

# Memorandum



Ground floor, 20 Chandos Street  
St Leonards NSW 2065  
PO Box 21  
St Leonards NSW 1590

T 02 9493 9500

E [info@emmconsulting.com.au](mailto:info@emmconsulting.com.au)

[www.emmconsulting.com.au](http://www.emmconsulting.com.au)

13 May 2021

To: Nicola Gardner  
From: Steve Rocks  
Subject: Camden Gas Project- FY20/21 Six-monthly monitoring update – April 2021

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Dear Nicola,

This memo presents the updated hydrographs for the Menangle Park and Glenlee groundwater monitoring bores in Figures A.1 to A.5, and the water quality results for the April 2021 sampling event in Table A.1, including the Nepean River. Results are presented for samples taken on 13 April 2021.

Key observations for this monitoring period (November 2020 to April 2021) are:

- Groundwater levels at the Menangle Park monitoring bores remain within the historic range with no increasing or decreasing overall trend identified. Bores MPMB01, MPMB02, MPMB03 and MPMB04 showed a short-term response to high rainfall events in March 2021 (Figures A.1 and A.2). The high rainfall event (236 mm over six days) in March 2021 led to significant flooding in the vicinity of the Menangle Park bores which were temporarily inundated. The bores were inspected during the April monitoring event for possible flood damage, however their condition appears to remain unaffected.
- The barometric datalogger located at Menangle Park stopped recording between 24 and 29 March 2021. This gap coincided with the March flood event and is therefore attributed to a temporary malfunction of the datalogger, likely due to its submersion during the inundation. The datalogger appears to have returned to normal functioning after this period. EMM will monitor the performance of the datalogger and replace it if the issue reoccurs.
- The datalogger at Glenlee monitoring bore GLMB03 was again malfunctioning and groundwater level data could not be retrieved during this monitoring round. This datalogger had already been replaced on 14 December 2020 because of a malfunction. A new datalogger was installed during this monitoring round (on 13 April 2021) and the faulty datalogger will be sent to a service technician for inspection and data retrieval. If retrieved, groundwater level data at GLMB03 will be presented and analysed in the next annual water monitoring report that will be issued in September 2021. It is noted that gas wells at this site are being rehabilitated (pressure cemented, plugged and abandoned) and repeated datalogger malfunctions may be related to changes in formation pressures in this area.
- As previously noted, the vibrating wire piezometer (VWP) sensors at GLMB01 and GLMB02 stabilised at lower piezometric pressure head levels compared with pressures observed from the former standpipe monitoring bores prior to conversion to VWPs. These data are not considered representative of formation pressures, potentially due to interference from the gravel pack surrounding the piezometers. Although the absolute pressure values post-VWP installation are not representative of formation pressures, the trends in the data are and are therefore still useful. Both VWPs have recorded stable trends over the monitoring period.

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

The results are included in the following attached figures and table:

- 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; and
- Table A.1: Water quality results for April 2021.

Yours sincerely

A handwritten signature in black ink, appearing to read 'Steve Rocks', written in a cursive style.

