

# Eastern Creek Business Hub

## Water Cycle Management Strategy Report Incorporating Water Sensitive Urban Design Techniques



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Prepared by:  
**J. WYNDHAM PRINCE**

CONSULTING CIVIL INFRASTRUCTURE ENGINEERS  
& PROJECT MANAGERS

PO Box 4366  
WESTFIELD NSW 2750  
DX 8032 PENRITH

**P** 02 4720 3300

**F** 02 4721 7638


**W** [www.jwprince.com.au](http://www.jwprince.com.au)

**E** [jwp@jwprince.com.au](mailto:jwp@jwprince.com.au)

**EASTERN CREEK BUSINESS HUB**

**WATER CYCLE MANAGEMENT STRATEGY INCORPORATING  
WATER SENSITIVE URBAN DESIGN TECHNIQUES**

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**EASTERN CREEK BUSINESS HUB**

**WATER CYCLE MANAGEMENT STRATEGY INCORPORATING  
WATER SENSITIVE URBAN DESIGN TECHNIQUES**

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## 1. EXECUTIVE SUMMARY

J. Wyndham Prince Pty Ltd in close consultation with the Western Sydney Parklands Trust have prepared a Water Cycle Management Strategy Incorporating Water Sensitive Urban Design Techniques to integrate with the State Significant Development Application process for the Eastern Creek Business Hub site, Eastern Creek. The strategy has been prepared to conform with statutory requirements and industry best practice for stormwater management in this catchment. Sufficient detail is provided to provide the basis for detailed design and development of the site and to identify the area that needs to be allocated for stormwater management infrastructure.

The overall water cycle management objectives for the development area were identified and are detailed in Section 4.6 of this report.

The proposed Water Cycle Management Strategy consists of a treatment train consisting of on lot treatment, street level treatment and subdivision / development treatment measures. The structural elements proposed for the development consists of:

- Proprietary GPT units at each stormwater discharge point.
- Rainwater tanks for each development site.
- A bio-filtration raingarden of total area 500m<sup>2</sup> for the southern development site.
- On lot bio-filtration raingardens or other equivalent water quality treatment devices for the northern development sites.
- A detention basin of approximate total volume 3,500m<sup>3</sup> for the southern development site.
- On Site Detention for the northern development sites of approximate total volume 5,800m<sup>3</sup> (equivalent to approximately 430 m<sup>3</sup>/ha of development area).
- A 200 m long grass lined swale accepting discharges from the road system, discharging into the reserve within the site.
- A grass lined channel system to safely collect and convey flows from the upstream catchment through the site, which has the capacity to convey future increases in peak discharges due to climate change.

The hydrology modelling undertaken shows that post development case peak discharges up to the 100 year ARI storm event from the site can be managed to existing levels.

Provision of the proposed water quality treatment devices within the development will ensure that the post development stormwater discharges will meet Blacktown City Council's and the Office of Environment and Heritage's water quality objectives for the development.

The provision of WSUD elements within the Eastern Creek Business Hub development will assist in minimising the impact of urbanisation on the waterway stability of downstream drainage reserves and Eastern Creek and comply with Office of Environment and Heritage Stream Erosion Index and water quality targets, whilst the required targets that form part of Blacktown City Council will be met by the Southern Catchment only.

The proposed Water Cycle Management Strategy for the developed site provides a basis for the detailed design and development of the site to ensure that the environmental, urban amenity, engineering and economic objectives for stormwater management and site discharge are achieved.

## 2. INTRODUCTION

The Eastern Creek Business Hub is located in the suburb of Eastern Creek. The site consists of approximately 35 hectares of land falling within the Blacktown Local Government Area.

The Western Sydney Parklands Trust has engaged J. Wyndham Prince (JWP) to prepare a Water Cycle Management Strategy to inform the Precinct planning process and support the State Significant Development Application process for the Precinct.

This report details the procedures used and presents the results of investigations undertaken by JWP in developing a Water Cycle Management Strategy that incorporates the principles of Water Sensitive Urban Design (WSUD) to integrate with and inform the planning process for the Eastern Creek Business Hub.

The objective of this investigation is to identify the stormwater issues to be taken into account in the development application, detailed design and development of the Eastern Creek Business Hub. The investigation identifies appropriate options and locations for the control of the quantity and quality of stormwater leaving the site, and to identify the land areas required to implement the recommended options.

The investigation addresses engineering considerations whilst placing a strong focus on conserving and enhancing the bio-diversity, ecological health and positive water quality benefits for the downstream riparian corridor of Eastern Creek.

The investigation involved the following specific tasks:

- Liaise with Western Sydney Parklands Trust and Blacktown City Council to determine their specific requirements for development of the Precinct.
- Investigate a range of stormwater management and water sensitive urban design measures suitable for the site. Liaise with the Western Sydney Parklands Trust and Blacktown City Council and identify the most appropriate strategy for the Eastern Creek Business Hub development.
- Undertake a hydrologic analysis to determine the peak 5 and 100 existing case and developed case flows.
- Determine the minimum detention storage requirements to restrict peak post development flows to existing conditions.
- Undertake a water quality analysis and determine the minimum treatment device areas required to achieve Blacktown City Council's water quality targets.
- Undertake a stream erosion index assessment to check that the post development stream forming flow duration is no greater than 3.5 times the pre-development duration (as nominated by Blacktown City Council). NSW Office of Environment and Heritage have determined a limit of 5.0 times the pre-development duration.
- Prepare a Water Cycle Management Concept Plan.
- Prepare a Water Cycle Management and Water Sensitive Urban Design Strategy Report to support the rezoning for the Eastern Creek Business Hub, detailing the investigations, findings, calculations and design details.

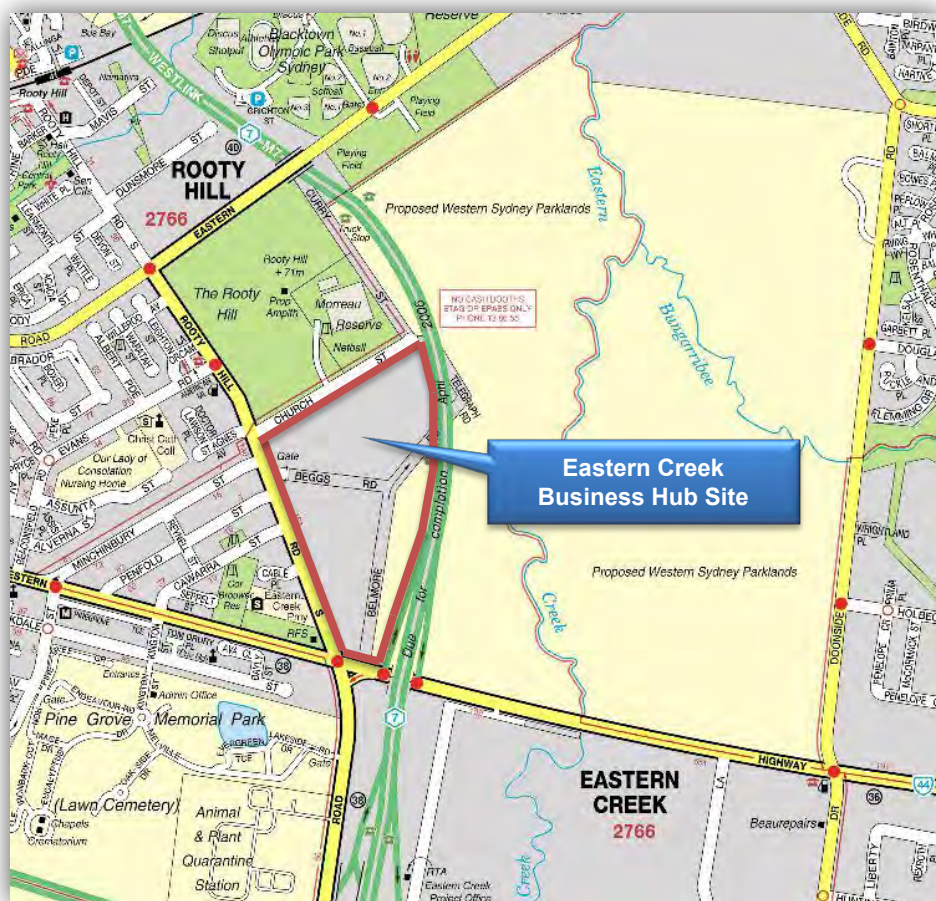
### 3. THE EXISTING ENVIRONMENT

#### 3.1. The Site

The Eastern Creek Business Hub, which totals approximately 35 hectares, is located within the suburb of Eastern Creek. The site is bounded by Church Street to the north, the Westlink M7 to the east, the Great Western Highway to the south and Rooty Hill Road South to the West.

