MAHANOY CREEK

MINE DRAINAGE POLLUTION ABATEMENT PROJECT

OPERATION SCARLIFT

COMMONWEALTH OF PENNSYLVANIA
Milton J. Shapp, Governor

DEPARTMENT
OF
ENVIRONMENTAL RESOURCES
Dr. Maurice K. Goddard, Secretary

PROJECT SL 197

SANDERS & THOMAS, INC.
CONSULTING ENGINEERS
POTTSTOWN, PENNSYLVANIA

SANDERS & THOMAS, INC.

CONSULTING ENGINEERS

A Unit of STV, Inc.

Griffith Towers Building
Pottstown, Pennsylvania 19464
215/326-4600
Cable: SANTOM

June 6, 1975

C. H. McConnell, Deputy Secretary
Resources Management
Department of Environmental Resources
Harrisburg, Pennsylvania 17120

Subject: Contract No. SL-197
Mahanoy Creek Watershed
Mine Drainage Pollution Abatement

Our Project No.: 3425

Dear Mr. McConnell:

In accordance with Section 1.5-8 of the above contract, we are submitting herewith our final report. The report presents the results of our study and recommendations for abatement of mine drainage pollution for the Mahanoy Creek Watershed.

Very truly yours,

SANDERS & THOMAS, INC.

G. D. McGinley, P.E.
Vice President

GDMcG:t

Enclosures:
As Noted Above

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
GEORGE DANIEL McGINLEY
ENGINEER
No. 5994-E

DEPARTMENT OF ENVIRONMENTAL RESOURCES

REVIEW NOTICE

This report, prepared by outside consultants, has been reviewed by the Department of Environmental Resources and approved for publication. The contents indicate the conditions that are existing as determined by the consultant, and the consultant's recommendations for correction of the problems. The foregoing does not signify that the contents necessarily reflect the policies, views, or approval of the Department.

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INTRODUCTION

The Mahanoy Creek Drainage Basin is located north and northwest of Pottsville, in the Counties of Northumberland, Schuylkill, and Columbia, PA (see Figure 1, p. 3). The watershed is bounded on the west by the Susquehanna River and extends eastward to the town of Delano. The Mahanoy Creek originates near Mahanoy City and flows west through the boroughs of Gilberton, Girardville, Ashland, and Gordon. Continuing west, the creek flows through Helfenstein, Hunter, and Otto.

A watershed study begun in July, 1973 of the Mahanoy Creek Drainage Basin has revealed:

1. the sources, distribution, and abundance of acid mine discharges

2. types of mine drainage

3. the effects of mine drainage on water quality of streams

4. several areas severely disturbed by strip mining

5. the extent of deep mining and its effects on surface areas

6. the extent of effects of silt and culm banks in the watershed

7. the extent of acid mine drainage pollution in the subwatersheds of the drainage basin and

8. that abatement of the coal mine drainage in the watershed is economically feasible (see Abatement Plan III, Table 12).

In the first two phases, field work was conducted to determine the water quality of each tributary of Mahanoy Creek with respect to acid mine drainage. The areas in the watershed affected by strip mining and deep mining were identified with dimensions of all stripping pits recorded. During these phases all acid mine discharges were located in the watershed, including discharges which re-entered deep mines a short distance downslope.

Phase I consisted of a reconnaissance survey of the watershed, including the identification of major sources of acid mine drainage and the division of the drainage basin into subwatersheds. Each of the streams in the watershed were visited, with samples taken of them as well as the acid mine discharges which entered them.

In Phase II the field mapping and the recording of the dimensions of the strip pits were completed. Areas which have been reclaimed, although few, were also located. Reclamation techniques used were partial regrading and replanting, replanting over disturbed areas without regrading, and regrading to original contours with and without replanting. Plates A and B (inside rear cover) show the extent of deep mining, strip mining, and all major mine refuse piles in the watershed.

Water samples were collected, analytical data evaluated and stream flows determined during Phase III. Based on the watershed investigations, the effectiveness and applicability of various abatement techniques were evaluated. Operating and initial costs using the most effective abatement procedures are detailed with priority areas outlined. All water analyses and flow measurements are shown in the Appendix.

Cross Sections A-A' thru F-F' are provided as reference locations for use with Figure 10.

Figure 1. Location map

STATEMENT OF PURPOSE

The specific purpose of this study was to:

1. Determine all sources of acid mine drainage pollution in the Mahanoy Creek Watershed.

2. Determine the extent and severity of pollution contributed to Mahanoy Creek and its tributaries from both active and abandoned mines.

3. Define the areas disrupted by surface and deep mining activities.

4. Evaluate and develop the most efficient and applicable abatement techniques to reduce or eliminate, where practicable, acid mine drainage pollution.

5. Present cost estimates of abatement procedures (see 4. above) and establish implementation priorities incorporating esthetic and socio-economic criteria in addition to abatement cost effectiveness.

SURVEY PROCEDURE

Background information on topography, geology, coal mining history, hydrology, and water quality of the Mahanoy Creek Watershed was collected together with the establishment of a basic field procedure. Aerial survey photographs were reviewed and a field data collection was performed by assigned personnel. Underground mine maps were obtained and/or reviewed at the Pottsville Office of the Department of Environmental Resources to determine the extent of underground mining.

The above information was correlated and integrated to develop inventory maps showing the extent of underground and surface mining with accompanying refuse piles, coal contours and outcrops, and severity of acid mine drainage pollution in the streams of the watershed.

Seventy-two sampling sites were established to monitor the effects of 31 coal mine discharges. A geochemical study was conducted to determine effects of coal mine drainage on water quality and to evaluate potential abatement techniques. The geochemical data were applied successfully to determine, in some cases, the true source of pollution where the sources of acid mine water was questionable.

During the first month of water sampling (November, 1973) two sets of water samples were collected (at 2-week intervals). Since data for both sampling periods was not significantly different, only one set of samples per month was collected for the remainder of the 12-month sampling period. Temperature and pH were checked and 2 water samples were taken at each sample site. pH of surface waters was determined in the field using a Beckman Model Chem-Mate pH Meter. Field measurement of pH was conducted according to the procedure of Barnes (1). Several subsamples were taken at each sampling site to minimize sampling error.

The second group of samples taken in November included analyses of Al, Ca, Mg, Mn, Na, K, Ni, and Si, as well as the standard acid mine drainage analyses.

In addition, the second group of samples taken in November included two water filled strip pits east of Girardville and a seepage pond east of Ashland.

SUMMATION OF RESULTS

Preventive and corrective approaches to abatement of acid mine drainage pollution are dependent on chemistry of the pollutants, geology, extent and types of mining activities, the feasibility of various abatement techniques in selected areas of the watershed, cost effectiveness and certain socio-economic conditions of the region.

The following conclusions are the findings of an investigation which resulted from a study authorized and financed by the Pennsylvania Department of Environmental Resources under Pennsylvania Act 443 of 1968 as amended, the "Land and Water Conservation and Reclamation Act."

1. The Mahanoy and Shenandoah Creeks through their entirety, 75 percent of the Zerbe Run and 80 percent of North Mahanoy Creek, are severely polluted by acid mine drainage while Big Mine Run and Big Run consist entirely of acid mine drainage (see Figure 1).

2. There are 31 mine discharges which drain into the watershed streams, and 3 discharges which re-enter the mine pools (see Plates A and B).

3. Little Mahanoy Creek, Rattling Run, Mouse Creek, and Swaben Creek are free from acid mine water pollution (see Figure 1).

4. Two basic types of acid mine drainage have been identified in the watershed, alkaline (net Alkalinity, pH>6) and acid (net acidity, pH<4.5).

5. The two basic types of discharges were found to be dependent on the following: geology, amount of surface water entering the mine, mineralogy, time, bacteria, and the particular mine conditions. The mine discharges, however, were found to be independent of location with some alkaline and acidic discharges located within 50 feet of each other.

6. Three major sources of pollution to receiving streams were found in the watershed: acid mine drainage from abandoned mines, silt from the numerous silt and culm banks, and domestic sewage. On a local basis leachate from silt and culm banks becomes a significant source of acid mine drainage.

7. After completion of sewage treatment facilities in Shenandoah, and other towns in the watershed, the severity of acid mine drainage pollution in

the streams may increase slightly due to the removal of part of the neutralizing characteristics of the untreated sewage (i.e. ammonia).

8. A zonation in water quality of Mahanoy Creek exists, which may be important in any future abatement program downstream of the Mahanoy Creek-Zerbe Run confluence and continuing to the mouth of the Mahanoy Creek.

9. Several large areas of the watershed have been severely disturbed by surface (strip) mining. These regions include the areas south of Trevorton, west of Shenandoah, north of Girardville, north of Ashland and the area north and northwest of Mahanoy City (see Plates A and B).

10. The concentrations of chemical constituents in the acid mine waters increase as the season changes from high to low flow periods. This is shown in data included in the Appendix.

11. The numerous mine openings (shafts, air vents, access tunnels, drainage tunnels, boreholes, crop falls) combined with numerous abandoned strip mines have resulted in great amounts of water being introduced into the large underground mine pools. In addition, these mine openings have made hydraulic sealing of mines, in most cases, unsuitable as an abatement technique.

12. The major influences on water quality in the watershed include the following:

    a. North Franklin overflow (severely pollutes almost all of Zerbe Run and causes zonation and a drop in water quality of Mahanoy Creek)

    b. Doutyville Tunnel affects Mahanoy Creek

    c. Centralia Tunnel, east of Ashland affects Mahanoy Creek

    d. Packer #5, east of Girardville affects Mahanoy Creek

    e. Mahanoy City boreholes, east of Mahanoy City affects Mahanoy Creek

    f. Gilberton shaft, affects Mahanoy Creek.

13. Refuse piles contribute large amounts of silt and fine grained coal during periods of heavy rainfalls and on a local basis contribute to acid mine production through leaching processes (i.e., Hammond Bore Hole area).

14. Several deep strip pits and some mine openings pose unnecessary safety hazards in the watershed.

15. Water supply-combine need for water and AMD treatment. The need for purified water for domestic and industrial use in the area may favor the combination of acid mine drainage treatment and water treatment to result in a new source of potable water.

16. Although the danger of coal refuse impoundment failures, such as the one which ruptured on February 6, 1972, across Buffalo Creek (Logan County) in West Virginia is not as great as in West Virginia, impoundment failure as well as the compliance with stream pollution regulations indicates a need for a water recycling method. This could be accomplished by returning water through the coal preparation plant rather than the use of impoundment dams in the active collieries within the watershed and elsewhere.

17. A further study of mine pool stratification in the anthracite region should aid in the abatement plans for the area. This study would indicate future changes in water quality in the mine pools (and possible sources of potable water) due to abatement techniques which reduce the amount of water entering the mine pools, The changes in water quality may be critical to treatment systems.

18. The hydrological mine pool and reclamation investigations in this watershed suggest disturbed aquifers may be a very important source of water in some of the mine pools. This indicates that surface reclamation alone may be inadequate in the reduction of coal mine drainage; a further study is recommended.

TOPOGRAPHY

The Mahanoy Creek Drainage Basin (157.1 sq mi), lies within the Ridge and Valley Province of the Appalachian Highlands. The drainage basin is one of a series of coal basins within a synclinorium which trends northeast to southwest. The axis of the syncline would be along a line from the town of Hunter to the city of Shenandoah.

The watershed is dominated by a series of almost parallel mountain ridges and valleys trending in the same direction as the drainage basin. The watershed is bounded on the east by Locust Mountain and Vulcan Hill, and on the north by portions of Locust, Mahanoy, and Little Mountains. The southern boundaries of the watershed are parts of Broad Mountain, Line Mountain, and Fisher Ridge (see Figure 1). The relief varies in elevation from a high of 2090 feet at the eastern end near Delano, to 420 feet where Mahanoy Creek enters the Susquehanna River. The elevation of the mountain ridges varies from 1400 feet to 1800 feet, with the valley floors being 600 to 800 feet lower.

The Mahanoy Creek drainage basin was divided into seven subwatersheds (see Figure 2, p. 15). The Upper Basin (21.8 sq mi), consists of the area drained by Mahanoy Creek upstream from its confluence with the Shenandoah Creek. Mahanoy Creek originates as a discharge from an abandoned slope mine, one and a half miles east of Mahanoy City. An intermittent unpolluted stream carrying predominately surface runoff from the Vulcan Hill area, was the original Mahanoy Creek streambed, The streambed, which is now dry most of the year joins the discharge flow one mile east of Mahanoy City.

North Mahanoy Creek originates from unpolluted springs and surface runoff from the south slope of Locust Mountain, and enters Mahanoy Creek in Mahanoy City. Although no mine discharges enter North Mahanoy Creek the stream flows through a region that has been seriously disrupted by strip mining. Mine waste leachants and pyritic materials contribute a significant amount of pollutants from the surrounding waste materials seriously degrading the stream. From Mahanoy City downstream to its confluence with Shenandoah Creek, Mahanoy Creek drains the south slope of Bear Ridge and the north slope of Broad Mountain. The Upper Basin has been severely disrupted by mining, with the Mahanoy Creek throughout the subwatershed seriously polluted by mine drainage.

The Shenandoah Basin (11.6 sq mi), includes the entire area drained by Shenandoah Creek. Before stripping operations began, Shenandoah Creek originated from unpolluted springs and surface runoff from the south slope of Locust Mountain. Presently this water is directly entering mine pools via strip pits and cropfalls, Both Kehley Run and Lost

Creek are clean streams that at one time drained into Shenandoah Creek but are now being intercepted by stripped areas and directed to mine pools. Shenandoah Creek now originates from sewage from the city of Shenandoah and the intermittent pumping of water from the mine pools in the area. Shenandoah Creek drains portions of the south slope of Locust Mountain from north of Shenandoah to the eastern end of Girardville, and the north slope of Bear Ridge. The Shenandoah Basin has been severely disrupted by mining resulting in the Shenandoah Creek being polluted throughout its entire length by acid mine drainage.

The Ashland Basin (17.7 sq mi) contains the area drained by Mahanoy Creek, from its confluence with Shenandoah Creek downstream to and including its confluence with Big Run. (This drainage basin does not include the area south of Ashland Mountain that is drained by Little Mahanoy Creek and Rattling Run.) This portion of the creek drains the south side of Locust Mountain from the eastern end of Girardville westward to an area just 4 miles past Ashland, and the north slope of Ashland Mountain. Two streams enter Mahanoy Creek in this basin. Big Mine Run originates from a drainage tunnel beneath Locust Mountain, one mile northeast of Ashland. Water flows southeast from the tunnel and enters Mahanoy Creek. The other stream, Big Run has its origin in strip pits 2 miles west of Ashland, and enters Mahanoy Creek 3/4 mile south of Lavelle. Both Big Run, and Big Mine Run are polluted throughout their length by mine drainage. The drainage basin has been heavily strip mined, leaving behind huge strip pits particularly in the Centralia Coal Basin, located east and southeast of Centralia. Throughout the Ashland Basin, Mahanoy Creek is severely polluted by mine drainage.

The Little Mahanoy Basin (11.6 sq mi) drains the south slope of Ashland Mountain from Frackville to Mahanoy Creek, and the north slope of Broad Mountain from Frackville to the western boundary of the Rattling Run drainage area. Little Mahanoy Creek originates in the area of Frackville and flows through the valley between Ashland and Broad Mountains. The valley is no more than a ravine just west of Frackville, but broadens out to almost two miles in width at Mahanoy Creek. Rattling Run, which is fed by springs on Broad Mountain, enters Little Mahanoy Creek in Gordon, just before the confluence of Little Mahanoy and Mahanoy Creeks. No mining has been done in this basin and both Little Mahanoy Creek and Rattling Run are unpolluted.

The Middle Basin (38.7 sq mi) drains the area between Mahanoy Mountain from Lavelle west to Hunter, and Line Mountain from Gordon west to the confluence of Mahanoy Creek and Zerbe Run at Hunter. Numerous spring fed intermittent creeks enter Mahanoy Creek along this length of stream. The valley floor varies from a width of one mile at points to just the width of the stream, Although no significant deep or surface mining has been done in this basin, the region has not escaped some of the harmful effects of mining. At numerous locations along the creek large silt deposits have accumulated from the mine wastes that are being continually transported downstream. Also, two

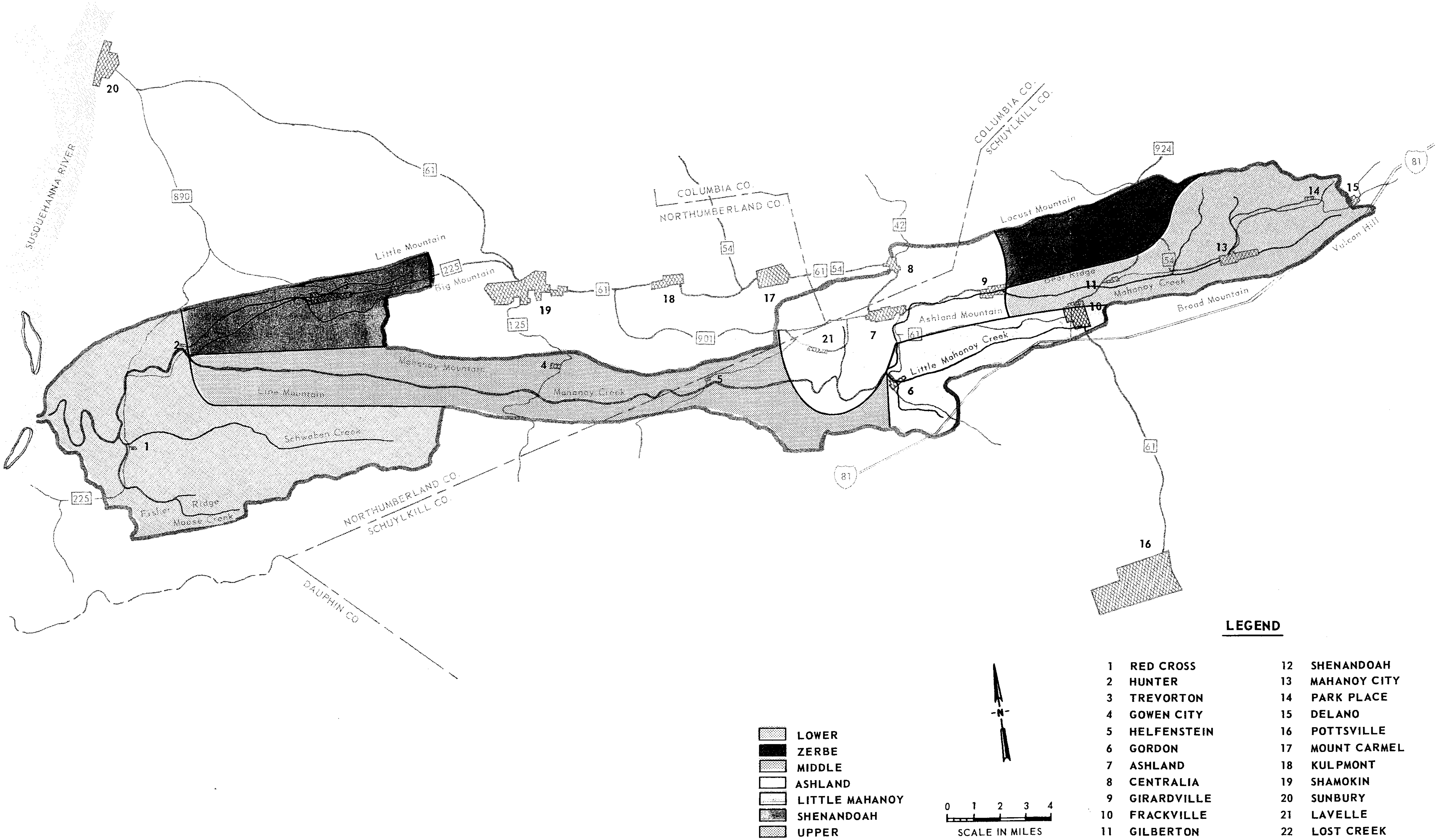


Figure 2. Subwatersheds in the Mahanoy Creek Watershed

drainage tunnels, whose flows originate from a neighboring watershed, contribute mine water to Mahanoy Creek. Throughout the Middle Basin, Mahanoy Creek is seriously polluted by mine drainage.

The Zerbe Basin (13.0 sq mi) encompasses the entire Zerbe Run watershed. Zerbe Run which originates from unpolluted springs east of Trevorton in the valley between Big and Little Mountains, flows through the entire length of the valley before entering Mahanoy Creek near the village of Hunter. South of Trevorton a large mine discharge flowing through a gap in Big Mountain drains an elevated basin between Big and Mahanoy Mountains. Mining in the elevated basin has resulted in one of the most severely disrupted subwatersheds in the study area. A large mine discharge draining the mine pools in the area enters Zerbe Run at the western end of Trevorton. From Trevorton downstream to its confluence with Mahanoy Creek, Zerbe Run is seriously polluted by mine drainage.

The Lower Basin (42.7 sq mi) consists of the area drained by Mahanoy Creek downstream from its confluence with Zerbe Run. Mouse Creek and Schwaben Creek (clean streams) combine to contribute a significant volume of water to Mahanoy Creek in this basin. Schwaben Creek's headwaters are on the south side of Line Mountain, four miles east of Gowen City, and drains the area between Line and Hooflander Mountains. Mouse Creek originates in a narrow valley between Hooflander Mountain and Fisher Ridge, and flows west until it breaks through Hooflander Mountain. It then flows north and enters Schwaben Creek, which in turn enters Mahanoy Creek northwest of Red Cross. Except for that portion of Mahanoy Creek which remains polluted by mine drainage, all streams in the basin are unpolluted and sustain a wide variety of aquatic life. The Lower Basin is dominated by hilly farm land and numerous intermittent streams.

All of the streams in the watershed follow a relatively direct course. The Mahanoy meanders slightly in a stretch around Gordon and Lavelle, and again just before it enters the Susquehanna River. For purposes of classification, the watershed drainage patterns identified in the field range from trellis and dentretic to an angular pattern.

MINING HISTORY

As far back as 1755, anthracite was being used to a limited extent as a fuel in homes, but it was not until the period from 1825 to 1835 that anthracite mining became an economically important industry. By 1828, railroad construction began and quickly spread throughout the geographic region. By the time the rail line to Philadelphia was completed in 1842, the anthracite industry became one of the giant economic industries in the United States, with most of the major coal companies being formed between 1825 and 1875.

Since the discovery of coal in the anthracite region, several methods have been used to remove the coal. One such method is the use of deep mines. There are three types of deep mines found in the region; drift, slope and shaft. A drift mine extends directly into a coal bed at an outcrop and follows the bed upward, usually at a slight angle to facilitate drainage. A slope mine extends downward at an angle of 45° or more to a fixed landing. The shaft mine uses a vertical entry to reach a desired point below the surface, where gangways would be driven into the coal beds. Where possible tunnels were driven into coal beds from the base of mountains to drain mine workings and to move men and materials.

Deep mines were located throughout the coal bearing areas of the watershed, with the heaviest concentrations in the areas south of Trevorton, north and northwest of Ashland, southwest of Girardville and surrounding Mahanoy City. See Figure 3, p. 18 for a complete distribution.

The methods used to remove coal from the deep mines consisted of the room and pillar method, chute methods, and the longwall method. Where the coal beds dipped less than 20°, the room and pillar method was used, when the dip was greater than 20° the chute method was employed. The longwall method was seldom used in this region. In both the room and pillar, and the chute methods, rooms and intervening pillars are removed and supporting timber inserted, this would result in the removal of approximately 50 percent of the coal. Later, a second mining or "robbing" might be done. This involved further removal of the pillars and the insertion of more supporting timbers. This was done until the roof began to sag and crack, or until the roof actually caved in. This resulted in an additional 10 to 20 percent removal of coal. This "robbing" is partially responsible for the barrier breaches and mine subsidence i.e., mine roof collapse, which occur today.

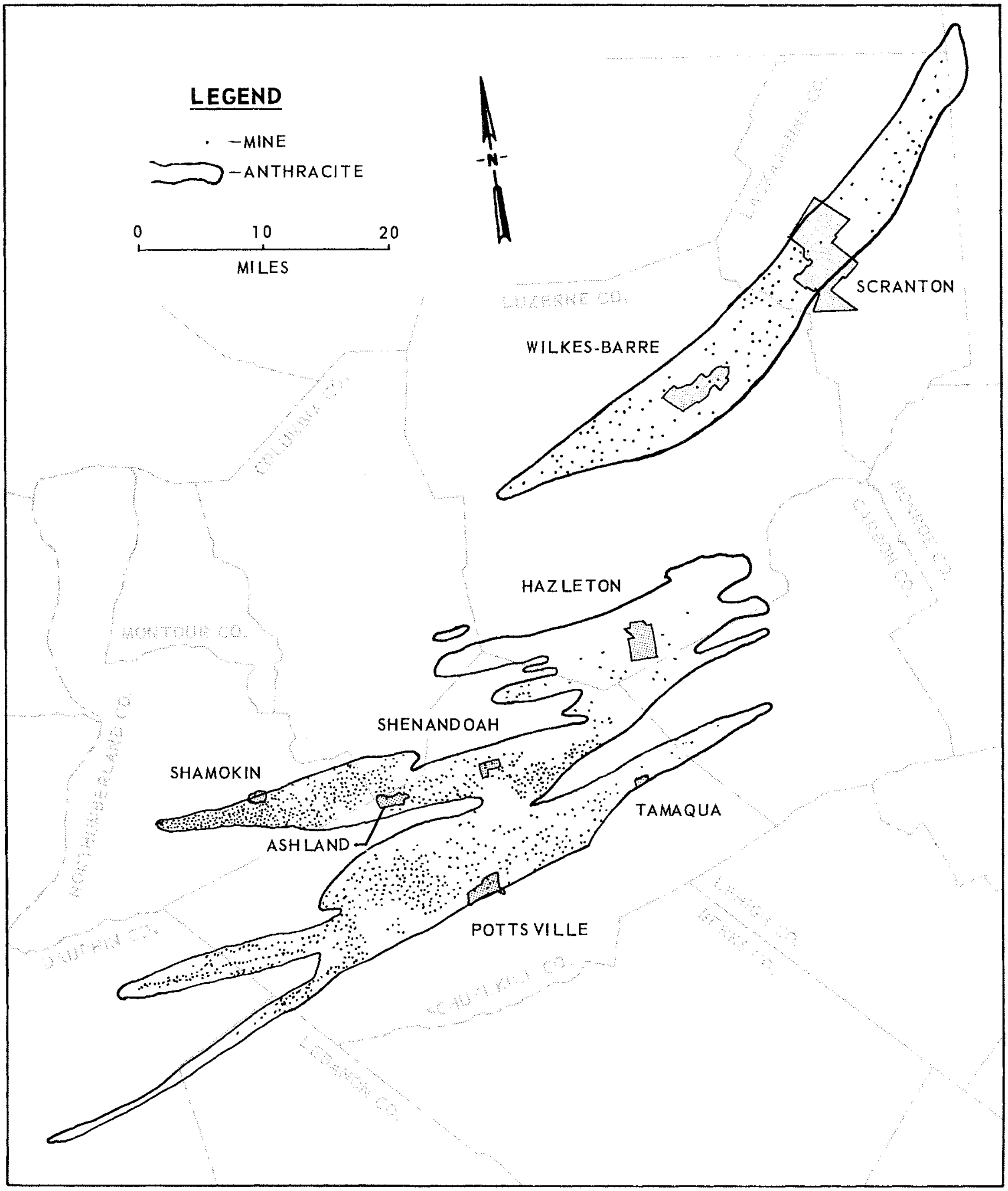


Figure 3. Distribution of deep anthracite mines, 1957
(After Deasy and Griess, 1963)

Many of the abandoned deep mines still contain large amounts of coal, but water seeping into the workings forced them to close. Some of the entrances to the abandoned deep mines are still open. These, along with numerous cropfalls create a substantial safety hazard.

Today, there are fewer deep mines in operation than at any time in the recent past. Active deep mines are now concentrated in the regions, south of Trevorton and west northwest of Ashland.

Approximately 25 percent of the Mahanoy Creek Watershed has either been strip mined or affected by the strip mining process. The strip mining was roughly concentrated in a two mile wide strip of land from Delano to the watershed boundary 4.5 miles west of Ashland, and again in the area between Big and Mahanoy Mountains, south of Trevorton See Figure 4, p. 20 for a complete distribution. The size of the strip pits depends on the amount of overburden that must be removed to expose the coal bed. The ratio of the thickness of the overburden to the thickness of the coal bed due to economic considerations is seldom higher than 25:1. Because some beds in the anthracite region are quite thick and stand almost on edge, the size of the strip pits can be quite large. The regions most devastated by strip mining include the areas south of Trevorton, southeast of Lost Creek north of Girardville, and the area north of Ashland.

In 1963 Pennsylvania passed the Bituminous and Anthracite Open Pit Mining Laws, requiring strip mine operators to restore the land to its original contours. However, the law made no provisions for restoring the thousands of acres of land already strip mined. The strip mining that is done today is centered around the areas north of Mahanoy City and south of Trevorton. Exploratory drilling for coal seams is being carried on in a number of areas.

A secondary source of coal in the anthracite region involves bank mining. In past years, because of the vast amounts of coal available, collieries did not wash and prepare material unless it contained a certain percentage of coal, and the coal was of a high enough grade. Also, only a limited market for fine grain coal existed, and much of it along with the other waste material was deposited on huge waste piles. Many operators when mining a major coal bed such as the Mammouth Vein (at times more than 70 feet thick), would ignore the smaller coal beds, which could often be close to 4 feet thick, above it. The coal from these smaller beds would be placed along with other rock on waste piles. It is now possible to rework these old piles for the coal. This process is called bank mining. Most bank mines are located near the old collieries, with some rich coal deposits under thousands of tons of worthless waste material.

Although a minor source of coal production, dredging techniques have been used

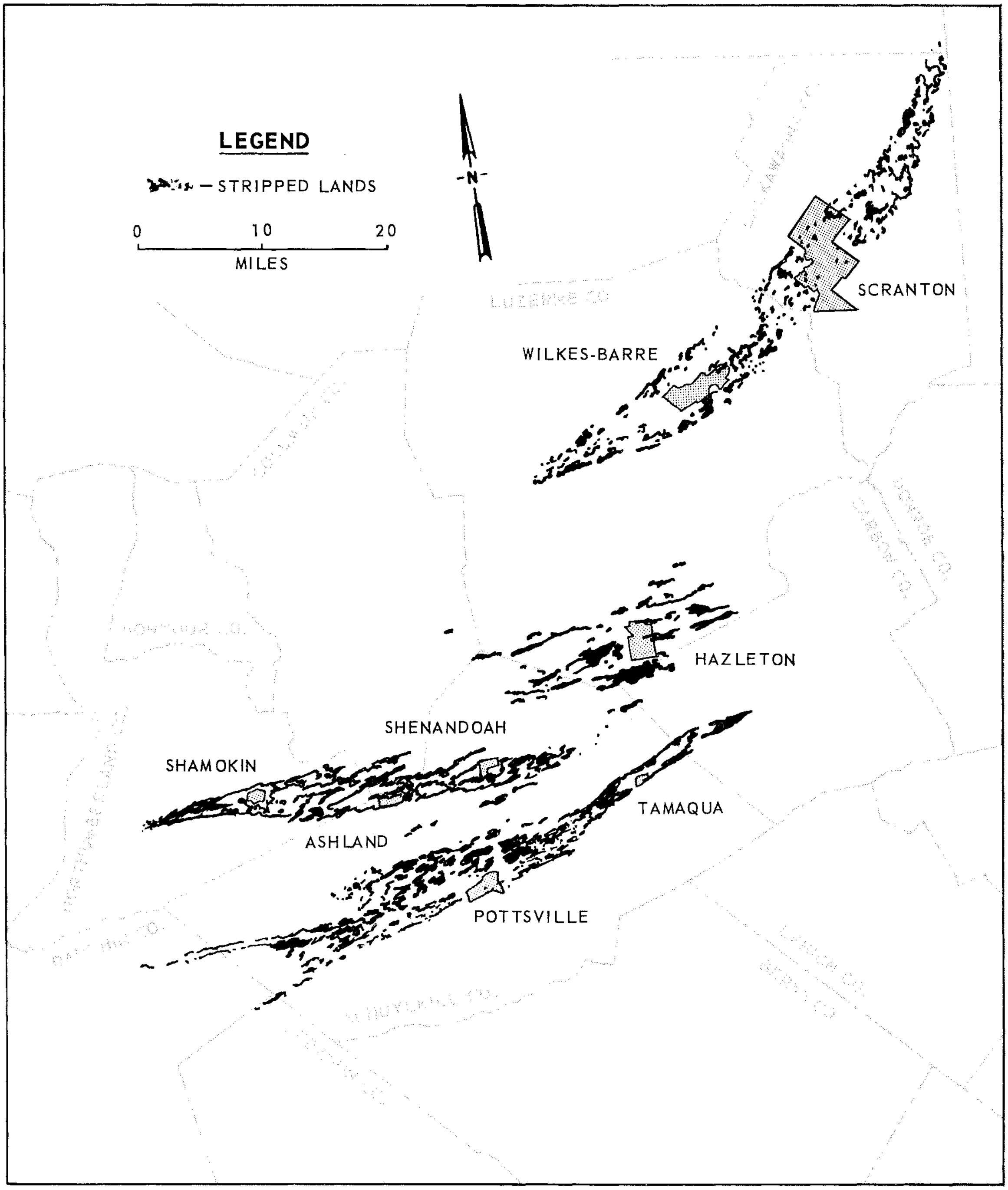


Figure 4. Distribution of areas affected by strip mining, 1960
(After Deasy and Griess, 1963)

in the watershed. The coal in the stream bed having originated from erosion of mining operations and coal preparation plants. In the area south of Trevorton along Mahanoy Creek there are two or three dredging operators removing coal from the silt deposits in the bottom of the creek. In this section of Mahanoy Creek, the water is continually eroding and depositing material, thus assuring a new supply of coal. With the closing down of many mines, coal being eroded into the stream has decreased substantially, resulting in a sharp decrease of production from dredging operations.

The mining and processing of millions of tons of coal has produced vast amounts of waste material in the region. The materials consist of three types of mineral waste: rock (1-5% coal), culm (20-80% coal), and silt (20-80% coal). Size is the major difference between culm and silt with culm materials being much coarser material. Figure 5, p. 22, shows the distribution of this material.

Over the years, huge amounts of silt have been deposited, i.e., on waste piles or discharged directly into the streams. At one time parts of Mahanoy Creek were flowing over 40 feet of deposited silt. During periods of flooding or heavy runoff, large amounts of material are eroded and washed into streams. When the water recedes the silt is deposited along the stream bed itself. Along some streams in the watershed there are portions of botton land where silt deposits have killed vegetation and destroyed farm land. Presently all of Mahanoy and Shenandoan Creeks and Zerbe Run from Trevorton downstream are affected to some extent by silt deposits. The heaviest silt deposits are concentrated along Mahanoy Creek from just below Ashland, downstream past Gordon, and again along the creek in the stretch south of Trevorton, In both of these areas, the silt deposits have killed vegetation. One large silt deposit is located along Zerbe Run 5 miles west of Trevorton.

Some of the larger silt piles in the watershed are located along North Mahanoy Creek near Park Place, and along the southern side of Mahanoy Creek between Mahanoy City and Gilberton. Two miles southeast of Shenandoah located on both sides of the road are several large silt piles. Just east of Centralia are a number of silt piles. A huge silt pile (over a mile long and 500 feet wide) exists along Zerbe Run on the west end of Trevorton. Numerous operations are still depositing silt, including collieries located 2 miles west of Mahanoy City and 5 miles west of Ashland, and also collieries at Shenandoah, Gilberton and Trevorton, (see Plates A and B).

Culm and rock banks are located throughout the coal bearing portion of the watershed, but are concentrated near the abandoned deep mines and collieries. Some of the larger culm and rock banks are located just east of Girardville, 2 miles east-northeast of Gilberton, and east of Centralia.

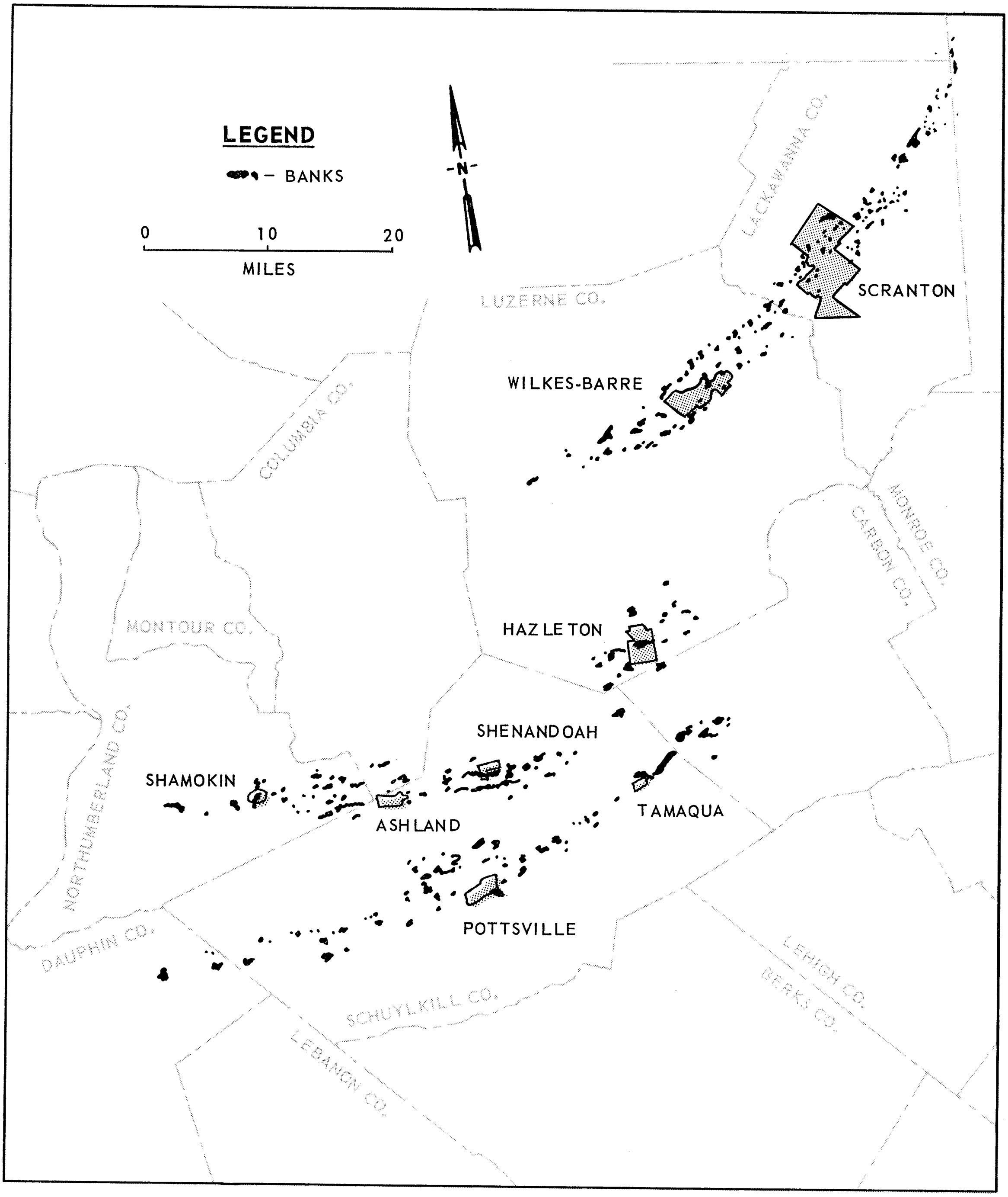


Figure 5. Distribution of culm, silt and rock banks, 1960
(After Deasy and Griess, 1963)

Although coal production today is only a fraction of what it was in the early 1900's there are more active mines now than during those peak years. In earlier times, operators were able to choose the best and most accessible coal veins to mine. This made it possible for a realtively few mines to produce large amounts of coal. Today the "easy" coal has been removed, and active mines are now removing coal from small and less accessible beds. The average mine today employs fewer people and produces much less coal than a mine did in the past.

In the anthracite region, the number of large deep mines (650), small deep mines (1150), and strip mines (230), all reached their maximum numbers around 1954 and 1955. A small deep mine is one that employs less than five people. A large deep mine has five or more employees. The number of bank mines (140), peaked in 1945. In 1960 there were 100 bank mines, 160 strip mines, 360 large deep mines, and 790 small deep mines in the anthracite region (see Figure 6, p. 24).

The production of coal in the anthracite region peaked at about 100 million net tons in 1917. During this period, the Western Middle Field also reached its peak production of 18.5 million tons. More than 90 percent of the coal produced in 1917 was mined by deep mining techniques. In 1960 the entire anthracite region produced about 18.0 million tons, of this 5.0 million was from the western middle field. At this time deep mining accounted for less than 50 percent of the coal produced. Of the total, 7,575,567 tons was from deep mining, 7,138,743 from strip mining and 3,006,803 from bank mining. Anthracite production data are given in Figure 7, p. 25.

By 1970 strip mining was the primary method of coal extraction, producing over 2-1/2 times as much coal as deep mines. Culm banks production also surpassed coal production from deep mines (see Table).

TABLE 1
PENNSYLVANIA ANTHRACITE PRODUCED IN 1970
(THOUSAND SHORT TONS)*

SOURCE (COAL FIELDS)	UNDERGROUND MINES	STRIP MINES	CULM BANKS	FROM RIVER DREDGING
Eastern Middle	19	857	635	-
Western Middle	307	1,088	1,145	W
Southern	860	1,591	733	W
Northern	556	1,006	524	-
Total	1,742	4,542	3,037	409

W = Withheld to avoid disclosure of Company Data.

* Data from Minerals Yearbook, 1970

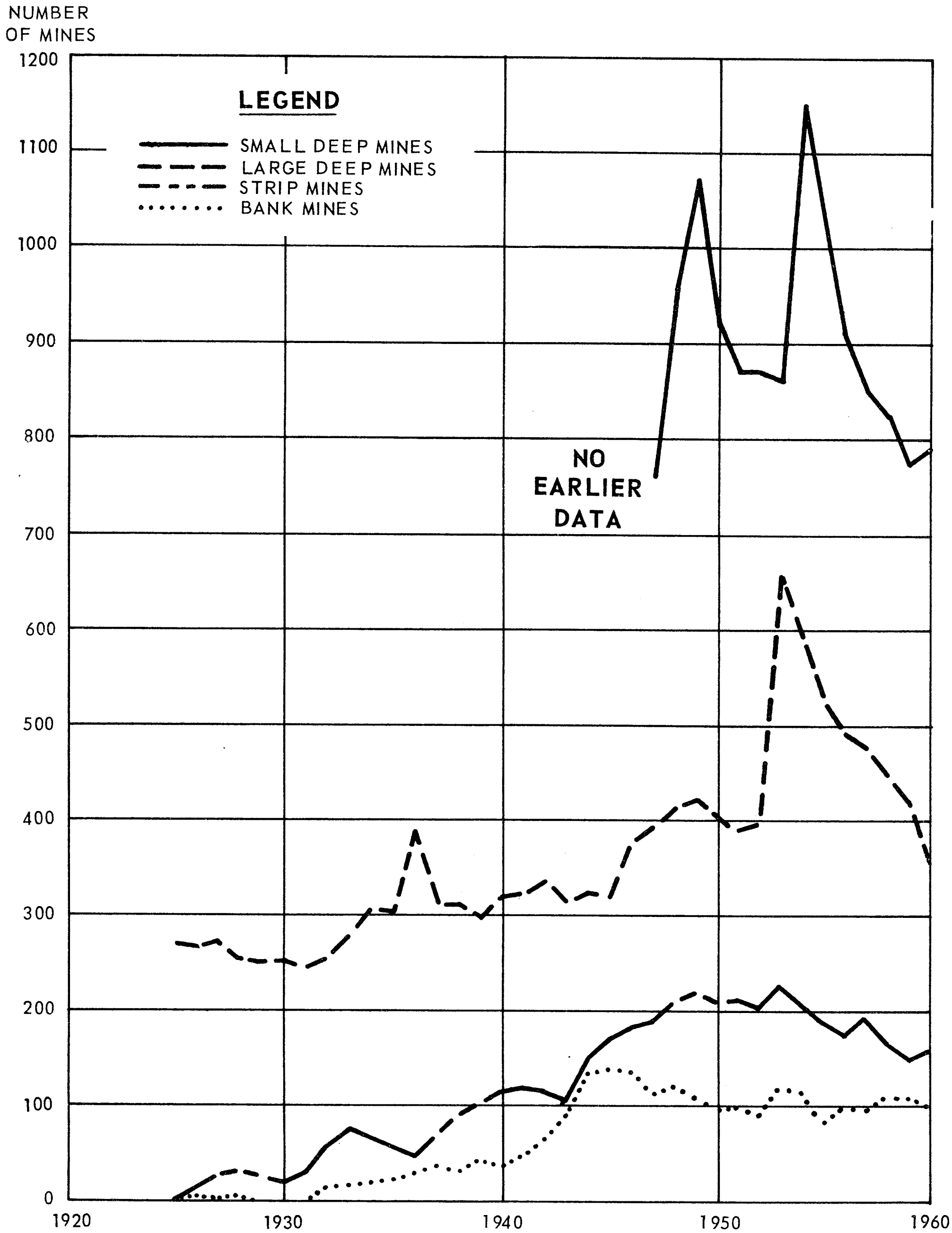


Figure 6. Number of anthracite mines by types, 1925-1960
(After Deasy and Griess, 1963)

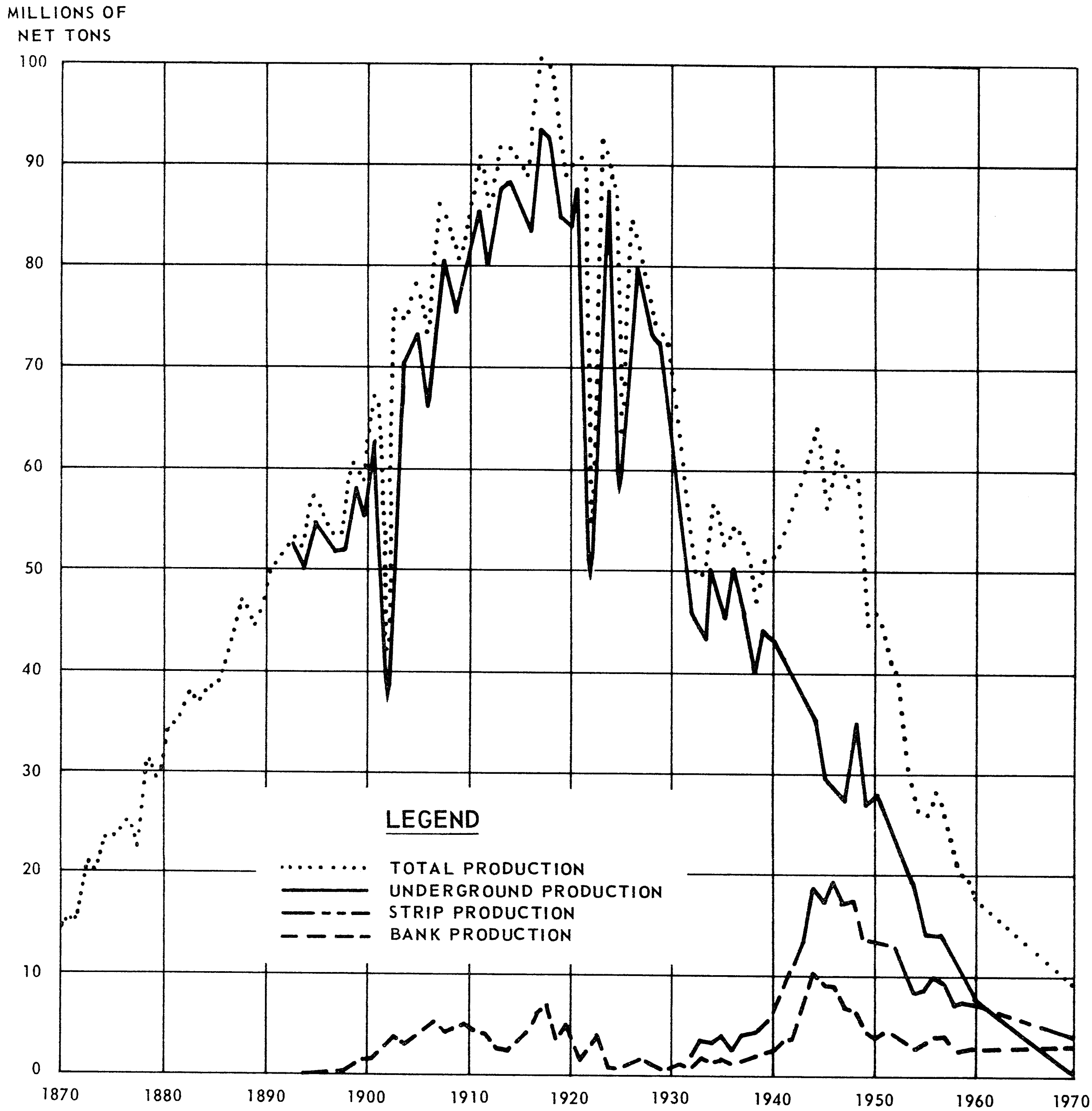


Figure 7. Anthracite production, 1870-1970
(After Deasy and Griess, 1963)

Although on a much smaller scale than the past, there are still several active mines in the Mahanoy Creek Watershed. The remaining active mines in the watershed are listed by category in Tables 2A and 2B.

