10 Attachment B – Summary of MUSIC Input Parameters

Attachment B: MUSIC modelling input parameter values and source.

Element	Factor	Input	Source
Setup	Climate File	Climate file (mlb file) from Nowra RAN from 26/11/1992 - 26/11/1997	BOM
Source Nodes	Node Type	The existing site will be a mixture of agricultual and forested nodes, depending on location across the site. Proposed will be a mixture of roof, road and residential nodes plus forest for undeveloped forest areas.	As per WBM (2010) and development layout
	Roof Area	As per proposed site coverage (ranges from 40% - 60%)	As per development layout
	Road Area	Area per lot layout. Area to be summed for each subcatchment.	As per development layout
	Residential	Remaining lot area (catchment area less road and roof area). Given driveways are not considered 'effective impervious areas' and laybacks are, residential nodes are generally 99% pervious	Assumed based on 'typical' lot layouts
	Rainfall Threshold	Based on land use type or surface type as specified in Table 3.6 of WBM (2010)	WBM (2010) guidelines
	Pervious Area Parameters	Based on soils within the top 0.5m of existing soil profile = Clayey Sand	Soil properties based on WBM (2010) Table 3-7 and 3-8 and site geotechnical testing by Martens (2010) of 24 boreholes.
	EMC's	As per WBM (2010) for Urban and Forest landuse	WBM (2010) guidelines
	Estimation Method	Stochastically generated	WBM (2010) guidelines
Bioretention Basin	Low Flow By-Pass	0 m^3/s	WBM (2010) guidelines
	High Flow Bypass	100 m^3/s	Online so no bypass (excluding Catchment C15a basin = 50% 1yr ARI)
	Extended Detention depth	Typically 0.5m	By design
	Surface area	Surface area at half the detention depth	WBM (2010) guidelines
	Filter area	By design.	Design of proposed basin
	Unlined filter media	Equal to square root of surface area (actual) multiplied by 4	WBM (2010) guidelines
	Saturated Hydraulic Conductivity	90 mm/hr	MUSIC model help guidelines (ewater) recommend a hydraulic conductibity of 180 mm/hr be used for sands. 50% of this value has been used in modelling as a conservative estimate of realistic long-term hydraulic conductivity of system (ewater).
	Fiter Depth	0.4 - 0.6m	Design of proposed basin
	TN content of filter media	500 mg/kg	Based on previous discussions with T. Weber (WBM) for other sites (Riverside development September 7, 2012).
	Orthophosphate content of filter media	40 mg/kg	Based on previous discussions with T. Weber (WBM) for other sites (Riverside development September 7, 2012) and product data sheet from RiverSands P/L for typical sand filter media (attached)
	Exfiltration rate	3.6 mm/hr	Based on medium clay subsoils
	Is based lined?	No	Basins shall not be lined
	Vegetation Properties	With effective nutrient removal plants	Landscaping of basins will include deep rooted vegetation.
	Oveflow weir width	varies	Basin design
	Underdrain present	Yes	Basin design
	Submerged zone with carbon present	Yes; 0.0 - 0.2m	Basin design
	Low Flow By-Pass	0 m^3/s	WBM (2010) guidelines
	High Flow Bypass	100 m^3/s	No Bypass
	Extended Detention depth	0.25m	By design
	Surface area	Surface area at half the detention depth	WBM (2010) guidelines
	Filter area	By design.	Design of proposed basin
	Unlined filter media	Equal to square root of surface area (actual) multiplied by 4	WBM (2010) guidelines
	Saturated Hydraulic Conductivity	90 mm/hr	MUSIC model help guidelines (ewater) recommend a hydraulic conductibity of 180 mm/hr be used for sands. 50% of this value has been used in modelling as a conservative estimate of realistic long-term hydraulic conductivity of system (ewater).
	Fiter Depth	0.6m	Design of proposed basin