The Eastern Creek Business Hub site currently consists primarily grass lands with some scattered trees and bushland. There are also several existing residential properties located adjacent to the western boundary and a single residential property adjacent to the northern boundary. A road / track (Beggs Road) also runs partially through the site from Rooty Hill Road South.

The location of the Eastern Creek Business Hub is indicated in Plate 1 below and is shown in more detail in Figure 1.



(Source: UBD)

**Plate 1: Location of the Eastern Creek Business Hub Development Site**

### 3.2. Existing Drainage Configuration

The Eastern Creek Business Hub site generally grades from west to east. An existing culvert, just south of Cable Place, partially conveys flows from the majority of the upstream catchment under Rooty Hill Road South and into the site. In larger storm events flows will exceed the capacity of the culvert and surcharge across Rooty Hill Road South and into the site. A channel then conveys these flows through the site to a culvert at the eastern boundary, which then runs under the Westlink M7.

A smaller portion of the catchment upstream of the site will discharge into the northern portion of the site, near the alignment of Beggs Road. The northern portion of the site discharges to a separate culvert toward the north-eastern boundary of the site, which also runs under the Westlink M7.

Flows from the site will eventually discharge to Eastern Creek. The existing drainage configuration and flow directions within the site is shown on Plate 2. The existing catchment boundaries are shown on Figure 3.



**Plate 2: Existing Drainage Configuration for the Eastern Creek Business Hub Site**

### 3.3. The Proposed Development

Development of the Eastern Creek Business Hub site will be a staged construction. The first stage involves development of the southern portion of the site (south of Beggs St easement), totalling approximately 10 hectares. A preferred and alternate Indicative Layout Plan (ILP) has been prepared for the site, with the extent of development south of the internal access road being the difference between the two plans. The preferred ILP is shown on Plate 3 and an alternate ILP on Plate 4.

The Phase 1 development is likely to consist of a single “Large Format Retailer” building (south of the new internal road), and commercial sites north of the new internal road. The works undertaken as part of Phase 1 will be the new road, stormwater infrastructure and open space works. Development of the lots themselves will be by tenants who will submit their own applications in due course.

The Phase 2 development portion of the site is located to the north of the Beggs St easement, totalling approximately 7.9 hectares. Proposed development in Phase 2 is likely to consist of Bulky Goods sites along with other commercial sites. The construction of the Phase 2 development (access road extension and works to Church Street) will be driven by market demand. This is expected to take up to 10 years.

Water quality and quantity control for the development sites, other than the southern Large Format Retail site, is proposed to be provided within each lot. The southern Large Format Retail site will drain to the bio-filtration device (quality) and detention basin (quantity) shown on Figure 4.

The remainder of the Eastern Creek Business Hub site to the east of the area proposed for development consists of open space and an easement and buffer zone for a major gas pipeline.

