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Memo

Date 18 May 2015
To Nicola Fry
From Carolina Sardella
Ref 2268518B-WAT-MEM-001 RevD
Subject Camden Gas Project - FY15 Q3 monitoring update - April 2015

This memo presents the updated hydrographs for the Denham Court, Menangle Park and Glenlee groundwater monitoring bores to April 2015 and the water quality results for the April 2015 sampling event. Full analysis and discussion of these results, and all the results from the 2014/15 monitoring period, will be presented in the comprehensive 2015 Annual Report.

Key observations for the FY15 Q3 period are as follows:

- The water level at RMB01 continues to slowly increase, as per the historical trend. However, no sample was collected as insufficient water was present across the screened section of the monitoring bore (69.0 – 81.0 m below ground level (mbgl)). The standing water level on 7 April 2015 was 79.2 mbgl.
- RMB04 continues to be dry since installation and therefore no hydrograph is presented.
- GLMB01 and GLMB02 were converted to vibrating wire piezometers on 12 March 2015 to maintain borehole integrity.

Figures A.1 – A.6: Individual hydrographs for the Denham Court, Menangle Park and Glenlee sites

Figures A.7 – A.8: Nested hydrographs for the Denham Court, Menangle Park and Glenlee sites

Table A.1: Water quality results for April 2015

Yours sincerely



Carolina Sardella
Hydrogeologist

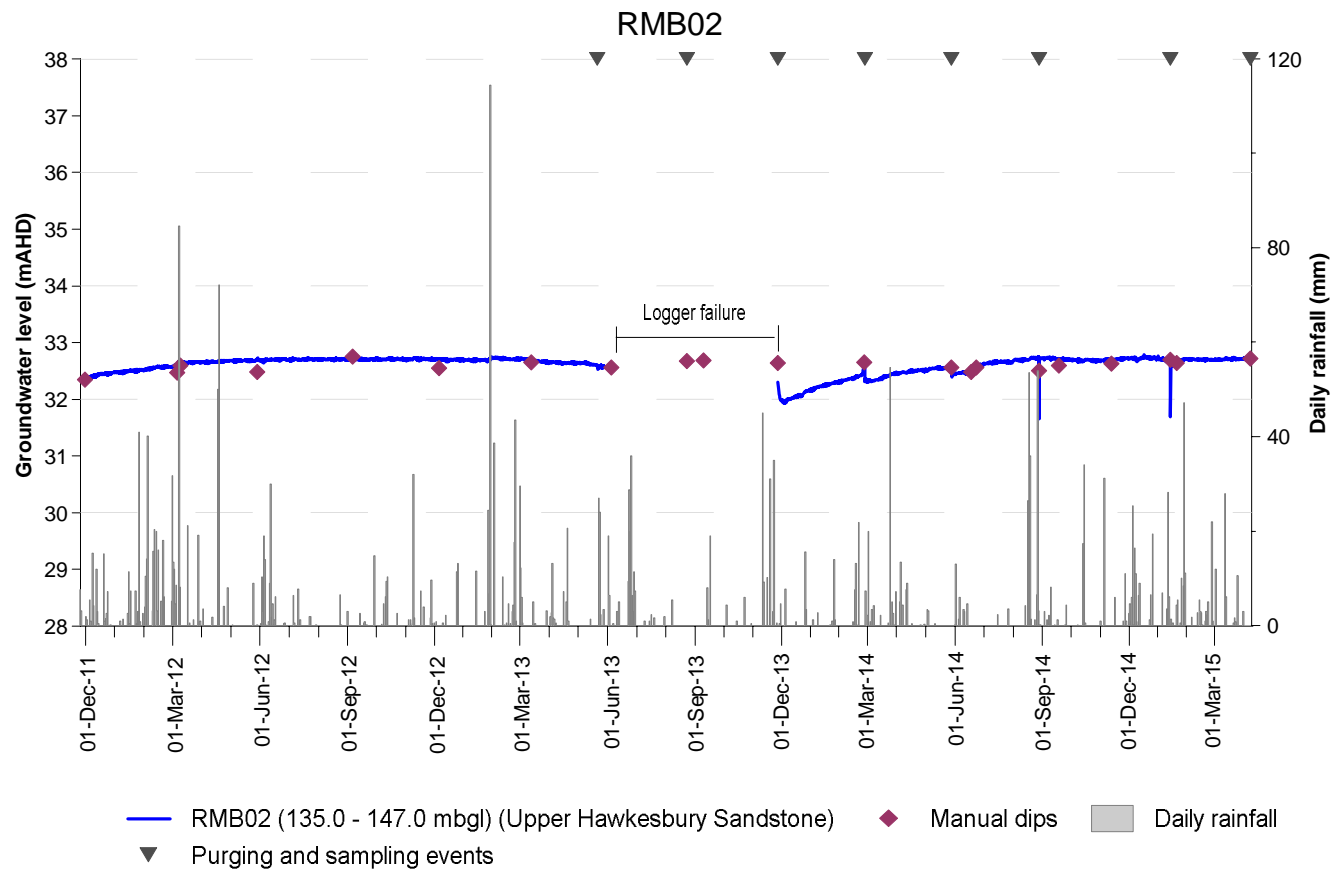
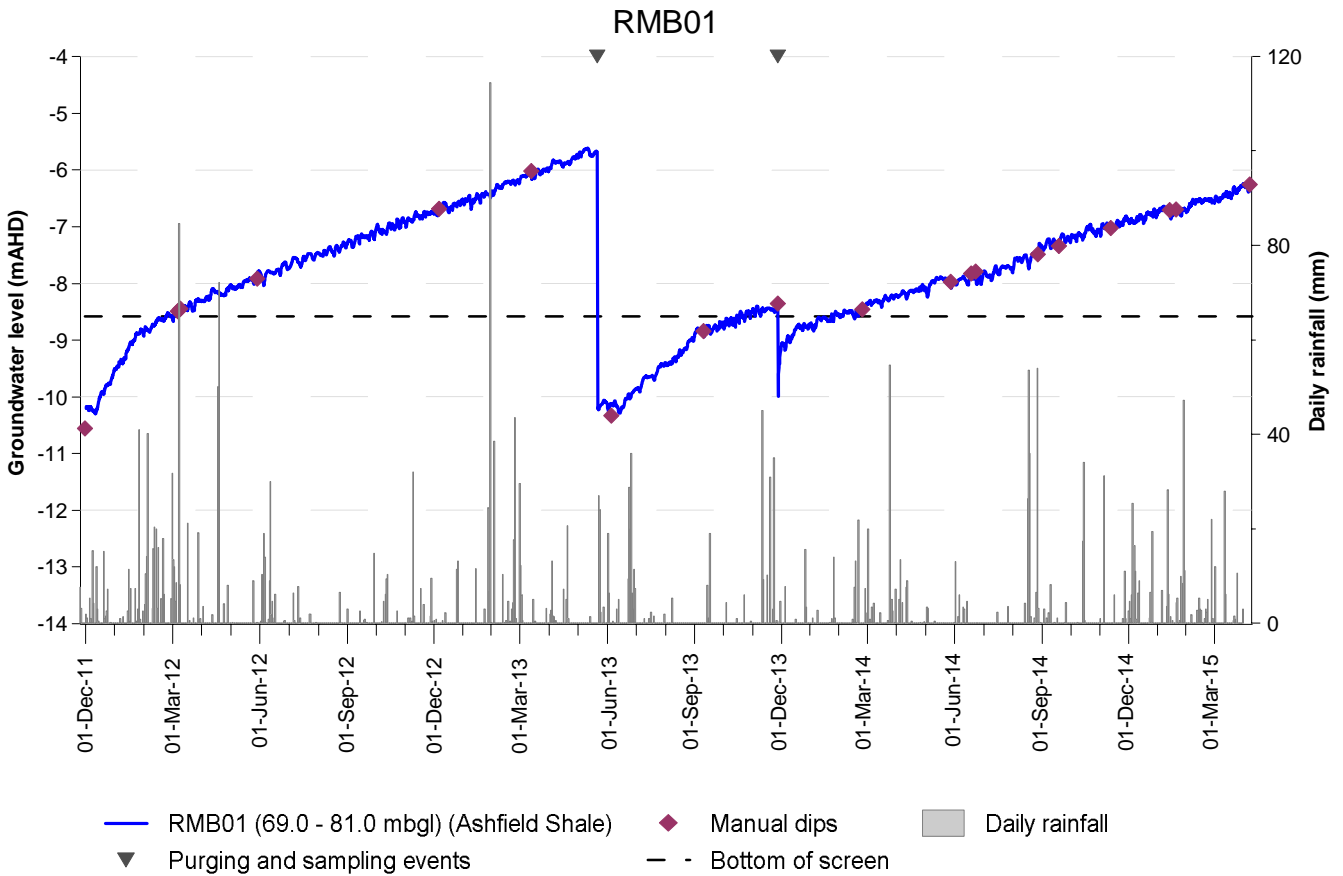


