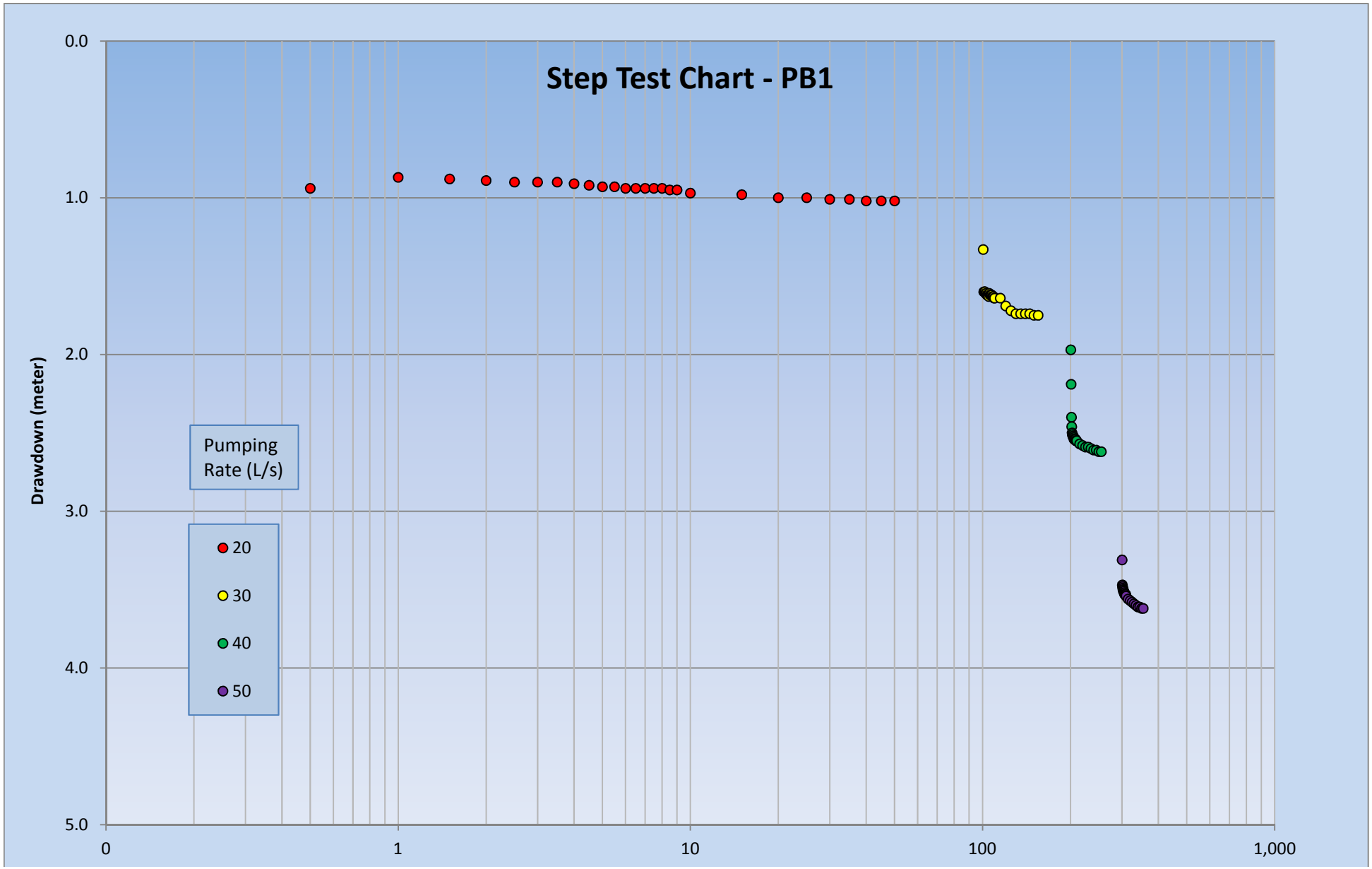
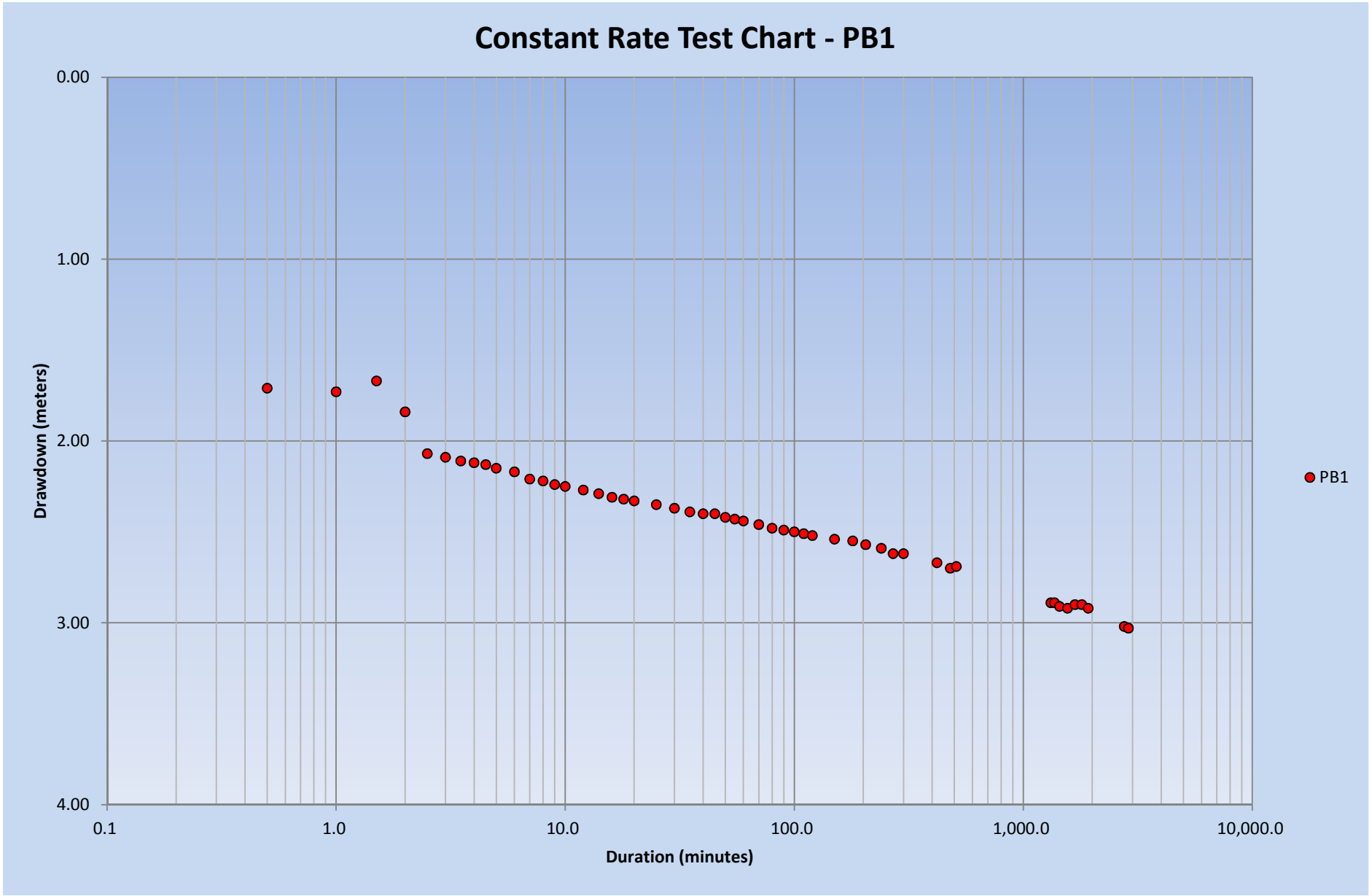
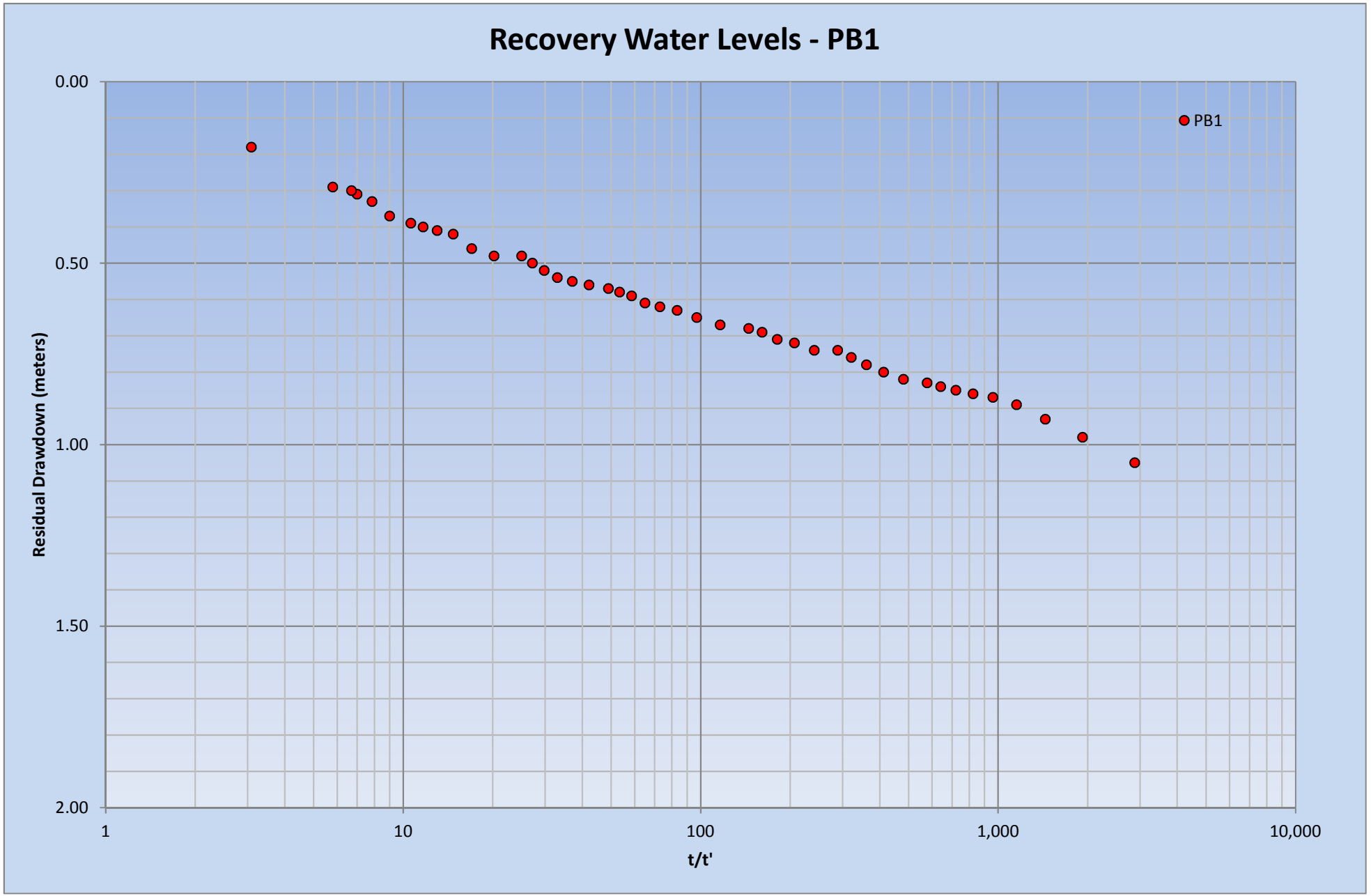
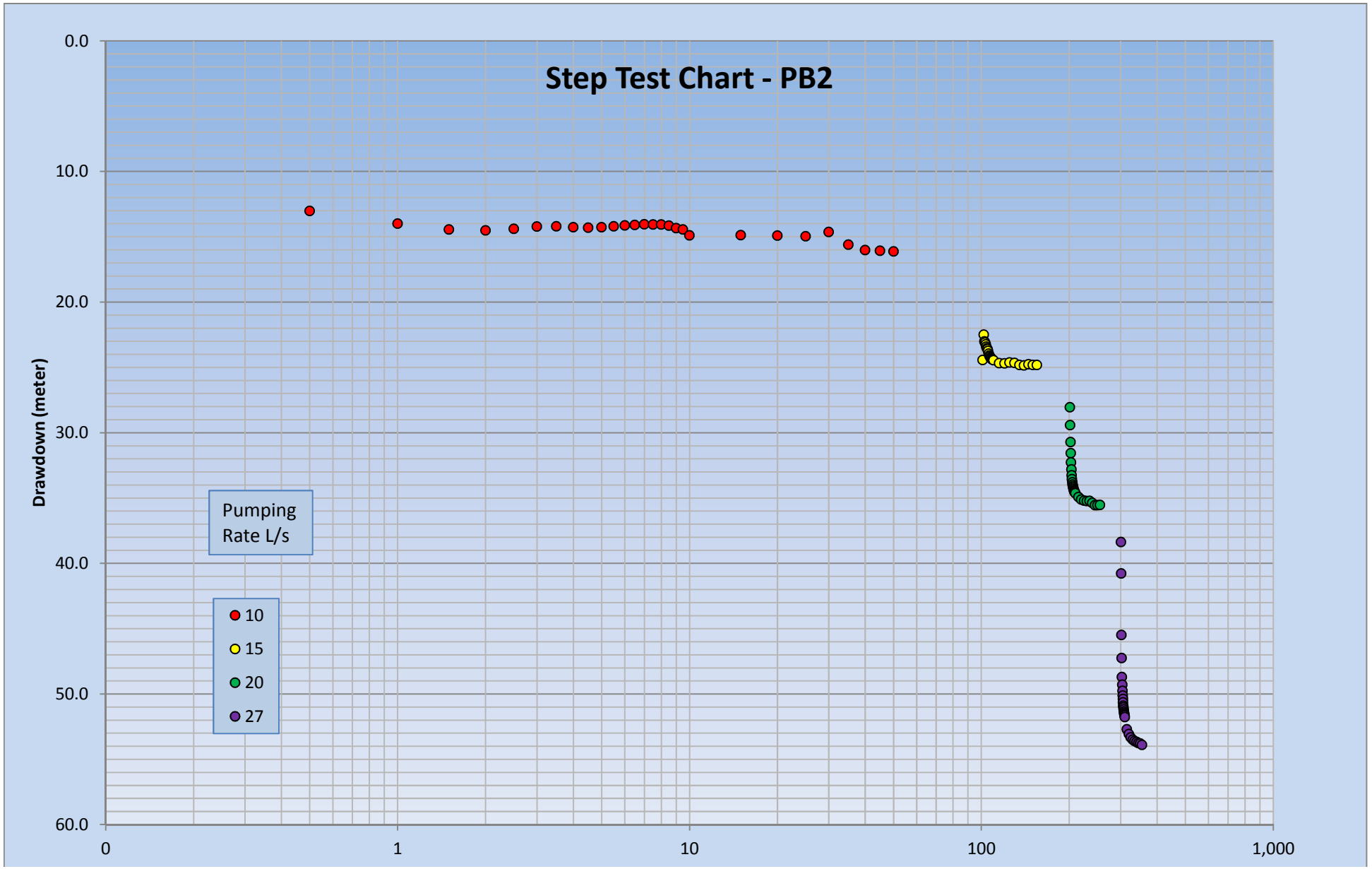
APPENDIX C

