

## Permit Review 13

### **FORCEY COAL COMPANY, BUTERBAUGH MINE (PERMIT # 17990112)**

#### **Site Summary**

The Forcey Coal Company Buterbaugh Mine is located in Bigler Township, Clearfield County, Pennsylvania, in the Clearfield Creek Priority Watershed 8C. About 24,538 tons of ash from Westvaco's Tyrone Paper Mill pulverized coal-fired power plant have been placed at this site in a mixture that is cited by PADEP to be approximately 10% fly ash and 90% bottom ash. Although the entire area of mining was about 72 acres, the ash was only placed over approximately 20 acres according to a 2005 Final Ash Placement Map in the permit file. Ash placement commenced during January 2001 and finished in August 2004. No ash was delivered to the site from October 2001 to November 2003. Ash was placed as active mining progressed, and mixed with spoil rather than being deposited in mined out benches at the coal seam levels as done at many other sites reviewed in this project. The purpose for placement was vaguely defined as "beneficial use" (Module 25.4, p.25-1-2) which is presumed to mean "placement" for the purpose of achieving final reclamation.

Some lime (and possibly lime kiln dust) was also mixed with the spoil, and placed on the pit floor. The authors can find no source information or chemical analysis for the lime in the permit files. The areas and amounts of lime addition are summarized in Exhibit 10.9, Special Handling Map. The actual tonnage of this lime placement is difficult to calculate, as the areas of placement are not clearly delineated on the Special Handling Map. However, as specified on the map, an "area of influence" was to receive 100 tons of lime per acre on the pit floor, and up to 840 tons per acre mixed with the mine spoils. Other areas were to receive 20 tons per acre on the pit floor, and up to 100 tons per acre mixed with the spoil at the discretion of the operator if there was less than 40 feet of cover (overburden depth down to the coal being mined). If one assumes the maximum addition rates for the whole 72 acre active mining area, the amount of lime placed on the site would have been well over twice the tonnage of ash. While this undoubtedly overstates the amount of lime placed at the site, its potential significance in effecting water quality at this site should be recognized. Two monitoring points (BC-3 and BC-14, both downgradient) were selected for analysis as the monitoring points with the most complete data sets. There are no upgradient ash monitoring points at this site.

#### **Geology**

The Forcey Coal Company Buterbaugh Mine worked the Upper Kittanning and Middle Kittanning Coals that occur in the middle of the Allegheny Group sedimentary rocks of the Pennsylvanian Period. The overburden rocks and coal seams are flat lying, with a very gentle dip (down slope) geological structure to the southeast. The Upper Kittanning Coal slopes 1.1 degrees and the Middle Kittanning 1.9 degrees. These slopes are very slight structure dip numbers and reflect the geometry of the depositional basin.

In between the Upper Kittanning and Lower Kittanning coals is a bed of limestone that varies in thickness from 2 to 5 feet. This limestone was encountered in many of the test bores, including BR-8, BR-7, DH-5A, OB-1, OB-2, and OB-13. The logs for these test holes were found in Module 7.1(B).

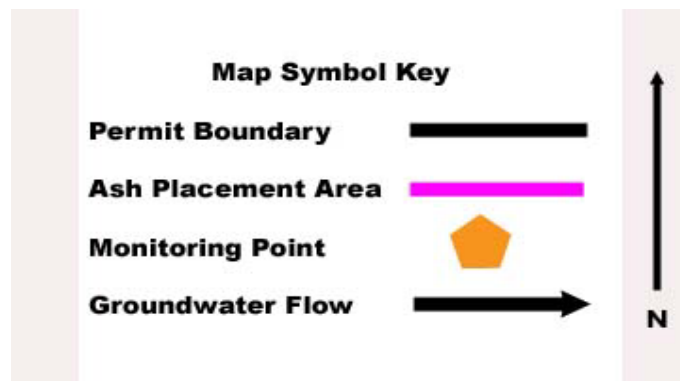
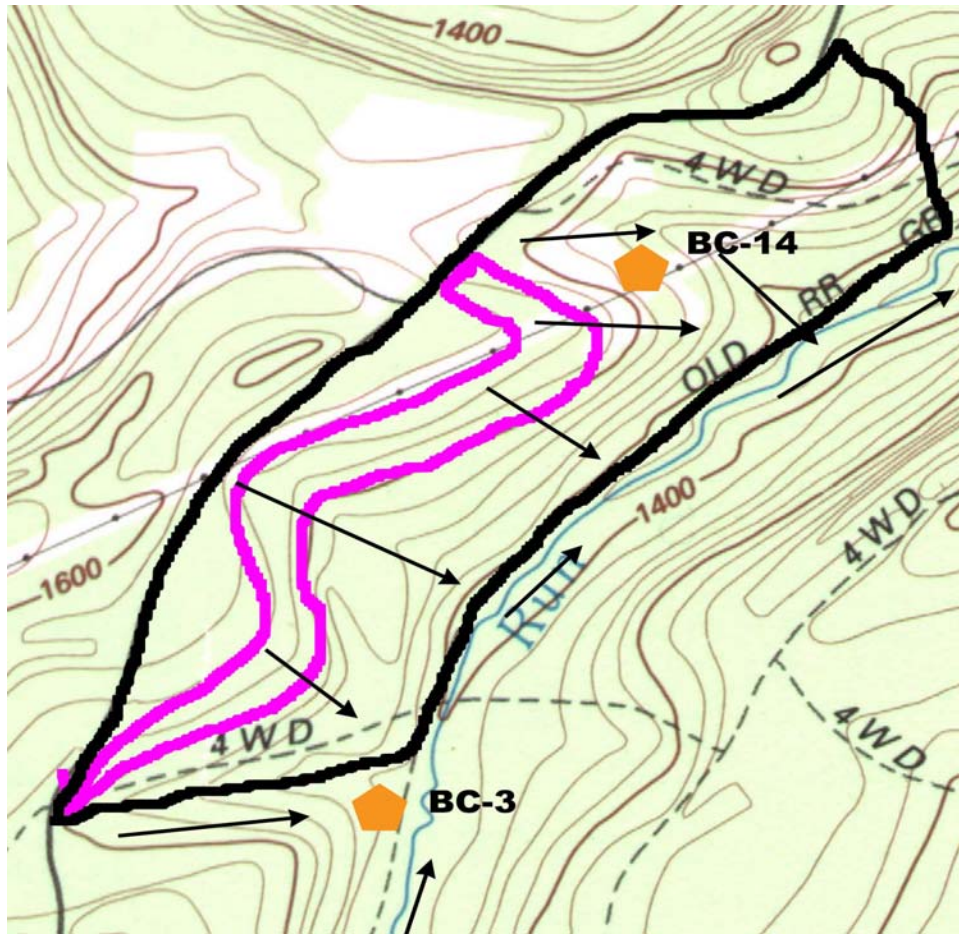
### **Topography**

The Buterbaugh Mine occupies the northwest side of a northeast/southwest trending valley, (see map below) with Banian Run at the bottom. The elevation of the mine ranges from 1350 feet (above sea level, at the downstream water level of Banian Run) to about 1600 feet at the top of the highest hill on the property. The Middle Kittanning Coal outcrops at about 1400 feet and the Upper Kittanning at about 1480 feet. The mine is in the Allegheny Mountain Physiographic province (figure 1).

### **Groundwater**

The groundwater at the Buterbaugh site flows generally from the northwest to the southeast, following topography and geological structure. The shallow groundwater and surface water flows into Banion Run, which flows northeast out of the site. All water exiting the property eventually runs into the West Branch of the Susquehanna River. Most of the shallow groundwater probably percolates down to where the permeable mine spoils and ash meet the much less permeable underclay that underlies the Middle Kittanning Coal mined in the permit, and exits the site where this coal outcropped at the surface. As with the large majority of permits in this report, there is not enough detailed information to discern more site-specific groundwater flow paths at this mine relative to the ash placement area.

