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CIVIL ENGINEERING REPORT FOR STATE SIGNIFICANT DEVELOPMENT APPLICATION SSD 7155 MOD 7

BUILDINGS 1A & 1B

PRESTONS INDUSTRIAL ESTATE
LOT 33 DP408207
YARRUNGA STREET
PRESTONS NSW

Prepared For:
Logos Property
Level 29
Aurora Place
88 Phillip Street
SYDNEY NSW 2000

Prepared by:
Costin Roe Consulting
Level 1, 8 Windmill Street
WALSH BAY NSW 2000

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	Name	**Signature**
Prepared by	Thilini Wagasooriya	
Checked by	Mark Wilson	
Issued by	Thilini Wagasooriya	
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1 INTRODUCTION

1.1 Introduction

Logos Property proposes to develop Lot 35 in DP2359 located in an industrial property on the southern side of Yarrunga Street to the west of Bernera Road in the suburb of Prestons, NSW.

Previous applications for development have been granted over part of the land under NSW Department of Planning and the Environment (DP&E) under SSD 7155 dated 16 February 2016, and construction of two of the buildings (Building 2 & 5) approved under the original application have been completed. A facility for Volvo is near completion, per Mod 3 dated 13 February 2018 included an amended masterplan layout to Building 1B (formerly referred to as Building 1 in the original application) and for a proposed workshop facility for Volvo (Building 1A).

The current Mod 7 modification application is provided to allows for changes to the Masterplan layout in relation to Building 1B for the proposed tenant (Intertrading) and a speculative tenant on the land.

1.2 Scope

Costin Roe Consulting Pty Ltd has been commissioned by Logos Property to prepare this *Engineering Report* in support of the proposed *SSD 7155 Mod 7* to be lodged over the site.

This report provides a 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 and the Stormwater Management Strategy for the Preston Industrial Estate approved under the original SSD 7155 application and subsequent modifications, specifically Mod3.

A set of drawings have been prepared to show the civil elements of a proposed industrial development, modifications to Building 1B and to incorporate as constructed elements relating to the works completed on Buildings 2 and 5, and the Volvo facility. The drawings include proposed finished levels, retaining walls, stormwater drainage layout and water quantity and quality requirements for the development relating to Building 1A. These drawings are for development approval only and subject to change during detail design.

1.3 Authority Jurisdiction

The consent authority is The NSW Department of Planning & Environment as the development is considered a State Significant Development (SSD). However, as the subject site is located within Liverpool City Council (LCC) local government area, the engineering and policy requirements of LCC have also been considered in the design.

The NSW Department of Planning & Environment has provided Secretary's Environmental Assessment Requirements (SEAR's) dated 11 September 2015, Ref: SSD7155. In addition to providing a general summary of civil engineering aspects of the project, this report addresses the Soil and Water components of the SEAR's including flooding impacts, surface water management, on-site detention and treatment, details of erosion and sediment control, details of proposed cut and fill works and measures to minimise the extent of cut to fill and details of any fill to be imported to site.

1.4 Differences Between the Mod 7 Current Application and SSD 7155

This application is for an amendment to SSD 7155 to suit layout changes to the Masterplan approved in the original application dated 16 February 2016, and subsequent Mod3 dated 13 February 2018. The main component of the amendment is for an adjustment to the previously approved lot and building layout for Building 1A/1B. Some minor amendments to other components of the design will be apparent due to this change. 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 SSD7155 and SSD7155 Mod 3 development.

Summary of design elements is as follows:

- Development Layout
  The development layout differs from the previously approved development application in that the building layout for Building 1A/B has been adjusted to suit the proposed tenant (Intertrading) and a speculative tenant.
- Stormwater Management
  The Stormwater Management strategy will remain generally consistent with the previously approved development application in terms of providing water quantity management to maintain pre- and post-development flow rates, and water quality management measures which meet councils load based pollution reduction values.
  On-site detention tanks will be provided for each development lot however the system locations and volumes have been adjusted from the previous application as discussed in subsequent sections of this report.
  Stormwater quality management was previously proposed to be met by the use of a treatment train consisting of a Humegard & Humeceptor in series. Since the original development approval, the substitution of the originally approved treatment train was made with an equivalent system offered by SPEL in their Stormceptor and SPEL Ecoceptor. Thus, was discussed and agreed with Liverpool City Council as part of the formal approval of the drainage system as required of the consent under *Condition C14*. Please refer to **Appendix H** for the council approval relating to the water quality devices.