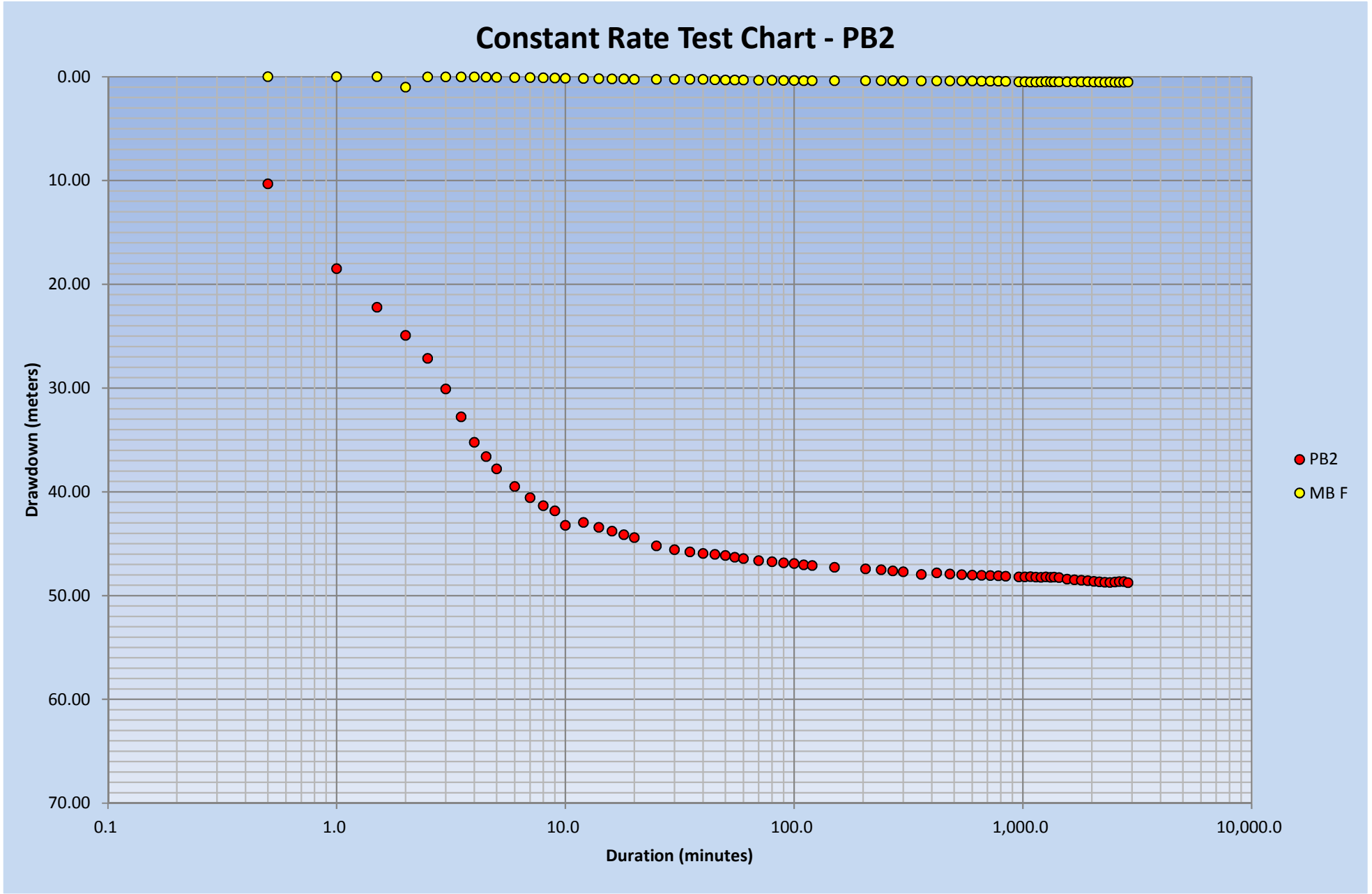
Aquifer Test Data

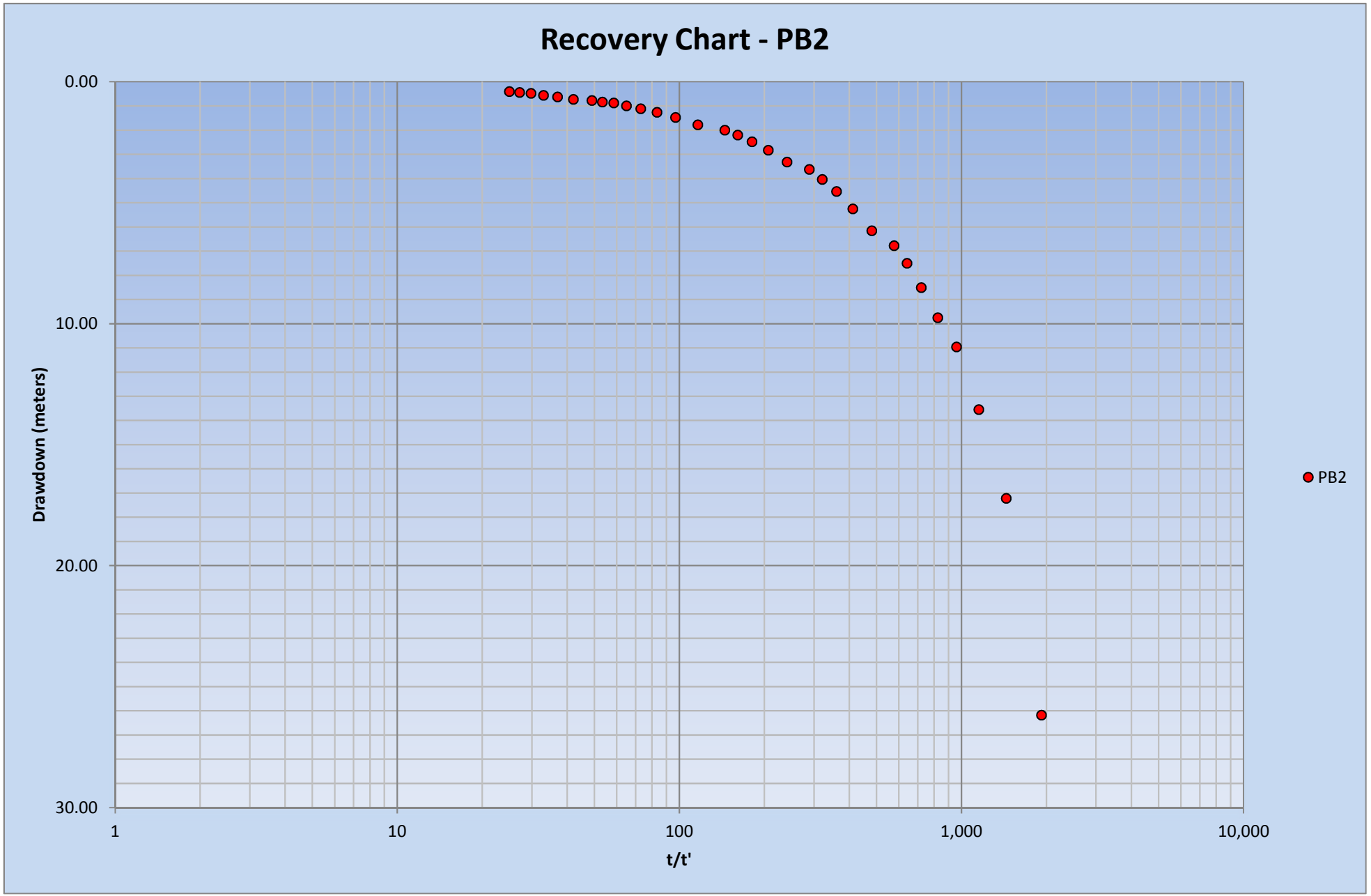

Step Test Chart - PB1
Drawdown (meter)
0.0
1.0
2.0
3.0
4.0
5.0
0
1
10
100
1,000
Pumping Rate (L/s)
20
30
40
50


Constant Rate Test Chart - PB1
0.00
1.00
2.00
3.00
4.00
Drawdown (meters)
0.1
1.0
10.0
100.0
1,000.0
10,000.0
Duration (minutes)
PB1


Recovery Water Levels - PB1
0.00
0.50
1.00
1.50
2.00
Residual Drawdown (meters)
1
10
100
1,000
10,000
t/t'
PB1


Step Test Chart - PB2
Drawdown (meter)
0.0
10.0
20.0
30.0
40.0
50.0
60.0
0
1
10
100
1,000
Pumping Rate L/s
10
15
20
27


Constant Rate Test Chart - PB2
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
Drawdown (meters)
0.1
1.0
10.0
100.0
1,000.0
10,000.0
Duration (minutes)
PB2
MB F


Recovery Chart - PB2
0.00
10.00
20.00
30.00
Drawdown (meters)
1
10
100
1,000
10,000
t/t'
PB2

APPENDIX D

Water Quality

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS		LABORATORY DETAILS	
Contact	Jane Puthiaparampil	Manager	Ros Ma
Client	AQ2	Laboratory	SGS Perth Environmental
Address	PO BOX 976 SOUTH PERTH WA 6951	Address	28 Reid Rd Perth Airport WA 6105
Telephone	61 8 93238821	Telephone	(08) 9373 3500
Facsimile	(Not specified)	Facsimile	(08) 9373 3556
Email	Jane.P@aq2.com.au	Email	au.environmental.perth@sgs.com
Project	**Iron Valley 013B**	SGS Reference	**PE099816 R0**
Order Number	(Not specified)	Report Number	0000109783
Samples	16	Date Reported	01 Jul 2015
Date Started	25 Jun 2015	Date Received	23 Jun 2015

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(898/20210).