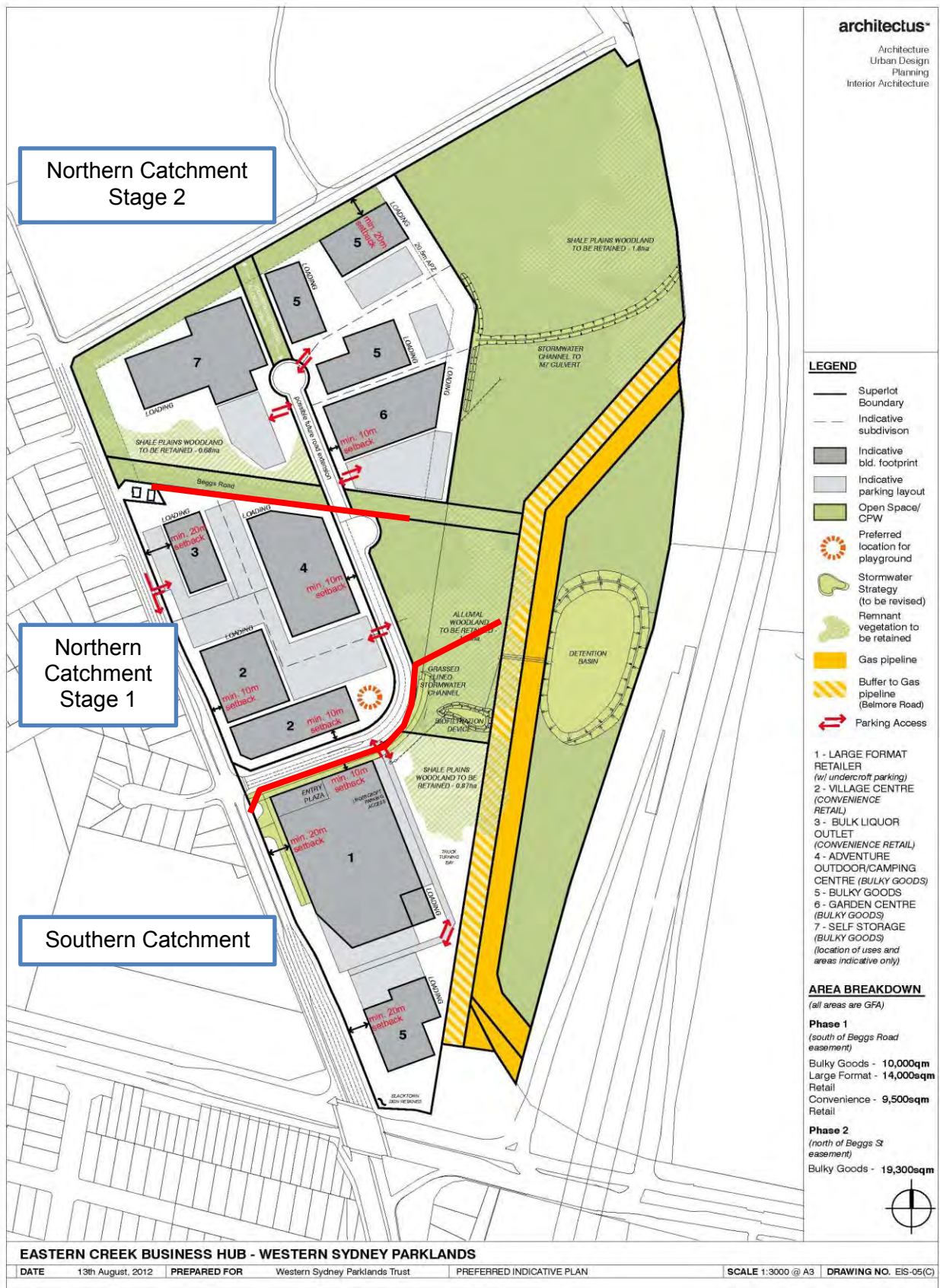


Plate 3 – Preferred Indicative Layout Plan

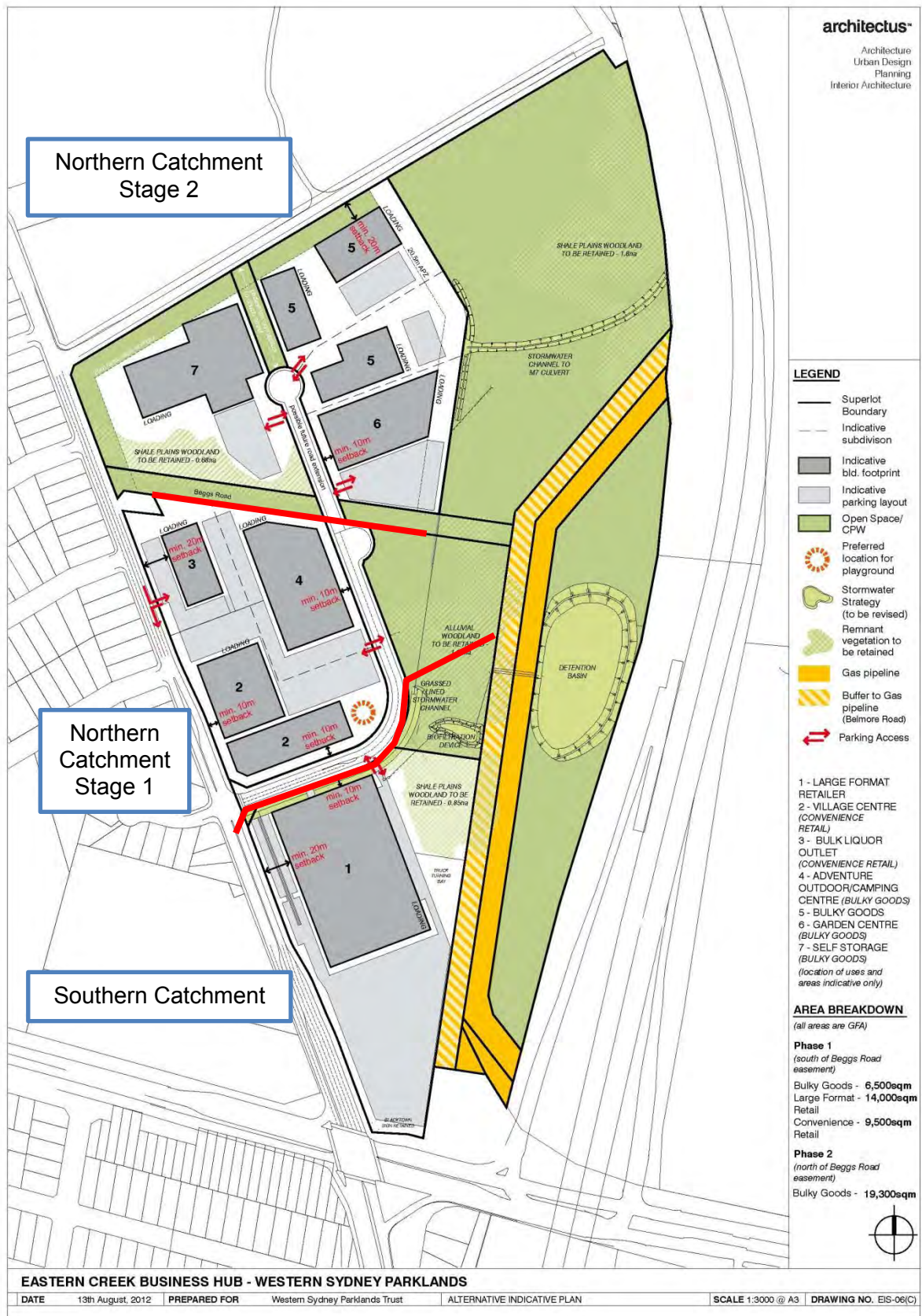


Plate 4 – Alternate Indicative Layout Plan

## 4. DEVELOPMENT GUIDELINES, OPPORTUNITIES AND CONSTRAINTS

The following guidelines were considered in developing the Water Cycle Management and WSUD strategy.

### 4.1. Blacktown City Council DCP 2006 Part R (Water Sensitive Urban Design and Integrated Water Cycle Management)

Blacktown City Council's Water Sensitive Urban Design and Integrated Water Cycle Management DCP (2006) aims to:

- Protect and enhance natural river systems and their associated ecosystems and ecological processes.
- Maintain, protect and/or rehabilitate modified watercourses and their associated ecosystems and ecological processes towards a natural state.
- Minimise potable water demand and wastewater generation.
- Match the post development runoff to the pre development or natural water runoff regime as closely as possible.
- Mitigate the impacts of development on water quality and quantity.
- Mitigate the impacts of development on groundwater, particularly in saline groundwater environments.
- Ensure any changes to the existing groundwater regime do not adversely impact upon adjoining properties.
- Integrate water cycle management measures into the landscape and urban design to maximise amenity.
- Minimise the potential impacts of development and other activity on the aesthetic, recreational and ecological values of receiving waters.
- Minimise soil erosion and sedimentation resulting from site disturbing activities.
- Ensure the principles of ecologically sustainable development are applied in consideration of economic, social and environmental values in water cycle management.

The development controls applicable to the Eastern Creek Business Hub development to achieve the above objectives have been identified as:

#### 4.1.1. Water Conservation

- Industrial and commercial developments must supply 80% of their non-potable demand using non potable sources. This shall include the use of rainwater as the primary source and be supplemented by recycled water only in instances where rainwater cannot meet 80% of the demand. Where the 80% demand threshold cannot be met, the use of non-potable sources shall be maximised and will be considered on a merits basis by Council. Examples of non-potable demand includes toilet and urinal flushing, washing machines, garden watering (irrigation), vehicular washing, ornamental ponds and cooling tower top up.

- The percentage of proposed roof area directed to a rainwater tank must be maximised to increase the effectiveness and reliability of the reuse system.
- Where cooling towers are used they are:
  - i. To be connected to a conductivity meter to ensure optimum circulation before discharge;
  - ii. To include a water meter connected to a building energy and water metering system to monitor water usage; and
  - iii. To employ alternative water sources for cooling towers where practical.
- Water use within public open space (for uses such as irrigation, pools, water features) must be supplied from non-potable sources such as recycled water, roof water, harvested stormwater or other non-licensed water sources to meet a minimum of 80 per cent of the demand and treated to NSW State Government and Commonwealth Government standards.

#### 4.1.2. Stormwater (Water Quality and Waterway Stability)

- 90% reduction in the post development average annual gross pollutant (>5mm) load.
- 85% reduction in the post development average annual load of Total Suspended Solids (TSS) load.
- 65% reduction in the post development average annual load of Total Phosphorus (TP) load.
- 45% reduction in the post development average annual load of Total Nitrogen (TN) load.
- 90% reduction in the post development average annual load of Total Hydrocarbons load.
- The post development duration of stream forming flows shall be no greater than 3.5 times the pre development duration of stream forming flows with a stretch target of 1.
- Minimisation of impervious areas that are directly connected to the stormwater system.

#### 4.2. New South Wales Office of Water (NOW) Requirements

As part of the request for input into the Director-General's requirements, the NSW Office of Water provided comments on the proposed Eastern Creek Business Hub. In these comments, NOW encourages the rehabilitation of the drainage channel to mimic a more natural system, however they do not classify the drainage channel as a "river" under the Water Management Act. NOW also confirmed that the drainage channel was not a river in email correspondence to Ecological Engineering on 5 April 2012.

#### 4.3. New South Wales Floodplain Development Manual

Only the far eastern fringes of the site are affected by mainstream flooding from the adjacent Eastern Creek floodplain. No development other than an earth embankment detention basin is proposed within the zone of affectation.

The site is however affected by local overland flooding from upstream catchments. The major and minor drainage systems within the site have therefore been designed to safely convey all flows through the site up to the 100 year ARI event, including flows generated from the upstream catchments.

#### 4.4. Salinity

Salinity is the accumulation of mineral salts in the soil, groundwater and surface waters. Dry land salinity results when these soluble salts are transported to the surface by rising water table. The groundwater itself can also cause soluble salts to migrate under the ground surface and emerge as saline seepage in low lying areas. Salinity can lead to vegetation loss, weed invasion, soil structure decline and in some cases structural damage to buildings.

##### 4.4.1. Salinity and Groundwater Control Measures

Groundwater **recharge** and **discharge** can both result in rising water tables and saline groundwater seepage. In 2009 Douglas Partners carried out a Preliminary Site Appraisal. The study found that the site is likely to have moderate salinity potential.

Salinity management measures should be implemented for the Eastern Creek Business Hub development in accordance with any recommendations outlined in any future Land Capability and Salinity Assessment and/or the WSROC Western Sydney Salinity Code of Practice.

#### 4.5. Water Sensitive Urban Design (WSUD)

Water Sensitive Urban Design aims to minimise the hydrological impacts of urban development and maximise the multiple use benefits of a stormwater system.

Australian Runoff Quality identifies the objectives of WSUD to include:

- Reducing potable water demand through water efficient appliances, rainwater and grey water reuse.
- Minimising wastewater generation and treatment of wastewater to a standard suitable for effluent reuse opportunities and/or release to receiving waters.
- Treating urban stormwater to meet water quality objectives for reuse and/or discharge to surface waters.
- Preserving the natural hydrological regime of catchments.

