

sizing will be performed in accordance with method outlined in the Catchments & Creeks Pty Ltd document *Rock Sizing for Single Pipe Outlets 2011*.

Following earthworks and prior to development of individual lots erosion control and stormwater management will be performed as per Fairfield Council Guidelines and recommendations of the Blue Book.

Reference to drawings Co11492.00-DA40, DA41-1 through DA41-8 shows the proposed drainage layout.

5.3.3 Site Discharge

The design and construction of the proposed outlet structures to overland flow paths and waterways has been assessed with consideration to the guidelines contained in the NSW Office of Water document *Controlled Activities: Guidelines for Outlet Structures*. Apron and rock sizing will be performed in accordance with method outlined in the Catchments & Creeks Pty Ltd document *Rock Sizing for Single Pipe Outlets 2011*.

Discharge from the estate access road and Basin 2 are proposed at the northern side of the development site. These are shown on drawings Co11492.00-DA41-7 and DA41-8.

Stormwater outlets are to consist of a reinforced concrete pipe and ‘natural’ energy dissipater. The outlet is to be aligned with the creek to remove the potential for bank scour and shall include rip rap energy dissipaters constructed in accordance with the Outlet Structures Guidelines as published by the Department of Water & Energy and The Blue Book. This is shown figuratively below in Figure 5.1 below. Further construction details regarding the dimensions, rock size and scour protection can be seen on drawing Co11492.00-DA46.

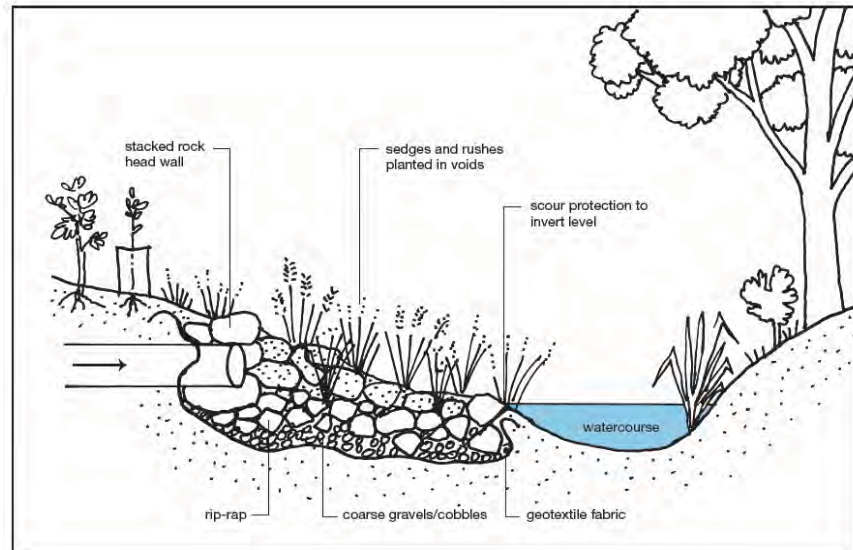


Figure 5.1. Outlet Structure Components

5.4 External Catchments

The site in its undeveloped state is affected by overland flows from the west, upstream of the Sydney Water Supply Channel. Allowance has been made in the drainage network to convey runoff from the two external catchments in the drainage system.

The southern most of the two catchments (Catchment 2a as nominated on drawing Co11492.00-DA70) is located midway along the estate boundary. Flows from this catchment will be piped and diverted through the site via a 2.5m wide easement.

Discharge from the northern of the two catchments (Catchment 3a as nominated on drawing Co11492.00-DA70) is located 100m south of the north-western corner of the site via two 750mm R.C.P.'s. It is proposed to convey flows from this catchment via an overland channel around the northern extent of the development, crossing the estate road via a three 825mm R.C.P. culvert configuration and into proposed Basin 2 prior to ultimate discharge to the north of Cowpasture Road.

5.5 Flooding at The Intersection of Cowpasture Road and Victoria Street

As part of the Director General's Requirement, an assessment of the potential for flooding on the south-west side of the intersection of Cowpasture Road and Victoria Street is required for the pre and post development conditions.

A conservative 1D analysis of this system has been performed using a RAFTS/DRAINS model. The model is based on the following configuration:

- A total of catchment of 81.54Ha drains to the low point adjacent to the Cowpasture Road and Victoria Street intersection. This has been shown on drawing Co11492.00-DA70.
- As requested by Fairfield Council an additional catchment of 2.06Ha, which is located on the east side of Trivet Street, has also been included in the model. The total catchment in this case is now 83.6Ha. This catchment and would likely enter the drainage system downstream of the system however the exact location is unclear and the inclusion of this catchment will result in a conservative estimate of flooding levels at the intersection with Victoria St.
- The 83.6Ha catchment can be broken down into two broad sub-catchments and a number of smaller sub-sub-catchments. These are also noted on drawing DA70.
- The overall catchment is generally undeveloped however agricultural land is located on the western side of the Sydney Water Supply Channel.
- Stormwater is conveyed overland as sheet flow to gullies and natural low points in the topography where it continues as overland flow. There are a number of culverts which convey stormwater from the western side of the Sydney Water

Supply Channel to the eastern side. For the purpose of our assessment it has been assumed that all stormwater will pass unimpeded across the Supply Channel.

- Stormwater is conveyed overland through the catchment to a low point on the western side of the Cowpasture Road and Victoria Street intersection. Stormwater, downstream of this point, is then conveyed via an underground drainage system in a north-easterly direction to its ultimate discharge point.
- The configuration of the underground drainage network is two inlet structures, consisting of 3x900mm R.C.P. culverts (which pick up the two broader sub-catchments), located 70m apart from each other. The two culverts connect and stormwater is then conveyed via a 3.0m wide and 2.4m high box culvert. The drainage configuration is based on information provided by Fairfield Council (Refer to Appendix D) and detail survey.
- The catchment low point forms a natural basin which, based on survey information, has an active storage volume of approximately 3,000m³ at overflow level and 4300m³, 0.2m above overflow level. The overflow level is defined by the Cowpasture Road level of 58.5m.
- Overflow at Cowpasture Road has been modelled as a broad-crested weir with free-flowing downstream conditions. Based on site inspections made this is considered consistent with flow regime in the area.

Our assessment of the pre-development Q100 ARI event, based on the above model configuration, found the following:

- Peak flows from the catchment are in the order of 20m³/s and the 2 hour storm is the critical duration.
- The culvert configurations have a capacity in the order of 6.5m³/s depending on the level of water in the adjacent 'basin' area.
- Stormwater flows will overtop Cowpasture Road for storm durations greater than or equal to 1 hour. A maximum flow of 12.0m³/s can be expected in an overtopping event.
- A maximum water surface level of 59.00m can be expected during the Q100 event. This equates to 500mm flow over Cowpasture road and 7000m³ of active storage.
- Overtopping of Cowpasture Road does not occur during a 2 year ARI storm however it is expected to occur in events greater than the 2 year ARI storm.

Based on the above assessment we recommend that a flood planning level of 59.50m be set for developments adjacent to the Cowpasture Road and Victoria Street Intersection. This allows for a 500mm freeboard to the assessed flood level.

Following the development and implementation of the OSD basin discussed in the following section, a minor reduction in peak flow and flooding levels is expected at the intersection of Cowpasture Road and Victoria Road. This means there will be no effect on downstream properties as a result of this development.