TABLE 2A

ACTIVE STRIP MINE PERMITS

DISTRICT NO.	PERMIT NO.	PERMITEE NAME	LOCATION	TOWNSHIP	COUNTY
3	16-1	Lehigh Valley Anthracite	76° 9' 20'' (Long.) 40° 47' 50'' (Lat.)	Mahanoy	Schuylkill
3	16-12	Lehigh Valley Anthracite	76° 20' 99'' 40° 47' 50''	Conyngham	Columbia
3	16-14	Lehigh Valley Anthracite	76° 7' 30'' 40° 49' 20''	Mahanoy	Schuylkill
3	16-17	Lehigh Valley Anthracite	76° 17' 40'' 40° 48' 00''	W. Mahanoy & Butler	Schuylkill
3	16-18	Lehigh Valley Anthracite	76° 9' 40'' 40° 49' 20''	Mahanoy	Schuylkill
3	16-24	Lehigh Valley Anthracite	76° 17' 10'' 40° 48' 10''	Mahanoy & Union	Schuylkill
3	23-8	Reading Anthracite Co	76° 11' 10'' 40° 49' 20''	Mahanoy	Schuylkill
3	23-9	Reading Anthracite Co.	76° 11' 10'' 40° 49' 20''	Mahanoy	Schuylkill
3	23-12	Reading Anthracite Co.	76° 40' 20'' 40° 45' 50''	Zerbe	Northumberland
3	23-19	Reading Anthracite Co.	76° 40' 30'' 40° 46' 20''	Zerbe	Northumberland
3	47-37	Rosini Coal Co.	76° 38' 50'' 40° 46' 10''	Zerbe	Northumberland

TABLE 2A (Cont'd)

ACTIVE STRIP MINE PERMITS

DISTRICT NO.	PERMIT NO.	PERMITEE NAME	LOCATION	TOWNSHIP	COUNTY
3	47-45	Rosini Coal Co.	76° 38' 50'' 40° 46' 10''	Zerbe	Northumberland
3	47-46	Rosini Coal Co.	76° 38' 10'' 40° 46' 10''	Zerbe	Northumberland
3	47-46	Rosini Coal Co.	76° 38' 10'' 40° 46' 10''	Zerbe	Northumberland
3	86-8	Brook Contracting Co.	76° 13' 40'' 40° 49' 00''	W. Mahanoy	Schuylkill
3	172-1	H.S. & H. Coal Co.	76° 38' 50'' 40° 46' 20''	Zerbe	Northumberland

TABLE 2B

UNDERGROUND DEEP MINES PERMITS

COMPANY	TOWNSHIP	COUNTY
MINING DISTRICT #6		
Polcovich Coal Co.	Conynsham	Columbia
Fireside Mining Inc.	Butler	Schuylkill
White Coal Co.	Conynsham	Schuylkill
MINING DISTRICT #7		
Zanella Brothers Coal Co.	Conynsham	Columbia
Metzinger Co.	Conynsham	Columbia
Locustdale Mining Co.	Conynsham	Columbia
Pewor Coal Co.	Conynsham	Columbia
Zakrowski Coal Co.	Conynsham	Columbia
MINING DISTRICT #8		
Norwood Mining Co.	West Cameron	Northumberland
Split Vein Coal Co.	Zerbe	Northumberland
D & J (s) Coal Co.	West Cameron	Northumberland
Twin Oaks Coal Co.	Zerbe	Northumberland
T & L Coal Co.	Zerbe	Northumberland
4-D Coal Co.	Zerbe	Northumberland

GEOLOGY

The Mahanoy Creek Watershed drains most of the Western Middle Anthracite Field. The coal field is one of four structural basins in northeastern Pennsylvania which contain anthracite. The coal field is also one of the larger structural basins approximately 36 miles long and up to 5 miles wide.

STRATIGRAPHY

The sedimentary rocks exposed in the watershed are of Devonian, Mississippian, and Pennsylvanian age. Quaternary deposits of unconsolidated material are also found in the watershed.

The Devonian age rocks are found only in the extreme western end of the watershed, just south of the Western Middle Anthracite Field (see Figure 8, p. 31).

Devonian System

The Devonian rocks in the watershed consist of the Hamilton Group and Onondoga Formation (DHo), Marine Beds (Dm), and the Catskill Formation (DcK). The Hamilton Group and Onondoga Formations, the oldest of the Devonian rocks, range from brown shales and sandstones at the top to black, fissile shales and dark blue to black limestones at the bottom. The Marine Beds (Dm) are light gray to olive sandstones, silt stones, and gray wackes with interbeds of gray to brown shales. Although a complex unit of shales, siltstones, sandstones, and conglomerates, the Catskill Formation consists primarily of red to brown shales and sandstones. It outcrops primarily in the lower subwatershed and along the north flank and the valley north of Little Mountain.

Mississippian System

Forming the crest and southern flanks of Little Mountain, the Pocono Group consists chiefly of sandstones and conglomerates. The rock units also contain thin beds of gray to red shales and siltstones. The Pocono Group contains the first occurrences of coal beds although these beds are of geological interest rather than of mining interest. Sandstone units are usually crossbedded. The rocks are highly resistant to weathering, forming high rough ridges and crests of mountains with steep, natural slopes. It is located in the extreme western end of the watershed.

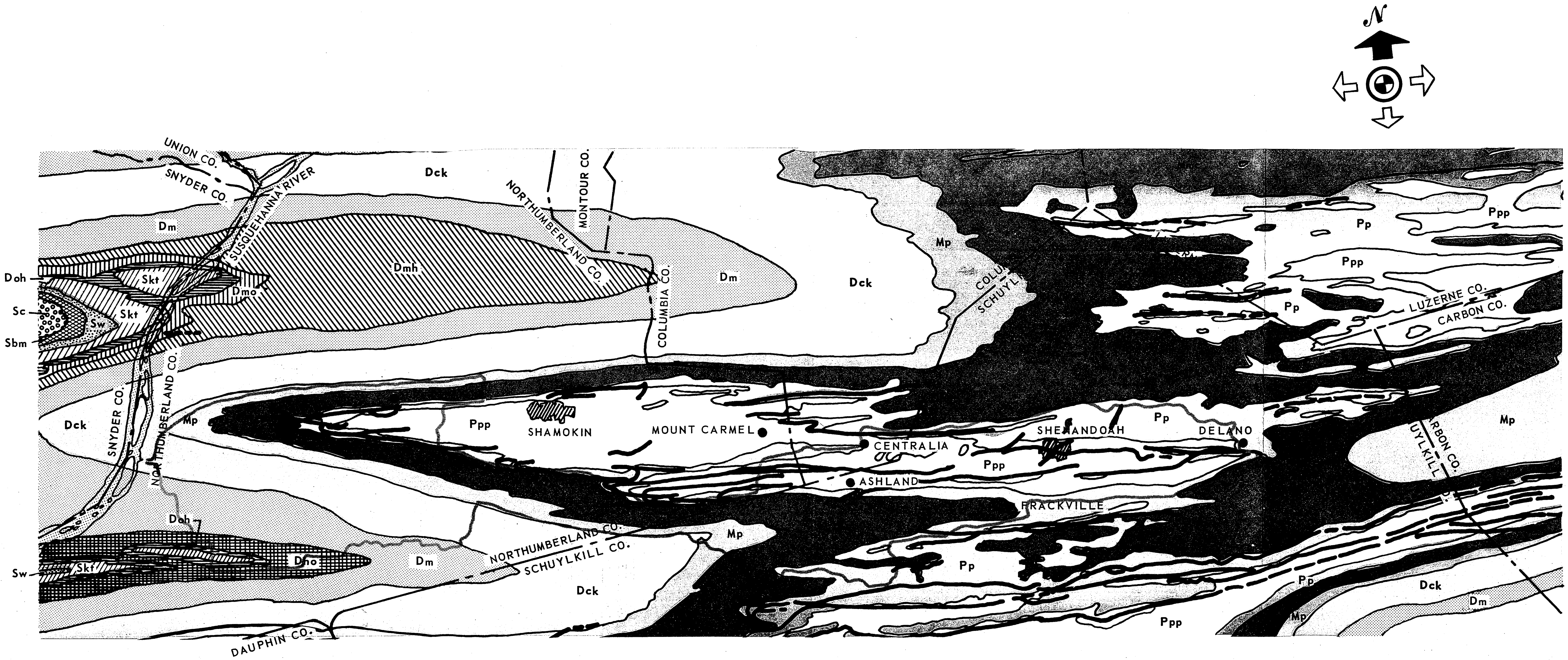
The Mauch Chunk formation outcrops along the north margin of the anthracite field in the valley occupied by Zerbe Run, along the south slope of Mahanoy Mountain, along the north flank of Locust Mountain, and the valley occupied by Messers Run (see Figure 8, p. 31). The dominant rock types are red shales, brown to gray claystones, sandstones and siltstones; other rock types include green siltstones and fine grained sandstones and scattered layers of gray or green conglomerate.

Rocks generally are moderately resistant to weathering, however, shale and claystone outcrops may be severely weathered. The Mauch Chunk Formation is considered the base of the coal field with all mineable coal beds found above this unit. The formation rings the entire coal basin from Hunter to Delano.

The Pennsylvanian System

The oldest of the Pennsylvania rocks is the Pottsville Group which overlies the Mauch Chunk formation. It consists primarily of fine to coarse grained sandstones and conglomerates, with some shales, siltstones and mineable coals. Rock types of the group are predominately light to dark gray in color. Thickness of the Pottsville group ranges from 650 feet near Trevorton to 1,250 feet west of Shenandoah and approximately 900 feet near Delano. Weathering characteristics are variable, reflecting the various rock types. Forming the crests and flanks of ridges as well as the cores of the mountains, the rocks are especially important ridge formers in the coal field. The Pottsville group outcrops on most of the mountains and ridges in the watershed including Big Mountain, Mahanoy Mountain and Locust Mountain. The coal beds of importance in this formation are Lykens Valley No. 2, 2-1/2, Little Buck Mountain (No. 4) and the White (No. 3).

Post-Pottsville (Llewellyn) formations are by far the most extensive rock units found in the Western Middle Anthracite Field. This unit contains numerous mineable coal beds (including all the large beds) and is the predominant rock type in all the coal basins of the region. These rocks conformably overlie the Pottsville group. The contact between the Pottsville group and Post-Pottsville formations is placed at the Buck Mountain (No. 5) coal bed. The three Mammouth coal beds, Skidmore, Seven-foot, Holmes, Primrose, Diamond, and Orchard as well as the Buck Mountain are among the more extensively mined and persistent beds. The formations contain brown gray sandstones and conglomerates, as well as black shales and some claystone. The rocks below the Mammouth Top Split coal bed in the lower section are both coarser and darker in color than the finer grained upper part of the formations. Rocks are generally slightly to moderately weathered, depending on lithology. High contents of iron sulfide are found in the coals and surrounding rock types. For distribution of rock types see Figure 8. The composite stratigraphic section shown in Figure 9, p. 32 indicates the ages of the coals and their relationship with various formations.



PENNSYLVANIAN

Ppp — POST-POTTSVILLE FORMATIONS

Pp — POTTSVILLE GROUP

MISSISSIPPIAN

Mmc — MAUCH CHUNK FORMATION

Mp — POCONO GROUP

DEVONIAN

Dck — CATSKILL FORMATION

Dm — MARINE BEDS

Dho { Dmh — MAHANTANGO; Dmo — MARCELLUS FORMATION, ONONDAGA FORMATION }

Doh — ORISKANY FORMATION, HELDERBERG FORMATION

SILURIAN

Skt — KEYSER FORMATION, TONOLOWAY FORMATION

Sw — WILLS CREEK FORMATION

Sbm — BLOOMSBURG FORMATION, McKENZIE FORMATION

Sc — CLINTON GROUP

Figure 8. Geological map of the Western Middle Anthracite Field (After Pennsylvania Topographic and Geological Surveys, 1960)

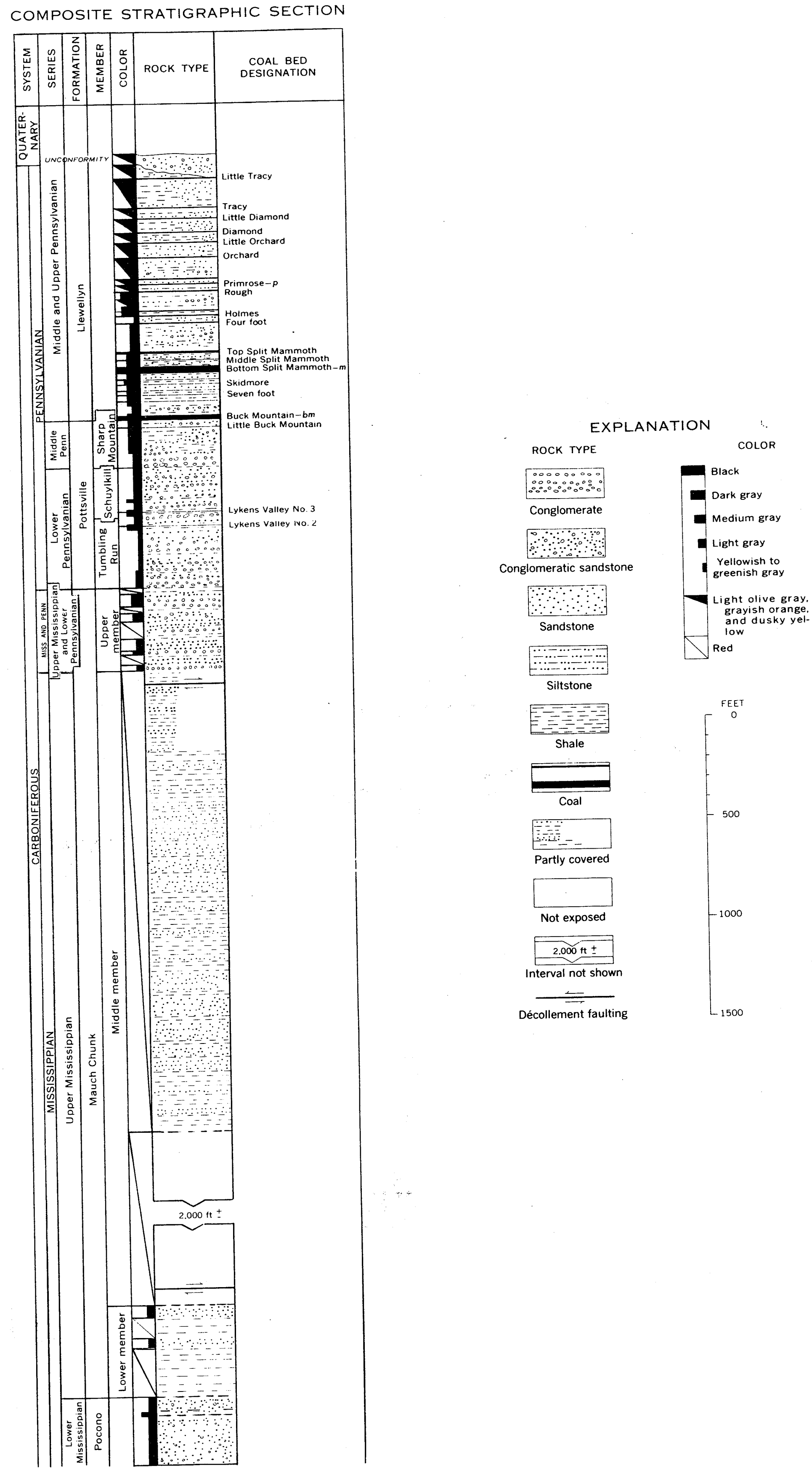


Figure 9. Composite stratigraphic section in the Western Middle Anthracite Field
(After Wood and Arndt, 1969)

Quaternary System

The Quaternary System is represented by deposits of unconsolidated deposits of clay, silt, sand, and fine to coarse gravel which cover bed rock in the valleys of the watershed. This unconsolidated material is either stream deposits, stream transported mine waste (carbonareous silt and fine coal) or talus deposits that occur at the base of steep mountain slopes. The deposits of stream transported coal accumulate locally, becoming economically valuable and are able to support two active dredging operations west of Gowen City.

STRUCTURE

The Western Middle Anthracite Field consists of a plunging synclinorium trending northeastward, with a series of inclinal and synclinal undulations which subdivide the region into smaller coal basins (see Figure 10, p. 34). These minor anticlines and synclines are parallel to subparallel to the trend of the synclinorium. Many of these fields are doubly plunging with some fields broken by thrust faults whose trend is subparallel to the axes of the folds. The trend of the subsidiary folds vary from N75° E to N85° E. Figure 9 indicates the complexity of the folds and the relationship of other structural features such as thrust faults (for location of cross sections see Figure 1, p. 3). Many of the folds are less than 1000 feet wide and only a few are longer than a mile or two along the strike before merging with or overlapping adjacent folds. The axial planes of the folds located in the central part of the coal field are close to vertical while folds near the northern and southern boundaries of the coal field are steeply inclined to the north or south with some cases of vertical axial planes.

While folds in the Post-Pottsville rocks tend to be tight and asymmetrical, anticlines in the structurally more competent Pottsville group generally consist of broad or open arches. Cross sections in Figure 10 indicate that some folds change in shape with depth.

The principal faults in the watershed are thrust faults which generally are parallel to the axes of the folds. They are known as longitudinal faults. This close association between the faults and folds as well as the type of fault suggests that these features are the result of compressional forces. Examples of these faults include the Centralia Fault, Lost Creek Fault, Shenandoah Fault, and the Suffolk Fault. In most cases, the faults are of sufficient magnitude to establish limits for mining and are usually used as underground mine boundaries by the mine companies.

Fault features which adversely affect mining include 1) faults with displacements greater than the thickness of the coal bed, sometimes called rock faults; 2) pinches,

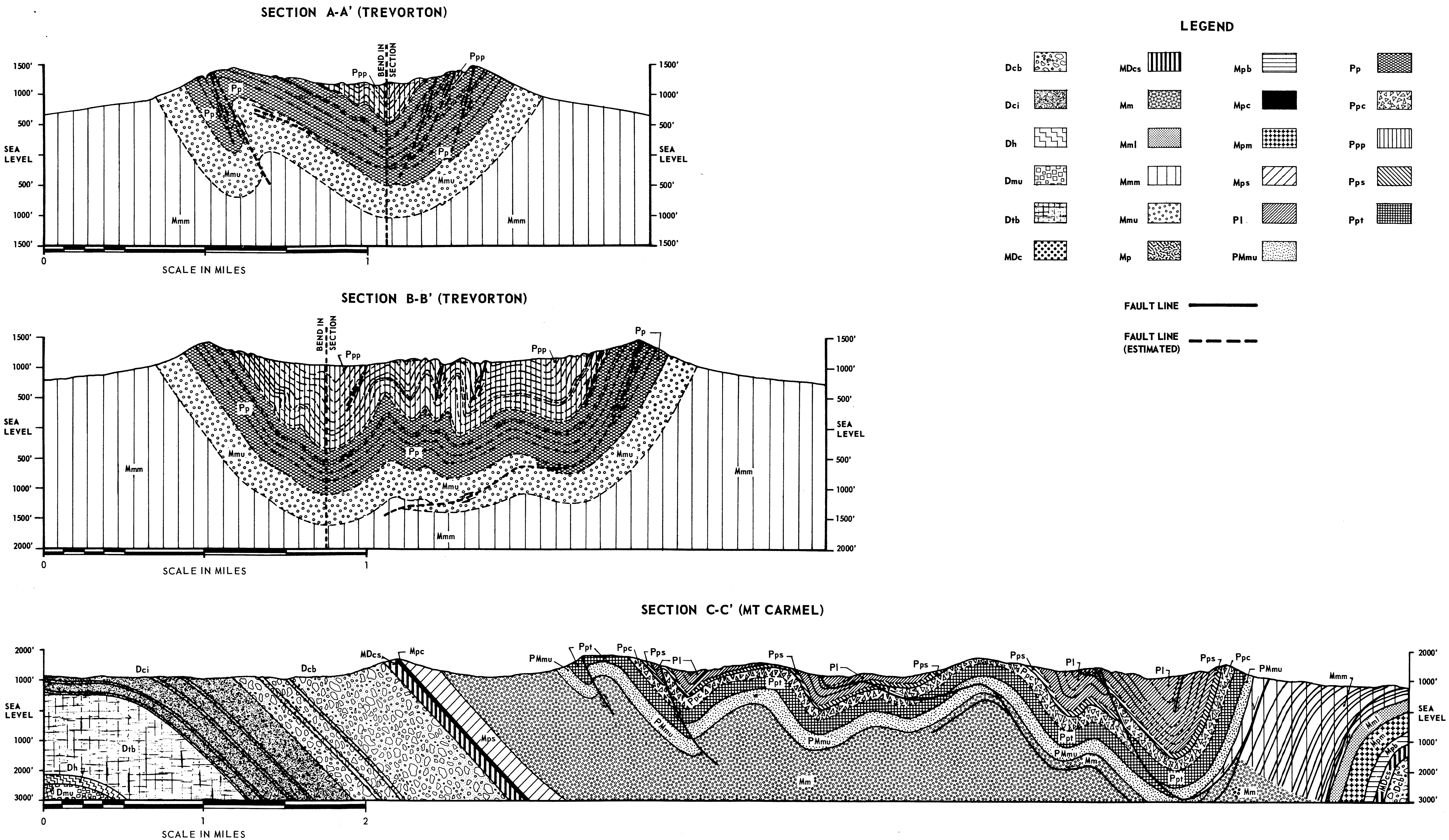


Figure 10. Geologic cross sections in the Western Middle Anthracite Field (sheet 1)
(After Arndt, 1971a, 1971b; Arndt et al, 1963; Maxwell and Rothrock, 1955; Wood and Arndt, 1969)

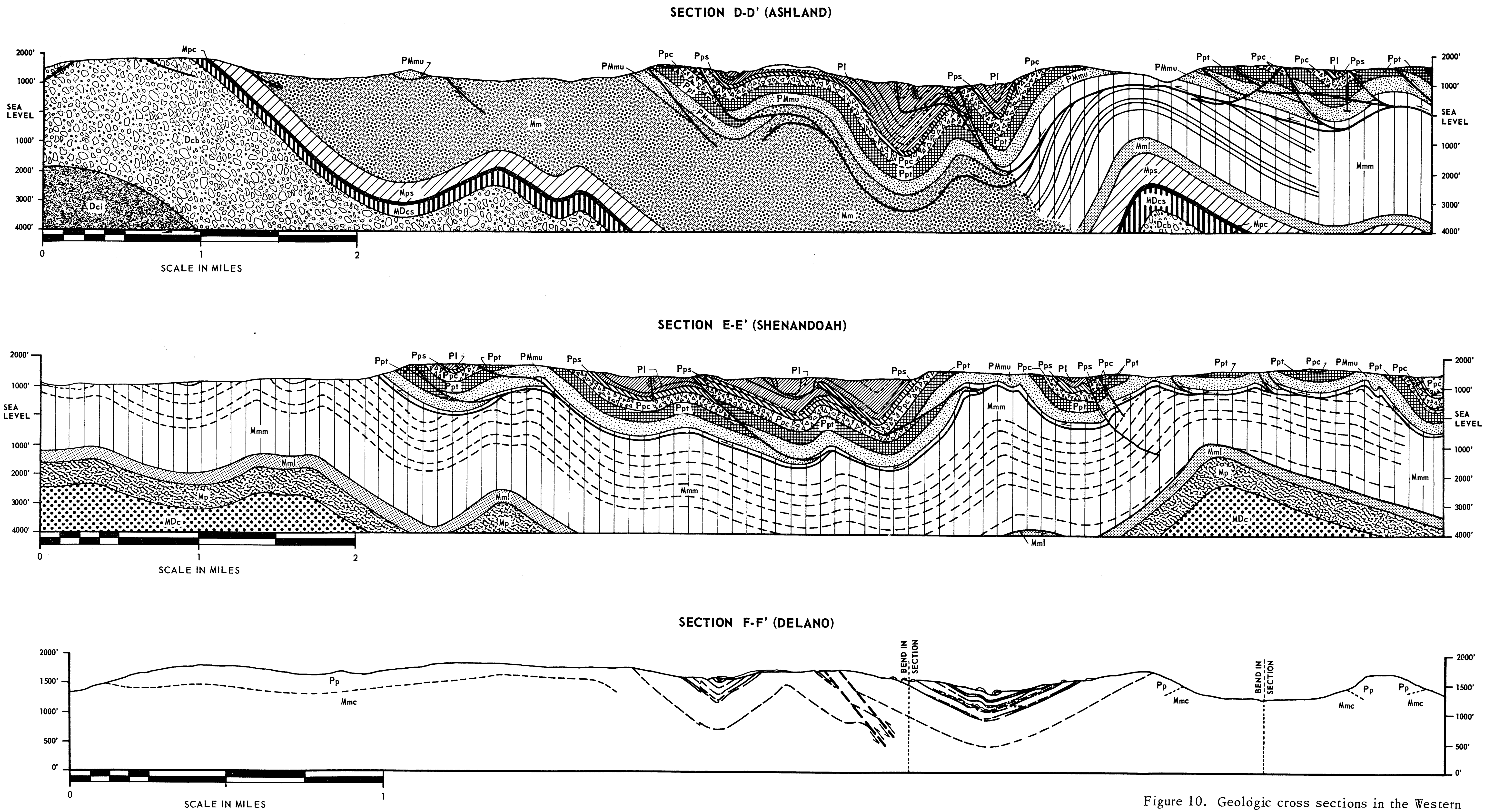


Figure 10. Geologic cross sections in the Western Middle Anthracite Field (sheet 2)
(After Arndt, 1971a, 1971b, Arndt et al, 1963; Maxwell and Rothrock, 1955; Wood and Arndt, 1969)

where the coal has been squeezed from between roof and floor rocks; 3) small folds that have thinned or thickened the coal called rolls; and 4) shear zones, areas in which the coal is so fractured that it cannot be mined profitably.

COAL

Anthracite, characterized by its hardness, lustrous black color, and conchoidal fracture, is a relatively high quality, low-sulfur coal. Variations, locally and regionally, occur in the rank and grade of the coal throughout the Western Middle Anthracite Field and other anthracite fields.

Variation in sulfur content is shown in Figure 11, p.37. The eastern half of the Western Middle coal field is below average to average in sulfur content (.55-.75%) with sulfur progressively increasing from the eastern to the western part of the field. Sulfur is primarily contained in pyrite, with lesser amounts in ferrous sulfate, elemental sulfur and other sulfur compounds.

The greatest variation is found in the progressive increase in the percentage of volatile matter from the eastern (less than 4%) to the western part (more than 11%) of the Western Middle Field. A result of the complex geological features found in the field is a confusing nomenclature used to designate particular coal beds.

Figure 12, p.38 shows the important coal beds which have been or are being mined in the coal field. Relative ages of the coals and the stratigraphic location as well as the average internal or rocks between each coal bed are also given. Shown in Figure 13, p. 39 is the correlation of two important coal beds mined in the Mahanoy Creek Watershed, the lower bed being the Buck Mountain and the upper bed the Mammouth Bed (Bottom Split). From these columnar sections an idea of which coal beds were important in a locality and regional variations in rock types, as well as thickness of sequences, between the two coal beds can be seen. In the eastern region more coal beds appear concentrated together so that fewer mines could produce larger amounts of coal. This may account for the larger number of mines and mine openings in the western section of the coal field (see Figure 4, p. 20) and indicate amounts of waste material generated.

As of January 1, 1970, Recoverable Reserves of anthracite (beds over 24 inches thick) consisted of eight (8) billion short tons with in-place reserves listed as 16 billion short tons (see Table 3, p. 40).

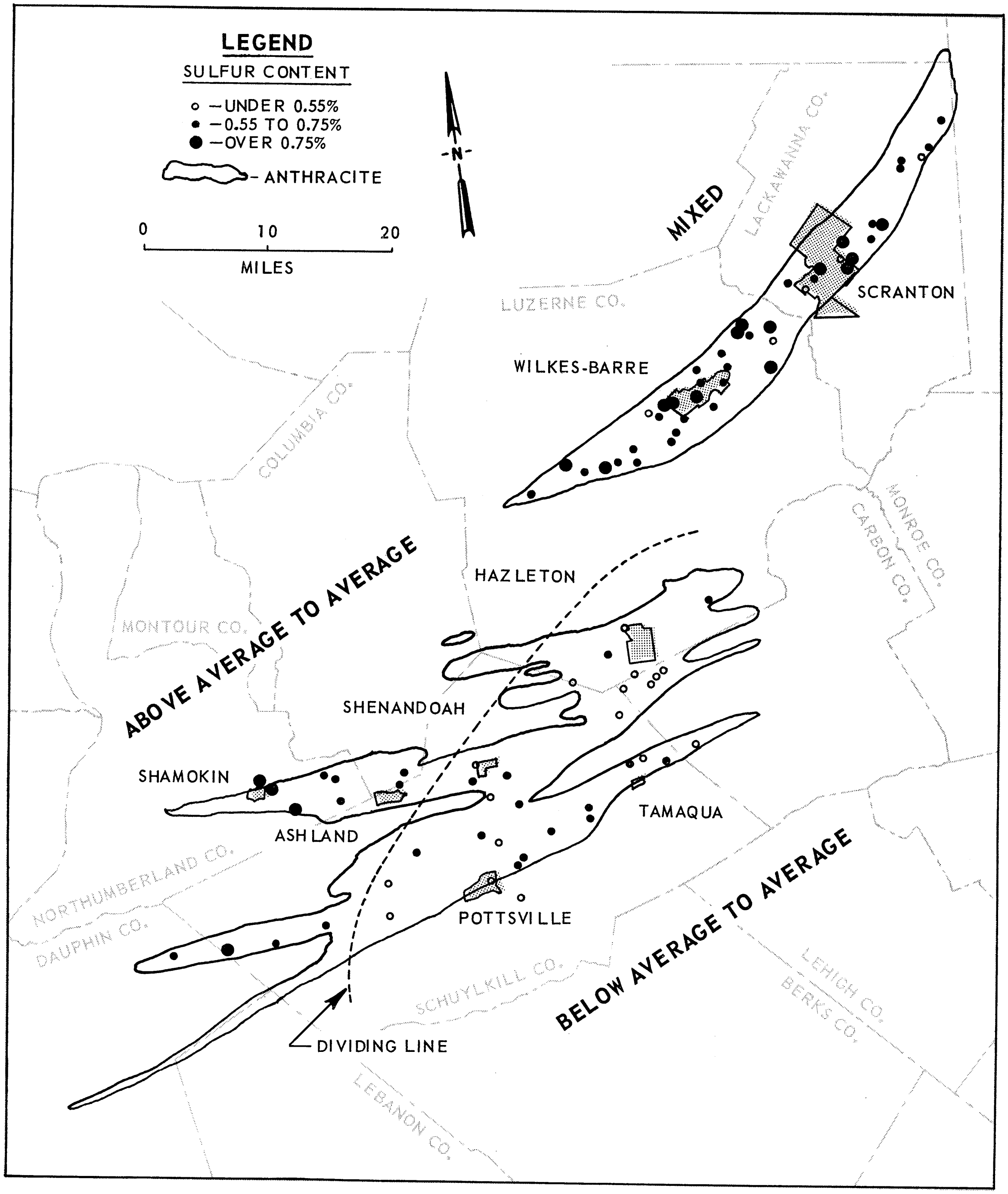


Figure 11. Variation of sulfur in anthracite

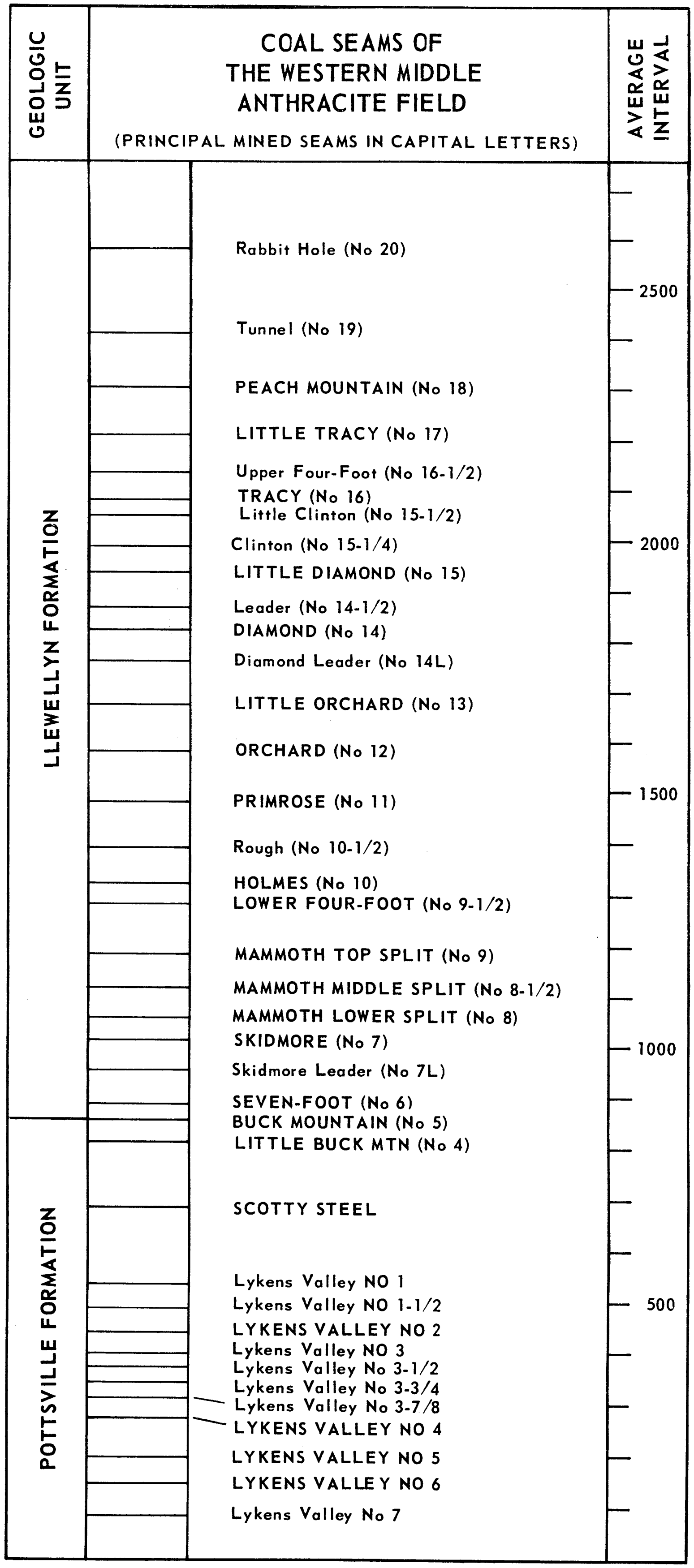


Figure 12. Major coal beds mined in the Mahanoy Creek Watershed
(After Edmunds, 1972)

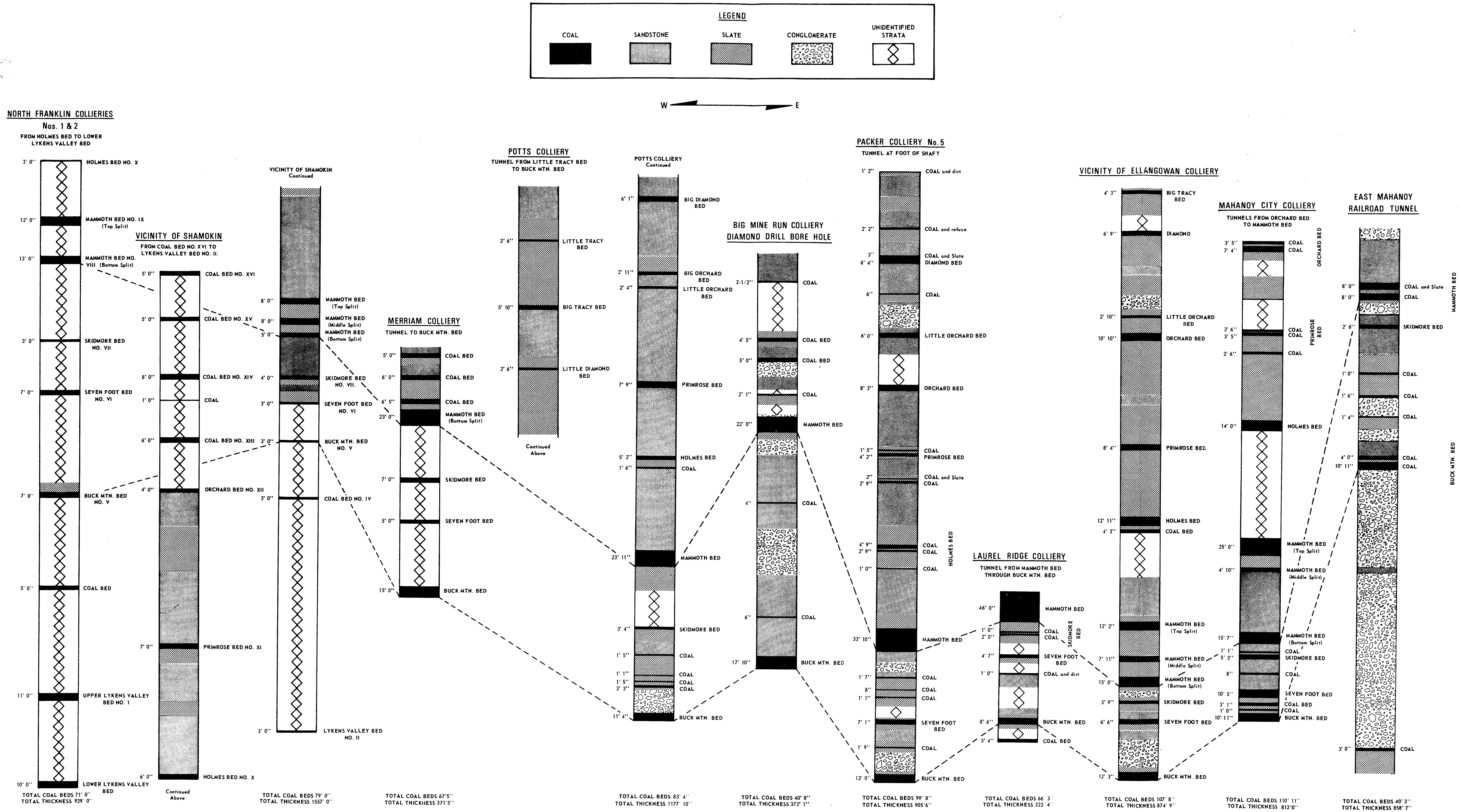


Figure 13. Correlation of the Mammoth and Buck Mountain Coal Beds
(After Pennsylvania Geological Survey, 1887)

TABLE 3

RECOVERABLE ANTHRACITE RESERVES BY COUNTY
(As of January 1, 1970)

COUNTY	SHORT TONS
Carbon	149,626,563
Columbia*	236,114,235
Dauphin	347,013,456
Lackawanna	170,127,429
Lebanon	468,678,971
Luzerne	816,456,269
Northumberland*	940,234,986
Schuylkill*	4,890,300,922
Susquehanna	2,292,609
Wayne	2,959,349
Total	8,023,805,789

* Counties included in Mahanoy Creek Watershed. (after Edmunds, 1972)

GEOCHEMISTRY

GENERAL CONCLUSIONS

As part of the watershed study, a geochemical survey was conducted to determine the condition of the streams, with respect to coal mine drainage. The geochemical characteristics of coal mine drainage as well as the chemical reactions taking place between mine discharges and receiving streams were investigated with applications of the geochemistry to abatement procedures. Analysis performed on water samples included pH, acidity, alkalinity, Ca, Mg, Na, K, Al, Ni, Si, Total Fe, Fe^{2+}, and $S0_4^{2-}$.

Water pollution caused by coal mine drainage has destroyed or severely affected large parts of Pennsylvania. Over 3,000 miles of streams and 302,400 acres of wildlife habitat have been adversely affected by strip and surface mining as a result of coal production in the Commonwealth (5). In the Mahanoy Creek watershed alone over 84 MGD of mine drainage enters the streams resulting in deterioration of water quality throughout the watershed.

BRIEF REVIEW OF COAL MINE DRAINAGE

The general nature of acid mine drainage, although complex, has been well reported to date (6) (8) (9). During mining, ground-water movement as well as aquifers are disrupted, bringing subsurface waters in contact with pyritic materials in the coal and in the associated rock strata. In many cases the flow directions are so drastically changed that the mine workings are inundated forming underground mine pools and causing water to drain through numerous mine openings. By exposing the sulfuritic materials, primarily pyrite and marcasite, to air and moisture, oxidation of these minerals occurs, resulting in products such as ferric hydroxide, ferrous sulfate and sulfuric acid. The ferric hydroxide and ferrous sulfate are commonly referred to as yellow boy.

The result of these oxidation reactions is a complex water system containing ferric and ferrous iron, aluminum and iron oxyhydroxides, various sulfur complexes including sulfate ions and other soluble salts. Precipitation of iron hydroxides will also remove other cations such as Ni by adsorption processes and coprecipitation. Changing equilibrium conditions as well as oxidation of iron sulfides by bacteria are other significant factors in the production of coal mine drainage.

SUMMARY OF GEOCHEMICAL CONCLUSIONS

The result of the geochemical study of the Mahanoy Creek watershed is summarized as follows:

1. The analysis of the mine discharges in the watershed indicates that the chemical composition of the drainage from any given coal mine has been found to be characteristic of that particular mine.

2. There is a tendency for concentrations of pollutants within the study area, especially sulfate and pH in mine waters, to increase as the season changes from high to low flow periods.

3. There are two distinct types of mine drainage occurring in the watershed, alkaline - pH >6.1 with net alkalinity and acidic discharges - pH< 4.5 with net acidity.

4. Acidic discharges are characterized by lower total Fe, Na, SO4, K, Mn, Mg, Ca, and higher Al concentrations.

5. Ni and Si content did not show any significant differences between the two types of mine discharges.

6. Silicate minerals may be breaking down aiding, in some cases, in the neutralization of acid mine waters.

7. Silt and culm banks become important contributors to acid mine drainage on a local basis.

8. The Little Mahanoy Creek Subwatershed is the only basin not affected in coal mine drainage.

9. Mouse and Schwaben Creeks in the polluted Lower Subwatershed are not affected by coal mine drainage.

10. North Mahanoy Creek, the entire length of Mahanoy Creek, Shenandoah Creek, Big Run, and Zerbe Run all are polluted by coal mine drainage. Streams severely polluted by mine waters include: Zerbe Run, Shenandoah Creek, Big Run, and the Eastern section of Mahanoy Creek (from the head waters east of Mahanoy City westward to Gordon, PA).

CHEMICAL ENVIRONMENT

The formation of coal mine drainage is dependent on several factors. Of primary concern is the amount and availability of the reactants. The amount of iron sulfides present as well as the form of the sulfide minerals is also of importance. It is generally assumed that as the amount of iron sulfides increases acidity increases. However, this is not always the case. In fact, the particle size of the iron sulfides has been shown by Caruccio (7) to be the controlling factor in many cases where the small particles of pyrite (2-15 microns) rapidly decompose when exposed to the atmosphere, and where coarse grains of pyrite (greater than 50 microns) remain stable. In addition, marcasite usually will produce more acidity than pyrite as a result of its crystal structure.

A distribution of the sulfur content of anthracite is shown in Figure 12. The sulfur usually exists as sulfides, sulfates and organic free sulfur. Since most of the sulfur is held by the sulfide minerals, the sulfur content may be an indirect indicator of the amount of iron sulfides and hence may indicate general trends in potential acid production. In the presence of sufficient oxygen (air) and moisture the iron sulfides will readily decompose. The rate of oxidation (and hence generation of acid) is also dependent on the high porosity of the sulfides. As oxygen content of the chemical environment increases so does the oxidation of the sulfides (10). The effect of water and oxygen can be seen in the following reaction:

1. $FeS_2 + H_2O + 7/2\ O_2\ (g) = Fe^{2+} + 2H^+ + 2SO_4^{2-}$

Barnes and Romberger (6) have indicated that pH's of 3 or less can result from oxidation at partial pressures of oxygen at 10^{-60} atmospheres or more. This indicates that air sealing of mines above the water table will be largely ineffective and impractical. For this reason as well as the numerous mine openings in the Mahanoy Creek watershed, mine sealing in most cases was rejected as an abatement technique.

The presence of bacteria also greatly increases the rate of oxidation of pyrite and its associated products as in reaction 1 and the following reaction:

2. $4Fe^{2+}\ 10H_2O + O_2\ (g) = 4Fe(OH)_3 + 8H^+$ - Barnes and Romberger (6)

The two parameters which most effectively describe the equilibrium conditions encountered in coal mine drainage are oxidation potential (Eh) and pH. Additional parameters important in influencing the solubility of iron are dissolved carbon dioxide and sulfur species. The Eh-pH diagram shown in Figure 14, p. 44 indicates the limiting conditions and the chemical behavior, which also determines the stability fields of the various elements involved in coal mine drainage. Three assumptions which are made with the diagram in applying it to real systems are:

a. That the system is at equilibrium

b. that complexes not considered in the calculation of the diagram are absent or exist in negligible amounts.

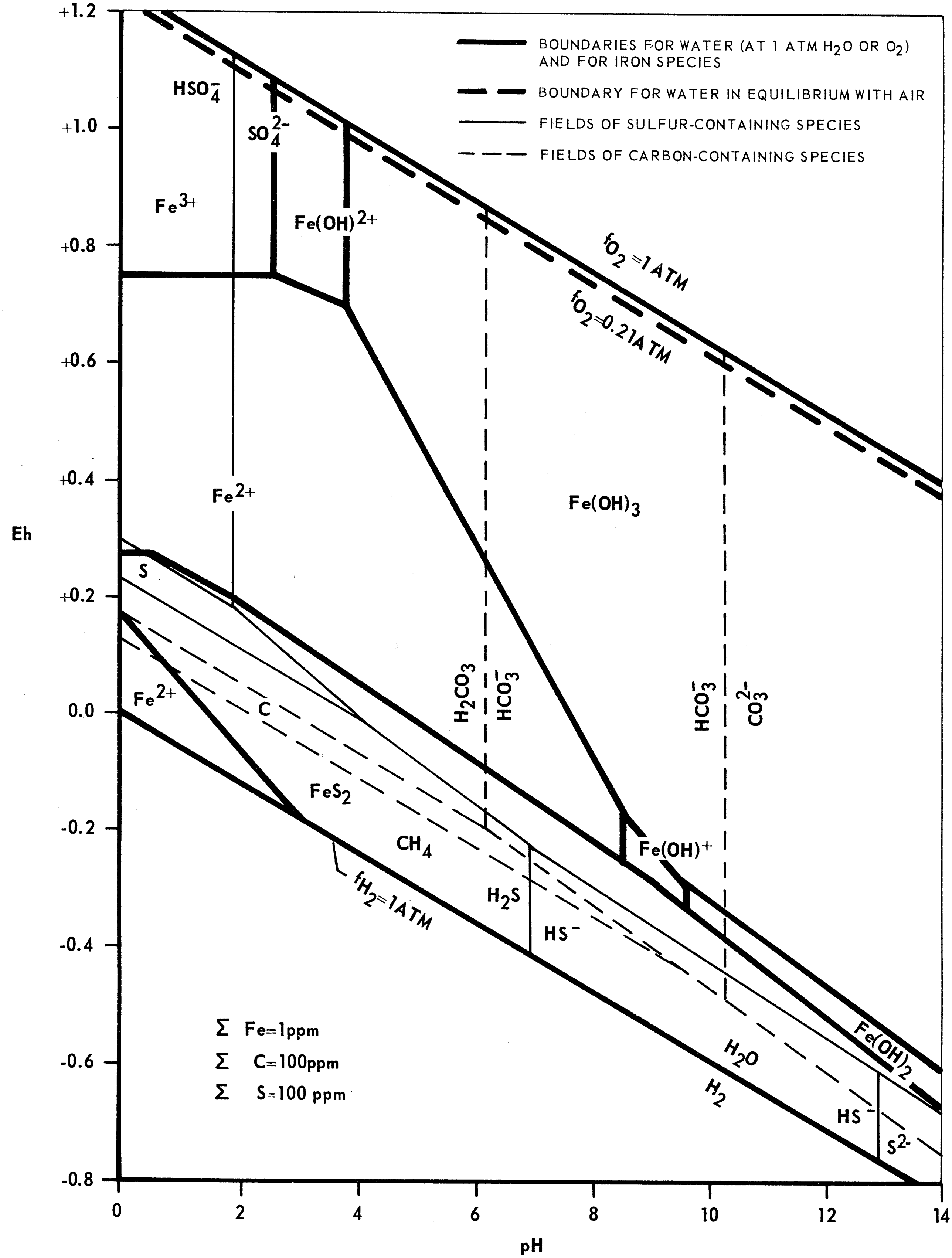


Figure 14. Stability fields of various elements involved in coal mine drainage
(After Barnes and Romberger, 1968)

c. that solid phases shown in the system are relatively pure.

Oxidizing environments are indicated by a positive oxidation potential and reducing environments by a negative potential. Normal surface waters in contact with the atmosphere have a pH range between 6 and 8 and potentials between .35 and .6 volts. Both pyrite and marcasite with a composition near FeS_2 are out of equilibrium under these conditions (see Figure 14).

The formation of acid due to the oxidation of iron sulfides (the principal source of acid) usually occurs by at least two steps as in reactions 1 and 2. Both reactions 1 and 2 result in large amounts of acid produced through the decomposition of each mole of pyrite or marcasite oxidized. Ferrous and ferric sulfates are additional sources of acid (see Tables 4 and 5). The Eh-pH diagram shows the conditions under which the principal reactions occur. Usually iron sulfieds are not found to decompose directly to ferric hydroxide. This is shown in the Eh-pH diagram where ferrous iron is formed in all cases before the hydroxide is formed. This indicates that the decomposition of iron sulfides can occur at relatively low Eh conditions found in some mine waters. It also explains the relatively high ferrous iron found under alkaline and neutral pH values in the streams of the watershed.

