PRECISION | COMMUNICATION | ACCOUNTABILITY

ORRCON STEEL FACILITY STORMWATER MANAGEMENT PLAN

MARSDEN PARK INDUSTRIAL ESTATE (SSD8606): LOT 24 IN DP 262886 HOLLINSWORTH ROAD MARSDEN PARK NSW

DRAFT

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

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

***Rev*: DRAFT**

DOCUMENT VERIFICATION

Project Title	Marsden Park Industrial Estate (SSD8606): Stage 4, Lot 24, Hollinsworth Road, Marsden Park
Document Title	Orrcon Steel Facility Stormwater Management Plan
Project No.	Co12829.14
Description	Stormwater Management Plan.
Client Contact	Mr Fraser McDonald, Logos Property

	Name	**Signature**
Prepared by	Shahid Mahfouz	
Checked by	Daniel Soliman	
Issued by		
File Name	12829.14-05draft.rpt	

Document History

Date	**Revision**	**Issued to**	**No. Copies**
1 July 2019	DRAFT	Mr Fraser McDonald, Logos Property	PDF

TABLE OF CONTENTS

1 INTRODUCTION

Costin Roe Consulting Pty Ltd has been commissioned by Logos Property to prepare this *Stormwater Management Plan* for the proposed Orrcon Steel facility construction. The proposed site is located within Stage 4 of the Marsden Park Industrial Estate approved by the NSW Department of Planning and Infrastructure under SSD_8606.

With reference to **Figure 1.1**, construction of Stages 1 and 2 of the industrial estate have now been completed. Logos Property now proposes to construct a facility for Orrcon Steel within Part Stage 4 of the estate. The proposed development property comprises an area of approximately 3.60 Ha of the overall 6.1 Ha Lot 1, which is located on the western region of the Marsden Park Industrial Estate, as shown on **Figure 1.2**.

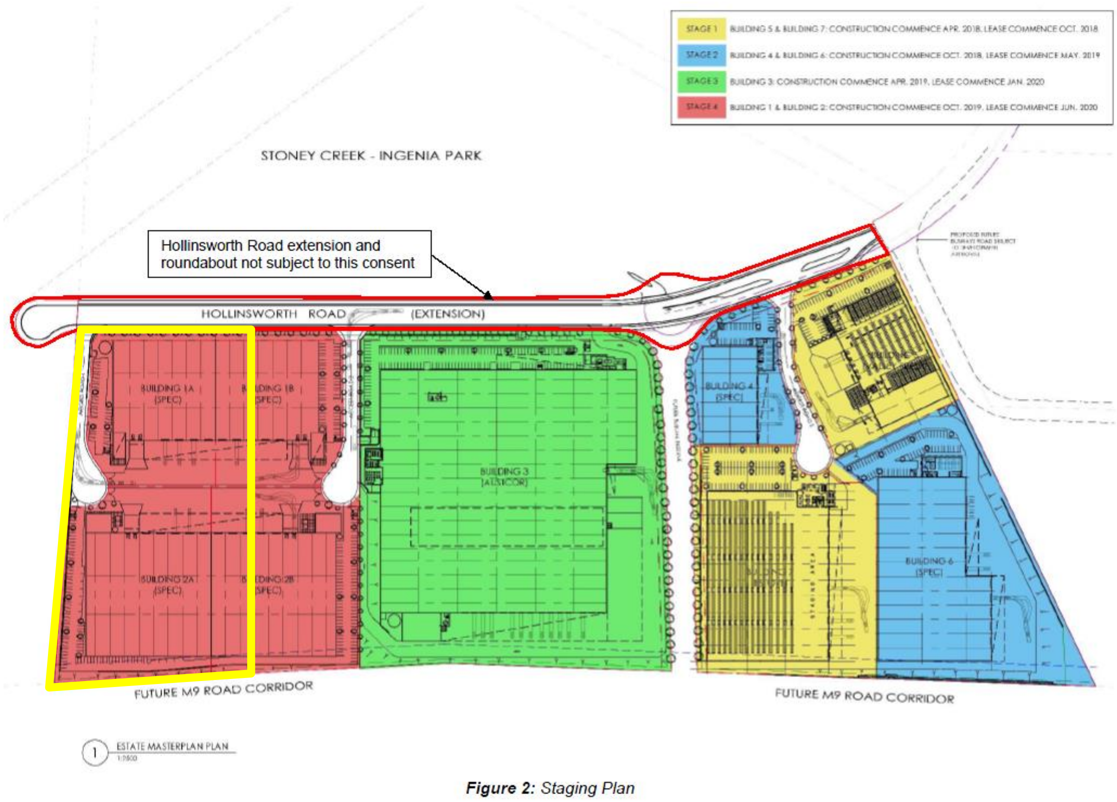


Figure 1.1. SSD8606 Staging Plan & Current Development Footprint

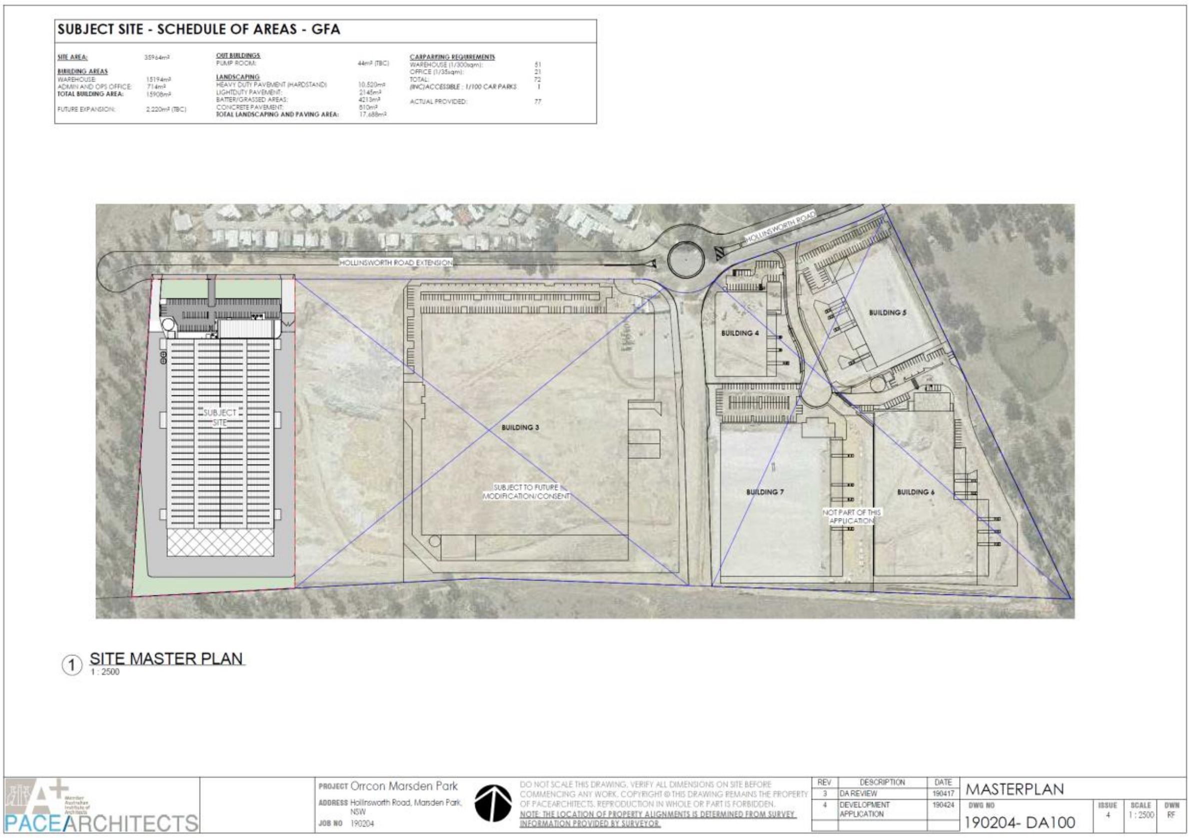


Figure 1.2. Estate & Proposed Development Layout

It is noted that previous applications for subdivision and infrastructure works have been granted over the land by Blacktown City Council under DA 15-275 dated 9 September 2015. The previous approval included subdivision of the land, earthworks and half road construction of the extension of Hollinsworth Road. A subsequent S96 and amending development approval application over the land relating to earthworks and road construction has been lodged by Logos Property and approved by Blacktown City Council. This SSD Application relates to the construction of a new warehouse with an ancillary office space, truck circulation and loading/unloading areas and associated car parking relating to Orrcon Steel.

