2015 Annual Performance Report

Aberthaw Quarry Ash Disposal Site

Permit Number: BP3339BH

March 2016

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The energy to lead

Summary

This document gives details on the performance of Aberthaw Quarry Ash Disposal Site over 2015, as required by condition 4.2.1 of the site's Environmental Permit (EP).

Aberthaw Quarry Ash Disposal Site is being constructed and filled with Pulverised Fuel Ash (PFA) in four distinct phases (see Appendix A). Phase 1 was constructed in 2008, filled between Quarter 4 2008 to Quarter 4 2010 and then capped and hydroseeded in Spring 2011. Phase 2 was constructed in 2009/10 with filling commencing from Quarter 4 2010. Phase 2 East was filled until Quarter 3 2013 before being capped and hydroseeded whilst Phase 2 West was filled until Quarter 4 2014 before being capped and hydroseeded. Phase 3A (east) was constructed in 2012/13 with filling commencing in Quarter 3 2013 and remained the working phase throughout 2014 and 2015. The construction of Phase 3B (west) was completed in 2014 with filling commencing in Quarter 2 2015.

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1. Review of Results for Emission Monitoring

1.1. Groundwater Quality Review

Monitoring Objective

To carry out routine monitoring of groundwater to monitor the performance of the ash disposal site by measurement of absolute levels and concentrations and trends relative to relevant criteria including background levels and concentrations, control levels and compliance limits.

Number and Location of Monitoring Points

A summary of the monitoring boreholes is provided in Table 1 below and the locations are shown in Appendix A. In January 2015, borehole improvement works were completed to improve water sampling. E05-03 and E06-01were re-drilled (new details provided in Table 1) and the top hat cover was replaced on E06-05. In addition, a new borehole was installed above Phase 3B, E15/1 to improve the understanding of groundwater quality potentially flowing into the site from the south-east. In total, there are 12 boreholes in natural ground, all completed in the Porthkerry Member limestone.

Groundwater flow beneath the ash disposal site is directed towards the Lafarge Lagoons and the River Thaw to the west. Hence, monitoring boreholes, E09-01A, E09-01B, E09-02A and E09-02B on the north-eastern site boundary (approximately 200m apart) are upgradient. Borehole E15/1 on the south site boundary is also upgradient.

Monitoring boreholes along the western site boundary (E05-03, E05-04 and E06-01) with an average spacing of 100m are downgradient of the current active Pulverised Fuel Ash (PFA) disposal area (Phase 1 and 2). Along the south-western site boundary, two of the monitoring boreholes with an average spacing of 100m (E06-02 and E06-03) are downgradient of the current active PFA disposal area (Phase 3A & 3B) and a future filling phase (Phase 4). Whilst the two remaining boreholes (E06-04 and E06-05) with an average spacing of 100m may be downgradient of a future filling phase (Phase 4).

Table 1: Summary of Monitoring Boreholes

Monitoring Borehole	Formation Sampled	Lithology Type – Natural (N)	Response Zone Depth (m b GL)	Designation
E09-01A	Limestone	N	16-25	Upgradient
E09-01B	Limestone	N	22-31	Upgradient
E09-02A	Limestone	N	19-28	Upgradient
E09-02B	Limestone	N	25-34	Upgradient
E15-1	Limestone	N	17-29	Upgradient
E05-03	Limestone	N	3 - 15	Downgradient Phase 1&2 Active Area
E05-04	Limestone	N	2 - 20	Downgradient Phase 1&2 Active Area
E06-01	Limestone	N	3 - 15	Downgradient Phase 1&2 Active Area
E06-02	Limestone	N	1 - 10	Downgradient Phase 3A & 3B Active Area
E06-03	Limestone	N	1 - 10	Downgradient Phase 3A & 3B Active Area
E06-04	Limestone	N	1 - 10	Downgradient Future Filling Phases
E06-05	Limestone	N	1 – 8	Downgradient Future Filling Phases

m b GL – metres below ground level

<u>Monitoring Measurements</u>

The groundwater monitoring analytical suite contains a range of parameters which are monitored on a quarterly basis along with the groundwater level and standard field measurements in accordance with the Environmental Permit. An independent external contractor is responsible for the sampling of the groundwater boreholes and an independent external laboratory is responsible for the analysis of the samples. There have been no changes to the contractor for the groundwater sampling and one change to the analytical laboratory in May 2010. Table 2 summarises the changes to the groundwater sampling method since monitoring began to improve the sample quality.

Table 2: Summary of Groundwater Sampling Methods

Monitoring Borehole	Purge Strategy	Purge Equipment	Date From	Date To
E09-01A, E09-01B, E09-02A, E09-02B, E05-04	1 x Well volume	Bailer	Quarter 1 2006	Quarter 2 2013
	Low flow steady state	Submersible pump	Quarter 3 2013	—
E05-03	1 x Well volume	Bailer	Quarter 1 2006	Quarter 3 2012
	1 x Well volume	Inertial pump	Quarter 4 2012	Quarter 2 2013
	Low flow steady state	Submersible pump	Quarter 3 2013	—
E06-01	1 x Well volume	Bailer	Quarter 1 2006	Quarter 2 2012
	1 x Well volume	Inertial pump	Quarter 3 2012	Quarter 2 2013
	3 x Well volume	Inertial pump	Quarter 3 2013	Quarter 4 2014
	Low flow steady state	Submersible pump	Quarter 3 2013	Quarter 1 2015
E06-02, E06-03	1 x Well volume	Bailer	Quarter 1 2006	Quarter 2 2012
	1 x Well volume	Inertial pump	Quarter 3 2012	Quarter 2 2013
	3 x Well volume	Inertial pump	Quarter 3 2013	Quarter 3 2014
	Low flow steady state	Submersible pump	Quarter 4 2014	—
E06-04, E06-05	1 x Well volume	Bailer	Quarter 1 2006	Quarter 2 2013
	3 x Well volume	Inertial pump	Quarter 3 2013	—

Figure 1 shows the recorded groundwater elevations for the previous 9 years which vary between +17 (E05-03) to +35m OD (E05-02B). Upgradient groundwater elevations are characterised by larger amplitude seasonal water level fluctuations with annual winter influxes of rainfall recharge. Downgradient groundwater elevations fluctuate only slightly due to effect of dewatering from the Quarry which maintains groundwater at near-constant elevations.

