CHAPTER V

WATER RESOURCES

MINE DRAINAGE POLLUTION

From April, 1974 through August, 1975, a total of 136 mine drainage discharges were identified and monitored. The mine drainage originated primarily from the Pittsburgh Coal in the Uniontown Syncline and from the two isolated mined-out areas north of the Youghiogheny River in the Hickman Run and Galley Run Watersheds. As shown on Table 7, 38 mine discharges were alkaline. Most of these alkaline discharges emanated from the same mine complexes that generated acid mine drainage. Several attempts were made to explain the causes of the alkaline mine drainage by apparent oxidation or by relation to assumed mine pool elevations, but no satisfactory patterns were found.

The mine effluents were concentrated in two areas. One area is the Phillips-Rankin Run-Bute Run area containing source P-1, the largest acid mine discharge in the study averaging 4,470 gpm. A flooded mine complex is believed to be contributing to P-1 by artesian pressure and to sources WL-1 through WL-9 by ground water recharge. The second general area receiving the majority of mine drainage is the Youghiogheny River portion of Hickman and Galley Runs. Here large artesian discharges from the Uniontown Syncline, notably M-19, M-54 and M-56, emanate from the north and south bank of the Youghiogheny River. North of source M-20 on Galley Run, the remaining discharges in the Galley Run watershed and those in the Hickman Run watershed are gravity drained deep mine discharges.

All mine discharges, except UR-2, US-28, UR-1, UR-3, P-7, P-8, and P-9 east of Uniontown are probably from the Pittsburgh Coal. A complete description of all documented mine drainage discharges can be found in Appendix D with reference to the Project Area Map for finding the source locations.

Water quality data for the mine drainage discharges is summarized in Appendix A and water quality data for each sample collection is shown in Volume II.

WATER QUALITY

The impact of mine drainage and other water pollution problems is discussed in two sections. The first section applies to the Redstone Creek and Browns Run watersheds, and the streams and tributaries in the adjacent Uniontown Syncline portion of the study area, and is interpreted from the stream monitoring program instituted for the study. The second discussion is for the Monongahela and Youghiogheny Rivers and is derived from published water data and from the STORET information retrieval system.

TABLE 7

SOURCE SUMMARY BY SUBWATERSHEDS

Subwatershed	Receiving Streams	Number of Sources	Number of Major Sources*	Number Net Acidic	Number Net Alkaline	Average Total Net Acid Load (lbs./day)	Average Total Iron Load (lbs./day)
Galley Run	Youghiogheny Galley	38	2	30	8	5,293	791
Hickman Run	Hickman	12	1	12	0	2,156	75
Opossum Run, South Bank of Youghio- gheny River	Youghiogheny	18	1	4	14	-5,148	2,091
Dickerson Run	Dickerson	3	0	3	0	439	10
Grindstone	Redstone	7	0	0	7	-4,355	85
Jennings Run	Jennings	1	0	1	0	244	10
West Leisenring	Rankin Bute Bolden	27	2	22	5	3,614	531
Phillips	Redstone Cove	11	3	10	1	16,752	8,215
Upper Redstone	Redstone	3	1	2	1	2,083	94
Browns Run	Browns	16	0	14	2	663	29
Totals:		136	10	98	38	21,741	11,931

*Average Net Acid Load of 400 lbs./day or greater

STREAM QUALITY

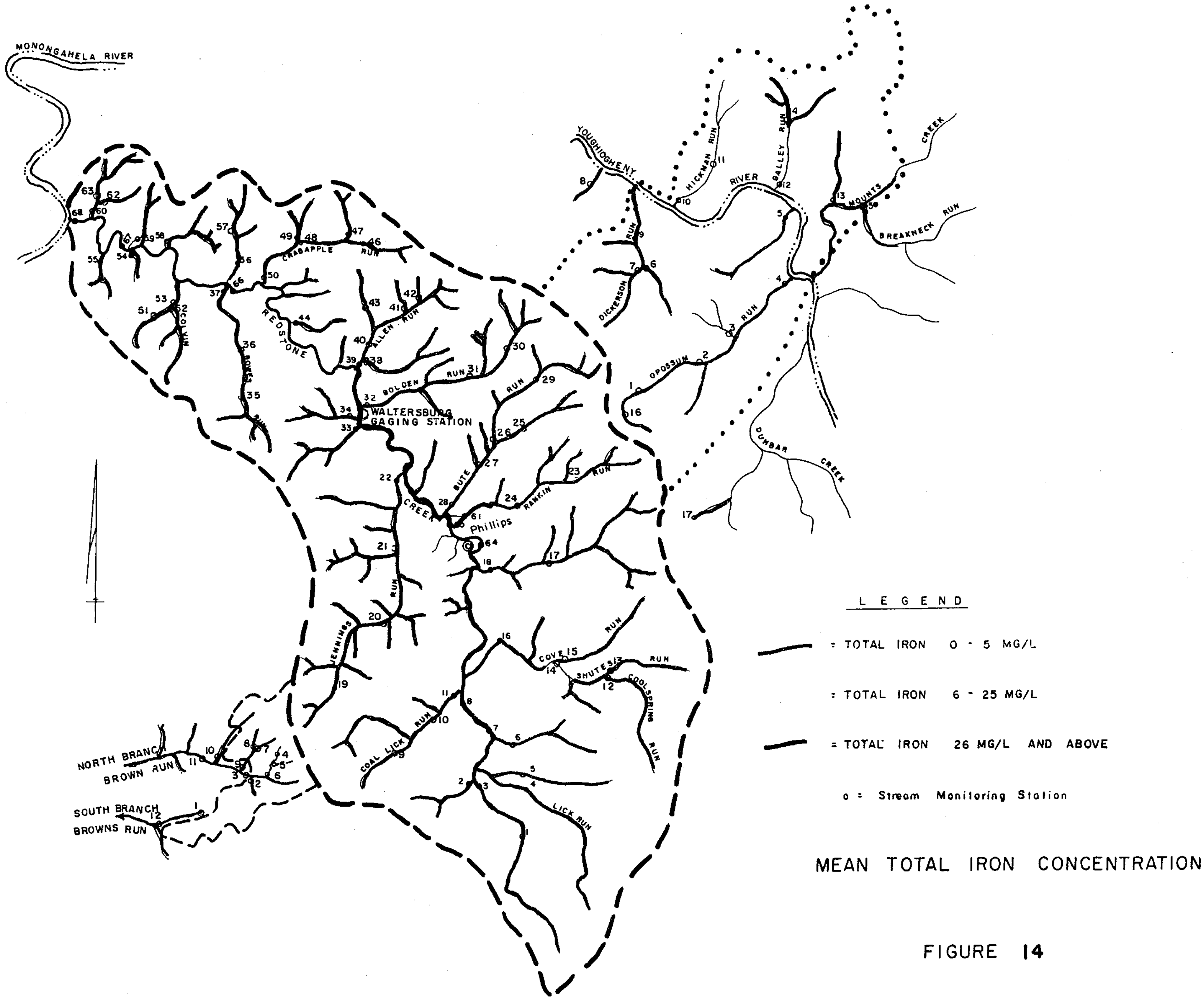
Stream Surveillance Network: Ninety-seven stream monitoring stations were established in the project area for the purpose of monitoring the stream quality at specific points. In addition to an original seventy-nine stream reading stations, samples were collected at five other locations along the main stem of Redstone Creek, plus the USGS gauging station at Waltersburg, and thirteen stations were added in the Browns Run project area. Appendix B summarizes water quality for each stream monitoring station. A complete summary of the water quality data collected during the study is found in Volume II of this report.

Utilizing the mean concentrations of net alkalinity, total iron, and sulfates at each stream reading station, Figures 14, 15 and 16 were developed to illustrate the general water quality characteristics of the streams of the project area.

General: The only tributaries which are seriously degraded by acid mine drainage are the lower reach of Rankin Run in the Redstone Creek Watershed, all of Hickman Run and all of Galley Run. These streams exhibited continually depressed pH and acid conditions. Redstone Creek is virtually unaffected by mine drainage upstream of the confluence with Source P-1 at which Redstone Creek receives a slug of acid and iron, 15,800 lbs. per day and 7,500 lbs. per day respectively. Redstone Creek provides enough buffering capacity to assimilate the acid from P-1 and from Rankin Run and to neutralize the acid at Waltersburg most of the time. Ten of the twelve water samples collected over the hydrologic water year at Waltersburg exhibited alkalinity exceeding or equaling acidity. The minimum recorded pH value was 5.3. This data is presented in Volume II.

