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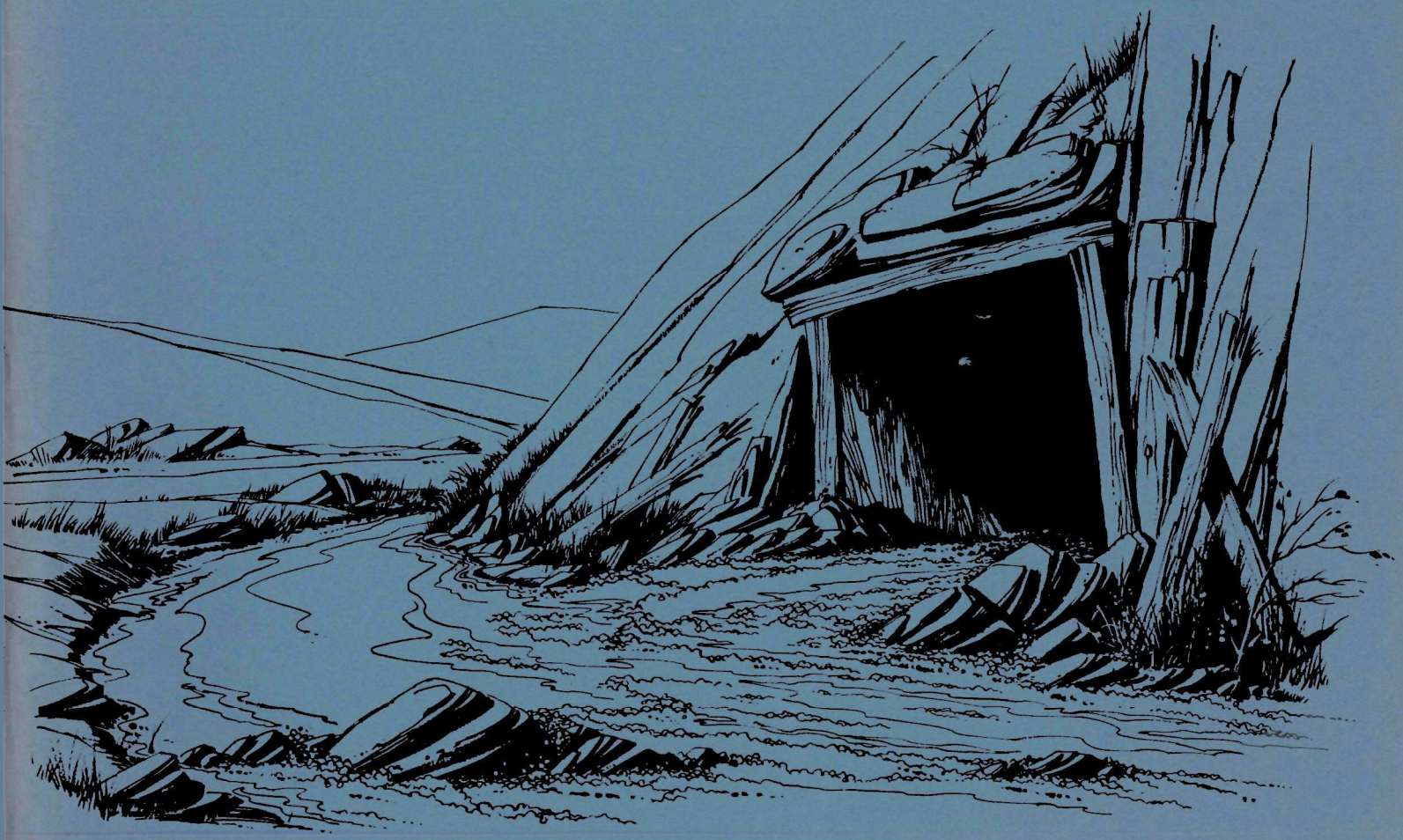
Feasibility Study

Upper Meander Creek

Mine Drainage Abatement Project



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Feasibility Study

Upper Meander Creek Mine Drainage Abatement Project

by

Stanley Consultants
Cleveland, Ohio

for the

ENVIRONMENTAL PROTECTION AGENCY

Project #14010 HBQ
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SYNOPSIS

The Upper Meander Creek Site in Mahoning County, Ohio, has been extensively surface mined for coal. The area has been graded to a moderately rolling terrain with the exception of the final cut which created a deeply incised valley. Required reclamation, including tree plantings, was completed in 1962. Revegetation of the spoil area has met with only limited success, leaving the majority of the site generally devoid of tree and grass cover and subject to rapid runoff and severe erosion. Water emanating from the study area generally exhibits a pH below 3.0 and a total acidity in excess of 1,000 milligrams per liter.

A mine drainage abatement demonstration project is recommended for the area to demonstrate effective techniques for mine drainage abatement and beneficial utilization of a mined area, and also to solve a specific mine drainage problem. The general features of the recommended program include the following steps:

1. Elimination of standing pools of acidic water.

2. Regrading of the final cut to provide positive drainage from the area.

3. Preparation of a suitable seed bed and planting of acid tolerant grasses, plants, and trees.

4. Implementation of beneficial land use features following successfull reclamation. This phase will be the responsibility of the agency retaining permanent control of the area and has not been included as part of the federally-aided demonstration.

A major jurisdictional problem must be solved immediately if an effective mine drainage demonstration program is to be initiated. The mined land is presently on private property and transfer to a public agency must be completed to meet State of Ohio requirements before an application can be submitted for federal demonstration grant funds. At the present time there are three public agencies which might be considered for ultimate ownership of the mined property. These are the Ohio Department of Natural Resources, the Mahoning County Commissioners, and the Mahoning Valley Sanitary District.

Based upon significant levels of input of equipment time and personnel services by local agencies, a total estimated cost for the demonstration project is $270,000. Substantial benefits will accrue to the project in the form of direct water treatment cost savings for the Mahoning Valley Sanitary District and its 275,000 customers. Less tangible but equally significant improvements in the aquatic environment of Meander Creek and aesthetic improvements of the mined land and the corridor along the waterway draining the area will result from the program.

PART I - INTRODUCTION

Scope of Investigation

This report is a presentation of an evaluation of the feasibility of a mine drainage control demonstration project for the Upper Meander Creek site in Mahoning County, Ohio. The specific scope of the investigations is as follows:

1. Review the history of mining, mine drainage problems, and mine drainage abatement measures in the study area.

2. Assess the jurisdictional framework through which a mine drainage abatement demonstration project may be carried out. Outline possible designation of responsibility for present and future pollution abatement practices, site acquisition and funding of an improvement program.

3. Inventory local physical features, hydrology, water quality, social and evironmental factors, and other elements influencing the value of a mine drainage demonstration project in the study area.

4. Develop preliminary engineering features of a workable mine drainage abatement program in sufficient detail to permit evaluation of the feasibility of the proposed project.

5. Estimate the effectiveness of the project and delineate possible beneficial uses for the reclaimed strip mined area upon completion of the drainage abatement improvements.

6. Determine tangible and intangible benefits of the recommended program.

7. Develop an outline of scheduling and budgeting to assure adequate administrative control of the proposed project.

8. Recommend facilities and a continuing program for surveillance of mine drainage from the improved area. Delineate means for measuring the accomplishments of the demonstration program with respect to presently envisioned objectives.

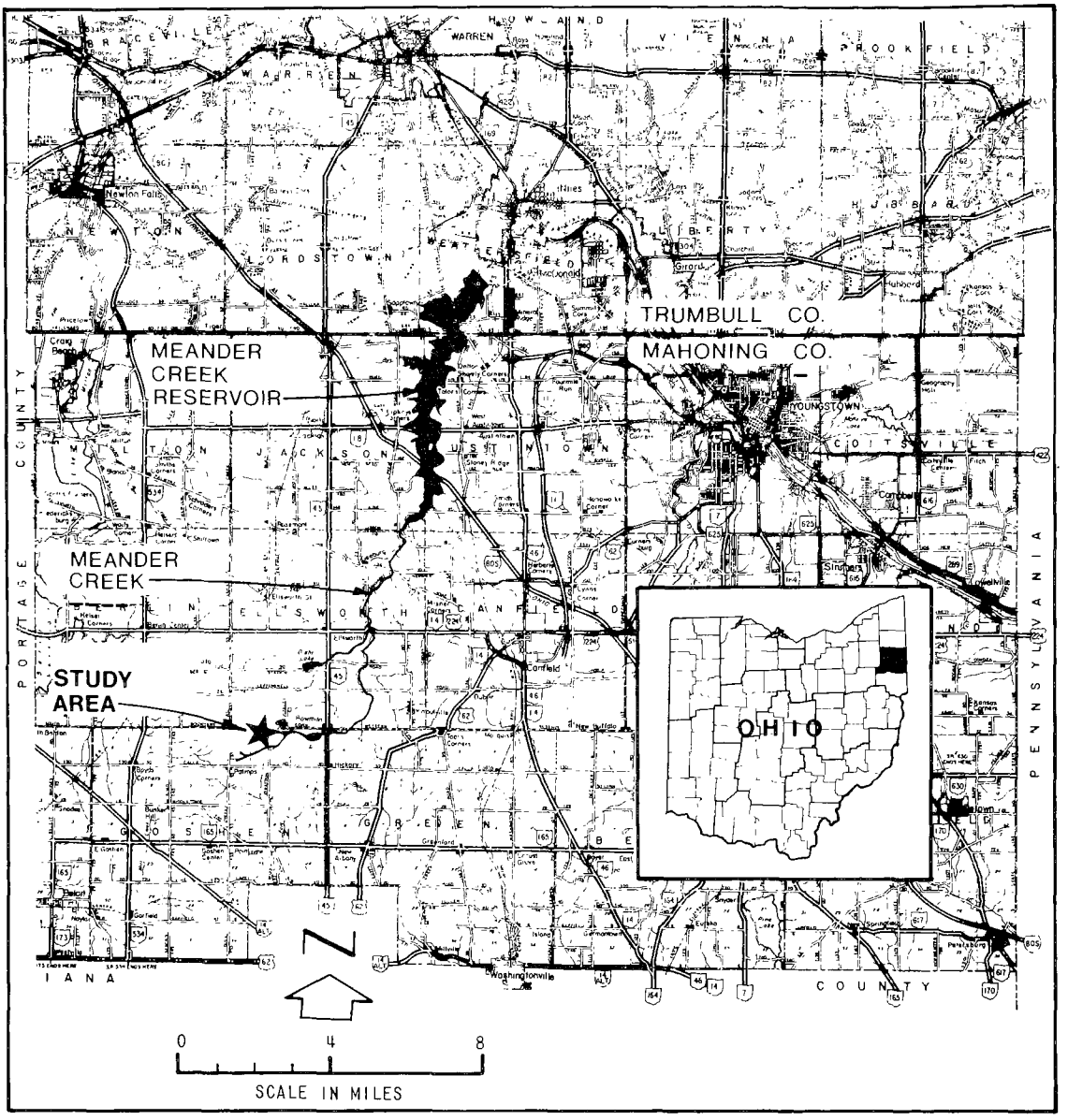

Figure 1 - Location Map

Project Objectives

The study area, which is the subject of this mine drainage feasibility investigation, is located in Mahoning County, Ohio, in the Meander Creek watershed, as shown in Figure 1. The acidic over-burden present in the geological structure has resulted in a spoil bank which, although limited in extent, is extremely toxic in character. Only sparse vegetation has been established on the spoil material and serious degradation of the natural water features below the site has developed.

The two major objectives of the mine drainage abatement program analyzed herein are:

1. Demonstrate effective techniques for mine drainage abatement including necessary management aspects and ultimate utilization of the mined area in a manner which will create a measurable public benefit.

2. Solve a specific troublesome mine drainage problem and thereby improve conditions for all downstream water-related activity.

Project Description

The Upper Meander Creek site has been mined entirely by surface techniques. The proposed mine drainage abatement project will demonstrate means for alleviating problems related to previous mining activity of this type.

The final cut from the stripping operation has been dammed at several locations. Resulting pools of water are quite acidic in nature and the source of an almost continual discharge into the downstream watercourse. The first phase of the mine drainage abatement project will involve elimination of the standing bodies of water which are contributory to the acidic situation. Following this activity, regrading of the spoil banks will be undertaken to provide positive drainage for the area and to cover, when possible, concentrations of acid forming materials. Following the necessary regrading for drainage control, surface treatment of the spoil banks will be undertaken. This will include surface grading, liming, fertilization, planting and seeding as necessary to retain the precipitation on the land, create a new soil layer, improve the aesthetics of the area, and provide for more beneficial utilization of the site. The final phase in the long-range program will involve addition of recreational and other public use features to the area to demonstrate and enhance the possible public benefits of a complete mine drainage abatement and reclamation effort.