The existing site has undergone cut to fill earthworks (approved under DA 15-275 dated 9 September 2015) and comprises benched building pads to suit future construction of industrial buildings. The previous use is noted to have been rural and bushland.

This report provides a summary of the following design principles and operational requirements of the stormwater management for the Orrcon Steel facility in accordance with the following requirements of Condition B22 & B23 of SSD_8606 and the stormwater management plan prepared and approved under SSD_8606:

- Management of stormwater quantity
- Management of stormwater quality;
- Flooding Considerations; and
- Erosion & Sediment Control.

The engineering objectives for the development are to provide a civil engineering solution which consideres the existing benched pads, to provide an appropriate and economical stormwater management system which incorporates best practice in water sensitive urban design and is consistent with the requirements of council's water quality objectives and takes into consideration previously approved engineering strategies over the land.

The consent authority is the *NSW Department of Planning and Environment*. As the site is located within the Blacktown City Council local government area, the requirements of the Blacktown City Council *Engineering Guide for Development* and *Part J* of the *Development Control Plan 2015* are to be considered for the development.

The site is also located within the Marsden Park Industrial Precinct and the requirements of *Schedule 3 Marsden Park Industrial Precinct* & *Blacktown City Council Growth Centres Development Control Plan* documents produced by Blacktown City Council.

2 DEVELOPMENT SITE

2.1 Site Description

The proposed site is located on Lot 24 in DP262886, and is approximately 3.6 Ha in area, generally rectangular in shape and located within Blacktown City Council Local Government Area. As noted the site is located within the Marsden Park Industrial Estate and requires consideration to the approved precinct wide policies. This SWMP has been prepared for the proposed Building 1 (Orrcon Steel) which is within the western portion of the previous Stage 4 (per **Figure 1.1**) footprint of the Marsden Park Industrial Estate.

The property is located on the southern side of the Hollinsworth Road extension in the suburb of Marsden Park as shown in **Figure 2.1**.

Figure 2.1 Locality Plan (Source: Nearmap 2019)

The site is bounded on the north by a residential caravan park/ removable home development (Ingenia Property), to the east by the remainder region of Lot 1, and to the south and west by undeveloped lands. The proposed Orrcon Steel site is located at the Western side of the Marsden Park Industrial Estate.

Access to the site is via Hollinsworth Road at the north-east corner of the site. The ground level at the termination point of Hollinsworth Road, being a partially formed cul-de-sac head, is approximately RL 54.5m AHD. The proposed site has undergone cut to fill earthworks to a certain extent (approved under DA 15-275 dated 9 September 2015).

Further discussion relating to catchments is made in the Stormwater Management section of the report following.

2.2 Proposed Development

The proposed development is for the construction of a new single level warehouse for Orrcon Steel at Lot 1, Hollinsworth Road, Marsden Park. The development also comprises ancillary office space, truck circulation and loading/unloading areas and associated car parking and landscaping areas. The overall building area covers around 1.59 Ha of the overall 3.6 Ha site as shown in **Figure 2.2.**

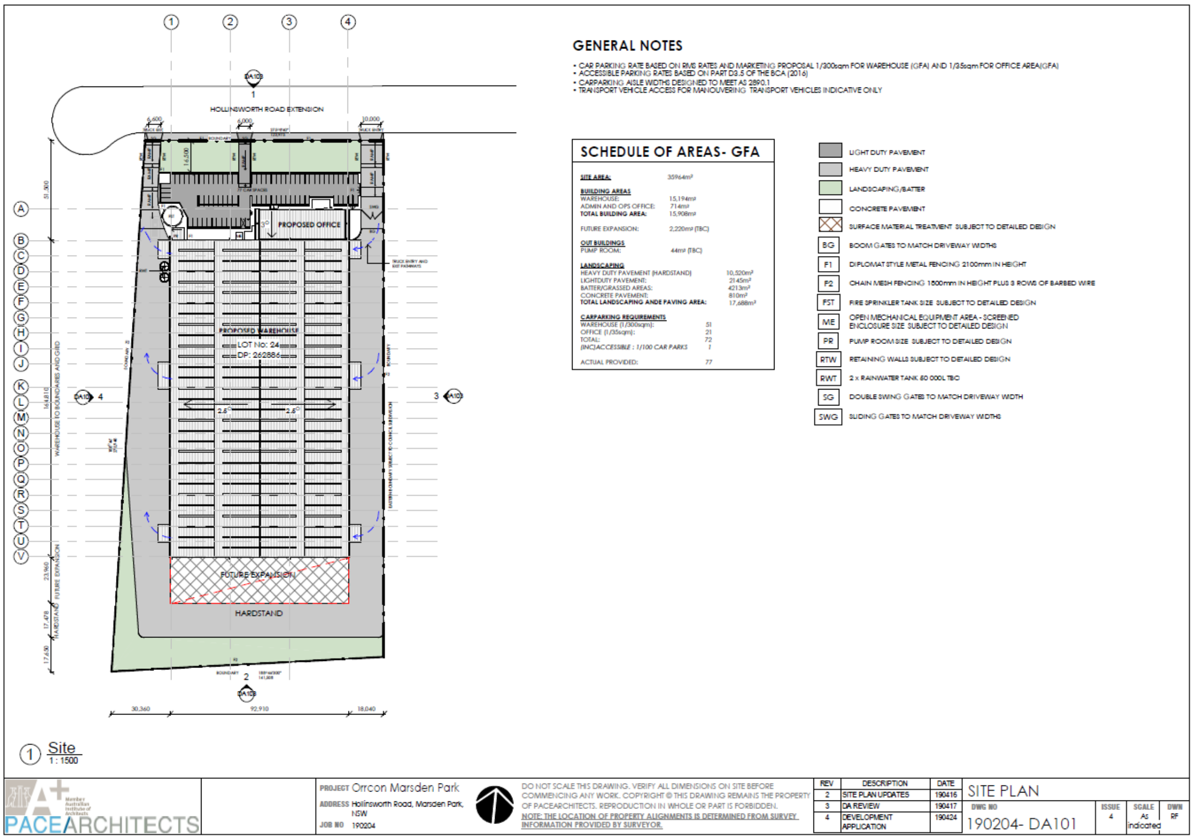


Figure 2.2 Proposed Development Layout

3 STORMWATER DRAINAGE

3.1 Site Drainage

3.1.1 Pre-Existing and Current Site Drainage

The existing site has undergone cut to fill earthworks (approved under DA 15-275 dated 9 September 2015). As part of these works a series of sediment and temporary detention basins were constructed. A sedimentation basin has been constructed at the north end of the proposed Building 1 development, along with another basin which is located on the north-eastern end of Lot 1.

Prior to the cut to fill works described above, the pre-existing site was undeveloped with little to no formal drainage located on site.

A catchment, with an area of 12.89 Ha, drains to Hollinsworth Road on the northern side of the property and ultimately to Sydney Business Park Basin E. The second catchment, with an area of 2.35 Ha, drains from the site through private property at the north-east corner of the development site and ultimately to the proposed Sydney Business Park Basin E as well. A third catchment drains with an area of 1.45 Ha to the east of the site, to an existing basin and ultimately to an existing overland flow path, where it ultimately joins with the remaining 5.29 Ha catchment. These two catchments drain to the south-east, through an existing flow path within the future RMS road corridor, toward an existing SP2 zoned drainage corridor which ultimately drains to Sydney Business Park Basin G, via an open channel and creek within the Ahmadiyya Muslim Association Australia land.

As part of the Sydney Business Park development, a series of regional detention basins have been either designed and constructed, or designed and approved for future construction. As we understand the Sydney Business Park Precinct catchment breakdown allows for the development site to drain to Basins E and G. These regional basins allow for attenuation of the site, and for water quality of Section 94 roads. At the time of writing, the construction of Basin E and Basin G are only partially completed.

