CEMEX UK Operations Ltd

Gilfach Quarry: Groundwater Monitoring Report 2017

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CONTENTS

FIGURES

TABLES

APPENDICES

Front cover photograph

The photograph shows a spring chamber at Cefn Faes Uchaf Farm which has been installed with an automatic water level datalogger and a flow meter. The installations complement the extensive water monitoring network around the quarry extension.

1. INTRODUCTION

CEMEX (UK) Limited currently operates Gilfach Quarry for the production of sandstone/gritstone for use in road construction and surfacing industry. The site works the Carboniferous Pennant Measures. The mineral is worked above the main water table thus no groundwater dewatering is required for the site. However, perched groundwater which is hydraulically isolated by low permeable boulder clays exist at shallow depth. The purpose of this report is to present the results of groundwater level monitoring around the quarry extension area from August 2007 to July 2017.

The detailed geological and hydrogeological setting of the site together with the assessment of potential impacts of the development and mitigation measures are described in the Hydrogeological Assessment Reports (Refs.1 & 2)

Conditions 39 of P2010/0655 and 37 of P2010/0658 require the submission of groundwater monitoring report within 3 years of the commencement of soil stripping, which is 3rd September 2015. Condition 40 of P2010/0655 requires the submission of monitoring results to the Mineral Planning Authority on six monthly basis. Details of the groundwater levels from piezometers around the extraction area should be recorded monthly. This report addresses the above planning conditions.

2. BACKGROUND

Gilfach Quarry is situated in the Upper Coal measures, also known in South Wales as the Pennant Measures. These are massive fluviatile sandstone strata, with an increasing proportion of shale, mudstones and productive measures moving up the sequence to the Upper Pennant Measures, which are thinner and less massive than the Lower Pennant Measures. According to the Natural Resources Wales (NRW, Groundwater Vulnerability Maps), the Pennant (Upper Coal) Measures are designated as a minor aquifer with low to medium permeability.

The Coal Measures sandstones are very well cemented and extremely hard and dense, and as such they exhibit very little primary porosity or intergranular permeability. The permeability of these units is determined by the distribution and size of fractures present in the sandstones. Naturally, the sandstone units act as individual aquifers, separated by intervening low permeability horizons, and therefore together they constitute a complex, multilayered aquifer system. Permeability within the sandstones tends to decrease with depth, as a result of increasing thickness of overburden and closure of fractures

The current development will work the Pennant Measures sandstones down to 2m above the basal mudstone that overlies the Mountain Coal Seam. The

proposed works will incorporate lateral extension of the site only and mineral extraction will remain above the main water table in the sandstone.

Evidence to date suggests that groundwater flow into the quarry is, and will continue to be minimal due to the low permeability of the Pennant Measures strata. Site observations indicate that groundwater inflow to the quarry sump has decreased to a negligible amount and most of the inflow comprises rainfall and surface water runoff. The worked out faces are dry with no evidence of significant groundwater seepage at any of the quarry faces, it is anticipated that this will remain the case for the current workings in the extension area.

3. WATER MONITORING

3.1 Groundwater level monitoring

The current groundwater monitoring network comprises of eight observation boreholes. Each borehole was installed with a 50mm ID uPVC pipe to the base of the hole. Groundwater monitoring network forms an envelope around the entire quarry. Any potential derogation of the surrounding water supplies will be picked up in these boreholes first before extending to the water supplies. Borehole water level monitoring takes place on a monthly basis. Dataloggers which record water levels every hour are installed observation boreholes OH01/07 & 10/07.

Monitoring data are available for the period August 2007 to July 2017. These data are summarised in Table 1 and included in Appendix A, composite hydrographs are presented in Figures 2.

Table 1: Summary of perimeter groundwater level data

Borehole	Ground Elevation (mAOD)	Base of Piezometer (mAOD)	Water level (mAOD)			Range (m)
			Min.	Mean	Max.	
OH01/07	160.18	133.47	138.30	147.88	157.30	19.00
OH02/07	190.49	158.03	171.52	179.88	187.13	15.61
OH03/07	199.43	163.42	187.95	195.36	198.76	10.81
OH04/07	191.26	161.20	182.69	190.61	191.70	9.01
OH05/07	187.91	146.98	155.94	163.26	187.98	32.04
OH06/07	181.44	127.76	126.70	127.96	131.16	4.46
OH07/07	149.44	103.49	113.47	119.88	138.79	25.32
OH10/07	154.06	119.44	138.60	142.99	149.03	10.43

Groundwater levels show a consistent trend with higher levels in the north and east decreasing to the south and west. This is consistent with the topography in the vicinity of the site and implies a general south westerly groundwater flow direction. A hydrogeological assessment for the northern extension (Refs. 1 & 2) concluded that that the groundwater contours reflect perched water levels and the dip of the strata to the south west and that the regional water table lies at depth below the Mountain Coal Seam. The springs in the vicinity of the quarry are therefore considered to be fed from perched groundwater (Ref. 1). The regional water table is located at some depth below the Mountain Coal Seam in the immediate vicinity of the quarry.

Observations made on the current excavation faces and discussions with site management suggest that the elevation of the water table is considerably lower in the vicinity of the quarry extension area. No evidence of seepage or groundwater inflow into the quarry void was seen on any of the quarry faces.

3.2 Groundwater trigger levels

Warning and action trigger levels were set in June 2009 for monitoring boreholes BH01/07 and BH10/07 which are closest to private water supplies down gradient of the quarry extension. Should the warning levels be reached in either of boreholes BH1/07 or BH10/07 this would trigger weekly or more frequent monitoring of both boreholes. An assessment of the potential cause of the drop in the water table would be undertaken using all available groundwater level data, rainfall data and records of dewatering at the quarry. Action levels may trigger mitigation measures depending on the outcome of the assessment triggered by the warning levels and with the agreement of the regulatory authorities. The agreed trigger levels are summarised in Table 2.

Table 2: Groundwater trigger levels

Borehole	BH1/07	BH10/07
Warning level (mAOD)	138.3	138.6
Action level (mAOD)	133.0	133.0

Groundwater levels have not dropped below the set trigger levels, see hydrographs in Figures 3 & 4. This trend in water levels is not expected to change during further developments of the quarry extension.