**Site Map Buterbaugh**



**Forcey Coal Co., Buterbaugh Operation (Permit # 17990112)**  
**Scale: 1" = Approximately 750'**

**Groundwater Monitoring Data: Discussion**

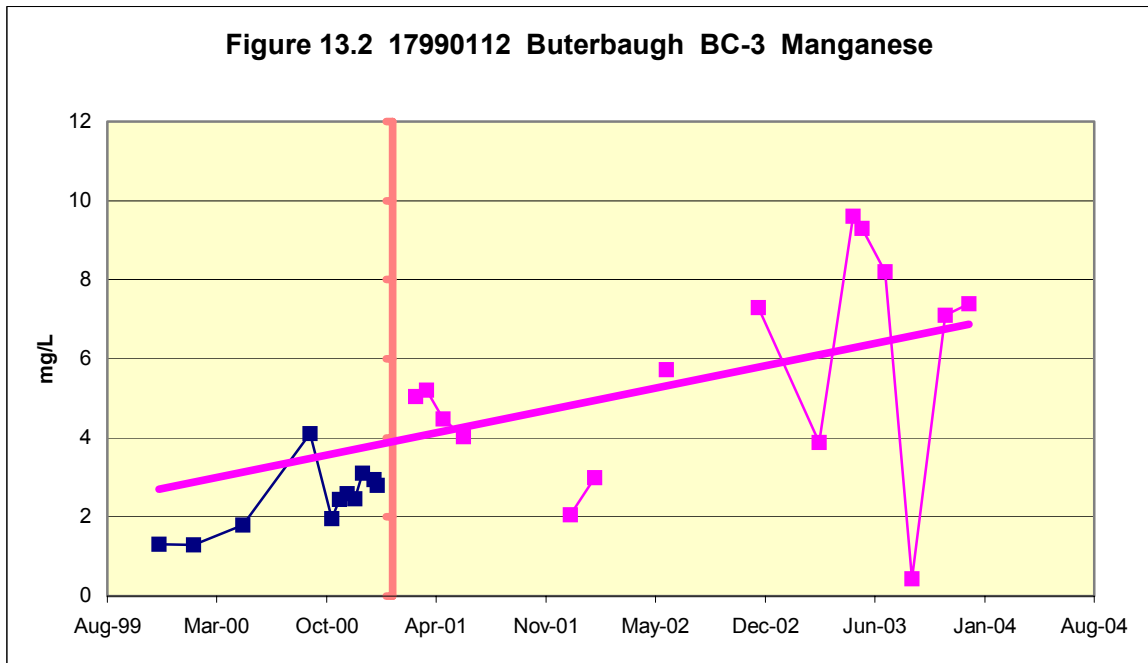
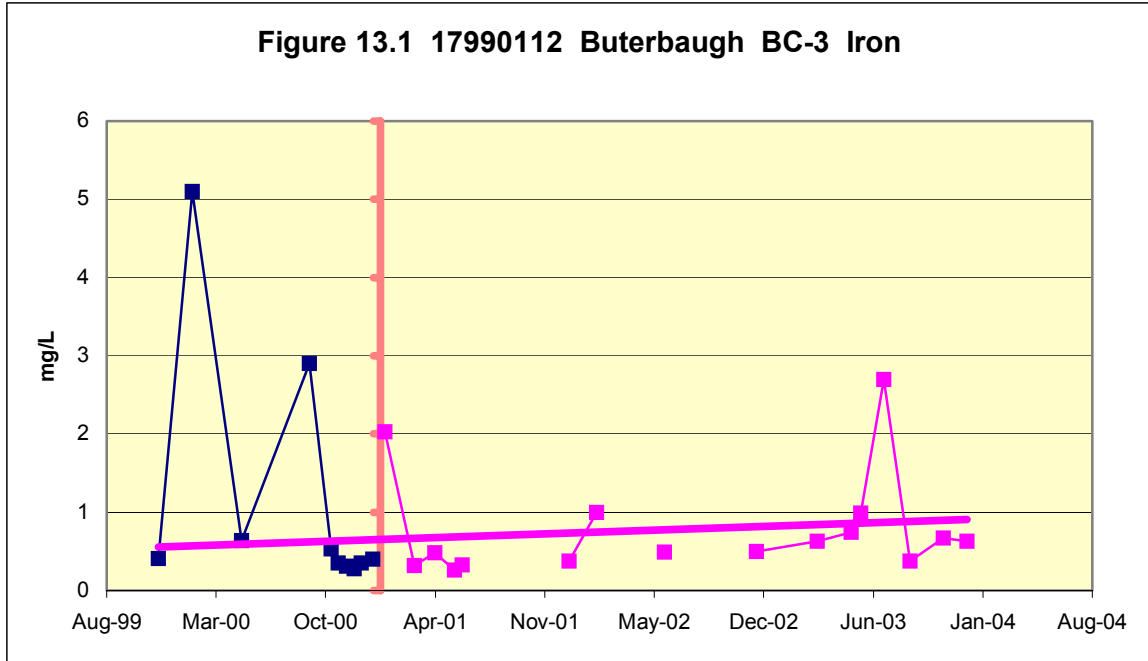
Two monitoring points are discussed in this report: BC-3 and BC-14. BC-3 is a small spring that discharges from the toe of the mine spoil pile. The water from this

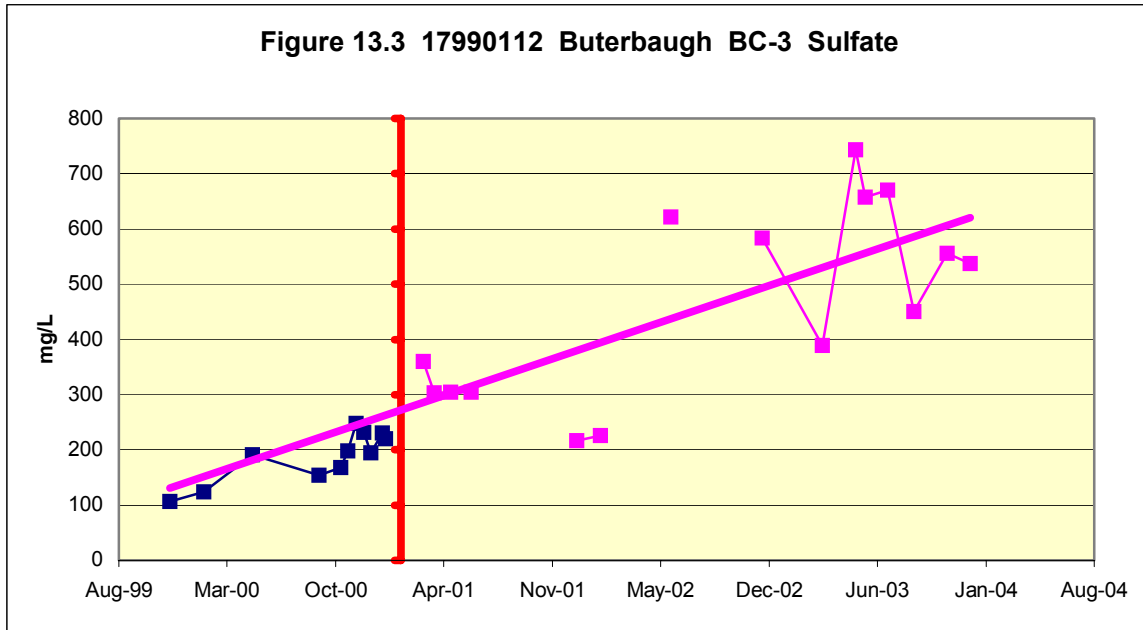
discharge flows into a small tributary of Banion Run. Surface water and shallow groundwater flow from the southern end of the ash placement area downhill to point BC-3. BC-14 is a discharge downhill from the ash placement area that flows into an unnamed tributary of Banion Run downstream and to the northeast of the ash placement area and BC-3. Both sampling points are downgradient from the spoil pile and areas of ash placement.

In comment on an earlier draft of this report, PADEP stated that data from two other ash monitoring points, BC12A and BC10, “are reflective of downgradient groundwater conditions” and should have been considered in this report. However, the authors of this report can find only one measurement collected from a monitoring point “BC12” (nothing for a “BC12A”) for the entire monitoring period and data from BC10 only for December 1999 through July 2001, a few months into the ash placement period. The rest of monitoring at this point (from November 2001 to November 2003) recorded an insufficient amount of water to sample. The monitoring reports in the permit file also do not have any trace element measurements for these monitoring points. There are however several trace element measurements collected from a D-12-A from September 1999 through November 2002 including two measurements during the period of mining and ash placement that do not show elevated trace element levels from the baseline period. Nonetheless, the paucity of data from BC-12 and BC10 does not warrant its graphing and discussion at this time.

