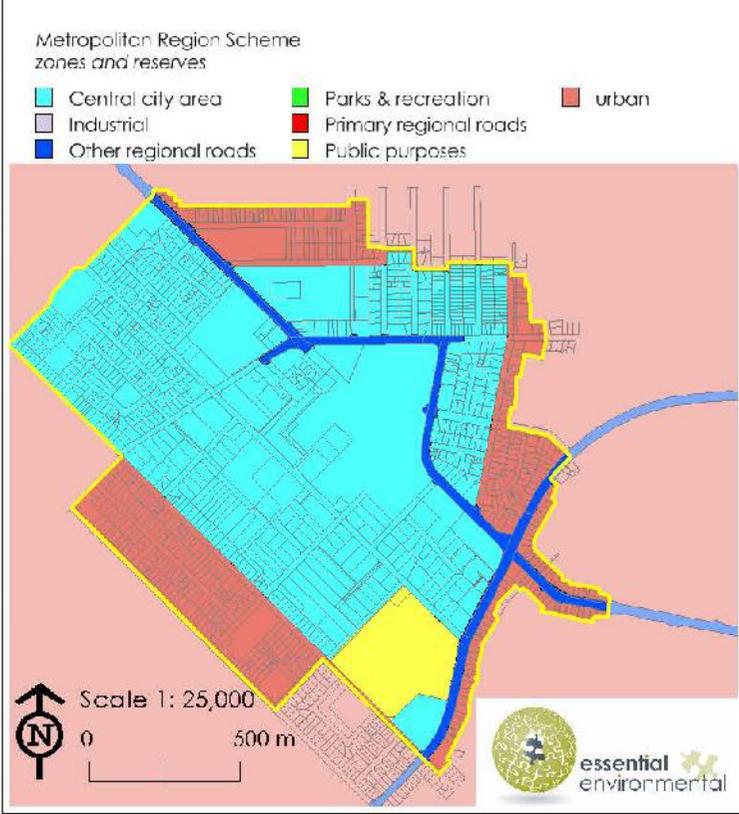
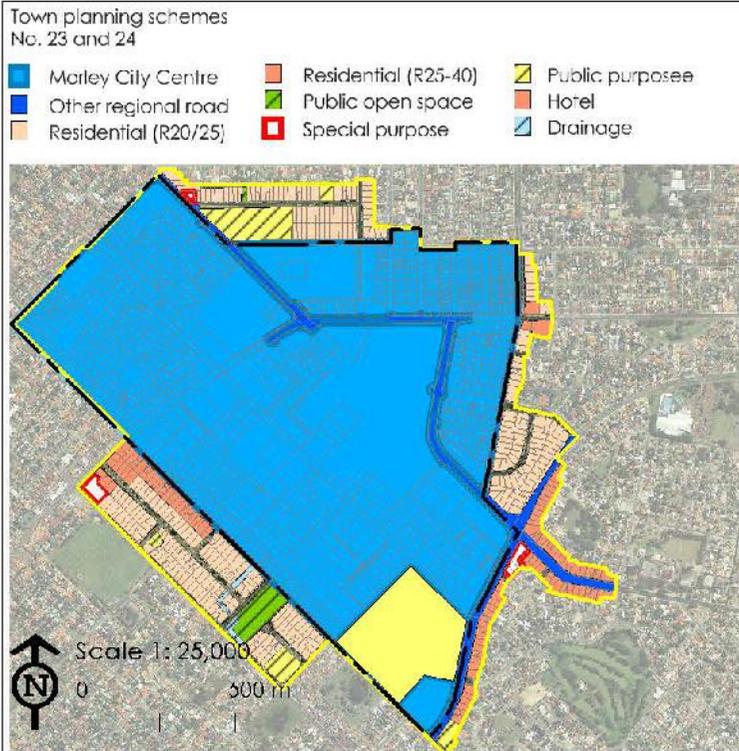
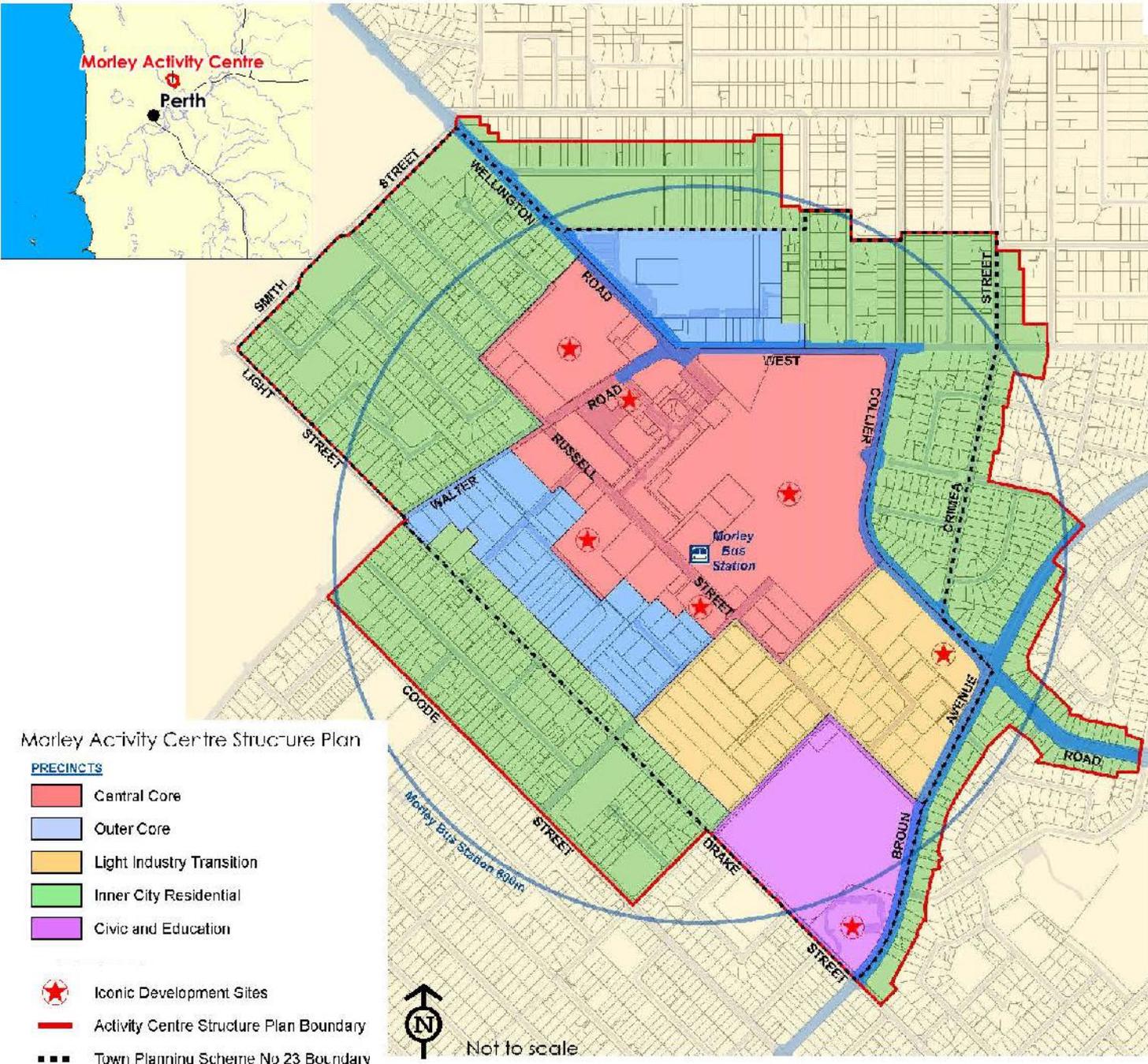
Table 3: Modelled land use (Draft Morley Activity Centre Structure Plan)

Activity	Existing area (SQM)	Target area (SQM)
Retail (Galleria & Coventry Markets)	25,000	110-120,000
Other retail	20,000	30-40,000
Office/business	60,000	120-125,000
Manufacturing distribution service	65,000	65,000
Health, welfare and community services	18,000	35-40,000
Culture, entertainment, recreation	19,000	40-50,000
Accommodation (hotel, serviced apartments)		36,000
Total	207,000	316-476,000

Whilst the structure plan does not propose to substantially increase residential areas in the Activity Centre, there is considerable densification proposed with much of the surrounding residential area, most of which is currently zoned R20/25, and provision for residential dwellings above commercial or office developments within the Core. Overall there is a dwelling target for the Activity Centre of between 5,500 to 8,200 residences.

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Figure 3: Planning and land use



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3 EXISTING SITE CHARACTERISTICS

3.1 Climate

The study area is typical of the Perth region, which has a Mediterranean climate comprising of hot dry summers and cool wet winters. The nearest rainfall station to the study area is Perth Metro (station no: 9225) which is approximately 4.8 km from the Morley Activity Centre and has recorded an average annual total rainfall of 733.8 mm for the period of 1993 to 2013. A longer term continuous record, since 1944, is available at Perth Airport (station ref: 9021) which has been used in charts 2, 3 and 4 to consider longer term climate trends.

Chart 1 identifies that both minimum and maximum monthly averages for temperature vary by around 10 degrees C over the year with the minimum usually experienced in July and maximum in February. The reverse is true of rainfall which reaches its peak of 146 mm for the month of July and has a minimum of 8.5 mm in February.

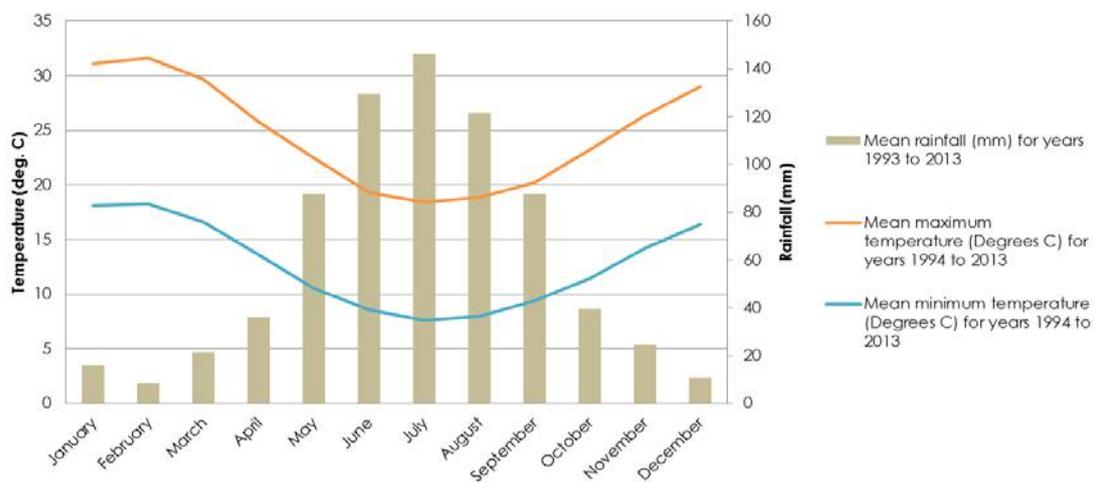


Chart 1: Climate summary data (Bureau of Meteorology station ref: 9225)

It can be seen in charts 3, 4 and 5 that the climate has been changing continuously since 1944 with the 30 year average rainfall declining some 150 mm since 1964 and 30 year averages of both minimum and maximum temperature increasing by approximately 1 degree C since 1964. This trend is typical of the south-west of Western Australia and has been accompanied by declining stream-flows and groundwater levels resulting in declining water availability for both environmental and human uses.