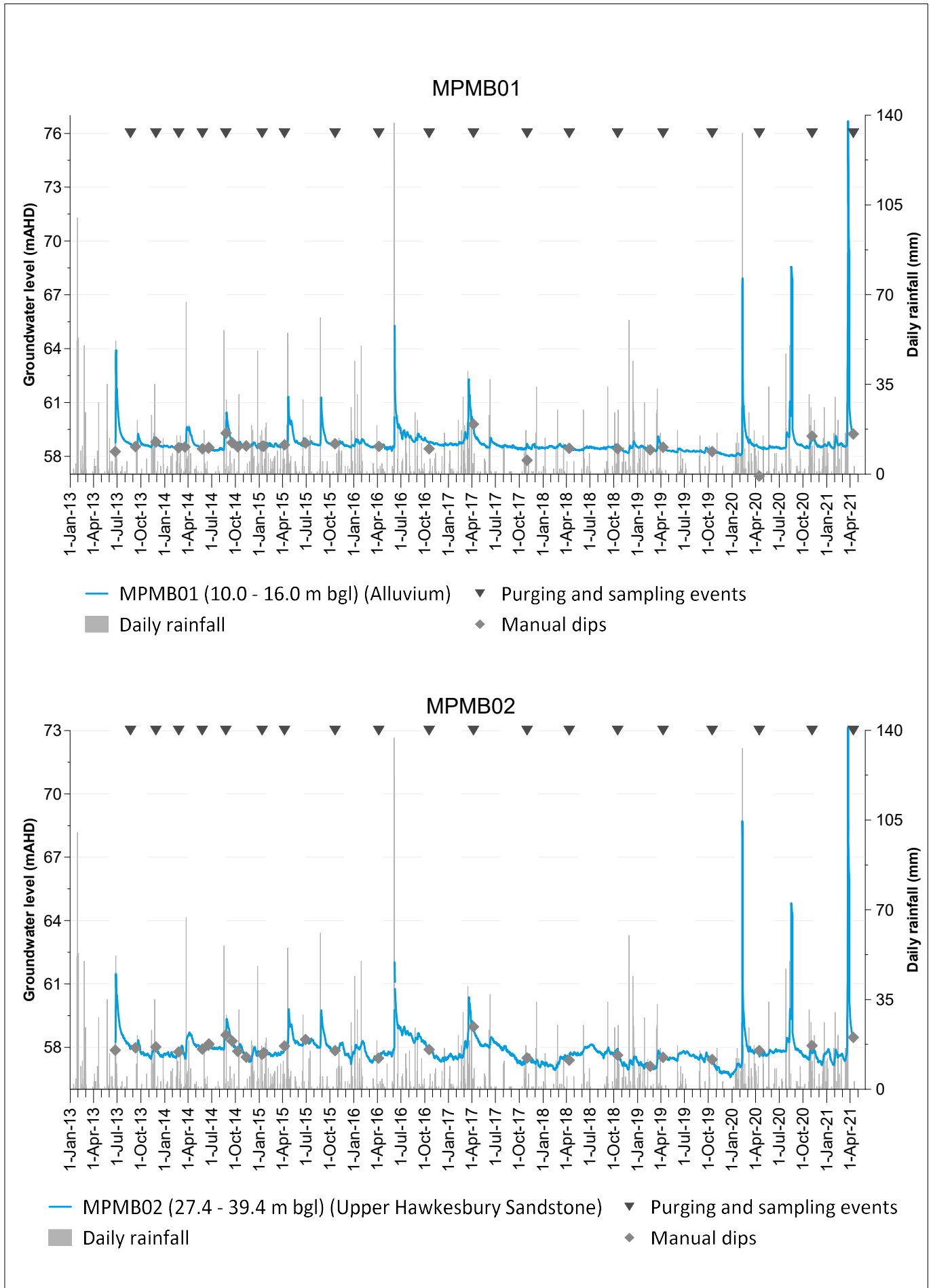
**Steve Rocks**  
Hydrogeologist  
[srocks@emmconsulting.com.au](mailto:srocks@emmconsulting.com.au)

