Site 4 - Hortert Mine

The Hortert Mine, a Pengrove Coal operation located in Eau Claire Township, Butler County, is identified by SMP No. 3078BC10 and BFC No. 94-37. Hortert is a reclaimed middle Kittanning coalbed surface mine with residual discharges that seep from a backfilled highwall area and are collected by a series of ditches and wetlands (figure 1). The discharge points and volunteer wetlands appear to occur along the 1440 foot contour of the reclaimed slope which may represent the approximate elevation of the former pit floor. One of the larger seeps (from the natural wetland closest to access road) was sampled as "left seep." Flows from the seeps are collected into a pipe that discharges into a cut-open 500-gallon plastic tank. Flow from the pipe is

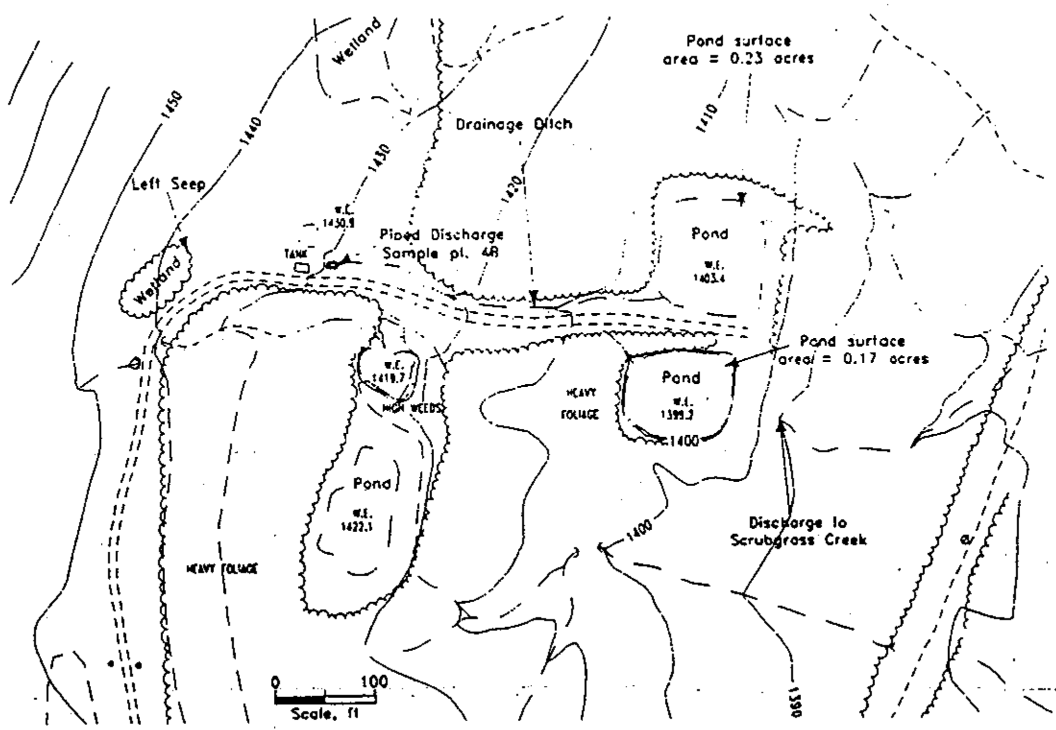

Figure 1. Hortert Mine site map.

designated sample point 4B. Manganese has been considered the primary water quality problem at Hortert. Riprap in a drainage ditch downstream from the tank has considerable dark precipitates/rock coatings, which probably indicates some manganese removal. The drainage ditch empties the combined discharge into a series of two settling ponds before entering the Scrubgrass Creek watershed. The two ponds to the south of the sample point 4B discharge are uncontaminated.

Sample Point 4B Discharge

Sample point 4B is formed by the collection of a series of seeps along the toe of the backfill slope that are fed to a single 6-inch pipe that empties into a 500-gallon plastic tank. Monthly water quality samples and flow measurements have been collected at the pipe since October 1994 (Table 1). The results of the sampling program at this site appears very consistent and sufficient for a confident characterization of the discharge.

