Mc Williams Hanwood Winery

Griffith, New South Wales

Wastewater Treatment Concept Design

JJC Engineering Pty Ltd

6 November 2012

1. Introduction

McWilliams Wines Pty Ltd ("McWilliams") proposes to upgrade its winery located at Hanwood, near Griffith, New South Wales. The winery will be developed in stages to a crush capacity of 65,000 tonne with packaging facilities for 100,000 tonne equivalent.

JJC Engineering Pty Ltd (JJC) has been engaged by McWilliams to develop a concept design for wastewater management and recycling.

JJC is a small team of specialised engineers with a reputation as industry leaders in industrial waste management. JJC's core expertise is in developing integrated waste system design, including:

- Understanding upstream processes and practices that produce waste.
- Waste stream elimination, minimisation, recycling and reuse.
- Assessment of work practice changes and treatment options.
- Treatment plant process design
- Construction project management
- Operational support and technical guidance

JJC has engineered a number of plants for treating winery wastewater, producing treated water for reuse within wineries and vineyards. A summary of JJC wine industry projects is provided at www.jjcgroup.com.au

For McWilliams, JJC's scope of work involved:

- Prepare design calculations and concepts.
- Discuss design concepts with McWilliams personnel on 6 November 2008.
- Review data from 2009 vintage with McWilliams personnel on 16 June 2009.
- Revise the draft report to reflect data collected during the 2009 and 2010 vintages.
- Submit a draft report for review with McWilliams and regulatory authorities dated 25 June 2012.
- Issue this final report, after making minor typographical corrections to the June 2010 draft report.

This final report comprises an overview of the concept design for wastewater management and recycling at the Hanwood winery. It has been produced to support McWilliams' application for project approvals.

2. Assessment Of Existing Wastewater

McWilliams has collected detailed information on its existing wastewater, in preparation for designing wastewater facilities for its expansion project.

The water supplied to the winery is discharged as wastewater, with the exception of water:

- Evaporated from cooling towers, but cooling tower blowdown (approx. 1 to 2ML p.a) is returned to the wastewater system.
- Supplied to amenities, that produces sewage that is treated in a separate treatment plant. Sewage is estimated at < 2 ML p.a.

For design purposes, we have assumed that winery wastewater volume is equal to water supplied to the winery, less the water supplied to the cooling towers.

Water supplied to landscaped areas is supplied prior to the winery water meter.

The water usage at the site is summarised in Figure 1 (2009) and Figure 2 (2010).

The estimated wastewater production in 2009 is summarised in Table 1. For 2009, the winery processed 38,000 tonnes of grapes, and produced an estimated 53ML of wastewater, equivalent to a water efficiency of 1.39 kL per tonne crushed.

Table 1: Wastewater Production (2009)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Metered Water Into Winery	5902	11441	11793	7645	4116	2014	1998	2582	3383	3813	4957	4971	64617
Metered Water To Cooling Towers	1698	2228	1857	1291	761	251	120	233	427	742	1168	987	11763
Winery Less Cooling Towers	4204	9213	9936	6354	3355	1763	1878	2349	2956	3071	3789	3984	52854
Assumed Wastewater	4204	9213	9936	6354	3355	1763	1878	2349	2956	3071	3789	3984	52854
Profile	4%	14%	19%	14%	11%	10%	6%	5%	3%	3%	8%	4%	100%

Metered Water to Cooling Towers is records from April 09 to March 10.

Figure 1: Water Usage 2009.

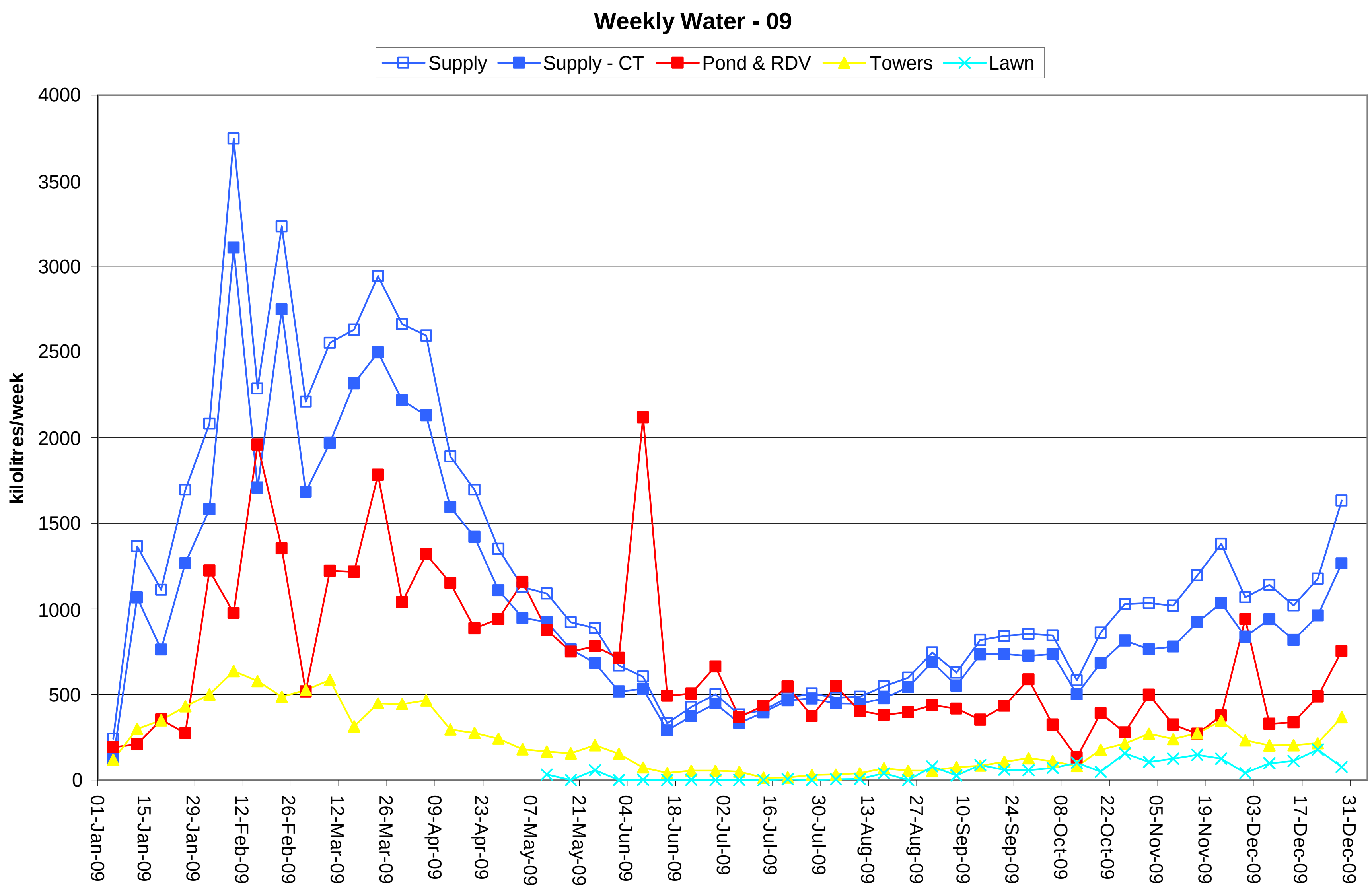
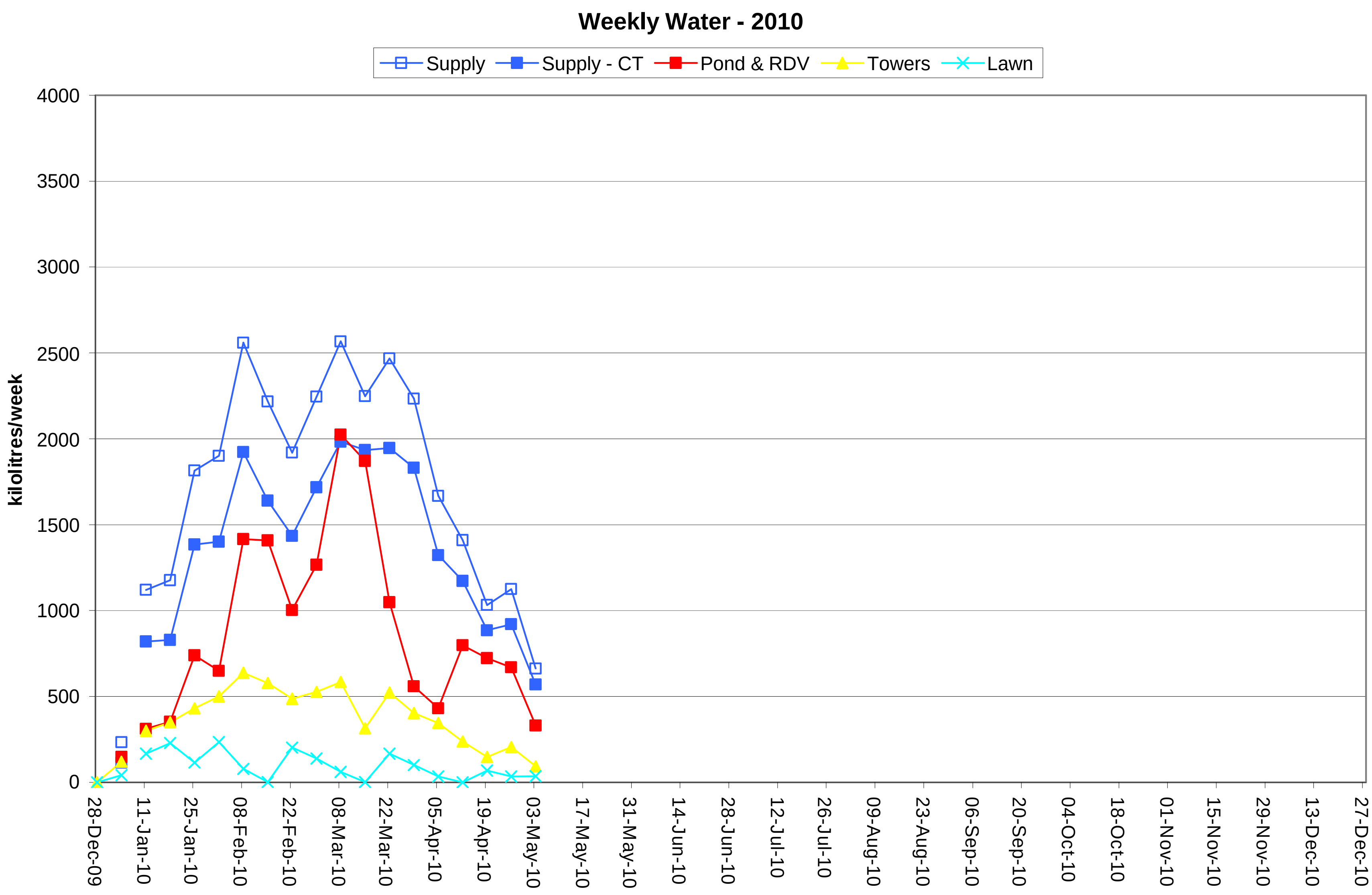


