City of Melville

Canning Bridge Activity Centre

Local Water Management Strategy

March 2014

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1. Introduction

GHD Pty Ltd was commissioned by City of Melville and City of South Perth to prepare a Local Water Management Strategy (LWMS) for the Canning Bridge Activity Centre Structure Plan (the study area).

The Canning Bridge Activity Centre study area is identified as a district centre under *State Planning Policy 4.2: Activity centres for Perth and Peel* (Western Australian Government 2010) and *Central Metropolitan Perth Sub-Regional Strategy; Direction 2031* (WAPC 2010). District centres are identified as having a community focus with provision of services, facilities and job opportunities to the local catchment. The Canning Bridge Activity Centre Structure Plan provides a framework for the redevelopment and revitalisation of the Canning Bridge Activity Centre.

The City of Melville and the City of South Perth are both Waterwise Councils and members of the Cities for Climate Protection, and support the implementation of a total water cycle management approach and best practice for planning and development for redevelopment and new development within the Canning Bridge Activity centre area.

1.1 Planning background

This LWMS has been prepared in accordance with *State Planning Policy 2.9: Water Resources* (WAPC 2004) and *Better Urban Water Management* (WAPC 2008). The planning framework for land and water planning is illustrated in Figure 1.

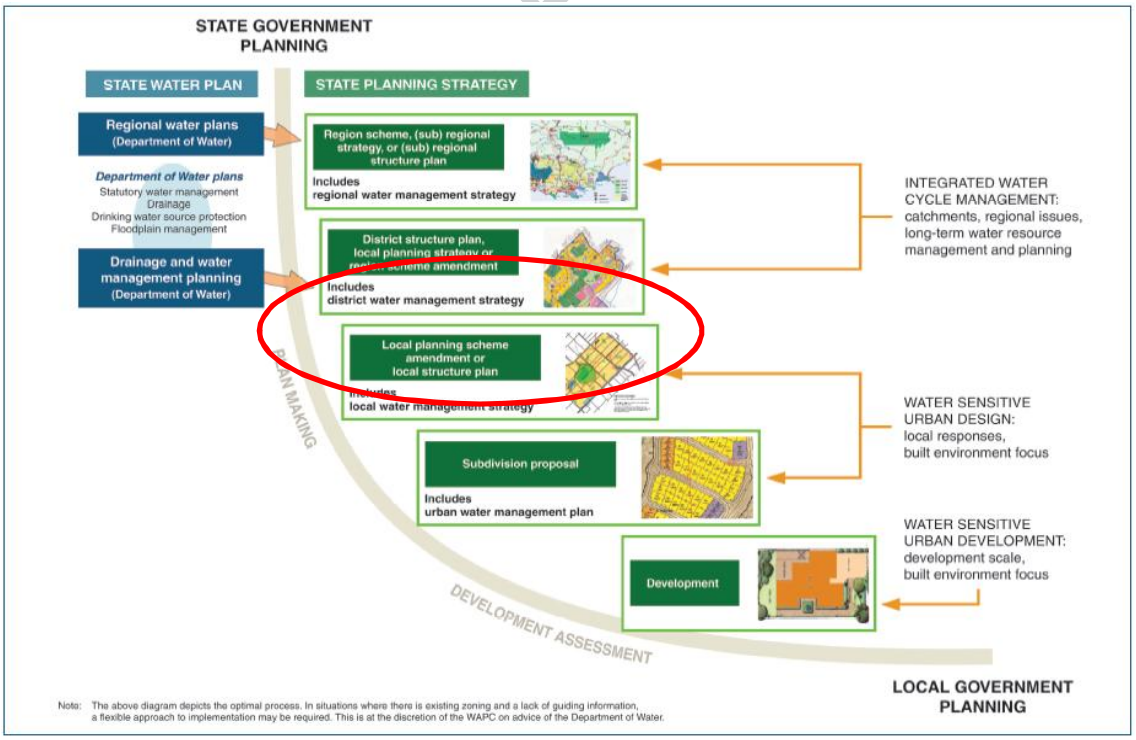

Figure 1 Framework for integrating water planning with land planning

1.2 Purpose of this report

This LWMS has been prepared to support new development and redevelopment within the Canning Bridge Activity Centre Structure Plan area. The strategy provides background to the study area, and identifies key principles, design criteria and development requirements, and additional guidance to support new development and redevelopment in the study area.

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1.3 Previous studies and relevant legislation

In addition to the planning documents identified in Section 1.1, the following documents have been used to inform the water management principles and design criteria outlined in this LWMS.

Water Sensitive Urban Design Guidelines for the City of South Perth

The *City of South Perth developed Water Sensitive Urban Design* Guidelines (Aurecon 2012) to provide guidance on the integration of water cycle management with urban development within the City, with the aim of transitioning to a Water Sensitive City. The Guidelines detail:

- Water sensitive urban design objectives for water conservation, wastewater management and stormwater management.
- Requirements for water management reporting for proposed development.
- Stormwater design criteria, including catchment pervious area criteria and storm event criteria.
- Climate change and its consideration for development.
- Recommended WSUD measures.

City of South Perth Integrated Catchment Management Plan

The *City of South Perth Integrated Catchment Management Plan* (JDA 2004) identifies surface water catchments and environmental priority catchments, and provides recommendations for the management of water quality issues within each catchment.

The plan recommends a total water cycle management approach and considers non-structural water quality control techniques to be vital in achieving sustainable stormwater quality improvements. The strategy recommends the use of education campaigns, native plantings, review of maintenance activities and street sweeping as preferred cost effective methods for protecting receiving environments. Additional structural controls are identified as potentially being required following a treatment train approach, requiring assessment on a case by case basis.

City of Melville Stormwater Management Strategy; Treatment Prescriptions

The *City of Melville Stormwater Management Strategy* (Kinhill 1997) was developed to provide guidance on stormwater management, including improving stormwater quality and investigating options for reuse. The strategy also notes the importance of integrated catchment management and land use planning in achieving stormwater outcomes.

The strategy presents conceptual treatment options for the 111 identified stormwater catchments based on the piped network within the City of Melville, noting that detailed investigations would be required to support final designs. As the strategy was prepared as water sensitive urban design was being introduced to Western Australian stormwater design the options may not represent current best management practice, however the strategy identifies existing site constraints and discusses potential options for the different catchments.

Within the Canning Bridge activity centre area a number of catchments are identified as 'lot and street scale (approx. < 1ha catchment) which are typically constrained at their outlet due to discharge within the tidal zone and in areas of limited foreshore reserve. Recommendations for these small catchments generally comprise lot scale treatment of soakwells, litter baskets and grassed filter strips, noting that effective improvements would most likely be achieved through changes in lot management practices. For larger catchments with outlets to public open space treatment options were identified to include shallow constructed basins at the outlet, although these areas may be constrained by high groundwater.

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Adapting to Climate Change in the City of Melville 2012-2017

The *Adapting to Climate Change in the City of Melville 2012*-2017 (Environmental Services 2012) report is an adaptation plan that proposes actions to reduce the risks of climate change on the services, facilities and assets within the City of Melville and assist the community to adapt to those changes. The report recognises that under a drying climate the City may need to implement the following strategies:

- Increase water use efficiency;
- Turf areas may be reduced by native landscaping recognising that local native plants are better adapted to the conditions of the south west than turf,
- Integration of best practice design into irrigation and community buildings to reduce potable water use;
- River localities may be impacted by rising sea levels and foreshore erosion from storm surge.

Key actions relevant to total water cycle management include:

- Undertake an assessment of drainage infrastructure to cope with storm events.
- Ensure landscape and road designs incorporate climate sensitive considerations.
- Maintain Waterwise Council status through implementing the criteria and continual improvement in water efficiency and reduced consumption.
- Ensure staff are aware of climate change risks and the City's obligations through the implementation of EMS training and awareness.
- Review foreshore management strategy including actions from the SRT sea level rise risk assessment.
- Develop a strategy to reduce reliance on groundwater sources – Water Rationalisation Strategy.
- Actively promote the use of local native plants in gardens and verges to create green corridors.
- Prepare response plans and preventative measures for mosquito and other vector borne diseases.

City of Melville Natural Areas Asset Management Plan

The City of Melville's *Natural Areas Asset Management Plan* (Waters 2011) provides a framework for the management of the natural area reserves, including assets that are priorities for maintenance and enhancement, threats that impact upon those assets and strategies and guidelines that manage threats to assets. Threats relevant to redevelopment and water management in the Canning Bridge Activity centre include stormwater, acid sulphate soils and groundwater.

Local Water Quality Improvement Plan Bull Creek Catchment

The *Local Water Quality Improvement Plan; Bull Creek Catchment* (SRT 2012) was prepared to provide a mechanism to prioritise recommendations for water quality improvements within the Bull Creek catchment. The portion of the Canning Bridge Activity centre study area located to the south of the Canning Highway within the City of Melville is located within the Bull Creek catchment.

Key issues within the catchment are identified as nutrient inputs, with non-nutrient contaminants (metals and hydrocarbons) also noted to be of concern. Specific issues are identified as fertiliser

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use, lack of water sensitive urban design best practice, impact from previous land use (contaminated sites and farming) and impact of light industry and septic tanks.

The local WQIP identifies a number of management strategies comprising both non-structural and structural controls that may be applied throughout the catchment.

State Planning Policy 4.2 Activity centres for Perth and Peel

State Planning Policy 4.2 (SPP 4.2) identifies the requirements for planning, redevelopment and renewal of existing centres. Under SPP 4.2 the Canning Bridge activity centre must ensure that planning contributes to the conservation of resources, in particular reduced consumption of water, with identification of design guidelines for the application of sustainable development principles to maximise water conservation. In particular SPP 4.2 identifies the planning considerations in Table 1 with regards to water.

Table 1 SPP 4.2 planning considerations for water management

Element	Planning considerations
Waterwise plants	While landscaping helps soften the public environment and provide respite consideration must be given to the type of plants used. Landscaped areas should be designed for high water efficiency through use of 'waterwise' planting.
Stormwater management	Investigate opportunities to apply Water Sensitive Urban Design principles to manage stormwater from roads and open space, and to incorporate other integrated water systems.
Efficiency measures	Water conservation may extend to buildings through water-saving installation and management measures. Structure plans may set design controls for water-efficient development including targets to collect and re-use rainwater.

SPP 4.2 also notes under clause 6.4 the following with respect to water:

- Mandate the use of waterwise plants and trees in all centre landscape plans.
- Establish targets for stormwater and greywater use.

1.4 Scope and limitations

This report: has been prepared by GHD for City of Melville, City of South Perth, Department of Planning, Department of Transport, Public Transport Authority and Main Roads Western Australia (Project Partners) and may only be used and relied on by the Project Partners for the purpose agreed between GHD and the Project Partners as set out in section 1 of this report.

GHD otherwise disclaims responsibility to any person other than Project Partners arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section(s) 1 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

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GHD has prepared this report on the basis of information provided by the Project Partners and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

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2. Proposed development

2.1 The strategy area

The Canning Bridge Activity Centre comprises approximately 164 ha of land within the City of Melville and City of South Perth, dissected on a north south alignment by the Canning River (Figure 2). The study area includes parts of the suburbs of Applecross and Mount Pleasant west of the river, and parts of Como and Manning east of the river.

The study area is located approximately 6 km south of Perth and can be broadly defined by an 800 m radius centred on the Canning Bridge Train Station.

2.2 Key elements of the proposed development

Planning for the Canning Bridge Activity Centre area has been undertaken recognising that the planning is long term, with some elements likely to occur over shorter timescales (10 to 20 years) while the whole plan will likely take over 50 years.

Key elements of a plan for Canning Bridge were proposed during the preparation of the Canning Bridge Precinct Vision and included:

- Substantial redevelopment opportunities with an increase in residential densities and building heights subject to performance based streetscape and built form design guidelines.
- Promotion of sustainable building types and uses which support the community.
- Creation of a town square and central community hub in Applecross.
- Opportunities for new commercial development adjacent to the freeway in Como in the longer term, including limited development on the foreshore.
- Enhancement of streetscapes and foreshore reserves, including increasing the size of the foreshore recreation areas.
- Improved pedestrian, cyclist and public transport connections and improvement in general pedestrian accessibility within each local government.
- A new traffic connection resulting from the establishment of a third (replacement) structure over the river.
- Identification of opportunities for improved traffic movement associated with the Canning Highway/Kwinana Freeway interchange.

