APPENDIX 3D – GROUNDWATER MONITORING DATA

Summary of Groundwater Results 2016

Site	Water Level (mbgl)			pH			EC (uS/cm)		
	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave
GWa1	4.85	5.20	4.94	0.00	0.00	0.00	0.00	0.00	0.00
GWa2	1.37	4.27	3.09	6.60	7.00	6.76	1480.00	1910.00	1621.82
GWa3	3.62	5.12	4.22	7.00	7.40	7.17	500.00	2580.00	1281.43
GWa4	4.02	4.89	4.56	7.00	7.20	7.10	3040.00	3850.00	3546.67
GWa5	2.54	4.33	3.68	7.20	7.60	7.40	8920.00	14200.00	11310.91
GWa6	1.04	2.44	1.62	7.50	7.80	7.63	6640.00	13600.00	9832.00
GWa7	3.25	4.87	4.12	7.00	7.80	7.26	12.83	10800.00	5788.21
GWa8	1.10	2.28	1.59	6.80	7.20	7.03	2080.00	2520.00	2234.55
GWa10	3.03	3.99	3.62	6.80	7.30	6.98	2660.00	3590.00	3350.83
GWa11	3.16	3.62	3.40	7.40	7.70	7.53	1700.00	3070.00	2289.17
GWa12	3.28	5.54	3.93	7.60	7.70	7.63	890.00	1250.00	1030.00
GWa14	1.53	1.53	1.53	7.80	7.80	7.80	790.00	790.00	790.00
GWa15	2.48	3.73	3.41	7.20	7.60	7.38	290.00	2910.00	2354.00
GWa16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GWa22	3.87	3.92	3.90	6.90	7.10	7.00	5340.00	5470.00	5405.00
GWa32	1.56	2.85	2.11	7.00	7.30	7.16	3740.00	5550.00	4255.00
GWa34	2.80	4.71	4.2275	4.10	6.50	5.25	190.00	6640.00	4740
GWc1	8.62	9.61	9.19	6.90	7.20	7.05	2050.00	3370.00	2762.73
GWc2	12.23	14.62	13.83	7.00	7.20	7.06	1240.00	1290.00	1260.91
GWc3	8.93	14.23	10.77	6.70	7.00	6.82	3810.00	4250.00	4044.55
GWc4	14.26	14.57	14.45	6.70	7.00	6.82	1980.00	2470.00	2348.00
GWc5	5.91	6.56	6.18	6.40	6.80	6.58	5480.00	5700.00	5582.73
GWc10	1.40	2.37	1.97	6.50	7.30	6.94	3580.00	4020.00	3847.50
GWc11	13.34	14.32	13.79	6.20	6.50	6.34	3470.00	3710.00	3573.33
GWc12	26.52	32.29	29.51	6.90	7.30	7.11	1180.00	4130.00	1842.73
GWc14	22.97	30.37	27.10	7.20	7.30	7.25	1080.00	1170.00	1107.27
GWc15	19.37	25.55	22.56	6.50	6.70	6.55	3180.00	3370.00	3266.36

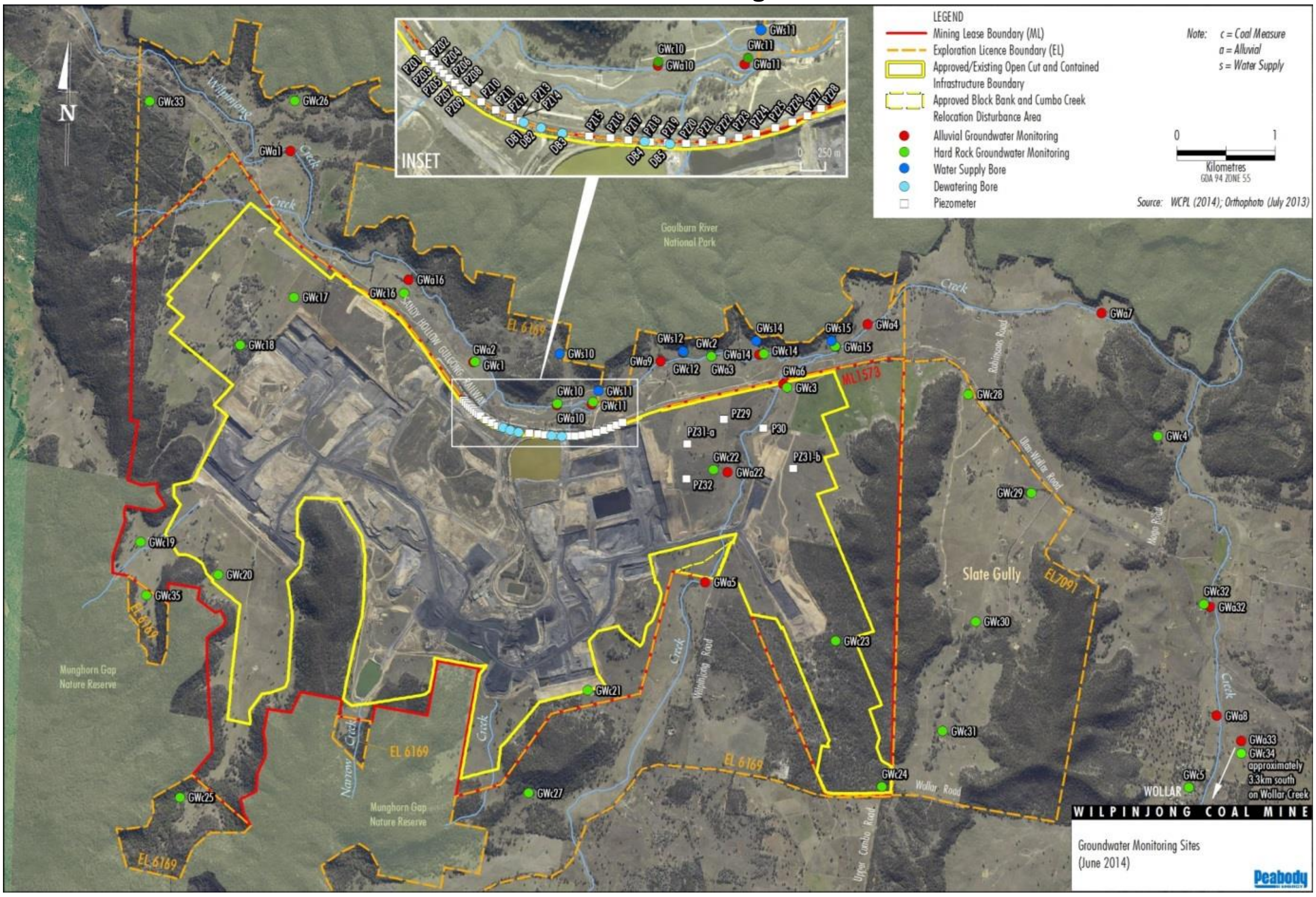
Summary of Groundwater Results 2015

Site	Water Level (mbgl)			pH			EC (uS/cm)		
	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave
GWa1	4.94	5.21	5.05	0.00	0.00	-	0.00	0.00	-
GWa2	3.78	4.20	4.01	6.70	6.90	6.81	1400.00	1510.00	1431.67
GWa3	4.88	5.45	5.22	6.90	7.20	7.03	2120.00	2640.00	2396.67
GWa4	3.80	13.67	5.08	6.50	7.20	6.92	2350.00	5260.00	4381.11
GWa5	3.24	4.19	3.67	7.00	7.50	7.23	9950.00	11070.00	10511.67
GWa6	2.47	2.79	2.72	7.50	7.60	7.55	8370.00	8830.00	8600.00
GWa7	4.66	5.21	4.95	7.00	7.30	7.05	12330.00	15270.00	13656.00
GWa8	1.42	2.25	1.72	6.80	7.10	6.95	2060.00	2290.00	2174.17
GWa10	3.43	4.18	3.87	6.80	7.00	6.90	3470.00	3840.00	3575.83
GWa11	3.16	4.07	3.57	7.40	7.70	7.53	2060.00	3920.00	2789.17
GWa12	5.04	5.85	5.62	0.00	0.00	-	0.00	0.00	0.00
GWa14	4.54	5.01	4.85	0.00	0.00	-	0.00	0.00	-
GWa15	3.54	3.69	3.62	7.20	7.40	7.30	2860.00	2960.00	2934.00
GWc1	9.62	10.12	9.85	6.90	7.10	7.03	2200.00	3320.00	2682.50
GWc2	12.47	14.51	13.61	7.00	7.30	7.13	1180.00	1300.00	1240.83
GWc3	9.88	10.73	10.27	6.70	6.80	6.74	4190.00	4630.00	4511.67
GWc4	13.23	14.09	13.83	6.40	6.70	6.56	2240.00	2480.00	2380.83
GWc5	5.81	6.47	6.08	6.40	6.70	6.56	5520.00	5770.00	5659.17
GWc10	2.66	5.04	3.98	6.90	7.50	7.22	3730.00	4020.00	3910.83
GWc11	13.49	14.80	14.20	6.10	6.40	6.23	3670.00	3820.00	3761.67
GWc12	24.28	32.33	27.79	7.10	7.60	7.24	1400.00	1700.00	1568.33
GWc14	19.64	29.58	24.56	7.20	7.40	7.26	1120.00	1170.00	1148.33
GWc15	15.32	23.11	19.53	6.50	6.70	6.55	3270.00	3370.00	3321.67

Summary of Groundwater Results 2014

Site	Water Level (mbgl)			pH			EC (uS/cm)		
	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave
GWa1	4.75	5.20	4.93	6.90	7.20	7.01	11450.00	15120.00	12915.71
GWa2	3.23	3.84	3.55	6.60	6.90	6.68	1200.00	1390.00	1266.00
GWa3	4.44	5.23	4.93	6.60	7.10	6.88	2260.00	2970.00	2428.89
GWa4	2.80	3.84	3.35	6.60	7.20	6.85	2300.00	3610.00	2565.00
GWa5	2.85	3.65	3.17	6.60	7.20	6.81	9530.00	13270.00	11197.00
GWa6	2.41	2.81	2.69	7.10	7.30	7.20	8040.00	9250.00	8716.67
GWa7	4.66	4.99	4.78	6.60	7.10	6.82	9800.00	14360.00	11154.00
GWa8	1.43	2.50	1.79	6.60	7.00	6.84	1620.00	2570.00	2223.00
GWa10	9.53	10.48	9.89	6.70	7.20	6.98	1900.00	2550.00	2093.00
GWa11	3.64	4.17	3.94	7.10	7.40	7.28	4350.00	9590.00	6294.44
GWa12	5.05	5.85	5.50	6.80	7.10	7.01	1980.00	2140.00	2050.00
GWa14	4.97	5.02	4.98	-	-	-	-	-	-
GWa15	3.12	3.53	3.39	7.20	7.40	7.29	1520.00	2920.00	2682.73
GWc1	9.53	10.48	9.89	6.70	7.20	6.98	1900.00	2550.00	2093.00
GWc2	10.19	13.31	12.30	6.80	7.30	7.06	1010.00	1240.00	3175.20
GWc3	7.29	10.90	9.39	6.50	6.80	6.64	3940.00	5140.00	4593.64
GWc4	13.03	13.55	13.26	6.40	6.70	6.48	1850.00	2480.00	2359.09
GWc5	5.36	6.12	5.82	6.40	6.60	6.50	5030.00	5720.00	5474.55
GWc10	3.93	5.30	4.46	7.00	7.40	7.19	3140.00	3630.00	2914.26
GWc11	11.85	14.07	12.91	5.70	6.10	5.93	1490.00	3790.00	3246.00
GWc12	20.02	26.52	24.74	6.90	7.60	7.21	1020.00	1360.00	1262.00
GWc14	20.77	21.08	21.01	7.00	7.20	7.15	1090.00	1160.00	1131.67
GWc15	14.94	16.30	15.53	6.40	6.60	6.50	3250.00	3320.00	3285.00

Groundwater Monitoring Locations



Complete Groundwater Results 2016

Sample Location	Sampling Date	Aluminium mg/L	Arsenic mg/L	Barium mg/L	Bicarbonate Alkalinity as CaCO3 mg/L	Carbonate Alkalinity as CaCO3 mg/L	Chloride mg/L	Copper mg/L	Depth to Standpipe m	Electrical Conductivity Field Reading) µS/cm	Hydroxide Alkalinity as CaCO3 mg/L	Iron mg/L	Lead mg/L	Magnesium mg/L	Nickel mg/L	pH - Field pH Unit	Selenium mg/L	Strontium mg/L	Sulfate mg/L	Temperature °C	Total Alkalinity as CaCO3 mg/L	Total Dissolved Solids @180°C – Dissolved mg/L	Zinc mg/L
GWA10	21-Jan-2016	2.61	0.018	0.12	452	<1	757	0.046	3.8	3590	<1	9.09	0.004	2.3	0.015	6.9	<0.01	1.28	329	19.5	452	2220	0.018
GWC10	21-Jan-2016	0.03	<0.001	0.071	463	<1	556	0.014	2.06	4020	<1	1.61	<0.001	0.222	0.005	7.0	<0.01	2.24	991	20.5	463	2330	0.013
GWA11	21-Jan-2016	3.17	<0.001	0.091	704	<1	181	0.289	3.29	2410	<1	3.06	0.004	0.396	0.009	7.6	<0.01	0.674	289	20.5	704	1460	0.013
GWC14	20-Jan-2016	0.04	<0.001	10.9	465	<1	72	0.005	29.4	1100	<1	0.68	0.009	0.07	0.001	7.3	<0.01	1.07	1	21	465	568	0.013
GWC12	20-Jan-2016	0.9	<0.001	13	543	<1	111	0.031	32.04	1390	<1	3.12	0.025	0.102	0.052	7.3	<0.01	1.09	41	21	543	722	0.067
GWC15	20-Jan-2016	0.19	<0.001	2.32	978	<1	254	0.02	23.62	3310	<1	2.62	0.003	0.083	<0.001	6.5	<0.01	1.8	407	19	978	1830	0.011
GWA15	20-Jan-2016																						
GWA12	20-Jan-2016																						
GWC11	21-Jan-2016	0.11	<0.001	0.048	225	<1	332	0.005	13.47	3710	<1	12	0.001	2.28	0.017	6.3	<0.01	1.32	1420	20	225	2780	0.066
GWC25	06-Jan-2016	0.08	<0.001	0.105	372	<1	247	0.143	24.93	1560	<1	0.47	0.003	0.096	0.191	6.8	<0.01	0.311	63	20	372	799	0.028
GWC35	06-Jan-2016	0.1	<0.001	0.246	202	<1	36	0.035	38.55	610	<1	0.73	0.001	0.256	0.009	6.8	<0.01	0.303	29	22	202	370	0.009
GWC22	06-Jan-2016	0.09	<0.001	0.043	474	<1	491	0.002	28.65	4160	<1	5.04	<0.001	0.261	0.001	6.5	<0.01	2.55	1020	21.5	474	2880	0.015
GWA22	06-Jan-2016	56.1	0.07	0.326	188	<1	760	1.67	3.87	5470	<1	120	0.189	1.11	0.131	6.9	0.03	2.94	2120	19	188	4980	0.272
GWC28	18-Jan-2016	0.06	<0.001	0.148	806	<1	506	0.064	37.39	3450	<1	1.6	<0.001	0.047	0.002	6.7	<0.01	2.08	283	22.5	806	1990	0.026
GWA16	21-Jan-2016																						
GWC33	21-Jan-2016	0.65	<0.001	0.744	<1	51	88	0.002	35.57	7710	1660	0.16	<0.001	0.009	0.003	12.6	<0.01	1.02	2	22	1710	1900	0.013
GWC26	21-Jan-2016	0.04	<0.001	0.295	497	<1	147	0.033	38.500	1390	<1	0.57	<0.001	0.042	0.002	7.1	<0.01	0.454	30	20	497	827	0.029
GWC17	21-Jan-2016	0.55	0.001	0.098	436	<1	247	0.002	42.73	1660	<1	15.5	0.002	0.053	0.001	6.9	<0.01	0.812	90	23	436	998	0.011
GWC16	21-Jan-2016	0.02	<0.001	0.142	554	<1	367	0.002	23.05	2270	<1	0.97	<0.001	0.032	<0.001	7.0	<0.01	0.823	80	20.5	554	1290	0.006
GWC29	05-Jan-2016	0.14	<0.001	0.146	822	<1	320	0.019	37.39	2890	<1	1.23	0.001	0.065	0.003	7.0	<0.01	1.28	213	20.5	822	1500	0.018
GWC30	05-Jan-2016	0.16	<0.001	0.291	472	<1	513	0.053	22.81	2780	<1	3.85	0.003	0.148	0.002	6.6	<0.01	2.37	280	19	472	1730	0.017
GWC31	11-Jan-2016	0.51	0.022	0.066	344	<1	596	0.058	44.93	4150	<1	6.11	0.002	0.852	0.043	6.6	<0.01	3.41	1260	24	344	2870	0.039
GWC24	11-Jan-2016	0.6	0.003	0.053	13	<1	581	0.11	22.62	3720	<1	109	0.005	7.49	0.238	5.8	<0.01	0.804	1180	21.5	13	1910	0.36
GWC27	11-Jan-2016	6.43	0.026	0.403	66	<1	373	0.671	16.18	1990	<1	39.1	0.076	5.06	0.25	6.0	<0.01	0.289	364	20.5	66	1180	0.957
GWC32	18-Jan-2016	0.02	0.005	0.053	1260	<1	322	0.191	3.750	3500	<1	0.63	0.005	0.075	0.023	6.6	<0.01	4.71	237	18.5	1260	2090	0.067
GWA32	18-Jan-2016	<0.01	<0.001	0.06	451	<1	673	0.05	2.85	4090	<1	0.08	<0.001	0.511	0.004	7.0	<0.01	2.55	748	18.5	451	2860	<0.005
GWA34	18-Jan-2016	46.6	0.025	0.272	38	<1	361	0.651	4.6	6640	<1	134	0.072	16	0.957	5.3	0.02	1.44	4030	19.5	38	6780	2.14
GWC34	18-Jan-2016	0.33	<0.001	0.181	<1	140	303	0.02	11.64	4590	368	0.56	0.004	0.029	0.168	12.2	<0.01	1.65	362	19	508	1140	0.034
GWA10	10-Feb-2016								3.82	3350						6.9				20			
GWC10	10-Feb-2016								1.66	3970						6.9				21.5			
GWA11	10-Feb-2016								3.3	2120						7.6				20.5			
GWC11	10-Feb-2016								13.34	3670						6.2				19			
GWA12	10-Feb-2016																						
GWC12	10-Feb-2016								32.29	1420						7.1				20			
GWC14	10-Feb-2016								30.37	1110						7.2				20			
GWA15	10-Feb-2016								3.6	2910						7.3				20.5			
GWC15	10-Feb-2016								24.55	3300						6.5				19			
GWC25	05-Feb-2016								25.03	1560						6.6				20			
GWC35	05-Feb-2016								38.64	610						6.9				22			
GWC22	05-Feb-2016								28.94	3980						6.6				21.5			
GWA22	05-Feb-2016								3.92	5340						7.1				19			
GWC33	09-Feb-2016								35.72	7740						12.6				20.5			