Figure 2 : Water Usage 2010.



Composite sampling of wastewater was conducted during Vintage 2006 and Vintage 2009. The results are summarised in Tables 2a) and 2b) below. The wastewater is characterised by high concentrations of suspended solids and COD, because of McWilliams' practice of discharging tanks lees to the wastewater system, via distillation.

For 2009, the weekly COD loads in wastewater are summarised in Table 3.

Table 3: COD Loads In Wastewater (2009)

Week Ending	Wastewater	
	kL/wk	kgCOD/wk
21/01/2009	762	6908
28/01/2009	1266	6406
3/02/2009	1582	12529
11/02/2009	3110	46028
17/02/2009	1709	16492
25/02/2009	2748	32426
3/03/2009	1683	22889
11/03/2009	1970	39006
17/03/2009	2316	20751
25/03/2009	2497	24096
31/03/2009	2218	41477
8/04/2009	2131	25359
14/04/2009	1594	26142
21/04/2009	1420	39689
29/04/2009	1108	31689
Peak Week	3110	46028
Ave FMA	2007	29121
Ave March	2137	29644
Ave Pk 4 Wks	2313	29459
Design Basis	**2007**	**29121**

For Vintage 2009, the average wastewater load was 29,121 kgCOD/week and an average flow of 2,007 kL/week.

Table 2a: Wastewater Analysis Results
(Vintage 2006)

	pH	E.C (uS/cm)	Susp Solids (mg/L)	COD (mg/L)	BOD (mg/L)	TKN (NH3+OrgN) (mg/L)	Total P (mg/L)	Total K (mg/L)	Sodium (mg/L)	Magnesium (mg/L)	Calcium (mg/L)	Zinc (mg/L)	Copper (mg/L)	Total Inorganic Carbon (mg/L)
Wastewater Results 2006														
Effluent composite 22/2-1/3/06	3.7	2.64	1700	15840	9250	NT	NT	NT	NT	NT	NT	NT	NT	NT
Effluent composite 1/3-8/3/6	3.7	2.66	1800	21320	12000	NT	NT	NT	NT	NT	NT	NT	NT	NT
Effluent composite 8/3-15/3/6	3.9	2.22	1960	13120	5100	NT	NT	NT	NT	NT	NT	NT	NT	NT
Effluent composite 15/3-22/3	3.2	2.5	2160	28500	7600	137	44	810	77	17	45	2.6	1	38
Effluent composite 22/3-29/3/6	3.6	3.1	3010	19200	9160	NT	NT	NT	NT	NT	NT	NT	NT	NT
Effluent composite 29/3-5/4/6	3.6	2.6	3000	21400	9880	NT	NT	NT	NT	NT	NT	NT	NT	NT
Effluent composite 5/4-12/4/6	3.9	2.68	3430	15500	9390	NT	NT	NT	NT	NT	NT	NT	NT	NT
Effluent composite 12/4-19/4/6	4.2	1.84	1500	17550	9000	NT	NT	NT	NT	NT	NT	NT	NT	NT
Effluent composite 19/4-26/4/6	3.9	2.68	3950	11400	5280	327	48	970	160	17	36	1.8	0.97	19
Effluent composite 19/4-26/4/6 Filtered	NT	NT	NT	9200	5400	NT	NT	930	NT	NT	NT	NT	NT	NT
Effluent Composite 26/4-2/5/6	5.7	0.458	190	8800	3600	NT	NT	NT	NT	NT	NT	NT	NT	NT
Effluent Composite 3/5/6-9/5/6	4.0	1.115	3400	12150	3700	NT	NT	NT	NT	NT	NT	NT	NT	NT
Effluent Composite 10/5/6-16/5/6	4.0	1.314	2270	10100	4260	NT	NT	NT	NT	NT	NT	NT	NT	NT
Effluent Composite 17/5/6 - 23/5/6	4.3	3.15	1150	11300	6700	NT	NT	NT	NT	NT	NT	NT	NT	NT
Effluent Composite 24/5/6-31/5/6	4.3	2.86	1030	16300	7850	75	16	610	470	9.7	30	1.3	0.3	110
Effluent Composite 1/6/6-7/6/6	4.8	1.89	420	9400	3855	NT	NT	NT	NT	NT	NT	NT	NT	NT
Effluent Composite 7/6/6-13/6/6	6.2	1.273	638	11400	4680	NT	NT	NT	NT	NT	NT	NT	NT	NT
Effluent Composite 14/6-20/6/6	6.5	0.756	755	9350	4160	NT	NT	NT	NT	NT	NT	NT	NT	NT
Effluent Composite 14/6-20/6/6	4.5	0.457	570	2800										
Statistics														
Average March	3.6	2624	2126	19596	8622	137	44	810	77	17	45	2.6	1.0	38
						One	One	One	One	One	One	One	One	One
Average All	4.3	2011	1830	13928	6715	180	36	830	236	15	37	1.9	0.8	56
Min	3.2	457	190	2800	3600	75	16	610	77	10	30	1.3	0.3	19
Max	6.5	3150	3950	28500	12000	327	48	970	470	17	45	2.6	1.0	110

Table 2b: Wastewater Analysis Results
(Vintage 2009)

	pH	E.C (uS/cm)	Susp Solids (mg/L)	COD (mg/L)	BOD (mg/L)	TKN (NH3+OrgN) (mg/L)	Total P (mg/L)	Total K (mg/L)	Sodium (mg/L)	Magnesium (mg/L)	Calcium (mg/L)	Zinc (mg/L)	Copper (mg/L)	Total Inorganic Carbon (mg/L)
Wastewater Results 2009														
21/01/2009	4.2	2550	1480	9065	6960	49.3	17	260	650	17	49	2.4	0.15	4200
28/01/2009	5.5	1933	340	5060	3400									
30/1/09 - 3/2/09	4.1	1602	1800	7920	6750									
11/02/2009	3.9	1900	2910	14800	9500									
10/2/09 - 17/2/09	4.2	1435	1140	9650	5140									
25/02/2009	4.0	1882	1660	11800	7590	61.7	8	370	200	10	35	1.8	0.09	4500
24/2/09 - 3/3/09	4.5	1976	1340	13600	8100									
11/03/2009	4.9	2640	1160	19800	12990									
10/3/09 - 17/3/09	4.8	2740	1270	8960	5000									
25/03/2009	4.0	2260	1740	9650	2890	65.1	12.3	450	280	11	27	2.5	0.39	260
24/3/09-31/3/09	3.9	2670	1860	18700	9600									
8/04/2009	3.6	1711	2410	11900	6010									
7/4/09-14/4/09	4.7	1814	8370	16400	3850									
14/4/09-21/4/09	4.6	2470	2875	27950	14100	186.5	40	310	350	22	55	4.3	1.2	<100
29/04/2009	3.9	1651	2380	28600	13500									
28/4/09-5/5/09	4.2	1481	1500	17200	10000									
Statistics		Same	Lower	Lower	Same									
Average March	4.4	2457	1474	14142	7716	65	12	450	280	11	27	2.5	0.4	260
						One	One	One	One	One	One	One	One	One
	Same	Same	Same	Same	Same			Lower	Higher					
Average All	4.3	2045	2140	14441	7836	91	19	348	370	15	42	2.8	0.5	2987
Min	3.6	1435	340	5060	2890	49	8	260	200	10	27	1.8	0.1	260
Max	5.5	2740	8370	28600	14100	187	40	450	650	22	55	4.3	1.2	4500

3. Stormwater Management

All stormwater at the Hanwood winery site is currently collected for reuse, and the current system is designed with the capacity for ultimate development of the site. The stormwater catchments and drains are shown in Attachment 1.

Roof catchments are harvested for water supply to the site. These catchments are directed to Lagoon #1 (the raw water feed dam to the winery) and do not contribute to the drainage system requirements. The car park and road areas not used for road tanker activities are designated stormwater catchments, and these feed into the stormwater drainage system.

With the exception of roof areas, car park and some roads, all external hard paved catchment areas are treated as wastewater catchments. Wastewater catchments are directed by gravity to a series of pump stations. These pump stations currently transfer wastewater to the existing evaporation pans, and in future will deliver to the proposed wastewater treatment plant.

