

IV PROPOSED PLAN FOR AMD ABATEMENT

GOALS AND OBJECTIVES

The major natural resource in the area is anthracite coal and coal mining is an important factor in the present and future economy of the area. Due to the relatively low sulphur content of anthracite coal, it is a potential energy source for the Commonwealth and can be a significant factor in the national energy needs. Therefore, the existence of coal reserves in the area and the potential importance of this natural resource to the area, to the Commonwealth and to the Nation should be taken into consideration in any AMD abatement plan for the study area.

Since both water and land resources in the study area are affected by abandoned and active mining operations, the ideal abatement plan should provide the following:

- a. Eliminate present discharges of AMD into the Commonwealth streams and restore cleanstreams for beneficial use by the public.
- b. Prevent basement flooding, subsidence, mine fires and air pollution problems.
- c. Stimulate "higher and better use" of land presently consisting of abandoned strip mine and waste banks.
- d. Provide for, account for, and not interfere with future mining activities in the area.

If the plan can fulfill all the aforementioned major objectives, without introducing any new problems or detrimental side effects, then such a plan would more readily be endorsed by local, state and federal agencies. Moreover, such an endorsement would encourage active participation and financial support by these agencies.

PREVENTION OF WATER LOSSES INTO THE DEEP MINES

Surface water losses and groundwater recharge into abandoned deep mines is the major cause of AMD pollution and basement flooding, both within and outside the study area. The occurrence of land subsidence in some parts of the area is closely related to the fluctuation of mine pool levels in the abandoned deep mines.

Therefore, the prevention or reduction of the present flow of water into the deep mines is the logical and most effective method that can be employed to abate the present AMD pollution, as well as to partially solve other area problems related to the abandoned deep mines.

The present recharge of water into the deep mines also constitutes a major obstacle to the possibility of future deep mining in the area. Therefore, in addition to resolving the problems related to AMD abatement, the prevention of water losses would facilitate future deep mining in the area.

The present sources of recharge to the mine pools are as follows:

1. Losses of water from streambeds.
2. Losses of runoff in abandoned strip mine areas.
3. Direct discharges of raw sewage, storm water and industrial waste into strip pits and deep mines.
4. Groundwater flow through fracture zones into the deep mines from aquifers (water bearing formations), adjacent to the coal measures.

The magnitude of each of the above sources of water losses is presented in PART III of this report. Prevention of mine pool recharge from these water sources by the methods suggested in the proposed plan of abatement, are expected to achieve all the four major objectives (a thru d) previously described.

PREVENTION OF STREAM POLLUTION

In addition to the major AMD discharges from the mine pools into Solomon and Nanticoke Creeks, the present quality of the streams in the study area is also affected by other pollution sources. These other sources consist of direct seepage of acid water into streams from mine waste piles, raw sewage discharges and accidental spills of coal wash water into the Solomon Creek from the Blue Coal Company silt sump basin. Since there are no major mine pool discharges into Warrior Creek, effective abatement of the minor pollution sources can be undertaken in this watershed at the present

time. However, in Solomon and Nanticoke Creeks, the major discharges of AMD pollution are near the mouth of these streams indicating that the prevention of stream pollution from these major AMD sources should be undertaken prior to the abatement of all other pollution sources.

SINGLE-PURPOSE AND MULTI-PURPOSE APPROACH TO AMD ABATEMENT

If improving the quality of the study area streams was the only objective, this could be achieved by diverting and conveying the present major discharges (the Buttonwood Tunnel, the Askam and the South Wilkes-Barre boreholes) directly into the Susquehanna River. It should be noted that prior to the construction of the Tunnel outlet and the boreholes, the mine pool discharges into the river consisted of numerous seeps and outlets throughout the valley. The present rate of the major AMD discharges into the river is similar to the sum of the numerous AMD discharges into the river, prior to the constructed outlets. Therefore, the magnitude of the total AMD discharges that were in existence prior to the Tunnel outlet and the boreholes is similar to the magnitude of the present AMD discharges into the river. Although the solution of diverting the AMD discharges directly into the river will improve the quality in the study area streams, it would be a single-purpose solution that would only benefit these specific watersheds, with no beneficial effect on the river.