The iron now mobilized in the ferrous state will oxidize in the mine pools as oxygen is replenished by circulating waters or as the iron approaches the surface environment through mine discharges and enters streams. Indeed, relatively high amounts of ferrous iron are found in most discharges and streams in the Mahanoy Creek Watershed. The stability field of Fe^{2+} indicates it is stable over a wide pH range if Eh values are only slightly oxidizing. Lower dissolved oxygen values in the streams of the watershed due to higher BOD values from the sewage present in the streams may result in lower than expected Eh values, thereby increasing the mobility of iron. The presence of the ferrous iron, an acid precursor, inhibits higher net alkalinities of the streams.

Under the conditions indicated in the Eh-pH diagram there are insufficient amounts of dissolved carbon dioxide or other carbonate species to form a stable iron carbonate as siderite. Only in waters containing much greater amounts of total carbon will an iron carbonate be stable in the conditions shown in Figure 14.

NEUTRALIZATION

Dilution effects, geology, and the role of silicate hydrolysis reactions in the neutralization of acid mine waters of the watershed were studied. The interdependence of these factors should be noted. Dilution includes water originating from surface runoff such as streams directly entering deep mines, water percolating through soil, and water

TABLE 4

INORGANIC CONSTITUENTS OF COAL

ELEMENT	
Si	Silicates and Sand
Al	Alumina in Combination with Silica
Fe	Pyrite and Marcasite
	Ferrous Oxide (in small quantities)
	Ferrous Sulfate
	Ferric Oxide
	Ferric Sulfate
	Iron Silicates
	"Organic" Iron
Ca	Carbonates, Sulfate, Silicates
Mg	Carbonates, Silicates
Na, K	Silicates, Carbonates, Chlorides (in small quantities)
Mn	Carbonates, Silicates
S (Inorganic)	Pyrite, Marcasite
	Ferrous Sulfate (in small quantities)
	Ferric Sulfate
	Calcium Sulfate
P	Phosphates

(After Pennsylvania State University Special Research Report SR-83)

TABLE 5

COMMON ELEMENTS FOUND IN THE ASHES OF COAL

CONSTITUENT	PERCENT
Silica (SiO_2)	30-60
Aluminum Oxide (Al_2O_3)	10-35
Ferric Oxide (Fe_2O_3)	5-35
Calcium Oxide (CaO)	1-20
Magnesium Oxide (MgO)	.3-4
Titanium Oxide (TiO_2)	.5-2.5
Alkalies ($Na_2O + K_2O$)	1-4
Sulfur Trioxide (SO_3)	.1-12

(After Pennsylvania State University Special Research Report SR-83)

originating from disturbed aquifers. pH can be increased in the acid mine pools by simple dilution and by buffering when water in the mine pool is mixed with water containing various concentrations of HCO_3-. The effects of dilution on pH of acid mine waters can be shown using the following equation from Barnes and Romberger (2):

$$pH_2 = pH, + \text{Log } X$$

Where pH_2 = Final pH, pH, = initial pH, x = ratio of final to initial volume. pH of the diluent is assumed to be 7. For example, if 100 volumes of water having a pH = 3.5 are diluted to a final volume of 10,000 volumes, x = 100 and the final pH would be 5.5.

A concentration of 10 ppm HCO_3^- in water results in much less diluent being used for neutralization due to the efficiency of bicarbonate neutralization. For example, acid water with a pH = 3.5 and containing 10 ppm HCO_3^- would need a dilution factor of 1:4 thus 100 volumes of water would be diluted to a final volume of 400 volumes, with a final pH = 7.0 (6).

The types of rock present, amounts of chemical constituents in the rocks, mineralogy, and structural geology all affect the quality of water in the mine pools. The role of iron sulfide has been previously mentioned. The porosity of the unsaturated zone in the subsurface environment as well as amount and type of fractures, joints, and faults control the rate of water infiltration and the travel path in the subsurface environment. The amount of carbonates in the rock strata, although variable, could aid in the neutralization of acid waters. Due to the lack of carbonate rocks in the watershed the streams do not contain sufficient bicarbonate concentrations which could neutralize acid mine water.

Although the existence of carbonates in coals (see Table 4) is known, only small amounts are present resulting in insignificant amounts of bicarbonate produced. However, calcareous shales are found throughout the eastern portion of our watershed. In the vicinity of Mahanoy City, boreholes have indicated the presence of calcite and calcite and quartz veins which if exposed in the mine pool, could contribute to neutralization (12). Rocks containing calcite veins are also found in several of the refuse banks in the watershed which may influence the quality of leachate produced from some of these refuse piles. The carbonates decompose through a series of chemical reactions which result in neutralizing the acid waters thereby raising pH, and then precipitating the iron contained in these waters. The reactions are as follows:

$$H^+ + CO_3^{2-} = HCO_3^-$$

$$H^+ + HCO_3^- = H_2CO_3$$

$$H_2CO_3 = CO_2 + H_2O$$

A comprehensive trace element analysis of the mine waters and streams of the watershed (data appears in Table 6, p. 51) indicates that the role of silicate reactions may be important, at least on a local basis, in the neutralization of acid mine waters. Silicates present in the coal or in the associated rock types decompose under acid conditions and in the process of breaking down release alkali metals and silica. The inorganic constituents of coal which are, in part, a source of these silicates and a list of elements found in coal are shown in Tables 4 and 5.

Alkalinities of several samples coupled with high sulfate indicate that the sulfate was derived from acid mine drainage which was neutralized. The Packer 5A Discharge having a net alkalinity of 115 ppm and a sulfate concentration of 1,037 ppm is an example. Equilibrium reactions indicate that a sulfate content of 740 ppm is usually associated with an acidity of 75 ppm (as $CaCO_3$). This suggests that neutralization has occurred and has resulted in an alkaline discharge.

Silica concentrations in certain mine discharges ranging between 20 and 45 ppm (i.e. samples 25, 29, 31, and 38) as well as high magnesium, sodium and alkalinity concentrations suggest that silicates are breaking down through hydrolysis reactions. In the process of hydrolysis these elements as well as aluminum and potassium are released. The numerous shales and claystones of the region are the sources of these silicates. Typical shales in the region contain 2-31 percent kaolinite, 0-1 percent feldspar, 34-51 percent mica (illite), 35-36 percent quartz and 0-2 percent chlorite-vermiculitemontmorillonite (13). Examples of chemical reactions which may occur follow:

3. Kaolinite + $5H_2O$ = Gibbsite + 2 H_4SiO_4 (aq)

4. Potassium mica + $2H^+$ + $18H_2O$= Gibbsite + $2K^+$ + $6H_4SiO_4$ (aq)

5. Potassium mica + $2H^+$ + $9H_2O$ = Kaolinite + $2K^+$ + $4H_4SiO_4$ (aq)

Both potassium and aluminum (Gibbsite) are released as shown in the above reactions. However, the potassium has a strong tendancy to be adsorbed by clays and iron hydroxides and will not stay in solution. Low potassium values result. When sufficient silica is present as is the case with certain discharges aluminum appears to rapidly precipitate, forming a poorly crystallized aluminum hydroxide such as gibbsite. Kaolinite can also breakdown as follows:

6. Kaolinite + $6H^+$ = $4Al(OH)^{2+}$ + $4H_4SiO_4$ (aq)

The aluminum hydroxide eventually precipitates, forming aluminum compounds.

In reactions 4,<5 and 6,>pH will be increased as the hydrogen ions are used. This results in neutralizing the acid mine water in the mine pools. Carbonates may account for calcium, some magnesium, and the neutralization of mine waters as well. Neutralization is probably a result of carbonate and silicate reactions with carbonate reactions predominating. However, magnesium concentrations which are higher than calcium concentrations as well as a lack of dolomite present (which could contribute magnesium) indicate that silicate reactions may predominate in certain instances. Supporting this are the high silica and alkali concentrations.

Two basic types of coal mine drainage have been identified in the watershed: 1) alkaline (net alkalinity, pH >6.0), and 2) acid (net acidity, pH<4.5). Acid discharges are generally characterized by lower total iron, ferrous iron, sodium, potassium, manganese, magnesium, calcium, and sulfate concentrations, and higher aluminum concentrations when compared to the alkaline discharges. Nickel and silica did not show any significant differences between the two types of mine discharges. General concentration values for the major pollution factors other than acid content of the two types of discharges are:

	ACID	ALKALINE
Total Iron	16 ppm	27 ppm
Ferrous Iron	9 ppm	20 ppm
Sulfate	500 ppm	720 ppm
Aluminum	10 ppm	1 ppm

On a local basis leachates from silt and culm banks can be a significant source of coal mine drainage. Between sample sites #2 and #3 silt banks containing pyritic material contribute significant concentrations of iron and acid as well as large amounts of silt to the North Mahanoy Creek. Substantial amounts of pyrite are found throughout several silt and culm deposits along Mahanoy Creek between samples #43 and #47 and samples 5 and 8.1 which significantly affect water quality as shown in Figure 17, p. 94. In addition, oxidation of ferrous iron to ferric iron also occurs between samples #43 and #47 resulting in additional amounts of acid produced. Evidence for this reaction is the abrupt decrease in ferrous iron between these two sample sites.

The geochemical analysis was also applied to other pollution source problems in the watershed. Acidity, total iron, ferrous iron, aluminum, sodium and silica indicate that Ashland Nos. 1 and 2 Discharges (samples 40 and 41 in Table 6) are two separate mine discharges draining different sections of the tunnel mine or possible separate mines and not, as previously reported before this watershed study, a single discharge which had two different overflow locations. This is important in determining the abatement measure to be used for these discharges.

The contribution of three silt banks in the production of coal mine drainage was evaluated using the geochemistry data. The silt banks were located between sample sites 52 and 55, 5 and 8a, and 2 and 3. Higher acid and total iron values were found downstream of the silt bank located west of site 52. However, other analytical data were inconclusive. Between sites 5 and 8a silt banks are probably contributing acid but the water analyses other than acid did not indicate a major influence on water quality of the Mahanoy Creek. The analyses for pH, aluminum, total iron, and sulfate did indicate a major influence of siltbanks on water quality in the North Mahanoy Creek between sites 2 and 3. To substantiate these results a field visit was conducted in the area which found several refuse pile leachate sources.

In Girardville two large water-filled strip pits located just above several discharge points were thought to be directly contributing mine drainage to mine discharges 10 and 11 as well as several seepages originating from the refuse piles which appear to separate the pits and mine discharges. Water analyses were taken of the two water-filled pits and compared to water analyses of the mine discharges. The mine discharges had significantly lower pH values and much greater acidity, total iron, ferrous iron, manganese, silica, potassium and sulfate. Total and ferrous iron, manganese and silica values indicate that water from the pits is picking up substantial amounts of pollutants. Considering the short distance separating the pits and discharges, the concentrations are not the result of direct flow through pyritic materials in the refuse pile, since a longer residence time is required to pick up these constituents. The analyses therefore indicate that the water from the strip pits enters the Girard mine workings first and then discharges at several mine openings located along Mahanoy Creek. This conclusion has been supported by mine map data of the area.

Mine pool stratification has been indicated by several chemical analyses of the mine discharges in the watershed. An example is the Bast Mine Pool. Chemical analyses at three different elevations in the mine pool (samples 31, 34, 38) indicate that layers of differing water quality exist. The top layer (Site 31) at 1020 feet elevation is alkaline and contains very high concentrations of iron, manganese, and silica. The middle layer (Site 34) at an elevation of 930 feet is highly acid and contains higher sulfate and aluminum concentrations with other chemical constituents at approximately the same levels. At an elevation of 874 feet the lower layer (Site 38) becomes alkaline with lower iron, manganese, and silica and no aluminum. These results indicate that in certain mine pools, where stratification exists, the elimination or reduction in water entering the mine pools may cause the layers to change in water quality. This may result in changing certain alkaline mine discharges to acidic discharges. Acid mine drainage may also become alkaline. To determine the changes in water quality more precisely a further study is recommended.

TABLE 6

CHEMICAL CHARACTERISTICS OF VARIOUS WATERS OF THE MAHANOY CREEK WATERSHED

Sample	pH	Acid	Alk	TotFe	Fe^{2+}	Al	Ca	Mg	Mn	K	Na	Ni	SO_4	Si
1*	3.3	80	–	1.7	–	22.6	.4	14.1	1.0	.8	4.9	.2	235	13.9
2	4.8	10	–	–	–	.4	.6	3.9	.1	.2	1.0	–	8	–
3	4.5	12	–	.4	–	.8	.6	5.9	.1	.3	1.0	–	40	–
4*	4.5	82	–	16.0	9.0	6.1	8.4	31.7	1.7	1.0	20.3	–	185	7.8
5	5.0	56	–	5.1	2.2	3.8	5.8	24.9	.9	1.8	15.5	.1	170	15.7
6	5.9	6	2	–	–	–	.7	3.9	.1	.2	–	.1	8	–
7*	6.2	190	64	59.0	56.0	.4	35.5	58.7	16.1	1.5	12.7	.4	850	6.3

TABLE 6 (Continued)

Sample	pH	Acid	Alk	TotFe	Fe^{2+}	Al	Ca	Mg	Mn	K	Na	Ni	SO_4	Si
8.1	4.6	74	–	6.0	5.6	4.7	9.2	29.4	1.1	1.0	14.6	.2	165	5.7
8.2	6.2	194	64	49.1	46.0	2.1	50.0	58.7	12.7	1.6	12.0	.4	800	6.9
9	6.8	66	–	46.1	40.3	3.8	41.1	61.3	14.4	1.6	14.0	.4	800	8.1
10*	5.9	120	60	24.8	22.4	–	38.9	58.7	14.4	1.6	17.5	.2	700	4.7
11*	6.0	80	48	30.6	16.8	–	36.9	58.7	12.1	1.9	16.5	–	375	4.2
12*	5.6	48	4	19.4	14.6	–	32.1	58.7	5.8	1.7	13.6	–	90	4.9
13*	3.5	80	–	11.5	10.1	.8	33.9	61.3	7.4	1.8	16.5	–	425	6.5
14	6.8	74	2	40.2	39.2	3.4	40.2	64.8	12.7	1.6	13.6	.6	950	7.9
15*	6.3	100	256	27.2	26.9	–	54.0	66.6	26.3	1.7	14.8	.6	1050	7.0
16*	6.2	130	242	29.6	26.9	–	51.1	66.6	24.8	1.3	14.0	.3	1150	6.4
17	6.3	100	–	46.1	40.3	11.6	42.2	64.8	15.5	3.1	20.2	.9	775	14.0
18	6.2	100	34	24.8	1.1	10.5	42.3	64.8	12.1	2.8	20.2	.6	675	14.9
19	4.3	340	–	46.1	–	24.1	36.5	64.8	47.1	7.3	18.1	1.2	650	18.3
20	4.3	340	–	510.7	46.0	33.0	52.9	64.8	36.9	8.0	29.1	.3	950	27.5
21*	4.0	28	–	.3	–	2.0	2.3	15.0	.6	1.0	26.8	.3	60	.9
22	5.9	6	10	.1	–	–	1.8	7.2	.1	.4	4.0	–	30	.6
23*	–	–	–	–	–	–	–	–	–	–	–	–	–	–
24	4.1	320	–	66.2	60.5	44.8	42.3	63.0	36.9	10.0	20.5	.9	675	66.8
25	6.1	216	240	46.1	–	–	39.1	63.0	14.9	2.0	51.2	.6	1125	45.4
26*	3.6	380	–	22.5	–	10.0	47.2	64.8	18.0	3.56	60.8	.2	1375	17.9
27	4.9	200	–	50.7	43.7	33.2	34.6	70.5	27.1	7.0	25.9	.5	950	64.9
28*	6.4	–	288	1.2	–	–	43.4	63.0	8.8	2.4	51.3	.2	725	5.4
29*	6.6	80	244	31.8	20.2	–	47.4	64.8	19.9	1.3	18.1	–	900	24.3

TABLE 6 (Continued)

Sample	pH	Acid	Alk	TotFe	Fe^{2+}	Al	Ca	Mg	Mn	K	Na	Ni	SO_4	Si
30	5.2	14	0	57.1	35.8	31.4	45.9	64.8	25.4	5.9	25.7	.3	675	65.9
31*	6.1	6	34	45.8	43.7	–	47.0	64.8	13.4	2.3	48.4	.2	800	44.8
32*	6.4	8	98	24.0	20.2	–	26.0	57.8	3.0	.8	8.3	–	275	19.9
33	6.2	6	88	30.5	30.2	3.2	54.1	64.8	21.7	1.9	21.5	.2	925	40.2
34*	3.4	360	–	41.4	22.4	15.3	57.1	68.5	13.4	.7	4.4	.4	975	41.1
35	6.4	16	56	39.9	39.2	5.3	42.3	64.8	20.3	2.7	19.2	–	800	56.0
36*	3.4	480	–	19.4	10.5	61.6	24.7	51.3	12.2	.8	6.2	.5	800	14.2
37	6.3	140	30	34.4	23.5	7.1	42.3	64.8	19.6	2.4	17.0	.3	875	48.4
38	6.5	80	146	27.9	24.6	1.6	37.0	64.8	5.4	1.1	15.0	.2	900	37.3
39	6.6	80	24	35.8	34.7	4.9	53.4	66.6	2.0	1.8	15.0	.3	825	49.7
40*	5.6	100	4	33.1	30.2	.7	39.0	66.6	7.5	1.4	18.5	.2	800	35.5
41*	7.1	–	406	7.6	–	–	47.2	66.6	2.9	2.1	51.3	–	825	9.0
42*	6.7	8	8	1.5	–	1.1	35.4	43.8	.7	.3	8.1	–	135	5.5
43	6.8	80	60	20.7	20.2	5.5	67.2	64.8	16.9	1.7	19.2	–	800	8.4
44	6.8	8	34	.3	–	–	6.8	17.0	.1	.5	5.7	–	45	1.9
45	6.7	8	8	–	–	–	1.6	7.2	–	.2	5.7	.3	9.0	.5
46	6.8	8	24	.3	–	–	5.1	15.0	–	.5	5.7	–	11	1.5
47	6.7	80	54	18.5	17.9	5.5	39.6	66.6	13.7	1.5	14.6	.2	825	8.0
48*	6.3	240	550	37.8	37.0	–	51.2	64.8	8.6	4.0	152.7	.2	1100	5.7
49*	6.4	140	414	16.4	15.7	–	44.6	66.6	4.1	1.4	18.8	–	775	4.9
50	7.3	60	334	24.0	11.2	–	41.1	64.8	3.9	1.4	41.6	–	725	5.2
51	7.6	–	228	1.8	–	–	39.1	64.8	2.0	1.2	34.4	–	550	3.7
52	6.5	20	50	14.2	6.7	6.1	40.2	64.8	13.2	2.5	21.3	.5	600	27.8

TABLE 6 (Continued)

Sample	pH	Acid	Alk	TotFe	Fe^{2+}	Al	Ca	Mg	Mn	K	Na	Ni	SO_4	Si
53*	3.3	76	–	2.7	–	3.0	2.1	18.1	1.8	.6	7.2	.5	175	12.5
54*	6.5	40	68	26.4	13.4	1.5	34.6	64.8	5.0	1.0	6.2	–	525	7.1
55	6.2	40	36	20.6	7.8	4.2	43.4	64.8	12.2	1.9	16.0	.2	600	7.2
56*	3.9	260	–	27.2	24.6	12.0	38.0	66.6	11.8	1.2	6.2	.6	800	7.8
57	6.1	40	22	26.4	10.1	4.2	43.4	63.0	13.7	1.1	17.0	.3	825	7.2
58	6.5	60	26	18.9	15.7	3.4	42.3	64.8	13.7	1.5	15.0	.3	525	6.4
59	5.8	60	6	16.1	–	5.1	42.2	64.8	9.1	1.7	12.9	–	400	8.7
60	6.2	40	16	21.0	–	7.2	39.1	64.8	10.3	1.2	14.0	.3	475	8.9
61	5.9	10	8	.3	–	–	2.2	11.0	–	.1	3.5	–	5.0	3.1
62*	3.9	180	–	41.6	37.0	3.0	32.9	66.6	7.9	1.0	3.5	.7	550	6.5
63*	3.3	120	–	9.4	–	4.7	1.5	20.2	1.7	.5	1.7	.5	200	8.8
64	3.8	180	–	13.3	12.3	4.7	33.0	59.5	3.7	1.1	4.4	.5	375	21.4
65*	3.2	180	–	2.5	–	3.4	1.6	19.2	2.1	.4	.9	.2	175	3.2
66	3.2	220	–	30.6	13.4	12.1	22.6	49.8	3.7	.6	3.5	.5	325	20.0
67	5.5	140	10	22.0	–	9.0	35.3	63.0	9.4	1.4	14.0	.2	600	39.6
68	6.5	14	48	.4	–	–	8.0	21.3	.1	1.1	4.4	–	425	2.0
69	6.3	10	48	.2	–	.8	13.1	24.7	.1	1.1	6.2	–	6	1.1
70	7.2	10	68	.2	–	–	19.5	29.4	–	.8	4.4	–	18	.7
71	5.7	80	6	30.5	–	10.5	42.3	63.0	9.4	1.3	12.0	.3	650	43.8

This analysis was completed in November, 1973 and does not represent average values.
* =Mine Discharge.
No discharge appeared at sample site 23 during November.

HYDROLOGY

Hydrologic data were used to determine the amount of surface water entering the underground mine pools of the region, which are the sources of the thirty-one (31) discharges in the watershed. Application of this data included the calculation of the maximum reduction in flow for each mine discharge which could be expected from various abatement techniques as well as the total reduction in the pollution load of the watershed. In addition, abatement techniques for reducing the flow were evaluated to determine which techniques were the most cost effective. Some of the techniques included the reclamation of abandoned strip mines, diversion of surface runoff, relocation of permanent streams, and treatment systems.

Information published by the National Climatic Center provides precipitation values for the various regions of Pennsylvania. Since no rain gages are located within the Mahanoy Creek Watershed, values from nearby gaging stations were averaged so a single value for the Mahanoy Creek area could be determined. It was found that the average yearly amount of precipitation over the Mahanoy Creek Watershed is approximately 42.9 inches (see Figure 15, p. 56).

During the 12 month sampling period from November, 1973 to October, 1974 the total amount of precipitation over the watershed was 46.2 inches. The total is 7.7 percent above the yearly average, and all stream and discharge flow readings can be expected to be above their yearly normal averages by a similar amount. All engineering calculations utilitzing the flow measurements taken during the study period can be considered conservative because they used as average conditions, flows which were actually above normal.

The infiltration of water into most mine pools (ground water) occurs primarily through recharge due to rainfall. Additional amounts of water enter these mine pools from disruption of natural aquifers which at times may become the major source of water, rock fracture zones, and faults. Faults and fracture zones may often collect and transport large quantities of water. Abatement techniques evaluated in this report to reduce this water entering the mine pools included the techniques mentioned above as well as sealing bore holes and mine seals. Increasing runoff involves changing surface drainage and installation of flumes, stream lining and diversion ditches or channels.

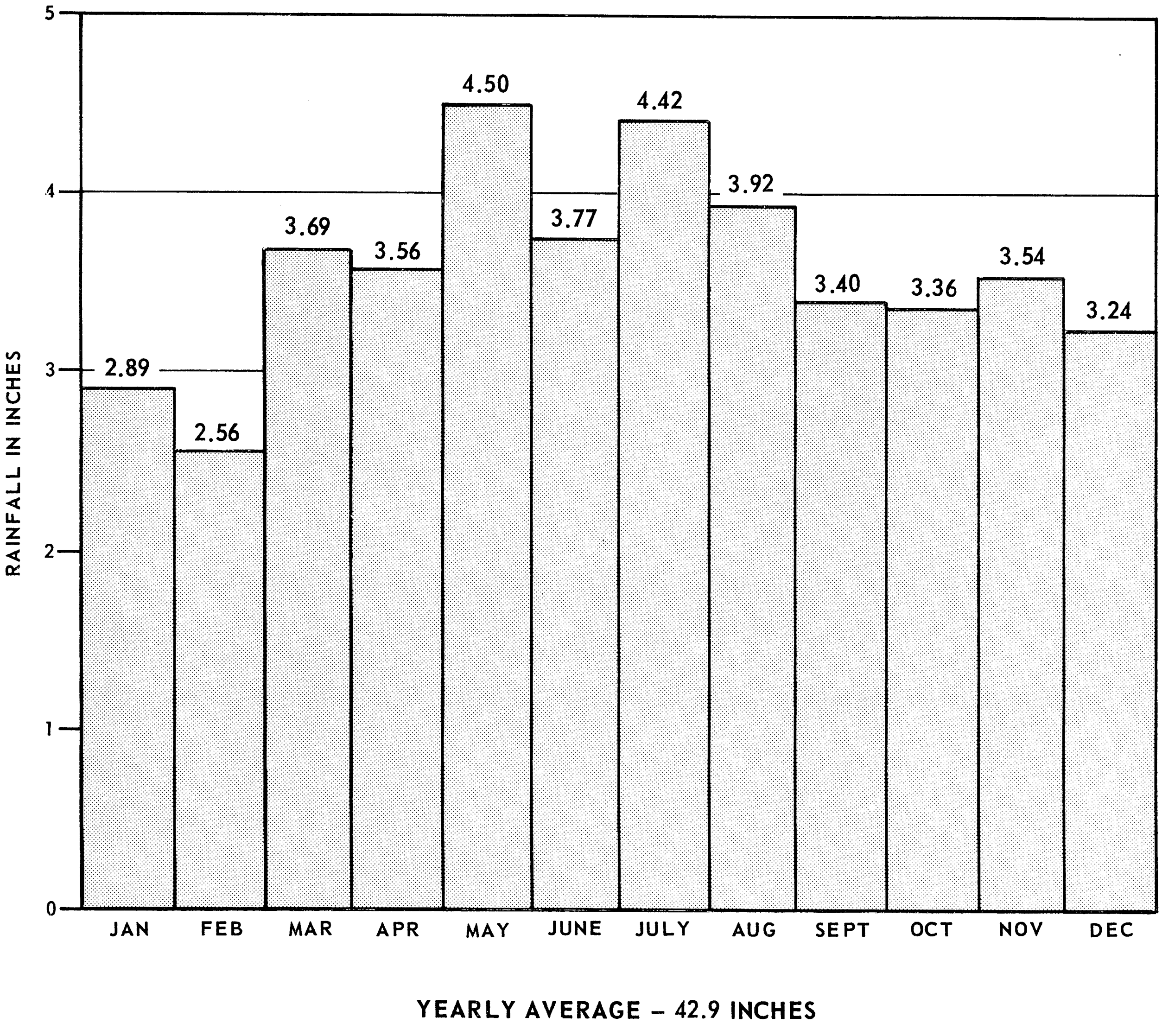


Figure 15. Average monthly precipitation for the Mahanoy Creek Watershed

In a hydrologic study of a watershed, the total amount of precipitation must be balanced with all forms of water consumption. The basic balance equation relating precipitation to total consumption is:

P = ET + R + S + I where:

P - is the total amount of precipitation.

ET - is the consumptive rate which is the amount of water consumed through evaporation and transpiration (evapotranspiration).

R - is the amount of direct surface runoff contributing to steam flow.

S - is the amount of water stored in lakes, stream channels, natural depressions, etc., the amount is very minor and may be considered zero.

I - is the amount of water that infiltrates into the ground water system. Although the elevation of the water table and mine pools may vary significantly during the year, the average elevation from year to year is relatively constant. Because of this, all water that infiltrates into the ground water system will be assumed to resurface as either intermittent and permanent springs or mine drainage discharges.

Factors which effect these values include:

ET - wind, temperature, humidity, sunlight, type and density of vegetation, type and amount of soil cover.

R and I - topography, soil type, ground cover (vegetation), rainfall intensity.

Before the quantities of mine drainage, generated by the disturbed portions of the watershed can be determined, the consumptive rate for these areas must be known. No direct method of determining this value could be found, but by determining all the remaining parameters of the watershed, the consumptive rate can be indirectly calculated.

By utilizing available information, the percentage of precipitation contributing to the flow of Mahanoy Creek can be directly determined. During the study period, the average flow of Mahanoy Creek at sample site No. 71 at Otto was 311.5 ft^3/sec. The flow includes the Doutyville and Helfenstein Tunnel Discharges, as well as an estimated 35 percent of the Centralia Tunnel Discharge which drains areas outside the study region. Summing these flows and deducting them from the total flow of Mahanoy Creek gives the following results:

Centralia Tunnel Disc.	5.32 ft^3/sec (35% of total flow)
Helfenstein Tunnel Disc.	2.78 ft^3/sec
Doutyville Tunnel Disc.	13.58 ft^3/sec
	21.68 ft^3/sec

Flow at sample site No. 71	311.5 ft^3/sec
Flow from other watersheds	-21.7 ft^3/sec
	289.8 ft^3/sec

The average amount of flow at sample site No. 71 that is contributed by the Mahanoy Creek Watershed is 289.8 ft^3/sec. The flow includes both direct surface runoff and infiltration that later resurfaces as springs and discharges.

The total area of the Mahanoy Creek Watershed is 157.1 square miles. However, sample site No. 71 is located upstream from the mouth of the creek and did not measure the flow contributed by the entire watershed. Approximately 3.5 square miles of land contribute water to Mahanoy Creek below the last sample site.

Total area of Mahanoy Creek Watershed	157.1 mi^2
Area below sample site No. 71	-3.5 mi^2
	153.6 mi^2

The effective area contributing to the flow of Mahanoy Creek at sample site No. 71 is 153.6 square miles.

As previously mentioned, during the study period of one year when flow measurements were taken, the amount of precipitation falling on the watershed was 46.2 inches. Utilizing the information just presented the runoff coefficient in the Rational Equation can be solved for.

The Rational Equation is:

$Q = CIA$ where

Q - is the average flow rate draining a specific watershed (289.8 ft^3/sec or 25,040,000 ft^3/day).

C - is the coefficient dependent on the physical characteristics of the watershed, which expresses that portion of the precipitation which contributes to stream flow.

I - is the amount of precipitation over the watershed during the period when flow readings were recorded, (46.2 in./yr or 0.01055 ft/day).

A - is the area of the watershed, (153.6 mi^2 or 4,282,000,000 ft^2).

Solving for "C".

$$C = \frac{Q}{IA} = \frac{25{,}040{,}000 \text{ ft}^3/\text{day}}{(0.01055 \text{ ft/day})(4{,}282{,}000{,}000 \text{ ft}^2)} = 0.55$$

For the Mahanoy Creek Watershed the average "C" value is 0.55. Therefore, 55 percent of all precipitation that falls on the watershed contributes to the stream flow of Mahanoy Creek. It should be noted that this is a special adaptation of the Rational Equation.

The "C" factor is a combination of both the direct surface runoff R, and the infiltration I, that enters the streams as intermittent and permanent springs and discharges. Relating this to the hydrologic balance equation, all terms except the consumptive rate are known.

P = 100%

I + R = 55%

S = 0%

Solving for ET.

ET = P –I –R –S = 100 -55 -0 = 45%

Therefore, the average consumptive rate for the Mahanoy Creek Watershed is 45 percent. Within the watershed the consumptive rate will vary significantly from the average value because of factors previously mentioned. For the purposes of this study, only two specific consumptive rates will be determined. The first consumptive rate will be for natural areas undisturbed by mining and the second for portions of the watershed disrupted by strip mining.

There are numerous methods for determining the consumptive rate of natural areas, one such method involves utilizing the Lowry-Johnson equation. The equation is:

$$U = 0.00156\ H + 0.8$$

where U - is the amount of water lost through evaporation and transpiration each year in feet.

H = is the number of degree days above 32° for the growing season.

MONTH	AVERAGE MONTHLY TEMP. OF MAHANOY CREEK WATERSHED IN °F	DEGREES ABOVE 32° F	DAYS	DEGREE DAYS
April	48.9	16.9	30	507
May	58.6	26.6	31	825
June	67.7	35.7	30	1071
July	72.0	40.0	31	1240
August	70.0	38.0	31	1178
Sept.	63.0	31.0	30	930
Oct.	52.2	20.2	31	626
				6377

$$U = 0.000156\ (6377) + 0.8 = 0.995 + 0.8 = 1.795 \text{ ft/yr}$$

$$\text{Consumptive rate} = \frac{\text{rainfall lost through evapotranspiration}}{\text{total amount of rainfall}} \times 100$$

Average rainfall = 42.9 inches/yr = 3.575 ft/yr

$$\text{Consumptive rate} = \frac{1.795 \text{ ft/yr}}{3.575 \text{ ft/yr}} (100) = 50.2\%$$

Other methods were also used to determine the consumptive rate for undisturbed areas, and in each case the results were similar. The consumptive rate for the undisturbed portions of the Mahanoy Creek Watershed is therefore 50 percent. Of the remaining 50% of the precipitation not consumed through evapotranspiration it is estimated that one-half will become infiltration and the other half surface runoff.

Of the total 153.6 square miles of the watershed contributing to sample point No. 71, 39.4 square miles, have been strip mined or otherwise disrupted by mining. The remaining 114.2 square miles are undisturbed. Since, the average consumptive rate for the entire Mahanoy Creek Watershed is known, along with that for the undisturbed areas, the consumptive rate for the disturbed areas can be easily found.

$$\frac{114.2 \text{ mi}^2 (0.50) + 39.4 \text{ mi}^2 (\text{ET})}{153.6 \text{ mi}^2} = 0.45$$

$$\text{ET} = \frac{12.02 \text{ mi}^2}{39.4 \text{ mi}^2} = 0.305$$

The consumptive rate for the disturbed portions of the watershed is therefore 30 percent, leaving the remaining 70 percent to be either surface runoff or infiltration. For the disturbed portions of the watershed an estimated 85 percent of the precipitation not consumed through evapotranspiration will become infiltration and contribute to the mine pool system, while only 15 percent is surface runoff. These are quite realistic values considering the terrain. In the Mahanoy Creek Watershed, the stripped areas are characterized by rocky barren "soil" where the water infiltrates easily and enters the ground water system and mine pools through numerous mine openings and rock fractures. In addition, longitudinal stripping pits and low points, created by disrupting the natural drainage pattern, trap much surface water and direct it to the abandoned mine workings. A summary of the results are given below.

For areas disturbed by mining the precipitation distribution is as follows:

30 percent of all precipitation is consumed by evapotranspiration.

70 percent of all precipitation becomes runoff and infiltration, of this

85 percent becomes infiltration (59.7 percent of total precipitation)

15 percent becomes runoff (10.5 percent of total precipitation)

For natural areas undisturbed by mining the precipitation distribution is as follows:

50 percent of all precipitation is consumed by evapotranspiration.

50 percent of all precipitation becomes runoff and infiltration, of this

50 percent becomes infiltration (25 percent of total precipitation)

50 percent becomes runoff (25 percent of total precipitation)

The consumptive rate for natural areas is significantly higher than for the areas disturbed by mining. This is quite understandable. In natural areas the existing soil horizons retain a large percentage of the precipitation, which is partially absorbed by the vegetation where much of it is then lost to the atmosphere through transpiration. Also, a significant portion of the water retained in the soil is lost directly through evaporation.

In disturbed areas, the soil horizons have been destroyed and little if any top soil exists. The surface does not retain much moisture, nor are the soil characteristics favorable to plant growth. As a result, the consumptive rate for the disturbed areas will be much less than for the undisturbed regions of the watershed.

It should be noted that the numbers chosen for the coefficients are only average values. Within the watershed are different types of stripped as well as undisturbed areas, but it would be unrealistic to assign a separate set of coefficients for each specific area. Where required, a correction factor was applied to hydrologic calculations to bring the coefficients in line with actual field conditions.

To insure that the figures just presented are a reasonable representation of the actual physical characteristics of the Mahanoy Creek Watershed, a flow balance of the acid mine discharges is presented. The total flow from all the discharges draining the watershed during the study period was 25,500 million gallons per year. Excluded from this total are the flows from the Doutyville and Helfenstein Tunnel Discharges and a portion of the Centralia Tunnel Discharge which are all fed by areas outside the watershed.

Water from three distinct sources gains entry into the mine pools which feed the discharges, with the major source being the 39.4 square miles of disturbed regions. The disturbed areas have a consumptive rate of 30 percent, with 85 percent of the remaining precipitation not lost through evapotranspiration infiltrating into the mine pool system.

$$(46.2 \text{ in./yr}) (0.70) (0.85) = 27.5 \text{ in./yr}$$

$$(27.5 \text{ in./yr}) (39.4 \text{ mi}^2) (17.4 \text{ MG/in.-mi}^2) = 18{,}900 \text{ MG/yr}$$

During the study period the disturbed areas of the watershed contributed approximately 18,900 million gallons of acid mine drainage to Mahanoy Creek.

Another source of water to the mine pools are undisturbed regions which lie above areas that have been strip mined. Here, the 50 percent of the precipitation that is not consumed by evapotranspiration, contributes directly to acid mine drainage. In this type of situation, surface water which accumulates in undisturbed areas begins flowing overland until it reaches a stripped area. Here the water is intercepted by strip pits where it can easily infiltrate into the mine pools below. Also, the precipitation which infiltrates the soil in these regions either resurfaces as springs only to be later intercepted by strip pits, or becomes polluted when the flow in the natural aquifers is discharged in the abandoned mine workings. There are an estimated 13 square miles of area in this category.

$$(46.2 \text{ in./yr})\ (0.50) = 23.1 \text{ in./yr}$$

$$(23.1 \text{ in./yr})\ (13.0 \text{ mi}^2)\ (17.4 \text{ MG/in.-mi}^2) = 5200 \text{ MG/yr}$$

During the study period, the undisturbed areas draining into strip mined areas, were responsible for contributing 5200 million gallons of acid mine drainage into Mahanoy Creek.

The remaining source of recharge to the acid mine discharges, are undisturbed areas which overlie areas that have been deep mined. Here, only that portion of precipitation which infiltrates the soil, contributes to the mine pools. There are approximately 4.0 square miles of land which satisfy this category.

$$(46.2 \text{ in./yr})\ (0.50)\ (0.50) = 11.6 \text{ in./yr}$$

$$(11.6 \text{ in./yr})\ (4.0 \text{ mi}^2)\ (17.4 \text{ MG/in.-mi}^2) = 800 \text{ MG/yr}$$

During the study period, undisturbed areas overlying deep mined regions, were responsible for contributing 800 million gallons of acid mine drainage to Mahanoy Creek. The total flow from all sources is:

18,900 MG/yr (areas affected by strip mining)

5,200 MG/yr (undisturbed areas)

800 MG/yr (areas overlying deep mines)

24,900 MG/yr

Utilizing the hydrologic coefficients previously determined, the total amount of acid mine drainage that should be generated by the Mahanoy Creek Watershed was calculated to be 24,900 million gallons per year. The calculated value is only 600 million gallons less than the actual measured value of 25,500 million gallons per year. This is a difference of 2.4 percent, which is well within measurement error.

AMOUNTS OF ACID MINE DRAINAGE GENERATED

The average rainfall for the Mahanoy Creek Watershed is 42.9 inches per year. Utilizing the consumptive rate of 30 percent, the amount of water available for runoff and infiltration for an average hydrologic year in disturbed areas can be determined.

(42.9 in./yr) (0.30) = 12.87 in./yr lost through evapotranspiration

42.9 in./yr -12.87 in./yr = 30.03 in./yr total infiltration and runoff

As previously stated 85 percent of the remaining precipitation not consumed by evapotranspiration will become infiltration.

(30.03 in./yr) (0.85) = 25.53 in./yr infiltrating into the groundwater system

In the Mahanoy Creek Watershed, during an average precipitation year, 25.53 inches of the total precipitation falling on areas disturbed by mining contribute directly to acid mine drainage.

In natural undisturbed areas located near regions that have been mined, both the portion of precipitation that contributes to runoff, and the portion that is infiltration may be entering the mine pools. The consumptive rate for undisturbed areas was found to be 50 percent, and of the remaining 50 percent half will be infiltration and half surface runoff.

(42.9 in./yr) (0.50) = 21.45 in./yr

In undisturbed areas, where both infiltration and runoff are entering mine pools, 21.45 inches of the total precipitation that falls will contribute to acid mine drainage.

In undisturbed areas, where only infiltration is entering mine pools, one half of the precipitation not consumed by evapotranspiration contributes to mine drainage.

(42.9 in./yr) (0.50) (0.50) = 10.73 in./yr

In these areas 10.73 in./yr of the total precipitation will contribute to mine drainage.

REDUCTION IN ACID MINE DRAINAGE (AVERAGE YEAR)

Disturbed Areas

By backfilling, regrading and planting the disturbed areas, the amount of water entering the deep mines and contributing to acid mine drainage can be significantly reduced. In theory, the reclamation measures should restore the land to its original state. If so, the disturbed areas would take on the same hydrological coefficients as the undisturbed areas presently have. Therefore, the only precipitation that would contribute to acid mine drainage would be that which infiltrated directly into the ground water system. That value for an undisturbed area is 10.73 inches/year.

The reduction in the amount of precipitation contributing to acid mine drainage in disturbed areas is equal to the amount of precipitation entering the deep mines before reclamation measures, minus the amount of precipitation entering the deep mines after reclamation measures are completed.

25.53 in./yr -10.73 in./yr = 14.80 in./yr

By backfilling and reclaiming stripped areas, the amount of water infiltrating into the soil and contributing to acid mine drainage can be reduced by 14.80 inches per year.

Undisturbed Areas

Reclaiming stripped areas downslope from undisturbed regions, makes it possible for the surface runoff from these regions to flow over the reclaimed strip mines, and enter the various streams. The reduction in the amount of precipitation contributing to acid mine drainage from the undisturbed area, would be equal to the surface runoff from the area, which is 10.73 inches/year.

SAMPLE CALCULATIONS

A number of sample calculations are presented as examples of how the reductions in the flows of the discharges were determined. To simplify the calculations, a conversion factor of 0.0737 was used. A flow of one inch of precipitation a year over an area of one square mile is equal to a flow of 0.0737 cubic feet per second.

Mahanoy City Group

An area of 180 acres should be backfilled, regraded and seeded. This would reduce the amount of precipitation entering the deep mines by 14.80 inches/year.

$$\frac{180 \text{ acres}}{640 \text{ acres/mile}^2} \text{ (14.80 inches/year) (0.0737) (0.9)} = 0.28 \text{ ft}^3\text{/sec}$$

An area of approximately 400 acres of undisturbed land is presently draining into the 180 acres of land to be reclaimed, the surface water from the undisturbed areas could drain directly into a stream, reducing the amount of precipitation entering the deep mines by 10.73 inches/year.

$$\frac{180 \text{ acres}}{640 \text{ acres/mile}^2} \text{ (10.73 in./year) (0.0737) (0.8)} = 0.40 \text{ ft}^3\text{/sec}$$

A 0.9 correction factor was applied to the first calculation and a 0.8 factor to the second to take into account the differences between theoretical and actual field conditions. Backfilling, regrading and replanting does not insure that reforestation will be complete nor does it insure that all surface water will be effectively drained.

Construction of a drainage pipe beneath the railroad tracks 2 miles east of Mahanoy City will allow water to drain under the tracks into Mahanoy Creek. Presently water from a rather large area northeast of Buck Mountain collects there and then infiltrates into the deep mines. Installing the drainage pipe will reduce the flow at the discharges by approximately 0.35 ft^3/sec.

The total reduction in flow is:

0.28 ft^3/sec

0.40 ft^3/sec

<u>0.35 ft^3/sec</u>

1.03 ft^3/sec or 0.66 MGD

The percentage decrease of flow is equal to the amount that will be eliminated, divided by the sum of the flows of the discharges affected.

Mahanoy Creek Headwaters Discharge	0.37 ft^3/sec
Mahanoy City Bore Hole Discharge	11.31 ft3/sec

The percentage reduction is:

$$\frac{1.03 \text{ ft}^3\text{/sec}}{0.37 \text{ ft}^3\text{/sec} + 11.31 \text{ ft}^3\text{/sec}} \text{ (100)} = 8.8\%$$

Packer Group Discharges

An area of 961 acres should be backfilled, regraded, and planted.

$$\frac{961\ \text{ac}}{640\ \text{ac/mi}^2}\ (14.80\ \text{inches/year})\ (0.0737)\ (0.8) = 1.31\ \text{ft}^3/\text{sec}$$

An area of approximately 450 acres of undisturbed land would be affected by the backfilling.

$$\frac{450\ \text{ac}}{640\ \text{ac/mi}^2}\ (10.73\ \text{in./yr})\ (0.0737)\ (0.8) = 0.44\ \text{ft}^3/\text{sec}$$

The construction of flumes and/or drainage ditches to direct clean streams across the stripped areas would reduce the flow at the discharges by the following:

Waste House Run	4.55 ft^3/sec
Lost Creek	0.66 ft^3/sec
N. Mahanoy Creek Trib.	0.25 ft^3/sec (estimate)
	5.46 ft^3/sec

The total reduction in flow is:

1.31 ft^3/sec

0.44 ft^3/sec

5.46 ft^3/sec

7.21 ft^3/sec or 4.65 MGD

The discharges affected by the abatement measures include:

Packer No. 5A Discharge	18.96 ft^3/sec
Packer No. 5B Discharge	22.49 ft^3/sec
Lost Creek Discharge	0.32 ft^3/sec

Lost Creek Ball Field Discharge	0.95 ft^3/sec
Connerton No. 1 Discharge	1.70 ft^3/sec
Connerton No. 2 Discharge	0.19 ft^3/sec
	44.61 ft^3/sec

The percentage reduction is:

$$\frac{7.21\ ft^3/sec}{44.61\ ft^3/sec}\ (100) = 16\%$$

UNDERGROUND MOVEMENT OF WATER

The types and complexity of mining in the watershed area (Mining History Section) as well as the hydrologic conditions (Hydrology Section) resulting in the formation of large underground mine pools has been given. Rocks above coal seams before mining are usually saturated with water. The mining of coal leaves the overlying rocks fractured permitting the flow of water into the numerous mine gangways and tunnels with the effect of lowering the local water table. Aquifers may also be disturbed creating significant sources of water in the mines. The formation of mine pools originally involved only one particular mine. However, as secondary mining and bootlegging operations continued barrier pillars which separated mines and isolated mine pools were breached. This usually resulted in the inundation of nearby mines creating interconnections for the passage of large volumes of polluted water between mine pools. The two types of barrier pillars used in past mining operations were primary and secondary barrier pillars. The primary barrier pillars separate individual mines while secondary barrier pillars usually separate mine workings within the mines.

The mine pool map of Figure 16, p. 73, a result of these processes, indicates the underground movement of water in the Mahanoy Creek Watershed. As water in these pools rise to the level of the numerous mine openings in the area, discharges form which enter and pollute the nearby streams. Thirty-three mine pools underlie or contribute polluted mine waters to the watershed. These mine opols result in a total of thirty-one discharges in the area (see Figure 16). Elevations of the pools are given in Table 7. In addition

TABLE 7

MINE POOL ELEVATIONS

MINE NO.	NAME OF MINE	ALTITUDE OF MINE WATER POOL (El.)
1	Vulcan – Buck Mountain	1249
2	Primrose	1095
3	Park No. 1 & 2	1250
4	Tunnel Ridge	1121
5	Mahanoy City	1095

TABLE 7 (Continued)

MINE NO.	NAME OF MINE	ALTITUDE OF MINE WATER POOL (El.)
6	North Mahanoy	1095
7	Knickerbocker	1095
8	Boston Run	1121
9	St. Nicholas	1121
10	Maple Hill	1095
11	Shenandoah City	1095
12	Kehley Run	1087
13	Kohinoor	1087
14	West Shenandoah	1087
15	Gilberton	1116
16	Lawrence	1116
17	East Bear Ridge	1116
18	William Penn	1025
19	Weston (Packer Nos. 2, 3, & 4)	1025
20	West Bear Ridge	1116
21	Packer No. 5	961
22	Hammond	1006
23	Raven Run	1254
24	Continental	1028
25	Bast	901
26	Girard	1008
27	Preston No. 3	958
28	Tunnel	879
29	Germantown	901
30	Centralia	1001
31	Potts	986
32	Locust Gap	755
33	North Franklin	866

to these large mine pools, at least two additional small (possibly isolated) mine pools exist. The first is the Lavelle Mine Pool which is the source of the Mowry Discharge (Site 53). This small pool is probably an extension of the Locust Gap Mine Pool and is referred to in this report as part of this larger pool. The Lost Creek Discharge (Site 21), located much higher than the nearby Weston Mine Pool is probably draining a local mine pool which drains into the larger Weston Mine Pool.

The arrows in Figure 16, p. 73, indicate the flow direction of water in the mine pools. Several mine pools such as the Girard or Vulcan-Buck Mountain Mine Pools are isolated from the majority of mine pools. However, water entering the Park No. 1 and 2 Mine Pool travels for great distances through a complicated network of 6 interconnected mine pools before emerging at the Packer Discharges east of Girardville. This system of underground movement of water negates efforts of simply backfilling one small area to eliminate a mine discharge. The increase in area reclaimed often results in higher costs without necessarily producing a significant reduction of flow.

Drainage tunnels also may be constructed to simplify drainage of several mines. The Centralia Tunnel drains two large mine pools, the Continental and Centralia Mine Pools, which are isolated from each other (note difference in mine pool levels). Mine water from areas outside the watershed also drain into the Centralia Mine Pool. Complicated abatement plans for the watershed are two drainage tunnels which drain the Locust Gap Mine Pool underlying the Shamokin Watershed to the north. The two tunnels emerge in the Mahanoy Creek Watershed as the Doutyville Tunnel (Site 56) and Helfenstein Tunnel (Site 54) Discharges.