4. Private Water Supply Monitoring

CEMEX monitors water level and pumping rates from the closest private water supply at Cefn Faes Uchaf Farm. The water supply has been installed with an automatic water level datalogger and a flow meter to monitor any impact the quarry might have on this water supply. As anticipated, the monitoring data indicates that there is no impact on this private water supply source as it is hydraulically upstream of the quarry extension. The source relies on perched groundwater which is hydraulically isolated by boulder clays. The monitoring data at Cefn Faes Uchaf Farm water supply provides useful background information relevant to other sources up gradient of the quarry extension relying on perched water table lying above the Mountain Coal Seam.

Groundwater monitoring data for boreholes 01/07 and 10/07 which are close to Gilfach Farm and Gilfach House show no reduction in groundwater levels due to the current quarry workings. Warning and action trigger levels were set for these boreholes have not been breached as shown on Figures 3 and 4. No derogation to these abstractions has been reported in relation to the current operations, and the distance of these abstractions from the quarry sump is not anticipated to change under the proposed extension and associated operations.

5. CONCLUSIONS

In conclusion, the groundwater level monitoring data indicate that none of the private water supplies are impacted by the workings in the quarry extension. The warning and action trigger levels set for boreholes 01/07 and 10/07 (Table 2) have not been reached. In addition, the water level at Cefn Faes Uchaf Farm which is the closest private water supply to the quarry extension has not shown any reduction in water levels. Water level in the quarry sump has increased due to pumped volumes from down gradient settlement lagoons in a bid to improve site water management and reduce amount of water discharged offsite. Groundwater observation boreholes around the quarry do not show any response to sump water level rise suggesting a negligible water leakage from the quarry sump. Site observations indicate that both groundwater inflow and outflow to and from the quarry sump is negligible due to limited rock fracturing, most of the accumulated water comprises of direct rainfall, surface runoff or pumped volumes. It is anticipated that the current groundwater level regimes will remain unchanged throughout the quarry extension workings.

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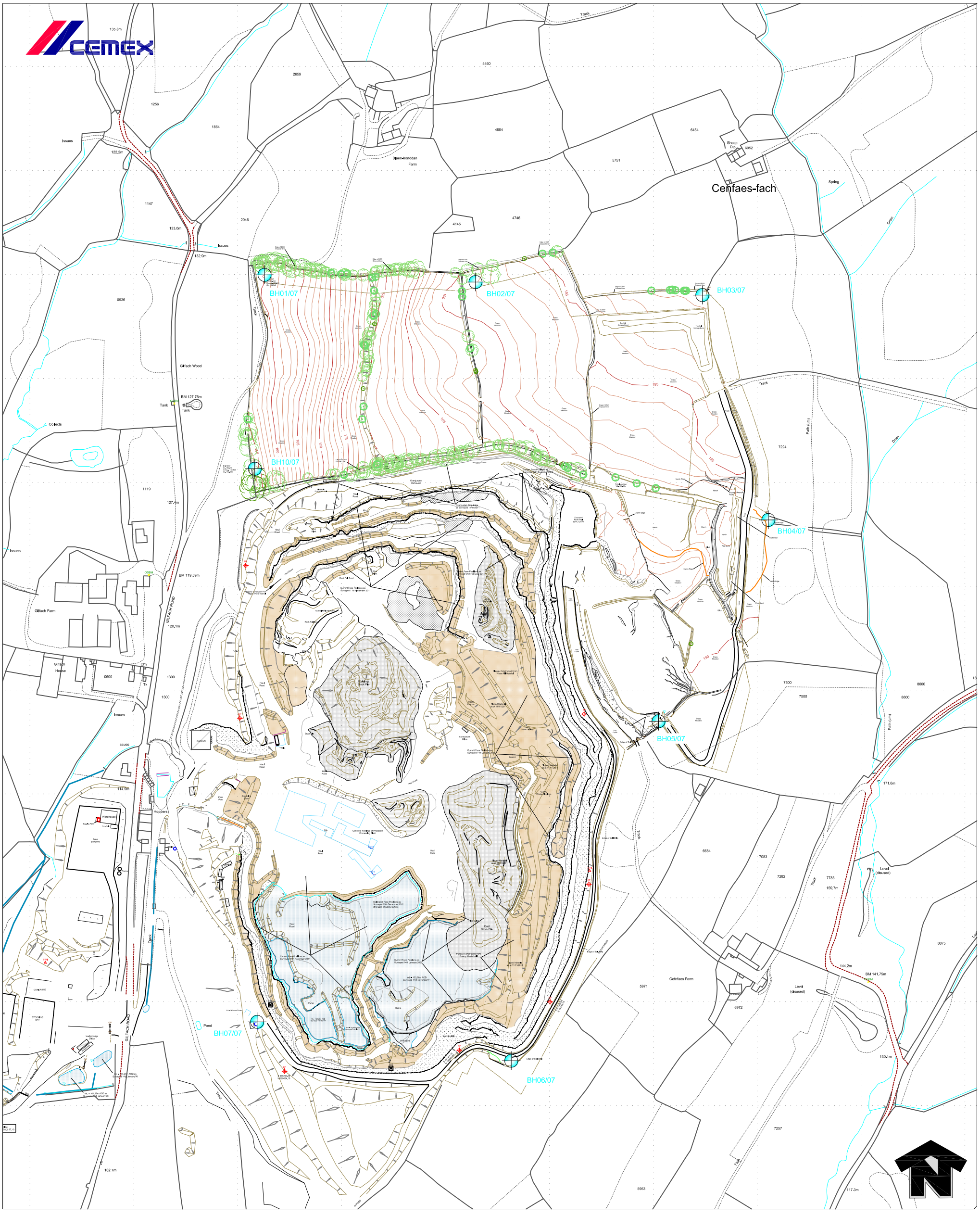
References

1. CEMEX, 2011. Gilfach Quarry: Supplementary Hydrogeological Assessment. Report reference SS7599.TS.180311.
2. ESI Ltd, 2008. Gilfach Quarry: hydrogeological assessment. Report reference 60116R1, prepared for a planning application for the proposed quarry extension.