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Appendix A

# Water Quality Results and Hydrographs

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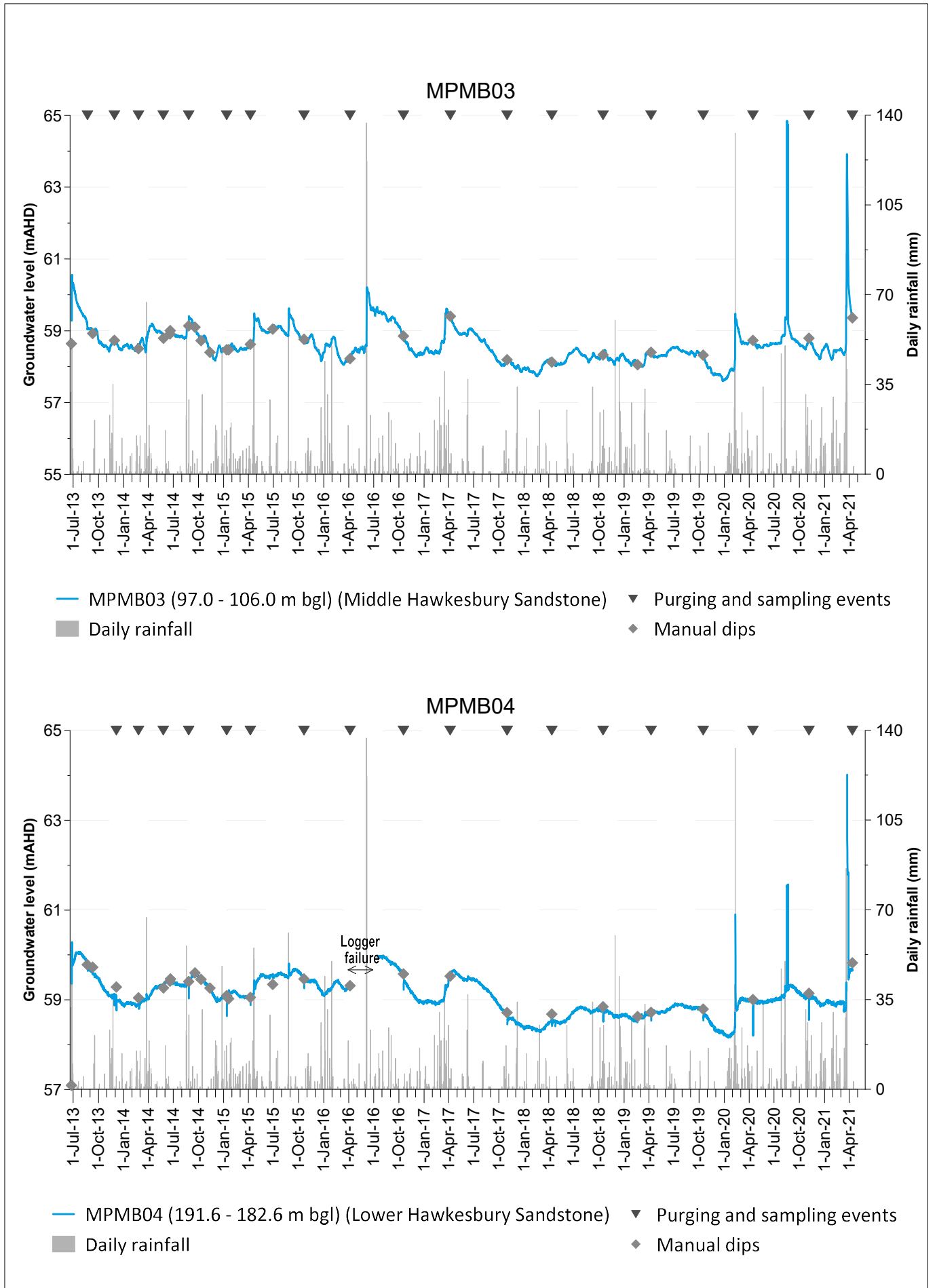


