

SECTION VI

INVENTORY OF WATERSHED ACID DISCHARGES

ACID MINE DRAINAGE SOURCE
LOCATION MAP

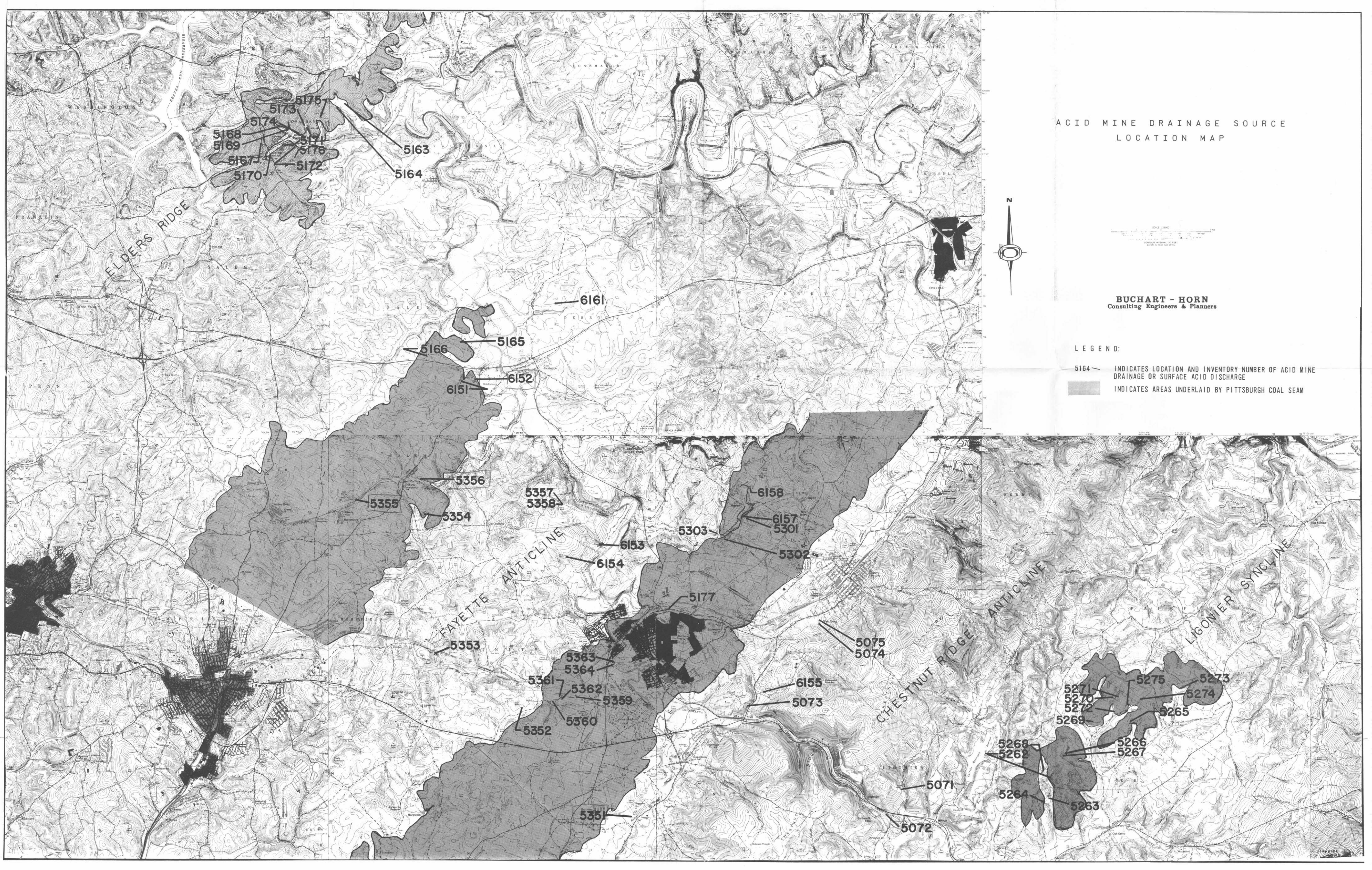


SCALE 1:4000
CONTour INTERVAL, 20 FEET
CONTOUR IN FEET

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LEGEND:

- 5164 — INDICATES LOCATION AND INVENTORY NUMBER OF ACID MINE DRAINAGE OR SURFACE ACID DISCHARGE
- INDICATES AREAS UNDERLAID BY PITTSBURGH COAL SEAM



5168
5169
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5177

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6155
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FAYETTE ANTICLINE

5363
5364
5361
5362
5359
5352
5360

5351

CHESTNUT RIDGE ANTICLINE

5271
5270
5272
5269

5275
5273
5274

5265

5268
5262
5264
5263

5266
5267

LIGOVER SYNCLINE

5072

5071

SECTION VI INVENTORY OF WATERSHED ACID DISCHARGES

The field survey of mine acid discharges conducted in the Loyalhanna watershed located 60 continuous or nearly continuous sources of drainage from mines, seepages and refuse piles. Each discharge was identified by an assigned STORET number and sampled at regular intervals.

The summary of the inventoried discharge data is organized in the following manner. Subsurface discharges are grouped by coal seam and synclinal structure. Within each structure, the dominant discharge or discharges are listed first followed by lesser discharges. At the conclusion of this summary, circumstances common to several coal seam structures are discussed. Surface discharges are discussed separately.

The Pittsburgh coal fields, named by their associated synclinal structure are discussed in the following order:

1. Latrobe Syncline North
2. Latrobe Syncline South
3. Greensburg Syncline
4. Elders Ridge Syncline
5. Ligonier Syncline

The Upper Freeport Coal Seam is discussed separately. While the Upper Freeport Coal Seam also underlies structures 1 through 5, its great depth and the presence of the more accessible Pittsburgh c seam above it have discouraged extensive mining. No known Freeport Coal Seam associated mine drainage occurs in areas which are also underlain by Pittsburgh coal.

SUBSURFACE DISCHARGES

Latrobe Syncline North.

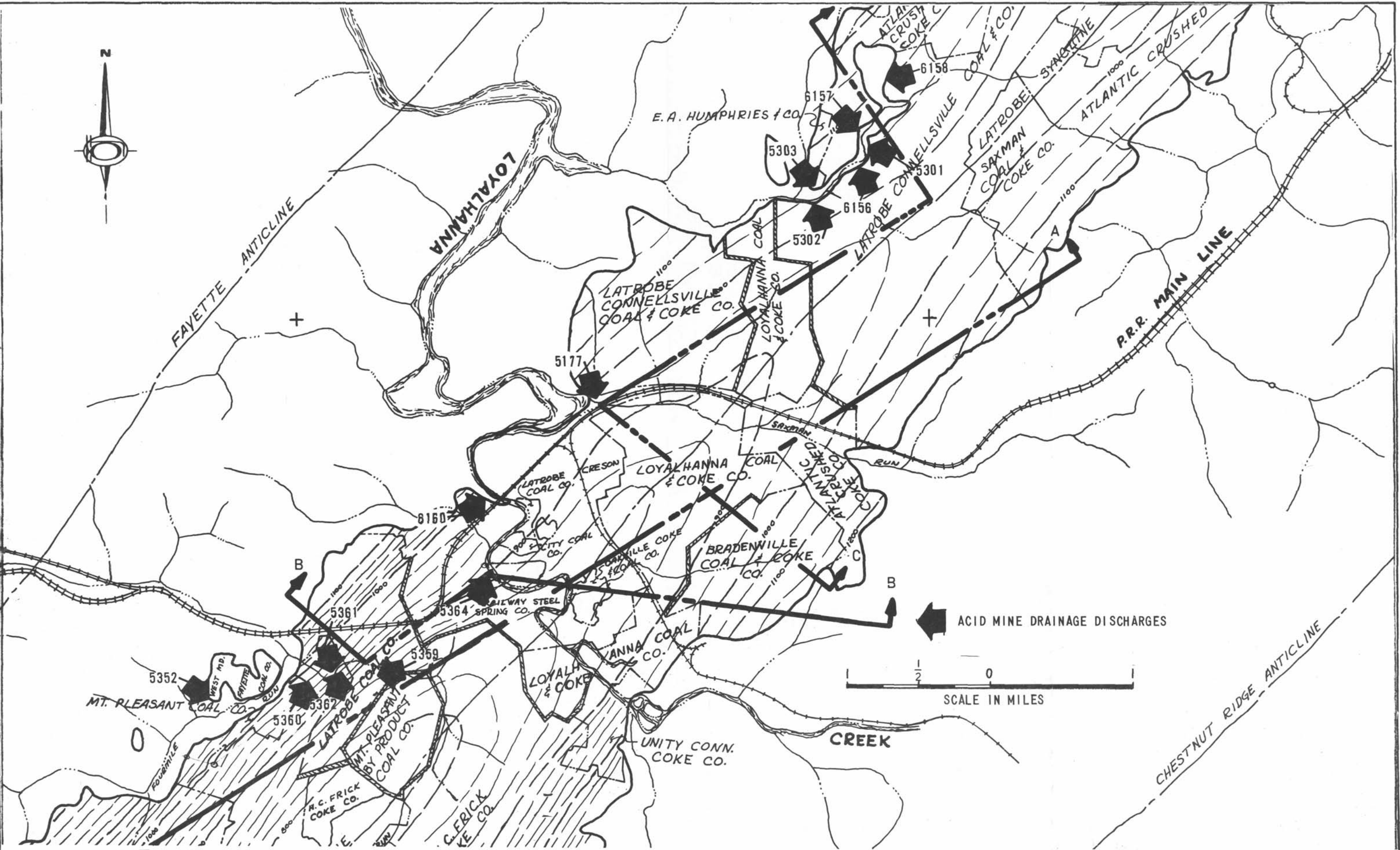
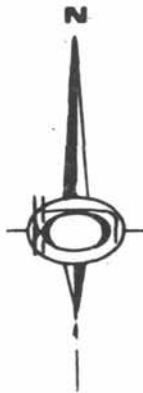
This field contains seven discharges. The major discharge, #5177 flows at an average rate of 2300 gallons per minute and contributes an average acidity of 14, 000 lbs/day to the watershed. The remaining discharges in Latrobe North contribute less than 500 lbs. of acidity total per day. Discharge #5177, the major discharge, is situated on the south bank of Saxman Run at (Elevation 990. All other Latrobe north discharges are minor and are located at elevations of 1040 or higher.

Discharge #5177 is a shaft or culvert located between the north side of the embankment of the Penn Central Railroad main line and Saxman Run. The discharge point is near the toe of the embankment slope and flow is directly into Saxman Run. About 1, 000 feet downstream of this discharge Saxman Run enters Loyalhanna Creek. This is not an original mine entry but a drainway placed during the construction of either Route 981 or the railway. The topography of the area has been altered by construction and the discharge does not coincide with any existing mine shaft as shown on earlier maps. This discharge is said to drain several large mines north of Latrobe. A map of the Latrobe-Connellsville Coal and Coke Company's mines which are in the area dated 1921, show a flooded area within the mines with a water surface at elevation 992. It is not clear if the mine was still in operation at the time of the map, and if it was, what means were used to keep the lower portion of the mine unflooded below elevation 992.

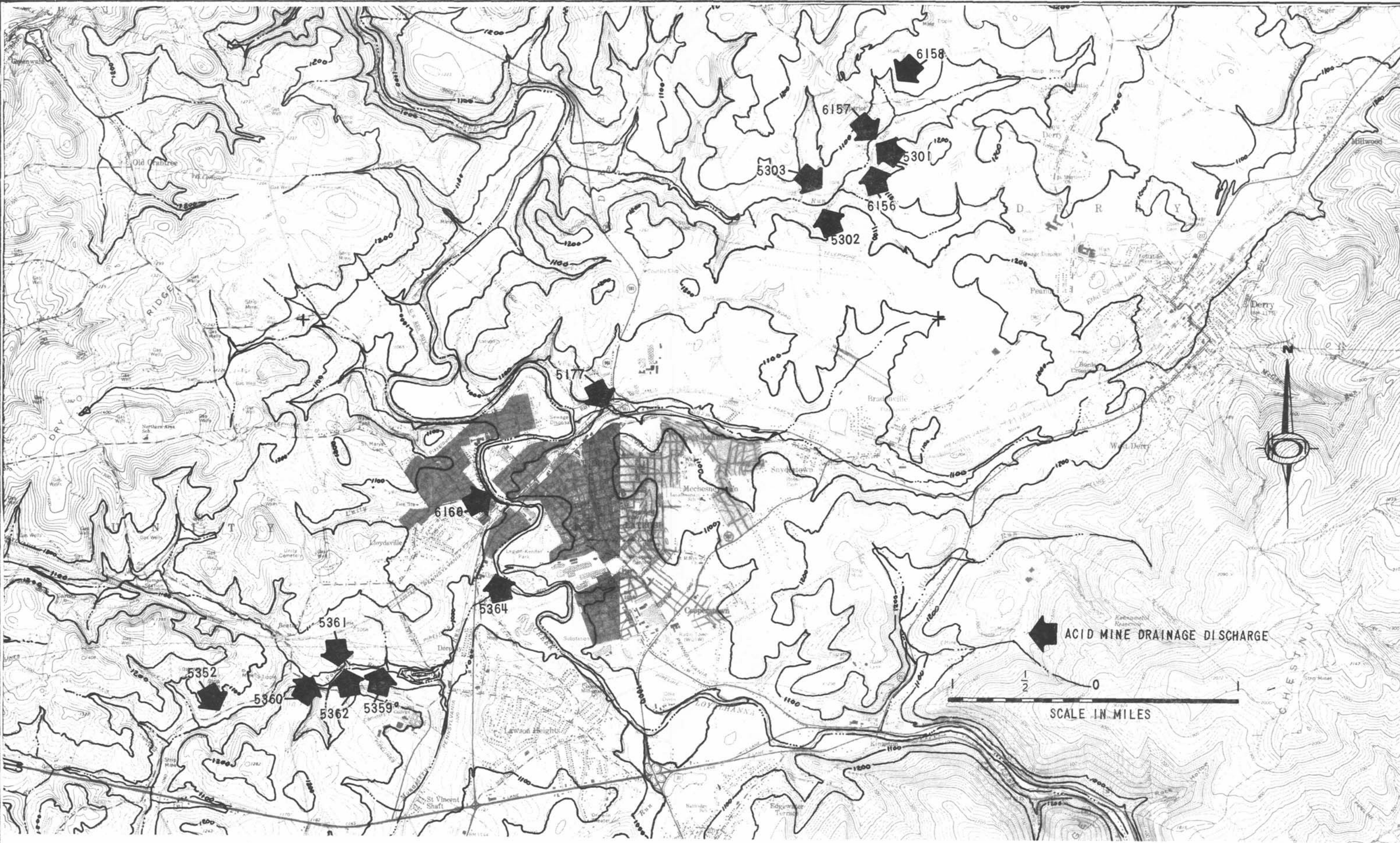
TABLE VI-1

SUBSURFACE ACID MINE DRAINAGE SOURCES OF THE LOYALHANNA WATERSHED
 (All Interconnected Sources Grouped and Listed in Order of Decreasing Acid Loads)

