STREAM QUALITY EVALUTION

GENERAL CONDITIONS

The study area is that portion of the Mahoning Creek Watershed comprising three major drainage systems- Big Run (19.2 square miles), Stump Creek (28.3 square miles), and East Branch of Mahoning Creek (41.8 square miles). These systems with their secondary streams and their watershed areas are shown below.

Big Run. ----------19.2 sq. mi.

Trout Run	2.54
Windfall Run	1.74
McKee Run	2.62
Laurel Run	1.33
Turnip Run	1.77

Stump Creek ---------- 2 8.3 sq. mi.

Limestone Run	5.43
Sugarcamp Run	3.55
Poose Run	2.05

East Branch Mahoning Creek ----------41.8 sq. mi.

Laurel Branch Run	6.83	Beech Run	1.60
Buck Run	0.90		
Beaver Run	2.48		
Laurel Run	6.02		
Clover Run	11.50	Lost Run	1.79
Stony Run	1.19		

Sample stations were established at selected locations to determine the effect of mine drainage from both active and abandoned mining operations on stream quality.

Sample stations were also established at stream locations near the mouth of each of the major drainage areas. The collective effect of these major drainage areas was determined by station MC-100 on Mahoning Creek. Deterioration of stream quality which could be directly attributable to major mined out areas were monitored at secondary stream flows.

WATER QUALITY

General Discussion

The headwaters of Mahoning Creek which make up the study area are comprised of three major drainage systems; the East Branch of Mahoning Creek (41.8 sq. mi.), Stump Creek (28.3 sq. mi.), and Big Run (19.2 sq. mi.). The East Branch of Mahoning Creek originates in the western portion of Clearfield County and flows southwest for approximately twelve miles where it joins Stump Creek converging from the north to form Mahoning Creek. Big Run enters the main stream about two miles downstream to the west of this point.

The average flow in Mahoning Creek just below the Big Run confluence representing collectively the drainage from the study area can be estimated at 154 cubic feet per second. This estimate is based on the drainage area and correlation with the average discharge at the Punxsutawney Gaging Station (32 year record). Flows at stream sampling stations were estimated during the survey and adjusted on this same basis using size of watershed and the actual discharge measured for Mahoning Creek at Punxsutawney.

In general the stream quality as modified by mine drainage in the study area can be classified as good. The combined effects of the mine drainage as measured in the main stream immediately below the borough of Big Run never dropped the pH below 6.5. Alkalinity exceeded the acidity at all times with an average of 34 parts per million net alkalinity during our survey. Only the moderately high sulphate concentration averaging 106 parts per

million at this location remained as evidence of mine drainage influence on water quality.

Although 1.05 sources of mine drainage wore located in the area under investigation, only few were found to contain the low pH-high acidity characteristics commonly attributed to coal mine discharges. Nost of the sources were "type a", that is low sulphate-neutral discharging a finding consistent with reports which associate mining in the Freeport seams of coal with production of mildly acidic to alkaline water. The predominance of this type of drainage was made evident during our survey as indicated by the following discussion and source inventory.

Mine Drainage Inventory

A total of 105 drainage points associated with coal mining activity in the study area, accounting for an average total daily discharge of 6.45 thousand gallons per day were investigated during the six month survey. For the most part the source locations were in three general areas, the headwaters of Big Run, the upper reaches of Stump Creek, and the lower reaches of East Branch and Clover Run, The last contains the heaviest concentration of mine drainage. For discussion purposes the watershed was subdivided into seventeen areas. A summary tabulation of loadings from these areas is given below followed by a detailed consideration of each area,

