Memorandum

Ground Floor, Suite 01, 20 Chandos Street
St Leonards, NSW, 2065
PO Box 21
St Leonards, NSW, 1590

T +61 2 9493 9500
F +61 2 9493 9599
E info@emmconsulting.com.au

www.emmconsulting.com.au

10 November 2017

To Aaron Clifton
From Susan Macolino

Subject Camden Gas Project- FY17/18 Six-monthly monitoring update – October 2017

Dear Aaron,

This memo presents the updated hydrographs for the Menangle Park and Glenlee groundwater monitoring bores to October 2017, and the water quality results for the October 2017 sampling event.

Key observations for this monitoring period (April to October 2017) are as follows:

- water levels at the Menangle Park monitoring bores show a slight response to the rainfall events in June 2017; this response decreases with depth;
- water levels at the Glenlee monitoring bore GLMB03 remain relatively stable; and
- the VWP sensors at GLMB01 and GLMB02, have not stabilised during this monitoring period. As such, the data has not been presented in this report as it is considered unreliable.

The groundwater quality results will be analysed and discussed in the next annual monitoring report.

Figures A.1 – A.4: Individual hydrographs for the Menangle Park and Glenlee sites

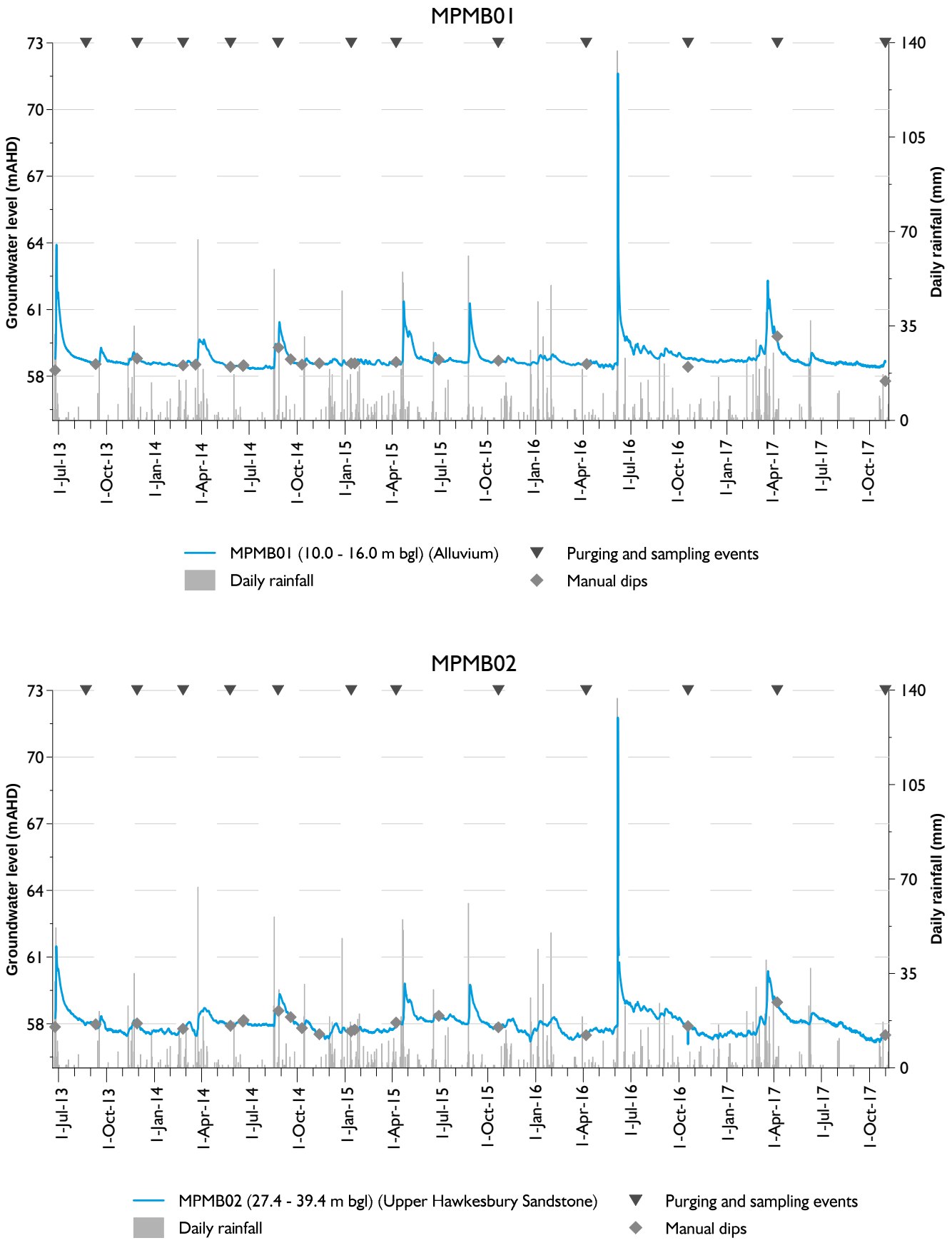
Figures A.5: Nested hydrographs for the Menangle Park and Glenlee sites