LEGEND
SECONDARY BARRIER PILLARS
PRIMARY BARRIER PILLARS
MINE POOLS
FLOW OF WATER
DRAINAGE TUNNELS
OVERFLOW
901 el. ELEVATION IN FEET
SCALE IN MILES
COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
MINE POOLS AND UNDERGROUND FLOW
IN THE
MAHANOY CREEK WATERSHED
WATERSHED BOUNDARY
MINE POOLS DRAINING TO OTHER WATERSHEDS
NORTH FRANKLIN
BEAR VALLEY ROCK SLOPE
BEAR VALLEY
GLEN BURN
CAMERON
HENRY CLAY-STIRLING
BURNSIDE
ROYAL OAK
BUCK RIDGE No.1 - GREENBACK
BIG MOUNTAIN
LUKE FIDLER
MAYSVILLE
COLBERT
CORBIN
EXCELSIOR
ENTERPRISE
HICKORY SWAMP
HICKORY RIDGE
SCOTT RIDGE
SCOTT
PENNSYLVANIA
GREENOUGH
NATALIE
RICHARDS WATER LEVEL
RICHARDS SHAFT
RELIANCE
A L A S K A
MIDVALLEY Nos. 1-2
MIDVALLEY No.5
SIOUX - SAYRE
CENTRALIA 1001 el.
CENTRALIA TUNNEL
GERMANTOWN 901 el.
POTTS 986 el.
LOCUST GAP 755 el.
DOUTYVILLE TUNNEL
HELFENSTEIN TUNNEL
HELFENSTEIN
LAVELLE
TUNNEL
879 el.
PRESTON No.3
BAST
CONTINENTAL 1028 el.
RAVEN RUN 1254 el.
HAMMOND
PACKER No.5 961 el.
1008 el.
1116 el.
WESTON 1025 el.
WM. PENN 1025 el.
LAWRENCE
GILBERTON
EAST BEAR RIDGE
ST NICHOLAS 1121 el.
BOSTON RUN 1121 el.
WEST SHENANDOAH 1087 el.
INDIAN RIDGE 1095 el.
KNICKERBOCKER 1095 el.
NORTH MAHANOY 1095 el.
MAHANOY CITY 1095 el.
MAPLE HILL 1095 el.
TUNNEL RIDGE
PARK No.2 1250 el.
PRIMROSE
VULCAN BUCK MOUNTAIN 1249 el.
76° 37' 30"
76° 30' 00"
76° 22' 30"
76° 15'

POLLUTION SOURCES

There are two major sources of pollution in the study area. These sources are coal mine drainage and raw sewage. Two additional sources of pollution, silt content in streams and leachates from silt and culm banks, become important locally. Silting operations at the active mines and breakers as well as silt piles located on or near the banks of the streams contribute large amounts of silt during heavy rainfalls which overload the streams. The locations of many of these refuse piles are shown in Plates A and B. The silt, particularly in the Shenandoah Creek, changes the streams from their usual color to a muddy black color and forms large deposits of silt banks along the streambeds.

Water percolating through the numerous refuse piles picks up acid and other oxidation products, if enough pyrite is available, before emerging as seepage discharges at the bottom of the piles. Examples of this type of discharge are the refuse piles near the Hammond Bore Hole (Site 25, Plate B) and along the stream banks at several points along the Shenandoah Creek. While the amounts of acid produced may be important locally, acid production is usually insignificant in comparison to the volume of the mine discharges.

One of the major sources of pollution to the streams is raw sewage. As of this writing the only sewage treatment plants in the watershed is a small plant located in Trevorton, and a plant located in Ashland. All of the other towns in the area discharge their wastes into the streams. The high pH and alkalinity of sewage aid in the neutralization of acid mine discharges in the streams. This affect is probably a much stronger influence on the acidity in the stream under most conditions than the acid produced by the oxidation of ferrous iron in the streams.

Coal mine drainage, the result of thirty-one mine discharges in the watershed, is the most important source of water pollution in the region. The distribution of these discharges is dependent on the locations of the many mine openings found in the watershed. As the level of the mine pools fluctuate in response to climatic conditions, mine discharges may disappear only to reappear after heavy rainfalls. Many of the discharge flows are affected by rainfall. This can be seen in the Appendix where monthly variations of the discharges are given. The location of all discharge points and their relation to the mining features of the watershed are shown in Plates A and B. The discharge parameters, such as which mine pool the discharge drains and the type of overflow, are given in Table 8 along with the land ownerships where these discharges are located. Descriptions of all discharges are discussed in groups where possible, the details being included in the Appendix.

The total mine drainage flow in the Mahanoy Creek watershed is 84.32 MGD. Of the thirty-one discharges in the watershed, only twelve discharges account for almost 91 percent of the total flow. Most of the discharges and hence a large portion of the total mine drainage flow (71%) is concentrated from Ashland east to Delano (the eastern half of the watershed.)

TABLE 8

DISCHARGE PARAMETERS

SAMPLE NO.	DESCRIPTION	SURFACE AND MINERAL RIGHTS OWNER
1	Headwaters Mahanoy Creek Discharge (Elevation 1370 Feet) Drains: Portion of Park Nos. 1 & 2 Mine Pool. Outfall: Morris Colliery Tunnel Overflow.	Natural Coal Co.
4	Mahanoy City Bore Hole Discharge (Elevation 1245 Feet) Drains: Vulcan-Buck Mountain Mine Pools. Outfall: Mahanoy City Bore Holes Overflow.	Leigh Service and Supply Corp.
7	Gilberton Shaft Discharge Drains: West Bear Ridge, Lawrence, East Bear Ridge, and Gilberton Mine Pools. Outfall: Gilberton Shaft (Pumping Station).	Gilberton Lawrence Fuel Inc.
10	Girardville No. 1 Discharge (Elevation 1005 Feet) Drains: Portion of Girard Mine Pool. Outfall: Overflow of Old Girard Workings.	Girard Estate
11	Girardville No. 2 Discharge (Elevation 1005 Feet) Drains: Portion of Girard Mine Pool. Outfall: Overflow of Old Girard Workings.	Girard Estate
12	Girardville No. 3 Discharge (Elevation 980 Feet) Drains: Portion of Girard Mine Pool. Outfall: Overflow of McTurks Bore Hole.	Girard Estate

TABLE 8 (Continued)

SAMPLE NO.	DESCRIPTION	SURFACE AND MINERAL RIGHTS OWNER
13	Girardville No. 4 Discharge (Elevation 1000 Feet) Drains: Portion of Girard Mine Pool. Outfall: Overflow of Girard Colliery Tunnel.	Kalinowski, Edward
15	Packer No. 5A Discharge (Elevation 966 Feet) Drains: Portions of Packer No. 5, Weston, William Penn, Kohinoor, West Shenandoah, Kehley Run, Indian Ridge, Maple Hill, Shenandoah City, Knickerbocker, North Mahanoy, Mahanoy City, Primrose, and Park Nos. 1 and 2 Mine Pools. Outfall: Packer No. 5 East Overflow.	Girard Estate
16	Packer No. 5B Discharge (Elevation 952 Feet) Drains: Same Mine Pools as Packer No. 5A Discharge. Outfall: Packer No. 5 West Overflow.	Girard Estate
21	Lost Creek Discharge (Elevation 1205 Feet) Drains: Portion of Weston Mine Pool. Outfall: Overflow of Buck Mountain Bed, West Slope.	Girard Estate
23	Lost Creek Ball Field Discharge (Elevation 1030 Feet) Drains: Portions of Weston and William Penn Mine Pools. Outfall: Packer No. 2 Overflow.	Girard Estate
25	Hammond Bore Hole Discharge (Elevation 1000 Feet) Drains: Hammond Mine Pool. Outfall: Hammond Bore Hole Overflow.	Girard Estate
26	Hammond Discharge (Elevation 1020 Feet) Drains: Portion of Hammond Mine Pool. Outfall: Hammond Mine Pool Overflow.	Girard Estate

TABLE 8 (Continued)

SAMPLE NO.	DESCRIPTION	SURFACE AND MINERAL RIGHTS OWNER
28	Connerton No. 1 Discharge (Elevation 980 Feet Average) Drains: Portion of Packer No. 5 Mine Pool. Outfall: Connerton Tunnel Overflow.	Girard Estate
29	Connerton No. 2 Discharge (Elevation 960 Feet) Drains: Portion of Packer No. 5 Mine Pool. Outfall: Connerton Overflow.	Girard Estate
31	North Girardville Discharge (Elevation 1020 Feet) Drains: Portion of Bast Mine Pool. Outfall: Preston No. 2 Overflow.	Girard Estate
32	South Preston Discharge (Elevation 960 Feet) Drains: Preston No. 3 Mine Pool. Outfall: Preston No. 3 Tunnel Overflow.	McDonald, Joseph
34	North Preston Discharge (Elevation 930 Feet) Drains: Portion of Bast Mine Pool. Outfall: Preston No. 1 Tunnel Overflow.	Reading Anthracite
36	Centralia Tunnel Discharge (Elevation 984 Feet) Drains: Centralia and Continental Mine Pools. Outfall: Centralia Tunnel.	Reading Anthracite
38	Bast Discharge (Elevation 874 Feet) Drains: Germantown and Bast Mine Pools. Outfall: Bast Tunnel (Overflow from Diamond Vein).	Philadelphia & Reading Corp.
40	Ashland No. 1 Discharge (Elevation 875 Feet) Drains: Portion of the Tunnel Mine Pool. Outfall: Tunnel Colliery, East Overflow.	Schuylkill Carbon Fuels Inc.
41	Ashland No. 2 Discharge (Elevation 875 Feet) Drains: Portion of the Tunnel Mine Pool. Outfall: Tunnel Colliery, West Overflow.	Schuylkill Carbon Fuels Inc.

TABLE 8 (Continued)

SAMPLE NO.	DESCRIPTION	SURFACE AND MINERAL RIGHTS OWNER
42	Ashland No. 3 Discharge (Elevation 876 Feet) Drains: Portion of the Tunnel Mine Pool. Outfall: Orchard Drift Overflow.	Borough of Ashland
48	Big Run No. 1 Discharge (Elevation 979 Feet) Drains: Potts Mine Pool. Outfall: Diamond Breach Overflow.	Reading Anthracite
49	Big Run No. 2 Discharge (Elevation 980 Feet) Drains: Potts Mine Pool. Outfall: Holmes Drift Overflow.	Reading Anthracite
53	Mowry Discharge (Elevation 1080 Feet) Drains: Locust Gap Mine Pool. Outfall: Laural Hill Slope Overflow.	Mourer, Clayton and Cora
54	Helfenstein Tunnel Discharge (Elevation 710 Feet) Drains: Locust Gap Mine Pool. Outfall: Helfenstein Tunnel.	Border: Zimmerman, K & Miller, Merl and Myrna
56	Doutyville Tunnel Discharge (Elevation 700 Feet) Drains: Locust Gap Mine Pool. Outfall: Doutyville Tunnel.	Shinskie, Kenneth J. and Vrona, John
62	North Franklin Overflow Discharge (Elevation 875 Feet) Drains: North Franklin Mine Pool. Outfall: Abandoned Pump House (Includes Rennie Tunnel).	Reserve Carbon Corp.
63	South Trevorton Discharge (Elevation 840 Feet) Drains: North Franklin Mine Pool. Outfall: North Franklin Overflow (Old North Franklin Mine Workings).	Reserve Carbon Corp.
65	Sunshine Mine Discharge (Elevation 855 Feet) Drains: North Franklin Mine Pool. Overfall: Sunshine Mine Overflow.	Stinehart Coal Co.

MAHANOY CITY GROUP DISCHARGES

The Headwaters Mahanoy Creek Discharge (1), which seeps from an abandoned slope located 1-1/2 miles east of Mahanoy City, is considered the headwaters of Mahanoy Creek (see Plates A and B). The slope drains a small portion of the Park No's 1 and 2 Mine Pool via the Morris Colliery Tunnel, and discharges AMD at an elevation of 1370 feet ±. The flow from the discharge fluctuates greatly and during extremely dry periods ceases to flow. Over the length of the study period the average flow was 0.24 MGD, with a pH of 3.4 and an acid concentration of 167 ppm. The iron and sulfate contents are 1.67 and 200 ppm respectively. The discharge contributes 315 lbs/day acid, 3 lbs/day iron, and 363 lbs/day sulfate into the Mahanoy Creek.

The Mahanoy City Bore Hole Discharge (4) flows from a series of bore holes located just off the south side of Route 54 at the eastern edge of Mahanoy City. During periods of heavy precipitation another bore hole located approximately 600 feet due east of the previously mentioned bore holes, also overflows. The average flow from the discharge is 7.31 MGD, with a pH of 4.6 and an acid concentration of 140 ppm. The average iron and sulfate contents are 11.21 and 229 ppm respectively. During the study period, an average of 6878 lbs/day acid, 724 lbs/day iron, and 14,658 lbs/day sulfate entered Mahanoy Creek from this discharge.

The bore holes which overflow at an elevation of 1245 feet, drain the Vulcan-Buck Mountain Mine Pool. The area contributing to the mine pool, and hence, the discharge, encompasses roughly 2.2 square miles east and northeast of Mahanoy City. The entire area is scattered with strip pits and waste piles, with the strip pits being relatively small and overgrown with vegetation. The Mahanoy City Bore Hole Discharge flows into Mahanoy Creek, but at the confluence the discharge is actually a much larger flow than the creek itself. This is one of the more significant pollution sources accounting for 8.7 percent of all mine drainage entering Mahanoy Creek.

GILBERTON SHAFT DISCHARGE

The Gilberton Shaft Discharge (7) consists of a pumping station located at the eastern end of Gilberton, that intermittently pumps water from the mine pools below. The purpose of the pumping station is to maintain the elevation of the mine pool at a sufficient level so no flooding of basements occurs in the area. During periods of heavy precipitation the pump is in operation almost constantly, and conversely during dry periods the pump is seldom in use. The pump which delivers water to Mahanoy Creek at the rate of 14.41 MGD, is considered to be in operation 40 percent of the time. The discharge has a pH of 6.3 and has a net acidity of 55.2 ppm. The iron and sulfate concentrations are 59.28 and 862 ppm. The Gilberton Shaft Discharge accounts for 3534 lbs/day acid, 3793 lbs/day iron, and 55,185 lbs/day sulfate which enter Mahanoy Creek.

The mine pools drained by the Gilberton Shaft Discharge include the West Bear Ridge, Lawrence, East Bear Ridge, and the Gilberton Mine Pools, also included may be the St. Nicholas, Boston Run and the Tunnel Ridge Mine Pools. 3.2 square miles of land contributes water to the discharge with most of it strip mined. The area is scattered with waste and silt piles, and numerous strip pits, with little if any vegetative cover.

GIRARDVILLE DISCHARGES

The Girardville Discharges are a series of four discharges located along the south bank of Mahanoy Creek just east of Girardville. In addition a series of seepages occurs along the creek from sample site 9 to 14. The surface area contributing to the discharges is located south and southeast of Girardville, and includes 0.93 square miles, of which 0.46 have been stripped. The strip pits run along the base of Ashland Mountain trapping all surface runoff and directing it into the Girard Mine Pool. Although all discharges drain the same mine pool, their water quality differs significantly. Girardville No's 1, 2 and 3 consist of two adjacent discharges which are sampled as one, resulting in three rather than six discharges.

The Girardville No. 1 (10) and the Girardville No. 2 (11) Discharges are both overflows of the old Girard Workings at elevation 1005 feet ±. The Girardville No. 1 Discharge has a flow rate of 1.99 MGD with a pH of 5.9 and a net acidity of 24 ppm. The discharge contributes 450 lbs/day acid, 422 lbs/day iron, and 7823 lbs/day sulfate into Mahanoy Creek. The iron and sulfate concentrations are 25.34 and 466 ppm respectively. The Girardville No. 2 Discharge has a flow rate of 0.63 MGD and chemical characteristics similar to those just mentioned. The pH is 6.4 with a net alkalinity of 4 ppm, while the iron and sulfate contents are 18.68 and 429 ppm respectively. The Girardville No. 2 Discharge accounts for 37 lbs/day alkalinity, 98 lbs/day iron and 2283 lbs/day of sulfate which enter Mahanoy Creek.

The Girardville No. 3 Discharge (12) is an overflow of McTurks Bore Hole at elevation 980 feet ±. The pH is 5.9, with a net acidity of 38 ppm. The iron and sulfate contents are 15.55 and 324 ppm respectively. The flow rate is 0.28 MGD. An average of 86 lbs/day net acidity, 36 lbs/day iron, and 750 lbs/day sulfate enter Mahanoy Creek from this discharge.

The Girardville No. 4 Discharge (13) overflows the Girard Colliery Tunnel at 1000 feet ±. The flow is quite small averaging only 0.06 MGD with pH 3.7 and acid concentration of 99 ppm. The iron and sulfate contents are 10.71 and 352 ppm. The Girardville No. 4 Discharge contributes 45 pounds of acidity, 5 pounds iron, and 170 pounds of sulfates daily to Mahanoy Creek.

PACKER GROUP DISCHARGES

The Packer No. 5A Discharge (15) surfaces at the eastern end of Girardville through the Packer No. 5 East Overflow. The discharge flows westward through a series of ditches and culverts before entering Mahanoy Creek. The elevation of the outfall is 966 feet ±, and the flow which fluctuated significantly during the study period averaged 12.25 MGD. The discharge pH is 6.3 and has a net alkaline concentration of 115 ppm, while the iron and sulfate contents are 30.28 and 1037 ppm respectively. The pollution loads entering Mahanoy Creek from the discharge are 12,136 lbs/day net alkalinity, 3118 lbs/day iron and 101,404 lbs/day sulfates.

The Packer No. 5B Discharge (16) surfaces from a series of openings west of the 5A Discharge and flows directly into it.. The discharge's outfall is the Packer No. 5 West Overflow and emerges at an elevation of 952 feet ±. This discharge drains the same area as that drained by the Packer No. 5A Discharge. The average flow from the 5B Discharge is 14.54 MGD with a pH of 6.3 and a net alkaline concentration of 107.2 ppm. The iron and sulfate contents are 31.62 and 1235 ppm respectively. The Packer No. 5B Discharge contributes 13,071 lbs/day net alkalinity, 3875 lbs/day iron and 152,866 lbs/day sulfates to Mahanoy Creek. The combined flows of the Packer Discharges account for 31.7 percent of the total mine drainage entering Mahanoy Creek.

Through a series of barrier pillar breaches, the Packer Discharges drain all or portions of 14 different mine pools, these include the Packer No. 5, Weston, William Penn, Kohinoor, West Shenandoah, Kehley Run, Indian Ridge, Maple Hill, Shenandoah City, Knickerbocker, North Mahanoy, Mahanoy City, Primrose, and the Park No's 1 and 2 Mine Pools. Approximately 30 square miles of surface area, stretching from Girardville eastward to Mahanoy City and northward to the watershed boundary, contributes water to the mine pools. Included in the area are some 11.9 square miles containing strip mines and waste piles. The most disturbed areas are those along Bear Ridge southeast of Lost Creek, and northwest of Mahanoy City. The stripped areas are characterized by large deep pits with near vertical slopes and huge piles of waste rock, little if any vegetation is present. A number of silt piles can be found in this area, most notably those along Mahanoy Creek from below Mahanoy City to Gilberton and again along North Mahanoy Creek.

The upper slopes of Locust Mountain north of Shenandoah through Mahanoy City has no coal, and therefore has not been disturbed by mining. Lost Creek, Kehley Run, Waste House Run and North Mahanoy Creek, all of which are unpolluted, drain this area. In the case of Lost Creek, Waste House Run and Kehley Run, the water flows down the mountain, only to be intercepted by crop falls or stripping pits where the water is directed to the mine pools and later becomes a portion of the AMD that flows from the Packer

Discharges. These unpolluted streams draining Locust Mountain contribute approximately 3.52 MGD to the Packer Discharges.

Within the area being drained by the Packer Discharges, are four additional discharges. These discharges drain portions of mine pools also being drained by the Packer Discharges.

The Lost Creek Discharge (21) is a very minor discharge located 2000 feet northeast of the village of Lost Creek. The discharge has an average flow of 0.15 MGD. The pH is 4.0 and the acid content is 23 ppm. The iron and sulfate concentrations are 0.47 and 160 ppm respectively. The discharge which generates 35 lbs/day acidity, 1 lb/day iron, and 197 lbs/day sulfates, is an overflow of the West Slope to the Buck Mountain Bed at elevation 1205 feet. The discharge which drains a portion of the Weston Mine Pool, is presently entering a mine slope at the bottom of an abandoned strip mine.

The Lost Creek Ball Field Discharge (23) is located in the village of Lost Creek. The discharge whose outfall is the Packer No. 2 Overflow at elevation 1030 feet ±, drains portions of the Weston and William Penn Mine Pools. The discharge, which enters Shenandoah Creek, flowed intermittently during the study period in response to mine pool level changes due to precipitation, with an average flow of 0.61 MGD. The pH value was 6.4, with a net alkaline, concentration of 49 ppm. The iron and sulfate concentrations were 21.5 and 929 ppm. An average of 434 pounds net akalinity, 183 pounds iron and 8314 pounds sulfates enter Shenandoah Creek from this discharge.

The Connerton No. 1 Discharge (28) (1.3 percent of the total mine drainage flow) which overflows the old Connerton Tunnel at elevation 980 ±, drains a portion of the Packer No. 5, and possibly the Hammond Mine Pools. The discharge emerges at a series of locations near the northeastern edge of Girardville before flowing through a swamp and then entering Shenandoah Creek. The average flow from the discharge is 1.10 MGD with a pH of 6.7 and a net alkalinity of 234 ppm. The iron and sulfate contents are 2.80 and 865 ppm respectively. The Connerton No. 1 Discharge contributes 2200 lbs/day net alkalinity, 26 lbs/day iron and 7571 lbs/day sulfates to Shenandoah Creek.

The Connerton No. 2 Discharge (29) located at the. eastern edge of Girardville also enters Shenandoah Creek. The discharge drains a portion of the Packer No. 5 Mine Pool through the Connerton Overflow at elevation 960 feet ±. Although the flow is not significant it is quite constant, averaging 0.13 MGD during the study period. The pH of the discharge is 6.4, with an alkaline concentration of 100 ppm. Both the iron and sulfate contents are very high being 34.93 and 1097 ppm respectively. The discharge accounts for 88 lbs/day of net alkalinity, 36 lbs/day of iron, and 1134 lbs/day of sulfates which enter Shenandoah Creek.

HAMMOND DISCHARGES

Located 6000 feet northeast of Girardville, the Hammond Bore Hole Discharge (25) (3 percent of the total mine drainage) drains the Hammond Mine Pool. The discharge which is an overflow of the Hammond Bore Hole at elevation 1000 feet ±, drains to Shenandoah Creek. The 1.34 square miles of land that contributes water to the mine pool, has been almost entirely disturbed by mining. Although the area has a relatively small number of strip pits, a vast number of waste piles dominate the entire region.

The average flow from the discharge is 2.53 MGD and is quite consistent. The pH is 6.2 with an alkalinity of 80 ppm. The iron and sulfate concentration are extremely high being 45.86 and 1002 ppm respectively. An average of 1542 lbs/day net alkalinity, 978 lbs/day iron and 20,546 lbs/day sulfates are introduced into Shenandoah Creek by the Hammond Bore Hole Discharge.

Also draining a small portion of the Hammond Mine Pool is the Hammond Discharge (26). The discharge located 300 feet northeast of the Hammond Bore Hole Discharge flows only during wet periods. The average flow during the study period was 0.01 MGD, with a pH of 4.1 and an acid concentration of 211 ppm. The iron and sulfate contents are 15.31 and 1171 ppm. The discharge is an overflow of an exposed portion of the Hammond Mine Pool at elevation 1020 feet ±, and contributes 35 lbs/day acidity, 3 lbs/day iron and 183 lbs/day of sulfates to Shenandoah Creek.

SOUTH PRESTON DISCHARGE

The South Preston Discharge (32) (1.2 percent of the total mine drainage) is located in the southwest section of Girardville and overflows the old Preston No. 3 Tunnel at an elevation of 960 feet ±. The discharge which enters Mahanoy Creek has a relatively consistent flow which averages 1.04 MGD. The pH of the discharge is 6.5 with a net alkaline concentration of 29 ppm. The average iron content is 14.26 ppm while the sulfate content is 240 ppm. The South Preston Discharge contributes 291 lbs/day net alkalinity, 114 lbs/day iron, and 1864 lbs/day of sulfates to Mahanoy Creek.

The discharge drains the Preston No. 3 Mine Pool which is located southwest of Girardville. Approximately 0.60 square miles of strip mine overlie the mine pool and an additional 0.31 square miles of undisturbed land on the upper slope of Ashland Mountain contributes to the discharge. The stripping are characterized by long narrow pits which follow the contour of the land very closely. The vegatative growth on the stripped areas varies from next to nothing to a dense thicket.

CENTRALIA TUNNEL DISCHARGE

The Centralia Tunnel Discharge (36) is located approximately 5000 feet northeast of the eastern edge of Ashland. The discharge overflows the old Centralia Drainage Tunnel at an elevation of 984 feet ±, and flows south 0.50 miles through a rocky, steep, ravine before entering Mahanoy Creek. The discharge is quite acidic with a pH of 3.4, and an acid concentration of 219 ppm. The iron and sulfate contents are 10.57 and 607 ppm respectively. The average flow is 9.83 MGD which accounts for 11.7 percent of the total mine drainage. The Centralia Tunnel Discharge contributes a very large amount of acid to Mahanoy Creek, 17,453 lbs/day, along with 858 lbs/day iron and 46,453 lbs/day sulfates. The discharge has a long response time to precipitation but will fluctuate monthly if significant differences in monthly precipitation occur.

The Centralia Tunnel Discharge drains both the Centralia and the Continental Mine Pools. The Continental Mine Pool lies entirely within the boundaries of the Mahanoy Creek Watershed but a portion of the Centralia Mine Pool extends westward into the Shamokin Creek Watershed. An estimated 1.1 square miles of land from the Shamokin Watershed drain into Mahanoy Creek via this drainage tunnel.

Within the Mahanoy Creek Watershed some 2.1 square miles of land contributes water to the mine pools, of this total approximately 1.4 square miles have been strip mined. The stripped areas are some of the most severely disrupted in the region, characterized by huge, deep pits and vast piles of waste rock. The present drainage pattern traps much of the surface runoff in the area.

BAST GROUP DISCHARGES

The Bast Discharge (38) (3.4 percent of the total mine drainage flow) emerges from the Bast Tunnel located on the north bank of Mahanoy Creek at the very eastern edge of Ashland. The elevation of the outfall is 874 feet ± and it drains both the Germantown and the Bast Mine Pools. The flow from the discharge is quite constant, averaging 2.86 MGD with a pH of 6.3 and an alkaline, concentration of 40 ppm. The iron and sulfate contents are quite high being 30.38 and 648 ppm respectively. The discharge contributes 958 lbs/day net alkalinity, 725 lbs/day iron and 15,017 lbs/day of sulfates to Mahanoy Creek.

The Bast Discharge drains 5.6 square miles of land stretching from 2.5 miles west of Ashland to Girardville and northward to the county line. Of the total area approximately 3.8 square miles have been strip mined. The stripped areas are scattered with pits of variyng dimensions, many are overgrown with a dense thicket while others are nearly void of vegetation.

Within the area drained by the Bast Discharge, are two other minor discharges, the North Preston and the North Girardville Discharges. Both of these drain portions of the Bast Mine Pool. The North Preston Discharge (34) located 2000 feet west of Girardville, is an overflow of a wet mine seal on the old Preston No. 1 Tunnel at elevation 930 feet ±. Water which discharges at a rate of 0.45 MGD has a pH of 3.2 and an acid concentration of 349 ppm. The iron and sulfate contents are 32.13 and 977 ppm respectively. The discharge fluctuates with the amount of precipitation. At average flow, the North Preston Discharge contributes 1033 lbs/day acidity, 117 lbs/day iron, and 3742 lbs/day of sulfates to Mahanoy Creek.

The North Girardville Discharge (31) located on the northern edge of Girardville has a very minor flow of 0.07 MGD. The discharge has a pH of 6.3 and a net alkalinity of 1 ppm. The iron and sulfate contents are 40.91 and 981 ppm. Each day the discharge contributes 7 pounds net alkalinity, 26 pounds iron and 580 pounds of sulfates to Mahanoy Creek. The outfall is the Preston No. 2 Overflow at elevation 1020 feet ±. This discharge is particularly affected by precipitation with the discharge immediately increasing with rainfall.

ASHLAND DISCHARGES

The Ashland Discharges are a series of three discharges located at the southeast edge of Ashland. They all drain the Tunnel Mine Pool and flow into Mahanoy Creek.

The outfall for the Ashland No. 1 Discharge (40) is the Tunnel Colliery East Overflow at elevation 875 ±. The flow is rather consistent and averaged 0.11 MGD with a pH of 6.1 and a net acidity of 57 ppm. The iron and sulfate contents were 39.84 and 569 ppm respectively. The discharge contributes 56 pounds of net acidity, 37 pounds of iron, and 513 pounds of sulfates daily to Mahanoy Creek.

The outfall for the Ashland No. 2 Discharge (41) is the Tunnel Colliery West Overflow at elevation 875 feet ±. The average flow is 0.12 MGD with a pH of 7.1 and net alkalinity of 345 ppm. The iron and sulfate concentrations are 11.19 and 667 ppm. The discharge contributes 355 lbs/day net alkalinity, 12 lbs/day iron and 661 lbs/day of sulfates to Mahanoy Creek. Both of these discharges drain an area of approximately 1.31 square miles southeast of Ashland. Except for a large waste pile and a few shallow overgrown strip pits the area is relatively undisturbed. Disturbed aquifers may be a significant source of water for the Ashland Nos. 1 and 2 Discharges.

The Ashland No. 3 Discharge (42) whose outfall is the Orchard Drift Overflow at elevation 876 feet ±, drains 0.49 square miles of land south of Ashland. The area is dominated by a strip pit that runs the length of the mountain south of Ashland, trapping surface water that later appears at the discharge. The average flow from the Ashland No. 3 Discharge is 0.19 MGD, with a pH of 6.3 and a net alkaline concentration of 6.6 ppm. The iron and sulfate contents are 1.16 and 191 ppm respectively. The discharge contributes 2 lbs/day net alkalinity, 2 lbs/day iron, and 279 lbs/day of sulfates to Mahanoy Creek. The Ashland No. 3 Discharge also fluctuates with precipitation.

BIG RUN DISCHARGES

Both discharges are located some 5000 feet west southwest of Ashland and drain the Potts Mine Pool; approximately 2.24 square miles of land west and northwest of Ashland contribute water to the discharges. The area has been almost completely disrupted by mining, small stripping pits and waste piles abound throughout the area. The discharges drain into Big Run.

The outfall for the Big Run No. 1 Discharge (48) is the Diamond Breach Overflow at elevation 979 feet ±. The average flow is 0.19 MGD with a pH of 6.5 and net alkalinity of 438 ppm. The iron and sulfate contents are 32.07 and 1322 ppm. The discharge does not fluctuate significantly in response to precipitation, and discharges 725 lbs/day net alkalinity, 52 lbs/day iron, and 2139 lbs/day of sulfates into Mahanoy Creek.

The Big Run No. 2 Discharge (49) (3.3 percent of the total mine drainage) overflows the Holmes Drift at an elevation of 980 feet ±. During very dry periods this discharge will cease flowing. The flow from the discharge during the study periods was 2.81 MGD, with a pH of 6.5 and net alkalinity concentration of 306 ppm. The iron and sulfate contents are 27.62 and 864 ppm. The discharge contributes 8338 lbs/day net alkalinity, 670 lbs/day iron and 20,622 lbs/day of sulfates to Mahanoy Creek.

MOWRY DISCHARGE

The Mowry Discharge (53) is located 4500 feet west of Lavelle and drains an extension of the Locust Gap Mine Pool. The discharge overflows the old Laurel Hill Slope at elevation 1080 feet ±, and flows several thousand feet down Mahanoy Mountain before entering Mahanoy Creek. Approximately 0.14 square miles of land on top of Mahanoy Mountain, including 31 acres of strip mines feed the mine pool. Most of the infiltration to the mine pool occurs through the stripped area on the north slope of the mountain. This area is characterized by long, narrow, parallel and overgrown strip pits.

The Mowry Discharge which has an average flow of 0.14 MGD, does not fluctuate significantly. The water is quite acidic with a pH of 3.7 and an acid concentration of 57 ppm. The iron and sulfate contents are 4.91 and 189 ppm respectively. The discharge contributes 62 pounds of acidity, 6 pounds iron, and 202 pounds of sulfates daily to Mahanoy Creek.

HELFENSTEIN TUNNEL DISCHARGE

The Helfenstein Tunnel Discharge (54) is located on the north bank of Mahanoy Creek, some 3500 feet east of the village of Helfenstein. The discharge emerges from the Helfenstein Drainage Tunnel at elevation 710 feet ±. The tunnel extends northward through Mahanoy Mountain and into the Shamokin Creek Watershed where it drains portions of the Locust Gap Mine Pool.

The average flow from the discharge is 1.80 MGD (2.1 percent of the total mine drainage flow), and it has a pH of 6.7 with a net alkalinity of 55 ppm. The iron and sulfate contents are 13.26 and 548 ppm respectively. The discharge accounts for 718 pounds net alkalinity, 189 pounds iron and 7342 pounds of sulfates, which enter Mahanoy Creek daily.

DOUTYVILLE TUNNEL DISCHARGE

The Doutyville Tunnel Discharge (56) is located approximately 8000 feet west southwest of the village of Helfenstein. The discharge which emerges from the Doutyville Drainage Tunnel at elevation 700 feet ±, flows southward some 300 feet through a very steep, erodable ravine, before entering Mahanoy Creek. The drainage tunnel extends northward through Mahanoy Mountain, into the Shamokin Creek Watershed where it too drains a portion of the Locust Gap Mine Pool.

The average flow from the discharge is 8.74 MGD, and accounts for 10.4 percent of all mine drainage entering Mahanoy Creek. The discharge is very acidic with a pH of 3.7 and an acid content of 161 ppm. The iron and sulfate concentrations are 22.85 and 805 ppm respectively. The discharge, which significantly affects water quality of Mahanoy Creek, contributes 11,337 lbs/day acidity, 1627 lbs/day iron and 53,947 lbs/day of sulfates to the stream.

NORTH FRANKLIN GROUP DISCHARGES

The North Franklin Overflow Discharge (62) is located 3700 feet south along the main road from Trevorton and emerges at the site of an abandoned pump house. The average flow from the discharge is 7.85 MGD and is quite acidic with a pH of 3.8 and acid concentration of 167 ppm. The iron and sulfate contents are 38.16 and 535 ppm respectively. The North Franklin Overflow Discharge which enters Zerbe Run at the western end of Trevorton, accounts for almost all (94%) of the coal mine drainage entering the stream. This discharge fluctuates over a period of time in response to the dry season but has a consistant flow over the short term. The discharge contributes 10,197 lbs/day acidity, 2420 lbs/day iron and 34,735 lbs/day of sulfates to Zerbe Run.

The outfall, which is an overflow of a bore hole which is connected to the Rennie Tunnel at elevation 875 feet ±, drains the North Franklin Mine Pool. Approximately 5.3 square miles of land located south of Trevorton between Big and Mahanoy Mountains contributes its surface runoff and/or its ground water infiltration to the mine pool. Of the total area 3.11 square miles have been strip mined. This stripped area is one of the most severely disturbed portions of the watershed, and is characterized by many huge deep pits, a number of which are waterfilled. The vegetation is very sparse. The North Franklin Overflow Discharge accounts for 9.3 percent of the total mine drainage entering Mahanoy Creek. The flow is considerably higher than Zerbe Run, completely overwhelming the stream which contains fish above its confluence with the discharge.

Also draining the North Franklin Mine Pool are two minor discharges, the South Trevorton and the Sunshine Mine Discharges.

The South Trevorton Discharge (63) is located 2700 feet south along the main raod from Trevorton. The discharge which has a very small flow of 0.17 MGD, is an overflow of the old North Franklin Mine Working at elevation 840 feet ±. The pH is 3.6 and the acid content is 80 ppm. The iron and sulfate contents are 4.06 and 185 ppm. This discharge joins the flow from the North Franklin Overflow Discharge. The South Trevorton Discharge contributes 120 pounds of acidity, 5 pounds of iron and 266 pounds of sulfates to Zerbe Run daily.

The Sunshine Mine Discharge (65) located at the base of Big Mountain, approximately 6000 feet northeast of the confluence of Zerbe Run and Mahanoy Creek, drains the western most portion of the North Franklin Mine Pool. The discharge which emerges from the Sunshine Mine Overflow at elevation 855 feet ±, has an average flow of 0.36 MGD with a pH of 3.7 and an acid concentration of 56 ppm. The iron and sulfate contents are 1.74 and 193 ppm respectively. A portion of the discharge is presently being used by the Sunshine Coal Company to wash coal. The water is retained in a holding pond until it seeps through the impoundment where along with the remainder of the discharge, it enters Zerbe Run. This discharge fluctuates considerably in response to precipitation. During average flow periods, the discharge contributes 148 lbs/day acidity, 5 lbs/day iron and 520 lbs/day of sulfates to Zerbe Run.

WATER QUALITY OF STREAMS

The present stream water quality criteria of concern in this report adopted by the Department of Environmental Resources are:

pH - not less than 6 or greater than 8.5

Total Iron - no values to exceed 1.5 ppm

Total Manganese - no values to exceed 1 ppm

Acidity - no acid

Sulfate - not greater than 250 ppm or natural levels, which ever is greater

Dissolved Solids - not more than 500 ppm as a monthly average

The average water quality of the major polluted streams of the Mahanoy Creek Watershed is summarized as follows:

	EASTERN HALF MAHANOY CREEK	WESTERN HALF MAHANOY CREEK	ZERBE RUN	SHENANDOAH CREEK
Acidity (ppm)	-31* to 60	-22 to 12	3 to 154	28 to 232
pH	4.5 to 6.5	6.4 to 6.8	3.6 to 6.9	4.6 to 5.9
Total Iron	6 to 29	9 to 22	.4 to 13	23 to 38

*Negative acidity represents alkalinity

The North Mahanoy Creek (acidity = 8 ppm, pH = 4.5, total iron = .6 ppm) and Big Run (alkalinity = 219 ppm, pH = 7.4, total iron = 10 ppm) which consists entirely of coal mine drainage, are smaller polluted streams, These polluted streams clearly do not meet the criteria given above.

The clean streams of the watershed include Little Mahanoy Creek, Rattling Run, Waste House Run, Schwaben Creek and Mouse Creek. The water quality of these tributaries which contain fish is characterized by 1) pH values between 6.6 and 7.6, 2) alkalinity values between 0 and 83 ppm, and 3) total iron contents of less than .5 ppm.

Significant changes in water quality occur in several sections of Mahanoy Creek and its tributaries. These changes are primarily the result of one or a combination of the following factors:

a. introduction of coal mine drainage

b. confluences of streams with differences in chemical constituents (dillution effects)

c. domestic sewage

d. influence of acid producing silt and culm banks

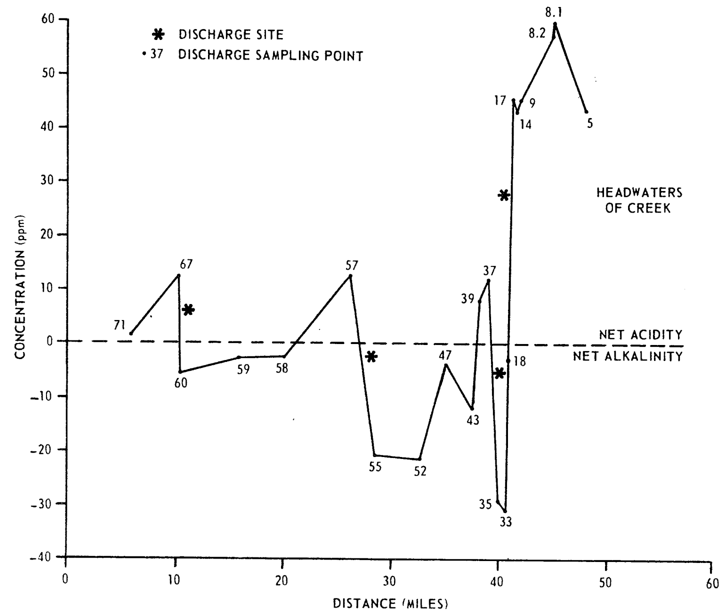
Deterioration in water quality of the Mahanoy Creek occurs in the following areas: vicinity of Mahanoy City, Gilberton, Girardville, East and South of Ashland, at sample Site 55, and at the confluence of Zerbe Run and Mahanoy Creek (Site 67). The changes in water quality of the stream are shown in the three graphs of Figure 17, p. 94. Since Mahanoy Creek originates from an abandoned mine and does not have a significant flow until the Mahanoy City Borehole Discharge enters the stream, the discharge which is located east of Mahanoy City is considered to be the major influence on water quality in the headwaters region. The Gilberton Shaft Discharge with its high concentration of iron and sulfate causes an abrupt increase of these pollutants in the stream downstream of sample Site 8.1. The increase in acidity between Sites 5 and 8.1 is due primarily to pyritic materials along the banks of the stream. In the vicinity of Girardville the Packer No. 5 discharges enter the creek downstream of Site 17. These discharges also increase the iron and sulfate content of Mahanoy Creek. However, the discharges which have a high alkalinity concentration also produces a net alkalinity in the stream. As the Centralia Tunnel Discharge (Site 36) enters the stream the high acidity of the discharge causes a net acidity in the stream east of Ashland which negates the affect of the Packer No. 5 discharges.

South of Ashland between Sites 43 and 47 the effects of silt and culm banks containing pyrite and the oxidation of ferrous iron result in an increase in acidity in the stream. Ferrous iron content decreases from 17 ppm to 9 ppm, a decrease of almost 50 percent. The Little Mahanoy Creek which enters the Mahanoy Creek downstream from sample Site 43 probably contains sufficient dissolved oxygen to cause oxidation reactions to occur. Dilution effects after the confluence of these two streams may also account for part of the reduction in ferrous iron content. The Doutyville Tunnel Discharge, entering

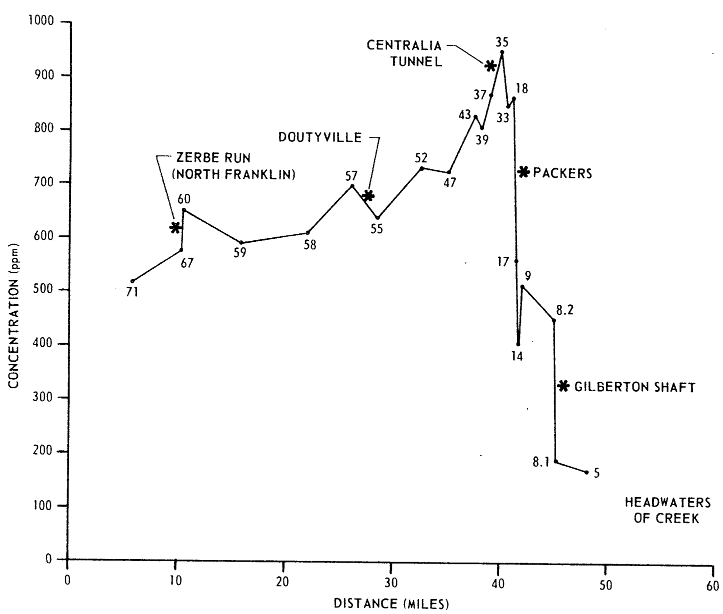
Mahanoy Creek downstream from Site 55, has a considerable influence on water quality of the stream; affecting sulfate, acidity and iron content. The severely polluted Zerbe Run also causes an abrupt change in water quality of Mahanoy Creek after the confluence of the two streams.

Variation of water quality in stream cross sections is a common occurrence in the watershed. This zonation is usually a result of mine discharges and other tributaries entering the streams. In certain cases, these variations have been severe enough to result in the relocation of sampling sites. Data collected at sample Site 67 in the first sampling period indicated a wide range of pH values existed in cross section profiles of Mahanoy Creek (see Figure 18, p. 95). This zonation occurs after the Zerbe Run and Mahanoy Creek confluence. The low pH and small flow of Zerbe Run when compared to the Mahanoy Creek as well as sand bars which delay mixing of the streams have caused the observed zonation. The sand bars tend to separate the currents so that water from Zerbe Run is contained on one side of the Mahanoy Creek preventing mixture of the two flows. Mahanoy Creek has a much higher velocity and volume which also tends to push the water from Zerbe Run to one side of the creek. After relocation 250 feet downstream this zonation was minimized. Although minor, the zonation does persist to the mouth of Mahanoy Creek.

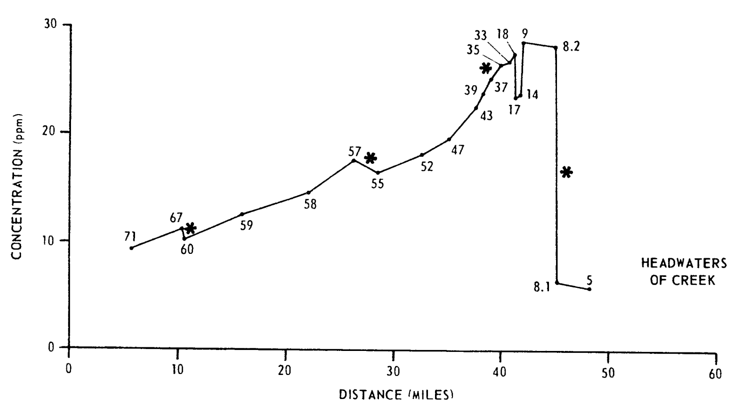
A cross section at the original site for sample Site 57 indicated a zonation existed in the stream. The site was located 75 feet downstream where pH values were consistent (pH = 6.1). The variation in water quality is a result of the Doutyville Tunnel Discharge. While not great, a zonation existed at sample Site 55 which was also relocated. This zonation may be accounted for by the Helfenstein Tunnel Discharge.



GRAPH A.
EFFECTS OF MINE DISCHARGES ON WATER QUALITY OF MAHANOY CREEK IN TERMS OF ACIDITY



GRAPH B.
EFFECTS OF MINE DISCHARGES ON WATER QUALITY OF MAHANOY CREEK IN TERMS OF SULFATE (SO_4^{2-})



GRAPH C.
EFFECTS OF MINE DISCHARGES ON WATER QUALITY OF MAHANOY CREEK IN TERMS OF TOTAL IRON

Figure 17. Effects of mine discharges on water quality of Mahanoy Creek in terms of acidity, total iron and sulfate

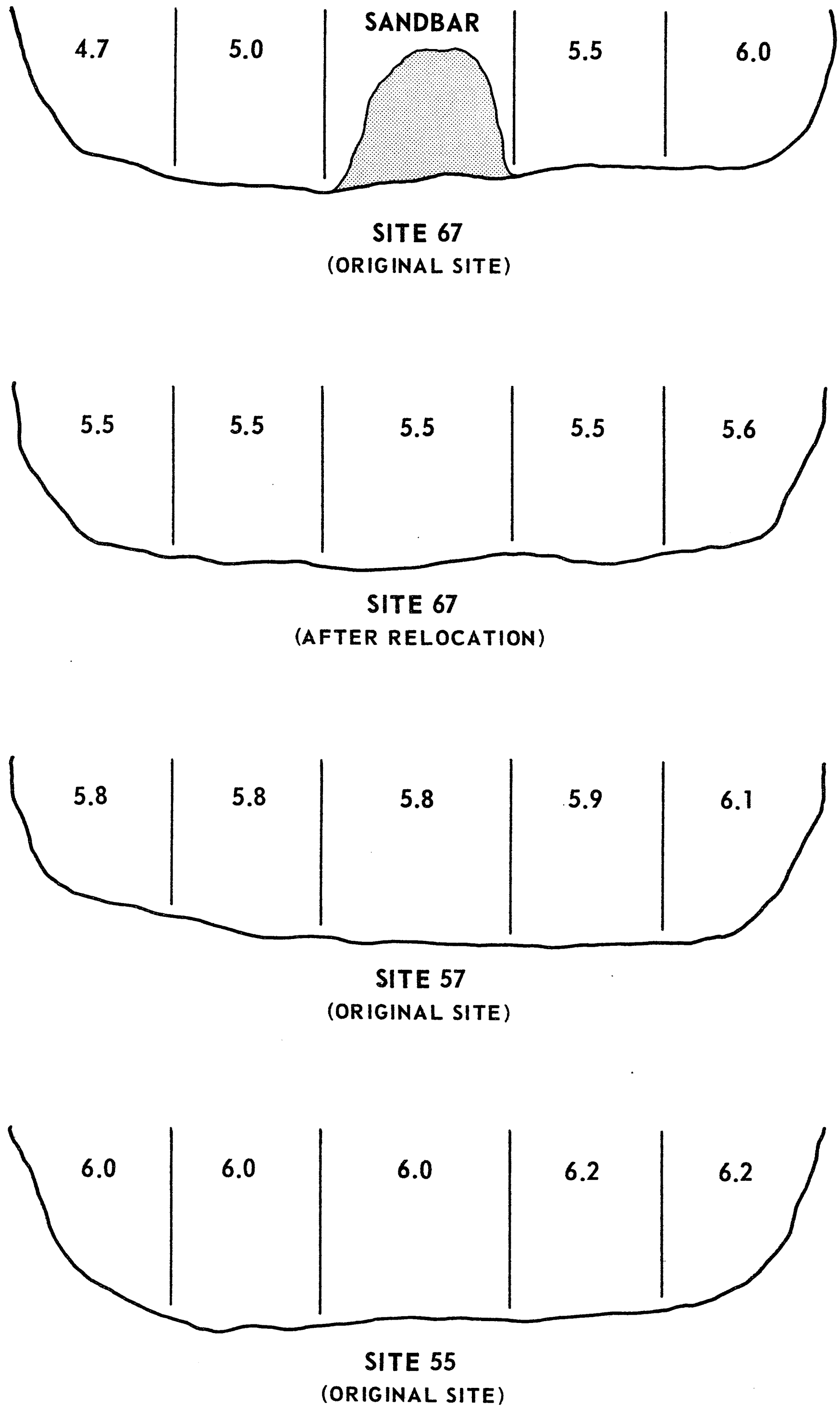


Figure 18. Zonation of water quality in the Mahanoy Creek

RECLAMATION

Strip mining, probably the oldest recorded method of extracting coal, completely alters the topography of the earth's surface, resulting in an area of more or less parallel ridges of waste material and numerous abandoned pits. In addition to destroying all original vegetation, strip mining creates material for new types of soils. Complicating destruction produced by strip mines is underground mining, with its associated refuse piles. The waste material from underground mines usually is left on the land surface since it is not feasible to return this waste rock to its original positions in the mines.

