# AN INTERGOVERNMENTAL PROJECT TO IMPROVE ENVIRONMENTAL QUALITY IN AN AREA OF ABANDONED MINES

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## INTRODUCTION

Mine drainage abatement has been the subject of research on the part of many state and federal agencies for years. Cooperation on such projects, also, is not new. The Environmental Protection Agency (EPA) and the Appalachian Regional Commission (ARC), for example, have cooperated on several projects in the past. However, a project specifically to evaluate interagency cooperation is new. In addition, this project is ultimately aimed at more than an evaluation of cooperation, environmental improvements accrued are the ultimate benefits.

Most of EPA's efforts in mine drainage abatement have been in the area of research and development and demonstration, in keeping with the laws under which EPA exists. Of course, the main constraint in EPA's efforts and its predecessor organizations has been the level of funding available to carry out abatement work using available technology. Technology development, however, has progressed to the point where many alternatives are presently available. While EPA and its predecessor organizations have been involved with technology development and demonstration, many other organizations, including federal, state and local governments as well as private corporations, have contributed enormously and impressively.

The Appalachian Regional Commission (ARC) was created in 1965 by the U. S. Congress to provide planning, program and financial aid to Appalachia. The ARC is a unique blend of federal and state cooperation.

Recommendations for a regional program contained in the 1963 report of the President's Appalachian Regional Commission (PARC) were significantly weighted toward resource projects. This weighting reflects several important characteristics of the President's Commission effort. Recommendations from the Commission for a regional program were to be such that they would receive generally favorable support from Congress. At that time (summer 1963), it was easier to identify generally acceptable program and project opportunities in the resources field, either in terms of development or in investigation, than in other fields such as health and welfare. Organizationally, therefore, there were a larger number of individuals and subteams directing efforts towards resource questions during the PARC effort. Each of the teams - water resources, forest resources, agricultural, recreation, coal and other mineral resources, and power - was able to draw upon a wide range of specific program and project opportunities that were available to them. Most of these represented specific and sometimes favored projects which had previously been proposed -- deferred for one reason or another -- or were an acceleration of existing activities.

### Section 205

At present, Section 205 of the Appalachian Act authorizes programs for: (1) the sealing and filling of voids in abandoned coal mines to prevent surface subsidences; (2) the extinguishment of underground and outcrop mine fires; (3) the sealing of abandoned oil and gas wells; (4) the abatement of mine drainage; (5) the reclamation of surface mine areas and mining waste banks on public lands; (6) the necessary planning and engineering required for the identification, selection, and implementation of these reclamation projects.

These projects are concentrated in or surrounding those areas with potential future growth. A major priority of this program is to reclaim land for intensive uses such as industrial and commercial development, school sites, or other public use purposes. There is a great need throughout the Appalachian Region for the creation of hazard-free lands suitable for development. Most land in mining areas is too steep for uses requiring construction and much of the land of appropriate slope is in river valleys and subject to flooding. The scarcity of this resource has been aggravated by past mining practices which have left, in some cases, otherwise useable land unreclaimed, covered with mountains of waste materials, or subject to subsidence from underground mines.

A wide array of work can be approved by ARC under Section 205 on private property so long as the mine problem stemmed from an abandoned deep mine. Only if strip mined land is owned by a non-profit, private organization, etc., or is publically owned, can the ARC make grants for surface mine reclamation. Only a fraction of the thousands of acres of stripped unreclaimed lands in Appalachia qualify as noted above. Thus, the ARC efforts to date have involved mainly deep mine reclamation work - extinguishing mine fires, mine subsidence control, refuse pile covering, etc.

Strip Mine Restoration

Four basic types of surface mine reclamation projects have been supported by ARC to date: (1) recreation areas; (2) school sites; (3) industrial parks; and (4) airport runway extensions. Recreation areas have been aided, for example, at Moraine State Park, Pennsylvania; Jellico, Tennessee; Friendship Park, Ohio; and Flemington, West Virginia. School sites have been created at Norton, Virginia; Martinsburg, West Virginia; and Luzerne County (Votech School), Pennsylvania. Industrial parks have been aided through ARC funds at Delano, Pennsylvania; Coshocton, Ohio; and Dickson City, Pennsylvania. The airport at Pittsburgh has benefitted from an abandoned strip mine restoration project which allowed an important extension on a runway.

With this in mind, EPA decided to undertake a special project based upon this available technology. This project was designed to enlist the cooperation of as many agencies as possible, at the local, state and federal levels, and to define the direction for the 208 and 303(e) sections of the law in areas where mining is a part of the continuing land use. The EPA regions are at the interface of technology and implementing pollution control. Sections 208 and 303(e) describe mechanisms regarding the planning process towards carrying this out. Another reason, and perhaps the most important one, is the cost of abatement at abandoned sites. This project was designed to be an initial step towards establishing a way for interagency cooperation using a combination of as many funding sources as possible to hopefully further the cause of pollution abatement.

## HISTORY OF THE PROJECT

At the outset, EPA contacted ARC, since a closely related contract was being administered at that time under an interagency agreement with EPA's Office of Research and Development. That contract was aimed at assessing the environmental problems of the Monongahela River Basin. Due to this, and ARC's close ties with state and local agencies in the area, EPA felt that ARC would have the greatest amount of knowledge on the Basin. An interagency agreement was then prepared specifically for this project.