Consideration was also given to the neutralization of the major AMD discharges in the study area by treatment. Although neutralization would reduce the acid load presently discharging into the study area streams, it would not reduce the sulfate and manganese concentration. If the present AMD discharges are diverted into treatment plants and the treated effluent is discharged directly into the river (diversion and treatment combined), the benefits to the study area streams would be similar to the single-purpose solution of diversion. The discharge of the treated effluent into the river would, at best, reduce the present acid and iron concentration in the river by 25 percent. The sulfate and manganese concentration in the river would remain virtually unchanged. Therefore,

the treatment to neutralize the study area AMD discharges can also be considered a single-purpose solution.

Although the magnitude of the major AMD discharges within the study area was determined, the locations of the mine pool recharge sources that originate outside the study area could not be determined during the present study. Although the scope and cost of abating the major AMD discharges (from the Buttonwood Tunnel and the South Wilkes-Barre boreholes) by neutralization methods can readily be determined, the scope and cost of other abatement methods can only be determined after completion of AMD abatement studies in the adjacent watersheds. However, knowledge of scope and cost of AMD abatement by treatment enables a determination of an upper limit of the cost of abatement prior to the completion of these additional studies. For this reason, the recommended abatement measures in this report are defined as "Alternative Multi-Purpose Abatement Methods" instead of single-purpose abatement by neutralization.

Multi-purpose projects provide solutions to more than one environmental problem and are therefore expected to be of greater significance to the study area interests as well as to the Commonwealth. Such projects consist of a total approach to the management of water resources in the study area. This includes the utilization of the surface water and groundwater sources so that such water can be put into beneficial use rather than its present function as the major source of recharge to the mine pools and the AMD discharges. Cost analysis of the proposed abatement measures in the study area indicates that the detention of storm runoff in impoundments reduces the size of channels and other water conveyance structures that are required for AMD abatement projects. If such detention can be achieved while sharing impoundment storage with other aspects of water resources management for the area, the cost of such future impoundments can be shared by all area interests. Moreover, cost allocation to each single water use of a multi-purpose impoundment is expected to be considerably lower than the cost of a single-purpose impoundment. Therefore, in addition to AMD abatement benefits,

the combined utilization of impoundments upstream of the coal measures, can also provide the area with water supply, recreation. and flood control.

The reclamation and conversion of present abandoned strip and waste bank areas by local interests to residential and industrial developments is a higher and better land use that also provides direct benefits to the abatement of AMD pollution in the study area. Combined participation by local, state and federal agencies in such efforts is therefore a desirable multi-purpose approach to the solution of problems in the area.

FUNDING ABATEMENT PROJECTS

The participation of the Department in AMD abatement project is regulated by Legislation such as:

Act 82, P.L. 258, (7/07/1955), provides for anthracite mine drainage, contingent on federal aid and makes an appropriation.

Act 443, P.L. 993 (8/16/1961), amended the above Act, extended certain provisions of the act and retained certain money for the control of mine drainage from anthracite coal formations.

Act 410, P.L. 1075 (12/15/1965), grants the Department certain duties and powers to initiate a program to alleviate pollution of streams from abandoned coal mines.

Act 2, P.L. 2 (5/05/1966), provides for Pennsylvania to enter into the "Interstate Mining Compact". Two of the compact purposes are:.

- (1) To advance the protection of land, water and other resources affected by mining, and
- (2) to assist in the reduction, elimination, or counteracting of pollution or deterioration of land, water and air caused by mining.

Act 443(1/19/1968) Land and Water Conservation and Reclamation Act, authorizes the creation of indebtedness of \$500,000,000 for the conservation and reclamation of land and water resources.

Act 318,(9/24/1968), provides for the protection of Pennsylvania citizens from conditions on coal refuse disposal piles which fail to comply with the established rules, regulations or quality standards adopted to avoid air or water pollution, and gives certain powers to the Department.

Although the aforementioned acts enable the Department to participate in abatement AMD emanating from a variety of pollution sources, their efforts are usually restricted to abandoned mines. The existing regulatory powers of the Department are sufficient to prevent AMD pollution from active mines. The aforementioned acts also provide for Federal participation in AMD abatement efforts within the study area, if such participation is desired by local or state agencies. Therefore, an attempt was made in this study to recommend abatement projects that comply with the aforementioned regulations and thereby qualify for active participation by the Department.

However, if considerable savings can be realized through multipurpose projects in the area, consideration should be given by the Department to promoting the participation of other Bureaus and agencies in such projects. Consequently, the total benefits to all interests may outweigh the benefits that can be derived by singlepurpose AMD abatement projects.

Multi-purpose projects can qualify for participation by the Department of Community Affairs in land acquisition, under Act 443 (1/19/1968). These projects can also qualify for participation by the Soil Conservation Service (SCS). Such participation can include structural measures and channel improvement for flood protection in the study area (P.L. 566 funds), as well as conservation and recreation, under the SCS Resource Conservation and Development program.