3.1.2 Proposed Stage 4 Infrastructure Drainage

As per general engineering practice and the guidelines of BCC, 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.

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. The major system through new paved areas has been designed to cater for storms up to and including the 1 in 100-year ARI storm event (Q100). The major system employs the use of defined overland flow paths to safely convey excess run-off from the site to the discharge point.

The catchment configuration for the overall estate is as follows:

- The existing 5.29 Ha RMS land catchment, located along the southern boundary of lots 1 & 2, will be diverted around the site via a series of pits and pipes in a 3.5m wide easement and ultimately to Basin E. This drainage system is subject to approval under the existing subdivision and infrastructure development application approval DA 15-275.

- The proposed extension of Hollinsworth Road, which has a total catchment area of 1.48Ha, drains to the west via pits and pipes within the road, and ultimately discharges to Basin E. This drainage system is subject to approval under the existing subdivision and infrastructure development application approval DA 15-275.
- The proposed Buslink road (Daniel's Road), which has a total catchment area of 0.52Ha, drains to either the north or the south, generally consistent with the existing site topography. No formal drainage is proposed under this approval or the separate DA approval for infrastructure works. Runoff from this area shall be captured in temporary swales as noted in the Costin Roe Amending Development Application documents in Appendix B.
- Lot 3 (being Stage 1 & Stage 2) has been previously proposed to have the 6.96 Ha collected by on-site drainage. Flows from this area are attenuated by the OSD and ultimately discharge to the existing low-point in the RMS corridor. The remainder of Lot 3 (~0.34Ha) would bypass formalised drainage – the flows from this bypass shall be accounted for in the OSD.

The catchment configuration for Lot 1 is as follows:

- Lot 1 is currently composed of 6.1 Ha collected by on-site drainage per the proposed masterplan layout. Flows from the proposed Building 1 within Lot 1 (occupying 3.6 Ha Land) will be attenuated with on-site detention (OSD) and discharge to Hollinsworth road per the above approval. The remainder of the proposed Building 1 area (0.422Ha) shall bypass formalised drainage – the flows from this bypass shall be accounted for in the OSD. The remainder of the Lot 1 land will discharge to the existing combined sediment/detention basin.

3.1.3 Proposed Building/ Lot Drainage for Building 1

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 BCC and accepted engineering practice and as defined in the Sydney Business Park Stormwater Management Strategy. 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).

Water quality and re-use are to be considered in the design to ensure that any increase in the detrimental effects of pollution is mitigated, BCC Water Quality Objectives are met and that the demand on potable water resources is reduced. This document confirms the requirements for future development lots based on a whole of catchment approach, allowing for treatment the proposed Hollinsworth Road extension to be completed within regional basins and treatment of buildings being performed on lot.

The provided concept stormwater management for the building each lot will comprise the following elements, which are further described and quantified in following sections:

- Minor drainage system consisting of a piped drainage system designed to accommodate the 1 in 20-year ARI storm event (Q20).
- Major drainage system through new paved areas has been designed to cater for storms up to and including the 1 in 100-year ARI storm event (Q100);
- Stormwater Quantity Management System comprising underground tank to attenuate post development stormwater runoff to pre-developed.
- Stormwater quality system which meets the load-based pollution reduction requirements of Blacktown City Council Part J DCP2015; and
- Rainwater reuse which reduces demand on non-potable water use by 80% as per Blacktown City Council Part J DCP2015.

3.2 Hydrologic Modelling and Analysis

3.2.1 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.

Specifically, the design will be based on:

- 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) – It is noted that a design principle is not yet in place for on-site detention systems using AR&R 2016 data;
- Blacktown City Council’s *Engineering Guidelines for Development 2005;*
- Storm events for the 2 to 100 Year ARI event have been assessed.

3.2.2 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.

3.2.3 Rainfall Data

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

3.2.4 Runoff Models

In accordance with the recommendations and standards of Blacktown City Council, the calculation of the runoff from storms of the design ARI will be calculated with the catchment modelling software DRAINS. The ILSAX hydrological model component will be utilised for the post-development site and the RAFTS model component for broad scale catchments. This will be in accordance with previous studies and approvals for land in the area.

The design parameters for the ILSAX 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 (Post Development)	5	mm
	Grassed (Pervious) Area Depression Storage (Pre-Development)	15	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 3.1. DRAINS ILSAX Parameters

3.3 Hydraulics

3.3.1 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.

3.3.2 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 level, for the peak runoff from the Minor System runoff. Where the pipes and junctions are sealed, this freeboard would not be required.

Freeboard of 300mm has been achieved to building levels during the Major Storm Event.

3.3.3 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.

3.3.4 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).

3.3.5 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.

3.4 External Catchments and Flooding

Stages 4 is not affected by any overland flow paths or external catchments. As such no allowance for conveyance of upstream catchments is required in this SWMP.

3.5 Stormwater Management

The proposed stormwater management for Stage 4 will be required to be consistent with Blacktown City Councils DCP2015 Part J and generally in accordance with the approved arrangement and Council Memo's included in **Appendix F**.

Sections 4 & 5 of this report describe the arrangement for the proposed Stormwater Management and objectives as designed.

4 STORMWATER QUANTITY MANAGEMENT

4.1 Introduction

Blacktown City Council requires water quantity to be managed 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 from the early works carried out. Water quantity management is sometimes referred to as stormwater detention, or on-site detention (OSD).

With the site ultimately discharging to Hollinsworth's Road Council Drainage, an on-site detention tank is required upon the development of Building 1.

The methodology employed to determine the attenuation requirements are based on assessing storms for the 1 in 2-year ARI to the 1 in 100 year ARI for the pre and post development phases. Given the pre and post development surfaces are both considered pervious, the pre-developed flows have been assessed based on a 15mm depression depth and the post development based on a fully impervious industrial lot. This is in line with Blacktown Councils requirements as set out in discussions with Tony Merrilees (Blacktown City Council's Senior Stormwater Engineer).

4.2 Existing & Post Development Peak Flows

Intensity/Frequency/Duration (IFD) data was adopted from councils Development Guidelines used in conjunction with rational method calculations to estimate peak flows for the site and surrounding catchments.

The attenuation volume for the proposed OSD Tank has been assessed based on attenuating the post development flow to pre-development flow for a pre-development catchment of 3.6 Ha and storms ranging from 1 in 2-year ARI to 1 in 100-year ARI. The flow rates and attenuation volumes for the Stage 1 detention system has been provided in **Tables 4.1 & 4.2**

The pre-development site discharge volumes for the proposed Building 1 development is provided in **Table 4.1** below.

ARI	Design Storm Duration	Peak Flow (m3/s)			
		Undeveloped	OSD Tank		
			Site (No Attenuation)	Bypass	Total Outflow
2	1 hr	0.158	0.51	0.013	0.130
	2 hr	0.194	0.487	0.019	0.138
	3 hr	0.178	0.379	0.007	0.121
	6 Hr	0.201	0.246	0.014	0.117
	12Hr	0.217	0.227	0.030	0.126
20	20 min	0.219	0.971	0.108	0.217
	30 min	0.341	0.948	0.110	0.236
	1 hr	0.479	0.887	0.116	0.247
	2 hr	0.519	0.844	0.125	0.358
	3 hr	0.402	0.659	0.092	0.377
	6 Hr	0.439	0.43	0.063	0.330
	12 Hr	0.401	0.384	0.058	0.118
100	20 min	0.432	1.26	0.186	0.325
	30 min	0.583	1.18	0.176	0.489
	1 hr	0.725	1.11	0.176	0.683
	2 hr	0.778	1.04	0.167	0.717
	3 hr	0.591	0.807	0.127	0.509
	6 Hr	0.553	0.520	0.081	0.449

Table 4.1. Stage 4 (Building 1) Pre-Development Flows

Post development site discharge volumes, as well as the provided detention volumes and depths for the OSD Tank are provided in **Table 4.2** below.