PART II - JURISDICTIONAL FRAMEWORK

Agency Responsibility

At the present time all of the previously mined area in the study region is on private property. As such, there has been no concerted local effort to make improvements for the purpose of abating acid mine drainage. However, there are three public agencies which have been considered for possible ultimate ownership of the mined property. These agencies are listed below along with a discussion of the reasons for considering this form of public ownership, and apparent disadvantages accruing to each agency.

1. State of Ohio. The majority of the public land in the State of Ohio is under the control of state agencies, principally the Department of Natural Resources. Therefore, it is logical to consider transfer of ownership of the Upper Meander Creek mined area to the State Department of Natural Resources. Administratively, a structure is available which could provide the operational resources to encourage public utilization. Practically, however, the mined tract is too small to be economically managed as a state area. Utilization would be almost exclusively by persons living in the immediate vicinity. The site is not well suited for development as an intensive use facility and the man-days of recreational activity which would accrue to a wilderness type development would not justify the expense in maintenance and administration of the project area with state forces.

2. Mahoning County Commissioners. A more reasonable arrangement for management of the area would be through the county government. Present operating departments have the expertise and equipment necessary for development and maintenance of facilities. The size of the area is reasonable for a county park development. The county agency would therefore appear to be the logical organization for further consideration for ultimate ownership and development of the mined area. At the present time, however, Mahoning County does not have an organized park district.

3. Mahoning Valley Sanitary District. This agency utilizes Meander Creek Reservoir as a source of raw water for a treatment plant and transmission system which serves Youngstown, Niles, and surrounding areas. Acidic runoff from the mined land enters the reservoir and adds to the cost of water treatment. Certain public benefits would therefore result if the Mahoning Valley Sanitary District would obtain ownership of the property as a means of preserving the integrity of water

entering Meander Creek Reservoir. The principal disadvantage to ownership by this agency is that there is no incentive to improve the property for public utilization; therefore, except for water quality improvements, little public benefit is likely to be derived from Sanitary District ownership of the property.

Mine Drainage Abatement Authority

Regardless of the public agency which ultimately retains ownership of the strip-mined area, it is reasonable to expect the State Department of Natural Resources to apply for and administer a mine drainage demonstration grant and to assume responsibility for the proper conduct of the construction and development program.

The State of Ohio Department of Natural Resources, through the Director, pursuant to Sections 1501.01; 1501.011; 1501.02; and 1501.021 of the Ohio Revised Code may enter into cooperative or contractural arrangements with the United States or any agency or department thereof for the accomplishment of the purposes for which the department was created. Senate Bill No. 13 (1949) created the Department of Natural Resources "...to formulate and put into execution a long-term comprehensive plan and program for the development and wide use of the natural resources of the State to the end that health, happiness, and wholesome enjoyment of life of the people of Ohio may be further encouraged; that increased recreational opportunities and advantages be made available to the people of Ohio and visitors; that industry, agriculture, employment, investment and other economic interests may be assisted and encouraged...."

Water Quality Standards

The Water Pollution Control Board of the State of Ohio adopted Water Quality Standards on October 13, 1970, for the Mahoning River and tributaries which includes the stream originating in the study area. The use classifications applicable to the Meander Creek and other tributaries in the immediate vicinity of the site include:

Recreation

Public water supply

Aquatic life A

Industrial water supply

Agricultural use and stock watering

The adopted criteria contain certain minimum conditions that are applicable to all waters at all places and at all times. These conditions state that the waters shall be:

1. Free from substances attributable to municipal, industrial or other discharges, or agricultural practices that will settle to form putrescent or otherwise objectionable sludge deposits.

2. Free from floating debris, oil, scum, and other floating materials attributable to municipal, industrial or other discharges, or agricultural practices in amounts sufficient to be unsightly or deleterious.

3. Free from materials attributable to municipal, industrial or other discharges, or agricultural practices producing color, odor or other conditions in such degree as to create a nuisance.

4. Free from substances attributable to municipal, industrial or other discharges, or agricultural practices in concentrations or combinations which are toxic or harmful to human, animal, plant, or aquatic life.

In addition to the foregoing minimum conditions, certain specific criteria have been adopted for each water use classification. Most of these are not applicable to the proposed mine drainage project. Those which are a consideration in the program are summarized as follows:

1. Water which is used as a source of public supply should not exhibit dissolved solids concentrations exceeding 500 mg/l as a monthly average nor 750 mg/l at any time.

2. To meet Aquatic Life A requirements, pH values should not be below 6.0 nor above 8.5 except that daily fluctuations outside of the specified range which are correlated with photosynthetic activity may be tolerated.

Site Acquisition

Recent ownership of all property in the square mile containing the tracts disturbed by the previous mining activity is shown in Figure 2. The extent of the mining on the affected parcels of property is also generally indicated in the figure.

A lawsuit has been brought against the present owners of the strip mined property by the City of Youngstown, Ohio, and the Mahoning Valley Sanitary District, claiming damages as a result of increased water treatment costs due to the acid mine drainage originating at the site. Although no firm commitments have been reached, attempts are being made to arrive at a settlement which would involve transfer of the property to public ownership as a condition of settlement of the pending lawsuit. For the purposes of this report, it has been assumed that a satisfactory agreement will be reached and property ownership will reside with a public agency.

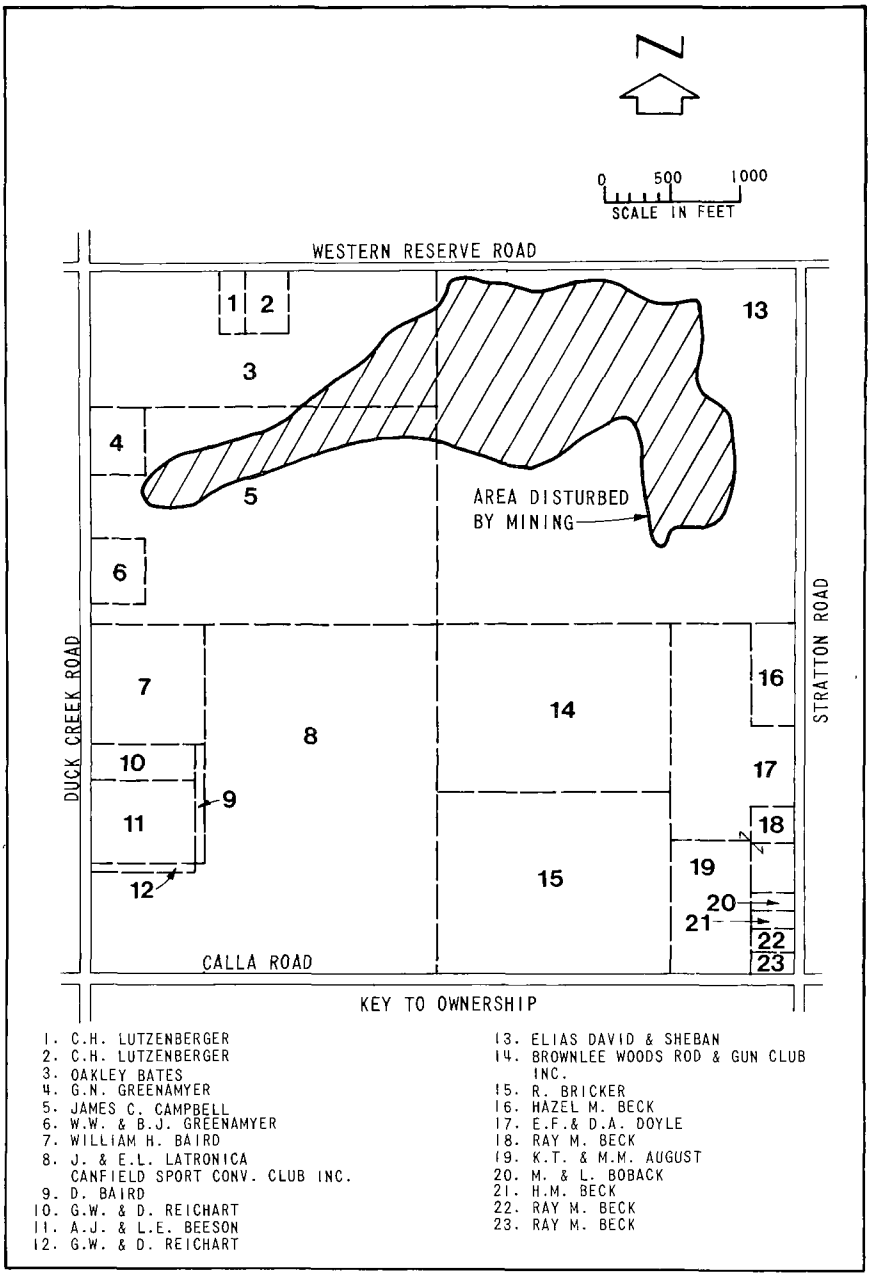

Figure 2 - Property Ownership

Recommended property acquisition for the demonstration program includes Tract 13 and approximately the north two-thirds of Tract 5 as shown in Figure 2. An easement may also be required to provide for limited grading at the southeast corner of Tract 3.

Water and Mineral Rights

It is anticipated that any agreement reached regarding transfer of property ownership would also entail a concurrent transfer of all water and mineral rights associated with the property.

Future Pollution Control

The study area is located at a high point in the watershed. Although drainage originates at the site, there is no upstream area contributing surface water flow into and through the mined property.

It is anticipated that virtually the entire mined area will be transferred to public ownership. As previously stated, all water and mineral rights will be transferred along with the title to the property. Therefore, full control of the mined portion of watershed will reside with the public agency and assurance can be given that the project area will not be adversely affected by the influx of acid or other mine water pollution from nearby sources.

Considerable state and local concern has been expressed over possible adverse environmental effects of strip mining. State permits must be obtained for any proposed new coal mining operation; the state thus can exert control over potential water pollution. Local interests also have a bearing on the permit procedure as illustrated by a recent action in the Meander Creek watershed in which a proposal to open a new strip mine was argued through the courts. The ultimate ruling was in favor of the coal company, however, because of mineral rights difficulties, mining was never initiated. The state policies and local awareness and concern provide a significant level of control over possible future water pollution situations.

A monitoring and maintenance program will be included as a part of remedial measures in the study area as a further water quality safeguard and to provide warning of any increase in acid discharge.

Physical Conditions

Figure 3 is a base map illustrating many of the significant physical features of the study area. This map has been prepared from U. S. Geological Survey, 7 1/2 minute topographic maps and supplemented with further information from numerous other sources.