PROPOSED ABATEMENT PROJECTS

The proposed abatement projects are directly related to the magnitude and direction of surface water flow within the limits of each of the three study area watersheds, as shown in FIGURES 14, 15 and 16 (pages 72, 73 and 74). The basic concept of these projects is subdivided into, two major categories, as follows:

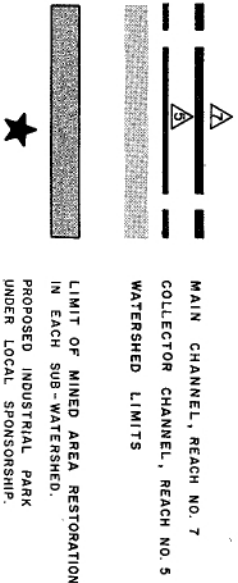
1. Interception and Transmission of Water: These abatement projects are proposed for the upper portions of the study area watersheds, upstream of the coal measures, identified as Sub-Areas A and B, FIGURE NO. 1 (pocket). Interception ditches for overland flow and diversion of streams by retention or

**A M D ABATEMENT PROJECTS
SOLOMON CREEK WATERSHED**

LOCATION	DESCRIPTION	ESTIMATED COST (\$)	ESTIMATED BENEFITS (MGT-LOSS \$/AC/DAY)	ESTIMATED BENEFITS (\$/LB/DAY)
SPRING RUN LAUREL RUN BRANCH	INTERCEPT RUNOFF FROM UNMINED AREAS & RESTORE STREAM CHANNELS MINED AREA RESTORATION (B)	1,335,500	321	4655
		1,122,000	110	1595
		2,457,500	431	6250
ZAYRE BRANCH (1) SPRING RUN	INTERCEPT RUNOFF AND RESTORE STREAM CHANNELS MINED AREA RESTORATION (A)	931,000	423	6133
COAL BROOK	INTERCEPT RUNOFF AND RESTORE STREAM CHANNELS MINED AREA RESTORATION (4)	1,196,000	352	5104
		665,000	775	11,237
MAIN BRANCH	LINE OLD CHANNEL LINE RIPRAP SECTION OF FLOOD CONTROL PROJECT AND EXTEND TO DIVISION ST.	120,000	25	363
		241,000	200(2)	2900
SOLOMON CREEK (B AREA, SEE NOTE 1)	INTERCEPT FLOW FROM UNMINED AREA (C)	350,000	70	1015
SUB-TOTAL IN WATERSHED (3)		6,764,500*	1501	21,765
* UPDATED COST ESTIMATE, SEE APPENDIX C; NOTE ORIGINAL COST ESTIMATE \$ 6,755,500 USED IN THE TEXT.				311

