APPENDIX 3C
SURFACE WATER MONITORING DATA

Summary of 2020 Surface Water Monitoring Results

SW Monitoring Point	EC (µS/cm)			pH			SO4 (mg/L)			Turbidity (NTU)		
	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave
CC1	262.0	1380.0	990.7	6.9	7.6	7.4	39.0	399.0	277.3	58.1	523.0	234.7
CC2	5850.0	8500.0	6786.7	7.8	8.2	8.0	2290.0	3080.0	2516.7	0.7	325.0	38.0
CC3	4330.0	4720.0	4592.5	8.5	8.6	8.5	1710.0	1960.0	1845.0	0.6	10.0	3.2
WIL (U)*												
WIL (U2)	388.0	4070.0	975.3	4.3	7.1	6.3	30.0	421.0	108.5	7.5	270.0	52.0
WIL (PC)*												
WIL (NC)*												
WIL (D)	311.0	2650.0	799.1	3.4	7.3	6.0	38.0	1150.0	250.9	5.9	30.5	20.4
WIL (D2)*												
WOL1	537.0	2420.0	1396.2	6.3	8.4	7.8	130.0	600.0	332.6	1.2	13.9	6.2
WOL2	1920.0	6740.0	2911.7	7.0	8.2	7.7	383.0	802.0	516.8	1.6	33.5	7.0

Notes: mg/L = micrograms per litre. mS/cm= micro Siemens per centimetre. NTU = nephelometric turbidity units. *Dry

Summary of 2019 Surface Water Monitoring Results

SW Monitoring Point	EC (µS/cm)			pH			SO4 (mg/L)			Turbidity (NTU)		
	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave
CC1	432.0	697.0	564.5	7.3	9.1	8.2	56.0	102.0	79.0	663.0	2310.0	1486.5
CC2	3240.0	9910.0	7207.1	7.7	8.0	7.9	884.0	3760.0	2716.3	2.0	16.0	5.1
CC3	5850.0	5850.0	5850.0	7.9	7.9	7.9	2670.0	2670.0	2670.0	4.4	4.4	4.4
WIL (U)*	-	-	-	-	-	-	-	-	-	-	-	-
WIL (U2)	3840.0	5850.0	4428.3	3.6	6.3	4.2	287.0	578.0	400.3	0.9	45.0	11.2
WIL (PC)*	-	-	-	-	-	-	-	-	-	-	-	-
WIL (NC)*	-	-	-	-	-	-	-	-	-	-	-	-
WIL (D)	1440.0	6420.0	4192.9	4.0	7.4	6.7	521.0	1960.0	1273.3	9.7	95.2	44.4
WIL (D2)*	-	-	-	-	-	-	-	-	-	-	-	-
WOL1	1180.0	4780.0	2877.5	7.9	8.5	8.1	240.0	1510.0	752.5	0.8	5.2	3.3
WOL2	1690.0	5610.0	3545.8	7.0	8.2	7.5	311.0	808.0	641.4	1.7	43.7	16.1

Notes: mg/L = micrograms per litre. mS/cm= micro Siemens per centimetre. NTU = nephelometric turbidity units. *Dry

Summary of 2018 Surface Water Monitoring Results

SW Monitoring Point	EC (µS/cm)			pH			SO4 (mg/L)			Turbidity (NTU)		
	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave
CC1	228.0	1280.0	491.7	6.70	7.60	7.23	19.0	384.0	84.2	20.0	5520.0	1321.9
CC2	364.0	7570.0	6262.4	7.60	8.10	7.92	67.0	3000.0	2379.7	1.4	499.0	57.1
CC3	40.0	40.0	40.0	7.80	7.80	7.80	4.0	4.0	4.0	141.0	141.0	141.0
WIL (U)	-	-	-	-	-	-	-	-	-	-	-	-
WIL (U2)	1790.0	4380.0	3441.8	3.50	7.40	6.03	80.0	446.0	58.5	5.1	159.0	58.5
WIL (PC)	-	-	-	-	-	-	-	-	-	-	-	-
WIL (NC)	239.0	383.0	319.1	6.70	7.50	7.28	41.0	100.0	66.3	0.4	2.8	1.4
WIL (D)	278.0	2020.0	669.7	5.20	8.00	6.92	20.0	553.0	134.7	1.3	288.0	44.3
WIL (D2)	236.0	569.0	386.3	4.20	7.80	6.84	33.0	204.0	80.9	1.6	396.0	104.3
WOL1	425.0	2150.0	1260.1	7.20	8.40	8.01	41.0	494.0	294.1	1.0	19.6	6.8
WOL2	1730.0	2850.0	2404.5	7.00	7.90	7.51	209.0	740.0	447.7	1.0	36.2	6.1

Summary of 2017 Surface Water Monitoring Results

SW Monitoring Point	EC (µS/cm)			pH			SO4 (mg/L)			Turbidity (NTU)		
	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave
CC1	279.0	5380.0	2392.3	7.00	8.30	7.58	45.0	1790.0	787.0	4.4	1970.0	600.9
CC2	5470.0	8230.0	6306.0	7.70	8.30	7.99	1700.0	3170.0	2145.0	0.6	15.8	4.1
CC3	4100.0	4990.0	4520.0	8.30	8.50	8.40	1490.0	1920.0	1688.0	0.6	1.8	1.2
WIL (U)*	-	-	-	-	-	-	-	-	-	-	-	-
WIL (U2)	1360.0	3890.0	2851.7	5.40	8.00	6.58	13.0	121.0	20.9	2.4	70.8	20.9
WIL (PC)*	-	-	-	-	-	-	-	-	-	-	-	-
WIL (NC)	230.0	411.0	313.2	6.80	8.30	7.27	10.0	85.0	48.1	0.2	15.2	3.7
WIL (D)	248.0	1480.0	493.5	7.30	7.80	7.55	7.0	87.0	46.4	2.2	5.6	3.8
WIL (D2)	256.0	650.0	386.8	7.30	7.90	7.53	2.0	83.0	47.7	1.7	31.9	10.3
WOL1	336.0	1490.0	872.4	8.10	8.60	8.25	19.0	184.0	97.2	0.9	6.1	2.9
WOL2	1800.0	2950.0	2133.6	7.40	8.00	7.82	184.0	440.0	304.2	0.4	21.1	3.2

Notes: mg/L = micrograms per litre. mS/cm= micro Siemens per centimetre. NTU = nephelometric turbidity units. *Dry

Summary of 2016 Surface Water Monitoring Results

SW Monitoring Point	EC (µS/cm)			pH			SO_4 (mg/L)			Turbidity (NTU)		
	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave
CC1	170.0	4470.0	2802.9	7.10	7.90	7.41	28.0	1710.0	978.9	4.6	6270.0	936.0
CC2	3020.0	7540.0	5036.3	7.50	8.00	7.84	920.0	2940.0	1738.8	0.5	26.4	5.0
CC3	80.0	4860.0	2771.7	7.40	8.40	8.18	8.0	1920.0	972.5	0.7	126.0	25.1
WIL (U)	520.0	950.0	632.0	6.20	7.40	6.94	13.0	83.0	36.8	5.8	43.5	21.2
WIL (U2)	440.0	4420.0	2140.0	6.50	7.60	7.04	14.0	102.0	34.8	3.3	153.0	34.8
WIL (PC)	260.0	1340.0	682.0	6.90	7.40	7.16	7.0	48.0	28.6	9.7	64.6	38.3
WIL (NC)	240.0	1650.0	560.8	7.10	7.80	7.39	8.0	265.0	64.5	8.6	201.0	54.2
WIL (D)	580.0	3030.0	1189.2	6.80	8.00	7.46	12.0	603.0	165.5	1.2	39.4	10.0
WIL (D2)	390.0	1840.0	796.1	6.90	8.10	7.50	9.0	466.0	159.1	3.9	323.0	43.8
WOL1	780.0	2220.0	1226.3	7.80	8.30	8.11	104.0	475.0	205.8	1.3	11.2	5.0
WOL2	740.0	3160.0	1693.3	7.20	8.00	7.56	97.0	650.0	303.1	0.9	70.7	15.3
SGC_1*	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Notes: mg/L = micrograms per litre. mS/cm= micro Siemens per centimetre. NTU = nephelometric turbidity units. *Dry

Summary of 2015 Surface Water Monitoring Results

SW Monitoring Point	EC (µS/cm)			pH			SO_4 (mg/L)			Turbidity (NTU)		
	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave
CC1	120.0	4380.0	2316.3	6.60	7.80	7.31	13.0	1660.0	237.7	3.3	13000.0	3415.4
CC2	350.0	5970.0	3591.4	7.30	7.90	7.67	1400.0	2290.0	1977.8	0.4	20.8	4.7
CC3	150.0	5130.0	2220.0	7.00	8.40	7.93	17.0	2100.0	946.0	1.2	359.0	93.7
WIL (U)	1650.0	7550.0	4306.7	4.80	6.80	5.93	38.0	146.0	99.0	7.4	263.0	77.0
WIL (U2)	790.0	5580.0	3353.8	5.60	7.40	6.71	22.0	118.0	41.9	1.5	158.0	41.9
WIL (PC)*	1170.0	6100.0	3256.3	6.80	7.90	7.23	3.0	42.0	16.0	1.8	222.0	90.4
WIL (NC)	410.0	3960.0	1987.1	6.60	7.80	7.31	4.0	106.0	43.0	1.2	1440.0	284.5
WIL (D)	340.0	5880.0	2713.0	7.10	8.10	7.67	29.0	607.0	253.2	2.6	363.0	63.1
WIL (D2)	500.0	6520.0	2457.5	7.50	8.20	7.73	16.0	693.0	148.4	7.5	557.0	113.2
WOL1	160.0	5540.0	2223.0	7.50	8.20	7.96	208.0	956.0	445.8	1.1	61.8	13.3
WOL2	400.0	5550.0	1830.0	7.30	7.80	7.54	262.0	822.0	532.8	0.6	486.0	53.9

Notes: mg/L = micrograms per litre. mS/cm= micro Siemens per centimetre. NTU = nephelometric turbidity units.

Summary of 2014 Surface Water Monitoring Results

SW Monitoring Point	EC (µS/cm)			pH			SO_4 (mg/L)			Turbidity (NTU)		
	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave
CC1	610.0	5430.0	2055.7	7.10	9.20	8.00	120.0	1880.0	785.0	2.3	352.0	91.3
CC2	160.0	6590.0	4944.0	6.90	7.80	7.44	85.0	2520.0	1733.5	0.2	151.0	16.4
CC3	400.0	5260.0	3522.5	7.60	8.00	7.80	23.0	2100.0	1380.8	1.1	346.0	96.0
WIL (U)	980.0	1540.0	1260.0	6.00	7.10	6.55	70.0	174.0	122.0	3.2	30.0	16.6
WIL (U2)	1340.0	5970.0	2886.0	6.30	7.40	6.78	10.0	110.0	50.1	4.5	290.0	50.1
WIL (PC)	-	-	-	-	-	-	-	-	-	-	-	-
WIL (NC)	310.0	790.0	445.0	7.00	7.40	7.25	6.0	96.0	27.0	1.8	2410.0	664.4
WIL (D)	1520.0	6010.0	3728.3	6.90	8.40	7.68	205.0	1680.0	634.8	1.0	26.8	6.6
WIL (D2)	780.0	7550.0	3756.0	7.00	8.70	8.02	120.0	1670.0	932.4	0.8	42.7	11.7
WOL1	1870.0	3680.0	2582.5	7.00	8.90	8.13	434.0	1120.0	635.6	1.2	18.6	3.8
WOL2	1670.0	4060.0	2779.2	7.20	7.80	7.46	452.0	842.0	589.9	0.6	69.7	16.1

Notes: mg/L = micrograms per litre. mS/cm= micro Siemens per centimetre. NTU = nephelometric turbidity units. * Indicates no sample available during the schedule monitoring programme.

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Summary of 2013 Surface Water Monitoring Results

SW Monitoring Point	EC (µS/cm)			pH			SO_4 (mg/L)			Turbidity (NTU)		
	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave
CC1	3150.0	5710.0	4568.5	6.9	8.2	7.9	828.0	3160.0	1647.0	0.4	1770	169.6
CC2	4380.0	6070.0	5040.0	7.4	8.1	7.7	1610.0	3110.0	2040.0	0.2	2.6	0.9
CC3	225.0	4890.0	3130.6	7.8	8.2	8.0	94.0	2270.0	1454.1	0.8	360.0	59.4
WIL (U)	448.0	1390.0	1065.0	6.5	7.0	6.8	7.0	63.0	38.1	1.5	74.5	26.5
WIL (U2)	413.0	4620.0	2165.5	6.3	7.6	6.7	4.0	89.0	47.4	6.1	473.0	62.8
WIL (PC)	395.0	1730.0	1158.0	6.7	7.1	6.9	31.0	186.0	93.8	5.2	148.0	47.6
WIL (NC)	340.0	930.0	510.0	7.4	7.9	7.7	5.0	140.0	59.6	2.2	4000	941.5
WIL (D)	1656.0	4200.0	2942.6	7.8	8.8	8.1	216.0	822.0	475.2	1.4	59.1	9.3
WIL (D2)	1500.0	4950.0	3051.6	7.8	8.1	7.9	217.0	1360.0	646.7	1.2	21.8	7.0
WOL1	1180.0	2710.0	1982.3	8.1	8.7	8.4	326.0	675.0	464.8	0.6	8.9	3.0
WOL2	1460.0	3150.0	2153.9	7.3	8.3	7.9	286.0	793.0	487.7	0.6	14.9	6.0

2020 Results for Surface Water Monitoring

Sample Num	Sample Location	Sampling Date	Sampling Time	Acidity as CaCO3 mg/L	Aluminium mg/L	Arsenic mg/L	Barium mg/L	Bicarbonate Alkalinity as CaCO3 mg/L	Carbonate Alkalinity as CaCO3 mg/L	Copper mg/L	Electrical Conductivity (Field Reading) µS/cm	Hydroxide Alkalinity as CaCO3 mg/L	Iron mg/L	Lead mg/L	Manganese mg/L	Molybdenum mg/L	Nickel mg/L	pH - Field pH Unit	Selenium mg/L	Strontium mg/L	Sulfate mg/L	Suspended Solids (SS) mg/L	Temperature °C	Total Alkalinity as CaCO3 mg/L	Turbidity NTU	Zinc mg/L	Selenium mg/L	Strontium mg/L	Sulfate mg/L	Temperature °C	Total Alkalinity as CaCO3 mg/L	Turbidity NTU	Zinc mg/L
ME2000044001	CC_1	10-Jan-2020	1215																								<0.01	0.094	56	27	60	663	0.03
ME2000044002	CC_2	10-Jan-2020	1652																								<0.01	1.63	884	34.5	211	2.9	<0.005
ME2000044003	CC_3	10-Jan-2020	1719																														
ME2000044004	WIL_U	10-Jan-2020	1128																														
ME2000044005	WIL_U2	10-Jan-2020	1115																														
ME2000044006	WIL_NC	10-Jan-2020	1152																														
ME2000044007	WIL_PC	10-Jan-2020	1125																														
ME2000044008	WIL_D	10-Jan-2020	1314																								<0.01	0.744	521	31.5	80	19	0.009
ME2000044009	WIL_D2	10-Jan-2020	1236																														
ME2000044010	WOL_1	10-Jan-2020	1527																								<0.01	0.608	240	36.5	163	4.1	<0.005
ME2000044011	WOL_2	10-Jan-2020	1459	6	0.13	0.005	0.08	720	<1	0.007	6740	<1	0.27	<0.001	0.483	<0.001	0.005	8.2	<0.01	2.93	802		33	720	9.5	0.028	<0.01	0.923	311	27.5	241	11.7	<0.005
ME2000044012	SGC_1	10-Jan-2020	1341																														
ME2000044013	30M_U_CC1	10-Jan-2020	1211																														
ME2000258001	CC_1	19-Feb-2020	1454	6	0.64	0.002	0.061	59	<1	0.003	1380	<1	0.52	0.001	0.239	0.001	0.004	6.9	<0.01	0.558	399	81	24	59	123	0.016							
ME2000258002	CC_2	18-Feb-2020	1448	14	0.08	0.002	0.045	334	<1	0.002	8500	<1	0.4	<0.001	12.7	0.011	0.013	8	<0.01	3.35	3080	18	31.5	334	5.2	0.006							
ME2000258003	CC_3	18-Feb-2020	1515																														
ME2000258004	WIL_U	18-Feb-2020	1156																														
ME2000258005	WIL_U2	18-Feb-2020	1142	8	0.92	<0.001	0.092	4	<1	0.002	1110	<1	2.42	<0.001	4.32	<0.001	0.117	5.5	<0.01	0.226	162	73	25.5	4	105	0.161							
ME2000258006	WIL_NC	18-Feb-2020	1210																														
ME2000258007	WIL_PC	18-Feb-2020	1154																														
ME2000258008	WIL_D	18-Feb-2020	1336	66	4.2	0.002	0.057	<1	<1	0.01	1190	<1	16	0.002	10.6	<0.001	0.202	3.4	<0.01	0.496	479	9	27.5	<1	5.9	0.386							
ME2000258009	WIL_D2	18-Feb-2020	1241	424	31.1	0.006	0.09	<1	<1	0.062	2070	<1	76.1	0.009	28.1	<0.001	0.647	3.5	0.01	0.958	1120	74	30.5	<1	75	0.957							
ME2000258010	WOL_1	18-Feb-2020	1410	18	0.27	0.002	0.116	39	<1	0.002	1660	<1	3.47	<0.001	13.8	<0.001	0.081	7.3	<0.01	0.883	581	24	28.5	39	13.9	0.098							
ME2000258011	WOL_2	18-Feb-2020	1353	11	0.93	0.002	0.118	190	<1	0.002	1920	<1	2.4	0.001	3.68	0.003	0.005	7	<0.01	0.914	383	63	26	190	33.5	0.01	<0.01	1.28	456	26	459	43.7	<0.005
ME2000258012	SGC_1	18-Feb-2020	1106																														
ME2000258013	30M_U_CC1	18-Feb-2020	1218	9	7.05	0.008	0.11	68	<1	0.019	207	<1	7.36	0.024	0.443	<0.001	0.015	7.1	<0.01	0.087	43	627	30	68	2020	0.056							
ME2000445001	CC_1	19-Mar-2020	1155	2	1.11	<0.001	0.072	76	<1	0.003	1330	<1	1.47	<0.001	0.039	<0.001	0.002	7.6	<0.01	0.568	394		21.5	76	58.1	<0.005							
ME2000445002	CC_2	19-Mar-2020	1435	15	0.04	0.002	0.027	409	<1	<0.001	6720	<1	0.32	<0.001	3.7	0.003	0.006	7.8	<0.01	3.76	2610		26.5	409	3.7	<0.005							
ME2000445003	CC_3	19-Mar-2020	1517																														
ME2000445004	WIL_U	19-Mar-2020	1130																														
ME2000445005	WIL_U2	19-Mar-2020	1113	89	0.08	0.003	0.231	6	<1	0.001	4070	<1	85	<0.001	21.4	<0.001	0.207	6.2	<0.01	0.884	421		18.5	6	270	0.076							
ME2000445006	WIL_NC	19-Mar-2020	1143																														
ME2000445007	WIL_PC	19-Mar-2020	1125																														
ME2000445008	WIL_D	19-Mar-2020	1256	9	0.29	0.001	0.098	4	<1	<0.001	2650	<1	2.1	<0.001	24	<0.001	0.099	4.9	<0.01	1.75	1150		24.5	4	18	0.123							
ME2000445009	WIL_D2	19-Mar-	1218																														

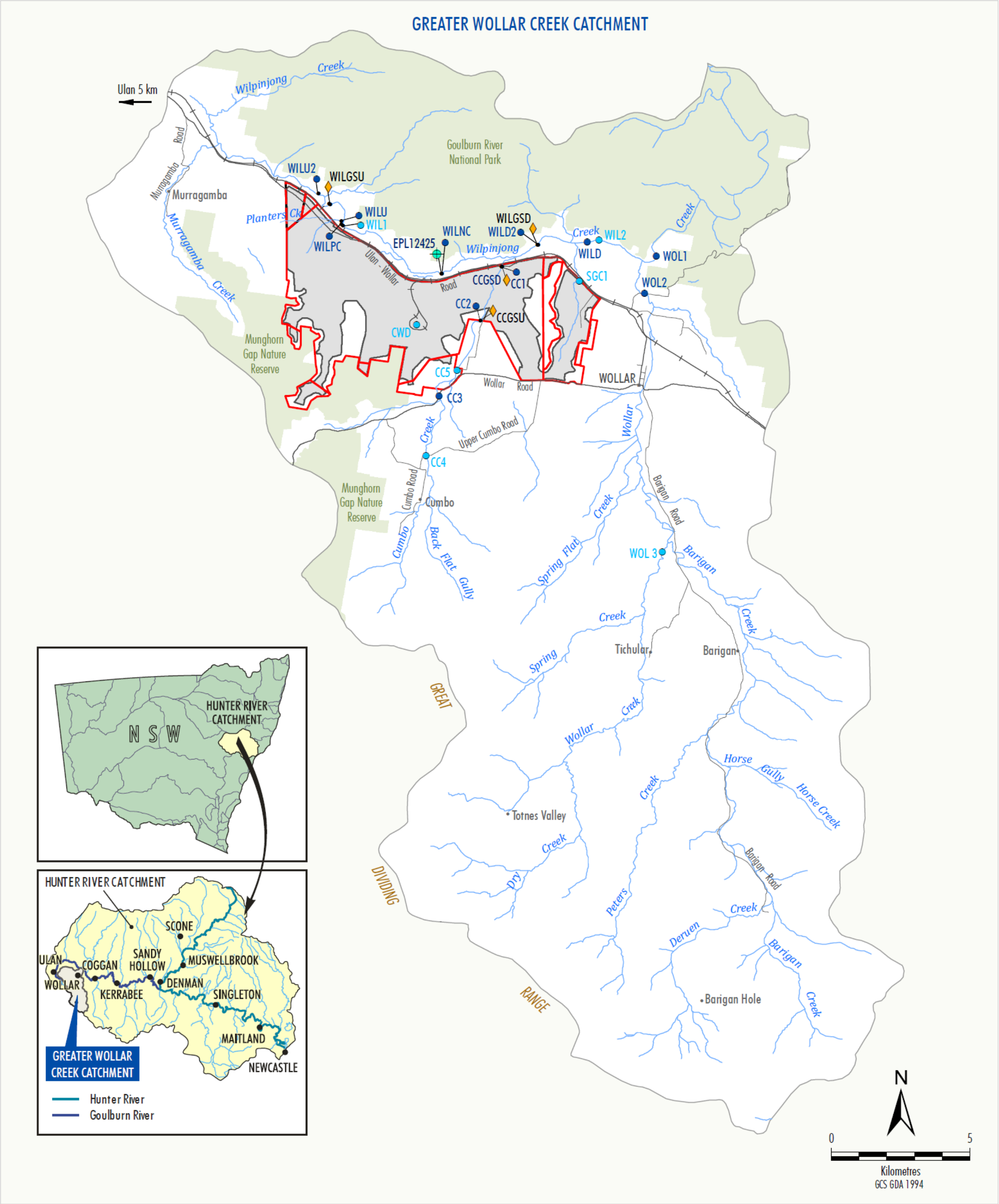
Sample Num	Sample Location	Sampling Date	Sampling Time	Acidity as CaCO3 mg/L	Aluminium mg/L	Arsenic mg/L	Barium mg/L	Bicarbonate Alkalinity as CaCO3 mg/L	Carbonate Alkalinity as CaCO3 mg/L	Copper mg/L	Electrical Conductivity (Field Reading) µS/cm	Hydroxide Alkalinity as CaCO3 mg/L	Iron mg/L	Lead mg/L	Manganese mg/L	Molybdenum mg/L	Nickel mg/L	pH - Field pH Unit	Selenium mg/L	Strontium mg/L	Sulfate mg/L	Suspended Solids (SS) mg/L	Temperature °C	Total Alkalinity as CaCO3 mg/L	Turbidity NTU	Zinc mg/L	Selenium mg/L	Strontium mg/L	Sulfate mg/L	Temperature °C	Total Alkalinity as CaCO3 mg/L	Turbidity NTU	Zinc mg/L
		2020																															
ME2000445010	WOL_1	19-Mar-2020	1355	5	0.04	<0.001	0.063	138	<1	<0.001	2250	<1	1.26	<0.001	1.6	<0.001	0.015	7.9	<0.01	1.42	600		29.5	138	7.9	0.005							
ME2000445011	WOL_2	19-Mar-2020	1322	12	0.04	0.002	0.112	426	<1	<0.001	3320	<1	1.09	<0.001	5.88	<0.001	0.003	7.5	<0.01	2.05	632		22	426	6.6	<0.005	<0.01	1.89	528	25	622	42	<0.005
ME2000445012	30M_U_CC1	19-Mar-2020	1204																														
ME2000623001	CC_1	23-Apr-2020	1201																														
ME2000623002	CC_2	23-Apr-2020	1505	18	0.01	<0.001	0.037	382	<1	0.006	5850	<1	0.3	<0.001	1.44	<0.001	0.004	8	<0.01	3.05	2290		22	382	2.6	0.014							
ME2000623003	CC_3	23-Apr-2020	1525																								<0.01	4.57	3350	21.5	222	16	0.005
ME2000623004	WIL_U	23-Apr-2020	1116	7	0.32	<0.001	0.064	14	<1	0.004	532	<1	4.34	0.002	2.12	<0.001	0.08	6.3	<0.01	0.139	83		16	14	32.6	0.095							
ME2000623005	WIL_U2	23-Apr-2020	1030	7	0.61	<0.001	0.065	10	<1	0.005	516	<1	6.99	0.002	2.06	<0.001	0.09	6.2	<0.01	0.133	82		15.5	10	37.2	0.107							
ME2000623006	WIL_NC	23-Apr-2020	1139	5	0.31	<0.001	0.053	10	<1	0.004	400	<1	0.53	<0.001	0.19	<0.001	0.013	6.2	<0.01	0.116	61		17.5	10	12	0.016	<0.01	1.32	578	18	<1	45	1.51
ME2000623007	WIL_PC	23-Apr-2020	1057	8	0.19	0.001	0.035	49	<1	0.003	523	<1	2.68	<0.001	1.33	<0.001	0.032	6.8	<0.01	0.154	61		18.5	49	10.4	0.029							
ME2000623008	WIL_D	23-Apr-2020	1313	6	0.18	<0.001	0.054	9	<1	0.002	510	<1	2.52	<0.001	0.978	<0.001	0.019	6.1	<0.01	0.168	147		21.5	9	20.1	0.019							
ME2000623009	WIL_D2	23-Apr-2020	1239	5	0.19	<0.001	0.048	8	<1	0.004	542	<1	1.51	<0.001	0.836	<0.001	0.018	6.4	<0.01	0.177	152		18.5	8	12.4	0.017	<0.01	1.48	1170	19.5	<1	9.7	1.21
ME2000623010	WOL_1	23-Apr-2020	1417	8	0.1	<0.001	0.054	13	<1	0.002	537	<1	1.32	<0.001	1.16	<0.001	0.02	6.4	<0.01	0.188	156		19.5	13	9	0.02							
ME2000623011	WOL_2	23-Apr-2020	1344	9	0.03	<0.001	0.063	214	<1	0.004	2120	<1	0.51	<0.001	0.609	<0.001	0.003	7.6	<0.01	1.06	426		17.5	214	3.8	<0.005	<0.01	1.21	623	20	114	0.8	<0.005
ME2000623012	30M_U_CC1	23-Apr-2020	1209																								<0.01	1.8	780	19.5	233	15.2	<0.005
ME2000778001	CC_1	19-May-2020	1124																														
ME2000778002	CC_2	19-May-2020	1416	6	0.01	<0.001	0.034	379	<1	<0.001	6270	<1	0.15	<0.001	0.27	<0.001	0.002	8	<0.01	3.42	2460		19.5	379	1.4	<0.005							
ME2000778003	CC_3	19-May-2020	1502																														
ME2000778004	WIL_U	19-May-2020	1051	7	0.17	<0.001	0.061	3	<1	<0.001	660	<1	1.61	<0.001	3.53	<0.001	0.136	6	<0.01	0.175	124		15	3	8.2	0.094	<0.01	4.38	3760	15.5	308	4.3	<0.005
ME2000778005	WIL_U2	19-May-2020	1014	6	0.27	<0.001	0.059	<1	<1	<0.001	709	<1	3.5	<0.001	3.6	<0.001	0.163	4.3	<0.01	0.172	136		15	<1	14.1	0.12							
ME2000778006	WIL_NC	19-May-2020	1112																														
ME2000778007	WIL_PC	19-May-2020	1037	4	0.07	0.001	0.028	136	<1	0.001	715	<1	1.2	<0.001	2.19	0.002	0.014	7.2	<0.01	0.293	50		16.5	136	7.3	0.006	<0.01	1.08	549	14.5	<1	1.4	0.38
ME2000778008	WIL_D	19-May-2020	1221	7	0.14	<0.001	0.06	3	<1	<0.001	744	<1	4.41	<0.001	3.06	<0.001	0.037	4.5	<0.01	0.291	261		19	3	25.2	0.032							
ME2000778009	WIL_D2	19-May-2020	1148	9	0.34	<0.001	0.092	3	<1	0.012	1080	<1	3.88	<0.001	6.4	<0.001	0.057	5.6	<0.01	0.446	410		18	3	20.2	0.053							
ME2000778010	WOL_1	19-May-2020	1333	5	0.06	<0.001	0.077	12	<1	<0.001	815	<1	0.62	<0.001	2.78	<0.001	0.021	6.3	<0.01	0.344	276		15	12	4.6	0.019	<0.01	2.56	1510	15	326	95.2	0.014
ME2000778011	WOL_2	19-May-2020	1254	5	0.01	<0.001	0.065	254	<1	<0.001	2800	<1	0.26	<0.001	0.177	<0.001	0.002	7.5	<0.01	1.34	613		15.5	254	2.4	<0.005							
ME2000778012	30M_U_CC1	19-May-2020	1126																														
ME2000976001	CC_1	17-Jun-2020	1130																								<0.01	1.82	808	13.5	356	5.1	<0.005
ME2000976002	CC_2	17-Jun-2020	1355	14	<0.01	<0.001	0.031	375	<1	<0.001	6440	<1	0.12	<0.001	0.169	<0.001	0.002	8	<0.01	3.09	2350		13.5	375	1	<0.005							
ME2000976003	CC_3	17-Jun-2020	1432	5	0.01	<0.001	0.036	267	<1	<0.001	4710	<1	<0.05	<0.001	0.003	<0.001	<0.001	8.5	<0.01	1.89	1960		12.5	267	0.6	<0.005							
ME2000976004	WIL_U	17-Jun-2020	1103	7	0.09	<0.001	0.054	6	<1	<0.001	698	<1	2.34	<0.001	3.06	<0.001	0.093	5.9	<0.01	0.17	102		10	6	12.5	0.053							
ME2000976005	WIL_U2	17-Jun-2020	1036	6	0.13	<0.001	0.058	13	<1	<0.001	740	<1	2.26	<0.001	2.08	<0.001	0.049	6.4	<0.01	0.16	82		8.5	13	14.4	0.03	<0.01	3.88	2600	10.5	356	2	<0.005
ME2000976006	WIL_NC	17-Jun-2020	1120	5	0.14	<0.001	0.129	3	<1	0.001	820	<1	0.09	<0.001	1.15	<0.001	0.049	5.6	<0.01	0.339	211		11.5	3	2.5	0.067							
ME2000976007	WIL_PC	17-Jun-2020	1057	6	0.28	<0.001	0.063	33	<1	0.001	734	<1	1.82	0.001	4.02	<0.001	0.035	6.7	<0.01	0.208	85		11	33	63.7	0.025							
ME2000976008	WIL_D	17-Jun-2020	1228	14	0.18	<0.001	0.055	1	<1	0.001	835	<1	8.1	<0.001	4.89	<0.001	0.03	5.2	<0.01	0.339	302		11.5	1	30.5	0.026	<0.01	0.83	326	5	<1	0.9	0.246

Sample Num	Sample Location	Sampling Date	Sampling Time	Acidity as CaCO3 mg/L	Aluminium mg/L	Arsenic mg/L	Barium mg/L	Bicarbonate Alkalinity as CaCO3 mg/L	Carbonate Alkalinity as CaCO3 mg/L	Copper mg/L	Electrical Conductivity (Field Reading) µS/cm	Hydroxide Alkalinity as CaCO3 mg/L	Iron mg/L	Lead mg/L	Manganese mg/L	Molybdenum mg/L	Nickel mg/L	pH - Field pH Unit	Selenium mg/L	Strontium mg/L	Sulfate mg/L	Suspended Solids (SS) mg/L	Temperature °C	Total Alkalinity as CaCO3 mg/L	Turbidity NTU	Zinc mg/L	Selenium mg/L	Strontium mg/L	Sulfate mg/L	Temperature °C	Total Alkalinity as CaCO3 mg/L	Turbidity NTU	Zinc mg/L
ME2000976009	WIL_D2	17-Jun-2020	1150	14	0.39	<0.001	0.086	1	<1	0.001	1280	<1	8.1	<0.001	8.92	<0.001	0.055	5.6	<0.01	0.544	507		15	1	55.8	0.04							
ME2000976010	WOL_1	17-Jun-2020	1314	9	0.02	<0.001	0.055	209	<1	<0.001	2420	<1	0.29	<0.001	0.151	0.001	0.006	8.2	<0.01	1.17	552		11.5	209	2.4	<0.005							
ME2000976011	WOL_2	17-Jun-2020	1255	7	0.02	<0.001	0.052	235	<1	<0.001	2530	<1	0.16	<0.001	0.055	<0.001	<0.001	8	<0.01	1.18	584		10	235	1.9	<0.005	<0.01	4.01	1570	6	456	29.6	<0.005
ME2000976012	30M_U_CC1	17-Jun-2020	1133																														
ME2001164001	CC_1	22-Jul-2020	1138																														
ME2001164002	CC_2	22-Jul-2020	1336	16	<0.01	<0.001	0.028	325	<1	<0.001	6280	<1	0.08	<0.001	0.087	<0.001	0.003	8.1	<0.01	2.99	2420		12	325	0.7	<0.005	<0.01	2.1	548	8	393	3.4	<0.005
ME2001164003	CC_3	22-Jul-2020	1424	5	0.19	<0.001	0.025	307	<1	<0.001	4720	<1	0.1	<0.001	0.014	<0.001	0.002	8.5	<0.01	1.82	1920		11	307	10	<0.005							
ME2001164004	WIL_U	22-Jul-2020	1110	7	0.19	<0.001	0.035	6	<1	<0.001	467	<1	2.03	<0.001	1.35	<0.001	0.056	6.5	<0.01	0.102	55		7.5	6	13.2	0.032							
ME2001164005	WIL_U2	22-Jul-2020	1055	9	0.2	<0.001	0.043	12	<1	<0.001	500	<1	3.21	<0.001	1.2	<0.001	0.036	6.5	<0.01	0.122	52		6.5	12	17.6	0.027							
ME2001164006	WIL_NC	22-Jul-2020	1129	9	0.12	<0.001	0.051	32	<1	<0.001	592	<1	0.28	<0.001	0.529	<0.001	0.01	6.8	<0.01	0.211	104		8	32	10.3	0.006	<0.01	3.92	2710	11	360	3.7	<0.005
ME2001164007	WIL_PC	22-Jul-2020	1105	11	0.76	0.002	0.062	77	<1	<0.001	514	<1	4.58	0.001	5.24	0.002	0.023	7	<0.01	0.147	35		9	77	54.5	0.013							
ME2001164008	WIL_D	22-Jul-2020	1215	10	0.21	<0.001	0.032	13	<1	<0.001	545	<1	2.76	<0.001	1.12	<0.001	0.011	6.7	<0.01	0.177	114		10.5	13	19.5	0.006							
ME2001164009	WIL_D2	22-Jul-2020	1154	8	0.24	<0.001	0.032	10	<1	<0.001	532	<1	1.71	<0.001	1.04	<0.001	0.012	6.7	<0.01	0.161	104		10	10	18.4	<0.005	<0.01	0.688	329	10	<1	3.8	0.346
ME2001164010	WOL_1	22-Jul-2020	1300	5	0.06	<0.001	0.033	141	<1	<0.001	1470	<1	0.48	<0.001	0.26	<0.001	0.004	8.4	<0.01	0.628	299		9.5	141	5	<0.005							
ME2001164011	WOL_2	22-Jul-2020	1241	7	0.02	<0.001	0.043	225	<1	<0.001	2020	<1	0.13	<0.001	0.051	<0.001	0.001	7.9	<0.01	0.927	436		8.5	225	1.6	<0.005							
ME2001164012	30M_U_CC1	22-Jul-2020	1141																								<0.01	3.55	1320	10	436	18.4	<0.005
ME2001298003	CC_3	17-Aug-2020	1412	6	0.02	<0.001	0.022	276	14	<0.001	4330	<1	<0.05	<0.001	0.009	<0.001	0.002	8.6	<0.01	1.69	1710		17	290	0.7	<0.005							
ME2001298004	WIL_U	17-Aug-2020	1044	4	0.18	<0.001	0.024	12	<1	0.002	260	<1	2.05	<0.001	0.3	<0.001	0.023	6.8	<0.01	0.051	15		11	12	11.8	0.016							
ME2001298005	WIL_U2	17-Aug-2020	1028																								<0.01	1.71	723	9	312	6.8	<0.005
ME2001298006	WIL_NC	17-Aug-2020	1108	5	0.29	<0.001	0.021	15	<1	0.002	298	<1	1.52	<0.001	0.054	<0.001	0.01	6.8	<0.01	0.072	32		12	15	20	0.006							
ME2001298007	WIL_PC	17-Aug-2020	1038	5	0.24	0.001	0.024	31	<1	0.002	272	<1	2.82	<0.001	0.649	<0.001	0.017	6.8	<0.01	0.068	19		12	31	25.1	0.01							
ME2001298008	WIL_D	17-Aug-2020	1225	4	0.4	<0.001	0.024	16	<1	0.002	311	<1	1.94	<0.001	0.129	<0.001	0.007	7.1	<0.01	0.082	38		16	16	26.3	<0.005							
ME2001298009	WIL_D2	17-Aug-2020	1145	8	0.48	<0.001	0.021	17	<1	0.002	318	<1	1.78	<0.001	0.1	<0.001	0.009	7.5	<0.01	0.081	38		13	17	24.1	<0.005	<0.01	3.41	2700	12	337	3.6	<0.005
ME2001298010	WOL_1	17-Aug-2020	1304	4	0.28	<0.001	0.029	80	<1	0.001	895	<1	1.11	<0.001	0.087	<0.001	0.006	8.4	<0.01	0.377	174		13.5	80	12.2	<0.005							
ME2001298011	WOL_2	17-Aug-2020	1242	4	0.05	<0.001	0.05	227	<1	<0.001	2100	<1	0.21	<0.001	0.048	<0.001	0.001	8.1	<0.01	1.08	453		14.5	227	2.8	<0.005							
ME2001298012	30M_U_CC1	17-Aug-2020	1129																								<0.01	0.688	287	10.5	<1	6	0.206
ME2001432001	CC_1	10-Sep-2020	1206	9	10.7	0.004	0.039	43	<1	0.01	262	<1	11.6	0.01	0.142	0.002	0.012	7.6	<0.01	0.056	39		16.5	43	523	0.026							
ME2001432002	CC_2	10-Sep-2020	1442	14	<0.01	<0.001	0.022	314	<1	<0.001	6850	<1	0.06	<0.001	0.046	0.001	0.003	8.1	<0.01	2.95	2410		18	314	1.3	<0.005							
ME2001432003	CC_3	10-Sep-2020	1500	6	0.04	<0.001	0.027	241	<1	<0.001	4610	<1	0.05	<0.001	0.02	<0.001	0.001	8.5	<0.01	1.62	1790		19	241	1.5	<0.005	<0.01	2.86	862	11.5	462	56.7	0.006
ME2001432004	WIL_U	10-Sep-2020	1134	4	0.3	<0.001	0.016	16	<1	0.001	291	<1	2.04	0.002	0.29	<0.001	0.024	7.2	<0.01	0.048	25		15	16	25.1	0.009							
ME2001432005	WIL_U2	10-Sep-2020	1052	5	0.23	<0.001	0.028	27	<1	<0.001	388	<1	2.51	<0.001	0.565	<0.001	0.019	7	<0.01	0.076	33		14	27	29.5	0.008	<0.01	1.61	637	10.5	252	2.9	<0.005
ME2001432006	WIL_NC	10-Sep-2020	1155	4	0.1	<0.001	0.019	21	<1	0.002	436	<1	0.65	<0.001	0.302	<0.001	0.012	7.1	<0.01	0.096	58		16.5	21	5.4	<0.005	<0.01	1.43	665	10	248	1.7	<0.005
ME2001432007	WIL_PC	10-Sep-2020	1124	5	0.38	0.002	0.041	61	<1	0.001	480	<1	2.79	<0.001	3.26	<0.001	0.016	7.1	<0.01	0.125	33		16.5	61	29.7	0.009							
ME2001432008	WIL_D	10-Sep-2020	1314	4	0.16	<0.001	0.024	33	<1	0.002	420	<1	2.32	<0.001	0.413	<0.001	0.009	7.3	<0.01	0.121	71		19.5	33	14.8	0.006							
ME2001432009	WIL_D2	10-Sep-2020	1234	4	0.22	<0.001	0.023	38	<1	0.002	488	<1	1.47	<0.001	0.486	<0.001	0.01	7.3	<0.01	0.136	88		17.5	38	13	0.01	<0.01	0.1	102	16	76	2310	0.092
ME2001432010	WOL_1	10-Sep-	1403	4	0.06	<0.001	0.03	150	<1	<0.001	1400	<1	0.48	<0.001	0.132	<0.001	0.004	8.3	<0.01	0.56	273		16.5	150	3.7	<0.005	<0.01	3.7	3010	16.5	326	3.3	0.007

Sample Num	Sample Location	Sampling Date	Sampling Time	Acidity as CaCO3 mg/L	Aluminium mg/L	Arsenic mg/L	Barium mg/L	Bicarbonate Alkalinity as CaCO3 mg/L	Carbonate Alkalinity as CaCO3 mg/L	Copper mg/L	Electrical Conductivity (Field Reading) µS/cm	Hydroxide Alkalinity as CaCO3 mg/L	Iron mg/L	Lead mg/L	Manganese mg/L	Molybdenum mg/L	Nickel mg/L	pH - Field pH Unit	Selenium mg/L	Strontium mg/L	Sulfate mg/L	Suspended Solids (SS) mg/L	Temperature °C	Total Alkalinity as CaCO3 mg/L	Turbidity NTU	Zinc mg/L	Selenium mg/L	Strontium mg/L	Sulfate mg/L	Temperature °C	Total Alkalinity as CaCO3 mg/L	Turbidity NTU	Zinc mg/L
		2020																															
ME2001432011	WOL_2	10-Sep-2020	1336	4	0.06	<0.001	0.044	263	<1	<0.001	2400	<1	0.24	<0.001	0.083	<0.001	0.002	8.2	<0.01	1.06	460		17.5	263	3.2	<0.005	<0.01	2.5	2670	16	334	4.4	0.014
ME2001432012	30M_U_CC1	10-Sep-2020	1217																														
ME2001636001	CC_1	14-Oct-2020	1135																								<0.01	0.765	333	14.5	8	9.8	0.099
ME2001636002	CC_2	14-Oct-2020	1419	4	0.02	<0.001	0.019	338	<1	<0.001	7120	<1	<0.05	<0.001	0.044	<0.001	0.002	8.2	<0.01	3.22	2530		26.5	338	1.2	<0.005							
ME2001636003	CC_3	14-Oct-2020	1514																														
ME2001636004	WIL_U	14-Oct-2020	1059	3	0.02	<0.001	0.022	32	<1	<0.001	518	<1	1.94	<0.001	0.348	<0.001	0.016	6.7	<0.01	0.11	43		18	32	6.6	<0.005	<0.01	3.5	1960	15.5	375	82.1	0.024
ME2001636005	WIL_U2	14-Oct-2020	1025	3	0.05	<0.001	0.025	34	<1	<0.001	627	<1	1.69	<0.001	0.637	<0.001	0.023	6.9	<0.01	0.123	55		15.5	34	7.5	0.009							
ME2001636006	WIL_NC	14-Oct-2020	1128																								<0.01	3.08	1510	16	110	5.2	0.006
ME2001636007	WIL_PC	14-Oct-2020	1050																								<0.01	1.92	673	13.5	339	4.5	0.007
ME2001636008	WIL_D	14-Oct-2020	1236	3	0.08	0.002	0.045	74	<1	<0.001	492	<1	7.02	<0.001	2.53	<0.001	0.008	7.1	<0.01	0.185	62		24	74	28.4	<0.005							
ME2001636009	WIL_D2	14-Oct-2020	1206																														
ME2001636010	WOL_1	14-Oct-2020	1324	4	<0.01	<0.001	0.037	217	<1	<0.001	1620	<1	0.1	<0.001	0.02	<0.001	0.003	8.2	<0.01	0.654	285		27	217	1.2	<0.005							
ME2001636011	WOL_2	14-Oct-2020	1305	6	0.04	<0.001	0.055	369	<1	<0.001	2830	<1	0.72	<0.001	0.736	<0.001	0.002	7.6	<0.01	1.29	501		22	369	5.8	<0.005							
ME2001636012	30M_U_CC1	14-Oct-2020	1141																														
ME2001866001	CC_1	27-Nov-2020	1222																														
ME2001866002	CC_2	27-Nov-2020	1425																														
ME2001866003	CC_3	27-Nov-2020	1437																														
ME2001866004	WIL_U	27-Nov-2020	1113	3	0.03	0.001	0.022	55	<1	<0.001	458	<1	2.46	<0.001	0.349	<0.001	0.011	6.9	<0.01	0.112	28		26	55	7.2	<0.005							
ME2001866005	WIL_U2	27-Nov-2020	1042	8	0.14	<0.001	0.029	64	<1	<0.001	550	<1	2.98	<0.001	0.522	<0.001	0.015	7.1	<0.01	0.134	32		23.5	64	14.1	<0.005							
ME2001866006	WIL_NC	27-Nov-2020	1137																														
ME2001866007	WIL_PC	27-Nov-2020	1103	7	0.09	0.002	0.039	62	<1	<0.001	456	<1	4.1	<0.001	1.15	<0.001	0.01	7	<0.01	0.114	23		26	62	19.7	<0.005							
ME2001866008	WIL_D	27-Nov-2020	1249	8	0.03	0.001	0.041	78	<1	<0.001	464	<1	4.31	<0.001	1.25	<0.001	0.007	7	<0.01	0.186	61		30.5	78	17.3	0.007	<0.01	1.88	699	23	381	12.2	<0.005
ME2001866009	WIL_D2	27-Nov-2020	1155	8	0.03	0.003	0.052	174	<1	<0.001	693	<1	8.58	<0.001	3.33	<0.001	0.009	7.4	<0.01	0.272	80		31	174	16.8	<0.005							
ME2001866010	WOL_1	27-Nov-2020	1344	4	0.05	<0.001	0.028	159	<1	<0.001	895	<1	0.38	<0.001	0.137	<0.001	0.005	8.2	<0.01	0.37	130		32	159	2.5	<0.005							
ME2001866011	WOL_2	27-Nov-2020	1316	9	0.04	<0.001	0.062	491	<1	<0.001	2960	<1	0.57	<0.001	2.16	<0.001	0.002	7.7	<0.01	1.42	432		28.5	491	6.4	<0.005							
ME2001866012	30M_U_CC1	27-Nov-2020	1231																														
ME2001947001	CC_1	10-Dec-2020	1235																														
ME2001947002	CC_2	10-Dec-2020	1442	22	1.95	0.004	0.141	349	<1	0.003	7050	<1	2.57	0.005	12.2	0.004	0.012	8.1	<0.01	3.21	2500		31.5	349	325	0.009							
ME2001947003	CC_3	10-Dec-2020	1457																														
ME2001947004	WIL_U	10-Dec-2020	1211	8	0.03	<0.001	0.024	74	<1	<0.001	471	<1	3.04	<0.001	0.783	<0.001	0.012	6.9	<0.01	0.115	20		24.5	74	8.8	<0.005							
ME2001947005	WIL_U2	10-Dec-2020	1138	6	0.15	<0.001	0.027	63	<1	<0.001	543	<1	1.8	<0.001	0.82	<0.001	0.011	7.1	<0.01	0.117	30		23.5	63	10.3	<0.005							
ME2001947006	WIL_NC	10-Dec-2020	1228																														
ME2001947007	WIL_PC	10-Dec-2020	1159	7	0.24	0.002	0.038	59	<1	0.001	430	<1	4.4	<0.001	0.829	<0.001	0.011	7.3	<0.01	0.1	21		30	59	26	<0.005							
ME2001947008	WIL_D	10-Dec-2020	1320	9	0.05	<0.001	0.044	97	<1	<0.001	629	<1	4.18	<0.001	1.22	<0.001	0.005	6.9	<0.01	0.234	75		28	97	18.3	<0.005							
ME2001947009	WIL_D2	10-Dec-2020	1250																														

Sample Num	Sample Location	Sampling Date	Sampling Time	Acidity as CaCO3 mg/L	Aluminium mg/L	Arsenic mg/L	Barium mg/L	Bicarbonate Alkalinity as CaCO3 mg/L	Carbonate Alkalinity as CaCO3 mg/L	Copper mg/L	Electrical Conductivity (Field Reading) µS/cm	Hydroxide Alkalinity as CaCO3 mg/L	Iron mg/L	Lead mg/L	Manganese mg/L	Molybdenum mg/L	Nickel mg/L	pH - Field pH Unit	Selenium mg/L	Strontium mg/L	Sulfate mg/L	Suspended Solids (SS) mg/L	Temperature °C	Total Alkalinity as CaCO3 mg/L	Turbidity NTU	Zinc mg/L	Selenium mg/L	Strontium mg/L	Sulfate mg/L	Temperature °C	Total Alkalinity as CaCO3 mg/L	Turbidity NTU	Zinc mg/L
ME2001947010	WOL_1	10-Dec-2020	1408																														
ME2001947011	WOL_2	10-Dec-2020	1352	15	0.06	<0.001	0.073	558	<1	<0.001	3200	<1	0.36	<0.001	1.37	<0.001	0.002	7.5	<0.01	1.46	479		27.5	558	6.2	<0.005							
ME2001947012	30M_U_CC1	10-Dec-2020	1240																														

Surface Water Monitoring Locations



LEGEND

□	Mining Lease Boundary
⬚	Mining Lease Application Boundary
▨	Approved/Existing Open Cut and Contained Infrastructure Area #
	WCPL Monitoring
◆	WCPL Gauging Station
⊕	EPL 12425 Licensed and Monitoring Point
●	Active Surface Water Monitoring Site
●	Historical Surface Water Monitoring Site

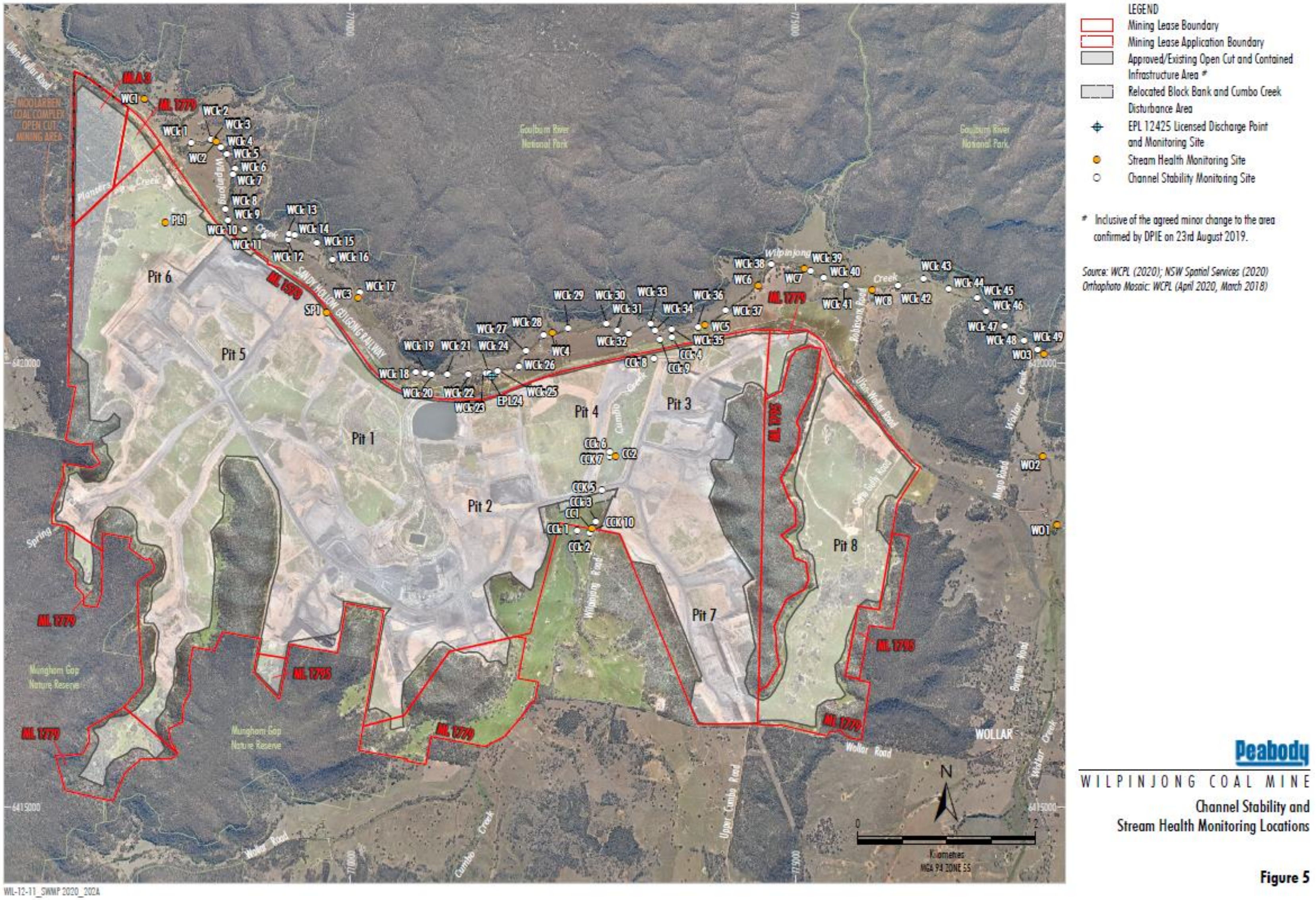
Inclusive of the agreed minor change to the area confirmed by DPIE on 23rd August 2019.

