Proposed Industrial Subdivision

Penrith Lakes Business Park

Stormwater Management Report

Great River NSW Pty Ltd

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Geoff Craig & Associates Pty Ltd
ABN 92 086 017 745

1 Hartley Drive
Thornton NSW 2322

PO Box 3337
Thornton NSW 2322
Australia

T: (02) 4964 1811
F: (02) 4964 1822

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1	Original Issue	KS	21.12.18	AS	21.12.18	AS	21.12.18
2	Minor Amendment	AS	10.01.19	AS	10.01.19	AS	10.01.19

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List of acronyms

AEP	Annual Exceedance Probability
ARI	Average Recurrence Interval
ARR	Australian Rainfall and Runoff
GCA	GCA Engineering Solutions
IFD	Intensity Frequency Duration
PLBP	Penrith Lakes Business Park
RCP	Reinforced Concrete Pipe
RL	Reduced Level

1. Introduction

1.1 Background

This stormwater strategy is to support a proposed industrial / commercial subdivision on three properties currently identified as Lots 308, 309, and 310 DP752021 (14 – 278 Old Castlereagh Road, Castlereagh).

The site accessed off Old Castlereagh Road and Lugart Street as shown on the Locality Plan in *Figure 1*.

The site comprises two land use zones – Employment and Unzoned – under *State Environmental Planning Policy (Penrith Lakes Scheme) 1989*.

It is understood that the Development Application (DA) for the proposed development is being submitted to the NSW Department of Planning. The consent authority for the DA is the NSW Minister for Planning and Environment.

This report has been prepared to inform and support the DA in respect to stormwater management for the proposed subdivision.

1.2 Site Description

The parent lot is bounded by Old Castlereagh Road to the north, existing industrial development to the east and south-east, the Nepean River to the south, and the Penrith Lakes Regional Park to the north.

The site was formerly part of a large quarry that has undergone an extensive rehabilitation program over a period of approximately 30 years. The site itself was a former tailings disposal area under the original quarry scheme.

The site is currently covered by grassy vegetation with scattered trees. The existing topography is considered ‘flat’ with surface slopes in the order of 0% - 1% but up to 5% in isolated areas.

The existing general pattern of site drainage is to the west into the Penrith Lakes Regional Park. The site will be subject to earthworks filling under separate approvals not falling under the DA for which this report has been prepared, and will continue to generally drain to the west under the proposed development.

1.3 Proposed Development

The development proposal is shown on the layout in *Appendix A* and comprises approximately 100 industrial / commercial lots with a mix of areas varying between 1,500m^2 and approximately 1ha. The roads, stormwater drainage, and utilities services infrastructure will be created under the DA for which this report has been prepared.

The layout has been prepared to accommodate a centralised scheme of interlinking wetlands which is sympathetic to the Penrith Lakes Regional Park to the north. The wetlands provide an opportunity to collect and convey stormwater from the development and remove nutrients and potential pollutants prior to release into the Penrith Lakes Regional Park.

FIGURE 1
LOCALITY PLAN

DWG REF: 18255 F01 r1 DATE: 18.12.18

1.4 Objectives

This report has been prepared to document the stormwater management philosophy in respect to stormwater flow rates and quality being discharged from the proposed subdivision.

1.5 Site context and stormwater detention

The site's context, in respect to broader regional drainage, is shown on Figure 2.

As noted later in this report, the stormwater management approach involves draining all lots into centralised wetlands which all discharge to a single point on the western boundary into the Penrith Lakes scheme to the west. The Penrith Lakes scheme ultimately overflows into the Nepean River.

Only a very small portion of the proposed road areas immediately at the site entrances will drain into Old Castlereagh Road and Lugard Street, with sufficient capacity in the receiving systems.

The Penrith Lakes scheme itself has a substantial water storage capacity and the developer is aware that a very large water storage facility is being constructed to the immediate west of the site in future by Penrith Lakes Development Corporation (PLDC), the entity currently responsible for ongoing rehabilitation of the Penrith Lakes Regional Park site.

Considering the site's drainage context, stormwater detention is not warranted for the proposed development. The discharge flow rates from the development site will be negligible by comparison to the significant capacity available in the Penrith lakes scheme and ultimate receiving waterbody being the Nepean River.