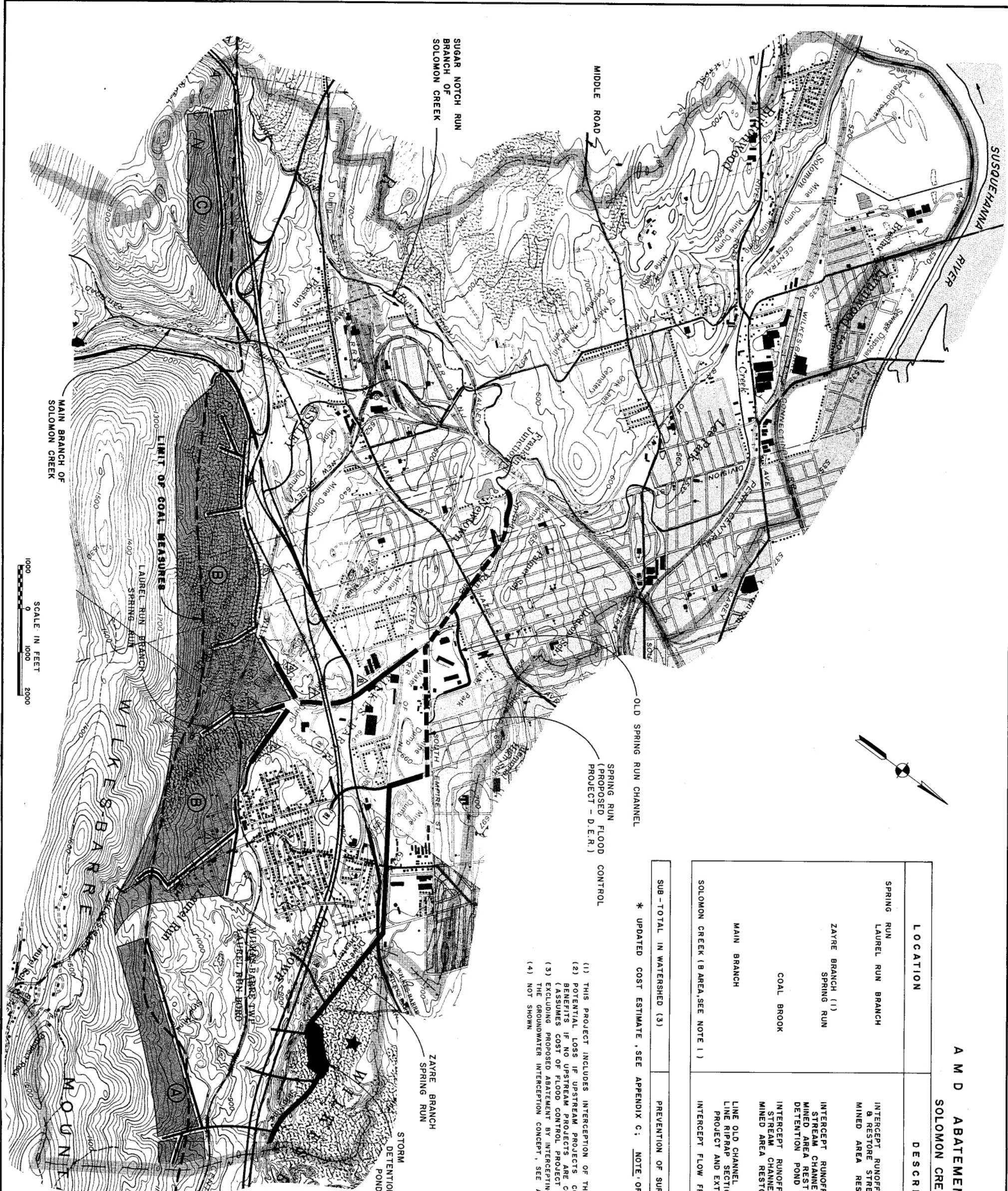
- (1) THIS PROJECT INCLUDES INTERCEPTION OF THE HEADWATERS OF COAL BROOK IN THE MILL CREEK WATERSHED.
- (2) POTENTIAL LOSS IF UPSTREAM PROJECTS CONSTRUCTED: 800 \$/LB/DAY.
(ASSUMES COST OF FLOOD CONTROL PROJECT AS AMD ABATEMENT COST - \$1,741,000)
- (3) EXCLUDING PROPOSED ABATEMENT BY INTERCEPTING GROUNDWATER RECHARGE OF DEEP MINES. FOR DESCRIPTION OF THE GROUNDWATER INTERCEPTION CONCEPT, SEE APPENDIX C.
- (4) NOT SHOWN

LEGEND



NOTES

1. FOR EXISTING CONDITIONS, SEE FIG. 3.
2. ADDITIONAL BENEFITS TO AMD ABATEMENT WOULD BE DERIVED FROM ANTICIPATED CHANGES IN PRESENT LAND USE. SUCH CHANGES CONSIST OF GRADING AND SEEDING WASTE BANKS AND FILLING STRIPPINGS BY LOCAL INTERESTS, FOR "HIGHER AND BETTER" LAND USE.



