Edmondson Park
Town Centre North

WATER CYCLE MANAGEMENT
STRATEGY REPORT

Landcom

August 2018

SUSTAINABLE
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Integrated Management System

J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS
& PROJECT MANAGERS

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PO Box 4366, PENRITH WESTFIELD, NSW 2750
77 Union Road, PENRITH, NSW 2750
P 02 4720 3300
W www.jwprince.com.au
E jwp@jwprince.com.au

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1 EXECUTIVE SUMMARY

The Water Cycle Management Strategy for Edmondson Park Town Centre North has been prepared to support the proposed Section 75W application to the NSW Planning and Environment Department. The modifications to the Stormwater Management Strategy for this portion of the Edmondson Park Precinct are due to the addition of Office of Strategic Lands (OSL) land to form part of the application as well as other development changes relating to school area, road layout, dwelling yield and lot mix, building height and bushfire asset protection zones.

Several studies have previously been completed on behalf of Liverpool City Council (LCC) for both hydrology (WMA, 2007) and water quality (JWP, 2007) for the wider Edmondson Park Precinct. These studies provide the basis for Liverpool City Council's regional watercycle management strategies and include the proposed construction of a series of regional bio-retention raingardens and regional detention basins (at strategic locations) which supports development across the precinct.

The Edmondson Park concept plan covers an area of approximately 413.3 ha falling within the Liverpool and Campbelltown local government areas. Edmondson Park Town Centre North represents approximately 30 ha of land and includes a Parkland Precinct, consisting of residential areas, a school site, Maxwell's Creek Precinct consisting of residential flat buildings and a Station Precinct, consisting of the Northern town centre including residential uses and around 5,200m^2 of retail/commercial floor space. The three (3) precincts are separated by Maxwell Creek and are bounded by the railway corridor to the south, regional park to the east and residential areas to the north and west. The Maxwell's Creek Precinct and the Station Precinct are separated by Maxwell Creek, which will be retained and revegetated.

The objective of this investigation is to identify the stormwater management needs as a result of the proposed modifications to the approved concept plan. This involves hydrological modelling to identify stormwater quantity management solutions as well as water quality modelling to ensure that stormwater runoff achieves the required pollutant concentration objectives.

Given the proposed changes in the Town Centre North, water quality and water quantity modelling has been completed to ensure that regional water quantity and local water quality devices are sized appropriately. Consistent with previous strategies, regional detention basins are required to manage 20% and 1% AEP flows while raingardens will contain storage components to attenuate 1.5 year ARI flows in accordance with the DCP as well as meet Council's Water Sensitive Urban Design (WSUD) objectives.

The previous Water Cycle Management Strategy proposed for the Edmondson Park release site consists of a regional detention basin located on an upper reach of Maxwell Creek as well as a treatment train including GPTs and bioretention systems. The Water Cycle Management Strategy previously comprised of the following:

- 45,400 m^3 regional detention basin upstream of Campbelltown Road (Device partly constructed as part of the Edmondson Park South development in 2010).
- Two (2) raingardens (Raingarden 5 and 13) to be located in the open space corridor adjacent to the site with a total filter area of 7,450 m^2. The raingardens were also proposed to provide 1.5 year (ARI) storage equivalent to 110 m^3/ha.
- Two (2) proprietary GPT units; one at each stormwater discharge point.

The Water Cycle Management Strategy developed for the site will ensure that requirements identified in the Sectretary's Environmental Assessment Requirements (SEARs) are adressed. SEARs were issued by the Department of Planning and Environment on 3 August 2017. These SEARs are aimed at providing guidance on the necessary issues that must be addressed in an environmental assessment. These requirements have been addressed in various sections throughout this report.

A summary that outlines how the proposal addresses each of the specific water management and flood risk issues specified in the SEARs is provided in Table 1.1 below.

Table 1.1 – SEAR's Requirements

SECRETARY ENVIRONMENTAL ASSESSMENT REQUIREMENT (SEAR)	STRATEGY RESPONSES
Statutory and Strategic Context The Environmental Assessment (EA) shall address the statutory provisions applying to the site contained in all relevant environmental planning instruments (EPIs), including: • *Greater Metropolitan Regional Environmental Plan 2 – Georges River Catchment* • *Liverpool Local Environmental Plan 2008* The EA shall address the relevant planning provisions, goals and strategic planning objectives in the following: • *Edmondson Park South Development Control Plan*	This Environmental Planning Instrument (EPI) requires the management of the environmental quality of the catchment and the implementation of controls aimed at providing an ecologically sustainable solution. Details of the aims and controls outlined in the relevant EPIs are described in Section 4 of this report. The Edmondson Park Precinct has a number of proposed gross pollutant traps (GPT) and bio-retention systems aimed at managing water quality. The devices that are proposed in the Edmondson Park Town Centre North site are detailed in Section 7 of this report.
Surface water, flooding groundwater and riparian corridors The EA shall address any potential impacts of proposed modification on hydrology and hydrogeology, flooding, groundwater, drainage and stormwater management infrastructure, and any riparian corridors.	Hydrological modelling was completed as part of this assessment to confirm the size and configuration of the stormwater management infrastructure required to attenuate post development flows to pre-development levels for the 1.5-year ARI event. Regional detention basins are to manage larger events while allowing for downstream catchments to flow unattenuated. Raingardens will contain storage components to attenuate 1.5-year ARI flows in accordance with the DCP and previous strategies as well as meet Council's Water Sensitive Urban Design (WSUD) objectives. Further details of this modelling can be found in Section 6 of this report.

Landcom have since reviewed and amended the plans for the site. Edmondson Park is changing and the market has shifted. The proposed modification to the Concept Plan and the State Environmental Planning Policy (State significant precincts) 2005 (Precincts SEPP) provides opportunities to capitalise on Government investment in transport infrastructure and meet the demand for housing in South West Sydney. This saw an amended set of requirements issued by the Department of Planning and Environment on 6 July 2018. A summary of the requested amendments to Modification 5 are provided in Table 1.2 below.

Table 1.2 – Amendments requested to SEARs and proposed MOD5

	Concept Plan	MOD 5 – August 2017	Amendments to MOD 5 – July 2018
Dwellings Yield	440	2,059 – 2,235	3,030 – 3,286
Dwelling Heights (m)	• Station Precinct – Max 24 m • Maxwells Creek Precinct – Up to 12 m • Maxwells Creek Precinct – Up to 21 m • School site – up to 15 m	• Station Precinct – Max 24 m (37 m for landmark buildings • Maxwells Creek Precinct – Up to 12 m • Maxwells Creek Precinct – Up to 21 m • School site – up to 15 m	• Station Precinct – Max 50 m (67 m for landmark buildings • Maxwells Creek Precinct – Up to 28 m • Maxwells Creek Precinct – Up to 21 m • School site – up to 21 m
Floor Space Ratio (FSR)	• Station Precinct – 2:1	• Station Precinct – 2:1	• Station Precinct – 2:1
Other			• Provision to include the definition of 'Studio Dwelling' in the Precincts SEPP (as per MOD 4) • Specifiy Studio Dwellings as permissible within the R1 General Residential zone • Allow subdivision of Studio Dwelling on to separate title • Prohibit Residential Flat Buildings in a portion of the Parkland Precinct • Revised road layout

The SEARs issued on the 6 July 2018 have not changed from the original SEARs associated with original Mod 5 in regards to surface water, flooding, groundwater and riparian corridors. Therefore, no amendments were made to the assessments and subsequent report that was produced to address the original SEARs (JWP, January 2018).

The assumed percentage impervious for the Edmondson Park North Catchment ranging from 80% in the Parkland Precinct to 85% Station Precinct. Given that the proposed amendment to Modification 5 relates to the height of buildings in the Station, Maxwell and Parkland Precincts, there will be no change to the expected runoff characteristic for the catchment.

The updated Water Cycle Management Strategy proposed for the Edmondson Park release site consists of the regional detention basin as well as the previously proposed treatment train including GPTs and bioretention systems. The updated Water Cycle Management Strategy comprises of the following:

- 45,400 m³ regional detention basin upstream of Campbelltown Road (Device partly constructed as part of the Edmondson Park South development in 2010).
- Two (2) raingardens to be located in the open space corridor adjacent to the site with a total filter area of 8,350 m². The raingardens were also proposed to provide 1.5-year (ARI) storage equivalent to 121 m³/ha (Raingarden 5) and 205 m³/ha (Raingarden 13).
- Two (2) proprietary GPT units; one at each stormwater discharge point.

2 PREVIOUS STUDIES AND BACKGROUND

2.1 Edmondson Park Master Planning, Water Cycle Management: Stormwater Report (GHD, 2003 - 2006)

In 2003, GHD prepared a report as part of the early Master Planning process for Edmondson Park. The report addressed water cycle management options, identified constraints and opportunities and presented a range of Water Sensitive Urban Design options. Hydrologic and hydraulic (flood mapping) analyses were also undertaken as part of the investigation.

The recommendations from the report addressing water quantity and quality issues included provision of a number of retarding basins and constructed wetlands.

In 2006, an addendum report was prepared to identify and assess potential impacts on the previous October 2003 report as a result of changes to the Edmondson Park Concept and footprint for Edmondson Park.

2.2 Edmondson Park Flood Study (Webb McKeown and Associates, 2007)

In 2007, a flood study and hydrologic / hydraulic assessment of Maxwell Creek was undertaken by Webb McKeown and Associates on behalf of Liverpool City Council. The study expanded on the analysis previously undertaken by GHD for the Maxwell's Creek catchment.

The study was able to define the design flood behaviour across Edmondson Park for both Base (pre-development) and conceptual Development conditions (within Edmondson Park).

The 2D hydraulic model provided estimates of flood levels and depths across the floodplain. Mapping of flood depths was provided in order to enable easier identification of fill areas, assisting the overall development and planning process.

The outcome of the study concluded that "a single *mitigation structure located in the upper reaches of Maxwell Creek upstream of Campbelltown Road can provide the performance required to reduce post development peak flows back to pre-development conditions while allowing the remainder of the study catchment to flow unattenuated".*

2.3 Edmondson Park Water Sensitive Urban Design Strategy (J. Wyndham Prince, 2007)

In 2007, a Water Sensitive Urban Design Strategy was undertaken by J. Wyndham Prince on behalf of Liverpool City Council.