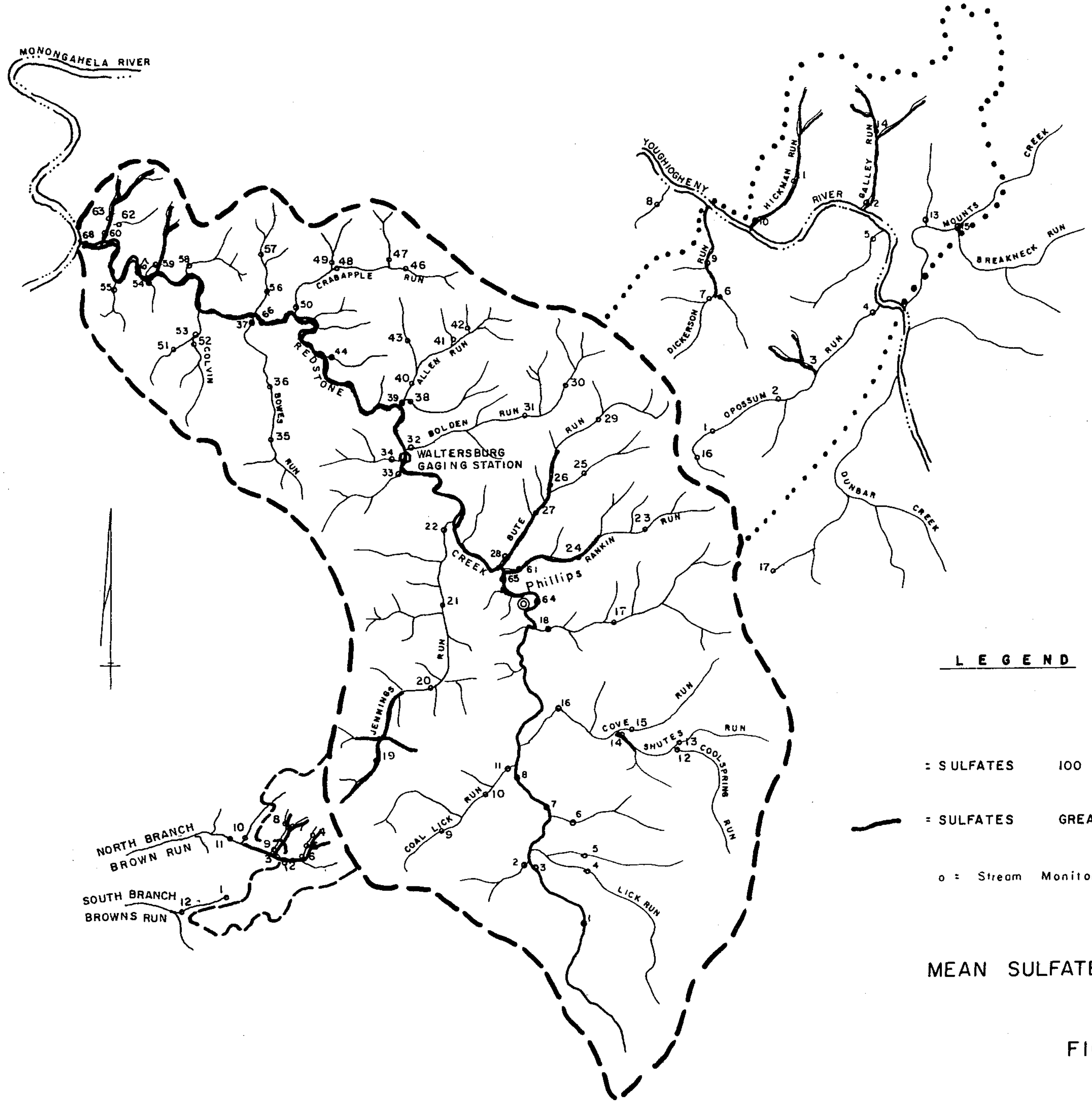
While the acid condition downstream from Source P-1 is marginal and dependent upon stream flow, the iron and sulfates seriously degrade the remaining 16.6 stream miles of Redstone Creek to the confluence with the Monongahela River. Alkaline stream flow mixes with the high iron of Source P-1 (discharge weighted total iron concentration of P-1 is 139 mg/l) causing rapid oxidation and precipitation of ferric iron. Consequently, yellowboy covers the stream substrate for as far downstream as the Waltersburg Gauging Station and destorys the aesthetic value of the stream as well as acquatic organisms in the stream benthos. Sulfate concentrations downstream of discharge P-1 are objectionable to human and acquatic life (greater than 250 mg/l) for the entire downstream reach under average flow conditions.

Total iron concentrations above 5 mg/l were present in Rankin Run, Shutes Run, Redstone Creek below Phillips, Hickman Run, Galley Run and a tributary of Opossum Run as illustrated in Figure 14. Sulfates were the most persistent acid mine drainage constituents within the project area. All major streams exhibited an average sulfate concentration above 100 mg/l. Those streams above 300 mg/l included Bute Run, Rankin Run,