FIGURES



LEGEND

Monitoring Borehole

Revisions				
	F			
	E			
	D			
	C			
	B			
	A	Remove BH 08 &09	20-9-17	ts/caw

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Drawn By: TS/caw	Company: CEMEX UK Materials Limited
Date: September 2017	Site: Gilfach Quarry
Scale(s): 1 : 3 500 @ A3	Project: Hydrogeological Monitoring Report
Checked/Model(s): .	Title: Figure 1- Water Monitoring Borehole Locations
Site Reference: .	Drawing Number: 14_C050_GIL_001_A

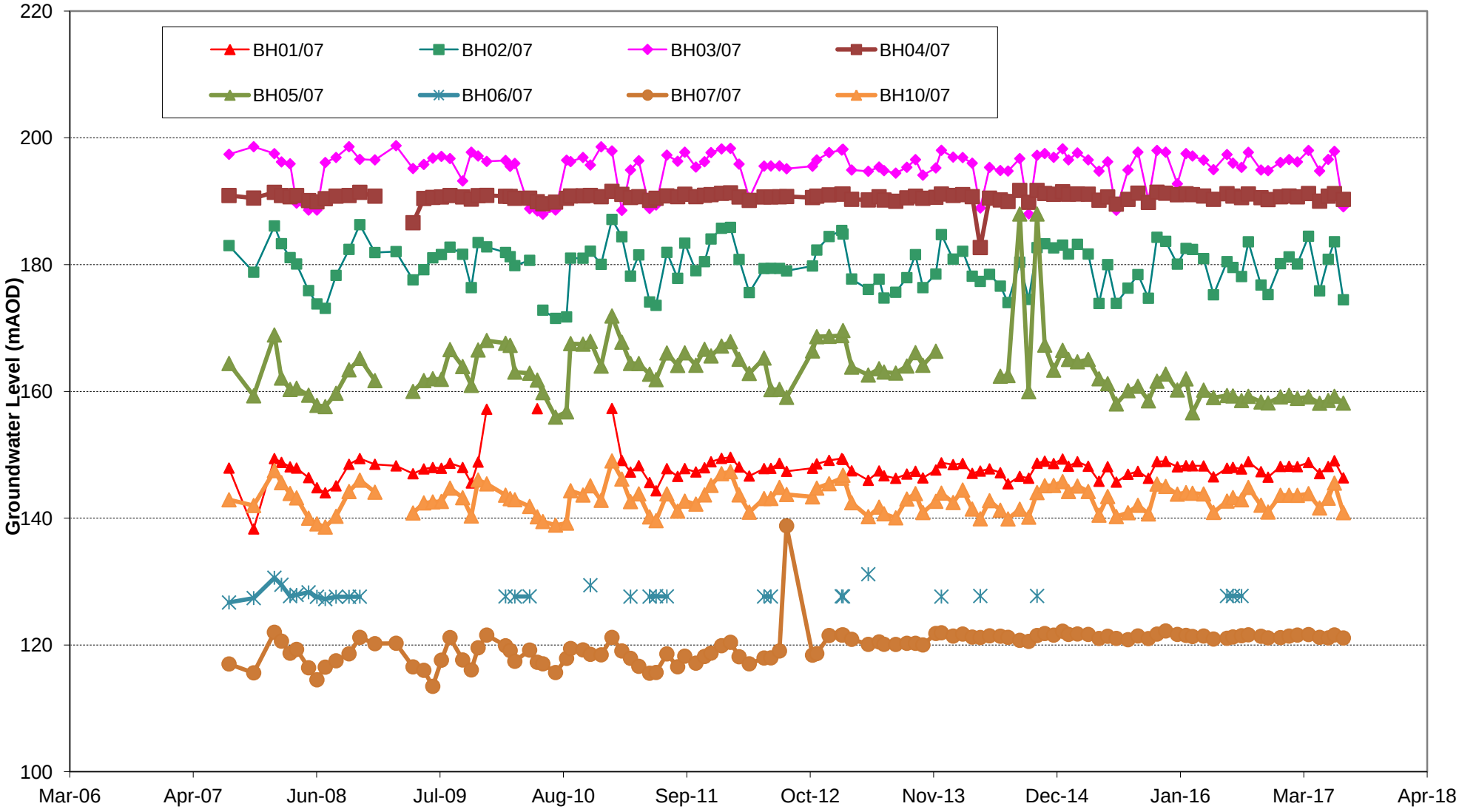