The report investigated the requirements of the Edmondson Park development within the Liverpool City Council local government area and identified the size and cost of Section 94 components for the Release Area which has been used in the development control plan developed by Liverpool City Council. The strategy proposed the following devices:

2.3.1 Litter & Sediment Control

Council approved proprietary gross pollutant traps are to be provided at stormwater discharge points to remove litter, vegetative matter, free oils and grease and sediments prior to discharge to the downstream treatment devices.

2.3.2 Bio-Retention Systems

Bio-retention swales and "Raingardens" were to integrated within targeted open space areas throughout the development and on the edge of riparian corridors to achieve nutrient reductions consistent with the nominated DECC and Georges River targets. The bio-retention systems were intended to be lined to prevent infiltration to groundwater which can exacerbate salinity problems.

2.3.3 Detention Storage

Detention storages were to be integrated with the bio-retention swales and sized to restrict post development discharges for storms up to the 1.5 year ARI design event to pre-development levels. This was intended to minimise the impact of the proposed development by reducing the most regular storm flows prior to discharge to the riparian corridor downstream of the site. This system was planned to complement the regional detention storage basins to be located within the riparian corridors to reduce peak post development storm flows to pre-development levels for storms up to and including the 1% AEP event.

A general arrangement plan indicating proposed locations for the water quality and quantity treatments for the site is shown on Plate 2.1.

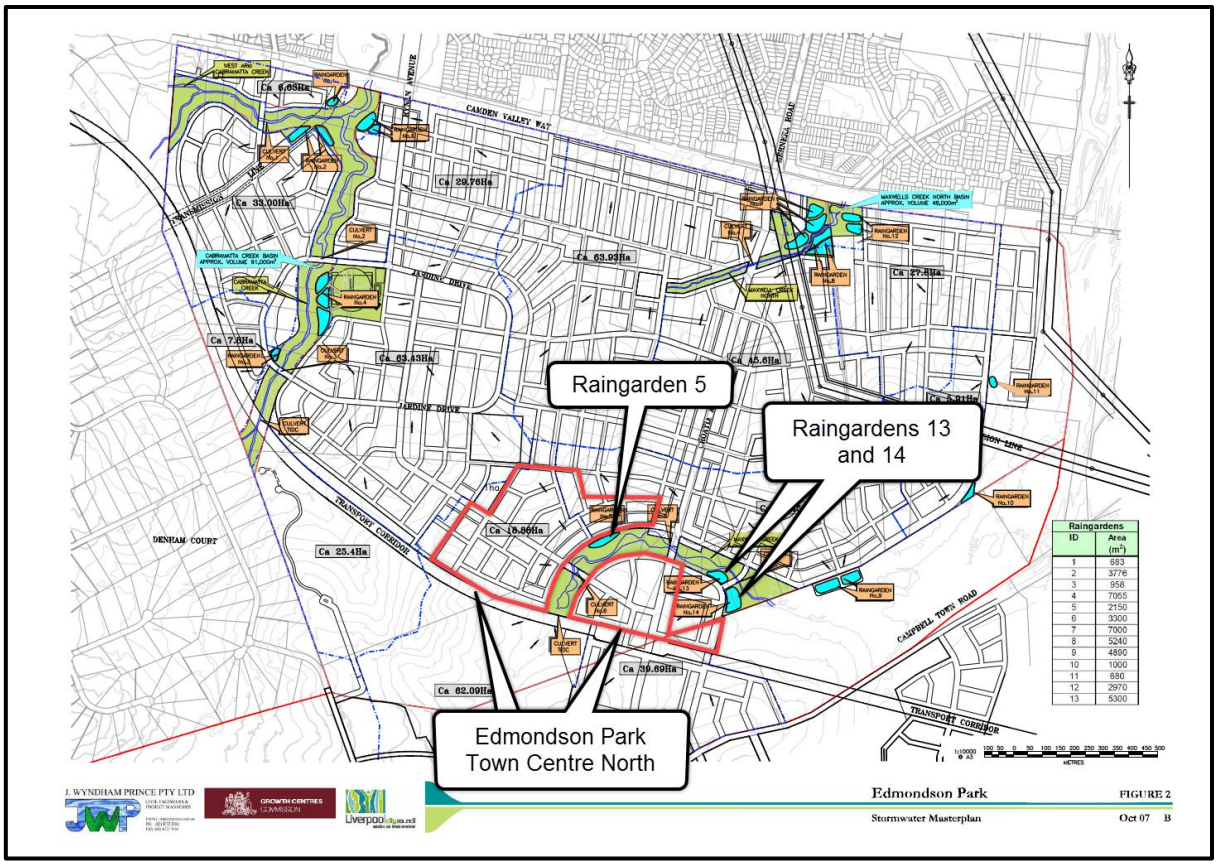


Plate 2.1 – Regional bio-retention raingarden locations
(Source: JWP Report, 2007)

2.4 Edmondson Park South, Part 3A Concept Plan – Water Cycle Management Plan (J. Wyndham Prince, 2010)

In 2010, a Water Cycle Management Plan was undertaken by J. Wyndham Prince on behalf of Landcom.

This report was prepared to accompany a Concept Plan Application under Part 3A of the Environmental Planning & Assessment Act, 1979 (EP&A Act) in relation to the former Ingleburn Army Base and certain adjoining lands within the Edmondson Park Precinct of the South West Growth Centre (referred to herein as Edmondson Park South).

Plate 2.2 shows the proposed Water Cycle Management Plan for Edmondson Park South.

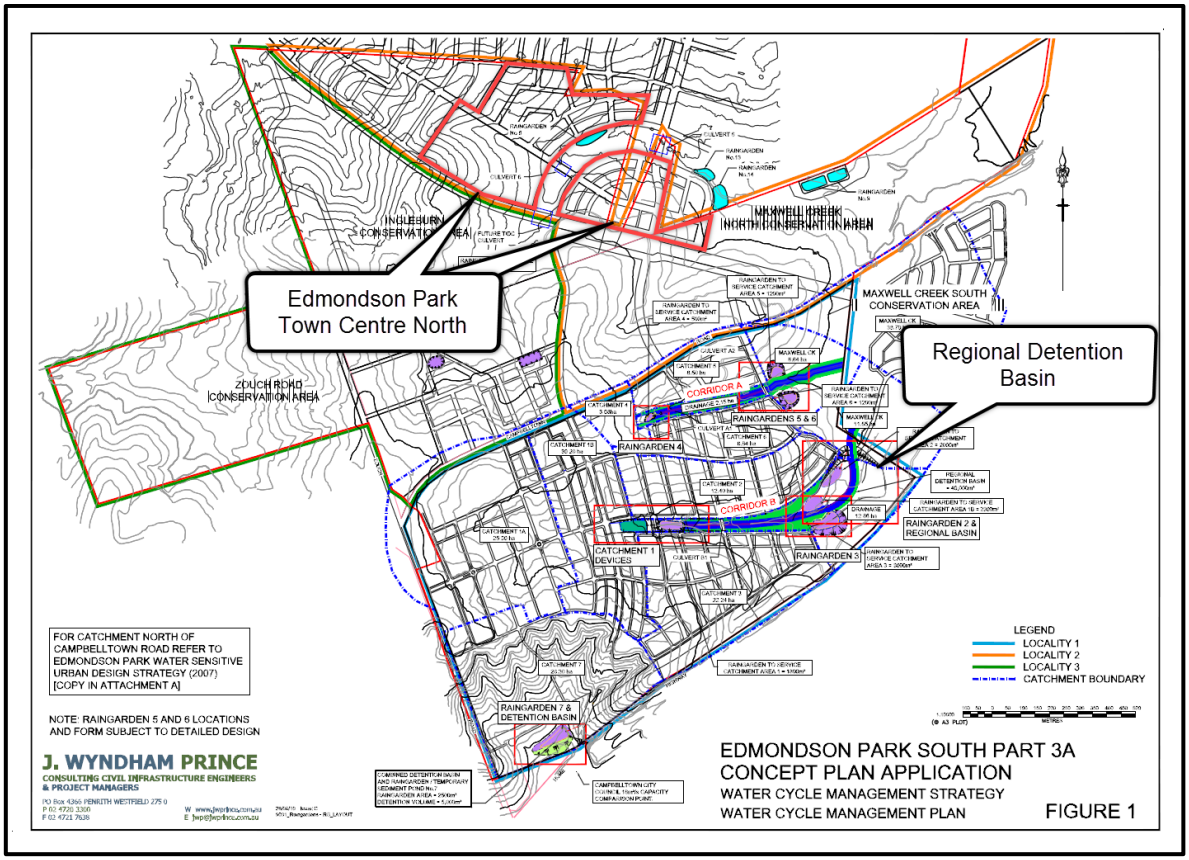


Plate 2.2 – Edmondson Park South Water Cycle Management Plan (Source: JWP Report, 2010)

The report built upon the findings within both the GHD report and the JWP 2007 report to provide the overall Water Cycle Management framework to manage both the water quantity and water quality for Edmondson Park South.

The Water Cycle Management Plan consisted of a treatment train consisting of an at lot treatment, street level treatment and Precinct Scale treatment measures. These devices included:

- Proprietary GPT units at each stormwater discharge point (11 required).
- Proposed ornamental pond with static water surface area of 3,000 m².
- 15 separate proposed raingardens with a combined surface area of 28,450 m².
- A proposed regional detention storage basin on Maxwell Creek with a storage volume of approximately 45,000 m³.
- A proposed regional detention storage basin at the Hume Highway in the Bunbury Curran Creek catchment with a storage volume of 5,000 m³.

Provision of the proposed detention basins within the development demonstrated peak post development discharges into Maxwell Creek are consistent with the flows management arrangements developed by Webb McKeown and Associates report (WMA, 2003).

Plate 2.2 shows the position of Edmondson Park Town Centre North relative to Edmondson Park South together with the location of the regional devices within the precinct.

