The impacts of mining on the Wanlock Water, Wanlockhead, Dumfries & Galloway.

Scoping Study

August 2014

The Coal Authority

Water Environment Fund

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VERSION	ORIGINATED	CHECKED	APPROVED	DATE
Final	Abby Moorhouse Lee Wyatt	Ian Watson	Steve Hill	August 2014

Executive Summary

Lead mining and its associated processes, has long been a feature of the area surrounding the Wanlock Water. Contaminants from this mining legacy have had a significant impact upon the quality of the watercourse and surrounding area. This pollution means that the Wanlock Water does not accord with the quality requirements of the Water Framework Directive.

The Coal Authority undertook a part funded scoping study lasting from May 2012 to May 2013 to determine the extent and magnitude of the contamination and provide potential options for the remediation of the area.

The data collated during the study show there is significant pollution of the Wanlock Water from metals including lead, zinc and cadmium; present in both particulate and dissolved states within the water. The mine water contributes to approximately half the total cadmium and zinc contamination.

The study highlighted a significant impact of lead pollution, predominantly present as dissolved lead, sourced from both the mine water (point source) and ore processing areas (diffuse source) with approximately 25% of the lead being from the mine water, and up to 75% of the lead from diffuse sources.

In addition to the lead pollution, the study also highlighted zinc and cadmium contamination, primarily sourced from the mine water, with an additional diffuse input from the ore processing areas.

It has been recommended that, prior to any remediation of the mine water; the inputs of contamination from the ore processing areas and surrounding alluvium are assessed for remediation. In addition to this, it is also recommended that any river flows entering in to the mine workings are prevented from doing so in the future; and that a subsequent re-assessment of the mine water is undertaken.

Samples taken from the river channels and surrounding sediment material indicate there is significant contamination in the form of lead, zinc, cadmium, and copper.

Measurements and observations of the flows from various mine water discharges indicate a seasonal pattern and occasionally, the Wanlock Water is made up predominantly of these mine water emissions.

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1. Background

The village of Wanlockhead in Dumfries and Galloway (see Figure 1.1) has long been acknowledged as the centre for lead mining in Scotland. Mining is thought to have occurred as early as 1239, with the majority of activity taking place between 1600 and the 1930s when metal mining took over this area (e.g. SEPA, 2008). The remnants of this major industry can be seen throughout this part of the catchment with spoil heaps and mining features dominating the landscape.

Whilst there is a visible reminder of the areas mining past, there is also an unseen pressure on this catchment; water from the mining legacy. Mine water and mine wastes containing elevated quantities of lead, cadmium and zinc discharge into the Wanlock Water likely causing pollution along an 8km stretch from Wanlockhead to the Crawick Water at Spango Bridge.

SEPA has identified the Wanlock Water as possibly being under pressure from mining inputs. The overall status within the River Basin Management Plan is 'Good' and the River Basin Management action plan is to ensure this classification remains in place. The water body has not been assessed for the zinc, lead and cadmium.

During mining, in order to safeguard the mineral reserves and to ensure dry working conditions within the mine, a series of drainage levels were installed. These carried water from the mine to local watercourses. This occurred many years prior to the quality of the local watercourses being monitored. Even though mining ceased *circa* 50 years ago, these drainage levels continue to discharge water from the mines to the present day.

Since 1994, the Coal Authority has been monitoring and treating water from coal mining sources. The Authority currently has nearly 60 mine water schemes throughout the UK, of which 14 are located in Scotland. The Authority has a longstanding and successful relationship with SEPA, the parties sharing a Memorandum of Understanding.

To date, the Coal Authority has carried out a number of projects throughout Scotland, England and Wales to investigate water from metal mines, working with SEPA, the Environment Agency, DEFRA, the Welsh Government and Natural Resources Wales.

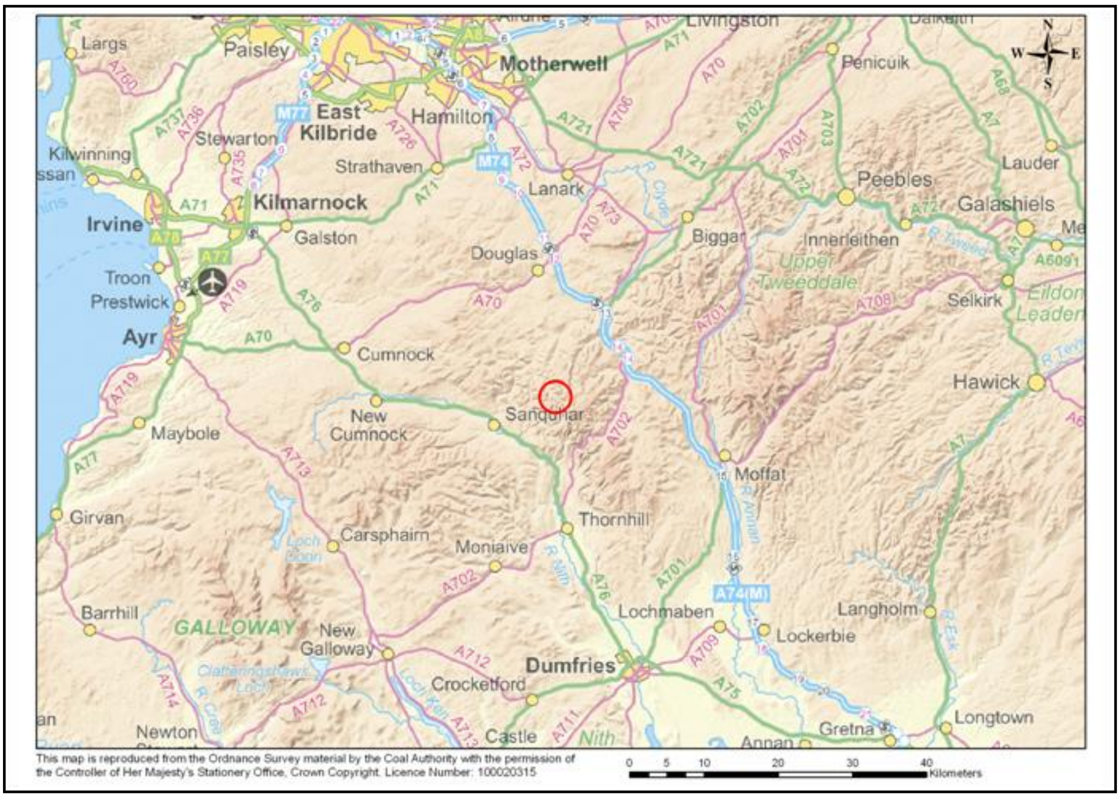


Figure 1.1 *- Location map*

2. Aim

Currently, the majority of discharges from metalliferous (non coal) mining sources in the UK have no one person/organisation responsible for the mitigation/prevention of the metal pollution. This is because the mining operations were abandoned prior to the introduction of environmental legislation enacted in the 1990's and 2000's to protect the environment; as a result, attainment of Water Framework Directive (WFD) 'Good' status by 2027 for these impacted water courses will be difficult to achieve. The Coal Authority have been encouraged by SEPA, following a similar exercise for SEPA, EA, DEFRA, NRW and the Welsh Government, to investigate the problems associated with the mine water from the metal mines in the Wanlockhead area. This scoping study is a precursor to a more detailed feasibility study, which would present treatment options that can be progressed in the future with a view to treating the Wanlock Water (and Glengonnar Water) and achieving an elevated status within the watercourse. A similar study for adjacent Leadhills mining areas was completed by the CA for SEPA in 2012.

Figure 2.1 *– Photographs of the potential inputs to the Wanlock Water*

SEPA do undertake water monitoring on the Wanlock Water but due to a limited number of monitoring points, one upstream and one 5km downstream of the study area, it has not been possible to pinpoint the sources and pathways of the pollution. This report will analyse the mine water inputs and sediment inputs (see figure 2.1), from the extensive spoil heaps, mineral processing sites and any other sources, which line the Wanlock Water between Wanlockhead and Sowen Burn.

It is assumed that the mine water drainage levels are one of the main contributors to the downgrading of the watercourse due to their direct connection to the mine workings that are now flooded; with the water containing elevated concentrations of lead, zinc and cadmium sourced from the mine. However, remobilisation of deposited sediment, e.g. erosion and washout from the spoil heaps and mineral processing areas, could have an equally important role in causing the WFD failures for water chemistry in the Wanlock

Water. During high flow events, in-stream bed sediments can be remobilised adding to the metals loading in the watercourse.

Figure 2.2 *– Photograph of the Wanlock Water downstream of Sowen Burn (west of Wanlockhead)*

This scoping phase of the project will determine and assess all of the major inputs to the Wanlock Water (see figure 2.2) via monitoring and conceptual models. This is the first report of its kind on the Wanlock Water and as such there is a requirement to set up a robust monitoring strategy, collecting both flow and chemistry data from key points along the watercourse. Once the data have been collated and interpreted, work can begin on ascertaining the appropriate ways to treat the sources of pollution.

3. Waterbody Status

Under the current Water Framework Directive (WFD) classification scheme the Wanlock Water is regarded as being at 'Good' status (water body information sheet (see figure 3.1)) although the chemical status only includes the pollutants of ammonium and iron (see figure 3.2) and no assessments have been made for cadmium, lead or zinc (SEPA, 2011).

Year	2008	2015	2021	2027
Status	Good	Good	Good	Good

Figure 3.1 - *Extract from water body information sheet 10619 (Wanlock Water)*

The River Basin Management Planning (RBMP) process, required under the WFD, provides a mechanism for identifying significant impacts on waterbodies, ensuring that public sector bodies, businesses and individuals work together to protect the water environment and address these significant impacts. The RBMP for the Solway Tweed River Basin District has indicated that the aim is to ensure that no deterioration from good status occurs.

Although the Wanlock Water has not been assessed for all pollutants including cadmium, lead and zinc; recent preliminary investigations made by SEPA in 2011 indicated that concentrations of these metals in the Wanlock Water are above the respective values of the annual average EQS (SEPA, 2011).

Parameter	Status	Confidence of Class
OVERALL STATUS	GOOD	HIGH
Pre-HMWB status	Good	High
Overall chemistry	Pass	Low
Priority substances	Pass	Low
Overall ecology	Good	High
Physico-Chem	High	High
Temperature	High	High
Soluble reactive phosphorus	High	High
pH	High	High
Dissolved Oxygen	High	High
Biological elements	Good	High
Phytobenthos	Good	High
Macrophytes	High	Low
Benthic invertebrates	Good	High
Macro-invertebrates (acid)	High	Low
Macro-invertebrates (RiCT)	Good	High
Macro-invertebrates (ASPT)	Good	High
Macro-invertebrates (NTAXA)	High	High
Alien species	High	Low
Fish	High	Low
Fish ecology	High	Low
Fish barrier	High	Low
Specific pollutants	Pass	High
Iron	Pass	Low
Ammonium	Pass	High
Hydromorphology	Good	Medium
Morphology	Good	Medium
Hydrology	High	Medium
Hydrology (impoundment)	High	Medium
Hydrology (abstraction)	High	Medium
Regulatory ammonium	High	High
Water quality	Good	
Morphological pressures	Good	

***Figure 3.2** - Water body information (water body information sheet 10619 (Wanlock Water))*

4. Topography, Hydrology and Geology

Topography & Hydrology

The head of the Wanlock Water emerges from a culvert (NS 87850 1300) under the B797 road to the east of Wanlockhead at an elevation of approximately 435mAOD, however the source of this water is likely to be located on the hillside and moors above and to the east. From this culvert the river flows approximately 8km in a north westerly direction to merge with the Spango Water at Spango Bridge (NS 823 178) at an elevation of approximately 235mAOD and form the Crawick Water which in turn flows to the River Nith at Sanquhar.

The study area encompasses the first 3km reach of the Wanlock Water from the road culvert to a point downstream of the confluence with the Sowen Burn at NS 854 145 at an elevation of approximately 315mAOD. Within the study area, the Wanlock Water includes the tributaries of Glencrieve, Glenglass, Limpen Burn, Glenmarchhope Burn, Sowen Burn and Whyte's Cleuch, combined with a number of hillside gullies and springs (see figure 4.1). The Wanlock Water catchment in the study area comprises upper moorland with steep sided slopes rising up to 588mAOD. The valley floor comprises a narrow stream a few metres wide and a floodplain up to approximately 60m wide.

Throughout the study period rainfall measurements were taken, which have been provided by SEPA. The annual rainfall for March 2012 to March 2013 was 1730mm, which corroborates previous studies that suggest annual rainfall exceeds 1500mm/a (i.e. Rowan *et al*, 1995) in the study area; the greatest amount of precipitation is most likely to occur in the winter months.

Geology

Locally Wanlockhead is situated in the Southern Uplands Terrane (see figure 4.2) comprising rocks of Ordovician (to Silurian) in age (Floyd, 2003) with some recent alluvium deposits along the valley floor. The mineral veins within the orefield (see figure 4.3) generally lie between the Leadhills Fault to the northwest and the Fardingmullach Fault to the southeast. The principle faults in the area trend northeast-southwest and the mineral veins mainly trend north-northwest to south-southeast. The primary ore mineralisation is related to the Caledonian Orogeny resulting in mineral veins consisting predominantly of metal sulphides including galena (PbS) and sphalerite (ZnS) along with other minor minerals.

In the study area, the Southern Uplands Terrane comprises primarily of the Crawford Group, Moffat Shale Group, Kirkcolm Formation and Portpatrick Formation. The Moffat Shale Group consists of dark mudstones and the Portpatrick Formation, which forms the host rock for the mineralisation, is dominated by volcaniclastic greywacke sandstones. The Kirkcolm Formation consists of sandstones and siltstones and the Crawford Group consists of mudstones, cherts and lava flows.

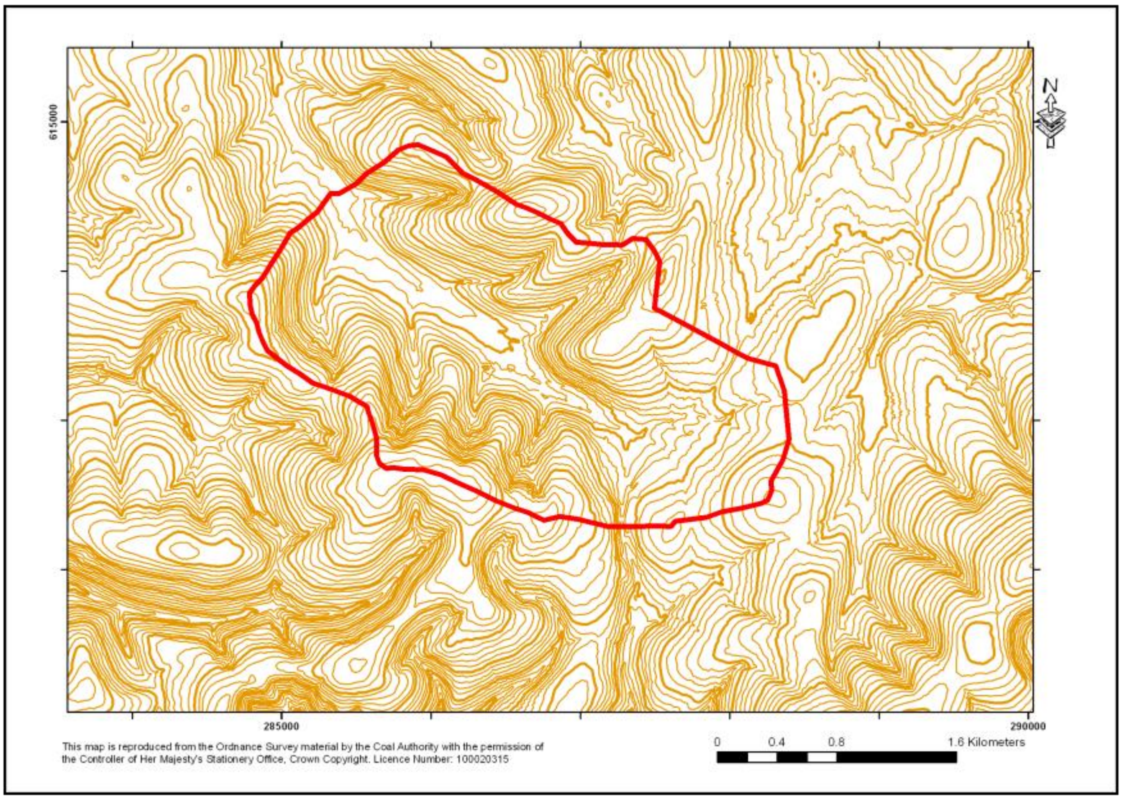


Figure 4.1 *-Topographic map of the area*

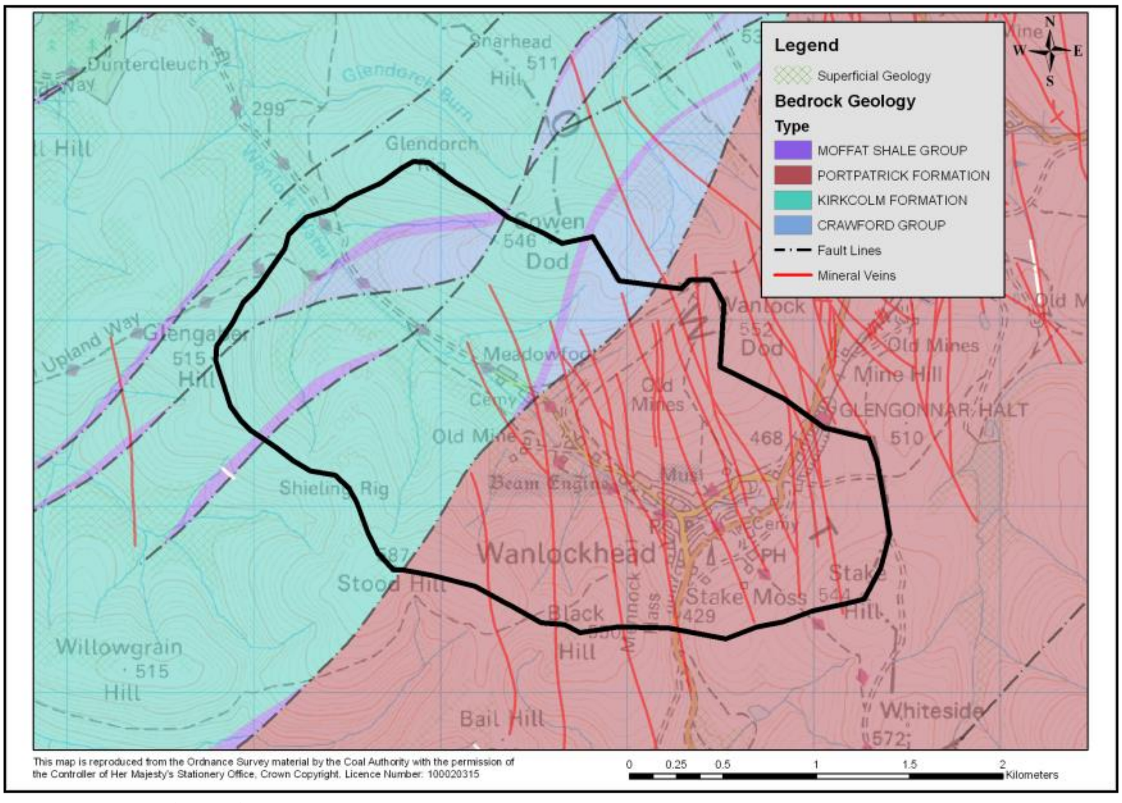


Figure 4.2 - *Geological map*

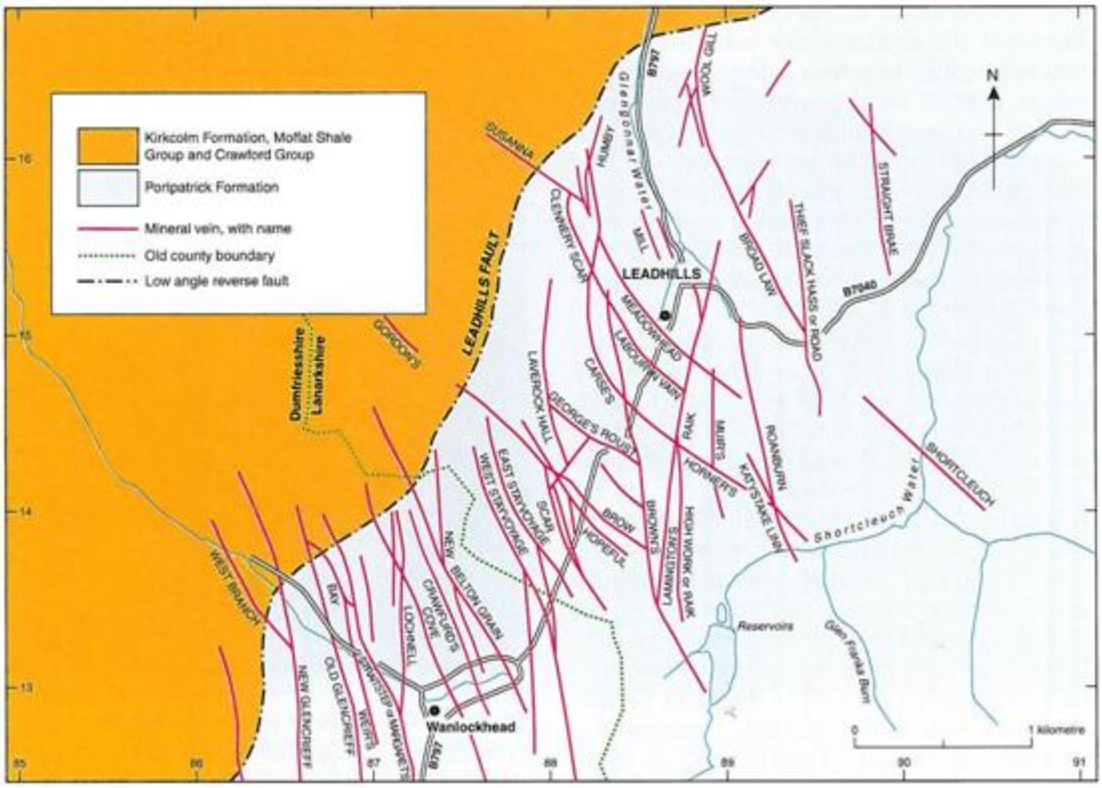


Figure 4.3 - *Principle mineral veins (from Floyd, 2003)*

5. Mining

The earliest notable mining in the orefield (*c*.13 Century) was localised and for alluvial gold deposits. Lead mining on a wider scale probably started in the 17th Century with the larger scale lead mining commencing during the late 18th Century and working until the 1930's (Rowan, 1995; Harvey, 2000; SEPA, 2008). The early mines were likely to have been small scale isolated mines which worked the upper reaches of the veins either by shallow shafts and adits or by hushing the hillside to expose lead ore. Later mine workings became deeper and involved mining by 'stoping' methods (see figure 5.1); this resulted in the mines penetrating the deeper sections of the orefield. As the mining progressed, water would have been encountered, which needed to be drained to allow mining to continue. Original drainage is likely to have been in the form of simple rope and bucket pumps and/or drainage levels driven in to the workings to dewater the mine by gravity. Further developments required water to be pumped and often pumps would be installed underground with water pumped up to drainage adits. After abandonment, the mines in the area flooded and 'excess' water discharged to surface; often via the old drainage adits.

Within the study area four low-lying adits were identified and include the Glenglass (Glencrieff) Level, Bay Mine (Charles) Adit, Meadowfoot Level, Lochnell Adit and some other unnamed adits. The Glenglass Level is on the south/west side of the Wanlock Water at an elevation of approximately 335mAOD and is connected to a large set of workings including the New (and West) Glencrieff Mine. The Bay Mine Adit drains mine water and is likely to be in part a resurgence of the Wanlock Water, which infiltrates in to the ground further up the valley. The adit drains from the northern side of the valley at an elevation of approximately 345mAOD and is connected to a large set of workings including Bay Mine and Straitsteps Mine. The Meadowfoot Level is partially blocked, although there is a consistent small discharge, it is believed to drain a small set of workings belonging to Meadowfoot Mine on the north side of the valley at an elevation of approximately 340mAOD. The Lochnell Adit is currently in use as part of the underground tour of the mining museum in Wanlockhead and no water currently discharges from this adit. The water is believed to flow in to the Straitsteps Mine system of workings. Upstream of the museum, two or three additional possible adits were identified which discharge water at elevations between approximately 425mAOD and 445mAOD, however during this study it was unclear if these adits are isolated upper workings or connected to the lower body of workings. It is therefore uncertain if these discharges are mine water and/or groundwater sourced. A detailed investigation of the mining plans would be required to ascertain and understand any of these uncertainties.

In addition to the extraction of the ore, the mining activity undertaken at Wanlockhead (see figures 5.2 to 5.10) also produced waste from ore refinement processes, resulting in spoil tips. These refinement processes included ore crushing, ore washing/floatation to separate the ore from the waste, and smelting. Evidence of all these processes can be seen in the study area, leaving their mark on the landscape. For instance, the area includes at least two smelt mills; the earlier (*c.*1746) one being Pates Knowes (see figure 5.4) and the later (larger) Queensberry (Meadowfoot) Mill (see figure 5.7). Upstream and adjacent to this later mill are the associated catch (tailings) ponds and crushing mill. A little further upstream the large grass covered settlement ponds for New Glencrieff Mine can be observed with additional ore processing features. Throughout this landscape a number of additional mining related features, some of which are historically important and or unique (i.e. Symmingtons and

Straitsteps Engines) are preserved. All of these ore processing techniques can produce different types of pollution and contamination ranging from airborne particulates from the smelters to fine grained sediments in the tailings ponds.

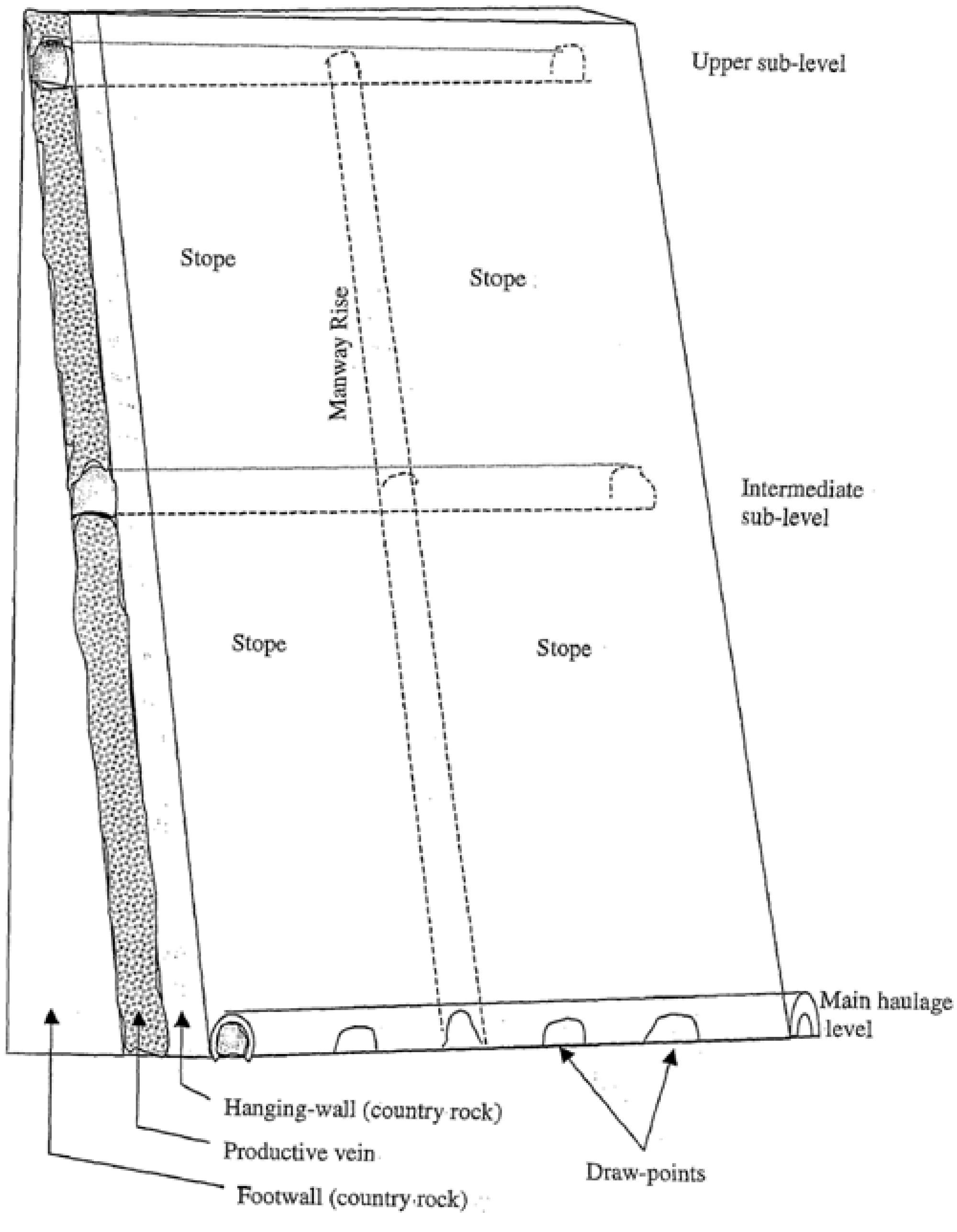
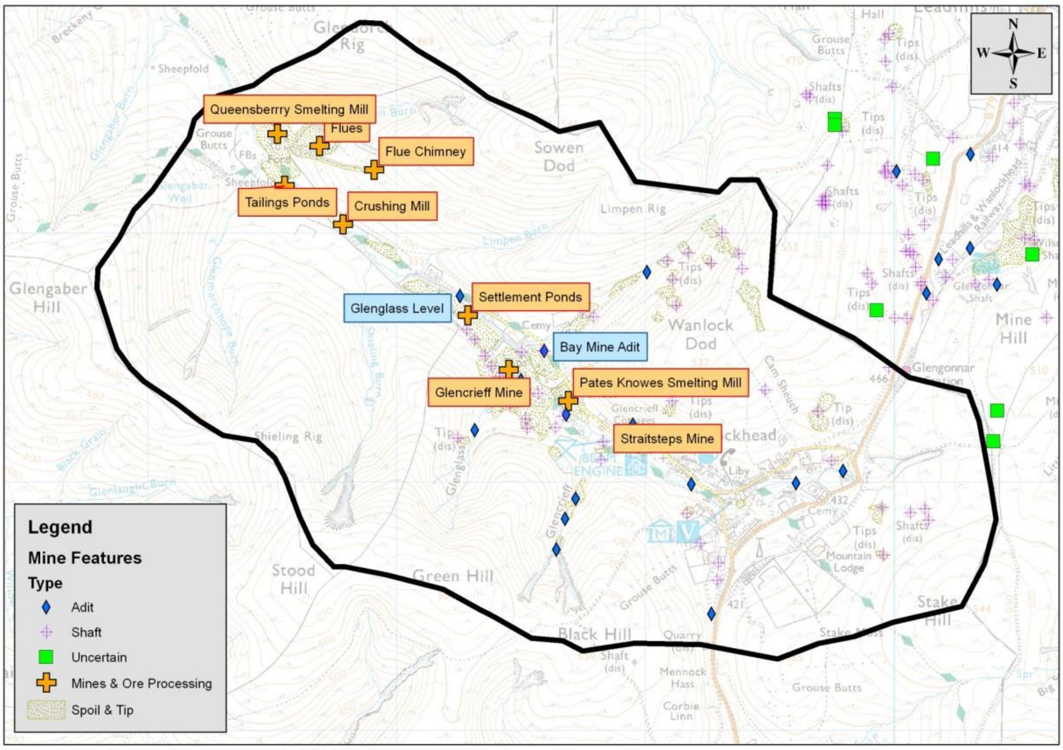


***Figure 5.1 –** Diagram of mining methods (from Younger & Adams, 1999)*



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0 0.25 0.5 1 1.5 2 Kilometers

Figure 5.2 *– Location map of mining features*

Figure 5.3 – *Photo of Glencrieff Mine showing spoil tip and part of ore processing*

Figure 5.4 – *Photo showing the 18 Century Pates Knowes Smelter*

Figure 5.5 – *Photo of Queensberry Tailings Ponds showing spoil, water and former buddles area*

Figure 5.6 – *Photo of Queensberry Crushing Mill, looking upstream*

Figure 5.7 – *Photo of Queensberry Smelting Mill*

Figure 5.8 – *Photo looking towards the area of the grassed covered Glencrieff Settlement Ponds*

Figure 5.9 – *Photo of Symmingtons Engine at Bay Mine*

Figure 5.10 – *Photo of Straitsteps Mine and Beam Engine*

6. Conceptual model

Prior to undertaking the study, background research in to relevant papers and reports along with a walkover study aided the development of a conceptual model to test the potential sources for pollution from mining impacting the Wanlock Water. In summary the potential inputs to the Wanlock Water were identified as follows:

- Water coming out of the mines and drainage levels – “mine water”.
- Hillside runoff washing down previously airborne pollutants from former smelting mills.
- Surface run-off and infiltration of the mine spoil heaps.
- Surface run-off and infiltration of mining related made ground from former ore processing areas.

All these pollutant pathways have potential to convey metals in either particulate or dissolved forms into the Wanlock Water.
Additionally during high flows, it is likely that metal deposits in the river sediments are remobilised into the water as both suspended solids and dissolved metals.

7. Data collation and results

During this study monitoring was undertaken between May 2012 and May 2013. Ideally a time period of at least one year would be used, to enable data analysis and comparisons throughout the year; and to allow appropriate correlation with Environmental Quality Standards (EQS) values based on annual averages. Although the study period covered one year, samples were not collected every month due to the severe weather encountered in the Spring of 2013. Despite this however, there are sufficient data to adequately compare and assess against appropriate EQS values and thus highlight any potential causes for concern. All water and sediment samples collected in this study were processed and analysed by a UKAS accredited laboratory adhering to MCERTS standards where applicable. The laboratory results and the on-site results are shown in appendix 1 and 2. Using the conceptual model shown in section 6, an indicative strategy was determined to give a constant baseline using fixed monitoring points, these include:

- Wanlock Water upstream: Routine sampling for laboratory and on site chemical analysis.
- Wanlock Water at the mining museum: Routine sampling for laboratory and on site chemical analysis.
- Wanlock Water at Straitsteps Mine: Routine sampling for laboratory and on site chemical analysis. Chosen to give a consistent 'fixed' point for the river upstream of Bay Mine, due to the river losing water between Straitsteps Mine and Bay Mine Adit.
- Wanlockhead Sewage Works: Routine sampling for laboratory and on site chemical analysis.
- Wanlock Water downstream of the sewage works: Routine sampling for laboratory and on site chemical analysis. Chosen to assess for any inputs between the sewage works and the Queensberry tailings pond.
- Wanlock Water upstream of tailings ponds: Routine sampling for laboratory and on site chemical analysis. Chosen to aid assessment of any inputs from the old tailings pond area and any upstream inputs.
- Wanlock Water downstream of tailings ponds: Routine sampling for laboratory and on site chemical analysis.
- Sowen Burn: Routine sampling for laboratory and on site chemical analysis. Chosen to assess for any impacts from the Queensberry smelter mill area.
- Glenmarchhope Burn: Routine sampling for laboratory and on site chemical analysis. This stream drains moorland where no mining activity is evident and is therefore used to represent the background water quality.
- Wanlock Water downstream of Sowen Burn: Routine sampling for laboratory and on site chemical analysis, and some occasional spot-flow measurements. This is the most downstream monitoring point and marks the end of the study area.
- Glenglass Level: Routine sampling for laboratory and on site chemical analysis, and occasional spot-flow rate measurements. There was also a datalogger installed for a short time period to assess for any changes in temperature (source) of the water and relative changes in flow rates.
- Bay Mine: Routine sampling for laboratory and on site chemical analysis, and occasional spot-flow rate measurements. There was also a datalogger installed for a short time period to assess for any changes in temperature (source) of the water and relative changes in flow rates.

During the study, in response to the sample results obtained during the first three site visits in conjunction to reacting to specific site conditions, a more dynamic programme of additional routine and ad-hoc samples were taken at the following locations:

- Adit below road: On site and laboratory analysis. A discharge adjacent to the road culvert from a possible adit and forming a channel alongside the stream channel.
- Adit spring: On site and laboratory analysis. An upwelling leading to a short gully channel, a possible spring or discharge from an adit roof.
- Adit downstream of road (2 pipes): On site and laboratory analysis and occasional spot flow measurements. Two pipes discharge water from an old concrete capped structure, possibly and adit and may relate to the adit spring.
- Adit 5 pipes: On site and laboratory analysis and occasional spot flow measurements. A group of five pipes issue water from a retaining wall of a possible collapsed (run-in) adit.
- Wanlock Water upstream of Adit 5 pipes: On site and laboratory analysis.
- Mennockhass Water Tunnel: On site and laboratory analysis. An old water tunnel originally driven to collect groundwater for use at the mines.
- Glencrieff Burn: On site and laboratory analysis. Tributary of Wanlock Water which runs over an area of spoil / scree material.
- Wanlock Water at Glencrieve Cottages: On site and laboratory analysis. Point between Bay Mine Adit and Straitsteps Mine, used to compare for any differences and or any inputs, on occasions this sample point was dry and less flow than at Straitsteps Mine.
- Wanlock Water upstream of Bay Mine: On site and laboratory analysis. On some occasions the river was flowing above the Bay Mine Adit and resurgence.
- Downstream of Glencrieff Mine tip: On site and laboratory analysis. The Glenglass stream appears to flow under the base and or through the spoil tip, this sample point was used to determine any inputs from the tip.
- Upstream of Glencrieff Mine tip: On site and laboratory analysis. Above the spoil tip the Glenglass stream flows in to a man-made reservoir, which overflows and disappears under the tip.
- Glencrieff Mine tip drain. On site and laboratory analysis. This is an old drain which runs alongside the track below the spoil tip. Originally the source of this water was uncertain, but later believed to be the same water as the downstream of Glencrieff Mine tip.
- Whyte’s Cleuch: On site and laboratory analysis. This is a tributary which during the study was usually very low flow or dry. It runs alongside and over the spoil area of Bay Mine.
- Wanlock Water Downstream of Bay Mine: On site and laboratory analysis. Used to assess any difference in wet weather conditions from drainage adjacent to Bay Mine adit.
- Glencrieff Mine settlement ponds spring: On site and laboratory analysis. An issue emerges from one of the old settlement ponds next to the Glenglass Level. Usually during the study this was dry.
- Limpen Burn: On site and laboratory analysis. A tributary which joins the Wanlock Water next to the sewage works outfall. This should have no mining impacts and thus was sampled to compare against the background.

- Upstream Queensberry crushing mill: On site and laboratory analysis. An area of ponded / flowing water upstream of the crushing mill. This location was usually dry.
- Downstream of Queensberry crushing mill: On site and laboratory analysis. An issue emerges slightly downstream of the crushing mill, the source of this water is uncertain, but during the study there was usually a small flow.
- Queensberry tailings pond ditch: On site and laboratory analysis and spot flow measurements. A ditched channel runs around the side of and then through the tailings pond.
- Queensberry tailings pond runoff: On site and laboratory analysis and spot flow measurements. The tailings pond area has a number of runoff areas; however the one chosen for sampling was usually flowing during the study period.
- Queensberry tailings pond ponded water: On site and laboratory analysis and spot flow measurements. On the tailings pond area two pools of ponded water were present for the majority of the study period, during the study there was usually a small discharge from these ponds.
- Meadowfoot Adit: On site and laboratory analysis. A minor flow from the adit mouth, behind the adit is a collapsed shaft.
- Shortcleuch Water: This sample point is outside of the catchment and a water sample and sediment sample were taken from the same place. This was to give a true but more localised background for the area.

In total there have been 35 different water sampling points at various sites within the area with samples taken at various intervals throughout the study. In addition to these samples and following from initial analysis of data, sediment and soils samples were taken at the following locations:

- Queensberry Tailings Pond – three samples collected from separate locations.
- Queensberry Crushing Mill.
- Glencrieff Mine Spoil Tip.
- Glenglass Level Sediment - collected from the discharge channel.
- Wanlock Water downstream of Sowen Burn – river bank sediment.
- Background Sediment Sample – Shortcleuch river sediment.
- Wanlock Water upstream of Bay Mine Adit - alluvial sediment.

Water samples collected in the field for laboratory analysis comprised of a 1 litre sample for a mineral suite; an unfiltered 250 millilitre acidified sample (using Nitric Acid) and a 250 millilitre filtered (using a 0.45µm filter) acidified sample (using Nitric Acid). At each sample location on site measurements were taken to aid assessment and the measured parameters include temperature, electrical conductivity, total dissolved solids, redox potential, lead and zinc.

Sediment and soil samples comprised of a 1 litre tub of the material, collected with a plastic trowel, which was sent to the laboratory for analyses. No screening or sieving for specific sizes was undertaken, however large clasts (approx >10mm) were excluded from the samples

The British National Grid coordinates of all the monitoring points are specified in appendix 3.

7.1 On site and datalogger results

The results from the routine monitoring are shown in figure 7.3 to figure 7.12 and the on-site measurements and laboratory results from all samples are given in table 7.1, table 7.2 and appendix 2.

7.11 Mine water level monitoring

Within the Wanlock Water study area there were no shafts in which water level monitoring was undertaken. The only shaft which was checked for water levels was the Bay Mine shaft; this proved to be usually dry during the study period and may reflect a partial blockage in the shaft and or adit connection. There are not any known build up in heads of water acting on any adits, thus risk of any 'blow-out' is currently believed to be fairly low.

7.12 Mine water flow monitoring

Spot flow measurements and gauging were undertaken at a number of the mine water type discharges in addition to the Wanlock Water downstream monitoring point. The salt gauging method (BS 3680-2A:1995) has been used to determine the flow rates at these points in the study area. This methodology requires a 'slug' injection of a known quantity and concentration of salt solution being introduced into the river channel, which is then compared against the measured conductivity at a point located downstream of the mixing zone. The results from this method, although not as accurate as those obtained from a gauging weir, are sufficiently accurate to enable a good approximation of the flow. The results from the flow monitoring are summarised in table 7.1. Although no continual flow monitoring was undertaken, dataloggers were installed at Glenglass Level and Bay Mine Adit to record changes in temperature and relative stages. The data from these loggers are shown in figure 7.1 and show that both discharges have a rainfall related and/or seasonal trend to them.