- Flooding

  Previous applications were affected by flooding and overland flow from upstream residential catchments to the south and south-east of the estate. Management of these upstream flows required a trunk drainage system and overland flow path between Kurrajong Road and Bernera Road. This system has now been constructed and no modifications are required as part of this application.

  Additional flood consideration on the north-west corner of the property, in and around the intersection of Kookaburra Road North, and Yarrunga Street have been addressed in the Mod3 application documents and are associated with the near complete construction of the Volvo facility. The overland flow at the intersection of Kookaburra Road North, and Yarrunga Street is related to flow from Cabramatta Creek and a minor overland flow path and twin 600mm culverts located on the north-west corner of the site.

  The current Mod 7 building layout is clear of any overland flow paths or affectation from flooding, and the requirements for management of overland flow and flooding on affected parts of the property have been addressed in previous applications. As such no provisions or requirements for flooding or overland flow management are included in the Mod 7 application.

- Roadworks

  No works to external roads are required as part of the current Mod 7 application.
  It is noted that upgrades to Yarrunga Street and Bernera Road were included in previous applications and approvals. These works included half road construction along the site frontages, and additional pavements on the northern side of Yarrunga Street. Upgrades to the Bernera Road and Yarrunga Street intersection and design responsibility for the intersection is now being taken on board by Liverpool City Council.
  It is noted that a new entry is proposed to be accessed from Walbunga Street which is located on the southern boundary of the development site. The Walbunga Street construction is now complete and has been approved by Liverpool City Council. We understand the road reserve has also been dedicated to Council and paperwork relating to this is currently being finalised with the Land Titles Office.

2 SITE CHARACTERISTICS

2.1 Site Description

The site areas for the development is approximately 5.6 Ha. The proposed site is rectangular in shape and is zoned to General Industrial land under the Liverpool City Council LEP as shown in **Figure 2.1.**

The site is bounded on the north by Yarrunga Street, on the east by constructed Warehouse 2, on the south by Walbunga Street, currently under construction industrial land and the proposed Toll Expansion facility (refer Mod 6 documentation). To the west of the development is the Volvo facility (approved under Mod 3). The adjacent Buildings 2, 3 and 5, to the east and south east of the site, have now been constructed as per the approval by NSW Department of Planning and the Environment (DP&E) under SSD 7155 dated 16 February 2016.

Figure 2.1 Locality Plan (Source: Nearmap 17 July 2018)

Infrastructure works including bulk earthworks and stormwater management measures have been completed on part of the land as part of the construction works for Lots 34 and 43 in DP2359.

Access to the site is currently available off Yarrunga Street, approximately 400m from the intersection with Bernera Road.

The site is located within the bounds of Liverpool City Council (LCC), therefore the engineering requirements of the LCC apply.

Reference to **Appendix E** should be made for details of the Walbunga Street design.

2.2 Proposed Development

The proposed development on Lot 35 in DP2359 is for a single level warehouse with two tenancies. Office space is provided on the south-east and south-west corners of the building. Dock faces, and truck loading areas are located on the south of the facility with parking provided on the east and western edges of the site. Perimeter access is available for fire brigade and vehicle circulation.

An indicative layout of the development has been produced by Axis Architecture and can be seen in **Figure 2.2** below.

No external road works are required or proposed for the building as Part of Mod 7. It is noted that upgrades to Yarrunga Street and Bernera Road were included in previous applications and approvals. These works included half road construction along the site frontages, and additional pavements on the northern side of Yarrunga Street. Upgrades to the Bernera Road and Yarrunga Street intersection and design responsibility for the intersection is now being taken on board by Liverpool City Council.

Primary vehicle access will be made via existing internal access Road 1, and Yarrunga Street. It is noted that a new entry is proposed to be accessed from Walbunga Street which is located on the southern boundary of the development site. The Walbunga Street construction is now complete and has been approved by Liverpool City Council. We understand the road reserve has also been dedicated to Council and paperwork relating to this is currently being finalised with the Land Titles Office.