3 RELEVANT DEVELOPMENT CONTROLS

3.1 Liverpool City Council – On Site Stormwater Detention Policy (2004) and Technical Specification (2003)

These policies provide guidance on how on-site detention systems shall be constructed within the Liverpool LGA. Key features include:

- A Stormwater Drainage Concept Plan shall be submitted with the DA demonstrating the feasibility of the proposed drainage system in the site and connection to Council's system. Plan to include 100-year ARI overland flowpaths, easements, location and size of OSD storage, cross sections, site constraints, weir, site layout, 0.1m contours and upstream catchments.
- Computations must be performed for the existing site conditions for a low recurrence interval (5-year ARI), a medium recurrence interval (10 or 20 or 50 year ARI), and the upper value, which will be the 100 year ARI storm.
- The rate of stormwater runoff (both piped and overland) from the post-developed site is not to exceed the rate of runoff from the pre-developed site for the above storm events.

3.2 Edmondson Park South – DCP 2012 – Section 4.1 Riparian Corridors and Water Cycle Management

The water quality objectives of the Edmondson Park South DCP are listed as follows:

a. To provide for sustainable urban stormwater management with flood detention basins and water quality treatment as part of the landscape and water systems.
b. To manage, protect and enhance ecosystems and their biodiversity, soil stability, fauna and aquatic habitats in natural streams and corridors.
c. To promote development, compatible with stormwater risk and public safety that encourage active and passive recreation, social, cultural and interpretation opportunities with the corridor.
d. To develop a maintenance strategy that aligns with Council's existing maintenance regime.

The DCP states that all development is to implement and be consistent with the water cycle strategies outlined in the Edmondson Park South Water Cycle Management Plan, September 2010, prepared by J. Wyndham Prince.

3.3 Liverpool City Council - WSUD Technical Guidelines (2016)

The Water Sensitive Urban Design (WSUD) technical guidelines were developed for the Liverpool City Council (LCC) as part of their Water Quality Management Strategy. The guidelines are to be used in implementing WSUD through the LCC Local Government Area (LGA).

Water quality targets outlined in the WSUD Technical Guidelines are summarised as follows:

- Reduce the baseline annual pollutant load for litter and vegetation larger than 5 mm by 90%;
- Reduce the baseline annual pollutant load for total suspended solids by 85%;
- Reduce the baseline annual pollutant load for total phosphorus by 65%; and
- Reduce the baseline annual pollutant load for total nitrogen by 45%.

3.4 Liverpool City Council –DCP 2016 – Growth Centre Precincts

The underlying Water Cycle Management objectives setout in this document are:

a. Ensure that the quality of stormwater discharged from urban areas into the environment complies with appropriate standards.

b. Minimise potable water consumption and maximise re-use of stormwater within urban areas.

c. Ensure that the water cycle management infrastructure is cost effective and maintainable.

d. Maintain and enhance the quality of natural water bodies.

3.5 Greater Metropolitan Regional Environmental Plan No 2 – Georges River Catchment

The general aims and objectives of this plan are as follows:

a. to maintain and improve the water quality and river flows of the Georges River and its tributaries and ensure that development is managed in a manner that is in keeping with the national, State, regional and local significance of the Catchment,

b. to protect and enhance the environmental quality of the Catchment for the benefit of all users through the management and use of the resources in the Catchment in an ecologically sustainable manner,

c. to ensure consistency with local environmental plans and also in the delivery of the principles of ecologically sustainable development in the assessment of development within the Catchment where there is potential to impact adversely on groundwater and on the water quality and river flows within the Georges River or its tributaries,

d. to establish a consistent and coordinated approach to environmental planning and assessment for land along the Georges River and its tributaries and to promote integrated catchment management policies and programs in the planning and management of the Catchment,

e. to provide a mechanism that assists in achieving the water quality objectives and river flow objectives agreed under the Water Reform Package.

4 EXISTING SITE

Edmondson Park Town Centre North forms part of the larger Edmondson Park Precinct within the South West Growth Centre. The Precinct is located to the north-west of the M5 Motorway and lies approximately 40 km to the south west of Sydney CBD.

Edmondson Park Town Centre North covers approximately 30 Ha of land which is bound by a Railway Corridor to the south, residential area to the north and west and regional park to the east.

The existing site consists of undulating grazing land, having generally been cleared and consisting of grass paddocks with scattered trees. Edmondson Park also includes significant portions of bushland, particularly within and adjacent to the watercourses.

There is an existing watercourse (Maxwell Creek) which bisects the site, creating a western and eastern portion. The larger (western) portion of the site grades from an existing ridgeline along the western boundary to the east and discharges into Maxwell Creek. The smaller (eastern) portion of the site naturally grades into Maxwell Creek to the north.

See Plate 4.1 for details of the existing site.

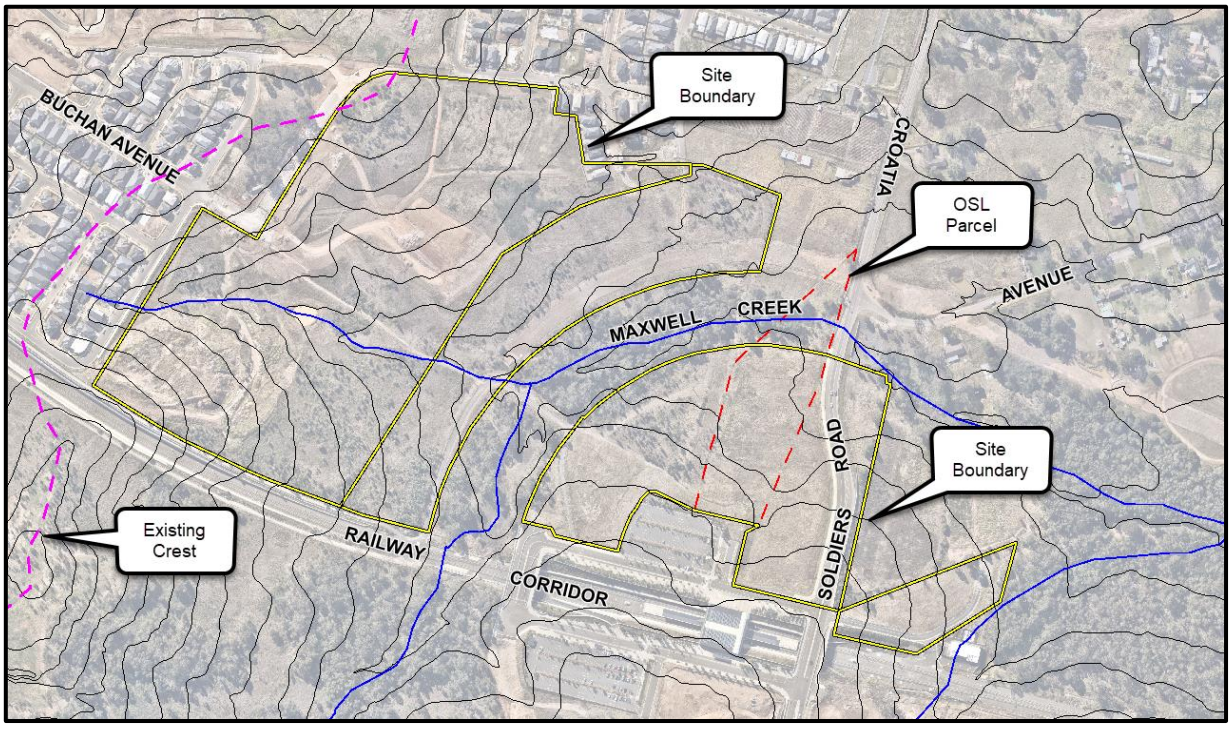


Plate 4.1 Existing Site

5 PROPOSED DEVELOPMENT

The proposed modification to the concept plan relates to Edmondson Park Town Centre North and consists of an approximately 30 ha parcel of land and includes:

- Revising the boundary area of the concept plan to include OSL land;
- Increasing the minimum yield within the Town Centre North site from 440 up to 3,286 dwellings;
- Increasing the building heights to allow for more dwellings adjacent to the train station;
- Introduce a maximum gross floor area for the Station Precinct equivalent to the floor space ratio (FSR) permissible under the Precincts SEPP;
- Revise the road hierarchy and road network;
- Amend the school site to allow for a minimum site area of 2ha and an additional 4ha if required by the Department of Education;
- Allow for strata subdivision of studio dwellings and prohibit residential flat buildings in specific locations.

See Plate 5.1 for details of the proposed development.

Plate 5.1 – Proposed Master Plan

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) for pre and post development flows.

The hydrological modelling for this study builds upon previous strategies that have been prepared in the Edmondson Park Precinct.

6.1 XP-RAFTS Modelling Parameters

The XP-RAFTS modelling parameters used in this assessment are consistent with the parameters that informed the Edmondson Park South – Watercycle Management Strategy (JWP, 2010). This previous concept plan approval forms the basis for the S75W application and, as such, parameters have been kept consistent across this strategy.

6.2 Sub-catchments (Pre and Post Development)

Pre-development sub-catchment areas contributing to this drainage system were delineated using existing contours obtained from Land and Property Management Information. The catchments were kept relatively consistent with the Edmondson Park South – Part 3A Concept Plan – Watercycle Management Strategy (JWP, 2010). See Figure 6.1 for further details.

The catchment delineation prepared for the post-development conditions has considered the subject site as “fully developed” which encompasses the future Parkland and Station Precincts. The external catchments were kept consistent with the 2010 conditions pre-developed catchments. See Figure 6.2 for further details.

The general layout of the XP-RAFTS model is shown on Plate 6.1.