Source: WCPL (2020); After DIPNR (2003); DPI Water (2015); NSW Spatial Services (2020)

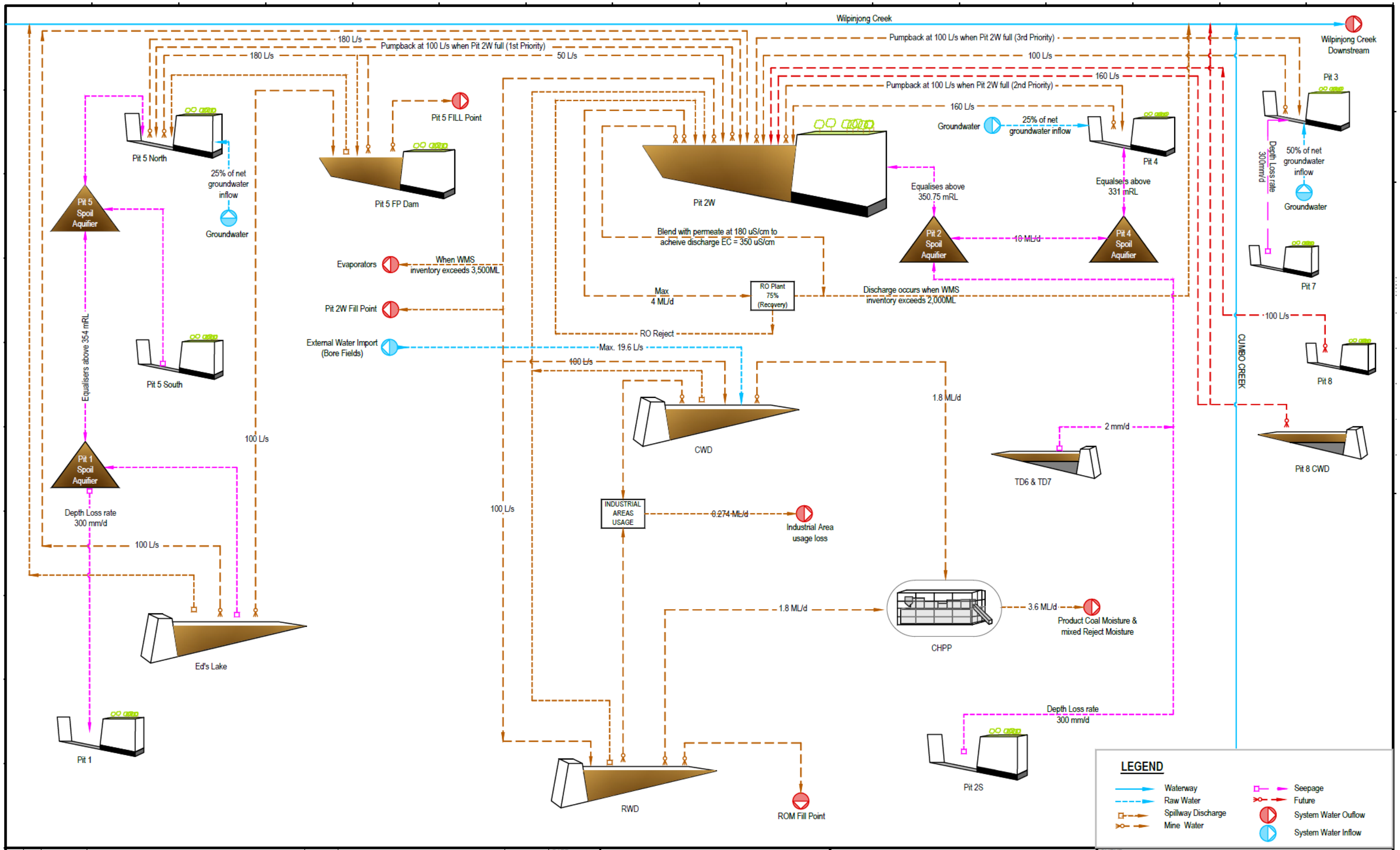
WILPINJONG COAL MINE

Wilpinjong Coal Mine
Surface Water Monitoring Network

Channel Stability & Stream Health Monitoring Locations



Water Balance Model Schematic (August 2020)



REVISIONS			
B	24.08.2020	PRELIMINARY ISSUE	MS
A	17.08.2020	PRELIMINARY ISSUE	MS
	DATE	DESCRIPTION	

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10 KINGS ROAD
NEW LAMBTON
NEW SOUTH WALES 2305
AUSTRALIA
T: 61 2 4037 3200
F: 61 2 4037 3201
www.slrconsulting.com

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WATER BALANCE UPDATE 2020

DRAWING TITLE: SITE SCHEMATIC

DRAWING NUMBER: FIGURE A1

ISSUE: B

Water Management Performance Measures

A summary of the water management performance measures was undertaken by WCPL as they related to the Development Consent SSD-6764 (1 January 2020 to 31 December 2020)

Assessment of Water Management Performance Measures for 2020

Feature	Performance Measure	Complied with Performance Measure (Yes/No)	Comments/Actions
General	Maintain separation between clean, dirty and mine water management systems. Minimise the use of clean water on site. Design, install, operation and maintain water management systems in a proper and efficient manager.	No	Refer to Site Water Balance (Section 7.7) Refer to Estimate Groundwater Take (Section 7.2) Refer to Surface Water Results (Section 7.6)
Clean water diversion and storage infrastructure	Maximise as far as reasonable and feasible the diversion of clean water around disturbed areas on site.	Yes	Refer to Erosion and Sediment Control (Section 7.5)
Sediment dams	Design, install and/or maintain sediment dams to ensure no discharges to surface waters, except in accordance with an EPL or in accordance with Section 120 of the POEO Act.	Yes	Refer to Erosion and Sediment Control (Section 7.5) Refer to Water Treatment Facility (Section 7.8)
Mine water storages	Design, install and/or maintain mine water storage infrastructure to ensure no discharge of untreated mine water off-site. Discharge treated mine water in accordance with an EPL or in accordance with Section 120 of the POEO Act.	No	Refer to Site Water Balance (Section 7.7) Refer to Surface Water Results (Section 7.6) Refer to Water Treatment Facility (Section 7.8)
Wilpinjong, Cumbo and Wollar Creeks	No greater impact than predicted for the development for water flow and quality.	Yes	Refer to Surface Water Results (Section 7.6) Refer to Stream Health (Section 7.9)
Aquatic, riparian and groundwater dependent ecosystems	Negligible environmental consequences beyond those predicted for the development.	Yes	Refer to Surface Water Results (Section 7.6) Refer to Stream Health (Section 7.9)
Flood mitigation measures*	Ensure all open cut pits, CHPP, coal stockpiles and main mine facilities areas exclude flows for all flood events up to and including the 1 in 100 year ARI. All final voids designed to exclude all flood events up to include the PMF event.	Yes	The Wilpinjong Coal Mine open cuts are located outside the extent of flooding from Wilpinjong Creek in the 1 in 1,000 AEP design flood. Flood mitigation works for open cut infrastructure in the vicinity of Cumbo Creek are already being implemented at the Wilpinjong Coal Mine and have been designed to a 1 in 100 AEP flood protection (WRM Water and Environment, 2015).
Overburden, CHPP Reject and Tailings	Design, install and maintain emplacements to prevent or minimise the migration of pollutants due to seepage.	Yes	Waste rock emplacements and coal reject management in accordance with the MOP
Chemical and hydrocarbon storage	Chemical and hydrocarbon products to be stored in bunded areas or structures in accordance with relevant Australian Standards.	Yes	Chemical and hydrocarbon products stored in bunded areas in accordance with relevant Australian Standards

Notes: * Consistent with Condition 29, Schedule 3 of Development Consent (SSD-6764), WCPL have maintained all open cut pits, CHPP, coal stockpiles and main mine facilities areas so that they exclude flows for all flood events up to and including the 1 in 100 year ARI. The final voids would be designed to exclude all flood events up to the probable maximum flood.

Surface Water Reports 2020

WILPINJONG COAL MINE

Surface Water 2020 Annual Monitoring Review

Prepared for:

Wilpinjong Coal Pty Ltd
1434 Ulan Wollar Road
WILPINJONG NSW 2850

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Version No: -v1.1
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PREPARED BY

SLR Consulting Australia Pty Ltd
ABN 29 001 584 612
Level 1, The Central Building, UoW Innovation Campus
North Wollongong NSW 2500 Australia

T: +61 2 4249 1000
E: wollongong@slrconsulting.com   www.slrconsulting.com

BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Wilpinjong Coal Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
665.10014.00305-R01-v1.1	29 March 2021	Adam Skorulis and Stephane Peignelin	Duncan Barnes	Duncan Barnes
665.10014.00305-R01-v1.0	5 March 2021	Adam Skorulis and Stephane Peignelin	Duncan Barnes	Duncan Barnes

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DOCUMENT REFERENCES

TABLES

FIGURES

1 Introduction

This report contains the analysis and information required for the review of flow and water quality trends at Wilpinjong Creek and Cumbo Creek near Wilpinjong Coal Mine (WCM). It serves as a supplementary document to the review of hydrogeological data conducted by SLR Consulting Pty Ltd (SLR) for the 2020 Annual Review and 2019-20 Water Year Licensing Audit. This report is presented in two sections and addresses the following requests:

1. Cause-and-effect analysis of data from the Wilpinjong Creek upstream (WILGSU), and Wilpinjong Creek downstream (WILGSD) gauging stations, including a trend analysis in respect to the long-term rainfall trend, discharge from the Water Treatment Facility (Licensed Discharge and Monitoring Point EPL12425) and flow from the Cumbo Creek upstream (CCGSU) gauging station.

2. Assessment of key water quality criteria at local creeks during the 2019-20 water year in respect to baseline data, as well as Water Quality Impact Assessment Criteria for downstream gauges at Cumbo and Wilpinjong Creeks defined in the current Surface Water Management Plan (SWMP).

The report consists of commentary on the cause-and-effect analysis and trigger level assessment, with the inclusion of supporting figures.

1.1 Note on the trend analysis

The trend analysis within this report has been conducted for both flow/ discharge and rainfall by assessing monthly data, the monthly deviation from the mean, and the cumulative monthly deviation from the mean. The deviation from the mean and cumulative deviation from the mean are useful tools for the evaluation of temporal correlation of rainfall with surface water flow or groundwater level observations. Short-term variability is filtered out, allowing for the display of longer-term trends. With a cumulative deviation from the mean curve (also referred to in this document as the ‘rainfall trend’ or ‘long-term rainfall trend’), an increase in the curve indicates above average conditions, while a declining trend indicates below average conditions. These trends are calculated in the following way.

1. Mean monthly rainfall/streamflow is calculated from all monthly rainfall/streamflow values (i.e. average rainfall for January).

2. Monthly deviation from the mean is calculated between the monthly mean rainfall/streamflow value and the value for a particular month.

3. Cumulative monthly deviation from the mean is determined for each month for the duration of monitoring at each site.

Cumulative deviation from the mean curves are also referred to as residual mass curves within this report.

2 Review of Surface Water Data

2.1 Flow Review

The following section assesses daily data from three continuous surface water monitoring gauges – two on Wilpinjong Creek (WILGSU and WILGSD) and one on Cumbo Creek (CCGSU) – and in conjunction with discharge data from the Water Treatment Facility (WTF) Licensed Discharge and Monitoring Point, (Point 24) - (EPL 12425). Supplementary assessment of the long term, monthly trends of the same sites can be found below in **Section 2.1.1** - Trend Analysis.

The locations of the gauges on Wilpinjong Creek are shown in **Figure 1**. The upstream site, WILGSU, is located northwest of WCM, WILGSD is northeast of Wilpinjong Coal Mine (WCM), downstream of the Water Treatment Facility discharge site (WTF) and downstream of the confluence of Wilpinjong and Cumbo Creek. The Cumbo Creek upstream gauging station (CCGSU) is located near bore GWa5, ~400 m to the East of Pit 2 and ~800m upstream of active mining at Pit 4 (not shown on **Figure 1**). Flow/ discharge, electrical conductivity, and pH are all measured and presented against the rainfall trend from the local rainfall station (Wollar, 062032).

The two Wilpinjong Creek gauging stations have been recording since January 2012. The catchment area reporting to the upstream site (WILGSU) is 86km^2 while the downstream site has a catchment area of 216km^2. The WTF commenced discharging treated water, in accordance with EPL12425, upstream of WILGSD in June 2012. CCGSU on Cumbo Creek has been recording data since August 2015.

Flows at both gauges, upstream (WILGSU) and downstream (WILGSD), show correlation with the long-term rainfall trend, with a decline from 2012 to July 2014 as well as 2017 to 2019 (**Figure 2**) in line with below average rainfall conditions. Flows at both gauges are also observed to increase in late 2016 and from early 2020, consistent with periods of above average rainfall.

Correlation between the flows at the two gauges is high, with essentially a 1:1 relationship until about April-June 2012 when the WTF begins discharging to Wilpinjong Creek. During periods of discharge from the WTF, flows at WILGSD are consistently higher than those at WILGSU. The change in proportionality is suggestive of the influence of the WTF discharge above WILGSD (WTF discharges shown in yellow on **Figure 2**). This influence is best demonstrated during 2017 and 2018, when low rainfall conditions have resulted in no flow at WILGSU, but WILGSD shows a near-perfect match with WTF discharge rates.

The WTF was inactive from late 2018 to December 2020 due to a lack of surplus water on site, however, the WTF began discharging again in late December 2020. It is anticipated that the relationship between flow at WILGSU and WILGSD will be consistent with past observations.

The Cumbo Creek gauging station (CCGSU), which commenced monitoring in August 2015 is also displayed in **Figure 2**. Peaks in flow match the peaks in the rainfall trend, while flow is maintained for a longer duration during periods of below average rainfall when compared with Wilpinjong Creek gauging stations. It is important to note the logarithmic scale used to display the flows in **Figure 2**.

During the 2019, CCGSU recorded long periods of no observable flow (approximately 9 months) but does record flow with a maximum of ~0.005 cumecs from June to September 2019. This period of flow may be related to increased baseflow in Cumbo Creek associated with above average rainfall received in March 2019.

As outlined by the NSW Department of Primary Industries and the Bureau of Meteorology, 2020 has shown rainfall above average and shown a 97% recovery from the 2017-2020 drought. This increased rainfall was reflected in the creek flows in 2020 when compared to 2019.

During 2020, flow at CCGSU fluctuates between 0.001 and 0.1 cumecs in response to rainfall events, with the highest flow events recorded later in 2020. CCGSU was observed to flow from March to mid-November and again in December for the remainder of the year. Flows were observed in both WILGSU and WILGSD throughout 2020 with some periods of no flow towards the end of the year for WILGSD. From **Figure 2**, all three monitoring points present similar trends in 2020 with WILGSU and WILGSD generally showing higher flows than CCGSU possibly linked to respective reporting catchment sizes.

Table 1 presents the calculated daily mean discharge from the WTF and flows at WILGSU, WILGSD and CCGSU for each year since 2013.

Table 1 Calculated daily mean discharge and flow (cumecs) at the monitoring locations along the Wilpinjong and Cumbo Creeks since 2013

Monitoring Location	Average Daily Flow (cumecs)							
	2013	2014	2015	2016	2017	2018	2019	2020
WTF	0.006	0.002	0.003	0.008	0.053	0.009	0	0.004
WILGSU	0.019	0.00034	0.0033	0.0033	0.00002	0	0	0.027
WILGSD	0.03	0.0025	0.0044	0.066	0.068	0.0078	0.000094	0.028
CCGSU	No data				0.0071	0.0043	0.00069	0.0099

2.1.1 Trend Analysis

The trend analysis conducted on flows from WILGSU, WILGSD, CCGSU, discharge from the WTF and the long-term rainfall from BOM Station 062032 (Wollar – Barrigan St), has helped to confirm and clarify the relationships between stream flow, rainfall and discharge at two watercourses near WCM.

Figure 3 (CCGSU), **Figure 4** (WILGSU), and **Figure 5** (WILGSD) present monthly flow, deviation from the monthly mean, and cumulative deviation from the monthly mean in comparison with available data from either streamflow, rainfall, or discharge that may have some influence on recorded flow at a particular gauging station. Trends from CCGSU (**Figure 3**) and WILGSU (**Figure 4**) are assessed only against the trends from the Wollar rainfall station as they are upstream of the Water Treatment Facility and the confluence of any other assessed streams. WILGSD (**Figure 5**) is assessed against the rainfall trend as well as the discharge trends from the WTF and flow trends from both the WILGSU and CCGSU gauging stations. Water from any of these sources can influence the flow recorded at WILGSD.

As identified in the initial flow review, CCGSU shows a good relationship with the rainfall trend (**Figure 3**) for the entire period of record (2015 to 2020). In the uppermost chart (showing a comparison between monthly rainfall and average monthly flow rate), peaks in monthly rainfall above 120 mm result in a strong increase in the monthly average flow rate recorded at the gauging station. Flow is sometimes maintained in periods of low monthly rainfall (observed during 2017 and 2018), which may indicate some contribution of baseflow from groundwater in to Cumbo Creek. Months with below average rainfall, indicated by values less than zero in the middle chart also correlate well with periods of below average flow in Cumbo Creek. The cumulative rainfall trend in the bottom chart (**Figure 3**) also shows a good match with the cumulative monthly deviation from mean flow trend at CCGSU.

In 2020 the response of flow trends to periods of above average rainfall appears to be lower than observed in 2015. Flow rates are also observed to increase throughout 2020 despite rainfall events of similar magnitudes being observed. This may be influenced by the following:

- Low groundwater levels in the Cumbo Creek alluvium may have muted the flow response in Cumbo creek despite the above average rainfall. Higher flow in December 2020 compared with March 2020 may be evidence of this. Low alluvial groundwater levels at upstream sites in Cumbo Creek is likely related to the extended period of below average rainfall but may also be caused by a minor WCM mining effect.
- It should also be noted that the short period of observation (since 2015 only) and the high flows experienced in September and October 2016 have resulted in monthly average flows around 10x higher in September and October than other months throughout the year. This limits the ability of flows observed in these two months to be observed as a positive trend on **Figure 3**.

In undertaking the 2019 review, SLR (2020a) contacted EISolutions, who administer the flow gauges on site at the WCM and other Western Coalfield sites. Communication with EISolutions identified the following key characteristics for Cumbo Creek catchment:

- The catchment is peaty/ boggy and likely has considerable ability to absorb rainfall/ runoff prior to flow being observed at CCGSU. Therefore, the soil moisture content prior to an event could impact on the amount of runoff observed.
- Large spatial variation in rainfall exists in the Wilpinjong/Western Coalfield region. Rain in the upper catchment resulting in high flow may not be observed downstream or at the Wollar BOM station.

The points are consistent with the increasing flow rates observed in 2020 correlating with a progressively wetter catchment throughout the year.

Similar trends between rainfall and flow are observed for WILGSU (**Figure 4**) to those seen at CCGSU. However, WILGSU frequently reports no flow in periods of low monthly rainfall, indicating that baseflow (groundwater component of flow) is a smaller component of flow. An excellent correlation between the long-term rainfall trend and the cumulative deviation from mean monthly flow for WILGSU is shown in the bottom chart of **Figure 4**. The flow trend is observed to decline for the period of below average rainfall from mid-2012 to mid-2015 as well as the period of below average flow from early 2017 through to the end of 2019, although it is important to note that no flow has been recorded at WILGSU since late 2017. Response to rainfall events in 2020 is observed at WILGSU, with similar flow volumes and response to rainfall as events observed in 2012 and 2016.

Figure 5 used to analyse the flow trends at WILGSD, displays monthly rainfall and deviation from monthly average rainfall as bar charts to allow for clearer analysis of all potential components of flow at WILGSD. As stated in the above flow review (**Section 2.1**), early observations of flow comparing WILGSU and WILGSD show an excellent match before WTF discharge begins, resulting in the maintenance of flow at WILGSD when discharge is occurring despite periods of low monthly rainfall.

A period in early 2013 where there was zero discharge from the WTF shows the maintenance of flow at WILGSD while no flow was recorded at WILGSU. This may indicate that a component of flow at WILGSD comes from baseflow. It may also indicate the influence of flow from a tributary such as Cumbo Creek, which itself is influenced by baseflow. The influence of the WTF discharge on flow at WILGSD, particularly in 2017 and 2018 becomes very clear in **Figure 5**. Prior to the significant (x10) increase in WTF discharge in 2017, [1]flow at WILGSD showed a good correlation with the long-term rainfall trend.

In 2017 and 2018, the declining rainfall trend has shown no influence on flow at WILGSD, where the increasing discharge trend from the WTF became the major contributor to flow. During 2019 through to early 2020, there was no discharge from the WTF and the flow observed at WILGSD decreased significantly. As was observed prior to the establishment of the WTF, flow at WILGSD indicates a strong dependence on rainfall which has continued to 2020 with a strong correlation between upstream and downstream gauging stations on Wilpinjong Creek.

2.2 Off-site discharge

Wilpinjong have had two reportable offsite discharge events during the reporting period, on the 9th and 19th of February 2020. Wilpinjong formally reported these events to the regulator (EPA) and have taken actions to mitigate these two events so that no further off-site discharge would occur. The following section summarises the two events, including the actions taken following the events, and provides an assessment of whether there were meaningful or ongoing impacts to water quality in Wilpinjong Creek as a result of the events.

2.2.1 Event 1 – 9th February 2020

Preceding the off-site discharge on the 9th February, Wilpinjong experienced a four day (6-9 February) 59.4 mm rainfall event. This is above the adopted Blue Book design criteria for a 5 day 95th percentile storm event (44 mm) as defined in the SWMP. This event resulted in water to breaking through a safety bund and flowing underneath a sedimentation fence, releasing approximately 200 m^3 into the Ulan-Wollar Road corridor before being captured in a farm dam on Peabody owned land.

The following actions were undertaken as a result of this discharge event:

- Farm dam flocked with gypsum to consolidate suspended sediment.
- Repair of the safety bund.
- Construction of sump directly upslope of event location and install a dedicated pump to manage any water reporting to the area in the future.

2.2.1.1 Water Quality Impacts

Total Suspended Solids (TSS) was identified as the key pollutant from the 9 February 2020 event, with a reading of 372 mg/L within the farm dam between the event location and Wilpinjong Creek. Two sites were also sampled from on Wilpinjong Creek, both upstream and downstream of the potential confluence with the drainage line from the farm dam to Wilpinjong Creek. The TSS results from the upstream and downstream sampling points in Wilpinjong Creek were 6 and 5 mg/L respectively. An inspection was also undertaken on 9 February 2020. This showed no evidence of the dam overtopping

---

[1] As a result of the EPL variation in January 2017 to increase the daily discharge limit from 5ML/day to 15ML/day (note: the EPL reverted back to 5ML/day on 31 December 2019.

The conclusions made by WCM, that water from the discharge event was contained in the farm dam and did not discharge to Wilpinjong Creek, are reasonable when considering the results of sampling and the inspection on 9 February 2020.

2.2.2 Event 2 – 19th February 2020

The off-site discharge event on 19th of February resulted from a 41.8 mm rainfall event (measured at the Wilpinjong Meteorological Station), below the adopted design criteria for sediment dams and associated infrastructure (44 mm for a 5-day event). This event caused an estimated 495 m^3 water to discharge through the safety bund that was damaged in the 9 February event, across the Ulan-Wollar Road corridor, to Wilpinjong Creek and the farm dam that captured the discharge of the earlier event.

It is noted that while this event is below the below the design criteria height; the storm event resulting in the discharge was un-forecasted, the rainfall was of high intensity (7.6mm in 5 minutes, exceeding a 2-year ARI event for the area), and a Red Alert for lightning was entered. These are factors reported by Wilpinjong that may have limited the ability of the pump system, installed after the 9 February event, to be operated in a timely manner. The following actions and remedial works were undertaken as a result of the 19 February discharge event:

- The damaged bund was reconstructed and incorporated into a dam bank;
- A dam has been constructed immediately upslope of the event site with a 2 megalitre capacity; and
- An 80 litre per second pump delivering captured water to Pit 3 and into the mine water management system.

The following measures were taken or proposed to prevent or mitigate against recurrence of such an event:

- A float system is being sourced which will allow for the pump on the constructed dam to run in auto start/stop mode when unattended.
- Continuation of mining in Pit 8, creating a significant void to the north to capture water for pumping into the mine water management system.
- Review Wilpinjong's Lightning Trigger Action Response Plan.
- Review of the Pollution Incident Response Management Plan following its implementation.

2.2.2.1 Water Quality Impacts

As with the 9 February 2020 event, TSS was sampled following the 19 February 2020 event. This sampling gave a TSS reading of 688 mg/L within the farm dam, whereas the sampling points both the upstream and downstream of the confluence with the drainage line from the farm dam to Wilpinjong Creek show TSS of 184 and 198 mg/L respectively. The sampling indicates a high sediment load exists in water near the drainage line (i.e. farm dam), and the drainage line which received the discharge event likely increased TSS in Wilpinjong Creek by 14 mg/L at the time of sampling (13:20 19 February 2020). The following factors are considered relevant when assessing the impact of the discharge event to Wilpinjong Creek:

- The discharge volume compared to other contributions from adjacent and nearby catchments.
  - The estimated volume of the discharge event (0.495 ML) is calculated to be 1.4% of the volume of water generated by the Slate Gully catchment during the event and 0.07% of the water generated by the broader Wilpinjong and Wollar Creek Confluence catchment.
- The nature of the event location catchment, and the nature of the catchment between the event location and Wilpinjong Creek.

  - The Ulan-Wollar Road, directly downgradient of the discharge event location was undergoing widening, with road expansion areas unsealed at the time of the event occurred. These construction works may have contributed additional sediment load to the drainage line where the discharge event occurred.
  - Prior to the February 2020 rainfall events, the Wilpinjong area (and much of NSW) had been in severe drought conditions. The Wilpinjong Coal letter to the Resources Regulator describes the ground cover as minimal, with the lack of ground cover and associated soil stabilisation enabling mobilisation of sediment within the area due to wind and then rain from early February 2020. The additional mobile sediment within the Wilpinjong area at the time of the rainfall event would have contributed to an increased sediment load in both the drainage where the discharge occurred, and Wilpinjong Creek.
- The WEP Surface Water Assessment considered the potential for flow of water from Wilpinjong Coal to the natural catchment.
  - “Some overflow of water from sediment dams may occur during wet periods that exceed the design standard of the sediment control…these overflows would flow to the surrounding environment. Overflows would only occur during significant rainfall events which will also generate runoff from surrounding undisturbed catchments. Hence, it is unlikely that sediment dam overflows will have a measurable impact on receiving water quality.”
  - It is noted that this event occurred due to the collapse of a bund not an overflow, which would likely contribute more sediment to the discharged water than an overflow event. The discharge also resulted from a rainfall event that did not exceed the design standard of sediment control, meaning there may not have been sufficient water in the catchment to dilute the TSS contribution from the discharged water. The details of the 19 February event differ from the considerations made in the WEP Surface Water Assessment and may have contributed to the short-term measurable impact to water quality in Wilpinjong Ck.
- The WEP Aquatic Ecology Assessment also provides an overview of the condition of Wilpinjong Creek.
  - “the riparian and instream habitats of the Project Area “have been substantially altered by historical and ongoing agricultural land use practices.”
  - “Assemblages of macroinvertebrates were generally dominated by pollution-tolerant taxa”
  - “Fish habitat within Wilpinjong Creek is generally of poor to moderate ecological value.”
  - “No aquatic threatened species, populations or communities were observed in the Study Area during past or current field surveys nor are there any records of their occurrence within the Study Area”
- The sampling time in Wilpinjong Creek compared with the time of the event.
  - Sampling within the farm dam, and upstream and downstream of the confluence with the drainage line associated with the discharge, occurred between 13:00 and 14:00hr on 19 February 2020. This is around 12 hrs after the pumper was dispatched (01:55 on 19 February 2020), which was able to reduce and ultimately contain water flowing through the bund and sedimentation fence. Due to the timing, the sampling event is unlikely to have captured the peak impact on water quality from the discharge event. However, the sampling does show that any additional contribution of TSS from the discharge event greater than 14 mg/L did not occur for greater than 12hrs.
- Sampling before and following the discharge event.

- Sampling on 18 Feb 2020 at WIL_U2 and WIL_D2 observed TSS of 73 and 74 mg/L respectively. Indicating an already increased sediment load in Wilpinjong Creek prior to the discharge event.
- Sampling on 6 March 2020 observed TSS of 107 mg/L at both WILGSU and WILGSD, upstream and downstream sites on Wilpinjong Creek (although different sites to the ones sampled after the event)
- Sampling on 27 October 2020 observed TSS of 6 mg/L at WILGSU and 13 mg/L WILGSD, upstream and downstream sites on Wilpinjong Creek.
- Sampling on 22 December 2020 observed TSS of 18 mg/L at WILGSU and 7 mg/L WILGSD, upstream and downstream sites on Wilpinjong Creek.
- Sampling on 30 December 2020 observed TSS of 4 mg/L at WILGSU and 4 mg/L WILGSD, upstream and downstream sites on Wilpinjong Creek.
- Sampling on 05 January 2021 observed TSS of 19 mg/L at WILGSU and 22 mg/L WILGSD, upstream and downstream sites on Wilpinjong Creek.
- No evidence of an ongoing impact is observed in sampling events following the 19 Feb 2020 offsite discharge.

Consideration of the above points suggest that this off-site discharge may have impacted TSS levels within Wilpinjong Creek at the time of the event, but only for a short period of time. It is also difficult to apportion the contribution of TSS between the discharge event and the Ulan-Wollar Road construction works.

The conclusion in the WCM letter to the Resources Regulator, is that it is “highly unlikely that the release of… water with suspended sediment from the Event location has led to any genuine environmental harm.” is reasonable and supported by ongoing monitoring collected in 2020 and early 2021.

2.3 Water Quality Review

Water quality is monitored continuously at WILGSU, WILGSD and CCGSU, with sondes measuring EC, pH (and temperature, which is not provided here). When water levels decline in dry periods, sondes may be ‘banked’ or capped to protect the instrument. These periods are marked on the EC and pH charts in **Figure 2**.

2.3.1 Electrical Conductivity Trends

Trends in Electrical Conductivity (EC) at WILGSU, WILGSD and CCGSU are influenced by the following different factors:

- As identified in **Section 2.1**, flow at WILGSU is most strongly influenced by the rainfall trend, with limited contribution identified from groundwater (baseflow). EC at WILGSU is therefore low (~1000 µS/cm) and relatively consistent, with a minor inverse response to the rainfall trend (rainfall down results in an increase in EC) likely resulting from increased evaporation and lower contribution of fresh water in periods of low rainfall.
- As identified in **Section 2.1**, flow at CCSGU is likely to have a persistent groundwater contribution that is sourced from weathered Permian coal measures. This results in observations of EC from 6000-8000 µS/cm). Declines in EC are observed following peak rainfall events (Dec 2020, Sep 2016).

- As identified in **Section 2.1**, flow at WILGSD is influenced by upstream flow from both Wilpinjong and Cumbo Creeks as well as the WTF, which all have varying EC values. From 2012 to 2014, EC at WILGSD followed an inverse trend with rainfall to reach an EC of ~7000 µS/cm, likely due to baseflow contributions within Wilpinjong Creek or from the more saline Cumbo Creek. From 2015 to the start of 2019, coincidental with the period of discharge from the WTF, and flow from WILGSU, EC at WILGSD freshened to around ~1000 µS/cm. EC in 2020 at WILGSD again appears to be influenced by flow from upstream Wilpinjong Creek.

In 2020 Cumbo Creek displayed EC levels of around 6000 µS/cm due to baseflows from the increased rainfall from 2019 while both WILGSU and WILGSD displayed EC levels around 500 µS/cm. Overall, 2020 EC levels during creek flows at all three locations are consistent with previous years of record containing flow data.

2.3.2 pH Trends

pH at CCGSU is generally consistent for the entire monitoring period at a level of around 7.7, with no strong correlation to rainfall or streamflow trends. Peaks in the pH readings prior to no-flow conditions in Cumbo Creek should be considered unreliable as water quality sondes may not be fully saturated.

pH at both gauging stations on Wilpinjong Creek are different by about 1pH unit and show some correlation to long-term rainfall trends. pH is generally observed to decrease in periods of lower flow and below average rainfall, before increasing back toward average levels following periods of flow and rainfall (Jul 2014, Apr 2015, Jun 2016, Jan 2018, April 2018, Feb 2020). It is possible that the measured decline in pH is due to natural processes resulting from saline groundwater discharge in creeks hosting chemical changes such as conversion of sulphates to sulphides, leading to acid generation. Such processes are not necessarily mining-related, but can be exacerbated by human activities, such as land clearing or water demand (e.g. irrigation, potable supply, mining).

In 2020 the pH levels in both WILGSD and WILGSU are their lowest on record (~pH5.5) and increase by about 1 pH unit over 2020. The more acidic conditions observed in WILGSD and WILGSU for 2020 compared to previous years could be associated with the 2017-2019 drought and the long period of no flow observed in Wilpinjong Creek. Analysis of data in Q1 2021 will help determine whether pH has returned to previously observed levels in Wilpinjong Creek.

3 Water Quality Assessment at Additional Locations

The following section reviews surface water quality data from monitoring sites specified in Section 8 of the Surface Water Management Plan (Peabody, 2018). This has been conducted with respect to 20th and 80th percentile baseline monitoring data, which was collected from 2004 to 2009, prior to the commencement of mining. Where no water quality triggers are defined, the review aims to identify trends in surface water quality that are not consistent with baseline observations (**Table 2**).

Table 2 Summary of Baseline Water Quality Data – Local Creeks (Peabody, 2018)

Monitoring Site[1]/Guideline		pH	EC (µS/cm)[2]	Turbidity (NTU)[2]
ANZECC (2000) Guideline Trigger Value	**Protection of Aquatic Ecosystems**	6.5-8.0	30-350	2-25
	Primary Industries (Livestock Drinking Water)	6-9	950	-
Wilpinjong Creek Upstream (Sites WIL-U2, WIL-U, WIL 1, WIL-PC)	Average	7	2435	20
	Minimum	5.7	450	6
	Maximum	9	12190	41
	No. Samples	49	49	5
	80th percentile	**7.7**	**4066**	**24**
	20th percentile	**6.9**	-	-
Wilpinjong Creek Downstream (Sites WIL-NC, WIL-D2, WIL 2, WIL-D)	Average	8	3531	22
	Minimum	6.7	680	4
	Maximum	9	7450	70
	No. Samples	55	55	9
	80th percentile	**7.9**	**5166**	**28**
	20th percentile	**7.4**	-	-
Cumbo Creek Upstream (Sites CC2, CC3, CC4, CC5)	Average	8	5303	11
	Minimum	6.8	100	5
	Maximum	9	10500	24
	No. Samples	70	70	15
	80th percentile	**8.2**	**6750**	**16**
	20th percentile	**7.4**	-	-
Cumbo Creek Downstream (Site CC1)	Average	8	6231	43
	Minimum	6.7	540	17
	Maximum	9	10470	94
	No. Samples	27	27	6
	80th percentile	**8.2**	**7510**	**77**
	20th percentile	**7.52**	-	-
Wollar Creek (Sites WOL 1, WOL 2, WOL 3)	Average	8	2311	16
	Minimum	6.5	90	2
	Maximum	8.4	6540	37
	No. Samples	90	90	20
	80th percentile	**8.0**	**3460**	**25**
	20th percentile	**7.4**	-	-

[2] µS/cm = micro-siemens per centimetre, NTU = Nephelometric Turbidity Units, mg/L = milligrams per litre

Assessment is also made with respect to Water Quality Impact Assessment Criteria (trigger levels) where applicable. Where trigger levels are defined (**Table 3**) the review will identify any exceedances and provide preliminary analysis.

Table 3 Water Quality Impact Assessment Criteria (Peabody, 2017)

Creek	Monitoring Site	Parameter	Trigger
Wilpinjong Creek (Downstream)	WIL_NC, WIL_D2, WIL_D, WIL_2	EC	If recorded value at the monitoring site is greater than **3,440 µS/cm** for 3 consecutive readings
		Turbidity	If recorded value at the monitoring site is greater than **24 NTU** for 3 consecutive readings
		pH (lower)	If recorded value at the monitoring site is less than **6.9 pH** for 3 consecutive readings
		pH (upper)	If recorded value at the monitoring site is greater than **7.7 pH** for 3 consecutive readings
Cumbo Creek (Downstream)	CC1	EC	If recorded value at the monitoring site is greater than **7,510 µS/cm** for 3 consecutive readings
		Turbidity	If recorded value at the monitoring site is greater than **77 NTU** for 3 consecutive readings
		pH (lower)	If recorded value at the monitoring site is less than **7.5 pH** for 3 consecutive readings
		pH (upper)	If recorded value at the monitoring site is greater than **8.2 pH** for 3 consecutive readings

[1] Trigger is only considered to have been exceeded if the recorded value at monitoring site is greater than (or less than for lower pH Trigger) all values from the upstream monitoring sites sampled on the same day. In the event that a single result is recorded above/below the 80th/20th percentile value, WCPL will undertake a preliminary investigation to ascertain whether the result was caused by an obvious anomaly or whether further testing is required.

3.1 Review of Creeks without Trigger Levels

Time-series water quality data from upstream monitoring sites at Wilpinjong (Sites WIL-U2, WIL-U, WIL 1, WIL-PC) and Cumbo Creeks (Sites CC2, CC3, CC4, CC5) as well as monitoring sites at Wollar Creek (Sites WOL 1, WOL 2) (**Table 4**) are reviewed against 20th and 80th percentile observation data for EC, Turbidity and pH from the baseline monitoring period (2004-2009). These monitoring sites are upstream or distant from WCM mining operations and provide a point of reference when assessing downstream sites with trigger levels.

Data at several additional monitoring sites was also provided to SLR by WCM. The observations from these additional sites have been included in the appropriate creek area.

Table 4 Additional surface water monitoring sites

Monitoring Site	Creek Area
CC-GS-U, CC-GS	Cumbo Creek Upstream
CC-GS-D, CC-1 (30m up)	Cumbo Creek Downstream
WIL-GS-U	Wilpinjong Creek Upstream
WIL-GS-D	Wilpinjong Creek Downstream

The review is conducted for each creek area by analysing time-series water quality data (EC, turbidity, pH) from January 2015 to December 2020 on a three-panel chart. It should be noted that turbidity data is assessed using a logarithmic y-axis.

3.1.1 Wilpinjong Upstream

The creek area defined as Wilpinjong Upstream (Peabody, 2017) is assessed using monitoring data from sites WIL-U2, WIL-U, WILGSU and WIL-PC (**Figure 6**). These sites are located along Wilpinjong Creek near the western edge of current and proposed WCM mining activity (**Figure 1**).

3.1.1.1 Electrical Conductivity

EC observations at Wilpinjong Creek Upstream monitoring sites have shown considerable variation between 2015 and 2020 (<1000 µS/cm to 7500 µS/cm). More elevated observations (>4000 µS/cm) are observed at WIL-U WIL-U2 and WIL-PC, and are observed to occur simultaneously with fresher observations at WIL-GS-U (~2000 µS/cm. This indicates EC observations at these sites may be influenced by localised effects in lower or average flow and rainfall conditions. A notable freshening at all Wilpinjong Creek Upstream sites occurs in late 2016 and again in 2020 in response to above average rainfall conditions. EC observations at Wilpinjong Creek Upstream monitoring sites are well below the 80th percentile baseline (4066 µS/cm) for 2020. All monitoring locations shows similar trends which is consistent with the rainfall increase observed in 2020, indicating connection and a consistent water source during higher periods of flow.

Rainfall, and subsequent flow conditions are considered to be the primary drivers of EC observations at Upstream Wilpinjong Creek monitoring sites.

3.1.1.2 Turbidity

Turbidity observations at Wilpinjong Creek Upstream monitoring sites fluctuate consistently from 2015 to 2020, with observations ranging from 6.6 – 2000 NTU, and are above the 80th percentile baseline monitoring value for around half of the observations. Turbidity observations with higher values generally appear to be associated with periods of below average rainfall. Increases in turbidity at the WIL-U2 and WIL-GS-U monitoring sites generally occur during periods of below average rainfall in mid-2016, early 2017, late 2017, late 2018 to early 2019, and early 2020. Comments made on field sheets during sampling in low flow conditions commonly use phrases such as ‘muddy brown colour’ and mention that samples are collected from disconnected pools with no-flow conditions. Sampling in conditions such as these will not be representative of the system as a whole. During 2020, turbidity observations generally range from 10-100 NTU with few outliers, again showing connectivity of the sites during periods of above average rainfall and flow. Initial peaks in 2020 (100-1000 NTU at WIL-GS-U and WIL-U2) may be related to an increased load of fine sediment being flushed down Wilpinjong Creek after low and no flow conditions since 2017.

Flow conditions (influenced by rainfall trends) are considered to be the primary drivers of turbidity observations at Upstream Wilpinjong Creek monitoring sites.

3.1.1.3 pH

pH observations at Wilpinjong Creek Upstream monitoring sites from 2015 to 2019 have generally been lower than the 20th percentile value defined in baseline monitoring data. Of note is the extended period of low pH recorded at WIL-U2 from mid-2016 to late 2019 during which pH was around 4 for 5 sampling events in 2019.

As was proposed in **Section 1.2.2**, this decline in pH may be associated with saline groundwaters or groundwater discharge into the system hosting chemical changes such as conversion of sulphates to sulphides, leading to acid generation. Sampling from disconnected pools and very low flow conditions will not be representative of the system as a whole.

pH observations at Wilpinjong Creek Upstream monitoring sites during 2020 once again show similar values with only two lower readings for WILGSU and WIL-U2. The start of 2020 shows lower pH readings (below the 20th percentile baseline (pH 6.9)) than the remainder of the year, with most observations stabilising near the 20th percentile baseline value in late 2020. Monitoring in 2021 will determine whether values return between the 80th and 20th percentiles from the baseline period.