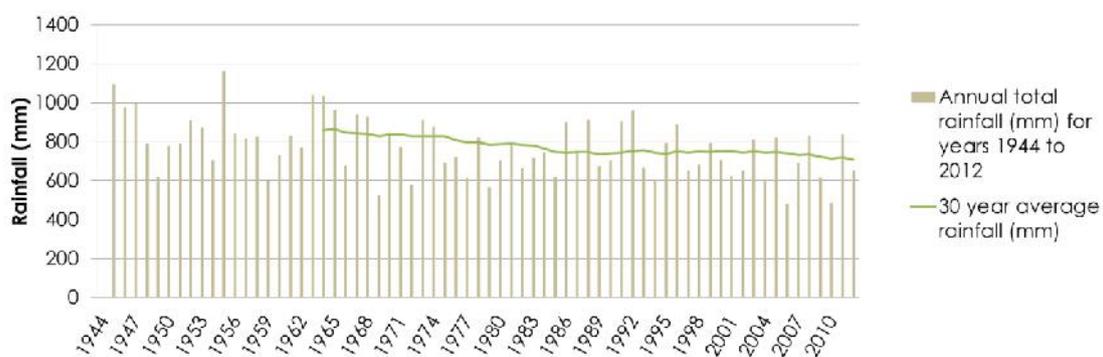


Chart 2: Historic rainfall (Bureau of Meteorology station ref: 9225)

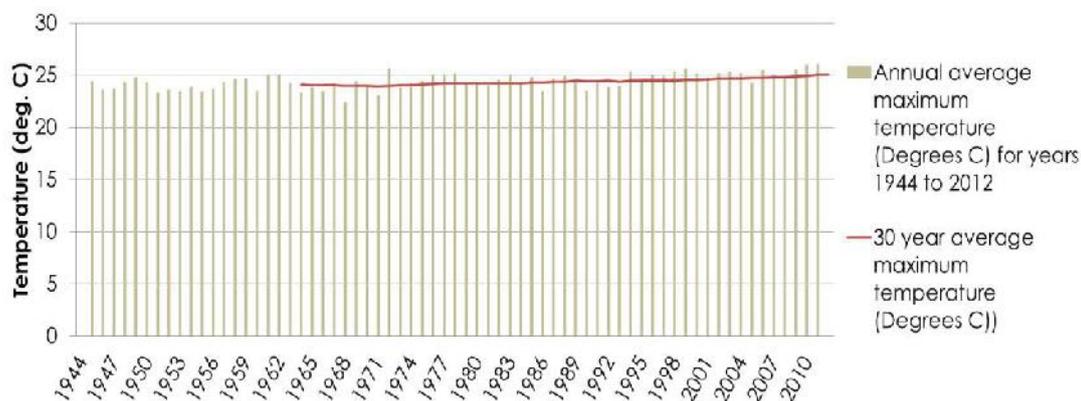


Chart 3: Historic maximum temperature (Bureau of Meteorology station ref: 9021)

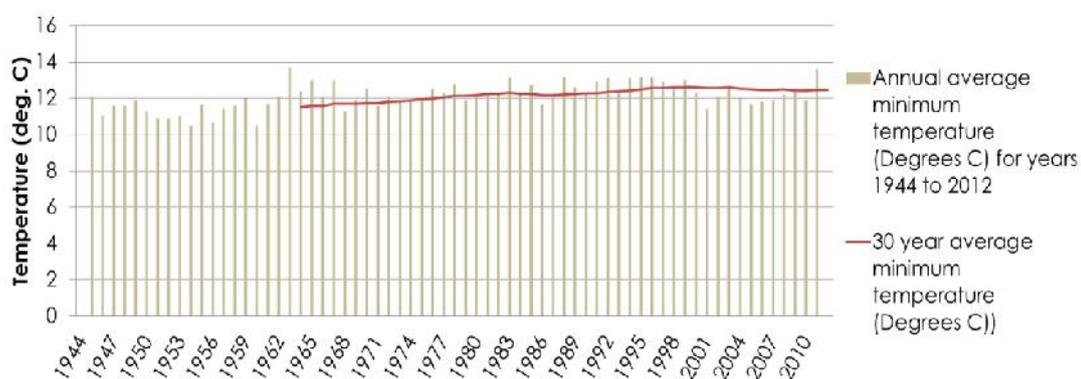


Chart 4: Historic minimum temperature (Bureau of Meteorology station ref: 9021)

3.2 Topography and geology

Topographic mapping of the Morley Activity Centre is presented in Figure 4. The general topography of the Activity Centre is flat with a very slight general slope from north to south. There is a more elevated section to the north between Walter Road and Halvorson Road where the highest point is at around 33 m AHD. The lowest points in the Activity Centre are associated with main drainage infrastructure towards the centre of the study area.

Figure 4 presents mapping from *Geological Survey of Western Australia, 1:50,000 Environmental Geology* (Gozzard 1986). The City is dominated by Bassendean sands with deposits of peaty clay.

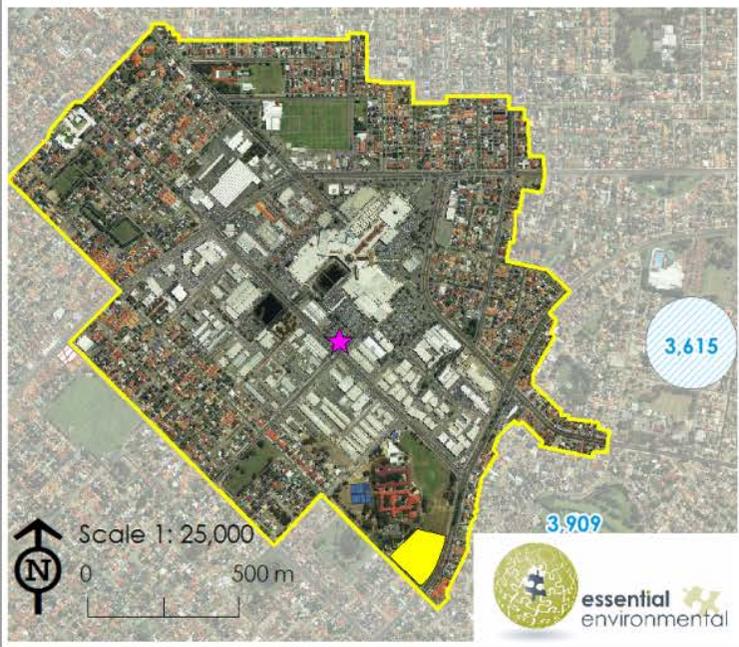
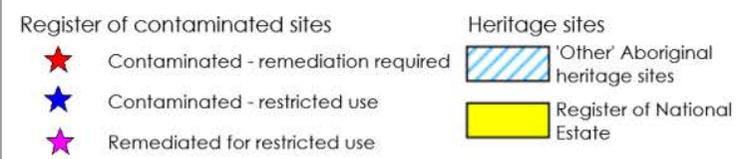
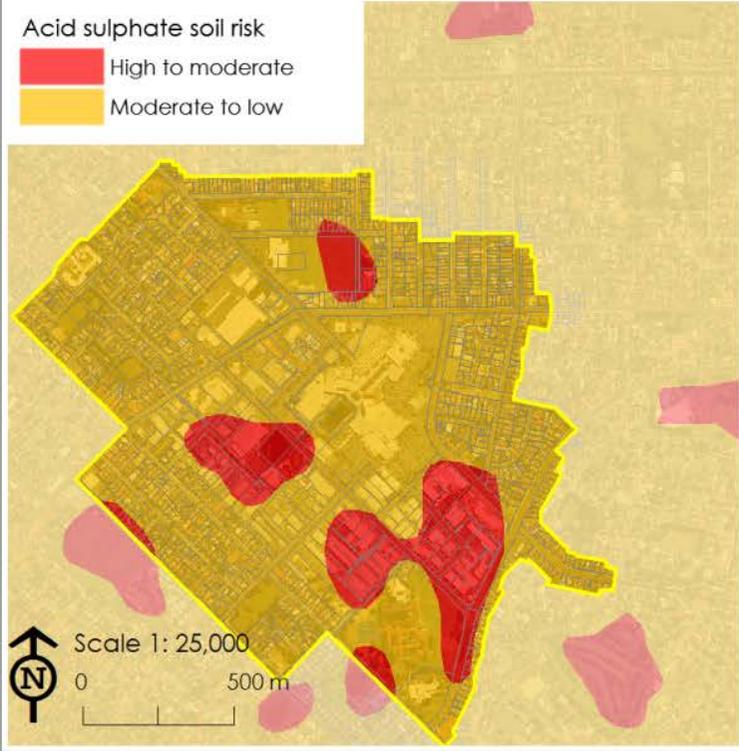
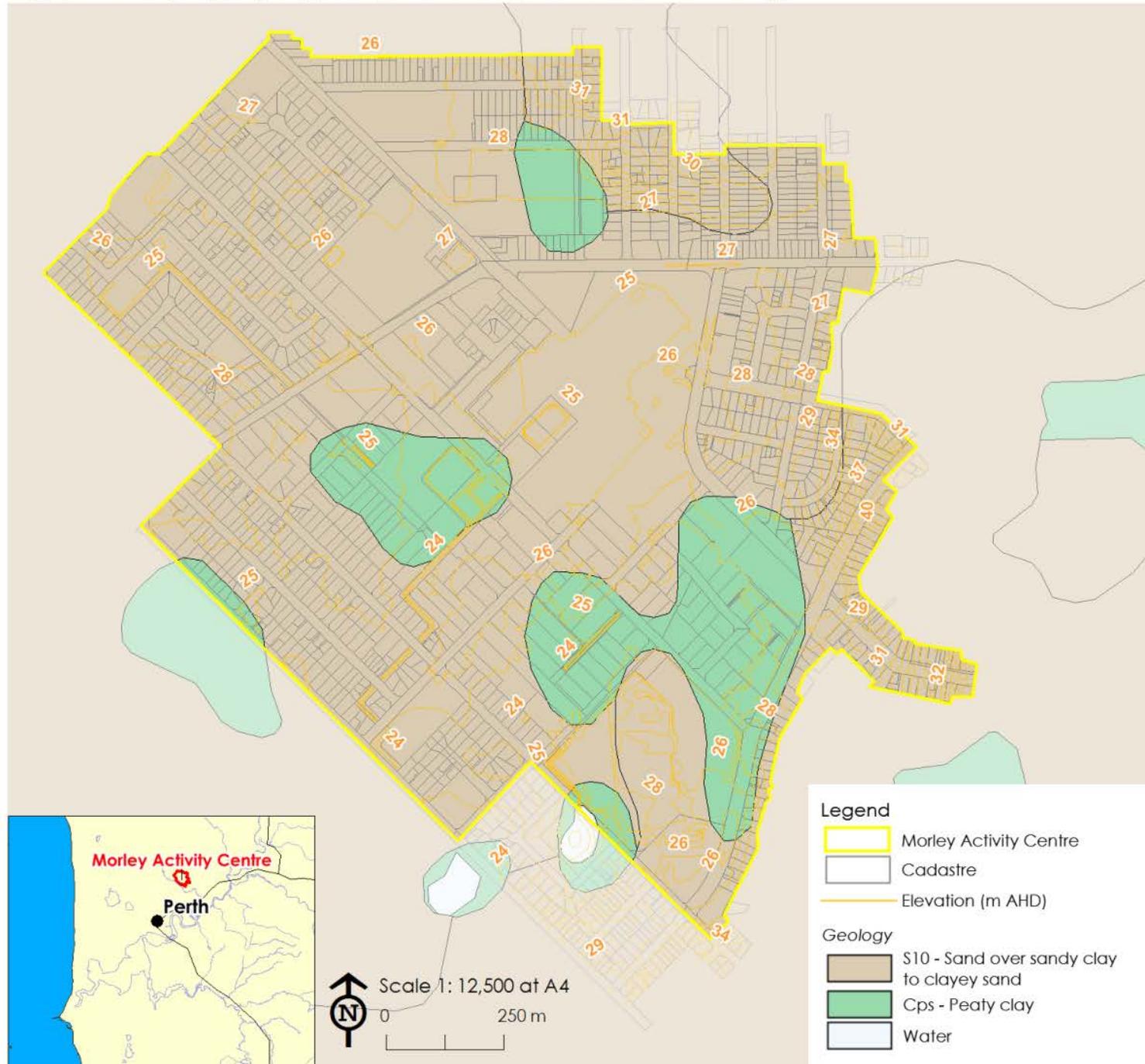
3.2.1 Acid sulfate soils