The cast overburden resulting from these operations does not resemble any type of soil, previously classified by the Agricultural Experiment Stations (12). There are no soil horizons or soil structures which soils usually contain. This waste material consists of an unorganized mass of slate and shale, sandstone, conglomerate and associated fines resulting from the processing of coal. Given enough time these new parent materials form completely new types of soil.

The great variations in material covering coal seams also results in a variation of materials in the refuse banks. In addition, a great variability in chemical content occurs in this material. Type and amount of iron sulfides and carbonates vary greatly between slates and other rock types. There is also a vertical change in chemical content within a rock layer as well as its proximity to a coal bed. The result of these variables is a range of pH values in the refuse banks from less than 4 to over 7.

Reclamation of a mined area depends on several factors which can determine the best use of the area. These factors include:

1. percentage of rock and size of rock in the waste material.

2. percentage of soil size particles.

3. amount of sulfides and other toxic materials present.

4. amount of nutrients available for plant growth.

Land use planning is also a factor in deciding the approach to reclaiming an area. Site requirements are different, for example, for agriculture, reforestation, recreation, commercial and industrial purposes. If waste material has a pH not less than 5.5 free of large rocks and enough nutrients to support plant growth, the land could be completely regraded for crop growth. Where material is too large, flattening of the ridges to provide rolling range land could be accomplished. Since grading reduces tree survival due primarily to compaction and lack of moisture, topping of ridges may only be needed while in some cases no grading at all would be required.

The purpose of this project is to provide a plan for abatement of all or at least part of the coal mine pollution which drains from coal mine shafts, access or drainage tunnels, and discharges from abandoned mine workings. Most of the mine water from these sources originates in the many open and abandoned strip mines in the watershed, especially in areas where stripping operations have been extensive. Underground mining is so extensive that the numerous access and drainage tunnels, slopes, drifts, air vents and barrier pillar breaches have made the use of mine seals, in most cases, impractical.

Prevention of the formation of coal mine drainage has been the approach taken in this report for the abatement plans. This is accomplished through reduction of the flow from the discharges where economically and physically possible. It is only after this consideration that treatment of the remaining discharges was considered. The major preventive measures recommended in the watershed are strip mine reclamation and surface water diversion. The reclamation of strip mines by backfilling, regrading, and planting operations reduces the volume of the discharges. Additional side effects include attraction of wildlife, the land becomes more aesthetically pleasing, may provide land for agricultural purposes, and reduction of the safety hazards that crop falls and other mining features present.

The abatement techniques evaluated in the Mahanoy Creek Watershed were deep mine sealing, strip mine reclamation (backfilling, regrading, planting), surface water diversion (diversion ditches, flumes), stream modification (channel improvement, removing adjacent silt piles), burial of refuse, and treatment methods.

This report does not recommend that all stripped areas are to be reclaimed. In some areas backfilling is not feasible due to the dimensions of the strip pits and cost. In others the amount of money expended does not justify the slight reduction in flow which results (cost effectiveness).

In addition to those given in the reclamation section, other decision variables in determining which areas are to be reclaimed follow:

1. Cost effectiveness including percent reduction in total pollution load, size of area affected (i.e. length of stream), size and distribution of strip pits, amount of surface runoff pits intercept and amount of fill required.

2. Accessibility

3. Actual cost

4. Property ownerships

ABATEMENT

Three abatement plans are given in this report. The discharges have been grouped together where possible to develop an effective abatement program. Description of the abatement plan for each discharge or group of discharges have been described to give a background of what can be accomplished in the watershed (see following sections). The Abatement Plan I includes all the areas indicated in those descriptions with the data given in Table 9, p. 101, and the locations of these recommended reclamation areas shown in Plates A and B.

The general abatement procedures for Abatement Plan I given in Table 9, include stream modification, backfilling, and diversion ditches which are not associated with any one particular discharge. In these cases stream modification is recommended to control silt and prevent water percolating through the stream bed and entering the mine pool. The areas to be reclaimed are the north portion of R25, R36, and R41 which affects 9 strip pits. A cropfall located at Park Place is recommended to be backfilled. A total of 3800 feet of stream modification is recommended for the North Mahanoy Creek to prevent the stream from picking up acid from pyritic materials as well as silt. West of Mahanoy City along the Mahanoy Creek the channel should be modified for the same reasons. In addition 12,600 feet of stream modification along the Shenandoah Creek would decrease the amount of water entering the underlying mine pools and decrease the silt content of the stream. Along the Mahanoy Creek south of Ashland 3500 feet of stream bed could be modified to decrease silt entering the creek.

MAHANOY CITY GROUP DISCHARGES

The Mahanoy City Group consists of both the headwaters of Mahanoy Creek and the Mahanoy City Bore Hole Discharges. These discharges are the major polluters of Mahanoy Creek from its headwaters, downstream to the town of Gilberton. The headwaters of Mahanoy Creek were originally located along the northern base of Vulcan Hill, but the construction of a fill area for a railroad in the region prevents that area from draining into Mahanoy Creek. The water, which flows only during wet periods, presently collects behind the fill area and infiltrates into the Vulcan-Buck Mountain mine pool. It is recommended that 1000 feet of stream channel be constructed through the fill area (near R45) to drain the water to Mahanoy Creek. This would reduce the flow from the discharges by an estimated .23 MGD.

The backfilling, regrading and seeding of 180 acres of strip mines, along with the construction of 8300 feet of diversion ditch will further reduce the flow from the discharges by approximately 0.43 MGD. A volume of 1,654,085 cubic yards of fill material is needed to backfill 16 strip pits. The pits are scattered throughout the contributing area, and all are either moderate or small in size. The reclamation areas included are R42, R43, R44, R45, R46, and R47.

The total reduction from the discharge is 0.66 MGD, or a percentage decrease of 8.8. The pollution load will be reduced by 629 lbs/day acidity, 64 lbs/day iron, and 1313 lbs/day of sulfates. The abatement measures should eliminate the flow from the Mahanoy Creek Headwaters Discharge.

GILBERTON SHAFT DISCHARGE

When the Gilberton Shaft Pump House is in operation, the discharge drastically affects the water quality of Mahanoy Creek from Gilberton downstream to its confluence with Shenandoah Creek. By reducing the amount of water entering the mine pools which contribute to the discharge, the levels of the mine pools can be lowered, therefore reducing the amount of time the pump must be in operation.

A total area of 124 acres is recommended to be backfilled, regraded, and seeded. The volume of fill required to backfill the 10 strip pits in the region is 1,456,434 cubic yards. Reclamation areas R32, R34 and the eastern portion of R26 are those effecting this discharge. The eastern portion of R26 has highest priority; here pits along the base of Ashland Mountain, just south of Mahanoy Plane trap surface runoff from the mountain above. A diversion ditch, 6900 feet long, will be constructed above the high wall of this area to deliver the water safely across the reclaimed area to Mahanoy Creek. The backfilling measures will reduce the overall flow of the Gilberton Shaft Discharge by 0.41 MGD, which is a reduction of 7.1 percent. This reduction in flow will result in decreasing by 251 lbs/day net acidity, 270 lbs/day iron, and 3929 lbs/day sulfates, the amount of these constituents which enter Mahanoy Creek.

GIRARDVILLE DISCHARGES

The Girardville Discharges combine to generate 2.96 MGD of acid mine drainage into Mahanoy Creek. To reduce the flow from the discharges approximately 138 acres located at the base of Ashland Mountain south and southeast of Girardville, should be backfilled, regraded, and seeded. The area includes 5 strip pits which will require 1,422,455 cubic yards of fill material. The reclamation areas affecting these discharges are the eastern portion of R23, R24, and the western portion of R26. Diversion ditches totalling 8500 feet will be constructed on the highwalls of all reclamation areas. This measure will allow all of Ashland Mountain to drain unimpeded into Mahanoy Creek. The discharges will be reduced by an estimated 0.35 MGD or 11.8 percent. The amount of pollutants entering Mahanoy Creek can be reduced by approximately 64 lbs/day net acidity, 66 lbs/day iron, and 1303 lbs/day sulfates.

PACKER GROUP DISCHARGES

The major abatement measure for the Packer Discharges is the relocation and diversion of a series of unpolluted streams. The streams, which enter the mine pool system via strip pits, cropfalls and rock fractures, will be safely routed to Mahanoy Creek or one of its tributaries.

A cropfall located 1.5 miles northwest of Mahanoy City, intercepts Waste House Run and directs the water to the Knickerbocker Mine Pool. The cropfall should he backfilled and a combination flume and channel constructed to deliver the stream 11,300 feet through a large stripped area to Mahanoy Creek. The stream channel is located south of area R35. The Abatement measure will reduce the flow from the Packer Discharges by 2.94 MGD, in addition to diluting the pollution presently in Mahanoy Creek.

Approximately 2000 feet northeast of the Village of Lost Creek the stream of Lost Creek enters a strip pit. Once the water enters the pit, it quickly infiltrates to the Weston Mine Pool. The pit and the surrounding area should be backfilled, regraded and seeded. A newly constructed stream channel roughly 2300 feet long, should direct the water to Shenandoah Creek. Implementing this measure will reduce the flow of the Packer Discharges by 0.43 MGD.

An unnamed tributary entering North Mahanoy Creek 4500 feet north of Mahanoy City, loses a significant portion of its flow by infiltration through the streambed to the Knickerbocker and North Mahanoy Mine Pools. By lining 2400 feet of stream, the flow from the Packer Discharges can be reduced by an estimated 0.16 MGD. The three measures just mentioned will reduce the flow of the discharge by 12 percent.

A project to extinguish a mine fire at the northern edge of Shenandoah is presently being completed by the Department of Environmental Resources. During the length of the project the water from Kehley Run has been allowed to flow into the work area, where it quickly enters the Kehley Run Mine Pool. When work has been completed, measures should be taken to insure that Kehley Run will be safely routed through the project area and into Shenandoah Creek.

Within the area drained by the Packer Discharges are a number of stripped areas that are especially susceptible to large amounts of surface water infiltration. Although not economically and physically feasible to reclaim all these areas, a total of 961 acres are recommended to be backfilled, regraded, and seeded. In the areas to be backfilled are 101 strip pits requiring 8,150,000 cubic yards of fill material. A number of the pits are quite large, needing nearly 1,000,000 cubic yards of fill. Much of the area to be reclaimed is located north of Mahanoy City. Reclamation areas included with this project are R28, R29, R30, R31, R33, R35, R37, R38, R39, R40. Accompanying the backfilling will be the construction of approximately 9600 feet of diversion ditch, to bring surface runoff safely across regraded areas. These abatement measures will reduce the flow from the Packer Discharges by an additional 1.12 MGD.

In addition to reducing the flow of the Packer No. 5A and 5B Discharges, the abatement measures will also effect four other discharges. The flow from the Lost Creek, Lost Creek Ball Field, Connerton No. 1 and the Connerton No. 2 Discharges will be eliminated or greatly reduced. The total reduction in flow for the Packer Discharges will be 4.65 MGD, a decrease of 16.2 percent. The reduction in pollutants will be 1170 lbs/day iron and 43,872 lbs/day sulfates, with an associated decrease of 4508 lbs/day net alkalinity.

The Packer Discharges which have alkaline characteristics, lend themselves to treatment utilizing aeration and sedimentation. For alkaline discharges this method is both effective and relatively inexpensive. Although the flow of the discharges requires large settling ponds, sufficient area exists in the eastern section of Girardville to construct the ponds. Once the flow has been reduced by previously mentioned abatement techniques, a treatment facility having a 20 MGD capacity will be required.

HAMMOND DISCHARGES

Although the entire region drained by the Hammond Discharges is greatly disrupted, only two areas are critical enough to justify reclamation. Areas R27 and the southern portion of R25 are designated to be backfilled, regraded and seeded. These regions encompass 118 acres and include 10 strip pits requiring 498,838 cubic yards of fill material. The flow reduction will be 0.16 MGD, a decrease of 6.3 percent. The Hammond Discharge (26) should be eliminated. The pollution these discharges contribute to Shenandoah Creek will be reduced by 62 lbs/day iron, 1306 lbs/day sulfates, as well as 95 lbs/day net alkalinity.

An aeration system is recommended for the Hammond Bore Hole Discharge, an alkaline discharge, to eliminate this source of iron to the Shenandoah Creek.

SOUTH PRESTON DISCHARGE

The flow from this discharge can be significantly reduced utilizing backfilling techniques. Areas totalling 100 acres, and containing 13 strip pits requiring 616,278 cubic yards of fill material, are recommended to be backfilled, regraded and seeded. The areas are located along the base of Ashland Mountain, and reclaiming them would allow the entire northern slope of the mountain to drain safely into Mahanoy Creek. The reclamation areas include R21, R22, and the western portion of R23. A diversion ditch along the highwall of area R23, 2200 feet long, should be constructed. An estimated reduction in flow of 0.28 MGD or 26.9 percent, can be achieved. This would result in a reduction of pollutants entering Mahanoy Creek by 31 lbs/day iron and 501 lbs/day sulfates, as well as reducing the amount of alkalinity by 78 lbs/day.

CENTRALIA TUNNEL DISCHARGE

After careful examination it was determined that the construction of a treatment facility is the only effective and economic means, of significantly reducing the effects of the AMD pollution from the Centralia Tunnel Discharge. Because of the extent and severity of the strippings, it is unrealistic to utilize strip mine reclamation as the major abatement method. The discharge, with its large flow and poor water quality, could not be reduced sufficiently by normal backfilling techniques to have a significant effect on Mahanoy Creek. Another factor considered is that a portion of the area contributing to the discharge lies in the Shamokin Creek Watershed, which is outside the reconnaissance region of this study. The treatment facility will involve the lime neutralization and sedimentation process.

To increase the value of the region, 386 acres are recommended to be backfilled, regraded and seeded. The area to be reclaimed, R19, contains 10 strip pits requiring 1,650,363 cubic yards of fill material; also accompanying this measure will be the installation of 3300 feet of diversion ditch. The flow from the discharge will be reduced by 0.45 MGD, a drop of 4.6 percent, resulting in the reduction of the amount of pollution entering Mahanoy Creek by 799 lbs/day acidity, 39 lbs/day iron and 2128 lbs/day sulfates.

BAST GROUP DISCHARGES

The major abatement measure for the Bast Discharges is the backfilling, regrading and seeding of 342 acres of strip mines. The areas encompass 20 strip pits which require 4,404,744 cubic yards of fill material, with one pit alone requiring over 1.9 million cubic yards. The reclamation areas effecting these discharges include R14, R16, R17, R18 and R20. Accompanying the backfilling will be the construction of 3600 feet of diversion ditch.

Implementing the abatement measures will reduce the flow of the discharges by 0.53 MGD, a decrease of 15.7 percent. In addition, the North Girardville Discharge may be eliminated. The reduction of pollutants entering Mahanoy Creek will be 11 lbs/day net acidity, 136 lbs/day iron, and 3032 lbs/day sulfates.

ASHLAND DISCHARGES

For these discharges, two strip pits, encompassing a total area of 35 acres, are recommended to be backfilled, regraded and seeded. The pits, which are located in reclamation areas R15, and the eastern portion of R13, will require 785,145 cubic yards of fill material. The abatement measures will reduce the flow of the discharges by approximately 0.05 MGD, but because of the location of the discharges, only the Ashland No. 3 Discharge is expected to be affected. The Ashland No. 3 Discharge would be reduced by 26.3 percent.

BIG RUN DISCHARGES

To reduce the flow of the Big Run Discharges, areas totalling 350 acres are recommended to be backfilled, regraded, and seeded. Included in the total area are 40 strip pits requiring 2,029,090 cubic yards of fill. Most of the land to be reclaimed lies northwest of Ashland, and includes the following reclamation areas: R9, R10, R11, R12, and the western portion of R13. A diversion ditch 2,700 feet long, should be constructed along the highwall in area R10. These reclamation measures should reduce the flow of the discharges by 0.71 MGD, a decrease of 23.7 percent. The resulting reduction in the mine pool level could greatly reduce the Big Run 2 Discharge (49) which is located near the top of the mine pool and could even eliminate the discharge. The reduction of pollutants entering Mahanoy Creek from these discharges would be 171 lbs/day iron, and 5442 lbs/day sulfates, along with a reduction in alkalinity of 2148 lbs/day.

MOWRY DISCHARGE

A total area of 121 acres is recommended to be backfilled, regraded, and seeded. The region, which includes reclamation areas R7 and R8, contains 23 strip pits requiring 521,620 cubic yards of fill. The reclamation measures will reduce the flow of the discharge by 0.13 MGD. Because of the small flow from the discharge and large area to be backfilled, a large percentage decrease may be achieved, in this case the reduction in flow is 92.8 percent. The resultant pollution reductions would be 54 lbs/day acidity, 6 lbs/day iron and 187 lbs/day sulfates.

DOUTYVILLE TUNNEL DISCHARGES

The large volume and poor quality of water flowing from the Doutyville Drainage Tunnel, seriously affect the lower reaches of Mahanoy Creek. Although the contributing area to the discharge lies entirely outside the Mahanoy Creek Watershed, the discharge is too critical to be ignored. As a result, it is recommended that a treatment facility be constructed to reduce or eliminate the harmful characteristics of the Doutyville Tunnel Discharge. Improved quality of the discharge would be evident in Mahanoy Creek from the plant's outfall downstream to the mouth. The treatment facility should utilize the lime neutralization and sedimentation process.

NORTH FRANKLIN GROUP DISCHARGES

As previously mentioned the large flow from the North Franklin Overflow Discharge, which accounts for nearly all of the AMD pollution entering Zerbe Run, has extremely poor water quality. In addition to polluting almost the entire length of Zerbe Run, the discharge also seriously affects the water quality of Mahanoy Creek. Backfilling, because of the totally disrupted drainage pattern in most of the stripped regions contributing to the discharge, is of only limited value in reducing the flow of the discharge. Because of these factors, a lime neutralization treatment facility is recommended to be constructed to treat the North Franklin Overflow Discharge. A treatment facility would bring the entire length of Zerbe Run up to acceptable water quality standards.

To reduce the amount of flow that the treatment facility must handle other abatement measures should be considered. A stream which drains the eastern portion of the stripped area, is presently being directed into an abandoned mine opening. Routing the stream past the mine opening and safely into Zerbe Run will reduce the flow of the discharge by 0.81 MGD. The length of stream modification required includes a section west of Trevorton which eliminates a serious silt problem. By reclaiming area R1 located at the western edge of the stripped region and areas R2, R3, R4, R5 and R6 located south and southwest of Trevorton the flow from the discharges can be significantly reduced. These areas encompass 621 acres, and include 65 strip pits that require 10,937,000 cubic yards of fill material. Accompanying the backfilling will be the construction of a diversion ditch 3300 feet long, on the highwall of the eastern portion of reclamation area R4. Backfilling area R1 will reduce the flow of the Sunshine Mine Discharge while the remainder of the reclamation areas will affect the North Franklin Overflow and the South Trevorton Discharges. The reduction in flow will be 0.60 MGD, making a total reduction of 16.8 percent. The South Trevorton Discharge may be eliminated. These measures would reduce the amounts of pollutants entering Mahanoy Creek by 1761 lbs/day acidity, 409 lbs/day iron, and 5978 lbs/day sulfates.

MINE SEALS

The use of mine seals as an abatement technique was evaluated for the following mine discharges: Sunshine (65), Doutyville Tunnel (56), Helfenstein Tunnel (54), Mowry (53), Big Run No. 2 (49), Bast (38), Centralia Tunnel (36), North Preston (34), South Preston (32), North Girardville (31), Lost Creek (21), and Headwaters Mahanoy Creek (1). Due to a hydraulic head of between 316-420 feet mine seals were not feasible for the Doutyville, Helfenstein, and Centralia Tunnels. A mine seal for Big Run No. 2 Discharge was not considered feasible due to the interconnection of this discharge with Big Run No. 1 (48) Discharge. Any attempt to seal the slope at discharge 49 would result in the mine water discharging at sample Site 48. The danger of mine seal failure to surrounding communities and the existence of several seepage discharges in the surrounding areas have indicated that mine seals for the Bast, North Preston, South Preston, North Girardville, and Lost Creek discharges are not feasible. Seepage areas at the Bast Discharge occur not only at points along the hillside but also at several locations in the adjacent roadways. In addition, several mine openings (mine slopes and air vents) exist near the Lost Creek and South Preston discharges which could easily become new discharge points as a result of a mine seal being constructed. Several mine slopes at elevations with 20-30 feet above the current discharge point for the Headwaters Mahanoy Creek Discharge (1) indicate that the construction of a mine seal for discharge 1 will result in new discharge locations and therefore will not abate mine drainage.

The placement of double bulkhead mine seals with associated grout curtains will be able to successfully abate mine drainage of two mine discharges in the watershed. A mine seal for the Mowry Discharge (53), while eliminating the discharge in the Mahanoy Creek, may eventually reach a mine pool level which will result in an additional discharge in the Shamokin Watershed located to the north of the Mahanoy Creek Watershed. The Sunshine Discharge (65) mine seal will flood mine workings which are isolated from the mine workings of several active mines in the region. The Sunshine Mine probably will contain sufficient volume to handle the flooding of the mines. The estimated hydraulic head will be 90-100 feet. However, there may be the possibility of a discharge eventually appearing at a mine opening located 150-175 feet above the current discharge. More detailed studies should be undertaken before the decision to install these mine seals is made.

ABATEMENT PLAN BREAKDOWNS

Abatement Plan I shown in Tables 9 and 10 at an expenditure of over 31,000,000 dollars only results in a reduction of the flow of mine drainage by 13 percent. The reduction of pollutants entering Mahanoy Creek will be approximately 4026 lbs/day acid, 2425 lbs/day iron and 69,037 lbs/day sulfates, along with a reduction of 8185 lbs/day alkalinity. However, the reduction of flow, and therefore of the pollutants could be higher due to the longterm effect of gradually lowering the mine pool levels. Effects of the elimination of water introduced by Waste House Run and other streams into the mines (see preceding section) may be larger due to concentrated flows created by heavy rainfalls. The heavy rainfall results in a much greater amount of surface runoff entering the streams which eventually enters the mine openings. Thus a larger than expected percentage of the average rainfall in the watershed is introduced during a short period of time. A one inch rainfall concentrated over one hour contributes more water to the stream than a one inch rainfall concentrated over a 24 hour period. This may result in some discharges being reduced to a greater degree than the reclamation procedures indicate. Examples of these discharges include the South Preston, Big Run No. 1 and 2, and the Packer Discharge Group. These comments are also applicable to the other Abatement Plans.

Since a large percentage of the total pollution load is represented by only a few discharges, Abatement Plan II considers only five of the largest discharges which are equivalent to approximately 72 percent of the mine drainage flow (see Table 11, p. 111). After surface reclamation procedures have been completed an aeration system for the Packer Discharges and a treatment system for the North Franklin Overflow should be installed. The treatment system for the North Franklin Overflow will clean up an entire subwatershed. The aeration system will eliminate a major iron source to the Mahanoy

Creek. This abatement plan only reduces the total mine drainage flow by 45.2 percent at a cost of 21,352,696 dollars. The plan will reduce the pollution load of the watershed by 12,443 lbs/day acid, 9836 lbs/day iron, and 299,735 lbs/day sulfate.

As a result of the investigations of this report as well as previous experience in this field, abatement plans based entirely on preventive measures for this watershed are not cost effective and are impractical. The net reduction in flow of the discharges is so small that the condition of the watershed with respect to coal mine drainage would not appreciably change, although the physical features of the area would be vastly improved.

The most practical and cost effective of the various abatement plans considered is shown in Table 12, p. 112. Abatement Plan III is a combination of preventive measures supplemented by treatment methods. Approximately 70 percent (58.62 MGD) of the total mine drainage flow is reduced at a cost of 6,419,567 dollars which is considerably less than the first two plans. It is felt by the engineer that reclamation of stripped areas is not cost effective for the Packer Discharge Group and has not been considered in this plan. Thus the capital costs for the Packer Discharge Group only includes the construction of 16,000 feet of flumes and stream channels at a cost of 288,000 dollars, along with the construction of a 20 MGD aeration treatment system. The construction of flumes and channels will reduce the flows of the Lost Creek, Lost Creek Ball Field and Connerton Nos. 1 and 2 Discharges by approximately 1.2 MGD, in addition to affecting the Packer No. 5A and 5B Discharges. The Centralia and Doutyville Tunnels and North Franklin Overflow discharges have been included due to their high concentrations of acid. These discharges have a major impact on the stream water quality of the watershed. Of particular importance is the North Franklin Overflow which is the only appreciable discharge entering Zerbe Run. The discharge affecting over 4.75 miles of stream not only deteriorates an entire subwatershed, but causes a significant zonation in the Mahanoy Creek after Zerbe Run enters the creek.

The annual costs of the treatment systems after amortization are given in the following:

SYSTEM	PROJECT COST	ANNUAL COST*	OPERATING COST
North Franklin Overflow (10MGD)	$157,600	$16,657	$35,800
Centralia Tunnel (10MGD)	157,600	16,657	45,800
Doutyville Tunnel (10MGD)	162,600	17,185	39,300
Hammond (3MGD)	53,500	5,654	6,000
Packer No. 5 (20MGD)	260,000	27,482	35,000

* Annual cost calculated on basis of 8.5 percent interest rate and 20 year repayment period. Operating cost includes cost of lime.

TABLE 9

ABATEMENT PLAN I

DISCHARGE GROUP	FILL REQ'D (YD^3)	COST (\$0.75/YD^3)	STREAM MODIFI-CATION (FEET)	COST* (\$18/LF)	AREA SEEDED (ACRES)	COST (\$700/AC)	AREA PLANTED (ACRES)	COST (\$90/AC)	DIVERSION DITCH (FEET)	COST (\$3.25/LF)	TOTAL COST
Mahanoy City											
Headwater Mahanoy Creek											
Mahanoy City Bore Holes	1,654,085	1,240,564	1,000	18,000	180	126,000	48	4,320	8,300	26,975	1,415,859
Gilberton Shaft Discharge	1,456,434	1,092,326	2,200	39,600	124	86,800	56	5,040	6,900	22,425	1,236,191
Girardville No's 1, 2, 3, and 4	1,422,455	1,066,841	0	0	138	96,600	61	5,490	8,500	27,625	1,196,556
Packer Discharges											
Packer No. 5A, 5B											
Lost Creek Ball Field											
Lost Creek											
Connerton No's 1 and 2	8,769,298	6,576,974	33,100	595,800	961	672,700	500	45,000	9,600	31,200	7,921,674
Hammond											
Hammond Bore Hole											
Hammond Discharge	498,838	374,129	0	0	118	82,600	118	10,620	0	0	467,349
South Preston Discharge	616,278	462,209	0	0	100	70,000	30	2,700	2,200	7,150	542,059
Centralia Tunnel	1,650,363	1,237,772	0	0	386	270,200	335	30,150	3,300	10,725	1,548,847
Bast											
Bast Discharge, North Girardville, North Preston	4,406,744	3,305,058	0	0	342	239,400	150	13,500	3,600	11,700	3,569,658
Ashland No's 1, 2, and 3	785,145	588,859	6,200	111,600	35	24,500	20	1,800	0	0	726,759
Big Run No's 1 and 2 Discharge	2,029,090	1,521,818	0	0	350	245,000	200	18,000	2,700	8,775	1,793,593
Mowry Discharge	521,620	391,215	0	0	121	84,700	41	3,690	0	0	479,605
North Franklin											
North Franklin Overflow											
South Trevorton											
Sunshine Mine	10,937,000	8,202,750	6,600	118,800	621	434,700	395	35,550	3,300	10,725	8,802,525
General	1,521,068	1,140,801	19,900	358,200	114	79,800	59	5,310	9,600	31,200	1,615,311
TOTALS	36,268,418	27,201,316	69,000	1,242,000	3,590	2,513,000	2,013	181,170	58,000	188,500	31,325,986

* Varies greatly with type and size of stream modification, \$18/LF is an average value.

TABLE 10

ABATEMENT PLAN I

DISCHARGES	FLOW (MGD)	POLLUTION LOAD (POUNDS/DAY)				REDUCTION IN POLLUTION LOAD					TOTAL COST, $	COST UNIT REDUCED				
		ACID	ALK	IRON	SULFATES	FLOW (MGD)	POUNDS/DAY ACID	ALK	IRON	SULFATES		FLOW $/1000 GAL	ACID $/LB	ALK $/LB	IRON $/LB	SULFATE $/LB
Mahanoy City Group	7.55	7,193	–	727	15,021	0.66	629	–	64	1,313	1,415,859	2,145	2,250	–	22,122	1,078
Gilberton Shaft Discharges	5.76	7,643	4,109	3,793	55,185	0.41	544	293	270	3,929	1,246,191	3,039	2,291	4,253	4,616	317
Girardville Discharges	2.96	581	37	561	11,026	0.35	69	4	66	1,303	1,196,556	3,419	17,341	229,139	18,130	918
Packer Discharge Group	28.8	35	27,929	7,239	271,486	4.65	6	5,411	1,170	43,845	7,921,674	1,704	1,302,279	1,464	6,771	181
Hammond Discharges	2.54	35	1,542	981	20,729	0.16	2	97	62	1,306	467,349	2,920	233,675	4,818	7,538	358
South Preston Discharges	1.04	–	291	114	1,864	0.28	–	78	31	501	542,059	1,936	–	6,949	17,486	1,082
Centralia Tunnel Discharges	9.83	17,453	–	858	46,453	0.45	799	–	39	2,128	1,548,847	3,412	1,938	–	39,714	728
Bast Group	3.38	1,033	965	868	19,339	0.53	162	151	136	3,032	3,569,658	6,735	22,034	23,640	26,247	1,177
Ashland Discharges	0.42	56	367	51	1,453	0.05[1]	–	3[1]	1[1]	73[1]	726,759	14,535	–	242,253	726,759	9,956
Big Run Discharges	3.00	–	9,063	722	22,961	0.71	–	2,148	171	5,442	1,793,593	2,526	–	835	10,488	330
Mowry Discharge	0.14	58	–	6	202	0.13	54	–	6	187	479,605	3,689	8,882	–	79,934	2,565
North Franklin Group	8.38	10,465	–	2,430	35,521	1.41	1,761	–	409	5,978	8,802,525	6,243	4,999	–	21,522	1,472
General											1,615,311					
TOTAL	73.8	44,552	44,303	18,350	501,240	9.79	4,026	8,185	2,425	69,037	31,325,986	3,200	7,781	3,827	12,918	454

1 Abatement measures will affect only the Ashland No. 3 Discharge.

TABLE 11

ABATEMENT PLAN II

DISCHARGES	REDUCTION IN POLLUTION LOAD (POUNDS/DAY)				COST $	COST UNIT REDUCED			
	ACID	ALK	IRON	SULFATES		ACID $/LB	ALK $/LB	IRON $/LB	SULFATE $/LB
Mahanoy City Group Reclamation	629	–	64	1,313	1,415,859	2,250	–	22,122	1,078
Gilberton Shaft Discharge Reclamation	544	293	270	3,929	1,246,191	2,291	4,253	4,616	317
Packer Discharge Group Reclamation Aeration System	6	25,517	7,033	256,844	7,921,674 260,000	1,363,612	320	1,163	32
Centralia Tunnel Discharge	799	–	39	2,128	1,548,847	1,938	–	39,714	728
North Franklin Group Reclamation Treatment System	10,465	–	2,430	35,521	8,802,525 157,600	856	–	3,687	252
TOTAL	12,443	25,810	9,836	299,735	21,352,696	1,716	827	2,170	71

TABLE 12

ABATEMENT PLAN III

DISCHARGES	REDUCTION IN POLLUTION LOAD (POUNDS/DAY)				COST $	COST/UNIT REDUCED			
	ACID	ALK	IRON	SULFATES		ACID $/LB	ALK $/LB	IRON $/LB	SULFATES $/LB
Mahanoy City Group Reclamation	629	–	64	1,313	1,415,859	2,250	–	22,122	1,078
Girardville Discharges Reclamation	69	4	66	1,303	1,196,556	17,341	229,139	18,130	918
Packer Discharge Group Reclamation Aeration System	5	25,300	7,010	256,000	288,000 260,000	109,600	22	78	2
Hammond Discharges Aeration System	35	1,542	981	20,729	53,500	1,529	35	55	3
South Preston Reclamation	–	78	31	501	542,059	–	6,949	17,486	1,082
Centralia Tunnel Discharge Treatment System	17,453	–	858	46,453	157,600	9	–	184	3
Big Run Discharges Reclamation	–	2,148	171	5,442	1,793,593	–	835	10,488	330

TABLE 12 (Continued)

DISCHARGES	REDUCTION IN POLLUTION LOAD (POUNDS/DAY)				COST $	COST/UNIT REDUCED			
	ACID	ALK	IRON	SULFATES		ACID $/LB	ALK $/LB	IRON $/LB	SULFATES $/LB
Mowry Discharge Mine Seal	58	–	6	202	18,500	319	–	3,083	92
Doutyville Tunnel Treatment System	11,337	–	1,627	53,947	162,600	14	–	100	3
North Franklin Group Treatment System Mine Seal	10,465	–	2,430	35,521	157,600 15,500	17	–	71	5
General Steam Modification					358,200				
TOTAL	40,051	29,072	13,244	421,411	6,419,567	160	220	484	15

As in the first abatement plan, general stream modification is included in Abatement Plan III. The same descriptions given in Abatement Plan I for this procedure are applicable in the third plan.

Aeration is recommended for the Hammond Bore Hole which contains very high amounts of iron. It is included in this plan as a result of the high concentration of iron which pollutes the Shenandoah Creek. The aeration system for the Packer Discharges will eliminate a major source of iron to Mahanoy Creek. These discharges are also the major influence on iron content in the creek from Girardville to the mouth of Mahanoy Creek.

The abatement of approximately 70 percent of the total mine drainage flow does not take into account certain discharges which could be eliminated or greatly reduced as pointed out in the preceding sections on abatement of the groups of discharges. The total reduction of pollutants is 40.051 lbs/day acid, 13,244 lbs/day iron, 421,411 lbs/day sulfates along with a reduction of alkalinity of 29,072 lbs/day. Therefore, the Abatement Plan III is the more realistic and cost effective of the several plans considered.

An all gravity collection system for mine discharges 15, 16, 25, 28, 29, 31, 32, 34, 36, 38, 40, 41, and 42 was considered as an option to Abatement Plan III. This collection system would combine acid and alkaline discharges to form a net alkaline discharge which would require aeration and sedimentation to remove iron and sulfate. The treatment plant would be located in the area northwest of Gordon, PA, on the west side of the Mahanoy Creek. The system would replace the treatment systems of Centralia Tunnel, Hammond Bore Hole, and Packer No. 5 Discharges. The initial project cost of the collection system, however, is much greater. The collection system installation will cost $2,440,000 with the associated treatment system costing $1,139,000 for a total initial cost of $3,579,000. The yearly operating cost will be close to $60,000. The disadvantages of the system include: the problem of overflows at the pollution source and leaks and breaks in the pipe; the breakdown of the system would have a major affect on the quality of the Mahanoy Creek while breakdowns in any one of the three individual systems would have a much less impact; sludge disposal at the treatment site is a serious problem; and cost. Although the collection system will eliminate more discharges than the individual systems, the disadvantages of the system indicate that individual treatment systems should be the abatement approach.

In addition to the three abatement plans presented an abatement technique connecting the Girard Mine Pool to the Packer No. 5 Mine Pool and the connection of the Vulcan-Buck Mountain Mine Pool to the Primrose Mine Pool will eliminate several discharges. Connecting the Girard Mine Pool to the Packer No. 5 Mine Pool will involve angle drilling (35°-45°) of 2 bore holes approximately 800 feet to lower the Girard Mine Pool level. Lowering the mine pool level will eliminate discharges 10, 11, 12, and 13. The cost of the project is estimated to be $65,000. Using the same method and drilling for 500 feet will lower the Vulcan-Buck Mountain Mine Pool. This will eliminate the Mahanoy City Bore Hole and Headwaters Mahanoy Creek Discharges. The mine water will enter the Primrose Mine Pool and eventually flow into the Packer No. 5 Discharges. The cost of this project is estimated to be $45,000. Changes in layers of the mine pools as well as a more detailed study to determine other effects should be conducted before beginning both of these drilling projects. The drilling projects can be accomplished in conjunction with any of the three abatement plans.

The total initial project costs and annual costs of the three abatement plans have been compared in Table 13. The total annual cost data indicate that Abatement Plan III is the most cost effective plan. The operating costs of the treatment systems can be justified not only by lower annual costs but by the elimination of a large proportion of the total pollution load which will result in the Mahanoy Creek meeting the water quality limits set by the State of Pennsylvania.

TABLE 13

ANNUAL ABATEMENT COSTS

	TOTAL INITIAL PROJECT COST	ANNUAL COST FOR SURFACE RECLAMATION[1]	ANNUAL COST OF TREATMENT SYSTEMS[2]	ANNUAL OPERATING COST	TOTAL ANNUAL COST
ABATEMENT PLAN I	31,325,986	2,708,445	0	0	2,708,445
ABATEMENT PLAN II	21,352,696	1,810,048	44,139	70,800	1,924,987
ABATEMENT PLAN III	6,419,567	486,620	83,635	161,900	732,155

1 Based on 8.5 percent interest rate and 50 year repayment period.

2 Based on 8.5 percent interest rate and 20 year repayment period.

The hydrological, mine pool, and reclamation investigations of this report suggest that disturbed aquifers are an important source of water in the mine pools. Surface reclamation (a preventive measure which reduces the flow of the mine discharges) alone may therefore be inadequate in the reduction of water entering the mine pools. If aquifers, for example, are contributing large amounts of water into the mine pools surface reclamation, while reducing a mine discharge will never eliminate enough water in the mine pool to eliminate the various mine discharges. This is due in part to water entering the aquifer in areas outside the watershed.

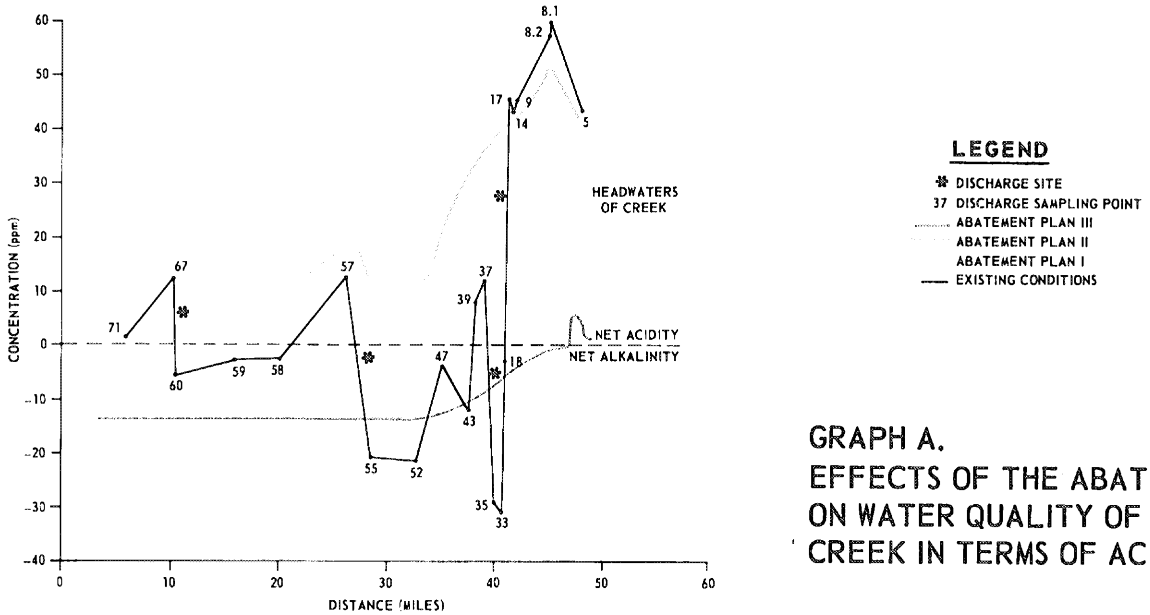
Water quality in the watershed will be significantly improved after implementation of the abatement plan. The treatment of the Doutyville Tunnel Discharge (Site 56) is anticipated to result in a net alkalinity in the Mahanoy Creek as well as lower the total iron content of the stream (see Figure 19). Treatment of the Centralia Tunnel Discharge (Site 36), also a major contributor of acid to the stream, should result in a net alkalinity of the Mahanoy Creek. The North Franklin Overflow treatment system is anticipated to clean 4.75 miles of Zerbe Run and hence an entire subwatershed as well as eliminate the discharge's influence on the water quality of the creek.

The water quality of Mahanoy Creek resulting from implementation of each of the three abatement plans is given in Figure 19, p. 117. The effects of Abatement Plan I will be minimal with water quality not significantly different than present conditions. Abatement Plan II will reduce the iron (primarily through abatement of the Packer Discharges), however, iron values for the Mahanoy Creek will still be higher than the water quality limits. In addition, abatement of the Packer Discharges will eliminate a major source of alkalinity which at present neutralizes the acid in the creek originating upstream of the discharges. If Abatement Plan II is implemented acid contents will actually increase downstream of the Packer Discharges. Sulfate content should be close to the sulfate water quality limits if Plan II is selected.

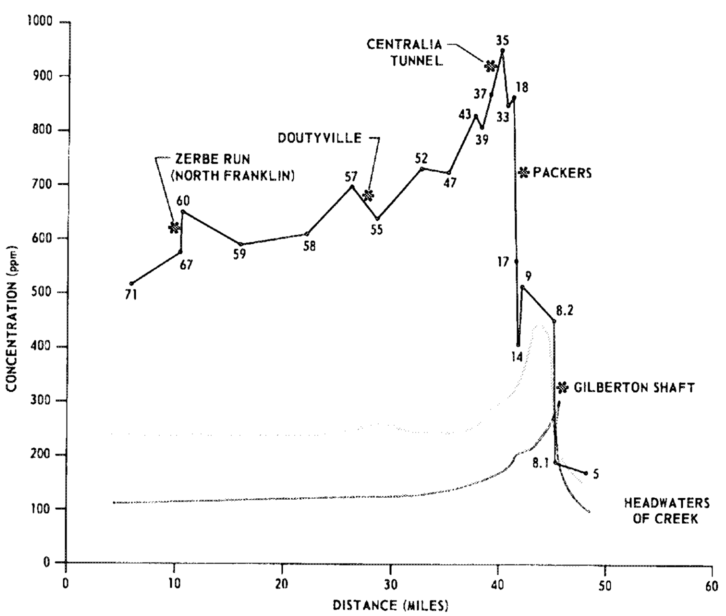
The recommended plan, Abatement Plan III, will result in the water quality of Mahanoy Creek meeting the water quality limits of pH, acid, iron, and sulfate. The immediate vicinity of Gilberton shaft is the only section of the stream which will not meet the water quality criteria. The creek immediately downstream from the discharge will be slightly acid and probably contain close to 7 ppm iron. Due to dilution effects of the clean stream, however, the impact of the discharge should be minimal.

The Shenandoah Creek is anticipated to have a much lower iron content as a result of treatment of the Hammond Bore Hole Discharge. Stream modification to eliminate contact with pyritic materials and especially to eliminate discharges from an active colliery would significantly reduce the abrupt increase in total iron and acidity between sample Sites 18 and 20 resulting in a substantial increase in water quality of the entire creek.

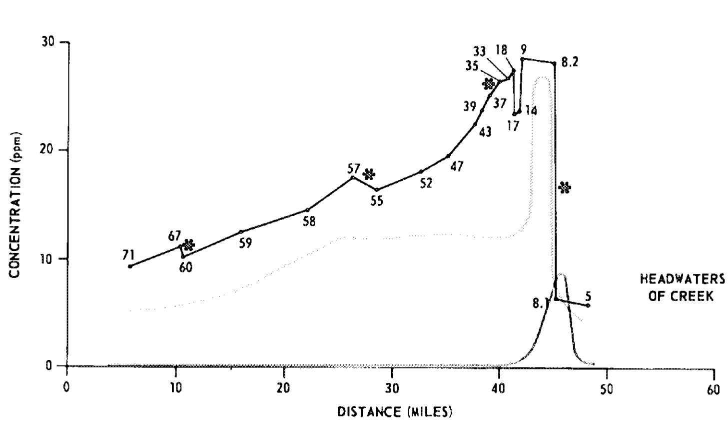
The other tributaries are also anticipated to improve in quality. Silt content should be greatly reduced in the North Mahanoy Creek. Removing pyritic materials also will reduce acid in this stream. The flow of Big Mine Run which is primarily a result of mine discharges should be reduced resulting in less pollution reaching Mahanoy Creek.



GRAPH A.
EFFECTS OF THE ABATEMENT PLANS ON WATER QUALITY OF MAHANOY CREEK IN TERMS OF ACIDITY



GRAPH B.
EFFECTS OF THE ABATEMENT PLANS ON WATER QUALITY OF MAHANOY CREEK IN TERMS OF SULFATE (SO_4^{2-})



GRAPH C.
EFFECTS OF THE ABATEMENT PLANS ON WATER QUALITY OF MAHANOY CREEK IN TERMS OF TOTAL IRON

Figure 19. Effects of the implementation of the three abatement plans on water quality in the Mahanoy Creek

ABATEMENT PRIORITIES

Based on cost benefit analysis (including area affected) priority projects of Abatement Plan III are listed below in decreasing priority.

1. North Franklin Treatment System

2. Packer Discharge Group and Aeration System

3. Big Run Discharges

4. Mahanoy City Group

5. General-Stream Modification

6. Girardville Group

7. Hammond Aeration System

8. Centralia Tunnel Treatment System

9. Doutyville Tunnel Treatment System

10. South Preston Discharge

OVERVIEW

The recommended plan when implemented will significantly improve the stream water quality of Mahanoy Creek. The Susquehanna River stream quality will also increase although to a lesser degree. Water quality in the Shenandoah Creek will improve but will still contain iron and will be slightly acid. Iron concentrations in the Mahanoy Creek are expected to be below 1.5 ppm; the only exception being the immediate vicinity of the Gilberton Shaft, The pH of the entire length of Mahanoy Creek will meet the Department's pH stream water quality criterion. Except in the vicinity of the Gilberton Shaft, Mahanoy Creek will meet the Department's limitations for acid after implementation of the abatement plan. The Mahanoy Creek after implementation of Abatement Plan III will be able to support fish life.

GLOSSARY

Abandoned mine - A mining operation where coal is no longer being produced. This term incluces strip, underground, and bank mines.

Aquifer - A water bearing formation, through which water moves more readily than in adjacent formations with lower permeability.

Backfill - The operation of refilling an excavation, usually abandoned strip mines (pits).

Barrier breach - The penetration of a mine barrier pillar, usually resulting in the interconnections of different mines.

Mine subsidence - The collapse of mine workings causing the loss of support for topsoils and surface structures, often resulting in exposing the mine working either directly or indirectly to the surface.

Oxidation potential - A measure of how oxidizing an environment is.

Refuse material - All the solid waste from a coal mine, including tailings and slurry. A more general term for rock, culm and silt bank. Also called cast overburden and waste material.

Stream modification - Erosion prevention and stabilization of stream banks. Also used to minimize infiltration of stream water to mine pools and to prevent contact of stream water with pyritic material.

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APPENDIX

The data presented in this Appendix are based on 72 samples taken during each month of a one year period from November, 1973 through October, 1974. During the first month two sets of 72 samples were taken. These two sample sets were averaged for the month to avoid a misinterpretation of the statistical analysis of the data. November, having two sampling periods, would have a larger influence on the average, for example, than each of the other months. The analysis of the samples was conducted by Buchart-Horn Consulting Engineers, using standard methods developed by the American Waterworks Association.

