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STORMWATER MANAGEMENT PLAN

AT

McWilliams Hanwood Winery

FOR

McWilliams Wines



ADELAIDE | BRISBANE | MELBOURNE

Document Status

Rev	Author	Approved for Issue		
		Name	App'd	Date
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TABLE OF CONTENTS

1. INTRODUCTION.....	1
2. SITE LOCATION.....	1
3. EXISTING SITE DEVELOPMENT.....	1
4. DESCRIPTION OF PROPOSED DEVELOPMENT	2
5. HYDROLOGY	2
5.1 Catchment Areas	2
5.2 Volumetric Discharge from Catchments	2
5.3 Internal Drainage System	3
6. DRAINAGE MODEL RESULTS.....	3
6.1 Volumetric Modelling.....	3
6.2 Internal Drains	4
7. CONCLUSIONS.....	4
APPENDIX A	V
APPENDIX B	VI
APPENDIX C	VII
APPENDIX D	IX
APPENDIX E	XI

1. Introduction

FMG Engineering has been engaged by Linney Engineering to prepare a Stormwater Management Plan for McWilliams Winery at Hanwood. This involves undertaking a hydrological assessment of the site to estimate the peak stormwater runoff and volumetric runoff for the proposed development at the winery. This assessment also involves providing detailed advice on necessary temporary stormwater storage to ensure that peak developed runoff can be managed within the regulatory criteria.

The Stormwater Drainage Management Plan has been prepared to assess proposed future development of the site within guidelines to be accepted by Murrumbidgee Irrigation (MI) and Griffith City Council.

The criteria to be met includes:

- 1 in 20 year ARI peak outflow to not exceed permitted flows into the MI Drain.
- In addition a nominal criteria for typical industrial sites to manage the 1 in 10 year ARI peak storm combined with a full tank spill of the largest storage tank on the site.
- Maximum discharge of 5.5 ML/day to the MI Drain at each of 3 locations.

2. Site Location

The subject land is located south of the City of Griffith, at Jack McWilliam Road, Hanwood.

The site currently houses a substantial winery development. The subject land has a total site drainage area of 17.5ha.

The topography of the land is very slightly grading towards the south. There is an open drain through the site, managed by Murrumbidgee Irrigation.

3. Existing Site Development.

The current site includes the original winery buildings, tank farms, Administration Building, Barrel Store and carparks/access roads. Water management elements include roofwater storage ponds (Lagoons 1 & 2) at the north end of the site, underground drains, Lagoon 4 at the south end of the site and Lagoon 3 which is a stormwater temporary storage pond toward the south of the site. The Murrumbidgee Irrigation drain runs through the site and the property has rights to discharge 5.5 ML per day of stormwater to this drain from each of three titles.

Trade waste water from process areas is collected and drained to a series of pumping stations, from which it is diverted to the site wastewater treatment plant which includes evaporation ponds.

Water from Lagoons 1 and 2 is used to process water in the winery and for irrigating landscaped areas around the site.

Lagoon 3 is used to collect stormwater from the drainage system and will also act as a site bund to contain the potential rare event of a large spill. Any water entering Lagoon 3 is assessed and the water diverted by pumping either to Lagoon 4 for re-use or the wastewater system for evaporation treatment.

Lagoon 4 is be used to store harvested stormwater for irrigation purposes.

The general layout of the site is shown in Figure A.

4. Description of Proposed Development

Future building development on the site is planned to include additional administration area, carparking, a large Packaging Building and tank farm and a new wastewater treatment plant (WWTP). With construction of the wastewater treatment plant use of the evaporation ponds will diminish. Water collected in Lagoon 3 will then be pumped automatically to the treatment plant where it will be assessed for contamination. The water will then either be diverted to Lagoon 4 immediately or treated and then diverted.

5. Hydrology

5.1 Catchment Areas

The catchments fall into the following categories:

- Roof areas used to harvest rainwater for reuse. These areas are directed to the existing Water Storage Lagoon 1 north of the Administration Building. The water is then filtered and disinfected for use in the winery, through the existing filtration plant.
- Stormwater catchments. The primary catchments are currently the Staff/Visitors carpark located west of the Administration Building and the east-west concrete roadway south of the Administration Building. Stormwater from these areas will flow by gravity to Lagoon 3. Further small catchments connect to a western drain line which connects directly to the MI Drain.
- Tradewaste catchments. These drain by gravity to tradewaste pump stations that pump through rising mains to the evaporation pans south of the winery. In the future, these pump stations will pump to the wastewater treatment plant.

Figure B shows the site subcatchments. Roof areas are excluded from the stormwater assessment as it is intended that all roofwater for storms up to 1 in 20 years ARI will be collected via roof gutters and diverted to Lagoon 1, Lagoon 2 or a future Lagoon 6.

5.2 Volumetric Discharge from Catchments

Separate stormwater analyses were undertaken for the main site. The primary assessment was to determine the volume of storage required to ensure that, in a 1 in 20 year ARI storm, the total runoff from the site does not exceed the permitted discharge to the MI Drain. This required calculation of the total runoff volume from the site and this was done for storm durations from 5 minutes to 24 hours.

The 1 in 10 year ARI storms were also assessed, to check the flows in combination with a breach of the largest tank storage in the winery.

The internal drainage system has also been assessed to ensure that flows generated within the site can be safely transported to the outlet being, primarily, Lagoon 3.

Sub-catchments 24 to 27 connect to an existing underground pipe drain which runs along the western boundary and connects directly to MI Drain. This pipe has a capacity of approximately 320 l/sec. A check has been made to ensure that the maximum daily discharge from this drain does not exceed 5.5 ML/day.

The undeveloped portion of the site is assumed to discharge directly to the MI Drain. This area is approximately 5.0 ha.

Future Packing Shed. The roof drainage system for this shed will capture rainfall for events up to 1 in 20 years ARI. This flow will be diverted to temporary rainwater tanks which will then be emptied

by pumps diverting most of the runoff to re-use ponds, Lagoon 2 or 6. The pumps are not planned to handle the full peak runoff for all storms up to 1 in 20 years ARI. Any excess will be diverted to the MI Drain.

5.3 Internal Drainage System

The Rational Method was used to determine the stormwater runoff and peak discharge for the proposed development for storms of 1 in 20 year average return interval (ARI).

The Rational Method calculates the peak flow at a point which is dependent on the time of concentration. The peak flow is the product of the combined coefficients of runoff and areas of catchment for the contributing catchment multiplied by the average rainfall intensity appropriate for the time of concentration. The time of concentration is defined as the travel time for flow from the most remote part of the catchment to the outlet, or the time taken from the start of the rainfall until all of the catchment is simultaneously contributing to the outlet. The critical storm duration is considered to be equivalent to the time of concentration.

