

**CIVIL ENGINEERING REPORT:
AMENDMENT TO STATE SIGNIFICANT
DEVELOPMENT 5175-2012**

**EASTERN CREEK BUSINESS HUB:
ROOTY HILL ROAD SOUTH
EASTERN CREEK NSW**

Prepared For:

**Western Sydney Parkland Trust
Level 7
10 Valentine Avenue
PARRAMATTA NSW 2150**

Prepared by:

**Costin Roe Consulting
Level 1, 8 Windmill Street
WALSH BAY NSW 2000**

Rev: B

DOCUMENT VERIFICATION

Project Title	Proposed Planning Application, Eastern Creek Business Hub
Document Title	Civil Engineering Report: Amendment to SSD 5175.
Project No.	Co12693.00
Description	Civil engineering report for proposed planning application
Client Contact	Mr Tim Ireson, Western Sydney Parkland Trust (WSPT)

	Name	Signature
Prepared by	Mark Wilson	
Checked by	Grant Roe	
Issued by	Mark Wilson	
File Name	12693.00-04b.rpt.docx	

Document History

Date	Revision	Issued to	No. Copies
1 April 2015	DRAFT	Mr Tim Ireson, WSPT	PDF
21 July 2015	A	Mr Tim Ireson, WSPT	PDF
4 August 2015	B	Mr Tim Ireson, WSPT	PDF

TABLE OF CONTENTS

1	INTRODUCTION	4
2	SITE CHARACTERISTICS	5
2.1	Location	5
2.2	Topography & Description	6
2.3	Proposed Development	6
3	AMMENDMENTS TO SSD 5175	8
4	SITE WORKS	9
4.1	Bulk Earthworks	9
4.2	Embankment Stability	9
4.3	Supervision of Earthworks	9
4.4	Retaining Walls	10
5	STORMWATER MANAGEMENT	11
5.1	Hydrologic Modelling and Analysis	11
5.1.1	General Design Principles	11
5.1.2	Minor/ Major System Design	11
5.1.3	Rainfall Data	11
5.1.4	Runoff Models	11
5.2	Hydraulics	12
5.2.1	General Requirements	12
5.2.2	Freeboard	12
5.2.3	Public Safety	12
5.2.4	Inlet Pit Spacing	13
5.2.5	Overland Flow	13
5.3	Site Drainage	13
5.3.1	Existing Site Drainage	13
5.3.2	Proposed Site Drainage	13
5.3.3	Site Discharge	13
5.4	External Catchments and Flooding	14
6	WATER QUANTITY MANAGEMENT	15
7	STORMWATER QUALITY CONTROLS	16

7.1	Regional Parameters	16
7.2	Proposed Stormwater Treatment System	16
7.3	Stormwater Quality Modelling	17
7.3.1	Introduction	17
7.3.2	Rainfall Data	17
7.3.3	Rainfall Runoff Parameters	18
7.3.4	Pollutant Concentrations& Source Nodes	18
7.3.5	Treatment Nodes	19
7.3.6	Results	20
7.3.7	Modelling Discussion	20
7.4	Stormwater Harvesting	21
7.4.1	Internal Base Water Demand	21
7.4.2	External Base Water Demand	21
7.4.3	Rainwater Tank Sizing	22
7.5	Maintenance And Monitoring	22
8	EROSION & SEDIMENT CONTROL PLAN	27
8.1	General Conditions	27
8.2	Land Disturbance	27
8.3	Erosion & Sediment Control Conditions	28
8.4	Pollution Control Conditions	29
8.5	Waste Management Conditions	29
8.6	Site Inspection and Maintenance	29
9	CONCLUSION	32
10	REFERENCES	33

1 INTRODUCTION

Costin Roe Consulting Pty Ltd has been commissioned by The Western Sydney Parkland Trust (WSPT) to prepare this Engineering Report in support of a proposed amendment to the approved development, SSD 5175-2012, over the site.

The site is located on the Rooty Hill Road South, opposite the intersection of Rooty Hill Road South with Cable Place, Eastern Creek, NSW. The proposed development is for an industrial and commercial business hub.

The amendment to SSD 5175 has been proposed for an adjustment to the approved Stormwater Management Strategy completed by J.W. Prince Consulting Engineers during 2012. The adjustment to the Stormwater Management Strategy will include for the provision of an estate level detention basin and bio-retention, water quality, system which will service the northern catchment and road network.

This report has been prepared to document the adjusted Stormwater Management Strategy and also provide a holistic summary of the design principles and planning objectives for the following civil engineering components of the project:

- Earthworks & Retaining Walls;
- Stormwater Management including stormwater quantity and quality; and
- Erosion & Sediment Control.

The engineering objectives for the development are to create a site which, based on the proposed architectural layout, responds to the topography and site constraints, to provide an appropriate and economical stormwater management system which incorporates best practice in water sensitive urban design consistent with the requirements of council's water quality objectives.

A set of drawings have been prepared to show the proposed finished levels, retaining walls, stormwater drainage layout and water quantity and quality requirements for the development. These drawings are for development approval only and subject to change during detail design.

The consent authority is The Director General NSW Planning as the proposal is considered a State Significant Development (SSD). However as the subject site is located within Blacktown City Council (BCC) local government area, the engineering and policy (Part R of DCP2006) requirements of BCC have also been considered in the design.

2 SITE CHARACTERISTICS

2.1 Location

The site is approximately 35 Ha in area and zoned to General Industrial land under the Blacktown City Council.

The site is bounded on the north by Church Street, on the east by Westlink M7, on the south by Great Western Highway and the west by Rooty Hill Road South. Land to the west of the site consists of residential developments and school precincts.

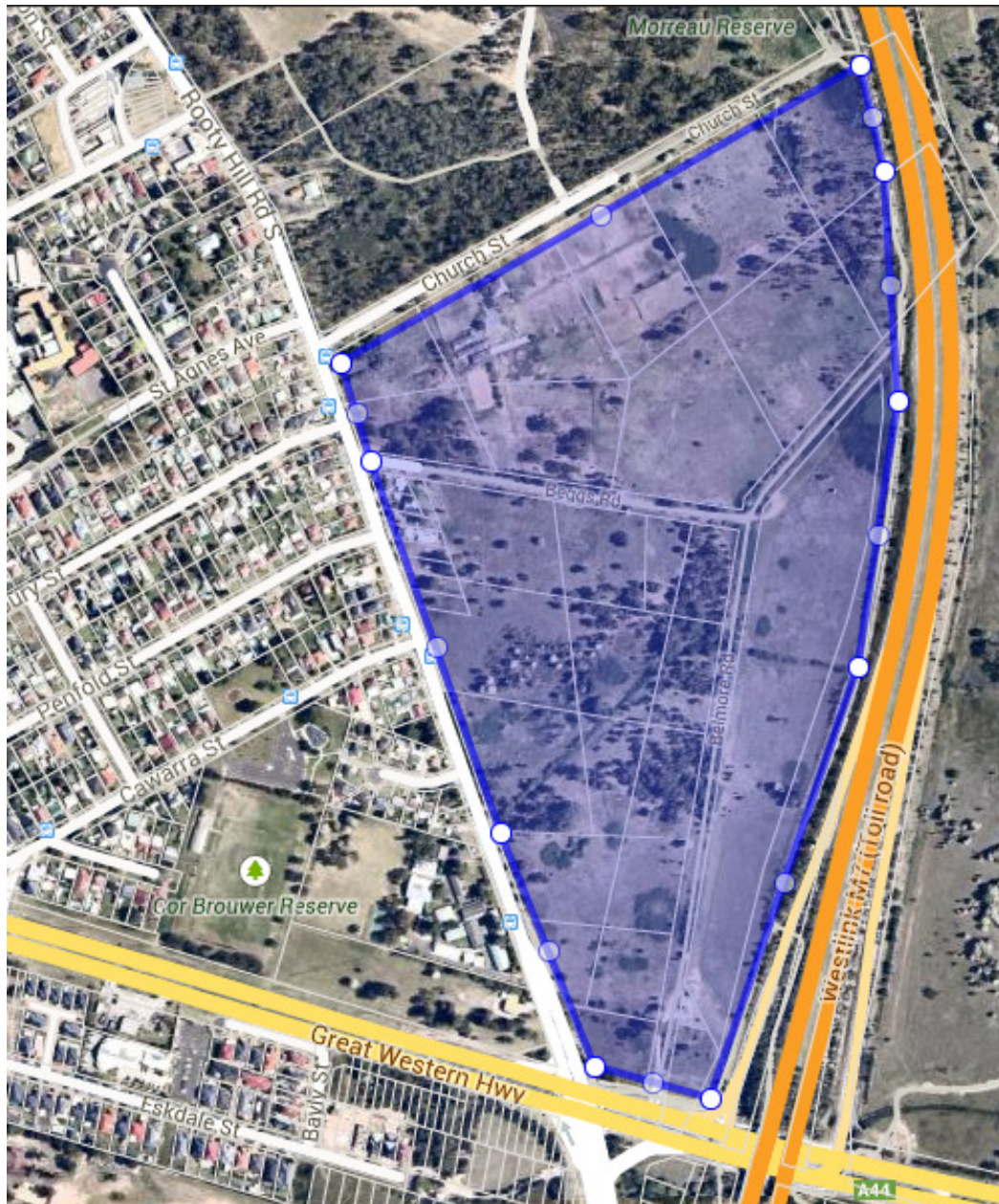


Figure 2.1. Locality Map (Source: Nearmap 2015)

2.2 Topography & Description

The site consists primarily of grasslands, scattered bushland and isolated trees. Several residential properties are currently present within the site located adjacent to the western boundary with frontages along Rooty Hill Road South. A single residential property is also present adjacent to the northern boundary fronting Church Street.