The 4B discharge was net acidic on every sampled date, ranging from a low of 74 mg/L to a high of 236 mg/L. Iron, always measured at concentrations of less than 2 mg/L, is a relatively minor component of mine drainage at this site. Aluminum is somewhat abundant, ranging from 3.71 to 9.51 mg/L, while manganese is the predominant contaminant, ranging from 47.2 to 96.95 mg/L. In fact, as shown in table 2, the major contributor to acidity is manganese, accounting for at least 67 percent to as high as 79 percent of the total. Aluminum in the water essentially accounts for the rest of the total acidity, with iron contributing only 1 percent. The three lowest net acidity values were in samples collected in April and December 1994 and April 1995, which correspond to the three highest flow days. These same samples also contain the lowest concentrations of metals and sulfate, indicating dilution from captured surface runoff.

Table 1.-Summary of water quality and flow data for sample point 4B.

Date	Flow gpm	Lab pH	Tot. Alk.	Net Acid.	Fe2+	Fe3+	Fe Tot.	Al	Mn	SO4
15-Apr-94	50.0	4.29		89.00	0.00	0.00	0.00	3.71	48.62	833.76
19-Oct-94	5.7	3.68		219.00	0.00	0.94	0.94	9.51	96.95	1431.30
17-Nov-94	14.0	3.70	0.00	112.00	0.52	0.31	0.83	6.61	54.90	1116.00
15-Dec-94	30.0	4.00	0.00	74.00	0.45	0.01	0.46	3.72	47.20	636.00
10-Jan-95	7.5	4.00	0.00	122.00	0.66	0.13	0.79	8.38	82.10	1234.00
16-Feb-95	15.0	4.10	0.00	178.00	0.52	0.06	0.59	5.44	61.60	845.00
21-Mar-95	22.0	4.30	0.00	156.00	0.55	0.90	1.45	4.35	48.90	685.00
11-Apr-95	26.0	4.00	0.00	82.00	0.25	0.09	0.34	4.15	47.60	724.00
04-May-95	11.0	3.93		165.00	0.00	0.36	0.36	6.48	69.85	1087.67
09-May-95	12.0	3.80	0.00	236.00	0.41	-0.02	0.39	7.67	80.00	1143.00
21-Jun-95	13.0	3.70	0.00	166.00	0.61	0.22	0.83	4.53	58.30	807.00
25-Jul-95	12.0	3.70	0.00	216.00	0.90	0.27	1.17	6.01	68.80	1044.00
15-Aug-95	6.9	3.47		218.00	0.00	1.85	1.85	6.80	94.89	1388.73

Note: Empty cells indicate below detection limits, ND indicates not done.

Table 2.-Calculated metals acidity and metals acidity as a percentage of total calculated acidity for sample point 4B.

Date	pH acid	Fe2+ acid	Fe3+ acid	Al3+ acid	Mn2+ acid	Calc Acid	%pH Acid	%Fe Acid	%Al Acid	%Mn Acid
15-Apr-94	2.57	0.00	0.00	20.64	88.58	112.51	2%	0%	18%	79%
19-Oct-94	10.46	0.00	2.53	52.92	176.62	243.81	4%	1%	22%	72%
17-Nov-94	9.99	0.93	0.83	36.78	100.02	148.55	7%	1%	25%	67%
15-Dec-94	5.00	0.81	0.03	20.70	85.99	112.53	4%	1%	18%	76%
10-Jan-95	5.00	1.18	0.34	46.63	149.57	202.73	2%	1%	23%	74%
16-Feb-95	3.98	0.93	0.17	30.27	112.22	147.58	3%	1%	21%	76%
21-Mar-95	2.51	0.99	2.42	24.21	89.09	119.21	2%	3%	20%	75%
11-Apr-95	5.00	0.45	0.25	23.09	86.72	115.51	4%	1%	20%	75%
04-May-95	5.88	0.00	0.97	36.06	127.25	171.09	3%	1%	21%	74%
09-May-95	7.93	0.73	-0.07	42.68	145.74	197.02	4%	0%	22%	74%
21-Jun-95	9.99	1.09	0.60	25.21	106.21	143.10	7%	1%	18%	74%
25-Jul-95	9.99	1.61	0.73	33.44	125.34	171.11	6%	1%	20%	73%
15-Aug-95	16.96	0.00	4.97	37.84	172.87	233.76	7%	2%	16%	74%

Note: The presence of zinc in samples accounts for any small discrepancy in acidity totals.

Left Seep Sample

Left seep is a relatively large seepage area along the toe of the backfill slope that has developed wetland-type vegetation (figure 1). A water quality sample was collected at this location in October 1994 for comparison to the combined 4B discharge water quality (table 3). The water quality of the left seep sample is very similar to that of the composite 4B discharge. The primary difference is the presence of higher levels of ferrous iron. This may be an indication of iron removal occurring in the natural, volunteer wetlands and drainage-ways before the seeps reach the 4B collection point.