The critical storm duration adopted for the modelling is based on the longest path of travel and on the slope of the site. The critical storm duration adopted for various points on the site were determined from Figure 5.3 – Overland flow travel (shallow sheet flow only) for Australian urban catchments from ARRB Special Report No. 34-Storm drainage design in small urban catchments: a handbook for Australian practice, John Argue.

The parameters utilised for determining the volume of stormwater runoff and peak flows are as follows:

- Runoff Coefficient for pervious areas of 0.10 (Table 5.3 – Basic Runoff Coefficients (C_{10}) For Various Developed Catchments from ARRB Special Report No. 34.
- Runoff Coefficient for paved areas of 0.90
- IFD rainfall was based on the actual rainfall intensity for Griffith. A copy of the rainfall data is included in Appendix C.

The stormwater runoff calculations were based on the weighted runoff coefficients for the mixed catchments.

6. DRAINAGE MODEL RESULTS

6.1 Volumetric Modelling.

Western Drain

This check shows that the maximum flow for storms up to 24 hrs duration is 0.72 ML.

Undeveloped Portion of Site

For the 1 in 20 year peak storm (Time of concentration = 60 mins) the peak runoff is equivalent to 100 l/s and the total runoff to MI Drain for this storm is 360m³.

Future Packing Shed

During the peak 20 year storm for the future Packing Shed it is expected that approximately 1,190 m³ of roof runoff will overflow to MI Drain. This is based on provision of 200 KL of temporary storage tank and 30 l/s of pump diversion to a roofwater storage pond (Lagoon 2 or future Lagoon 6). A larger temporary storage tank or larger pump capacity would reduce the overflow.

In summary, the peak discharge from 1 in 20 year ARI storms from the site to MI drain comprises:

Western Drain	0.72 ML
---------------	---------

Main Stormwater Catchment	Nil
Packing Shed	1.19 ML
Undeveloped site	<u>0.036 ML</u>
Total	1.95 ML

Taken as the peak daily flow from each catchment, this is much less than the permitted 3 x 5.5 ML per day.

The volumetric analysis for the range of 1 in 20 years ARI storms for the catchments draining to Lagoon 3 shows that a total of 4.97 ML would flow to Lagoon 3, this being related to the 24 hour duration storm. With a pump-out rate of 36L/s (to WWTP and Lagoon 4) the net storage in Lagoon 3 is 2.74ML.

A copy of the drainage calculations for these situations is included in Appendix D.

6.2 Internal Drains

The existing and future underground stormwater system for the main site has been modelled using DRAINS software. The output report for the critical 1 in 20 year storm is included in Appendix E. This modelling assumes that all of the trade waste pumps are not operating; hence the flow in the pipe drain system is the worst case.

6.3 1 in 100 Year Storm

An assessment has been made of the potential net increase in runoff from the site for the 1 in 100 year ARI storm compared with the 1 in 20 year storms already evaluated. It is assumed that this flow would escape to the MI Drain, although some would actually be retained in areas below bank level on the site.

This gap flow comprises the difference between the 1 in 20 and the 1 in 100 year ARI storms over the Western Catchment, Main Catchment and the undeveloped catchment. It also includes all roof runoff in excess of the 1 in 20 year storm.

The assessment shows that a total gap flow of 1.93 ML occurs. This, together with the 1.95 ML (Para 6.1 above) amounts to 3.88 ML, which is less than the allowable 3 x 5.5 ML flow into MI Drain.

7. Conclusions

A further calculation for the 1 in 10 year ARI storm was undertaken. This shows a net storage in Lagoon 3 of 2.21ML. Combined with the largest winery tank of 1.2ML the required minimum storage at Lagoon 3 is 3.41ML.

The stormwater analysis for the existing and proposed winery development of the Hanwood Winery site has been based on the proposed development drawings.

The stormwater analysis has considered the worst scenario of a particular storm event. It was designed to cater for rainfall events where none of the tradewaste diversion pumps are operating. Hence the design runoff includes all tradewaste areas as well as normal clean stormwater runoff areas.

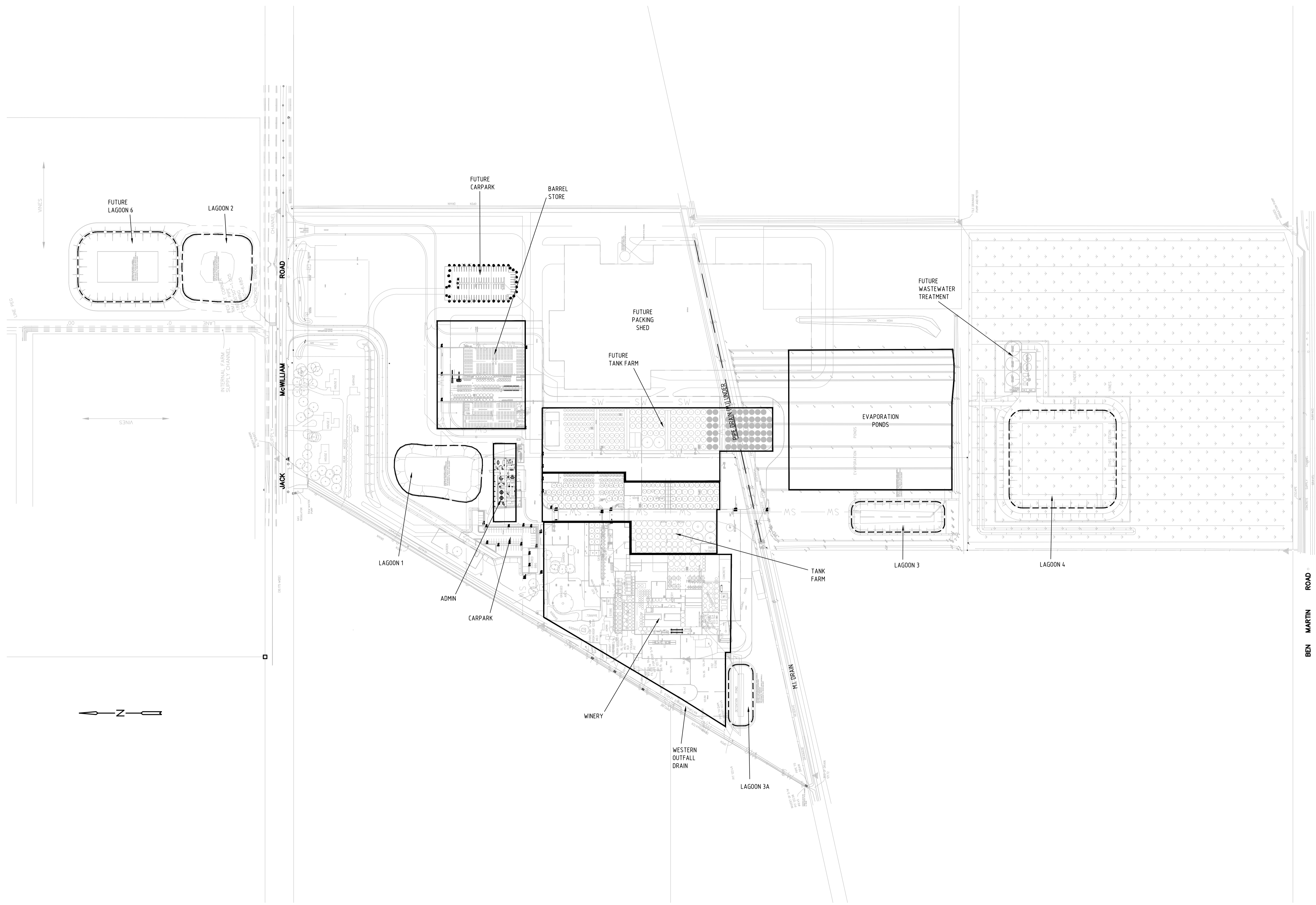
The plan includes for maximum stormwater harvesting for irrigation or other uses.

