

5B. Lower Portion, Main Stream, Two Lick Creek Watershed

a. General

The lower portion of the main stream is located between the breast of the Two Lick Creek Dam and the junction of Blacklick Creek.

Major tributaries discharging into this portion of Two Lick Creek are: Ramsey Run, Stoney Run, Yellow Creek, Tearing Run, and Cherry Run. As previously mentioned, for the purpose of this study, the above tributaries are excluded from this portion of Two Lick Creek and are treated as separate watersheds elsewhere in this section of the report.

The total stream length including all tributaries, except those mentioned above, is approximately 25.5 miles. Total area is approximately 15.5 square miles.

b. Stream Condition

An analysis of mine drainage contamination within the watershed provides the following breakdown on stream condition.

Table 50

Stream Condition

Lower Portion, Main Stream, Two Lick Creek Watershed

<u>Stream Classification</u>	<u>Stream Length Miles</u>	<u>Percent Total Stream Length</u>
Non-Polluted	12.0	48
Severely Polluted	12.5	49
Moderately Polluted	1.0	3

Approximately 52 percent of the watershed is seriously degraded by mine drainage pollution. Most of the feeder tributaries are not effected by mine drainage.

Plate 51 show the locations of sampling stations and the extent of mine drainage pollution within the watershed.

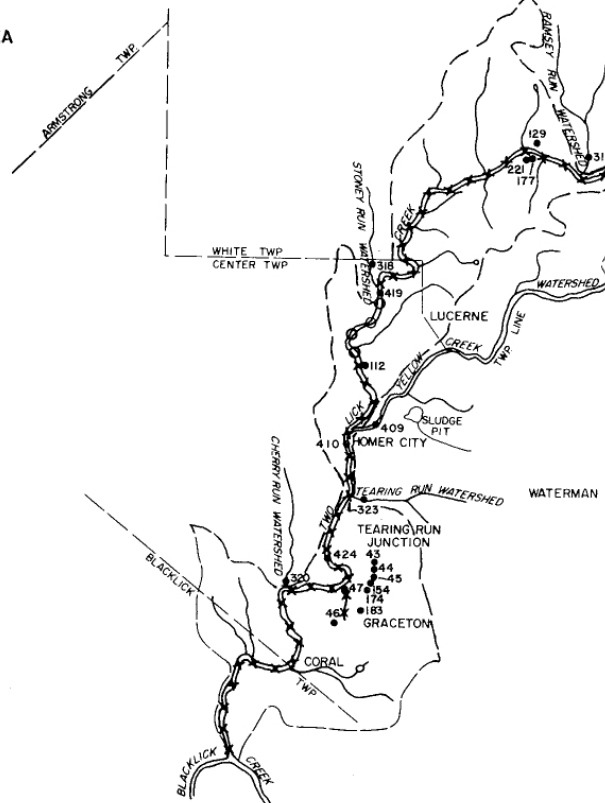
c. Sampling Station Data

Fifteen (15) sampling stations were installed and monitored. The minimums, maximums, and yearly averages of water quality data obtained from these stations are listed in Table 51 on Page 183.

MAIN STREAM
LOWER PORTION: TWO LICK CREEK WATERSHED

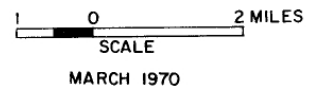


WATERSHED AREA



LEGEND

- TWO LICK CREEK DRAINAGE BASIN
- SAMPLING STATION
- MODERATELY ACID
- SEVERELY ACID



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TWO LICK CREEK
MINE DRAINAGE POLLUTION
ABATEMENT PROJECT
INDIANA COUNTY, PENNSYLVANIA