Table A.1: Water quality results for October 2017

Yours sincerely

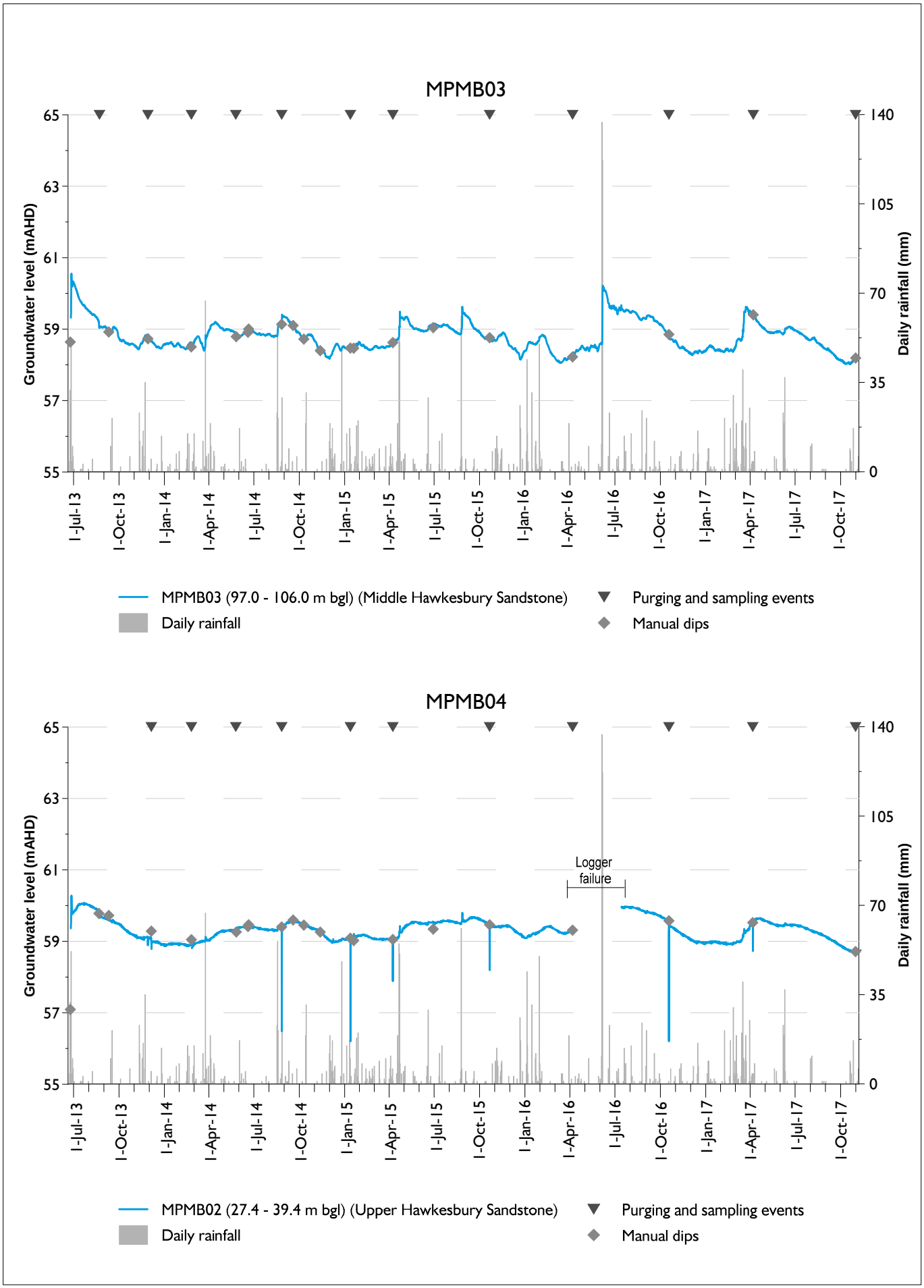
S. Macolino

Susan Macolino
Hydrogeologist
smacolino@emmconsulting.com.au
Reviewed: JD



MPMB01 and MPMB02 hydrographs