TABLE 1

SUMMARY OF MINE DRAINAGE LOADINGS

UPPER MAHONING CREEK WATERSHED

	No. Of Discharges	Flow GPM	Net/Alk. lbs/day	Iron lbs/day	Sulphates lbs/day
1.Headwaters Area-E. Br. Mahoning Creek	3	16	-9.9	.16	26.5
2.Laurel Run-Trib.E. Br. Mahoning Creek	2	15	-1.2	.14	23.1
3. E. Br. Mahoning-Laurel to Clover Run	17	132	2.1	.80	144.1
4. Lost Run-Trib. To Clover Run	3	19	-2.0	.20	24.4
5. Upper Clover Run	13	87	-6.4	.15	85.6
6. Stoney Run-Trib to Clover Run	5	85	-15.4	.03	296.6
7. Lower Clover Run	15	132	-2.1	.52	83.4
8. Stump Creek-Headwaters Area	3	15	-22.7	3.18	330.8
9.Limestone Run-Trib. to Stump Creek	2	17	10.8	.44	32.6
10. Sugarcamp Run-Trib. to Stump Creek	4	1938	-1191.3	548.06	5272.0
11.Upper Stump Creek	10	1100	7115.5	349.70	6332.4
12. Lower Stump Creek	2	11	-2.3	.40	10.2
13 Mouth East Branch Mahoning Creek	2	10	-1.3	.18	12.4
14. Laurel Run-Trib. to Big Run	3	116	104.6	.10	92.2
15.Upper Big Run	12	303	583.1	1.62	297.8
16. Lower Big Run	3	366	275.5	98.98	693.6
17. Mahoning Creek-East Branch to Big Run	6	90	35.3	.14	104.8
TOTALS	105	4452	862.1	1005.6	13862.2

Net results in terms of the total 6.46 mgd of mine drainage discharge investigated shows an average daily loading of 862 pounds per day of alkalinity, one-half ton per day of iron and almost seven tons per day of sulphates. Basic data relative to the individual drainage sources shown on the location Map (Plates 1 & 11) are given in the Appendix A. The discharges were grouped and tabulated according to their combined effect on local watershed areas to facilitate the discussion which follows.

For all practical purposes the effect of mine drainage in the headwaters of East Branch of Mahoning Creek including Beaver Run (2.48 sq. mi.) and Laurel Branch Run is negligible. Three strip mine discharges nos. 103, 104, and 105 were sampled. Alkalinity and acidity were low and of equal concentration(6 ppm) for the average of samples from no. 103. Approximately ten pounds per day of acid flowed into Beech Run from nos. 104 and 105.

TABLE 2

Mine Drainage Loadings

East Branch Mahoning Creek- Headwaters Area

Source Type	No.	Flow GPM	pH	Net Alk. lbs/day	Iron lbs/day	Sulphates lbs/day
Strip Mines	103	6	5.3	0	.06	9.2
Strip Mines	104	4	4.7	-3.2	.10	6.5
Strip Mines	105	6	4.8	-6.7	0	10.8
Totals	3	16		-9.9	.16	26.5

TABLE 3

MINE DRAINAGE LOADINGS

LAUREL RUN TRIBUTARY TO EAST BRANCH OF MAHONING CREEK

Source Type	No.	Flow GPM	pH	Net Alk. lbs/day	Iron lbs/day	Sulphates lbs/day
Strip Mines	21	10	6.4	.6	.06	12.4
Strip Mines	49	5	5.0	-1.8	.08	10.7
Totals	2	15		-1.2	.14	23.1

Two strip mine discharges were sampled in this area. No. 21 was found to be alkaline except for one sample(March Sample). No. 49 is a small volume low acid discharge averaging 14 ppm of acidity, 1.3 ppm of iron, and 179 ppm of sulphates.

TABLE 4

MINE DRAINAGE LOADINGS

EAST BRANCH MAHONING CREEK- REACH BETWEEN LAUREL & CLOVER RUNS

Source Type	No.	Flow GPM	pH	Net alk. lbs/day	Iron lbs/day	Sulphates lbs/day
Strip Mines	33	6	6.0	-.10	.04	2.1
Strip Mines	34	4	5.7	-.05	0	2.8
Strip Mines	35	4	6.6	.80	0	5.9
Strip Mines	36	17	6.5	3.20	.10	18.0
Strip Mines	37	11	5.6	-.10	0	10.4
Strip Mines	38	7	4.4	-1.40	0	6.0
Strip Mines	39	5	5.1	-.70	.20	5.2
Strip Mines	40	7	4.8	-1.20	0	7.9

Strip Mines	41	9	5.5	-.10	0	11.0
Strip Mines	42	10	6.0	.60	.10	8.3
Strip Mines	43	6	5.1	-.80	0	4.3
Strip Mines	44	7	7.0	2.70	.10	10.4
Strip Mines	45	10	5.6	-.70	.10	15.0
Strip Mines	46	14	5.6	-.30	.07	25.0
Strip Mines	47	5	5.3	-.06	.04	4.6
Strip Mines	48	7	5.2	-.30	.04	6.3
Strip Mines	55	3	6.6	.60	0	0.9
Totals	17	132		2.1	.8	144.1