Bioretention Swales	TN content of filter media	500 mg/kg	Based on previous discussions with T. Weber (WBM) for other sites (Riverside development September 7, 2012).
	Orthophosphate content of filter media	40 mg/kg	Based on previous discussions with T. Weber (WBM) for other sites (Riverside development September 7, 2012) and product data sheet from RiverSands P/L for typical sand filter media (attached)
	Exfiltration rate	3.6 mm/hr	Based on medium clay subsoils
	Is based lined?	No	Swales shall not be lined
	Vegetation Properties	With effective nutrient removal plants	Landscaping of basins will include deep rooted vegetation.
	Oveflow weir width	varies	Basin design
	Underdrain present	Yes	Basin design
	Submerged zone with carbon present	Yes; 0.2m	Basin design
Wetlands	Low Flow By-Pass	0 m^3/s	WBM (2010) guidelines
	High Flow Bypass	100 m^3/s	Online so no bypass (excluding Catchment C15a basin = 50% 1yr ARI)
	Inlet Pond Volume	Varies	By design
	Surface area	Surface area at half the detention depth	WBM (2010) guidelines
	Extended Detention depth	0.4 - 0.5m	Design of proposed wetlands
	Permanent Pool Volume	Varies	Design of proposed wetlands
	Exfiltration rate	3.6 mm/hr	Based on medium clay subsoils
	Equivalent Pipe Diameter	Varies	Adjusted to achieve detention time of 40 - 48 hrs
	Weir width	Varies	Design of proposed wetlands
	Reuse	Where used based on 6ML/ha/yr	Typical irrigation rate for golf course grade landscaping
GPT (CDS GPT)	Low Flow By-Pass	0 m3/s	WBM (2010) guidelines
	High Flow Bypass	Varies - Q (3month)	As per manufactures specification (Rocla) and catchment area
	TSS (mg/L)	Input 1075 Ouput 376.7	As per manufactures specification (Rocla)
	TN (mg/L)	Input 50 Ouput 50	As per manufactures specification (Rocla)
	TP (mg/L)	Input 10 Ouput 7	As per manufactures specification (Rocla)
	GP (kg/ML)	Input 100 Ouput 2	As per manufactures specification (Rocla)
GPT (SPEL Stormceptor)	Low Flow By-Pass	0 m3/s	WBM (2010) guidelines
	High Flow Bypass	Varies	As per manufactures specification (SPEL) 90% of daily maxima inflow
	TSS (mg/L)	Input 1000 Ouput 30	As per manufactures specification (SPEL)
	TN (mg/L)	Input 50 Ouput 35	As per manufactures specification (SPEL)
	TP (mg/L)	Input 5 Ouput 3.5	As per manufactures specification (SPEL)
	GP (kg/ML)	Input 15 Ouput 0	As per manufactures specification (SPEL)
Rainwater Tank	Low Flow By-Pass	0 m3/s	WBM (2010) guidelines
	High Flow Bypass	0.005 m3/s per dwelling (for free standing houses, townhouses, retirement and tourist accomodation). 100mm/hr for unit blocks by assumed roof perimeter	WBM (2010) guidelines
	Volume below overflow	Based on 3KL/dwelling or 3KL/tenement. A volume of 80% of total tank volume is assumed	Development design. As per WBM (2010) MUSIC modelling guidelines
	Depth above overflow	0.2m	By design
	Surface area	Cumulative surface area	By design
	Overflow pipe diameter	100mm	WBM (2010) guidelines
	Reuse	274L/day/ET	Shoalhaven Water
Buffer	% upstream area buffered	100	WBM (2010) guidelines
	Buffer Area (%)	50	As per WBM (2010) MUSIC modelling guidelines. A maximum of 50% can be entered. Buffer area is greater than upstream impervious area
	Exfiltration rate	0.1 mm/hr	Maximum allowable as per WBM (2010) MUSIC modelling guidelines

RIVER SANDS PTY LTD
ACN 009 919 215 ABN 41 009 919 215

Brisbane Head Office
683 Beenleigh-Redland Bay Rd,
Carbrook Qld 4130
PO Box 4127
Loganholme DC Qld 4129

Toll Free 1800 077 744
Phone 07 3287 6444
Fax 07 3287 6445
Email info@riversands.com.au
Web www.riversands.com.au

Accounts Office
Phone 07 5539 1511
Fax 07 5597 1226
PO Box 727
Ashmore City Qld 4214

PRODUCT DATA SHEET

This is a typical analysis of material produced and does not constitute as a Product Certification for material supply.

Product: Bioretention Filter Media Manufactured to**:**

- **The Facility for Advance Water Biofiltration Guidelines (Version 3.01 June 2009)**
- **The Healthy Waterways / Water By Design Specifications (November 2010)**

A Blend of Sands, Soils, Loams and Organic Materials

Application: Bioretention Filter Media Basin

Technical Information:

Analysis	FAWB Specification	Result
Organic Matter (%)	>3-10	8.1
Saturated Hydraulic Conductivity (Ksat) (mm/hr)	100-500	321
Electrical Conductivity (1:5) (dS/m)	<1.2	0.23
pH (1:5) in H2O (pH units)	5.5-7.5	5.8
Total Nitrogen (LECO) (%)	<0.1	<0.05
Phosphate as PO4 (mg/kg)	<80	2.2
Total Phosphorus (%)	≤0.01 (need to test for potential leaching if >0.01)	0.01

The below attached Particle Size Distribution (PSD) is a recommended range and is of secondary importance compared with saturated hydraulic conductivity.

Size (mm)	FAWB Indicative PSD	Result
<0.05	<3.0%	2.9%
0.05-0.15	5-30%	6.0%
0.15-0.25	10-30%	21.7%
0.25-1.0	40-60%	68.7%
1.0-2.0	7-10%	0.6%
2.0-3.35	<3.0%	0.0%
>3.35		0.1%

River Sands operates and maintains a Quality Certified system in accordance with AS/NZS ISO 9001:2008
The quality system is third party certified by NCSI – Registration #6898
River Sands operates a NATA accredited laboratory – Registration #10470
Testing results achieved at time of manufacture

