WATER CYCLE MANAGEMENT REPORT

344 PARK ROAD WALLACIA

PROJECT NO:7410

VERSION R.1

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PD Engineer to amend	DG
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TABLE OF CONTENS

ACRONYMS AND ABBREVIATIONS

AEP	ANNUAL EXCEEDANCE PROBABILITY
AHD	AUSTRALIAN HEIGHT DATUM
CL	CONTINUOUS LOSS
DA	DEVELOPMENT APPROVAL
GIS	GEOGRAPHIC INFORMATION SYSTEM
GPT	GROSS POLLUTANT TRAP
IL	INITIAL LOSS
LGA	LOCAL GOVERNMENT AUTHORITY
MUSIC	MODEL FOR URBAN STORMWATER IMPROVEMENT CONCEPTUALISATION
OSD	ONSITE DETENTION
POI	POINT OF INTEREST
PSD	PERMISSIBLE SITE DISCHARGE
SCMA	SYDNEY CATCHMENT MANAGEMENT AUTHORITY
WSUD	WATER SENSITIVE URBAN DESIGN
LEP	LOCAL ENVIRONMENTAL PLAN

1. INTRODUCTION

This Water Cycle Management Report has been prepared to support a Development Application to council pre lodgement advice ref PL/0115 at 344 Park Road Wallacia.

The scope of this report includes an assessment of the water cycle management requirements to support the proposed development. Accordingly, this report includes findings of the assessment and proposes a best practice water cycle management strategy.

1.1 SITE

The site is 344 Park Road Wallacia (Lot 5 DP655046) is located on the southern side of Park Road. The Lot site has total area of 20.15Ha with the north eastern portion of subject site is developed RU1 Primary Production zone under Penrith LEP 2010. The lot site is located in the Duncan Creek catchment with creek forming the south boundary of the lot site and existing local overland flow travel across the subject site towards north western boundary to Mulgoa Creek catchment.

The site falls evenly from RL 80m AHD at the eastern boundary of the site to RL 78m AHD on the western boundary. The south eastern of lot site, the subject site area 2.76 Ha has been substantially cleared from previous uses and is covered with grass, bitumen, single house and trees.

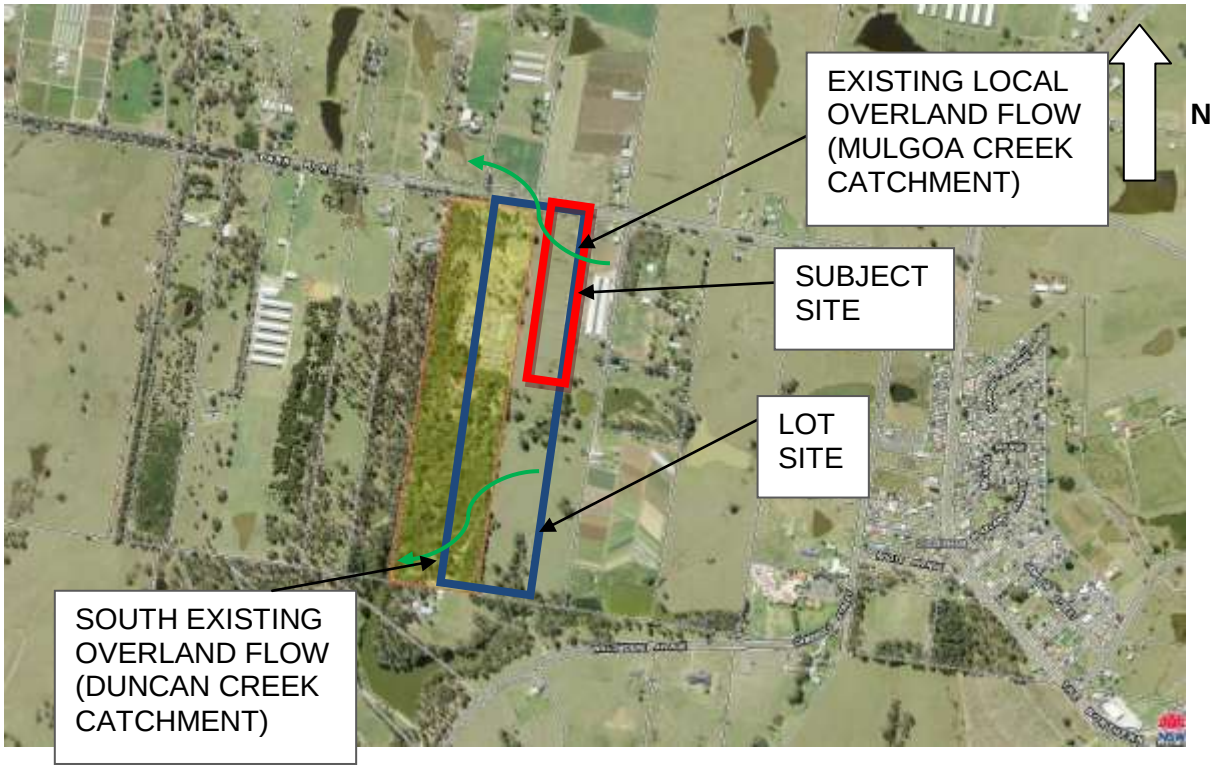


Figure 1.1 - Locality Map

SOURCE: SIXMAP

1.2 PROPOSED DEVELOPMENT

The proposed development is to build resource recovery facility means a building used for the recovery of resources from waste, including works or activities such as separating and sorting, processing or treating the waste and temporary storage. The future use comprises of a private road, building, landscape/pavement and existing house as shown in Appendix A.

To address the Council's stormwater requirements for on-site detention and storm water quality treatment ie: Bioretention, Gross Pollutant Trap and rainwater tank are to be built as described in Onsite Detention and Water Quality Strategy section.

Proposed culverts and to maintain existing riparian corridor within overland flow path travel under proposed internal road within subject site which as per council advise will be described in Overland flow Analysis section.

Engineering concept design on the proposed water cycle management strategy are provided in figure 1.2 below below to comply with council planning requirement.

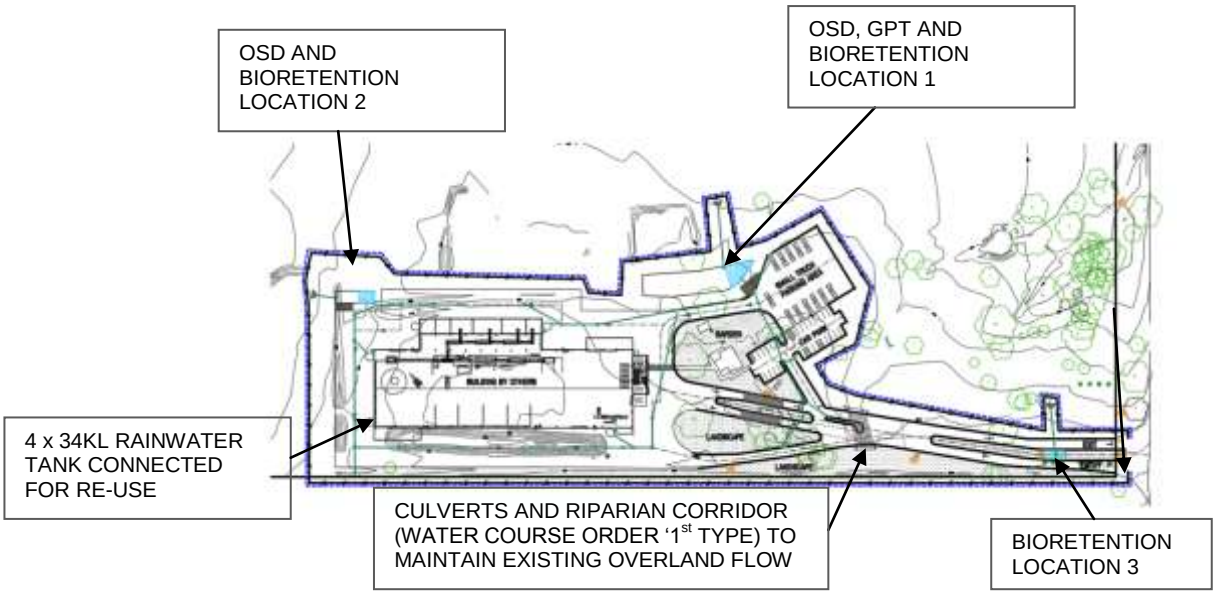


Figure 1.2 – Proposed Stormwater Drainage SOURCE: ENGINEERING CONCEPT PLAN

2. COUNCIL REQUIREMENTS

The site is located within the Penrith City Council LGA and as such the following specific requirements and guidelines have been adopted:

- Pre-Logdment Advice Ref; PL17/0115 dated 23 November 2017
- Penrith Development Control Plan 2014

- Penrith Stormwater Drainage Policy ES002 dated 28 November 2016
- Penrith City Council WSUD Technical Guidelines Addendum 1 – Deemed to Comply Toolkit dated June 2015 (Version 1)
- Guidelines for Riparian Corridors on Waterfront lands – NSW Department of Primary Industries Office of Water
- Penrith Flood Information dated 26 March 2020

3. STORMWATER ANALYSIS OVERVIEW

To determine the appropriate discharge control for the site and external flow, QGIS water shed analysis was used to define an existing stream flow and subcatchment within lot site. As seen from figure 3.1 below, there are 3 local streamflows arriving from subject site.

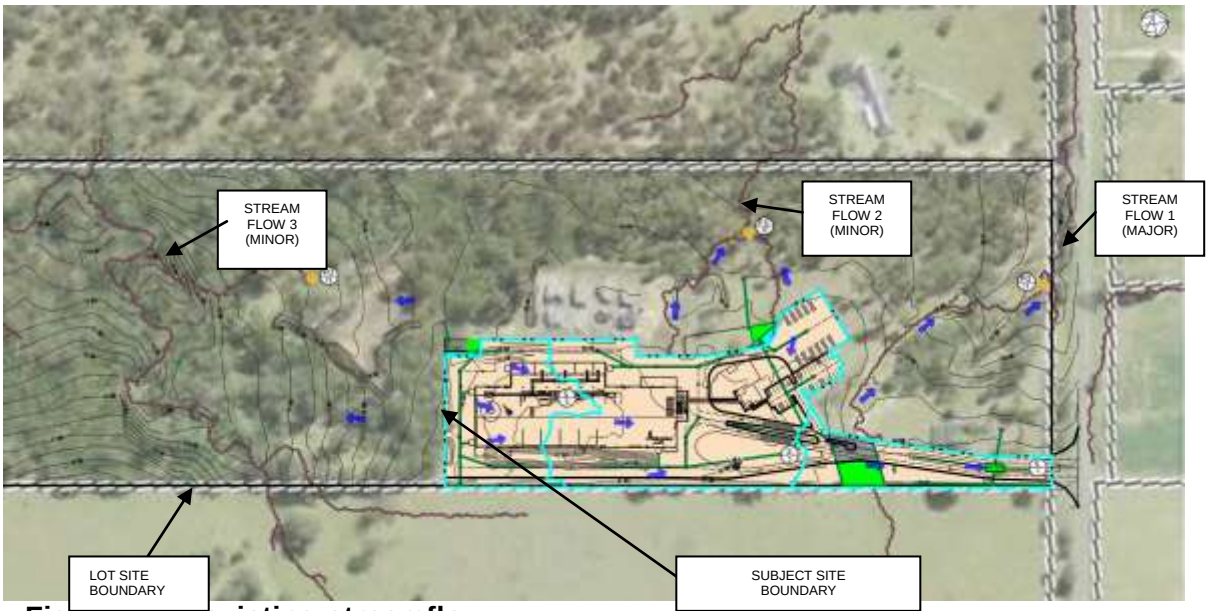


Figure 3.1 – existing streamflow source: QGIS watershed

The purpose of this analysis is to maintain existing major streamflow 1 by constructing proposed culverts for internal road.

As per Penrtih Onsite Detention Policy, DRAINS hydrological computer software was set up to maintain permissible site discharge and site storage requirement for subject site.

A site specific MUSIC model was developed to analyse the stormwater quality treatment train. These models are discussed in the following sections.

3.1 HYDROLOGICAL ANALYSIS

3.1.1 Hydrological model setup

The IFD data was obtained from IFD 1987 for subject site location as the following Table 3.1 below.

Table 3.1 – IFD1987 data

$2I_1$	$^2I12$	$^2I72$	$50I_1$	$50I_{12}$	$50I_{72}$	F2	F50	G
29.29	6.65	1.93	59.52	13.24	4.39	4.3	15.79	0.02

The DRAINS parameter shall be used as the following table 3.2

Table 3.2 –DRAINS Parameter

HORTON/ILSAX TYPE HYDROLOGY MODEL

Paved (impervious) area depression storage (mm)	1
Supplementary area depression storage (mm)	1
Grassed (pervious) area depression storage (mm)	5
Soil Type	3
Overland flow Use	Kinematic wave equation

3.2 CATCHMENT AREAS

A Combination of orthophoto map imagery, GIS information, detailed survey and confirmation was used to determine the internal and external catchment areas into the existing site conditions. The total drainage area to the outlet receiving node (RN) is shown in figure 3.2 below.