Two unformed road reserves are present on the site, being Beggs Road and Belmore Road. The Beggs Road reserve currently comprises a dirt track and travels in a west-east direction through the site starting at Rooty Hill Road South. Belmore Road is currently unformed travelling in a south-north direction and starting at the Great Western Highway.

The site generally falls from west to east at an average slope of 3% towards existing drainage culverts which convey stormwater flows under the Westlink M7 Motorway and to the north.

2.3 Proposed Development

The proposed development is for an industrial subdivision of the land comprising earthworks and infrastructure construction to facilitate development of the land. Individual industrial warehouse and distribution facilities developments would be subject to future separate detailed building design and development applications.

The proposed development layout can be seen in **Figure 2.2**. The likely development will comprise a number of large format bulky goods retailers and industrial facilities. These will be defined in future separate development applications for individual development lots.

The estate layout comprises a northern and southern precinct which is defined by the limit of the proposed estate access road. It is expected that construction will be performed in two phases with the southern precinct being constructed as Phase 1, followed by the northern precinct in Phase 2.

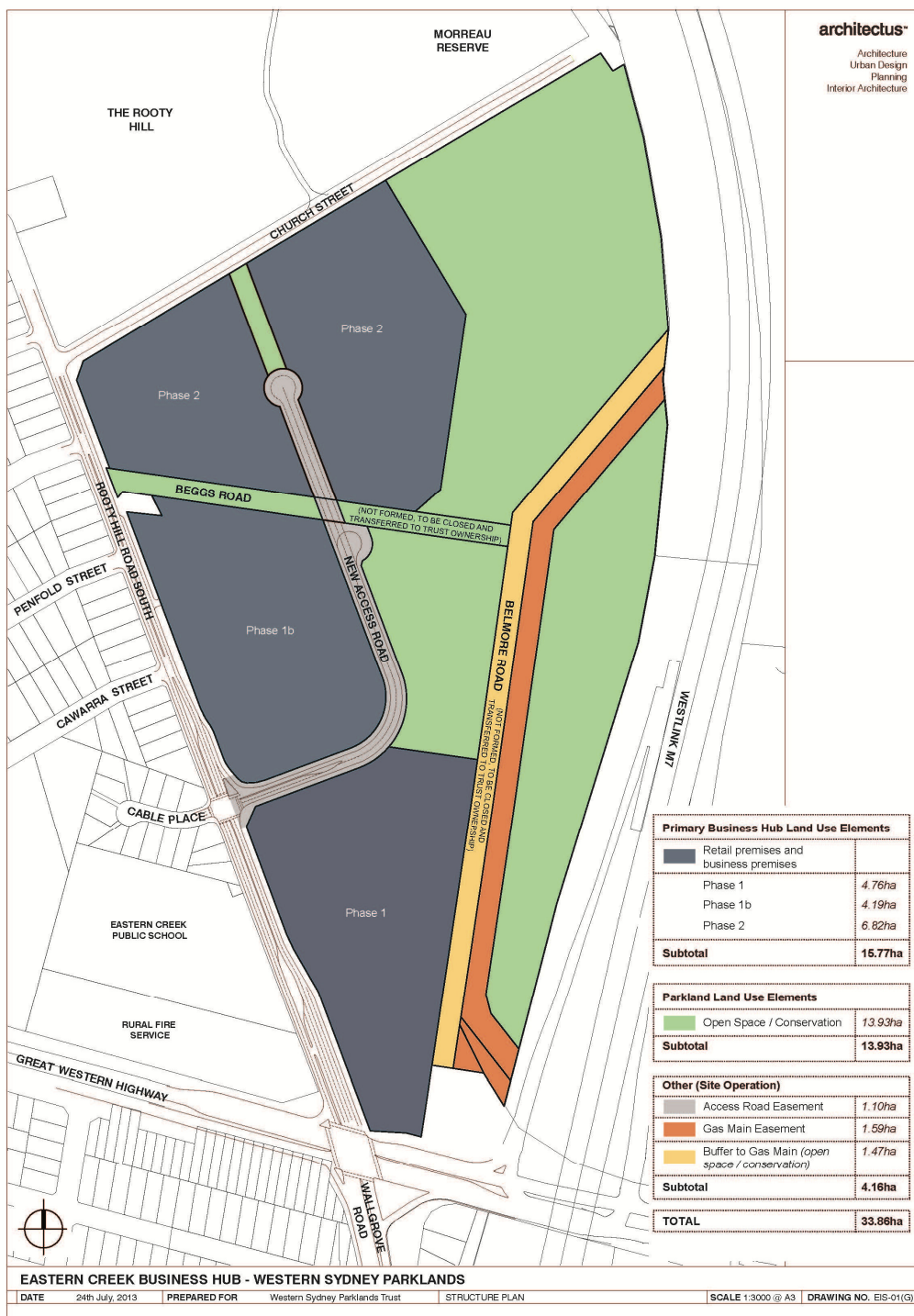


Figure 2.2. Proposed Site Layout

3 AMMENDMENTS TO SSD 5175

This application is for an amendment to SSD 5175. The main component of the amendment is for an adjustment to the approved Stormwater Management Strategy completed by J.W. Prince Consulting Engineers during 2012 however some minor amendments to other components of the design will be apparent due to this adjustment. This section of the report provides a summary of the engineering components of the development which will change from, or remain consistent with, the approved SSD 5175 development.

Summary of design elements as follows:

- Development Layout
The development layout, including proposed development lots and access road configuration, remains consistent with the layout previously approved in the SSD 5175 application.
- Stormwater Management
The adjustment to the Stormwater Management Strategy will include for the provision of an estate level detention basin and bio-retention, water quality system which will service the northern catchment and road network. The approved SSD strategy was for detention of stormwater and water quality provisions to be performed on-lot for each individual development lot. The proposed adjustment will consolidate the separate systems providing for an increased efficiency in treatment and also improving the flexibility for the development within the northern catchment lots.
The new combined detention basin and bio-retention basin is proposed to be located downstream of the Estate Road, within the revegetation area. The geometry of the basin will be completed such that it remains clear of the defined Cumberland Plain Bushland retention corridor.
The management of stormwater from the southern catchment and from upstream residential properties remains consistent with the approved SSD 5175 design. Site discharge remains consistent utilising the two existing culverts beneath the M7 Motorway.
- Stormwater System
As a result of the stormwater attenuation being completed downstream of the estate access road, the un-attenuated flows need to be allowed for within the road drainage network. As such an increase in pipe sizes has been made to account for the increase flows present within the network.
The piped and overland stormwater system layout remains generally consistent with that approved under SSD 5175.
- Earthworks
There are some adjustments proposed to the earthworks to suit the stormwater management strategy modifications and also to reduce the amount of retaining walls requirements over the site. The proposed earthworks levels are shown on drawings **Co12693.00-DA30 and DA35**.
- Intersection with Rooty Hill Road South
There are no adjustments currently proposed to the intersection layout produced and approved under the original SSD 5175 application.

4 SITE WORKS

4.1 Bulk Earthworks

Bulk earthworks will be undertaken to facilitate the construction of the development. The objective for the site is to balance cut and fill earthworks volumes while minimising the requirements for retaining walls.

A high level earthworks and volume estimate assessment has been completed for the development. This assessment can be found on drawings Co12693.00-DA30 and DA35. The assessment has been made based on flat pads throughout development lots; road boxing based on proposed finished road levels and excavation of the stormwater management basins. The earthworks analysis has been completed to a level of detail to enable general pad levels to be set and to obtain an order of magnitude cut and fill volume estimate. Detailed assessment of the earthworks level will be completed during detailed design stage.

The earthworks volume estimates are as follows:

Cut	- 37,650m ³	
Detailed Ex./Services	- 16,000m ³	
Road Boxing	- 4,000m ³	
Fill	+217,800m ³	
Balance	+160,150m³	<i>(Approx. import required.)</i>

Soil erosion and sediment control measures including sedimentation basins will also be provided for the development – please refer to the Soil and Water Management Plan in Section 5 of this report.

Earthworks over the site will be minor and no impact on groundwater is expected as a result of these works.