Acid sulfate soils are soils and sediments that contain iron sulfides. They occur naturally in Western Australia and are harmless when left in a waterlogged, undisturbed environment. However, when exposed to air, through drainage or excavation, the iron sulfides in the soil react with oxygen and water to produce iron compounds and sulfuric acid. This acid can release other substances, including heavy metals, from the soil and into the surrounding environment and waterways (DEC, 2012a).

Much of Western Australia's acid sulfate soil material lies just below current water-tables. Continuing declines in annual rainfall, changes in land uses and increasing ground-water abstraction will lead to lower water-tables, resulting in possible widespread acid sulfate soil oxidation (DEC, 2012).

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Figure 4: Topography, soils, contamination and heritage



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Predictive maps for risk of acid sulfate soil occurrence on the Swan Coastal Plain have been prepared by the Department of Environment Regulation by identifying the landforms most likely to host acid sulfate soil in their natural environment. High priority for low-lying coastal landforms was based on the hypothesis that potential acid sulphate soil material was confined to superficial layers of landscapes within 5 m of the current mean sea level (DEC, 2012b). The maps, provided as Figure 4, describe two risk categories:

- high to moderate risk of acid sulfate soils occurring within 3m of natural soil surface.
- moderate to low risk of acid sulfate soils occurring within 3m of natural soil surface but high to moderate risk of acid sulfate soils beyond 3m of natural soil surface.

The Morley Activity Centre has a moderate to low risk of acid sulfate soils occurring within 3 m of the natural surface in the majority of its land, although there are several pockets of moderate to high risk also present coinciding with areas of peaty clay (Figure 4).

3.2.2 Contaminated sites

Western Australia's contaminated sites legislation aims to protect people's health and save the environment from harm. Under the *Contaminated Sites Act 2003*, contaminated sites must be reported to the Department of Environment Regulation, investigated and, if necessary, cleaned up.

Land owners, occupiers and polluters are required to report all known or suspected contaminated sites to the Department of Regulation. Reported sites are then classified, in consultation with the Department of Health, based on the risks posed to the community and environment.

Figure 4 provides a map of sites currently registered on the Department of Environment Regulation's database. There is one site registered in the City which is classified as 'remediated for restricted use'.

Other sites reported to the Department of Environment Regulation, including sites awaiting classification are recorded separately and have not been mapped.

3.3 Flora and fauna

A number of species of flora and fauna protected under the *Environmental Protection and Biodiversity Conservation Act 1999* as Matters of National Environmental Significance are listed as occurring within 1.5km of the centre of the Morley Activity Centre. A search of the federal Protected Matters Search Tool found a number of threatened species within the Morley Activity Centre including five birds (Forest Red-Tailed Black-Cockatoo, Carnaby's Cockatoo, Malleefowl, Australian Painted Snipe and Australian Fairy Tern), two mammals (Chuditch and Western Ringtail Possum) and 12 plants (such as the Muchea Bell, Purdie's Donkey Orchid and Dwarf Green Kangaroo Paw).

Threatened (Declared Rare) and Priority flora and fauna is also protected under State legislation, the *Wildlife Conservation Act 1950*. Information requested from the Department of Parks and Wildlife database within 5 km of the Morley Activity Centre indicated that 12 species of flora and fauna are protected under the Act (see Table 4). This includes Threatened species: Carnaby's Cockatoo, the Numbat, and the plant *Caladenia huegellii* (also ranked as Critically Endangered).

Table 4: Threatened and Priority flora and fauna in the Morley Activity Centre (DPaW, 2013)

Conservation Status	No. of species
Rare or likely to become extinct	3
Protected under international agreement	2
Priority 1	2
Priority 3	4
Priority 4	1
Total	12

The City of Bayswater, in partnership with the Town of Bassendean, and the City of Belmont has developed a collective biodiversity strategy with the focus of protecting and effectively managing the City's natural areas (EMRC 2008).

The strategy incorporates the following elements:

- identification of the extent of the biodiversity resource
- development of a vision, objectives and targets for the protection and management of natural areas and other biodiversity features
- assessment of Local Natural Areas
- identification of ecological linkages
- identification of broad management options for Local Natural Areas and ecological linkages
- provision of costing schedules for the management of natural areas and ecological linkages
- development of a preliminary framework for monitoring and review
- a preliminary review of existing Council policy and programs related to biodiversity conservation
- recommendations for the ongoing implementation of the Strategy

Specifically relevant to this strategy is the specified Wetlands and Waterways Target:

Enhance all wetlands, waterways and drainage lines, their buffers and associated riparian and upland vegetation contained within reserves owned or managed by the councils of the Swan River Precinct. Where appropriate, improve the protection status of the vegetation contained within each of these reserves.

This strategy proposes a series of drainage system improvement 'projects' which will support the delivery of this target and provide opportunities for community engagement in improving local biodiversity. These projects are discussed in more detail in section 3.7.1 but are summarised as follows:

- Russell St Compensating Basin and open drain – wetland enhancement and creation of living stream
- Vera St open drain – creation of living stream
- Jakobsons Way open drain – creation of living stream
- Rudloc Rd open drain – creation of living stream
- Nora Hughes open drain – creation of living stream

3.4 Heritage

A search of the Department of Aboriginal Affairs' Aboriginal heritage inquiry system returned no records on or within 1 km of the study area. Four 'other' heritage places, classified as 'insufficient information' (ID 3615) and 'stored data' (ID 3327, ID 3909 and ID 3165), are located within approximately 500 m of the study area and are mapped in Figure 4.

An Aboriginal site may still exist and:

- Not have been recorded in the Register of Aboriginal sites or elsewhere; or
- Not have been identified in previous heritage surveys or reports on that area but remains fully protected under the Act.

The City of Bayswater Administration Centre is also listed as heritage site on the Register of National Estate due to its historic value.

The City of Bayswater's Municipal Heritage Inventory lists three sites within the Activity Centre area, these are:

- Les Hansman Community Centre – 246 Walter Road West
- Tree – 250-260 Walter Road West
- Classroom, Morley Primary School – 36 Wellington Road

During the late 1950s, Morley began to develop as a major shopping and commercial area.

3.5 Surface water

The Morley Activity Centre is part of the Bayswater Brook catchment (Figure 5) which in turn is part of the lower catchment of the Swan River.