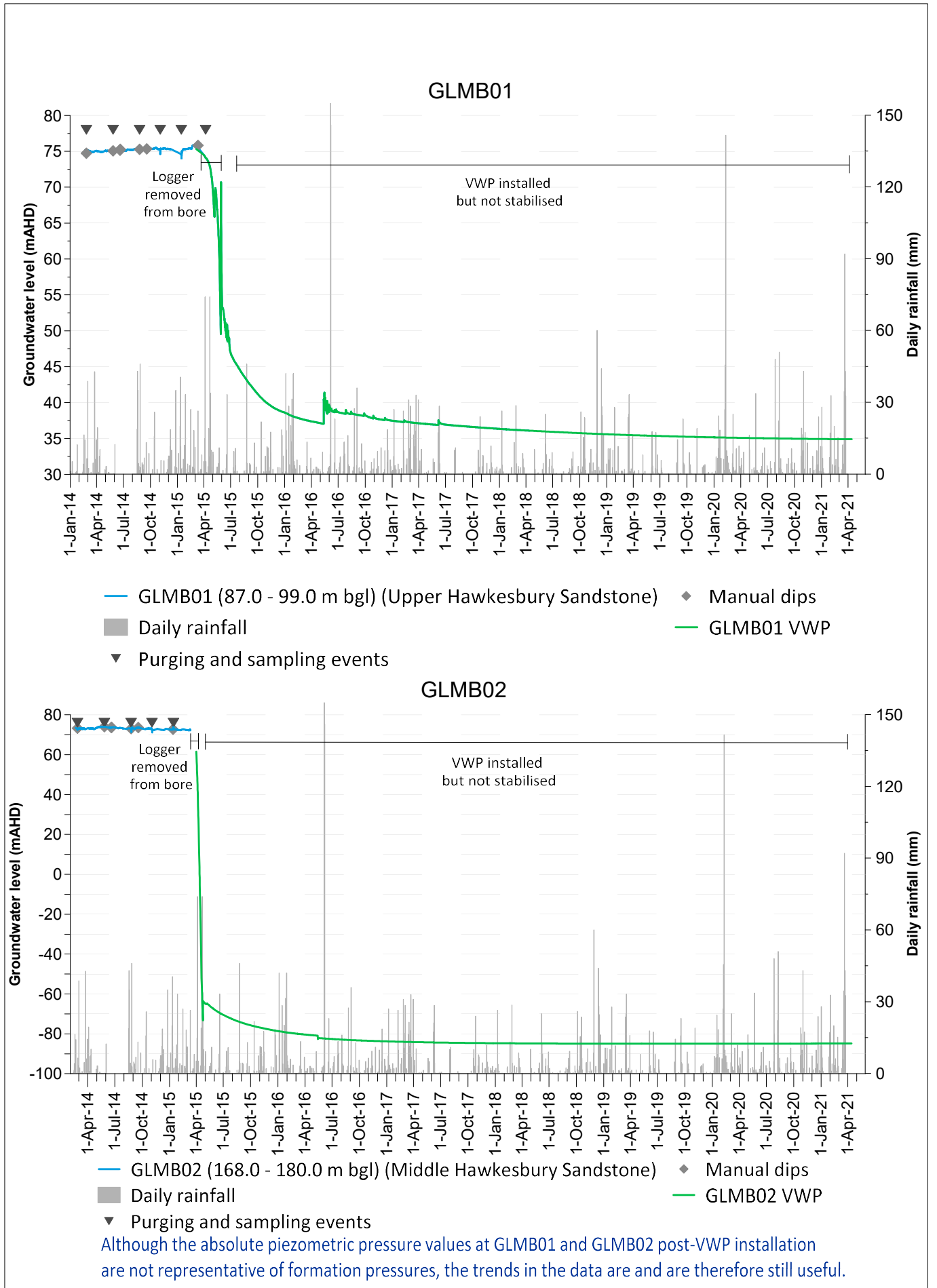
**MPMB01 and MPMB02 hydrographs**

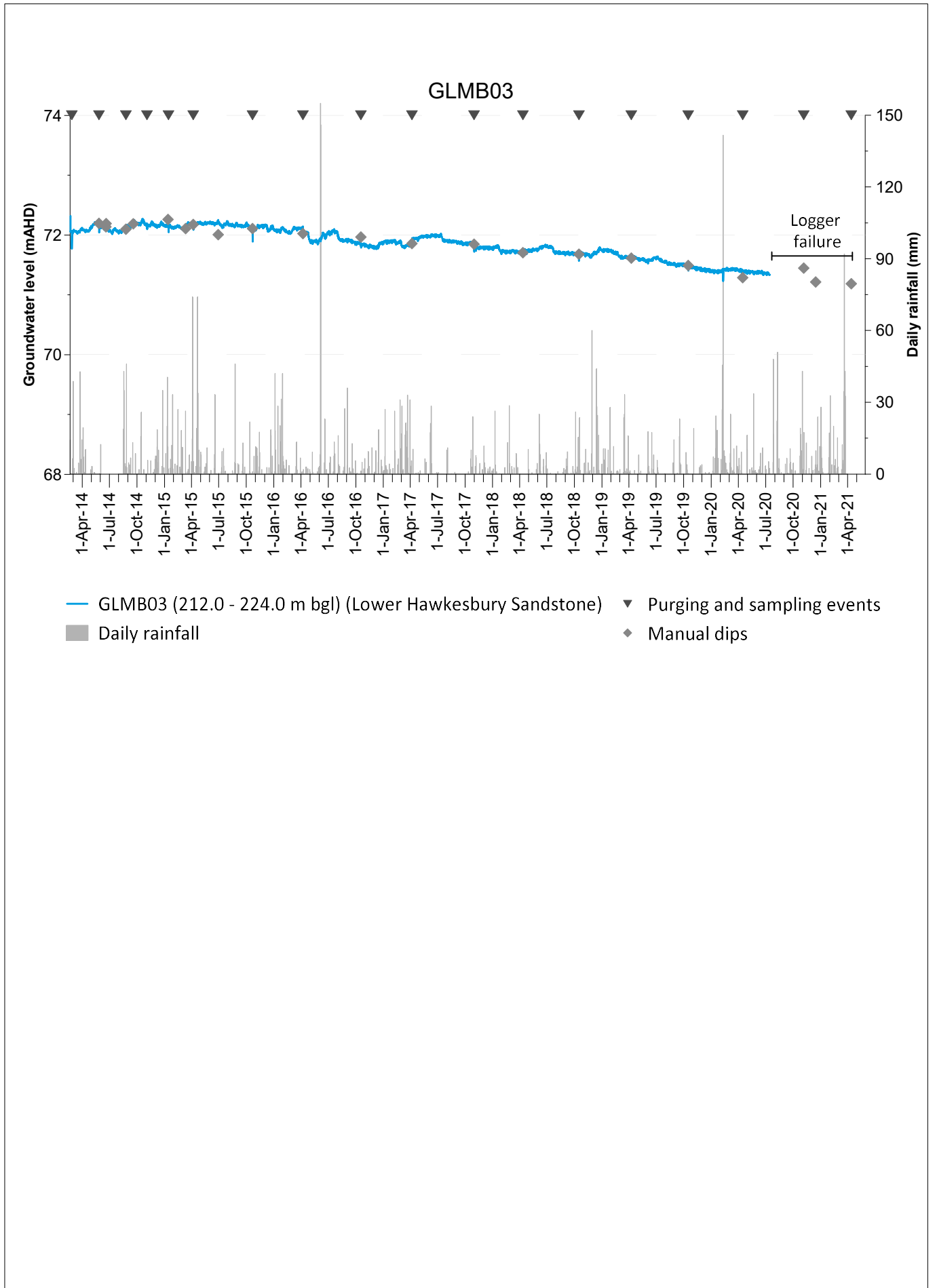
Camden Gas Project

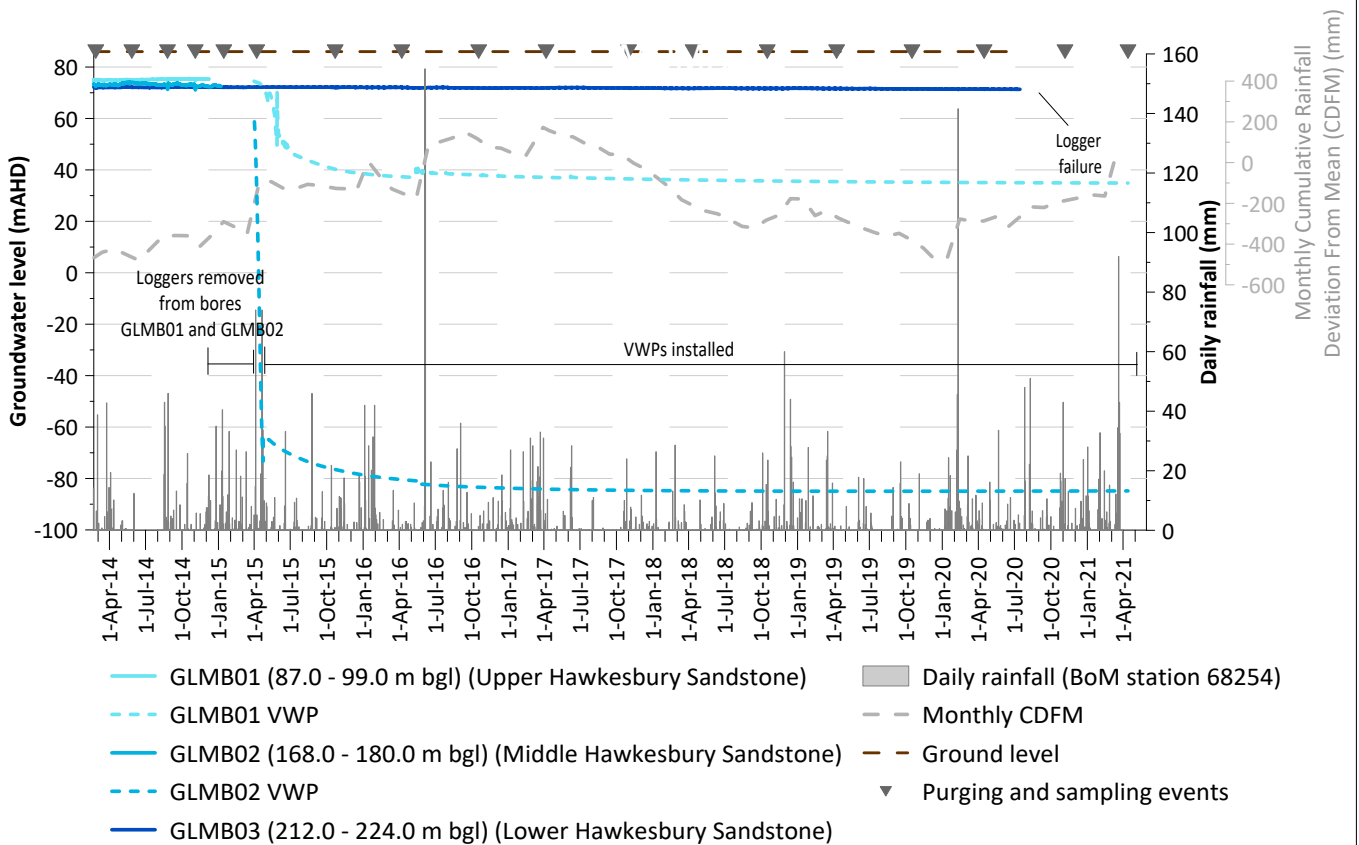