4.2 Embankment Stability

To assist in maintaining embankment stability, permanent batter slopes will be no steeper than 3 horizontal to 1 vertical while temporary batters will be no steeper than 2 horizontal to 1 vertical. This is in accordance with the recommended maximum batter slopes for residual clays and shale which are present in the area.

Permanent batters will also be adequately vegetated or turfed which will assist in maintaining embankment stability.

Stability of batters and reinstatement of vegetation shall be in accordance with the submitted drawings and the Soil and Water Management Plan in Section 5.

4.3 Supervision of Earthworks

All geotechnical testing and inspections performed during the earthworks operations will be undertaken to Level 1 geotechnical control, in accordance with AS3798-1996.

4.4 Retaining Walls

The civil engineering objective is to minimise retaining walls within the constraints of the architectural layout and allowable grading (as per AS2890.1 and AS2890.2) through paved areas and batters in landscaped areas.

Retaining walls will be required for the development. As the development layouts are not defined at this stage, the configurations of walls are shown figuratively on drawings **Co12693.00-DA31 and DA32**. These will be subject to future design development and definition during development applications for individual development sites. Walls will be configured in accordance with Blacktown City Council requirements and will be constructed of masonry and providing 1.5m wide tiers for walls over 3m in height.

5 STORMWATER MANAGEMENT

5.1 Hydrologic Modelling and Analysis

5.1.1 General Design Principles

The design of the stormwater system for this site will be based on relevant national design guidelines, Australian Standard Codes of Practice, Blacktown City Council and accepted engineering practice.

Runoff from buildings will generally be designed in accordance with AS 3500.3 National Plumbing and Drainage Code Part 3 – Stormwater Drainage.

Overall site runoff and stormwater management will generally be designed in accordance with the Institution of Engineers, Australia publication “Australian Rainfall and Runoff” (1987 Edition), Volumes 1 and 2 (AR&R).

Storm events for the 2 to 100 Year ARI events have been assessed.

5.1.2 Minor/ Major System Design

The piped stormwater drainage (minor) system has been designed to accommodate the 20-year ARI storm event (Q20). Overland flow paths (major) which will convey all stormwater runoff up to and including the Q100 event have also been provided which will limit major property damage and any risk to the public in the event of a piped system failure.

5.1.3 Rainfall Data

Rainfall intensity Frequency Duration (IFD) data used as a basis for DRAINS modelling for the 2 to 100 Year ARI events, was taken from Blacktown City Council’s *Engineering Guidelines for Development 2005*.

5.1.4 Runoff Models

In accordance with the recommendations and standards of Blacktown City Council, the calculation of the runoff from storms of the design ARI has been calculated with the catchment modelling software DRAINS.

The design parameters for the DRAINS model are to be based on the recommendations as defined by BCC and parameters for the area and are as follows:

Model	Model for Design and analysis run	Rational method	
	Rational Method Procedure	ARR87	
	Soil Type-Normal	3.0	
	Paved (Impervious) Area Depression Storage	1	mm
	Supplementary Area Depression Storage	1	mm
	Grassed (Pervious) Area Depression Storage	5	mm
AMC	Antecedent Moisture Condition (ARI=1-5 years)	2.5	
AMC	Antecedent Moisture Condition (ARI=10-20 years)	3.0	
AMC	Antecedent Moisture Condition (ARI=50-100 years)	3.5	
	Sag Pit Blocking Factor (Minor Systems)	0	
	On Grade Pit Blocking Factor (Minor Systems)	0	
	Sag Pit Blocking Factor (Major Systems)	0.5	
	On Grade Pit Blocking Factor (Major Systems)	0.2	
	Inlet Pit Capacity		

Table 4.1. DRAINS Parameters

5.2 Hydraulics

5.2.1 General Requirements

Hydraulic calculations will be carried out utilising DRAINS modelling software during the detail design stage to ensure that all surface and subsurface drainage systems perform to or exceed the required standard.

5.2.2 Freeboard

The calculated water surface level in open junctions of the piped stormwater system will not exceed a freeboard level of 150mm below the finished ground/ grate level, for the peak runoff from the Minor System runoff.

The calculated water surface for the peak runoff from the Major System runoff will not exceed a freeboard level of 300mm below the finished floor level of the building/ development pads.

5.2.3 Public Safety

For all areas subject to pedestrian traffic, the product (dV) of the depth of flow d (in metres) and the velocity of flow V (in metres per second) will be limited to 0.4, for all storms up to the 100-year ARI.

For other areas, the dV product will be limited to 0.6 for stability of vehicular traffic (whether parked or in motion) for all storms up to the 100-year ARI.

5.2.4 Inlet Pit Spacing

The spacing of inlets throughout the site will be such that the depth of flow, for the Major System design storm runoff, will not exceed the top of the kerb (150mm above gutter invert).

5.2.5 Overland Flow

Dedicated flow paths have been designed to convey all storms up to and including the 100-year ARI. These flow paths will convey stormwater from the site to the estate road system and to Estate Detention Basins 1 and 2.

5.3 **Site Drainage**

5.3.1 Existing Site Drainage

The property is currently undeveloped with no formal drainage located on site. Two culvert systems are located on the eastern boundary of the development site. These convey stormwater from localised gullies within the development site under the M7 Motorway. The southern most of these culverts conveys stormwater flows from an upstream residential catchment which traverses through the development site from Rooty Hill Road near to its intersection with Cable Place. This is discussed further in following sections.

5.3.2 Proposed Site Drainage

The proposed stormwater system consists of a major/ minor system which conveys surface water from the proposed development lots to via in-ground drainage connection points to the estate infrastructure and combined water quality/ detention basins. This will be by an open channel, water quality basin to Basin 1 for the southern catchment. The northern catchment will be conveyed via the estate road infrastructure drainage system to an open channel and Basin 2. Ultimate discharge from the development site is via existing culvert systems beneath the M7 Motorway in a northerly direction.

Further discussion on the Stormwater Management Strategy is provided in Section 6 and 7 of this report. Reference to drawing **Co12693.00-DA40** shows the proposed drainage layout.

5.3.3 Site Discharge

Discharge from the site is proposed at two points on the eastern boundary of the development area. The proposed discharge points correspond to the existing culverts under the M4 Motorway described in Section 5.3.1 above. Details of the proposed discharge points can be seen on drawing **Co12693.00-DA40**.

5.4 External Catchments and Flooding

Stormwater flows from an upstream residential catchment are required to be drained through the development site. The catchment is located on the western side of Rooty Hill Road South and is approximately 35.4 Ha. Land use generally comprises residential urban uses. An existing dual 750mm r.c.p. culvert, located south of Cable Place along Rooty Hill Road South, conveys the majority of the upstream flows into the site. The culvert, running under Rooty Hill Road South, currently discharges into a rudimentary channel which conveys flows through the site. The channel runs from west to east towards the existing culvert under the Westlink M7. The external catchment has been defined in the approved SSD 5175 documentation by JW Prince as shown in Figure 5.1 below.

The existing channel will be formalised as part of the proposed development. Flows are to be conveyed through the proposed development to the southern on-site detention (OSD) system. Stormwater from upstream catchments will bypass any site or estate water quality measures.



Figure 5.1. Upstream Catchment as defined by J. W. Prince 2012

6 WATER QUANTITY MANAGEMENT

Blacktown City Council requires water quantity management, or stormwater detention, to be provided to limit the runoff discharged from private property into the underground piped drainage system to pre-developed flow and to assist in mitigating the increased stormwater runoff generated by development.

Attenuation of stormwater runoff from the Southern Catchment will need to allow for attenuation of the upstream residential catchment defined in earlier sections of this report. This will be performed in proposed Basin 1.

Stormwater runoff from the northern catchment will be drained to proposed Basin 2. The proposed introduction of Basin 2 into the Stormwater Management Strategy constitutes the main change in the overall strategy providing efficiency in design and construction and also allows for an increase level of flexibility in the development of individual lots within the northern catchment.

The proposed Basin 2 system will be a combined OSD and bio-retention basin which will satisfy both water quantity and water quality requirements for the development. A combined system is not proposed for Basin 1 due to the large volume of water associated with the upstream residential catchment that would overload any water treatment system if placed within Basin 1. Basin 1 will hence only allow for stormwater storage and attenuation with water quality system kept separate to the OSD basin.

Sizing of the basins has been completed in accordance with the hydrological rafts modelling completed by JW Prince in Section 5.5 of their Water Cycle Management Strategy 8801Rpt1C dated 24 August 2012 and approved under SSD 5175. On-site detention basins details based on these requirements are as below:

- Basin 1 (Southern Catchment)

Catchment =	4.12 Ha
Detention Storage Rate =	850 m ³ /Ha
Detention Storage =	3500 m ³

- Basin 2 (Northern Catchment)

Catchment 2 =	12.18 Ha
Detention Storage Rate =	460 m ³ /Ha
Detention Storage =	5600 m ³

The storage volume for Catchment 1 includes the upstream catchment to be detained. Detention storage will fully active and will be provided as above ground basins in open space and conservation areas.

Detention basin locations and details can be found on drawing **Co12693.00-DA40**.