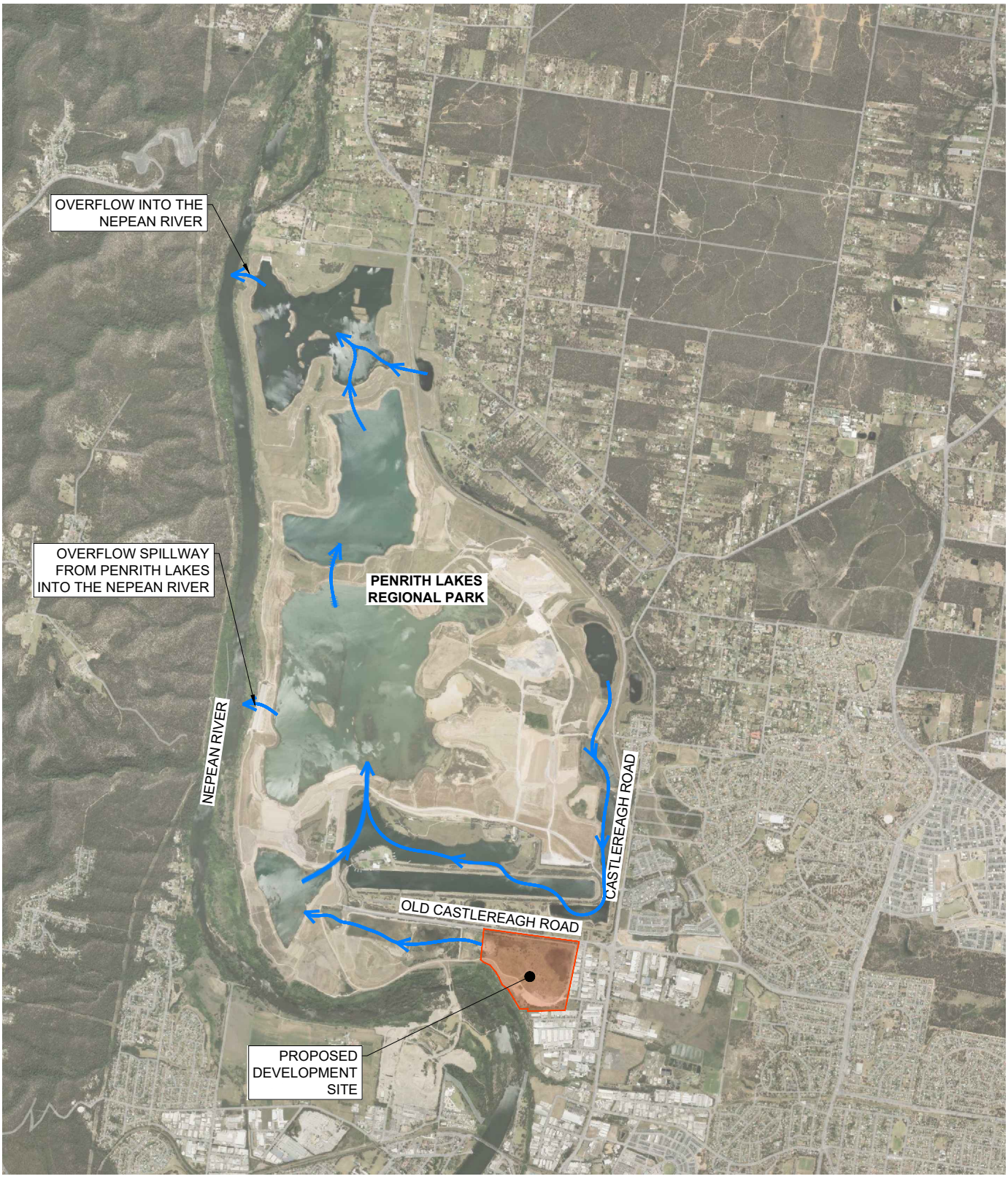


FIGURE 2
SITE CONTEXT

DWG REF: 18255 F02 r1 DATE: 18.12.18

2. Stormwater Management Strategy

It is a commonly accepted principle that core stormwater management infrastructure for a subdivision development should, where practical, be centralised and located within public reserve areas where they are accessible and visible.

The proposed stormwater strategy is shown on *Figure 3* and involves:

- Capture of stormwater from lot and road areas by a conventional pit and pipe drainage network located in the street or in inter-allotment drainage as required.

  It is anticipated that the pipe network will be designed for the 20 year ARI standard and the combined pipe / channel / road overland flow system will be capable of safely conveying the 100 year ARI design flows. This is typical for all new development within the Penrith Council Local Government Area.