The proposed building is to be set at RL 42.7m (+/-500mm). The variance in the final level has been provided to ensure that, following a detail earthworks assessment, excess cut or spoil is not required to be exported from the site. The final level of the building will be subject to detail design confirmation.

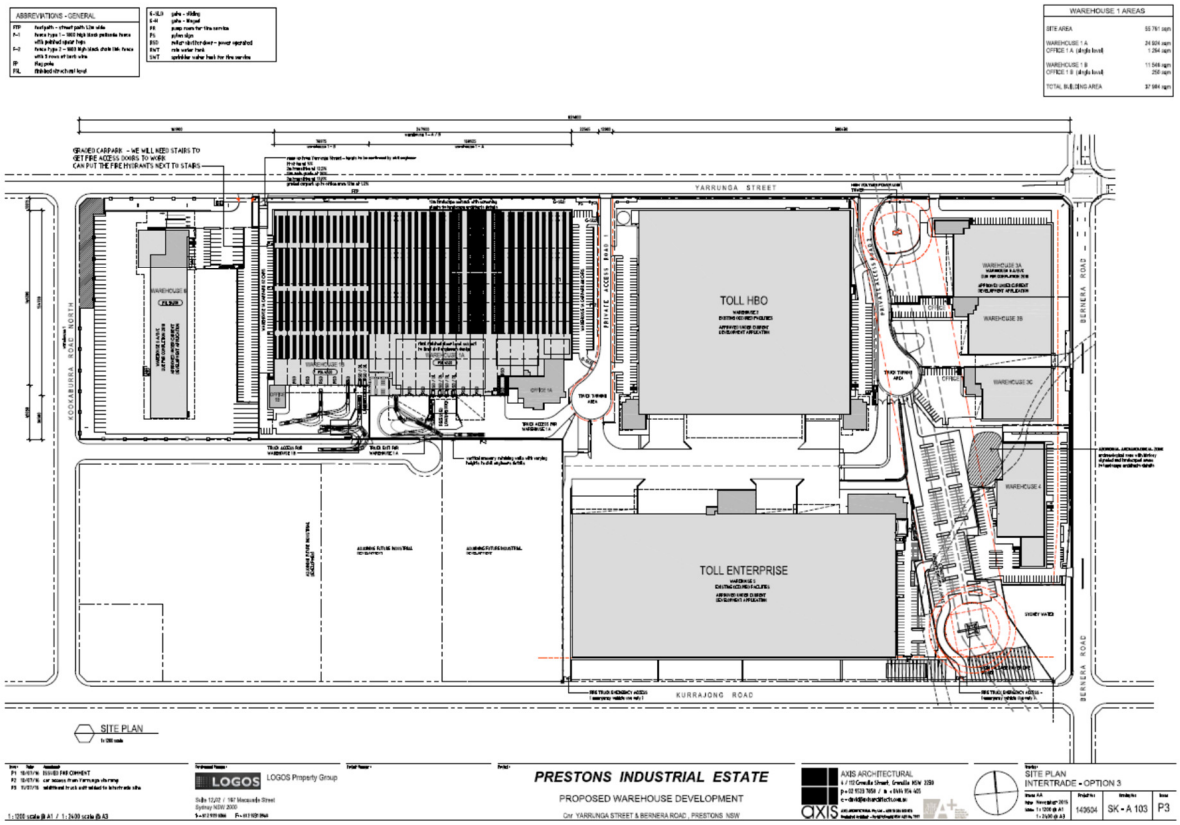

Figure 2.2. Development Layout

The development will include the following engineering components:

- Stormwater drainage system based on a major/ minor design philosophy;
- Management of stormwater quality using a treatment train approach to pollutant loads on a developed catchment in accordance with councils load based pollutant reduction percentages; and
- Management of stormwater quantity by reducing post developed flow to pre-developed over the range of storms between the 1 in 2-year Average Recurrence Interval (ARI) to the 1 in 100-year ARI as per council policy.