7 STORMWATER QUALITY CONTROLS

7.1 Regional Parameters

There is a need to provide design which incorporates the principles of Water Sensitive Urban Design (WSUD) and to target pollutants that are present in the stormwater so as to minimise the adverse impact these pollutants could have on receiving waters and to also meet the requirements specified by the Blacktown City Council.

Blacktown City Council have nominated, in *Part R* of their *DCP 2006*, the requirements for stormwater quality to be performed on a catchment wide basis. These are presented in terms of annual percentage pollutant reductions on a developed catchment and are as follows:

Gross Pollutants	90%
Total Suspended Solids	85%
Total Phosphorus	65%
Total Nitrogen	45%
Total Hydrocarbons	90%

7.2 Proposed Stormwater Treatment System

Roof, hardstand, car parking, roads and other extensive paved areas are required to be treated by the Stormwater Treatment Measures (STM's). The STM's shall be sized according to the whole catchment area of the development. The STM's for the development shall be based on a treatment train approach to ensure that all of the objectives above are met. A different approach has been completed for the Northern and Southern Catchments. The Southern Catchment treatment strategy remains consistent with the strategy approved under SSD 5175. The strategy for the Northern Catchment relocates the main treatment measures from lot to an estate level bio-retention basin as further discussed below.

Components of the treatment train for the Southern Catchment development are as follows:

- Primary treatment to parking and hardstand areas is to be performed via the provision of a proprietary vortech style GPT. Acceptable solutions for this would be Rocla CDS, Humeceptor or Stormwater360 Vortech. Pre-treatment of stormwater will assist in mitigating the potential for early onset sedimentation of the bio-retention system;
- Tertiary treatment is to be performed via a 500 m² bio-retention (Bio Basin 1) located adjacent to the Cumberland Plains Woodland Corridor in the middle of the site;
- It is noted that stormwater from the upstream residential catchment will bypass treatment systems; and
- A portion of building roof (approx. 25%) will also be treated via rainwater reuse and settlement within the rainwater tank however.

Components of the treatment train for the Northern Catchment are as follows:

- Primary treatment to development lots is to be performed via the provision pit inserts to surface inlet pits. Acceptable solutions for this would be Stormwater360 Enviropods or equivalent BCC approved pit insert. Pre-treatment of stormwater will assist in mitigating the potential for early onset sedimentation of the bio-retention system;
- Primary treatment of the roads are to be performed via Stormwater360 Enviropod Pit Inserts;
- Tertiary treatment is to be performed via a 1,150 m² bio-retention system located within Basin 2. Basin 2 will comprise combined detention and water quality functions; and
- A portion of building roofs will also be treated via rainwater reuse and settlement within the rainwater tank however, as the building configuration and use has not been defined this component has not been included in the modelling of the treatment train.

7.3 Stormwater Quality Modelling

7.3.1 Introduction

The MUSIC model was chosen to model water quality. This model has been released by the Cooperative Research Centre for Catchment Hydrology (CRCCH) and is a standard industry model for this purpose. MUSIC (the Model for Urban Stormwater Improvement Conceptualisation) is suitable for simulating catchment areas of up to 100 km² and utilises a continuous simulation approach to model water quality.

By simulating the performance of stormwater management systems, MUSIC can be used to predict if these proposed systems and changes to land use are appropriate for their catchments and are capable of meeting specified water quality objectives (CRC 2002). The water quality constituents modelled in MUSIC and of relevance to this report include Total Suspended Solids (TSS), Total Phosphorus (TP) and Total Nitrogen (TN).

The pollutant retention criteria set out in Part R of BCC's DCP2006 and nominated in Section 5.1 of this report were used as a basis for assessing the effectiveness of the selected treatment trains.

The MUSIC model "*12693.00 ECBH DA_Rev1.sqz*" was set up to examine the effectiveness of the water quality treatment train and to predict if BCC requirements have been achieved. The layout of the MUSIC model is presented in **Appendix B**.

7.3.2 Rainfall Data

Six minute pluviographic data was provided by BCC which has been sourced from the Bureau of Meteorology (BOM) as nominated below. Evapo-transpiration data for the period was sourced from the Sydney Monthly Areal PET data set supplied with the MUSIC software.

Input	Data Used
Rainfall Station	67035 Liverpool (Whitlam)
Rainfall Period	1 January 1967 – 31 December 1976 (10 years)
Mean Annual Rainfall (mm)	857
Evapotranspiration	Sydney Monthly Areal PET
Model Timestep	6 minutes

7.3.3 Rainfall Runoff Parameters

Parameter	Value
Rainfall Threshold	1.40
Soil Storage Capacity (mm)	170
Initial Storage (% capacity)	30
Field Capacity (mm)	70
Infiltration Capacity Coefficient a	210
Infiltration Capacity exponent b	4.7
Initial Depth (mm)	10
Daily Recharge Rate (%)	50
Daily Baseflow Rate (%)	4
Daily Seepage Rate (%)	0

7.3.4 Pollutant Concentrations & Source Nodes

Pollutant concentrations for source nodes are based on BCC land use parameters as per the Table 5.1.:

Flow Type	Surface Type	TSS (log ₁₀ values)		TP (log ₁₀ values)		TN (log ₁₀ values)	
		Mean	Std Dev.	Mean	Std Dev.	Mean	Std Dev.
Baseflow	Roof	1.20	0.17	-0.85	0.19	0.11	0.12
	Roads	1.20	0.17	-0.85	0.19	0.11	0.12
	Landscaping	1.2	0.17	-0.85	0.19	0.11	0.12
Stormflow	Roof	1.30	0.32	-0.89	0.25	0.30	0.19
	Roads	2.43	0.32	-0.30	0.25	0.34	0.19
	Landscaping	2.15	0.32	-0.6	0.25	0.30	0.19

Table 7.1. Pollutant Concentrations

The MUSIC model has been setup with a treatment train approach based on the pollutant concentrations in **Table 7.1** above and the catchments shown on drawing **Co12693.00-DA41** in **Appendix A**.

All developable land has been included in the assessment. The revegetation areas and Cumberland Plain Woodland areas which are areas not requiring treatment have been excluded from the modelling. This is consistent with the approved SSD 5175 modelling.

7.3.5 Treatment Nodes

Bio-retention, rainwater tank and Stormwater360 S200 Enviropod (EP S200) nodes have been used in the modelling of the development.

There are two proposed bio-retention basins which will be provided in accordance with industry best practice and the guidelines of the Monash University Facility for Advancing Water Bio-filtration with the following parameters:

Bioretention 1

Parameter	Value
<u>Storage Properties</u>	
Extended Detention Depth	300 mm
Storage Surface Area	500 m ² (minimum)
<u>Filter and Media Properties</u>	
Filtration Area	500** m ²
Saturated Hydraulic Conductivity	100 mm/hr
Filter Depth	500 mm

Bioretention 2

Parameter	Value
<u>Storage Properties</u>	
Extended Detention Depth	300 mm
Storage Surface Area	1,150 m ² (minimum)
<u>Filter and Media Properties</u>	
Filtration Area	1150** m ²
Saturated Hydraulic Conductivity	100 mm/hr
Filter Depth	500 mm

** Nominated filtration area excludes all pits, scour protection and other structures which may be present in bio-retention basins.

Stormwater 360 Series 200 Enviropod Inserts (stand alone use)

(Noted "EP S200" in Table 5.2)

Parameter	Value
Treatable Flow	0.020 m ³ /s per Enviropod
<u>Pollutant Reductions</u>	
TSS	30 %
TP	15 %
TN	7 %
GP's	100 %

7.3.6 Results

Table 5.3 shows the results of the MUSIC analysis. The reduction rate is expressed as a percentage and compares the post-development pollutant loads without treatment versus post-development loads with treatment.

	Source	Residual Load	% Reduction	Target Met
Total Suspended Solids (kg/yr)	18900	2320	87.7	Y
Total Phosphorus (kg/yr)	38.2	11.9	68.9	Y
Total Nitrogen (kg/yr)	245	120	50.9	Y
Gross Pollutants (kg/yr)	2810	0	100	Y

Table 5.3. MUSIC analysis results

The model results indicate that, through the use of the STM's in the treatment train, pollutant load reductions for Total Suspended Solids, Total Phosphorous, Total Nitrogen and Gross Pollutants will meet the requirements of Part R of BCC's DCP 2006 on an overall catchment basis.

7.3.7 Modelling Discussion

MUSIC modelling has been performed to assess the effectiveness of the selected treatment trains and to ensure that the pollutant retention requirements of Part R of BCC's DCP2006 have been met.

The MUSIC modelling has shown that the proposed treatment train of SQID's will provide stormwater treatment which will meet BCC requirements in an effective and economical manner.