2.3 Proposed development

The Canning Bridge Structure Plan identifies the following growth plan for the activity centre:

Population

Current population	approx. 3,800
Population in 2051	approx. 24,000

Dwellings

Current dwellings	approx. 1,900
Dwellings in 2031	approx. 4,000 (dwelling density per hectare 25)
Dwellings in 2051	approx. 12,000 (dwelling density per hectare 74)

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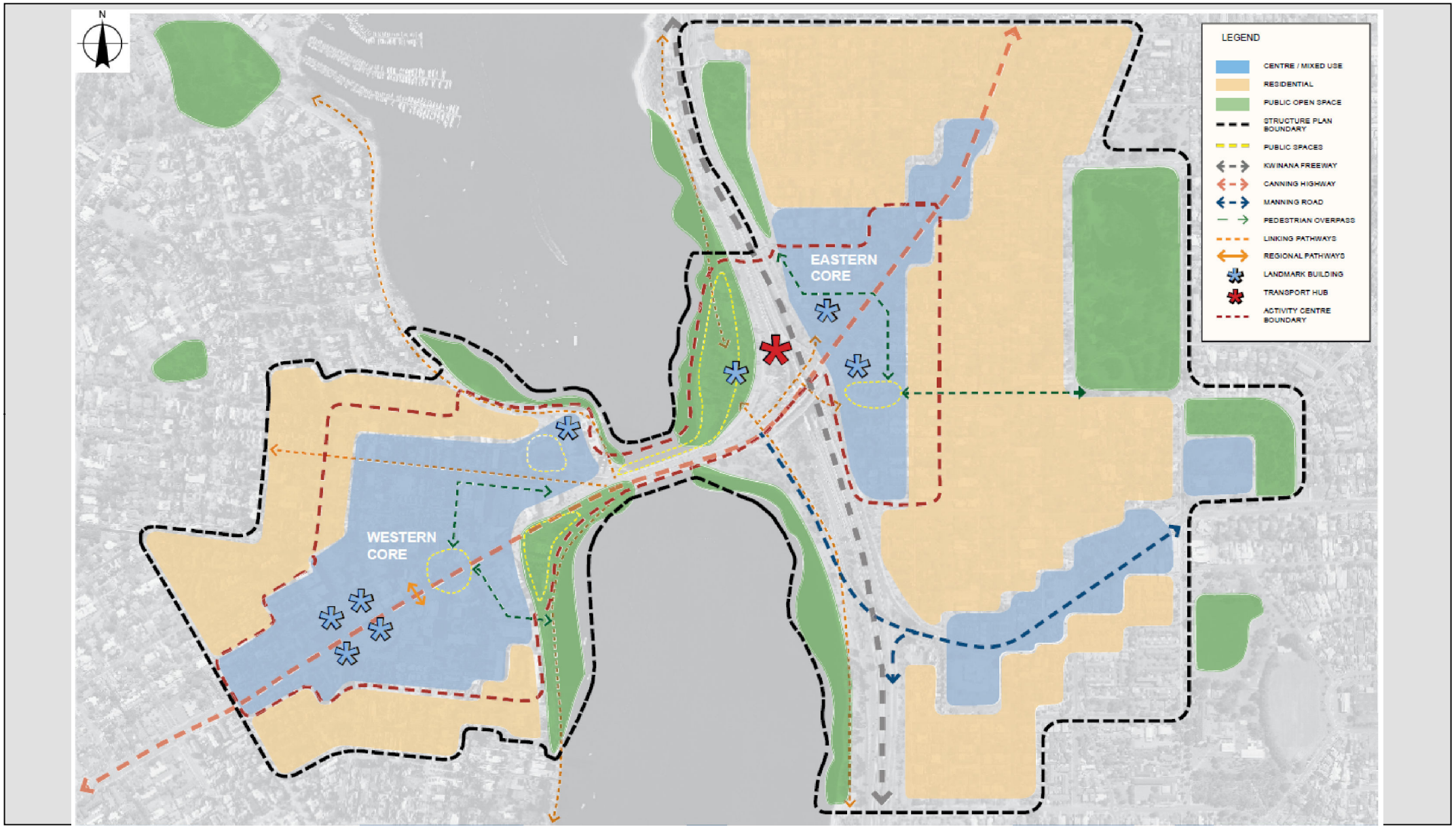

Sketch

City of Melville
Canning Bridge LWMS

Job Number 61-28373
Revision A
Date 25 Feb 2014

Structure plan area

Figure 2

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Created by: GHD Planningand Urban Design Team

3. Existing site characteristics

3.1 Climate

The climate within the study area is typically classified by hot dry summers and mild, wet winters. The nearest Bureau of Meteorology weather station with long term data is located at Subiaco Treatment Plant, located approximately seven kilometres away. Rainfall has been at this station since 1968, however annual totals are not available for the years 1999-2008 due to gaps in data collection.

The average annual rainfall recorded at the station since 1968 is 721.9 mm, with a recorded annual rainfall range of 439.7 mm to 924.9 mm. The majority of rainfall falls in winter months (generally May to September), with the monthly distribution of rainfall shown in Table 2.

Table 2 Mean rainfall for Subiaco Treatment Plant

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean rainfall (mm)	11.6	13.6	18.9	36.5	84.9	142.7	148.2	106.2	75.1	40.2	23.7	10.2

3.2 Features and topography

The Canning Bridge activity centre is dissected by the Canning River and Kwinana Freeway running north-south, as well as by Canning Highway and Manning Road (Figure 3).

The ground surface is at 0.4 mAHD at the banks of the Canning River. Ground level rises rapidly west of the river bank to a maximum of 20 mAHD within the study area. To the east of the river ground level rises to around 11 mAHD, peaks at 20 mAHD just south east of Canning Bridge and then falls to a minimum of 3 mAHD in depressions located at the north east and south east corners of the study area.

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3.3 Geology and soils

The area is dominated by pale sands consisting of quartz and feldspar (Figure 4). Along the river sands are grey-white and contain bivalve and gastropod shells, elsewhere sand is yellow-brown. At McDougall Park, in the north east of the study area, soils consist of a dark peaty clay with variable organic content and some quartz sand.

3.3.1 Acid sulfate soils

Acid sulfate soils are naturally occurring soils and sediments containing sulphide minerals, predominantly pyrite (an iron sulphide). In an undisturbed state below the water table, these soils are benign and not acidic. However if the soils are drained, excavated or exposed by lowering of the water table, the sulphides will react with oxygen to form sulphuric acid. Inappropriate disturbance of these soils can generate large amounts of sulphuric acid and leaching of contaminants naturally occurring in soils.

Acid sulfate soil risk mapping classifies the majority of the study area as having a low risk of acid sulfate soils (Figure 4). Areas adjacent to the river and foreshore area are classified as moderate to low risk of acid sulphate soils, with the river bed and McDougall Park lake classified as high to moderate risk of acid sulfate soils within 3 m of the ground surface.

McDougall Park contains a lake / wetland and is not likely to be subject to development pressure in the short to medium term future.

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LEGEND

Study Area
Roads

Elevation (in meters)

0 - 7
8 - 13
14 - 19
20 - 25
26 - 31
32 - 37

1:15,000 at A4

0 55 110 220 330 440

Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

City of Melville
Canning Bridge LWMS

Topography

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Revision	B
Date	25 Feb 2014

Figure 3

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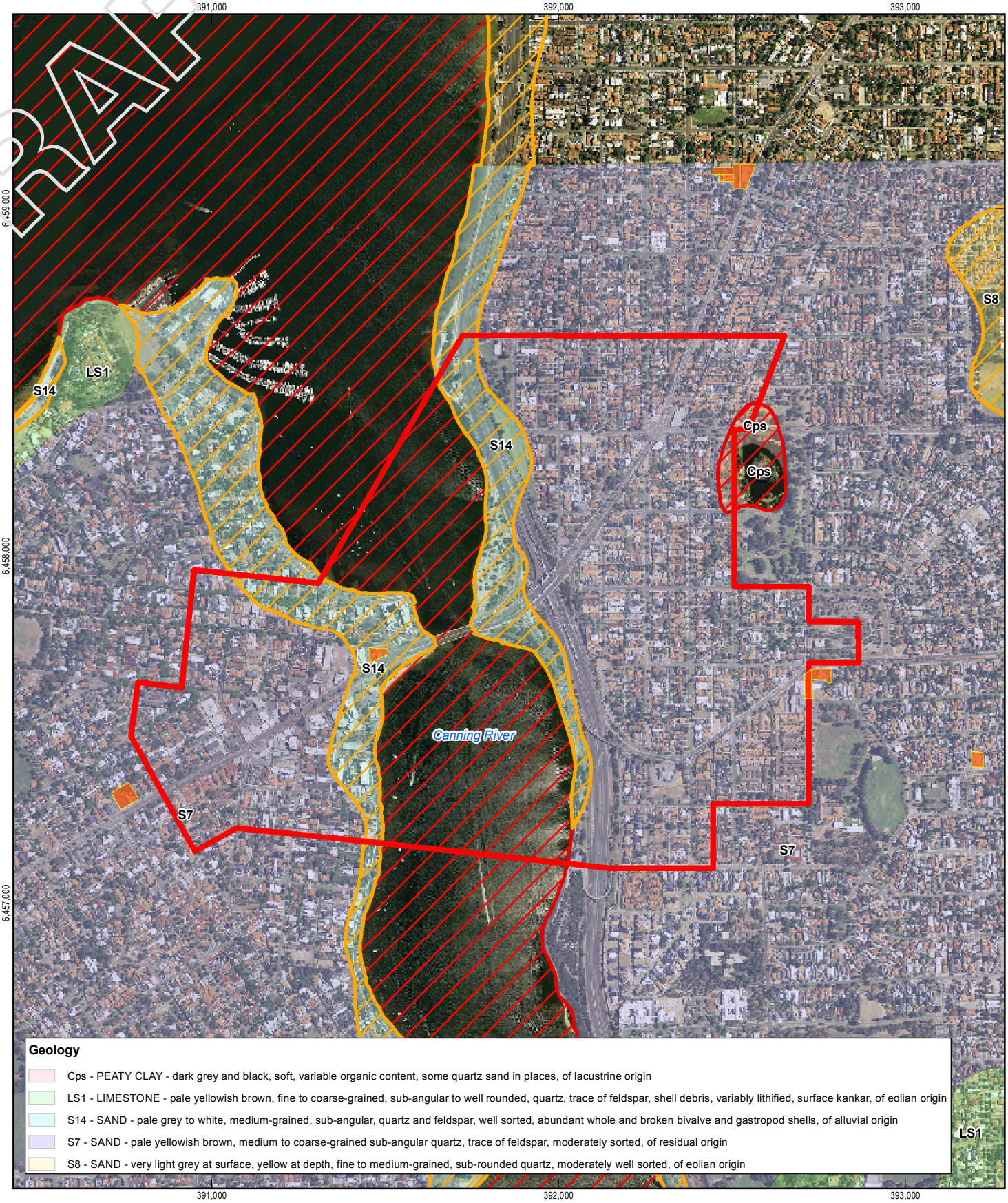

LEGEND

Study Area

Contaminated site

Acid Sulfate Soil

High to moderate risk

Moderate to low risk

1:15,000 at A4

0 75 150 300 450 600

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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City of Melville
Canning Bridge LWMS

Soil types, acid sulphate soils and contaminated sites

Job Number 61-28373
Revision A
Date 25 Feb 2014

Figure 4

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Data source: Landgate: Metro Central Feb 2012 Mosaic - 20120814; DOIR: Geology - 20120718; DEC : Acid Sulfate Soil - 20120718; GHD: Contaminated sites - 20120809, Study Area - 20120809, Contaminated Sites - 20120724. Created by: vdinh

3.3.2 Contaminated sites

A search of the Department of Environment Regulation contaminated sites database identified two registered contaminate sites within or on the study area boundary (Figure 5). Both sites are service stations that have been in operation for in excess of 25 years and classified as contaminated – remediation required. Two further sites are identified in close proximity. Registered sites within and in proximity to the study area are summarised in Table 3.