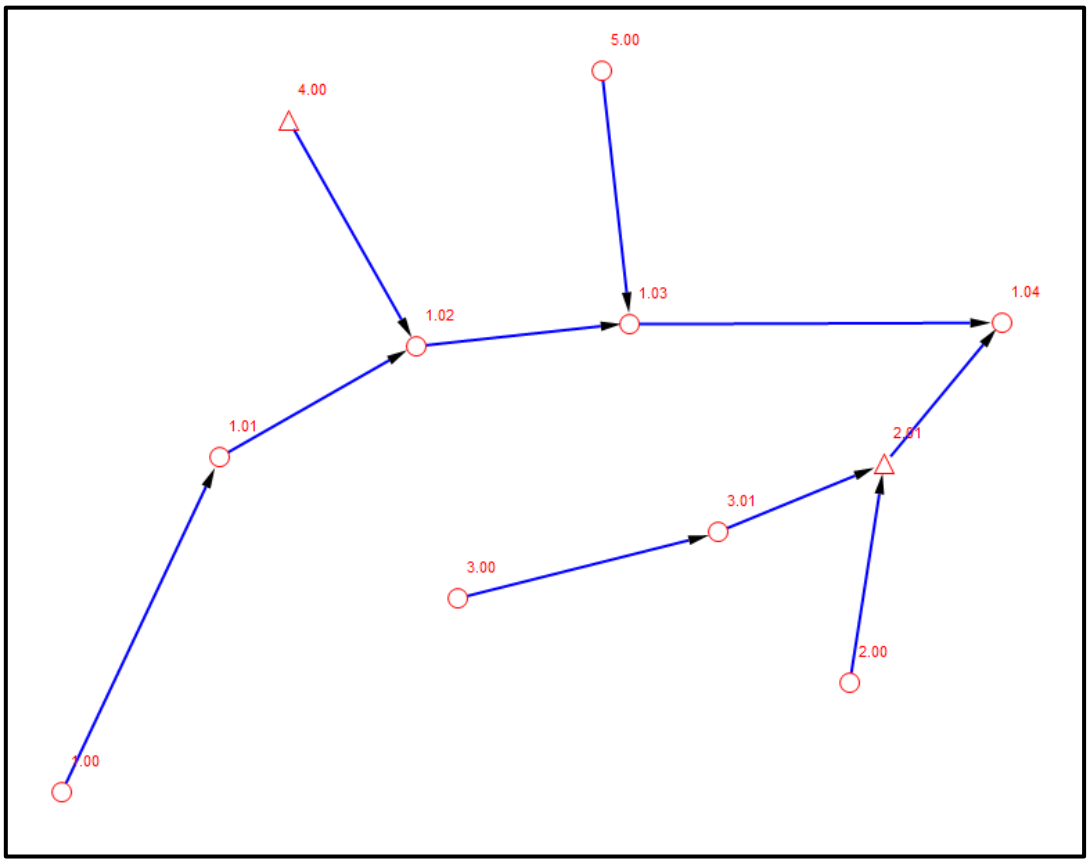


Plate 6.1 – Post Development Conditions XP-RAFTS Model Layout

(110462RA_02 (Dev_1.5yr).xp)

6.3 Raingarden Detention Storage

Detention storage has been provided in the two (2) raingardens to be located within Maxwells Creek. These storages will manage local environmental flows (1.5 year ARI). Details of the peak flows discharging from the site at local discharge points as well as details of the required detention storages are provided in Tables 6.4 and 6.5 respectively.

Table 6.4 – Comparison of Peak Flows

Comparison Node	Flow (m^3/s) 1.5 yr ARI	
	Pre	Post
1.02	3.21	3.11
2.01	1.31	1.28

Table 6.5 –Summary of 1.5 Year Detention Performance at Raingardens

Raingarden	Inflow (m^3/s)	Outflow (m^3/s)	Storage Used (m^3)	m^3/ha
5	5.6	2.5	3,300	121
13	8.7	1.3	7,700	205

The previous modelling completed for these detention storages involved the modelling of a typical 10 ha catchment to reflect the overall Edmondson Park development (JWP, 2007). This resulted in a figure of approximately 110 m^3/ha of detention required to attenuate 1.5 year ARI flows. Table 6.5 provides an updated modelling result and concludes that an increased volume will be required.

The substantial increase in volume per hectare at Raingarden 13 can be attributed to the increase in percentage impervious in the town centre catchments from the time of the original strategy.

6.4 Detention Basin Performance

Previous hydrologic modelling was completed for the regional catchment as part of the Edmondson Park South – Stormwater Management Plan (2010) and the Edmondson Park Flood Study Part 4 – Hydrologic/Hydraulic Assessment of Maxwells Creek (2007). These assessments concluded that the regional detention basin to be located in the upper reach of Maxwells Creek would provide sufficient attenuation to allow the remaining catchment to flow unattenuated.

As part of the 2010 study, the regional basin was designed to provide 45,400 m^3 of storage to achieve a regional water quantity outcome. Future investigation will be required to be undertaken at the next stage of the development to ensure that regional outcomes are still satisfied.

7 WATER QUALITY ANALYSIS

The overall Edmondson Park Precinct includes a series of gross pollutant traps and regional bio-retention raingardens to support development. The bio-retention raingardens which will ultimately receive flows from the Town Centre North are “RG 5” and “RG 13”. These regional water quality elements were previously sized as part of the Edmondson Park Water Sensitive Urban Design Strategy (JWP, 2007). Gross pollutant traps will also be constructed as part of the development just upstream of the raingardens.

7.1 MUSIC Modelling

The water quality analysis for Edmondson Park Town Centre North was undertaken using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC). 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 6.2.1 was adopted for this study.

The model provides a number of features relevant to 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.

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.

7.2 Catchments

A MUSIC model was established for Edmondson Park Town Centre North’s proposed Water Cycle Management components. The general arrangement of these elements is shown in Plate 7.1.

Fraction impervious was adopted for each land use in accordance with Liverpool City Council’s guidelines. The impervious proportion varied according to the expected planning density of the catchments.

The development will be treated by devices within Edmondson Park Town Centre North to achieve the minimum water quality target reductions required by LCC’s guidelines. All urbanised areas will discharge to the water quality elements prior to discharging into the downstream watercourse.

The treated catchments were divided into three (3) sub-catchments representing the proposed, developed catchment (Roads, Urban Previous and Urban Impervious). For further details of catchment configuration and land use, break up see Figure 7.1. Areas external to the proposed development were modelled with the densities consistent with the previous assessments.

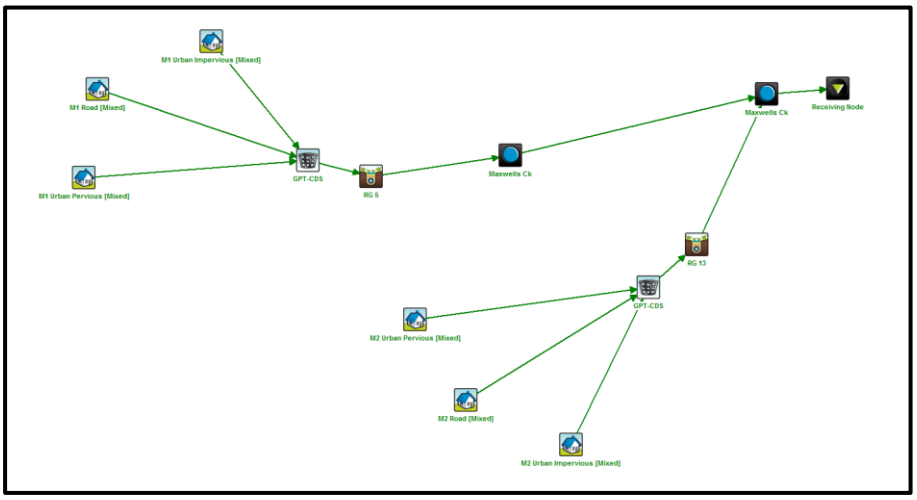


Plate 7.1 – Proposed Treatment Train

7.3 Pollutant Loading Rates and Treatment Train Device Performance

In the absence of site specific data, the soil / groundwater parameters and pollutant loading rates adopted for the natural and urban catchments of the Edmondson Park South site are based on the recommended parameters provided by the Liverpool City Council's WSUD Technical Guidelines for areas within Western Sydney.

The adopted technical parameters used in this modelling for the individual water quality devices are presented in Appendix C.

7.4 Pollutant Load Estimates and Discussion of Modelling

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

The estimated annual pollutant loads and reductions are presented in Table 7.1 and a summary of the raingarden sizes are presented in Table 7.2.

Table 7.1 – Summary of Pollutant Concentration Reductions

Pollutant	Total Developed Source Nodes	Total Residual Load from Site	Total Reduction Achieved	Target Reduction Required	Total Reduction Achieved
	(kg/yr)	(kg/yr)	(kg/yr)	(%)	(%)
TSS	101000	14400	86600.0	85.0%	85.7%
TP	163	57.1	105.90	65.0%	65.0%
TN	1040	546	494.00	45.0%	47.5%
GP	12000	345	11655.0	90.0%	97.1%

Table 7.2 – Summary of Water Quality Elements

	2007 WCM Strategy			2017 WCM Strategy		
Raingarden ID	Filter Area (m^2)	Catchment Area (ha)	% of Catchment	Filter Area (m^2)	Catchment Area (ha)	% of Catchment
RG 5	2150	18.88	1.1%	2600	27.37	0.9%
RG 13	5300	39.69	1.3%	5750	42.83	1.3%

8 CONCLUSION

The Water Cycle Management Strategy for Edmondson Park Town Centre North has been prepared to support the Section 75W submission to the NSW Department of Planning and Environment.

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.

The strategy proposed for the development site is functional; delivers the required technical performance; lessens environmental degradation and pressure on downstream ecosystems and infrastructure; and provides for a sustainable solution for stormwater management within the site.