Hydrocarbon removal cannot easily be modelled with MUSIC software. The proposed distribution/ storage facility would be expected to produce low source loadings of hydrocarbons. Potential sources of hydrocarbons would be limited to leaking engine sumps or for accidental fuel spills/leaks and leaching of bituminous pavements (car parking only). The potential for hydrocarbon pollution is low and published data from the CSIRO indicates that average concentrations from Industrial sites are in the order of 10mg/L and we would expect source loading from this site to be near to or below this concentration. Hydrocarbon pollution would also be limited to surface areas which will be treated via bio-retention swales which are predicted to achieve a 90% reduction of this pollutant.

Given the expected low source loadings of hydrocarbons and removal efficiencies of the treatment devices we consider that the requirements of the Blacktown Council have been met.

7.4 Stormwater Harvesting

Stormwater harvesting refers to the collection of stormwater from the developments internal stormwater drainage system for re-use in non-potable applications. Stormwater from the stormwater drainage system can be classified as either rainwater where the flow is from roof areas only, or stormwater where the flow is from all areas of the development.

For the purposes of this development, we refer to a rainwater harvesting system, where benefits of collected stormwater from roof areas over a stormwater harvesting system can be made as rainwater is generally less polluted than stormwater drainage.

Rainwater harvesting is proposed for this development with re-use for non-potable applications. Internal uses include such applications as toilet flushing while external applications will be used for irrigation. The aim is to reduce the water demand for the development by a minimum of 80% and to satisfy the requirements of Blacktown City Council DCP2006 Part R.

In general terms the rainwater harvesting system will be an in-line tank for the collection and storage of rainwater. At times when the rainwater storage tank is full rainwater can pass through the tank and continue to be discharged via gravity into the stormwater drainage system. Rainwater from the storage tank will be pumped for distribution throughout the development in a dedicated non-potable water reticulation system.

A rainwater tank has been designed for the Southern Catchment, using MUSIC software to balance the supply and demand, based on the below base water demands and the requirement of Blacktown Council DCP2006 Part to provide 80% reduction in non-potable water demand. As the development lots in the Northern Catchment are less defined, no allowance for rainwater tanks has been made in the current application. Rainwater tanks for these site would be subject to future development applications over these development lots which would be completed in accordance with the requirements of DCP2006 Part R.

7.4.1 Internal Base Water Demand

Indoor water demand has been based on Section 7.11 of Blacktown Council DRAFT MUSIC Modelling Guideline 2013 for an industrial/ commercial development. Section 7.11 of the BCC document requires an allowance of 0.1kL/day/ toilet or urinal. No allowance is required for disable toilets.

These rates give the following internal non-potable demand for an estimated 8 pans and 4 urinals:

Southern Catchment	12 Toilets	1.2kL/day
--------------------	------------	-----------

7.4.2 External Base Water Demand

The external base water demand has also been based on Section 7.11 of Blacktown Council DRAFT MUSIC Modelling Guideline 2013 and recent agreed rates with Mr Tony Merilee's from Blacktown Council (30 October 2013 for adjacent K&N Facility) for an industrial/ commercial development. Section 7.11 requires an allowance of

0.3kL/year/m² as PET-Rain for subsurface irrigation in addition to the agreed rate for bio-retention areas of 1kL/year/m².

The above regime for the landscaped area for the site gives the following yearly outdoor water demand:

Irrigated Area (0.3kL/year/m ²)	1500m ²	450kL/year
Bio-retention Area (1kL/year/m ²)	500m ²	500kL/year
TOTAL		950kL/year

7.4.3 Rainwater Tank Sizing

The use of rainwater reduces the mains water demand and the amount of stormwater runoff. By collecting the rainwater run-off from roof areas, rainwater tanks provide a valuable water source suitable for flushing toilets and landscape irrigation.

Rainwater tanks have been designed, using MUSIC software to balance the supply and demand, based on the calculated base water demands and proposed roof catchment areas.

Roof Catchment (m ²)	Tank Size in MUSIC (kL)	Predicted Demand Reduction (%)	Provided Tank (kL)
5,000	100	82.14	120

Table 7.4. Rainwater Reuse Requirements (Southern Catchment)

The MUSIC model, results summarised in **Table 7.4**, predicts that the requirements of Blacktown Council DCP2006 Part R (80% reduction in non-potable water demand) will be met for the development with the provision of a minimum 120kL rainwater tank.

We note that the final configuration and sizing of the rainwater tanks, and those in the northern catchment, is subject to detail design considerations and optimum site utilisation.

7.5 Maintenance And Monitoring

It is important that each component of the water quality treatment train is properly operated and maintained. In order to achieve the design treatment objectives, an indicative maintenance schedule has been prepared (refer to **Table 7.5** below) to assist in the effective operation and maintenance of the various water quality components.

Note that inspection frequency may vary depending on site specific attributes and rainfall patterns in the area. In addition to the below nominated frequency it is recommended that inspections are made following large storm events.

Table 5.5. Indicative Maintenance Schedule

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
SWALES/ LANDSCAPED AREAS			
Check density of vegetation and ensure minimum height of 150mm is maintained. Check for any evidence of weed infestation	Six monthly	Maintenance Contractor	Replant and/or fertilise, weed and water in accordance with landscape consultant specifications
Inspect swale for excessive litter and sediment build up	Six monthly	Maintenance Contractor	Remove sediment and litter and dispose in accordance with local authorities' requirements.
Check for any evidence of channelisation and erosion	Six monthly/ After Major Storm	Maintenance Contractor	Reinstate eroded areas so that original, designed swale profile is maintained
Weed Infestation	Three Monthly	Maintenance Contractor	Remove any weed infestation ensuring all root ball of weed is removed. Replace with vegetation where required.
Inspect swale surface for erosion	Six Monthly	Maintenance Contractor	Replace top soil in eroded area and cover and secure with biodegradable fabric. Cut hole in fabric and revegetate.
BIO-RETENTION BASINS/ BIORETENTION SWALES			
Check all items nominated for SWALES/ LANDSCAPED AREAS above	Refer to SWALES/ LANDSCAPED AREAS section above	Refer to SWALES/ LANDSCAPED AREAS section above	Refer to SWALES/ LANDSCAPED AREAS section above
Check for sediment accumulation at inflow points	Six monthly/ After Major Storm	Maintenance Contractor	Remove sediment and dispose in accordance with local authorities' requirements.
Check for erosion at inlet or other key structures.	Six monthly/ After Major Storm	Maintenance Contractor	Reinstate eroded areas so that original, designed profile is maintained

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
Check for evidence of dumping (litter, building waste or other).	Six monthly	Maintenance Contractor	Remove waste and litter and dispose in accordance with local authorities' requirements.
Check condition of vegetation is satisfactory (density, weeds, watering, replating, mowing/ slashing etc)	Six monthly	Maintenance Contractor	Replant and/or fertilise, weed and water in accordance with landscape consultant specifications
Check for evidence of prolonged ponding, surface clogging or clogging of drainage structures	Six monthly/ After Major Storm 10-15 years	Maintenance Contractor	Remove sediment and dispose in accordance with local authorities' requirements. Replace filter media & planting – refer to appropriately qualified engineer or stormwater specialist
Check stormwater pipes and pits	Six monthly/ After Major Storm	Maintenance Contractor	Refer to INLET/ JUNCTION PIT section below.
OSD BASINS			
Check all items nominated for SWALES/ LANDSCAPED AREAS above	Refer to SWALES/ LANDSCAPED AREAS section above	Refer to SWALES/ LANDSCAPED AREAS section above	Refer to SWALES/ LANDSCAPED AREAS section above
Inspect and remove any blockage from orifice	Six Monthly	Maintenance Contractor/ Owner	Remove grate and screen to inspect orifice.
Inspect trash screen and clean	Six Monthly	Maintenance Contractor/ Owner	Remove grate and screen if required to clean it.
Inspect flap valve and remove any blockage.	Six Monthly	Maintenance Contractor/ Owner	Remove grate. Ensure flap valve moves freely and remove any blockages or debris.

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
Inspect pit sump for damage or blockage.	Six Monthly	Maintenance Contractor/ Owner	Remove grate & screen. Remove sediment/ sludge build up and check orifice and flap valve is clear.
Inspect storage areas and remove debris/ mulch/ litter etc likely to block screens/ grates.	Six Monthly	Maintenance Contractor/ Owner	Remove debris and floatable materials.
Check attachment of orifice plate and screen to wall of pit	Annually	Maintenance Contractor	Remove grate and screen. Ensure plate or screen mounted securely, tighten fixings if required. Seal gaps if required.
Check orifice diameter is correct and retains sharp edge.	Five yearly	Maintenance Contractor	Compare diameter to design (see Work-as-Executed) and ensure edge is not pitted or damaged.
Check screen for corrosion	Annually	Maintenance Contractor	Remove grate and screen and examine for rust or corrosion, especially at corners or welds.
Inspect overflow weir and remove any blockage	Six monthly	Maintenance Contractor/ Owner	Ensure weir is free of blockage.
Inspect walls for cracks or spalling	Annually	Maintenance Contractor	Remove grate to inspect internal walls, repair as necessary.
Check step irons	Annually	Maintenance Contractor	Ensure fixings are secure and irons are free from corrosion.
RAINWATER TANK			
Check for any clogging and blockage of the first flush device	Monthly	Maintenance Contractor	First flush device to be cleaned out
Check for any clogging and blockage of the tank inlet - leaf/litter screen	Six monthly	Maintenance Contractor	Leaves and debris to be removed from the inlet leaf/litter screen

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
Check the level of sediment within the tank	Every two years	Maintenance Contractor	Sediment and debris to be removed from rainwater tank floor if sediment level is greater than the maximum allowable depth as specified by the hydraulic consultant
INLET & JUNCTION PITS			
Inside of pits	Six Monthly	Maintenance Contractor	Remove grate and inspect internal walls and base, repair where required. Remove any collected sediment, debris, litter.
Outside of pits	Four Monthly/ After Major Storm	Maintenance Contractor	Clean grate of collected sediment, debris, litter and vegetation.
STORMWATER SYSTEM			
General Inspection of complete stormwater drainage system	Bi-annually	Maintenance Contractor	Inspect all drainage structures noting any dilapidation in structures and carry out required repairs.