PREPARED FOR
PENNSYLVANIA
DEPARTMENT OF MINES
AND
MINERAL INDUSTRIES

Table 51

Water Quality DataLower Portion, Main Stream, Two Lick Creek Watershed

<u>Sampling Station</u>	<u>Flow GPM</u>	<u>pH Range</u>	<u>Acid Load Lbs./Day</u>	<u>Acidity Mg./L.</u>	<u>Iron Mg./L.</u>	<u>Sulfate Mg./L.</u>
424	Max. 229,695 Min. 13,077 Ave. 78,564	3.5 - 5.8	53,899	Max. 192 Min. 6 Ave. 57	Max. 19 Min. 2 Ave. 9	Max. 750 Min. 0 Ave. 311
419	Max. 194,278 Min. 10,732 Ave. 39,636	4.3 - 6.5	9,841	Max. 100 Min. 4 Ave. 21	Max. 4 Min. 1 Ave. 2	Max. 875 Min. 46 Ave. 253
410	Max. 132,776 Min. 10,120 Ave. 68,157	3.6 - 5.4	43,683	Max. 420 Min. 18 Ave. 53	Max. 35 Min. 1 Ave. 8	Max. 1,250 Min. 68 Ave. 288
221	Max. 20 Min. 4 Ave. 9	3.6 - 4.2	54	Max. 880 Min. 410 Ave. 503	Max. 296 Min. 10 Ave. 169	Max. 2,500 Min. 1,250 Ave. 2,049
183	Max. 20 Min. 1 Ave. 5	3.1 - 3.5	70	Max. 1,455 Min. 0 Ave. 1,156	Max. 500 Min. 225 Ave. 386	Max. 4,500 Min. 1,300 Ave. 2,577
177	Max. 12 Min. 2 Ave. 5	3.6 - 4.1	18	Max. 550 Min. 110 Ave. 297	Max. 175 Min. 30 Ave. 108	Max. 3,300 Min. 900 Ave. 1,536
174	Max. 39 Min. 1 Ave. 18	3.3 - 4.4	130	Max. 760 Min. 360 Ave. 595	Max. 120 Min. 27 Ave. 68	Max. 3,000 Min. 800 Ave. 2,125
154	Max. 220 Min. 1 Ave. 64	2.8 - 3.8	674	Max. 1,500 Min. 236 Ave. 868	Max. 900 Min. 60 Ave. 249	Max. 5,000 Min. 750 Ave. 1,981

Table 51 Continued

Water Quality Data

Lower Portion, Main Stream, Two Lick Creek Watershed

<u>Sampling Station</u>	<u>Flow GPM</u>		<u>pH Range</u>	<u>Acid Load Lbs./Day</u>	<u>Acidity Mg./L.</u>	<u>Iron Mg./L.</u>	<u>Sulfate Mg./L.</u>			
129	Max.	745	3.0 - 4.0	315	Max.	1,380	Max.	4,000		
	Min.	1			Min.	320	Min.	50	Min.	200
	Ave.	56			Ave.	463	Ave.	99	Ave.	1,272
112	Max.	328	3.4 - 4.7	4,526	Max.	2,000	Max.	6,000		
	Min.	61			Min.	680	Min.	1	Min.	1,000
	Ave.	244			Ave.	1,541	Ave.	1,064	Ave.	5,541
47	Max.	1,017	2.7 - 4.4	1,024	Max.	946	Max.	1,300		
	Min.	4			Min.	196	Min.	3	Min.	45
	Ave.	139			Ave.	610	Ave.	230	Ave.	1,686
46	Max.	71	2.4 - 4.0	130	Max.	1,500	Max.	425		
	Min.	1			Min.	520	Min.	4	Min.	375
	Ave.	15			Ave.	752	Ave.	88	Ave.	1,393
45	Max.	200	2.6 - 4.9	392	Max.	1,790	Max.	570		
	Min.	3			Min.	100	Min.	3	Min.	450
	Ave.	31			Ave.	1,031	Ave.	246	Ave.	2,359
44	Max.	77	2.7 - 4.2	183	Max.	2,450	Max.	725		
	Min.	3			Min.	710	Min.	3	Min.	125
	Ave.	14			Ave.	1,117	Ave.	271	Ave.	2,611
43	Max.	95	3.7 - 4.9	81	Max.	1,320	Max.	400		
	Min.	1			Min.	100	Min.	1	Min.	12
	Ave.	25			Ave.	266	Ave.	34	Ave.	691

Plate 52 graphically illustrates the monthly relationship between stream flow, contamination load, and weather elements within the watershed based on measurements taken at Sampling Station #424 located near the mouth of Two Lick Creek. It should be noted that the measurements include the pollution load contributed by the upstream major tributaries, but does not include measurements from Cherry Run as this stream enters Two Lick Creek downstream from Sampling Station #424.

Peak flow, pollution load, and pH levels occurred during the spring months with low readings recorded during the late summer and fall.

The pH level fluctuated considerably from a low of 3.7 recorded in September to a high of 5.2 in March.

Two Lick Creek, as measured at Sampling Station #424, discharged an average of approximately 113,132,000 gallons of water per day into Blacklick Creek during the study period.

d. Coal Mining Activity General

The area was extensively mined from the early 1900's to the late 1960's. Both the Upper Freeport (E) and the Lower Kittanning (B) seams were mined. Map Sheets 6, 9, 10, 12, and 13, Appendix A show the locations and extent of both deep and strip mines.