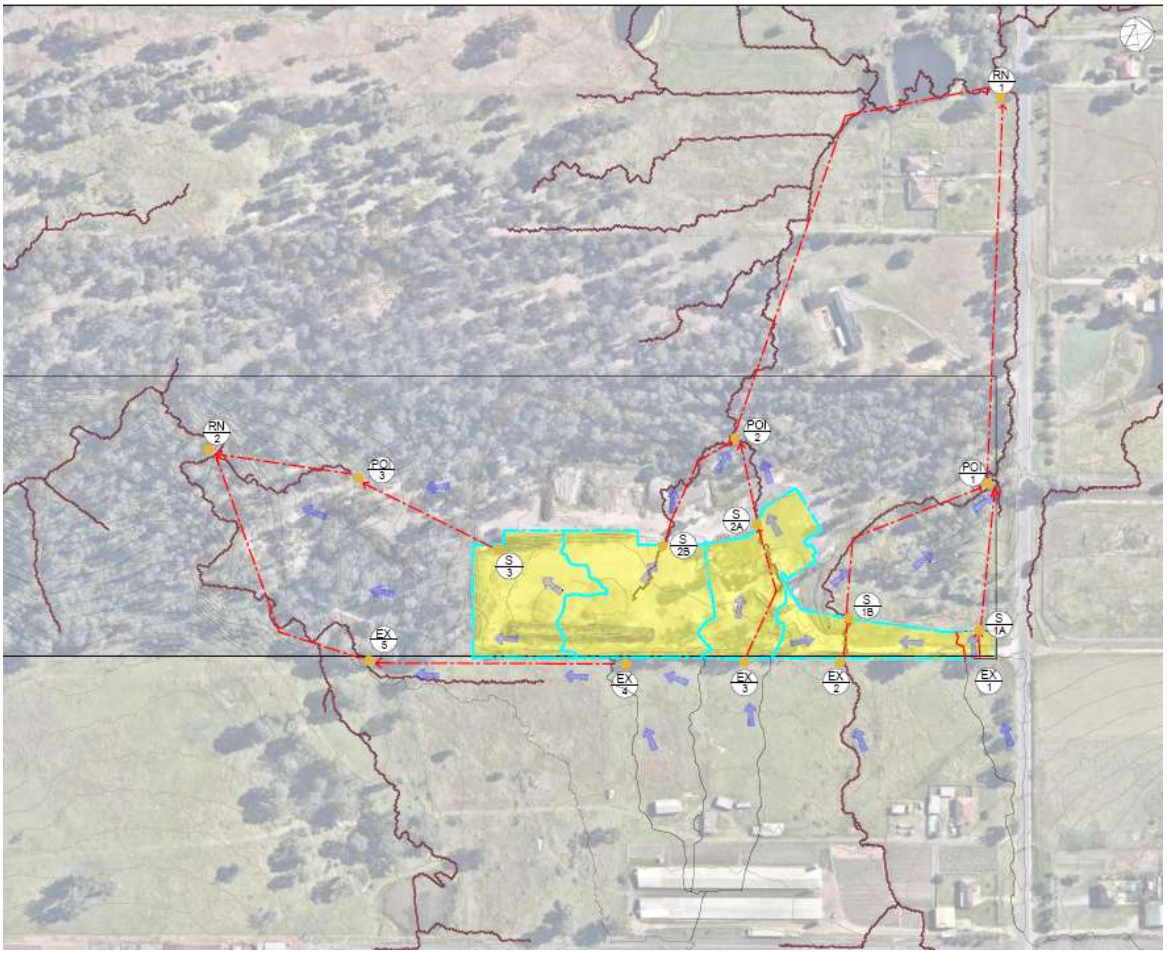


Figure 3.2 – Existing Catchment Plan Source: QGIS Model

The catchment is splitted into internal and external (upstream) subcatchment at the following subcatchments table 3.3 and figure 3.3.

Table 3.3 – Existing Subcatchment

SUBCATCHMENT ID	SUBCATCHMENT	AREA (Ha)
INTERNAL		
S1A	EXISTING	0.057
S1B	EXISTING LAND	0.413
S2A	EXISTING HOUSE	0.703
S2B	EXISTING HOUSE	0.951
S3	EXISTING	0.652
	TOTAL	2.777
EXTERNAL		
EX1	EXISTING	0.444
EX2	EXISTING	13.505
EX3	EXISTING	0.840
EX4	EXISTING	0.702
EX5	EXISTING	1.814
	TOTAL	17.305

The DRAINS model was constructed using nodes and links. Detailed information on the existing case model is shown Figure 3.3

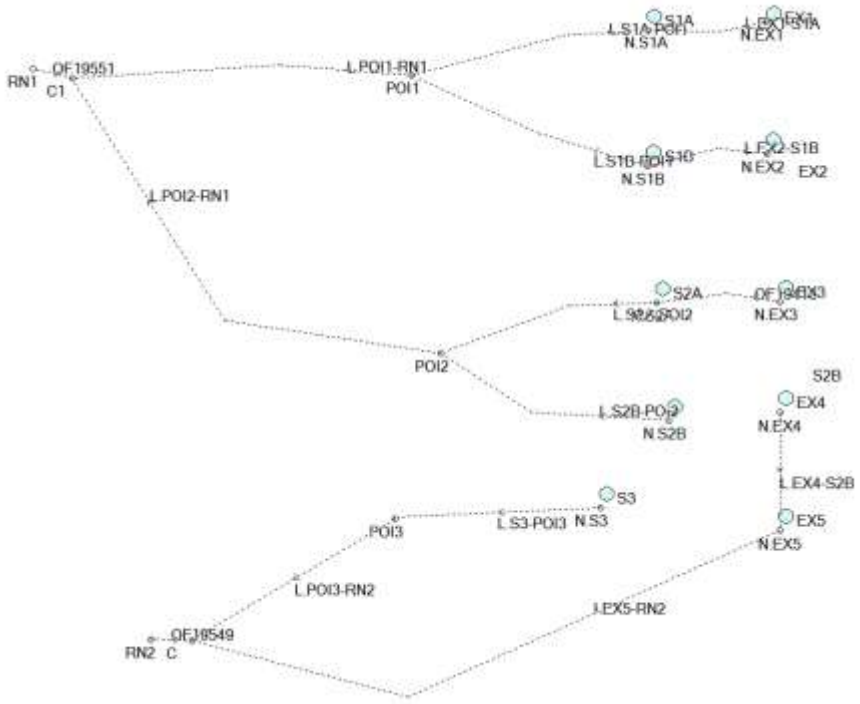


Figure 3.3 – DRAINS Hydrology Structure Existing Catchment Source: DRAINS model

3.3 EXISTING FLOWS

The existing flows at RN1 (middle west boundary) and RN2 (south west boundary) are critical locations and the adopted Permissible Site Discharge (PSD) for the site (Existing) at is summarised in table 3.4:

Table 3.4 – Permissible Site Discharge

FLOW SUMMARY NODE RN1

STORM EVENTS AEP (%)	EXISTING (m^3/s)
0.5EY	1.325
0.2EY	2.401
10	2.953
5	3.686
2	4.416
1	5.16

FLOW SUMMARY NODE RN2

STORM EVENTS AEP (%)	EXISTING (m^3/s)
0.5EY	0.386
0.2EY	0.638
10	0.777
5	0.953
2	1.142
1	1.326

4. OVERLAND FLOW ANALYSIS ON PROPOSED INTERNAL ROAD

Flood information from council shown that 1%AEP local overland flow flood level as indicated on the map below in white colour RL does not affect proposed building and only impact on the proposed driveway.

Figure 4.2 1%AEP Flood Level

Source: Council Flood Information

The protection, restoration of vegetated riparian corridors is important for maintaining the shape, stability and ecological functions of a watercourse and overland flow channel.

According to watercourse type in sixmap, this existing watercourse does not exhibit the features of a defined channel with bed bank. Therefore, the watercourse under the proposed driveway is not waterfront land for the purposes of Water Management Act. However, 10m riparian corridor both side and 6.6m wide existing channel will be maintained in landscape area.

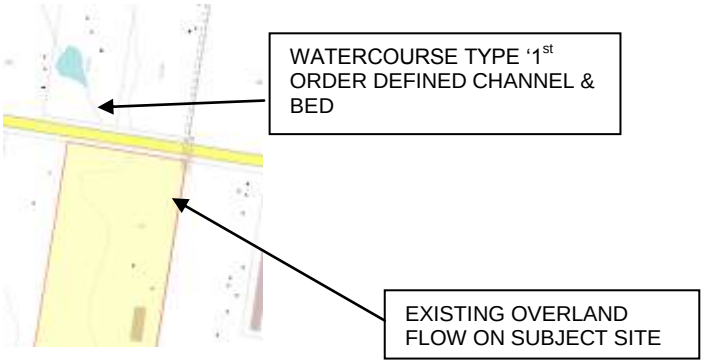


Figure 4.1 Watercourse Type map

Source: Six Map

4.1 PROPOSED CULVERT

The existing overland flow channel width is maintained by designing new culverts underneath proposed driveway as shown in Figure 4.2:

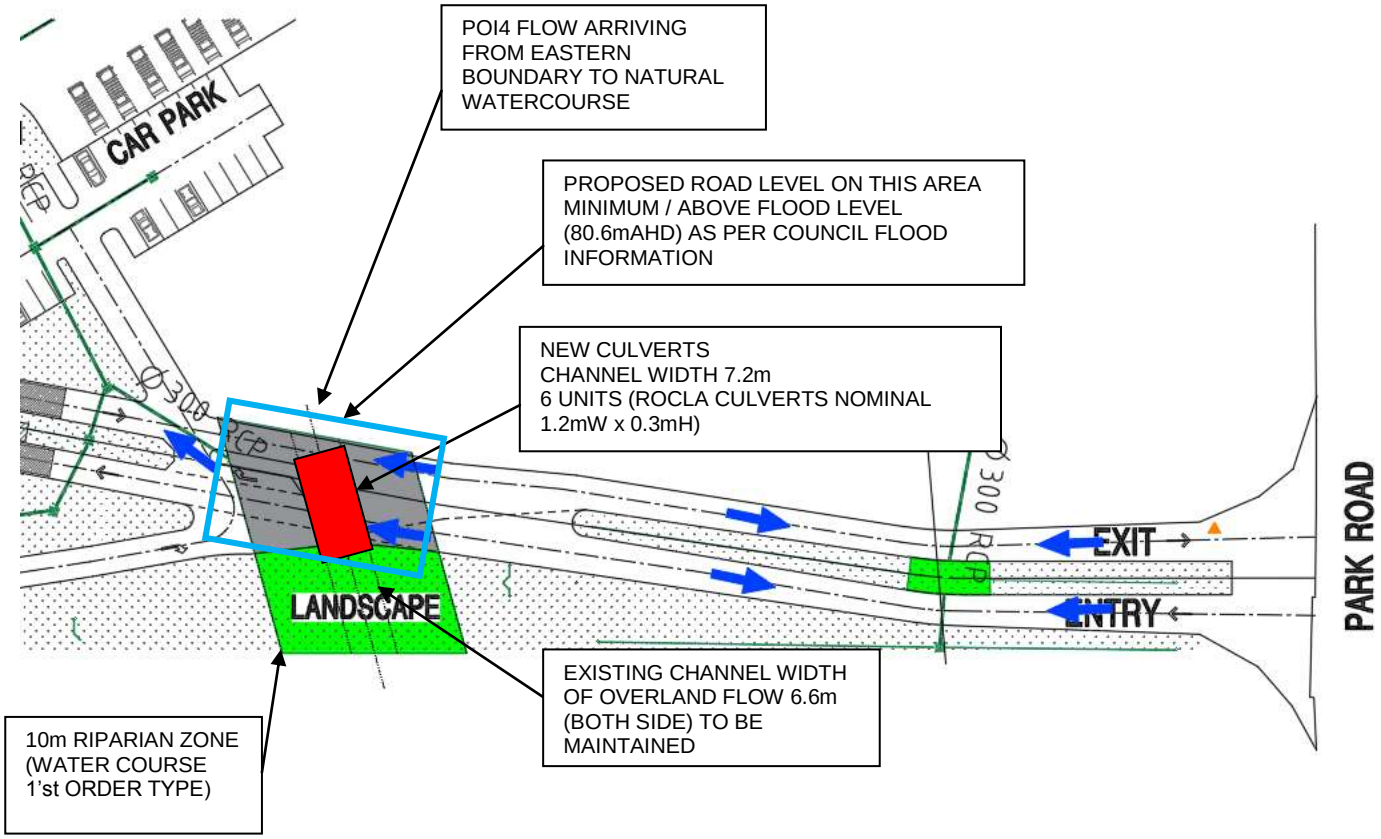


Figure 4.2 – New Culverts Location

Source: Engineering Plan

Refer to engineering drawing sheet no 7410-DA-415 for culvert design calculation and detailed drawing.