MEAN TOTAL IRON CONCENTRATION

FIGURE 14



LEGEND

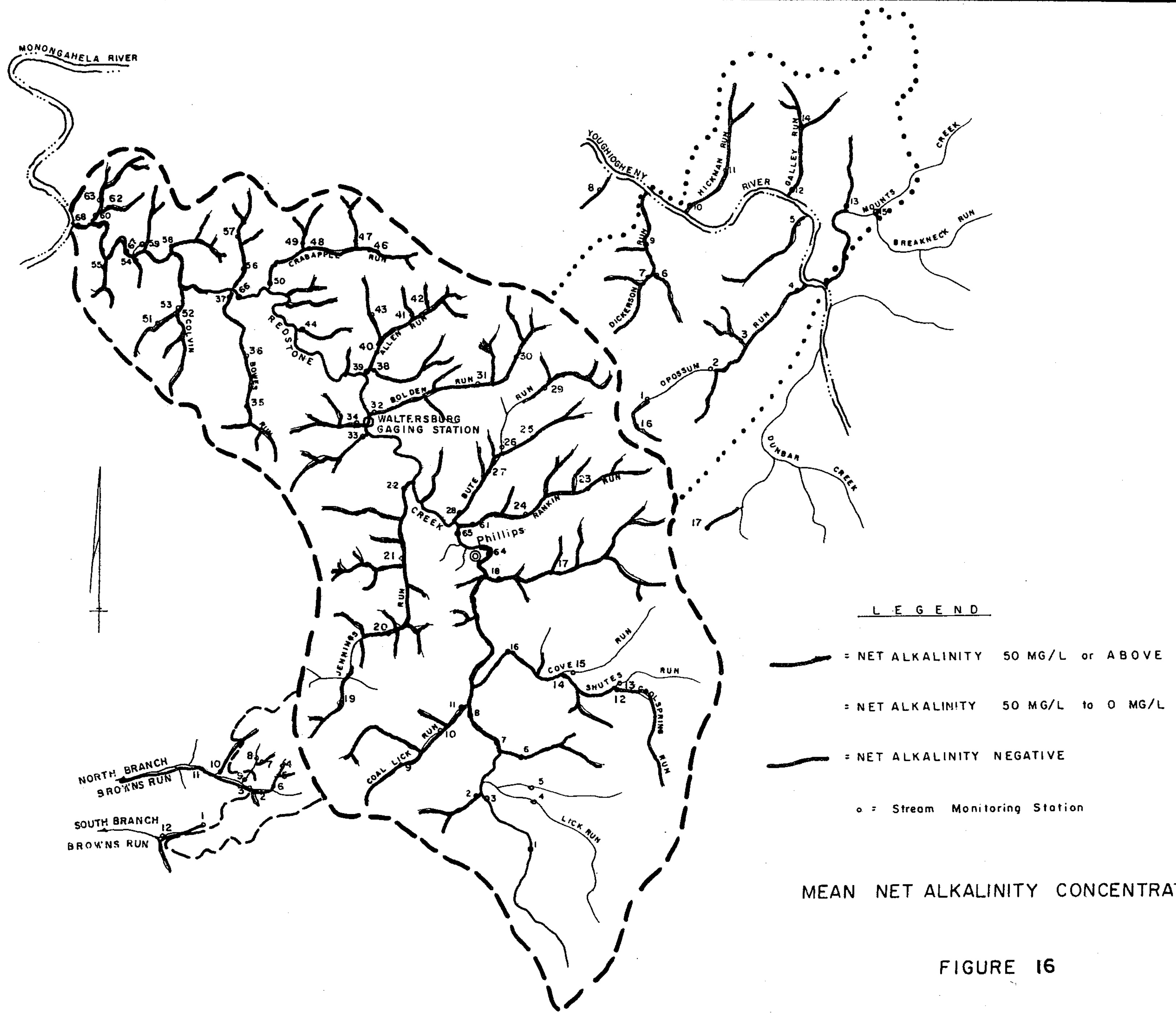
= SULFATES 100 - 300 MG/L

= SULFATES GREATER THAN 300 MG/L

o = Stream Monitoring Station

MEAN SULFATE CONCENTRATION

FIGURE 15



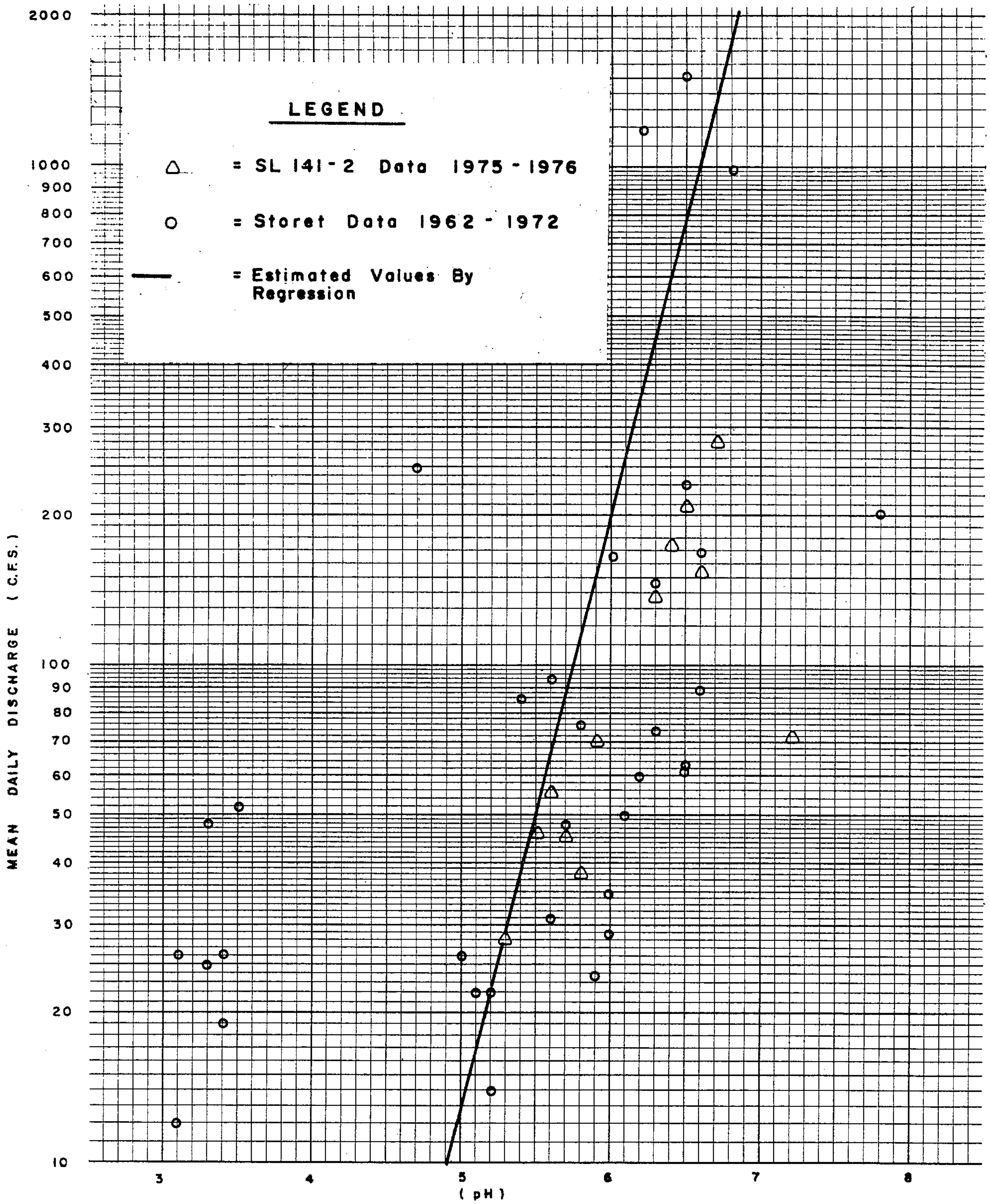
MEAN NET ALKALINITY CONCENTRATION

FIGURE 16

Shutes Run and Jennings Run, Hickman, Galley Run, Dickerson Run, two unnamed tributaries to Redstone Creek in the Grindstone subwatershed, and Redstone Creek downstream of the Phillips discharge as illustrated in Figure 15. Areas exhibiting net acidity include the mouth of Rankin Run, the headwaters of Jennings Run, Hickman Run, Galley Run, and the headwaters of Opossum Run as illustrated in Figure 16.

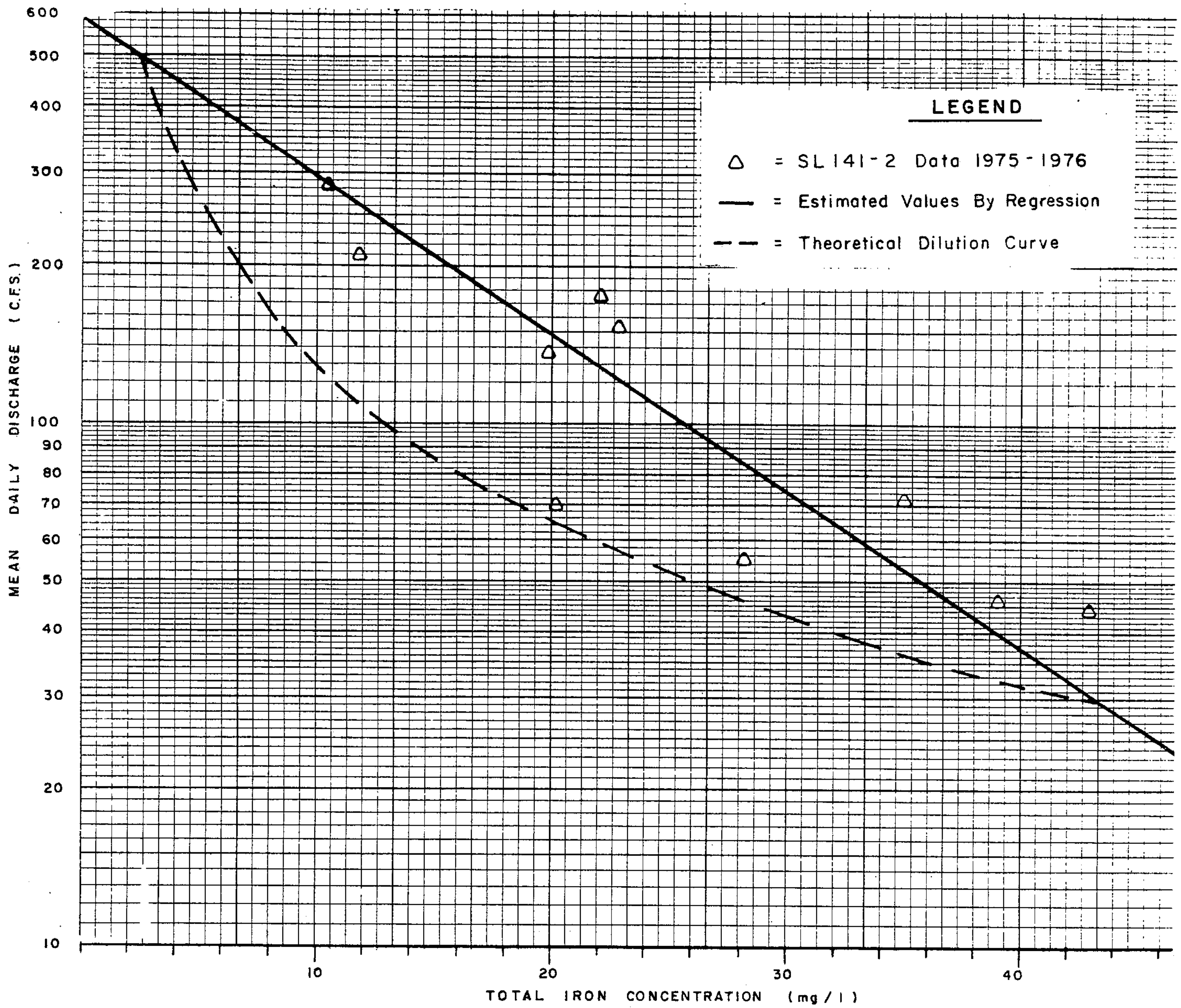
Iron, however, was consistently higher than clean stream standards at Waltersburg throughout the sampling program. Figures 17, 18 and 19 show the relation between stream flow and pH, iron and sulfates respectively at Waltersburg. All graphs are regression curves with a regression coefficient that is significant at the .05 level of significance. The stream flow versus iron and stream flow versus sulfates were derived from the SL 141-2 monitoring program whereas the stream flow versus pH graph includes available STORET raw data from 1962 through 1972. In order to compare water quality with variations in stream flow, a flow duration curve based upon 30 years of data at the Waltersburg gauging station is included as Figure 20.

Effect of AMD Source P-l on Redstone Creek: The largest AMD source, P-1, discharges into Redstone approximately 5.l miles upstream of Waltersburg and 0.6 miles downstream of station RS-64. Therefore, the water quality at Waltersburg does not necessarily reflect the impact of AMD source P-1 upon Redstone Creek. Based upon the estimated stream flow at RS-64, the immediate effect of AMD source P-1 was calculated. This calculation assumed a constant flow and iron, net alkalinity and sulfate concentration for AMD source P-1. It was also assumed that the background net alkalinity, iron and sulfate concentrations were constant at monitoring station RS-64. Based upon these assumptions, Table 8 was prepared to depict the assumed water quality of Redstone Creek after mixing with AMD source P-1, if the stream flow of Redstone Creek varied and all other factors were constant. Based upon estimated stream flow at station RS-64, Redstone Creek is able to neutralize the acidity of source P-1 about 50% of the time. As shown on Table 8, this event occurs when the estimated discharge at station RS-64 is 37 cfs. Furthermore, the estimated mixture of Redstone Creek and AMD source P-1 can be considered polluted by iron and sulfate at least 98% of the time. The calculation used to determine the effect of AMD source P-1 upon Redstone Creek assumes that complete mixing has occurred. The point at which complete mixing occurs may actually be a considerable distance downstream from AMD source P-1.