Camden Gas Project
Six-monthly Monitoring Update - October 2017
Figure A.1



MPMB03 and MPMB04 hydrographs

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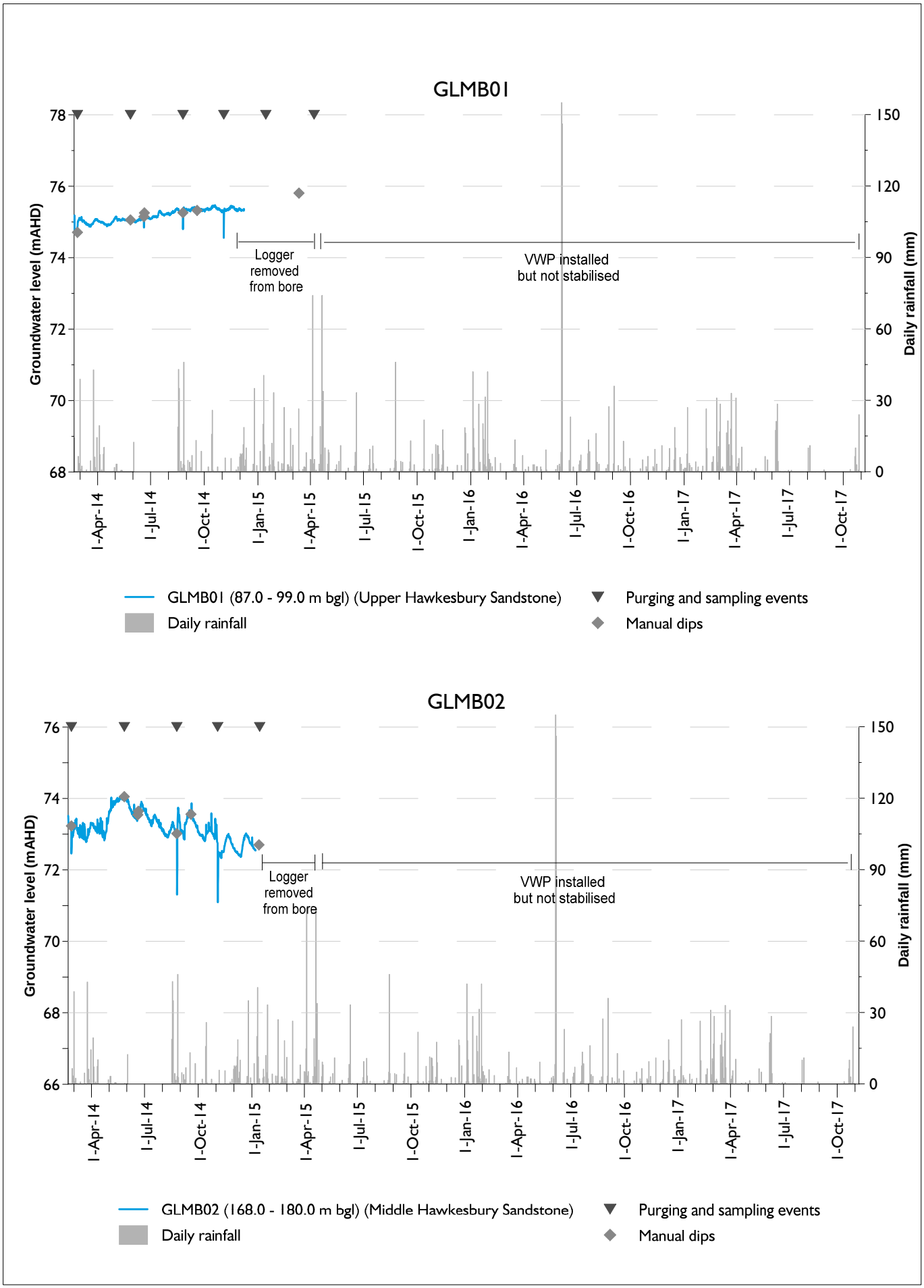
Figure A.2