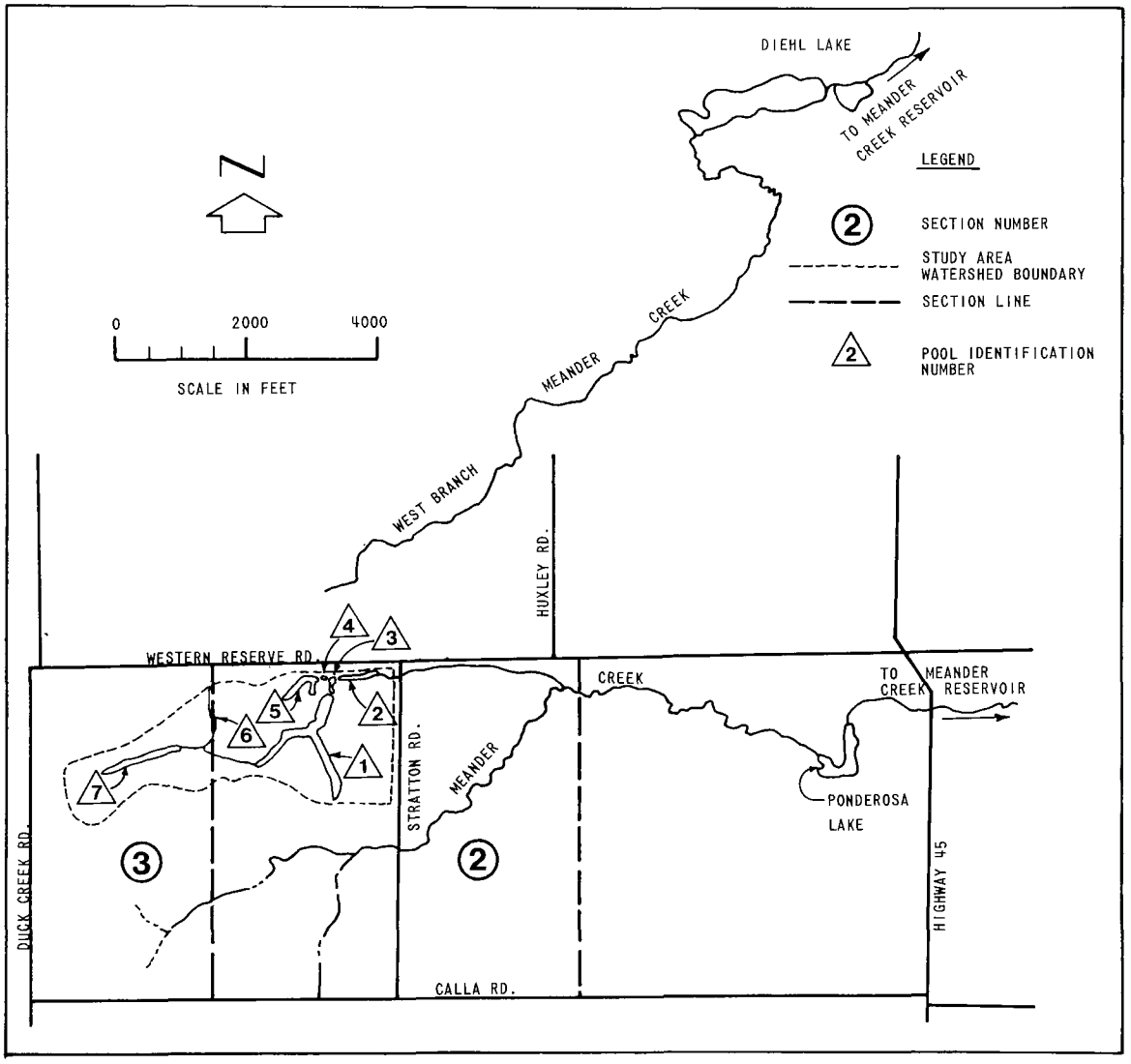

Figure 3 - Area Physical Features

The study area is located in Goshen township, Mahoning County, Ohio. The surface mining activity which has resulted in objectional acid mine drainage has been confined to the northwest quarter of Section 2 and the northeast quarter of Section 3, Township 17 North, Range 4

West. Western Reserve Road runs along the north edge of the mined land and Stratton Road bisects Section 2 and forms the eastern boundary for the site.

The entire study area is within the Meander Creek drainage basin. The watershed boundary for the strip mined land is shown in Figure 3. Virtually all drainage from the area flows east, parallel to Western Reserve Road and joins with the main stem of Meander Creek approximately one-half mile east of Stratton Road.

A series of pools of water remain impounded in the final cut. Identification numbers have been assigned to these pools and are shown in Figure 3. These numbers are used throughout the balance of this report.

There are no known gas, oil, or water wells in the immediate vicinity of the mined land. Detailed soil investigations were not undertaken prior to mining or, if taken, were not recorded. Borings were not authorized as part of the current feasibility study. As a result, only a limited amount of subsurface information is available. Figure 4 illustrates a core drilling taken near Western Reserve Road in the vicinity of Pools 3 and 4. As shown, at this point about 42 feet of overburden covered the top of the coal seam. This drilling was done for the Mahoning Valley Sanitary District who also had analyses made of the pyritic sulphur content at various depths in the shale and sandstone formation immediately above the coal. The sulphur content increases with depth and undoubtedly is a factor in the production in acid mine drainage.

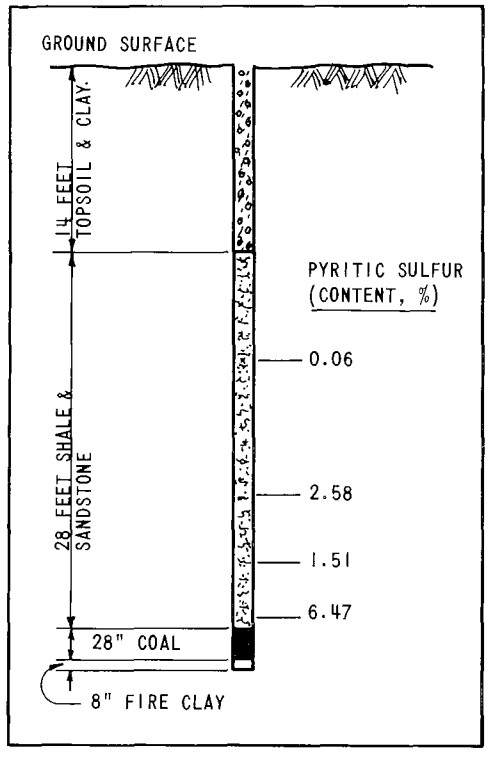

Figure 4 - Geological Core Section

Land Use

Within the Meander Creek watershed, existing land use is primarily agricultural with scattered rural residential developments. Figure 5 illustrates significant land use features. As shown, industrial operations in the watershed consist of a limited number of small mining operations. Recreation facilities in the watershed include three private lakes, two conservation and gun clubs, two camps, a small park, and a golf course. Of note is the fact that the property of both conservation clubs directly adjoins the tracts that will be improved by the proposed mine drainage abatement demonstration program.

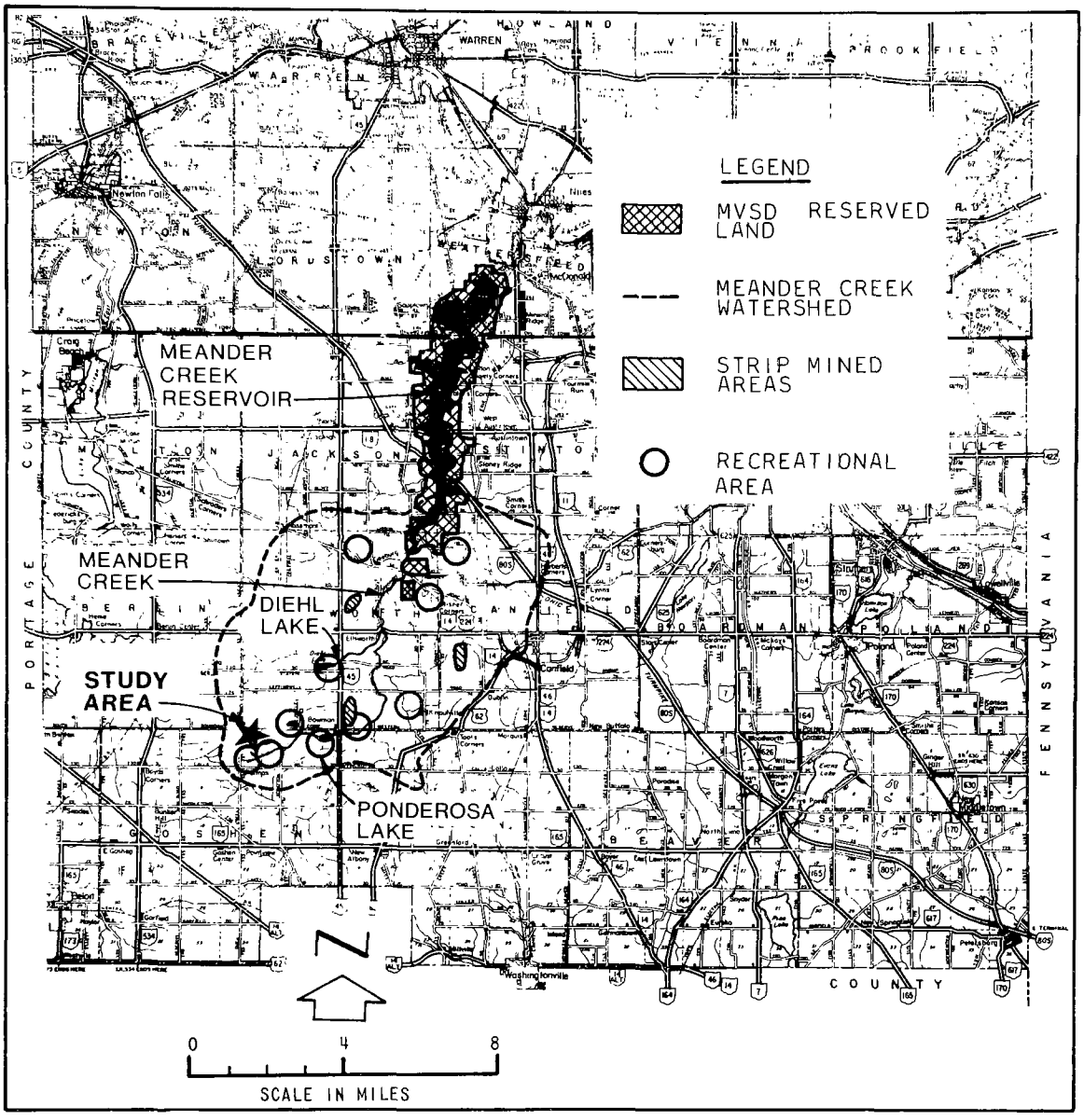

Figure 5 - Land Use Features

Mining and Reclamation History

Surface mining operations were begun in the study area in the early 1940's, before legislation relating to reclamation of strip-mined land was enacted. C & M Mining Company was the first operator in the area affecting approximately 18.1 acres. Sheban Mining Company stripped a total of 21.7 acres between 1950 and 1956. Fairfield Coal Company was the third and final operator on the site affecting a total acreage of 67 acres during the five-year period from 1956 to 1960. Figure 6 illustrates the areas stripped by each of the three mining companies.

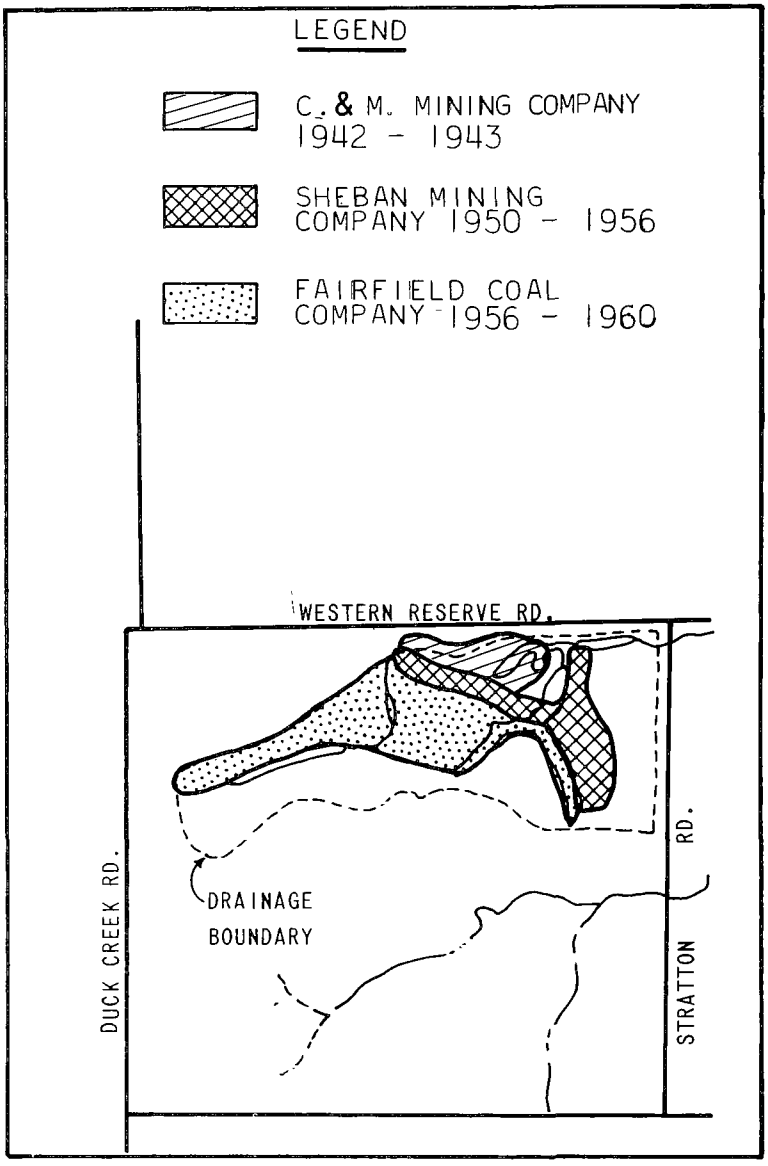

Figure 6 Mining History

The Middle Kittanning (No. 6) coal seam was the geological formation mined. The coal layer was 26 to 28 inches thick and was characterized by a vein of clay four to six inches above the bottom of the coal, thus giving the impression of a false bottom. No accurate data was recorded relative to the elevation of the coal seam; however, discussions with Fairfield Coal Company personnel and others familiar with the mining operation indicated a general dip to the southeast of five feet per mile with some irregularities noted.