Rainfall, and subsequent flow conditions are considered to be the primary drivers of pH observations at Upstream Wilpinjong Creek monitoring sites.

3.1.2 Cumbo Creek Upstream

The creek area defined as Cumbo Creek Upstream (Peabody, 2017) is assessed using monitoring data from sites CC2, CC3, CC-GS and CC-GS-U (**Figure 7**). These sites are located along Cumbo Creek to the south of WCM (**Figure 1**).

3.1.2.1 Electrical Conductivity

EC observations at Cumbo Creek Upstream show considerable variation between 2012 and 2015 (<1000 µS/cm to ~10,000 µS/cm) but are generally saline. Freshening may occur following increases in the long-term rainfall trend as is seen in late 2016, with the inverse observed in periods of low rainfall. However, most of the 2019 and 2020 EC observations at CC2 and CCGSU are above the 80th percentile value taken from 2004 to 2009 baseline observations, with a high EC reading of ~10,000 µS/cm at CC-2 in March 2019, that decreases to ~7,000 µS/cm toward the middle of 2019 and through 2020. This is likely related to ongoing groundwater contributions to flow in Cumbo Creek. It is also noted that overall, EC observations for 2020 are grouped in a tighter range than previously observed over the rest of monitoring period (2014-2019).

A combination of rainfall, subsequent flow, and ongoing groundwater contributions are considered to be the primary drivers of EC observations at Cumbo Creek monitoring sites.

3.1.2.2 Turbidity

Turbidity observations at Cumbo Creek Upstream monitoring sites from 2015 to 2020 were generally below the 80th percentile baseline value for data collected from 2004 to 2009. Higher values (1000-10,000 NTU) that are not clearly linked with the rainfall trend occurred throughout 2015 and again in early-2018. During 2019 and 2020, turbidity observations have generally been below the 80th percentile baseline value aside December 2020 readings CCGSU and CC-2 which are around 200-300 NTU. Ongoing monitoring in 2021 will determine whether these observations are outliers or require additional investigation. The availability of a longer period of historic data may allow for more in-depth cause and effect analysis between turbidity and external or environmental influences.

3.1.2.3 pH

pH observations at Cumbo Creek Upstream have been relatively stable from 2015-2020. CC-3 observations were generally marginally higher than the 80th percentile value defined from the baseline monitoring during 2017. While observations at CC-2 and CC-GS-U were consistently within the 20th and 80th percentile bands defined in the baseline period. During 2020, pH observations at Cumbo Creek Upstream monitoring sites are generally within both the 20th and 80th percentile baselines with CC-3 showing more alkaline readings which is consistent with previous monitoring cycles. Similar to turbidity, pH observations at Cumbo Creek Upstream monitoring sites show limited response to rainfall fluctuation, likely indicating Cumbo Creek is more influenced by groundwater inflows.

3.1.3 Wollar Creek

Wollar Creek is assessed using monitoring data from sites WOL-1, and WOL-2 (**Figure 7**). The sites are located along Wollar Creek to the east of WCM, with WOL-1 located downstream of the confluence between Wilpinjong and Wollar Creeks (**Figure 1**). The Wollar Creek monitoring sites are located approximately 1-2km (WOL2 and WOL1 respectively) from the current extent of WCM mining activity.

3.1.3.1 Electrical Conductivity

EC observations at both Wollar Creek monitoring sites can remain stable or show periods of considerable variation. EC ranged from less than 1000 µS/cm to greater than 5500 µS/cm in 2015; was stable and less than 3000 µS/cm from 2016 to 2019; and then above 3000 µS/cm to a maximum of ~6800 µS/cm during 2019. This appears to be generally related to the rainfall trend. Above average rainfall likely results in stable EC below the 80th percentile value, while low rainfall results in more saline and more variable observations.

EC observations at Wollar Creek monitoring sites WOL-1 and WOL-2 are below the 80th percentile baseline (3460 µS/cm) for 2020 and showing similar trend the 2015-2018 period. These EC readings seem to be related to the rainfall trend and groundwater inflows. Drought periods return higher EC readings than wet periods, likely due to less dilution of the more saline groundwater.

3.1.3.2 Turbidity

Turbidity observations at Wollar Creek monitoring sites were relatively stable from 2015 to 2019 and have generally recorded below the 80th percentile of baseline data collected from 2004-2009. Notable increases in turbidity, above the 80th percentile baseline value, occur on two occasions during this time -In late 2015, and in late 2018, for a single observation at both WOL-1 and WOL-2 monitoring sites. These increases appear to be associated with a period of above average rainfall that follows a period of low or below average rainfall. These periods of low rainfall would be associated with lower flow in Wollar Creek, which may facilitate the settling of suspended material to the stream bed. The higher flow events associated with above average rainfall may resuspend this fine material, resulting in the temporary spikes in turbidity.

Turbidity observations during 2020 at Wollar Creek monitoring sites are generally below the 80th percentile baseline (25 NTU), except for WOL-2 showing one reading above the baseline in early 2020. Overall, NTU readings for 2020 are consistent with the observed trend for the entire monitoring period (2014-2019).

3.1.3.3 pH

pH observations at Wollar Creek have been relatively stable from 2015-2019. WOL-2 observations have been generally marginally higher than the 80th percentile value defined from the baseline monitoring. While observations at WOL-1 were consistently within the 20th and 80th percentile bands defined in the baseline period.

pH observations at Wollar Creek Upstream monitoring sites for 2020 are consistent with those observed for the 2014-2019 period. WOL-2 has two outlier observations giving slightly acidic readings (pH 6.3) in the second quarter of 2020 that are not maintained for the rest of 2020. WOL-1 readings are within the 20th and 80th percentile baselines while WOL-2 readings are just above the 80th percentile baseline, as previously observed.

3.2 Assessment of Creeks with Trigger Levels

Time series water quality data from the downstream monitoring sites at Wilpinjong (Sites WIL-NC, WIL-D2, WIL-D, WIL-GS-D) and Cumbo Creeks (Site CC-1) are assessed against Water Quality Impact Assessment Criteria (trigger levels) as defined in the SWMP (Peabody, 2017). These monitoring locations are adjacent to or close downstream from WCM mining activity and are therefore more likely to indicate impacts to surface water quality caused by mining.

3.2.1 Wilpinjong Creek Downstream

The creek area defined as Wilpinjong Creek Downstream (Peabody, 2017) is assessed against water quality trigger levels at sites WIL-NC, WIL-D2, WIL-D and WIL-GS-D (**Figure 8**). These sites are located along Wilpinjong Creek, adjacent to, or just downstream of WCM mining operations (**Figure 1**).

3.2.1.1 Electrical Conductivity

As discussed in **Section 2.3** EC observations at Wilpinjong Creek Downstream monitoring sites are influenced by upstream flow from Wilpinjong Creek, flow from Cumbo Creek, WTF discharge, and some contribution of baseflow. This has resulted in higher EC observations in periods of low flow, above the defined trigger level in 2015 and 2019, attributed to greater contributions from baseflow or Cumbo Creek flow. Also observed are longer periods of consistently low EC observations from 2016 to 2018 attributed to fresh WTF discharge (**Figure 6**).

While historical observations have been above the defined trigger level, these have not been assessed as exceedances related to WCM mining activity. EC observations at Wilpinjong Creek upstream monitoring sites during these periods were also elevated and reasonably consistent with observations at the downstream monitoring sites.

During the 2020 monitoring period, EC observations at Wilpinjong Creek Downstream monitoring sites are well below the 80th percentile baseline as well as below the trigger level (3440 µS/cm). Overall, the observations seem to reach equilibrium at around 500 µS/cm as the rainfall trend increases in 2020.

3.2.1.2 Turbidity

Turbidity observations at monitoring sites in the Wilpinjong Creek downstream area show some variability from 2015 to 2020 (10-1000 NTU) (**Figure 8**), with a minor inverse relationship to the rainfall trend. Observations during average or below average dry periods in 2015 and 2018/19 have a higher turbidity than wetter periods (2016/17 and 2020). Although turbidity observations are frequently above the trigger level at Wilpinjong Creek downstream monitoring sites, consistencies with turbidity observations at Wilpinjong Creek upstream monitoring locations mean these observations are unlikely to be related to WCM mining activity and do not constitute a trigger exceedance.

During 2020, turbidity observations at Wilpinjong Creek Downstream monitoring sites are close to the 80th percentile baseline (28 NTU) and trigger level (24 NTU) with 5-10 observations for WIL-D, WIL-D2 and WILGSD above the trigger level in 2020. However, three consecutive readings were not observed above the trigger level in 2020, and the observations are very similar to those recorded at upstream monitoring sites. As described in the paragraph above, this does not constitute an exceedance of the trigger level.

3.2.1.3 pH

pH at the monitoring sites in the Wilpinjong Creek Downstream area have been reasonably consistent and did not exceeded the trigger levels defined in the SWMP (Peabody, 2017) from 2015 to the end of 2017. During early 2018, sites WIL-D and WIL-D2 record pH levels considerably lower than the lower trigger value. WIL-D2 has 2 consecutive observations with a minimum pH of 4, below the trigger level, while WIL-D has 3 consecutive observations, with a minimum pH of 5, below the trigger level. Due to low pH values observed simultaneously at Wilpinjong Creek Upstream monitoring site WIL-U2 (**Figure 6**), this does not constitute a trigger exceedance.

As was proposed in Section 1.2.2 and Section 3.1.1, this decline in pH may be associated with saline groundwaters or groundwater discharge into the system, hosting chemical changes such as conversion of sulphates to sulphides, leading to acid generation. Aside from a single observation with a low pH (~pH4), pH observations during 2019 have been stable and do not exceed defined trigger levels.

During 2020 pH observations at Wilpinjong Creek Downstream monitoring sites are below the lower trigger level at the beginning of the year, before increasing to values within the trigger level bounds. A similar trend was observed at Wilpinjong Creek Upstream monitoring sites, it is likely that the low pH readings are likely to be related to catchment response to the 2019 drought rather than a WCM mine impact.

3.2.2 Cumbo Creek Downstream

The creek area defined as Cumbo Creek Downstream is assessed against water quality trigger levels at site CC1, CC-GS-D, CC-1-(up 30m) (**Figure 10**). These sites are located close to the confluence of Wilpinjong and Cumbo Creeks and are near the northern extent of WCM mining operations.

3.2.2.1 Electrical Conductivity

EC observations at Cumbo Creek Downstream monitoring sites show considerable variation from 2015 to 2020 (<1000 µS/cm to ~6400 µS/cm) but have not recorded an observation above the trigger level since 2015.

During 2020, EC observations at Cumbo Creek Downstream monitoring sites are mostly well below the trigger level (7510 µS/cm) with one reading just above 6270 µS/cm at CCGSD.

3.2.2.2 Turbidity

With respect to the 80th percentile baseline data trigger value, turbidity observations at Cumbo Creek Downstream monitoring sites were elevated for 2015, low during 2016, corresponding with a period of above average rainfall, and again generally elevated from 2017 to 2020 (**Figure 10**). Turbidity observations exceed the trigger level for Cumbo Creek Downstream during late 2015 and early 2016 and again during 2018 and 2019. These exceedances of the turbidity trigger at the Cumbo Creek Downstream area are likely to be a combination of low/no-flow conditions in Cumbo Creek, in conjunction with an increase of sediment to the creek. The CC-1 surface water monitoring site is near to WCM Pit 3 (~50 m) and Pit 4 (~250 m) but is also directly adjacent to the unsealed Ulan-Wollar Road (<10 m) (**Figure 11**). It is likely that the high turbidity levels occurring at the Cumbo Creek Downstream area are due to an increased sediment load caused by the heavily used and unsealed Ulan-Wollar Road during a period of low rainfall (this road has since been sealed).

While turbidity observations at Cumbo Creek Downstream monitoring sites in 2020 are mostly above the trigger level (77 NTU) three consecutive observations above the trigger level were not observed, therefore not constituting an exceedance. The influence of Ulan-Wollar Road or site activity should be investigated further if trigger exceedances continue in to 2021.

3.2.2.3 pH

From 2015 to early 2019, pH observations at Cumbo Creek Downstream monitoring sites are consistently below the trigger level defined in the SWMP (Peabody, 2017) at level of around pH 7 (**Figure 10**). They are also generally lower than pH observations from Cumbo Creek Upstream monitoring sites (**Figure 7**).

While these observations constitute an exceedance of the pH trigger level, all observations are within the pH 6.5-8 range defined in the ANZECC (2000) guidelines for the protection of aquatic ecosystems and do not pose a threat to the health of the system.

pH observations at Cumbo Creek Downstream monitoring sites during 2020 are mostly within the defined trigger levels band with only a single observation at three sites with a pH below the lower trigger for 2020.

3.3 Assessment with respect to SWMP (Peabody, 2017) water quality triggers

Table 6 identifies Water Quality Impact Assessment Criteria defined in the SWMP (Peabody, 2017) that have been exceeded during monitoring from (2015-2018). This assessment, in line with the SWMP (Peabody, 2017) has only considered triggers to be exceeded under the following circumstances:

- *Trigger is only considered to be exceeded if recorded value at the monitoring site is greater than (or less than for lower pH trigger) for 3 consecutive readings.*
- *Trigger is only considered to have been exceeded if the recorded value at monitoring site is greater than (or less than for lower pH Trigger) all values from the upstream monitoring sites sampled on the same day.*

Table 5 Exceedances of Water Quality Impact Assessment Criteria (Peabody, 2017)

Creek	Site	Parameter	Trigger[1,2]	Exceedance[1,2] during 2020 reporting period	Summary of Assessment
Wilpinjong Creek (Downstream)	WIL_NC, WIL_D2, WIL_D, WIL_2	EC	**3,440 µS/cm**	No	
		Turbidity	**24 NTU**	No	Three consecutive readings were not observed. Observations consistent with upstream sites.
		pH (lower)	**6.9 pH**	No	Observations below trigger level but consistent with upstream sites.
		pH (upper)	**7.7 pH**	No	
Cumbo Creek (Downstream)	CC1	EC	**7,510 µS/cm**	No	
		Turbidity	**77 NTU**	No	Three consecutive readings were not observed above the trigger level during the 2020 monitoring period.
		pH (lower)	**7.5 pH**	No	Three consecutive readings were not observed above the trigger level during the 2020 monitoring period.
		pH (upper)	**8.2 pH**	No	

[1] Trigger is only considered to have been exceeded if the recorded value at monitoring site is greater than (or less than for lower pH Trigger) all values from the upstream monitoring sites sampled on the same day. In the event that a single result is recorded above/below the 80th/20th percentile value, WCPL will undertake a preliminary investigation to ascertain whether the result was caused by an obvious anomaly or whether further testing is required.
2 Trigger is only considered to be exceeded if recorded value at the monitoring site is greater than (or less than for lower pH trigger) for 3 consecutive readings.

All Wilpinjong Creek Downstream monitoring sites are below the pH trigger for at least three consecutive readings for the first half of 2020. However, a similar trend was observed at Wilpinjong Creek Upstream therefore excluding a WCM mining impact to the creek water quality. Overall, no site has met the exceedance criteria during the 2020 monitoring period.

4 Conclusions and Recommendations

4.1 Conclusion

Analysis of the available surface water quality data in 2020 is not indicating observable impacts from WCM mining operations into the adjacent creek lines. Additionally, the water quality impact assessment criteria were not exceeded during this reporting period.

Even though water quality monitoring locations around the WCM did not exceed any criteria defined in the SWMP, SLR proposes the following recommendations to enable a more robust analysis of monitoring data.

4.2 Recommendations

SLR proposes the following recommendations with respect to SWMP (Peabody, 2017) water quality triggers:

- Further investigation of the baseline data (2004-2009) at Wilpinjong surface water monitoring locations. The following are examples of sites where this data would help to improve analysis:
    - Cumbo Ck Downstream: Analysis of baseline data may assist in determining the validity of the pH trigger level;
    - Cumbo Creek all sites: Analysis of baseline data may assist in determining the relationship between turbidity observations at upstream and downstream monitoring sites at Cumbo Creek during the baseline period (2004-2009). This may assist in determining whether turbidity trigger exceedances are likely to be related to WCM activity.
    - Analysis of baseline data at all sites would provide evidence of water quality response under a broader range of climatic conditions than experienced since 2015.

SLR also proposes the following additional recommendations for Wilpinjong to consider regarding relocation of a flow monitoring station at downstream Cumbo Creek. This will allow for ongoing monitoring and analysis regarding the following objectives:

- Changes to the flow relationship along Cumbo Creek between sites that are upstream and downstream of Wilpinjong mining operations;
- Assist in isolating whether changes to water quality downstream of the site are related to activity at Wilpinjong Creek or Cumbo Creek; and
- Provide baseline data to measure the efficacy of the approved Cumbo Creek diversion.

5 References

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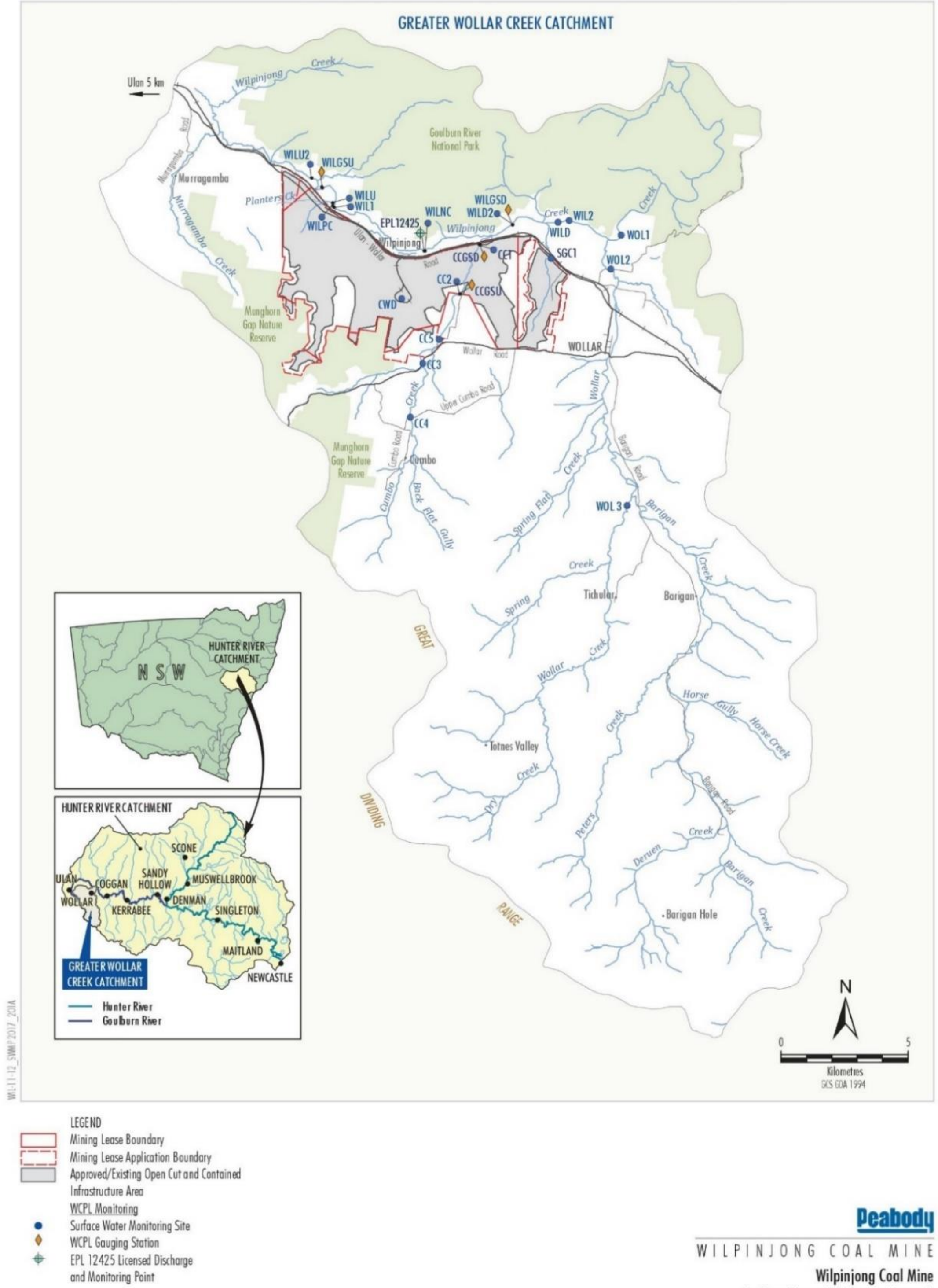
FIGURES



Source: WCPL (2017); After DIPNR (2003); DPI Water (2015); NSW Land & Property Information (2013)

Figure 1 Wilpinjong Coal Mine – Surface Water Monitoring Network (WCPL, 2017)

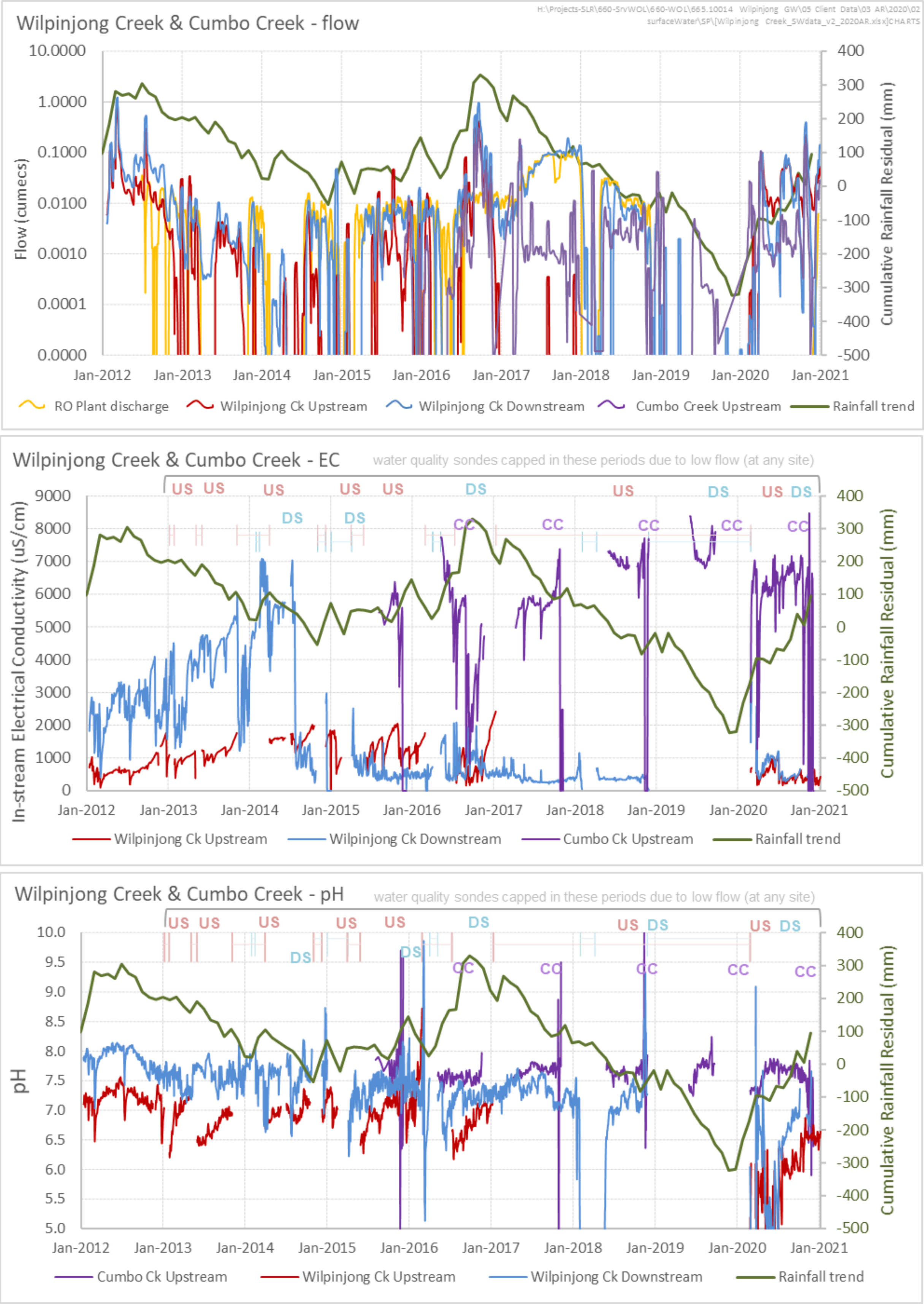


Figure 2 Summary of assessed surface sites near Wilpinjong Coal Mine

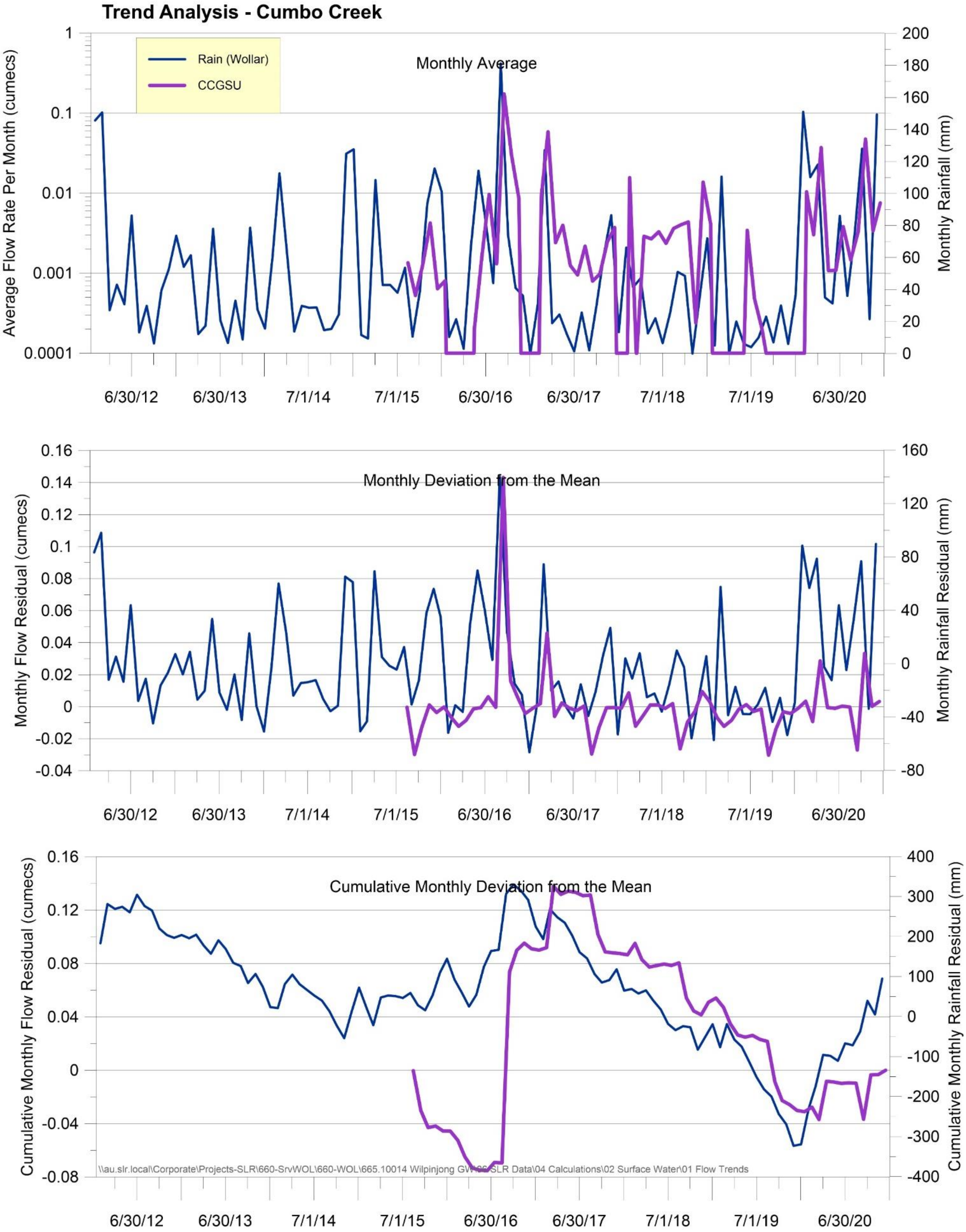


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Figure 3 Summary of the Trend Analysis on Cumbo Creek Upstream gauging station (CCGSU)

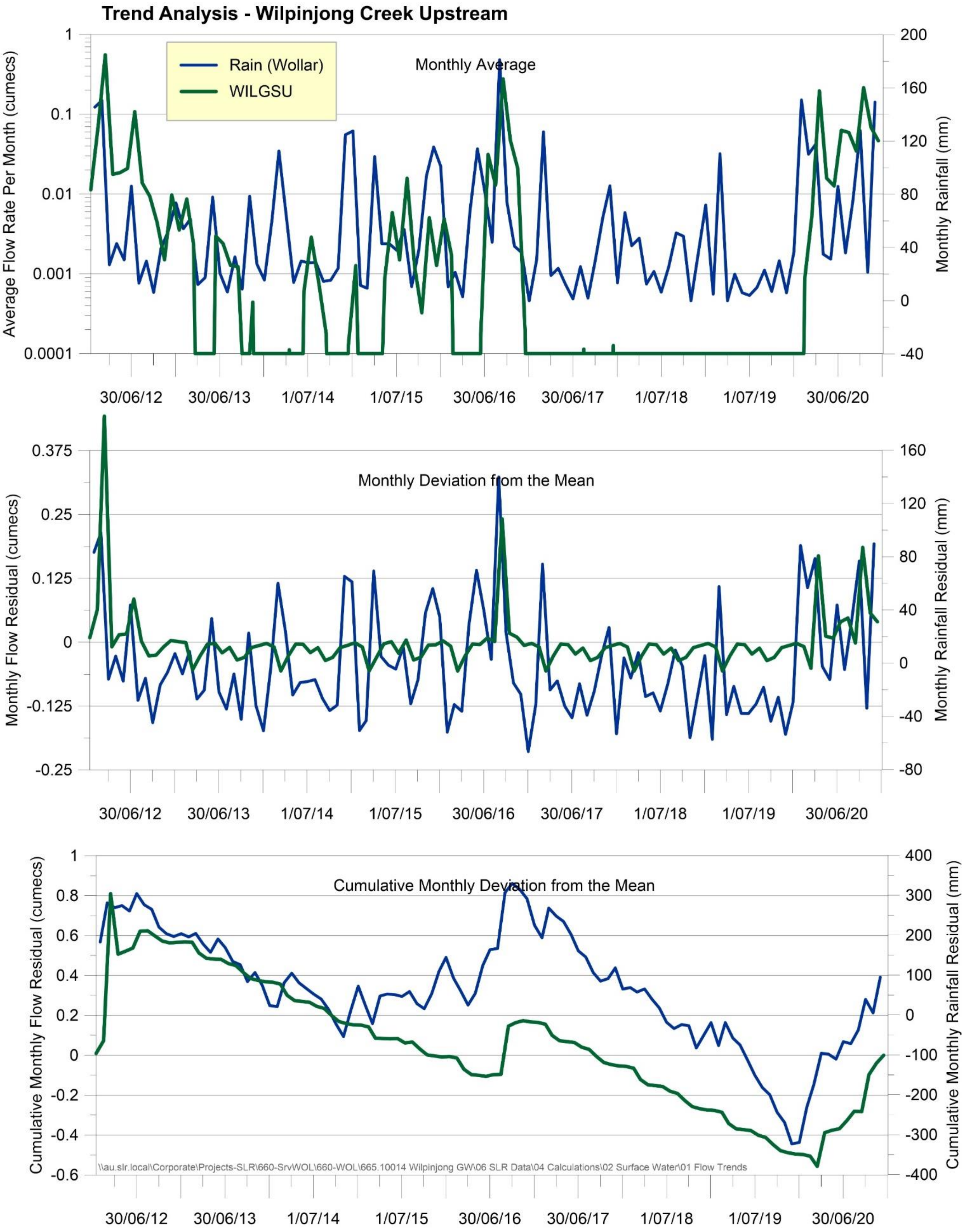

Figure 4 Summary of the Trend Analysis on Wilpinjong Creek Upstream gauging station (WILGSU)

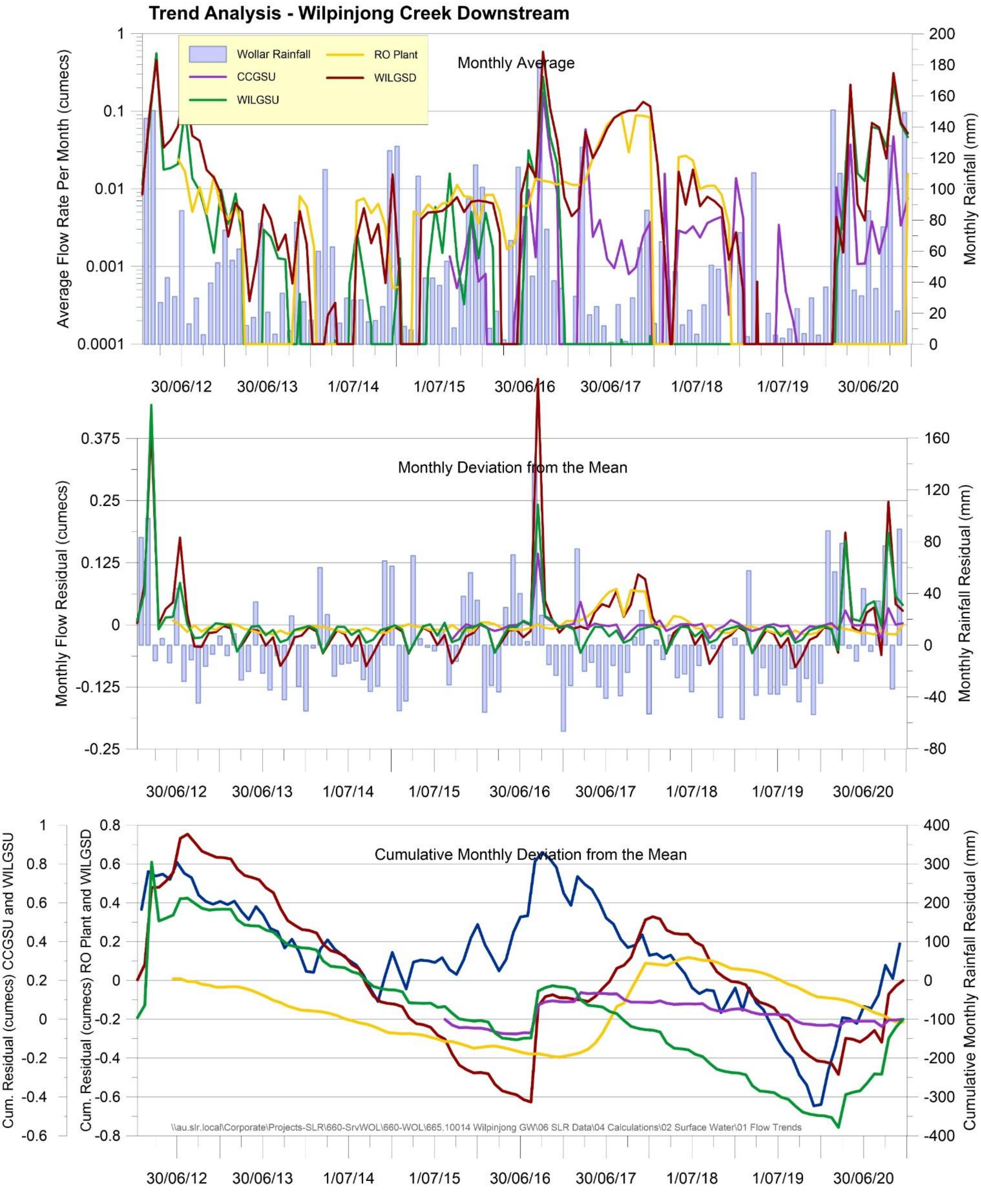

Figure 5 Summary of the Trend Analysis on Wilpinjong Creek Downstream gauging station (WILGSD)

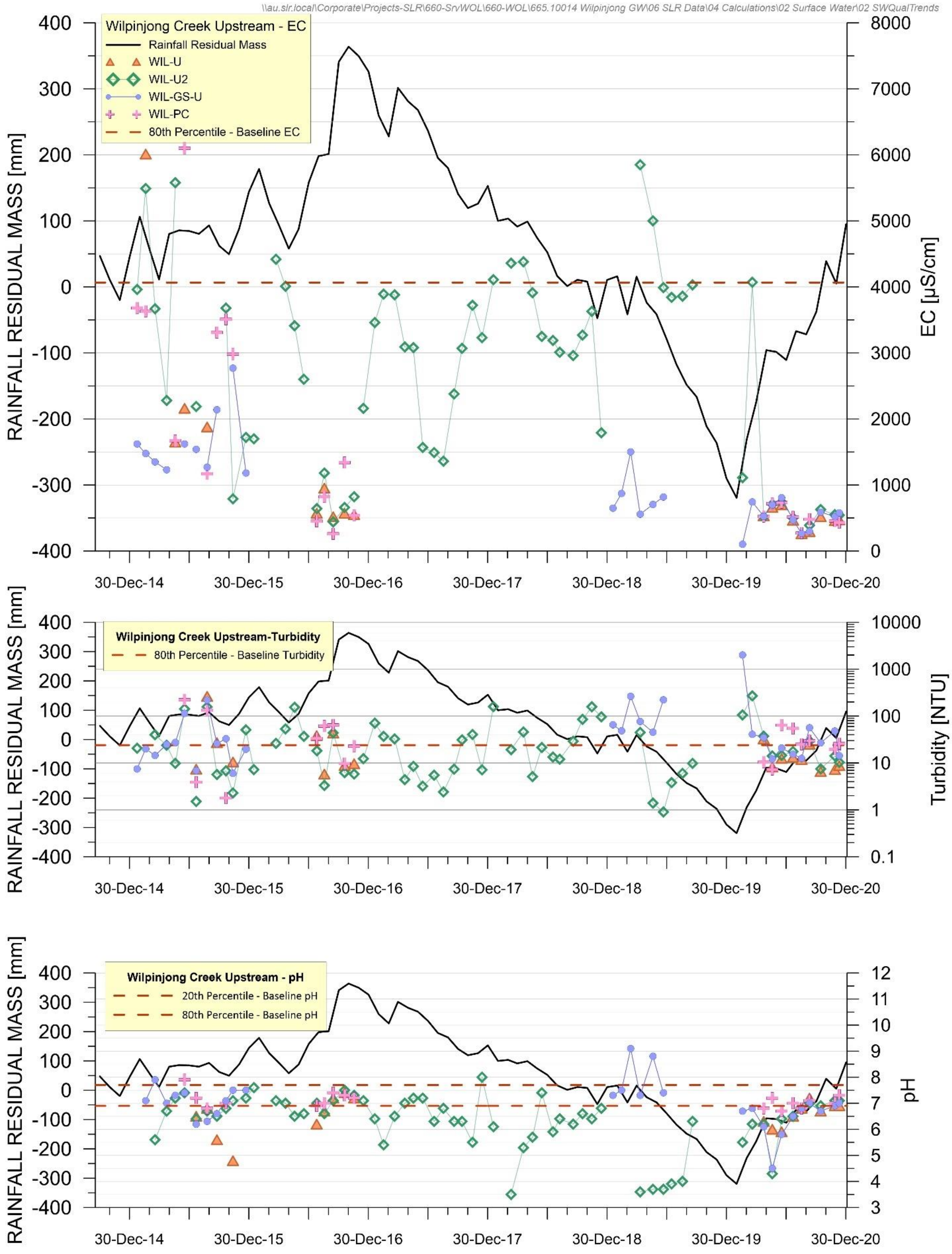

Figure 6 Time-series water quality for Wilpinjong Creek Upstream

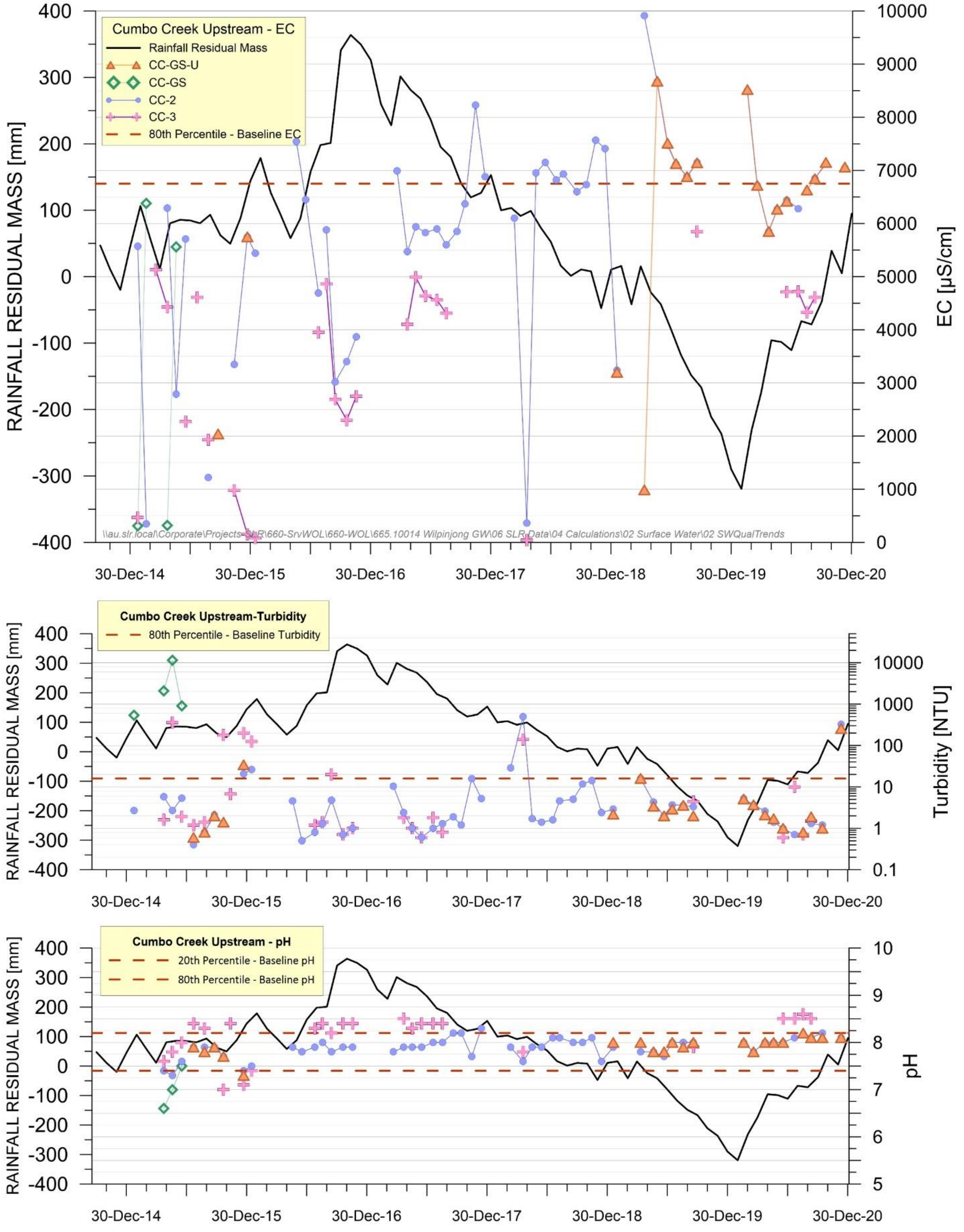

Figure 7 Time-series water quality for Cumbo Creek Upstream

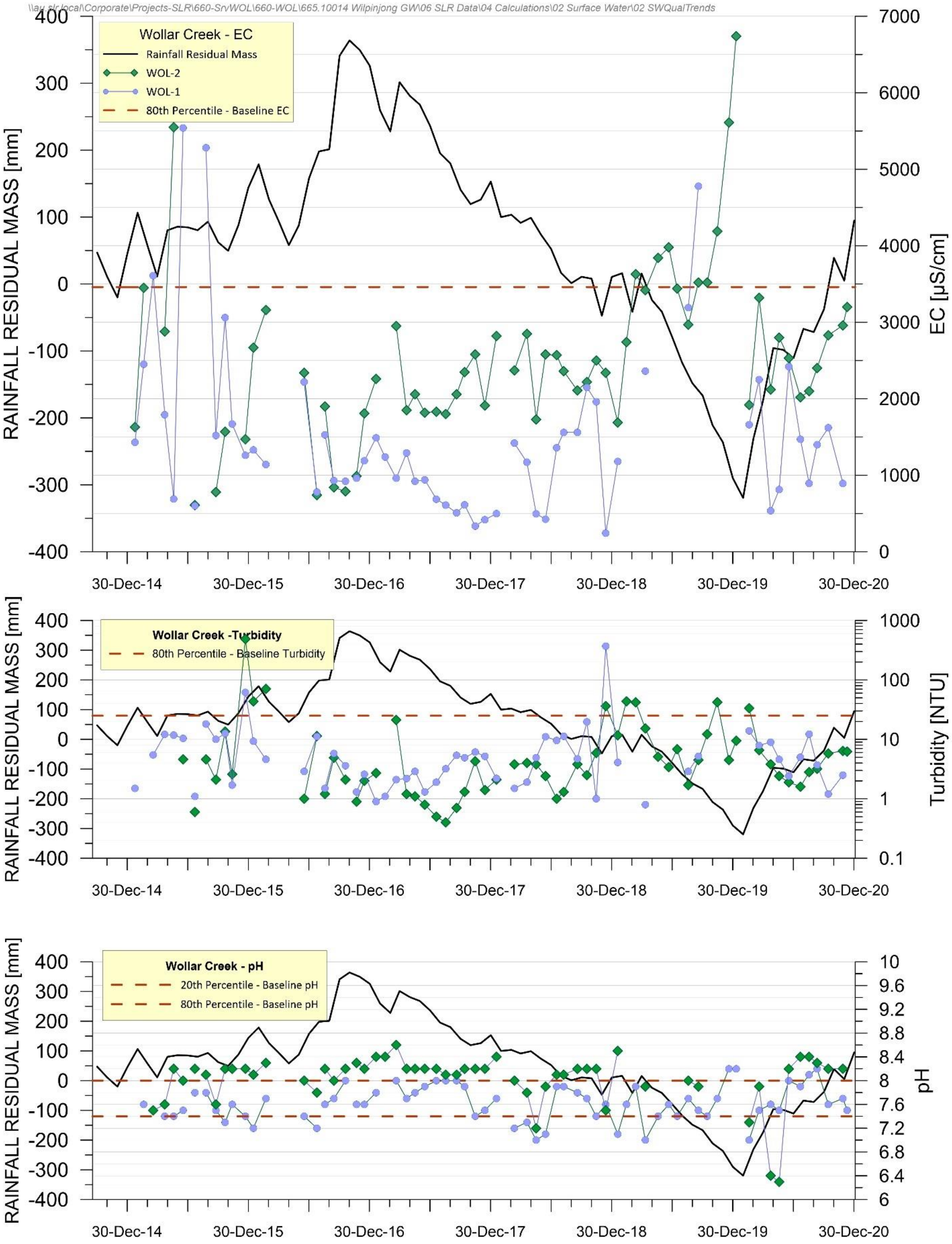

Figure 8 Time-series water quality for Wollar Creek[2]

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[2] Please note that monitoring sites WOL-1 and WOL-2 are labelled in reverse on **Figure 9** above.