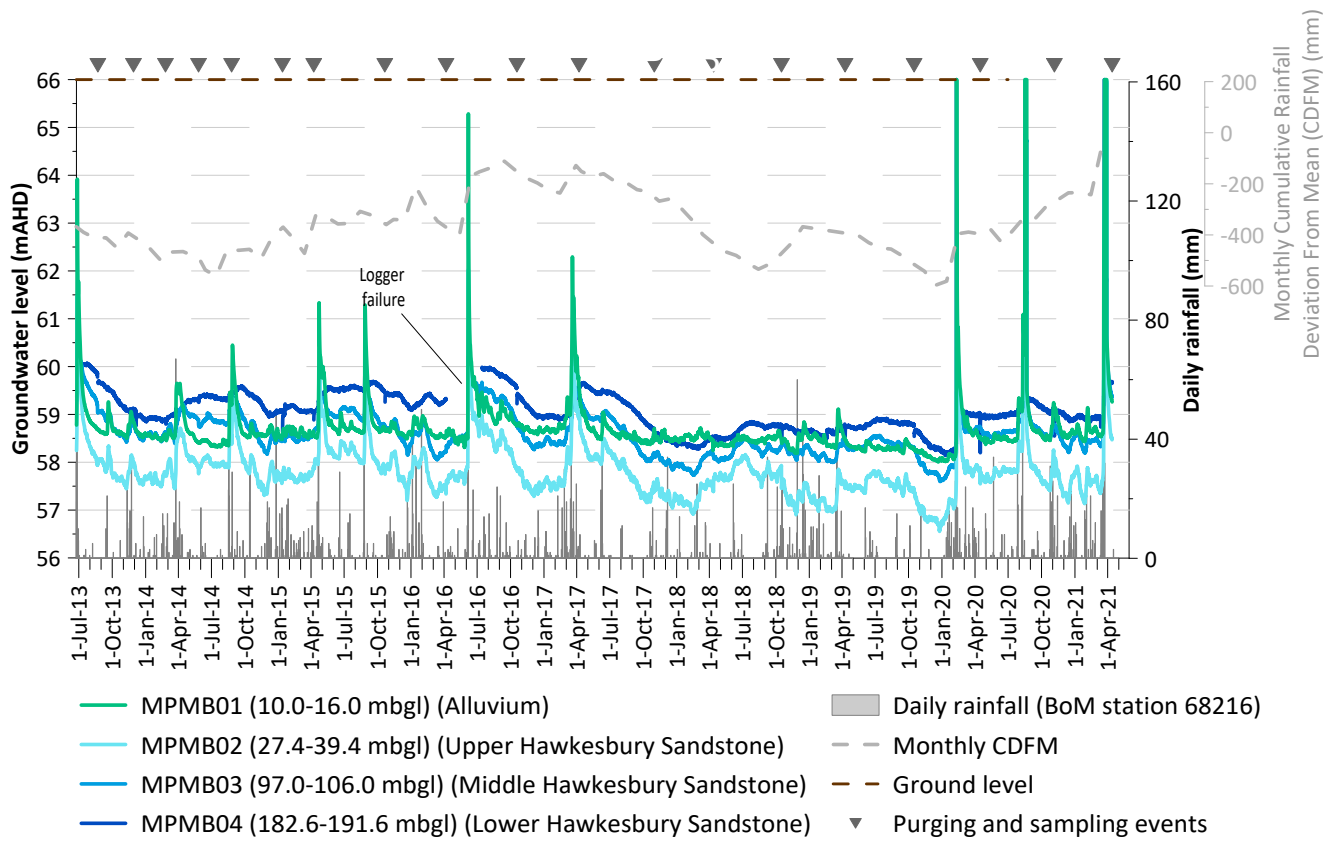
Six-monthly event - April 2021

Figure A.1









Although the absolute piezometric pressure values at GLMB01 and GLMB02 post-VWP installation are not representative of formation pressures, the trends in the data are and are therefore still useful.