Figure A.1: RMB01 and RMB02 monitoring bores

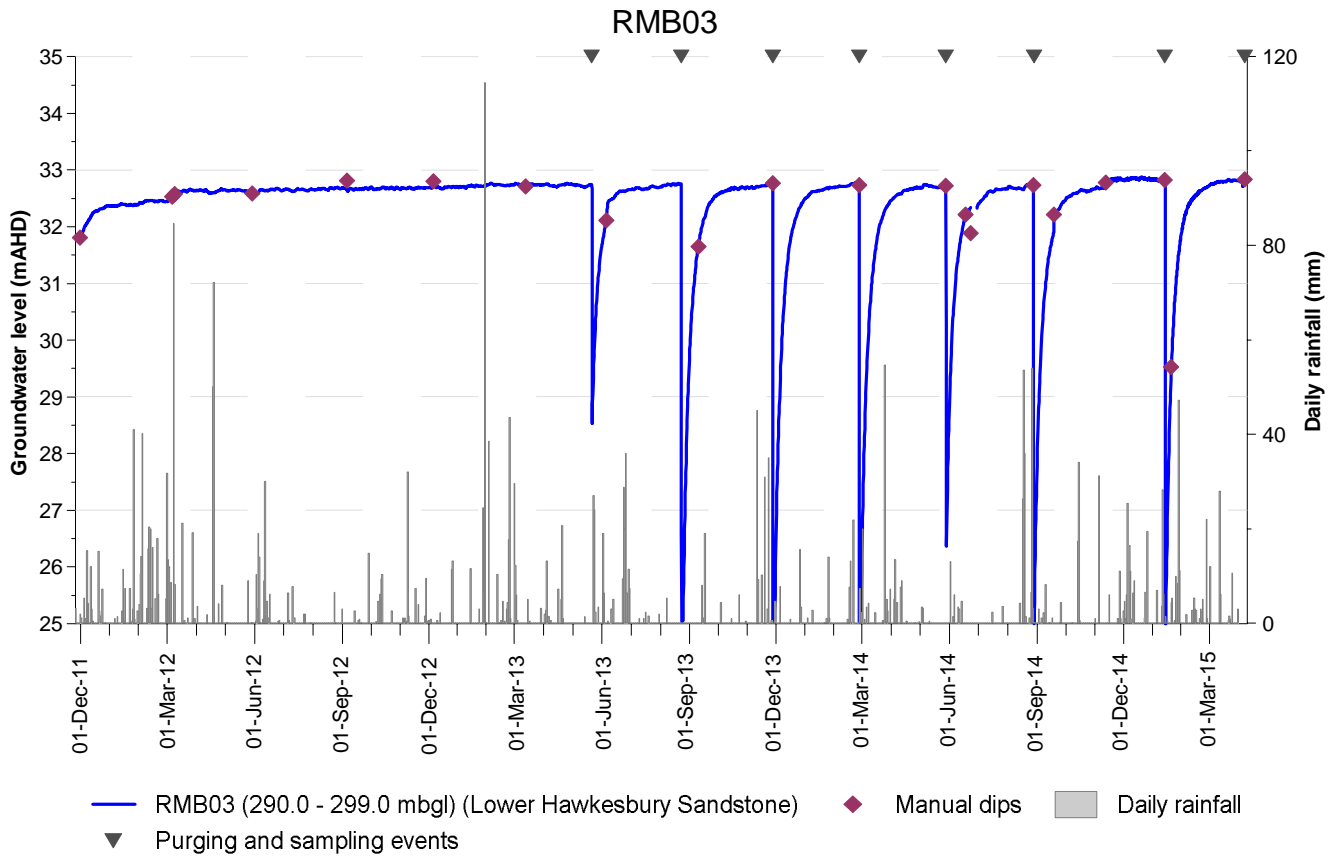


Figure A.2: RMB03 monitoring bore