4.1.1 UPSTREAM CATCHMENT

Upstream catchment flow into node POI4 is approximately 14.99Ha

Table 4.1 – OVERLAND FLOW CATCHMENT SCHEDULE

SUBCATCHMENT ID	SUBCATCHMENT	AREA (Ha)
INTERNAL		
E	LANDSCAPE	0.206
EXTERNAL		
EX1	EXISTING	0.444
EX2	EXISTING	13.505
EX3	EXISTING	0.840
TOTAL		14.995

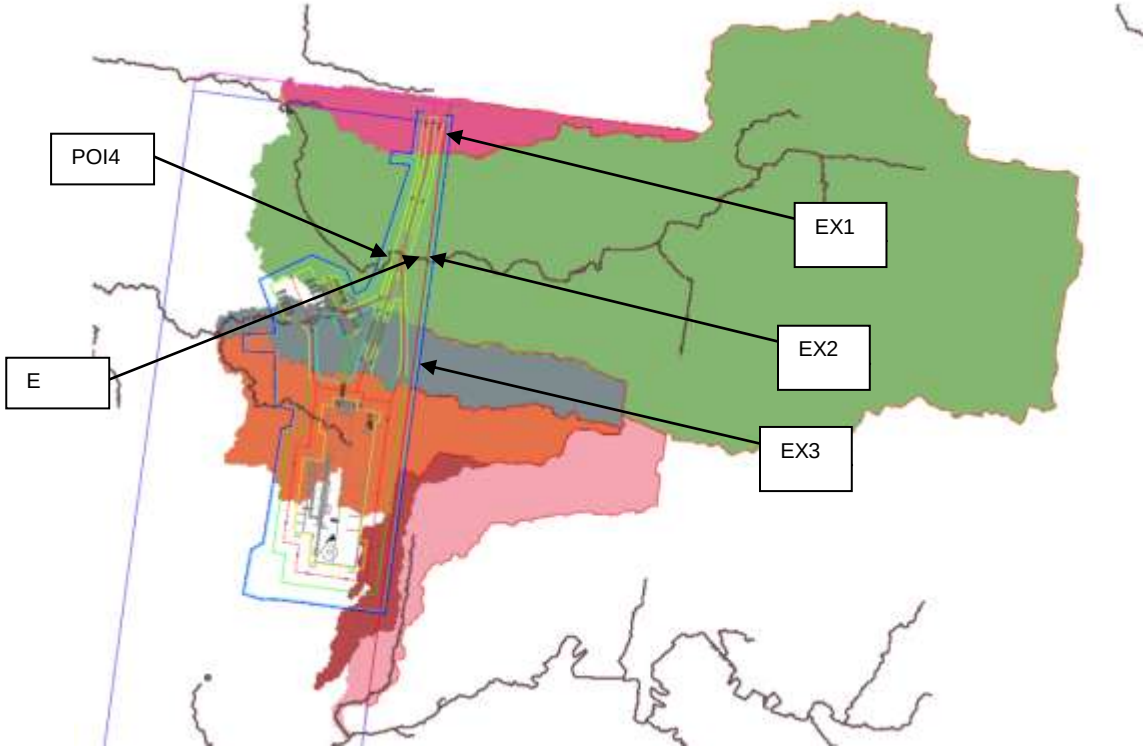


Figure 4.3 Upstream Catchment Source QGIS watershed analysis

The upstream inflow arriving at POI4 flow was calculated in a DRAINS model.

Table 4.1 – FLOW SUMMARY NODE POI4

STORM EVENTS AEP (%)	FLOW (m3/s)
0.5EY	1.03
0.2EY	1.89
10	2.41
5	3.08
2	3.76
1	4.39

5. ONSITE DETENTION DESIGN

Given the configuration of existing streamflow through the site, 2 OSD are required to locate in middle and southern west boundary to maintain permissible site discharge as per existing discharge point. The proposed internal road area at northern side primarily is bypass discharged to north western boundary.

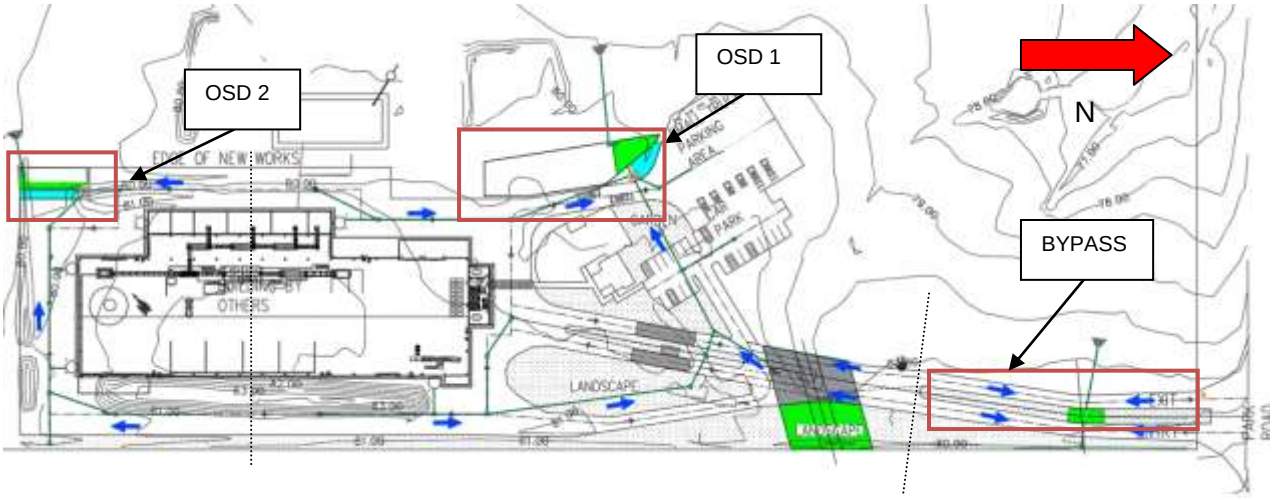


Figure 5.1 Engineering Concept Plan

Source Engineering Plan

The developed case DRAINS model has been structured to simulate the post-development flows from the site with a simplified predevelopment model. Whilst this model is of a uncomplicated structure, it provides a robust indication of the stormwater runoff and storage requirements, as well as readily comparing the pre and post development flows from the site. The design DRAINS model layout is shown in Appendix B

To determine a compliance with the OSD requirement (which is to compare the total peak post development flow rates with the predevelopment for a range of storm events) the basin's outlets will need to be capable of detaining the range of flows for all these events. In the event of total blockage of the outlet pipe from the basin, an emergency overflow weir is provided and it will drain into the open space at the bottom of the site and into the existing watercourse.

The table below summarises the peak flow from the developed site compared to the PSD:

Table 5.1 – FLOW SUMMARY

Source: DRAINS Output

FLOW SUMMARY NODE RN1

STORM EVENTS AEP (%)	EXISTING (m^3/s)	POST DEVELOPMENT (m^3/s)
0.5EY	1.325	1.143
0.2EY	2.401	2.048
10	2.953	2.605
5	3.686	3.325
2	4.416	4.028
1	5.16	4.686

FLOW SUMMARY NODE RN2

STORM EVENTS AEP (%)	EXISTING (m^3/s)	POST DEVELOPMENT (m^3/s)
0.5EY	0.386	0.38
0.2EY	0.638	0.581
10	0.777	0.694
5	0.953	0.842
2	1.142	0.997
1	1.326	1.145

Table 5.2 – Post Development Flow & Onsite Detention 1

Source: DRAINS Output

AEP (%)	STORM EVENTS YEAR ARI	Q ENTRY m3/s	Q EXIT m3/s	Q REDUCTION m3/s	PONDING DEPTH m	WATER LEVEL mAHD	VOLUME m3	ORIFICE mm
0.5EY	2	0.276	0.103	0.173	0.24	79.44	338.2	400
0.2EY	5	0.359	0.138	0.221	0.28	79.48	370.5	400
10	10	0.395	0.175	0.22	0.32	79.52	409	400
5	20	0.511	0.213	0.298	0.4	79.6	475.2	400
2	50	0.597	0.238	0.359	0.49	79.69	557.6	400
1	100	0.703	0.256	0.447	0.57	79.77	628.4	400

OSD RL BASE 79.2

Table 5.3 – Post Development Flow & Onsite Detention 2

Source: DRAINS Output

AEP (%)	STORM EVENTS YEAR ARI	Q ENTRY m3/s	Q EXIT m3/s	Q REDUCTION m3/s	PONDING DEPTH m	WATER LEVEL mAHD	VOLUME m3	ORIFICE mm
0.5EY	2	0.139	0.093	0.046	0.32	79.12	76.5	280
0.2EY	5	0.157	0.103	0.054	0.39	79.19	89.7	280
10	10	0.17	0.108	0.062	0.42	79.22	96.5	280
5	20	0.187	0.114	0.073	0.47	79.27	105.9	280
2	50	0.204	0.126	0.078	0.52	79.32	116.6	280
1	100	0.22	0.125	0.095	0.57	79.37	126.5	280

OSD RL BASE 78.8

To detain the post development flows to pre development conditions an OSD basin as shown in table 5.4 and DRAINS Output in Appendix B

Table 5.4 – Post Development Flow & Onsite Detention

Source: DRAINS Output

BASIN 1%AEP	BASIN VOLUME REQUIRED (m3)	MAXIMUM BASIN STAGE (m)	BASIN VOLUME PROVIDED (m3)
OSD 1	628.4	0.57	692
OSD 2	126.5	0.57	154
TOTAL	754.9		

6. STORMWATER QUALITY TREATMENT

6.1 PROPOSED TREATMENT MEASURES

This WSUD strategy has been developed in accordance with the Penrith City Council's requirements and guidelines, as well as industry best practice. The proposed treatment trains consists of the following table 6.1:

Table 6.1 – MUSIC Treatment Train Source: MUSIC treatment Node

TREATMENT TRAIN	TYPE	UNIT	SIZE	QTY
BIORETENTION 1	450 mm FILTER MEDIA	m2	100	1
BIORETENTION 2	450 mm FILTER MEDIA	m2	50	1
BIORETENTION 3	450 mm FILTER MEDIA	m2	50	1
GPT SPEL	VORTCEPTOR SVI.055M	ls	1	1
GPT SPEL	VORTCEPTOR SVI.025	ls	1	1
RAINWATER TANK	RT-40 KINGSPAN	kL	40KL *	4

* ALLOWED 20% LOSS (32KL)

Bioretentions and GPT SPEL (or approved equivalent) located near the private road for future maintenance access. Refer to Appendix D WSUD Maintenance Activity. This system has been designed to manage the pollutant loads from the site to meet the required targets.

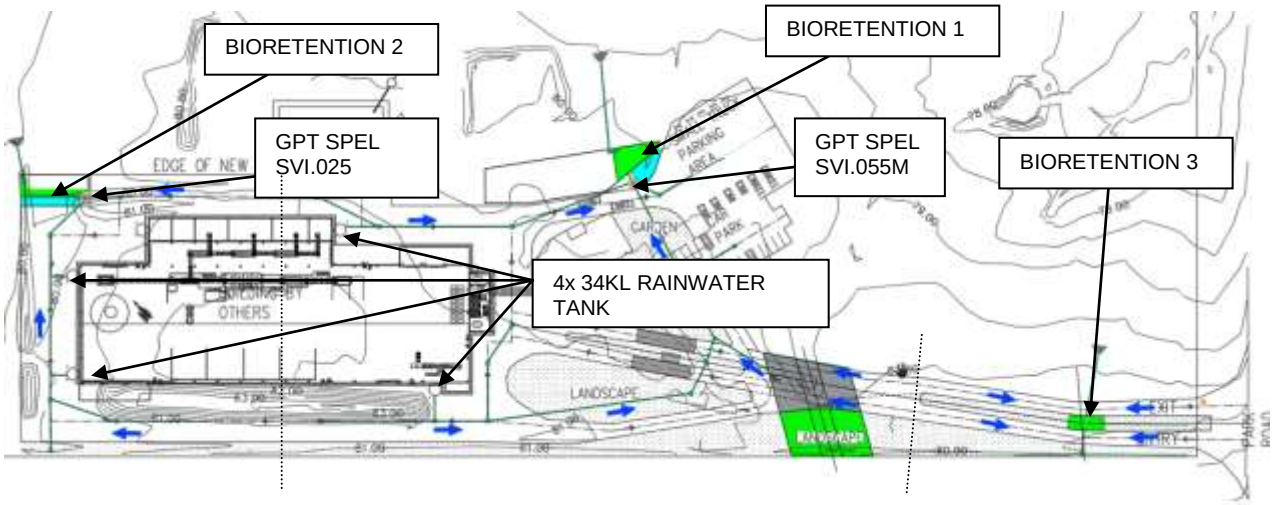


Figure 6.1 Concept Plan Source Engineering Plan

The treatment train for the site has been modelled using the MUSIC stormwater quality modelling software, as required by Council. The modelling parameters have been adopted Penrith City Council MUSIC Link template for all inputs including rainfall and evaporation, rainfall-runoff, pollution generation and treatment node parameters.

The objective of the WSUD strategy is to capture the following percentage of the following pollutant loadings:

- Total Suspended Solids 85 %
- Total Phosphorus 60 %
- Total Nitrogen 45 %

- Total Gross Pollutant 90 %

6.2 PROPOSED TREATMENT MEASURES

This WSUD strategy prescribes the use of 3 major components, as described below.

6.2.1 Bioretention

A standard bioretentention consists of 400mm depth filter media planted to collect stormwater runoff from driveway. The total filter area is 200m^2 with 300 mm Extension Detention Depth are located in 3 different locations on each outflow.