The mined area has been graded to a moderately rolling terrain with the exception of the final cut which generally conforms to the same cross-section which existed when mining operations ceased. In 1961,

five earthen dams were constructed by Fairfield Coal Company in an attempt to control acid drainage. Reclamation, including necessary tree plantings, was completed in 1962 with all legal requirements having been satisfied. Revegetation of the spoil area has met with only limited success, leaving the majority of the site generally devoid of tree and grass cover and subject to rapid run-off and severe erosion. A small area at the west end of the site has been reclaimed for agricultural purposes with a reasonable degree of success.

Water Quality Situation

A series of ten water samples were collected on April 23, 1971, for analysis of chemical constituents. Sample locations are shown on Figure 7 and analytical results presented in Table 1. Flow rates were determined for each sample collected from a flowing stream utilizing a portable V-notch weir.

TABLE 1

WATER QUALITY ANALYSES

Sample No.	Flow gpm	Total Solids mg/l	pH	Conductivity micromhos	Iron mg/l	Acidity mg/l
1	64	5,544	2.8	3,100	5.2	1,080
2	61	5,970	2.9	2,900	2.1	1,180
3	100	5,620	2.9	3,200	13.4	1,160
4	---	3,076	2.9	1,850	14.8	400
5	3.1	6,624	2.8	3,200	4.3	940
6	---	5,138	3.0	3,000	2.0	1,040
7	24	5,550	2.9	2,900	8.6	1,420
8	1.8	8,114	3.0	3,700	12.8	1,920
9	8	4,625	3.1	2,500	10.4	1,080
10	---	4,559	3.2	2,500	12.8	1,100

Sample 1 was collected at Stratton Road and represents the composite of all drainage originating in the mined area. As shown in the table, the pH of the water was 2.8 and the total acidity (to the phenolphthalein end point) was 1,080 mg/l. The measured flow was 64 gallons per minute or a rate of 92,000 gallons per day.

Sample 2 was collected at the west or inlet end of the long narrow pool (No. 2) which parallels Western Reserve Road. This pool was apparently created as a surge lagoon to contain or buffer drainage originating in the area during the active mining operation. The measured flow rate was approximately the same as at Point 1 and the acidity was 100 mg/l greater.

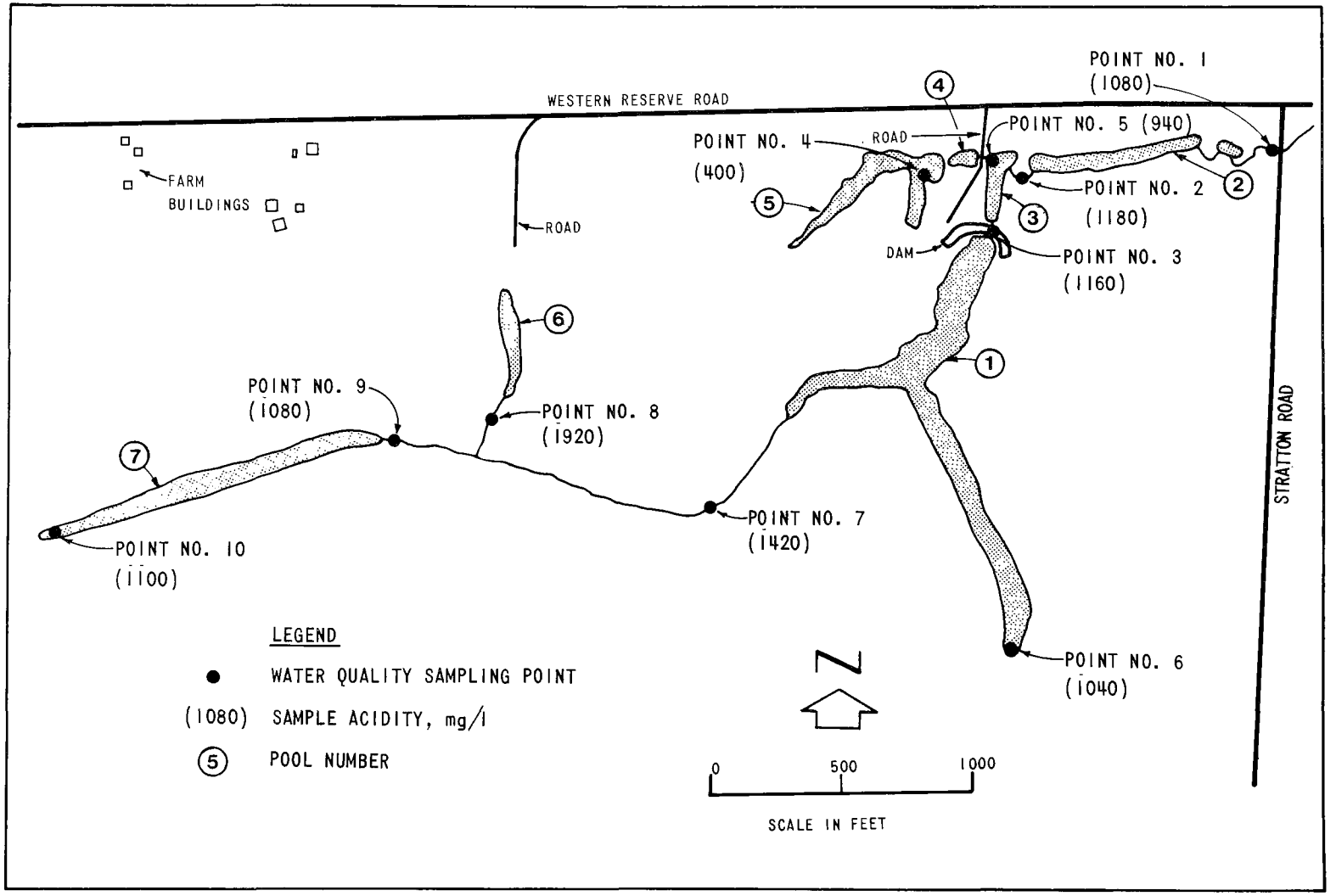

Figure 7 - Water Quality Data

Sample 3 was taken at the dam of Pool 1. Measured flow at this point was 100 gallons per minute with acidity of 1,160 mg/l. The apparent loss of water between Point 3 and Points 1 and 2 is difficult to explain. Gaging errors might be suspected, except that these results are confirmed by a similar series of measurements by other investigators approximately one year ago. A loss of water was noted between the same two points and in about the same order-of-magnitude. Soil borings to evaluate subsurface conditions and to verify elevation of the groundwater table were not within the scope of the investigations. However, it is apparent that soil formations and groundwater levels are such that a portion of the discharge from Pool 1 is percolating downward into the underground water system.

Discharge from Pool 4, the very small pond immediately west of the entrance road into the mined area, is characterized by Sample 5. There was no visible flow or seepage into No. 4 from the larger pool to the west from which Sample No. 4 was collected. This latter pool (No. 5) was created by the earliest mining activity in the area and has, therefore, experienced over 20 years of natural weathering of the tributary area. This has resulted in an acidity of 400 mg/l, which is the best water quality of any of the pools on the site.

Sample 6 was taken from the extreme south end of Pool 1 and exhibited an acidity of 1,040 mg/l. This is only slightly less than was measured at the outlet of the pool.

Sample 8 represents the stream feeding the west arm of Pool 1. A flow of 24 gallons per minute was recorded and the acidity of 1,420 mg/l was somewhat higher than the 1,160 mg/l measured at Point 3. This indicates that the additional water entering the large pond, probably from underground sources, is of better quality than that entering in the surface stream flowing down the old final cut pit.

Small flows were measured at sample Points 8 and 9 (1.8 and 8 gpm, respectively). Flow from the north at Point 8 exhibited the highest acidity of any of the samples, 1,920 mg/l, but was extremely small in volume. Sample 10 was taken from the west end of Pool 7. Acidity at this point was essentially the same as in the stream leaving the pool.

Using the acid flow rate in pounds per unit of time at Stratton Road as a base, approximately 5 percent of the base flow is represented by the sample at Point 8 and another 10 percent by the sample at Point 9. The acid flow rate at Point 7 is approximately 50 percent of the base figure, indicating that there is a significant acid pick-up through the stream channel between Point 7 and Points 8 and 9. This can be partially attributed to the considerable amount of coal refuse lying exposed along the stream channel.

The Mahoning Valley Sanitary District has been routinely sampling the water quality at Stratton Road for several years. Results of tests collected over the time span of a recent year are shown in Table 2.

TABLE 2

STRATTON ROAD
WATER QUALITY ANALYSES

Date	pH	Acidity mg/l	COD mg/l
April, 1970	3.2	1,110	13.8
May, 1970	3.0	270	1.2
June, 1970	2.8	150	3.3
July, 1970	2.8	1,330	7.4
August, 1970	2.9	3,820	8.0
September, 1970	2.8	1,240	6.1
October, 1970	2.8	1,380	3.8
November, 1970	3.1	1,020	25.7
December, 1970	3.2	1,090	36.6
January, 1971	3.2	970	23.6
February, 1971	3.4	720	29.3
March, 1971	3.4	530	16.8
April, 1971	3.3	980	33.2

Review of the data indicates a considerable range of values. For the most part, however, acidity was in the 1,000-1,400 mg/l range. On this basis, it can be concluded that the series of samples presented in Table 1 represents reasonably typical conditions.

Hydrology and Meteorology

Hydrology, particularly as related to the underground flow of water, is one of the most important considerations dealing with mine drainage and possible abatement measures in the Upper Meander Creek area. The recent hydrologic history of the mined land is difficult to assess from available records. Verbal accounts persist regarding artesian flow from boreholes drilled prior to initiation of mining in the area. These accounts are not substantiated by written or photographic records and the occurrence of artesian flow is difficult to relate to the specific geology of the region.

Figure 8 presents a cross-section cut diagonally across the strip mined area and intersecting Stratton Road, Western Reserve Road and Meander Creek. As shown in the figure, the flow line of Meander Creek is at an elevation of approximately 1167. Pool No. 1 in the stripped area presently exhibits a water surface of 1180.5; the elevation of the bottom of the pond is approximately 1160. To the north, Pool No. 5 has a water surface elevation of 1185.5 and a bottom elevation of about 1180. Continuing to the northwest along the line of the cross-section, the ground slopes downward from Western Reserve Road to the West Branch Meander Creek.