8 EROSION & SEDIMENT CONTROL PLAN

An erosion and sediment control plan (ESCP) is included in drawings **Co12693.00-DA20 and DA25**. These plans show the works can proceed without polluting receiving waters. A detailed plan will be prepared after development consent is granted and before works commence.

8.1 General Conditions

1. The ESCP is to be read in conjunction with the engineering plans, and any other plans or written instructions that may be issued by the site manager, council inspector or other authorised representative in relation to development at the subject site.
2. Contractors will ensure that all soil and water management works are undertaken as instructed in this report and constructed following the guidelines stated in Managing Urban Stormwater, Soils and Construction (1998) and PCC's specifications.
3. All subcontractors will be informed by the site manager of their responsibilities in minimising the potential for sedimentation and soil erosion.

8.2 Land Disturbance

1. Where practicable, the soil erosion hazard on the site will be kept as low as possible and as recommended in Table 8.1

Land Use	Limitation	Comments
Construction areas	Limited to 5 (preferably 2) metres from the edge of any essential construction activity as shown on the engineering plans.	All site workers will clearly recognise these areas that, where appropriate, are identified with barrier fencing (upslope) and sediment fencing (downslope), or similar materials.
Temporary construction access	Limited to a maximum width of 5 metres	The site manager will determine and mark the location of these zones onsite. All site workers will comply with these restrictions.
Remaining lands	Entry prohibited except for essential management works	

Table 8.1 Limitations to access

8.3 Erosion & Sediment Control Conditions

1. Clearly visible barrier fencing shall be installed as shown on drawing **Co12693.00-DA20** and elsewhere at the discretion of the site superintendent to ensure traffic control and prohibit unnecessary site disturbance. Vehicular access to the site shall be limited to only those essential for construction work and they shall enter the site only through the stabilised access points.
2. Soil materials will be replaced in the same order they are removed from the ground. It is particularly important that all subsoils are buried and topsoils (landscaped areas only) remain on the surface at the completion of works.
3. The construction program should be scheduled so that period of time from starting land disturbance to stabilisation is minimised.
4. Notwithstanding this, schedule works so that the duration from the conclusion of land shaping to completion of final stabilisation is less than 20 working days.
5. Land recently established with grass species will be watered regularly until an effective cover has properly established and plants are growing vigorously. Further application of seed might be necessary later in areas of inadequate vegetation establishment.
6. Where practical, foot and vehicular traffic will be kept away from all recently established areas
7. Earth batters shall be constructed in accordance with the Geotechnical Engineers Report or with as law a gradient as practical but not steeper than:
 - 2H:1V where slope length is less than 7 metres
 - 2.5H:1V where slope length is between 7 and 10 metres
 - 3H:1V where slope length is between 10 and 12 metres
 - 4H:1V where slope length is between 12 and 18 metres
 - 5H:1V where slope length is between 18 and 27 metres
 - 6H:1V where slope length is greater than 27 metres
8. All earthworks, including waterways/drains/spillways and their outlets, will be constructed to be stable in at least the design storm event of 1 in 2 year ARI (Q2).
9. During windy weather, large, unprotected areas will be kept moist (not wet) by sprinkling with water to keep dust under control. In the event water is not available in sufficient quantities, soil binders and/or dust retardants will be used or the surface will be left in a cloddy state that resists removal by wind.

8.4 Pollution Control Conditions

1. Stockpiles will not be located within 5 metres of hazard areas, including likely areas of high velocity flows such as waterways, paved areas and driveways.
2. Sediment fences will:
 - a) Be installed where shown on the drawings, and elsewhere at the discretion of the site superintendent to contain the coarser sediment fraction (including aggregated fines) as near as possible to their source.
 - b) Have a catchment area not exceeding 720 square metres, a storage depth (including both settling and settled zones) of at least 0.6 metres, and internal dimensions that provide maximum surface area for settling, and
 - c) Provide a return of 1 metre upslope at intervals along the fence where catchment area exceeds 720 square meters, to limit discharge reaching each section to 10 litres/second in a maximum 20 year t_c discharge.
3. Sediment removed from any trapping device will be disposed of in locations where further erosion and consequent pollution to down slope lands and waterways will not occur.
4. Water will be prevented from directly entering the permanent drainage system unless it is relatively sediment free (i.e. the catchment area has been permanently landscaped and/or likely sediment has been treated in an approved device). Nevertheless, stormwater inlets will be protected.
5. Temporary soil and water management structures will be removed only after the lands they are protecting are fully stabilised.

8.5 Waste Management Conditions

Acceptable bind will be provided for any concrete and mortar slurries, paints, acid washings, lightweight waste materials and litter. Clearance service are to be provided by the respective contractors at least weekly.

8.6 Site Inspection and Maintenance

1. A self-auditing program will be established based on a check sheet (refer **Appendix D**). A site inspection using the check sheet will be made by the site manager:
 - At least weekly;
 - Immediately before site closure; and
 - Immediately following rainfall events in excess of 5mm in any 24 hour period.

The self-audit will include:

- Recording the condition of every sediment control device;
- Recording maintenance requirements (if any) for each sediment control device;
- Recording the volumes of sediment removed from sediment retention systems, where applicable;
- Recording the site where sediment is disposed; and

- Forwarding a signed duplicate of the completed Check Sheet to the project manager/developer for their recording.
2. In addition, the site manager will be required to oversee the installation and maintenance of all soil and water management works on the site. The person shall be required to provide a short monthly written report to the superintendent. The responsible person will ensure that:
 - The plan is being implemented correctly;
 - Repairs are undertaken as required; and
 - Essential modifications are made to the plan if and when necessary.

The report shall include a certificate that works have been carried out in accordance with the plan.

3. Waste bins will be emptied as necessary. Disposal of waste will be in a manner approved by the Site Superintendent.
4. Proper drainage will be maintained. To this end, drains (including inlet and outlet works) will be checked to ensure that they are operating as intended, especially that:
 - No low points exist that can fill and overtop in a large storm event;
 - Areas of erosion are repaired (e.g. lined with a suitable material) and/or velocity of flow is reduced appropriately through construction of small check dams and installing additional diversion upslope; and
 - Blockages are cleared (these might occur because of sediment pollution, sand/soil/spoil being deposited in or too close to them, breached by vehicle wheels, etc.).
5. Sand/soil/spoil materials placed closer than 2 metres from hazard areas will be removed. Such hazard areas include areas of high velocity water flows (e.g. waterways and gutters), paved areas and driveways.
6. Recently stabilised lands will be checked to ensure that erosion hazard has been effectively reduced. Any repairs will be initiated as appropriate.
7. Excessive vegetation growth will be controlled through mowing or slashing.
8. All sediment detention systems will be kept in good working condition. In particular, attention will be given to:
 - a) Recent works to ensure they have not resulted in diversion of sediment laden water away from them;
 - b) Degradable products to ensure they are replaced as required; and
 - c) Sediment removal, to ensure the design capacity remains in the settling zone.
9. Any pollutants removed from sediment basins or litter traps will be disposed of in areas where further pollution to down slope lands and waterways should not occur.
10. Additional erosion and/or sediment control works will be constructed as necessary to ensure the desired protection is given to down slope lands and waterways, i.e.

make ongoing changes to the plan where it proves inadequate in practice or is subjected to changes in conditions at the work site or elsewhere in the catchment.

11. Erosion and sediment control measures will be maintained in a functioning condition until all earthwork activities are completed and the site fully stabilised.
12. Litter, debris and sediment will be removed from the gross pollutant traps and trash racks as required.

9 CONCLUSION

This Civil Engineering Details Report has been prepared to support an adjustment to the Stormwater Management Strategy for the Eastern Creek Business Hub, approved under SSD 5175-2012, at Rooty Hill Road South, Eastern Creek. The adjustment to the Stormwater Management Strategy will include for the provision of an estate level detention basin and bio-retention, water quality, system which will service the northern catchment and road network.