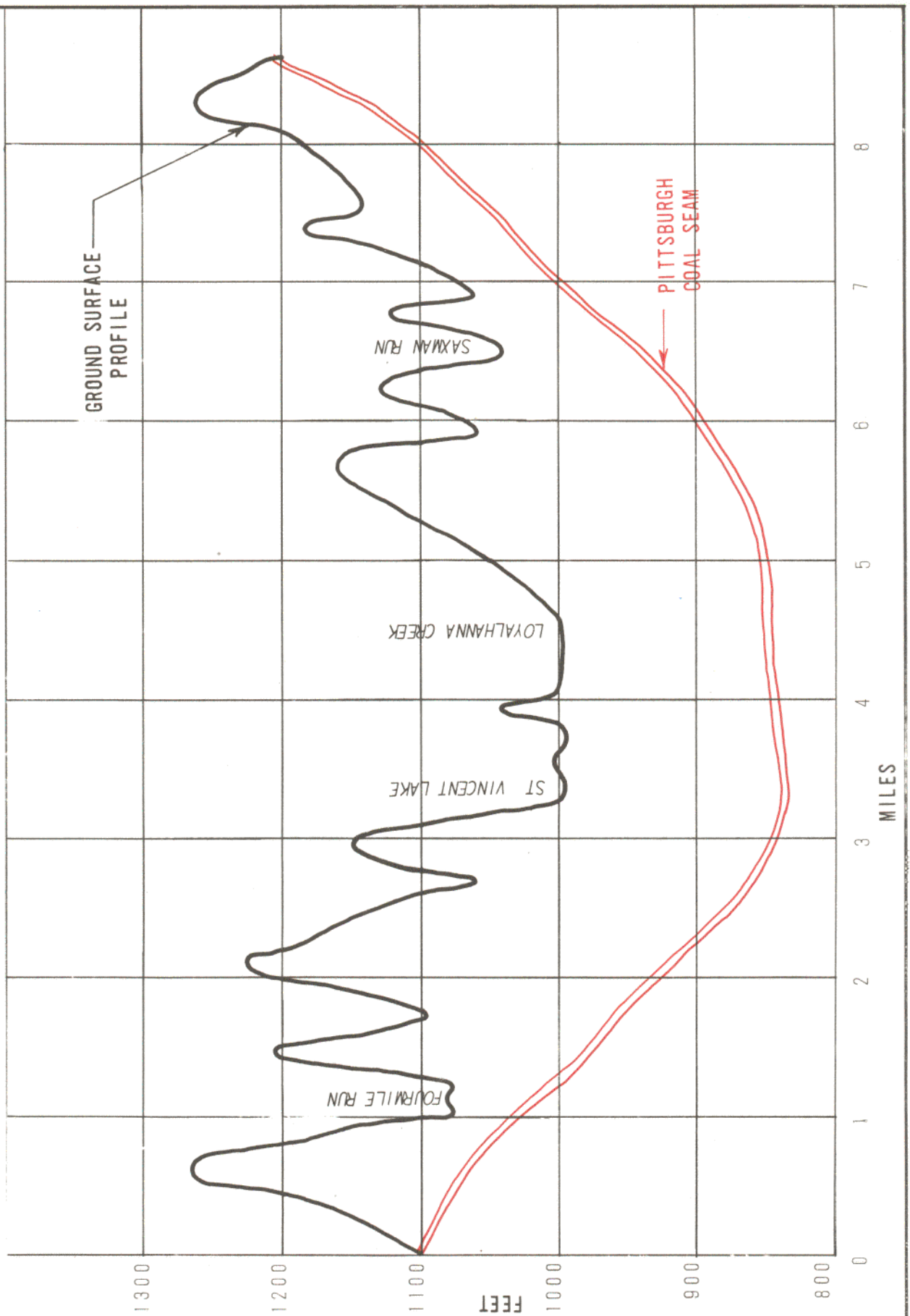
<u>Area</u>	<u>Discharge Number</u>	<u>Flow (GPM)</u>	<u>Acidity (Mg/l)</u>	<u>Acid Load (lbs/day)</u>	<u>Source Type</u>	<u>Discharge Elevation</u>
<u>Latrobe North</u>						
Main Seam	5177	2269	518	14050	Shaft	990
	5302	17	600	123	Drift	1030
	5301	11	720	95	Seep	1050
	6157	3	1088	40	Seep	1050
	6158	2	152	4	Drift	1120
	6156	Dry	---	--	Drift	---
		Total Flow = 2,302 gpm		Total Acid Load = 14,312 lbs/day		
Adjacent Outcrop	5303	3	410	15	Drift	1045
		Total Seam Flow = 2,305 gpm		Total Seam Acid Load = 14,327 lbs/day		



PITTSBURGH COAL SEAM
AND ASSOCIATED DISCHARGES
LATROBE SYNCLINE



SURFACE MAP
LATROBE SYNCLINE

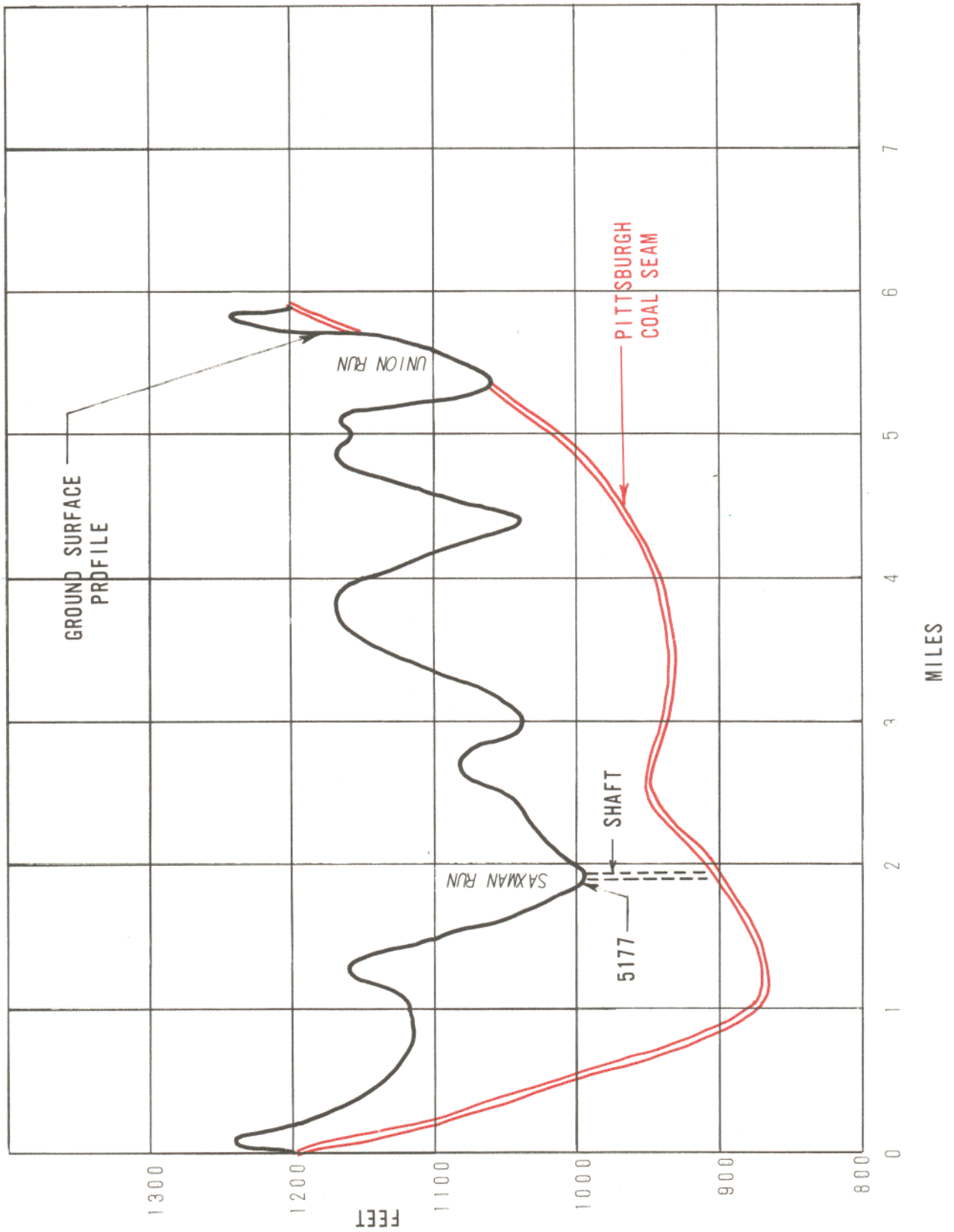


SECTION A A - LATROBE SYNCLINE

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MINE DRAINAGE POLLUTION
ABATEMENT MEASURES FOR THE
LOYALHANNA WATERSHED

PLATE
VI-4



SECTION C C - LATROBE SYNCLINE
DISCHARGE 5177

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MINE DRAINAGE POLLUTION
ABATEMENT MEASURES FOR THE
LOYALHANNA WATERSHED

PLATE
VI-5

Other minor discharges from this coal field are discharges #5301, #5302, #5303, #6157 and #6158 where acid flows of 3 to 17 gallons per minute are released into the headwaters of Union Run at elevations of 1040 to 1050. These discharges are all located in the same general area near the town of Superior. In this area the headwaters of Union Run have eroded through the upper limb of the coal seam creating outcrops on both sides of the stream valley.

At site #5301, Union Run had been channeled towards an abandoned drift opening into which it drained. However, during the course of this study, the drainage has been redirected away from the mine opening but the opening itself is still submerged.

The pH of Union Run varies seasonally from 3.0 to 7.5. Lowest pH occurs in late winter and spring coincident with high ground water levels. The late summer and fall pH was higher and measured acidity lower. This variation in pH and acidity associated with discharges located above a major discharge suggest that they function as seasonal overflows for discharge #5177. This relationship can be seen in Plate VI-3.

Saxman Run instream pH at Latrobe varied from 3.1 to 7.2 with the lower pH predominating, relieved only during periods of high run-off. This suggests that Saxman Run acidity is a function of the ratio of acid discharge from discharge #5177 to non acid upstream runoff.

The area underlain by the Latrobe North coal field is equal to 11 square miles. Discharge from source #5177 is equal to 0.467 cfs per square mile of interconnected mine roof area or 6.25 inches per year. Long term average rainfall in southwestern Pennsylvania is equal to about 41 inches per year. Long term average Loyalhanna basin watershed drainage is equal to 22 inches/year. Discharge #5177 is equivalent in flow to 15% of the average precipitation over the roof area of the mines it drains.

Latrobe Syncline South

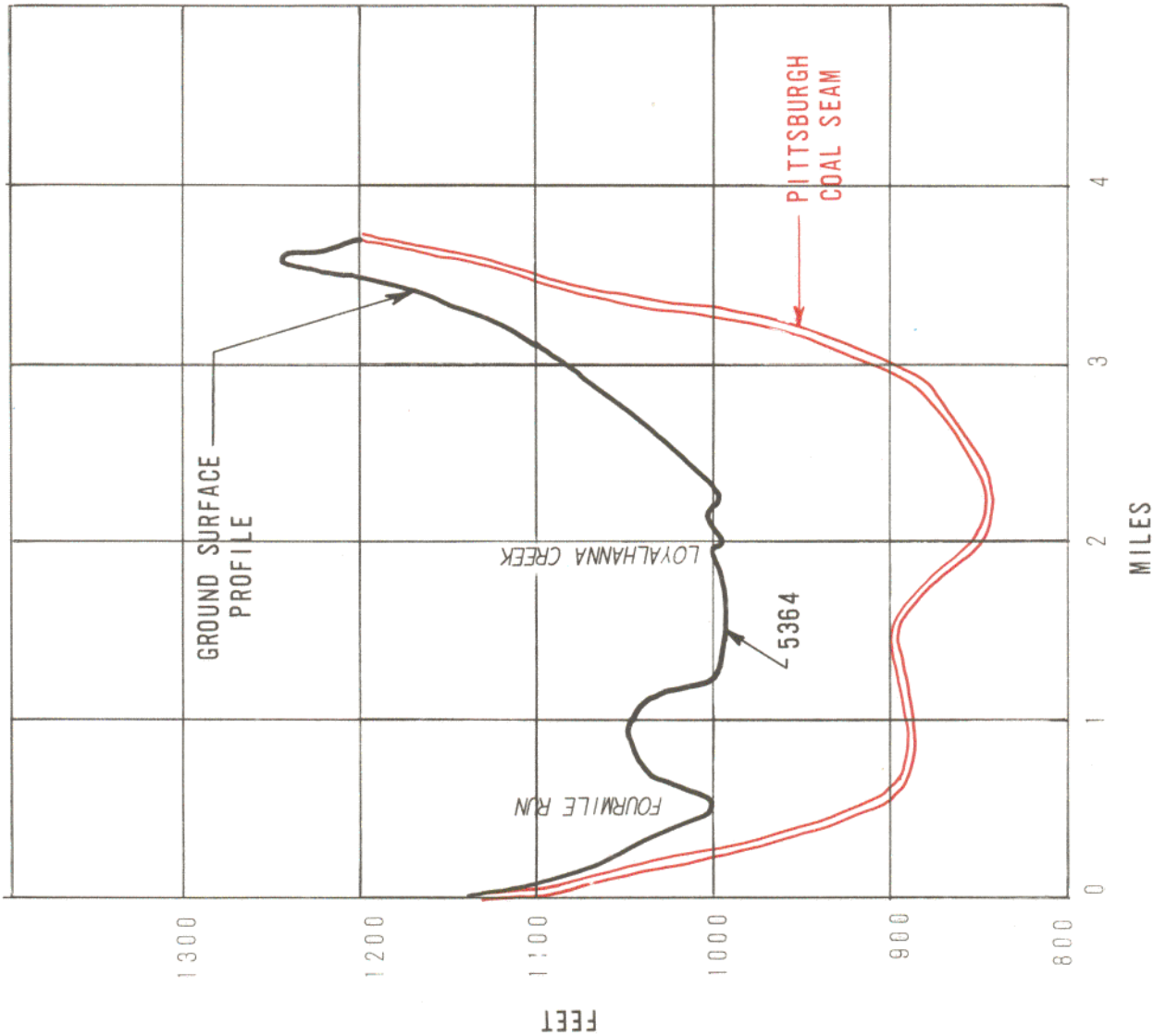
This field contains six subsurface discharges, the largest being discharge #5364, flowing at 2000 gpm and discharging 14,300 lbs. of acid per day into Loyalhanna Creek at Latrobe. This mine discharge is through a horizontal pipe emerging from the south bank of Loyalhanna Creek 500 feet downstream of Monastery Run. This discharge is situated at elevation 975. There are also several other smaller but significant discharges occurring along Four Mile Run, west of Saint Vincent Lake. These discharges are situated at elevation 995 and are about 7,000 feet southwest of discharge #5364. These discharges are located in a swampy area fed by springs or boreholes, and are indicated as discharges #5360, #5361 and #5362. They contribute about 150 gpm flow and 1500 lbs. of acidity per day. The remaining sources are #5352 and #5359 which are minor (1 and 22 gpm) and contribute only 300 lbs. per day.

The mines of the Latrobe South coal field are known to be flooded and the

TABLE VI-2

SUBSURFACE ACID MINE DRAINAGE SOURCES OF THE LOYALHANNA WATERSHED
 (All Interconnected Sources Grouped and Listed in Order of Decreasing Acid Loads)

<u>Area</u>	<u>Discharge Number</u>	<u>Flow (GPM)</u>	<u>Acidity (Mg/l)</u>	<u>Acid Load (lbs/day)</u>	<u>Source Type</u>	<u>Discharge Elevation</u>
<u>Latrobe South</u> Main Seam	5364	1990	600	14300	Drain Pipe	975
	5361	70	1080	909	Shaft	1005
	5362	65	1070	834	Seep	997
	5359	22	935	250	Seep	997
	6160	30	125	127	Seep	1000
	5360	10	895	108	Bore Hole	1000
	5363	Removed			Drain Pipe	1030
Total Flow = 2,157 gpm				Total Acid Load = 16,528 lbs/day		
Adjacent Outcrop	5352	1	1401	17	Drain Pipe	1060
Total Seam Flow = 2,158 gpm				Total Acid Load = 16,545 lbs/day		



SECTION B B - LATROBE SYNCLINE
DISCHARGE 5364

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MINE DRAINAGE POLLUTION
ABATEMENT MEASURES FOR THE
LOYALHANNA WATERSHED

PLATE
VI-6

discharge pipe (#5364) was placed in the ground to relieve the subsurface condition which was causing uncontrolled local seepage. Discharges #5364, #5360, #5361 and #5362 are all artesian in nature, occurring well above the elevation of the flooded coal seam. The combined flow from these discharges is 2200 gallons per minute. The seam underlies an area of 14.0 square miles within the Loyalhanna basin portion of the Latrobe syncline. The discharges from all sources are equal to 4.8 inches of flow per year or 12% of the total precipitation over the roof area of the drained mines.

The waterways affected are Four Mile Creek, Monastery Run and Loyalhanna Creek. Four Mile Run exhibited a seasonal change of pH from 3.2 in late spring to 8.0 in late summer. Four Mile Run is fed by the discharges at a higher elevation than #5364 and the seasonal variation in flow and acidity are believed to reflect the variations in the level of the ground water table occurring between spring and late summer. The relationship of the discharges may be seen in Plate VI-2. Monastery Run contains no direct discharges but, receives the flows of Four Mile Run and exhibits similar seasonal variations. Discharge #5364 constitutes the first major pollution source into the mainstream of Loyalhanna Creek.