In order to cater for the surplus stormwater runoff, a temporary storage of 3.6 ML at Lagoon 3 is suitable, together with a temporary rainwater tank of at least 200 KL at the future Packing Shed.

APPENDIX A

Figure A – Site Layout Plan

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APPENDIX B

Figure B – Site Subcatchments

APPENDIX C

Intensity Frequency Duration Data for Griffith.

Intensity-Frequency-Duration Table

Location: 34.250S 146.075E NEAR.. Griffith NSW Issued: 22/7/2012

Rainfall intensity in mm/h for various durations and Average Recurrence Interval

Average Recurrence Interval

Duration	1 YEAR	2 YEARS	5 YEARS	10 YEARS	20 YEARS	50 YEARS	100 YEARS
5Mins	53.3	70.7	97.5	115	137	168	192
6Mins	49.4	65.6	90.5	106	127	155	178
10Mins	40.1	53.1	73.1	85.9	102	125	143
20Mins	29.1	38.5	52.8	62.0	73.8	90.1	103
30Mins	23.4	31.0	42.4	49.7	59.2	72.1	82.5
1Hr	15.4	20.3	27.6	32.3	38.3	46.6	53.2
2Hrs	9.55	12.6	17.0	19.8	23.4	28.3	32.2
3Hrs	7.13	9.36	12.6	14.6	17.2	20.7	23.5
6Hrs	4.29	5.60	7.43	8.57	10.1	12.1	13.6
12Hrs	2.59	3.37	4.43	5.09	5.94	7.10	8.00
24Hrs	1.57	2.04	2.68	3.07	3.57	4.26	4.79
48Hrs	.936	1.21	1.59	1.82	2.11	2.51	2.83
72Hrs	.669	.859	1.12	1.28	1.49	1.77	1.99

(Raw data: 20.73, 3.4, 0.87, 46.17, 6.93, 1.73, skew=0.11, F2=4.34, F50=15.26)

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APPENDIX D

Stormwater Drainage Results - Volumetric

FUTURE PACKING SHED - ROOF RUNOFF						
20 year ARI Flow		(200 KI buffer tank and 30 l/sec harvesting pump.)				
Storm Duration	Intensity, I (mm/hr)	Qin m ³ /s	Qout m ³ /s	Q Total m ³ /s	VOLin (m ³)	O'FLOW TO MI DRAIN (m ³)
5 mins	137	1.117	0.030	1.087	325.97	325.97
6 mins	127	1.035	0.030	1.005	361.82	361.82
10 mins	102	0.831	0.030	0.801	480.78	480.78
20 mins	73.8	0.601	0.030	0.571	685.76	685.76
30 mins	59.2	0.482	0.030	0.452	814.46	814.46
60 mins	38.3	0.312	0.030	0.282	1015.72	1015.72
2 hrs	23.4	0.191	0.030	0.161	1157.11	1157.11
3 hrs	17.2	0.140	0.030	0.110	1189.94	1189.94
6 hrs	10.1	0.082	0.030	0.052	1130.00	1130.00
12 hrs	5.94	0.048	0.030	0.018	795.36	795.36
24 hrs	3.57	0.029	0.030	-0.001	-78.15	0.00
Excess flow to MI Drain		=	1190	m3		

20 year ARI Flow		Lagoon 3 - 36 Ips Pumpout				
Storm Duration	Intensity, I (mm/hr)	Qin m ³ /s	Qout m ³ /s	Q Total m ³ /s	VOLin (m ³)	STORAGE VOL. (m ³)
5 mins	137	2.209	0.036	2.173	651.94	651.94
6 mins	127	2.048	0.036	2.012	724.28	724.28
10 mins	102	1.645	0.036	1.609	965.25	965.25
20 mins	73.8	1.190	0.036	1.154	1384.83	1384.83
30 mins	59.2	0.955	0.036	0.919	1653.48	1653.48
60 mins	38.3	0.618	0.036	0.582	2093.72	2093.72
2 hrs	23.4	0.377	0.036	0.341	2457.54	2457.54
3 hrs	17.2	0.277	0.036	0.241	2606.58	2606.58
6 hrs	10.1	0.163	0.036	0.127	2740.23	2740.23
12 hrs	5.94	0.096	0.036	0.060	2582.60	2582.60
24 hrs	3.57	0.058	0.036	0.022	1863.32	1863.32

LAGOON 3 - Q10 STORMS - VOLUME USED						
10 year ARI Flow			Lagoon 3 - 36 lps Pumpout			
Storm Duration	Intensity, I (mm/hr)	Qin m ³ /s	Qout m ³ /s	Q Total m ³ /s	VOLin (m ³)	STORAGE VOL. (m ³)
5 mins	115	1.854	0.036	1.818	545.51	545.51
6 mins	106	1.709	0.036	1.673	602.37	602.37
10 mins	85.9	1.385	0.036	1.349	809.48	809.48
20 mins	62	1.000	0.036	0.964	1156.50	1156.50
30 mins	49.7	0.801	0.036	0.765	1377.74	1377.74
60 mins	32.3	0.521	0.036	0.485	1745.42	1745.42
2 hrs	19.8	0.319	0.036	0.283	2039.58	2039.58
3 hrs	14.6	0.235	0.036	0.199	2153.79	2153.79
6 hrs	8.57	0.138	0.036	0.102	2207.33	2207.33
12 hrs	5.09	0.082	0.036	0.046	1990.49	1990.49
24 hrs	3.07	0.050	0.036	0.014	1166.72	1166.72
PEAK STORMWATER STORAGE REQUIRED			2,207	m ³		
ADD MAX WINERY TANK VOLUME			1,200	m ³		
TOTAL			3,407	m³		
Lagoon 3 Volume	=	3,600	m ³	O.K.		

Western Drain outfall.

Area = 0.93 ha
C = 0.9
CxA = 0.837

Tc = 15 min.