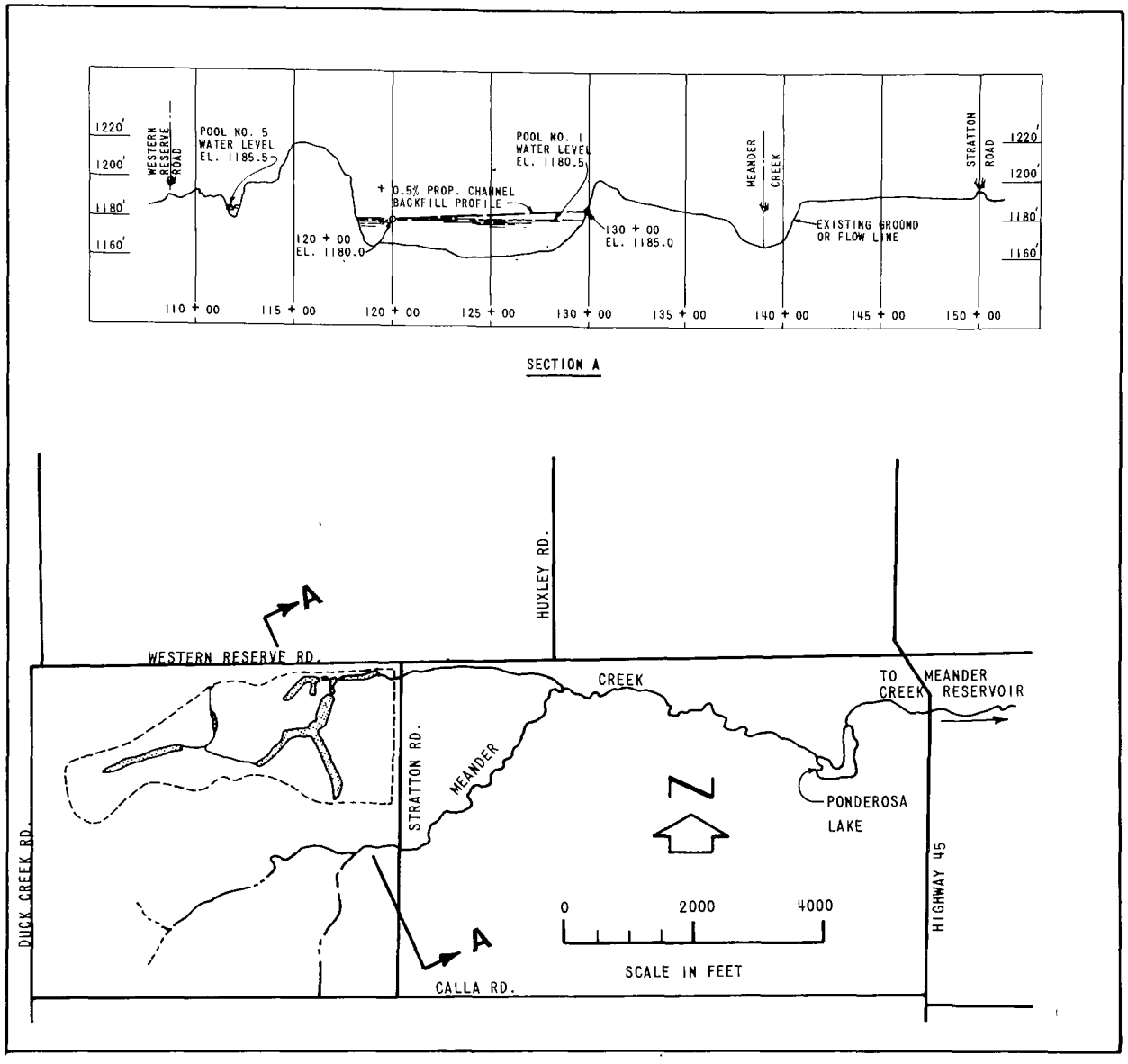

Figure 8 - Area Cross Section

It would appear that prior to mining in the area, there was probably very little discharge of water from the site except during precipitation events. The normal groundwater table was intercepted by Meander Creek and West Branch Meander Creek, and thus stabilized at an elevation well below the ground surface. As a result of the mining in the area, the groundwater table was intercepted and a convenient channel provided for release of the water. Continuation of this net flow from the strip mined area contributes significantly to the mine drainage problem which exists today.

The previously described water sampling and gaging program conducted by Stanley Consultants yielded a discharge from the entire area as measured at Stratton Road of approximately 64 gallons per minute. With a tributary drainage area of 143 acres, this discharge corresponds to a yield of 0.64 cubic feet per second per square mile. Comparing this value with long-term records for Meander Creek at Ohlstown prior to any regulation or diversion of the stream, a median discharge of 0.16 cfs per square mile has been recorded and an average discharge of 0.92 cfs per square mile is noted. The drainage area for the gaging station is 77.2 square miles. This data has been taken from the "Water Inventory of the Mahoning and Grand River Basins and Adjacent Areas in Ohio" Inventory Report No. 16 of the Ohio Department of Natural Resources Division of Water.

On the basis of the foregoing comparison, the flow as measured at Stratton Road does not appear to be unreasonable or even excessively high. More definitive conclusions with regard to the water yield of the mined area cannot be drawn without extensive long-term collection of flow data.

Precipitation records are not available for the specific strip mined property. Table 1 is a presentation of precipitation probability data for Canfield, Ohio, which is approximately 8 miles northeast of the site. This data is taken from the Ohio Agricultural Research and Development Center, Research Bulletin 1017, March, 1969, "Monthly and Annual Precipitation Probabilities for Selected Locations in Ohio."

TABLE 3

Precipitation Probability Data

	Precipitation With Probability Equal or Less Than								
	.10	.20	.30	.40	.50	.60	.70	.80	.90
Jan.	.95	1.29	1.58	1.86	2.16	2.48	2.86	3.35	4.11
Feb.	.87	1.12	1.34	1.54	1.75	1.97	2.24	2.57	3.00
Mar.	1.52	1.88	2.18	2.46	2.74	3.03	3.38	3.81	4.47
Apr.	1.51	1.92	2.27	2.59	2.92	3.27	3.68	4.20	4.99
May	1.41	1.92	2.36	2.79	3.23	3.72	4.30	5.04	6.21
Jun.	1.91	2.37	2.76	3.12	3.48	3.87	4.32	4.88	5.74
Jul.	1.78	2.27	2.68	3.06	3.46	3.88	4.38	5.00	5.96
Aug.	1.20	1.62	1.98	2.32	2.68	3.07	3.53	4.12	5.04
Sept.	.90	1.29	1.63	1.97	2.33	2.73	3.20	3.82	4.80
Oct.	.67	1.04	1.38	1.74	2.12	2.56	3.09	3.79	4.91
Nov.	1.09	1.44	1.74	2.02	2.31	2.63	3.00	3.48	4.21
Dec.	.93	1.23	1.48	1.73	1.98	2.25	2.58	2.99	3.62
Annual	27.99	29.94	31.40	32.69	33.92	35.19	36.58	38.25	40.65

The precipitation data, as indicated, is typical for north central Ohio. Of significance is the fact that in a normal year, over 53 percent of the annual precipitation occurs between April and October. This is the season during which vegetative cover on the strip mined area would be most beneficial for reducing the runoff and also corresponds with the period when downstream uses are most adversely affected by mine drainage.

Social and Economic Environment

Acid mine drainage has been a major source of pollution to Meander Creek and Meander Creek Reservoir for over 20 years. In September, 1963, the first major fish kill in Meander Creek was reported. The Ohio Division of Wildlife estimated that approximately 6,650 fish of various species were destroyed by acid pollution, reportedly from the study area.

The release of acid water has also had an adverse effect on several small recreational lakes in the vicinity. Ponderosa Lake, formerly Dunn Eden Lake, depends on Meander Creek for water to maintain adequate lake levels. Each recent year, Ponderosa Lake has been drained concurrently with the release of acid water from the mined area. This procedure allows the acid to pass rapidly through the lake with a minimum of damage. After the slug of contaminated water is past, Ponderosa Lake is allowed to refill with better water. This yearly drainage operation has caused the owner of Ponderosa Park considerable expense and inconvenience, but has been necessary to ensure adequate water quality for swimming and fishing throughout the summer recreation season. Recently, the lake has been completely restocked each year at the owner's expense.

A major flood occurred in June, 1970, when the large dam at the strip mine area burst, and an estimated 20 million gallons of acid water was released. Area residents indicate that the 1970 flood, although the most severe, was the third such occurrence in three years.

Ponderosa Lake was forced to release water to prevent dam failure. The 1970 flood essentially put Ponderosa out of business for fishing and swimming during the remainder of the recreation season.

Damage was widespread affecting not only Ponderosa Lake, but Diehl Lake and a small private lake immediately adjacent to the study area. Flood water reportedly running two feet deep forced the temporary closure of Western Reserve Road. The owners of the small private lake reported $1,000 damage to their driveway as well as pollution of their lake.

Diehl Lake, north of the study area, is located on West Branch Meander Creek and is not normally affected by drainage from the site unless the

water gets out of control and crosses Western Reserve Road. In 1970, property owners around Diehl Lake reported property damage as a result of the flood and expressed concern for their recently stocked lake.

Meander Creek Reservoir, operated by Mahoning Valley Sanitary District, is the primary water supply source for the Youngstown metropolitan area. The District provides water to Youngstown and Niles, which in turn supply potable water to approximately one-third of the rural portion of Mahoning County and two townships in Trumbull County, for a total present service population of approximately 275,000 people. Acid contaminated water entering Meander Creek Reservoir from the mined area increases the cost of water treatment for acidity and hardness. A six percent water rate increase has recently been initiated by MVSD for the entire distribution service area. Approximately one-quarter of this rate hike has been attributed to increased water treatment costs.

Acid mine water from the study area has serious environmental implications. Naturally occurring aquatic life along the twelve miles of Meander Creek from the mined site to the reservoir has been adversely affected or entirely destroyed due to the high acidity of the water. Wildlife cover along the creek has been stunted or eliminated by the action of the acid. Local conservationists and hunters have noticed a marked decline in wildlife habitat and a corresponding reduction in wildlife along Meander Creek. The continued pollution and degradation of Meander Creek with acid mine water is not consistent with state and federal goals of improving and preserving water quality in natural waterways.

Local, state, and federal officials have been searching for a solution to this particular mine drainage problem since 1963. Several solutions including a sanitary landfill development have been proposed, but nothing has materialized. Two previous applications for federal demonstration improvement projects have been rejected due to the expense involved.

The proposed demonstration project will alleviate many of the water quality problems resulting from drainage from the site. Improved water quality will eventually restore the Meander Creek environment to the quality level necessary to sustain aquatic and plant life.

Data Adequacy

Available information on water quality and hydrology related to the study area is somewhat sketchy. Sufficient data is available, however, to define the order-of-magnitude of the problem and to establish a base against which improvements can be measured.

Additional specific water resource data would be helpful, but is not absolutely necessary for the proper design of a remedial program. Adequate judgments can be made regarding the type of improvements to be

undertaken; it is more important to move ahead with the implementation of a program than to expend further time and effort in refining the basic data inventory.

PART IV - PRELIMINARY ENGINEERING FEATURES

Abatement Project Description

The mine drainage problems resulting from previous mining of the study area are typical of those resulting from surface mining for coal in regions characterized by acidic overburden materials. The low pH and high salt content of the spoil banks has inhibited plant growth. As a result, there is little or no ground cover to retain surface runoff and curtail erosion. The proposed mine drainage demonstration program is designed to break the cycle of erosion, acid formation, inhibition of plant growth and further erosion. Provisions will be outlined for returning the presently unproductive land back into an asset to the region.

A multi-phase demonstration program has been developed. The four steps required to fully implement the mine drainage abatement and reclamation features are as follows:

1. Elimination of standing pools of acidic water which are contributing to the pollution of Meander Creek.

2. Regrading of the final cut to provide positive drainage from the area, to reduce the rate of discharge of water from the groundwater table, and to provide surface conditions amenable to establishment of ground cover.

3. Preparation of a suitable seed bed and planting of acid tolerant grasses, plants, and trees to reduce runoff and create a more usable and appealing area.

4. Construction of recreational features. Ultimate land use development is beyond the scope of the program required for mine drainage abatement. A typical plan has been prepared, however, which illustrates possible public utilization benefits which may result from the mine drainage abatement program.

Field Survey and Mapping

Available information has been utilized to the fullest possible extent in analysis of the mine drainage problem and in the development of a workable abatement program. U. S. Geological Survey maps and field surveys by the Mahoning Valley Sanitary District have provided much of the required basic information.

In addition, however, detailed maps were developed specifically for this project. Utilizing aerial photography and related mapping techniques, contour maps with a horizontal scale of one inch to 100 feet, and a contour interval of two feet have been prepared. Coverage includes all of the final cut--highwall area and sufficient width on

either side of the final cut to permit analysis of drainage patterns and the topography influencing area regrading.

A series of soundings were taken to determine the depth of water in the impoundments and to estimate the quantity of silt and muck which has been deposited at the bottom of the pools. Copies of the contour maps and depth soundings are on file with EPA.

Drainage Improvements

The water presently impounded throughout the study area can be immediately recognized as a potential threat to downstream water uses. Characteristics of the water have previously been discussed. As a long-term mine drainage abatement measure, it appears desirable that the majority of the impounded water be treated and released, and positive drainage provided for the area. It is proposed that all of the pools except Nos. 2 and 5 be drained and filled. Pool 2 did not result from the excavation of the coal seam but was instead created for the purpose of providing capacity for handling surges of water during the active mining period. The water quality analyses previously presented do not indicate any net increase in acid concentrations through Pool 2. This pool can therefore be retained to provide a water feature in the ultimate development of the property and to provide a surge basin for partial sediment and acid control, particularly during the period immediately following the proposed grading and planting.