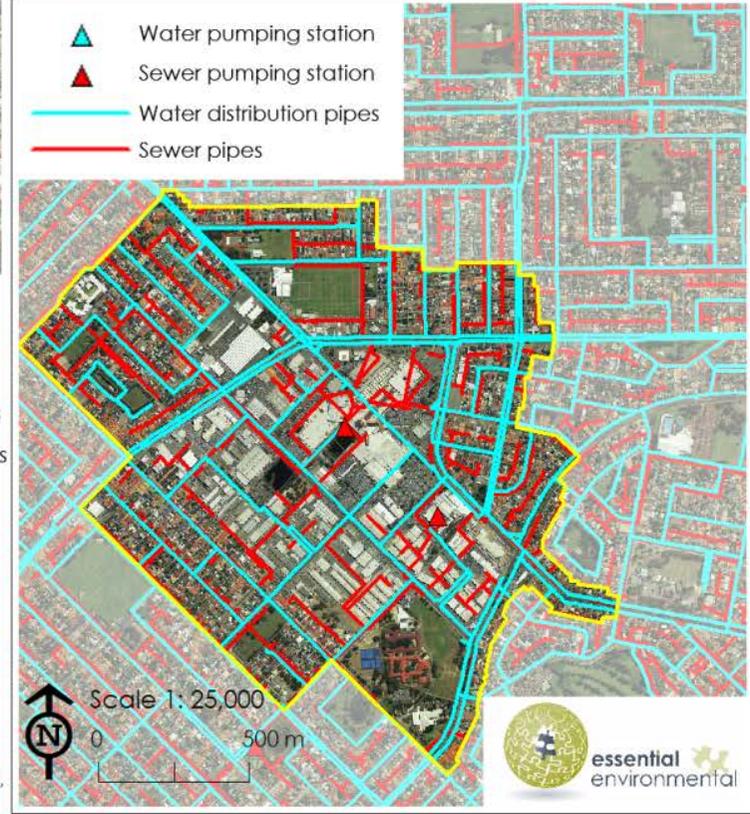
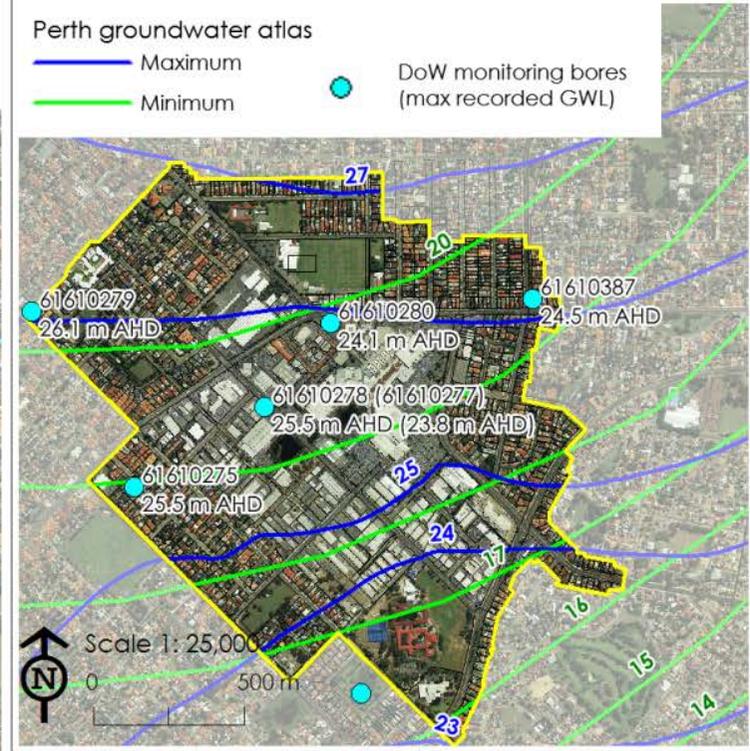
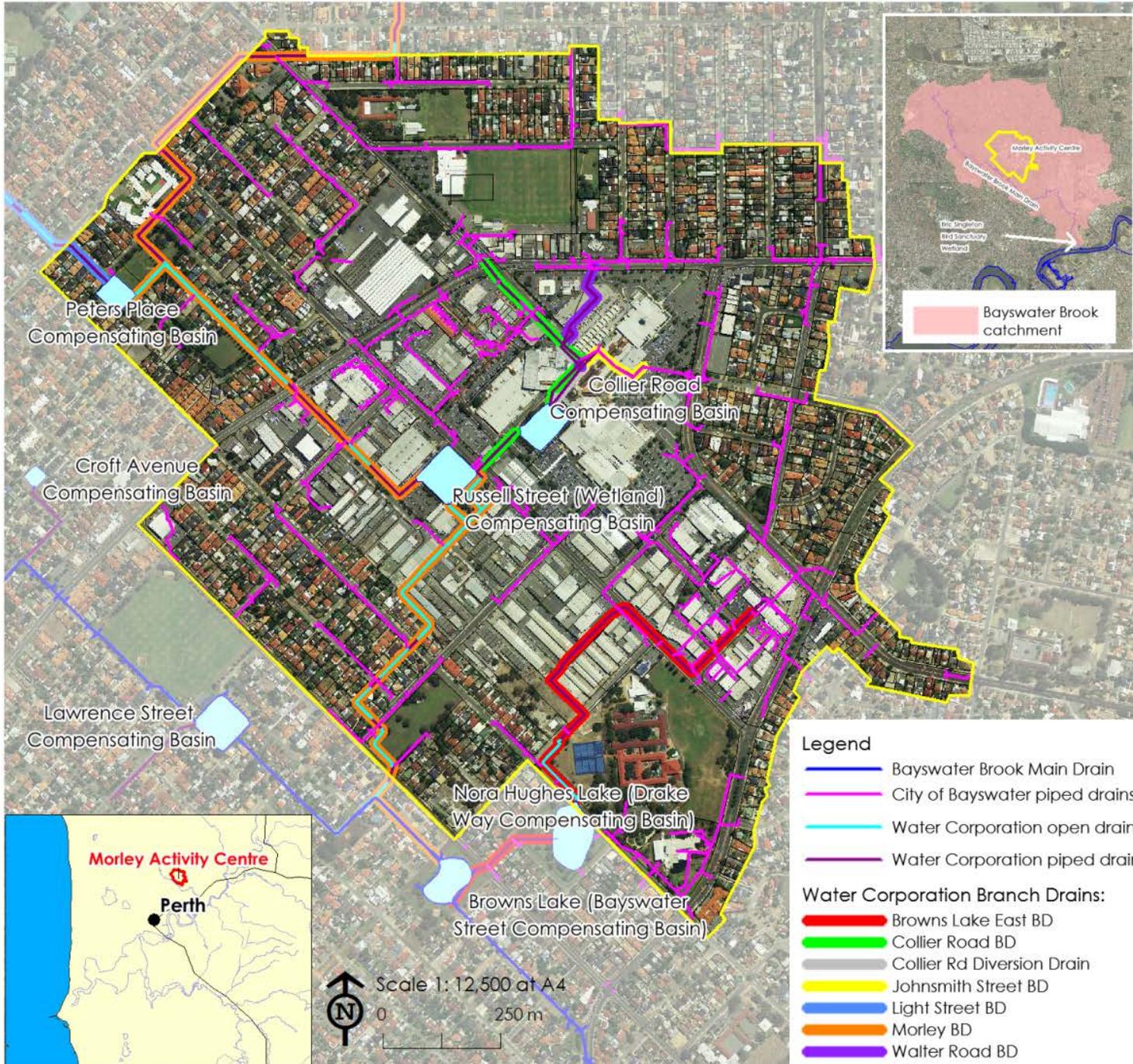
The Bayswater Brook catchment, previously known as the Bayswater Main Drain is a large drainage network with a catchment area of 27,000 ha, receiving stormwater from all or part of the suburbs of Bassendean, Bayswater, Bedford, Dianella, Eden Hill, Embleton, Mirrabooka, Morley, Nollamara and Noranda (Klemm & Switzer 1994). It is the largest urban catchment in the Perth Metropolitan area and flows into the Swan River all year round, with both open and closed sections of drain (Department of Water 2010a).

The Bayswater Brook flows in a south easterly direction just outside the Activity Centre and the drainage system within the Activity Centre is connected to it at two locations as shown in Figure 5. The bulk of drainage from the Activity Centre discharges to the Brook at Rudloc reserve on Coode Street. A second, smaller drainage system discharges to Nora Hughes Lake, which in turn is connected to Bayswater Brook.

The drains within the Activity Centre are a mixture of Water Corporation open and piped drains and City of Bayswater piped local drains as shown on Figure 5. Open drains in the area are steep sided trapezoidal drains following road reserves and lot boundaries and bear little resemblance to the natural watercourses that would originally have drained the area (Plate 2).

City of Bayswater - Morley Activity Centre Local Water Management Strategy

Figure 5: Water resources and infrastructure



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Plate 2: Water Corporation open drain taken from Kennedy Road looking north

3.5.1 *Wetlands and waterbodies*

There are two open waterbodies within the Activity Centre which are an integral part of the drainage system. These are Russell Street Compensating Basin (also known as Russell Street Wetland – Plates 3, 4 and 5) and Collier Road Compensating Basin. In addition, Nora Hughes Lake (also known as Drake Way Compensating Basin) is located on the boundary of the Activity Centre (Plate 6).



Plate 3: Russell Street Wetland (Russell Street Compensating Basin) taken from Russell Street looking south



Plate 4: Russell Street Wetland (Russell Street Compensating Basin) taken from Bunnings forecourt looking east



Plate 5: Russell Street Wetland (Russell Street Compensating Basin) looking north-west



Plate 6: Nora Hughes Lake (Drake Way Compensating Basin)

Downstream of the Activity Centre, adjacent to the discharge point of the Bayswater Brook catchment to the Swan River, is the Eric Singleton Bird Sanctuary wetland, a former landfill site constructed as a permanent wetland. The wetland was recently rehabilitated to strip nutrients from local surface water and groundwater to improve water quality in the Bayswater Brook catchment, and ultimately reduce nutrients and contaminants entering the Swan River (URS, 2010).

Major rehabilitation works have been programmed at this lake for implementation in 2014/15.

3.5.2 *Stormwater management system*

Water Corporation drainage infrastructure

The Activity Centre is located within the Water Corporations Bayswater Main Drain catchment and is served by a number of Water Corporation branch drains and compensating basins which are presented in Figure 5, namely:

- Browns Lake Branch Drain
 - Drake Way Compensating Basin (wet)
- Morley Branch Drain
 - Russell Street Compensating Basin (wet)
- Collier Road Branch Drain
 - Collier Road Compensating Basin (wet)
- Walter Road Branch Drain/Collier Rd Diversion Drain
- Light Street branch Drain
 - Peters Place Compensating Basin (dry)
- Johnsmith Street Branch Drain

The Water Corporation undertook capacity review modelling of the Bayswater Brook drainage catchment in 2009 based on existing land use zonings at that time. A summary of the results of their analysis are presented in Table 5.

Table 5: Surface water modelling results (Water Corporation 2009)

Location	Ground level	Top water level (mAHD)		Peak flow rate (m ³ /s)	
		10 year	100 year	10 year	100 year
Inlets:					
• Morley BD (Halvorson Rd)	27.43	26.01	26.04	0.32	0.33
• Light St BD (Smith St)	25.88	25.18	25.52	0.36	0.47
Outlets:					
• Morley BD (Coode St)	24.25	23.47	24.00	1.27	1.60
• Browns Lake East BD (Drake St)	23.70	23.42	23.86*	2.28	3.19
Compensating Basins:					
• Drake Way (wet)	23.78	23.42	23.86		
• Russell Street (wet)	25.00	24.95	25.30		
• Collier Road (Wet)	24.70	25.18**	25.32*		
• Peters Place (dry)	25.50	25.14	25.49		

Notes:

- *indicates that flooding is predicted at this location in the 100 year ARI event
- **indicates that flooding is predicted at this location in the 10 year ARI event

Modelling has not been completed to consider the impacts of proposed development; however, it is expected that development will not substantially increase the extent of impervious area within the Activity Centre core. Where additional impervious areas are created, most likely in the outer core residential areas, water sensitive urban design principles will be applied to minimise increases in stormwater runoff entering the main drainage system.

The Water Corporations modelling identified a number of locations where flooding is predicted to occur and considered improvement options for future investigation, in summary these are:

- Brown's Lake East Branch Drain (and City of Bayswater system) at Barnett Court
 - Duplication or upgrade of pipework at Russell Street and Barnett Court
- Collier Road Compensating Basin and pumping station
 - Upgrade Collier Rd pumping station and enlarge Russell St compensating basin, or
 - Remove Collier Rd compensating basin, enlarge Russell St compensating basin and construct new compensating basin at Rudloc Reserve.

Development proposals in these locations will need to consider the potential future need for these upgrades to be undertaken or make alternative provisions to ensure that the capacity of the main drains is sufficient to meet the conditions of the Water Corporations operating license.

City of Bayswater drainage infrastructure

The existing capacity of the City's drainage system, beyond modelling assessments undertaken by the Water Corporation which are predominantly focused on their own assets but include some consideration of local authority assets, is not well understood. For this reason, where development is occurring it is important that water management is focussed on limiting post development drainage discharges to pre-development peak flows and/or volumes

Although much of the likely future development in the Morley Activity Centre needs to occur at the lot or small-street scale and therefore the ability to 'manage' stormwater onsite may be spatially limited. Soil and groundwater conditions will allow for infiltration at source and so in

these areas, below ground infiltration and/or storage devices under driveways and gardens can be utilised to ensure that the existing capacity of drainage systems is not exceeded.

3.6 Groundwater

Groundwater in the Morley Activity Centre is present in four major aquifers which are (in order of increasing depth):

- Superficial aquifer – unconfined
- Mirabooka aquifer - unconfined
- Leederville aquifer – confined
- Yarragadee aquifer – confined

The Activity Centre is located within the Gngarara mound groundwater system where the hydrogeological layering of aquifers is broadly characterised in the representative cross-section shown in plate 7.