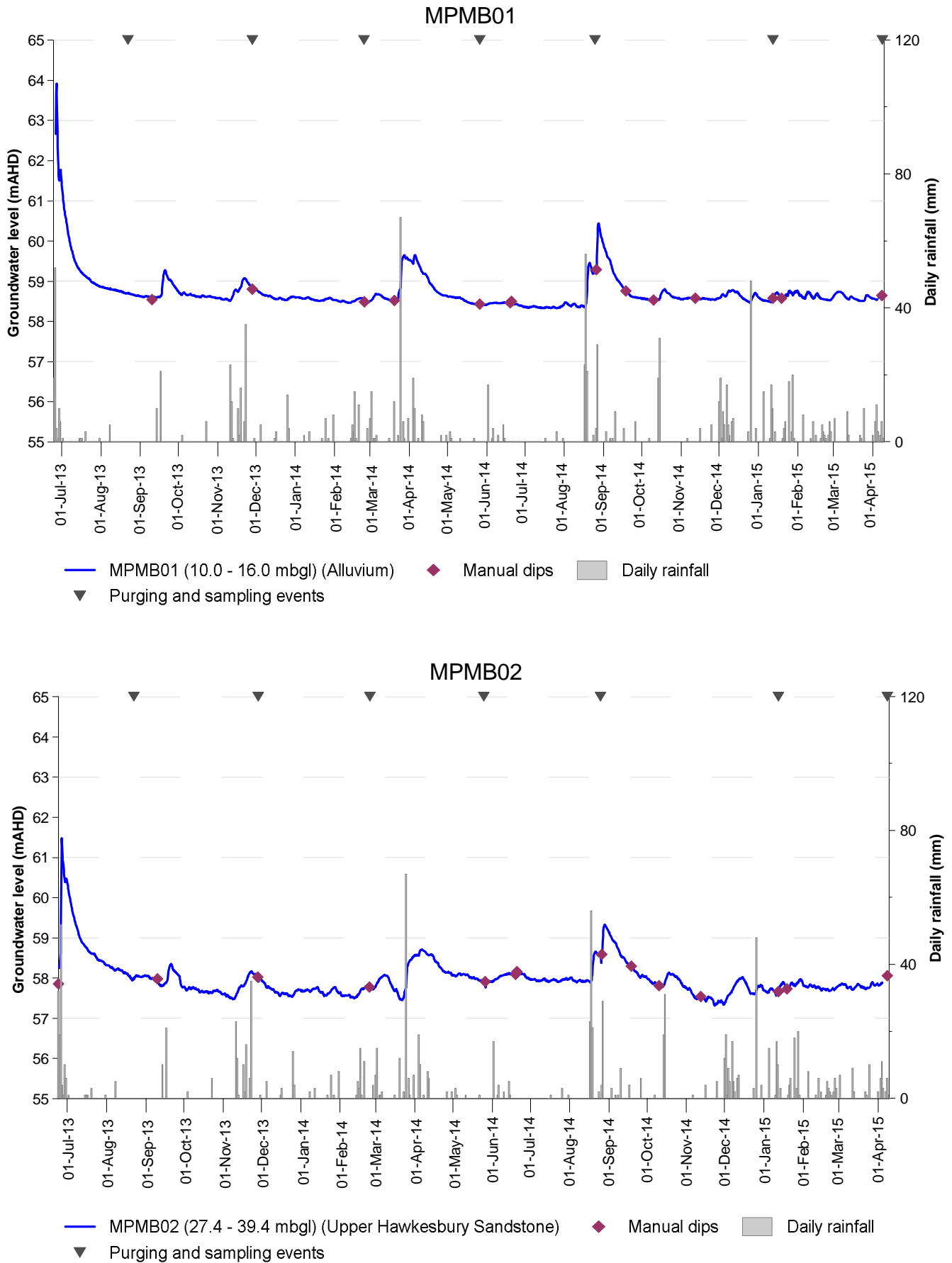


Figure A.3: MPMB01 and MPMB02 monitoring bores

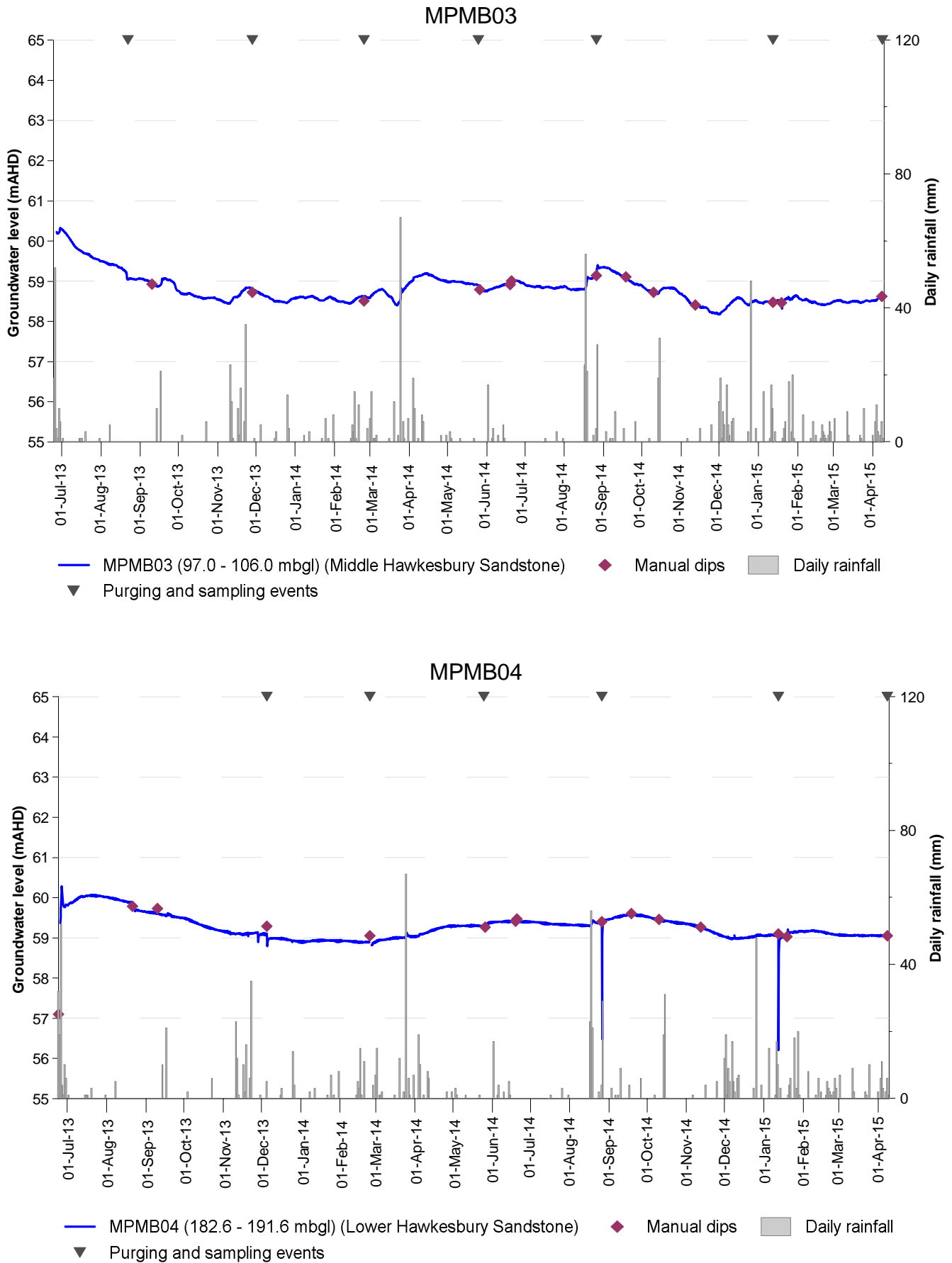


Figure A.4: MPMB03 