Pool 5 remains from the first mining activity in the area. Over twenty years of natural leaching have thus removed many of the acid forming salts from the tributory drainage area. The present acidity in the pool is about 400 mg/l, contrasted to the 1,000 mg/l or more which is found in the rest of the pools throughout the study area. Some revegetation has occurred in the area around Pool 5. Due to the relatively good quality of water, and the partially revegetated condition of the adjacent slopes, it has been deemed desirable to leave Pool 5 intact. This relatively small impoundment could be filled during a later phase of the program if, after the initial elements are completed, it is determined to have a detrimental effect on drainage from the site.

The rest of the pools will be drained. On the basis of recent aerial photographs and soundings of water depth, the volume in the various pools has been calculated to be approximately as shown in Table 4. Of the nearly 23 million gallons presently impounded, over 20 million will be displaced during the regrading phase of the demonstration project.

TABLE 4

IMPOUNDED WATER VOLUMES

Pool Number	Volume, Gallons
1	15,050,000
2	825,000
3	400,000
4	120,000
5	1,400,000
6	280,000
7	4,910,000
TOTAL IMPOUNDED WATER	22,985,000

Uncontrolled release of this water could cause serious damage to the reach of Meander Creek between the study area and Meander Creek Reservoir. In the reservoir itself, the dilution factor would minimize the effect of the acid on aquatic life.

Upon reaching Meander Creek Reservoir the acidic water will ultimately be taken through the Mahoning Valley Sanitary District Water Treatment Plant. Additional chemical costs will be incurred by the District for treatment of the water which is now held on the site. However, neutralization of the water prior to release to the stream would require the same amount of neutralizing chemical as if treatment were accomplished at the water treatment plant. It would, undoubtedly, be more efficient and economical to allow the release of the untreated water to the stream with subsequent treatment at the plant.

The main problem, therefore, is to eliminate or minimize damage to the stream between the site and the reservoir. If the impounded water were released at a controlled rate during the winter months when there is no water related recreational activity along the stream, the amount of damage could be held to a minimum. Discussions with Ohio State Health Department personnel indicate that such an approach might be tolerated if an acceptable agreement could be reached with the downstream property owners. However, based upon the initial reaction of all concerned parties and considering the probable environmental impact, it has been assumed that neutralization of the impounded acid water must be provided on site. To accomplish this neutralization, a facility with a flow pattern as shown in Figure 9 is proposed.

The major features and operating sequence of the neutralization facility are as follows:

1. The dam at the north end of Pool 1 should be raised to provide storage capacity and operational flexibility.

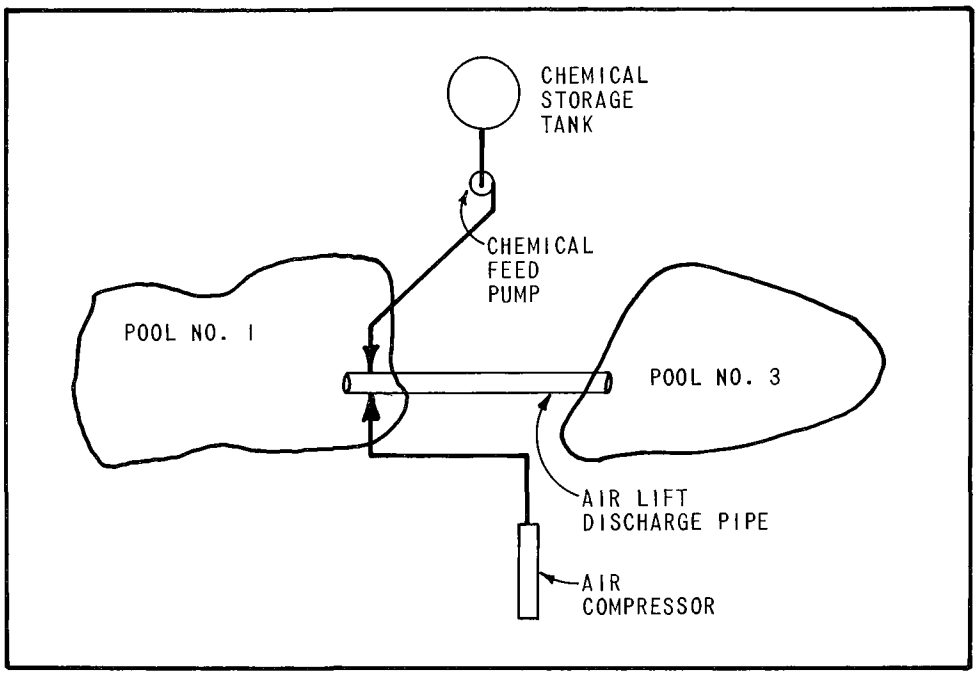

Figure 9 - Neutralization Schematic

2. A chemical storage tank and feed pump will be provided to proportion the neutralizing agent into the acid waste. The chemical will be added to the system at the intake of the pump.

3. An air lift type pump has been tentatively selected to pull water from Pool 1 for discharge to Pool 3. This type of pumping system has been selected to minimize exposure of equipment to the acidic water. The air lift action will also provide mixing for the neutralizing chemical and oxidation of the iron present in the mine drainage.

Initial regrading efforts will be moving forward concurrently with the neutralization process. As material is forced into the upper reaches of the pools, the water will be displaced and channeled to the intake of the neutralization facilities.

Planning has been based upon utilization of calcium hydroxide as the alkaline chemical. Considering measured water volumes and the present acidity of the water, there are approximately 100 tons of acid to be neutralized. Allowing for an increase in acid production during the regrading operations, an estimated 135 tons of lime are required for neutralization.

Iron will generally be precipitated and settled in Pools 2 and 3. As the regrading nears completion and most of the water has been eliminated

from the area, slight over-neutralization will increase the pH of Pool 3 so that it can be drained without relocating the neutralization plant.

Regrading

The recommended permanent channel backfill profile grades for the pool and pit areas are shown in Figures 8 and 10. Also illustrated are the existing ground and channel lines along the longitudinal axis of the pits.

Deposits of a soft gelatinous material, generally ranging from two to four feet in thickness, exist in the bottoms of the pools. Experience in other areas indicates this material to be extremely difficult to handle by conventional earthmoving techniques. The viscous silty material is fluid and difficult to dewater. The most appropriate method of releasing the contained moisture is to drain the water from the pool leaving the soft deposits exposed to a winter of freezing and thawing to break the structure of the material and release the entrapped water. This approach has been considered for the study area. However, as shown in the profiles, the relative elevations of the pools require the construction of deep temporary channels through the present final cut pits. This construction would be costly and the soft material would probably not provide a suitable platform for conventional excavation equipment. Recent soundings in several areas indicate the occasional presence of bedrock, thus greatly increasing the cost of excavation. For these reasons, the concept of draining and leaving the semi-liquid silt deposits exposed over a winter season is not considered feasible.

Proposed grading and borrow areas are shown on Figure 11. The general grading pattern is depicted by slope line schematics with suggested borrow areas outlined by dashed lines. Typical cross sections for recommended channel regrading along existing final cuts and haul roads are indicated in Figures 12 and 13. The sections establish approximate grading lines for final shaping but can be varied somewhat to suit materials encountered and equipment used.

As previously indicated, regrading operations, drainage, and acid neutralization are to be conducted concurrently. As water in Pool 1 is treated and released, grading will commence at the upper end of Pool 7. Removal of the water will be accomplished by displacement with material pushed from the upper edge of the spoil bank directly into the pool, using bulldozers and/or dragline equipment. The spoil material should be deposited uniformly along the north edge of the pit, thus forcing the gelatinous deposits to the south edge of the pool and highwall. At the same time, the deposited material will displace impounded water which will drain into Pool 1 for subsequent treatment and release.