- Stormwater collected in the minor (piped) system will pass through enhanced Gross Pollutant Traps. For the purpose of this strategy the Humeceptor (Holcim) has been included in the water quality treatment simulation, although there are alternatives such as the SPEL Stormceptor that could be considered at detail design for construction certificate and are likely to have roughly equivalent performance.

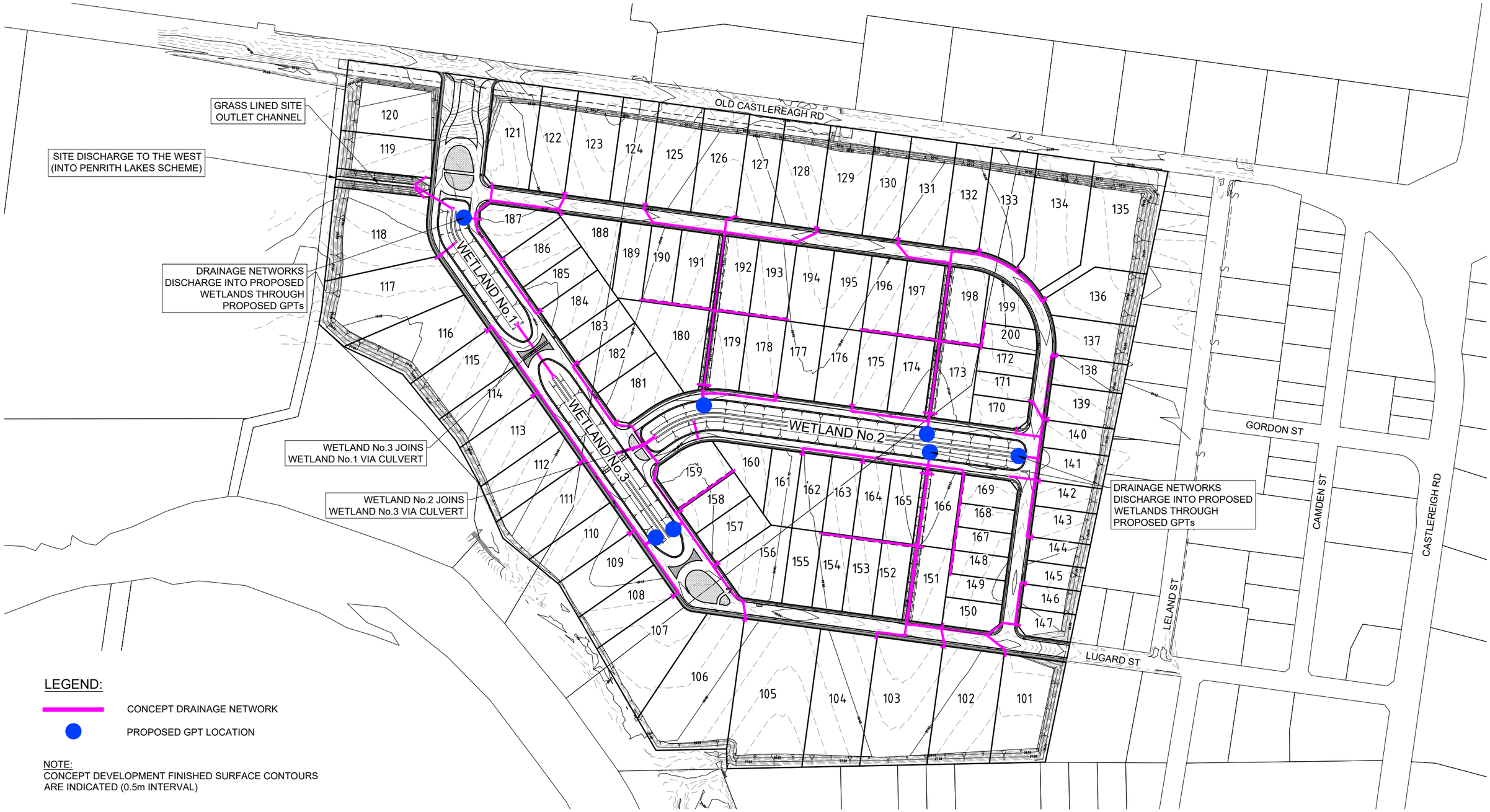
- Stormwater will be directed into the central spine of three wetlands. The wetlands provide the opportunity for permanent pools of water which will provide tertiary water quality treatment. The wetlands also assist with minimising levels across the site (avoiding excessing filling under separate operation).