The stormwater drainage system currently delivers into Lagoon #3. This lagoon serves two purposes:

- To collect stormwater for re-use , and,
- To act as a site safety bund, to collect any large spills that may occur in the catchments that could exceed the capacity of the pump stations, such as a door seal failure on a large tank, or an uncontrolled spill in the case where a wastewater pump station fails to operate, such as during a power failure.

Lagoon #3 is located at the south end of the winery site at the lowest end of the gravity stormwater drainage system. It is constructed as an in- ground lagoon with a maximum depth of 2.7m below existing ground level and an embankment height of 0.5m. It is lined with an HDPE liner. With a freeboard of 0.5m, the lagoon has a capacity of 3.8ML. It has been conservatively sized to contain a 1:10 year stormwater event on the site at ultimate development (an area of 7.5Ha, giving 2.4ML of stormwater) plus a spill of the largest above ground wine storage tank (1.2ML).

During minor storm events, when the wastewater pumps can keep up with the inflow of stormwater, the drainage system caters only for flows from the stormwater (non-wastewater) catchments. During these events, stormwater from the wastewater catchments is pumped through rising mains to the existing evaporation pans currently, and in future to the wastewater treatment plant.

The wastewater pump stations have been fitted with a high level overflow pipe. During large storm events when the wastewater pumps cannot keep up with the inflow of stormwater, the chambers overflow through this pipe into the stormwater drainage system. The overflow pipe is located above the level of the ‘high-level’ alarm, giving pre-warning that the pump chamber is about to over-flow.

During large storm events when the wastewater pumps cannot keep up with the inflow of stormwater, the drainage system caters for flows from both the stormwater and the wastewater catchments.

The drainage system feeds into lined Lagoon #3. After a storm event, Lagoon #3 will be emptied by pumping clean stormwater to Lagoon #4.

Should Lagoon #3 contain wastewater following a large spill event, the wastewater will be pumped to the proposed wastewater treatment plant. The emptying operation will not be an automatic process, requiring management intervention and testing. Lagoon #3 is fitted with a HDPE liner, in lieu of a clay liner, to facilitate cleaning of the lagoon.

Lagoon #3 is maintained empty so that it is available for stormwater collection or as an emergency site bund should a major spill occur.

At present, Lagoon #4 is used for storage of stormwater received from Lagoon #3, with the water used for vineyard irrigation purposes. Only clean stormwater is pumped to Lagoon #4 and this is a manual operation as noted above.

The future wastewater treatment plant will discharge treated wastewater into Lagoon #4, for use in vineyard irrigation.

Lagoon #4 is a 'turkey's nest' construction. It has a maximum depth below existing ground level of 2.6m and an embankment height of 2.1m, with a total storage volume of 35ML with 500mm freeboard. It is lined with an impervious clay liner.

The current system has been designed with capacity for the ultimate development of the site, and will be integrated with the proposed wastewater treatment facilities.

The estimates of annual stormwater volume to be collected in the wastewater and stormwater drainage systems are:

2009:	391mm median rainfall on 2.9 ha = 11ML p.a
Ultimate Development:	391mm median rainfall on 6.8 ha = 27ML p.a

4. Design Loads

The volume of wastewater and stormwater for the 2009 crush of 38,000 tonnes is estimated at 64ML p.a, comprising:

• Winery Wastewater:	38,000 tonnes crush at 1.39 kL/tonne =	53 ML
• Stormwater:	391mm median rainfall on 2.9 ha =	11 ML

McWilliams plan to increase wine making activity at the Hanwood site into the future, with projected ultimate activity of 65,000 tonnes winemaking plus 100,000 tonnes packaging.

Projections of wastewater volume (including stormwater from paved areas) for the ultimate development are based on following assumptions:

• Winery Wastewater	1.30 kL per tonne grape crush
• Packaging Wastewater	0.83 kL per kL wine packaged
	0.72 kL of wine per tonne grape crushed
	0.60 kL packaging wastewater per equiv tonne grape crush.

The projected volume of wastewater and stormwater for the ultimate development is 171ML p.a, comprising:

• Winery Wastewater:	65,000 tonnes crush at 1.30 kL/tonne = 85 ML
• Packaging Wastewater:	72,465 kL packed at 0.83 kL/kL = 60 ML
• Stormwater:	391mm median rainfall on 6.8 ha = 27ML

The design load projections on a monthly basis are summarised in Table 5. Note that the projected annual profile in wastewater volume is relatively "flat" (unusual for a winery), due to the influence of wastewater packaging flows. For wastewater for ultimate development of the site:

• Average Flow in March (peak Vintage)	630 kL/d
• Average Flow in Feb, March & April	594 kL/d
• Average Annual Flow	396 kL/d

Table 4: Wastewater Design Loads

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
CURRENT (2009)														
Winery Wastewater	*kL*	4347	9221	9786	6354	3355	1763	1878	2349	2956	3071	3789	3984	52854
		8.2%	*17.4%*	*18.5%*	*12.0%*	*6.3%*	*3.3%*	*3.55%*	*4.44%*	*5.59%*	*5.81%*	*7.17%*	*7.54%*	*100%*
Packaging Wastewater	*kL*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
		6.7%	*9.0%*	*6.5%*	*7.0%*	*6.3%*	*7.7%*	*11.1%*	*10.2%*	*10.1%*	*10.1%*	*8.8%*	*6.4%*	*100%*
Wastewater Volume	kL/month	4347	9221	9786	6354	3355	1763	1878	2349	2956	3071	3789	3984	52854
	kL/day	140	329	316	212	108	59	61	76	99	99	126	129	145
Vintage	kL			25361										
	kL/day			279										
Peak Month	kL/month			9786										
	kL/day			316										
Peak Week **(150% Average)**	kL/week			3670										
	kL/day			524										
Stormwater														
Rainfall (Griffith CSIRO median annual)	mm	21	23	23	27	35	39	38	48	35	41	26	35	391
Runoff To Trade Waste Drains	kL/month	529	585	591	680	874	985	954	1209	877	1037	652	886	9858
Runoff To Stormwater Drains	kL/month	83	92	93	107	138	155	150	191	138	164	103	140	1555
TOTAL	kL/month	4960	9898	10470	7141	4366	2903	2983	3749	3971	4271	4544	5010	64268
ULTIMATE DEVELOPMENT														
Winery Wastewater	*kL*	6950	14742	15646	10158	5363	2819	3003	3755	4726	4910	6058	6369	84500
		8.2%	*17.4%*	*18.5%*	*12.0%*	*6.3%*	*3.3%*	*3.6%*	*4.4%*	*5.6%*	*5.8%*	*7.2%*	*7.5%*	*100%*
Packaging Wastewater	*kL*	4035	5400	3892	4232	3800	4660	6650	6134	6099	6075	5319	3850	60146
		6.7%	*9.0%*	*6.5%*	*7.0%*	*6.3%*	*7.7%*	*11.1%*	*10.2%*	*10.1%*	*10.1%*	*8.8%*	*6.4%*	*100%*
Wastewater Volume	kL/month	10985	20143	19537	14391	9164	7479	9653	9889	10825	10984	11377	10219	144646
	kL/day	354	719	630	480	296	249	311	319	361	354	379	330	396
Vintage	kL			54071										
	kL/day			594										
Peak Month	kL/month			19537										
	kL/day			630										
Peak Week **(150% Average)**	kL/week			7327										
	kL/day			1047										
Stormwater														
Rainfall (Griffith CSIRO median annual)	mm	21	23	23	27	35	39	38	48	35	41	26	35	391
Runoff To Trade Waste Drains	kL/month	1144	1264	1277	1470	1889	2129	2062	2614	1896	2242	1410	1916	21314
Runoff To Stormwater Drains	kL/month	283	313	316	364	467	527	510	647	469	555	349	474	5274
TOTAL	kL/month	12412	21719	21131	16225	11520	10134	12226	13151	13190	13781	13136	12609	171234

Projections of peak COD load are summarised in Table 5 below. Winery load is assumed to increase proportionately from V2009 summarised in Table 3 above. Packaging wastewater is projected assuming:

- 6.5% of annual packaging occurs in March.
- Packaging produces 0.6L wastewater per tonne equivalent crush.
- Wastewater contains an average of 4000 mg/L COD.

Table 5: March COD Load Projections

Year		Design Load			
		Crush (t)	Volume (kL/wk)	COD (mg/L)	COD Load (kg COD/wk)
2009	Winery	38000	2007	14512	29,121
	Packaging	0	0	0	0
Total			2007	14512	29,121
2027	Winery	65000	3432	14512	49,812
	Packaging	100000	881	4,000	3,523
Total			4313	12366	53,335

The design of the McWilliams winery wastewater system is based on consideration of growth from the current winery to ultimate development:

Current: 38,000 tonnes crush. The design loads are:

- Total Wastewater & Stormwater — 64 ML p.a
- Average Inflow During Vintage — 279 kL/day
- Average COD Load During Vintage — 29,121 kgCOD/week

Ultimate Development: 65,000 tonnes crush and 100,000 tonnes packaging. The design loads are:

- Total Wastewater & Stormwater — 171 ML p.a
- Average Inflow During Vintage — 594 kL/day
- Average COD Load During Vintage — 53,335 kgCOD/week

5. Concept Design

The concept design for wastewater treatment at McWilliams Hanwood winery is described in this section. Wastewater will be treated, stored and reused to irrigate vineyards near the Hanwood winery.

The initial design case is based on handling the 2009 crush of 38,000 tonnes, producing a total wastewater volume of 64ML. The final design case is for ultimate development of the site to a crush of 65,000 tonnes plus packaging at 100,000 tonnes, producing a total wastewater volume of 171ML.

The concept design is summarised in Figure 3. A preliminary layout plan is provided in Attachment 2 (Drawing 0802-PR001).