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GLMB01 and GLMB02 hydrographs

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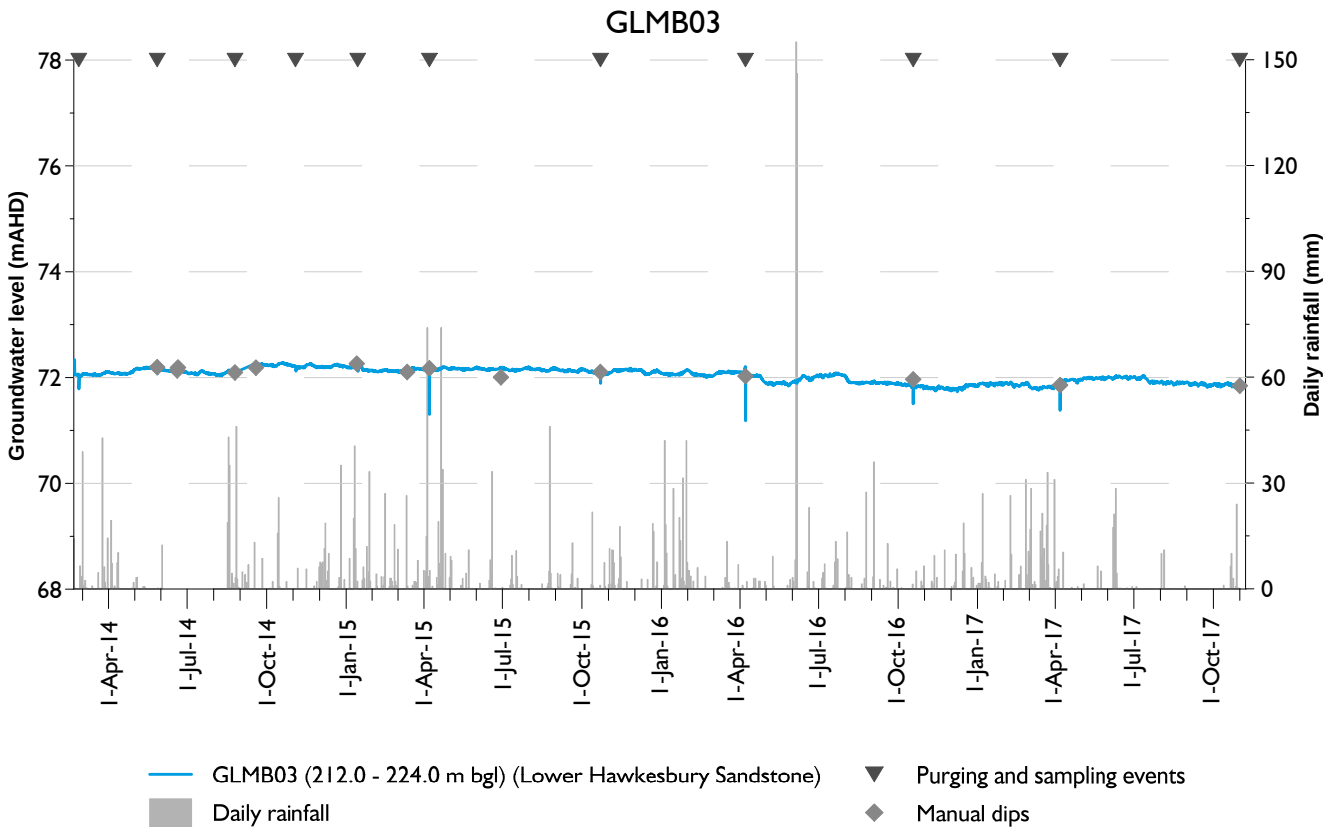
Figure A.3