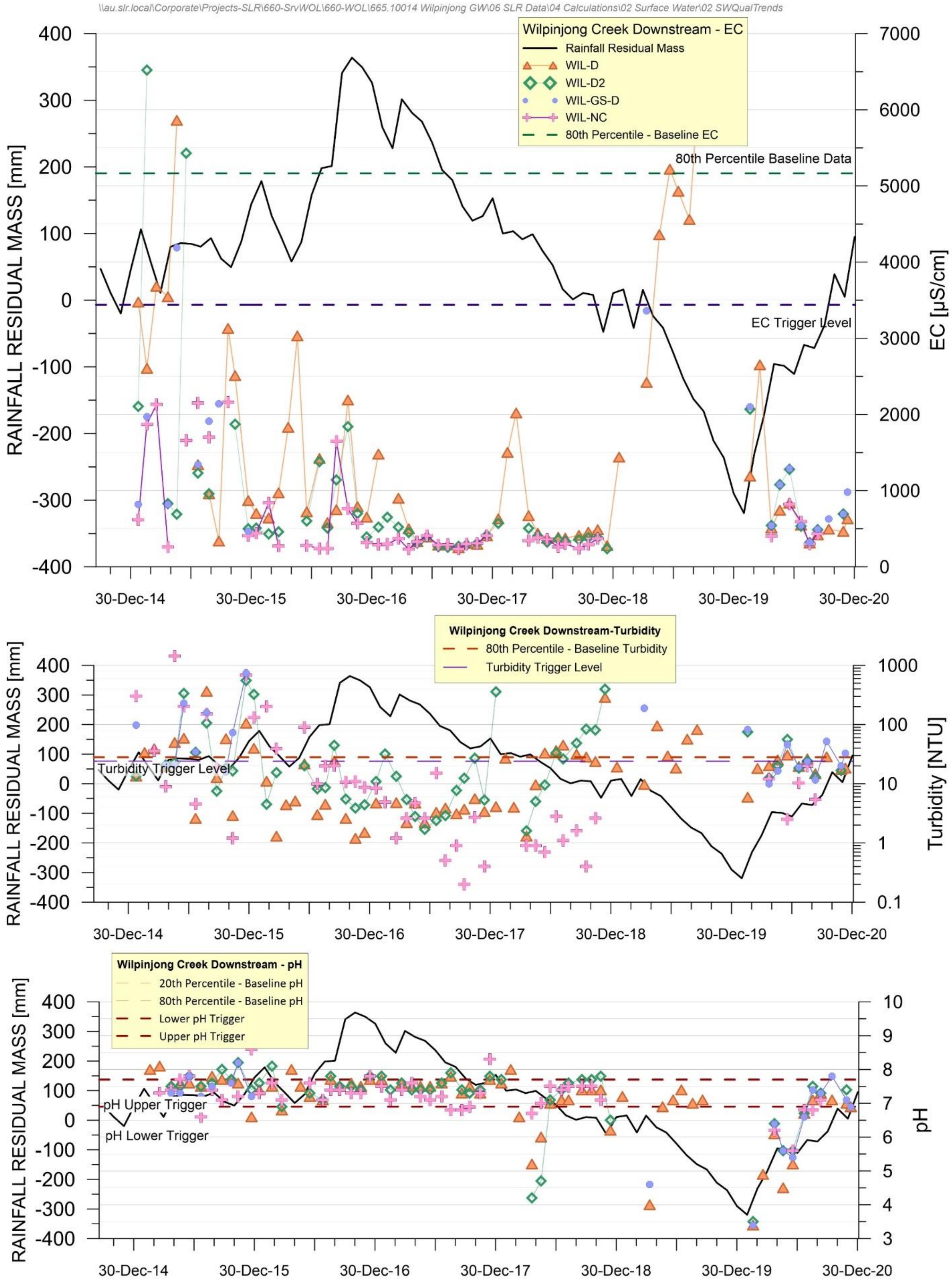

Figure 9 Time-series water quality for Wilpinjong Creek Downstream

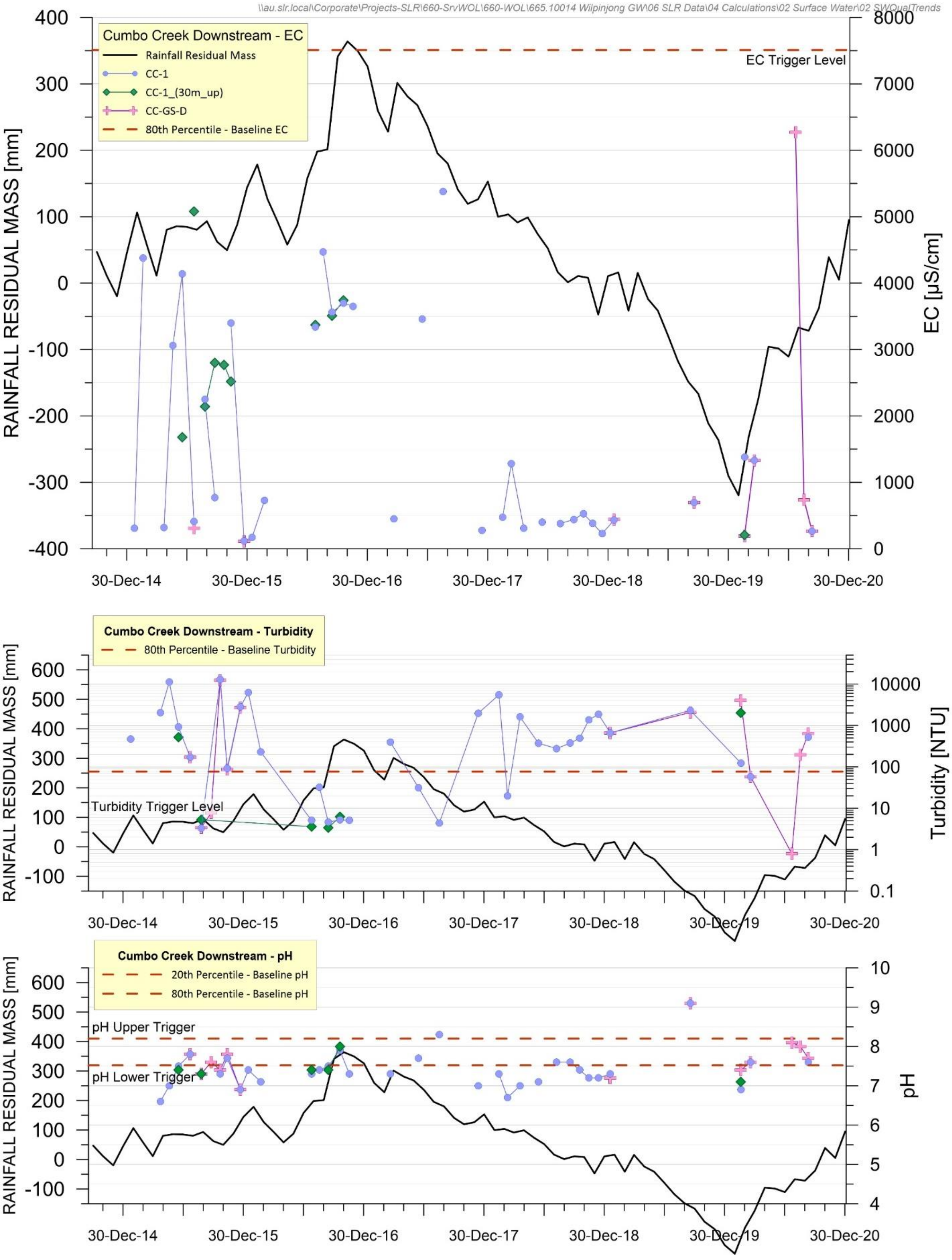

Figure 10 Time-series water quality for Cumbo Creek Downstream

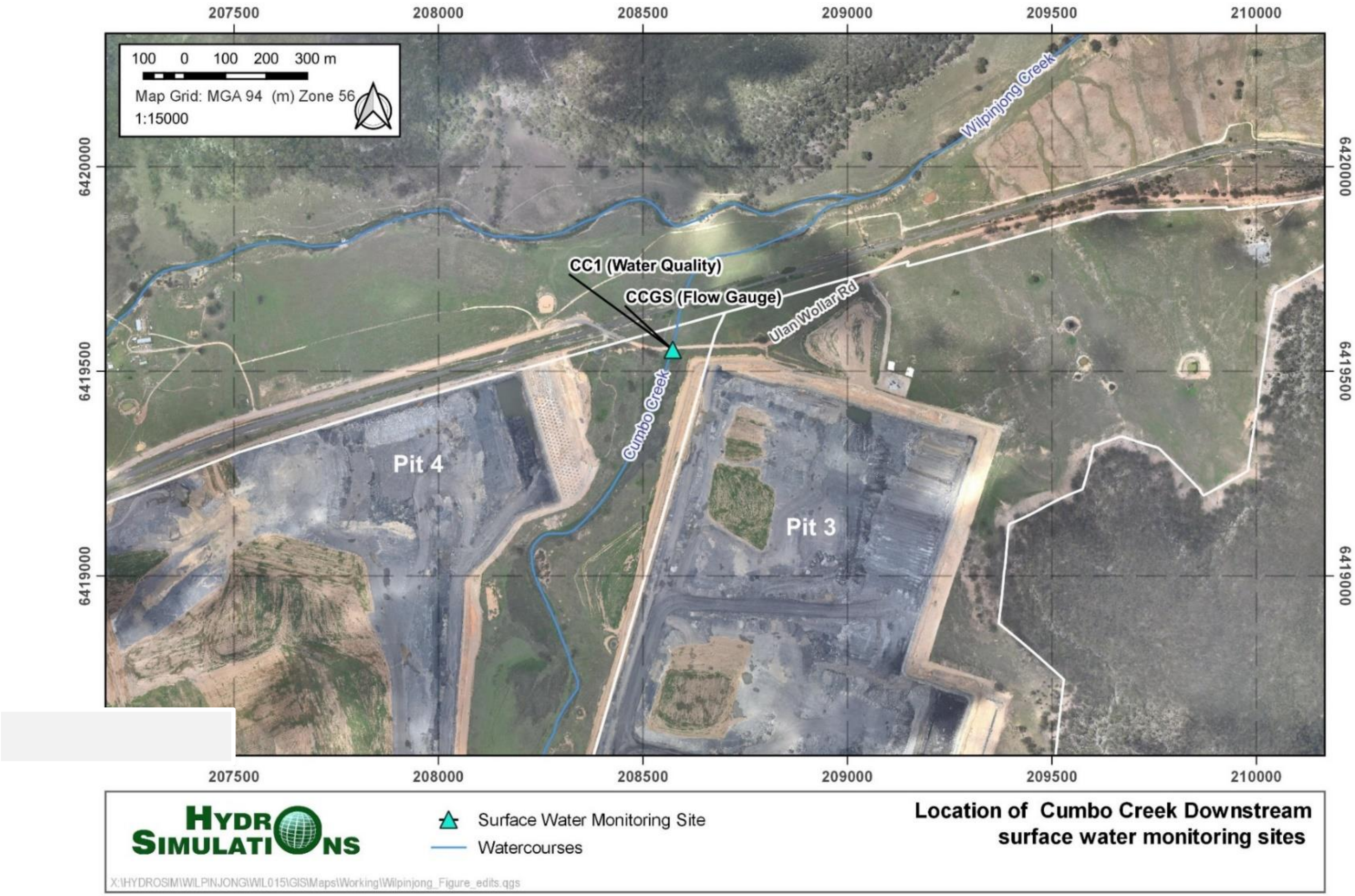

Figure 11 Location of Cumbo Creek Downstream surface water monitoring sites

ASIA PACIFIC OFFICES

BRISBANE
Level 2, 15 Astor Terrace
Spring Hill QLD 4000
Australia
T: +61 7 3858 4800
F: +61 7 3858 4801

CANBERRA
GPO 410
Canberra ACT 2600
Australia
T: +61 2 6287 0800
F: +61 2 9427 8200

DARWIN
Unit 5, 21 Parap Road
Parap NT 0820
Australia
T: +61 8 8998 0100
F: +61 8 9370 0101

GOLD COAST
Level 2, 194 Varsity Parade
Varsity Lakes QLD 4227
Australia
M: +61 438 763 516

MACKAY
21 River Street
Mackay QLD 4740
Australia
T: +61 7 3181 3300

MELBOURNE
Level 11, 176 Wellington Parade
East Melbourne VIC 3002
Australia
T: +61 3 9249 9400
F: +61 3 9249 9499

NEWCASTLE
10 Kings Road
New Lambton NSW 2305
Australia
T: +61 2 4037 3200
F: +61 2 4037 3201

PERTH
Ground Floor, 503 Murray Street
Perth WA 6000
Australia
T: +61 8 9422 5900
F: +61 8 9422 5901

SYDNEY
Tenancy 202 Submarine School
Sub Base Platypus
120 High Street
North Sydney NSW 2060
Australia
T: +61 2 9427 8100
F: +61 2 9427 8200

TOWNSVILLE
12 Cannan Street
South Townsville QLD 4810
Australia
T: +61 7 4722 8000
F: +61 7 4722 8001

WOLLONGONG
Level 1, The Central Building
UoW Innovation Campus
North Wollongong NSW 2500
Australia
T: +61 404 939 922

AUCKLAND
68 Beach Road
Auckland 1010
New Zealand
T: 0800 757 695

NELSON
6/A Cambridge Street
Richmond, Nelson 7020
New Zealand
T: +64 274 898 628

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WATER BALANCE MODEL UPDATE 2021

Model Update & Calibration Report

Prepared for:

Wilpinjong Coal Pty Ltd

SLR Ref: 665.10014-R02
Version No: -v2.0
March 2021

PREPARED BY

SLR Consulting Australia Pty Ltd
ABN 29 001 584 612
10 Kings Road
New Lambton NSW 2305 Australia
(PO Box 447 New Lambton NSW 2305)
T: +61 2 4037 3200
E: newcastleau@slrconsulting.com www.slrconsulting.com

BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Wilpinjong Coal Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
665.10014-R02-v2.0 (Final)	31 March 2021	Emily Curtis	Paul Delaney	Paul Delaney
665.10014-R02-v1.0 (Final)	30 March 2021	Emily Curtis	Paul Delaney	Paul Delaney
665.10014-R02-v1.1 (Draft)	26 March 2021	Emily Curtis	Paul Delaney	Paul Delaney

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APPENDICES

1 Introduction

Wilpinjong Coal Pty Ltd (WCPL) operates the Wilpinjong Coal Mine (WCM), which is located approximately 40 km north-east of Mudgee, in central New South Wales (NSW).

WCPL have developed and continue to maintain a water balance simulation model for the WCM. The model was updated and converted to Goldsim software in 2020 by SLR Consulting Pty Ltd (SLR, 2020), based on calibration against monitoring data collected between January 2018 and December 2019. Prior to this update the model utilised OPSIM simulation software which was calibrated to monitoring data between January 2014 and January 2018.

WCPL are required to prepare a site water balance in accordance with Condition 30(d)(ii), Schedule 3 of Development Consent (SSD-6764). WCPL have engaged SLR to review and update the Wilpinjong water balance model (WBM), using monitoring data collected up to the end of December 2020.

This report documents the model update process and outcomes, including:

- Collation and review of historical water monitoring data;
- Updated catchment and land use mapping;
- Calibration of Wilpinjong Goldsim model against the 2020 Goldsim output and data collected between January 2018 and December 2020;
- Description of Goldsim model, operating rules and model schematic; and
- Forecast of site water behaviour for the three years 2021 - 2023

The intent of this Report is to document the basis of the updated Wilpinjong Goldsim model, and to serve as a platform that future planning studies can build upon.

2 Background

2.1 Operational Description

The WCM is an open-cut coal thermal coal mine located approximately 40 kilometres north-east of Mudgee, near the Village of Wollar, within the Mid-Western Regional Local Government Area, in central NSW. WCM is owned and operated by WCPL, a wholly owned subsidiary of Peabody Energy Australia (PEA). The mine extracts run-of-mine (ROM) coal from the Ulan Seam or Moolarben Coal Member which is either processed on site at the Coal Handling and Preparation Plant (CHPP) or bypassed directly to product stockpiles. Current approvals permit production of up to 16 million tonnes per annum (Mtpa) of ROM coal. Coal products are transported by rail on the existing Sandy Hollow Gulgong Railway to domestic energy generators and to the Port of Newcastle for export (Resource Strategies, 2015).

The WCM has eight approved open cut mining areas, named Pit 1 through to Pit 8. Mining is currently undertaken in Pits 1 to 7 and recently Pit 8 which commenced during 2020. Open cut mining of Pit 1, 2 and 5 has historically originated at a point and has progressed outward, forming a series of peripheral excavations separated by backfilled spoil. These sub-pits are defined based on their relative position within the associated main pit, i.e. Pit 5 South (Pit 5S), Pit 5 North (Pit 5N) etc (WRM, 2019).

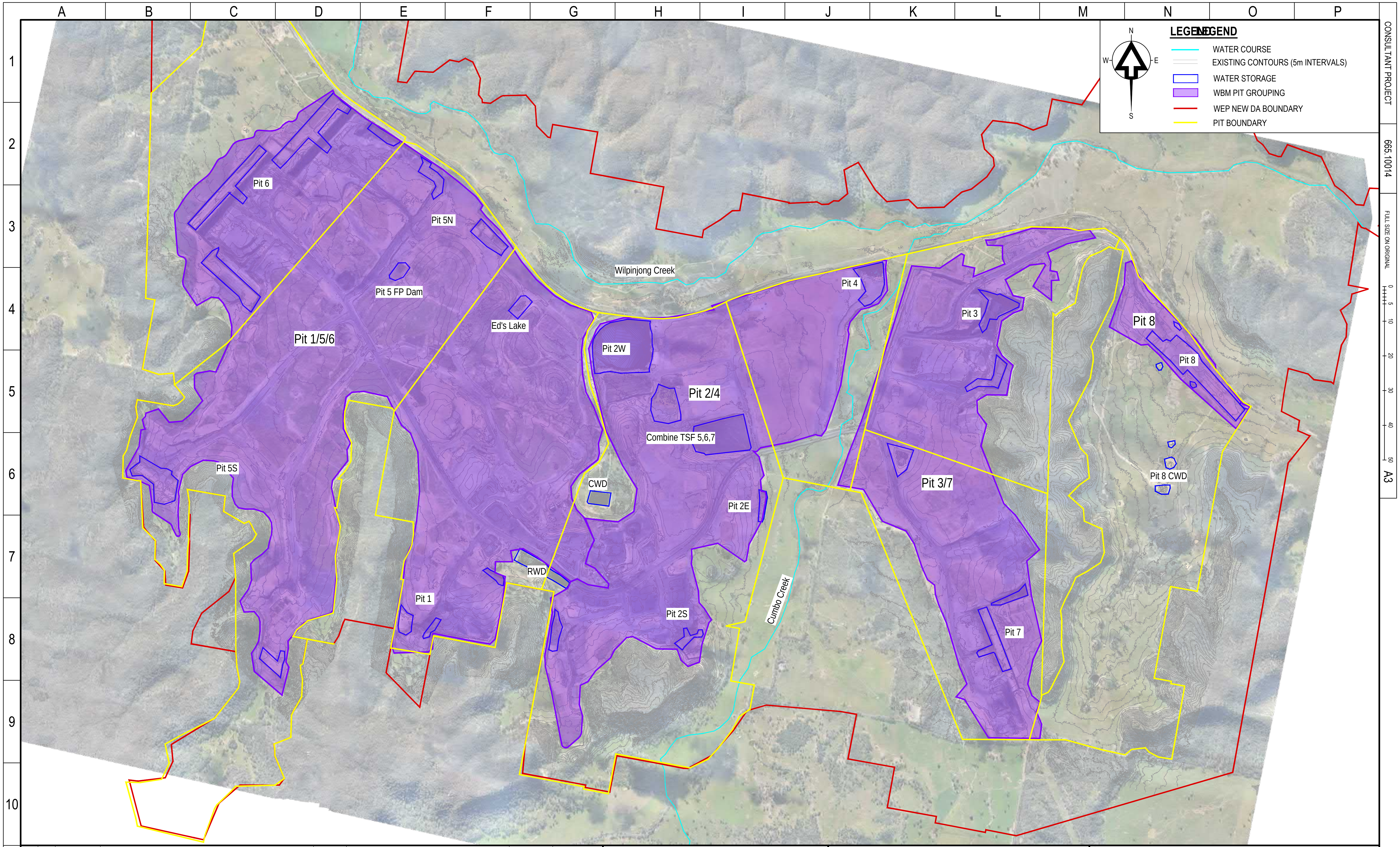
WCM is located on the right (southern) bank of Wilpinjong Creek, which is incised into a valley between the sandstone plateaus of the Munghorn Gap Nature Reserve to the south, and the Goulburn River National Park to the north. The mine is located on the alluvial/colluvial flats associated with the gullies draining the southern escarpment. The valley flats have typical gradients toward Wilpinjong Creek of approximately 1 in 65 (1.5 percent). The escarpment rises approximately 100 m from the valley floor to elevations exceeding 450 m Australian Height Datum (mAHD) on the plateau. The sandstone plateaus are heavily forested. The valley flats in the nearby area are used for cattle and sheep grazing with intermittent cropping, principally for fodder (WRM, 2015).

A general arrangement plan, as of the 31 December 2020 has been provided in **Figure 1.**

2.2 Approvals & Licences

WCM originally operated under Project Approval 05-0021 that was granted by the NSW Minister for Planning under Part 3A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) on 1 February 2006. On 24 April 2017, WCPL was granted Development Consent (SSD-6764) for the Wilpinjong Extension Project (WEP) that provides for the continued operation of the Wilpinjong Coal Mine at rates of up to 16 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal out to 2033, and access to approximately 800 hectares (ha) of open cut extensions. Development Consent (SSD-6764) has superseded the Project Approval (Project Approval 05-0021).

WCM is also subject to conditions outlined in Environmental Protection License (EPL) No. 12425. Mining operations are carried out upon Mining Leases (ML) 1573, 1779 and 1795, in accordance with the Mining Operations Plan (MOP), a requirement of MLs and SSD-6764.



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AUSTRALIA
T: 61 2 4037 3200
F: 61 2 4037 3201
www.slrconsulting.com

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3 Water Management System

3.1 Overview

The WCM Water Management System (WMS) comprises a network of internal dams interconnected via pumps/pipelines and drainage channels. The main objective of the WMS during wet periods is to minimise the risk of uncontrolled discharge of water to the receiving environment and to minimise the risk of pit inundation which may impact coal production. During dry periods, the main objective of the WMS is to ensure that adequate reserves are available to maintain water supply to for the coal mining operations, if required WCM have access to a water supply borefield which can be activated to import external water during these periods. The majority of the system's water storage capacity is provided by Pit 2W, a former open cut mining pit located adjacent to the Ulan Wollar Road. Other significant water storages include the Recycled Water Dam (RWD) and Clean Water Dam (CWD) (see **Figure 1**).

WCM currently has eight open cut mining pits (i.e. Pit 1, 2, 3, 4, 5, 6, 7 and 8). Review of deepest mined topographic data shows that historical mining has occurred within three distinct voids, which each share a common and continuous pit floor, and are divided from each other by an unmined in-situ rock barrier. These voids are referred to herein as Pit 1/5/6 (containing Pits 6, 5S, 5N, and 1), Pit 2/4 (containing Pits 2W, 2S, and 4) and Pit 3/7 (containing Pits 3 and 7). Pit 1/5/6 and Pit 2/4 feature a central overburden emplacement area, which acts as a highly permeable aquifer. During 2020 mining activities commenced in an additional open cut pit (Pit 8). This pit is located to the east of Pit 3/7 and is considered a new void area in the context of water management.

Water within each void passively drains down the dip of the former coal seam, collecting in either Pit 5N, Pit 4, or Pit 3, where it is then pumped to the Pit 2W hub water storage. Note that the Pit 1/5/6, Pit 2/4 and Pit 3/7 definitions are only used in the context of water management; these definitions do not align with mine planning terminology.

Water inflows to the WMS include rainfall, catchment runoff and groundwater interception. The mine has intersected several ephemeral creeks and these catchments now report to the WMS. It is also noted that WCM's mine rehabilitation has not yet had sufficient time to mature to the extent that would allow runoff from these areas to be discharged off-site.

Water is used for dust suppression (road watering, stockpile sprays), wash down (washbays and vehicle wash stations) and for washing coal. The majority of water used for these applications is lost via evaporation or entrainment within railed product coal and waste rock dumps. The coal washing process formerly included a wet-tailings circuit, with tailings slurry pumped to a number of approved tailings dams (TD) adjacent to Pit 2W for consolidation and water recovery (note that tailings was pumped into two approved TDs located at the northern end of Pit 1 prior to using the Pit 2 TDs).

The process was modified in April 2015 to include a tailings belt filter press (BFP). Mixed reject is now co-disposed of within the overburden dumps. TD1 to TD4 have been capped and rehabilitated. Capping of TD5 began in December 2019 while TD6 and TD7 remain active to allow for the deposition of tailings slurry during periods in which the BFP is undergoing maintenance.

During periods of high-water inventory, WCM operates a water treatment facility (WTF) which utilises reverse osmosis (RO) technology and discharges a blend of permeate and Pit 2W water to the adjacent Wilpinjong Creek in accordance with flow and water quality limits specified in EPL 12425.

Prior to 2018, the WTF comprised a WCPL owned primary plant, supplemented with a second leased plant installed to provide temporary additional treatment/discharge capacity. The temporary WTF was decommissioned at the beginning of 2018. WTF reject was pumped to Pit 1S and/or the RWD until late 2018 when Pit 1S was taken offline and was mined through in early 2019. WTF reject, along with backwash from the WTF and water that doesn't meet the requirements outlined in EPL 12425, is now directed to Pit 2W and/or the RWD.

During periods of low water inventory (extended drought), WCM are licenced to draw water from a network of water supply bores to supplement site water demands.

WCM also imports potable water which is used to supply amenities. Sewage is treated and disposed of via irrigation in accordance with EPL 12425. The potable water circuit has no functional influence on the performance of the WMS and is not discussed further in this study.

The following sub-sections summarise the physical characteristics of the WCM water management system, including water storage specifications and function, catchment and land use classification breakdown, and key transfer infrastructure specifications as incorporated in the model.

3.2 Water Storage Infrastructure and Voids

3.2.1 Function and Specification

Table 1 summarises the location, specifications and description for key water storages and voids within the WMS. Consistent with documentation associated with previous water model updates, infrastructure has been grouped as follows:

- Water Storages: Infrastructure used for storing water that has come into contact with mining operations. Comprises surface ponds/dams and inactive mining pits used for bulk water storage;
- Sediment Dams: Sumps/dams used to intercept and capture sediment laden runoff generated from disturbed areas. Water captured in these structures is pumped back to the mine WMS.
- Tailings: Dams or repurposed open cut mining pits used to store tailings waste. Note that tailings storage capacities have not been listed in the following tabulation, as available air space is not intentionally used for water storage; or
- Mining Pits: Open cut voids currently subject to active mining. Not used for water storage.

Table 1 Key Water Storage and Void Specifications and Functional Description

Storage	Location (GDA94 Zone 55)		Catchment (ha)	Full Storage Capacity		Functional Description
	Easting	Northing		(mAHD)	(ML)	
Water Storages						
Pit 2 West	770,975	6,419,350	212.3	370.0	2,276	Hub water storage, and primary buffer storage. Receives dewatering from mining and processing areas, and supplies water to industrial tasks as required. Feed water supply for the WTF.

Storage	Location (GDA94 Zone 55)		Catchment (ha)	Full Storage Capacity		Functional Description
	Easting	Northing		(mAHD)	(ML)	
Pit 1 South (offline from late 2018)	769,250	6,417,120	-	421.4*	295*	Stores reject from the WTF.
Pit 5 Fill Point (FP) Dam	769,030	6,419,995	34.0	392.2	8	Water supply for dust suppression activities in the Pit 5 mining area. Water makeup from local mining area dewatering, or Pit 2W as a backup.
Clean Water Dam (CWD)	770,785	6,418,000	2.1	396.6	45	Water supply for CHPP/MIA area tasks. Water makeup from Pit 2W.
Recycled Water Dam (RWD)	770,270	6,417,430	26.8	412.6	295	Water supply for CHPP/MIA area tasks and to the ROM truck fill point. Water makeup from Pit 2W. May also receive concentrate from the WTF.
Ed's Lake	770,085	6,419,690	288.5	375.3	110	Transfer dam located in backfilled Pit 1N void. Storage capacity includes basin to the north-east of the main void storage.
MIA Dam	770,570	6,417,820	-	-	-	Sediment trap located near admin area. Intercepts sediments from water draining back to Pit 2W from the CHPP/MIA area. Note: not included in Goldsim model.
Pit 8 CWD (constructed in Q1 2020)	775,683	6,418,277	330.0	-	9	A series of three dams modelled as a single dam with a combined capacity. Captures majority of Pit 8 upslope catchment via Pit 8 upstream diversion. Constructed March 2020.
Sediment Dams						
Pit 5N Sed. Dams	769,530	6,420,700	-	-	-	Sediment interception works located adjacent to open cut workings. Function is to capture sediment laden runoff, allowing this water to then be pumped back to the WMS. Note: these dams have been functionally modelled as additional catchment assigned to their respective open cut void (i.e. assumes no storage in sediment ponds, and no pumping constraints).
Pit 2E Sed. Dams	772,800	6,418,580	-	-	-	
Pit 3 Sed. Dams	773,850	6,420,010	-	-	-	
Pit 7 Sed. Dams	773,240	6,417,880	-	-	-	
Pit 8 Sed. Dams	775,782	6,419,484	-	-	-	
Mining Pits						
Pit 5 South	767,730	6,418,020	623.9	n/a	n/a	Active mining pits.
Pit 5 North	769,220	6,420,690	709.9	n/a	n/a	
Pit 1	769,440	6,417,660	295.5	n/a	n/a	
Pit 2 South	771,250	6,416,940	148.2	n/a	n/a	
Pit 2 East	772,070	6,417,900	34.1	n/a	n/a	
Pit 4	772,840	6,419,850	132.8	n/a	n/a	
Pit 3	773,840	6,419,230	287.7	n/a	n/a	
Pit 7	774,210	6,417,780	292.9	n/a	n/a	
Pit 6	767,950	6,420,330	257.7	n/a	n/a	

Storage	Location (GDA94 Zone 55)		Catchment (ha)	Full Storage Capacity		Functional Description
	Easting	Northing		(mAHD)	(ML)	
Pit 8	775,851	6,419,225	137.5	n/a	n/a	
Tailings Storage						
TD6	771,800	6,418,530	79.3	n/a	n/a	Inactive tailings storage facilities. Scheduled to be capped and rehabilitated. Note that TD6 is used intermittently when the BFP is offline. TD7 does not receive tailings however does collect seepage from TD6.
TD7	771,320	6,418,860		n/a	n/a	

*2018 data prior to decommissioning

3.2.2 Storage Characteristics

Storage characteristics (level-area-volume relationships) remain generally consistent with the previous model update (SLR, 2020).

Modelled level-area-volume profiles for all storages have been provided for reference in **Appendix C**.

3.2.3 Storage Capacities

3.2.3.1 Water Storages

Adopted full storage levels (FSL) for all water are listed in **Table 2**.

Table 2 Adopted Full Storage Level (Source: WRM, 2019)

Storage	FSL(mAHD)	Basis
Pit 2 West	370	Per previous 2019 model update (WRM,2019)
Pit 1 South (offline from late 2018)	422	Nominal 0.5m offset below the level at which additional seepage flows to Ed's Lake were inferred as part of the WBM verification (WRM,2019)
Pit 5 Fill Point (FP) Dam	392	Defined based on review of 2019 surface topography. Nominal level at which overflow to Pit 5N would occur.
Clean Water Dam	397	Maximum water level recorded in historical water level survey. FSL defined as a maximum operating level rather than a spillway level. It is understood that this dam has no formally constructed spillway outlet.
Dirty Water Dam	413	It is understood that this dam seeps to the CHPP area at high water levels, and water levels in the dam are managed to minimise the risk of this occurring. FSL defined as an operational level rather than a spillway level. It is understood that this dam has no formally constructed spillway outlet (WRM, 2019)
Ed's Lake	375	Defined based on review of 2019 surface topography. Nominal elevation at which overflow to Wilpinjong Creek would occur via a low point in adjacent road/rail
Pit 8 CWD	-	A series of three dams with combined capacity of 9ML.

3.2.3.2 Open Cut Pits

In order to prevent an uncontrolled release of water to the receiving environment, excess mine water would be temporarily stored within one or more open cut mining pits. This practise would continue until the excess water is drawn down through evaporation, supply to demands (e.g. dust suppression) and EPL authorised creek discharge (via the site's WTF).

The assumed order of preference in which pits would be filled is Pit 5N, Pit 4 then Pit 3 (per WRM, 2019). Note that water storage in up-dip pits (i.e. Pit 5S, Pit 1, Pit 2S, Pit 7, Pit 6) is not possible as these voids freely drain down the dip of the coal seam, through the in-pit spoil placement areas to their respective down-dip pits.

Overflow and recommended maximum fill levels have been listed in **Table 3**. Recommended maximum fill levels reflect settings incorporated into the WBM for current storage capacities. Recommended fill levels have been set five metres below the nominal overflow level. Actual fill levels (which trigger filling of the next pit in sequence) should continue to be confirmed/defined to reflect changes due to mine progression.

Table 3 Mining Pits Overflow and Recommended Maximum Fill Levels

Pit	Level		Notes
	Overflow	Max Fill	
Pit 5N	374.0	369.0	Assumed hydraulic connection between Pit 5N and Ed's Lake. Pit 5N overflow level defined based on Ed's Lake overflow level (per WRM, 2019).
Pit 4	367.0	362.0	Overflow level based on low point in northern end of Pit 4N high wall. Note that low point will reduce as mining progresses eastward.
Pit 3	363.0	358.0	Overflow level based on low point on western side of Pit 3N void (adjacent to Cumbo Creek).

3.2.4 Catchment Breakdown

Catchment boundaries for water storages within the WCM have been delineated based on the most recent available topographic data and advice from operational personnel. 2020 catchment areas have been summarised in **Table 1**. Catchment maps and land use maps have been provided in **Appendix B**.

Land use classifications used for the model calibration have been determined based on Peabody mapping and review of end of year 2020 satellite imagery.

Current investigations have adopted a land use classification schedule to align with catchment yield parameters:

- Natural / undisturbed – no disturbance, typically grass or brush;
- Roads / industrial / hardstand/ Mining Pit – sealed or unsealed road or track, cleared and compacted earth or concrete (layout areas etc.), open-cut void;
- Spoil / overburden – unrehabilitated spoil emplacement, clear of vegetation, also includes cleared areas and beach and other exposed tailings reject areas;
- Rehabilitated overburden – emplacement areas that have been shaped and re-vegetated;

Land use data has been used to calculate catchment yield within the water balance model. Different land use classifications generally correspond with a unique catchment runoff model parameter set. Catchment yield is discussed further in **Section 4.4**.

A breakdown of land use type per water storage catchment area has been provided in **Appendix B**, in addition to catchment and land use plans.

3.2.5 Water Transfer Infrastructure

The WCM transfer network comprises a mixture of fixed pump and pipeline infrastructure connections, supplemented with portable infrastructure that can be moved around for pit dewatering. Water transfer capacities adopted as part of the WCM Goldsim WBM are consistent with the previous model update and are summarised in **Table 4**. Active management of Pit 8 commenced in 2020 and is included below. Note the following:

- Assumed no pumping from up-dip pits, i.e. Pit 5S, Pit 1, Pit 2S and Pit 7. These pits passively drain along the dip of the mined coal seam (either along the surface or through the highly permeable in-pit spoil placement areas) to their respective down-dip pits.
- Water transfers from dams to industrial tasks are assumed to be constrained by demand, not by pump/pipeline capacity.
- Assumed no pumping from any tailings dams – water inflow to these areas is assumed to evaporate or seep to the underlying Pit 2/4 spoil aquifer which is hydraulically connected to Pit 2W.

Table 4 Water Transfer Infrastructure, Modelled Capacities

Category	Connection Points		Flow Capacity	
	Storage (From)	Directed (To)	L/s	ML/d
Pit Dewatering	Pit 5N	Pit 2W	180*	15.5
	Pit 4	Pit 2W	160*	13.8
	Pit 3N	Pit 2W	100	8.6
	Pit 8	Pit 2W	100	8.6
Mine Water Containment	Ed's Lake	Pit 5 FP Dam	100	8.6
	Ed's Lake	Pit 2W	100	8.6
	Pit 2W	Pit 5N	100	8.6
	Pit 2W	Pit 3N	100	8.6
Other	Pit 2W	CWD	100	8.6
	Pit 2W	RWD	100	8.6
	Pit 8 CWD	Pit 2W	160	13.8

*dewatering capacity for active pits is variable subject to allocation of pump resources

4 Climate

4.1 Overview

Climatic influences on the WMS include catchment rainfall–runoff and evaporation (from wetted areas) and evapotranspiration (from catchments). The WBM has been configured to simulate system performance on the basis of long-term historical climate data. Historical data has been directly applied, based on the assumption that climatic conditions observed in the past, and captured in the data, are indicative of persistent local climatic trends. Historical data is therefore assumed to represent the range of potential conditions likely to be observed in the near future.

Investigations have not included allowance for climate change effects as this not likely to be material in the three year forecasting period.

Updated climatic data for WCM (latitude -32.35, longitude 149.9) has been sourced from the SILO Data Drill service (Queensland Government Department of Science, Information Technology and Innovation). The Data Drill service accesses grids of climate data interpolated from point observations by the Bureau of Meteorology (BoM), for any point in Australia. Sourced information includes daily resolution rainfall and evaporation data, for the 120-year period 1900 to present. This information has been processed and summarised in the following sub-sections.

WCPL have also provided rainfall data for the January 2016 to December 2020 period, recorded at the site automated weather station (AWS), located within the rail loop (near the CWD). Rainfall data from the Site AWS for the period January 2014 to December 2015 has also been extracted from the previous OPSIM model. Rainfall data recorded at the neighbouring BoM rainfall gauge at Wollar (Wollar Barrigan St Station 062032) has also been sourced and used for reference. Site AWS and BoM rainfall data has been compared against Data Drill rainfall in Section 4.2.3

4.2 Rainfall

4.2.1 Annual Rainfall (Data Drill)

WCM experienced drought conditions during the end of 2018 and throughout 2019. During 2019 a total annual rainfall of 266 mm was recorded at the Site AWS, which is significantly less than a 10th percentile annual rainfall. Changes to the WBM were undertaken in the previous update (SLR, 2020) to reflect monitored conditions during these years. During 2020 rainfall increased significantly with an annual rainfall of 987 mm experienced at WCM, which is greater than an 95th percentile annual rainfall. Annual rainfall totals (calendar year) have been presented in **Figure 2** on a percentile basis.

Annual rainfall varies between approximately 200 mm and 1,200 mm (~1,000 mm spread), with a median of 606 mm ± 180 mm. Approximately 70% of the data set falls within 1 standard deviation of the median. Also shown for reference are calendar year rainfall totals for the seven most recent years. Review of this information shows that during the recent drought conditions the 2018 rainfall was equivalent to a historical 26th percentile (dry), whilst the 2019 rainfall was equivalent to a historical 1st percentile (very dry). In contrast, rainfall experienced during 2020 was equivalent to a historical 97th percentile rainfall (very wet).

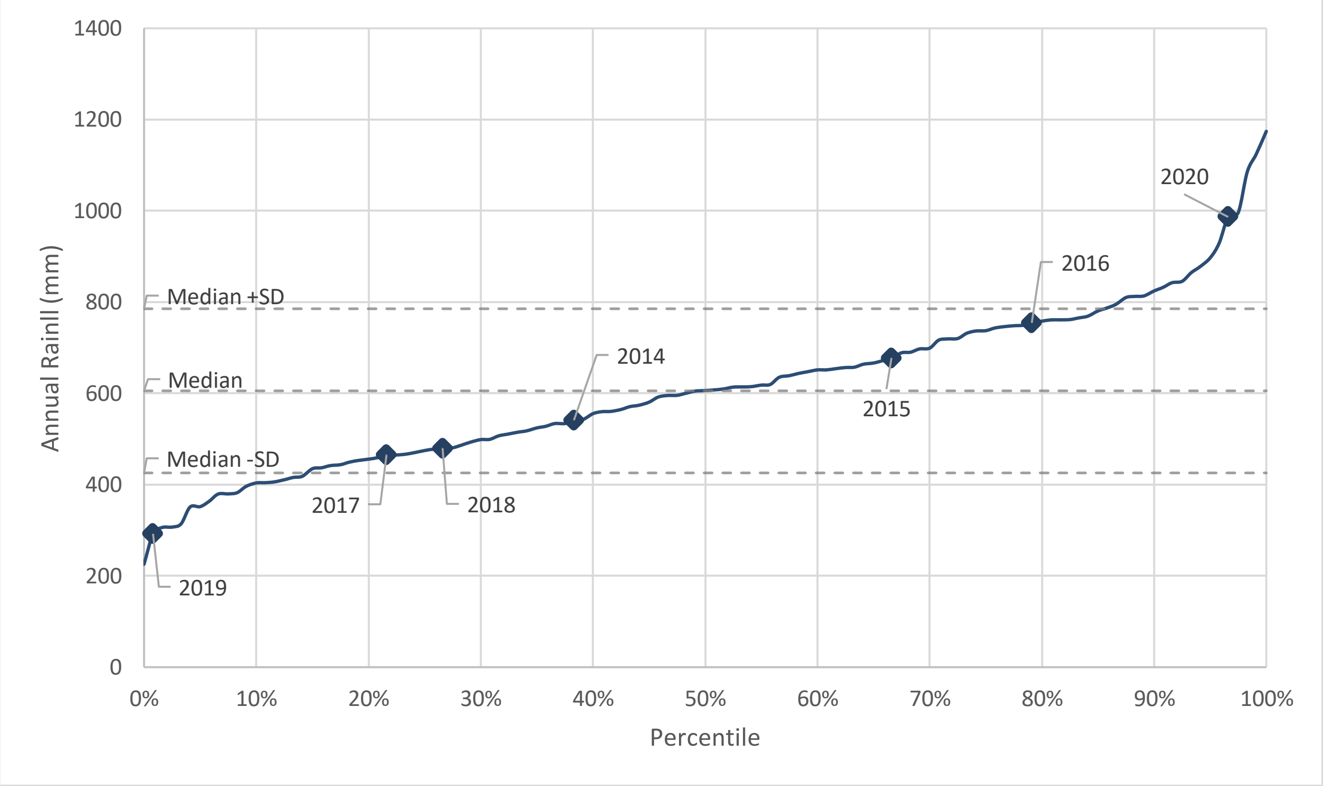

Figure 2 Historical Annual Rainfall Percentiles

4.2.2 Rainfall Statistics (Data Drill)

The statistics for the long-term Data Drill rainfall data for the 120 year period are summarised in **Table 5**. Annual totals are for a calendar year January to December.

Table 5 Long term Data Drill Rainfall Statistics (mm)

Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Max	204	364	241	200	184	249	175	137	174	216	266	203	**1174**
90th %ile	132	144	116	79	74	88	97	82	90	104	118	124	**824**
Median	60	45	45	29	31	34	40	37	35	46	52	50	**606**
10th %ile	14	5	5	2	5	10	7	12	10	9	10	11	**404**
Min	0	0	0	0	0	0	1	0	0	0	0	0	**226**
Mean	66	62	56	40	39	45	44	44	43	53	59	61	**612**
Std Dev	45	60	48	38	33	41	33	29	32	42	46	47	**180**
Count	121	121	121	121	121	121	121	121	121	121	121	121	**121**

4.2.3 Data Drill vs Site and BoM Rainfall

SILO Data Drill rainfall data has been compared against data recorded at the WCM AWS and also at the neighbouring BoM rainfall gauge at Wollar (approximately 8km to the east of Wilpinjong).

The intent of comparing SILO Data Drill rainfall against the site and BoM reference data was to:

- Demonstrate that the SILO rainfall is comparable to local measurements, and is therefore an appropriate input time-series to the Wilpinjong WBM model (for long- term modelling); and
- Identify an appropriate measured rainfall data set to be used in the WBM calibration exercise completed as part of current investigations.

Cumulative rainfall totals, resetting on an annual basis, have been presented in **Figure 3.**

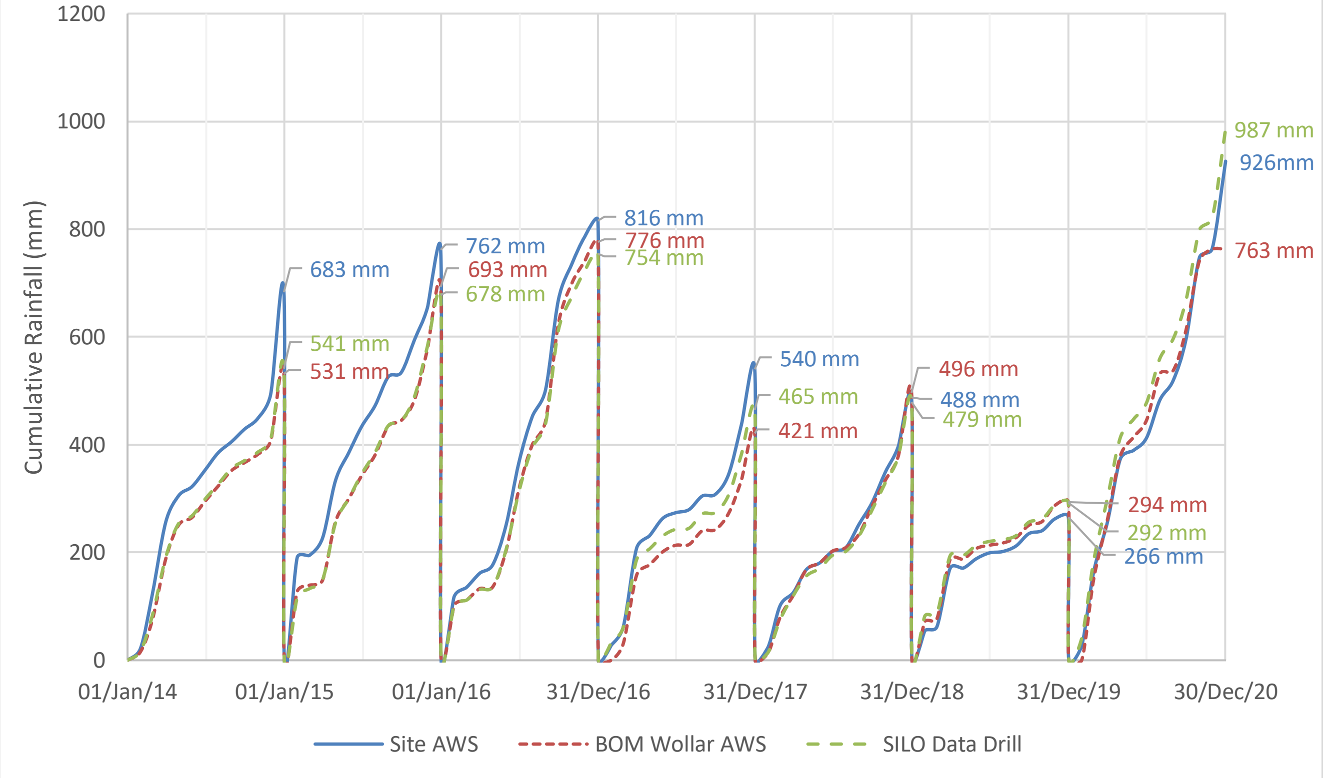

Figure 3 Cumulative Rainfall (resetting 1st Jan) – Site AWS, BoM Wollar, SILO

Review of **Figure 3** shows the following:

- Cumulative rainfall reported by the site AWS was significantly higher than the other two datasets prior to mid-2015, primarily due to discrepancies in events in March 2014, December 2014 and January 2015. From July 2015 onward, data from the AWS appears to be more consistent with the other gauges. Note the previous 2016 model update (Hatch, 2017) compared site AWS data against data from *nine* surrounding BoM rainfall gauges (including Wollar) and observed similar trends in 2014 and early 2015.
- SILO Data Drill rainfall totals are generally consistent with the Wollar BoM gauge throughout the review period, and with the site AWS data from mid-2015 onward.

Key outcomes of the above comparison include:

- The model calibration exercise completed as part of current investigations has focused on the period January 2018 to December 2020 (three years). The first year of this period overlaps with the calibration period studied as part of previous investigations (WRM, 2019). For consistency with the previous model updates, model calibration was based on the site AWS data.
- SILO Data Drill rainfall is consistent with rainfalls recorded at gauges in the study area and is therefore considered to be an appropriate input time-series to the WBM.