Australian Runoff Quality also identifies WSUD as the adoption of the following planning and design approaches that integrate the following opportunities into the built form of cities and towns:

- Detention, rather than rapid conveyance of stormwater.
- Capture and use of stormwater as an alternative source of water to conserve potable water.
- Use of vegetation for filtering purposes.
- Protection of water-related environmental, recreational and cultural values.
- Localised water harvesting for various uses.

## 4.6. Stormwater Management Objectives

### 4.6.1. Overall Objectives

The overall site stormwater management objectives were identified as follows:

<b>Environmental</b>	Provision of appropriately designed, functional water quantity and quality facilities, limitation of downstream discharge peaks and velocities and maintenance of existing downstream water quality. Maintenance of environmental flows to ecosystems downstream of the site.
<b>Urban Amenity</b>	Provision of a water cycle management strategy that identifies and controls limits of flood affectation and provision of aesthetic design forms that enhance amenity.
<b>Engineering Considerations</b>	Effective management and control of peak discharges, discharge velocities, site detention, and water quality; industry best practice technical analysis of catchment hydrology and system hydraulic performance.
<b>Economics</b>	Provision of a cost effective, functional site drainage system that optimises performance, provides maximum value for expenditure and keeps on-going maintenance requirements to a minimum.

### 4.6.2. Specific Development Objectives

In accordance with the principles of Ecologically Sustainable Development (ESD), the area needs to be designed, developed and maintained in accordance with the following stormwater management objectives:

- Preserve the ecological integrity where possible to assist in maintaining the health of identified downstream riparian zones.
- Restrict development to above the 1% AEP flood level.
- Incorporate water sensitive urban design principles within the development.
- Ensure post-development water quality complies with Council's and the OEH's requirements.
- Provision of a sustainable environment that preserves the potential for creating habitat for locally indigenous flora and fauna.
- Minimise maintenance requirements for open space, litter control structures and nutrient and sediment removal devices.

## 4.7. Opportunities

In the design of any urban drainage scheme it is desirable to build on the naturally occurring physical and environmental assets of the site to maximise the quality of the ultimate living environment. In particular water should be recognised as an important resource that can enhance and bring a focus to areas accessible to the whole community.

For the Eastern Creek Business Hub site there are major opportunities to:

- Incorporate water sensitive urban design principles to help protect the downstream Eastern Creek riparian corridor.
- Incorporate reuse schemes to irrigate any landscaped and open space areas wherever possible.
- Maximise habitat retention within the undeveloped eastern portion of the site to provide sustainable aquatic and terrestrial ecosystems.
- Retain existing areas of Cumberland Plain Woodland wherever possible.

#### **4.8. Constraints**

The constraints to be considered in the preparation of a drainage strategy for this site include:

- Flows from the upstream catchment are to be safely conveyed through the site.
- Water quality and quantity objectives will require allocation of land for stormwater control structures.
- Potential site soil salinity and groundwater salinity constraints.
- Water use activities that can cause unnatural charging of groundwater and create rising watertables (e.g. over-irrigation of public areas, private lawns and gardens).
- Due to the flat nature of parts of the site and the likely development requiring large, flat building pads, some site fill is expected. Filling should be kept to the minimum amount required.
- A major gas line easement and buffer zone runs through the site. Development is restricted within this zone.

## 5. WATER CYCLE MANAGEMENT STRATEGY CONCEPT

The Water Cycle Management Strategy proposed for the Eastern Creek Business Hub development has been prepared with consideration of the statutory requirements and guidelines listed in Section 4 of this report. The strategy focuses on mitigating the impacts of the development on the total water cycle and maximising the environmental, social and economic benefits achievable by utilising responsible and sustainable stormwater management practices.

### 5.1. Water Quality Management Options

A range of stormwater management techniques and options considered for the management of nutrients and suspended solids discharging from the site are summarised as follows:

#### 5.1.1. Vegetated Swales and Buffers

Swales are formed, vegetated depressions that are used for the conveyance of stormwater runoff from impervious areas. They provide a number of functions including:

- removing sediments by filtration through the vegetated surface;
- reducing runoff volumes (by promoting some infiltration to the sub-soils); and
- delaying runoff peaks by reducing flow velocities.

Swales are typically linear, shallow, wide, vegetation lined channels. They are often used as an alternative to kerb and gutter along roadways but can also be used to convey stormwater flows in recreation areas and car parks.

*Comment: The grade of the majority of land within the Eastern Creek Business Hub is suitable for swales and buffers (< 3%). The likely nature of the development (large scale commercial) will potentially allow swales to be provided adjacent to the streets (footways) with minimal crossings required for driveways. Swales and buffers could also be incorporated within individual development sites to convey stormwater to other WSUD or detention basin devices. Swales and buffers should be further considered at development application and detailed design stages for the development sites to maximise their use.*

#### 5.1.2. Sand Filters

Sand filters typically comprise of a bed of filter medium through which stormwater is passed to treat it prior to discharging to the downstream stormwater system. The filter media is usually sand, but can also contain sand/gravel and peat/organic mixtures. Sand filters provide a number of functions including:

- removing fine to coarse sediments and attached pollutants by infiltration through a sand media layer; and
- delaying runoff peaks by providing retention capacity and reducing flow velocities.

Sand filters can be constructed as either small or large scale devices. Small scale units are usually located in below ground concrete pits (at residential/lot level) comprising of a preliminary sediment trap chamber with a secondary filtration chamber. Larger scale units may comprise of a preliminary sedimentation basin with a downstream sand filter basin-type arrangement.

*Comment: Sand filters are generally suited to smaller catchments. They are inefficient when compared to bio-retention systems and require frequent maintenance.*

### 5.1.3. Permeable Pavement

Permeable pavements, which are an alternative to typical impermeable pavements, allow runoff to percolate through hard surfaces to an underlying granular sub-base reservoir for temporary storage until the water either infiltrates into the ground or discharges to a stormwater outlet. They provide a number of functions including:

- removing some sediments and attached pollutants by infiltration through an underlying sand/gravel media layer;
- reducing runoff volumes (by infiltration to the sub-soils); and
- delaying runoff peaks by providing retention/detention storage capacity and reducing flow velocities.

Commercially available permeable pavements include pervious/open-graded asphalt, no fines concrete, modular concrete blocks and modular flexible block pavements.

There are two main functional types of permeable pavements:

- infiltration (or retention) systems – temporarily holding surface water for a sufficient period to allow percolation into the underlying soils; and
- detention systems – temporarily holding surface water for short periods to reduce peak flows and later releasing into the stormwater system.

*Comment: Permeable pavements are generally a more at source solution and best suited as an on lot approach or for small roadway catchments. Permeable pavers may possibly be considered at the development application stage for on lot treatment or for areas draining small catchment areas with low sediment loads, however may not be suitable due to high traffic volumes and vehicle weights.*

### 5.1.4. Infiltration Trenches and Basins

Infiltration trenches temporarily hold stormwater runoff within a sub-surface trench prior to infiltrating into the surrounding soils. Infiltration trenches provide the following main functions:

- removing sediments and attached pollutants by infiltration through the sub-soils;
- reducing runoff volumes (by infiltration to the sub-soils); and
- delaying runoff peaks by providing detention storage capacity and reducing flow velocities.

Infiltration trenches typically comprise of a shallow, excavated trench filled with reservoir storage aggregate. The aggregate is typically gravel or cobbles but can also comprise of modular plastic cells (similar to a milk crate). Runoff entering the system is stored in the void space of the aggregate material or modular cells prior to percolating into the surrounding soils. Overflow from the trench is usually to downstream drainage system. Infiltration trenches are similar in concept to infiltration basins, however trenches store runoff water below ground within a pit and tank system, whereas basins utilise above ground storage.

*Comment: Infiltration trenches and basins are not appropriate for clay soils or where there is potential for salinity issues. Infiltration trenches and basins are therefore not recommended for the Eastern Creek Business Hub site.*

#### 5.1.5. Constructed Wetlands

Constructed wetlands can take the form of either a surface or sub surface system.

**Surface**            Conventional wetlands.

**Sub Surface**    Gravel filled shallow wetland.

Wetlands are shallow water body systems, densely vegetated with emergent aquatic macrophytes. Wetlands are effective in trapping suspended solids, as well as chemical and biological uptake of pollutants.