GLMB03 hydrograph

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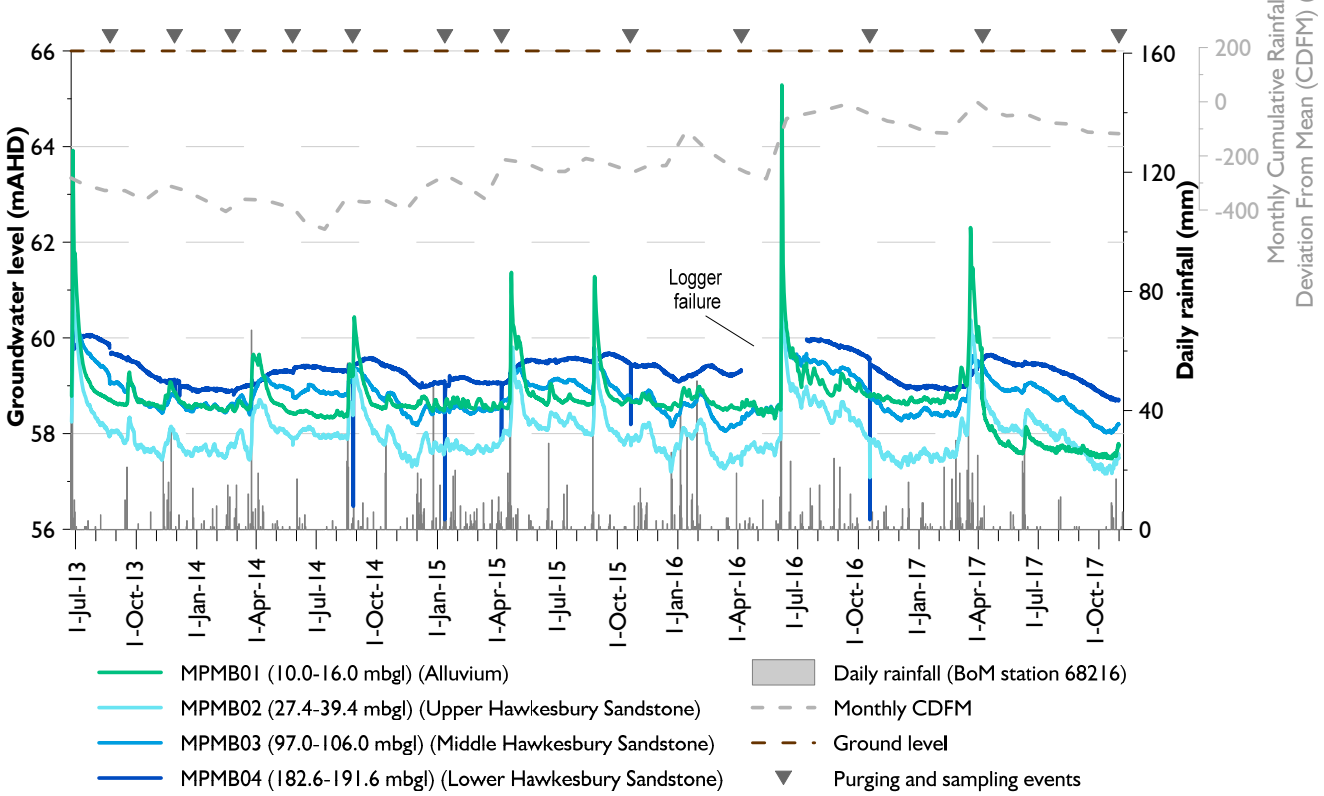
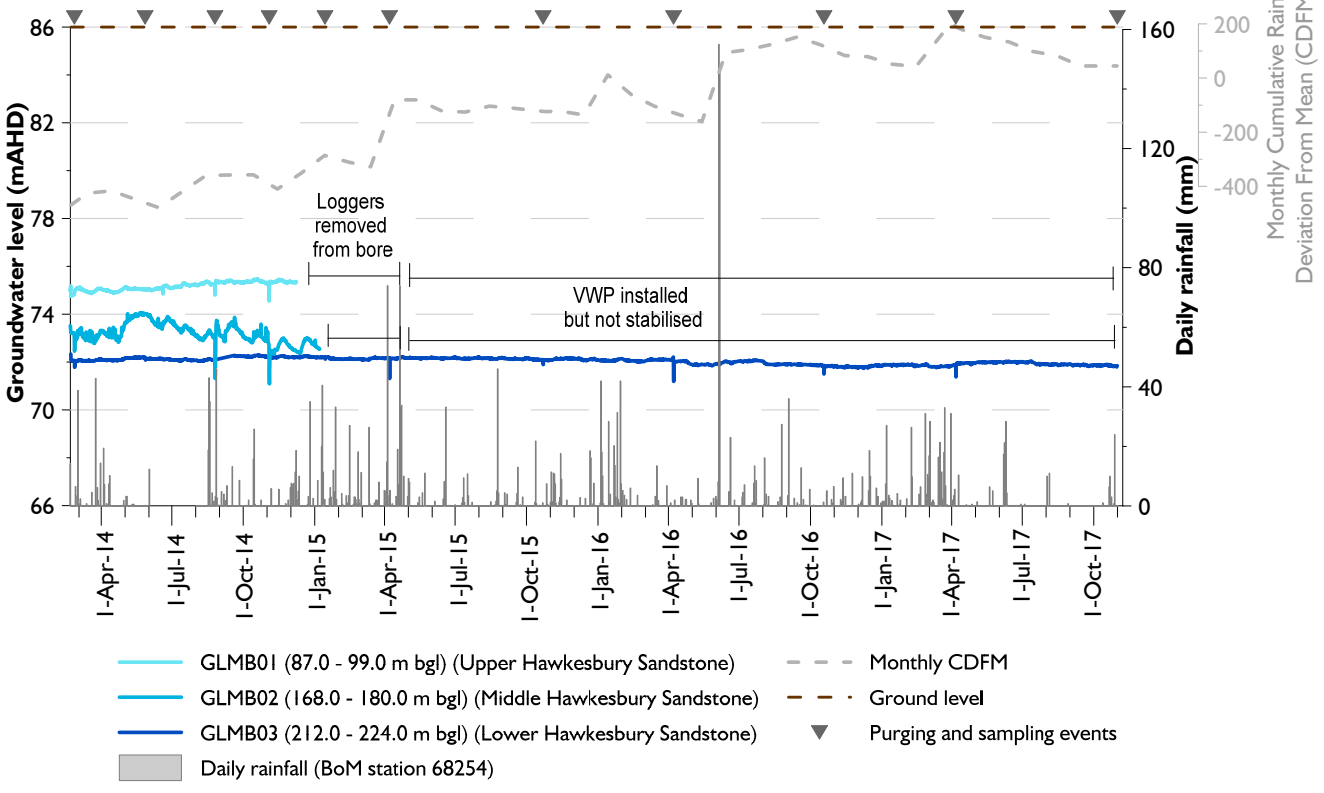
Figure A.4