Greensburg Syncline

This field contains four subsurface discharges, the major discharge being #5356 which flows at the rate of 5100 gpm and discharges 19,500 lbs. of

acid per day to the Crabtree Creek. This is the only major subsurface discharge point in the coal field. All other subsurface discharges are flowing at less than 30 gpm and discharging 100 lbs. of acidity or less.

Discharge #5354 is one other possible source of sub-surface discharge interconnected with discharge #5356. However it could not be determined if discharge #5354 originates in refuse piles or is subsurface in origin.

A second area of possible subsurface discharge is located adjacent to Finney Run near Shieldsburg. Discharges #5165, #5166, #6151 and #6152 occur in conjunction with refuse piles but conditions favoring artesian discharges do exist. The total dry weather acid drainage of all 4 discharges is less than 200 lbs. per day. The major source of acid discharge in this area is the surface generated acidity associated with refuse piles. All discharges are into Finney Run.

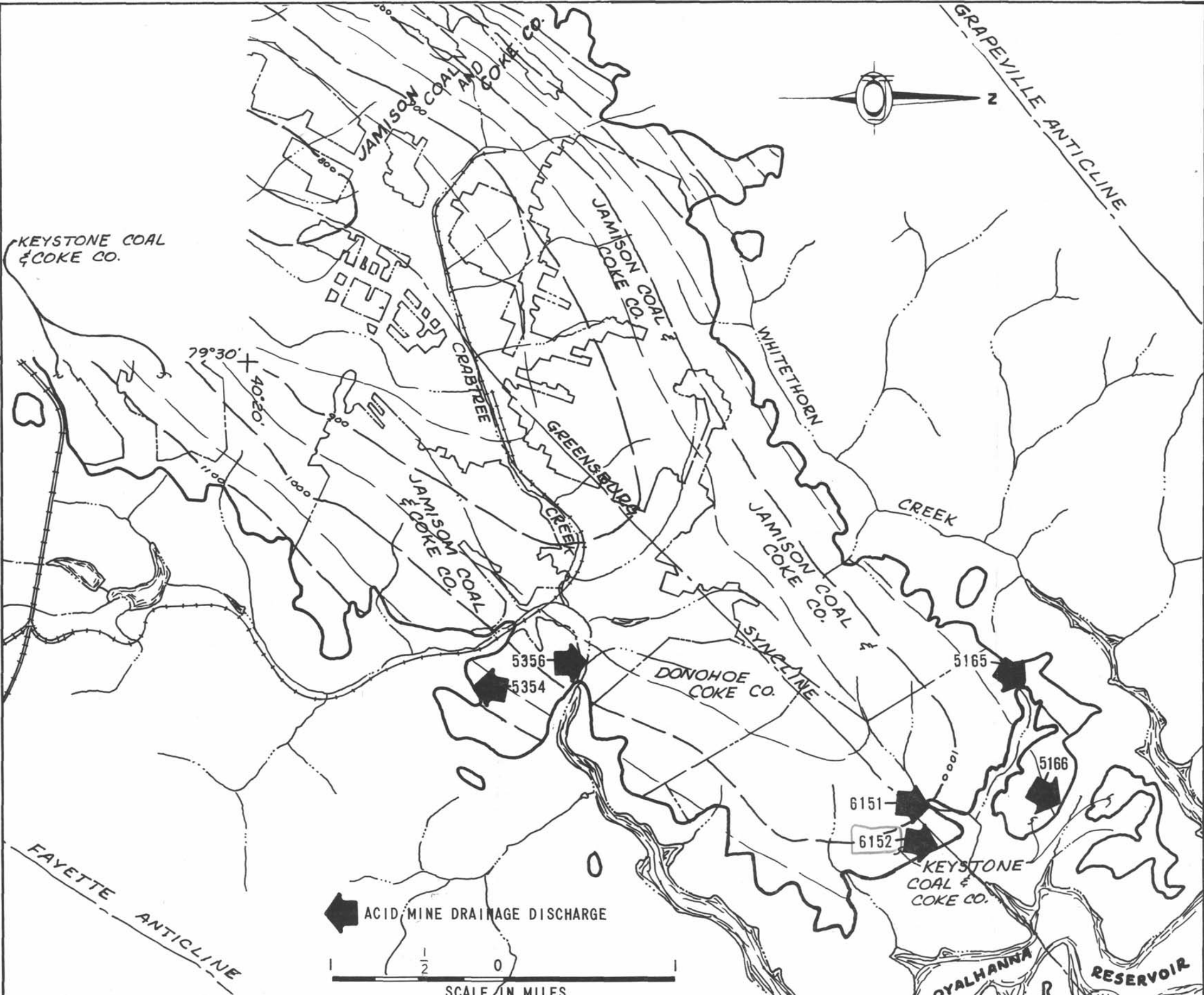
Crabtree Creek has been grossly affected by both the direct discharge at #5356 which during periods of low flow accounts for a large portion of the, stream flow and by run-off from several gob piles located in the watershed. Crabtree Creek is subject to slug loads of acid drainage during initial periods of heavy runoff.

The Greensburg coal field within the Loyalhanna Creek watershed has an area of 15 square miles. Discharge from #5356 is equal to an equivalent flow of 10.7 inches per year over the mine roof area or 26% of the pre-

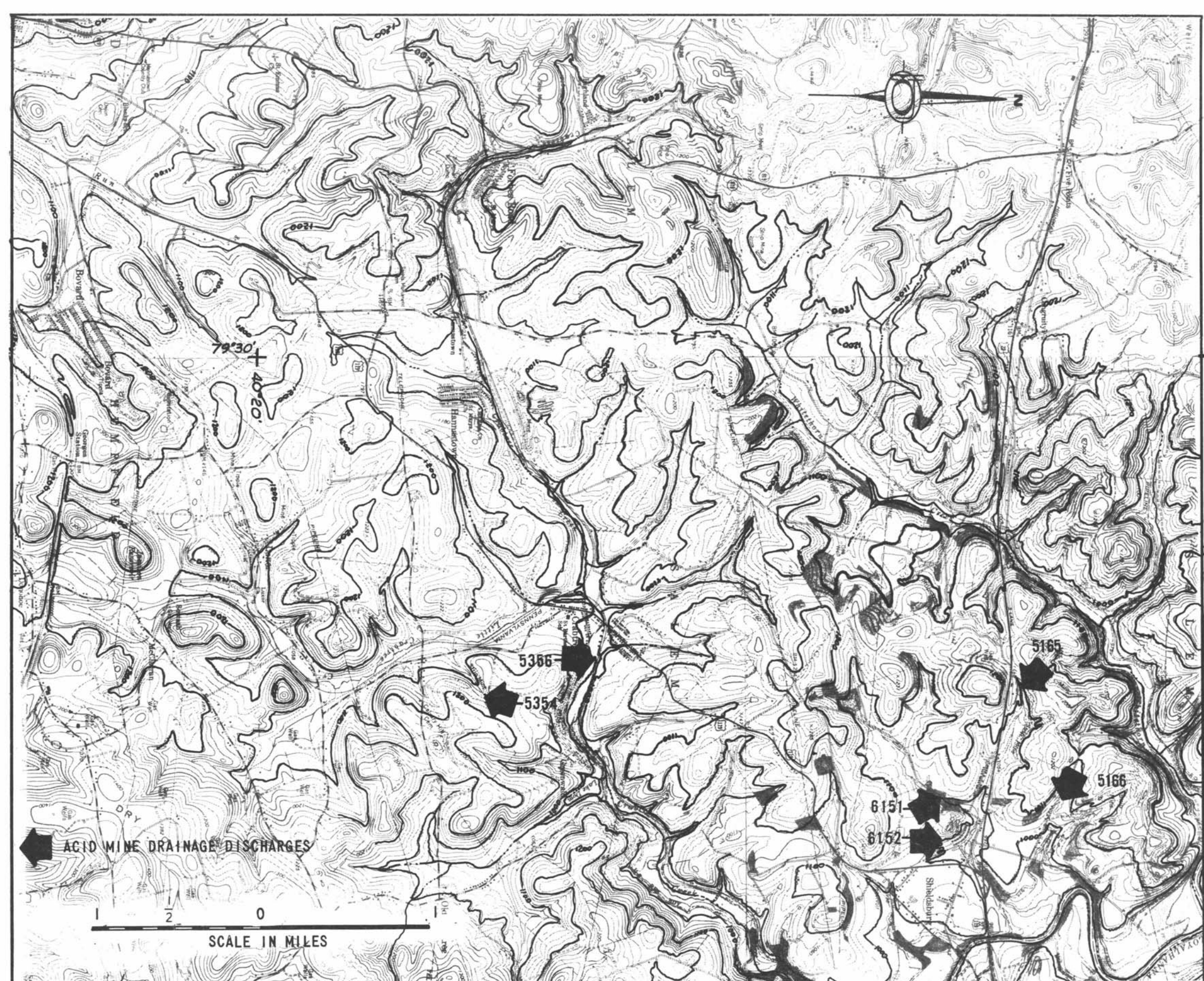
TABLE VI-3

SUBSURFACE ACID MINE DRAINAGE SOURCES OF THE LOYALHANNA WATERSHED
 (All Interconnected Sources Grouped and Listed in Order of Decreasing Acid Loads)

<u>Area</u>	<u>Discharge Number</u>	<u>Flow (GPM)</u>	<u>Acidity (Mg/l)</u>	<u>Acid Loads (lbs/day)</u>	<u>Source Type</u>	<u>Discharge Elevation</u>
<u>Greensburg</u>						
Main Seam						
Crabtree	5356	5097	258	19605	Slope Mine	1080
	5354	10	830	100	Seep/Strip	1100
		Total Flow = 1,107 gpm		Total Acid Load = 19,705 lbs/day		
Shieldsburg	5166	24	305	88	Drift/Strip	1100
	6151	3	760	27	Drift	1010
	5165	3	655	24	Seep/Refuse Pile	1050
	6152	10	100	12	Seep/Refuse Pile	990
		Total Flow =	40 gpm	Total Acid Load = 151 lbs/day		
Adjacent Outcrop	6161	2	65	2	Strip/Seep	1090
		Total Seam Flow = 1,149 gpm		Total Seam Acid Load = 19,858 lbs/day		



PITTSBURGH COAL SEAM
AND ASSOCIATED DISCHARGES
GREENSBURG SYNCLINE



**SURFACE MAP
GREENSBURG SYNCLINE**

precipitation occurring. However, interbasin flows are suspected. The lack of any major discharge over 900 gpm in the interconnected portion of the seam in the adjacent watershed may account for this high flow.

Elders Ridge Syncline

Elders Ridge, unlike the three previously described coal fields does not contain one dominant AMD discharge source. The largest discharge flows at 240 gpm carrying an acid loading of 4076 lbs/day. The five next largest discharges contribute a total of 4050 additional lbs. of acidity per day with a combined flow of 244 gpm. The field contains 12 known discharge locations.

An examination of the Elders Ridge portion of the Pittsburgh Coal Seam indicates that the low center portion of the seam at the synclinal axis has been removed by the downward cutting of Getty Run. In previously discussed synclinal structures it was the lower portion of the seam near the axis which drained both limbs of the syncline from the outcrops and contained the major discharge source of the structure. The Elders Ridge coal field with the lowest portion of the seam missing, lacks a single major discharge source, draining the total structure. Instead because, of this lack of subsurface interconnectivity there is one large discharge but this discharge (#5170) accounts for only 50% of the total acid flow.

The strength of the Elders Ridge discharges is significantly higher than the major discharges of the other coal seams but the total flow (3.92" per year)

is lower, amounting to less than 10% of the annual precipitation fall over the mine roof area.

The only stream affected by these discharges is Getty Run the pH of which varied from 2.5 and 4.2 during the study period. There does not appear to be any strong seasonal pattern in stream acidity. The confluence of Getty Run with Loyalhanna Creek is located below Loyalhanna Dam and only one mile from the confluence of the Loyalhanna Creek with the Kiskiminetas River. The effects of the Elders Ridge coal seam are locally severe but of little consequence to the watershed as a whole.

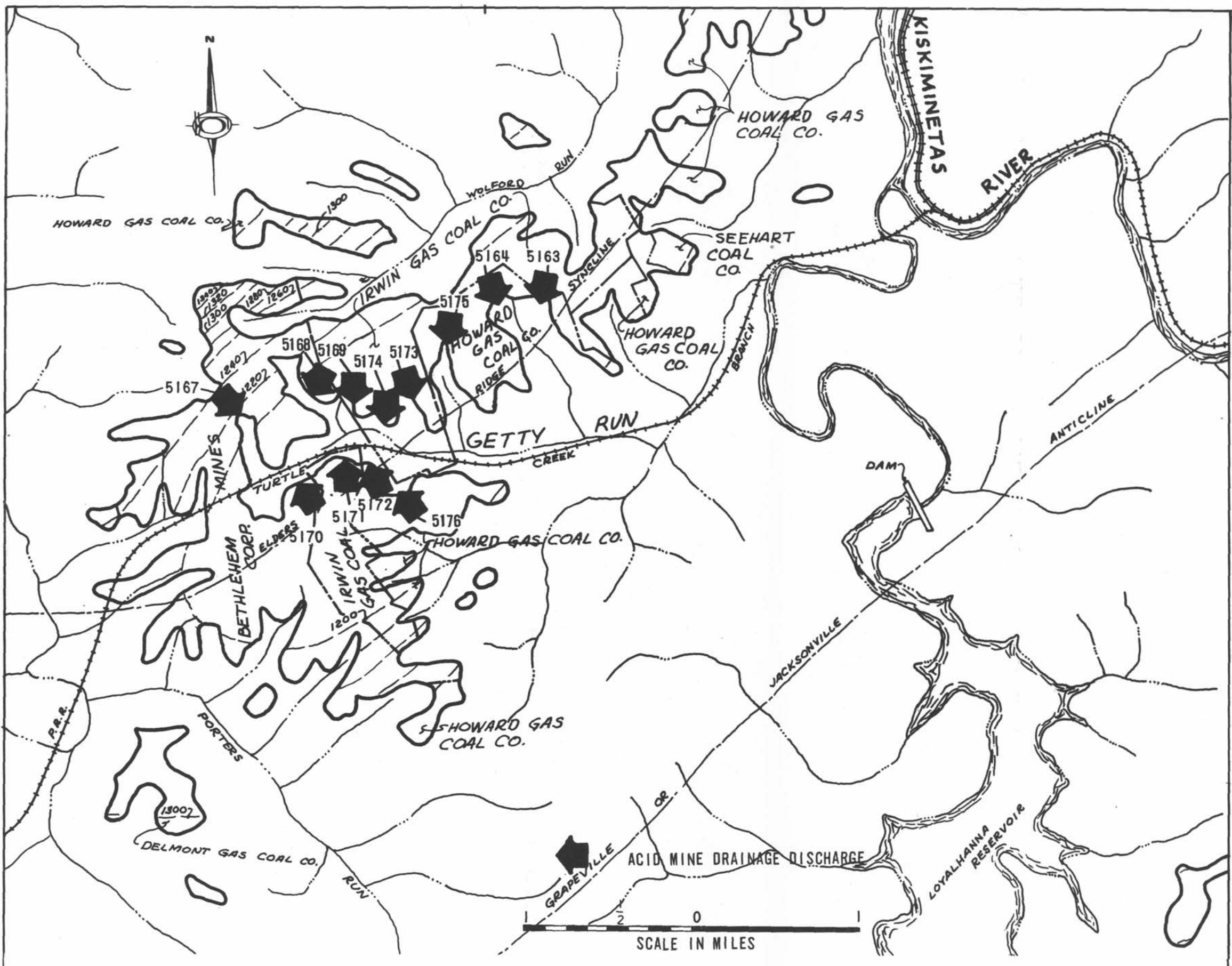
Ligonier Syncline

The Ligonier coal fields consist of two non-connected hill top outcrop areas. The total coal field consists of 4.4 square miles of hill tops underlain by the Pittsburgh seam. There is no dominant discharge; the largest volume of flow issues from discharge #5265 but contains a low concentration of acidity (34 mg/L). The greatest acidity contribution is from discharge #5264 which amounts to 260 lbs/day. The total discharge for the two fields is 1200 lbs.per day which is equal to less than 20% of the discharge from any other field. The slight localized effect is felt only on Hannas Run in the immediate vicinity of the discharges. Mill Creek, the major stream draining the watershed is highly alkaline at its headwater in the Laurel Hill anticline. The major cause of stream acidity is the effects of surface runoff which passes through surface coal dump piles