*Comment: Wetlands are effective in removing sediment and nutrient loads typically generated from urban development. They do however require a large footprint area in relation to the catchment size. Wetlands also require a significant amount of maintenance. They are susceptible to algal blooms and require recirculation systems. Consideration of public safety measures are also required due to permanent deep water areas. Wetlands could be considered for the Eastern Creek Business Hub development.*

#### 5.1.6. Bio-filtration Systems

Bio-filtration systems consist of a filtration bed with either gravel or sandy loam media and an extended detention zone typically from 100-300 mm deep designed to detain and treat first flush flows from the upstream catchment. They typically take the form of an irregular bed or a linear swale and are located within the verge area of a road reserve or extend within the bushland corridors or other open space areas. The surface of the bio-filtration system can be grassed or mass planted with water tolerant species. Filtration beds of these systems are typically 0.4 to 0.6 metres deep.

*Comment: Bio-filtration systems are an effective and efficient means of treating pollutants from urban developments when part of an overall treatment train. Bio-filtration systems require a reasonable amount of maintenance during the vegetation establishment phase. The use of bio-filtration systems within the Eastern Creek Business Hub site is recommended.*

### 5.1.7. Cartridge Filtration Systems

Cartridge filtration systems are underground pollution control devices that treat first flush flows. The units consist of a vault containing a number of cartridges each loaded with media that targets specific pollutants. Each cartridge has a maximum treatable flowrate of up to 1.5 litres per second, and a unit can be configured to accommodate well over 100 cartridges providing a potential treatable flow rate of over 150 litres per second.

*Comment: Cartridge filtration systems are an efficient means of treating pollutants from urban developments as they are typically located underground and therefore do not require additional landtake. As cartridge systems have a low treatable flow rate, additional "buffer" storage is usually provided to keep the capital costs down. Cartridge filtration systems also need to be supplemented with additional treatment devices to achieve pollutant reduction targets. This requires significant height differences between the inlet to the filtration system and the discharge point from the supplementary system. It also generally results in expensive capital and ongoing maintenance costs. Due to the relatively flat nature of the site and land available for alternate, above-ground WSUD solution, cartridge filtration systems are unlikely to be feasible for the Eastern Creek Business Hub site.*

### 5.1.8. Rainwater Tanks

Rainwater tanks are sealed tanks designed to contain rainwater collected from roofs. Rainwater tanks provide the following main functions:

- allow the reuse of collected rainwater as a substitute for mains water supply, for use for toilet flushing, laundry, or garden watering; and
- when designed with additional storage capacity above the overflow, provide some on-site detention, thus reducing peak flows and reducing downstream velocities.

The water collected can be reused as a substitute for mains water supply either indoors (toilet flushing and laundry) or outdoors (garden watering or hardstand wash-down). Rainwater tanks can be either above ground or underground. Above ground tanks can be placed on stands to prevent the need of installing a pump to distribute the water. Such systems are referred to as gravity systems. Pressure systems require a pump and can be either above or below ground tanks.

Tanks can be constructed of various materials such as Colorbond™, galvanised iron, polymer or concrete.

*Comment: Rainwater tanks are effective in removing suspended solids and a small amount of nutrient pollutants. They are also effective in reducing overall runoff volumes. The effectiveness of rainwater tanks is also increased when plumbed in for internal use. Rainwater tanks should be incorporated within the Eastern Creek Business Hub development wherever possible.*

Each of these management techniques were evaluated and compared with consideration of a range of Environmental, Social/Amenity, Economic, Maintenance and Engineering criteria.

## 5.2. Proposed Stormwater Control Strategy

The stormwater management strategy proposed for the site focuses on minimising the impacts of the development on the total water cycle and maximising the environmental, social and economic benefits achievable by utilising responsible and sustainable stormwater management practices.

A critical consideration is the ecological sustainability of the Eastern Creek Riparian corridor, which is located just east of the Westlink M7. To maintain stormwater quality at the required levels, a “treatment train” approach is proposed where various types of pollutants are removed by a number of devices acting in series. The stormwater management treatment train will consist of the following elements.

### WATER EFFICIENCY

#### On Lot Treatment

- Implementation of water efficient fittings and appliances in all buildings (dual flush toilet, AAA shower heads, water efficient taps and plumbing).
- Minimisation of impervious areas through acceptable development controls.
- The provision of rainwater tanks on each allotment, along with implementation of the above water efficient devices. Rainwater tanks connected for internal uses will ensure maximum reuse for captured stormwater.



## WATER QUALITY

### On Lot Treatment

Water quality for the Eastern Creek Business Hub development should be provided within each of the individual tenanted lots as much as possible. It is proposed to provide on lot water quality treatment to all development sites except the southern most Large Retail Format site. On lot water quality cannot be accommodated within this site without excessive filling and impacting on existing high quality remnant Cumberland Plain Woodland. The land immediately to the east of the proposed southern development site, where the water quality device would be located, consists of Shale Plains Woodland. The water quality bio-filtration device is proposed for this site has therefore been located further to the north-east and is described in further detail below.

The on lot treatment is to be sized to achieve Blacktown City Council's water quality targets (as outlined in Section 4) and should also be sized to compensate, as much as practical, for the internal access road, the runoff from which will be subjected to limited water quality treatment.

Configuration and design of the on lot treatment train would be undertaken at the development application and detailed design stages for each of the future lot developments.

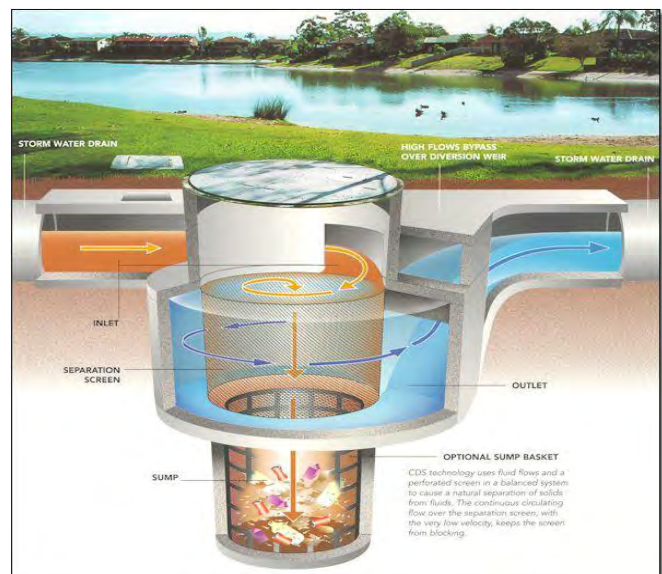
### Street Level Treatments

#### Inlet Pit Filter Inserts and Gross Pollutant Traps (GPTs)

GPT devices are typically provided at the outlet to stormwater pipes. These systems operate as a primary treatment to remove litter, vegetative matter, free oils and grease and coarse sediments prior to discharge to a downstream (Secondary and Tertiary) treatment devices. They can take the form of trash screens or litter control pits, filter pit inserts and wet sump gross pollutant traps.

A proprietary GPT device is proposed for the southern Large Retail Format site. Inlet pit filter inserts are recommended for the internal road.

The form and configuration of GPT's for the remaining development sites can be further considered at development application and detailed design stages.



## Subdivision / Development Treatment

### Bio-filtration “Raingardens”

A bio-filtration “raingarden” is proposed within the development to service the southern Large Format Retailer site. Raingardens are large scale, non-linear bio-filtration systems. The raingarden has been appropriately sized to achieve the nutrient reduction targets proposed in Blacktown City Council’s DCP (Part R 2006). The raingarden will also attenuate first flush flows to reduce the risk of stream erosion on the existing channel and Eastern Creek, which is located downstream of the site. The location of the raingarden is shown on Figure 4.

Raingardens may also be adopted within each of the northern lots as part of the on lot water quality treatment train. Alternate water quality measures that achieve the required target reductions can also be adopted within the lots.



### Swales

A drainage swale is proposed to treat stormwater runoff from the internal access road. It is proposed that the on lot treatment measures proposed for the development lots be sized to compensate, as much as practical, for the bypassing road areas. The swale would be sized to make up any shortfall from the on lot treatment measures.

The strategy for the Precinct does not preclude the use of additional or alternate WSUD elements within the streetscape or landscape. These elements, such as swales or bio-filtration systems elsewhere within the site, can be considered at the development application and detailed design stages of subsequent building applications. The use of such elements would require consideration of issues such as practicality in the urban environment, safety, maintenance and performance.