Metals: The over range results on ICPMS Method AN318 were reported using ICPOES method AN320.

SIGNATORIES

Hue Thanh Ly
Metals Team Leader

Mary Ann Ola-A
Inorganics Team Leader

Michael McKay
Inorganics and ARD Supervisor

Ohmar David
Metals Chemist

Ros Ma
Laboratory Manager

Parameter	Units	LOR	Sample Number: PE099816.001 Sample Matrix: Water Sample Date: 16/6/15 14:02 Sample Name: MBA	PE099816.002 Water 15/6/15 16:20 MBCa	PE099816.003 Water 16/6/15 7:50 MBD	PE099816.004 Water 18/6/15 10:10 MBE
pH in water Method: AN101 Tested: 23/6/2015						
pH**	pH Units	-	8.4	8.5	8.3	8.3
Conductivity and TDS by Calculation - Water Method: AN106 Tested: 23/6/2015						
Conductivity @ 25 C	µS/cm	2	730	830	890	800
Total Dissolved Solids (TDS) in water Method: AN113 Tested: 30/6/2015						
Total Dissolved Solids Dried at 175-185°C	mg/L	10	420	490	500	460
Alkalinity Method: ME-AU-ENVAN135 Tested: 23/6/2015						
Total Alkalinity as CaCO3	mg/L	5	230	270	300	260
Carbonate Alkalinity as CO3	mg/L	1	5	8	<1	<1
Bicarbonate Alkalinity as HCO3	mg/L	5	270	310	360	320
Chloride by Discrete Analyser in Water Method: AN274 Tested: 25/6/2015						
Chloride, Cl	mg/L	1	82	90	95	88
Sulphate in water Method: AN275 Tested: 25/6/2015						
Sulphate, SO4	mg/L	1	43	55	56	49
Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 25/6/2015						
Calcium, Ca	mg/L	0.2	42	44	48	43
Magnesium, Mg	mg/L	0.1	38	44	48	43
Potassium, K	mg/L	0.1	7.5	9.6	8.9	8.4
Sodium, Na	mg/L	0.5	46	56	57	53

Parameter	Units	LOR	Sample Number: PE099816.001 Sample Matrix: Water Sample Date: 16/6/15 14:02 Sample Name: MBA	PE099816.002 Water 15/6/15 16:20 MBCa	PE099816.003 Water 16/6/15 7:50 MBD	PE099816.004 Water 18/6/15 10:10 MBE
Trace Metals (Total) in Water by ICPMS Method: AN022/AN318 Tested: 25/6/2015						
Total Iron	µg/L	5	<5	**74**	**13**	<5
Trace Metals (Dissolved) in Water by ICPMS Method: AN318 Tested: 25/6/2015						
Aluminium, Al	µg/L	5	<5	**24**	<5	<5
Arsenic, As	µg/L	1	<1	**1**	<1	<1
Cadmium, Cd	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Chromium, Cr	µg/L	1	<1	<1	<1	<1
Copper, Cu	µg/L	1	<1	<1	<1	<1
Lead, Pb	µg/L	1	<1	<1	<1	<1
Manganese, Mn	µg/L	1	**1**	**9**	**36**	<1
Nickel, Ni	µg/L	1	<1	**1**	<1	<1
Selenium, Se	µg/L	1	<1	<1	<1	<1
Zinc, Zn	µg/L	5	<5	**16**	<5	<5
Mercury (dissolved) in Water Method: AN311/AN312 Tested: 29/6/2015						
Mercury	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005

Parameter	Units	LOR	Sample Number: PE099816.005 Sample Matrix: Water Sample Date: 14/6/15 12:55 Sample Name: MBF	PE099816.006 Water 14/6/15 15:20 MBG	PE099816.007 Water 16/6/15 10:35 MBH	PE099816.008 Water 17/6/15 10:25 MBJ
pH in water Method: AN101 Tested: 23/6/2015						
pH**	pH Units	-	8.3	8.4	8.4	8.2
Conductivity and TDS by Calculation - Water Method: AN106 Tested: 23/6/2015						
Conductivity @ 25 C	µS/cm	2	840	900	820	340
Total Dissolved Solids (TDS) in water Method: AN113 Tested: 30/6/2015						
Total Dissolved Solids Dried at 175-185°C	mg/L	10	470	500	460	290
Alkalinity Method: ME-AU-ENVAN135 Tested: 23/6/2015						
Total Alkalinity as CaCO3	mg/L	5	280	290	270	120
Carbonate Alkalinity as CO3	mg/L	1	2	6	8	<1
Bicarbonate Alkalinity as HCO3	mg/L	5	340	350	310	150
Chloride by Discrete Analyser in Water Method: AN274 Tested: 25/6/2015						
Chloride, Cl	mg/L	1	89	100	89	24
Sulphate in water Method: AN275 Tested: 25/6/2015						
Sulphate, SO4	mg/L	1	52	59	52	10
Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 25/6/2015						
Calcium, Ca	mg/L	0.2	45	50	45	19
Magnesium, Mg	mg/L	0.1	45	50	45	15
Potassium, K	mg/L	0.1	8.7	9.5	9.4	8.0
Sodium, Na	mg/L	0.5	55	58	57	24

Parameter	Units	LOR	Sample Number: PE099816.005 Sample Matrix: Water Sample Date: 14/6/15 12:55 Sample Name: MBF	PE099816.006 Water 14/6/15 15:20 MBG	PE099816.007 Water 16/6/15 10:35 MBH	PE099816.008 Water 17/6/15 10:25 MBJ
Trace Metals (Total) in Water by ICPMS Method: AN022/AN318 Tested: 25/6/2015						
Total Iron	µg/L	5	**8**	**6**	**400**	**20**
Trace Metals (Dissolved) in Water by ICPMS Method: AN318 Tested: 25/6/2015						
Aluminium, Al	µg/L	5	<5	<5	**34**	**10**
Arsenic, As	µg/L	1	<1	**1**	<1	<1
Cadmium, Cd	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Chromium, Cr	µg/L	1	<1	<1	<1	<1
Copper, Cu	µg/L	1	<1	<1	**1**	<1
Lead, Pb	µg/L	1	<1	<1	<1	<1
Manganese, Mn	µg/L	1	**8**	**41**	**1**	**31**
Nickel, Ni	µg/L	1	<1	<1	<1	<1
Selenium, Se	µg/L	1	<1	<1	<1	<1
Zinc, Zn	µg/L	5	<5	<5	**26**	<5
Mercury (dissolved) in Water Method: AN311/AN312 Tested: 29/6/2015						
Mercury	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005

Parameter	Units	LOR	Sample Number: PE099816.009 Sample Matrix: Water Sample Date: 18/6/15 15:55 Sample Name: MBK	PE099816.010 Water 17/6/15 13:20 MBL	PE099816.011 Water 17/6/15 8:12 MBN	PE099816.012 Water 16/6/15 16:40 MBO
pH in water Method: AN101 Tested: 23/6/2015						
pH**	pH Units	-	8.3	8.3	8.4	8.4
Conductivity and TDS by Calculation - Water Method: AN106 Tested: 23/6/2015						
Conductivity @ 25 C	µS/cm	2	1000	860	910	880
Total Dissolved Solids (TDS) in water Method: AN113 Tested: 30/6/2015						
Total Dissolved Solids Dried at 175-185°C	mg/L	10	590	500	540	520
Alkalinity Method: ME-AU-ENVAN135 Tested: 23/6/2015						
Total Alkalinity as CaCO3	mg/L	5	310	290	270	290
Carbonate Alkalinity as CO3	mg/L	1	<1	<1	3	6
Bicarbonate Alkalinity as HCO3	mg/L	5	380	350	320	340
Chloride by Discrete Analyser in Water Method: AN274 Tested: 25/6/2015						
Chloride, Cl	mg/L	1	130	91	110	95
Sulphate in water Method: AN275 Tested: 25/6/2015						
Sulphate, SO4	mg/L	1	65	52	65	57
Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 25/6/2015						
Calcium, Ca	mg/L	0.2	45	48	48	48
Magnesium, Mg	mg/L	0.1	48	47	48	48
Potassium, K	mg/L	0.1	17	8.6	9.4	9.3
Sodium, Na	mg/L	0.5	92	57	66	57

Parameter	Units	LOR	Sample Number: PE099816.009 Sample Matrix: Water Sample Date: 18/6/15 15:55 Sample Name: MBK	PE099816.010 Water 17/6/15 13:20 MBL	PE099816.011 Water 17/6/15 8:12 MBN	PE099816.012 Water 16/6/15 16:40 MBO
Trace Metals (Total) in Water by ICPMS Method: AN022/AN318 Tested: 25/6/2015						
Total Iron	µg/L	5	**34**	<5	<5	<5
Trace Metals (Dissolved) in Water by ICPMS Method: AN318 Tested: 25/6/2015						
Aluminium, Al	µg/L	5	<5	<5	<5	**5**
Arsenic, As	µg/L	1	<1	**8**	<1	<1
Cadmium, Cd	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Chromium, Cr	µg/L	1	<1	<1	<1	<1
Copper, Cu	µg/L	1	<1	<1	<1	<1
Lead, Pb	µg/L	1	<1	<1	<1	<1
Manganese, Mn	µg/L	1	**52**	**60**	**2**	**41**
Nickel, Ni	µg/L	1	<1	<1	<1	<1
Selenium, Se	µg/L	1	<1	<1	<1	<1
Zinc, Zn	µg/L	5	<5	<5	<5	<5
Mercury (dissolved) in Water Method: AN311/AN312 Tested: 29/6/2015						
Mercury	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005

Parameter	Units	LOR	Sample Number: PE099816.013 Sample Matrix: Water Sample Date: 15/6/15 7:35 Sample Name: MBP	PE099816.014 Water 15/6/15 12:00 MBQ	PE099816.015 Water 15/6/15 14:15 MBR	PE099816.016 Water 15/6/15 6:45 PB1 CRT
pH in water Method: AN101 Tested: 23/6/2015						
pH**	pH Units	-	8.4	8.6	8.5	8.3
Conductivity and TDS by Calculation - Water Method: AN106 Tested: 23/6/2015						
Conductivity @ 25 C	µS/cm	2	800	750	820	830
Total Dissolved Solids (TDS) in water Method: AN113 Tested: 30/6/2015						
Total Dissolved Solids Dried at 175-185°C	mg/L	10	470	460	490	480
Alkalinity Method: ME-AU-ENVAN135 Tested: 23/6/2015						
Total Alkalinity as CaCO3	mg/L	5	260	250	280	270
Carbonate Alkalinity as CO3	mg/L	1	4	15	10	<1
Bicarbonate Alkalinity as HCO3	mg/L	5	310	270	320	330
Chloride by Discrete Analyser in Water Method: AN274 Tested: 25/6/2015						
Chloride, Cl	mg/L	1	84	76	85	87
Sulphate in water Method: AN275 Tested: 25/6/2015						
Sulphate, SO4	mg/L	1	50	47	52	51
Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 25/6/2015						
Calcium, Ca	mg/L	0.2	43	38	45	44
Magnesium, Mg	mg/L	0.1	42	39	45	44
Potassium, K	mg/L	0.1	8.5	9.0	9.2	8.5
Sodium, Na	mg/L	0.5	53	50	55	53

Parameter	Units	LOR	Sample Number: PE099816.013 Sample Matrix: Water Sample Date: 15/6/15 7:35 Sample Name: MBP	PE099816.014 Water 15/6/15 12:00 MBQ	PE099816.015 Water 15/6/15 14:15 MBR	PE099816.016 Water 15/6/15 6:45 PB1 CRT
Trace Metals (Total) in Water by ICPMS Method: AN022/AN318 Tested: 25/6/2015						
Total Iron	µg/L	5	**11**	<5	**13**	**120**
Trace Metals (Dissolved) in Water by ICPMS Method: AN318 Tested: 25/6/2015						
Aluminium, Al	µg/L	5	<5	**7**	**6**	<5
Arsenic, As	µg/L	1	<1	<1	<1	<1
Cadmium, Cd	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Chromium, Cr	µg/L	1	<1	<1	<1	<1
Copper, Cu	µg/L	1	<1	<1	<1	<1
Lead, Pb	µg/L	1	<1	<1	<1	<1
Manganese, Mn	µg/L	1	<1	**210**	**2**	**9**
Nickel, Ni	µg/L	1	<1	<1	<1	<1
Selenium, Se	µg/L	1	<1	<1	<1	<1
Zinc, Zn	µg/L	5	<5	<5	<5	<5
Mercury (dissolved) in Water Method: AN311/AN312 Tested: 29/6/2015						
Mercury	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005