***Table 7.1** – Summary table of selected mean on-site data*

Site	pH	Eh (mV)	EC (25°C)	TDS (ppm)	Temp (°C)	Flow Rate (L/s)
Glencrieff settlement ponds issue	6.53	142	60	45	6.2	1.0
Downstream of crushing mill	6.92	115	57	44	7.8	0.7
Queensberry tailings pond ditch						0.7
Queensberry tailings pond ponded water	6.96	104	28	16	10.4	0.3
Queensberry tailings pond runoff	6.96	108	58	35	8.0	0.3
Bay Mine Adit discharge	6.48	112	140	91	7.4	123
Glenglass Level discharge	6.88	117	173	113	8.5	44
Wanlock Water downstream of Sowen Burn	6.63	140	137	81	8.2	278

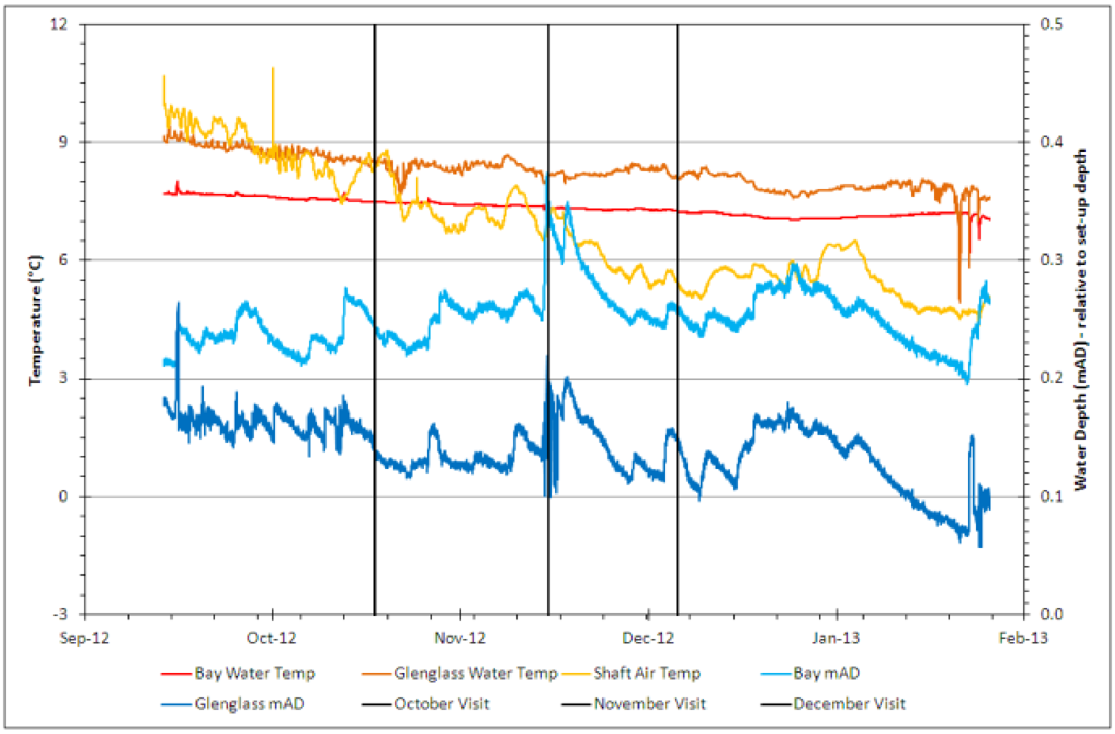

***Figure 7.1** – Graph of datalogger stage and temperature measurements*

7.13 Mine water temperature monitoring

Temperature monitoring was undertaken during the routine on site monitoring of all sites, the results from which are summarised in table 7.1. During part of the study, dataloggers were installed in Bay Mine Adit and Glenglass Level discharges to measure the temperature and relative stage changes. The results from the datalogger are shown in figure 7.1 and show the mine water temperature has a general seasonal variation. The logged temperature for Bay Mine Adit generally varies between approximately 7°C and 7.8°C, although there are a number of temperature inversions; in particular in January 2013. The logged temperature data for Glenglass Level show that this water is warmer than the water from Bay Mine adit, with temperatures generally varying between approximately 7.7°C and 9.4°C. Similarly to Bay Mine Adit, the Glenglass Level also has a number of temperature inversion spikes, particularly in January 2013. These sharp decreases in the water temperature at Bay Mine Adit and Glenglass Level are likely to represent inflows of surface water and or shallow groundwater in to the mine workings, with the lows in January likely to represent colder water from snow/ice melt. The exact areas of any inflows in to the mine workings are uncertain and could range from a single point (i.e. shaft or adit) to an area of mined ground with numerous mine entries.

7.2 Results from laboratory analyses

Throughout the study regular samples were taken at 11 sites within the Wanlock Water and associated mine water inputs (see figure 7.2). Additional ad-hoc samples were also taken at 21 sites to aid assessment of water chemistry and various inputs to Wanlock Water. Along with these water samples a further nine soil/sediment samples were taken throughout sites situated on the floodplain and one background sample from outside the Wanlock Water catchment.

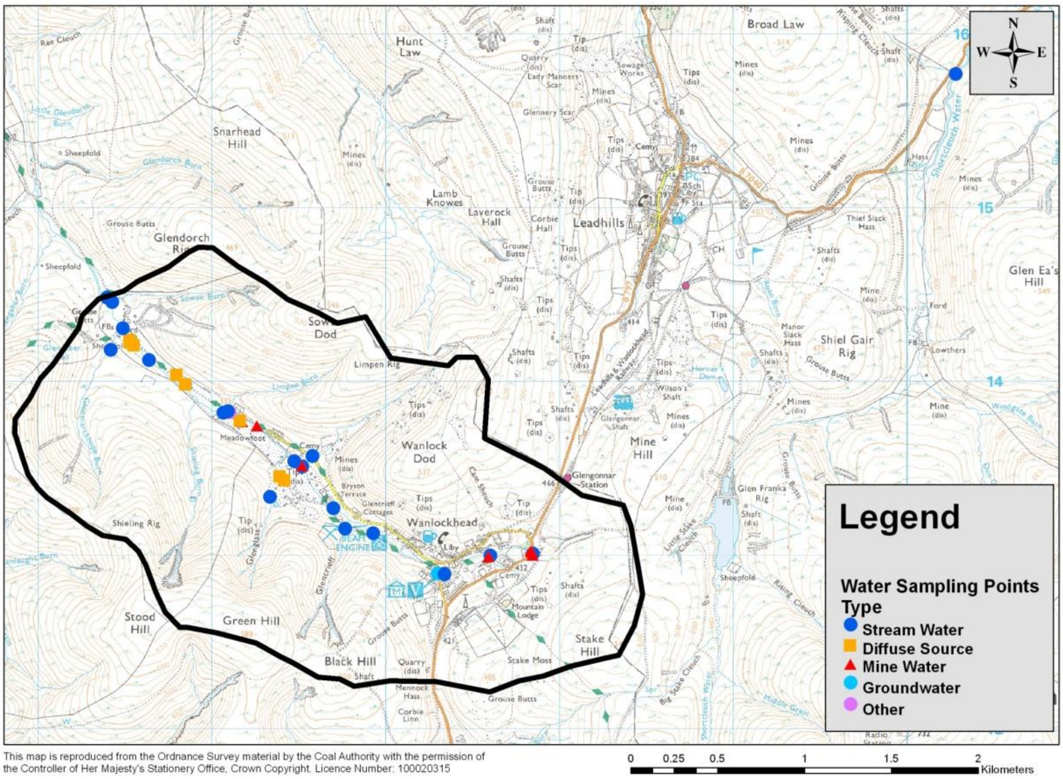

Figure 7.2 - *Map of water sample locations*

The results from the laboratory analyses are summarised in table 7.2 and presented in full in appendix 1.

Table 7.2 - *Summary table of laboratory analyses taken May 2012 to April 2013 (excluding anomalous readings)*

Sample Location	Cadmium (µg/L)			Lead (µg/L)			Zinc (µg/L)			Copper (µg/L)		
	Mean (Total)	Mean (Dissolved)	Samples Taken	Mean (Total)	Mean (Dissolved)	Samples Taken	Mean (Total)	Mean (Dissolved)	Samples Taken	Mean (Total)	Mean (Dissolved)	Samples Taken
Background - Glenmarchhope Burn	0.1	0.1	11	8.4	5.8	10	8.3	4.1	11	1.5	1.0	11
Wanlock Water Upstream (below	0.1	0.1	11	3.2	4.1	11	2.7	3.2	11	1.0	1.1	11
Wanlock Water Upstream of Adit U/S of Museum	0.1	0.1	1	7.0	7.0	1	4.0	3.0	1	1.0	1.0	1
Adit Discharge directly below road	0.1	0.1	2	1.0	1.0	2	2.0	2.0	2	1.0	1.0	2
Adit Discharge from pipe D/S of road	0.1	0.1	4	1.0	2.0	4	2.0	2.0	4	1.0	1.0	4
Adit Spring Discharge D/S of road	0.1	0.1	1	1.0	1.0	1	2.0	2.0	1	1.0	1.0	1
Adit (5 pipes) U/S of Museum	0.1	0.1	6	1.0	1.8	6	2.3	2.5	6	1.0	1.3	6
Wanlock Water by Museum	0.1	0.1	11	25.7	17.1	11	16.7	17.2	11	2.2	1.1	11
Mennockhass Water Tunnel	1.7	1.8	1	5.0	5.0	1	216.0	216.0	1	1.0	1.0	1
Glencrieff Stream	0.4	0.5	3	67.7	65.3	3	33.7	34.3	3	1.0	1.0	3
Wanlock Water U/S of Bay Mine at Straitsteps	0.7	0.7	11	27.1	14.9	11	79.5	78.1	11	1.3	1.2	11
Wanlock Water U/S at Pates Knowles Bridge	0.6	0.6	5	12.8	12.0	5	67.8	67.2	5	1.0	1.2	5
Wanlock Water U/S of Bay Mine (at Bay Mine)	1.1	1.0	2	51.5	30.0	2	139.0	132.0	2	2.5	1.0	2
Glenglass Stream U/S of Tip (Pond Outlet)	0.1	0.1	5	1.0	1.6	5	2.4	2.0	5	1.0	1.0	5
New Glencreiff Mine Tip Discharge by path	0.1	0.1	7	11.3	3.6	7	13.6	11.7	7	1.3	1.0	7
New Glencrieff Mine Tip Drain	0.1	0.1	1	4.0	4.0	1	14.0	13.0	1	1.0	1.0	1
Bay Mine Adit Discharge	1.6	1.6	11	21.9	20.4	11	119.8	118.5	11	1.2	1.1	11
Whyte's Cleuch (Bay Mine Stream)	0.3	0.3	1	86.0	80.0	1	27.0	26.0	1	6.0	6.0	1
Wanlock Water D/S of Bay Mine (at Cemetry)	1.1	1.1	1	48.0	34.0	1	120.0	116.0	1	2.0	2.0	1
Meadowfoot Adit Discharge	0.2	0.2	1	6.0	56.0	1	17.0	43.0	1	1.0	1.0	1
Glenglass (Glencrieff Mine) Adit Discharge	4.3	4.4	11	55.8	47.9	11	470.5	469.6	11	3.5	3.1	11
Old Settlement Pond Runoff (by Glenglass Level)	6.1	5.0	4	72.0	75.3	4	1904.5	1831.3	4	3.0	3.0	4
Wanlockhead Sewage Works Outfall	0.4	0.3	11	31.3	14.3	11	95.5	77.4	11	2.5	1.9	11
Limpen Burn (by Sewage Works)	0.1	0.1	2	6.0	8.0	2	3.0	4.5	2	1.0	1.5	2
Wanlock Water D/S of Sewage Works	2.4	2.3	11	37.6	31.5	11	239.9	239.7	11	1.7	1.7	11
Upstream of Crusher	1.3	1.3	1	96.0	89.0	1	163.0	162.0	1	3.0	3.0	1
Downstream of crushing mill	5.7	5.6	8	1098.3	956.4	8	598.9	554.6	8	3.3	2.4	8
Wanlock Water U/S Smelter Mill Tailings Ponds	2.5	2.3	11	71.6	28.9	11	266.7	254.0	11	2.5	1.9	11
Tailings Pond Ditch	9.5	9.3	6	2039.0	1056.8	6	1267.5	1236.2	6	25.7	22.7	6
Tailings Pond Runoff	6.4	5.3	7	5328.0	931.5	6	979.3	756.3	7	54.7	46.0	7
Ponded water on tailings pond	9.2	9.0	8	1950.0	1853.8	8	368.9	361.7	7	18.3	11.4	8
Wanlock Water D/S of tailings ponds	3.1	3.2	11	145.8	96.5	11	308.0	310.1	11	2.9	2.2	11
Sowen Burn prior to Wanlock Water	0.5	0.5	11	15.9	12.4	11	40.2	40.8	11	1.2	1.1	11
Wanlock Water D/S of Sowen Burn	2.7	2.6	11	245.6	51.0	11	302.4	274.8	11	3.5	2.0	11
Shortcleuch Water	0.1	0.1	1	13.0	14.0	1	10.0	10.0	1	3.0	2.0	1

Note that the detection limits for cadmium is 0.1 µg/L, and results of 0.1 are ≤0.1 µg/L

7.21 Lead

All water samples were tested for total and dissolved lead concentrations, in addition some ad-hoc on site sample analyses were undertaken. The results from these tests are shown in figure 7.3; figure 7.4, figure 7.5 and table 7.2.

Laboratory results from the mine water samples show typical mean dissolved lead concentrations of 20µg/L (12µg/L to 67µg/L) for Bay Mine adit and 48µg/L for Glenglass Level (26µg/L to 142µg/L). These results show the mine water samples are generally between approximately two and four times greater than annual average EQS values for dissolved lead (annual average of 7.2µg/L based on hardness of 50 to 100mg/L $CaCO_3$). The dissolved lead concentrations for Bay Mine Adit however, are usually only twice that of annual average EQS values. The dissolved lead concentrations for Glenglass Level are generally fairly consistent and are greater than the concentrations for Bay Mine Adit. The laboratory results from the mine water samples for total lead show typical mean concentrations of 22µg/L (13µg/L to 77µg/L) for Bay Mine Adit and 56µg/L (32 to 151µg/L) for Glenglass Level. The total lead concentrations, like the dissolved lead concentrations are greater in the Glenglass Level discharge than the Bay Mine Adit discharge. Both these mine water discharges show little differences between their respective concentrations of total and dissolved lead.

In addition to the Bay Mine Adit and Glenglass Level, the Meadowfoot Level and three/four other possible unnamed adit discharges were investigated (see table 7.3 and appendix 1). The laboratory results for these sites had typical mean dissolved lead concentrations 56µg/L for Meadowfoot Level; <1.8µg/L for the 5 pipes adit; <1µg/L for the adit below the road; <2µg/L for the 2 pipes adit and <1µg/L for the adit spring discharge. All of the 'upper' unnamed adit concentrations are below the annual average EQS values for dissolved lead.

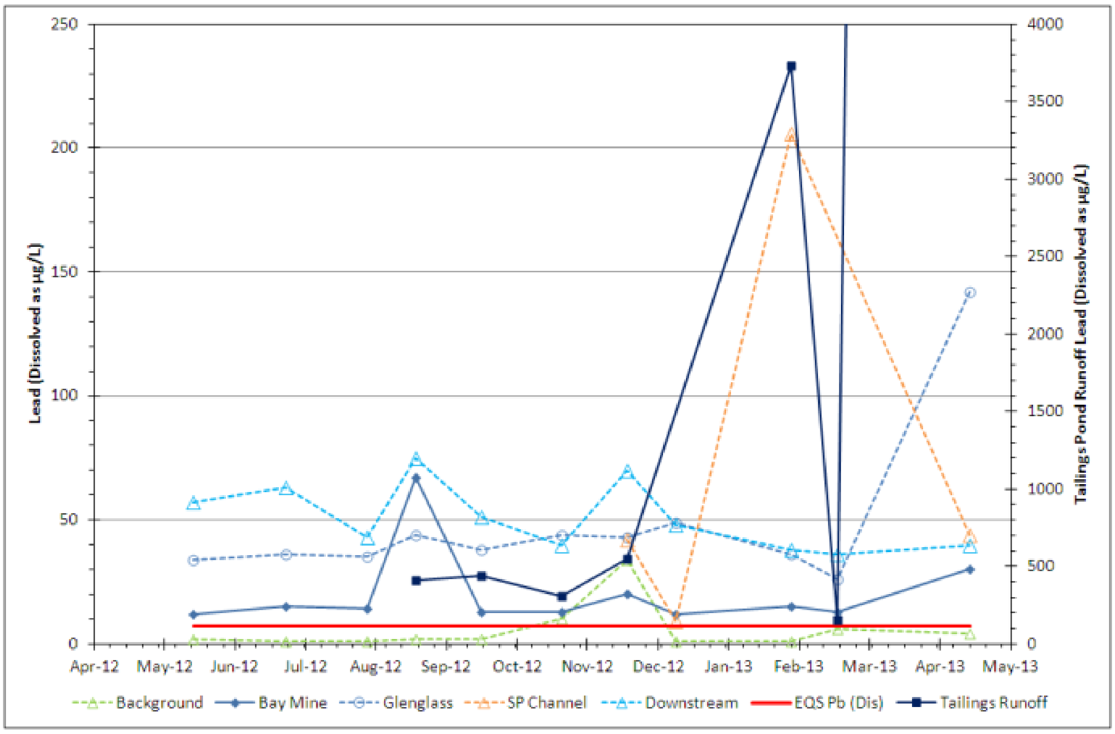

***Figure 7.3** – Time-series graph of dissolved lead concentrations for selected mining related sources*

The laboratory results for the dissolved lead concentrations within the mining/ore processing sample points are summarised in table 7.2. These results (not including any anomalous readings) show that water from the Queensberry Tailings Ponds have varying dissolved lead concentrations with typical mean values for the ponded water being 1854µg/L (534µg/L to 3484µg/L); the ditch being 1057µg/L (604µg/L to 1666µg/L) and the run-off being 931µg/L (153µg/L to 3733µg/L). The laboratory results for the total lead from the tailings ponds samples points have typical mean concentrations of 1950µg/L (485µg/L to 3796µg/L) for the ponded water; 2039µg/L (665µg/L to 4490µg/L) for the ditch; and 5328µg/L (633µg/L to 15310µg/L) for the run-off. There was one anomalous result for lead concentrations in the run-off, with total lead of 49,220µg/L and dissolved lead of 59,800µg/L.

Other mining related features which have been sampled include upstream of the crushing mill, downstream of the crushing mill (DS Crusher) and former Glencrieff Mine settlement ponds (SP Channel). The typical mean dissolved lead concentrations for these sites are 89µg/L for upstream of the crushing mill; 956µg/L for downstream of the crushing mill and 75µg/L for the old settlement ponds. All these concentrations are above the annual average EQS values for dissolved lead; however two of these points were only flowing in wet periods. The typical mean total lead concentrations for these monitoring points are 96µg/L for upstream of the crushing mill; 1098µg/L for downstream of the crushing mill and 72µg/L for the old settlement pond.

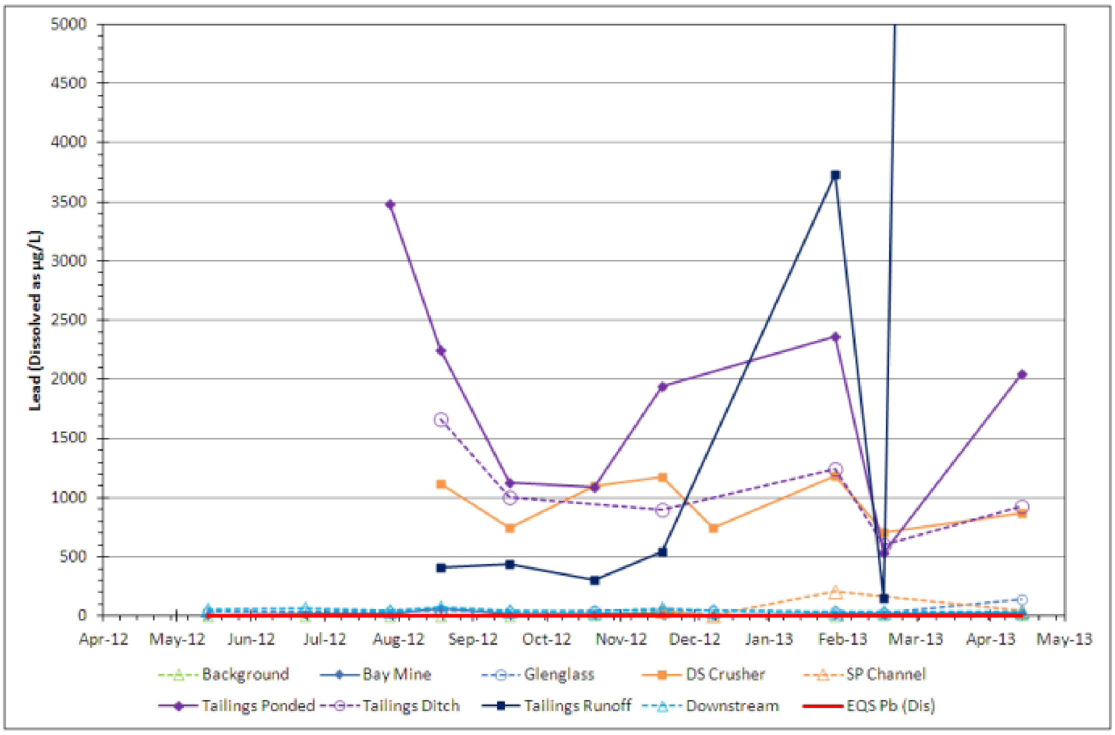

Figure 7.4 – Time-series graph of dissolved lead concentrations for mining related sources

Regular samples were taken along the course of the Wanlock Water, the results (not including any anomalous readings) from which are summarised in Table 7.2 and shown in figure 7.5. Generally the dissolved lead concentrations increase further downstream, with typical mean concentrations of 4µg/L (≤1µg/L to 17µg/L) for upstream; 17µg/L (7µg/L to

50µg/L) at the museum; 15µg/L (8µg/L to 40µg/L) at Straitsteps Mine; 12µg/L (7µg/L to 17µg/L) at Glencrieve Cottage; 32µg/L (22µg/L to 49µg/L) downstream of the sewage works; 29µg/L (18µg/L to 52µg/L) upstream of the tailings ponds; 97µg/L (35µg/L to 359µg/L) downstream of the tailings ponds; 51µg/L (36µg/L to 75µg/L) downstream of Sowen Burn. Typically mean total lead concentrations are 3µg/L for upstream; 26µg/L at the museum; 27µg/L at Straitsteps; 13µg/L at Glencrieve Cottage; 38µg/L downstream of the sewage works; 72µg/L upstream of the tailings ponds; 66µg/L downstream of the tailings ponds and 112µg/L downstream of Sowen Burn. Comparing the total and dissolved lead concentrations for the Wanlock Water samples show that the water is generally approximately 80% to 100% dissolved lead; however the mean value for the downstream of Sowen Burn sample is 70% dissolved lead. The Wanlock Water downstream of Sowen Burn is typically seven times greater than annual average EQS values (7.2µg/L) for dissolved lead.

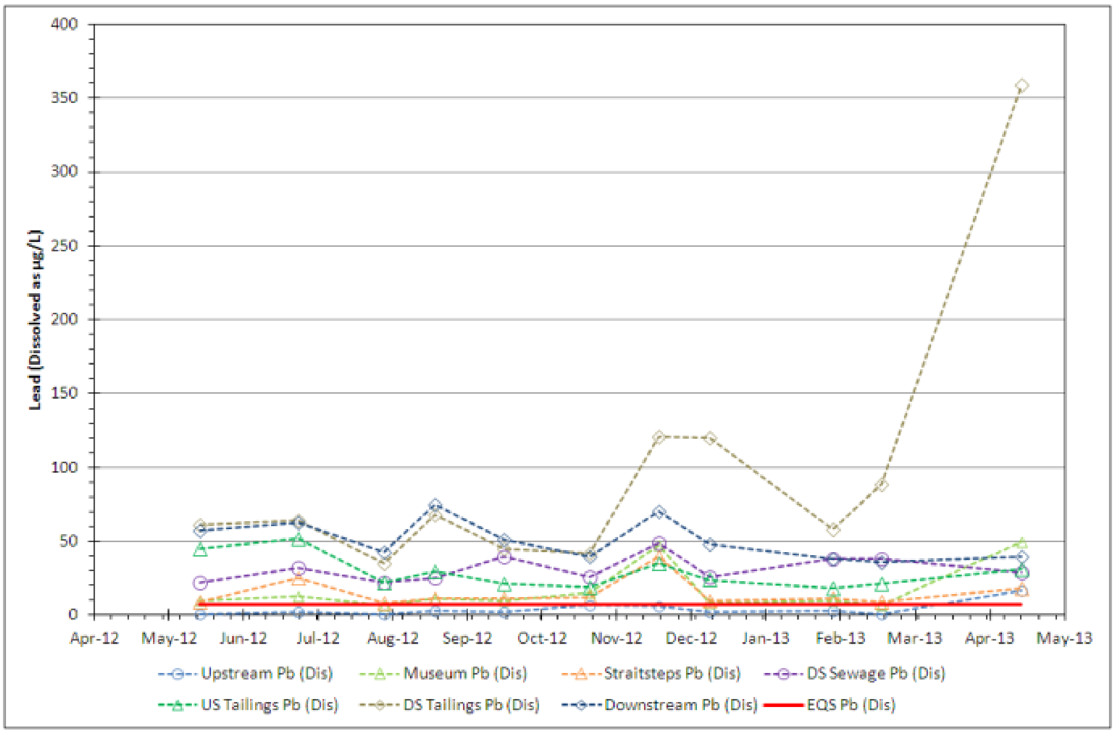

***Figure 7.5 –** Time-series graph of dissolved lead concentrations for Wanlock Water samples*

Regular samples were taken from a background location at Glenmarchhope Burn, which is in the Wanlock Water catchment, but has limited exposure to mining and ore processing. The results show a mean concentration of dissolved lead of 5.8µg/L (≤1µg/L to 34µg/L), and a mean concentration of total lead of 8.4µg/L (≤1µg/L to 39µg/L). There was one anomalous result for total lead of 388µg/L. In addition to this, a single sample was obtained from the Shortcleuch Water, where the results showed a dissolved lead concentration of 14µg/L and a total lead concentration of 13µg/L; these results compare to 4µg/L and 8µg/L detected respectively in the Glenmarchhope Burn on the same sampling date.

7.22 Zinc

All water samples were tested for total and dissolved zinc concentrations, in addition some ad-hoc on site sample analyses were also undertaken. The results from these tests are shown in figure 7.6; figure 7.7 and Table 7.2.

Laboratory results from the mine water samples show typical mean dissolved zinc concentrations of 118µg/L (97µg/L to 155µg/L) for Bay Mine adit and 470µg/L for Glenglass Level (271µg/L to 596µg/L). The dissolved zinc concentrations for Glenglass Level are generally fairly consistent and are greater than the concentrations for Bay Mine Adit. The laboratory results from the mine water samples for total zinc show typical mean concentrations of 120µg/L (96µg/L to 160µg/L) for Bay Mine Adit and 470µg/L (269 to 601µg/L) for Glenglass Level. The total zinc concentrations, like the dissolved zinc concentrations, are greater in the Glenglass Level discharge than the Bay Mine Adit discharge. These results show the mine water samples are generally two times greater than EQS values for total zinc (annual average of 50µg/L based on hardness of 50 to 100mg/L $CaCO_3$) for Bay Mine Adit; and nine times greater than annual average EQS values for Glenglass Level. Both these mine water discharges show little differences between their respective concentrations of total and dissolved zinc.

In addition to the Bay Mine Adit and Glenglass Level, the Meadowfoot Level and three/four other possible unnamed adit discharges were investigated (see table 7.2 and appendix 1). The laboratory results for these sites had typical mean total zinc concentrations 17µg/L for Meadowfoot Level; 2µg/L for the 5 pipes adit; 2µg/L for the adit below the road; 2µg/L for the 2 pipes adit and 2µg/L for the adit spring discharge. All of the 'upper' unnamed adit concentrations are below the annual average EQS values for total zinc.

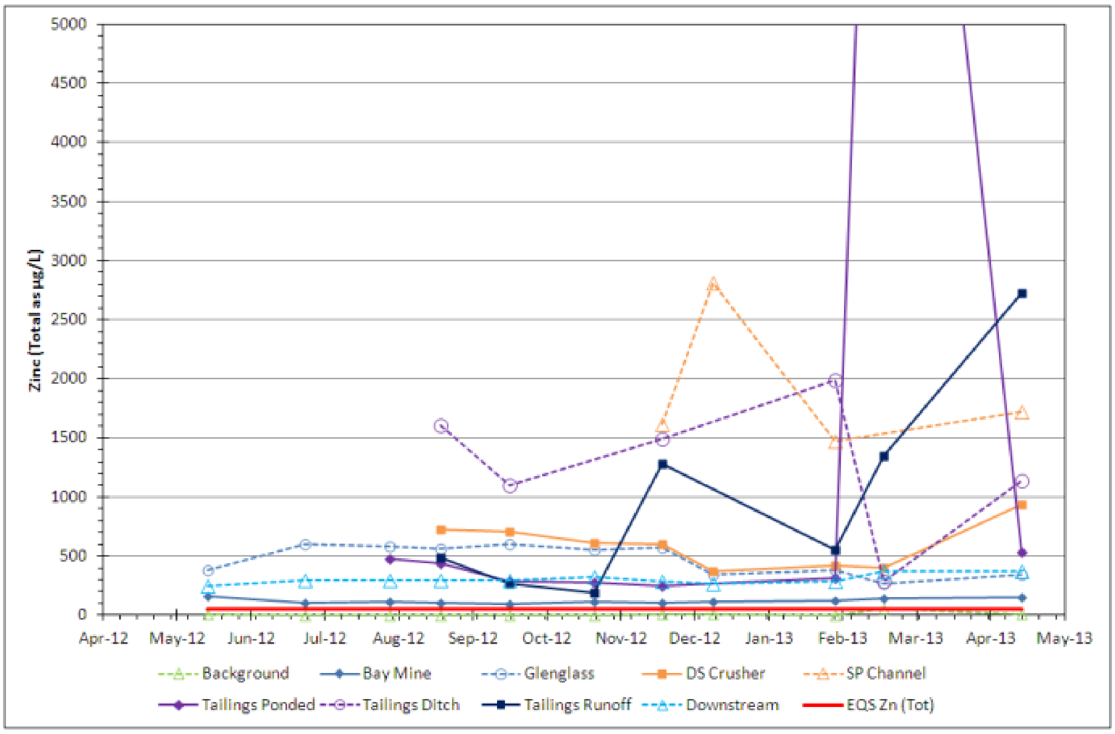

***Figure 7.6** – Time-series graph of total zinc concentrations for mining related sources*

The laboratory results for the total zinc concentrations within the mining/ore processing sample points are summarised in table 7.2. These results (not including any anomalous readings) show that water from the Queensberry Tailings Ponds have varying total zinc concentrations with typical mean values for the ponded water being 369µg/L (249µg/L to 530µg/L); the ditch being 1268µg/L (281µg/L to 1987µg/L) and the run-off being 979µg/L (187µg/L to 2725µg/L). The laboratory results for the dissolved zinc from the tailings ponds samples points have typical mean concentrations of 362µg/L (245µg/L to 512µg/L) for the ponded water; 1236µg/L (291µg/L to 1926µg/L) for the ditch and 756µg/L (160µg/L to 2946µg/L) for the run-off. There was one anomalous result for zinc concentrations at the ponded water, with total zinc of 11,170µg/L and dissolved zinc of 12,010µg/L.

Other mining related features which have been sampled include upstream of the crushing mill, downstream of the crushing mill (DS Crusher) and former Glencrieff Mine settlement ponds (SP Channel). The typical mean total zinc concentrations for these sites are 163µg/L for upstream of the crushing mill; 599µg/L for downstream of the crushing mill and 1905µg/L for the old settlement ponds. All these concentrations are above the EQS values for dissolved zinc; however two of these points were only flowing in wet periods. The typical mean dissolved zinc concentrations for these monitoring points are 162µg/L for upstream of the crushing mill; 554µg/L for downstream of the crushing mill and 1831µg/L for the old settlement pond.

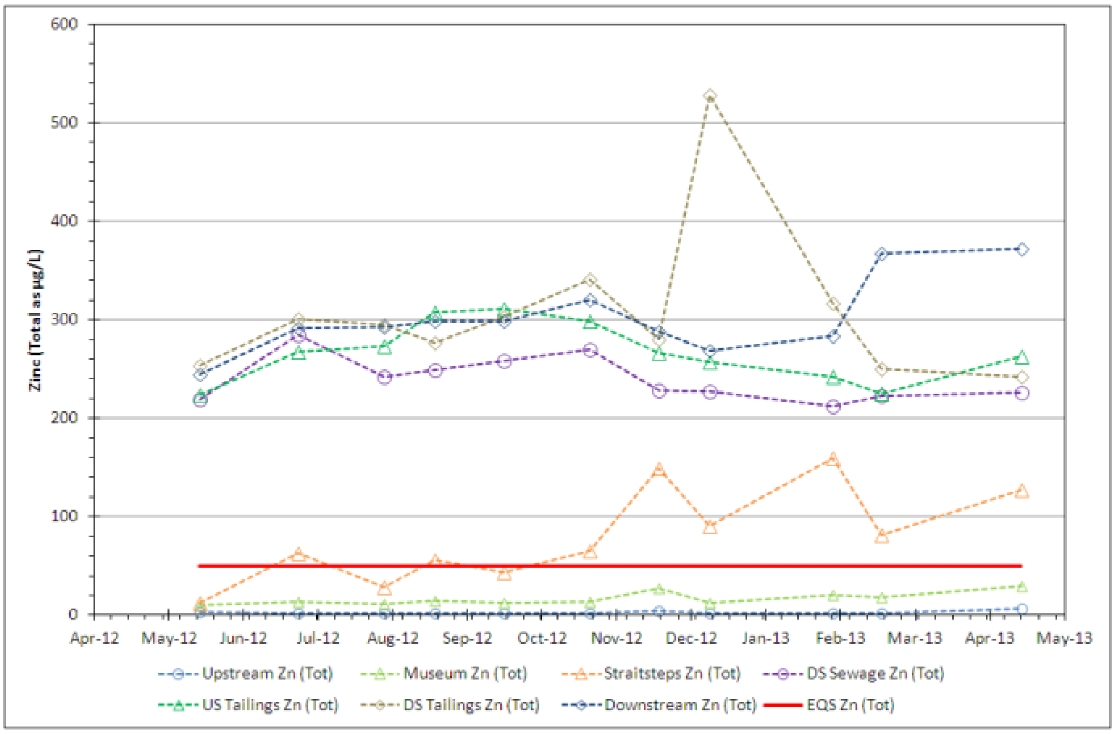

***Figure 7.7 –** Time-series graph of total zinc concentrations for Wanlock Water*

Regular samples were taken along the course of Wanlock Water, the results from which are summarised in table 7.2 and shown in figure 7.7. Generally the total zinc concentrations increase further downstream, with typical mean concentrations of 3µg/L (2µg/L to 7µg/L) for upstream; 17µg/L (10µg/L to 30µg/L) at the museum; 80µg/L (12µg/L to 160µg/L) at

Straitsteps Mine; 68µg/L (50µg/L to 88µg/L) at Glencrieve Cottage; 240µg/L (212µg/L to 285µg/L) downstream of the sewage works; 268µg/L (224µg/L to 311µg/L) upstream of the tailings ponds; 308µg/L (242µg/L to 528µg/L) downstream of the tailings ponds and 302µg/L (245µg/L to 372µg/L) downstream of Sowen Burn. Typically mean dissolved zinc concentrations are 3µg/L for upstream; 17µg/L at the museum; 78µg/L at Straitsteps; 67µg/L at Glencrieve Cottage; 240µg/L downstream of the sewage works; 254µg/L upstream of the tailings ponds; 310µg/L downstream of the tailings ponds and 275µg/L downstream of Sowen Burn. Comparing the total and dissolved zinc concentrations for the Wanlock Water samples show that generally, the zinc is nearly entirely present as dissolved zinc. The Wanlock Water downstream of Sowen Burn is typically six times greater than annual average EQS values (50µg/L) for total zinc.

Regular samples were taken from a background location at Glenmarchhope Burn, which is in the Wanlock Water catchment, but has limited exposure to mining and ore processing. The results show a mean concentration of dissolved zinc of 4.1µg/L (2µg/L to 8µg/L), and a mean concentration of total zinc of 8.3µg/L (2µg/L to 52µg/L). In addition to this, a single sample was obtained from the Shortcleuch Water, where the results showed a dissolved zinc concentration of 10µg/L and a total zinc concentration of 10µg/L; these results compare to 6µg/L and 7µg/L detected respectively in the Glenmarchhope Burn on the same sampling date.

7.23 Cadmium

All water samples were tested for total and dissolved cadmium concentrations. The results from these tests are shown in figure 7.8; figure 7.9 and table 7.2.

Laboratory results from the mine water samples show typical mean dissolved cadmium concentrations of 1.6µg/L (1.3µg/L to 2.0µg/L) for Bay Mine adit and 4.4µg/L for Glenglass Level (2.6µg/L to 5.5µg/L). These results show the mine water samples are generally between approximately 15 and 50 times greater than EQS values for dissolved cadmium (annual average of 0.09µg/L based on hardness of 50 to 100mg/L $CaCO_3$). The dissolved cadmium concentrations for Glenglass Level and Bay Mine are generally fairly consistent and are greater at Glenglass Level than for Bay Mine Adit. The laboratory results from the mine water samples for total cadmium show typical mean concentrations of 1.6µg/L (1.3µg/L to 2.1µg/L) for Bay Mine Adit and 4.3µg/L (2.5 to 5.5µg/L) for Glenglass Level. The total cadmium concentrations, like the dissolved cadmium concentrations are greater in the Glenglass Level discharges than the Bay Mine Adit discharge. Both these mine water discharges show little differences between their respective concentrations of total and dissolved cadmium.

In addition to the Bay Mine Adit and Glenglass Level, the Meadowfoot Level and three/four other possible unnamed adit discharges were investigated (see table 7.2 and Appendix 1). The laboratory results for these sites had typical mean dissolved cadmium concentrations 0.2µg/L for Meadowfoot Level; <0.1µg/L for the 5 pipes adit; <0.1µg/L for the adit below the road; <0.1µg/L for the 2 pipes adit and <0.1µg/L for the adit spring discharge. All of the 'upper' unnamed adit concentrations are below the detection limits for dissolved cadmium.

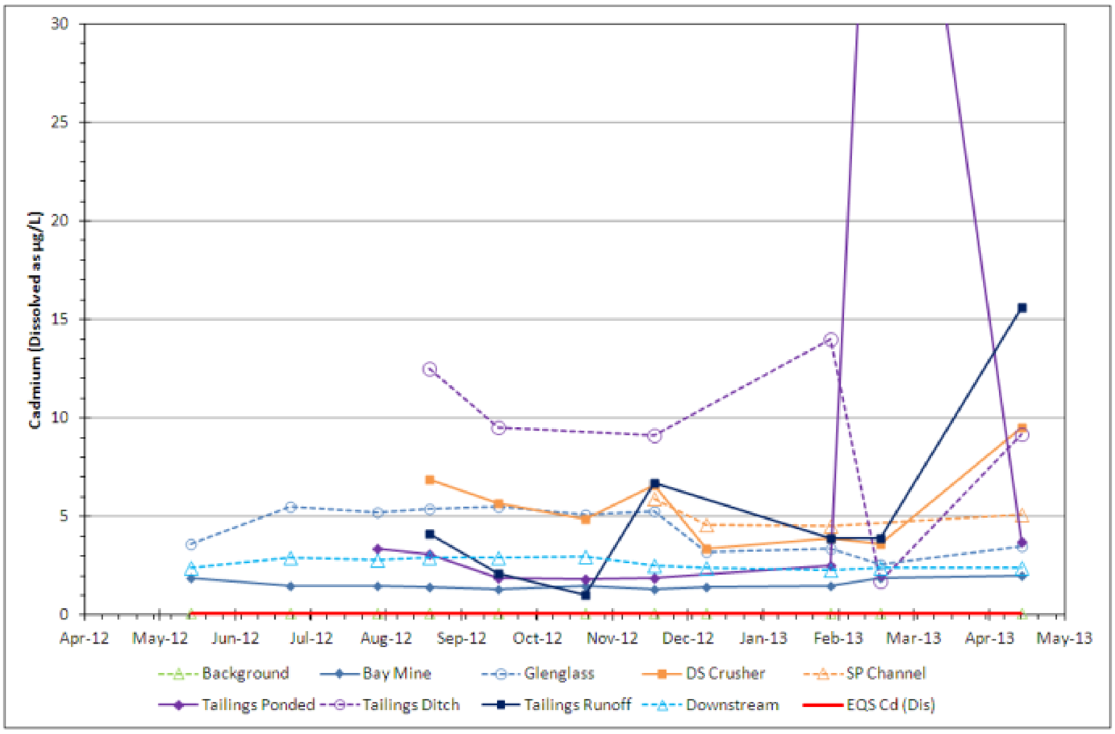

***Figure 7.8** – Time-series graph of dissolved cadmium concentrations for selected mining related sources*

The laboratory results for the dissolved cadmium concentrations within the mining/ore processing sample points are summarised in table 7.2. These results (not including any anomalous readings) show that water from the Queensberry Tailings Ponds have varying dissolved cadmium concentrations with typical mean values for the ponded water being 2.6µg/L (1.8µg/L to 3.7µg/L); the ditch being 9.3µg/L (1.7µg/L to 14µg/L) and the run-off being 3.6µg/L (1.0µg/L to 6.7µg/L). The laboratory results for the total cadmium from the tailings ponds samples points have typical mean concentrations of 2.6µg/L (1.7µg/L to 3.7µg/L) for the ponded water; 9.5µg/L (1.7µg/L to 14.2µg/L) for the ditch and 4.8µg/L (1.1µg/L to 9.8µg/L) for the run-off. The tailings ponds samples are generally 25 to 100 times greater than the EQS values for dissolved cadmium.

Other mining related features which have been sampled include upstream of the crushing mill, downstream of the crushing mill (DS Crusher) and former Glencrieff Mine settlement ponds (SP Channel). The typical mean dissolved cadmium concentrations for these sites are 1.3µg/L for upstream of the crushing mill; 5.6µg/L for downstream of the crushing mill and 5.0 µg/L for the old settlement ponds. All these concentrations are above the EQS values for dissolved cadmium; however two of these points were only flowing in wet periods. The typical mean total cadmium concentrations for these monitoring points are 1.3µg/L for upstream of the crushing mill; 5.7µg/L for downstream of the crushing mill and 6.0µg/L for the old settlement pond. There were two anomalous sample results for cadmium, one at the ponded water with total cadmium of 56µg/L and dissolved cadmium of 53µg/L; the second was the run-off with total cadmium of 16µg/L and dissolved cadmium of 16µg/L.

Regular samples were taken along the course of Wanlock Water, the results from which are summarised in table 7.2 and shown in figure 7.9. Generally the dissolved cadmium concentrations increase further downstream, with typical mean concentrations of <0.1µg/L for upstream; 0.1µg/L (≤0.1µg/L to 0.2µg/L) at the museum; 0.7µg/L (0.2µg/L to 1.3µg/L) at Straitsteps Mine; 0.6µg/L (0.5µg/L to 0.8µg/L) at Glencrieve Cottage; 2.3µg/L (1.9µg/L to 2.9µg/L) downstream of the sewage works; 2.3µg/L (2.0µg/L to 2.6µg/L) upstream of the tailings ponds; 3.2µg/L (2.4µg/L to 7.9µg/L) downstream of the tailings ponds and 2.6µg/L (2.3µg/L to 3µg/L) downstream of Sowen Burn. Typically mean total cadmium concentrations are <0.1µg/L for upstream; 0.1µg/L at the museum; 0.7µg/L at Straitsteps; 0.6µg/L at Glencrieve Cottage; 2.4µg/L downstream of the sewage works; 2.5µg/L upstream of the tailings ponds; 3.1µg/L downstream of the tailings ponds and 2.7µg/L downstream of Sowen Burn. Comparing the total and dissolved cadmium concentrations for the Wanlock Water samples show that the water is generally approximately >90% dissolved cadmium. The Wanlock Water downstream of Sowen Burn is typically 30 times greater than annual average EQS values (annual average of 0.09µg/L bases on 50 to 100mg/L $CaCO_3$) for dissolved cadmium.