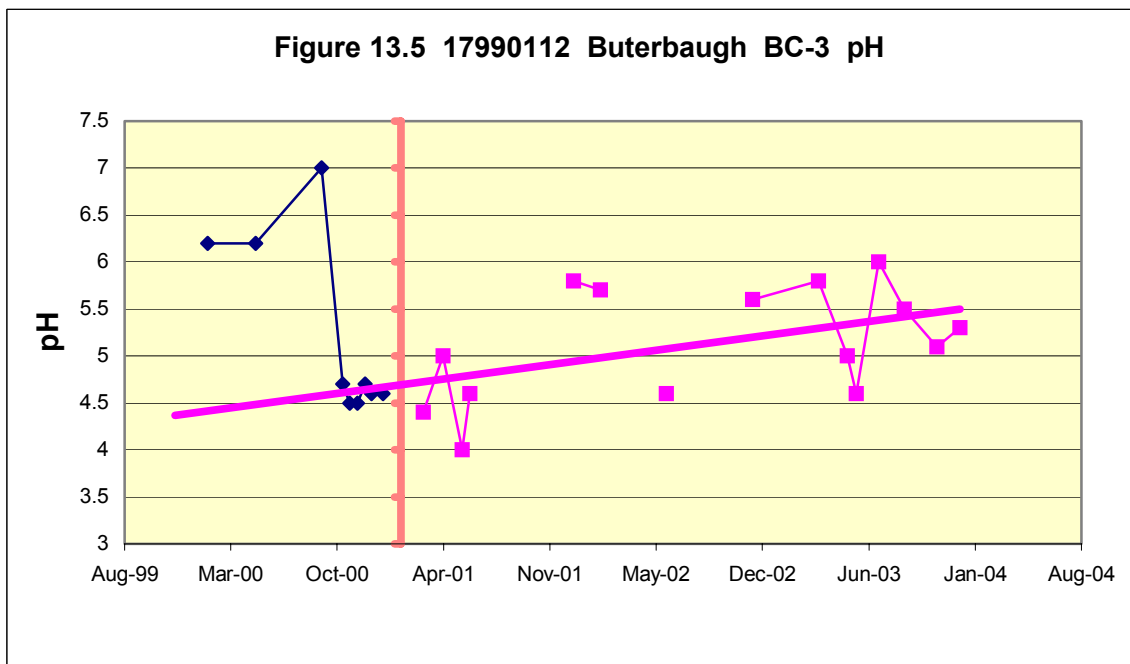
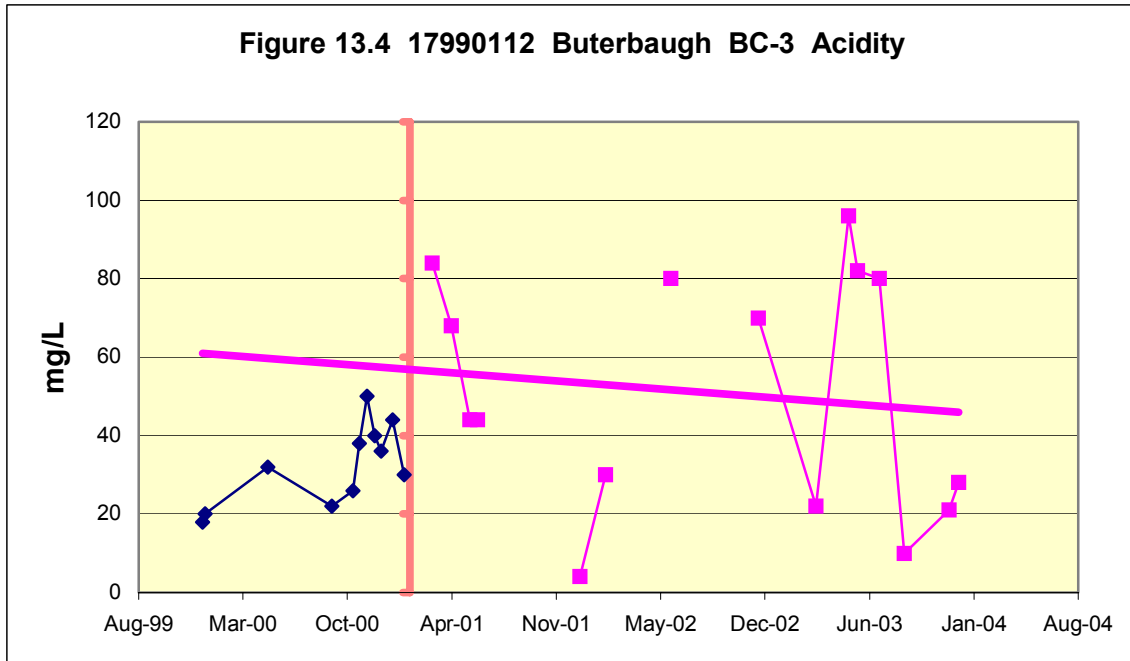
### **BC-3**

BC-3 was monitored from January 2000 to July 2004. Baseline monitoring data was recorded from September 11, 2000 to December 26, 2000 in six samplings. There are four other data points also recorded before this baseline data was collected. Figures 13.1, 13.2, and 13.3 are graphs of iron, manganese, and sulfates plotted against time. The iron values in figure 13.1 range from about 0.3 mg/L (equal to the federal secondary MCL (DWS)) to 5.09 mg/L. This high value was measured during baseline data collection. During ash placement, iron rose from a low value of about 0.26 mg/L to a high of 2.7 mg/L, 9 times the DWS. The last three sampling points in 2003 show a short decline in iron values to below 1.0 mg/L. Some data are missing during 2002, as the spring monitored by this sampling point was dry.





Manganese concentrations (figure 13.2) fluctuated widely, but had a general increasing trend from a peak of 4.1 mg/L during the baseline period, 82 times the DWS of 0.05 mg/L, to a high of 9.6 mg/L on May 19, 2003. This level is 192 times the drinking water standard and reveals a trend from degraded water prior to mining and ash placement to badly degraded water two and a half years after these activities started. The sulfate concentration trends (figure 13.3) roughly mirror those of manganese, rising from maximum levels equal to the DWS of 250 mg/L before ash placement, to a high value of 743 mg/L in May 2003 which represents degraded water. These trends have resulted from ash placement, and/or mining activity. Acidity at BC-3 rises significantly after mining and ash and lime placement start but then begins to decline. Acidity concentrations vary somewhat from a low of 4 mg/L to a high of 96 mg/l yet experience an overall decreasing trend throughout the mining and ash placement period (figure 13.4). The pH at BC-3 (figure 13.5) mirrors the acidity. PHs as high as 7 during the baseline period drop abruptly just before the mining operation starts to values around 4.5 and then drop further after mining starts to as low as 4 units. However as the mining and ash/lime placement proceeds the average pH values increase from 4.7 to 5.5 units with a range from 4 to 6 units over the life of the operation. The rising pH and rising alkalinity (figure 13.7) suggest an impact to water quality from ash as well as lime.



The TDS (figure 13.6) rose from less than 200 mg/L in December 1999 to nearly 900 mg/L in early 2004 with seven out of the nine measurements exceeding the DWS (500 mg/L) after permit operations started. All but one of these higher measurements occurred from the spring of 2002 onward. This indicates that the total amount of material carried in the dissolved state in the groundwater was increasing from that point onward due to the availability of easily dissolved mineral phases; this could have resulted from mining disturbance, ash and lime placement, or both activities. Alkalinity concentrations

(figure 13.7) undergo a modest rise from an average of approximately 3.1 mg/L to 7.1 mg/L after falling initially somewhat from baseline measurements. The alkalinity, acidity and pH data at BC-3 show an initial impact from mining that increased acidity which was overtaken by alkalinity as the operation progressed.