Yours faithfully

J. WYNDHAM PRINCE

DAVID CROMPTON
Manager - Stormwater and Environment

9 REFERENCES

GHD (2003) – Edmondson Park Master Planning, Water Cycle Management: Stormwater

GHD (2006) – Edmondson Park Master Planning, Water Cycle Management: Stormwater – Addendum to October 2003 Report

J. Wyndham Prince (2007) – Edmondson Park Water Sensitive Urban Design Strategy

J. Wyndham Prince (2010) – Edmondson Park South, Part 3A Concept Plan – Water Cycle Management Plan

Liverpool City Council (2003) – On-site Stormwater Detention Technical Specification

Liverpool City Council (2004) – On-site Stormwater Detention Policy

Liverpool City Council (2012) – Edmondson Park South Development Control Plan

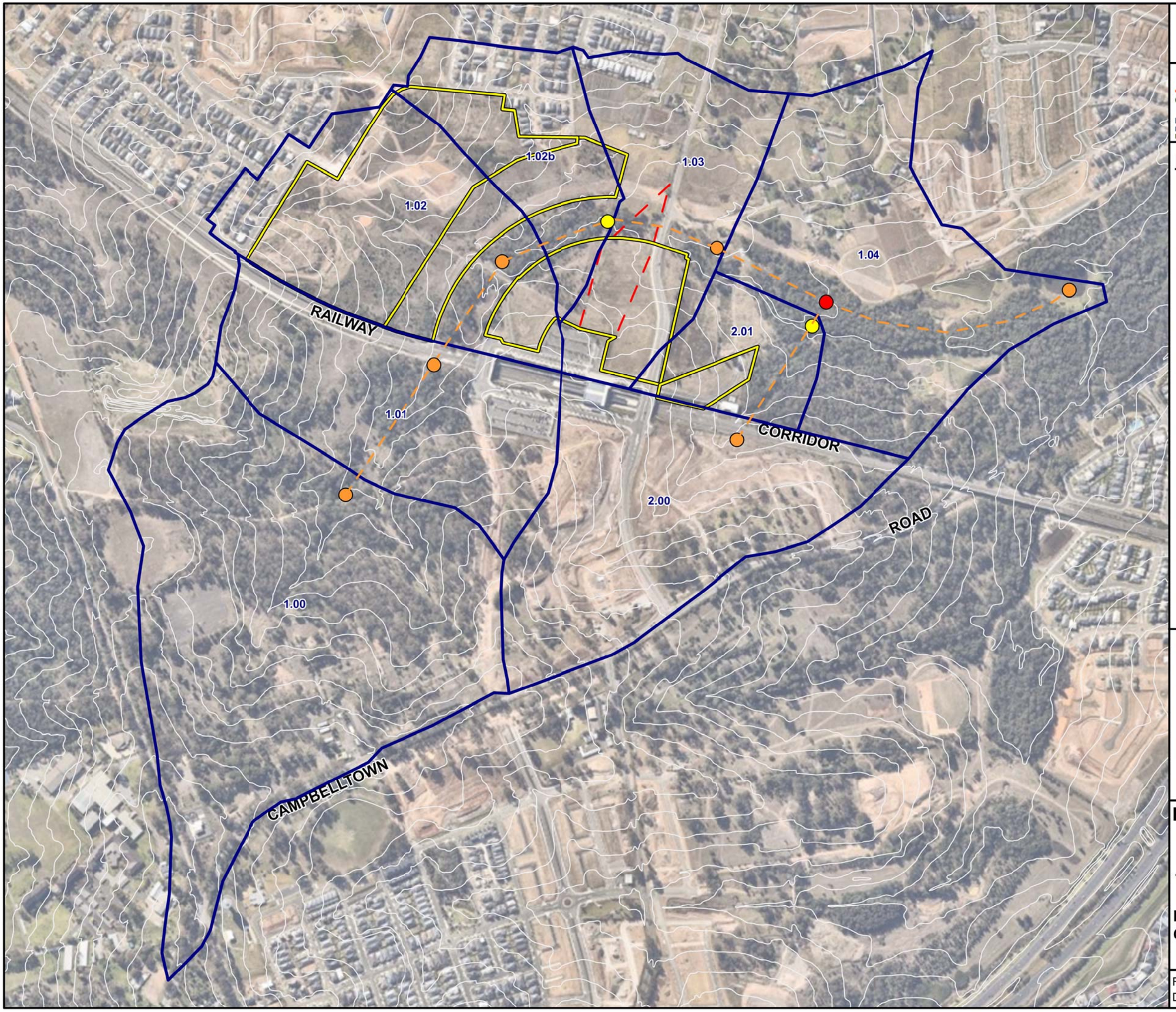
Liverpool City Council (2016) – Growth Centre Precincts Development Control Plan

Liverpool City Council (2016) – WSUD Technical Guidelines

Webb, McKeown and Associates (2007) – Edmondson Park Flood Study, Part 1 – Background and Overview

Webb, McKeown and Associates (2007) – Edmondson Park Flood Study, Part 4 – Hydrologic / Hydraulic Assessment of Maxwells Creek

APPENDIX A – Figures



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J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS
& PROJECT MANAGERS
PO Box 4366 PENRITH WESTFIELD NSW 2750
P 02 4720 3300 W www.jwprince.com.au
F 02 4721 7638 E jwp@jwprince.com.au

LEGEND

- Site Boundary
- OSL Parcel
- Catchment Boundary
- 1.03 — Rafts ID
- XP-Rafts Link
- XP-Rafts Node / Basin
- XP-Rafts Dummy Node
- XP-Rafts Comparison Node
- 2 m Contour (m AHD)

N
W E
S

Scale 1: 7,000 @ A3

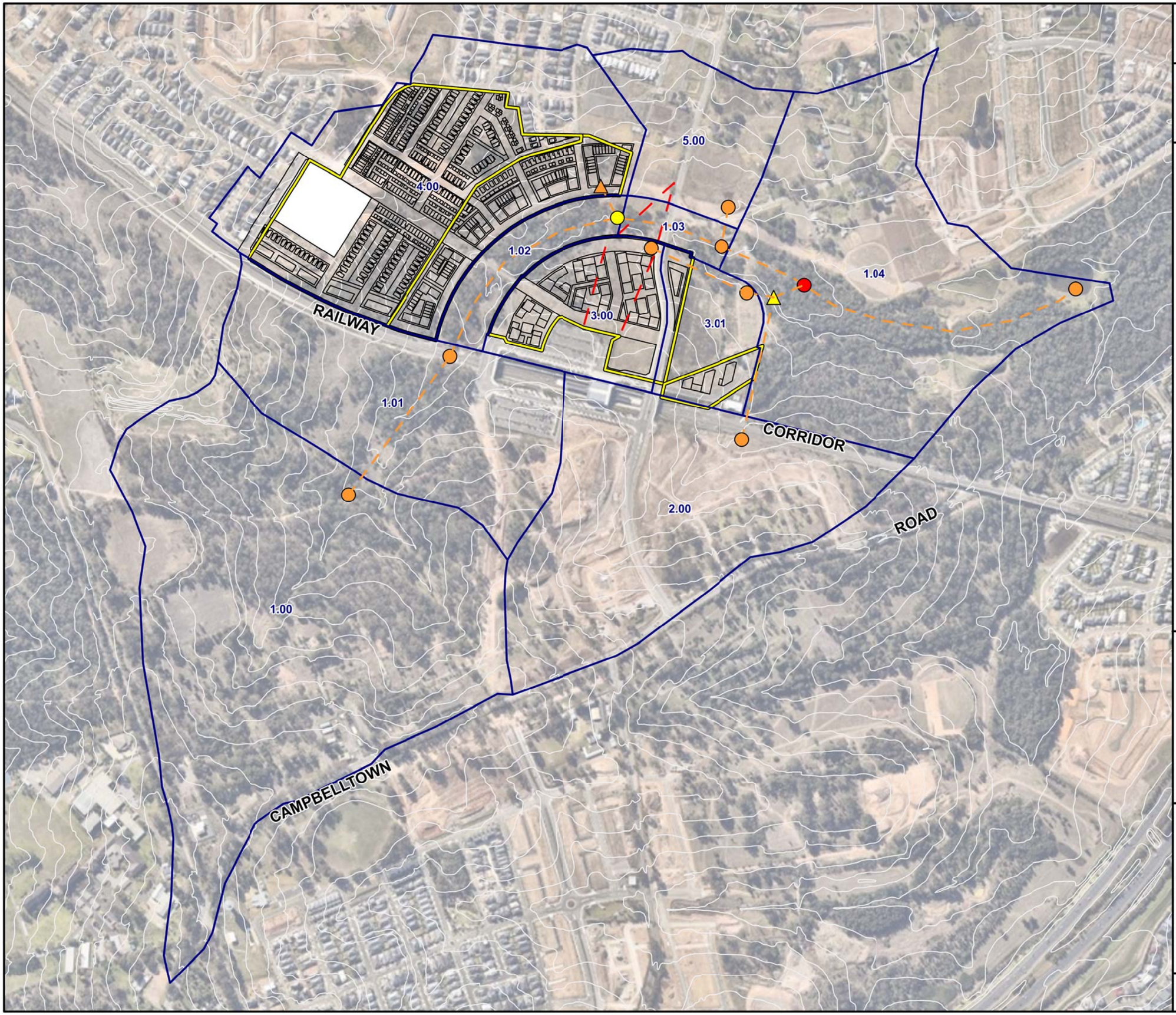
500 0 m

Figure 6.1

Edmondson Park Town Centre North

Existing Conditions Catchment Plan

File Name: 110462_02_Fig6.1_ExCat_C
Date : 10/08/18 Issue : C



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PO Box 4366 PENRITH WESTFIELD NSW 2750
P 02 4720 3300 W www.jwprince.com.au
F 02 4721 7638 E jwp@jwprince.com.au

LEGEND

- Site Boundary
- OSL Parcel
- Catchment Boundary
- 1.03 Rafts ID
- XP-Rafts Link
- XP-Rafts Node / Basin
- XP-Rafts Dummy Node
- XP-Rafts Comparison Node
- Proposed Masterplan
- 2 m Contour (m AHD)