  The wetlands have been sized (and will be designed in future) from the perspective of water quality treatment and landscape amenity. Whilst they will provide stormwater detention benefits, they have not been provided necessarily for this purpose (refer Section 1.5).

The performance of the proposed stormwater strategy has been predicted by water quality modelling software simulation and is documented in Section 3 of this report.

GCA ENGINEERING SOLUTIONS

PENRITH LAKES BUSINESS PARK
OLD CASTLEREAGH ROAD, CASTLEREAGH



LEGEND:

CONCEPT DRAINAGE NETWORK

PROPOSED GPT LOCATION

NOTE:
CONCEPT DEVELOPMENT FINISHED SURFACE CONTOURS ARE INDICATED (0.5m INTERVAL)

N

FIGURE 3
CONCEPT STORMWATER MANAGEMENT STRATEGY

1:4000 0 80 160 240 m

DWG REF: 18255 F03 r1 DATE: 18.12.18

3. Water Quality

3.1 Criteria

In general, the industry standard approach for new developments involves treatment of stormwater runoff in centralised systems prior to discharge into existing drainage networks and/or waterways. The treatment targets are expressed as a percentage retention of development pollutant and nutrients generated by the development.

The treatment targets adopted for this development are summarised in Table 3-1 below and are consistent with those adopted by several Councils in the Sydney Region including Penrith Council.

Table 3-1: Stormwater treatment targets for Penrith Lakes Business Park

Pollutant	Target Reduction (Pollutants Retained)
Gross Pollutants >5mm	90 %
Total Suspended Solids (TSS)	85 %
Total Phosphorous (TP)	60 %
Total Nitrogen (TN)	45 %
Free Oils and Grease[1]	90 % (and no visible discharge)

It is noted that the water quality modelling software does not explicitly consider free oils and grease, but is reported here for completeness. The proposed stormwater management strategy includes a number of enhanced gross pollutant traps which are designed with hydraulic dwell and therefore provide high degree of performance removing free oils and grease from stormwater.

3.2 Methodology

The proposed development and stormwater management strategy was modelled using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) published by eWater Limited, which is the current best practice tool for estimating the ameliorating effects of proposed Stormwater Quality Improvement Devices (SQIDS) in a treatment train approach.

MUSIC uses real historical continuous rainfall records (over several years) as input and compares the theoretical pollutant generation within the catchment to the final theoretical export rate (usually expressed in kg/year) to determine a treatment train effectiveness. The effectiveness is expressed as percentages that are directly comparable to the targets shown in Table 3-1.

3.3 Stormwater Quality model

3.3.1 Rainfall and Evapotranspiration

Input rainfall and potential evapotranspiration data (PET) was sourced from the MUSIC database for Penrith Council Local Government Area.

The long term mean annual rainfall is 691mm and the mean annual average PET is 1158mm.

3.3.2 Land use

The following developed land use types were used in MUSIC to simulate the site in a developed state:

- Lots – The lot areas comprise of only the area within the lot boundaries. This was assigned an "Urban" source node type and pollutant generation data was adopted from the default data in Penrith Council's Water Sensitive Design (WSUD) Technical Guidelines (Version 3, June 2015).
- Roads – The road areas comprise of the area within the road reserve, excluding any wetland area. This was also assigned an "Urban" source node type and the stormflow concentration parameters were altered to be in accordance with Penrith City Council's WSUD Technical Guidelines.

3.3.3 Hydrology

Hydrology parameters used in the model for each land use were adopted from Penrith Council's WSUD Technical Guidelines, with summary presented in Table 3-2.

Table 3-2: MUSIC parameters for the developed site

Parameter	Lots	Roads
Surface Type Classification	Urban	Urban
Impervious Area		
Impervious Percentage	90	72-85
Rainfall Threshold (mm/day)	1.4	1.4
Pervious Area		
Soil Storage Capacity (mm)	105	105
Initial Storage (% of Capacity)	30	30
Field Capacity (mm)	70	70
Infiltration Capacity Coefficient - a	150	150
Infiltration Capacity Exponent - b	3.5	3.5
Ground Water Properties		
Initial Depth (mm)	10	10
Daily Recharge Rate (%)	25	25
Daily Baseflow Rate (%)	10	10
Daily Seepage Rate (%)	0	0

3.3.1 Treatment Devices

Gross Pollutant Trap - Humeceptor

MUSIC Treatment Nodes were supplied by Humes / Holcim for Humeceptor GPTs. The pollutant removal rates are summarised in Table 3-3.