TABLE VI-4

SUBSURFACE ACID MINE DRAINAGE SOURCES OF THE LOYALHANNA WATERSHED
 (All Interconnected Sources Grouped and Listed in Order of Decreasing Acid Loads)

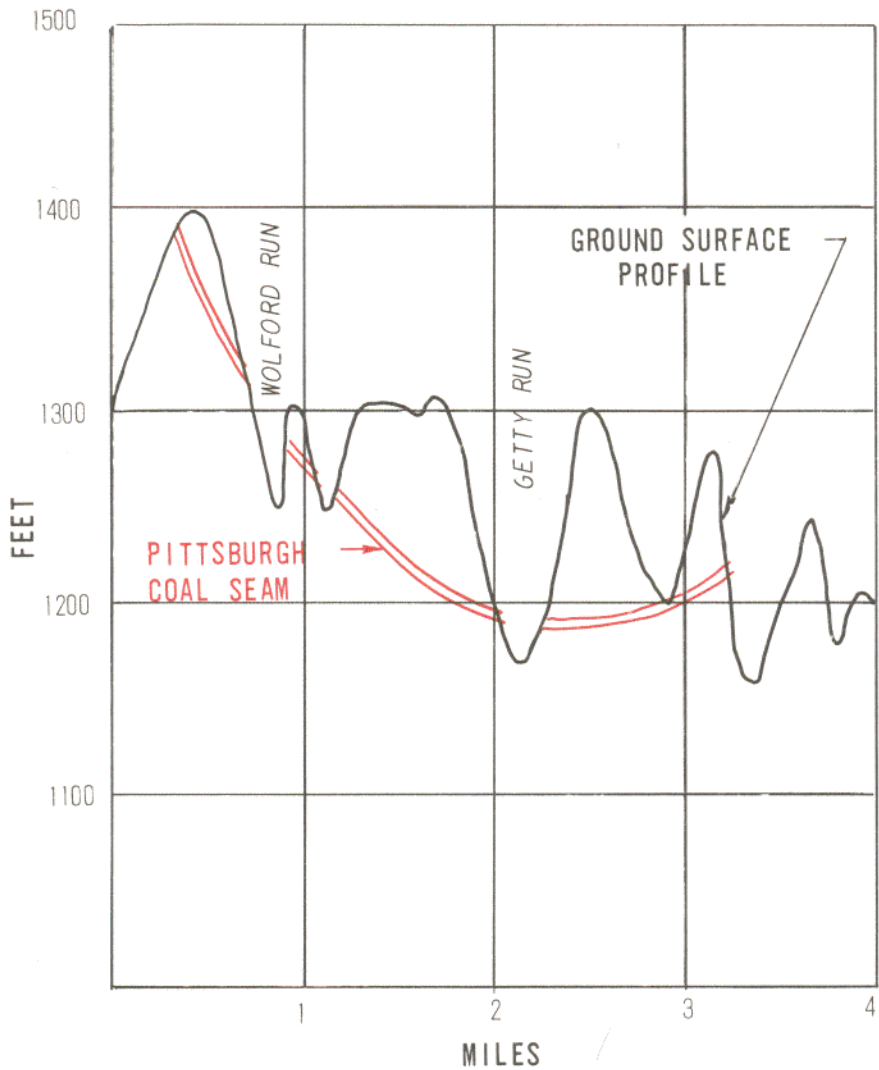
<u>Area</u>	<u>Discharge Number</u>	<u>Flow (GPM)</u>	<u>Acidity (Mg/l)</u>	<u>Acid Loads (lbs/day)</u>	<u>Source Type</u>	<u>Discharge Elevation</u>
<u>Elders Ridge</u>						
North of Getty Run	5173	50	1560	940	Shaft/Seep	1205
	5163	60	955	689	Drift	1130
	5164	45	1086	587	Drift	1130
	5167	8	1405	135	Drift	1250
	5175	10	1025	123	Seep	1150
	5168	3	2395	86	Drift/Strip	1170
	5169	3	1840	66	Drift	1180
5174	2	1470	35	Strip/Drift	1160	
Total Flow = 181 gpm			Total Acid Load = 2,661 lbs/day			
South of Getty Run	5170	240	1413	4076	Drift	1170
	5171	45	1740	941	Seepage	1160
	5176	25	1025	418	Drift	1170
	5172	3	1025	40	Seepage	1200
Total Flow = 313 gpm			Total Acid Load = 5,475 lbs/day			
Total Seam Flow = 494 gpm			Total Seam Acid Load = 8,136 lbs/day			



PITTSBURGH COAL SEAM
AND ASSOCIATED DISCHARGES
ELDERS RIDGE SYNCLINE



SURFACE MAP
ELDERS RIDGE SYNCLINE



SECTION THRU ELDERS RIDGE SYNCLINE

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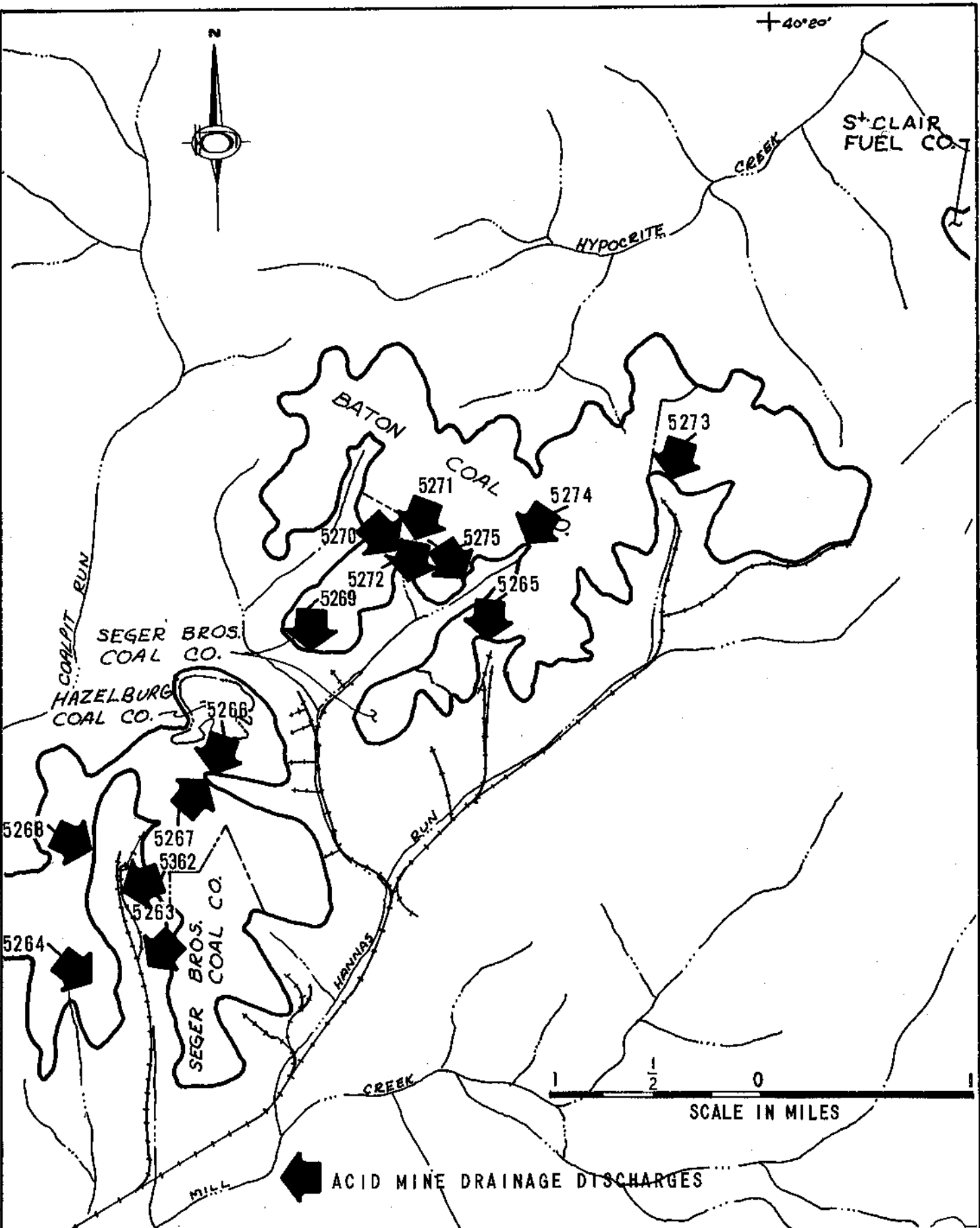
MINE DRAINAGE POLLUTION
ABATEMENT MEASURES FOR THE
LOYALHANNA WATERSHED

PLATE
VI-11

TABLE VI-5

SUBSURFACE ACID MINE DRAINAGE SOURCES OF THE LOYALHANNA WATERSHED
 (All Interconnected Sources Grouped and Listed in Order of Decreasing Acid Loads)

<u>Area</u>	<u>Discharge Number</u>	<u>Flow (GPM)</u>	<u>Acidity (Mg/l)</u>	<u>Acid Loads (lbs/day)</u>	<u>Source Type</u>	<u>Discharge Elevation</u>
<u>Ligonier</u>						
West Outcrop	5263	105	360	454	Strip/Seep	1230
	5264	40	540	260	Drift	1360
	5266	30	185	67	Drift	1360
	5267	7	625	53	Drift/Seep	1360
	5268	3	540	19	Seep	1450
	5262	No Flow			Seep	1450
	Total Flow = 185 gpm		Total Acid Load = 853 lbs/day			
East Outcrop	5270	30	420	152	Drift	1400
	5275	45	205	111	Drift	1400
	5271	30	300	108	Strip/Drift	1360
	5265	180	34	74	Drift	1350
	5269	13	430	67	Drift	1400
	5272	60	50	36	Drift	1420
	5274	60	5	3	Drift/Strip	1430
	5273	12	12	2	Drift	1500
	Total Flow = 430 gpm		Total Acid Load = 553 lbs/day			
	Total Seam Flow = 615 gpm		Total Seam Acid Load = 1,406 lbs/day			

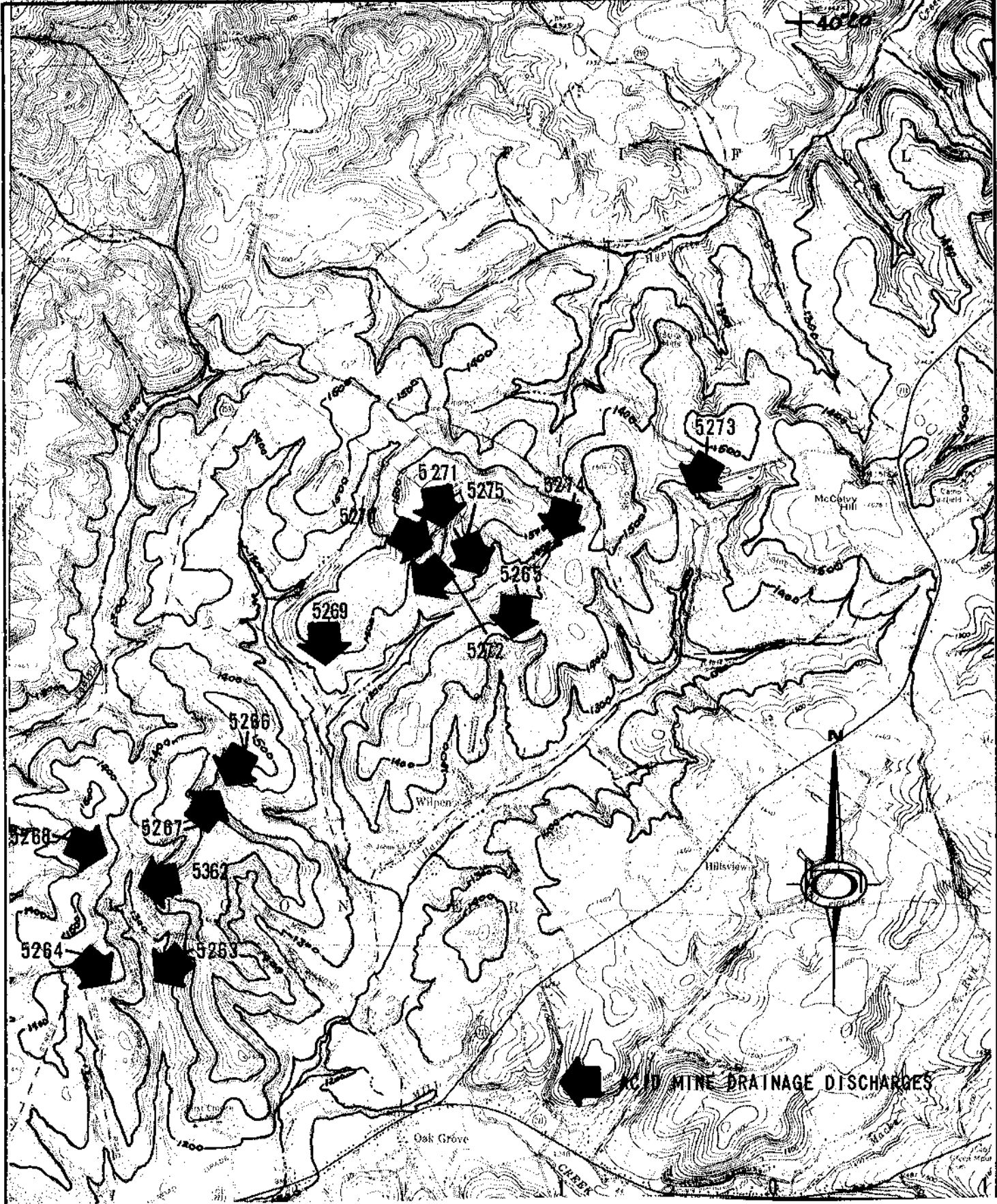


PITTSBURGH COAL SEAM AND ASSOCIATED DISCHARGES LIGONIER SYNCLINE

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**MINE DRAINAGE POLLUTION
ABATEMENT MEASURES FOR THE
LOYALHANNA WATERSHED**

**PLATE
VI-12**



**SURFACE MAP
LIGONIER SYNCLINE**

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**MINE DRAINAGE POLLUTION
ABATEMENT MEASURES FOR THE
LOYALHANNA WATERSHED**

PLATE

VI-13

before draining into the streams of the area.

Upper Freeport Formation

The Upper Freeport coal seam in the Loyalhanna Watershed underlies the Pittsburgh coal seam by some 750 feet and outcrops only in anticlinal structures.

The major outcrops occur on the east and west flanks of Chestnut Ridge. The Upper Freeport seam outcrops as the structural rise of the anticline exceeds the slope of surface topography. The major mining of the seam occurred along the Miller Run and upper Saxman Run. The seam also outcrops further up Chestnut Ridge but the area was never fully exploited, probably because of its relative inaccessibility.

Discharges similar to those of the Pittsburgh seam do not exist because the extent of mining has been limited and interconnections and voids between the higher mine openings which occur along the hillsides and potential artesian discharge locations do not exist. Discharges are limited to localized flows such as #5074 which contribute 183 lbs. of acid per day with a flow of 70 gallons per minute.

The pH of Miller Run varied from 5.85 to 6.75, the lower pH corresponding to the high ground water table existing in the spring.

In the Loyalhanna watershed the mines of the Upper Freeport seam do not present the same problems as those of the Pittsburgh seam. This is be-

cause the Freeport seam has not been worked as extensively. The Freeport outcrops occur at much higher elevations and in rougher topography than Pittsburgh seam outcrops. The presence of the more accessible Pittsburgh Coal discouraged the intensive early mining of the Freeport seam which would have resulted in the creation of acid mine pools. If future exploitation of the underlying Freeport seam does take place, it should be noted that this seam also contains the prerequisites for future artesian acid discharges particularly in the Latrobe syncline. If haphazard mining methods are used for future extensive removals of Freeport coal, a series of similar discharges to those of the Pittsburgh seam could occur.