5.6 On-site Detention

Fairfield City Council, in common with many other local authorities in the Sydney region, limit the runoff discharged from private property into the underground piped drainage system. As part of the Director General's Requirements for the development, the OSD sizing is to be performed in consultation with Fairfield City Council. Although a departure from Fairfield City Councils adopted OSD policy (which requires post-development peak flows to be less than pre-development flows), Fairfield City Council Engineers have requested that the OSD for the site be assessed using the principals outlined in document *WSUD: Basic Procedures for 'Source Control' of Stormwater*, by John R Argue. The strategy outlined in this document is to target not only reductions in peak flow from the development but also reduction in peak stormwater volume. This requires an assessment of the greater catchment and the location of the development within the catchment and respective time of concentrations and differing local and regional storm durations. In terms of this development, Fairfield Council has advised that the Wetherill Park Catchment has a time of concentration of 30 minutes, hence for outlet controls the basins must be sized for the critical local storm (2hours) and the 30minute duration storm. The results of this analysis can be seen in the following tables. We also note that, for Basin 2, due to the capacity and hydraulic characteristics of the receiving system downstream of the basin at the intersection of Victoria Street and Cowpasture Road (as discussed in Section 5.5) that the effect from our development is actually beneficial to downstream flooding with a minor reduction in peak flows and flood levels with a marginal change in the overall outflow hydrographs.

Due to the presence of two catchments on the site, two basins are proposed for the development and these are shown on drawings Co11492.00-DA41-1 and DA41-8. Pre and post-development flows were calculated using a RAFTS model (using in-built function within DRAINS model) which includes road network and external catchments. Tables 5.3 and 5.4 shows the pre and post development flows over the catchment and the proposed storage capacity for each of the two basins.

ARI (yrs)	Storm Duration (hrs)	Flow (m ³ /s)			Water Level (m)	Storage (m ³)
		Pre-Devel.	Post Devel. (un-attenuated)	Post Devel. (with attenuation)		
2	0.5	0.376	1.87	0.325	62.35	1100
2	2	0.701	1.90	0.347	62.50	1350
100	0.5	1.77	3.77	1.407	63.18	2300
100	2	2.62	3.83	2.575	63.25	2450

Table 5.3. BASIN 1, Pre and Post Development Flows and OSD Storage

ARI (yrs)	Storm Duration (hrs)	Flow (m ³ /s)			Water Level (m)	Storage (m ³)
		Pre-Devel.	Post Devel. (un-attenuated)	Post Devel. (with attenuation)		
2	0.5	1.22	3.49	1.12	61.10	1400
2	2	2.38	3.50	2.37	61.30	2400
100	0.5	6.86	8.20	5.85	61.70	4500
100	2	9.59	10.20	8.45	61.83	5000

Table 5.4. BASIN 2, Pre and Post Development Flows and OSD Storage

In order to maintain the above flow attenuation in Basin 1 a total of 2,450m³ of active storage will be provided with a maximum depth of 1.7m during the Q100 ARI storm event.

In order to maintain the above flow attenuation in Basin 2 a total of 5,000m³ of active storage will be provided with a maximum depth of 1.03m during the Q100 ARI storm event. Basin 2 has a minimum floor level of 60.8m which is above the flood planning level nominated in Section 5.5 above.

500mm freeboard above the maximum top water level nominated in Tables 5.3 and 5.4 will be provided to the embankments of Basin 1 and 2.

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 the Fairfield City Council.

Fairfield City Council have nominated the requirements for stormwater quality to be performed on a catchment wide basis and in accordance with the Sydney Catchment Management Authority. These are presented in terms of annual percentage pollutant reductions on a developed catchment and are as follows:

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

6.2 Proposed Stormwater Treatment System

Development lots, verges and road 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. 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 estate development are as follows:

- At minimum a vortech style gross pollutant trap will be located on each development lot prior to discharging into the estate stormwater system. This will ensure that the estate system is free from gross pollutants and some sediments and ensure that early onset sedimentation of the estate bioretention basin. This, at source, approach has been adopted over a larger end of line device so that each device can be specified based on individual use on each development lot; and
- On-site detention/ bioretention basins will act as tertiary treatment for suspended solids and nutrients.

6.3 Stormwater Quality Modelling

6.3.1 Introduction

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

By simulating the performance of stormwater management systems, MUSIC can be used to determine 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 nominated in Section 6.1 of this report were used as a basis for assessing the effectiveness of the selected treatment trains.

The MUSIC model “11492.00 WSPT Rev1.sqz” was set up to examine the effectiveness of the water quality treatment train and to determine if FCC requirements have been achieved. The layout of the MUSIC model is presented in Appendix B.

As Basin 2 is subject to flows from upstream catchments, source nodes (assuming a developed condition) were included to account for the additional volume of stormwater passing through the stormwater treatment device. The upstream catchments were assumed to have been treated to the level nominated in Section 6.1 prior to entering Basin 2. The inclusion of these upstream catchment increases the required filter media area to treat the development alone by approximately 40%.

6.3.2 Rainfall Data

Six minute pluviographic data 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

Pollutant concentrations for source nodes are based on values nominated by Blacktown City Council for industrial land use 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	-1.11	0.48	0.14	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

Table 6.1. Pollutant Concentrations

6.3.5 Source Nodes

The MUSIC model has been setup with source nodes based on the pollutant concentrations in Table 6.1 above. As exact areas of land use are not know at this time, pollutants catchments breakdown for development lots have been modelled as following:

Estate Road	As per plan
Roof	50% of development lot.
Hardstand	50% of development lot

6.3.6 Treatment Nodes

Bioretention and gross pollutant trap nodes have been used in the modelling of the development.

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

Bioretention 1

Parameter	Value
<u>Storage Properties</u>	
Extended Detention Depth	300 mm
Storage Surface Area	1300 m ² (minimum)
<u>Filter and Media Properties</u>	
Filtration Area	1150 m ²
Saturated Hydraulic Conductivity	100 mm/hr
Filter Depth	600 mm

Bioretention 2

Parameter	Value
<u>Storage Properties</u>	
Extended Detention Depth	300 mm
Storage Surface Area	3500 m ² (minimum)
<u>Filter and Media Properties</u>	
Filtration Area	3500 m ²
Saturated Hydraulic Conductivity	100 mm/hr
Filter Depth	500 mm

6.3.7 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
Flow (ML/yr)	301	285	5.2
Total Suspended Solids (kg/yr)	54000	5070	90.6
Total Phosphorus (kg/yr)	108	29.7	72.6
Total Nitrogen (kg/yr)	689	378	45.2
Gross Pollutants (kg/yr)	7990	0.0	100.0

Table 6.2. MUSIC analysis results

6.3.8 Modelling Discussion

MUSIC modelling has been performed to assess the effectiveness of the selected treatment trains and to ensure that the pollutant retention requirements nominated in Section 6.1 have been met. The MUSIC modelling predicts that the proposed treatment measures meet the requirements of the Sydney Catchment Management Authority and Fairfield Council.

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.

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 future development lots within 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 non-potable water demand for the individual future developments in the range of 50-80%.

