

Permit Review 10

SKY HAVEN COAL COMPANY, BLOOM #1 MINE (PERMIT # 17950111)

Site Summary

The Sky Haven Coal Company Bloom #1 Mine is located in Bigler Township in Clearfield County, Pennsylvania. This site covers 51.7 acres in the Clearfield Creek Priority Watershed 8C. Bloom #1 was a subchapter F active surface mining operation. Mining started in December, 1996 and ended in 2003. The permit authorized placement of approximately 80,200 tons of FBC ash as an alkaline addition, starting in December 1996. According to PADEP, just 45,000 to 50,000 tons was deposited at the site as of June 2005 with the ash coming from the Piney Creek and Scrubgrass (also FBC) Power Plants in the Clarion Pennsylvania area. The ash was deposited in the backfilling phases as alkaline addition for the remediation of AMD. During mining operations, an abandoned surface mine (6 acres) and portions of a deep mine (2 acres) were daylighted and treated with FBC ash which was also mixed with spoils and used to plug holes created from auger mining under the permit. Data from two groundwater monitoring wells (MW-1 and MW-3) and four downgradient subchapter F monitoring points (FA-19, FA-30, FA-32 and FA-20) were assessed in this review.

Geology

The rocks exposed during mining at the Bloom #1 Mine belong to the middle Pennsylvanian System of geological time. The coals on the site include the Clarion, Lower Kittanning, Middle Kittanning, and Lower Freeport, but only the Middle Kittanning seam was actively mined for this permit. This coal was mined by open pit and auger methods. The structure of the sedimentary beds is essentially flat lying, with a gentle dip (inclination) to the southeast.

Because the Middle Kittanning seam was deposited in nearshore brackish and marine conditions, the amount of sulfur in this coal is higher than in younger coals. This high sulfur content enhances the potential for AMD to result from mining at this site.

Topography

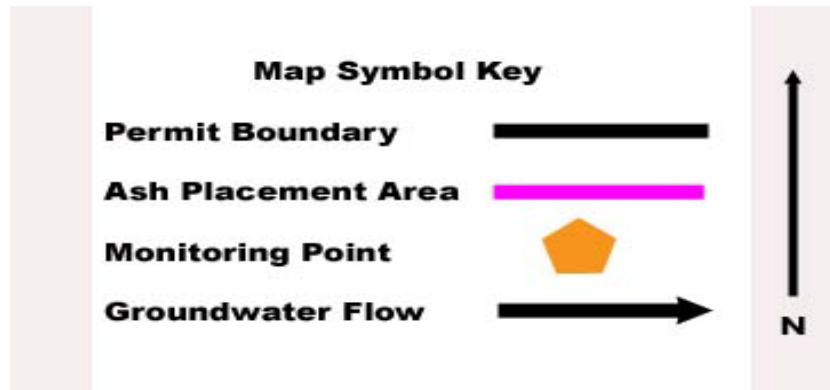
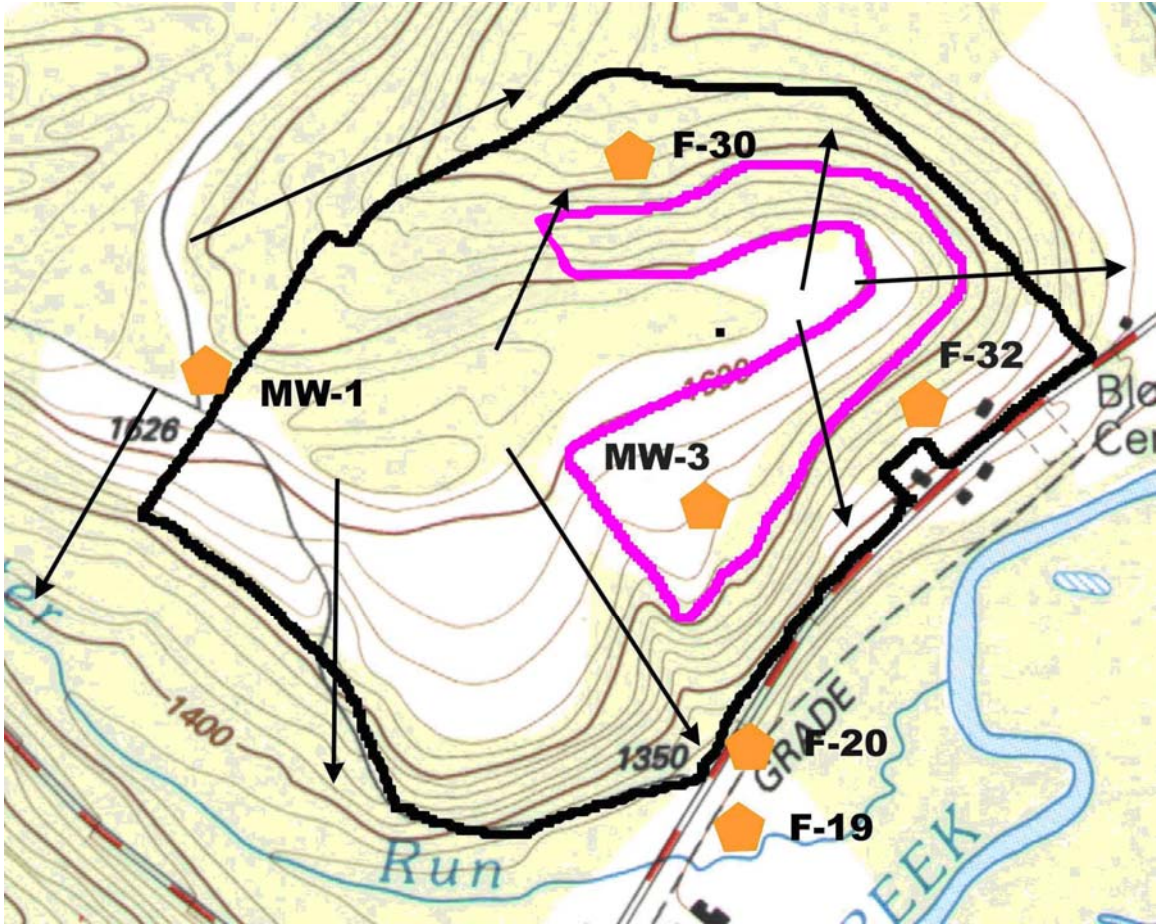
The Bloom #1 Mine is in the Allegheny Mountain physiographic province (figure 1) and is situated near the top of the eastern end of an east-west trending hill (see map below). The mine is on the north, east, and south slopes of this hill and is shaped like a horseshoe, with the open end pointing west. The top of the hill was not removed during mining; the coal under the hilltop was auger mined.

Groundwater

The groundwater at the Bloom #1 site follows the topographic trends closely, even though they have been disturbed by mining. The water moves from the top of the hill, and flows north, east, or south, depending on what part of the “horseshoe” it is

above. The water travels through the spoil and ash and down to the horizon of the Middle Kittanning Coal, which has become the local base level for groundwater movement that eventually exits the site. The underclay below the coal acts as a water trap, or aquitard.

Site Map: Bloom



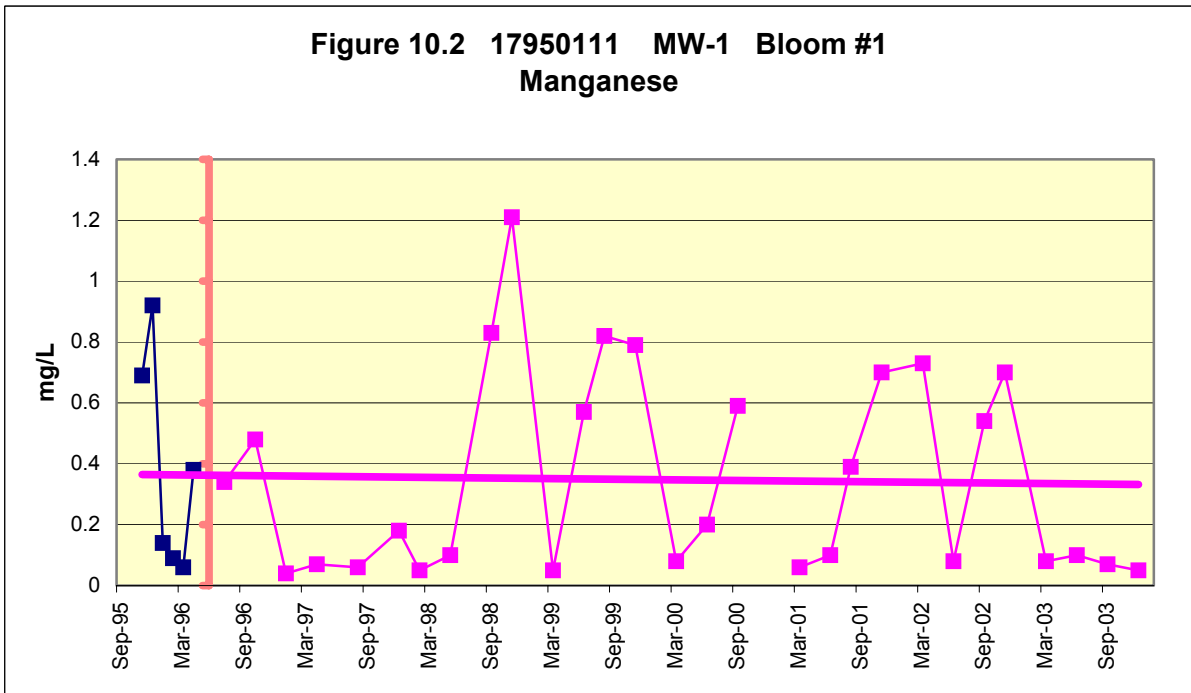
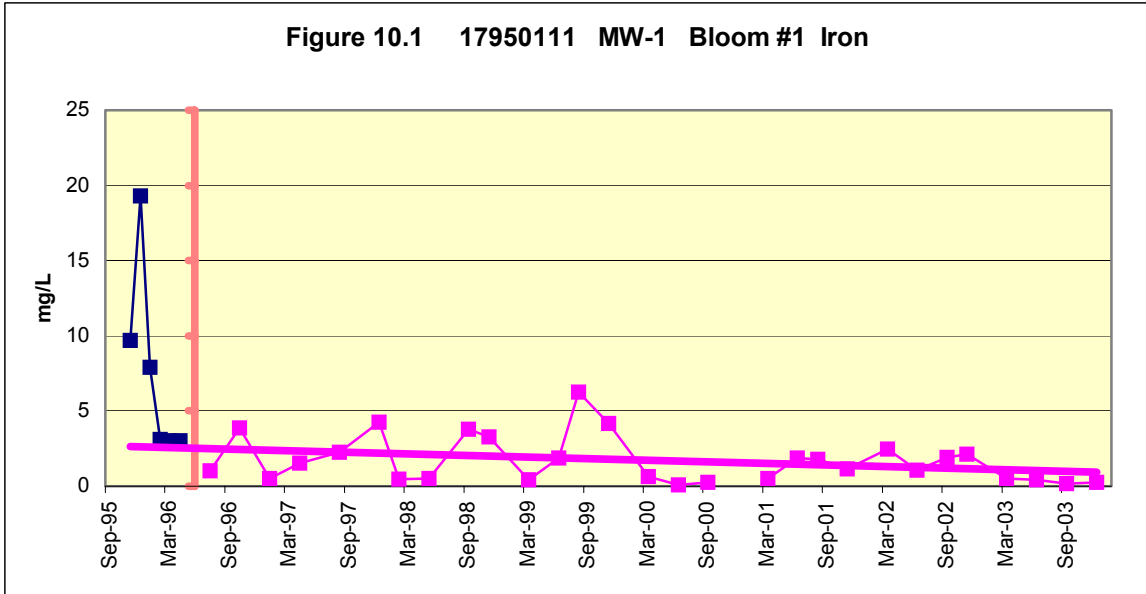
Sky Haven Coal Co., Bloom #1 Operation (Permit # 17950111)
Scale: 1" = Approximately 800'

Water monitoring data: Discussion

Concentration data was examined from five monitoring points: (1) MW-1, an upgradient monitoring well on the top of the hill which was dug into previously mined ground and is screened in spoil; (2) MW-3, a well in the mined area backfilled with ash and spoil; (3) subchapter F point FA-19, monitoring discharges of a seep flowing from the mining and ash placement area downhill to the south of the “horseshoe;” (4) subchapter F point FA-30, monitoring a seep discharging from the mining and ash placement area downhill to the north; and (5) FA-32, a well monitoring shallow groundwater flowing east from the “horseshoe.” Monitoring points FA-19, FA-30 and FA-32 can be expected to see different degrees of impacts, because the extent of mining and ash placement is greater on the south side of the horseshoe than on the north side. All five monitoring points have concentration data, and the two subchapter F points (FA-19 and FA-30) also have loading data that was examined. Thus these points were selected to include an upgradient point (MW-1, not always possible at the sites examined in this report), a monitoring point inside the ash (MW-3, also rarely provided in the examined monitoring systems) and monitoring points on different downgradient sides of the horseshoe that have the most complete sets of data for assessing impacts at the site both from a concentration and a loading standpoint. In addition, the review will briefly discuss loadings from a sixth monitoring point, FA-20 that have increased significantly in the last year for manganese and acidity resulting in an increased frequency of monitoring required by PADEP. FA-20 is a subchapter F monitoring point located close to FA-19.

MW-1

Figures 10.1, 10.2, and 10.3 are graphs of concentrations for iron, manganese, and sulfates for upgradient MW-1. The baseline monitoring period ended by June 1996. All of the MW-1 data have a gap in the sampling on December 27, 2000, due to “inaccessible” conditions. The baseline data for iron has a “spike” of 19 mg/L in December 1995, and then the trend for the rest of the monitoring period is relatively flat, with a gradual decrease in concentration. The average value for iron after baseline monitoring is about 1.7 mg/L, nearly 6 times the drinking water standard (DWS) of 0.30 mg/L. The concentrations for manganese are all under 1.3 mg/L. Although they fluctuate widely and follow a seasonal trend of increases in the fall and winter, they nonetheless undergo a slightly decreasing average trend during the permit operation. The DWS for manganese is 0.05 mg/L, so the maximum value for manganese at MW-1 is 24 times the DWS. The sulfate (figure 10.3) has an increasing trend although values are less than 25 mg/L. The average concentration for sulfate during baseline monitoring is about 10 mg/L, which increases to about 17 mg/L at the end of monitoring with actual values all well under the DWS of 250 mg/L. These values and trends represent groundwater that is not badly degraded.