A total of seventeen discharges, all the results of strip mining, were monitored in the reaches of the East Branch of Mahoning Creek between Laurel Run and Clover Run. Mine drainage sources nos. 33 through 48 and no. 55 collectively contribute an average flow of 132 gallons per minute with an average alkalinity of 2.1, iron of .8 and sulphates of 144 pounds per day respectively. None of these samples showed a significant dominance in the concentration of alkalinity or acidity as evidenced by their close balance and a net result of only two pounds per day of alkalinity. This near-neutral quality is characteristic of the water in the study area.

TABLE 5

Mine Drainage Loadings

Lost Run Tributary To Clover Run

Source Type	No.	Flow GPM	pH	Net Alk. lbs/day	Iron lbs/day	Sulphates lbs/day
Deep Mines	18	6	6.1	.30	0	6.1

Deep Mines	19	8	6.6	.50	0	6.8
Deep Mines	20	5	4.5	-2.80	.2	11.5
Totals	3	19		-2.00	.2	24.4

Deep mines contribute three discharges to Lost Run upstream from the Punxsutawney Reservoir. Only one of these drainage sources, no. 20, is acid. This discharge shows a pH of 4.5, acidity of 46 ppm, iron of 4 ppm, and sulphates of 191 ppm.

TABLE 6

Mine Drainage Loadings

Upper Clover Run

Source Type	No.	Flow GPM	pH	Net Alk. lbs/day	Iron lbs/day	Sulphates lbs/day
Strip Mines	9	10	5.0	-1.10	.06	10.3
Strip Mines	10	8	5.6	.30	.05	11.3
Strip Mines	11	5	5.4	-.50	0	7.2
Strip Mines	12	8	5.2	-.80	0	2.0
Strip Mines	13	4	6.2	.50	0	3.7
Strip Mines	14	5	5.1	-1.00	.04	2.1
Strip Mines	15	5	5.5	-1.00	0	1.3
Strip Mines	16	9	5.6	-1.50	0	17.8
Strip Mines	17	5	5.7	-.60	0	3.7
Strip Mines	22	10	6.6	2.60	0	4.3
Strip Mines	23	9	4.8	-1.70	0	10.2
Strip Mines	24	4	4.6	-.90	0	4.8
Strip Mines	27	5	5.4	-.70	0	7.9
Totals	13	87		-6.40	.15	85.6

Ten mine drainage discharges to Clover Run above the Punxsutawney Reservoir were found to contribute six and one-half pounds of acid per day. Three other discharges (nos. 10, 13, and 22) are predominately alkaline. Four of the drainage points (nos. 14, 15, 16, and 17) are associated with abandoned deep mines which produce about 64% of the total acid.

Stoney Run, also a tributary to the Punxsutawney Reservoir receives 57 gpm and nineteen pounds of acid per day from three principal sources (nos. 25, 28, and 29). The largest contributor is the strip mine discharge no. 28 which produces about 14 pounds per day of acid or about 74% of the total acid load.

TABLE 7

Mine Drainage Loadings

Stoney Run- Tributary To Clover Run

Source Type	No.	Flow GPM	pH	Net Alk. lbs/day	Iron lbs/day	Sulphates lbs/day
Strip Mines	7	13	6.8	3.7	0	4.2
Strip Mines	25	11	5.4	-1.3	0	30.4
Strip Mines	26	15	5.8	-.5	0	12.8
Strip Mines	28	36	5.0	13.8	.03	203.0
Strip Mines	29	10	4.6	-3.5	0	46.2
Totals	5	85		-15.4	.03	296.6