Sample Location	Sampling Date	Aluminium mg/L	Arsenic mg/L	Barium mg/L	Bicarbonate Alkalinity as CaCO3 mg/L	Carbonate Alkalinity as CaCO3 mg/L	Chloride mg/L	Copper mg/L	Depth to Standpipe m	Electrical Conductivity Field Reading) µS/cm	Hydroxide Alkalinity as CaCO3 mg/L	Iron mg/L	Lead mg/L	Magnesium mg/L	Nickel mg/L	pH - Field pH Unit	Selenium mg/L	Strontium mg/L	Sulfate mg/L	Temperature °C	Total Alkalinity as CaCO3 mg/L	Total Dissolved Solids @180°C – Dissolved mg/L	Zinc mg/L
GWC26	09-Feb-2016								37.64	1400						7.1				20			
GWC17	09-Feb-2016								42.77	1720						6.8				22			
GWC16	09-Feb-2016								23.74	2320						7.0				19.5			
GWA16	09-Feb-2016																						
GWC28	11-Feb-2016								37.88	3310						6.8				21			
GWC29	15-Feb-2016								38.17	2100						11.7				20.5			
GWC30	15-Feb-2016								22.49	2820						6.6				20			
GWC31	11-Feb-2016								44.93	3870						6.5				22.5			
GWC24	03-Feb-2016								22.645	3590						5.9				22.5			
GWC27	11-Feb-2016								16.24	2090						5.8				19			
GWC32	11-Feb-2016								3.72	3620						6.6				19			
GWA32	11-Feb-2016								2.19	4100						7.1				20.5			
GWA34	03-Feb-2016								4.535	6340						4.9				20.5			
GWC34	03-Feb-2016								12.8	3890						11.9				20			
GWA1	09-Feb-2016																						
GWA2	09-Feb-2016								4.07	1480						6.8				19			
GWA3	10-Feb-2016								4.88	2580						7.0				21			
GWA4	10-Feb-2016								4.48	3850						7.0				21.5			
GWA5	03-Feb-2016								3.745	10600						7.4				21			
GWA6	10-Feb-2016								2.44	8430						7.5				20			
GWA7	11-Feb-2016								4.75							7.0				21			
GWA8	03-Feb-2016								1.57	2130						7.2				22			
GWC1	09-Feb-2016								8.83	3370						6.9				17.5			
GWC2	10-Feb-2016								14.59	1280						7.0				19			
GWC3	10-Feb-2016								10.22	4100						6.7				19.5			
GWC4	11-Feb-2016								14.26	2360						6.6				20.5			
GWC5	03-Feb-2016								6.11	5580						6.6				19			
GWA14	10-Feb-2016																						
GWC20	05-Feb-2016								31.09	1500						6.8				21.5			
GWC19	05-Feb-2016								22.695	1430						6.5				20			
GWC18	09-Feb-2016								62.830	3040						6.9				22.5			
GWA1	04-Mar-2016																						
GWA2	04-Mar-2016								4.06	1540						6.7				19.5			
GWA3	08-Mar-2016								5.12	2400						7.0				22			
GWA4	08-Mar-2016																						
GWA5	09-Mar-2016								4.03	10600						7.2				21			
GWA6	09-Mar-2016																						
GWA7	09-Mar-2016																						
GWA8	09-Mar-2016								2	2200						6.8				20.5			
GWC1	04-Mar-2016								9	3330						6.9				17.5			
GWC2	08-Mar-2016								14.58	1280						7.0				19.5			
GWC3	09-Mar-2016								10.33	4040						6.7				19			
GWC4	09-Mar-2016								14.35	2440						6.6				20.5			

Sample Location	Sampling Date	Aluminium mg/L	Arsenic mg/L	Barium mg/L	Bicarbonate Alkalinity as CaCO3 mg/L	Carbonate Alkalinity as CaCO3 mg/L	Chloride mg/L	Copper mg/L	Depth to Standpipe m	Electrical Conductivity Field Reading) µS/cm	Hydroxide Alkalinity as CaCO3 mg/L	Iron mg/L	Lead mg/L	Magnesium mg/L	Nickel mg/L	pH - Field pH Unit	Selenium mg/L	Strontium mg/L	Sulfate mg/L	Temperature °C	Total Alkalinity as CaCO3 mg/L	Total Dissolved Solids @180°C – Dissolved mg/L	Zinc mg/L
GWC5	09-Mar-2016								6.44	5660						6.5				19			
GWA14	08-Mar-2016																						
GWC20	23-Mar-2016																						
GWC19	23-Mar-2016								23.17	1410						6.6				20			
GWC18	04-Mar-2016								62.79	2930						7.0				22.5			
GWA10	08-Mar-2016								3.96	3550						6.8				20.5			
GWC10	08-Mar-2016								1.91	3930						6.9				22.5			
GWA11	08-Mar-2016								3.59	3070						7.4				21			
GWC11	08-Mar-2016								13.61	3630						6.2				19.5			
GWA12	08-Mar-2016																						
GWC12	08-Mar-2016								30.01	1760						7.1				19.5			
GWC14	08-Mar-2016								29.68	1110						7.2				20			
GWA15	08-Mar-2016								3.7	2860						7.2				23			
GWC15	08-Mar-2016								25.55	3370						6.5				19.5			
GWC25	23-Mar-2016								25.18	1580						7.0				20.5			
GWC35	23-Mar-2016								38.82	600						6.9				21.5			
GWC22	23-Mar-2016																						
GWA22	23-Mar-2016																						
GWC33	04-Mar-2016								35.85	7630						12.7				20.5			
GWC26	04-Mar-2016								37.85	1360						7.3				20			
GWC17	04-Mar-2016								42.94	1690						6.8				23			
GWC16	04-Mar-2016								24.96	2450						7.0				19.5			
GWA16	04-Mar-2016																						
GWC28	09-Mar-2016								38.33	3190						6.8				21			
GWC29	10-Mar-2016								38.63	2440						6.9				21			
GWC30	10-Mar-2016								23.58	2760						6.6				20			
GWC31	10-Mar-2016								45.01	3440						6.4				22.5			
GWC24	09-Mar-2016								23	3520						5.8				20.5			
GWC27	10-Mar-2016								16.4	2070						5.7				19			
GWC32	09-Mar-2016								3.86	3520						6.5				19.5			
GWA32	09-Mar-2016								2.42	3930						7.1				21			
GWA34	10-Mar-2016								4.71	6320						4.7				20.5			
GWC34	10-Mar-2016								13.75	5040						6.9				19.5			
GWA10	08-Apr-2016	3.17	0.016	0.128	463	<1	705	0.027	3.99	3540	<1	10.1	0.004	130	0.014	7.0	<0.01	1.34	305	20.5	463	1910	0.018
GWC10	08-Apr-2016	0.04	<0.001	0.065	463	<1	513	0.012	2.18	3960	<1	2.12	<0.001	120	0.006	7.0	<0.01	2.44	925	21.5	463	2570	0.013
GWA11	08-Apr-2016	8.37	0.003	0.257	841	<1	229	0.873	3.62	2990	<1	17.8	0.051	42	0.044	7.5	<0.01	0.899	320	20.5	841	1540	0.088
GWC11	08-Apr-2016	0.09	<0.001	0.034	239	<1	314	0.005	13.67	3590	<1	11.1	<0.001	158	0.014	6.3	<0.01	1.3	1160	19	239	2530	0.034
GWA12	08-Apr-2016																						
GWC12	08-Apr-2016	0.3	<0.001	0.394	1690	<1	256	0.004	28.79	4130	<1	1.05	0.002	14	0.002	7.0	<0.01	0.841	318	20	1690	2110	0.011
GWC14	08-Apr-2016	0.04	<0.001	7.15	484	<1	72	0.005	29.18	1110	<1	0.56	0.008	20	<0.001	7.3	<0.01	0.812	2	19.5	484	538	0.018
GWA15	08-Apr-2016																						
GWC15	08-Apr-2016	3.31	0.002	1.09	1020	<1	261	0.04	24.57	3280	<1	5.06	0.009	51	0.006	6.5	<0.01	1.52	415	18.5	1020	1950	0.055
GWC25	04-Apr-2016	0.08	<0.001	0.08	425	<1	238	0.147	25.23	1560	<1	0.3	0.002	71	0.201	6.8	<0.01	0.279	43	20.5	425	650	0.032

Sample Location	Sampling Date	Aluminium mg/L	Arsenic mg/L	Barium mg/L	Bicarbonate Alkalinity as CaCO3 mg/L	Carbonate Alkalinity as CaCO3 mg/L	Chloride mg/L	Copper mg/L	Depth to Standpipe m	Electrical Conductivity Field Reading) µS/cm	Hydroxide Alkalinity as CaCO3 mg/L	Iron mg/L	Lead mg/L	Magnesium mg/L	Nickel mg/L	pH - Field pH Unit	Selenium mg/L	Strontium mg/L	Sulfate mg/L	Temperature °C	Total Alkalinity as CaCO3 mg/L	Total Dissolved Solids @180°C – Dissolved mg/L	Zinc mg/L
GWC35	04-Apr-2016	0.04	<0.001	0.217	232	<1	38	0.02	38.84	610	<1	0.4	<0.001	24	0.006	6.8	<0.01	0.268	26	22	232	280	0.013
GWC22	04-Apr-2016																						
GWA22	04-Apr-2016																						
GWC33	05-Apr-2016	0.98	<0.001	0.604	<1	48	100	0.006	35.955	7490	1490	0.08	0.001	<1	0.002	12.5	<0.01	0.678	<1	22	1540	1330	0.044
GWC26	05-Apr-2016	0.04	<0.001	0.195	526	<1	139	0.057	38.13	1380	<1	0.47	<0.001	22	0.002	7.2	<0.01	0.37	31	20.5	526	540	0.026
GWC17	04-Apr-2016	0.82	0.002	0.135	454	<1	232	0.006	43.14	1660	<1	45.6	0.012	46	<0.001	6.9	<0.01	0.717	96	22.5	454	824	0.019
GWC16	05-Apr-2016	0.02	<0.001	0.095	568	<1	371	0.004	26.03	2320	<1	1.01	<0.001	41	<0.001	7.2	<0.01	0.778	101	20.5	568	972	0.013
GWA16	05-Apr-2016																						
GWC28	08-Apr-2016	0.08	<0.001	0.127	719	<1	474	0.034	38.6	3150	<1	0.98	0.001	80	0.009	6.8	<0.01	2.2	277	20.5	719	1720	0.07
GWC29	12-Apr-2016	0.13	<0.001	0.159	706	<1	283	0.019	38.99	2440	<1	1.7	0.001	101	0.007	6.8	<0.01	1.24	226	21	706	1390	0.01
GWC30	12-Apr-2016	0.06	<0.001	0.13	480	<1	438	0.049	24.76	2590	<1	4.51	<0.001	120	<0.001	6.6	<0.01	2.05	249	19.5	480	1680	0.012
GWC31	11-Apr-2016	0.48	0.012	0.087	397	<1	555	0.133	45	3920	<1	2.12	0.002	162	0.052	6.6	<0.01	3.71	896	22.5	397	2670	0.031
GWC24	07-Apr-2016	2.8	0.01	0.15	22	<1	519	0.752	22.92	3550	<1	136	0.016	168	0.281	5.9	<0.01	0.781	1010	21	22	2510	0.817
GWC27	07-Apr-2016	1.52	0.016	0.128	32	<1	348	0.133	16.36	2010	<1	39.8	0.023	64	0.242	6.0	<0.01	0.216	372	19	32	1250	0.45
GWC32	11-Apr-2016	0.02	<0.001	0.05	1300	<1	319	0.02	3.95	3550	<1	2.51	<0.001	112	0.002	6.6	<0.01	5.16	244	19	1300	2070	0.015
GWA32	11-Apr-2016	0.01	<0.001	0.061	465	<1	617	0.006	2.4	3910	<1	0.08	<0.001	188	0.002	7.3	<0.01	2.46	705	19	465	2560	0.006
GWA34	11-Apr-2016	17.1	0.003	0.019	2	<1	351	0.25	4.69	6410	<1	94	0.005	580	1.04	5.0	0.03	1.1	3600	20.5	2	6580	2.65
GWC34	11-Apr-2016	1.45	0.007	0.264	1970	<1	259	0.025	16.43	4860	<1	7.29	0.11	104	0.57	7.0	<0.01	9.63	467	19	1970	3300	0.349
GWA1	05-Apr-2016																						
GWA2	05-Apr-2016	0.97	0.037	0.118	169	<1	336	0.012	4.18	1620	<1	34.8	0.003	53	0.008	7.0	<0.01	0.414	111	20.5	169	846	0.028
GWA3	05-Apr-2016																						
GWA4	05-Apr-2016																						
GWA5	12-Apr-2016	23.2	0.234	3.74	508	<1	1610	0.035	4.12	10300	<1	20	0.07	452	0.07	7.4	0.02	5.73	3160	21	508	8560	0.288
GWA6	11-Apr-2016																						
GWA7	11-Apr-2016																						
GWA8	11-Apr-2016	0.74	<0.001	0.082	167	<1	306	0.007	2.21	2160	<1	1.15	0.002	108	0.01	7.0	<0.01	1.13	446	19.5	167	1330	0.013
GWC1	05-Apr-2016	0.03	0.002	0.087	476	<1	603	0.003	9.41	3280	<1	1.61	<0.001	101	0.005	7.1	<0.01	1.25	291	18.5	476	1870	0.018
GWC2	05-Apr-2016	1.49	<0.001	0.641	508	<1	110	0.012	14.515	1290	<1	2.84	0.002	34	0.004	7.1	<0.01	0.607	24	20.5	508	677	0.035
GWC3	11-Apr-2016	1.14	0.022	0.144	566	<1	610	0.028	10.49	4100	<1	93.9	0.004	127	0.003	6.8	<0.01	1.27	686	19.5	566	2570	0.033
GWC4	11-Apr-2016	0.1	<0.001	0.096	624	<1	326	0.003	14.4	2460	<1	2.03	0.002	87	0.001	6.6	<0.01	1.91	229	20.5	624	1510	0.015
GWC5	11-Apr-2016	0.02	<0.001	0.241	2430	<1	498	0.001	6.56	5700	<1	2.19	0.004	165	0.029	6.5	<0.01	7.98	261	18.5	2430	3480	0.016
GWA14	08-Apr-2016																						
GWC20	04-Apr-2016																						
GWC19	04-Apr-2016	0.19	0.004	0.216	242	<1	278	0.004	23.24	1420	<1	4.17	0.002	65	0.003	6.4	<0.01	0.298	47	20	242	709	0.031
GWC18	04-Apr-2016	7.12	0.008	0.342	466	<1	205	0.049	62.73	2830	<1	63.3	0.064	106	0.142	7.0	<0.01	1.93	732	22.5	466	1480	0.403
GWA10	17-May-2016								3.87	3530						6.9				20			
GWC10	17-May-2016								2.25	3930						6.8				20			
GWA11	17-May-2016								3.52	2390						7.4				20			
GWC11	17-May-2016								13.93	3600						6.3				19.5			
GWA12	17-May-2016								5.54														
GWC12	17-May-2016								29.2	1460						6.9				19			
GWC14	17-May-2016								26.57	1110						7.2				19			
GWA15	17-May-2016								3.73	2880						7.3				20.5			