07.08.2012:3AHS,8.23348/LWR6409

11 Attachment C - Figures

13 Attachment E – Bioretention Basin and Wetland MUSIC Input Parameters

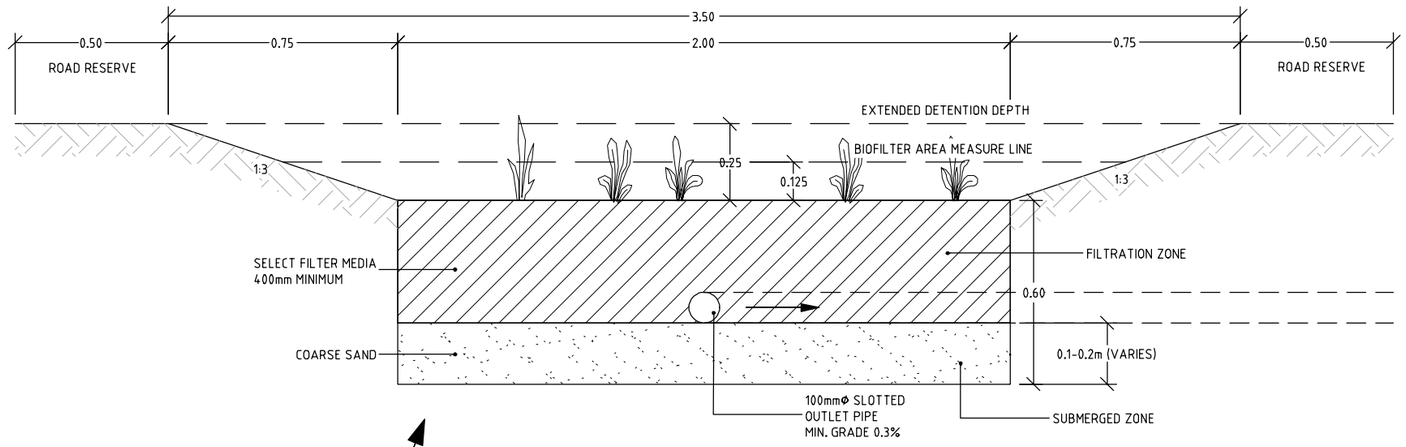
WETLAND INPUT PARAMETERS

	Wetland 3	Wetland 4	Wetland 5	Units
Stormwater Re-use		27.9		{ML/yr}
Inlet Properties - Low Flow By-pass (cubic metres per sec)	0	0	0	{cubic metres per sec}
Inlet Properties - High Flow By-pass (cubic metres per sec)	100	100	100	{cubic metres per sec}
Inlet Properties - Inlet Pond Volume (cubic metres)	0	25	0	{cubic metres}
Storage Properties - Surface Area (square metres)	9042	1806.1	6066	{square metres}
Storage Properties - Extended Detention Depth (metres)	0.4	0.5	0.4	{metres}
Storage Properties - Permanent Pool Volume (cubic metres)	730	150	500	{cubic metres}
Storage Properties - Exfiltration Rate (mm/hr)	3.6	3.6	3.6	{mm/hr}
Storage Properties - Evaporative Loss as % of PET	125	125	125	
Outlet Properties - Equivalent Pipe Diameter (mm)	130	60	100	{mm}
Outlet Properties - Overflow Weir Width (metres)	650	20	650	{metres}
Outlet Properties - Notional Detention Time (hrs)	40	42	46	{hrs}

BIORETENTION BASIN INPUT PARAMETERS

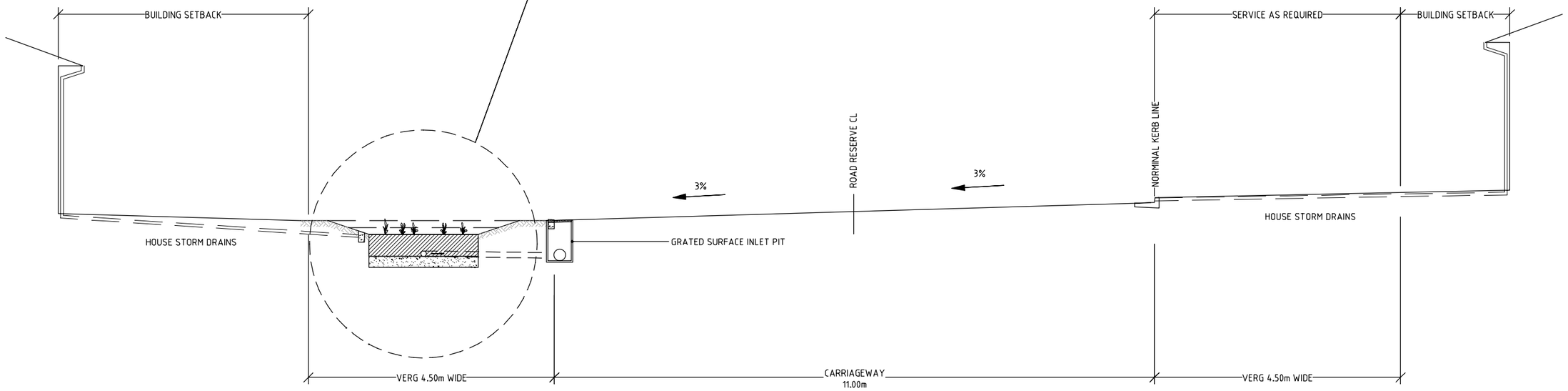
	B1 BASIN	B7 BASIN	B15A BASIN	B20 BASIN	B5 BASIN	B8 BASINS	Units
Node ID	68	75	102	108	109	111	
Inlet Properties - Low Flow By-pass (cubic metres per sec)	0	0	0	0	0	0	{cubic metres per sec}