Within the winery, Cleaner Production measures will be developed and implemented, to reduce water use, and wastewater load. Strong salt streams such as caustic washwater and lees will be segregated, and discharged to the existing evaporation pans.

Wastewater will be discharged from the winery, screened to remove large solids, settled to remove fine solids, and then stored in the Covered Anaerobic Lagoon (CAL). This CAL will operate at a minimum volume of 5ML, and is able to surge up to 20ML, providing 15ML of floating storage in a covered lagoon.

This floating storage is used to average and store vintage flows. It will also achieve reduction in COD. Experience at other sites is that initially 20% COD removal will be achieved, and an effluent BOD of about 1000 mg/L (about 80% COD removal) is a realistic goal able to be achieved through manipulating operational settings.

The sizing of the aerobic treatment process involves consideration of the load profile from the winery, the volume surged in the CAL, the operational settings in the CAL and the COD removal in the CAL. Calculations are summarised in Table 6 below.

Table 6: SBR Sizing Calculations

Parameter		2009		Ultimate	
		20%COD	80%COD	20% COD	80%COD
Annual Flow	(ML p.a)	64	64	171	171
Ave Feb & March & April Flow	(ML/day)	0.28	0.28	0.59	0.59
Design COD Load Into CAL	(kgCOD/wk)	29,121	29,121	53,335	53,335
COD Removal in CAL	(%)	20%	80%	20%	80%
Peak Gas Production	(m3/day)	499	1997	914	3657
Design COD Load Into SBRs	(kgCOD/wk)	23,879	8,154	43,735	14,934
Recirculation Rate	(% of CAL Inflow)	0%	100%	0%	100%
SBR Inflow Flowrate	(kL/day)	279	557	594	1,188
SBR Inflow COD	(mgCOD/L)	12,240	2,090	10,515	1,795
SBR Volume	(kL)	2,200	2,200	3,300	3,300
SBR F/M	(kgCOD/kg MLSS/d)	0.31	0.11	0.38	0.13
SBR Retention Time	(days)	7.9	3.9	5.6	2.8
SBR Aeration	(kW)	152	52	279	95
Biosolids Production	(kgDS/d)	1,362	770	2,495	1,410
	(Cake t/d)	6.8	3.8	12.5	7.0
	(Cake tpa)	943	444	2157	1016

For 171ML p.a at ultimate development, the average inflow during vintage is projected to be 594 kL/day, with peak daily wastewater flows up to 1047kL/day. On the fully developed 7.5Ha site, a 1:10 yr storm event will generate 2.4ML stormwater. The CAL will provide buffer capacity for these peak flow events.

Of the 54ML of wastewater discharged from the winery during February, March and April, up to 15ML could be stored in the CAL. Leaving the remaining 39ML to be processed during February, March and April, at an average rate of 429kL/day. The rest of the annual wastewater (132ML) could be processed at an average rate of 482kL/day over the remainder of the year.

Wastewater will be pumped from the CAL to the Sequencing Batch Reactor (SBR) for aerobic processing. The design of the SBR allows provision to treat a design load of up to 43,725 kg COD/week that would result from removal in the CAL of only 20% of the estimated COD load at ultimate development. But the SBR will be implemented in stages, as determined by growth in wastewater load and CAL performance.

For the contingency that wastewater load exceeds the treatment capacity of the CAL/SBR system during peak periods, fresh wastewater will be irrigated onto the existing evaporation pan area or vineyards.

Treated water discharge from the SBR will be polished and stored in the Storage Lagoons, providing a total of 74ML of winter storage. This process will give good quality treated water, suitable for storage and irrigation.

The works will be staged to meet wastewater load and volume as the winery and packaging facilities grow over the years to ultimate development.

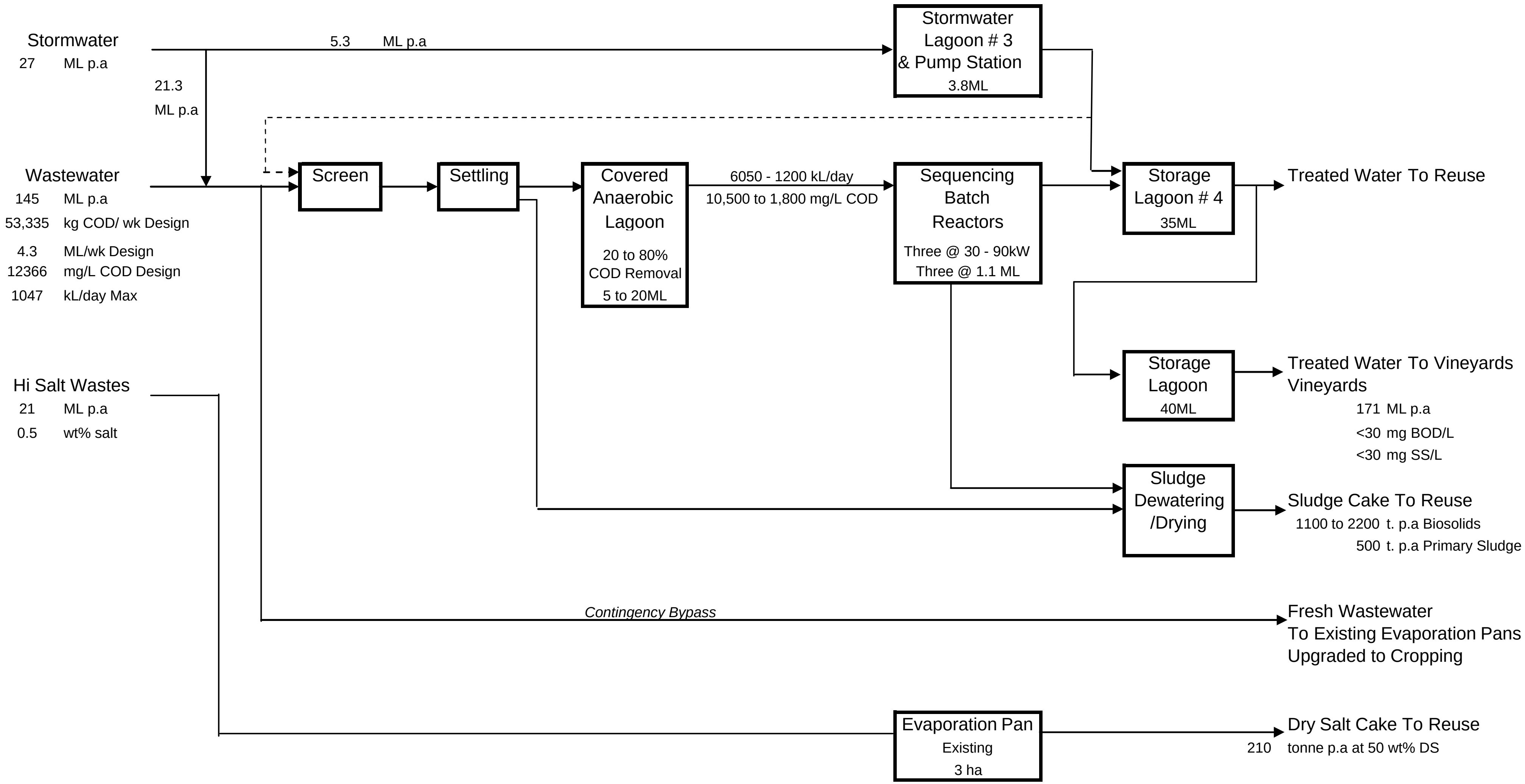
The concept design for wastewater treatment at McWilliams Hanwood consists of the following:

- Cleaner Production within the winery.
- Segregation of high salt wastes to evaporation.
- Screening of large solids.
- Settling of fine solids.
- Surge storage & anaerobic biotreatment.
- Aerobic biotreatment.
- Storage of treated water.
- Reuse of treated water.
- Dewatering of Solids.
- Control and automation.
- Environmental protection.

The scope of each of these elements is described in the following sections.

Figure 3: Wastewater Concept Design

(65,000 Tonne Winery, 100,000 Tonne Packaging)



4.1 Cleaner Production In The Winery

McWilliams will develop and implement a series of Cleaner Production works within the winery, intended to reduce water consumption, wastewater generation and wastewater load. These works include:

- Measures to minimise lees left in tanks.
- Lees recovery and filtration.
- Caustic recovery and reuse.
- Segregation of high salt wastes, to evaporation pans.
- Provide roofing over processing areas for additional collection of water for supply to the winery and reduction in wastewater.

If McWilliams' operate the winery diligently, these works are expected to achieve wastewater BOD levels during vintage as low as 5000 mg/L and average EC levels below 1500 uS/cm.

4.2 Screening

The objective for screening is to remove large solids, down to the size of grape seeds.

Concept design is installation of a rotary screen at the WWTP, with 0.5mm aperture mesh, sized to accept all winery wastewater pumps operating simultaneously.

Screenings will be collected in a portable bin, moved by a front-end loader, for disposal with solid waste.

4.3 Settling

The objective of settling is to remove the majority of inorganic solids (such as earth or bentonite) prior to the Covered Anaerobic Lagoon, minimising the frequency for desludging of the Covered Anaerobic Lagoon. It is preferable that organic solids pass into the Covered Anaerobic Lagoon, where they will be anaerobically biodegraded.

The proposal is to remove inorganic solids as primary sludge in gravity settling tanks or hydrocyclones without use of chemicals.

Based on removal of 750mg/L of suspended solids, from 171ML p.a, 130 tonnes per annum of dry solids will be removed.

The following equipment is proposed:

- Settling Tank – Two, each 8m diameter, 2.4 m high epoxy coated, concrete tanks fitted with supernatant launder, and desludging systems are envisaged.
- Hydrocyclones – Sized for peak flowrate.
- Sludge Tank – 40 kL, stainless steel, shallow cone, fitted with mechanical mixer, air sparger and overflow to the Settling Tanks or SBR. Shared duty for Biosolids.