N
W E
S

Scale 1: 7,000 @ A3

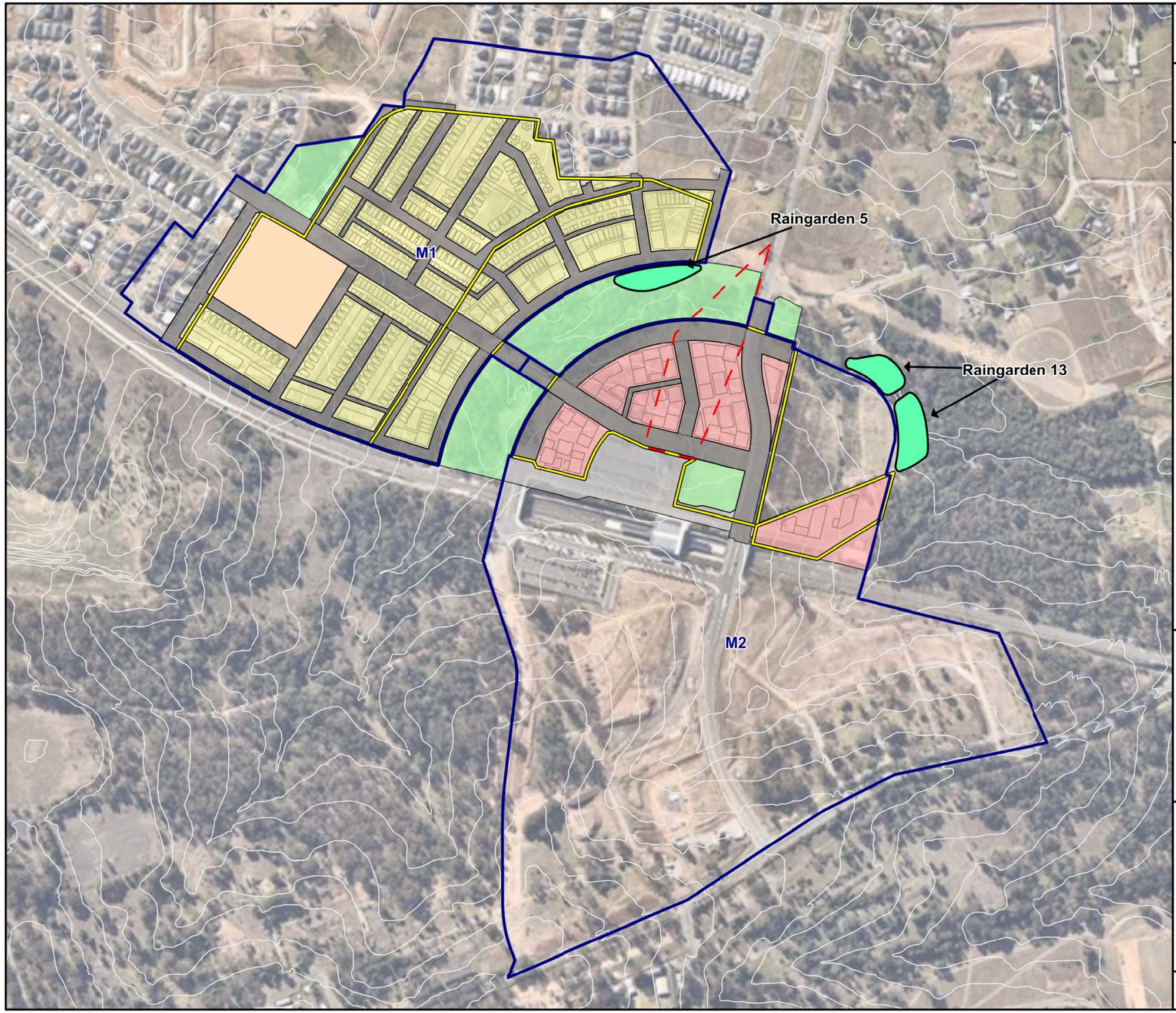
500 0 m

Figure 6.2

Edmondson Park Town Centre North

Developed Conditions Catchment Plan

File Name: 110462_02_Fig6.2_DevCat_C
Date : 10/08/18 Issue : C



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J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS
& PROJECT MANAGERS
PO Box 4366 PENRITH WESTFIELD NSW 2750
P 02 4720 3300 W www.jwprince.com.au
F 02 4721 7638 E jwp@jwprince.com.au

LEGEND

- Site Boundary
- OSL Parcel
- MUSIC Catchments
- Residential
- Commercial
- Road
- Carpark
- School
- Open Space
- Proposed Raingarden

N
W E
S

Scale 1: 5,000 @ A3

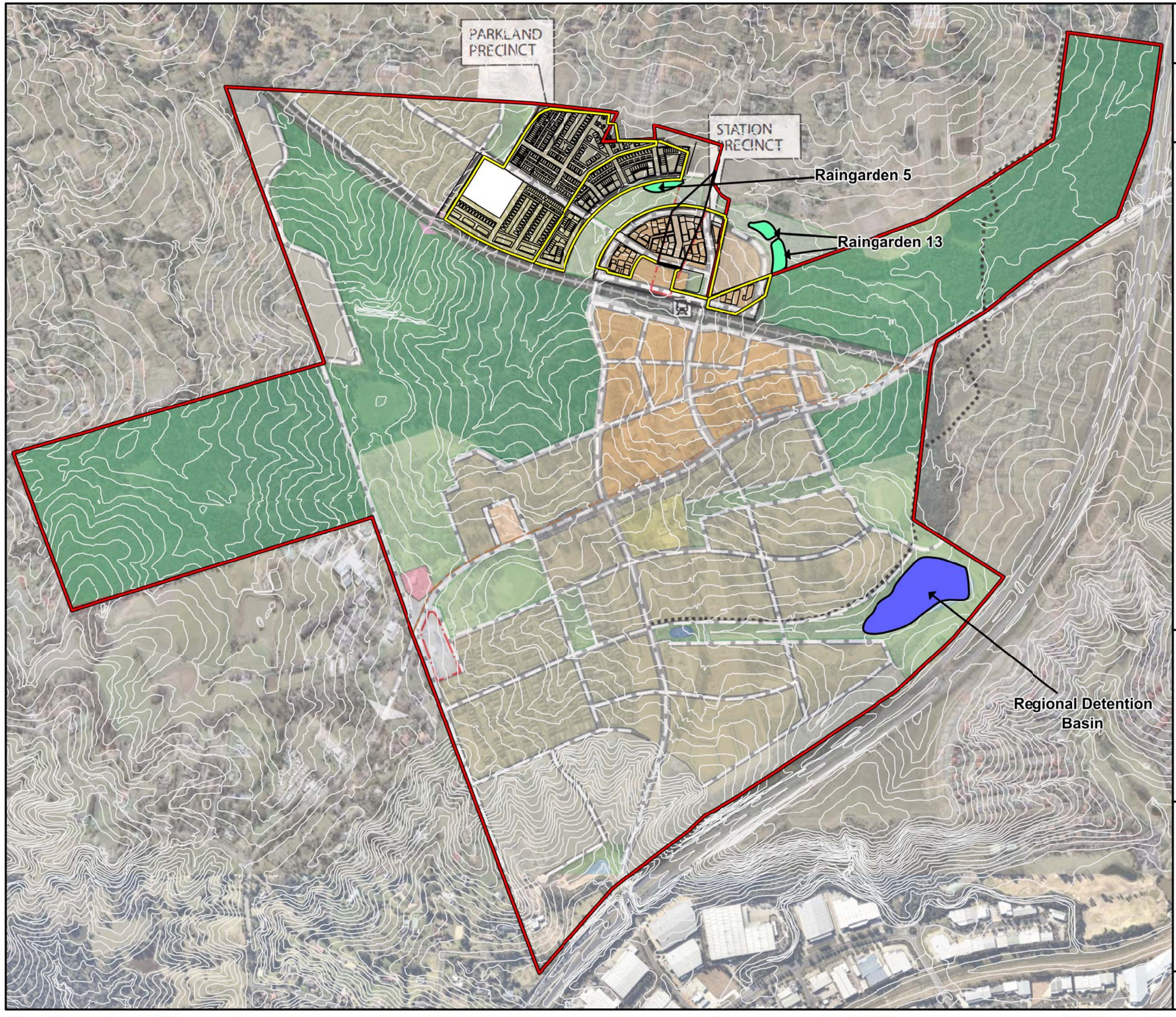
500 0 m

Figure 7.1

Edmondson Park Town Centre North

Water Quality Model MUSIC Breakup

File Name: 110462_02_Fig7.1_MUSIC_C
Date : 10/08/18 Issue : C



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CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS
PO Box 4366 PENRITH WESTFIELD NSW 2750
P 02 4720 3300 W www.jwprince.com.au
F 02 4721 7638 E jwp@jwprince.com.au

LEGEND

- Site Boundary
- OSL Parcel
- Edmondson Park South Boundary
- Proposed Raingarden
- Detention Basin