Figure 1: Groundwater Hydrograph

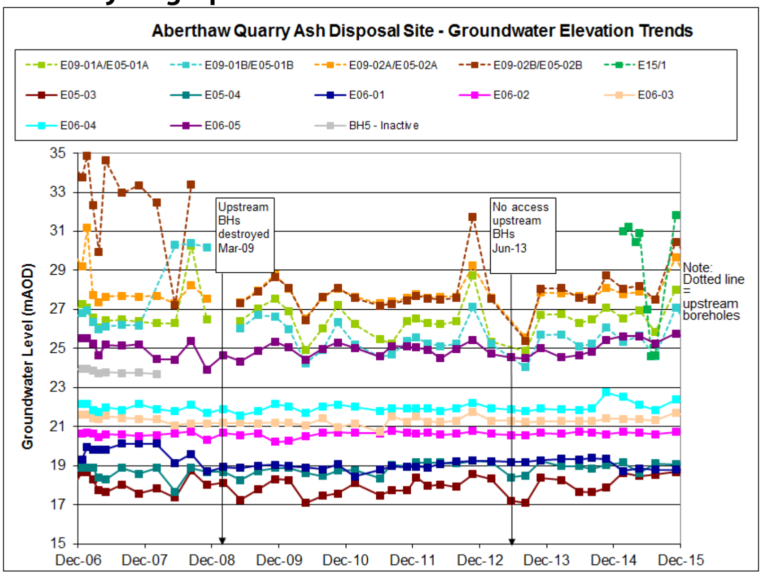


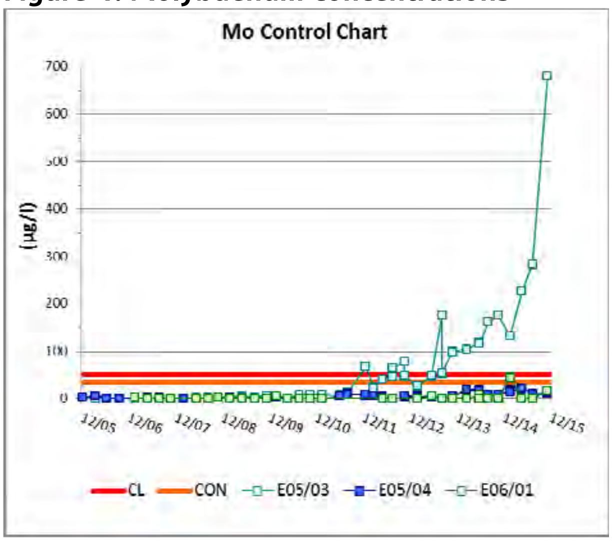
Figure 2 shows the general groundwater quality for the major ions in each of the groundwater boreholes. Natural groundwater quality varies between upgradient and downgradient groundwater. Calcium is depleted in downgradient boreholes, E05-03, E05-04, E06-01 and E06-02 and correlated with elevated sodium, suggesting ion exchange reactions are occurring along the groundwater flow path. Whilst in downgradient boreholes, E06-03, E06-04 and E06-05, major ion chemistry is distinctly different with elevation of calcium, magnesium and sulphate, suggesting a natural geological or quarry-related source in or upgradient of this area.

Figure 3 shows the groundwater control charts with concentrations of all downgradient boreholes plotted as well as the average upgradient concentration (representing concentrations in boreholes E09-01A, E09-01B, E09-02A and E09-02B i.e. background groundwater quality). It should be noted that the compliance limits apply to boreholes E05-03, E05-04 and E06-01 whilst the control levels (where defined) apply to all downgradient boreholes. An exceedance is defined as a result above the compliance limit or control level for 3 consecutive sampling events.

In 2015, there were no exceedances of the compliance limit or control level for any critical parameter except the continued exceedance in Molybdenum in E05-03, which has been on an upward trend since January 2012. The elevated mercury result in E05-03 in November 2013 is confirmed as a spurious result as all subsequent results have been below the method detection limit of 0.01µg/l.

Figure 4 shows the control chart for molybdenum for E05-03 and the two other boreholes closest to it, E05-04 and E06-01 as well as the surface water monitoring points (note there are no surface water compliance limits or control levels for molybdenum). The boreholes are located to the west of and adjacent to Phase 1 and are downgradient of active filling operations. Natural background concentrations of molybdenum in the Porthkerry Formation are <3µg/l and the average pre-filling concentration for the Lafarge Lagoon (SW12) is 3µg/l.

Figure 4: Molybdenum concentrations



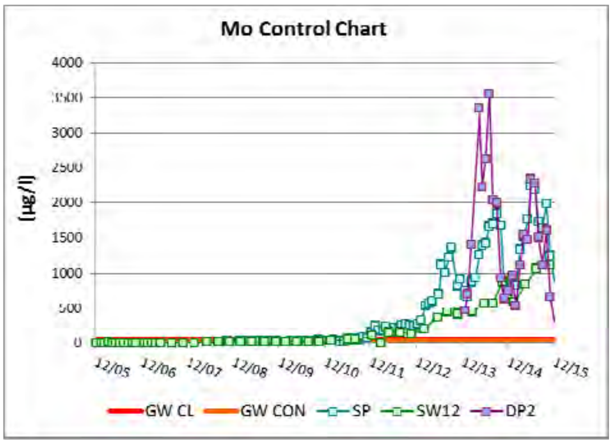
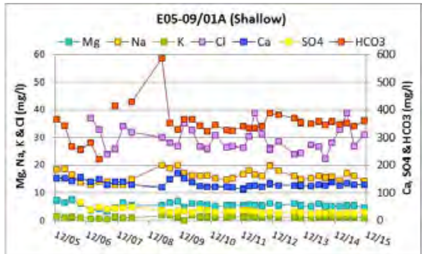
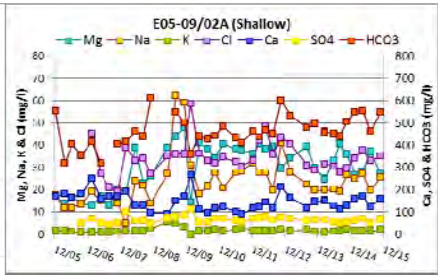


Figure 2: General Groundwater Quality Charts

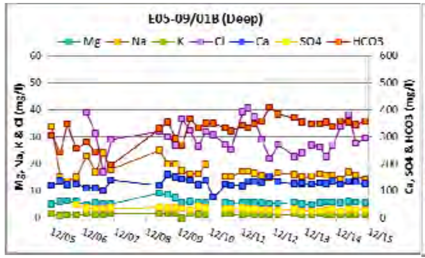
Upgradient Boreholes



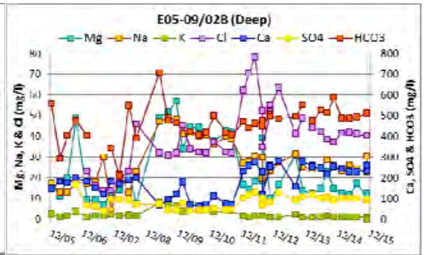
All analytes low and concentrations steady.



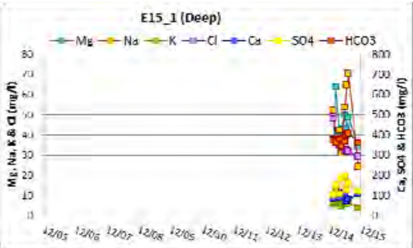
All analytes low but fluctuating.



All analytes low and concentrations steady.

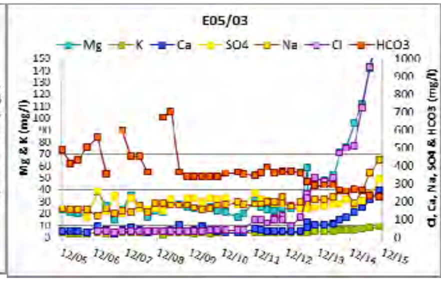


All analytes low but fluctuating, spike Mg 09-11.

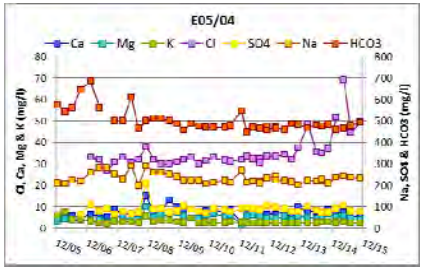


All analytes low, Mg & Na higher than other upgradient boreholes.

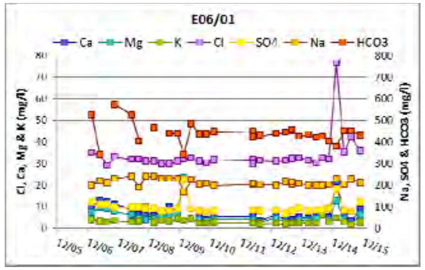
Downgradient Boreholes Phase 1/2



All analytes low, Cl, Mg and Ca increasing from Jan-12 and Na from May-15.

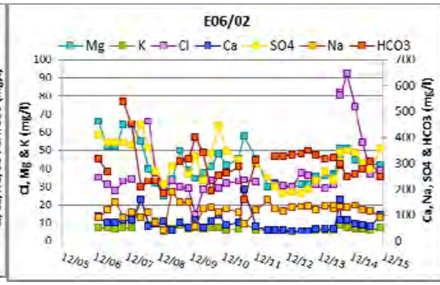


All analytes low, concentrations steady, Ca depleted.

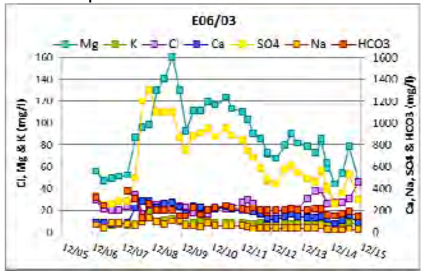


All analytes low, concentrations steady, Ca depleted.