QC SUMMARY

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage.* Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Alkalinity Method: ME-AU-ENVAN135

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Alkalinity as CaCO3	LB104601	mg/L	5	<5	0 - 1%	100 - 101%
Carbonate Alkalinity as CO3	LB104601	mg/L	1	<1		
Bicarbonate Alkalinity as HCO3	LB104601	mg/L	5	<5		

Chloride by Discrete Analyser in Water Method: ME-(AU)-[ENV]AN274

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Chloride, Cl	LB104571	mg/L	1	<1	0 - 1%	102%	88 - 93%

Conductivity and TDS by Calculation - Water Method: ME-(AU)-[ENV]AN106

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Conductivity @ 25 C	LB104596	µS/cm	2	<2	0%	99%

Mercury (dissolved) in Water Method: ME-(AU)-[ENV]AN311/AN312

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Mercury	LB104736	mg/L	0.00005	<0.00005	0%	106%	117%

Metals in Water (Dissolved) by ICPOES Method: ME-(AU)-[ENV]AN320/AN321

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Calcium, Ca	LB104545	mg/L	0.2	<0.2	2%	95%	91%
Magnesium, Mg	LB104545	mg/L	0.1	<0.1	1 - 2%	98%	94%
Potassium, K	LB104545	mg/L	0.1	<0.1	1 - 2%	110%	104%
Sodium, Na	LB104545	mg/L	0.5	<0.5	2%	102%	100%

QC SUMMARY

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

pH in water Method: ME-(AU)-[ENV]AN101

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
pH**	LB104596	pH Units	-	5.5 - 5.7	0%	100%

Sulphate in water Method: ME-(AU)-[ENV]AN275

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Sulphate, SO4	LB104571	mg/L	1	<1	0 - 1%	102%	92 - 97%

Total Dissolved Solids (TDS) in water Method: ME-(AU)-[ENV]AN113

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery	MSD %RPD
Total Dissolved Solids Dried at 175-185°C	LB104784	mg/L	10	<10	0%	97%	100%	3%

Trace Metals (Dissolved) in Water by ICPMS Method: ME-(AU)-[ENV]AN318

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Aluminium, Al	LB104554	µg/L	5	<5	0%	98%	105%
Arsenic, As	LB104554	µg/L	1	<1	0 - 6%	103%	107%
Cadmium, Cd	LB104554	µg/L	0.1	<0.1	0%	105%	106%
Chromium, Cr	LB104554	µg/L	1	<1	0%	99%	103%
Copper, Cu	LB104554	µg/L	1	<1	0%	103%	101%
Lead, Pb	LB104554	µg/L	1	<1	0 - 15%	106%	105%
Manganese, Mn	LB104554	µg/L	1	<1	3 - 6%	97%	98%
Nickel, Ni	LB104554	µg/L	1	<1	0%	102%	103%
Selenium, Se	LB104554	µg/L	1	<1	0%	103%	107%
Zinc, Zn	LB104554	µg/L	5	<5	0%	110%	105%

Trace Metals (Total) in Water by ICPMS Method: ME-(AU)-[ENV]AN022/AN318

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Iron	LB104609	µg/L	5	<5	0 - 3%	98%	112%

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
AN022/AN318	Following acid digestion of un filtered sample, determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode (glass plus reference electrode) and is calibrated against 3 buffers purchased commercially. For soils, an extract with water is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.
AN106	Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as µmhos/cm or µS/cm @ 25°C. For soils, an extract with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Total Dissolved Salts can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. SGS use 0.6. Reference APHA 2520 B.
AN113	Total Dissolved Solids: A well-mixed filtered sample of known volume is evaporated to dryness at 180°C and the residue weighed. Approximate methods for correlating chemical analysis with dissolved solids are available. Reference APHA 2540 C.
AN135	Alkalinity (and forms of) by Titration: The sample is titrated with standard acid to pH 8.3 (P titre) and pH 4.5 (T titre) and permanent and/or total alkalinity calculated. The results are expressed as equivalents of calcium carbonate or recalculated as bicarbonate, carbonate and hydroxide. Reference APHA 2320. Internal Reference AN135 Free and Total Carbon Dioxide may be calculated using alkalinity forms only when the samples TDS is <500mg/L. If TDS is >500mg/L free or total carbon dioxide cannot be reported. APHA4500CO2 D.
AN274	Chloride by Aquakem DA: Chloride reacts with mercuric thiocyanate forming a mercuric chloride complex. In the presence of ferric iron, highly coloured ferric thiocyanate is formed which is proportional to the chloride concentration. Reference APHA 4500Cl-
AN275	sulfate by Aquakem DA: sulfate is precipitated in an acidic medium with barium chloride. The resulting turbidity is measured photometrically at 405nm and compared with standard calibration solutions to determine the sulfate concentration in the sample. Reference APHA 4500-SO42-. Internal reference AN275.
AN311/AN312	Mercury by Cold Vapour AAS in Waters: Mercury ions are reduced by stannous chloride reagent in acidic solution to elemental mercury. This mercury vapour is purged by nitrogen into a cold cell in an atomic absorption spectrometer or mercury analyser. Quantification is made by comparing absorbances to those of the calibration standards. Reference APHA 3112/3500.
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN320/AN321	Metals by ICP-OES: Samples are preserved with 10% nitric acid for a wide range of metals and some non-metals. This solution is measured by Inductively Coupled Plasma. Solutions are aspirated into an argon plasma at 8000-10000K and emit characteristic energy or light as a result of electron transitions through unique energy levels. The emitted light is focused onto a diffraction grating where it is separated into components. Photomultipliers or CCDs are used to measure the light intensity at specific wavelengths. This intensity is directly proportional to concentration. Corrections are required to compensate for spectral overlap between elements. Reference APHA 3120 B.

FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed, but not received.	↑↓	Raised or Lowered Limit of Reporting
*	This analysis is not covered by the scope of accreditation.	QFH	QC result is above the upper tolerance
**	Indicative data, theoretical holding time exceeded.	QFL	QC result is below the lower tolerance
^	Performed by outside laboratory.	-	The sample was not analysed for this analyte
		NVL	Not Validated

Samples analysed as received.
Solid samples expressed on a dry weight basis.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here: http://www.sgs.com.au/~/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS		LABORATORY DETAILS	
Contact	Jane Puthiaparampil	Manager	Ros Ma
Client	AQ2	Laboratory	SGS Perth Environmental
Address	PO BOX 976 SOUTH PERTH WA 6951	Address	28 Reid Rd Perth Airport WA 6105
Telephone	61 8 93238821	Telephone	(08) 9373 3500
Facsimile	(Not specified)	Facsimile	(08) 9373 3556
Email	Jane.P@aq2.com.au	Email	au.environmental.perth@sgs.com
Project	**Iron Valley 013B/B3**	SGS Reference	**PE099623 R0**
Order Number	(Not specified)	Report Number	0000109305
Samples	1	Date Reported	22 Jun 2015
Date Started	17 Jun 2015	Date Received	15 Jun 2015

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(898/20210).

SIGNATORIES

Gary Walton
Organics Supervisor

Hue Thanh Ly
Metals Team Leader

Mary Ann Ola-A
Inorganics Team Leader

Michael McKay
Inorganics and ARD Supervisor

Ohmar David
Metals Chemist

Parameter	Units	LOR	Sample Number: PE099623.001 Sample Matrix: Water Sample Date: 10/6/15 6:45 Sample Name: PB2
Trace Metals (Dissolved) in Water by ICPMS Method: AN318 Tested: 17/6/2015			
Aluminium, Al	µg/L	5	<5
Arsenic, As	µg/L	1	<1
Cadmium, Cd	µg/L	0.1	<0.1
Chromium, Cr	µg/L	1	<1
Copper, Cu	µg/L	1	<1
Lead, Pb	µg/L	1	<1
Manganese, Mn	µg/L	1	**26**
Nickel, Ni	µg/L	1	<1
Selenium, Se	µg/L	1	<1
Zinc, Zn	µg/L	5	**37**
Mercury (dissolved) in Water Method: AN311/AN312 Tested: 19/6/2015			
Mercury	mg/L	0.00005	<0.00005

QC SUMMARY

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage.* Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

pH in water Method: ME-(AU)-[ENV]AN101

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
pH**	LB104187	pH Units	-	5.7	0%	100%

Sulphate in water Method: ME-(AU)-[ENV]AN275

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Sulphate, SO4	LB104160	mg/L	1	<1	0 - 1%	103 - 104%	92 - 102%

Total Dissolved Solids (TDS) in water Method: ME-(AU)-[ENV]AN113

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery	MSD %RPD
Total Dissolved Solids Dried at 175-185°C	LB104276	mg/L	10	<10	1 - 2%	97 - 101%	100%	3%

Trace Metals (Dissolved) in Water by ICPMS Method: ME-(AU)-[ENV]AN318

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Aluminium, Al	LB104148	µg/L	5	<5	0 - 196%	118%	
Arsenic, As	LB104148	µg/L	1	<1	0%	98%	99%
Cadmium, Cd	LB104148	µg/L	0.1	<0.1	0 - 199%	116%	108%
Chromium, Cr	LB104148	µg/L	1	<1	0 - 180%	103%	103%
Copper, Cu	LB104148	µg/L	1	<1	0 - 200%	106%	100%
Lead, Pb	LB104148	µg/L	1	<1	0 - 193%	105%	98%
Manganese, Mn	LB104148	µg/L	1	<1	5 - 198%	111%	105%
Nickel, Ni	LB104148	µg/L	1	<1	0 - 172%	106%	104%
Selenium, Se	LB104148	µg/L	1	<1	0%	115%	100%
Zinc, Zn	LB104148	µg/L	5	<5	6 - 198%	112%	97%

Trace Metals (Total) in Water by ICPMS Method: ME-(AU)-[ENV]AN022/AN318

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Iron	LB104223	µg/L	5	<5	2%	92%	104%

FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed, but not received.	↑↓	Raised or Lowered Limit of Reporting
*	This analysis is not covered by the scope of accreditation.	QFH	QC result is above the upper tolerance
**	Indicative data, theoretical holding time exceeded.	QFL	QC result is below the lower tolerance
^	Performed by outside laboratory.	-	The sample was not analysed for this analyte
		NVL	Not Validated

Samples analysed as received.
Solid samples expressed on a dry weight basis.

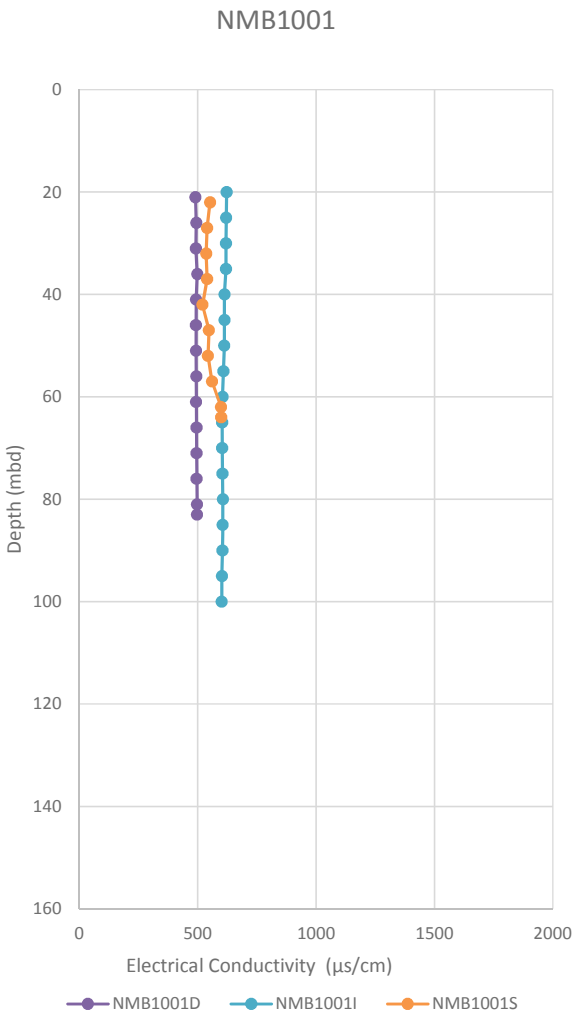
Some totals may not appear to add up because the total is rounded after adding up the raw values.