Sample Location	Sampling Date	Aluminium mg/L	Arsenic mg/L	Barium mg/L	Bicarbonate Alkalinity as CaCO3 mg/L	Carbonate Alkalinity as CaCO3 mg/L	Chloride mg/L	Copper mg/L	Depth to Standpipe m	Electrical Conductivity Field Reading) µS/cm	Hydroxide Alkalinity as CaCO3 mg/L	Iron mg/L	Lead mg/L	Magnesium mg/L	Nickel mg/L	pH - Field pH Unit	Selenium mg/L	Strontium mg/L	Sulfate mg/L	Temperature °C	Total Alkalinity as CaCO3 mg/L	Total Dissolved Solids @180°C – Dissolved mg/L	Zinc mg/L
GWC15	17-May-2016								22.25	3280						6.5				18.5			
GWC25	18-May-2016								25.32	1560						6.8				19			
GWC35	18-May-2016								38.92	600						6.7				21			
GWC33	16-May-2016								36.15	7360						12.7				20			
GWC26	04-May-2016								38.47	1370						7.2				19.5			
GWC17	16-May-2016								43.35	1640						6.8				21.5			
GWC16	16-May-2016								25.73	2320						7.0				19			
GWC28	18-May-2016								38	3120						6.8				20.5			
GWC29	17-May-2016								38.74	2230						7.0				20			
GWC30	17-May-2016								25.6	2490						6.4				19.5			
GWC31	17-May-2016								45.03	3510						6.4				22.5			
GWC24	12-May-2016								22.9	3360						5.7				20			
GWC27	04-May-2016								16.39	1970						5.8				18.5			
GWC32	12-May-2016								3.95	3450						6.6				19			
GWA32	12-May-2016								2.18	3740						7.0				18			
GWA34	17-May-2016								4.65	6240						4.4				20			
GWC34	17-May-2016								16.81	4750						7.0				18.5			
GWA1	04-May-2016																						
GWA2	16-May-2016								4.27	1550						6.6				19.5			
GWA3	12-May-2016																						
GWA4	17-May-2016																						
GWA5	04-May-2016								4.16	10300						7.4				20			
GWA6	04-May-2016																						
GWA7	12-May-2016																						
GWA8	04-May-2016								2.28	2090						6.8				18.5			
GWC1	16-May-2016								9.6	3350						7.0				17.5			
GWC2	12-May-2016								14.62	1260						7.0				18			
GWC3	04-May-2016								11.43	4040						6.8				18.5			
GWC4	12-May-2016								14.44	2400						6.5				19.5			
GWC5	04-May-2016								6.21	5590						6.5				18.5			
GWA14	17-May-2016																						
GWC19	18-May-2016								23.61	1280						6.4				19			
GWC18	16-May-2016								62.99	2760						6.8				21.5			
GWA1	08-Jun-2016																						
GWA2	08-Jun-2016								4.27	1490						6.9				18			
GWA3	10-Jun-2016																						
GWA4	03-Jun-2016																						
GWA5	10-Jun-2016								4.33	10800						7.6				17			
GWA6	10-Jun-2016																						
GWA7	10-Jun-2016																						
GWA8	10-Jun-2016								1.77	2080						7.0				16.5			
GWC1	08-Jun-2016								9.36	3370						7.0				17			
GWC2	10-Jun-2016								14.6	1250						7.1				17.5			

Sample Location	Sampling Date	Aluminium mg/L	Arsenic mg/L	Barium mg/L	Bicarbonate Alkalinity as CaCO3 mg/L	Carbonate Alkalinity as CaCO3 mg/L	Chloride mg/L	Copper mg/L	Depth to Standpipe m	Electrical Conductivity Field Reading) µS/cm	Hydroxide Alkalinity as CaCO3 mg/L	Iron mg/L	Lead mg/L	Magnesium mg/L	Nickel mg/L	pH - Field pH Unit	Selenium mg/L	Strontium mg/L	Sulfate mg/L	Temperature °C	Total Alkalinity as CaCO3 mg/L	Total Dissolved Solids @180°C – Dissolved mg/L	Zinc mg/L
GWC3	10-Jun-2016								13.89	3980						6.8				18			
GWC4	10-Jun-2016								14.45	2380						6.6				19			
GWC5	10-Jun-2016								6.19	5550						6.6				18			
GWA10	03-Jun-2016								3.97	3460						6.9				18.5			
GWC10	03-Jun-2016								2.15	3900						7.1				18.5			
GWA11	03-Jun-2016								3.47	2810						7.4				18.5			
GWC11	03-Jun-2016								13.86	3550						6.3				18			
GWA12	03-Jun-2016																						
GWC12	03-Jun-2016								29.76	1300						7.0				18.5			
GWA14	03-Jun-2016																						
GWC14	03-Jun-2016								26.11	1100						7.2				18.5			
GWA15	03-Jun-2016																						
GWC15	03-Jun-2016								21.69	3220						6.5				18			
GWC25	29-Jun-2016								25.53	1560						6.9				18.5			
GWC19	29-Jun-2016								23.775	1280						6.6				18.5			
GWC35	29-Jun-2016								39.22	600						6.9				19			
GWC33	08-Jun-2016								36.23	7250						12.8				20			
GWC26	08-Jun-2016								38.61	1320						7.2				18.5			
GWC18	08-Jun-2016								62.98	2750						6.9				21.5			
GWC17	08-Jun-2016								43.7	1630						6.8				21			
GWC16	08-Jun-2016								27.44	2370						7.0				19			
GWC28	15-Jun-2016								37.53	3300						6.9				19.5			
GWC29	15-Jun-2016								38.345	2360						7.0				18.5			
GWC30	15-Jun-2016								26.34	2390						6.6				19			
GWC31	15-Jun-2016								45.2	3350						6.7				21.5			
GWC24	15-Jun-2016								22.915	3420						5.8				19			
GWC27	30-Jun-2016								16.5	1970						6.0				17			
GWC32	10-Jun-2016								3.86	3440						6.6				18.5			
GWA32	10-Jun-2016								1.84	5550						7.3				16			
GWA34	15-Jun-2016								4.66	6460						5.3				19			
GWC34	15-Jun-2016								17.355	4820						7.1				18			
GWA1	01-Jul-2016																						
GWA2	01-Jul-2016	3.78	0.078	0.246	154	<1	328	0.032	4.26	1500	<1	152	0.01	41	0.017	6.9	<0.01	0.485	86	17	154	742	0.03
GWA3	07-Jul-2016																						
GWA4	04-Jul-2016																						
GWA5	13-Jul-2016	2.96	0.038	0.589	384	<1	2990	0.014	3.45	14200	<1	5.43	0.008	865	0.028	7.4	0.01	8.32	4640	15.5	384	9340	0.102
GWA6	07-Jul-2016																						
GWA7	07-Jul-2016																						
GWA8	07-Jul-2016	0.06	0.001	0.029	204	<1	309	0.001	1.38	2170	<1	0.13	<0.001	105	0.006	7.1	<0.01	1.29	507	15.5	204	1300	0.008
GWC1	01-Jul-2016	0.02	0.001	0.086	452	<1	644	<0.001	9.13	3310	<1	2.26	<0.001	91	0.003	7.0	<0.01	1.63	326	16	452	1950	<0.005
GWC2	07-Jul-2016	0.23	<0.001	0.394	565	<1	91	0.003	14.42	1260	<1	1.97	0.001	30	0.002	7.1	<0.01	0.608	23	18	565	654	0.032
GWC3	07-Jul-2016	2.4	0.007	0.193	680	<1	588	0.041	14.23	4040	<1	274	0.004	120	0.019	6.8	0.01	2.12	712	18.5	680	2420	0.082
GWC4	07-Jul-2016	0.19	<0.001	0.058	647	<1	296	0.008	14.46	2340	<1	3.3	0.004	75	0.003	6.7	<0.01	1.99	222	19.5	647	1360	0.039

Sample Location	Sampling Date	Aluminium mg/L	Arsenic mg/L	Barium mg/L	Bicarbonate Alkalinity as CaCO3 mg/L	Carbonate Alkalinity as CaCO3 mg/L	Chloride mg/L	Copper mg/L	Depth to Standpipe m	Electrical Conductivity Field Reading) µS/cm	Hydroxide Alkalinity as CaCO3 mg/L	Iron mg/L	Lead mg/L	Magnesium mg/L	Nickel mg/L	pH - Field pH Unit	Selenium mg/L	Strontium mg/L	Sulfate mg/L	Temperature °C	Total Alkalinity as CaCO3 mg/L	Total Dissolved Solids @180°C – Dissolved mg/L	Zinc mg/L
GWC5	07-Jul-2016	0.06	<0.001	0.228	1920	<1	494	0.003	6.135	5620	<1	2.34	0.005	160	0.028	6.7	<0.01	8.78	269	19	1920	3080	0.033
GWA10	04-Jul-2016	1.44	0.016	0.086	459	<1	697	0.041	3.73	3490	<1	10	0.004	121	0.013	6.9	<0.01	1.35	340	17	459	2160	0.006
GWC10	04-Jul-2016	0.05	<0.001	0.058	414	<1	464	0.017	1.4	3840	<1	1.27	0.002	115	0.006	7.2	<0.01	2.44	1090	16	414	2760	0.018
GWA11	04-Jul-2016	2.32	<0.001	0.077	690	<1	145	0.165	3.23	2120	<1	4.46	0.011	26	0.01	7.6	<0.01	0.608	260	17	690	1290	0.037
GWC11	04-Jul-2016	0.2	<0.001	0.045	247	<1	302	0.007	13.55	3530	<1	12.6	0.002	143	0.013	6.3	<0.01	1.53	1450	18	247	2690	0.054
GWA12	04-Jul-2016																						
GWC12	04-Jul-2016	0.08	<0.001	1.09	532	<1	113	<0.001	29.27	1410	<1	0.4	0.001	18	0.003	7.2	<0.01	0.537	42	18.5	532	848	<0.005
GWA14	04-Jul-2016																						
GWC14	04-Jul-2016	0.05	<0.001	6.35	446	<1	73	0.015	25.14	1100	<1	0.85	0.012	18	<0.001	7.3	<0.01	0.73	1	18.5	446	552	0.017
GWA15	04-Jul-2016																						
GWC15	04-Jul-2016	0.16	0.001	0.208	951	<1	251	0.005	20.78	3220	<1	2	0.002	48	0.001	6.6	<0.01	1.73	441	17.5	951	2040	0.134
GWC25	13-Jul-2016	0.16	0.003	0.088	405	<1	236	0.27	25.53	1580	<1	0.46	0.002	62	0.163	8.9	<0.01	0.564	57	18	405	980	0.021
GWC19	13-Jul-2016	0.19	0.002	0.22	229	<1	266	0.014	23.935	1370	<1	3.66	0.002	57	0.008	6.5	<0.01	0.368	60	18.5	229	862	0.032
GWC35	13-Jul-2016	0.23	<0.001	0.252	219	<1	62	0.022	39.25	600	<1	1.78	0.003	21	0.006	6.9	<0.01	0.336	21	18	219	322	0.015
GWC33	04-Jul-2016	0.62	<0.001	0.61	<1	58	104	<0.001	36.35	7250	1450	0.08	<0.001	<1	0.002	12.7	<0.01	0.612	4	20	1510	1890	0.008
GWC26	01-Jul-2016	0.03	<0.001	0.229	499	<1	126	0.086	38.96	1390	<1	0.59	<0.001	19	0.001	7.1	<0.01	0.432	31	19	499	696	0.026
GWC18	01-Jul-2016	1.1	0.003	0.204	452	<1	191	0.008	63.1	2650	<1	21.5	0.013	82	0.077	7.1	<0.01	2.32	686	21	452	1670	0.072
GWC17	01-Jul-2016	0.13	<0.001	0.114	435	<1	221	0.002	39.98	1660	<1	20.6	0.003	38	<0.001	6.9	<0.01	0.823	88	20.5	435	813	<0.005
GWC16	01-Jul-2016	0.06	<0.001	0.177	604	<1	329	0.009	27.48	2200	<1	3.53	<0.001	33	<0.001	7.1	<0.01	0.825	79	19	604	1150	0.013
GWC28	06-Jul-2016	0.27	<0.001	0.204	954	<1	470	0.017	36.98	3420	<1	1.02	0.002	90	0.015	6.9	<0.01	3.07	318	17.5	954	2040	0.077
GWC29	06-Jul-2016	0.07	<0.001	0.165	868	<1	261	0.011	37.83	2480	<1	0.85	<0.001	94	0.01	7.0	<0.01	1.54	221	18.5	868	1370	0.025
GWC30	06-Jul-2016	0.11	<0.001	0.074	518	<1	386	0.068	26.5	2440	<1	5.54	<0.001	112	<0.001	6.6	<0.01	2.17	254	18.5	518	1500	0.012
GWC31	06-Jul-2016	1.08	0.014	0.096	436	<1	512	0.048	45.02	3760	<1	4.6	0.003	147	0.048	6.7	<0.01	3.57	950	19.5	436	2610	0.046
GWC24	06-Jul-2016	1.57	0.004	0.128	22	<1	446	0.232	22.535	3450	<1	94.1	0.013	161	0.254	5.5	<0.01	0.926	1100	18.5	22	1740	0.574
GWC27	13-Jul-2016	5.25	0.024	0.185	25	<1	336	0.076	16.54	1910	<1	39.8	0.051	52	0.247	7.5	<0.01	0.246	337	15	25	1360	0.487
GWC32	07-Jul-2016	0.04	<0.001	0.038	1410	<1	299	0.027	3.66	3490	<1	1.94	<0.001	110	0.002	6.7	<0.01	4.52	250	18.5	1410	2060	0.018
GWA32	07-Jul-2016	0.01	<0.001	0.057	518	<1	746	0.007	1.71	4760	<1	0.17	<0.001	240	0.004	7.2	<0.01	3.42	993	15	518	2900	0.014
GWA34	07-Jul-2016	19.4	0.004	0.033	<1	<1	328	0.239	4.58	6300	<1	109	0.005	524	0.941	4.1	<0.01	0.851	3660	19	<1	4500	2.99
GWC34	07-Jul-2016	1.5	0.01	0.125	2270	<1	226	0.031	18.26	4940	<1	9.14	0.053	100	0.591	7.0	<0.01	8.66	472	18.5	2270	3430	0.191
GWA1	09-Aug-2016																						
GWA2	18-Aug-2016								2.225	1580						6.8				14.5			
GWA3	18-Aug-2016								4.15	720						7.4				17.5			
GWA4	18-Aug-2016																						
GWA5	01-Aug-2016								3.49	13500						7.3				16			
GWA6	25-Aug-2016								1.91	7790						7.8				13.5			
GWA7	25-Aug-2016								4.87	12.83						7.3				15.5			
GWA8	02-Aug-2016								1.325	2520						7.2				14			
GWC1	18-Aug-2016								8.62	2100						7.1				16.5			
GWC2	18-Aug-2016								13.785	1240						7.2				18			
GWC3	25-Aug-2016								10.34	3910						6.8				17.5			
GWC4	16-Aug-2016								14.57	2220						6.6				19.5			
GWC5	02-Aug-2016								6.315	5520						6.6				17.5			
GWA10	25-Aug-2016								3.42	3070						7.3				14.5			

Sample Location	Sampling Date	Aluminium mg/L	Arsenic mg/L	Barium mg/L	Bicarbonate Alkalinity as CaCO3 mg/L	Carbonate Alkalinity as CaCO3 mg/L	Chloride mg/L	Copper mg/L	Depth to Standpipe m	Electrical Conductivity Field Reading) µS/cm	Hydroxide Alkalinity as CaCO3 mg/L	Iron mg/L	Lead mg/L	Magnesium mg/L	Nickel mg/L	pH - Field pH Unit	Selenium mg/L	Strontium mg/L	Sulfate mg/L	Temperature °C	Total Alkalinity as CaCO3 mg/L	Total Dissolved Solids @180°C – Dissolved mg/L	Zinc mg/L
GWC10	25-Aug-2016								1.87	3820						7.3				14			
GWA11	25-Aug-2016								3.44	1880						7.7				15			
GWC11	25-Aug-2016								14.15	3540						6.4				17.5			
GWA12	25-Aug-2016																						
GWC12	25-Aug-2016								31.2	1180						7.3				18.5			
GWA14	25-Aug-2016																						
GWC14	25-Aug-2016								28.72	1100						7.3				18			
GWA15	25-Aug-2016								3.55	2830						7.5				15			
GWC15	25-Aug-2016								23.74	3240						6.6				17			
GWC25	05-Aug-2016								25.65	1560						6.9				18.5			
GWC19	05-Aug-2016								24.16	1370						6.6				18.5			
GWC35	05-Aug-2016								39.38	610						6.9				20.5			
GWC33	09-Aug-2016								36.5	7010						12.6				20			
GWC26	09-Aug-2016								39.17	1360						7.3				19			
GWC18	09-Aug-2016								62.915	2520						7.1				19.5			
GWC17	09-Aug-2016								43.06	1820						7.0				21			
GWC16	09-Aug-2016								26.37	2330						7.2				19			
GWC28	02-Aug-2016								37.69	3420						6.6				20			
GWC29	02-Aug-2016								38.18	2470						6.9				19.5			
GWC30	02-Aug-2016								25.83	2420						6.6				18.5			
GWC31	01-Aug-2016								45.13	3600						6.6				21			
GWC24	01-Aug-2016								22.68	3410						5.6				19.5			
GWC27	05-Aug-2016								16.19	1950						5.9				18			
GWC32	16-Aug-2016								3.64	3360						6.8				18			
GWA32	16-Aug-2016								1.795	4160						7.2				14			
GWA34	01-Aug-2016								4.47	5400						5.1				18.5			
GWC34	01-Aug-2016								18.595	4780						7.0				18.5			
GWA1	02-Sep-2016																						
GWA2	07-Sep-2016								1.725	1910						6.7				15			
GWA3	07-Sep-2016								4.045	700						7.3				17.5			
GWA4	29-Sep-2016																						
GWA5	20-Sep-2016								2.54	8920						7.3				15			
GWA6	07-Sep-2016								1.035	6640						7.8				14			
GWA7	29-Sep-2016																						
GWA8	08-Sep-2016								1.1	2400						7.2				14.5			
GWC1	07-Sep-2016								8.81	2090						7.1				17			
GWC2	07-Sep-2016								13.67	1240						7.1				19.5			
GWC3	07-Sep-2016								10.295	3810						6.8				19			
GWC4	29-Sep-2016																						
GWC5	02-Sep-2016								6.16	5560						6.4				17.5			
GWA10	06-Sep-2016								3.03	2660						7.3				16.5			
GWC10	06-Sep-2016								1.57	3790						7.2				15			
GWA11	06-Sep-2016								3.16	1700						7.8				15.5			