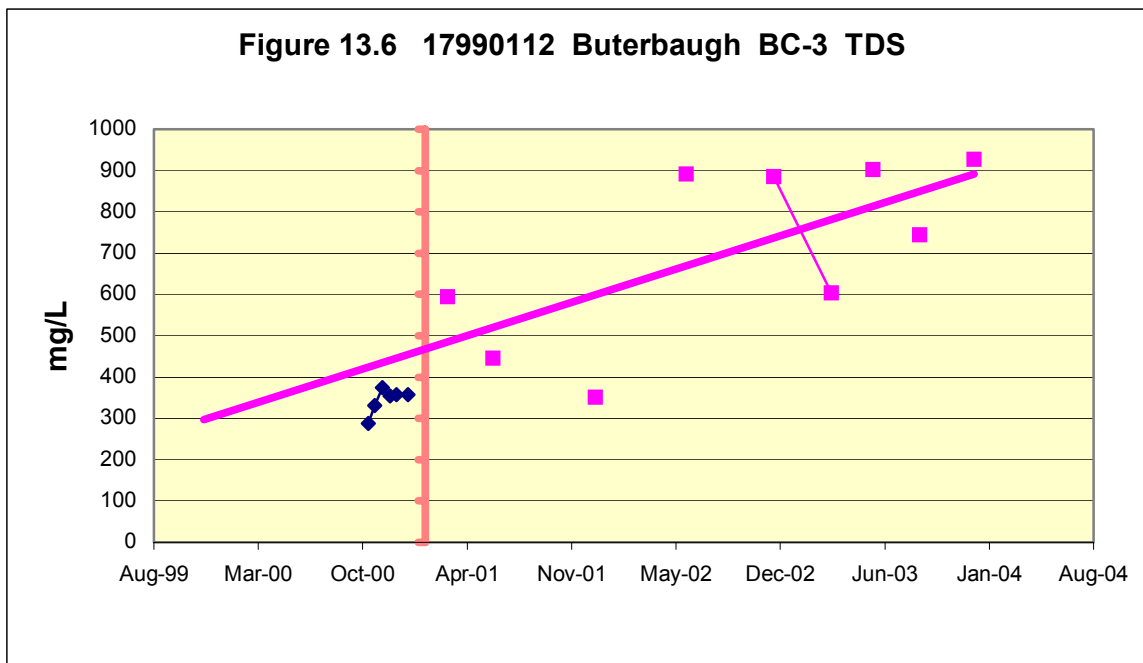
The concentrations of the elements calcium, magnesium, and chloride at BC-3 are graphed in figure 13.7A. Concentrations of calcium and magnesium rise noticeably above baseline values after mining and ash placement begin. Calcium concentrations increase from an average baseline value of about 35 mg/L up to an average value during mining and ash/lime placement of 107 mg/L and a high of 138 mg/L in June, 2004. Magnesium has a similar pattern, with concentrations more than doubling from an average of 22 mg/L during the baseline period to 56 mg/L during mining and ash/lime placement and a high of 85 mg/L in June 2004. The fact that each of the four measurements for these two constituents during mining and ash/lime placement was successively higher than the previous one with the highest concentrations measured in the most recent sample suggests mobilization of alkalinity from ash and lime being added to the site more than a source already in the spoils such as any limestone mined at the site. Nevertheless as chemical analyses for calcium and magnesium are not available for the placed lime or site limestones, it is impossible to differentiate the contributions of these constituents between ash, lime and limestone at BC-3.

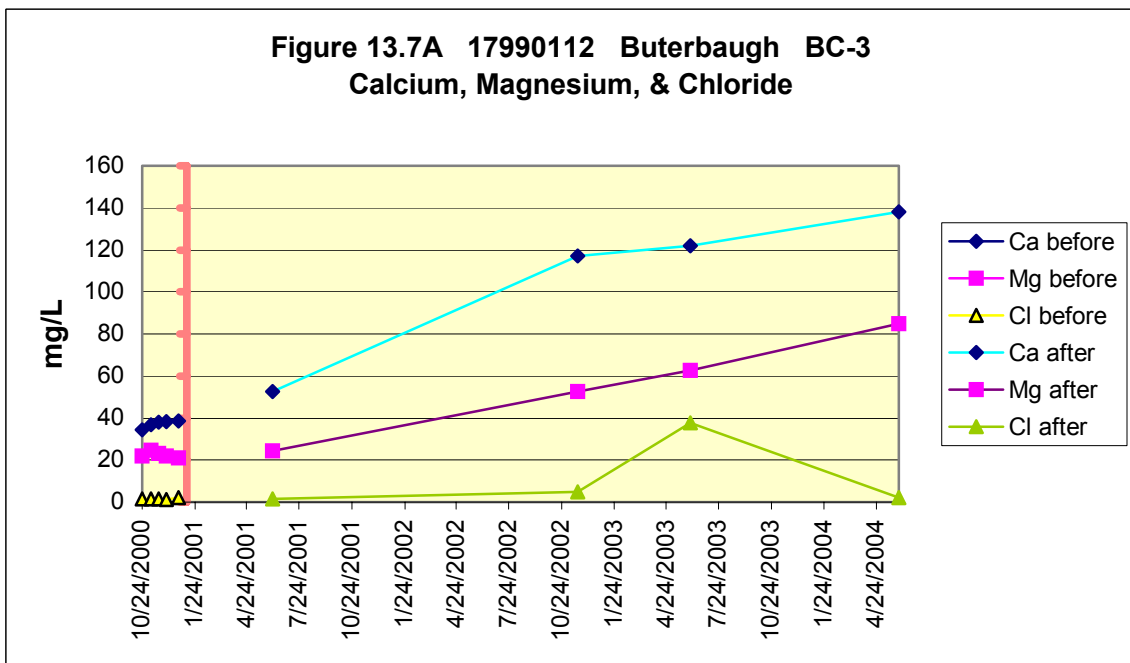
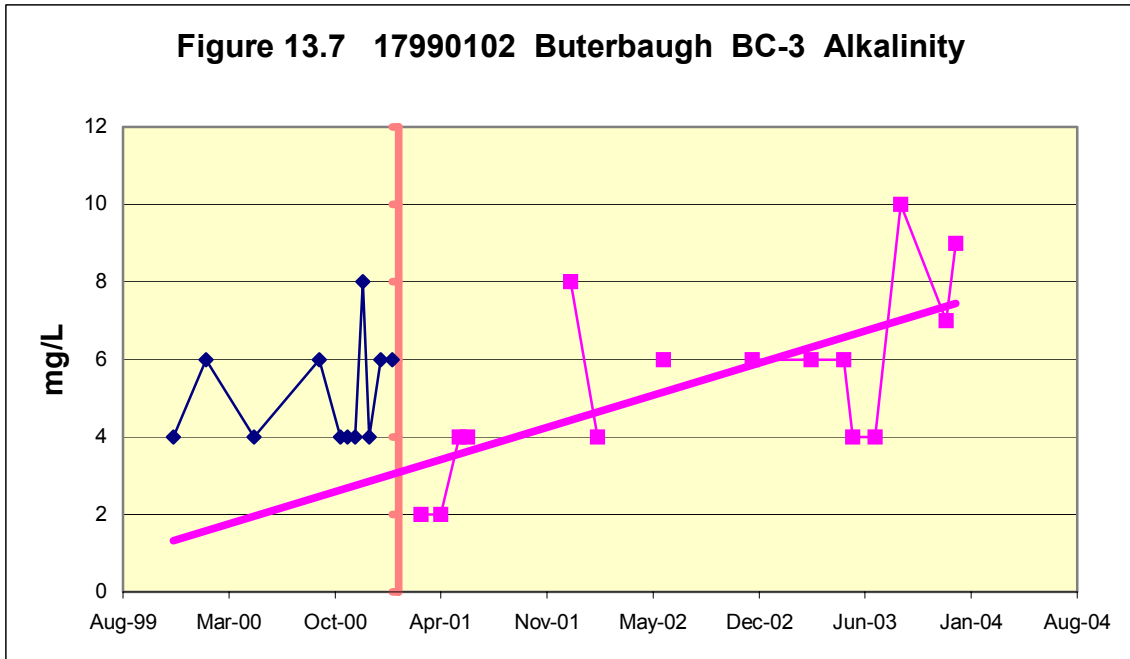
The chloride values of between 1 and 2 mg/L in the baseline period rise during mining and ash placement to 4.8 mg/L in November 2002 and 37.6 mg/L in June, 2003 with an average of 11.45 mg/L due to that measurement. The permit leach tests on the ash placed at this site indicate an average value of 2.5 mg/L of chloride leaching in the 24 hour tests, suggesting there may be an additional source of chloride along with the ash leachate at this site as the test concentrations are much less than November 2002 field value. Still the accuracy of this test beyond its ability as a benchmark indicator of solubility under fixed laboratory conditions has been repeatedly questioned, and there are too few field measurements to conclude that the chloride would or would not be coming from the ash.