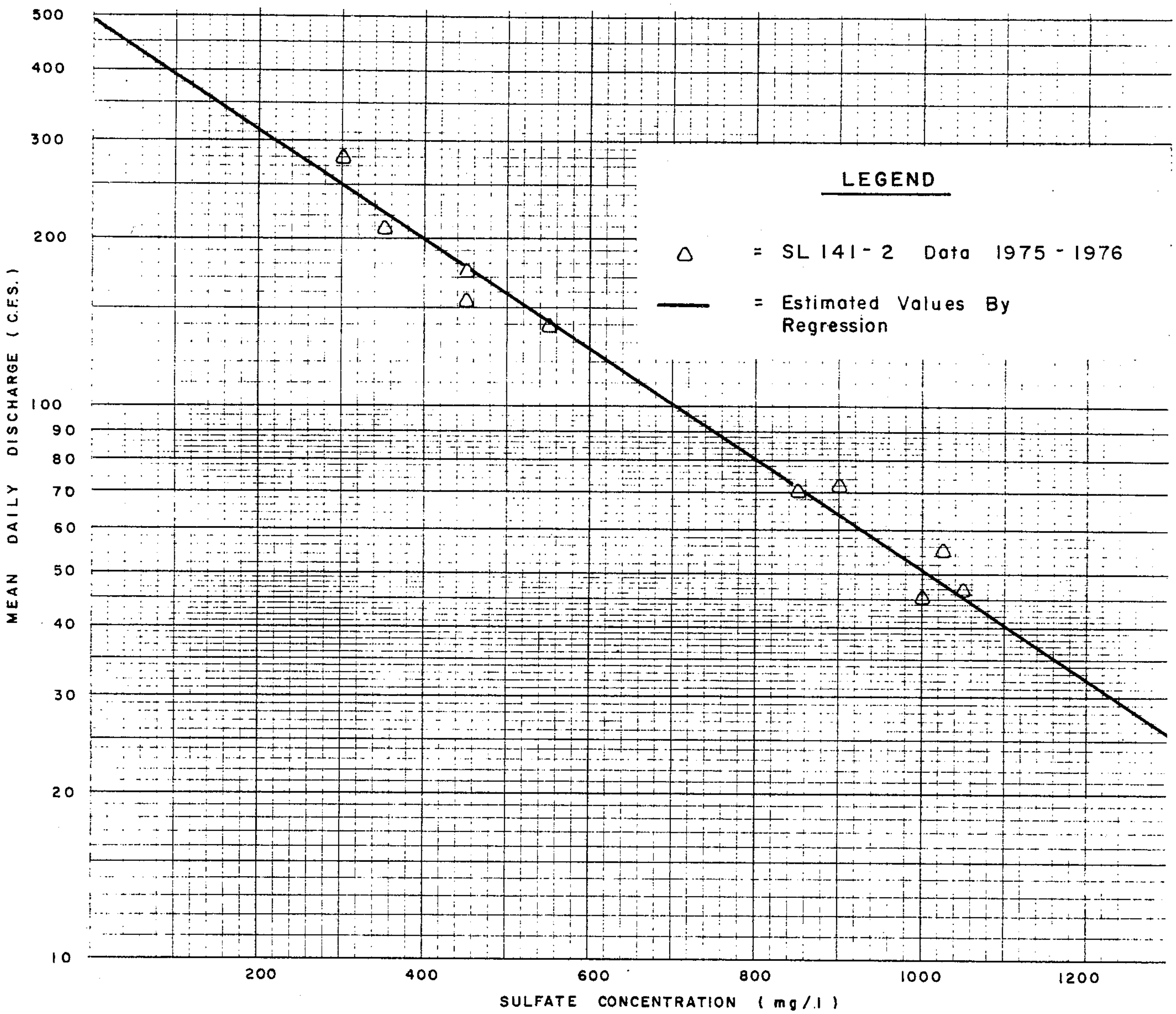
DISCHARGE VS pH RELATIONSHIP
REDSTONE CREEK AT WALTERSBURG

FIGURE 17



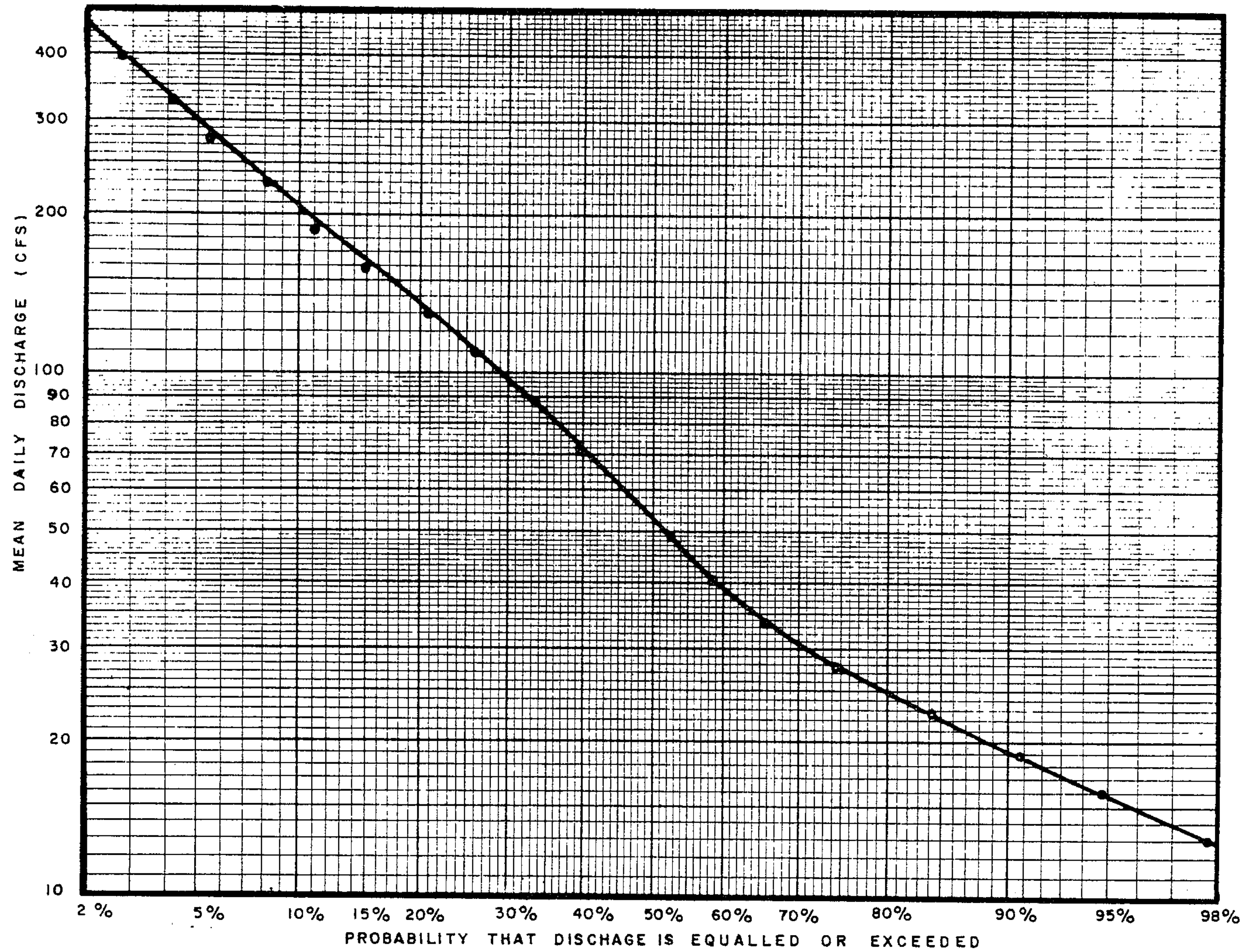
DISCHARGE VS TOTAL IRON RELATIONSHIP
REDSTONE CREEK AT WALTERSBURG

FIGURE 18



DISCHARGE VS SULFATE RELATIONSHIP
REDSTONE CREEK AT WALTERSBURG

FIGURE 19



SOURCE: US GEOLOGICAL SURVEY,
WATER RESOURCES DIVISION
DURATION TABLE OF DAILY
DISCHARGES FOR WATER
YEARS 1943 - 1972

DURATION CURVE FOR MEAN DAILY DISCHARGE
REDSTONE CREEK AT WALTERSBURG

FIGURE 20

TABLE 8

THE EFFECT OF AMD DISCHARGE P-1 UPON REDSTONE CREEK

Flow Condition (1)	Redstone Creek(2) Upstream Discharge to P-1 (cfs)	Concentrations of Redstone Creek After Complete Mixing with AMD Source P-1: Net Alkalinity (mg/1)	Total Iron (mg/1)	Ferrous Iron (mg/1)	Sulfates (mg/1)
98%	9	-110	71	52	1,076
90%	14	- 71	57	42	902
80%	18	- 48	49	36	802
65%	25	- 20	40	29	678
50%	37	+ 8	30	21	552
35%	59	+ 34	21	14	436
20%	96	+ 54	14	9	350
10%	150	+ 66	10	6	297
2%	320	+ 78	5	3	242

(1) Percent of Time Stream Flow in Column 2 is Equaled or Exceeded.