I₂₀ = 89 mm/hr

Q = CIA = 0.837 x 89/0.360 = 207 l/s

Vol. discharge to MI Drain during storm = 0.207 x 15 x 60
= 186 m³

Volume during 24 hr duration storm = (0.837 x 3.57/0.36) x 0.001 x 24 x 60 x 60
= 717 m³
= 0.72 ML

APPENDIX E

Stormwater Calculations – DRAINS for Main Winery Catchment

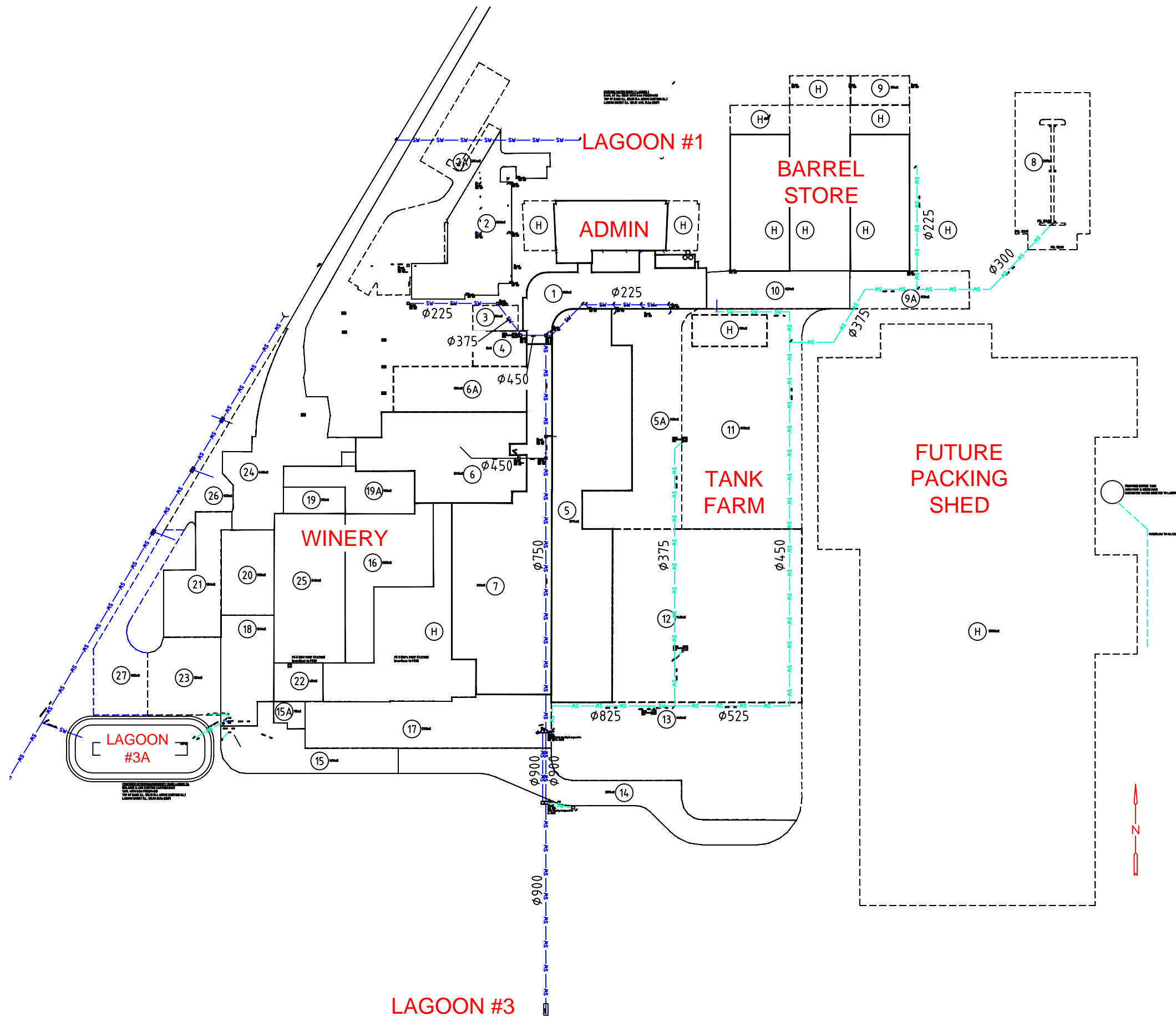


FIGURE E

PROPOSED STORMWATER DESIGN _ DATA SHEET

PIT / NODE DETAILS

Name	Type	Size	Ponding Volume (m ³)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (m ³ /s)	Blocking Factor	x	y	Part Full Shock Loss	Inflow Hydrograph
P025	OnGrade	1200x1200 JB		1.5	123.7		0	0	985688.1	726855.6	1 x Ku	No
PS18A	OnGrade	1200x1200 JB		1.5	123.9		0	0	985852.7	692843.6	1 x Ku	No
PS18A_1	OnGrade	1200x1200 JB		1.5	123.9		0	0	987162.7	692843.6	1 x Ku	No
P020B	OnGrade	600x600 JB		1.5	123.72		0	0	989951.4	917307.4	1 x Ku	No
P021	OnGrade	900x900 JB		1.5	123.74		0	0	987338.8	915580.3	1 x Ku	No
P022	OnGrade	900x900 JB		1.5	123.69		0	0	987237.7	867323.6	1 x Ku	No
P024	OnGrade	900x900 JB		1.5	123.69		0	0	987305	856916.2	1 x Ku	No
P025_1	OnGrade	1200x1200 JB		1.5	123.7		0	0	987129.4	726951.7	1 x Ku	No
P015	Sag	900x900 JB		1.5	123.37		0	0	964364.5	930867.5	1 x Ku	No
P016	OnGrade	900x900 JB		1.5	123.85		0	0.3	975484.3	915520.2	1 x Ku	No
P017	OnGrade	600x600 JB		1.5	123.62		0	0	1046846	928533	1 x Ku	No
P105	OnGrade	900x900 JB	3		123.6	0.3	0		1228906	968601.3		
P104	OnGrade	900x900 JB		1.5	123.6		0	0	1163249	937179.6	1 x Ku	No
P103	OnGrade	900x900 JB		1.5	123.6		0	0	1105096	911854.7	1 x Ku	No
P101	OnGrade	600x600 JB		1.5	123.6		0	0	1103220	738332.1	1 x Ku	No
P100	OnGrade	900x900 JB		1.5	123.6		0	0	1047411	737863.2	1 x Ku	No
P102	OnGrade	900x900 JB		1.5	123.6		0	0	1052570	864487.7	1 x Ku	No
OUTLET	Node			1.5	123.42		0	0	986443.6	544643.5	1 x Ku	No
OF01	OnGrade	600x600 JB		1.5	123.73		0	0	946371.6	862483.6	1 x Ku	No
P023	OnGrade	900x900 JB		1.5	123.73		0	0	952052.3	856348.4	1 x Ku	No
P14	OnGrade	1200x1200 JB		1.5	123.9		0	0	1002065	689226	1 x Ku	No
N12	Node	Double Pit, no Deflectors, 75 mm Lid & No Central Support		1.5	123.4		0	0	1031919	772546	1 x Ku	No
N23	Node	Double Pit, no Deflectors, 75 mm Lid & No Central Support		1.5	123.6		0	0	851846.4	719573	1 x Ku	No