4.4 Covered Anaerobic Lagoon

The objectives of the Covered Anaerobic Lagoon (CAL) are to:

- Average peak contaminant and hydraulic loads discharged from the winery, before subsequent aerobic biotreatment.
- Store peak loads discharged from the winery during vintage, for aerobic biotreatment after the vintage.
- Treat BOD under anaerobic conditions, reducing load on the subsequent aerobic process, and producing biogas for potential reuse.

The Covered Anaerobic Lagoon will be covered with a 1.1mm polypropylene floating cover (or similar) that stores biogas and contains any odour. The biogas is pumped from the CAL and will be burnt in a flare destroying any odour. The flare is naturally aspirated and is very quiet.

On initial commissioning, the CAL will remove only minor COD load. In time, as sludge load in the CAL increases, anaerobic treatment efficiency will increase. Ultimately, COD removal efficiency of 50 to 80% is expected.

Sizing calculations indicate that 20ML reactor volume is sufficient to provide optimum reactor loading during the peak of vintage and floating storage of 15ML. Out of vintage, volume stored in the CAL will decrease to a minimum of approximately 5ML.

The proposed equipment is:

- Covered Anaerobic Lagoon (20ML). Earthen lagoon lined with 1.5mm HDPE or impermeable clay, with 1.1mm thick reinforced polypropylene cover (or similar). A minimum operating volume of 5ML. Fitted with contact mixing, cover drainage and alarm systems.
- SBR Fill Pumps - Submersible pumps, capable of feed rate to SBR of 300 kL/hr.
- Gas Collection and Flaring Facilities: Capacity of 6000m3/day, based on a 100% safety factor. Naturally aspirated flare system, controlled by biogas pressure.

4.5 Sequencing Batch Reactor

The objective of the Sequencing Batch Reactor (SBR) is to remove BOD from wastewater by aerobic biotreatment of the wastewater. The SBR uses the following sequence to biotreat the wastewater:

- *Feed & Aeration*: A volume of wastewater containing organic contaminants (the “food”) is pumped into the reactor. The reactor is aerated to:
  - Mix sludge floc (the “bugs”) with water containing the food,
  - Provide oxygen required to sustain the “bugs”.
- *Aeration*: The reactor is aerated while the biological reaction finishes.
- *Settle*: Aeration ceases, and sludge floc settles away from supernatant treated water.
- *Decant*: Treated water is decanted from the top of the reactor.

The cycle usually takes 8 to 12 hours to complete. In each cycle, typically a volume of 1/10th of the reactor volume is fed and decanted.

Activated sludge is a fully aerobic biological process and has no discernable odour.

Aeration equipment is selected to minimise noise:

- Fine bubble diffusers.
- Blowers are housed in a sound enclosure, and have a noise rating of 78dBa at 1 metre.

Aerobic biotreatment produces waste biosolids. In the early years of operation, these biosolids will be returned to the CAL, to create sludge layer that will increase the amount of anaerobic treatment that occurs in the CAL. Later these biosolids will be dewatered.

The volumetric throughput of the SBR must allow for the internal recycling of water from waste activated sludge, and treated water that is recirculated to the CAL. When CAL efficiency improves to 80% COD removal, then SBR hydraulic capacity will be greater. An internal recycle of 600kL/day, added to the required throughput of 600kL/day, gives a total feeding rate to the SBR of 1,200 kL/day, that is catered for in the design.

The proposed equipment is:

- SBR 1 – 1100kL lined Panel Tank. Typical dimensions of 16.2m diameter, 5.5m water depth plus 500mm freeboard. Fitted with up to 90kW of blowers and 190 diffusers, and decanter system.
- SBR 2 – 1100kL lined Panel Tank. Typical dimensions of 16.2m diameter, 5.5m water depth plus 500mm freeboard. Fitted with up to 90kW of blowers and 190 diffusers. Operated in series with SBR1, so decanter system not required.
- SBR 3 – 1100kL lined Panel Tank. Typical dimensions of 16.2m diameter, 5.5 m water depth plus 500mm freeboard. Fitted with up to 90kW of blowers and 190 diffusers. Operated in series with SBR1, so decanter system not required.
- Biosolids Pump – 20kL/hour, helical rotor.
- SBR1 Decant System, sized for 600kL/hour

4.6 Storage Of Treated Water

The objective is to store treated water for reuse, and over the winter period, without odour nuisance.

McWilliams proposes that the treated winery wastewater will be reused for:

- Irrigation of 40 ha of existing vineyards, surrounding the winery (farm 130).
- Irrigation of an additional 395 ha of vineyards, 8 km from the winery (farms 195, 196 & 199).
- Potential use for washdown in the winery, of up to 20% of the wastewater volume produced.
- Potential irrigation of up to 3 hectares of potential cropland.

Water balances have been constructed for the worst-case scenario that all treated water is reused on 395 ha of vineyards, and treated water is stored over winter. The water balances for the vineyards for 2009 and ultimate development are provided in Attachment 3.

This water balances show:

- **<u>2009</u>**: 64ML p.a of wastewater, winter storage volume of 22ML is required in a 1 in 10 wet year.
- **<u>Ultimate Development</u>** : 171ML p.a of wastewater, winter storage volume of 74ML is required in a 1 in 10 wet year.

The proposed equipment is:

- Storage Lagoon # 4 – existing 35ML earthen lagoon, lined with an impermeable clay layer.
- Storage Lagoon (Future) – proposed 25ML lined with 1.5mm HDPE or an impermeable clay layer, located at the wastewater treatment site.
- Storage Lagoon – proposed 40ML earthen lagoon, lined with 1.5mm HDPE or an impermeable clay layer, located at farm 199, approximately 8 km from the winery.
- Transfer Pipeline – 8 km 110 mm diameter treated water pipeline, from the WWTP adjacent to the winery, to the farm 199 vineyard.
- Diversion facilities, to allow treated water from SBR to be directed to vineyards.

4.7 Reuse of Treated Water

Treated water is to be supplied for reuse in the wastewater plant and winery, and for irrigation of vineyards.

The proposed equipment is:

- Plant Water Pump: Located at WWTP, capable of 40 kL/hr at 600 kPa. Connection into the existing vineyard irrigation system adjacent to the winery.
- Plant Water Filters: Backwashing sand filters, to manage high algae concentrations caused by the nutrients contained in treated wastewater. Located at WWTP, capable of 40 kL/hr.
- Irrigation Pump Set: Existing irrigation pump system located at farm 199.
- Irrigation Water Filters: Replace existing filters at farm 199 with backwashing sand filters, to manage high algae concentrations caused by the nutrients contained in treated wastewater.

4.8 Reuse of Sludges

Primary sludge and waste biosolids are to dewatered onsite and stored, prior to reuse on vineyards.

At ultimate development, for the 171ML p.a wastewater , with worst-case 20% COD removal in CAL, the projected peak dewatering duty is:

- Primary Sludge – 16 kL/day at 5wt% DS, producing 3.1tpd of cake at 25wt% DS. Annual production of 510tpa of cake.
- Biosolids – 160kL/day at 1.5wt% DS, producing 12tpd of cake at 20wt% DS. Annual production of 2200 tpa of cake.

The proposed equipment is to be implemented in stages as the site develops:

- To initially, pump the sludges out onto the existing evaporation pans for air drying and sludge harvesting.
- Later, install a 5ML clay lined sludge lagoon to thicken solids prior to air drying on existing evaporation pans

- Ultimately, install dewatering plant capable of processing up to 2400 kg per day of dry solids, using a belt press or centrifuge (or similar).
- For the dewatering plant provide automatic polymer makeup facilities, including storage of 40 X 25 kg bags of polyelectrolyte on pallet, in storage shed.

Sludge cakes will be disposed of in accordance with EPA regulations. After commissioning, sludge cakes will be characterised through an analysis program. After characterisation, it is envisaged that sludge cakes will be directed to beneficial reuse in McWilliams' vineyards, perhaps via commercial composters.

4.9 Contingency Bypass of Fresh Wastewater.

In the event of plant failure, or slow processing rates through the SBR, wastewater level in the CAL will rise towards overflow level.

The contingency plan is to irrigate fresh wastewater direct from the Settling Tank, into the existing evaporation pans or vineyards.

For Concept Design, equipment is:

- Use of a portable pump.
- Manual hoses to allow irrigation of the fresh wastewater.

4.10 Control & Automation

The WWTP is to be controlled from a local SCADA system with remote access, with option to run the facilities manually from the field. A control room will be located at the WWTP, including PC for SCADA access.

The plant will be engineered to be failsafe. Should a critical fault occur, the process will be stopped in safe condition until the fault is rectified.

4.10 Environmental Safeguards

In addition to that described above, the WWTP will include the following environmental safeguards:

- Underliner leak detection, leak alarm and leak recovery systems for each lined lagoon.
- Bunding of the Process Pad Area, so that any stormwater runoff drains into the CAL or the Stormwater Containment Dam.
- A site containment bund, preventing offsite runoff from the WWTP.
- Site bund & recovery pump.
- Callout system for critical alarms.
- Groundwater monitoring bores.
- Flow measurement and composite sampling into WWTP and out of WWTP.
- High level switches on all process vessels.
- Treated water used for plant and dewatering plant wash down.
- Lab facilities in the onsite control room suitable for conduct of all routine process testing.

Fresh Water is not required for the wastewater treatment process, other than for make up of polymer for dewatering. It is required for use in lab/office, and a supply will be run from the winery.

A toilet and shower will be provided in the lab/office, draining to a new septic tank system. This will not be connected to the winery wastewater treatment process.