For several reasons the interagency agreement is a good mechanism for a project of this kind. It places the project on firm footing by acting as a formal contract between governmental agencies. Cost savings are realized through the absorption of overhead costs as part of daily operating procedures. In addition, specific expertise is more readily available than is usually the case when formal contracting procedures with non-government organizations are used.

## SITE SELECTION AND PREVIOUS WORK

As with any project of this kind, a great deal of effort was initially expended in locating an appropriate site. In consultation with one or two states, several potential sites were discussed, all in the Ohio River Basin, with all but one located in the Monongahela River Basin. This Basin, it was felt, deserved the greatest amount of attention since EPA had supported a comprehensive study on the Basin that was carried out by the Appalachian Regional Commission. The present site at Settler's Cabin Park in Pennsylvania (Figure 1) was chosen and has proven to be the best as time has passed. For example, an important aspect of the project is its relation to 208 and 303(e), as stated previously. Shortly after the inter-agency agreement between EPA and ARC was signed, a 208 agency was designated by EPA for the Pittsburgh area. This project in Settler's Cabin Park then assumed a larger image and has now been granted additional funding for the expansion of the EPA-sponsored portions of the project, amounting to more than twice as much as originally granted by EPA.

Several sites were investigated and one by one were discarded for various reasons until one was left. The site chosen lies in an undeveloped portion of a county regional park in an area of incompletely restored strip mines, deep mines, as well as active and abandoned oil and gas wells. The review process required contact with county and state officials and part of this contact represents initiating cooperation among local, state and federal agencies. The site chosen will act as a test case for this cooperative effort within the bounds of legislation and regulation and part of the project will result in a critique of this inter-agency cooperation.

Over a million people live within the immediate vicinity of the Settler's Cabin Regional Park. The Allegheny County Commissioners, many years ago, as part of a recreation development master plan, located in various sections surrounding metropolitan Pittsburgh a number of regional parks. The site of this proposed project has remained in a somewhat undeveloped state due to the adverse environmental effects of previous mineral exploitation. With the growth of the greater Pittsburgh area and especially the growing concentration of housing areas to the west and southwest of Pittsburgh in the corridor between downtown Pittsburgh and the Greater Pittsburgh Airport, the importance of making the Settler's Cabin Regional Park available for public use is even more important than in the past.

The Settler's Cabin Mine Reclamation Project is located in Allegheny County, Pennsylvania, southwest of the City of Pittsburgh. Settler's Cabin Park is named for the ancient log cabin being restored at the park. Future programs at the Cabin will accent regional history and the life style of the early settlers. The park area includes some land which was formerly used for farming. The remnants of these various commercial uses will provide rich and varied subject matter for future nature interpretive programs, in addition to the extensive history of energy related extraction activities.

Nearing 1,000 acres, this park site offers a variety of attractive picnic areas and playground equipment, and when the requested mine reclamation work is done, the park will be nearly ready for full utilization. The Park layout is shown in Figure 2. A unique trail system is under development for this park. It will encompass the natural resources of the area as well as the remnants of previous commercial land uses.

### Site Justification and Benefits

Pinkerton Run is located in the center of a county park within the Pittsburgh metropolitan area, and reclamation will result in reduction of acid load in the stream. Water based recreation is a major part of the county park plan. The County has twice postponed the development of recreational facilities along Pinkerton Run because of the acid mine drainage problem. Matching State funds are available for park development if the mine drainage pollution problem can be