4.3 Evaporation

Long term daily evaporation data for the WCM has been sourced from the SILO Data Drill service. Morton lake (M_{lake}) evaporation has been used to estimate evaporation from the wet surface areas of surface storages. No adjustment factors have been applied to pits or catchment areas. The statistics for the long-term Data Drill M_{lake} evaporation data are summarised in **Table 6**.

Table 6 Long term Data Drill M_{lake} evaporation statistics (mm)

Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Max	229	186	164	108	67	45	53	84	122	165	204	232	**1539**
90th %ile	218	174	151	98	62	42	50	76	112	158	186	213	**1461**
Median	196	156	137	90	57	38	44	69	102	142	169	193	**1393**
10th %ile	171	138	125	81	50	34	40	63	92	126	150	177	**1322**
Min	153	122	107	67	44	31	33	58	80	112	137	149	**1234**
Mean	195	156	136	90	56	38	44	69	102	142	168	193	**1390**
Std Dev	17	14	11	7	5	3	4	6	8	11	14	15	**58**
Count	121	121	121	121	121	121	121	121	121	121	121	121	**121**

4.4 Catchment Yield

4.4.1 Overview

Accurate estimation of catchment yield hydrology is an important component of water management investigations. Catchment yield within the WBM is simulated using the Australian Water Balance Model (AWBM). The AWBM is a saturation overland flow model which uses daily rainfalls and estimates of catchment evapotranspiration to calculate daily values of runoff using a water balance approach (Boughton, 1993). The AWBM is widely accepted and commonly used throughout Australia.

4.4.2 Parameters

Different AWBM model parameters are defined for each land use type within the mine catchment. AWBM model parameters were initialised using values from the previous 2019 model update (WRM, 2019) and are considered to remain well suited to current site conditions, determined through the WBM calibration. Adopted AWBM model parameters are summarised in **Table 7**.

Table 7 Calibrated AWBM Parameters

Parameter		Natural	Rehab	Spoil	High Runoff (Hardstand/Active Pit)
Partial Areas	A1	0.134	0.134	0.134	1.0
	A2	0.433	0.433	0.433	-
	A3	0.433	0.433	0.433	-
Soil Storage	S1	17.6 mm	14.7 mm	11.0 mm	17.0 mm
	S2	182.6 mm	153.2 mm	114.1 mm	-
	S3	366.2 mm	306.9 mm	228.8 mm	-
Baseflow Index	BFI	0.50	0.50	0.50	0.00
Surface Lag	Ks	0.80	0.97	0.97	0.00
Baseflow Lag	Kb	0.97	0.80	0.80	0.00
Avg. Storage	Savg	239.9 mm	201.2 mm	150.0 mm	17.0 mm

5 Site Water Usage

5.1 CHPP & MIA Usage

Water is pumped from Pit 2W to the RWD and CWD. Water is then pumped from these dams into a distribution network which is used to supply water to the following demands within the CHPP and MIA area:

- CHPP process;
- Heavy vehicle (HV) and light vehicle (LV) wash bays;
- MIA wash-down pads;
- Coal handling/stockpile dust sprays; and
- Other miscellaneous MIA/CHPP tasks (cleaning/hoses, clarifier tank overflow or bleed-off via old tailings lines).

Water supply from the RWD and CWD to the distribution network is metered, but the individual offtakes are not (WRM, 2019).

The following sub-sections summarise a process which has attempted to separate the CHPP process water makeup from the other MIA area demands.

5.1.1 CHPP Usage

5.1.1.1 Overview

A conceptual model of the coal washing process is shown in **Figure 4**. Note that prior to April 2015 the CHPP reject circuit comprised separate coarse and fine waste material streams. Coarse rejects were trucked and disposed of within in-pit overburden dumps, and fine tailings were pumped as a slurry to tailings cells adjacent to Pit 2W. The CHPP tailings circuit was modified in April 2015 to include a BFP, which dewaters the tailings stream and allows this material to be disposed of as a dry waste stream with the coarse reject. Any moisture bleed-off from within the BFP process is captured and re-circulated to the clarified water tank. Excess water from the clarified water tank may be drained off by pumping water to the tailings dams via the old slurry pipelines (WRM, 2019).

The following moisture contents are assumed for various material streams within the CHPP:

- ROM: 5% moisture w/w
- Bypass coal: 7.5% moisture w/w
- CHPP feed: 7.5% moisture w/w
- Product coal: 10.3% moisture w/w
- Mixed reject: 28.0% moisture w/w

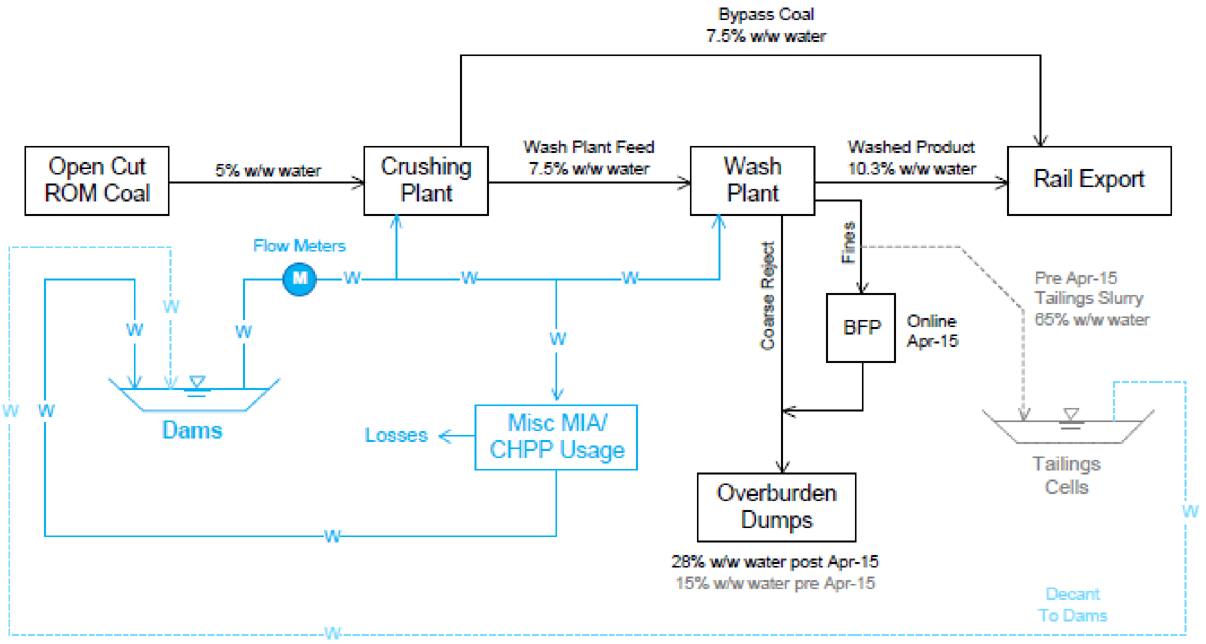

Figure 4 Coal Washing Process Conceptual Model (Source: WRM, 2019)

5.1.1.2 Historical Production

Recent historical material tonnages have been summarised in **Table 8** for the 2018, 2019, 2020 and predicted 2021 calendar years. Review of **Table 8** shows that the annual railed product was approximately 12.50 Mtpa in 2020 which is a slight decrease from 2019 of 12.79 Mtpa. Furthermore, production is expected to remain within the range of previous years with 12.40 Mtpa expected to be railed in 2021, this is a slight reduction compared to 2020.

Table 8 Production Summary

Material Stream	2018	2019	2020	Predicted 2021
Waste Rock/Overburden	39.30 Mbcm	45.52 Mbcm	54.59 Mbcm	52.20 Mbcm
ROM coal^	14.92 Mt	15.12 Mt	14.74 Mt	14.23 Mt
Coarse Reject & Tailings (TFP*)	2.13 Mt	2.31 Mt	2.63 Mt	2.36 Mt
Fine Tailings	0	0	0	0
Railed product	12.45 Mt	12.79 Mt	12.50 Mt	12.03 Mt

^WCM approved rate of up to 16Mtpa out to 2033
*Tailings Filter Press

5.1.1.3 Process Water Makeup

Figure 6 presents the metered water supply from the RWD and CWD to the CHPP-MIA water distribution network. Data relating to the allocation of water to the CHPP area and MIA separately is not available for the 2020 monitoring period.

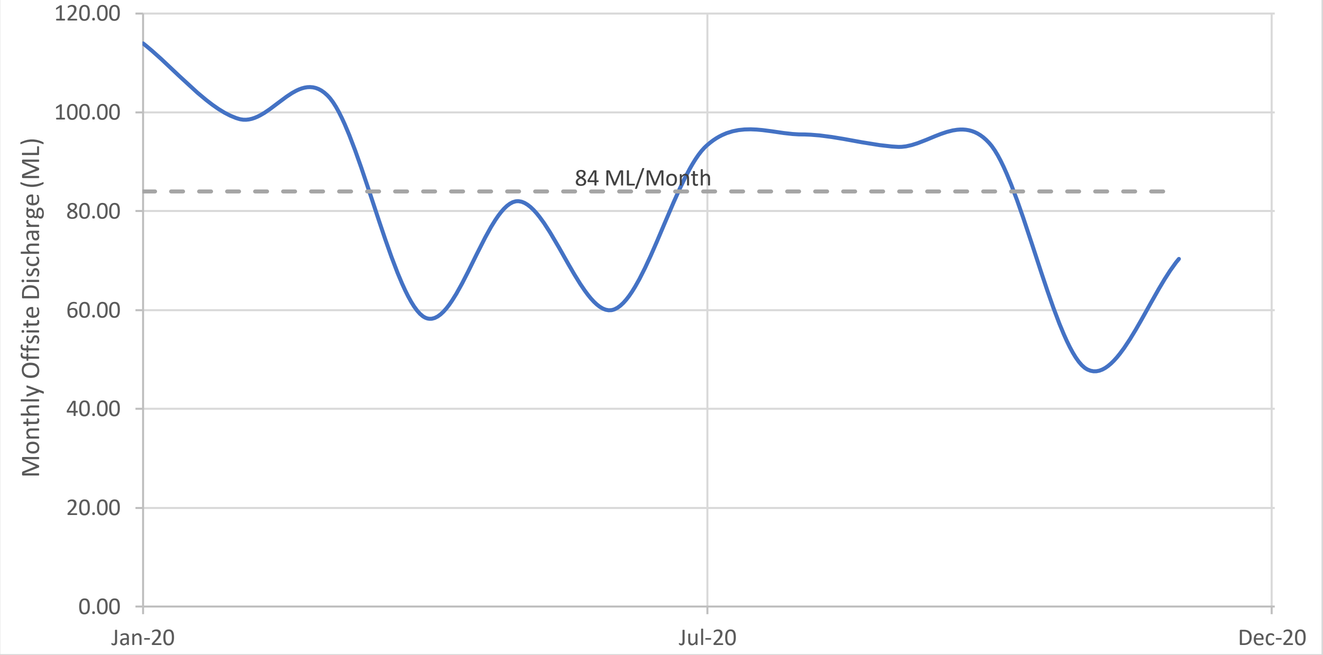

Figure 5 CHPP and MIA Monitored Demand

Review of **Figure 6** gives the following:

- The water supply rate for 2020 fluctuates between 48 ML/mth and 113 ML/mth throughout the year. The average monthly usage rate was 84 ML/mth.
- Combined CHPP and MIA water usage for 2018 recorded as part of the previous 2019 model update was an average water supply rate of 124 ML/mth. No water usage data is available for 2019; and
- Given the above the average water supply for the calibration period is approximately 104 ML/mth.

5.1.1.4 Model Configuration

Prior model update reports (Hatch, 2017; WRM, 2018) presented historical production data for the period January 2014 to January 2018, and forecast production data through to December 2018. Comparison of this information against the calculated 2018 data from the previous report shows that the recent production has been higher relative to 2017 trends. Therefore, in previous model updates the simulated CHPP water usage was based on the 2018 forecast production rates rather than historical averages. Total railed product in 2020 was 12.50 Mt which closely correlates to that of 2018 of 12.45 Mt. As production remains consistent in 2020 and the average water demand across the calibration period closely relates to that previously assumed CHPP water demand of 110 ML/mth (with consideration for no available data for 2019), this rate was maintained within the model and is considered an effective monthly average to account for fluctuations in the CHPP water supply.

The CHPP water demand has been set at 110 ML/mth (3.6 ML/d), which is consistent with the design model assumptions adopted in the previous water balance investigations. Note the model assumes all water sent to the CHPP to close the mass balance is lost, with nil recovered (e.g. all water is entrained within railed product or in-pit dumps). Note that a 20 ML/mth miscellaneous usage is modelled with a large percentage of this water returning to Pit 2W (see **Section 5.1.2**). It is possible that a portion of this water is associated with activities in the CHPP.

5.1.2 MIA and Miscellaneous Usage

Previous model updates have shown an unaccounted-for component of the RWD and CWD water supply which is estimated at approximately 20 ML/mth. This flow rate is understood to represent water supply to the various demands listed in **Section 5.1**.

Based on the previous water balance modelling, the inferred net loss rate from this miscellaneous water usage stream is expected to be relatively low. Modelling has adopted a net water loss of 100 ML/year (8.3 ML/mth) which is consistent with the previous 2019 model update (WRM, 2019) and typical MIA water consumption observed at other operations similar to Wilpinjong.

The WBM has been configured to extract 20 ML/mth from the CWD or RWD and recirculate 17.4 ML/mth of this flow back into the WMS via Pit 2W.

5.2 Haul Road Dust Suppression

5.2.1 Measured Water Usage

Water is extracted from the WMS and applied using water trucks over HV/LV roads to minimise dust lift-off. There are three fill points (FPs) in operation: the ROM FP, Pit 2 FP and Pit 5 FP. All water truck fill points have been fitted with flow meters.

Dust-a-side (DAS) is a dust suppression agent that reduces dust generation on roads, hardstand and laydown areas and reduces the need for water carts. To help water usage associated with dust suppression WCM commenced the use of DAS in 2019.

On the occasion that FP flow meters are offline or technical malfunction occurs and daily data cannot be obtained, trip-count data is used to estimate usage. WCM operates a GPS logging system which maintains a count of how many times each truck has driven within a certain proximity of a fill point. Water usage is estimated by multiplying each individual truck's trip count by its respective water fill capacity.

WCPL have provided updated flow meter data and trip-count-based estimates of water usage for January 2016 to December 2020. This information has been processed and presented in **Figure 6**. Water usage data is based on flow metered records and trip count data.

It has been assumed that actual haul road dust suppression water losses are lower than what is recorded by the flowmeters and/or estimated based GPS trip counts. Consistent with previous model updates an adjustment factor of 0.9 has been applied to the historical water usage data to account for the following:

- Flow recirculation recorded by flow meters (e.g. trucks being overfilled, with excess water draining back to the supply dam); and
- Over-estimation bias inherent to trip-count based methods, which assume every 'trip' entails a truck being filled from empty to full, whereas in practise trucks may return to the fill point part-full, or may even drive past the fill point without stopping (which is still registered as a 'trip').

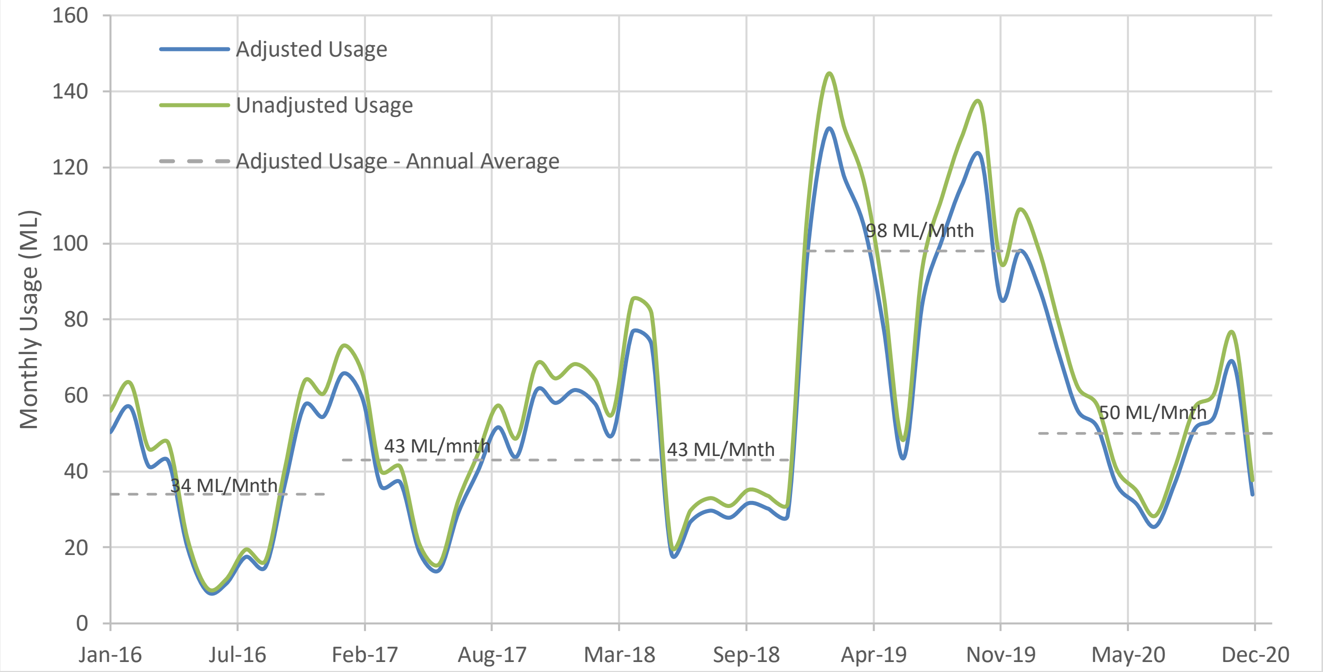

Figure 6 Metered Haul Road Dust Suppression Water Usage

Review of **Figure 6** shows that:

- Water usage is seasonal, with highest usage rates occurring in summer, and lows in winter. Seasonal variability is driven largely by changes in ambient temperature and evaporation rates;
- Water usage is also lower during periods of rainfall; and
- Average water usage rates during 2016-2018 are relatively consistent year-to-year at around 34-43 ML/mth (408-516 ML/yr), however, 2019 usage is significantly larger than previous years. This is likely to be attributed to the significant drought conditions experienced throughout 2019 including limited rainfall and increased evaporation. Water Usage during 2020 has reduced to closely follow pre-2019 trends with an annual average of 50 ML/Mnth due to increased rainfall throughout the year.

No data of breakdown of dust suppression demand by fill-point was provided for 2019 or 2020 and is therefore assumed to be consist to 2018 values discussed in the previous 2019 update (WRM, 2019). The breakdown by fill-point in 2018 is as follows:

- ROM FP 75.08%
- Pit 2 FP 24.91%
- Pit 5 FP 0.01%

5.2.2 Dust Suppression Sub Model

Haul road dust suppression water usage is simulated within the WBM using a sub-model, which accounts for the seasonal variation and sensitivity to rainfall observed in the metered usage data. Daily water application is calculated as a function of wetted haul road area, evaporation, and rainfall. Water is applied to offset daily evaporation from the wetted area. Evaporation rates are subject to monthly adjustment factors. Application is cancelled if rainfall exceeds a nominated minimum threshold (1.5 mm/day) (WRM, 2019).

Monthly evaporation factors and the rainfall threshold determined in the previous model update are compared to measured water usage rates during the period January 2018 to December 2020 and adjusted as required. The results of this process are presented in **Figure 7**. Note that measured data has been factored per **Section 5.2.1**.

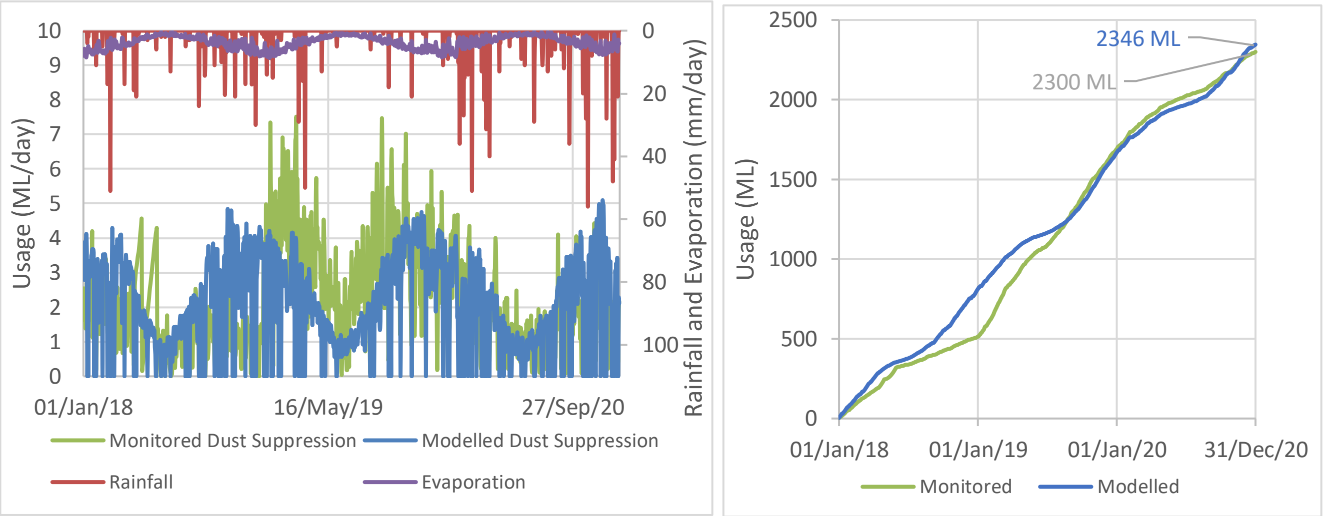

Figure 7 Dust Suppression Sub Model: Modelled vs Monitored Values

Review of **Figure 7** shows relatively good agreement between calculated and measured data. Anomalies do occur throughout the calibration period however overall usage shows good correlation with seasonal trends demonstrated. Results have been derived using the following parameter set consistent with the previous 2019 model update (WRM, 2019):

- Haul road wetted area: 44.0 ha (per WEP surface water assessment, WRM 2015)
- Rainfall threshold: 1.5 mm/day
- Evaporation adjustments:
  - January to February: 1.1
  - March to June: 1.6
  - July to September: 1.9
  - October 1.7
  - November 1.5
  - December 1.3

The parameter adjustment process has sought to reproduce: 1) total usage volumes, 2) seasonal variation in water usage (i.e. general peaks and troughs in spring/summer and autumn/winter respectively), and 3) sensitivity to rainfall (reductions in usage during wet periods such as winter 2016 and 2020). Additionally, monthly adjustment factors are the same for each year, and should also follow a relatively smooth profile within the year (e.g. not varying up and down repeatedly).

5.3 Water Destruction (Sprays)

WCPL have previously operated a system of evaporator sprays which are located on the eastern bank of Pit 2W between October 2017 and February 2018. During this time, there were 10 sprays in operation. Water supply to the spray system was unmetered and has been estimated at approximately 1 ML/day. Net water losses have been estimated at 0.25 ML/day assuming a 25% spray efficiency, which has been selected based on past experience with similar systems at other operations. These evaporator sprays where not operated during 2019 or 2020. The WBM has been configured to model a net 0.25 ML/day water extraction from Pit 2W. The outflow is assumed to remove no salt from Pit 2W. Operation of the spray system has been assumed to cease if the combined inventory in the WMS reduced below a specified minimum threshold, which has been initially defined at 1,000 ML in previous models. This threshold has been increased to 3,500 ML in most recent model update to better reflect site operations during dryer periods. This threshold is considered suitable for continued use in this model update, however this threshold should continue to be confirmed on a scenario by scenario basis.

6 Water Treatment Facility

6.1 Overview

WCM operate a water treatment facility (WTF), which is used to treat excess mine water, and discharge a blend of permeate and mine water to Wilpinjong Creek in accordance with conditions outlined in EPL 12425. The WTF comprises a RO treatment plant which has the capacity to release at a rate of 5 ML/day. For the period between January 2017 and January 2018, a secondary RO treatment plant leased from General Electric (GE) was in operation, increasing the prescribed maximum release rate to 15 ML/day. The second RO treatment plant was decommissioned at the beginning of 2018 once the site's mine water inventory had been sufficiently reduced. Following decommission the GE Plant the capacity of the WTF reverted back to the original capacity of 5ML/day. Due to considerable drought conditions experienced during 2019 the RO treatment plant was decommissioned for the period between November 2018 and November 2020, the plant was recommissioned following considerable rainfall throughout 2020 resulting in significant surplus water within the site inventory. Current license conditions require a maximum release water electrical conductivity of 500 µS/cm, a pH range between 6.5 and 8.5, oil and grease not to exceed 10mg/L and total suspended solids not to exceed 50mg/L.

The WTF is located adjacent to and east of Pit 2W (location marked in **Figure 1**). Feed water is extracted from Pit 2W (EC 3,500 to 4,000 µS/cm), and then passes through a process of strainers, UF filters and RO membranes to produce a low EC permeate stream (typ. 180 µS/cm EC). The permeate stream is blended with a small amount of feed water prior to release to achieve a mixed EC closer to the 500 µS/cm limit prescribed in the EPL. The EC of the RO reject by-product varies depending on permeate recovery but is typically around 14,000 µS/cm EC. Prior to Q4 2018, reject was pumped to Pit 1S. Reject is now pumped to either the RWD or Pit 2W given that Pit 1S has been taken offline (mined through). Some permeate is also used for RO back-flushing/cleaning. A conceptual schematic of the WTF and river discharge process is presented in **Figure 8** (based on the configuration prior to Q4 2018).

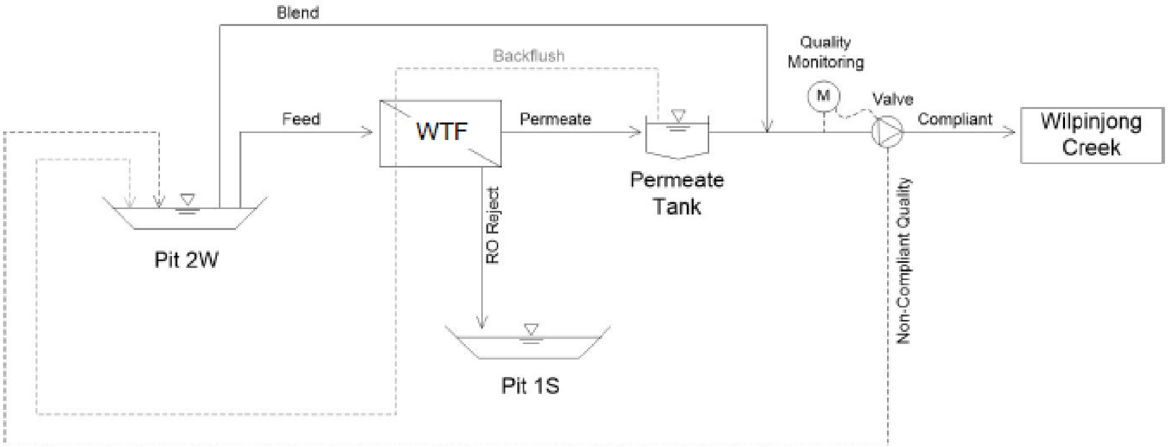

Figure 8 Conceptual Schematic – WTF and River Discharge Process (Configuration prior to Q4 218) (Source, Hatch, 2017)

The WCPL WTF is currently capable of producing enough permeate to discharge a blended stream of water to Wilpinjong Creek at up to 3 ML/day. With both the WCM and GE WTFs operating, the combined rate of discharge had the capacity to reach up to approximately 8 ML/day. Due to the significant rainfall experienced at WCM during 2020, rapidly increasing water volumes have been experienced within the site WMS.

6.2 Historical Performance

WCPL have provided records of daily volumes discharged to Wilpinjong Creek (from both plants), for the period January 2016 to December 2020. This information has been presented in **Figure 9**.

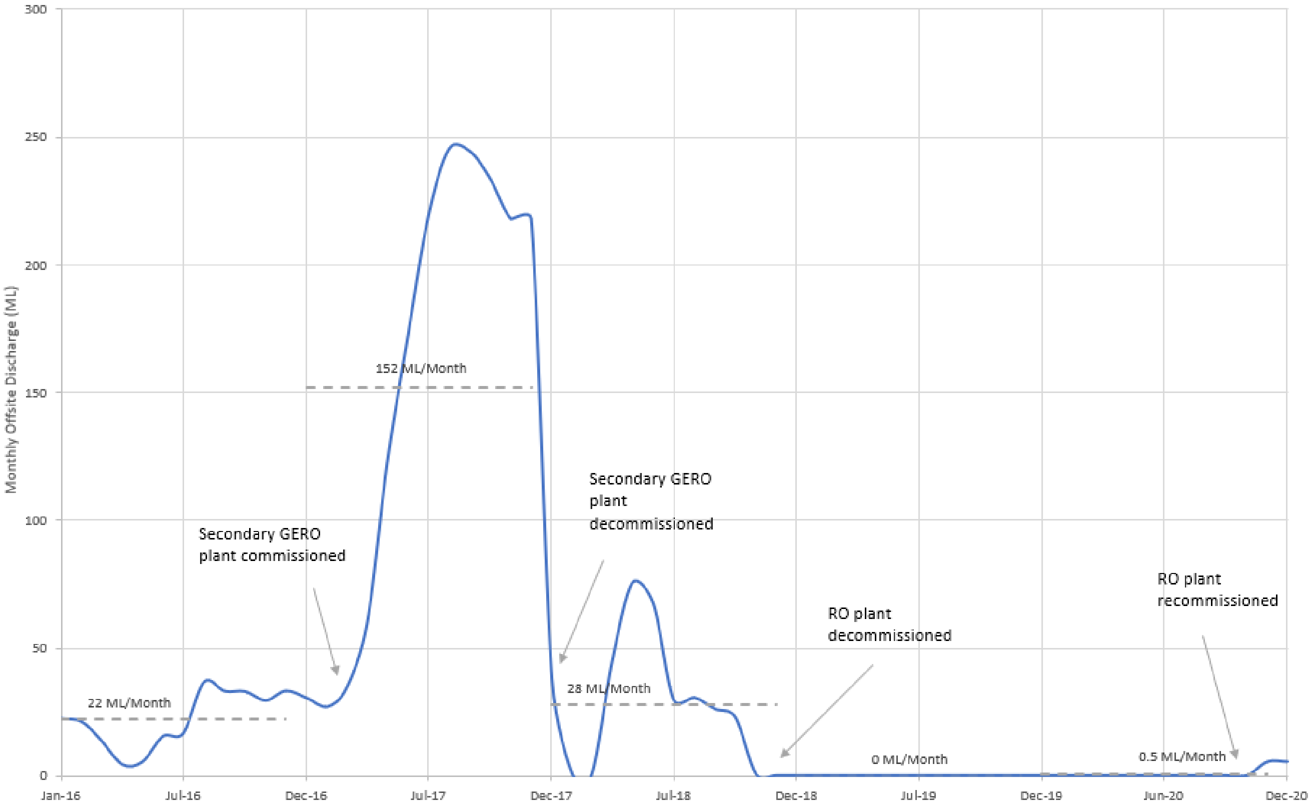

Figure 9 Historical WTF Discharge Volumes

Review of **Figure 9** shows the following:

- The WTF facility was not operated during 2019 and majority of 2020 due to low levels within the site inventory and very low rainfall throughout 2019;
- Discharge volumes significantly increase after March 2017, following a significant wet period, modification of the Site's EPL discharge limit, optimisation of the WCPL WTF, and installation/ramp-up of the GE WTF.
- Slightly higher discharge volumes in 2018 compared to 2016, given a comparable WTF configuration. However, it is understood that the WCPL WTF was upgraded/optimised in 2016 to rectify performance problems associated with out- of-spec feed water.

6.3 Model Configuration

The WBM has been constructed to be used for future studies with the following defined as part of the previous model updates, assuming the GE plant is offline:

- WTF capacity: 4 ML/day;
- Permeate recovery: 75% of feed;
- Permeate EC: 180 µS/cm EC;
- Reject EC: calculated in model based on feed water EC;
- Discharge water EC: 350 µS/cm EC (per recent historical sampling – see **Table 12**);
- Blend water volume: assumed 0.3 ML/day based on average feed water EC and required discharge EC; and
- Assumed no reduction in RO recovery due to increasing feed water EC.

As part of the previous model update at set of operating rules were established within the WBM which aim to reflect onsite decisions regarding the WTF for use in future studies. These updates included adjustment of the WTFs deactivation trigger to 2,000 ML rather than the previously adopted 1,000 ML, and incorporation of relationship between climatic conditions (i.e. rainfall) and feed water flow. These changes have been further verified as part of this update.

Operation of the WTF is based on both site mine water inventory and rainfall forecasts. From historical monitoring data it is also observed that discharge flows vary and may not always operate at full capacity. Due to limited software capabilities, predicting rainfall beyond the current timestep cannot be determined. Rather, daily feed water flows within the WBM are determined by the previous 5-day rainfall and the level within the site mine water inventory. Application is cancelled if site inventory exceeds the nominated minimum threshold of 2,000 ML.

Inflow rates to the WTF have been based on discharge flows and their associated rainfall and site inventory levels given in the January 2018 to December 2020 monitoring data. The results of this process are shown in **Figure 10**. It should be noted that adjustments to the model were made to account for WTF decommission throughout majority of 2020.

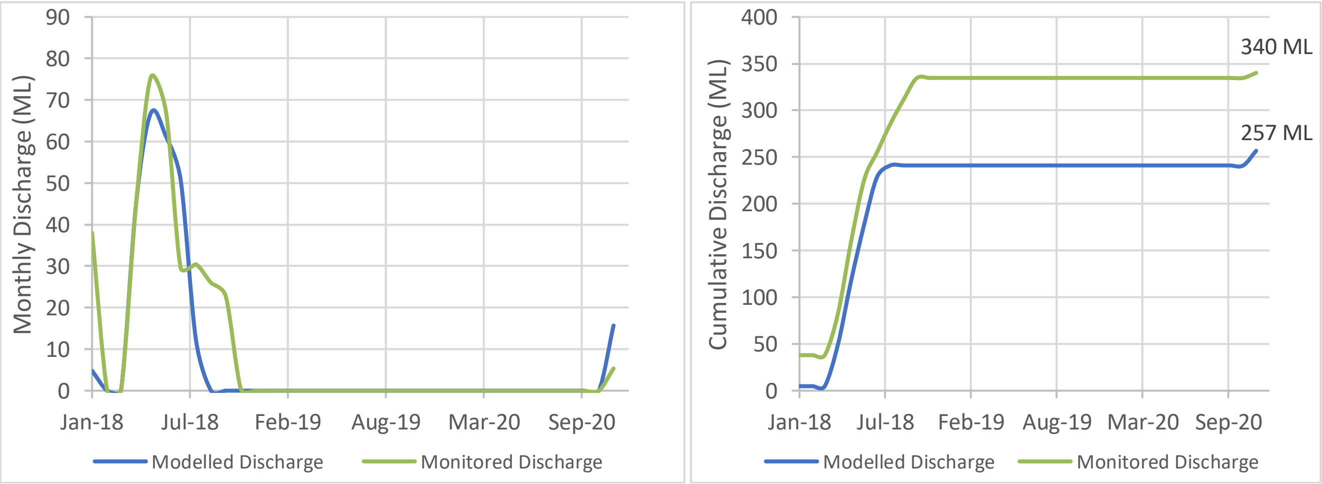

Figure 10 WTF Sub Model: Modelled vs Monitored Values

Review of **Figure 10** shows relatively good agreement between calculated and measured data. Results have been derived using the relationship described in **Table 9**.

Table 9 Feedwater Flow Rate Relationship

Site Inventory (ML)	5 Day Rainfall (mm)	Feedwater Flow (ML/day)
>3500	-	4
3500 - 3000	-	3.5
3000 - 2800	-	3.2
2800 - 2700	-	3.1
2700 - 2600	>1.5	2.9
	≤1.5	2.0
2600 - 2500	>1.5	2.8
	≤1.5	0.9
2500 - 2400	>1.5	2.5
	≤1.5	0.8
2400 - 2350	>20	0.9
	20 – 1.5	0.7
	≤1.5	0.3
2350 - 2000	>20	0.3
	≤20	0
<2000	-	0

The WTF operating rules has sought to better simulate inflows and associated outflows for the WTF based on climate variation and site inventory levels for use in predictive studies. The WBM has been verified with three years of data and should continue to be refined and validated using site monitored data.

7 External Water Import

WCM have access to external water supply bores that are operated when required. Given the previous surplus mine water in storage at the site WCM have not required to use this source until the extreme drought conditions that occurred during 2018 and 2019. External water was sourced from the water supply bores during May 2019 to March 2020. Accessible external water supply sources are outlined below:

- WCM water supply system includes a water supply borefield;
- It is understood that WCPL are licensed to collectively take up to 3,121 ML annually (equivalent to 8.55 ML/day) including water pumped from mining pits, inferred groundwater and water supply bores;
- Based on the 2019-2020 monitoring data a maximum of 27.3 L/s of water was supplied to the mine via the water supply borefield; and
- WCPL has an in-principle agreement with the nearby Moolarben Coal Mine to source excess water from this mining operation (by pipeline) if required in the future (subject to approval).

WCM have provided records of water import volumes for the January 2019 to December 2020 period. This information has been presented in **Figure 11**.

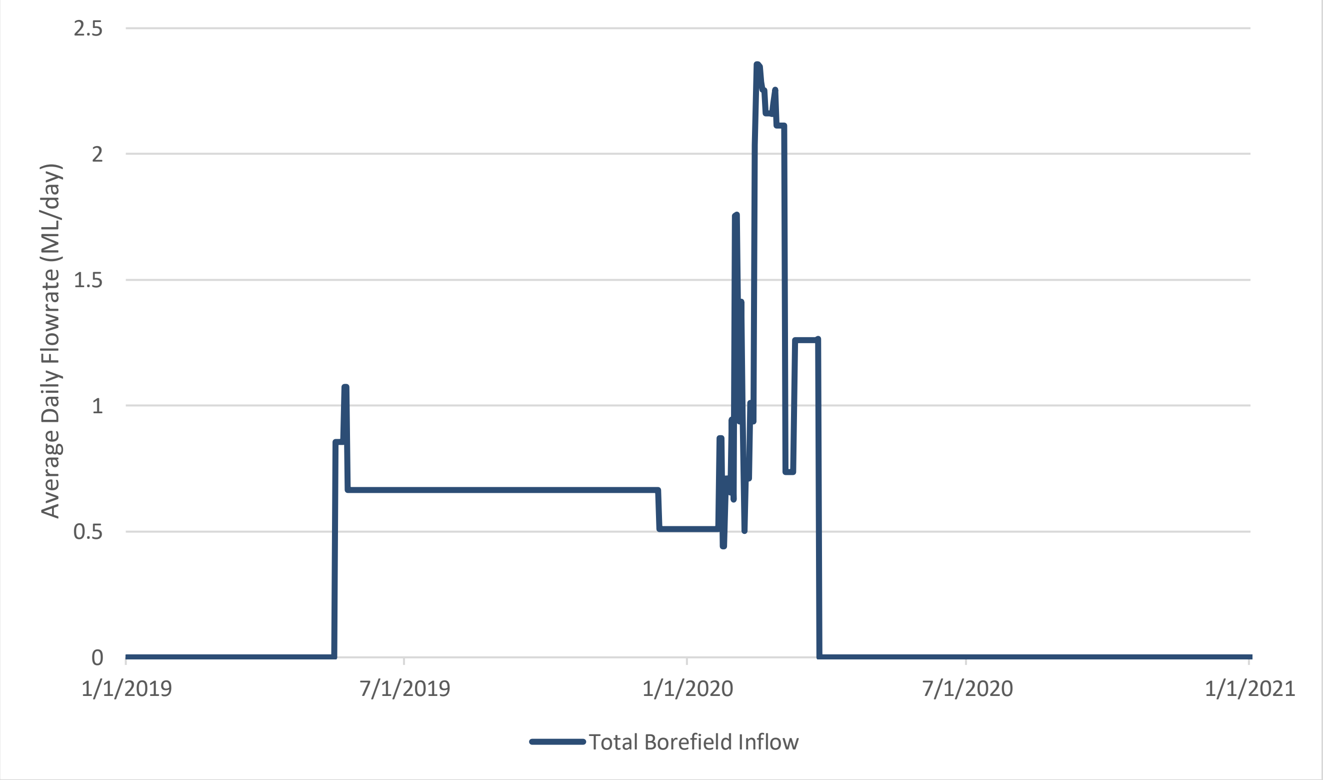

Figure 11 Average Daily Import Rates

A review of **Figure 11** shows a consistent supply of water from the 17 May 2019 to the 26 March 2020 with an average flowrate of 0.67 ML/day (7.8 L/s) in 2019 and 1.16 ML/day (13.4 L/s) in 2020.

7.1 Model Configuration

The WBM has been configured to import water from an external source if the combined mine water inventory falls below a specified minimum threshold. This threshold was increased from 500 ML to 2,000 ML in the previous model update to reflect observed operations during dry periods. Additionally, a series of pump operation rules have been established to relate the rate of external supply into the WMS to the site inventory levels. These operating rules have been further refined during this model update by altering the pump rate for the set benchmark values. The external supply operating rules included in the WBM are as follows:

- External water is supplied at a varying rate depending on combined mine water inventory levels;
- Benchmark values are set as:
    - Combined mine water inventory 2,000 ML - assumed pumping rate of 5.1 L/s (0.44 ML/d);
    - Combined mine water inventory 1,000 ML - assumed pumping rate of 9.9 L/s (0.86 ML/day); and
    - Combined mine water inventory 500 ML - assumed pumping rate of 27.3 L/s (2.35 ML/d).
- External water supply pump rates are linearly interpolated between the benchmark values based on the combined mine water inventory; and
- Water is assumed to be sourced from the borefield and pumped into the CWD storage, where it is then pumped on to supply tasks as required.

Modelled external supply volumes determined using the above operating rules have been compared to the measured water supply volumes during the January 2019 to December 2020 period. The results of this process are presented in **Figure 12**.

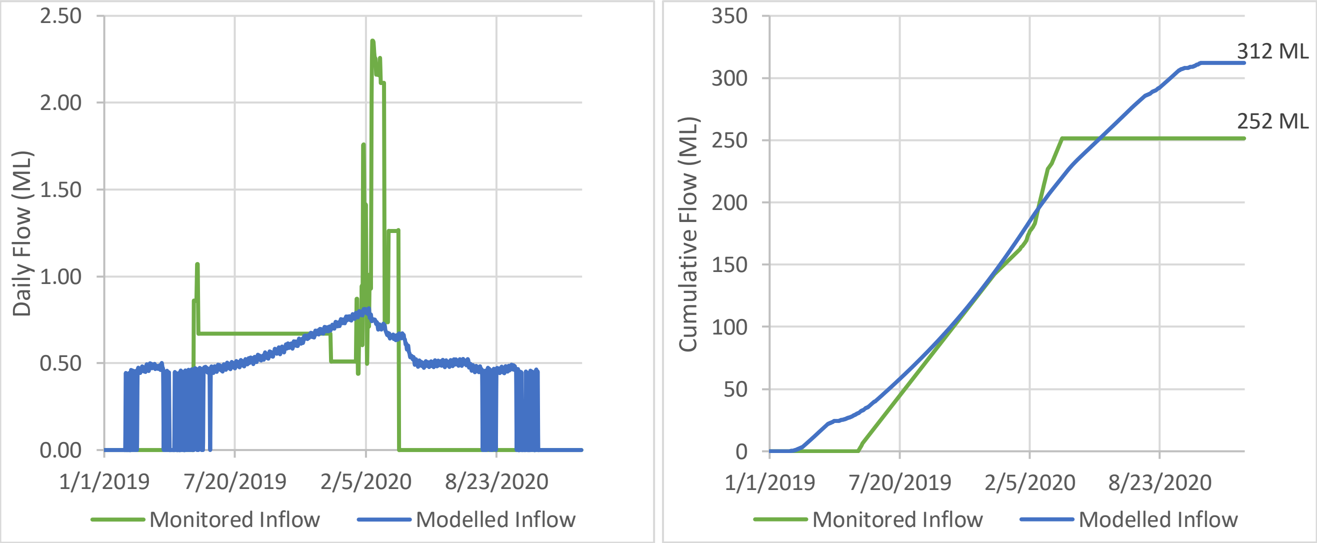

Figure 12 External Water Supply: Modelled vs Monitored Values

As shown in **Figure 12** modelled data shows reasonable correlation to measured data. Although anomalies are observed between the modelled inflows and that of the monitored data, the intent of this operation is to allow predictive studies to more effectively determine reliance on external water sourcing. The modelled operating rules provide a more reflective simulation during dry conditions as opposed to a single threshold trigger as previously applied within the WBM.

8 Groundwater

8.1 Groundwater Inflows

8.1.1 Definition

Groundwater inflows are defined as waters reporting to the WMS from aquifers external to the current extent of disturbance. This generally includes seepage from coal seams and in- situ rock and alluvial aquifers, and water released from cracks and pores within coal and rock as it is broken as part of the mining process (WRM, 2019).

8.1.2 Previous estimates

Previous estimates of groundwater inflow to the WCM include the following:

- WEP EIS (2015): net groundwater inflow rates adopted as part of the WEP surface water assessment (WRM, 2015) were derived by applying highwall evaporative losses to gross inflow rates determined through hydrogeological modelling as part of the groundwater assessment (HydroSimulations, 2015);
- Previous 2016 model update (Hatch, 2017): net groundwater inflow rates were inferred at a constant rate of 3.8 ML/day through the period January 2014 to January 2017 as part of the water balance model calibration process;
- Previous 2019 model update (WRM, 2019): net inflow rates determined through model calibration exercise varying from 3.51 ML/day in 2014 to 2.00 ML/day in 2018;
- Previous 2020 model update (SLR, 2020): net inflow rates determined through model calibration exercise as 2.19 ML/day in 2019; and
- Groundwater Model Update (SLR, 2020): net groundwater inflow rates determined from hydrogeological modelling.

8.1.3 Current estimates (this study)

Groundwater inflow rates have previously been inferred for a given year through historical model calibration (WRM, 2019). However, during the previous model update an operation within the model was established that varies groundwater inflow depending on the state of groundwater influences therefore allowing the model to be more effectively used as a predictive tool for determining future onsite water volumes. This operation allows groundwater inflows to be adjusted based on recent rainfall trends to align simulated mine water inventory trends during dry and wet periods. The degree to which groundwater inflows are adjusted has been determined using historical model calibration. Adjustment factors were modified during this model update from 40% rainfall deviation to 25% during calibration. Updated adjustment factors include the following:

- Mean 6-monthly rainfall (304mm) correlates to the mean modelled groundwater inflow (SLR, 2020) of 2.2 ML/day;
- 6-monthly rainfall greater than 25% of the mean correlates to a 25% increase in groundwater inflow (2.7 ML/day) to reflect increased groundwater recharge; and
- 6-monthly rainfall less than 25% of the mean correlates to a 25% decrease in groundwater inflow (1.6 ML/day) to reflect reduced groundwater recharge.

Based on the above operation average groundwater inflow for the calibration period are as shown in **Table 10**. It should be noted that assessment of inferred groundwater take for WCM licence conditions is assessed based on the water year (period 1 July to 30 June).

Table 10 Summary of Average Daily Groundwater Inflow

Calendar Year		Water Year	
Period	**Modelled Groundwater Inflow (ML/day)**	**Period**	**Modelled Groundwater Inflow (ML/day)**
2018	1.64	2018-2019	1.9
2019	1.64	2019-2020	1.7
2020	2.28	2020-2021	TBC

TBC – To be confirmed

Groundwater inflows in 2020 were estimated at an annual average of 2.28 ML/day and 1.7ML/day for the 2019-2020 water year. This is comparable to predication's made in the previous WEP (Hydrosimulations, 2015) for start of Pit 8 mining and current groundwater modelling (SLR, 2020) of 2.0 ML/day (for the 2019-2020 water year) and 2.35 ML/day (calendar year) respectively.