Sample Location	Sampling Date	Aluminium mg/L	Arsenic mg/L	Barium mg/L	Bicarbonate Alkalinity as CaCO3 mg/L	Carbonate Alkalinity as CaCO3 mg/L	Chloride mg/L	Copper mg/L	Depth to Standpipe m	Electrical Conductivity Field Reading) µS/cm	Hydroxide Alkalinity as CaCO3 mg/L	Iron mg/L	Lead mg/L	Magnesium mg/L	Nickel mg/L	pH - Field pH Unit	Selenium mg/L	Strontium mg/L	Sulfate mg/L	Temperature °C	Total Alkalinity as CaCO3 mg/L	Total Dissolved Solids @180°C – Dissolved mg/L	Zinc mg/L
GWC11	06-Sep-2016								13.945	3470						6.4				18.5			
GWA12	29-Sep-2016																						
GWC12	29-Sep-2016																						
GWA14	29-Sep-2016																						
GWC14	29-Sep-2016																						
GWA15	29-Sep-2016																						
GWC15	29-Sep-2016																						
GWC25	13-Sep-2016								25.69	1630						7.0				20			
GWC19	13-Sep-2016								24.3	1310						6.5				19.5			
GWC35	13-Sep-2016								39.5	610						6.9				21			
GWC33	05-Sep-2016								36.55	6930						12.5				21			
GWC26	13-Sep-2016								38.31	1280						7.1				19.5			
GWC18	05-Sep-2016								63.26	2470						7.1				19.5			
GWC17	07-Sep-2016								41.595	1870						7.0				22			
GWC16	07-Sep-2016								24.64	2230						7.2				20			
GWC28	22-Sep-2016								38.795	3220						6.8				19.5			
GWC29	22-Sep-2016								39.16	2200						6.9				19			
GWC30	22-Sep-2016								25.06	2500						6.6				19			
GWC31	08-Sep-2016								45.27	3430						6.5				22			
GWC24	02-Sep-2016								22.4	3480						5.6				19.5			
GWC27	06-Sep-2016								14.9	1960						5.5				18			
GWC32	22-Sep-2016								3.45	3380						7.0				16.5			
GWA32	22-Sep-2016								1.56	3930						7.2				14.5			
GWA34	08-Sep-2016								2.795	210						6.5				16.5			
GWC34	08-Sep-2016								18.86	4900						6.9				19			
GWA1	13-Oct-2016																						
GWA2	18-Oct-2016	0.04	<0.001	0.087	80	<1	468	0.001	1.37	1860	<1	0.3	<0.001	62	<0.001	6.7	<0.01	0.507	159	16	80	1100	0.006
GWA3	18-Oct-2016	13	0.003	0.08	81	<1	79	0.014	3.62	500	<1	10.9	0.008	12	0.02	7.3	<0.01	0.143	24	16.5	81	407	0.028
GWA4	18-Oct-2016	23.6	0.019	1.48	534	<1	359	0.034	4.18	3040	<1	44.7	0.035	148	0.037	7.2	<0.01	1.85	666	16	534	1960	0.121
GWA5	05-Oct-2016	4.55	0.027	0.948	418	<1	2140	0.013	3.27	12100	<1	7.59	0.006	710	0.04	7.4	<0.01	6.35	3570	15	418	10600	0.11
GWA6	18-Oct-2016	3.52	0.003	0.166	710	<1	2680	0.009	1.13	12700	<1	3.72	0.003	618	0.008	7.6	0.03	4.57	3560	15.5	710	10100	0.017
GWA7	18-Oct-2016	1.24	<0.001	0.156	152	<1	326	0.002	3.245	1840	<1	1.19	<0.001	49	0.003	7.8	<0.01	0.671	288	16.5	152	1160	0.006
GWA8	05-Oct-2016	0.19	<0.001	0.049	194	<1	322	0.003	1.1	2250	<1	0.4	0.001	104	0.02	7.0	<0.01	1.41	423	14	194	1590	0.006
GWC1	18-Oct-2016	0.03	<0.001	0.078	264	<1	446	0.002	9.315	2060	<1	1.51	<0.001	60	<0.001	7.2	<0.01	0.68	156	17	264	1180	0.006
GWC2	18-Oct-2016	0.1	<0.001	0.406	547	<1	106	0.003	12.455	1250	<1	0.59	<0.001	29	0.002	7.1	<0.01	0.627	16	18.5	547	630	0.024
GWC3	18-Oct-2016	2.62	0.024	0.098	520	<1	705	0.013	9.265	4250	<1	103	0.012	128	0.01	7.0	<0.01	1.49	732	18	520	2380	0.034
GWC4	05-Oct-2016	0.14	0.001	0.082	561	<1	229	0.011	14.495	1980	<1	1.92	0.016	55	0.004	6.7	<0.01	1.56	171	19.5	561	1160	0.03
GWC5	05-Oct-2016	0.03	<0.001	0.252	2560	<1	478	0.004	5.91	5600	<1	0.64	0.008	149	0.026	6.8	<0.01	8.82	249	17.5	2560	3630	0.04
GWA10	14-Oct-2016	0.48	0.008	0.053	427	<1	678	0.012	3.11	3220	<1	4.7	<0.001	108	0.007	7.0	<0.01	1.12	261	15	427	1650	0.008
GWC10	14-Oct-2016	0.04	<0.001	0.065	416	<1	376	0.196	2.26	3700	<1	0.45	0.001	120	0.006	6.9	<0.01	2.13	874	16	416	2640	0.019
GWA11	14-Oct-2016	3.94	<0.001	0.05	574	<1	114	0.037	3.245	1700	<1	3.33	0.004	17	0.007	7.8	<0.01	0.489	147	15.5	574	837	0.01
GWC11	14-Oct-2016	0.07	<0.001	0.042	312	<1	316	0.005	13.515	3500	<1	9.72	<0.001	135	0.013	6.5	<0.01	1.36	997	18.5	312	1990	0.092
GWA12	14-Oct-2016	2.28	<0.001	0.073	460	<1	116	0.028	3.28	1250	<1	1.65	0.003	16	0.005	7.6	0.03	0.346	42	15.5	460	620	0.012

Sample Location	Sampling Date	Aluminium mg/L	Arsenic mg/L	Barium mg/L	Bicarbonate Alkalinity as CaCO3 mg/L	Carbonate Alkalinity as CaCO3 mg/L	Chloride mg/L	Copper mg/L	Depth to Standpipe m	Electrical Conductivity Field Reading) µS/cm	Hydroxide Alkalinity as CaCO3 mg/L	Iron mg/L	Lead mg/L	Magnesium mg/L	Nickel mg/L	pH - Field pH Unit	Selenium mg/L	Strontium mg/L	Sulfate mg/L	Temperature °C	Total Alkalinity as CaCO3 mg/L	Total Dissolved Solids @180°C – Dissolved mg/L	Zinc mg/L
GWC12	14-Oct-2016	0.06	<0.001	0.421	739	<1	140	0.026	26.615	1920	<1	1.9	0.002	17	0.007	7.1	<0.01	0.605	103	18	739	1040	0.014
GWA14	14-Oct-2016	33.9	0.002	0.153	374	<1	18	0.083	1.530	790	<1	12.6	0.009	5	0.061	7.8	<0.01	0.216	64	16	374	984	0.06
GWC14	14-Oct-2016	0.16	<0.001	26.3	487	<1	75	0.013	25.4	1080	<1	1.3	0.017	14	0.003	7.3	<0.01	2.18	2	19	487	572	0.027
GWA15	14-Oct-2016	23.3	0.002	1.49	96	<1	21	0.24	2.48	290	<1	12.7	0.018	1	0.029	7.6	<0.01	0.164	27	16	96	725	0.055
GWC15	14-Oct-2016	0.16	<0.001	0.621	1030	<1	257	0.014	21.98	3210	<1	1.33	0.002	44	<0.001	6.7	<0.01	1.55	327	18	1030	1990	0.014
GWC25	13-Oct-2016	0.79	0.003	0.116	199	<1	77	0.037	24.59	1300	<1	2.99	0.015	44	0.08	7.3	<0.01	1.61	292	19.5	199	709	0.038
GWC19	13-Oct-2016	0.09	0.002	0.196	239	<1	267	0.004	24.04	1330	<1	1.97	<0.001	51	0.002	6.5	<0.01	0.368	46	18.5	239	738	0.015
GWC35	13-Oct-2016	0.27	0.001	0.241	244	<1	42	0.017	39.79	610	<1	2.26	0.002	20	0.005	6.9	<0.01	0.354	17	21	244	340	0.009
GWC33	13-Oct-2016	0.85	<0.001	0.478	<1	40	93	0.002	36.49	6690	1500	0.15	<0.001	<1	0.001	12.5	<0.01	0.517	<1	20	1540	1660	0.009
GWC26	13-Oct-2016	0.02	<0.001	0.19	422	<1	153	0.008	37.15	1270	<1	1.19	<0.001	22	0.003	7.2	<0.01	0.526	30	19.5	422	648	<0.005
GWC18	18-Oct-2016	0.06	0.002	0.075	515	<1	201	0.002	62.365	2340	<1	8.64	<0.001	71	0.064	7.1	<0.01	1.61	490	21.5	515	1550	0.01
GWC17	18-Oct-2016	0.43	<0.001	0.116	528	<1	222	0.002	38.49	2040	<1	5.4	0.002	58	<0.001	7.0	<0.01	1.18	283	21.5	528	1320	0.006
GWC16	18-Oct-2016	0.02	<0.001	0.139	620	<1	370	0.001	21.89	2240	<1	0.7	<0.001	41	<0.001	7.2	<0.01	0.858	72	19	620	1310	0.007
GWC28	11-Oct-2016	0.1	<0.001	0.115	821	<1	448	0.117	38.445	3150	<1	1.79	<0.001	75	0.096	6.8	<0.01	2.32	322	19.5	821	2020	0.059
GWC29	11-Oct-2016	0.08	<0.001	0.09	742	<1	277	0.018	39.1	2380	<1	1.72	<0.001	92	0.002	6.8	<0.01	1.27	259	20.5	742	1530	0.01
GWC30	11-Oct-2016	0.14	<0.001	0.106	498	<1	405	0.195	25.09	2540	<1	2.37	0.001	106	0.005	6.7	<0.01	2.26	355	19.5	498	1830	0.053
GWC31	13-Oct-2016	0.32	0.006	0.063	388	<1	499	0.006	45.24	3380	<1	1.41	<0.001	126	0.043	6.6	<0.01	2.95	657	22	388	2370	0.031
GWC24	05-Oct-2016	0.43	<0.001	0.074	4	<1	442	0.068	22.715	3460	<1	42.5	0.004	161	0.249	5.6	<0.01	0.996	957	20	4	2580	0.502
GWC27	05-Oct-2016	1.34	0.02	0.366	27	<1	357	0.025	13.135	1890	<1	53.4	0.012	38	0.079	5.5	<0.01	0.237	276	17.5	27	1240	0.532
GWC32	11-Oct-2016	0.08	<0.001	0.213	1430	<1	300	0.089	3.38	3390	<1	0.58	0.001	98	0.004	6.8	<0.01	4.42	281	17.5	1430	2250	0.028
GWA32	11-Oct-2016	0.02	<0.001	0.054	545	<1	670	0.008	1.745	3990	<1	0.08	<0.001	195	0.004	7.2	<0.01	2.52	693	15	545	2790	0.008
GWA34	05-Oct-2016	1.2	<0.001	0.038	57	<1	8	0.01	2.92	190	<1	1.67	0.002	10	0.009	6.4	<0.01	0.101	23	16	57	153	0.015
GWC34	05-Oct-2016	40.8	0.064	0.67	2290	<1	238	0.48	19.44	4910	<1	109	0.188	84	0.628	6.9	0.03	8.13	378	18	2290	3520	0.535
GWA1	04-Nov-2016																						
GWA2	04-Nov-2016								1.43	1750						6.7				17			
GWA3	25-Nov-2016								3.805	800						7.0				17.5			
GWA4	24-Nov-2016																						
GWA5	01-Nov-2016								3.41	11900						7.4				16			
GWA6	25-Nov-2016								1.38	13600						7.5				17.5			
GWA7	25-Nov-2016								3.73	10500						7.2				18			
GWA8	01-Nov-2016								1.24	2250						7.0				15			
GWC1	04-Nov-2016								9.38	2050						7.2				17.5			
GWC2	25-Nov-2016								12.225	1260						7.0				19			
GWC3	25-Nov-2016								8.93	4080						7.0				18.5			
GWC4	28-Nov-2016								14.48	2430						6.6				21			
GWC5	01-Nov-2016								5.92	5480						6.6				17.5			
GWA10	24-Nov-2016								3.215	3430						6.9				16			
GWC10	24-Nov-2016								1.97	3730						6.5				17			
GWA11	24-Nov-2016								3.38	2060						7.6				16.5			
GWC11	24-Nov-2016								14.06	3610						6.4				18.5			
GWA12	24-Nov-2016								3.33	950						7.6				18.5			
GWC12	24-Nov-2016								26.52	3060						7.1				19			
GWA14	24-Nov-2016																						

Sample Location	Sampling Date	Aluminium mg/L	Arsenic mg/L	Barium mg/L	Bicarbonate Alkalinity as CaCO3 mg/L	Carbonate Alkalinity as CaCO3 mg/L	Chloride mg/L	Copper mg/L	Depth to Standpipe m	Electrical Conductivity Field Reading) µS/cm	Hydroxide Alkalinity as CaCO3 mg/L	Iron mg/L	Lead mg/L	Magnesium mg/L	Nickel mg/L	pH - Field pH Unit	Selenium mg/L	Strontium mg/L	Sulfate mg/L	Temperature °C	Total Alkalinity as CaCO3 mg/L	Total Dissolved Solids @180°C – Dissolved mg/L	Zinc mg/L
GWC14	24-Nov-2016								22.97	1170						7.2				19			
GWA15	24-Nov-2016																						
GWC15	24-Nov-2016								19.37	3320						6.6				18.5			
GWC25	10-Nov-2016								25.14	1620						6.6				20			
GWC19	10-Nov-2016								23.89	1360						6.5				19.5			
GWC35	10-Nov-2016								40	620						6.9				21.5			
GWC33	04-Nov-2016								36.375	6530						12.5				20.5			
GWC26	04-Nov-2016								36.29	1250						7.2				19.5			
GWC18	04-Nov-2016								61.5	2210						7.0				22			
GWC17	04-Nov-2016								37.83	1970						7.0				22			
GWC16	04-Nov-2016								21.435	2280						7.2				19.5			
GWC28	15-Nov-2016								36.8	3340						6.7				20.5			
GWC29	15-Nov-2016								37.84	2430						6.9				21			
GWC30	15-Nov-2016								25.88	2560						6.6				20			
GWC31	01-Nov-2016								45.205	3280						6.6				21.5			
GWC24	01-Nov-2016								22.715	3460						5.1				20.5			
GWC27	01-Nov-2016								13.6	1810						5.5				18			
GWC32	15-Nov-2016								3.43	3450						6.8				18			
GWA32	15-Nov-2016								1.8	4230						7.2				18			
GWA34	01-Nov-2016								3.89	2020						6.1				17			
GWC34	01-Nov-2016								19.895	4790						6.9				20			
GWA1	05-Dec-2016																						
GWA2	23-Dec-2016								2.18	1560						6.6				19.5			
GWA3	23-Dec-2016								3.925	1270						7.2				19			
GWA4	23-Dec-2016								4.02	3750						7.1				20.5			
GWA5	15-Dec-2016								3.96	11200						7.6				17.5			
GWA6	23-Dec-2016								1.84							7.6				20.5			
GWA7	22-Dec-2016								3.99	10800						7.0				19.0			
GWA8	22-Dec-2016								1.535	2330						7.0				18.5			
GWC1	23-Dec-2016								9.61	2080						7.1				17.5			
GWC2	23-Dec-2016								12.65	1260						7.0				20.0			
GWC3	23-Dec-2016								9.065	4140						6.8				19.5			
GWC4	14-Dec-2016								14.55	2470						6.7				22.5			
GWC5	22-Dec-2016								6.065	5550						6.6				18.5			
GWA10	23-Dec-2016								3.535	3320						6.9				18.5			
GWC10	23-Dec-2016								2.365	3580						6.5				20.5			
GWA11	23-Dec-2016								3.54	2220						7.6				19.0			
GWC11	23-Dec-2016								14.32	3480						6.5				19.5			
GWA12	23-Dec-2016								3.55	890						7.7				19.0			
GWC12	23-Dec-2016								28.9	1240						7.1				20.5			
GWA14	23-Dec-2016																						
GWC14	23-Dec-2016								24.515	1090						7.2				20.5			
GWA15	23-Dec-2016																						