6.2.2 Rainwater Tanks

At this stage, the MUSIC model has a four x 34KL tank to simulate stormwater harvesting for washing facility building ie: floor at daily use and toilet. An overflow from the tank is to be connected to the stormwater system and conveyed to the stormwater management system for the site. It is assumed 100% Roof catchment drains to rainwater tank. Half or roof area drain to OSD 1 and the other half drain to OSD 2.

The water demand is estimated for industrial development is as follows:

Table 6.2 - Water Reuse Calculation Source: Blacktown Council Developer HandBook Water Sensitive Urban Design pg 92

DEMAND USE TYPE	NO	RATE	UNIT	TOTAL DEMAND	UNIT
WASHING MACHINE FACILITY	1	100	kL/day	100	kL/day
TOILETS	3	0.1	KL/day/toilet	0.3	kL/day
				100.3	kL/day

6.2.3 Gross Pollutant Trap (GPT)

The proposed GPT SPEL Vortceptor (refer to Appendix D) or equivalent also can take into account industrial catchment characteristics, hydraulic site, system capacities, velocity, backwater as well as the location of services and access for maintenance shown in Figure 6.2 below as inline system.

ISOMETRIC VIEW

Figure 6.2 – GPT inline Structure Source: SPEL info

The MUSIC model layout is shown in Figure 6.3.

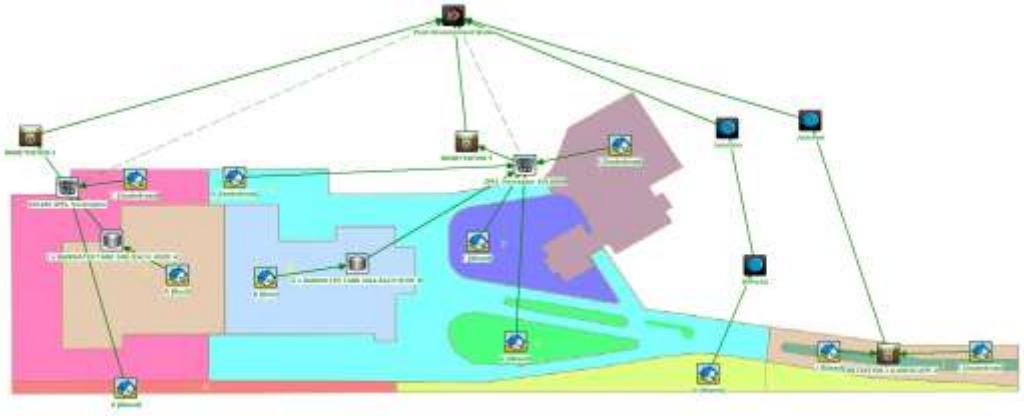


Figure 6.3 – MUSIC MODELLING – Post Development Source: MUSIC Model

6.3 RESULTS

The estimated treatment train effectiveness is summarised in the table below:

Table 6.3 – MUSIC Result Source: MUSIC Output

POLLUTANT DICHARGE TREATMENT	SOURCES	RESIDUAL LOAD	% REDUCTION
Flow (ML/yr)	13.8	9.95	27.9
Total Suspended Solids (kg/yr)	3340	356	89.4
Total Phosphorus (kg/yr)	6	1.45	75.7
Total Nitrogen (kg/yr)	32	13.6	57.3
Gross Pollutants (kg/yr)	380	2.54	99.3

Refer Appendix C to MUSIC link result.

7. CONCLUSION

This report is submitted for Council's review and approval and should be read in conjunction with the water cycle plan drawings submitted for a planning proposal of proposed works.

Based on the proposed stormwater drainage concept the key features are:

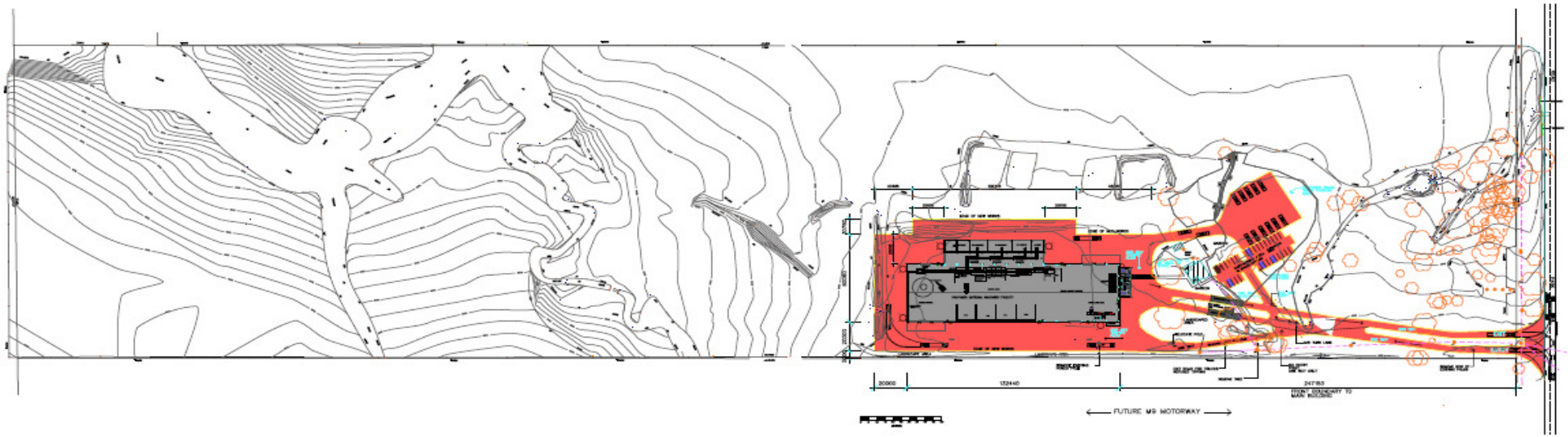
- Post-development flows will be attenuated to at least pre-development rates for the range of events up to the 1% AEP event.
- An OSD basin will be provided with a minimum detention total volume of 754.9m^3.
- 4 units 34KL Rainwater tank will capture the runoff from the 100% roof areas and reused onsite.
- 3 units of bioretentions total area 200m^2
- 2 units GPT SPEL VORTCEPTOR or equivalent will be provided to remove gross pollutants.
- 6 units Culverts channel width 7.2m to maintain an existing overland flow arriving on middle Eastern boundary as shown in flood map do not impact to a proposed

internal road access at developed site.

It is therefore concluded that the drainage design for the site addresses the Council's water cycle management requirements for the development.

APPENDIX A

CONCEPT LAYOUT PLAN



APPENDIX B

DRAINS MODEL RESULT

DRAINS results prepared from Version 2020.033

PIT / NODE DETAILS Version 8

Name	Max HGL	Max Pond HGL	Max Surfac Flow Arrivi (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
B7-1	80.52		0.018		0.11	0	None
B1-6	80.47		0.067		0	0.065	Outlet System
B1-5	80.33		0.07		0.02	0.014	Inlet Capacity
B1-4	80.07		0.068		0	0.078	Outlet System
B1-3	79.73		0.115		0.34	0.014	Inlet Capacity
B1-2	79.67		0.038		0.25	0.01	Inlet Capacity
B1-1	79.34		0		0.8		None
OUTLET TO	79.23		0.01				
A1-1	80.32		0.045		0.05	0	None
OUTLET DI	79.78		0				
B2-7	80.9		0.025		0	0.025	Outlet System
B2-6	80.9		0.048		0	0.047	Outlet System
B2-5	80.9		0.089		0	0.084	Outlet System
B2-4	80.9		0.084		0	0.09	Outlet System
B2-3	80.9		0.12		0	0.089	Inlet Capacity
B2-2	80.54		0.114		0.13	0.022	Inlet Capacity
B2-1	79.99		0.031		0.11	0	None
C3-1	80.17		0.019		0	0.066	Outlet System
C1-5	80.23		0		0.67	0	None
C1-4	80.28		0.069		0.62		None
C1-3	80.16		0.078		0.74	0.009	Inlet Capacity
C1-2	79.81		0		1.17		None
C1-1	79.69		0		1.21		None
C1-0	79.4		0		0.63		None
DISCHARGI	79.09		0				
B3-3	80.9		0.023		0	0.016	Outlet System
B3-2	80.9		0.072		0	0.061	Outlet System
B3-1	80.89		0.061		0.01	0.018	Inlet Capacity
C1-7	80.56		0.023		0.34	0	None
C1-6	80.47		0.011		0.43	0	None
B1-9	80.5	80.57	0.017	0.8	0	0	Outlet System
B1-8	80.47		0.027		0	0.039	Outlet System
B1-7	80.47		0.066		0	0.067	Outlet System
C2-2	80.35		0.014		0.55	0	None
C2-1	80.19		0.023		0.71	0	None
B6-1	80.22		0.014		0	0.044	Outlet System

B5-1	80.1	0.018	0.11	0	None
B4-1	79.75	0.033	0.17	0.008	Inlet Capacity
OUTLET DI	78.56	0			
OUTLET DI	78.26	0			

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
C.B7-1	0.018	0.014	0.005	5	5	5	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1
C.B1-5	0.005	0	0.005	5	5	5	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1
C.B1-4	0.012	0.012	0	5	5	5	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
C.B1-3	0.04	0.002	0.037	5	5	5	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1
C.B1-2	0.03	0.03	0	5	5	5	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
C.A1-1	0.045	0.034	0.011	5	5	0	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1
C.B2-7	0.025	0.025	0	5	5	5	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
C.B2-6	0.024	0.024	0	5	5	5	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
C.B2-5 (R4)	0.047	0.047	0	5	5	5	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
C.B2-3	0.036	0.036	0	5	5	5	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
C.B2-2	0.024	0.024	0	5	5	5	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
C.B2-1	0.022	0.022	0	5	5	5	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
C.C3-1	0.019	0.001	0.018	5	5	5	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1
C1-4 + R2	0.069	0.069	0	8	8	5	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
C.C1-3 + R1	0.078	0.078	0	8	8	5	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
C.B3-3	0.023	0.023	0	5	5	5	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
C.B3-2 (R3)	0.058	0.058	0	8	8	5	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
C.C1-7	0.023	0.023	0	5	5	5	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
C.C1-6	0.011	0.011	0	5	5	5	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
C.B1-9	0.017	0.017	0	5	5	2	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
C.B1-8	0.027	0.002	0.025	5	5	2	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1
C.B1-7	0.026	0.02	0.007	5	5	5	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1
C.C2-2	0.014	0.014	0	5	5	5	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
C.C2-1	0.023	0.023	0	8	8	5	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
C.B6-1	0.014	0.014	0	5	5	5	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
C.B5-1	0.018	0.018	0	5	5	5	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
C.B4-1	0.033	0.033	0	5	5	5	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
C.E	0.051	0.003	0.047	5	5	5	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1
EX1	0.103	0.007	0.097	6	6	0	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1
EX2	1.757	0.142	1.634	17	17	0	AR&R 5 year, 1 hour storm, average 38.3 mm/h, Zone 1
EX3	0.182	0.012	0.17	7	7	0	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1
EX4	0.163	0.01	0.153	6	6	0	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1
EX5	0.393	0.026	0.367	7	7	0	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1

Outflow Volumes for Total Catchment (3.00 impervious + 17.1 pervious = 20.1 total ha)

Storm	Total Rainf	Total Runo	Impervious	Pervious Runoff
	cu.m	cu.m (Runc	cu.m (Runc	cu.m (Runoff %)
AR&R 5 yea	2091.81	432.90 (20	282.66 (90.	150.24 (8.4%)
AR&R 5 yea	3209.68	1144.35 (3	449.76 (93.	694.59 (25.4%)
AR&R 5 yea	4658.88	2143.40 (4	666.39 (95.	1477.02 (37.3%)
AR&R 5 yea	5662.79	2670.15 (4	816.45 (96.	1853.69 (38.5%)
AR&R 5 yea	7691.01	3805.44 (4	1119.63 (9	2685.82 (41.1%)
AR&R 5 yea	15782.98	7495.38 (4	2329.20 (9	5166.18 (38.5%)
AR&R 5 yea	20723	9589.64 (4	3067.66 (9	6521.99 (37.0%)