Inlet Properties - High Flow By-pass (cubic metres per sec)	100	100	0.4	100	100	100	{cubic metres per sec}
Storage Properties - Extended Detention Depth (metres)	0.5	0.5	0.5	0.5	0.5	0.3	{metres}
Storage Properties - Surface Area (square metres)	2875	1320	4189	1132.3	1765	7202	{square metres}
Filter and Media Properties - Filter Area (square metres)	2712	1113.5	4066	1049.1	1649	7202	{square metres}
Filter and Media Properties - Unlined Filter Media Perimeter (metres)	215	140	260	135	169	340	{metres}
Filter and Media Properties - Saturated Hydraulic Conductivity (mm/hr)	90	90	90	90	90	90	{mm/hr}
Filter and Media Properties - Filter Depth (metres)	0.5	0.4	0.4	0.3	0.4	0.6	{metres}
Filter and Media Properties - TN Content of Filter Media (mg/kg)	500	500	500	500	500	500	{mg/kg}
Filter and Media Properties - Orthophosphate Content of Filter Media (mg/kg)	40	40	40	40	40	40	{mg/kg}
Infiltration Properties - Exfiltration Rate (mm/hr)	3.6	3.6	3.6	3.6	3.6	3.6	{mm/hr}
Lining Properties - Base Lined	No						
Vegetation Properties - Vegetation Properties	Vegetated with Effective Nutrient Removal Plants						
Outlet Properties - Overflow Weir Width (metres)	65	35	40	30	15	50	{metres}
Outlet Properties - Underdrain Present	Yes						
Outlet Properties - Submerged Zone With Carbon Present	Yes			1	Yes		
Outlet Properties - Submerged Zone Depth (metres)	0.1	0.2	0.2	0	0.2	0.3	{metres}