Sample Location	Sampling Date	Aluminium mg/L	Arsenic mg/L	Barium mg/L	Bicarbonate Alkalinity as CaCO3 mg/L	Carbonate Alkalinity as CaCO3 mg/L	Chloride mg/L	Copper mg/L	Depth to Standpipe m	Electrical Conductivity Field Reading) µS/cm	Hydroxide Alkalinity as CaCO3 mg/L	Iron mg/L	Lead mg/L	Magnesium mg/L	Nickel mg/L	pH - Field pH Unit	Selenium mg/L	Strontium mg/L	Sulfate mg/L	Temperature °C	Total Alkalinity as CaCO3 mg/L	Total Dissolved Solids @180°C – Dissolved mg/L	Zinc mg/L
GWC15	23-Dec-2016								20.095	3180						6.6				19.5			
GWC25	06-Dec-2016								25.35	1640						6.7				20.5			
GWC19	06-Dec-2016								23.67	1370						6.6				22.0			
GWC35	06-Dec-2016								40.15	640						7.0				22.5			
GWC33	05-Dec-2016								36.25	6570						12.3				24.5			
GWC26	05-Dec-2016								35.37	1280						7.2				23.5			
GWC18	05-Dec-2016								61.61	2220						7.1				25.0			
GWC17	05-Dec-2016								36.95	1980						7.1				24.5			
GWC16	14-Dec-2016								20.49	2390						7.2				21.5			
GWC28	22-Dec-2016								36.065	3380						6.8				20.0			
GWC29	22-Dec-2016								36.91	2460						6.9				20.5			
GWC30	22-Dec-2016								27.05	2450						6.6				20.5			
GWC31	14-Dec-2016								45.29	3530						6.6				24.5			
GWC24	14-Dec-2016								22.57	3630						5.9				23.0			
GWC27	02-Dec-2016								13.75	1790						5.3				20.5			
GWC32	22-Dec-2016								3.56	3420						6.7				19.5			
GWA32	22-Dec-2016								2.77	4670						7.1				19.0			
GWA34	22-Dec-2016								4.23	4350						5.2				18.5			
GWC34	22-Dec-2016								20.075	4810						7.0				20.5			

Groundwater Review & Water Licence Review Report

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DATE:	31 March 2017
TO:	Ian Flood Manager Project Development and Approvals
	Wilpinjong Coal Pty Ltd Peabody Energy Australia Locked Bag 2005, Mudgee NSW 2850
FROM:	Dr Noel Merrick and Adam Skorulis
RE:	Wilpinjong Annual Review Groundwater Analysis
OUR REF:	WIL012 – Report HS2017/12

INTRODUCTION

This letter report contains the analysis and information required to address licence conditions for pit extraction and dewatering bores for the 'water year' July 2015- June 2016. It also contributes to the Annual Review for the Wilpinjong Coal Mine (WCM) for the 2016 calendar year. The report is presented in three sections that address the following requests

1. Reporting against the commitments in the Groundwater Monitoring Program – January 2016 to December 2016.
2. Reporting against the licence conditions 2, 3, 4 and 6 for pit extraction – July 2015 to June 2016.
3. Reporting against the licence conditions 7, 9 and 10 for dewatering bores – July 2015 to June 2016.

While the commitments in the Groundwater Monitoring Program (GWMP) occupy a later period in time to the licence conditions, the data presented in reporting on the GWMP commitments will also be used in addressing licence conditions for both pit extraction and dewatering bores.

Pit names and pit progression during 2015-2016 are indicated in **Figure 1**. Groundwater monitoring bore locations are marked on **Figure 2**.

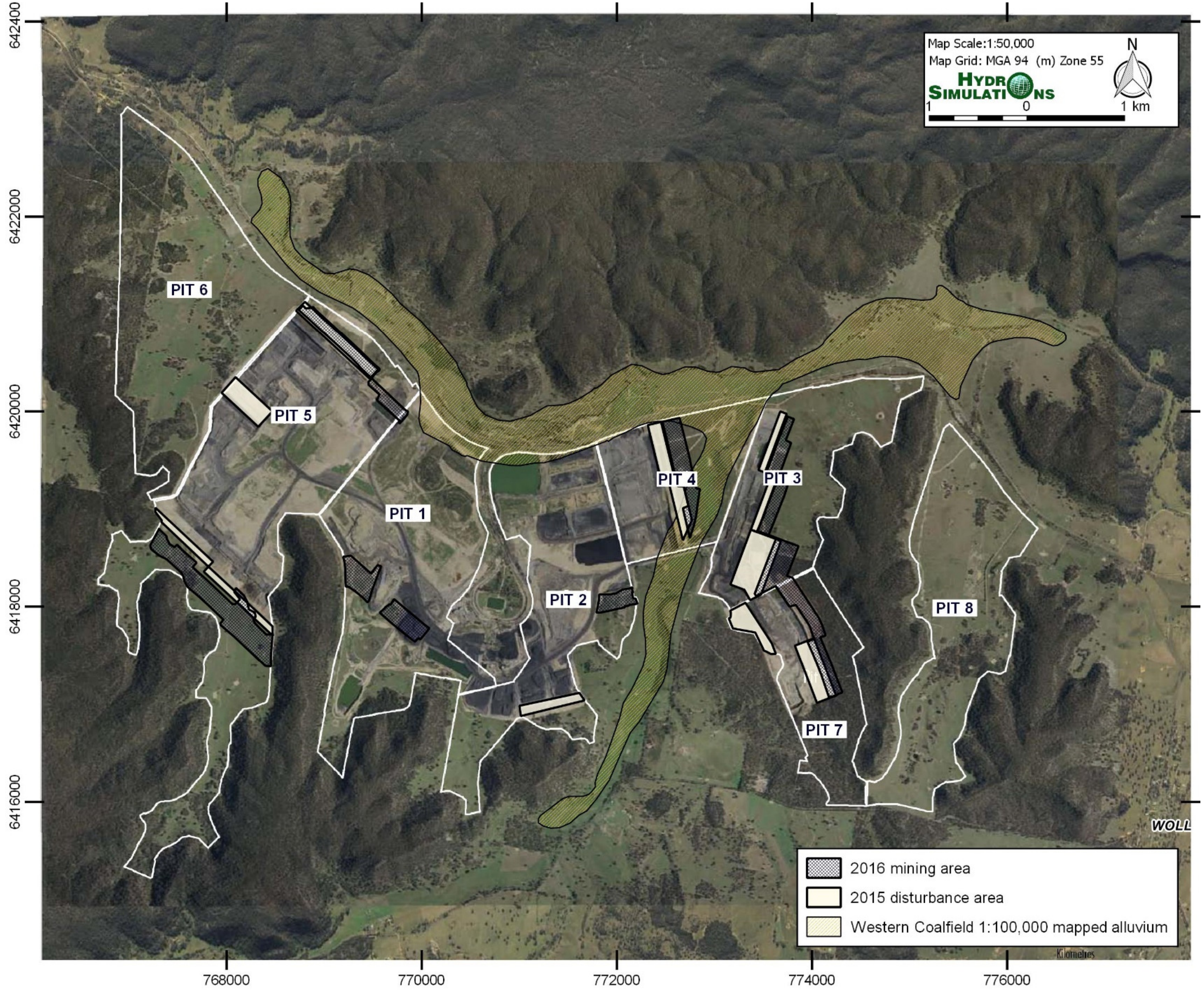

Figure 1 Wilpinjong Coal Mine open cut pit progression 2015-16

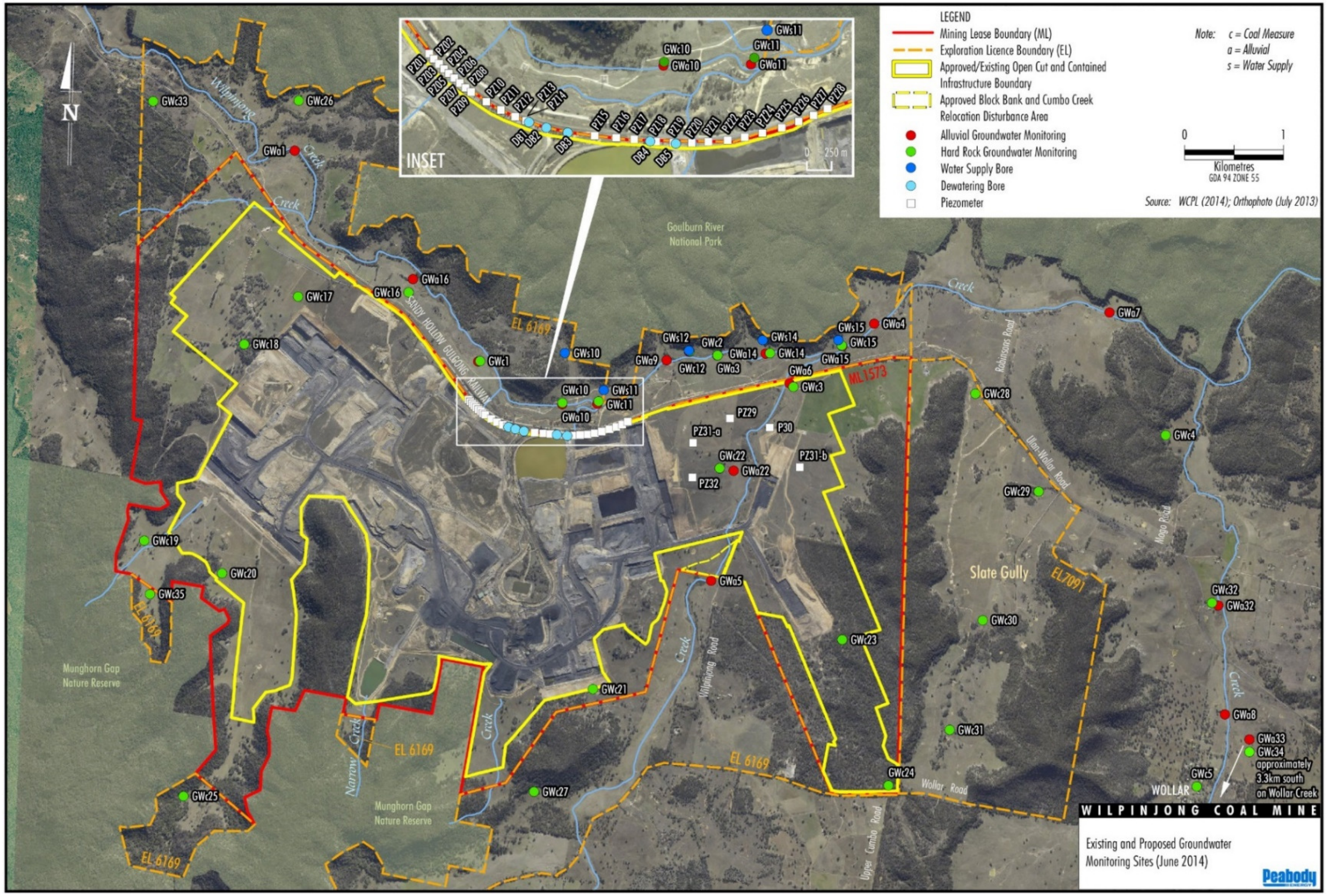

Figure 2 Groundwater Monitoring Sites at Wilpinjong Coal Mine

1 GROUNDWATER MONITORING PROGRAM

This section presents key groundwater level and groundwater quality data for the 2016 reporting period to address the conditions within the Wilpinjong Groundwater Monitoring Program (Peabody, 2016) relating to:

- Cause and effect analysis (Section 6.5.3).
- Triggers (Section 4.3)
- Modelling verification (Section 7.2)

Trends from the entire period of observation have also been assessed to provide context for the 2016 monitoring period.

1.1 Cause and effect analysis

A groundwater monitoring network has been in place at the WCM since April 2006, as illustrated in **Figure 2**. Many paired monitoring bores have been drilled along the Wilpinjong Creek alluvium, with a shallow bore screened in the alluvium and a deeper bore screened across the coal seam. More recently, since late 2013, several new bores have been drilled around the periphery of the site, in Slate Gully and along Wollar Creek (**Figure 2**).

1.1.1 Review of Groundwater level data

For bores with sufficient record, groundwater levels around the WCM site have been investigated in detail to check for cause-and-effect responses in temporal water level changes which could result from rainfall recharge, creek dynamics, short-term dewatering/production pumping or a mining effect. The detailed analysis and presentation of hydrographs are included in **Appendix A**.

Summary bore hydrographs are shown in **Figure 3** (alluvial) and **Figure 4** (coal seam).

Figure 3 presents the groundwater hydrographs for all alluvial bores from the west (higher elevations) to the east (lower elevations), in relation to the long-term rainfall trend, along Wilpinjong Creek. There was a pronounced dry period from July 2006 to March 2007 which coincided with the commencement of Pit 1. Pit 2 commenced under normal climatic conditions but within two months was exposed to a very wet period. Both pits were exposed to another very wet period that commenced in October 2007. The transition from a very dry period to a very wet period explains the initial experience of unexpectedly low pit inflows followed by excessive groundwater discharges. Additional wet periods are indicated by the rainfall trend, especially from 2010 onwards. Since the commencement of Pit 4, conditions have been drier than normal. This means that groundwater levels have been naturally lower since then, which complicates the detection of possible mining effects due to Pit 4 and/or Pit 3. Where mining effects are considered a possibility, the individual hydrographs in **Attachment A** are annotated to that effect.

The groundwater table in the alluvium varies from about 385 mAHD to about 345 mAHD over a distance of 8.4 km from GWa1 to GWa7, with hydraulic gradient 0.5% (0.005). Groundwater responds to this gradient by flowing to the east through the alluvium.

Water table rises are evident at most bores in correlation with rises in the rainfall trend. This confirms the expectation that rainfall is an important source of recharge for the alluvial aquifer. Given the proximity of the alluvium to the elevated Goulburn River National Park to the north, groundwater discharge from the Park's Narrabeen sediments will provide another stable source of recharge to the alluvium.

Based on the analysis of the hydrographs in **Appendix A**, some mining effects are considered to have occurred at the following bores located in the Wilpinjong alluvium and Cumbo Creek alluvium (**Figure 3**) (albeit these effects are minor and therefore are difficult to discern from climatic variations):

- GWa1 at 1.2 km north of pit 5, in the order of 1 m from 2014 to 2016;
- GWa3 at 450 m north of Pit 4, in the order of 1 m during 2014;

- GWa14 at 300 m north of Pit 4, approximately 1 m during 2013 and 2014 (this bore has gone dry, probably due to a combination of climate and mining drivers, and so the estimate of drawdown is uncertain);
- GWa5 at Cumbo Creek between Pit 2, and Pit3, 500 m south of Pit4, in the order of 3 m from 2013 to 2016. It is noted that Wilpinjong Coal Pty Ltd (WCPL) is approved to relocate and excavate the lower reaches of Cumbo Creek
- GWa4 at 450 m north of Pit 3, in the order of 1 m from 2014 to 2016;
- GWa15 at 250 m north of Pit 3, less than 1 m but mining effect obscuring the rainfall response from 2012 to 2016;
- GWa6 at the northern junction of Pits 3 and 4, approximately 1 m during 2014 (this bore has gone dry at times, probably due to a combination of climate and mining drivers, and so the estimate of drawdown is uncertain).

The other bore hydrographs from the Wilpinjong Creek alluvium (e.g., GWa2, GWa11, GWa12) show no discernible mining effects.