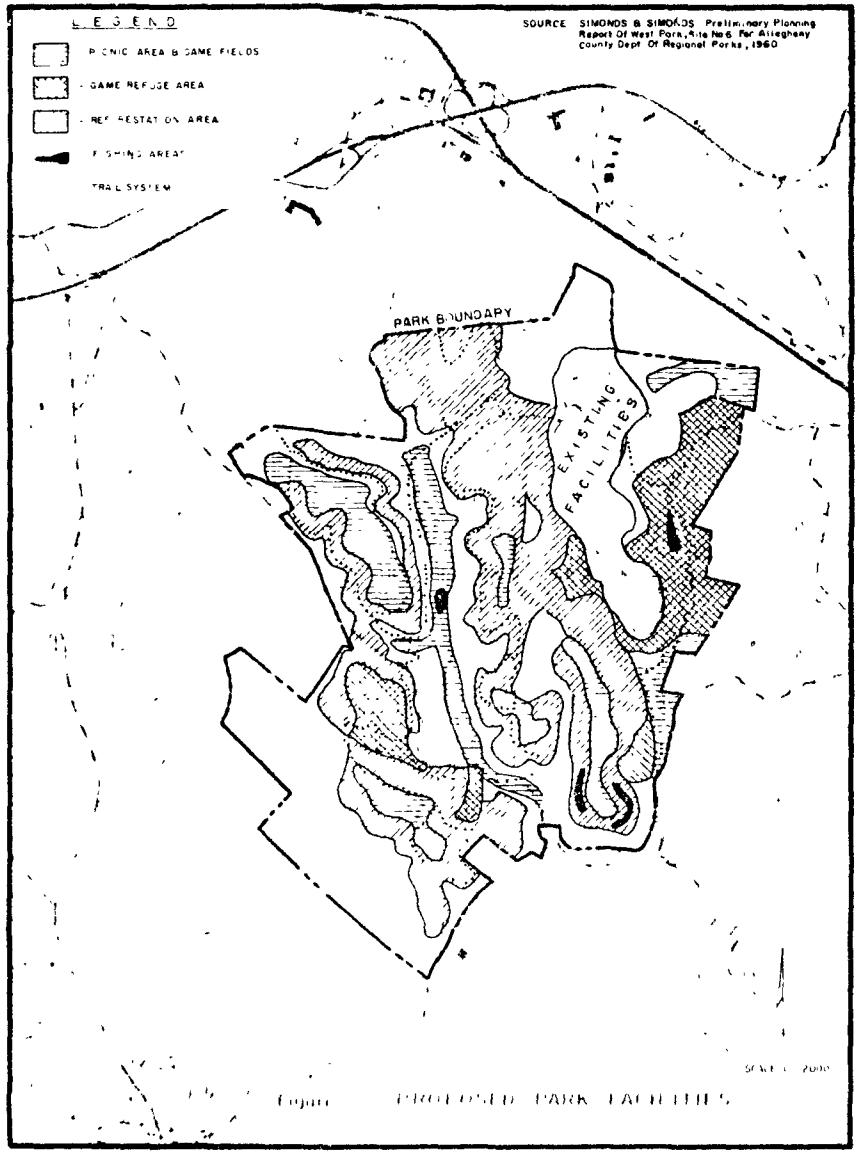


Figure PROPOSED PARK FACILITIES

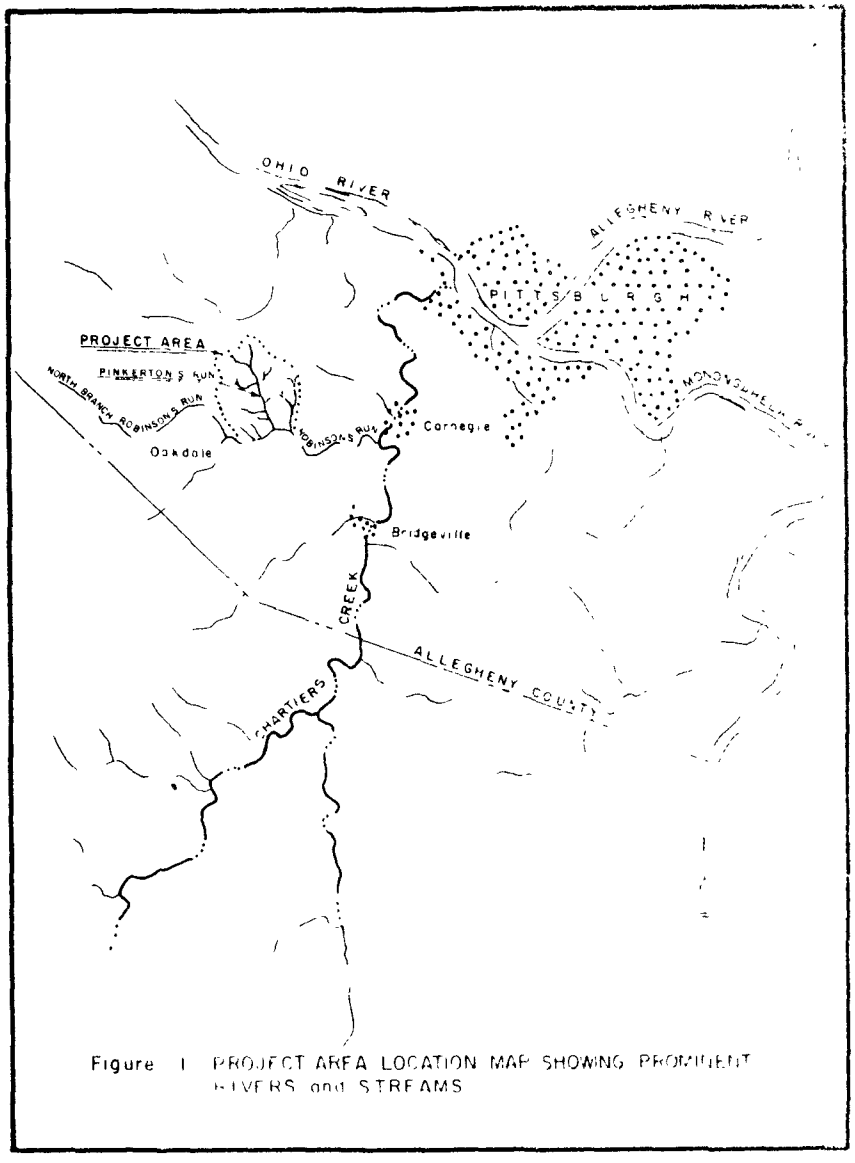


Figure 1 PROJECT AREA LOCATION MAP SHOWING PROMINENT RIVERS and STREAMS

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successfully reduced. Related projects outside the Pinkerton Run area [illegible] now in the design or execution phase will, when coupled with the proposed [illegible] the Settler's Cabin Regional Park, have an impact on the overall improvement of water quality in Pinkerton Run. The entire area of the park is publicly owned and construction could be performed within a short period of time rather than being subjected to long delays which are sometimes encountered when construction is scheduled on private property.