In general terms the rainwater harvesting systems will be in-line tanks 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 falling on roofs is soft, clear and generally low in microbial and chemical contamination. Any contamination of rainwater generally occurs during collection and storage. The use of simple and cost effective rainwater collection and treatment systems ensures reliable operation and water quality for non-potable use. The proposed rainwater treatment will be a first flush diverter in accordance with council engineering guidelines.

Indoor and outdoor water demand and rainwater tanks sizing will be based on individual site requirements and form part of separate future development applications over these development lots in accordance with Fairfield Council requirements and the targets nominated above.

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 7.4** 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 7.4. 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.

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
OSD BASIN			
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.
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	Ensure fixings are secure and irons are free from

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
		Contractor	corrosion.
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.

BIORETENTION BASIN			
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.
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

7 EROSION & SEDIMENT CONTROL PLAN

An erosion and sediment control plan (ESCP) is shown on drawings Co11492.00-DA20 to DA23. 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 Fairfield Council 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 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 Work Schedule Conditions

Works will be undertaken in the following sequence. The management of water and soil for the proposed development is to be staged in conjunction with the proposed construction sequence to ensure that minimal land disturbance occurs. Each subsequent stage is not to be commenced until the previous one is completed.

Works

Stage 1 works are detailed on drawing Co11492.00-DA20 (refer to Appendix) and are to be carried out in the following sequence:

1. Installation of stabilised site entry.
2. Installation of sediment fencing and construction of catch drains.
3. Construction of diversion channels
4. Construction of sedimentation basins as nominated on plan.
5. Diversion of existing overland flow path around the works.
6. Grading of site to Bulk Earthworks Levels
7. Construction of estate road and stormwater drainage lines.
8. Finalisation of construction of OSD basins.
9. Sediment basins on development lots are to remain until such time that the disturbed areas are stabilised and/ or building works take place.

7.4 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 low 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.

7.5 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.

7.6 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.

7.7 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 or installing additional diversion upslope.
- Blockages are cleared (these might occur because of sediment pollution, sand/soil/spoil being deposited in or too close to them, breached by vehicle wheels, etc.).

5. Sand/soil/spoil materials placed closer than 2 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 Civil Engineering Details Report has been prepared to support the Development Application for a proposed industrial subdivision development over the Western Sydney Parkland Trust land located at the corner of The Horsley Drive and Cowpasture Road.

A civil engineering and infrastructure strategy for the site has been developed which provides a best fit solution within the constraints of the existing landform and proposed estate layout. Within this strategy a stormwater quantity and quality management strategy has been also been developed to mitigate downstream effect from increased stormwater runoff and to reduce pollutant loads in stormwater leaving this site in accordance with principle of WSUD and long term council policy.

It is recommended that the management strategies mentioned in this report be incorporated into the future detailed design. Detailed design may result in changes to the concept however design criteria will be followed.

9 REFERENCES

- Fairfield City Council Development Control Plan
- WSUD: Basic Procedures for 'Source Control of Stormwater', John R Argue, 2008.
- Water Sensitive Urban Design – “Technical Guidelines for Western Sydney” by URS Australia Pty Ltd, May 2004

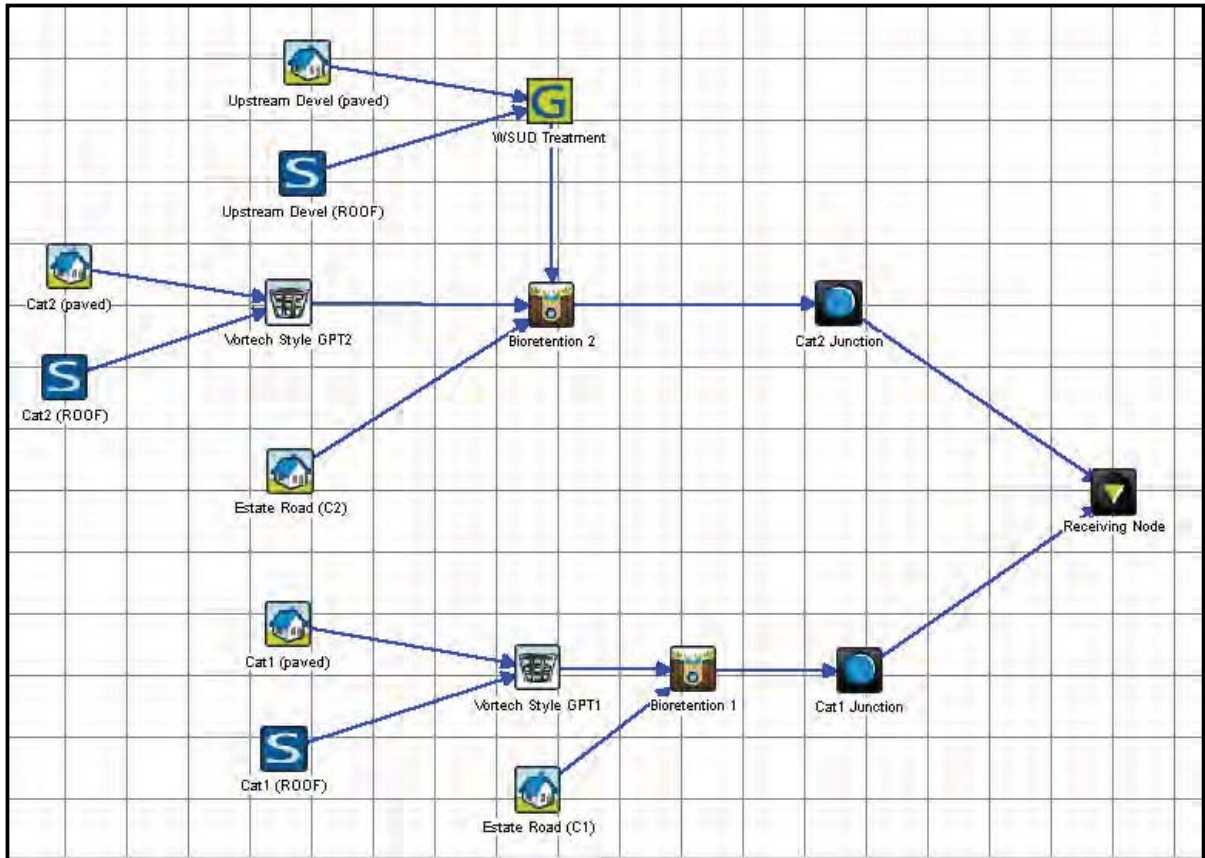
Appendix A

DRAWINGS BY COSTIN ROE CONSULTING

Co11492.00-DA10	DRAWING LIST & GENERAL NOTES
Co11492.00-DA20	EROSION & SEDIMENT CONTROL PLAN
Co11492.00-DA25	EROSION & SEDIMENT CONTROL DETAILS - SHEET 1
Co11492.00-DA31 & DA32	BULK EARTHWORKS PLAN – SHEETS 1 & 2
Co11492.00-DA33 TO 38	BULK EARTHWORKS SECTIONS – SHEETS 1 TO 6
Co11492.00-DA40	STORMWATER MASTERPLAN
Co11492.00-DA41-1 to 10	CONCEPT STORMWATER & FINISHED LEVELS PLAN, SHEETS 1 TO 10
Co11492.00-DA45 & DA46	STORMWATER DETAILS – SHEETS 1 TO 2
Co11492.00-DA50	ROAD TYPICAL DETAILS SHEET 1 & 2
Co11492.00-DA60	RETAINING WALL LAYOUT PLAN
Co11492.00-DA65	RETAINING WALL DETAILS
Co11492.00-DA70	STORMWATER CATCHMENT PLAN