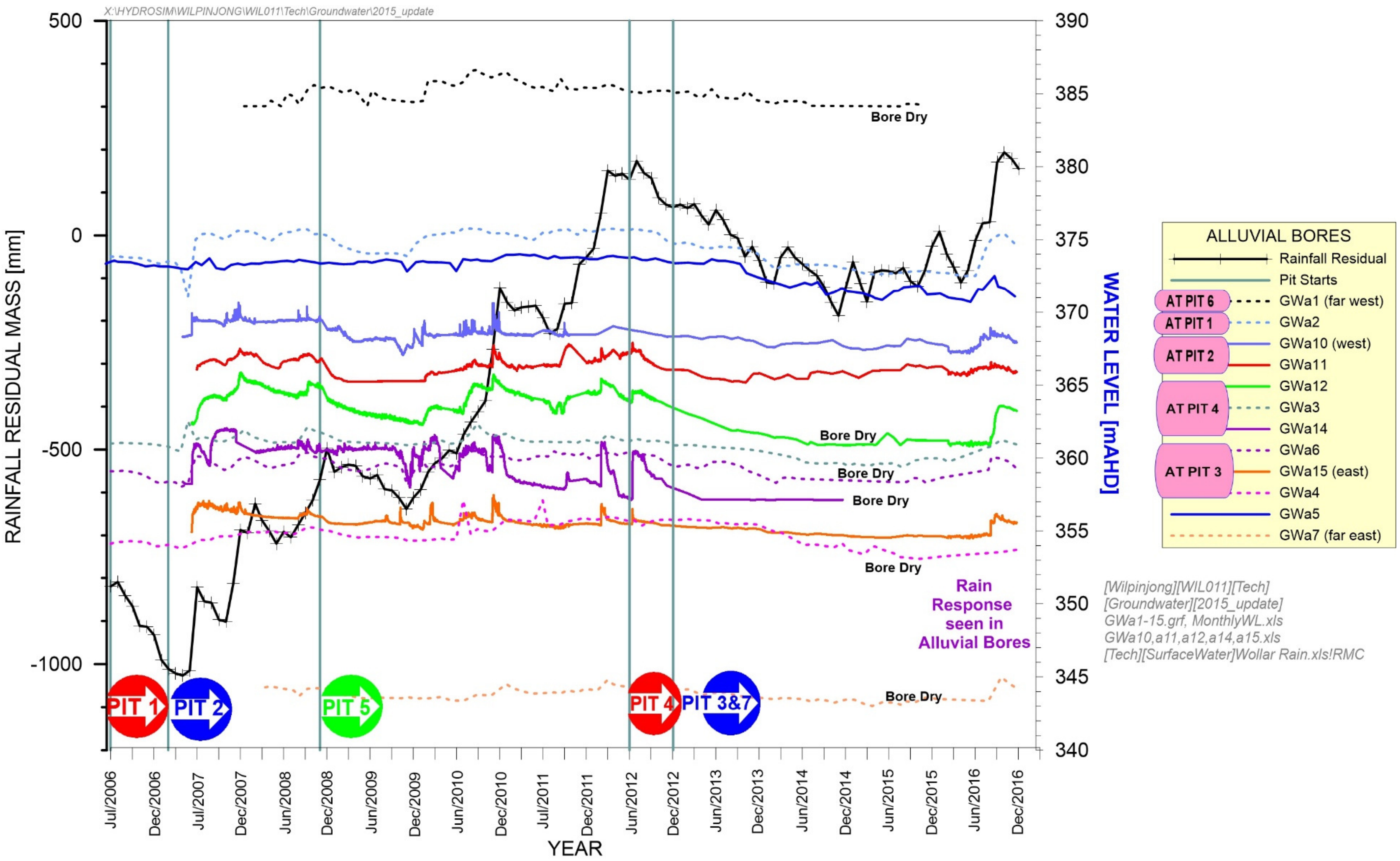

Figure 3 **Transition in Alluvial Bore Groundwater Levels from West to East along Wilpinjong Creek**

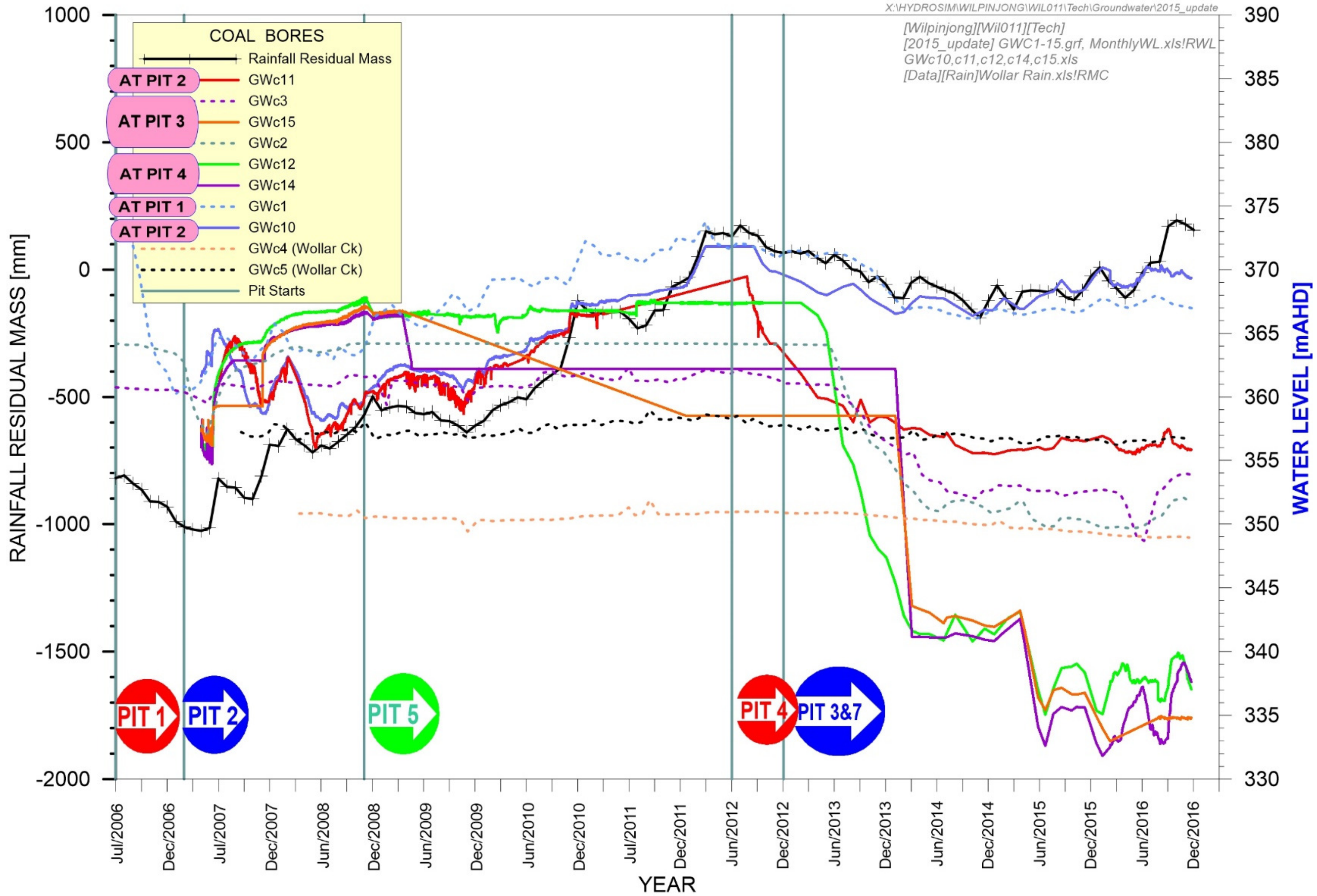

Figure 4 Transition in Coal Bore Groundwater Levels from West to East along Wilpinjong Creek

Figure 4 presents the groundwater hydrographs for all coal bores from the west (higher elevations) to the east (lower elevations), in relation to rainfall residual mass and the commencement of mining in each pit. Three bores (GWc1, GWc2 and GWc3) have records extending back to 2006. These hydrographs show clearly the drawdown caused by excavation of Pit 1 and Pit 2. At the bore closest to mining in Pit 1 (GWc1), the drawdown was about 13 m. At the bores closest to Pit 2 mining (GWc2, GWc3), the early drawdowns were about 7 m and 1 m respectively. The water level at GWc1 commenced recovering in mid-2007 and had returned to pre-mining levels by 2012.

Some bores, e.g. GWc14 and GWc15, show response to the short period of historical pumping at production bores at WCM. This is exemplified by the short and sharp drawdown and subsequent recovery seen in early to mid-2007.

At the other coal bores, the pre-mining water levels are not known exactly. The hydrographs show the expected response of drawdown contingent upon the distance from mining, with gradual recovery over about five years in line with the long term rainfall trend. The most distant site (GWc5 at Wollar) shows no discernible drawdown effect from mining.

Three of the monitored coal sites are considered to have been unreliable (GWc14, GWc15 and GWc12) in early years at high pressures. It is noted that they display artesian conditions. However, readings in 2014 to 2016 appear plausible in response to depressurisation caused by Pits 3, 4 and 7.

In **Appendix A**, definite mining effects on monitored coal groundwater levels are noted at the following bores:

- GWc1 - primarily due to Pits 1 and 5 (**Figure A-3**) - drawdown about 3-4 m;
- GWc11 – primarily due to Pits 2 and Pit 4 (**Figure A-5**) - drawdown about 11 m;
- GWc12 - primarily due to Pit 4 (**Figure A-6**) - drawdown more than 20 m;
- GWc2 - primarily due to Pit 4 (**Figure A-7**) - drawdown about 14 m;
- GWc14 - primarily due to Pits 4 and 3 (**Figure A-8**) - drawdown more than 20 m;
- GWc3 - primarily due to Pits 3 and 4 (**Figure A-9**) - drawdown about 8 m; and
- GWc15 - primarily due to Pits 3 and 4 (**Figure A-10**) - drawdown more than 20 m.

For bores not displayed in **Figure 3** or **Figure 4**:

- There is a probable mining effect on the coal bore GWc22 adjacent to Cumbo Creek but no effect on the companion alluvial bore GWa22 (**Figure A-14**).
- There are definite mining effects at coal bores GWc28 and GWc29 in Slate Gully (**Figure A-15**).
- There are no obvious mining effects at any other bores.

The general trend is for mining-related drawdown to be apparent in coal seam hydrographs, typically within a few hundred metres of active mine areas, but drawdown is much less, if apparent at all, in alluvial bore hydrographs. This is due to the following properties:

- alluvial bodies not being directly connected to mined areas;
- rock strata overlying the coal seams and underlying the alluvium serving to mitigate the drawdown response because of low vertical hydraulic conductivity; and
- unconfined conditions and a greater aquifer storage in the alluvium than in the confined coal seams resulting in much lower head variation (drawdown) in the alluvium.

1.1.2 Review of Groundwater Quality Data

Groundwater electrical conductivity statistics have been computed from 1,323 measurements from April 2006 to June 2014 (**Table 1**). The median value of the measurements at the 13 monitoring sites is about 2,500 microSiemens per centimetre (µS/cm). The average of about 4,000 µS/cm is considerably higher than the median, and the standard deviation (3,300 µS/cm) is commensurate with the mean.

The lowest mean salinity in the alluvium holes is 1,500 µS/cm at GWa2, whereas the highest mean is 9,900 µS/cm at GWa5. The lowest mean salinity in the coal holes is 1,100 µS/cm at GWc2, whereas the highest mean is 4,900 µS/cm at GWc5. On the whole, the alluvial groundwaters are more saline than the coal seam waters. This suggests that the alluvial waters are sourced from Permian sediments and are concentrated through evapotranspiration which is expected to be an active process.

Table 1 Groundwater Electrical Conductivity Statistics (µS/cm)

	Mean	Standard Deviation		Mean	Standard Deviation	Location
ALLUVIUM:			**COAL:**			
GWa1	8000	3200				North of Pit 6: Far west
GWa2	1500	530	**GWc1**	2200	480	North of Pit 1
GWa3	1800	430	**GWc2**	1100	120	North of Pit 4
GWa4	2400	690				North-east of Pit 3
GWa5	10000	2700				South of Pit 4 on Cumbo Ck
GWa6	5500	2300	**GWc3**	3600	600	Northern end of Cumbo Ck
GWa7	9900	2000	**GWc4**	2400	500	North-east of Slate Gully
GWa8	2100	460	**GWc5**	5000	530	Wollar: SE of Slate Gully

The highest salinities occur on Cumbo Creek to the south of Pit 4, on Wilpinjong Creek near Pit 6 and on Wilpinjong Creek to the north-east of Slate Gully. The lowest salinities are along Wilpinjong Creek from Pit 1 to Pit 4, upstream of the Cumbo Creek junction, and on Wollar Creek.

Temporal variations in groundwater salinity are illustrated in **Appendix A** (**Figure A-20** for alluvium and **Figure A-21** for the coal seam) and are compared with rainfall residual mass and pit commencements. Alluvial sites have a large range in salinities, from very high with large fluctuations to near fresh and stable that bear some apparent relationship with rainfall and mining. This is examined further in **Section 2**. The salinities in the coal holes are consistently stable. The different signatures for shallow and deep waters reflect dynamic evapotranspiration acting preferentially on shallow groundwater.

2 TRIGGER COMPLIANCE

The following section addresses the compliance of groundwater level and groundwater quality observations during the 2016 reporting period in relation to statistical analysis performed on pre-mining, baseline monitoring data. **Table 2** presents the trigger levels from the Groundwater Monitoring Program (Peabody, 2016).

Time series charts showing groundwater level EC and pH in comparison with the trigger levels can be found in **Appendix B.**

Table 2 Peabody (2016) Groundwater Level and Quality Trigger Levels

Monitoring Site	Aquifer Type	Groundwater Level	Groundwater Quality		
		Trigger RWL (mAHD)	EC (µS/cm)	pH min	pH max
GWa1	Alluvium	383.9	12,272	6.5	8
GWa1	Alluvium	370.6	2,280		
GWa3	Alluvium	360.3	1,970		
GWa4	Alluvium	353.5	2,596		
GWa5	Alluvium	372.7	13,926		
GWa6	Alluvium	357.8	6,720		
GWa7	Alluvium	343.2	10,126		
GWa8	Alluvium	353.1	2,898		
GWc1	Coal	#N/A	2,844		
GWc2	Coal		1,290		
GWc3	Coal		3,304		
GWc4	Coal		2,412		
GWc5	Coal		4,798		

Not applicable

2.1 Trigger Level Exceedances

The ranges of natural fluctuations in groundwater level have been analysed at alluvial monitoring locations from April 2006 to June 2012, with trigger elevations developed based on a 10 percent change in groundwater level beyond natural fluctuation from these ranges. Three successive monthly exceedances (or two successive quarterly exceedances) of the lower threshold level will trigger an investigation (Peabody, 2016).

Water quality statistics for April 2006 to December 2009 have been analysed at alluvium and coal bores to develop trigger levels for EC and pH. An exceedance of a trigger level on three consecutive monthly (or two consecutive quarterly) observations results in the initiation of the groundwater impact investigation protocol found in the SGWRP (Surface and Groundwater Response Plan). A single trigger exceedance may also result in a preliminary investigation to identify anomalous data or whether further testing is required.

- EC trigger levels are based on 80th percentile values from the historical monitoring period.
- The 20th and 80th percentile values for pH taken at Wilpinjong monitoring locations between April 2006 and December 2009 are captured within the ANZEC and ARMCANZ (2000) default trigger values (6.5-8). As such, these are used for triggers at all coal and alluvial monitoring sites.

Table 3 presents the occurrence of trigger level exceedances for the 2016 monitoring period.

Table 3 Trigger Level exceedances in the 2016 monitoring year

Bore	Trigger Level Exceedance in 2016 Observations			
	Minimum RWL (mAHD)	EC	pH min	pH max
GWa1^		*No measurements in 2016*		
GWa2				
GWa3	Y	Y		
GWa4	Y	Y		
GWa5	Y			
GWa6		Y		
GWa7	Y	Y		
GWa8				
GWc1	#N/A	Y		
GWc2	#N/A			
GWc3	#N/A	Y		
GWc4	#N/A			
GWc5	#N/A	Y		

Blank cells represent no trigger exceedance, #Not applicable, Y= Yes (trigger exceedance recorded), ^ Bore was dry in 2016

2.1.1 Groundwater Level Trigger Exceedances

The following section examines trigger exceedances at Wilpinjong alluvial monitoring bores during the 2016 monitoring period (**Table 3**), to identify whether their cause can be attributed to a climatic or mining effect. If a mining effect is likely, further investigation may be required as per the Groundwater Monitoring Program (Peabody, 2016).

While groundwater level at GWa1 does not exceed the groundwater trigger level as defined in the GWMP, observations during the 2016 monitoring period identified the bore as 'dry' (**Figure B-1**). This indicates the groundwater trigger level is located below the base of the bore and is not useful in identifying a mining effect at GWa1. No significant rainfall response and a general decline in groundwater level has been observed at GWa1 since early 2011, with dry or near-dry observations occurring from mid-2014.

Groundwater level at GWa3 was recorded below the trigger value for the first half of the 2016 monitoring period (**Figure B-3**), with a 'dry' reading for four of these months (April-July) observed. This was followed by groundwater level recovering to above the trigger level for the last five observations of the year (August-December), correlating with an increase in the rainfall trend. Historically, groundwater levels are observed to be below the trigger level from early 2014, through to July 2016 that correlates well with a declining rainfall trend. However, from early 2011, there is a decrease in the magnitude of the groundwater level response to the rainfall trend, possibly indicating a mining effect. This is apparently ongoing, with the recovery observed in late 2016 approximately 1 m below the groundwater level peaks in response to rainfall pre-2011. It is likely the trigger level was exceeded at GWa3 due to the combination of a mild mining effect and a decrease in average rainfall.

GWa4 reports a dry bore for nine (9) months of the 2016 monitoring period with the January 2016 observation below the trigger level. Only October and December 2016 observations are above the trigger level (**Figure B-4**). This trigger exceedance likely indicates an ongoing mining effect following the start of Pit 3 extraction, with drawdown exacerbated by a period of below average rainfall. Currently, only a minor response to rainfall events is observed.

All GWa5 observations during the 2016 monitoring period exceed the groundwater trigger level (**Figure B-5**). This can be attributed to an ongoing mining effect that possibly began in late 2011. This is indicated by a lack of groundwater level response to an increasing rainfall trend. A definite effect is observed from early 2014 with a drawdown of ~3 m to July 2016. Groundwater level still shows a response to the rainfall trend following early 2014 although the average water level is approximately 2 m lower and shows far greater fluctuations.