MPMB and GLMB hydrographs

Camden Gas Project
Six-monthly Monitoring Update - October 2017
Figure A.5

Table A.1 Water quality results October 2017

		Field ID	GLMB03	MPMB01	MPMB02	MPMB03	MPMB04
		Date	31/10/2017	31/10/2017	31/10/2017	31/10/2017	31/10/2017
		Water level (mbgl)	14.59	9.42	9.64	8.78	8.2
	Units	EQL					
Field parameters							
Dissolved Oxygen	mg/L		1.52	0.38	0.53	1.06	0.39
pH (field)	pH units		10.24	5.04	6.49	7.55	10.22
Electrical conductivity (field)	uS/cm		2,577	720	852	1,110	499
Electrical conductivity (lab)	µS/cm	1	4,550	804	809	1,080	569
Temp (Field)	°C		21.3	20.3	19.1	19.5	19.8
Dissolved oxygen (field)	%		17.3	4.4	5.8	11.8	4.4
Total dissolved solids (field)	mg/L		1,677	468	553	722	324
Total dissolved solids (lab)	mg/L	10	2,730	436	406	568	256
Suspended solids	mg/L	5	<5	450	1,090	66	<5
Redox (field)	mV		-366.2	111	-95.9	-213.2	-371.8
Laboratory analytes							
Alkalinity (Hydroxide) as CaCO3	mg/L	1	<1	<1	<1	<1	<1
Carbonate Alkalinity-mg CaCO3/L	mg/L	1	766	<1	<1	<1	91
Bicarbonate Alkalinity-mg CaCO3/L	mg/L	1	881	14	186	519	65
Alkalinity (total) as CaCO3	mg/L	1	1,650	14	186	519	157
Sulfate as SO4 - Turbidimetric	mg/L	1	<10	2	4	<10	<10
Chloride	mg/L	1	708	251	159	65	72
Calcium	mg/L	1	30	10	35	92	2
Magnesium	mg/L	1	57	20	27	23	<1
Sodium	mg/L	1	994	105	82	113	107
Potassium	mg/L	1	37	1	3	13	6
Reactive Silica	mg/L	0.05	6.23	18.3	11.6	9.16	7.52
Fluoride	mg/L	0.1	<0.1	0.2	0.2	0.2	0.6
Bromide	mg/L	0.01	1.3	0.458	0.275	0.121	0.153
Cyanide Total	mg/L	0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Dissolved metals							
Aluminium	mg/L	0.01	<0.01	0.02	<0.01	<0.01	<0.01
Antimony	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	0.005	<0.001	0.008	0.006	0.002
Barium	mg/L	0.001	3.92	0.666	0.541	3.51	0.399
Beryllium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Bromine	mg/L	0.1	1.6	0.5	0.3	0.1	0.2
Cadmium	mg/L	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
Cobalt	mg/L	0.001	<0.001	0.044	0.002	0.001	<0.001
Copper	mg/L	0.001	0.003	0.002	<0.001	<0.001	0.002
Iron	mg/L	0.05	<0.05	0.45	3.3	2.27	<0.05
Lead	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	0.003	0.447	0.2	0.061	<0.001
Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Molybdenum	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.008
Nickel	mg/L	0.001	<0.001	0.016	0.006	<0.001	<0.001
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Strontium	mg/L	0.001	2.36	0.127	0.506	0.941	0.09
Uranium	mg/L	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
Zinc	mg/L	0.005	0.031	0.046	0.01	<0.005	0.026
Nutrients							
Ammonia (as N)	mg/L	0.01	2.65	0.04	0.09	0.98	0.76
Nitrite (as N)	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrate (as N)	mg/L	0.01	<0.01	0.29	<0.01	<0.01	<0.01
Nitrite + Nitrate as N	mg/L	0.01	<0.01	0.29	<0.01	<0.01	<0.01
Total phosphorus	mg/L	0.01	<0.01	0.22	0.18	0.05	0.01
Reactive phosphorus (as P)	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	0.01
Total organic carbon	mg/L	1	53	2	1	<1	5