SIMILARITIES OF GEOLOGIC STRUCTURE ASSOCIATED WITH MAJOR DISCHARGES

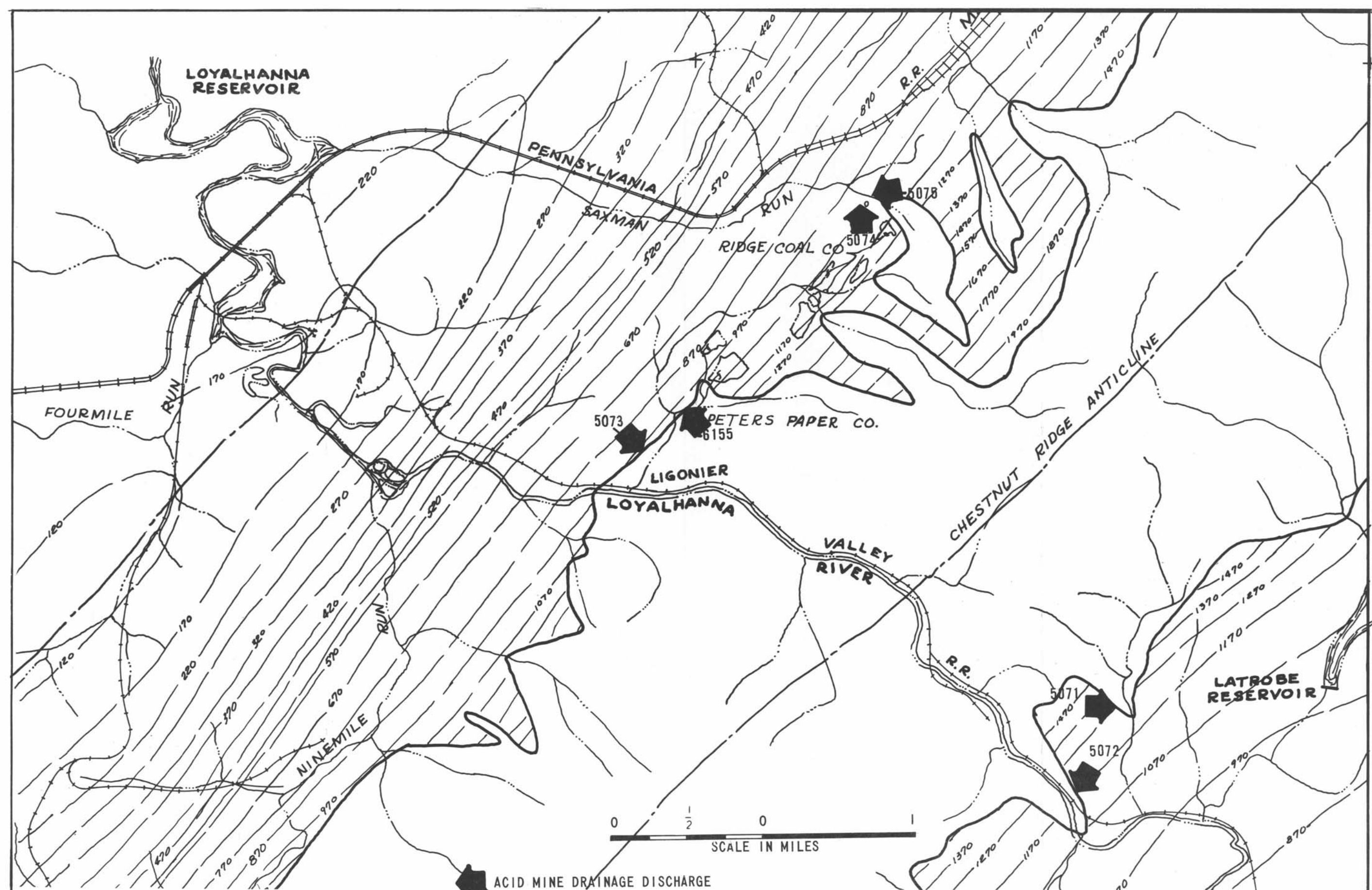
A review of the geologic and topographic conditions under which the three major discharges #5177, #5356 and #5364 occur, and the lack of other discharges of similar type or magnitude in other formations in the watershed suggest the existence of certain common geologic characteristics.

As observed in the geologic history of the Loyalhanna watershed, the major drainage system was established while the surface topography of the watershed was a level mature peneplain. The ground surface having been eroded to a peneplain, all differences in elevation due to variations in rock resistance to erosion had been overcome by this time. In this mature condition,

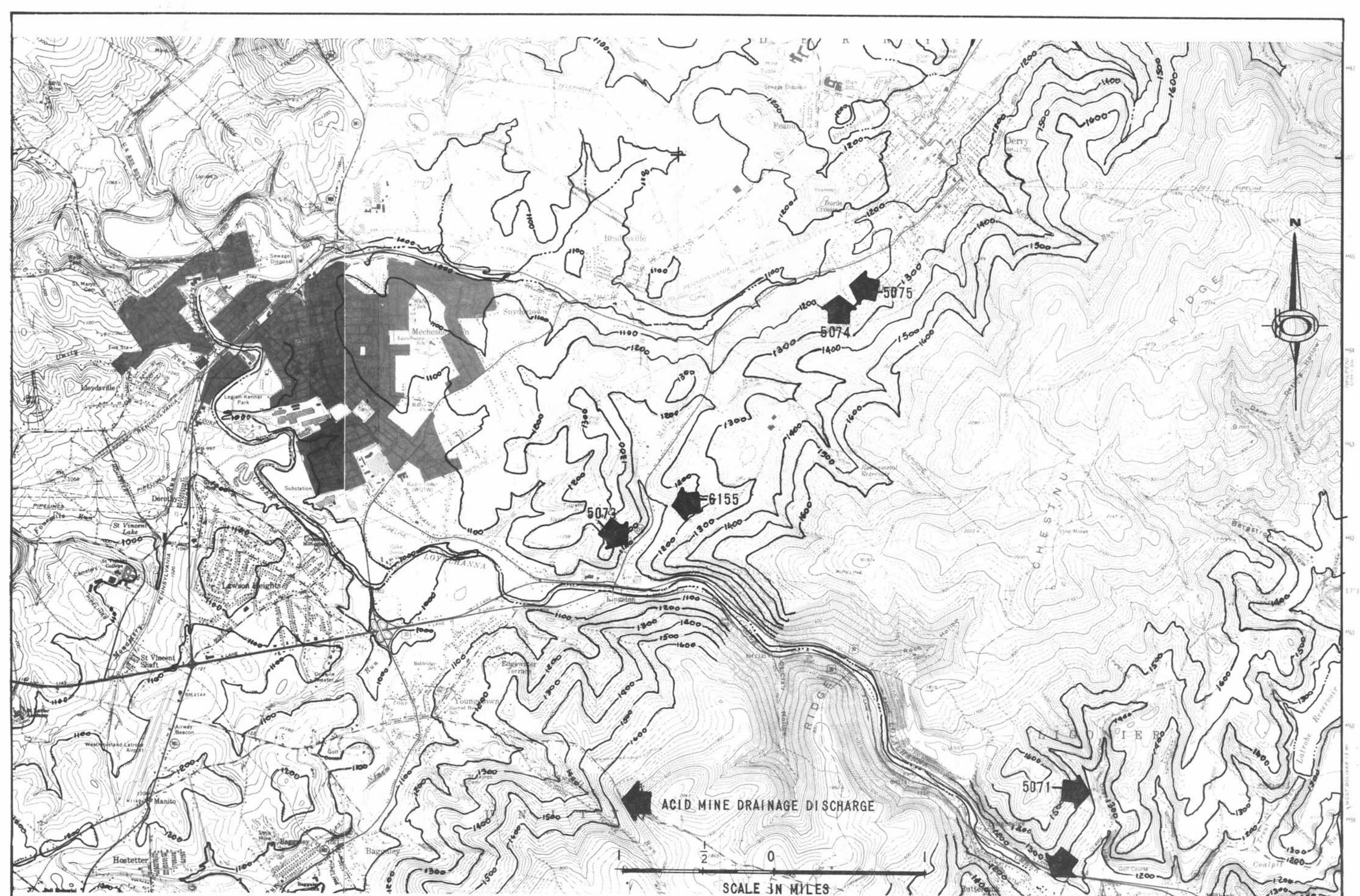
TABLE VI-6

SUBSURFACE ACID MINE DRAINAGE SOURCES OF THE LOYALHANNA WATERSHED
 (All Interconnected Sources Grouped and Listed in Order of Decreasing Acid Loads)

<u>Area</u>	<u>Discharge Number</u>	<u>Flow (GPM)</u>	<u>Acidity (Mg/l)</u>	<u>Acid Loads (lbs/day)</u>	<u>Source Type</u>	<u>Discharge Elevation</u>
<u>Chestnut Ridge</u>						
West Outcrop	5074	70	218	183	Shaft	1140
	5075	15	195	35	Shaft	1140
	5073	37	60	28	Drift	1080
	6155	2	75	2	Seep	1120
		Total Flow = 124 gpm		Total Acid Load = 248 lbs/day		
East Outcrop	5072	12	295	43	Drift	1130
	5071	2	430	10	Drift	1300
		Total Flow = 14 gpm		Total Acid Load = 53 lbs/day		



**FREEPORT COAL SEAM
AND ASSOCIATED DISCHARGES
CHESTNUT RIDGE ANTICLINE**



SURFACE MAP
CHESTNUT RIDGE ANTICLINE

TABLE VI-7

SUBSURFACE ACID MINE DRAINAGE SOURCES OF THE LOYALHANNA WATERSHED
(All Interconnected Sources Grouped and Listed in Order of Decreasing Acid Loads)

<u>Area</u>	<u>Discharge Number</u>	<u>Flow (GPM)</u>	<u>Acidity (Mg/l)</u>	<u>Acid Loads (lbs/day)</u>	<u>Source Type</u>	<u>Discharge Elevation</u>
<u>Fayette Anticline</u>						
<u>(Dry Ridge)</u>						
	5357	5	2015	121	Drift	1150
	6154	30	174	63	Strip/Seep	1160
	6153	5	490	30	Drift	1000
	5358	2	110	3	Drift/Strip	1180
		Total Flow = 42 gpm		Total Acid Load = 217 lbs/day		
	5353	45	-10 (alkaline)	-54	Strip/Drift	1180
	6159	60	170	125	Drift	1030
		Total Seam Flow = 263 gpm		Total Seam Acid Load = 589 lbs/day		
<u>Loyalhanna Watershed Summary</u>						
Total Subsurface Acid Load = 60,681 lbs/day						
Inventoried Surface				#5351	1,931 lbs/day	
Discharges unrelated to Subsurface Flows				#5355	899 lbs/day	
				Total Acid Load = 63,511 lbs/day		

TABLE VI-8

NUMERICAL LIST OF INVENTORIED
ACID MINE DRAINAGE (AMD) SOURCES

DISCHARGE NUMBER	RANK	AREA	COAL SEAM
5071	55	Chestnut Ridge	Freeport
5072	28	Chestnut Ridge	Freeport
5073	33	Chestnut Ridge	Freeport
5074	12	Chestnut Ridge	Freeport
5075	29	Chestnut Ridge	Freeport
5163	9	Elders Ridge	Pittsburgh
5164	13	Elders Ridge	Pittsburgh
5165	32	Greensburg	Pittsburgh
5166	38	Greensburg	Pittsburgh
5167	18	Elders Ridge	Pittsburgh
5168	45	Elders Ridge	Pittsburgh
5169	44	Elders Ridge	Pittsburgh
5170	4	Elders Ridge	Pittsburgh
5171	7	Elders Ridge	Pittsburgh
5172	48	Elders Ridge	Pittsburgh
5173	10	Elders Ridge	Pittsburgh
5174	47	Elders Ridge	Pittsburgh
5175	21	Elders Ridge	Pittsburgh
5176	14	Elders Ridge	Pittsburgh
5177	2	Latrobe North	Pittsburgh
5262	NF*	Ligonier	Pittsburgh
5263	35	Ligonier	Pittsburgh
5264	17	Ligonier	Pittsburgh
5265	22	Ligonier	Pittsburgh
5266	25	Ligonier	Pittsburgh
5267	53	Ligonier	Pittsburgh
5268	50	Ligonier	Pittsburgh
5269	42	Ligonier	Pittsburgh
5270	39	Ligonier	Pittsburgh
5271	40	Ligonier	Pittsburgh
5272	51	Ligonier	Pittsburgh
5273	57	Ligonier	Pittsburgh
5274	56	Ligonier	Pittsburgh
5275	23	Ligonier	Pittsburgh

TABLE VI-8 (CONTINUED)

DISCHARGE NUMBER	RANK	AREA	COAL SEAM
5301	26	Latrobe North	Pittsburgh
5302	19	Latrobe North	Pittsburgh
5303	27	Latrobe North	Pittsburgh
5351	6	Latrobe South	Pittsburgh
5352	46	Latrobe South	Pittsburgh
5353	58	FayetteFreeport	
5354	41	Greensburg	Pittsburgh
5355	5	Greensburg	Pittsburgh
5356	1	Greensburg	Pittsburgh
5357	24	FayetteFreeport	
5358	54	FayetteFreeport	
5359	16	Latrobe South	Pittsburgh
5360	20	Latrobe South	Pittsburgh
5361	8	Latrobe South	Pittsburgh
5362	11	Latrobe South	Pittsburgh
5363	15	Latrobe South	Pittsburgh
5364	3	Latrobe South	Pittsburgh
6151	52	Greensburg	Pittsburgh
6152	30	Greensburg	Pittsburgh
6153	31	FayetteFreeport	
6154	43	FayetteFreeport	
6155	36	Chestnut Ridge	Freeport
6156	NF*	Latrobe North	Pittsburgh
6157	49	Latrobe North	Pittsburgh
6158	34	Latrobe North	Pittsburgh
6159	NR 4'	FayetteFreeport	
6160	NR*	LatrobePittsburgh	
6161	37	Greensburg (Adjacent Outcrop)	Pittsburgh

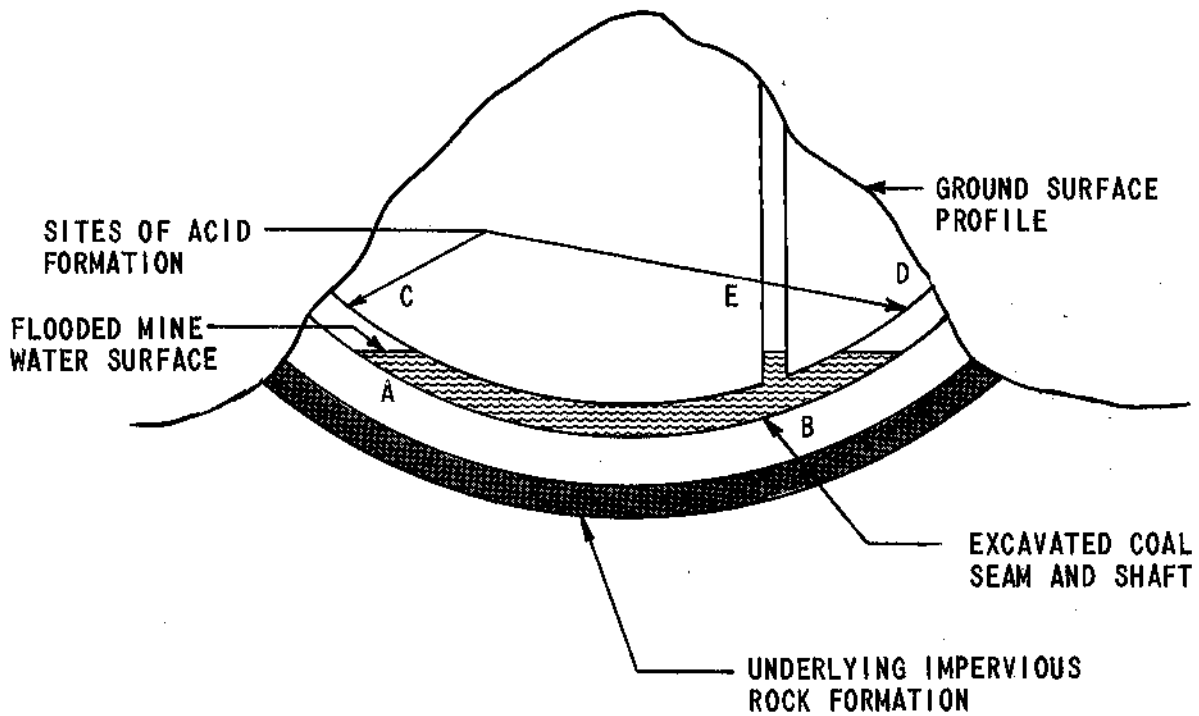
NF* - Indicates no flow at time of survey

NR* - Indicates discharge not included in initial ranking

the ancestral Loyalhanna Creek established its present meandering path. The stream gradient was slight and little further erosion occurred. However due to other geologic events the relative drainage elevation of the area was once again uplifted, thus increasing the stream gradient of the Loyalhanna. As the Loyalhanna mainstream once again continued to erode its bed downward, the stream gradient of its tributaries was similarly increased. Thus began a new cycle of surface erosion. The less resistant rocks were once again subject to the initial effects of erosion. The current topography of the watershed once again reflects the varying degrees of resistance (or lack of resistance) to erosion of the underlying rock. The current pattern of ridges and valleys corresponds to the outcrops of resistant and less resistant rock formations. The drainage pattern created by this re-erosion is described as "trellis" drainage, resembling a garden trellis with parallel branches attached to a meandering trunk. The eventual landform of the Loyalhanna watershed, if no subsequent uplift occurs, will be a re-eroded peneplain once again at sea level datum. However, this event lies far in the geologic future, and the present landform represents an unstable intermediate geologic (several million year) period. What relates the existing trellis drainage pattern with acid mine drainage are the water gaps through the ridges which overlie coal bearing synclines. The stream has not cut its way through the surrounding ridges, but rather the stream originally level with the ridge tops eroded its bed downward keeping pace with the erosion which created the valleys. The flat hilltops all at a common elevation are the remains of the original peneplain surface.