FIGURE 2: GILFACH QUARRY - COMPOSITE LONG TERM GROUNDWATER HYDROGRAPH

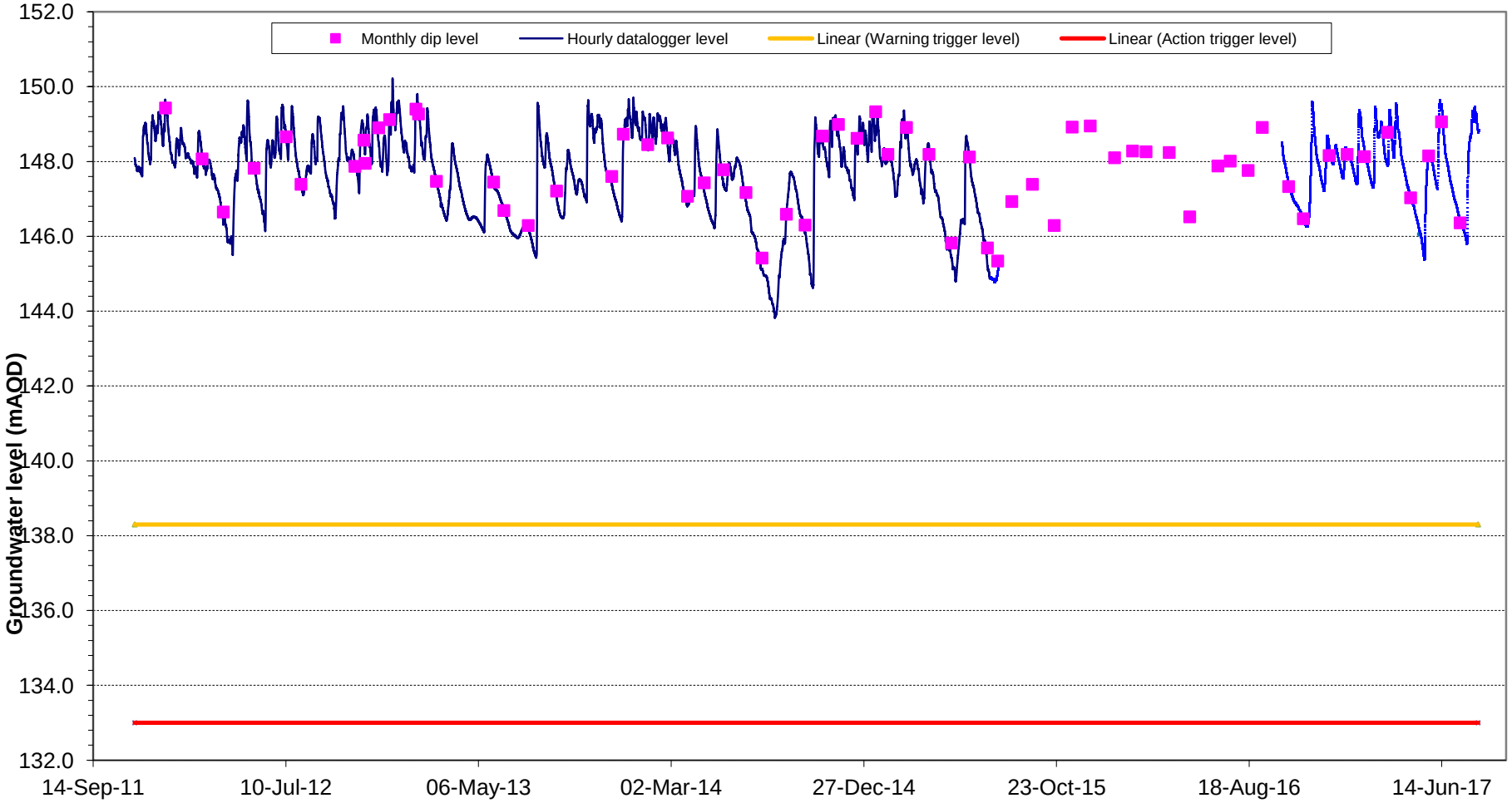


FIGURE 3: GILFACH QUARRY - BH01/07 CONTINUOUS GROUNDWATER HYDROGRAPH

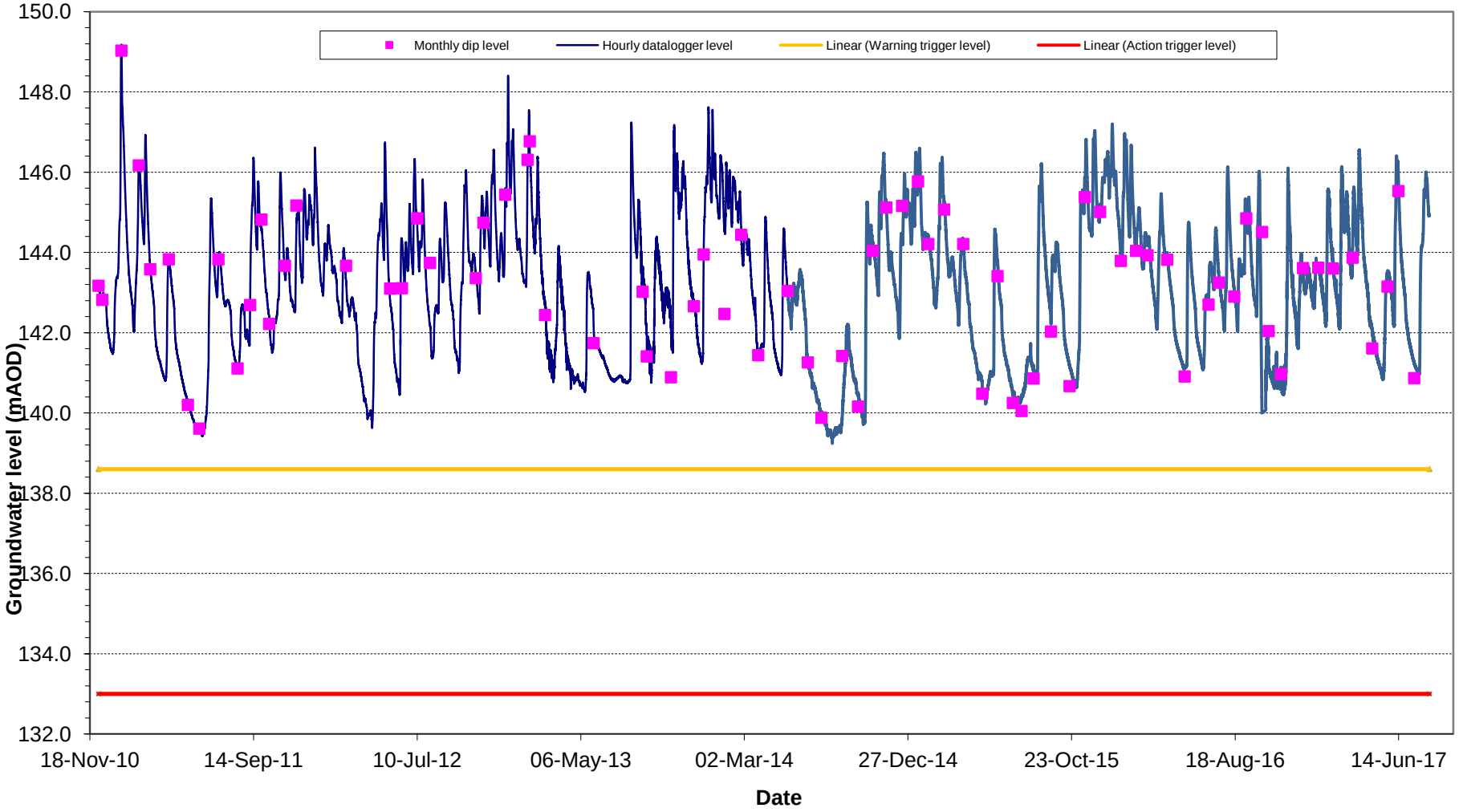
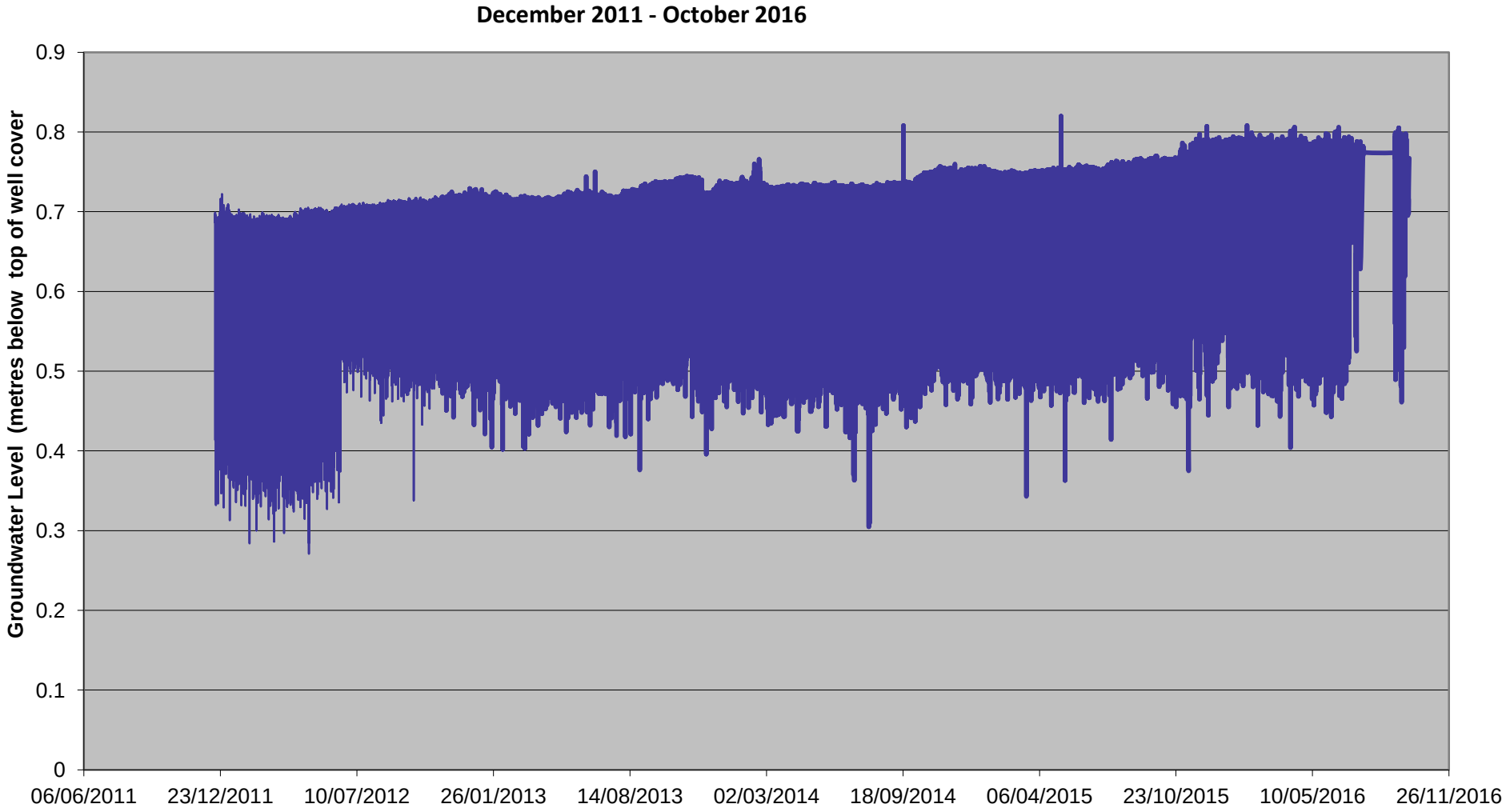