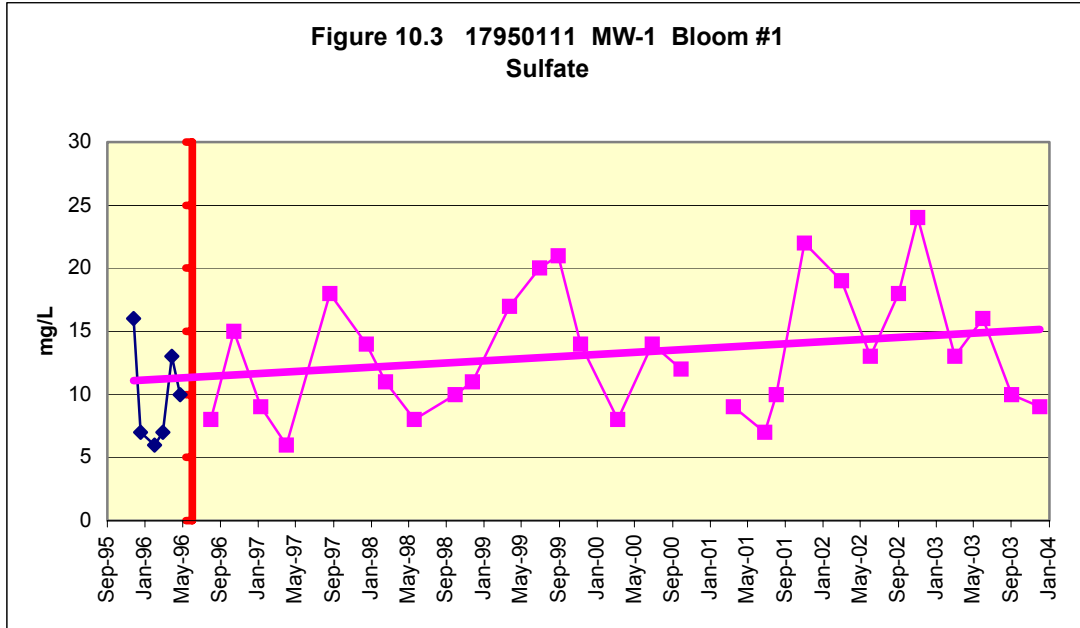
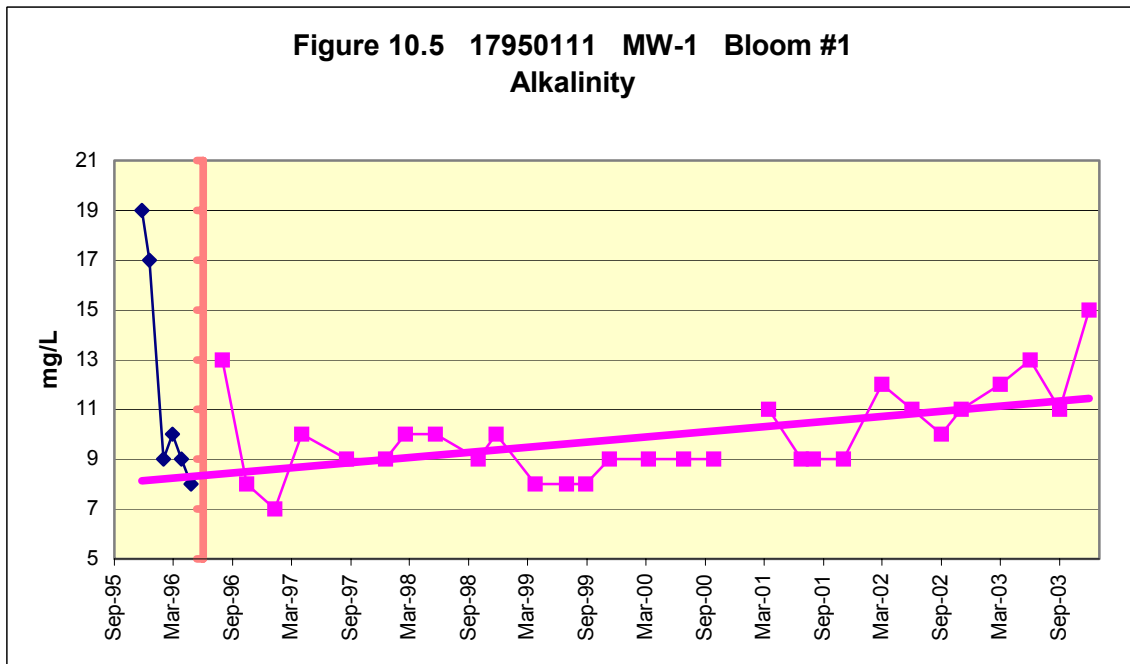
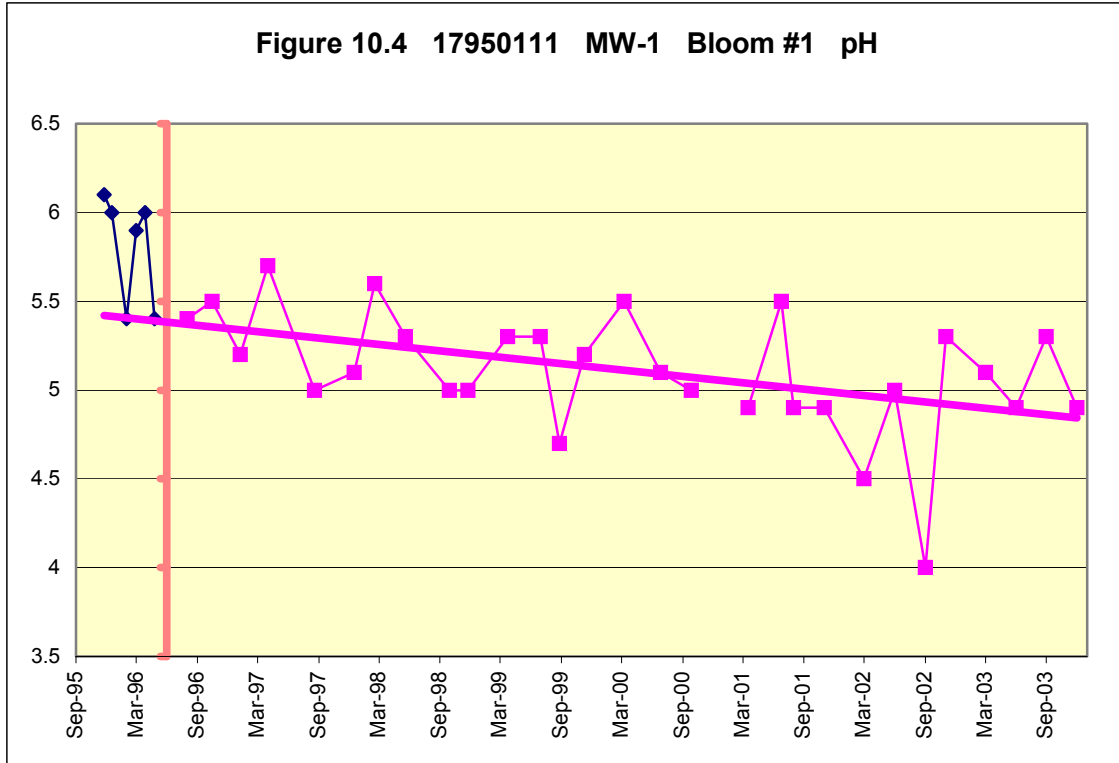
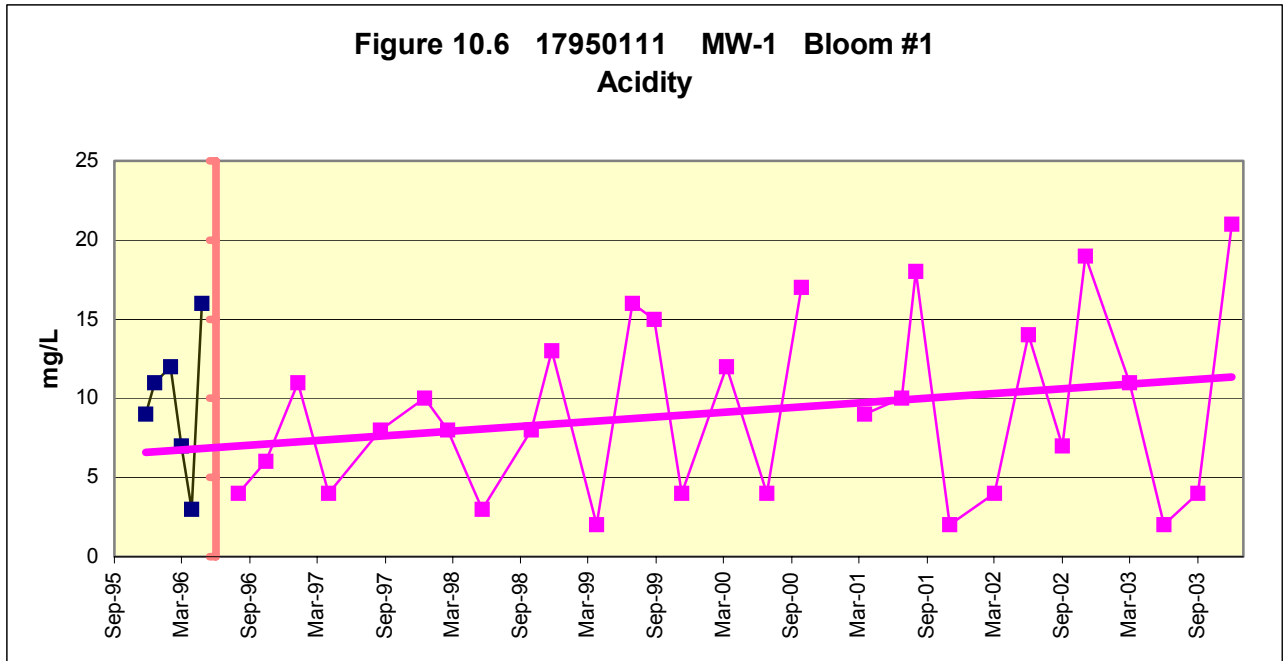
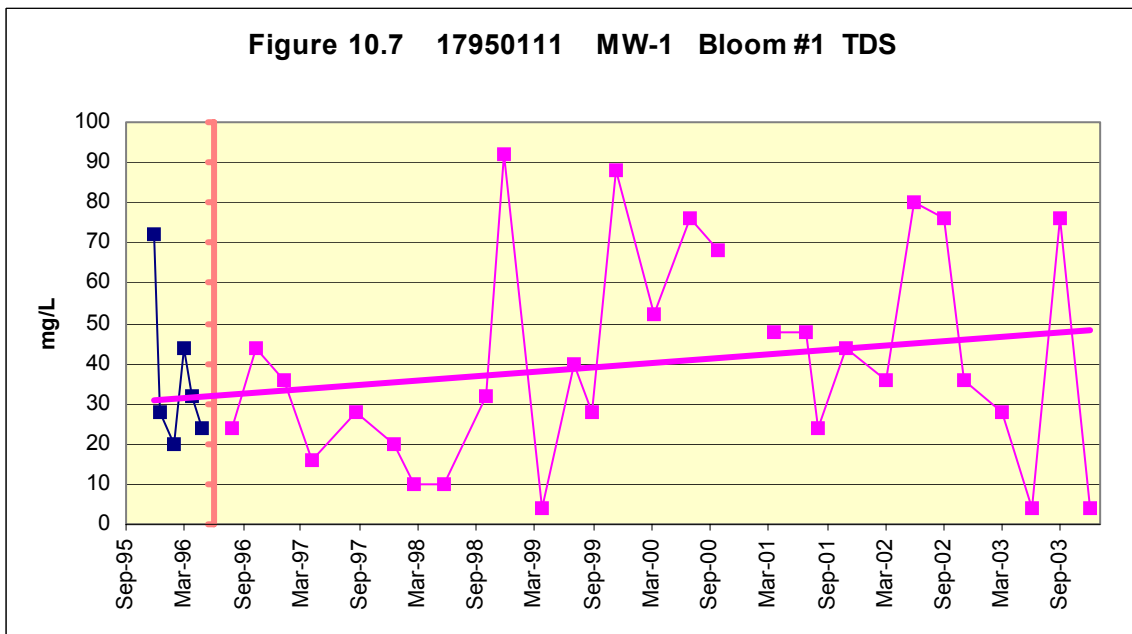


Figure 10.4 charts the field pH at MW-1. Field instead of laboratory pH data is used in this report because it should best represent natural groundwater conditions. The pH is slowly falling over time, along with a gradually increasing acidity (figure 10.6), both indicating activity producing AMD. The alkalinity (figure 10.5) also rises slightly over time after baseline monitoring. The position of this well, upgradient from the ash but screened in mined ground reveals low levels of residual degradation from previous mining although these levels of gradually increasing alkalinity and AMD may indicate a some hydrologic connection or flow path from the permitted operation that is not characterized by the permit.



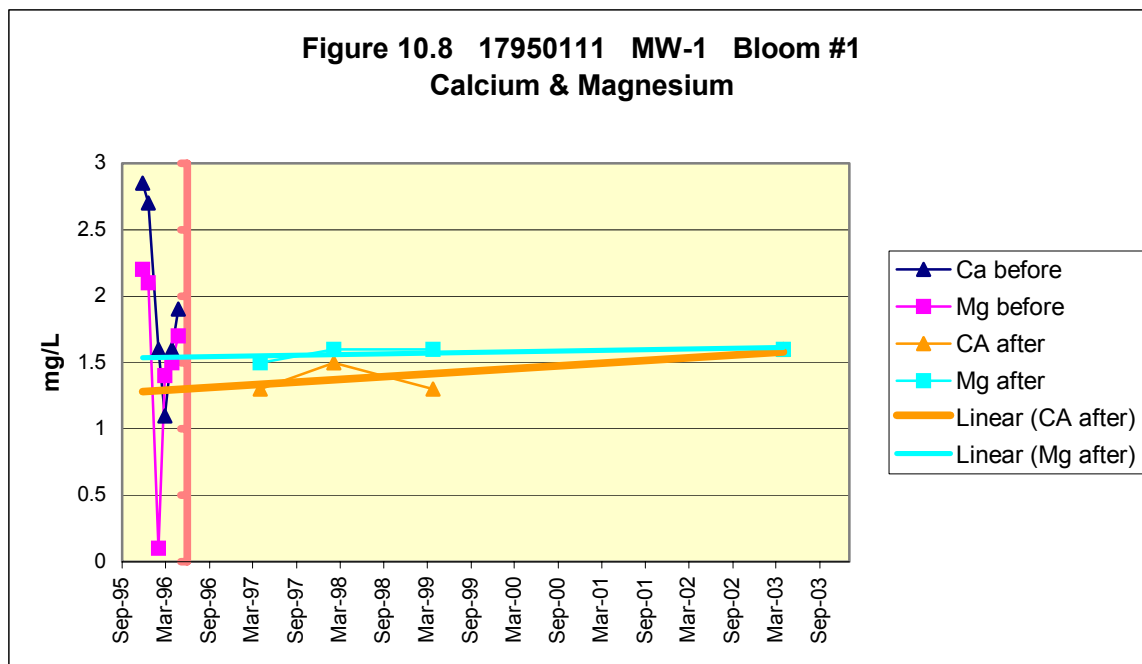


The TDS trends are illustrated in figure 10.7. The concentrations are not that high, (all under one fifth the secondary DWS). Nonetheless they fluctuate greatly with an average overall rising trend possibly due to both AMD and ash placement leachates.

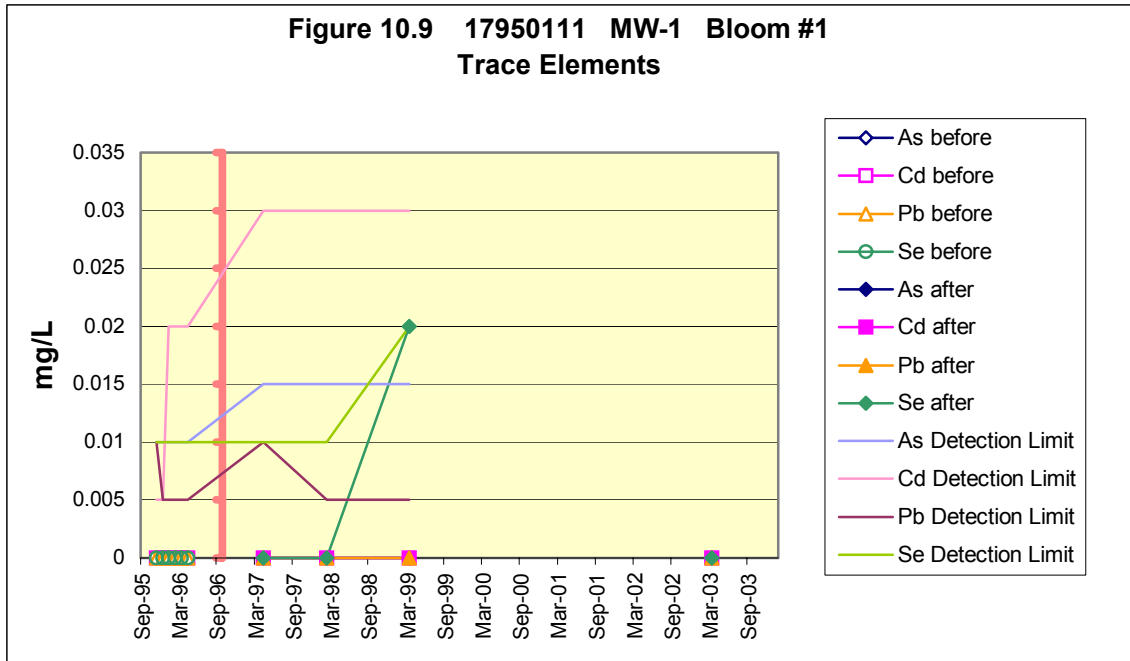


Calcium and magnesium concentrations are both plotted on figure 10.8. No data were found for concentrations of these constituents in 2000, 2001, or 2002. There is one data point for magnesium in 2003. Given this paucity of data, general trends cannot be established after 1999. After the baseline period, both calcium and magnesium have fairly

flat trends from the beginning of 1997 through early 1999. If the 2003 magnesium data point represents the continuation of this trend, then the average concentrations for both elements have not changed by more than 0.5 mg/L over the entire ash placement period, but the gap in measurements leaves that to speculation.

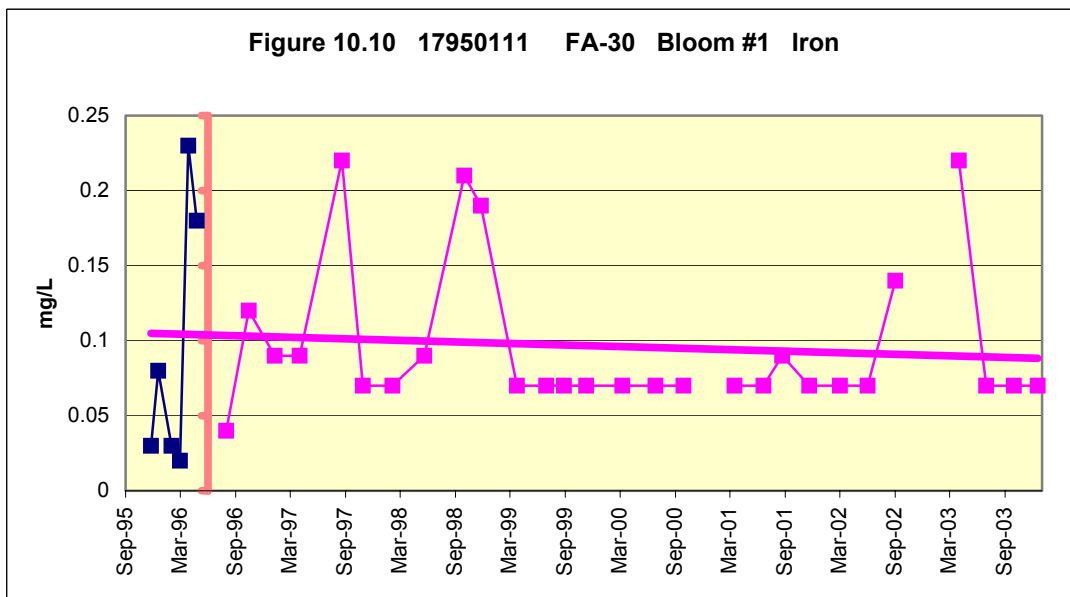


Trace element values measured at MW-1 (figure 10.9) portray increases in detection limits for arsenic, cadmium, and selenium concentrations and unchanging detection limits for lead concentrations from baseline levels. All of the values in figure 10.9 are listed in the monitoring reports as detection limits or levels, except for the March 1999 selenium value which is an actual concentration measured of 0.02 mg/L. In other words, with the exception of this single selenium value, rather than an actual concentration, the laboratory analysis indicates the trace element was not present at a concentration at or above the detection limit used in the analysis. Curiously, the higher detection limits recorded after mining and ash placement started indicate that PADEP accepted results from analyses with even greater limitations such as matrix interferences than occurred in baseline samples. This is the opposite of what reviewers of this data might expect, i.e., that the agency would have at least requested that the laboratory reduce detection limits from those used in the baseline analyses to determine the impacts of ash placement more accurately if not required new baseline samples with lower, more accurate detection limits to begin with. The last reading for selenium in March 2003 was <0.05 mg/L, a detection limit five times higher than detection limit values recorded during baseline monitoring. Detection limits for arsenic and cadmium also increased from the baseline detection levels. Similar to calcium and magnesium, there is a four-year gap in sampling data for these trace elements from 1999 to 2003.