DETENTION BASIN DETAILS

Name	Elev	Surf Area (m ²)	Outlet Type	Dia(mm)	Centre RL	x	y	HED
LAGOON 3	120.6	20	None			987381.6	590603.5	No
	121.2	969						
	123.3	2394.2						

SUB-CATCHMENT DETAILS

Name	Pit or Node	Total Area (ha)	Paved Area (%)	Grass Area (%)	Supp Area (%)	Paved Length (m)	Grass Length (m)	Supp Length (m)	Paved Slope (%)	Grass Slope (%)	Supp Slope (%)	Paved Rough	Grass Rough	Supp Rough
C17	P025	1.002	90	10	0	120	120	0	0.5	0.5	0.5	0.015	0.035	0.015
C3	P015	0.502	90	10	0	100	100	0	0.5	0.5	0.5	0.015	0.035	0.015
C4	P016	0.043	90	10	0	20	20	0	0.5	0.5	0.5	0.015	0.035	0.015
C1	P017	0.189	90	10	0	70	70	0	0.5	0.5	0.5	0.015	0.035	0.015
C8	P105	0.2465	90	10	0	88	88	0	0.5	0.5	0.5	0.015	0.035	0.015

C9	P104	0.039	90	10	0	76	76	0	0.5	0.5	0.5	0.015	0.035	0.015
C10	P103	0.226	90	10	0	76	76	0	0.5	0.5	0.5	0.015	0.035	0.015
C11	P101	0.603	90	10	0	200	200	0	0.5	0.5	0.5	0.015	0.035	0.015
C13	P100	0.547	90	10	0	200	200	0	0.5	0.5	0.5	0.015	0.035	0.015
C5A	P102	0.312	90	10	0	200	200	0	0.5	0.5	0.5	0.015	0.035	0.015
C6A	OF01	0.1385	90	10	0	200	200	0	0.5	0.5	0.5	0.015	0.035	0.015
C6	P023	0.2875	90	10	0	200	200	0	0.5	0.5	0.5	0.015	0.035	0.015
C14	P14	0.2595	90	10	0	100	100	0	0.5	0.5	0.5	0.015	0.035	0.015
C12	N12	0.746	90	10	0	120	120	0	0.5	0.5	0.5	0.015	0.035	0.015
C23	N23	0.8165	90	10	0	120	120	0	0.5	0.5	0.5	0.015	0.035	0.015

PIPE DETAILS

Name	From	To	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Type	Dia I.D. (mm)	Rough	Pipe Is	No. Pipes	Chg From	At Chg
LINE 38_A	P025	PS18A	32.8	120.13	119.87	0.79	Concrete,	900	900	0.3 New	1 P025	0	0
LINE38B	PS18A	PS18A_1	2	120.132	120.13	0.1	Concrete,	900	900	0.3 New	1 PS18A	0	0
LINE 39	PS18A_1	LAGOON 3	100.1	121.9	121.34	0.56	Concrete,	900	900	0.3 NewFixed	1 PS18A_1	0	0
LINE FMG01	P020B	P021	2.95	123.21	123.11	3.39	Concrete,	150	150	0.3 New	1 P020B	0	0
LINE 11	P021	P022	47.4	122.78	122.44	0.72	Concrete,	450	450	0.3 New	1 P021	0	0
LINE 13	P022	P024	9.44	122.4	122.36	0.42	Concrete,	750	750	0.3 New	1 P022	0	0
LINE 16	P024	P025_1	129.15	122.36	122.12	0.19	Concrete,	750	750	0.3 New	1 P024	0	0
LINE 38	P025_1	PS18A_1	32.8803	120.13	119.87	0.79	Concrete,	900	900	0.3 New	1 P025_1	0	0
LINE10B	P015	P016	18.073	122.88	122.826	0.3	Concrete,	375	375	0.3 New	1 P015	0	0
LINE 10D	P016	P021	11.07	122.79	122.78	0.09	Concrete,	450	450	0.3 New	1 P016	0	0
LINE 8	P017	P021	64.17	123.11	122.72	0.61	Concrete,	225	225	0.3 New	1 P017	0	0
LINE 105	P105	P104	73.2	123.192	122.972	0.3	Concrete,	300	300	0.3 New	1 P105	0	0
LINE 104	P104	P103	65.813	122.972	122.775	0.3	Concrete,	450	450	0.3 New	1 P104	0	0
LINE 103	P103	P101	173.43	122.755	122.321	0.25	Concrete,	450	450	0.3 New	1 P103	0	0
LINE 101	P101	P100	54.6	122.321	122.185	0.25	Concrete,	525	525	0.3 New	1 P101	0	0
LINE 100	P100	P025_1	62	122.185	122.03	0.25	Concrete,	825	825	0.3 New	1 P100	0	0
LINE 102	P102	P100	126.4	122.595	122.216	0.3	Concrete,	375	375	0.3 New	1 P102	0	0
LINE 15A	OF01	P023	4.407	123	122.7	6.81	Concrete,	375	375	0.3 New	1 OF01	0	0
LINE 15B	P023	P024	11.92	122.75	122.68	0.59	Concrete,	450	450	0.3 New	1 P023	0	0
LINE 14	P14	PS18A_1	12.08	122.14	122.08	0.5	Concrete,	300	300	0.3 New	1 P14	0	0

OVERFLOW ROUTE DETAILS

Name	From	To	Travel Time (min)	Spill Level (m)	Crest elev (m)	Weir Coeff. C	Cross Section	Safe Depth Major Storms (m)	SafeDepth Minor Storms (m)	Safe DxV (m ² /s)	Bed Slope (%)	D/S Area Contributi ng (%)
OF10	P025	PS18A_1	0.5				Dummy us	0.2	0.05	0.6	1	0
OF12	PS18A_1	LAGOON 3	1				Dummy us	0.2	0.05	0.6	1	0
PS3	LAGOON 3	OUTLET	0	121.2			Dummy us	0.2	0.05	0.6	1	0
OF6	P017	P102	0.5				Dummy us	0.2	0.05	0.6	0.5	0
OF4	P100	P025	0.5				Dummy us	0.2	0.05	0.6	0.5	0

DRAINS RESULTS (1 in 20 YEAR ARI ANALYSIS)