Dissolved gases							
Methane	mg/L	0.01	27.2	0.072	1.07	32.5	44.2
Ethane	mg/L	0.01	0.194	<0.01	<0.01	<0.01	<0.01
Ethene	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Propane	mg/L	0.01	0.047	<0.01	<0.01	<0.01	<0.01
Propene	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Butene	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Butane	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Phenolic compounds							
Phenol	µg/L	1	2.6	<1	<1	<1	1.1
2-chlorophenol	µg/L	1	<1	<1	<1	<1	<1
2-methylphenol	µg/L	1	<1	<1	<1	<1	<1
3-&4-methylphenol	µg/L	2	<2	<2	<2	<2	<2
2-nitrophenol	µg/L	1	<1	<1	<1	<1	<1
2,4-dimethylphenol	µg/L	1	<1	<1	<1	<1	<1
2,4-dichlorophenol	µg/L	1	<1	<1	<1	<1	<1
2,6-dichlorophenol	µg/L	1	<1	<1	<1	<1	<1
4-chloro-3-methylphenol	µg/L	1	<1	<1	<1	<1	<1
2,4,6-trichlorophenol	µg/L	1	<1	<1	<1	<1	<1
2,4,5-trichlorophenol	µg/L	1	<1	<1	<1	<1	<1
Pentachlorophenol	µg/L	2	<2	<2	<2	<2	<2
Polycyclic aromatic hydrocarb							
Acenaphthene	µg/L	1	<1	<1	<1	<1	<1
Acenaphthylene	µg/L	1	<1	<1	<1	<1	<1
Fluorene	µg/L	1	<1	<1	<1	<1	<1
Phenanthrene	µg/L	1	<1	<1	<1	<1	<1
Anthracene	µg/L	1	<1	<1	<1	<1	<1
Fluoranthene	µg/L	1	<1	<1	<1	<1	<1
Pyrene	µg/L	1	<1	<1	<1	<1	<1
Benz(a)anthracene	µg/L	1	<1	<1	<1	<1	<1
Chrysene	µg/L	1	<1	<1	<1	<1	<1
Benzo(k)fluoranthene	µg/L	1	<1	<1	<1	<1	<1
Benzo(b&j)fluoranthene	µg/L	1	<1	<1	<1	<1	<1
Benzo(a) pyrene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc (Zero)	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1,2,3-c,d)pyrene	µg/L	1	<1	<1	<1	<1	<1
Dibenz(a,h)anthracene	µg/L	1	<1	<1	<1	<1	<1
Benzo(g,h,i)perylene	µg/L	1	<1	<1	<1	<1	<1
PAHs (Sum of total)	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total petroleum hydrocarbons							
C 6 - C 9 Fraction	µg/L	20	130	<20	<20	<20	40
C10 - C14 Fraction	µg/L	50	<50	<50	<50	<50	<50
C15 - C28 Fraction	µg/L	100	<100	<100	<100	<100	<100
C29 - C36 Fraction	µg/L	50	<50	<50	<50	<50	<50
TPH+C10 - C36 (Sum of total)	µg/L	50	<50	<50	<50	<50	<50
Total recoverable hydrocarbons							
C6-C10 fraction	µg/L	20	130	<20	<20	<20	40
C6 - C10 fraction minus BTEX	µg/L	20	<20	<20	<20	<20	<20
C10 - C16 fraction	µg/L	100	<100	<100	<100	<100	<100
TRH >C10-C16 less Naphthalene (F2)	µg/L	100	<100	<100	<100	<100	<100
C16 - C34 fraction	µg/L	100	<100	<100	<100	<100	<100
C34 - C40 fraction	µg/L	100	<100	<100	<100	<100	<100
C10 - C40 fraction (Sum)	µg/L	100	<100	<100	<100	<100	<100
Aromatic hydrocarbons							
Benzene	µg/L	1	<1	<1	<1	<1	<1
Toluene	µg/L	2	113	<2	<2	<2	32
Ethylbenzene	µg/L	2	<2	<2	<2	<2	<2
Xylene (m & p)	µg/L	2	<2	<2	<2	<2	<2
Xylene (o)	µg/L	2	<2	<2	<2	<2	<2
Xylene Total	µg/L	2	<2	<2	<2	<2	<2
Total BTEX	µg/L	1	113	<1	<1	<1	32
Naphthalene	µg/L	1	<1	<1	<1	<1	<1
Additional analytes							
Ionic Balance	%	0.01	2.48	4.7	4.23	1.97	2.58
Cations Total	meq/L	0.01	50.4	6.74	7.61	11.7	4.91
pH (Lab)	pH_Units	0.01	9.35	5.69	6.99	7.58	9.64
Anions Total	meq/L	0.01	52.9	7.4	8.28	12.2	5.17

Note: mbgl - metres below ground level; EQL - laboratory estimated quantitation limit