8.1.4 Model Configuration

The WBM has been configured to simulate a future net inflow rate based on 6 monthly rainfall trends as described in Section 8.1.3, reporting to the site WMS. Prior to 2020 the combined rate is apportioned as follows:

- Pit 1/5/6 void: 25%
- Pit 2/4 void: 25%
- Pit 3/7 void: 50%

Note that the 2019 WBM model configuration does not include any groundwater inflow to Pit 8. Activities in the Pit 8 extraction area began during 2019, predominantly during the early stages of mining (i.e. pre-tripping) with limited pit development. It is therefore expected that Pit 8 was elevated above the groundwater table throughout 2019 hence no groundwater intercept would have occurred. Groundwater inflow to Pit 8 was expected to occur during 2020 with the commencement of mining within Pit 8. Therefore, the model configuration for 2020 onwards is given as:

- Pit 1/5/6 void: 30%
- Pit 2/4 void: 20%
- Pit 3/7 void: 20%
- Pit 8 void: 30%

Groundwater operations within the model are used as a preliminary tool to determine groundwater inflows, however, there remains scope to improve measurement of groundwater inflow to the pits in order to further validate groundwater inflow within the WBM. It is recommended that inflow assumptions continue to be revised/adjusted as further information becomes available.

8.2 Spoil Aquifers

8.2.1 Overview

Mining operations have extracted coal from three distinct voids, termed Pit 1/5/6, Pit 2/4 and Pit 3/7 with the addition of Pit 8 in 2019 (see **Section 3.1** and **Figure 1**). In-pit spoil placement areas have been formed within Pit 1/5/6 and Pit 2/4 for creation of the most mining landform. These in-pit placement areas are porous and highly permeable. The drainage characteristics of the spoil are such that up-dip pits (such as Pit 5S, Pit 1 and Pit 2S) do not need to be pumped out following rainfall events, as they freely drain down the dip of the coal (through the spoil) to the down-dip pits (i.e. Pit 5N and Pit 4). Pit 2W is also observed to seep at a high rate to Pit 4, through the interconnecting spoil placement areas, due to the high water level difference between these two areas. As mining commenced within Pit 8 during 2020 some groundwater interaction is expected to have taken place, however, is not expected to interact with the spoil aquifers.

Storage of water in-pit is expected to result in flow of water from the open water body into the adjoining spoil placement area, forming a saturated zone within the spoil in which significant volumes of water may be stored. In the event of a pit filling with water, leakage to the adjoining spoil aquifer will prolong the filling process, and conversely, leakage from the aquifer will prolong the subsequent dewatering process.

8.2.2 Properties

Spoil aquifer extents have been estimated based on comparison between end of year 2017 surface topography and deepest mined topographic survey (WRM, 2019). Spoil aquifer storage capacity is a function of the spoil extent and the spoil porosity.

The previous 2016 water balance model update (Hatch, 2017) adopted a spoil aquifer porosity of 30%, determined through model calibration (January 2014 to January 2017). The 2017 water balance update (WRM, 2018) extended the model calibration to include data recorded between January 2017 and December 2017, which includes the drawn-down of Pit 5N and its adjacent spoil aquifer. A reduction in the spoil aquifer porosity value from 30% to 20% was found to be required. The 2018 water balance update (WRM, 2019) assumes a further reduction in the Pit 5N spoil aquifer porosity to 10% to replicate the observed rate of draw-down in Pit 5N during 2018. The 2018 water balance update (WRM, 2019) assumes values of 20% and 10% porosity for Pit 2 and Pit 4 spoil aquifers respectively. The porosity of spoil aquifers in this model update has been assumed as consistent with the 2018 values.

8.2.3 Model Configuration

Spoil aquifers have been modelled in the Wilpinjong WBM in accordance with the following:

- Spoil aquifers have been modelled adjacent to Pit 5N, below Ed's Lake, Pit 2W and Pit 4;
- Recharge and discharge occurs to balance water levels between the pit lake and the adjacent spoil aquifer. Rates of transfer are governed by head difference but are typically in the order of 10 ML/day – 20 ML/day when flowing (model assumption);
- Pit 2W spoil aquifer drainage to Pit 4 (via Pit 4 spoil aquifer) modelled at a constant rate of ~10 ML/day;
- Storage characteristics have been modelled assuming 10-20% spoil porosity. Stage- storage characteristics have been provided for reference in **Appendix C**; and
- Seepage from up-dip pits into spoil aquifers, and back out into down-dip pits (e.g. Pit 5S to Pit 5N, or Pit 2E to Pit 2W), at relatively unconstrained flow rates.

9 Water Quality

Water quality sampling at WCM is undertaken at a number of locations with samples analysed for the standard suite of quality indicators. Monthly average measurements of EC for selected surface water locations have been summarised in **Table 12**. Note that limited EC data for the WMS dams or pits was provided in 2020. Review of this information shows the following:

- Water circulating through the WMS is typically within the EC range of 3,000-4,000 µS/cm (see Pit 2W and CWD);
- The EC of water within CWD increased slightly in 2019, coinciding with input from external bore supplies;
- During 2019 and 2020 EC of water within the RWD has increased to slightly above average levels;
- The EC of water within Pit 1S prior to 2018 is higher than the water in the rest of the WMS, due to inflow of RO reject. Concentrations of salt within this storage appear to have been diluted with upstream clean catchment runoff (RO reject EC sampled at 14,000 µS/cm in Feb-17 vs. Pit 1S EC of around 7,850 µS/cm in October 2017).
- The EC of the blended discharge stream to Wilpinjong Creek is typically around 300 to 350 µS/cm vs the 500 µS/cm EC end-of-pipe limit specified in EPL 12425.

The WBM maintains a running account of salt mass in all water storages which is equated to and reported as EC. Salt mass inflows are typically estimated by assigning salinity concentrations to runoff from various land use types, and to point water sources (e.g. groundwater, pipeline water).

Water quality model parameters were initially defined as part of the WEP surface water assessment (WRM, 2015). This water balance model update confirmed that these parameters continued to produce reasonable estimates of EC in the circulating WMS inventory (based on Pit 2W data). The current investigation has retained water quality parameters from these earlier studies. Adopted water quality parameters are summarised in **Table 11**.

Table 11 Adopted Salinity Generation Rules

Item	Salinity (EC) (µS/cm)
Catchment Runoff	
Natural / undisturbed	1,600
Roads / industrial / hardstand / pit	3,000
Spoil / overburden / cleared	2,500
Rehabilitated overburden	2,000
Point water sources	
Groundwater	3,000
External water supply (e.g. borefield)	3,000

Table 12 Average Electrical Conductivity (uS/cm) by month and sampling location

Year	Month	Monthly Rainfall (mm)	Dams						Pits				WTF				Reference (Waterways)		
			Pit 2W	Pit 1S	Pit 5 FP	CWD	RWD	Ed's Lake	Pit 5	Pit 2 NB	Pit 4	Pit 3	Feed	Permeate	Discharge (ML)	Concentrate	Wilp. Ck Upstream	Wilp Ck Downstream	Cumbo Creek
2015	Jan	115.7													325				
	Feb	17.5								5,290									
	Mar	16.3	3,048							4,790					310				
	Apr	109.3	3,390	6,670		3,330	3,510	880	1060	4,940	3,960				285				
	May	43.2													210				
	Jun	45.8		9,180						4,100					221				
	Jul	38.4								4,620					144				
	Aug	51.5													185		739	530	5,112
	Sep	10.6	3,490	5,690	2,110	3,440	3,580		2,290		4,250	3,030			158		1,296	365	5,203
	Oct	46.9			3,540					5,190					176		1,957	379	6,005
	Nov	90.3													212		1,007	352	4,694
	Dec	105.1								4,290					269		883	446	
2016	Jan	99.9	3,280	5,770		3,470	3,440	2,210	2,330	4,940	3,640				267		1,053	431	
	Feb	9.1													255		1,351	441	
	Mar	19.2													235			590	
	Apr	4.4													232				
	May	67.9													195				3,620
	Jun	107.7		7,700											176			386	6,254
	Jul	83													208		497	1,082	3,987

Year	Month	Monthly Rainfall (mm)	Dams						Pits				WTF				Reference (Waterways)		
			Pit 2W	Pit 1S	Pit 5 FP	CWD	RWD	Ed's Lake	Pit 5	Pit 2 NB	Pit 4	Pit 3	Feed	Permeate	Discharge (ML)	Concentrate	Wilp. Ck Upstrem	Wilp Ck Downstream	Cumbo Creek
	Aug	43.3													201		792	562	5,582
	Sep	172	3,310	6,180		3,280	3,320		2,740		3,880				199		313	73	1,942
	Oct	71.3													235		430	1,100	2,530
	Nov	44.9													284		536	976	
	Dec	35.6													276		1,446	465	
2017	Jan	34.4	3,545												294			486	
	Feb	25.8	3,520												305	14,000		539	
	Mar	130.4	3,670												301	13,400		686	
	Apr	19.4	3,620												307			539	1,431
	May	23.4	3,660												276			359	4,804
	Jun	11.8	3,630												347			344	5,796
	Jul	1.9	3,580												372			272	5,716
	Aug	26.4													357			285	5,365
	Sep	76.3													336			26	5,745
	Oct	33.3	3,710	3,710			7,610								321			290	6,280
	Nov	76.3	3,950	3,950											335			310	
	Dec	82.3													342			384	
2018	Jan	15.7															4,110	599	
	Feb	60.7																1,500	476
	Mar	45.2															4,360	2,020	3,690
	Apr	37.4															2,363	590	237

Year	Month	Monthly Rainfall (mm)	Dams						Pits				WTF				Reference (Waterways)		
			Pit 2W	Pit 1S	Pit 5 FP	CWD	RWD	Ed's Lake	Pit 5	Pit 2 NB	Pit 4	Pit 3	Feed	Permeate	Discharge (ML)	Concentrate	Wilp. Ck Upstrem	Wilp Ck Downstream	Cumbo Creek
	May	13.4															2,147	424	6,950
	Jun	24.2															1,805	351	3,776
	Jul	7.5													288		1,726	375	6,820
	Aug	29													312		1,656	356	3,655
	Sep	48.9													229		1,600	385	3,521
	Oct	51.3													328		1,781	418	3,629
	Nov	49.6													365		2,001	437	3,977
	Dec	105													367				
2019	Jan	82.3	4,350																
	Feb	4.8	4,290																
	Mar	107.3	4,340																
	Apr	0	4,250																
	May	18.9	4,170																
	Jun	7.2	4,010																7,860
	Jul	3.2	4,120																7,077
	Aug	7.5	4,120			4,100	3,990												6,956
	Sep	25.1	4,260			4,180	4,250												7,580
	Oct	5.6	4,400																
	Nov	26.2				4,350	4,370												
	Dec	4.2	4,430																
2020	Jan	27	4,550			4,610	4,550												

Year	Month	Monthly Rainfall (mm)	Dams						Pits				WTF				Reference (Waterways)		
			Pit 2W	Pit 1S	Pit 5 FP	CWD	RWD	Ed's Lake	Pit 5	Pit 2 NB	Pit 4	Pit 3	Feed	Permeate	Discharge (ML)	Concentrate	Wilp. Ck Upstrem	Wilp Ck Downstream	Cumbo Creek
	Feb	137																1,190	4,940
	Mar	92	3,560			3,740	4,390											2,650	4,025
	Apr	117	2,990			3,260	3,750										532	510	5,850
	May	16	3,000			3,140	3,530										660	744	6,270
	Jun	23	3,080			3,060	3,410										698	835	5,575
	Jul	70	3,050			3,050	3,240										467	545	5,500
	Aug	36	3,080			3,000	3,190										260	311	4,330
	Sep	77	3,110			3,060	3,170										291	420	3,907
	Oct	151	3,140			3,070	3,100										518	492	7,120
	Nov	17															458	464	
	Dec	162													**5.4**		471	629	7,050

Note: Wilpinjong Creek and Cumbo Creek EC values are flow-weighted averages, calculated for that month Rainfall totals were calculated based on the data obtained from the SILO Data Drill service

10 Water Balance Model

10.1 Overview

The WBM has been designed to simulate the operation of all major components of the water management system, including: catchment runoff, water inventory fluctuation and overflow, pump and gravity transfers, coal mining operations usage and return, climatic influence, groundwater inflow, open cut mine dewatering, external water supply, discharge of water to Wilpinjong Creek (via the WTF), and interaction with spoil aquifers. Key components of the WMS are generally described and quantified in the preceding report sections.

10.2 Model Schematisation

A representative schematic of the WBM has been provided in **Appendix A**. Review of this figure shows the model is comprised of a collection of inter-connected nodes. Nodes represent key components of the water management system (dams, wash plant, pits, etc.).

10.3 Model Calibration

10.3.1 Overview

The Goldsim model has been constructed to represent the operations taking place at WCM in the period 2018 - 2020 hence calibration of the model has been undertaken using the monitoring data provided by WCPL for the January 2018 to December 2020 period. Water level data has been converted to estimates of water volume using storage characteristics as described in **Section 3.2.2**. Inventory data and water usage data/discharge data has been utilised for model calibration.

The model calibration exercise has specifically focused on reproducing the measured inventory in the combined WMS (Pit 2W, Pit 1S, RWD, CWD, Pit 5N, Pit 4 and Pit 3N) with particular focus on behaviour of the water inventory during drought conditions experienced during 2018 and 2019 followed by recovery of the water inventory during the 2020 wet period. The objective of the exercise was to infer or establish key model inputs and parameters, and to demonstrate that the WBM suitably replicates observed site inventory trends.

10.3.2 Configuration

The following inflows and outflows were hard-coded into the model as time-series data:

- Extraction of water from the RWD and CWD to supply demands in the MIA/CHPP area, including the CHPP and miscellaneous MIA demands (modelled as per metered stream in **Section 5.1**);

The following processes were simulated within the model:

- Climatic influence: evaporation, evapotranspiration, direct rainfall and catchment runoff based on daily rainfall data at the BoM Wollar Gauge and site AWS (see **Section 4.2.3**) and SILO Data Drill evaporation data (refer to **Section 4.3**);
- Water extraction from Pit 2W, the RWD and Pit 5 FP Dam for dust suppression (per **Section 5.2**);
- Transfer of water between storages, pit dewatering etc (refer to **Table 4**);

- Seepage from up-dip pits into down-dip pits via spoil aquifers (e.g. Pit 5S seepage to Pit 5N);
- Saturation and drainage of spoil aquifers adjacent to open cut pits (spoil aquifers modelled adjacent to Pit 5N, Pit 2W and Pit 4) (refer to **Section 8.2**);
- WTF inflow and outflow rates (refer to **Section 6.3**);
- Groundwater inflow rates (refer to **Section 8.1**); and
- External water supply rates (refer to **Section 7**).

The following parameters were adjusted to improve the overall agreement between simulated and observed historical WMS performance:

- External water supply operating rules;
- Groundwater adjustment factors and groundwater inflow apportioning to Pits; and
- Incorporation of operations regarding Pit 8.

Other settings and configuration assumptions include:

- Catchment and land use information described in **Section 3.2.4**; and
- Catchment and land use data in 2018 and 2019 based on data in the previous model updates.

10.3.3 Outcomes

Model simulated volumes have been compared against historical measurements in **Figure 13** for the period January 2018 to December 2020. Results have been plotted for the combined water inventory in the WMS (comprising Pit 2W, Pit 1S, RWD, CWD, Pit 5N, Pit 4 and Pit 3).

Review of **Figure 13** found discrepancies in modelled and monitored inventory levels during the period July 2019 and May 2020. Investigation found a significant drop in site inventory occurred in July as a result of gaps in Pit 4 monitoring, monitoring then resumed in May 2020 resulting in a sudden spike in site inventory. In order to account for these discrepancies, the model results have been adjusted to account for the sudden loss and gain of volume associated with Pit 4 monitoring results, as shown in **Figure 13**. By adjusting these values to match monitoring variances **Figure 13** shows that the simulated WMS inventory is well aligned with historical inventory measurements throughout the 2018 to 2020 calibration period.

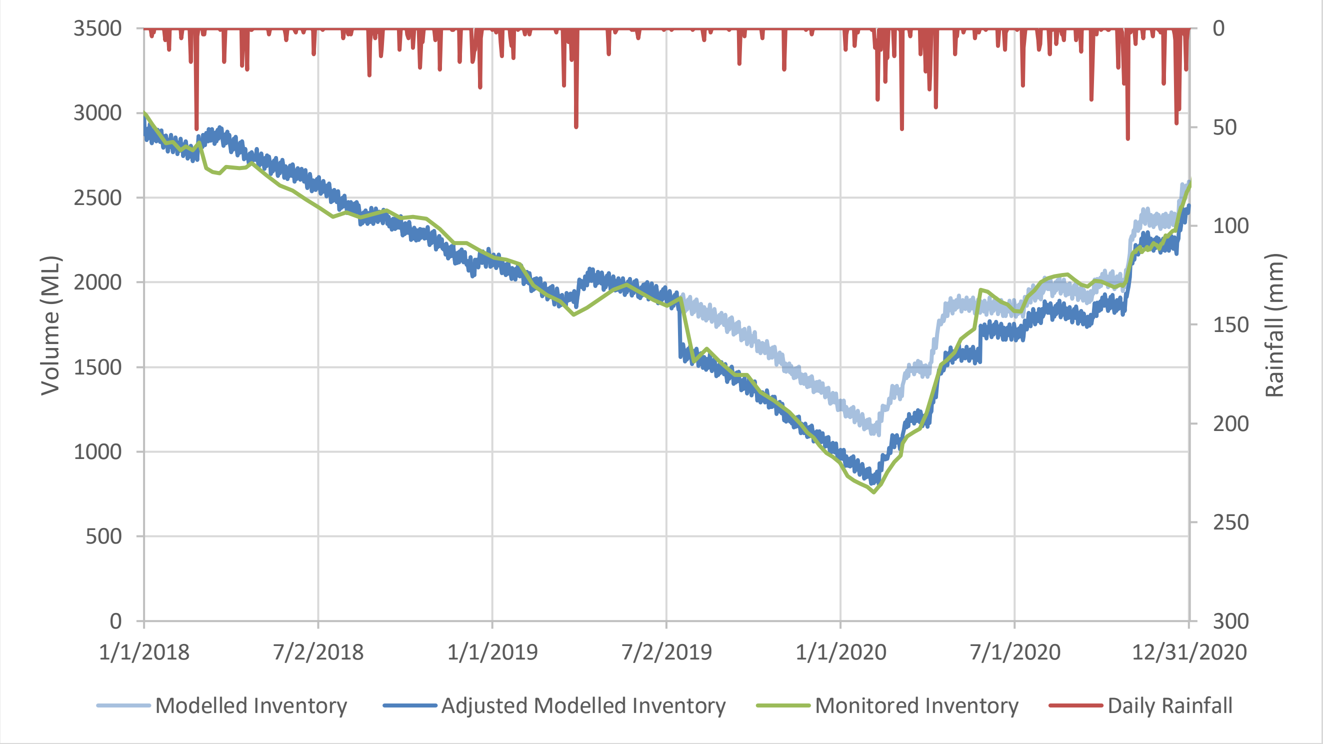

Figure 13 WBM Calibration Simulated vs Measured Combined Site Inventory

Key outcomes of the calibration process include:

- Effective representation during significantly dry conditions and during subsequent water recovery; and
- Verification of a series of operating rules regarding groundwater inflow rates, WTF operation and external water supply to allow the model to be more effectively used as a predictive tool for onsite water behaviour.

10.4 Basecase Model Operating Rules

Representative operating rules that define the Wilpinjong WBM are summarised in **Table 13**. The operating rules have been refined by calibration against monitored data over a 4 year period.

Table 13 Wilpinjong WBM Operating Rules

Item	Description	Operating Rules
1.0	**External Water Supply**	
1.1	External Water Supply	• Water imported from an external source to sustain mine water demands during prolonged drought periods • External water supplied when site inventory below 2,000ML, import rate dependent on site inventory level and ranges from 5.1L/s to 27.3L/s (see section 7). • Inflow directed to CWD
2.0	**Supply to Demands**	
2.1	CHPP	• Modelled as a net water extraction of 110 ML/month (3.6 ML/day) sourced evenly between the CWD and RWD • Usage consistent with CHPP water balance and forecast production (WRM, 2019) (see Section 5.1.1.4) • No return from demand
2.2	Miscellaneous Industrial Area	• Modelled as a net water extraction of 20 ML/month (0.66 ML/day) sourced evenly between the CWD and RWD • Assumed loss rate of 0.274 ML/d (100 ML/yr) • Balance assumed to return to Pit 2W

2.3	Dust suppression	• Water usage calculated daily in model as a function of climate and application area. (Refer to Section 5.2.2)
		• No dust suppression if rainfall exceeds 1.5 mm/day
		• Demand supplied based on the following breakdown:
		  • ROM FP (RWD) – 75.08%
		  • Pit 2 FP (Pit 2W) – 24.91%
		  • Pit 5 FP (Pit 5 FP Dam) – 0.01%
		• No return from demand modelled

2.4	Evaporators	• Modelled as a net 0.25 ML/day loss from Pit 2W • Outflow stream assumed to be water only, no salt removed from Pit 2W • Disabled if site water inventory is less than 3,500 ML

Item	Description	Operating Rules
2.5	WTF	- Used to draw down mine water inventory. Operated if inventory in WMS exceeds 2,000 ML - Supplied from Pit 2W at up to 4 ML/day, flowrate modelled dependent of previous 5-day rainfall (see Section 6.3) - Permeate recovery modelled as 75% of feed. No reduction in recovery modelled due to high feed water EC - Permeate EC modelled at 180 µS/cm - WTF reject EC modelled as a function of feed water EC based on salt mass balance - WTF reject pumped to Pit 1S prior to Q4 2018 after which reject pumped to RWD. If Pit 1S/RWD full, reject pumped to Pit2W. Following recommission in December 2020 reject is pumped to Pit 2W. - Discharge water EC modelled at 350 µS/cm, achieved by adding Pit 2W water to the residual permeate stream assumed 0.3 ML/day based on average EC of Pit 2W and discharge water
3.0	**Operation of Key Storages**	
3.1	Water Storages	

3.1.1	Pit 2W	- Primary hub mine water storage
		- Supplies makeup water to the following locations as required:
		  - RWD and CWD
		  - Pit 2 FP
		  - Pit 5 FP Dam
		- Receives pumped dewatering from Pit 5N, Pit 4, Pit 3N, Pit 8 and Pit 8 CWD
		- Pumps to Pit 5N at 100 L/s (8.64 ML/day) if water level exceeds 370 mAHD. If Pit 5N is full, Pit 2W pumps to Pit 4, and then to Pit 3 as a last resort
		- Seeps to Pit 4 via Pit 2/4 spoil aquifer
		- Supplies water to WTF for treatment and discharge to Wilpinjong Creek under EPL 12425
		- Feed water for evaporator spray system
		- Exchanges water with adjacent Pit 2/4 spoil aquifer to maintain equalised water levels (exchanges water with Pit 2 half of spoil aquifer only)
		- No spillway overflows modelled.

Item	Description	Operating Rules

3.1.2	RWD	• Mine water dam in the CHPP/MIA area
		• Supplies water to the following locations:
		  • CHPP process water makeup
		  • MIA/CHPP miscellaneous water usage
		  • ROM FP
		• Sources water from Pit 2W to maintain water level at 412.6 mAHD (295 ML)
		• Receives reject from WTF following decommission of Pit 1S in Q4 2018
		• No spillway overflow modelled

3.1.3	CWD	• Mine water dam located north of CHPP/MIA, within the rail loop.
		• Supplies water to the following locations:
		  • CHPP process water makeup
		  • MIA/CHPP miscellaneous water usage
		• Sources water from Pit 2W to maintain water level at 395.7 mAHD (30 ML)
		• No spillway overflow modelled

3.1.4	Pit 1S (offline as of Q4 2018)	• RO reject storage dam • Receives pumped inflow of reject from WTF • Maximum operating level defined as 421.4 mAHD (295 ML) to minimize seepage to downstream areas within the WMS • Constant seepage rate of 1 mm/d modelled. Seepage assumed to report to Pit 1/5/6 spoil aquifer • Additional seepage of 0.45 ML/d to Pit 1/5/6 spoil aquifer modelled if water level exceeds 422.4 mAHD (345 ML)
3.1.5	Pit 5 FP Dam	• Water supply for Pit 5 FP • Receives pumped inflows from Pit 5N and Ed’s Lake • Sources makeup water from Pit 2W to maintain a minimum water level of 391.5 mAHD (3 ML) • Spillway overflow to Pit 5N at 392.2 mAHD (full storage volume 8.5 ML)
3.1.6	Ed’s Lake	• Residual void left within backfilled and rehabilitated Pit 1N void • Supplies makeup water to Pit 5 FP Dam • Pumps excess water to Pit 2W at 100 L/s (8.64 ML/day) • Seepage to underlying Pit 1/5/6 spoil aquifer modelled at 0.5 ML/day • Spillway overflow to Wilpinjong Creek at 375.3 mAHD (storage capacity nominally 110 ML)

Item	Description	Operating Rules
3.1.7	Pit 8 Clean Water Dams	• Constructed in 2020 • Capture water from the Pit 8 upstream diversion • Excess water pumped to Pit 2W at 160L/s when volume reaches 6.5ML
3.2	**Tailings Storage Facilities**	
3.2.1	All TD's	• Old tailings storage cells • All receive local catchment runoff with no pumped inflows • No pumped outflows modelled. Standing water left to evaporate, or seep to Pit 2/4 spoil aquifer (at an assumed rate of 2 mm/day)
3.3	**Mining Pits**	
3.3.1	Pit 5N	• Pumps to Pit 5 FP Dam if it requires water. Excess water pumped to Pit 2W at 180 L/s (15.6 ML/day) unless receiving storage is above its maximum operating level • Maximum water level of 369 mAHD modelled. If water level exceeds this threshold, pumping to Pit 2W will occur regardless of downstream inventory (this will trigger filling of next pit in sequence) • Receives groundwater inflow of 25% of total inflow prior to 2020, receives 30% groundwater inflow following the commencement of mining Pit 8 (modelled via Pit 1/5/6 spoil aquifer) • Exchanges water with adjacent Pit 1/5/6 spoil aquifer to maintain equalised water levels • Receives seepage from up-dip pits (Pit 5S, Pit 6 and Pit 1) via spoil aquifer
3.3.2	Pit 5S	• Seepage to Pit 5N (via Pit 1/5/6 spoil aquifer) modelled as a depth loss rate of 300 mm/day • No pumped dewatering
3.3.3	Pit 4	• Receives seepage from Pit 2W via Pit 2/4 spoil aquifer • Excess water pumped to Pit 2W at 160 L/s (14.0 ML/day) unless receiving storage is above its maximum operating level • Maximum water level of 362.0 mAHD modelled. If water level exceeds this threshold, pumping to Pit 2W will occur regardless of downstream inventory (this will trigger filling of next pit in sequence) • Receives groundwater inflow of 25% of total inflow prior to 2020, receives 20% groundwater inflow following the commencement of mining Pit 8 • Exchanges water with adjacent Pit 2/4 spoil aquifer to maintain equalised water levels (exchanges water with Pit 4 half of spoil aquifer only)
3.3.4	Pit 1	• Seepage to Pit 1/5/6 spoil aquifer modelled as a depth loss rate of 300 mm/day • No pumped dewatering
3.3.5	Pit 2S	• Seepage to Pit 2/4 spoil aquifer modelled as a depth loss rate of 300 mm/day • No pumped dewatering

Item	Description	Operating Rules
3.3.6	Pit 3	- Receives drainage from Pit 7 - Excess water pumped to Pit 2W at 90 L/s (7.8 ML/day) unless receiving storage is above its maximum operating level - Maximum water level of 358.0 mAHD modelled. If water level exceeds this threshold, pumping to Pit 2W will occur regardless of downstream inventory - Receives groundwater inflow of 50% of total inflow prior to 2020, receives 20% groundwater inflow following the commencement of mining Pit 8
3.3.7	Pit 7	- Passively drains to Pit 3 - No pumped dewatering
3.3.8	Pit 6	- Seepage to Pit 5N (via Pit 1/5/6 spoil aquifer) modelled as a depth loss rate of 300 mm/day - No pumped dewatering
3.3.9	Pit 8	- No pumped dewatering prior to 2020 - Excess water pumped to Pit 2W at 100L/s - Receives groundwater inflow of 30% of total inflow from 2020, does not receive groundwater inflow prior to 2020
3.4	**Spoil Aquifers**	
3.4.1	Pit 1/5/6 Aquifer	- Modelled as two separate cells: Pit 5 spoil aquifer and Pit 1 spoil aquifer - Pit 5 spoil aquifer equalises with Pit 5N open cut above 351 mRL - Pit 5 spoil aquifer equalises with Pit 1 spoil aquifer above 354 mRL
3.4.2	Pit 2/4 Aquifer	- Modelled as two separate cells: Pit 2 spoil aquifer and Pit 4 spoil aquifer - Pit 2 spoil aquifer equalises with Pit 2W open cut above 350.75 mRL. - Pit 4 spoil aquifer equalises with Pit 4 open cut above 331 mRL. - Pit 2 spoil aquifer seeps to Pit 4 spoil aquifer at a fixed rate of 10 ML/day (seepage calculation based on level difference cannot be modelled within OPSIM due to large head difference – i.e. unstable calculation)
4.0	**Other**	
4.1	Climate	- All water storages receive catchment runoff and lose water to evaporation.

Item	Description	Operating Rules
4.2	Groundwater Inflow	- Passive groundwater inflow is experienced due to active mining - Groundwater inflow is determined using adjustment factors to simulate rainfall and recharge responses (see section 8.1.4) - Inflow directed to downdip pits within void areas, Pit 5N, Pit 4, Pit 3 and Pit 8 (Post 2019), the total expected rate is apportioned as follows: • Pit 1/5/6 void: 25% (prior to 2020), 30% (from 2020) • Pit 2/4 void: 25% (prior to 2020), 20% (from 2020) • Pit 3/7 void: 50% (prior to 2020), 20% (from 2020) • Pit 8 void: 30% (from 2020)

10.5 Forecast of Site Water Behaviour

10.5.1 Overview

The Wilpinjong WBM, as described in the preceding sections, has been utilised to investigate the behaviour of the site water inventory for the forecast period 1 January 2021 to 31 December 2023. This investigation includes assessment of several scenarios regarding the operation of the site WTF throughout this period. The scenarios assessed for the reporting period are as follows:

- Scenario 1: The WTF will operate under current conditions within the WBM (see **Section 6**); and
- Scenario 2: A second WTF is commissioned giving a combined maximum discharge rate of 5ML/day.

10.5.2 Model Configuration

The WBM has been configured to account for changes required to simulate, site operations proceeding current conditions (2020) and varying operation scenarios. The WBM primarily operates as per the configuration previously described in this report, however, adjustments have been made to the simulation methodology, catchment breakdown, site WMS operations and WTF operating rules. These elements are described in the following sections.

10.5.2.1 Simulation Methodology

The WBM was run on a daily timestep for the period between 1 January 2021 and 31 December 2023. As described in **Section 4.2** and **4.3**, 121 years of climate data sourced from the SILO Data Drill is available for WCM for use in analysis in long-term climate trends. Rainfall data was analysed in three-year climate sequences from which five sequences were chosen to represent the 1st (very dry three years), 10th (dry three years), 50th (median three years), 90th (wet three years) and 99th percentiles (very wet three years). This approach provides analysis for a large range of climate conditions represented in the historical rainfall records. The 3-yearly percentile rainfalls and the respective sequence years are shown in **Table 14**.

Table 14 Representative Climate Sequences

Climate Scenario	3-Yearly Rainfall (mm)	Years
Very Dry (1st %ile)	1,238	2017 – 2019
Dry (10th %ile)	1,446	1940 – 1942
Median (50th %ile)	1,818	2011 - 2013
Wet (90th %ile)	2,228	1989 - 1991
Very Wet (99th %ile)	2,563	1954 - 1956

Evaporation data for each sequence described in **Table 14** was sourced for the respective years from the SILO Drill Data (M_{lake}) evaporation.

The stored volumes prior to the simulated forecast period (to 31 December 2020) were estimated based on monitored water level data recorded by WCPL. The combined site volume on the 31 December 2020 was 2671 ML.

10.5.2.2 Catchment Breakdown

Catchment boundaries for water storages within WCM along with land use classifications for the years 2021, 2022 and 2023 have been delineated based on the most recent available catchment areas and land types provided by WCPL and the long-term mine forecast. A breakdown of land use type per water storage catchment area and catchment and land use maps, have been provided in **Appendix B**.

10.5.2.3 Site Water Management System Operations

The operations within the site water management system for the forecast period are expected to be generally consistent with the arrangement described previously in this report. However, WCM has gained approval to pump water from the Pit 8 CWD directly offsite to the north of Pit 8. This change has been incorporated into the WMS operations for the forecast period and is reflected in the WMS schematic provided in **Appendix A**.

10.5.2.4 Water Treatment Facility Operation

Two scenarios were assessed for the operation of the WTF during the forecast period which required changes to the operating rules within the WBM. Adjustments to the WBM for each scenario are as follows:

- Scenario 1: No changes to the WTF were made, operating rules remain consistent with **Section 6**; and
- Scenario 2: A second WTF is commissioned increasing the current capacity to discharge a maximum of 5ML/d. The feedwater flow rate relationship, described in **Table 9,** has been adjusted to account for this additional capacity with consideration for operations under wet conditions. The Scenario 2 WTF feed water flow rate relationship is shown in **Table 15**.

Table 15 Forecast Scenario 2 WTF Feedwater Flow Rate Relationship

Site Inventory (ML)	5 Day Rainfall (mm)	Feedwater Flow (ML/day)
>2600	-	6.6
2600 - 2500	>1.5	6.6
	≤1.5	5.0
2500 – 2400	>20	5.8
	20 - 1.5	4.5
	≤1.5	3.0
2400 - 2350	>20	2.5
	20 – 1.5	2.0
	≤1.5	1
2350 - 2000	>20	0.5
	≤20	0
<2000	-	0

10.5.3 Outcomes

Model simulated volumes have been forecast for the period 1 January 2021 to 31 December 2023 for two site operation scenarios. Results have been plotted for the combined water inventory in the WMS (comprising Pit 2W, Pit 1S, RWD, CWD, Pit 5N, Pit 4 and Pit 3).

Figure 14 shows the forecasted total site inventory and associated WTF discharge for the period 1 January 2021 to 31 December 2023 for Scenario 1 through varying climatic conditions.

Figure 14 Forecast Site Water Inventory: Scenario 1

Review of **Figure 14** shows the following:

- The 1%ile (very dry climatic conditions) results in a total site water decrease to 2010 ML at the end of 2021, 1474 ML at the end of 2022 and 767 ML at the end of 2023;
- The 10%ile (dry climatic conditions) results in a total site water decrease to 1822 ML at the end of 2021, 1460 ML at the end of 2022 and 1695 ML at the end of 2023;
- The 50%ile (median climatic conditions) results in a total site water decrease to 2415 ML at the end of 2021, 2373 ML at the end of 2022 and 2003 ML at the end of 2023;
- The 90%ile (wet climatic conditions) results in a total site water increase to 3172 ML at the end of 2021, 3385 ML at the end of 2022, 2724 ML at the end of 2023; and
- The 99%ile (very wet climatic conditions) results in a total site water increase to 3213 ML at the end of 2021, 4160 ML at the end of 2022 and 4843 ML at the end of 2023.

Figure 15 shows the forecasted total site inventory and associated WTF discharge for the period 1 January 2021 to 31 December 2023 for Scenario 2 through varying climatic conditions.

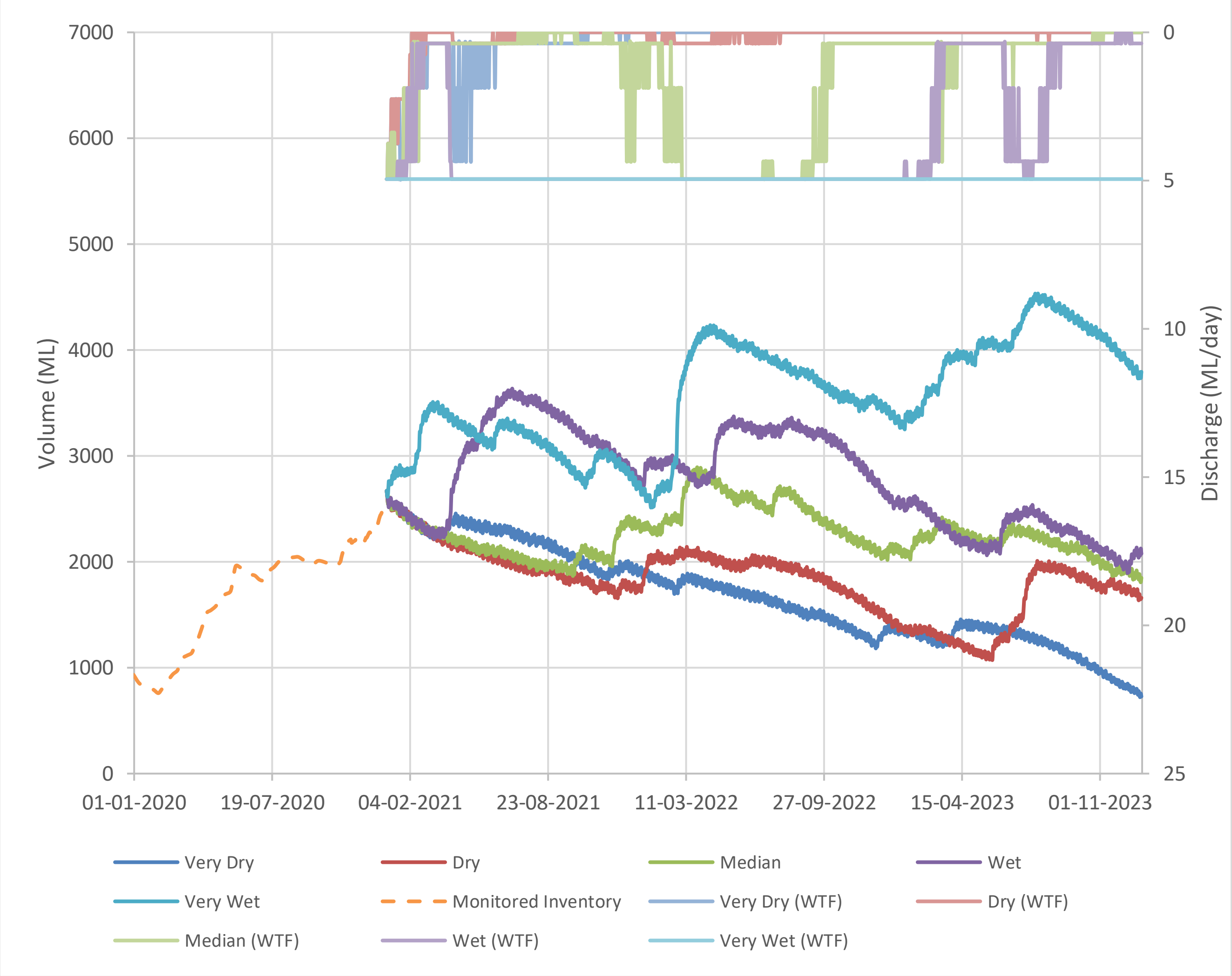

Figure 15 Forecast Site Water Inventory: Scenario 2

Review of **Figure 15** shows the following:

- The 1%ile (very dry climatic conditions) results in a total site water decrease to 1870 ML at the end of 2021, 1366 ML at the end of 2022 and 728 ML at the end of 2023;
- The 10%ile (dry climatic conditions) results in a total site water decrease to 1777 ML at the end of 2021, 1439 ML at the end of 2022 and 1660 ML at the end of 2023;
- The 50%ile (median climatic conditions) results in a total site water decrease to 2382 ML at the end of 2021, 2094 ML at the end of 2022 and 1849 ML at the end of 2023;
- The 90%ile (wet climatic conditions) results in a total site water increase to 2746 ML at the end of 2021, followed by a decrease to 2561 ML at the end of 2022 and 2076 ML at the end of 2023; and
- The 99%ile (very wet climatic conditions) results in a total site water increase to 2695 ML at the end of 2021, 3409 ML at the end of 2022 and 3794 ML at the end of 2023.

10.6 Model Limitations

Climatic data (rainfall and evaporation), supply, demand and transfer volumes have been modelled as daily totals. The model assumes that daily data can be distributed over 24 hours. The model does not accurately represent events with durations less than 24 hours. For example, storm runoff events with durations less than 24 hours cannot be accounted for using the WBM.

The WBM has been developed and calibrated with a focus on the water management system as a whole. Model accuracy is considered better for design applications of wider scope (e.g. site water balance) relative to studies of narrower focus (e.g. single dams). Although the model is well suited for undertaking smaller studies, inputs and controls should always be first understood and then modelled to a level of detail suitable to the task at hand.

11 Conclusion and Recommendations

Current investigations have been undertaken to update the WCM WBM to reflect changes in the WMS and additional monitoring data recorded during 2020. Key outcomes of current investigations include:

- Updated catchment schedule and land use classifications based on information current as at the end of year 2020. Pit 8 added into WMS;
- Refinement of model rules for operation of the WTF based on both rainfall and combined site mine water inventory. Operating rules are based on available data for the calibration period and should continue to be reviewed if further information becomes available;
- Refinement of model rules for external water supply to reflect observed site operations during both dry periods and in subsequent recovery of the site inventory as a result of a significant wet period. Operating rules are based on available data for the calibration period and should continue to be reviewed if further information becomes available;
- Refinement of groundwater inflow estimates as a function of climate (rainfall and recharge). There remains scope to improve site measurement of groundwater inflows to pits for more effective calibration of the WBM.;
- Overall, the WBM provides a good correlation between monitored and predicted water inventory and provides a sound platform for future studies; and
- Forecast site mine water inventory behaviour for the period 2021-2023 under different site operating scenarios and climatic conditions.

It is recommended that WCM implement improved monitoring of groundwater inflows which will allow for improved calibration on this aspect of the WBM in future studies.

The updated WBM is considered to be well suited for planning studies, infrastructure sizing and operational decision making, provided these studies incorporate sensitivity analysis (as any robust study should).

It should be noted that the content of this report may be subject to revision with any future improved understanding of the operational and response characteristics of the WCM water management system.