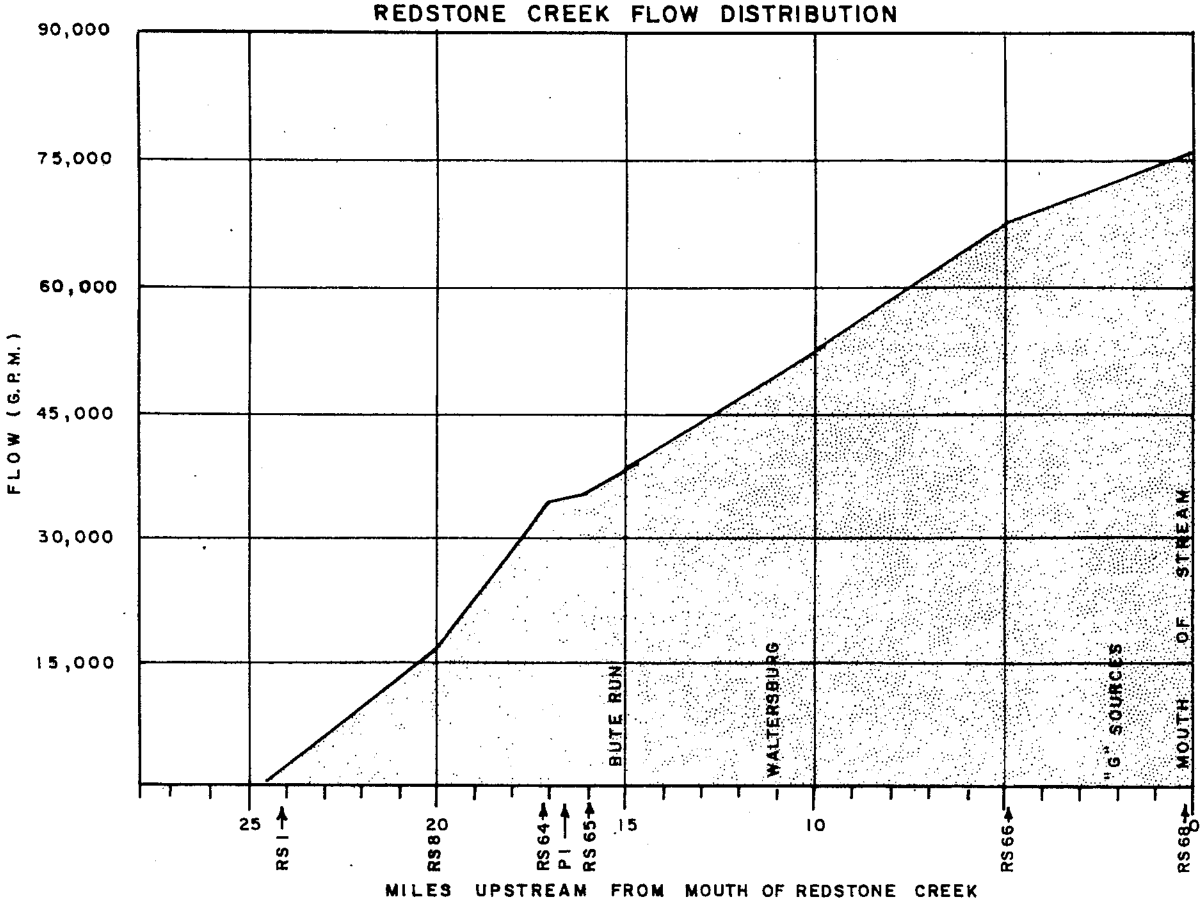
(2) Derived from Estimated Flow at Monitoring Station RS-64

The Effects of the Phillips and Rankin Run Discharges Upon Redstone Creek: Because of sufficient buffering capacity to neutralize the acid from Rankin Run and the Phillips discharges 80% of the time at Waltersburg, acidity and depressed pH are not critical problems for Redstone Creek. However, as shown on Figures 21 and 22, under average sample data conditions, the distribution of iron and sulfates persists in objectionable quantities from source P-1 to the mouth of Redstone Creek and presents the most serious degradation resulting from AMD in the Redstone Creek Watershed. Moreover, 81% of the iron concentration of source P-1 was found to be in the ferrous state at the discharge point. As this high ferrous iron mine drainage aerates and mixes with the alkaline Redstone Creek waters, the ferrous iron oxidizes and converts to the ferric state. As the pH quickly reverts to its background level, the ferric iron precipitates and causes both an aesthetic and ecological problem.

The process of in-stream neutralization of acid, oxidation of ferrous iron and eventual dilution and precipitation thought to occur in Redstone Creek has been illustrated on Figure 18. This figure represents a mathematical relation describing the processes.

Various transformations of the data were used in determining the best relationship between discharge and total iron. A maximum correlation coefficient of -.875, significant at the 95% confidence level, was obtained using the transformation log flow vs. total iron concentration indicating that a good inverse correlation existed. The correlation coefficient is a measure of how well the equation derived through linear regression fits the actual data. The linear regression was also tested using an analysis of variance and found to be significant at the 99% confidence level, indicating that a large portion of the variation in total iron could be explained by variation in flow as described by the regression equation. A theoretical dilution curve was constructed based on the proportional dilution of total iron concentration during the lowest sampled flow at Waltersburg with water containing no iron. The relationship between discharge and total iron, according to the regression equation, actual sampled data, and the theoretical dilution curve is shown on Figure 18.

A comparison of the regression line with the theoretical dilution curve shows that total iron decreases as flow increases (regression line has a negative slope) but is more concentrated than would be expected by dilution alone. Deviation of the regression line from the theoretical dilution curve may occur because the water diluting Redstone Creek contains higher concentrations of iron due to acid mine drainage from other causes than the theoretical iron concentration of zero assumed to be added by the diluting water to form the dilution curve. Additional considerations for explaining the deviation is the scouring of previously precipitated yellowboy from the stream bed during periods of high flow. This effect may diminish as flows increase and the contribution of unpolluted runoff becomes a predominant factor.


REDSTONE CREEK FLOW DISTRIBUTION
90,000
75,000
60,000
45,000
30,000
15,000
FLOW (G.P.M.)
BUTE RUN
WALTERSBURG
"G" SOURCES
MOUTH OF STREAM
25
20
15
10
0
RS 1
RS 8
RS 64
P 1
RS 65
RS 66
RS 68
MILES UPSTREAM FROM MOUTH OF REDSTONE CREEK

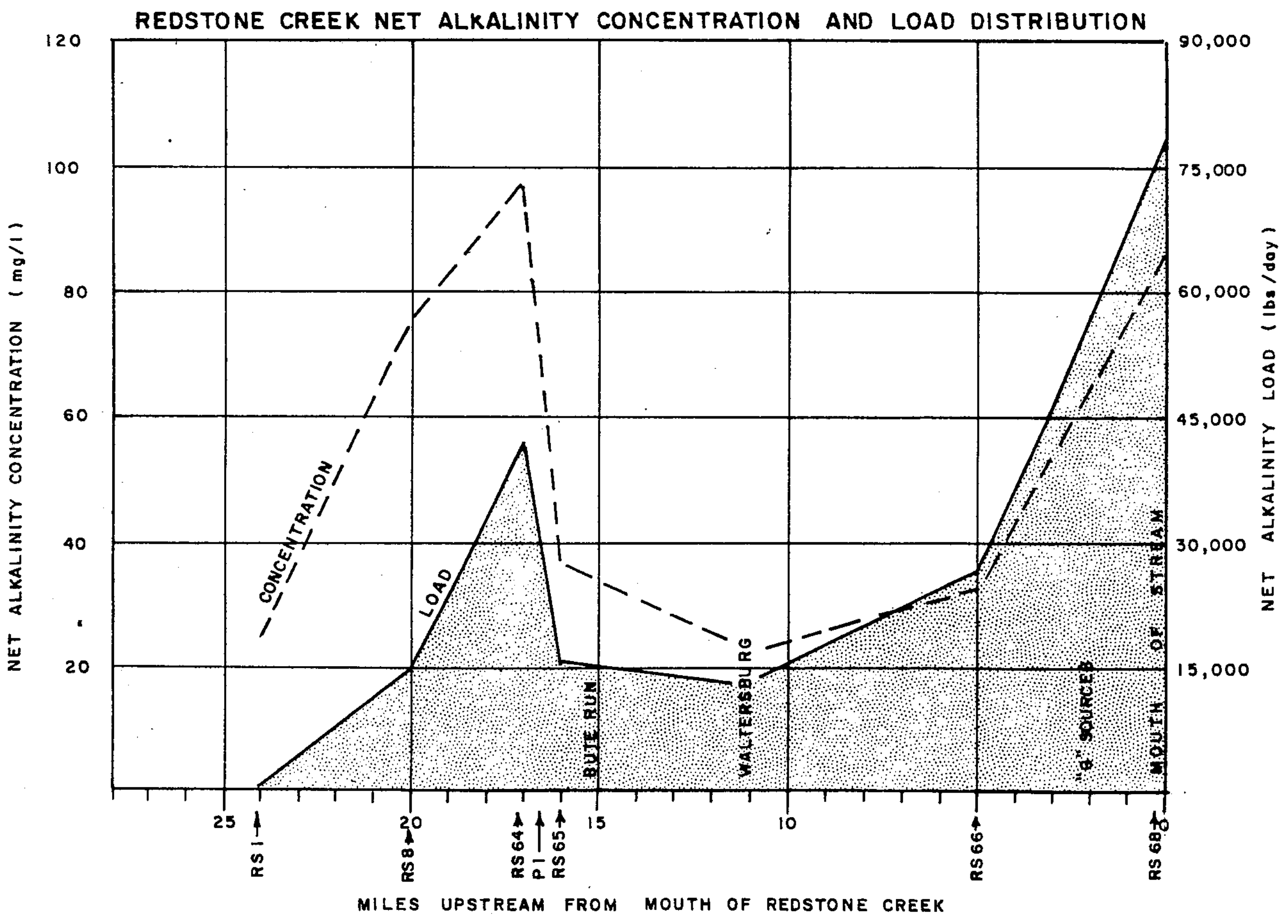
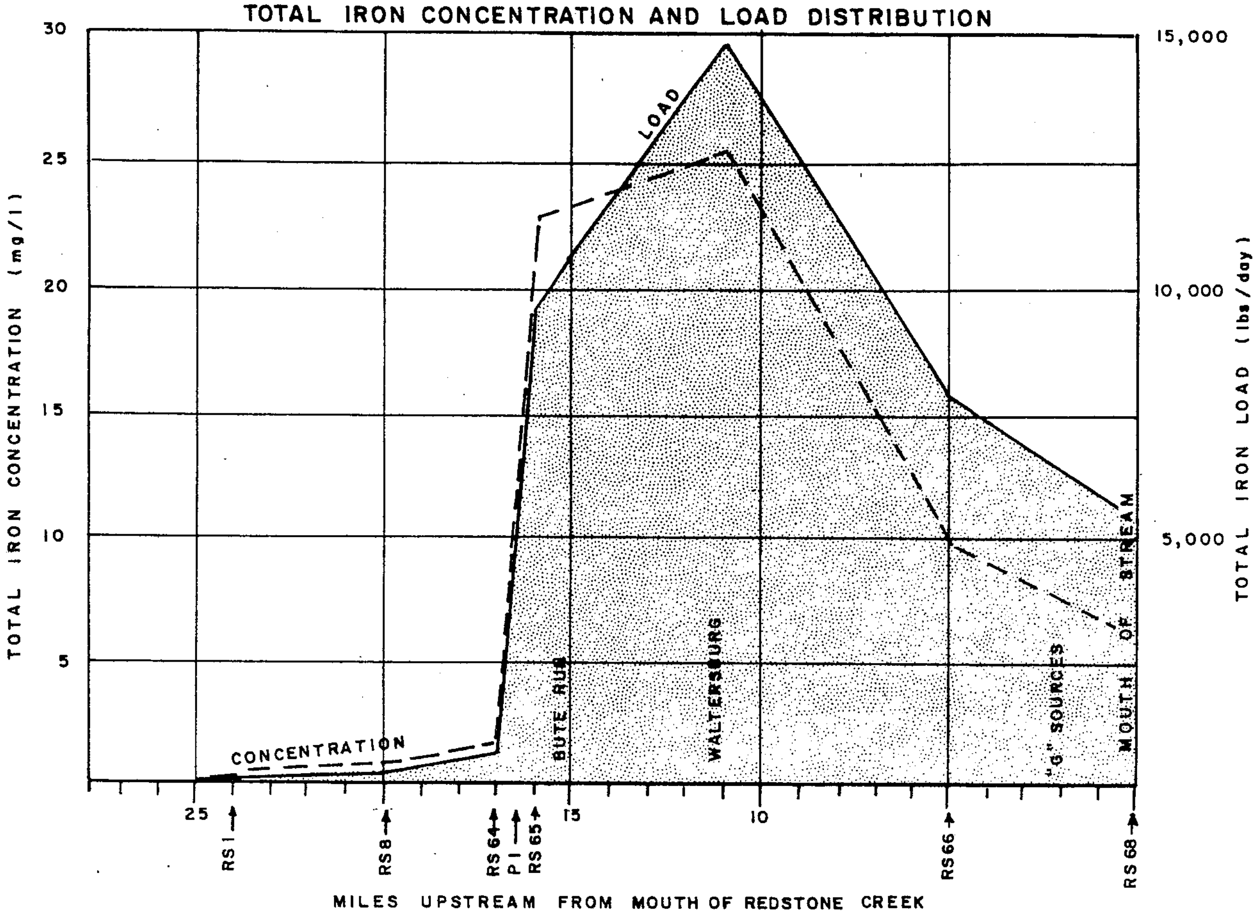