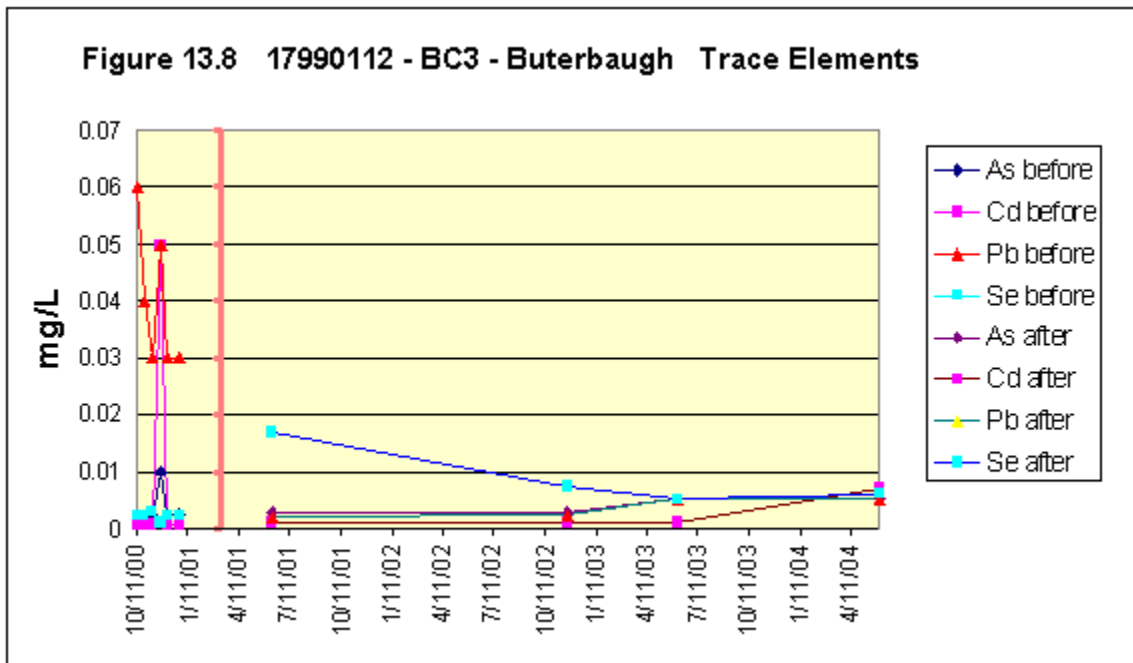
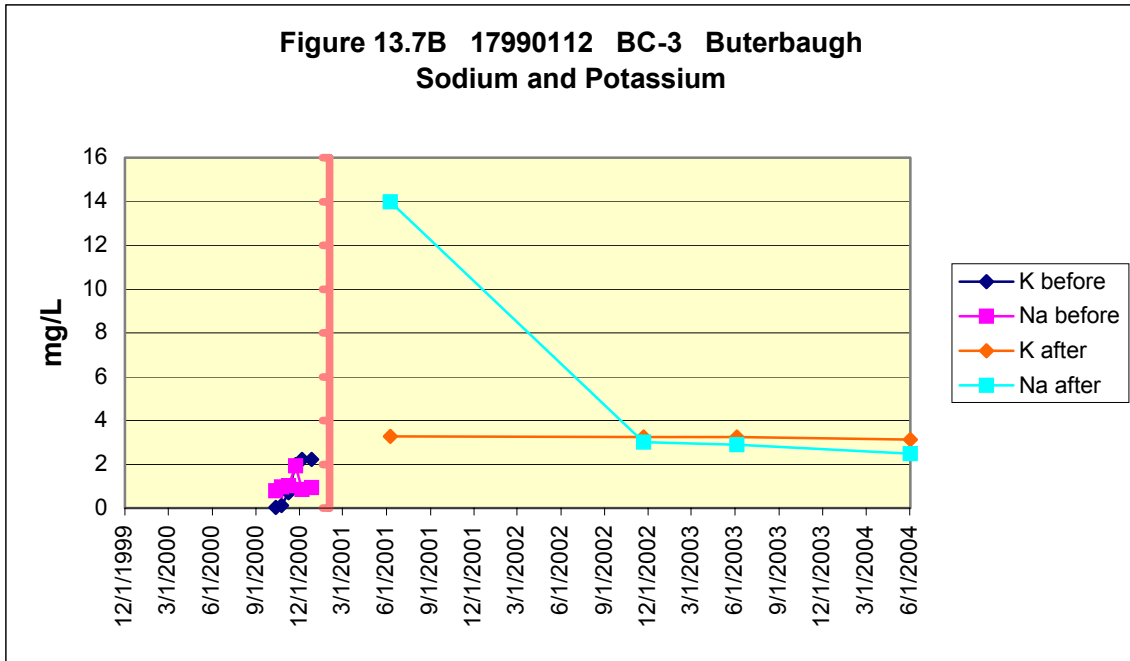
Figure 13.7B shows the concentrations for sodium and potassium at BC-3. Baseline concentrations for sodium range from 0.80 mg/L to 1.93 mg/L while the range in baseline concentrations for potassium is from <.02 mg/L to 2.23 mg/L. Potassium rises to between 3.13 and 3.27 mg/L after ash placement, showing only a slight change from baseline to ash placement values. Sodium concentrations rise to 14 mg/L in June 2001, six months after ash placement began and then drop down to values similar to those of potassium. The permit's ash leach tests produce an average value of 25.75 mg/L for sodium, and 50.3 mg/L for potassium from the ash placed at this site. As sodium and potassium are very mobile elements in groundwater, the placed ash could be a source of these constituents since the leach test concentrations are well above the reported concentrations at BC-3 suggesting the dilution of these constituents as they migrate from ash deposits in site water.

Figure 13.8 shows trace element concentrations. Selenium increased from baseline levels below an analysis detection limit (<0.0023 mg/L) to actual levels as high as 0.0168 mg/L in June 2001, while initial baseline concentrations of lead exceeding the DWS by up to four times decreased to below 0.01 mg/L during mining and ash placement. Concentrations of arsenic during and after the baseline period were below detection limits that were also below the DWS. Cadmium levels were actually measured although well below the DWS until the last measurement in June 2004 when cadmium reached 0.007 mg/L (DWS is 0.005 mg/L). November 2000 measurements of 0.05 mg/L for cadmium and 0.01 mg/L for arsenic were actually below the detection limits of the analysis at those levels. The higher selenium concentrations are consistent with rising alkalinity and pH and could have come from the ash or lime or have been mobilized from site materials under those conditions.

The baseline monitoring time period for Module 25 ash parameters was October 11, 2000 to December 26, 2000. As in the previous major element graphs, data from 2002 are missing. The existence of only four data points from the three year period of mining and ash placement and changing levels of detection used in the laboratory analysis limits the ability to assess trends in trace elements at BC-3.