SAMPLE POINT NO. 1 HEADWATERS MAHANOY CREEK DISCHARGE

DATE	FLOW			PH	ACIDITY		ALKALINITY		TOTAL IRON		SULFATES	
	CFS	GPM	MGD		CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY
11/ 6/73	0.20	90.	0.13	3.2	162.0	175.	0.0	0.	1.52	2.	135.0	200.
12/11/73	0.91	408.	0.59	3.4	132.0	648.	0.0	0.	1.20	6.	146.0	717.
1/ 9/74	0.45	202.	0.29	3.5	118.0	286.	0.0	0.	1.68	4.	155.0	376.
2/ 5/74	0.60	269.	0.39	3.6	110.0	356.	0.0	0.	1.68	5.	120.0	388.
3/ 5/74	0.45	202.	0.29	3.5	96.0	233.	0.0	0.	1.68	4.	150.0	364.
4/ 3/74	0.45	202.	0.29	3.5	140.0	340.	0.0	0.	1.12	3.	150.0	364.
5/ 8/74	0.14	63.	0.09	3.5	130.0	98.	0.0	0.	1.80	1.	225.0	170.
6/11/74	0.08	36.	0.05	3.5	118.0	51.	0.0	0.	2.10	1.	200.0	86.
7/ 9/74	0.36	162.	0.23	3.5	400.0	777.	0.0	0.	2.10	4.	150.0	291.
8/13/74	0.14	63.	0.09	3.4	160.0	121.	0.0	0.	2.30	2.	325.0	245.
9/11/74	0.50	224.	0.32	3.3	134.0	361.	0.0	0.	1.20	3.	300.0	809.
10/ 9/74	0.21	94.	0.14	3.3	300.0	340.	0.0	0.	1.70	2.	300.0	340.
MINIMUM	0.08	36.	0.05	3.2	96.0	51.	0.0	0.	1.12	1.	120.0	86.
MAXIMUM	0.91	408.	0.59	3.6	400.0	777.	0.0	0.	2.30	6.	325.0	809.
AVERAGE	0.37	168.	0.24	3.4	166.7	315.	0.0	0.	1.67	3.	200.5	363.

SAMPLE POINT NO. 2 NORTH MAHANOY CREEK AT PARK PLACE

DATE	FLOW			PH	ACIDITY		ALKALINITY		TOTAL IRON		SULFATES	
	CFS	GPM	MGD		CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY
11/ 6/73	2.09	938.	1.35	4.3	13.0	147.	0.0	0.	0.00	0.	6.0	68.
12/11/73	13.90	6239.	8.98	4.7	6.0	450.	0.0	0.	0.15	11.	45.0	3374.
1/ 9/74	4.68	2101.	3.02	4.7	4.0	101.	2.0	50.	0.15	4.	6.0	151.
2/ 5/74	2.35	1055.	1.52	6.4	6.0	76.	4.0	51.	0.15	2.	8.0	101.
3/ 5/74	1.62	727.	1.05	5.2	4.0	35.	0.0	0.	0.44	4.	7.0	61.
4/ 3/74	2.65	1189.	1.71	4.9	0.0	0.	4.0	57.	0.00	0.	30.0	429.
5/ 8/74	0.30	135.	0.19	4.8	2.0	3.	0.0	0.	0.00	0.	150.0	243.
6/11/74	0.15	67.	0.10	4.6	2.0	2.	0.0	0.	0.20	0.	4.0	3.
7/ 9/74	0.50	224.	0.32	4.6	16.0	43.	0.0	0.	0.00	0.	175.0	472.
8/13/74	0.40	180.	0.26	4.8	8.0	17.	0.0	0.	0.00	0.	275.0	593.
9/11/74	1.50	673.	0.97	5.2	10.0	81.	0.0	0.	0.30	2.	200.0	1618.
10/ 9/74	1.25	561.	0.81	4.8	4.0	27.	0.0	0.	0.20	1.	275.0	1854.
MINIMUM	0.15	67.	0.10	4.3	0.0	0.	0.0	0.	0.00	0.	4.0	3.
MAXIMUM	13.90	6239.	8.98	6.4	16.0	450.	4.0	57.	0.44	11.	275.0	3374.
AVERAGE	2.62	1174.	1.69	4.9	6.3	82.	0.8	13.	0.13	2.	98.4	747.

SAMPLE POINT NO. 3 NORTH MAHANOY CREEK AT BOWMANS

DATE	FLOW			PH	ACIDITY		ALKALINITY		TOTAL IRON		SULFATES	
	CFS	GPM	MGD		CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY
11/ 6/73	8.60	3360.	5.56	4.1	8.0	371.	0.0	0.	0.37	17.	22.0	1020.
12/11/73	21.70	9740.	14.03	4.7	6.0	702.	0.0	0.	0.59	69.	56.0	6554.
1/ 9/74	12.80	5745.	8.27	4.7	8.0	552.	2.0	138.	0.15	10.	9.0	621.
2/ 5/74	11.20	5027.	7.24	4.9	4.0	242.	4.0	242.	0.59	36.	9.0	544.
3/ 5/74	4.80	2154.	3.10	4.8	6.0	155.	0.0	0.	2.18	56.	6.0	155.
4/ 3/74	11.20	5027.	7.24	4.8	6.0	362.	0.0	0.	0.48	29.	30.0	1812.
5/ 8/74	1.52	682.	0.98	4.2	10.0	82.	0.0	0.	0.80	7.	150.0	1230.
6/11/74	1.30	583.	0.84	4.2	8.0	56.	0.0	0.	0.20	1.	14.0	98.
7/ 9/74	3.10	1391.	2.00	4.5	20.0	334.	0.0	0.	0.40	7.	175.0	2926.
8/13/74	1.20	539.	0.78	4.3	12.0	78.	0.0	0.	0.10	1.	250.0	1618.
9/11/74	2.96	1329.	1.91	4.7	10.0	160.	0.0	0.	0.60	10.	200.0	3193.
10/ 9/74	1.60	718.	1.03	4.3	6.0	52.	0.0	0.	0.10	1.	250.0	2157.
MINIMUM	1.20	539.	0.78	4.1	4.0	52.	0.0	0.	0.10	1.	6.0	98.
MAXIMUM	21.70	9740.	14.03	4.9	20.0	702.	4.0	242.	2.18	69.	250.0	6554.
AVERAGE	6.83	3066.	4.42	4.5	8.7	262.	0.5	32.	0.55	20.	97.6	1827.

SAMPLE POINT NO. 4 MAHANOY CITY BORE HOLE DISCHARGE

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 6/73	7.06	3169.	4.56	3.8	91.0	3465.	0.0	0.	17.45	664.	180.0	6854.
12/11/73	27.00	12118.	17.45	4.5	80.0	11650.	0.0	0.	16.90	2461.	350.0	50969.
1/ 9/74	8.56	3842.	5.53	4.8	92.0	4248.	0.0	0.	8.37	386.	204.0	9418.
2/ 5/74	17.70	7944.	11.44	4.9	102.0	9737.	0.0	0.	8.63	824.	195.0	18616.
3/ 5/74	14.60	6553.	9.44	4.7	74.0	5827.	0.0	0.	9.16	721.	175.0	13780.
4/ 3/74	8.45	3793.	5.46	4.7	80.0	3646.	0.0	0.	7.38	336.	200.0	9115.
5/ 8/74	10.50	4713.	6.79	4.7	50.0	2832.	0.0	0.	8.40	476.	225.0	12742.
6/11/74	7.57	3398.	4.89	4.8	64.0	2613.	0.0	0.	8.90	363.	175.0	7145.
7/ 9/74	5.98	2684.	3.86	4.6	600.0	19352.	0.0	0.	10.50	339.	170.0	5483.
8/13/74	6.93	3110.	4.48	4.5	88.0	3289.	0.0	0.	10.60	396.	325.0	12148.
9/11/74	14.40	6463.	9.31	4.9	60.0	4660.	0.0	0.	16.40	1274.	225.0	17475.
10/ 9/74	6.93	3110.	4.48	4.6	300.0	11213.	0.0	0.	11.80	441.	325.0	12148.
MINIMUM	5.98	2684.	3.86	3.8	50.0	2613.	0.0	0.	7.38	336.	170.0	5483.
MAXIMUM	27.00	12118.	17.45	4.9	600.0	19352.	0.0	0.	17.45	2461.	350.0	50969.
AVERAGE	11.31	5075.	7.31	4.6	140.1	6878.	0.0	0.	11.21	724.	229.1	14658.

SAMPLE POINT NO. 5 MAHANOY CREEK AT FOOTBALL FIELD

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 6/73	17.40	7810.	11.25	4.3	28.0	2628.	0.0	0.	7.02	659.	173.0	16236.
12/11/73	59.10	26526.	38.20	4.4	50.0	15938.	0.0	0.	11.84	3774.	110.0	35063.
1/ 9/74	25.10	11266.	16.22	4.8	62.0	8393.	0.0	0.	4.94	669.	149.0	20171.
2/ 5/74	31.90	14318.	20.62	4.8	56.0	9635.	0.0	0.	4.94	850.	135.0	23227.
3/ 5/74	22.20	9964.	14.35	5.0	30.0	3592.	0.0	0.	5.57	667.	125.0	14967.
4/ 3/74	27.00	12118.	17.45	4.9	42.0	6116.	0.0	0.	4.76	693.	225.0	32766.
5/ 8/74	12.30	5521.	7.95	5.0	40.0	2654.	0.0	0.	5.20	345.	150.0	9951.
6/11/74	8.90	3995.	5.75	5.2	22.0	1056.	0.0	0.	5.10	245.	149.0	7152.
7/ 9/74	9.30	4174.	6.01	4.8	72.0	3612.	0.0	0.	4.70	236.	125.0	6270.
8/13/74	7.51	3371.	4.85	4.8	42.0	1701.	0.0	0.	5.20	211.	225.0	9114.
9/11/74	15.60	7002.	10.08	4.6	52.0	4375.	0.0	0.	7.20	606.	200.0	16828.
10/ 9/74	8.87	3981.	5.73	4.8	30.0	1435.	0.0	0.	5.30	254.	275.0	13156.
MINIMUM	7.51	3371.	4.85	4.3	22.0	1056.	0.0	0.	4.70	211.	110.0	6270.
MAXIMUM	59.10	26526.	38.20	5.2	72.0	15938.	0.0	0.	11.84	3774.	275.0	35063.
AVERAGE	20.43	9170.	13.21	4.8	43.8	5095.	0.0	0.	5.98	767.	170.1	17075.

SAMPLE POINT NO. 6 WASTE HOUSE RUN

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 6/73	4.55	2042.	2.94	5.2	5.0	123.	1.0	25.	0.00	0.	17.0	417.
12/11/73	15.30	6867.	9.89	4.9	6.0	495.	2.0	165.	0.15	12.	45.0	3713.
1/ 9/74	4.37	1961.	2.82	5.9	2.0	47.	4.0	94.	0.00	0.	7.0	165.
2/ 5/74	10.60	4758.	6.85	7.0	4.0	229.	8.0	457.	0.00	0.	8.0	457.
3/ 5/74	2.24	1005.	1.45	6.4	2.0	24.	2.0	24.	0.15	2.	6.0	72.
4/ 3/74	7.48	3357.	4.83	6.7	4.0	161.	0.0	0.	0.24	10.	35.0	1412.
5/ 8/74	1.81	812.	1.17	7.2	2.0	20.	0.0	0.	0.30	3.	30.0	293.
6/11/74	1.32	592.	0.85	6.7	2.0	14.	0.0	0.	0.30	2.	6.0	43.
7/ 9/74	2.63	1180.	1.70	6.9	12.0	170.	0.0	0.	0.10	1.	30.0	426.
8/13/74	0.87	390.	0.56	7.7	4.0	19.	0.0	0.	0.00	0.	250.0	1173.
9/11/74	1.95	875.	1.26	7.7	8.0	84.	6.0	63.	0.00	0.	175.0	1841.
10/ 9/74	1.50	673.	0.97	6.7	8.0	65.	0.0	0.	0.00	0.	225.0	1820.
MINIMUM	0.87	390.	0.56	4.9	2.0	14.	0.0	0.	0.00	0.	6.0	43.
MAXIMUM	15.30	6867.	9.89	7.7	12.0	495.	8.0	457.	0.30	12.	250.0	3713.
AVERAGE	4.55	2043.	2.94	6.6	4.9	121.	1.9	69.	0.10	3.	69.5	986.

SAMPLE POINT NO. 7 GILBERTON SHAFT DISCHARGE

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 6/73	22.30	10009.	14.41	5.9	105.0	12629.	46.0	5533.	57.32	6894.	762.0	91650.
12/13/73	22.30	10009.	14.41	6.2	18.0	2165.	22.0	2646.	37.90	4558.	825.0	99228.
1/ 9/74	22.30	10009.	14.41	6.4	120.0	14433.	74.0	8900.	42.26	5083.	1550.0	186428.
2/ 8/74	22.30	10009.	14.41	6.4	118.0	14193.	152.0	18282.	85.05	10229.	650.0	78179.
3/ 5/74	22.30	10009.	14.41	6.4	200.0	24055.	126.0	15155.	71.60	8612.	550.0	66152.
4/ 3/74	22.30	10009.	14.41	6.3	130.0	15636.	100.0	12028.	50.40	6062.	750.0	90207.
5/ 8/74	22.30	10009.	14.41	6.3	96.0	11546.	0.0	0.	61.20	7361.	575.0	69159.
6/13/74	FLOW NOT DETERMINED/NOWATER SAMPLE TAKEN											
					0.0	0.	0.0	0.	0.00	0.	0.0	0.
7/ 9/74	FLOW NOT DETERMINED/NOWATER SAMPLE TAKEN											
					0.0	0.	0.0	0.	0.00	0.	0.0	0.
8/13/74	22.30	10009.	14.41	6.1	100.0	12028.	32.0	3849.	54.60	6567.	950.0	114262.
9/11/74	22.30	10009.	14.41	6.5	188.0	22612.	26.0	3127.	73.20	8804.	1150.0	138317.
10/ 9/74	FLOW NOT DETERMINED/NOWATER SAMPLE TAKEN											
					0.0	0.	0.0	0.	0.00	0.	0.0	0.
MINIMUM	0.00	0.	0.00	0.0	0.0	0.	0.0	0.	0.00	0.	0.0	0.
MAXIMUM	22.30	10009.	14.41	6.5	200.0	24055.	152.0	18282.	85.05	10229.	1550.0	186428.
AVERAGE	16.72	7507.	10.81	6.3	119.4	14366.	64.2	7724.	59.28	7130.	862.4	103731.

SAMPLE POINT NO. 8.1 MAHANOY CREEK ABOVE GILBERTON SHAFT

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 6/73	17.72	7953.	11.45	4.1	47.0	4492.	0.0	0.	8.30	793.	183.0	17490.
12/13/73	54.30	24372.	35.10	4.2	88.0	25772.	0.0	0.	20.59	6030.	190.0	55645.
1/ 9/74	22.80	10233.	14.74	4.7	94.0	11559.	0.0	0.	8.63	1061.	255.0	31358.
2/ 8/74	37.20	16697.	24.04	4.7	70.0	14045.	0.0	0.	7.61	1527.	135.0	27086.
3/ 5/74	22.20	9964.	14.35	4.7	70.0	8382.	0.0	0.	6.44	771.	100.0	11974.
4/ 3/74	39.10	17549.	25.27	4.9	40.0	8435.	0.0	0.	3.10	654.	175.0	36905.
5/ 8/74	9.38	4210.	6.06	4.6	58.0	2934.	0.0	0.	3.90	197.	150.0	7589.
6/13/74	10.20	4578.	6.59	4.5	42.0	2311.	0.0	0.	3.70	204.	150.0	8252.
7/ 9/74	9.64	4327.	6.23	4.4	58.0	3016.	0.0	0.	2.20	114.	115.0	5979.
8/13/74	7.85	3523.	5.07	4.4	58.0	2456.	0.0	0.	2.70	114.	250.0	10585.
9/11/74	15.30	6867.	9.89	4.3	52.0	4291.	0.0	0.	4.80	396.	275.0	22693.
10/ 9/74	10.70	4803.	6.92	4.0	40.0	2308.	0.0	0.	3.90	225.	275.0	15870.
MINIMUM	7.85	3523.	5.07	4.0	40.0	2308.	0.0	0.	2.20	114.	100.0	5979.
MAXIMUM	54.30	24372.	35.10	4.9	94.0	25772.	0.0	0.	20.59	6030.	275.0	55645.
AVERAGE	21.37	9590.	13.81	4.5	59.8	7500.	0.0	0.	6.32	1007.	187.8	20952.

SAMPLE POINT NO. 8.2 MAHANOY CREEK BELOW GILBERTON SHAFT

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 6/73	41.10	18447.	26.56	5.7	117.0	25936.	36.0	7980.	44.37	9836.	665.0	147413.
12/13/73	76.60	34381.	49.51	5.8	56.0	23136.	0.0	0.	28.71	11861.	550.0	227230.
1/ 9/74	45.10	20242.	29.15	6.3	118.0	28703.	4.0	973.	44.35	10788.	950.0	231086.
2/ 8/74	59.27	26602.	38.31	6.2	50.0	15984.	64.0	20459.	38.06	12167.	505.0	161436.
3/ 5/74	44.50	19973.	28.76	6.3	98.0	23521.	30.0	7200.	36.85	8844.	325.0	78004.
4/ 3/74	61.40	27558.	39.68	6.3	90.0	29805.	20.0	6623.	31.43	10408.	350.0	115907.
5/ 8/74	31.70	14228.	20.49	6.3	76.0	12994.	10.0	1710.	49.20	8412.	475.0	81213.
6/13/74	10.20	4578.	6.59	4.5	42.0	2311.	0.0	0.	3.70	204.	150.0	8252.
7/ 9/74	9.64	4327.	6.23	4.4	58.0	3016.	0.0	0.	2.20	114.	115.0	5979.
8/13/74	7.85	3523.	5.07	4.4	58.0	2456.	0.0	0.	2.70	114.	250.0	10585.
9/11/74	37.60	16876.	24.30	6.5	48.0	9734.	0.0	0.	53.50	10850.	800.0	162238.
10/ 9/74	10.70	4803.	6.92	4.0	40.0	2308.	0.0	0.	3.90	225.	275.0	15870.
MINIMUM	7.85	3523.	5.07	4.0	40.0	2308.	0.0	0.	2.20	114.	115.0	5979.
MAXIMUM	76.60	34381.	49.51	6.5	118.0	29805.	64.0	20459.	53.50	12167.	950.0	231086.
AVERAGE	36.30	16295.	23.46	5.6	70.9	14992.	13.7	3745.	28.25	6985.	450.8	103768.

SAMPLE POINT NO. 9 MAHANOY CREEK BELOW MAHANOY PLANE

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 6/73	52.30	23474.	33.80	5.2	43.0	12130.	1.0	282.	42.83	12082.	685.0	193226.
12/11/73	71.90	32271.	46.47	6.1	60.0	23268.	0.0	0.	24.80	9617.	445.0	172569.
1/ 8/74	55.60	24955.	35.94	6.6	78.0	23391.	0.0	0.	46.18	13848.	700.0	209916.
2/ 5/74	63.70	28591.	41.17	6.9	38.0	13056.	18.0	6184.	33.34	11455.	695.0	238780.
3/ 4/74	51.10	22935.	33.03	6.8	50.0	13780.	0.0	0.	41.83	11529.	450.0	124024.
4/ 3/74	79.90	35862.	51.64	6.8	44.0	18962.	16.0	6895.	28.33	12209.	400.0	172377.
5/ 8/74	59.20	26571.	38.26	7.0	62.0	19796.	0.0	0.	44.70	14273.	675.0	215526.
6/11/74	14.10	6329.	9.11	6.6	14.0	1065.	2.0	152.	3.10	236.	110.0	8365.
7/ 9/74	16.50	7406.	10.66	6.6	60.0	5340.	0.0	0.	35.60	3168.	750.0	66745.
8/12/74	8.32	3734.	5.38	5.6	40.0	1795.	0.0	0.	1.80	81.	225.0	10097.
9/11/74	36.40	16338.	23.53	6.8	60.0	11779.	0.0	0.	38.60	7578.	800.0	157060.
10/ 8/74	11.80	5296.	7.63	4.6	32.0	2037.	0.0	0.	3.10	197.	275.0	17502.
MINIMUM	8.32	3734.	5.38	4.6	14.0	1065.	0.0	0.	1.80	81.	110.0	8365.
MAXIMUM	79.90	35862.	51.64	7.0	78.0	23391.	18.0	6895.	46.18	14273.	800.0	238780.
AVERAGE	43.40	19480.	28.05	6.3	48.4	12200.	3.1	1126.	28.69	8023.	517.5	132182.

SAMPLE POINT NO. 10 GIRARDVILLE NO. 1 DISCHARGE

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 6/73	1.57	705.	1.01	5.8	80.0	677.	45.0	381.	24.96	211.	565.0	4784.
12/11/73	4.26	1912.	2.75	5.6	88.0	2022.	38.0	873.	24.06	553.	600.0	13786.
1/ 8/74	3.86	1732.	2.49	6.0	114.0	2373.	34.0	708.	28.37	591.	490.0	10201.
2/ 5/74	4.52	2029.	2.92	6.2	60.0	1463.	74.0	1804.	25.73	627.	505.0	12311.
3/ 4/74	3.78	1697.	2.44	6.1	80.0	1631.	76.0	1549.	24.70	504.	350.0	7136.
4/ 3/74	3.98	1786.	2.57	6.0	135.0	2898.	64.0	1374.	23.33	501.	350.0	7513.
5/ 8/74	1.96	880.	1.27	6.2	74.0	782.	46.0	486.	26.60	281.	300.0	3171.
6/11/74	2.48	1113.	1.60	6.5	28.0	375.	52.0	696.	25.60	342.	275.0	3678.
7/ 9/74	2.78	1248.	1.80	6.3	60.0	900.	22.0	330.	26.70	400.	480.0	7197.
8/12/74	2.03	911.	1.31	6.0	80.0	876.	64.0	701.	24.00	263.	450.0	4927.
9/11/74	3.34	1499.	2.16	6.1	82.0	1477.	40.0	721.	27.40	494.	600.0	10809.
10/ 8/74	2.48	1113.	1.60	4.6	10.0	134.	44.0	589.	22.60	302.	625.0	8360.
MINIMUM	1.57	705.	1.01	4.6	10.0	134.	22.0	330.	22.60	211.	275.0	3171.
MAXIMUM	4.52	2029.	2.92	6.5	135.0	2898.	76.0	1804.	28.37	627.	625.0	13786.
AVERAGE	3.09	1385.	1.99	5.9	74.3	1301.	49.9	851.	25.34	422.	465.8	7823.

SAMPLE POINT NO. 11 GIRARDVILLE NO. 2 DISCHARGE

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 6/73	0.83	373.	0.54	6.1	50.0	224.	37.0	166.	25.99	116.	425.0	1903.
12/11/73	1.34	601.	0.87	5.9	18.0	130.	40.0	289.	23.96	173.	680.0	4915.
1/ 8/74	0.74	332.	0.48	6.3	64.0	255.	48.0	192.	14.74	59.	410.0	1636.
2/ 5/74	1.40	628.	0.90	6.5	14.0	106.	68.0	513.	19.44	147.	445.0	3360.
3/ 4/74	1.08	485.	0.70	6.4	66.0	384.	60.0	350.	15.20	89.	300.0	1748.
4/ 3/74	1.22	548.	0.79	6.4	84.0	553.	68.0	447.	15.24	100.	350.0	2303.
5/ 8/74	0.84	377.	0.54	6.9	38.0	172.	46.0	208.	18.40	83.	350.0	1586.
6/11/74	0.96	431.	0.62	6.5	30.0	155.	44.0	228.	19.00	98.	225.0	1165.
7/ 9/74	0.62	278.	0.40	6.5	62.0	207.	40.0	134.	18.60	62.	410.0	1371.
8/12/74	0.68	305.	0.44	6.6	80.0	293.	62.0	227.	17.50	64.	475.0	1742.
9/11/74	1.11	498.	0.72	6.5	28.0	168.	40.0	239.	18.40	110.	600.0	3592.
10/ 8/74	0.81	364.	0.52	6.2	6.0	26.	30.0	131.	17.70	77.	475.0	2075.
MINIMUM	0.62	278.	0.40	5.9	6.0	26.	30.0	131.	14.74	59.	225.0	1165.
MAXIMUM	1.40	628.	0.90	6.9	84.0	553.	68.0	513.	25.99	173.	680.0	4915.
AVERAGE	0.97	435.	0.63	6.4	45.0	223.	48.6	260.	18.68	98.	428.8	2283.

SAMPLE POINT NO. 12 GIRARDVILLE NO. 3 DISCHARGE

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 6/73	0.44	197.	0.28	5.8	34.0	81.	8.0	19.	20.11	48.	270.0	641.
12/11/73	0.42	189.	0.27	5.2	64.0	145.	8.0	18.	23.96	54.	405.0	917.
1/ 8/74	0.39	175.	0.25	5.9	90.0	189.	14.0	29.	14.35	30.	325.0	684.
2/ 5/74	0.42	189.	0.27	5.9	54.0	122.	36.0	82.	18.37	42.	380.0	861.
3/ 4/74	0.42	189.	0.27	6.0	98.0	222.	40.0	91.	15.15	34.	275.0	623.
4/ 3/74	0.42	189.	0.27	5.8	80.0	181.	24.0	54.	10.48	24.	225.0	510.
5/ 8/74	0.51	229.	0.33	6.1	42.0	116.	16.0	44.	12.50	34.	225.0	619.
6/10/74	0.39	175.	0.25	6.3	120.0	252.	30.0	63.	13.10	28.	225.0	473.
7/ 8/74	0.42	189.	0.27	6.3	36.0	82.	20.0	45.	14.80	34.	335.0	759.
8/12/74	0.42	189.	0.27	6.0	60.0	136.	28.0	63.	12.40	28.	350.0	793.
9/10/74	0.49	220.	0.32	6.5	38.0	100.	16.0	42.	18.30	48.	375.0	991.
10/ 8/74	0.42	189.	0.27	5.6	6.0	14.	28.0	63.	13.10	30.	500.0	1133.
MINIMUM	0.39	175.	0.25	5.2	6.0	14.	8.0	18.	10.48	24.	225.0	473.
MAXIMUM	0.51	229.	0.33	6.5	120.0	252.	40.0	91.	23.96	54.	500.0	1133.
AVERAGE	0.43	193.	0.28	5.9	60.2	137.	22.3	51.	15.55	36.	324.2	75[illegible].

SAMPLE POINT NO. 13 GIRARDVILLE NO. 4 DISCHARGE

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 6/73	0.06	27.	0.04	3.4	50.0	16.	0.0	0.	12.74	4.	425.0	138.
12/11/73	0.08	35.	0.05	3.2	70.0	30.	0.0	0.	13.96	6.	476.0	205.
1/ 8/74	0.11	49.	0.07	4.1	88.0	52.	0.0	0.	12.86	8.	420.0	249.
2/ 4/74	0.11	49.	0.07	3.4	86.0	51.	0.0	0.	16.44	10.	325.0	193.
3/ 4/74	0.11	49.	0.07	3.9	60.0	36.	0.0	0.	13.96	8.	225.0	133.
4/ 2/74	0.11	49.	0.07	4.0	94.0	56.	0.0	0.	8.81	5.	200.0	119.
5/ 8/74	0.11	49.	0.07	3.8	70.0	42.	0.0	0.	6.40	4.	175.0	104.
6/10/74	0.11	49.	0.07	3.7	70.0	42.	0.0	0.	8.20	5.	225.0	133.
7/ 8/74	0.06	27.	0.04	3.8	400.0	129.	0.0	0.	10.40	3.	375.0	121.
8/12/74	0.06	27.	0.04	3.9	70.0	23.	0.0	0.	7.90	3.	350.0	113.
9/10/74	0.09	40.	0.06	3.7	72.0	35.	0.0	0.	8.60	4.	425.0	206.
10/ 8/74	0.10	45.	0.06	3.5	62.0	33.	0.0	0.	8.20	4.	600.0	324.
MINIMUM	0.06	27.	0.04	3.2	50.0	16.	0.0	0.	6.40	3.	175.0	104.
MAXIMUM	0.11	49.	0.07	4.1	400.0	129.	0.0	0.	16.44	10.	600.0	324.
AVERAGE	0.09	42.	0.06	3.7	99.3	45.	0.0	0.	10.71	5.	351.8	170.

SAMPLE POINT NO. 14 MAHANOY CREEK BELOW GIRARDVILLE DISCHARGES

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 6/73	52.40	23519.	33.87	5.5	47.0	13283.	1.0	283.	38.05	10754.	765.0	216205.
12/11/73	92.00	41293.	59.46	6.1	26.0	12901.	0.0	0.	23.84	11830.	440.0	218330.
1/ 8/74	63.00	28276.	40.72	6.4	64.0	21747.	0.0	0.	38.37	13038.	685.0	232758.
2/ 5/74	66.70	29937.	43.11	6.9	68.0	24463.	22.0	7914.	31.08	11181.	400.0	143900.
3/ 4/74	59.70	26795.	38.59	6.7	40.0	12880.	0.0	0.	31.08	10008.	450.0	144897.
4/ 2/74	87.20	39138.	56.36	6.5	36.0	16931.	12.0	5644.	8.81	4143.	175.0	82305.
5/ 8/74	68.90	30925.	44.53	6.9	52.0	19324.	0.0	0.	42.40	15756.	475.0	176517.
6/10/74	56.50	25359.	36.52	6.8	52.0	15846.	0.0	0.	43.30	13195.	425.0	129512.
7/ 9/74	25.30	11355.	16.35	6.5	52.0	7096.	0.0	0.	6.50	887.	225.0	30703.
8/12/74	12.20	5476.	7.89	6.5	38.0	2500.	8.0	526.	7.70	507.	300.0	19740.
9/10/74	35.10	15754.	22.69	6.8	40.0	7573.	0.0	0.	6.30	1193.	175.0	33130.
10/ 8/74	19.50	8752.	12.60	5.8	40.0	4207.	0.0	0.	7.50	789.	325.0	34182.
MINIMUM	12.20	5476.	7.89	5.5	26.0	2500.	0.0	0.	6.30	507.	175.0	19740.
MAXIMUM	92.00	41293.	59.46	6.9	68.0	24463.	22.0	7914.	43.30	15756.	765.0	232758.
AVERAGE	53.21	23882.	34.39	6.4	46.3	13229.	3.6	1197.	23.74	7773.	403.3	121848.

SAMPLE POINT NO. 15 PACKER NO. 5A DISCHARGE

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 6/73	10.20	4578.	6.59	6.5	60.0	3301.	186.0	10233.	27.91	1535.	1065.0	58590.
12/11/73	11.40	5117.	7.37	6.1	88.0	5411.	200.0	12297.	26.13	1607.	1300.0	79932.
1/ 8/74	11.40	5117.	7.37	6.3	132.0	8116.	246.0	15126.	34.69	2133.	1325.0	81469.
2/ 5/74	25.40	11400.	16.42	6.3	136.0	18631.	260.0	35619.	31.08	4258.	850.0	116446.
3/ 5/74	27.30	12253.	17.64	6.4	80.0	11779.	282.0	41523.	36.85	5426.	425.0	62578.
4/ 3/74	25.40	11400.	16.42	6.3	144.0	19727.	274.0	37537.	26.67	3654.	1050.0	143846.
5/ 7/74	25.40	11400.	16.42	6.3	100.0	13700.	222.0	30413.	29.10	3987.	950.0	130146.
6/10/74	20.30	9111.	13.12	6.2	180.0	19708.	230.0	25182.	29.70	3252.	1075.0	117700.
7/ 9/74	18.60	8348.	12.02	6.3	108.0	10835.	230.0	23074.	28.70	2879.	1350.0	135432.
8/12/74	17.80	7989.	11.50	6.3	66.0	6336.	258.0	24769.	28.50	2736.	1275.0	122406.
9/11/74	17.80	7989.	11.50	6.4	76.0	7296.	116.0	11137.	36.40	3495.	1475.0	141607.
10/ 8/74	16.50	7406.	10.66	6.2	142.0	12637.	182.0	16197.	27.60	2456.	300.0	26698.
MINIMUM	10.20	4578.	6.59	6.1	60.0	3301.	116.0	10233.	26.13	1535.	300.0	26698.
MAXIMUM	27.30	12253.	17.64	6.5	180.0	19727.	282.0	41523.	36.85	5426.	1475.0	143846.
AVERAGE	18.96	8509.	12.25	6.3	109.3	11456.	223.8	23592.	30.28	3118.	1036.7	101404.

SAMPLE POINT NO. 16 PACKER NO. 5B DISCHARGE

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 6/73	15.40	6912.	9.95	6.4	75.0	6230.	179.0	14868.	30.92	2568.	1125.0	93443.
12/11/73	38.10	17101.	24.62	6.1	0.0	0.	184.0	37811.	28.56	5869.	1375.0	282554.
1/ 8/74	38.10	17101.	24.62	6.4	180.0	36989.	214.0	43976.	39.69	8156.	1050.0	215768.
2/ 4/74	24.10	10817.	15.58	6.3	170.0	22097.	240.0	31196.	29.99	3898.	1075.0	139733.
3/ 4/74	19.20	8618.	12.41	6.3	114.0	11805.	244.0	25268.	33.34	3453.	1075.0	111323.
4/ 2/74	12.10	5431.	7.82	6.3	110.0	7179.	222.0	14488.	28.33	1849.	1350.0	88103.
5/ 7/74	13.60	6104.	8.79	6.3	112.0	8215.	232.0	17018.	30.10	2208.	925.0	67851.
6/10/74	11.20	5027.	7.24	6.2	112.0	6766.	222.0	13410.	30.70	1855.	950.0	57387.
7/ 8/74	23.40	10503.	15.12	6.3	140.0	17669.	210.0	26504.	31.10	3925.	1300.0	164071.
8/12/74	31.70	14228.	20.49	6.3	42.0	7181.	226.0	38640.	29.10	4975.	1450.0	247914.
9/10/74	19.70	8842.	12.73	6.4	40.0	4250.	210.0	22313.	38.40	4080.	1525.0	162035.
10/ 8/74	23.30	10458.	15.06	6.2	130.0	16337.	128.0	16086.	29.20	3670.	1625.0	204213.
MINIMUM	11.20	5027.	7.24	6.1	0.0	0.	128.0	13410.	28.33	1849.	925.0	57387.
MAXIMUM	38.10	17101.	24.62	6.4	180.0	36989.	244.0	43976.	39.69	8156.	1625.0	282554.
AVERAGE	22.49	10095.	14.54	6.3	102.1	12060.	209.3	25131.	31.62	3875.	1235.4	152866.

SAMPLE POINT NO. 17 CONFLUENCE OF SHENANDOAH AND MAHANOY CREEKS

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 6/73	66.30	29758.	42.85	5.5	60.0	21455.	1.0	358.	30.61	10946.	580.0	207403.
12/10/73	120.00	53860.	77.56	5.9	62.0	40128.	2.0	1294.	26.92	17423.	550.0	355973.
1/ 8/74	102.00	45781.	65.92	6.4	64.0	35209.	8.0	4401.	39.69	21835.	690.0	379597.
2/ 4/74	110.00	49372.	71.10	6.3	52.0	30851.	0.0	0.	26.78	15888.	350.0	207651.
3/ 4/74	98.50	44210.	63.66	6.6	44.0	23376.	0.0	0.	24.70	13122.	425.0	225787.
4/ 2/74	120.00	53860.	77.56	6.0	54.0	34950.	16.0	10356.	13.10	8479.	400.0	258890.
5/ 7/74	113.00	50718.	73.03	6.3	36.0	21941.	30.0	18284.	21.40	13043.	575.0	350445.
6/10/74	78.60	35278.	50.80	6.5	62.0	26284.	24.0	10174.	29.80	12633.	600.0	254359.
7/ 8/74	63.60	28546.	41.11	6.7	84.0	28814.	0.0	0.	35.60	12212.	800.0	274423.
8/12/74	25.90	11625.	16.74	6.7	50.0	6985.	60.0	8382.	11.20	1565.	550.0	76831.
9/10/74	42.60	19120.	27.53	7.1	34.0	7812.	2.0	460.	7.50	1723.	400.0	91906.
10/ 8/74	43.10	19345.	27.86	4.8	88.0	20457.	0.0	0.	13.90	3231.	950.0	220838.
MINIMUM	25.90	11625.	16.74	4.8	34.0	6985.	0.0	0.	7.50	1565.	350.0	76831.
MAXIMUM	120.00	53860.	77.56	7.1	88.0	40128.	60.0	18284.	39.69	21835.	950.0	379597.
AVERAGE	81.97	36789.	52.98	6.2	57.5	24855.	11.9	4476.	23.43	11008.	572.5	242008.

SAMPLE POINT NO. 18 MAHANOY CREEK BELOW PACKERS

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 6/73	92.10	41338.	59.53	6.1	60.0	29805.	30.0	14902.	30.99	15394.	725.0	360140.
12/10/73	130.00	58348.	84.02	6.0	18.0	12621.	34.0	23839.	26.92	18875.	745.0	522364.
1/ 8/74	140.00	62837.	90.48	6.4	88.0	66448.	66.0	49836.	34.74	26232.	1050.0	792850.
2/ 4/74	163.00	73160.	105.35	6.2	80.0	70332.	78.0	68573.	31.08	27324.	400.0	351658.
3/ 4/74	150.00	67325.	96.95	6.5	116.0	93848.	52.0	42070.	21.73	17580.	800.0	647224.
4/ 2/74	140.00	62837.	90.48	6.3	90.0	67959.	76.0	57387.	20.00	15102.	600.0	453057.
5/ 7/74	108.00	48474.	69.80	6.5	50.0	29125.	144.0	83880.	26.60	15495.	1000.0	582502.
6/10/74	119.00	53411.	76.91	6.3	102.0	65467.	104.0	66750.	31.80	20410.	650.0	417190.
7/ 8/74	113.00	50718.	73.03	6.5	54.0	32911.	44.0	26817.	33.00	20112.	1025.0	624706.
8/12/74	66.50	29847.	42.98	6.4	78.0	27976.	164.0	58822.	23.30	8357.	1125.0	403504.
9/10/74	87.80	39408.	56.75	6.5	40.0	18942.	74.0	35043.	28.40	13449.	950.0	449875.
10/ 8/74	84.00	37702.	54.29	6.1	80.0	36245.	30.0	13592.	21.70	9831.	1300.0	588974.
MINIMUM	66.50	29847.	42.98	6.0	18.0	12621.	30.0	13592.	20.00	8357.	400.0	351658.
MAXIMUM	163.00	73160.	105.35	6.5	116.0	93848.	164.0	83880.	34.74	27324.	1300.0	792850.
AVERAGE	116.12	52117.	75.05	6.3	71.3	45973.	74.7	45126.	27.52	17347.	864.2	516170.

SAMPLE POINT NO. 19 SHENANDOAH CREEK IN SHENANDOAH

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 6/73	6.99	3137.	4.52	4.6	223.0	8407.	2.0	75.	36.44	1374.	650.0	24506.
12/11/73	4.20	1885.	2.71	4.3	220.0	4984.	0.0	0.	29.39	666.	800.0	18122.
1/ 9/74	4.20	1885.	2.71	4.9	170.0	3851.	0.0	0.	29.86	676.	675.0	15291.
2/ 5/74	3.36	1508.	2.17	5.1	120.0	2175.	8.0	145.	31.85	577.	625.0	11326.
3/ 5/74	6.04	2711.	3.90	4.8	202.0	6581.	0.0	0.	7.86	256.	550.0	17917.
4/ 3/74	12.80	5745.	8.27	3.8	170.0	11736.	0.0	0.	10.48	724.	725.0	50052.
5/ 8/74	14.60	6553.	9.44	4.0	186.0	14647.	0.0	0.	10.60	835.	825.0	64965.
6/11/74	1.47	660.	0.95	7.0	40.0	317.	74.0	587.	1.10	9.	150.0	1189.
7/ 9/74	6.13	2751.	3.96	4.3	266.0	8795.	0.0	0.	22.30	737.	1200.0	39675.
8/13/74	1.08	485.	0.70	7.5	92.0	536.	272.0	1584.	1.90	11.	275.0	1602.
9/11/74	0.90	404.	0.58	7.1	50.0	243.	60.0	291.	14.00	68.	200.0	971.
10/ 8/74	13.80	6194.	8.92	4.3	182.0	13546.	0.0	0.	23.00	1712.	1550.0	115368.
MINIMUM	0.90	404.	0.58	3.8	40.0	243.	0.0	0.	1.10	9.	150.0	971.
MAXIMUM	14.60	6553.	9.44	7.5	266.0	14647.	272.0	1584.	36.44	1712.	1550.0	115368.
AVERAGE	6.30	2827.	4.07	5.1	160.1	6318.	34.7	224.	18.23	637.	685.4	30082.

SAMPLE POINT NO. 20 SHENANDOAH CREEK BELOW SHENANDOAH

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 6/73	12.90	5790.	8.34	3.9	252.0	17533.	0.0	0.	40.31	2805.	900.0	62619.
12/11/73	16.10	7226.	10.41	3.6	222.0	19278.	0.0	0.	28.56	2480.	850.0	73811.
1/ 9/74	12.80	5745.	8.27	5.0	166.0	11460.	0.0	0.	38.37	2649.	880.0	60753.
2/ 5/74	13.00	5835.	8.40	5.0	190.0	13322.	8.0	561.	23.71	1662.	625.0	43822.
3/ 5/74	15.20	6822.	9.82	4.5	142.0	11641.	0.0	0.	133.88	10976.	425.0	34842.
4/ 3/74	18.00	8079.	11.63	4.1	130.0	12621.	0.0	0.	23.57	2288.	1025.0	99511.
5/ 8/74	26.30	11804.	17.00	4.2	200.0	28370.	0.0	0.	13.00	1844.	675.0	95749.
6/11/74	11.60	5206.	7.50	4.9	134.0	8384.	0.0	0.	76.90	4811.	350.0	21898.
7/ 9/74	17.40	7810.	11.25	4.4	196.0	18394.	0.0	0.	19.90	1868.	850.0	79770.
8/13/74	8.13	3649.	5.25	6.7	82.0	3596.	0.0	0.	17.80	781.	575.0	25213.
9/11/74	6.98	3133.	4.51	4.9	112.0	4216.	0.0	0.	16.20	610.	725.0	27294.
10/ 9/74	14.80	6643.	9.57	3.9	202.0	16125.	0.0	0.	20.50	1636.	1700.0	135701.
MINIMUM	6.98	3133.	4.51	3.6	82.0	3596.	0.0	0.	13.00	610.	350.0	21898.
MAXIMUM	26.30	11804.	17.00	6.7	252.0	28370.	8.0	561.	133.88	10976.	1700.0	135701.
AVERAGE	14.43	6479.	9.33	4.6	169.0	13745.	0.7	47.	37.72	2867.	798.3	63415.

SAMPLE POINT NO. 21 LOST CREEK DISCHARGE

	FLOW				ACIDITY		ALKALINITY		TOTAL IRON		SULFATES	
DATE	CFS	GPM	MGD	PH	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY
11/ 6/73	0.05	22.	0.03	4.0	25.0	7.	0.0	0.	0.29	0.	63.0	17.
12/11/73	0.55	247.	0.36	3.6	44.0	131.	0.0	0.	0.44	1.	60.0	178.
1/ 9/74	0.16	72.	0.10	4.3	18.0	16.	0.0	0.	0.59	1.	63.0	54.
2/ 5/74	0.38	171.	0.25	4.1	28.0	57.	0.0	0.	0.74	2.	56.0	115.
3/ 5/74	0.31	139.	0.20	4.3	20.0	33.	0.0	0.	0.59	1.	225.0	376.
4/ 3/74	1.10	494.	0.71	3.2	26.0	154.	0.0	0.	0.71	4.	225.0	1335.
5/ 8/74	0.15	67.	0.10	4.1	18.0	15.	0.0	0.	0.50	0.	150.0	121.
6/11/74	0.01	4.	0.01	4.2	14.0	1.	0.0	0.	0.40	0.	57.0	3.
7/ 9/74	0.04	18.	0.03	4.4	20.0	4.	0.0	0.	0.30	0.	350.0	76.
8/13/74	0.03	13.	0.02	4.3	20.0	3.	0.0	0.	0.70	0.	225.0	36.
9/11/74	0.02	9.	0.01	4.2	22.0	2.	0.0	0.	0.10	0.	175.0	19.
10/ 9/74	0.02	9.	0.01	3.8	20.0	2.	0.0	0.	0.30	0.	275.0	30.
MINIMUM	0.01	4.	0.01	3.2	14.0	1.	0.0	0.	0.10	0.	56.0	3.
MAXIMUM	1.10	494.	0.71	4.4	44.0	154.	0.0	0.	0.74	4.	350.0	1335.
AVERAGE	0.23	105.	0.15	4.0	22.9	35.	0.0	0.	0.47	1.	160.3	197.

SAMPLE POINT NO. 22 LOST CREEK

	FLOW				ACIDITY		ALKALINITY		TOTAL IRON		SULFATES	
DATE	CFS	GPM	MGD	PH	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY
11/ 6/73	0.29	130.	0.19	5.7	5.0	8.	8.0	13.	0.15	0.	30.0	47.
12/11/73	1.32	592.	0.85	5.4	8.0	57.	2.0	14.	0.00	0.	35.0	249.
1/ 9/74	0.63	283.	0.41	5.7	2.0	7.	4.0	14.	0.15	1.	11.0	37.
2/ 5/74	1.03	462.	0.67	6.7	4.0	22.	10.0	56.	0.15	1.	9.0	50.
3/ 5/74	0.70	314.	0.45	6.4	6.0	23.	22.0	83.	0.44	2.	150.0	566.
4/ 3/74	2.36	1059.	1.53	5.4	6.0	76.	10.0	127.	0.24	3.	30.0	382.
5/ 8/74	0.85	382.	0.55	7.0	2.0	9.	10.0	46.	0.00	0.	30.0	138.
6/11/74	0.10	45.	0.06	6.7	4.0	2.	14.0	8.	0.30	0.	13.0	7.
7/ 9/74	0.15	67.	0.10	7.0	8.0	6.	2.0	2.	0.10	0.	300.0	243.
8/13/74	0.15	67.	0.10	7.5	6.0	5.	14.0	11.	0.00	0.	175.0	142.
9/11/74	0.15	67.	0.10	7.5	8.0	6.	10.0	8.	0.30	0.	14.0	11.
10/ 9/74	0.16	72.	0.10	6.4	8.0	7.	0.0	0.	0.00	0.	225.0	194.
MINIMUM	0.10	45.	0.06	5.4	2.0	2.	0.0	0.	0.00	0.	9.0	7.
MAXIMUM	2.36	1059.	1.53	7.5	8.0	76.	22.0	127.	0.44	3.	300.0	566.
AVERAGE	0.66	295.	0.42	6.4	5.6	19.	8.8	32.	0.15	1.	85.2	172.

SAMPLE POINT NO. 23 LOST CREEK BALL FIELD DISCHARGE

	FLOW				ACIDITY		ALKALINITY		TOTAL IRON		SULFATES	
DATE	CFS	GPM	MGD	PH	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY
11/ 6/73	FLOW NOT DETERMINED/NOWATER SAMPLE TAKEN				0.0	0.	0.0	0.	0.00	0.	0.0	0.
12/11/73	FLOW NOT DETERMINED/NOWATER SAMPLE TAKEN				0.0	0.	0.0	0.	0.00	0.	0.0	0.
1/ 8/74	2.81	1261.	1.82	6.4	48.0	727.	84.0	1273.	19.44	295.	1100.0	16671.
2/ 5/74	0.99	444.	0.64	6.6	58.0	310.	104.0	555.	31.85	170.	850.0	4539.
3/ 5/74	1.31	588.	0.85	6.5	150.0	1060.	134.0	947.	21.73	154.	725.0	5123.
4/ 3/74	1.95	875.	1.26	6.1	46.0	484.	112.0	1178.	19.76	208.	950.0	9992.
5/ 8/74	1.36	610.	0.88	6.4	30.0	220.	136.0	998.	21.60	158.	900.0	6602.
6/11/74	1.76	790.	1.14	6.3	44.0	418.	116.0	1101.	20.50	195.	825.0	7831.
7/ 9/74	1.20	539.	0.78	6.3	40.0	259.	72.0	466.	15.90	103.	1150.0	7443.
8/13/74	FLOW NOT DETERMINED/NOWATER SAMPLE TAKEN				0.0	0.	0.0	0.	0.00	0.	0.0	0.
9/11/74	FLOW NOT DETERMINED/NOWATER SAMPLE TAKEN				0.0	0.	0.0	0.	0.00	0.	0.0	0.
10/ 9/74	FLOW NOT DETERMINED/NOWATER SAMPLE TAKEN				0.0	0.	0.0	0.	0.00	0.	0.0	0.
MINIMUM	0.00	0.	0.00	0.0	0.0	0.	0.0	0.	0.00	0.	0.0	0.
MAXIMUM	2.81	1261.	1.82	6.6	150.0	1060.	136.0	1273.	31.85	295.	1150.0	16671.
AVERAGE	0.95	426.	0.61	6.4	59.4	497.	108.3	931.	21.54	183.	928.6	8314.

SAMPLE POINT NO. 24 SHENANDOAH CREEK AT LOST CREEK

DATE	FLOW			PH	ACIDITY		ALKALINITY		TOTAL IRON		SULFATES	
	CFS	GPM	MGD		CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY
11/ 6/73	19.00	8528.	12.28	3.8	242.0	24799.	0.0	0.	54.50	5585.	825.0	84544.
12/11/73	18.20	8169.	11.76	4.2	1040.0	102089.	0.0	0.	24.59	2414.	1025.0	100616.
1/ 8/74	14.20	6373.	9.18	4.7	300.0	22976.	0.0	0.	41.27	3161.	1050.0	80418.
2/ 5/74	12.80	5745.	8.27	5.0	190.0	13117.	0.0	0.	6.44	445.	600.0	41422.
3/ 5/74	15.30	6867.	9.89	4.7	152.0	12543.	0.0	0.	80.48	6641.	550.0	45387.
4/ 3/74	21.00	9425.	13.57	3.9	164.0	18575.	0.0	0.	28.33	3209.	825.0	93443.
5/ 8/74	28.50	12792.	18.42	4.5	230.0	35355.	0.0	0.	17.40	2675.	850.0	130658.
6/11/74	10.10	4533.	6.53	6.2	44.0	2397.	0.0	0.	26.60	1449.	275.0	14981.
7/ 9/74	17.80	7989.	11.50	4.6	148.0	14209.	0.0	0.	20.70	1987.	1100.0	105605.
8/13/74	9.06	4066.	5.86	6.8	100.0	4887.	126.0	6157.	12.80	625.	500.0	24433.
9/11/74	6.42	2882.	4.15	4.9	72.0	2493.	0.0	0.	18.70	648.	800.0	27701.
10/ 9/74	14.90	6688.	9.63	4.1	230.0	18484.	0.0	0.	21.30	1712.	1300.0	104473.
MINIMUM	6.42	2882.	4.15	3.8	44.0	2397.	0.0	0.	6.44	445.	275.0	14981.
MAXIMUM	28.50	12792.	18.42	6.8	1040.0	102089.	126.0	6157.	80.48	6641.	1300.0	130658.
AVERAGE	15.61	7005.	10.09	4.8	242.7	22660.	10.5	513.	29.43	2546.	808.3	71140.