REDSTONE CREEK NET ALKALINITY CONCENTRATION AND LOAD DISTRIBUTION
120
100
80
60
40
20
NET ALKALINITY CONCENTRATION (mg/l)
90,000
75,000
60,000
45,000
30,000
15,000
NET ALKALINITY LOAD (lbs/day)
CONCENTRATION
LOAD
BUTE RUN
WALTERSBURG
"G" SOURCES
MOUTH OF STREAM
25
20
15
10
0
RS 1
RS 8
RS 64
P 1
RS 65
RS 66
RS 68
MILES UPSTREAM FROM MOUTH OF REDSTONE CREEK

FIGURE 21


TOTAL IRON CONCENTRATION AND LOAD DISTRIBUTION
TOTAL IRON CONCENTRATION (mg/l)
TOTAL IRON LOAD (lbs/day)
30
25
20
15
10
5
15,000
10,000
5,000
LOAD
CONCENTRATION
BUTE RUN
WALTERSBURG
"G" SOURCES
MOUTH OF STREAM
25
15
10
RS1
RS8
RS64
P1
RS65
RS66
RS68
MILES UPSTREAM FROM MOUTH OF REDSTONE CREEK

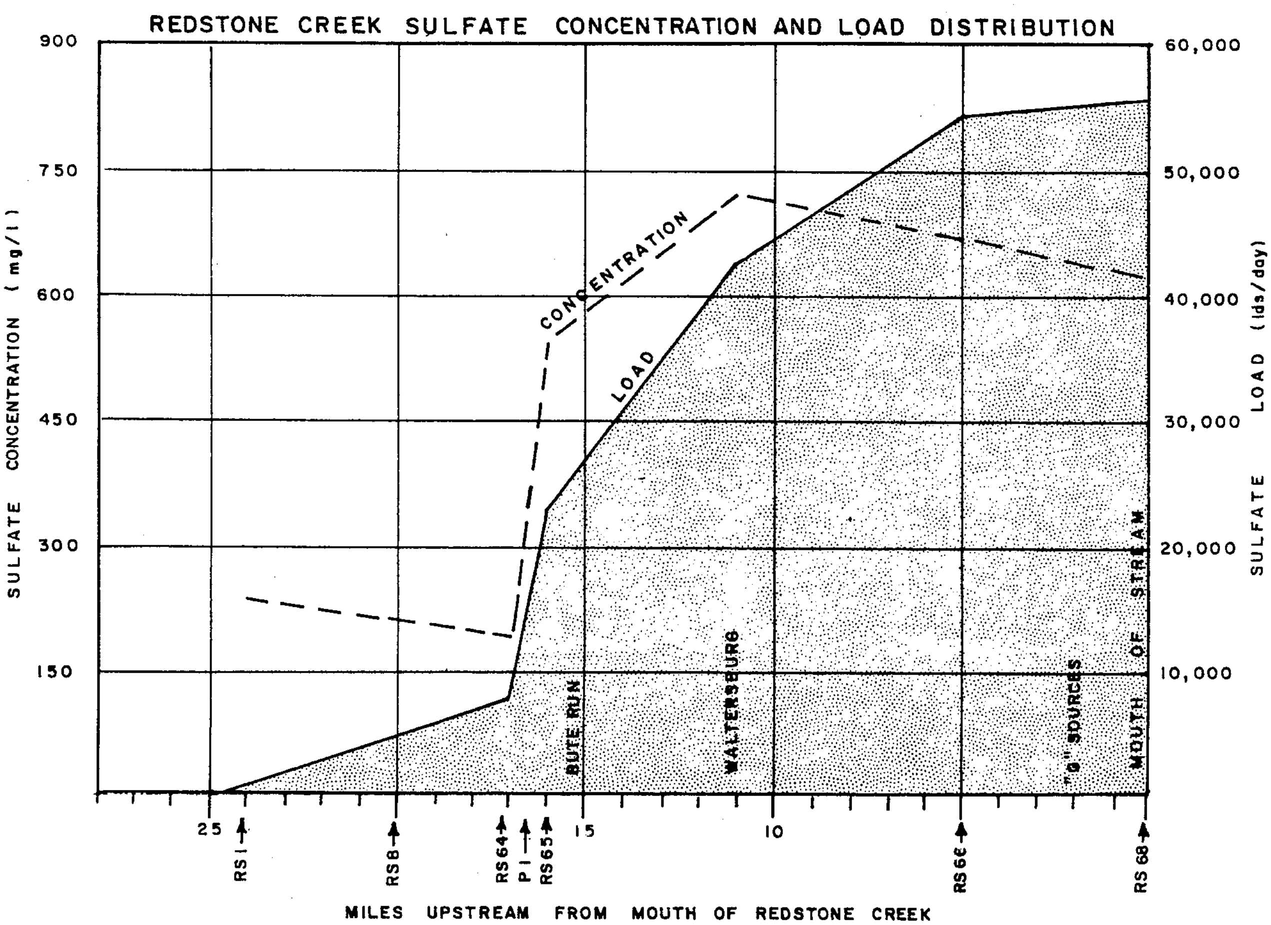

REDSTONE CREEK SULFATE CONCENTRATION AND LOAD DISTRIBUTION
SULFATE CONCENTRATION (mg/l)
SULFATE LOAD (lds/day)
900
750
600
450
300
150
60,000
50,000
40,000
30,000
20,000
10,000
CONCENTRATION
LOAD
BUTE RUN
WALTERSBURG
"G" SOURCES
MOUTH OF STREAM
25
15
10
RS1
RS8
RS64
P1
RS65
RS66
RS68
MILES UPSTREAM FROM MOUTH OF REDSTONE CREEK

FIGURE 22

Effect of AMD Upon Browns Run: Relative to the other subwatersheds in the project area, acid mine drainage pollution in the Browns Run Watershed is severe. Fortunately, the flows of the AMD sources are generally small but they contribute 663 lbs/day of acidity to Browns Run. However, downstream at Stations BR-11 and BR-12 in-stream neutralization appears to partially neutralize the acidic conditions. The most severe acid mine drainage pollution comes from the coal outcrops around the communities of Amend and Newcomer where deep mine discharges occur.

WATER QUALITY OF THE MONONGAHELA AND YOUGHIOGHENY RIVERS

Water quality data for the Monongahela and Youghiogheny Rivers was obtained from a 1971 Environmental Protection Agency report on the Monongahela River (14) and available STORET data. The effects of the mine drainage from the study area upon the rivers is interpreted below.