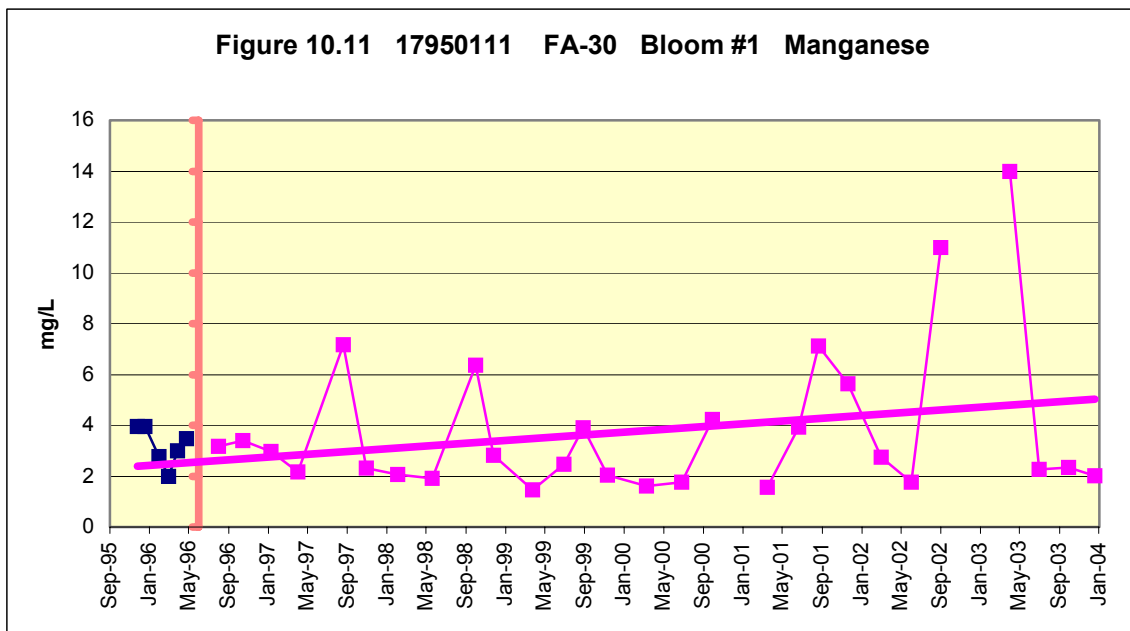


FA-30

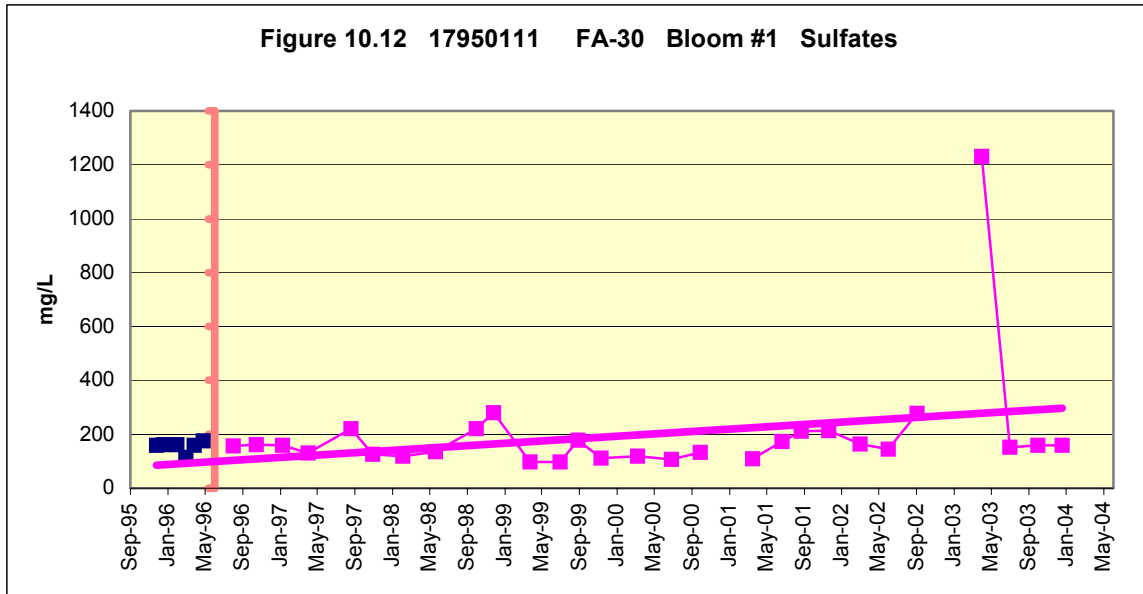
Figures 10.10, 10.11 and 10.12 are graphs that plot iron, manganese and sulfate concentrations from the subchapter F monitoring point, FA-30, a surface discharge that is downgradient below the northern arm of the horseshoe. The values for iron are very low (figure 10.10), fluctuate widely until December 1998, and then flatten until a spike in early 2003. Iron values for this well are lower than those for upgradient MW-1 and are all below the DWS of 0.3 mg/L. The flat-lined portion of the graph represents points whose values were below the detection limit of the analysis, at 0.07 mg/L.



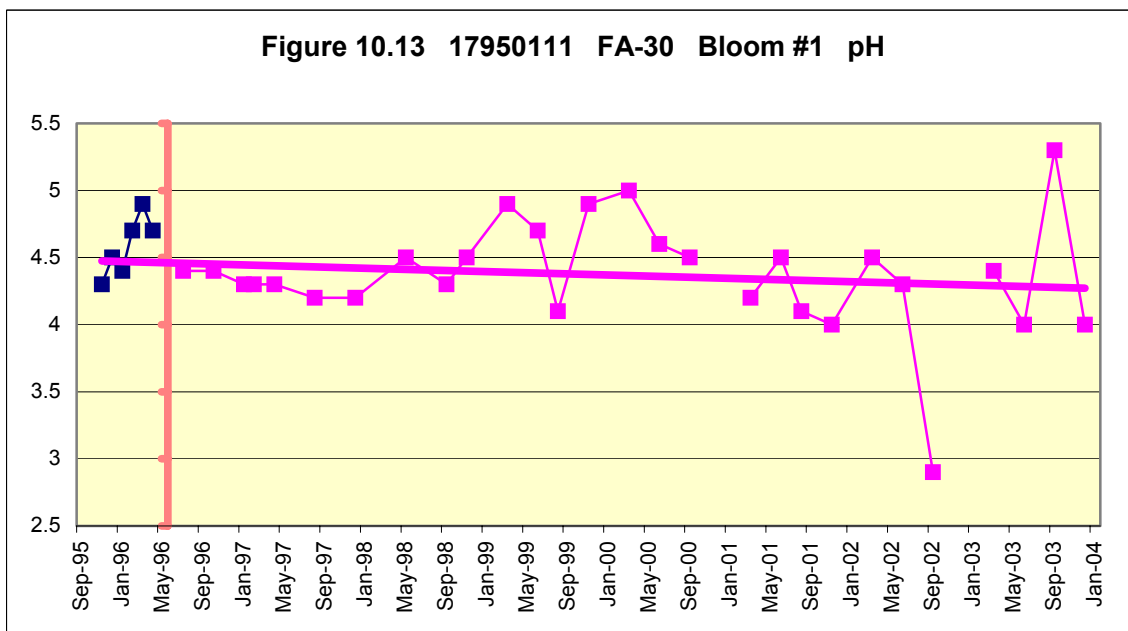
Manganese values (figure 10.11) are about 4 times the MW-1 concentrations and fluctuate widely, with a slow average increase. While this plot shows manganese concentrations no higher than 3.96 mg/L during the baseline period, some six measurements of manganese exceed 5 mg/L after ash placement starts, and a spike in manganese concentrations reaches 11 mg/L, 220 times the DWS in September 2002 and 14 mg/L in March 2003, 280 times the DWS. However, low manganese values also occur after ash placement, resulting in an average measured concentration for manganese after ash placement of 3.8 mg/L, 76 times the DWS. This can be compared to an average manganese concentration before ash placement of 3.2 mg/L, 64 times the DWS. These levels indicate degraded water that is gradually becoming more degraded with manganese after mining and ash placement.

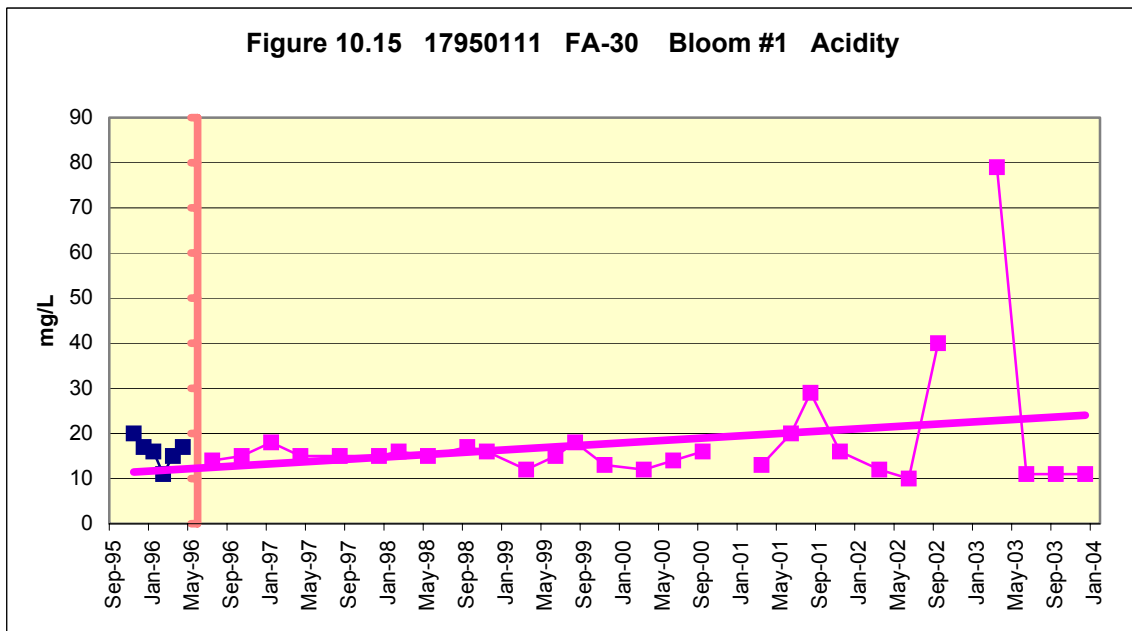
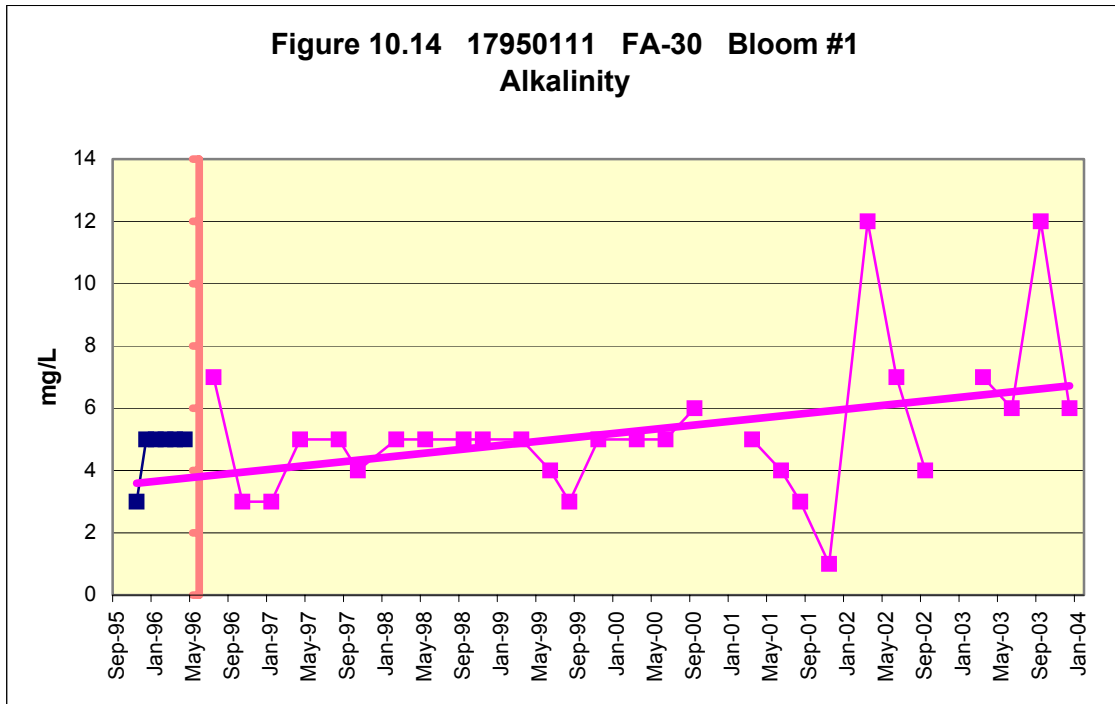


Sulfate concentrations at FA-30 (figure 10.12) are on average 10 times higher than sulfate concentrations at MW-1, although the levels rise above the DWS of 250 mg/L only three times, in all instances after ash placement started. A spike in sulfate concentrations to 1,231 mg/L, occurred in March, 2003. Nonetheless an average sulfate concentration of 155 mg/L before ash placement rises to about 300 mg/L after ash placement indicating that while the trend in sulfate concentrations is increasing after ash placement, the water is not yet badly degraded by this constituent.

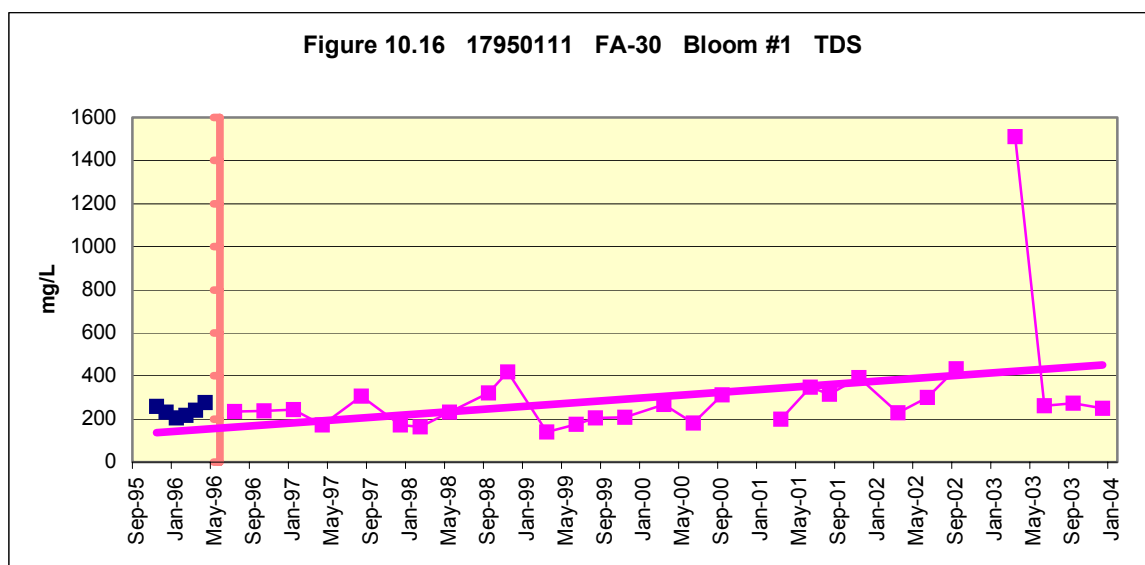


The field pH, alkalinity and acidity at FA-30 are plotted on figures 10.13, 10.14, and 10.15, respectively. Each component has a fairly flat trend line. The pH values have a slightly declining trend during the period of mining and ash placement from an average of 4.4 standard units to 4.3 standard units, and average acidity is increasing slightly. The range of acidity values from 10 to 40 mg/L of CaCO₃ equivalence and range of alkalinity from 1 to 12 mg/L of CaCO₃ equivalence indicates a weaker level of AMD compared to more degraded mine sites in Pennsylvania. Yet it also suggests that the FBC ash placed in this mine is not having a significant buffering effect on the acidity at this monitoring point despite the relative weakness of the AMD.



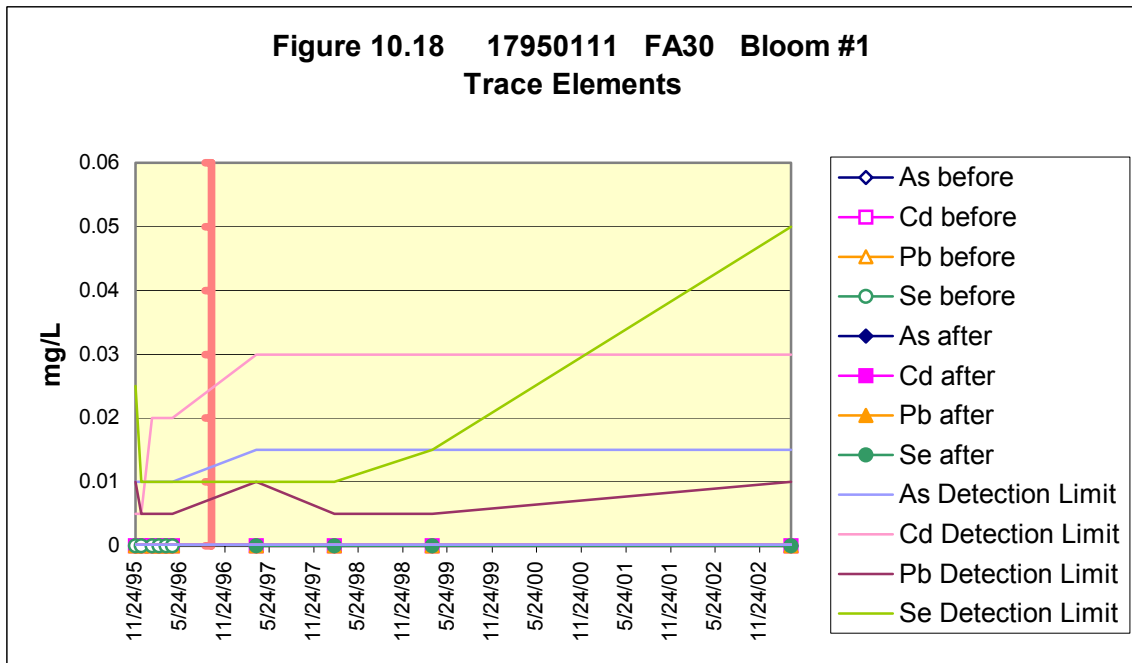
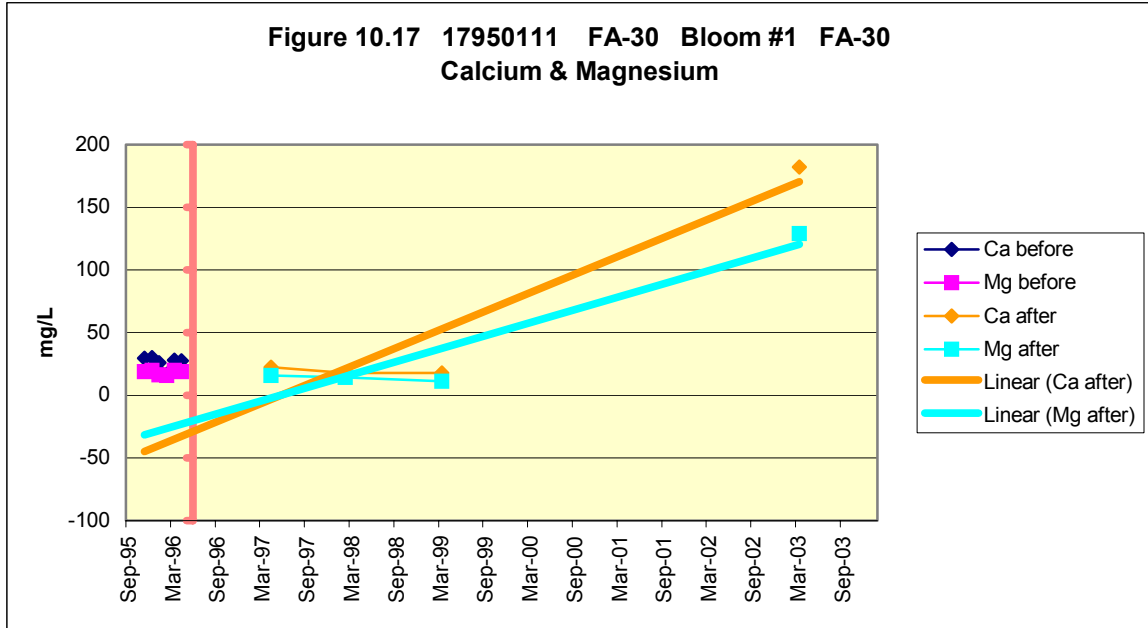


TDS concentrations at FA-30 are shown in figure 10.16. There is a definitive upward trend after ash placement starts. The average concentration increase is about 300 mg/L during the ash placement period with a peak of 1512 mg/L in March 2003, coinciding with the peak in sulfate and exceeding the DWS for TDS of 500 mg/L by over 3 times.