6. Projected Treated Water Quality

Successful biological treatment of the wastewater is expected to remove COD to around 100 mg/L, and BOD to below 30 mg/L, but will not remove salt.

The major salts in winery wastewater are sodium (Na^+), potassium (K^+) and bicarbonate ($HCO3^-$). Sodium derives from the use of caustic-based cleaning chemicals. McWilliams can reduce sodium content of wastewater by:

- Minimising the amount of cleaning chemicals used.
- Maximising reuse and recycling of cleaning chemicals.
- Substituting for non-sodium based cleaners, such a potassium hydroxide.

The main source of bicarbonate (measures as Total Inorganic Carbon) is probably the absorption of atmospheric carbon dioxide into the caustic solution, during neutralisation of the solution. If so, McWilliams can reduce the bicarbonate levels by optimising the amount and concentration of cleaning chemicals.

The main source of potassium in winery wastewater is lees (sludges) washed out of tanks within the winery. Tank lees also impose a substantial BOD load in wastewater.

Projected water efficiency is approximately 1.3 kL of water per tonne of grapes processed, indicating that it will be a relatively water-efficient winery. A water-efficient winery that is careful with use of cleaning chemicals is expected to achieve the following *increase* in salt levels in wastewater across the winery:

- Sodium 100 to 150 mg/L
- Potassium 100 to 150 mg/L
- TDS 600 to 1000 mg/L
- EC 1000 to 1600 uS/cm

If potassium hydroxide was used in the winery, instead of sodium hydroxide ("caustic"), then potassium would be substituted for sodium. While not lowering the EC level, potassium has the advantage of being a valuable nutrient in agriculture at low concentrations.

Projected water quality of water for reuse from the water storage is summarised in Table 7.

Table 7: Projected Average Treated Water Quality For Irrigation

Parameter		Projected Storage
pH		8.5
Electrical Conductivity	uS/cm	1600
Total Dissolved Solids	mg/L	976
Chemical Oxygen Demand	mg/L	150
Biochemical Oxygen Demand	mg/L	10
Suspended Solids	mg/L	30
Calcium	mg/L	22
Magnesium	mg/L	10
Sodium	mg/L	133
Potassium	mg/L	395
Alkalinity (CO3 & HCO3)	mg/L	315
Sulphate	mg/L	26
Chloride	mg/L	113
Total Nitrogen	mg/L	10.0
Total Phosphorous	mg/L	5.0
Adj SAR		6.5
SAR		5.9

Attachment 1

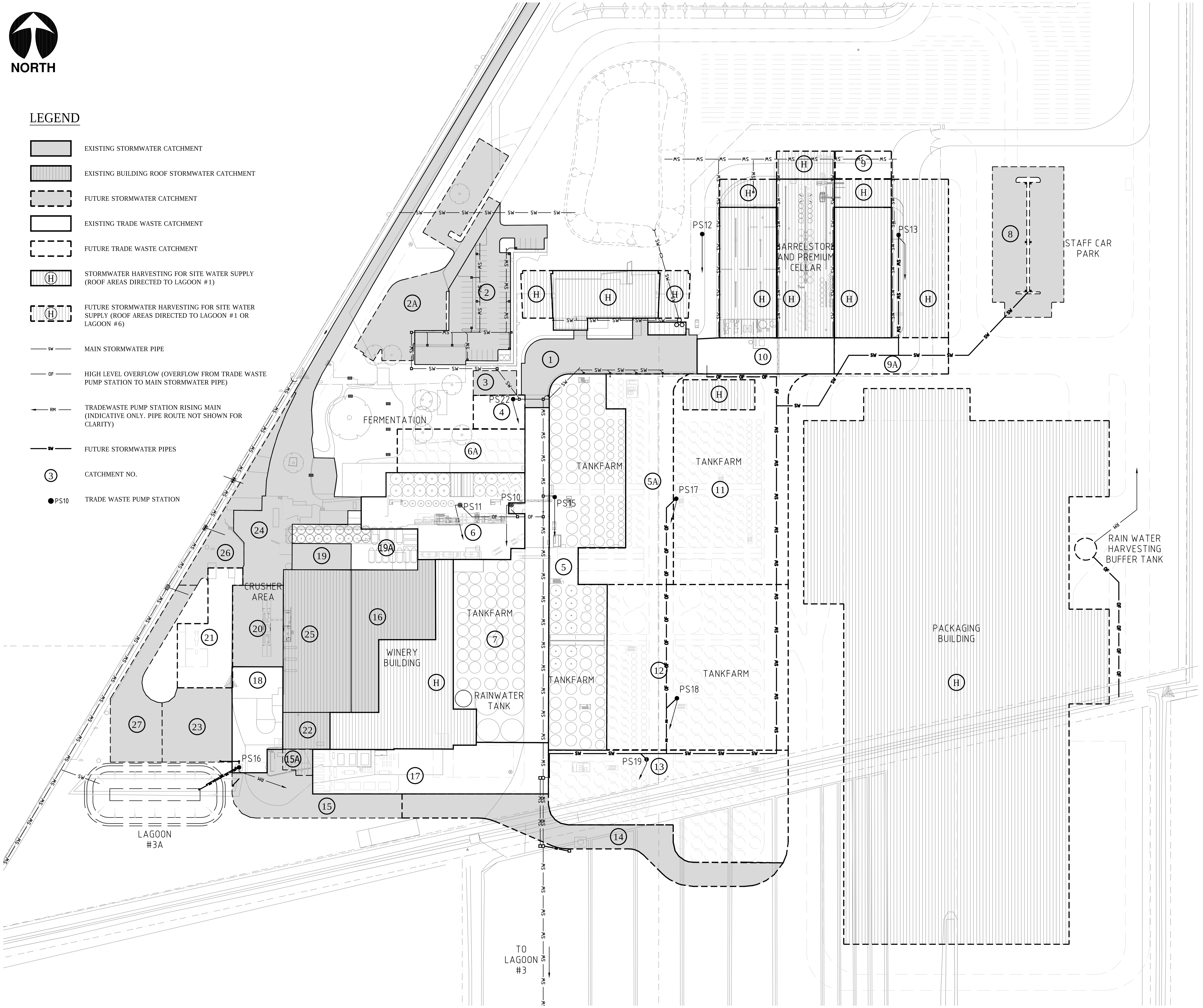
Stormwater and Wastewater Catchments

ATTACHMENT 5

NORTH

LEGEND

- EXISTING STORMWATER CATCHMENT
- EXISTING BUILDING ROOF STORMWATER CATCHMENT
- FUTURE STORMWATER CATCHMENT
- EXISTING TRADE WASTE CATCHMENT
- FUTURE TRADE WASTE CATCHMENT
- (H) STORMWATER HARVESTING FOR SITE WATER SUPPLY (ROOF AREAS DIRECTED TO LAGOON #1)
- (H) FUTURE STORMWATER HARVESTING FOR SITE WATER SUPPLY (ROOF AREAS DIRECTED TO LAGOON #1 OR LAGOON #6)
- —SW— MAIN STORMWATER PIPE
- —OF— HIGH LEVEL OVERFLOW (OVERFLOW FROM TRADE WASTE PUMP STATION TO MAIN STORMWATER PIPE)
- —RM— TRADEWASTE PUMP STATION RISING MAIN (INDICATIVE ONLY. PIPE ROUTE NOT SHOWN FOR CLARITY)
- —SW— FUTURE STORMWATER PIPES
- (3) CATCHMENT NO.
- ●PS10 TRADE WASTE PUMP STATION



PUMP STATION SCHEDULE

PUMP STATION	RISING MAIN DESTINATION	CATCHMENT TYPE
PS10	WASTEWATER TREATMENT PLANT	EXISTING
PS11	WASTEWATER TREATMENT PLANT	EXISTING
PS12	PS10	EXISTING
PS13	PS10	EXISTING
PS15	WASTEWATER TREATMENT PLANT	EXISTING
PS16	WASTEWATER TREATMENT PLANT	EXISTING
PS17	WASTEWATER TREATMENT PLANT	FUTURE
PS18	WASTEWATER TREATMENT PLANT	FUTURE
PS19	WASTEWATER TREATMENT PLANT	FUTURE
PS22	WASTEWATER TREATMENT PLANT	FUTURE