SAMPLE POINT NO. 25 HAMMOND BORE HOLE DISCHARGE

DATE	FLOW			PH	ACIDITY		ALKALINITY		TOTAL IRON		SULFATES	
	CFS	GPM	MGD		CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY
11/ 6/73	4.22	1894.	2.73	6.0	130.0	2959.	171.0	3892.	48.60	1106.	1100.0	25037.
12/11/73	3.80	1706.	2.46	6.0	66.0	1353.	198.0	4058.	33.87	694.	650.0	13322.
1/ 9/74	4.94	2217.	3.19	6.3	118.0	3144.	220.0	5862.	46.38	1236.	1100.0	29308.
2/ 5/74	5.37	2410.	3.47	6.4	222.0	6430.	210.0	6082.	54.40	1576.	675.0	19550.
3/ 5/74	3.83	1719.	2.48	6.4	260.0	5371.	260.0	5371.	48.57	1003.	775.0	16009.
4/ 3/74	4.28	1921.	2.77	6.3	96.0	2216.	220.0	5079.	41.91	967.	925.0	21353.
5/ 8/74	3.52	1580.	2.28	6.3	156.0	2962.	170.0	3227.	46.80	889.	775.0	14714.
6/11/74	4.33	1943.	2.80	6.4	174.0	4064.	206.0	4811.	48.80	1140.	800.0	18683.
7/ 9/74	4.31	1934.	2.79	6.3	66.0	1534.	174.0	4045.	47.10	1095.	1150.0	26733.
8/13/74	2.27	1019.	1.47	6.3	18.0	220.	220.0	2694.	42.30	518.	1100.0	13468.
9/11/74	3.24	1454.	2.09	6.3	46.0	804.	170.0	2971.	49.10	858.	1300.0	22718.
10/ 9/74	2.84	1275.	1.84	6.0	62.0	950.	158.0	2420.	42.50	651.	1675.0	25657.
MINIMUM	2.27	1019.	1.47	6.0	18.0	220.	158.0	2420.	33.87	518.	650.0	13322.
MAXIMUM	5.37	2410.	3.47	6.4	260.0	6430.	260.0	6082.	54.40	1576.	1675.0	29308.
AVERAGE	3.91	1756.	2.53	6.2	117.8	2667.	198.1	4209.	45.86	978.	1002.1	20546.

SAMPLE POINT NO. 26 HAMMOND DISCHARGE

DATE	FLOW			PH	ACIDITY		ALKALINITY		TOTAL IRON		SULFATES	
	CFS	GPM	MGD		CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY
11/ 6/73	0.00	0.	0.00	3.6	267.0	0.	0.0	0.	17.87	0.	1415.0	0.
12/11/73	0.00	0.	0.00	3.4	166.0	0.	0.0	0.	16.90	0.	1050.0	0.
1/ 9/74	0.04	18.	0.03	4.3	288.0	62.	0.0	0.	20.59	4.	1150.0	248.
2/ 5/74	0.08	36.	0.05	3.7	270.0	117.	0.0	0.	26.44	11.	1525.0	658.
3/ 5/74	0.03	13.	0.02	4.2	220.0	36.	0.0	0.	17.01	3.	1000.0	162.
4/ 3/74	0.05	22.	0.03	4.2	200.0	54.	0.0	0.	11.91	3.	1100.0	297.
5/ 8/74	0.04	18.	0.03	4.3	176.0	38.	0.0	0.	12.60	3.	1100.0	237.
6/11/74	0.01	4.	0.01	4.4	92.0	5.	0.0	0.	8.80	0.	900.0	49.
7/ 9/74	0.00	0.	0.00	4.4	218.0	0.	0.0	0.	5.70	0.	1300.0	0.
8/13/74	FLOW NOT DETERMINED/NOWATER SAMPLE TAKEN				0.0	0.	0.0	0.	0.00	0.	0.0	0.
9/11/74	FLOW NOT DETERMINED/NOWATER SAMPLE TAKEN				0.0	0.	0.0	0.	0.00	0.	0.0	0.
10/ 9/74	FLOW NOT DETERMINED/NOWATER SAMPLE TAKEN				0.0	0.	0.0	0.	0.00	0.	0.0	0.
MINIMUM	0.00	0.	0.00	0.0	0.0	0.	0.0	0.	0.00	0.	0.0	0.
MAXIMUM	0.08	36.	0.05	4.4	288.0	117.	0.0	0.	26.44	11.	1525.0	658.
AVERAGE	0.02	9.	0.01	4.1	210.8	35.	0.0	0.	15.31	3.	1171.1	183.

SAMPLE POINT NO. 27 SHENANDOAH CREEK AT CONNERTON

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 6/73	15.30	6867.	9.89	4.5	135.0	11140.	0.0	0.	41.58	3431.	940.0	77570.
12/11/73	15.40	6912.	9.95	5.1	94.0	7808.	0.0	0.	25.35	2106.	750.0	62295.
1/ 8/74	22.00	9874.	14.22	5.8	106.0	12578.	0.0	0.	24.36	2891.	950.0	112725.
2/ 5/74	21.80	9785.	14.09	6.3	114.0	13404.	18.0	2116.	31.85	3745.	950.0	111700.
3/ 5/74	18.40	8259.	11.89	5.8	70.0	6947.	0.0	0.	27.83	2762.	575.0	57064.
4/ 3/74	26.30	11804.	17.00	5.0	140.0	19859.	0.0	0.	22.38	3175.	600.0	85110.
5/ 8/74	27.40	12298.	17.71	5.1	138.0	20394.	0.0	0.	17.80	2631.	800.0	118226.
6/11/74	14.30	6418.	9.24	6.4	22.0	1697.	74.0	5707.	16.10	1242.	675.0	52061.
7/ 9/74	19.30	8662.	12.47	5.9	84.0	8744.	0.0	0.	22.20	2311.	1100.0	114505.
8/13/74	10.10	4533.	6.53	6.4	40.0	2179.	116.0	6319.	19.90	1084.	950.0	51751.
9/11/74	11.50	5162.	7.43	6.4	32.0	1985.	20.0	1241.	19.80	1228.	1050.0	65127.
10/ 9/74	19.20	8618.	12.41	4.7	202.0	20918.	0.0	0.	22.40	2320.	1450.0	150156.
MINIMUM	10.10	4533.	6.53	4.5	22.0	1697.	0.0	0.	16.10	1084.	575.0	51751.
MAXIMUM	27.40	12298.	17.71	6.4	202.0	20918.	116.0	6319.	41.58	3745.	1450.0	150156.
AVERAGE	18.42	8266.	11.90	5.6	98.1	10638.	19.0	1282.	24.30	2410.	899.2	88191.

SAMPLE POINT NO. 28 CONNERTON NO. 1 DISCHARGE

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 6/73	1.12	503.	0.72	6.8	0.0	0.	217.0	1311.	1.62	10.	875.0	5286.
12/11/73	1.67	750.	1.08	6.6	0.0	0.	260.0	2342.	9.44	85.	700.0	6305.
1/ 8/74	2.80	1257.	1.81	6.9	44.0	664.	270.0	4078.	2.35	35.	1000.0	15102.
2/ 5/74	2.50	1122.	1.62	6.9	24.0	324.	280.0	3775.	4.14	56.	825.0	11124.
3/ 5/74	2.13	956.	1.38	6.8	34.0	391.	288.0	3309.	2.01	23.	600.0	6893.
4/ 3/74	3.71	1665.	2.40	6.7	36.0	720.	280.0	5603.	1.91	38.	700.0	14007.
5/ 8/74	1.40	628.	0.90	6.8	14.0	106.	282.0	2129.	2.30	17.	725.0	5474.
6/11/74	1.20	539.	0.78	6.8	0.0	0.	264.0	1709.	1.50	10.	575.0	3722.
7/ 9/74	1.60	718.	1.03	6.7	78.0	673.	270.0	2330.	0.90	8.	1050.0	9061.
8/12/74	0.86	386.	0.56	6.7	0.0	0.	296.0	1373.	1.60	7.	1025.0	4754.
9/11/74	0.72	323.	0.47	6.8	24.0	93.	210.0	816.	1.60	6.	1075.0	4175.
10/ 9/74	0.75	337.	0.48	6.5	20.0	81.	166.0	671.	4.20	17.	1225.0	4955.
MINIMUM	0.72	323.	0.47	6.5	0.0	0.	166.0	671.	0.90	6.	575.0	3722.
MAXIMUM	3.71	1665.	2.40	6.9	78.0	720.	296.0	5603.	9.44	85.	1225.0	15102.
AVERAGE	1.70	765.	1.10	6.7	22.3	254.	256.9	2454.	2.80	26.	864.6	7571.

SAMPLE POINT NO. 29 CONNERTON NO. 2 DISCHARGE

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 7/73	0.05	22.	0.03	6.6	50.0	13.	174.0	47.	30.48	8.	1000.0	270.
12/12/73	0.08	36.	0.05	6.0	0.0	0.	224.0	97.	30.59	13.	575.0	248.
1/ 8/74	0.09	40.	0.06	6.6	128.0	62.	186.0	90.	41.27	20.	1075.0	522.
2/ 5/74	0.36	162.	0.23	6.7	126.0	245.	160.0	311.	33.34	65.	775.0	1505.
3/ 5/74	0.32	144.	0.21	6.4	26.0	45.	170.0	293.	39.30	68.	925.0	1596.
4/ 3/74	0.41	184.	0.26	6.1	150.0	332.	170.0	376.	29.29	65.	1150.0	2543.
5/ 8/74	0.20	90.	0.13	6.4	82.0	88.	202.0	218.	34.30	37.	1025.0	1106.
6/10/74	0.20	90.	0.13	6.4	12.0	13.	200.0	216.	36.80	40.	950.0	1025.
7/ 9/74	0.26	117.	0.17	6.5	144.0	202.	180.0	252.	36.60	51.	1450.0	2033.
8/12/74	0.12	54.	0.08	6.6	20.0	13.	216.0	140.	33.20	21.	1300.0	841.
9/11/74	0.11	49.	0.07	6.4	74.0	44.	132.0	78.	39.60	23.	1375.0	816.
10/ 9/74	0.13	58.	0.08	6.0	120.0	84.	116.0	81.	34.40	24.	1575.0	1104.
MINIMUM	0.05	22.	0.03	6.0	0.0	0.	116.0	47.	29.29	8.	575.0	248.
MAXIMUM	0.41	184.	0.26	6.7	150.0	332.	224.0	376.	41.27	68.	1575.0	2543.
AVERAGE	0.19	87.	0.13	6.4	77.7	95.	177.5	183.	34.93	36.	1097.9	1134.

SAMPLE POINT NO. 30 SHENANDOAH CREEK BELOW CONNERTON

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 7/73	20.50	9201.	13.25	4.8	17.0	1880.	1.0	111.	42.34	4681.	875.0	96747.
12/12/73	19.50	8752.	12.60	5.7	46.0	4838.	8.0	841.	21.66	2278.	575.0	60475.
1/ 8/74	31.60	14183.	20.42	6.1	92.0	15680.	14.0	2386.	27.37	4665.	1025.0	174697.
2/ 5/74	23.80	10682.	15.38	6.3	72.0	9242.	20.0	2567.	27.83	3572.	775.0	99484.
3/ 5/74	22.10	9919.	14.28	6.4	90.0	10728.	20.0	2384.	26.76	3190.	550.0	65558.
4/ 3/74	36.30	16293.	23.46	5.4	100.0	19579.	16.0	3133.	20.24	3963.	700.0	137050.
5/ 8/74	43.80	19659.	28.31	5.4	98.0	23151.	2.0	472.	19.90	4701.	825.0	194895.
6/11/74	12.50	5610.	8.08	6.3	10.0	674.	90.0	6068.	13.80	930.	600.0	40452.
7/ 9/74	22.60	10144.	14.61	6.3	100.0	12189.	126.0	15359.	17.50	2133.	1150.0	140178.
8/12/74	11.40	5117.	7.37	6.4	40.0	2459.	154.0	9469.	17.50	1076.	900.0	55338.
9/11/74	12.60	5655.	8.14	6.6	60.0	4078.	22.0	1495.	18.80	1278.	1100.0	74754.
10/ 9/74	20.80	9336.	13.44	4.8	88.0	9872.	0.0	0.	19.70	2210.	1550.0	173888.
MINIMUM	11.40	5117.	7.37	4.8	10.0	674.	0.0	0.	13.80	930.	550.0	40452.
MAXIMUM	43.80	19659.	28.31	6.6	100.0	23151.	154.0	15359.	42.34	4701.	1550.0	194895.
AVERAGE	23.12	10379.	14.95	5.9	67.8	9531.	39.4	3690.	22.78	2890.	885.4	109459.

SAMPLE POINT NO. 31 NORTH GIRARDVILLE DISCHARGE

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 7/73	0.01	4.	0.01	6.0	23.0	1.	33.0	2.	50.74	3.	915.0	49.
12/11/73	0.00	0.	0.00	5.6	190.0	0.	0.0	0.	32.93	0.	425.0	0.
1/ 8/74	0.27	121.	0.17	6.3	170.0	248.	62.0	90.	46.03	67.	1055.0	1536.
2/ 4/74	0.24	108.	0.16	6.4	84.0	109.	98.0	127.	48.57	63.	900.0	1165.
3/ 4/74	0.26	117.	0.17	6.5	100.0	140.	108.0	151.	52.96	74.	850.0	1192.
4/ 2/74	0.17	76.	0.11	6.5	12.0	11.	92.0	84.	37.14	34.	900.0	825.
5/ 8/74	0.17	76.	0.11	6.6	72.0	66.	120.0	110.	43.50	40.	825.0	756.
6/10/74	0.11	49.	0.07	6.6	0.0	0.	150.0	89.	0.00	0.	755.0	448.
7/ 8/74	0.08	36.	0.05	6.4	142.0	61.	150.0	65.	43.40	19.	1350.0	583.
8/12/74	0.02	9.	0.01	6.4	60.0	6.	164.0	18.	41.80	5.	1100.0	119.
9/11/74	0.02	9.	0.01	6.6	116.0	13.	82.0	9.	49.60	5.	1200.0	129.
10/ 8/74	0.02	9.	0.01	6.3	208.0	22.	126.0	14.	44.20	5.	1500.0	162.
MINIMUM	0.00	0.	0.00	5.6	0.0	0.	0.0	0.	0.00	0.	425.0	0.
MAXIMUM	0.27	121.	0.17	6.6	208.0	248.	164.0	151.	52.96	74.	1500.0	1536.
AVERAGE	0.11	51.	0.07	6.3	98.1	56.	98.8	63.	40.91	26.	981.3	580.

SAMPLE POINT NO. 32 SOUTH PRESTON DISCHARGE

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 7/73	0.60	269.	0.39	6.5	54.0	175.	70.0	227.	23.96	78.	300.0	971.
12/10/73	0.86	386.	0.56	6.3	80.0	371.	88.0	408.	23.22	108.	275.0	1276.
1/ 8/74	1.50	673.	0.97	6.0	46.0	372.	24.0	194.	12.52	101.	230.0	1861.
2/ 4/74	1.68	754.	1.09	6.2	10.0	91.	90.0	816.	10.59	96.	200.0	1812.
3/ 4/74	1.32	592.	0.85	6.5	60.0	427.	54.0	384.	14.35	102.	225.0	1602.
4/ 2/74	2.12	952.	1.37	6.4	24.0	274.	52.0	595.	10.71	122.	225.0	2573.
5/ 7/74	2.40	1077.	1.55	6.4	18.0	233.	62.0	803.	12.50	162.	75.0	971.
6/10/74	2.67	1198.	1.73	6.5	2.0	29.	78.0	1123.	12.70	183.	100.0	1440.
7/ 8/74	2.50	1122.	1.62	6.8	60.0	809.	80.0	1079.	13.50	182.	250.0	3371.
8/12/74	1.04	467.	0.67	6.9	32.0	179.	100.0	561.	13.00	73.	275.0	1543.
9/10/74	1.35	606.	0.87	6.8	30.0	218.	52.0	379.	12.50	91.	325.0	2366.
10/ 8/74	1.20	539.	0.78	6.2	44.0	285.	60.0	388.	11.60	75.	400.0	2589.
MINIMUM	0.60	269.	0.39	6.0	2.0	29.	24.0	194.	10.59	73.	75.0	971.
MAXIMUM	2.67	1198.	1.73	6.9	80.0	809.	100.0	1123.	23.96	183.	400.0	3371.
AVERAGE	1.60	720.	1.04	6.5	38.3	289.	67.5	580.	14.26	114.	240.0	1864.

SAMPLE POINT NO. 33 MAHANOY CREEK BELOW SOUTH PRESTON

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 7/73	87.60	39318.	56.62	6.4	23.0	10867.	72.0	34018.	27.93	13196.	900.0	425226.
12/10/73	148.00	66427.	95.66	6.3	34.0	27140.	48.0	38316.	26.13	20858.	450.0	359209.
1/ 8/74	160.00	71813.	103.41	6.4	64.0	55230.	82.0	70763.	33.59	28987.	995.0	858650.
2/ 4/74	151.00	67774.	97.59	6.0	46.0	37463.	72.0	58638.	26.78	21810.	425.0	346130.
3/ 4/74	138.00	61939.	89.19	6.4	80.0	59545.	84.0	62522.	34.49	25671.	725.0	539623.
4/ 2/74	145.00	65081.	93.72	6.4	30.0	23462.	80.0	62565.	24.76	19364.	775.0	606099.
5/ 7/74	122.00	54758.	78.85	6.6	70.0	46061.	140.0	92122.	28.80	18951.	975.0	641561.
6/10/74	121.00	54309.	78.20	6.5	6.0	3916.	112.0	73093.	32.90	21471.	675.0	440517.
7/ 8/74	120.00	53860.	77.56	6.5	110.0	71195.	68.0	44011.	23.00	14886.	950.0	614863.
8/12/74	65.20	29264.	42.14	6.6	82.0	28836.	174.0	61189.	22.10	7772.	1050.0	369241.
9/10/74	95.20	42729.	61.53	6.6	64.0	32862.	70.0	35943.	18.50	9499.	925.0	474955.
10/ 8/74	87.00	39048.	56.23	6.2	74.0	34724.	54.0	25339.	21.80	10229.	1350.0	633471.
MINIMUM	65.20	29264.	42.14	6.0	6.0	3916.	48.0	25339.	18.50	7772.	425.0	346130.
MAXIMUM	160.00	71813.	103.41	6.6	110.0	71195.	174.0	92122.	34.49	28987.	1350.0	858650.
AVERAGE	120.00	53860.	77.56	6.4	56.9	35942.	88.0	54876.	26.73	17725.	849.6	525795.

SAMPLE POINT NO. 34 NORTH PRESTON DISCHARGE

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 7/73	0.99	444.	0.64	3.3	190.0	1015.	0.0	0.	39.54	211.	1000.0	5340.
12/10/73	0.13	58.	0.08	3.1	480.0	337.	0.0	0.	32.93	23.	925.0	649.
1/ 8/74	2.34	1050.	1.51	3.1	254.0	3206.	0.0	0.	26.48	334.	1050.0	13252.
2/ 4/74	1.04	467.	0.67	3.0	296.0	1660.	0.0	0.	32.20	181.	900.0	5048.
3/ 4/74	0.48	215.	0.31	3.3	294.0	761.	0.0	0.	39.30	102.	725.0	1877.
4/ 2/74	0.74	332.	0.48	3.3	204.0	814.	0.0	0.	26.43	105.	825.0	3293.
5/ 8/74	0.66	296.	0.43	3.4	210.0	748.	0.0	0.	29.40	105.	725.0	2581.
6/10/74	0.18	81.	0.12	3.2	290.0	282.	0.0	0.	33.50	33.	700.0	680.
7/ 8/74	0.24	108.	0.16	3.4	1300.0	1683.	0.0	0.	34.50	45.	1100.0	1424.
8/12/74	0.50	224.	0.32	3.4	260.0	701.	0.0	0.	30.60	83.	1100.0	2966.
9/10/74	0.50	224.	0.32	3.3	210.0	566.	0.0	0.	27.20	73.	1325.0	3573.
10/ 8/74	0.58	260.	0.37	3.1	200.0	626.	0.0	0.	33.50	105.	1350.0	4223.
MINIMUM	0.13	58.	0.08	3.0	190.0	282.	0.0	0.	26.43	23.	700.0	649.
MAXIMUM	2.34	1050.	1.51	3.4	1300.0	3206.	0.0	0.	39.54	334.	1350.0	13252.
AVERAGE	0.70	313.	0.45	3.2	349.0	1033.	0.0	0.	32.13	117.	977.1	3742.

SAMPLE POINT NO. 35 MAHANOY CREEK BELOW PRESTON

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 7/73	110.00	49372.	71.10	6.4	18.0	10679.	58.0	34411.	33.01	19584.	925.0	548792.
12/10/73	164.00	73609.	106.00	6.4	50.0	44227.	50.0	44227.	26.92	23812.	850.0	751858.
1/ 8/74	150.00	67325.	96.95	6.5	84.0	67959.	76.0	61486.	32.56	26342.	1050.0	849482.
2/ 4/74	171.00	76750.	110.52	6.2	34.0	31358.	72.0	66405.	27.83	25667.	800.0	737836.
3/ 4/74	149.00	66876.	96.30	6.6	62.0	49825.	80.0	64291.	26.78	21521.	800.0	642909.
4/ 2/74	170.00	76302.	109.87	6.5	52.0	47679.	80.0	73352.	26.67	24454.	850.0	779365.
5/ 7/74	143.00	64183.	92.42	6.6	60.0	46277.	124.0	95638.	29.40	22676.	775.0	597739.
6/10/74	134.00	60144.	86.61	6.4	88.0	63601.	102.0	73719.	31.60	22838.	800.0	578187.
7/ 8/74	122.00	54758.	78.85	6.5	82.0	53957.	88.0	57905.	25.20	16582.	1175.0	773163.
8/12/74	69.60	31239.	44.98	6.6	60.0	22523.	174.0	65318.	20.30	7620.	1075.0	403544.
9/10/74	99.20	44524.	64.11	6.8	60.0	32102.	92.0	49224.	16.90	9042.	1075.0	575167.
10/ 8/74	90.30	40530.	58.36	6.2	50.0	24352.	52.0	25326.	20.40	9936.	1250.0	608795.
MINIMUM	69.60	31239.	44.98	6.2	18.0	10679.	50.0	25326.	16.90	7620.	775.0	403544.
MAXIMUM	171.00	76750.	110.52	6.8	88.0	67959.	174.0	95638.	33.01	26342.	1250.0	849482.
AVERAGE	131.01	58801.	84.67	6.5	58.3	41212.	87.3	59275.	26.46	19173.	952.1	653903.

SAMPLE POINT NO. 36 CENTRALIA TUNNEL DISCHARGE

	FLOW				ACIDITY		ALKALINITY		TOTAL IRON		SULFATES	
DATE	CFS	GPM	MGD	PH	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY
11/ 7/73	8.92	4004.	5.77	3.4	280.0	13471.	0.0	0.	17.09	822.	800.0	38488.
12/10/73	18.70	8393.	12.09	3.3	290.0	29249.	0.0	0.	21.85	2204.	750.0	75644.
1/ 8/74	25.30	11355.	16.35	3.4	210.0	28656.	0.0	0.	7.37	1006.	560.0	76416.
2/ 4/74	27.90	12522.	18.03	3.1	180.0	27086.	0.0	0.	8.89	1338.	500.0	75240.
3/ 4/74	17.90	8034.	11.57	3.5	212.0	20467.	0.0	0.	9.71	937.	350.0	33790.
4/ 2/74	19.70	8842.	12.73	3.6	164.0	17425.	0.0	0.	9.76	1037.	425.0	45157.
5/ 7/74	15.20	6822.	9.82	3.5	198.0	16232.	0.0	0.	7.50	615.	475.0	38941.
6/10/74	13.40	6014.	8.66	3.5	180.0	13009.	0.0	0.	8.70	629.	425.0	30716.
7/ 8/74	8.25	3703.	5.33	3.5	232.0	10323.	0.0	0.	10.00	445.	775.0	34485.
8/12/74	9.45	4241.	6.11	3.6	230.0	11723.	0.0	0.	8.40	428.	575.0	29307.
9/10/74	9.36	4201.	6.05	3.4	206.0	10400.	0.0	0.	7.80	394.	825.0	41649.
10/ 8/74	8.45	3793.	5.46	3.2	250.0	11394.	0.0	0.	9.80	447.	825.0	37600.
MINIMUM	8.25	3703.	5.33	3.1	164.0	10323.	0.0	0.	7.37	394.	350.0	29307.
MAXIMUM	27.90	12522.	18.03	3.6	290.0	29249.	0.0	0.	21.85	2204.	825.0	76416.
AVERAGE	15.21	6827.	9.83	3.4	219.3	17453.	0.0	0.	10.57	858.	607.1	46453.

SAMPLE POINT NO. 37 MAHANOY CREEK AT BIG MINE RUN

	FLOW				ACIDITY		ALKALINITY		TOTAL IRON		SULFATES	
DATE	CFS	GPM	MGD	PH	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY
11/ 8/73	135.00	60592.	87.25	6.1	90.0	65531.	23.0	16747.	34.82	25353.	900.0	655315.
12/10/73	164.00	73609.	106.00	5.8	94.0	83147.	6.0	5307.	23.84	21087.	650.0	574951.
1/ 8/74	189.00	84829.	122.15	6.3	56.0	57085.	26.0	26504.	29.73	30306.	1010.0	1029572.
2/ 4/74	207.00	92908.	133.79	6.4	60.0	66988.	36.0	40193.	25.73	28727.	650.0	725700.
3/ 4/74	160.00	71813.	103.41	6.5	88.0	75941.	62.0	53504.	26.78	23110.	600.0	517779.
4/ 2/74	222.00	99641.	143.48	6.5	20.0	23947.	26.0	31131.	25.00	29934.	600.0	718419.
5/ 7/74	164.00	73609.	106.00	6.6	40.0	35382.	80.0	70763.	26.90	23794.	950.0	840312.
6/10/74	145.00	65081.	93.72	6.4	80.0	62565.	82.0	64129.	28.30	22132.	775.0	606099.
7/ 8/74	127.00	57002.	82.08	6.5	66.0	45209.	50.0	34249.	29.10	19933.	1175.0	804850.
8/12/74	81.60	36625.	52.74	6.6	60.0	26407.	116.0	51053.	18.70	8230.	1100.0	484124.
9/10/74	107.00	48025.	69.16	6.7	52.0	30010.	62.0	35781.	14.50	8368.	950.0	548253.
10/ 8/74	99.30	44569.	64.18	6.2	34.0	18210.	30.0	16067.	19.30	10337.	1125.0	602525.
MINIMUM	81.60	36625.	52.74	5.8	20.0	18210.	6.0	5307.	14.50	8230.	600.0	484124.
MAXIMUM	222.00	99641.	143.48	6.7	94.0	83147.	116.0	70763.	34.82	30306.	1175.0	1029572.
AVERAGE	150.07	67359.	97.00	6.4	61.7	49202.	49.9	37119.	25.22	20943.	873.8	675658.

SAMPLE POINT NO. 38 BAST DISCHARGE

	FLOW				ACIDITY		ALKALINITY		TOTAL IRON		SULFATES	
DATE	CFS	GPM	MGD	PH	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY
11/ 8/73	3.63	1629.	2.35	6.4	50.0	979.	103.0	2017.	27.40	536.	900.0	17621.
12/10/73	4.35	1952.	2.81	6.1	120.0	2815.	88.0	2065.	26.32	618.	650.0	15250.
1/ 7/74	4.35	1952.	2.81	6.2	148.0	3472.	150.0	3519.	29.73	698.	575.0	13491.
2/ 4/74	5.75	2581.	3.72	6.2	50.0	1551.	152.0	4714.	33.34	1034.	450.0	13956.
3/ 4/74	4.35	1952.	2.81	6.3	180.0	4223.	162.0	3801.	32.20	755.	400.0	9385.
4/ 2/74	5.25	2356.	3.39	6.4	70.0	1982.	134.0	3794.	27.38	775.	550.0	15574.
5/ 7/74	5.08	2280.	3.28	6.3	80.0	2192.	128.0	3507.	29.80	816.	700.0	19179.
6/10/74	5.00	2244.	3.23	6.4	100.0	2697.	138.0	3722.	31.70	855.	450.0	12135.
7/ 8/74	4.75	2132.	3.07	6.3	94.0	2408.	130.0	3331.	31.50	807.	700.0	17934.
8/12/74	3.20	1436.	2.07	6.3	20.0	345.	136.0	2347.	30.10	520.	725.0	12513.
9/10/74	3.75	1683.	2.42	6.5	100.0	2023.	84.0	1699.	33.90	685.	850.0	17192.
10/ 8/74	3.59	1611.	2.32	6.1	2.0	39.	88.0	1704.	31.20	604.	825.0	15974.
MINIMUM	3.20	1436.	2.07	6.1	2.0	39.	84.0	1699.	26.32	520.	400.0	9385.
MAXIMUM	5.75	2581.	3.72	6.5	180.0	4223.	162.0	4714.	33.90	1034.	900.0	19179.
AVERAGE	4.42	1984.	2.86	6.3	84.5	2060.	124.4	3018.	30.38	725.	647.9	15017.

SAMPLE POINT NO. 39 MAHANOY CREEK BELOW BAST

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 8/73	146.00	65530.	94.36	6.4	50.0	39373.	22.0	17324.	32.20	25356.	1000.0	787456.
12/10/73	168.00	75404.	108.58	6.1	60.0	54367.	14.0	12686.	24.59	22281.	550.0	498363.
1/ 7/74	201.00	90215.	129.91	6.4	38.0	41196.	20.0	21682.	27.25	29542.	575.0	623358.
2/ 4/74	202.00	90664.	130.56	6.6	32.0	34864.	38.0	41401.	29.99	32674.	800.0	871595.
3/ 4/74	164.00	73609.	106.00	6.4	66.0	58380.	66.0	58380.	24.70	21848.	525.0	464383.
4/ 2/74	241.00	108169.	155.76	6.5	40.0	51994.	28.0	36396.	23.10	30026.	600.0	779905.
5/ 7/74	170.00	76302.	109.87	6.6	52.0	47679.	84.0	77020.	27.30	25031.	575.0	527218.
6/10/74	148.00	66427.	95.66	6.4	32.0	25544.	80.0	63859.	19.10	15246.	550.0	439034.
7/ 8/74	137.00	61490.	88.55	6.4	44.0	32512.	52.0	38424.	21.10	15591.	1150.0	849752.
8/12/74	95.60	42908.	61.79	6.7	40.0	20625.	118.0	60843.	19.40	10003.	1025.0	528513.
9/10/74	114.00	51167.	73.68	6.8	40.0	24595.	52.0	31973.	18.20	11191.	1075.0	660978.
10/ 8/74	104.00	46679.	67.22	6.4	24.0	13462.	40.0	22437.	20.10	11275.	1275.0	715183.
MINIMUM	95.60	42908.	61.79	6.1	24.0	13462.	14.0	12686.	18.20	10003.	525.0	439034.
MAXIMUM	241.00	108169.	155.76	6.8	66.0	58380.	118.0	77020.	32.20	32674.	1275.0	871595.
AVERAGE	157.55	70714.	101.83	6.5	43.2	37049.	51.2	40202.	23.92	20839.	808.3	645478.

SAMPLE POINT NO. 40 ASHLAND NO. 1 DISCHARGE

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 8/73	0.13	58.	0.08	5.5	80.0	56.	5.0	4.	33.54	24.	725.0	508.
12/10/73	0.15	67.	0.10	5.5	130.0	105.	0.0	0.	26.92	22.	550.0	445.
1/ 7/74	0.20	90.	0.13	6.0	90.0	97.	2.0	2.	46.38	50.	475.0	512.
2/ 4/74	0.18	81.	0.12	6.1	54.0	52.	0.0	0.	43.13	42.	475.0	461.
3/ 4/74	0.16	72.	0.10	6.2	70.0	60.	8.0	7.	43.13	37.	400.0	345.
4/ 2/74	0.25	112.	0.16	6.2	92.0	124.	0.0	0.	30.95	42.	525.0	708.
5/ 7/74	0.20	90.	0.13	6.3	36.0	39.	0.0	0.	36.70	40.	425.0	458.
6/10/74	0.21	94.	0.14	6.0	44.0	50.	22.0	25.	47.20	53.	400.0	453.
7/ 8/74	0.19	85.	0.12	6.5	110.0	113.	20.0	20.	45.50	47.	650.0	666.
8/12/74	0.11	49.	0.07	6.6	58.0	34.	20.0	12.	39.90	24.	625.0	371.
9/10/74	0.15	67.	0.10	6.1	170.0	138.	10.0	8.	48.30	39.	775.0	627.
10/ 8/74	0.14	63.	0.09	5.8	70.0	53.	238.0	180.	36.40	27.	800.0	604.
MINIMUM	0.11	49.	0.07	5.5	36.0	34.	0.0	0.	26.92	22.	400.0	345.
MAXIMUM	0.25	112.	0.16	6.6	170.0	138.	238.0	180.	48.30	53.	800.0	708.
AVERAGE	0.17	77.	0.11	6.1	83.7	77.	27.1	21.	39.84	37.	568.8	513.

SAMPLE POINT NO. 41 ASHLAND NO. 2 DISCHARGE

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 8/73	0.14	63.	0.09	7.6	0.0	0.	251.0	190.	5.60	4.	825.0	623.
12/10/73	0.16	72.	0.10	7.3	0.0	0.	350.0	302.	6.17	5.	575.0	496.
1/ 7/74	0.22	99.	0.14	7.2	0.0	0.	434.0	515.	13.22	16.	600.0	712.
2/ 4/74	0.22	99.	0.14	7.0	14.0	17.	400.0	475.	10.00	12.	525.0	623.
3/ 4/74	0.18	81.	0.12	7.0	0.0	0.	422.0	410.	11.52	11.	575.0	558.
4/ 2/74	0.28	126.	0.18	6.9	36.0	54.	392.0	592.	14.52	22.	575.0	868.
5/ 7/74	0.22	99.	0.14	6.8	0.0	0.	390.0	463.	7.10	8.	650.0	771.
6/10/74	0.19	85.	0.12	7.0	20.0	20.	396.0	406.	19.50	20.	475.0	487.
7/ 8/74	0.20	90.	0.13	7.0	68.0	73.	360.0	388.	16.40	18.	825.0	890.
8/12/74	0.12	54.	0.08	7.1	0.0	0.	406.0	263.	13.20	9.	700.0	453.
9/10/74	0.15	67.	0.10	7.3	24.0	19.	246.0	199.	13.50	11.	825.0	667.
10/ 8/74	0.17	76.	0.11	7.2	0.0	0.	266.0	244.	3.50	3.	850.0	779.
MINIMUM	0.12	54.	0.08	6.8	0.0	0.	246.0	190.	3.50	3.	475.0	453.
MAXIMUM	0.28	126.	0.18	7.6	68.0	73.	434.0	592.	19.50	22.	850.0	890.
AVERAGE	0.19	84.	0.12	7.1	13.5	15.	359.4	370.	11.19	12.	666.7	661.

SAMPLE POINT NO. 42 ASHLAND NO. 3 DISCHARGE

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 8/73	0.07	31.	0.05	6.9	4.0	2.	9.0	3.	1.77	1.	155.0	59.
12/10/73	0.11	49.	0.07	5.8	0.0	0.	14.0	8.	2.01	1.	275.0	163.
1/ 7/74	0.43	193.	0.28	4.6	24.0	56.	4.0	9.	1.36	3.	180.0	417.
2/ 4/74	0.39	175.	0.25	5.2	10.0	21.	6.0	13.	1.52	3.	191.0	402.
3/ 4/74	0.34	153.	0.22	6.5	10.0	18.	14.0	26.	1.20	2.	176.0	323.
4/ 2/74	0.52	233.	0.34	6.7	12.0	34.	8.0	22.	0.95	3.	135.0	379.
5/ 7/74	0.31	139.	0.20	6.7	6.0	10.	20.0	33.	0.90	2.	105.0	176.
6/10/74	0.27	121.	0.17	6.8	4.0	6.	16.0	23.	0.50	1.	151.0	220.
7/ 8/74	0.53	238.	0.34	6.8	24.0	69.	12.0	34.	1.10	3.	175.0	500.
8/12/74	0.10	45.	0.06	7.1	2.0	1.	8.0	4.	0.80	0.	225.0	121.
9/10/74	0.23	103.	0.15	6.5	8.0	10.	10.0	12.	0.40	0.	300.0	372.
10/ 8/74	0.18	81.	0.12	6.4	4.0	4.	66.0	64.	1.40	1.	225.0	218.
MINIMUM	0.07	31.	0.05	4.6	0.0	0.	4.0	3.	0.40	0.	105.0	59.
MAXIMUM	0.53	238.	0.34	7.1	24.0	69.	66.0	64.	2.01	3.	300.0	500.
AVERAGE	0.29	130.	0.19	6.3	9.0	19.	15.6	21.	1.16	2.	191.1	279.

SAMPLE POINT NO. 43 MAHANOY CREEK BELOW ASHLAND

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 8/73	151.00	67774.	97.59	6.3	50.0	40721.	38.0	30948.	28.96	23586.	865.0	704476.
12/10/73	179.00	80341.	115.69	6.0	62.0	59857.	12.0	11585.	24.59	23740.	450.0	434449.
1/11/74	210.00	94255.	135.73	6.4	54.0	61163.	26.0	29449.	28.04	31759.	675.0	764534.
2/ 6/74	203.00	91113.	131.20	6.7	72.0	78832.	50.0	54744.	22.71	24865.	925.0	1012771.
3/ 6/74	161.00	72262.	104.06	6.7	54.0	46891.	60.0	52102.	29.99	26042.	600.0	521015.
4/ 3/74	262.00	117594.	169.34	6.3	80.0	113048.	32.0	45219.	21.43	30283.	600.0	847864.
5/ 9/74	178.00	79892.	115.04	6.8	14.0	13441.	94.0	90245.	19.50	18721.	650.0	624032.
6/11/74	154.00	69120.	99.53	6.7	8.0	6645.	132.0	109640.	20.00	16612.	725.0	602188.
7/ 9/74	152.00	68223.	98.24	6.7	68.0	55748.	62.0	50829.	16.50	13527.	1050.0	860808.
8/13/74	101.00	45332.	65.28	6.9	30.0	16342.	114.0	62101.	20.00	10895.	950.0	517510.
9/11/74	119.00	53411.	76.91	6.8	36.0	23106.	64.0	41077.	17.60	11296.	1050.0	673922.
10/ 9/74	106.00	47576.	68.51	6.2	42.0	24012.	30.0	17151.	20.80	11892.	1475.0	843279.
MINIMUM	101.00	45332.	65.28	6.0	8.0	6645.	12.0	11585.	16.50	10895.	450.0	434449.
MAXIMUM	262.00	117594.	169.34	6.9	80.0	113048.	132.0	109640.	29.99	31759.	1475.0	1012771.
AVERAGE	164.67	73908.	106.43	6.5	47.5	44984.	59.5	49591.	22.51	20268.	834.6	700570.

SAMPLE POINT NO. 44 LITTLE MAHANOY CREEK

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 8/73	11.40	5117.	7.37	6.7	6.0	369.	24.0	1476.	0.22	14.	40.0	2459.
12/13/73	37.30	16741.	24.11	6.7	12.0	2414.	10.0	2012.	0.15	30.	5.0	1006.
1/11/74	21.50	9650.	13.90	6.7	2.0	232.	12.0	1392.	0.15	17.	11.0	1276.
2/ 6/74	21.50	9650.	13.90	7.0	14.0	1623.	16.0	1855.	0.15	17.	13.0	1507.
3/ 6/74	22.60	10144.	14.61	7.4	4.0	488.	26.0	3169.	0.15	18.	50.0	6095.
4/ 3/74	54.60	24506.	35.29	6.8	4.0	1178.	22.0	6479.	0.00	0.	30.0	8835.
5/ 9/74	9.46	4246.	6.11	7.3	4.0	204.	22.0	1123.	0.10	5.	150.0	7653.
6/11/74	11.80	5296.	7.63	7.4	2.0	127.	28.0	1782.	0.30	19.	7.0	446.
7/ 9/74	9.87	4430.	6.38	7.4	10.0	532.	24.0	1278.	0.10	5.	175.0	9316.
8/13/74	5.66	2540.	3.66	7.8	2.0	61.	36.0	1099.	0.10	3.	45.0	1374.
9/11/74	11.40	5117.	7.37	8.0	8.0	492.	16.0	984.	0.20	12.	225.0	13834.
10/ 9/74	6.16	2765.	3.98	6.5	4.0	133.	30.0	997.	0.00	0.	275.0	9137.
MINIMUM	5.66	2540.	3.66	6.5	2.0	61.	10.0	984.	0.00	0.	5.0	446.
MAXIMUM	54.60	24506.	35.29	8.0	14.0	2414.	36.0	6479.	0.30	30.	275.0	13834.
AVERAGE	18.60	8350.	12.02	7.1	6.0	654.	22.2	1970.	0.13	12.	85.5	5245.

SAMPLE POINT NO. 45 RATTLING RUN

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 8/73	6.42	2882.	4.15	6.6	5.0	173.	6.0	208.	0.10	3.	27.0	935.
12/13/73	22.30	10009.	14.41	6.6	4.0	481.	4.0	481.	0.29	35.	40.0	4811.
1/11/74	14.60	6553.	9.44	6.7	4.0	315.	8.0	630.	0.15	12.	7.0	551.
2/ 6/74	10.40	4668.	6.72	7.2	6.0	337.	8.0	449.	0.00	0.	7.0	393.
3/ 6/74	9.21	4134.	5.95	7.4	6.0	298.	18.0	894.	0.15	7.	8.0	397.
4/ 3/74	23.80	10682.	15.38	7.2	4.0	513.	6.0	770.	0.00	0.	35.0	4493.
5/ 9/74	4.05	1818.	2.62	7.5	4.0	87.	10.0	218.	0.20	4.	35.0	765.
6/11/74	5.76	2585.	3.72	7.3	2.0	62.	8.0	249.	0.00	0.	6.0	186.
7/ 9/74	5.70	2558.	3.68	7.5	18.0	553.	10.0	307.	0.50	15.	200.0	6149.
8/13/74	5.92	2657.	3.83	7.9	2.0	64.	12.0	333.	0.00	0.	225.0	7184.
9/11/74	8.02	3600.	5.18	8.3	12.0	519.	20.0	865.	0.50	22.	175.0	7570.
10/ 9/74	2.50	1122.	1.62	6.7	4.0	54.	14.0	189.	0.00	0.	250.0	3371.
MINIMUM	2.50	1122.	1.62	6.6	2.0	54.	4.0	189.	0.00	0.	6.0	186.
MAXIMUM	23.80	10682.	15.38	8.3	18.0	553.	20.0	894.	0.50	35.	250.0	7570.
AVERAGE	9.89	4439.	6.39	7.2	5.9	288.	10.3	470.	0.16	8.	84.6	3067.

SAMPLE POINT NO. 46 LITTLE MAHANOY CREEK BELOW RATTLING RUN

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 8/73	15.50	6957.	10.02	6.6	6.0	502.	17.0	1421.	0.15	13.	23.0	1923.
12/13/73	66.20	29713.	42.79	6.6	12.0	4285.	6.0	2142.	0.15	54.	9.0	3213.
1/11/74	33.40	14991.	21.59	6.6	4.0	721.	12.0	2162.	0.15	27.	9.0	1621.
2/ 6/74	30.00	13465.	19.39	7.1	4.0	647.	14.0	2265.	0.15	24.	9.0	1456.
3/ 6/74	25.50	11445.	16.48	7.4	6.0	825.	18.0	2476.	0.29	40.	9.0	1238.
4/ 3/74	85.30	38285.	55.13	7.0	2.0	920.	12.0	5521.	0.00	0.	225.0	103515.
5/ 9/74	19.60	8797.	12.67	7.3	4.0	423.	18.0	1903.	0.30	32.	30.0	3171.
6/11/74	15.60	7002.	10.08	7.3	2.0	168.	22.0	1851.	0.20	17.	6.0	505.
7/ 9/74	13.90	6239.	8.98	7.4	24.0	1799.	16.0	1200.	0.10	7.	35.0	2624.
8/13/74	11.60	5206.	7.50	7.6	2.0	125.	22.0	1376.	0.00	0.	225.0	14077.
9/11/74	21.20	9515.	13.70	8.0	10.0	1143.	6.0	686.	0.00	0.	175.0	20010.
10/ 9/74	7.46	3348.	4.82	6.6	4.0	161.	10.0	402.	0.30	12.	250.0	10059.
MINIMUM	7.46	3348.	4.82	6.6	2.0	125.	6.0	402.	0.00	0.	6.0	505.
MAXIMUM	85.30	38285.	55.13	8.0	24.0	4285.	22.0	5521.	0.30	54.	250.0	103515.
AVERAGE	28.77	12914.	18.60	7.1	6.7	977.	14.4	1950.	0.15	19.	83.8	13618.

SAMPLE POINT NO. 47 MAHANOY CREEK AND LITTLE MAHANOY CREEK CONFLUENCE

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 8/73	144.00	64632.	93.07	6.3	50.0	38833.	31.0	24077.	21.58	16761.	900.0	699002.
12/13/73	231.00	103680.	149.30	5.9	90.0	112132.	2.0	2492.	27.37	34100.	400.0	498362.
1/11/74	239.00	107271.	154.47	6.6	44.0	56718.	24.0	30937.	29.44	37950.	575.0	741207.
2/ 6/74	220.00	98743.	142.19	6.9	46.0	54583.	44.0	52209.	29.44	34933.	825.0	978927.
3/ 6/74	152.00	68223.	98.24	6.8	34.0	27874.	46.0	37712.	15.20	12461.	400.0	327927.
4/ 4/74	333.00	149461.	215.22	6.8	20.0	35921.	20.0	35921.	10.95	19667.	400.0	718419.
5/ 9/74	192.00	86176.	124.09	6.7	20.0	20711.	88.0	91129.	17.25	17863.	950.0	983781.
6/12/74	167.00	74955.	107.94	7.0	40.0	36029.	76.0	68455.	21.80	19636.	550.0	495396.
7/ 9/74	170.00	76302.	109.87	6.7	46.0	42177.	54.0	49513.	13.00	11920.	950.0	871055.
8/13/74	120.00	53860.	77.56	6.9	22.0	14239.	76.0	49189.	16.70	10809.	900.0	582502.
9/11/74	141.00	63285.	91.13	7.1	24.0	18252.	30.0	22815.	13.10	9962.	850.0	646415.
10/ 9/74	115.00	51616.	74.33	6.5	34.0	21089.	26.0	16127.	21.50	13336.	1000.0	620257.
MINIMUM	115.00	51616.	74.33	5.9	20.0	14239.	2.0	2492.	10.95	9962.	400.0	327927.
MAXIMUM	333.00	149461.	215.22	7.1	90.0	112132.	88.0	91129.	29.44	37950.	1000.0	983781.
AVERAGE	185.33	83184.	119.78	6.7	39.2	39880.	43.1	40048.	19.78	19950.	725.0	680270.

SAMPLE POINT NO. 48 BIG RUN NO. 1 DISCHARGE

	FLOW				ACIDITY		ALKALINITY		TOTAL IRON		SULFATES	
DATE	CFS	GPM	MGD	PH	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY
11/ 8/73	0.24	108.	0.16	6.5	130.0	168.	401.0	519.	36.83	48.	1265.0	1637.
12/12/73	0.27	121.	0.17	6.1	134.0	195.	478.0	696.	30.25	44.	1400.0	2039.
1/ 7/74	0.34	153.	0.22	6.0	124.0	227.	658.0	1207.	35.87	66.	1050.0	1925.
2/ 6/74	0.36	162.	0.23	6.6	186.0	361.	628.0	1219.	29.99	58.	1300.0	2524.
3/ 6/74	0.32	144.	0.21	6.6	154.0	266.	676.0	1167.	29.99	52.	850.0	1467.
4/ 4/74	0.36	162.	0.23	6.5	20.0	39.	710.0	1379.	26.67	52.	1100.0	2136.
5/ 9/74	0.29	130.	0.19	6.8	30.0	47.	622.0	973.	29.80	47.	1375.0	2151.
6/12/74	0.22	99.	0.14	6.6	154.0	183.	690.0	819.	31.20	37.	1000.0	1187.
7/10/74	0.37	165.	0.24	6.6	224.0	447.	640.0	1277.	30.20	60.	1550.0	3093.
8/13/74	0.28	126.	0.18	6.7	44.0	66.	614.0	927.	34.60	52.	1475.0	2228.
9/12/74	0.28	126.	0.18	6.4	140.0	211.	388.0	586.	34.80	53.	1775.0	2681.
10/10/74	0.28	126.	0.18	6.4	236.0	356.	328.0	495.	34.70	52.	1725.0	2605.
MINIMUM	0.22	99.	0.14	6.0	20.0	39.	328.0	495.	26.67	37.	850.0	1187.
MAXIMUM	0.37	166.	0.24	6.8	236.0	447.	710.0	1379.	36.83	66.	1775.0	3093.
AVERAGE	0.30	135.	0.19	6.5	131.3	214.	569.4	939.	32.07	52.	1322.1	2139.