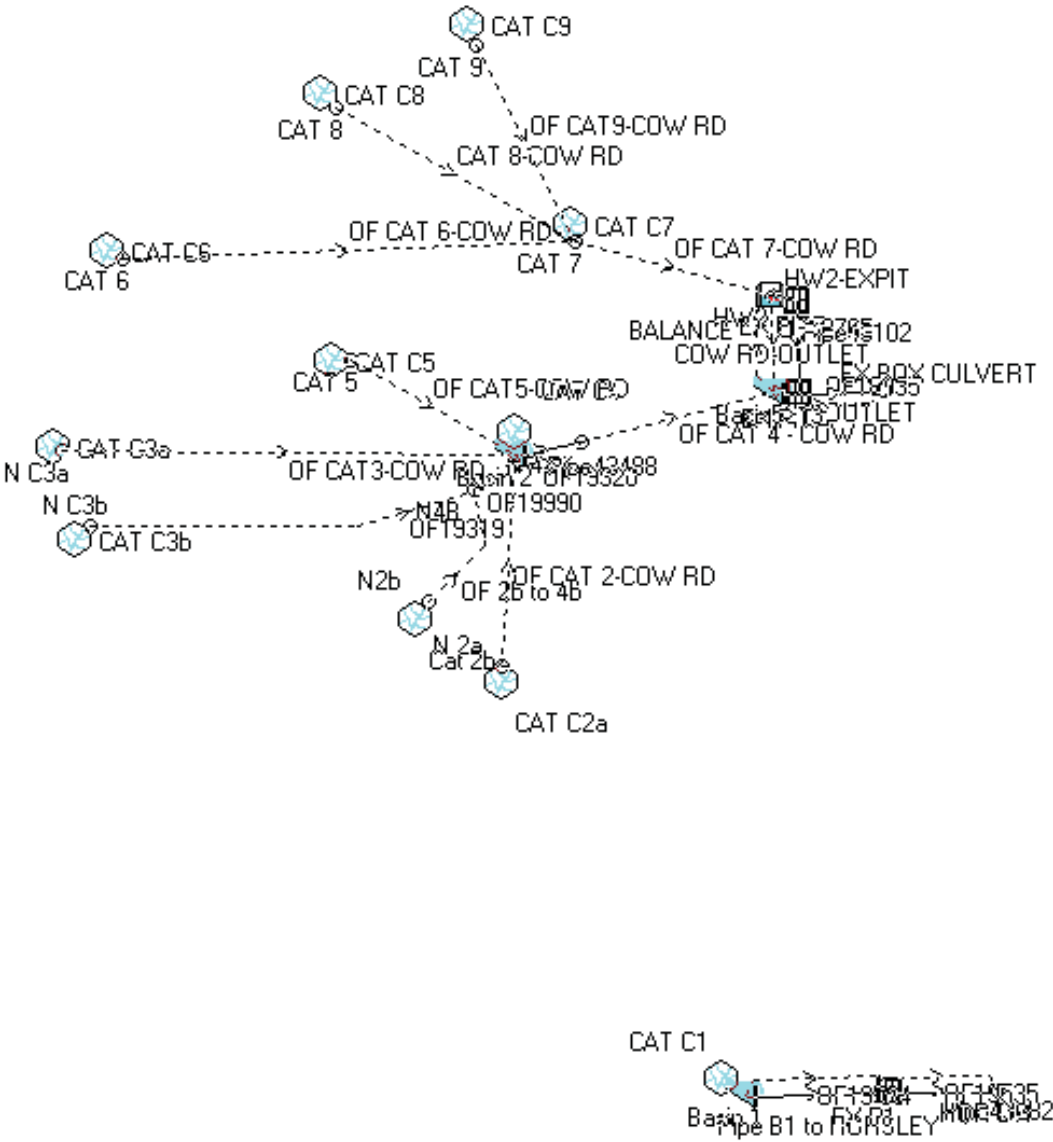
Appendix B

MUSIC MODEL CONFIGURATION



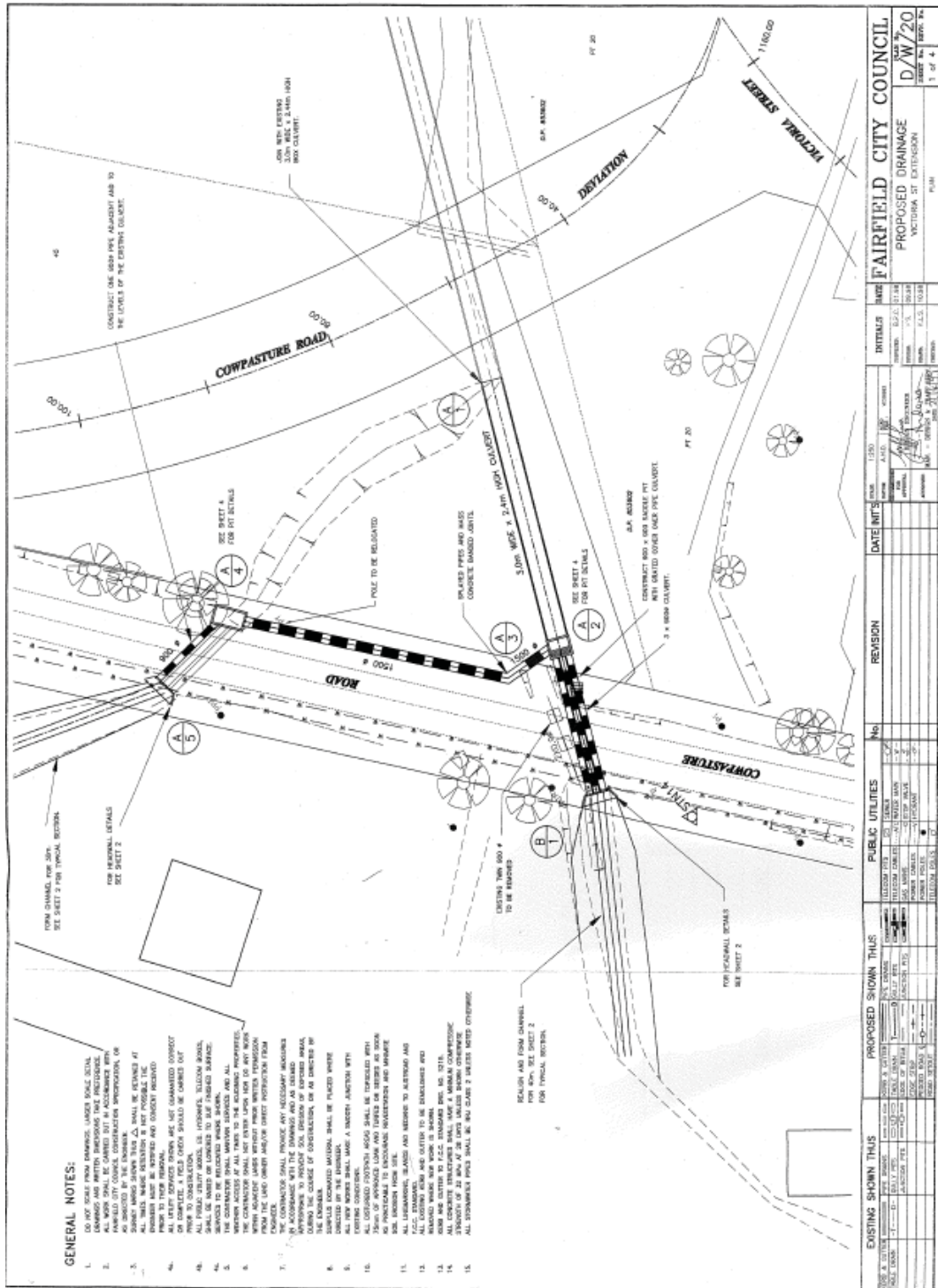
	Sources	Residual Load	% Reduction
Flow (ML/yr)	301	285	5.2
Total Suspended Solids (kg/yr)	54.0E3	5.07E3	90.6
Total Phosphorus (kg/yr)	108	29.7	72.6
Total Nitrogen (kg/yr)	689	378	45.2
Gross Pollutants (kg/yr)	7.99E3	0.00	100.0