CATCHMENT SCHEDULE

CATCHMENT NO.	CATCHMENT TYPE	AREA (m^2)	DESCRIPTION
1	EXISTING STORMWATER	1888	EXISTING CONCRETE ROADWAY. TANKER LOADING/UNLOADING NOT PERMITTED
2	EXISTING STORMWATER	2245	EXISTING ASPHALT CARPARK
2A	FUTURE STORMWATER	2504	FUTURE CARPARK EXTENSION
3	FUTURE STORMWATER	264	FUTURE ROOF AREA
4	FUTURE TRADEWASTE	432	FUTURE PROCESSING AREA. TRADEWASTE DIRECTED TO FUTURE PUMP STATION PS22
5	EXISTING TRADEWASTE	5774	EXISTING PROCESSING AREA. TRADEWASTE DIRECTED TO EXISTING PUMP STATION PS15
5A	FUTURE TRADEWASTE	3120	FUTURE PROCESSING AREA. TRADEWASTE DIRECTED TO EXISTING PUMP STATION PS15
6	EXISTING TRADEWASTE	2873	EXISTING PROCESSING AREA. TRADEWASTE DIRECTED TO EXISTING PUMP STATION PS11
6A	FUTURE TRADEWASTE	1384	FUTURE PROCESSING AREA. TRADEWASTE DIRECTED TO EXISTING PUMP STATION PS11
7	EXISTING TRADEWASTE	5151	EXISTING PROCESSING AREA. TRADEWASTE DIRECTED TO EXISTING PUMP STATION PS10
8	FUTURE STORMWATER	2198	FUTURE CARPARK
9	FUTURE TRADEWASTE	385	FUTURE PROCESSING AREA. TRADEWASTE DIRECTED TO EXISTING PUMP STATION PS13
9A	FUTURE TRADEWASTE	1029	FUTURE PROCESSING AREA. TRADEWASTE DIRECTED TO EXISTING PUMP STATION PS13
10	EXISTING TRADEWASTE	1229	EXISTING PROCESSING AREA. TRADEWASTE DIRECTED TO EXISTING PUMP STATION PS12
11	FUTURE TRADEWASTE	6026	FUTURE PROCESSING AREA. TRADEWASTE DIRECTED TO FUTURE PUMP STATION PS17
12	FUTURE TRADEWASTE	7458	FUTURE PROCESSING AREA. TRADEWASTE DIRECTED TO FUTURE PUMP STATION PS18
13	FUTURE TRADEWASTE	5466	FUTURE PROCESSING AREA. TRADEWASTE DIRECTED TO FUTURE PUMP STATION PS19
14	FUTURE STORMWATER	2595	FUTURE CONCRETE ROADWAY. TANKER LOADING/UNLOADING NOT PERMITTED
15	FUTURE STORMWATER	1496	FUTURE ASPHALT ROADWAY. TANKER LOADING/UNLOADING NOT PERMITTED. STORMWATER DIRECTED TO EXISTING PUMP STATION PS16
15A	FUTURE STORMWATER	176	FUTURE ROOF AREA. STORMWATER DIRECTED TO EXISTING PUMP STATION PS16
16	EXISTING STORMWATER	2008	EXISTING ROOF AREA. STORMWATER DIRECTED TO EXISTING PUMP STATION PS16
17	EXISTING TRADEWASTE	2763	EXISTING TANKER HANDLING AREA. STORMWATER & SPILLS DIRECTED TO EXISTING PUMP STATION PS16
18	EXISTING TRADEWASTE	1246	EXISTING TANKER/TRUCK HANDLING AREA. STORMWATER & SPILLS DIRECTED TO EXISTING PUMP STATION PS16
19	EXISTING STORMWATER	372	EXISTING ROOF AREA. STORMWATER DIRECTED TO EXISTING PUMP STATION PS8 AND OVERFLOW PIPE TO PS16
19A	EXISTING TRADEWASTE	982	EXISTING PROCESS AREA. TRADEWASTE DIRECTED TO PS08 AND OVERFLOW TO PS16
20	EXISTING STORMWATER	1030	EXISTING ROOF AREA. STORMWATER DIRECTED TO EXISTING PUMP STATION PS8 AND OVERFLOW PIPE TO PS16
21	FUTURE TRADEWASTE	1266	EXISTING TANKER/TRUCK HANDLING AREA. STORMWATER & SPILLS DIRECTED TO EXISTING PUMP STATION PS16
22	EXISTING STORMWATER	429	EXISTING ROOF AREA. STORMWATER DIRECTED TO EXISTING PUMP STATION PS8 AND OVERFLOW PIPE TO PS16
23	FUTURE STORMWATER	1251	FUTURE ASPHALT HARDSTAND. TANKER LOADING/UNLOADING NOT PERMITTED. STORMWATER DIRECTED TO EXISTING PUMP STATION PS16
24	EXISTING STORMWATER	4496	EXISTING ASPHALT AREA. STORMWATER DIRECTED TO EXISTING WESTERN DRAINAGE & TO M.I. CHANNEL
25	EXISTING STORMWATER	2406	EXISTING ROOF AREA. STORMWATER DIRECTED TO EXISTING WESTERN DRAINAGE & TO M.I. CHANNEL
26	FUTURE STORMWATER	1029	EXISTING GRASSED AREA TO BE ASPHALTED. STORMWATER DIRECTED TO EXISTING WESTERN DRAINAGE & TO M.I. CHANNEL
27	FUTURE STORMWATER	1382	EXISTING GRASSED AREA TO BE ASPHALTED. STORMWATER DIRECTED TO EXISTING WESTERN DRAINAGE & TO M.I. CHANNEL

PRELIMINARY ISSUE
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0 20 40 60 80 100m
HORIZONTAL SCALE (A1) 1 : 1000

Rev.	Drawing Issue	Drn	Ckd	Date
B	DRAWING UPDATED - PRELIMINARY ISSUE	MB	JL	1.08.12
A	PRELIMINARY ISSUE	MJB	JL	5.07.12

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Client: McWILLIAM'S WINES GROUP
Six generations of winemaking since 1877
HANWOOD WINERY

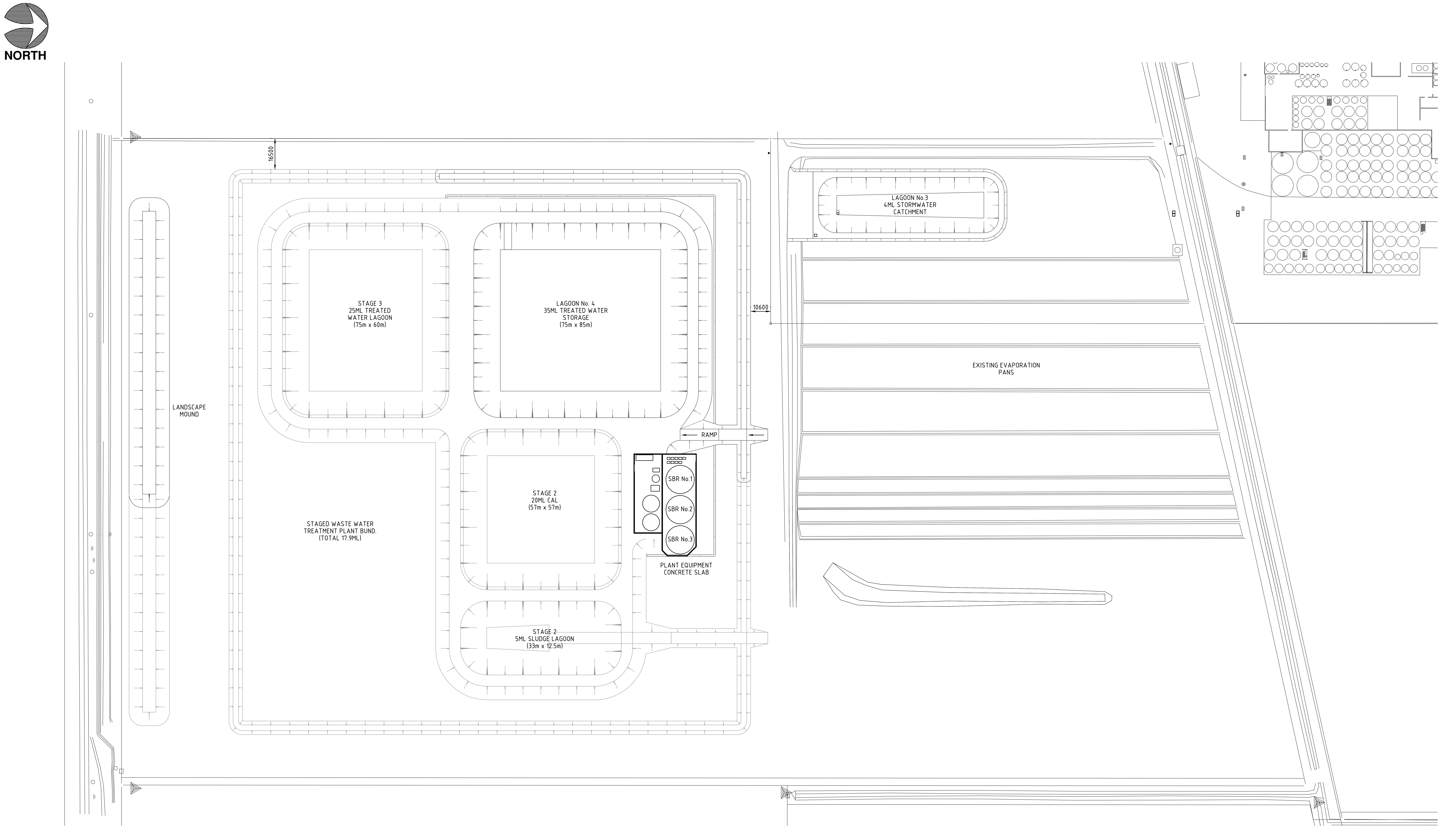
Project: ENVIRONMENTAL IMPACT STUDY

Title: PRELIMINARY STORMWATER DRAINAGE CONCEPT PLAN

Designer: J.LINNEY Date: JULY 2012
Drawn By: M.BOSSY Date: JULY 2012
Drawing No: 0802-05-PR015
Sheet Size: A1
Scale: 1 : 1000 (A1) 1 : 2000 (A3)
Rev: B

Attachment 2

Preliminary Layout Of Wastewater Plant



0 20 40 60 80 100m

HORIZONTAL SCALE (A1) 1 : 1000

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Rev.	Drawing Issue	Drn	Ckd	Date
A	PRELIMINARY ISSUE	MJB	JL	24.06.10

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ABN 83 120 383 931

Client: McWILLIAM'S WINES GROUP
HANWOOD WINERY

Project: ENVIRONMENTAL IMPACT STUDY

Title: PRELIMINARY
WASTE WATER TREATMENT PLANT
PLAN

Designer: J.LINNEY	Date: JUNE 2010	Sheet Size: A1
Drawn By: M.BOSSY	Date: JUNE 2010	Scale: 1 : 1000 (A1) 1 : 2000 (A3)
Drawing No: 0802-05-PR001		Rev: A