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arrival (m ³ /s)	Max Pond Volume (m ³)	Min Freeboard (m)	Over Flow (m ³ /s)	Constraints
P025	122.92		0.523		0.78	0.002	Inlet Capacity
PS18A	122.87		0		1.03		None
PS18A_1	122.83		0.002		1.07	0.002	Inlet Capacity
P020B	123.28		0		0.44		None
P021	123.28		0		0.46		None
P022	123.11		0		0.58		None
P024	123.1		0		0.59		None
P025_1	123.01		0		0.69		None
P015	123.48	123.61	0.147	1.7	-0.11		Outlet System
P016	123.34		0.015		0.51		None
P017	123.61		0.062		0.01	0.017	Inlet Capacity
P105	123.58		0.074		0.02		None
P104	123.49		0.012		0.11		None
P103	123.48		0.07		0.12		None
P101	123.36		0.154		0.24		None
P100	123.18		0.346		0.42	0.009	Inlet Capacity
P102	123.38		0.089		0.22		None
OF01	123.18		0.035		0.55		None
P023	123.15		0.073		0.58		None
P14	122.92		0.076		0.98		None

SUB-CATCHMENT DETAILS

Name	Max Flow Q (m ³ /s)	Paved Max Flow Q (m ³ /s)	Grass Max Flow Q (m ³ /s)	Pave T _c (min)	Grass T _c (min)	Supp T _c (min)	Due to Storm
C17	0.284	0.274	0.012	8.7	14.46		0 AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
C3	0.147	0.142	0.006	7.34	12.2		0 AR&R 20 year, 15 minutes storm, average 85 mm/h, Zone 2
C4	0.015	0.015	0.001	2.31	3.84		0 AR&R 20 year, 5 minutes storm, average 137 mm/h, Zone 2
C1	0.062	0.06	0.001	4.89	8.14		0 AR&R 20 year, 5 minutes storm, average 137 mm/h, Zone 2
C8	0.074	0.071	0.003	6.8	11.3		0 AR&R 20 year, 15 minutes storm, average 85 mm/h, Zone 2
C9	0.012	0.012	0	5.14	8.55		0 AR&R 20 year, 5 minutes storm, average 137 mm/h, Zone 2
C10	0.07	0.069	0.002	5.14	8.55		0 AR&R 20 year, 5 minutes storm, average 137 mm/h, Zone 2
C11	0.154	0.149	0.005	11.82	19.65		0 AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
C13	0.14	0.135	0.005	11.82	19.65		0 AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
C5A	0.08	0.077	0.003	11.82	19.65		0 AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
C6A	0.035	0.034	0.001	11.82	19.65		0 AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
C6	0.073	0.071	0.003	11.82	19.65		0 AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
C14	0.076	0.073	0.003	7.34	12.2		0 AR&R 20 year, 15 minutes storm, average 85 mm/h, Zone 2
C12	0.212	0.204	0.009	8.7	14.46		0 AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
C23	0.232	0.223	0.01	8.7	14.46		0 AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2

Outflow Volumes for Total Catchment

Storm	Total Rainfall (m ³)	Impervious Runoff (m ³)	Pervious Runoff (m ³)	Total Runoff (m ³)
AR&R 20 year, 5 minutes storm, average 137 mm/h, Zone 2	680.15	568.56 (83.6%)	558.52 (91.2%)	10.05 (14.8%)
AR&R 20 year, 10 minutes storm, average 103 mm/h, Zone 2	1022.7	898.37 (87.8%)	866.82 (94.2%)	31.55 (30.8%)
AR&R 20 year, 15 minutes storm, average 85 mm/h, Zone 2	1265.97	1132.77 (89.5%)	1085.76 (95.3%)	47.01 (37.1%)
AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2	1449.66	1308.58 (90.3%)	1251.07 (95.9%)	57.52 (39.7%)
AR&R 20 year, 30 minutes storm, average 59 mm/h, Zone 2	1757.46	1599.41 (91.0%)	1528.10 (96.6%)	71.31 (40.6%)
AR&R 20 year, 1 hour storm, average 39 mm/h, Zone 2	2323.42	2134.63 (91.9%)	2037.48 (97.4%)	97.15 (41.8%)
AR&R 20 year, 1.5 hours storm, average 28.9 mm/h, Zone 2	2582.58	2368.95 (91.7%)	2270.69 (97.7%)	98.26 (38.0%)
AR&R 20 year, 2 hours storm, average 23.3 mm/h, Zone 2	2776.19	2545.72 (91.7%)	2444.95 (97.9%)	100.78 (36.3%)
AR&R 20 year, 6 hours storm, average 10.1 mm/h, Zone 2	3610.25	3283.63 (91.0%)	3195.53 (98.3%)	88.10 (24.4%)
AR&R 20 year, 12 hours storm, average 5.94 mm/h, Zone 2	4246.5	3820.85 (90.0%)	3769.29 (98.6%)	51.56 (12.1%)

PIPE DETAILS

Name	Max Flow Q (m ³ /s)	Max v (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
LINE 38_A	0.509	0.8	122.88	122.869	AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
LINE38B	0.502	0.79	122.828	122.828	AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
LINE 39	1.341	2.25	122.699	122.695	AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
LINE FMG01	0.001	0.17	123.278	123.277	AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
LINE 11	0.192	1.21	123.249	123.11	AR&R 20 year, 15 minutes storm, average 85 mm/h, Zone 2
LINE 13	0.183	0.43	123.1	123.098	AR&R 20 year, 15 minutes storm, average 85 mm/h, Zone 2
LINE 16	0.283	0.66	123.061	123.013	AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
LINE 38	0.889	1.4	122.881	122.828	AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
LINE10B	0.14	1.27	123.386	123.336	AR&R 20 year, 15 minutes storm, average 85 mm/h, Zone 2
LINE 10D	0.151	0.95	123.298	123.277	AR&R 20 year, 15 minutes storm, average 85 mm/h, Zone 2
LINE 8	0.044	1.11	123.533	123.277	AR&R 20 year, 5 minutes storm, average 137 mm/h, Zone 2
LINE 105	0.072	1.02	123.557	123.493	AR&R 20 year, 15 minutes storm, average 85 mm/h, Zone 2
LINE 104	0.079	0.49	123.488	123.476	AR&R 20 year, 5 minutes storm, average 137 mm/h, Zone 2
LINE 103	0.126	0.79	123.456	123.356	AR&R 20 year, 15 minutes storm, average 85 mm/h, Zone 2
LINE 101	0.235	1.09	123.282	123.184	AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
LINE 100	0.594	1.11	123.097	123.013	AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
LINE 102	0.083	0.75	123.347	123.184	AR&R 20 year, 15 minutes storm, average 85 mm/h, Zone 2
LINE 15A	0.036	0.9	123.147	123.147	AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
LINE 15B	0.104	0.76	123.11	123.098	AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
LINE 14	0.073	1.04	122.854	122.828	AR&R 20 year, 15 minutes storm, average 85 mm/h, Zone 2