PIPE DETAILS

Name	Max Q	Max V	Max U/S	Max D/S	Due to Storm
	(cu.m/s)	(m/s)	HGL (m)	HGL (m)	
Pipe3699	0.018	0.46	80.505	80.47	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1
Pipe3723	0.04	1.01	80.399	80.331	AR&R 5 year, 5 minutes storm, average 125 mm/h, Zone 1
Pipe3725	0.053	1.33	80.196	80.07	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1
Pipe3698	0.068	1.7	79.872	79.726	AR&R 5 year, 5 minutes storm, average 125 mm/h, Zone 1
Pipe3697	0.132	1.2	79.725	79.67	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1
Pipe3718	0.347	2.1	79.503	79.343	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
Pipe3696	0.348	2.44	79.298	79.229	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
Pipe3700	0.045	1.34	79.964	79.777	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1
Pipe3703	0.014	0.35	80.9	80.9	AR&R 5 year, 5 minutes storm, average 125 mm/h, Zone 1
Pipe3728	0.023	0.58	80.9	80.9	AR&R 5 year, 1 hour storm, average 38.3 mm/h, Zone 1
Pipe3704	0.03	0.74	80.9	80.9	AR&R 5 year, 1 hour storm, average 38.3 mm/h, Zone 1
Pipe3701	0.046	1.16	80.897	80.896	AR&R 5 year, 1 hour storm, average 38.3 mm/h, Zone 1
Pipe3727	0.064	1.62	80.799	80.543	AR&R 5 year, 5 minutes storm, average 125 mm/h, Zone 1
Pipe3702	0.179	1.63	80.261	79.993	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1
Pipe3717	0.2	1.81	79.774	79.67	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
Pipe3712	0.01	0.09	80.169	80.232	AR&R 5 year, 1 hour storm, average 38.3 mm/h, Zone 1
Pipe3730	0.03	0.75	80.232	80.277	AR&R 5 year, 1 hour storm, average 38.3 mm/h, Zone 1
Pipe3706	0.06	0.84	80.22	80.158	AR&R 5 year, 1 hour storm, average 38.3 mm/h, Zone 1
Pipe3707	0.113	1.03	79.854	79.812	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
Pipe3708	0.113	1.03	79.734	79.693	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
P40216	0.148	1.34	79.406	79.397	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
Pipe3709	0.148	1.69	79.215	79.095	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
Pipe3713	0.019	0.47	80.899	80.9	AR&R 5 year, 5 minutes storm, average 125 mm/h, Zone 1
Pipe3729	0.056	1.4	80.892	80.886	AR&R 5 year, 5 minutes storm, average 125 mm/h, Zone 1
Pipe3714	0.064	1.61	80.886	80.543	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
Pipe3715	0.023	0.57	80.535	80.473	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1

Pipe3705	0.034	0.84	80.358	80.232	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
Pipe3720	0.015	0.38	80.472	80.47	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
Pipe3721	0.017	0.42	80.47	80.47	AR&R 5 year, 1 hour storm, average 38.3 mm/h, Zone 1
Pipe3722	0.029	0.74	80.469	80.47	AR&R 5 year, 1 hour storm, average 38.3 mm/h, Zone 1
Pipe3716	0.014	1.11	80.28	80.189	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
Pipe3710	0.035	1.58	80.02	79.908	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
Pipe3724	0.013	0.34	80.22	80.331	AR&R 5 year, 5 minutes storm, average 125 mm/h, Zone 1
Pipe3719	0.018	0.44	80.078	80.07	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
Pipe3726	0.025	0.64	79.719	79.671	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
Pipe3695	0.138	1.53	78.714	78.565	AR&R 5 year, 12 hours storm, average 8.6 mm/h, Zone 1
Pipe3711	0.103	1.4	78.312	78.263	AR&R 5 year, 1 hour storm, average 38.3 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF18952	0	0	0.307	0	0	0	0	
OF18993	0.065	0.065	0	0.026	0.01	8.55	0.46	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1
OF18995	0.014	0.014	0	0.014	0	6.09	0.28	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1
OF18999	0.078	0.078	0	0.079	0.01	14.61	0.1	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1
OF19001	0.014	0.014	0	0.036	0	10.27	0.06	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1
OF19004	0.01	0.01	0	0.031	0	9.61	0.05	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
OF18923	0.353	0.353	0	0.055	0.04	12.15	0.79	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
OF18944	0	0	0	0	0	0	0	
L.A1-POI1	0.045	0.045	0	0.022	0.01	7.73	0.42	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1
OF18974	0.025	0.025	0.091	0.077	0.01	4	0.1	AR&R 5 year, 5 minutes storm, average 125 mm/h, Zone 1
OF18976	0.047	0.047	0.091	0.105	0.01	4	0.13	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
OF18978	0.084	0.084	0.091	0.144	0.02	4	0.16	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
OF18980	0.09	0.09	0.091	0.149	0.02	4	0.17	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
OF18982	0.089	0.089	0.091	0.147	0.02	4	0.17	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
OF19496	0.022	0.022	0.031	0.133	0.02	3.58	0.11	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
OF18972	0	0	0.307	0	0	0	0	
OF19758	0.066	0.066	0	0.074	0.01	14.02	0.1	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1
OF19691	0	0	0	0	0	0	0	
OF19695	0.009	0.009	0.091	0.048	0	4	0.07	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
OF18926	0.148	0.148	0	0.037	0.02	10.39	0.6	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
OF19489	0.016	0.016	0.091	0.063	0.01	4	0.09	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1
OF19491	0.061	0.061	0.091	0.121	0.02	4	0.14	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
OF19494	0.018	0.018	0.091	0.065	0.01	4	0.09	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
OF19687	0	0	0.091	0	0	0	0	

OF19689	0	0	0.091	0	0	0	0	
OF18929	0	0	0	0	0	0	0	
OF18931	0.039	0.039	0	0.021	0.01	7.5	0.4	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1
OF18933	0.067	0.067	0	0.027	0.01	8.67	0.46	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1
OF19697	0	0	0.091	0	0	0	0	
OF19699	0	0	0.091	0	0	0	0	
OF18959	0.044	0.044	0	0.022	0.01	7.73	0.41	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1
OF18962	0	0	0.307	0	0	0	0	
OF18964	0.008	0.008	0.307	0.045	0.03	0.62	0.65	AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1
EMERGENC	0	0	0.091	0	0	0	0	
L.OSD1-PO	0.138	0.138	0	0.036	0.02	10.27	0.58	AR&R 5 year, 12 hours storm, average 8.6 mm/h, Zone 1
EMERGENC	0	0	0.091	0	0	0	0	
L.OSD2 - PC	0.103	0.103	0	0.032	0.02	9.72	0.53	AR&R 5 year, 1 hour storm, average 38.3 mm/h, Zone 1
L.E-POI4	1.891	1.891	0	0.12	0.16	18.71	1.3	AR&R 5 year, 1 hour storm, average 38.3 mm/h, Zone 1
L.POI1-RN1	1.907	1.907	0	0.12	0.16	18.71	1.31	AR&R 5 year, 1 hour storm, average 38.3 mm/h, Zone 1
OF19711	0.138	0.138	0	0.036	0.02	10.27	0.58	AR&R 5 year, 12 hours storm, average 8.6 mm/h, Zone 1
POI3-RN2	0.103	0.103	0	0.032	0.02	9.72	0.53	AR&R 5 year, 1 hour storm, average 38.3 mm/h, Zone 1
L.EX1-EX2	0.103	0.103	0	0.032	0.02	9.72	0.53	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1
L.EX2-E	1.875	1.875	0	0.12	0.16	18.65	1.3	AR&R 5 year, 1 hour storm, average 38.3 mm/h, Zone 1
L.EX3-EX2	0.182	0.182	0	0.041	0.03	10.74	0.64	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1
L.EX4-EX5	0.163	0.163	0	0.039	0.02	10.57	0.61	AR&R 5 year, 30 minutes storm, average 56.4 mm/h, Zone 1
LEX5-RN2	0.478	0.478	0	0.063	0.05	12.97	0.87	AR&R 5 year, 1 hour storm, average 38.3 mm/h, Zone 1
L.POI4-POI	1.891	1.891	0	0.12	0.16	18.71	1.3	AR&R 5 year, 1 hour storm, average 38.3 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
OSD 1	79.48	370.5	0.138	0.138	0
OSD2	79.19	89.7	0.103	0.103	0

CONTINUITY CHECK for AR&R 5 year, 20 minutes storm, average 69.6 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Ch (cu.m)	Difference %
B7-1	11.57	11.54	0	0.3
B1-6	51.52	51.73	0	-0.4
B1-5	43.95	43.98	0	-0.1
B1-4	82.78	82.81	0	0
B1-3	98.98	99.11	0	-0.1
B1-2	326.77	326.95	0	-0.1
B1-1	322.5	322.54	0	0
OUTLET TC	326.99	326.99	0	0

A1-1	28.64	28.55	0	0.3
OUTLET DI	28.55	28.55	0	0
B2-7	16.43	16.77	0	-2.1
B2-6	32.97	33.85	0	-2.6
B2-5	65.15	65.42	0	-0.4
B2-4	65.42	67.73	0	-3.5
B2-3	91.7	94.81	0	-3.4
B2-2	170.15	170.41	0	-0.2
B2-1	185.29	185.43	0	-0.1
C3-1	7.73	7.74	0	-0.1
C1-5	3.87	3.83	0	1.1
C1-4	55.77	53.94	0	3.3
C1-3	112.55	112.53	0	0
C1-2	109.46	109.5	0	0
C1-1	136.24	136.28	0	0
C1-0	136.28	136.32	0	0
DISCHARGI	136.32	136.32	0	0
B3-3	15.54	15.53	0	0.1
B3-2	59.04	59.37	0	-0.6
B3-1	59.37	59.35	0	0
C1-7	15.1	14.99	0	0.7
C1-6	22.31	22.23	0	0.4
B1-9	11.1	11.05	0	0.4
B1-8	22.1	22.06	0	0.2
B1-7	38.59	39.98	0	-3.6
C2-2	9.55	9.48	0	0.7
C2-1	26.8	26.74	0	0.2
B6-1	9.32	9.3	0	0.2
B5-1	11.77	11.73	0	0.3
B4-1	21.98	21.93	0	0.2
OSD 1	326.99	80.68	246.3	0
OUTLET DI	80.68	80.56	0	0.2
OSD2	139.39	102.96	36.42	0
OUTLET DI	102.96	102.94	0	0
N.E	1378.14	1378.14	0	0
RN2	380.03	380.03	0	0
POI1	1406.69	1406.69	0	0
POI2	80.56	78.73	0	2.3
RN1	1485.41	1485.41	0	0
POI3	102.94	102.44	0	0.5
N.EX1	44.52	44.52	0	0
N.EX2	1357.45	1357.45	0	0

N.EX3	83.86	83.86	0	0
N.EX4	70.39	70.39	0	0
N.EX5	277.59	277.59	0	0
POI4	1378.14	1378.14	0	0

DRAINS results prepared from Version 2020.033

PIT / NODE DETAILS Version 8

Name	Max HGL	Max Pond HGL	Max Surfac Flow Arrivi (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
B7-1	80.62		0.033		0.01	0.009	Inlet Capacity
B1-6	80.47		0.121		0	0.123	Outlet System
B1-5	80.34		0.132		0.01	0.088	Inlet Capacity
B1-4	80.07		0.16		0	0.204	Outlet System
B1-3	80.01		0.271		0.06	0.097	Inlet Capacity
B1-2	79.91		0.374		0.01	0.282	Inlet Capacity
B1-1	79.4		0		0.74		None
OUTLET TC	79.28		0.282				
A1-1	80.36		0.081		0.01	0.034	Inlet Capacity
OUTLET DI	79.78		0.034				
B2-7	80.9		0.043		0	0.045	Outlet System
B2-6	80.9		0.087		0	0.08	Outlet System
B2-5	80.9		0.159		0	0.143	Outlet System
B2-4	80.9		0.143		0	0.151	Outlet System
B2-3	80.9		0.203		0	0.202	Outlet System
B2-2	80.66		0.355		0.01	0.233	Inlet Capacity
B2-1	80.1		0.255		0	0.276	Outlet System
C3-1	80.17		0.036		0	0.13	Outlet System
C1-5	80.45		0		0.45	0	None
C1-4	80.83		0.115		0.07		None
C1-3	80.76		0.13		0.14	0.031	Inlet Capacity
C1-2	80.28		0		0.7		None
C1-1	80.11		0		0.79		None
C1-0	79.63		0		0.4		None
DISCHARGI	79.13		0				
B3-3	80.9		0.04		0	0.037	Outlet System
B3-2	80.9		0.126		0	0.139	Outlet System
B3-1	80.9		0.139		0	0.124	Inlet Capacity
C1-7	80.9		0.039		0	0.018	Inlet Capacity
C1-6	80.87		0.034		0.03	0	None
B1-9	80.53	80.62	0.029	1.7	0	0.005	Outlet System
B1-8	80.47		0.056		0	0.076	Outlet System
B1-7	80.47		0.122		0	0.121	Outlet System
C2-2	80.88		0.025		0.02	0.004	Inlet Capacity
C2-1	80.81		0.043		0.09	0	None
B6-1	80.22		0.027		0	0.058	Outlet System

B5-1	80.16	0.031	0.05	0	None
B4-1	79.92	0.057	0	0.034	Inlet Capacity
OUTLET DI	78.65	0			
OUTLET DI	78.29	0			

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
C.B7-1	0.033	0.024	0.009	5	5	5	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
C.B1-5	0.01	0.001	0.01	5	5	5	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
C.B1-4	0.02	0.02	0	5	5	5	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
C.B1-3	0.076	0.004	0.071	5	5	5	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
C.B1-2	0.053	0.053	0	5	5	5	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
C.A1-1	0.081	0.059	0.022	5	5	0	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
C.B2-7	0.043	0.043	0	5	5	5	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
C.B2-6	0.042	0.042	0	5	5	5	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
C.B2-5 (R4)	0.081	0.081	0	5	5	5	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
C.B2-3	0.062	0.062	0	5	5	5	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
C.B2-2	0.042	0.042	0	5	5	5	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
C.B2-1	0.039	0.039	0	5	5	5	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
C.C3-1	0.036	0.002	0.034	5	5	5	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
C1-4 + R2	0.115	0.115	0	8	8	5	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
C.C1-3 + R1	0.13	0.13	0	8	8	5	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
C.B3-3	0.04	0.04	0	5	5	5	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
C.B3-2 (R3)	0.096	0.096	0	8	8	5	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
C.C1-7	0.039	0.039	0	5	5	5	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
C.C1-6	0.019	0.019	0	5	5	5	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
C.B1-9	0.029	0.029	0	5	5	2	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
C.B1-8	0.052	0.003	0.049	5	5	2	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
C.B1-7	0.047	0.034	0.013	5	5	5	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
C.C2-2	0.025	0.025	0	5	5	5	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
C.C2-1	0.038	0.038	0	8	8	5	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
C.B6-1	0.024	0.024	0	5	5	5	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
C.B5-1	0.031	0.031	0	5	5	5	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
C.B4-1	0.057	0.057	0	5	5	5	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
C.E	0.097	0.006	0.091	5	5	5	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
EX1	0.199	0.012	0.187	6	6	0	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
EX2	3.865	0.237	3.635	17	17	0	AR&R 100 year, 1 hour storm, average 67.0 mm/h, Zone 1
EX3	0.363	0.021	0.342	7	7	0	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
EX4	0.314	0.018	0.296	6	6	0	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
EX5	0.784	0.046	0.739	7	7	0	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1