FIGURE 4: GILFACH QUARRY - BH10/07 CONTINUOUS GROUNDWATER HYDROGRAPH

FIGURE 5: Gilfach Quarry: Cefn Faes Uchaf Farm Spring Water Level (mbtc)



APPENDIX A

GROUNDWATER LEVEL DATA

BH ID	BH01/07		BH02/07		BH03/07		BH04/07		BH05/07		BH06/07		BH07/07		BH10/07	
Ref. Elev. mAOD	160.47		191.03		199.92		191.7		187.98		181.76		149.49		154.44	
Piezo depth (mbgl)	27.0		33.0		36.5		30.5		41.0		54.5		46.0		35.0	
	mbgl	mAOD	mbgl	mAOD	mbgl	mAOD	mbgl	mAOD	mbgl	mAOD	mbgl	mAOD	mbgl	mAOD	mbgl	mAOD
22-Aug-07	12.57	147.90	8.03	183.00	2.52	197.40	0.8	190.90	23.58	164.40	55.06	126.70	32.49	117.00	11.54	142.90
10-Nov-07	22.17	138.30	12.23	178.80	1.32	198.60	1.2	190.50	28.68	159.30	54.36	127.40	33.89	115.60	12.44	142.00
16-Jan-08	11.07	149.40	4.93	186.10	2.42	197.50	0.3	191.40	19.08	168.90	51.16	130.60	27.49	122.00	6.94	147.50
08-Feb-08	11.67	148.80	7.73	183.30	3.72	196.20	0.8	190.90	25.88	162.10	52.26	129.50	28.89	120.60	8.84	145.60
07-Mar-08	12.37	148.10	9.93	181.10	4.02	195.90	1	190.70	27.68	160.30	54.06	127.70	30.79	118.70	10.54	143.90
28-Mar-08	12.57	147.90	10.93	180.10	10.22	189.70	0.8	190.90	27.48	160.50	53.86	127.90	30.19	119.30	11.24	143.20
06-May-08	14.07	146.40	15.13	175.90	11.32	188.60	1.6	190.10	28.58	159.40	53.46	128.30	33.09	116.40	14.44	140.00
02-Jun-08	15.67	144.80	17.23	173.80	11.32	188.60	1.8	189.90	30.18	157.80	54.16	127.60	34.99	114.50	15.34	139.10
29-Jun-08	16.47	144.00	17.93	173.10	3.82	196.10	1.3	190.40	30.38	157.60	54.53	127.23	32.99	116.50	15.84	138.60
03-Aug-08	15.37	145.10	12.73	178.30	3.02	196.90	0.9	190.80	28.28	159.70	54.16	127.60	31.99	117.50	14.14	140.30
14-Sep-08	11.97	148.50	8.63	182.40	1.32	198.60	0.8	190.90	24.58	163.40	54.16	127.60	30.89	118.60	10.24	144.20
19-Oct-08	11.07	149.40	4.73	186.30	3.32	196.60	0.3	191.40	22.78	165.20	54.14	127.62	28.29	121.20	8.44	146.00
07-Dec-08	11.97	148.50	9.13	181.90	3.4	196.52	0.9	190.80	26.28	161.70			29.29	120.20	10.34	144.10
13-Feb-09	12.22	148.25	8.98	182.05	1.16	198.76							29.22	120.27		
09-Apr-09	13.46	147.01	13.44	177.59	4.76	195.16	5.09	186.61	27.98	160.00			32.95	116.54	13.62	140.82
14-May-09	12.70	147.77	11.83	179.20	4.12	195.80	1.27	190.43	26.27	161.71			33.49	116.00	12.03	142.41
12-Jun-09	12.48	147.99	9.96	181.07	3.13	196.79	1.1	190.60	25.98	162.00			36.02	113.47	11.88	142.56
10-Jul-09	12.60	147.87	9.44	181.59	2.85	197.07	1.03	190.67	26.08	161.90			31.89	117.60	11.8	142.64
07-Aug-09	11.80	148.67	8.28	182.75	3.19	196.73	0.8	190.90	21.39	166.59			28.32	121.17	9.7	144.74
17-Sep-09	12.48	147.99	9.4	181.63	6.72	193.20	1.02	190.68	24.06	163.92			31.86	117.63	11.21	143.23
15-Oct-09	14.92	145.55	14.66	176.37	2.19	197.73	1.37	190.33	27.03	160.95			33.43	116.06	14.1	140.34
06-Nov-09	11.62	148.85	7.55	183.48	2.79	197.13	0.82	190.88	21.45	166.53			29.94	119.55	8.42	146.02
04-Dec-09	3.29	157.18	8.23	182.80	3.64	196.28	0.78	190.92	19.95	168.03			27.93	121.56	9.03	145.41
03-Feb-10			9.12	181.91	3.49	196.43	0.92	190.78	20.39	167.59	54.11	127.65	29.62	119.87	10.81	143.63
18-Feb-10			9.78	181.25	4.42	195.50	0.94	190.76	20.72	167.26			30.37	119.12	11.36	143.08
05-Mar-10			11.19	179.84	3.96	195.96	1.24	190.46	24.94	163.04	54.13	127.63	32.07	117.42	11.53	142.91
22-Apr-10			10.36	180.67	11.1	188.82	1.22	190.48	25.11	162.87	54.1	127.66	30.3	119.19	12.59	141.85
17-May-10	3.20	157.27			11.44	188.48	1.78	189.92	26.19	161.79			32.22	117.27	14.22	140.22
04-Jun-10			18.22	172.81	11.97	187.95	2.1	189.60	28.18	159.80			32.47	117.02	14.97	139.47
15-Jul-10			19.51	171.52	11.31	188.61	1.84	189.86	32.04	155.94			33.84	115.65	15.54	138.90
20-Aug-10			19.28	171.75	3.45	196.47	1.24	190.46	31.21	156.77			31.61	117.88	15.22	139.22
02-Sep-10			10.01	181.02	3.67	196.25	0.87	190.83	20.44	167.54			30.05	119.44	10.11	144.33
12-Oct-10			10.02	181.01	3.02	196.90	0.85	190.85	20.53	167.45			30.27	119.22	10.79	143.65
05-Nov-10			8.91	182.12	4.21	195.71	0.79	190.91	20.09	167.89	52.34	129.42	30.97	118.52	9.33	145.11
10-Dec-10			10.98	180.05	1.34	198.58	0.99	190.71	23.99	163.99			31.05	118.44	11.62	142.82
14-Jan-11	3.17	157.30	3.9	187.13	1.99	197.93	0.15	191.55	16.09	171.89			28.3	121.19	5.41	149.03
15-Feb-11	11.37	149.10	6.63	184.40	11.37	188.55	0.62	191.08	20.21	167.77			30.44	119.05	8.27	146.17