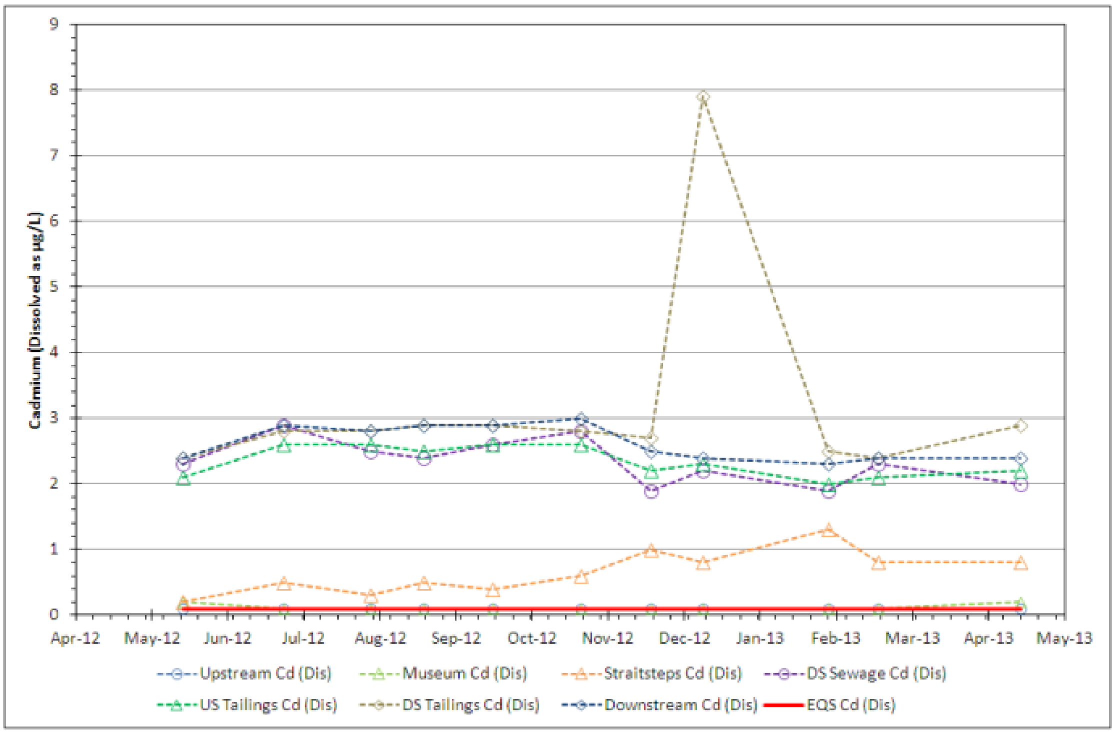

Figure 7.9 – *Time-series graph of dissolved cadmium concentrations for Wanlock Water samples*

Regular samples were taken from a background location at Glenmarchhope Burn, which is in the Wanlock Water catchment, but has limited exposure to mining and ore processing. The results show a mean concentration of dissolved cadmium of <1µg/L, and a mean concentration of total cadmium of 1.2µg/L (≤1µg/L to 3µg/L). In addition to this, a single sample was obtained from the Shortcleuch Water, where the results showed a dissolved cadmium concentration of <1µg/L and a total cadmium concentration of <1µg/L; these results compare to <1µg/L and <1µg/L detected respectively in the Glenmarchhope Burn on the same sampling date.

7.24 Copper

All water samples were tested for total and dissolved copper concentrations. The results from these tests are shown in figure 7.10; figure 7.11 and table 7.2.

Laboratory results from the mine water samples show typical mean dissolved copper concentrations of 1.1µg/L (≤1.0µg/L to 2.0µg/L) for Bay Mine adit and 3.1µg/L for Glenglass Level (2.0µg/L to 4.0µg/L). These results show the mine waters from both the Bay Mine adit the Glenglass Level are within the EQS values for dissolved copper (annual average of 6µg/L based on hardness 50 – 100 mg/l $CaCO_3$). The dissolved cadmium concentrations for Glenglass Level and Bay Mine are generally fairly consistent and are greater at Glenglass Level than for Bay Mine Adit. The laboratory results from the mine water samples for total copper show typical mean concentrations of 1.0µg/L (≤1.0µg/L to 3.0µg/L) for Bay Mine Adit and 3.5µg/L (2.0µg/L to 5.0µg/L) for Glenglass Level. The total copper concentrations, like the dissolved copper concentrations are greater in the Glenglass Level discharges than the Bay Mine Adit discharge. Both these mine water discharges show little differences between their respective concentrations of total and dissolved copper, however some of these concentrations are at the level of detection for ICP-MS (1µg/L) and therefore must be treated with some caution.

In addition to the Bay Mine Adit and Glenglass Level, the Meadowfoot Level and three/four other possible unnamed adit discharges were investigated (see table 7.2 and appendix 1). The laboratory results for these sites had typical mean dissolved copper concentrations <1.0µg/L for Meadowfoot Level; 1.33µg/L for the 5 pipes adit and <1.0µg/L for the adit below the road; <1.0µg/L for the 2 pipes adit and <1.0µg/L for the adit spring discharge. All of the ‘upper’ unnamed adit concentrations are close to the ICP-MS detection limits for dissolved copper.

The laboratory results for the dissolved copper concentrations within the mining/ore processing sample points are summarised in table 7.3. These results (not including any anomalous readings) show that water from the Queensberry Tailings Ponds have varying dissolved copper concentrations with typical mean values for the ponded water being 11.4µg/L (5.0µg/L to 16µg/L); the ditch being 22.7µg/L (6µg/L to 43µg/L) and the run-off being 27.0µg/L (7.0µg/L to 17µg/L). The laboratory results for the total copper from the tailings ponds sample points have typical mean concentrations of 18.3µg/L (5.0µg/L to 41µg/L) for the ponded water; 25.7µg/L (7µg/L to 38µg/L) for the ditch and 33.7µg/L (8.0µg/L to 60µg/L) for the run-off. The tailings ponds samples are generally up to five times the EQS value (annual average of 6µg/L based on hardness 50 to 100 mg/l $CaCO_3$) for dissolved copper. There was one anomalous sample result for copper for the run-off, with total copper of 181µg/L and dissolved copper at 160µg/L.

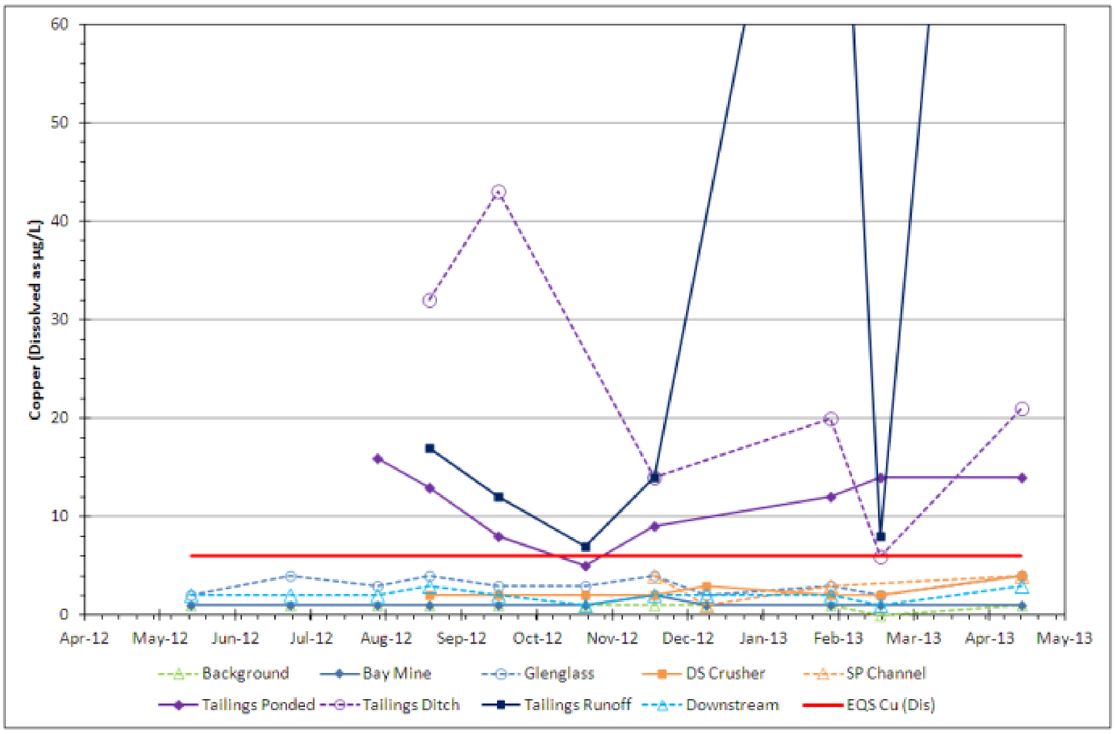

***Figure 7.10** – Time-series graph of dissolved copper concentrations for selected mining related sources*

Other mining related features which have been sampled include upstream of the crushing mill, downstream of the crushing mill (DS Crusher) and former Glencrieff Mine settlement ponds (SP Channel). The typical mean dissolved copper concentrations for these sites are 3.0µg/L for upstream of the crushing mill; 2.4µg/L for downstream of the crushing mill and 2.5µg/L for the old settlement ponds. All these concentrations are below the EQS value of 6 µg/L for dissolved copper (hardness 50 to 100mg/L $CaCO_3$); however two of these points were only flowing in wet periods. The typical mean total copper concentrations for these monitoring points are 3.0µg/L for upstream of the crushing mill; 3.2µg/L for downstream of the crushing mill and 3.0µg/L for the old settlement pond.

Regular samples were taken along the course of the Wanlock Water, the results from which are summarised in table 7.3 and shown in figure 7.11. Generally the dissolved copper concentrations increase further downstream, with typical mean concentrations of 1.1µg/L for upstream (≤1.0µg/L to 2.0µg/L); 1.1µg/L (<1.0µg/L to 1.0µg/L) at the museum; 1.2µg/L (≤1.0µg/L to 2.0µg/L) at Straitsteps Mine; 1.25µg/L (≤1.0µg/L to 2.0µg/L) at Glencrieve Cottage; 1.7µg/L (≤1.0µg/L to 3.0µg/L) downstream of the sewage works; 1.9µg/L (≤1.0µg/L to 3.0µg/L) upstream of the tailings ponds; 2.2µg/L (≤1.0µg/L to 4.0µg/L) downstream of the tailings ponds and 2.µg/L (≤1.0 µg /L to 3.0µg/L) downstream of Sowen Burn. Typically mean total copper concentrations are ≤1.0µg/L for upstream; ≤1.1µg/L at the museum; 1.3µg/L at Straitsteps; ≤1.0µg/L at Glencrieve Cottage; 1.7µg/L downstream of the sewage works; 2.45µg/L upstream of the tailings ponds; 2.9µg/L downstream of the tailings ponds and 2.63µg/L downstream of Sowen Burn. Comparing the total and dissolved copper concentrations for the Wanlock Water samples show that the water is generally approximately >90% dissolved copper. The Wanlock Water downstream of Sowen Burn is typically within the annual average EQS values (6µg/L based on a Hardness of 50 – 100 mg/l $CaCO_3$) for dissolved copper.

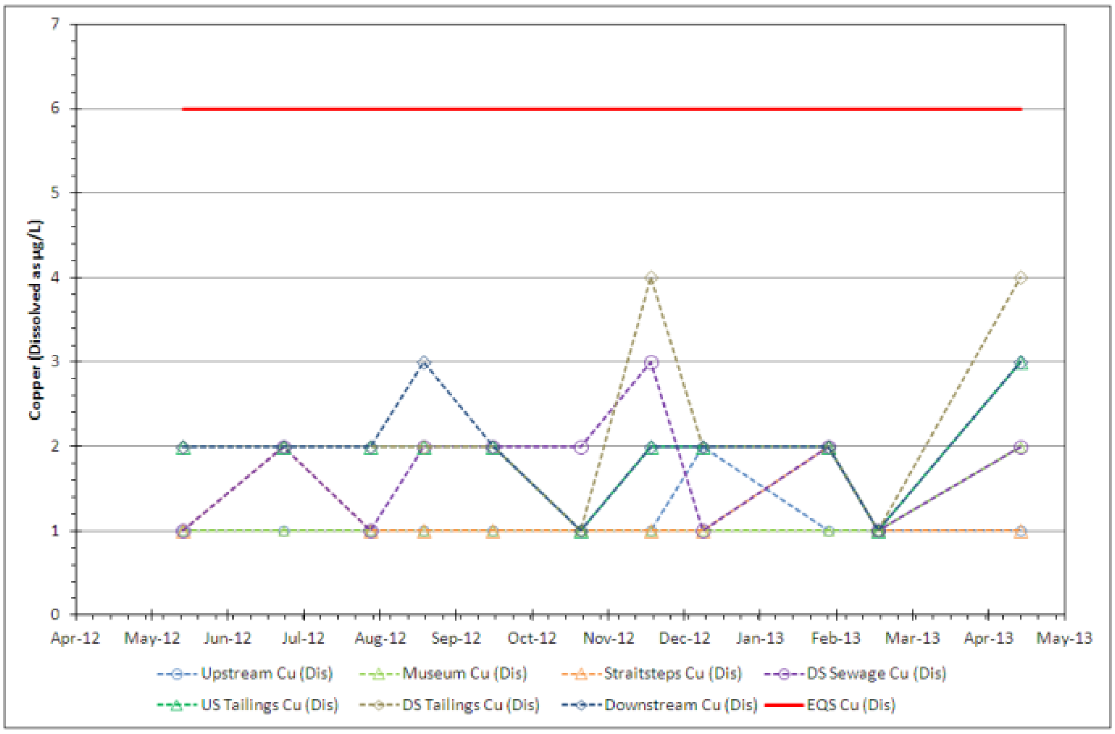

***Figure 7.11** – Time-series graph of dissolved copper concentrations for Wanlock Water samples*

Regular samples were taken from a background location at Glenmarchhope Burn, which is in the Wanlock Water catchment, but has limited exposure to mining and ore processing. The results show a mean concentration of dissolved copper of <1µg/L, and a mean concentration of total copper of 1.5µg/L (≤1µg/L to 5µg/L). There was one anomalous sample result for dissolved copper of 29µg/L. In addition to this, a single sample was obtained from the Shortcleuch Water, where the results showed a dissolved copper concentration of 2µg/L and a total copper concentration of 3µg/L; these results compare to <1µg/L and <1µg/L detected respectively in the Glenmarchhope Burn on the same sampling date.

7.3 Sediment Samples

Throughout the study a total of nine sediment samples were taken from seven different sites (see figure 7.12), predominantly within the study area; one sediment sample was collected from outside of the orefield in an area with similar geology to obtain a background sediment sample with limited anthropogenic metalliferous contamination. These sites are classified for the purposes of this study in to two separate types including:

- Fluvial sediment: These samples were taken from the active river channel in the Glenglass Level, upstream of Bay Mine Adit, to obtain a sample of material upstream of the ore processing area and downstream of the study area to determine the particulate contamination in the watercourse.
- Mine Tailings: This is the largest group of sediment material analysed in this study as diffuse sources of contamination were identified as being significant in the area.

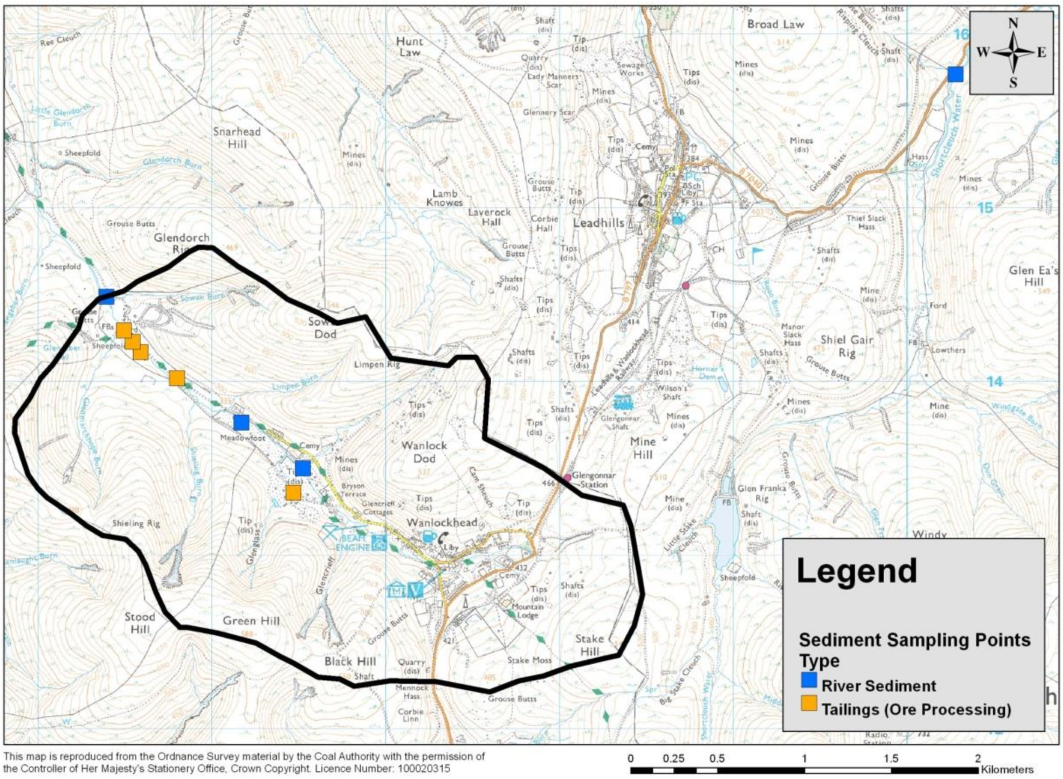

Figure 7.12 *– Map of sediment sampling points*

All the samples described in this section have been subjected to partial acid digestion using aqua regia (3:1 mixture of hydrochloric and nitric acids); therefore the figures reported here may not represent the true total metal concentrations. However, for the purposes of this report, the values can be regarded as semi-total as the silicate minerals present in the samples that are resistant to this type of acid digestion are unlikely to contain significant concentrations of the targeted elements discussed here. In contrast, any sulphide/carbonate mineral phases present in the samples will be successfully decomposed, thereby resulting in the release of PHE (Potentially Harmful Elements) such as lead, zinc, cadmium, copper, nickel and arsenic in to solution.

The results for the sediments samples are shown in table 7.3. Few soil and sediment quality guidelines are available which are specifically tailored for metal mine sediments, therefore the chemistry of the samples collected in this study have been compared to a number of different soil guideline values to provide some context to the metal concentrations reported by the analysis. These guidelines include the ICRCL Guidance Note 70/90: Notes on the restoration and aftercare of metalliferous mining sites for pasture and grazing (1990); CCME (Canadian Council of Ministers of the Environment) Soil Quality Guidelines for Environmental Health (1999); the Dutch Soil Remediation Circular (2009) and the Environment Agency (EA) Soil Guideline Values (2009). In addition, the mean chemistry of soils in the Southern Uplands as reported by Towers *et al.* (2006) are also used to provide some local context to the chemistry of the sediment samples analysed in this study (see table 7.4).

Table 7.3 *– Summary table of sediment sample analyses*

Sample name	Sample Date	Sediment Type	Arsenic (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead (wt %)	Mercury (mg/kg)	Nickel (mg/kg)	Selenium (mg/kg)	Zinc (wt %)	Total moisture (%)
Glenglass Level Sediment	17/05/2012	Fluvial Sediment	25.8	54.0	46.7	437	0.60	1.43	38.1	1.20	0.67	23.2
Glencrieff Mine Tip	17/05/2012	Mine Tailings	19.0	203	25.0	1220	5.92	1.65	47.0	2.10	3.14	16.7
Queensberry Tailings Pond #1	17/05/2012	Mine Tailings	58.7	44.6	26.8	1380	7.02	20.4	42.1	4.40	1.04	31.0
Queensberry Tailings Pond #2	31/07/2012	Mine Tailings	61.3	84.4	16	1538	6.17	1.58	51.1	3.40	2.25	18.9
Queensberry Tailings Pond #3	07/04/2013	Mine Tailings	45.8	37.4	12.8	1241	5.06	0.55	40.7	3.10	0.79	18.4
Queensberry Tailings Pond mean			*55.3*	*55.5*	*18.5*	*1386*	*6.08*	*7.51*	*44.6*	*3.63*	*1.36*	*22.8*
Queensberry Crushing Mill	31/07/2012	Mine Tailings	14.2	3.2	43.2	74.1	0.08	0.22	50.3	0.70	0.02	6.20
Downstream Sowen Burn	07/04/2013	Fluvial Sediment	25.6	12.3	34.2	164	0.98	0.35	45.9	0.8	0.24	15.6
Wanlock Water U/S Bay Mine	07/04/2013	Fluvial Sediment	17.8	5.84	73.2	80.0	0.47	0.14	67.5	<0.5	0.18	14.0
Background Sediment (Shortcleuch Water)	07/04/2013	Fluvial Sediment	23.8	0.90	82.2	40.1	0.03	<0.1	86.6	<0.5	0.02	14.0

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Table 7.4 *- Summary of published soil guideline values for selected elements. All data are quoted in mg/kg dry weight*

Soil Guideline	Date	Element	Categories	
			Trigger Threshold	**Maximum Action Threshold**
ICRCL Metalliferous Mine Sites	1990	Arsenic	50	500
		Cadmium	3	30
		Copper	250	500
		Lead	300	1000
		Zinc	1000	3000
Soil Guideline	**Date**	**Element**	**Intervention Value**	
Dutch Soil Remediation Circular	2009	Arsenic	60	
		Cadmium	13	
		Copper	190	
		Lead	530	
		Mercury	36	
		Nickel	100	
		Zinc	720	
Soil Guideline	**Date**	**Element**	**Residential**	**Allotments**
EA Soil Guidelines	2009	Arsenic	32	43
		Cadmium	10	1.8
		Mercury	170	80
		Nickel	130	230
Soil Guideline	**Date**	**Element**	**Environmental Health**	
CCME Soil Guidelines	1999	Arsenic	17	
		Cadmium	3.8	
		Chromium	64	
		Copper	63	
		Lead	70	
		Mercury	12	
		Nickel	50	
		Zinc	200	
Soil Comparison	**Date**	**Element**	**Mean Soil Concentrations for Southern Uplands**	
Towers *et al.*	2006	Cadmium	1.28	
		Chromium	8.6	
		Copper	12	
		Lead	139	
		Nickel	6.5	
		Zinc	67	

7.31 Tailings samples

This group comprises all of the samples collected from the Queensberry Tailings Pond, the Glencrieff Spoil Tip and the Queensberry Crushing Mill. A total of three samples have been collected from the Queensberry Tailings Pond as the water data suggest that this material is a significant source of diffuse metal pollution and the feature covers a wide region in the lower reaches of the study area. These samples have been collected from different locations within the tailings area to produce an average chemistry in order to mitigate the heterogeneous nature of the sediment.

Queensberry Tailings
When the mean metal concentrations of the Queensberry Tailings are compared to the ICRCL guidelines (1990) the maximum action trigger concentrations for cadmium (30 mg/kg), copper (500 mg/kg), lead (1000 mg/kg) and zinc (3000 mg/kg) are all exceeded in the sediment. The mean lead concentration (6.08 wt %; range 5.06 – 7.02 wt %) exceeds the guideline by 61 times, the mean zinc concentration (1.36 wt %; range 0.79 – 2.25 wt %) is five times greater than the guideline value, and the mean cadmium (55.5 mg/kg; range 37.4 – 84.4 mg/kg) and copper (1386 mg/kg; range 1241 – 1538 mg/kg) concentrations exceed the guideline values by approximately two and three times respectively. In contrast, the mean arsenic concentration (55.3 mg/kg; range 45.8 – 61.3 mg/kg) is below the maximum action trigger value; however, it does exceed the trigger value of 50 mg/kg.

Compared to the more recent soil guidelines, the mean concentrations of lead, zinc, cadmium and copper in these tailings also exceed the various guideline values. Mean lead concentrations exceed the 1999 Canadian CCME Environmental Health guideline (70 mg/kg) by approximately 870 times and the 2009 Dutch Soil Remediation Circular guideline (530 mg/kg) by 115 times. Mean zinc concentrations exceed the Canadian guideline (200 mg/kg) and Dutch guideline (720 mg/kg) by 68 and 19 times respectively whereas the mean cadmium concentrations exceed the Canadian (3.8 mg/kg) and Dutch guidelines (13 mg/kg) by 14 and four times respectively. The EA Soil Guideline Values (2009) for cadmium in residential areas and allotments (10 and 1.8 mg/kg respectively) are also exceeded in these tailings by at least six times (based on the guideline value for residential areas). The mean copper concentrations exceed the Canadian (63 mg/kg) and Dutch (190 mg/kg) guidelines by 22 and seven times respectively. The mean arsenic concentrations exceed the Canadian guideline (17 mg/kg) and EA soil guidelines (residential areas: 32 mg/kg; allotments: 43 mg/kg) by three and two (based on the residential guideline value of 32 mg/kg) times respectively, but are within the Dutch guidelines (76 mg/kg).

A comparison of the typical concentrations found in soils in the Southern Uplands as reported by Tower *et al.* (2006) (see Table 7.4), show that cadmium (55.5 mg/l), chromium (18.5 mg/l), copper (1386 mg/kg), lead (6.08 wt %), nickel (44.6 mg/kg) and zinc (1.36 wt %) are all enriched in the Queensberry Tailings.

Glencrieff Mine Tailings

Only one sample was collected from the spoil tip at Glencrieff Mine as the water data obtained in this study suggest that, in contrast to the Queensberry Tailings, this tip is not contributing a significant amount of metal contamination to the Wanlock Water. The sample was not collected from the main tip as there was some uncertainty of the stability of the structure; the sample was therefore collected from an area in the vicinity of the abandoned buildings.

When compared to the ICRCL guidelines (1990), the sample analysed from Glencrieff Tip has concentrations which exceed the cadmium (30 mg/kg), copper (500 mg/kg), lead (1000 mg/kg) and zinc (3000 mg/kg) maximum action trigger concentrations. The lead concentration (5.92 wt %) is 60 times greater, the zinc concentration (3.14 wt %) is 10 times greater and the cadmium (203 mg/kg) and copper (1120 mg/kg) concentrations exceed the guidelines by seven and two times respectively.

Compared to the more recent soil guidelines, the concentrations of lead, zinc, cadmium and copper in these tailings also exceed some of these alternative guideline values. The lead concentration exceeds the 1999 Canadian CCME Environmental Health guideline (70 mg/kg) by approximately 845 times and the 2009 Dutch Soil Remediation Circular guideline (530 mg/kg) by 112 times. The zinc concentration exceeds the Canadian guidelines (200 mg/kg) and Dutch guidelines (720 mg/kg) by 157 and 44 times respectively whereas the cadmium concentration exceeds the Canadian (3.8 mg/kg) and Dutch guidelines (13 mg/kg) by 53 and 15 times respectively. The EA Soil Guideline Values (2009) for cadmium in residential areas and allotments (10 and 1.8 mg/kg respectively) are also exceeded in these tailings by at least 20 times (example quoted for the residential area guideline) and the copper concentrations also exceed the Canadian (63 mg/kg) and Dutch (190 mg/kg) guidelines by 18 and three times respectively. The arsenic concentration (19 mg/kg) marginally exceeds the Canadian guideline of 17 mg/kg, but is within the EA (residential areas: 32 mg/kg; allotments: 43 mg/kg) and Dutch (76 mg/kg) soil guidelines.

A comparison of the typical concentrations found in soils in the Southern Uplands as reported by Tower *et al.* (2006) (see Table 7.5), show that cadmium (203 mg/l), chromium (25.0 mg/l), copper (1220 mg/kg), lead (5.92 wt %), nickel (47.0 mg/kg) and zinc (3.14 wt %) are all enriched in the Glencrieff Mine Tailings.

Queensberry Crushing Mill

One sample was collected from the sediment present in the vicinity of the Queensberry Crushing Mill to provide some indication of the PHE concentrations present in this material.

When compared to the ICRCL guidelines (1990), the sample analysed from the Queensberry Crushing Mill has concentrations which exceed the lead (300 mg/kg) and cadmium (3 mg/kg) threshold trigger concentrations. The lead concentration (769 mg/kg) is 2.5 times greater than the threshold trigger concentration whereas the cadmium concentration (3.2 mg/kg) marginally exceeds the guideline value. In contrast to the samples collected from the Queensberry Tailings and Glencrieff Mine Tip, the zinc (217 mg/kg) and copper (74.1 mg/kg) concentrations are below the threshold trigger concentrations of 1000 mg/kg and 250 mg/kg respectively.

Compared to the more recent soil guidelines, the concentrations of lead, zinc, cadmium and copper in these tailings also exceed some of these alternative values. The lead concentration (769 mg/kg) exceeds the 1999 Canadian CCME Environmental Health guideline (70 mg/kg) by approximately 11 times and the 2009 Dutch Soil Remediation Circular guideline (530 mg/kg) by 1.5 times. The zinc (217 mg/kg) and copper (74.1 mg/kg) concentrations marginally exceed the Canadian guidelines (zinc: 200 mg/kg; copper 63 mg/kg) but are within the limits of the Dutch guidelines (zinc: 720 mg/kg; copper: 190 mg/kg). In contrast to the ICRCL guidelines (1990), the cadmium concentration (3.2 mg/kg) in the crushing mill tailings is within both the Canadian (3.8 mg/kg) and Dutch soil guidelines (13 mg/kg). The EA Soil Guideline Values (2009) for cadmium in residential areas (10 mg/kg) is also complied with; however, the guideline value for allotments (1.8 mg/kg) is exceeded by these tailings. The arsenic concentration (14.2 mg/kg) is also below the Canadian (17 mg/kg), the Dutch (76 mg/kg) and the EA (residential areas: 32 mg/kg; allotments: 43 mg/kg) soil guidelines.

A comparison of the typical concentrations found in soils in the Southern Uplands as reported by Tower *et al.* (2006) (see Table 7.5), show that cadmium (3.2 mg/l), chromium (43.2 mg/l), copper (74.1 mg/kg), lead (769 mg/kg), nickel (50.3 mg/kg) and zinc (217 mg/kg) are all enriched in the Queensberry Crushing Mill Tailings.

7.32 Fluvial sediment

Three spot samples have been collected from the Wanlock Water in the lower reaches of the study area to provide an indication of the extent of PHE concentrations present in the fluvial sediments. The first sample was collected from the Wanlock Water upstream of Bay Mine Adit (GR NS 90280 15770) to provide a comparison for the fluvial sediments collected lower down in the catchment in the region of the Queensberry Tailings pond and Crushing Mill. The second sample was collected at water sample point NS 86173 13770 in the Glenglass Level and the third sample was collected at the downstream water point designated Wanlock Water downstream of Sowen Burn (NS 85397 14483). In addition to these three samples, a fourth fluvial sediment has also been collected from the Shortcleuch Water (GR NS 90361 15919) to represent the local background fluvial sediment, where it is believed there is minimal impact from anthropogenic metalliferous contamination.

Glenglass Level

When compared to the ICRCL guidelines (1990), the fluvial sediment collected from the Glenglass Level discharge channel has concentrations which exceed the lead (1000 mg/kg), zinc (3000 mg/kg) and cadmium (30 mg/kg) maximum action trigger concentrations. The lead concentration (6000 mg/kg) is 6 times greater than the maximum action trigger concentration whereas the zinc concentration (6720 mg/kg) and the cadmium concentration (54.0 mg/kg) are approximately two times greater than the guideline values. In contrast, the copper concentration (437 mg/kg) is below the maximum action trigger concentration (500 mg/kg), but exceeds the threshold trigger concentration of 250 mg/kg

In preference to the soil quality guidelines summarised in Table 7.3, these fluvial sediments are compared to the Canadian CCME Freshwater Sediment Quality Guidelines for Environmental Health (1999), which provide a more appropriate comparison (see Table 7.5). A comparison of the PHE concentrations determined in this sample with these more recent Canadian freshwater sediment guidelines (lead 91.3 mg/kg; zinc: 315 mg/kg; cadmium: 3.5 mg/kg; copper: 197 mg/kg; arsenic: 17.0 mg/kg), show that in these fluvial sediments the concentrations of lead, zinc, cadmium, copper and arsenic all exceed the PEL (Potential Effect Level) thresholds; the PEL threshold is defined as the concentration which can potentially have a harmful effect on the environment. The lead concentration (6000 mg/kg) exceeds the guideline (91.3 mg/kg) by approximately 66 times. The zinc (6720 mg/kg) concentrations exceed the guidelines (315 mg/kg) by 21 times and the cadmium concentration (54 mg/kg) exceeds the guideline by 15 times. The copper concentration (437 mg/kg) is over double the guideline concentration (197 mg/kg) and the arsenic concentration (25.8 mg/kg) is marginally higher than the guideline value (17.0 mg/kg).

To provide a more local comparison, the data from the fluvial sediments have also been compared to the typical concentrations found in soils in the Southern Uplands as reported by Tower *et al.* (2006) (see Table 7.5). This shows that the cadmium (54.0 mg/kg), chromium (46.7 mg/kg), copper (437 mg/kg), lead (6000 mg/kg), nickel (38.1 mg/kg) and zinc (6720 mg/kg) are all enriched in the fluvial sediments of the Glenglass Level discharge channel when compared to the average local soils.

Table 7.5 - *Summary of Canadian CCME Freshwater Sediment Quality Guidelines (1999) for selected elements. All values are quoted in mg/kg dry weight. ISQG (Interim Sediment Quality Guideline); PEL (Potential Effect Level).*

Element	ISQG Threshold	PEL Threshold
Lead	3	91.3
Zinc	123	315
Cadmium	0.6	3.5
Copper	35.7	197
Arsenic	5.9	17

Fluvial Sediment Bay Mine Adit

When compared to the ICRCL guidelines (1990), the alluvial sediment collected from the floodplain near Bay Mine Adit has lead concentrations which exceed the lead (1000 mg/kg) maximum action trigger concentrations; the lead concentration (4740 mg/kg) is nearly five times greater than this threshold level. In contrast, the zinc concentration (1772 mg/kg) and cadmium concentration (5.84 mg/kg) are both below the maximum action trigger concentrations (3000 mg/kg and 30 mg/kg respectively), but exceed the threshold trigger concentrations of 1000mg/kg and 3 mg/kg respectively. In contrast the copper concentration (73.2 mg/kg) is below the 250 mg/kg threshold trigger concentration.

In preference to the soil quality guidelines summarised in Table 7.4, these alluvial sediments are compared to the Canadian CCME Freshwater Sediment Quality Guidelines for Environmental Health (1999), which provide are a more appropriate comparison (see Table 7.5). A comparison of the PHE concentrations determined in this sample with these more recent Canadian freshwater sediment guidelines (lead 91.3 mg/kg; zinc: 315 mg/kg; cadmium: 3.5 mg/kg; copper: 197 mg/kg; arsenic: 17.0 mg/kg), show that in these fluvial sediments the concentrations of lead, zinc, cadmium and arsenic all exceed the PEL (Potential Effect Level) thresholds. The lead concentration (4740 mg/kg) exceeds the guideline (91.3 mg/kg) by approximately 68 times. The zinc (6720 mg/kg) concentrations exceed the guidelines (315 mg/kg) by nine times and the cadmium concentration (5.84 mg/kg) is nearly double the guideline concentration. In addition, the arsenic concentration

(17.8 mg/kg) is marginally higher than the guideline value (17.0 mg/kg). In contrast, the copper concentration (80.0 mg/kg) is below the guideline concentration (197 mg/kg).

To provide a more local comparison, the data from the alluvial sediments have also been compared to the typical concentrations found in soils in the Southern Uplands as reported by Tower *et al.* (2006) (see Table 7.5). This shows that the cadmium (5.84 mg/kg), chromium (73.2 mg/kg), copper (80 mg/kg), lead (4740 mg/kg), nickel (67.5 mg/kg) and zinc (1772 mg/kg) are all enriched in the alluvial sediments near Bay Mine Adit when compared to the average local soils.

Wanlock Water Downstream of Sowen Burn

When compared to the ICRCL guidelines (1990), the fluvial sediment collected from the Wanlock Water downstream of the Sowen Burn, has concentrations which exceed the lead (1000 mg/kg) maximum action trigger concentrations; the lead concentration (9811 mg/kg) is nearly 10 times greater than this threshold level. In contrast, the zinc concentration (2389 mg/kg), cadmium concentration (12.3 mg/kg) and copper concentration (164 mg/kg) are all below the maximum action trigger concentrations (3000 mg/kg, 30 mg/kg and 500 mg/kg respectively), but exceed the threshold trigger concentrations of 1000mg/kg, 3 mg/kg and 250 mg/kg respectively.

In preference to the soil quality guidelines summarised in Table 7.3, these fluvial sediments are compared to the Canadian CCME Freshwater Sediment Quality Guidelines for Environmental Health (1999), which provide a more appropriate comparison (see Table 7.5). A comparison of the PHE concentrations determined in this sample with these more recent Canadian freshwater sediment guidelines (lead: 91.3 mg/kg; zinc: 315 mg/kg; cadmium: 3.5 mg/kg; copper: 197 mg/kg; arsenic: 17.0 mg/kg), show that in these fluvial sediments the concentrations of lead, zinc, cadmium, copper and arsenic all exceed the PEL thresholds. The lead concentration (9811 mg/kg) exceeds the PEL guideline (91.3 mg/kg) by approximately 107 times; the zinc (2389 mg/kg) concentrations exceed the guidelines (315 mg/kg) by eight times; the cadmium concentration (12.28 mg/kg) exceeds the guideline by four times and the arsenic concentration (25.6 mg/kg) is marginally higher than the guideline value (17.0 mg/kg). In contrast, the copper concentration (164 mg/kg) is below the guideline concentration (197 mg/kg).

To provide a more local comparison, the data from the fluvial sediments have also been compared to the typical concentrations found in soils in the Southern Uplands as reported by Tower *et al.* (2006) (see Table 7.4). This shows that the cadmium (12.3 mg/kg), chromium (34.2 mg/kg), copper (164 mg/kg), lead (9811 mg/kg), nickel (45.9 mg/kg) and zinc (2389 mg/kg) are all enriched in the fluvial sediments of the Wanlock Water in this area of the catchment when compared to the average local soils.

Shortcleuch Water (Background) Fluvial Sediment

When compared to the ICRCL guidelines (1990), the fluvial sediment collected from the Shortcleuch Water has zinc (237 mg/kg), cadmium (0.9 mg/kg) and copper (40.1 mg/kg) concentrations that are below the trigger threshold concentrations (see Table 7.3). In contrast, the lead concentration (314 mg/kg) marginally exceeds the threshold trigger concentrations of 300 mg/kg.

In preference to the soil quality guidelines summarised in Table 7.3, these fluvial sediments are compared to the Canadian CCME Freshwater Sediment Quality Guidelines for Environmental Health (1999), which provides a more appropriate comparison (see Table 7.5). A comparison of the PHE concentrations determined in this sample with these more recent Canadian freshwater sediment guidelines (lead: 91.3 mg/kg; zinc: 315 mg/kg; cadmium: 3.5 mg/kg; copper: 197 mg/kg; arsenic: 17.0 mg/kg), show that in these fluvial sediments the concentrations of lead and arsenic both exceed the PEL thresholds. The lead concentration (314 mg/kg) exceeds the PEL guideline (91.3 mg/kg) by approximately three times and the arsenic concentration (23.8 mg/kg) is marginally higher than the guideline value (17.0 mg/kg). In contrast, the zinc (237 mg/kg) and cadmium (0.9 mg/kg) concentrations are approximately double the ISQG (Interim Sediment Quality Guideline value) concentrations (123 mg/kg and 0.6 mg/keg respectively) whereas the copper concentration (40.1 mg/kg) marginally exceeds the ISQG concentration (35.7 mg/kg).

To provide a more local comparison, the data from the fluvial sediments have also been compared to the typical concentrations found in soils in the Southern Uplands as reported by Tower *et al.* (2006) (see Table 7.4). This shows that the chromium (82.2 mg/kg), copper (40.1 mg/kg), lead (314 mg/kg), nickel (86.6 mg/kg) and zinc (237 mg/kg) are all enriched in the fluvial sediments of the Shortcleuch Water when compared to the average local soils.

7.4 Rainfall Data

Daily rainfall collected from Meadowfoot has been provided by SEPA, the results are presented below and shown on figure 7.13. For the period between January 2012 and March 2013, the average daily rainfall is 4.6mm/day with a maximum amount of 39.6mm/day. Between September 2012 and January 2013 dataloggers were installed in to the discharge channels for Bay Mine and Glenglass Level. The peaks in rainfall correspond to rises in the water depths in the channels; thus suggesting a relationship between mine water flow rates and rainfall events.

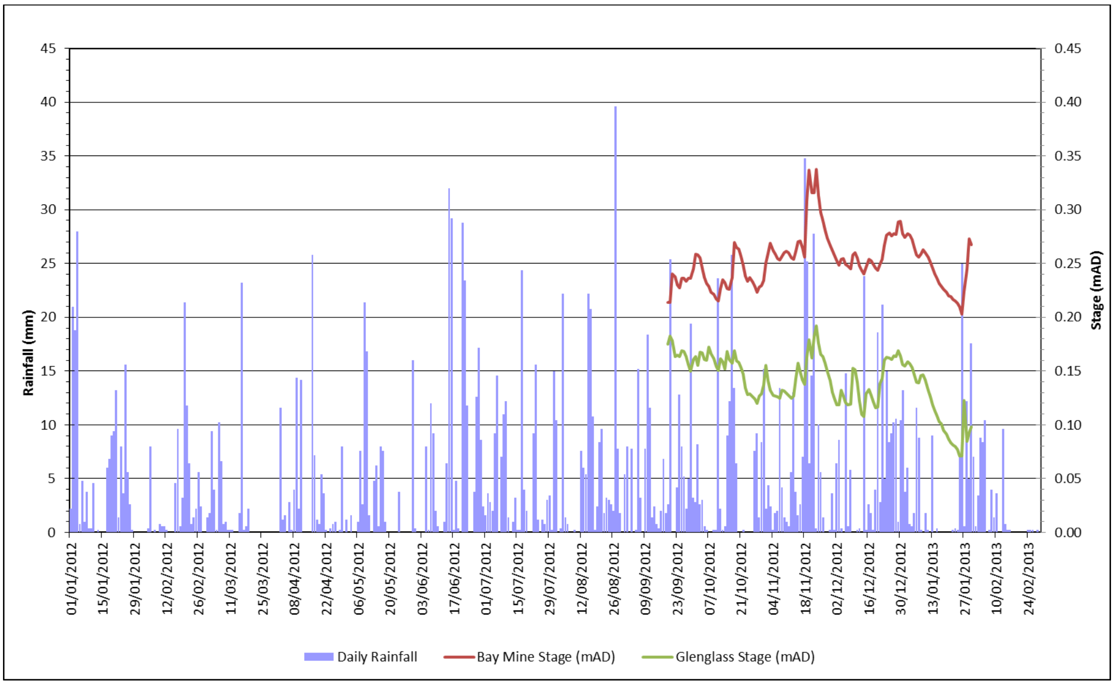

Figure 7.13 Graph of daily rainfall against depths of water in mine water discharges

8. Data Analyses

Primary data collation and the sampling results have been shown in section 7, in addition to presenting these results, further analyses have been made on the water samples for lead, zinc and cadmium. Although copper was described in section 7, the results in the Wanlock Water indicated this was not a problem (i.e. concentrations < EQS), thus are not analysed fully below.