3 SITE WORKS

3.1 Bulk Earthworks

Bulk earthworks have been performed over the estate as per the original approval documentation. These works included part of the proposed Building 1B site, whose current level was benched during the construction of the warehouse and distribution facilities for Toll on Lots 34 and 43 of DP2359. Currently a large flat building pad has been benched as part of the above-mentioned earthworks.

Bulk earthworks will be required for Building 1A and additional earthworks will be required for Building 1B to accommodate a cut to fill balance of earthworks for the entire development.

The objective for the site will be to provide large flat building pads, facilitate site access, to drain the stormwater system via gravity, keep building levels above the 1 in 100-year ARI flood level (with appropriate freeboards) and to perform a cut to fill balance of earthworks.

All geotechnical testing and inspections performed during the earthworks operations will be undertaken to Level 1 geotechnical control, in accordance with AS 3798-1996.

High level earthworks and volume estimates have 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. These have been shown on drawing **Co8753.21-C30**, **C35** and **C36** of **Appendix A**. It is noted that the final pad, and hence building level, will be subject to a detail earthworks assessment during detail design stage and variance of +/-500mm has been noted to the pad and building floor level. The variance in the final level has been provided to ensure that, following the detail earthworks assessment, excess cut or spoil is not required to be exported from the site.

The earthworks volume estimates are as follows:

Cut	- 2,500 m^3
Fill	+ 17,700 m^3
Detailed Excavation	- 4,200 m^3
Cut Bulking	- 100 m^3
Import from adjacent site	- 11,000 m^3
Balance	**- 100 m^3** *(Approx. cut and fill achieved)*

The existing surface levels and the proposed levels are as shown on drawing **Co8753.21-C50** of **Appendix A**.

3.2 Erosion and Sediment Control

Soil Erosion and Sediment Control measures including sedimentation basins will also be provided for the development during the construction phase. All Soil and Sediment Control measures will be performed in accordance with Liverpool City Council

requirements and Landcom Managing Urban Stormwater, Soils and Construction (1998) – The Blue Book.

Earthworks over the site will be relatively small when compared to large scale development or mining activity. The effect on groundwater is expected to be minor as a result of these works.

3.3 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 7.

3.4 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.

3.5 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 have been constructed as part of the estate infrastructure works approved under SSD7155. Numerous retaining walls are proposed for Buildings 1A and 1B however these remain generally consistent with the layout and heights proposed and approved under Mod 3.

Retaining will be required around the north-west corner of the building, for a portion along the southern boundary and along the eastern carpark, adjacent to the access road and Walbunga Street. These walls are currently partially constructed.

The proposed method of construction will be reinforced concrete masonry, masonry faced reinforced earth retaining, pile and shot-crete, or other concrete or masonry type construction.

Location and indicative heights of retaining walls are shown on drawing **Co8753.21-C50**.

4 STORMWATER MANAGEMENT

4.1 Hydrologic Modelling and Analysis

4.1.1 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, Liverpool 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.

4.1.2 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.

4.1.3 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 The Bureau of Meteorology Online IFD Tool.

4.1.4 Runoff Models

In accordance with the recommendations and standards of Liverpool 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 council 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

4.2 Hydraulics

4.2.1 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.

4.2.2 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.

4.2.3 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.

4.2.4 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).

4.2.5 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 detention systems prior to discharge

4.3 Site Drainage

4.3.1 Existing Site Drainage

Drainage infrastructure, including lot connections, trunk drainage and overland flow paths, and detailed building systems have been approved and constructed in association with Building 2, 5 and 7 construction works. Flows are conveyed through the property to Yarrunga Street where street drainage, as approved by Liverpool Council will convey site runoff to the west, to a twin 600mm diameter culvert under Yarrunga Street to final discharge into Cabramatta Creek.

4.3.2 Proposed Site Drainage

Detailed stormwater systems will be required to be constructed for the development.

As per general engineering practice and the guidelines of LCC, the proposed stormwater drainage system for the development will comprise a minor and major system to safely and efficiently convey collected stormwater run-off from the development to the legal point of discharge.