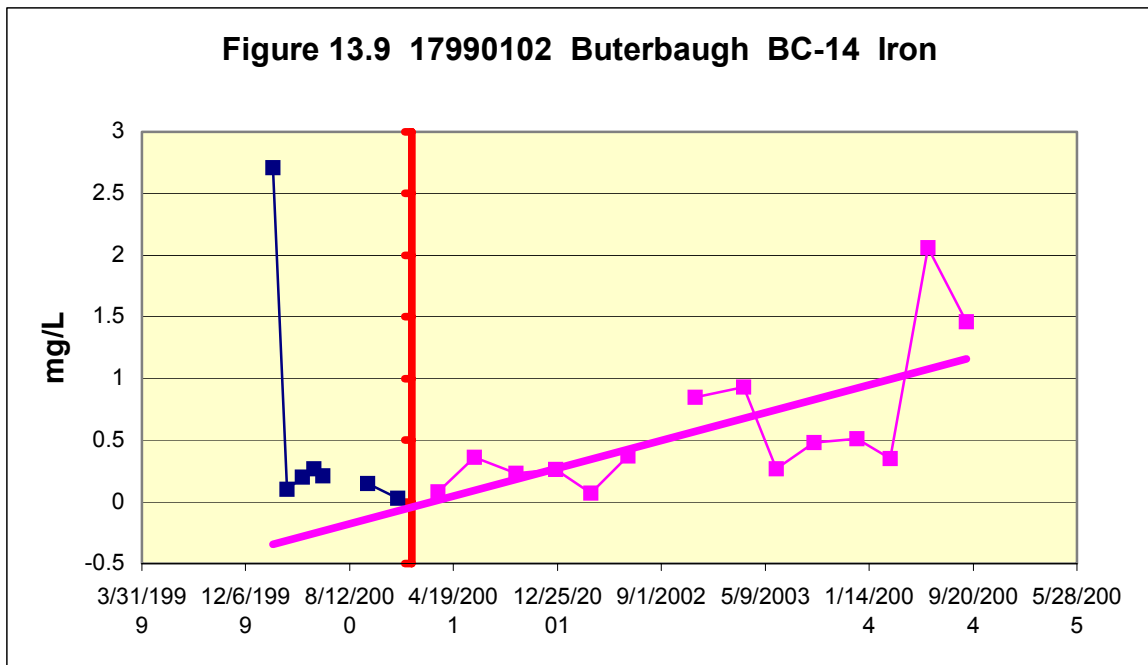


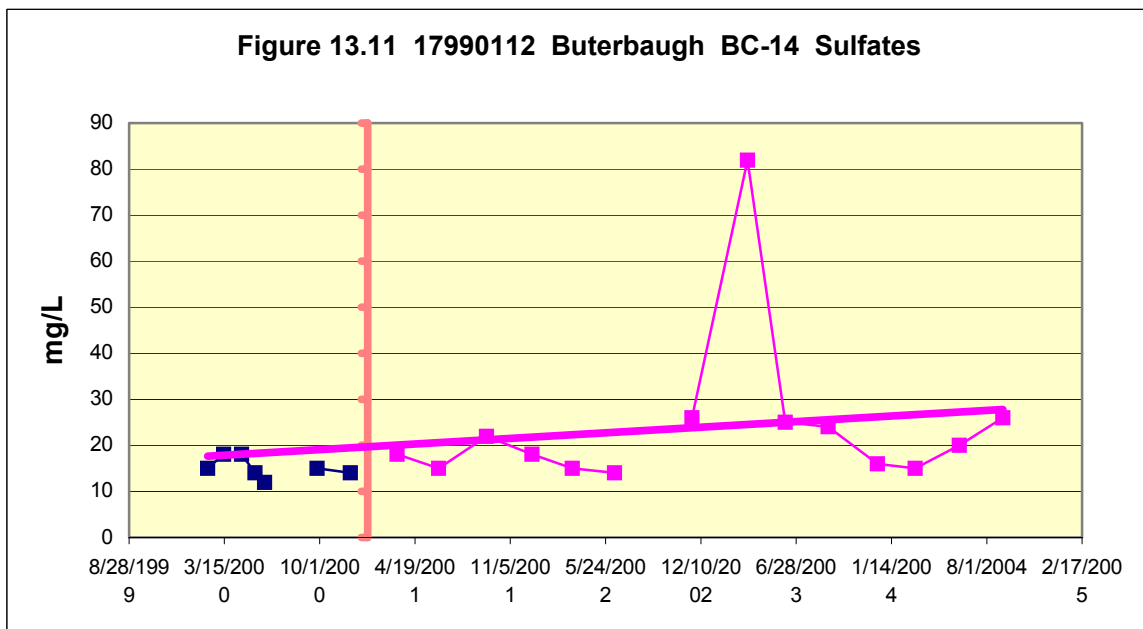
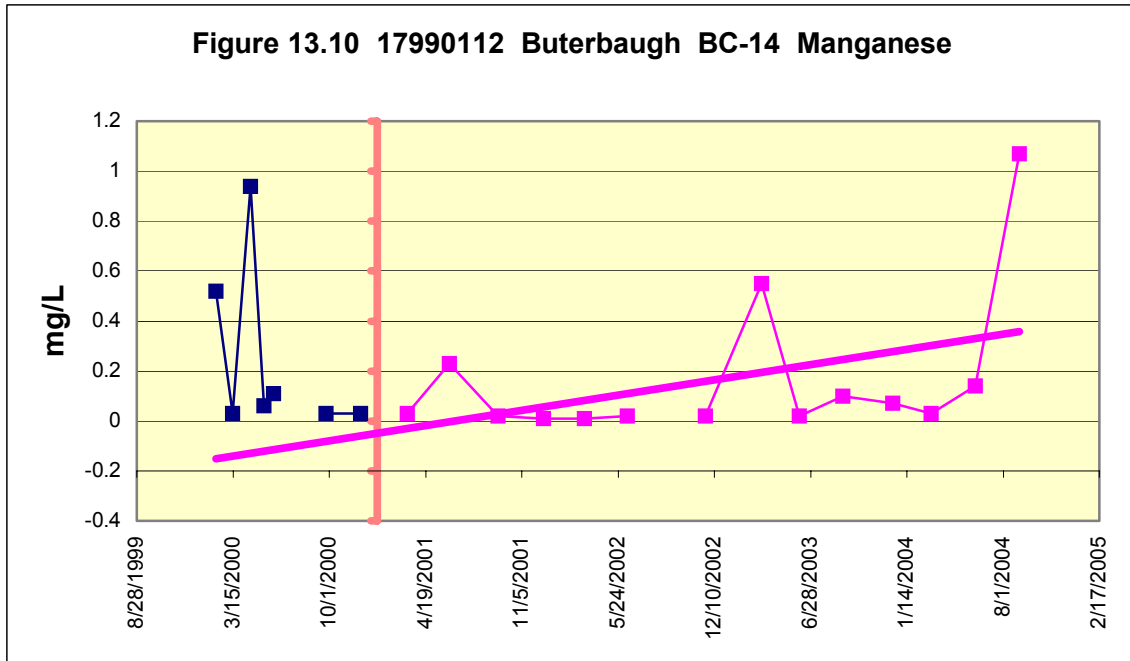
**BC-14**

The ash monitoring point BC-14 is a discharge that drains into Banion Run northeast of the mining area and well downstream from where the BC-3 discharge enters this stream. This discharge is slightly below the level of where the Middle Kittanning Coal was mined out, at an old deep mine working exit that was mined through by the surface mining operations. The water quality at BC-14 appears to be less affected by the permit activities than at BC-3. Figures 13.9, 13.10, and 13.11 are graphs of iron,

manganese, and sulfate concentrations, respectively. Data were recorded from February 2000 to September 2004, with baseline monitoring starting in February 2000 and ending in September 2000. There are some data missing in 2000 and 2002, as the sampling points were dry for these times. Iron (figure 13.9) had an increasing trend from baseline values, although after operations started, its highest level reached in the second to last measurement (2.06 mg/L in June 2004), was less than the highest baseline value of 2.71 mg/L. These concentrations are similar to those from sampling point BC-3.

The manganese (figure 13.10) fluctuates with a high initial baseline reading, two spikes and the highest concentration 1.07 mg/L reached in the last measurement, September 2004. However these values are barely one tenth of the manganese concentrations at BC-3. Sulfates at this point (figure 13.11) are also much lower than at BC-3; the highest concentration reached only 82 mg/L in March 2003, compared with a high of 743 mg/L at BC-3 in May 2003. Average sulfate levels at BC-14 slowly rose above baseline values to only 28.4 mg/L.