Table 3 Contaminated sites

Address	Classification under the Contaminated Sites Act (2003)	Contamination source
Sites within study area boundary		
918 Canning Highway (corner Kintail Road)	Contaminated – remediation required	Service station since 1981
73 Manning Road (corner Ley Street)	Contaminated – remediation required	Service station since 1989
Sites in proximity to study area		
848 Canning Highway (corner Reynolds Road)	Contaminated – remediation required	Service station since 1976
16 Bradshaw Crescent (corner Welwynn Avenue)	Remediated for restricted use	Historic service station (1963-2009)

3.1 Heritage

The Swan and Canning Rivers have a long history of use by the local Nyoongar population and heritage sites of significance within the study area are focused around the rivers and the foreshore.

The Swan and Canning Rivers are identified by the Department of Aboriginal Affairs *Aboriginal Heritage Inquiry System* as sites of significance (Figure 5), with two further sites of significance occurring along the City of South Perth foreshore area.

European heritage sites by the Heritage Council of WA within the study area include Canning Bridge, Raffles Hotel Precinct, Raffles Hotel (Canning Bridge Hotel), Applecross District Hall (Tivoli Theatre), and Applecross Library.

Neill McDougall Park and Hazel McDougall House is listed as a place of local significance by the City of South Perth.

3.2 Environmentally sensitive areas

The Canning River and its banks are classified Environmentally Sensitive Areas (Figure 5). Within the study area, the environmentally sensitive area of river bank is 150 m wide at its widest (just north west of Canning Bridge) and 10 m wide at its narrowest (south west of the bridge).

3.3 Flora and fauna

Desktop assessments identified 22 flora species and 46 fauna species of conservation significance as potentially occurring within 5 km of the study area. No flora or fauna species of conservation significance were recorded during the GHD field assessment on 02/08/2012. Due to the highly degraded nature of the study area and the lack of suitable habitat it is unlikely that many of the conservation significant species identified through the desktop investigations would occur within the study area. It is possible that cockatoos and transitory bird waders utilise the site for feeding, however these species are transient and can utilise other areas of similar habitat around the Swan River and therefore do not rely on the habitat in the study area.

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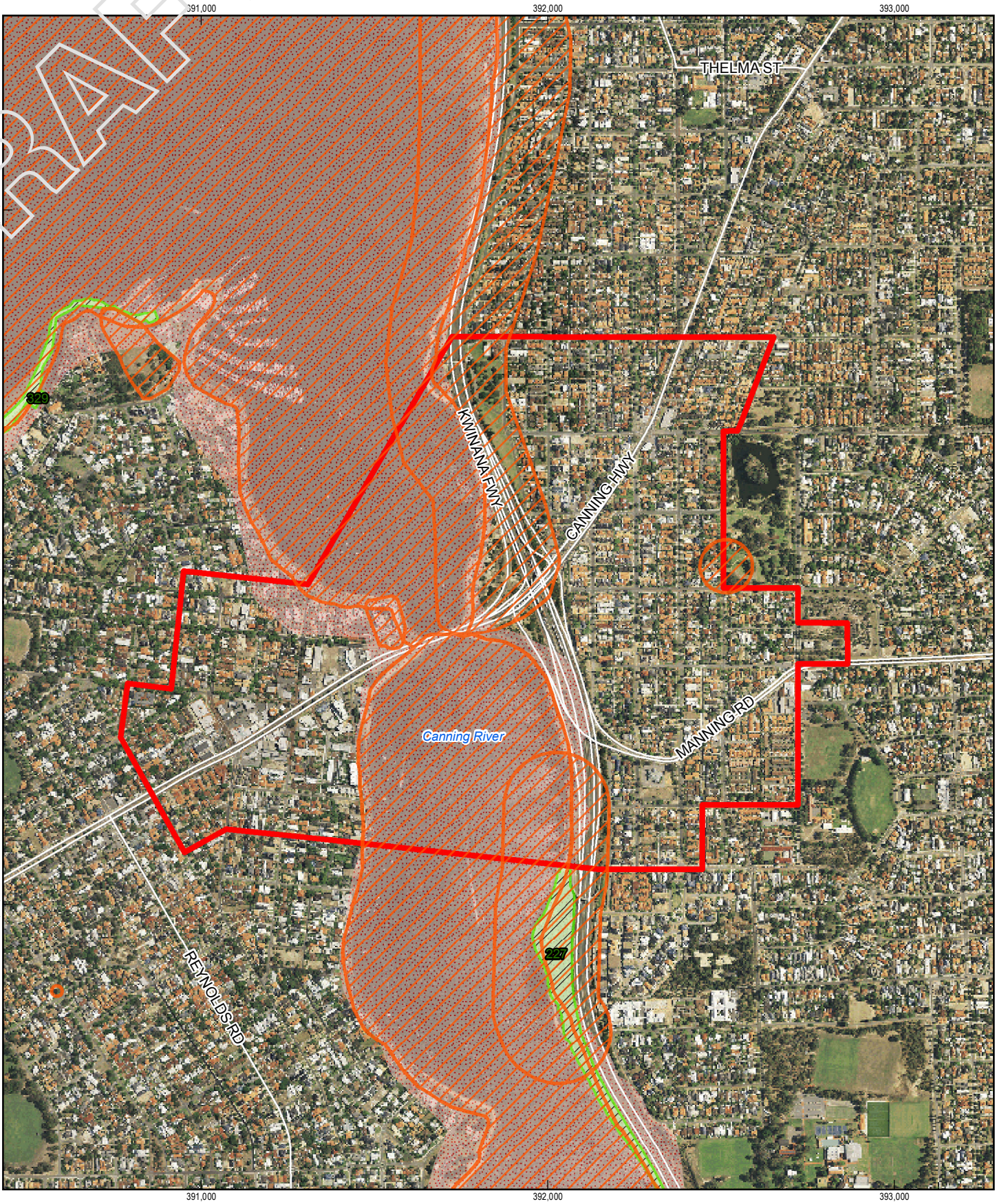

LEGEND

- Roads
- Study Area
- Bush Forever Sites
- Environmentally Sensitive Areas
- Aboriginal heritage site

1:15,000 at A4

0 75 150 300 450 600

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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City of Melville
Canning Bridge - Environment and Heritage

Job Number 61-28373
Revision A
Date 25 Feb 2014

Heritage, environmentally sensitive areas and bush forever

Figure 5

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Data source: Landgate: Metro Central Feb 2012 Mosaic - 20120814; DAA: Aboriginal heritage site - 20120720; DPI: Bush forever - 2120718; DEC: Environmentally Sensitive Areas - 20120814; GHD: Study Area - 20120809. Created by: vdinh

3.3.1 Threatened ecological communities

There are no threatened ecological communities or priority ecological communities within the study area.

3.4 Bush Forever sites

A Bush Forever site borders the study area at the southern boundary (Figure 5). Bush Forever Site No. 227 (Mount Henry Bushland) covers an area of 11.9 ha between the east bank of the Canning River and the Kwinana Freeway. The site has been entered into the Register of the National Estate and is subject to protection under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999.

A second Bush Forever site is located approximately 400 m north-west of the study area (Figure 5). Bush Forever Site No. 329 (Point Heathcote Foreshore) contains a wetland and is listed on the Directory of Important Wetlands in Australia. This site is a considerable distance from the study area and is unlikely to be impacted by the development.

3.5 Waterways and wetlands

The study area is dissected by the Canning River, which is protected under the *Environmental Protection (Swan and Canning Rivers) Approval Order 1998*. The floodway (extent of 100 year ARI floodplain required for conveyance) of the river generally conforms to the existing river banks, with minor extension in the City of Melville south of Canning Highway and a narrow band along the foreshore reserve adjacent to the Kwinana Freeway in the City of South Perth (Figure 6).

Aside from the rivers, the only surface water feature in the study area is a lake at McDougall Park (Figure 6). The lake was constructed in the late 1960s when the South Perth area was largely swampland.

The Swan and Canning Rivers are classified as Conservation Category Wetlands (Figure 6). The objective for Conservation Category Wetlands is to preserve the natural attributes and functions of the wetlands.

Development, clearing or any activity that may lead to further loss or degradation of the wetland is considered inappropriate. These wetlands can attract buffers of between 50 and 100 m, depending on the threat to and nature of the wetlands.

3.6 Stormwater

City of Melville

Existing stormwater drainage within the City of Melville component of the study area comprises an existing piped network of local authority drains (Figure A.1, Appendix A).

Stormwater drainage in the City of Melville part of the study area is located within the Downstream Catchment north of the Canning Bridge and the Bull Creek Catchment south of Canning Bridge based on the catchment mapping within the *Swan Canning Water Quality Improvement Plan* (WQIP) (SRT 2009). Stormwater within the study area boundary primarily discharges to the Canning River.

City of South Perth

Existing stormwater drainage within the City of South Perth component of the study area comprises an existing piped network of local authority drains (Figure A.2a, Appendix A).

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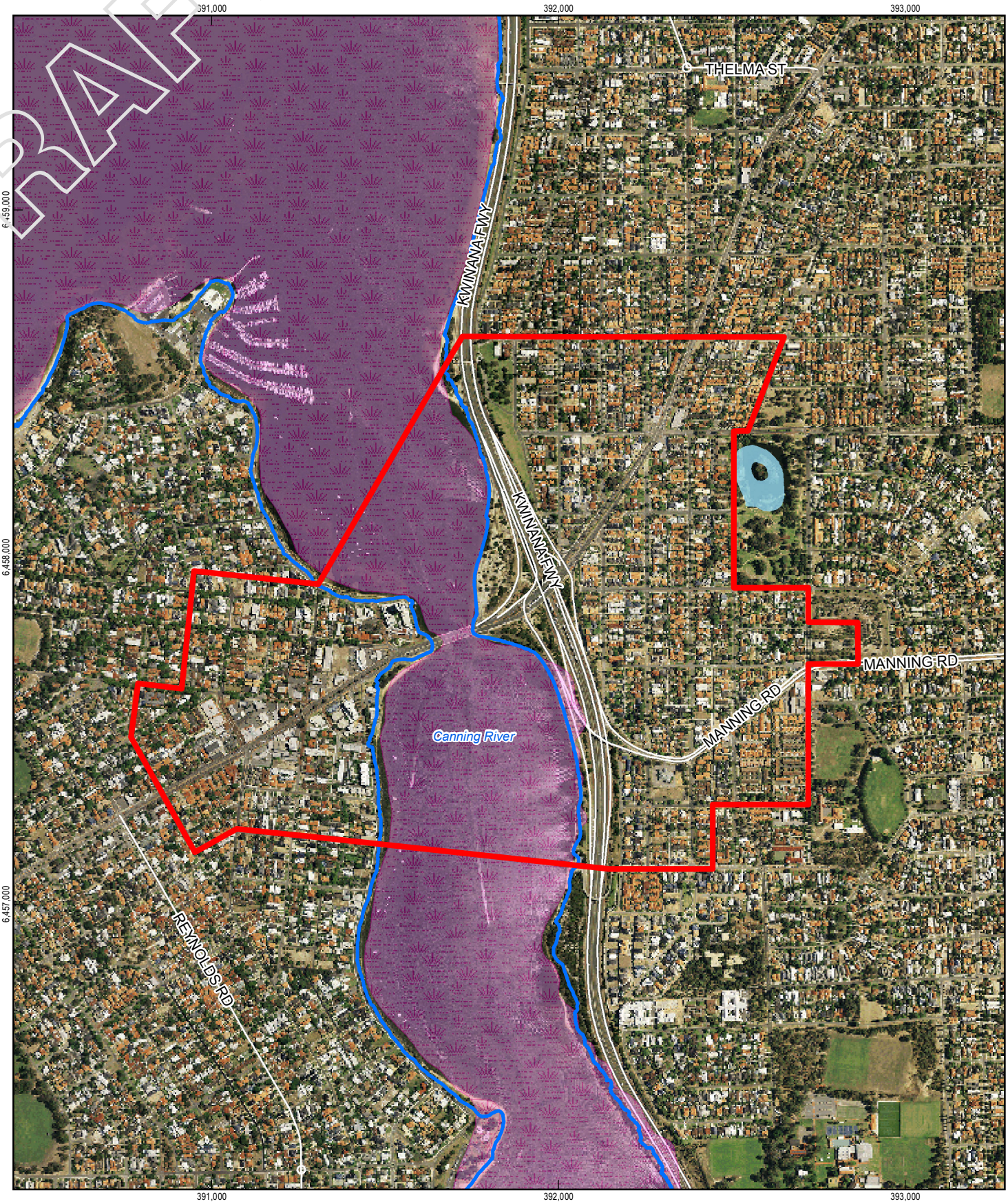