The park reclamation plan will be worked out as noted elsewhere to both reduce pollution and to provide the best possible recreation use of the existing land forms. Possible use of the restored strip mines may include development of archery ranges, ball fields, outdoor amphitheaters, campsites and nature study areas. The revegetation of selected areas may include development of an arboretum. Many areas that already sustain a stand of "volunteer" trees will be preserved as far as possible and insofar as these sites and their vegetation do not require movement for abatement work. Hiking trails and similar access may be developed from roads built for equipment entry for the reclamation work.

## PRELIMINARY INFORMATION

The Commonwealth of Pennsylvania, through its Department of Environmental Resources (DER), under the funds made available from the "Land and Water Conservation Bond Issue", supported an investigation of the Chartiers Creek watershed several years ago. As part of this overall inventory of mining related pollution problems in the Chartiers Creek, which is tributary to the Ohio River, certain tracts of land in and near the park were identified as being serious or important pollution problems. The references in this section will relate to the identification of these sources and suggested solutions as noted in the referenced site, performed by the consulting engineer firm of Ackenheil and Associates Geo Systems, of Pittsburgh, Pennsylvania, under DER sponsorship under project SL 102.

1. Pinkerton Run is a tributary to Robinson Run and contains no major sources of pollution. However, five minor sources affect Pinkerton Run in its lower reaches.

2. Following tabulation is the water quality parameters for the above listed sources. The flow is in gallons per minute and the parameters are reported as pounds per day.

| Source | Flow | Acidity | Alkalinity | Hardness | Sulfate | Iron | Manganese | pH |
|---|---|---|---|---|---|---|---|---|
| 4668 | 15 | 86 | 0 | 144 | 248 | 7.4 | 0.7 | 2.8 |
| 4669 | 90 | 346 | 0 | 908 | 1270 | 5.7 | 1.9 | 2.9 |
| 4670 | 30 | 8 | 0 | 159 | 5 | 0.1 | 0.3 | 4.1 |
| 4671 | 17 | 51 | 0 | 286 | 337 | 2.1 | 1.5 | 3.0 |
| 4672 | 25 | 315 | 0 | 294 | 713 | 26.3 | 2.3 | 2.8 |

3. The following is the tabulation of the strip mines which have a direct effect on the park area and the estimates cost (1970) to improve the drainage through these strip mines or to totally reclaim the strip mines. These costs are shown in Chapter C-11 of the Chartiers Creek Pollution Abatement Survey:

| Strip Mine | Acreage | Improve Drainage Only | Reclaim |
|---|---|---|---|
| OAK 27 | 48 | ------- | $ 45,500 |
| OAK 28 | 6 | $ 3,600 | 14,100 |
| OAK 32 | 101 | 54,400 | 107,000 |
| OAK 33 | 50 | ------- | 41,300 |
| OAK 34 | 102 | 9,000 | 57,500 |
| OAK 35 | 102 | 61,000 | 130,000 |

The description of the study area included in this chapter encompasses not only Settler's Cabin Park, but also privately-owned property around the periphery of the park. This slightly expanded study area was developed because of the difficulty in analysis of mining, related surface features, and mine drainage discharge points within a confined area. Actually, most of the deep mines that contribute to mine drainage within the park extend beyond the park boundary.

The study area is contained within the Robinson Run Watershed. Pinkerton's Run originates outside Settler's Cabin Park in North Fayette Township and flows through the park before discharging into Robinson Run, then into Chartiers Creek, and ultimately into the Ohio River. The location is shown on Figure 1, along with the major drainage basins of the area.

## Topography

The Pinkerton's Run study area is part of the Allegheny Plateau geomorphic province. The rock strata encountered are essentially horizontal. The landscape is an erosional one where valleys have been carved by streams downcutting through layers of sedimentary rock. Land areas between valleys remain as topographic highs but have a moderately rounded appearance due to weathering and erosional forces. The valley wall slopes generally range from about 25% to about 40% while the rounded valley divides have more gentle slopes ranging from about 4% to about 10 The maximum relief of the study area is roughly 400 feet. The Pittsburgh coal seam outcrops along valley walls within the project area. The coal had great economic value and has been extensively deep and strip mined resulting in altered land forms.