8.1 Analysis of Wanlock Water samples

A number of routine samples were taken along the course of the Wanlock Water, with some additional ad-hoc samples taken, these were dependant on river flow conditions at the time of the visits. The dissolved and total concentrations of lead, zinc, cadmium and copper along the course of the river are shown in figures 8.1 to 8.3.

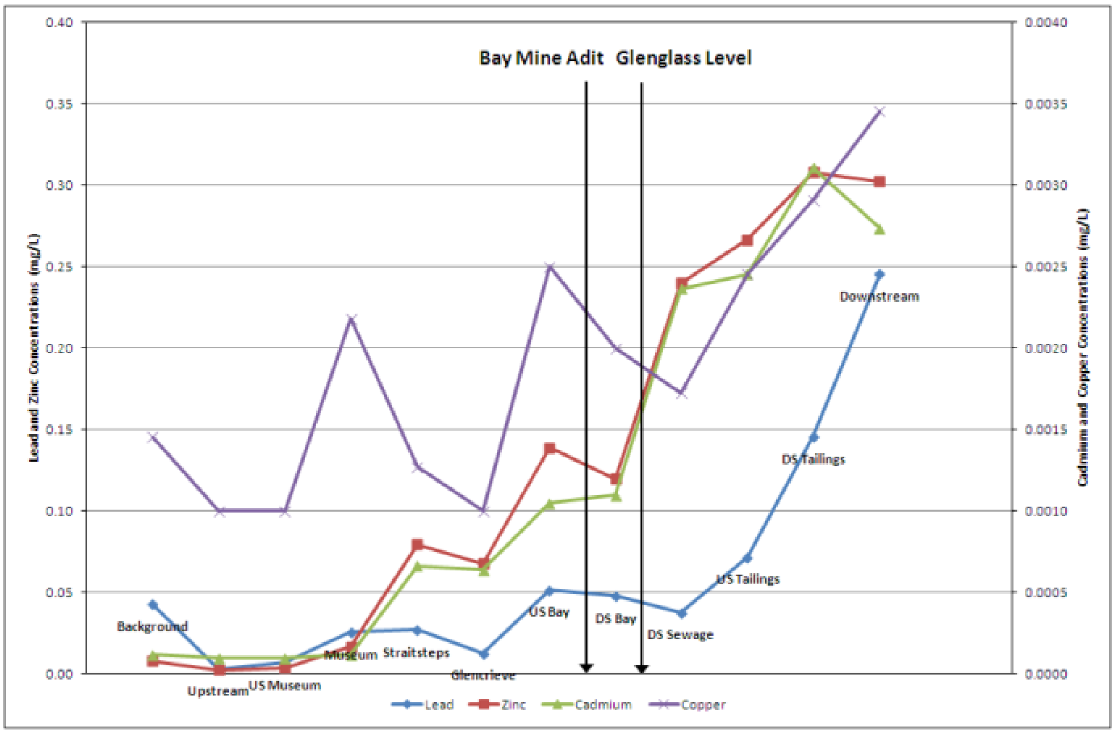

__Figure 8.1__ – Mean total metal concentrations along Wanlock Water

Figure 8.1 shows the mean total metal concentrations going from upstream on the left to downstream on the right, with successive samples being in relative order. The zinc and cadmium concentrations show a very similar pattern; there are low values in the region of Straitsteps Mine, when there is a step in the concentration. These values increase to the point where the Glenglass Level enters the river, and is followed by a second larger step where the concentrations more than double. The concentrations of zinc and cadmium increase slightly as the Wanlock Water passes the tailing pond and smelter mill areas. The lead concentrations show a different pattern to the zinc and cadmium, albeit the lead still increases downstream through the study area. The values upstream of Glencrieve Cottage are fairly low, however there is a step between Glencrieve and Bay mine, this is most likely due to inflows from the Pates Knowes Smelter area and/or Glencrieff Mine area. Between

Bay Mine and the tailings pond, there is little change, except for a small increase likely to be caused by the crushing mill area. As the Wanlock Water flows past the Queensberry tailings pond (and the smelter mill), the lead concentrations rapidly increase by a factor of three, between the upstream of the tailings pond sampling point and downstream of the Sowen Burn. The downstream of tailings pond location is situated upstream of the Glenmarchhope Burn and Wanlock Water confluence; the bottom section of the burn runs alongside and cuts through the end of the tailing pond. Thus, this is the likely reasoning for the increase between the downstream of tailings pond and downstream of Sowen Burn sampling points.

The dissolved metal concentrations along Wanlock Water are shown in figures 8.2 and 8.3, the patterns (and concentrations) for the zinc and cadmium results are very similar to the trends in the total metal concentrations. The initial section of the dissolved metal concentrations graph for lead is similar albeit at a slightly lower concentration than the total lead, up to the tailing area. Around the tailing area there is not the rapid and marked increase in dissolved lead concentrations. The results at these sample points are also much lower than the total concentrations; this is likely to be due to lead being present in the particulate form and not as dissolved lead.

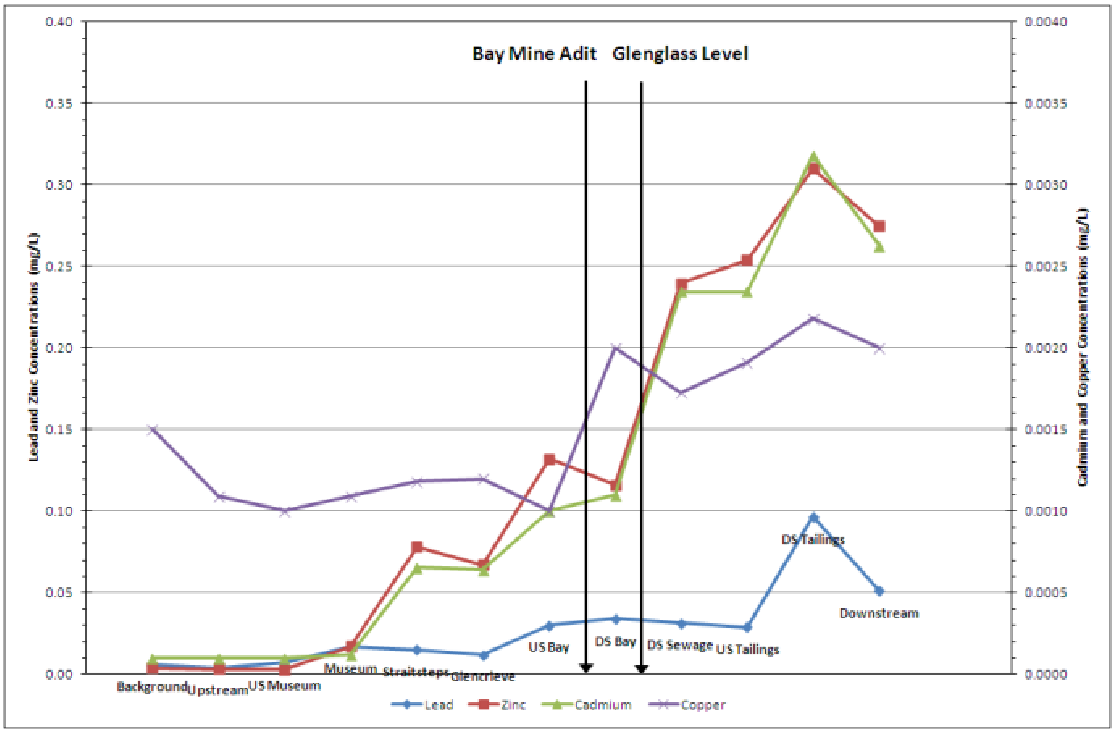

Figure 8.2 *– Mean dissolved metal concentrations along Wanlock Water*

In figure 8.3 the relevant metal concentrations are plotted with their respective EQS values. The graph indicates that zinc and cadmium concentrations exceed the EQS values in the vicinity of Straitsteps Mine and remain above EQS throughout the study area. The lead concentrations reach and/or marginally exceed the EQS values in the region of Straitsteps Mine, and go markedly above EQS close to the Pates Knowes Smelter / Glencrieff Mine. It should be noted that the copper concentration, which although demonstrate an increasing trend along the course of the Wanlock Water, do not exceed the EQS values for copper.

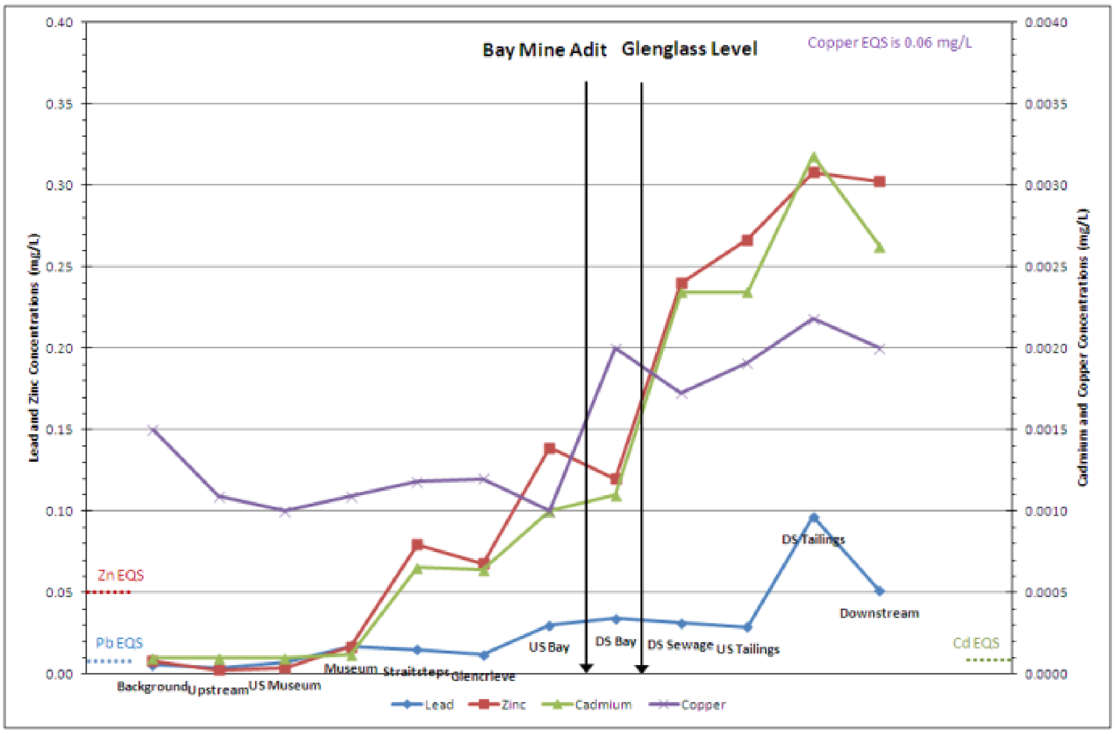

Figure 8.3 *–Mean metal concentrations along Wanlock Water and respective EQS values*

8.2 Analysis of mine water samples

Throughout the first part of the study, regular samples were taken at number of unnamed adits upstream of the museum; the results from these are shown in appendix 1. However, these adits do not appear to contribute any pollution to Wanlock Water, and their water analysis appears to be similar to the groundwater/shallow water. Regular water samples were taken from two substantial mine water discharges from Bay Mine adit and Glenglass Level; the results from which are shown in section 7. Both these two discharges were present throughout the study period, however in some instances the Wanlock Water became dry upstream of Bay Mine Adit and it is believed that the Bay Mine Adit discharge is in part the resurgence of Wanlock Water. Thus, for a proper analysis, the sample results upstream of Bay Mine should be used in conjunction with those from Bay Mine Adit.

Table 8.1 *– Summary table of mean metal concentrations (as µg/L) for mine discharges (excluding anomalous readings)*

Site	Cadmium (Dissolved)	Copper (Dissolved)	Lead (Dissolved)	Zinc (Total)
Upstream of Bay Mine (at Straitsteps)	0.65	≤1	14.91	80
Upstream of Bay Mine (at Glencrieve Cottage)	0.64	≤1	12.00	68
Bay Mine Adit Discharge	1.57	≤1	20.36	120
Glenglass Level	4.39	3.09	38.50	471
Wanlock Water Downstream of Sowen Burn	2.63	2.00	51.00	302
November 2012 and January 2013 Data Only				
Upstream of Bay Mine (at Straitsteps)	≤1.15	≤1.5	25.5	155
Upstream of Bay Mine (at Bay Mine)	1.00	≤1	30	139
Bay Mine Adit Discharge	1.40	≤1	18	113

The results of the water analysis for the mine water discharges and associated sampling are summarised in table 8.1. At Bay Mine Adit, the cadmium concentration increases by a factor of 2.4; the copper is unchanged; the lead increases by a factor of 1.4; and the zinc increases by a factor of 5.9 from that of the Wanlock Water at Straitsteps. Comparing the samples from Bay Mine Adit to Glenglass Level, the cadmium is higher by a factor of 2.8; the copper by 3; the lead by 1.9; and the zinc by 3.9.

With the flow from Bay Mine Adit being, in part, a resurgence of the Wanlock Water, the chemistry and flow rates of any 'mine water' inputs are uncertain. As such, any further analysis is currently not feasible. However it is probable that the mine water chemistry may be similar to that from the Glenglass Level. Comparing the results of Bay Mine Adit and Glenglass Level with the Wanlock Water samples (see figure 8.3 and table 8.1) show there is a sharp increase in the cadmium and zinc concentrations in the river after the Glenglass Level; however, the concentrations of lead remain fairly constant after Glenglass Level. Although the actual concentrations in Glenglass are reasonably high, they are lower than those observed downstream of Sowen Burn (i.e. 38.5µg/L compared to 51µg/L); this increase suggests another significant source of lead pollution, especially considering the

38.5µg/L at Glenglass Level would naturally be diluted by the Wanlock Water and any further tributaries.

8.3 Analysis of diffuse source samples

Set sample locations were chosen along the Wanlock Water for the length of the study area. These sample sites included areas around potential diffuse sources of pollution in conjunction with areas which may be contaminated by the areas of diffuse pollution. Although this section describes diffuse area sources of pollution, they are some parts where there are distinct flows and or collections of a number of sources. These distinct points of flows have been sampled and use to estimate flow rates and patterns of contamination arising from diffuse sources. However, the sample points analysed may give an incomplete quantification of the metal loadings from these diffuse areas.

Analysis of the sample results, which are shown in section 7 and below in figure 8.4 to 8.6, indicate there is little input of metal contamination (Pb, Zn, Cd and Cu) upstream of the Bay Mine Adit discharge. In addition to the mine water point sources from Glenglass Level and Bay Mine Adit, there are other sources further downstream which also significantly contribute to the concentrations of lead, zinc, cadmium and copper present in the Wanlock Water.

Further sample locations and a focused analysis of data downstream of Glenglass Level, showed there were very high concentrations of lead, zinc, cadmium and copper present from a number (at least four) low flow-rate discharge locations from the ore processing areas around the old crushing mill and the old tailings (catch) ponds next to the Queensberry Smelting Mill; in addition to this there was also an extra ‘point’ source discharge from the former Glencrieff Mine Settlement Ponds near to Glenglass Level. The results from these diffuse discharges are summarised in table 8.2 and the flows from these points are likely to be approximately half the total flow from diffuse sources. The individual results however, for each of these points (see appendix 1), are generally highly variable in nature; albeit they always contained high metal concentrations. This is likely to reflect the heterogeneous nature of the tailings pond. Some of the sample results show a large difference between the dissolved and total metal concentrations; this is especially true for some of the lead readings, where a significant proportion (*c. 70 – 80%)* of the lead is reported as total lead, and is likely to be present in the particulate form.

Although each individual discharge listed in table 3 typically has a flow of <1 L/s, considerably lower compared to the mine water discharges (total of 115 to 221 L/s), the concentrations are appreciably greater than the mine water, with typical loadings (based on a total flow of 5.5 L/s and mean dissolved metal concentrations) of 5280µg/s of lead, 5135µg/s of zinc and 37µg/s of cadmium. For comparative purposes, the total mean loadings for the mine water discharges are 4907µg/s for lead, 49,108µg/s for zinc, and 497µg/s for cadmium.

***Table 8.2** – Summary table of mean metal concentrations (as µg/L) for diffuse discharges (excluding anomalous readings)*

Site	Cadmium		Lead		Zinc		Flow Rate (L/s)
	Total	Diss.	Total	Diss.	Total	Diss.	
Glencrieff settlement pond runoff	6.1	5.0	72	75.3	1904	1831	0.9
Downstream of old crushing mill	5.7	5.6	1098	956	599	555	0.8
Queensberry tailings pond ditch	9.5	9.3	2039	1057	1268	1236	0.7
Queensberry tailings pond ponded water	6.4	5.3	5328	932	979	756	0.3
Queensberry tailings pond runoff channel	9.2	9.0	1950	1854	369	362	0.3

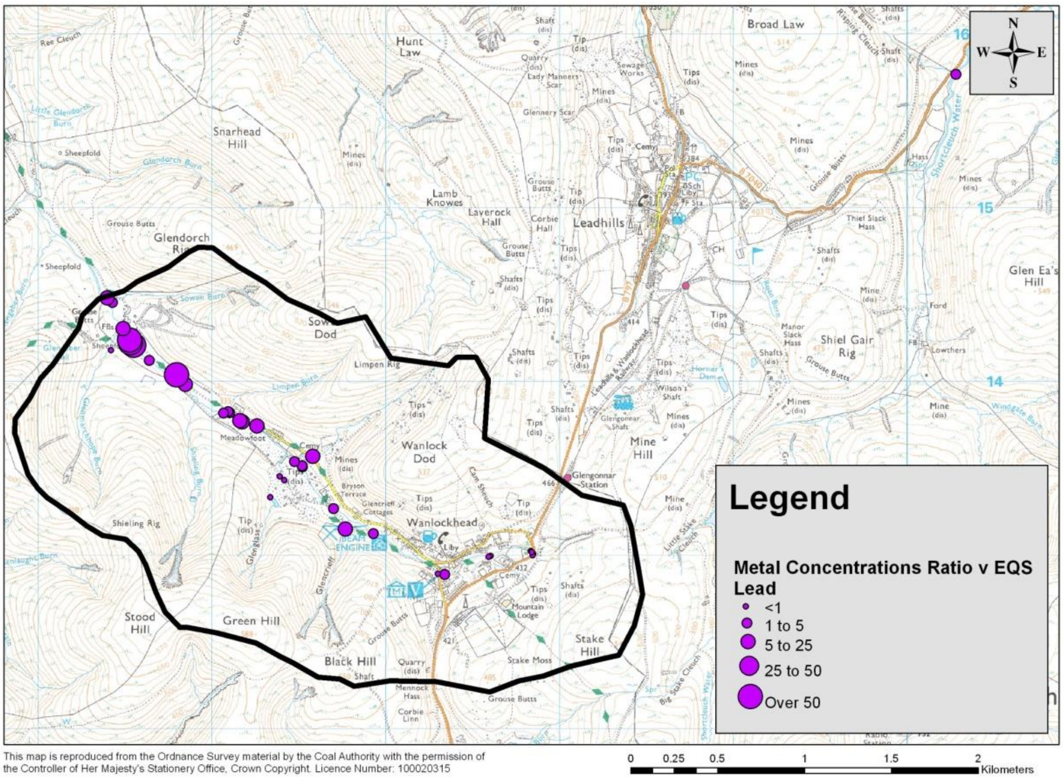

***Figure 8.4** – Map of dissolved lead concentrations (as mean concentration / EQS value)*

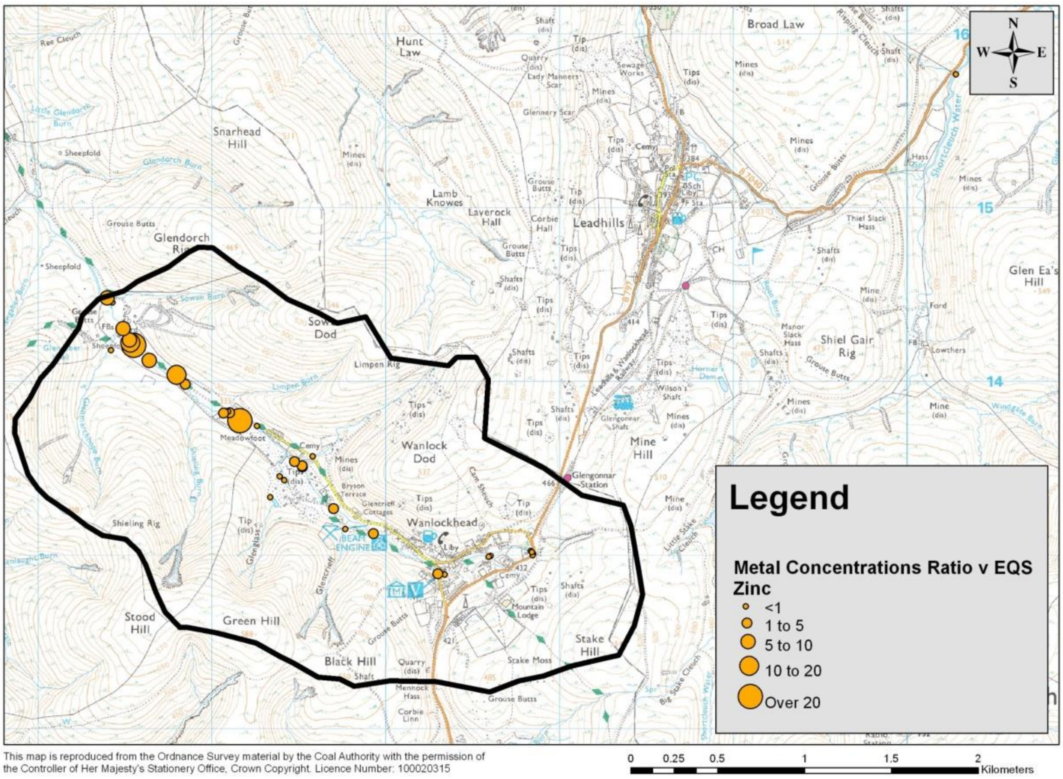

***Figure 8.5** – Map of total zinc concentrations (as mean concentration / EQS value)*

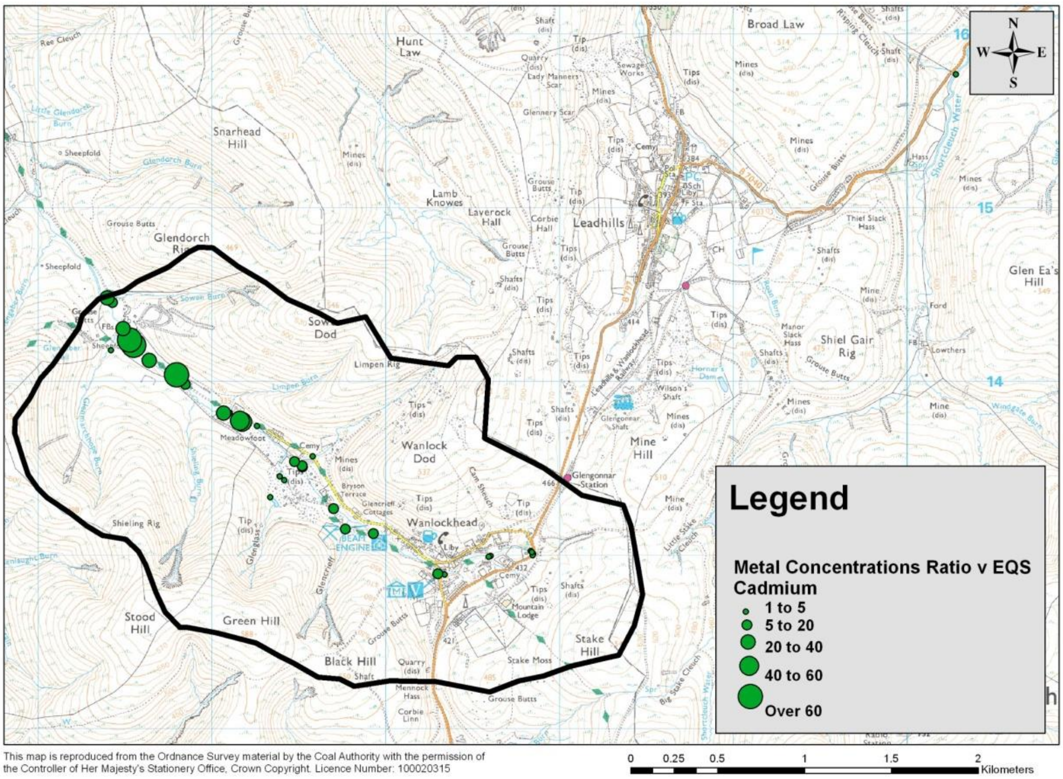

***Figure 8.6** – Map of dissolved cadmium concentrations (as mean concentration / EQS value)*

8.4 Analysis of sediment samples

The results from the sediment samples discussed in Section 7.3 show that the fluvial material associated with the Wanlock Water is impacted by metalliferous contamination from the mine workings at Wanlockhead. Furthermore, the results obtained from the 'background' sample from Shortcleuch Water demonstrate that, compared to the average local soil in the Southern Uplands, the area as a whole has elevated concentrations of metals (e.g. lead, zinc, copper, nickel and chromium), originating from the local mineralised bedrock geology.

The three tailings samples collected from the Queensberry Tailings Pond have lead and zinc concentrations in the weight percent level of 6.1 wt % and 1.6 wt % respectively. To put this in to some context, the amount of lead and zinc in this unconsolidated material is approximately 200 and 60 times greater than the local background concentrations detected in the sample of fluvial sediment obtained from the Shortcleuch Water (lead: 314 mg/kg; zinc 237 mg/kg). In addition, the Queensberry Tailing are also enriched in cadmium (55.5 mg/kg), arsenic (55.3 mg/kg), copper 91386 mg/kg), nickel (44.6 mg/kg) and mercury (7.51 mg/kg) compared to the background fluvial samples collected from Shortcleuch Water (see Table 7.4). These tailings ponds cover an area of approximately 9000 m^2, and are located along a reach of approximately 300 m in length along the Wanlock Water and 75 m along the Glenmarchhope Burn. There is therefore, a direct pathway for particulate material, in addition to the contaminated surface waters (discussed above), to enter the Wanlock Water from the Queensberry Tailings Pond. This is reflected in the increase in concentrations for lead and zinc between the fluvial sediments collected from upstream of Bay Mine Adit (lead: 4740 mg/kg; zinc: 1772 mg/kg) and downstream of the Sowen Burn (lead: 9811 mg/kg: zinc: 2389 mg/kg) (see Figure 8.7). In conjunction with lead and zinc, there are increases in other metals between these two sample points (e.g. arsenic, cadmium, mercury and copper – see Table 7.4) suggesting that these metals may also be introduced into the sediments of the Wanlock Water from the Queensberry Tailings Pond (see Figure 8.7 and 8.8). Not all metals show an increase between these two sample points however (e.g. chromium and nickel – see Table 7.4), therefore these results indicate that some metals present in the Wanlock Water sediments have sources other than the Queensberry Tailings.

In contrast to the Queensberry Tailings, the Queensberry Crushing Mill sediments do not appear to be such a significant source of particulate contaminants (see Figure 8.7 and 8.8). These sediments have lower/similar concentrations of arsenic, cadmium, chromium, mercury, nickel, copper and zinc compared to the sediments collected upstream of Bay Mine Adit and downstream of Sowen Burn (see Table 7.4). In contrast, the sediments collected from the crushing mill do have an elevated concentration of lead (780 mg/kg) compared to the fluvial sediments; although the concentrations are significantly lower than the concentrations recorded in the tailings samples. Although the results obtained in this study suggest that the Queensberry Crushing Mill is not a primary source of particulate contamination, when compared to the background sample from Shortcleuch Water, these sediments have elevated cadmium, copper, mercury and selenium concentrations in addition to lead and zinc (see Table 7.4).

A single tailings sample was collected from the tip at Glencrieff Mine which demonstrated lead and zinc concentrations of 5.92 wt % and 3.14 wt % respectively; the lead concentration is similar to the mean concentrations calculated for the Queensberry Tailings, however the zinc concentration is double. Furthermore, these tailings also have the highest recorded concentration of cadmium (203 mg/kg) determined in this study. These results indicate that the tailings in the Glencrieff Mine tip have a higher content of ZnS (sphalerite) compared to the material at the Queensberry Tailings. However, the Glencrieff Mine Tip is located approximately 120 m from the water channel and therefore poses less of a risk to the Wanlock Water compared to the Queensberry Tailings Ponds.

The fluvial sediment collected from the Glenglass Level discharge channel has lead (6000 mg/kg) and zinc (6720 mg/kg) concentrations, which are approximately 20 and 30 times higher than the concentration found in the background sediment collected from Shortcleuch Water. In contrast to the sediments collected from the Queensberry Tailings Pond and Crushing Mill and the Glencrieff Mine Tip, the zinc concentration in the Glenglass Level discharge channel exceeds that of lead. These higher concentrations of zinc, relative to lead, reported in the both the Glencrieff Mine Tip and the Glenglass Level discharge channel may be the result of a higher percentage of ZnS being present in the ore-body mined by Glencrieff Mine compared to other workings in the vicinity. This may explain the why the Glenglass Level (0.52 mg/L) and the surface runoff water samples draining the grassed-over Glencrieff Settlement Ponds (2.2 mg/L) have some of the highest concentrations of zinc.

The number of sediment samples collected and analysed in this study are limited, and can therefore only provide a guide to the level of metal contamination present in the sediments. For a greater level of confidence in identifying the sources of the particulate contaminants, in addition to obtaining a more representative indication in the metal concentrations present in the tailings and fluvial sediments, further samples are required for analysis

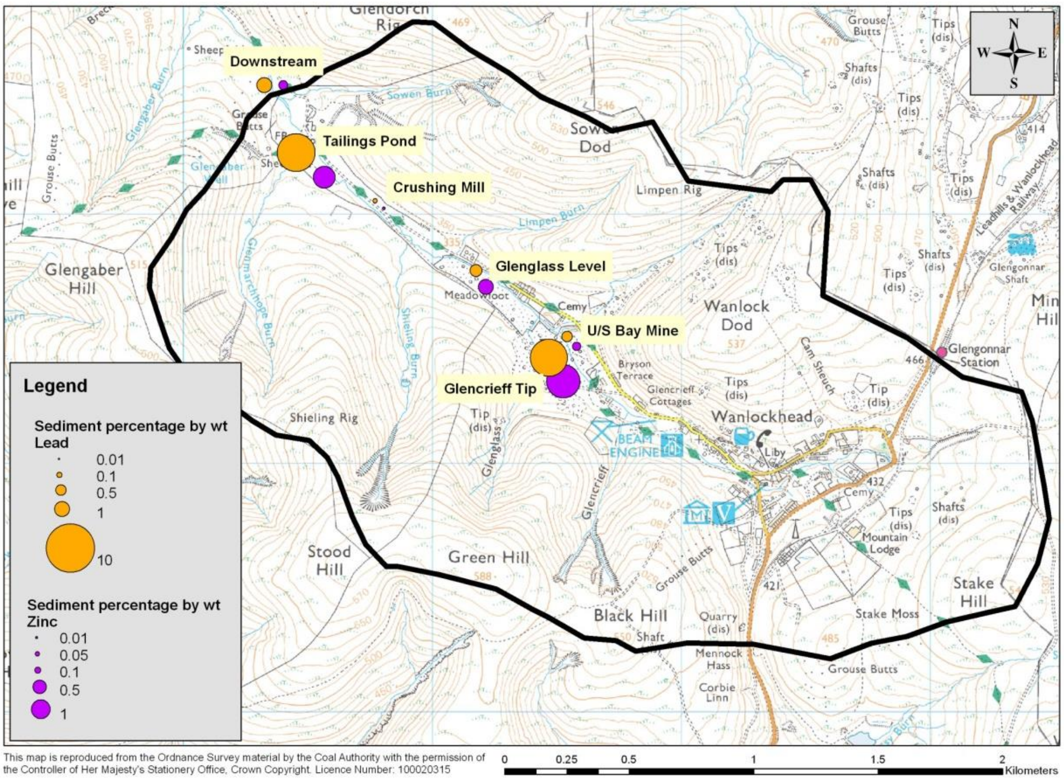

Figure 8.7 *– Map of lead and zinc sediment samples*

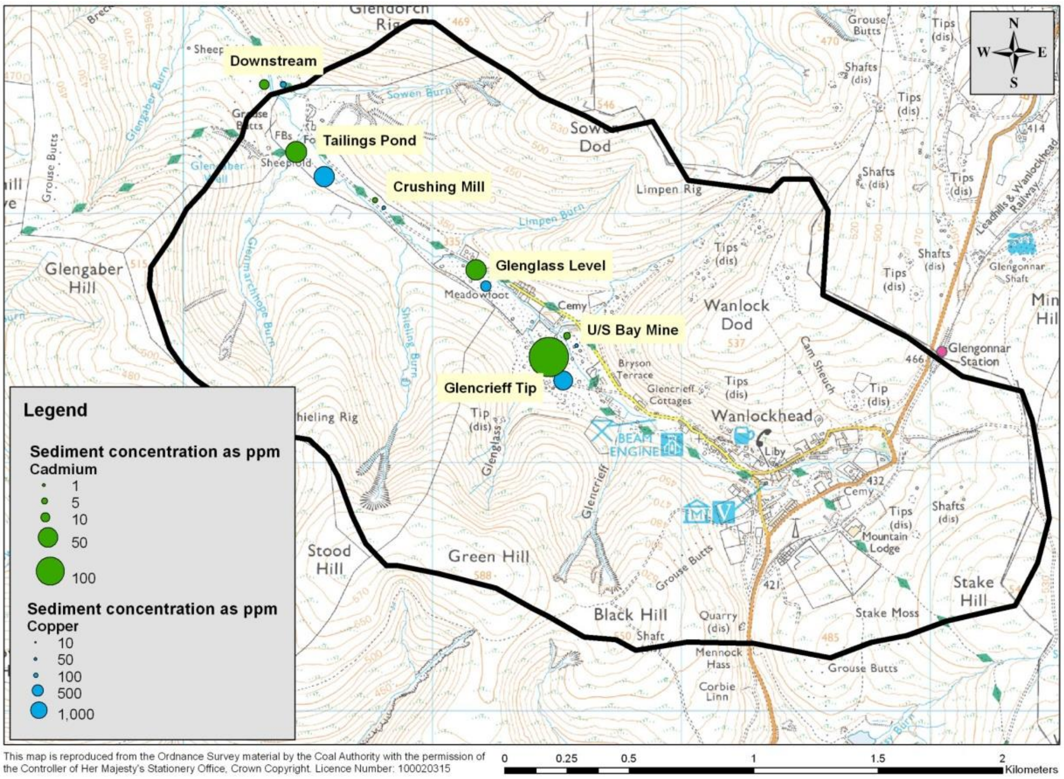

Figure 8.8 *– Map of lead and zinc sediment samples*

8.5 Analysis of metal contamination contributions

Results from the various samples and spot flow measurements allowed for an analysis of the contributions to the cadmium, lead and zinc contamination in the Wanlock Water. For the main observed contributors of the mine water and diffuse sources (which have been highlighted above), an estimate of the metal loadings can be determined and quantified as a percentage of the total downstream loadings. The results from this have been summarised in table 8.3, however, it should be noted that the flows are only estimated and the rates from the diffuse source are based on visual estimates.

A review of the data shown in table 8.3 has highlighted a number of key observations summarised below:

- The mine water sources (i.e. Bay Mine Adit and Glenglass Level) contribute to between approximately 25% and 50% of the metal loading observed in the Wanlock Water downstream of the confluence with the Sowen Burn. The percentage of cadmium and zinc loadings sourced from the mine water sources are greater (53% and 40% respectively), suggesting that the mine water is the primary source of these two dissolved metals. In contrast, it is estimated that only 25% of the dissolved lead originates from the mine water.

- Based on the available data, it appears that the diffuse water sources (i.e. surface waters from the Queensberry Tailings Pond) only contribute between approximately 6% and 11% of the metal loading observed in the Wanlock Water downstream of the confluence with the Sowen Burn. However, because of the estimated nature of the flow measurements recorded from the tailings pond, combined with the high metal concentrations recorded and a number of additional minor flows where it was not possible to obtain an estimated flow rate, this figure is believed to be an underestimate of the true metal loading originating from the diffuse sources.

The total loadings of the estimated values for the diffuse and mine water sources described above (and shown in table 8.3) do not equal that measured downstream of Sowen Burn - Wanlock water confluence. The total of the mean metal loadings for the diffuse sources and mine water contributes to approximately 30% (lead) to 60% (cadmium) of the total metal loadings observed at the downstream sampling point. These results suggest that there is a significant portion of contamination which has not been measured in this study. There are a number of factors which may account for this discrepancy in the data which are detailed below:

1. The measured flow rates based on the salt gauging method may be underestimated.
2. The total amount of surface flow originating from the Queensberry Tailings Pond (and other areas of diffuse contamination) has not been fully quantified in this study.
3. Both the Wanlock Water and Glenmarchhope Burn are actively eroding the banks of the tailings pond (see figure 8.9). This bank erosion will be contributing to the metal loadings measured at the downstream sampling point.

4. Re-mobilisation of alluvial sediments and contaminants present within the Wanlock Water and other tributaries will be making some contribution to the metal loadings, some of which may not have been accounted for in this study.
5. Sub-surface flows entering the Wanlock Water (i.e. surface water permeating through tip material as a shallow groundwater) may be contributing to the metal loadings.
6. Other sources for the metals may remain in the study area, which have not been identified in this study.

***Table 8.3** – Summary table of mean metal loadings and percentage of the downstream loading below Sowen Burn*

Site	**Cadmium (dissolved)**		**Lead (dissolved)**		**Zinc (total)**	
	Loading (kg/day)	Percentage of downstream	Loading (kg/day)	Percentage of downstream	Loading (kg/day)	Percentage of downstream
Glencreiff settlement pond runoff	0.0006		0.007		0.127	
Downstream of crushing mill	0.0004		0.013		0.039	
Tailings Pond Ditch	0.0004		0.017		0.207	
Tailings Pond Ponded Water	0.0003		0.010		0.010	
Tailings Pond Runoff	0.0001		0.010		0.016	
Diffuse Sources Measured (Total Means)	*0.0018*		*0.048*		*0.399*	
Diffuse Sources Estimated (Total Means)	***0.0036***	***5.7 %***	***0.096***	***7.7 %***	***0.798***	***11 %***
Bay Mine Adit	0.0164		0.168		1.258	
Glenglass Level	0.0170		0.146		1.676	
Mine Water Sources (Total Means)	***0.0334***	***53 %***	***0.314***	***25 %***	***2.934***	***40 %***
Wanlock Water Downstream	0.0628	***100 %***	1.243	***100 %***	7.245	***100 %***

***Figure 8.9** – Photos showing the erosion of the bank of tailings pond from Glenmarchhope Burn. The main photo was taken in July 2012; the insert photo was taken in August 2012.*

8.6 Rainfall analysis

From the rainfall data provided by SEPA (see section 7.4) there are a number of higher rainfall events which correspond to the higher flow rates (as depth of water) from both Bay Mine and Glenglass Level. This reinforces the hypothesis that rain water and / or surface water is entering the mine workings and being discharged through these adits. During one of these events in November 2012, a round of monitoring and water sampling was undertaken. The results from these samples show the following; however it should be noted that in some instances there could be a delay in rainfall effects on the mine water discharges.

- Cadmium: Bay Mine and Glenglass concentrations were unchanged compared to previous results; although during the winter months, concentrations were lower in Glenglass.
- Lead: Little or no change in concentrations were observed at Glenglass in response to rainfall; however there may be a slight increase at Bay Mine. It is also noted that the background concentrations in the Wanlock Water were also elevated in November 2012.
- Zinc: The zinc concentrations show the same trends as those observed for Cadmium.
- Copper: No observable change was recorded with respect to rainfall events.

9. Conclusions

Based upon the analysis of the data and subsequent the discussion presented in sections 7 and 8, the following conclusions can be made:

- The study at Wanlockhead and throughout the upper parts of the Wanlock Water, successfully ran for 12 months, with 210 water samples taken and 9 sediment samples collected for analysis. These water and sediment samples included a combination of routine and ad-hoc samples of 42 locations throughout the area.

- Throughout the study, on-site analyses were taken at all water sampling points; the results of the on-site data aided a better understanding and more prompt decisions on sampling localities.

- During part (autumn-winter) of the study, dataloggers were installed at Bay Mine Adit and Glenglass Level discharges; these showed that in certain wet weather circumstances, there is a significant input of shallow, and/or surface water, entering the mining system.

- The temperature data from the dataloggers also shows the water in Glenglass Level is warmer than that from Bay Mine Adit, indicating a deeper route/source for Glenglass, and/or the water at Bay Mine includes colder surface water.

- During the study, it was observed that the Wanlock Water lost water before reaching Bay Mine; often the river was dry upstream of Bay Mine and on occasions dry at Glencrieve Cottage. Visually, the river appears to lose water between Straitsteps mine and Glencrieve Cottage, with some extra losses occurring slightly upstream of Bay Mine Adit discharge. It is believed that the discharge from Bay Mine is in part the resurgence of Wanlock Water with some additional mine water input.

- Spot flow rate measurements were made of the two main mine water discharges. Using these data, in conjunction with the chemistry data, the following loading rates can be determined: the water from Bay Mine has a lead loading of 0.17 kg/day; a zinc loading of 1.3 kg/day and cadmium loading of 0.016 kg/day. The Glenglass Level discharge has a lead loading of 0.15 kg/day; zinc loading of 1.7 kg/day and cadmium loading of 0.017 kg/day. Thus the total metal loadings from mine water are 0.31 kg/day for lead, 2.9 kg/day for zinc and 0.03 kg/day for cadmium.

- There are a number of small flows and seepages associated with mineral processing features including old mine settlement ponds, tailings pond and ore crushing areas. Estimates of flow rates along with water samples taken from some of the discharges have been obtained; these data give an overall approximate loading of diffuse sources of 0.1 kg/day of lead, 0.4 kg/day of zinc and 0.004 kg/day of cadmium. These values are between approximately 6% and 11% of the total downstream metals loading, and are likely to be an under-estimate of the diffuse source.

- A comparison of the two mine water source loadings (Bay Mine Adit and Glenglass Level) indicate that the lead pollution is contributed by approximately 25% from both of these sources. In contrast, the data suggest that approximately 50% of the zinc and cadmium are contributed from the mine water sources, primarily the Glenglass Level.

- Based on the data obtained from the Wanlock Water downstream of the Sowen Burn with those obtained from the mine water and diffuse sources, the total contribution of the metal loadings are approximately 33% for lead, 59% for cadmium and 49% for zinc. This suggests that there is a significant contribution from sources which have not been directly measured in this study. This is probably as a result of an underestimation of the diffuse pollution and/or re-mobilisation of contamination in the alluvial material.

