WATERSHED STUDY

General Discussion

A preliminary, pre-contract, field investigation was made of the Watershed on April 16, 1971. The investigation indicated there were at least two prime and separate sources of deep mine drainage that contribute to the Acid Mine Drainage pollution of Stony Creek. Both of these known sources are located directly east of Hooversville along Legislative Route 55091. The proposal by Carson Engineers was predicated upon the investigation of these two sources of mine drainage, defined as the Site Evaluation Projects. However, it was determined that if, during the course of the Watershed Study, a more severe singular source of deep mine drainage was found, another study, similar in nature to the ones proposed, would be initiated.

During the fall of 1972, after reviewing the data collected from the sampling programs and the Fish Commission reports along with the availability of deep mine maps, the Wells Creek (4R) Sub-watershed was selected for the three Site Evaluation Projects. The Fish Commission's survey indicated that stocking of game fish had taken place from the headwaters of Stony Creek downstream to the area of Beaverdam Creek, the next major tributary downstream from Wells Creek. However, this stocking was to be sharply reduced, if not entirely eliminated, due to the amount of AMD that was entering Stony Creek from Wells Creek and other smaller tributaries upstream. The probable abatement of AMD from Wells Creek could conceivably alter the decision of the Fish Commission and may even increase the length of Stony Creek that would be stocked. This seems entirely probable since it was found that three of the discharging mines in the Wells Creek watershed contributed 130% of the pollution load as measured at the mouth of Wells Creek. The abatement of these three mines would significantly reduce the acid load in Wells Creek to the point the Fish Commission may also include this stream in its future stocking programs.

General Discussion (contd.)

The determination of pollution in the main stream, Stony Creek, and the location of the polluting sources have been prime objectives of this study. The investigation of this Watershed was carried out in a number of different phases, not including those extra activities that involved the Site Evaluation Projects. Early sampling of Stony Creek and its main tributaries were taken and analyzed to ascertain the areas of immediate concern. This preliminary sampling was done in October, 1971, shortly after receiving orders from the Department of Environmental Resources to proceed with the execution of the contract. Our source sampling was carried out in two overlapping phases: first, the deep mine discharges, and then the flows from the strip mines with Stony Creek being monitored along with the sampling stations on the primary tributaries during these two phases. Because the flow characteristics of Stony Creek, the primary tributaries and the polluting sources varied during the testing program, it was necessary to correlate the resulting pollution loads during the same periods of time. The percentages of flows and pollution load that each source contributes, found in the "Conclusions and Recommendations by Sub-watersheds" section of this report, reflects this correlation.

Historical data concerning the water quality and the mining activities within the study area were ferreted out and acquired from various local, state, and federal agencies. This information helped focus the study on known pollution sources, and highlighted other problem areas such as a need for improved water supply to the communities along Stony Creek. Aerial photos of the study area were acquired from the United States Department of Agriculture in an effort to aid our field crews to locate and identify strip mines, refuse piles and gob piles.

To better enable us to identify and correlate the information, we subdivided the study area portion of the watershed into sub-watersheds. Starting at Hooversville in the north and proceeding to the headwaters in the south we established fifteen (15) sub-watersheds on the left hand side of Stony Creek and eleven (11) sub-watersheds on the right hand side. These divisions are not watersheds in the true sense of the word since some of them encompass more than one tributary. However, this subdivision does enable us to locate mining operations and pollution sources with a great amount of speed.

The accumulation of maps for the abandoned deep mines fell short of our expectations. Various sources for these maps were contacted to enable us to acquire as many as possible. Unfortunately, only a small percentage of the potential number of the mine maps could be found. The extent of mining, both deep and strip, within the study area was identified from the Commonwealth records on mining permits and water permits, the acquisitions of available mine maps, but most important, through our field investigations.

These field investigations consisted of several phases. Every road in the watershed was driven to familiarize the crews with the area and to locate the visible deep mines.

The locations of the mines taken from the Commonwealth records were plotted on maps to better enable the field crews to locate all of the mines. In walking to the mines shown on the maps, our field crews found other, unrecorded mine openings, some of which had flows. Talking to the local residents and farmers in the area was another method in locating still more unrecorded flowing mines. Then came the walking of the tributaries which was the final method used in locating flowing mines that could have been missed by the other methods. After each mine was found, its location was sketched in a field book to enable the office personnel to accurately record the opening on a map. Following the locating of a flowing opening, a weir was placed as close to the source as possible. It then became part of our regular monthly sampling program.

The Commonwealth records indicated 199 mines in the study area. Our field crews, however, found 443 mine openings with 160 of them having flows of one gallon per minute or greater.

The location and investigation of deep mines was made simultaneously with the selection and cross-sectioning of 10 permanent monitoring stations along the 23 mile length of Stony Creek. In addition to the stations on the main stream, 41 of the primary tributaries were either cross-sectioned or had weirs placed as close to its mouth as possible. These too became part of our monthly monitoring program.