LEGEND

- Roads
- FPM Extent of Flooding (100 year ARI)
- Study Area
- Surface Water
- **Wetland**
- Conservation

1:15,000 at A4

0 75 150 300 450 600

Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

City of Melville
Canning Bridge LWMS

Surface water, flood levels and wetlands

Job Number	61-28373
Revision	B
Date	25 Feb 2014

Figure 6

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239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au
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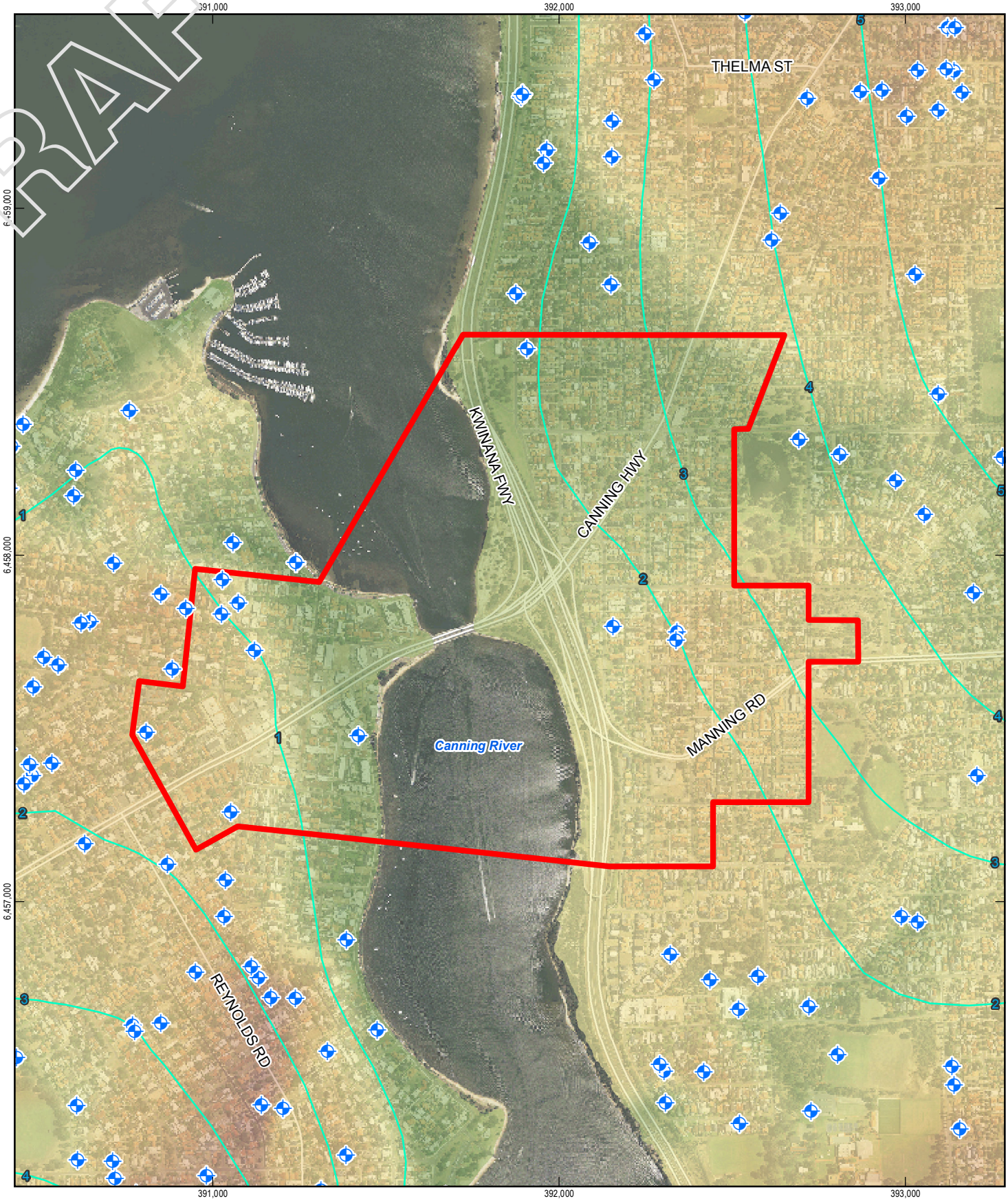
Data source: Landgate: Metro Central Feb 2012 Mosaic - 20120814; DEC: Surface water - 20120817; DOIR: Geology - 20120718; DOW :FPM Extent of Flooding - 20120718; GHD: Study Area - 20120809. Created by: vdinh



LEGEND

- WIN groundwater sites with groundwater depth in meters below ground level (mBGL)
- Groundwater contour maximum (mAHD)
- Study Area

Depth to Groundwater (mBGL)

- 33
- 22
- 15
- 8
- 1

1:15,000 at A4

0 75 150 300 450 600

Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

City of Melville
Canning Bridge LWMS

Job Number	61-28373
Revision	A
Date	25 Feb 2014

Groundwater

Figure 7

G:\61\28373\GIS\Maps\MXD\612837304_G011_Fig7_A4_RevB.mxd
239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au
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Data source: Landgate: Metro Central Feb 2012 Mosaic - 20120814; DOW: Groundwater contour maximum - 20131012, WIN Sites - 20120720; GHD: Study Area - 20120809, Contaminated Sites - 20120724, Depth to Groundwater - 20140225.
Created by: vdinh

The majority of stormwater drainage comprises predominantly small street scale sub-catchments discharging directly to the Canning River, with some outlets also treating runoff from the Kwinana Freeway. A couple of drainage sub-catchments discharge directly into the infiltration lake at McDougall Park. A small internal catchment also discharges to a small dry infiltration basin/swale. The outfall locations and flow contribution are identified in mapping completed as part of the *City of South Perth ICMP* (JDA 2004) included as Figure A.2b in Appendix A.

Stormwater drainage in the City of South Perth part of the study area is located within the South Perth catchment based on catchment mapping within the *Swan Canning WQIP* (SRT 2009). The South Perth Catchment was identified as a catchment that is required to maintain or improve existing water quality for nutrient concentrations (SRT 2009).

3.6.1 Water quality

There is no published surface water quality information for the stormwater drains within the study area boundary. Stormwater drains located to the south-east of the study area (within the Bullcreek and South Perth Catchments) have previously been sampled as part of a wider baseline study of stormwater contamination in the metropolitan region conducted by the DoW (Nice *et al*. 2009).

The Bullcreek Catchment was identified as having unacceptable total nitrogen load in the Swan Canning WQIP (SRT 2009) and has been identified as one of eight priority catchments for nutrient reduction across the Swan Canning region, with a Local WQIP developed specific to the catchment (SRT 2012). Although outside the study area, this catchment is considered representative of the subject catchment.

Limited stormwater monitoring sampling was completed as part of the existing study. Due to the piped nature of the drainage within the study area, and associated site access constraints, snapshot surface water quality samples were collected during September 2012 only.

Surface water quality results from the snapshot sampling are compared to existing surface water quality data from adjacent drainage catchments reported in the WIN database in Appendix B. The results show that the water quality from the snapshot sampling is within the historic and recent range for nearby catchments that exhibit similar land use and drainage characteristics.

3.7 Groundwater

3.7.1 Groundwater level

Mapping of historical maximum groundwater levels in the Perth Groundwater Atlas (DoW 2013) identifies that the depth to groundwater within the study area varies between 0.0 m below ground level (bgl) along the river banks and foreshore of the Swan and Canning River, increasing to above 5.0 m bgl outside of the floodplain area (Figure 7).

A review of the Department of Water (DoW) Water Information Network (WIN) groundwater dataset identifies numerous groundwater bores within and adjacent to the study area, however the majority of these bores are private garden bores or are inactive. Available groundwater level data (as m bgl) for these bores is identified in Figure 7, with the majority of these levels recorded in the period 1977-1978 (Appendix C).

The depth to groundwater within the study area is largely a reflection of the surface topography and increases inland with increasing topographic elevation. Based on the high soil permeability

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of the soils and the topography (Figure 3) the majority of the study area has considerable depth to groundwater and provides an opportunity for infiltration of surface drainage.

3.7.2 Groundwater allocation

The study area is located within two groundwater subareas, the City of Melville and the City of South Perth, of the Perth groundwater management area.

The groundwater subareas report the following aquifers in order of depth from ground surface:

- Unconfined superficial
- Confined Leederville
- Confined Yarragadee

Both the City of Melville and the City of South Perth extract groundwater for irrigation purposes from various local bores from both the deep (Leederville) and shallow (Superficial) aquifers.

Within the Superficial aquifer there is some groundwater allocation currently available with the City of Melville[1]. Table 4 outlines the details of the available groundwater allocations.

Table 4 Groundwater allocations

Groundwater sub area	Aquifer	Allocation limit (kL)	Allocated, committed and requested (kL)	Available (kL)
City of Melville	Perth – Superficial	5,498,725	4,173,848	1,324,877
City of South Perth	Perth – Superficial	3,000,000	2,621,102	378,898

Source: DoW January 2014

[1] DoW 13 December 2012

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4. Sustainable water use initiatives

4.1 Existing servicing

4.1.1 Potable water

The drinking water supply for study area is provided from the Water Corporation's Integrated Water Supply Scheme from existing water sources. The capacity of the existing distribution infrastructure is sufficient to meet the existing planning scheme. However as the proposed activity centre structure plan plans increased density, it is likely that augmentation to the existing water distribution and local network will be required. The detail of any upgrades will be subject to further assessment as well as the implementation of any alternative services strategies.

4.1.2 Wastewater

The study area is serviced by an existing sewer network. The sewer network consists of a complex link of gravity systems, pump stations and pressure mains. In most cases, a gravity system from one sewer catchment is pumped into the gravity system of another. All of the sewer pump stations within or directly impacting on the study area are operated and maintained by Water Corporation. Further details of the existing sewer network can be found in the Canning Bridge Structure Plan Services Report (GHD 2012).

Water Corporation currently caters for the designated density for each area, and where developments result in any variation to their Operating Licence (be it through low pressure etc.), improvements are made. The current system at Canning Bridge appears to have sufficient capacity to cope with the existing demand.

As the density increases within the study area, it is likely that augmentation to the existing wastewater network will be required. The detail of any upgrades will be subject to further assessment as well as the implementation of any alternative services strategies.

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4.2 Water efficiency measures

4.2.1 Drinking water

The drinking water supply for study area will be provided from the Water Corporation's Integrated Water Supply Scheme from existing water sources.

Water efficiency is part of the business as usual approach and is enabled through the use of technology and by changing behaviour to use less water. The Western Australian Government has introduced a range of measures to ensure that new houses built in Western Australia meet minimum standards for energy and water efficiency including:

- All tap fittings must be minimum 4 stars WELS rated;
- All showerheads must be minimum 3 stars WELS rated;
- All sanitary flushing systems must be a minimum 4 stars WELS rated dual flush;
- Water using appliances installed (such as washing machines and dish washers) are 4 stars WELS rated or better.

The estimates of water demands within the Canning Bridge precinct have assumed that all dwellings, office and commercial properties would meet these requirements.

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4.2.2 Irrigation

The construction or upgrade of any new or existing irrigation or landscaping areas (including public open space and domestic gardens) will be required to adopt the following criteria for open space landscape design, soil improvement and irrigation (based on the Water Corporations Waterwise Development Criteria):

- Irrigation of POS regardless of where water is from (potable and/or non-potable) must be no more than 7,500 kilolitres per hectare per year;
- Use of a soil conditioner certified to AS4454 to a minimum depth of 150 mm for turf and 300 mm for gardens;
- Mulching of gardens beds to 50 mm – 75 mm using mulch certified to AS4454.

Design guidelines for residential irrigation controllers are to be developed and included within the detailed design stages and the *Waterwise Display Village Criteria* (Water Corporation 2007) should be referenced as a guide.