- The fluvial sediments collected from the Wanlock Water show that the mining activity in the area has contaminated the river channel sediments; lead concentrations in the fluvial sediments collected downstream of the confluence with the Sowen Burn contain 9811 mg/kg of lead; 2389 mg/kg of zinc; 12.3 mg/kg cadmium and 164 mg/kg copper. These concentrations are all elevated compared to the concentrations found in typical soils present in the Southern Uplands as reported by Towers *et al.* (2006) and exceed the Canadian Freshwater Sediment Quality Guidelines (1999) PEL (Potential Effect Level) for lead, zinc and cadmium.

- The main sources of the particulate contamination in the fluvial sediments of the Wanlock Water identified in this study are the Queensberry Tailings Ponds. This feature covers approximately 9000 m^2 in the lower region of the study area and is bordered by both the Wanlock Water and the Glenmarchhope Burn.

- The sediment contained within the tailings pond is unconsolidated, predominantly fine-grained and easily washed into the river channel; erosion gullies are common features present across this feature. In contrast to the Queensberry Tailings Ponds, the results obtained from this study suggest, that although the lead and zinc concentrations are elevated compared to background values in the Glencrieff Mine Tip (present at the weight percent level) and in the Queensberry Crushing Mill, these areas are less significant sources of particulate contamination.

- The results from the water and sediment sample analyses both suggest that of the two point sources of mine water, the Glenglass Level is the primary source of zinc and cadmium, whereas lead is sourced from both the diffuse sources and the point sources of the Bay Mine Adit and the Glenglass Level. The metal loadings from these two point sources contribute to the Wanlock Water failing EQS for lead (7.2 µg/L), zinc (50 µg/L based on hardness of 50 – 100 mg/L of $CaCO_3$) and cadmium (0.09 µg/L based on hardness of 50 – 100 mg/L of $CaCO_3$).

- The water and sediment samples also highlight that, in addition to the point sources, diffuse sources of metal (lead, zinc, cadmium and copper) contamination, present in both the dissolved and particulate form, originate from the spoil heaps present in the area, especially the Queensberry Tailings Ponds and the Glencrieff Tailings Pond.

10. Recommendations

A number of recommendations have been identified in this report for further work that is required to form a remediation strategy for the site. These recommendations are as follows:

- Undertake an ecological survey of the Wanlock Water and surrounding mine spoil tips to assess the impact of the metalliferous mining activity on the local flora and fauna. This survey would also identify any metal tolerant species which may be present in the area.

- Undertake detailed stream monitoring to determine the amount of water that is lost from the Wanlock Water. This could potentially be achieved using tracer tests to determine the source(s) of the water being discharged at Bay Mine and Glenglass Level.

- Prevent the Wanlock Water losing water to the mine workings by re-engineering / sealing the existing channel through the village of Wanlockhead, and subsequently re-assess the flows and chemistry data from Bay Mine Adit and Glenglass Level.

- Undertake a survey of the tailings pond and other mineral processing areas present in the catchment to determine the erosion rates of the sediment and assess the tailings material in relation to contaminated land guidelines. This information would be required to inform the assessment for viable remediation options (e.g. soil washing, phyto-remediation, capping, removal of material etc.).

- Stabilise and/or remediate the Queensberry Tailings Pond to restrict or prevent particulate contamination from entering the fluvial sediments of the Wanlock Water. Further investigative work would be required post any remedial works to assess the success of the activity.

- Once the above recommendations have been completed a second study, following a similar strategy discussed in this report, would be required to determine the success of any remedial works undertaken and to identify any additional significant sources of zinc, lead or cadmium and associated loadings. A strategy for treating any residual pollution would subsequently be required.

- If the above works are not undertaken, then it is recommended that the water originating from the Glenglass Level, Queensberry Tailings Pond, and Bay Mine Adit be assessed for treatment, preferably by passive methods, which may include novel techniques currently being tested. For example treating Glenglass Level using a conventional reed bed (*Phragmities* sp.) could require an estimated size in the order of 40,000 m^2; whereas a compost bio-reactor in the order of 10,000m^2† might be a feasible alternative. The flow rate from Bay Mine Adit may change following the remedial works recommended above; based on the current flow and metal loading, the area required for a conventional, passive reed bed would be in the order of 20,000m^2†.

† The sizes quoted here are an estimated guide only and should not be used as definitive sizings

- Because of the high percentages of lead and zinc detected in the Queensberry Tailings Pond sediment, it is recommended that the area should be fenced off to prevent livestock and deter members of the public (the Southern Uplands Way follows the southern edge of the ponds) from entering the site (see appendix 3).

- It is recommended that work be undertaken to investigate the impact the bio-available metal concentrations have upon the fresh water environment to fully understand the impact the metal concentrations have on the ecology of the Wanlock Water.

- No analysis has been undertaken in this report to assess the potential for the Queensberry Tailings Ponds to produce airborne contaminants as this is beyond the scope of this report. However, the fine-grained nature of some of the material present at the site may be susceptible to becoming airborne during periods of dry weather. Therefore, although the village of Wanlockhead is located to the SE of the area (i.e. the village is not located downwind of the site based on the prevailing SW wind direction), because of the close proximity of the Queensberry Tailings Pond to the Southern Uplands Way, it is recommended that this potential impact also be investigated in future.

11. References

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APPENDICES 1

COLLATED LABORATORY DATA

	Analyte:	pH units w	On Site pH	Conductivity uS/cm @ 25C w	On Site Conductivity	Suspended Solids w	Total Alkalinity as CaCO3 w	Total Acidity as CaCO3 w	Total Hardness as CaCO3	Chloride as Cl w	Total Sulphur as SO4 (Dissolved) a	Calcium as Ca (Total) a	Calcium as Ca (Dissolved) a	Magnesium as Mg (Total) a	Magnesium as Mg (Dissolved) a
	Method Code:	WSLM3		WSLM2		WSLM10	WSLM12	WSLM17	Calc_HD	KONENS	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPWATVAR
Site	Units:	pH units	pH	µS/cm	µs/cm 25°C	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Background - Glenmarchhope Burn	17-May-12	7	6.41	<100	40	<5	16	0	18	6	4	5	4	2	2
Background - Glenmarchhope Burn	26-Jun-12	7.9	7.27	<100	52	<5	18	0	25	5	5	5	5	3	3
Background - Glenmarchhope Burn	31-Jul-12	7.4	6.88	<100	65	<5	<2		27	6	4	6	6	3	3
Background - Glenmarchhope Burn	21-Aug-12	7.9	7.02	<100	125	<5	19		25	5	4	5	5	3	3
Background - Glenmarchhope Burn	18-Sep-12	7.9	7.31	85	61	<5	16	0	21	6	<3	5	5	2	2
Background - Glenmarchhope Burn	23-Oct-12	7.9	7.24	<100	54	<5	19	0	25	5	3	5	5	3	3
Background - Glenmarchhope Burn	20-Nov-12	7.8	6.61	<100	36	<5	10	0	16	4	<3	2	3	2	2
Background - Glenmarchhope Burn	11-Dec-12	7.7	7.21	<100	55	<5	33		25	5	5	5	5	3	3
Background - Glenmarchhope Burn	30-Jan-13	7.7	7.1	<100	44	<5	22	0	18	6	4	4	4	2	2
Background - Glenmarchhope Burn	19-Feb-13	7.8	7.27	<100	65	<5	30	0	25	5	4	5	5	3	3
Background - Glenmarchhope Burn	17-Apr-13	8.0		100		<5	26	0	18	7	5	4	4	2	2
Mennockhass Water Tunnel	20-Nov-12	7.7	6.71	145	104	<5	50	0	43	9	8	14	14	2	2
Wanlock Water Upstream (below road)	17-May-12	7.6	6.53	<100	105	<5	52	0	48	5	4	15	16	2	2
Wanlock Water Upstream (below road)	26-Jun-12	7.9	6.85	104	86	<5	44	0	43	5	4	14	14	2	2
Wanlock Water Upstream (below road)	31-Jul-12	7.7	6.58	122	116	<5	44		55	6	5	17	17	3	3
Wanlock Water Upstream (below road)	21-Aug-12	7.9	7.20	129	96	<5	45		43	4	4	14	14	2	2
Wanlock Water Upstream (below road)	18-Sep-12	7.9	7.07	122	104	<5	38	0	46	5	<3	15	15	2	2
Wanlock Water Upstream (below road)	23-Oct-12	7.9	7.15	117	95	<5	47	0	43		4	14	14	2	2
Wanlock Water Upstream (below road)	20-Nov-12	8.4	6.95	<100	31	<5	11	0	<14	3	<3	4	4	<1	<1
Wanlock Water Upstream (below road)	11-Dec-12	3.4**	7.25	288**	101	<5	0**	24**	48	5	5	15	16	2	2
Wanlock Water Upstream (below road)	30-Jan-13	7.8	7.1	<100	65	<5	28	0	33	5	4	10	10	2	2
Wanlock Water Upstream (below road)	19-Feb-13	8.0	7.65	125	103	<5	50	0	43	5	5	14	14	2	2
Wanlock Water Upstream (below road)	17-Apr-13	7.9		<100		<5	25	0	<12	7	<3	3	3	<1	<1
Adit Discharge directly below road	26-Jun-12	7.9	6.60	140	120	<5	55	0	67	4	6	21	22	3	3
Adit Discharge directly below road	31-Jul-12	7.6	6.82	121	139	<5	45		70	6	5	22	23	3	3
Adit Discharge from pipe D/S of road	17-May-12	7.3	6.53	118	151	<5	64	0	67	19	5	20	22	2	3
Adit Discharge from pipe D/S of road	26-Jun-12	8	6.84	167	142	<5	55	0	65	12	6	20	21	3	3
Adit Discharge from pipe D/S of road	31-Jul-12	7.5	7.11	132	153	<5	58		67	10	6	22	22	3	3
Adit Discharge from pipe D/S of road	21-Aug-12	7.7	7.17	178	152	<5	62		65	10	4	21	21	3	3
Adit Spring Discharge D/S of road	31-Jul-12	7.8	7.07	117	136	<5	65		65	6	5	22	21	3	3
Wanlock Water Upstream of Adit U/S of Museum	17-May-12	7.9	7.01	122	133	<5	59	0	62	7	5	20	20	3	3
Adit (5 pipes) U/S of Museum	17-May-12	7.1	6.17	119	126	<5	50	0	53	8	5	16	18	2	2
Adit (5 pipes) U/S of Museum	26-Jun-12	7.7	6.71	128	106	<5	<2	0	48	8	8	16	16	2	2
Adit (5 pipes) U/S of Museum	31-Jul-12	7.4	7.05	109	140	<5	31		53	9	6	18	18	2	2
Adit (5 pipes) U/S of Museum	21-Aug-12	7.6	7.02	148	117	<5	49		55	7	6	17	17	3	3
Adit (5 pipes) U/S of Museum	23-Oct-12	7.6	6.96	129	102	<5	54	0	46		6	16	15	2	2
Adit (5 pipes) U/S of Museum	11-Dec-12	7.8	7.26	123	108	<5	51		51	7	8	17	17	2	2
Wanlock Water by Museum	17-May-12	7.6	6.95	121	134	<5	54	0	53	11	5	17	18	2	2
Wanlock Water by Museum	26-Jun-12	8	7.30	151	128	<5	48	0	57	10	8	18	18	3	3
Wanlock Water by Museum	31-Jul-12	7.7	7.00	123	142	<5	39		60	10	7	20	19	3	3
Wanlock Water by Museum	21-Aug-12	7.9	7.02	164	135	<5	60		60	9	6	19	19	3	3
Wanlock Water by Museum	18-Sep-12	7.9	7.10	156	137	<5	42	0	56	7	4	18	19	2	2
Wanlock Water by Museum	23-Oct-12	7.9	7.12	149	120	<5	48	0	57	9	6	17	18	3	3
Wanlock Water by Museum	20-Nov-12	7.8	6.98	<100	65	<5	20	0	24	8	4	8	8	1	1
Wanlock Water by Museum	11-Dec-12	7.8	6.96	121	125	<5	57		60	11	8	19	19	3	3
Wanlock Water by Museum	30-Jan-13	7.7	7.1	138	115	<5	39	0	46	14	6	15	15	2	2
Wanlock Water by Museum	19-Feb-13	8.0	7.54	164	140	<5	54	0	52	12	6	16	16	2	3
Wanlock Water by Museum	17-Apr-13	8.0		124		11	35	0	33	14	4	10	10	2	2
Glencrieff Stream	17-May-12	7.3	6.56	<100	50	<5	18	0	18	6	5	4	4	2	2
Glencrieff Stream	21-Aug-12	7.9	7.31	<100	51	<5	16		21	4	3	5	5	2	2
Glencrieff Stream	23-Oct-12	7.9	6.64	<100	53	<5	17	0	18	4	5	4	4	2	2
Wanlock Water U/S of Bay Mine at Straitsteps	17-May-12	7.8	7.44	119	129	5	53	0	51	11	5	16	17	2	2
Wanlock Water U/S of Bay Mine at Straitsteps	26-Jun-12	8	6.77	156	136	<5	42	0	60	12	9	19	19	3	3
Wanlock Water U/S of Bay Mine at Straitsteps	31-Jul-12	7.8	7.18	119	143	<5	48		60	11	7	19	19	3	3
Wanlock Water U/S of Bay Mine at Straitsteps	21-Aug-12	7.9	7.18	170	140	<5	53		60	10	7	20	19	3	3
Wanlock Water U/S of Bay Mine at Straitsteps	18-Sep-12	8.0	6.89	159	140	<5	48	0	56	9	5	19	19	2	2
Wanlock Water U/S of Bay Mine at Straitsteps	23-Oct-12	8.0	6.70	153	131	<5	55	0	53	9	7	18	18	3	2
Wanlock Water U/S of Bay Mine at Straitsteps	20-Nov-12	7.8	6.64	113	82	<5	30	0	29	10	5	10	10	1	1
Wanlock Water U/S of Bay Mine at Straitsteps	11-Dec-12	7.8	7.36	133	135	<5	57		62	13	8	20	20	3	3
Wanlock Water U/S of Bay Mine at Straitsteps	30-Jan-13	7.7	7.25	115	134	<5	38	0	51	20	7	16	17	2	2
Wanlock Water U/S of Bay Mine at Straitsteps	19-Feb-13	7.9	7.51	180	154	<5	50	0	51	17	6	17	17	2	2
Wanlock Water U/S of Bay Mine at Straitsteps	17-Apr-13	8.0		184		14	45	0	43	21	5	14	14	2	2
Wanlock Water U/S at Pates Knowles Bridge	26-Jun-12	8	7.35	153	133	<5	50	0	60	10	9	19	19	3	3
Wanlock Water U/S at Pates Knowles Bridge	21-Aug-12	8	7.50	165	139	<5	55		60	10	7	19	19	3	3
Wanlock Water U/S at Pates Knowles Bridge	23-Oct-12	8.0	6.83	157	124	<5	45	0	57	9	7	18	18	2	3
Wanlock Water U/S at Pates Knowles Bridge	11-Dec-12	3.9**	7.27	230**	134	<5	<2**	20**	62	13	9	19	20	3	3
Wanlock Water U/S at Pates Knowles Bridge	19-Feb-13	7.9	7.45	176	153	<5	57	0	51	17	6	17	17	2	2
Wanlock Water U/S of Bay Mine (at Bay Mine)	20-Nov-12	7.9	6.65	126	81	<5	32	0	29	9	5	10	10	1	1
Wanlock Water U/S of Bay Mine (at Bay Mine)	30-Jan-13	7.7	7.32	124	126	<5	36	0	43	18	6	14	14	2	2

	Strontium as Sr (Total) a	Strontium as Sr (Dissolved) a	Sodium as Na (Total) a	Sodium as Na (Dissolved) a	Potassium as K (Total) a	Potassium as K (Dissolved) a	Nickel as Ni (Total)	Nickel as Ni (Dissolved)	Chromium as Cr (Total)	Chromium as Cr (Dissolved)	Cadmium as Cd (Total)	Cadmium as Cd (Dissolved)	Copper as Cu (Total)	Copper as Cu (Dissolved)	Lead as Pb (Total)	Lead as Pb (Dissolved)
	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPMSW	ICPMSW	ICPMSW	ICPMSW	ICPMSW	ICPMSW	ICPMSW	ICPMSW	ICPMSW	ICPMSW
Site	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Background - Glenmarchhope Burn	0.02	0.01	4	3	<1	<1	0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	0.001	<0.001	0.002	0.002
Background - Glenmarchhope Burn	0.02	0.02	3	3	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	<0.001	0.001
Background - Glenmarchhope Burn	0.02	0.02	4	4	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	<0.001	<0.001
Background - Glenmarchhope Burn	0.02	0.02	4	4	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	0.003	0.002
Background - Glenmarchhope Burn	<0.01	<0.01	3	4	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	0.001	<0.001	0.002	0.002
Background - Glenmarchhope Burn	0.02	0.01	3	3	<1	<1	0.011	<0.001	0.022	0.001	<0.0001	<0.0001	<0.001	<0.001	0.006	0.01
Background - Glenmarchhope Burn	<0.01	<0.01	3	3	<1	<1	0.001	<0.001	0.001	0.001	<0.0001	<0.0001	0.005	0.001	0.021	0.034
Background - Glenmarchhope Burn	0.02	0.02	4	4	<1	<1	0.003	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	0.039	0.001
Background - Glenmarchhope Burn	0.01	0.01	4	3	<1	<1	0.001	0.001	0.001	0.001	<0.0001	<0.0001	<0.001	<0.001	<0.001	<0.001
Background - Glenmarchhope Burn	0.02	0.01	3	3	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0003	<0.0001	0.002	0.029	0.388	0.006
Background - Glenmarchhope Burn	0.01	0.01	3	3	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	0.001	0.001	0.008	0.004
Mennockhass Water Tunnel	0.05	0.05	7	7	<1	<1	<0.001	<0.001	0.002	0.001	0.0017	0.0018	<0.001	<0.001	0.005	0.005
Wanlock Water Upstream (below road)	0.06	0.06	4	5	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	0.001	0.001
Wanlock Water Upstream (below road)	0.05	0.05	5	5	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	0.002	0.002
Wanlock Water Upstream (below road)	0.07	0.07	5	5	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	<0.001	<0.001
Wanlock Water Upstream (below road)	0.06	0.06	6	6	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	0.003	0.003
Wanlock Water Upstream (below road)	0.03	0.03	5	5	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	0.001	<0.001	0.003	0.002
Wanlock Water Upstream (below road)	0.06	0.05	4	4	<1	<1	<0.001	<0.001	<0.001	0.001	<0.0001	<0.0001	<0.001	<0.001	0.003	0.007
Wanlock Water Upstream (below road)	0.02	0.02	2	2	<1	<1	0.001	<0.001	0.003	<0.001	<0.0001	<0.0001	<0.001	<0.001	0.005	0.006
Wanlock Water Upstream (below road)	0.06	0.07	5	5	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	0.002	0.002	0.002
Wanlock Water Upstream (below road)	0.04	0.04	5	5	<1	<1	0.001	0.001	0.001	0.001	<0.0001	<0.0001	<0.001	<0.001	0.002	0.003
Wanlock Water Upstream (below road)	0.05	0.05	5	5	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	0.001	<0.001
Wanlock Water Upstream (below road)	0.01	0.01	3	3	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	0.001	0.012	0.017
Adit Discharge directly below road	0.09	0.1	5	4	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	<0.001	<0.001
Adit Discharge directly below road	0.1	0.1	5	5	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	<0.001	<0.001
Adit Discharge from pipe D/S of road	0.09	0.09	7	8	<1	<1	<0.001	<0.001	<0.001	0.001	<0.0001	<0.0001	<0.001	<0.001	<0.001	<0.001
Adit Discharge from pipe D/S of road	0.09	0.1	10	10	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	<0.001	<0.001
Adit Discharge from pipe D/S of road	0.1	0.1	8	8	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	<0.001	<0.001
Adit Discharge from pipe D/S of road	0.09	0.09	11	11	<1	<1	<0.001	<0.001	0.001	0.001	<0.0001	<0.0001	<0.001	<0.001	<0.001	0.005
Adit Spring Discharge D/S of road	0.09	0.09	5	5	<1	<1	0.001	<0.001	0.003	<0.001	<0.0001	<0.0001	<0.001	<0.001	<0.001	<0.001
Wanlock Water Upstream of Adit U/S of Museum	0.08	0.09	6	6	<1	<1	<0.001	<0.001	<0.001	0.001	<0.0001	<0.0001	<0.001	<0.001	0.007	0.007
Adit (5 pipes) U/S of Museum	0.08	0.09	5	6	<1	<1	<0.001	<0.001	<0.001	0.001	<0.0001	<0.0001	<0.001	<0.001	<0.001	<0.001
Adit (5 pipes) U/S of Museum	0.08	0.08	6	6	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	<0.001	<0.001
Adit (5 pipes) U/S of Museum	0.08	0.09	6	6	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	0.001	<0.001	<0.001	<0.001
Adit (5 pipes) U/S of Museum	0.08	0.08	7	8	<1	<1	0.017	<0.001	0.001	0.001	<0.0001	<0.0001	<0.001	<0.001	<0.001	0.001
Adit (5 pipes) U/S of Museum	0.08	0.07	5	5	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	0.003	0.001	0.006
Adit (5 pipes) U/S of Museum	0.09	0.08	6	7	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	<0.001	0.001
Wanlock Water by Museum	0.08	0.08	6	6	<1	<1	<0.001	<0.001	<0.001	0.001	<0.0001	0.0002	<0.001	<0.001	0.009	0.01
Wanlock Water by Museum	0.09	0.09	8	8	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	0.012	0.013
Wanlock Water by Museum	0.09	0.09	8	7	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	0.0001	<0.001	<0.001	0.008	0.007
Wanlock Water by Museum	0.08	0.09	9	9	<1	<1	<0.001	<0.001	0.001	<0.001	0.0001	<0.0001	<0.001	<0.001	0.02	0.011
Wanlock Water by Museum	0.06	0.06	7	7	<1	<1	<0.001	<0.001	<0.001	0.002	<0.0001	<0.0001	<0.001	0.001	0.012	0.01
Wanlock Water by Museum	0.08	0.08	7	7	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0001	0.0001	<0.001	<0.001	0.012	0.015
Wanlock Water by Museum	0.03	0.03	5	4	<1	<1	<0.001	<0.001	<0.001	0.001	0.0002	0.0001	0.001	0.001	0.064	0.047
Wanlock Water by Museum	0.09	0.09	8	8	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	0.0001	<0.001	<0.001	0.018	0.008
Wanlock Water by Museum	0.07	0.07	9	10	<1	<1	0.001	0.001	0.001	0.001	0.0001	0.0001	0.013	0.001	0.013	0.01
Wanlock Water by Museum	0.07	0.07	8	8	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0001	<0.0001	<0.001	<0.001	0.04	0.007
Wanlock Water by Museum	0.05	0.05	7	7	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0002	0.0002	0.002	0.002	0.075	0.05
Glencrieff Stream	0.02	0.02	3	3	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0005	0.0005	<0.001	<0.001	0.053	0.051
Glencrieff Stream	0.02	0.02	4	4	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0004	0.0004	0.001	0.001	0.106	0.103
Glencrieff Stream	0.02	0.02	3	3	<1	<1	<0.001	<0.001	0.001	<0.001	0.0004	0.0005	<0.001	<0.001	0.044	0.042
Wanlock Water U/S of Bay Mine at Straitsteps	0.07	0.08	7	7	<1	<1	<0.001	<0.001	<0.001	0.001	0.0002	0.0002	<0.001	<0.001	0.008	0.009
Wanlock Water U/S of Bay Mine at Straitsteps	0.09	0.09	8	8	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0005	0.0005	<0.001	0.002	0.012	0.025
Wanlock Water U/S of Bay Mine at Straitsteps	0.09	0.09	7	8	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0004	0.0003	<0.001	<0.001	0.011	0.008
Wanlock Water U/S of Bay Mine at Straitsteps	0.09	0.08	10	10	<1	<1	<0.001	<0.001	0.001	<0.001	0.0005	0.0005	<0.001	0.001	0.014	0.011
Wanlock Water U/S of Bay Mine at Straitsteps	0.06	0.06	8	8	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0004	0.0004	0.001	0.001	0.013	0.011
Wanlock Water U/S of Bay Mine at Straitsteps	0.08	0.08	8	7	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0005	0.0006	<0.001	<0.001	0.015	0.012
Wanlock Water U/S of Bay Mine at Straitsteps	0.04	0.04	6	6	<1	<1	<0.001	<0.001	0.001	<0.001	0.001	0.001	0.002	0.001	0.056	0.04
Wanlock Water U/S of Bay Mine at Straitsteps	0.09	0.09	10	10	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0008	0.0008	0.001	<0.001	0.012	0.01
Wanlock Water U/S of Bay Mine at Straitsteps	0.07	0.07	12	13	<1	<1	0.001	<0.001	0.002	<0.001	0.0013	0.0013	0.002	0.002	0.055	0.011
Wanlock Water U/S of Bay Mine at Straitsteps	0.07	0.07	14	10	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0008	0.0008	<0.001	<0.001	0.011	0.009
Wanlock Water U/S of Bay Mine at Straitsteps	0.06	0.06	11	11	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0009	0.0008	0.002	0.001	0.091	0.018
Wanlock Water U/S at Pates Knowles Bridge	0.09	0.09	8	9	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0005	0.0005	<0.001	<0.001	0.012	0.012
Wanlock Water U/S at Pates Knowles Bridge	0.08	0.08	10	10	<1	<1	0.013	<0.001	<0.001	<0.001	0.0005	0.0005	<0.001	0.002	0.016	0.017
Wanlock Water U/S at Pates Knowles Bridge	0.08	0.08	7	7	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0006	0.0006	<0.001	<0.001	0.013	0.012
Wanlock Water U/S at Pates Knowles Bridge	0.09	0.09	10	10	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0008	0.0008	<0.001	<0.001	0.013	0.012
Wanlock Water U/S at Pates Knowles Bridge	0.07	0.08	10	10	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0008	0.0008	<0.001	<0.001	0.01	0.007
Wanlock Water U/S of Bay Mine (at Bay Mine)	0.04	0.04	6	6	<1	<1	<0.001	<0.001	0.001	<0.001	0.001	0.0009	0.002	0.001	0.065	0.046
Wanlock Water U/S of Bay Mine (at Bay Mine)	0.06	0.06	12	12	<1	<1	0.001	0.001	0.002	0.001	0.0011	0.0011	0.003	<0.001	0.038	0.014

Site	On Site Lead	Zinc as Zn (Total)	Zinc as Zn (Dissolved)	On Site Zinc	Manganese as Mn (Total) a	Manganese as MN (Dissolved) a	Iron as Fe (Total) a	Iron as Fe (Dissolved) a	Aluminium as Al (Total) a	Aluminium as Al (Dissolved) a	Arsenic as As (Total)	Arsenic as As (Dissolved)	Boron as B (Total) a	Boron as B (Dissolved) a	Mercury as Hg (Total)	Mercury as Hg (Dissolved)
		ICPMSW	ICPMSW		ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPMSW	ICPMSW	ICPWATVAR	ICPWATVAR	ICPMSW	ICPMSW
Site	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Background - Glenmarchhope Burn	0.17*	0.004	0.003	0.16*	<0.01	<0.01	0.13	0.11	0.08	0.06	<0.001	<0.001	0.04	0.02	<0.0001	<0.0001
Background - Glenmarchhope Burn		<0.002	<0.002		<0.01	<0.01	0.07	0.06	0.03	0.03	<0.001	<0.001	<0.01	<0.01		
Background - Glenmarchhope Burn		0.002	0.003		<0.01	0.02	0.1	0.06	0.02	0.02	<0.001	<0.001	0.02	<0.01		
Background - Glenmarchhope Burn		0.003	0.003		0.02	0.02	0.19	0.15	0.07	0.06	<0.001	<0.001	<0.01	<0.01		
Background - Glenmarchhope Burn		0.002	<0.002		<0.01	<0.01	0.14	0.1	0.01	<0.01	<0.001	<0.001	<0.01	<0.01		
Background - Glenmarchhope Burn		<0.002	0.003		0.02	<0.01	0.19	0.05	0.12	0.02	<0.001	<0.001	<0.01	<0.01		
Background - Glenmarchhope Burn		0.008	0.007		0.01	<0.01	0.17	0.13	0.09	0.08	<0.001	<0.001	0.02	0.04		
Background - Glenmarchhope Burn		0.007	0.004		0.01	<0.01	0.08	0.03	0.04	0.01	<0.001	<0.001	<0.01	<0.01		
Background - Glenmarchhope Burn		0.002	0.008		<0.01	<0.01	0.1	0.05	0.05	0.04	<0.001	<0.001	<0.01	<0.01		
Background - Glenmarchhope Burn		0.052	0.004		0.01	<0.01	0.11	0.04	0.04	0.01	<0.001	<0.001	<0.01	<0.01		
Background - Glenmarchhope Burn		0.007	0.006		0.02	0.01	0.17	0.07	0.07	0.03	<0.001	<0.001	<0.01	<0.01		
Mennockhass Water Tunnel		0.216	0.216		<0.01	<0.01	<0.01	<0.01	0.02	0.01	0.001	0.001	<0.01	<0.01		
Wanlock Water Upstream (below road)	0.49*	0.003	<0.002		<0.01	<0.01	<0.01	<0.01	0.03	0.02	<0.001	<0.001	0.04	<0.01	<0.0001	<0.0001
Wanlock Water Upstream (below road)		<0.002	<0.002		<0.01	<0.01	<0.01	<0.01	0.04	0.04	<0.001	<0.001	<0.01	<0.01		
Wanlock Water Upstream (below road)		0.002	0.003		<0.01	<0.01	<0.01	<0.01	0.03	0.02	<0.001	<0.001	<0.01	<0.01		
Wanlock Water Upstream (below road)		<0.002	0.002		<0.01	<0.01	<0.01	<0.01	0.06	0.06	<0.001	<0.001	<0.01	<0.01		
Wanlock Water Upstream (below road)		<0.002	<0.002		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.01	<0.01		
Wanlock Water Upstream (below road)		<0.002	<0.002		<0.01	<0.01	<0.01	<0.01	0.03	0.03	<0.001	<0.001	<0.01	<0.01		
Wanlock Water Upstream (below road)		0.004	0.004		<0.01	<0.01	0.12	0.1	0.27	0.15	<0.001	<0.001	0.04	0.05		
Wanlock Water Upstream (below road)		<0.002	0.004		<0.01	<0.01	<0.01	0.03	0.03	0.03	<0.001	<0.001	<0.01	<0.01		
Wanlock Water Upstream (below road)		0.002	0.003		<0.01	<0.01	<0.01	0.02	0.05	0.05	<0.001	<0.001	<0.01	0.02		
Wanlock Water Upstream (below road)		<0.002	<0.002		<0.01	<0.01	<0.01	<0.01	0.02	0.02	<0.001	<0.001	<0.01	<0.01		
Wanlock Water Upstream (below road)		0.007	0.009		0.01	0.01	0.13	0.07	0.17	0.13	<0.001	<0.001	<0.01	<0.01		
Adit Discharge directly below road		<0.002	<0.002		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.01	0.01		
Adit Discharge directly below road		<0.002	<0.002		<0.01	<0.01	<0.01	<0.01	0.01	0.01	<0.001	<0.001	<0.01	0.02		
Adit Discharge from pipe D/S of road	0.23*	<0.002	<0.002	0.03	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.001	<0.001	<0.01	<0.01	<0.0001	<0.0001
Adit Discharge from pipe D/S of road	0.12	<0.002	<0.002	0.13	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.01	<0.01		
Adit Discharge from pipe D/S of road		<0.002	<0.002		<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.001	<0.001	<0.01	<0.01		
Adit Discharge from pipe D/S of road		<0.002	0.002		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	0.01	0.02		
Adit Spring Discharge D/S of road		<0.002	0.002		<0.01	<0.01	<0.01	<0.01	0.23	<0.01	<0.001	<0.001	<0.01	0.07		
Wanlock Water Upstream of Adit U/S of Museum		0.004	0.003		<0.01	<0.01	<0.01	<0.01	0.02	0.02	<0.001	<0.001	0.04	<0.01	<0.0001	<0.0001
Adit (5 pipes) U/S of Museum	0.23*	0.003	<0.002	**	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.001	<0.001	0.03	<0.01	<0.0001	<0.0001
Adit (5 pipes) U/S of Museum	0.15	<0.002	<0.002	0.15	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.01	<0.01		
Adit (5 pipes) U/S of Museum		0.003	0.003		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.01	<0.01		
Adit (5 pipes) U/S of Museum		0.002	0.002		<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.001	<0.001	0.02	0.04		
Adit (5 pipes) U/S of Museum		<0.002	0.003		<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.001	<0.001	<0.01	<0.01		
Adit (5 pipes) U/S of Museum		0.002	0.003		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	0.01	0.01		
Wanlock Water by Museum	0.25*	0.01	0.009	0.21*	<0.01	<0.01	<0.01	<0.01	0.02	0.01	<0.001	<0.001	0.02	<0.01	<0.0001	<0.0001
Wanlock Water by Museum		0.014	0.013		<0.01	<0.01	<0.01	<0.01	0.02	0.02	<0.001	<0.001	<0.01	<0.01		
Wanlock Water by Museum		0.011	0.011		<0.01	<0.01	<0.01	<0.01	0.02	0.02	<0.001	<0.001	<0.01	<0.01		
Wanlock Water by Museum		0.015	0.016		<0.01	<0.01	<0.01	<0.01	0.03	0.01	<0.001	<0.001	<0.01	<0.01		
Wanlock Water by Museum		0.012	0.028		<0.01	<0.01	<0.01	<0.01	<0.01	0.04	<0.001	<0.001	<0.01	<0.01		
Wanlock Water by Museum		0.014	0.014		<0.01	<0.01	<0.01	<0.01	0.03	0.02	<0.001	<0.001	<0.01	<0.01		
Wanlock Water by Museum		0.027	0.025		<0.01	<0.01	0.09	0.05	0.11	0.08	<0.001	<0.001	<0.01	<0.01		
Wanlock Water by Museum		0.013	0.012		<0.01	0.01	<0.01	<0.01	0.05	0.01	<0.001	<0.001	0.03	0.04		
Wanlock Water by Museum		0.02	0.02		<0.01	<0.01	<0.01	<0.01	0.02	0.01	<0.001	<0.001	<0.01	<0.01		
Wanlock Water by Museum		0.018	0.014		<0.01	<0.01	0.08	0.02	0.08	0.01	<0.001	<0.001	<0.01	<0.01		
Wanlock Water by Museum		0.03	0.027		<0.01	<0.01	0.16	0.02	0.14	0.04	<0.001	<0.001	<0.01	0.01		
Glencrieff Stream	0.35*	0.038	0.035	0.11	<0.01	<0.01	<0.01	<0.01	0.03	0.02	<0.001	<0.001	0.03	<0.01	<0.0001	<0.0001
Glencrieff Stream		0.03	0.03		<0.01	<0.01	0.03	0.02	0.05	0.03	<0.001	<0.001	<0.01	<0.01		
Glencrieff Stream		0.033	0.038		<0.01	<0.01	<0.01	<0.01	0.02	0.01	<0.001	<0.001	<0.01	<0.01		
Wanlock Water U/S of Bay Mine at Straitsteps		0.012	0.013		<0.01	<0.01	<0.01	<0.01	0.02	0.02	<0.001	<0.001	<0.01	<0.01	<0.0001	<0.0001
Wanlock Water U/S of Bay Mine at Straitsteps		0.063	0.064		<0.01	<0.01	<0.01	<0.01	0.02	0.02	<0.001	<0.001	<0.01	<0.01		
Wanlock Water U/S of Bay Mine at Straitsteps		0.028	0.027		<0.01	<0.01	<0.01	<0.01	0.02	0.02	<0.001	<0.001	<0.01	<0.01		
Wanlock Water U/S of Bay Mine at Straitsteps		0.056	0.055		<0.01	<0.01	<0.01	<0.01	0.03	0.02	<0.001	<0.001	<0.01	<0.01		
Wanlock Water U/S of Bay Mine at Straitsteps		0.043	0.042		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.01	<0.01		
Wanlock Water U/S of Bay Mine at Straitsteps		0.065	0.07		<0.01	<0.01	<0.01	<0.01	0.03	0.01	<0.001	<0.001	<0.01	<0.01		
Wanlock Water U/S of Bay Mine at Straitsteps		0.149	0.142		<0.01	<0.01	0.07	0.03	0.08	0.06	<0.001	<0.001	0.01	0.01		
Wanlock Water U/S of Bay Mine at Straitsteps		0.091	0.091		<0.01	0.01	<0.01	<0.01	0.03	0.02	<0.001	<0.001	0.01	0.01		
Wanlock Water U/S of Bay Mine at Straitsteps		0.16	0.172		0.01	<0.01	0.06	<0.01	0.05	0.01	<0.001	<0.001	<0.01	<0.01		
Wanlock Water U/S of Bay Mine at Straitsteps		0.081	0.081		0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.001	<0.001	<0.01	<0.01		
Wanlock Water U/S of Bay Mine at Straitsteps		0.127	0.102		0.02	<0.01	0.21	<0.01	0.18	0.02	<0.001	<0.001	<0.01	<0.01		
Wanlock Water U/S at Pates Knowles Bridge		0.057	0.057		<0.01	<0.01	<0.01	<0.01	0.02	0.02	<0.001	<0.001	<0.01	<0.01		
Wanlock Water U/S at Pates Knowles Bridge		0.05	0.052		<0.01	<0.01	<0.01	<0.01	0.02	0.02	<0.001	<0.001	<0.01	<0.01		
Wanlock Water U/S at Pates Knowles Bridge		0.067	0.065		<0.01	<0.01	<0.01	<0.01	0.02	0.02	<0.001	<0.001	<0.01	<0.01		
Wanlock Water U/S at Pates Knowles Bridge		0.088	0.087		<0.01	<0.01	<0.01	<0.01	0.04	0.01	<0.001	<0.001	0.02	0.02		
Wanlock Water U/S at Pates Knowles Bridge		0.077	0.075		<0.01	<0.01	<0.01	<0.01	0.01	0.01	<0.001	<0.001	<0.01	<0.01		
Wanlock Water U/S of Bay Mine (at Bay Mine)		0.142	0.136		<0.01	<0.01	0.06	0.03	0.08	0.06	<0.001	<0.001	0.02	0.02		
Wanlock Water U/S of Bay Mine (at Bay Mine)		0.136	0.128		<0.01	0.02	0.02	0.16	0.05	0.02	<0.001	<0.001	<0.01	<0.01		