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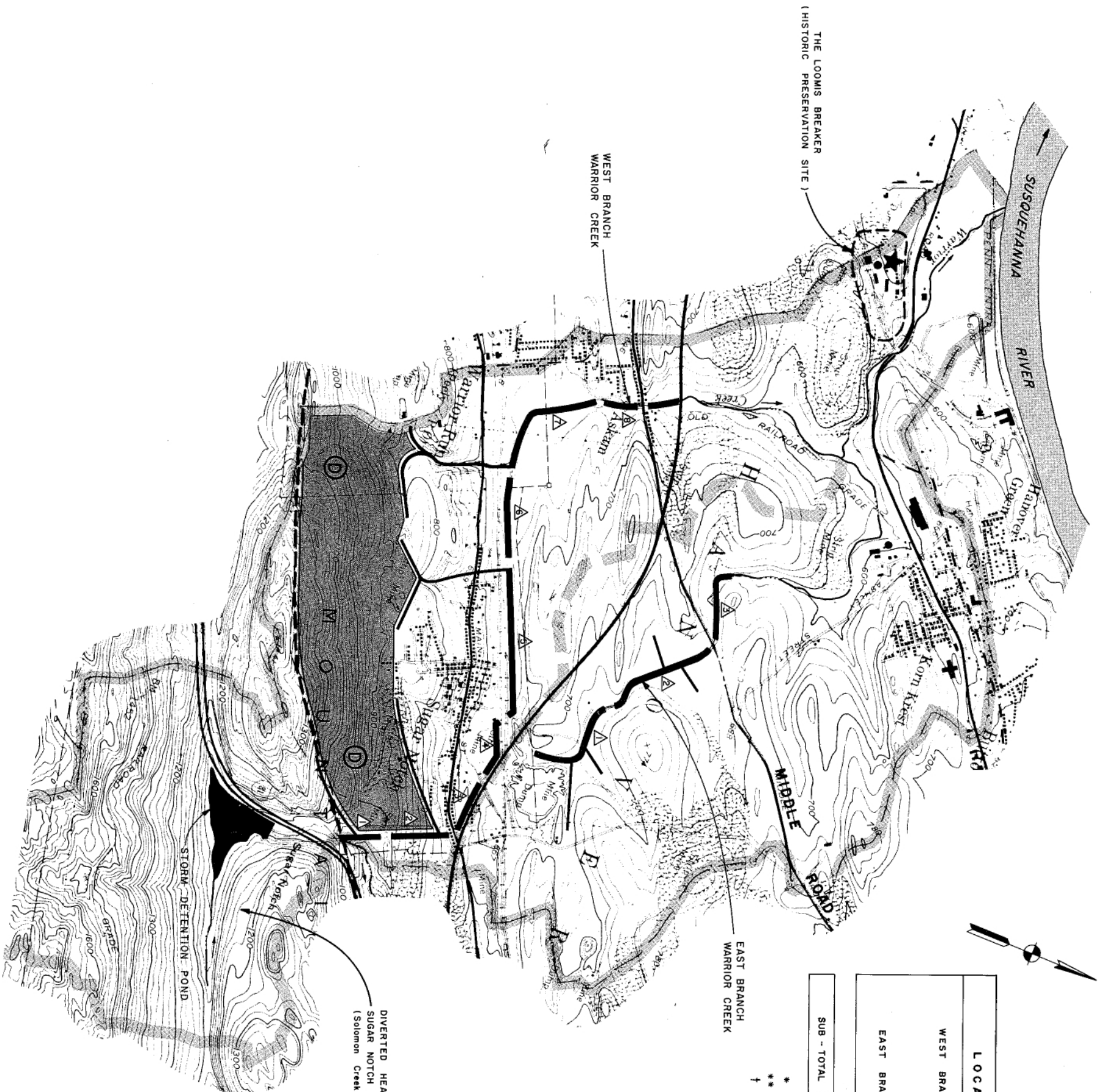
COMMONWEALTH OF PENNSYLVANIA
 DEPARTMENT OF ENVIRONMENTAL RESOURCES
AMD ABATEMENT STUDY
 NANTICOKE, WARRIOR AND SOLOMON CREEKS
 PROJECT NO. SL 181-3
 HANOVER & WILKES BARRE TOWNSHIPS, LUZERNE CO. PENNA.
PROPOSED PLAN FOR AMD ABATEMENT
SOLOMON CREEK WATERSHED

DATE: JAN. 1975
 PREPARED BY: G.E.O. - Technical Services
 CONSULTING ENGINEERS & GEOLOGISTS
 HARRISBURG, PENNA.
 FIGURE NO. 14

AMD ABATEMENT PROJECTS WARRIOR CREEK WATERSHED

LOCATION	DESCRIPTION	ESTIMATED COST (\$)	MOY-LOSS (LB/AC/DAY)	ESTIMATED BENEFITS (\$/LB/DAY)
WEST BRANCH	RESTORE & LINE STREAM CHANNEL	1,429,000	306	4437
	MINED AREA RESTORATION (D)	1,300,500	156	2262
		2,729,500	462	6699
EAST BRANCH	RESTORE & LINE STREAM CHANNEL & CONSTRUCT LINE COLLECTION SYSTEM	842,000	104	1508
				558
SUB-TOTAL IN WATERSHED **		3,571,500 †	566 *	8207
				435

* INCLUDING 288 MG/YEAR OF SUGAR NOTCH DIVERSION.
 ** EXCLUDING PROPOSED ABATEMENT BY INTERCEPTING GROUNDWATER RECHARGE OF DEEP MINES.
 † UPDATED COST ESTIMATE, SEE APPENDIX C; ORIGINAL COST ESTIMATE \$ 3,392,000 USED IN THE TEXT, TABLE XVI, PAGE 84.