Calcium and magnesium values (figure 10.17) initially decrease slightly or appear static. However, after a three-year gap in data the concentrations in March 2003 of calcium (182 mg/L) and magnesium (129 mg/L) were 6 and 11 times greater than their highest earlier measurements respectively suggesting an impact from burnt limestone in the FBC ash. Nonetheless the gap in data collection prevents further substantiation of any trend pointing to placed ash.

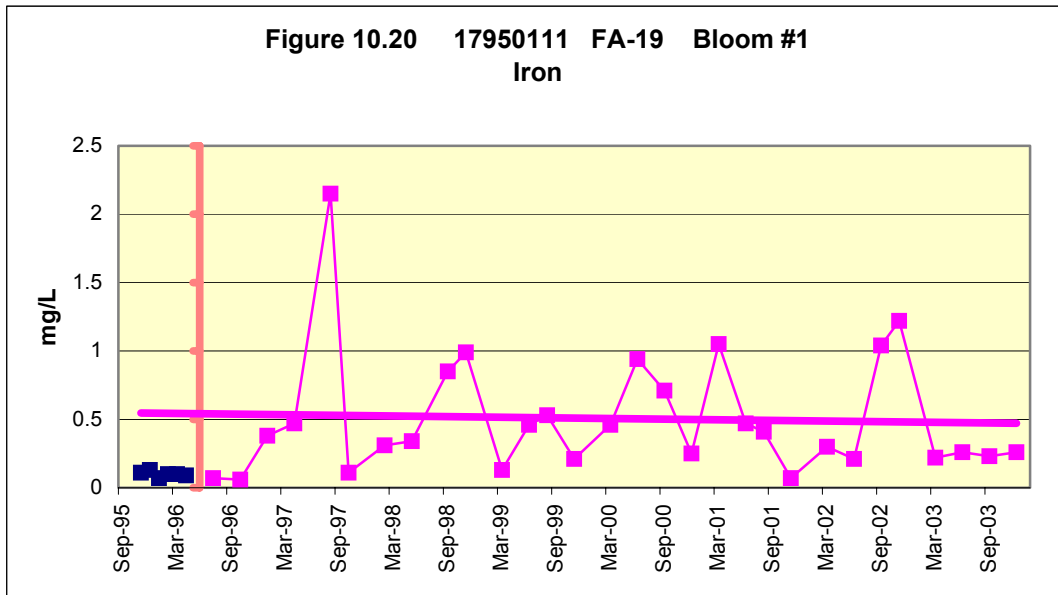
The trace elements, arsenic, cadmium, lead, and selenium, are shown in figure 10.18 for FA-30. All of the concentrations shown are below instrument detection limits. As with MW-1, the detection levels reported for cadmium, arsenic, and selenium increase at FA-30 beyond baseline detection levels once ash placement is underway. This leaves reviewers only with questions, unable to discern whether metals are present much less increasing to levels exceeding the DWS or decreasing, only that concentrations are not higher than the detection values reported. After ash placement, arsenic detection levels rise from 0.010 mg/L (the level of the new DWS) to 0.015 mg/L. Cadmium detection values rise from a range of 0.005 mg/L (the DWS) to 0.020 mg/L before ash placement to 0.030 mg/L after ash placement, exceeding the DWS by 6 times. Selenium reaches its highest detection level, 0.050 mg/L, equal to the DWS, in March 2003.



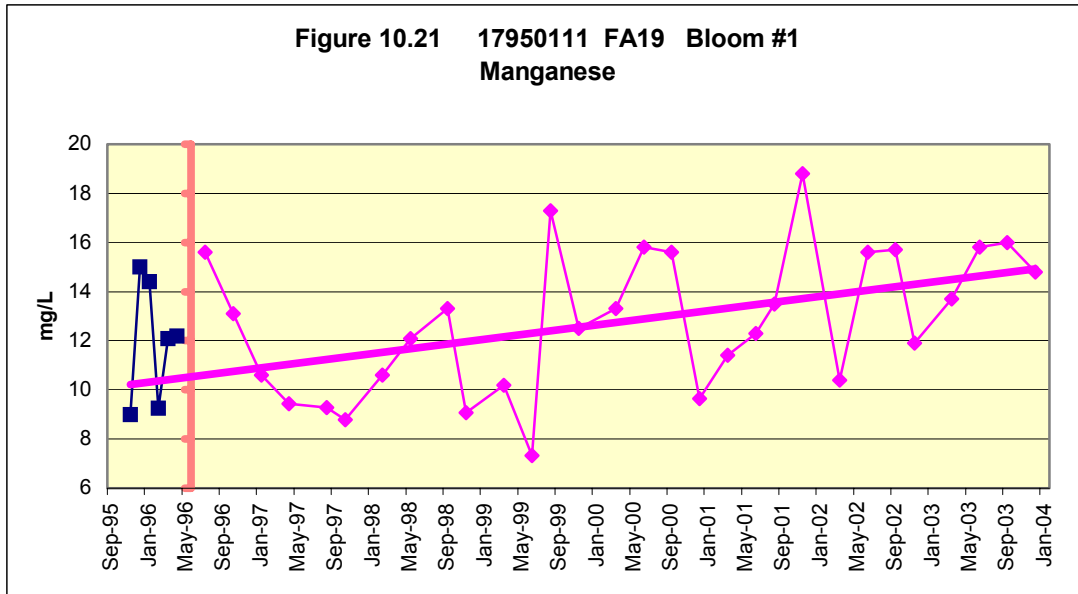
The substantial rises at FA-30 in concentrations of manganese, sulfates and TDS above baseline levels and DWS, combined with relatively static and weak pH and acidity throughout the monitoring period, suggest that the FBC ash is contributing to the degradation of water seen at this point.

FA-19

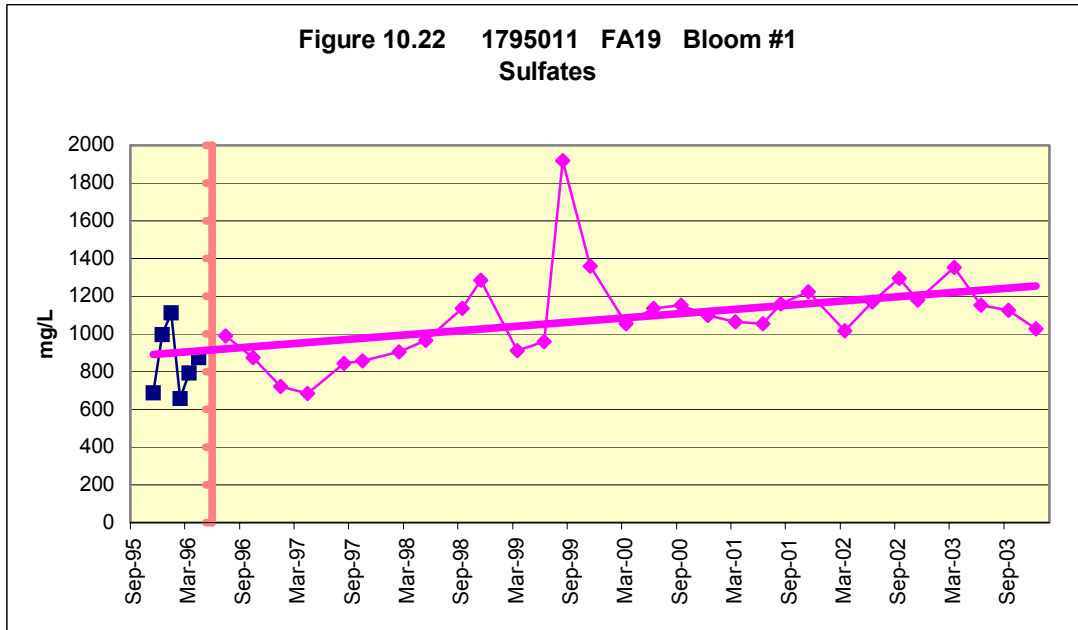
Figures 10.20, 10.21, and 10.22 are plots for iron, manganese, and sulfates for the subchapter F monitoring point FA-19, which is located on a downgradient surface discharge south of the horseshoe. Iron fluctuates considerably, jumping after mining and ash placement begin to levels several times to more than 16 times over the highest baseline concentration and more than 7 times the DWS. These levels slowly decline to levels about twice baseline concentrations in the latest data available in the permit file, resulting in an overall average of 0.4 mg/L, not far above the DWS of 0.3 mg/L.



Manganese levels (figure 10.21) fluctuate with average concentrations rising over time. Nine of the 30 concentrations measured for manganese after ash placement exceeded the highest baseline concentration, and 17 of these measurements were between 250 and 376 times the DWS. This illustrates degraded water that has become more degraded as a result of mining and ash placement.

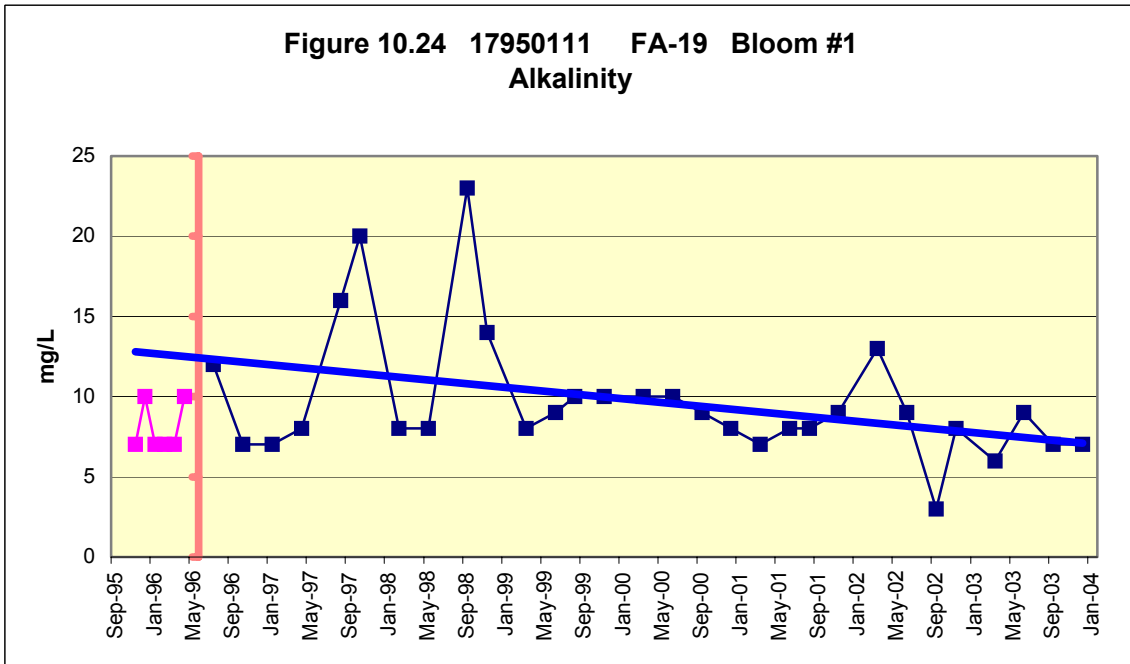
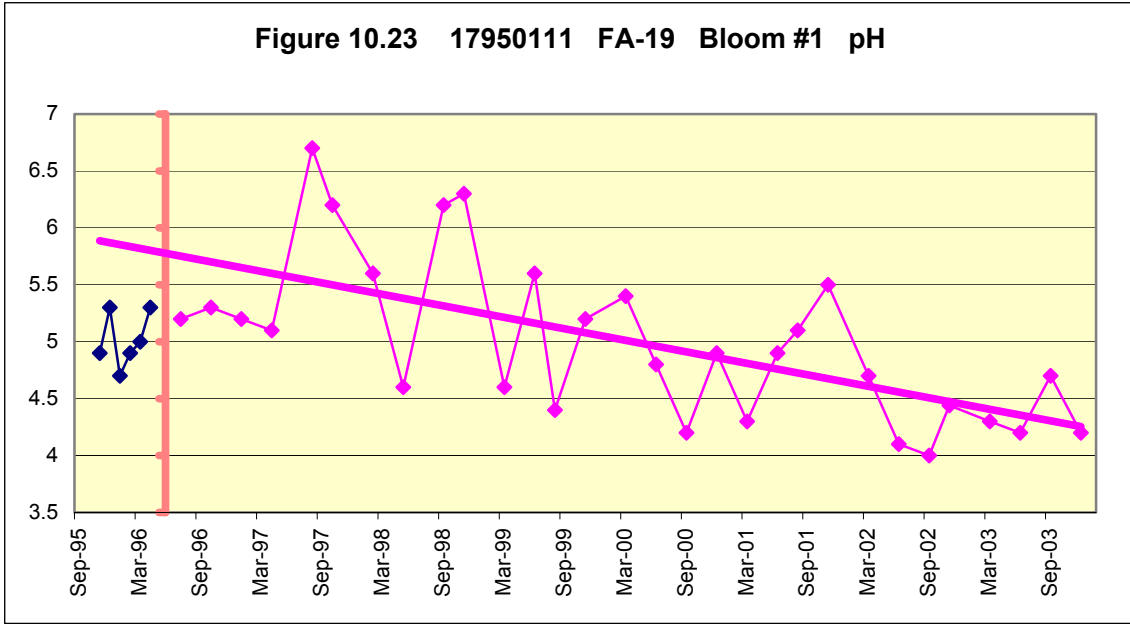


Sulfates are high with an upward trend (figure 10.22). Fifteen of 30 concentrations measured after the start of mining and ash placement exceeded the highest baseline concentration of 1113 mg/L and these values peak at 1900 mg/L, 7.6 times the DWS. Thus degraded groundwater is becoming badly degraded. All but two of the sulfate concentrations after the baseline period were at least 3 times the DWS. The sources for these rising levels of manganese and sulfate are some combination of coal mine spoil drainage, ash leachate, and leachate generated from the reactions of ash, spoils and other host materials at the Bloom site.



The field pH and alkalinity at FA-19 (figures 10.23 and 10.24) show an overall downward trend in the monitoring period. However these parameters both rise initially after baseline monitoring, with six pH measurements and five alkalinity measurements exceeding their highest baseline measurements during the first three years after mining and ash placement began in July 1996. The pH rose from a maximum of 5.3 during baseline monitoring to a maximum of 6.7 in this period, before dropping eventually to a low of 4.2 by the end of 2003 (the last monitoring data available in the permit file). The acidity (figure 10.25) drops after baseline monitoring, reflecting the higher alkalinity. After 1998, however, the acidity rose to levels usually about 20 mg/L above baseline values, with a drop to baseline levels in November 2001 and March 2002. These graphs suggest a scenario in which ash was placed shortly after baseline monitoring, resulting in some buffering of acidity before the ash lost its neutralization potential and was overridden by AMD or was cut off from water.

The TDS (figure 10.26) rises after baseline monitoring but then falls after 1999. The TDS drops again after the middle of 2002.