ARI	Duration (mins)	Peak Flow (m^3/s)						
		No Attenuation	With Attenuation					
			Orifice 1	Q20 Weir	Emergency	Total	Depth (mm)	Storage (m^3)
2	2 Hr	0.194	0.107	0	0	0.138	730	609
20	2 Hr	0.833	0.137	0.096	0	0.358	1390	1158
100	2 Hr	1.04	0.137	0.580	0	0.717	1550	1286

Table 4.2. Detention System Flow and Volume Requirements – Lot 1 (Stage 4)

As shown in **Table 4.2** above, an active detention storage of 1,286m^3 is required in the OSD Tank to attenuate the post development flows to pre-development flows for the 3.60 Ha catchment, which will discharge into the proposed council drainage infrastructure along Hollinsworth Road, Marsden Park.

It is noted that, in addition to the confirmation of detention storage through modelled stage discharge, council also require that a minimum storage of 455m^3/Ha in the 100-year ARI event is met, as such the provided storage will be required to increase to 1640 m^3 in order to meet BCC's minimum site storage requirement (SSR) rate.

Based on the assessment above, a minimum active storage of 1640m^3 will be adopted for the development

5 STORMWATER QUALITY CONTROLS

5.1 Stormwater Management Objectives

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.

Stormwater quality will comprise a treatment train which meets the percentage-based pollution reduction objectives of Blacktown Council Policy DCP2015 Part J.

The water quality objectives for the entire development are presented in terms of annual percentage pollutant reductions on a developed catchment:

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

Water quality for development lots will be completed as part of individual future development applications for building development. Water quality measures will need to be provided for each lot in accordance with Blacktown City Council DCP2015 Part J reductions quoted above and proven by MUSIC modelling.

It is noted that provision for water quality treatment of the catchments associated with the Hollinsworth Road extension have been accounted for in the overall precinct Stormwater Management Strategy and S94 Contribution plan. Allowance for treatment of these catchments has been made in water quality measures provided in the *Sydney Business Park Regional Basins E and G*. As such no allowance for water quality treatment associated with these road corridors is required in the current SSD Approval.

5.2 Proposed Stormwater Treatment System

Roof, hardstand, car parking, roads, other paved areas and landscaping 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, except the S94 roads. 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 concept for the treatment of each building has been presented which would need to be confirmed at detail design stage to meet the load-based objectives noted above.

Components of the treatment train for each building are expected to comprise the following elements:

- Primary treatment to parking and hardstand areas is to be performed Ocean Protect OceanGuards OG200 Pit Inserts;
- Tertiary treatment is to be made via Stormfilter Cartridges in a Stormfilter Chamber within the Proposed OSD for Building 1.
- A portion of the roof will also be treated via rainwater reuse and settlement within a proposed rainwater tank.
- Hydrocarbon removal to be completed by treatment within the bio-retention system and to a lesser extent by pit inserts as discussed in **Section 5.4**.

In order to estimate the number of Stormfilter cartridges and number of Oceanguards required to meet the requirements of councils load based pollution reduction objectives, a MUSIC model has been prepared and generated.

A conservative estimate for the amount of Oceanguards and rainwater reuse has been made with the expectation that the final arrangement for the proposed site will provide at least the minimum number of Oceanguards in the model or greater.

5.3 Stormwater Quality Modelling

5.3.1 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 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 Part J of BCC's DCP2015 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 "*12829.14-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 model was set up using the latest Blacktown City Council *MUSICLINK* parameters and the layout of the MUSIC model is presented in **Appendix C**.

5.3.2 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
Evapotanspiration	Sydney Monthly Areal PET
Model Timestep	6 minutes

5.3.3 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

5.3.4 Pollutant Concentrations & Source Nodes

Pollutant concentrations for source nodes are based on BCC land use parameters as per the **Table 6.1**.:

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 5.1. Pollutant Concentrations

The MUSIC model has been setup with a treatment train approach based on the pollutant concentrations in **Table 5.1** above and the catchments shown in **Table 5.2**.

The relevant stormwater catchment sizes are listed below in **Table 5.2** and shown in **Appendix C**.

Catchment	Area (Ha)	Source Node	% Impervious	Stormwater Treatment
Building 1 – Stage 4				
Roof 1 to RWT (R1)	0.383	Roof	100%	Rainwater Tank/ StormFilter Cartridges
Roof (R2)	0.383	Roof	100%	OceanGuard OG 200 Pit Insert/ StormFilter Cartridges
Roof (R3)	0.766	Roof	100%	OceanGuard OG 200 Pit Insert/ StormFilter Cartridges
Roof (R4)	0.078	Roof	100%	OceanGuard OG 200 Pit Insert/ StormFilter Cartridges
Carpark (A1)	0.285	Sealedroad	100%	StormFilter Cartridges
Carpark Driveway Bypass (A2)	0.011	Sealedroad	0%	Bypass
Eastern Driveway (A3)	0.054	Sealedroad	100%	Bypass
Western Driveway (A4)	0.041	Sealedroad	100%	Bypass
Hardstand (H1)	1.173	Sealedroad	100%	OceanGuard OG 200 Pit Insert/ StormFilter Cartridges
Landscape Bypass 1 (LS1)	0.163	RevegetatedLand	0%	Bypass
Landscape Bypass 2 (LS2)	0.258	RevegetatedLand	0%	Bypass
Total	3.595			

Table 5.2. Music Model Source Nodes

5.3.5 Treatment Nodes

Rainwater tank, OceanGuards OG200 and Stormfilter Chamber and Filters' Nodes have been used in the modelling of the development.

5.3.6 Results

Table 6.3 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 over the modelled 1 Ha catchment.

	Source	Residual Load	% Reduction	Target Met
Flow (ML/yr)	24	22.6	6	NA
Total Suspended Solids (kg/yr)	4410	609	86.2	Y
Total Phosphorus (kg/yr)	8.69	3.04	65	Y
Total Nitrogen (kg/yr)	54.8	29.8	45.6	Y
Gross Pollutants (kg/yr)	604	1.01	99.8	Y

Table 6.3. 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 J of BCC's DCP 2015 over the known site configurations of **Stage 2,** Building 1.

As can be seen, the proposed treatment train achieves reductions greater than the required pollutant reduction objectives. This will any ensure any variance in assumed arrangements in the Building 1 drainage systems will not affect the overall outcomes of the solution.

5.3.7 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 J of BCC's DCP2015 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.

Further discussion on hydrocarbon removal which is not readily modelled in MUSIC is provided in Section 5.4 as follows.

5.4 Hydrocarbon Removal

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 (carparking 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 as further discussed below.

Hydrocarbon removal cannot be readily modelled with MUSIC software however there is sufficient information on the expected source loads and treatment .

5.4.1 Hydrocarbon Sources

The average storm flow concentration of hydrocarbons in an industrial facility is 9.5mg/L (3 & 30mg/L 95% confidence limits) sourced from Fletcher T, Duncan H, Poelsma P & Lloyd S, 2004: *Stormwater Flow and Quality, and the Effectiveness of Non-Proprietary Stormwater Treatment Measures - A review and Gap Analysis. Cooperative Research Centre for Catchment Hydrology, Technical Report 04/8*;

5.4.2 OceanGuard Treatment

The following information relating to the performance of the OceanGuard OG200 (previously known as EnviroPods) has been provided by the product manufacturers, Ocean Protect:

The EnviroPod filter has been evaluated to remove all particles above 100µm when fitted with a 200µm filter mesh. Research has shown (Walker, Allison, Wong and Wootton, 1999, pg.2) that the majority of heavy metal and contaminants found in stormwater runoff are associated with fine partials (under 500 microns). This research also stated that 70% of oils and 85% of hydrocarbons were associated with solids in the stormwater and that over a period of dry weather conditions the highest oil content was found in the sediment range of 200 to 400 microns. The removal mechanism for the EnviroPod 200micron filter is direct screening, and hence removal of particles greater than the screen opening is guaranteed.

The average O&G/Hyrdocarbon reduction of the EnviroPod filter, and recommended removal rate for the treatment nodes made by SW360, is hence 77.5%. For the purpose of any simulation the lower end of this spectrum, at 70%, should be adopted.

5.4.3 Conclusion

Overall, when combining a treatment train of OceanGaurd OG200 and stormfilter cartridges, a reduction of greater than 90% of hydrocarbons is achieved with an extended detention depth of 400mm hence meeting the requirements of Blacktown Council Part J DCP.