Soil amendment will be required in areas of public open space that are subject to redevelopment, with the exception of areas dedicated for drainage and infiltration purposes. In these areas, the phosphorus retention index of new or upgraded infrastructure is to be greater than 10. Design guidelines for the irrigation and soil improvement for public open space are to be included within the detailed design stages.

4.3 Water source

The available non-drinking water sources that could be feasibly considered for the Canning Bridge study area include:

- Rainwater from rooftop runoff stored in tanks situated on lots;
- Stormwater runoff from hard surfaces stored in tanks situated within the study area development (with or without rooftop runoff);
- Abstracted groundwater;
- Greywater extracted from the plumbing system of buildings, specifically from bath, shower, washing machine, and laundry trough; and
- Recycled wastewater extracted from the sewerage collection system and treated in accordance with the Australian Guidelines for Water Recycling in a manner acceptable to DoH.

Outlined below is a brief description of the available non drinking water sources for the site.

4.3.1 Groundwater

Groundwater abstraction is one of the easiest and usually most cost effective method of providing an alternative to scheme water for non-drinking water uses such as irrigation. It is generally acknowledged that the consumption of water by households owning a private bore is greater than for those households irrigating from scheme water, and thus it is considered that encouraging private bore use within the study area would not lead to achievement of the water conservation objectives. However, if a centralised system were to be installed, supplying groundwater via a third pipe network for irrigation or in house non potable use and with central management, this could be implemented in such a way as to minimise the use of irrigation water and help achieve the water conservation objectives.

The use of groundwater presents only a small health risk due to water quality. With respect to irrigation, the presence of significant iron concentrations, hardness, alkalinity, nutrients or

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salinity can impact upon the receiving vegetation and soils and/or contribute to scaling or scour of irrigation pipework. Potential water quality issues of concern for in-house use include the presence of suspended solids and pathogens. If contamination is present in the aquifer, the use of groundwater will pose a risk for both irrigation and in-house uses and may lead to environmental problems due to mobilisation of contaminants. It is understood that DoH would require disinfection of groundwater if it was proposed for non-potable uses inside the house.

Existing groundwater allocation planning by the Department of Water indicates that within the City of South Perth and the City of Melville groundwater sub-areas, the Superficial aquifer is currently 87% and 76% allocated respectively (including requested allocations)[2]. As such, there may be some groundwater available for use for POS irrigation. The current groundwater allocations are provided in Table 4.

4.3.2 Rainwater

Collection and reuse of rainwater at the building scale within rainwater tank systems can be constrained by storage requirements within a high density urban development. The use of this water is generally limited to in-house non-drinking water uses (ie toilets and washing machines) because rainfall does not occur during the irrigation season and tank sizes to retain sufficient water for year round irrigation demands are likely to be excessive.

The major potential risk posed by the use of rainwater is the risk to public health due to poor water quality. Rainwater quality is generally considered to be of a high standard if regular maintenance and appropriate management of the system is undertaken. Appropriate maintenance and management of rainwater tank systems includes installation of first flush diverters, prevention of access to any vermin or disease vectors, filters to minimise the entry of large particles and leaves, regular de-sludging to avoid build-up of sediments at the base of the tank and regular inspection and maintenance of gutters and downpipes.

With appropriate maintenance and management, it is considered that the rainwater quality would be of a sufficient standard for non-potable in-house use without further treatment.

The use of rainwater tanks is not considered to present a significant risk to the environment and may provide a benefit in the management of stormwater across the development, by reducing and/or detaining roof runoff from lots.

4.3.3 Stormwater

Harvesting of stormwater from drainage infrastructure is constrained by storage requirements and its use may be limited by the seasonality of irrigation demands or treatment requirements for use inside the house.

There is scope to investigate the potential for stormwater harvesting for managed aquifer recharge (MAR). This involves injection of treated stormwater into a suitable groundwater aquifer to be later re-abstracted and used locally or distributed to the wider development area for use as a year round fit-for-purpose water source. Storage and treatment requirements for this type of scheme can vary significantly according to the quality and suitability of the receiving aquifer as well as the quality and availability of stormwater for harvesting. This process is regulated in Western Australia under the Department of Water's *Operational policy 1.01 - Managed aquifer recharge in Western Australia* (DoW, 2011). Under this policy, changes in land use that result in additional runoff and would typically increase the groundwater recharge are not considered MAR. In order to gain additional abstractable water it would be necessary to demonstrate that an excess exists and cannot be infiltrated at source.

[2] DoW advice January 2014

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It is expected that there will be a slight increase in runoff from the development in the ultimate scenario which will need to be managed. The possible options for capturing this stormwater include:

- Storage areas (eg lined basins or tanks) during the winter months for reuse in the summer months;
- Infiltration of the additional runoff at source; or
- Discharge into the Canning River.

Stormwater management of the study area is described in Section 5. The preferred management strategy for stormwater is to infiltrate at source or store water for reuse. If stormwater harvesting were to be viable from a quantity perspective, the implementation and construction of storage areas would likely be expensive and is not recommended.

4.3.4 Treated wastewater

There is an existing wastewater network throughout the site and this provides an opportunity for onsite wastewater harvesting for treatment and local distribution. In order to reuse wastewater for non-drinking purposes, treatment, storage and distribution infrastructure will be required. New development or redevelopment of lots and roads within the study area provide an opportunity to harvest and treat wastewater as an alternative water source.

Additionally, if several lots were to be redeveloped by one developer, there is the opportunity to investigate a small package wastewater treatment plant and reuse the recycled wastewater within the lot. Prior to the this occurring, investigations into the available supply and the required demand, the required quality, governance and operational arrangements as well as necessary approvals would be required to be undertaken by the developer.

The advantage of treated wastewater is that it will be a continuous and reliable source and is independent of the future climate. To implement treated wastewater as a non-drinking water source, additional distribution and treatment infrastructure will be required, however the reuse has the potential to avoid or minimise any necessary upgrades of the existing wastewater network.

Where there is an excess of treated wastewater (ie the available treated wastewater is greater than the non-drinking water demands), disposal options will need to be considered.

4.3.5 Greywater

At the dwelling scale, treated greywater is suitable for garden irrigation or infiltration in accordance with the Code of Practice for the Reuse of Greywater in Western Australia. Greywater can typically only be stored for up to 24 hours after which time there are significant impacts to water quality and subsequent risks to public health.

If greywater were to be used for domestic irrigation, the supply would be greater than the demand during the winter months. Alternative uses or disposal to the sewerage network would be required.

Individuals may choose to install a greywater system for household irrigation and they will be responsible for adhering to the Code of Practice for Greywater Reuse in Western Australia. In this case the responsibility and costs for operation and maintenance are with the householder.

4.3.6 Preferred water source

The preferred non-drinking water source is treated wastewater. The reuse of treated wastewater presents a reliable water source as well as the potential to minimise, delay or avoid upgrades to

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the existing wastewater network in the study area. This is further outlined in the Canning Bridge Sustainable Infrastructure Study (GHD 2014).

The Canning Bridge Sustainable Infrastructure Study (GHD, 2014) also outlines the options for disposal of any excess treated wastewater as well as the measures required to implement the preferred water source. In summary, the current approvals necessary for developing an integrated water scheme are managed through the *Guidelines for the approval of non-drinking water systems in Western Australia* (DoW 2013). DoW is the lead agency for coordinating cross-agency approvals for non-drinking water schemes in Western Australia through this framework. Under the current framework all agencies including DoH, ERA and Department of Environment Regulation (DER) have an opportunity to comment on the proposed scheme. All proposals submitted under the approval framework will have to demonstrate compliance with relevant legislation, guidelines and requirements of each agency (eg demonstration that appropriate treatment and disinfection of recycled wastewater has been adopted for use within the house).

As the Canning Bridge activity centre is developed, it is recommended that the approval and legislative requirements for the use of non-drinking water are regularly reviewed to ensure that any designs and documentation are prepared in accordance with the current approval framework.

4.4 Water demands

This section aims to provide a summary of calculations undertaken to estimate the current and future water demands within the Canning Bridge activity centre study area. These calculations have been made for residential, commercial/office areas and public open space (POS). In addition calculations were made to determine future drinking and non-drinking water demands.

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4.4.1 Current water demands

Outlined below is a summary of the current water demands for the study area; estimated from Water Corporation data.

Currently the study area is home to approximately 3,500 people as well as commercial and office buildings, with an average water use of 457,214 kilolitres (kL) water per year. This is equivalent to approximately:

- 211 kL/dwelling/year
- 130 kL/person/year

4.4.2 Projected water demands

The project water demands have been calculated based on the proposed land use for the study area. The adopted parameters are as provided in Table 5.

Table 5 Land use areas

Land use	Unit	Existing number	Ultimate number
Residential	Dwellings	1,840	16,916
Non-residential (1)	m^2	178,348	124,834
POS irrigation (2)	ha		20.50

1) includes office, retail, and entertainment/recreation/culture land uses

2) includes open space within and adjacent to the study area boundary and road verges.

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The water usage estimates were undertaken using a combination of current water use data, the Water Corporation water demand calculator and current industry knowledge (in respect of irrigation of public open space). It has been assumed that waterwise principles will be implemented throughout the study area and the water demand estimate has been calculated on this basis. Outlined in Table 6 below are the unit rates adopted for the demand estimates.

Table 6 Water demand unit rates (kL/year)

	In-building		Ex-building	Totals		
	A	B	C	A	B+C	A+B+C
	DW	NDW	Irrigation	DW	NDW	DW+NDW
Residential (per dwelling)	43	34	11.3	43	45.3	88.3
Office (per m^2)	0.48	0.28	0.04	0.48	0.32	0.8
Retail (per m^2)	0.60	0.30	0.10	0.60	0.40	1.0
POS./ verge irrigation (per ha)	-	-	5,000		5,000	5,000

DW – drinking water NDW – drinking water

Based on the unit demands provided above, the demands for the total ultimate development have been calculated and provided in Table 7. As shown in the tables below, the estimated total water demand assuming waterwise measures is 1,810 ML/year.

Table 7 Waterwise water demand (kL/year)

Land use			DW (kL)	NDW (kL)	Irr. (kL)	Total (kL)
Dwell.	No.	16,916	727,388	575,144	191,709	1,494,241
Comm.	m^2 GFA	182,740	87,715	51,167	7,310	146,192
Retail	m^2 GFA	66,928	40,157	20,078	6,693	66,928
POS	ha	13.60	-	-	68,000	68,000
Verges	ha	6.90	-	-	34,500	34,500
Total			855,260	646,390	308,211	1,809,861

DW – drinking water NDW – non-drinking water Irr, = irrigation

Assuming approximately 90% of the drinking water consumed within the study area becomes wastewater, there is surplus treated wastewater for all non-drinking water sources. The Canning Bridge Sustainable Infrastructure Study (GHD, 2014) outlines the options for disposal of the excess treated wastewater if a non-drinking water scheme is implemented.

The study area covers the City of South Perth and the City of Melville groundwater subareas with the proposed and existing open space predominately located within the City of South Perth groundwater subarea. As outlined in Table 4, there is approximately 379,000 kL in available groundwater allocation within the City of South Perth subarea which is sufficient to supply the POS demands should a non drinking water system not be implemented.

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5. Water management strategy

An overview of the key components of the water management strategy for the Canning Bridge activity centre is detailed in the following sections along with the water management strategy principles, design criteria and development requirements.

5.1 Water conservation and water resource use

Based on existing and projected water use within the Canning Bridge activity centre (Section 4) there will be an increase in water demand of approximately 1,360 ML per year following full redevelopment of the area. In order to achieve this additional water demand under projections of future rainfall reduction associated with climate change, redevelopment within the Canning Bridge activity centre should aim to optimise water conservation, maximise water reuse and incorporate water management initiatives through the life of the development.

The nature of the redevelopment presents opportunities at the development area, precinct and lot scale to achieve sustainable water management for both in-house and ex-house applications. This is proposed to be achieved using the principles, design criteria and development requirements outlined in Table 8.