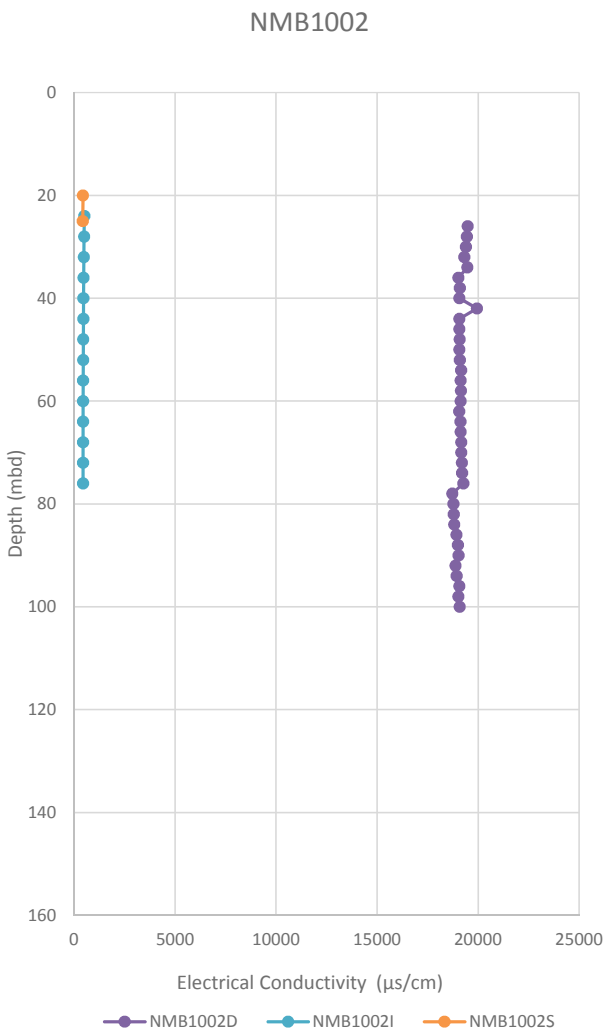
The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here: http://www.sgs.com.au/~/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf

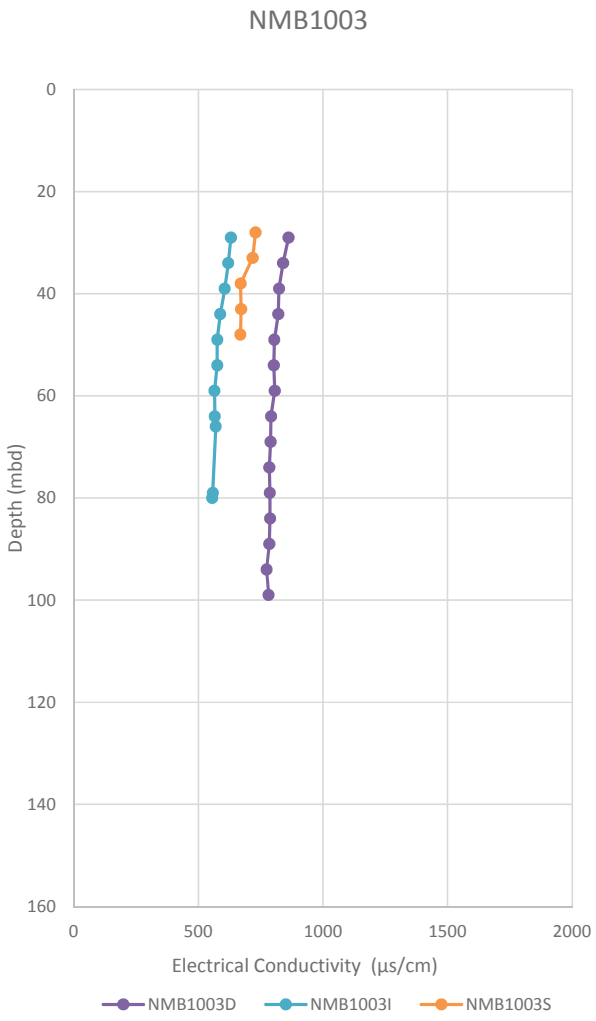
APPENDIX E

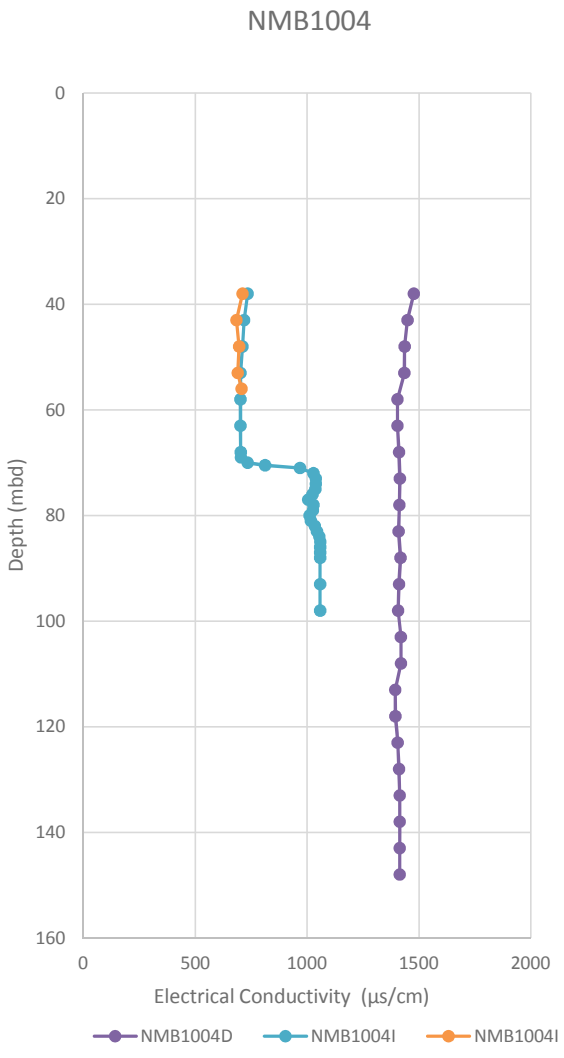
Downhole Salinity

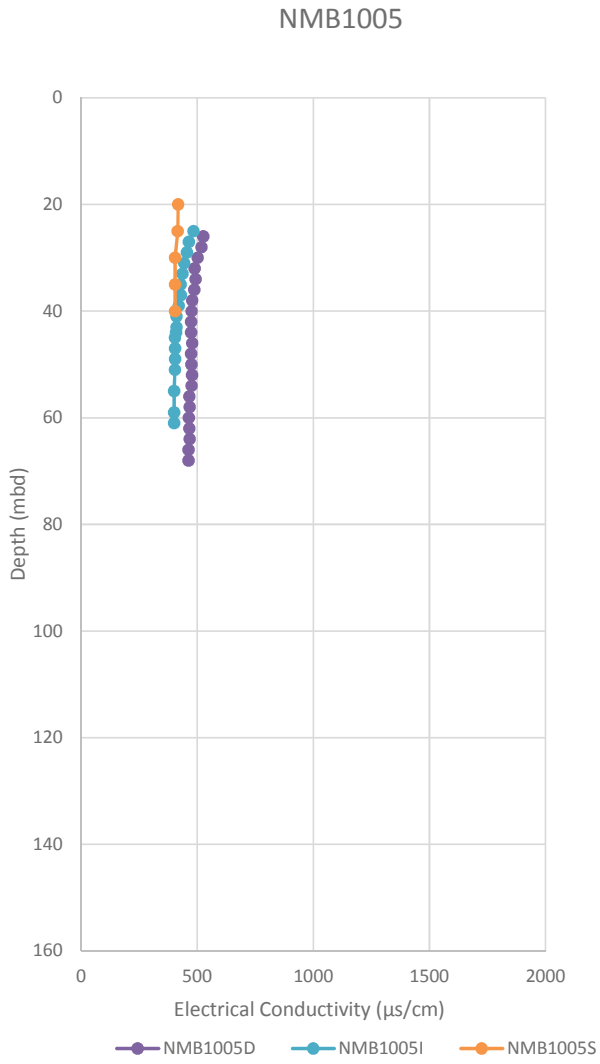
BoreID	Date	SWL (m bgl)	Date	SWL (m bgl)
NMB1001_I	15/04/2012	23.89	8/06/2015	19.7
NMB1001_S	15/04/2012	24.41	8/06/2015	20.89
NMB1002_D	15/04/2012	29.737	8/06/2015	25.29
NMB1002_I	15/04/2012	27.731	8/06/2015	23.32
NMB1002_S	15/04/2012	23.675	8/06/2015	19.49
NMB1002_WT	15/04/2012	17.02	8/06/2015	blocked
NMB1003_D			8/06/2015	27.61
NMB1003_I	15/04/2012	30.63	8/06/2015	27.61
NMB1003_S	15/04/2012	30.43	8/06/2015	27.72
NMB1004_D			5/06/2015	37.43
NMB1004_I	15/04/2012	39.71	5/06/2015	37.42
NMB1004_S	15/04/2012	39.89	5/06/2015	37.77
NMB1005_D	15/04/2012	29.37	8/06/2015	24.64
NMB1005_I	15/04/2012	29.05	8/06/2015	23.85
NMB1005_S	15/04/2012	24.6	5/06/2015	19.51
NMB1007_D	15/04/2012	21.78	8/06/2015	20.22
NMB1007_I	15/04/2012	21.76	8/06/2015	20.19
NMB1007_S	15/04/2012	21.72	8/06/2015	20.19
NMB1009_D	15/04/2012	37.039	9/06/2015	36.89
NMB1009_I	15/04/2012	33.801	9/06/2015	27.545
NMB1009_S	15/04/2012	26.904	8/06/2015	25.13
NMB1009_WT	15/04/2012	27.911	9/06/2015	27.35
NMB1013A_S	14/04/2012	24.49	8/06/2015	21.34
NMB1013A_WT	14/04/2012	23.93	8/06/2015	21.55
NMB1013B_D	14/04/2012	25.4	8/06/2015	21.3
NMB1013B_I	14/04/2012	25.33	8/06/2015	21.17

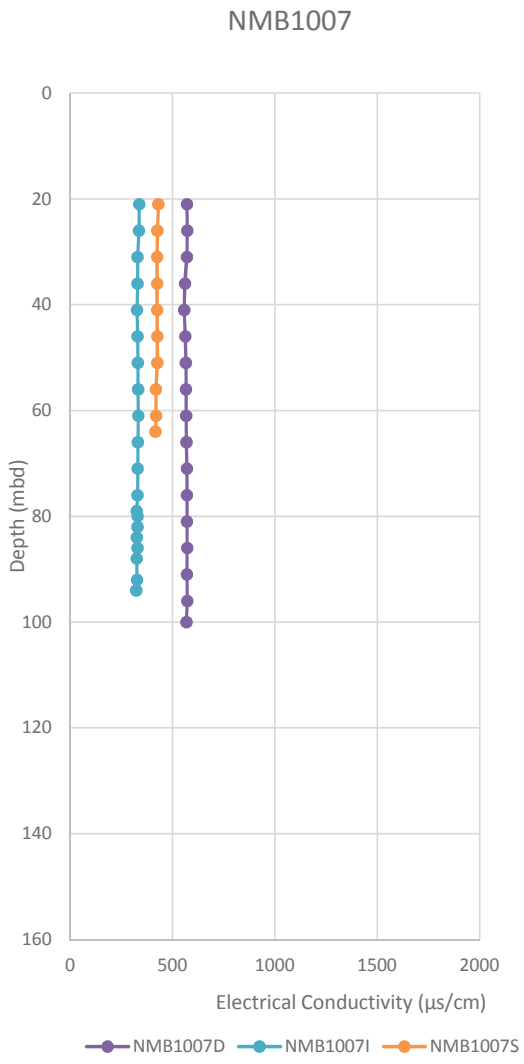

NMB1001
Depth (mbd)
0
20
40
60
80
100
120
140
160
0
500
1000
1500
2000
Electrical Conductivity (µs/cm)
NMB1001D
NMB1001I
NMB1001S


NMB1002
Depth (mbd)
0
20
40
60
80
100
120
140
160
0
5000
10000
15000
20000
25000
Electrical Conductivity (µs/cm)
NMB1002D
NMB1002I
NMB1002S