TABLE 8

Mine Drainage Loadings

Lower Clover Run

Source Type	No.	Flow GPM	pH	Net Alk. lbs/day	Iron lbs/day	Sulphates lbs/day

Strip Mines	1	5	5.2	-.40	.06	3.0
Strip Mines	2	7	6.0	.30	0	7.2
Strip Mines	3	6	6.6	.90	.04	2.9
Strip Mines	4	4	5.8	.04	0	1.8
Strip Mines	5	10	6.5	1.20	0	4.3
Strip Mines	6	28	5.8	-2.40	0	12.8
Strip Mines	8	12	6.8	.80	.10	6.5
Strip Mines	30	5	6.1	-.30	0	4.2
Strip Mines	31	3	4.7	-.30	.10	2.7
Strip Mines	50	4	4.7	-.50	.02	3.4
Strip Mines	51	6	6.0	-.20	0	2.1
Strip Mines	52	12	6.5	1.00	0	7.5
Deep & Strip Mines	53	6	6.3	.60	0	2.7
Strip Mines	54	12	4.7	-3.70	0	15.4
Totals	15	132		-2.06	.32	83.4

Fifteen mine drainage sources were located in the Clover Run watershed below the Punxsutawney Reservoir. Only seven of these contributed an acid loading based on the average concentration occuring during the survey. Total flow and acidity from these sources were 63 gpm and 7.8 pounds per day respectively. Offsetting alkalinity contained by the other discharges produced a net acid load of only two pounds per day.

TABLE 9

Mine Drainage Loadings

Stump Creek Headwaters

Source Type	No.	Flow GPM	pH	Net Alk. lbs/day	Iron lbs/day	Sulphates lbs/day
Gob Pile	99	5	4.7	-14.00	2.18	200.2

Gob Pile	100	4	4.4	-11.45	1.00	122.3
Strip Mines	102	6	5.3	.20	0	8.3
Totals	3	15		-25.65	3.18	330.8

Refuse piles near the reservoir on Stump Creek at Helvetia are responsible for two discharges (nos. 99 & 100) contributing twenty-five pounds per day of acidity.

TABLE 10

Mine Drainage Loadings

Limestone Run Tributary to Stump Creek

Source Type	No.	Flow GPM	pH	Net Alk. lbs/day	Iron lbs/day	Sulphates lbs/day
Strip Mines	98	8	6.7	8.7	.40	17.0
Strip Mines	101	9	5.9	2.1	.04	15.6
Totals	2	17		10.8	.44	32.6

The two discharges sampled on Limestone Run drainage were associated with strip mines. Alkalinity was determined to be the dominent characteristic averaging 91 ppm for no. 98 and 20 ppm for no. 101.

TABLE 11

Mine Drainage Loadings

Sugarcamp Run Tributary to Stump Creek

Source Type	No.	Flow GPM	pH	Net Alk. lbs/day	Iron lbs/day	Sulphates lbs/day
Deep Mines	89	4	7.8	5.7	.30	5.4
Deep Mines	88	5	7.5	8.6	.56	9.6
Deep Mines	90	1820	5.3	-1003.0	518.0	4896.0

Deep Mines	91	109	5.1	-174.0	30.2	362.0
Totals	4	1938		-1191.3	549.06	5272.0

By far the most significant acid contributors in the Study Area are nos. 90 and 91 located in the Sugarcamp Run watershed north of Sykesville. Both discharges are from abandoned deep mines flowing into Sugarcamp Run about .8 mile from the mouth of the stream. Together these two discharges produce an average flow of 2.79 mgd containing 1191 pounds of acid which easily identifies them as the worst acid pollution sources in the Study Area.

All remaining discharges associated with coal mining activity in the upper reaches of Stump Creek are alkaline.

TABLE 12

Mine Drainage Loadings

Upper Stump Creek

Source Type	No.	Flow GPM	pH	Net Alk. lbs/day	Iron lbs/day	Sulphates lbs/day
Deep Mines	84	47	6.9	141.4	20.0	1304.0
Deep Mines	85	886	6.5	704.5	278.0	4686.0
Deep Mines	86	46	7.4	82.7	9.2	73.9
Deep Mines	87	6	6.0	18.7	15.9	17.6
Deep Mines	92	6	6.9	8.0	.9	7.7
Deep Mines	93	15	7.1	15.3	2.2	33.1
Deep Mines	94	32	7.0	54.0	13.0	65.6
Deep Mines	95	16	7.3	27.6	2.7	33.5
Deep Mines	96	21	6.6	29.3	3.2	46.0
Deep Mines	97	25	6.8	34.0	4.6	65.0
Totals	10	1100		1115.5	349.7	6332.4

The survey showed that these discharges accounted for a flow of nearly 1.6 mgd with 1100 pounds per day of alkalinity. It is sufficient to neutralize the acid contributions of nos. 90 and 91 on Sugarcamp Run. The acceptable quality of water in Stump Creek is largely due to the combined effect of these alkaline discharges and the reserve alkalinity in the main stream at Limestone Run.