Downgradient Boreholes Phase 3/4

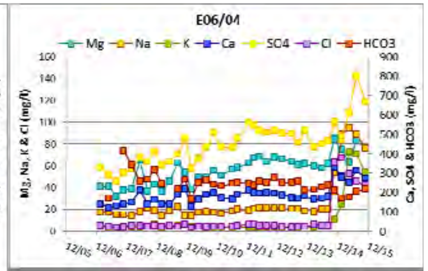


All analytes low but fluctuating, Mg/SO4 decreasing then increasing since Sept-14.

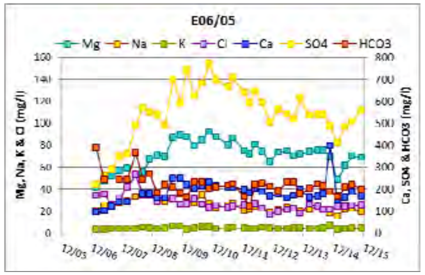


All analytes low except Mg and SO4 elevated.

Downgradient Boreholes Future Phase



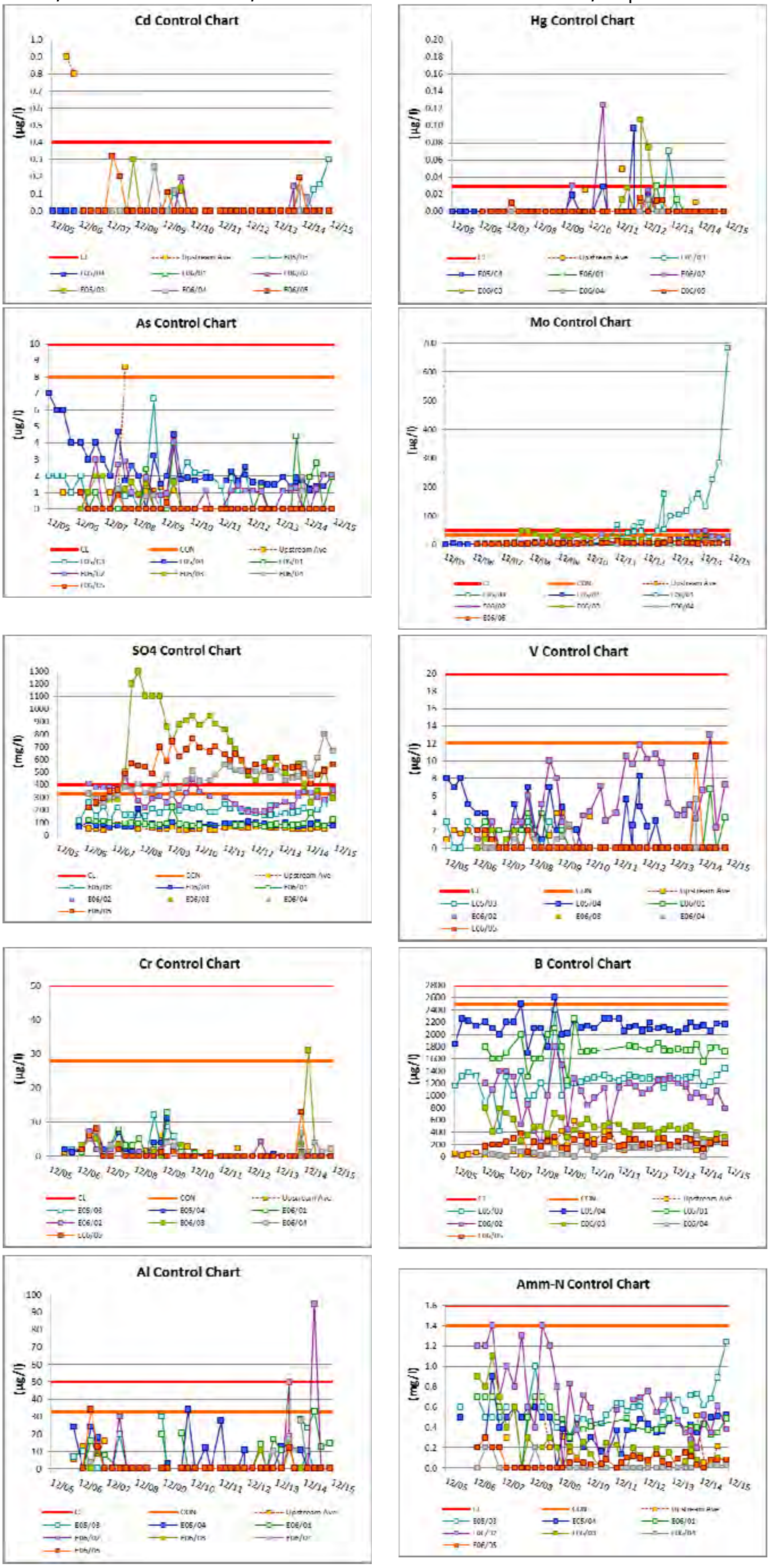
All analytes low except SO4 increasing and from Nov-14 Cl, Mg, Na and K increasing .



All analytes low except SO4 elevated.

Figure 3: Control charts for groundwater boreholes

(CL – Compliance Limit, CON – Control Level, 0 – result at Method Detection Limit, Duplicate results also plotted)



The molybdenum concentrations in E06-01 consistently reflect the natural background concentrations whilst in E05-04, concentrations are approximately double. There is no increasing trend in molybdenum in either of these boreholes, which suggests the source is localised to E05-03. Concentrations in E05-03 have been increasing since January 2012, around a year after Phase 1 was completed, which suggests the source is unlikely to be from the deposited PFA. There is also no co-association of increasing concentrations in other indicative PFA leachate parameters which also supports this theory. During site investigations in 2014, it was identified that the discharge from the wheel wash is currently piped across Phase 1 and discharged into the unlined western boundary ditch adjacent to Phase 1 and close to E05-03. The wheel wash uses water from the settlement ponds which as shown in Figure 4 has high concentrations of molybdenum and therefore represents a possible source for the elevated levels in E05-03. Similarly the rise in molybdenum concentration in SW12 as a result of the discharge from the settlement ponds may be causing the rise in E05-03 if the groundwater is in hydraulic continuity with the Lafarge lagoon, as the borehole is located just to the north with a response zone between 3 and 15mbgl. In August 2015 the wheel wash discharge pipe re-routing into Settlement Pond 1 was completed and hopefully molybdenum concentrations in E05-03 will reduce as a consequence.

In general the control charts in Figure 3 show that there are no increasing trends in critical parameter concentrations except for molybdenum as discussed above. Other key points to note are:

- a decrease in arsenic concentrations in E05-04 from 7µg/l to 2µg/l;
- naturally elevated sulphate concentrations in E06-03, E06-04 and E06-05 above 400mg/l; and;
- variable vanadium concentrations in E06-02 between 1µg/l and 12µg/l .

A summary of the average groundwater quality for all monitoring parameters between 2006 and 2015 is provided in Appendix B with a comparison of pre- and post-fill concentrations. The key trends in the data have been discussed above, however, it can be summarised that in general, groundwater at Aberthaw Quarry Ash Disposal Site has not been significantly impacted by PFA-derived substances.

The difference in pH between field and laboratory measurements in 2015 was less that 0.5 pH units which indicates stable sample conditions. For Electrical Conductivity the difference was between 0-30% with field measurements consistently higher. A change greater than 10% may indicate a change in sample conditions and therefore for some samples precipitation of solids between sampling and analysis may be occurring. Yet Major ion balances were all within +/- 5% suggesting precipitation of solids is minimal. Duplicate samples collected during 2015 showed good repeatability and were within the expected laboratory error of +/- 20%.

1.2. Surface Water Quality Review

Monitoring Objective

To carry out routine monitoring of surface water to;

- monitor the performance of the ash disposal site by measurement of absolute levels and concentrations and trends relative to relevant criteria including background concentrations and control levels; and;
- identify and quantify effects on surface water receptors.

Number and Location of Monitoring Points

A summary of the surface water monitoring points is provided in Table 3 below and the locations are shown in Appendix A. As detailed in a letter to NRW dated 13th June 2014 a new surface water monitoring point has been added, DP2, to monitor the composition of water from the under-drainage. Routine monitoring at DP2 began in May 2014.