## WATER QUANTITY

### Subdivision / Development Treatment

<b>Detention Basins</b>	Peak storm flow attenuation up to the 100 year ARI event for the southern portion of the site is addressed through the provision of a detention basin to be located adjacent to the eastern boundary. It is proposed to provide on lot detention for the remaining development sites to attenuate flows up to and including the 100 year ARI event.
<b>Stream Erosion Index</b>	Limiting the post development stream forming flow duration so that it is no more than 3.5 times that of the pre-development stream forming flow duration for Blacktown City Council, up to 5.0 is acceptable to NSW Office of Environment and Heritage.

Key features of the proposed strategy are as follows:

#### **Social:**

- Integration of the bio-filtration raingarden with the overall landscape strategy for the development to create an integrated natural resource for the incoming and wider community.
- Retaining areas of high quality Cumberland Plain Woodland.
- Enhanced visual amenity (views to the east to areas of remnant Cumberland Plain Woodland).
- Flood / overland flow affectation and public safety issues identified and controlled.
- Provision of aesthetic soft design forms that enhance urban and environmental amenity.

#### **Environmental:**

- Limited downstream and in-channel discharge peaks and velocities to avoid scouring, siltation and flora and fauna impacts
- Enhanced ecological health and biodiversity within the drainage corridors.
- Provision of gross pollutant traps, bio-filtration systems, drainage swales and on lot treatment devices to achieve water quality capable of sustaining aquatic ecosystems (for the downstream Eastern Creek riparian corridor).
- Limitation of frequent wetting flows and peak velocities to avoid creek bed/bank erosion and sedimentation. Peak storm flow attenuation is addressed through provision of a detention basin located within the open space area for the southern lot and on lot detention systems for the northern development sites.

- A holistic and interdisciplinary approach to the management of urban salinity, using an approach to construction, stormwater management, building and landscaping practices, consistent with the WSROC Western Sydney Salinity Code of Practice and in accordance with any recommendations from future studies and investigations associated with the future development sites.
- Provision of extensive deep rooted vegetation in strategic areas to intercept ground water flows and generate natural groundwater discharge processes (evapotranspiration).
- Revegetation of allotments and streetscape, where possible, and a bio-filtration system to manage urban salinity and provide habitat.
- Maintaining and enhancing areas of high value Cumberland Plain Woodland.
- Provision of reticulated recycled water or rainwater tanks within the development to reduce reliance on potable water supplies by using recycled water as a resource.

#### **Economic:**

- Minimisation of land-take consistent with the achievement of environmental and social objectives.
- Proposed water quality improvement measures that keep recurrent maintenance tasks and costs to a minimum.

The water cycle management strategy proposed for the Eastern Creek Business Hub development site is functional; delivers the required technical performance; lessens environmental degradation and pressure on downstream ecosystems and infrastructure; and provides for a 'soft' sustainable solution for stormwater management within the development. The water cycle management concept is illustrated on Figure 4 for the preferred ILP, the alternative ILP layout is expected to have a similar concept.

### **5.3. Construction Stage**

Erosion and sediment control measures are to be implemented during the construction phase in accordance with the requirements of Blacktown City Council and the guidelines set out by Landcom (the "Blue Book").

As the operation of "bio-filtration" (raingarden) type water quality treatment systems are sensitive to the impact of sedimentation, these controls should generally be maintained until the majority of the southern site building works are complete. Alternatively, a very high level of at source control on individual allotments during the building and site landscaping works, which is regularly inspected by Council officers, would be required.

### **5.4. Interim Treatment Measures**

The raingarden media bed should be protected throughout the civil and building construction phases of the development. The floor of the raingarden should be lined with either a layer of turf or a sacrificial upper media bed layer and planting that would need to be replaced upon completion of the building construction.

Upon completion of building construction within the catchment, the turf or sacrificial layer can be removed, replaced and the final planting completed.

## 5.5. Long Term Management

Regular maintenance of the stormwater quality treatment devices is required to control weeds, remove rubbish, and monitor plant establishment and health. Some sediment build-up may occur on the surface of the raingarden and may require removal to maintain the high standard of stormwater treatment.

Proper management and maintenance of the water quality control systems will ensure long-term, functional stormwater treatment. It is recommended that a site-specific Operation and Maintenance (O & M) Manual is prepared for the system. The O & M manual will provide information on the Best Management Practices (BMP's) for the long-term operation of the treatment devices. The manual will provide site-specific management procedures for:

- Maintenance of the GPT structures including rubbish and sediment removal.
- Management of the raingarden including plant monitoring, replanting guidelines, monitoring and replacement of the filtration media and general maintenance (i.e. weed control, sediment removal).

## 5.6. Stormwater Monitoring Programme

A stormwater monitoring programme should be implemented to ensure the water quality raingarden continues to operate as efficiently as possible. The management system should involve regular in-situ testing of the hydraulic conductivity of the media bed. The procedure recommended for testing the in-situ hydraulic conductivity has been described in detail by the Facility for Advancing Water Bio-filtration (FAWB) and is reproduced as Appendix A in this report.

Should the testing show a deficiency in the hydraulic conductivity, it is recommended that the following rectification procedure be implemented:

- Determine the filtration bed level (RL) at which the hydraulic conductivity falls below the minimum recommended value.
- Remove the portion of media bed above this level and replace with material in accordance the original specification.

It is recommended that the stormwater monitoring programme be developed for the Precinct and included in the Operation and Maintenance Manual.

## 6. HYDROLOGIC ANALYSIS

The hydrologic analyses for this study were undertaken using the rainfall - runoff flood routing model XP-RAFTS (Runoff and Flow Training Simulation with XP Graphical Interface). The hydrologic analysis for the Eastern Creek Business Hub development was undertaken to determine the size of detention basins required to restrict peak post development flows to pre development levels.

### 6.1. Sub-Catchments (Existing and Post Development)

Sub-catchment areas contributing to the drainage system were established through detailed survey and Land and Property Management Authority data covering the catchment for the site. Catchment boundaries for the existing and developed areas contributing to the drainage system are shown on Figures 2 and 3, respectively, and the catchment details are provided in Appendices B and C.

### 6.2. Rainfall Data & XP-Rafts Parameters

Rainfall data used in the hydrologic study is consistent with Blacktown City Council's Rainfall Intensity Frequency Duration data (Table 3.0 in Appendix D of Blacktown City Council's Engineering Guide for Development).

The XP-Rafts modelling was undertaken using a standard initial and continuing loss rate model. The values adopted are consistent with those accepted by Council at other nearby sites within the Blacktown LGA, as shown in Table 6.1. The pern values adopted in the modelling are also shown in Table 6.1.

**Table 6.1**  
**XP-RAFTS PARAMETERS**

Parameter	Catchment Condition	Adopted Value
<b>Pern</b>	Existing Pervious	0.04
	Urban Pervious	0.025
	Urban Impervious	0.015
<b>Losses</b>		
<i>Undeveloped Site Under Existing Conditions</i>		
Initial Loss	Pervious Catchment	15.0
Continuing Loss	Pervious Catchment	2.5
<i>Developed Site</i>		
Initial Loss	Pervious Catchment	5.0
Continuing Loss	Pervious Catchment	1.0
Initial Loss	Impervious Catchment	1.0
Continuing Loss	Impervious Catchment	0.0

### 6.3. Tailwater Assumptions

Previous flood modelling of Eastern Creek (JWP 2009) has indicated that land within the eastern fringes of the site is below the 100 year flood level. The existing culverts at the M7 Motorway would allow flows to enter the site. Due to the difference in catchment areas for the site and Eastern Creek, it is unlikely that peak 100 year flood levels in Eastern Creek would coincide with peak levels in the detention basin. However, if this were to occur, the

basin may overtop and water would be forced into the low lying areas of the site until the flood levels in Eastern Creek receded. The discharge rate through the culvert would be restricted due to the tailwater impact and would be less than for a free outlet situation. Therefore, the less conservative option is to assume a free outlet.

#### 6.4. Discharge Estimates

Discharge estimates were derived for both the existing and developed catchments for storms with Average Recurrence Intervals (A.R.I.'s) of 5 and 100 years. A range of storm durations from 10 minutes to 24 hours were analysed to determine the critical storm duration for each sub-catchment. The post development discharge estimates are based on full development of the Eastern Creek Business Hub site.