The minor system is to consist of a piped drainage system which has been designed to accommodate the 1 in 20-year ARI storm event (Q20). This results in the piped system being able to convey all stormwater runoff up to and including the Q20 event. This meets the requirements of LCC and is the minimum recommended capacity for an industrial development.

The major system will be designed to cater for storms up to and including the 1 in 100-year ARI storm event (Q100). The major system will employ the use of defined overland flow paths, such as roads and open channels, to safely convey excess run-off from the site.

The design of the stormwater system for this site will be based on relevant national design guidelines, Australian Standard Codes of Practice, the standards of LCC 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" (1988 Edition), Volumes 1 and 2 (AR&R).

Stormwater Management is required to be provided for water quantity and quality in accordance with the requirements of LCC DCP and as per the items included in Liverpool City Council pre-development application minutes dated 30 October 2014 and further meeting with Liverpool City Council held between Liverpool Council, DBL Property and Costin Roe Consulting on 15 October 2015.

Further discussion on the Stormwater Management Strategy is provided in **Section 5** and **6** of this report. Reference to drawing **Co8753.21-C40** shows the proposed drainage layout.

4.3.3 Site Discharge

Discharge from the site is proposed at two locations on the north and north-west of the property. These points correspond to the location and catchment breakdown as approved in the original SSD7155 approval documentation.

The first discharge point conveys flows for a catchment of 2.465Ha from part of site 1B, through a stub provided as part of the infrastructure works, off Yarrunga Street. The stub is located along the northern boundary of the site.

The second discharge point will be connecting into proposed road drainage infrastructure and are located at the north- west corner of the site A catchment of 2.780Ha will be directed to Discharge Point 2.

Reference to drawing **Co8753.21-C40** shows the proposed discharge points.

4.4 Flooding

The current Mod 7 building layout is clear of any overland flow paths or affectation from flooding. Requirements for management of overland flow and flooding on affected parts of the property have been addressed in previous applications. As such no provisions or requirements for flooding or overland flow management are included in the Mod 7 application.

As noted areas of the overall Prestons Industrial Estate have been identified as being affected by overland flow and flooding from two primary areas. The first of these is located on the south and south-east of the estate generated from an upstream residential catchment south of Kurrajong Road. The second being on the far north-west of the estate at the intersection of Kookaburra Road North, and Yarrunga Street.

Management of the flow from the residential catchment required a reinforced concrete box culvert trunk drainage system and overland flow path between Kurrajong Road and Bernera Road. This system has now been constructed and no modifications are required as part of this application.

Additional flood consideration on the north-west corner of the property, in and around the intersection of Kookaburra Road North, and Yarrunga Street have been addressed in the Mod3 application documents and are associated with the near complete construction

of the Volvo facility. The overland flow at the intersection of Kookaburra Road North, and Yarrunga Street is related to flooding from Cabramatta Creek and a minor overland flow path and twin 600mm culverts located on the north-west corner of the site. No modifications to the approved management are proposed or required as part of this application.

5 WATER QUANTITY MANAGEMENT

Liverpool 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 development is proposed to be managed via a detention tanks provided in strategic locations for each of the development lots. As discussed with Liverpool Council the objective is to attenuate stormwater flow from the development to pre-developed flows.

Sizing of the basin systems has been completed using DRAINS modelling software in accordance with the Liverpool City Council Policy for the 1 in 2-year ARI to 1 in 100-year ARI storms for various durations. The modelling accounts for the drainage system provided for the adjacent sites.

Table 5.1 provides details for the pre-and post-development flows and storage for the total detention system. The critical storm duration for the 1in 2 year, 1in 20 year and 1 in 100-year ARI storms is 1 hour and flows and storage information are provided for this storm.

ARI	**Pre-developed Flow (m^3/s)**	**Post Developed Flow (m^3/s)**	
		Un-attenuated	**Attenuated**
2	1.079	1.381	0.818
20	1.955	2.249	1.331
100	2.411	2.69	2.400

Table 5.1. Site and Detention Hydrology

Indicative locations of the two (2) detention systems can be found on drawing **Co8753.21-C40**. These have been shown as detention tanks on the planning application drawings. The final arrangement of tanks would be confirmed in detail design stage, ensuring the flow arrangements of **Table 5.1** are achieved. Indicative hydrological and storage arrangements are shown below.