Table 8 Water conservation and water resource use

Principle
Demonstrate a sustainable approach to water management on the site by reducing water demand, maximising water reuse and incorporating water management initiatives throughout the life of the development. Management of water within the redevelopment area should be wholly sustainable across all aspects and ensure use is efficient.
Design criteria

• Consumption target for water of 80 kL/person/year, including not more than 40 kL/person/year scheme water where an alternative water source (rainwater tank or grey water system) is available.
• Potable water used outside of homes and buildings is to be minimised.
• Ensure all new fixtures and fittings are water efficient, with a minimum WELS (Water Efficiency Labelling and Standards) rating of:
  o All tap fittings must be minimum 4 stars WELS rated.
  o All showerheads must be minimum 3 stars WELS rated.
  o All sanitary flushing systems must be a minimum 4 stars WELS rated dual flush.
  o Water using appliances installed (such as washing machines and dish washers) are 4 stars WELS rated or better.
• Development design is to demonstrate the ability to accommodate wastewater reuse for internal non-potable uses and external irrigation.
• Landscaping plans to demonstrate full compliance with the Water Corporations Waterwise Development criteria, including the use of plants with low water requirements and use of waterwise irrigation types and practices. This includes subsurface irrigation systems, selection of 'waterwise' species, and soils improved with conditioners and mulch to reduce water demand.

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Development requirements
Water and wastewater reuse in accordance with the *Guidelines for Non-potable uses of recycled water in Western Australia* (DoH 2011) and *Guidelines for the approval of non-drinking water systems in Western Australia* (DoW 2013).
Consider incorporation of fit-for-purpose water supplies through a development scale water balance which investigates opportunities to: • Recycle greywater from public bathroom basins for use in public toilets; • Harvest stormwater from roof areas for use in public bathroom basins; and • 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, urinals and appliances.
Incorporate fit-for-purpose supply options and requirements into design guidelines.
Development design for large development areas to demonstrate the ability to accommodate wastewater reuse for internal non-potable uses (toilet flushing, laundry, irrigation and potentially cooling towers) and external irrigation. Full details of the functioning of the system (including required connections to centralised infrastructure) can be provided at Development Application stage. All systems are to be designed in accordance with the requirements of the Department of Health.
Smart meters for water use in all new developments. Retrofitting of meters for POS irrigation.
Water use within public open space (for uses such as irrigation, pools, water features, etc) should be supplied from alternative water sources to meet 80% of this demand.
Landscaping which incorporates the use of waterwise gardens, rain gardens, smart irrigation systems, and use of alternative sources of water.
Identify opportunities to reduce irrigation needs of existing open space areas through re-landscaping and hydro-zoning, whilst retaining drainage and recreational functions of these areas.
Maximise efficiency of groundwater usage for irrigation of any additional open spaces through appropriate landscape design so that additional allocations are not required.

5.2 Stormwater quantity management

5.2.1 Existing stormwater management

As noted in Section 3.5 the existing stormwater within the Canning Bridge activity centre comprises local authority drains within the City of Melville and the City of South Perth that discharge directly to the Canning River.

Currently the methods of stormwater disposal from buildings and carparks within the study area are not well documented. It is assumed that there is some on-site storage, with overflow from lots contributing to the existing piped network.

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5.2.2 Proposed stormwater management

While the study area is largely developed it is anticipated that there will be an increase in impervious areas and therefore an increase in stormwater runoff following redevelopment. The stormwater management system for the study area proposes to maintain the discharge volumes and peak flows to pre-development conditions for all parts of the study area.

For the purposes of stormwater quantity management the pre-development scenario is considered the level development as at February 2014.

Based on the stormwater management proposed for the study area, minimal upgrade to the existing piped network will be required to accommodate increase in stormwater runoff. This assumption is based on no known or reported insufficiencies or deficiencies in the existing drainage network. Any required upgrades to the existing drainage network should consider the stormwater quantity principles and design criteria outlined within this strategy and the future development scenarios for the study area.

The proposed stormwater management system for the Canning Bridge activity centre is based on a major / minor approach to convey and detain stormwater.

Road catchments

For the road catchments the proposed stormwater management system will consist of:

- The minor drainage system will consider the 1 in 1 year and 1 in 10 year average recurrence interval (ARI) storm events and is defined as the system of swale drains, side entry pits, gullies, pipes, kerbs, gutters etc designed to carry and/or infiltrate runoff
- Within road reserves the proposed swale drains and pipe networks will be designed to cater for storm events up to the 10 year ARI event. For major events exceeding the 10 year ARI event the road reserve will convey stormwater via flooding of the pavement areas.
- The major drainage system will cater for the 1 in 100 year ARI storm event and is defined as the roads, drainage reserves and flood storage areas planned to convey the stormwater runoff from extreme events that exceed the capacity of the minor system, to the defined flood storage areas.

Within lot

Within lots the stormwater management system proposes the following:

- Storms less than the 1 year ARI event will be detained on-site in sub-surface storage tanks or above ground biofiltration systems designed to promote on-site infiltration.
- For storms up to the 1 in 10 year ARI event stormwater generated within lots will be detained on-site in sub-surface storage tanks or above ground flooding of non-habitable areas.
- It is proposed that roof runoff be directed to sealed sub-surface or above ground tanks for reuse on-site as irrigation water or for non-potable water use.
- For major storms in excess of the 10 year ARI event stormwater runoff from lots will be designed to flood into road reserves for conveyance at pre-development discharge volumes and peak flow rates. Where flood routing to road reserves is not possible a piped or overland relief path shall be identified and provided with a Drainage Easement vested in the relevant local government authority.

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Storage requirements

In order to retain all 10 year ARI stormwater runoff within lots of new development sites, it has been estimated that the following storage requirements are required:

- 1,230 m^3 of storage required per hectare of equivalent impervious area.
- 116 m^3 of storage is required per hectare of equivalent pervious area.

Using the impervious fraction identified in the *City of South Perth Water Sensitive Urban Design Guidelines* (Aurecon 2012) the storage requirements for the various land uses are identified in Table 9. The storage requirements identified are indicative only and are based on the assumption that the existing drainage network has no insufficiencies or deficiencies. Developers should refine the storage requirements and ensure adherence to the strategy based on local, site specific conditions where possible.

Table 9 Storage requirement for land use type

Land Use	Impervious area (estimated)	Storage requirements (m^3/ha)
Residential	50%	672.2
Commercial	80%	1,075.5
Industrial	90%	1,210.0
Recreational	15%	1,142.7
Road with verges	50%	672.2

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Management of local stormwater within the Canning Bridge activity centre proposes to maintain the flood protection and conveyance capacity of the local stormwater system relative to pre-development flows, using the principles, design criteria and development requirements identified in Table 10. For the purposes of stormwater quantity management the pre-development scenario is considered the level development as at February 2014.

Additional design criteria may need to be met within particular precincts, the details of which will be outlined within the relevant Detailed Area Plan or development guidelines.

Table 10 Stormwater quantity management

Principle
Maintain water discharge volumes and peak flows post-development, relative to pre-development conditions.
Design criteria
• The post-development critical 1 year ARI peak flow and volume shall be retained on-site, for all parts of the catchment. • All runoff from the 10 year ARI storm event shall be retained on-site for all new developments. • Piped drainage networks for minor flows to be designed to cater for 10 year ARI event, and designed in accordance with the current industry standards. • The post-development flow shall not exceed the pre-development flow in the 100 year ARI event at the discharge points for development areas.

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- Roads and public open space to be designed to cater for the 100 year ARI event.
- Provision of freeboard to habitable floor levels of at least 300 mm above flowing water and 500 mm above standing water in the 100 year ARI flood event. The site shall also consider the impacts of sea level rise and climate change.
- 100 year floodpaths going through or stored in private property to be provided with a Drainage Easement vested in the relevant local government authority.

Development requirements
Achieve storage for equivalent impervious area and land use type.
On-site stormwater retention to meet the identified stormwater quantity design criteria, unless subject to agreement of the relevant local government authority.
Should off-site stormwater disposal be considered then modelling/UWMP, completed by appropriately qualified personnel, should be provided for approval by the Department of Water and relevant local government authority, to justify the proposal.
Piped drainage should incorporate pits with silt traps and weep holes to promote recharge/infiltration to groundwater.
Should dewatering be required for the placement of footings or on-site storage tanks a Dewatering Management Plan should be prepared addressing both environmental aspects and physical activities for submission to the Department of Water, Swan River Trust and local government.

5.3 Water quality management

As noted in Section 3.5 the existing stormwater within the Canning Bridge activity centre comprises local authority drains within the City of Melville and the City of South Perth that discharge directly to the Canning River. Existing stormwater drainage has little or no at source or end of pipe treatment to improve the quality of stormwater discharged off-site.

Due to the sensitive nature of the receiving environment, the Canning River, and limited treatment in the existing piped network the redevelopment of the Canning Bridge activity centre proposes to improve the quality of water leaving the site through a best practice hierarchy of principles including:

- Implement controls at or near the source to prevent pollutants entering the system and/or treat stormwater.
- Install in-transit measures to treat stormwater and mitigate pollutants that have entered the conveyance system.
- Implement end-of-pipe controls to treat stormwater, addressing any remaining pollutants prior to discharging to receiving environments.

As noted in Section 5.2 no major upgrades of the existing stormwater network are proposed to accommodate additional stormwater runoff. Key upgrades that are recommended as part of this strategy include retrofitting of the existing network consistent with best management practice water sensitive urban design (WSUD). Where retrofitting of the existing drainage network is proposed the design should also consider the stormwater quantity principles and design criteria outlined within this strategy, and the future development scenarios for the study area, in order to maintain stormwater volumes and flow rates.

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Current best practice water sensitive urban design measures for the Canning Bridge activity centre are outlined in Table 11 and summarised in Figure 8.

Table 11 Best practice water sensitive urban design measures

Development scale	WSUD measures
Residential - lot scale	Onsite retention Water wise and nutrient-wise landscaping Porous pavements Amended topsoils Rainwater tanks Raingardens and vegetated soakwells
Commercial - lot scale	Landscaped infiltration structures Hydrocarbon management and sediment traps Roof gardens
Commercial and Residential - carparks	Porous pavements Landscaped infiltration structures Hydrocarbon management and sediment traps Underground storage
Street scale	Landscaped infiltration structures Hydrocarbon management and sediment traps Conveyance biofilter systems
Landscaping	Waterwise gardens Landscaped infiltration structures Roof gardens

The WSUD measures identified in Table 11 may be implemented throughout the redevelopment area as at source or in transit measure to improve water quality. End of pipe controls are proposed within the Canning River foreshore reserve as ephemeral vegetated bioretention basins/swales to treat flows prior to discharge into the river, subject to approval. The proposed basins/swales will be designed as follows:

- Stormwater will initially be directed to a primary treatment area sized to treat runoff associated with frequent events. This primary treatment area will be designed to have an overflow into a larger basin area if space is available, or alternatively bypass flows into the river.
- The basins should be sized to treat the 1 year ARI event, and attenuate stormwater runoff up to the 10 year ARI event to the pre-development flow rate.
- The basins will be designed to flood in 100 year ARI event as well as accommodate overflow from the river in the event of storm surge.

It is recommended that proponents seek early advice on measures best suited to the development proposal from the relevant local government authority, and the Department of Water and Swan River Trust where required. Design guidelines or standard drawings for WSUD elements located in public spaces are recommended.

The surface and ground water quality within the Canning Bridge activity centre is proposed to be managed using the principles, design criteria and development requirements outlined in Table 12.