Table 3: Summary of Surface water monitoring points

Monitoring Point	Description	Direction from site	Designation
SW12	East shore of Lafarge lagoon in NW area	West	Surface water Receptor
Settlement Ponds	Two concrete ponds collecting groundwater and surface water	South-west	
DP2	Surface water and groundwater drainage channel at base of Phase 1 and 2	West within site	

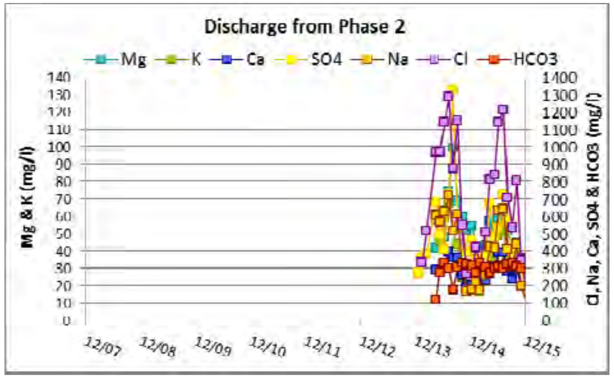
A proportion of the upstream and underlying groundwater will be collected in the groundwater drainage layer and directed towards the two settlement ponds along with any water that has infiltrated through the PFA and the barrier/attenuation layer. Surface water from runoff is also directed into the two settlement ponds via a series of perimeter ditches and toe drains. The settlement ponds are constructed on the quarry floor, contained by concrete and butyl lined 3m high bunds and are designed to allow suspended solids to settle out before the water is discharged through penstocks into the nearby Lafarge Lagoon (SW12).

Monitoring Measurements

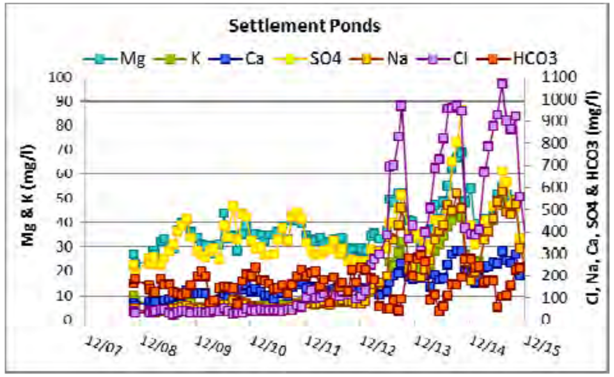
The surface water monitoring analytical suite contains a range of parameters which are monitored on a quarterly basis for SW12 and a monthly basis for the Settlement Ponds and DP2, in accordance with the Environmental Permit. Trained in-house operatives are responsible for the sampling of the Settlement Ponds and DP2 and an independent external contractor is responsible for the sampling of SW12. There have been no changes to the in-house operatives or the contractor for the surface water sampling. An independent external laboratory is responsible for the analysis of the samples. There was a change to the analytical laboratory in September 2009 for the Settlement Ponds surface water analysis and in May 2010 for the SW12 surface water analysis.

Figure 5 shows the general surface water quality for the major ions which is closely similar to the downgradient boreholes, E06-03, E06-04 and E06-05 with elevation of magnesium and sulphate, suggesting a natural geological or quarry-related source upgradient of this area. Concentrations appear to be seasonably variable in the settlement ponds with highs in July to December and lows in February to June. This seasonal pattern is much more marked in 2013, 2014 and 2015 with much higher chloride concentrations than seen previously. It is not clear where the source of chloride is coming from and this will be investigated during 2016 as it may be impacting on water quality results.

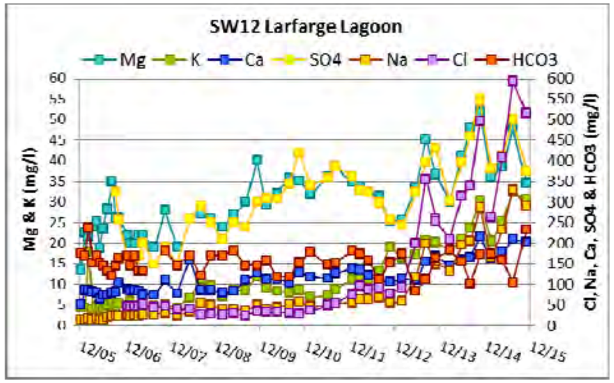
Figure 5: General Surface Water Quality Charts



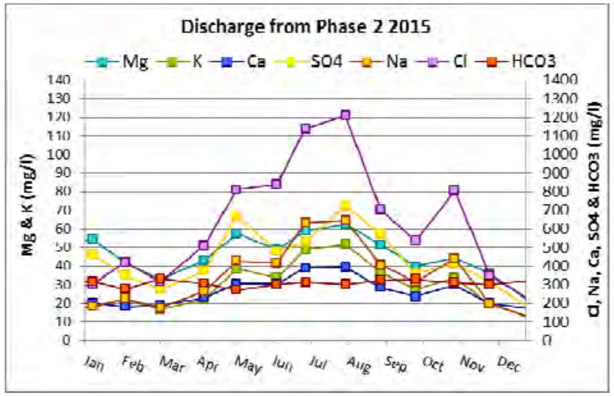
Fluctuations in SO4 & Cl with high concentrations in summer and low concentrations in winter.



From Jun-13 Fluctuations in Mg, K, Ca, SO4, Na & Cl with high concentrations in summer and low concentrations in winter.



Concentrations steady with seasonal increase in Cl, SO4, Mg, K & Na from Feb-13.



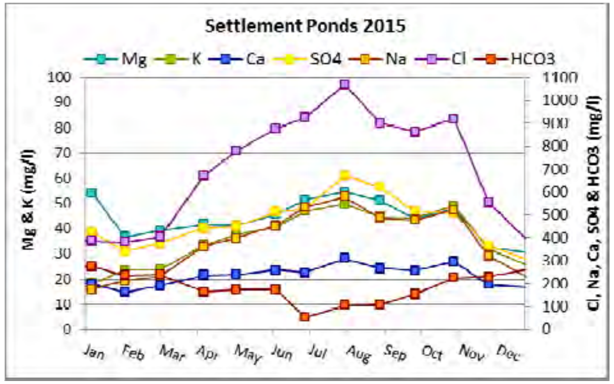


Figure 6 shows the surface water control charts. It should be noted that the compliance limits apply to the discharge from the settlement ponds whilst the control levels (where defined) apply to both the discharge from the settlement ponds and SW12. An exceedance is defined as a result above the compliance limit or control level for 3 consecutive sampling events.

In 2015, there were no exceedances of the compliance limit or control level for any critical parameter, except for sulphate. Concentrations exceeded the compliance limit of 400mg/l between April 2015 and November 2015, which appears to be linked to the previous exceedance period between May 2014 and January 2015. A temporary approval of the elevated discharge is in place with NRW on the basis of no environmental impact and the understanding that the elevated concentrations are being caused by drainage into the site from the south-east. A request to vary the permit will be submitted in 2016.

In general, Figure 6 shows that there are no increasing trends in critical parameter concentrations except for sulphate as discussed above and that although concentrations of critical parameters have been variable over time there appears to be no impact on the water quality within SW12 – Lafarge lagoon into which the settlement ponds discharge. Other key points to note are:

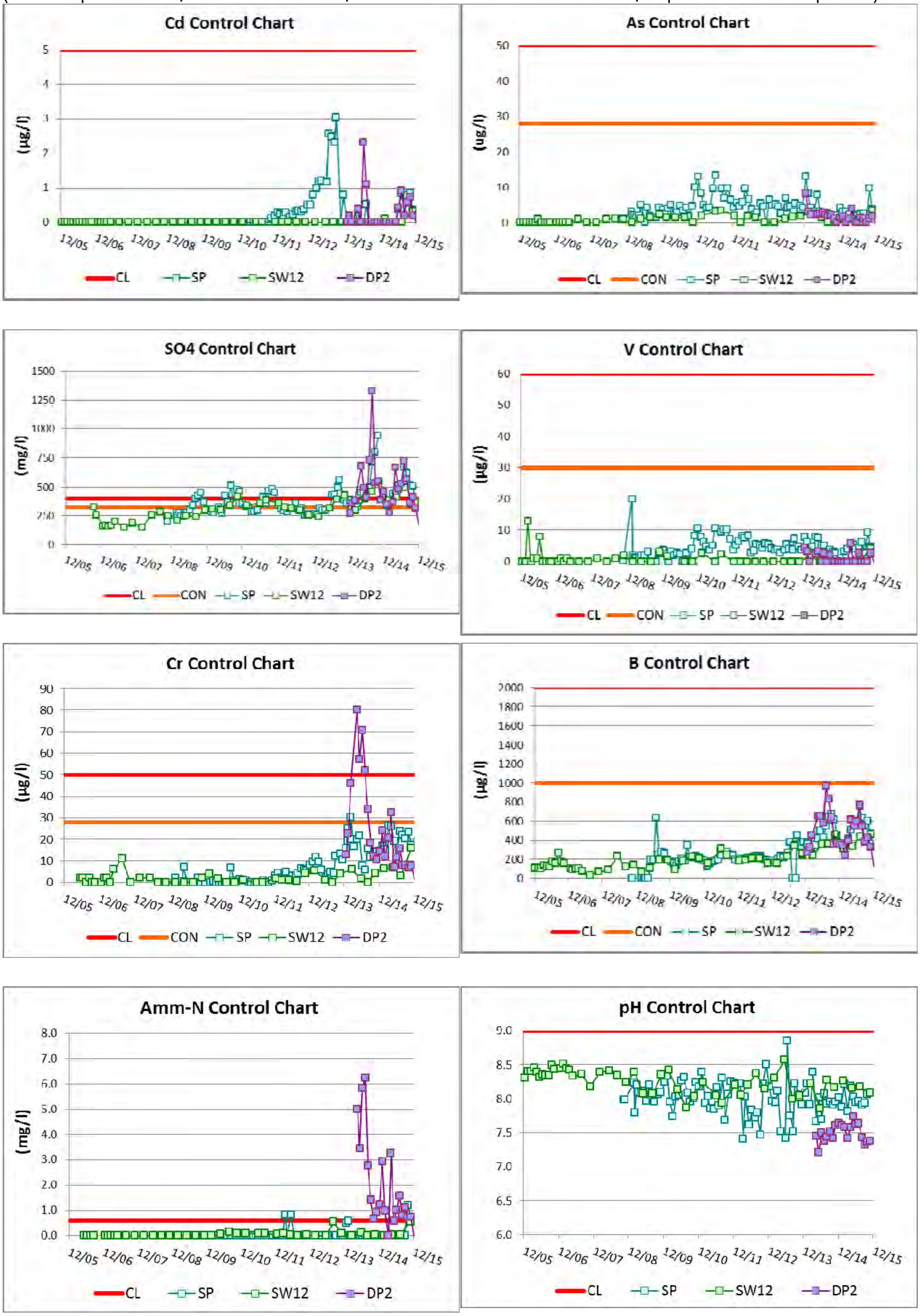
- variable chromium concentrations in SP (between 1µg/l and 30µg/l) and DP2 (between 10µg/l and 80µg/l).
- variable boron concentrations in SP (between 129µg/l and 746µg/l) and DP2 (between 241µg/l and 970µg/l).
- variable ammoniacal nitrogen concentrations in DP2, between 0.5mg/l and 6.2mg/l.

During 2015, works to improve surface water management included the re-profiling of drainage ditches, concrete lining of some of the key surface water ditches and removal of small PFA slippages.

A summary of the average surface water quality between 2006 and 2015 is provided in Appendix B with a comparison of pre- and post-fill concentrations. The key trends in the data have been discussed above, however, it can be summarised that there may be some low level contamination from fugitive emissions of PFA, which is considered to have not significantly impacted the surface water receptors.

Figure 6: Surface Water Control Charts

(CL – Compliance Limit, CON – Control Level, 0 – result at Method Detection Limit, Duplicate results also plotted)



2. Annual Improvement Targets Summary

Aberthaw Power Station continues to maintain its ISO 14001 Certification for the "Generation of electricity, by the combustion of fossil fuel and biomasses, together with the associated sale or disposal of ash". The station had 2 surveillance visits by Lloyds Register Quality Assurance during 2015 and no non-conformities were identified. Table 4 provides details of the improvement targets for 2015 and the performance against those targets.

Table 4: Environmental Performance 2015

Objective	Target	Target Date	Responsible Person	Final Status
Maintain a High Level of Environmental Compliance	No more then 2 environmental incidents resulting in justified complaints.	End 2015	All employees	0
	No more then zero exceedences of permit conditions which result or have potential to cause significant environmental harm. (Natural Resources Wales CCS Category 1 and 2).	End 2015	All employees	0
	Minimise exceedences of permit conditions which result or have potential to cause minor environmental harm. (Natural Resources Wales CCS Category 3). Fully investigate all exceedences of this type and implement improvements to minimise the likelihood of environmental harm.	End 2015	All employees	2 - CW low pH Discharge & Noise from de-glazing
	No more than zero non-compliance with emissions limits or conditions as set out in EPR permits (Natural Resources Wales CCS Category 4). Submit all NRW reporting on time.	End 2015	Environmental Compliance Engineer	0
	Provide environmental support for the Low NOx Boiler Project including environmental permitting, impact assessment and analysis.	Ongoing	Environmental Compliance Engineer	Permit Variation received 28/08/15.
	Complete response to Improvement Condition 35 – Cost benefit appraisal of best available technique for safe passage of eel.	30/06/2015	Environmental Compliance Engineer	Response submitted 24/06/15.
	Complete responses to Improvement Condition 7: (1) 2015 soil sampling/vegetation analysis report. (2) 2014 Third year monitoring report	31/08/2015 13/11/2015	Environmental Compliance Engineer	(1) Report submitted 20/08/15. (2) Report submitted 13/11/15.
Ensure Efficient Uses of Resources	Waste < 15 segregation non-compliances. Non-compliance definition: - >10% wrong material in the skip. - Waste causing a safety or environmental hazard.	End 2015	All employees	6
	Monitor and regularly report waste disposal and recycling statistics to identify minimisation opportunities.	Ongoing	Environmental Compliance Engineer	Completed
	Water 5% reduction on 2013 target < 110 m3/GWh process water (Ely Wells and St Lythans supplement).	End 2015	All employees	Dec - 229m3/GWhr YTD - 173m3/GWhr
	Monitor and regularly report process and potable water use to identify minimisation opportunities.	Ongoing	Section Head Performance & Commercial Section Head Regulation	Completed

Objective	Target	Target Date	Responsible Person	Final Status
Be Responsive to Concerns and Complaints regarding our Operations	Provide response to public enquiries and complaints within 48hrs of normal office hours.	Ongoing	Section Head Regulation Environmental Compliance Engineer	Compliant
Be Accountable by Publicly Reporting our Environmental Performance	Hold a Local Liaison Committee.	Nov-15	Station Manager Section Head Regulation	Held 28/10/15 - no issues.
Reduce the Carbon Intensity of Electricity Generated	To meet the business plan targets for biomass burn and thermal efficiency.	End 2015	Section Head Materials Handling Section Head Performance & Commercial	Biomass -39% TEMP -0.45%
Drive Continuous Improvements in Standards of Environmental Management	Ensure the Environmental Management System (EMS) is maintained to ISO 14001 and plan for updating the EMS to the revised 2015 Standard.	Ongoing	Section Head Regulation Environmental Compliance Engineer	BIP created. Two successful surveillance visits. Training attended.
	Ensure all staff and residential contractors (managers and first line supervisors) new to site in 2015 have completed the environmental training program.	End 2015	Section Heads Technical Officers	Staff - 71% Contractors - 100%
	Progress development of a new environmental training program.	Q4 2015	Environmental Compliance Engineer	Contract in place and work in progress.
	Update the Biodiversity Management Plan.	Q3 2015	Environmental Compliance Engineer	Draft received.
	Upgrade the emissions to air monitoring and reporting systems to meet the requirements of the Industrial Emissions Directive.	Dec-15	Environmental Compliance Engineer	MERS, G2 & PIPB Updated.
	Plan for demolition of the 3MW carbon capture pilot plant.	Q2 2015	Section Head Regulation	Planning Permission Condition for demolition removed.
	Complete installation of water meters on the process water system.	Q4 2015	Station Chemist	2 Magflow Meters waiting for installation on HP and LP (AR 15/500976 & 15/500977).
	Install oil in water monitor in the site drainage system at P2.	Q4 2015	Station Chemist	Installation planned.
	Install a weather station at Aberthaw Centre for Energy and the Environment.	Q4 2015	Section Head Regulation	Weather station installed awaiting connection to PIPB.