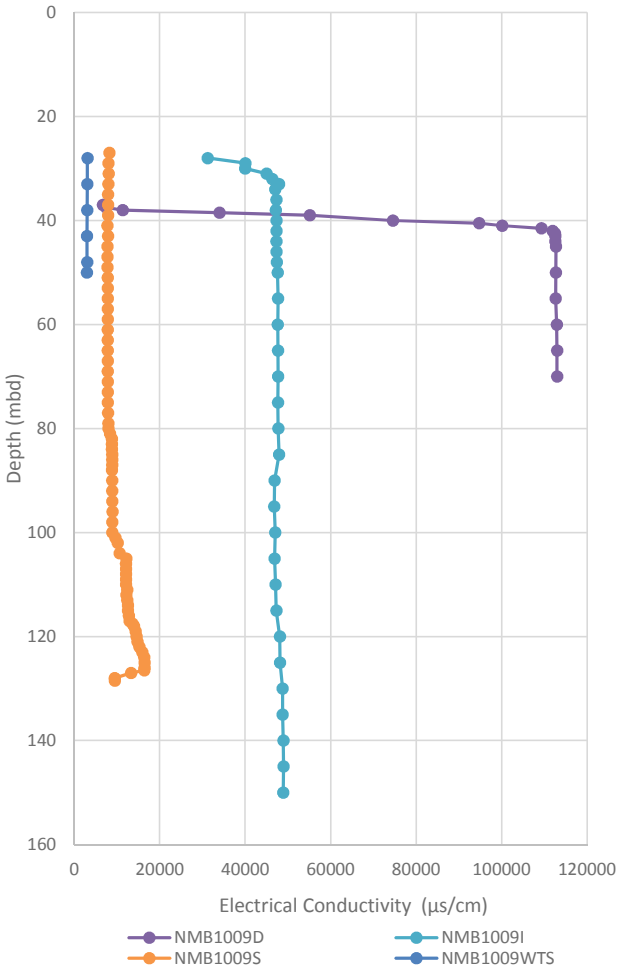

NMB1003
Depth (mbd)
0
20
40
60
80
100
120
140
160
0
500
1000
1500
2000
Electrical Conductivity (µs/cm)
NMB1003D
NMB1003I
NMB1003S


NMB1004
Depth (mbd)
0
20
40
60
80
100
120
140
160
0
500
1000
1500
2000
Electrical Conductivity (µs/cm)
NMB1004D
NMB1004I
NMB1004I

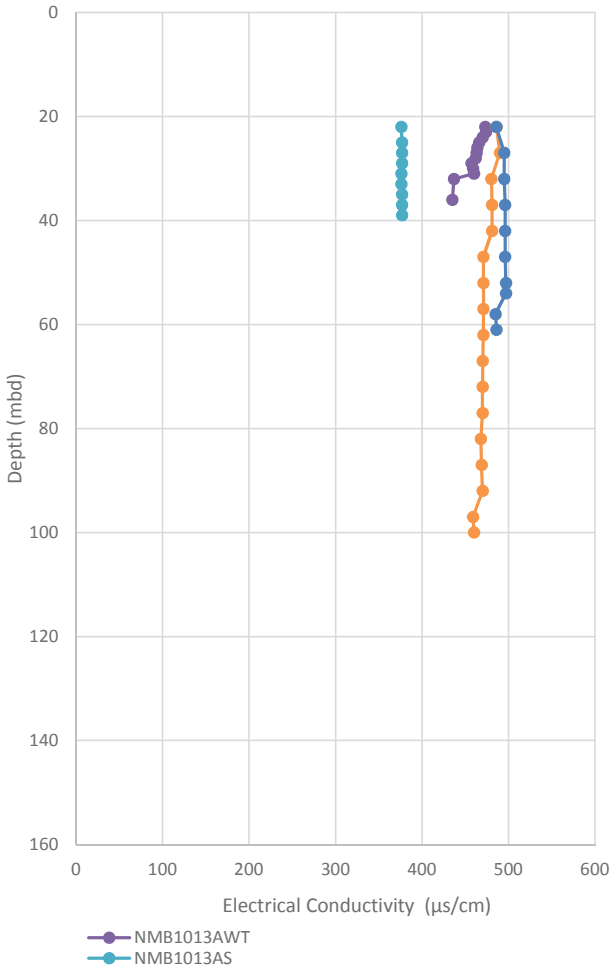

NMB1005
Depth (mbd)
0
20
40
60
80
100
120
140
160
0
500
1000
1500
2000
Electrical Conductivity (µs/cm)
NMB1005D
NMB1005I
NMB1005S


NMB1007
Depth (mbd)
0
20
40
60
80
100
120
140
160
0
500
1000
1500
2000
Electrical Conductivity (µs/cm)
NMB1007D
NMB1007I
NMB1007S

NMB1009



NMB1013



APPENDIX B

Modelling Background

APPENDIX B MODEL UNCERTAINTY ANALYSIS

An Uncertainty Analysis has been completed to assess the potential range of predicted dewatering given the uncertainty in some of the model assigned parameters. The Uncertainty Analysis was completed by re-running the model calibration (steady state and transient) with changes to aquifer parameters of interest. Then using the model generated water levels from the end of the transient calibration (end of December 2014), model predictions, with a similar set up to the Base Case were completed with the same changes to aquifer parameters A summary of parameters changed in the calibrated and Base Case predictive model is presented in Table B1.

Table B1: Summary of Uncertainty Runs

Uncertainty Case	Description
1	Specific yield of orebody aquifer increased from 5% to 10% Specific yield of fault east of orebody increased from 15% to 20%
2	Hydraulic conductivity of scree increased to 0.1 m/d from 0.01m/d Specific yield of scree increased to 5% from 1%
3	Hydraulic conductivity of orebody aquifer increased from 3m/d to 5m/d. Hydraulic conductivity of submineralised orebody aquifer increased from 0.5m/d to 1m/d.
4	Hydraulic conductivity of fault east of orebody aquifer de3creased from 100m/d to 50m/d

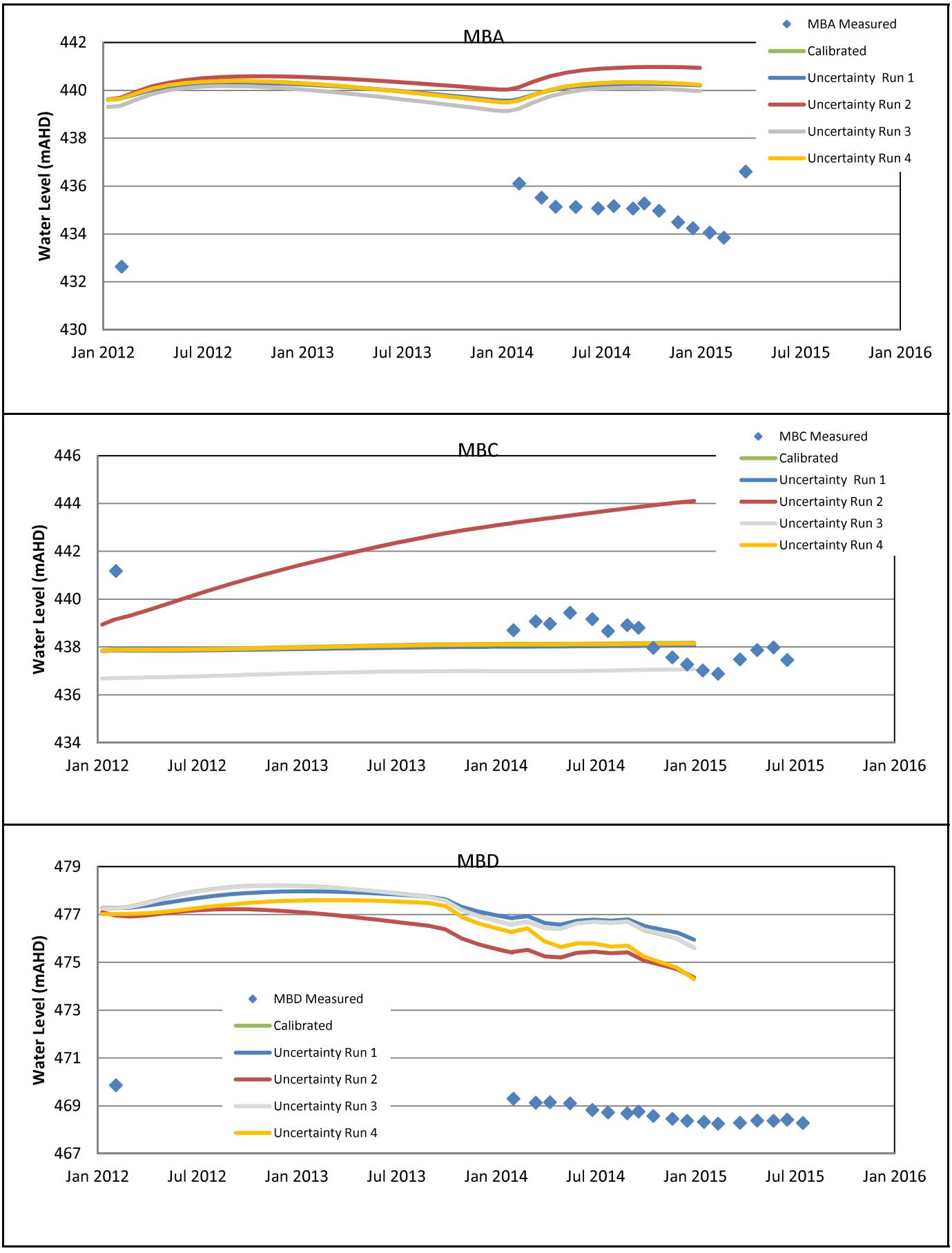
It is noted that for the current Uncertainty Analysis, other model parameters (in addition to those listed in Table B1) were not changed to improve the model calibration performance. Instead, the models were run only with the changes outlined in Table B1.

Predicted water levels over the model calibration period for the Calibrated Case and the Uncertainty Cases are presented in Figures B1 to B6. In most areas the model performance is unchanged when the aquifer parameters summarised in Table B1 are included. The following observations are made in areas where the model performance changes significantly as a result of the parameter changes in Table B1.

- For Uncertainty Run 2, which tests the parameters assigned to the scree, the model response to ongoing pumping is over predicted (MBD (Figure B1), MBE, MBF and MBG (Figure B2)). Additionally, the model predicts ongoing water level rises at MBC (Figure B1), MBH (Figure B2) MBQ (Figure B5) and MBR (Figure B6). This parameter change allows the water level variations associated with ongoing pumping and recharge to Weeli Wolli Creek to be propagated more readily across the area between Weeli Wolli Creek and the Iron Valley mine area.
- For Uncertainty Run 4, which tests a reduced aquifer hydraulic conductivity in the fault east of the orebody, the response to ongoing pumping is also over predicted.