This monitoring program, scheduled for twelve months, gave a continual picture of pollution activities along the entire length of the stream, and helped to determine those areas in the Watershed that were most affected by pollution, and thus served as a guide for determining areas that are most critical to this study. The twelve month testing period was extended to eighteen months due to the number of additional mines located by our field crews. During the sampling period, flow measurements were taken along with the field pH and temperature. The bottle sample was sent to the laboratory for analysis of pH, acidity, alkalinity, ferrous iron, total iron, sulfates, and hardness.

The location and investigation of surface or strip mines activity along with refuse and gob piles within the Watershed was started approximately six (6) months after the start of the investigation of the deep mines. The actual location of these areas was accomplished with much the same methods employed by our field crews as with the deep mines. We had received additional help, in this phase, from the Department of Agriculture field office, along with a revision of aerial photographs and our own observations by airplane. Although the records from the Commonwealth indicate there have been two hundred fourteen (214) separate strip mines in the Study area, it is difficult, at times, to determine where one operator started his mining activates and another left off. It is for this reason that a noticeable difference between the number of mines on the state records and the number we have found through our field investigations exists.

General Discussion (contd.)

To date we have located 151 strip mines having 213 flows.

After the sampling and monitoring stations were established, they were staked, flagged, and marked for future identification. Detail sketches were prepared of each sample location that was part of our monitoring program.

A biological report is enclosed which has furnished us with a valuable tool, when interpreted, for evaluating the degree of mine drainage pollution, and can be found in the section titled "Water Quality Criteria".

A method for analyzing the results of the water sampling program was necessary in order to determine a priority or severity rating for each pollution source or area. A discussion of this analysis method is enclosed and is found in the sub-section titled "Pollution Indexing".

Pollution Indexing

The designation of any mine flow or area as a source of pollution involves considerable judgment of the various parameters, e.g.: flow, pH, net acidity, total iron, etc., especially if the sources of pollution are to be determined and catalogued in order of severity. To make this determination, a system has been established whereby it is possible to make a judgment using any combination or all of the parameters involved. This is accomplished by assigning each parameter a number designation, known as the pollution rating, in a range from 0 to 10; the assigned numbers being dependent upon the severity of the particular parameter in parts per million, as shown in the following table.

TABLE 1

Net Acidity (Cold)	Ferrous & Total Iron	Sulfate & Hardness	Pollution Rating
1 - 30	0 - 1	1 - 250	1
31 - 75	1.1 - 10	251 - 350	2
76 - 150	10.1 - 25	351 - 450	3
151 - 300	25.1 - 75	451 - 550	4
301 - 400	75.1 - 125	551 - 650	5
401 - 500	125.1 - 175	651 - 750	6
501 - 600	175.1 - 225	751 - 850	7
601 - 700	225.1 - 275	851 - 950	8
701 - 800	275.1 - 325	951 - 1050	9
801+	325.1+	1051+	10

The Pollution Rating Number for pH = 10.0 - pH

Pollution Indexing (contd.)

The volume of flow was also assigned a pollution rating number ranging from 0.1 to 10; the assigned number being proportional to the volume of flow in gallons per minute as shown in the following table. The flow rates were considered to have a multiplicative effect upon the summation of assigned parameter values for the pollution sources.

TABLE 2

Flow GPM	Multiplier	Flow GPM	Multiplier
1 - 75	0.1	1801 - 1875	2.5
76 - 150	0.2	1826 - 1950	2.6
151 - 225	0.3	1951 - 2025	2.7
226 - 300	0.4	2026 - 2100	2.8
301 - 375	0.5	2101 - 2175	2.9
376 - 450	0.6	2176 - 2250	3.0
451 - 525	0.7	2251 - 2325	3.1
526 - 600	0.8	2326 - 2400	3.2
601 - 675	0.9	2401 - 2475	3.3
676 - 750	1.0	2476 - 2550	3.4
751 - 825	1.1	2551 - 2625	3.5
826 - 900	1.2	2626 - 2700	3.6
901 - 975	1.3	2701 - 2775	3.7
976 - 1050	1.4	2776 - 2850	3.8
1051 - 1125	1.5	2851 - 2925	3.9
1126 - 1200	1.6	2926 - 3000	4.0
1201 - 1275	1.7	3001 - 3075	4.1
1276 - 1350	1.8	3076 - 3150	4.2
1351 - 1425	1.9	3151 - 3225	4.3
1426 - 1500	2.0	3226 - 3300	4.4
1501 - 1575	2.1	3301 - 3375	4.5
1575 - 1650	2.2	3376 - 3450	4.6
1651 - 1725	2.3	3451 - 3525	4.7
1726 - 1800	2.4	3526 - 3600	4.8

TABLE 2 (contd.)