GILFACH QUARRY: MONTHLY GROUNDWATER LEVEL MONITORING DATA

BH ID	BH01/07		BH02/07		BH03/07		BH04/07		BH05/07		BH06/07		BH07/07		BH10/07	
Ref. Elev. mAOD	160.47		191.03		199.92		191.7		187.98		181.76		149.49		154.44	
Piezo depth (mbgl)	27.0		33.0		36.5		30.5		41.0		54.5		46.0		35.0	
	mbgl	mAOD	mbgl	mAOD	mbgl	mAOD	mbgl	mAOD	mbgl	mAOD	mbgl	mAOD	mbgl	mAOD	mbgl	mAOD
15-Mar-11	13.20	147.27	12.84	178.19	4.99	194.93	1.11	190.59	23.57	164.41	54.13	127.63	31.60	117.89	11.83	142.61
11-Apr-11	12.19	148.28	9.50	181.53	3.53	196.39	0.99	190.71	23.59	164.39			32.86	116.63	10.61	143.83
16-May-11	14.85	145.62	16.92	174.11	11.06	188.86	1.57	190.13	25.27	162.71	54.13	127.63	33.95	115.54	14.24	140.20
06-Jun-11	16.15	144.32	17.46	173.57	10.52	189.40	1.24	190.46	26.13	161.85	54.07	127.69	33.83	115.66	14.83	139.61
11-Jul-11	12.66	147.81	9.10	181.93	2.65	197.27	0.86	190.84	21.92	166.06	54.10	127.66	30.90	118.59	10.61	143.83
15-Aug-11	13.88	146.59	13.19	177.84	3.62	196.30	0.98	190.72	23.89	164.09			32.94	116.55	13.33	141.11
07-Sep-11	12.65	147.82	7.65	183.38	2.19	197.73	0.60	191.10	21.90	166.08			31.26	118.23	11.75	142.69
13-Oct-11	13.18	147.29	11.99	179.04	4.53	195.39	0.98	190.72	23.86	164.12			32.36	117.13	12.22	142.22
10-Nov-11	12.52	147.95	10.56	180.47	3.69	196.23	0.76	190.94	21.34	166.64			31.31	118.18	10.77	143.67
01-Dec-11	11.57	148.90	6.99	184.04	2.25	197.67	0.66	191.04	22.39	165.59			30.78	118.71	9.27	145.17
04-Jan-12	11.04	149.43	5.30	185.73	1.67	198.25	0.46	191.24	20.83	167.15			29.61	119.88	7.42	147.02
02-Feb-12	10.86	149.61	5.16	185.87	1.59	198.33	0.38	191.32	20.14	167.84			29.07	120.42	7.11	147.33
01-Mar-12	12.40	148.07	10.22	180.81	4.07	195.85	1.03	190.67	22.91	165.07			31.35	118.14	10.77	143.67
03-Apr-12	13.82	146.65	15.44	175.59	9.42	190.50	1.57	190.13	25.15	162.83			32.47	117.02	13.49	140.95
21-May-12	12.65	147.82	11.64	179.39	4.38	195.54	1.03	190.67	22.72	165.26	54.12	127.64	31.55	117.94	11.34	143.10
12-Jun-12	12.62	147.85	11.62	179.41	4.36	195.56	1.02	190.68	27.70	160.28	54.12	127.64	31.53	117.96	11.33	143.11
10-Jul-12	11.81	148.66	11.63	179.40	4.35	195.57	1.00	190.70	27.67	160.31			30.44	119.05	9.59	144.85
02-Aug-12	13.08	147.39	12.02	179.01	4.80	195.12	0.96	190.74	28.92	159.06			10.70	138.79	10.70	143.74
25-Oct-12	12.60	147.87	11.25	179.78	4.40	195.52	1.12	190.58	21.60	166.38			31.10	118.39	11.08	143.36
08-Nov-12	11.90	148.57	8.73	182.30	3.40	196.52	0.90	190.80	19.35	168.63			30.85	118.64	9.70	144.74
18-Dec-12	11.35	149.12	6.60	184.43	2.25	197.67	0.70	191.00	19.30	168.68			28.00	121.49	9.00	145.44
28-Jan-13	11.07	149.40	5.64	185.39	1.85	198.07	0.57	191.13	19.18	168.80	54.09	127.67	27.93	121.56	8.13	146.31
01-Feb-13	11.20	149.27	6.20	184.83	1.72	198.20	0.56	191.14	18.38	169.60	54.11	127.65	27.90	121.59	7.67	146.77
01-Mar-13	13.00	147.47	13.30	177.73	5.00	194.92	1.40	190.30	24.15	163.83			28.60	120.89	12.00	142.44
24-Apr-13	14.50	145.97	14.95	176.08	5.20	194.72	1.50	190.20	25.40	162.58	50.60	131.16	29.40	120.09	14.20	140.24
29-May-13	13.02	147.45	13.33	177.70	4.53	195.39	1.00	190.70	24.40	163.58			29.01	120.48	12.70	141.74
14-Jun-13	13.78	146.69	16.30	174.73	5.10	194.82	1.51	190.19	24.93	163.05			29.39	120.10	13.75	140.69
22-Jul-13	14.18	146.29	15.39	175.64	5.49	194.43	1.71	189.99	25.09	162.89			29.41	120.08	14.38	140.06
27-Aug-13	13.51	146.96	13.09	177.94	4.57	195.35	1.17	190.53	23.98	164.00			29.23	120.26	11.42	143.02
24-Sep-13	13.07	147.40	9.46	181.57	3.36	196.56	0.91	190.79	21.87	166.11			29.23	120.26	10.57	143.87
18-Oct-13	14.12	146.35	14.66	176.37	5.81	194.11	1.24	190.46	23.86	164.12			29.49	120.00	13.55	140.89
29-Nov-13	12.87	147.60	12.52	178.51	4.67	195.25	1.08	190.62	21.64	166.34			27.68	121.81	11.78	142.66
17-Dec-13	11.74	148.73	6.30	184.73	1.89	198.03	0.57	191.13			54.13	127.63	27.57	121.92	10.49	143.95
24-Jan-14	12.02	148.45	10.16	180.87	2.96	196.96	0.79	190.91					28.09	121.40	11.97	142.47
24-Feb-14	11.84	148.63	8.93	182.10	3.03	196.89	0.66	191.04					27.77	121.72	10.00	144.44
27-Mar-14	13.40	147.07	12.86	178.17	3.92	196.00	0.98	190.72					28.25	121.24	13.00	141.44
22-Apr-14	13.04	147.43	13.68	177.35	10.99	188.93	9.01	182.69			54.03	127.73	28.31	121.18	14.54	139.90