Table 3-3: Supplied Humeceptor Treatment Parameters

Parameter	Value
Total Suspended Solids (TSS) Removal Rate	80%
Total Phosphorus (TP) Removal Rate	30%
Total Nitrogen (TN) Removal Rate	30%
Gross Pollutants (GP) Removal Rate	100%

Alternative GPTs may be implemented in the detailed design for Construction Certificate, but the pollutant generation rates should be similar provided that 'enhanced' models employing a hydraulic dwell time (Humeceptor, Stormceptor or similar) are incorporated.

Wetland

The wetlands will be located immediately downstream of the GPTs and have been modelled using the "Wetland" treatment node. This approach was adopted (instead of a simple water quality pond) because of the very high proportion of vegetation coverage that is anticipated within these areas for the future final detailed landscape designs.

It is proposed to provide outlet control devices to each wetland to provide permanent pooling volume and link the wetlands in series. The estimated wetland summary properties and adopted parameter values are provided in Table 3-4.

Table 3-4: Wetland MUSIC Parameters

State	Wetland No.1	Wetland No.2	Wetland No.3
Inlet Properties			
Low Flow By-pass (m^3/s)	0.00	0.00	0.00
High Flow By-pass (m^3/s)	2.73	1.63	2.35
Storage Properties			
Surface Area (m^2)	2125	5888	3253
Extended Detention Depth (m)	0.30	0.30	0.30
Permanent Pool Volume (m^3)	1150	3111	1708
Exfiltration Rate (mm/hr)[1]	0.05	0.05	0.05
Evaporative Loss as % of PET	125.00	125.00	125.00
Outlet Properties			
Equivalent Pipe Diameter (mm)[2]	1050	900	1050
Overflow Weir Width (m)	10.0	10.0	10.0

1. Some exfiltration has been included in the model with consideration to an impermeable lining not being proposed for the wetlands. The adopted rate is very low. By comparison, the MUSIC Model manual suggests a base limit of 0 to 0.36 mm/hr for "heavy clay" whilst actual site soils may be more permeable. The model results should therefore be a conservative (lower bound) estimate of anticipated pollutant removal rates.
2. The outlet pipe diameter has been sized based on the approximate 1 year ARI flow rate for the cumulative catchments to each wetland and will be confirmed at Construction Certificate.

3.4 MUSIC Model Results

The average annual pollutant loadings of Total Suspended Solids, Total Phosphorus, Total Nitrogen and Gross Pollutants for developed conditions are shown in Table 3-5. Also provided is the relative reduction (%) expected to arise with the provision of the proposed stormwater quality treatment train.

Table 3-5: Comparison of MUSIC predicted average annual pollutant export for the proposed treatment train

Pollutant	Source Generation	Residual Load	Treatment Train Effectiveness[1]
Gross Pollutants	6,460	0	100 %
TSS (kg/yr)	44,200	4,440	90 %
TP (kg/yr)	72.2	24.8	65.7 %
TN (kg/yr)	487	265	45.6 %

1. Expressed as a percentage reduction in average annual pollutant load, compared with the situation where no controls are provided (i.e. percentage reduction in post-development 'source' loads).

The results show that the proposed combination of GPTs in conjunction with large wetlands will achieve the treatment targets adopted for the site.

4. Summary and Conclusions

The proposed development involves industrial / commercial subdivision creating approximately 100 lots ranging from 1500m^2 to 1ha in area.

The site is situated in the southern end of the Penrith Lakes Regional Park. The site currently drains generally into the Penrith Lakes scheme and will continue to do so when the site is developed.

Stormwater detention is not warranted for the proposed development due to it draining into the Penrith Lakes scheme and ultimately discharging to the Nepean River. The stormwater flow rates from the development site will be negligible compared to the capacity of the Penrith Lakes scheme and will have no practical impact upon flow within the Nepean River.

The stormwater management approach for the proposed development involves capture and conveyance of stormwater from lot and road areas in a minor / major flow system. The pit and pipe network will comprise the minor system (generally designed for 20 year ARI). The major system will be the combined pit, pipe, road and channel network (generally designed to safely convey 100 year ARI).

Stormwater will pass through ‘enhanced’ gross pollutant traps before entering several large wetlands that will provide both stormwater quality treatment and landscape amenity.