Table A.1 Water quality results six-monthly monitoring event - April 2021

Field ID	Date	GLMB03	MPMB01	MPMB02	MPMB03	MPMB04	Nepean River	
		13/04/2021	13/04/2021	13/04/2021	13/04/2021	13/04/2021	13/04/2021	
	Water level (mbgl)	15.25	7.95	8.66	7.61	7.09	N/A	
	Units	EQL						
<b>Field parameters</b>								
Dissolved Oxygen	mg/L	0.01	0.20	0.04	1.53	0.00	6.30	
pH (field)	pH units	10.98	5.24	6.59	6.72	8.94	7.40	
Electrical conductivity (field)	µS/cm	3144.00	574.00	385.40	210.70	363.60	102.70	
Electrical conductivity (lab)	µS/cm	1	4420.00	739.00	525.00	494.00	128.00	
Temp (Field)	°C	24.4	20.0	22.0	22.8	21.5	21.8	
Dissolved oxygen (field)	%	0.1	11.1	0.5	18.4	0.0	72.8	
Total dissolved solids (field)	mg/L	2041.0	559.0	263.9	137.2	236.0	67.0	
Total dissolved solids (lab)	mg/L	10	2450.0	445.0	300.0	336.0	74.0	
Suspended solids	mg/L	5	20	392	44	9	10	
Redox (field)	mV		-116.0	123.1	-3.9	-134.4	-113.0	
<b>Laboratory analytes</b>								
pH (Lab)	pH Units	0.01	10.8	5.97	6.99	6.99	8.73	7.11
Alkalinity (Hydroxide) as CaCO3	mg/L	1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity-mg CaCO3/L	mg/L	1	1,350	<1	<1	<1	19	<1
Bicarbonate Alkalinity-mg CaCO3/L	mg/L	1	7	26	135	135	193	24
Alkalinity (total) as CaCO3	mg/L	1	1,360	26	135	135	212	24
Sulfate as SO4 - Turbidimetric	mg/L	1	5	3	6	6	<1	4
Chloride	mg/L	1	633	209	87	87	28	22
Calcium	mg/L	1	6	10	19	19	8	3
Magnesium	mg/L	1	10	17	19	19	5	3
Sodium	mg/L	1	919	92	53	53	92	17
Potassium	mg/L	1	36	2	3	3	11	2
Reactive Silica	mg/L	0.05	0.5	15.9	9	9	3.33	2.87
Fluoride	mg/L	0.1	<0.1	<0.1	0.1	0.1	0.1	<0.1
Bromide	mg/L	0.01	1.7	0.483	0.198	0.198	0.069	0.055
Cyanide Total	mg/L	0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
<b>Dissolved metals</b>								
Aluminium	mg/L	0.01	<0.01	<0.01	<0.01	0.03	<0.01	0.06
Antimony	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	<0.001	<0.001	0.012	0.003	<0.001	<0.001
Barium	mg/L	0.001	0.822	0.484	0.282	0.329	0.954	0.028
Beryllium	mg/L	0.001	<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	<0.05
Bromine	mg/L	0.1	1.5	0.5	0.2	0.2	<0.1	<0.1
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	0.027	0.005	0.002	<0.001	<0.001
Copper	mg/L	0.001	0.003	<0.001	<0.001	<0.001	0.005	<0.001
Iron	mg/L	0.05	<0.05	<0.05	2.64	2.64	<0.05	0.28
Lead	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	<0.001	0.375	0.199	0.636	0.007	0.029
Mercury	mg/L	0.0001	<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	<0.001	<0.001
Nickel	mg/L	0.001	<0.001	0.011	0.007	0.002	<0.001	<0.001
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Strontium	mg/L	0.001	1.5	0.111	0.222	0.222	0.234	0.024
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	0.005	<0.005	0.034	0.006	<0.005	0.06	0.005
<b>Nutrients</b>								
Ammonia (as N)	mg/L	0.01	3.01	0.03	0.1	0.1	0.64	0.02
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	0.46	<0.01	<0.01	<0.01	0.11
Nitrite + Nitrate as N	mg/L	0.01	<0.01	0.46	<0.01	<0.01	<0.01	0.11