A civil engineering strategy for the site has been developed, incorporating the SSD 5175 approved strategy and the proposed adjustment to the strategy, which provides a best practice solution within the constraints of the existing landform and proposed development layout. Within this design a stormwater quantity and quality management strategy has been developed to reduce both peak flows and pollutant loads in stormwater leaving this site. The stormwater management for the development has been designed in accordance with Blacktown City Council's Part R of DCP2006.

The hydrological assessment proves local post development flows from the site will be less than pre-development flows and demonstrates that the site discharge would not adversely affect any land, drainage system or watercourse as a result of the development.

During the construction phase, a Sediment and Erosion Control Plan will be in place to ensure the downstream drainage system and receiving waters are protected from sediment laden runoff.

During the operational phase of the development, a treatment train incorporating the use of the proprietary pre-treatment and tertiary bio-retention treatment is proposed to mitigate any increase in stormwater pollutant load generated by the development. MUSIC modelling results indicate that the proposed STM are effective in reducing pollutant loads in stormwater discharging from the site and meet the requirements of Council's pollution reduction targets. Best management practices have been applied to the development to ensure that the quality of stormwater runoff is not detrimental to the receiving environment.

It is recommended the management strategies in this report be approved and incorporated into the future detailed design.

10 REFERENCES

- Managing Urban Stormwater: Harvesting and Reuse – 2006 (NSW DEC);
- Managing Urban Stormwater: Source Control – 1998 (NSW EPA);
- Managing Urban Stormwater: Treatment Techniques – 1997 (NSW EPA);
- Managing Urban Stormwater: Soils & Construction – 2004(LANDCOM);
- Blacktown City Council – DCP 2006 Part R; and
- Water Sensitive Urban Design – “Technical Guidelines for Western Sydney” by URS Australia Pty Ltd, May 2004

Appendix A

DRAWINGS BY COSTIN ROE CONSULTING

EASTERN CREEK BUSINESS HUB

WESTERN SYDNEY PARKLANDS

CIVIL WORKS PACKAGE



DRAWING LIST

DRAWING NO.	DRAWING TITLE
CO12564.01-DA10	DRAWING LIST & GENERAL NOTES
CO12564.01-DA15	OVERALL SITE PLAN
CO12564.01-DA20	SEDIMENT AND EROSION CONTROL PLAN
CO12564.01-DA25	SEDIMENT AND EROSION CONTROL DETAILS
CO12564.01-DA30	BULK EARTHWORKS PLAN
CO12564.01-DA31	RETAINING WALL PLAN
CO12564.01-DA32	RETAINING WALL DETAILS
CO12564.01-DA35	BULK EARTHWORKS SECTIONS - SHEET 1
CO12564.01-DA40	STORMWATER DRAINAGE PLAN
CO12564.01-DA41	STORMWATER CATCHMENT PLAN
CO12564.01-DA42	STORMWATER DRAINAGE LONGSECTIONS - SHEET 1
CO12564.01-DA45	STORMWATER DRAINAGE DETAILS - SHEET 1
CO12564.01-DA46	STORMWATER DRAINAGE DETAILS - SHEET 2
CO12564.01-DA50	ROAD 1 - FINISHED LEVELS PLAN
CO12564.01-DA51	ROAD 1 - LONGITUDINAL SECTION
CO12564.01-DA55	ROAD 1 - TYPICAL CROSS SECTIONS

GENERAL NOTES:

- THESE DRAWINGS SHALL BE READ IN CONJUNCTION WITH ALL ARCHITECTURAL AND OTHER CONSULTANTS' DRAWINGS AND SPECIFICATIONS AND WITH SUCH OTHER WRITTEN INSTRUCTIONS AS MAY BE ISSUED DURING THE COURSE OF THE CONTRACT. ANY DISCREPANCY SHALL BE REFERRED TO THE ENGINEER BEFORE PROCEEDING WITH THE WORK.
- ALL MATERIALS AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH THE RELEVANT AND CURRENT STANDARDS AUSTRALIA CODES AND WITH THE BY-LAWS AND ORDINANCES OF THE RELEVANT BUILDING AUTHORITIES EXCEPT WHERE VARIED BY THE PROJECT SPECIFICATION.
- ALL DIMENSIONS SHOWN SHALL BE VERIFIED BY THE BUILDER ON SITE. ENGINEER'S DRAWINGS SHALL NOT BE SCALED FOR DIMENSIONS. ENGINEER'S DRAWINGS ISSUED IN ANY ELECTRONIC FORMAT MUST NOT BE USED FOR DIMENSIONAL SETOUT. REFER TO THE ARCHITECT'S DRAWINGS FOR ALL DIMENSIONAL SETOUT INFORMATION.
- DURING CONSTRUCTION THE STRUCTURE SHALL BE MAINTAINED IN A STABLE CONDITION AND NO PART SHALL BE OVERSTRESSED. TEMPORARY BRACING SHALL BE PROVIDED BY THE BUILDER TO KEEP THE WORKS AND EXCAVATIONS STABLE AT ALL TIMES.
- UNLESS NOTED OTHERWISE ALL LEVELS ARE IN METRES AND ALL DIMENSIONS ARE IN MILLIMETRES.
- ALL WORKS SHALL BE UNDERTAKEN IN ACCORDANCE WITH ACCEPTABLE SAFETY STANDARDS & APPROPRIATE SAFETY SIGNS SHALL BE INSTALLED AT ALL TIMES DURING THE PROGRESS OF THE JOB.

ELECTRONIC INFORMATION NOTES:

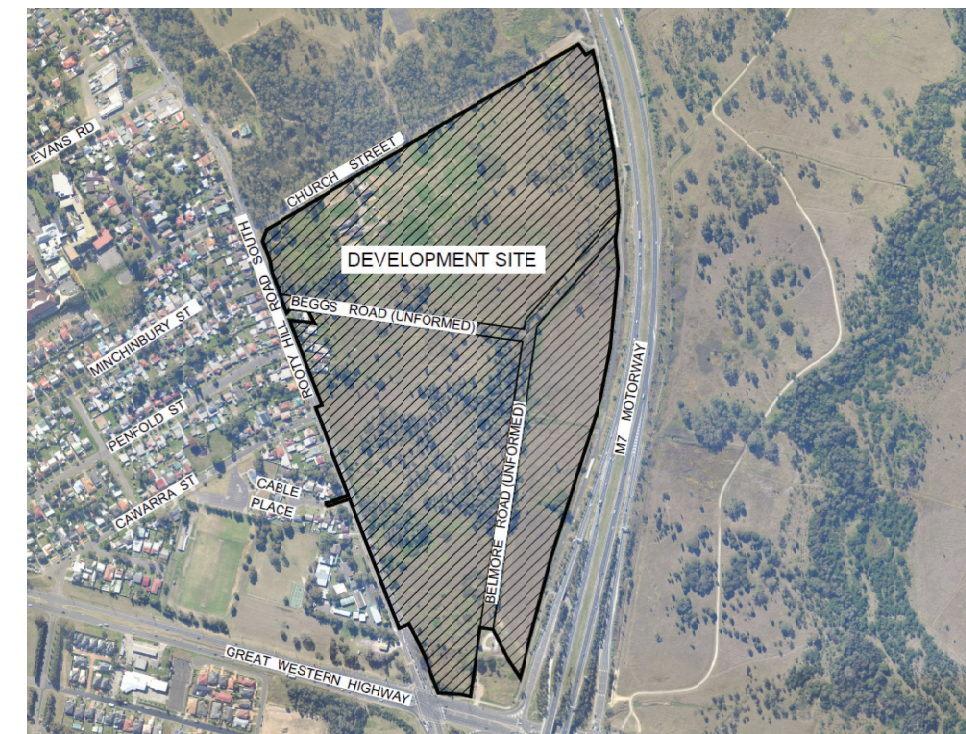
- THE ISSUED DRAWINGS IN HARD COPY OR PDF FORMAT TAKE PRECEDENCE OVER ANY ELECTRONICALLY ISSUED INFORMATION, LAYOUTS OR DESIGN MODELS.
- THE CONTRACTOR'S DIRECT AMENDMENT OR MANIPULATION OF THE DATA OR INFORMATION THAT MIGHT BE CONTAINED WITHIN AN ENGINEER-SUPPLIED DIGITAL TERRAIN MODEL AND ITS SUBSEQUENT USE TO UNDERTAKE THE WORKS WILL BE SOLELY AT THE DISCRETION OF AND THE RISK OF THE CONTRACTOR.
- THE CONTRACTOR IS REQUIRED TO HIGHLIGHT ANY DISCREPANCIES BETWEEN THE DIGITAL TERRAIN MODEL AND INFORMATION PROVIDED IN THE CONTRACT AND/OR DRAWINGS AND IS REQUIRED TO SEEK CLARIFICATION FROM THE SUPERINTENDENT.
- THE ENGINEER WILL NOT BE LIABLE OR RESPONSIBLE FOR THE POSSIBLE ON-GOING NEED TO UPDATE THE DIGITAL TERRAIN MODEL, SHOULD THERE BE ANY AMENDMENTS OR CHANGES TO THE DRAWINGS OR CONTRACT INITIATED BY THE CONTRACTOR.