	Tin as Sn (Total)	Tin as Sn (Dissolved)	Nitrate as N	Phosphate as P	Total Organic Carbon w	Ammoniacal Nitrogen as N	Barium as Ba (Total) a	Barium as Ba (Dissolved) a	Lithium as Li (Total) a	Lithium as Li (Dissolved) a	Dissolved Organic Carbon w	Silicon as Si (Dissolved) a	Cold Acidity as CaCO3 w		
	ICPMSW	ICPMSW	KONENS	KONENS	WSLM13	KONENS	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPWATVAR	WSLM13	ICPWATVAR	WSLM17		
Site	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	Easting	Northing
Background - Glenmarchhope Burn	<0.001	<0.001	0.3	<0.01	5.1		0.02	0.02	<0.01	<0.01	5.4			285418	614181
Background - Glenmarchhope Burn			<0.2	<0.01	1.3		0.02	0.02	<0.01	<0.01	1.1		2	285418	614181
Background - Glenmarchhope Burn			<0.2	<0.01	0.96		0.02	0.02	<0.01	<0.01	1.2			285418	614181
Background - Glenmarchhope Burn			0.4	<0.01	3		0.02	0.02	<0.01	<0.01	3			285418	614181
Background - Glenmarchhope Burn			<0.2	0.02	2		0.02	0.02	<0.01	<0.01	2.1			285418	614181
Background - Glenmarchhope Burn			<0.2	<0.01	0.56		0.02	0.02	<0.01	<0.01	0.76			285418	614181
Background - Glenmarchhope Burn							0.01	0.02	<0.01	<0.01	4.5			285418	614181
Background - Glenmarchhope Burn			0.3	0.07	0.57		0.02	0.02	<0.01	<0.01	0.59			285418	614181
Background - Glenmarchhope Burn			0.2	0.05	0.96		0.02	0.02	<0.01	<0.01	1.1			285418	614181
Background - Glenmarchhope Burn			0.6	0.49	<0.2		0.1	0.02	<0.01	<0.01	<0.2			285418	614181
Background - Glenmarchhope Burn			<0.2	<0.01	3.4		0.02	0.02	<0.01	<0.01	3.3			285418	614181
Mennockhass Water Tunnel							0.04	0.04	<0.01	<0.01	0.77			287300	612895
Wanlock Water Upstream (below road)	<0.001	<0.001	<0.2	<0.01	0.94		0.04	0.03	<0.01	<0.01	0.9			287847	613008
Wanlock Water Upstream (below road)			<0.2	<0.01	1.6	<0.01	0.04	0.04	<0.01	<0.01		3.2	2	287847	613008
Wanlock Water Upstream (below road)			<0.2	<0.01	0.9	<0.01	0.04	0.04	<0.01	<0.01	1.1	3.9		287847	613008
Wanlock Water Upstream (below road)			0.6	0.03	2.2	<0.01	0.04	0.04	<0.01	<0.01	2.2	3.6		287847	613008
Wanlock Water Upstream (below road)			0.2	0.01	1.3	0.05	0.04	0.04	<0.01	<0.01	1.4	3.7		287847	613008
Wanlock Water Upstream (below road)			<0.2	<0.01	0.77	<0.01	0.04	0.04	<0.01	<0.01	0.91	3.6		287847	613008
Wanlock Water Upstream (below road)							0.01	0.02	<0.01	<0.01	5.5			287847	613008
Wanlock Water Upstream (below road)			16.9**	0.09	0.82		0.04	0.04	<0.01	<0.01	0.74			287847	613008
Wanlock Water Upstream (below road)			0.2	0.07	1.4	<0.01	0.03	0.03	<0.01	<0.01	1.7	2.9		287847	613008
Wanlock Water Upstream (below road)			0.2	0.15	<0.2	<0.01	0.03	0.03	<0.01	<0.01	<0.2	3.3		287847	613008
Wanlock Water Upstream (below road)			0.9	<0.01	5.5		0.01	0.01	<0.01	<0.01	5.4			287847	613008
Adit Discharge directly below road			0.3	<0.01	0.54	<0.01	0.04	0.04	<0.01	<0.01		5.9	3	287844	613002
Adit Discharge directly below road			<0.2	<0.01	0.36	<0.01	0.04	0.04	<0.01	<0.01	0.5	5.6		287844	613002
Adit Discharge from pipe D/S of road	<0.001	<0.001	0.3	<0.01	0.47	<0.01	0.04	0.04	<0.01	<0.01	0.54	4.9		287833	613024
Adit Discharge from pipe D/S of road			0.4	<0.01	1.3	<0.01	0.04	0.04	<0.01	<0.01		5.4	2	287833	613024
Adit Discharge from pipe D/S of road			<0.2	<0.01	0.46	<0.01	0.04	0.04	<0.01	<0.01	0.59	5.3		287833	613024
Adit Discharge from pipe D/S of road			0.7	<0.01	0.64	<0.01	0.04	0.04	<0.01	<0.01	0.6	5.3		287833	613024
Adit Spring Discharge D/S of road			<0.2	<0.01	0.42	<0.01	0.04	0.04	<0.01	<0.01	0.64	5.3		287841	613018
Wanlock Water Upstream of Adit U/S of Museum	<0.001	<0.001	0.2	<0.01	0.73		0.04	0.04	<0.01	<0.01	0.55			287602	612997
Adit (5 pipes) U/S of Museum	<0.001	<0.001	0.5	<0.01	0.41	<0.01	0.03	0.03	<0.01	<0.01	0.24	4.7		287591	612993
Adit (5 pipes) U/S of Museum			0.5	<0.01	0.55	<0.01	0.03	0.04	<0.01	<0.01		5	2	287591	612993
Adit (5 pipes) U/S of Museum			0.3	<0.01	0.31	<0.01	0.03	0.03	<0.01	<0.01	0.54	5		287591	612993
Adit (5 pipes) U/S of Museum			0.8	0.02	0.47	<0.01	0.03	0.04	<0.01	<0.01	0.44	5		287591	612993
Adit (5 pipes) U/S of Museum			<0.2	<0.01	<0.2	<0.01	0.03	0.03	<0.01	<0.01	<0.2	4.9		287591	612993
Adit (5 pipes) U/S of Museum			0.8	0.25	0.28		0.03	0.03	<0.01	<0.01	0.22			287591	612993
Wanlock Water by Museum	<0.001	<0.001	0.4	<0.01	0.64		0.04	0.04	<0.01	<0.01	0.53			287339	612890
Wanlock Water by Museum			0.5	0.01	0.69		0.05	0.05	<0.01	<0.01	0.68		2	287339	612890
Wanlock Water by Museum			<0.2	0.04	0.49		0.04	0.04	<0.01	<0.01	0.61			287339	612890
Wanlock Water by Museum			0.7	0.02	0.84		0.05	0.04	<0.01	<0.01	0.79			287339	612890
Wanlock Water by Museum			0.3	0.01	0.21		0.04	0.04	<0.01	<0.01	0.37			287339	612890
Wanlock Water by Museum			<0.2	<0.01	<0.2		0.04	0.05	<0.01	<0.01	0.32			287339	612890
Wanlock Water by Museum							0.03	0.03	<0.01	<0.01	4.1			287339	612890
Wanlock Water by Museum			0.5	0.09	0.43		0.05	0.05	<0.01	<0.01	0.36			287339	612890
Wanlock Water by Museum			0.4	0.11	0.34		0.04	0.04	<0.01	<0.01	0.54			287339	612890
Wanlock Water by Museum			0.4	0.16	<0.2		0.05	0.04	<0.01	<0.01	<0.2			287339	612890
Wanlock Water by Museum			0.3	<0.01	2.7		0.03	0.03	<0.01	<0.01	2.7			287339	612890
Glencrieff Stream	<0.001	<0.001	<0.2	<0.01	1.7		0.03	0.03	<0.01	<0.01	1.4			286766	613152
Glencrieff Stream			0.4	0.02	2.8		0.03	0.04	<0.01	<0.01	2.8			286766	613152
Glencrieff Stream			<0.2	<0.01	0.63		0.03	0.03	<0.01	<0.01	0.84			286766	613152
Wanlock Water U/S of Bay Mine at Straitsteps	<0.001	<0.001	0.3	0.05	0.9		0.03	0.04	<0.01	<0.01	0.76			286927	613125
Wanlock Water U/S of Bay Mine at Straitsteps			0.5	<0.01	0.75		0.05	0.05	<0.01	<0.01	0.72		2	286927	613125
Wanlock Water U/S of Bay Mine at Straitsteps			<0.2	<0.01	0.54		0.05	0.04	<0.01	<0.01	0.76			286927	613125
Wanlock Water U/S of Bay Mine at Straitsteps			0.8	0.03	0.89		0.05	0.05	<0.01	<0.01	0.79			286927	613125
Wanlock Water U/S of Bay Mine at Straitsteps			0.4	0.01	0.22		0.04	0.04	<0.01	<0.01	0.48			286927	613125
Wanlock Water U/S of Bay Mine at Straitsteps			<0.2	<0.01	<0.2		0.05	0.05	<0.01	<0.01	0.32			286927	613125
Wanlock Water U/S of Bay Mine at Straitsteps							0.03	0.03	<0.01	<0.01	3.4			286927	613125
Wanlock Water U/S of Bay Mine at Straitsteps			0.6	0.14	0.48		0.05	0.05	<0.01	<0.01	0.53			286927	613125
Wanlock Water U/S of Bay Mine at Straitsteps			0.5	0.07	0.37		0.05	0.04	<0.01	<0.01	0.65			286927	613125
Wanlock Water U/S of Bay Mine at Straitsteps			0.4	0.26	<0.2		0.04	0.04	<0.01	<0.01	<0.2			286927	613125
Wanlock Water U/S of Bay Mine at Straitsteps			0.4	<0.01	1.2		0.04	0.04	<0.01	<0.01	1.1			286927	613125
Wanlock Water U/S at Pates Knowles Bridge			0.5	0.03	0.79		0.05	0.05	<0.01	<0.01	0.52		148	286698	613269
Wanlock Water U/S at Pates Knowles Bridge			0.7	0.04	0.95		0.05	0.05	<0.01	<0.01	0.95			286698	613269
Wanlock Water U/S at Pates Knowles Bridge			<0.2	<0.01	<0.2		0.05	0.05	<0.01	<0.01	0.35			286698	613269
Wanlock Water U/S at Pates Knowles Bridge			14.6**	0.31	0.45		0.05	0.05	<0.01	<0.01	0.38			286698	613269
Wanlock Water U/S at Pates Knowles Bridge			0.6	0.33	<0.2		0.04	0.04	<0.01	<0.01	<0.2			286698	613269
Wanlock Water U/S of Bay Mine (at Bay Mine)							0.03	0.03	<0.01	<0.01	3			286520	613510
Wanlock Water U/S of Bay Mine (at Bay Mine)			0.5	0.08	0.41		0.06	0.04	<0.01	<0.01	0.7			286520	613510

	Analyte:	pH units w	On Site pH	Conductivity uS/cm @ 25C w	On Site Conductivity	Suspended Solids w	Total Alkalinity as CaCO3 w	Total Acidity as CaCO3 w	Total Hardness as CaCO3	Chloride as Cl w	Total Sulphur as SO4 (Dissolved) a	Calcium as Ca (Total) a	Calcium as Ca (Dissolved) a	Magnesium as Mg (Total) a	Magnesium as Mg (Dissolved) a
	Method Code:	WSLM3		WSLM2		WSLM10	WSLM12	WSLM17	Calc_HD	KONENS	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPWATVAR
Site	Units:	pH units	pH	µS/cm	µs/cm 25°C	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Bay Mine Adit Discharge	17-May-12	7.7	6.57	109	144	<5	62	0	61	11	7	23	21	3	2
Bay Mine Adit Discharge	26-Jun-12	8	6.85	162	143	<5	21	0	70	11	10	23	23	3	3
Bay Mine Adit Discharge	31-Jul-12	7.6	7.17	124	149	<5	45		61	11	8	21	21	2	2
Bay Mine Adit Discharge	21-Aug-12	7.9	7.08	167	144	<5	55		67	9	8	22	22	3	3
Bay Mine Adit Discharge	18-Sep-12	8.0	7.70	166	145	<5	44	0	61	10	6	20	21	2	2
Bay Mine Adit Discharge	23-Oct-12	7.9	6.48	151	123	<5	46	0	58		8	19	20	2	2
Bay Mine Adit Discharge	20-Nov-12	7.9	6.63	147	122	<5	49	0	53	9	9	18	18	2	2
Bay Mine Adit Discharge	11-Dec-12	8.0	7.12	135	138	<5	62		63	11	9	22	22	2	2
Bay Mine Adit Discharge	30-Jan-13	7.7	7.3	132	131	<5	51	0	61	12	8	21	21	2	2
Bay Mine Adit Discharge	19-Feb-13	7.9	7.27	183	161	<5	55	0	61	15	8	21	21	2	2
Bay Mine Adit Discharge	17-Apr-13	8.0		196		<5	60	0	61	14	7	21	21	2	2
Whyte's Cleuch (Bay Mine Stream)	20-Nov-12	7.9	6.76	<100	58	<5	21	0	28	4	4	8	8	2	2
Wanlock Water D/S of Bay Mine (at Cemetry)	20-Nov-12	8.0	6.70	140	97	<5	38	0	41	8	7	13	13	2	2
Glenglass Stream U/S of Tip (Pond Outlet)	17-May-12	7.3	6.65	<100	58	6	20	0	25	6	4	5	5	2	3
Glenglass Stream U/S of Tip (Pond Outlet)	26-Jun-12	7.9	6.67	<100	61	<5	21	0	27	7	4	6	6	3	3
Glenglass Stream U/S of Tip (Pond Outlet)	31-Jul-12	7.6	7.12	<100	76	<5	25		34	6	3	7	7	4	4
Glenglass Stream U/S of Tip (Pond Outlet)	21-Aug-12	7.9	7.33	<100	68	<5	33		34	5	3	6	7	4	4
Glenglass Stream U/S of Tip (Pond Outlet)	20-Nov-12	7.9	6.90	<100	37	<5	12	0	16	3	<3	3	3	2	2
New Glencrieff Mine Tip Drain	17-May-12	7.6	6.60	<100	78	<5	34	0	32	6	5	7	8	3	3
New Glencreiff Mine Tip Discharge by path	17-May-12	7.4	6.78	<100	37	<5	34	0	32	8	5	7	8	3	3
New Glencreiff Mine Tip Discharge by path	26-Jun-12	8	7.14	<100	74	<5	<2	0	39	6	9	9	9	4	4
New Glencreiff Mine Tip Discharge by path	31-Jul-12	7.8	7.10	106	96	<5	<2		41	6	8	10	10	4	4
New Glencreiff Mine Tip Discharge by path	21-Aug-12	8	7.39	118	83	<5	38		39	5	6	9	9	4	4
New Glencreiff Mine Tip Discharge by path	20-Nov-12	7.9	6.76	<100	56	<5	17	0	27	4	9	6	6	3	3
New Glencreiff Mine Tip Discharge by path	30-Jan-13	7.9	7.25	<100	52	<5	20	0	27	5	5	6	6	3	3
New Glencreiff Mine Tip Discharge by path	19-Feb-13	7.9	7.60	106	75	<5	32	0	30	5	6	7	7	3	3
Meadowfoot Adit Discharge	26-Jun-12	7.9	7.11	130	110	<5	43	0	52	10	9	16	16	3	3
Glenglass (Glencrieff Mine) Adit Discharge	17-May-12	7.4	6.75	160	200	<5	80	0	100	9	19	30	32	4	5
Glenglass (Glencrieff Mine) Adit Discharge	26-Jun-12	7.8	7.05	178	152	<5	54	0	77	9	17	25	26	3	3
Glenglass (Glencrieff Mine) Adit Discharge	31-Jul-12	7.7	6.62	160	179	<5	54		84	8	16	27	27	4	4
Glenglass (Glencrieff Mine) Adit Discharge	21-Aug-12	7.7	6.95	199	165	<5	67		79	8	18	24	25	3	4
Glenglass (Glencrieff Mine) Adit Discharge	18-Sep-12	7.8	7.11	186	170	<5	50	0	77	8	12	26	26	3	3
Glenglass (Glencrieff Mine) Adit Discharge	23-Oct-12	7.8	6.99	178	145	<5	54	0	72		15	24	24	3	3
Glenglass (Glencrieff Mine) Adit Discharge	20-Nov-12	7.7	6.30	203	155	<5	67	0	79	7	17	25	25	4	4
Glenglass (Glencrieff Mine) Adit Discharge	11-Dec-12	8.0	7.01	187	185	<5	98		103	10	19	33	33	5	5
Glenglass (Glencrieff Mine) Adit Discharge	30-Jan-13	7.5	6.75	174	162	<5	64	0	86	9	16	28	28	4	4
Glenglass (Glencrieff Mine) Adit Discharge	19-Feb-13	7.9	7.23	223	217	<5	77	0	84	12	17	27	27	4	4
Glenglass (Glencrieff Mine) Adit Discharge	17-Apr-13	8.0		243		6	78	0	91	12	18	29	30	4	4
Old Settlement Pond Runoff (by Glenglass Level)	20-Nov-12	7.4	6.21	<100	58	<5	32	0	28	4	4	8	8	2	2
Old Settlement Pond Runoff (by Glenglass Level)	11-Dec-12	7.2	7.01	<100	79	17	45		45	3	9	13	13	3	3
Old Settlement Pond Runoff (by Glenglass Level)	30-Jan-13	7.4	6.85	<100	62	<5	30	0	31	4	7	9	9	2	2
Old Settlement Pond Runoff (by Glenglass Level)	17-Apr-13	7.7		114		5	28	0	31	6	14	10	9	2	2
Wanlockhead Sewage Works Outfall	17-May-12	6.5	7.20	157	203	7	30	0	46	15	12	14	15	2	2
Wanlockhead Sewage Works Outfall	26-Jun-12	7.4	7.93	191	174	5	30	0	62	16	14	20	20	3	3
Wanlockhead Sewage Works Outfall	31-Jul-12	7.1	6.74	214	235	<5	18		53	17	17	18	18	2	2
Wanlockhead Sewage Works Outfall	21-Aug-12	7.6	7.20	202	180	6	33		53	13	12	18	18	3	2
Wanlockhead Sewage Works Outfall	18-Sep-12	7.3	7.11	222	221	8	44	0	51	16	12	17	17	2	2
Wanlockhead Sewage Works Outfall	23-Oct-12	7.6	6.95	238	195	<5	16	0	53	15	15	18	18	2	2
Wanlockhead Sewage Works Outfall	20-Nov-12	7.6	6.66	148	105	11	37	0	43	9	11	14	14	2	2
Wanlockhead Sewage Works Outfall	11-Dec-12	7.4	6.96	353	361	<5	19		48	69	18	16	16	2	2
Wanlockhead Sewage Works Outfall	30-Jan-13	6.7	6.95	162	166	43	24	0	48	23	11	16	16	2	2
Wanlockhead Sewage Works Outfall	19-Feb-13	7.4	7.22	547	533	5	58	0	48	99	19	16	16	2	2
Wanlockhead Sewage Works Outfall	17-Apr-13	7.4		247		30	36	0	48	26	12	17	16	3	2
Limpen Burn (by Sewage Works)	21-Aug-12	7.9	7.38	<100	51	<5	12		21	5	4	4	5	2	2
Limpen Burn (by Sewage Works)	23-Oct-12	7.9	7.41	<100	49	<5	14	0	18	5	5	4	4	2	2
Wanlock Water D/S of Sewage Works	17-May-12	7.6	6.60	112	145	<5	60	0	67	11	10	20	22	3	3
Wanlock Water D/S of Sewage Works	26-Jun-12	7.9	7.04	165	143	<5	54	0	70	10	12	23	23	3	3
Wanlock Water D/S of Sewage Works	31-Jul-12	7.5	6.87	134	150	<5	47		65	11	11	21	21	3	3
Wanlock Water D/S of Sewage Works	21-Aug-12	7.9	6.92	165	140	<5	60		62	8	9	20	20	3	3
Wanlock Water D/S of Sewage Works	18-Sep-12	7.9	7.01	165	141	<5	44	0	61	10	8	21	21	2	2
Wanlock Water D/S of Sewage Works	23-Oct-12	7.9	6.34	159	124	<5	51	0	60	7	9	19	19	3	3
Wanlock Water D/S of Sewage Works	20-Nov-12	7.7	6.64	133	91	<5	39	0	38	8	8	13	12	2	2
Wanlock Water D/S of Sewage Works	11-Dec-12	7.8	6.98	141	141	<5	67		72	10	12	24	24	3	3
Wanlock Water D/S of Sewage Works	30-Jan-13	7.4	7.1	127	122	<5	45	0	60	11	10	18	19	3	3
Wanlock Water D/S of Sewage Works	19-Feb-13	7.9	7.15	188	166	<5	54	0	65	13	12	21	21	3	3
Wanlock Water D/S of Sewage Works	17-Apr-13	7.9		192		<5	56	0	60	13	10	19	19	3	3
Upstream of Crusher	20-Nov-12	7.7	6.53	<100	44	<5	13	0	21	5	4	5	5	1	2

	Strontium as Sr (Total) a	Strontium as Sr (Dissolved) a	Sodium as Na (Total) a	Sodium as Na (Dissolved) a	Potassium as K (Total) a	Potassium as K (Dissolved) a	Nickel as Ni (Total)	Nickel as Ni (Dissolved)	Chromium as Cr (Total)	Chromium as Cr (Dissolved)	Cadmium as Cd (Total)	Cadmium as Cd (Dissolved)	Copper as Cu (Total)	Copper as Cu (Dissolved)	Lead as Pb (Total)	Lead as Pb (Dissolved)
	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPMSW	ICPMSW	ICPMSW	ICPMSW	ICPMSW	ICPMSW	ICPMSW	ICPMSW	ICPMSW	ICPMSW
Site	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Bay Mine Adit Discharge	0.09	0.08	7	7	<1	<1	<0.001	<0.001	<0.001	0.001	0.0021	0.0019	<0.001	<0.001	0.014	0.012
Bay Mine Adit Discharge	0.09	0.09	8	8	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0014	0.0015	<0.001	0.001	0.014	0.015
Bay Mine Adit Discharge	0.09	0.08	8	8	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0016	0.0015	<0.001	<0.001	0.015	0.014
Bay Mine Adit Discharge	0.08	0.08	9	9	<1	<1	<0.001	0.001	<0.001	<0.001	0.0014	0.0014	0.001	0.001	0.014	0.067
Bay Mine Adit Discharge	0.05	0.06	8	8	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0013	0.0013	0.001	0.001	0.015	0.013
Bay Mine Adit Discharge	0.07	0.07	7	7	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0015	0.0015	<0.001	<0.001	0.019	0.013
Bay Mine Adit Discharge	0.07	0.07	7	7	<1	<1	<0.001	<0.001	0.001	<0.001	0.0013	0.0013	0.001	0.002	0.015	0.02
Bay Mine Adit Discharge	0.09	0.09	8	8	<1	<1	0.001	<0.001	<0.001	<0.001	0.0014	0.0014	<0.001	<0.001	0.014	0.012
Bay Mine Adit Discharge	0.08	0.08	8	8	<1	<1	0.001	0.001	0.002	0.001	0.0015	0.0015	0.003	0.001	0.077	0.015
Bay Mine Adit Discharge	0.08	0.08	9	9	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0019	0.0019	<0.001	<0.001	0.013	0.013
Bay Mine Adit Discharge	0.08	0.08	8	8	<1	<1	<0.001	<0.001	<0.001	<0.001	0.002	0.002	0.001	0.001	0.031	0.03
Whyte's Cleuch (Bay Mine Stream)	0.02	0.02	2	2	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0003	0.0003	0.006	0.006	0.086	0.08
Wanlock Water D/S of Bay Mine (at Cemetry)	0.05	0.05	6	6	<1	<1	<0.001	<0.001	0.001	<0.001	0.0011	0.0011	0.002	0.002	0.048	0.034
Glenglass Stream U/S of Tip (Pond Outlet)	0.02	0.03	3	3	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	<0.001	<0.001
Glenglass Stream U/S of Tip (Pond Outlet)	0.03	0.03	4	4	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	0.001	0.004
Glenglass Stream U/S of Tip (Pond Outlet)	0.03	0.03	4	4	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	<0.001	<0.001
Glenglass Stream U/S of Tip (Pond Outlet)	0.03	0.03	5	5	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	0.001	<0.001	0.001	0.001
Glenglass Stream U/S of Tip (Pond Outlet)	0.01	0.02	2	3	<1	<1	<0.001	<0.001	0.001	<0.001	<0.0001	<0.0001	<0.001	0.001	0.001	0.001
New Glencrieff Mine Tip Drain	0.03	0.03	3	3	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0001	0.0001	<0.001	<0.001	0.004	0.004
New Glencreiff Mine Tip Discharge by path	0.03	0.03	3	3	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	0.002	0.002
New Glencreiff Mine Tip Discharge by path	0.04	0.04	4	4	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	0.009	0.007
New Glencreiff Mine Tip Discharge by path	0.04	0.04	4	5	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	0.001	0.005	<0.001
New Glencreiff Mine Tip Discharge by path	0.04	0.04	4	5	<1	<1	<0.001	<0.001	0.001	<0.001	0.0001	<0.0001	0.001	<0.001	0.025	0.004
New Glencreiff Mine Tip Discharge by path	0.03	0.03	2	3	<1	<1	<0.001	<0.001	0.001	<0.001	0.0001	0.0001	0.003	<0.001	0.012	0.004
New Glencreiff Mine Tip Discharge by path	0.02	0.02	3	3	<1	<1	0.001	0.001	0.002	0.001	0.0001	<0.0001	<0.001	<0.001	0.014	0.005
New Glencreiff Mine Tip Discharge by path	0.03	0.03	4	4	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	0.012	0.002
Meadowfoot Adit Discharge	0.07	0.08	6	6	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0002	0.0002	<0.001	<0.001	0.006	0.056
Glenglass (Glencrieff Mine) Adit Discharge	0.11	0.11	5	6	<1	<1	0.002	0.002	<0.001	0.001	0.0034	0.0036	0.002	0.002	0.032	0.034
Glenglass (Glencrieff Mine) Adit Discharge	0.09	0.09	6	6	<1	<1	0.002	0.002	<0.001	<0.001	0.0054	0.0055	0.004	0.004	0.036	0.036
Glenglass (Glencrieff Mine) Adit Discharge	0.1	0.1	6	6	<1	<1	0.002	0.002	<0.001	<0.001	0.0053	0.0052	0.003	0.003	0.038	0.035
Glenglass (Glencrieff Mine) Adit Discharge	0.09	0.09	8	10	<1	2	0.002	0.002	<0.001	<0.001	0.0054	0.0054	0.004	0.004	0.043	0.044
Glenglass (Glencrieff Mine) Adit Discharge	0.06	0.07	6	6	<1	<1	0.002	0.002	<0.001	<0.001	0.0055	0.0055	0.004	0.003	0.046	0.038
Glenglass (Glencrieff Mine) Adit Discharge	0.08	0.08	6	6	<1	<1	0.002	0.002	<0.001	0.001	0.005	0.0051	0.004	0.003	0.044	0.044
Glenglass (Glencrieff Mine) Adit Discharge	0.09	0.09	5	5	<1	<1	0.002	0.002	0.001	<0.001	0.0052	0.0053	0.005	0.004	0.064	0.043
Glenglass (Glencrieff Mine) Adit Discharge	0.12	0.12	8	8	<1	<1	0.002	0.002	<0.001	<0.001	0.0032	0.0032	0.003	0.002	0.056	0.049
Glenglass (Glencrieff Mine) Adit Discharge	0.1	0.1	8	8	<1	<1	0.003	0.003	0.001	0.001	0.0035	0.0034	0.003	0.003	0.068	0.036
Glenglass (Glencrieff Mine) Adit Discharge	0.1	0.1	8	8	<1	<1	0.002	0.002	<0.001	<0.001	0.0025	0.0026	0.002	0.002	0.036	0.026
Glenglass (Glencrieff Mine) Adit Discharge	0.11	0.11	7	8	<1	<1	0.002	0.002	<0.001	<0.001	0.0034	0.0035	0.004	0.004	0.151	0.142
Old Settlement Pond Runoff (by Glenglass Level)	0.02	0.02	2	2	<1	<1	0.002	0.002	0.001	<0.001	0.0059	0.0059	0.003	0.004	0.042	0.042
Old Settlement Pond Runoff (by Glenglass Level)	0.03	0.03	3	3	<1	<1	0.004	0.003	<0.001	<0.001	0.0093	0.0046	0.003	0.001	0.212	0.009
Old Settlement Pond Runoff (by Glenglass Level)	0.02	0.02	2	3	<1	<1	0.002	0.003	0.001	0.002	0.0043	0.0045	0.003	0.003	0.024	0.206
Old Settlement Pond Runoff (by Glenglass Level)	0.02	0.02	4	3	1	1	0.002	0.002	<0.001	<0.001	0.0047	0.0051	0.003	0.004	0.01	0.044
Wanlockhead Sewage Works Outfall	0.06	0.06	12	13	3	3	<0.001	<0.001	<0.001	0.001	<0.0001	<0.0001	0.001	0.001	0.004	0.004
Wanlockhead Sewage Works Outfall	0.07	0.08	13	13	1	1	<0.001	<0.001	<0.001	<0.001	0.0002	0.0003	0.002	0.002	0.02	0.023
Wanlockhead Sewage Works Outfall	0.07	0.07	17	17	4	4	<0.001	0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	0.001	0.008	0.005
Wanlockhead Sewage Works Outfall	0.06	0.06	13	13	3	2	<0.001	<0.001	<0.001	<0.001	0.0001	<0.0001	0.002	0.001	0.021	0.011
Wanlockhead Sewage Works Outfall	0.04	0.04	16	16	4	4	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	0.002	0.002	0.022	0.014
Wanlockhead Sewage Works Outfall	0.06	0.06	13	13	3	3	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	0.001	0.001	0.015	0.009
Wanlockhead Sewage Works Outfall	0.04	0.05	6	6	<1	<1	0.001	<0.001	0.002	<0.001	0.002	0.0014	0.004	0.002	0.057	0.026
Wanlockhead Sewage Works Outfall	0.06	0.06	53	53	4	4	<0.001	0.001	<0.001	<0.001	0.0002	0.0001	0.002	0.001	0.018	0.011
Wanlockhead Sewage Works Outfall	0.06	0.06	15	21	2	2	0.003	0.003	0.002	0.002	0.0014	0.0006	0.006	0.006	0.089	0.03
Wanlockhead Sewage Works Outfall	0.06	0.06	70	71	5	5	<0.001	<0.001	<0.001	<0.001	0.0001	<0.0001	0.001	0.001	0.015	0.007
Wanlockhead Sewage Works Outfall	0.06	0.06	16	16	2	2	0.001	<0.001	<0.001	<0.001	0.0005	0.0001	0.005	0.003	0.075	0.017
Limpen Burn (by Sewage Works)	0.01	0.02	4	5	<1	<1	0.001	0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	0.002	0.007	0.011
Limpen Burn (by Sewage Works)	0.02	0.02	4	3	<1	<1	<0.001	<0.001	0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	0.005	0.005
Wanlock Water D/S of Sewage Works	0.08	0.08	6	6	<1	<1	<0.001	<0.001	<0.001	0.001	0.0022	0.0023	0.001	0.001	0.02	0.022
Wanlock Water D/S of Sewage Works	0.09	0.09	7	7	<1	<1	<0.001	<0.001	<0.001	<0.001	0.003	0.0029	0.002	0.002	0.03	0.032
Wanlock Water D/S of Sewage Works	0.08	0.08	7	7	<1	<1	<0.001	0.001	<0.001	<0.001	0.0025	0.0025	0.002	0.001	0.025	0.022
Wanlock Water D/S of Sewage Works	0.08	0.07	8	8	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0025	0.0024	0.002	0.002	0.028	0.025
Wanlock Water D/S of Sewage Works	0.05	0.05	7	7	<1	<1	<0.001	0.001	<0.001	0.002	0.0026	0.0026	0.002	0.002	0.035	0.04
Wanlock Water D/S of Sewage Works	0.07	0.07	6	6	<1	<1	<0.001	<0.001	<0.001	0.001	0.0027	0.0028	0.002	0.002	0.033	0.026
Wanlock Water D/S of Sewage Works	0.05	0.05	5	5	<1	<1	0.001	<0.001	0.001	<0.001	0.002	0.0019	0.002	0.003	0.068	0.049
Wanlock Water D/S of Sewage Works	0.09	0.09	8	8	<1	<1	0.001	0.001	<0.001	<0.001	0.0022	0.0022	0.001	0.001	0.033	0.026
Wanlock Water D/S of Sewage Works	0.07	0.07	8	8	<1	<1	0.002	0.002	0.001	0.001	0.0019	0.0019	0.002	0.002	0.056	0.038
Wanlock Water D/S of Sewage Works	0.08	0.08	8	8	<1	<1	0.001	0.001	<0.001	<0.001	0.0023	0.0023	0.001	0.001	0.045	0.038
Wanlock Water D/S of Sewage Works	0.07	0.07	7	7	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0021	0.002	0.002	0.002	0.041	0.029
Upstream of Crusher	0.01	0.01	2	2	<1	<1	0.001	0.001	<0.001	0.001	0.0013	0.0013	0.003	0.003	0.096	0.089

	On Site Lead	Zinc as Zn (Total)	Zinc as Zn (Dissolved)	On Site Zinc	Manganese as Mn (Total) a	Manganese as MN (Dissolved) a	Iron as Fe (Total) a	Iron as Fe (Dissolved) a	Aluminium as Al (Total) a	Aluminium as Al (Dissolved) a	Arsenic as As (Total)	Arsenic as As (Dissolved)	Boron as B (Total) a	Boron as B (Dissolved) a	Mercury as Hg (Total)	Mercury as Hg (Dissolved)
		ICPMSW	ICPMSW		ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPMSW	ICPMSW	ICPWATVAR	ICPWATVAR	ICPMSW	ICPMSW
Site	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Bay Mine Adit Discharge	0.26*	0.16	0.139	0.28*	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.001	<0.001	0.04	<0.01	<0.0001	<0.0001
Bay Mine Adit Discharge	0.27	0.106	0.108	0.27	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.01	0.01		
Bay Mine Adit Discharge		0.113	0.113		<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.001	<0.001	<0.01	<0.01		
Bay Mine Adit Discharge		0.101	0.109	0.24	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.01	<0.01		
Bay Mine Adit Discharge	0.28*	0.096	0.097	1.1*	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.01	<0.01		
Bay Mine Adit Discharge	0.42*	0.116	0.115	1.46*	<0.01	<0.01	<0.01	<0.01	0.02	0.04	<0.001	<0.001	<0.01	<0.01		
Bay Mine Adit Discharge		0.104	0.105		<0.01	<0.01	<0.01	<0.01	0.01	0.01	<0.001	<0.001	0.01	0.01		
Bay Mine Adit Discharge		0.109	0.109		<0.01	<0.01	<0.01	<0.01	0.03	0.01	<0.001	<0.001	<0.01	0.01		
Bay Mine Adit Discharge		0.122	0.113		<0.01	<0.01	0.05	<0.01	0.03	<0.01	<0.001	<0.001	<0.01	<0.01		
Bay Mine Adit Discharge		0.138	0.14		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.01	<0.01		
Bay Mine Adit Discharge		0.153	0.155		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	0.02	<0.01		
Whyte's Cleuch (Bay Mine Stream)		0.027	0.026		<0.01	<0.01	0.03	0.01	0.05	0.04	<0.001	<0.001	<0.01	<0.01		
Wanlock Water D/S of Bay Mine (at Cemetry)		0.12	0.116		<0.01	<0.01	0.03	<0.01	0.05	0.03	<0.001	<0.001	0.02	0.03		
Glenglass Stream U/S of Tip (Pond Outlet)		0.003	<0.002		<0.01	<0.01	0.05	0.05	0.02	<0.01	<0.001	<0.001	<0.01	<0.01	<0.0001	<0.0001
Glenglass Stream U/S of Tip (Pond Outlet)		<0.002	<0.002		<0.01	<0.01	0.17	0.19	0.02	0.02	<0.001	<0.001	0.01	0.03		
Glenglass Stream U/S of Tip (Pond Outlet)		0.003	0.002		0.01	<0.01	0.31	0.1	0.02	0.01	<0.001	<0.001	<0.01	<0.01		
Glenglass Stream U/S of Tip (Pond Outlet)		0.002	<0.002		<0.01	<0.01	0.21	0.14	0.03	0.02	<0.001	<0.001	<0.01	<0.01		
Glenglass Stream U/S of Tip (Pond Outlet)		<0.002	<0.002		<0.01	<0.01	0.08	0.05	0.05	0.04	<0.001	<0.001	0.01	<0.01		
New Glencrieff Mine Tip Drain	0.15*	0.014	0.013	0.08	<0.01	<0.01	0.02	0.02	0.02	<0.01	<0.001	<0.001	<0.01	<0.01	<0.0001	<0.0001
New Glencreiff Mine Tip Discharge by path	0.21*	0.009	0.01	0.08	<0.01	<0.01	0.03	0.01	0.02	<0.01	<0.001	<0.001	0.01	<0.01	0.0001	<0.0001
New Glencreiff Mine Tip Discharge by path	0.12	0.011	0.01	1.95*	<0.01	<0.01	0.12	0.1	0.02	0.02	<0.001	<0.001	<0.01	<0.01		
New Glencreiff Mine Tip Discharge by path		0.012	0.012		<0.01	<0.01	0.06	<0.01	0.02	0.01	<0.001	<0.001	<0.01	<0.01		
New Glencreiff Mine Tip Discharge by path		0.015	0.01	0.07	0.01	<0.01	0.3	0.04	0.04	0.01	<0.001	<0.001	<0.01	<0.01		
New Glencreiff Mine Tip Discharge by path		0.017	0.013		0.01	<0.01	0.14	0.03	0.04	0.03	<0.001	<0.001	0.01	0.01		
New Glencreiff Mine Tip Discharge by path		0.013	0.015		0.01	<0.01	0.12	0.02	0.03	0.01	<0.001	<0.001	<0.01	<0.01		
New Glencreiff Mine Tip Discharge by path		0.018	0.012		0.02	0.01	0.07	0.01	0.02	<0.01	<0.001	<0.001	<0.01	<0.01		
Meadowfoot Adit Discharge	0.1	0.017	0.043	0.18	<0.01	<0.01	<0.01	0.04	0.01	0.03	<0.001	<0.001	<0.01	<0.01		
Glenglass (Glencrieff Mine) Adit Discharge	0.37*	0.381	0.402	0.57*	<0.01	<0.01	<0.01	<0.01	0.02	0.01	<0.001	<0.001	0.03	<0.01	<0.0001	<0.0001
Glenglass (Glencrieff Mine) Adit Discharge	0.2	0.597	0.596	2.11*	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.001	<0.001	<0.01	<0.01		
Glenglass (Glencrieff Mine) Adit Discharge		0.58	0.574		<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.001	<0.001	<0.01	<0.01		
Glenglass (Glencrieff Mine) Adit Discharge		0.562	0.565	0.55	<0.01	0.01	<0.01	<0.01	0.02	0.03	<0.001	<0.001	0.05	0.08		
Glenglass (Glencrieff Mine) Adit Discharge	0.31*	0.601	0.57	3.0*	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.01	0.01		
Glenglass (Glencrieff Mine) Adit Discharge	0.48	0.553	0.547	0.58	0.01	<0.01	<0.01	<0.01	0.04	0.01	<0.001	<0.001	<0.01	<0.01		
Glenglass (Glencrieff Mine) Adit Discharge		0.568	0.563		<0.01	<0.01	0.04	<0.01	0.05	0.01	<0.001	<0.001	0.01	0.01		
Glenglass (Glencrieff Mine) Adit Discharge		0.343	0.337		0.01	<0.01	<0.01	<0.01	0.02	0.01	<0.001	<0.001	<0.01	0.01		
Glenglass (Glencrieff Mine) Adit Discharge		0.381	0.376		<0.01	<0.01	0.01	<0.01	0.02	0.01	<0.001	<0.001	<0.01	<0.01		
Glenglass (Glencrieff Mine) Adit Discharge		0.269	0.271		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.01	<0.01		
Glenglass (Glencrieff Mine) Adit Discharge		0.341	0.365		<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.001	<0.001	<0.01	<0.01		
Old Settlement Pond Runoff (by Glenglass Level)		1.616	1.607		0.04	0.03	0.07	0.06	0.02	0.02	<0.001	<0.001	0.01	0.02		
Old Settlement Pond Runoff (by Glenglass Level)		2.817	2.388		1.34	0.02	1.45	0.02	0.07	0.01	0.001	<0.001	0.01	0.01		
Old Settlement Pond Runoff (by Glenglass Level)		1.468	1.493		0.02	0.02	0.05	0.08	0.02	0.02	<0.001	<0.001	<0.01	<0.01		
Old Settlement Pond Runoff (by Glenglass Level)		1.717	1.837		<0.01	<0.01	0.02	0.03	0.02	<0.01	<0.001	<0.001	0.02	<0.01		
Wanlockhead Sewage Works Outfall		0.025	0.023		<0.01	<0.01	<0.01	<0.01	0.03	0.01	<0.001	<0.001	0.03	<0.01	<0.0001	<0.0001
Wanlockhead Sewage Works Outfall		0.075	0.08		0.01	0.02	0.05	0.07	0.06	0.07	<0.001	<0.001	<0.01	<0.01		
Wanlockhead Sewage Works Outfall		0.026	0.024		0.01	<0.01	0.02	0.01	0.03	0.03	<0.001	<0.001	<0.01	0.03		
Wanlockhead Sewage Works Outfall		0.059	0.051		<0.01	<0.01	0.05	0.02	0.05	0.02	<0.001	<0.001	<0.01	<0.01		
Wanlockhead Sewage Works Outfall		0.039	0.032		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	0.02	<0.01		
Wanlockhead Sewage Works Outfall		0.041	0.031		0.01	<0.01	0.03	<0.01	0.04	0.02	<0.001	<0.001	0.01	0.02		
Wanlockhead Sewage Works Outfall		0.333	0.293		<0.01	<0.01	0.08	0.01	0.11	0.03	<0.001	<0.001	0.01	0.01		
Wanlockhead Sewage Works Outfall		0.094	0.082		0.02	0.03	0.07	0.05	0.06	0.04	<0.001	<0.001	0.02	0.02		
Wanlockhead Sewage Works Outfall		0.168	0.11		0.03	0.02	0.23	0.37	0.24	0.06	<0.001	<0.001	<0.01	<0.01		
Wanlockhead Sewage Works Outfall		0.053	0.041		0.03	0.02	0.06	0.05	0.04	0.03	<0.001	<0.001	<0.01	<0.01		
Wanlockhead Sewage Works Outfall		0.138	0.084		0.02	0.02	0.23	0.03	0.23	0.02	<0.001	<0.001	0.01	0.02		
Limpen Burn (by Sewage Works)		0.003	0.005		<0.01	<0.01	0.22	0.18	0.07	0.07	<0.001	<0.001	<0.01	<0.01		
Limpen Burn (by Sewage Works)		0.003	0.004		<0.01	<0.01	0.05	0.03	0.03	0.02	<0.001	<0.001	<0.01	<0.01		
Wanlock Water D/S of Sewage Works		0.219	0.231		<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.001	<0.001	0.03	<0.01	<0.0001	<0.0001
Wanlock Water D/S of Sewage Works		0.285	0.285		<0.01	<0.01	<0.01	<0.01	0.01	0.01	<0.001	<0.001	<0.01	<0.01		
Wanlock Water D/S of Sewage Works		0.242	0.24		<0.01	<0.01	<0.01	<0.01	0.02	0.01	<0.001	<0.001	<0.01	<0.01		
Wanlock Water D/S of Sewage Works		0.249	0.25		<0.01	<0.01	<0.01	<0.01	0.02	0.01	<0.001	<0.001	<0.01	<0.01		
Wanlock Water D/S of Sewage Works		0.258	0.26		<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.001	<0.001	<0.01	<0.01		
Wanlock Water D/S of Sewage Works		0.27	0.273		<0.01	<0.01	<0.01	<0.01	0.02	0.01	<0.001	<0.001	<0.01	<0.01		
Wanlock Water D/S of Sewage Works		0.228	0.214		<0.01	<0.01	0.11	0.02	0.08	0.04	<0.001	<0.001	<0.01	<0.01		
Wanlock Water D/S of Sewage Works		0.227	0.231		<0.01	<0.01	<0.01	<0.01	0.02	0.01	<0.001	<0.001	<0.01	<0.01		
Wanlock Water D/S of Sewage Works		0.212	0.214		0.01	0.01	0.04	<0.01	0.02	0.01	<0.001	<0.001	<0.01	<0.01		
Wanlock Water D/S of Sewage Works		0.223	0.219		<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.001	<0.001	<0.01	<0.01		
Wanlock Water D/S of Sewage Works		0.226	0.22		<0.01	<0.01	0.01	<0.01	0.03	0.01	<0.001	<0.001	0.02	<0.01		
Upstream of Crusher		0.163	0.162		<0.01	<0.01	0.04	0.04	0.06	0.06	<0.001	<0.001	0.02	0.03		