The role of the watergap in producing acid mine drainage, may be better understood by first examining the subsurface drainage pattern of a continuous synclinal ridge, uncrossed by water gaps with an extensively mined coal seam outcropping along the hillsides and dipping towards the center. Assume that the coal seam has been completely mined and now forms a continuous void. There are shafts at scattered locations on the ridge all with surface elevations higher than the outcrop line. Because all surfaces overlaying the coal seam are between the outcrops and hence uphill from them, all shafts reach the surface above the highest elevations in the coal seam. Assume also that the shale formation below the coal is undamaged and remains an aquaclude, while the roof rock above the seam has collapsed and allows water to flow into or out of the mine. As the ground water flows into the mines flooding occurs. The mines remain flooded as the water is contained by the underlying aquaclude until the water surface elevation of the stagnant pool is equal to the outcrop elevation. At all shaft entrances located on the ridge overlying the mines, the mine water surface elevation is below the shaft elevation, hence no discharges to the surface. Once the water surface rises above the outcrop elevation, flows may develop along the outcrops, but because the mines are now completely flooded, and oxygen is prevented from reaching the pyritic rocks, the flows will be non-polluted or normal ground water. (The prevention of mine acid formation by flooding is discussed fully in Section VIII). This represents an ideal condition.

GEOLOGIC SIMILARITIES OF
MAJOR DISCHARGE SOURCES I



1. After abandonment, ground water continues to infiltrate mines through roof leaks and cave ins. Without pumping lower section of mine (A,B) begins to flood. No water is discharged to surface. Acid drainage is produced through the exposure of pyrites to air and moisture in the unflooded upper portion of the mines (C and D).

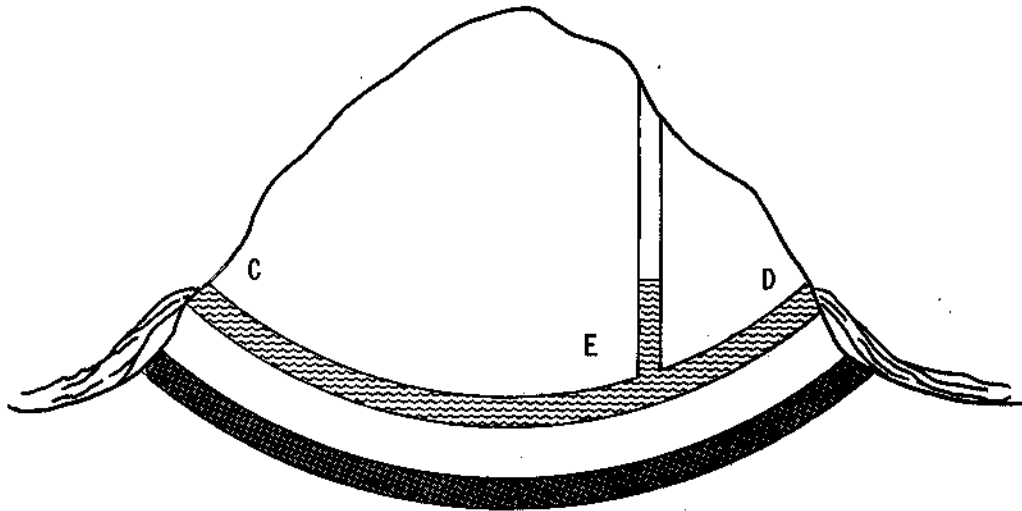
GEOLOGIC SIMILARITIES OF
MAJOR DISCHARGE SOURCES I

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MINE DRAINAGE POLLUTION
ABATEMENT MEASURES FOR THE
LOYALHANNA WATERSHED

PLATE
VI-16

GEOLOGIC SIMILARITIES OF
MAJOR DISCHARGE SOURCES II



2. If mine is completely flooded, sites C and D are inundated thus decreasing rate of acid production to minimal rate. Mine water discharges at outcrop line but contains 10 MG/L acid or less and is considered benign.

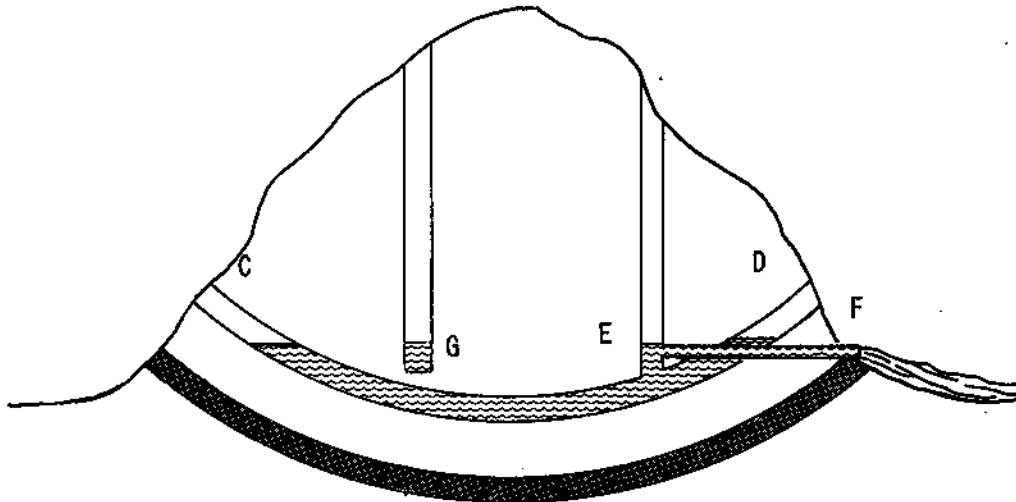
GEOLOGIC SIMILARITIES OF
MAJOR DISCHARGE SOURCES II

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MINE DRAINAGE POLLUTION
ABATEMENT MEASURES FOR THE
LOYALHANNA WATERSHED

PLATE
VI-17

GEOLOGIC SIMILARITIES OF
MAJOR DISCHARGE SOURCES III



3. If gravity drain F is added to original shaft, and it discharges to hillside below outcrop elevation, mine water surface is lowered re-exposing sites C and D. Full acid production resumes. Discharge contains 1,000 to 2,000 MG/L of acid. Discharge flow E will continue to drain acid as it accumulates. A water gap intercepting the coal seam below the outcrop line will function in a way similar to discharge E F, see next plate.

Note also that flow may seep into a second shaft (G) which does not intersect the coal seam directly. This shaft will fill to the same water surface elevation as the mine if the rock between them is either porous or weakened and cracked by subsidence. Shaft G may be drained in the same manner as shaft E.

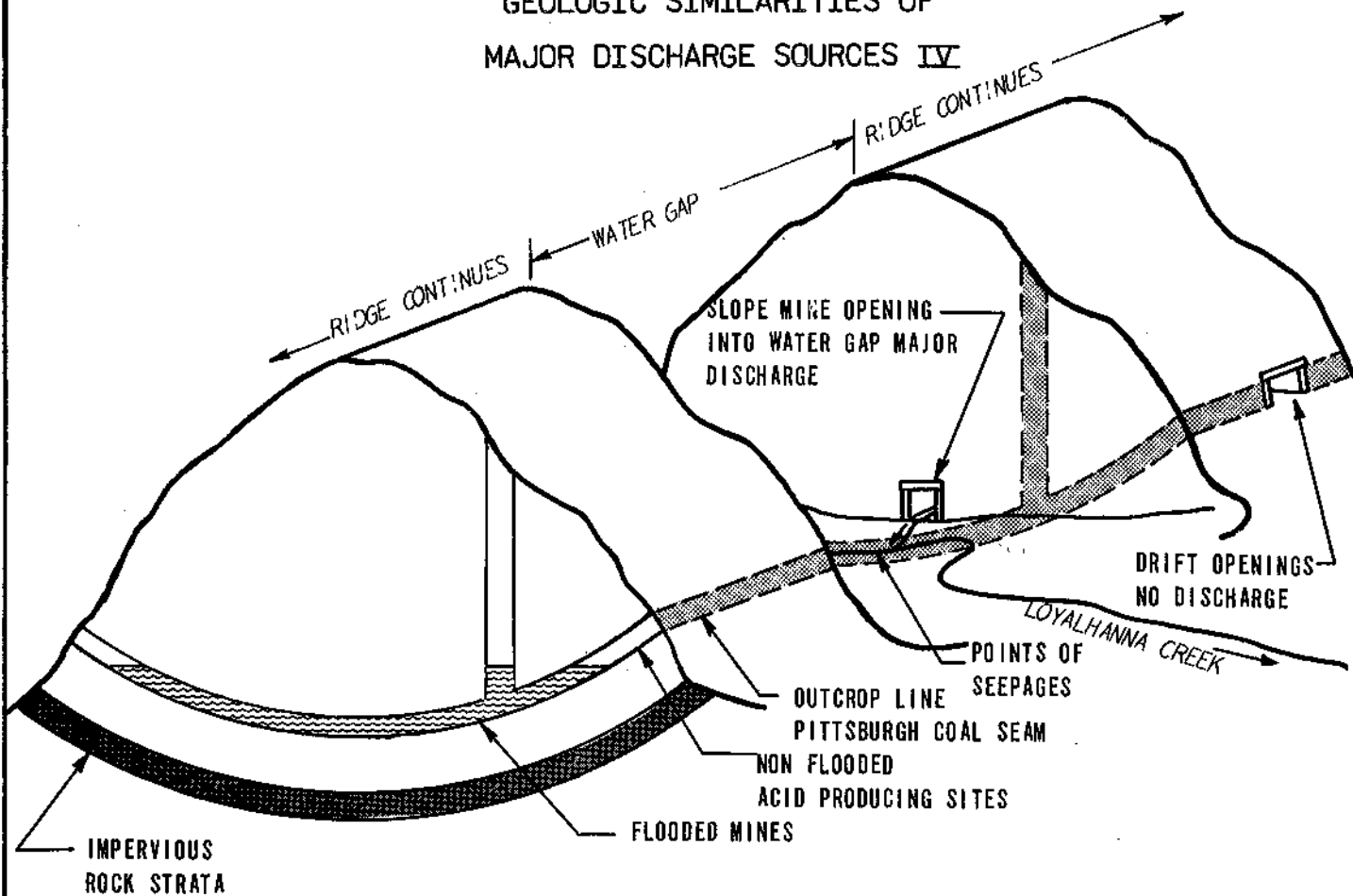
GEOLOGIC SIMILARITIES OF
MAJOR DISCHARGE SOURCES III

BUCHART-HORN
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MINE DRAINAGE POLLUTION
ABATEMENT MEASURES FOR THE
LOYALHANNA WATERSHED

PLATE
VI-18

GEOLOGIC SIMILARITIES OF
MAJOR DISCHARGE SOURCES IV



Schematic Representation of Latrobe
Syncline at Latrobe

Note that the bed of Loyalhanna Creek is below the elevation of the Pittsburgh coal seam outcrop. Discharges from slope mine and natural seepages prevent complete flooding of abandoned mines. If major discharge is sealed, mine water surface elevation would rise, increasing upward hydrostatic pressure in water gap thus increasing seepages. Mine water surface would restabilize before achieving complete flooding and acid formation would continue. Condition can be geologically corrected only by reestablishing original resistance to flow of undisturbed coal seam. High flow resistance of original undisturbed strata will reduce transmitted pressure under water gap under conditions of minimal groundwater flow.

GEOLOGIC SIMILARITIES OF
MAJOR DISCHARGE SOURCES IV

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MINE DRAINAGE POLLUTION
ABATEMENT MEASURES FOR THE
LOYALHANNA WATERSHED

PLATE
VI-19

To disrupt this ideal condition, suppose an excavation was dug from the surface over the mines downward to an elevation below the outcrop line but above the coal bed. This excavation, while not in direct contact with the flooded mines but overlying an area of fractured rock, would soon fill with water to the elevation of the water table which is close to the level of the outcrop line. If this excavation were drained by gravity into one of the adjacent valleys located below the elevation of the shaft, the excavation would continue to refill until, the water table was lowered to the level of the discharge of the excavation. This flow of ground water would gradually dewater the upper flanks of the coal seam and allow oxygen to enter and react with in-place pyrites. Discharge through the excavation would continue as it was replenished by ground water infiltration but it would now contain acid. mine drainage from the upper dewatered portion of the coal seam.

If we replace the excavation with a water gap through the ridge at a level below the coal outcrop line, then the same result can be observed; except that the discharge would be considered as being artesian. The constant dewatering of the upper limbs of a mined out coal seam through an artesian discharge located in a water gap describes the occurrence of discharges #5177, #5356 and #5364.

This configuration of surface topography and sub-surface structure is most obvious at the water gap through the Latrobe syncline ridge made by both

Loyalhanna Creek and Saxman Run at Latrobe. Less obvious is the gap created by Crabtree Creek at Crabtree. (The landform of the Crabtree water gap may indicate that the ancestor to the present Crabtree Creek may have at one time drained areas now tributary to Beaver Run and Whitehorn Creek and the present Crabtree Creek is a less significant -Aream than its predecessor). A gap also exists through the remains of the Pittsburgh seam in the Elders Ridge syncline at Slickville, but the apparent pattern of a single dominant discharge is not followed. This is easily explained by the lack of continuity of the coal seam, the lower center portion of the seam having been eroded by the flow of Getty Run. The lack of a dominant major discharge in connection with the Ligonier syncline is explained by the extremely limited area of the seam and the relative flatness of the formation at the synclinal axis.

The three major acid discharges of the Loyalhanna watershed are all fed from the Pittsburgh coal seam. There are however, no similar discharges from the underlying Freeport seam. The potential for discharges of even greater magnitude exists in the Freeport seam because of the higher outcrop elevation of the seam along the flanks of Chestnut and Dry Ridges. (Chestnut Ridge and Fayette anticlines). However, the lack of intensive mining in the Freeport seam has kept the lower reaches of the seam intact and not subject to infiltration and seepage to the same extent as the Pittsburgh seam.

The three major discharges may then be viewed as relief outlets for the mine drainage flows of the total interconnected coal field and not simply as isolated discharges. Any attempt at superficial abatement such as sealing alone will not affect the conditions which generate these flows. To seal discharges #5177, #5364 or #5356 without eliminating flows into the contributing mines will cause the eruption of new flows at different locations and at slightly higher elevations. The difficulty of abating these major acid discharges in the Loyalhanna watershed may be attributed to the near impossibility of maintaining totally flooded or totally dry conditions in the abandoned mines of these coal fields.

SURFACE DISCHARGES

All previously discussed sources of acid mine drainage were discharges generated by subsurface flows through abandoned mine voids. A second source of acid drainage in the watershed is runoff contaminated by the contact with pyritic materials brought to the surface by earlier mining operations. The causes and characteristics of this runoff generated acidity responsible for peak or slug loads of acid discharged into the streams of the watershed are discussed in Section VIII.