and MPMB04 monitoring bores

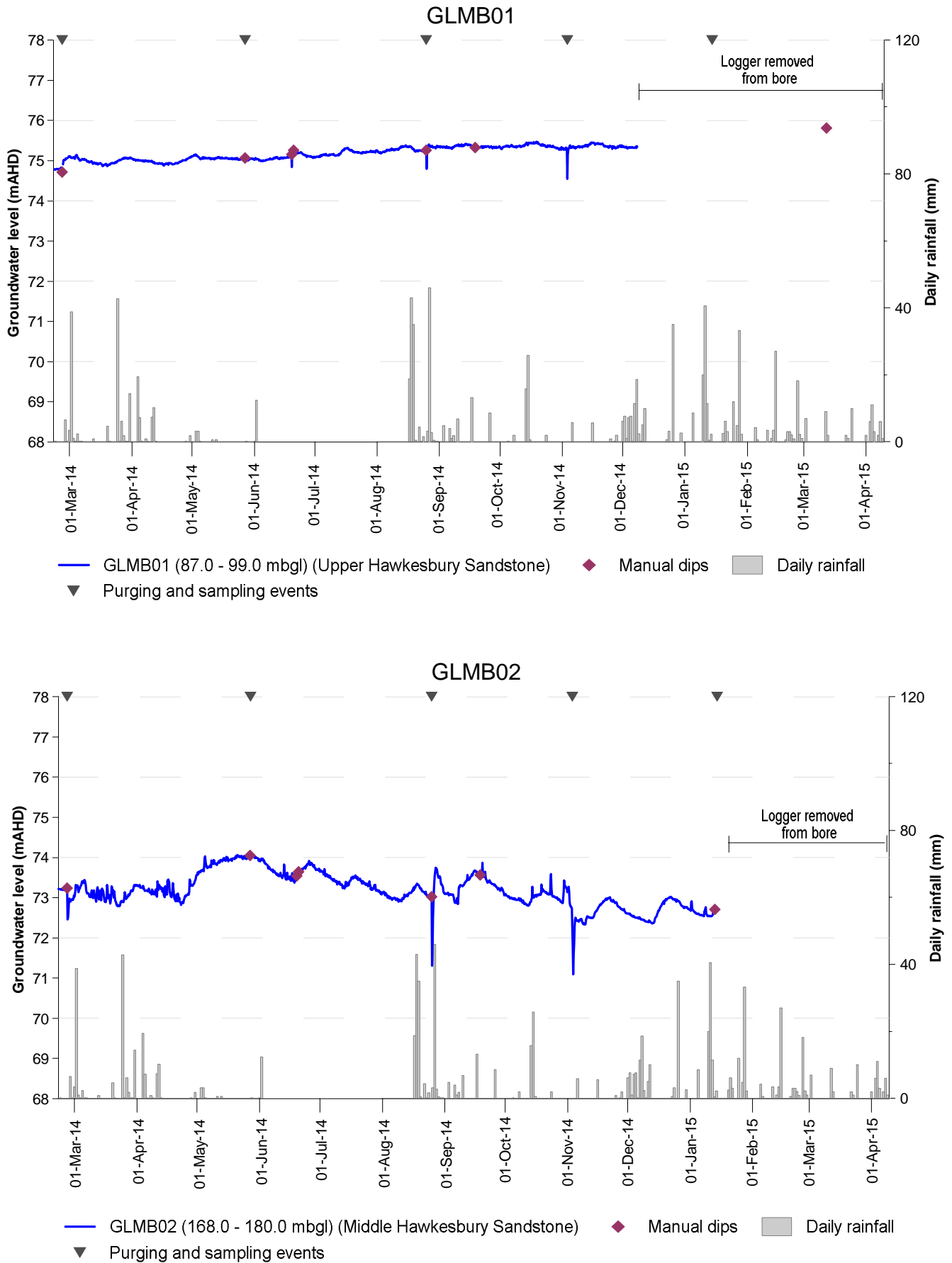


Figure A.5: GLMB01 and GLM02 monitoring bores

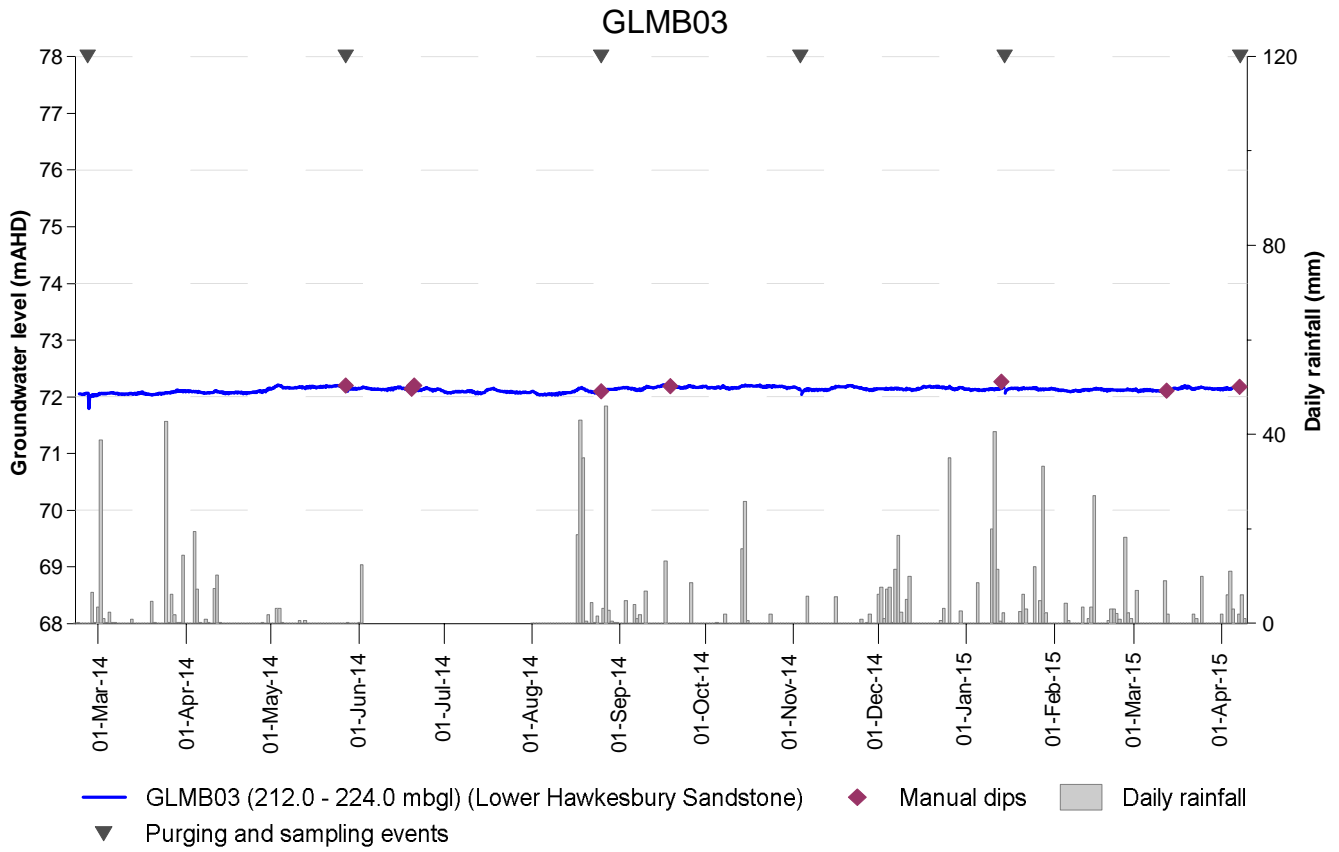