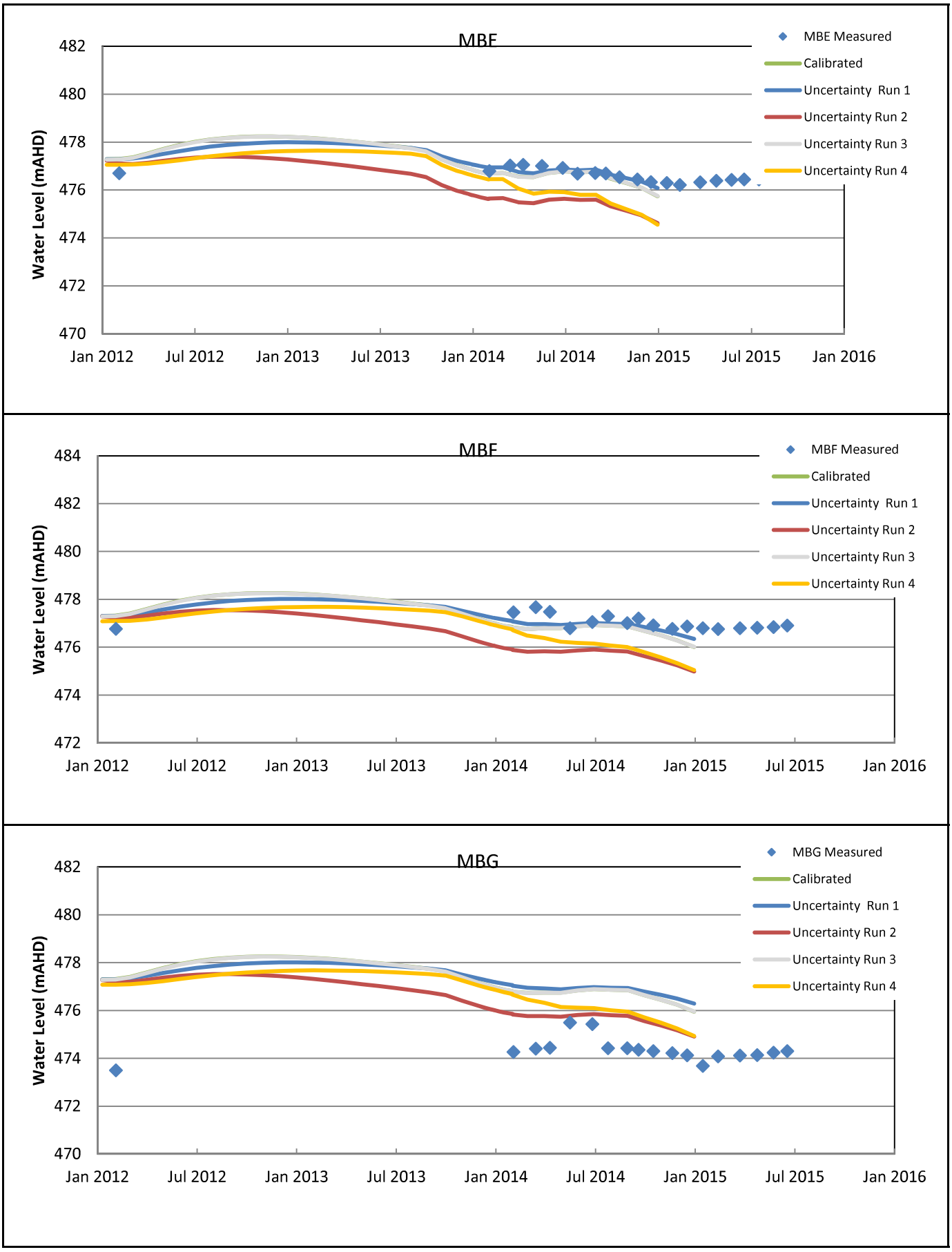
The observed differences in model calibration performance are only small for the parameters changes associated with Uncertainty Runs 2 and 4.

The results of Uncertainty Predictions are summarised in Section 4.9.



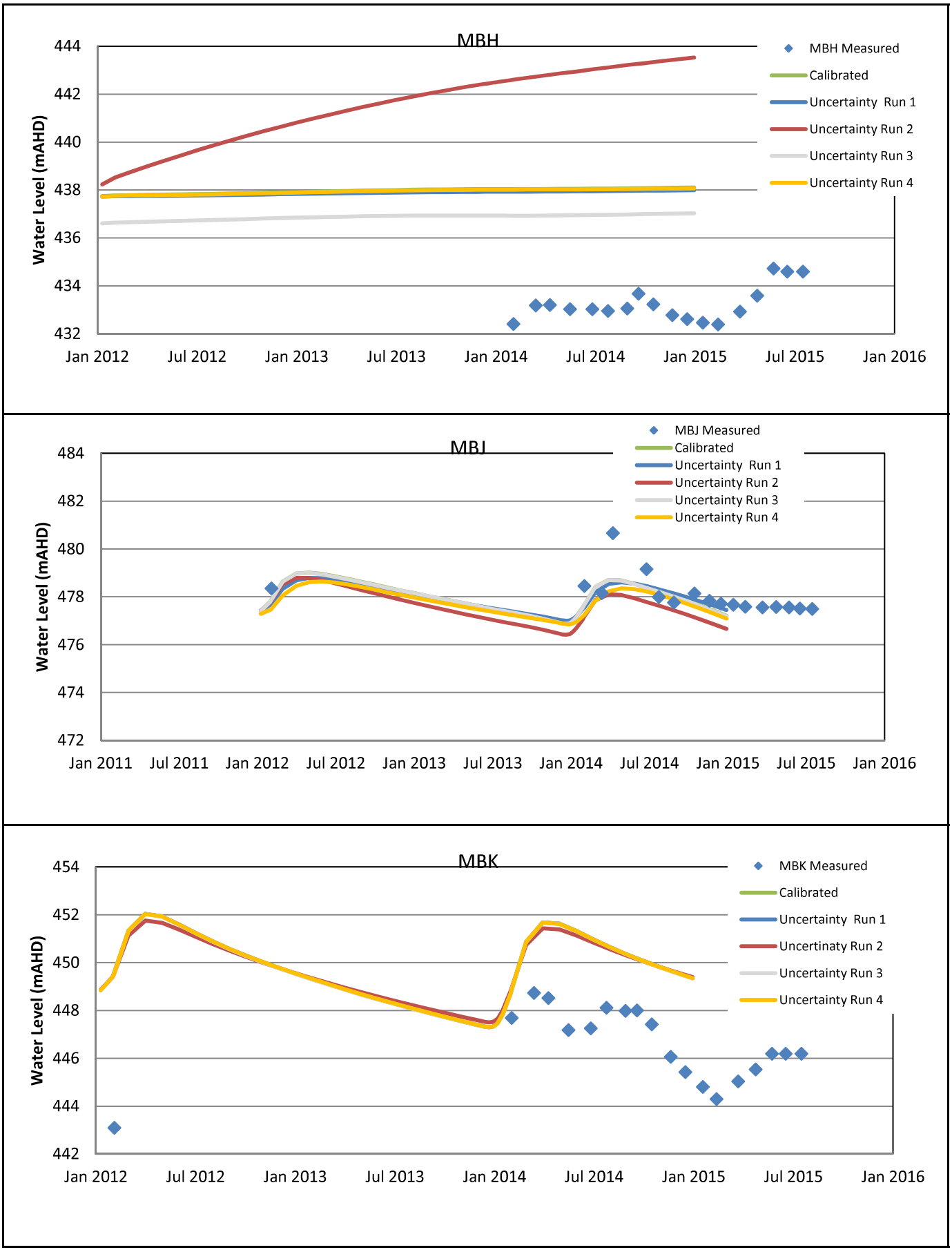
CALIBRATION AND UNCERTAINTY HYDROGRAPHS FIGURE B1

F:\013B\2 TECH\Modelling\AQ2 Model\Sensitivity\[TRCAL_All.xlsx]Figure B1



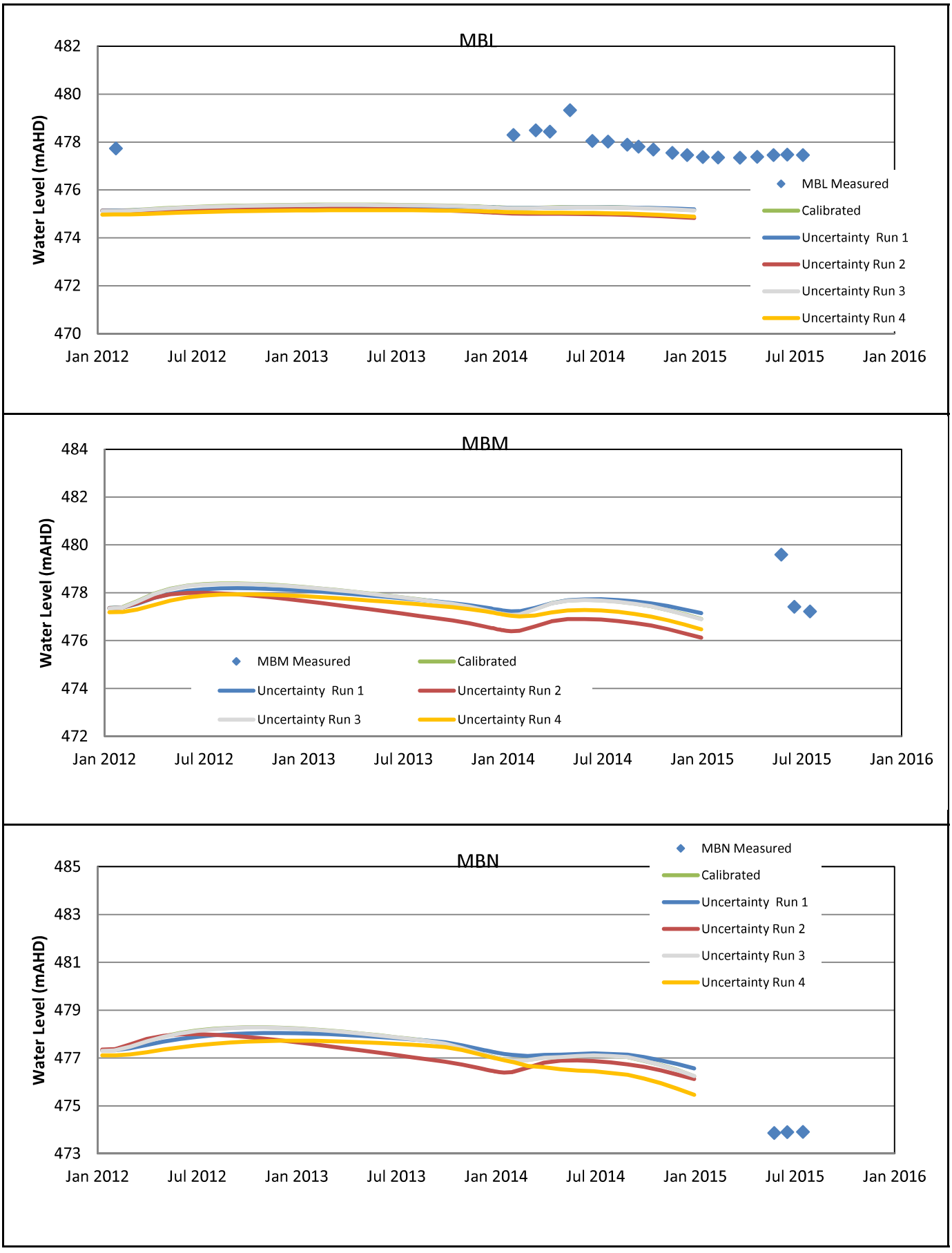
CALIBRATION AND UNCERTAINTY HYDROGRAPHS FIGURE B2

F:\013B\2 TECH\Modelling\AQ2 Model\Sensitivity\[TRCAL_All.xlsx]Figure B2



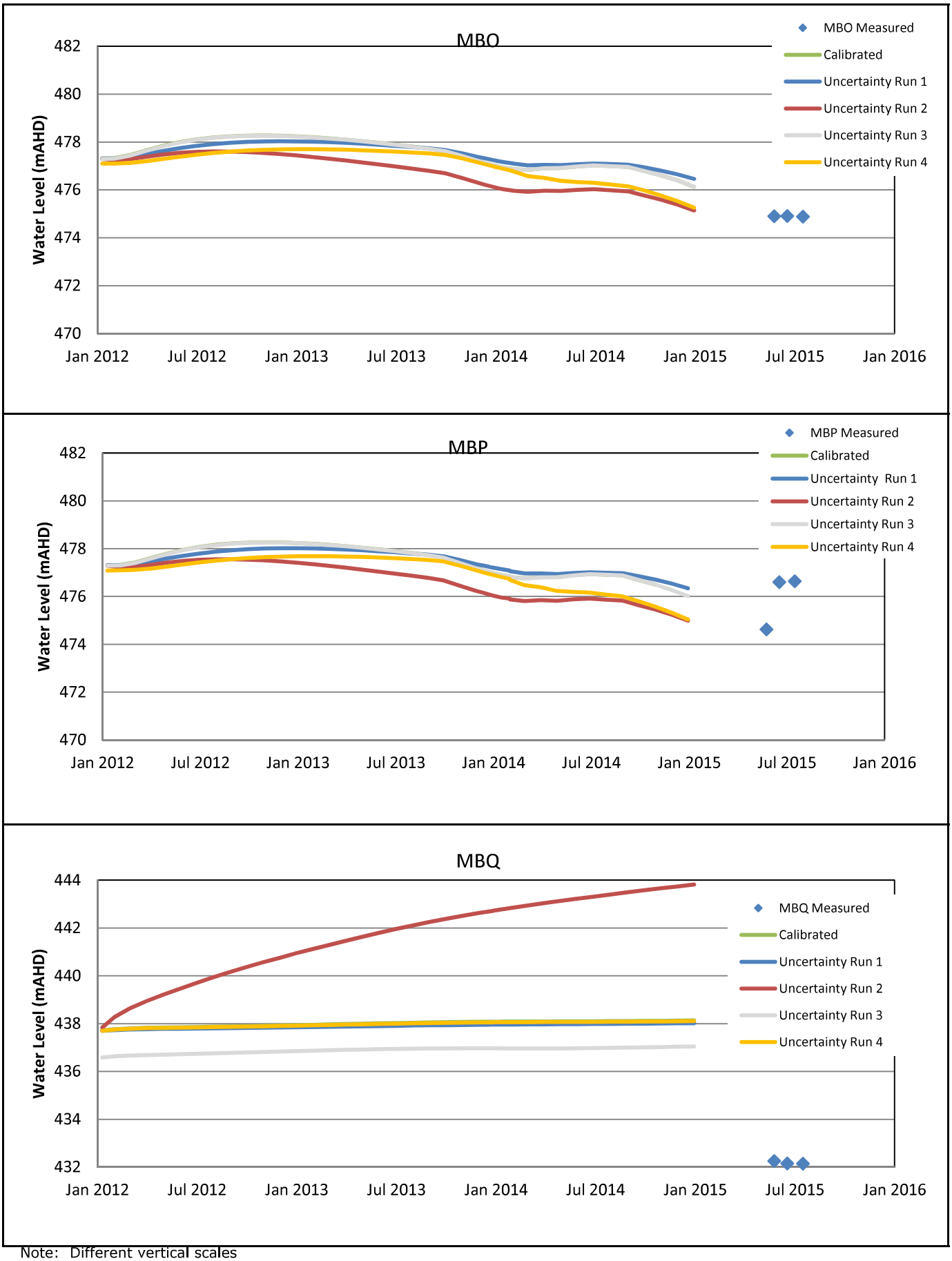
CALIBRATION AND UNCERTAINTY HYDROGRAPHS FIGURE B3