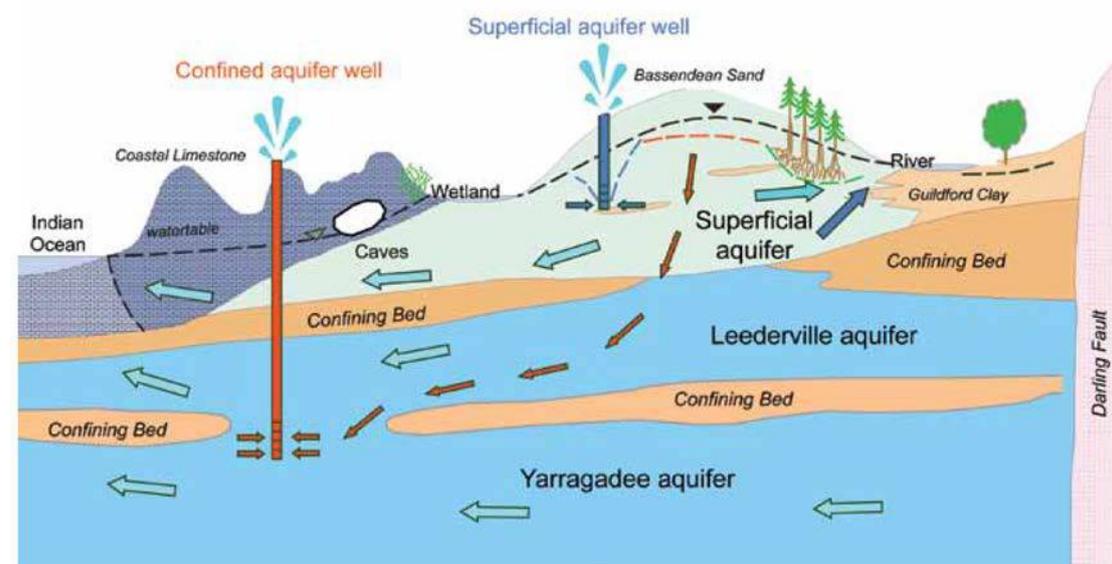


Plate 7: Gngarara system hydrogeological cross-section (Source: DoW)

The water resources present in these aquifers are managed by the Department of Water under the *Rights in Water and Irrigation Act 1914*. The City of Bayswater subarea of the Perth groundwater management area covers the entire Activity Centre and water from the superficial and Mirabooka aquifers are licensed and allocated from within this boundary. However, the Leederville and Yarragadee aquifers are licensed and allocated from within the Perth North Confined groundwater subarea which covers the entire Activity Centre and extends to encompass much of the northern metropolitan region.

Groundwater allocation limits and availability (as at 14 November 2013) are reported in Table 6.

Table 6: Groundwater allocation limits and availability

Aquifer	Allocation limit (kL/year)	Allocated, Committed and Requested (%)	Availability
Perth - Mirrabooka	50,000	0 (0%)	Available
Perth - Superficial Swan	2,300,000	1,724,343 (75%)	Available
Perth - Leederville.	1,364,220	1,364,220 (100%)	Not available
Perth - Yarragadee North.	247,000	80,000 (32%)	Available

Notes:

- Data provided by the Department of Water – 14 November 2013

Groundwater use

There are five groundwater licenses currently held within the Activity Centre, two of which are held by the City of Bayswater and are consolidated licenses for irrigation of public open spaces throughout the City from the Superficial and Leederville Aquifers. The remaining licenses are all for water from the Superficial Aquifer and are held by the Department of Education (for John Forrest Secondary College and Morley Primary School), Infant Jesus School and Abel Baker Pty Ltd (Mrs Macs Pty Ltd).

Morley Activity Centre Structure Plan does not propose the creation of substantial new public open spaces or provision of new schools. However, with a significantly increased residential and working population with limited private open spaces there will be a need for existing open spaces and streetscapes to provide high amenity green open spaces that can expect high use and will therefore require significant maintenance and irrigation. These spaces will also be important in combating urban heat island effects in the future and the irrigation of these spaces should consequently be seen as a 'high value use' for water.

Currently the public open spaces within the Morley Activity Centre are irrigated using groundwater and this is likely to continue in the future. However there may be opportunities to investigate stormwater harvesting from the existing main drainage system to facilitate increased demands for irrigation in the future.

3.6.1 Groundwater levels

The Superficial aquifer is shallow in the Activity Centre, typically within one to two metres of the ground surface at its historical maximum.

The Bayswater Brook main drainage network was constructed by the Water Corporation in the 1960's, and was developed from what was once an extensive wetland system, which has since been significantly modified to provide land for development (Klemm & Switzer 1994). The Bayswater Brook drains groundwater to prevent flooding of low-lying areas and also receives stormwater from the large catchment area from numerous local government stormwater drains. Some sections of the drain flow all year round, while other areas are ephemeral.

Maximum recorded groundwater levels at selected locations within the activity centre are presented on Table 7 and in Figure 5.

Table 7: Maximum recorded groundwater levels at selected locations

Monitoring bore reference (active dates)	Ground level at bore (m AHD)	Maximum recorded groundwater level (m AHD)	Date recorded
61610277 (1991-2013)	24.972	23.842	26/09/2011
61610280 (1991-1995)	26.276	24.146	02/10/1991
61610387 (1991-1995)	26.204	24.494	13/10/1992
61610274 (1947-1976)	23.579	24.579	01/11/1947
61610275 (1961-1970)	25.96	25.455	28/08/1963
61610278 (1961-1970)	26.276	25.466	28/08/1963
61610279 (1961-1970)	26.762	26.1	28/08/1963

Notes:

- Bore ref: 61610277 is situated at approximately the same location as bore ref: 61610278. It is not known whether the ground level has changed significantly at this location (perhaps due to addition of fill for development) or if the ground level is incorrectly reported for one of the bores. In this case, the groundwater levels should be adjusted to reflect the true ground level.

3.7 Water quality

The catchments of the Swan Canning River system are the subject of the *Swan Canning Water Quality Improvement Plan* (SRT 2009) which contains catchment management measures and control actions. It was developed as a part of the Coastal Catchments Initiative, with the following aim of reducing nitrogen and phosphorus inputs to the Swan-Canning river system.

On the basis of predictive modelling, the *Swan Canning Water Quality Improvement Plan* reports the maximum acceptable load to the Swan and Canning rivers per year as 130 tonnes of total nitrogen (TN) and 14 tonnes of total phosphorus (TP). To meet these objectives the *Swan Canning water quality improvement plan* aims to:

- reduce the nitrogen load by 120 tonnes per year (49%); and
- reduce the phosphorus load by 12 tonnes per year (46%).

The Bayswater Brook catchment has been identified in the *Swan Canning Water Quality Improvement Plan* (SRT 2009) as having 'unacceptable water quality'. These catchments require load reductions of greater than 45% and are the subject of individual local water quality improvement plans. The Bayswater Brook was given a high priority as a result of very poor water quality within its watercourses and the *Bayswater Brook Local Water Quality Improvement Plan* (SRT 2008) was one of the first of these plans to be prepared.

The *Bayswater Brook Local Water Quality Improvement Plan* (SRT 2008) contains target annual loads and concentrations for nitrogen and phosphorous to achieve a 30% reduction by 2015. These are:

- Total Nitrogen – 6.69 tonnes/year, 0.7 mg/L
- Total Phosphorous – 0.65 tonnes/year, 0.07 mg/L

The *Bayswater Brook Action Plan* (BlueSands Environmental 2012) identifies a variety of surface water and sediment monitoring has historically been undertaken within the catchment by various stakeholders. It should be noted that limited groundwater quality monitoring data is available within the catchment (Barron et al. 2010), although groundwater is a significant source of flows from the catchment and is arguably just as important as surface water in transporting pollutants. Recent and current monitoring includes:

- The Department of Water gauging station, which is located towards the bottom of the catchment. Surface water discharge is regularly monitored and nutrient and physio-chemical parameters are analysed on a fortnightly basis. Data collected at this station is used to estimate the load of nutrients being discharged to the Swan River.
- Surface water and sediment quality snapshot sampling for the Eric Singleton Bird Sanctuary in 2007. This sampling was undertaken by the North Metro Conservation Group (NMCG 2007a) in conjunction with the City of Bayswater and Department of Water (and was supported by Perth Region Natural Resource Management (PRNRM)).
- A catchment wide annual surface water quality monitoring program undertaken by NMCG in 2007 (NMCG 2007b) and the South East Regional Centre of Urban Landcare (SERCUL) in successive years (SERCUL 2008, 2009 & 2010). This monitoring program has also been undertaken in conjunction with the City of Bayswater and Department of Water (and was supported by PRNRM) and is continuing in 2012 (supported by the Swan River Trust).
- A baseline study of non-nutrient contaminants (in both surface water and sediment) in the drainage system in 2006 (Nice et al. 2009). This work was undertaken by the DoW as part of the Swan River Trust's Non Nutrient Contaminants Program, which was aimed at examining the nature of contaminants draining into and present within the Swan and Canning Rivers (SRT 2009).
- A snapshot of contaminants (in both surface water and sediment) in the drainage system downstream of the light industrial area (Foulsham 2009). This work was undertaken by the Department of Water.
- Snapshot surface water sampling by CSIRO in 2009 (Barron et al. 2010) to assess the impact of groundwater discharge on water quality within the lower reaches of the surface water drainage system.
- Snapshot sediment, water and fish sampling in the Bayswater Brook and adjacent Swan River (DoW 2003) to investigate the potential impacts from the CSBP Cresco site.
- Groundwater sampling results from August 2008 to June 2009, along with previous monitoring data was assessed by GHD (2009) to help quantify the groundwater nutrient fluxes to Eric Singleton Bird Sanctuary, to assist with the concept design for the rehabilitation of the wetland.
- A baseline soil, groundwater and surface water sampling program was undertaken by URS in 2010, with the objective of providing some baseline data to assist with the design and reconstruction of a wetland at Eric Singleton Bird Sanctuary. The Swan River Trust and City of Bayswater have undertaken a detailed investigation of the wetland sediment and underlying soils in consultation with the Department of Environment Regulation's Contaminated Sites Branch. This investigation has confirmed that contamination issues at the Eric Singleton Bird Sanctuary are manageable and that construction of a nutrient stripping wetland at the site is feasible. The Wetland has been designed (GHD 2013) and construction is planned to commence in November 2014. (Pers. Comm. J. Stritzke, Swan River Trust, March 2014)

Collectively, results from these monitoring programs have indicated that nutrients, metals, herbicides, pesticides, hydrocarbons, suspended solids, hormones, phenols and surfactants are present in significant concentrations within the surface water drainage system and are thus contaminants of potential concern.

The *Water and sediment quality in the Bayswater Brook winter 2012* report (SERCUL, 2013) summarises the results of the most recent water and sediment quality testing undertaken throughout the Bayswater Brook catchment by the Swan River Trust and South East Regional

Centre for Urban Landcare (SERCUL). Generally, water quality throughout Bayswater Brook catchment was identified as poor in 2012, with over half the sampled sites recording total nitrogen and total oxidised nitrogen concentrations above the ANZECC trigger value. In addition, the majority of sites sampled recorded nitrogen as ammonia/ammonium, total phosphorus and soluble reactive phosphorus above the ANZECC trigger value for lowland rivers. Metal concentrations also exceeded ANZECC trigger values for most sites sampled throughout the catchment, particularly for total and soluble aluminium, total chromium, soluble copper, and total and soluble zinc (SERCUL, 2013). Eric Singleton Wetland in particular was found to be an ongoing source of total nitrogen, total phosphorus and aluminium. This is a source of concern due to its downstream position in Bayswater Brook, before the brook discharges into the Swan River.