TABLE 13

Mine Drainage Loadings

Lower Stump Creek

Source Type	No.	Flow GPM	pH	Net Alk. lbs/day	Iron lbs/day	Sulphates lbs/day
Deep Mine	58	6	5.5	-1.0	.10	6.1
Strip Mines	59	5	4.5	-1.3	.30	4.1
Totals	2	11		-2.3	.40	10.2

These two sources from the strip mine and a small deep mine with a small associated gob pile contribute a slight amount of acid loading.

TABLE 14

Mine Drainage Loadings

East Branch of Mahoning Creek at Mouth

Source Type	No.	Flow GPM	pH	Net Alk. lbs/day	Iron lbs/day	Sulphates lbs/day
Deep Mines	56	6	4.4	-1.70	.14	8.3
Deep Mines	57	4	5.8	.40	.04	4.1
Totals	2	10		-1.30	.18	12.4

Strip mining and several small deep mines are responsible for some minor flow and acid contribution near the East Branch Mahoning Creek confluence. Two deep mine discharges(nos. 56 and

58) account for about 12 gpm of flow and about two pounds of acid per day.

TABLE 15

Mine Drainage Loadings

Laurel Run Tributary to Big Run

Source Type	No.	Flow GPM	pH	Net Alk. lbs/day	Iron lbs/day	Sulphates lbs/day
Deep Mines	81	30	7.0	18.4	.10	24.5
Deep Mines	82	6	6.7	1.7	0	5.3
Deep Mines	83	80	7.0	84.5	0	62.4
Totals	3	116		104.6	.10	92.2

TABLE 16

Mine Drainage Loadings

Upper Big Run

Source Type	No.	Flow GPM	pH	Net Alk. lbs/day	Iron lbs/day	Sulphates lbs/day
Deep Mines	69	8	5.9	1.2	.02	8.3
Deep Mines	70	9	6.6	2.3	.10	5.2
Deep Mines	71	5	6.8	1.7	.10	2.8
Deep Mines	72	7	6.9	1.7	1.00	7.5
Deep Mines	73	4	6.7	1.5	.01	1.3
Deep Mines	74	6	7.5	7.7	0	4.6
Deep Mines	75	20	7.5	22.8	.10	14.9
Deep Mines	76	5	7.5	4.3	0	3.8
Deep Mines	77	6	7.1	5.3	.02	7.6
Deep Mines	78	194	7.7	460.0	.20	208.0
Deep Mines	79	28	7.4	68.0	.03	23.8
Deep Mines	80	11	7.0	6.6	.04	10.0
Totals	12	303		583.1	1.62	297.8

TABLE 17

Mine Drainage Loadings

Lower Big Run

Source Type	No.	Flow GPM	pH	Net Alk. lbs/day	Iron lbs/day	Sulphates lbs/day
Deep Mines	66	348	6.9	269.0	98.0	681.0
Deep Mines	67	11	7.0	4.5	.90	9.1
Deep Mines	68	7	6.7	2.0	.08	3.5
Totals	3	366		275.5	98.98	693.6

A total of eighteen mine drainage sources were investigated in the Big Run watershed: Three on the Laurel Run tributary, twelve above the confluence of Big Run and Turnip Run, and three on the mainstream between McKee Run and Windfall Run. All of these discharges, without exception, showed predominately alkaline characteristics. Total flow from all of these sources indicated an average daily contribution of 785 gpm and 963 pounds per day of alkalinity.