## Geology

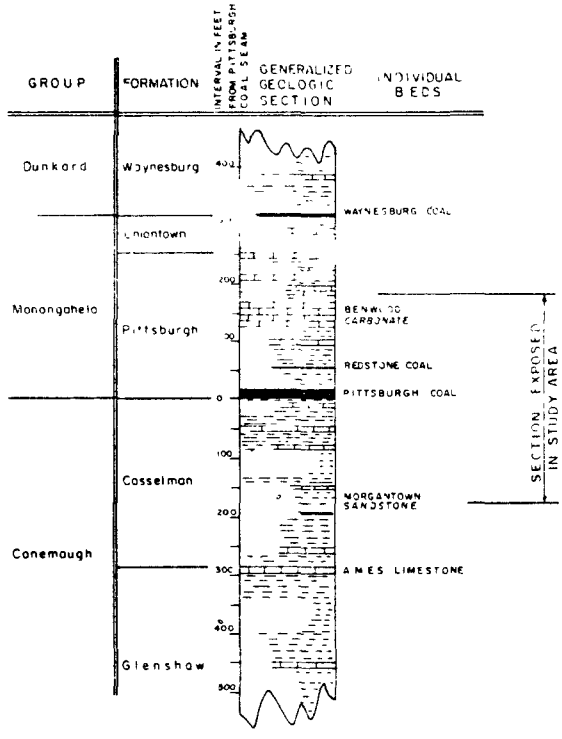
The sedimentary rock strata outcropping in the Pinkerton's Run study area are of Pennsylvanian age. The rock types generally encountered are interbedded sandstone, shale, limestone and coal. The rock strata are members of the Monongahela and Conemaugh Groups. The contact between these two groups marks the position of the economically valuable Pittsburgh coal seam. A generalized columnar section showing the rock units exposed in the study area appears in Figure 3.

The strata exposed in the study area dips slightly toward the south. Structure contours on the base of the Pittsburgh coal seam reflect the gentle southward dip.

## Soils

Soil associations are groups of soils which ordinarily occur together in the landscape. Each soil has its characteristic location depending on the land slope and material from which it was derived. The soil associations are named in order of their importance within the association. For instance, the Westmoreland-Guernsey soil association is composed primarily of Westmoreland soils with secondary amounts of Guernsey soils, as well as other minor soils. The Pinkerton Run study area generally exhibits two soil associations. These soil associations and a brief general physical description of each are listed on the following table:

| Soil Association | Description |
|---|---|
| Westmoreland-Guernsey-Clarksburg | Soils have developed in material derived from weathered shales, sandstones and limestones. Slopes range from gentle to steep, but are mostly moderate. |
| Westmoreland-Guernsey | Soils have developed in material derived from weathered shales, sandstones and limestones. Slopes are steep. |




DATA FROM GEOLOGY OF THE PITTSBURGH [illegible]
GENERAL GEOLOGY REPORT [illegible]
Published by PA GEOLOGICAL SURVEY

Figure 3 GENERALIZED COLUMNAR SECTION

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Each soil series takes into account several physical characteristics, each partially determining their potential erodibility. The potential soil erosion limit for any location can be estimated by combining the physical soil characteristics with the slopes on which they are found. Potential soil erodibility applies to areas distrubed by the activities of man, such as strip mining. In general, the potential erodibility of the existing soil associations within Settler's Cabin Park is estimated as high, except in flat or moderate slope areas where the potential erodibility is estimated as medium.

## Water

### Water Quality

The water quality of the Settler's Cabin Park area is affected primarily by acid mine drainage. In an underground mine, water percolates through the overburden and contacts pyrite in the strata lying above the coal (usually carbonaceous shales and sandstone). The water then flows along the floor of the mine and eventually discharges at an outcrop or exposed entry or, in some cases, rises to the surface under artesian pressure. All but two of the 25 documented acid mine drainage discharges routinely collected during the sampling period were gravity drained deep mine discharges. The remaining two acid discharges resulted from an unreclaimed strip mine in which runoff becomes entrapped in depressions and contacts acid forming strip mine spoil material.

Acid mine drainage most seriously affects Pinkerton's Run and its major tributaries which are continuously polluted. The streams monitored by SR-3 and SR-4 are also continuously polluted by acid mine drainage. The least affected stream is monitored by station SR-6, its eastern tributary monitored by SR-16 is relatively clean, while the western branch monitored by SR-5 is intermittently affected by acid mine drainage. The effect of acid mine drainage pollution on the aquatic life of the project area is significant. A comparison of the chemical water quality during the study and the concentrations required to sustain viable fish populations provide little or no likelihood that fish live within the park. A possible exception would be upstream of Station SR-16 where the chemical water quality during the sampling period remained acceptable.

A field investigation was performed to locate and sample mine drainage discharges. Twelve deep and strip mine discharges were known from the Chartiers Creek Mine Drainage Pollution Abatement Survey, which was published in 1970. A total of 80 mine drainage discharge points and stream monitoring stations were located by the field crews. However, most of the mine drainage discharges were located during the period of high ground water and subsequent high mine flows. Consequently, for the purpose of routine sample collection and monitoring for 15 weeks, the sampling program was reduced to include 49 samples. Of the 49 samples, 25 were from localized mine drainage discharge points and 24 were established as stream monitoring stations. Grab samples were obtained at each station and were analyzed for pH, acidity, alkalinity, total and ferrous iron, sulfates and aluminum. All grab samples were obtained with a corresponding flow measurement.

No evidence was found to indicate either organic or industrial pollution. Seventeen BOD (Biochemical Oxygen Demand) tests were conducted at selected stream locations throughout the project area. These tests revealed a high level of dissolved oxygen, which normally indicates little or no organic enrichment.