N
W E
S

Scale 1: 11,000 @ A3

500 0 m

Figure 9.1

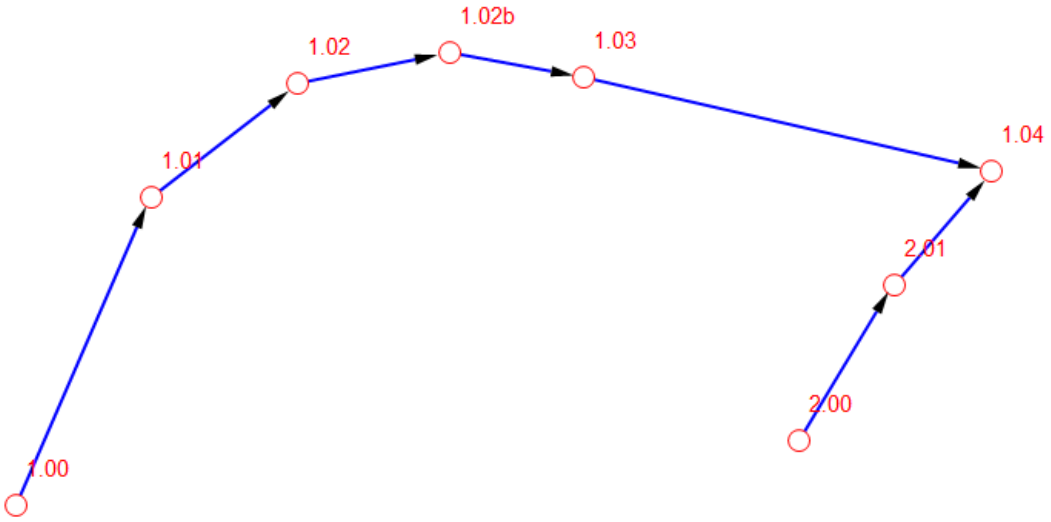
Edmondson Park Town Centre North

Stormwater Concept Plan

File Name: 110462_02_Fig9.1_WCM_C
Date : 10/08/18 Issue : C

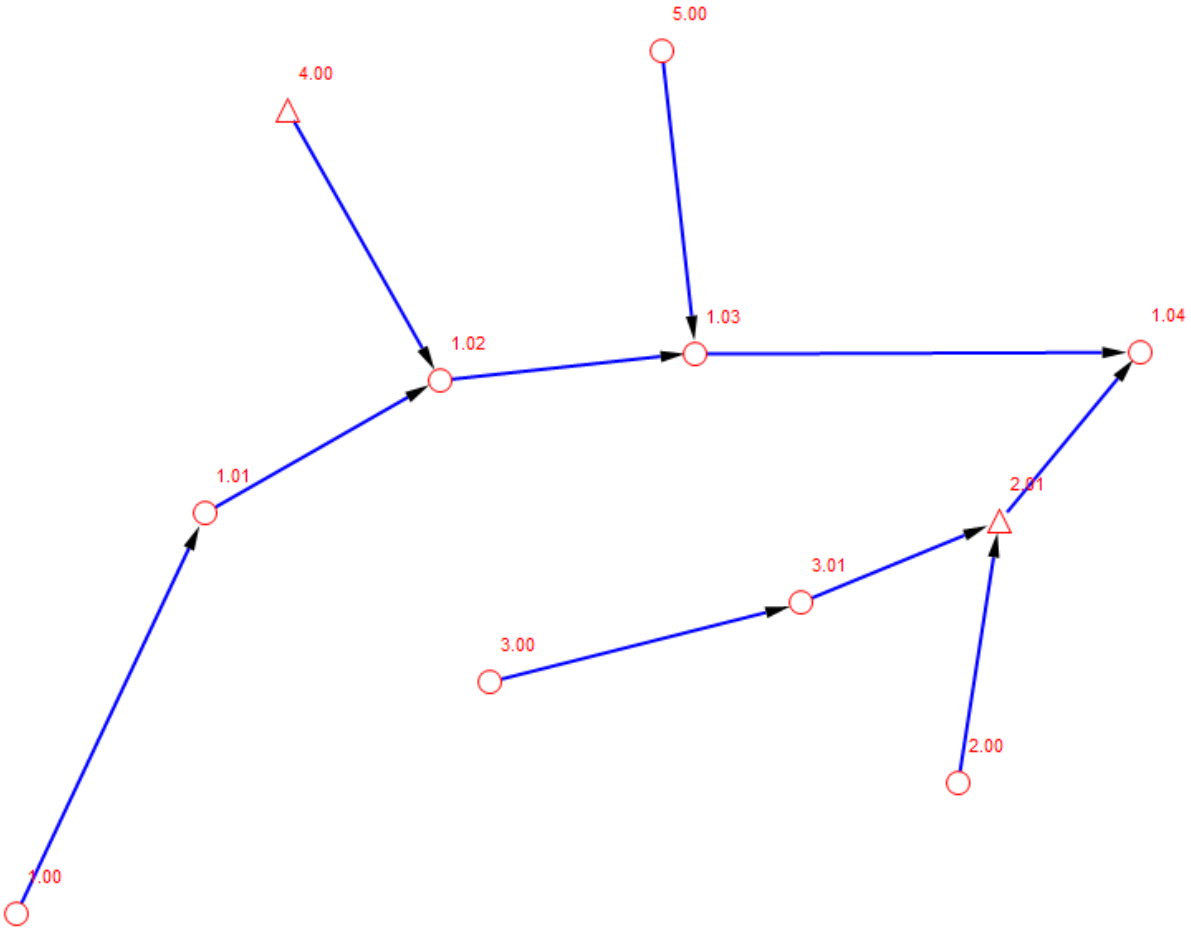
APPENDIX B – XP-RAFTS Results

Pre-Development Conditions – XP-Rafts Model



(110462RA_01 (Ex_1.5yr).xp)

Post-Development Conditions – XP-Rafts Model



(110462RA_02 (Dev_1.5yr).xp)

```
################################################################################
#####
Ed Park - Pre-Development Catchment

Continuous run: block    1 of    2
Results for period from  0: 0.0  7/ 4/2002
                     to 10: 0.0  7/ 4/2002
################################################################################
#####
```

ROUTING INCREMENT (MINS) = 2.00
STORM DURATION (MINS) = 720.
RETURN PERIOD (YRS) = 2.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 174.34
TOTAL OF SECOND SUB-AREAS (ha) = 0.00
TOTAL OF ALL SUB-AREAS (ha) = 174.34

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	Catch. Area #2 (ha)	Slope #1 (%)	Slope #2 (%)	% Impervious #1 (%)	% Impervious #2 (%)	Pern #1	Pern #2	B #1	B #2	Link No.
1.00	46.990	0.000	3.500	0.000	0.000	0.000	.050	0.00	.1717	0.000	1.000
1.01	19.500	0.000	3.000	0.000	0.000	0.000	.050	0.00	.1173	0.000	1.001
1.02	21.470	0.000	3.100	0.000	0.000	0.000	.050	0.00	.1214	0.000	1.002
1.02b	11.340	0.000	4.100	0.000	0.000	0.000	.050	0.00	.0757	0.000	1.003
1.03	16.660	0.000	2.400	0.000	0.000	0.000	.050	0.00	.1208	0.000	1.004
2.00	24.960	0.000	3.700	0.000	0.000	0.000	.050	0.00	.1202	0.000	2.000
2.01	6.870	0.000	3.800	0.000	0.000	0.000	.050	0.00	.0606	0.000	2.001
1.04	26.552	0.000	3.500	0.000	0.000	0.000	.050	0.00	.1276	0.000	1.005

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
1.00	5.670	15.00	0.000	2.500	0.000	36.063	0.000	1.634	422.0	3.000
1.01	5.670	15.00	0.000	2.500	0.000	36.063	0.000	2.384	422.0	3.000
1.02	5.670	15.00	0.000	2.500	0.000	36.063	0.000	3.206	422.0	2.000
1.02b	5.670	15.00	0.000	2.500	0.000	36.063	0.000	3.717	422.0	2.000
1.03	5.670	15.00	0.000	2.500	0.000	36.063	0.000	4.323	422.0	8.000
2.00	5.670	15.00	0.000	2.500	0.000	36.063	0.000	0.9903	422.0	2.000
2.01	5.670	15.00	0.000	2.500	0.000	36.063	0.000	1.311	422.0	6.000
1.04	5.670	15.00	0.000	2.500	0.000	36.063	0.000	6.658	422.0	0.000

##
Ed Park - Post-Development Catchment

Results for period from 0: 0.0 7/ 4/2002
                    to 5: 0.0 7/ 4/2002
##

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS)   = 90.
RETURN PERIOD (YRS)   = 2.
BX   = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 120.55
TOTAL OF SECOND SUB-AREAS (ha) = 53.78
TOTAL OF ALL SUB-AREAS (ha)   = 174.33

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	Catch. Area #2 (ha)	Slope #1 (%)	Slope #2 (%)	% Impervious #1 (%)	% Impervious #2 (%)	Pern #1	Pern #2	B #1	B #2	Link No.
3.00	1.150	6.514	3.600	3.600	0.000	100.0	.025	.015	.0148	.0021	1.000
3.01	0.7500	4.249	3.700	3.700	0.000	100.0	.025	.015	.0117	.0016	1.001
2.00	3.743	21.213	3.700	3.700	0.000	100.0	.025	.015	.0269	.0038	2.000
2.01	.00001	0.000	.0010	0.000	0.000	0.000	.050	0.00	.0034	0.000	1.002
1.00	46.990	0.000	3.500	0.000	0.000	0.000	.050	0.00	.1717	0.000	3.000
1.01	19.500	0.000	3.000	0.000	0.000	0.000	.050	0.00	.1173	0.000	3.001
4.00	5.452	21.809	3.100	3.100	0.000	100.0	.025	.015	.0357	.0042	4.000
1.02	3.785	0.000	1.200	0.000	0.000	0.000	.050	0.00	.0790	0.000	3.002
5.00	7.875	0.000	2.900	0.000	0.000	0.000	.050	0.00	.0745	0.000	5.000
1.03	1.723	0.000	1.000	0.000	0.000	0.000	.050	0.00	.0575	0.000	3.003
1.04	29.580	0.000	2.500	0.000	0.000	0.000	.050	0.00	.1596	0.000	1.003

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
3.00	23.500	15.00	1.500	2.500	0.000	17.542	33.750	1.676	28.00	2.000
3.01	23.500	15.00	1.500	2.500	0.000	17.542	33.750	2.775	30.00	0.000
2.00	23.500	15.00	1.500	2.500	0.000	17.542	33.750	5.438	28.00	2.000
2.01	23.500	1.500	0.000	0.000	0.000	33.750	0.000	8.213	30.00	8.000
1.00	23.500	15.00	0.000	2.500	0.000	17.542	0.000	1.294	76.00	3.000
1.01	23.500	15.00	0.000	2.500	0.000	17.542	0.000	1.895	78.00	5.000
4.00	23.500	15.00	1.500	2.500	0.000	17.542	33.750	5.571	28.00	0.000
1.02	23.500	15.00	0.000	2.500	0.000	17.542	0.000	3.114	44.00	2.000
5.00	23.500	15.00	0.000	2.500	0.000	17.542	0.000	0.2931	63.00	0.000

1.03	23.500	15.00	0.000	2.500	0.000	17.542	0.000	3.375	47.00	8.000
1.04	23.500	15.00	0.000	2.500	0.000	17.542	0.000	5.367	75.00	0.000

SUMMARY OF BASIN RESULTS

Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	Basin Vol.(m^3) Avail	Basin Vol.(m^3) Used	Basin Stage Used (m)
2.01	30.00	8.213	63.00	1.277	11773.2	0.0000	7699.0	46.962
4.00	28.00	5.570	32.00	2.460	8308.4	0.0000	3307.9	50.894

SUMMARY OF BASIN OUTLET RESULTS

Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
2.01	2.0	.6000		0.000	20.000	1.000
4.00	2.0	1.500		0.000	20.000	1.000