Outflow Volumes for Total Catchment (3.00 impervious + 17.1 pervious = 20.1 total ha)

Storm	Total Rainf	Total Runo	Impervious	Pervious Runoff
	cu.m	cu.m (Runc	cu.m (Runc	cu.m (Runoff %)
AR&R 100	3681.59	1876.99 (5	520.30 (94	1356.69 (43.3%)
AR&R 100	5622.79	3494.44 (6	810.47 (96	2683.97 (56.1%)
AR&R 100	8166.44	5553.20 (6	1190.69 (9	4362.50 (62.8%)
AR&R 100	9900.13	6799.49 (6	1449.84 (9	5349.65 (63.5%)
AR&R 100	13454.37	9402.22 (6	1981.13 (9	7421.09 (64.9%)
AR&R 100	27229.38	18209.59 (	4040.23 (9	14169.36 (61.2%)
AR&R 100	35907.55	22495.46 (	5337.53 (9	17157.93 (56.2%)

PIPE DETAILS

Name	Max Q	Max V	Max U/S	Max D/S	Due to Storm
	(cu.m/s)	(m/s)	HGL (m)	HGL (m)	
Pipe3699	0.03	0.74	80.613	80.47	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
Pipe3723	0.042	1.06	80.406	80.342	AR&R 100 year, 6 hours storm, average 22.6 mm/h, Zone 1
Pipe3725	0.054	1.35	80.201	80.07	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
Pipe3698	0.069	1.75	80.032	80.015	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
Pipe3697	0.183	1.66	80.015	79.906	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
Pipe3718	0.429	2.24	79.523	79.404	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
Pipe3696	0.429	2.53	79.353	79.288	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
Pipe3700	0.047	1.37	79.977	79.779	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
Pipe3703	0.016	0.4	80.9	80.9	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
Pipe3728	0.023	0.57	80.9	80.9	AR&R 100 year, 30 minutes storm, average 98.6 mm/h, Zone 1
Pipe3704	0.029	0.74	80.9	80.9	AR&R 100 year, 1 hour storm, average 67.0 mm/h, Zone 1
Pipe3701	0.046	1.15	80.899	80.9	AR&R 100 year, 1 hour storm, average 67.0 mm/h, Zone 1
Pipe3727	0.063	1.58	80.844	80.662	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
Pipe3702	0.195	1.77	80.37	80.1	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
Pipe3717	0.23	2.08	79.957	79.906	AR&R 100 year, 10 minutes storm, average 168 mm/h, Zone 1
Pipe3712	0.011	0.1	80.169	80.446	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
Pipe3730	0.032	0.81	80.446	80.831	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
Pipe3706	0.061	0.87	80.795	80.756	AR&R 100 year, 12 hours storm, average 14.9 mm/h, Zone 1
Pipe3707	0.134	1.21	80.334	80.278	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
Pipe3708	0.134	1.21	80.17	80.113	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
P40216	0.189	1.72	79.644	79.63	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
Pipe3709	0.189	1.9	79.213	79.134	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
Pipe3713	0.022	0.56	80.9	80.9	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
Pipe3729	0.06	1.51	80.898	80.896	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
Pipe3714	0.065	1.64	80.896	80.662	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
Pipe3715	0.031	0.77	80.887	80.872	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1

Pipe3705	0.047	1.17	80.604	80.446	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
Pipe3720	0.022	0.55	80.489	80.47	AR&R 100 year, 30 minutes storm, average 98.6 mm/h, Zone 1
Pipe3721	0.02	0.5	80.47	80.47	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
Pipe3722	0.039	0.99	80.47	80.47	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
Pipe3716	0.025	0.63	80.838	80.814	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
Pipe3710	0.057	1.42	80.215	80.113	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
Pipe3724	0.013	0.32	80.22	80.342	AR&R 100 year, 30 minutes storm, average 98.6 mm/h, Zone 1
Pipe3719	0.031	0.77	80.091	80.07	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
Pipe3726	0.034	0.86	79.909	79.906	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
Pipe3695	0.258	1.8	78.803	78.653	AR&R 100 year, 1 hour storm, average 67.0 mm/h, Zone 1
Pipe3711	0.125	1.47	78.338	78.288	AR&R 100 year, 1 hour storm, average 67.0 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF18952	0.009	0.009	1.201	0.046	0.03	0.67	0.68	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
OF18993	0.123	0.123	0.288	0.034	0.02	10.1	0.56	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
OF18995	0.088	0.088	0.288	0.03	0.02	9.26	0.51	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
OF18999	0.204	0.204	0.029	0.124	0.02	19.12	0.13	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
OF19001	0.097	0.097	0.029	0.088	0.01	15.43	0.11	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
OF19004	0.282	0.282	0.029	0.144	0.02	20.63	0.15	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
OF18923	0.701	0.701	0.288	0.075	0.07	14.2	0.98	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
OF18944	0.034	0.034	0.288	0.02	0.01	7.26	0.38	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
L.A1-POI1	0.081	0.081	0.288	0.029	0.01	9.14	0.48	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
OF18974	0.045	0.045	0.302	0.102	0.01	4	0.13	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
OF18976	0.08	0.08	0.302	0.141	0.02	4	0.16	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
OF18978	0.143	0.143	0.302	0.194	0.04	4	0.2	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
OF18980	0.151	0.151	0.302	0.2	0.04	4	0.2	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
OF18982	0.202	0.202	0.302	0.237	0.05	4	0.23	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
OF19496	0.233	0.233	0.263	0.288	0.06	7.79	0.21	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
OF18972	0.276	0.276	1.201	0.143	0.17	3.9	1.18	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
OF19758	0.13	0.13	0.029	0.1	0.01	16.72	0.12	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
OF19691	0	0	0.029	0	0	0	0	
OF19695	0.031	0.031	0.302	0.085	0.01	4	0.11	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
OF18926	0.189	0.189	0.288	0.041	0.03	10.8	0.65	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
OF19489	0.037	0.037	0.302	0.093	0.01	4	0.12	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
OF19491	0.139	0.139	0.302	0.191	0.04	4	0.2	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
OF19494	0.124	0.124	0.302	0.179	0.03	4	0.19	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
OF19687	0.018	0.018	0.302	0.065	0.01	4	0.09	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1

OF19689	0	0	0.302	0	0	0	0	
OF18929	0.005	0.005	0.288	0.009	0	5.16	0.21	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
OF18931	0.076	0.076	0.288	0.028	0.01	8.9	0.49	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
OF18933	0.121	0.121	0.288	0.034	0.02	10.1	0.55	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
OF19697	0.004	0.004	0.302	0.036	0	4	0.05	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
OF19699	0	0	0.302	0	0	0	0	
OF18959	0.058	0.058	0.288	0.025	0.01	8.32	0.44	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
OF18962	0	0	1.201	0	0	0	0	
OF18964	0.034	0.034	1.201	0.073	0.06	1.55	0.81	AR&R 100 year, 30 minutes storm, average 98.6 mm/h, Zone 1
EMERGEN(	0	0	0.302	0	0	0	0	
L.OSD1-PO	0.258	0.258	0.288	0.048	0.03	11.44	0.71	AR&R 100 year, 1 hour storm, average 67.0 mm/h, Zone 1
EMERGEN(	0	0	0.302	0	0	0	0	
L.OSD2 - P(	0.125	0.125	0.288	0.035	0.02	10.16	0.56	AR&R 100 year, 1 hour storm, average 67.0 mm/h, Zone 1
L.E-POI4	4.394	4.394	0.288	0.175	0.3	22.49	1.7	AR&R 100 year, 1 hour storm, average 67.0 mm/h, Zone 1
L.POI1-RN1	4.427	4.427	0.288	0.175	0.3	22.53	1.7	AR&R 100 year, 1 hour storm, average 67.0 mm/h, Zone 1
OF19711	0.258	0.258	0.288	0.048	0.03	11.44	0.71	AR&R 100 year, 1 hour storm, average 67.0 mm/h, Zone 1
POI3-RN2	0.125	0.125	0.288	0.035	0.02	10.16	0.56	AR&R 100 year, 1 hour storm, average 67.0 mm/h, Zone 1
L.EX1-EX2	0.199	0.199	0.288	0.042	0.03	10.92	0.65	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
L.EX2-E	4.342	4.342	0.288	0.174	0.29	22.46	1.68	AR&R 100 year, 1 hour storm, average 67.0 mm/h, Zone 1
L.EX3-EX2	0.363	0.363	0.288	0.055	0.04	12.21	0.8	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
L.EX4-EX5	0.314	0.314	0.288	0.052	0.04	11.85	0.76	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
LEX5-RN2	1.015	1.015	0.288	0.09	0.1	15.66	1.09	AR&R 100 year, 20 minutes storm, average 122 mm/h, Zone 1
L.POI4-POI	4.394	4.394	0.288	0.175	0.3	22.49	1.7	AR&R 100 year, 1 hour storm, average 67.0 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
OSD 1	79.78	635.9	0.258	0.258	0
OSD2	79.37	126.5	0.125	0.125	0

CONTINUITY CHECK for AR&R 100 year, 1 hour storm, average 67.0 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Ch (cu.m)	Difference %
B7-1	37.39	37.4	0	0
B1-6	177.75	182.57	0	-2.7
B1-5	158.05	158.14	0	-0.1
B1-4	278.36	278.38	0	0
B1-3	350.71	350.85	0	0
B1-2	1053.55	1053.6	0	0
B1-1	927.29	927.32	0	0
OUTLET TC	1053.63	1053.63	0	0

A1-1	92.58	92.54	0	0
OUTLET DI	92.54	92.54	0	0
B2-7	48.84	49.59	0	-1.5
B2-6	97.77	100.24	0	-2.5
B2-5	193.3	194.31	0	-0.5
B2-4	194.31	204.35	0	-5.2
B2-3	275.63	294.86	0	-7
B2-2	532.47	532.42	0	0
B2-1	576.64	577.03	0	-0.1
C3-1	34.59	34.62	0	-0.1
C1-5	0.25	0.3	0	-19.7
C1-4	154.74	144.92	0	6.3
C1-3	319.15	319.27	0	0
C1-2	304.64	304.74	0	0
C1-1	384.54	384.64	0	0
C1-0	384.64	384.7	0	0
DISCHARGI	384.7	384.7	0	0
B3-3	46.2	47.02	0	-1.8
B3-2	176.38	184.34	0	-4.5
B3-1	184.34	190.09	0	-3.1
C1-7	44.88	44.82	0	0.1
C1-6	66.6	66.56	0	0.1
B1-9	33	32.96	0	0.1
B1-8	82.38	82.4	0	0
B1-7	135.81	140.35	0	-3.3
C2-2	28.38	28.32	0	0.2
C2-1	79.8	79.8	0	0
B6-1	27.72	27.74	0	0
B5-1	34.98	34.98	0	0
B4-1	65.34	65.35	0	0
OSD 1	1053.63	780.87	272.76	0
OUTLET DI	780.87	780.63	0	0
OSD2	399.32	363.83	35.5	0
OUTLET DI	363.83	363.81	0	0
N.E	6675.5	6675.5	0	0
RN2	1593.2	1593.2	0	0
POI1	6768.04	6768.04	0	0
POI2	780.63	777.14	0	0.4
RN1	7545.18	7545.18	0	0
POI3	363.81	363.46	0	0.1
N.EX1	199.32	199.32	0	0
N.EX2	6582.95	6582.95	0	0

N.EX3	376.79	376.79	0	0
N.EX4	315.13	315.13	0	0
N.EX5	1229.74	1229.74	0	0
POI4	6675.5	6675.5	0	0

APPENDIX C

MUSIC LINK RESULT

PENRITH CITY COUNCIL

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MUSIC-*link* Report

Project Details		Company Details	
Project:	344 PARK ROAD WALLACIA	**Company:**	INDESCO CONSULTING
Report Export Date:	18-Sep-20	**Contact:**	DAVID GUNAWAN
Catchment Name:	7421 MUSIC	**Address:**	Suite 401, Level 4 24 Hunter Street PARRAMATTA NSW 2150
Catchment Area:	0.156ha	**Phone:**	02 7809 8953
Impervious Area*:	73.24%	**Email:**	david.gunawan@indesco.com.au
Rainfall Station:	67113 PENRITH		
Modelling Time-step:	6 Minutes		
Modelling Period:	1-01-1999 - 31-12-2008 11:54:00 PM		
Mean Annual Rainfall:	691mm		
Evapotranspiration:	1158mm		
MUSIC Version:	6.2.1		
MUSIC-link data Version:	6.22		
Study Area:	Penrith		
Scenario:	Penrith Development		