Deep Mines

There are presently no deep mines in operation as the last active mine, Lucerne #3-B, ceased operations in 1969.

Abandoned mines in the area are the most extensive of any area within the entire Two Lick Creek Watershed. They include Lucerne Numbers 3-A and 3-B, Graceton Numbers 1, 2, 3, 4, and 5, and Wharton Number 1, all of which have openings within the area.

Table 52 shown on Page 187 lists the abandoned mines and the following information: Type of opening, total number of openings, seam mined, maximum head, whether or not the mine is draining water, and number of acres mined.

STATION 424 LOWER PORTION TWO LICK CREEK (Near Graceton) RELATIONSHIP BETWEEN STREAM FLOW, POLLUTION LOAD AND WEATHER ELEMENTS

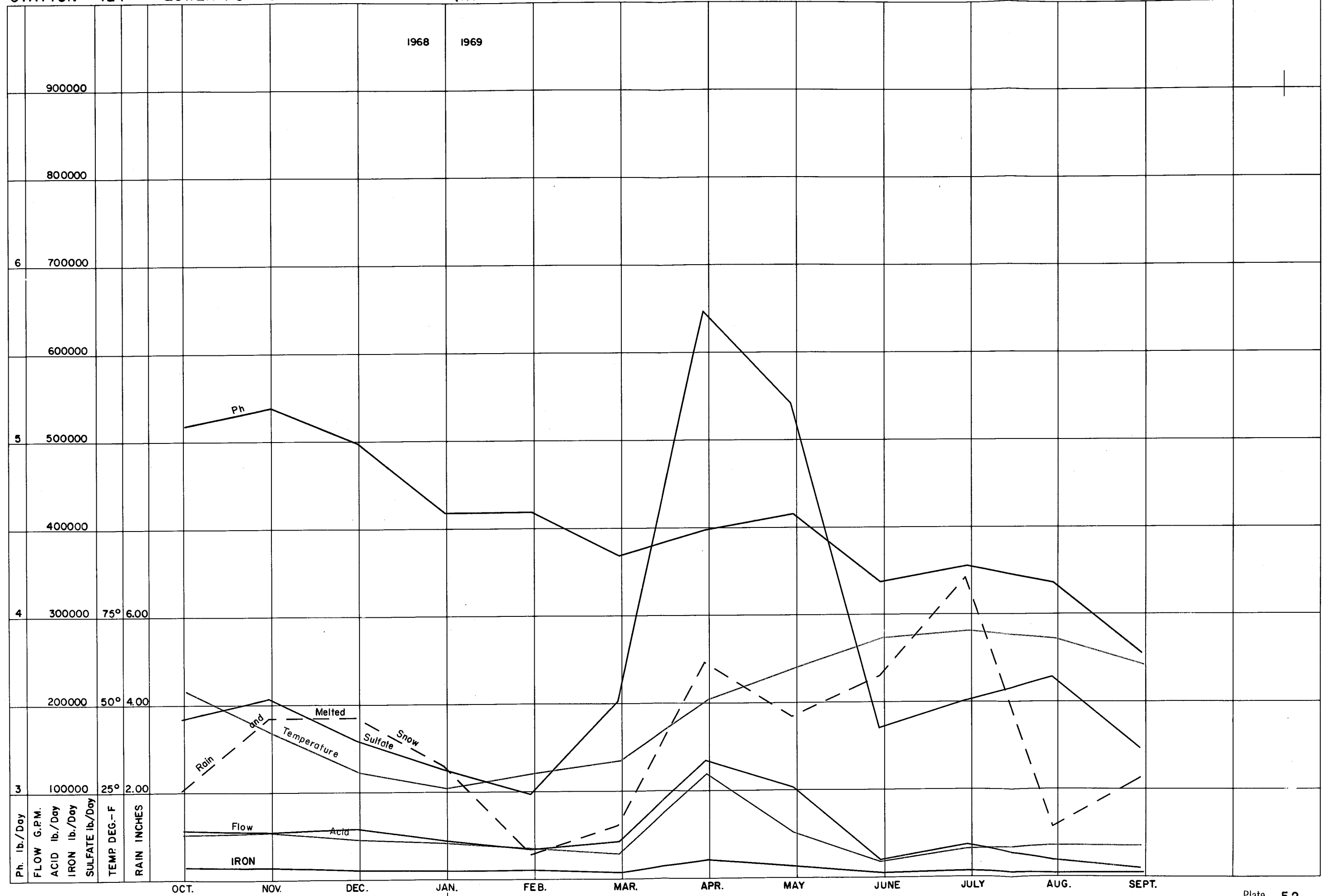


Table 52

Abandoned MinesLower Portion, Main Stream, Two Lick Creek Watershed

<u>Name of Mine</u>	<u>Type of Opening</u>	<u>Seam Mined</u>	<u>Draining Water</u>	<u>Total No. Openings</u>	<u>Area Mined (Acres)</u>	<u>Maximum Head (Feet)</u>	
1. Lucerne #2*	Churn Drill Holes	E	X	2	-	719	(591) ¹
2. Lucerne #3-A	Slope	E	-	2	756	60	
3. Lucerne #3-B	Drift	E	X	2	934	164	
4. Snyder-Waterman Complex**	Fan Shaft	B	X	1	-	802	(432) ¹
5. Campbell	Drift	E	X	5	99	23	
6. Graceton #1	Drift	E	X	4	47	207	
7. Graceton #2***	Drift	E	X	3	264	280	
8. Graceton #3****	Slope	E	X	2	2,310	253	
9. Graceton #4	Drift	E	X	1	31	211	
10. Graceton #5	Drift	E	X	1	29	233	
11. Wharton #1	Slope	E	-	2	202	-	
12. Barrish	Drift	E	-	3	11	20	
13. R. E. Young	Drift	E	-	1	2	20	

*Lucerne #2 has its main drift entries in Lower Yellow Creek Watershed and additional entries in the Tearing Run Watershed.