Figure A.6: GLM03 monitoring bore

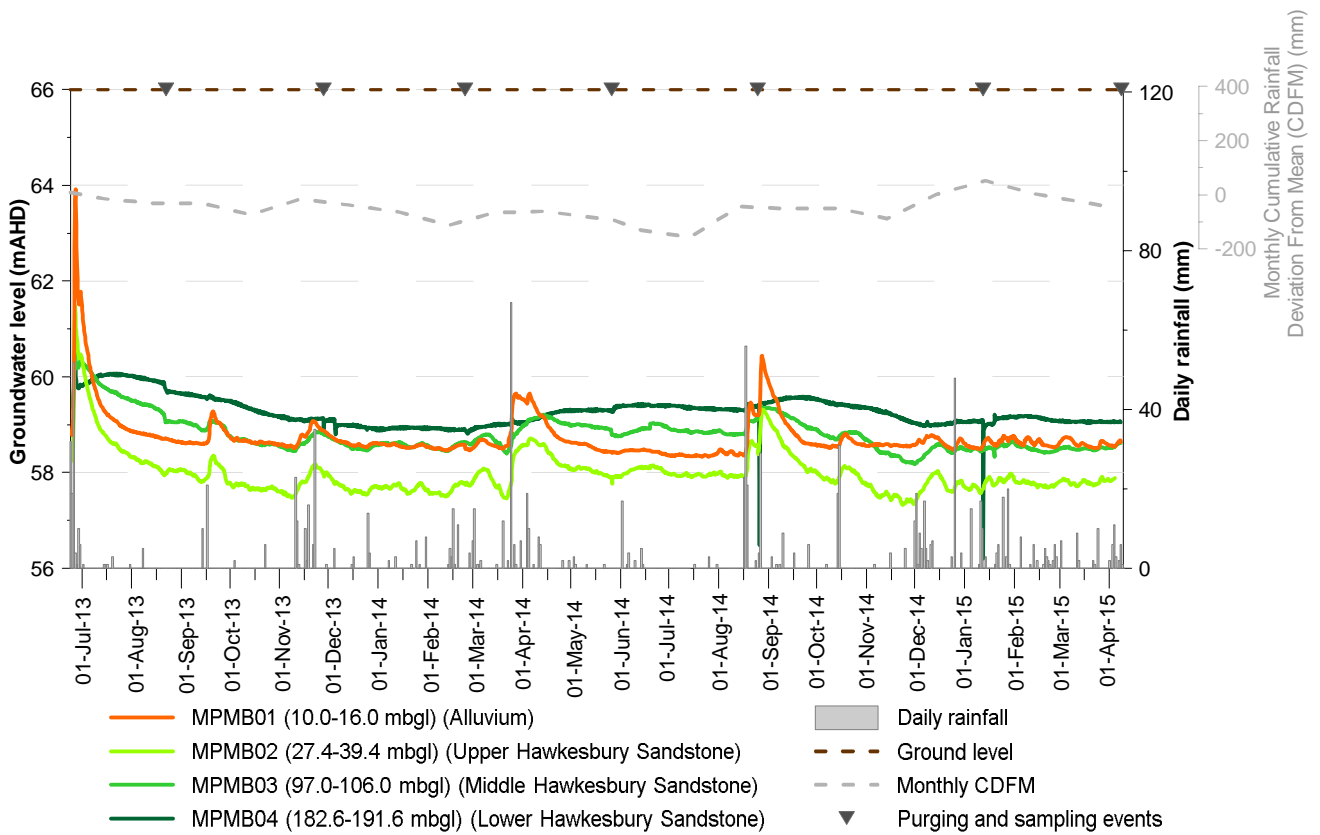
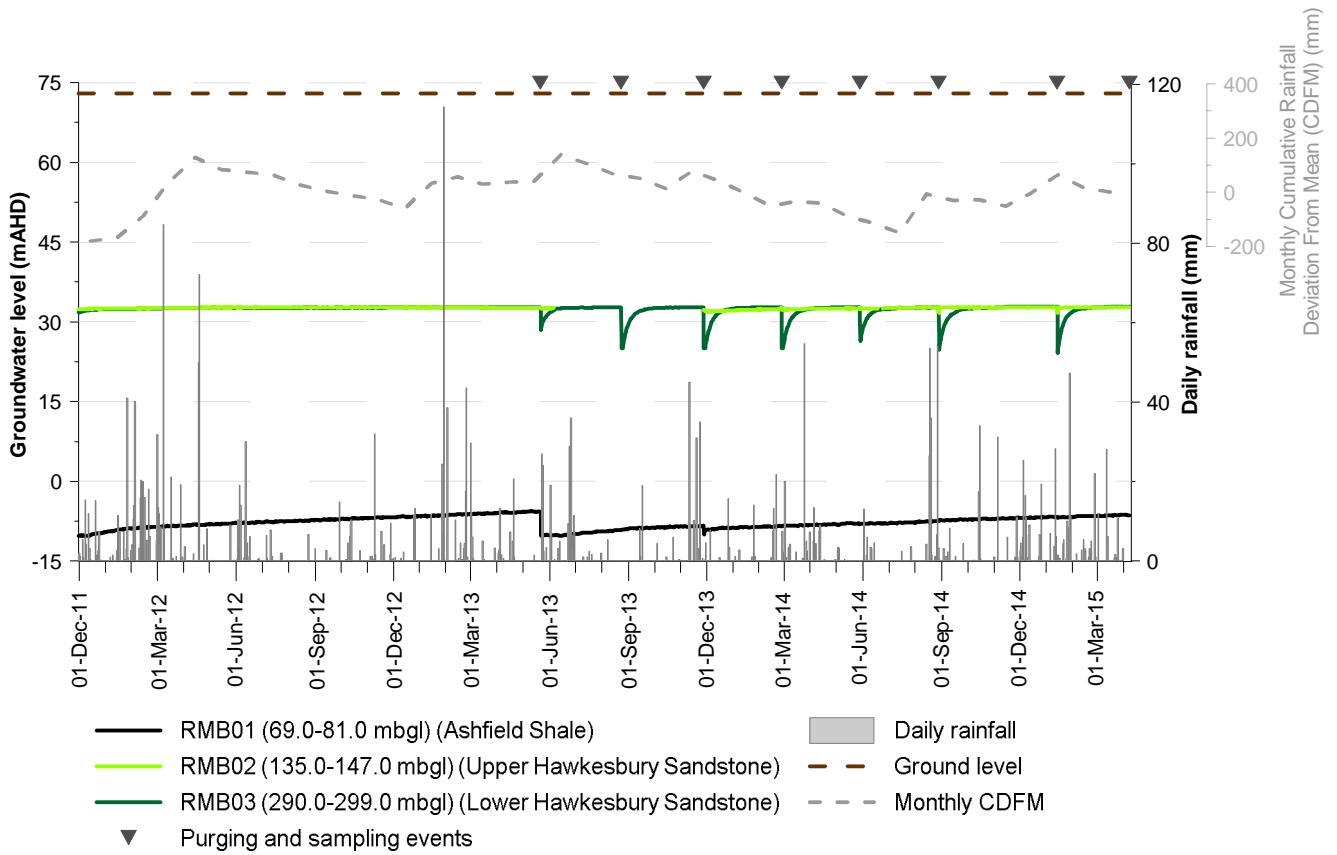