As was seen for GWa1, the groundwater trigger level for GWa6 is at an elevation below that at which the bore is observed 'dry' (**Figure B-6**). As such, this trigger value is not a good measure for determining a mining effect at GWa6. Observations have reported GWa6 as dry following the beginning of nearby Pit 3 extraction. While this correlates with a period of below average rainfall, previous periods of below average rainfall as seen in early observations did not result in 'dry' observations at GWa6. It is likely a slight mining effect is observed at GWa6 that has been enhanced by low rainfall. Groundwater level responds to an increase in the rainfall trend in mid-2016, with the remaining observations all reporting a readable groundwater level.

GWa7 also reports an exceedance of groundwater level triggers at the beginning of the 2016 monitoring period with the bore reporting dry (**Figure B-7**). However, GWa7 is located over 3 km east of current mining at Wilpinjong, so it is not likely to be directly affected by mining. The decrease in water level correlates with the declining rainfall trend, and the full recovery following the mid-2016 increase in the rainfall trend further confirms this.

2.1.2 EC Trigger Exceedances

The following section provides analysis and assessment of the EC trigger exceedances recorded in **Table 3** based on the time series plots from **Appendix B**.

Trigger exceedances in EC at alluvial bores occur at GWa3, GWa4, GWa6 and GWa7 (**Figures B-3** to **B-7**), and all follow similar trends despite varying baseline EC levels. As detailed in the above section, these bores reported a declining groundwater level that either correlated with a declining rainfall trend and a mild mining effect (GWa3, GWa4, GWa6) or a declining rainfall trend only (GWa7), with the timing of the decline in groundwater level showing a good match with increases in groundwater EC. This reduction in water level may result in increased groundwater EC as the water table is now being sourced proportionally more from higher salinity Permian sources. Groundwater EC is observed to decline in all these bores with the increase in the rainfall trend in late 2016. They do not require further investigation.

The only possibly anomalous bore is GWa6, at the downstream end of Cumbo Creek, which reports its highest ever EC measurement in the last observation of 2016. However, the explanation for this is likely found in historical trends between groundwater level and EC. Recessions in groundwater level are commonly accompanied by peaks in EC, as observed in: July 2007, March 2008, December 2009, August 2012, July 2013, August 2016 (**Figure B-6**), The two most recent peaks occurred during and soon after a period of below average rainfall that is likely coupled with an ongoing mining effect. The concentration effect that would occur with increased evapotranspiration (especially in late 2016 following an extended period of the bore being dry) would enhance the EC peaks that are observed following other groundwater level recessions.

Trigger exceedances for coal bores are observed in GWc1, GWc3 and GWc5 (**Figures B-9, B-11, B-13**), with the exceedances at GWc1 and GWc5 unable to be linked to a Wilpinjong Coal Mine effect. GWc1 is observed to be at a consistent level approximately 500 µS/cm above the trigger level for the first half of the 2016 monitoring period. EC then drops to a consistent level approximately 750 µS/cm below the trigger level. Both periods occur apparently separate to any mining, groundwater level or climatic influence. GWc5 is located on Wollar Creek, upstream of the confluence of Wilpinjong Creek and 3.5 km from active mining in Pit 7. EC has increased gradually since early 2010, apparently separate to climatic or groundwater level influence and is now relatively stable at approximately 5,500 µS/cm.

GWc3 at the downstream end of Cumbo Creek reports the only exceedance that may be attributable to WCM mining. All EC observations during 2016 are above the trigger level and have been since the beginning of nearby Pit 3 extraction. The observed drawdown of about 8 m may have resulted in groundwater now being sourced from more saline material with EC observations approximately 4,000 µS/cm for 2016 observations, 700 µS/cm above the trigger.

2.1.3 pH Trigger Exceedances

No exceedances of pH trigger levels were observed during the 2016 monitoring period.

3 GROUNDWATER MODEL VERIFICATION AND REFINEMENT

Previous reporting (HydroSimulations, 2015a; Peabody, 2016) has utilised the HydroSimulations (2013) groundwater model to assess likely impacts of the WIlpinjong Coal Mine and ensure sufficient water licences are purchased prior to a water year. This model was converted from the original numerical groundwater model used by AGE (2005).

A more recent groundwater model has been constructed (HydroSimulations, 2015b) that has been used in this report. As is required by the Groundwater Monitoring Program (Peabody, 2016), the following section reports on the new model and presents the results of the model verification.

3.1 Updated groundwater model

The new model (HydroSimulations, 2015b) is a complete rebuild of the previous Wilpinjong groundwater models to now utilise MODFLOW-USG, which allows refinement of the model grid that is limited to areas of interest as well as model cells of various sizes. Further information on the model can be found in Section 5 of the HydroSimulations (2015b) report for the proposed Wilpinjong Extension Project, with some of the key features summarised below:

- The active model extent is centred on Wilpinjong Coal Mine and includes the full extent of the neighbouring Moolarben Coal Complex as part of the cumulative impact assessment. The Wilpinjong and Cumbo Creek catchments as well as most of the Upper Goulburn River catchment are also included within the active model extent.
- The stratigraphic section is represented by eight (8) layers.
- The model domain is discretised into 56,430 cells for each layer, using a Voronoi-based mesh. This has the advantage being both irregular but maintaining the property that a line connecting adjacent cell-centres is perpendicular to the shared cell boundary. The mesh was generated using the proprietary HydroAlgorithmics (2014) software 'AlgoMesh', which provides significant control over the mesh generation process.
- Model grid resolution in key areas of interest is as follows:
  - 70 m in most WCM open cut pit areas;
  - 80 and 100 m in Moolarben longwalls and 100 m in Moolarben open cut areas;
  - 20 m in the area between Pit 4 and Pit 3, which is the area of the mine lease through which Cumbo Creek flows;
  - 30 m regular hexagonal grid in alluvium near to WCM (Wilpinjong Creek, Wollar Creek and Cumbo Creek); and
  - 100 m regular hexagonal grid in alluvium in areas away from the WCM.
- Maximum cell dimension of about 1 km in areas away from the WCM
- Spatially and temporally variable groundwater recharge rates based upon outcropping geology.
- Temporal variation in rainfall recharge based on a daily timestep water balance that accounts for runoff, soil moisture deficit and recharge from inputs of rainfall and potential evaporation

3.2 Model Verification

Hydrographs of observed groundwater levels and HydroSimulations (2015b) modelled groundwater levels are found in **Appendix C**. The following section contains an assessment of the modelled groundwater levels where mining impacts might be observed.

3.2.1 Model Performance at Alluvium Monitoring Bores

At each alluvium monitoring site along Wilpinjong Creek, modelling predicts less than 2 m drawdown for the life of approved mining. However, substantial drawdowns in excess of 2 m are expected at most of the coal monitoring bores.

The alluvial bores examined in this section have been identified from the cause and effect analysis (**Section 2**) or the trigger level analysis (**Section 3**) as likely to show a Wilpinjong Coal Mine mining effect. The performance of the model at these sites can be seen in **Appendix C** (**Figures C-1** to **C-8**)

The timing of the mining effects observed at the alluvial bores shows good correlation with the observed effect and often indicates a repressed response to rainfall that is also seen in the observed data. The drawdown observed is often greater (e.g. GWa5, GWa12, GWa14) than is seen in the modelled data but this is likely due to the below average rainfall during this period contributing to the decline in groundwater level rather than the model underestimating the mining effect. A recovery of groundwater level is also observed to occur in the modelled data following a 5-year mining effect. The length of time a mining effect is observed at alluvial bores is often longer than is predicted by the model, but this is expected when coupled with the low rainfall effect. Most alluvial bores have again started responding to the rainfall trend as is observed in the modelled data.

3.2.1.1 Comments on possible discrepancies

Observed data at GWa1 shows no recovery from the drawdown beginning in 2011, while the modelled groundwater levels show recovery and begin to again respond to climatic influences in early 2015 (**Figure C-1**). It is possible that the cumulative effect of mining related drawdown coupled with below average rainfall has lengthened the period that GWa1 will be affected. It should also be noted that groundwater level has been below an observable elevation for much of the period since 2014, meaning that some response to climatic influence may not be observable.

The drawdown in the observed groundwater level at GWa5 is about 1.5 m greater than the model predicts for the same period from mid-2013 to the end of 2016 (**Figure C-4**). However, a lack of flow in Cumbo Creek associated with the below average rainfall may serve to explain this discrepancy. Both modelled and observed groundwater levels continue to show good correlation with spikes in the rainfall trend despite the difference in head.

Similar trends are seen at GWa14 between observed and modelled groundwater levels (**Figure C-7**). The drawdown in observed groundwater level is about 1.5 m greater than that modelled, with limited ongoing response to rainfall trends. This is likely again to be attributable to the period of below average rainfall during the mining affected drawdown. Gwa14 has been reporting dry and near dry conditions since 2014 meaning the full extent of the drawdown or groundwater level response to climatic influence is unable to be observed.

3.2.2 Model Performance at Coal Monitoring Bores

Figures C-9 to **C-18** show the comparison between modelled and observed groundwater levels at coal bores identified from the cause and effect analysis (**Section 2**) to show a mining effect. The largest drawdowns are expected to occur while Pit 3 and Pit 4 are being excavated, with continued drawdowns seen in some bores with the extraction of Pit 5. Noting the uncertainty in interpreting the climate-related versus the mining-related component of the observed drawdown, modelled groundwater levels at the coal bores generally show a good correlation with the timing and magnitude of observed drawdown.

A comparison of predicted and observed drawdowns at coal bores (from July 2006 to Dec 2016) is offered in **Table 4**.

Table 4 Predicted and Observed Drawdown (m) at Coal Monitoring Bores at December 2016

	GWc1	GWc2	GWc3	GWc11	GWc12	GWc14	GWc15	GWc28^	GWc29^
Predicted	11.3	12.3	25	10.3	20	25	30	17	11
Observed	3-4	14	8	11	>25	>25	25	14	12

^observations at GWc28 and GWc29 began after a mining effect had already begun.

4 REVIEW OF WATER BALANCE AND GROUNDWATER 'TAKE'

The following describes a review of dewatering or pumping records at the WCM, and the method to estimate 'groundwater take' from those records.

4.1 Trends in inflow

Figure 5 presents the 'inferred groundwater inflow' at Wilpinjong Coal Mine, with the most recent value for the 2015-16 water year based on the Hatch (2017) estimate of gross inflow at 4.4 ML/day. The figure includes the historical data used in previous groundwater licensing audits for 2013-14 and 2014-15 water years (HydroSimulations, 2014; HydroSimulations 2015a). It should be noted that the 2006-11 data is not corrected for runoff or other processes, and so represents the inferred maximum groundwater inflow. The monthly data for 2006-2011 is distinguishable from both:

- the daily data in the period late-2012 to 2014; and
- the 2014-15 data, that is presented as a daily average based on the WRM (2015) estimated upper limit of total annual inflow.

Moving average trends of 6-months and 12-months have been plotted, as well as the 'Rainfall Residual Mass' (rainfall trend) curve. Steep slopes in either direction are indicative of more extreme rainfall patterns.

The results suggest that there is some correlation between mine inflow trend (12-monthly dotted trend line) and the rainfall trend, e.g. there is a rise in mine inflow in 2006-2009 which is congruent with above average rainfall in this period. However, this period is also congruent with the commencement of several of the pits at Wilpinjong Mine. In 2009-10, the inflow hydrograph and trend lines decline in line with the rainfall trend curve, along with a short-term rise in 2011.

From late 2012 the graph on Error! Reference source not found. is based on the net pump-out from each of the pits, minus an estimate of runoff to each area, minus the water accumulated in storages and tailings dams near to active pits (as an attempt to account for recirculation from these). After 2012 the pumping rates appear to have increased (**Figure 5**Error! Reference source not found.), although it should be noted that these increased rates do not agree with the rates subsequently estimated as part of WRM's water balance. Further analysis of these discrepancies is discussed in HydroSimulations (2015a).

With respect to groundwater inflow determined from the site water balance (the pink series 2013-2015 labelled as 'Inferred GW Inflow (6-month averages 2013-2015 on **Figure 5**), the rise in inflow in 2013 does not correspond to a rise in rainfall trend. The subsequent levelling out of the inflow curve corresponds to average rainfall conditions from early 2014 into 2016.

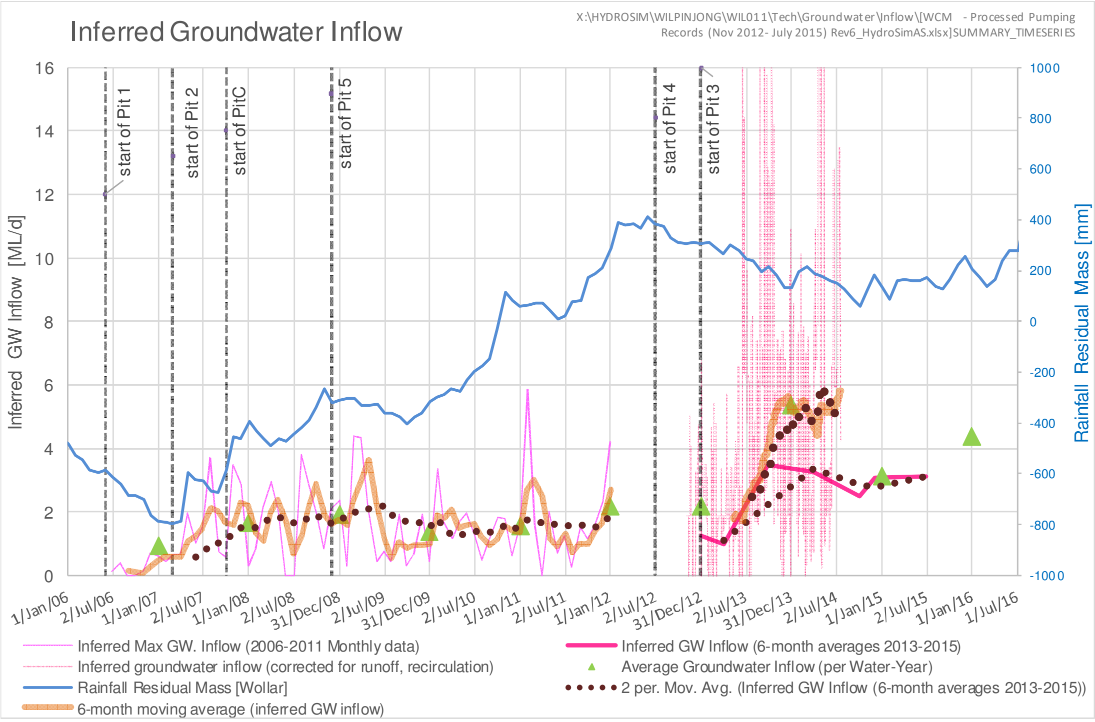

Figure 5 Historical Trends in Inferred Groundwater Inflow

4.2 Assessment of Annualised Groundwater Inflow against Licence

As of the water year 2015-16, WCPL holds a consolidated licence (number 20BL173513) to cover the extraction of water from all pits. The total authorised volume of groundwater extraction is 2,021 ML/a which is equivalent to the combined total of the individual pit entitlements for the 2014-15 water year (authorised by licences 20 BL173513, 20BL173514, 20BL173515, 20BL173516 and 20BL173517).

Previously:

- WCPL held two licences from 2006 until 2008 that entitled a combined groundwater take of 697 ML in any 12-month period.
- A third licence was added in 2008 that covered another mine pit, but without additional volume attached (i.e. still a combined 697 ML).
- In 2013 WCPL sought additional licensed volume, to a total of 1,730 ML/a. Licences were granted to cover each of the five active or soon-to-be-active pits (Pits 1-5). The total entitlement held by WCPL at that time was 2,021 ML/a.

When annualised from a daily inflow value of 4.4 ML/day, the Hatch (2017) estimate for the 2015-2016 water year is about 1600 ML/a. **Table 5** presents the relevant entitlement volume of the now consolidated licence, the estimated inflow or 'take' for 2015-16, as well as a summary of the groundwater take from each of the pits, as inferred, for 2012-13, 2013-14 and 2014-15. It also presents an assessment of compliance to the allocated licence volumes for each water year. The Hatch (2017) annualised estimate is within the allocated licence volume for the 2015-16 water year.

The modelled estimate for groundwater take (HydroSimulations, 2015b) also indicates the predicted inflow falls beneath the licensed volume for the 2015-16 water year.