Total phosphorus	mg/L	0.01	<0.01	0.24	0.04	0.04	<0.01	0.01
Reactive phosphorus (as P)	mg/L	0.01	<0.01	<0.01	0.02	0.02	<0.01	<0.01
Total organic carbon	mg/L	1	<1	<1	<1	<1	18	6
<b>Dissolved gases</b>								
Methane	µg/L	10	7,220	15	321	321	32,600	<10
Ethane	µg/L	10	69	<10	<10	<10	<10	<10
Ethene	µg/L	10	<10	<10	<10	<10	<10	<10
Propane	µg/L	10	28	<10	<10	<10	<10	<10
Propene	µg/L	10	<10	<10	<10	<10	<10	<10
Butene	µg/L	10	<10	<10	<10	<10	<10	<10
Butane	µg/L	10	<10	<10	<10	<10	<10	<10
<b>Phenolic compounds</b>								
Phenol	µg/L	1	<1	<1	<1	<1	<1	<1
2-chlorophenol	µg/L	1	<1	<1	<1	<1	<1	<1
2-methylphenol	µg/L	1	<1	<1	<1	<1	<1	<1
3-&4-methylphenol	µg/L	2	<2	<2	<2	<2	2.1	<2
2-nitrophenol	µg/L	1	<1	<1	<1	<1	<1	<1
2,4-dimethylphenol	µg/L	1	<1	<1	<1	<1	<1	<1
2,4-dichlorophenol	µg/L	1	<1	<1	<1	<1	<1	<1
2,6-dichlorophenol	µg/L	1	<1	<1	<1	<1	<1	<1
4-chloro-3-methylphenol	µg/L	1	<1	<1	<1	<1	<1	<1
2,4,6-trichlorophenol	µg/L	1	<1	<1	<1	<1	<1	<1
2,4,5-trichlorophenol	µg/L	1	<1	<1	<1	<1	<1	<1
Pentachlorophenol	µg/L	2	<2	<2	<2	<2	<2	<2
<b>Polycyclic aromatic hydrocarb</b>								
Acenaphthene	µg/L	1	<1	<1	<1	<1	<1	<1
Acenaphthylene	µg/L	1	<1	<1	<1	<1	<1	<1
Fluorene	µg/L	1	<1	<1	<1	<1	<1	<1
Phenanthrene	µg/L	1	<1	<1	<1	<1	<1	<1
Anthracene	µg/L	1	<1	<1	<1	<1	<1	<1
Fluoranthene	µg/L	1	<1	<1	<1	<1	<1	<1
Pyrene	µg/L	1	<1	<1	<1	<1	<1	<1
Benz(a)anthracene	µg/L	1	<1	<1	<1	<1	<1	<1
Chrysene	µg/L	1	<1	<1	<1	<1	<1	<1
Benzo(k)fluoranthene	µg/L	1	<1	<1	<1	<1	<1	<1
Benzo(b&j)fluoranthene	µg/L	1	<1	<1	<1	<1	<1	<1
Benzo(a) pyrene	µg/L	0.5	<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	<0.5
Indeno(1,2,3-c,d)pyrene	µg/L	1	<1	<1	<1	<1	<1	<1
Dibenz(a,h)anthracene	µg/L	1	<1	<1	<1	<1	<1	<1
Benzo(g,h,i)perylene	µg/L	1	<1	<1	<1	<1	<1	<1
PAHs (Sum of total)	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
<b>Total petroleum hydrocarbons</b>								
C 6 - C 9 Fraction	µg/L	20	90	<20	<20	<20	<20	<20
C10 - C14 Fraction	µg/L	50	<50	<50	<50	<50	<50	<50
C15 - C28 Fraction	µg/L	100	<100	<100	<100	<100	<100	<100
C29 - C36 Fraction	µg/L	50	<50	<50	<50	<50	<50	<50
TPH+C10 - C36 (Sum of total)	µg/L	50	<50	<50	<50	<50	<50	<50
<b>Total recoverable hydrocarbons</b>								
C6-C10 fraction	µg/L	20	90	<20	<20	<20	<20	<20
C6 - C10 fraction minus BTEX	µg/L	20	20	<20	<20	<20	<20	<20
C10 - C16 fraction	µg/L	100	<100	<100	<100	<100	<100	<100
TRH >C10-C16 less Naphthalene (F2)	µg/L	100	<100	<100	<100	<100	<100	<100
C16 - C34 fraction	µg/L	100	<100	<100	<100	<100	<100	<100
C34 - C40 fraction	µg/L	100	<100	<100	<100	<100	<100	<100
C10 - C40 fraction (Sum)	µg/L	100	<100	<100	<100	<100	<100	<100
<b>Aromatic hydrocarbons</b>								
Benzene	µg/L	1	<1	<1	<1	<1	<1	<1
Toluene	µg/L	2	69	<2	<2	<2	11	<2
Ethylbenzene	µg/L	2	<2	<2	<2	<2	<2	<2
Xylene (m & p)	µg/L	2	<2	<2	<2	<2	<2	<2
Xylene (o)	µg/L	2	<2	<2	<2	<2	<2	<2
Xylene Total	µg/L	2	<2	<2	<2	<2	<2	<2
Total BTEX	µg/L	1	69	<1	<1	<1	11	<1
Naphthalene	µg/L	1	<5	<5	<5	<5	<5	<5

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