Figure A.7: RMB and MPMB monitoring bores

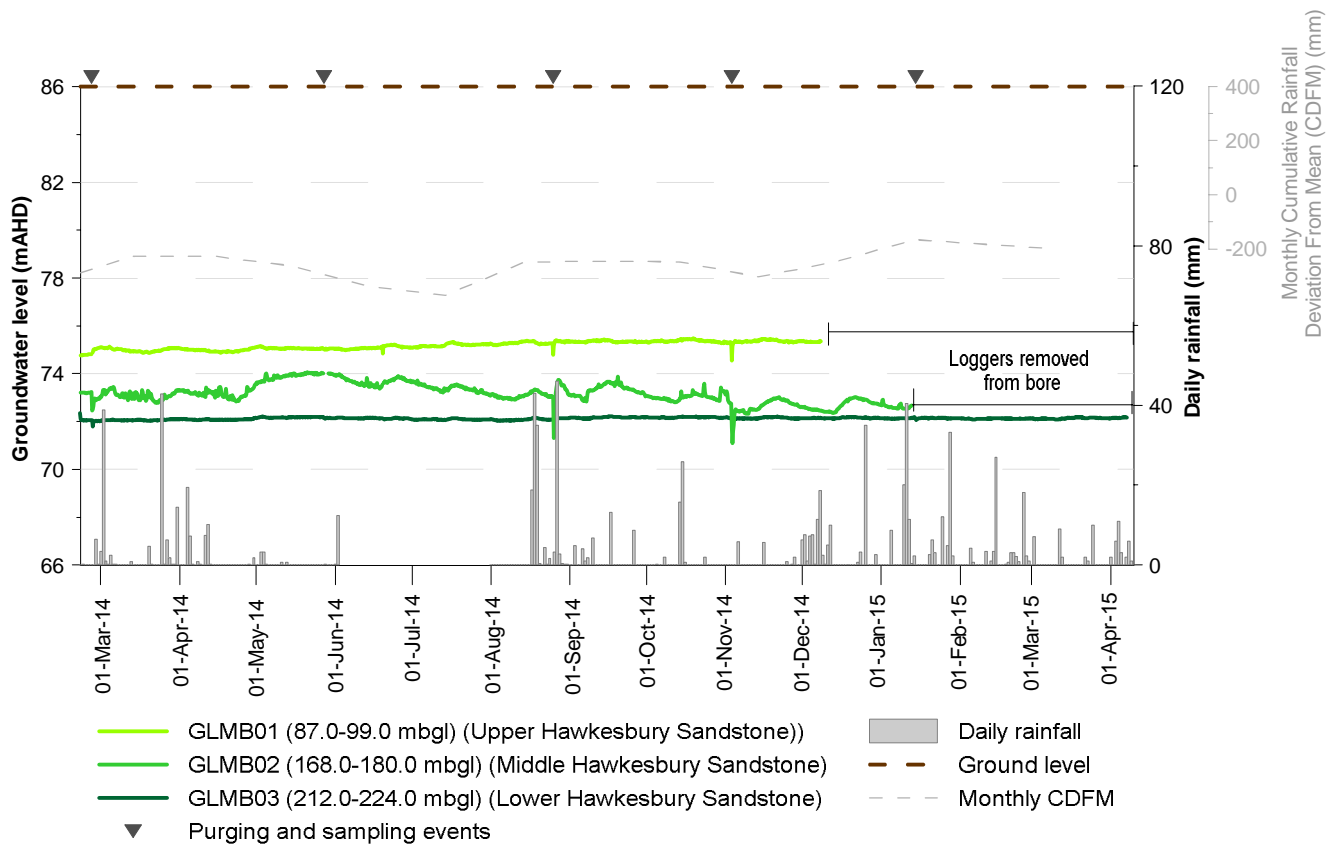


Figure A.8: GLMB monitoring bores

Table A.1: Water quality results Camden Gas Project April 2015

Analyte	Units	Denham Court		Menangle Park				Glenlee
		RMB02	RMB03	MPMB01	MPMB02	MPMB03	MPMB04	GLMB03
Hydrogeological unit		Upper Hawkesbury Sandstone	Lower Hawkesbury Sandstone	Alluvium	Upper Hawkesbury Sandstone	Middle Hawkesbury Sandstone	Lower Hawkesbury Sandstone	Lower Hawkesbury Sandstone
Sample date		7/04/2015	7/04/2015	8/04/2015	8/04/2015	8/04/2015	8/04/2015	7/04/2015
General parameters								
pH (field)	pH units	7.55	9.81	5.41	7.31	7.99	9.86	9.31
Electrical conductivity (field)	µS/cm	10,390	7,486	896	953	1,059	956	4,842
Electrical conductivity (lab)	µS/cm	10,700	7,730	912	963	1,090	984	5,010
Temperature	°C	19.46	19.45	19.60	20.18	18.67	19.91	20.47
Dissolved oxygen	% sat	na	5.1	21.0	9.4	4.7	1.7	2.4
Total dissolved solids (field)	mg/L	6,753	4,865	584	620	689	621	3,151
Total dissolved solids (lab)	mg/L	6,170	4,140	526	420	528	540	2,750
Suspended solids	mg/L	<5	<5	74	5	6	<5	<5
Redox	mV	-41.5	-94.1	88.9	-101.9	-138.1	-2.1	-209.0
Laboratory analytes								
Hydroxide alkalinity as CaCO ₃	mg/L	<1	<1	<1	<1	<1	<1	<1
Carbonate alkalinity as CaCO ₃	mg/L	<1	252	<1	<1	<1	209	129
Bicarbonate alkalinity as CaCO ₃	mg/L	895	224	14	238	522	110	1510
Total alkalinity as CaCO ₃	mg/L	895	476	14	238	522	319	1640
Sulfate as SO ₄ ²⁻	mg/L	<10	<1	2	4	<1	<1	19
Chloride	mg/L	3,280	2,310	258	170	77	126	774
Calcium	mg/L	326	10	13	34	91	4	31
Magnesium	mg/L	88	11	23	31	23	5	61
Sodium	mg/L	1,890	1,600	110	105	110	189	1,050
Potassium	mg/L	30	16	1	3	14	15	39
Silica	mg/L	10.4	6.68	19.2	12.7	8.82	3.48	11.80
Fluoride	mg/L	0.1	0.6	<0.1	0.2	0.2	0.6	<0.1
Bromide	mg/L	6.79	4.68	0.601	0.409	0.213	0.275	1.98
Total cyanide	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Dissolved metals								
Aluminium	mg/L	<0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01
Antimony	mg/L	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	<0.001	0.001	<0.001	0.002	0.018	0.002	0.032
Barium	mg/L	33.0	4.64	0.664	0.584	3.27	0.753	7.63
Beryllium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	<0.001	<0.001	0.041	<0.001	0.004	<0.001	<0.001
Copper	mg/L	<0.001	0.003	0.003	<0.001	<0.001	0.001	0.002
Lead	mg/L	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.024	<0.001	0.488	0.144	0.047	<0.001	0.005
Mercury	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0003	<0.0001
Molybdenum	mg/L	<0.001	0.005	<0.001	<0.001	<0.001	0.005	0.003
Nickel	mg/L	0.001	<0.001	0.016	<0.001	0.004	<0.001	<0.001
Selenium	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Strontium	mg/L	8.47	1.58	0.143	0.352	0.887	0.198	2.23
Uranium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/L	0.031	0.051	0.066	0.018	0.012	0.047	0.008
Boron	mg/L	<0.05	0.17	<0.05	<0.05	<0.05	<0.05	0.05
Iron	mg/L	4.42	<0.05	0.06	4.21	1.13	<0.05	0.12
Bromine	mg/L	7.0	5.4	0.7	0.4	0.2	0.3	2.0
Nutrients								
Ammonia as N	mg/L	4.43	3.33	0.02	0.06	0.92	0.86	2.87
Nitrite as N	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrate as N	mg/L	<0.01	<0.01	0.16	<0.01	<0.01	<0.01	<0.01