### Water Supply

The Pinkerton's Run study area is partially serviced by the West Allegheny County Municipal Authority. Homes located along Pinkerton Run Road receive service from the Authority. The municipal water treatment plant has a design capacity of 0.7 million gallons per day, but only used an average volume of 0.223 million gallons per day in 1973. No water wells were known to exist in the project area, according to data available in 1973.

## Ground Water

The major water bearing beds which are potential sources of water supply in the Pinkerton's Run study area are the Pittsburgh Sandstone, Connellsville Sandstone and Morgantown Sandstone. The reliability of the Pittsburgh Sandstone, which overlies the Pittsburgh coal, is questionable as a water source in the study area. This is because the Pittsburgh coal has been extensively mined and subsequent subsidence of the overlying strata has probably drained the aquifer. The Morgantown Sandstone, which lies roughly 150 to 220 feet below the Pittsburgh coal, is the best and most persistent aquifer in the area for domestic uses, and is permeable enough to sustain some public water supplies. The Connellsville Sandstone is not as reliable an aquifer in the study area as the Morgantown Sandstone. This is because the Connellsville Sandstone, which lies 30 to 60 feet below the Pittsburgh coal, is more shaley and thus less permeable. However, areas which are not shaley are generally permeable enough to sustain domestic needs.

Unconsolidated deposits of alluvium on the flood plain of Pinkerton's Run could prove to be a source of water. The water bearing potential of the unconsolidated flood plain material is dependent on its thickness and lithology and warrants further study.

## Mining History

Deep mining activities in the general area of the Pinkerton's Run Watershed roughly covered the years 1908 through 1937. Mining operations were conducted using the room and pillar method where drift entries were driven to provide access to the coal. The coal was then mined from room-size areas leaving pillars of coal in place to provide roof support. This phase of the mining operation occurred roughly from 1913 to 1932.

The final phase of mining involved the recovery of the coal pillars as deep mining operations concluded. Most of the mining was done under shallow cover causing localized subsidence and subsequent disruption of surface and subsurface patterns. The numerous mine openings in the area were usually left unsealed, allowing water and air to enter the mine complex which contributed to the acid mine drainage problem.

Strip mining operations were primarily conducted in the 1940's. The coal left in place by previous deep mining was entirely stripped from the coal outcrop following the contours of the land surface. Many of these strip mines were improperly reclaimed and now provide a means for surface water to enter the deep mine where it can discharge as acid mine drainage. No strip or deep mines are currently in operation within the watershed.

# ANALYSIS OF DATA

All available mine maps were obtained. An overlay was prepared in an effort to ascertain where underground workings were near the surface or had been intercepted by surface mining.

Following the collection of water quantity and quality data, mine maps, and other available sources of information, an analysis was made of alternative pollution abatement plans which would maximize acid load reduction, be least cost in effectuating, and blend in best with the long-term park department plans.

From the process of screening abatement plan alternatives, a recommended abatement plan was developed. This section summarizes that plan and includes a preliminary scope of work with cost estimates.

General

A comprehensive mine drainage abatement plan was devised for Settler's Cabin Park which includes five steps or phases for implementation. The first phase, or Phase I, should, by itself, be sufficient to fulfill the technical criteria of achieving an inflow of 30 mg/l of net alkalinity concentration at each stream monitoring station in the Pinkerton's Run Watershed during the once in ten year, seven day consecutive low flow. The plans are numbered Phase I through Phase V, with each phase being successively more complex.

Certain individual abatement methods are common to all five phases. These common methods were judged to be the minimum requirements necessary to achieve the project objectives in all five phases.

The first and most important abatement method common to the five phases is the reclamation of the strip mine formally designated OAK 30 in the Chartiers Creek report and designated here as Work Area No. 1. Work Area No. 1 was recommended in the Chartiers Creek report as a method of decreasing the flow at mine discharge 4688. The design of the project was authorized by DER as Project SL 102-7-20. Plans, drawings, and a cost estimated were completed for this site, although the design was never finalized by DER. Reclamation of strip mine OAK 30 was halted when the property owner, Patrick J. Fleck, doing business as Deep Valley Coal Company, obtained a mine drainage permit, 3474SM15, for an area covering OAK 30. As of this writing, a strip mine permit has been applied for but has not been granted for OAK 30.

Two mine drainage discharges were attributed to Work Area No. 1. Since the two discharges result only during or after a storm when water-filled depressions overflow, these two sources have the capacity to degrade Pinkerton's Run with a slug of acidic water.

The second abatement method found in all five alternatives is an interceptor system designed to collect localized deep mine discharges and bypass the streams and eventually discharge the collected AMD into Robinson Run, either treated or untreated, depending upon the selected plan.

## ABATEMENT SUMMARY

The location of all recommended work areas is shown by phases on the abatement plan, and an impact summary of all phases is shown on Table 1. A "no-action" alternative is also summarized for baseline establishment.

## COST SUMMARY

Provided on Table 2 is a summary of the total estimates costs to implement each phase. Part of the capital costs include estimated engineering and design services, exclusive of surveying, aerial photography and map preparation. All costs are derived from 1976 unit prices for construction labor and materials or adjusted to 1976 based on the "Engineering News Record" 20 cities construction cost index. Finally, capital costs were amortized at 7% interest for 20 years and added to estimated operation and maintenance costs to yield an equivalent annual cost for each phase. All estimated costs have been rounded to the nearest $1,000.