3. Performance Parameters

The table below details the site performance parameters for 2015:

Performance Parameter	Quantity	Unit
Surface water disposed off site	0	m^3/yr
Groundwater disposed off site	0	m^3/yr
Energy used (including for leachate treatment)	Mains electricity supply for the amenities and wheel wash.	MWh of electricity

4. Contamination/Decontamination of Site

There have been no incidents or emissions which may have caused any site contamination during 2015, and, therefore, no requirement to decontaminate the site during 2015.

5. Topographical Surveys

The last topographical survey to ordnance datum was carried out in September 2014 which is shown in Appendix C.

6. Landfill Capacity

The table below details the amount of PFA (EWC 10.01.02) deposited at Aberthaw Quarry Ash Disposal Site during 2015.

Reporting Period	PFA Deposited (tonnes)
January 15 – December 15	319,799

The above data has been reported to Natural Resources Wales via the Waste Return Form. The total amount deposited is well below the permitted annual waste input limit which was increased to 650,000 tonnes in 2012 due to an increase in power station ash production. It is estimated that around 3,732,272 tonnes of void capacity remains (Phases 1 -4).

7. Waste Acceptance Compliance Testing

Aberthaw Quarry Ash Disposal Site is a mono-landfill site which is under the direct operational control of Aberthaw Power Station. All the ash is transported directly from the Power Station using lorries.

The exact composition of PFA is dependent upon the composition of the fuel utilised by Aberthaw Power Station. RWE has well established procedures which control the quality of fuel supplied to its stations. The coal purchased by RWEST for Aberthaw is only from an approved ‘matrix’ for the site (i.e. a list of named coals specifically approved for use at Aberthaw). Any new fuels undergo a rigorous fuel assessment process before trial/use on site to ensure they meet the mandatory fuel specifications and safety requirements of the station.

Table 5 summarises the analytical data obtained for leachate tests performed on composite samples of conditioned PFA from Aberthaw Power Station between 2012 and 2015. The CEN two-stage method for leachate analysis was used (BS EN 12457-3:2002 Characterisation of waste – Leaching – Compliance test for leaching of granular waste materials and sludges of which Part 3).

Table 5: Summary of 10:1 Leachate Calculated Results (mg/kg)

	Jul-15	Apr-12	to	Jul-15	
Analyte:	Latest Result	Minimum	Mean	Maximum	Number of results
Aluminium as Al (Dissolved)	2.4	2.4	24.8	75.4	12
Ammoniacal Nitrogen as N	4.2	4.2	74.7	158.1	12
Antimony as Sb (Dissolved)	0.020	0.020	0.2	0.256	12
Arsenic as As (Dissolved)	0.461	0.077	1.7	3.274	12
Barium as Ba (Dissolved)	0.1	0.1	2.7	5.9	12
Boron as B (Dissolved)	0.7	0.7	12.7	17.7	12
Bromide as Br	0.6	0.6	86.1	293.5	12
Cadmium as Cd (Dissolved)	0.0004	0.0004	0.0023	0.0056	12
Chromium as Cr (Dissolved)	0.01	0.01	0.33	1.03	12
Copper as Cu (Dissolved)	0.004	0.004	0.017	0.028	12
Cyanide (Total) as CN	<0.02	bld*	bld*	bld*	12
Dissolved Organic Carbon	2.2	2.2	19.8	34.4	12
Fluoride as F	2.3	2.3	25.6	45.1	12
Iron as Fe (Dissolved)	0.52	0.52	0.89	1.17	12
Lead as Pb (Dissolved)	0.013	0.013	0.036	0.083	12
Manganese as Mn (Dissolved)	0.006	0.006	0.081	0.174	12
Mercury as Hg (Dissolved)	0.0004	0.0004	0.0063	0.0132	12
Molybdenum as Mo (Dissolved)	0.7	0.7	8.8	16.2	12
Nickel as Ni (Dissolved)	0.003	0.003	0.012	0.019	12
Nitrate as N	<0.01	2.6	2.7	2.7	12
Selenium as Se (Dissolved)	0.3	0.2	2.1	3.5	12
Sodium as Na (Dissolved)	9	9	974	2696	12
Total Dissolved Solids	350	350	8125	16169	12
Total Nitrogen as N	5.0	5.0	83.5	166.0	12
Total Sulphur as SO4 (Dissolved)	170	170	3338	4271	12
Vanadium as V (Dissolved)	0.40	0.40	2.28	3.43	12
Zinc as Zn (Dissolved)	0.01	0.01	0.15	0.57	12
*bld = below limit of detection					

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Appendix A. Groundwater and Surface Water Monitoring Locations

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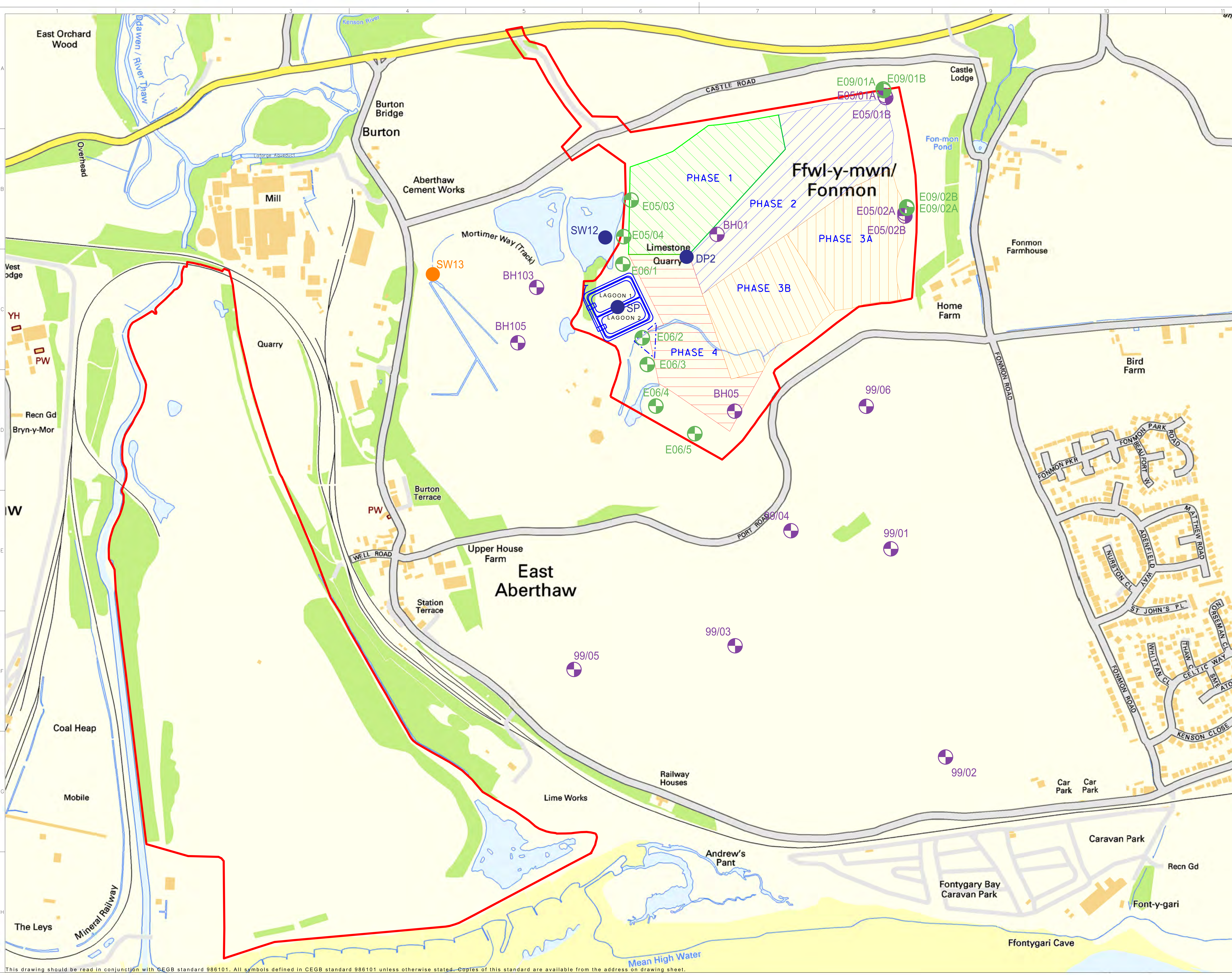

N

- ACTIVE POINT
- INACTIVE POINT
- ACTIVE BOREHOLE
- INACTIVE BOREHOLE
- SP SETTLEMENT PONDS
- ENVIRONMENTAL PERMIT BOUNDARY

GROUNDWATER QUALITY & LEVELS WILL BE MONITORED IN ACTIVE BOREHOLES. SURFACE WATER QUALITY WILL BE MONITORED AT ACTIVE POINTS

0 50 100 150 200 250
METRES

JGB	MHP	1.10.14	AL	D
Drawn	Checked	Date	Approved	Rev.