Five sites in the sampling program are located within the Morley Activity Centre at Coode St (site 21), Jacobson's Way (site 22), Vera St (site 23), and Drake Way (sites 24 and 25). Site 24 in particular was identified as a contaminant hot spot, with a poor water quality similarly observed in previous years of sampling. Concentrations of nutrients (total oxidised nitrogen, nitrogen as ammonia/ammonium, total phosphorus, soluble reactive phosphorous) some metals (total and dissolved aluminium, and total and soluble zinc), and dissolved oxygen and electrical conductivity were all found to exceed ANZECC water quality trigger values at this site (SERCUL, 2013).

Groundwater salinity in the study area is typically in the range of 1500 to 3000 mg/L. Water from both the Leederville and Superficial aquifers in the groundwater management subarea is considered to be sufficiently good quality for irrigation of public and private open space without treatment.

There are no long term water-quality monitoring bores located within the study area however; it is known that nutrient levels in the groundwater within the Bayswater Brook catchment area are elevated. Because there is year-round discharge of groundwater flow to the Swan River via the Bayswater Brook drainage system, groundwater represents one of the most significant contributions to elevated nutrient levels within the Swan River system.

Gross pollutants, including; sediments, rubbish and plastics, are also a significant issue within the Morley Activity Centre. This is typical for commercial and light industrial areas and should be managed through the use of structural and non-structural approaches including:

- Gross pollutant traps at inlets and outlets of detention structures and on any discharges from commercial and light industrial lots
- Community engagement and education

3.7.1 Water quality improvement projects

The City of Bayswater is currently working with the Swan River Trust, Department of Water, CSIRO, Water Corporation and Perth NRM implement the Bayswater Brook Action Plan. One of the key projects which have been developed in the action plan is the restoration of the Eric Singleton Bird Sanctuary. This project is expected to significantly improve the quality of the water flowing from the Bayswater Brook catchment into the Swan River. Pollutant removal within the restored wetland has been estimated, a summary of which is presented in Table 8.

Table 8: Modelled pollutant removal of the Eric Singleton Bird Sanctuary design

Pollutant	Modelled wetland reduction
Phosphorous	200 kg
Nitrogen	1,350 kg
Total Suspended Solids	32,000 kg
Large Gross Pollutants	7,000 kg

Within the study area, the Russell Street Compensating Basin was previously the subject of a wetland creation project in 1994. The wetland was planted with emergent vegetation prior to the winter of 1994 and was monitored through 1995 under both steady flow conditions (ie during the normal rains of early, mid and late winter) and under storm conditions, where the wetland effectively held the first flush of stormwater runoff (DoE 2008).

An assessment of the wetland over the twelve month period identified significant growth of both emergent and floating vegetation and the existence of a complex assemblage of aquatic invertebrates as well as a number of fish species (DoE 2008).

The wetland was demonstrated to be somewhat effective in containing the most polluting form of stormwater - the first flush after a dry period. Monitoring in 1995 identified some removal (although sometimes an increase) of suspended solids and the nutrients, nitrogen and phosphorus through the wetland. Under steady flow conditions, the amounts of sediment and nitrate flowing through the Bayswater Main Drain were reduced. During high rainfall conditions (storm events) the Russell Street wetland was effective for nitrate removal (DoE 2008).

The current design of the Russell St compensating basin (wetland), whilst somewhat improved by these works, does not meet current best practice standards for constructed wetlands and the resulting water quality outcomes are poor in comparison to more recent projects such as at the Eric Singleton Bird Sanctuary wetland.

More recently the Bayswater Integrated Drainage Management Strategy Working Group undertook a prioritisation process to identify sites for improvement based on water quality monitoring. Sites identified within the Morley Activity Centre included (Figure 6):

- Russell St Compensating Basin and open drain (Plate 8)
- Jakobsons Way open drain (Plate 9)
- Rudloc Rd open drain (Plate 10)
- Vera St open drain (Plate 11)
- Nora Hughes open drain (Plate 12)

Each of these sites was identified as a 'priority site' as a result of poor water quality results during sampling in 2012 (SERCUL 2013). These sites also represent key opportunities to make improvements to the ecological and water quality functions of the drainage system being located within or adjacent to public reserves, school sites or retail sites (Bunnings in the case of Russell St Compensating Basin).

Collier Road and Russell St Compensating Basins and Open Drain



Plate 8: Russell Street Compensating Basin and Open Drain

Previous improvement works at Russell Street Compensating Basin focussed on revegetation around the basin itself as well as lengthening the flow path through the basin by creating a central island. There is vacant land to the east of the basin, where the open drain discharges downstream, which is in Water Corporation ownership. This land has been previously identified as necessary for increasing the capacity of the basin in the future, in particular if the removal of Collier Road Compensating basin is to occur. Because of the high profile location of this basin and the opportunity afforded by adjacent vacant land it is a key outcome of the Activity Centre structure plan to provide a high amenity area of public open space in this location. In addition to the proposed amenity improvements it is recommended that a key objective for this site is to enhance the wetland design to achieve improved biodiversity and water quality outcomes and convert the downstream open drain into a new living stream providing in-stream water quality treatment.

The City has had recent discussions with a key stakeholder/land owner in Morley which could potentially result in works to improve the capacity of the Collier Road compensating basin next to the Galleria shopping centre. A decked car parking structure could then potentially be built over the top of the expanded/improved basin.

The Water Corporation is currently undertaking conceptual modelling of the Bayswater Main Drain system to investigate proposals for aesthetic improvements to open drains and compensating basins. Various options, including the Collier Road Compensating Basin and its associated drainage pump station and pressure main, plus the Russell Street Compensating Basin, are being considered.

Jakobsons Way Open Drain

Jakobsons Way open drain (Plate 9) connects two areas of public open space; Jakobsons Reserve and Peters Place Reserve. The site is also close to Infant Jesus Primary School which provides a good opportunity for community involvement in a potential improvement project. Because of the adjacent and connecting public open spaces there is an excellent opportunity to improve amenity as well as environmental outcomes creating a new vegetated living stream with an adjacent footpath.



Plate 9: Jakobsons Way Open Drain

Rudloc Road Open Drain

Rudloc Road open drain (Plate 10) is located within the Rudloc Road Reserve and provides an excellent opportunity for improved amenity and environmental outcomes with sufficient surrounding space to provide for many alternative approaches to treatment and revegetation to be considered. The drain also extends upstream of the reserve between residential lots and there may also be opportunities to improve the amenity and function of this section of open drain. If the removal of Collier Road Compensating Basin is envisaged, Russell Road Compensating Basin will require enlargement and it is likely that a new basin will need to be constructed. Rudloc Road Reserve provides a possible location for this to occur. This 'collective management' approach has been the subject of discussions between the City of Bayswater and the Water Corporation and will require further investigation in order to optimise drainage, water quality and public open space outcomes.



Plate 10: Rudloc Road Open Drain

Vera Street Open Drain

Vera Street open drain (Plate 11) is a relatively short stretch of open drain along the backs of residential lots, access to the drain is relatively good and its location close to Morley Primary School provides a good opportunity for community involvement in a potential improvement project. However, the site is relatively constrained, with limited opportunities (space) for creation of meanders or revegetation.



Plate 11: Vera Street Open Drain

Nora Hughes Open Drain

Nora Hughes open drain (Plate 12) provides a key opportunity to improve water quality in Nora Hughes Lake through conversion to a living stream providing improved treatment and amenity. The drain is located adjacent to John Forrest Secondary College and close to the City of Bayswater Administration Centre making it an ideal location for a community demonstration projects. In addition, engagement of the community in a project to make improvements that will affect a significant and valued existing asset (Nora Hughes Lake) would be a valuable outcome as a part of the Morley Activity Centre revitalisation.



Plate 12: Nora Hughes Open Drain

Gross Pollutant Traps

As previously discussed, gross pollutants are a significant issue within the Bayswater Brook catchment. The installation of gross pollutant traps is recognised as a cost effective way to achieve immediate outcomes as a retrofitted element of an existing drainage system. Gross pollutant traps have been incorporated into the Eric Singleton Bird Sanctuary designs and a significant proportion of the expected water quality outcomes are related to these structures.

The installation of gross pollutant traps throughout the Bayswater Brook catchment is proposed to be undertaken by the City and incorporated into their long term financial plan. The priorities for implementation will focus on capturing discharges from commercial and industrial parts of the catchment, as well as areas located upstream of wetlands and compensating basins.

Tree planting and improvement works

A program of tree planting and improvement works is currently being designed for key sites throughout the City of Bayswater. Increased tree numbers will improve amenity, reduce urban heat island effects and provide opportunistic habitat for native species.

The provision of new street trees provides an excellent opportunity for retention of small rainfall events and integration of water quality treatment within existing streetscapes. Plate 13 shows some examples of how street tree pits can be installed in existing urban and suburban streets.

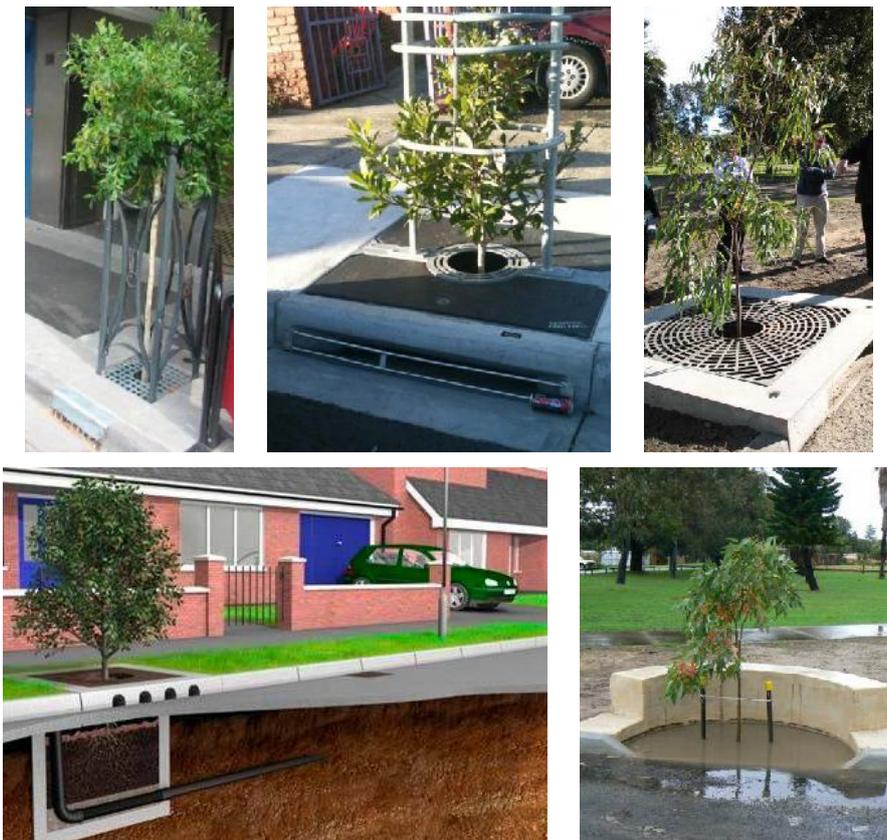


Plate 13: Street tree pits for stormwater retention and water quality treatment

3.8 Water Supply

3.8.1 Potable water supply

The structure plan area is located within the Water Corporation's East Yokine-Morley Water Supply Scheme area.