POST DEVELOPED LAYOUT



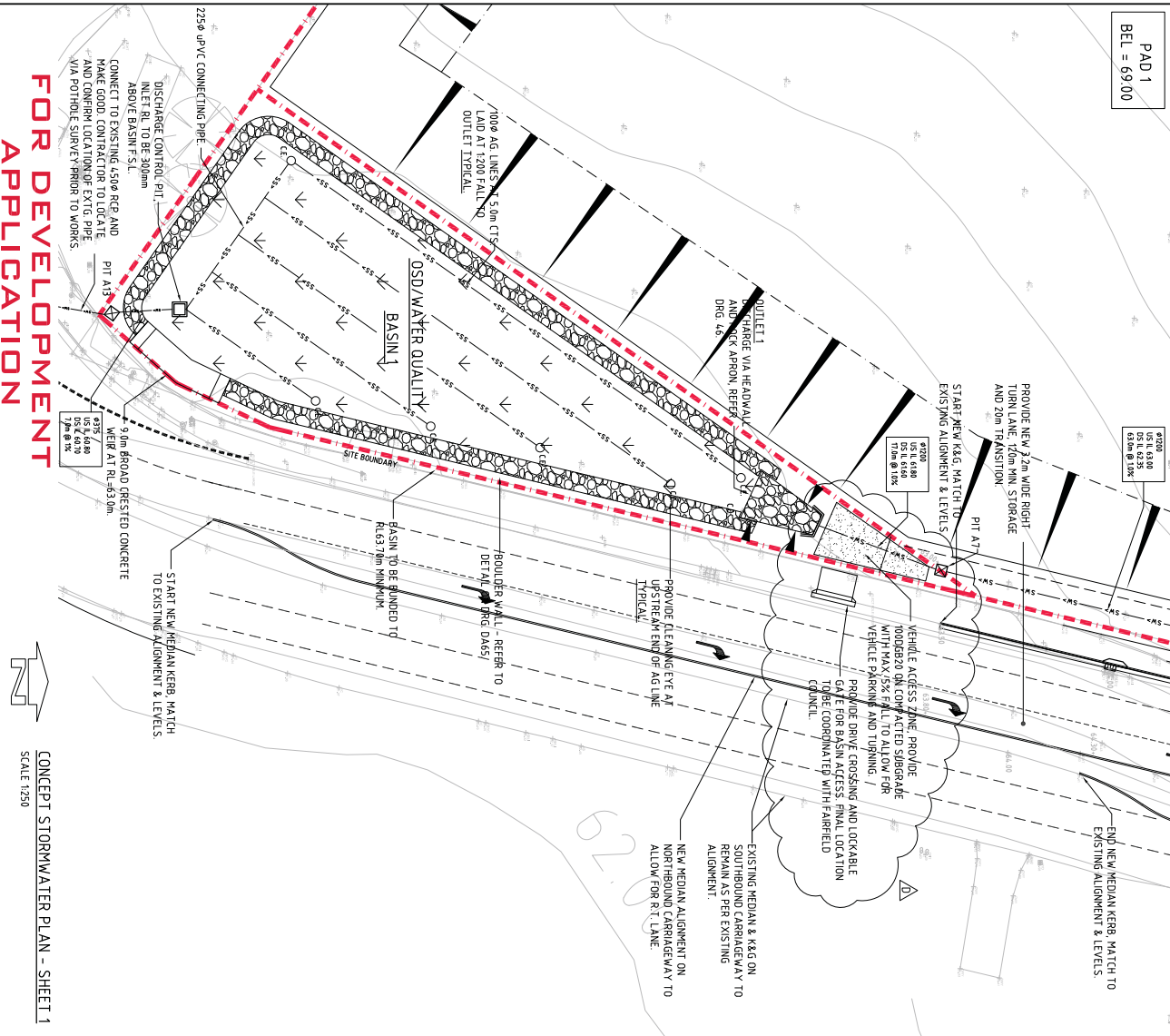
Appendix D

DRAINAGE CONFIGURATION AT COWPASTURE ROAD & VICTORIA STREET INTERSECTION



PAD 1
BEL = 69.00

BREAKLINE - FOR CONTINUATION REFER TO DRAWING DA4.1-2



FOR DEVELOPMENT APPLICATION

INTERSECTION NOTES:
THROUGH LANES TO BE 3.5m MINIMUM
TURN LANES TO BE 3.2m WIDE MINIMUM
EXISTING ROUNDABOUT TO BE DECOMMISSIONED AND NEW
ALL WORKS TO BE COMPLETED IN ACCORDANCE WITH NSW
ROAD AND MARITIME SERVICE (FORMER RTA) REQUIREMENTS.

LEGEND:
LEVELS DATUM IS AHD

- SGGP, SINGLE GRATED GULLY PIT
- SJP, SEALED JUNCTION PIT
- RIP, KERB INLET PIT
- DRAINAGE LINE
- OVERLAID FLOW PATH
- EXISTING DRAINAGE LINE
- FINISHED PAVEMENT SPOT HEIGHT
- FINISHED PAVEMENT CONTOUR (MALOR) 0.5m INTERVALS
- FINISHED PAVEMENT CONTOUR (INORI) 0.1m INTERVALS
- EXISTING SURFACE CONTOUR
- EXISTING SURFACE SPOT HEIGHT

BASIN 1 - WATER QUALITY DETAILS
STORMWATER TREATMENT MEASURE: BIORETENTION
STORAGE PROPERTIES
EXTENDED DETENTION DEPTH: 300mm
STORAGE SURFACE AREA: 1300sqm MIN
FILTER & MEDIA PROPERTIES
FILTRATION AREA: 1150sqm MIN
SAT. HYDRAULIC CONDUCTIVITY: 100m/hr
FILTER DEPTH: 600mm
REFER TO DRG DATA FOR BIORETENTION NOTES AND DETAILS.