ARI	Post Developed Flow (m^3/s)				Storage (m^3)
	Un-attenuated	Attenuated			
		Low Flow	High Flow	Total	
2	0.652	0.422	0	0.422	240
20	1.180	0.604	0.100	0.704	430
100	1.460	0.628	0.606	1.234	460

Table 5.2. Detention Tank 1

ARI	Post Developed Flow (m^3/s)				Storage (m^3)
	Un-attenuated	Attenuated			
		Low Flow	High Flow	Total	
2	0.427	0.307	0	0.307	210
20	0.774	0.437	0.064	0.501	380
100	0.956	0.455	0.487	0.942	410

Table 5.3. Detention Tank 2

The modelling has shown that, with the provision of a total storage volume of $875m^3$ contained in the two modelled systems, stormwater flows from the development will be attenuated to predevelopment flows. Detention storage will be fully active and will be provided as underground tanks, and where available as above ground basins in open space and conservation areas. The proposed detention system meets the policy requirements of Liverpool City Council.

6 STORMWATER QUALITY CONTROLS

6.1 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 Liverpool City Council.

Liverpool City Council have nominated, in *Section 6.4* of *Part 1* of their *DCP 2008*, 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	80%
Total Phosphorus	45%
Total Nitrogen	45%
Total Hydrocarbons	90%

6.2 Proposed Stormwater Treatment System

Developed impervious areas including roof, hardstand, car parking, roads and other extensive impervious 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.

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

- Treatment of stormwater on the development is to be performed via the provision of a treatment train of proprietary systems;
- Primary treatment will be completed via Gross Pollutant Trap (GPT). The proposed GPT is the SPEL Ecoceptor;
- Tertiary treatment is to be performed via the SPEL Stormceptor separation system;
- It is noted that stormwater from the upstream catchments will bypass treatment systems and undeveloped areas are not included in the modelling; and
- A portion of the future building roof wills also provide a level of treatment via rainwater reuse and settlement within rainwater tanks. Indicative locations and sizes of rainwater tanks has been included in the modelling of the development and shown on drainage layout plans.

6.3 Stormwater Quality Modelling

6.3.1 Introduction

The MUSIC modelling software 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 km^2 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 Councils DCP and nominated in **Section 7.1** of this report were used as a basis for assessing the effectiveness of the selected treatment trains.

The MUSIC model "*8753.21 Prestons Mod7 Rev1.sqz*" was set up to examine the effectiveness of the water quality treatment train and to predict if council requirements have been achieved. The layout of the MUSIC model is presented in **Appendix B**.

6.3.2 Rainfall Data

Six-minute pluviographic data 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

6.3.3 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

6.3.4 Pollutant Concentrations& Source Nodes

Pollutant concentrations for source nodes are not available from Liverpool City Council. The source nodes used are based on the land use parameters defined by Liverpool City Council and are shown as per the **Table 7.1**:

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	1.20	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	-0.60	0.25	0.30	0.19

Table 6.1. Pollutant Concentrations

The MUSIC model has been setup with a treatment train approach based on the pollutant concentrations in **Table 6.1** above and the catchments shown on drawing **Co8753.21-C42** in **Appendix A**.

6.3.5 Treatment Nodes

Gross Pollutant Trap and Hydrodynamic Separation device treatment nodes have been used in the modelling of the development as provided by the suppliers of the products based on testing completed by the product manufacturers. Detention basin nodes were also introduced to the model using typical parameters contained in MUSIC modelling guidelines.

Gross Pollutant Trap (SPEL Ecoceptor)

Parameter	**Value**
Treatable Flow	6-month ARI flow
Pollutant Reductions	
TSS	50 %
TP	30 %
TN	24 %
GP's	95 %

Hydrodynamic Separator (SPEL Stormceptor)

Parameter	**Value**
Treatable Flow	6-month ARI flow
Pollutant Reductions	
TSS	87 %
TP	30 %
TN	30 %
GP's	100 %

6.3.6 Results

Table 6.2 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)	4550	614	86.5	Y
Total Phosphorus (kg/yr)	10.7	5.17	51.6	Y
Total Nitrogen (kg/yr)	88.3	48.1	45.5	Y
Gross Pollutants (kg/yr)	1010	8.16	99.2	Y

Table 6.2. 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 1 of Liverpool City Councils DCP 2008 on an overall catchment basis.