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Figure 8 WSUD measures for different scales of development

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Table 12 Water quality

Principle
Improve the quality of surface and ground water leaving the development area to maintain and restore ecological systems.
Design criteria
• Ensure that all stormwater from constructed impervious surfaces receives treatment through WSUD measure prior to infiltration of discharge consistent with the *Stormwater Management Manual* (DoW 2007). • Incorporate best management practice stormwater management into stormwater design and retrofit. • Swales/vegetated bioretention systems (also referred to as rain gardens) are to be sized at 2 per cent of the constructed impervious area from which they receive runoff. • Outflows from subsoils, where implemented, shall receive treatment prior to discharge to the stormwater system. • Achieve concentration targets for nutrients in stormwater discharging to the Canning River in accordance with the *Swan Canning Water Quality Improvement Plan* (SRT 2009), of 0.1 mg/L for total phosphorus and 1.0 mg/L for total nitrogen. • Ensure adequate resourcing and budgets for the planning, implementation and maintenance for all WSUD projects and assets.
Development requirements
Maximise stormwater retrofitting of existing stormwater management systems with appropriate biofiltration and structural controls to achieve improved water quality outcomes at source.
Identify low traffic areas including pathways and medians in parking areas and incorporate appropriate permeable pavements where practicable.
Discharge from major highways and freeways (trucking routes) to have spill containment for 23 m^3 (one tanker) prior to environmental discharge.
Identify high traffic volume road areas or areas adjacent to the river for the installation of pollutant trapping/treatment devices.
In order to achieve the water quality objectives identified in the *Swan Canning Water Quality Improvement Plan* (SRT 2009) it is proposed that stormwater runoff will flow through ephemeral biofiltration basins prior to discharge into the Swan and Canning Rivers where practicable.
Construction of any WSUD features, such as biofiltration basins or swales, within foreshore reserve areas will need to be undertaken in consultation with the Swan River Trust and will require further detailed design, justification and agreement.
Use signage throughout the catchment to identify the hydrological connections between stormwater, groundwater and the Swan and Canning Rivers.
Identify and manage the risk of contamination of surface and groundwater by

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disturbance of acid sulfate soils during dewatering and construction in accordance with *Treatment and management of soils and water acid sulphate soil landscapes* (DEC 2009), prepare an acid sulphate soil management plan.

Contaminated sites to be managed in accordance with the *Contaminated Sites Act 2003*.

5.4 Groundwater

Parts of the Canning Bridge activity centre along the Canning River foreshore are characterised by shallow groundwater. Development proponents will need to take shallow groundwater into consideration when identifying appropriate construction methods. This will ensure the structural integrity of buildings is not compromised by inundation and provide suitable living conditions for residents and their property. Development in areas of shallow groundwater traditionally uses a combination of groundwater drainage and imported fill to provide dry, stable foundations for buildings. However, alternative construction methods can reduce the need for substantial groundwater drainage and imported fill.

If management of groundwater levels is proposed in proximity to environmentally sensitive areas the development must show that water levels of the ecosystem will be protected, and ecosystems will be protected from modified runoff following development.

The principles, design criteria and development requirements for groundwater level management within the Canning Bridge activity centre are identified in Table 13.

Table 13 Groundwater management

Principle
Groundwater levels shall be managed to protect and enhance ecosystems and protect the built environment from inundation and water logging.
Design criteria
• Manage and minimise changes in groundwater levels following development/redevelopment. • Protect infrastructure and assets from flooding and inundation by high seasonal groundwater levels, perching and/or soil moisture.
Development requirements
Development will need to provide adequate separation of new buildings from groundwater levels as specified by relevant authorities.
Groundwater level management is required where the maximum groundwater level is within 2 m of the current surface level.
Where groundwater level management is required, work with the Swan River Trust to manage runoff and meet the appropriate design and performance criteria for the Swan and Canning Rivers.
Where clean fill is imported onto site to maintain adequate clearance to groundwater, the fill will contain a band of material that will reduce phosphorous export via soil leaching, whilst also meeting soil permeability and soil compaction criteria specified by the local government authority.

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If controlled groundwater level is proposed for a development they must be designed to ensure:

- Water dependent ecosystems are protected.
- Free draining outlets.
- Adequate separation between the development surface and groundwater.

5.5 Disease vector and nuisance insect management

Mosquito breeding sites can occur where there is standing water. Within the Canning Bridge activity centre mosquito breeding can be controlled by ensuring that structural controls for stormwater management are appropriately designed. Ephemeral structures that cater for a drying climate are preferred.

The principles and design criteria for mosquito control within the Canning Bridge activity centre are identified in Table 14.

Table 14 Disease vector and nuisance insect management

Principle
Reduce health risks from mosquitoes.
Design criteria
• Retention and detention treatments should be designed to ensure that between the months of November and May, detained immobile stormwater is fully infiltrated in a time period not exceeding 72 hours. • Permanent water bodies are discouraged – ephemeral basins that cater for a drying climate are preferred. • Where permanent water bodies are accepted by the Department of Water, they shall be designed to maximise predation of mosquito larvae by native fauna to the satisfaction of the local government on advice of the Department of Water and the Department of Health.

5.6 Climate change

The City of Melville and the City of South Perth are members of the Cities for Climate Protection program, and have established a foundation for climate change adaptation across the range of local government operations. It is suggested that in order to plan for climate change major storm surge and flood events that a finished floor level of 2.1 m from the 100 year ARI event flood level is adopted for development within the Canning Bridge activity centre, as identified in the *City of South Perth Water Sensitive Urban Design Guidelines* (Aurecon 2012). This level is conservative, and is estimated based on:

- 0.9 m sea level rise
- 0.3 m tide
- 0.6 m wave run up
- 0.3 m freeboard.

The principles and design criteria for consideration of climate change within the Canning Bridge activity centre are identified in Table 15.

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Table 15 Climate change

Principle
All new development and redevelopment to consider the risk of climate change in design.
Design criteria
• Redevelopment and new development along the Canning River foreshore to have a freeboard for habitable floors of 2.1 m above the 100 year flood event level. • Bio-remediation systems, vegetation and wetlands to be designed as ephemeral systems to cater for dry periods. • Recharge of the aquifer is to be maximised, in particular to support downstream environmentally sensitive ecosystems. • IFD (Intensity Frequency Duration) charts are developed based on historical data. To cater for increased peak storm events a sensitivity check with critical IFD values increased by 30% is to be completed. Critical structures and infrastructure that are impacted are to be protected. • Treatment systems along the foreshore are to be designed for inundation.

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6. Implementation

As the Canning Bridge activity centre is an existing urban area implementation of this local water management strategy will occur over extended time frames and on an ad-hoc basis, as development and redevelopment proposals are approved and constructed.

6.1 Requirements for future planning and development

This local water management strategy provides guidance on water management within the Canning Bridge activity centre. Urban water management plans are not anticipated to be required to support small scale residential redevelopment of individual lots within the study area. Urban water management plans may be required for larger scale development areas supported by Detailed Area Plans (DAPs), or where a development is proposed that will significantly alter the hydrology and drainage of a site or is unable to meet the design criteria identified in Section 5.

Where an urban water management plan is required it should be consistent with the requirements of the Department of Water's *Urban water management plans: Guidelines for preparing plans and complying with subdivision conditions* (DoW 2008). The urban water management plan should demonstrate that water management within the subdivision will meet the objectives and criteria in the local water management strategy, except where alternative agreement has been reached with the Department of Water and the local government authority.

6.1.1 Subdivision

Small scale subdivision (<30 lots) should be undertaken in accordance with the structure plan and the objectives, strategies and design criteria in this local water management strategy. An urban water management plan is generally not required for infill development unless the Department of Water or local government authority require additional information to demonstrate compliance with this local water management strategy, or where proposed development may have an impact on significant resources.

Where subdivision is at a larger scale or subject to a detailed area plan, the subdivision should be undertaken in accordance with the detailed area plan and the accompanying urban water management plan, as well as demonstrating compliance with this local water management strategy.

Developers subdividing land for urban residential or mixed use development are required to provide a stormwater drainage system. The drainage system should consider the total contributing catchment area, ensuring that the ultimate design is capable of carrying the ultimate design flow from the upstream catchment. Developers whose land shares a common drainage catchment have a shared responsibility for ensuring that the whole of the catchment, including distributor roads, is drained.

If the development is unable to retain flows in accordance with the design criteria in Section 5.2, the developer shall liaise with and gain approval from the relevant local government authority regarding overflow or connection to the existing local drainage system and any required upgrades to the network to accommodate the additional flow.

The developer shall liaise with the Department of Water and Swan River Trust where the drainage system discharges into the Canning River.

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6.1.2 Development

Development applications submitted to Council, including engineering and building drawings, should be supported by clear and auditable documentation that details the water management requirements, including any proposed staging, and demonstrating compliance with the objectives and criteria in this local water management strategy.

Additional design criteria may be relevant to the development such as where a Detailed Area Plan and urban water management plan have been prepared for a precinct.

Development applications should also be supported by other environmental investigations and management plans where required; including acid sulfate soil management plans, dewatering management plan or detailed site investigation. Developers should seek advice from the local government authority, the Department of Water, Swan River Trust and Department of Environment Regulation in this regard.

The local government authority may require the applicant to prepare as a condition of approval, but prior to commencing site works, a Site Environmental Management Plan detailing management actions and responsibilities for construction activities.

6.2 Review

This Local Water Management Strategy should be reviewed every 5 years or as required for the duration of the development in the Canning Bridge activity centre, ensuring the information presented and the recommendations remain current in achieving best management practice in total water cycle management through the life of the development.

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7. References

Aurecon (2012) *City of South Perth developed Water Sensitive Urban Design Guidelines*, prepared for City of South Perth, March 2012

(DoH) Department of Health (2011) *Guidelines for Non-potable uses of recycled water in Western Australia*, Government of Western Australia, August 2011

(DoW) Department of Water (2013) *Guideline for the approval of non-drinking water systems in Western Australia*, Government of Western Australia, December 2013

Environmental Services (2012) *Adapting to Climate Change in the City of Melville 2012*-2017, prepared for the City of Melville, May 2012

GHD (2014) *Draft Canning Bridge Structure Plan Sustainable Infrastructure Study* prepared for the City of Melville and the City of South Perth, February 2014

GHD (2012) *Canning Bridge Structure Plan Services Report Phase 1: Analysis* prepared for the City of Melville and the City of South Perth, October 2012

(JDA) Jim Davies and Associates (2004) *City of South Perth Integrated Catchment Management Plan*, prepared for City of South Perth, September 2004

Kinhill (1997) *City of Melville Stormwater Management Strategy; Treatment Prescriptions*, prepared for City of Melville, November 1997

Nice, H.E.,Grassi, M., Foulsham, G., Morgan, B., Evans, S.J., Robb, M. (2009) *A baseline study of contaminants in the sediments of the Swan and Canning estuaries*, Department of Water report to Swan River Trust.

(SRT) Swan River Trust (2012) *Local Water Quality Improvement Plan; Bull Creek Catchment*

(WAPC) Western Australian Planning Commission (2010) *Central Metropolitan Perth Sub-Regional Strategy; Direction 2031*

Water Corporation (2007) Guidelines for Waterwise Criteria.

Waters, A. (2011) *City of Melville – Strategic Natural Areas Asset Management Plan 2011*, report by Woodgis Environmental Assessment and Management for the City of Melville, Western Australia.

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Appendix A – Local stormwater drainage

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LEGEND

Drainage infrastructure

- Pipe 0525
- Pipe 0225
- Pipe_0300
- Pipe 0375
- Pipe 0450
- Pipe 0450
- Pipe 0450
- Study Area