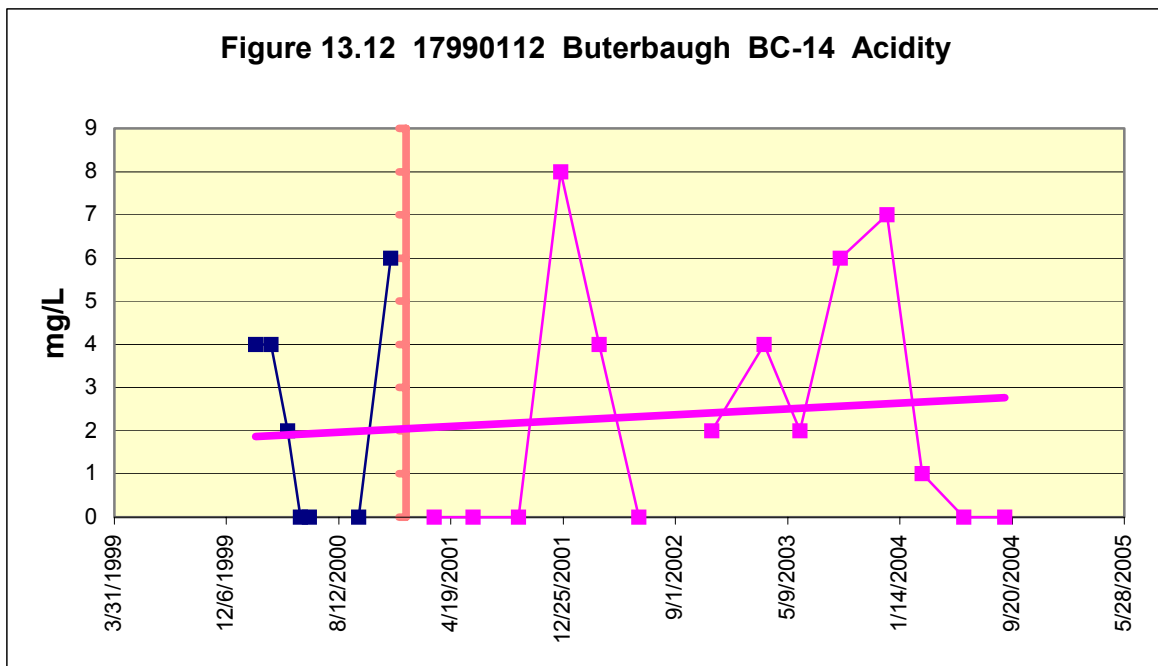


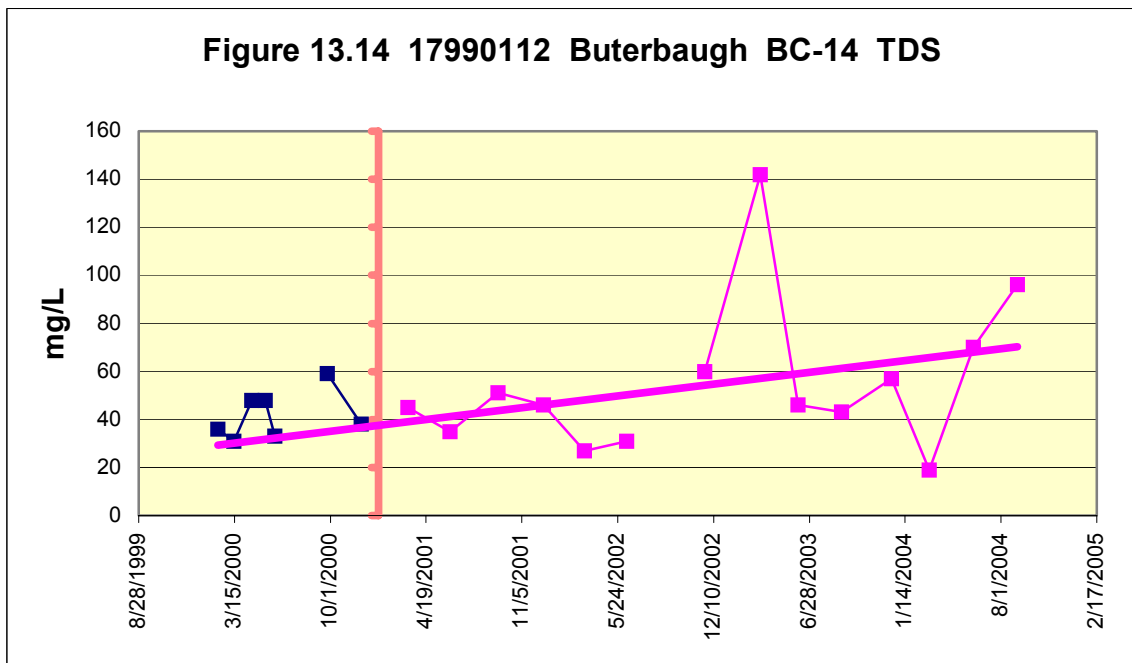
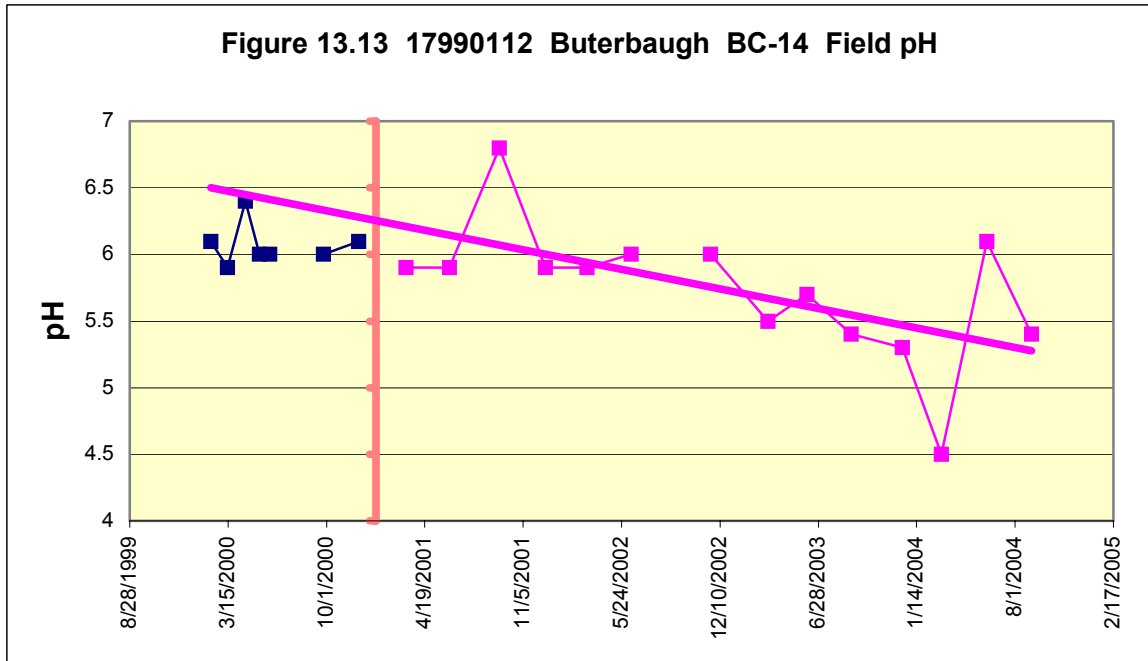