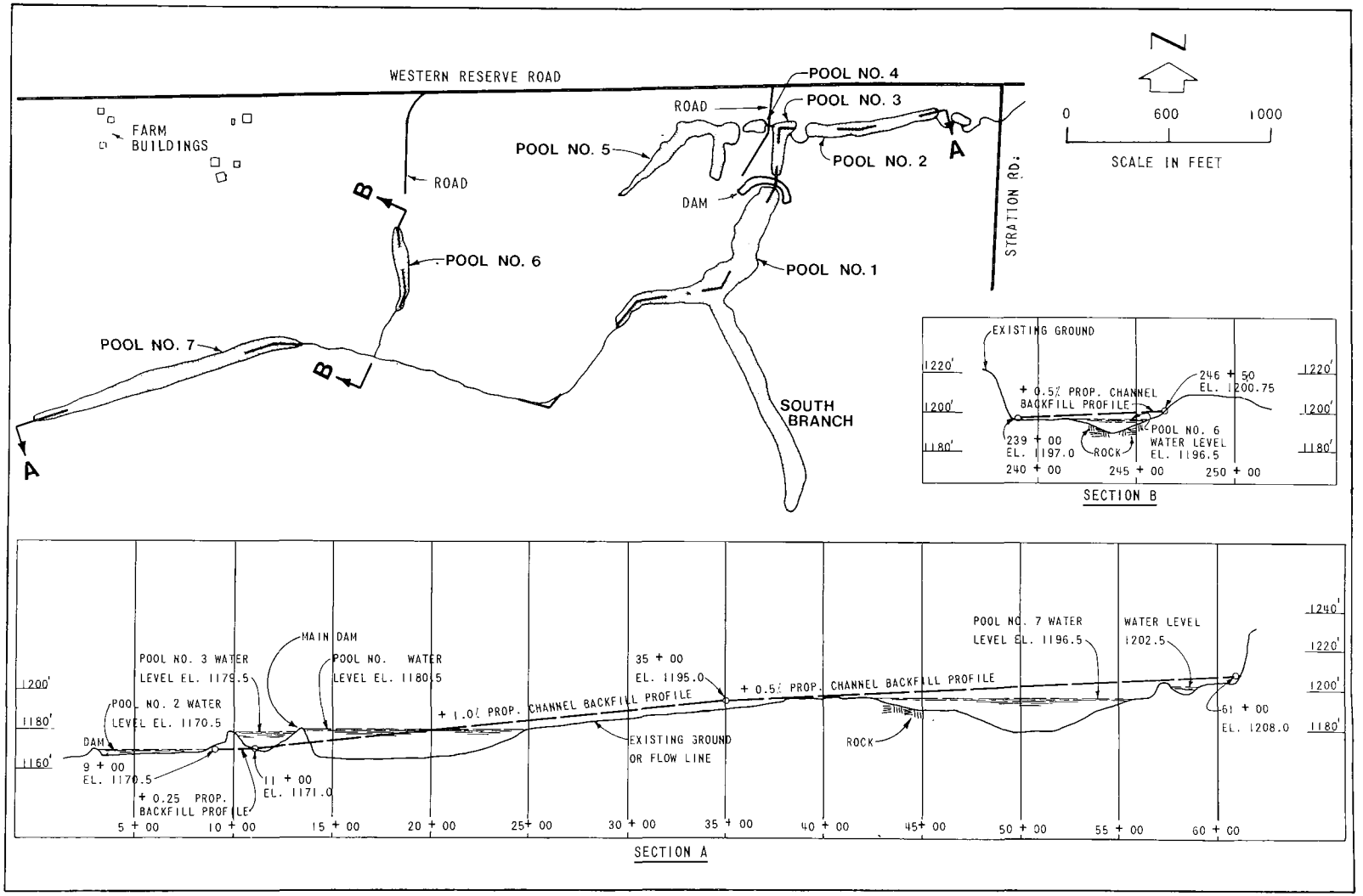

Figure 10 - Regraded Channel Profile

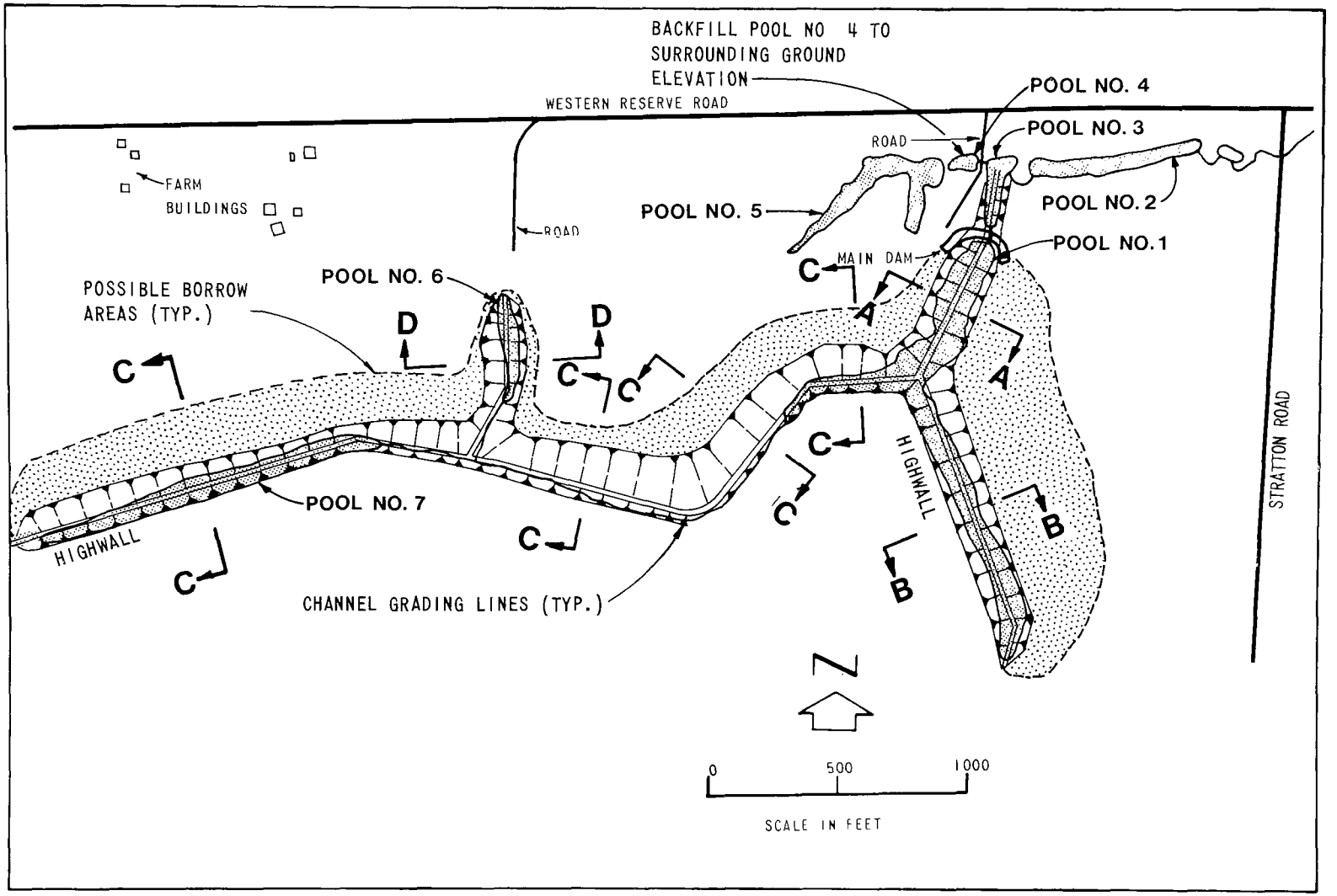

Figure 11 - Grading Plan

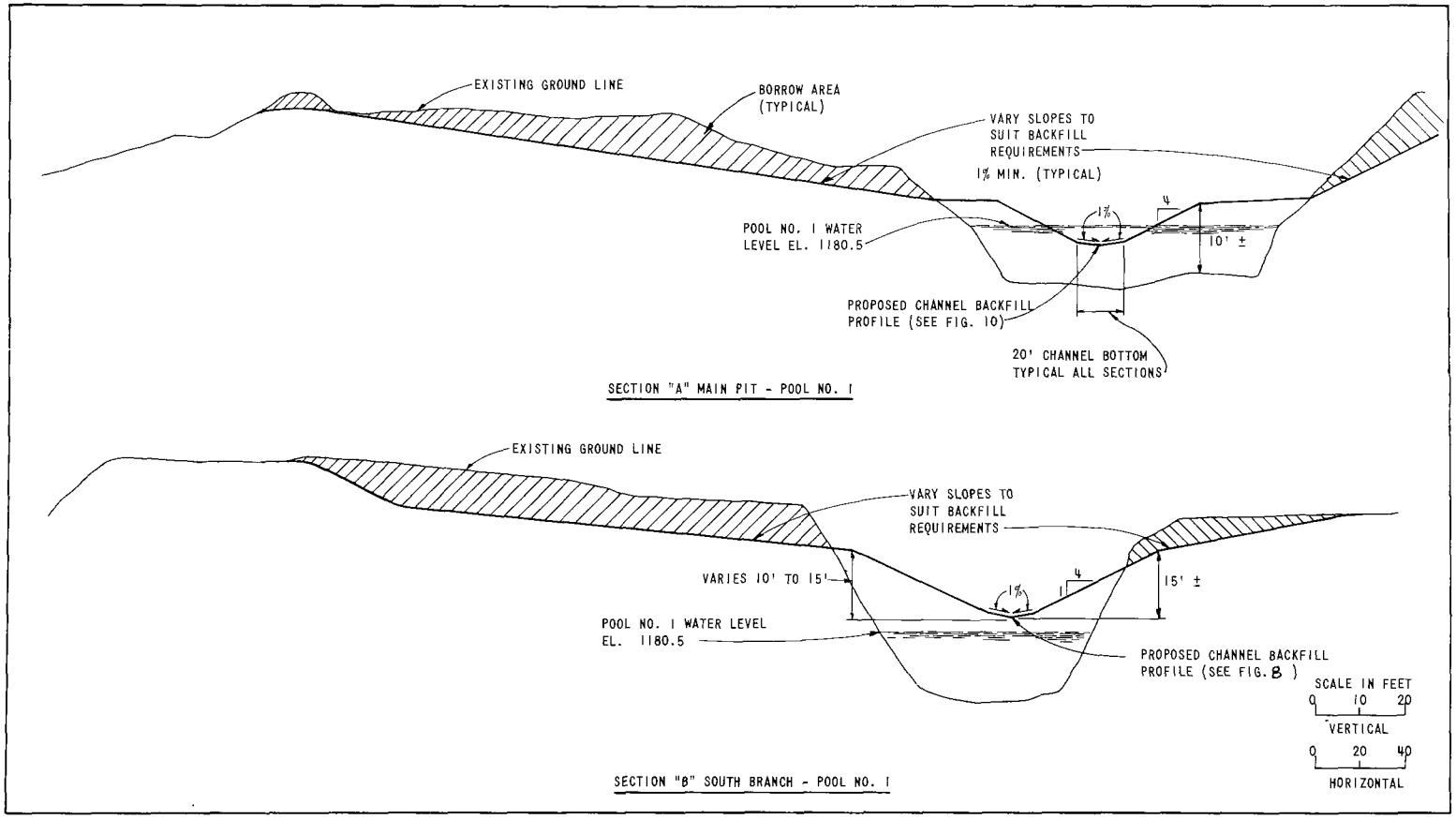

Figure 12 - Typical Regraded Sections

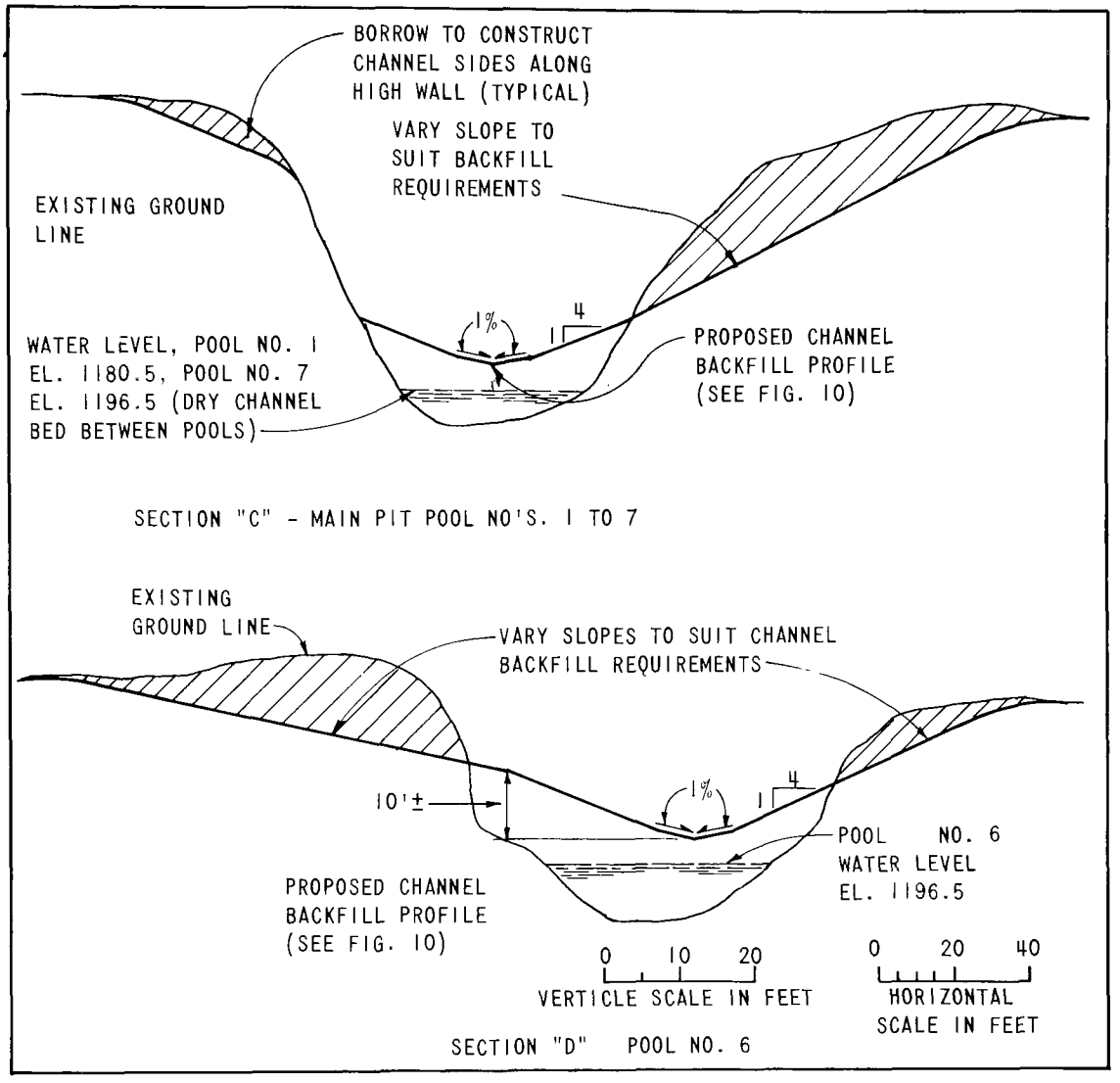

Figure 13 - Typical Regraded Sections

Sufficient material should be deposited in the pits to provide an initial channel bed profile approximately two to three feet above that indicated in Figure 10. This is to allow for future settlement and shrinkage since direct compaction is not practical. When Pool 7 has been filled, the same procedure will be followed for Pools 6 and 1.

After the channel profile grade has been established, construction of side slopes and rough shaping of the 20-foot channel bottom will proceed. It is recommended that material be scraped from both the high wall and spoil pile sides with the better quality overburden material placed on top. Whenever possible clay should be packed against the high wall to minimize the exposure of acid sandstone to atmospheric conditions.

It is anticipated that due to dumping of spoil into pools of water, the center portion of the channel will settle and require additional grading at a later date. Caution must be exercised in the use of heavy compaction and excavation equipment in the pit area since the material is likely to remain in a soft condition for an extended period. It is suggested that at least one year elapse before final grading and planting along channel beds be concluded.

Table 5 indicates the approximate quantities of earth backfill required along various lengths of the pit area. In estimating these quantities variable shrinkage factors were used reflecting the expected conditions in each location.

TABLE 5

BACKFILL QUANTITIES

Location	Backfill Required Cu. Yd.
Pool 1 - Main Pit	83,000
Pool 1 - South Branch	85,000
Pool 3	1,000
Pool 4	1,000
Pool 6	12,000
Pool 7	117,000
Dry Bed Areas Between Pools 1 & 7	22,000
TOTAL ESTIMATED BACKFILL	320,000

Revegetation

Spoil in the project area is very acid, relatively high in sulfate, manganese, aluminum, and soluble salts but rather low in essential plant nutrients. Table 6 indicates the results of surface soil tests taken in 1967 by Kent State University and specifically for this report early in 1971.