	Tin as Sn (Total)	Tin as Sn (Dissolved)	Nitrate as N	Phosphate as P	Total Organic Carbon w	Ammoniacal Nitrogen as N	Barium as Ba (Total) a	Barium as Ba (Dissolved) a	Lithium as Li (Total) a	Lithium as Li (Dissolved) a	Dissolved Organic Carbon w	Silicon as Si (Dissolved) a	Cold Acidity as CaCO3 w		
	ICPMSW	ICPMSW	KONENS	KONENS	WSLM13	KONENS	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPWATVAR	WSLM13	ICPWATVAR	WSLM17		
Site	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	Easting	Northing
Bay Mine Adit Discharge	<0.001	<0.001	0.5	<0.01	0.44	0.02	0.07	0.06	<0.01	<0.01	0.41	4.1		286517	613517
Bay Mine Adit Discharge			0.4	<0.01	0.7	<0.01	0.07	0.07	<0.01	<0.01		4.4	4	286517	613517
Bay Mine Adit Discharge			<0.2	<0.01	0.47	<0.01	0.06	0.06	<0.01	<0.01	0.7	4.4		286517	613517
Bay Mine Adit Discharge			0.6	0.01	0.63	<0.01	0.06	0.06	<0.01	<0.01	0.64	4.4		286517	613517
Bay Mine Adit Discharge			0.3	0.09	<0.2	0.02	0.06	0.06	<0.01	<0.01	<0.2	4.5		286517	613517
Bay Mine Adit Discharge			<0.2	<0.01	<0.2	<0.01	0.06	0.06	<0.01	<0.01	<0.2	4.3		286517	613517
Bay Mine Adit Discharge							0.06	0.06	<0.01	<0.01		4		286517	613517
Bay Mine Adit Discharge			0.9	0.11	0.29	<0.01	0.06	0.06	<0.01	<0.01	0.28	4.7		286517	613517
Bay Mine Adit Discharge			0.4	0.09	<0.2	<0.01	0.07	0.06	<0.01	<0.01	0.25	4.1		286517	613517
Bay Mine Adit Discharge			0.6	0.16	<0.2	<0.01	0.06	0.06	<0.01	<0.01	<0.2	4.1		286517	613517
Bay Mine Adit Discharge			0.4	<0.01	0.36	0.02	0.07	0.07	<0.01	<0.01	0.44	3.9		286517	613517
Whyte's Cleuch (Bay Mine Stream)							0.05	0.05	<0.01	<0.01	2.6			286580	613570
Wanlock Water D/S of Bay Mine (at Cemetry)							0.05	0.05	<0.01	<0.01	1.9			286475	613540
Glenglass Stream U/S of Tip (Pond Outlet)	<0.001	<0.001	<0.2	<0.01	1.6		<0.01	<0.01	<0.01	<0.01	1.6			286335	613335
Glenglass Stream U/S of Tip (Pond Outlet)			<0.2	<0.01	1.5		<0.01	<0.01	<0.01	<0.01	1.4		6	286335	613335
Glenglass Stream U/S of Tip (Pond Outlet)			<0.2	<0.01	1.4		<0.01	<0.01	<0.01	<0.01	1.6			286335	613335
Glenglass Stream U/S of Tip (Pond Outlet)			0.3	0.02	2.2		<0.01	<0.01	<0.01	<0.01	2.3			286335	613335
Glenglass Stream U/S of Tip (Pond Outlet)							<0.01	<0.01	<0.01	<0.01	2.4			286335	613335
New Glencrieff Mine Tip Drain	<0.001	<0.001	<0.2	<0.01	1.3		0.01	0.01	<0.01	<0.01	1.2			286416	613434
New Glencreiff Mine Tip Discharge by path	<0.001	<0.001	<0.2	<0.01	1.3		0.01	0.01	<0.01	<0.01	1.3			286390	613455
New Glencreiff Mine Tip Discharge by path			<0.2	<0.01	1.3		0.01	0.01	<0.01	<0.01	1.2		2	286390	613455
New Glencreiff Mine Tip Discharge by path			<0.2	<0.01	1.2		0.01	0.01	<0.01	<0.01	1.4			286390	613455
New Glencreiff Mine Tip Discharge by path			0.3	0.02	1.9		0.02	0.01	<0.01	<0.01	1.9			286390	613455
New Glencreiff Mine Tip Discharge by path							<0.01	<0.01	<0.01	<0.01	2.1			286390	613455
New Glencreiff Mine Tip Discharge by path			0.3	0.07	0.72		<0.01	<0.01	<0.01	<0.01	1			286390	613455
New Glencreiff Mine Tip Discharge by path			0.3	0.39	<0.2		0.01	<0.01	<0.01	<0.01	<0.2			286390	613455
Meadowfoot Adit Discharge			0.4	<0.01	0.62	<0.01	0.02	0.03	<0.01	<0.01		3.1	3	286258	613745
Glenglass (Glencrieff Mine) Adit Discharge	<0.001	<0.001	0.4	<0.01	0.56	<0.01	0.07	0.08	<0.01	<0.01	0.65	3.2		286173	613770
Glenglass (Glencrieff Mine) Adit Discharge			0.4	<0.01	0.45	<0.01	0.07	0.07	<0.01	<0.01		3.7	3	286173	613770
Glenglass (Glencrieff Mine) Adit Discharge			<0.2	0.01	0.69	<0.01	0.07	0.07	<0.01	<0.01	0.78	3.5		286173	613770
Glenglass (Glencrieff Mine) Adit Discharge			0.4	<0.01	1	<0.01	0.06	0.06	<0.01	<0.01	1	3.4		286173	613770
Glenglass (Glencrieff Mine) Adit Discharge			0.3	0.02	0.21	<0.01	0.07	0.07	<0.01	<0.01	0.4	3.8		286173	613770
Glenglass (Glencrieff Mine) Adit Discharge			<0.2	<0.01	0.23	<0.01	0.07	0.07	<0.01	<0.01	0.42	3.6		286173	613770
Glenglass (Glencrieff Mine) Adit Discharge							0.07	0.07	<0.01	<0.01		3.3		286173	613770
Glenglass (Glencrieff Mine) Adit Discharge			0.2	0.12	0.39	<0.01	0.08	0.08	<0.01	<0.01	0.35	4		286173	613770
Glenglass (Glencrieff Mine) Adit Discharge			0.3	0.05	0.21	<0.01	0.08	0.07	<0.01	<0.01	0.45	3.3		286173	613770
Glenglass (Glencrieff Mine) Adit Discharge			0.3	0.17	<0.2	<0.01	0.07	0.07	<0.01	<0.01	<0.2	3.2		286173	613770
Glenglass (Glencrieff Mine) Adit Discharge			<0.2	<0.01	0.49	0.02	0.1	0.08	<0.01	<0.01	0.46	3.1		286173	613770
Old Settlement Pond Runoff (by Glenglass Level)							0.05	0.05	<0.01	<0.01	2.7			286160	613775
Old Settlement Pond Runoff (by Glenglass Level)			<0.2	0.21	2.2		0.12	0.06	<0.01	<0.01	2.1			286160	613775
Old Settlement Pond Runoff (by Glenglass Level)			<0.2	0.19	2		0.05	0.05	<0.01	<0.01	2.3			286160	613775
Old Settlement Pond Runoff (by Glenglass Level)			<0.2	<0.01	3.6		0.06	0.05	<0.01	<0.01	3.6			286160	613775
Wanlockhead Sewage Works Outfall	<0.001	<0.001	2	0.85	4		0.02	0.02	<0.01	<0.01	3.5			286102	613821
Wanlockhead Sewage Works Outfall			3.6	0.38	2.9		0.04	0.04	<0.01	<0.01	2.7		2	286102	613821
Wanlockhead Sewage Works Outfall			5.9	0.58	5.4		0.03	0.03	<0.01	<0.01	5.6			286102	613821
Wanlockhead Sewage Works Outfall			3.4	0.46	3.1		0.03	0.03	<0.01	<0.01	3.1			286102	613821
Wanlockhead Sewage Works Outfall			2.8	0.45	4		0.03	0.03	<0.01	<0.01	4.3			286102	613821
Wanlockhead Sewage Works Outfall			2.1	0.49	4		0.03	0.03	<0.01	<0.01	4.1			286102	613821
Wanlockhead Sewage Works Outfall							0.04	0.03	<0.01	<0.01	2.4			286102	613821
Wanlockhead Sewage Works Outfall			8.2	0.75	3.7		0.03	0.03	<0.01	<0.01	3.5			286102	613821
Wanlockhead Sewage Works Outfall			0.2	1.16	3.7		0.04	0.03	<0.01	<0.01	3.7			286102	613821
Wanlockhead Sewage Works Outfall			3.5	1.1	4.1		0.03	0.03	<0.01	<0.01	4.3			286102	613821
Wanlockhead Sewage Works Outfall			0.6	1.94	3.4		0.03	0.02	<0.01	<0.01	3.4			286102	613821
Limpen Burn (by Sewage Works)			<0.2	<0.01	4.0.		0.02	0.02	<0.01	<0.01	4			286092	613827
Limpen Burn (by Sewage Works)			<0.2	<0.01	0.71		0.02	0.02	<0.01	<0.01	0.89			286092	613827
Wanlock Water D/S of Sewage Works	<0.001	<0.001	0.3	<0.01	0.7		0.06	0.06	<0.01	<0.01	0.65			286067	613819
Wanlock Water D/S of Sewage Works			1.1	<0.01	0.26		0.07	0.07	<0.01	<0.01	0.57		2	286067	613819
Wanlock Water D/S of Sewage Works			0.2	<0.01	0.64		0.06	0.06	<0.01	<0.01	0.74			286067	613819
Wanlock Water D/S of Sewage Works			0.5	0.01	1.2		0.06	0.06	<0.01	<0.01	1.3			286067	613819
Wanlock Water D/S of Sewage Works			0.3	0.02	0.22		0.06	0.06	<0.01	<0.01	0.32			286067	613819
Wanlock Water D/S of Sewage Works			<0.2	<0.01	0.21		0.06	0.06	<0.01	<0.01	0.4			286067	613819
Wanlock Water D/S of Sewage Works							0.05	0.04	<0.01	<0.01	2.1			286067	613819
Wanlock Water D/S of Sewage Works			0.5	0.09	0.35		0.06	0.06	<0.01	<0.01	0.37			286067	613819
Wanlock Water D/S of Sewage Works			0.4	0.1	0.47		0.06	0.05	<0.01	<0.01	0.7			286067	613819
Wanlock Water D/S of Sewage Works			0.5	0.19	<0.2		0.06	0.06	<0.01	<0.01	<0.2			286067	613819
Wanlock Water D/S of Sewage Works			0.5	0.08	0.64		0.06	0.05	<0.01	<0.01	0.63			286067	613819
Upstream of Crusher							0.04	0.04	<0.01	<0.01	3.2			285845	613985

	Analyte:	pH units w	On Site pH	Conductivity uS/cm @ 25C w	On Site Conductivity	Suspended Solids w	Total Alkalinity as CaCO3 w	Total Acidity as CaCO3 w	Total Hardness as CaCO3	Chloride as Cl w	Total Sulphur as SO4 (Dissolved) a	Calcium as Ca (Total) a	Calcium as Ca (Dissolved) a	Magnesium as Mg (Total) a	Magnesium as Mg (Dissolved) a
	Method Code:	WSLM3		WSLM2		WSLM10	WSLM12	WSLM17	Calc_HD	KONENS	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPWATVAR
Site	Units:	pH units	pH	µS/cm	µs/cm 25°C	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Downstream of crushing mill	21-Aug-12	7.7	6.76	114	78	<5	15		32	6	11	7	8	3	3
Downstream of crushing mill	18-Sep-12	7.7	7.03	99	79	<5	14	0	26	7	8	7	7	2	2
Downstream of crushing mill	23-Oct-12	7.6	7.18	<100	62	<5	10	0	23	6	11	6	6	2	2
Downstream of crushing mill	20-Nov-12	7.6	6.46	<100	55	<5	11	0	21	5	10	5	5	2	2
Downstream of crushing mill	11-Dec-12	7.6	7.06	<100	58	<5	18		23	5	10	6	6	2	2
Downstream of crushing mill	30-Jan-13	7.1	6.8	<100	50	<5	12	0	21	5	8	5	5	2	2
Downstream of crushing mill	19-Feb-13	7.7	7.15	<100	64	14	22	0	21	5	10	5	5	2	2
Downstream of crushing mill	17-Apr-13	8.9		123		5	23	0	23	5	10	7	6	2	2
Wanlock Water U/S Smelter Mill Tailings Ponds	17-May-12	7.2	6.38	115	124	5	56	0	55	9	10	16	17	2	3
Wanlock Water U/S Smelter Mill Tailings Ponds	26-Jun-12	7.9	7.03	158	130	<5	45	0	65	9	12	22	21	3	3
Wanlock Water U/S Smelter Mill Tailings Ponds	31-Jul-12	7.5	6.73	131	145	<5	41		62	9	9	20	20	3	3
Wanlock Water U/S Smelter Mill Tailings Ponds	21-Aug-12	7.9	6.90	159	132	<5	42		57	8	9	18	18	3	3
Wanlock Water U/S Smelter Mill Tailings Ponds	18-Sep-12	7.8	6.95	155	139	<5	44	0	56	9	6	20	19	2	2
Wanlock Water U/S Smelter Mill Tailings Ponds	23-Oct-12	7.9	6.97	153	119	<5	45	0	57	8	10	18	18	3	3
Wanlock Water U/S Smelter Mill Tailings Ponds	20-Nov-12	7.7	6.99	140	102	<5	42	0	43	8	9	16	14	2	2
Wanlock Water U/S Smelter Mill Tailings Ponds	11-Dec-12	7.7	7.14	135	133	<5	62		67	10	12	22	22	3	3
Wanlock Water U/S Smelter Mill Tailings Ponds	30-Jan-13	7.5	6.8	121	119	<5	43	0	55	11	9	18	17	3	3
Wanlock Water U/S Smelter Mill Tailings Ponds	19-Feb-13	7.8	6.76	180	147	<5	49	0	62	13	11	20	20	3	3
Wanlock Water U/S Smelter Mill Tailings Ponds	17-Apr-13	9.1		257		8	70	0	57	12	10	18	18	3	3
Tailings Pond Ditch	21-Aug-12	7.6	6.74	<100	46	9	13		21	3	5	5	5	2	2
Tailings Pond Ditch	18-Sep-12	7.5	7.00	60	39	8	7	10	24	5	<3	3	8	<1	1
Tailings Pond Ditch	20-Nov-12	7.5	7.04	<100	37	25	8	0	<14	3	7	5	4	1	<1
Tailings Pond Ditch	30-Jan-13	7.2	7	<100	58	<5	16	0	24	4	13	8	8	1	1
Tailings Pond Ditch	19-Feb-13	7.6	7.12	<100	72	<5	29	0	25	7	4	5	5	3	3
Tailings Pond Ditch	17-Apr-13	9.0		<100		7	32	0	12	7	5	3	3	1	1
Tailings Pond Runoff	21-Aug-12	7.9	6.83	100	65	<5	23		30	4	<3	7	7	3	3
Tailings Pond Runoff	18-Sep-12	7.8	7.10	81	58	<5	17	0	21	6	<3	5	5	2	2
Tailings Pond Runoff	23-Oct-12	7.9	7.15	<100	53	<5	19	0	25	5	4	5	5	3	3
Tailings Pond Runoff	20-Nov-12	7.7	6.36	<100	33	39	13	0	12	3	3	4	3	1	1
Tailings Pond Runoff	30-Jan-13	6.5	6.8	<100	23	53	11	4	<9	4	5	2	2	<1	<1
Tailings Pond Runoff	19-Feb-13	7.7	7.44	<100	82	173	33	0	27	6	4	9	6	4	3
Tailings Pond Runoff	17-Apr-13	7.8		115		393	30	0	31	6	8	12	9	3	2
Ponded water on tailings pond	31-Jul-12	7.3	6.76	<100	38	<5	6	8	12	5	7	3	3	1	1
Ponded water on tailings pond	21-Aug-12	7.7	7.14	<100	30	<5	8	2	12	3	<3	3	3	1	1
Ponded water on tailings pond	18-Sep-12	7.6	6.95	49	32	<5	4	10	<9	6	<3	2	2	<1	<1
Ponded water on tailings pond	23-Oct-12	7.6	7.46	<100	25	<5	4	0	<9	4	4	2	2	<1	<1
Ponded water on tailings pond	20-Nov-12	7.5	6.67	<100	18	<5	2	6	<7	3	3	1	1	<1	<1
Ponded water on tailings pond	30-Jan-13	7	7	<100	22	<5	13	0	<9	3	3	2	2	<1	<1
Ponded water on tailings pond	19-Feb-13	7.3	6.77	338	322	46	78	0	149	5	84	57	53	4	4
Ponded water on tailings pond	17-Apr-13	7.7		<100		7	19	0	<9	6	6	2	2	<1	<1
Wanlock Water D/S of tailings ponds	17-May-12	7.4	6.55	113	125	<5	48	0	57	9	10	16	18	2	3
Wanlock Water D/S of tailings ponds	26-Jun-12	7.9	6.75	159	131	<5	49	0	65	9	12	21	21	3	3
Wanlock Water D/S of tailings ponds	31-Jul-12	7.5	6.55	122	143	<5	37		62	10	10	21	20	3	3
Wanlock Water D/S of tailings ponds	21-Aug-12	7.8	6.90	156	129	<5	44		57	5	10	18	18	3	3
Wanlock Water D/S of tailings ponds	18-Sep-12	7.8	6.90	154	136	<5	43	0	56	9	6	19	19	2	2
Wanlock Water D/S of tailings ponds	23-Oct-12	7.8	6.87	155	192	<5	51	0	57	8	9	18	18	3	3
Wanlock Water D/S of tailings ponds	20-Nov-12	7.8	6.38	141	99	<5	42	0	43	7	9	14	14	2	2
Wanlock Water D/S of tailings ponds	11-Dec-12	7.8	7.14	133	133	13	59		67	8	12	22	22	3	3
Wanlock Water D/S of tailings ponds	30-Jan-13	7.3	6.7	121	118	14	44	0	57	10	10	18	18	3	3
Wanlock Water D/S of tailings ponds	19-Feb-13	7.7	7.03	175	153	<5	52	0	62	13	10	20	20	3	3
Wanlock Water D/S of tailings ponds	17-Apr-13	8.8		180		<5	60	0	57	12	10	20	18	3	3
Sowen Burn prior to Wanlock Water	17-May-12	7.4	6.50	<100	80	<5	23	0	34	6	9	6	7	3	4
Sowen Burn prior to Wanlock Water	26-Jun-12	7.9	7.00	<100	72	<5	15	0	30	6	12	7	7	4	3
Sowen Burn prior to Wanlock Water	31-Jul-12	7.5	7.15	<100	78	<5	<2		32	8	7	6	6	4	4
Sowen Burn prior to Wanlock Water	21-Aug-12	7.9	7.35	<100	68	<5	16		29	6	7	5	5	4	4
Sowen Burn prior to Wanlock Water	18-Sep-12	7.9	7.04	92	72	<5	15	0	25	6	4	5	5	3	3
Sowen Burn prior to Wanlock Water	23-Oct-12	7.9	7.10	<100	61	<5	15	0	22	6	7	4	4	3	3
Sowen Burn prior to Wanlock Water	20-Nov-12	7.7	7.19	<100	41	<5	7	0	13	6	6	2	2	2	2
Sowen Burn prior to Wanlock Water	11-Dec-12	8.0	6.80	<100	61	<5	22		29	6	8	5	5	4	4
Sowen Burn prior to Wanlock Water	30-Jan-13	7.8	6.7	<100	47	<5	23	0	20	11	6	3	3	3	3
Sowen Burn prior to Wanlock Water	19-Feb-13	7.8	6.82	<100	60	<5	32	0	22	5	4	4	4	3	3
Sowen Burn prior to Wanlock Water	17-Apr-13	8.0		<100		<5	23	0	20	6	6	4	3	3	3
Wanlock Water D/S of Sowen Burn	17-May-12	7.4	6.66	105	117	<5	42	0	52	8	9	13	16	2	3
Wanlock Water D/S of Sowen Burn	26-Jun-12	7.8	7.05	138	120	<5	42	0	57	9	12	18	18	3	3
Wanlock Water D/S of Sowen Burn	31-Jul-12	7.4	6.85	118	136	<5	54		57	10	10	18	18	3	3
Wanlock Water D/S of Sowen Burn	21-Aug-12	7.9	6.90	150	125	<5	35		52	7	10	16	16	3	3
Wanlock Water D/S of Sowen Burn	18-Sep-12	7.8	6.30	147	126	<5	36	0	51	8	6	17	17	2	2
Wanlock Water D/S of Sowen Burn	23-Oct-12	7.8	6.31	139	137	<5	44	0	52	7	9	16	16	3	3
Wanlock Water D/S of Sowen Burn	20-Nov-12	7.8	6.70	125	128	<5	36	0	38	8	10	12	12	2	2
Wanlock Water D/S of Sowen Burn	11-Dec-12	7.8	6.55	116	129	<5	54		60	9	12	19	19	3	3
Wanlock Water D/S of Sowen Burn	30-Jan-13	7.5	6.1	131	121	<5	53	0	50	9	10	15	15	3	3
Wanlock Water D/S of Sowen Burn	19-Feb-13	7.8	6.87	167	231	<5	50	0	57	12	12	18	18	3	3
Wanlock Water D/S of Sowen Burn	17-Apr-13	7.9		152		8	48	0	50	10	10	16	15	3	3
Elvan Water	17-Apr-13	8.0		<100		17	30	0	14	8	<3	4	4	1	1

	Strontium as Sr (Total) a	Strontium as Sr (Dissolved) a	Sodium as Na (Total) a	Sodium as Na (Dissolved) a	Potassium as K (Total) a	Potassium as K (Dissolved) a	Nickel as Ni (Total)	Nickel as Ni (Dissolved)	Chromium as Cr (Total)	Chromium as Cr (Dissolved)	Cadmium as Cd (Total)	Cadmium as Cd (Dissolved)	Copper as Cu (Total)	Copper as Cu (Dissolved)	Lead as Pb (Total)	Lead as Pb (Dissolved)
	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPMSW	ICPMSW	ICPMSW	ICPMSW	ICPMSW	ICPMSW	ICPMSW	ICPMSW	ICPMSW	ICPMSW
Site	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Downstream of crushing mill	0.03	0.03	4	4	<1	<1	0.002	0.003	<0.001	<0.001	0.0068	0.0069	0.002	0.002	1.143	1.115
Downstream of crushing mill	<0.01	<0.01	4	4	<1	<1	0.003	0.002	<0.001	<0.001	0.0058	0.0057	0.006	0.002	0.925	0.745
Downstream of crushing mill	0.02	0.02	3	3	<1	<1	0.002	0.003	<0.001	0.002	0.0047	0.0049	0.004	0.002	1.116	1.095
Downstream of crushing mill	0.02	0.02	2	3	<1	<1	0.002	0.002	0.001	<0.001	0.0068	0.0066	0.002	0.002	1.277	1.178
Downstream of crushing mill	0.02	0.02	3	4	<1	<1	0.002	0.002	<0.001	<0.001	0.0033	0.0034	0.001	0.003	0.741	0.748
Downstream of crushing mill	0.02	0.02	3	3	<1	<1	0.003	0.003	0.002	0.001	0.0038	0.0039	0.002	0.002	1.32	1.189
Downstream of crushing mill	0.02	0.02	3	3	<1	<1	0.002	0.002	<0.001	<0.001	0.0035	0.0036	0.002	0.002	0.784	0.71
Downstream of crushing mill	0.02	0.02	3	3	<1	<1	0.003	0.002	<0.001	<0.001	0.0105	0.0095	0.007	0.004	1.48	0.871
Wanlock Water U/S Smelter Mill Tailings Ponds	0.06	0.06	5	5	<1	<1	0.001	0.001	<0.001	<0.001	0.0022	0.0021	0.002	0.002	0.043	0.045
Wanlock Water U/S Smelter Mill Tailings Ponds	0.08	0.08	6	7	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0026	0.0026	0.002	0.002	0.051	0.052
Wanlock Water U/S Smelter Mill Tailings Ponds	0.07	0.07	7	7	<1	<1	0.001	0.001	<0.001	<0.001	0.0026	0.0026	0.002	0.002	0.041	0.022
Wanlock Water U/S Smelter Mill Tailings Ponds	0.06	0.07	7	8	<1	<1	0.001	0.001	<0.001	<0.001	0.003	0.0025	0.003	0.002	0.082	0.03
Wanlock Water U/S Smelter Mill Tailings Ponds	0.05	0.04	7	7	<1	<1	<0.001	<0.001	0.001	<0.001	0.0029	0.0026	0.002	0.002	0.019	0.021
Wanlock Water U/S Smelter Mill Tailings Ponds	0.07	0.07	6	6	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0026	0.0026	0.002	0.001	0.027	0.019
Wanlock Water U/S Smelter Mill Tailings Ponds	0.06	0.05	5	5	<1	<1	0.001	<0.001	0.001	0.001	0.0023	0.0022	0.003	0.002	0.098	0.035
Wanlock Water U/S Smelter Mill Tailings Ponds	0.08	0.08	8	8	<1	<1	0.001	0.001	<0.001	<0.001	0.0024	0.0023	0.002	0.002	0.076	0.024
Wanlock Water U/S Smelter Mill Tailings Ponds	0.07	0.06	7	7	<1	<1	0.002	0.002	0.002	0.001	0.002	0.002	0.003	0.002	0.145	0.018
Wanlock Water U/S Smelter Mill Tailings Ponds	0.07	0.07	7	7	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0021	0.0021	0.002	0.001	0.052	0.021
Wanlock Water U/S Smelter Mill Tailings Ponds	0.07	0.06	7	7	<1	<1	0.001	0.001	<0.001	<0.001	0.0023	0.0022	0.004	0.003	0.154	0.031
Tailings Pond Ditch	0.01	0.01	3	3	<1	<1	0.003	0.003	0.001	0.001	0.0133	0.0125	0.038	0.032	2.408	1.666
Tailings Pond Ditch	<0.01	<0.01	2	2	<1	<1	0.003	0.004	0.001	0.001	0.0074	0.0095	0.025	0.043	1.685	1.004
Tailings Pond Ditch	0.02	<0.01	2	2	<1	<1	0.003	0.002	0.002	0.001	0.0109	0.0091	0.034	0.014	4.49	0.898
Tailings Pond Ditch	0.01	<0.01	2	2	<1	<1	0.003	0.003	0.002	0.002	0.0142	0.014	0.024	0.02	1.596	1.241
Tailings Pond Ditch	0.01	0.01	4	4	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0017	0.0017	0.007	0.006	0.665	0.604
Tailings Pond Ditch	<0.01	<0.01	3	3	<1	<1	0.002	0.002	<0.001	<0.001	0.0092	0.0092	0.026	0.021	1.39	0.928
Tailings Pond Runoff	0.02	0.02	4	3	<1	<1	0.001	0.001	<0.001	<0.001	0.0044	0.0041	0.022	0.017	0.756	0.41
Tailings Pond Runoff	<0.01	<0.01	3	3	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0021	0.0021	0.012	0.012	0.641	0.438
Tailings Pond Runoff	0.01	0.02	3	3	<1	<1	0.001	0.018	0.003	0.035	0.0011	0.001	0.008	0.007	0.633	0.307
Tailings Pond Runoff	0.01	<0.01	2	2	<1	<1	0.003	<0.001	0.002	<0.001	0.0098	0.0067	0.057	0.014	3.688	0.548
Tailings Pond Runoff	0.01	<0.01	1	2	<1	<1	0.002	0.002	0.002	0.001	0.0041	0.0039	0.043	0.104	10.94	3.733
Tailings Pond Runoff	0.04	0.02	5	3	<1	<1	0.003	<0.001	<0.001	<0.001	0.007	0.0039	0.06	0.008	15.31	0.153
Tailings Pond Runoff	0.06	0.02	3	3	<1	<1	0.006	0.003	0.001	<0.001	0.0164	0.0156	0.181	0.16	49.22	59.8
Ponded water on tailings pond	<0.01	<0.01	2	2	<1	<1	0.002	0.002	0.001	<0.001	0.0034	0.0034	0.017	0.016	3.796	3.484
Ponded water on tailings pond	<0.01	0.01	2	3	<1	<1	0.001	0.001	0.001	0.001	0.0032	0.0031	0.041	0.013	2.489	2.244
Ponded water on tailings pond	<0.01	<0.01	2	2	<1	<1	0.001	0.001	0.001	0.001	0.0019	0.0019	0.008	0.008	1.275	1.124
Ponded water on tailings pond	<0.01	<0.01	2	2	<1	<1	<0.001	0.001	0.001	0.002	0.0017	0.0018	0.005	0.005	1.294	1.09
Ponded water on tailings pond	<0.01	<0.01	2	1	<1	<1	<0.001	<0.001	0.001	0.001	0.0019	0.0019	0.01	0.009	2.145	1.946
Ponded water on tailings pond	<0.01	<0.01	2	2	<1	<1	0.002	0.002	0.002	0.002	0.0023	0.0025	0.01	0.012	1.773	2.359
Ponded water on tailings pond	0.06	0.06	4	4	<1	<1	0.01	0.009	<0.001	<0.001	0.0555*	0.0534*	0.039	0.014	0.485	0.534
Ponded water on tailings pond	<0.01	<0.01	3	3	<1	<1	0.001	0.001	<0.001	<0.001	0.0037	0.0037	0.016	0.014	2.343	2.049
Wanlock Water D/S of tailings ponds	0.06	0.06	5	5	<1	<1	0.001	<0.001	<0.001	<0.001	0.0024	0.0024	0.002	0.002	0.058	0.061
Wanlock Water D/S of tailings ponds	0.08	0.07	7	6	<1	<1	0.002	<0.001	<0.001	<0.001	0.0029	0.0028	0.003	0.002	0.058	0.064
Wanlock Water D/S of tailings ponds	0.08	0.07	7	7	<1	<1	0.001	0.001	<0.001	<0.001	0.0028	0.0028	0.002	0.002	0.043	0.035
Wanlock Water D/S of tailings ponds	0.07	0.07	7	7	<1	<1	0.001	0.001	<0.001	<0.001	0.0026	0.0029	0.002	0.002	0.036	0.068
Wanlock Water D/S of tailings ponds	0.04	0.04	7	7	<1	<1	<0.001	0.001	<0.001	<0.001	0.0029	0.0029	0.002	0.002	0.047	0.045
Wanlock Water D/S of tailings ponds	0.07	0.07	6	6	<1	<1	<0.001	<0.001	<0.001	<0.001	0.003	0.0028	0.002	0.001	0.118	0.042
Wanlock Water D/S of tailings ponds	0.05	0.05	5	5	<1	<1	0.001	0.001	<0.001	0.001	0.0024	0.0027	0.003	0.004	0.064	0.121
Wanlock Water D/S of tailings ponds	0.08	0.08	7	7	<1	<1	0.002	0.002	<0.001	<0.001	0.0078	0.0079	0.007	0.002	0.051	0.12
Wanlock Water D/S of tailings ponds	0.06	0.07	7	7	<1	<1	0.002	0.002	0.001	0.001	0.0027	0.0025	0.006	0.002	1.029	0.058
Wanlock Water D/S of tailings ponds	0.07	0.07	7	8	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0024	0.0024	0.001	0.001	0.049	0.089
Wanlock Water D/S of tailings ponds	0.07	0.07	7	6	<1	<1	<0.001	0.001	<0.001	<0.001	0.0023	0.0029	0.002	0.004	0.051	0.359
Sowen Burn prior to Wanlock Water	0.03	0.03	3	3	<1	<1	0.002	0.002	<0.001	<0.001	0.0013	0.0013	<0.001	<0.001	0.011	0.012
Sowen Burn prior to Wanlock Water	0.02	0.03	4	4	<1	<1	0.002	0.002	<0.001	<0.001	0.0016	0.0016	<0.001	<0.001	0.026	0.027
Sowen Burn prior to Wanlock Water	0.02	0.03	4	4	<1	<1	0.002	0.002	<0.001	<0.001	0.0003	0.0002	<0.001	<0.001	0.003	0.001
Sowen Burn prior to Wanlock Water	0.02	0.02	4	5	<1	<1	0.002	0.002	<0.001	<0.001	0.0003	0.0003	<0.001	<0.001	0.035	0.025
Sowen Burn prior to Wanlock Water	<0.01	<0.01	4	4	<1	<1	0.002	0.002	<0.001	<0.001	0.0003	0.0003	<0.001	<0.001	0.011	0.006
Sowen Burn prior to Wanlock Water	0.02	0.02	3	4	<1	<1	0.002	0.002	<0.001	0.002	0.0004	0.0003	0.001	<0.001	0.011	0.006
Sowen Burn prior to Wanlock Water	0.01	<0.01	3	3	<1	<1	0.002	0.002	0.001	<0.001	0.0002	0.0002	<0.001	<0.001	0.03	0.025
Sowen Burn prior to Wanlock Water	0.02	0.02	4	4	<1	<1	0.002	0.002	<0.001	<0.001	0.0003	0.0003	<0.001	<0.001	0.005	0.004
Sowen Burn prior to Wanlock Water	0.01	0.01	7	5	<1	<1	0.003	0.003	0.002	0.001	0.0003	0.0004	<0.001	<0.001	0.015	0.015
Sowen Burn prior to Wanlock Water	0.01	0.01	3	3	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	<0.001	0.003
Sowen Burn prior to Wanlock Water	0.02	0.02	4	4	<1	<1	0.003	0.002	<0.001	<0.001	0.0002	0.0002	0.003	0.002	0.027	0.012
Wanlock Water D/S of Sowen Burn	0.05	0.06	4	5	<1	<1	0.001	0.001	<0.001	<0.001	0.0023	0.0024	0.002	0.002	0.054	0.057
Wanlock Water D/S of Sowen Burn	0.06	0.07	6	6	<1	<1	<0.001	<0.001	<0.001	<0.001	0.0029	0.0029	0.002	0.002	0.066	0.063
Wanlock Water D/S of Sowen Burn	0.07	0.07	6	6	<1	<1	0.001	0.001	<0.001	<0.001	0.0028	0.0028	0.002	0.002	0.051	0.043
Wanlock Water D/S of Sowen Burn	0.05	0.06	7	7	<1	<1	0.001	0.002	<0.001	<0.001	0.0028	0.0029	0.002	0.003	0.073	0.075
Wanlock Water D/S of Sowen Burn	0.03	0.03	6	6	<1	<1	0.001	0.001	<0.001	<0.001	0.0029	0.0029	0.002	0.002	0.065	0.051
Wanlock Water D/S of Sowen Burn	0.06	0.06	5	5	<1	<1	<0.001	0.001	0.001	0.001	0.003	0.003	0.002	0.001	0.045	0.04
Wanlock Water D/S of Sowen Burn	0.05	0.04	5	5	<1	<1	0.001	0.001	0.001	<0.001	0.0025	0.0025	0.003	0.002	0.117	0.07
Wanlock Water D/S of Sowen Burn	0.07	0.07	7	7	<1	<1	0.002	0.002	<0.001	<0.001	0.0025	0.0024	0.006	0.002	0.12	0.048
Wanlock Water D/S of Sowen Burn	0.05	0.05	15	19	<1	<1	0.002	0.002	0.002	0.002	0.0024	0.0023	0.003	0.002	0.128	0.038
Wanlock Water D/S of Sowen Burn	0.06	0.07	7	7	<1	<1	0.002	<0.001	<0.001	<0.001	0.003	0.0024	0.009	<0.001	1.583	0.036
Wanlock Water D/S of Sowen Burn	0.06	0.05	6	16	<1	<1	0.002	0.002	<0.001	<0.001	0.003	0.0024	0.005	0.003	0.4	0.04
Elvan Water	0.02	0.02	4	3	<1	<1	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	0.003	0.002	0.013	0.014

	On Site Lead	Zinc as Zn (Total)	Zinc as Zn (Dissolved)	On Site Zinc	Manganese as Mn (Total) a	Manganese as MN (Dissolved) a	Iron as Fe (Total) a	Iron as Fe (Dissolved) a	Aluminium as Al (Total) a	Aluminium as Al (Dissolved) a	Arsenic as As (Total)	Arsenic as As (Dissolved)	Boron as B (Total) a	Boron as B (Dissolved) a	Mercury as Hg (Total)	Mercury as Hg (Dissolved)
		ICPMSW	ICPMSW		ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPMSW	ICPMSW	ICPWATVAR	ICPWATVAR	ICPMSW	ICPMSW
Site	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Downstream of crushing mill		0.729	0.729		0.04	0.03	<0.01	<0.01	0.04	0.03	<0.001	<0.001	0.03	0.03		
Downstream of crushing mill	1.1	0.708	0.631	3*	<0.01	<0.01	0.01	<0.01	0.01	<0.01	<0.001	<0.001	<0.01	<0.01		
Downstream of crushing mill	1.27	0.607	0.59	0.70	0.01	0.01	<0.01	<0.01	0.03	0.03	<0.001	<0.001	<0.01	<0.01		
Downstream of crushing mill		0.606	0.577		0.01	0.01	0.03	<0.01	0.03	0.03	<0.001	<0.001	<0.01	<0.01		
Downstream of crushing mill		0.376	0.378		0.01	0.01	<0.01	0.01	0.03	0.03	<0.001	<0.001	<0.01	<0.01		
Downstream of crushing mill		0.424	0.417		<0.01	<0.01	0.02	0.05	0.03	0.03	<0.001	<0.001	<0.01	0.02		
Downstream of crushing mill		0.401	0.407		0.01	<0.01	0.01	0.01	0.03	0.02	<0.001	<0.001	<0.01	<0.01		
Downstream of crushing mill		0.94	0.708		0.03	0.02	0.19	<0.01	0.07	0.01	<0.001	<0.001	<0.01	<0.01		
Wanlock Water U/S Smelter Mill Tailings Ponds		0.224	0.24		<0.01	<0.01	0.02	0.03	0.04	0.03	<0.001	<0.001	0.02	<0.01	<0.0001	<0.0001
Wanlock Water U/S Smelter Mill Tailings Ponds		0.267	0.27		<0.01	<0.01	0.03	0.02	0.02	0.02	<0.001	<0.001	0.03	0.05		
Wanlock Water U/S Smelter Mill Tailings Ponds		0.273	0.27		0.02	0.01	0.02	<0.01	0.02	0.01	<0.001	<0.001	<0.01	<0.01		
Wanlock Water U/S Smelter Mill Tailings Ponds		0.308	0.27		0.02	0.02	0.03	0.02	0.03	0.02	<0.001	<0.001	<0.01	<0.01		
Wanlock Water U/S Smelter Mill Tailings Ponds		0.311	0.268		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.01	<0.01		
Wanlock Water U/S Smelter Mill Tailings Ponds		0.298	0.292		<0.01	<0.01	<0.01	<0.01	0.01	0.01	<0.001	<0.001	<0.01	<0.01		
Wanlock Water U/S Smelter Mill Tailings Ponds		0.266	0.255		<0.01	<0.01	0.06	0.02	0.05	0.03	<0.001	<0.001	<0.01	0.01		
Wanlock Water U/S Smelter Mill Tailings Ponds		0.257	0.246		0.01	<0.01	0.05	<0.01	0.02	0.01	<0.001	<0.001	<0.01	<0.01		
Wanlock Water U/S Smelter Mill Tailings Ponds		0.242	0.229		<0.01	0.01	0.07	0.01	0.04	0.01	<0.001	<0.001	<0.01	<0.01		
Wanlock Water U/S Smelter Mill Tailings Ponds		0.225	0.219		<0.01	<0.01	0.06	<0.01	0.02	0.02	<0.001	<0.001	<0.01	<0.01		
Wanlock Water U/S Smelter Mill Tailings Ponds		0.263	0.235		0.02	<0.01	0.14	0.02	0.06	0.01	<0.001	<0.001	<0.01	<0.01		
Tailings Pond Ditch	1.84	1.605	1.455	1.6	0.18	0.16	0.57	0.39	0.42	0.36	0.001	<0.001	<0.01	<0.01		
Tailings Pond Ditch	1.7	1.102	1.579	1.3	0.14	0.44	0.4	1.22	0.37	0.44	<0.001	0.002	<0.01	<0.01		
Tailings Pond Ditch		1.495	1.07		0.09	0.04	0.77	0.3	0.3	0.23	0.002	<0.001	<0.01	<0.01		
Tailings Pond Ditch		1.987	1.926		0.08	0.08	0.2	0.12	0.17	0.14	<0.001	<0.001	<0.01	<0.01		
Tailings Pond Ditch		0.281	0.291		0.04	0.04	0.14	0.1	0.03	0.02	<0.001	<0.001	<0.01	<0.01		
Tailings Pond Ditch		1.135	1.096		0.06	0.05	0.24	0.11	0.14	0.1	<0.001	<0.001	<0.01	<0.01		
Tailings Pond Runoff	0.75	0.491	0.407	0.5	0.19	0.18	0.38	0.18	0.07	0.04	<0.001	<0.001	<0.01	0.01		
Tailings Pond Runoff	0.5	0.266	0.26	0.05*	0.08	0.07	0.18	0.12	<0.01	<0.01	<0.001	<0.001	<0.01	<0.01		
Tailings Pond Runoff	0.32	0.187	0.16	0.35*	0.03	0.04	0.08	0.19	0.04	0.18	<0.001	<0.001	<0.01	0.01		
Tailings Pond Runoff		1.283	0.656		0.07	0.03	0.76	0.09	0.26	0.04	0.003	<0.001	0.01	0.02		
Tailings Pond Runoff		0.555	0.414		0.06	0.04	0.74	0.24	0.28	0.08	0.002	<0.001	<0.01	<0.01		
Tailings Pond Runoff		1.348	0.451		0.19	0.02	1.05	0.01	0.13	<0.01	0.003	<0.001	<0.01	<0.01		
Tailings Pond Runoff		2.725	2.946		0.45	0.07	2.87	0.28	0.56	0.07	0.009	0.001	<0.01	<0.01		
Ponded water on tailings pond		0.481	0.479		0.05	0.05	0.66	0.56	0.23	0.18	<0.001	<0.001	<0.01	<0.01		
Ponded water on tailings pond	2.14	0.438	0.411	0.6	0.08	0.08	1.1	0.91	0.25	0.22	<0.001	<0.001	<0.01	<0.01		
Ponded water on tailings pond	1.4	0.289	0.273	1.7*	0.04	0.03	0.87	0.77	0.19	0.17	<0.001	<0.001	<0.01	<0.01		
Ponded water on tailings pond	1.41	0.277	0.269	0.59*	0.04	0.04	0.42	0.41	0.14	0.14	<0.001	<0.001	<0.01	<0.01		
Ponded water on tailings pond		0.249	0.245		0.03	0.03	0.31	0.29	0.12	0.12	<0.001	<0.001	<0.01	<0.01		
Ponded water on tailings pond		0.318	0.343		0.04	0.04	0.48	0.32	0.11	0.12	<0.001	<0.001	<0.01	<0.01		
Ponded water on tailings pond		11.17	12.01		0.28	0.16	0.62	<0.01	0.43	0.03	0.002	<0.001	<0.01	<0.01		
Ponded water on tailings pond		0.53	0.512		0.05	0.05	0.19	0.11	0.09	0.07	<0.001	<0.001	<0.01	<0.01		
Wanlock Water D/S of tailings ponds		0.254	0.252		<0.01	0.01	0.02	0.02	0.04	0.03	<0.001	<0.001	0.02	<0.01	<0.0001	<0.0001
Wanlock Water D/S of tailings ponds		0.301	0.301		<0.01	<0.01	0.02	0.02	0.02	0.02	<0.001	<0.001	<0.01	<0.01		
Wanlock Water D/S of tailings ponds		0.295	0.29		0.01	<0.01	<0.01	<0.01	0.02	0.02	<0.001	<0.001	<0.01	<0.01		
Wanlock Water D/S of tailings ponds		0.277	0.309		0.02	0.03	0.04	0.02	0.03	0.03	<0.001	<0.001	0.02	0.02		
Wanlock Water D/S of tailings ponds		0.303	0.306		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.01	<0.01		
Wanlock Water D/S of tailings ponds		0.341	0.318		0.02	0.01	<0.01	<0.01	0.02	0.02	<0.001	<0.001	<0.01	<0.01		
Wanlock Water D/S of tailings ponds		0.28	0.307		<0.01	0.01	0.02	0.08	0.03	0.05	<0.001	<0.001	0.01	0.01		
Wanlock Water D/S of tailings ponds		0.528	0.5		0.05	0.02	0.32	<0.01	0.1	0.03	<0.001	<0.001	<0.01	<0.01		
Wanlock Water D/S of tailings ponds		0.317	0.271		0.01	0.01	0.12	0.05	0.05	0.02	<0.001	<0.001	<0.01	<0.01		
Wanlock Water D/S of tailings ponds		0.25	0.247		<0.01	0.01	0.01	<0.01	0.01	<0.01	<0.001	<0.001	<0.01	<0.01		
Wanlock Water D/S of tailings ponds		0.242	0.31		<0.01	0.02	0.01	0.08	0.03	0.04	<0.001	<0.001	0.02	<0.01		
Sowen Burn prior to Wanlock Water		0.133	0.139		0.02	0.03	0.04	0.04	0.02	0.01	<0.001	<0.001	0.02	<0.01	<0.0001	<0.0001
Sowen Burn prior to Wanlock Water		0.136	0.136		0.04	0.03	0.09	0.09	0.04	0.04	<0.001	<0.001	<0.01	0.01		
Sowen Burn prior to Wanlock Water		0.019	0.02		0.03	0.03	0.21	0.06	0.03	0.02	<0.001	<0.001	<0.01	<0.01		
Sowen Burn prior to Wanlock Water		0.017	0.017		0.07	0.06	0.13	0.07	0.06	0.04	<0.001	<0.001	0.01	<0.01		
Sowen Burn prior to Wanlock Water		0.025	0.025		0.04	0.04	0.16	0.06	<0.01	<0.01	<0.001	<0.001	0.01	0.02		
Sowen Burn prior to Wanlock Water		0.027	0.026		0.04	0.05	0.13	0.07	0.03	0.03	<0.001	<0.001	0.01	0.02		
Sowen Burn prior to Wanlock Water		0.013	0.013		0.03	0.03	0.18	0.06	0.08	0.05	<0.001	<0.001	<0.01	<0.01		
Sowen Burn prior to Wanlock Water		0.02	0.021		0.03	0.03	0.11	0.04	0.04	0.03	<0.001	<0.001	<0.01	0.01		
Sowen Burn prior to Wanlock Water		0.025	0.033		0.03	0.04	0.15	0.14	0.06	0.05	<0.001	<0.001	<0.01	<0.01		
Sowen Burn prior to Wanlock Water		<0.002	<0.002		<0.01	0.01	0.07	0.03	0.01	<0.01	<0.001	<0.001	<0.01	<0.01		
Sowen Burn prior to Wanlock Water		0.025	0.017		0.04	0.03	0.28	0.05	0.07	0.03	<0.001	<0.001	<0.01	<0.01		
Wanlock Water D/S of Sowen Burn	0.3*	0.245	0.249	0.7*	<0.01	<0.01	0.03	0.03	0.03	0.02	<0.001	<0.001	0.03	<0.01	<0.0001	<0.0001
Wanlock Water D/S of Sowen Burn	0.31	0.291	0.287	0.8*	0.02	0.02	0.03	0.03	0.03	0.03	<0.001	<0.001	0.02	0.02		
Wanlock Water D/S of Sowen Burn		0.293	0.292		0.02	<0.01	0.02	<0.01	0.02	0.01	<0.001	<0.001	0.01	<0.01		
Wanlock Water D/S of Sowen Burn		0.299	0.301		0.03	0.03	0.06	0.04	0.03	0.04	<0.001	<0.001	<0.01	<0.01		
Wanlock Water D/S of Sowen Burn	0.25*	0.298	0.297	2.6*	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.001	<0.001	0.03	0.01		
Wanlock Water D/S of Sowen Burn		0.32	0.315		0.02	0.02	0.01	<0.01	0.02	0.02	<0.001	<0.001	0.02	0.04		
Wanlock Water D/S of Sowen Burn		0.288	0.278		0.01	0.01	0.09	0.02	0.05	0.03	<0.001	<0.001	<0.01	<0.01		
Wanlock Water D/S of Sowen Burn		0.269	0.262		0.02	0.01	0.16	0.07	0.04	0.02	<0.001	<0.001	0.01	0.02		
Wanlock Water D/S of Sowen Burn		0.284	0.252		0.01	<0.01	0.1	0.1	0.05	0.02	<0.001	<0.001	<0.01	<0.01		
Wanlock Water D/S of Sowen Burn		0.367	0.242		0.07	<0.01	0.55	<0.01	0.14	<0.01	0.001	<0.001	<0.01	<0.01		
Wanlock Water D/S of Sowen Burn		0.372	0.248		0.03	0.01	0.22	0.04	0.1	0.02	<0.001	<0.001	<0.01	<0.01		
Elvan Water		0.01	0.01		0.03	<0.01	0.32	0.04	0.27	0.07	<0.001	<0.001	<0.01	<0.01		