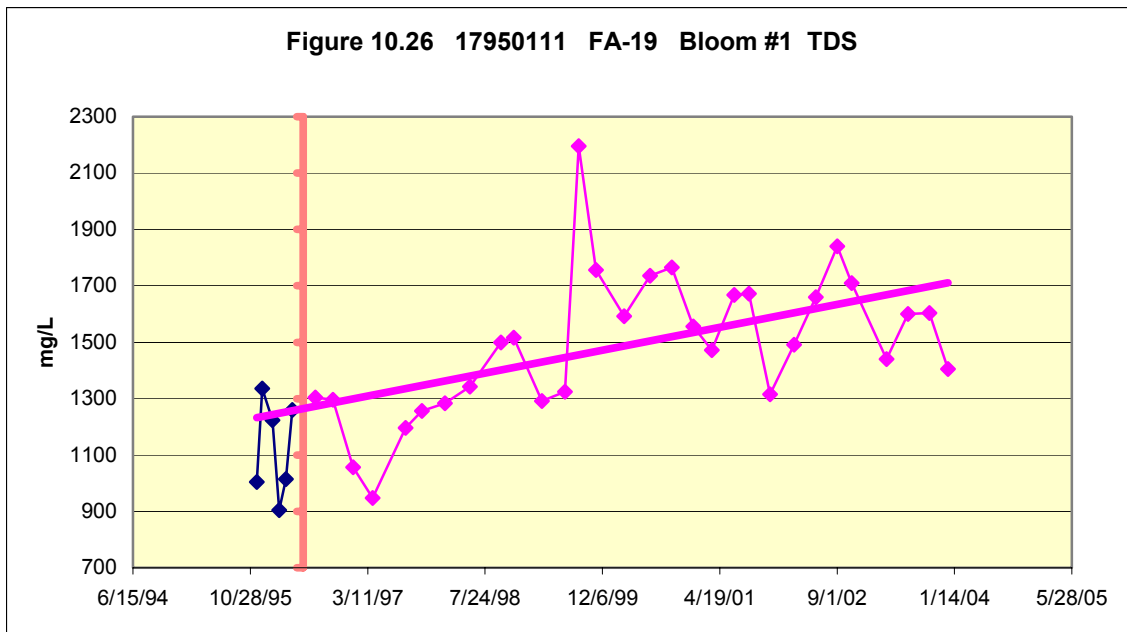
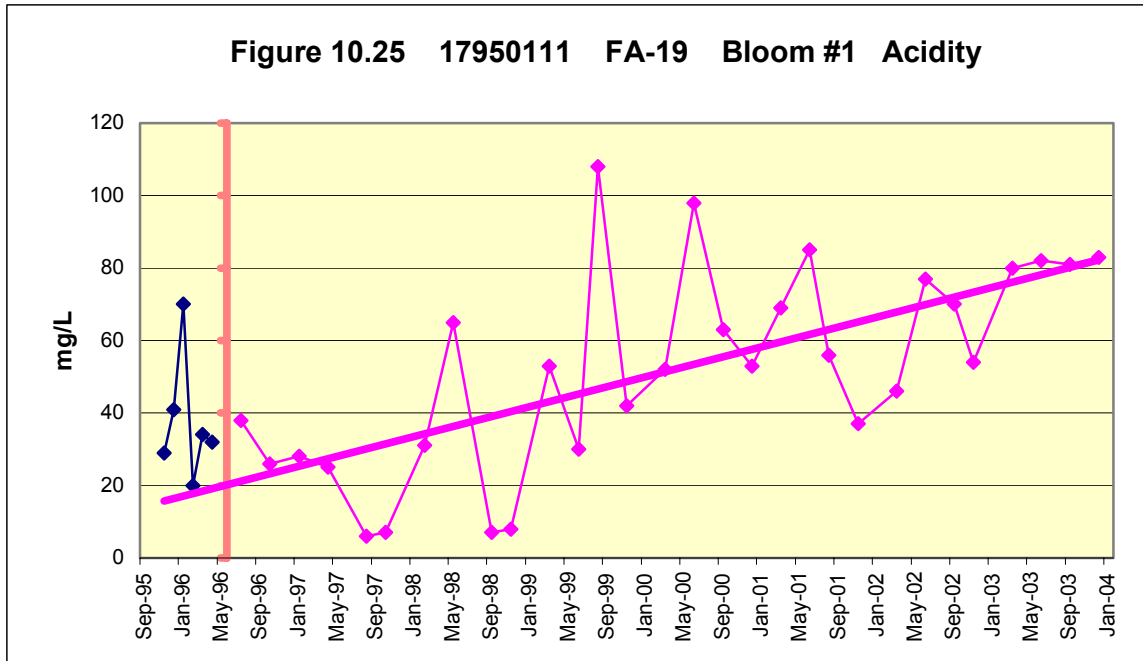
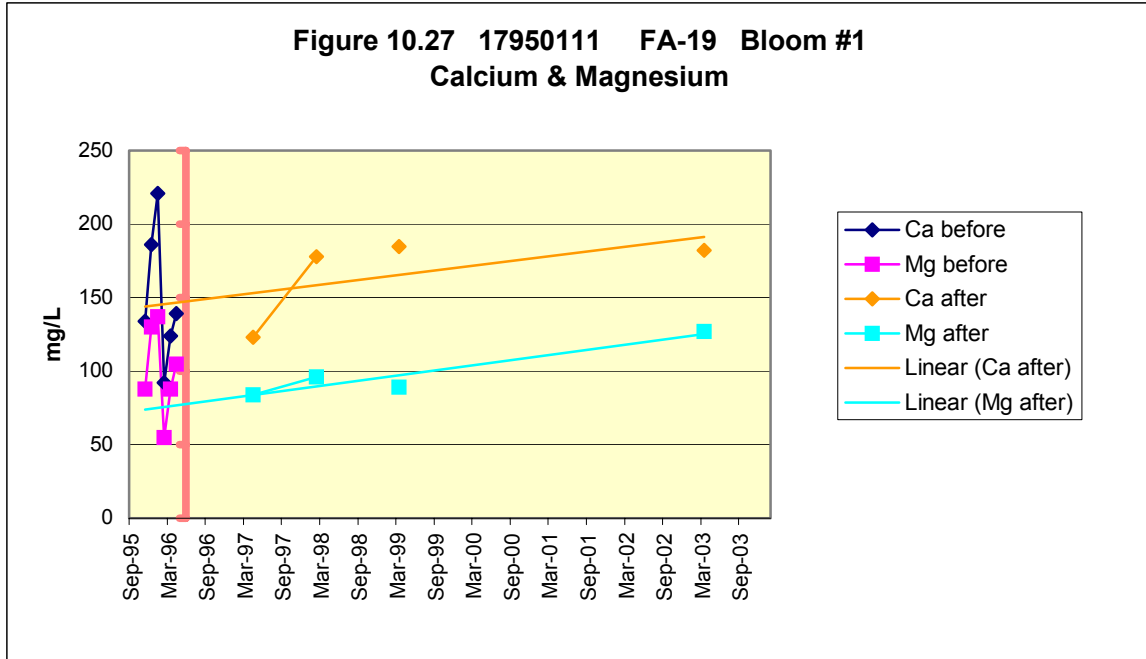
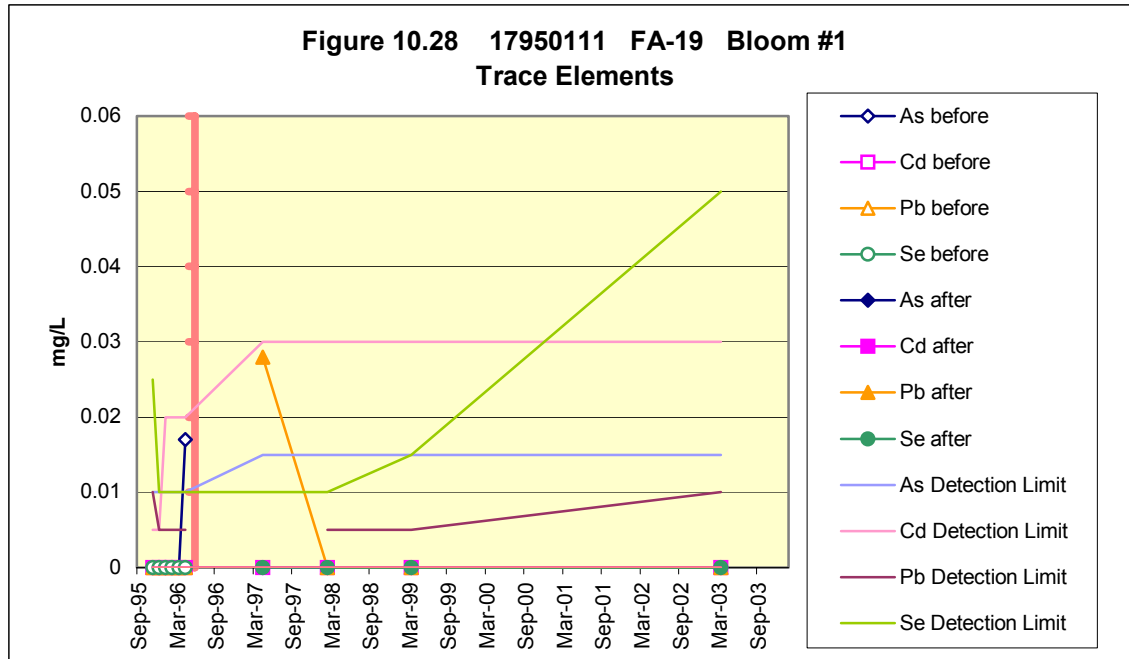


Figure 10.27 is a plot of calcium and magnesium at FA-19 through mid-1999. After baseline monitoring, these constituents rise but do not surpass baseline levels which are high to begin with. The baseline concentrations, the existence of only four data points after mining and ash placement started, and the absence of chloride data prevents a suggestion that these constituents are coming from the ash but does suggest that a previous source of alkalinity such as lime or lime kiln dust may have been placed at this site.



As is the case at other monitoring points, values for trace elements in figure 10.28 are detection levels rather than actual concentrations except for arsenic in April 1996 during baseline monitoring (of 0.017 mg/L) and lead in April 1997. While detection limits for arsenic, cadmium, and selenium, are lower at FA-19 than at MW-1 (figure 10.28), the dissolved concentration of lead actually measured at FA-19 of 0.028 mg/L in April, 1997 is higher than any measurement or detection limit recorded at MW-1, the upgradient monitoring point. The existence of only 4 data points after the baseline period representing only detection limits in nearly every instance greatly limits the ability to assess trace elements at this monitoring point.



FA-32

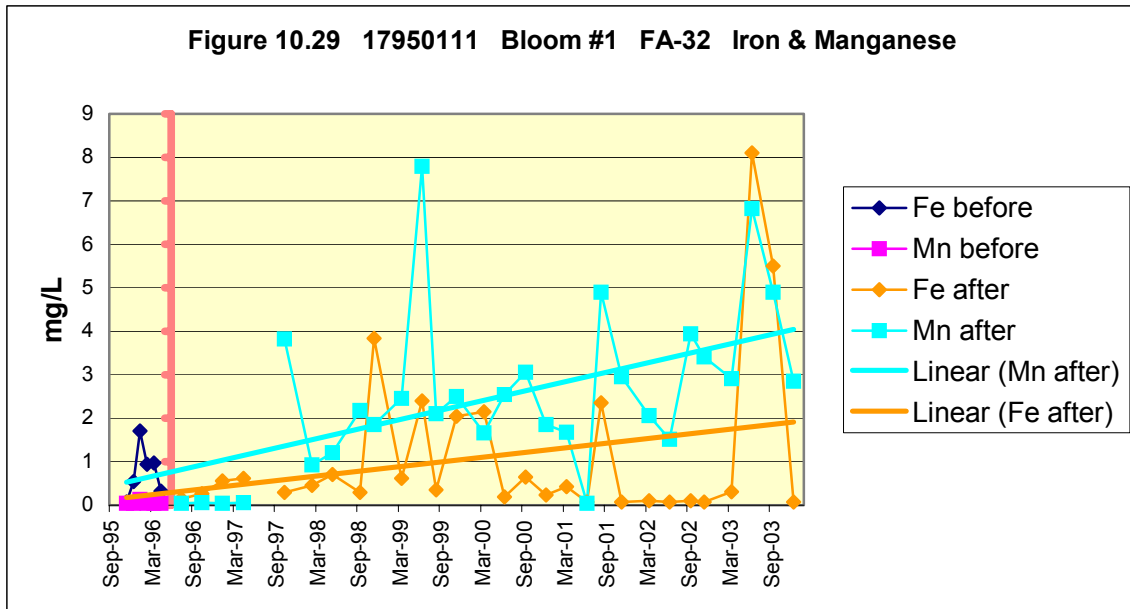
The subchapter F monitoring point FA-32 is a well dug on the eastern side of the “horseshoe,” slightly below the elevation of the Middle Kittanning coal bed.

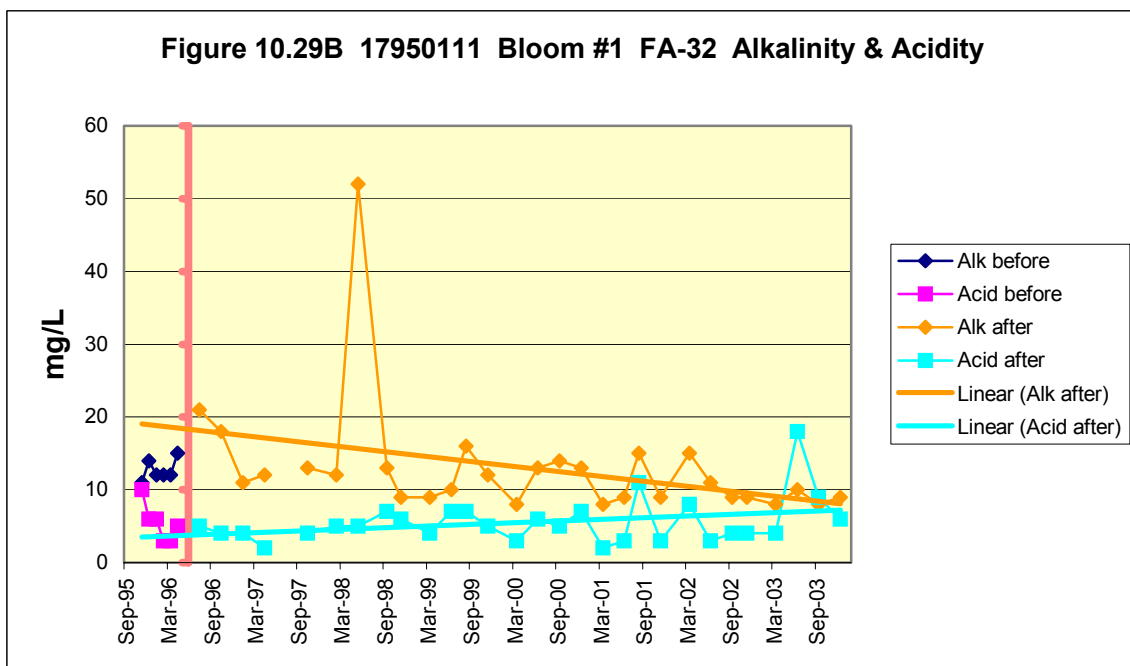
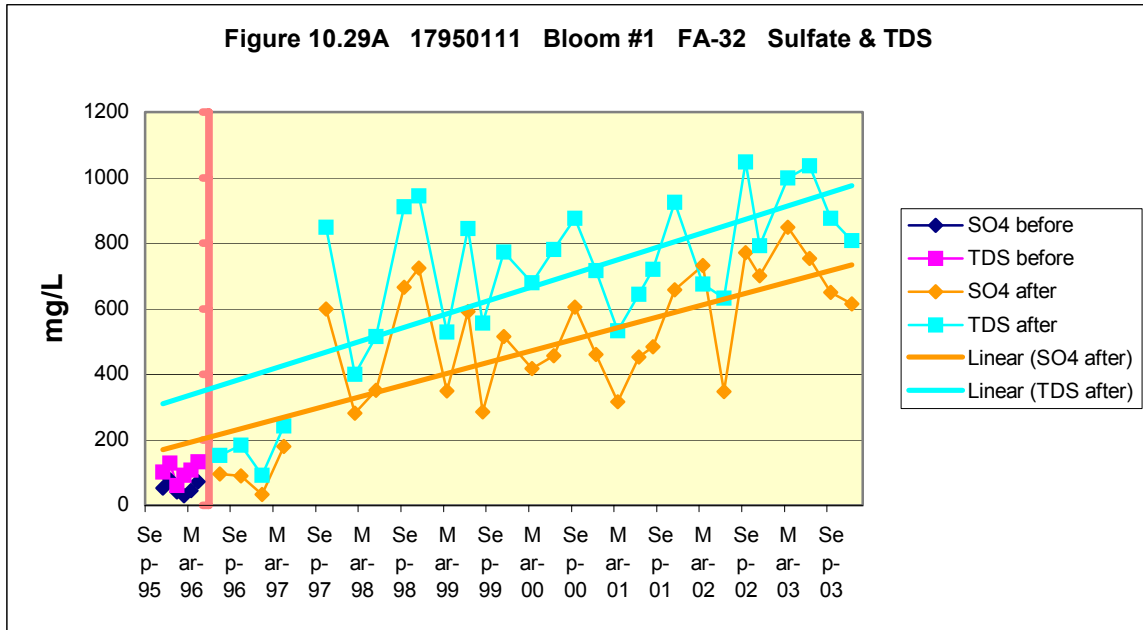
Figure 10.29 is a plot of the iron and manganese concentrations over time. There are a couple of instances in which these constituents drop below detection levels (.04 to .07 mg/L), but for the most part both show an increasing trend from levels relatively close to the DWS during the baseline period, to levels many times over the DWS after mining and ash placement. Manganese is rising more precipitously to levels up to 200 times the DWS by the latest monitoring data available.

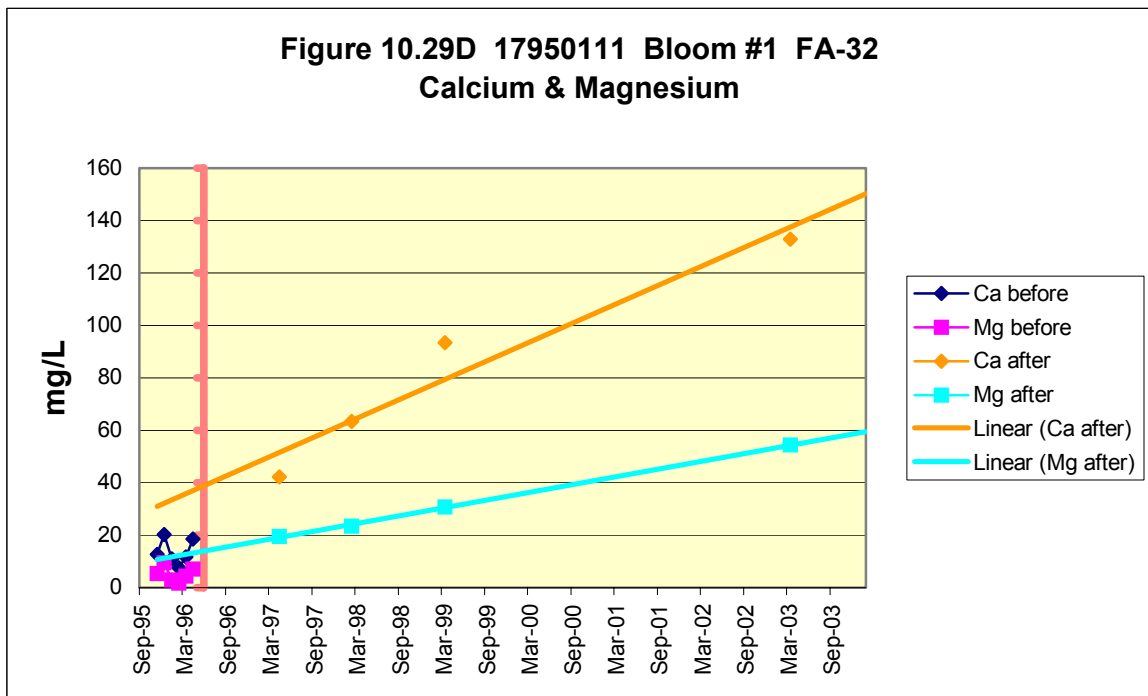
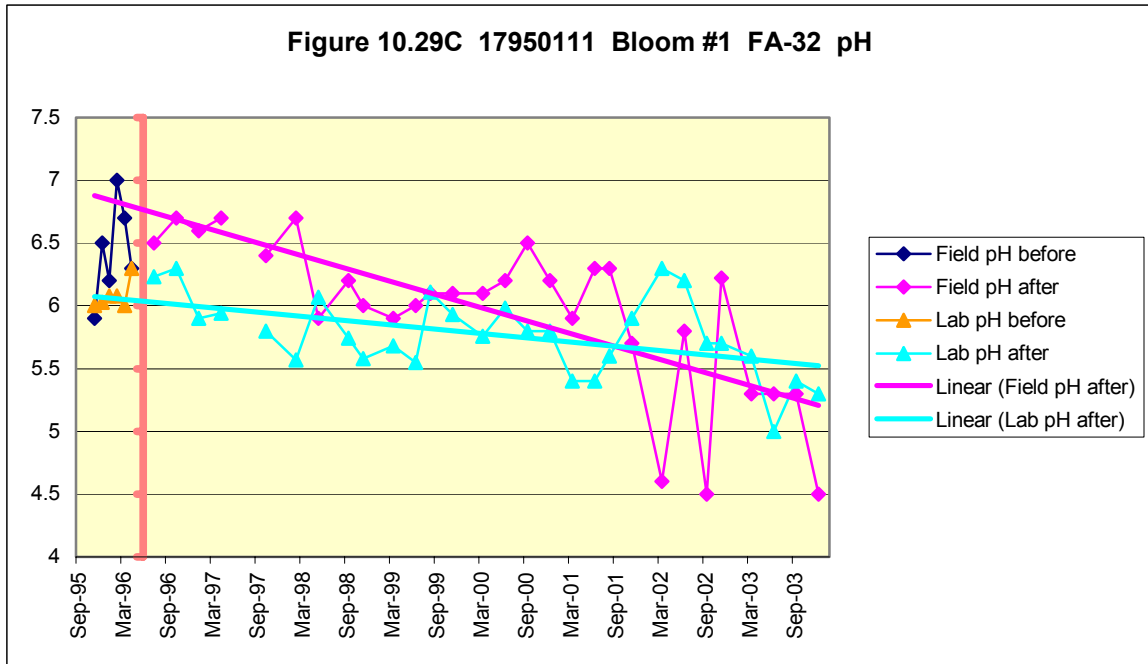
The sulfate and TDS values are plotted in figure 10.29A, and both also increase rapidly after mining and ash deposition from below DWS to average concentrations reaching three times higher than the DWS for sulfates and two times higher than the DWS for TDS by the most recent data available in the monitoring period.