Title 25 specifying Department of Environmental Resources Rules and Regulations (15) prescribed limits for pH and total iron for both the Monongahela and Youghiogheny Rivers in the vicinity of the project area. These limits are:

pH   Not less than 6.0, not more than 8.5

Iron: Total not more than l.5 mg/l

Acidity, alkalinity and sulfates were not specified in Title 25.

Table 9 reveals that the Monongahela River water quality in 1965-1967 was below Department of Environmental Resources' standards, but it seemed to improve while flowing northward. The table also indicates that in 1965-1967 a large amount of acid mine drainage was contaminating the river upstream of the confluence of Redstone Creek. Downstream from the confluence of Redstone Creek the waters still showed a slight improvement in net alkalinity, total iron and sulfates. The effect of Redstone Creek on the Monongahela is difficult to determine precisely from the 1967 data, but it appears that the Redstone may have slowed the natural purification processes, but not reversed them.

The water quality data, as shown on Table 9, reveals that as the Youghiogheny River flowed past Connellsville just upstream of the project area, it met the DER Standards for pH and total iron at the time of sampling. Sample data was not available to indicate the effect of the Uniontown Syncline discharges on the quality of the Youghiogheny River; however, the effect was thought to be minor as discussed in later sections of the report.

ORGANIC POLLUTION

Observations: Analysis and testing for organic pollution was behind the scope of this study; however, during the course of the project, evidence indicating organic pollution was noted. The observations indicate some sewage pollution may be present in Redstone Creek near Uniontown, both upstream and downstream, in Rankin Run, Bute Run, and possibly Hickman and Galley Runs.

TABLE 9

WATER QUALITY OF THE MONONGAHELA AND YOUGHIOGHENY RIVERS

Date(s)	Date Source	Number of Samples	Average pH or pH Range	Average Net Alkalinity (mg/1)	Average Total Iron (mg/1)	Average Sulfates (mg/1)
Monongahela River at Greensboro, Pennsylvania						
8/65-12/67	EPA*	21	2.9 - 6.5	-87	5.3	261
4/50-12/75	STORET	81+	4.2		3.2	139
Monongahela River at Charleroi, Pennsylvania						
4/65-12/75	EPA	35	3.3 - 5.6	-54	1.2	237
4/50-9/74	STORET	86+	4.9		2.3	172
Youghiogheny River at Ohiopyle, Pennsylvania						
4/50-11/75	STORET	88+	6.3	+ 9	0.9	30
Youghiogheny River at Connellsville, Pennsylvania						
4/50-12/75	STORET	92+	6.2	+ 8	1.2	38

*References: Environmental Protection Agency, Monongahela River Mine Drainage Remedial Project, Summary Report, Division of Field Investigations, Cincinnati, Ohio, 1971

Sewerage Facilities: The Redstone Creek project area is primarily serviced by six disposal systems. System names, service areas, and projected capacities are found on Table 10. Two systems, Dunlop Creek Regional Sewage Disposal System and Dawson-Vanderbilt Sewage Disposal System, discharge untreated sewage directly into Dunlop Creek and Smiley Run respectively. The remaining four systems utilize primary or secondary treatment methods prior to discharge into nearby streams. Two other facilities, Grindstone and Smock, serve only to collect sewage prior to discharge. Of the four systems utilizing treatment methods, only the Newell Area Sewage Disposal System does not combine storm and sanitary facilities. The danger involved in combining facilities is due to hydraulic overloads of the system during periods of heavy rainfall. The overload can lead to discharge of raw sewage into receiving streams.

Areas not served by the existing public sewage services use individual systems such as septic tanks, leaching fields or pits, cesspools, and privies. These methods are used by homeowners, schools, industries, commerical establishments and camps. The effectiveness of the above individual systems is limited in many cases by soil conditions not conducive to septic tank operations.

AQUATIC ECOLOGY

INTRODUCTION

The aquatic ecology of Redstone Creek and two tributaries, Allen Run and Crabapple Run, was evaluated according to the fish community structures and observed physical condition of the stream. Fish were chosen as the means of evaluation because of their effective position in the aquatic food web and ease in sampling and analysis.

Because fish are highly sensitive to environmental factors, their community structure may be indicative of the composition and condition of other aquatic organisms and environmental conditions. Water quality conditions may affect the fish population directly or indirectly by affecting the lower tropic levels of the food chain. These effects may be reflected in the abundance of species composition and condition of the fish population.

As a means of measuring and comparing the fish communities in the three streams, fish species diversity indexes were calculated for each of the three fish collections. Brillouin's diversity index was used which quantitatively evaluates the number of species of fish and the abundance of each species within a community. An "evenness" ratio was also calculated which indicates how the individuals are distributed among the species. A maximum evenness ratio (approaching one) would indicate that there is an equal number of individuals within and between species. A high evenness indicates that the environment is suited to all species equally well. If the community contains pollution sensitive individuals which have a high species diversity value and a high evenness ratio, it may be assumed the quality of that particular environment is good.

TABLE 10

PUBLIC SEWER SYSTEMS WITHIN THE PROJECT AREA

System Name	Boroughs, Cities and Townships Served	Projected Number of Homes to Be Served Between 1975-1980	
		Number of Homes	Capacity
Brownsville Area Sewage Disposal System	Brownsville City Jefferson Township Redstone Township	860	.086 MGD
Connellsville Regional Sewage Disposal System	Dunbar Borough South Connellsville Borough Connellsville City Bullskin Township Connellsville Township Dunbar Township	29,540	2.954 MGD
Dawson-Vanderbilt Area Sewage Disposal System	Dawson Borough Vanderbilt Borough Dunbar Township Franklin Township Lower Tyrone Township	2,760	.276 MGD
Dunlap Creek Regional Sewage Disposal System	German Township Luzerne Township Menallen Township Redstone Township	12,700	1.270 MGD
Newell Area Sewage Disposal System	Newell Borough Jefferson Township	780	.062 MGD
Scottdale-Everson Sewage Disposal System	Everson Borough Scottdale Borough Upper Tyrone Township	2,270	.227 MGD

Source: Comprehensive Development Plan for Fayette County, Volume 4, Sewage Facilities Planning, Fayette County Planning Commission, September, 1972.

PURPOSE

The purpose of this investigation was to determine the fish species diversity of three collections, one from Redstone Creek, one from Crabapple Run, and one from Allen Run, and to determine if they significantly differ between streams, and to evaluate the aquatic ecology of these three stream areas based on the fish community structure and the observed physical condition of the streams.

METHODS

The study was conducted from November 7, 1975, to November 11, 1975. Fish were captured by electro-shocking techniques. Redstone Creek was sampled at five locations; south of Uniontown, north of Uniontown, north of Phillips, near the mouth of Allen Run, and near the mouth of Crabapple Run. Locations of sampling areas are shown on Figure 23. Redstone Creek was sampled for a total length of 690 ft. and an area of approximately 16,834 sq. ft. Allen Run was sampled from its mouth to 190 ft. upstream totaling approximately 1,870 sq. ft. Crabapple Run was sampled from its mouth, 200 ft. upstream, totaling approximately l,935 sq. ft. Stream morphology was investigated which included average width, length and depth, bottom strata, shoreline structure and vegetation.

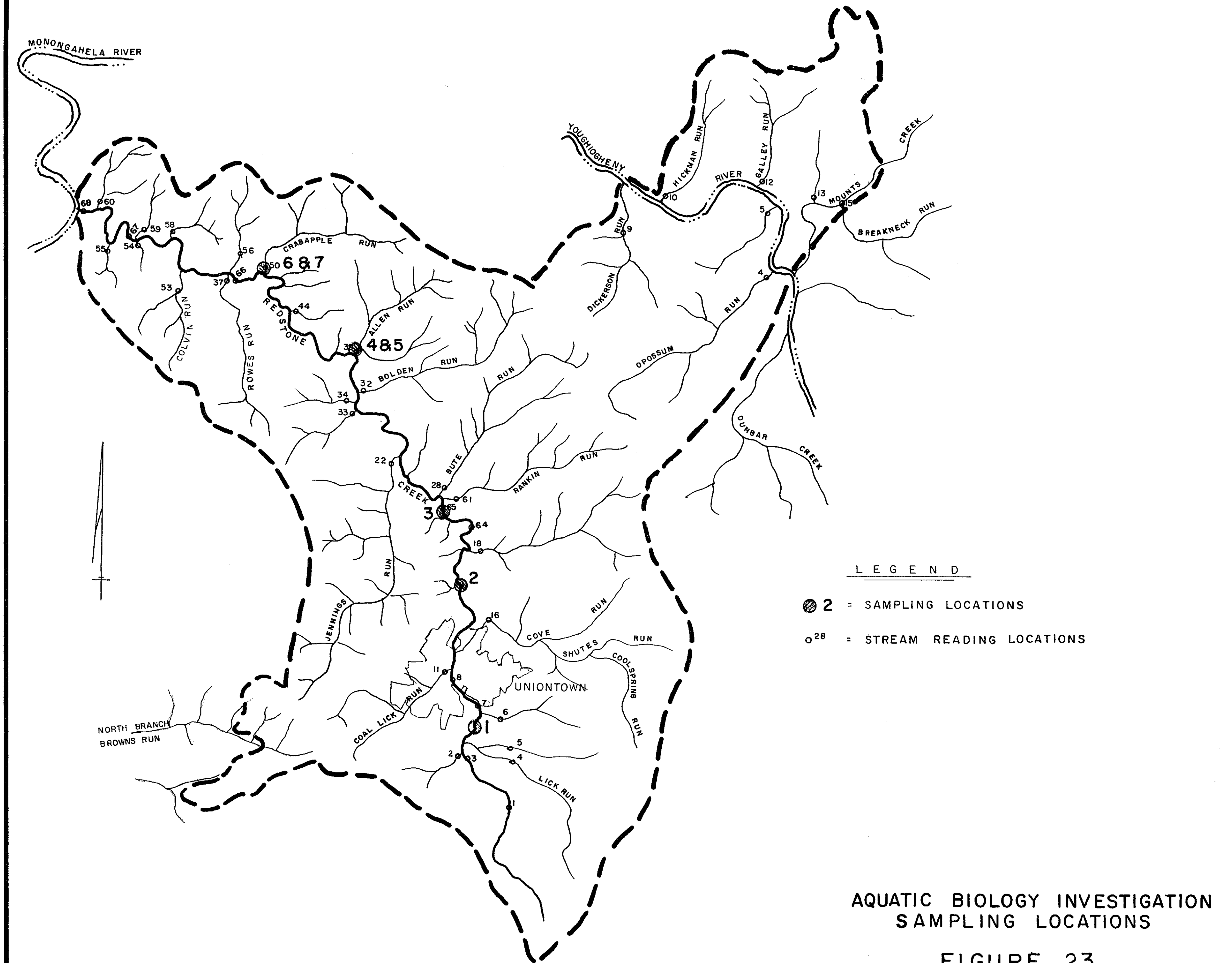
Species diversity was calculated using Brillouin's species diversity index, treating each sample as a population. Samples from all five stations on Redstone Creek were combined and treated as one population, due to the small number of individuals. This combined collection represents 690 ft. (16,834 sq. ft.) of shocked stream and 164 fish. Since Brillouin's index is dependent on sample size, diversities were calculated with actual sample sizes and with equal sample sizes for comparison between streams. Equal sample sizes were determined by randomly choosing 164 individuals (the number of fish captured in Redstone) from Allen and Crabapple Run collections. Species diversities may be seen on Tables F-2 and F-3 in Appendix F.