It is further noted that our design specification sets the extended detention at 400mm however our MUSIC modelling is based on 300mm. This provides a level of conservatism in relation to achieving the design requirements of other pollution targets and achieving the hydrocarbon treatment requirements.

It is noted that this solution has been previously assessed and agreed with Blacktown City on a similar industrial development in Eastern Creek as part of Development Consent DA14-1466 in 2014.

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.

5.5 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, 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 DCP2015 Part J.

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.

Rainwater tanks have been designed, using MUSIC software to balance the supply and demand, based on the below base water demands and the requirement of Blacktown Council DCP2015 Part J to provide 80% reduction in non-potable water demand.

5.5.1 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 requires an allowance of 0.1kL/day/ toilet or urinal. No allowance is required for disable toilets. It is noted that for this assessment, the masterplan office configurations of **Stage 2** Building 1 have been used to determine re-use rates. It should be noted that this tank will need to be appropriately sized during the detailed design phase of these developments.

The above rates result in the following internal non-potable demand:

Building 1	15 Toilets	1.5kL/day

As noted above, the final number of toilets & subsequent re-use for Buildings 1 shall be confirmed during detailed design.

5.5.2 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 for an industrial development. Section 7.11 requires an allowance of 0.3kL/year/m^2 as PET-Rain for subsurface irrigation and 0.4 kl/year/m^2 as PET-Rain for Sprinkler Systems.

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

Building 1 Irrigated Area (0.4kL/year/m^2)	2680m^2	1072 kL/year

5.5.3 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. Allowances in the MUSIC model have been made for high flow bypass which will be managed by a dual high flow (300mm downpipe) and low flow (100mm downpipe) roofwater collection configuration along a portion of the southern elevation of the warehouse. The final configuration, including the arrangement of downpipes shall be sized and confirmed by the hydraulic engineering consultant during the detailed design of individual warehouses.

Building	Roof Catchment (m^2)	Highflow Bypass (l/s)	Tank Size in MUSIC (kL)	Predicted Demand Reduction (%)	Estimated Tank (kL)
1	3830	100	192	89.17	240

Table 6.4. Rainwater Reuse Requirements

The MUSIC model, results summarised in **Table 6.4**, predicts that the requirements of Blacktown Council DCP2015 Part J (80% reduction in non-potable water demand) will be met for the development.

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

5.6 Stream Erosion Index

A Stream Erosion Index (SEI) calculation has been made, in accordance with the methodology set out in Blacktown City Councils *Developer Handbook for Water Sensitive Urban Design 2013, Section 19.* Blacktown City Council *Growth Centre DCP* requires that the post development duration of stream forming flows shall be between 3.5-5.0 times the pre-development duration of stream forming flows with a stretch target of 1.

The SEI has been calculated for the site area relating on a per-hectare basis, given that the final site arrangement has not yet been approved.

The four following steps, as defined in the council document, were used in estimating the SEI:

1. Estimate the critical flow for the receiving waterway above which mobilisation of bed material or shear erosion of bank material commences.

2. Develop and run a calibrated MUSIC model of the area of interest for predevelopment conditions to estimate the mean annual runoff volume above the critical flow.
3. Develop and run a MUSIC model for the post developed scenario to estimate the mean annual runoff volume above the critical flow.
4. Use the outputs from steps 3 and 4 to calculate the SEI for the proposed scenario.

The 2 year ARI flow for the catchment is 0.104m3/s. The critical flow for the receiving water for the 2 year ARI, being 25% of the 2 year ARI, has been estimated at 0.0259m3/s, based on a time of concentration of 8 minutes.

A pre-developed model was set up based on the site being modelled as 100% undeveloped forest. The pre-development runoff volume, above the critical flow, based on the calibrated MUSIC model was calculated at 14.82 ML/yr.

The post-development runoff volume, above the critical flow, based on the post-developed MUSIC model was calculated at 44.96 ML/yr.

The corresponding SEI was calculated at 3.03. This can be seen to be below the maximum allowable range of 3.5-5.0, hence the requirements of the SEI assessment have been met.

Refer to **Appendix E** for MUSIC model Output relating to the SEI.

6 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, a stormwater system maintenance schedule has been prepared (refer to **Section 6.3**).

Note that inspection frequency may vary depending on site specific attributes and rainfall patterns in the area. In addition to the maintenance requirements below it is also recommended that inspections are made following heavy rainfall or major storm events. Event heavy rain inspections should be carried out as soon as practicable following an intense period of rainfall, (i.e. greater than 100mm over 48 hours), as measured at the Horsley Park or Prospect Reservoir weather stations.

6.1 Types of Maintenance

Water Sensitive Urban Design (WSUD) assets require both proactive and reactive maintenance to ensure long term system health and performance.

Proactive maintenance refers to regular scheduled maintenance tasks, whereas reactive maintenance is required to address unscheduled maintenance issues. If an asset is not functioning as intended, then rectification may be required to restore the asset back to its desired function.

Our preferred approach is on proactive maintenance.

6.1.1 Proactive Maintenance

Proactive maintenance is a set of scheduled tasks to ensure that the WSUD asset is operating as designed.

Proactive maintenance involves:

- Regular inspections of the WSUD asset;
- Scheduled maintenance tasks for issues that are known to require regular attention (e.g. litter removal, weed control); and
- Responsive maintenance tasks following inspections for issues which require irregular attention (e.g. sediment removal, mulching, and scour management).

Proactive maintenance in the first two years after the establishment period (construction and planting phases) are the most intensive and important to the long-term success of the treatment asset.

Proactive maintenance is a cost-effective means of reducing the long-term costs associated with operating stormwater treatment assets.

Maintenance activities specific to each WSUD asset type are detailed in the inspection and maintenance schedules and checklists provided in the report. The frequency of scheduled maintenance depends on the asset type and the issue being managed.

As a general guide, scheduled maintenance should be completed on a three to four-month cycle. The checklists provided should be used as a minimum guide to scheduled maintenance tasks. The lists should be amended to suit site conditions and maintenance requirements.

Treatment assets should also be inspected at least once a year during or immediately after a significant rainfall event. This is important to confirm that the treatment system is functioning correctly under wet conditions.

A higher level of scheduled maintenance may be arranged for some treatment assets. This is often the case for treatment assets which are located in high profile locations (e.g. streetscapes and parklands), and where public amenity is considered to be a high priority. In these cases, a more frequent maintenance regime may be required to remove litter and weeds and to ensure vegetation health and cover is maintained to a high level.

6.1.2 Reactive Maintenance

Reactive maintenance is undertaken when a problem or fault is identified that is beyond the scope of proactive maintenance. Reactive maintenance may occur following a complaint about the WSUD asset (e.g. excessive odours or litter). Reactive maintenance often requires a swift response, and may involve specialist equipment or skills.

6.1.3 Rectification

Rectification of a WSUD asset is undertaken when the system is not functioning as intended, and proactive and reactive maintenance activities are unable to return the asset to functional condition.

The lack of functional performance and therefore failure of a stormwater treatment asset may be related to many factors including inappropriate design, poor construction, and lack of regular maintenance or end of life cycle. In many cases, the design of assets has not included adequate consideration of the maintenance requirements, in terms of the system's ability to cope with catchment pollutant loads (i.e. sediments) and the frequency of maintenance required to maintain the system at a functional level.

Maintenance planning at the design phase is therefore crucial to both the long-term operating costs and the expected life cycle of the treatment system. In general, the expected lifecycle of a stormwater treatment asset (e.g. a bio-retention system) that has been well designed and constructed, and is regularly maintained should be at least 15-20 years.

However, the lifecycle for each treatment system will be different and related to:

- whether the system has been designed, constructed and maintained according to best practice;
- catchment characteristics (influences the quality of the stormwater);
- the age and general health of the system; and
- the type of plants that have been used in the system.

Regular asset condition assessments should be undertaken to monitor the system condition and to inform where an asset is in terms of its expected lifecycle. Renewal of a system refers to replacing the main elements of the system including:

- infrastructure;
- removing deposited sediment, removing and replacing the top soil (or filter media in the case of a bio-retention system) and profiling the top soil level back to the design levels;
- re-planting; and
- pavement and sub-layers (in the case of permeable pavements).