BASIN 1 - HYDROLOGIC DETAILS

ARI (yrs)	Storm Duration (hrs)	Flow (m ³ /s)		Water Level (m)	Storage (m ³)
		Pre-attenuated	Post-attenuated		
2	0.5	0.316	1.87	0.235	100
2	2	0.701	1.90	0.347	1350
100	0.5	1.17	3.77	1.407	2300
100	2	2.62	3.83	2.575	2450

CONCEPT STORMWATER PLAN - SHEET 1
SCALE 1:250

DESIGNER	24.03.12	0
FOR INFORMATION ONLY	08.04.12	C
FOR INFORMATION ONLY	07.04.12	B
FOR INFORMATION ONLY	28.03.12	A

CLIENT
Western Sydney
NSW
PARRAMATTA NSW 2150

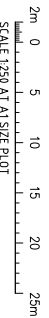
PROJECT
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CNR THE HORSELEY DV & COMPOSTURE RD
WETHERILL PARK, NSW

COORDINATOR
Costin Roe Consulting Pty Ltd
Level 11, 8 National Street
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SCALE
Value in Engineering and Management

DATE
2012.04.11

PROJECT NO.
C011492.00-DA.4.1-1



FOR DEVELOPMENT APPLICATION

CONCEPT STORMWATER PLAN - SHEET 8
SCALE 1:250

LEGEND:
LEVELS (DA41-6 & 7)

EXISTING SITE LEVELS AND DETAILS BASED ON SURVEY INFORMATION PROVIDED BY LAND PARTNERS SURVEYORS DATED 12.04.12

	SGP - SINGLE GRATED GULLY PIT		SGP - SEALED JUNCTION PIT
	KIP - KERB INLET PIT		FINISHED PAVEMENT CONTOUR (M4.0B) 0.5m INTERVALS
	DRAINAGE LINE		FINISHED PAVEMENT CONTOUR (MINOR) 0.1m INTERVALS
	OVERLAND FLOW PATH		EXISTING SURFACE CONTOUR
	EXISTING DRAINAGE LINE		EXISTING SURFACE SPOT HEIGHT

ENGINEER GENERAL DESIGN	24.8.12	D
FOR DEVELOPMENT APPLICATION	08.06.12	C
FOR INFORMATION ONLY	07.06.12	B
FOR INFORMATION ONLY	28.05.12	A

DATE	SSQC	AMENDMENTS
DATE	SSQC	AMENDMENTS

CLIENT

WESTERN SYDNEY PARKLANDS
PARABANDA, NSW 2150

PROJECT

HORSLEY DV. BUSINESS PARK
CNR THE HORSELEY DV. & COMCASTURE RD
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OWNER

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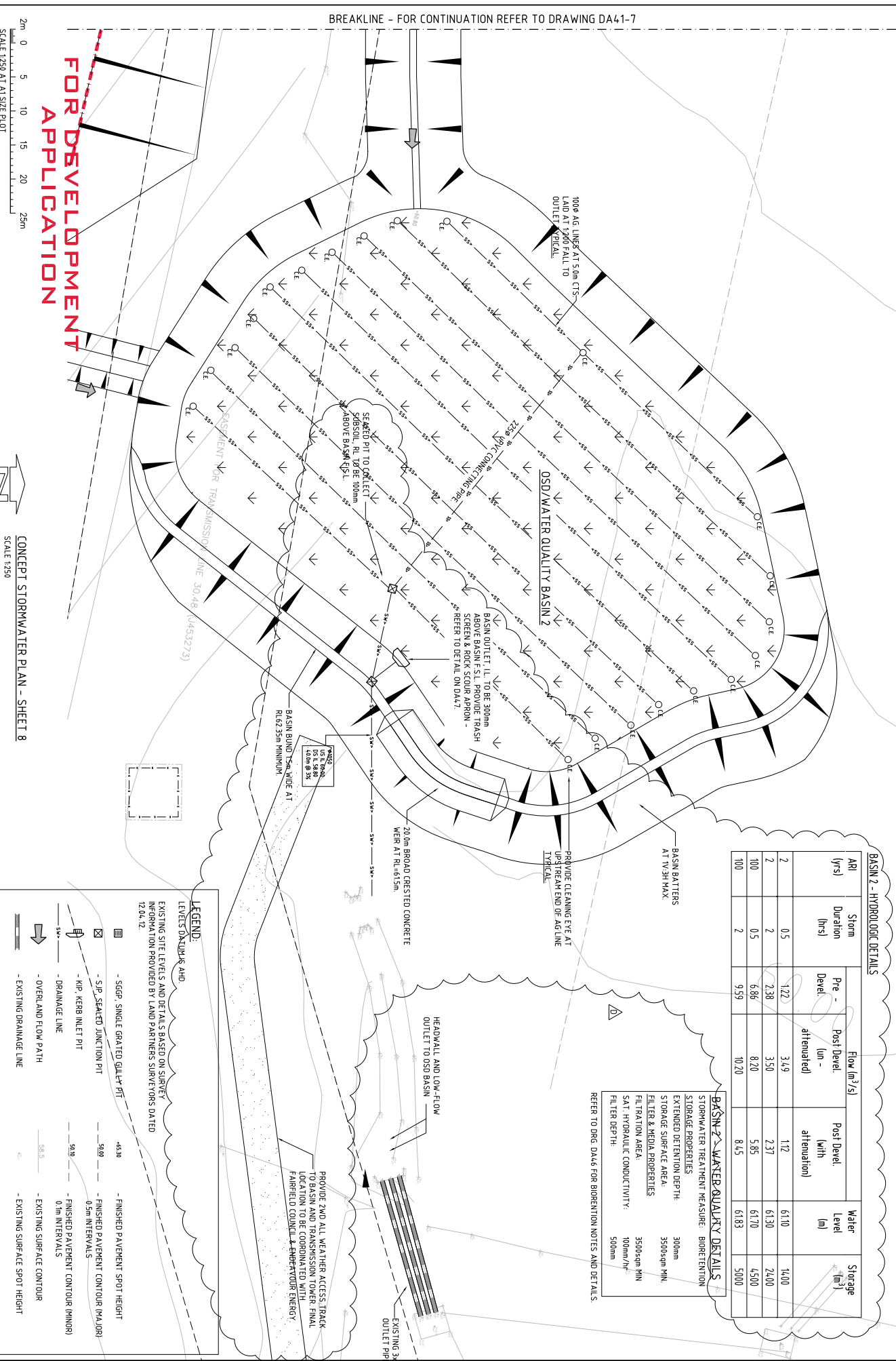
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Costin Roe Consulting

CONCEPT STORMWATER & FINISHED LEVELS PLAN SHEET 8

DATE: 01/14/12 00-DA41-8



BASIN 2 - HYDROLOGIC DETAILS

ARI (yrs)	Storm Duration (hrs)	Pre - Level (un-attenuated)	Post Level (with attenuation)	Water Level (m)	Storage (m ³)
2	0.5	1.22	3.49	6.10	1400
2	2	2.38	3.50	6.30	2400
100	0.5	6.86	8.20	5.85	4500
100	2	9.59	10.20	8.45	5000

BASIN 2 - WATER QUALITY DETAILS

STORMWATER TREATMENT MEASURE: BIORETENTION

STORAGE PROPERTIES

EXTENDED DETENTION DEPTH:	300mm
STORAGE SURFACE AREA:	3500sqm MIN.
FILTER & MEDIA PROPERTIES:	3500sqm MIN.
FILTRATION AREA:	100mm/yr
SAT. HYDRAULIC CONDUCTIVITY:	500mm
FILTER DEPTH:	

REFER TO DRG. DA46 FOR BIORETENTION NOTES AND DETAILS.