XP-Rafts modelling was undertaken to determine the estimated peak discharges from the catchment for the following conditions:

- Existing rural and urban catchments.
- Site developed and a detention system provided.

The 5 and 100 year A.R.I. peak inflows from the catchment for both the existing and developed conditions are presented in Table 6.2. The XP-Rafts output for the 100 year A.R.I. peak nodal inflows for the existing and developed conditions is provided in Appendix B and C respectively.

**Table 6.2**  
**SUMMARY OF PEAK 5 & 100 YEAR ARI FLOWS AT THE M7 CULVERTS**  
**(SITE DOWNSTREAM BOUNDARY)**

Location	5 Year			100 Year		
	Max Outflow (m <sup>3</sup> /s)	Storm Dur. (min)	Time to Peak (min)	Max Outflow (m <sup>3</sup> /s)	Storm Dur. (min)	Time to Peak (min)
<b>EXISTING DEVELOPMENT</b>						
Northern M7 Culvert	2.78	90	35	6.40	90	35
Southern M7 Culvert	7.95	120	43	13.4	20	18
<b>POST DEVELOPMENT</b>						
Northern M7 Culvert	2.54	120	47	6.04	120	44
Southern M7 Culvert	7.60	120	44	13.3	20	18

The XP-RAFTS modelling results presented in Table 6.2 show that the proposed detention storages within the Eastern Creek Business Hub development are adequate to restrict post development discharges to existing development levels for storm events between the 5 and 100 year ARI.

#### 6.5. Detention Basin Performance

The proposed detention basin located in the south-eastern portion of the site has been included in the XP-Rafts modelling. For the remaining portion of the site that does not drain to the southern basin, an indicative detention basin representing all of the proposed on lot detention systems has been incorporated into one node. The detention requirements can then be apportioned to each individual lot.

The performance of the basin for the 5 and 100 year ARI storm events are detailed in Tables 6.3 and 6.4 for the northern basins and Table 6.5 for the southern basin.

Table 6.3

**OSD PERFORMANCE (NORTHERN STAGE 2 STORAGES) - NODE 1.02**

ARI	Max Inflow (m <sup>3</sup> /sec)	Storm Dur. (min)	Time to Peak (min)	Max Outflow (m <sup>3</sup> /sec)	Storm Dur. (min)	Time to Peak (min)	Storage Used (m <sup>3</sup> )	Stage Used * (m)
5 Year	4.26	25	22	1.70	120	45	2361	39.04
100 Year	6.66	15	11	3.83	90	33	3374	39.49

\* Assumed basin base level RL 38.0

Table 6.4

**OSD PERFORMANCE (NORTHERN STAGE 1 STORAGES) - NODE 3.00**

ARI	Max Inflow (m <sup>3</sup> /sec)	Storm Dur. (min)	Time to Peak (min)	Max Outflow (m <sup>3</sup> /sec)	Storm Dur. (min)	Time to Peak (min)	Storage Used (m <sup>3</sup> )	Stage Used * (m)
5 Year	1.96	20	8	0.31	540	331	1627	38.98
100 Year	3.09	20	15	0.73	120	43	2366	39.42

\* Assumed basin base level RL 38.0

Table 6.5

**OSD PERFORMANCE (SOUTHERN STORAGES) – NODE 2.02**

ARI	Max Inflow (m <sup>3</sup> /sec)	Storm Dur. (min)	Time to Peak (min)	Max Outflow (m <sup>3</sup> /sec)	Storm Dur. (min)	Time to Peak (min)	Storage Used (m <sup>3</sup> )	Stage Used * (m)
5 Year	9.12	25	18	7.49	120	43	2683	39.00
100 Year	14.47	20	15	12.36	120	43	3496	39.28

\* Assumed basin base level RL 38.08

Based on the above results, the northern lots require approximately 420 m<sup>3</sup>/ha of detention storage.

## 6.6. Climate Change Sensitivity Assessment

Preliminary assessments of hydrologic impacts, resulting from changes to rainfall patterns as a consequence of Climate Change, were undertaken to determine the impact of such changes on the performance of the proposed Trunk Drainage system. These assessments followed the sensitivity analysis procedures recommended in the *Impacts of Climate Change on Urban Stormwater Infrastructure in Metropolitan Sydney, Sydney Metropolitan Catchment Management Authority* (SMCMA 2011).

In summary:

- Summer runoff depths are expected to increase by a maximum of 26%.
- The 40-year 24-hour duration rainfall intensity is expected to increase by a maximum of 12%.

- The net average annual runoff is expected to fluctuate with an overall minor increase.

Consequently for the purposes of this assessment, the worst-case scenario of projected increased rainfall intensities (15% increase) and runoff depths (25% increase based on rainfall intensities increased by 15%), were adopted.

This approach has been referred to OEH for comment and has been confirmed as “a pragmatic approach to considering the impacts of Climate Change on urban drainage systems.”

A discussion of the impacts of climate change on flood levels within the trunk drainage channel and extent of flow across Rooty Hill Road is discussed in Section 7.1.

## 7. LOCAL OVERLAND FLOODING

An upstream catchment of approximately 35 hectares drains to the Eastern Creek Business Hub site. The majority of this catchment (30.6 hectares) discharges toward the southern portion of the site. The total 100 year ARI flow from this catchment was estimated to be 12.9m<sup>3</sup>/sec (as determined from the hydrologic assessment using XP-Rafts).

An existing 2 x 750mm diameter concrete culvert conveys part of the flow under Rooty Hill Road, with the remainder surcharging across the road. Following assessment of the available detail survey data, the capacity of the existing culvert, assuming 50% blockage, was estimated to be 1.3m<sup>3</sup>/sec (approximately 10% of the 100 year ARI or 2 month ARI capacity). Therefore the 100 year ARI flow surcharging across Rooty Hill Road was estimated to be 11.6m<sup>3</sup>/sec.

Weir flow calculations were undertaken (see Appendix D) to determine the width and depth of flow across Rooty Hill Road and also to assess the mechanisms required to capture the overland flows and convey them through the site. The results show that the width of flow across Rooty Hill Road in the 100 year ARI storm event is approximately 150 metres, with a maximum depth of approximately 210mm (refer to flow extents on Figure 4).

A trunk drainage channel will be incorporated within the development running parallel to the eastern side of Rooty Hill Road to capture the overland flow. This channel will then extend in an easterly direction to convey the flows safely through the site and discharge them downstream of the development. Once past the development, the channel discharges to the existing channel through a small stilling pool and berm where the flows will be conveyed as currently occurs to the eastern boundary of the site.

The hydrologic and hydraulic calculations for conveyance of stormwater flows from the external upstream catchment are included in Appendix D. The proposed channel details are shown on Figure 4 for the preferred Indicative Layout Plan.

### 7.1. Climate Change Sensitivity Assessment

As discussed in Section 6.6, a sensitivity analysis was undertaken to assess the potential impact of climate change on the 100 year ARI flood levels within the trunk drainage channel, as well as the extent of flow across Rooty Hill Road. The estimated peak 100 year ARI flow from the upstream catchment was increased by 15% to 14.8m<sup>3</sup>/sec. The increase in 100 year ARI flood level in the channel as a result is approximately 115 mm, which is within the freeboard allowance for variations in flow, such as the potential impact of climate change.

An sensitivity analysis was also undertaken to determine the potential impact on the extent of flow across Rooty Hill Road as a result of climate change. The results of the assessment show that the depth of flow across Rooty Hill Road increases by approximately 16 mm and the difference in flood extents is negligible.

A summary of the results of the climate change sensitivity assessment are included in Appendix D.

## 8. WATER QUALITY ANALYSIS

The water quality analysis for the post exhibition study was undertaken using the model MUSIC (Model for Urban Stormwater Improvement Conceptualisation) Version 5. This water quality modelling software was developed by the Cooperative Research Centre (CRC) for Catchment Hydrology, which is based at Monash University and was first released in July 2002. Version 5 was released in 2011.

The model provides a number of features relevant for the development:

- It is able to model the potential nutrient reduction benefits of gross pollutant traps, constructed wetlands, grass swales, bio-retention systems, sedimentation basins, infiltration systems and it incorporates mechanisms to model stormwater re-use as a treatment technique;
- It provides mechanisms to evaluate the attainment of water quality objectives;
- Allows for a Stream Erosion Index assessment.