SAMPLE POINT NO. 49 BIG RUN NO. 2 DISCHARGE

	FLOW				ACIDITY		ALKALINITY		TOTAL IRON		SULFATES	
DATE	CFS	GPM	MGD	PH	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY
11/ 8/73	2.35	1055.	1.52	6.5	80.0	1014.	307.0	3891.	19.51	247.	815.0	10330.
12/12/73	3.80	1706.	2.46	6.3	80.0	1640.	400.0	8198.	20.97	430.	650.0	13322.
1/ 7/74	5.70	2558.	3.68	6.1	56.0	1722.	532.0	16355.	30.75	945.	1100.0	33817.
2/ 6/74	7.12	3196.	4.60	6.6	88.0	3379.	554.0	21275.	24.70	949.	950.0	36482.
3/ 6/74	6.50	2917.	4.20	6.5	88.0	3085.	458.0	16057.	35.67	1251.	675.0	23664.
4/ 4/74	7.50	3366.	4.85	6.5	90.0	3641.	456.0	18446.	28.10	1137.	975.0	39440.
5/ 9/74	5.70	2558.	3.68	6.9	4.0	123.	389.0	11959.	25.50	784.	950.0	29206.
6/12/74	3.90	1750.	2.52	6.6	80.0	1683.	394.0	8288.	29.90	629.	675.0	14198.
7/10/74	2.85	1279.	1.84	6.5	158.0	2429.	398.0	6118.	28.40	437.	650.0	9992.
8/13/74	4.00	1795.	2.59	6.6	102.0	2201.	416.0	8975.	37.60	811.	975.0	21035.
9/12/74	2.50	1122.	1.62	6.5	128.0	1726.	222.0	2993.	29.30	395.	1100.0	14832.
10/10/74	0.25	112.	0.16	6.4	100.0	135.	202.0	272.	21.10	28.	850.0	1146.
MINIMUM	0.25	112.	0.16	6.1	4.0	123.	202.0	272.	19.51	28.	650.0	1146.
MAXIMUM	7.50	3366.	4.85	6.9	158.0	3641.	554.0	21275.	37.60	1251.	1100.0	39440.
AVERAGE	4.35	1951.	2.81	6.5	87.8	1898.	394.0	10236.	27.62	670.	863.8	20622.

SAMPLE POINT NO. 50 BIG RUN BELOW DISCHARGES

	FLOW				ACIDITY		ALKALINITY		TOTAL IRON		SULFATES	
DATE	CFS	GPM	MGD	PH	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY
11/ 8/73	4.62	2074.	2.99	7.3	30.0	746.	247.0	6155.	21.71	541.	790.0	19685.
12/12/73	4.11	1845.	2.66	6.7	0.0	0.	250.0	5542.	18.89	419.	600.0	13300.
1/ 9/74	6.86	3079.	4.43	7.1	0.0	0.	428.0	15836.	26.44	978.	900.0	33300.
2/ 6/74	8.00	3591.	5.17	7.0	54.0	2330.	400.0	17259.	30.59	1320.	725.0	31283.
3/ 6/74	4.34	1948.	2.81	7.2	52.0	1217.	386.0	9035.	19.80	463.	1025.0	23993.
4/ 4/74	12.20	5476.	7.89	7.0	22.0	1448.	258.0	16977.	20.00	1316.	625.0	41126.
5/ 9/74	4.29	1925.	2.77	7.4	26.0	602.	330.0	7636.	18.90	437.	825.0	19089.
6/12/74	2.80	1257.	1.81	7.4	0.0	0.	342.0	5165.	17.40	263.	475.0	7173.
7/10/74	4.06	1822.	2.62	7.4	64.0	1401.	370.0	8102.	20.00	438.	1150.0	25182.
8/13/74	3.92	1759.	2.53	7.4	32.0	677.	364.0	7696.	19.20	406.	950.0	20086.
9/12/74	3.30	1481.	2.13	7.4	34.0	605.	230.0	4094.	19.10	340.	1050.0	18689.
10/10/74	2.10	943.	1.36	6.7	28.0	317.	194.0	2197.	11.60	131.	850.0	9627.
MINIMUM	2.10	943.	1.36	6.7	0.0	0.	194.0	2197.	11.60	131.	475.0	7173.
MAXIMUM	12.20	5476.	7.89	7.4	64.0	2330.	428.0	17259.	30.59	1320.	1150.0	41126.
AVERAGE	5.05	2267.	3.26	7.2	28.5	779.	316.6	8808.	20.30	588.	830.4	21878.

SAMPLE POINT NO. 51 BIG RUN AT CONFLUENCE WITH MAHANOY CREEK

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 8/73	2.96	1329.	1.91	7.6	0.0	0.	182.0	2906.	2.62	42.	565.0	9020.
12/12/73	15.00	6732.	9.69	6.7	0.0	0.	136.0	11003.	5.57	451.	300.0	24271.
1/ 9/74	9.79	4394.	6.33	7.4	0.0	0.	304.0	16052.	13.59	718.	675.0	35642.
2/ 6/74	13.50	6059.	8.73	7.2	0.0	0.	308.0	22426.	17.86	1300.	600.0	43688.
3/ 6/74	8.52	3824.	5.51	7.7	0.0	0.	260.0	11948.	12.18	560.	400.0	18381.
4/ 4/74	22.60	10144.	14.61	7.3	16.0	1950.	140.0	17065.	13.57	1654.	275.0	33521.
5/ 9/74	11.80	5296.	7.63	7.5	0.0	0.	194.0	12347.	3.50	223.	475.0	30231.
6/12/74	2.23	1001.	1.44	7.8	0.0	0.	248.0	2983.	6.10	73.	450.0	5412.
7/10/74	6.31	2832.	4.08	7.7	42.0	1429.	270.0	9189.	13.20	449.	950.0	32332.
8/13/74	4.88	2190.	3.15	7.6	0.0	0.	294.0	7738.	11.70	308.	850.0	22372.
9/12/74	2.78	1248.	1.80	7.7	0.0	0.	168.0	2519.	8.50	127.	925.0	13869.
10/10/74	2.50	1122.	1.62	6.8	0.0	0.	186.0	2508.	11.50	155.	875.0	11798.
MINIMUM	2.23	1001.	1.44	6.7	0.0	0.	136.0	2508.	2.62	42.	275.0	5412.
MAXIMUM	22.60	10144.	14.61	7.8	42.0	1950.	308.0	22426.	17.86	1654.	950.0	43688.
AVERAGE	8.57	3848.	5.54	7.4	4.8	282.	224.2	9890.	9.99	505.	611.7	23378.

SAMPLE POINT NO. 52 MAHANOY CREEK BELOW BIG RUN

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 8/73	122.00	54758.	78.85	6.6	20.0	13160.	36.0	23688.	23.66	15569.	715.0	470478.
12/12/73	251.00	112657.	162.23	6.1	0.0	0.	12.0	16245.	14.35	19427.	395.0	534742.
1/ 9/74	263.00	118043.	169.98	6.9	30.0	42555.	38.0	53903.	26.44	37505.	850.0	1205724.
2/ 6/74	248.00	111311.	160.29	7.0	0.0	0.	50.0	66880.	19.80	26484.	600.0	802558.
3/ 6/74	235.00	105476.	151.89	6.9	50.0	63374.	48.0	60839.	18.86	23905.	525.0	665427.
4/ 4/74	361.00	162029.	233.32	6.8	24.0	46730.	32.0	62306.	13.10	25507.	330.0	642532.
5/ 9/74	201.00	90215.	129.91	6.9	60.0	65046.	92.0	99737.	15.30	16587.	900.0	975691.
6/12/74	170.00	76302.	109.87	7.0	30.0	27507.	74.0	67851.	21.30	19530.	725.0	664753.
7/10/74	179.00	80341.	115.69	6.9	54.0	52134.	62.0	59857.	19.30	18633.	925.0	893034.
8/13/74	130.00	58348.	84.02	6.9	28.0	19632.	80.0	56093.	16.30	11429.	950.0	666102.
9/12/74	145.00	65081.	93.72	7.0	38.0	29718.	30.0	23462.	12.60	9854.	775.0	606099.
10/10/74	126.00	56553.	81.44	6.3	28.0	19028.	66.0	44853.	16.90	11485.	1100.0	747544.
MINIMUM	122.00	54758.	78.85	6.1	0.0	0.	12.0	16245.	12.60	9854.	330.0	470478.
MAXIMUM	361.00	162029.	233.32	7.0	60.0	65046.	92.0	99737.	26.44	37505.	1100.0	1205724.
AVERAGE	202.58	90926.	130.93	6.8	30.2	31574.	51.7	52976.	18.16	19659.	732.5	739557.

SAMPLE POINT NO. 53 MOWRY DISCHARGE

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 8/73	0.06	27.	0.04	3.4	75.0	24.	0.0	0.	3.72	1.	150.0	49.
12/12/73	0.20	90.	0.13	3.3	74.0	80.	0.0	0.	5.36	6.	110.0	119.
1/ 9/74	0.31	139.	0.20	4.0	48.0	80.	0.0	0.	5.15	9.	150.0	251.
2/ 6/74	0.39	175.	0.25	3.9	60.0	126.	0.0	0.	4.35	9.	102.0	215.
3/ 6/74	0.31	139.	0.20	3.9	42.0	70.	0.0	0.	1.68	3.	225.0	376.
4/ 4/74	0.57	256.	0.37	3.9	44.0	135.	0.0	0.	8.57	26.	200.0	615.
5/ 9/74	0.17	76.	0.11	4.8	50.0	46.	0.0	0.	1.90	2.	225.0	206.
6/12/74	0.17	76.	0.11	3.7	48.0	44.	0.0	0.	5.20	5.	175.0	160.
7/10/74	0.17	76.	0.11	3.6	74.0	68.	0.0	0.	3.60	3.	175.0	160.
8/14/74	0.06	27.	0.04	3.6	58.0	19.	0.0	0.	7.00	2.	225.0	73.
9/12/74	0.09	40.	0.06	3.4	64.0	31.	0.0	0.	6.80	3.	200.0	97.
10/10/74	0.06	27.	0.04	3.4	52.0	17.	0.0	0.	5.60	2.	325.0	105.
MINIMUM	0.06	27.	0.04	3.3	42.0	17.	0.0	0.	1.68	1.	102.0	49.
MAXIMUM	0.57	256.	0.37	4.8	75.0	135.	0.0	0.	8.57	26.	325.0	615.
AVERAGE	0.21	96.	0.14	3.7	57.4	62.	0.0	0.	4.91	6.	188.5	202.

SAMPLE POINT NO. 54 HELFENSTEIN TUNNEL DISCHARGE
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DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 8/73	1.14	512.	0.74	6.4	22.0	135.	36.0	221.	26.01	160.	625.0	3843.
12/12/73	2.88	1293.	1.86	6.1	42.0	652.	4.0	62.	16.90	263.	575.0	8932.
1/10/74	4.41	1979.	2.85	6.6	22.0	523.	122.0	2902.	12.18	290.	475.0	11298.
2/ 6/74	5.69	2554.	3.68	6.4	26.0	798.	54.0	1657.	13.22	406.	475.0	14577.
3/ 6/74	2.55	1145.	1.65	6.8	26.0	358.	120.0	1650.	12.86	177.	350.0	4814.
4/ 4/74	6.53	2931.	4.22	6.7	30.0	1057.	14.0	493.	10.00	352.	350.0	12327.
5/ 9/74	2.59	1162.	1.67	7.0	0.0	0.	158.0	2207.	10.10	141.	550.0	7683.
6/13/74	1.91	857.	1.23	7.1	36.0	371.	152.0	1566.	11.80	122.	325.0	3348.
7/10/74	2.00	898.	1.29	6.9	44.0	475.	96.0	1036.	11.90	128.	675.0	7281.
8/14/74	1.90	853.	1.23	7.3	18.0	184.	102.0	1045.	11.70	120.	675.0	6917.
9/12/74	0.83	373.	0.54	6.7	20.0	90.	70.0	313.	11.10	50.	750.0	3357.
10/10/74	0.92	413.	0.59	6.4	38.0	189.	60.0	298.	11.30	56.	750.0	3722.
MINIMUM	0.83	373.	0.54	6.1	0.0	0.	4.0	62.	10.00	50.	325.0	3348.
MAXIMUM	6.53	2931.	4.22	7.3	44.0	1057.	158.0	2902.	26.01	406.	750.0	14577.
AVERAGE	2.78	1247.	1.80	6.7	27.0	403.	82.3	1121.	13.26	189.	547.9	7342.

SAMPLE POINT NO. 55 MAHANOY CREEK BELOW HELFENSTEIN TUNNEL
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DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 8/73	130.00	58348.	84.02	6.1	30.0	21035.	25.0	17529.	21.27	14914.	765.0	536387.
12/12/73	286.00	128366.	184.85	6.2	16.0	24681.	14.0	21596.	10.89	16798.	360.0	555318.
1/10/74	270.00	121185.	174.51	6.5	28.0	40775.	36.0	52425.	20.00	29125.	575.0	837346.
2/ 6/74	273.00	122531.	176.45	6.8	54.0	79511.	50.0	73622.	24.74	36428.	525.0	773028.
3/ 6/74	267.00	119838.	172.57	6.6	46.0	66243.	42.0	60483.	17.01	24496.	475.0	684035.
4/ 4/74	375.00	168312.	242.37	6.8	10.0	20226.	24.0	48542.	11.19	22633.	150.0	303386.
5/ 9/74	198.00	88869.	127.97	7.1	22.0	23494.	78.0	83298.	14.90	15912.	825.0	881034.
6/13/74	170.00	76302.	109.87	6.9	40.0	36676.	80.0	73352.	25.00	22923.	575.0	527218.
7/10/74	181.00	81239.	116.98	5.9	44.0	42954.	54.0	52716.	17.80	17377.	850.0	829795.
8/14/74	128.00	57451.	82.73	7.1	26.0	17950.	108.0	74560.	9.30	6420.	825.0	569557.
9/12/74	145.00	65081.	93.72	7.1	22.0	17205.	40.0	31282.	11.30	8837.	825.0	645202.
10/10/74	134.00	60144.	86.61	6.6	24.0	17346.	60.0	43364.	14.40	10407.	925.0	668529.
MINIMUM	128.00	57451.	82.73	6.1	10.0	17205.	14.0	17529.	9.30	6420.	150.0	303386.
MAXIMUM	375.00	168312.	242.37	7.1	54.0	79511.	108.0	83298.	25.00	36428.	925.0	881034.
AVERAGE	213.08	95639.	137.72	6.7	30.2	34008.	50.9	52731.	16.48	18856.	639.6	650903.

SAMPLE POINT NO. 56 DOUTYVILLE TUNNEL DISCHARGE
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DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 9/73	10.10	4533.	6.53	3.7	140.0	7626.	0.0	0.	27.94	1522.	890.0	48482.
12/13/73	14.90	6688.	9.63	3.5	186.0	14948.	0.0	0.	28.56	2295.	725.0	58264.
1/10/74	16.30	7316.	10.54	4.0	84.0	7385.	0.0	0.	22.52	1980.	525.0	46155.
2/ 6/74	21.80	9785.	14.09	3.9	134.0	15756.	0.0	0.	21.85	2569.	675.0	79366.
3/ 6/74	13.70	6149.	8.85	3.7	204.0	15074.	0.0	0.	19.80	1463.	550.0	40640.
4/ 4/74	19.50	8752.	12.60	3.5	110.0	11569.	0.0	0.	14.52	1527.	425.0	44699.
5/ 9/74	12.60	5655.	8.14	4.6	152.0	10330.	0.0	0.	18.90	1284.	850.0	57765.
6/13/74	15.00	6732.	9.69	3.8	172.0	13915.	0.0	0.	23.60	1909.	600.0	48542.
7/10/74	12.50	5610.	8.08	3.7	216.0	14563.	0.0	0.	22.00	1483.	925.0	62363.
8/14/74	10.70	4803.	6.92	3.6	184.0	10619.	0.0	0.	25.30	1460.	1025.0	59154.
9/12/74	7.40	3321.	4.78	3.7	160.0	6386.	0.0	0.	20.90	834.	1175.0	46897.
10/10/74	7.85	3523.	5.07	3.3	186.0	7875.	0.0	0.	28.30	1198.	1300.0	55041.
MINIMUM	7.40	3321.	4.78	3.3	84.0	6386.	0.0	0.	14.52	834.	425.0	40640.
MAXIMUM	21.80	9785.	14.09	4.6	216.0	15756.	0.0	0.	28.56	2569.	1300.0	79366.
AVERAGE	13.53	6072.	8.74	3.7	160.7	11337.	0.0	0.	22.85	1627.	805.4	53947.

SAMPLE POINT NO. 57 MAHANOY CREEK BELOW DOUTYVILLE

	FLOW				ACIDITY		ALKALINITY		TOTAL IRON		SULFATES	
DATE	CFS	GPM	MGD	PH	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY
11/ 9/73	151.00	67774.	97.59	5.5	30.0	24433.	13.0	10588.	28.52	23227.	800.0	651539.
12/13/73	296.00	132855.	191.31	5.8	76.0	121333.	8.0	12772.	15.57	24857.	400.0	638595.
1/10/74	282.00	126571.	182.26	6.4	32.0	48671.	10.0	15210.	21.85	33233.	550.0	836537.
2/ 6/74	311.00	139587.	201.01	6.6	40.0	67096.	20.0	33548.	24.74	41499.	475.0	796760.
3/ 6/74	283.00	127020.	182.91	6.6	30.0	45791.	24.0	36633.	17.93	27368.	475.0	725026.
4/ 5/74	403.00	180880.	260.47	6.4	38.0	82597.	2.0	4347.	10.48	22779.	325.0	706418.
5/10/74	206.00	92460.	133.14	6.9	36.0	39998.	48.0	53331.	14.80	16444.	850.0	944408.
6/13/74	189.00	84829.	122.15	6.7	44.0	44853.	48.0	48930.	24.60	25077.	600.0	611627.
7/10/74	187.00	83932.	120.86	6.6	64.0	64550.	38.0	38326.	17.60	17751.	1050.0	1059020.
8/14/74	137.00	61490.	88.55	6.9	32.0	23645.	58.0	42857.	10.40	7685.	875.0	646550.
9/12/74	152.00	68223.	98.24	6.9	24.0	19676.	22.0	18036.	10.90	8936.	925.0	758331.
10/10/74	142.00	63734.	91.78	6.3	28.0	21445.	34.0	26040.	14.40	11029.	1075.0	823323.
MINIMUM	137.00	61490.	88.55	5.5	24.0	19676.	2.0	4347.	10.40	7685.	325.0	611627.
MAXIMUM	403.00	180880.	260.47	6.9	76.0	121333.	58.0	53331.	28.52	41499.	1075.0	1059020.
AVERAGE	228.25	102446.	147.52	6.5	39.5	50341.	27.1	28385.	17.65	21657.	700.0	766511.

SAMPLE POINT NO. 58 MAHANOY CREEK IN EAST CAMERON AT RT. 125

	FLOW				ACIDITY		ALKALINITY		TOTAL IRON		SULFATES	
DATE	CFS	GPM	MGD	PH	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY
11/ 9/73	143.00	64183.	92.42	6.0	40.0	30851.	16.0	12340.	22.23	17145.	675.0	520611.
12/13/73	309.00	138689.	199.71	5.7	50.0	83330.	2.0	3333.	12.86	21433.	275.0	458316.
1/11/74	291.00	130610.	188.08	6.4	20.0	31390.	26.0	40807.	13.22	20749.	425.0	667045.
2/ 6/74	311.00	139587.	201.01	6.7	22.0	36903.	30.0	50322.	17.86	29958.	575.0	964499.
3/ 6/74	282.00	126571.	182.26	6.8	22.0	33461.	32.0	48671.	17.01	25872.	400.0	608391.
4/ 5/74	408.00	183124.	263.70	6.7	24.0	52813.	14.0	30808.	10.95	24096.	225.0	495126.
5/10/74	210.00	94255.	135.73	6.9	8.0	9061.	50.0	56632.	14.00	15857.	700.0	792850.
6/13/74	193.00	86625.	124.74	6.9	40.0	41638.	54.0	56211.	17.10	17800.	575.0	598548.
7/10/74	192.00	86176.	124.09	7.1	46.0	47636.	36.0	37280.	15.80	16362.	975.0	1009670.
8/15/74	140.00	62837.	90.48	7.4	32.0	24163.	48.0	36245.	10.80	8155.	900.0	679586.
9/13/74	147.00	65978.	95.01	7.0	16.0	12686.	20.0	15857.	10.20	8087.	700.0	554995.
10/10/74	144.00	64632.	93.07	6.5	16.0	12427.	38.0	29513.	13.50	10485.	900.0	699002.
MINIMUM	140.00	62837.	90.48	5.7	8.0	9061.	2.0	3333.	10.20	8087.	225.0	458316.
MAXIMUM	408.00	183124.	263.70	7.4	50.0	83330.	54.0	56632.	22.23	29958.	975.0	1009670.
AVERAGE	230.83	103605.	149.19	6.7	28.0	34697.	30.5	34835.	14.63	18000.	610.4	670719.

SAMPLE POINT NO. 59 MAHANOY CREEK IN WEST CAMERON

	FLOW				ACIDITY		ALKALINITY		TOTAL IRON		SULFATES	
DATE	CFS	GPM	MGD	PH	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY
11/ 9/73	155.00	69569.	100.18	5.9	40.0	33440.	10.0	8360.	16.98	14195.	600.0	501598.
12/13/73	316.00	141831.	204.24	5.7	34.0	57948.	2.0	3409.	12.18	20759.	325.0	553916.
1/11/74	298.00	133752.	192.60	6.5	20.0	32145.	24.0	38575.	11.20	18001.	425.0	683091.
2/ 6/74	307.00	137792.	198.42	6.8	38.0	62921.	28.0	46363.	12.86	21294.	425.0	703721.
3/ 6/74	304.00	136445.	196.48	6.9	22.0	36072.	38.0	62306.	15.15	24840.	375.0	614863.
4/ 5/74	415.00	186266.	268.22	6.7	20.0	44766.	14.0	31336.	9.05	20257.	225.0	503621.
5/ 9/74	220.00	98743.	142.19	7.1	10.0	11866.	46.0	54583.	9.60	11391.	800.0	949262.
6/12/74	208.00	93357.	134.43	7.0	20.0	22437.	50.0	56093.	15.00	16828.	475.0	532881.
7/10/74	195.00	87522.	126.03	7.1	46.0	48380.	26.0	27345.	11.70	12305.	675.0	709924.
8/15/74	147.00	65978.	95.01	7.4	24.0	19028.	52.0	41228.	10.70	8483.	875.0	693743.
9/13/74	150.00	67325.	96.95	7.2	20.0	16181.	20.0	16181.	16.30	13187.	775.0	626998.
10/10/74	142.00	63734.	91.78	6.5	12.0	9191.	28.0	21445.	10.40	7965.	1125.0	861617.
MINIMUM	142.00	63734.	91.78	5.7	10.0	9191.	2.0	3409.	9.05	7965.	225.0	501598.
MAXIMUM	415.00	186266.	268.22	7.4	46.0	62921.	52.0	62306.	16.98	24840.	1125.0	949262.
AVERAGE	238.08	106859.	153.88	6.7	25.5	32865.	28.2	33935.	12.59	15792.	591.7	661270.

SAMPLE POINT NO. 60 MAHANOY CREEK ABOVE ZERBE RUN

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 9/73	170.00	76302.	109.87	6.3	30.0	27507.	14.0	12837.	17.46	16009.	625.0	573063.
12/12/73	409.00	183573.	264.34	5.9	30.0	66179.	2.0	4412.	9.71	21420.	1300.0	2867741.
1/10/74	326.00	146320.	210.70	6.2	20.0	35166.	12.0	21100.	0.00	0.	235.0	413199.
2/ 7/74	310.00	139138.	200.36	6.7	22.0	36784.	22.0	36784.	10.00	16720.	425.0	710598.
3/ 7/74	299.00	134201.	193.25	6.7	16.0	25803.	30.0	48380.	13.96	22513.	325.0	524117.
4/ 4/74	423.00	189856.	273.39	6.8	16.0	36503.	20.0	45629.	13.10	29887.	275.0	627403.
5/ 9/74	213.00	95601.	137.67	6.9	10.0	11488.	32.0	36762.	9.60	11029.	750.0	861617.
6/12/74	204.00	91562.	131.85	7.0	26.0	28607.	56.0	61616.	12.90	14194.	525.0	577648.
7/10/74	199.00	89318.	128.62	6.9	26.0	27906.	32.0	34346.	10.60	11377.	750.0	804985.
8/15/74	144.00	64632.	93.07	7.5	20.0	15533.	44.0	34173.	9.30	7223.	875.0	679586.
9/12/74	153.00	68671.	98.89	7.5	20.0	16504.	18.0	14854.	6.20	5116.	850.0	701429.
10/10/74	145.00	65081.	93.72	6.4	8.0	6257.	30.0	23462.	8.50	6648.	875.0	684305.
MINIMUM	144.00	64632.	93.07	5.9	8.0	6257.	2.0	4412.	0.00	0.	235.0	413199.
MAXIMUM	423.00	189856.	273.39	7.5	30.0	66179.	56.0	61616.	17.46	29887.	1300.0	2867741.
AVERAGE	249.58	112021.	161.31	6.7	20.3	27853.	26.0	31196.	10.11	13511.	650.8	835474.

SAMPLE POINT NO. 61 ZERBE RUN IN TREVORTON

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 9/73	2.55	1145.	1.65	6.2	6.0	83.	8.0	110.	0.29	4.	90.0	1238.
12/13/73	7.80	3501.	5.04	5.7	10.0	421.	4.0	168.	0.44	19.	30.0	1262.
1/10/74	6.50	2917.	4.20	6.6	4.0	140.	10.0	351.	0.15	5.	12.0	421.
2/ 7/74	6.14	2756.	3.97	7.2	4.0	132.	10.0	331.	0.15	5.	8.0	265.
3/ 7/74	3.23	1450.	2.09	7.2	4.0	70.	16.0	279.	0.29	5.	300.0	5226.
4/ 4/74	18.70	8393.	12.09	6.6	6.0	605.	6.0	605.	0.24	24.	45.0	4539.
5/ 9/74	6.43	2886.	4.16	7.2	0.0	0.	14.0	486.	1.00	35.	30.0	1040.
6/12/74	1.62	727.	1.05	7.2	6.0	52.	18.0	157.	0.40	3.	6.0	52.
7/10/74	2.58	1158.	1.67	7.4	24.0	334.	10.0	139.	0.50	7.	200.0	2783.
8/14/74	1.23	552.	0.79	7.7	6.0	40.	16.0	106.	0.60	4.	325.0	2156.
9/13/74	1.12	503.	0.72	7.5	14.0	85.	10.0	60.	0.60	4.	150.0	906.
10/10/74	1.20	539.	0.78	6.6	8.0	52.	10.0	65.	0.50	3.	250.0	1618.
MINIMUM	1.12	503.	0.72	5.7	0.0	0.	4.0	60.	0.15	3.	6.0	52.
MAXIMUM	18.70	8393.	12.09	7.7	24.0	605.	18.0	605.	1.00	35.	325.0	5226.
AVERAGE	4.92	2211.	3.18	6.9	7.7	168.	11.0	238.	0.43	10.	120.5	1792.

SAMPLE POINT NO. 62 NORTH FRANKLIN OVERFLOW DISCHARGE

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 9/73	14.00	6284.	9.05	3.6	110.0	8306.	0.0	0.	43.52	3286.	590.0	44551.
12/13/73	11.60	5206.	7.50	3.4	140.0	8759.	0.0	0.	32.93	2060.	450.0	28154.
1/10/74	14.00	6284.	9.05	3.9	162.0	12233.	0.0	0.	33.01	2493.	550.0	41530.
2/ 7/74	11.20	5027.	7.24	3.9	130.0	7853.	0.0	0.	38.06	2299.	350.0	21143.
3/ 7/74	8.81	3954.	5.69	3.8	144.0	6842.	0.0	0.	40.55	1927.	350.0	16631.
4/ 4/74	17.70	7944.	11.44	3.6	124.0	11838.	0.0	0.	25.95	2477.	400.0	38186.
5/10/74	17.90	8034.	11.57	5.0	90.0	8689.	0.0	0.	33.70	3254.	625.0	60340.
6/12/74	11.00	4937.	7.11	4.0	130.0	7713.	0.0	0.	37.50	2225.	450.0	26698.
7/10/74	14.10	6329.	9.11	3.8	212.0	16122.	0.0	0.	36.70	2791.	625.0	47531.
8/15/74	9.02	4048.	5.83	3.8	160.0	7784.	0.0	0.	51.20	2491.	575.0	27974.
9/13/74	8.06	3618.	5.21	3.6	500.0	21736.	0.0	0.	48.40	2104.	700.0	30430.
10/10/74	8.32	3734.	5.38	3.8	100.0	4487.	0.0	0.	36.40	1633.	750.0	33656.
MINIMUM	8.06	3618.	5.21	3.4	90.0	4487.	0.0	0.	25.95	1633.	350.0	16631.
MAXIMUM	17.90	8034.	11.57	5.0	500.0	21736.	0.0	0.	51.20	3286.	750.0	60340.
AVERAGE	12.14	5450.	7.85	3.8	166.8	10197.	0.0	0.	38.16	2420.	534.6	34735.

SAMPLE POINT NO. 63 SOUTH TREVORTON DISCHARGE
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DATE	FLOW			PH	ACIDITY		ALKALINITY		TOTAL IRON		SULFATES	
	CFS	GPM	MGD		CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY
11/ 9/73	0.08	36.	0.05	3.3	70.0	30.	0.0	0.	7.61	3.	150.0	65.
12/13/73	0.17	76.	0.11	3.1	140.0	128.	0.0	0.	8.89	8.	275.0	252.
1/10/74	0.31	139.	0.20	3.7	70.0	117.	0.0	0.	3.40	6.	175.0	293.
2/ 7/74	0.39	175.	0.25	3.7	74.0	156.	0.0	0.	3.59	8.	175.0	368.
3/ 7/74	0.17	76.	0.11	3.6	84.0	77.	0.0	0.	4.15	4.	150.0	138.
4/ 4/74	0.50	224.	0.32	3.5	88.0	237.	0.0	0.	3.81	10.	150.0	405.
5/10/74	0.32	144.	0.21	5.0	52.0	90.	0.0	0.	2.70	5.	175.0	302.
6/12/74	0.15	67.	0.10	3.7	80.0	65.	0.0	0.	3.10	3.	100.0	81.
7/10/74	0.65	292.	0.42	3.8	102.0	358.	0.0	0.	3.00	11.	200.0	701.
8/15/74	0.17	76.	0.11	3.6	74.0	68.	0.0	0.	2.60	2.	225.0	206.
9/13/74	0.17	76.	0.11	3.3	62.0	57.	0.0	0.	2.60	2.	175.0	160.
10/10/74	0.15	67.	0.10	3.3	68.0	55.	0.0	0.	3.30	3.	275.0	222.
MINIMUM	0.08	36.	0.05	3.1	52.0	30.	0.0	0.	2.60	2.	100.0	65.
MAXIMUM	0.65	292.	0.42	5.0	140.0	358.	0.0	0.	8.89	11.	275.0	701.
AVERAGE	0.27	121.	0.17	3.6	80.3	120.	0.0	0.	4.06	5.	185.4	266.

SAMPLE POINT NO. 64 ZERBE RUN BELOW TREVORTON
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DATE	FLOW			PH	ACIDITY		ALKALINITY		TOTAL IRON		SULFATES	
	CFS	GPM	MGD		CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY
11/ 9/73	10.30	4623.	6.66	3.6	100.0	5555.	0.0	0.	17.54	974.	450.0	24999.
12/13/73	24.00	10772.	15.51	3.5	88.0	11391.	0.0	0.	16.00	2071.	275.0	35597.
1/10/74	24.40	10952.	15.77	3.9	82.0	10791.	0.0	0.	21.21	2791.	200.0	26320.
2/ 7/74	15.50	6957.	10.02	3.9	104.0	8694.	0.0	0.	17.37	1452.	200.0	16720.
3/ 7/74	10.80	4847.	6.98	3.8	134.0	7806.	0.0	0.	16.10	938.	225.0	13106.
4/ 4/74	43.90	19704.	28.37	4.2	54.0	12786.	0.0	0.	8.81	2086.	175.0	41436.
5/ 9/74	21.35	9583.	13.80	5.4	50.0	5758.	0.0	0.	13.30	1532.	300.0	34546.
6/12/74	10.40	4668.	6.72	4.0	106.0	5946.	0.0	0.	32.30	1812.	350.0	19632.
7/10/74	17.50	7855.	11.31	3.7	148.0	13969.	0.0	0.	23.30	2199.	500.0	47193.
8/14/74	10.50	4713.	6.79	3.9	160.0	9061.	0.0	0.	27.50	1557.	450.0	25484.
9/13/74	8.29	3721.	5.36	3.8	90.0	4024.	0.0	0.	14.60	653.	450.0	20121.
10/10/74	9.42	4228.	6.09	3.6	106.0	5386.	0.0	0.	22.10	1123.	475.0	24133.
MINIMUM	8.29	3721.	5.36	3.5	50.0	4024.	0.0	0.	8.81	653.	175.0	13106.
MAXIMUM	43.90	19704.	28.37	5.4	160.0	13969.	0.0	0.	32.30	2791.	500.0	47193.
AVERAGE	17.20	7718.	11.11	3.9	101.8	8431.	0.0	0.	19.18	1599.	337.5	27441.

SAMPLE POINT NO. 65 SUNSHINE MINE DISCHARGE
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DATE	FLOW			PH	ACIDITY		ALKALINITY		TOTAL IRON		SULFATES	
	CFS	GPM	MGD		CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY	CONC.	LB/DAY
11/ 9/73	0.16	72.	0.10	3.2	112.0	97.	0.0	0.	2.69	2.	190.0	164.
12/13/73	0.43	193.	0.28	3.2	50.0	116.	0.0	0.	5.15	12.	105.0	244.
1/10/74	0.63	283.	0.41	3.9	38.0	129.	0.0	0.	1.36	5.	300.0	1019.
2/ 7/74	0.73	328.	0.47	3.8	38.0	150.	0.0	0.	1.05	4.	100.0	394.
3/ 7/74	0.60	269.	0.39	3.5	48.0	155.	0.0	0.	1.52	5.	175.0	566.
4/ 4/74	1.50	673.	0.97	3.8	50.0	405.	0.0	0.	1.67	14.	150.0	1214.
5/ 9/74	0.80	359.	0.52	4.6	40.0	173.	0.0	0.	1.00	4.	175.0	755.
6/12/74	0.65	292.	0.42	3.7	34.0	119.	0.0	0.	1.30	5.	175.0	614.
7/10/74	0.67	301.	0.43	3.7	80.0	289.	0.0	0.	1.20	4.	175.0	632.
8/15/74	0.15	67.	0.10	3.7	46.0	37.	0.0	0.	1.40	1.	225.0	182.
9/12/74	0.17	76.	0.11	3.6	66.0	61.	0.0	0.	0.90	1.	225.0	206.
10/10/74	0.14	63.	0.09	3.4	68.0	51.	0.0	0.	1.70	1.	325.0	245.
MINIMUM	0.14	63.	0.09	3.2	34.0	37.	0.0	0.	0.90	1.	100.0	164.
MAXIMUM	1.50	673.	0.97	4.6	112.0	405.	0.0	0.	5.15	14.	325.0	1214.
AVERAGE	0.55	248.	0.36	3.7	55.8	148.	0.0	0.	1.74	5.	193.3	520.

SAMPLE POINT NO. 66 ZERBE RUN AT CONFLUENCE

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 9/73	18.70	8393.	12.09	3.2	215.0	21685.	0.0	0.	26.27	2650.	400.0	40344.
12/12/73	38.00	17056.	24.56	3.3	132.0	27054.	0.0	0.	11.84	2427.	175.0	35867.
1/10/74	30.20	13555.	19.52	3.9	100.0	16288.	0.0	0.	15.15	2468.	225.0	36649.
2/ 7/74	41.90	18806.	27.08	3.4	154.0	34802.	0.0	0.	12.58	2843.	355.0	80226.
3/ 7/74	19.00	8528.	12.28	3.7	118.0	12092.	0.0	0.	13.44	1377.	150.0	15372.
4/ 4/74	66.60	29892.	43.04	4.0	54.0	19397.	0.0	0.	6.67	2396.	175.0	62862.
5/ 9/74	39.70	17819.	25.66	4.6	134.0	28693.	0.0	0.	15.30	3276.	325.0	69590.
6/12/74	10.51	4717.	6.79	3.4	160.0	9070.	0.0	0.	9.30	527.	350.0	19840.
7/10/74	27.20	12208.	17.58	3.5	170.0	24940.	0.0	0.	11.00	1614.	425.0	62349.
8/15/74	11.80	5296.	7.63	3.5	162.0	10310.	0.0	0.	21.50	1368.	500.0	31822.
9/12/74	9.78	4390.	6.32	3.5	148.0	7807.	0.0	0.	6.20	327.	575.0	30331.
10/10/74	12.00	5386.	7.76	3.3	300.0	19417.	0.0	0.	11.40	738.	550.0	35597.
MINIMUM	9.78	4390.	6.32	3.2	54.0	7807.	0.0	0.	6.20	327.	150.0	15372.
MAXIMUM	66.60	29892.	43.04	4.6	300.0	34802.	0.0	0.	26.27	3276.	575.0	80226.
AVERAGE	27.12	12170.	17.53	3.6	153.9	19296.	0.0	0.	13.39	1834.	350.4	43404.

SAMPLE POINT NO. 67 MAHANOY CREEK BELOW ZERBE RUN

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 9/73	205.00	92011.	132.50	5.3	90.0	99511.	7.0	7740.	18.16	20079.	650.0	718689.
12/12/73	413.00	185368.	266.93	5.3	48.0	106921.	2.0	4455.	10.00	22275.	255.0	568020.
1/10/74	338.00	151706.	218.46	5.9	6.0	10938.	8.0	14584.	9.71	17701.	550.0	1002658.
2/ 7/74	340.00	152603.	219.75	6.4	18.0	33008.	10.0	18338.	9.71	17806.	505.0	926069.
3/ 7/74	311.00	139587.	201.01	6.4	32.0	53676.	24.0	40257.	12.52	21001.	350.0	587086.
4/ 4/74	491.00	220377.	317.34	6.7	10.0	26482.	12.0	31779.	10.95	28998.	280.0	741503.
5/ 9/74	241.00	108169.	155.76	6.8	10.0	12998.	26.0	33796.	10.30	13388.	675.0	877394.
6/12/74	228.00	102334.	147.36	6.9	12.0	14757.	52.0	63946.	13.10	16109.	475.0	584120.
7/10/74	221.00	99192.	142.84	6.9	54.0	64366.	8.0	9536.	10.90	12992.	600.0	715183.
8/15/74	153.00	68671.	98.89	7.2	26.0	21455.	32.0	26407.	10.20	8417.	725.0	598278.
9/12/74	162.00	72711.	104.70	6.9	20.0	17475.	6.0	5243.	6.30	5505.	825.0	720846.
10/10/74	162.00	72711.	104.70	6.4	20.0	17475.	12.0	10485.	11.40	9961.	1025.0	895597.
MINIMUM	153.00	68671.	98.89	5.3	6.0	10938.	2.0	4455.	6.30	5505.	255.0	568020.
MAXIMUM	491.00	220377.	317.34	7.2	90.0	106921.	52.0	63946.	18.16	28998.	1025.0	1002658.
AVERAGE	272.08	122120.	175.85	6.4	28.8	39922.	16.6	22214.	11.10	16186.	576.3	744620.

SAMPLE POINT NO. 68 SCHWABEN CREEK

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 9/73	25.60	11490.	16.55	6.4	8.0	1105.	36.0	4971.	0.22	30.	220.0	30376.
12/12/73	72.50	32540.	46.86	6.0	14.0	5474.	12.0	4692.	0.29	113.	30.0	11731.
1/10/74	28.40	12747.	18.36	7.0	2.0	306.	20.0	3064.	0.15	23.	40.0	6127.
2/ 7/74	30.40	13645.	19.65	7.1	4.0	656.	20.0	3279.	0.15	25.	35.0	5739.
3/ 7/74	24.50	10996.	15.83	8.1	0.0	0.	24.0	3171.	0.00	0.	75.0	9911.
4/ 4/74	129.00	57899.	83.38	7.3	2.0	1392.	20.0	13915.	0.24	167.	200.0	139153.
5/ 9/74	22.00	9874.	14.22	7.5	4.0	475.	36.0	4272.	0.60	71.	175.0	20765.
6/12/74	9.01	4044.	5.82	7.4	6.0	292.	56.0	2721.	0.30	15.	225.0	10934.
7/10/74	18.30	8214.	11.83	8.0	20.0	1974.	38.0	3751.	0.20	20.	200.0	19740.
8/14/74	11.90	5341.	7.69	8.1	4.0	257.	60.0	3851.	2.00	128.	225.0	14441.
9/12/74	8.86	3977.	5.73	8.1	10.0	478.	20.0	956.	0.30	14.	175.0	8363.
10/10/74	6.63	2976.	4.29	6.4	10.0	358.	24.0	858.	0.30	11.	250.0	8940.
MINIMUM	6.63	2976.	4.29	6.0	0.0	0.	12.0	858.	0.00	0.	30.0	5739.
MAXIMUM	129.00	57899.	83.38	8.1	20.0	5474.	60.0	13915.	2.00	167.	250.0	139153.
AVERAGE	32.26	14479.	20.85	7.3	7.0	1064.	30.5	4125.	0.40	51.	154.2	23852.

SAMPLE POINT NO. 69 SCHWAEBEN CREEK BELOW MOUSE CREEK

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 9/73	30.40	13645.	19.65	6.5	6.0	984.	43.0	7050.	0.15	25.	21.0	3443.
12/12/73	86.10	38645.	55.65	6.3	16.0	7430.	14.0	6501.	0.44	204.	11.0	5108.
1/10/74	40.10	17998.	25.92	6.6	8.0	1730.	40.0	8651.	0.15	32.	20.0	4326.
2/ 7/74	41.50	18627.	26.82	7.1	2.0	448.	38.0	8506.	0.15	34.	12.0	2686.
3/ 7/74	31.80	14273.	20.55	7.4	0.0	0.	38.0	6518.	0.00	0.	200.0	34303.
4/ 4/74	150.00	67325.	96.95	7.1	4.0	3236.	32.0	25889.	0.48	388.	150.0	121355.
5/ 9/74	25.70	11535.	16.61	7.5	2.0	277.	62.0	8594.	0.50	69.	200.0	27723.
6/12/74	11.60	5206.	7.50	7.4	6.0	375.	86.0	5381.	0.30	19.	225.0	14077.
7/10/74	27.70	12433.	17.90	8.0	20.0	2988.	50.0	7470.	0.30	45.	175.0	26145.
8/14/74	16.80	7540.	10.86	8.0	0.0	0.	70.0	6343.	0.10	9.	150.0	13592.
9/12/74	10.20	4578.	6.59	8.2	0.0	0.	40.0	2201.	0.20	11.	175.0	9627.
10/10/74	10.80	4847.	6.98	6.6	10.0	583.	38.0	2214.	0.00	0.	225.0	13106.
MINIMUM	10.20	4578.	6.59	6.3	0.0	0.	14.0	2201.	0.00	0.	11.0	2686.
MAXIMUM	150.00	67325.	96.95	8.2	20.0	7430.	86.0	25889.	0.50	388.	225.0	121355.
AVERAGE	40.22	18054.	26.00	7.2	6.2	1504.	45.9	7943.	0.23	70.	130.3	22958.

SAMPLE POINT NO. 70 MOUSE CREEK

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 9/73	7.03	3155.	4.54	7.3	5.0	190.	73.0	2768.	0.15	6.	19.0	720.
12/12/73	19.20	8618.	12.41	6.6	10.0	1036.	40.0	4142.	0.15	16.	13.0	1346.
1/10/74	10.10	4533.	6.53	7.2	0.0	0.	62.0	3377.	0.15	8.	35.0	1907.
2/ 7/74	10.50	4713.	6.79	7.2	2.0	113.	76.0	4304.	0.00	0.	11.0	623.
3/ 7/74	8.75	3927.	5.66	7.6	0.0	0.	88.0	4153.	0.29	14.	175.0	8259.
4/ 4/74	30.50	13689.	19.71	7.1	4.0	658.	50.0	8225.	0.48	79.	175.0	28788.
5/ 9/74	8.51	3820.	5.50	7.7	2.0	92.	108.0	4957.	0.20	9.	200.0	9180.
6/12/74	2.79	1252.	1.80	7.9	2.0	30.	140.0	2107.	0.10	2.	175.0	2633.
7/10/74	10.10	4533.	6.53	8.3	26.0	1416.	108.0	5883.	0.10	5.	175.0	9533.
8/14/74	2.52	1131.	1.63	8.7	0.0	0.	130.0	1767.	0.20	3.	200.0	2718.
9/12/74	1.10	494.	0.71	8.2	0.0	0.	78.0	463.	0.10	1.	200.0	1187.
10/10/74	1.12	503.	0.72	7.6	0.0	0.	86.0	520.	0.00	0.	300.0	1812.
MINIMUM	1.10	494.	0.71	6.6	0.0	0.	40.0	463.	0.00	0.	11.0	623.
MAXIMUM	30.50	13689.	19.71	8.7	26.0	1416.	140.0	8225.	0.48	79.	300.0	28788.
AVERAGE	9.35	4197.	6.04	7.6	4.3	295.	86.6	3556.	0.16	12.	139.8	5726.

SAMPLE POINT NO. 71 MAHANOY CREEK AT OTTO

DATE	FLOW CFS	FLOW GPM	FLOW MGD	PH	ACIDITY CONC.	ACIDITY LB/DAY	ALKALINITY CONC.	ALKALINITY LB/DAY	TOTAL IRON CONC.	TOTAL IRON LB/DAY	SULFATES CONC.	SULFATES LB/DAY
11/ 9/73	243.00	109066.	157.06	6.3	50.0	65531.	7.0	9174.	23.23	30446.	740.0	969865.
12/12/73	486.00	218133.	314.11	5.6	28.0	73395.	2.0	5243.	6.44	16881.	260.0	681527.
1/10/74	381.00	171005.	246.25	6.1	8.0	16439.	8.0	16439.	7.37	15145.	430.0	883623.
2/ 7/74	364.00	163375.	235.26	6.6	20.0	39265.	12.0	23559.	7.86	15431.	420.0	824564.
3/ 7/74	321.00	144075.	207.47	6.6	0.0	0.	16.0	27701.	10.59	18335.	325.0	562681.
4/ 4/74	668.00	299820.	431.74	6.8	12.0	43235.	12.0	43235.	11.19	40316.	290.0	1044835.
5/ 9/74	263.00	118043.	169.98	7.2	8.0	11348.	28.0	39718.	9.20	13050.	550.0	780175.
6/12/74	237.00	106373.	153.18	6.9	12.0	15339.	34.0	43461.	12.70	16234.	425.0	543264.
7/10/74	244.00	109515.	157.70	6.9	26.0	34217.	12.0	15792.	0.88	1158.	525.0	690912.
8/14/74	172.00	77199.	111.17	7.1	16.0	14843.	26.0	24120.	6.20	5752.	650.0	602997.
9/12/74	179.00	80341.	115.69	7.6	10.0	9654.	8.0	7724.	5.90	5696.	675.0	651674.
10/10/74	180.00	80790.	116.34	6.3	20.0	19417.	28.0	27183.	8.80	8543.	925.0	898024.
MINIMUM	172.00	77199.	111.17	5.6	0.0	0.	2.0	5243.	0.88	1158.	260.0	543264.
MAXIMUM	668.00	299820.	431.74	7.6	50.0	73395.	34.0	43461.	23.23	40316.	925.0	1044835.
AVERAGE	311.50	139811.	201.33	6.7	17.5	28557.	16.1	23612.	9.20	15582.	517.9	761178.

PLATE A

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES

MINING AND RELATED FEATURES AND RECOMMENDED ABATEMENT PROJECTS IN THE MAHANOY CREEK WATERSHED

LEGEND
- SHAFT
55 - SAMPLE SITE
62 - DISCHARGE POINT
- COLLIERY
- CROP FALL
- WATERSHED BOUNDARY
B - DISCHARGES RE-ENTERING MINES
- REFUSE AREA
- DRAINAGE FROM OTHER WATERSHEDS
- STRIP AREA
- AREA UNDERLAIN WITH DEEP MINES
- STRIP AREA UNDERLAIN WITH DEEP MINES
- STREAM MODIFICATION
- DIVERSION DITCH
R9 - RECLAIMED AREA
SCALE IN MILES
0 1 2 3 4
PLATE B
COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
MINING AND RELATED FEATURES
AND
RECOMMENDED ABATEMENT PROJECTS
IN THE
MAHANOY CREEK WATERSHED
MOUNT CARMEL
CENTRALIA
ASHLAND
GIRARDVILLE
LOST CREEK
SHENANDOAH
SHENANDOAH HEIGHTS
GILBERTON
MAHANOY CITY
FRACKVILLE
GORDON
LAVELLE
LOCUST GAP
PARK PLACE
DELANO
RINGTOWN
WILBURTON NO. 1
ATLAS
STRONG