TABLE 1

IMPACT SUMMARY OF ABATEMENT PLAN BY PHASES

| | Water Quality | Ecology | Aesthetics | Recreation |
|---|---|---|---|---|
| No action | Waters will remain polluted by AMD and will have little recreational value | Abandoned strip mines will prohibit vegetation, continued depressed aquatic habitat | Unsightly strip mines and deep mine refuse areas will persist | Restricted by strip mines, poor vegetation and subsidence areas |
| Phase I | Improve water quality of Pinkerton's Run and unnamed tributary monitored by SR-6 | Improve the aquatic ecology conditions of Pinkerton's Run and 3 major tributaries | Rehabilitation of Work Area 1 will improve the attractiveness of that location | Return the location to productive use in accordance with park planning |
| Phase II | Improves water quality by reducing infiltration to deep mine | Improves aquatic and terrestrial habitat within the park | Increase aesthetic value of park | Returns 63 acres to productive recreational lands |
| Phase III | Improves water quality by reducing siltation | Improves the terrestrial habitat and facilitates park planning | Increases aesthetic value of park | Returns an additional 77 acres to productive recreational lands |
| Phase IV | Restores tributary at SR-17 | Improves the terrestrial and aquatic habitat, enables picnic area development | Increases aesthetic value of park | Returns an additional 34 acres to productive recreational lands |
| Phase V | Improves the water quality of additional streams beyond the park boundary | Improves the aquatic ecology at streams beyond park boundary | Reduction of chemical precipitates in Robinson Run | Allows greater public utilization of streams |

TABLE

COST SUMMARY

| Phase | Estimated First Costs Construction | Engineering | Total | Estimated Operation and Maintenance Costs Per Year | Equivalent Annual Cost |
|---|---|---|---|---|---|
| I | $326,000 | $17,000 | $343,000 | $11,000 | $43,000 |
| II | 69,000 | 6,000 | 75,000 | - | 7,000 |
| III | 42,000 | - | 42,000 | - | 4,000 |
| IV | 863,000 | 63,000 | 926,000 | - | 87,000 |
| V | 1,369,000 | 102,000 | 1,471,000 | 107,000 | 246,000 |

## CONCLUSION
## WHERE ARE WE NOW?

The cooperating agencies have been maintaining liaison and good rapport with information exchange taking place throughout the project to date. Each organization has contributed to the collection and development of the data available to the consultant. The site has been inventoried, alternatives defined, and recommendations costed out. The next step is to initiate engineering plans and specifications on those specific tasks chosen for early abatement action.

The decision regarding priorities for physical work will be arrived at through dialogue between the local, state, regional, and federal cooperating agencies. Engineering on high priority sites will be well underway by the time this paper is delivered. Funding for this engineering will be available in part from EPA sources.

In the event DER, through the Pennsylvania Governor's Office, applies to ARC for grant funds for all or part of the abatement work, the ARC can, under Section 205, provide up to 75% of the engineering and construction costs of mine reclamation projects on qualifying sites. Decisions on such application endorsement and funding are expected within the next year.

Local, county, or state fund availability for the non-federal portion of costs must also be arranged. It may be possible to use cash, materials, or services, or combination thereof, to complete the non-federal portion of the project costs. Concurrent with the engineering and construction work, a study of the institutional and land-use implications will be initiated.

In conclusion, the authors feel that this type of project can be a prototype of local-state-regional-federal cooperation and an example of restoring surface mines to useful secondary land use that may be replicated elsewhere.

## APPENDIX

### Plan Description

The recommended sequence of implementation for the abatement begins with Phase I and proceeds with a comprehensive plan for the project area, culminating with Phase V. This section describes the recommended scope of work.

### Phase I

Phase I includes the reclamation of one strip mine and for the installation of an interceptor system designed to intercept 10 AMD discharges and bypass Pinkerton's

Area 1. It is located on land owned by Patrick J. Fleck. The area is currently under a mine drainage permit. If the area is to be strip mined, close cooperation with the Bureau of Surface Mine Reclamation is needed to insure adequate reclamation of Work Area 1.

Scope of Work

Regrade 26 acres of Work Area 1 to provide positive drainage, drain and treat existing water-filled depressions, close two mine openings. Construct 2,200 lin. ft. of diversion ditch at the top of the existing highwall, and install 290 lin. ft. of bituminous flume across the required bench to minimize infiltration into the spoils.

Install 23,000 lin. ft. of plastic pipe from 10 AMD discharges. Install concrete catch basins at 9 discharges and excavate a trench through the toe of the reclaimed strip mine upstream of SR-23 to place a perforated pipe to collect AMD seepage. Install a total of 78 manholes, one at every pipe confluence and at every 300 lin. ft. along each interceptor. The pipe is to be installed at a minimum of 4 ft. below the ground surface and should parallel the streams along the floodplain. The impact of this Phase I work is shown in Table 3.

Phase II

Phase II adds the restoration of five portions of unreclaimed strip mines. All five areas currently contain depressions which restrict natural surface drainage and allow infiltration from water-filled depressions into adjacent abandoned deep mines. The work areas are designated 2, 5, 7, 8, and 10.