Attachment 3

Water Balances

McWilliams Hanwood

Water Balance 2009

Decile 5 Water Balance

Minimum Volume In Storage = 0 kL
Wastewater Volume = 64268 kL p.a

PIRSA Effective Rainfall Factor = 0.85

Pasture Area = 0 ha
Vineyard Area = 500 ha

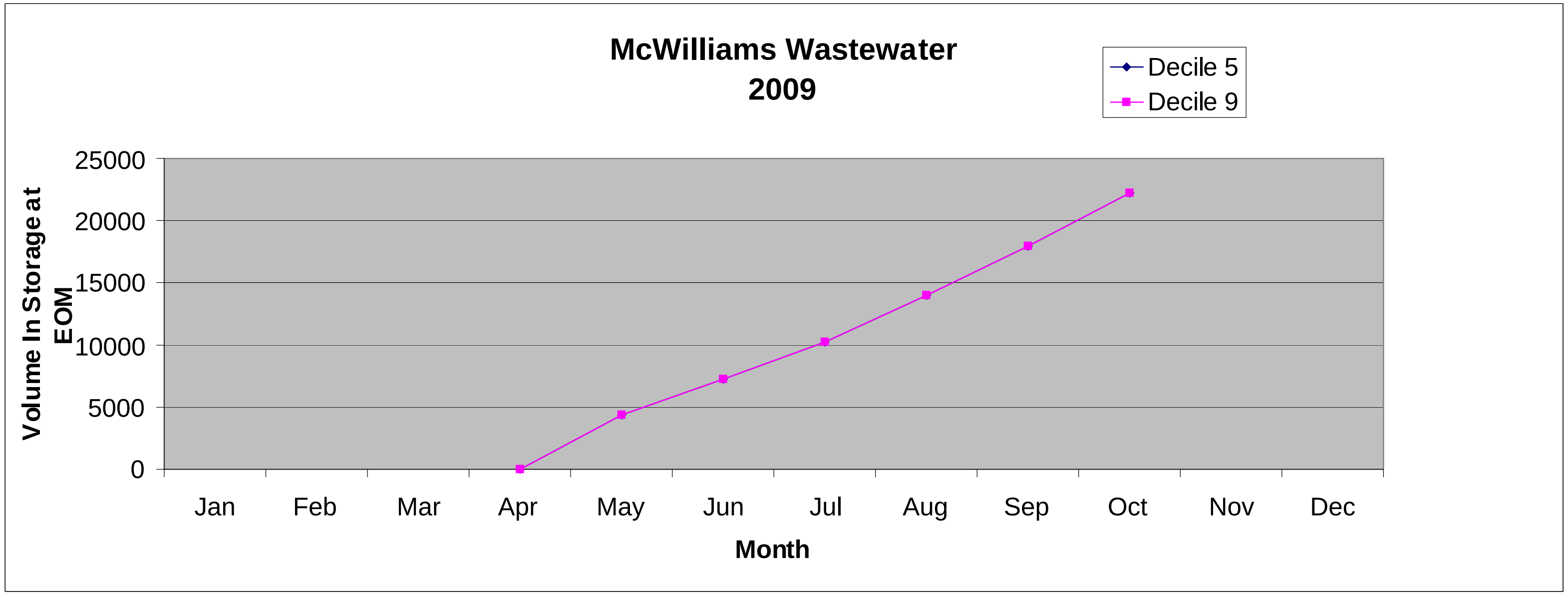
Irrigation Rate = 4.6 ML/ha/annum

Median Rainfall Water Balance

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly
1	Average Evap (Griffith CSIRO)	mm	270	232	186	111	65	42	50	74	108	164	219	276	1797
2	Rainfall (Griffith CSIRO median annual)	mm	21	23	23	27	35	39	38	48	35	41	26	35	391
3	Effective Rainfall	mm	17.9	19.7	19.9	22.9	29.5	33.2	32.2	40.8	29.6	35.0	22.0	29.9	333
4	Potential Evapotranspiration	mm	134.9	116.2	91.1	34.4	13.0	8.4	9.9	14.9	21.6	32.9	76.7	138.0	692
5	Irrigation Requirements	mm	117.0	96.5	71.2	11.5	-16.5	-24.8	-22.3	-25.9	-8.0	-2.1	54.6	108.0	359
6	Irrigation Area Available	ha	500	500	500	500	500	500	500	500	500	500	500	500	
7	Maximum Possible Irrigation	kL	584951	482356	356018	57311	0	0	0	0	0	0	273184	540226	2294047
8	Wastewater Volume	kL	4960	9898	10470	7141	4366	2903	2983	3749	3971	4271	4544	5010	64268
		kL/day	160	319	338	230	141	94	96	121	128	138	147	162	
9	Water Into Storage (PIRSA Crop)	kL					4366	2903	2983	3749	3971	4271			22244
11	Volume In Storage at EOM (PIRSA)	kL				0	4366	7270	10253	14002	17973	22244			
12	Direct Crop Coefficient (Vineyards PIRSA 2000)		0.50	0.50	0.49	0.31	0.20	0.20	0.20	0.20	0.20	0.20	0.35	0.50	

Decile 9 Water Balance

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly
1	Evaporation	mm	270	232	186	111	65	42	50	74	108	164	219	276	1797
2	Rainfall (Griffith CSIRO 90% ile annual)	mm	29	32	32	37	47	53	52	66	48	56	35	48	535
3	Effective Rainfall	mm	24.4	27.0	27.3	31.4	40.3	45.4	44.0	55.8	40.5	47.8	30.1	40.9	455
4	Potential Evapotranspiration	mm	135	116	91	34	13	8	10	15	22	33	77	138	692
5	Irrigation Requirements	mm	110	89	64	3	-27	-37	-34	-41	-19	-15	47	97	329
6	Irrigation Area Available	ha	500	500	500	500	500	500	500	500	500	500	500	500	
7	Maximum Possible Irrigation	kL	552189	446165	319445	15215	0	0	0	0	0	0	232802	485368	2051184
8	Volume of Wastewater	kL	4960	9898	10470	7141	4366	2903	2983	3749	3971	4271	4544	5010	64268
9	Water Into Storage (PIRSA Crop)	kL					4366	2903	2983	3749	3971	4271			
10	Volume In Storage at EOM (PIRSA)	kL				0	4366	7270	10253	14002	17973	22244			
12	Direct Crop Coefficient		0.50	0.50	0.49	0.31	0.20	0.20	0.20	0.20	0.20	0.20	0.35	0.50	



McWilliams Hanwood

Water Balance 2009

Decile 5 Water Balance

Minimum Volume In Storage = 0 kL
Wastewater Volume = 171234 kL p.a

PIRSA Effective Rainfall Factor = 0.85

Pasture Area = 0 ha
Vineyard Area = 500 ha

Irrigation Rate = 4.6 ML/ha/annum

Median Rainfall Water Balance

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly
1	Average Evap (Griffith CSIRO)	mm	270	232	186	111	65	42	50	74	108	164	219	276	1797
2	Rainfall (Griffith CSIRO median annual)	mm	21	23	23	27	35	39	38	48	35	41	26	35	391
3	Effective Rainfall	mm	17.9	19.7	19.9	22.9	29.5	33.2	32.2	40.8	29.6	35.0	22.0	29.9	333
4	Potential Evapotranspiration	mm	134.9	116.2	91.1	34.4	13.0	8.4	9.9	14.9	21.6	32.9	76.7	138.0	692
5	Irrigation Requirements	mm	117.0	96.5	71.2	11.5	-16.5	-24.8	-22.3	-25.9	-8.0	-2.1	54.6	108.0	359
6	Irrigation Area Available	ha	500	500	500	500	500	500	500	500	500	500	500	500	
7	Maximum Possible Irrigation	kL	584951	482356	356018	57311	0	0	0	0	0	0	273184	540226	2294047
8	Wastewater Volume	kL	12412	21719	21131	16225	11520	10134	12226	13151	13190	13781	13136	12609	171234
		kL/day	400	701	682	523	372	327	394	424	425	445	424	407	
9	Water Into Storage (PIRSA Crop)	kL					11520	10134	12226	13151	13190	13781	-260048	-527617	-713664
11	Volume In Storage at EOM (PIRSA)	kL				0	11520	21655	33880	47031	60221	74002			
12	Direct Crop Coefficient (Vineyards PIRSA 2000)		0.50	0.50	0.49	0.31	0.20	0.20	0.20	0.20	0.20	0.20	0.35	0.50	

Decile 9 Water Balance

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly
1	Evaporation	mm	270	232	186	111	65	42	50	74	108	164	219	276	1797
2	Rainfall (Griffith CSIRO 90% ile annual)	mm	29	32	32	37	47	53	52	66	48	56	35	48	535
3	Effective Rainfall	mm	24.4	27.0	27.3	31.4	40.3	45.4	44.0	55.8	40.5	47.8	30.1	40.9	455
4	Potential Evapotranspiration	mm	135	116	91	34	13	8	10	15	22	33	77	138	692
5	Irrigation Requirements	mm	110	89	64	3	-27	-37	-34	-41	-19	-15	47	97	329
6	Irrigation Area Available	ha	500	500	500	500	500	500	500	500	500	500	500	500	
7	Maximum Possible Irrigation	kL	552189	446165	319445	15215	0	0	0	0	0	0	232802	485368	2051184
8	Volume of Wastewater	kL	12412	21719	21131	16225	11520	10134	12226	13151	13190	13781	13136	12609	171234
9	Water Into Storage (PIRSA Crop)	kL					11520	10134	12226	13151	13190	13781			
10	Volume In Storage at EOM (PIRSA)	kL				0	11520	21655	33880	47031	60221	74002			
12	Direct Crop Coefficient		0.50	0.50	0.49	0.31	0.20	0.20	0.20	0.20	0.20	0.20	0.35	0.50