14 Attachment F – Typical Bioretention Swale, Basin and Wetland Design



TYPICAL BIOSWALE SECTION

SCALE 1:20 @ A3



TYPICAL SECTION
ROAD 20m WIDE

SCALE 1:80 @ A3

0 0.2 0.4 0.6 0.8 1.0

UNITS - METRES

Martens & Associates Pty Ltd ABN 85 070 240 890		**Environment | Water | Wastewater | Geotechnical | Civil | Management**	
Drawn:	KT	**TYPICAL BIOSWALE SECTION CULBURRA WEST, NSW MIXED USE SUBDIVISION**	Drawing No./ID: **SK001**
Approved:	AN		
Date:	20/11/12		
Scale @A3:	1:20	6/37 Leighton Place, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767 Email: mail@martens.com.au Internet: http://www.martens.com.au	Project: P1203365 | File: JD02V01 | Revision: A

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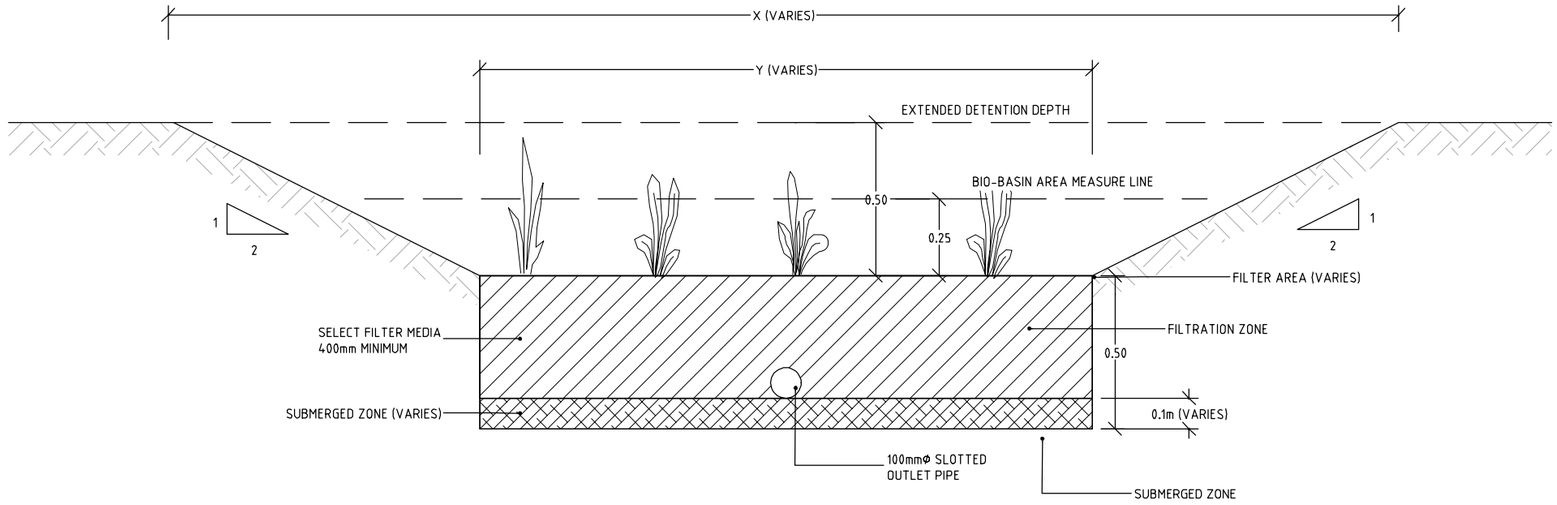
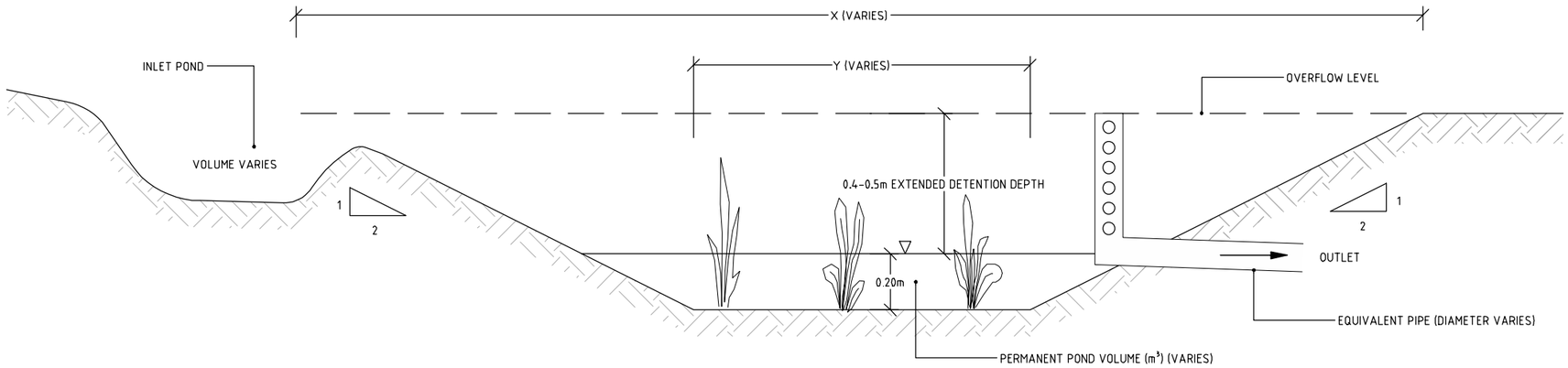


TYPICAL BIOREMEDIATION BASIN SECTION

SCALE 1:20 @ A3



TYPICAL WETLAND SECTION

SCALE 1:20 @ A3

0 0.2 0.4 0.6 0.8 1.0

UNITS - METRES

Martens & Associates Pty Ltd ABN 85 070 240 890	**Environment | Water | Wastewater | Geotechnical | Civil | Management**
Drawn: KT	**TYPICAL BIOREMEDIATION BASIN SECTION AND TYPICAL WETLAND SECTION CULBURRA WEST, NSW MIXED USE SUBDIVISION**
Approved: AN	Drawing No./ID: **SK002**
Date: 20/11/12	
Scale @A3: 1:20	

6/37 Leighton Place, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767
Email: mail@martens.com.au Internet: http://www.martens.com.au