THE PERSON NAMED IN THE "APPROVED BY" BOX HOLDS RESPONSIBILITY FOR THE TECHNICAL CONTENT OF THIS DRAWING AND SHOULD BE CONSULTED PRIOR TO REQUESTING MODIFICATION.

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Size of original: A2
Scale of original: 1:5250

Site: ABERTHAW QUARRY ASH DISPOSAL SITE

Title: GROUNDWATER AND SURFACE WATER MONITORING LOCATIONS

Status: ISSUED

Drawing number: UKP/ATB/1255/D

This drawing should be read in conjunction with CEGB standard 986101. All symbols defined in CEGB standard 986101 unless otherwise stated. Copies of this standard are available from the address on drawing sheet.

Appendix B. Groundwater and Surface Water Quality

(Dark orange exceeds compliance limits, light orange exceeds EQS/DWS, blue exceeds background >25%)

	Aquifer	Response Zone Interval	Al		Sb		As		B		Cd		Ca		Cr		Cu		Fe	
		m b GL	µg/l		µg/l		µg/l		µg/l		µg/l		mg/l		µg/l		µg/l		µg/l	
Background - Limestone			11		3		2		201		0.6		147		3		2		81	
Background - Seawater			256		<10		2		4166		0.1				1		12		<100	
GW EQS/DWL			200		5		10		2000		5.0		250		50		2000		200	
GW MRV							1				1.0									
GW CL			**50**				**10**		**2800**		**0.4**				**50**					
SW CL							**50**		**2000**		**5.0**				**50**					
Upstream Groundwater			**Average**		**Average**		**Average**		**Average**		**Average**		**Average**		**Average**		**Average**		**Average**	
E05-09_01A	Limestone	24-30	14		3		1		43		<0.1		133		3		3		106	
E05-09_01B	Limestone	18-24	14		1		1		42		<0.1		128		3		2		75	
E05-09_02A	Limestone	21-27	12		3		1		121		0.1		148		3		2		52	
E05-09_02B	Limestone	27-33	9		2		2		339		0.6		187		4		2		86	
E15-1	Limestone	17-29	21		<1		<1		305		<0.1		91		3		2		64	
Downstream Active Filling Operations			**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**
E05_03	Limestone	3-15	15	11	4	1	1	2	1109	1280	<0.1	0.1	37	66	3	1	7	1	38	58
E05_04	Limestone	2.5-20	21	11	6	2	4	2	2123	2129	<0.1	<0.1	6	8	4	1	5	1	39	31
E06_01	Limestone	1-15	16	15	6	2	1	1	1667	1765	<0.1	<0.1	10	6	4	1	1	1	47	31
E06_02	Limestone	1-10	21	15	6	1	2	1	1113	1027	<0.1	0.1	89	70	3	1	5	2	86	30
Downstream Future Filling Operations			**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**
E06_03	Limestone	1-10	19	10	5	2	1	1	561	456	<0.1	0.1	131	171	3	2	2	2	71	<30
E06_04	Limestone	1-10	17	11	4	1	1	1	58	148	<0.1	0.1	147	205	3	1	5	3	55	40
E06_05	Limestone	1-8	21	10	5	1	1	1	224	235	0.4	0.1	129	195	3	1	2	2	33	<30
Downstream Surface Water			**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**
DP2 Phase 2 West				13		1		2		480		0.3		275		23		3		<30
Settlement Ponds				92		1		5		293		0.3		153		8		2		56
SW12 Lafarge Lagoon			21	11	5	1	1	2	122	249	<0.1	0.1	86	139	2	3	2	1	32	31

	Aquifer	Response Zone Interval[1]	Mg		Mn		Hg		Mo		Ni		K		Se		Na		Vn	
		m b GL	mg/l		µg/l		µg/l		µg/l		µg/l		mg/l		µg/l		mg/l		µg/l	
Background - Limestone			17		50		0.02		3		4		2		3		21		2	
Background - Seawater					<20		0.02		<30		9		380		<1				<20	
GW EQS/DWL			50		50		1.00		70		20		12		10		200		60	
GW MRV							0.10													
GW CL							**0.03**		**50**										**20**	
SW CL																			**60**	
Upstream Groundwater			**Average**		**Average**		**Average**		**Average**		**Average**		**Average**		**Average**		**Average**		**Average**	
E05-09_01A	Limestone	24-30	6		12		0.01		1		4		1		2		16		2	
E05-09_01B	Limestone	18-24	6		8		0.02		3		3		1		3		17		2	
E05-09_02A	Limestone	21-27	30		78		0.01		3		4		2		3		24		2	
E05-09_02B	Limestone	27-33	23		51		0.01		2		5		2		2		28		2	
E15-1	Limestone	17-29	44		22		<0.01		5		2		6		<1		51		<2	
Downstream Active Filling Operations			**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**
E05_03	Limestone	2.5-15	24	44	11	28	<0.01	0.01	1	84	2	1	4	4	1	1	149	210	2	2
E05_04	Limestone	2.5-20	4	5	6	9	<0.01	0.01	2	6	2	1	4	3	2	1	241	230	4	3
E06_01	Limestone	1-15	7	5	<10	11	<0.01	0.01	1	5	1	1	3	3	1	1	215	211	2	2
E06_02	Limestone	1-10	56	39	18	9	<0.01	0.02	3	14	4	2	10	7	2	1	109	121	2	6
Downstream Future Filling Operations			**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**
E06_03	Limestone	1-10	62	92	10	13	<0.01	0.02	11	19	5	3	7	9	5	2	70	51	1	2
E06_04	Limestone	1-10	42	61	5	28	<0.01	0.01	3	4	4	3	4	12	2	1	17	32	1	2
E06_05	Limestone	1-8	52	74	6	10	0.04	0.01	2	6	4	3	4	5	2	1	27	24	1	2
Downstream Surface Water			**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**	**Prefill**	**Postfill**
DP2 Phase 2 West				50		16		0.02		1475		18		35		1		401		2
Settlement Ponds				37		10		0.03		558		9		16		2		176		5
SW12 Lafarge Lagoon			23	36	2	15	0.05	<0.01	3	305	2	4	6	16	2	2	23	119	2	2