Due to the depth of Redstone Creek near the mouths of Allen Run and Crabapple Run, it could not be shocked its entire width. An average width of 27+ ft. was shocked; however, the actual average stream width was greater than 27 ft.

RESULTS

Fish collection data is recorded in Tables F-1 and F-2 in Appendix F. Redstone Creek collection had 164 total individuals belonging to eight species. Allen Run collection had 397 individuals belonging to 10 species. The Crabapple Run collections had 211 individuals representing 11 species.

Tables F-2 and F-4 in Appendix F show the actual fish collection sizes along with the general morphology of the area of stream sampled. The Redstone Creek collection was taken from by far the largest area. This sample had the lowest fish species diversity (l.52) in the study. A low



AQUATIC BIOLOGY INVESTIGATION
SAMPLING LOCATIONS

FIGURE 23

evenness (equal distribution of individuals among species) value (.53) was also present, with one species (Creekchub) dominating the fish collection in numbers. Crabapple Run had a high diversity of 2.67 and an evenness value of 0.81. The high evenness value indicates little domination of the sample by any one species. Allen Run had a high species diversity of 3.15 and a high evenness value of 0.71. The area of Redstone sampled was approximately nine times as great.

Comparison of diversity indices between streams (Table F-3, Appendix F) with equal sample size showed the following results: Redstone Creek had the lowest diversity of 1.52 and the lowest evenness factor of 0.53. Crabapple Run had the highest diversity of 2.54 and the highest evenness ratio of 0.81. Allen Run was intermediate with a species diversity of 2.02 and an evenness ratio of 0.71.

DISCUSSION

Redstone Creek, in comparison with Crabapple Run, and Allen Run, is maintaining a poor fish community, based on samples collected at five stations on Redstone. An area nine times greater than Allen or Crabapple was sampled on Redstone Creek, yet the fish species diversity in Redstone Creek was significantly lower. This indicates that a stress is being exerted upon the fish community and significantly lowering the ability of certain fish species to exist within the aquatic habitat. The stress limiting the fish community to a small number of pollution tolerant species of fish suggests a similar negative effect upon other aquatic life within Redstone Creek. This stress, based upon past and present investigations, is probably acid mine drainage pollution. Acid mine drainage pollution was not observed in Crabapple or Allen Runs and, based on fish community structures in these streams, they are considered in good condition with few pollutants. Contrasting the apparent good quality of Allen Run and Crabapple Run, the poor aquatic quality of Redstone Creek is directly attributed to acid mine drainage.

Further indication of the poor quality of Redstone Creek may be seen in the relatively low numbers of fish captured in a relatively large sampling area. This low population size may be indicative of the poor environmental condition in Redstone Creek. A low evenness value showed most of the individuals are found in one or two species, indicating that the environment was suited to only a few tolerant species. The Creekchub dominated all species by numbers. The Creekchub is a well-known tolerant, foraging fish, not uncommon to waters polluted by organic wastes, and tolerant to various degrees of acid mine drainage. Individuals were more evenly distributed in Crabapple Run and Allen Run, with no one species dominating the others. The aquatic environment in these two streams is suited to more species of less tolerant types, including Shiners, Stonerollers, Darters, Bluntnose Minnows, Bluegills, and Small Mouth Bass.

Dominating Redstone Creek by biomass is the Carp. Three carp were captured; however, it was observed during the collection that some carp detected the electrical field of the shocking device and were seen "running" ahead of the electrodes. Carp are probably one of the most tolerant fish to pollutants of the organic and acid mine drainage types. It appears that pollution from sewage and acid mine drainage increases with downstream progression in Redstone Creek. At least from direct observation of the physical condition of the stream, iron floculant obviously increases from apparently none south of Uniontown, to an obvious orange flock, blocking vision beyond 8 in. into the water at the other sampling stations. Sewage pollution was obvious below the sewage treatment plant north of Phillips. The massive influx of AMD beyond this point appears so great that any neutralization by sewage is of little value. This increase in stress by AMD on the aquatic environment increasing downstream is evidenced by examination of the fish collection data, Table F-1 in Appendix F. One hundred forty individuals from four species were collected south of Uniontown. Sewage pollution was observed in this area and evidenced by mats of blue-green algae on the bottom of the stream. All stations north of Uniontown combined had only 24 individuals from four species. Biologically, the fish community structure indicated an increase in pollution downstream from south of Uniontown to Crabapple Run.

The most detrimental effect of AMD on the fish population in Redstone Creek appears to be of the following types - sulfates, iron and sedimentation. High sulfates are usually found as a result of AMD. Sulfate concentrations beyond 300 ppm may injure respiratory structures in some fish and, even more important, destroy the substrata of organic food. Iron is another major pollutant resulting from AMD. Iron concentrations ranging between 1 to 3 ppm may be directly harmful to fish respiratory functions, especially when associated with low pH.

Sedimentation is thought to be a major pollutant in Redstone Creek affecting the aquatic quality. Floculation, debris, sewage pollution, and heavy iron deposits in suspension all contribute to heavy sedimentation in the study area of Redstone Creek. Blockage of light reduces primary productivity; sedimentation on the bottom strata eliminates food or makes it unavailable to the fish population.

CONCLUSIONS

It was found that fish species diversity and the evenness distribution of individuals among species were significantly different between the samples collected from Redstone Creek, Allen Run and Crabapple Run. Redstone Creek had the lowest species diversity and evenness values, a poorer fish community structure dominated by Creekchubs and Carp, both tolerant species to pollution. The aquatic quality, as determined by the fish population and observation of physical factors, is poor. The pollutants have compounded effects, one on another. The most obvious pollutant is AMD. The study area of Redstone Creek south of Uniontown appears not to have as poor a fish community and aquatic quality as the stations north of Uniontown where the effects from AMD appear to increase, at least to Crabapple Run. Allen Run and Crabapple Run both had significantly high fish species diversity and evenness distribution values.

Larger numbers of fish were captured per sampled area. The presence of less pollution tolerant species including Small Mouth Bass, Shiners, Stonerollers, Bluegills, Darters and Bluntnose Minnows indicate that the aquatic habitat is suitable for larger number of species in Crabapple and Allen Run than in Redstone Creek, based upon the fish community structure.

WATER USES

WATER SUPPLY

There are six public companies servicing the Redstone Creek project area. These companies and their sources of water are summarized on Table 11. Areas not serviced by the public water supply companies utilize individual supplies from wells or cisterns. Aquifers lying above deep mined coal seams have unreliable water bearing properties. Water shortages have occurred where mine subsidence fractures in strata overlying the coal seam have drained the aquifer.

TABLE 11

PUBLIC WATER SUPPLY SYSTEMS WITHIN THE PROJECT AREA

Company Name	Boroughs, Cities, Townships Served	Source of Supply
Brownsville Water Company	Brownsville City Redstone Township	Monongahela River
Mountain Water Supply Co.	Connellsville City Uniontown City	Indian Creek
North Fayette County Municipal Authority	Dawson Borough Dunbar Borough Vanderbilt Borough Connellsville City Uniontown City Connellsville Township Dunbar Township Franklin Township Georges Township Lower Tyrone Township Menallen Township North Union Township South Union Township Upper Tyrone Township	Youghiogheny River
Pleasant Valley Water Authority	Bullskin Township	Westmoreland County Water Authority
Redstone Water Company	Menallen Township Redstone Township	Redstone Creek Mountain Water Supply Co.
Western Pennsylvania Water Company	Connellsville City Uniontown City Connellsville Township North Union Township South Union Township	Monongahela River

Sources: Overall Economic Development Program, Fayette County, Pennsylvania, July, 1963.
North Fayette County Municipal Authority, Phone Conversation, October 20, 1976.