TABLE 18

Mine Drainage Loadings

Mahoning Creek- East Branch to Big Run

Source Type	No.	Flow GPM	pH	Net Alk. lbs/day	Iron lbs/day	Sulphates lbs/day
Deep Mines	60	8	6.6	2.20	.05	4.6
Deep Mines	61	14	6.7	9.40	.06	24.5
Deep Mines	62	8	5.2	-.80	0	13.8
Deep Mines	63	6	5.6	-.10	0	8.5
Deep Mines	64	7	6.6	2.50	.03	10.0
Strip Mines	65	47	6.9	20.30	0	43.4
Totals	6	90		35.30	.14	104.8

Small deep mines are the primary source of the discharges along the short reach of Mahoning Creek between the East Branch Stump Creek confluence and Big Run. However, only two of the six sources monitored were even slightly acid. No. 62 had an average pH of 5.2 with a net acidity concentration of 8 ppm and no. 63 had an average pH of 5.6 with a net acidity concentration of 5 ppm. This low concentration of acidity and alkalinity (below 20 ppm) is not great enough to affect the water quality.

STREAM QUALITY

In order to determine the effect of coal mine drainage on stream quality, sampling stations were established near the mouth of each major tributary, namely East Branch of Mahoning Creek, Stump Creek, and Big Run. Two locations were monitored on Mahoning Creek to determine the stream quality in the main stream above and below the confluence of Big Run. Additional stream sampling points were located according to the concentration of mining activity. A total of thirteen in-stream water quality stations, MC-100 to MC-112, were tested during the survey. The data collected from these stations is presented in Appendix A. A summary of the information is given in the following table.

TABLE 19

Average In-Stream Loadings

Mahoning Creek Watershed In The Study Area

Number	Location	Est. Flow C. NS	pH	Net Alk. lbs/day	Sulphates lbs/day
MC-100	Mahoning Creek Below Big Run	76	6.9	14,760	43,460
MC-101	Mahoning Creek Above Big Run	60	7.1	11,664	28,836
MC-102	Big Run Near Mouth	15	7.0	3,645	6,966
MC-103	Clover Run Near Mouth	9	6.0	292	3,304
MC-104	East Branch Mahoning Creek	24	6.8	2,851	5,702
MC-105	Stump Creek	18	6.9	2,819	22,064
MC-106	Unnamed Trib. To Limestone Run	2.1	6.7	284	748
MC-107	Stump Creek Below Reservoir	3.7	6.2	160	1,638
MC-108	East Branch Upstream Laurel Run	12	6.5	842	2,527
MC-109	Laurel Run Near Mouth	4.8	6.6	282	641
MC-110	Clover Run-Headwaters	1.2	6.4	61	472
MC-111	Lost Run Near Mouth	1.4	6.3	63	243
MC-112	Stoney Run Near Mouth	1.0	6.6	126	388

It is readily apparent that all of the streams sampled during the study period exhibited alkaline characteristics. The lowest average pH (6.0) was observed at Clover Run near the mouth. While this is not a critical value, it is indicative of the marginal water quality in Clover Run which yields to lower pH's (5.0 to 5.5) caused by acid slugs during spring runoff.

Acid mine pollution was not found to be a critical problem in the study area. Based on the investigation, the following summary statements can be made regarding stream quality in the subject watershed.

1. The terminal drainage point for the study area is MC 100 Mahoning Creek just downstream from the Big Run confluence. Results of the survey show that the collective effect of the mine drainage sources contributing to this water quality point never lowered the pH below 6,5. The net alkalinity concentration averaged 34 ppm. The moderately high sulphate concentration of 106 ppm was the only indication of coal mine drainage influence on water quality.

2. Big Run MC 102 is known locally as a good trout fishing stream. The survey results confirmed a water quality consistent in this regard. The average pH was 7.0 and the alkalinity was 45 ppm.

3. Clover Run near the mouth MC.103 showed a pH range from 5.4 (April) to 6.5 (July). The acidity exceeded the alkalinity in three of the six samples taken,. but only by a small margin of 5 ppm. In general Clover Run is known to experience slugs of acid pollution and it is not uncommon to

find a pH of 5.0 to 5.2 in a grab sample below the reservoir during spring runoff.

4, East Branch of Mahoning Creek is another well known trout fishing stream in the area. Our survey showed a predominance of alkalinity for all samples with an average concentration of 22 ppm, at station MC 104,

5. Water quality in Stump Creek (MC 105) evaluated in terms of mine drainage parameters indicates with certainly the presence of neutralized mine acid water by the high sulphate concentration of 227 ppm and alkalinity at this location. have been restored to acceptable levels with an average pH of 6.9 and an alkalinity of 29 ppm.