Project:	File:	Revision:
P1203365	JD02V01	A

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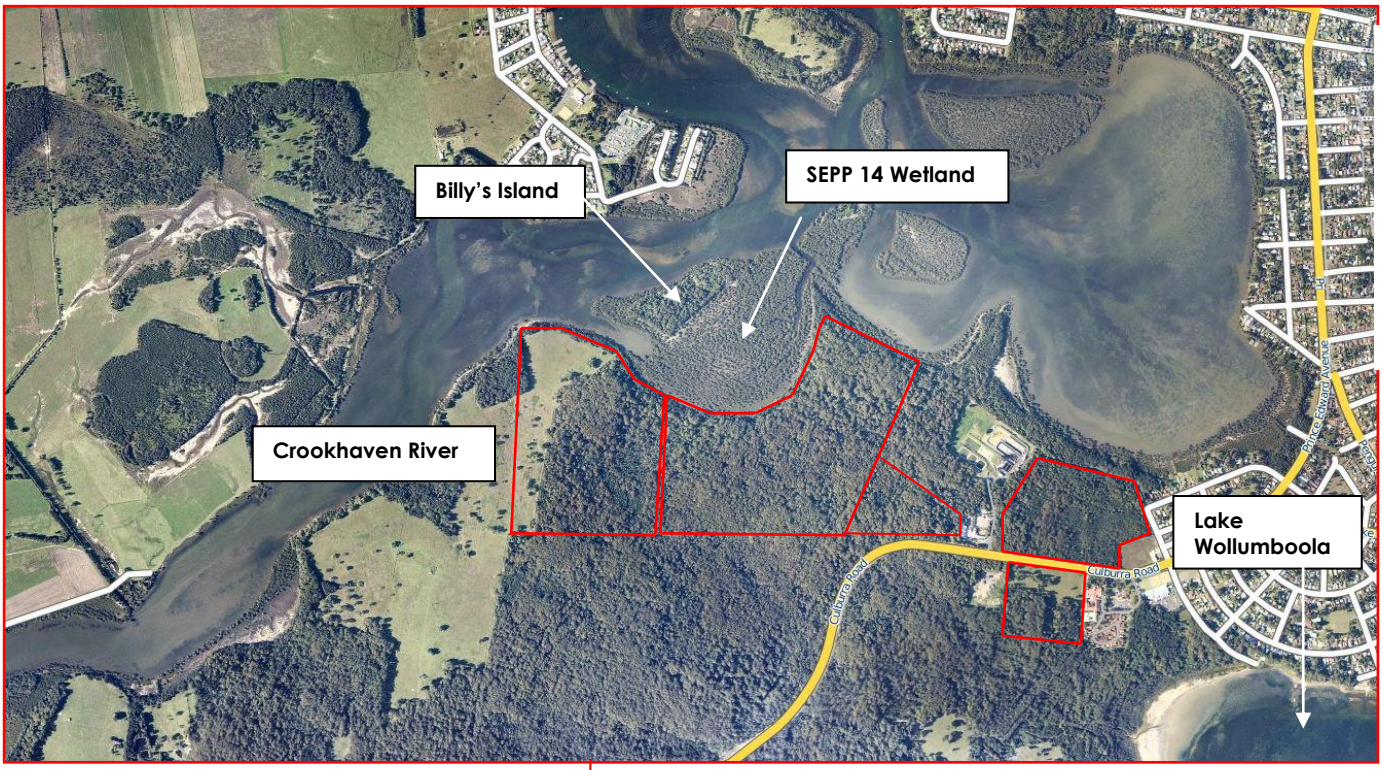
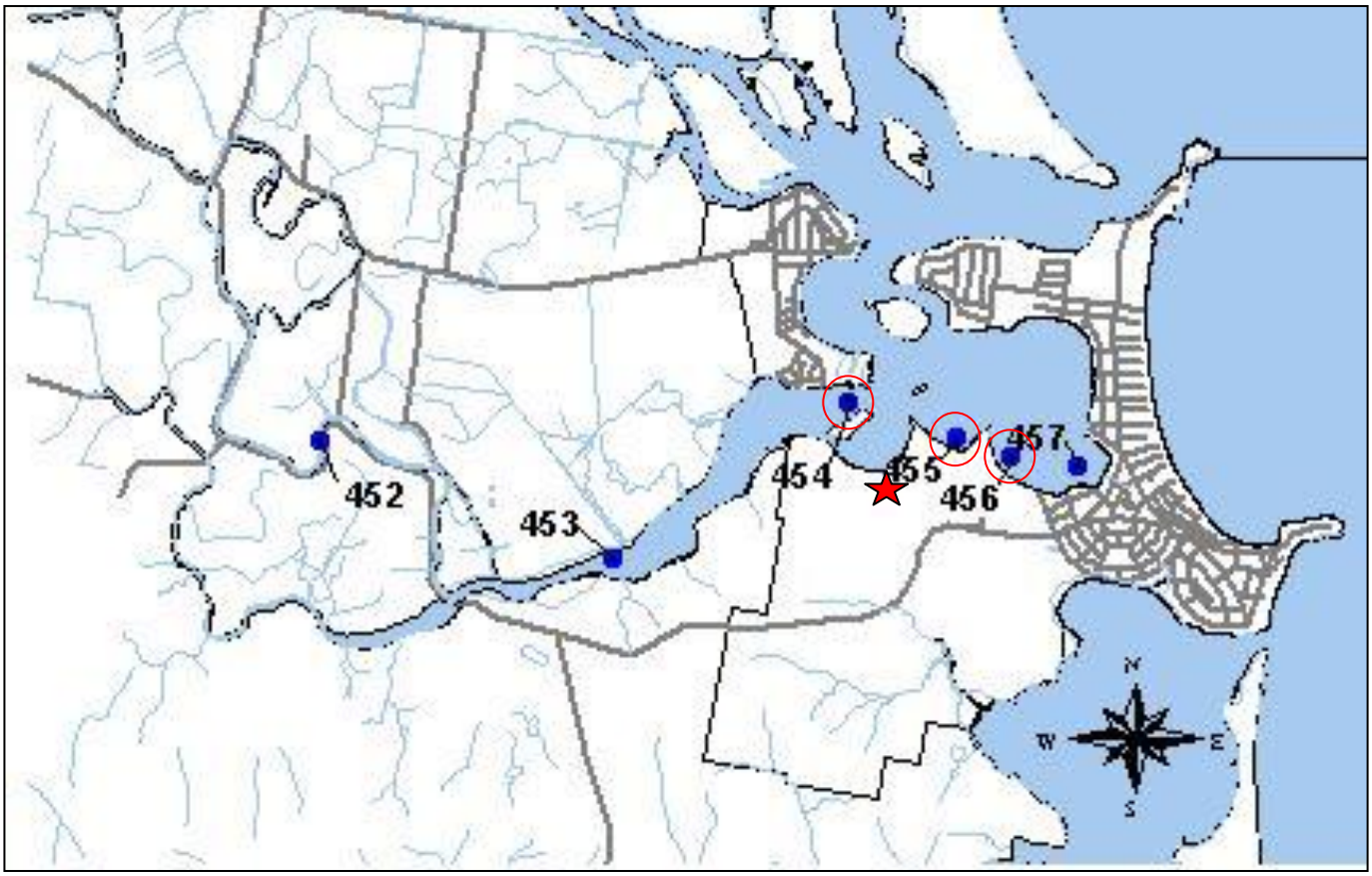