* takes into account area from all source nodes that link to the chosen reporting node, excluding Import Data Nodes

Treatment Train Effectiveness		Treatment Nodes		Source Nodes	
Node: Junction	**Reduction**	**Node Type**	**Number**	**Node Type**	**Number**
Flow	12.2%	Bio Retention Node	3	Urban Source Node	11
TSS	99.2%	Rain Water Tank Node	2		
TP	89.7%	GPT Node	2		
TN	73.9%				
GP	100%				

Comments

USE PENRITH COUNCIL MUSIC LINK

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Passing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
Bio	BIORETENTION 1	PET Scaling Factor	2.1	2.1	2.1
Bio	BIORETENTION 2	PET Scaling Factor	2.1	2.1	2.1
Bio	BIORETENTION 3 (LANDSCAPE 3)	PET Scaling Factor	2.1	2.1	2.1
GPT	SPEL Vorceptor SVI.055M	Hi-flow bypass rate (cum/sec)	None	99	0.055
GPT	SVI.025 SPEL Vortceptor	Hi-flow bypass rate (cum/sec)	None	99	0.026
Post	Post-Development Node	% Load Reduction	None	None	27.9
Post	Post-Development Node	GP % Load Reduction	90	None	99.3
Post	Post-Development Node	TN % Load Reduction	45	None	57.3
Post	Post-Development Node	TP % Load Reduction	60	None	75.7
Post	Post-Development Node	TSS % Load Reduction	85	None	89.4
Urban	A	Area Impervious (ha)	None	None	0.338
Urban	A	Area Pervious (ha)	None	None	0
Urban	A	Total Area (ha)	None	None	0.338
Urban	B	Area Impervious (ha)	None	None	0.337
Urban	B	Area Pervious (ha)	None	None	0
Urban	B	Total Area (ha)	None	None	0.337
Urban	C	Area Impervious (ha)	None	None	0.382
Urban	C	Area Pervious (ha)	None	None	0
Urban	C	Total Area (ha)	None	None	0.382
Urban	D	Area Impervious (ha)	None	None	0.714
Urban	D	Area Pervious (ha)	None	None	0
Urban	D	Total Area (ha)	None	None	0.714
Urban	E	Area Impervious (ha)	None	None	0.112
Urban	E	Area Pervious (ha)	None	None	0
Urban	E	Total Area (ha)	None	None	0.112
Urban	F	Area Impervious (ha)	None	None	0.091
Urban	F	Area Pervious (ha)	None	None	0.091
Urban	F	Total Area (ha)	None	None	0.182
Urban	G	Area Impervious (ha)	None	None	0.00690499999999999
Urban	G	Area Pervious (ha)	None	None	0.127
Urban	G	Total Area (ha)	None	None	0.134
Urban	H	Area Impervious (ha)	None	None	0.010
Urban	H	Area Pervious (ha)	None	None	0.195
Urban	H	Total Area (ha)	None	None	0.206
Urban	I	Area Impervious (ha)	None	None	0.25
Urban	I	Area Pervious (ha)	None	None	0
Urban	I	Total Area (ha)	None	None	0.25
Urban	J	Area Impervious (ha)	None	None	0.002
Urban	J	Area Pervious (ha)	None	None	0.041
Urban	J	Total Area (ha)	None	None	0.044

Only certain parameters are reported when they pass validation

Node Type	Node Name	Parameter	Min	Max	Actual
Urban	K	Area Impervious (ha)	None	None	0.003
Urban	K	Area Pervious (ha)	None	None	0.073
Urban	K	Total Area (ha)	None	None	0.077

Only certain parameters are reported when they pass validation

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music@link

Failing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
Bio	BIORETENTION 1	Filter depth (m)	0.5	0.8	0.4
Bio	BIORETENTION 1	Hi-flow bypass rate (cum/sec)	None	99	100
Bio	BIORETENTION 2	Filter depth (m)	0.5	0.8	0.4
Bio	BIORETENTION 2	Hi-flow bypass rate (cum/sec)	None	99	100
Bio	BIORETENTION 3 (LANDSCAPE 3)	Filter depth (m)	0.5	0.8	0.4
Bio	BIORETENTION 3 (LANDSCAPE 3)	Hi-flow bypass rate (cum/sec)	None	99	100
Rain	2 x RAINWATER TANK 34KL/EACH ROOF A	% Reuse Demand Met	80	None	4.4517
Rain	2 x RAINWATER TANK 34kL/EACH ROOF B	% Reuse Demand Met	80	None	4.44282

Only certain parameters are reported when they pass validation

APPENDIX D

WSUD MAINTENANCE

OSD Maintenance Schedule

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
Outlets			
Inspect & remove any blockage of orifices	Six monthly	Owner	Remove grate & screen to inspect orifice. See plan for location of outlets
Check attachment of orifice plates to wall of chamber and/or pit (gaps less than 5 mm)	Annually	Maintenance Contractor	Remove grate and screen. Ensure plates are mounted securely, tighten fixings if required. Seal gaps as required.
Check orifice diameters are correct and retain sharp edges	Five yearly	Maintenance Contractor	Compare diameter to design (see Work-as-Executed) and ensure edge is not pitted or damaged.
Inspect screen and clean	Six monthly	Owner	Remove grate(s) and screens if required to clean them.
Check attachment of screens to wall of chamber or pit	Annually	Maintenance Contractor	Remove grate(s) and screen(s). Ensure screen fixings are secure. Repair as required.
Check screen(s) for corrosion	Annually	Maintenance Contractor	Remove grate(s) and examine screen(s) for rust or corrosion, especially at corners or welds.
Inspect walls (internal and external, if appropriate) for cracks or spalling	Annually	Maintenance Contractor	Remove grate(s) to inspect internal walls. Repair as required. Clear vegetation from external walls if necessary and repair as required.
Inspect outlet sumps & remove any sediment/sludge	Six monthly	Owner	Remove grate(s) and screen(s). Remove sediment/sludge build-up and check orifices are clear.
Inspect grate(s) for damage or blockage	Six monthly	Owner	Check both sides of a grate for corrosion, (especially corners and welds) damage or blockage.
Inspect outlet pipe & remove any blockage	Six monthly	Maintenance Contractor	Remove grate(s) and screen(s). Ventilate underground storage if present. Check orifices and remove any blockages in outlet pipe. Flush outlet pipe to confirm it drains freely. Check for sludge/debris on upstream side of return line.
Check step irons for corrosion	Annually	Maintenance Contractor	Remove grate. Examine step irons and repair any corrosion or damage.

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
Check fixing of step irons is secure	Six monthly	Maintenance Contractor	Remove grate(s) and ensure fixings are secure prior to placing weight on step iron.
Storage			
Inspect storage & remove any sediment/sludge	Six monthly	Owner	Remove grate(s) and screen(s) where required. Remove sediment/sludge build-up.
Inspect internal walls of storage (and external, if appropriate) for cracks, spalling or any other defects	Annually	Maintenance Contractor	Remove grate(s) to inspect internal walls if required. Repair as required. Clear vegetation from internal and external walls if necessary and repair as required.
Inspect & remove any debris/litter/mulch etc blocking grates	Six monthly	Owner	Remove blockages from grate(s) and check if storage is blocked.
Inspect areas draining to the storage(s) & remove debris/mulch/litter etc likely to block screens/grates	Six monthly	Owner	Remove debris and floatable material likely to be carried to grates.
Compare storage volume to volume approved. (Rectify if loss > 5%)	Annually	Maintenance Contractor	Compare actual storage available with Work-as Executed plans. If volume loss is greater than 5%, arrange for reconstruction to replace the volume lost. Council to be notified of the proposal.
Inspect storages for subsidence near pits	Annually	Maintenance Contractor	Check along drainage lines and at pits for subsidence likely to indicate leakages.

WSUD Maintenance and Monitoring Schedule

Maintenance Action	Frequency	Responsibility	Procedure
Rainwater Tanks			
Prevent mosquito breeding	*Monthly	Owner	In accordance with tank manufacturer maintenance specifications
Clean tank of sludge	2-3 yearly	Maintenance Contractor	In accordance with tank manufacturer maintenance specifications

Bio-Retention Basins and Swales			
Inspect screen and clean	*Six monthly	Owner	Remove grate(s) and screens if required to clean them.
Check attachment of screens to wall of pits	*Annually	Maintenance Contractor	Remove grate(s) and screen(s). Ensure screen fixings are secure. Repair as required.
Check screen(s) for corrosion	*Annually	Maintenance Contractor	Remove grate(s) and examine screen(s) for rust or corrosion, especially at corners or welds.
Inspect walls (internal and external, if appropriate) for cracks or spalling	*Annually	Maintenance Contractor	Remove grate(s) to inspect internal walls. Repair as required. Clear vegetation from external walls if necessary and repair as required.
Inspect grate(s) for damage or blockage	*Six monthly	Owner	Check both sides of a grate for corrosion, (especially corners and welds) damage or blockage.
Inspect outlet pipe & remove any blockage	*Six monthly	Maintenance Contractor	Remove grate(s) and screen(s). Ventilate underground storage if present. Check orifices and remove any blockages in outlet pipe. Flush outlet pipe to confirm it drains freely. Check for sludge/debris on upstream side of return line.
Inspect subsoil drainage system	*Six monthly	Maintenance Contractor	Inspect, clean and flush subsoil drainage system.
Basin vegetated/open areas	*Two monthly	Owner	Inspect basins for litter, debris and weeds and clear as required.

SPEL ENVIRONMENTAL
INTEGRATED WATER SOLUTIONS

SPEL Vortceptor

Operation & Maintenance Manual

www.spel.com.au

Document Set ID: 9333067
Version: 1, Version Date: 13/10/2020

Introduction

The frequency of cleaning will depend on the pollutant loads of the catchment, so inspections are recommended to confirm the maintenance intervals, which could be either three, six or twelve months.

The following cleaning options allow asset owners to choose the best option available for ongoing maintenance and the required cleaning frequency with the right cleaning services and resources available.

Depending on the size, access and depth of the system, the three following methods can be used to maintain the SPEL Vortceptor;

When considering maintenance costs and procedures, these three maintenance options can offer operational flexibility and low life-cycle cost considerations.

1. VACUUM SUCTION CLEANING

Due to the time and costs of water disposal, the vacuum suction cleaning is generally the most expensive option.
By taking advantage of the optional large sump volumes available in SPEL Vortceptor systems, it still may be a cost effective option.

Suction cleaning is used for most proprietary GPT's. Even if a more cost effective method is used at shorter intervals, suction cleaning is recommended for Vorceptor® Units at one to two year intervals so that a thorough inspection of the screen and lower chambers can be carried out. Physical entry may or may not be required.

2. GRAB CLEANER

The Grab Cleaner can be carried out without dewatering the system and is a generally a single person operation.

This cleaning technique is generally quicker, cheaper and safer. It also allows an inspection of the pollution captured, as opposed to the other options.

Check access opening size to ensure this option will suit the system installed.

The grab truck cleaning option offers the removal of 80 – 90% of the pollution stored in a sump and is subjected to similar constraints as the removable basket option.

3. REMOVABLE BASKET

If a removal waste basket is fitted, it can be lifted at any time, without the need for dewatering. Also it provides a safe and cost effective method of cleaning. The cost benefit depends on the design and waste disposal set up.

Normally an appropriate sump volume to allow cleaning 3 or 4 times per year. These maintenance cleans would be carried out either by using a basket or a grab, with a single clean per year completed by suction.

Maintenance options will depend on tidal or backwater impact, pollution load and cleaning frequency as well as access and disposal costs for pump-down water.

Sometimes valves are used to isolate the unit during maintenance operations. This would be essential where a unit is affected by backwater and/or high levels of tidal inundation.

The main benefit of removable baskets is their speed and ease of cleaning, particularly in tidal zones. But the storage basket must be smaller than the screen to allow its removal.

Consequently, whilst it may be cheaper, cleaning removable baskets might also be required 4 or 5 times more often.

SPEL Vorceptor Maintenance Capacities & Dimensions

Models	Treatable Flow rate (L/s)	Dimensions (mm)				Capacities		
		Internal Diameter	Overall Height	Manhole Size	Depth below invert	Sump Capacity (m^3)	Light Liquid Volume (L)	Floatables Volume (m^3)
IN-LINE SERIES								
SVI.025	26	1200	2300	600x600	1400	0.6	110	0.06
SVI.055	55	1800	2750	900x900	1650	1.4	246	0.22
SVI.055.M	55	2200	2885		1585	1.9	394	0.22
OFFLINE SERIES								
SVO.096	96	1500	3340	900x900	2340	2.8	239	0.39
SVO.140	140	1500	3670		2670	2.8	239	0.39
SVO.180	180	1500	3625		2325	2.8	239	0.39
SVO.220	220	2200	3390		2390	4.0	515	1.1
SVO.360	360	2200	3990		2990	4.0	515	1.1
SVO.530	530	3000	4800		3500	10.5	1263	2.8
SVO.800	800	3000	5780		4480	10.5	1263	2.8
SVO.810	800	4000	4290		2990	11.95	2155	5.65
SVO.1200	1200	4000	5320		3720	11.95	2155	5.65
SVO.1600	1200	4000	6010		4410	11.95	2155	5.65

Maintenance

The Vorceptor system should be inspected at regular intervals and maintained when necessary to ensure optimum performance.