MUSIC stormwater modelling was undertaken as part of this strategy and has demonstrated that the proposed stormwater strategy will satisfactorily reduce development pollutant loads in accordance with the targets adopted for most of the Sydney region including Penrith Council.

Generally, stormwater quality treatment for the broad development site including future development on each lot has been catered for within the subdivision stormwater management system. As a result it is not expected that typical “low impact” developments such as bulky goods or warehousing will require any further on-site treatment devices as part of the future building developments. However, the proposals for each building site will need to be assessed on merit in future, with sites considered to be at higher risk of releasing stormwater with high concentrations of nutrients and/or other pollutants incorporating site specific stormwater treatment devices and/or resolving trade waste agreements with Sydney Water Corporation. No development shall be permitted to release free oils, grease, heavy metals, or contaminants into the street stormwater drainage and wetland system.

It is recommended that the development water quality modelling is revisited as part of future Construction Certificate when the final stormwater management network is designed, GPT models selected and sized, and the geometry of each wetland is confirmed.

Appendix A

Development Layout

LEGEND

NET LAND AREA	381125m²	(81.23%)
NET ROAD/VERGE AREA	59341m²	(12.65%)
NET WETLAND AREA	28711m²	(6.12%)
SITE AREA	469177m²	

NOTE: APPROXIMATE AREAS. TO BE CONFIRMED BY SURVEY.

(B) - PROPOSED EASEMENT TO DRAIN WATER 10 WIDE (VIDE D.P.)
(C) - PROPOSED EASEMENT TO DRAIN WATER 10 WIDE

OVERALL SITE PLAN

SCALE 1:2000

PRELIMINARY ISSUE
NOT FOR CONSTRUCTION

Amendment	Description	Drawn	App'd	Date
17	BOUNDARY SPLAYS ADDED	KS	AS	06.12.18
16	PEDESTRIAN CROSSINGS ADDED	KS	AS	05.12.18
15	ROAD NAMES ADDED	DB	AS	28.11.18
14	FOOTPATHS ADDED	DB	AS	28.11.18
13	WETLAND, ROADS & LOT NUMBERING AMENDED	DB	AS	27.11.18
12	STAGING AMENDED	DB	AS	26.11.18
11	ROAD, MEDIAN AND LOTS AMENDED	DB	AS	19.11.18

North

Scale
0 40 80 120 160m
1:2000 (A1) 1:4000 (A3)

Designed	AM
Cad Reference	18255LD LD03 r17
Scale	1:2000
	A1 SHEET
Project Approval	IAN HILL (B.E) Consulting Civil Engineer

Client

GCA ENGINEERING SOLUTIONS
A.B.N. 92 086 017 745
1 HARTLEY DRIVE, THORNTON NSW 2322
PO BOX 3337, THORNTON NSW 2322
PHONE: (02) 4964 1811 ◆ FAX: (02) 4964 1822

PENRITH LAKES

INDICATIVE CONCEPT ONLY

Project No	
18255LD	
Drawing No	Revision
LD03	17

PLOT DATE: 14/12/2018 12:04:53 PM CAD FILE: Q:\18\18255 Penrith Lakes Industrial\02_CAD\AutoCAD\LD\18255LD LD03 r17.dwg