OVERFLOW ROUTE DETAILS

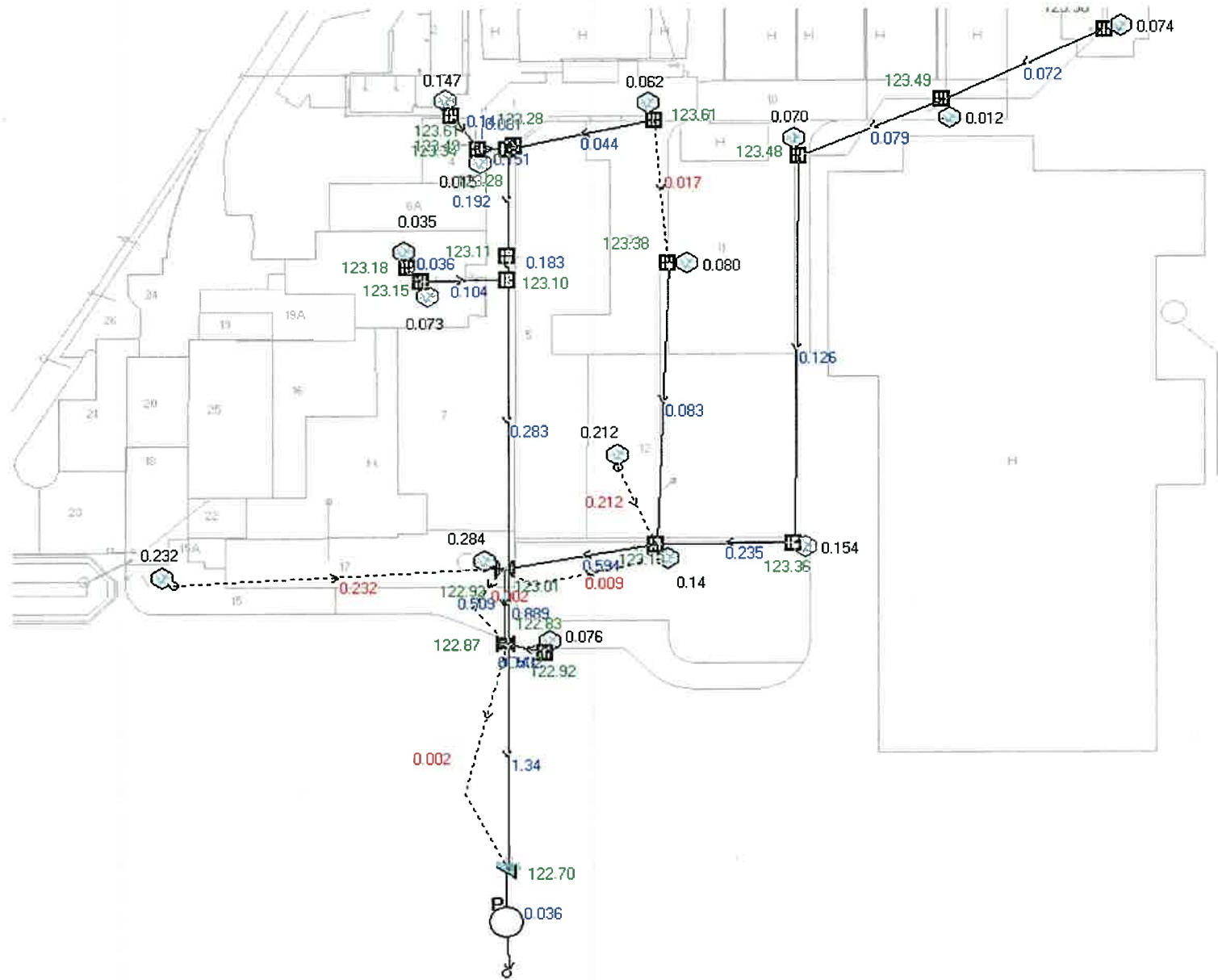
Name	Max Flow Q US (m ³ /s)	Max Flow Q DS (m ³ /s)	Safe Q (m ³ /s)	Max D (m)	Max D x V	Max Width (m)	Max V (m/s)	Due to Storm
OF10	0.002	0.002	10.912	0.007	0	3.65	0.16	AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
OF12	0.002	0.002	10.912	0.007	0	3.65	0.16	AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
PS3	0.036	0	10.912	0.02	0.01	10.07	0.35	AR&R 20 year, 5 minutes storm, average 137 mm/h, Zone 2
OF6	0.017	0.017	7.716	0.018	0	8.8	0.21	AR&R 20 year, 15 minutes storm, average 85 mm/h, Zone 2
OF4	0.009	0.009	7.716	0.014	0	7.09	0.19	AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
OF2	0.212	0.212	7.716	0.046	0.02	19.52	0.44	AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
OF8	0.232	0.232	10.912	0.042	0.02	17.94	0.58	AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2

DETENTION BASIN DETAILS

Name	Max WL (m)	Max Vol (m ³)	Max Q Total (m ³ /s)	Max Q Low Level (m ³ /s)	Max Q High Level (m ³ /s)
LAGOON 3	122.7	2345	0.036	0	0.036

CONTINUITY CHECK for AR&R 100 year, 20 minutes storm, average 91 mm/h, Zone 6

Node	Inflow (m ³)	Outflow (m ³)	Storage Change (m ³)	Difference
P025	400.87	391.48	0	2.3
PS18A	391.31	396.58	0	-1.3
PS18A_1	1295.31	1293.4	0	0.1
LAGOON 3	1293.4	215.54	1060.39	1.4
P020B	0	-0.01	0	0
P021	158.04	157.15	0	0.6
P022	157.15	158.1	0	-0.6
P024	251.28	251.22	0	0
P025_1	849.32	841.71	0	0.9
P015	110.4	110.33	0	0.1
P016	119.81	120.23	0	-0.3
P017	41.61	41.71	0	-0.2
P105	54.23	53.21	0	1.9
P104	61.8	61.51	0	0.5
P103	111.26	110.77	0	0.4
P101	242.95	242.48	0	0.2
P100	598.7	599.32	0	-0.1
P102	72.27	72.38	0	-0.1
OUTLET	215.54	215.54	0	0
OF01	30.36	30.36	0	0
P023	93.38	93.18	0	0.2
P14	57.07	56.86	0	0.4
N12	163.94	163.94	0	0
N23	179.44	179.44	0	0



DRAINS RESULTS (1 in 20 YEAR ARI ANALYSIS - HGL)

Results of a simplified bottom up HGL analysis.

This provides a simple analysis that can be checked manually. It is useful where Council insists on a manual check on HGLs.

The HGLs shown here may be different to the more accurate values normally calculated by Drains.

the maximum flows and HGLs throughout the system occur at the same time. In fact, in different parts of the system, they may occur during different storms, or even at different times within the one storm, and that flow is steady.