The Water Corporation was consulted during development of the Morley City Centre Masterplan in 2010. Advice received in response, indicated that there were no major upgrades planned within the project area although mains duplication on Walter Road (DN 500 between Collier Rd and Crimea St) and a new DN300 main on Catherine St were planned at that time outside of the area.

Further, the Water Corporation have advised that:

The proposed concepts may present service implications for the area's water supply in terms of capacity and its structural alignment, however at this stage land use planning is not developed enough for the Corporation to determine its specific requirements. In progressing planning for the project area, the Corporation encourages consideration be afforded to the following matters:

Service Capacity – Should the revitalisation concept incorporate significant densification of uses, above and beyond what the Corporation's current infrastructure planning is based upon, service upgrades both internal and external to the project area may be required. Accordingly upgrades to reticulation infrastructure will be undertaken by relevant developers and headworks items by the Corporation.

Protection of Infrastructure Assets – the design should seek to protect the Corporation's existing infrastructure assets.

In an update to the above advice, received in October 2013, the Water Corporation identified that there are no strategic changes to the Corporation's infrastructure planning although it was suggested that this project may trigger a planning review.

3.8.2 Non-potable supply

There are limited opportunities to introduce widespread use of non-potable water in the Morley Activity Centre. Groundwater is currently used by the City for irrigation of public open space and this will continue, with water efficient landscape design and irrigation practices used to limit future public open space irrigation demand to current licensed volumes.

There are significant opportunities for industrial and commercial sites to incorporate rainwater tanks or greywater recycling systems on an individual basis.

A water demand assessment has been developed for the study area to consider the impact of proposed development. The Morley Activity Centre structure plan proposes to significantly increase residential density and commercial floorspace within the Activity Centre as described in section 2 transforming the existing land use breakdown presented in Table 1 to the proposed future (2031) land use breakdown in Table 2.

Overall drinking water demand within the Activity Centre is predicted to more than double based on the target residential densities and increase in commercial floorspace. The demand for water for irrigation of public spaces also increases, as a result of improvements to amenity in streetscapes and changing public open space requirements.

Table 9: Annual summary water demands

Scenario	Domestic	Commercial	Public open space and streetscape irrigation	Total
Existing	443.3	286.9	161.1	891.3
Future (2031)	1,207.2	431.4	181.3	1,819.9

Note: All quantities are in ML/year

Projected per capita domestic water demands are presented in Table 9 and identify that the increasing residential density is expected to lead to significantly reduced per capita domestic irrigation demand through reduced private open space. It will be important to ensure that high amenity public open spaces and streetscapes are provided in the City Centre to compensate for this and this is expected to necessitate an increased public open space irrigation demand, particularly in the short term to establish trees and vegetation throughout the Activity Centre.

Table 10: Per capita annual residential water demands

Scenario	Household usage	Domestic irrigation	Total
Existing	63	30	93
Future (2031)	65	15	80

Note: All quantities are in kL/person/year

From the demands assessment presented above it is clear that a residential per capita water use target of 80 kL/person/year can be achieved. Considering a scenario where an alternative water source can be identified to provide for domestic irrigation and/or in-house non-drinking water demands it is reasonable to expect that a target of 65 kL/person/year could be achieved.

3.9 Wastewater services

The structure plan area is located within the Water Corporation's Morley – SD053 Sewer Catchment District which collects wastewater and conveys it to the Beenyup Wastewater Treatment Plant. The structure plan area contains two existing wastewater pumping stations located in commercial/light industrial areas as shown in Figure 5.

The Water Corporation was consulted during development of the Morley City Centre Masterplan in 2010. Advice received in response, indicated that there were no major upgrades planned within or surrounding the project area. Further, the Water Corporation advised that:

Based on the nature of the developments shown on the proposed development concepts, the project may present service implications for the areas wastewater service infrastructure in terms of capacity, as future development may exceed the densities for which the current service infrastructure was planned to accommodate. Notwithstanding this, it is premature at this stage, for the Corporation to determine its specific upgrade requirements. In progressing planning for the project area, the Corporation encourages consideration be afforded to the following matters:

Protection of Infrastructure Assets – The Corporations existing assets, should be protected within adequately designed road reservations or within land afforded to or

currently owned by the Corporation. The project team should also be conscious that once an understanding of the form and location of future uses becomes clear, consultation with the Corporation should be undertaken as a priority, in order for the need for infrastructure upgrades to be clarified.

Land use planning – in the arrangement of uses within the area, the Corporation has certain requirements in respect of its infrastructure assets. Sensitive uses should be adequately separated from assets such as wastewater pumping stations so as not to be impacted upon by odour or noise emissions, and provision for service mains should be provided for within road reserves etc.

Service Capacity – Should the revitalisation concept incorporate significant densification of uses, above and beyond what the Corporation's current infrastructure planning is based upon, service upgrades both internal and external to the project area may be required. Accordingly upgrades to reticulation infrastructure will be undertaken by relevant developers and headworks items by the Corporation.

In an update to the above advice, received in October 2013, the Water Corporation identified that there are no strategic changes to the Corporation's infrastructure planning although it was suggested that this project may trigger a planning review.

3.10 Key water resource issues

Key issues relevant to development within the Morley Activity Centre are:

Water quality – Existing and future commercial and light industrial areas present a significant risk to water quality in the surface water and groundwater of the Bayswater Brook catchment particularly through the introduction of gross pollutants to wetlands and watercourses. Development within the Morley Activity Centre has an opportunity to positively contribute to water quality improvement through the implementation of water sensitive urban design and creation of living streams from exiting open drains.

Drinking water supply and wastewater services – The increases in residential density and commercial areas proposed by the Morley Activity Centre Structure Plan will significantly increase the demand for drinking water and generation of wastewater in the area. This will place a burden on existing services and is likely to require upgrades to those systems and services. To minimise this impact, development will need to carefully consider water efficiency measures as well as investigating the use of alternative water sources for non-drinking water demands.

Groundwater use and public open spaces – the Morley Activity Centre Structure Plan does not propose the creation of substantial new public open spaces. However, with a significantly increased residential and working population with limited private open spaces there will be a need for existing open spaces and streetscapes to provide high amenity green open spaces that can expect high use and will therefore require significant maintenance and irrigation. These spaces will also be important in combating urban heat island effects in the future and the irrigation of these spaces should consequently be seen as a 'high value use' for water. Currently the public open spaces within the Morley Activity Centre are irrigated using groundwater and this is likely to continue in the future. However there may be opportunities to investigate stormwater harvesting from the existing main drainage system to facilitate increased demands for irrigation in the future.

4 WATER MANAGEMENT STRATEGY

The Morley Activity Centre Local Water Management Strategy proposes that the redevelopment of the area will achieve the following objectives:

- i. Improve water quality within the stormwater system while maintaining the flood protection and conveyance capacity of the drainage system.
- ii. Maximise opportunities for creation of living streams to improve water quality treatment and amenity outcomes
- iii. Optimise water use efficiencies including for irrigation and increase water reuse.
- iv. Achieve water sensitive landscapes (both public and private realm) which incorporate water quality management and reflect the Western Australian climate.

These objectives are to be achieved through the implementation of the following strategies and design criteria for stormwater and groundwater management; water resource use; and landscaping.

4.1 Stormwater and groundwater management

The Morley Activity Centre Local Water Management Strategy proposes to promote the enhancement of the stormwater management system through the potential creation of living streams in the following locations shown on Figure 6:

- Russell St Compensating Basin and open drain
- Vera St open drain
- Jakobsons Way open drain
- Rudloc Rd open drain
- Nora Hughes open drain

The creation of living streams in these locations can occur in isolation from any surrounding development however there are substantial opportunities for better outcomes to be achieved through integration with the planning process. It is therefore recommended that local development plans are prepared for these locations with supporting urban water management plans. The development of local development plans and urban water management plans for these sites should incorporate the following tasks:

- Undertake pre and post development modelling of the stormwater system to ensure run-off from future development scenarios is able to be adequately managed by the proposed stormwater system
- Design and construct identified living stream pathways, having consideration of existing infrastructure capacity requirements and delivery of Activity Centre objectives

4.1.1 Water Corporation involvement

As stated previously, the Water Corporation has undertaken preliminary drainage planning for the area and has identified a number of upgrades to the system. These, together with the stormwater enhancement projects as proposed above, are identified on Figure 6.

The Water Corporation is also undertaking conceptual modelling of the Bayswater Main Drain system to investigate some of the stormwater enhancement projects, including the Collier Road and Russell Street Compensating Basins and the basin in Rudloc Reserve. These investigations will determine the viability of these projects (Pers. Comm. F. Kroll, Water Corporation, March 2014).

Any changes to the Water Corporation drainage system will need to be undertaken in consultation with the Water Corporation and will require further detailed design, justification and agreement. This includes consideration of the modifications outlined in section 3.5.4 to ensure that the capacity of the main drains is sufficient to meet the conditions of the Water Corporation's operating license.

4.1.2 Local stormwater and groundwater management

The following additional actions are proposed to achieve improvements in the water quality of the stormwater system while maintaining the flood protection and conveyance capacity of the drainage system.

Local development plans, subdivision and development applications will need to address water management issues and deliver the objectives of this strategy through a number of actions which should include:

- Integrate stormwater detention (drainage basins/biofilters) into any proposed new or retrofitted area of public open space to improve water quality and increase the capacity of the drainage storage system if appropriate
- Maximise retrofitting of stormwater management systems to achieve improved water quality outcomes through the installation of biofilters (raingardens), amended soils and the use of structural controls to address litter, sediment and vegetative materials at source. Consider car parks for location of biofilters and other controls.
- Where practical create vegetated buffer zones/verges and implement water sensitive urban design principles between waterways and turf in council reserves to help prevent herbicides, fertilisers and grass clippings entering waterways
- Work with the Swan River Trust to ensure that surface and groundwater flows and quality meet the appropriate design and performance criteria for the Swan River
- Identify low traffic areas including pathways and medians in parking areas and incorporate permeable pavements where practicable
- Ensure developers, builders and landscapers implement best management practices to control erosion and sedimentation to protect waterways
- Maintain street sweeping programs and develop a monitoring plan to assess the efficiency of current schedules and future procedures
- Use artwork and signage to emphasise environmental and hydrological connections between wetlands, groundwater and the Swan River

City of Bayswater - Morley Activity Centre Local Water Management Strategy

Figure 6: Proposed modifications to existing drainage system



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4.1.3 Design criteria

Any development within the Morley Activity Centre area should aim to meet the following specified design criteria using appropriate best management practices. Additional design criteria may need to be met, particularly where they are specific to particular precincts. These will be outlined in the relevant Local Development Plan or associated development guidelines.