**The Snyder-Waterman complex has its main entries in Tearing Run Watershed and additional entries in Lower Yellow Creek Watershed.

***Graceton #2 has several additional entries in the Tearing Run Watershed.

****Graceton #3 is partially flooded and is discharging mine drainage at a bore hole located in the Cherry Run Watershed. The drainage indicated above is from a small portion of the mine located above the main entry. 1 Indicates head at surface elevations.

Strip Mines

There are several small strip mines totaling approximately 117 acres located near Graceton, Coral, and the Two Lick Creek Dam.

The Upper Freeport (E) seam, only, was mined principally in the outcrop of the Graceton deep mine complex.

There are presently no strip mines in operation.

Several strips broke into or cut close to old deep mine workings, and as a result, water from the old workings is draining over and through the stripped areas.

The majority of the strips were at least partially backfilled, however, several of these are inadequately revegetated.

e. Description of Mine Drainage Sources

The major mine drainage sources are listed on the following page in Table 53 beginning with the most serious contributor of acid load. Each source is associated with the sampling station(s) measuring the mine drainage and the respective contamination load.

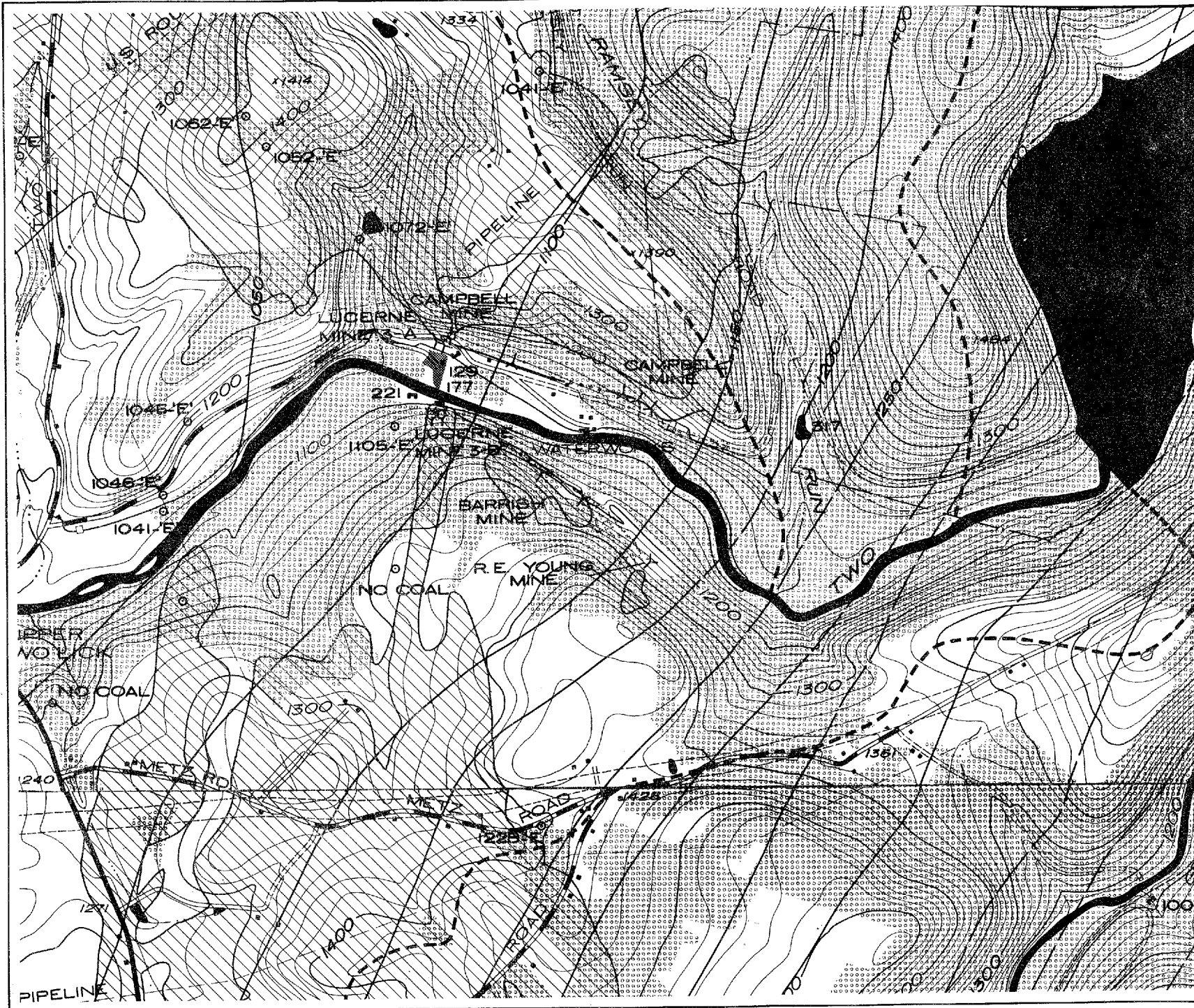
Deep mines that are interconnected are listed collectively as one source. Plates 53, 54, and 55 show the locations of the various sources.