FINISHED LEVELS PLAN NOTES:

- LEVELS DATUM IS A.H.D.
- ALL CONTOUR LINES & SPOT LEVELS INDICATE FINISHED PAVEMENT LEVELS UNLESS OTHERWISE NOTED.
- THE MAJOR CONTOUR INTERVAL IS 0.5m
- THE MINOR CONTOUR INTERVAL IS 0.1m
- MINIMUM PAVEMENT GRADE IS TO BE 1:100 (1%) UNLESS OTHERWISE NOTED.
- MAXIMUM PAVEMENT GRADE IS TO BE 1:20 (5%) IN CARPARKING AREAS AND 1:25 (4%) ELSEWHERE.
- MAXIMUM RAMP GRADES ARE TO BE 1:12 (8.3%) UNLESS OTHERWISE NOTED.
- PROVIDE MINIMUM 3.0m LONG TRANSITION WHERE CHANGES GRADE EXCEED 1:20 (5%).
- PERMANENT BATTER SLOPES ARE TO HAVE A MAXIMUM GRADE OF 1V:3H.
- ALL BATTER SLOPE WITH GRADES AT OR EXCEEDING 1V:4H ARE TO BE TURFED IMMEDIATELY OR APPROPRIATE EROSION CONTROL IS TO BE PROVIDED TO THE SATISFACTION OF THE ENGINEER.
- ALL FOOTPATHS ARE TO FALL AWAY FROM THE BUILDING AT 2.5% NOMINAL GRADE.
- ALL PAVEMENTS ARE TO BE SET AT 50mm BELOW THE FINISHED FLOOR LEVEL OF THE WAREHOUSE AND OFFICE AREAS IF NO AWNING OR CANOPY ARE PRESENT.

STORMWATER DRAINAGE NOTES:

- ALL STORMWATER WORKS TO BE COMPLETED IN ACCORDANCE WITH AUSTRALIAN STANDARD AS3500.3.020 PLUMBING AND DRAINAGE, PART 3: STORMWATER DRAINAGE.
- ALL STORMWATER WORKS / DETAILS SHALL BE IN ACCORDANCE WITH BLACKTOWN CITY COUNCIL ENGINEERING GUIDE FOR DEVELOPMENT (2005), BLACKTOWN CITY COUNCIL WORKS SPECIFICATION CIVIL (2005) AND BLACKTOWN CITY COUNCIL STANDARD DRAWINGS.
- THE MINOR (IPPEI) SYSTEM HAS BEEN DESIGNED FOR THE 1 IN 20 YEAR ARI STORM EVENT AND THE MAJOR (OVERLAND) SYSTEM HAS BEEN DESIGNED FOR THE 1 IN 100 YEAR ARI STORM EVENT.
- ALL FINISHED PAVEMENT LEVELS SHALL BE AS INDICATED ON FINISHED LEVELS PLANS C50.
- PIT SIZES SHALL BE AS INDICATED IN THE SCHEDULE WHILE PIPE SIZES AND DETAILS ARE PROVIDED ON PLAN.
- EXISTING STORMWATER PIT LOCATIONS AND INVERT LEVELS TO BE CONFIRMED BY SURVEY PRIOR TO COMMENCING WORKS ON SITE.
- ALL STORMWATER PIPES #375 OR GREATER SHALL BE CLASS 2 REINFORCED CONCRETE WITH RUBBER RING JOINTS UNLESS NOTED OTHERWISE.
- ALL PIPES UP TO AND INCLUDING #300 TO BE uPVC GRADE SNI UNLESS OTHERWISE NOTED.
- PIPE CLASSES NOMINATED ARE FOR IN-SERVICE LOADING CONDITIONS ONLY. CONTRACTOR IS TO MAKE ANY NECESSARY ADJUSTMENTS REQUIRED FOR CONSTRUCTION CONDITIONS.
- ALL CONCRETE PITS GREATER THAN 1000mm DEEP SHALL BE REINFORCED USING N12-200 EACH WAY CENTERED IN WALL AND BASE. LAP MINIMUM 300mm WHERE REQUIRED. ALL CONCRETE FOR PITS SHALL BE F: 25 MPa. PRECAST PITS MAY BE USED WITH THE APPROVAL OF THE ENGINEER.
- IN ADDITION TO ITEM 6 ABOVE, ALL CONCRETE PITS GREATER THAN 3000mm DEEP SHALL HAVE WALLS AND BASE THICKNESS INCREASED TO 200mm.
- PIPES SHALL BE LAID AS PER PIPE LAYING DETAILS. PARTICULAR CARE SHALL BE TAKEN TO ENSURE THAT THE PIPE IS FULLY AND EVENLY SUPPORTED. RAM AND PACK FILLING AROUND AND UNDER BACK OF PIPES AND PIPE FAUCETS, WITH NARROW EDGED RAMMERS OR OTHER SUITABLE TAMPING DETAILS.
- WHERE PIPE LINES ENTER PITS, PROVIDE 2m LENGTH OF STOCKING WRAPPED SLOTTED #100 uPVC TO EACH SIDE OF PIPE.
- ALL SUBSOIL DRAINAGE LINES SHALL BE #100 SLOTTED uPVC WITH APPROVED FILTER WRAP LAID IN 300mm WIDE GRANULAR FILTER UNLESS NOTED OTHERWISE. LAY SUBSOIL LINES TO MATCH FALLS OF LAND AND/OR 1 IN 200 MINIMUM. PROVIDE CAPPED CLEANING EYE RODDING POINTS AT UPSTREAM END OF LINE AND AT 30m MAX. CTS. PROVIDE SUBSOIL LINES TO ALL PAVEMENT / LANDSCAPED INTERFACES, TO REAR OF RETAINING WALLS (AS NOMINATED BY STRUCTURAL ENGINEER) AND AS SHOWN ON PLAN.
- WHERE SUBSOIL DRAINAGE LINES PASS UNDER PAVEMENTS, UNSLOTTED uPVC PIPE IS TO BE USED.
- ALL PIPE GRADES 1 IN 100 MINIMUM UNLESS OTHERWISE NOTED.
- PROVIDE 5 STEP IRONS IN PITS DEEPER THAN 1000mm.
- MIN. 400 COVER TO PIPE OBVERT BENEATH ROADS & MIN. 400 COVER BENEATH LANDSCAPED AND PEDESTRIAN AREAS.
- PIT COVERS IN TRAFFICABLE PAVEMENT SHALL BE CLASS 2 'HEAVY DUTY'. THOSE LOCATED IN NON-TRAFFICABLE AREAS SHALL BE CLASS B 'MEDIUM DUTY' UNLESS OTHERWISE NOTED.
- PROVIDE CLEANING EYES (RODDING POINTS) TO PIPES AT ALL CORNERS AND T-JUNCTIONS WHERE NO PITS ARE PRESENT.
- DOWN PIPES (DPI) TO BE AS PER HYDRAULIC ENGINEERS DETAILS WITH CONNECTOR TO MATCH DP SIZE UNLESS OTHERWISE NOTED. PROVIDE CLEANING EYE AT GROUND LEVEL.
- PIPE LENGTHS NOMINATED ON PLAN OR LONGSECTIONS ARE MEASURED FROM CENTER OF PITS TO THE NEAREST 0.5m AND DO NOT REPRESENT ACTUAL LENGTH. THE CONTRACTOR IS TO ALLOW FOR THIS.



FOR SECTION 96

DRAWING LIST REVISED FOR DA31 & DA32 ISSUED FOR SECTION 96 FOR INFORMATION ONLY		04.08.15 21.07.15 30.03.15	C B A	AMENDMENTS	DATE	ISSUE	AMENDMENTS	DATE	ISSUE	ARCHITECT	CLIENT Western Sydney Parklands Trust WESTERN SYDNEY PARKLANDS TRUST LEVEL 1, 10 VALENTE AVE PARRAMATTA NSW 2150	PROJECT EASTERN CREEK BUSINESS HUB WESTERN SYDNEY PARKLANDS	DESIGNED M.W.	DRAWN X.C.	DATE MAR 2015	CHECKED	SCALE AS SHOWN	CAD REF: 12693.00-DA10	Costin Roe Consulting Pty Ltd. Consulting Engineers Level 1, 8 Windmill Street Wahsh Bay, Sydney NSW 2000 Tel: (02) 9551-7899 Fax: (02) 9544-3721 email: mail@costinroe.com.au	CostinRoe Consulting	DRAWING TITLE DRAWING LIST & GENERAL NOTES	DRAWING No CO12693.00-DA10	ISSUE C
---	--	----------------------------------	-------------	------------	------	-------	------------	------	-------	-----------	--	---	------------------	---------------	------------------	---------	-------------------	---------------------------	---	----------------------	---	-------------------------------	------------

Value in Engineering and Management