Martens & Associates Pty Ltd ABN 85 070 240 890		**Environment | Water | Wastewater | Geotechnical | Civil | Management**	
Drawn:	MLK	**Site Locality and Regional Context**	**Figure 1**
Approved:	AN		
Date:	21.11.2012		
Scale:	NA		Job No: P1203365



Martens & Associates Pty Ltd ABN 85 070 240 890		**Environment | Water | Wastewater | Geotechnical | Civil | Management**	
Drawn:	MLK	**Crookhaven River: Shoalhaven City Council Monitoring Locations**	**Figure 2**
Approved:	AN		
Date:	21.12.2012		
Scale:	NA		Job No: P1203365

12 Attachment D – MUSIC Model Catchment Areas

SOIL TYPES

Soil Types in top 0.5m - Real Data								Inputs for MUSIC					
Layer 1	Depth	SSC (MUSIC guidelines)	FC (MUSIC Guidelines)	Layer 2	Depth	SSC (MUSIC guidelines)	FC (MUSIC Guidelines)	Weighted average SSC	Weighted average FC	Inf a	Inf b	DRR (%)	DBR (%)
LOAMY SAND	0.3	139	69	CLAY	0.2	93	68	120.6	68.6	270	1.9	64	34

PRE DEVELOPMENT CATCHMENT AREAS

RECEIVING NODE	CATCHMENT ID	TOTAL AREA (HA)	IMPERVIOUS AREA (HA)	%	PERVIOUS AREA (HA)	%	EMC CATEGORY
O1	C1 AG	10.54	0	0%	10.54	100%	AGRICULTURAL
	C1 FOREST	4.384	0	0%	4.384	100%	FOREST
	C2 AG	3.38	0	0%	3.38	100%	AGRICULTURAL
O2	C2 FOREST	16.733	0	0%	16.733	100%	FOREST
	C3	6.54	0	0%	6.54	100%	FOREST
	C5	11.21	0	0%	11.21	100%	FOREST
	C6	11.52	0	0%	11.52	100%	FOREST
O7	C4	8.46	0	0%	8.46	100%	FOREST
O3	C7	8.88	0	0%	8.88	100%	FOREST
	C8	10.5	0	0%	10.5	100%	FOREST
	C14	4	0	0%	4	100%	FOREST
	C15	3.45	0	0%	3.45	100%	FOREST
O4	C9	4.38	0	0%	4.38	100%	FOREST
	C10	18.283	0	0%	18.283	100%	FOREST
	C10ag	3.167	0	0%	3.167	100%	AGRICULTURAL
	C10comm	1.47	0.588	40%	0.882	60%	COMMERCIAL
	C11	1.72	1.72	100%	0	0%	INDUSTRIAL
	C12	1.78	1.78	100%	0	0%	ROAD
O5	C13	6.62	0	0%	6.62	100%	FOREST
	TOTAL	**137.0**					

POST DEVELOPMENT CATCHMENT AREAS NB: Roads are 50% Pervious 50% Pervious based on DCP100 pg 24 Table 3 and using a 'local street'

RECEIVING NODE	CATCHMENT	Total Area	Bioswale Area	Road Area	%Pervious Road*	House Area	Residential Node	% Impervious (Res)	%Pervious (Res)	NODE
	C1 FOREST	1.30	0.0925	0		0	0	0%	100%	FOREST
	C1	12.43	0.3852	3.84	41%	3.44	4.77	1%	99%	RESIDENTIAL
	C1 Tourist	0.63					0.63	90%		
O1	C2 FOREST A	2.18	0.2116	0		0	0	0%	100%	FOREST
	C2 Tourist	0.32					0.32	90%		
	C2	12.57	0.4379	3.36	38%	3.69	5.09	1%	99%	RESIDENTIAL
	C1 UPSLOPE	0.70								
	TOTAL	**30.43**								
	C2 Forest b	2.79								
	C3 FOREST	3.90		0		0	0	0%	100%	FOREST
	C3	17.24	0.51705	5.0389	41%	4.88	6.80	1%	99%	RESIDENTIAL
	C3 WETLAND	0.7476								
O2	C5 FOREST A	2.63								
	C5 WETLAND3(b)	0.22								
	C5 WETLAND5(a)	0.31								
	C5 A	3.76	0.1307	1.69	43%	0.83	1.11	1%	99%	
	C7	3.04	0.131	0		1.82	1.09	0%	100%	RESIDENTIAL
	TOTAL	**34.33**								
O7	C4	5.12	0.1887	0.34		0	4.59	0%	100%	RESIDENTIAL
	C5 FOREST B	5.41	0.19	0		0	0	0%	100%	FOREST
O3	Wetland 5	0.63								
	C5 B	13.78	0.3992	4.05	44%	3.89	5.44	1%	99%	RESIDENTIAL
	C6	0.1131		0		0.05	0.07	0%	100%	RESIDENTIAL
	TOTAL	**19.94**								
O4	C9	2.73		0		0	0	0%	100%	FOREST
	C8	9.23	0.8426	1.91	44%	0	6.4815	100%	0%	INDUSTRIAL
	TOTAL	**11.96**								
	C10	2.45		0		0.000	0.000	5%	95%	FOREST
	C11	1.72		0		0.0	1.7	100%	0%	INDUSTRIAL
	C15a	2.7787	0.4313	0		0.0	2.8	0%	100%	RESIDENTIAL
	C15b	4.52		0		0.0	0.0	0%	100%	FOREST
	C12	1.272		0		0.0	1.3	95%	5%	INDUSTRIAL
O5	C13	2.804	0.046	0.57	43%	0.9	1.3	0%	100%	RESIDENTIAL
	C14	1.78		1.78		0.0	0.0	100%	0%	ROAD
	C16	3.97	0.1085	1.449	38%	1.0	1.5	2%	98%	RESIDENTIAL
	C17	1.89	0.0518	0		1.1	0.8	0%	100%	RESIDENTIAL
	C18	1.287	0.03544	0		0.0	1.3	100%	0%	COMMERCIAL
	C19	3.25	0.03465	0		2.0	1.3	100%	0%	RESIDENTIAL
	C22	1.47					1.5	40%	60%	COMMERCIAL
	TOTAL	**29.62**								
O6	C20	4.85	0.09492	1.464	42%	0.847	2.54	2%	98%	RESIDENTIAL
	C21	0.73		0		0	0	0%	100%	FOREST
	TOTAL	**5.58**								
	TOTAL	**137.0**								