	Aquifer	Response Zone Interval[1]	pH		EC		Bicarbonate		Sulphate		Ammoniacal Nitrogen as N		Total Oxidised Nitrogen as N		Nitrate		Chloride		Fluoride		Total Organic Carbon	
		m b GL			µS/cm		mg/l		mg/l		mg/l		mg/l		mg/l		mg/l		mg/l		mg/l	
Background - Limestone			7.45		803		405		56		0.2		9.53		19		33		0.2		8	
Background - Seawater			7.88				97		2396								16300		1.3			
GW EQS/DWL			8.50		2500		250		400		0.3				50		250		1.5			
GW MRV																						
GW CL									**400**		**1.6**											
SW CL			**9.00**						**400**		**0.6**											
Upstream Groundwater			**Average**		**Average**		**Average**		**Average**		**Average**		**Average**		**Average**		**Average**		**Average**		**Average**	
E05-09_01A	Limestone	24-30	7.45		681		351		35		0.03		5.52		52		29		0.1		5	
E05-09_01B		18-24	7.47		670		330		32		0.03		5.10		28		29		0.1		7	
E05-09_02A		21-27	7.40		854		464		65		0.60		6.60		3		34		0.3		7	
E05-09_02B		27-33	7.32		1019		465		86		0.16		21.84		18		40		0.3		8	
E15-1		17-29	7.53		818		377		139		0.41		3.17		3		36		0.3		2	
Downstream Active Filling Operations			**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
E05_03	Limestone	2.5-15	8.50	7.88	977	1438	462	350	178	198	0.53	0.59	0.14	0.06	0.42	0.40	33	217	1.4	1.7	16	9
E05_04		2.5-20	8.79	8.55	1010	928	564	479	79	90	0.53	0.38	0.30	0.08	0.84	<0.2	31	36	6.4	5.2	19	18
E06_01		2-15	8.66	8.58	923	865	473	433	106	93	0.58	0.45	0.45	0.06	<0.2	0	33	34	2.1	2.7	19	17
E06_02		2-10	8.39	7.85	1214	1019	336	290	390	280	1.09	0.54	0.72	0.57	0.60	0.45	38	40	0.6	0.5	11	17
Downstream Future Filling Operations			**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
E06_03	Limestone	2-10	8.20	7.69	1224	1390	276	194	443	685	0.67	0.14	2.28	1.11	1.60	0.18	23	24	0.5	0.4	4	23
E06_04		2-10	7.99	7.59	930	1299	290	235	320	488	0.20	0.04	0.10	0.33	0.50	1.30	26	84	<0.5	0.3	12	22
E06_05		2-8	8.08	7.60	1063	1245	289	203	363	581	0.21	0.06	0.30	0.23	3.30	<0.2	37	25	<0.5	0.3	9	27
Downstream Surface Water			**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
DP2 Phase 2 West				7.48		3332		295		482		1.88		18.73		16.27		694		0.2		1
Settlement Ponds				8.02		1678		161		381		0.09		6.25		11.37		293		0.3		2
SW12 Lafarge Lagoon			8.38	8.16	713	1324	159	154	207	356	<0.2	0.09	1.16	2.38	5.09	3.20	44	172	<0.5	0.2	8	5

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Appendix C. Topographical Survey September 2014

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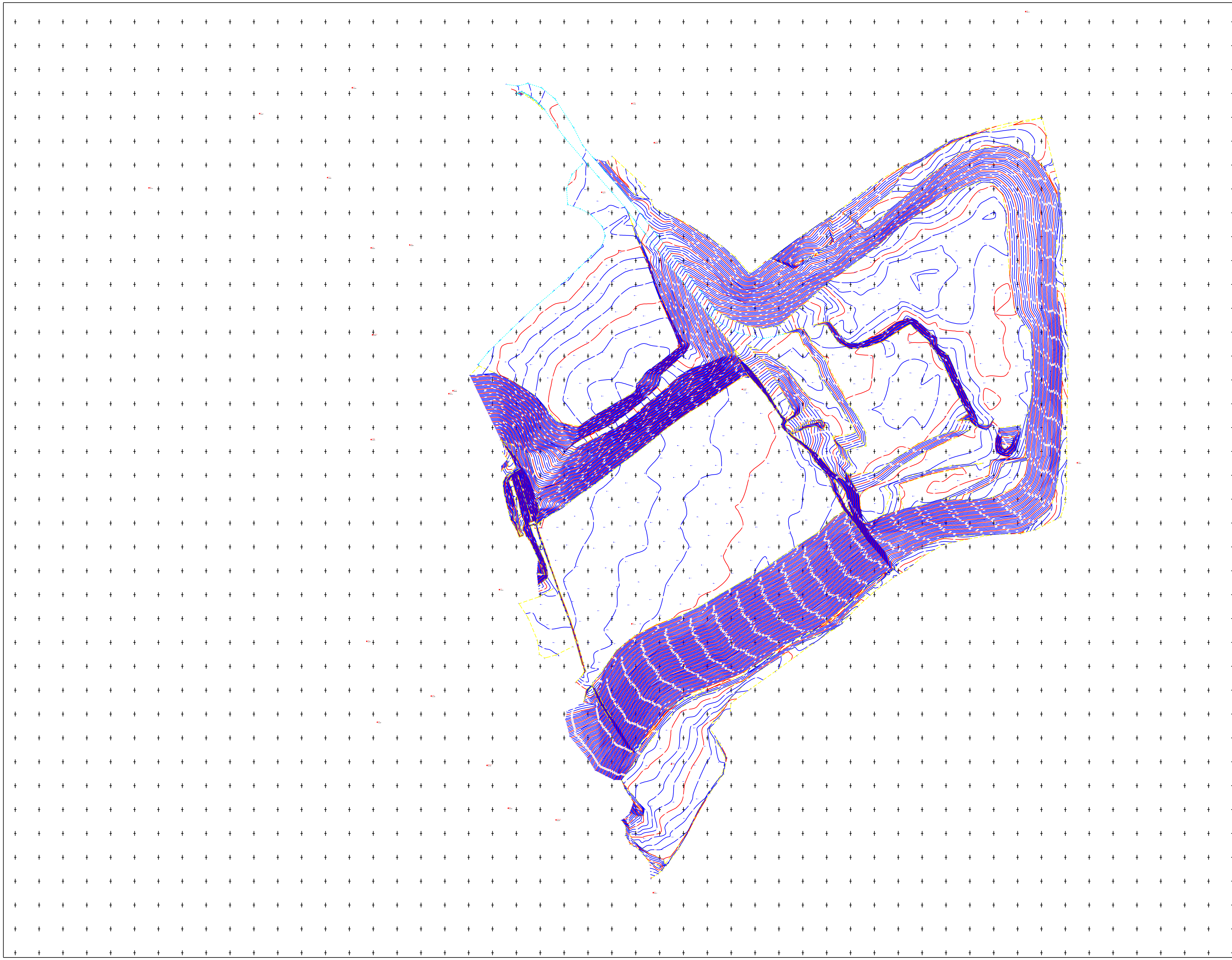

Key to Abbreviations

Asp.	Asphalt
B	Bollard
BB	Belisha Beacon
BH	Bush
Bl.	Block wall
Br.	Brick wall
BT	British Telecom Cover
B/W	Barbed Wire
CB	Telephone Control Cabinet
C/B	Close Boarded
CCTV	Closed Circuit Television
CDP	Cable Draw Pit
C/I	Corrugated Iron
CL	Cover Level
C/L	Chain Link
C/P	Chestnut Paling
Conc.	Concrete
Elec.	Electricity Inspection Cover
El Sub Stn	Electricity Sub Station
EP	Electricity Pole
ER	Earth Rod
FH	Fire Hydrant
FW	Foul Water
G	Gully
Gab.	Gabion Wall
GV	Gas Valve
IC	Inspection Chamber
IL	Invert Level
I/R	Iron Railings
LB	Litter Bin
L/L	Larch Lap
LP	Lamp Post
MH	Manhole
Mkr	Marker
P/R	Post and Rail
RE	Rodding Eye
RS	Road Sign
RWP	Rain Water Pipe
SL	Sump Level
St.	Stone Wall
SV	Stop Valve
SW	Surface Water
TL	Traffic Light
TOW	Top of Wall
TP	Telegraph Pole
TV	Cable Television Cover
UTL	Unable to Lift
VP	Vent Pipe
WL	Water Level
WM	Water Meter

LINE TYPES

Building
Canopy
Edge of Surfaces
Embankments and ditches
Fences
Overhead cables
Vegetation
Walls, Kerbs etc.
Hedges

Kerb levels are channel levels unless otherwise stated.

Notes

Sheet Layout

North Point

N

All levels related to:-
Ordnance Survey Datum derived by GPS.

Title
NORTH QUARRY,
ABERTHAW.

Client
RWE NPOWER

Scale:- 1:1000 @ A0	Date:- September 2014
Surveyed by:- DMJ/CB/PJB	Checked by:- A H Davies
Drawing Number:- 2019	Rev. L

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