BREAKLINE - FOR CONTINUATION REFER TO DRAWING DA41-8

BREAKLINE - FOR CONTINUATION REFER TO DRAWING DA41-6

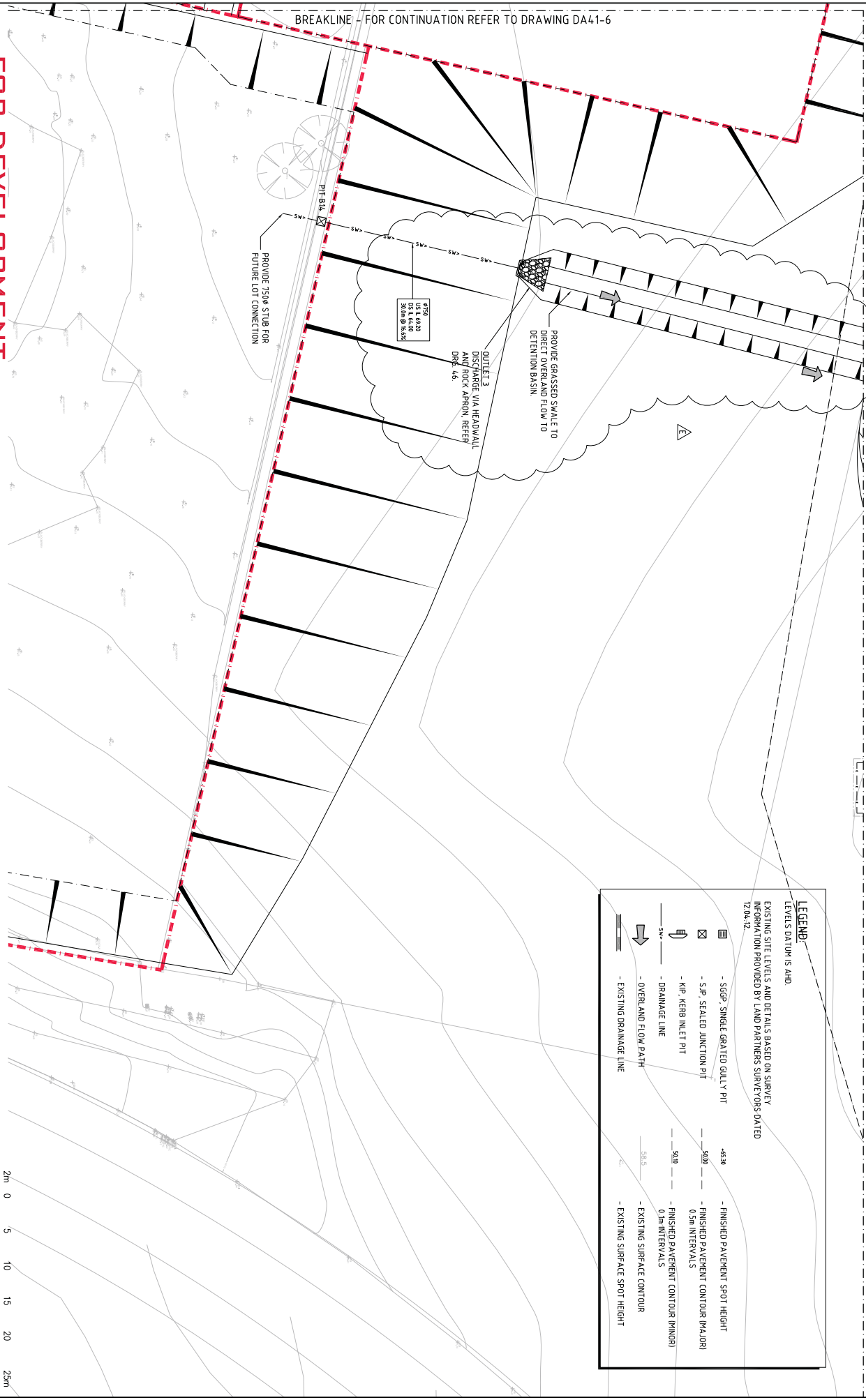
FOR DEVELOPMENT APPLICATION

CONCEPT STORMWATER PLAN - SHEET 9
SCALE 1:250

LEGEND:
LEVELS DATUM IS AHD.

EXISTING SITE LEVELS AND DETAILS BASED ON SURVEY INFORMATION PROVIDED BY LAND PARTNERS SURVEYORS DATED 12.04.12

	- SGGP, SINGLE GRATED GULLY PIT		- FINISHED PAVEMENT SPOT HEIGHT
	- SJP, SEALED JUNCTION PIT		- FINISHED PAVEMENT CONTOUR (MAJOR) 0.5m INTERVALS
	- KIP, KERB INLET PIT		- FINISHED PAVEMENT CONTOUR (MINOR) 0.1m INTERVALS
	- DRAINAGE LINE		- EXISTING SURFACE CONTOUR
	- OVERLAND FLOW PATH		- EXISTING SURFACE SPOT HEIGHT
	- EXISTING DRAINAGE LINE		



REVISIONS SHOWN (NUMBER, DATE, BY)	26.09.12	E	CLIENT	HORSLEY DV, BUSINESS PARK		<p>Costin Roe Consulting Pty Ltd Level 11, 8 Macdonald Street North Sydney, Sydney NSW 1585 Phone: (02) 9387 2000 Email: info@costinroe.com.au</p>	
FOR INFORMATION ONLY	01.06.12	B	PROJECT	CNR THE HORSLEY DV & COMPOSTURE RD WETHERILL PARK, NSW			
FOR INFORMATION ONLY	01.06.12	A	AMENDMENTS	DATE	ISSUE	DATE	ISSUE

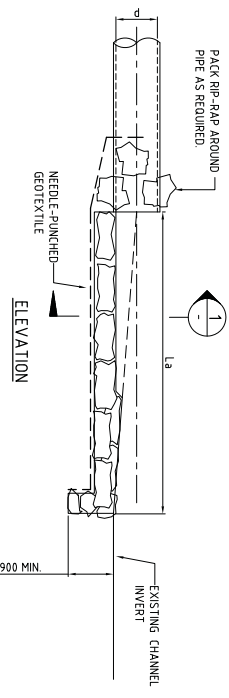
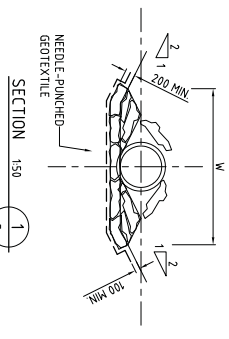
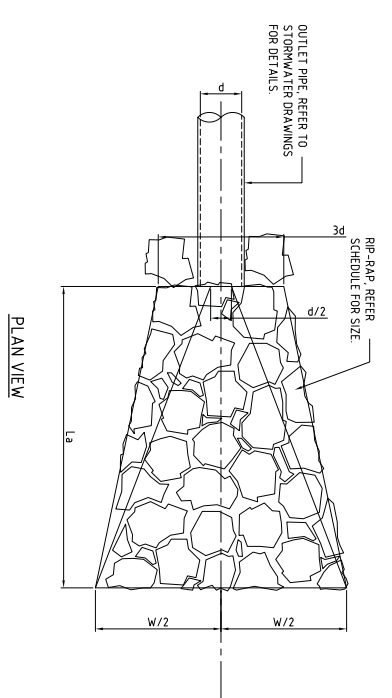
NSW **Partnerships Trust**
WESTERN SYDNEY UNIVERSITY
PARRAMATTA NSW 2150