Combined maximum heads are given for deep mines that are discharging mine drainage.

Table 53

Major Mine Drainage SourcesLower Portion, Main Stream, Two Lick Creek Watershed

















<u>Source Description</u>	<u>Flow GPM</u>	<u>Sampling Station(s)</u>	<u>Pollution Load - Lbs./Day</u>			<u>Combined Maximum Head (Feet)</u>
			<u>Acid</u>	<u>Iron</u>	<u>Sulfate</u>	
1. Snyder-Waterman Fan Shaft	244	112	4,526	3,125	16,278	432
2. Graceton #1, #2, #4, and #5 Mines	147	44, 45, 46, 154, 174, 183	1,588	386	3,742	280
3. Campbell Mine	56	129	315	68	865	23
4. Graceton #2, #3, #4, and #5 Coal Refuse Piles	1,225	Estimated	300	10	2,000	-
5. Lucerne 3-B Mine	14	177, 221	72	25	312	164
6. Graceton Strip Mines	416	Estimated	50	5	400	-
7. Lucerne #3 Coal Refuse	208	Estimated	50	5	400	-
8. Graceton #1 and Wharton #1 Coal Refuse Piles	208	Estimated	50	5	400	-




LOWER TWO LICK CREEK

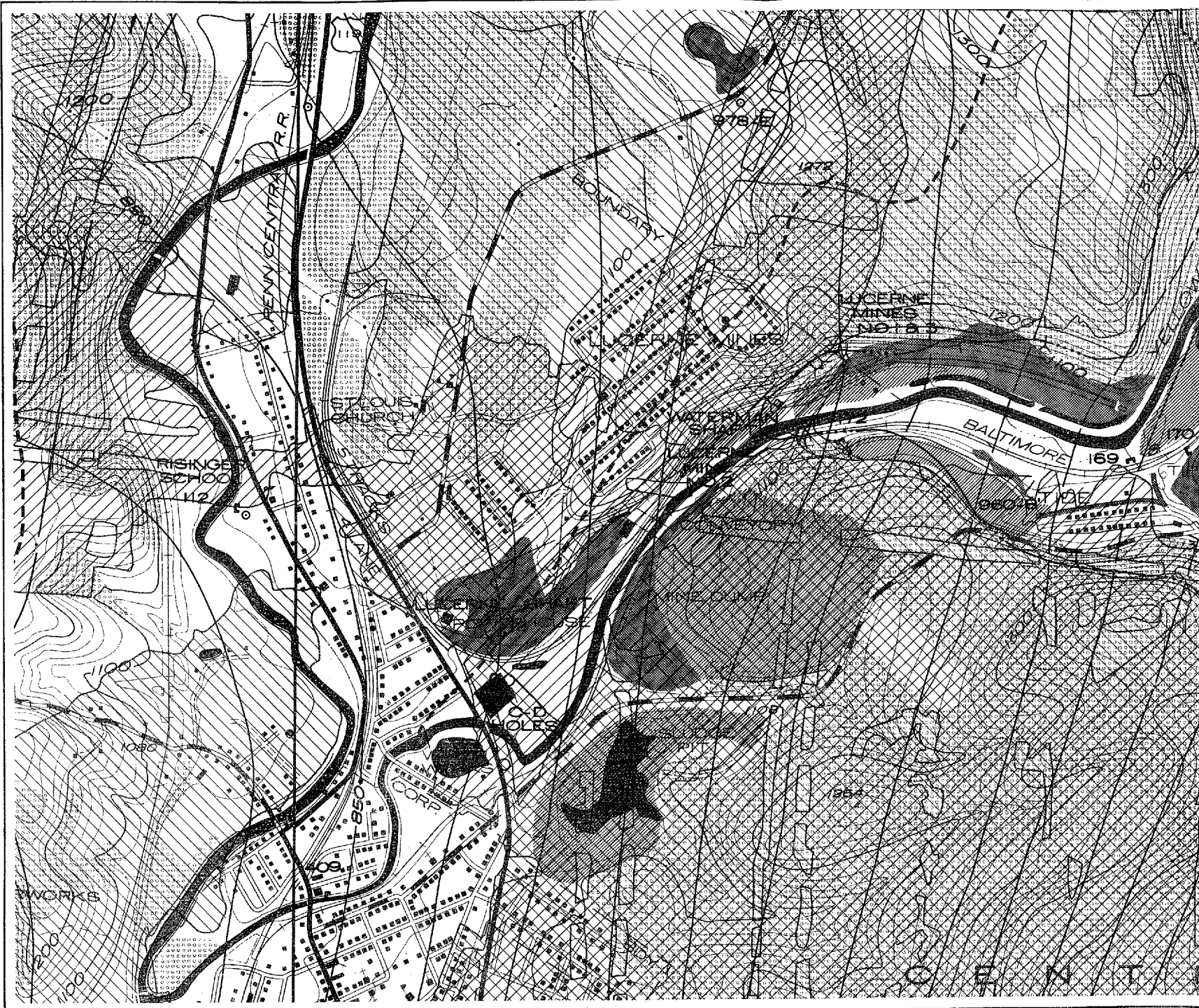


LEGEND

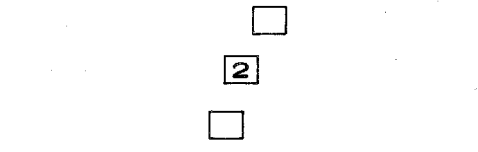
-  KITTANNING SEAM
-  FREEPORT SEAM
-  UPPER FREEPORT (E) SEAM
-  LOWER FREEPORT (D) SEAM
-  LOWER KITTANNING (B) SEAM
-  COAL REFUSE AREA (NEW)
-  COAL REFUSE AREA (OLD)
-  STRIP MINE AREA
-  SAMPLING STATION
-  DIAMOND DRILL HOLE
-  MINE OPENING (DRY)
-  MINE OPENING (DRAINING)
-  WATERSHED PERIMETER (EXTERIOR)
-  WATERSHED PERIMETER (INTERIOR)
-  COAL CONTOUR UPPER FREEPORT SEAM
-  COAL CONTOUR LOWER FREEPORT SEAM (COAL MISSING DUE TO EROSION)

TWO LICK CREEK MINE DRAINAGE POLLUTION ABATEMENT PROJECT INDIANA COUNTY, PENNSYLVANIA PROJECT N° SL109 INVENTORY MAP

0 500 1000 1500	MARCH, 1970	
SCALE IN FEET		
L. ROBERT KIMBALL Consulting Engineers EBENSBURG, PENNSYLVANIA		SHEET N° 1