DIVERTED HEAD WATERS
(SUGAR NOTCH RUN
Solomon Creek Watershed)



- NOTES:**
1. FOR EXISTING CONDITIONS, SEE FIG. 4.
 2. ADDITIONAL BENEFITS TO AMD ABATEMENT ARE EXPECTED FROM LOCALLY SPONSORED PROJECTS, RELATED TO GRADING AND SEEDING OF WASTE BANKS.

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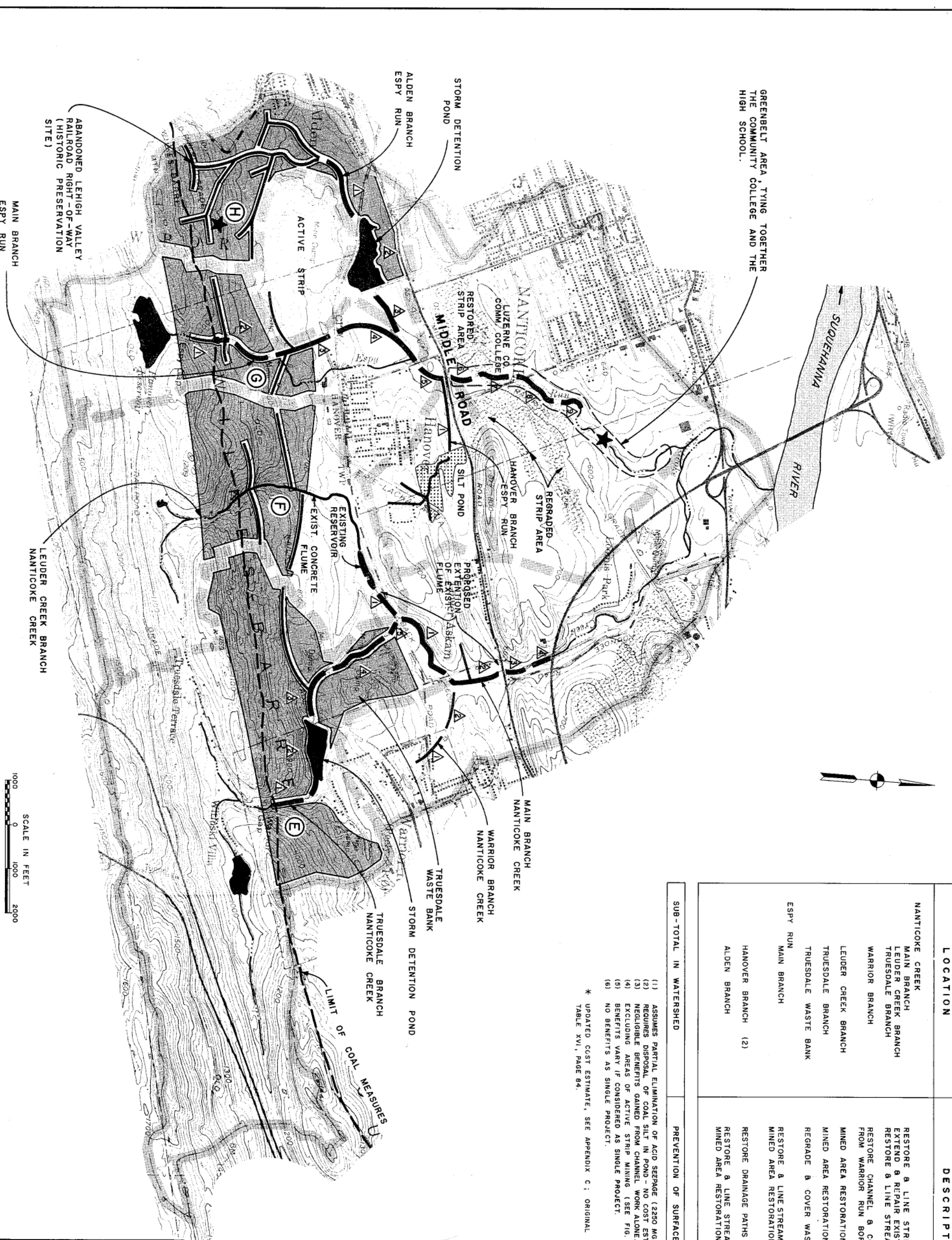
COMMONWEALTH OF PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL RESOURCES	
AMD ABATEMENT STUDY	
NANTICOKE, WARRIOR AND SOLOMON CREEKS PROJECT NO. SL 181-3 HANOVER & WILKES BARRE TOWNS, LUZERNE CO. PENNA.	
PROPOSED PLAN FOR AMD ABATEMENT WARRIOR CREEK WATERSHED	
DATE JAN. 1975	PREPARED BY GEO - Technical Services CONSULTING ENGINEERS & GEOLOGISTS HARRISBURG, PENNA.
	FIGURE NO. 15