A WSUD specialist may be required to assess whether a treatment system has reached the end of its life cycle and to provide advice on the renewal works.

Asset condition assessments can also identify assets that need to be rectified. The decision to continue with an increased maintenance regime or to rectify an asset, and over what timeframe, can be a difficult one to make. This is because certain maintenance items are more important to overall system function than others. For example, extended ponding on the surface of a bio-retention system or persistent scouring of a swale should be addressed more rapidly than recurrent weed problems.

6.2 Routine Inspections and Maintenance Schedule for General Stormwater System

Routine inspections are to be carried out to assess the need for maintenance and are primarily concerned with checking the functionality of the stormwater drainage facilities; items such as drains, drainage pits, box culverts, detention tanks and rainwater reuse tank systems. Maintenance of these items is vitally important for the ongoing drainage and treatment of stormwater.

Should the inspection reveal that maintenance of any item is required, this is to be reported to the building management for action.

Items that are to be subject to Routine Inspections for Maintenance may comprise, but not be limited to those listed in the table below. This table is to be read in conjunction with the Stormwater design drawings.

It is vitally important that each component of the stormwater system is properly operated and maintained. In order to achieve the modelled and design treatment outcomes, a maintenance schedule has been prepared (below) to assist in the effective operation and maintenance of the various drainage and water quality components.

6.3 Stormwater 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.
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
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

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
			depth as specified by the hydraulic consultant
INLET & JUNCTION PITS			
Inside Pit	Six Monthly	Maintenance Contractor	Remove grate and inspect internal walls and base, repair where required. Remove any collected sediment, debris, litter.
Outside of Pit	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.
OSD SYSTEM			
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.
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.

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
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.
BIORETENTION BASIN/ 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
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.

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
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 5-10 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.

Routine Inspections for Maintenance shall be carried out over the life of the development.

The inspections shall occur on a monthly frequency during the construction period, and shall continue on a regular basis as per the frequency specified above in perpetuity.

In addition to the normal inspection frequency nominated inspections should also be carried out following heavy rain events. Event heavy rain inspections should be carried out as soon as practicable following an intense period of rainfall, (i.e. greater than 100mm over 48 hours), as measured at Prospect Dam Weather Station No. 67019. A process to establish when periods of high rainfall occur should be put in place with Estate Management.

6.4 Records

Records detailing each of the routine inspections for maintenance should be completed during the inspection, and describe in detail any required maintenance. The inspection records are to be provided to Estate or Building Management for action and then filed appropriately.

Records of any maintenance carried out as a result of the inspection should be completed immediately after the works have been finalised, and filed appropriately.

6.5 Personnel

Routine inspections for maintenance are required to establish the need for basic maintenance, as described above. On this basis, such inspections do not require professional engineering knowledge and may be carried out by any responsible person, including property management staff or maintenance staff.

7 EROSION & SEDIMENT CONTROL

An erosion and sediment control plan (ESCP) is shown on Early Works CC drawings **Co12829.06-EWC20** and **EWC25**. These are conceptual plans only providing sufficient detail to clearly show that the works can proceed without undue pollution to receiving waters. A detailed plan will be prepared once consent is given and before works start.

7.1 General Conditions

1. The ESCP will be read in conjunction with the engineering plans, and any other plans or written instructions that may be issued 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 specification and constructed following the guidelines stated in Managing Urban Stormwater, Soils and Construction (1998) and BCC specifications.
3. All subcontractors will be informed of their responsibilities in minimising the potential for soil erosion and pollution to down slope areas.

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.
Access areas	Limited to a maximum width of 5 metres	The site manager will determine and mark the location of these zones onsite. They can vary in position so as to best conserve existing vegetation and protect downstream areas while being considerate of the needs of efficient works activities. All site workers will clearly recognise these boundaries.
Remaining lands	Entry prohibited except for essential management works	

Table 7.1 Limitations to access

7.3 Erosion Control Conditions

1. Clearly visible barrier fencing shall be installed as shown on the plan 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 remain on the surface at the completion of works.
3. Where practicable, schedule the construction program so that the time from starting land disturbance to stabilisation has a duration of less than six months.
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 meters
   - 2.5H:1V where slope length is between 7 and 10 meters
   - 3H:1V where slope length is between 10 and 12 meters
   - 4H:1V where slope length is between 12 and 18 meters
   - 5H:1V where slope length is between 18 and 27 meters
   - 6H:1V where slope length is greater than 27 meters
8. All earthworks, including waterways/drains/spillways and their outlets, will be constructed to be stable in at least the design storm event.
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 meters 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 meters, a storage depth (including both settling and settled zones) of at least 0.6 meters, and internal dimensions that provide maximum surface area for settling, and

c) Provide a return of 1 meter 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 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 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 will be provided at least weekly.

7.6 Site Inspection and Maintenance

1. A self-auditing program will be established based on a Check Sheet. A site inspection using the Check Sheet will be made by the site manager:
   - At least weekly.
   - Immediately before site closure.
   - 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
- Forwarding a signed duplicate of the completed Check Sheet to the project manager/developer for their information

2. In addition, a suitably qualified person 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. The responsible person will ensure that:
   - The plan is being implemented correctly

- Repairs are undertaken as required
- Essential modifications are made to the plan if and when necessary

The report shall carry 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 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 of installing additional diversion upslope.
   - 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 meters from hazard areas will be removed. Such hazard areas include and 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 or less 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 stabilised
12. Litter, debris and sediment will be removed from the gross pollutant traps and trash racks as required.

8 CONCLUSION

This *Stormwater Management Plan* has been prepared in relation to the proposed Orrcon Steel Facility located within Part Stage 4 of the Marsden Park Industrial Estate SSD_8606.

A civil engineering strategy for the works has been developed which provides a best practice solution within the constraints of the existing landform and proposed subdivision layout. Within this design a stormwater quantity management strategy has been developed to reduce peak flows leaving this site to remain consistent with the existing flows as a permanent fixture.

The proposed development and civil works considers the infrastructure and site servicing designs completed and submitted as part of separate development approvals to Blacktown City Council including earthworks, the widening and upgrade of Hollinsworth Road and the extension of Hollinsworth Road. A Sediment and Erosion Control Plan will also be in place to ensure the downstream drainage system and receiving waters are protected from sediment laden runoff.

9 REFERENCES

- Upper Parramatta River Catchment Trust – "Onsite Stormwater Detention Handbook".
- Part J, Development Control Plan (2015), Blacktown City Council
- Engineering Guide for Development (2005), Blacktown City Council
- Water Sensitive Urban Design – Technical Guidelines for Western Sydney (May 2004), URS Australia Pty Ltd
- Managing Urban Stormwater, Soils and Construction (1998) – The Blue Book, Landcom
- Water Sensitive Urban Design – "Technical Guidelines for Western Sydney" by URS Australia Pty Ltd, May 2004

10 GLOSSARY

Afflux	The rise in water level upstream of a hydraulic structure such as a bridge or culvert, caused by losses incurred from the hydraulic structure. The change in flood surface or depth as a result in a modification or change to the hydraulic flood model scenario.
Australian Height Datum (AHD)	National survey datum corresponding approximately to mean sea level.
Annual Exceedance Probability (AEP)	The chance of a flood of a given size or larger occurring in any one year, generally expressed as percentage probability. For example, a 100 year ARI flood is a 1% AEP flood. An important implication is that when a 1% AEP flood occurs, there is still a 1% probability that it could occur the following year.
Average Recurrence Interval (ARI)	Is statistically the long term average number of years between the occurrence of a flood as big as, or larger than the selected flood event. An ARI is the reciprocal of the AEP.
Catchment	The catchment at a particular point is the area of land which drains to that point.
Depth to velocity value (DV)	A ratio of flow depth and velocity used as a measure of safety for pedestrians and vehicles subject to flood water. Normally a maximum DV of 0.4 is recommended for pedestrian safety and 0.6 for vehicles.
Design floor level	The minimum (lowest) floor level specified for a building.
Design flood	A hypothetical flood representing a specific likelihood of occurrence (for example the 100 year or 1% probability flood). The design flood may comprise two or more single source dominated floods.
Development	Existing or proposed works which may or may not impact upon flooding. Typical works are filling of land, and the construction of roads, floodways and buildings.
Discharge	The rate of flow of water measured in terms of volume over time. It is not the velocity of flow which is a measure of how fast the water is moving rather than how much is moving. Discharge and flow are interchangeable.
Digital Terrain Model (DTM)	A three-dimensional model of the ground surface that can be represented as a series of grids with each cell representing an