1:15,000 at A4

0 75 150 300 450 600

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

N

City of Melville
Canning Bridge LWMS

Drainage infrastructure

Job Number	61-28373
Revision	B
Date	25 Feb 2014

Figure A.1

G:\61\28373\GIS\Maps\MXD\612837304_G017_FigA1_A4_RevA.mxd
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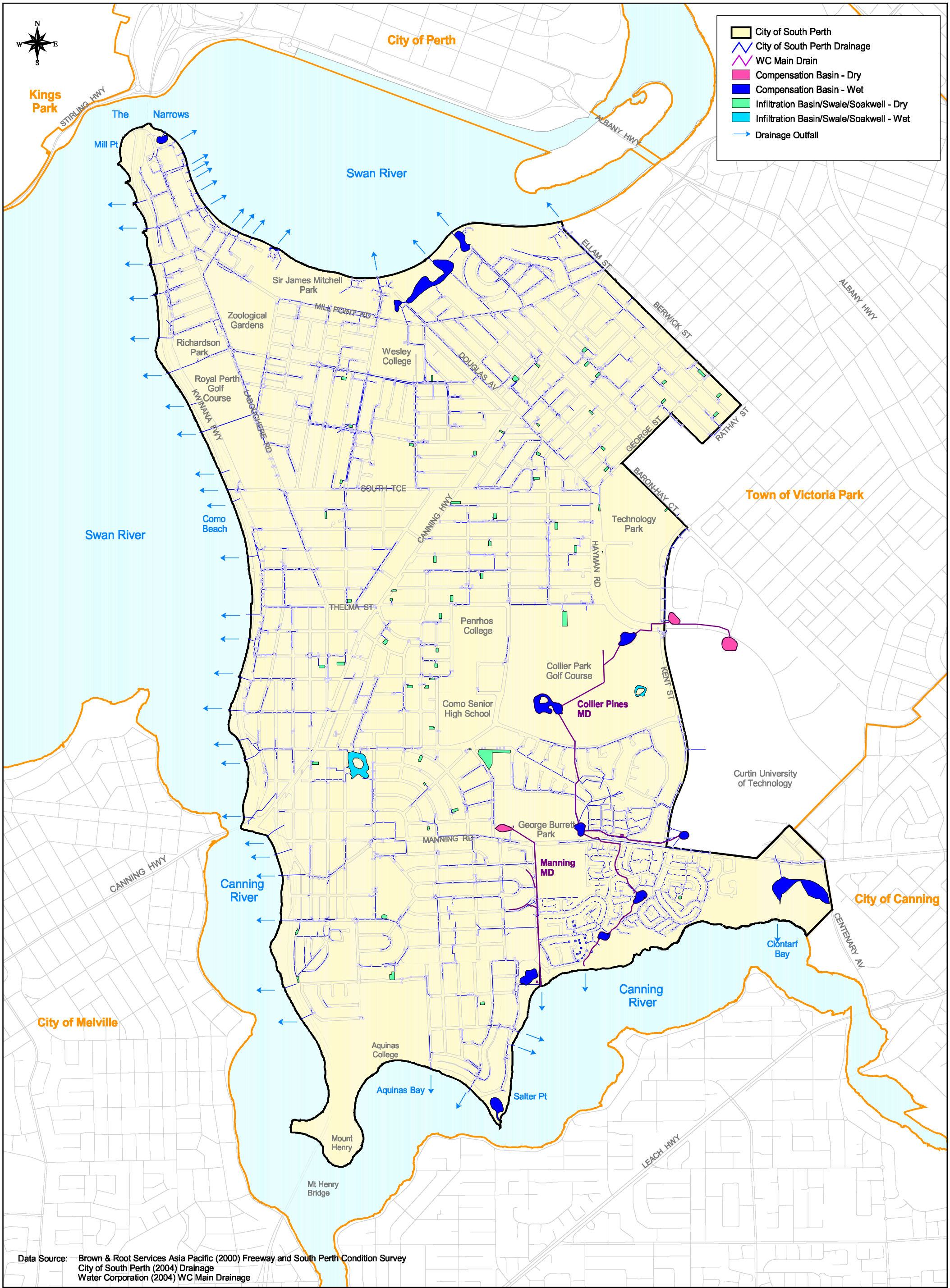
Data source: Landgate: Metro Central Feb 2012 Mosaic - 20120814; City of Melville: Drainage infrastructure - 20140225; GHD: Study Area - 20120809. Created by: vdinh



Data Source: Brown & Root Services Asia Pacific (2000) Freeway and South Perth Condition Survey
City of South Perth (2004) Drainage
Water Corporation (2004) WC Main Drainage

JDA Consultant Hydrologists

Job No. J3341

Scale 1:25000

0 0.5 1 1.5 Kilometres

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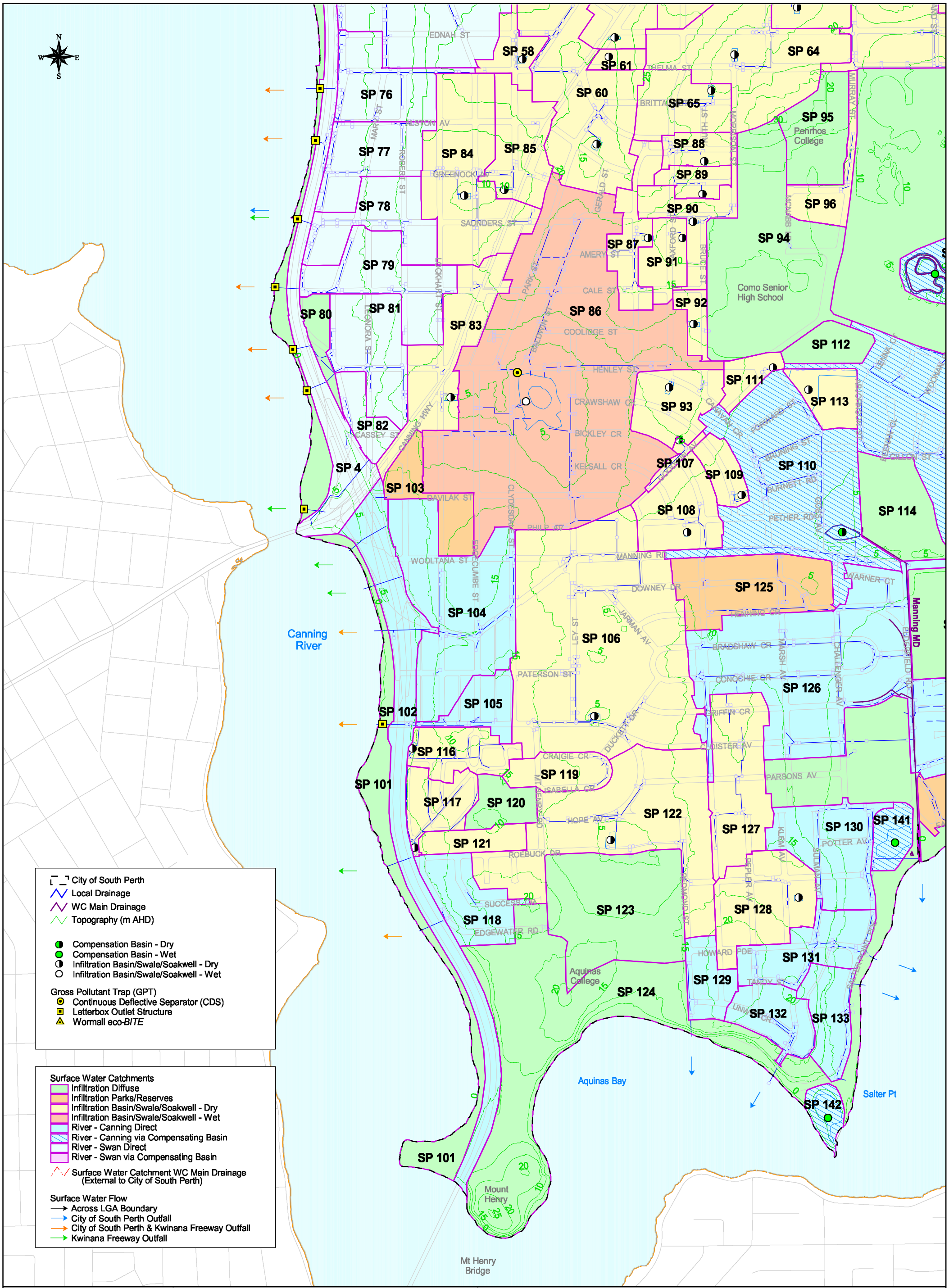
City of South Perth

Integrated Catchment Management Plan

Figure 5: Drainage Overview (City of South Perth & Water Corporation)



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Scale 1:12000

0 200 400 600 800 Metres

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Integrated Catchment Management Plan

Figure 12: Surface Water Catchment Mapping
Map C

Appendix B – Stormwater quality

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SITE NAME	AWRC Site	CATCHMENT	pH	Nutrients (mg/L)							Dissolved Metals (mg/L)							
				DON	NOx-N	TKN	TN	NHx-N	TP	FRP	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
SEPTEMBER 2012 GRAB SAMPLES																		
Helm St1		Melville	6.8		0.13	1.3	1.4	0.014	0.2	0.014	BD	BD	BD	0.009	BD	0.001	0.002	0.072
Helm St 2		Melville	6.9		0.062	0.96	1	BD	0.12	0.024	BD	BD	0.001	0.006	BD	BD	BD	0.03
Esplanade Park		Melville	6.9		BD	0.77	0.77	BD	0.12	0.013	BD	BD	BD	0.004	BD	BD	BD	0.023
Moreua		Melville	6.8		BD	0.8	0.8	BD	0.27	0.17	BD	BD	BD	0.006	BD	0.001	0.001	0.049
Neil McDougall Park Lake Infiltration Basin (Henley Street Drain Inflow)		South Perth	6.9		0.06	0.7	0.76	0.016	0.09	0.016	BD	BD	BD	0.006	BD	0.001		0.026
WIN SUMMARY DATA (Average of samples)																		
Manning Main Drain (DRAIN NO18)	6161888	Manning/ Waterford	6.84	-	0.20	0.65	-	0.16	0.04	0.01	-	-	-	-	-	-	-	-
Collier Pines Main Drain (DRAIN NO19)	6161889	Manning/ Waterford	7.06	-	0.21	0.81	-	0.26	0.04	0.01	-	-	-	-	-	-	-	-
Bullcreek (BCMDBPI)	6161690	Bull Creek		0.90	0.13	6.77	6.47	5.22	0.02	0.00	-	-	-	-	-	-	-	-
Bullcreek (BWMDBPI)	6161691	Bull Creek		0.30	0.16	0.53	0.68	0.15	0.02	0.00	-	-	-	-	-	-	-	-
Bull Creek MD (PSDTBCMD)	6162178	Bull Creek		0.57	1.98	1.16	3.12	0.52	0.02	0.00	-	-	-	-	-	-	-	-
Bullcreek Drainage (BAMDKD)	6164523	Bull Creek		0.63	0.20	0.81	1.01	0.08	0.10	0.05	-	-	-	-	-	-	-	-
Sixth Ave Main Drain (DRAIN NO35)	6161905	Bull Creek	7.16	-	1.00	0.97	-	0.15	0.16	0.09	-	-	-	-	-	-	-	-
Bullcreek Main Drain (DRAIN NO36)	6161906	Bull Creek	7.04	-	0.66	0.47	-	0.09	0.04	0.01	-	-	-	-	-	-	-	-
Brentwood Main Drain (DRAIN NO37)	6161907	Bull Creek	4.20	-	0.12	0.62	-	0.36	0.04	0.00	-	-	-	-	-	-	-	-
Neil McDougall Park Lake Infiltration Basin (CLYDESDALE ST INLET, SP4)	6164561	South Perth		-	0.05	0.82	0.87	0.02	0.57	0.40	0.002	BD	BD	0.001	BD	BD	0.002	0.007
Neil McDougall Park Lake Infiltration Basin (BICKLEY CRESCENT INLET, SP5)	6164562	South Perth		-	0.02	0.65	0.67	0.02	0.35	0.27	0.001	BD	BD	0.002	BD	BD	0.002	0.013
Collier Pines Main Drain (SP11)	6164566	South Perth		0.34	0.12	0.65	0.77	0.12	0.02	0.00	0.001	BD	0.001	0.002	BD	BD	BD	0.017
Coffee Point (SWF008)	6160882	South Perth		-	0.00	0.43	0.43	0.03	0.04	0.02	-	-	-	-	-	-	-	-
Deepwater Point (SWF009)	6160883	South Perth		-	0.01	0.39	0.40	0.03	0.03	0.02	-	-	-	-	-	-	-	-
Collier Pines Main Drain (CPMD1)	6160062	South Perth			0.27	-	1.10	0.32	0.03	0.01	-	-	-	-	-	-	-	-

BD - Below detection

Appendix C – Groundwater level

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Table C.1 WIN groundwater levels

AWRC reference	Water level (mAHD)	Water depth (mBGL)	Date
City of Melville			
61611797	0-1.135	1.355-0.22	16/03/1992-24/07/2000
61611798	-0.005-0.949	1.36-0.406	16/03/1992-24/07/2000
61611799	-0.08-0.965	1.435-0.39	16/03/1992-24/07/2000
61601303	-	7.92	22/08/1977
61601447	1.110	11.89	09/01/1978
61601482	-	14.78	28/09/1977
61601483	-	14.94	12/01/1978
61601484	-	16.76	-
61601489	-	10.49	4/01/1978
61601683	-	10.0	23/09/1978
61601684	-	18.28	25/07/1978
61601784	-	1.52	10/12/1977
61602085	0.010	1.3	02/12/1983
61615614	-	12.8	30/06/1978
City of South Perth			
61601366	-	1.98	13/10/1977
61601368		7.62	18/08/1977
61601629		14.36	30/06/1977
61601814		14.33	18/10/1978
61602109		3.4	01/07/1997

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