12 References

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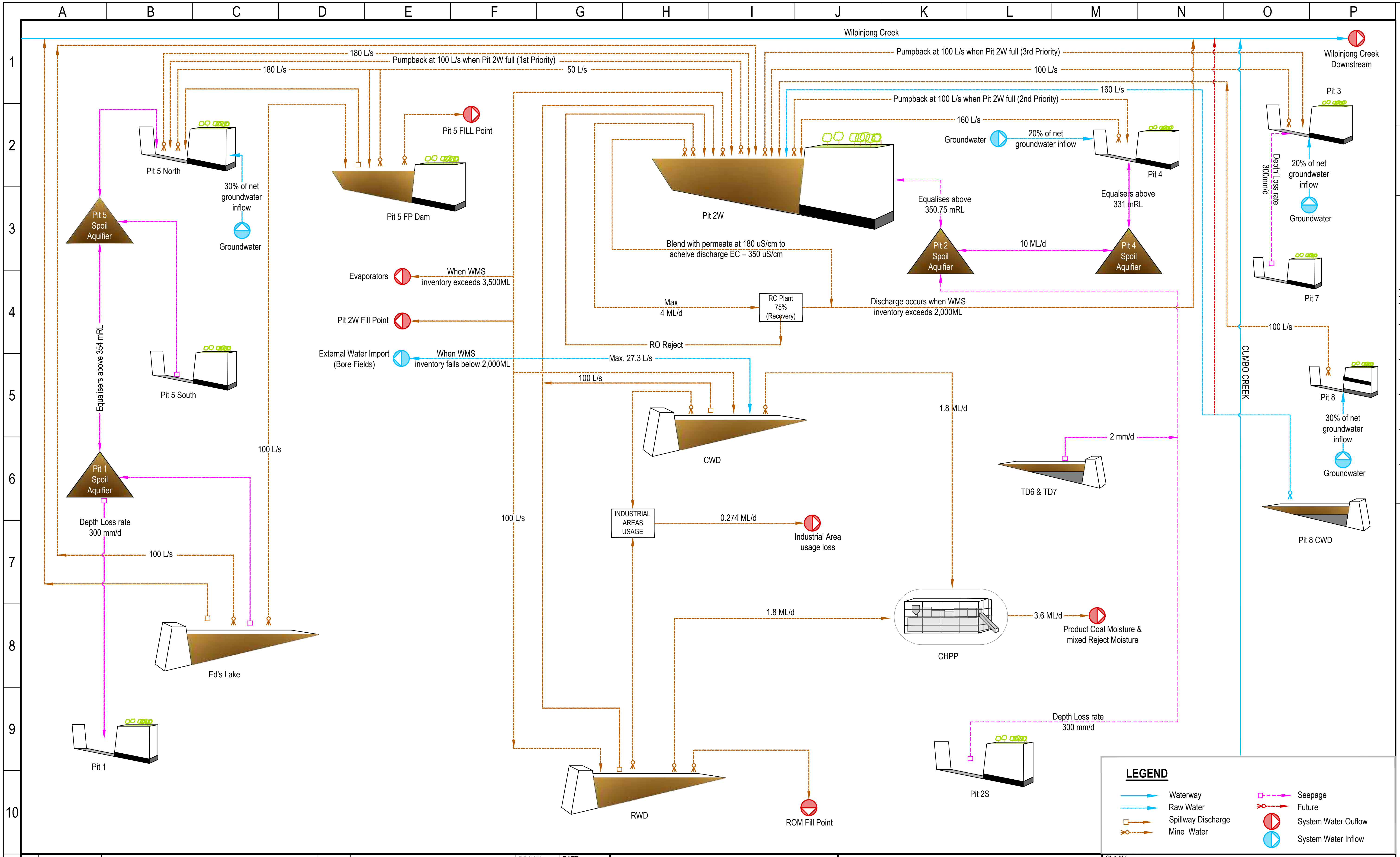
APPENDIX A

Model Schematic



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AUSTRALIA
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APPENDIX B

Catchment and Land Use

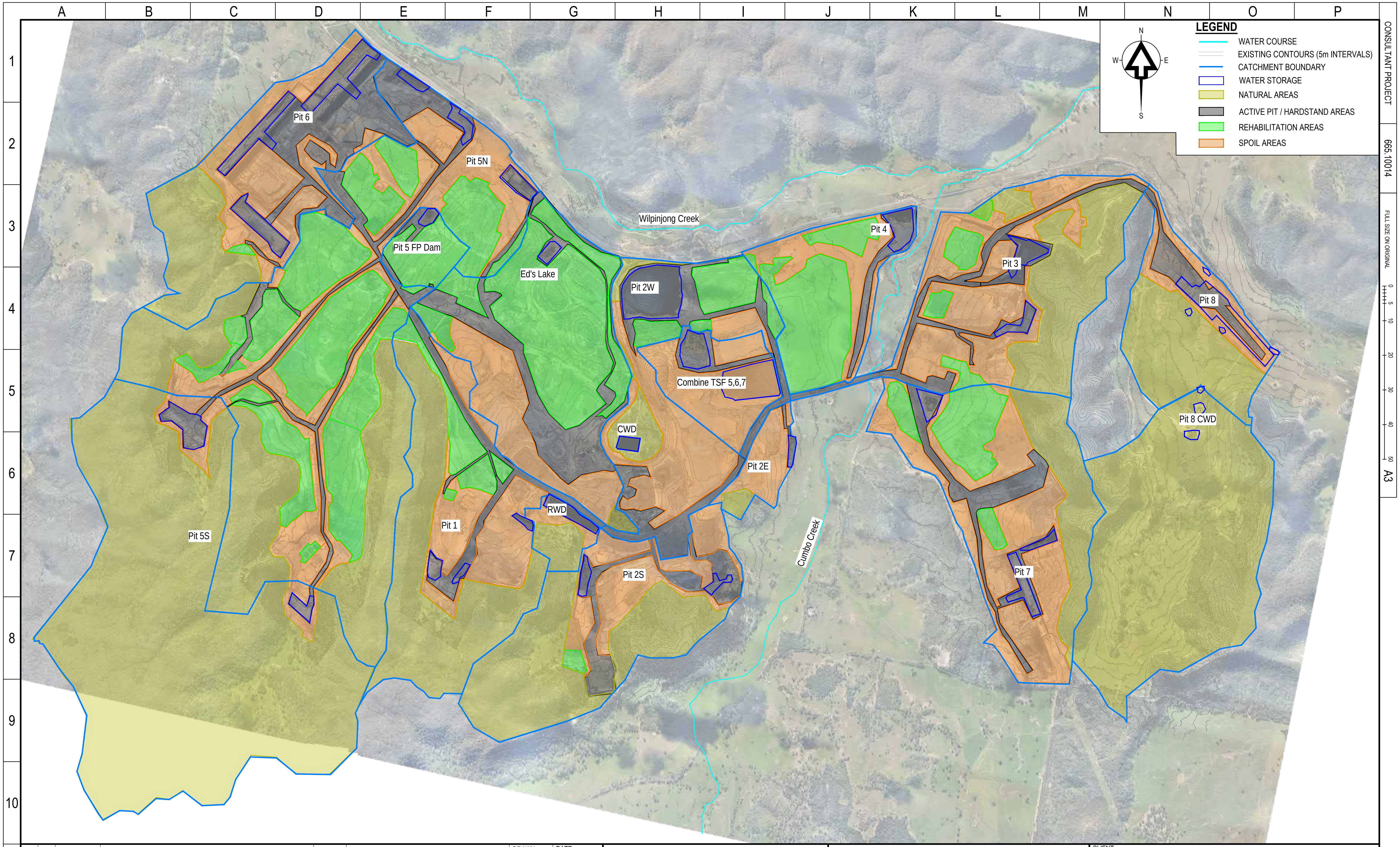

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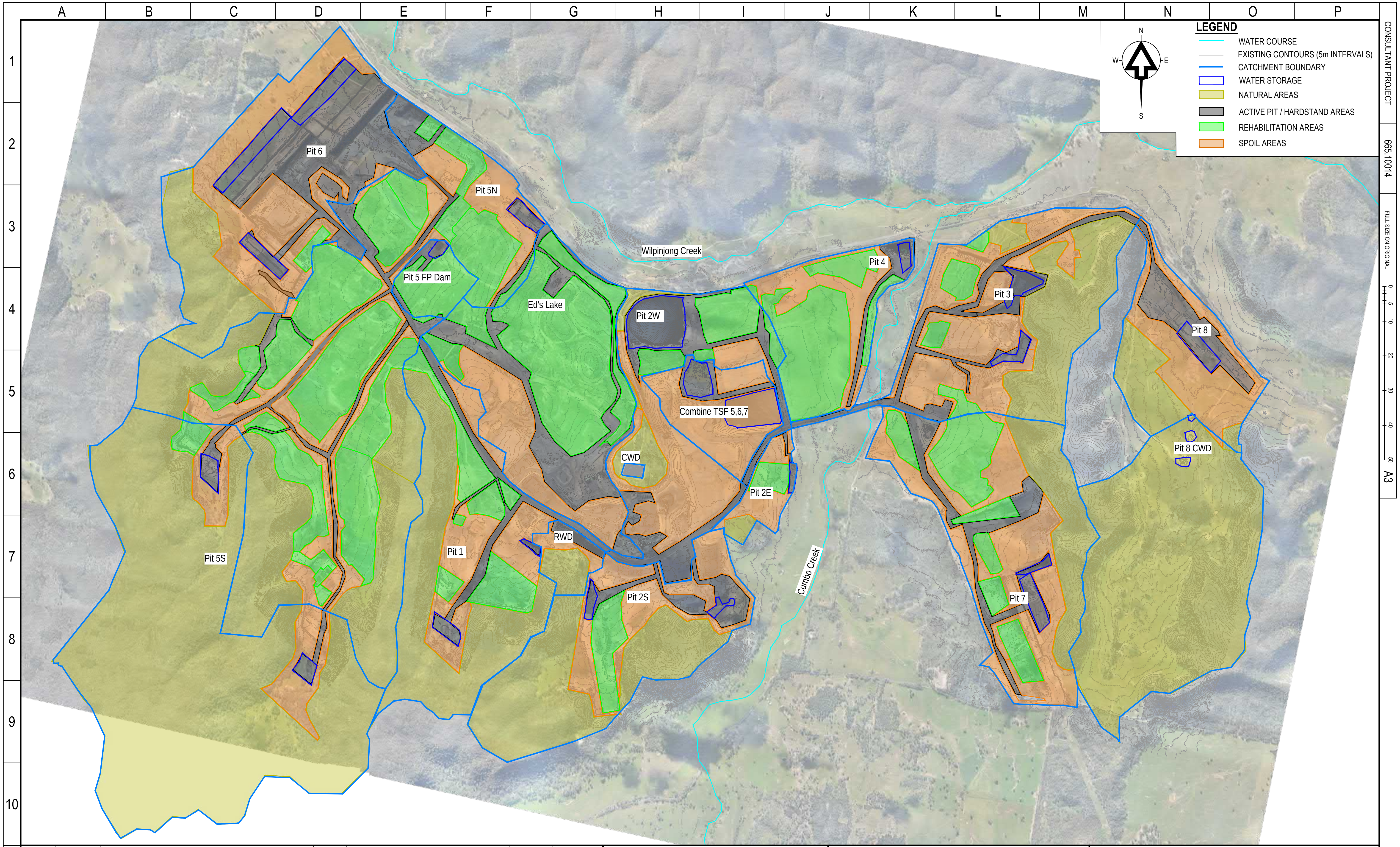
Table B1: Catchment and Land Type Areas (based on end of year 2020 conditions)

Name	Natural (ha)	Rehabilitation (ha)	Spoil (ha)	Hardstand/Active Pit (ha)	Total (ha)
Water Storages					
Pit 2 West	22.5	33.9	82.9	73.1	**212.3**
Clean Water Dam (CWD)	-	-	-	2.1	**2.1**
Ed's Lake	-	152.2	67.2	69.1	**288.5**
Pit 1S	-	-	-	-	**-**
Pit 5 FP Dam	-	27.8		6.2	**34.0**
Recycled Water Dam (RWD)	14.4	-	7.0	5.4	**26.8**
Pit 8 Mine Water Dam (CWD)	330.0	-	-	-	**330.0**
Sediment Dams					
Including in respective pit catchments					
Mining Pits					
Pit 1	156.6	28.0	77.6	33.3	**295.5**
Pit 2 East	5.1	-	26.3	2.7	**34.1**
Pit 2 South	141.6	3.2	67.5	36.0	**248.2**
Pit 3	106.0	20.8	116.0	44.8	**287.7**
Pit 4		79.3	36.6	16.9	**132.8**
Pit 5 North	225.8	269.2	139.5	75.5	**709.9**
Pit 5 South	591.0		20.3	12.6	**623.9**
Pit 6	77.0	1.4	82.3	97.0	**257.7**
Pit 7	65.1	47.3	135.3	45.2	**292.9**
Pit 8	86.3		28.0	23.2	**137.5**
Other					
Combined (5, 6 & 7) Tailings Dams			66.0	13.3	**79.3**



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PROJECT: WATER BALANCE UPDATE 2021

DRAWING TITLE:

END OF YEAR 2021 CATCHMENT PLAN

DRAWING NUMBER: 665.10014 - Figure 2B

ISSUE: B

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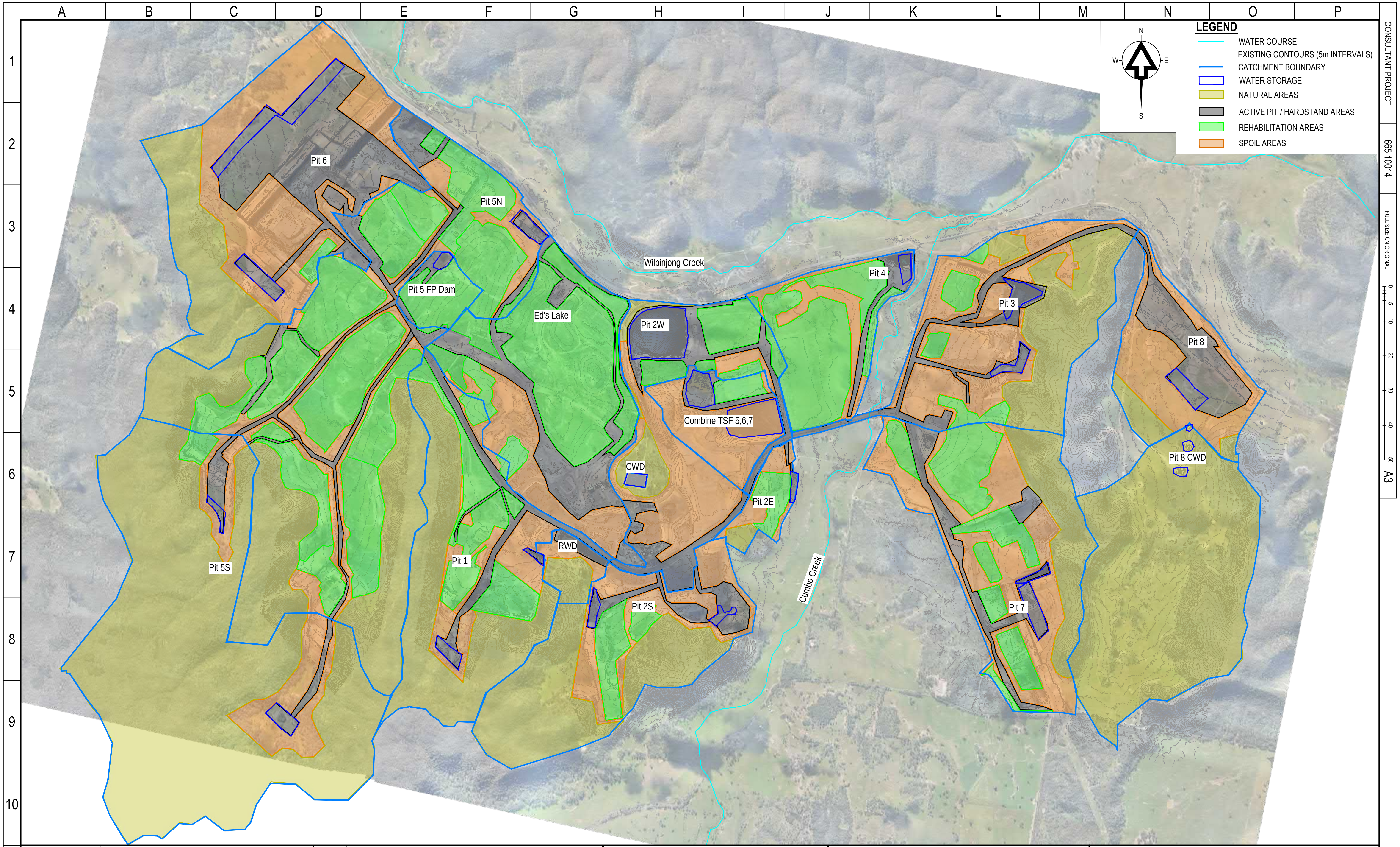
Table B2: Catchment and Land Type Areas (based on end of year 2021 conditions)

Name	Natural (ha)	Rehabilitation (ha)	Spoil (ha)	Hardstand/Active Pit (ha)	Total (ha)
Water Storages					
Pit 2 West	21.4	33.9	82.9	73.1	**211.3**
Clean Water Dam (CWD)	-	-	-	2.1	**2.1**
Ed's Lake	-	152.3	67.2	69.1	**288.6**
Pit 1S		-	-	-	**-**
Pit 5 FP Dam	-	27.8	-	6.2	**34.0**
Recycled Water Dam (RWD)	14.4	-	7.0	5.4	**26.8**
Pit 8 Mine Water Dams (CWD)	327.9	-	-	-	**327.9**
Sediment Dams					
Including in respective pit catchments					
Mining Pits					
Pit 1	147.3	51.3	65.3	31.3	**295.2**
Pit 2 East	5.1	8.3	18.1	2.3	**33.8**
Pit 2 South	139.8	20.8	64.7	25.8	**251.1**
Pit 3	106.0	20.8	113.9	44.8	**285.5**
Pit 4	-	85.0	34.4	13.6	**133.0**
Pit 5 North	225.8	303.6	117.4	64.0	**710.8**
Pit 5 South	559.8	6.7	44.0	12.8	**623.3**
Pit 6	75.6	4.6	122.5	135.1	**337.8**
Pit 7	64.9	71.3	117.0	41.6	**294.8**
Pit 8	39.4		63.3	36.2	**138.9**
Other					
Combined (5, 6 & 7) Tailings Dams	-	-	66.0	13.3	**79.3**



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PROJECT: WATER BALANCE UPDATE 2021

DRAWING TITLE:

END OF YEAR 2022
CATCHMENT PLAN

DRAWING NUMBER: 665.10014 - Figure 3B

ISSUE: B

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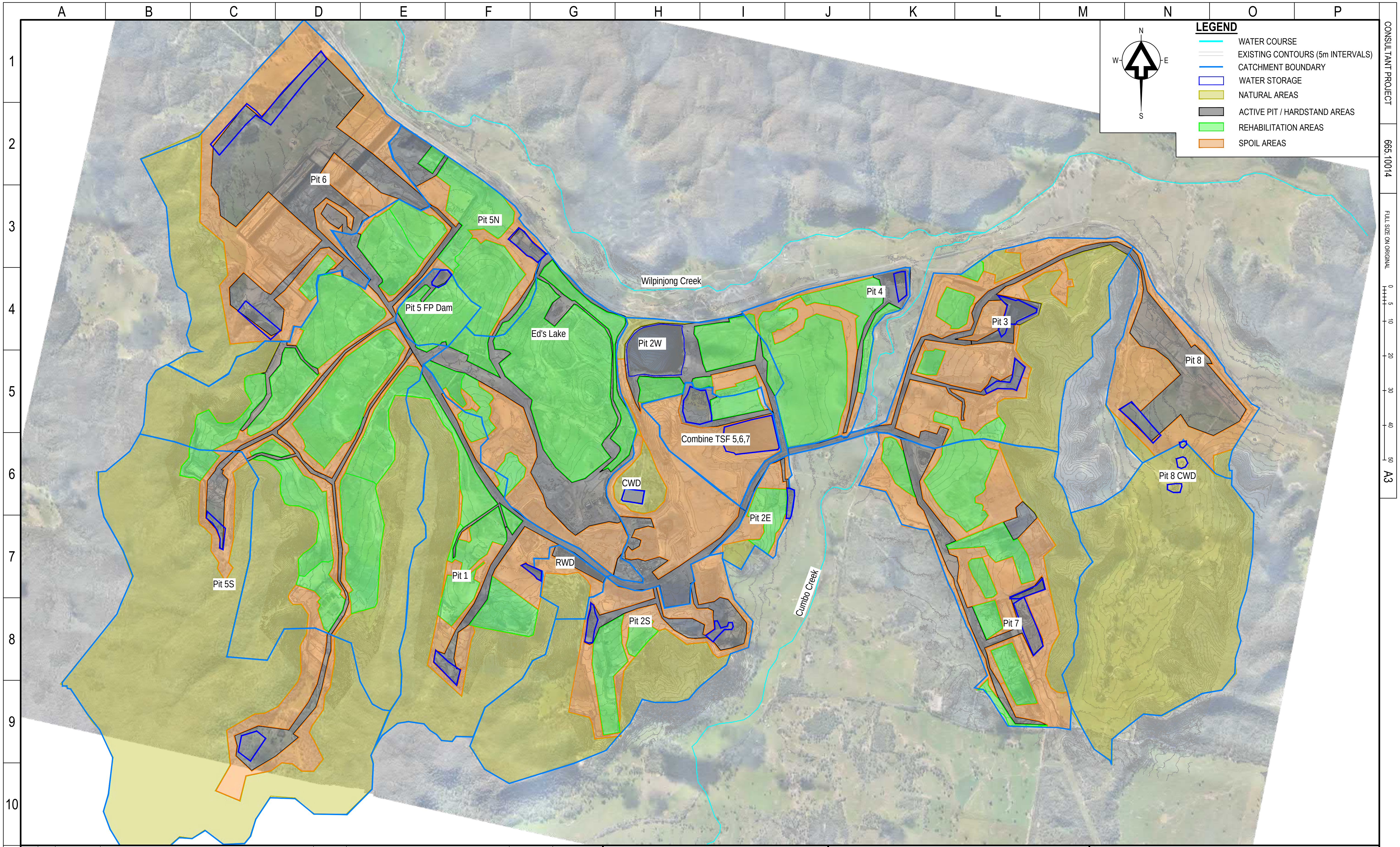
Table B3: Catchment and Land Type Areas (based on end of year 2022 conditions)

Name	Natural (ha)	Rehabilitation (ha)	Spoil (ha)	Hardstand/Active Pit (ha)	Total (ha)
Water Storages					
Pit 2 West	21.4	37.3	79.3	73.0	**211.0**
Clean Water Dam (CWD)	-	-	-	2.1	**2.1**
Ed's Lake	-	152.2	67.2	69.1	**288.5**
Pit 1S	-	-	-	-	**-**
Pit 5 FP Dam		27.8		4.9	**32.7**
Recycled Water Dam (RWD)	14.4	-	7.0	5.4	**26.8**
Pit 8 Mine Water Dams (CWD)	327.1	-	-	-	**327.1**
Sediment Dams					
Including in respective pit catchments					
Mining Pits					
Pit 1	147.3	70.4	45.1	32.4	**295.2**
Pit 2 East	5.1	13.3	13.1	2.3	**33.8**
Pit 2 South	139.8	26.3	58.8	25.8	**250.7**
Pit 3	106.0	24.4	110.3	44.8	**285.5**
Pit 4	-	94.9	23.9	14.0	**132.8**
Pit 5 North	225.8	342.6	77.4	64.0	**709.8**
Pit 5 South	534.3	6.7	62.9	19.9	**623.8**
Pit 6	97.7	4.6	159.9	143.1	**405.3**
Pit 7	64.9	82.6	113.0	41.3	**301.8**
Pit 8	16.8	-	68.9	54.4	**140.1**
Other					
Combined (5, 6 & 7) Tailings Dams	-	8.3	56.9	13.1	**78.3**



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CATCHMENT PLAN

DRAWING NUMBER: 665.10014 - Figure 4B

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Table B4: Catchment and Land Type Areas (based on end of year 2023 conditions)

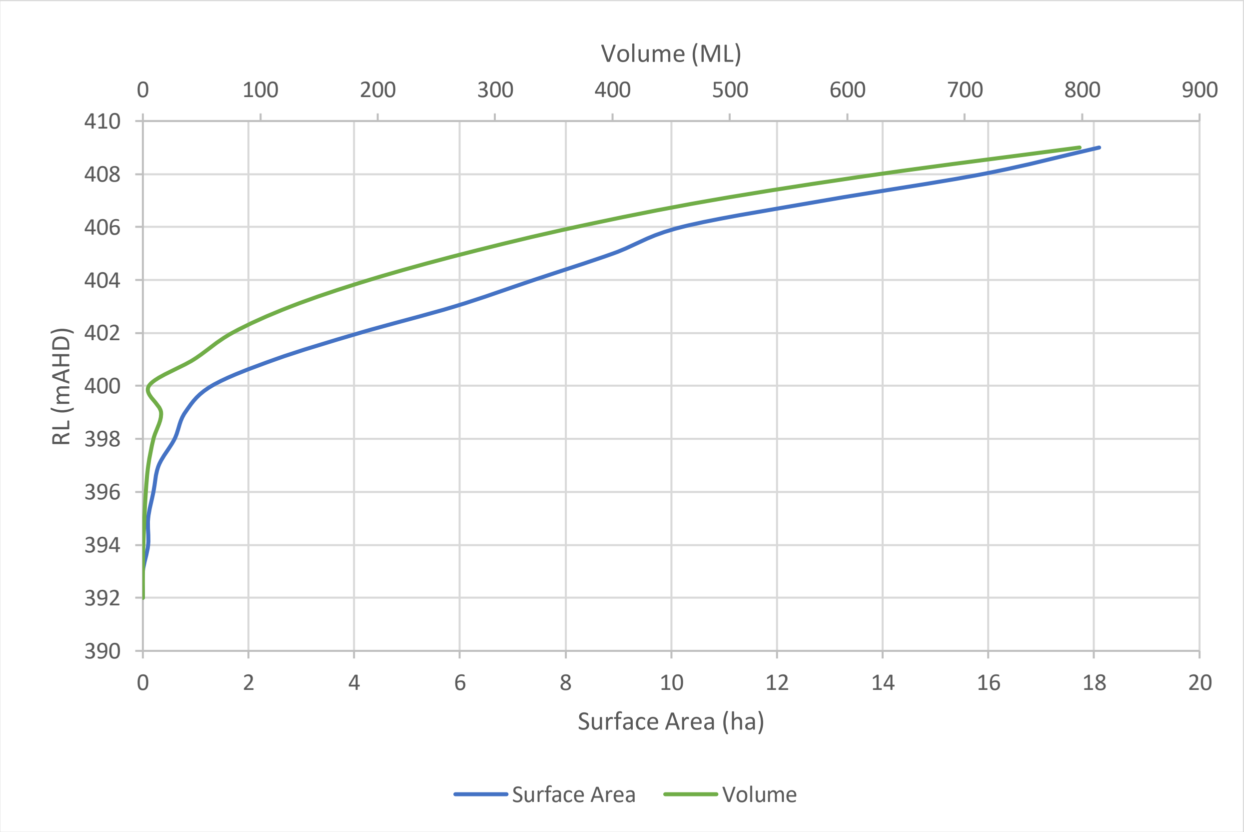
Name	Natural (ha)	Rehabilitation (ha)	Spoil (ha)	Hardstand/Active Pit (ha)	Total (ha)
Water Storages					
Pit 2 West	21.4	37.3	79.3	73.0	**211.0**
Clean Water Dam (CWD)	-	-	-	2.1	**2.1**
Ed's Lake	-	164.4	54.6	69.1	**288.1**
Pit 1S	-	-	-	-	**-**
Pit 5 FP Dam	-	27.8		4.9	**32.7**
Recycled Water Dam (RWD)	14.4	-	7.0	5.4	**26.8**
Pit 8 Mine Water Dams (CWD)	327.1	-	-	-	**327.1**
Sediment Dams					
Including in respective pit catchments					
Mining Pits					
Pit 1	147.3	70.4	45.1	32.4	**295.2**
Pit 2 East	5.1	13.3	13.1	2.3	**33.8**
Pit 2 South	139.8	26.3	58.8	25.8	**250.7**
Pit 3	106.0	24.4	110.2	44.8	**285.4**
Pit 4	-	94.9	23.9	14.0	**132.8**
Pit 5 North	225.8	342.6	77.4	64.0	**709.8**
Pit 5 South	522.5	6.7	65.0	30.1	**624.3**
Pit 6	88.8	4.6	162.2	175.4	**431.0**
Pit 7	64.9	82.6	113.0	41.3	**301.8**
Pit 8	8.3	-	65.6	66.1	**140.0**
Other					
Combined (5, 6 & 7) Tailings Dams	-	8.3	56.9	13.1	**78.3**

APPENDIX C

Storage Curve

Pit 1

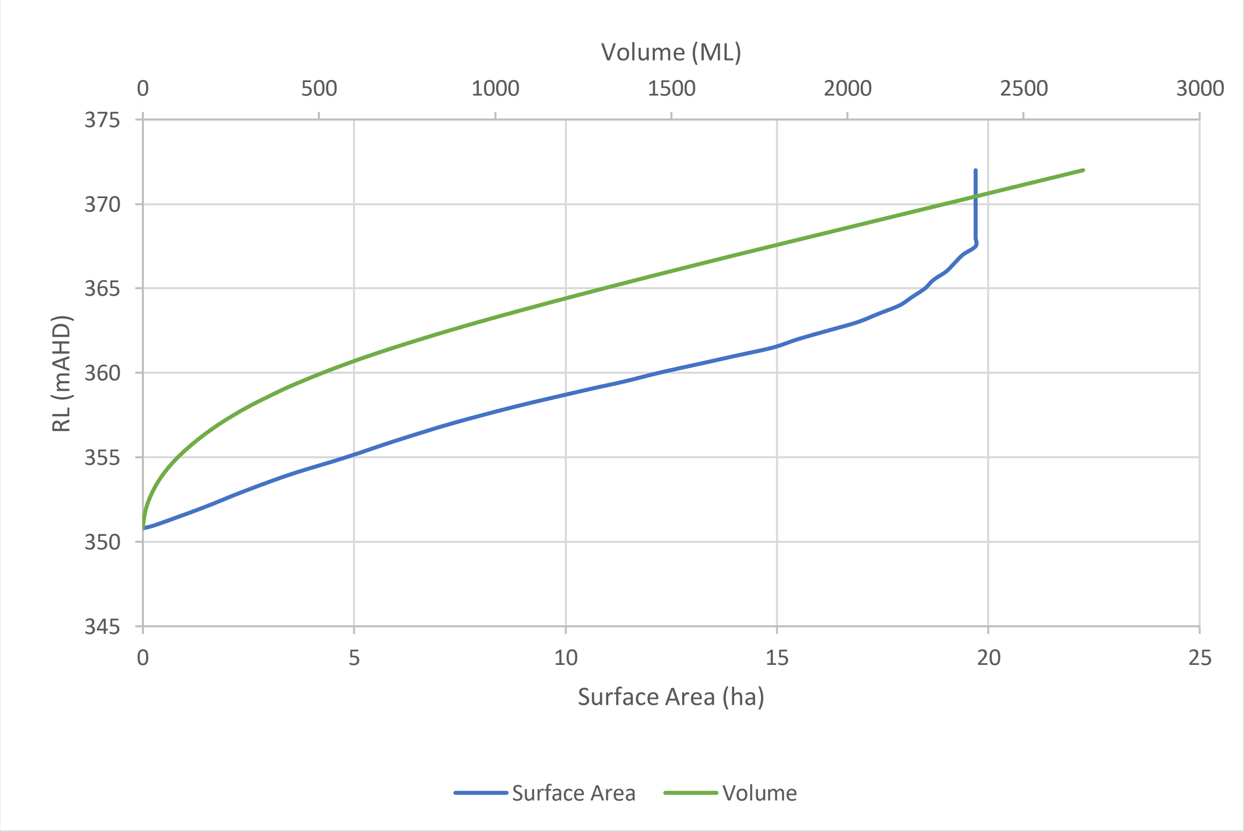
RL (mAHD)	Area (ha)	Volume (ML)
392	0	0
393	0	0
394	0.1	0.4
395	0.1	1.3
396	0.2	2.5
397	0.3	4.6
398	0.6	9
399	0.8	15.5
400	1.3	5.1
401	2.5	43.4
402	4.1	76
403	5.9	126
404	7.4	192.7
405	8.9	274
406	10.2	368.9
407	12.9	483.4
408	15.9	627.6
409	18.1	797.8



Pit 2W

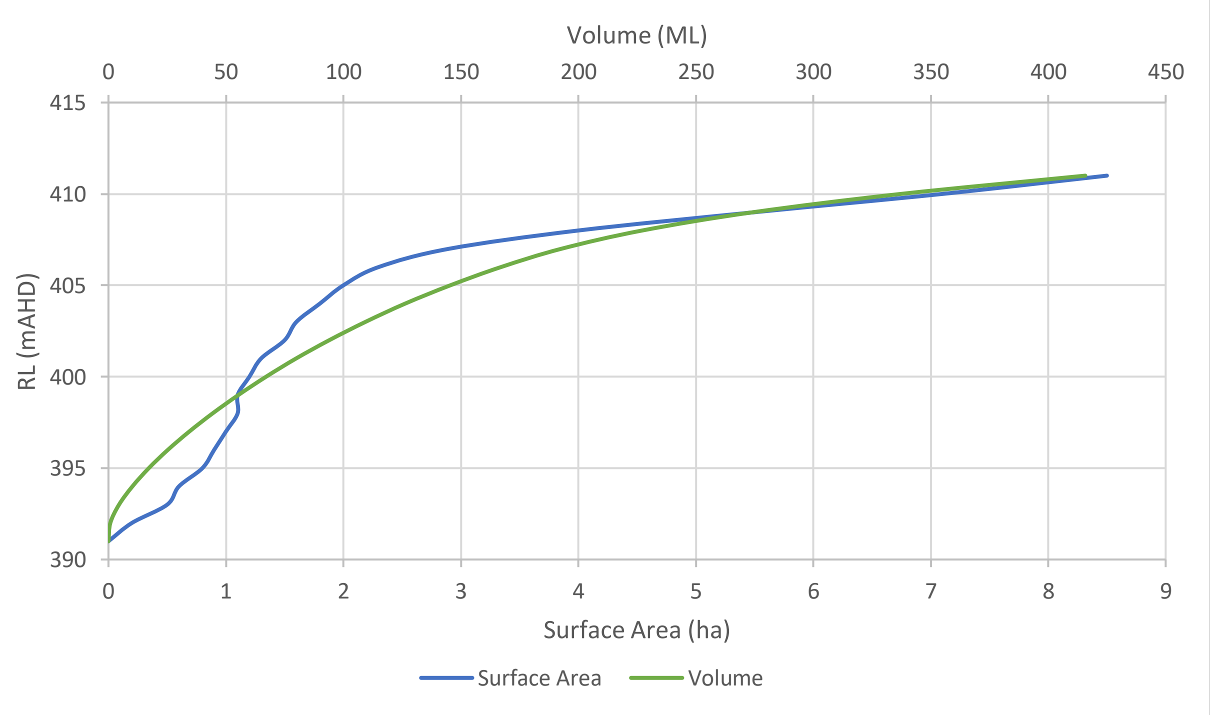
RL (mAHD)	Area (ha)	Volume (ML)
350.8	0	0
351	0.3	0.4
352	1.4	9.3
353	2.4	28.2
354	3.5	57.5
355	4.8	98.9
356	6	152.9
357	7.3	219
358	8.8	299.4
359	10.5	396
359.5	11.4	450.7
360	12.2	509.7
360.5	13.1	572.8
361	14	640.6
361.5	14.9	713
362	15.5	789.2
362.5	16.2	868.5
363	16.9	951.3

RL (mAHD)	Area (ha)	Volume (ML)
363.5	17.4	1037.3
364	17.9	1125.6
364.5	18.2	1215.8
365	18.5	1307.7
365.5	18.7	1400.9
366	19	1495.1
366.5	19.2	1590.5
367	19.4	1686.8
367.5	19.7	1784.5
368	19.7	1882.8
368.5	19.7	1981.1
369	19.7	2079.4
369.5	19.7	2177.7
370	19.7	2276.1
370.5	19.7	2374.4
371	19.7	2472.7
371.5	19.7	2571
372	19.7	2669.3



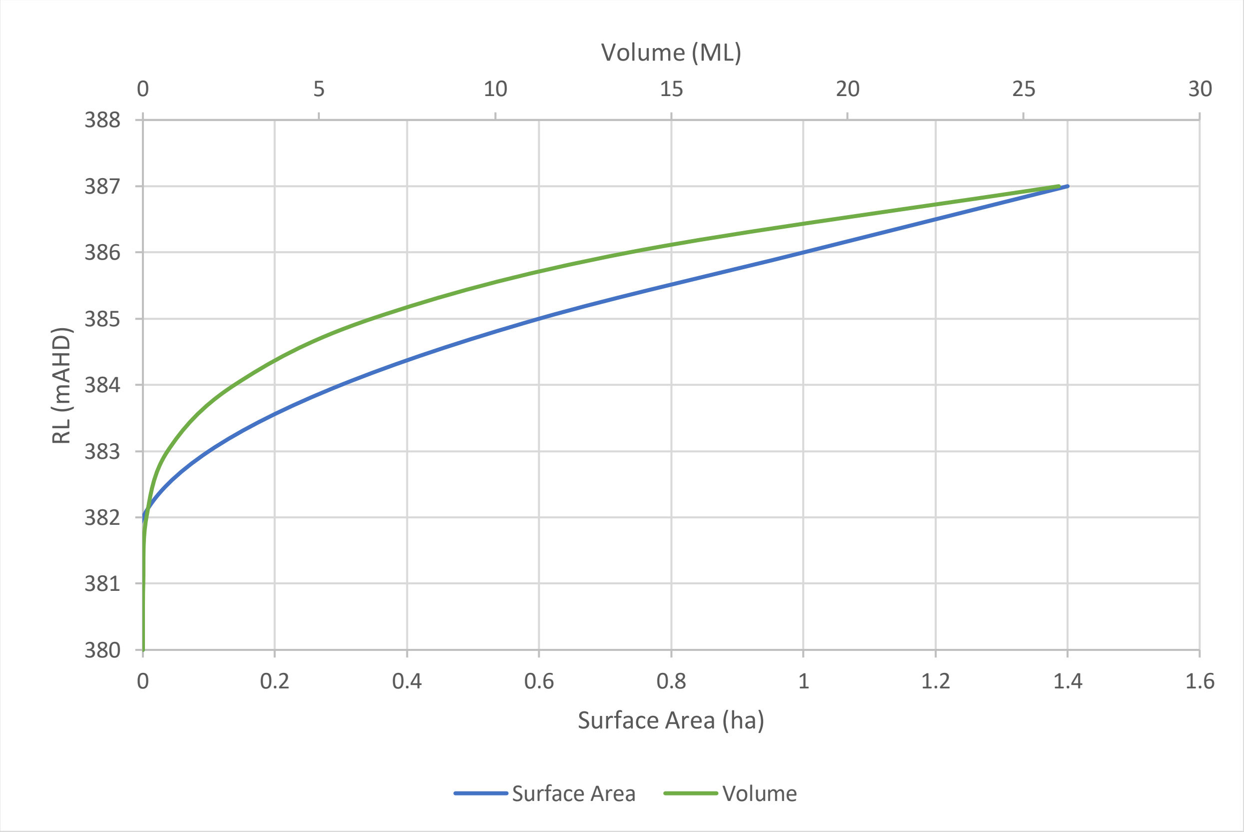
Pit 2 South

RL (mAHD)	Area (ha)	Volume (ML)
391	0	0
392	0.2	0.8
393	0.5	4.5
394	0.6	10.2
395	0.8	17.2
396	0.9	25.3
397	1	34.4
398	1.1	44.4
399	1.1	55.3
400	1.2	67.1
401	1.3	79.9
402	1.5	94
403	1.6	109.4
404	1.8	126.3
405	2	145.5
406	2.3	167.1
407	2.9	192.8
408	4	227.2
409	5.5	274.4
410	7.1	337.3
411	8.5	415.8



Pit 2 East

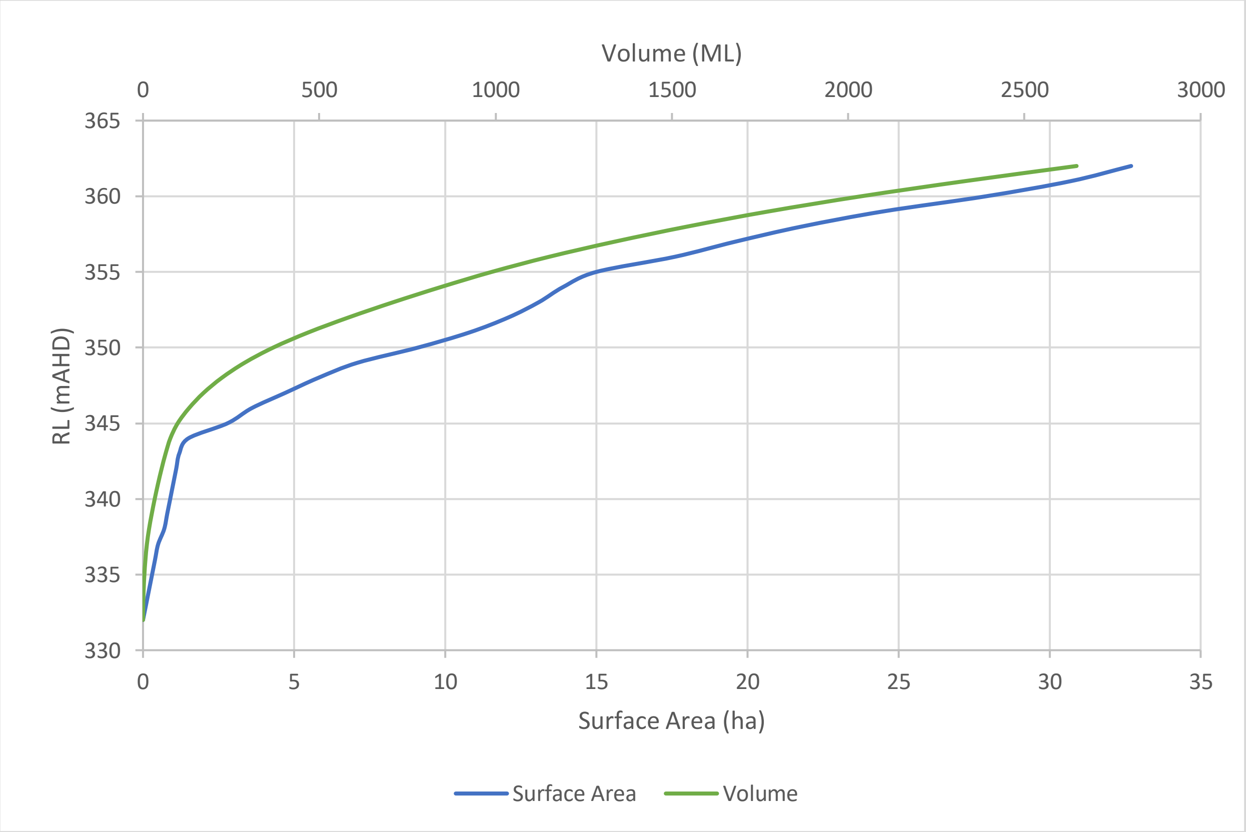
RL (mAHD)	Area (ha)	Volume (ML)
380	0	0
381	0	0.01
382	0	0.1
383	0.1	0.7
384	0.3	2.6
385	0.6	6.5
386	1	13.8
387	1.4	26



Pit 3

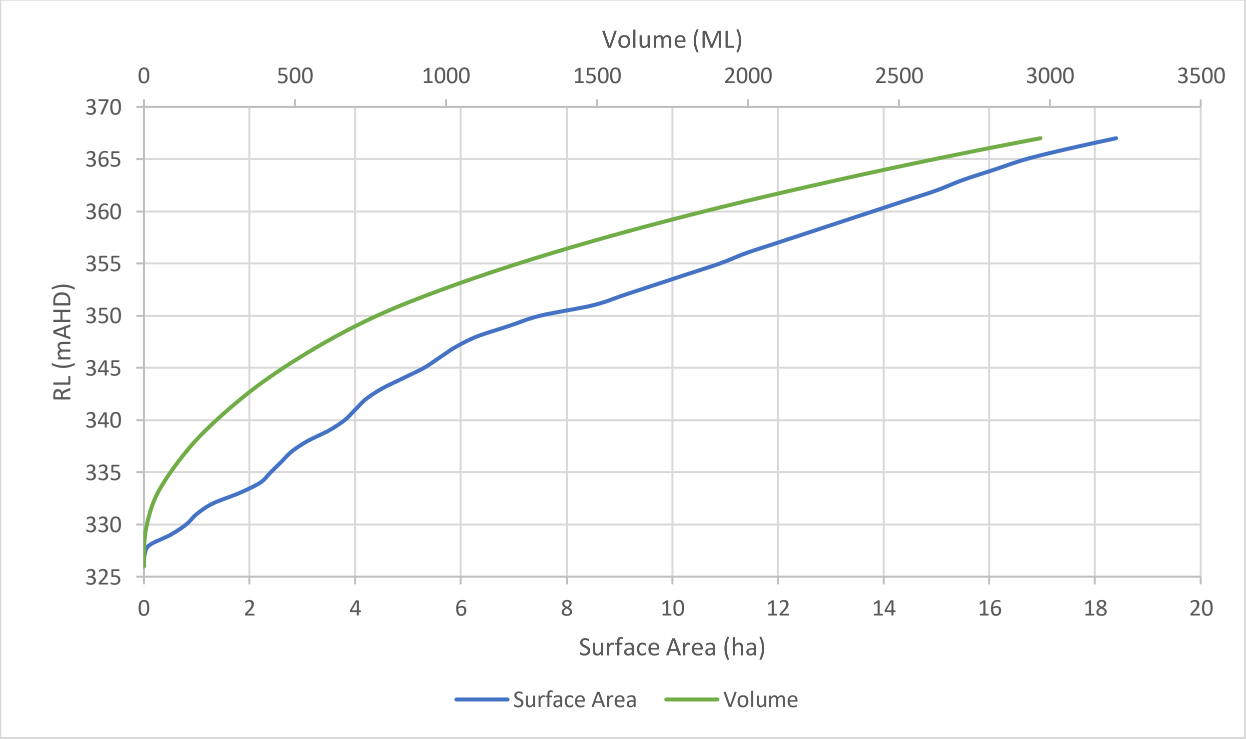
RL (mAHD)	Area (ha)	Volume (ML)
332	0	0
333	0.1	0.6
334	0.2	1.8
335	0.3	3.9
336	0.4	6.9
337	0.5	11
338	0.7	17
339	0.8	24.7
340	0.9	33.2
341	1	42.6
342	1.1	52.8
343	1.2	64.1
344	1.5	77.5
345	2.8	98.4
346	3.6	130.5
347	4.7	171.5

RL (mAHD)	Area (ha)	Volume (ML)
348	5.8	223.4
349	7.1	288.2
350	9.1	369.3
351	10.8	468.7
352	12.1	584
353	13.1	710.1
354	13.9	844.7
355	15	988.9
356	17.6	1151.9
357	19.6	1337.9
358	21.8	1544.2
359	24.5	1775.1
360	27.9	2037.2
361	30.7	2331.2
362	32.7	2648.1



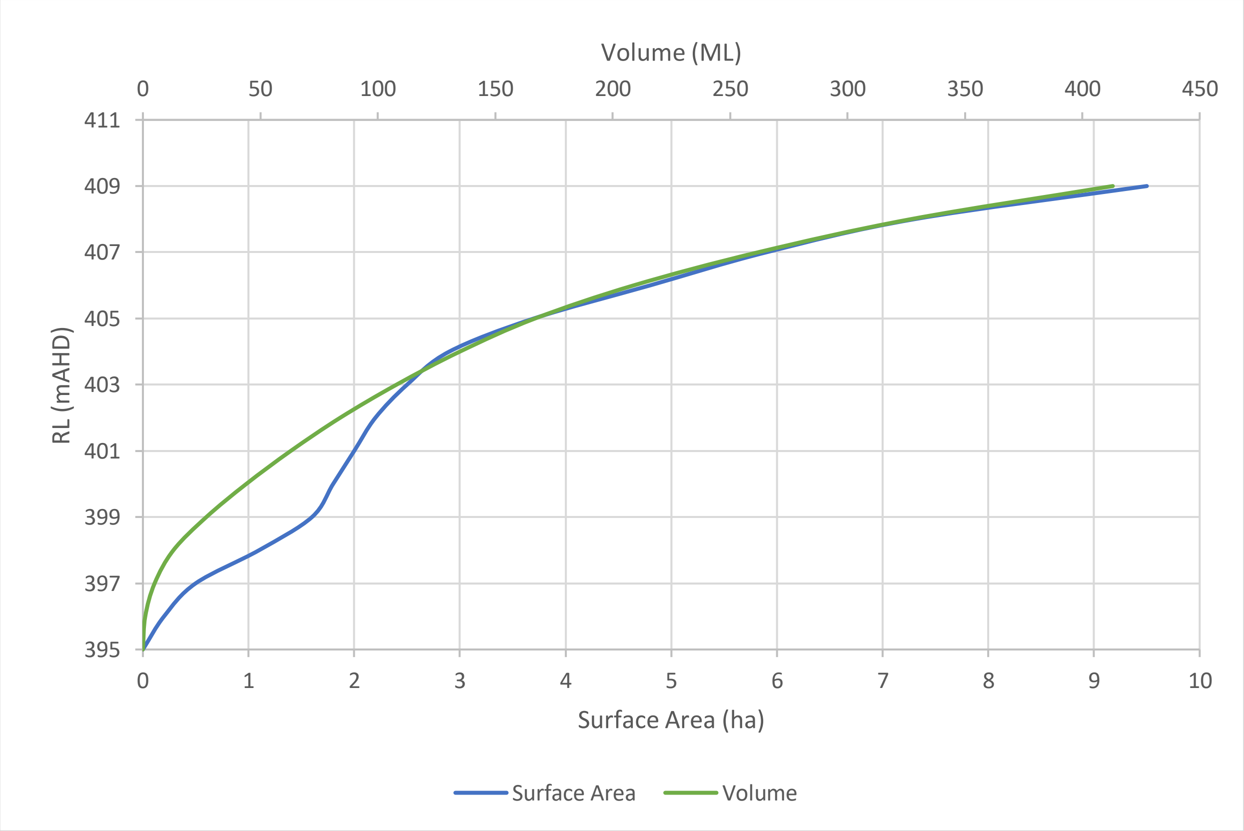
Pit 4

RL (mAHD)	Area (ha)	Volume (ML)
326	0	0
327	0.01	0.4
328	0.1	1.2
329	0.5	3.9
330	0.8	10.1
331	1	18.7
332	1.3	29.9
333	1.8	45.2
334	2.2	65.3
335	2.4	88.1
336	2.6	113.3
337	2.8	140.6
338	3.1	170.4
339	3.5	203.8
340	3.8	240.3
341	4	279
342	4.2	320
343	4.5	363.6
344	4.9	410.9
345	5.3	461.8
346	5.6	516
347	5.9	573.5
348	6.3	634.6
349	6.9	700.5
350	7.5	772.3
351	8.5	852.3
352	9.1	940.7
353	9.7	1034.8
354	10.3	1134.6
355	10.9	1240.3
356	11.4	1351.8
357	12	1469
358	12.6	1592.1
359	13.2	1721.3
360	13.8	1856.5
361	14.4	1997.8
362	15	2145
363	15.5	2297.6
364	16.1	2455.6
365	16.7	2619.6
366	17.5	2790.4
367	18.4	2969.2



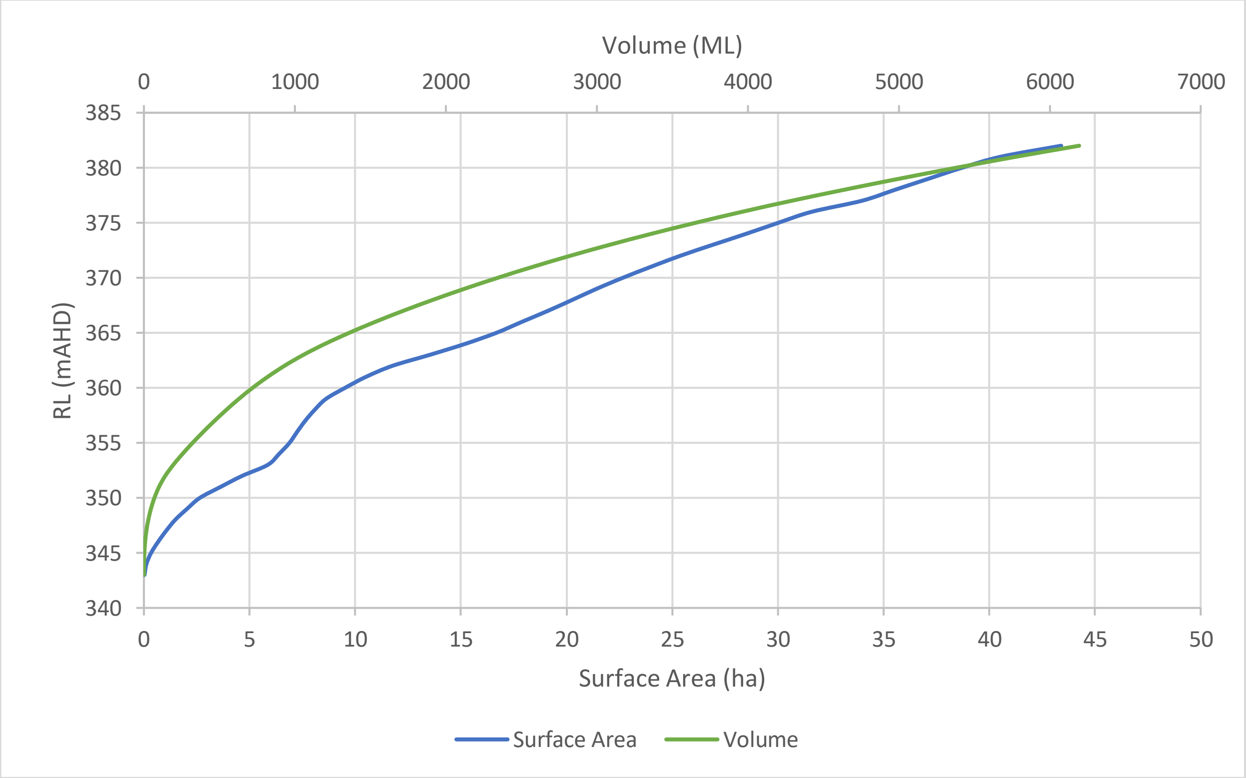
Pit 5 South

RL (mAHD)	Area (ha)	Volume (ML)
395	0	0
396	0.2	1
397	0.5	5
398	1.1	13
399	1.6	27
400	1.8	44
401	2	63
402	2.2	84
403	2.5	108
404	2.9	135
405	3.7	167
406	4.8	209
407	5.9	262
408	7.3	327
409	9.5	413