6.3.7 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 1 of Councils DCP 2008 have been met.

The MUSIC modelling has shown that the proposed treatment train of STM's will provide stormwater treatment which will meet council 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 will be treated by the treatment train of propriety devices described above and based on the manufacturers testing would 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 Liverpool City Council have been met.

6.4 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.

Rainwater harvesting will be required for the development in order to meet Liverpool Council Policy and NSW Department of Planning and The Environment requirements with the aim being to reduce overall demand by providing re-use for non-potable applications. Internal uses include such applications as toilet flushing while external applications will be used for irrigation.

As individual building uses have not yet been defined as part of this application, sizing of rainwater tanks has not been undertaken. These would be defined in future detail design and development applications based on a water balance assessment as outlined in Council Policy and the document Managing Urban Stormwater: Harvesting and Reuse – 2006 (NSW DEC).

In general terms, the rainwater harvesting systems are expected to comprise 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. This however would be, as noted, subject to future detail design.

6.5 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 6.3** 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 6.3. 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.
OSD SYSTEM			
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

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
			and remove any blockages or debris.
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 -	Six monthly	Maintenance Contractor	Leaves and debris to be removed from the inlet leaf/litter screen

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
leaf/litter screen			
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.
PROPRIETARY TREATMENT DEVICES (GPT AND HYDRODYNAMIC)			
Refer to Manufacturers Operation and Maintenance Manuel	Annually	Maintenance Contractor	Refer to Manufacturers Operation and Maintenance Manuel
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.

7 EROSION & SEDIMENT CONTROL PLAN

An erosion and sediment control plan (ESCP) is included in drawings **Co8753.21-C20 and C25**. 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.

7.1 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 Liverpool Council's specifications.
3. All subcontractors will be informed by the site manager of their responsibilities in minimising the potential for sedimentation and soil erosion.

7.2 Land Disturbance

1. Where practicable, the soil erosion hazard on the site will be kept as low as possible and as recommended in **Table 7.1**.

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 7.1. Limitations to access

7.3 Erosion & Sediment Control Conditions

1. Clearly visible barrier fencing shall be installed as shown on drawing **Co8753.21-C20** 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.

7.4 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.

7.5 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.

7.6 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 night 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.

8 CONCLUSION

This *Civil Engineering Report* has been prepared in support of a modification to SSD7155 for layout changes to Warehouse 1 at Yarrunga Street, Prestons.

A civil engineering strategy for the site has been developed which provides a best practice solution within the constraints of the existing landform and proposed development layout, the previously approved development under SSD7155 and the constructed Buildings 2 & 5, and Mod 3 and currently under construction Volvo facility. Within this strategy 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 Liverpool City Council's Part 1 of DCP2008.

The stormwater layout for the development sites maintain the existing catchment breakdown and adopt the stormwater discharge points provided as part of the infrastructure works and adopt proposed new discharge points. A hydrological assessment has been undertaken which confirms 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. Stormwater detention systems comprising total active storage of 875m^3 is proposed to attenuate developed stormwater flows to pre-developed flows.

Although parts of the Prestons Industrial Estate are identified as being flood affected, the current Mod 7 development zone is not affected by flooding and works in relation to this Mod 7 development will not affect any management systems as proposed and approved under previous application on the site.

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 Stormwater Treatment Measures (STM's) comprising a proprietary treatment train of gross pollutant trap, detention tanks and vortech style hydrodynamic separation unit have been proposed to mitigate the increase in stormwater pollutant loads generated by the development. MUSIC modelling results indicate that the proposed STM are effective in reducing pollutant loads from the stormwater discharging from the site and that the provided treatment 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.

9 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);
- Liverpool City Council – DCP 2008 (Part 1); and
- Water Sensitive Urban Design – "Technical Guidelines for Western Sydney" by URS Australia Pty Ltd, May 2004

Appendix A

DRAWINGS BY COSTIN ROE CONSULTING