SCALE 1:250 AT A1 SIZE PLOT

Value in Engineering and Management

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CONCEPT STORMWATER & FINISHED LEVELS PLAN SHEET 9
Drawing No: C011492.00-DA41-9



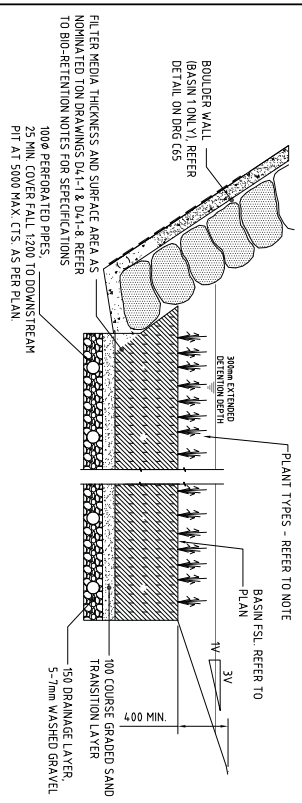
DISSIPATER NOTES:

- 1) PIPE TO REST ON, AND BE PACKED IN, BY RIP-RAP (SEE AS NOTED)
- 2) 100mm DRAINAGE SAND TO BE PLACED OVER EACH PIPE AND PACKED AS NOTED
- 3) GAPS IN RIP-RAP TO BE PLANTED WITH NATIVE SEDGES & RUSHES.

DISSSIPATER SCHEDULE	d	L1	L2	W	RIP-RAP
OUTLET 1	1200	5000	3200	300	300
OUTLET 2	1200	7000	3500	500	500
OUTLET 3	1500	3500	3000	400	400

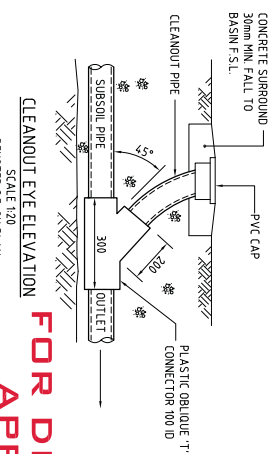
STORMWATER OUTLET DISSIPATER

SCALE 1:50



TYPICAL BIO-RETENTION DETAIL

SCALE 1:20



CLEANOUT EYE ELEVATION

SCALE 1:20

BIO-RETENTION NOTES:

FILTER MEDIA TO BE LOAMY SAND WITH A PERMEABILITY NOT LESS THAN 200mm/hr. FILTER MEDIA TO BE FREE OF RUBBISH, DELETERIOUS MATERIAL, TOXICANTS, DECLARED PLANTS AND LOCAL WEEDS, AND IS TO NOT BE HYDROPHOBIC.

FILTER MEDIA TO HAVE THE FOLLOWING COMPOSITION RANGE:

VERY FINE SAND (0.075-0.15mm)	5-30%
FINE SAND (0.15-0.25mm)	10-30%
MEDIUM TO COARSE SAND (0.25-1.00mm)	40-60%
COARSE SAND (1.0-2.0mm)	7-10%
FINE GRAVEL (2.0-3.4mm)	<3%

FILTER MEDIA THAT DOES NOT MEET THE FOLLOWING CRITERIA SHALL BE REJECTED:

- ORGANIC MATTER CONTENT TO BE IDEALLY WITHIN 1% TO 3% (W/W) AND TO BE NO GREATER THAN 5% (W/W)
- PH TO BE BETWEEN 5.5 AND 7.5
- PHOSPHOROUS CONTENT TO BE NO GREATER THAN 35mg/kg

FILTER MEDIA TO BE ASSESSED BY QUALIFIED HORTICULTURALIST TO ENSURE CAPABILITY OF SUPPORTING PLANT LIFE.

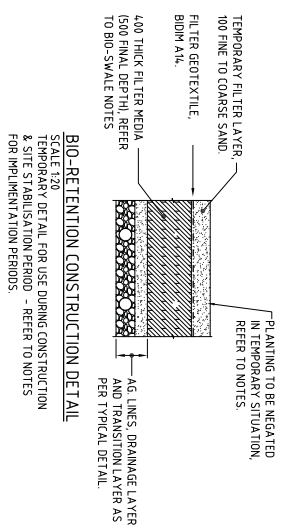
DRAINAGE LAYER TO BE CLEAN GRAVEL 5-7mm.

PROVIDE 100mm TOPSOIL AND TEMPORARY EROSION PROTECTION (LUTEKASTER OR EQUIV) TO SWALE BATTER SLOPES AND ADJACENT LANDSCAPED AREAS NOTE THAT NO TOPSOIL IS TO BE PLACED OVER FILTRATION MEDIA. PROVIDE SILT FENCE TO TOP OF BANK UNTIL SUCH TIME AS THIS STABILISING AND VEGETATION HAS BEEN COMPLETED.

BIO-RETENTION TO BE PARTIALLY INSTALLED FOLLOWING COMPLETION OF THE ROAD WITH THE TOP 75-100mm OF FILTER MEDIA REPLACED WITH A FINE TOPSOIL. THE FINE TOPSOIL IS TO BE PLACED OVER THE REMAINING DETAIL DURING COMPLETION OF THE UPSTREAM DEVELOPMENT AND SITE STABILISATION. THE SANDS IS TO BE REMOVED, REPLACED WITH FILTER MATERIAL AND PLANTED OUT. REFER TO TEMPORARY BIO-BASIN DETAIL PRIOR TO PLANTING. THE TOP 100mm OF THE BIO-RETENTION FILTER MEDIA IS TO BE AMENDMENTED WITH APPROPRIATE ORGANIC MATTER, FERTILISER AND TRACE ELEMENTS TO AID PLANT ESTABLISHMENT AS PER THE TABLE BELOW.

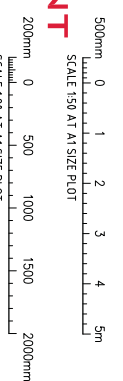
TABLE 1: BIODIVERSITY AND PLANTING REQUIREMENTS FOR BIO-RETENTION

CONSTITUENT	QUANTITY (KG/M2) OF FILTER MEDIA
GRANULATED POLYMER BINDER	50
HYDROLYSABLE NITROGEN	2
PHOSPHOROUS	2
FERTILISER (NPK 16:16:16)	4
TRACER	20



BIO-RETENTION CONSTRUCTION DETAIL

SCALE 1:20
 SCALE 1:50 AT A1 SIZE PLOT
 SCALE 1:20 AT A1 SIZE PLOT



FOR DEVELOPMENT APPLICATION

REVISION NUMBER	25.01.12	C
FOR DEVELOPMENT APPLICATION	08.06.12	B
AMENDMENTS	01.06.12	A



PROJECT
 HORSELEY DV BUSINESS PARK
 CORNER THE HORSELEY DV & COMPASTURE RD
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