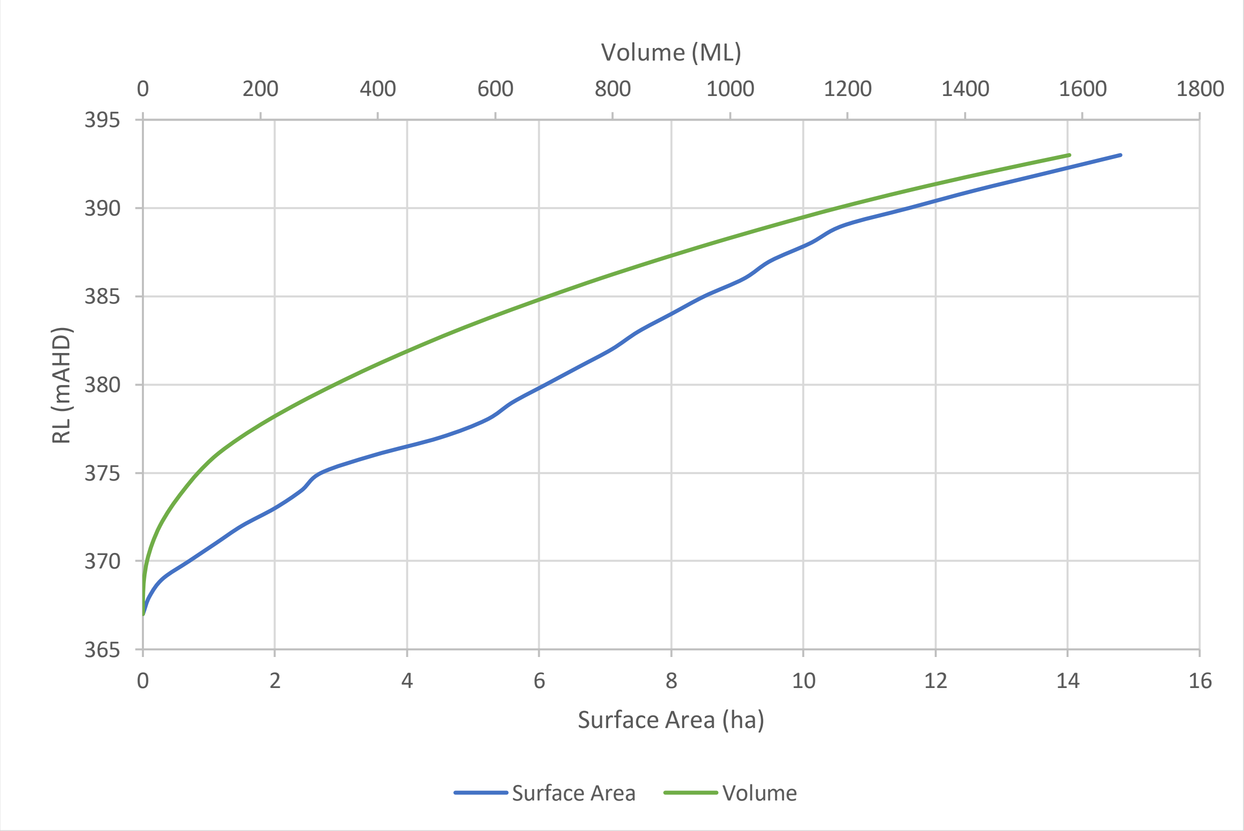
Pit 5 North

RL (mAHD)	Area (ha)	Volume (ML)
343	0.03	0
344	0.12	0.76
345	0.34	2.99
346	0.67	8.04
347	1.05	16.54
348	1.48	29.25
349	2.04	46.39
350	2.65	69.92
351	3.63	100.19
352	4.65	141.33
353	5.86	194.54
354	6.4	256.15
355	6.89	322.64
356	7.25	393.41
357	7.63	467.71
358	8.08	546.31
359	8.62	629.62
360	9.52	720.22
361	10.51	820.1
362	11.76	930.99
363	13.53	1056.89
364	15.21	1200.47
365	16.68	1360.3
366	17.89	1533.14
367	19.12	1718.27
368	20.28	1915.27
369	21.42	2123.7
370	22.66	2344.09
371	23.99	2577.3
372	25.38	2824.09
373	26.92	3085.54
374	28.5	3362.54
375	30.02	3655.22
376	31.6	3963.04
377	33.97	4290.58
378	35.54	4638.47
379	37.12	5001.83
380	38.71	5381.06
381	40.54	5776.55
382	43.4	6194.65



Pit 6

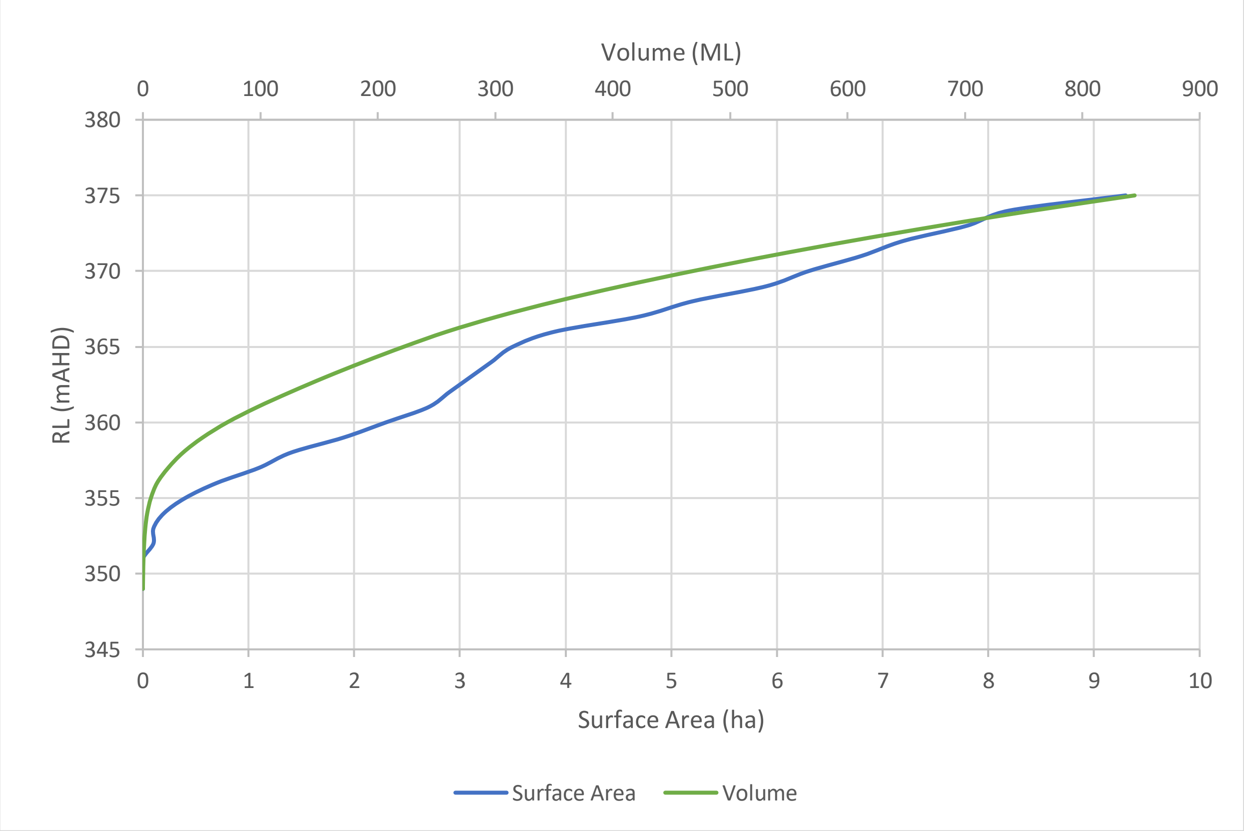
RL (mAHD)	Area (ha)	Volume (ML)
367	0	0
368	0.1	0.2
369	0.3	2
370	0.7	7
371	1.1	16
372	1.5	29
373	2	47
374	2.4	69
375	2.7	94
376	3.5	125
377	4.5	166
378	5.2	214
379	5.6	268
380	6.1	327
381	6.6	390
382	7.1	458
383	7.5	530
384	8	608
385	8.5	691
386	9.1	778
387	9.5	871
388	10.1	969
389	10.6	1073
390	11.6	1183
391	12.6	1304
392	13.7	1436
393	14.8	1578



Pit 7

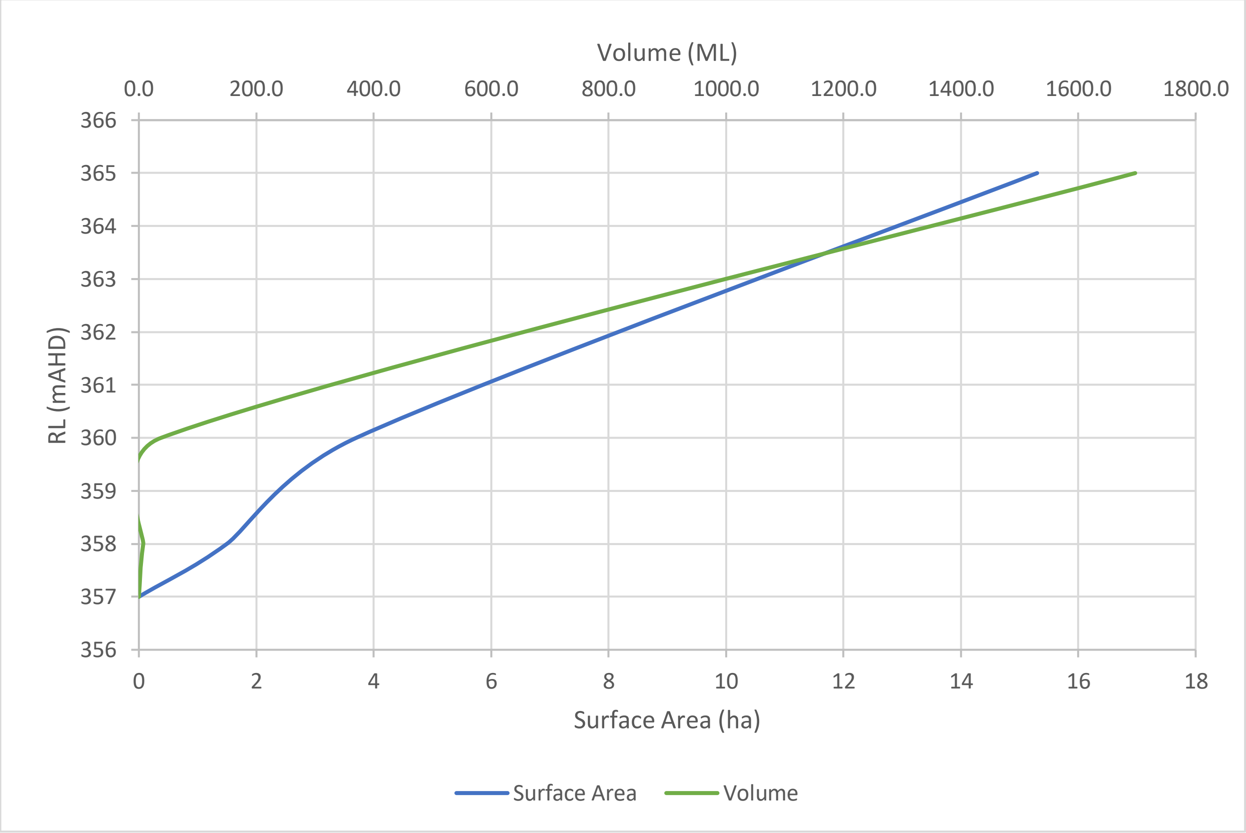
RL (mAHD)	Area (ha)	Volume (ML)
349	0	0
350	0	0.2
351	0	0.5
352	0.1	1.1
353	0.1	2
354	0.2	3.7
355	0.4	6.8
356	0.7	12.1
357	1.1	21.6
358	1.4	34.1
359	1.9	50.9
360	2.3	71.8
361	2.7	97.1
362	2.9	125.6

RL (mAHD)	Area (ha)	Volume (ML)
363	3.1	155.8
364	3.3	188
365	3.5	222.2
366	3.9	259
367	4.7	302.3
368	5.2	352
369	5.9	407.6
370	6.3	468.3
371	6.8	533.7
372	7.2	603.7
373	7.8	678.7
374	8.2	758.5
375	9.3	844.6



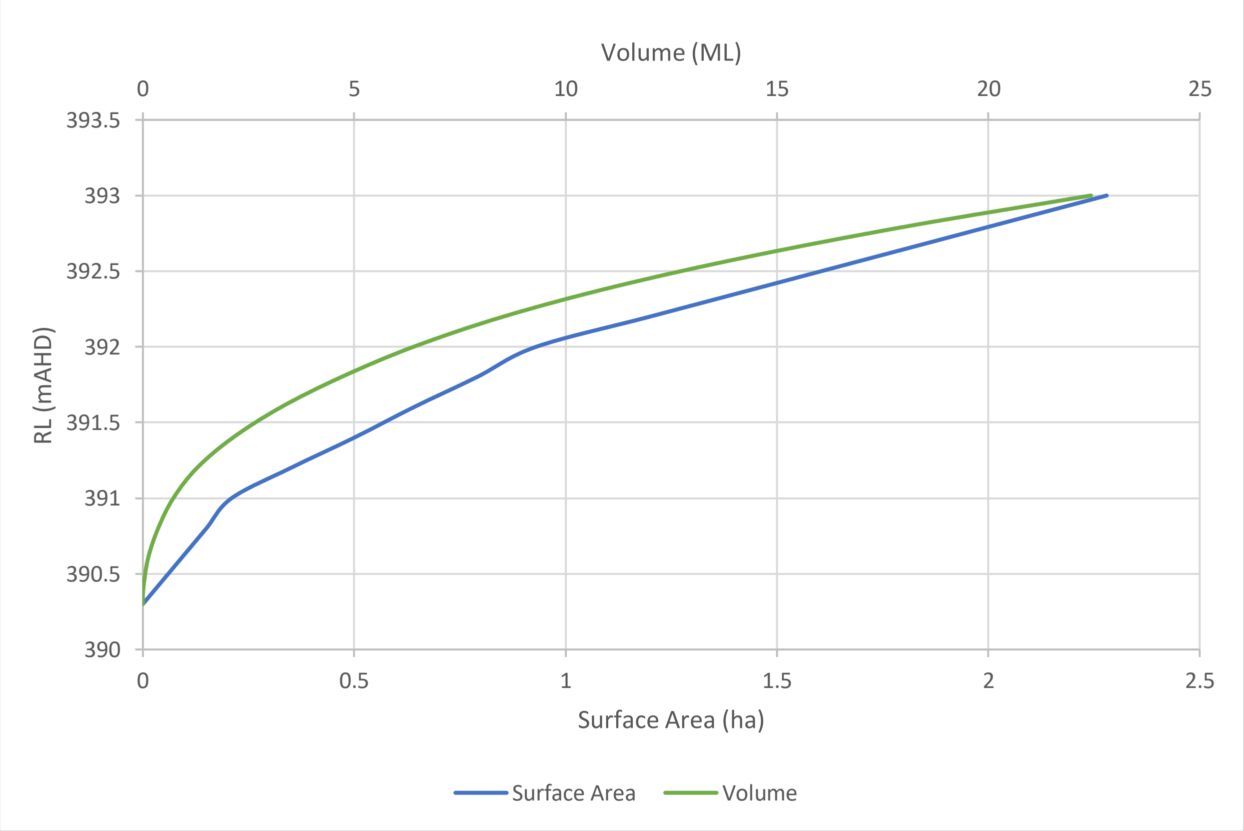
Pit 8

RL (mAHD)	Area (ha)	Volume (ML)
357	0.0	0.0
358	1.5	7.5
360	3.7	37.5
365	15.3	1697.0



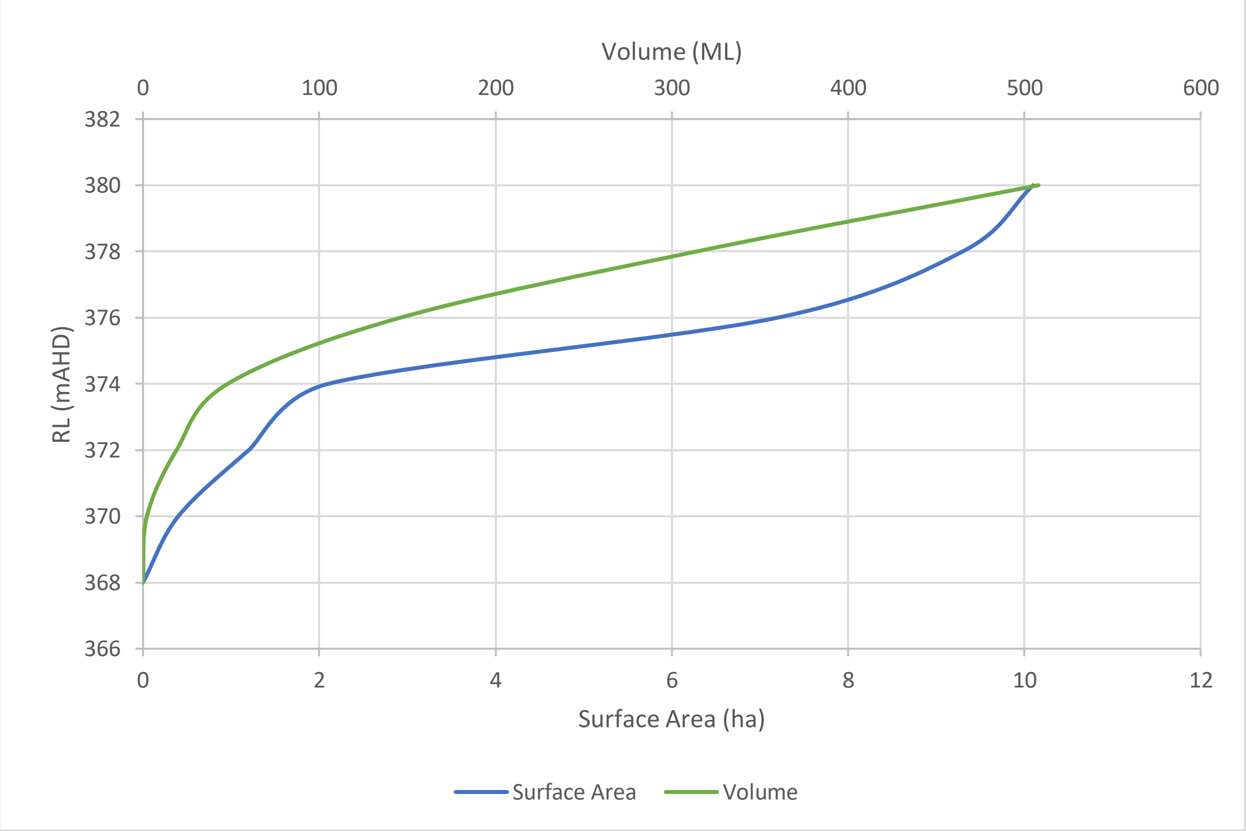
Pit 5 FP Dam

RL (mAHD)	Area (ha)	Volume (ML)
390.3	0	0
390.4	0.03	0.01
390.6	0.09	0.12
390.8	0.15	0.36
391	0.21	0.72
391.2	0.35	1.28
391.4	0.5	2.13
391.6	0.64	3.26
391.8	0.79	4.69
392	0.93	6.4
392.2	1.2	8.53
392.4	1.47	11.19
392.6	0.74	14.4
392.8	2.01	18.15
393	2.28	22.43



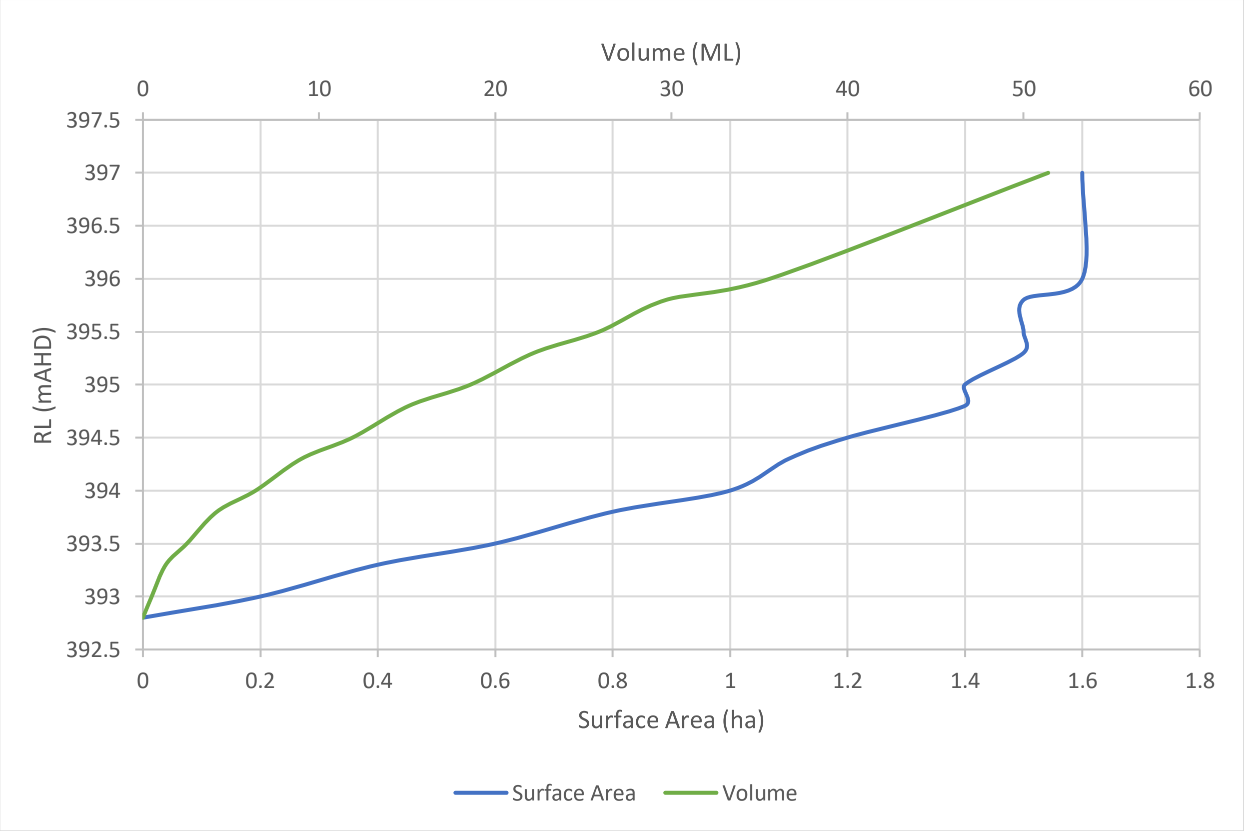
Ed's Lake

RL (mAHD)	Area (ha)	Volume (ML)
368	0	0
370	0.4	2.2
372	1.2	19
374	2.1	48
376	7.2	146
378	9.3	314
380	10.1	508



CWD

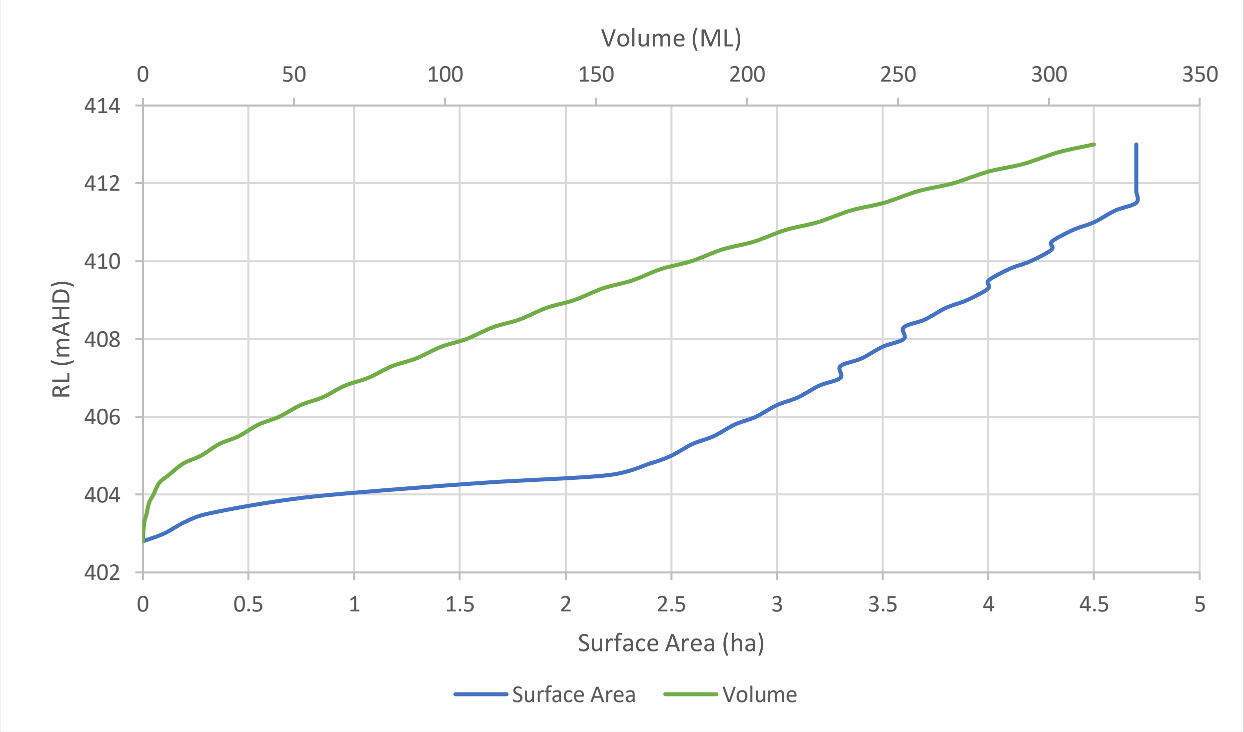
RL (mAHD)	Area (ha)	Volume (ML)
392.8	0	0
393	0.2	0.5
393.3	0.4	1.3
393.5	0.6	2.5
393.8	0.8	4.2
394	1	6.4
394.3	1.1	9
394.5	1.2	11.9
394.8	1.4	15.1
395	1.4	18.6
395.3	1.5	22.2
395.5	1.5	25.9
395.8	1.5	29.7
396	1.6	35.6
397	1.6	51.4



RWD

RL (mAHD)	Area (ha)	Volume (ML)
402.8	0	0
403	0.1	0.1
403.3	0.2	0.5
403.5	0.3	1.2
403.8	0.6	2.1
404	0.9	3.5
404.3	1.6	5.4
404.5	2.2	8.5
404.8	2.4	13.4
405	2.5	19.2
405.3	2.6	25.3
405.5	2.7	31.7
405.8	2.8	38.3
406	2.9	45.1
406.3	3	52.2
406.5	3.1	59.5
406.8	3.2	66.9
407	3.3	74.6
407.3	3.3	82.5
407.5	3.4	90.5
407.8	3.5	98.8

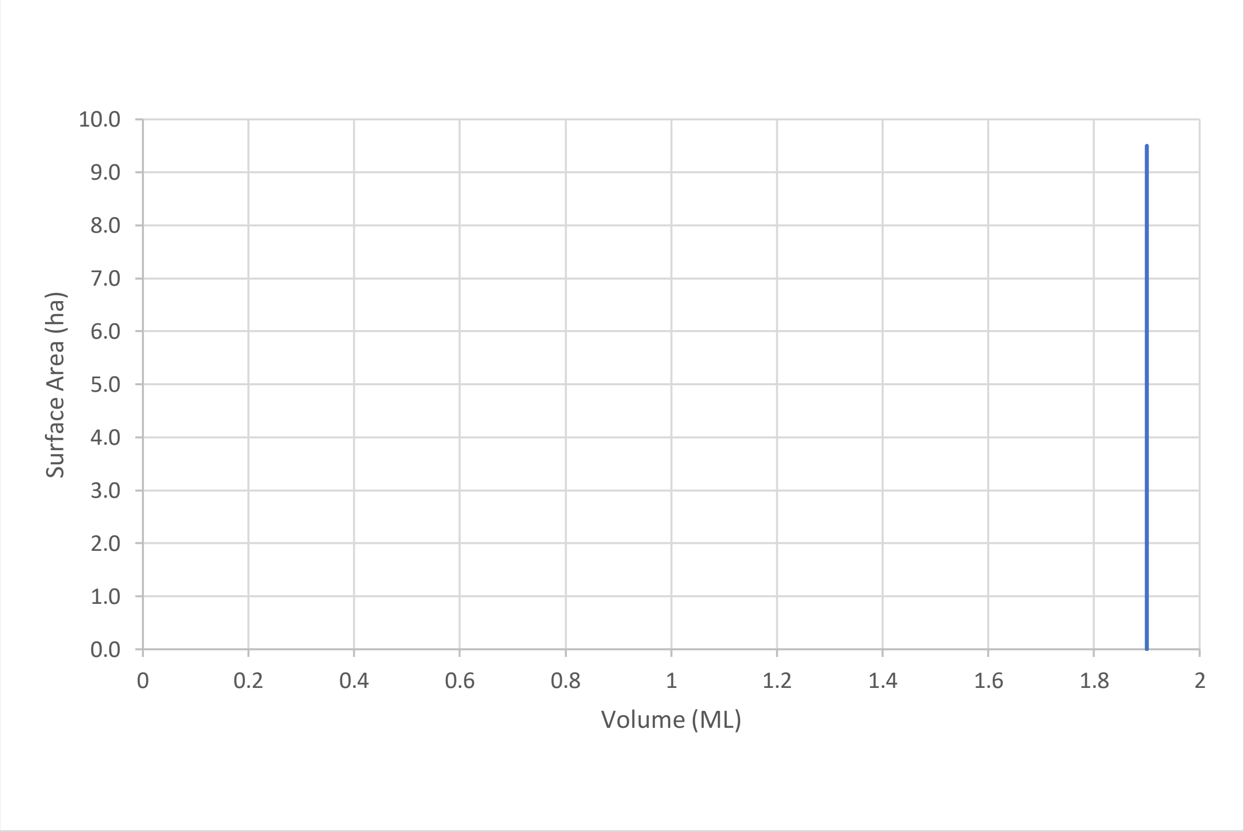
RL (mAHD)	Area (ha)	Volume (ML)
408	3.6	107.2
408.3	3.6	115.9
408.5	3.7	124.7
408.8	3.8	133.7
409	3.9	142.9
409.3	4	152.3
409.5	4	161.9
409.8	4.1	171.7
410	4.2	181.7
410.3	4.3	191.9
410.5	4.3	202.3
410.8	4.4	212.8
411	4.5	223.5
411.3	4.6	234.4
411.5	4.7	245.5
411.8	4.7	256.8
412	4.7	268.3
412.3	4.7	280
412.5	4.7	291.7
412.8	4.7	303.3
413	4.7	315



Pit 8 CWD

Area (ha)	Volume (ML)
1.9	0
1.9	9

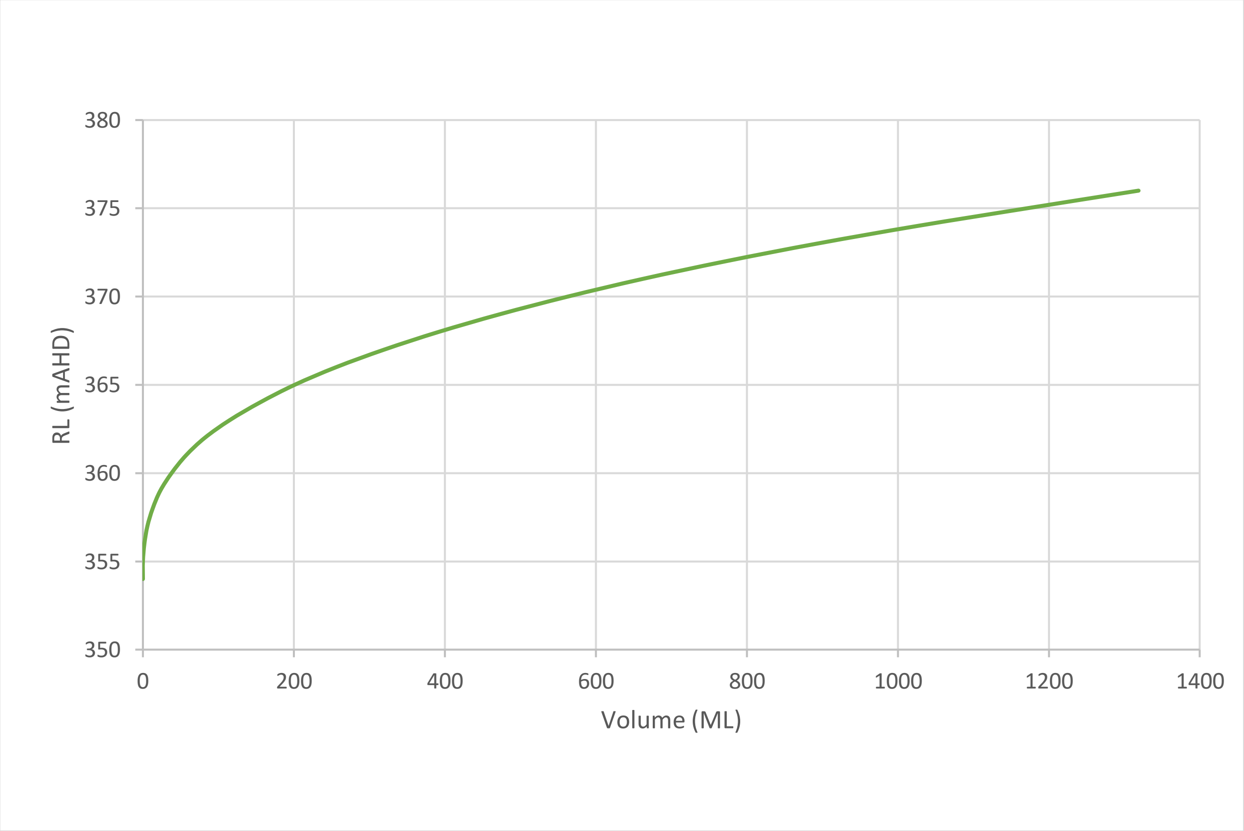
*Includes 3 combined dams with combined surface area of 1.9 m^2 as no detailed data is available



Pit 1 Spoil Aquifer (20% Porosity)

RL (mAHD)	Volume (ML)
354	0
355	0.01
356	2
357	6
358	13
359	23
360	38
361	57
362	82
363	115
364	155
365	201

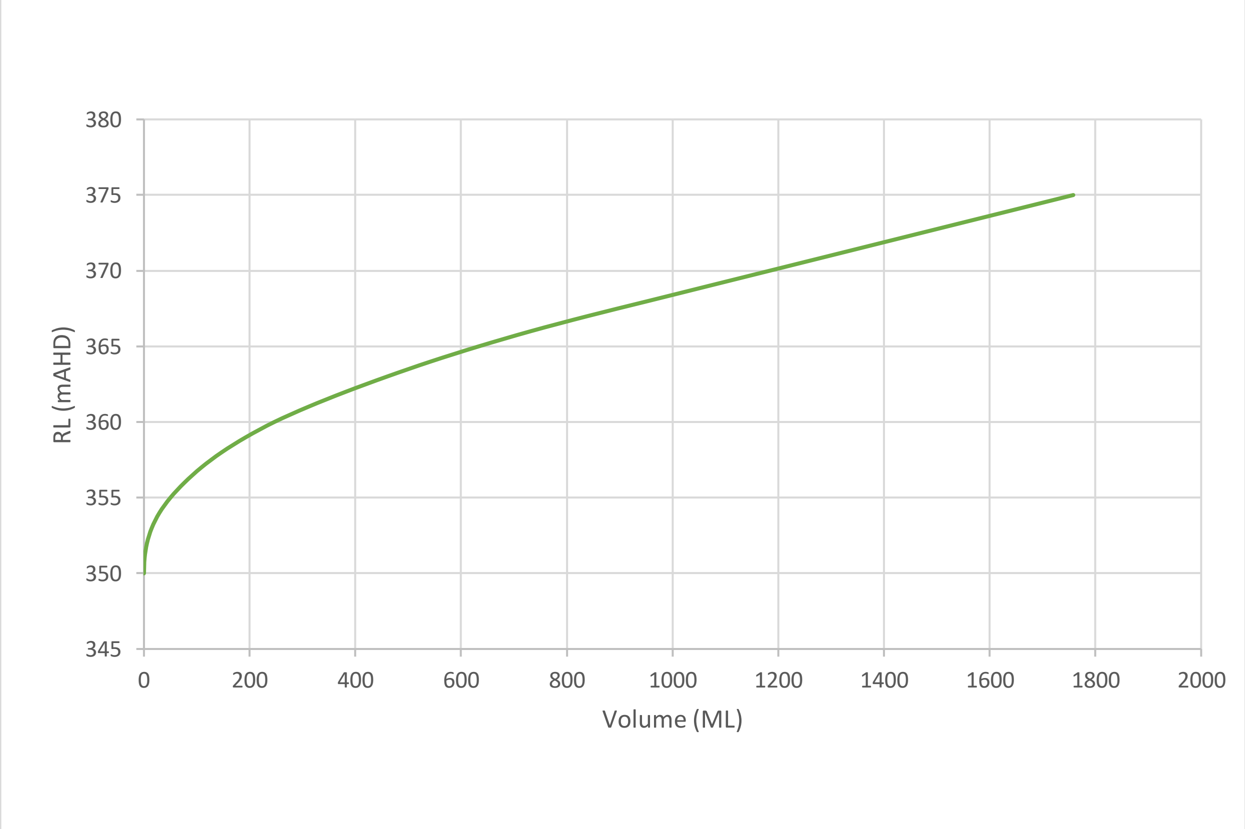
RL (mAHD)	Volume (ML)
366	256
367	320
368	392
369	473
370	563
371	662
372	772
373	893
374	1026
375	1171
376	1319



Pit 2 Spoil Aquifer (20% Porosity)

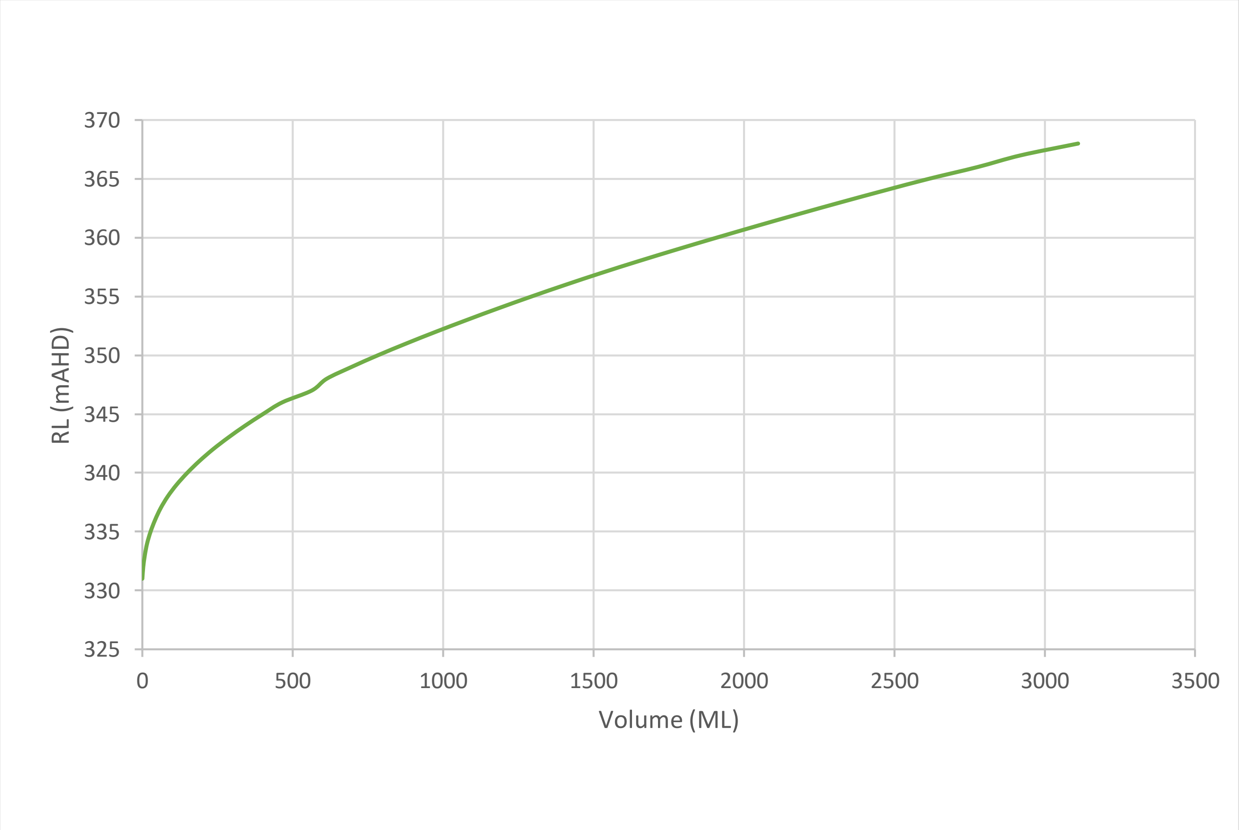
RL (mAHD)	Volume (ML)
350	0
351	1.2
352	5.8
353	14.8
354	29.3
355	50.1
356	76.8
357	108.7
358	147.1
359	193
360	246.6
361	310.5
362	381.9

RL (mAHD)	Volume (ML)
363	459.6
364	542.7
365	633.3
366	31.6
367	839.3
368	954.1
369	1068.9
370	1183.8
371	1298.6
372	1413.5
373	1528.3
374	1643.2
375	1758.1



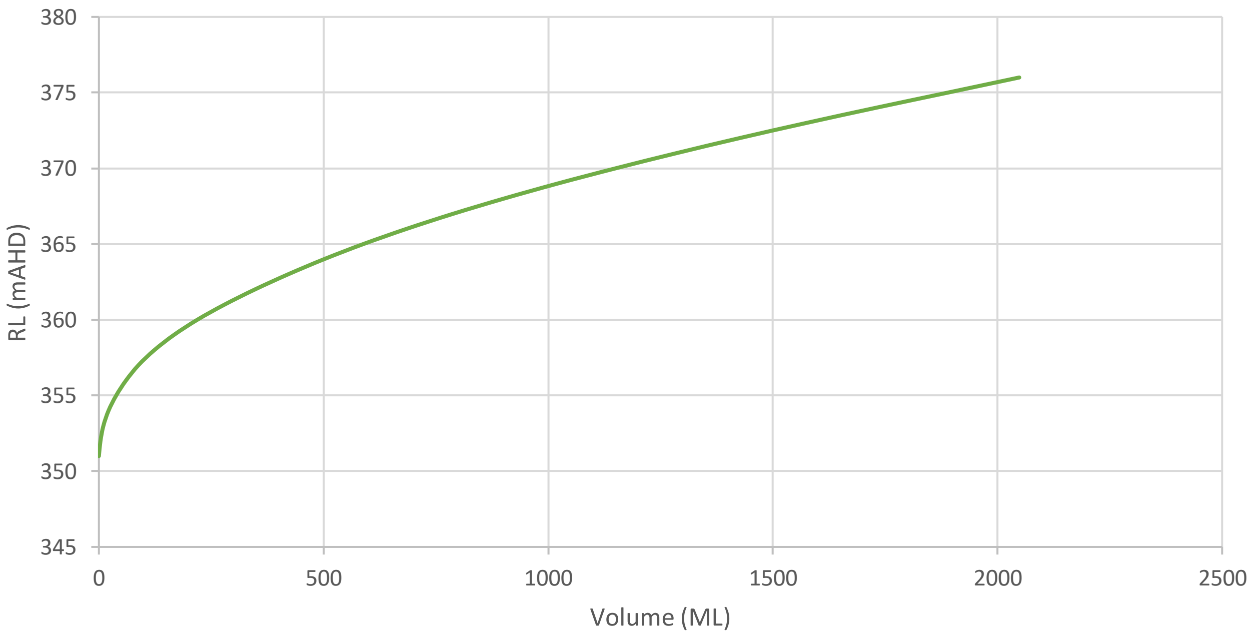
Pit 4 Spoil Aquifer (10% Porosity)

RL (mAHD)	Volume (ML)
331	0
332	3
333	8.3
334	15.8
335	27.4
336	42.4
337	60.9
338	84.6
339	114.1
340	149.3
341	189.4
342	234.7
343	285.6
344	341
345	401
346	465.7
347	563.3
348	612.9
349	695
350	783.4
351	877.6
352	976.2
353	1078.8
354	1184.7
355	1294.4
356	1408.1
357	1526.3
358	1649.9
359	1778
360	1909.5
361	2044
362	2181.4
363	2321.7
364	2466.1
365	2614.9
366	276.8
367	2920.7
368	3111.3



Pit 5 Spoil Aquifer (10% Porosity)

RL (mAHD)	Volume (ML)
351	0
352	3.5
353	10
354	21.5
355	38.5
356	60.5
357	88
358	123.5
359	167
360	219
361	279.5
362	347
363	421
364	501
365	588.5
366	684.5
367	788.5
368	901
369	1021.5
370	1150
371	1285
372	1426.5
373	1575
374	1729.5
375	1889.5
376	2048.5



ASIA PACIFIC OFFICES

BRISBANE
Level 2, 15 Astor Terrace
Spring Hill QLD 4000
Australia
T: +61 7 3858 4800
F: +61 7 3858 4801

CANBERRA
GPO 410
Canberra ACT 2600
Australia
T: +61 2 6287 0800
F: +61 2 9427 8200

DARWIN
Unit 5, 21 Parap Road
Parap NT 0820
Australia
T: +61 8 8998 0100
F: +61 8 9370 0101

GOLD COAST
Level 2, 194 Varsity Parade
Varsity Lakes QLD 4227
Australia
M: +61 438 763 516

MACKAY
21 River Street
Mackay QLD 4740
Australia
T: +61 7 3181 3300

MELBOURNE
Level 11, 176 Wellington Parade
East Melbourne VIC 3002
Australia
T: +61 3 9249 9400
F: +61 3 9249 9499

NEWCASTLE
10 Kings Road
New Lambton NSW 2305
Australia
T: +61 2 4037 3200
F: +61 2 4037 3201

PERTH
Ground Floor, 503 Murray Street
Perth WA 6000
Australia
T: +61 8 9422 5900
F: +61 8 9422 5901

SYDNEY
Tenancy 202 Submarine School
Sub Base Platypus
120 High Street
North Sydney NSW 2060
Australia
T: +61 2 9427 8100
F: +61 2 9427 8200

TOWNSVILLE
12 Cannan Street
South Townsville QLD 4810
Australia
T: +61 7 4722 8000
F: +61 7 4722 8001

WOLLONGONG
Level 1, The Central Building
UoW Innovation Campus
North Wollongong NSW 2500
Australia
T: +61 2 4249 1000

AUCKLAND
68 Beach Road
Auckland 1010
New Zealand
T: 0800 757 695

NELSON
6/A Cambridge Street
Richmond, Nelson 7020
New Zealand
T: +64 274 898 628

www.slrconsulting.com