LINK 3.00 4.000

ESTIMATED VOLUME (CU METRES*10**3) = 2.522
ESTIMATED PEAK FLOW (CUMECS) = 1.5
ESTIMATED TIME TO PEAK (MINS) = 33.00

LINK 3.01 4.000

ESTIMATED VOLUME (CU METRES*10**3) = 4.167
ESTIMATED PEAK FLOW (CUMECS) = 2.5
ESTIMATED TIME TO PEAK (MINS) = 35.00

LINK 2.00 4.000

ESTIMATED VOLUME (CU METRES*10**3) = 8.211
ESTIMATED PEAK FLOW (CUMECS) = 4.9
ESTIMATED TIME TO PEAK (MINS) = 33.00

LINK 2.01 4.000

ESTIMATED VOLUME (CU METRES*10**3) = 12.38
ESTIMATED PEAK FLOW (CUMECS) = 7.4
ESTIMATED TIME TO PEAK (MINS) = 35.00

LINK 1.00 4.000

ESTIMATED VOLUME (CU METRES*10**3) = 8.265
ESTIMATED PEAK FLOW (CUMECS) = 1.3
ESTIMATED TIME TO PEAK (MINS) = 86.00

LINK 1.01 4.000

ESTIMATED VOLUME (CU METRES*10**3) = 11.73
ESTIMATED PEAK FLOW (CUMECS) = 1.8
ESTIMATED TIME TO PEAK (MINS) = 88.00

LINK 4.00 4.000

ESTIMATED VOLUME (CU METRES*10**3) = 8.733
ESTIMATED PEAK FLOW (CUMECS) = 5.0

ESTIMATED TIME TO PEAK (MINS) = 33.00

LINK 1.02 4.000

ESTIMATED VOLUME (CU METRES*10**3) = 20.80
ESTIMATED PEAK FLOW (CUMECS) = 2.9
ESTIMATED TIME TO PEAK (MINS) = 86.00

LINK 5.00 4.000

ESTIMATED VOLUME (CU METRES*10**3) = 1.418
ESTIMATED PEAK FLOW (CUMECS) = 0.28
ESTIMATED TIME TO PEAK (MINS) = 80.00

LINK 1.03 4.000

ESTIMATED VOLUME (CU METRES*10**3) = 22.51
ESTIMATED PEAK FLOW (CUMECS) = 3.2
ESTIMATED TIME TO PEAK (MINS) = 87.00

LINK 1.04 4.000

ESTIMATED VOLUME (CU METRES*10**3) = 37.28
ESTIMATED PEAK FLOW (CUMECS) = 5.2
ESTIMATED TIME TO PEAK (MINS) = 92.00

APPENDIX C – Stormwater Management Strategy Elements and Water Quality Parameters

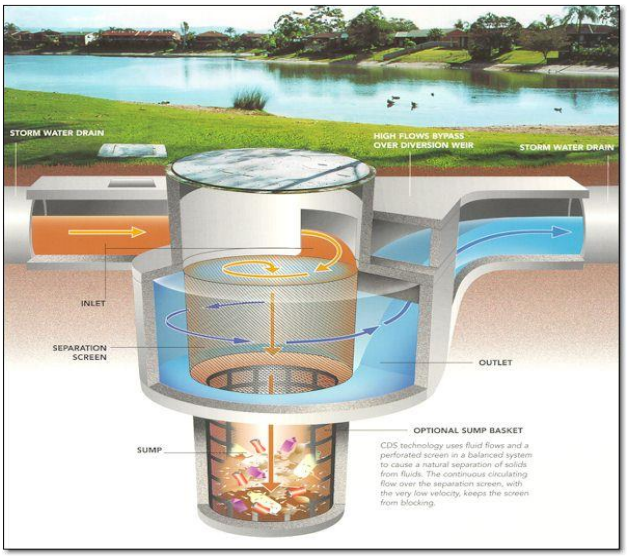
Water Quality Elements

On Lot Treatment

- Adoption of appropriate waterwise landscaping practices (resident education, native gardens, mulch, micro-irrigation).
- Implementation of water efficient fittings and appliances in all dwellings (dual flush toilet, AAA shower heads, water efficient taps and plumbing).
- Minimisation of impervious areas.
- The provision of a future reticulated recycled water main to the site, along with implementation of the above water efficient devices, will satisfy the requirements of BASIX.

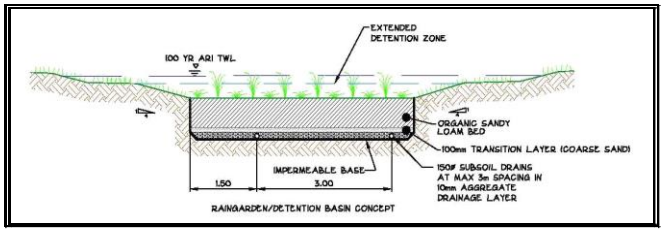
Gross Pollutant Traps (GPTs)

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. Council approved GPT units are to be provided at the end of stormwater pipes from urbanised catchments prior to discharging to the receiving waters.



Bio-Retention Raingarden

Bio-retention raingardens 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 are typically located within bushland corridors or other open space areas. The depth of the bio-retention raingarden media beds are typically 400 - 600 mm deep.



Raingardens have been sized to manage 1.5-year ARI flows as a storage component. Flows in excess of this event will bypass the raingardens. It is also assumed that trash and gross sediments will be effectively removed prior to entering the raingardens by the proposed GPT units.

MUSIC Model Parameters

Soil/Groundwater Parameters and Pollutant Concentration Rates

In the absence of site specific data, the soil/groundwater parameters and pollutant loading rates adopted for the natural and urban catchments of Edmondson Park Town Centre North were kept consistent with Liverpool City Council's "WSUD Technical Guidelines" (LCC, 2016). The adopted parameters are presented in Tables C.1 and C.2.

Table C.1 – Adopted Soil/Groundwater Parameters

Property	Units	Value
Rainfall Threshold - (mm/day)	mm/day	1.5*
Pervious Area Properties		
Soil Storage Capacity	mm	187
Initial Storage*	% of Capacity	30
Field Capacity	mm	127
Inifiltration Capacity Coefficient - a		135
Inifiltration Capacity Coefficient - b		4.0
Groundwater Properties		
Initial Depth	mm	10
Daily Recharge Rate	%	10
Daily Baseflow Rate	%	10
Daily Deep Seepage Rate	%	0

*Adopt value of 0.3 for roofs

Table C.2 – Pollutant Concentration Parameters

Surface Type	TSS		TP		TN	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Storm Flow						
Roof	1.3	0.32	-0.89	0.25	0.30	0.19
Road	2.43	0.32	-0.3	0.25	0.34	0.19
Other	2.15	0.32	-0.6	0.25	0.30	0.19
Base Flow						
Roof	-*	-*	-*	-*	-*	-*
Road	-*	-*	-*	-*	-*	-*
Other	1.2	0.17	-0.85	0.19	0.11	0.12

* Base flows are only generated from pervious areas, therefore these parameters are not relevant to impervious areas

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 User's Manual.

The Bureau of Meteorology provided the 6-minute pluviography data available at the closest station to Edmondson Park (Station 67035 Liverpool [Whitlam Centre]). The MUSIC modelling was undertaken using the 10 years (1965 - 1974) of 6 Minute data provided for this station.

The rainfall for the 10-year (1965 - 1974) period analysed is shown on the graph which is provided in Plate C.1.

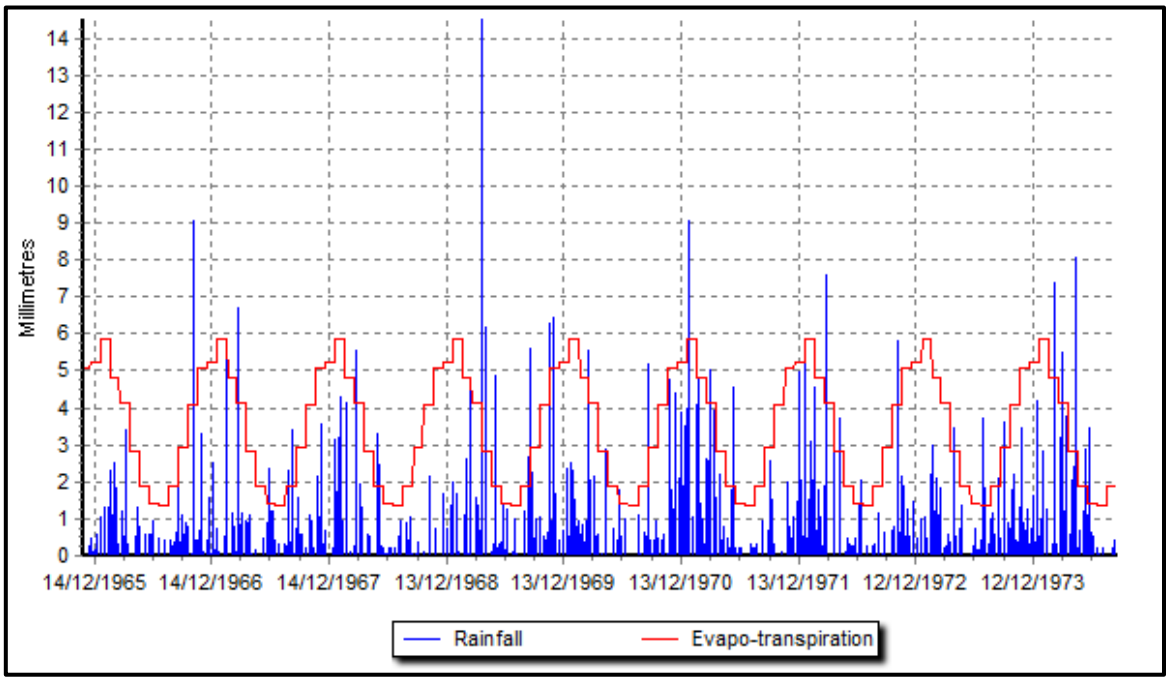


Plate C.1 – Rainfall and Evapo-Transpiration Data for Liverpool (1965-1974)

Bio-Retention Raingardens

Treatment within bio-retention raingardens is attained by detaining flows to promote sedimentation, direct filtration of particulate matter and nutrient stripping by bio-films which establish on the surface of the media bed and within the gravel layer. The organic sandy loam bed and plant system minimises evaporation losses and the raingarden will be constructed with an impermeable barrier to prevent seepage losses and to avoid groundwater salinity impacts. The adopted parameters for the bio-retention raingardens are presented in Table C.3.

Table C.3 – General Features & Configuration

Parameter	Value
Extended Detention Depth (m)	0.3
Unlined Filter Media Perimeter (m)	0.01
Saturated Hydraulic Conductivity (mm/h)	100
Filter Depth (m)	0.5
TN Content of Filter Media (mg/kg)	800
Orthophosphate Content of Filter Media (mg/kg)	40
Exfiltration Rate (mm/hr)	0