Flow GPM	Multiplier GPM	Flow	Multiplier
3601 - 3675	4.9	6001 - 6500	8.1
3676 - 3750	5.0	6501 - 7000	8.2
3751 - 3825	5.1	7001 - 7500	8.3
3826 - 3900	5.2	7501 - 8000	8.4
3901 - 3975	5.3	8001 - 8500	8.5
3976 - 4050	5.4	8501 - 9000	8.6
4051 - 4125	5.5	9001 - 9500	8.7
4126 - 4200	5.6	9501 - 10,000	8.8
4201 - 4275	5.7	10,001 - 10,500	8.9
4276 - 4350	5.8	10,501 - 11,000	9.0
4351 - 4425	5.9	11,001 - 11,500	9.1
4426 - 4500	6.0	11,501 - 12,000	9.2
4501 - 4575	6.1	12,001 - 12,500	9.3
4576 - 4650	6.2	12,501 - 13,000	9.4
4651 - 4725	6.3	13,001 - 13,500	9.5
4726 - 4800	6.4	13,501 - 14,000	9.6
4801 - 4875	6.5	14,001 - 14,500	9.7
4876 - 4950	6.6	14,501 - 15,000	9.8
4951 - 5025	6.7	15,001 - 15,500	9.9
5026 - 5100	6.8	15,501+	10.0
5101 - 5175	6.9		
5176 - 5250	7.0		
5251 - 5325	7.1		
5326 - 5400	7.2		
5401 - 5475	7.3		
5476 - 5550	7.4		
5551 - 5625	7.5		
5626 - 5700	7.6		
5701 - 5775	7.7		
5776 - 5850	7.8		
5851 - 5925	7.9		
5926 - 6000	8.0		

Pollution Indexing (contd.)

The resulting summation of any combination or all of the parameters times the multiplier allows us to determine what we call a "Pollution Index Number".

(pH+Net Cold Acidity+Ferrous Iron+Total Iron+Sulfate+Hardness X GPM = PIN or Pollution Index Number.)

However, for this report, in accordance with the criteria set forth by the Department of Environmental Resources

i.e. pH - less than 6.0
Acidity - any amount of net acidity
Total Iron - exceeding 7.0 PPM

we will only use the pollution rating numbers and multiplier for the following parameters:

pH less than 6.0 + Net Cold Acidity + Total Iron exceeding 7.0 PPM X Gallons per minute = PIN or Pollution Index Number.

This establishment of a pollution index number well satisfies the requirements of this report for identifying and arranging in order the severity of pollution sources within the study area and is an extremely valuable tool in highlighting areas of AMD pollution. It is not necessarily a priority list for doing work, but only an overview of the whole watershed as far as the magnitude of AMD pollution is concerned. The priorities for doing work are listed in the section titled "Conclusions and Recommendations by Sub-watersheds" and are established on a cost, i.e. dollars per pound of acid abated, basis.

There are individual lists for each sub-watershed accompanied by the estimated costs that were used to set the priorities. It must be pointed out that remedial measures of these sources can only be scheduled after the feasibility for abatement has been determined.

Many other parameters could be introduced into the system, such as closeness of the pollution source to human habitation, closeness to recreational areas, etc. However,

Pollution Indexing (contd.)

the addition or deletion of parameters must be a matter of judgment for each individual case.

In view of the fact that the polluting sources are ranked on a cost basis, the following two tables only include the ranking of the monitoring stations on the main stem, Stony Creek, and the polluting tributaries feeding Stony Creek.

TABLE 3

MONITORING STATIONS ON THE MAIN STEM OF
STONY CREEK THAT ARE POLLUTED
by Rank
Using Four Parameters
pH, Net Cold Acidity, Total Iron and Flow

Rank	Station Number	Distance Up-stream from Hooversville	Pollution Index Number
1	SC 1	0 miles	78
2	SC 3	4.41 miles	76
3	SC 2	2.94 miles	74
4	SC 5	9.38 miles	60
5	SC 6	9.64 miles	57
6	SC 4	6.11 miles	54

TABLE 4

POLLUTING TRIBUTARIES
By Rank
Using Four Parameters
pH, Net Cold Acidity, Total Iron and Flow

Rank	Station No.	Name of Tributary	PIN
1	SC6L1	Lamberts Run	111.72
2	SC1L2	Dixie Run	70.15
3	SC4R1	Wells Creek	64.00
4	SC4L2	Oven Run	55.76
5	SC10L1	Rhoads Creek	52.00
6	SC13L1	Reitz Creek	51.47
7	SC7R1	Schrock Run	37.95
8	SC7L1	Grove Run	34.65
9	SC11L2	Glade Church Run	32.34
10	SC3L2	Pokeytown Run	26.68
11	SC2L1	Fallen Timber Run	16.74
12	SC5L1	unnamed	9.90
13	SC8R2	unnamed	6.89
14	SC5R1	unnamed	4.95
15	SC5L3	unnamed	2.82
16	SC5L2	unnamed	2.28
17	SC11R1	unnamed	2.28
18	SC1R1	unnamed	1.68
19	SC10R2	unnamed	1.30
20	SC4L1	unnamed	1.10
21	SC1L1	unnamed	.55