GILFACH QUARRY: MONTHLY GROUNDWATER LEVEL MONITORING DATA

BH ID	BH01/07		BH02/07		BH03/07		BH04/07		BH05/07		BH06/07		BH07/07		BH10/07	
Ref. Elev. mAOD	160.47		191.03		199.92		191.7		187.98		181.76		149.49		154.44	
Piezo depth (mbgl)	27.0		33.0		36.5		30.5		41.0		54.5		46.0		35.0	
	mbgl	mAOD	mbgl	mAOD	mbgl	mAOD	mbgl	mAOD	mbgl	mAOD	mbgl	mAOD	mbgl	mAOD	mbgl	mAOD
22-May-14	12.69	147.78	12.57	178.46	4.59	195.33	1.22	190.48					28.05	121.44	11.68	142.76
26-Jun-14	13.30	147.17	14.43	176.60	5.08	194.84	1.50	190.20	25.59	162.39			28.11	121.38	13.18	141.26
21-Jul-14	15.05	145.42	17.02	174.01	5.16	194.76	1.75	189.95	25.48	162.50			28.29	121.20	14.56	139.88
28-Aug-14	13.88	146.59	10.65	180.38	3.19	196.73		191.70		187.98			28.76	120.73	13.02	141.42
26-Sep-14	14.17	146.30	16.52	174.51	11.92	188.00	1.87	189.83	28.03	159.95			28.93	120.56	14.28	140.16
23-Oct-14	11.79	148.68	8.35	182.68	2.68	197.24		191.70		187.98	53.19	127.73	28	121.49	10.4	144.04
17-Nov-14	11.48	148.99	7.74	183.29	2.4	197.52	0.48	191.22	20.68	167.30			27.69	121.80	9.32	145.12
16-Dec-14	11.85	148.62	8.39	182.64	3	196.92	0.6	191.10	24.63	163.35			27.94	121.55	9.28	145.16
14-Jan-15	11.14	149.33	7.95	183.08	1.65	198.27	0.21	191.49	21.5	166.48			27.32	122.17	8.67	145.77
02-Feb-15	12.28	148.19	9.36	181.67	3.4	196.52	0.59	191.11	22.94	165.04			27.83	121.66	10.23	144.21
03-Mar-15	11.56	148.91	7.83	183.20	2.3	197.62	0.56	191.14	23.31	164.67			27.76	121.73	9.37	145.07
07-Apr-15	12.28	148.19	9.36	181.67	3.4	196.52	0.59	191.11	22.94	165.04			27.83	121.66	10.23	144.21
12-May-15	14.65	145.82	17.16	173.87	5.18	194.74	1.54	190.16	25.99	161.99			28.47	121.02	13.96	140.48
09-Jun-15	12.35	148.12	11.03	180	3.7	196.22	1.03	190.67	26.76	161.22			28.12	121.37	11.03	143.41
07-Jul-15	14.78	145.69	17.15	173.88	11.35	188.57	2.16	189.54	29.96	158.02			28.46	121.03	14.19	140.25
14-Aug-15	13.54	146.93	14.74	176.29	4.99	194.93	1.41	190.29	27.87	160.11			28.66	120.83	13.58	140.86
15-Sep-15	13.08	147.39	12.61	178.42	2.18	197.74	0.43	191.27	27.17	160.81			28.07	121.42	12.41	142.03
19-Oct-15	14.18	146.29	16.33	174.7	9.75	190.17	1.89	189.81	29.47	158.51			28.49	121	13.77	140.67
16-Nov-15	11.55	148.92	6.72	184.31	1.91	198.01	0.28	191.42	26.37	161.61			27.78	121.71	9.06	145.38
14-Dec-15	11.52	148.95	7.36	183.67	2.19	197.73	0.44	191.26	25.25	162.73			27.28	122.21	9.43	145.01
21-Jan-16	12.37	148.1	10.95	180.08	7.17	192.75	0.68	191.02	27.76	160.22			27.83	121.66	10.65	143.79
18-Feb-16	12.19	148.28	8.48	182.55	2.41	197.51	0.53	191.17	26.01	161.97			27.98	121.51	10.4	144.04
10-Mar-16	12.21	148.26	8.64	182.39	2.79	197.13	0.66	191.04	31.35	156.63			28.16	121.33	10.51	143.93
15-Apr-16	12.23	148.24	10.08	180.95	3.44	196.48	0.88	190.82	27.78	160.2			28.08	121.41	10.62	143.82
17-May-16	13.95	146.52	15.79	175.24	4.94	194.98	1.4	190.3	28.95	159.03			28.56	120.93	13.53	140.91
30-Jun-16	12.59	147.88	10.56	180.47	2.56	197.36	0.52	191.18	28.63	159.35	54.17	127.73	28.44	121.05	11.74	142.7
19-Jul-16	12.46	148.01	11.48	179.55	3.91	196.01	0.89	190.81	28.7	159.28	54.13	127.73	28.23	121.26	11.19	143.25
16-Aug-16	12.71	147.76	12.91	178.12	4.58	195.34	1.13	190.57	29.42	158.56	54.14	127.73	28.03	121.46	11.54	142.9
07-Sep-16	11.56	148.91	7.43	183.6	2.21	197.71	0.56	191.14	28.76	159.22			27.89	121.6	9.59	144.85
18-Oct-16	13.14	147.33	14.25	176.78	5	194.92	1.14	190.56	29.65	158.33			28.12	121.37	12.4	142.04
10-Nov-16	14	146.47	15.76	175.27	5.1	194.82	1.44	190.26	29.8	158.18			28.38	121.11	13.47	140.97
20-Dec-16	12.31	148.16	10.88	180.15	3.8	196.12	1	190.7	28.85	159.13			28.33	121.16	10.83	143.61
17-Jan-17	12.28	148.19	9.81	181.22	3.35	196.57	0.88	190.82	28.61	159.37			28.09	121.4	10.82	143.62
13-Feb-17	12.34	148.13	10.93	180.1	3.72	196.2	1.01	190.69	29.09	158.89			27.93	121.56	10.84	143.6
21-Mar-17	11.69	148.78	6.56	184.47	1.91	198.01	0.49	191.21	28.84	159.14			27.85	121.64	10.57	143.87
26-Apr-17	13.44	147.03	15.17	175.86	5.15	194.77	1.69	190.01	29.85	158.13			28.29	121.2	12.83	141.61
24-May-17	12.32	148.15	10.19	180.84	3.33	196.59	0.9	190.8	29.41	158.57			28.38	121.11	11.29	143.15

GILFACH QUARRY: MONTHLY GROUNDWATER LEVEL MONITORING DATA

BH ID	BH01/07		BH02/07		BH03/07		BH04/07		BH05/07		BH06/07		BH07/07		BH10/07	
Ref. Elev. mAOD	160.47		191.03		199.92		191.7		187.98		181.76		149.49		154.44	
Piezo depth (mbgl)	27.0		33.0		36.5		30.5		41.0		54.5		46.0		35.0	
	mbgl	mAOD	mbgl	mAOD	mbgl	mAOD	mbgl	mAOD	mbgl	mAOD	mbgl	mAOD	mbgl	mAOD	mbgl	mAOD
13-Jun-17	11.41	149.06	7.42	183.61	2.05	197.87	0.5	191.2	28.76	159.22			27.91	121.58	8.91	145.53
12-Jul-17	14.11	146.36	16.58	174.45	10.8	189.12	1.41	190.29	29.83	158.15			28.39	121.1	13.57	140.87

GILFACH QUARRY: MONTHLY GROUNDWATER LEVEL MONITORING DATA