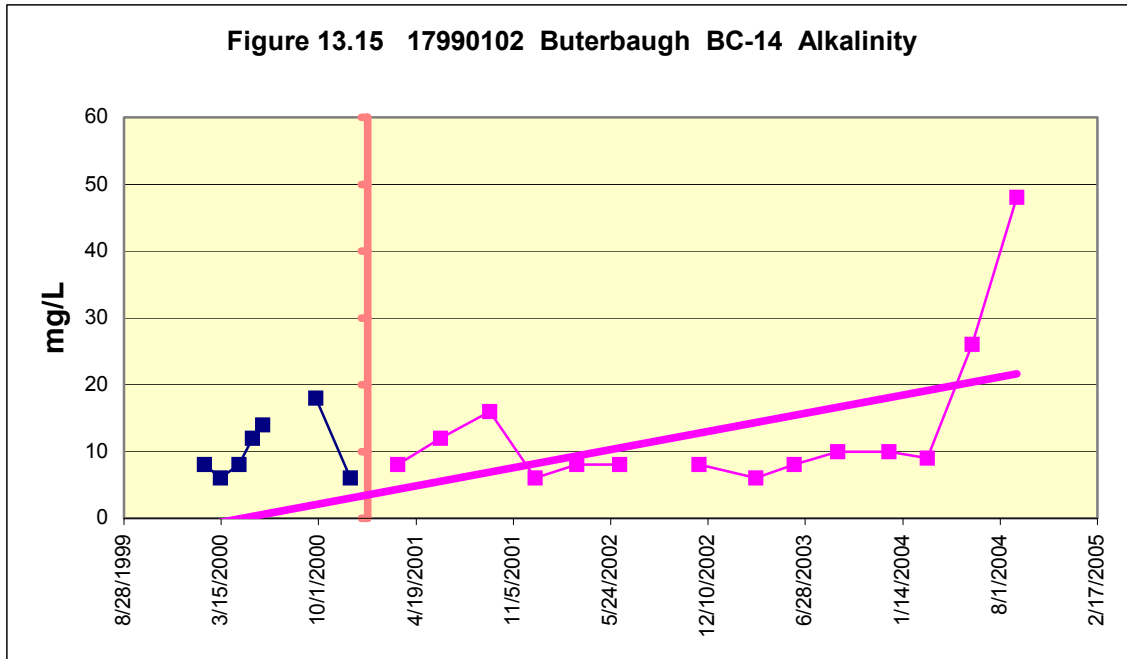
The acidity values at BC-14 (figure 13.12) were lower than at BC-3 and had a very slight increasing trend while alkalinity values at BC-14 (figure 13.15) rose from an average of approximately 4 mg/L at the start of mining to an average of 21 mg/L when monitoring stopped at BC-14. This rise in average alkalinity however does not reflect actual alkalinity measurements which remained at or below baseline levels until the last two measurements when alkalinity jumped to 26 mg/L in June 2004 and 48 mg/L in September 2004, indicating a delayed influence from broken limestone, lime, or ash at

BC-14. Average field pH (figure 13.13) at BC-14 appeared to reflect mining impact and not much alkalinity from these trends, dropping from approximately 6.25 to 5.3 units. The laboratory pH (ungraphed) had no general trend down or up and ranges from 4.6 to 6.3 units.

Figure 13.14 shows that TDS values increased over time. The high value of 142.9 mg/L in March 2003 correlates to the highest sulfate value (82 mg/L) and a peak in specific conductance to 236 micromhos also measured in this sampling at BC-14. The latest TDS values between 70-100 mg/L indicate a continuation of this rising trend from baseline values (31-59 mg/L).







Concentrations for ash parameters measured annually showed no elevated levels at BC-14 and were therefore not graphed. However, data for calcium, magnesium, and chloride indicated slightly rising values for all three of these parameters after the mining and ash and lime placement got underway although their concentrations remained a tenth or less concentrations for these parameters at BC-3. The values for sodium were well below sodium concentrations at BC-3 and all under 1.0 mg/L in the baseline period and after mining started, showing no discernable trends. Potassium values are also low, ranging from 1.22 mg/L during the baseline period to 2.58 mg/L in the last sampling, with no apparent trend. Trace element data from BC-14 for arsenic, cadmium, selenium, and lead usually remained at analysis detection levels, (below 0.010 mg/L) and did not rise notably above baseline concentrations. While the levels of these ash parameters were not elevated, the annual frequency of sampling for them prevents a definitive conclusion that the ash is not contributing these constituents to waters at BC-14. This permit is not a subchapter F permit and contained no loading data.

**Conclusion**

The data available for this review shows degradation is occurring to shallow groundwater from the Buterbaugh operation, but the source or sources of the pollution cannot be effectively differentiated from the information available. The general upward contaminant trends from the major element graphs indicate waters are being degraded at sampling point BC-3 and to a lesser extent, at BC-14. Sulfate rose at BC-3 from levels below the DWS to nearly three times the DWS in recent samplings. Manganese concentrations in BC-3 that exceeded the DWS by 28 to 82 times prior to ash placement increased to levels 142 to 192 times the standard in the latest samplings. Iron concentrations in BC-3, however, declined from values that were 10 to 20 times over the DWS to levels closer to the standard during ash placement. This decline did not follow the total concentration of pollution measured by TDS that rose steadily beyond baseline

levels from around 288 mg/L just after mining and placement of ash and lime started to nearly 900 mg/L in recent measurements, almost twice the DWS.

Amidst these rises, acidity declined at BC-3, while alkalinity rose and field pH rose after the subsiding of initial impacts from mining that had increased acidity and reduced alkalinity. Values for calcium and magnesium also rose steadily over the monitoring period, while chloride, sodium and potassium rose but to lesser extents at BC-3. These trends present a distinct possibility of contamination from the ash. However placed lime and broken overburden limestone could also be contributing these parameters at this site.

Higher selenium values that occurred at BC-3 during the rises of these constituents suggests ash as a source of the degradation, but the lack of information characterizing the chemistry of the lime or limestone at this site prevents these sources from being ruled out also as possible sources of selenium. Nonetheless increasing concentrations of several different ash parameters suggests in turn that markedly increasing concentrations of sulfates, manganese and TDS at BC-3 amidst a decline in acidity could be coming at least partially from the ash. It should be noted that sulfate leaches prolifically from most coal ashes placed in Pennsylvania coal mines, and manganese is also concentrated in conventional eastern Type F coal ashes and can readily leach from them under acidic pHs (see “The Influence of Fly Ash Additions on Acid Mine Drainage Production from Coarse Coal Refuse,” Stewart *et al.*, Virginia Tech, 1996).

Pollutant concentrations at BC-14 do not yet reflect degraded groundwater, but are increasing. TDS levels have increased from typically less than one tenth to between one fifth and one fourth the DWS. Sulfates from BC-14 were well below the DWS, but rose from around 15 mg/L before ash placement to a peak of 82 mg/L in 2003 before declining again to just over 20 mg/L. Concentrations for manganese exceeded its DWS 6 times at BC-14, although the levels usually remained less than a tenth of those at BC-3. Before ash placement, iron concentrations measured at BC-14 started with a spike of 2.71 mg/L, but then fell to levels below the DWS. After ash placement began, the iron concentrations hovered at or slightly above the standard, and in June 2003, iron rose to 2.06 mg/L.

Although pH values decreased, acidity did not increase and alkalinity eventually increased at BC-14. These trends suggest an impact from mining which could have disrupted limestone on the site that, in concert with lime and ash, eventually produced an increase in alkalinity at BC-14 just as monitoring ended at this point. The higher sulfate trend could also reflect some contamination from the ash. The sources for these trends at BC-14 could be better differentiated if there were chemical analysis of the ash, lime, site limestone and spoils for trace elements, calcium, magnesium, chloride, sodium and potassium. A decreasing pH at BC-14 results from acid mine water, but the shallow slope of the pH trend and rising alkalinity suggests some buffering by ash and/or lime placement and/or overburden limestone.

The gaps in monitoring data, short duration of monitoring – none occurred at most monitoring points after mining and ash placement were completed, low frequency of monitoring for trace elements and other ash parameters, deficient chemical analysis of ash and other alkaline materials at the site and absence of an upgradient monitoring point prevent a definitive analysis of the contribution of pollution from ash placement at this site. Although the permit's Operations Map shows a proposed monitoring well MW-2, uphill from the mining and ash placement operations, which would have functioned as an upgradient monitoring well, there was no data in the permit for this well. Most PADEP permits clearly label which monitoring points are upgradient or downgradient; this was not the case with this permit.

The data from this site suggests ash could be contributing to the contamination of water in this mining operation. Continuation of monitoring at this site after the completion of mining and ash placement which occurred in late 2004 is necessary to allow a fuller interpretation of the data. The impact of degradation at this site on the intermittent stream, Banion Run, is unknown as there are no monitoring data from this stream for annual ash parameters in the permit file. Monitoring for these parameters should be expanded to points on this stream downstream and upstream from the Buterbaugh Mine and additional points should be established monitoring waters directly in the ash/spoil configurations at the site. Additional chemical analysis of the ash, lime and limestone at this site should be undertaken. Monitoring parameters should then be expanded to include more constituents' exclusive to the leachate of the ash placed at this site to differentiate its impacts from the effects of lime additions, overburden limestone, and the mining itself. Additional parameters would likely include boron and molybdenum. Monitoring for ash parameters should be increased from an annual to at least a quarterly basis.