The acid discharges generated by surface materials are unrelated to subsurface sources except for a few instances of surface flows created by discharges from subsurface sources subsequently running through surface piles. These conditions are most prevalent in the Elders Ridge and

Ligonier areas. The major sources of surface generated acid drainage, however, are the large surface refuse or gob piles associated with mine shafts and coking works. Within the Loyalhanna watershed, strip mine cuts account for relatively little acid drainage.

A total area of approximately 480 acres within the watershed are covered with refuse or gob piles. The rate of acid formation within the refuse piles of the watershed is estimated to be about 50 lbs. of acid per day per acre. The 480 acres within the watershed could generate an average of 24, 000 lbs. of potential acid per day. While potential acidity accumulates at this rate it is removed from the piles and released by runoff in quantities one to ten times higher depending upon the length of the period of accumulation. The major refuse piles by number and areas covered are as follows:

Refuse Pile #	Location	Area Covered
#55	Shieldsburg	45 acres
#65	Hannastown	114 acres
#66	Crabtree	44 acres
#124	Hostetter	59 acres

These four piles cover approximately 260 of the 480 acres covered and alone may account for an average daily acid generation of 13, 000 lbs.

Seepage from refuse piles #65 (Hannastown) and #124 (Hostetter) have been inventoried as continuous dry weather sources of acid drainage.

Refuse pile #65, the source of discharge #5355 produces an average dry weather acid flow of 2, 300 lbs/day or 20 lbs/acre per day. This flow

increases after precipitation and acidity strength is dependent on the elapsed interval since the last runoff. The average estimated rate of acid production is 5,700 lbs of acid/day, as discharged into Crabtree Creek.

Refuse pile #124 at Hostetter is the source of discharge #5351, which produced a measured dry weather flow of 2000 lbs. of acidity per day or 33 lbs. of acidity per acre per day. The average estimated daily rate of acid generation is 3000 lbs. of acidity per day. Discharge is into a tributary of Nine Mile Creek. The formation of surface generated acidity and an abatement program for surface discharges are discussed in the appropriate following section.

TABLE VI-9

SUMMARY OF COAL MINE REFUSE PILE AND
STRIP MINE SURFACE AREAS

Total Area Covered = 3,726 acres or 5.8 square miles or 2% of the Loyalhanna Watershed Surface Area

7-1/2 min. USGS Map	Coal Mining Area						
	Elders Ridge	Greensburg	Greensburg Extended	Latrobe South	Latrobe North	Ligonier	Upper Freeport
Slickville	394	70					
Saltsburg	289	746	253				35
Greensburg		118					
Latrobe		340		371	72		187
Derry					513		42
Wilpen						649	
Donegal							50
TOTAL	<u>541</u>	<u>1,013</u>	<u>253</u>	<u>371</u>	<u>585</u>	<u>649</u>	<u>314</u>

TABLE VI-10
MINE REFUSE PILES AND STRIP MINE SPOIL AREAS
(Map Numbers Refer to Plates VI-20 thru VI-25)

ELDERS RIDGE

GREENSBURG EXT.

Saltsburg Quadrangle

Saltsburg Quadrangle

Map #	Area in Acres	
1	27	
2	4	
3	46	
4	6	
5	33	
6	2	
7	20	
8	4	
9	13	
10	7	
11	2	
12	1	
13	1	
14	100	
18	23	289

Slickville Quadrangle

256	48	
257	7	
258	4	
259	21	
260	19	
Z61	6	
262	4	
263	13	
264	1	
265	1	
266	1	
267	2	
268	6	
269	9	
270	5	
271	4	
272	16	
273	4	
274	34	
275	4	
276	20	
277	<u>23</u>	<u>252</u>

Map #	Area in Acres
19	9
20	9
21	14
22	17
23	6
24	11
25	11
26	4
27	10
28	3
29	4
30	11
31	10
32	1
33	28
34	17
35	10
36	8
37	25
38	4
39	10
40	8
41	23

Total Area - Greensburg Ext.
253 acres

Total Area Elders Ridge 541 acres

TABLE VI-I0(CONTINUED)

GREENSBURG SYNCLINE

Saltsburg Quadrangle

Map #	Area in Acres
42	20
43	58
44	90
45	8
46	42
47	20
48	6
49	27
50	2
51	2
52	1
53	1
54	6
55	44
56	4
57	29
58	23
59	26
60	53
61	<u>14</u>

476

Latrobe Quadrangle

63	2
64	9
65	114
66	45
67	4
68	27
69	7
70	1
71	16
72	1
73	17
74	5
75	3
76	9
80	43
81	3
82	16
83	7
84	<u>11</u>

340

Slickville Quadrangle

Map#	Area in Acres
247	53
248	<u>26</u>

79

Greensburg Quadrangle

249	16
250	26
251	47
252	10
253	1
254	4
255	<u>14</u>

118

Total Greensburg Syncline Coal Field

1, 013 acres

TABLE VI-I0(CONTINUED)

LATROBE (SOUTH) COALFIELD

Latrobe Quadrangle

Map #	Area in Acres
105	27
106	10
107	21
108	12
109	7
110	21
111	10
112	31
113	13
114	17
115	10
116	3
117	8
118	7
119	9
120	2
121	9
122	10
123	6
124	59
125	6
126	14
127	59

Total Area Latrobe South
Coalfield = 371

LATROBE (NORTH) COALFIELD

Latrobe Quadrangle

94	26
95	28
96	9
97	<u>9</u>
	72

Derry Quadrangle

Map #	Area in Acres
128	73
129	23
130	6
131	6
132	24
133	2
134	9
135	10
136	32
137	12
138	4
139	29
140	5
141	4
142	2
143	21
144	11
145	23
146	3
147	3
148	23
149	7
150	23
151	35
152	4
153	40
154	3
155	9
156	14
157	2
158	3
159	4
160	1
161	7
162	3
163	10
164	3
165	5
166	4
167	5
168	2
169	<u>4</u>

Total Latrobe North Coalfield 585 acres

TABLE VI-10 (CONTINUED)

LIGONIER SYNCLINE COALFIELD

<u>Wilpen Quadrangle</u>		<u>Wilpen Quadrangle continued</u>	
Map	Area in Acres	Map	Area in Acres
178	19	220	7
179	33	221	14
180	2	222	1
181	4	223	4
182	20	224	4
183	23	225	3
184	19	226	4
185	34	227	5
186	5	228	6
187	19	229	7
188	9	230	34
189	7	231	15
190	10	232	6
191	9	233	2
192	6	234	9
193	2	235	11
194	6	236	4
10/5	4	237	4
196	7	238	6
197	7	239	14
198	2	240	4
199	33	241	4
200	10		
201	40		
202	3		
203	4		
204	6		
205	15		
206	8		
207	7		
208	30		
209	12		
210	4		
211	6		
212	8		
213	4		
214	3		
215	7		
216	17		
217	10		
218	4		
219	3		

Total Area in Ligonier Syncline = 649 acres

TABLE VI-10 (CONTINUED)

UPPER FREEPORT COAL SEAM

Saltsburg Quadrangle

Map #	Area in Acres
15	7
16	6
17	15
62	7
	35

Donegal Quadrangle

Map	Area in Acres
242	23
243	9
244	14
245	2
246	-2

50

Latrobe Quadrangle

77	5
78	12
79	4
85	2
86	2
87	3
88	34
89	25
90	14
91	12
92	4,
93	10
98	1
99	3
100	11
101	4
102	4
103	20
104	17

Total Upper Freeport Coal Seam 314 acres

187

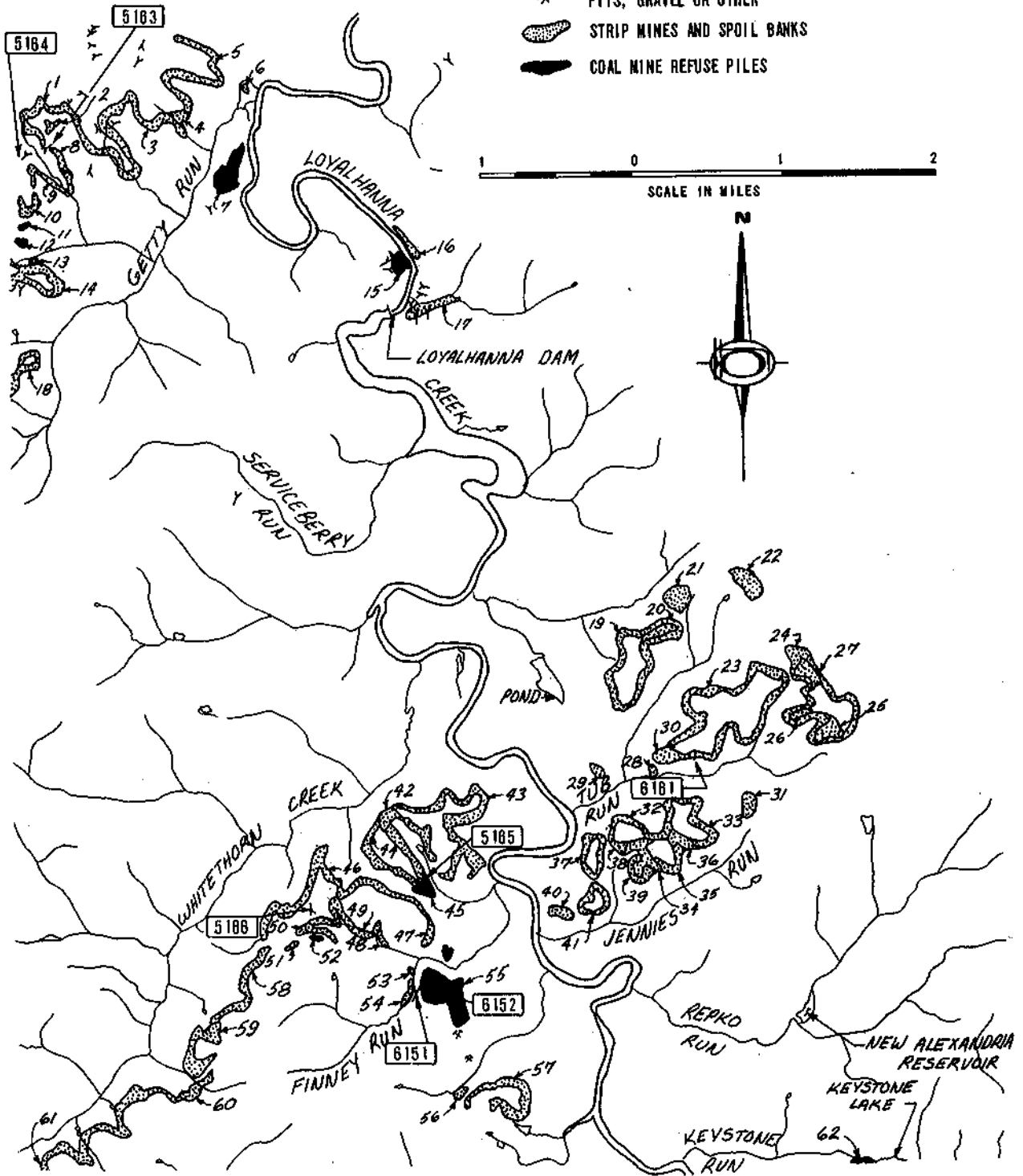
Derry Quadrangle

170	4
171	4
172	4
173	4
174	14
175	4
176	5
177	3

42

LEGEND:

- 5271 ACID MINE DRAINAGE INVENTORY NUMBER
- 123 STRIP MINE SPOIL BANK OR REFUSE PILE NUMBER
- MINE TUNNEL OPENING AND DIRECTION
- ⊗ PITS, GRAVEL OR OTHER
- ▨ STRIP MINES AND SPOIL BANKS
- COAL MINE REFUSE PILES



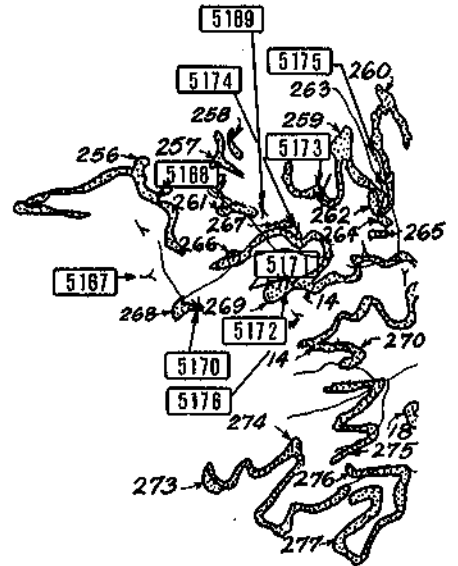
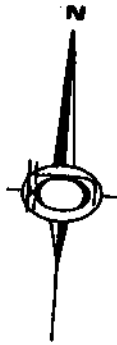
LOCATION MAP - SURFACE AND SUBSURFACE
DISCHARGES - SALTSBURG QUADRANGLE

BUCHART - HORN
CONSULTING ENGINEERS & PLANNERS

MINE DRAINAGE POLLUTION
ABATEMENT MEASURES FOR THE
LOYALHANNA WATERSHED

PLATE

VI-20



LEGEND:

- 5271 ACID MINE DRAINAGE INVENTORY NUMBER
- 123 STRIP MINE SPOIL BANK OR REFUSE PILE NUMBER
- MINE TUNNEL OPENING AND DIRECTION
- * PITS, GRAVEL OR OTHER
- STRIP MINES AND SPOIL BANKS
- COAL MINE REFUSE PILES

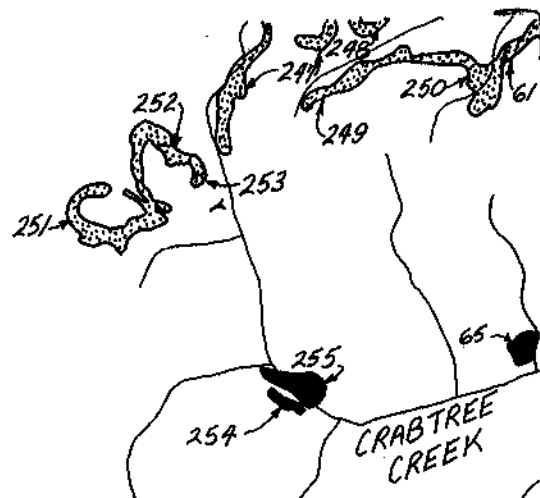


LOCATION MAP - SURFACE AND SUBSURFACE
DISCHARGES - SLICKVILLE QUADRANGLE

BUCHART - HORN
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MINE DRAINAGE POLLUTION
ABATEMENT MEASURES FOR THE
LOYALHANNA WATERSHED

PLATE
VI-21



LEGEND:

- 5271 ACID MINE DRAINAGE INVENTORY NUMBER
- 23 STRIP MINE SPOIL BANK OR REFUSE PILE NUMBER
- Y MINE TUNNEL OPENING AND DIRECTION
- X PITS, GRAVEL OR OTHER
- STRIP MINES AND SPOIL BANKS
- COAL MINE REFUSE PILES