F:\013B\2 TECH\Modelling\AQ2 Model\Sensitivity\[TRCAL_All.xlsx]Figure B3



CALIBRATION AND UNCERTAINTY HYDROGRAPHS FIGURE B4

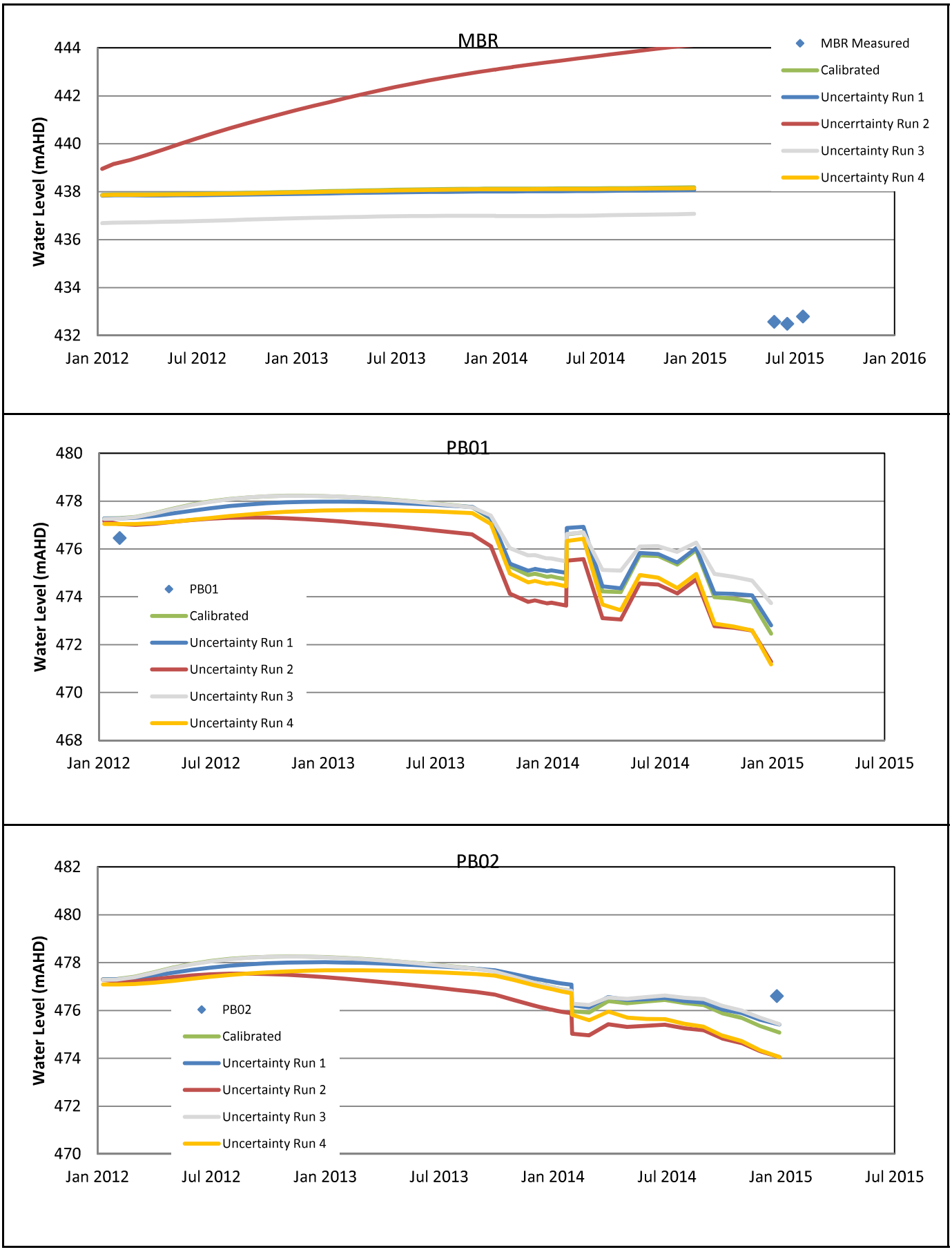
F:\013B\2 TECH\Modelling\AQ2 Model\Sensitivity\[TRCAL_All.xlsx]Figure B4



Note: Different vertical scales

CALIBRATION AND UNCERTAINTY HYDROGRAPHS FIGURE B5

F:\013B\2 TECH\Modelling\AQ2 Model\Sensitivity\[TRCAL_All.xlsx]Figure B5



CALIBRATION AND UNCERTAINTY HYDROGRAPHS FIGURE B6

F:\013B\2 TECH\Modelling\AQ2 Model\Sensitivity\[TRCAL_All.xlsx]Figure B6

APPENDIX C

Dewatering System – Capital Costs

APPENDIX C
Capital Cost Estimate
Iron Valley
Dewatering and Discharge System

Item	Unit Cost	Unit	Quantity	Spares	Total
S Deposit					
Bore Fitout					
110kW submersible pump	$ 25,000	No.	8	2	$ 250,000
125NB Pump Column	$ 100	m	1360	340	$ 170,000
125NB Bore Headworks Trailer	$ 25,000	No.	8	2	$ 250,000
Electrical Control Panel (inc Soft Starter)	$ 25,000	No.	8	2	$ 250,000
Diesel Generator and Fuel Pod	$ 50,000	No.	8	2	$ 500,000
Installation	$ 25,000	Allowance	8	2	$ 250,000
Sub Total					**$ 1,670,000**
Pipework					
315DN PN25 Pipe Supply/Install (Bore Spurs)	$ 225	m	2400		$ 540,000
500DN PN10 Pipe Supply/Install (Discharge Pipe)	$ 250	m	600		$ 150,000
Miscellaneous (valves, road crossings etc.)	$ 10,000	Allowance	1		$ 10,000
Outfall Structure	$ 50,000	Allowance	1		$ 50,000
Sub Total					**$ 750,000**
C Deposit					
Bore Fitout					
110kW submersible pump	$ 25,000	No.	10	2	$ 300,000
55kW submersible pump	$ 16,000	No.	2	1	$ 48,000
125NB Pump Column	$ 100	m	2000	400	$ 240,000
80NB Pump Column	$ 60	m	400	200	$ 36,000
125NB Bore Headworks (ex-pit)	$ 15,000	No.	6	0	$ 90,000
125NB Bore Headworks Trailer	$ 25,000	No.	4	2	$ 150,000
80NB Bore Headworks Trailer	$ 20,000	No.	2	1	$ 60,000
Electrical Control Panel (inc Soft Starter)	$ 25,000	No.	12	3	$ 375,000
Diesel Generator (110kW) and Fuel Pod	$ 50,000	No.	10	2	$ 600,000
Diesel Generator (55kW) and Fuel Pod	$ 30,000	No.	2	1	$ 90,000
Installation	$ 25,000	Allowance	12	3	$ 375,000
Sub Total					**$ 2,364,000**
Pipework					
200DN PN25 Pipe Supply/Install (Bore Spurs)	$ 110	m	600		$ 66,000
315DN PN10 Pipe Supply/Install (Bore Spurs)	$ 110	m	1800		$ 198,000
315DN PN25 Pipe Supply/Install (Bore Spurs)	$ 225	m	1200		$ 270,000
500DN PN10 Pipe Supply/Install (Trunk Main)	$ 250	m	3500		$ 875,000
Miscellaneous (valves, road crossings etc.)	$ 30,000	Allowance	1		$ 30,000
Sub Total					**$ 1,439,000**
N Deposit					
Bore Fitout					
110kW submersible pump	$ 25,000	No.	1	1	$ 50,000
55kW submersible pump	$ 16,000	No.	1	1	$ 32,000
125NB Pump Column	$ 100	m	190	190	$ 38,000
80NB Pump Column	$ 60	m	190	190	$ 23,000
125NB Bore Headworks (ex-pit)	$ 15,000	No.	1	1	$ 30,000
80NB Bore Headworks Trailer	$ 20,000	No.	1	1	$ 40,000
Electrical Control Panel (inc Soft Starter)	$ 25,000	No.	2	2	$ 100,000
Diesel Generator (110kW) and Fuel Pod	$ 50,000	No.	1	1	$ 100,000
Diesel Generator (55kW) and Fuel Pod	$ 30,000	No.	1	1	$ 60,000
Installation	$ 25,000	Allowance	2	2	$ 100,000
Sub Total					**$ 573,000**
Pipework					
315DN PN10 Pipe Supply/Install (Bore Spurs)	$ 110	m	1200		$ 132,000
200DN PN25 Pipe Supply/Install (Bore Spurs)	$ 110	m	300		$ 33,000
Miscellaneous (valves, road crossings etc.)	$ 10,000	Allowance	1		$ 10,000
Sub Total					**$ 175,000**

APPENDIX C
Capital Cost Estimate
Iron Valley
Dewatering and Discharge System

Item	Unit Cost	Unit	Quantity	Spares	Total
E Deposit					
Bore Fitout					
110kW submersible pump	$ 20,000	No.	2	1	$ 60,000
125NB Pump Column	$ 100	m	440	220	$ 66,000
125NB Bore Headworks Trailer	$ 25,000	No.	2	1	$ 75,000
Electrical Control Panel (inc Soft Starter)	$ 25,000	No.	2	1	$ 75,000
Diesel Generator and Fuel Pod	$ 50,000	No.	2	1	$ 150,000
Installation	$ 5,000	Allowance	2	1	$ 15,000
Sub Total					**$ 441,000**
Pipework					
315DN PN25 Pipe Supply/Install (Bore Spurs)	$ 225	m	600		$ 135,000
400DN PN10 Pipe Supply/Install (Trunk)	$ 160	m	800		$ 128,000
Miscellaneous (valves, road crossings etc.)	$ 10,000	Allowance	1		$ 10,000
Outfall Structure	$ 50,000	Allowance	1		$ 50,000
Sub Total					**$ 323,000**
Water Disposal System					
Turkeys Nest					
Earthworks	$ 40	m3	5000		$ 200,000
Liner	$ 20	m2	3600		$ 72,000
Pipework	$ 10,000	Allowance	1		$ 10,000
Sub Total					**$ 282,000**
Discharge System					
Diesel Transfer Pump Station	$ 250,000	No.	2		$ 500,000
400DN PN10 Pipe Supply/Install (Discharge Pipe)	$ 160	m	5000		$ 800,000
Controls	$ 10,000	Allowance	2		$ 20,000
Outfall Structure	$ 50,000	Allowance	2		$ 100,000
Sub Total					**$ 1,420,000**
Total					**$ 9,437,000**
Preliminaries	10%				$ 944,000
EPCM	15%				$ 1,416,000
Contingency	30%				$ 2,831,000
Grand Total					**$ 14,628,000**