Table 3.-Left seep water quality analysis.

Date	Flow gpm	Lab pH	Alk.	Acid.	Fe2+	Fe3+	Fe Tot.	Al	Mn	SO_4
19-Oct-94	ND	3.80		201.00	6.84	0.00	6.84	8.91	95.06	1416.00

Recommendations

The strongly net acidic water at this site requires alkaline addition. However, the presence of aluminum, absence of iron, and predominance of manganese acidity in this water complicates the passive treatment decision process. The aluminum in the water, ranging from 3.71 to 9.51 mg/L, could be removed with a small pH adjustment, but would inhibit the long term performance of an ALD. This leaves two options: an anaerobic wetland or SAPS configuration. The SAPS configuration is recommended because of the expense and seasonal performance limitations associated with anaerobic wetlands.

Table 4.-Wetland treatment sizing options in acres based on metal and acid loading.

			Sizing Criteria (From g/day load)		
Sample Point	Date Sampled	Flow, GPM	Fe Load Aerobic	Mn Load Aerobic	Net Acid Anaerobic
4	19-Oct-94	ND	0.00	0.00	0.00
4B	15-Apr-94	50	0.00	6.55	1.71
4B	19-Oct-94	6	0.00	1.47	0.48
4B	17-Nov-94	14	0.00	2.07	0.60
4B	15-Dec-94	30	0.00	3.81	0.85
4B	10-Jan-95	8	0.00	1.66	0.35
4B	16-Feb-95	15	0.00	2.49	1.03
4B	21-Mar-95	22	0.00	2.90	1.32
4B	11-Apr-95	26	0.00	3.33	0.82
4B	04-May-95	11	0.00	2.07	0.70
4B	09-May-95	12	0.00	2.58	1.09
4B	21-Jun-95	13	0.00	2.04	0.83
4B	25-Jul-95	12	0.00	2.22	1.00
4B	15-Aug-95	7	0.00	1.75	0.57

A SAPS/aerobic settling pond combination is appropriate for this site. A single SAPS cell would probably be sufficient to remove the iron and aluminum in the 4B water and raise the effluent pH. Using the ALD design criteria, a SAPS cell containing 1,500 tons of limestone is necessary to provide 14 hours of contact time for an expected life of 30 years for the maximum measured flow of 50 gallons per minute. Using the 50 mg/L of acidity removal per square meter of SAPS surface area sizing criteria results in a 0.12 acre pond. The SAPS cell would be followed by a single aerobic settling pond. Since the aluminum in the water would precipitate in the SAPS cell, the small amount of iron would require only a very small containment area, as shown in table 4. Any additional area built might serve to lower manganese concentrations.

The existing ponds at the Hortert site could be used in the construction of this PTS configuration. The first pond, which would need to be drained and dredged, has an existing surface area of 0.23 acres (figure 1). A 3-foot layer of layer of 3 to 4 inch limestone aggregate covering 0.23 acres will provide the necessary 1,500 tons of limestone. A 6-inch perforated, corrugated black plastic drain pipe should be snaked across the bottom of the pond within the first foot of limestone. The limestone should be covered with a 1.5-foot thick layer of spent mushroom compost. The design should include 2 to 3-feet of standing water head with an additional 4 feet of freeboard available to raise the head if it becomes necessary.

The second pond, with a surface area of 0.17 acres, is more than sufficient as it exists to contain any iron precipitates. However, the water surface elevation may need to be lowered slightly to provide sufficient head to the first pond. The ditch between the second pond and the stream discharge point should be lined with coarse limestone riprap to promote bacterial reduction of manganese.

Capture of the effluent water along the 1440 contour horizon and diversion of surface runoff above it should be given consideration at Hortert. The topography of the site serves to channel surface runoff along with the mine water discharges into the existing treatment system. The average flow collected at sample point 4B, excluding the obvious high flows with depressed sulfate levels, is 12.5 gallons per minute. Discharge capture and a runoff diversion ditch could eliminate excess flow volume, thus reducing sediment loading and flow surge in the PTS. Any contaminated discharge capture design should incorporate inert river rock to avoid geochemical interactions that might compromise flow.

Because of the predominance of acid load attributable to manganese at this site, which will not be realized within the PTS, this design will probably be a net exporter of alkalinity to the watershed.