Total phosphorus	mg/L	0.04	0.01	0.05	0.02	<0.01	<0.01	0.04
Reactive phosphorus	mg/L	0.03	0.01	<0.01	0.03	<0.01	0.01	0.05
Total organic carbon	mg/L	5	40	<1	<1	4	22	10
Dissolved gases								
Methane	µg/L	39,100	38,100	<10	273	44,600	52,300	41,700
Ethane	µg/L	<10	<10	<10	<10	<10	<10	<10
Ethane	µg/L	<10	11	<10	<10	<10	<10	108
Propene	µg/L	<10	<10	<10	<10	<10	<10	<10
Propane	µg/L	<10	<10	<10	<10	<10	<10	19
Butene	µg/L	<10	<10	<10	<10	<10	<10	<10
Butane	µg/L	<10	<10	<10	<10	<10	<10	<10
Phenolic compounds								
Phenol	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	2.8	<1.0
2-Chlorophenol	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Methylphenol	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
3-&4-Methylphenol	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
2-Nitrophenol	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4-Dimethylphenol	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4-Dichlorophenol	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,6-Dichlorophenol	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
4-Chloro-3-Methylphenol	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4,6-Trichlorophenol	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4,5-Trichlorophenol	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Pentachlorophenol	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Polycyclic aromatic hydrocarbons								
Naphthalene	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	µg/L	<1.0	<1.0	1.1	1.9	<1.0	<1.0	<1.0
Fluorene	µg/L	<1.0	<1.0	1.3	1.7	<1.0	<1.0	<1.0
Phenanthrene	µg/L	<1.0	<1.0	1.8	4.7	<1.0	<1.0	<1.0
Anthracene	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b)fluoranthene	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1,2,3-cd)pyrene	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a,h)anthracene	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g,h,i)perylene	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Sum of PAHs	µg/L	<0.5	<0.5	4.2	8.3	<0.5	<0.5	<0.5
Total petroleum hydrocarbons								
C ₆ -C ₉ fraction	µg/L	<20	70	<20	<20	<20	110	190
C ₁₀ -C ₁₄ fraction	µg/L	<50	<50	<50	70	<50	<50	<50
C ₁₅ -C ₂₈ fraction	µg/L	<100	<100	<100	<100	<100	<100	<100
C ₂₉ -C ₃₆ fraction	µg/L	<50	<50	<50	<50	<50	<50	<50
C ₁₀ -C ₃₆ fraction (sum)	µg/L	<50	<50	<50	70	<50	<50	<50
Total recoverable hydrocarbons								
C ₆ -C ₁₀ fraction	µg/L	<20	70	<20	<20	<20	110	190
C ₆ -C ₁₀ fraction minus BTEX	µg/L	<20	30	<20	<20	<20	40	70
>C ₁₀ -C ₁₆ fraction	µg/L	<100	<100	<100	<100	<100	<100	<100
>C ₁₆ -C ₃₄ fraction	µg/L	<100	<100	<100	<100	<100	<100	<100
>C ₃₄ -C ₄₀ fraction	µg/L	<100	<100	<100	<100	<100	<100	<100
>C ₁₀ -C ₄₀ fraction (sum)	µg/L	<100	<100	<100	<100	<100	<100	<100
Aromatic hydrocarbons								
Benzene	µg/L	<1	<1	<1	<1	<1	<1	<1
Toluene	µg/L	<2	39	<2	<2	<2	66	124
Ethylbenzene	µg/L	<2	<2	<2	<2	<2	<2	<2
m&p-Xylenes	µg/L	<2	<2	<2	<2	<2	<2	<2
o-Xylenes	µg/L	<2	<2	<2	<2	<2	<2	<2
Total xylenes	µg/L	<2	<2	<2	<2	<2	<2	<2
Sum of BTEX	µg/L	<1	39	<1	<1	<1	66	124
Naphthalene	µg/L	<5	<5	<5	<5	<5	<5	<5