Appendix B

MUSIC Node Layout and Subcatchment Data

GCA ENGINEERING SOLUTIONS

PENRITH LAKES BUSINESS PARK
OLD CASTLEREAGH ROAD, CASTLEREAGH

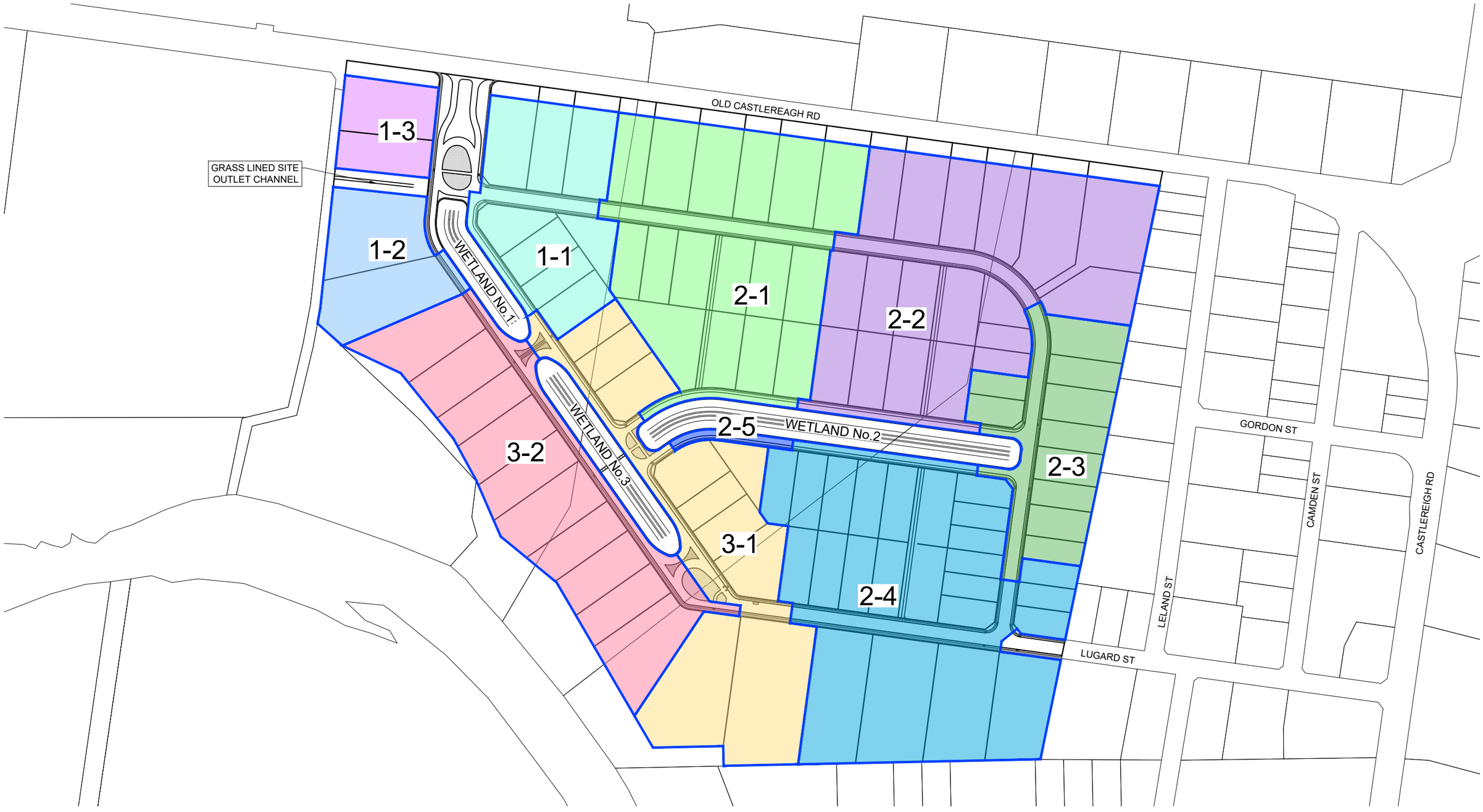


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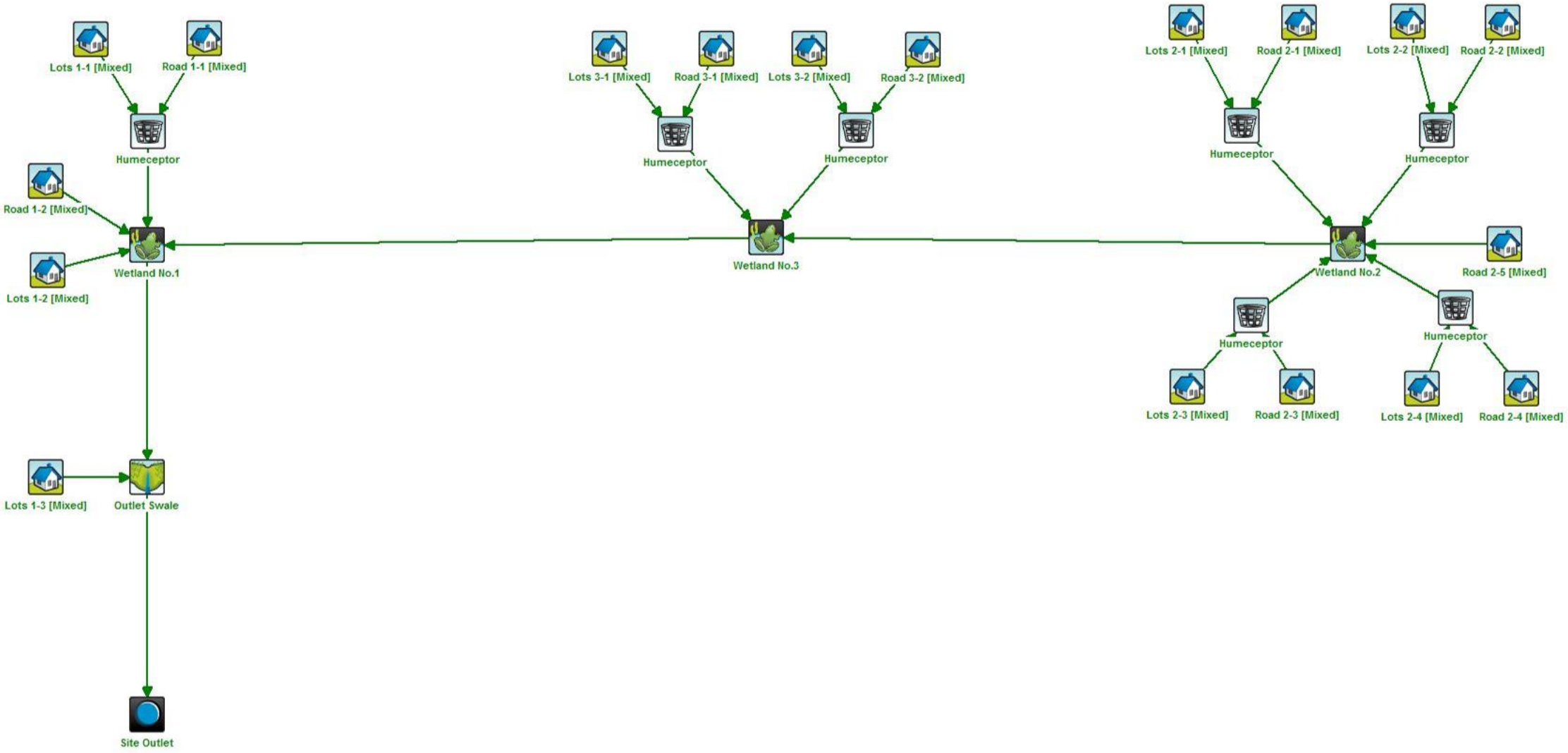
FIGURE B1
MUSIC MODEL SUB-CATCHMENT PLAN

1:4000 0 80 160 240 m

DWG REF: 18255 FB1 r1 DATE: 18.12.18


Lots 1-1 [Mixed]
Road 1-1 [Mixed]
Humeceptor
Road 1-2 [Mixed]
Lots 1-2 [Mixed]
Wetland No.1
Lots 1-3 [Mixed]
Outlet Swale
Site Outlet
Lots 3-1 [Mixed]
Road 3-1 [Mixed]
Lots 3-2 [Mixed]
Road 3-2 [Mixed]
Humeceptor
Humeceptor
Wetland No.3
Lots 2-1 [Mixed]
Road 2-1 [Mixed]
Lots 2-2 [Mixed]
Road 2-2 [Mixed]
Humeceptor
Humeceptor
Wetland No.2
Road 2-5 [Mixed]
Humeceptor
Humeceptor
Lots 2-3 [Mixed]
Road 2-3 [Mixed]
Lots 2-4 [Mixed]
Road 2-4 [Mixed]

Penrith Lakes Business Park — Project No. 18255
Stormwater Management Strategy
MUSIC Model Subcatchment Data — Date: 20/12/18

Catchment	Road Area				Lots	
	Pervious (ha)	Conc+Pave (ha)	Total (ha)	% Imperv	Area (ha)	% Imperv
1-1	0.011	0.317	0.425	75%	2.581	90%
1-2	0.011	0.045	0.056	81%	0.830	90%
1-3					1.819	90%
2-1	0.173	0.518	0.691	75%	5.643	90%
2-2	0.195	0.480	0.675	71%	6.511	90%
2-3	0.154	0.528	0.682	77%	2.178	90%
2-4	0.193	0.622	0.815	76%	7.474	90%
2-5	0.040	0.103	0.144	72%		
3-1	0.215	0.621	0.835	74%	4.575	90%
3-2	0.106	0.580	0.686	85%	4.729	90%
Totals	**1.097**	**3.813**	**5.008**	**76%**	**36.341**	