* where bioswales are on road then pervious area cannot be 50%

15 Attachment G – Sediment Detention Basin Sizing

1. Erosion Hazard and Sediment Basins

Site Name: NA

Site Location: West Culburra Mixed Use Subdivision

Precinct/Stage: NA

Other Details: NA

Site area	Sub-catchment or Name of Structure						Notes
	A	B	C	D	E		
Total catchment area (ha)	28.1	25.7	12.1	18.6	6.5		
Disturbed catchment area (ha)	27	24.5	10.1	15	6.5		

Soil analysis (enter sediment type if known, or laboratory particle size data)

Sediment Type (C, F or D) if known:	F	F	F	F	F		From Appendix C (if known)
% sand (fraction 0.02 to 2.00 mm)	45	45	45	45	45		Enter the percentage of each soil fraction. E.g. enter 10 for 10%
% silt (fraction 0.002 to 0.02 mm)	19	19	19	19	19		
% clay (fraction finer than 0.002 mm)	25	25	25	25	25		
Dispersion percentage	27.0	27.0	27.0	27.0	27.0		E.g. enter 10 for dispersion of 10%
% of whole soil dispersible	9.315	9.315	9.315	9.315	9.315		See Section 6.3.3(e). Auto-calculated
Soil Texture Group	F	F	F	F	F		Automatic calculation from above

Rainfall data

Design rainfall depth (no of days)	5	5	5	5	5		See Section 6.3.4 and, particularly, Table 6.3 on pages 6-24 and 6-25.
Design rainfall depth (percentile)	85	85	85	85	85		
x-day, y-percentile rainfall event (mm)	42.1	42.1	42.1	42.1	42.1		
Rainfall R-factor (if known)	3300	3300	3300	3300	3300		Only need to enter one or the other here
IFD: 2-year, 6-hour storm (if known)							

RUSLE Factors

Rainfall erosivity (*R*-factor)	3300	3300	3300	3300	3300		Auto-filled from above
Soil erodibility (*K*-factor)	0.042	0.042	0.042	0.042	0.042		
Slope length (m)	300	300	300	300	300		
Slope gradient (%)	5.5	5.7	3.7	3	2.5		RUSLE LS factor calculated for a high rill/interrill ratio.
Length/gradient (*LS*-factor)	2.89	3.04	1.65	1.22	0.94		
Erosion control practice (*P*-factor)	1.3	1.3	1.3	1.3	1.3	1.3	
Ground cover (*C*-factor)	1	1	1	1	1	1	

Sediment Basin Design Criteria (for Type D/F basins only. Leave blank for Type C basins)

Storage (soil) zone design (no of months)	2	2	2	2	2		Minimum is generally 2 months
Cv (Volumetric runoff coefficient)	0.58	0.58	0.58	0.58	0.58		See Table F2, page F-4 in Appendix F

Calculations and Type D/F Sediment Basin Volumes

Soil loss (t/ha/yr)	521	548	297	220	169		
Soil Loss Class	5	5	3	2	2		See Table 4.2, page 4-13
Soil loss (m^3/ha/yr)	401	422	228	169	130		Conversion to cubic metres
Sediment basin storage (soil) volume (m^3)	1804	1721	384	422	141		See Sections 6.3.4(i) for calculations
Sediment basin settling (water) volume (m^3)	6861	6275	2955	4542	1587		See Sections 6.3.4(i) for calculations
Sediment basin total volume (m^3)	8665	7996	3339	4964	1728		