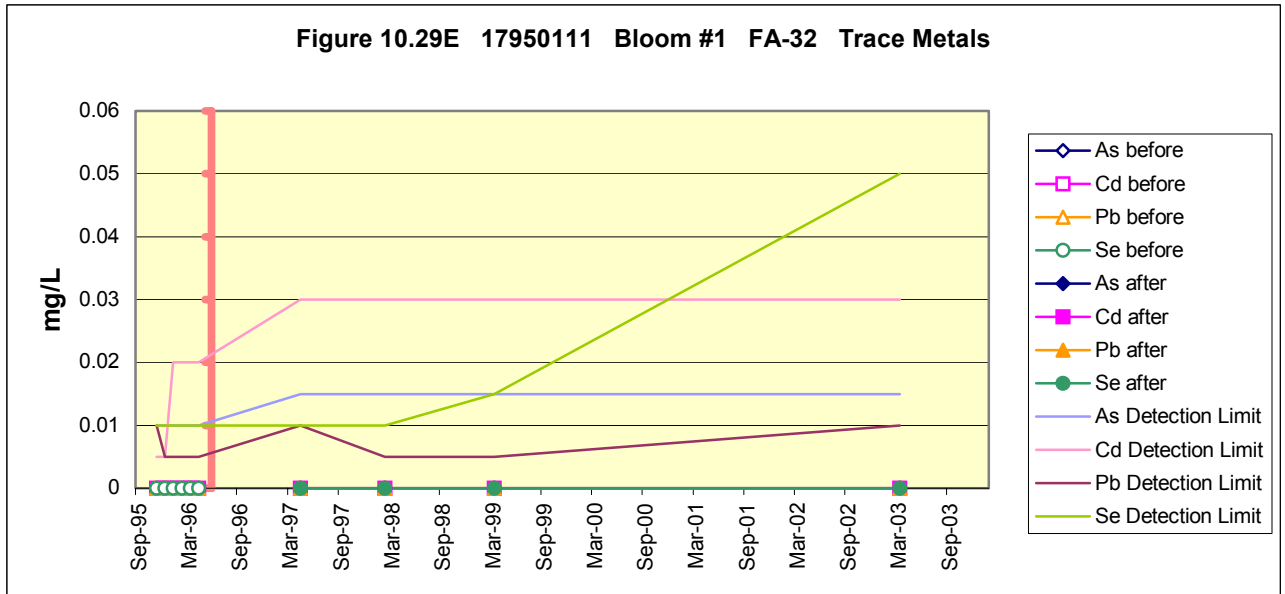
Figure 10.29B shows the trends for alkalinity and acidity; while alkalinity is initially significantly higher than acidity, alkalinity is falling, while acidity is increasing, suggesting that the driving source of contamination is rising AMD, instead of ash placement even if some of the pollution could be coming from dissolution of the ash. Both the field and lab pH are also falling during this period, from an average of almost 7 down to nearly 5 (figure 10.29C), which is further evidence of AMD. Calcium and magnesium values rise steadily over time (figure 10.29D) beyond baseline levels, suggesting input from placed ash, though not enough to neutralize the AMD.

Values for selenium, cadmium, lead, and arsenic are shown in figure 10.29E. There were no actual concentrations of these trace elements measured at FA-32. As at other monitoring points, the detection limits, particularly those for selenium have a rising trend, increasing by 5 times to 0.05 mg/L, equal to the federal DWS in the latest sampling. For arsenic, cadmium, and selenium, detection levels after mining and ash placement started were raised to levels at or above their respective DWS. Without lower detection limits, reviewers are unable to discern whether actual concentrations of trace elements are rising, declining or remaining the same as before mining and ash placement started.



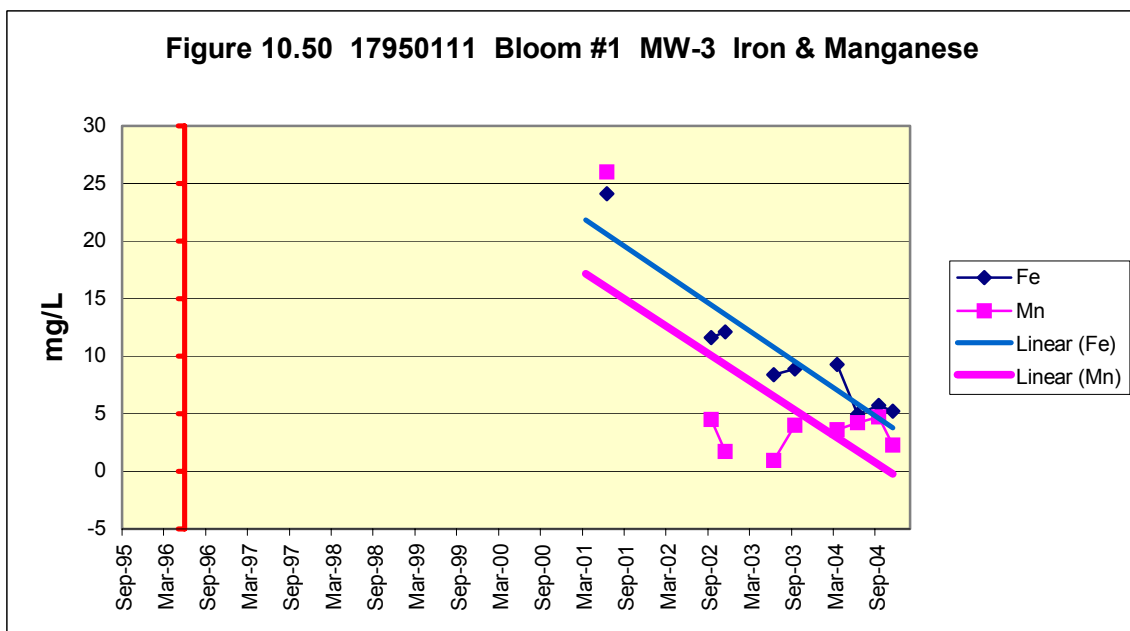






MW-3

Monitoring well MW-3 is located inside the southern end of the “horseshoe,” and was placed in the ash-spoil backfill after the permitted operation had been underway for five years to sample water affected by ash placement at the coal seam elevation, explicitly to measure alkalinity effects of the ash placement. Most of the trends in the following figures indicate the ash is imparting significant alkalinity to the water but also significantly contaminating the water with other constituents.



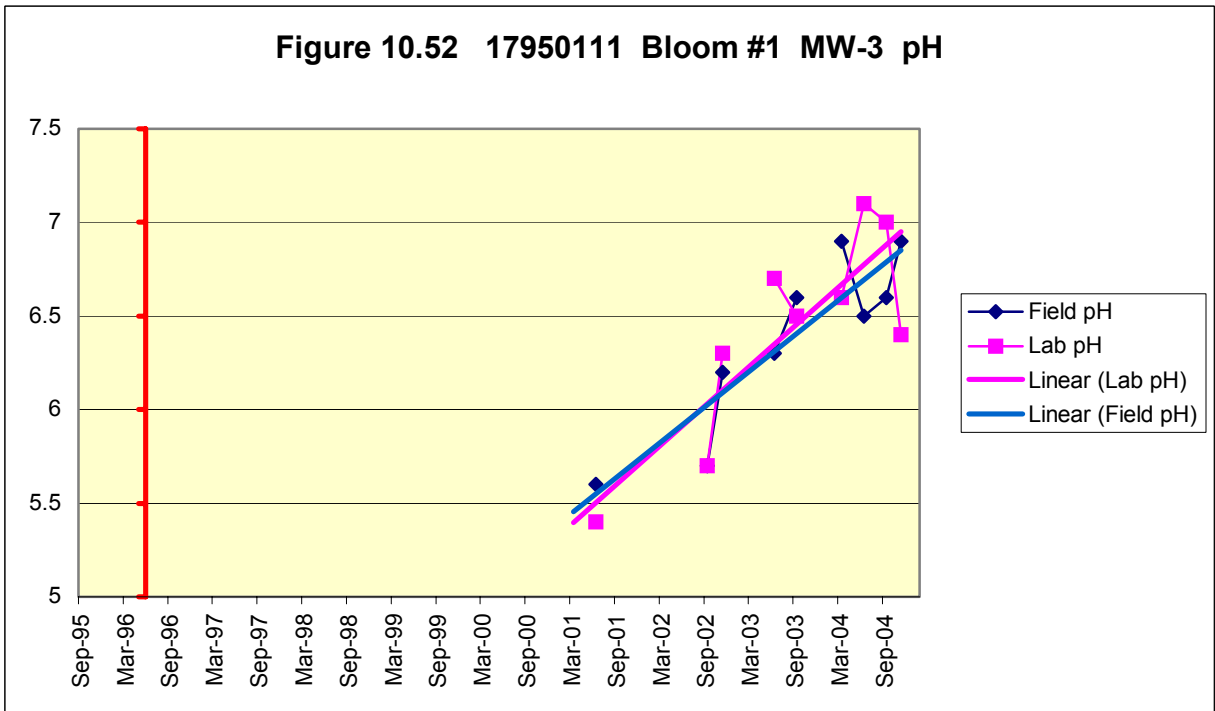
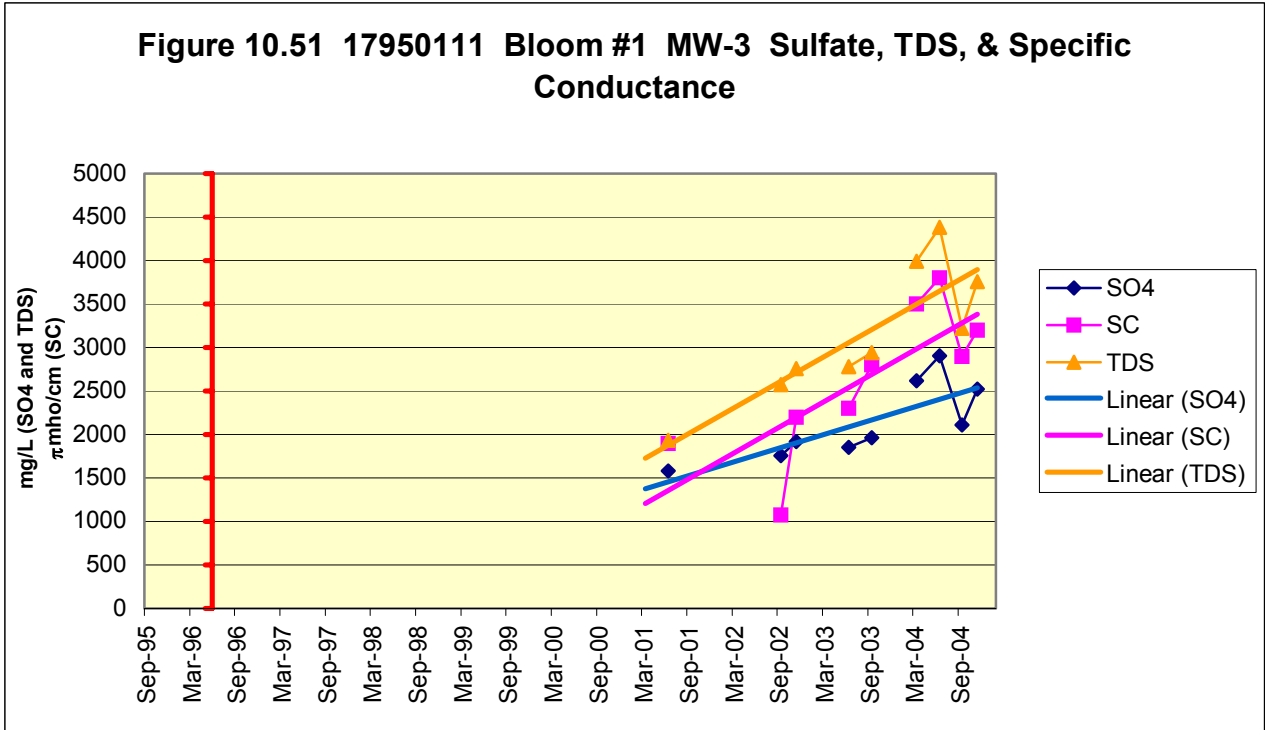
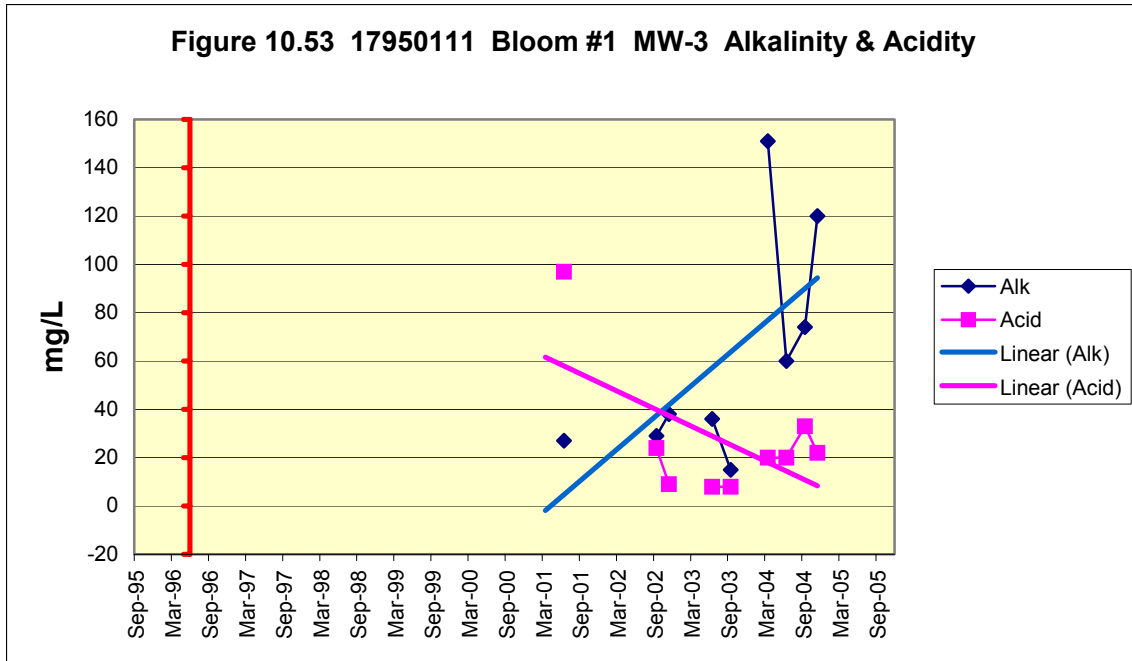


Figure 10.50 shows iron and manganese at MW-3 dropping from levels initially found in June 2001 of 26 mg/L for manganese and 24.1 mg/L for iron, the highest concentrations measured on the site from any monitoring point. Both constituents are declining decisively at the same rates although there are multiple gaps in the data due to the well being dry or inaccessible.

In contrast to the trends for iron and manganese, figure 10.51 shows concentrations of sulfate rising steadily to levels between six and 12 times the DWS, TDS rising to between seven and nine times its DWS and specific conductance rising in unison with TDS. The sulfate and these broader parameters more reflective of all pollution in the water are rising to their highest levels seen at any of the monitoring points, showing a large amount of material being mobilized in the groundwater at MW-3.

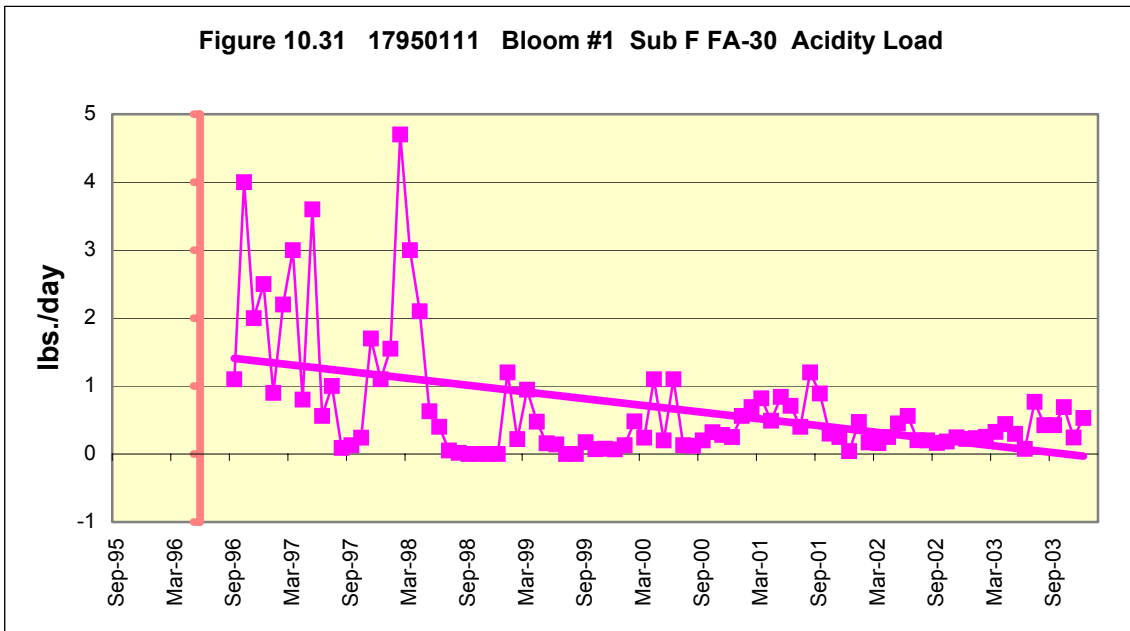
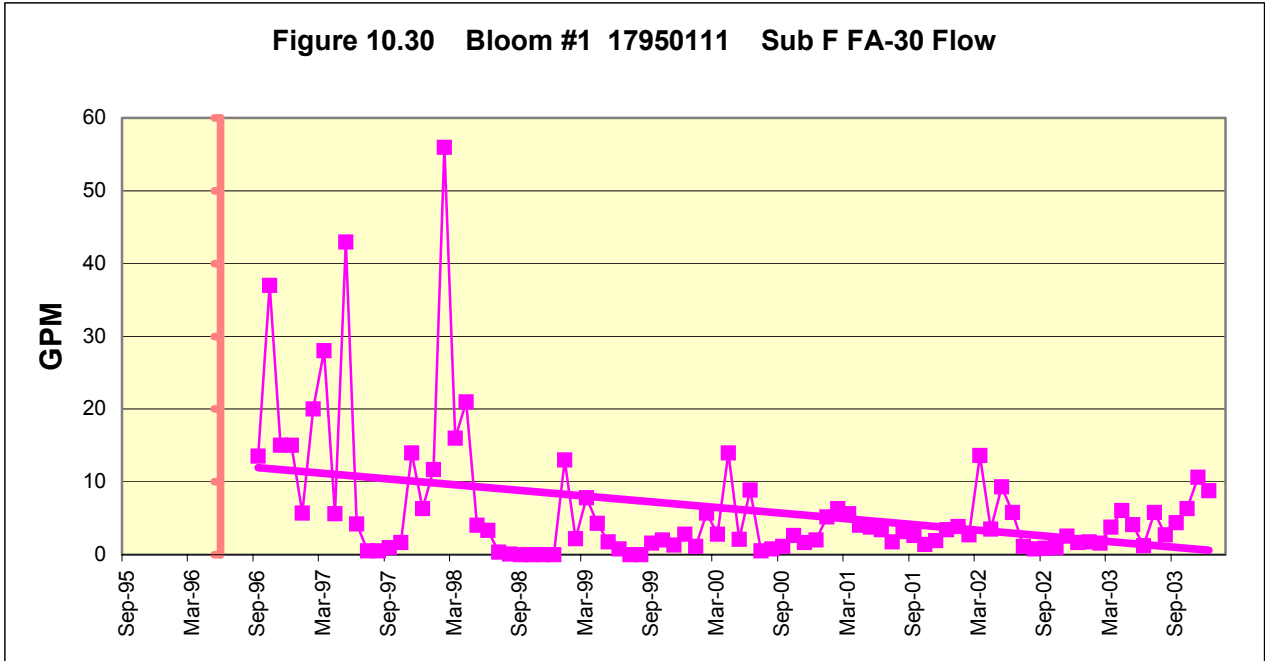
Figure 10.52 graphs the lab and field pH, whose trends are both increasing noticeably and at about the same rate, i.e., by nearly 1.5 units from around 5.5 to 6.9 units in the three years of monitoring at this point. The acidity drops, and the alkalinity rises sharply. The marked dominance of alkalinity over acidity at this monitoring point is not seen at any of the other monitoring points and gives the clearest evidence of water contamination from ash placement (figure 10.53).