Scope of Work

Regrade a total of 18 acres in five unreclaimed strip mine areas to provide positive drainage and revegetation. Samples of the upper spoil layer should be tested for nutrients and fertilizer requirements to insure adequate soil treatment.

Phase III

Phase III consists of revegetating four strip mines with appropriate grasses, legumes, trees and shrubs. The revegetation will enhance the aesthetics of the park, facilitate development of proposed revegetation facilities, provide a buffer zone between existing and proposed high density picnic areas and unsightly strip mines, and minimize erosion.

Scope of Work

Revegetate a total of 77 acres in Work Areas 3, 4, 6, and 11. Appropriate grasses, legumes, trees and shrubs for reforestation areas and game refuge areas, and their locations, are shown on the abatement plan map.

Phase IV

Work Areas 9 and 12 are approximately 30 to 50 ft. above an abandoned deep mine. Roof collapse in the deep mines and subsequent fracturing of the rock units above the coal have caused extensive surface subsidence in each of these areas. This subsidence causes severe limitations upon land development within the park, especially Area 12 which is intended to become a picnic area. Moreover, Area 9 is promoting rapid infiltration of storm runoff through subsidence areas. This infiltration probably discharges as part of AMD source 4676 located at the headwaters of the stream monitored by station SR-3. Also, the interpretation of subsurface structure and mine drainage patterns indicates that the mine complex of Work Area 12 is responsible for the 380 lbs. per day of acid monitored at station SR-17.

TABLE 3

ESTIMATED WATER QUALITY FOLLOWING THE IMPLEMENTATION OF PHASE I

| Monitoring Station | Existing Water Quality* | | | | | Estimated Water Quality After Phase I | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Flow (gpm) | pH | Net Alkalinity (mg/l) | Total Iron (mg/l) | Total Aluminum (mg/l) | Flow (gpm) | pH | Net Alkalinity (mg/l) | Total Iron (mg/l) | Total Aluminum (mg/l) |
| SR-2 | 2241 | 3.6 | -35 | 2.9 | 6.8 | 1490 | 6.1 | 61 | 2.3 | 1.5 |
| SR-7 | 125 | 3.6 | -181 | 9.2 | 15.4 | 40 | 6.4 | 218 | 0.0 | 0.0 |
| SR-8 | 231 | 3.1 | -168 | 5.0 | 17.4 | 90 | 6.1 | 59 | 0.0 | 5.6 |
| SR-11 | 1141 | 4.4 | -30 | 2.5 | 4.7 | 790 | 6.0 | 46 | 0.0 | 0.0 |
| SR-13 | 251 | 4.7 | -55 | 1.9 | 6.4 | 70 | 6.5 | 247 | 2.3 | 0.0 |
| SR-14 | 431 | 4.6 | -34 | 5.2 | 7.4 | 260 | 6.3 | 147 | 0.0 | 0.0 |
| SR-15 | 210 | 4.5 | -35 | 2.7 | 7.5 | 210 | 4.5 | -35 | 2.7 | 7.5 |

* Based upon sample data, estimated water quality is based upon similar flow condition as the sample data.

Daylight or excavate the deep mine workings of 3 acres of Work Area 9 and 51 acres of Work Area 12. Remove remnants of the main Pittsburgh coal plus roof and bony coals and the Pittsburgh rider coal. Approximately 6,000 and 62,000 tons of marketable coal for Work Areas 9 and 12, respectively, could be recovered to offset the construction costs.

In Work Area 9, place approximately 2,700 cu. yds. of rock filter material along the working face before backfilling, if additional deep mine drainage is encountered. Regrade to approximate original contour. For Work Area 12, place a clay blanket and select relatively impervious spoil material along the northern work limits prior to backfilling. Backfill and grade to finished contours for the proposed picnic area development.

Phase V

The final phase of the recommended abatement program includes a lime neutralization treatment facility to chemically neutralize the AMD conveyed by the Phase I interceptor system and for the construction of additional interceptors from AMD discharges 4673 through 4688 located to the west and southwest of the project area.

This phase is intended as a long range goal and should be considered as a possible component of a more comprehensive appraisal of mine drainage and water resources problems throughout the Robinson Run and Chartiers Creek drainage basins.

Scope of Work

Install approximately 31,000 lin. ft. of plastic pipe to intercept at least 11 AMD discharges designated 4673 through 4688 in the west and southwest portions of the project area. The AMD sources should be conveyed by gravity to a lime neutralization treatment facility located in the flood plain of Robinson Run near the confluence with Pinkerton's Run. The treatment facility will chemically neutralize and oxidize the mine drainage such that the discharged effluent will comply with Title 25, Chapter 95, Water Quality Criteria for pH and iron.

The design flow for the treatment facility was estimated at 2,500 gal. per minute with a weighted average acidity concentration of 275 mg/l. All design parameters for the unnamed tributary to the North Branch of Robinson Run, monitored by station SR-12, were estimated due to AMD discharges beyond the scope of the current survey. Additional flow and water quality characteristics should be obtained along this stream reach for design purposes.

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