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Table 5 Summary of Annual Volume of Inferred Maximum Groundwater Take (water years: 2012-16)

Licence	Pit	Limit [ML/a]	Inferred Groundwater Inflow [ML] 2012-13*	2013-14	2014-15		2015-16		
					WRM inflow pro-rata w/ modelled	Modelled inflow (HS, 2015b)		Hatch (2017)	Modelled inflow (HS, 2015b)
20BL173517	Pit 1	1	0	0	6-11	13	License Consolidated	1600	1043
20BL173516	Pit 2	190	<1	<1	4- 7	9			
20BL173515	Pit 3	680	38- 54	890-1270	210- 351	433			
	Pit 7			10 to 16#	10 to 16#	20#			
20BL173514	Pit 4	350	136-273	345-695	100- 168	207			
20BL176513	Pit 5	800	160-453	140-405	347- 579	714			
	Pit 6		not yet mined (commencement in 2018)						
TOTAL		**2021**	**335-780**	**1380-**	**678-1133**	**1397**		**1600**	**1043**

Full year (or scaled full year) of pumping data assessed: Compliant (based on available pumping data)

Pit 7 inflow should be considered under the Pit 3 licence (680 ML/a)

4.3 Assessment of Annualised Groundwater Take

Comparisons of the annualised total inflow to the mine (based on pumping records) and WCPL's groundwater extraction licence are made in **Figure 6** and **Figure 7** with predicted total annual inflows from two versions of the groundwater model for the WCM. **Figure 6** shows the results from the earlier model (HydroSimulations, 2013), as used to support Modification 5, while **Figure 7** shows the results for the better calibrated current model (HydroSimulations, 2015b), as used to support the Wilpinjong Extension Project (WEP).

In each figure, the total entitlement volumes are displayed as a red dashed line and the bar charts show the annualised inflow volumes from groundwater modelling. The totals from WRM's (2015) water balance are shown as a continuous brown line (the "Annualised Inferred GW inflow").

Given that the simulated mine plans differ a little, the models are in good agreement for most years with a median difference of 40 percent (of the 2013 estimate) in estimated groundwater take. An exception occurs in the 2015-16 water year when the models differ by 50 percent (of the 2013 estimate). The earlier model predicted about 2,000 ML/a while the current model predicts a little over 1,000 ML/a. The two estimates bracket the independent water balance estimate of 1,600 ML/a.

The inferred groundwater inflow (from the independent water balance) tracks the total predicted inflow quite well for the period 2006-2011, except for 2007-08 for the earlier model (**Figure 6**). Except for that year, during this period, inflows peak at 600-700 ML/a in agreement with the licensed volume at that time.

Pumping records suggest increased inflows from 2012, and two lines (on **Figure 6** and **Figure 7**) are used to indicate the likely range in groundwater inflow for 2012-13 to 2014-15. In 2013-14 a total of 1,870 ML (the upper estimate in the likely range) was estimated as being pumped from all pits, compared to the total site-wide entitlement of 2,021 ML.

Predicted inflows increased materially from 2012 due to concurrent progression of Pits 3, 4 and 5 to the north). Pit pumping rates are likely to have been exacerbated by problems with recirculating water after it is pumped from open cuts to nearby storages (i.e. water storages and tailings dams).

The two models agree exactly for the 2014-15 water year, but give opposite trends in the 2015-16 water year. This could be due to the difference in mine progression simulated in that year. Lower inflow is to be expected when developing areas to the south, which is both up-dip and away from the major drainage lines (**Figure 1**).

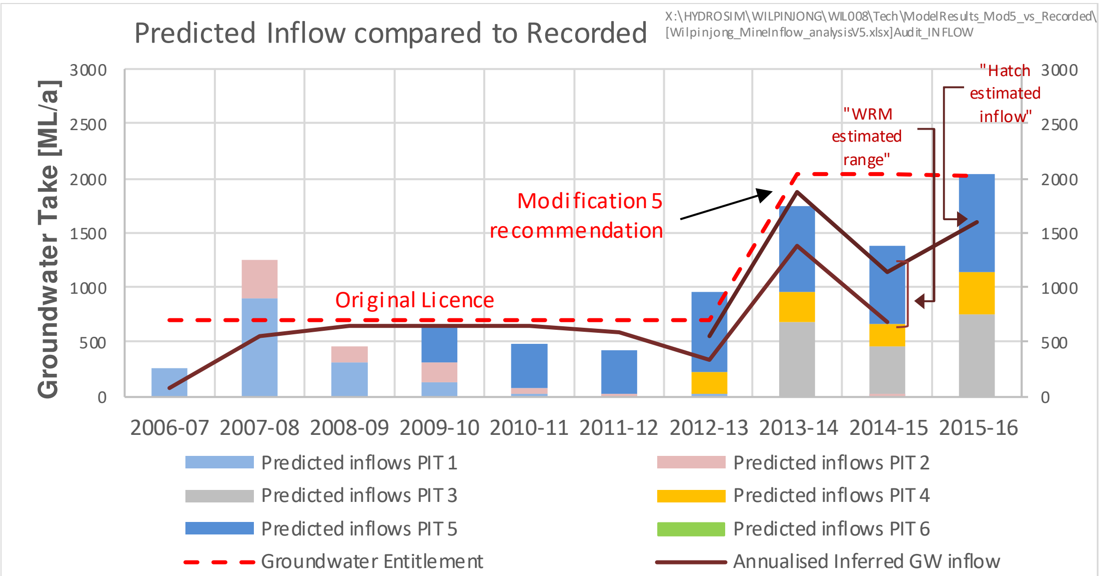

Figure 6 Comparison of Predicted and Pumped Volumes against Groundwater Entitlement for the HydroSimulations (2013) Groundwater Model

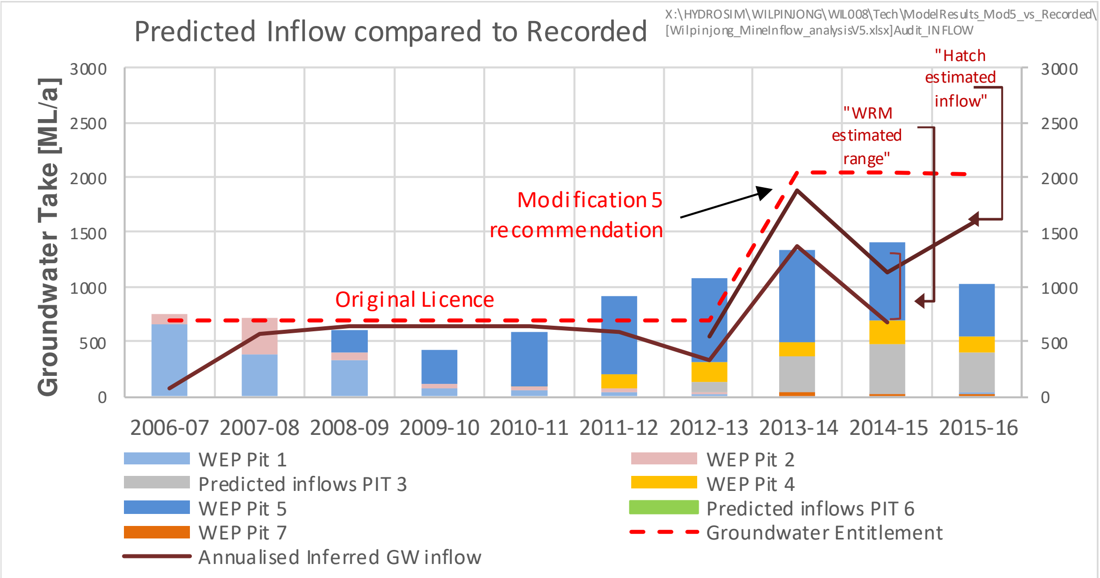

Figure 7 Comparison of Predicted and Pumped Volumes against Groundwater Entitlement for the HydroSimulations (2015b) Groundwater Model

4.4 Alluvial Groundwater Inflow

Groundwater can be lost from alluvium to underlying Permian sediments through natural processes or as incidental take in response to mining. As there are no physical means by which this volume of alluvial water can be measured, groundwater modelling is necessary to quantify the expected loss.

The HydroSimulations (2015b) model has predicted the likely alluvial take during the 2015-2016 water year, as shown in **Figure 8** for both Wilpinjong Creek alluvium and Cumbo Creek alluvium. The predicted loss from Wollar Creek is negligible.

For the 2015-2016 water year the additional alluvial water loss, over and above what occurs naturally, is estimated to be about 0.17 ML/day from Wilpinjong Creek alluvium and about 0.11 ML/day from Cumbo Creek alluvium. This gives an alluvial groundwater take of about 100 ML/year.

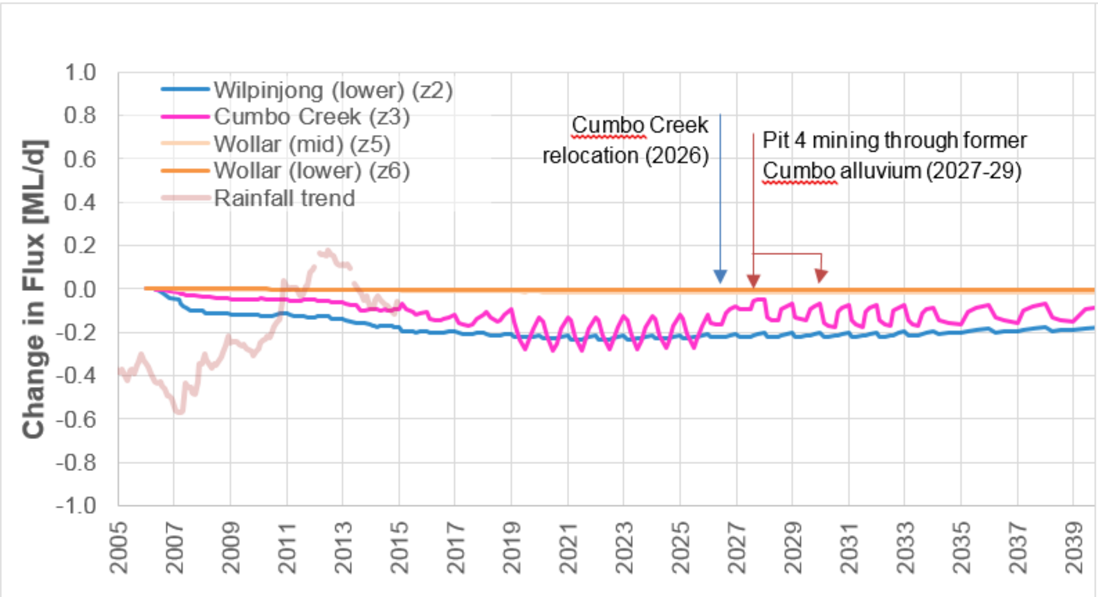

Figure 8 Modelled Take from Alluvium

5 DEWATERING BORES

Five production bores (GWs10, GWs11, GWs12, GWs14, GWs15) designed for dewatering are located at the foot of the escarpment on the northern side of Wilpinjong Creek (**Figure2**).

In all, there are seven licences covering the separate dewatering works: 20BL170147, 20BL170148, 20BL170149, 20BL170150, 20BL170151, 20BL170152 and 20BL170153. The combined authorised volume of groundwater extraction is 770 ML/year.

There have been no recorded uses of the dewatering bores during the 2015-16 water year. Nevertheless, compliance with the licence conditions is addressed in **Section 7**.

6 PIT EXTRACTION LICENSING COMPLIANCE

The following section contains information and analysis reporting against the licence conditions 2, 3, 4 and 8 for pit extraction for the water year 1 July 2015 to 30 June 2016.

6.1 Licence Condition (2)

'The licence holder must implement the methodology to estimate the annual volume of alluvial water inflow (water budget), the licence holder is likely to extract during the water year. This estimate must be reported annually in the AEMR.'

The alluvial water inflow (water budget) for the 2015-16 water year is 100ML/a (See **Section 4.4**).

6.2 Licence Condition (3)

'The licence holder must include in the AEMR a map which shows the licensed site and the current areas that mine works have interfered with alluvial sediment.'

Figure 1 shows the progression of mining in the last two years, and the extent of alluvium as mapped on the Western Coalfield 1:100000 geological sheet.

6.3 License Condition (4)

The licence holder must report in the AEMR:

I) the monitoring results of any groundwater monitoring with respect to this licence;
II) an assessment of compliance with this licence, regarding pit extraction,
III) a summary of new bores or pits constructed during the year;
IV) the trend graphs for monitoring data collected for each bore that is near to the licensed site;
V) a summary of any contingency event (event) that impacted on groundwater during the last report period, including actions taken to remedy the event and any additional monitoring carried out on the event.
VI) provide any recommendations for improvements for the next reporting period.

6.3.1 I) the monitoring results of any groundwater monitoring with respect to this licence;

Groundwater monitoring results are presented in the form of time-series charts in **Appendix A** for groundwater level data and **Appendix B** for groundwater level, EC and pH data in relation to trigger level compliance.

6.3.2 II) an assessment of compliance with this licence, regarding pit extraction,

See **Section 4.3, Figure 6 and Figure 7** for an assessment of compliance with this licence regarding pit extraction. The groundwater model estimate and the independent water balance estimate are both less than the authorised volume of 2,021 ML/a.

6.3.3 III) a summary of new bores or pits constructed during the year;

HydroSimulations has been advised that no new bores have been constructed during the 2015-16 water year.

All coal extraction has come from pits that were already operational prior to the 2015-16 water year.

6.3.4 IV) the trend graphs for monitoring data collected for each bore that is near to the licensed site

Annotated trend graphs for alluvial and coal bores at Wilpinjong are provided in **Appendix A**.

6.3.5 V) a summary of any contingency event (event) that impacted on groundwater during the last report period, including actions taken to remedy the event and any additional monitoring carried out on the event.

See **Section 2.1** and **Table 3** for an assessment of groundwater level and quality in relation to trigger levels from the most recent Groundwater Monitoring Program (Peabody, 2016).

Trigger exceedances for minimum groundwater level occurred at alluvium bores GWa3, GWa4, GWa5 and GWa7.

Trigger exceedances for groundwater EC occurred at alluvium bores GWa3, GWa4, GWa6 and GWa7; and at coal bores GWc1, GWc3, and GWc5.

No exceedance of groundwater pH occurred.

To the best of HydroSimulations' knowledge, no actions have yet been undertaken to remedy the events recorded in **Section 2**.

To the best of HydroSimulations' knowledge, no additional monitoring has been undertaken in response to the events in **Section 2**.

6.3.6 VI) provide any recommendations for improvements for the next reporting period.

- Drilling of deeper bores at alluvial locations that are persistently observed as dry (GWa1, GWa6).

- An adjustment of trigger levels so that they are not located below the elevation at which a bore is reported dry.

6.4 Licence Condition (8)

The volume of groundwater extracted from the works authorised by this license and by license(s) 20BL173514, 20BL173515, 20BL173516 and 20BL173517 shall not exceed 2021 megalitres in any 12-month period commencing 1st July.

Sections 4.1-4.3 identify that both the Hatch (2017) inferred groundwater extraction at 1,600 ML/year and HydroSimulations (2015b) modelled inflow at 1,043 ML/year for the 2015-16 water year fall below the 2,021 megalitres allowed in any 12-month period as required by this licence condition.

7 BORE DEWATERING LICENCE COMPLIANCE

The following section contains information and analysis reporting against the licence conditions 7, 9 and 10 for dewatering bores for the water year from 1 July 2015 to 30 June 2016.

7.1 Licence Condition (7)

The licence holder must report in the AEMR:

I) the monitoring results of any groundwater monitoring with respect to this licence;
II) an assessment of compliance with this licence, regarding water extraction,
III) a summary of new bores or pits constructed during the year;
IV) the trend graphs for monitoring data collected for each bore that is near to the licensed site;
V) a summary of any contingency event (event) that impacted on groundwater during the last report period, including actions taken to remedy the event and any additional monitoring carried out on the event.
VI) provide any recommendations for improvements for the next reporting period.

The AEMR response relevant to these bore dewatering licence conditions is essentially the same as is addressed in **Section 6.3** for the pit extraction licence condition [4].

7.1.1 I) the monitoring results of any groundwater monitoring with respect to this licence;

Groundwater monitoring results are presented in the form of time-series charts in **Appendix A** for groundwater level data and **Appendix B** for groundwater level, EC and pH data in relation to trigger level compliance.

7.1.2 II) an assessment of compliance with this licence, regarding water extraction,

See **Section 5** where it is noted that there have been no recorded uses of the dewatering bores during the 2015-16 water year. Accordingly, groundwater extraction is less than the authorised volume of 770 ML/a.

7.1.3 III) a summary of new bores or pits constructed during the year;

HydroSimulations has been advised that no new bores have been constructed during the 2015-16 water year.

7.1.4 IV) the trend graphs for monitoring data collected for each bore that is near to the licensed site;

Annotated trend graphs for alluvial and coal bores at Wilpinjong, close to the dewatering bores, are provided in **Appendix A.**

7.1.5 V) a summary of any contingency event (event) that impacted on groundwater during the last report period, including actions taken to remedy the event and any additional monitoring carried out on the event.

No event occurred as no dewatering occurred.

7.1.6 VI) provide any recommendations for improvements for the next reporting period.

No recommendations are necessary while the bores remain unused.

7.2 Licence Condition (9)

The volume of groundwater extracted from the works authorised by this licence shall not exceed 110 megalitres in any 12-month period commencing 1st July.

HydroSimulations was advised by WCPL that no groundwater was extracted from the works authorised by this licence and as such, is compliant.

7.3 Licence Condition (10)

The volume of groundwater extracted from the works authorised by this license and by license(s) 20BLL70148, 20BLL70149, 20BLL70150, 20BLL7015 I, 20BLL70152, 20BLL70153 shall not exceed 770 megalitres in any 12-month period commencing 1st July.

HydroSimulations was advised by WCPL that no groundwater was extracted from the works authorised by this licence and licence(s) *20BLL70148, 20BLL70149, 20BLL70150, 20BLL7015 I, 20BLL70152, 20BLL70153,* and as such, is compliant. See **Section 5**.

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Figures