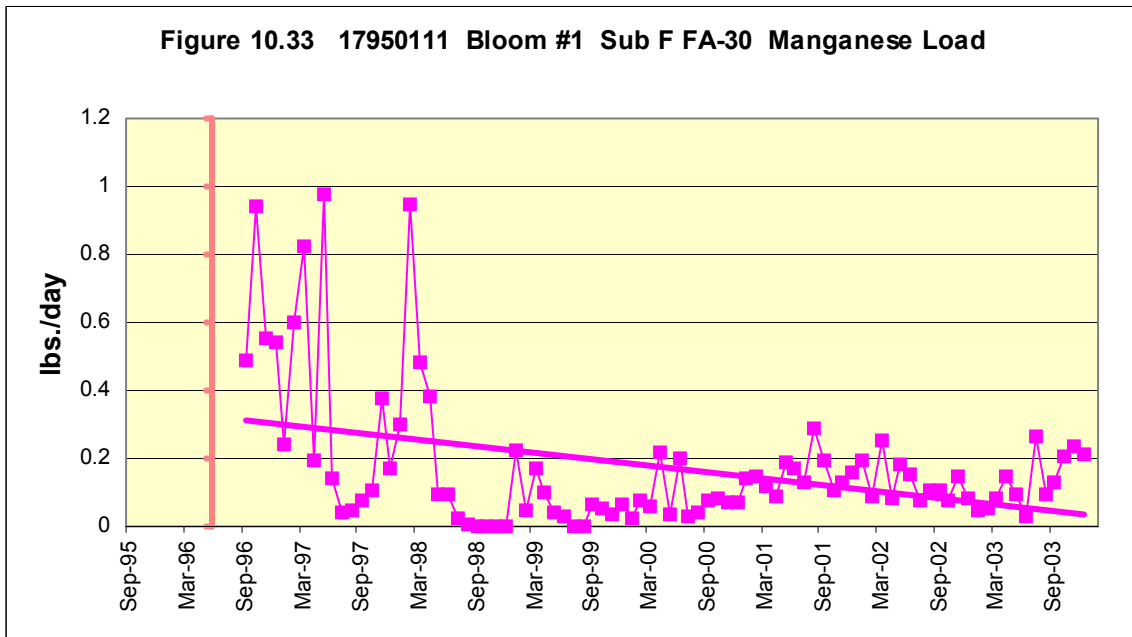
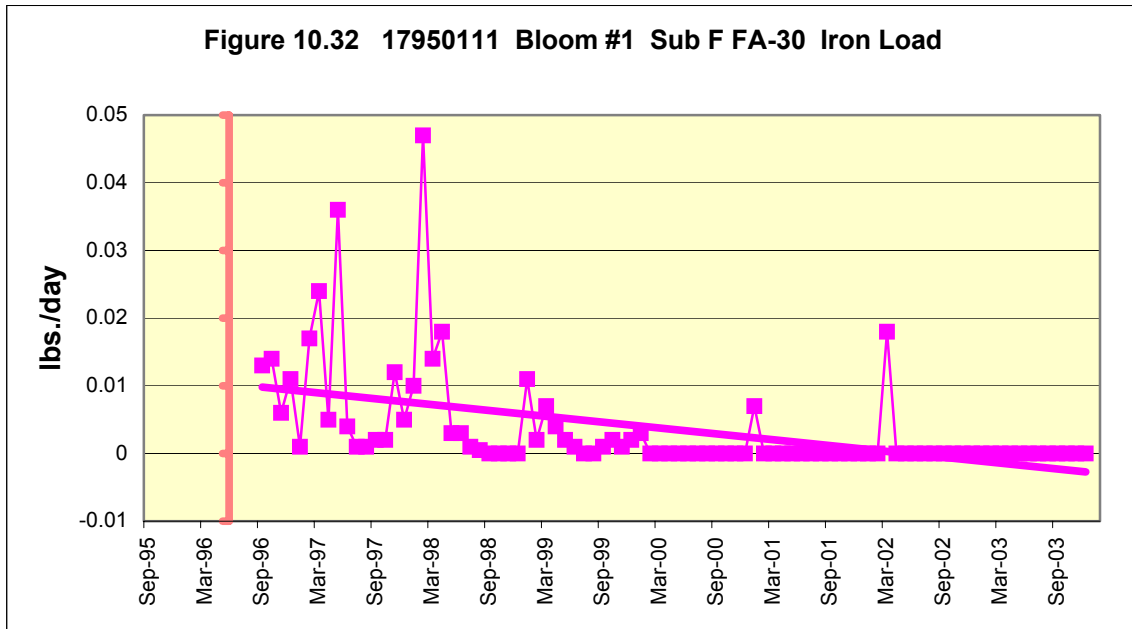
There are no graphs for trace metals because only one measurement of concentrations at MW-3 for trace elements and other ash parameters such as calcium, magnesium, and chloride that are normally measured with them was found in the permit file from March 2004. However, this sampling reveals very high levels of certain elements that point to ash contamination. Calcium is 632 mg/L, magnesium is 254 mg/L, potassium is 70.30 mg/L, chloride is 153.0 mg/L, sodium is 23.80 mg/L and arsenic is 21.5 mg/L. This level of arsenic is 430 times the old DWS and 2,150 times the new DWS (0.010 mg/L). Data from sites studied in this report indicate that arsenic is more likely to leach from placed ash and the more neutral pHs generated by alkaline ash placement than from coal mine spoils or gob in an environment dominated by AMD. High levels of Total Suspended Solids (TSS) have been measured at MW-3, and the highest of those levels, 418 mg/L, was measured in the March 2004 sampling raising a question of how much of this arsenic is actually dissolved in the water versus undissolved arsenic bound to sediments. If all of the arsenic is undissolved, it would comprise more than 5% of the TSS. The dominance of alkalinity over acidity, rising pH levels and levels of calcium, magnesium, potassium, chloride, and sodium all indicator parameters for FBC ash leachate, that were substantially higher in this sampling of MW-3 than found at any other monitoring point at the site, suggest that the arsenic whether dissolved or not, is in fact coming from the ash or at least from the effects of the ashes placement on mine materials at the site.

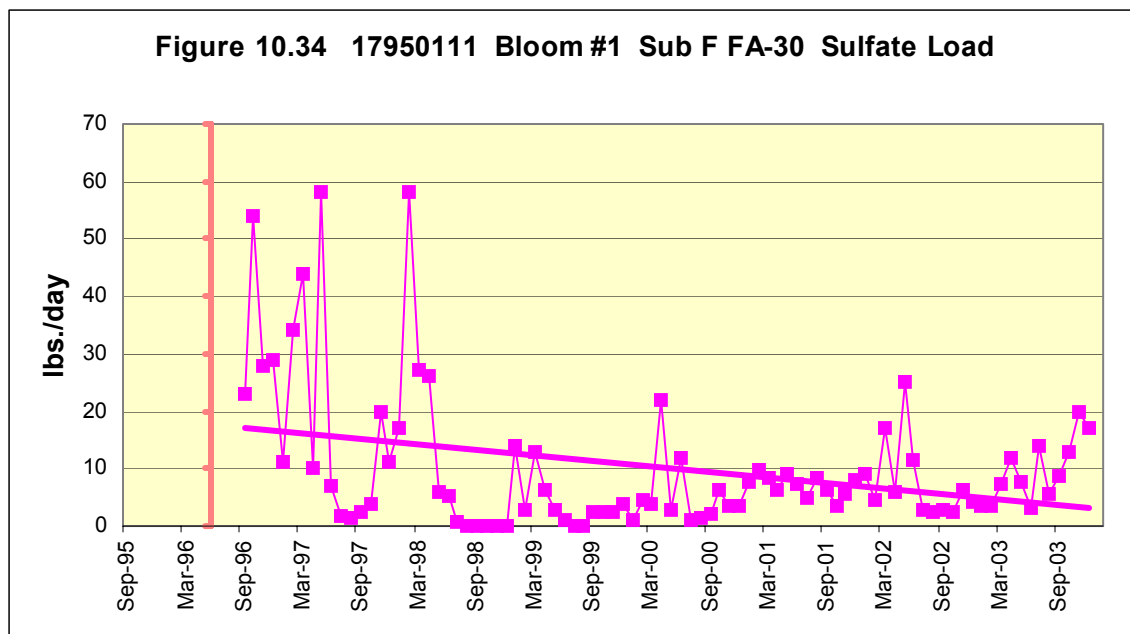


Loads

Figure 10.30 is a plot of the rate of water flow in gallons per minute (GPM) at subchapter F monitoring point FA-30. The same pattern is seen in all of the load graphs for this point; the acidity load is almost identical (figure 10.31) to the flow graph, indicating the trends are controlled more by flow rate than concentration values. Coinciding with the sharp decrease in flow, the sulfate load (figure 10.34) shows a precipitous drop in the first half of 1998 from 58 lbs/day to a level below detection limits throughout the fall of 1998. Sulfate levels then start a slow and steady increase back to levels mostly between 5-20 lbs/day in 2003. The manganese load is similar (figure 10.33) to that for sulfate, but the seasonal variations are not quite as pronounced as in the previous graphs indicating more of a concentration control than flow over the graph trends. The iron load (figure 10.32) drops down to instrument detection limits.







The average water flow at subchapter F monitoring point FA-19 (figure 10.35) is four to ten times the flow of FA-30 (figure 10.30), with high values reaching over 90 GPM at least four times in the first two years of mining and ash placement and the highest flow in the period of ash placement, 113 GPM, measured in April 2000. There are peaks in loads of acidity, manganese and sulfate that coincide with this measurement. The large majority of flows after 1998 however are well under half these levels with average values declining. The acidity load has a bimodal shape (figure 10.36), declining until the beginning of 2000 and then rising slightly to the end of monitoring. This suggests more evidence of a placed ash that lost its neutralizing powers. The iron load (figure 10.37) rises with oscillating values after the baseline period to a peak in February, 2000 of 1.7 lbs/day before dropping to values generally less than one tenth this load for the rest of the monitoring period. The manganese load (figure 10.38) has a similar curve shape to the acidity load with higher peaks accentuated by higher manganese concentrations. The sulfate load (figure 10.39) generally decreases over the life of the permit, although, many sulfate values remained high, with measurements of over 500 lbs/day of sulfate leaving the site at FA-19 recorded 8 times from 2000 to the end of the monitoring in 2004 and an average sulfate load more than 40 times the average amount of this pollutant leaving the site at FA-30 attesting to the impact that higher flows and somewhat higher concentrations of sulfates are having at FA-19.

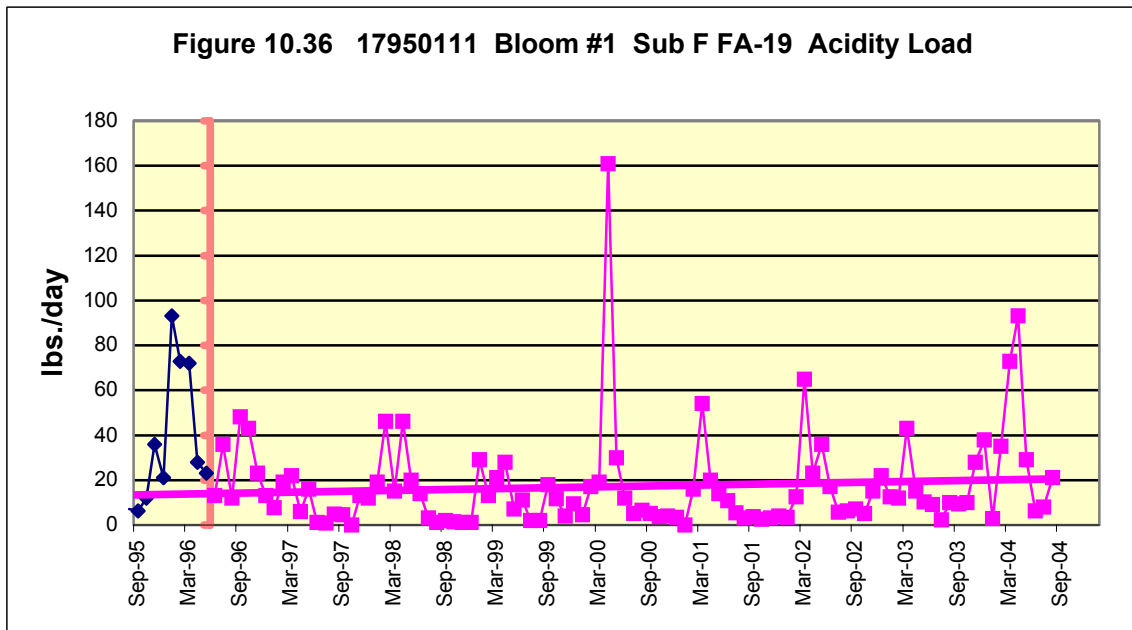
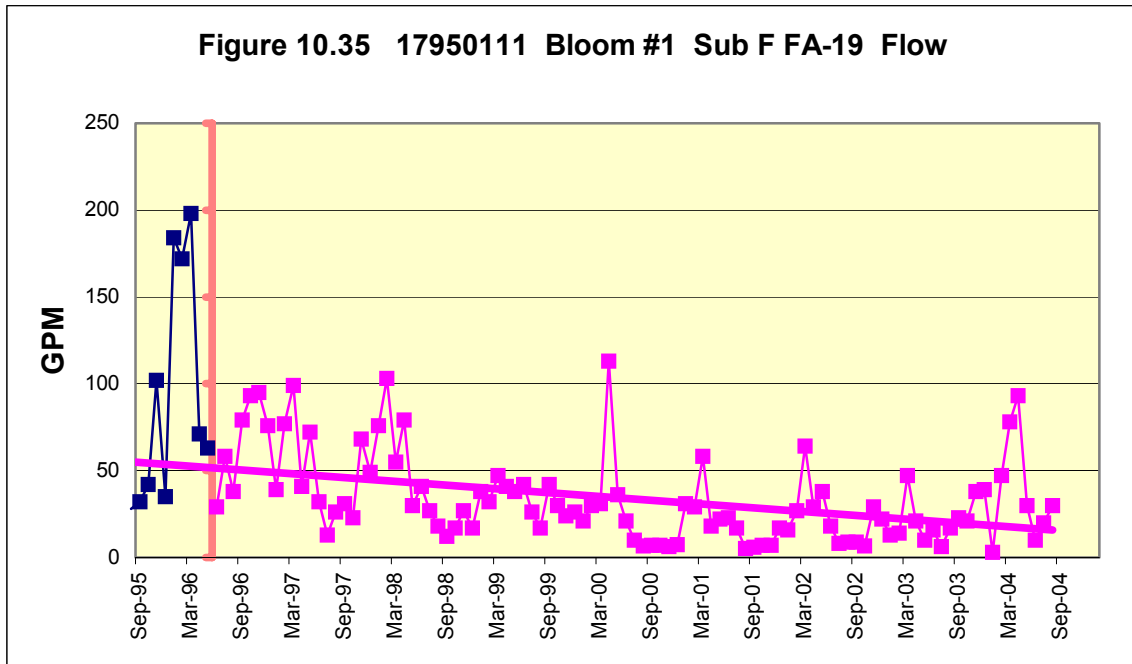
These declining loading values indicate an overall improvement from the baseline period in the total amounts of iron, manganese and sulfate leaving the Bloom #1 mine at these monitoring points. This improvement starts during a sharp reduction in flow that begins in the spring of 1998 at both monitoring points and continues through 2002. There is not enough information in the permit materials to determine the extent of any less permeable conditions that may have developed in the deposited ash much less what impact such conditions could have had on flows and pollutant loads exiting the site. There is also no data base of site precipitation measurements in the permit files that

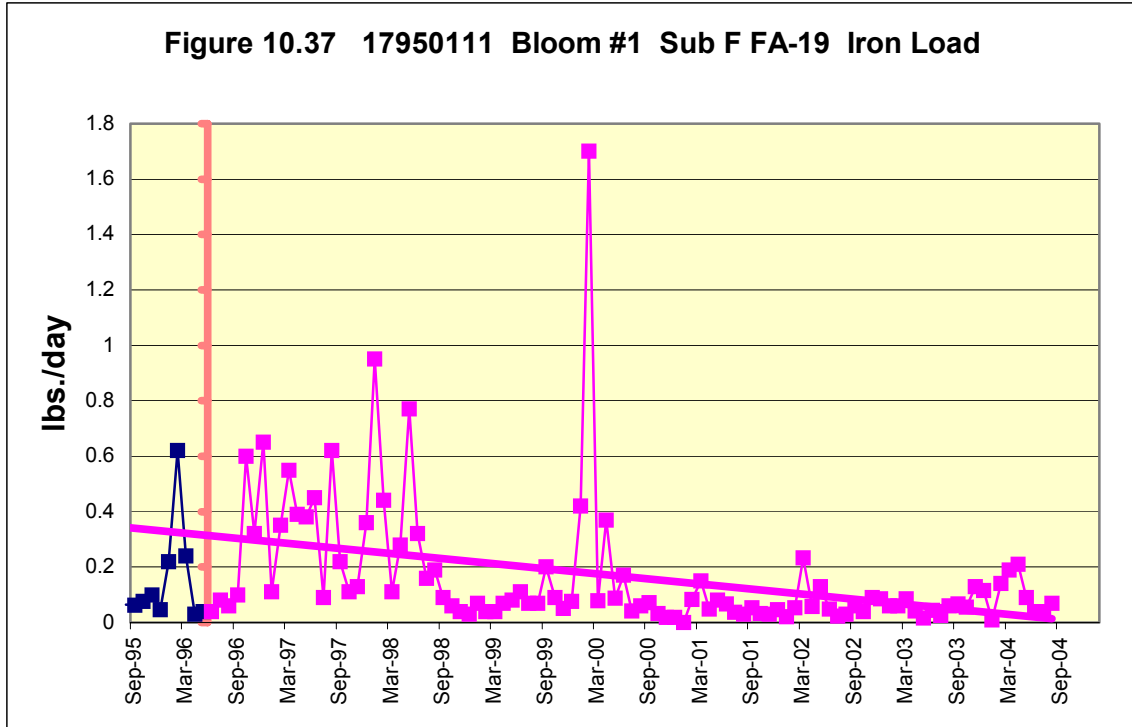
would enable reviewers to assess if changing precipitation patterns at the site may have played a role in this decline in flow and loads.