**A M D ABATEMENT PROJECTS
NANTICOKE CREEK WATERSHED**

LOCATION	DESCRIPTION	ESTIMATED COST (\$)	ESTIMATED MG/Y - LOSS	ESTIMATED BENEFITS (LB/ACID/DAY)	ESTIMATED BENEFITS (\$/LB/DAY)
NANTICOKE CREEK					
MAIN BRANCH	RESTORE A LINE STREAM CHANNEL	686,000	45	653	-
LEUDER CREEK BRANCH	EXTEND & REPAIR EXISTING FLUME & RESERVOIR	271,000	94	1363	(5)
TRUESDALE BRANCH	RESTORE A LINE STREAM CHANNEL	575,000	320	4640	-
WARRIOR BRANCH	RESTORE CHANNEL & COLLECT RUNOFF FROM WARRIOR RUN BORO	1,532,000	459	6556	230
		347,100	60	870	399
LEUDER CREEK BRANCH	MINED AREA RESTORATION - AREA F	586,000	72	1044	561
TRUESDALE BRANCH	MINED AREA RESTORATION - AREA E	800,000	125	1813	441
TRUESDALE WASTE BANK	REGRADE & COVER WASTE BANK	720,000	(1)	1397	515
ESPY RUN					
MAIN BRANCH	RESTORE A LINE STREAM CHANNEL	997,000	133	1929	517
HANOVER BRANCH (2)	MINED AREA RESTORATION - AREA G	732,300	51	740	(6)
ALDEN BRANCH	RESTORE DRAINAGE PATHS FROM SUBSIDENCE AREA	1,729,300	184	2669	648
	RESTORE A LINE STREAM CHANNEL	216,800	37	537	404
	MINED AREA RESTORATION - AREA H	537,500	(3)	1407	(3)
		835,000	97	1407	(6)
		1,372,500	97	1407	975
SUB-TOTAL IN WATERSHED	PREVENTION OF SURFACE WATER LOSSES	7,303,700*	1034	16,393	446

- (1) ASSUMES PARTIAL ELIMINATION OF ACID SEEPAGE (2250 MG/L ACIDITY) & PREVENTION OF 8" OF INFILTRATION AT 600 MG/L.
- (2) REQUIRES DISPOSAL OF COAL SILT IN POND - NO COST ESTIMATED FOR REMOVAL.
- (3) NEGLECTIBLE BENEFITS GAINED FROM CHANNEL WORK ALONE.
- (4) EXCLUDING AREAS OF ACTIVE STRIP MINING (SEE FIG. 5, EXISTING CONDITIONS)
- (5) BENEFITS VARY IF CONSIDERED AS SINGLE PROJECT.
- (6) NO BENEFITS AS SINGLE PROJECT.

* UPDATED COST ESTIMATE, SEE APPENDIX C; ORIGINAL COST ESTIMATE \$6,637,300 USED IN THE TEXT.
TABLE XVI, PAGE 84.



LEGEND

- MAIN CHANNEL, REACH NO. 4
- COLLECTOR CHANNEL, REACH NO. 1
- WATERSHED LIMITS
- SUB-WATERSHED LIMITS
- LIMIT OF MINED AREA RESTORATION IN EACH SUB-WATERSHED.
- LOCALLY SPONSORED PROJECTS IN THE PLANNING STAGE THAT (WHEN IMPLEMENTED) WOULD INCREASE THE ESTIMATED BENEFITS OF THE PROPOSED AMD ABATEMENT PLAN.

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES

AMD ABATEMENT STUDY

NANTICOKE, WARRIOR AND SOLOMON CREEKS
PROJECT NO. SL 181-3
HANOVER & WILKES BARRE TOWNSHIPS, LUZERNE CO. PENNA.