	elevation (DEM) or a series of interconnected triangles with elevations (TIN).
Effective warning time	The available time that a community has from receiving a flood warning to when the flood reaches their location.
First Flush	The initial surface runoff of a rainstorm. During this phase, water pollution in areas with high proportions of impervious surfaces is typically more concentrated compared to the remainder of the storm.
Flood	Above average river, creek, channel or other flows which overtop banks and inundate floodplains or urban areas.
Flood awareness	An appreciation of the likely threats and consequences of flooding and an understanding of any flood warning and evacuation procedures. Communities with a high degree of flood awareness respond to flood warnings promptly and efficiently, greatly reducing the potential for damage and loss of life and limb. Communities with a low degree of flood awareness may not fully appreciate the importance of flood warnings and flood preparedness and consequently suffer greater personal and economic losses.
Flood behaviour	The pattern / characteristics / nature of a flood.
Flooding	The State Emergency Service uses the following definitions in flood warnings: *Minor flooding:* causes inconvenience such as closing of minor roads and the submergence of low level bridges *Moderate flooding*: low-lying areas inundated requiring removal of stock and/or evacuation of some houses. Main traffic bridges may be covered. *Major flooding*: extensive rural areas are flooded with properties, villages and towns isolated and/or appreciable urban areas are flooded.
Flood frequency analysis	An analysis of historical flood records to determine estimates of design flood flows.
Flood fringe	Land which may be affected by flooding but is not designated as a floodway or flood storage.
Flood hazard	The potential threat to property or persons due to flooding.

Flood level	The height or elevation of flood waters relative to a datum (typically the Australian Height Datum). Also referred to as "stage".
Flood liable land	Land inundated up to the probable maximum flood – flood prone land.
Floodplain	Land adjacent to a river or creek which is inundated by floods up to the probable maximum flood that is designated as flood prone land.
Flood Planning Levels (FPL)	Are the combinations of flood levels and freeboards selected for planning purposes to account for uncertainty in the estimate of the flood level.
Flood proofing	Measures taken to improve or modify the design, construction and alteration of buildings to minimise or eliminate flood damages and threats to life and limb.
Floodplain Management	The coordinated management of activities which occur on flood liable land.
Floodplain Management Manual	A document by the NSW Government (2001) that provides a guideline for the management of flood liable land. This document describes the process of a floodplain risk management study.
Flood source	The source of the flood waters.
Floodplain Management	A set of conditions and policies which define the benchmark from standard which floodplain management options are compared and assessed.
Flood standard	The flood selected for planning and floodplain management activities. The flood may be an historical or design flood. It should be based on an understanding of the flood behaviour and the associated flood hazard. It should also take into account social, economic and ecological considerations.
Flood storages	Floodplain areas which are important for the temporary storage of flood waters during a flood.
Floodways	Those areas of the floodplain where a significant discharge of flow occurs during floods. They are often aligned with naturally defined channels or overland flow paths. Floodways are areas that, even if they are partially blocked, would cause significant redistribution of flood flows, or a significant increase in flood levels.

Freeboard	A factor of safety usually expressed as a height above the flood standard. Freeboard tends to compensate for the factors such as wave action, localised hydraulic effects, uncertainties in the hydrology, uncertainties in the flood modelling and uncertainties in the design flood levels.
Geographical Information System (GIS)	A form of computer software developed for mapping applications and data storage. Useful for generating terrain models and processing data for input into flood estimation models.
High hazard	Danger to life and limb; evacuation difficult; potential for structural damage, high social disruption and economic losses. High hazard areas are those areas subject to a combination of flood depth and flow velocity that are deemed to cause the above issues to persons or property.
Historical flood	A flood which has actually occurred – Flood of Record.
Hydraulic	The term given to the study of water flow.
Hydrograph	A graph showing how flow rate changes with time.
Hydrology	The term given to the study of the rain-runoff process in catchments.
Low hazard	Flood depths and velocities are sufficiently low that people and their possessions can be evacuated.
Map Grid of Australia (MGA)	A national coordinate system used for the mapping of features on a representation of the earth's surface. Based on the geographic coordinate system 'Geodetic Datum of Australia 1994'.
Peak flood level, flow or velocity	The maximum flood level, flow or velocity occurring during a flood event.
MUSIC	Acronym for Model for Urban Stormwater Improvement Conceptualisation. A computer model which is used to simulate rainfall runoff, associated pollutants within the runoff and expected treatment of the pollutants using different treatment measures.
Probable Maximum Flood (PMF)	An extreme flood deemed to be the maximum statistical flood likely to occur at a particular location.

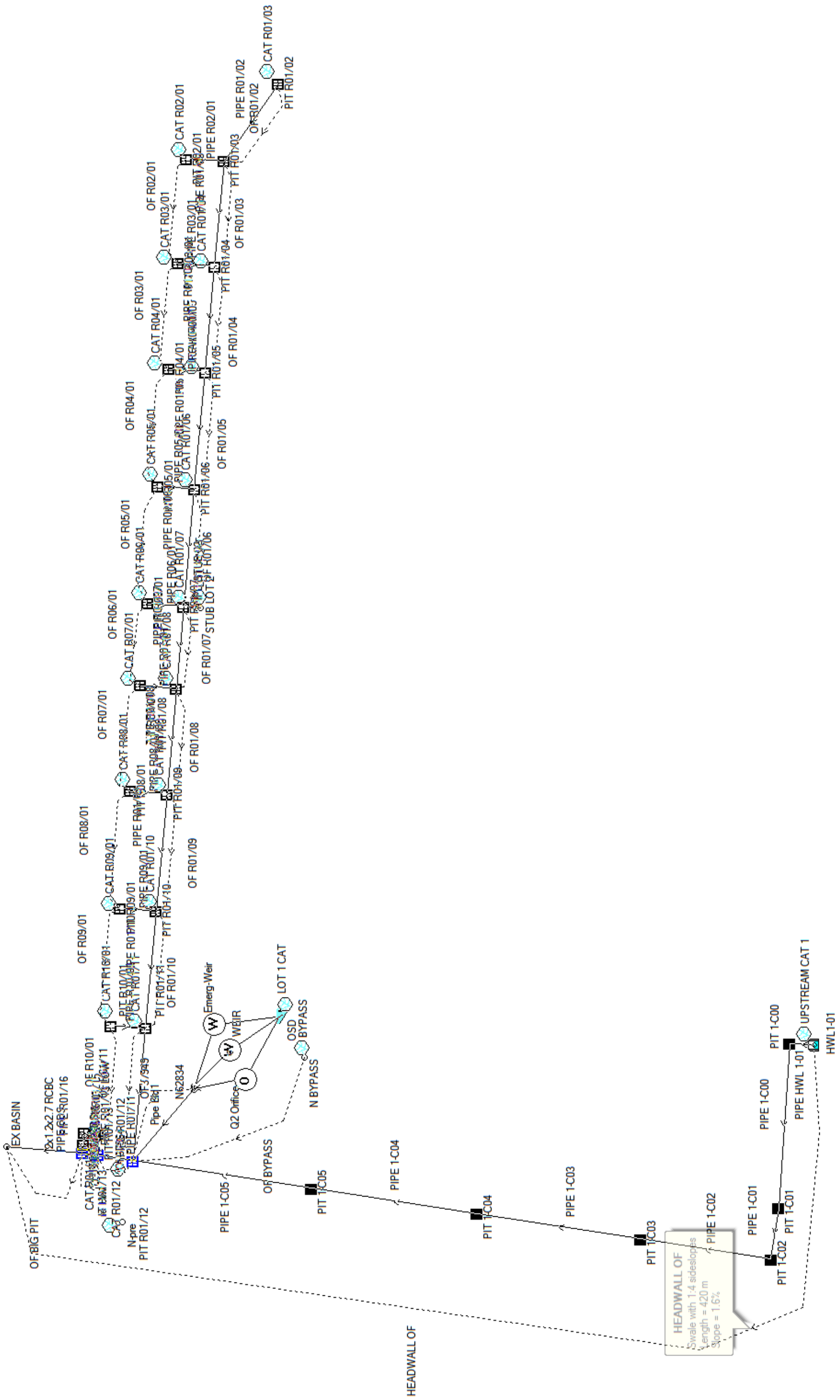
Probable Maximum Precipitation (PMP)	The greatest statistical depth of rainfall for a given duration meteorologically possible over a particular location. Used to estimate the probable maximum flood.
Probability	A statistical measure of the likely frequency or occurrence of flooding.
Riparian Zone	Areas that are located adjacent to watercourses. Their definition is vague and can be characterised by landform, vegetation, legislation or their function.
Runoff	The amount of rainfall from a catchment which actually ends up as flowing water in the river of creek.
Stage	Equivalent to water level above a specific datum- see flood level.
Treatment train	A term used to describe a series of water quality measures which act in conjunction with one another to provide a combined water quality outcome.
Triangular Irregular Network (TIN)	A mass of interconnected triangles used to model three-dimensional surfaces such as the ground (see DTM) and the surface of a flood.
Velocity	The speed at which the flood waters are moving. Typically, modelled velocities in a river or creek are quoted as the depth and width averaged velocity, i.e. the average velocity across the whole river or creek section