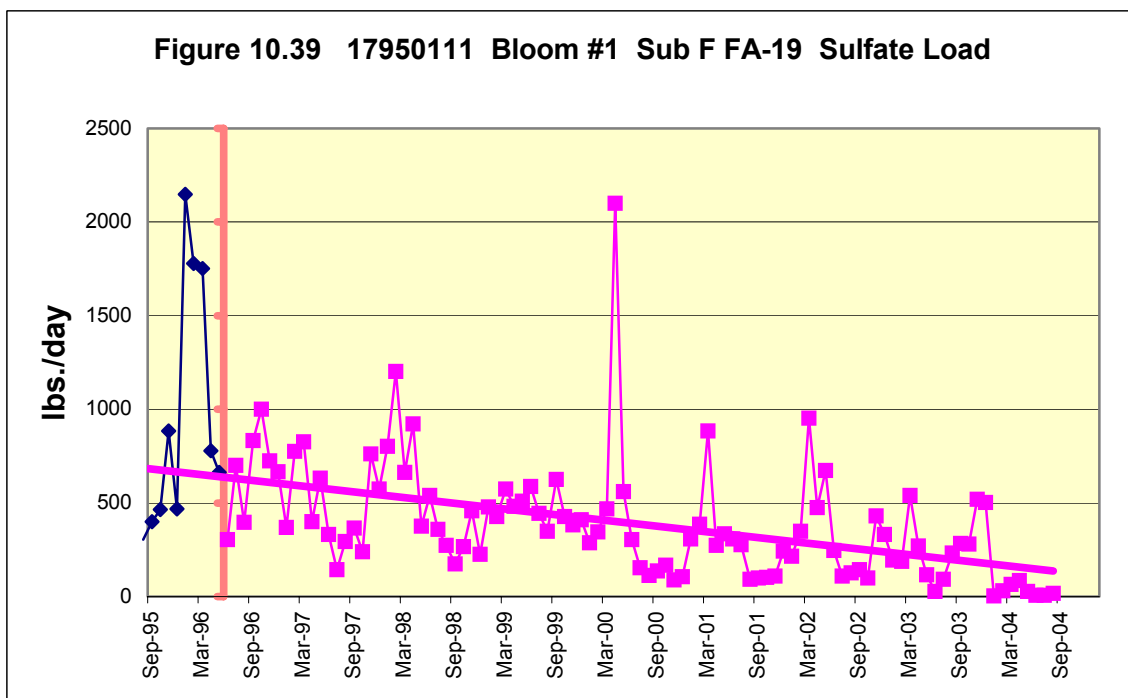
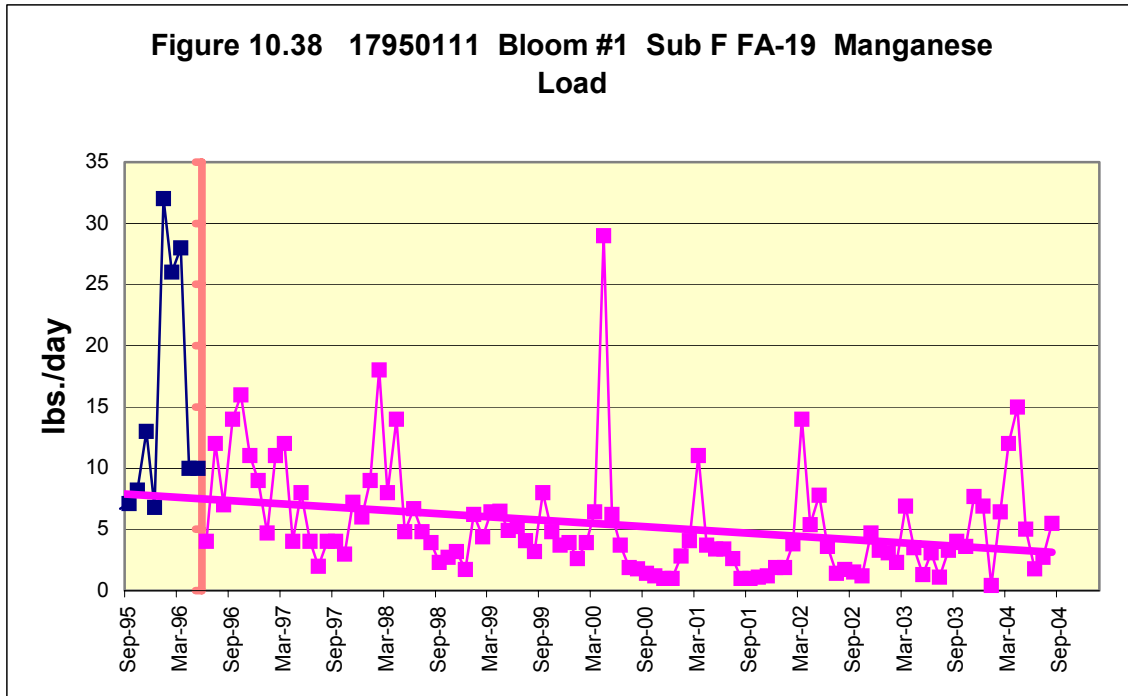
Climate data maintained by Penn State University (at <http://climate.met.psu.edu/data/state.php>) indicates that average annual precipitation in Climate Region 7 of western Pennsylvania which appears from a general map to include the Bloom site, dropped from 54.41 inches in 1996 to 38.96 inches in 1997 and 37.03 inches in 1998. Reduced annual precipitation levels continued through 2001 when the average annual precipitation in Region 7 dropped to 33.41 inches, some 21 inches below the precipitation in this Region in 1996. A similar drop occurred in Climate Region 10, just west (within 20 miles approximately) of the Bloom site where average annual precipitation in 1996 was more than 19 inches greater than the average annual precipitation in 2001.

A comparison of the average monthly precipitation in Climate Region 7 to the flow volumes recorded at FA-19 (figure 10.35) and FA-30 (figure 10.30) shows that during the years of lower annual precipitation, the highest gallon per minute flows nearly always occurred in the spring months of March, April and May when higher monthly average rainfalls generally occurred in Region 7. Presumably the greatest period of snow melt would also have occurred in these months adding to the flows at these points. Not surprisingly, loads of sulfate, iron, manganese and acidity, particularly at FA-19 are usually highest in these spring months, what one would expect if loads at the Bloom site are being driven by the amount of rain and snow melt occurring there.

An exception to the overall decline in loads is the gradually rising acidity load at FA-19 from an average of 15 lbs/day to 20 lbs/day over the mining and ash placement period.

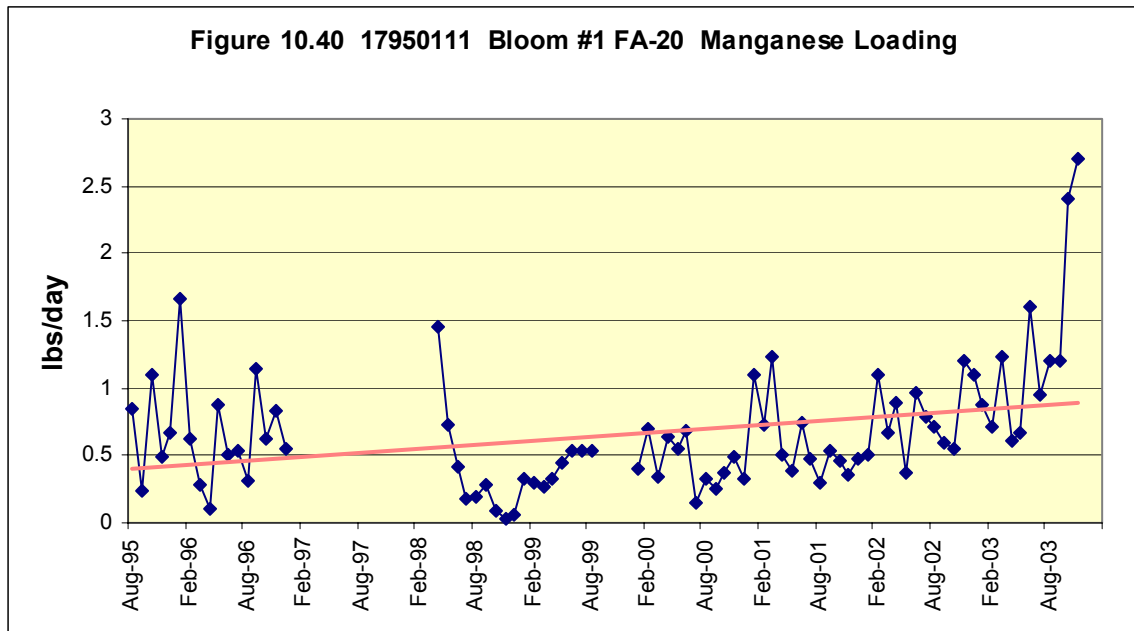




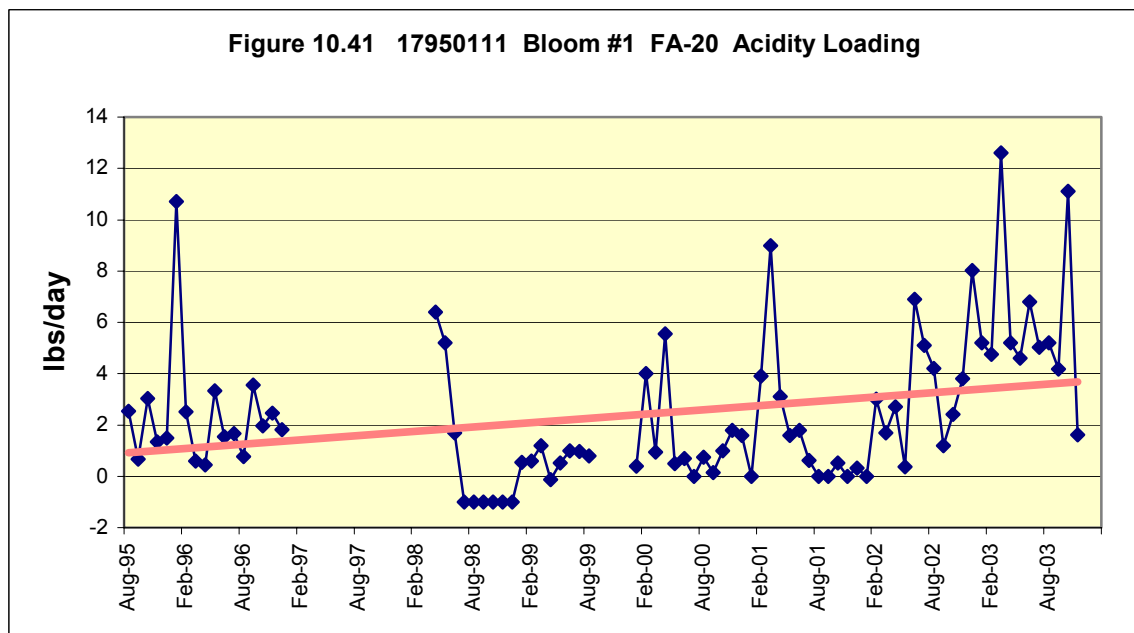


FA-20

Loading data for acidity and manganese were plotted for subchapter F point FA-20, which is a downgradient seep on the southeastern side of the “horseshoe” near FA-19. (see map). Inspection reports indicate that PADEP is concerned about rising loads of these parameters at this monitoring point.



The average manganese loading stays below 1 lbs./day for most of the site life (figure 10.40) and then jumps steeply in the middle of 2003.



The graph of loads for net acidity (figure 10.41) shows the same general behavior as the manganese loading; a fairly consistent, slight rise over the life of the site, until 2003, when consistently higher measurements are recorded. This large load increase induced the PADEP to require weekly sampling for these parameters (not shown in graphs) at FA-20 in the fall of 2003.

Conclusion

Assessment of the data generated by the monitoring points at this site reveals a high potential for ash to degrade site waters and the complexity of the relationship between ash and AMD. Rising concentrations of ash indicator parameters in or downgradient from the ash suggest this impact is already occurring to some extent. This is best shown by the data from monitoring well FA-32 east of the mining and ash placement area. The data from MW-3 located in the FBC ash and spoil shows a clear impact from the ash with average pH rising from 5.5 to 7 units in less than 4 years, alkalinity dominating acidity, and sulfate, TDS and specific conductance rising to the highest concentrations measured at the site. An extremely high level of arsenic (21.5 mg/L) measured in March, 2004 at MW-3 is not dismissed as a sampling or laboratory anomaly in the monitoring reports and was also found with the highest levels documented at this site of other ash parameters such as calcium, magnesium, chloride, potassium and sodium. This suggests a very harmful potential in the leachate being generated in the ash-spoil mixtures at this site and underscores why more than annual monitoring of ash leachate parameters at only a few monitoring points is needed at these sites.

However, monitoring at the subchapter F points reveals that in a relatively short period of time, as water moves outward from the ash placement area, the ash's alkalinity is overrun by the site's acidity. To the south of the mining and ash placement area at FA-19 where monitoring reveals the most polluted water prior to mining, rising alkalinity and pH from 1996 through 1998 is followed by a steady decrease in alkalinity, increase in acidity, and a decline in average pH of 1.5 units through 2004. Although acidity is weaker at FA-30 north of the mining area and at FA-32 southeast of the mining area, by the latest data reviewed in this report, average acidity had overtaken alkalinity and average pH levels had declined by .5 units at FA-30 and 1.5 units at FA-32. Either the alkalinity of the ash is being exhausted or the ash becomes hydrologically isolated from groundwater and thus its full potential alkalinity is not being utilized. In the overall picture, despite levels of acidity that were not that high throughout the monitoring period, (generally below 100 mg/L), the ash does not appear to have had a significant buffering effect on acidity for more than temporary periods at any of the downgradient subchapter F monitoring points assessed in this report.

From a concentration standpoint the effect of the mining and ash placement on manganese and sulfates has not been good. These constituents were already at or exceeding the DWS in baseline monitoring but their average concentrations have risen substantially further and by roughly the same amounts after mining and ash placement at all three subchapter F monitoring points. This trend is also reflected in rising TDS levels. On the other hand, iron is rising at FA-32 to levels as high as 8.1 mg/L in June 2003, 27 times over the DWS, yet declining at FA-30 and after an initial increase, also declining at FA-19 to levels near or below the DWS. And the highest iron levels at the site were measured in baseline monitoring at the upgradient MW-1 (up to 19.5 mg/L) and in the initial measurements at MW-3 in the ash and spoil of the site (up to 24.1 mg/L). In both of these cases, field pH was 6-7 and alkalinity was exceeding acidity.

Concentrations of calcium and magnesium did rise substantially as a result of the operation at FA-30 and FA-32, although the high levels of these constituents in the baseline monitoring at FA-19 indicate a source of alkalinity was already placed at least on the south side of the site prior to this ash placement operation. Still, the near absence of calcium and magnesium at upgradient MW-1 (whose concentrations are all under 3 mg/L) compared to the highest levels measured for these constituents at the site in the ash-spoil mixture surrounding MW-3 (calcium at 632 mg/L and magnesium at 254 mg/L in March, 2004) indicates not surprisingly that the FBC ash at this site is a source for rising levels of these constituents.

Dissolved concentrations of trace elements, arsenic, cadmium, lead, and selenium, are below detection limits of the lab analysis in the large majority of results reported from the monitoring points assessed in this report. In addition the detection limits reported for cadmium, arsenic, and selenium increase beyond baseline detection values to levels equal to or exceeding the DWS once ash placement is underway. This leaves reviewers unable to discern if these trace heavy metals are even present much less increasing to levels exceeding the DWS or decreasing, only that their concentrations are not higher than the detection limits reported. The worst examples of this are the detection limits used for cadmium which rise from the DWS before ash placement to 0.030 mg/L after ash placement, six times the DWS.

Despite MW-1's designation as an upgradient monitoring well in the permit, water quality at MW-1 appears to reflect some impacts from the activities in this operation. Manganese, sulfates, and TDS were a tenth or less their concentrations at all other monitoring points, yet sulfates and TDS rise slightly during the mining and ash placement. These rising concentrations along with gradual rises in alkalinity and acidity and an average pH decline of a half unit during mining suggest the existence of a flow pathway between the mining and ash placement area and MW-1 that is not identified or characterized by the permit.

There have been reductions in loadings in pounds per day of iron, sulfate and manganese over the monitoring period at FA-19 and FA-30 that appear to have been driven by a substantial decline in flow in the permit area starting in 1998. While average acidity loads have also declined at FA-30, they are gradually increasing at FA-19. There is not enough information in the permit materials to determine the whether the ashes physical characteristics, i.e., any less permeable conditions the ash is creating in its deposited state, are having any impact on flows or loads at this site. Reviewers also could not locate rain gauge data or other site precipitation data. However regional climate data at Penn State University reveals that the reduced loads have been occurring in years with significantly less precipitation in the climatic region in which the Bloom site is located. Furthermore within those years of reduced rainfall, the highest loads of iron, sulfate, manganese and acidity have nearly all occurred during the spring when the greatest precipitation and snow melt also occurs, suggesting that reduced loads at this site are primarily a function of weather and changing climatic conditions. While these reductions in loads are normally an important sign of reduced impact to the watershed,

the significant increases in concentrations of manganese and sulfates at these and other monitoring points and the potential connection to ash placed at the site should not be discounted. If the reduced load is a function of reduced precipitation, flow in the receiving stream would be similarly reduced and the higher concentration would have a proportionately greater impact. Loading data from FA-20, near FA-19, also shows a marked rise in the manganese and net acidity leaving the site in 2003. The reasons for these higher inputs into the water should be investigated as the data show worsening conditions at a time when reclamation should be resulting in improved water quality.

Given the rises in loadings and in concentrations of ash parameters in the water flowing from this site, the need for an enhanced post-placement monitoring program is apparent. In addition to continued sampling of the existing monitoring points, efforts should be made to improve the understanding of flow pathways at the site and establish more monitoring points closer to the ash, in the ash and upgradient of the ash. Monitoring for trace elements and other ash indicator parameters such as calcium, magnesium, chloride and potassium should be conducted on at least a quarterly rather than annual basis, and boron, antimony and molybdenum should be added to the list of monitored constituents. Detection limits used in the lab analysis should be reduced to levels that enable reviewers and regulators to tell if trace metals are increasing and posing a problem in waters exiting the site. These steps will help pinpoint the timing of ash-generated leachate flow and thus greatly contribute to the understanding of the influence of ash and other potential sources of pollution at the site and any responses needed.



CAPTION - Sulfate increased to higher concentrations in downstream drainages after ash placement started at the EME Generation Site than had occurred during at least 8 years of prior active gob disposal at this site. Iron and aluminum also increased. Nickel, chromium, zinc, copper, silver and barium increased and exceeded drinking water standards in several instances in downgradient waters after ash placement started at this site, a.k.a. the Homer City Coal Refuse Disposal site in Indiana County, PA. These trends took place amidst a decline in acidity and increase in alkalinity and pH at all but one monitoring point. The ash at this site is from the conventional Homer City Power plant in the picture and thus gray to black rather than tan or reddish brown, the color of FBC ash. Photo by Jeff Stant, August 2007.