SUB-CATCHMENT DETAILS

Name	Max Flow Q (m ³ /s)	Paved Max Flow Q (m ³ /s)	Grass Max Flow Q (m ³ /s)	Pave T _c (min)	Grass T _c (min)	Supp T _c (min)	Due to Storm
C17	0.284	0.274	0.012	8.7	14.46		0 AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
C3	0.147	0.142	0.006	7.34	12.2		0 AR&R 20 year, 15 minutes storm, average 85 mm/h, Zone 2
C4	0.015	0.015	0.001	2.31	3.84		0 AR&R 20 year, 5 minutes storm, average 137 mm/h, Zone 2
C1	0.062	0.06	0.001	4.89	8.14		0 AR&R 20 year, 5 minutes storm, average 137 mm/h, Zone 2
C8	0.074	0.071	0.003	6.8	11.3		0 AR&R 20 year, 15 minutes storm, average 85 mm/h, Zone 2
C9	0.012	0.012	0	5.14	8.55		0 AR&R 20 year, 5 minutes storm, average 137 mm/h, Zone 2
C10	0.07	0.069	0.002	5.14	8.55		0 AR&R 20 year, 5 minutes storm, average 137 mm/h, Zone 2
C11	0.154	0.149	0.005	11.82	19.65		0 AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
C13	0.14	0.135	0.005	11.82	19.65		0 AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
C5A	0.08	0.077	0.003	11.82	19.65		0 AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
C6A	0.035	0.034	0.001	11.82	19.65		0 AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
C6	0.073	0.071	0.003	11.82	19.65		0 AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
C14	0.076	0.073	0.003	7.34	12.2		0 AR&R 20 year, 15 minutes storm, average 85 mm/h, Zone 2
C12	0.212	0.204	0.009	8.7	14.46		0 AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
C23	0.232	0.223	0.01	8.7	14.46		0 AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2

PIPE DETAILS

PIT & NODE DETAILS

Pipe	Flow Q (m ³ /s)	Length (m)	Max U/S IL (m)	Max D/S IL (m)	Slope (%)	Int. Dia (mm)	Rough (mm)	Nom. Capacity (m ³ /s)	V (m/s)	D/S HGL (m)	Friction Loss (m)	U/S HGL (m)	Node	Headloss Coeff (Ku)	Shock Loss (m)	HGL (m)	Free- board	Over Flow (m ³ /s)
LINE 39	1.341	100.1	121.9	121.34	0.56	900	0.3	1.598	2.2	122.695	0.398	123.093	PS18A_1	1.5	0.34	123.433	0.47	0.002
LINE 14	0.073	12.08	122.14	122.08	0.5	300	0.3	0.084	1	123.433	0.046	123.479	P14	1.5	0.082	123.562	0.34	
LINE 38	0.889	32.8803	120.13	119.87	0.79	900	0.3	1.904	1.4	123.433	0.058	123.492	P025_1	1.5	0.149	123.641	0.06	
LINE 16	0.283	129.15	122.36	122.12	0.19	750	0.3	0.567	0.7	123.641	0.063	123.704	P024	1.5	0.031	123.735	-0.04	
LINE 15B	0.104	11.92	122.75	122.68	0.59	450	0.3	0.267	0.8	123.735	0.011	123.746	P023	1.5	0.033	123.779	-0.05	
LINE 15A	0.036	4.407	123	122.7	6.81	375	0.3	0.569	0.9	123.779	0.001	123.78	OF01	1.5	0.008	123.788	-0.06	
LINE 100	0.594	62	122.185	122.03	0.25	825	0.3	0.846	1.1	123.641	0.078	123.719	P100	1.5	0.095	123.814	-0.21	0.009
LINE 102	0.083	126.4	122.595	122.216	0.3	375	0.3	0.117	0.7	123.814	0.194	124.008	P102	1.5	0.043	124.051	-0.45	
LINE 101	0.235	54.6	122.321	122.185	0.25	525	0.3	0.258	1.1	123.814	0.114	123.928	P101	1.5	0.09	124.018	-0.42	
LINE 103	0.126	173.43	122.755	122.321	0.25	450	0.3	0.173	0.8	124.018	0.238	124.257	P103	1.5	0.048	124.305	-0.7	
LINE 104	0.079	65.813	122.972	122.775	0.3	450	0.3	0.189	0.5	124.305	0.036	124.341	P104	1.5	0.019	124.36	-0.76	
LINE 105	0.072	73.2	123.192	122.972	0.3	300	0.3	0.065	1	124.36	0.269	124.629	P105	1.5	0.079	124.708	-1.11	
LINE 13	0.183	9.44	122.4	122.36	0.42	750	0.3	0.862	0.4	123.735	0.002	123.737	P022	1.5	0.013	123.75	-0.06	
LINE 11	0.192	47.4	122.78	122.44	0.72	450	0.3	0.295	1.2	123.75	0.148	123.898	P021	1.5	0.112	124.01	-0.27	
LINE 8	0.044	64.17	123.11	122.72	0.61	225	0.3	0.044	1.1	124.01	0.404	124.414	P017	1.5	0.095	124.509	-0.89	0.017

LINE 10D	0.151	11.07	122.79	122.78	0.09	450	0.3	0.102	1	124.01	0.022	124.032	P016	1.5	0.069	124.101	-0.25
LINE10B	0.14	18.073	122.88	122.826	0.3	375	0.3	0.117	1.3	124.101	0.077	124.178	P015	1.5	0.123	124.301	-0.93
LINE FMGO	0.001	2.95	123.21	123.11	3.39	150	0.3	0.036	0.2	124.01	0	124.01	P020B	1.5	0	124.011	-0.29
LINE38B	0.502	2	120.132	120.13	0.1	900	0.3	0.667	0.8	123.433	0.001	123.435	PS18A	1.5	0.048	123.482	0.42
LINE 38_A	0.509	32.8	120.13	119.87	0.79	900	0.3	1.906	0.8	123.482	0.02	123.502	P025	1.5	0.049	123.551	0.15

OVERFLOW ROUTE DETAILS

Name	Max Flow Q US (m ³ /s)	Max Flow Q DS (m ³ /s)	Safe Q (m ³ /s)	Max D (m)	Max D x V	Max Width (m)	Max V (m/s)	Due to Storm
OF10	0.002	0.002	10.912	0.007	0	3.65	0.16	AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
OF12	0.002	0.002	10.912	0.007	0	3.65	0.16	AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
PS3	0.036	0	10.912	0.02	0.01	10.07	0.35	AR&R 20 year, 5 minutes storm, average 137 mm/h, Zone 2
OF6	0.017	0.017	7.716	0.018	0	8.8	0.21	AR&R 20 year, 15 minutes storm, average 85 mm/h, Zone 2
OF4	0.009	0.009	7.716	0.014	0	7.09	0.19	AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
OF2	0.212	0.212	7.716	0.046	0.02	19.52	0.44	AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2
OF8	0.232	0.232	10.912	0.042	0.02	17.94	0.58	AR&R 20 year, 20 minutes storm, average 73 mm/h, Zone 2