The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable ground conditions and high silt areas will cause the silt chamber to fill more quickly but regular cleaning of catchment area will help slow the process.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year however more frequent inspections may be necessary where operations may lead to accumulations, or in washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the Vorceptor unit is typically achieved through access covers. These allow for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. Also allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The Vorceptor system should be cleaned when the level of sediment has reached 75% of capacity in the sump or when an appreciable level of hydrocarbons and trash has accumulated.

If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of the Vorceptor systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump.

The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment.

However, the system should be cleaned out immediately in the event of an oil or fuel spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be power washed to ensure it is free of trash and debris.

Access covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the Vorceptor system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins.

Inspection & Maintenance Log

SPEL Model: _____ **Location:**_____

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintence Preformed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.
2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

SPEL ENVIRONMENTAL
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APPENDIX E

PENRITH PRE DA LOGDEMENT

Our Ref: PL17/0115
Contact: Allison Cattell
Telephone: (02) 4732 7909

23 November 2017

C/- Adam Coburn
Mecone Pty Ltd
Suite 1204B Level 12
179 Elizabeth Street
SYDNEY NSW 2000

Dear Mr Coburn,

Pre-lodgement Advice
Proposed Extractive Industry
Lot 5 DP 655046, 344 Park Road WALLACIA NSW 2745

We welcome your initiative to undertake a project in the Penrith Area.

Thank you for taking part in Council's pre-lodgement meeting on 14 November 2017**.** The meeting was useful for Council in gaining an understanding of your proposal.

Unfortunately, the proposal in its current form is not considered suitable as outlined in the attached information.

As I am sure you are aware, Council's full assessment and determination can only be made after you lodge an application.

If we can help you any further regarding the attached advice, please feel free to contact me on (02) 4732 7909.

Yours sincerely

Allison Cattell
Senior Environmental Planner

PROPERTY AND PLANNING INFORMATION	
Attendees	**Proponent** Adam Coburn – Mecone Pty Ltd Georgia Sedgemen – Mecone Pty Ltd **Penrith City Council** Allison Cattell – Senior Environmental Planner Fred Shockair – Senior Development Engineer Paul Reynolds – Team Leader for Environmental Health and Compliance Graham Green – Senior Traffic Engineer
Proposal	Extractive Industry
Address	Lot 5 DP 655046, 344 Park Road WALLACIA NSW 2745
Zoning and permissibility	The site is zoned RU1 – Primary Production under Penrith Local Environmental Plan 2010. A Section 149 Planning Certificate will confirm the zone of the site, and you are encouraged to obtain this document to confirm the zone of the site. 'Extractive industries' is a permissible land use in the zone, with Council consent, and subject to compliance with relevant planning legislation including, but not limited to, State Environmental Planning Policy (SEPP) No.33 – Hazardous and Offensive Development. 'Extractive industry' means "*the winning or removal of extractive materials (otherwise than from a mine) by methods such as excavating, dredging, tunnelling or quarrying, including the storing, stockpiling or processing of extractive materials by methods such as recycling, washing, crushing, sawing or separating, but does not include turf farming".* Please note that potentially hazardous or offensive industries are prohibited if the development is proposed on a floodway in accordance with SREP No.20 – Hawkesbury Nepean River. A '*waste or resource management facility'* is permissible in the RU1 zone under Part 3, Division 23 of State Environmental Planning Policy (SEPP) (Infrastructure) 2007. A '*waste or resource management facility'* includes '*resource recovery facility*' and '*waste or resource transfer station'*.
Site constraints	• Flood-related development controls • Bushfire prone land • Scenic and landscape values • Native vegetation on site • Located on a main road • Mapped watercourse(s) traverse the site • Assessment is required to confirm the contamination status of the land • Site is located on the boundary of two local government areas, being Penrith and Liverpool
Development	Designated and integrated development (refer to **Appendix A**)

KEY ISSUES AND OUTCOMES

The proposal is to address the following issues:

RELEVANT EPI's POLICIES AND GUIDELINES

Planning provisions applying to the site, the provisions of all plans and policies are contained in **Appendix B**.

PLANNING REQUIREMENTS

The following advice is provided for your information regarding the key matters discussed at the meeting in relation to the proposal.

Permissibility and site suitability
The subject land is zoned *RU1 Primary Production* under Penrith Local Environmental Plan (LEP) 2010. The proposal is most closely categorised as a "resource recovery facility" (refer to land use definition below). Resource recovery facilities are a prohibited form of development in the *RU1* zone.

"Resource recovery facility means a building or place used for the recovery of resources from waste, including works or activities such as separating and sorting, processing or treating the waste, composting, temporary storage, transfer or sale of recovered resources, energy generation from gases and water treatment, but not including re-manufacture or disposal of the material by landfill or incineration".

It is noted that resource recovery facilities are a permissible form of development in the *RU1 Primary Production* zone under Clause 121 of State Environmental Planning Policy (Infrastructure) 2007 (Infrastructure SEPP).

Alternatively, if the use were considered 'extractive industry', this is a permissible land use on the RU1 zone.

However, notwithstanding permissibility, it is considered that the site is not suitable for the proposed development based on the following considerations:

- The proposed development is located in a significant overland flow path which will have adverse impacts on the surrounding properties.

- Inconsistency with several objectives of the *RU1 Primary Production* zone under Penrith LEP 2010, as detailed below.
  - *To minimise conflict between land uses within this zone and land uses within adjoining zones.*
  - *To protect and enhance the existing agricultural landscape character of the land.*
  - *To ensure development is compatible with the environmental capabilities of the land and does not unreasonably increase the demand for public services or public facilities.*
  - *To preserve and improve natural resources through appropriate land management practices.*

- Earth mounds and hardstand areas would adversely affect the visual amenity and scenic quality of the area. In this regard, the site is identified as having scenic character and landscape values under Clause 6.5 of Penrith LEP 2010. The location and layout of the proposed development would result in unacceptable visual impacts.

- The development would have the potential to adversely affect the environmental values of the site. In this regard, the site is mapped as containing:

  - Cumberland Plain Woodland - a Critically Endangered Ecological Community under both State and Federal legislation;
  - Shale Plains Woodland which is listed as a critically endangered ecological community under State legislation; and
  - *Dillwynia Tenuifolia* , a vulnerable plant species under the Threatened Species Conservation Act 1995.

  In addition, the site is mapped as bush fire prone land, and being subject to flood-related development controls, increasing the likelihood for required vegetation removal to facilitate the proposed use.

- The development would significantly impact on the surrounding rural and residential environment, particularly by way of noise, dust, flood and traffic generation. Mitigation measures to these issues may then result in visual impacts that are not acceptable in rural settings.

- The site is relatively proximate to more appropriately zoned, serviced and unconstrained land within the industrial areas of the City.

- The site is identified as being subject to flood-related development controls. The use of the site and any necessary supporting development is likely to create unacceptable flooding impacts on adjoining properties.

- The site is traversed by a natural watercourse. No filling or altering of watercourses is permitted.

- It is noted that the site has recently been used for the storage of used wooden packaging pallets. Concern is raised as to whether this use of the land has resulted in land contamination. This matter will need to be investigated via a Phase 2 land contamination assessment including soil sampling and analysis to confirm the site is suitable for use.

- Concern is raised over the compatibility of the proposed development with dwelling house development adjoining, surrounding and on site.

In summary, the proposal is unlikely to be supported in its current form. Should it be intended to pursue the proposal in a modified form, a follow-up meeting with Council officers is recommended. It is preferable that Roads and Maritime Service (RMS) pre-lodgement comments are obtained should a second meeting be arranged.

Documents to be submitted with development application	The application is not supported in its current form, and the site is unlikely to be suitable for the proposed use for reasons raised earlier in this advice. Should you choose to pursue consent on this site for the proposed use despite this advice, the following documents would be required to make a complete application: ▪ **Survey Drawing (to AHD)** ▪ **Site Plan** ▪ **Floor Plan(s)** ▪ **Elevation and Section Plans** ▪ **Environmental Impact Statement** This is to accord with any Secretary's Environmental Assessment Requirements (SEARs) obtained from the Department of Planning ▪ **Roads and Maritime Service pre-lodgement advice** ▪ **Overland Flow Flood Report prepared by a suitably qualified person** ▪ **Stormwater Concept Plan (with report and calculations)** ▪ **Waste Management Plan** ▪ **Overland Flow Flood Report** ▪ **Water Sensitive Urban Design (WSUD) Strategy** ▪ **Landscape Plan** ▪ **Traffic and Access Report** Prepared by a suitably qualified person addressing but not limited to traffic generation, impact on the road network (including the intersection of Park Road and The Northern Road, Park Road and the development access at Park Road), size, type and volume of vehicle access to site, driveway access, heavy vehicle access, management of staff/visitor vehicle conflict with heavy vehicle access, loading areas, manoeuvring areas and car parking in accord with RMS Guidelines, Austroads guidelines, Australian Standard (AS) 2890 Parts 1, 2 and Council Development Control Plans) clearly demonstrating satisfactory manoeuvring on-site and forward entry and exit to and from the public road ▪ **Flora and fauna assessment report** The impacts of noise, dust and vibration on animals in the immediate vicinity is to be considered ▪ **A Wastewater Report** ▪ **An air quality impact assessment** This is to be prepared in accordance with relevant NSW EPA guidelines ▪ **A Water Quality Management Plan** ▪ **Contamination Assessment (SEPP 55) – Phase 2** A Remediation Action Plan is required where remediation is required ▪ **A noise impact assessment** This is to be prepared in accordance with the NSW EPA's Noise Policy for Industry (October 2017) and other relevant guidelines. The report must assess noise associated with all processing and transport activities including the operation of plant and equipment, and the movement of vehicles at the site. ▪ **Operational Plan of Management**

	One (1) printed and 2 x CD copies of your development application Please refer to Council's Development Application checklist, as attached, for further details of submission requirements and ensure that plans submitted illustrate consistent detail. Please ensure you contact Council's duty officer on 4732 7991 to make an appointment for lodgement of this application. **ALL DOCUMENTS ON THE REQUIRED DISCS MUST BE IN PDF FORMAT**
Fees	Please call the Development Services Department Administrative Support on (02) 4732 7991 to enquire about fees and charges.

APPENDIX A

Category of development ('Designated' and 'Integrated' development)

The category of development will need to be addressed in any development application including:

- ***Designated development***
  There a few categories of 'designated development' that can be triggered for uses involving glass recycling, some of which involve consideration of the capacity of the operations and others that do not. Of most relevance to your proposal is 'concrete works' and/or 'crushing, grinding or separating works'. Processing capacity, the distance to residential dwellings, or distance to natural waterbodies/mapped watercourse triggers this requirement.

  It appears the application represents 'designated development' under Schedule 3 of the Environmental Planning and Assessment (EP&A) Regulation 2000. It is noted that you have advised the handling of substances under the Australian Dangerous Goods Code does not occur as part of the proposed use.

  You are encouraged to discuss this proposal with the Department of Planning prior to pursuit of a development application to confirm their requirements in preparing any required Environmental Impact Statement.

- ***Integrated development***
  The application is integrated development under the Protection of the Environmental Operations Act (POEO) 1997. The triggers for 'integrated' development include, though are not limited to, 'concrete works', 'crushing, grinding, or separating', 'resource recovery', and/or 'waste storage'.

  Based on the type of development described in the meeting and pre-lodgement documents, the proposal represents "Crushing, grinding or separating works". The threshold in Schedule 1 of POEO for crushing, grinding and separating works is a capacity to process more than 150 tonnes per day or 30,000 tonnes per year. Based on the information provided, including the specifications for the crusher and frequency of vehicles relative to their size, the proposal exceeds this capacity threshold and is likely to require an environment protection licence from the NSW EPA.

  You are encouraged to discuss the proposal with the Environmental Protection Authority for their licensing requirements.

APPENDIX B

- Environmental Planning and Assessment Act 1979
- Environmental Planning and Assessment Regulation 2000
- Threatened Species Conservation Act 1995
- Sydney Regional Environmental Plan No.20 – Hawkesbury Nepean River (No.2 - 1997)
- State Environmental Planning Policy (SEPP). No 55 – Remediation of Land
- SEPP No.33 – Hazardous and Offensive Development
- State Environmental Planning Policy (Infrastructure) 2007
- Protection of the Environment Operations Act 1997
- Penrith Local Environmental Plan 2010
- Penrith Development Control Plan 2014

Important Note

The pre-lodgement panel will endeavour to provide information which will enable you to identify issues that must be addressed in any application. The onus remains on the applicant to ensure that all relevant controls and issues are considered prior to the submission of an application.

Information given by the pre-lodgement panel does not constitute a formal assessment of your proposal and at no time should comments of the officers be taken as a guarantee of approval of your proposal.

It is noted that there is no Development Application before the Council within the meaning of the Environmental Planning and Assessment Act 1979. This response is provided on the basis that it does not fetter the Council's planning discretion and assessment of any Development Application if lodged. It is recommended that you obtain your own independent expert advice.

The response is based upon the information provided at the time of the meeting.