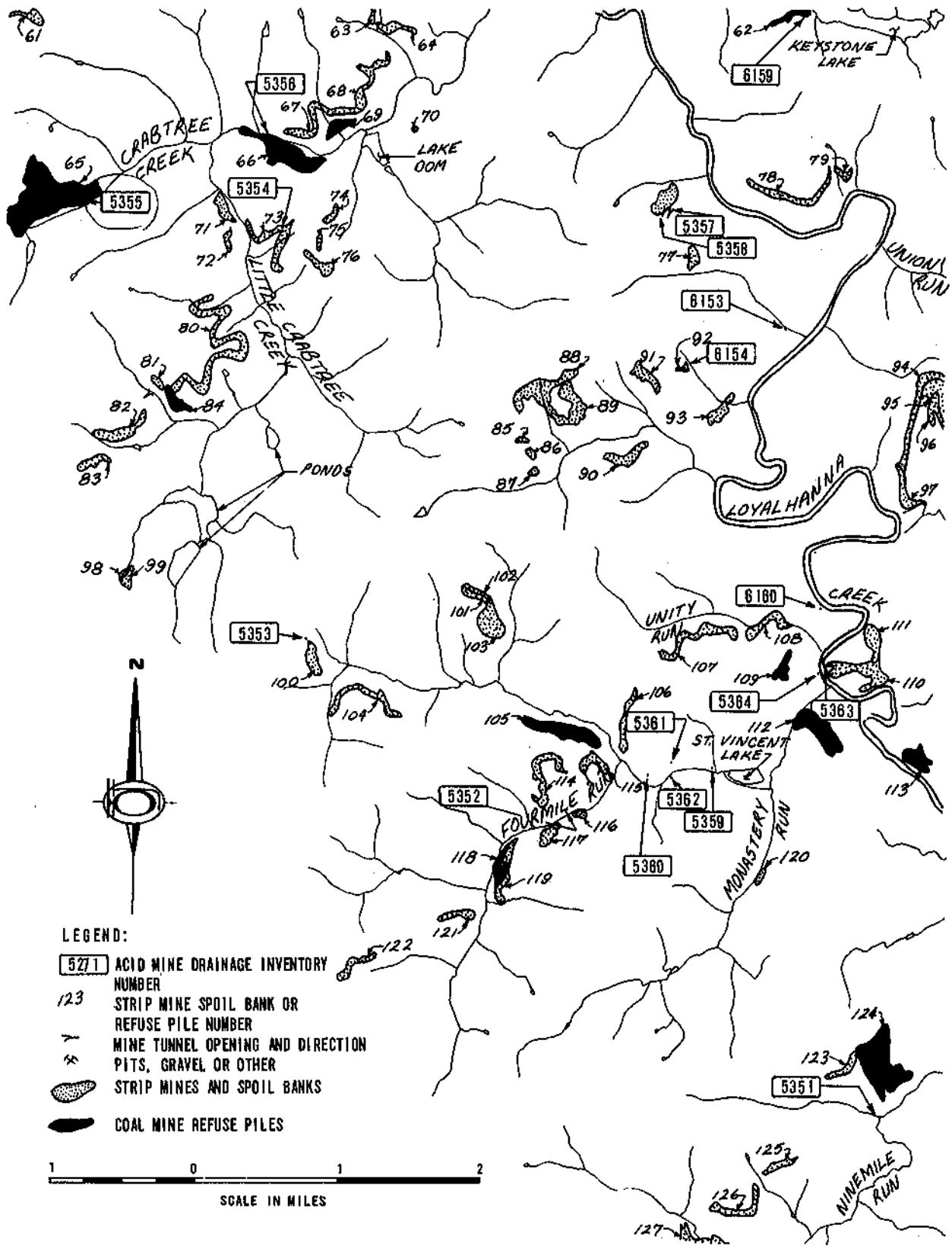
LOCATION MAP - SURFACE AND SUBSURFACE
DISCHARGES - GREENSBURG QUADRANGLE

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MINE DRAINAGE POLLUTION
ABATEMENT MEASURES FOR THE
LOYALHANNA WATERSHED

PLATE

VI-22



LEGEND:

- 5271 ACID MINE DRAINAGE INVENTORY NUMBER
- 123 STRIP MINE SPOIL BANK OR REFUSE PILE NUMBER
- 7 MINE TUNNEL OPENING AND DIRECTION
- * PITS, GRAVEL OR OTHER
- [stippled box] STRIP MINES AND SPOIL BANKS
- [solid black box] COAL MINE REFUSE PILES

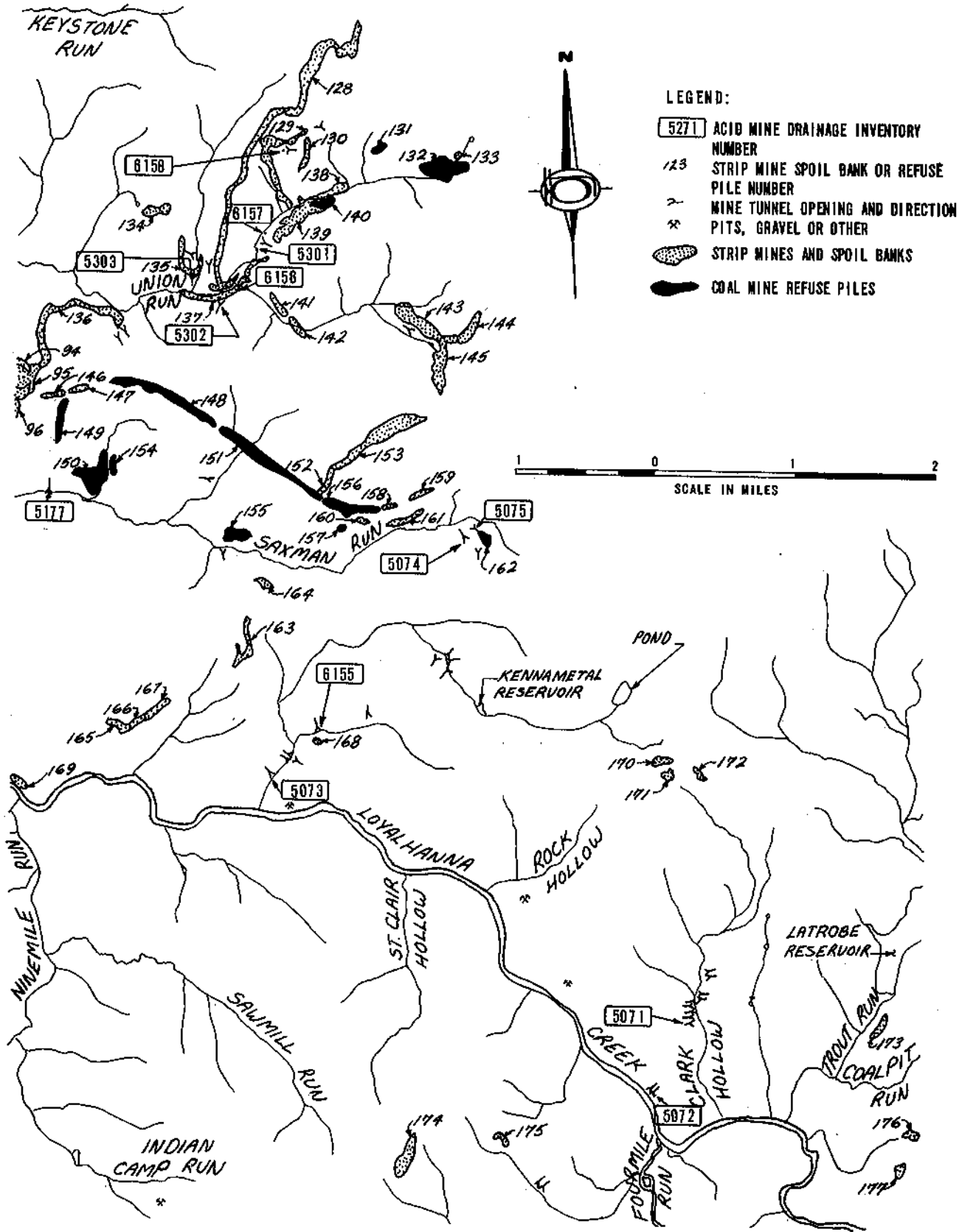


LOCATION MAP - SURFACE AND SUBSURFACE DISCHARGES - LATROBE QUADRANGLE

BUCHART-HORN
CONSULTING ENGINEERS & PLANNERS

MINE DRAINAGE POLLUTION ABATEMENT MEASURES FOR THE LOYALHANNA WATERSHED

PLATE VI-23



LOCATION MAP - SURFACE AND SUBSURFACE DISCHARGES - DERRY QUADRANGLE

BUCHART - HORN

CONSULTING ENGINEERS & PLANNERS

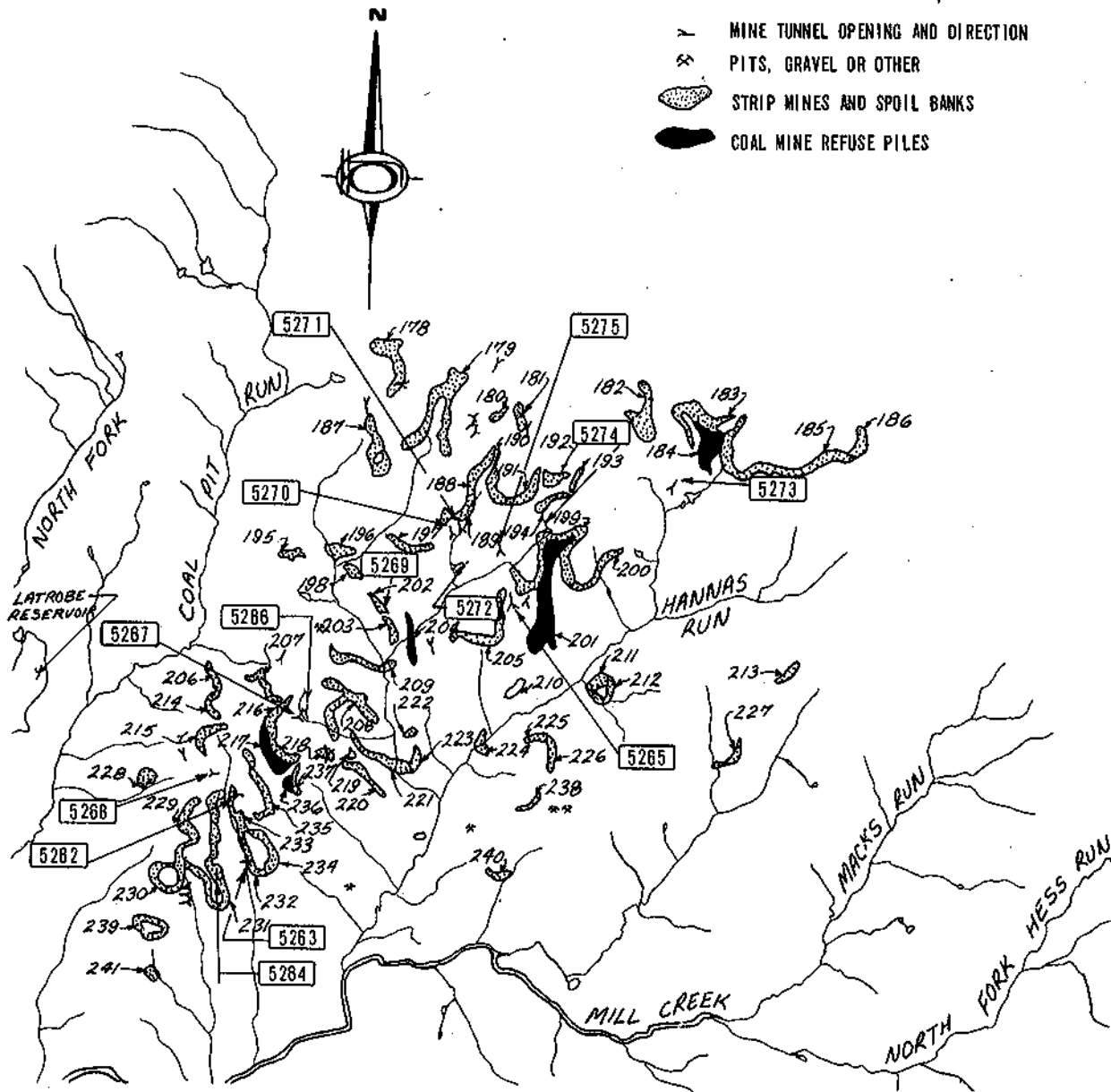
MINE DRAINAGE POLLUTION ABATEMENT MEASURES FOR THE LOYALHANNA WATERSHED

PLATE VI-24



LEGEND:

- 5271 ACID MINE DRAINAGE INVENTORY NUMBER
- 123 STRIP MINE SPOIL BANK OR REFUSE PILE NUMBER
- MINE TUNNEL OPENING AND DIRECTION
- ⊗ PITS, GRAVEL OR OTHER
- STRIP MINES AND SPOIL BANKS
- COAL MINE REFUSE PILES

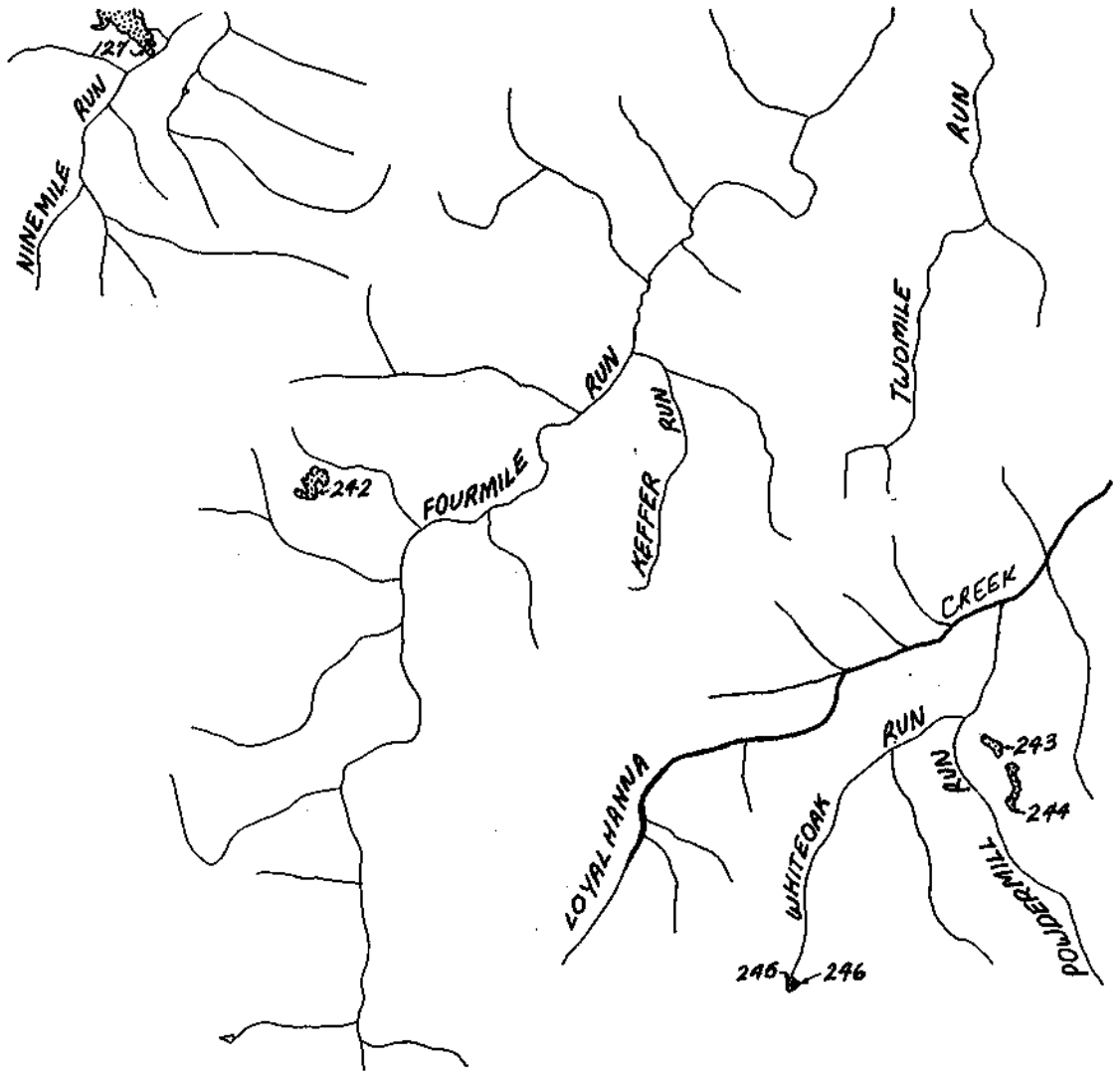


LOCATION MAP - SURFACE AND
SUBSURFACE DISCHARGES - WILPEN QUADRANGLE

BUCHART-HORN
CONSULTING ENGINEERS & PLANNERS

MINE DRAINAGE POLLUTION
ABATEMENT MEASURES FOR THE
LOYALHANNA WATERSHED

PLATE
VI-25



LEGEND:

- 5271 ACID MINE DRAINAGE INVENTORY NUMBER
- 123 STRIP MINE SPOIL BANK OR REFUSE PILE NUMBER
- Y MINE TUNNEL OPENING AND DIRECTION
- ⊗ PITS, GRAVEL OR OTHER
- STRIP MINES AND SPOIL BANKS
- COAL MINE REFUSE PILES



LOCATION MAP - SURFACE AND SUBSURFACE
DISCHARGES - DONEGAL QUADRANGLE

BUCHART-HORN
CONSULTING ENGINEERS & PLANNERS

MINE DRAINAGE POLLUTION
ABATEMENT MEASURES FOR THE
LOYALHANNA WATERSHED

PLATE
VI-26