The MUSIC modelling was undertaken to demonstrate that the water cycle management system proposed for the development will result in reductions in overall post-development pollutant loads and concentrations being discharged from the proposed development and that these discharges comply with the designated target objectives.

### 8.1. Catchments

As discussed in Section 3.3, there is both a Preferred and Alternate Indicative Layout Plans (ILP) for the Eastern Creek Business Hub site. The preferred ILP has a higher area of development than the alternate ILP and will therefore require larger water quality devices. The water quality assessment was therefore carried out for the preferred ILP only.

The southern development (south of the proposed internal access road) will have a treatment train consisting of rainwater tanks, gross pollutant trap and bio-filtration system. The remaining development sites will have on lot water quality treatment. These sites should compensate for the bypassing road area, as much as practical. The extent of the catchments is shown on Figure 3 and in more detail in Appendix E. The general arrangements of the MUSIC models are also included in Appendix E.

In accordance with Blacktown City Council's DCP (BCC 2010) an overall fraction impervious of 1.00 was adopted (i.e. no pervious area) for the proposed development. The catchments were split into roofs, roads and carparking area, as appropriate to represent each post development subcatchment within the development. A certain amount of nature reserve and landscaped area is expected to be intercepted by the development drainage system and was also included in the model, a fraction imperviousness of 0.1 was adopted for these areas.

The majority of urbanised areas will discharge to the water quality elements prior to discharge from the site and to Eastern Creek. Those areas bypassing the water quality elements (internal road system) will be compensated for by oversizing the provided devices so that the pollutant reduction targets from the overall site are achieved. All stormwater runoff from urban areas should be treated by at least a GPT prior to discharge.

The general arrangements of the MUSIC model treatment trains are included in Appendix E.

## 8.2. Rainfall Data

The MUSIC model is able to utilise rainfall data based on 6 minute, hourly, 6 hourly and daily time steps. A 6 minute time step was used in the analysis which was chosen in accordance with the recommendations for selecting a time step within the MUSIC Users Manual.

Rainfall records for the area were provided by Blacktown City Council. The nearest rainfall station to the site with a reasonable period of 6 minute rainfall data for a suitably representative period of rainfall for the site nominated by Council was:

Station No	Location	Years of Record	Type of Data
67033	Liverpool	1967 - 1976	6 minute

It is understood that Blacktown Council have modified the data supplied by the Bureau of Meteorology for the Liverpool site to rectify a significant amount of missing data between 1974 – 1976. The mean annual rainfall in the data set supplied by Council is 857mm, while the mean annual rainfall available from the Bureau of Meteorology's long term data for the station closest to the site (Seven Hills) is 915mm.

The rainfall and potential evapo-transpiration data for the period analysed is included in Appendix E.

## 8.3. Pollutant Loading Rates

In the absence of site specific data, the soil / groundwater parameters and pollutant loading rates adopted for the natural and urban catchments of the Eastern Creek Business Hub site are based on the recommended parameters provided by the Office of Environment and Heritage for areas within Western Sydney and the Cooperative Research Centre for Catchment Hydrology. The adopted parameters are presented in Tables E.1 and E.2 included within Appendix E. These values are consistent with those nominated in Blacktown City Council's DCP (BCC 2006) for urban areas.

## 8.4. Treatment Device Performance

### 8.4.1. Rainwater Tanks

Until the development sites are tenanted and the building layouts finalised, the rainwater tank sizing and reuse amounts cannot be determined. For the purpose of this water quality assessment, it is assumed that the developments will have a reasonable demand for reuse, for things such as toilet flushing, irrigation of landscaped areas, cooling towers (if provided), ornamental ponds, vehicular washing and other appropriate uses.

The reuse demand was assumed to be 2,000 litres/day internally and 1000 kL/year externally for each hectare of development area. It is noted that these higher reuse rates have minimal effect on the overall performance of the water quality system. The size of tank to meet Blacktown Council's requirement of 80% of reuse demand from a non-potable source is 100,000 litres per hectare of captured roof area. These volumes would need to be confirmed once the building formats and designs are being finalised.

### 8.4.2. Gross Pollutant Trap

Local drainage throughout the development should be filtered prior to discharge into the on lot water quality treatment systems, the downstream drainage systems, raingarden and the drainage swales and channels. The road system is proposed to be filtered utilising pit inserts.

### 8.4.3. Bio-filtration Raingarden & Swale

The location and size of the proposed bio-filtration system for the southern site is shown on Figure 4. The bio-filtration size and design assumptions that were used are presented in Table E.3, whilst the parameters of the grassed swale servicing the northern catchment road system is presented in Table E.4, both tables are provided in Appendix E. The water quality treatment train servicing the northern development allotments is assumed to consist of a generic treatment node configured to treat site runoff to the required targets prior to discharge from the allotments.

## 8.5. Pollutant Load Estimates

Total annual pollutant load estimates were derived using MUSIC for the developed site incorporating the proposed water quality treatment system.

The pollutant load reductions have been assessed at the northern and southern discharge points from the development. The sub-catchment treatment train and estimated annual pollutant load reductions for the local sub-catchments within the Eastern Creek Business Hub site are presented in Table 8.1 for the northern portion of the site and Table 8.2 for the southern site.

It should be noted that due to limitations of the MUSIC program, discharges from the central Catchment 3 (Junction 3 in the MUSIC model) show an average annual increase of 0.9 kg/year in TN residual loads after discharging through the grassed swale. This apparent increase will not happen in practice and is a result of the MUSIC modelling algorithms when stormwater is treated by a primary or secondary treatment device (grassed swale) after being treated by a higher quality tertiary treatment device (bio-filtration). The reality is that the grassed swale is expected to further improve the water quality, however it has been conservatively assumed that the grassed swale will provide no further benefit to the treatment of TN.

In order to offset this apparent increase, the residual TN load results tabulated for the Northern Site (Table 8.1) have been adjusted by -0.9 kg'yr (i.e. the resultant residual load has been decreased from 92.8 kg/yr to 91.9 kg/yr to account for the apparent increase).

**Table 8.1**

### SUMMARY OF SUBCATCHMENT TREATMENT TRAIN AND POLLUTANT LOAD REDUCTIONS (NORTHERN SITE)

	Mean Annual Loads (kg/yr)			
	TSS	TP	TN	GP
Total Development Source Loads	14,200	28	167	2,030
<b>Minimum Reduction Req'd. (%)</b>	<b>85%</b>	<b>65%</b>	<b>45%</b>	<b>90%</b>
Minimum Reduction Required (kg/yr)	12,070	18	75	1,827
Total Residual Load From Site	1,230	9.6	92	0
Total Reduction Achieved (kg/yr)	12,970	18	75	2,030
<b>Total Reduction Achieved (%)</b>	<b>91.3%</b>	<b>65.5%</b>	<b>45.0%</b>	<b>100.0%</b>

**Table 8.2**

**SUMMARY OF SUBCATCHMENT TREATMENT TRAIN AND  
POLLUTANT LOAD REDUCTIONS (SOUTHERN SITE)**

	Mean Annual Loads (kg/yr)			
	TSS	TP	TN	GP
Total Development Source Loads	3,440	8	57	694
<b>Minimum Reduction Req'd. (%)</b>	<b>85%</b>	<b>65%</b>	<b>45%</b>	<b>90%</b>
Minimum Reduction Required (kg/yr)	2,924	5	26	625
Total Residual Load From Site	288	2.4	22.0	0
Total Reduction Achieved (kg/yr)	3,152	5	35	694
<b>Total Reduction Achieved (%)</b>	<b>91.6%</b>	<b>67.6%</b>	<b>61.3%</b>	<b>100.0%</b>

### 8.6. Discussion of Modelling

The performance of the proposed water quality management strategy for the Eastern Creek Business Hub development site obtained from the MUSIC model, as summarised in Tables 8.1 and 8.2, shows that the various treatment trains proposed will meet the requirements specified within Blacktown City Council's guidelines.

The assumed treatment train for the northern site, where on lot treatments are proposed, shows that rainwater tanks in conjunction with on-site treatment devices and 200 metres of grassed swale for the road will meet the target pollutant reductions. The bio-filtration area treating the southern catchment equates to approximately 1.25% of the total development area discharging to it.