Appendix A

DRAWINGS BY COSTIN ROE CONSULTING

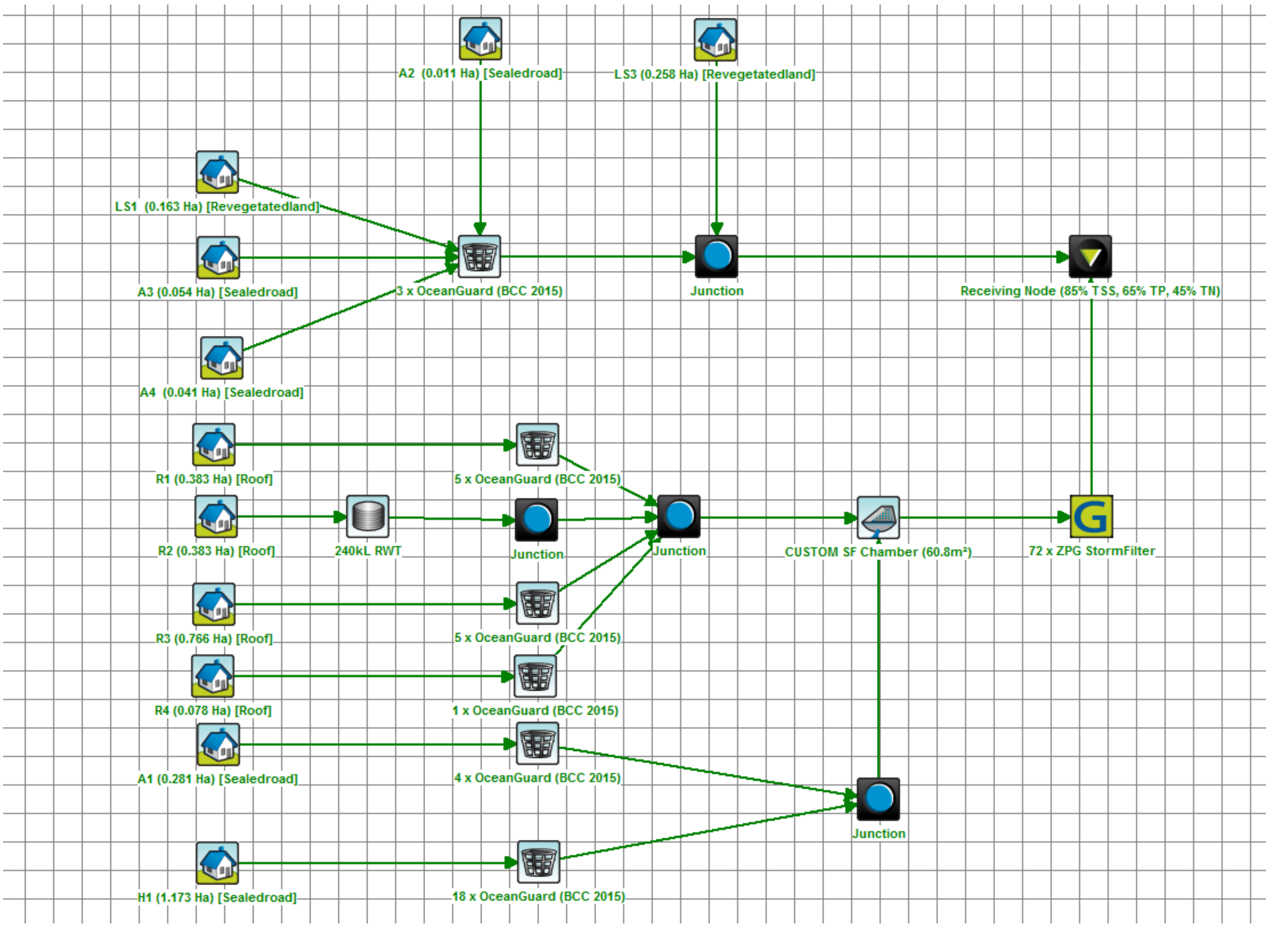
Appendix B

DRAINS MODEL CONFIGURATION



Appendix C

MUSIC MODEL CONFIGURATION AND MUSIC LINK



Treatment Train Effectiveness - Receiving Node (85% TSS, 65% TP, 45% TN)

	Sources	Residual Load	% Reduction
Flow (ML/yr)	24	22.6	6
Total Suspended Solids (kg/yr)	4410	609	86.2
Total Phosphorus (kg/yr)	8.69	3.04	65
Total Nitrogen (kg/yr)	54.8	29.8	45.6
Gross Pollutants (kg/yr)	604	1.01	99.8

Appendix D

SEI PRE AND POST DEVELOPMENT MUSIC CONFIGURATION

Pre-Development

Post-Development

Appendix E

EROSION CONTROL CHECK SHEET

EROSION AND SEDIMENT CONTROL
WEEKLY SITE INSPECTION SHEET

LOCATION . . . .

INSPECTION OFFICER . . . . **DATE** . . . .

SIGNATURE . . . .

Legend: OK Not OK N/A Not applicable

Item	Consideration	Assessment
1	Public roadways clear of sediment.	. . . .
2	Entry/exit pads clear of excessive sediment deposition.	. . . .
3	Entry/exit pads have adequate void spacing to trap sediment.	. . . .
4	The construction site is clear of litter and unconfined rubbish.	. . . .
5	Adequate stockpiles of emergency ESC materials exist on site.	. . . .
6	Site dust is being adequately controlled.	. . . .
7	Appropriate drainage and sediment controls have been installed prior to new areas being cleared or disturbed.	. . . .
8	Up-slope “clean” water is being appropriately diverted around/through the site.	. . . .
9	Drainage lines are free of soil scour and sediment deposition.	. . . .
10	No areas of exposed soil are in need of erosion control.	. . . .
11	Earth batters are free of “rill” erosion.	. . . .
12	Erosion control mulch is not being displaced by wind or water.	. . . .
13	Long-term soil stockpiles are protected from wind, rain and stormwater flow with appropriate drainage and erosion controls.	. . . .
14	Sediment fences are free from damage.	. . . .
15	Sediment-laden stormwater is not simply flowing “around” the sediment fences or other sediment traps.	. . . .
16	Sediment controls placed up-slope/around stormwater inlets are appropriate for the type of inlet structure.	. . . .
17	All sediment traps are free of excessive sediment deposition.	. . . .
18	The settled sediment layer within a sediment basin is clearly visible through the supernatant prior to discharge such water.	. . . .
19	All reasonable and practicable measures are being taken to control sediment runoff from the site.	. . . .
20	All soil surfaces are being appropriately prepared (i.e. pH, nutrients, roughness and density) prior to revegetation.	. . . .
21	Stabilised surfaces have a minimum 70% soil coverage.	. . . .
22	The site is adequately prepared for imminent storms.	. . . .
23	All ESC measures are in proper working order.	. . . .