LOWER TWO LICK CREEK

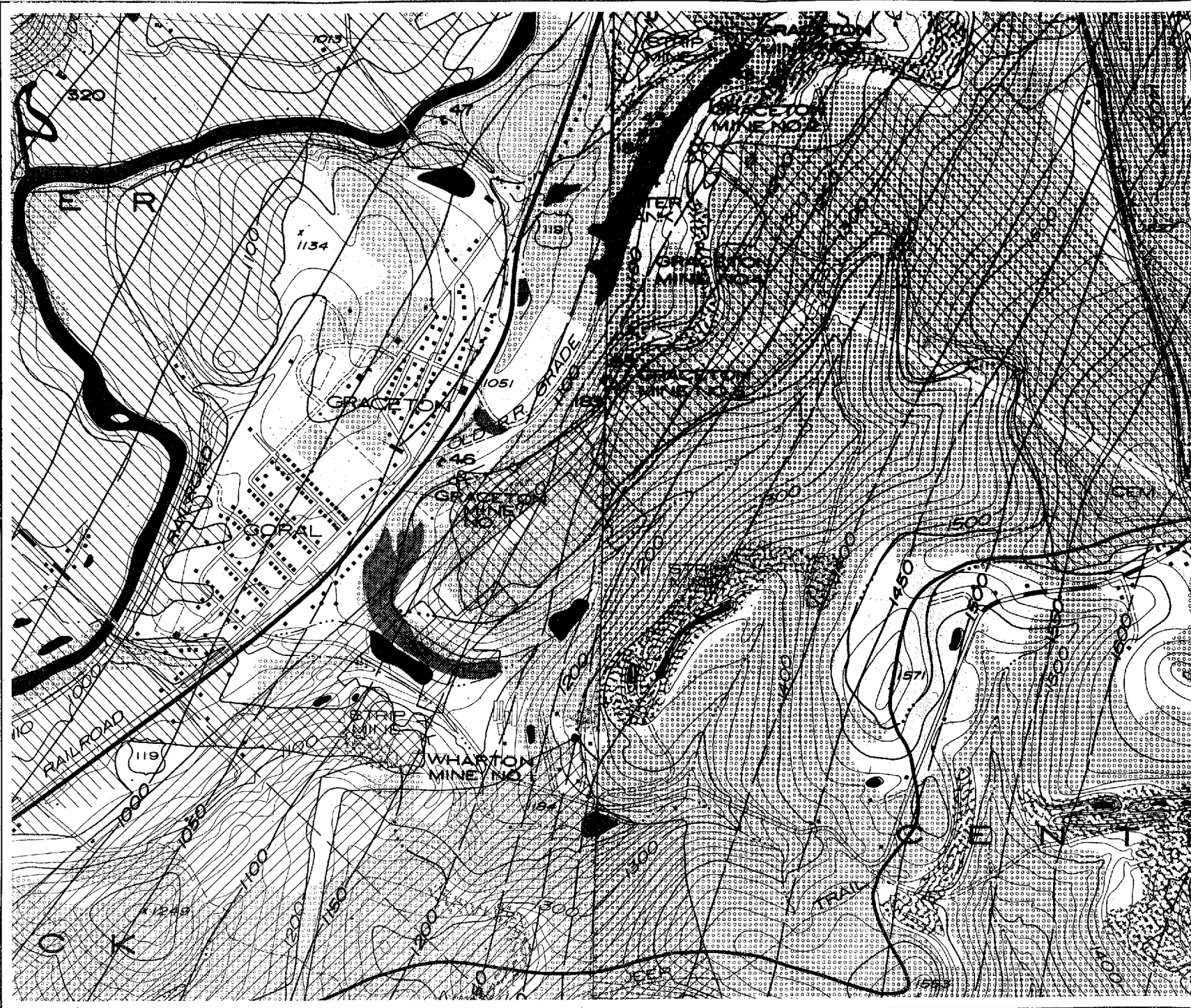


LEGEND

- KITTANNING SEAM
- FREEPORT SEAM
- UPPER FREEPORT (E) SEAM
- LOWER FREEPORT (D) SEAM
- LOWER KITTANNING (B) SEAM
- COAL REFUSE AREA (NEW)
- COAL REFUSE AREA (OLD)
- STRIP MINE AREA
- SAMPLING STATION
- DIAMOND DRILL HOLE
- MINE OPENING (DRY)
- MINE OPENING (D & A NING)
- WATERSHED PERIMETER (EXTERIOR)
- WATERSHED PERIMETER (INTERIOR)
- COAL CONTOUR UPPER FREEPORT SEAM
- COAL CONTOUR LOWER FREEPORT SEAM (COAL MISSING DUE TO EROSION)

TWO LICK CREEK
MINE DRAINAGE POLLUTION
ABATEMENT PROJECT
 INDIANA COUNTY, PENNSYLVANIA
 PROJECT N° SL109
INVENTORY MAP

 SCALE IN FEET	MARCH, 1970	
L. ROBERT KIMBALL Consulting Engineers EBENSBURG, PENNSYLVANIA		SHEET N° 2