Site	Tin as Sn (Total)	Tin as Sn (Dissolved)	Nitrate as N	Phosphate as P	Total Organic Carbon w	Ammoniacal Nitrogen as N	Barium as Ba (Total) a	Barium as Ba (Dissolved) a	Lithium as Li (Total) a	Lithium as Li (DIssolved) a	Dissolved Organic Carbon w	Silicon as Si (Dissolved) a	Cold Acidity as CaCO3 w	Easting	Northing
	ICPMSW	ICPMSW	KONENS	KONENS	WSLM13	KONENS	ICPWATVAR	ICPWATVAR	ICPWATVAR	ICPWATVAR	WSLM13	ICPWATVAR	WSLM17		
	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		
Downstream of crushing mill			<0.2	<0.01	0.46		0.09	0.08	<0.01	<0.01	0.38			285795	614040
Downstream of crushing mill			0.2	0.01	<0.2		0.12	0.09	<0.01	<0.01	0.26			285795	614040
Downstream of crushing mill			0.3	<0.01	<0.2		0.08	0.08	<0.01	<0.01	<0.2			285795	614040
Downstream of crushing mill							0.08	0.07	<0.01	<0.01	0.41			285795	614040
Downstream of crushing mill			0.3	0.1	0.38		0.07	0.07	<0.01	<0.01	0.31			285795	614040
Downstream of crushing mill			0.2	0.14	<0.2		0.07	0.07	<0.01	<0.01	0.25			285795	614040
Downstream of crushing mill			<0.2	0.19	<0.2		0.07	0.07	<0.01	<0.01	<0.2			285795	614040
Downstream of crushing mill			0.6	<0.01	<0.2		0.13	0.07	<0.01	<0.01	0.21			285795	614040
Wanlock Water U/S Smelter Mill Tailings Ponds	<0.001	<0.001	0.4	0.01	1.7		0.05	0.05	<0.01	<0.01	1.6			285638	614123
Wanlock Water U/S Smelter Mill Tailings Ponds			0.4	0.01	0.92		0.07	0.07	<0.01	<0.01	0.66		4	285638	614123
Wanlock Water U/S Smelter Mill Tailings Ponds			<0.2	<0.01	0.67		0.06	0.06	<0.01	<0.01	0.92			285638	614123
Wanlock Water U/S Smelter Mill Tailings Ponds			1	0.02	1.7		0.05	0.05	<0.01	<0.01	1.6			285638	614123
Wanlock Water U/S Smelter Mill Tailings Ponds			0.3	0.02	0.51		0.04	0.06	<0.01	<0.01	0.59			285638	614123
Wanlock Water U/S Smelter Mill Tailings Ponds			<0.2	<0.01	0.3		0.06	0.06	<0.01	<0.01	0.58			285638	614123
Wanlock Water U/S Smelter Mill Tailings Ponds							0.05	0.05	<0.01	<0.01	1.6			285638	614123
Wanlock Water U/S Smelter Mill Tailings Ponds			0.4	0.11	0.4		0.07	0.06	<0.01	<0.01	0.43			285638	614123
Wanlock Water U/S Smelter Mill Tailings Ponds			0.2	0.08	0.43		0.07	0.05	<0.01	<0.01	0.58			285638	614123
Wanlock Water U/S Smelter Mill Tailings Ponds			0.2	0.39	<0.2		0.06	0.06	<0.01	<0.01	<0.2			285638	614123
Wanlock Water U/S Smelter Mill Tailings Ponds			0.4	<0.01	0.85		0.07	0.06	<0.01	<0.01	0.79			285638	614123
Tailings Pond Ditch			0.7	0.01	14		0.14	0.07	<0.01	<0.01	14			285550	614210
Tailings Pond Ditch			<0.2	0.01	12		0.14	0.5	<0.01	<0.01	13			285550	614210
Tailings Pond Ditch							0.49	0.05	<0.01	<0.01	10			285550	614210
Tailings Pond Ditch			<0.2	0.1	5.5		0.09	0.07	<0.01	<0.01	5.6			285550	614210
Tailings Pond Ditch			0.2	0.31	1.4		0.07	0.07	<0.01	<0.01	1.5			285550	614210
Tailings Pond Ditch			<0.2	<0.01	5.8		0.12	0.06	<0.01	<0.01	5.9			285550	614210
Tailings Pond Runoff			0.7	0.02	3.7		0.17	0.16	<0.01	<0.01	3.7			285530	614225
Tailings Pond Runoff			<0.2	0.01	2.3		0.16	0.15	<0.01	<0.01	2.5			285530	614225
Tailings Pond Runoff			<0.2	<0.01	1.5		0.14	0.1	<0.01	<0.01	1.6			285530	614225
Tailings Pond Runoff							0.57	0.08	<0.01	<0.01	3			285530	614225
Tailings Pond Runoff			<0.2	0.05	5.1		0.57	0.04	<0.01	<0.01	5.1			285530	614225
Tailings Pond Runoff			<0.2	0.23	<0.2		1.48	0.1	<0.01	<0.01	0.26			285530	614225
Tailings Pond Runoff			<0.2	<0.01	1.6		3.3	0.13	<0.01	<0.01	1.7			285530	614225
Ponded water on tailings pond			<0.2	<0.01	15		0.06	0.06	<0.01	<0.01	15			285525	614240
Ponded water on tailings pond			0.9	0.02	13		0.07	0.07	<0.01	<0.01	13			285525	614240
Ponded water on tailings pond			<0.2	0.29	11		0.07	0.06	<0.01	<0.01	11			285525	614240
Ponded water on tailings pond			<0.2	<0.01	8.6		0.05	0.05	<0.01	<0.01	8.6			285525	614240
Ponded water on tailings pond							0.04	0.03	<0.01	<0.01	7.9			285525	614240
Ponded water on tailings pond			<0.2	0.07	6.6		0.03	0.05	<0.01	<0.01	6.8			285525	614240
Ponded water on tailings pond			<0.2	0.26	0.38		0.62	0.13	<0.01	<0.01	0.55			285525	614240
Ponded water on tailings pond			0.9	<0.01	5.5		0.11	0.05	<0.01	<0.01	5.3			285525	614240
Wanlock Water D/S of tailings ponds	<0.001	<0.001	0.4	0.01	1.5		0.05	0.06	<0.01	<0.01	1.5			285489	614305
Wanlock Water D/S of tailings ponds			0.3	0.01	1.6		0.07	0.07	<0.01	<0.01	0.77		3	285489	614305
Wanlock Water D/S of tailings ponds			<0.2	<0.01	0.73		0.07	0.06	<0.01	<0.01	0.88			285489	614305
Wanlock Water D/S of tailings ponds			0.5	<0.01	1.6		0.05	0.05	<0.01	<0.01	1.7			285489	614305
Wanlock Water D/S of tailings ponds			0.3	0.02	0.54		0.06	0.06	<0.01	<0.01	0.63			285489	614305
Wanlock Water D/S of tailings ponds			<0.2	<0.01	0.33		0.07	0.06	<0.01	<0.01	0.48			285489	614305
Wanlock Water D/S of tailings ponds							0.05	0.06	<0.01	<0.01	1.6			285489	614305
Wanlock Water D/S of tailings ponds			0.8	0.11	0.42		0.14	0.06	<0.01	<0.01	0.43			285489	614305
Wanlock Water D/S of tailings ponds			0.3	0.05	0.68		0.15	0.06	<0.01	<0.01	0.7			285489	614305
Wanlock Water D/S of tailings ponds			0.4	0.21	<0.2		0.06	0.06	<0.01	<0.01	<0.2			285489	614305
Wanlock Water D/S of tailings ponds			0.3	<0.01	0.79		0.06	0.1	<0.01	<0.01	0.83			285489	614305
Sowen Burn prior to Wanlock Water	<0.001	<0.001	<0.2	<0.01	0.76		0.03	0.04	<0.01	<0.01	0.45			285427	614457
Sowen Burn prior to Wanlock Water			<0.2	<0.01	0.71		0.04	0.04	<0.01	<0.01	0.45		3	285427	614457
Sowen Burn prior to Wanlock Water			<0.2	<0.01	0.46		0.03	0.03	<0.01	<0.01	0.76			285427	614457
Sowen Burn prior to Wanlock Water			<0.2	<0.01	1		0.03	0.03	<0.01	<0.01	0.86			285427	614457
Sowen Burn prior to Wanlock Water			<0.2	0.02	0.32		0.03	0.03	<0.01	<0.01	0.44			285427	614457
Sowen Burn prior to Wanlock Water			<0.2	<0.01	<0.2		0.03	0.03	<0.01	<0.01	0.35			285427	614457
Sowen Burn prior to Wanlock Water							0.02	0.02	<0.01	<0.01	0.89			285427	614457
Sowen Burn prior to Wanlock Water			0.3	0.08	0.47		0.03	0.03	<0.01	<0.01	0.41			285427	614457
Sowen Burn prior to Wanlock Water			0.9	0.05	0.39		0.03	0.03	<0.01	<0.01	0.51			285427	614457
Sowen Burn prior to Wanlock Water			<0.2	0.07	<0.2		0.02	0.02	<0.01	<0.01	<0.2			285427	614457
Sowen Burn prior to Wanlock Water			<0.2	<0.01	0.74		0.03	0.03	<0.01	<0.01	0.77			285427	614457
Wanlock Water D/S of Sowen Burn	<0.001	<0.001	0.3	<0.01	1.9		0.04	0.05	<0.01	<0.01	1.8			285397	614483
Wanlock Water D/S of Sowen Burn			0.3	<0.01	1.1		0.06	0.06	<0.01	<0.01	0.76		2	285397	614483
Wanlock Water D/S of Sowen Burn			<0.2	0.01	0.66		0.06	0.06	<0.01	<0.01	0.98			285397	614483
Wanlock Water D/S of Sowen Burn			0.3	0.01	1.6		0.05	0.05	<0.01	<0.01	1.6			285397	614483
Wanlock Water D/S of Sowen Burn			0.3	0.02	0.68		0.06	0.06	<0.01	<0.01	0.8			285397	614483
Wanlock Water D/S of Sowen Burn			<0.2	<0.01	0.43		0.05	0.06	<0.01	<0.01	0.46			285397	614483
Wanlock Water D/S of Sowen Burn							0.05	0.05	<0.01	<0.01	15			285397	614483
Wanlock Water D/S of Sowen Burn			0.4	0.08	0.45		0.06	0.06	<0.01	<0.01	0.39			285397	614483
Wanlock Water D/S of Sowen Burn			<0.2	0.06	<0.2		0.06	0.05	<0.01	<0.01	0.53			285397	614483
Wanlock Water D/S of Sowen Burn			0.4	0.07	<0.2		0.18	0.06	<0.01	<0.01	<0.2			285397	614483
Wanlock Water D/S of Sowen Burn			0.3	<0.01	0.74		0.1	0.05	<0.01	<0.01	0.8			285397	614483
Elvan Water			<0.2	<0.01	3.3		0.01	0.01	<0.01	<0.01	3.3			290280	615770

APPENDICES 2

COLLATED ON SITE DATA

Site Ref	Date	Time	pH	Eh (mV)	EC (µs/cm @ 25°C)	TDS (ppm)	Temp (°C)	Pb (mg/l)	Zn (mg/L)	Comments
Adit 5 Pipes	17-May-12	11:30	6.17		126	63	7.1	0.23		Flow approx 0.5 to 1l/s
Adit 5 Pipes	18-May-12	11:00	6.90		128	64	7.1	0.25	5.45	Flow approx 1l/s Very High Zn - confirm with lab data
Adit 5 Pipes	26-Jun-12	11:15	6.71		106	52	7.1	0.15	0.15	
Adit 5 Pipes	31-Jul-12	10:30	6.90	78	126	81	7.9			Flow 1.0l/s
Adit 5 Pipes	21-Aug-12	17:00	7.02	170	117	76	7.6			
Adit 5 Pipes	24-Oct-12	15:40	6.96	124	102	75	7.2			
Adit 5 Pipes	11-Dec-12	15:10	7.26	131	108	79	5.6			
Adit Pipe D/S of Road	17-May-12	11:15	6.53		151	75	6.1			Flow approx 0.5l/s
Adit Pipe D/S of Road	18-May-12	10:30	6.99		151	76	6.7	0.23	0.03	Flow approx 0.5 to 1l/s
Adit Pipe D/S of Road	31-Jul-12	10:15	7.11	60	153	100	7.4			Flow 1.0l/s
Adit Spring D/S of Road	18-May-12	10:45	6.88		131	65	6.4	0.25		Zn measured as 1.99 believed to be sampling error
Adit Spring D/S of Road	26-Jun-12	10:00	6.92		424	63	6.9			Flow approx 0.5 to 1l/s
Adit Spring D/S of Road	31-Jul-12	10:00	7.07	41	136	88	7.6			Flow 0.5l/s
Adit Spring D/S of Road	21-Aug-12	16:35	7.13	156	129	84	7.4			
Background	17-May-12	15:45	6.41		40	21	7.4	0.17	0.16	
Background	26-Jun-12	15:45	7.27		52	26	9.8			
Background	31-Jul-12	15:00	6.88	103	65	42	10.9			
Background	21-Aug-12	10:20	7.02	86	59	38	10.8			
Background	18-Sep-12	10:40	7.31	43	61	40	8.7			
Background	24-Oct-12	10:30	7.24	58	54	39	82			
Background	20-Nov-12	10:20	6.61	116	36	25	7.8			
Background	11-Dec-12	10:15	7.21	147	55	40	3.5			
Background	30-Jan-13	10:10	7.1	152	44	32	5			
Background	19-Feb-13	11:20	7.27	96	64.6	49.6	4.8			
Bay Mine Adit	17-May-12	18:00	6.57		144	77	7.0	0.26	0.28	No flow in Wanlock Water upstream of Bay Mine
Bay Mine Adit	26-Jun-12	13:30	6.85		143	71	7.5	0.27	0.27	Higher flow than previous visits
Bay Mine Adit	31-Jul-12	13:00	7.17	99	149	96	8.7			
Bay Mine Adit	21-Aug-12	14:20	7.08	142	144	93	8.5		0.24	
Bay Mine Adit	18-Sep-12	14:30	7.7	80	145	94	7.8	0.28	1.1	L:9.2 W:0.9 D:0.24 T:7.8 EC192 START 16:38:20
Bay Mine Adit	24-Oct-12	13:45	6.48	72	123	89	7.8	0.42	1.46*	Pb / Zn on 25 October 2012
Bay Mine Adit	20-Nov-12	13:00	6.63	135	122	89	7.4			
Bay Mine Adit	11-Dec-12	13:40	7.12	133	138	100	5.5			
Bay Mine Adit	30-Jan-13	13:30	7.3	130	131	96	6.7			
Bay Mine Adit	19-Feb-13	12:45	7.27	104	161	107	7.2			

Site Ref	Date	Time	pH	Eh (mV)	EC (µs/cm @ 25°C)	TDS (ppm)	Temp (°C)	Pb (mg/l)	Zn (mg/L)	Comments
Crushing Mill D/S	21-Aug-12	12:15	6.76	134	78	50	14.6			
Crushing Mill D/S	18-Sep-12	12:00	7.03	85	79	51	11.4	1.1	3	0.1LPS
Crushing Mill D/S	24-Oct-12	11:40	7.18	72	62	45	8.9	1.27	0.7	Pb / Zn on 25 October 2012
Crushing Mill D/S	20-Nov-12	11:20	6.46	132	55	41	8.2			flow 1lps
Crushing Mill D/S	11-Dec-12	11:30	7.06	146	58	42	2.9			
Crushing Mill D/S	30-Jan-13	11:30	6.8	126	5	38	4.3			FLOW 1LPS
Crushing Mill D/S	19-Feb-13	11:20	7.15	113	63.6	42.5	4.6			
Ditch through tailings	21-Aug-12	11:30	6.74	130	46	29	17.4	1.84	1.6	
Ditch through tailings	18-Sep-12	11:20	7.03	56	39	25	11.1	1.72	1.3	0.2LPS
Ditch through tailings	20-Nov-12	10:55	7.04	113	37	25	8.5			flow 1-2lps
Ditch through tailings	30-Jan-13	10:50	7	146	58	43	3.1			FLOW 0.2LPS
Ditch through tailings	19-Feb-13	10:40	7.12	97	71.96	448.2	2.1			
Glencrieff Stream	17-May-12	13:15	6.56		50	25	6.5	0.35	0.11	
Glencrieff Stream	21-Aug-12	15:50	7.31	122	51	33	13.6			
Glencrieff Stream	24-Oct-12	14:50	6.64	94	53	39	8			
Glenglass level	17-May-12	17:45	6.75		200	100	8.2	0.37	0.57	Flow approx 20l/s
Glenglass level	26-Jun-12	14:45	7.05		152	77	8.7	0.20	2.11*	
Glenglass level	31-Jul-12	13:30	6.62	106	179	116	9.9			
Glenglass level	21-Aug-12	12:30	6.95	140	165	107	10.6		0.55	
Glenglass level	18-Sep-12	12:15	7.11	86	170	110	9.7	0.31	3	L:11 W:1.1 D:0.12 T:22S EC187.5MS START 15:24
Glenglass level	24-Oct-12	12:00	6.99	62	145	105	8.5	0.48	0.58	Pb / Zn on 25 October 2012
Glenglass level	20-Nov-12	11:40	6.3	151	155	113	8.4			
Glenglass level	11-Dec-12	11:50	7.01	144	185	136	6.6			
Glenglass level	30-Jan-13	11:50	6.75	132	162	119	7.1			
Glenglass level	19-Feb-13	12:00	7.23	116	217	146	7.4			

Site Ref	Date	Time	pH	Eh (mV)	EC (µs/cm @ 25°C)	TDS (ppm)	Temp (°C)	Pb (mg/l)	Zn (mg/L)	Comments
Glenglass Stream above Glencrieff Tip	17-May-12	13:00	6.65		58	28	9.4			Flow approx 1 to 2l/s
Glenglass Stream above Glencrieff Tip	26-Jun-12	12:45	6.67		15.1	30	61.0			
Glenglass Stream above Glencrieff Tip	31-Jul-12	11:30	7.12	97	76	48	13.8			
Glenglass Stream above Glencrieff Tip	21-Aug-12	15:30	7.33	93	68	43	14.1			
Glenglass Stream above Glencrieff Tip	20-Nov-12	14:10	6.9	109	37	27	8.1			
Glenglass Stream below Glencrieff Tip	17-May-12	12:30	6.78		37	64	7.2	0.21	0.08	Flow approx 1 to 2l/s
Glenglass Stream below Glencrieff Tip	26-Jun-12	12:15	7.14		74	37	11.6	0.12	1.95*	
Glenglass Stream below Glencrieff Tip	31-Jul-12	11:15	7.10	84	96	62	12.4			
Glenglass Stream below Glencrieff Tip	21-Aug-12	14:45	7.39	132	83	53	13.8		0.07	
Glenglass Stream below Glencrieff Tip	20-Nov-12	13:40	6.76	134	56	42	7.9			flow 10lps
Glenglass Stream below Glencrieff Tip	30-Jan-13	14:15	7.25	118	52	39	3.5			
Glenglass Stream below Glencrieff Tip	19-Feb-13	13:15	7.60	91	74.56	49.8	3.9			
Glenglass stream spring below tip	26-Jun-12	12:30	7.13		73	37	10.9			
Left Adit Pipe Discharge	26-Jun-12	10:15	6.84		144	72	7.2			Flow 0.8l/s (1.6l in 2secs)
Left Adit Pipe Discharge	21-Aug-12	16:50	7.15	150	157	102	7.6			
Limpen Burn	21-Aug-12	13:45	7.38	129	51	33	13.7			
Limpen Burn	24-Oct-12	12:25	7.41	66	49	36	9.3			
Meadowfoot Adit	26-Jun-12	15:00	7.11		110	55	8.8	0.10	0.18	Flow approx 0.5l/s
Mennockhass Tunnel	20-Nov-12	12:50	6.71	150	104	76	7.9			flow 5lps
Ponded Water on tailings	31-Jul-12	15:30	6.76	127	38	24	22.3			
Ponded Water on tailings	21-Aug-12	11:15	7.14	103	30	19	16.3	2.14	0.6	
Ponded Water on tailings	18-Sep-12	11:30	6.95	70	32	2	9.8	1.37	1.7	0.1LPS
Ponded Water on tailings	24-Oct-12	11:00	7.46	90	25	18	10.1	1.41	0.59	Pb / Zn on 25 October 2012
Ponded Water on tailings	20-Nov-12	10:50	6.67	101	18	13	8.8			flow 1ps
Ponded Water on tailings	30-Jan-13	10:40	7	113	22	15	2.9			FLOW 0.1LPS
Ponded Water on tailings	19-Feb-13	10:50	6.77	125	322	222	2.3			
Right Adit Pipe Discharge	26-Jun-12	10:30	6.84		142	72	7.2	0.12	0.13	Flow 0.9l/s (2l in 2.2secs)
Right Adit Pipe Discharge	21-Aug-12	16:45	7.17	145	152	99	7.7			
Road Adit	26-Jun-12	09:45	6.60		120	60	6.6			Flow approx 0.2l/s
Road Adit	31-Jul-12	09:45	6.82	35	139	90	7.4			Flow 0.1l/s

Site Ref	Date	Time	pH	Eh (mV)	EC (µs/cm @ 25°C)	TDS (ppm)	Temp (°C)	Pb (mg/l)	Zn (mg/L)	Comments
Runoff from tailings	21-Aug-12	11:45	6.83	120	65	41	20.4	0.75	0.5	
Runoff from tailings	18-Sep-12	11:40	7.1	84	58	37	11.1	0.52	0.05	0.1LPS
Runoff from tailings	24-Oct-12	11:10	7.15	89	53	38	10.4	0.32	0.35	Pb / Zn on 25 October 2012
Runoff from tailings	20-Nov-12	11:00	6.36	108	33	24	9.1			flow 0.5lps
Runoff from tailings	11-Dec-12	11:10	7.01	144	79	28	0.5			
Runoff from tailings	30-Jan-13	11:00	6.8	111	23	17	2.9			FLOW 0.05LPS
Runoff from tailings	19-Feb-13	10:55	7.44	100	91.7	61	1.3			
Settlement Pond Issues	20-Nov-12	11:45	6.21	153	58	43	8.7			flow 2-3lPs
Settlement Pond Issues	30-Jan-13	12:00	6.85	130	62	46	3.6			FLOW 1LPS
Sewage Works	17-May-12	17:15	7.20		203	101	7.9			Flow approx 1l/s
Sewage Works	26-Jun-12	14:30	7.93		174	87	10.7			
Sewage Works	31-Jul-12	13:45	6.74	85	235	153	13.2			
Sewage Works	21-Aug-12	13:30	7.2	139	180	117	13			
Sewage Works	18-Sep-12	12:45	7.11	84	221	145	10.3			
Sewage Works	24-Oct-12	12:15	6.95	60	195	145	8.9			
Sewage Works	20-Nov-12	11:50	6.66	147	105	77	8			
Sewage Works	11-Dec-12	12:00	6.98	126	361	275	2.6			
Sewage Works	30-Jan-13	12:10	6.95	126	166	123	4.6			
Sewage Works	19-Feb-13	11:45	7.22	131	533	369.1	4.5			
Sowen Burn	17-May-12	14:45	6.50		80	40	8.3			
Sowen Burn	26-Jun-12	16:15	7.00		72	36	11.1			
Sowen Burn	31-Jul-12	16:15	7.15	102	78	50	13.4			
Sowen Burn	21-Aug-12	10:00	7.35	113	68	44	11.5			
Sowen Burn	18-Sep-12	10:15	7.04	20	72	47	8.5			
Sowen Burn	24-Oct-12	10:10	7.1	94	61	45	8.2			
Sowen Burn	20-Nov-12	10:10	7.19	108	41	30	7.8			
Sowen Burn	11-Dec-12	09:45	6.8	169	61	45	2.9			
Sowen Burn	30-Jan-13	09:45	6.7	159	47	35	4.7			
Sowen Burn	19-Feb-13	10:15	6.82	84	60.2	40.2	4.8			
Tip Drain	17-May-12	12:45	6.60		78	37	7.2	0.15	0.12	Flow approx 0.5 to 1l/s
Tip Drain	21-Aug-12	14:50	7.42	142	84	54	13.7			
Tip Drain	20-Nov-12	13:45	6.67	138	65	48	7.7			flow 5lps
U/S of adit 5 pipes	17-May-12	11:45	7.01		133	66	6.8			
U/S of crushing mill	20-Nov-12	11:25	6.53	141	44	32	8.4			
Whyte's Cleuch	20-Nov-12	15:40	6.76	138	58	43	7.4			

Site Ref	Date	Time	pH	Eh (mV)	EC (µs/cm @ 25°C)	TDS (ppm)	Temp (°C)	Pb (mg/l)	Zn (mg/L)	Comments
WW at Glencrieve Cottage	26-Jun-12	13:00	7.35*		133	66	11.4			
WW at Glencrieve Cottage	21-Aug-12	15:10	7.5*	134	139	89	12.5			
WW at Glencrieve Cottage	24-Oct-12	14:10	6.83	119	124	90	9.2			
WW at Glencrieve Cottage	11-Dec-12	13:55	7.27	126	134	100	3.6			
WW at Glencrieve Cottage	19-Feb-13	13:30	7.45	111	163.1	101.4	6.4			
WW at Museum	17-May-12	12:00	6.95		134	66	7.2	0.25	0.21	
WW at Museum	26-Jun-12	12:00	7.30		128	63	9.5			
WW at Museum	31-Jul-12	11:00	7.00	142	142	92	9.8			
WW at Museum	21-Aug-12	12:45	7.02	142	135	87	10.6			
WW at Museum	18-Sep-12	13:00	7.1	80	137	88	8.2			
WW at Museum	24-Oct-12	13:20	7.12	110	120	87	8.2			
WW at Museum	20-Nov-12	12:25	6.98	145	65	47	8.1			
WW at Museum	11-Dec-12	13:15	6.96	127	125	91	4.7			
WW at Museum	30-Jan-13	13:10	7.1	117	115	84	5.7			
WW at Museum	19-Feb-13	13:00	7.34	97	140.3	92.9	6.4			
WW at Straitsteps	17-May-12	18:30	7.44*		129	65	8.5			pH appears high
WW at Straitsteps	26-Jun-12	13:15	6.77*		136	67	10.6			
WW at Straitsteps	31-Jul-12	11:45	7.18	81	143	92	13.8			
WW at Straitsteps	21-Aug-12	16:05	7.18	132	140	90	11.8			
WW at Straitsteps	18-Sep-12	14:00	6.89	77	140	90	8.5			
WW at Straitsteps	24-Oct-12	14:30	6.7	131	126	90	9			
WW at Straitsteps	20-Nov-12	13:15	6.64	124	82	61	8.1			
WW at Straitsteps	11-Dec-12	14:10	7.36	123	135	99	4.1			
WW at Straitsteps	30-Jan-13	13:50	7.25	111	134	99	5.5			
WW at Straitsteps	19-Feb-13	13:40	7.51	114	164.2	102.3	6.2			
WW D/S of Bay Mine	20-Nov-12	15:30	6.7	135	97	71	7.6			
WW D/S of sewage works	17-May-12	16:45	6.60		145	72	7.5			
WW D/S of sewage works	26-Jun-12	14:15	7.04		143	71	8.8			
WW D/S of sewage works	31-Jul-12	14:00	6.87	77	150	97	10.5			
WW D/S of sewage works	21-Aug-12	14:00	6.92	140	140	90	10.6			
WW D/S of sewage works	18-Sep-12	12:30	7.01	98	141	92	8.7			
WW D/S of sewage works	24-Oct-12	12:40	6.34	54	124	90	8.1			
WW D/S of sewage works	20-Nov-12	12:05	6.64	149	91	67	8..1			
WW D/S of sewage works	11-Dec-12	12:15	6.98	138	141	103	5.2			
WW D/S of sewage works	30-Jan-13	12:20	7.1	127	122	92	6			
WW D/S of sewage works	19-Feb-13	11:40	7.15	132	169	110	6.6			

Site Ref	Date	Time	pH	Eh (mV)	EC (µs/cm @ 25°C)	TDS (ppm)	Temp (°C)	Pb (mg/l)	Zn (mg/L)	Comments
WW D/S of tailings pond	17-May-12	15:15	6.55		125	62	8.2			
WW D/S of tailings pond	26-Jun-12	15:30	6.75		131	65	10.0			
WW D/S of tailings pond	31-Jul-12	14:45	6.55*	154	143	91	13.8			
WW D/S of tailings pond	21-Aug-12	12:00	6.9	134	129	83	12			
WW D/S of tailings pond	18-Sep-12	11:50	6.9	53	136	88	9			
WW D/S of tailings pond	24-Oct-12	11:25	6.87	65	1192	86	8.4			
WW D/S of tailings pond	20-Nov-12	11:10	6.38	133	99	72	8.1			
WW D/S of tailings pond	11-Dec-12	11:20	7.14	158	133	97	4.2			
WW D/S of tailings pond	30-Jan-13	11:10	6.7	118	118	87	5.4			
WW D/S of tailings pond	19-Feb-13	11:10	7.03	115	153	101.7	5.8			
WW Downstream of Sowen Burn	17-May-12	14:30	6.66		117	63	8.3	0.30	0.70	
WW Downstream of Sowen Burn	26-Jun-12	16:00	7.05		120	60	10.4	0.31	0.80	
WW Downstream of Sowen Burn	31-Jul-12	16:00	6.85	140	136	87	12.7			
WW Downstream of Sowen Burn	21-Aug-12	09:45	6.9	119	125	81	11.2			
WW Downstream of Sowen Burn	18-Sep-12	10:00	6.3	-11	126	81	8.6	0.25	2.6	L:1M W:2.5M D:0.22M SEC:17.1
WW Downstream of Sowen Burn	24-Oct-12	10:00	6.31	100	137	80	8.2			
WW Downstream of Sowen Burn	20-Nov-12	10:00	6.7	131	128	93	8.1			
WW Downstream of Sowen Burn	11-Dec-12	09:30	6.55	172	129	93	3.6			
WW Downstream of Sowen Burn	30-Jan-13	09:30	6.1	181	121	88	5.6			
WW Downstream of Sowen Burn	19-Feb-13	09:50	6.87	136	231	156	5.5			
WW U/S of Adit 5 Pipes	31-Jul-12	10:45	7.05	74	140	90	9.8			
WW U/S of Adit 5 Pipes	21-Aug-12	17:00	7.09	176	131	85	9.7			
WW U/S of Bay Mine	20-Nov-12	15:15	6.65	129	81	59	7.8			
WW U/S of Bay Mine	30-Jan-13	15:15	7.32	117	126	92	5			
WW U/S of Sowen Burn	26-Jun-12	16:30	7.10		125	62	10.2			
WW U/S of tailing pond	17-May-12	16:15	6.38		124	62	8.1			
WW U/S of tailing pond	26-Jun-12	15:15	7.03		130	66	10.0			
WW U/S of tailing pond	31-Jul-12	14:30	6.73	113	145	93	12.1			
WW U/S of tailing pond	21-Aug-12	10:45	6.9	96	132	85	10.6			
WW U/S of tailing pond	18-Sep-12	11:10	6.95	65	139	88	9			
WW U/S of tailing pond	24-Oct-12	10:50	6.97	96	119	86	8.2			
WW U/S of tailing pond	20-Nov-12	10:40	6.99	132	102	74	8			
WW U/S of tailing pond	11-Dec-12	10:40	6.84	169	134	98	4.1			
WW U/S of tailing pond	30-Jan-13	10:30	6.8	147	119	87	5.7			
WW U/S of tailing pond	19-Feb-13	10:30	6.76	103	147	97.7	6.0			

Site Ref	Date	Time	pH	Eh (mV)	EC (µs/cm @ 25°C)	TDS (ppm)	Temp (°C)	Pb (mg/l)	Zn (mg/L)	Comments
WW Upstream	17-May-12	11:00	6.52		105	53	6.3	0.49		Pb appears high - confirm with lab data
WW Upstream	18-May-12	10:15	6.99		88	44	6.2	0.18	0.06	
WW Upstream	26-Jun-12	09:30	6.85		86	43	9.3			
WW Upstream	31-Jul-12	09:30	6.58	36	116	17	9.1			
WW Upstream	21-Aug-12	16:30	7.2	127	96	62	11.4			
WW Upstream	18-Sep-12	13:30	7.07	79	104	68	8.9			
WW Upstream	24-Oct-12	15:20	7.15	101	95	69	8.1			
WW Upstream	20-Nov-12	16:15	6.95	142	31	23	7.2			
WW Upstream	11-Dec-12	14:45	7.25	130	101	75	4.4			
WW Upstream	30-Jan-13	14:45	7.1	119	65	48	4.5			
WW Upstream	19-Feb-13	14:15	7.65	113	103.3	68	5.9			

APPENDICES 3

PHOTOGRAPHS OF MONITORING SITES AND MINING FEATURES

Background Water Sample Point at Glenmarchhope Burn, looking downstream towards Queensberry Smelter, May 2012 (NGR: 285418, 614181),

View towards Mennockhass Water Tunnel, May 2012 (NGR: 287300, 612895)

Wanlock Water Upstream, below B797 road, May 2012 (NGR: 287847, 613008)

Possible adit discharge below B797 road, July 2012 (NGR: 287844, 613002)

Possible adit structure below B797 road, with 2 outlet pipes, May 2012, (NGR: 287833, 613024)

Possible spring from adit below B797 road, May 2012, (NGR: 287841, 613018)

Wanlock Water looking upstream from the 5 pipes adit discharge, May 2012 (NGR: 287602, 612997)

Adit 5 pipes discharge, upstream of the museum, August 2012 (NGR: 287591, 612993)

Wanlock Water at the mining museum, November 2012 (NGR: 287339, 512890)

Glencrieff Stream, upstream of old railway, May 2012 (NGR: 286766, 613152)

Wanlock Water at Straitsteps Mine, looking upstream, August 2012 (NGR: 286927, 613125)

Wanlock Water at Pates Knowes / Glencrieve Cottage, looking upstream, August 2012 (NGR: 286698, 613269)

Wanlock Water upstream of Bay Mine (this is often dry), looking upstream, November 2012 (NGR: 28652, 613510)

Bay Mine Adit discharge, near confluence with Wanlock Water, July 2012 (NGR: 286517, 613517)

Whyte's Cleuch above Bay Mine Adit (usually dry), November 2012 (NGR: 286580, 613570)

Wanlock Water downstream of Bay Mine Adit Discharge, looking upstream, November 2012 (NGR: 286475, 613540)

Glenglass Stream outlet from old reservoir above Glencrieff Tip, August 2012 (NGR: 286335, 613335)

Glencrieff Tip Drain (left) with Glencrieff Mine on the right, May 2012 (NGR: 286416, 613434)

Glenglass Stream after it collects below the Glencrieff tip, November 2012 (NGR: 286390, 613455)

Meadowfoot Adit, June 2012 (NGR: 286258, 613745)

Glenglass (New Glencrieff) Level Discharge channel, looking upstream from near to confluence with Wanlock Water, January 2013 (NGR: 286173, 613770)

Upwelling from former Glencrieff Mine settlement ponds, adjacent to Glenglass Level, April 2013 (NGR: 286160, 613775)

Wanlockhead Sewage Works Outfall, July 2012 (NGR: 286102, 613821)

Limpen Burn, next to Wanlockhead Sewage Works and near to confluence with Wanlock Water, August 2012 (NGR: 286092, 613827)

Wanlock Water downstream of Wanlockhead Sewage Works outfall, July 2012 (NGR: 286067, 613819)

Issues upstream of Queensberry Crushing Mill (usually dry), November 2012 (NGR: 285845, 613985)

Channel downstream of Queensberry Crushing Mill (in the background), August 2012 (NGR: 285795, 614040)

Wanlock Water upstream of Queensberry Tailings Pond (back left), looking downstream, July 2012 (NGR: 285638, 614123)

Ditch through Queensberry Tailings Pond area, near to confluence with Wanlock Water, September 2012 (NGR: 285550, 614210)

Runoff channel from Queensberry Tailings Pond, near confluence with Wanlock Water, January 2013 (NGR: 285530, 614225)

Ponded water on Queensberry Tailings Pond area, discharge from pond to the left, January 2013 (NGR: 285525, 614240)

View towards Wanlock Water downstream of Queensberry Tailings Pond / Upstream of Glenmarchhope Burn and Upstream of Smelter Mill, July 2012 (NGR: 285489, 614305)

Sowen Burn, approximately 10m upstream of confluence with Wanlock Water, looking upstream, August 2012 (NGR: 285427, 614457)

Wanlock Water downstream of Sowen Burn, looking upstream, September 2012 (NGR: 285397, 614483)

Shortcleuch Water, water sampling and sediment sampling point, April 2013 (NGR: 290280, 615770)

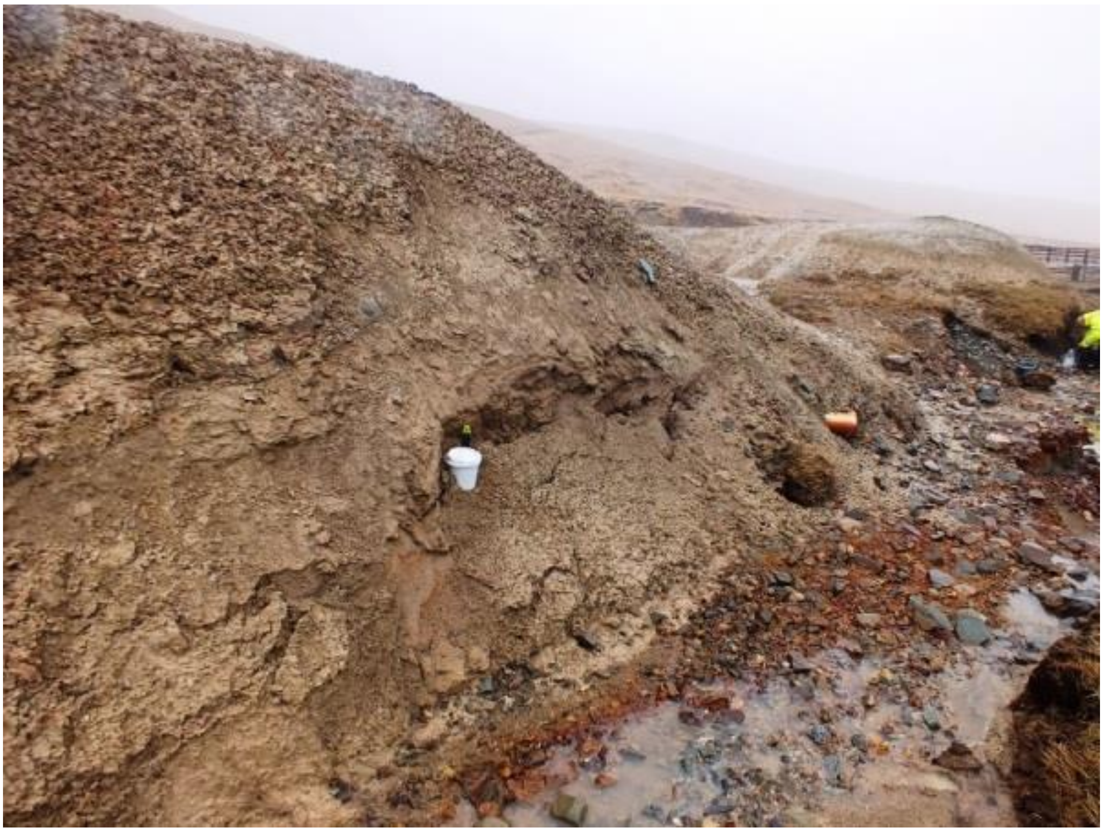
Queensberry Tailings Pond Sediment Sample Point, May 2012 (NGR: 285495, 614295)

Glencrieff Mine Area Tailings Sediment Sample Point, May 2012 (NGR: 286470, 613360)

Glenglass Level Channel, Fluvial Sediment Sample Point, May 2012 (NGR: 286170, 613765)

Queensberry Tailings Pond Sediment Sample Point, July 2012 (NGR: 285545, 614230)

Queensberry Crushing Mill Sediment Sample Point, July 2012 (NGR: 285800, 614020)



Queensberry Tailings Pond Tailings Sediment Sample Point, April 2013 (NGR: 285590, 614170)

Wanlock Water upstream of Bay Mine Adit Discharge, Fluvial Sediment Sample Point, April 2013 (NGR: 286525, 613500)

Wanlock Water Downstream Fluvial Sediment Sampling Point

Bank erosion and cutting of the tailings pond area by the Wanlock Water, August 2012.

Wanlock Water in high flow along the edge of the tailings pond area, November 2012.

Views looking upstream above Bay Mine and looking downstream towards Bay Mine, taken from approximately the same location on the same day and time, June 2012.

View looking at the downstream section of the tailings pond area with some sheep grazing, May 2012.