**PROPOSED PLAN FOR AMD ABATEMENT
NANTICOKE CREEK WATERSHED**

DATE	PREPARED BY	FIGURE NO.
JAN. 1975	GEO-Technical Services CONSULTING ENGINEERS & GEOLOGISTS HARRISBURG, PENNA.	16

diversion structures would prevent or considerably reduce the present losses of surface water into the underlying mine pools. Transmission of this collected surface water by means of closed conduits, or lined channels, to the nearest stream recharge areas (Sub-Area E, FIGURE NO. 1 (pocket) would bypass the present "in-stream" water loss areas (Sub-Areas C and D, FIGURE NO. 1 (pocket). Interception of groundwater flow into the deep mines also falls under this category.

2. Prevention or Reduction of Water Infiltration: These abatement projects are proposed for selected water loss areas within the coal measures (Sub-Areas C and D). Prevention of water losses from streambeds consists of sealing or lining the stream channels. Increasing runoff characteristics and decreasing present infiltration of precipitation by regrading and by propagating plant life, will reduce the present "off-stream" water losses into the deep mines.

The approach taken in this report is based on total abatement of AMD discharges. With the completion of this study, only the projects proposed in the Warrior and Nanticoke watersheds (see FIGURES 15 and 16 -pages 73 and 74) will provide the complete abatement of AMD pollution in these streams. If this approach is acceptable to the Department, the estimated total construction cost for all the proposed projects in these two watersheds is \$10,153,000. The proposed projects will stop the Askam borehole discharges, resulting in the removal of 29,100 lbs of acid per day at the cost of \$350/lb/ day ($\$10,153,000 = 29,100/\text{lbs}/\text{day} = \$3148.9/\text{lb}/\text{day}$). If total abatement is desired, the scheduling of construction need not be dependent on individual cost of each proposed project. Using this approach, the scheduling of construction can be governed by priorities related to fiscal policies and to multi-purpose preferences for projects.

In the Solomon Creek watershed, the above approach for abatement projects will not produce a complete solution to the Buttonwood and South Wilkes-Barre AMD discharges. These projects will only abate the pollution sources that originate within this watershed. The estimated construction cost for all the projects in the Solomon Creek watershed, shown in FIGURE NO. 14 (page 72), is \$6,755,500. The construction of these projects would reduce 21,760 lbs. of acid per day from the South Wilkes-Barre boreholes

at the cost of \$310/lb/day.

A detailed scope and cost breakdown for each of the proposed projects, and a description of the groundwater interception concept are presented in Appendix C.

PRESENT STATUS OF AMD, ABATEMENT

At this writing, two abatement projects are being sponsored by the Department in the study area.

SUGAR NOTCH PROJECT: The Sugar Notch Project is an abatement plan that consists of preventing existing surface water losses in the streambed of Sugar Notch Run. The stream water will be diverted upstream of the coal measures and conveyed through a newly constructed channel into the West Branch of the Warrior Creek. The new channel will also provide for the collection of surface runoff and the prevention of present surface water losses to the deep mines in the Warrior Creek Watershed. The project is presently in the final design stage. Upon approval of the design by the Department, it is expected that the project will be implemented by 1976. The solicitation of construction bids is anticipated in May, 1975. The limits of this project are shown in FIGURE NO. 15 (page 73).

ZAYRE PROJECT: The Zayre Project is the first phase of an abatement plan in the Solomon Creek and Coal Brook watersheds. Completion of this project will benefit multiple interests in the area. The project was stimulated by the flood control provisions to be implemented by the Department in Spring Run. Additional stimulation was provided by the proposed Industrial Park, presently being planned in the area under the sponsorship of the Wilkes-Barre Chamber of Commerce.

The surface water that is presently trapped and lost within and upslope of the Zayre strip mine and water that is lost in the streambed of Coal Brook, will be conveyed to the Susquehanna River through the lined channel of the flood control project in Spring Run. The combined benefits of flood control and AMD abatement that will be realized from the construction of this project by the state and the Industrial Park by local interests, is a good example of the multi-purpose approach to AMD abatement.

The first phase of this project utilizes an existing strip pit which will be regraded as a water detention structure. A subsequent phase will provide future diversion and release of the water into Spring Run. In addition to serving the storm detention requirements for Coal Brook and preventing over taxing the capacity of the flood control channel in Spring Run, the strip pit water detention structure will also accommodate future runoff from the Industrial Park. Consequently, the runoff from the Park will not increase flooding hazards, nor will this runoff be lost into the deep mines. Bid opening for the first phase of construction was completed in January and the construction contract was awarded in February, 1975 and should be completed in one year.