LOWER TWO LICK CREEK

-
-
- 3

LEGEND

- KITTANNING SEAM
- FREEPORT SEAM
- UPPER FREEPORT (E) SEAM
- LOWER FREEPORT (D) SEAM
- LOWER KITTANNING (B) SEAM
- COAL REFUSE AREA (NEW)
- COAL REFUSE AREA (OLD)
- STRIP MINE AREA
- ⊥ SAMPLING STATION
- DIAMOND DRILL HOLE
- Y MINE OPENING (DRY)
- Y MINE OPENING (DRAINING)
- WATERSHED PERIMETER (EXTERIOR)
- - - WATERSHED PERIMETER (INTERIOR)
- COAL CONTOUR UPPER FREEPORT SEAM
- COAL CONTOUR LOWER FREEPORT SEAM (COAL MISSING DUE TO EROSION)

TWO LICK CREEK MINE DRAINAGE POLLUTION ABATEMENT PROJECT INDIANA COUNTY, PENNSYLVANIA PROJECT N° SL109 INVENTORY MAP

0 500 1000 1500	MARCH, 1970	N
SCALE IN FEET		
L. ROBERT KIMBALL Consulting Engineers EBENSBURG, PENNSYLVANIA		SHEET N° 3

f. Recommended Abatement Procedures - Cost Benefication

Recommended abatement treatments and related costs are listed for the various sources of pollution in Table 54.

All treatments and costs are based on data described in Section X.

A key to define the recommended abatement procedures is shown on Page 196.

Two abatement plans, a primary and alternate, are recommended for rehabilitation of the watershed.

Plan A is recommended as the primary plan and Plan B as the alternate.

An estimated effectiveness of 75% reduction of pollution load is assigned for each recommended treatment in both plans.*

Plan A is based on an arbitrary maximum cost of \$1,000.00 per pound of acid load abated and will provide an estimated reduction of acid load in the magnitude of 82% for the watershed.

Plan B is based on an arbitrary cost of \$400.00 per pound of acid load abated and will provide an estimated reduction of acid load of approximately 78% for the watershed.

Table 54a lists the sources to be abated, the amount of benefication, and costs associated with both plans.

*With the exception of treatment plants which are assigned an effectiveness of 100% reduction of pollution load.

Table 54

Recommended Abatement Procedures - Cost Benefication

Lower Portion, Main Stream, Two Lick Creek Watershed

<u>Source Name</u>	<u>Pollution Order</u>	<u>Recommended Treatment Proceasures</u>	<u>Total Cost \$</u>	<u>Cost Per Pound \$</u>	<u>Total Abatement Lbs. Acid/Day</u>
1. Graceton Strip Mine	6	31A - R3	\$ 1,705	\$ 45.47	37
2. Snyder-Waterman Fan Shaft	1	Plant	655,817	144.90	4,526
Graceton #1, #2, #4, and #5 Mines	2	Plant	230,116	144.90	1,588
3. Campbell Mine	3	6 Seals	66,000	279.31	236
4. Lucerne #3-B Mine	5	2 Seals	22,000	407.41	54
5. Graceton #2, #3, #4, and #5 Refuse Piles	4	15A - RP	110,880	492.80	225
6. Lucerne #3 Refuse Pile	7	13A - RP	96,096	2,562.56	37
7. Graceton #1 Refuse Pile	8	13A - RP	<u>96,096</u>	2,562.56	<u>37</u>
Total all Sources			\$1,278,710		6,740

Table 54a

Benefication - Recommended Plans

Lower Portion, Main Stream, Two Lick Creek Watershed

<u>Plan</u>	<u>Above Sources Abated</u>	<u>Benefication Pollution Reduction Acid</u>		<u>Benefication Pollution Reduction Iron</u>		<u>Benefication Pollution Reduction Sulfate</u>		<u>Total Cost</u>
		<u>Lbs./Day - % of Total</u>		<u>Lbs./Day - % of Total</u>		<u>Lbs./Day - % of Total</u>		
A	1 - 5	6,667	- 96%	3,592	- 99%	22,703	- 93%	\$1,086,518
B	1 - 3	6,388	- 92%	3,566	- 98%	20,969	- 86%	953,638

KEY TO RECOMMENDED ABATEMENT PROCEDURES

- R1 - Grass and legumes - Method #1
- R2 - Grass and Legumes - Method #2
- R3 - Seedlings
- F - Flumes
- D - Ditching
- B - Terrace Backfill
- A - Acreage on strip mines and refuse piles
- RP - Standard Refuse Pile Reclamation
- RB - Refuse Burial and Reclamation
- SC - Soil Cover
- Plant - Treatment Plant
- Pond - Pond Construction and Reclamation
- Seal - Mine Seal