- The post-development critical one-year average recurrence interval peak flow and volume shall be equal to or less than pre-development flows at the discharge points of all plan and/or development areas
- All flows from constructed impervious surfaces are to receive treatment prior to infiltration or discharge
- Flows from subsoil drains are to be treated prior to infiltration or discharge
- Gross pollutant traps are to be provided at inlets and/or outlets of detention structures and on any discharges from commercial and light industrial lots
- Runoff from events greater than the 1 in 1 year average recurrence interval event and up to the 5 year average recurrence interval event in residential areas and 10 year average recurrence interval event in commercial/industrial areas are to be managed in accordance with the agreed post-development scenario, to the serviceability requirements of *Australian Rainfall and Runoff* (Engineers Australia, 2001) minor/major system.
- Roads and public open spaces are to be designed to cater for the surface overflow for more severe storm events with habitable floors at least 0.3 m above the 100 year average recurrence interval flood or storage level at any location
- Water quality treatment systems and stormwater management structures should be designed in accordance with the *Stormwater Management Manual for Western Australia* (Department of Water, 2004-07) and *Australian Runoff Quality: A guide to water sensitive urban design* (Engineers Australia, 2006)
- Adopt or maintain regular cleaning of gullies and stormwater pollutant traps to enable pollution spills to be contained and educted before entering the waterways.

4.2 Water resource use

The following actions are proposed to optimise water use efficiencies and maximise reuse wherever possible. It is proposed that water use is no more than 80 kL/person/year, including no more than 65kL/person/year scheme water where provision of an alternative source (rainwater tank or grey water system) is feasible.

Local development plans and development applications will need to address water management issues and deliver the objectives of this strategy through a number of actions which should include:

- Harvest stormwater from impervious areas (excess roof water, paved areas and roads) for non-potable reuse or to recharge superficial aquifers where appropriate
- Maximise efficiency of groundwater usage for irrigation of any additional open spaces so that additional allocations are not required.
- Consider opportunities for new development to incorporate fit-for-purpose water supplies through the development of a local water balance
- Develop and implement design guidelines which require water use efficiency measures to be implemented in private and public open spaces and within developments, including
 - water efficient fixtures, fittings and appliances, including WELS (Water Efficiency Labelling and Standards) rated flow controllers, toilets, taps and urinals;

- landscaping which incorporates the use of waterwise gardens, rain gardens, smart irrigation systems, and use of alternative sources of water;
- smart metres for water in all new developments;
- Incorporate fit-for-purpose supply options and requirements into design guidelines
- Development to consider opportunities for wastewater recycling

It is recommended that the City of Bayswater undertake an audit of water usage in all public open spaces to identify opportunities for modification to landscaping and irrigation systems to reduce water consumption and improve efficiency. It is also recommended that the City of Bayswater investigate opportunities for stormwater harvesting from the main drainage system as an alternative water supply for irrigation. Any proposal for stormwater harvesting will need to ensure that environmental water flows into the Swan River and wetlands will be maintained.

Although the Water Corporation runs an intensive water efficiency campaign, it is considered that the City of Bayswater could also promote water efficiency measures within the community and workplace including behaviour change and the retrofit of more water efficient fittings and fixtures.

4.3 Landscaping

The following actions are proposed to facilitate the use of water sensitive design to minimise heat island effects and the incorporation of water quality treatment measures as part of landscaping.

Local development plans, subdivision and development applications will need to address water management issues and deliver the objectives of this strategy through a number of actions which should include:

- Include bioretention areas and tree pits in the (re)design of parking areas
- Use waterwise, locally native plants in all landscaped areas
- Consider opportunities for roof gardens and green walls in new medium density commercial and residential areas
- Incorporate bioretention areas and tree pits into streetscapes

5 IMPLEMENTATION

As this area is an existing town centre and urban area, implementation of this local water management strategy will occur largely on an ad-hock basis, as development and redevelopment proposals are approved and constructed. The key opportunities for redevelopment include:

- Commercial development associated with Centro Galleria commercial complex and Coventry Square Markets.
- High density residential throughout the centre
- Creation of living streams and associated public parklands
- Residential intensification throughout the structure plan area

5.1 Water quality improvement projects

The City of Bayswater is committed to the implementation of water quality improvement projects within the Morley Activity Centre and is currently progressing with the allocation of funds and programming of key actions for the following identified projects.

5.1.1 *Living Stream - Jakobsons Way*

\$240,000 is programmed in the City of Bayswater Long Term Financial Plan 2012-23 for the design and construction of a Living Stream in Jakobsons Way.

The project will occur in three phases as follows:

- \$50,000 is programmed for the design phase which will occur in 2015/16.
- \$140,000 is programmed for the implementation phase which will occur in 2017/18.
- \$50,000 is programmed for the re-vegetation of the Living Stream.

5.1.2 *Living Stream - Location yet to be finalised*

An additional living stream project (with the same level of funding as Jakobsons Way) is programmed in the City of Bayswater Long Term Financial Plan 2012-23. Design and implementation is programmed to occur from 2018 through to 2021. Opportunities for this project exist at the following locations which are discussed in more detail in section 3.7.1:

- Rudloc Rd open drain
- Vera St open drain
- Nora Hughes open drain

5.1.3 *Gross pollutant traps*

The City will aim to develop a ten year 'roll out plan' to install gross pollutant traps in the Morley Activity Centre including identification of critical locations to capture discharges from commercial and industrial areas upstream of compensating basins and wetlands.

5.1.4 *Streetscape Masterplan*

The City of Bayswater is developing a Streetscape Masterplan that will provide a vision for the future streetscape of the Morley activity centre. The plan will outline the location, number and species to be planted in the centre and will incorporate Water Sensitive Urban Design principles and help to provide for enhanced stormwater management and permeability. The

Streetscape Masterplan is currently programmed for completion by 2017 and has an allocated budget of \$50,000.

5.1.5 Tree planting and improvement works

A program of tree planting and improvement works is currently being designed for key sites throughout the City of Bayswater. The City will investigate opportunities to incorporate stormwater retention and water quality treatment within tree pits for implementation wherever feasible.

5.1.6 Compensating Basins

The City continues to work closely with the Water Corporation and other key stakeholders to progress with modifications and improvements to selected compensating basins within the Morley Activity Centre. The Water Corporation are currently undertaking a conceptual drainage study to investigate the feasibility of various options which is expected to be completed by December 2014.

5.2 Requirements for future planning and development

Although this Strategy provides guidance on water management in the Morley Activity Centre area, additional design and detail is required and will be provided via Local Development Plans in order to guide subdivision. Each local development plan will need to be accompanied by an Urban Water Management Plan. Subdivision and development will then be required to be consistent with the Morley Activity Centre structure plan and local development plan.

The requirements for implementation of this Local Water Management Strategy are outlined below and summarised in Table 11.

5.2.1 Local Development Plans

More detailed information to guide the redevelopment will be provided at the precinct scale, via preparation of Local Development Plans. Each local development plan should be accompanied by an Urban Water Management Plan, which will need to be developed in consultation with the City of Bayswater and the Department of Water.

Each urban water management plan should be based on local site investigations appropriate to the proposal and level of risk to water resources, and contain more detailed design which demonstrates how the objectives, strategies and design criteria contained in this Strategy are to be achieved.

The urban water management plans should be consistent with the requirements of the Department of Water's *Urban water management plans: Guidelines for preparing plans and for complying with subdivision conditions* (DoW, 2008a), recognising that the area is a redevelopment area rather than a greenfield site.

In addition, post-development monitoring is essential to assess hydrological impacts of larger redevelopment proposals, particularly where these have the potential to impact sensitive environments or may be affected by contamination or acidic or contaminated groundwater. Monitoring programs are to be designed in cooperation with the Department of Water, and in accordance with the *Stormwater Management Manual for Western Australia* (Department of Water, 2004-2007). The results of post-development monitoring programs should be reported to the City of Bayswater and the Department of Water, in a manner acceptable to each.

Urban water management plans are to be developed by the body responsible for preparation of the local development plan and should be lodged together with the local development plan for public comment, to be subsequently adopted with the final local development plan.

5.2.2 Subdivision

Subdivision should be undertaken in accordance with the approved local development plan and associated urban water management plan, as well as with the objectives, strategies and design criteria in this Local Water Management Strategy.

It is recognised that where subdivision is proposed in an area that is not covered by a local development plan, this is likely to involve less than 30 lots. In these instances, an urban water management plan will not normally be required; however development should be consistent with the objectives, strategies and design criteria in this Local Water Management Strategy.

The City of Bayswater and/or the Department of Water may, however, request preparation of an urban water management plan to support an application for subdivision where they consider additional information is required to demonstrate compliance with this Strategy. In this instance, the urban water management plan should be developed and assessed in accordance with the Department of Water's *Urban water management plans: Guidelines for preparing plans and for complying with subdivision conditions* (DoW, 2008a).

5.2.3 Development

All development is to be in accordance with the objectives, strategies and design criteria in this Local Water Management Strategy. Additional design criteria may need to be met, particularly where they are specific to particular precincts. These will be outlined in the relevant Local development plan, urban water management plan or associated development guideline.

Engineering and building drawings submitted to Council for development approval are to be supported by clear and auditable documentation, providing details outlining the water management requirements including any proposed staging, and demonstrating compliance with design criteria.

Where required, the City of Bayswater may seek the advice of the Department of Water regarding water management measures outlined in any development application.

Table 11: Summary of roles and responsibilities

Planning action	Water planning requirement	Timing and responsibility	Additional comments
Morley Activity Centre Structure Plan	Supported by LWMS which includes objectives, strategies and criteria to be met as part of planning and development	LWMS accompanies the structure plan City of Bayswater	LWMS may be revised as detailed planning progresses or information comes to light
Local Development Plan (LDP)	Supported by an urban water management plan (UWMP) which demonstrates how the proposed development meets the objectives,	Required prior to any subdivision or development occurring Proponent	Where development is proposed to include amendments to Water Corporation drainage infrastructure the UWMP will need to include detailed

Planning action	Water planning requirement	Timing and responsibility	Additional comments
	strategies and criteria in the LWMS.		designs for the modified drainage infrastructure agreed by the Water Corporation.
Subdivision	Must meet the requirements of the relevant UWMP (and LWMS)	Should not occur until LDP and UWMP completed Proponent	Unlikely that a UWMP will be required due to the small scale nature of likely subdivision
Development	Must meet the requirements of the relevant UWMP (and LWMS)	Should not occur until LDP and LWMS completed Proponent	Should be consistent with relevant design guidelines

5.3 Review

This Local Water Management Strategy should be reviewed every 5 years or as required to ensure currency of recommendations and that ongoing, viable and sustainable water management solutions are being achieved.

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Report	Version	Prepared by	Reviewed by	Submitted to Client	
				Copies	Date
Preliminary draft	V1	HBr	SSh	Electronic	Dec 2013
Final draft	V2	HBr	SSh	Electronic	Jan 2014
Draft for consultation	V3	HBr	SSh	Electronic	Feb 2014
Final report	V4	HBr	SSh	Electronic	March 2014
Final report (updated SP)	V5	HBr	SSh	Electronic	August 2014

Essential Environmental

land & water solutions

622 Newcastle St Leederville 6007

p: 08 9328 4663 | f: 08 6316 1431

e: info@essentialenvironmental.com.au

www.essentialenvironmental.com.au