TABLE 6

SOIL ANALYSES

Element	Plot #1		Plot #2		Plot #3
	August 1967	April 1971	August 1967	April 1971	April 1971
pH	3.2	3.6	3.8	3.5	3.6
NO_3	1.4	1.8	34.3	1.6	2.1

Element	Plot #1		Plot #2		Plot #3
	August 1967	April 1971	August 1967	April 1971	April 1971
NH_3	42.0	25.0	84.0	30.0	28.0
P_2O_5	0.6	1.6	0.8	1.2	1.3
K_2O	26.0	22.0	191.0	31.0	26.0
Ca	142.0	34.0	560.0	28.0	46.0
Mg	60.0	32.0	110.0	50.0	40.0
Fe	1.3	0.3	0.3	0.3	0.4
Mn	16.0	2.6	9.8	4.5	3.6
B	0.4	0.3	0.4	0.4	0.3
Cu	0.5	2.8	0.5	3.0	2.2
Zn	0.2	2.3	0.2	4.9	4.4
Al	1.0	29.0	0.4	40.0	37.0
SO_4	232.0	137.0	184.0	131.0	118.0
Soluble Salts	1700.0	360.0	980.0	440.0	400.0

Note: All quantities except pH expressed in pounds per acre.

Soluble salt content of stripped mined lands serves as a good indicator of plant toxicity. Most species of domestic plants have a maximum tolerance level of about 2,000 lbs. of salts per acre. Soluble salts at the area were well below the maximum level in 1971, but judging from the low pH, it is reasonable to expect that when the spoil is regraded, soluble salts will increase drastically and may approach 3,000 lbs. per acre. Thus, the following steps are recommended to assure adequate survival of new plantings.

Furrow Grading - After completion of spoil movement to provide the desired channel profile, furrow grading of side slopes is recommended. This technique encourages rapid leaching of soluble salts and creates a soil structure in the furrows which has been shown to encourage plant growth. Furrows should always follow the contour and are recommended to be 24 to 30 inches in height and 48 inches between the peaks. Furrow grading can be accomplished by permitting the spoil to fall off the end of an angled dozer blade or a ripper may be used in tight spoil. If excessive rock is encountered, a Rome disc may be required for this specialized grading operation. Furrow grading is the key to leaching out the salts prepatory to successful revegetation. Grading should be completed in early fall to permit leaching through the fall and winter seasons.

Fertilization - Furrow grading will provide a suitable soil structure and retain available moisture for plant utilization. Fertilizing the

spoil surface is required to provide the initial push for tree and grass cover. A complete (10-10-10) fertilizer is recommended over the entire spoil area at the rate of 600 lbs. per acre. Application with a hydro-seeder or hydro-mulcher at the time of seeding is also recommended.

The extremely high acidity of the spoil must be corrected before a vegetative cover can be established. A minimum pH of 4.0 to 4.5 is desirable, an increase over present levels of approximately one unit. Agricultural lime should be applied at the rate of three tons per acre and mixed into the top three to four inches of spoil. Areas which have been furrow graded will receive the same lime application, but without subsequent surface mixing.

Plantings - Plant materials have been selected for acid tolerance, wildlife benefits, and aesthetic value. Trees and shrubs will be planted at the rate of 1,600 seedlings per acre. This relatively high density will allow for some mortality due to adverse conditions; improve the visual appearance of the area more quickly; enhance the soil conditions more rapidly by adding organic matter and nitrogen; and use more moisture (evapo-transpiration) thereby reducing erosion and runoff.

Two tree-shrub mixtures are proposed. The standard mixture will consist of the following number of plants per acre:

400 Black Locust
400 Black Alder
100 Red Oak
300 Silver Maple
200 Autumn Olive
100 False Indigo or Rose Acacia
100 Cottonwood

A second mixture with increased autumn olive and false indigo or rose acacia is suggested to improve wildlife food and habitat. The wildlife mixture will consist of the following plants per acre:

300 Black Locust
200 Black Alder
100 Red Oak
100 Silver Maple
500 Autumn Olive
300 False Indigo or Rose Acacia
100 Cottonwood

Some white pine and Norway spruce may be scattered near the roads for aesthetic purposes.

Trees should be carefully planted the spring following regrading operation. Plants should be spaced approximately 5 to 6 feet apart and placed in the ravine and lower slopes of the furrow graded areas. Plants should

be at least two-year-old seedlings grown under climatic conditions similar to Mahoning County. Trees and shrubs will be hand planted using conventional approved methods of reforestation.

Black locust will provide quick cover but can only be expected to last five to ten years due to inevitable infestation by locust borers. After the locust has served its purpose, the canopy will open and alder will replace the locust as the dominant tree. Autumn olive and false indigo will reseed as a thicket or hedge cover in the ravines and provide excellent wildlife benefits.

The entire spoil surface must be heavily seeded, at the rate of 30 pounds per acre, to insure rapid revegetation. Fertilizer, seed, and mulching material (1,500 lbs/acre) should be applied with hydro-seeding equipment. This planting technique will conserve moisture and produce conditions favorable for germination, and for erosion control.

The recommended seeding mixture includes the following grass species:

10 lbs. Blackwell Switchgrass
5 lbs. Birdsfoot Trefoil
5 lbs. Alsike Clover
10 lbs. Kentucky Fescue "31"

A revegetation plan as shown in Figure 14 has been developed to accomplish the primary goal of acid mine drainage abatement and also to provide wildlife and recreational benefits. The final cut area and fringe areas of the spoil surface should be planted with the wildlife mixture to provide a transition with the existing vegetation and to improve the natural habitat. The ravine formed by the final cut area should be allowed to develop as a thicket for wildlife cover and protection. The upland areas of the project site should be planted with the standard plant mixture. This mixture consists of additional shade type species which are desirable for recreational activities such as picnicking, camping, and hiking. The entire spoil surface will be seeded with the suggested grass mixture.

Land Use Redevelopment

Upon completion of the reclamation of the Upper Meander Creek site, the area will have public recreational potential for primitive camping, picnicking, and hiking. Mahoning County, based on the 1970 Lakeshore Upland Region Report of the Ohio Outdoor Recreation Plan, has a need for development of approximately 4,000 acres for land-based activities. Recreational needs for Mahoning County residents are currently being satisfied in the surrounding counties. Development of the study area for land-based recreational activities would provide needed facilities within a shorter driving distance and establish a worthwhile use for the reclamation area.

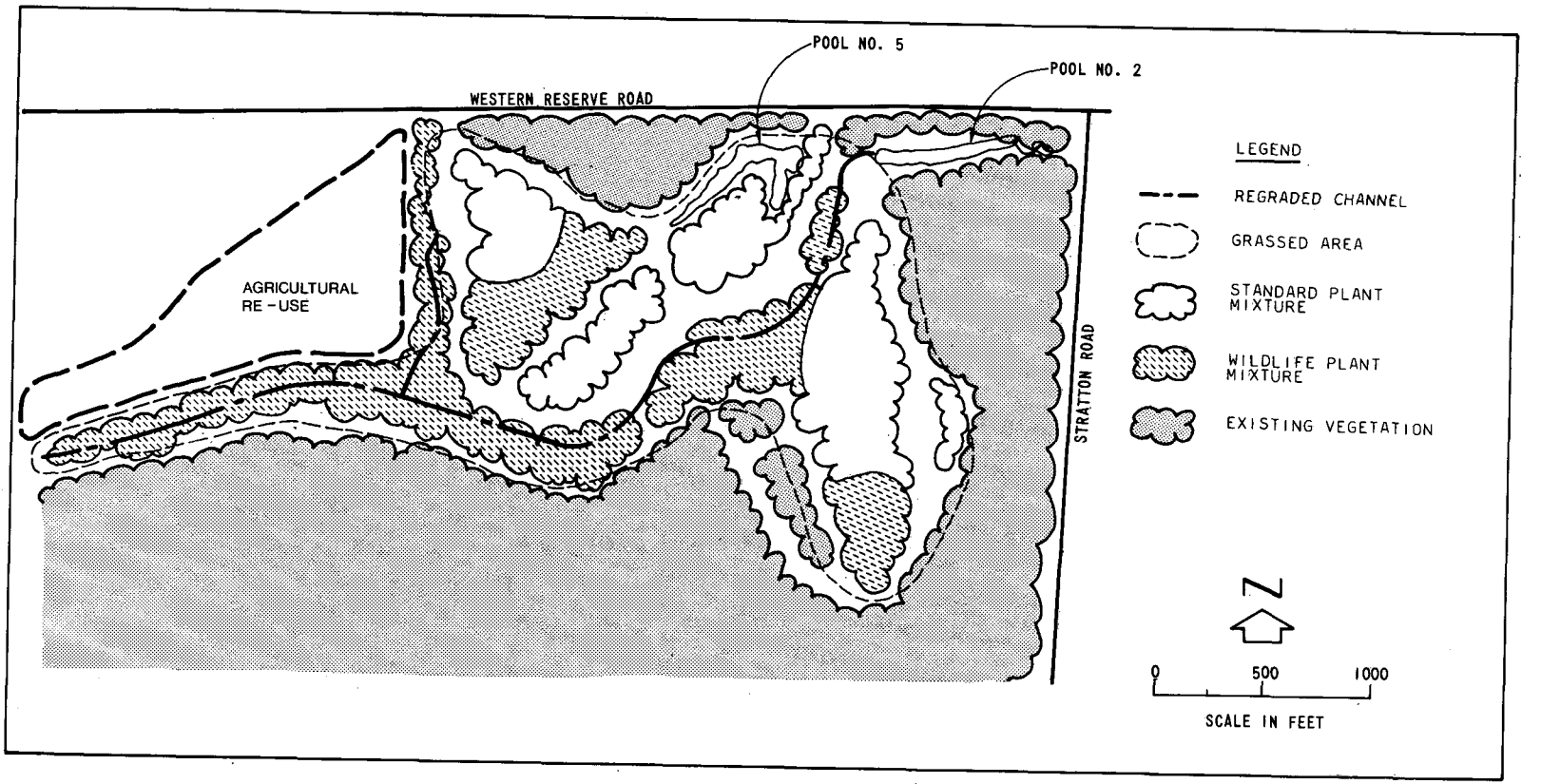

Figure 14 - Revegetation Plan

The Sheban property (northwest quarter, Section 2) involves approximately 160 acres, which after reclamation, will be moderately rolling with a ravine in the final cut area. The site is somewhat isolated from the Youngstown metropolitan area, but should provide an excellent retreat from urban development. Recreational features should be limited to primitive camping and picnicking facilities with trails winding through the entire area. Revegetation has been planned to accommodate recreational development as well as provide wildlife benefits in the ravine and nondeveloped areas. Figure 15 schematically illustrates a possible plan for the reuse of the project area. Recreational development, as shown, includes access roads, parking, water, sanitary facilities, camping push-offs, trails, picnic tables, and fire grills.

Trail development could accommodate hiking, horseback riding, and bicycling in the spring, summer, and fall months, and snowmobiling in the winter. This type of utilization would encourage year-round use and increase the recreational benefits of the reclamation project. Interpretive displays illustrating surface mining operations, reclamation techniques, and nature appreciation could be provided along the hiking system. Outdoor classrooms would also be beneficial for educational experimentation and instruction.

Program Surveillance

For demonstration of the effectiveness of the proposed mine drainage abatement program, a limited amount of monitoring and analysis of water discharging from the area will be required. An early element of the improvement effort will involve installation of a flow metering and recording structure and sampling station to monitor all normal flows from the area. This facility will be located near Stratton Road where the entire study area outflow is in a common channel and there is relatively easy access for servicing the metering equipment.

Continuous recording instrumentation is anticipated to provide a complete permanent record of the flow rate from the study area. An automatic proportioning sampler will extract a representative sample of the discharge stream for subsequent analysis. Schedules will be established for servicing metering equipment and analyzing the water sample on a once per week basis. More frequent sampling will, of course, be possible if desirable to better define characteristics of the discharge stream. Recommended routine analysis of composite samples includes the following parameters:

Acidity
pH
Conductivity
Iron
Sulfate
Total and Dissolved Solids

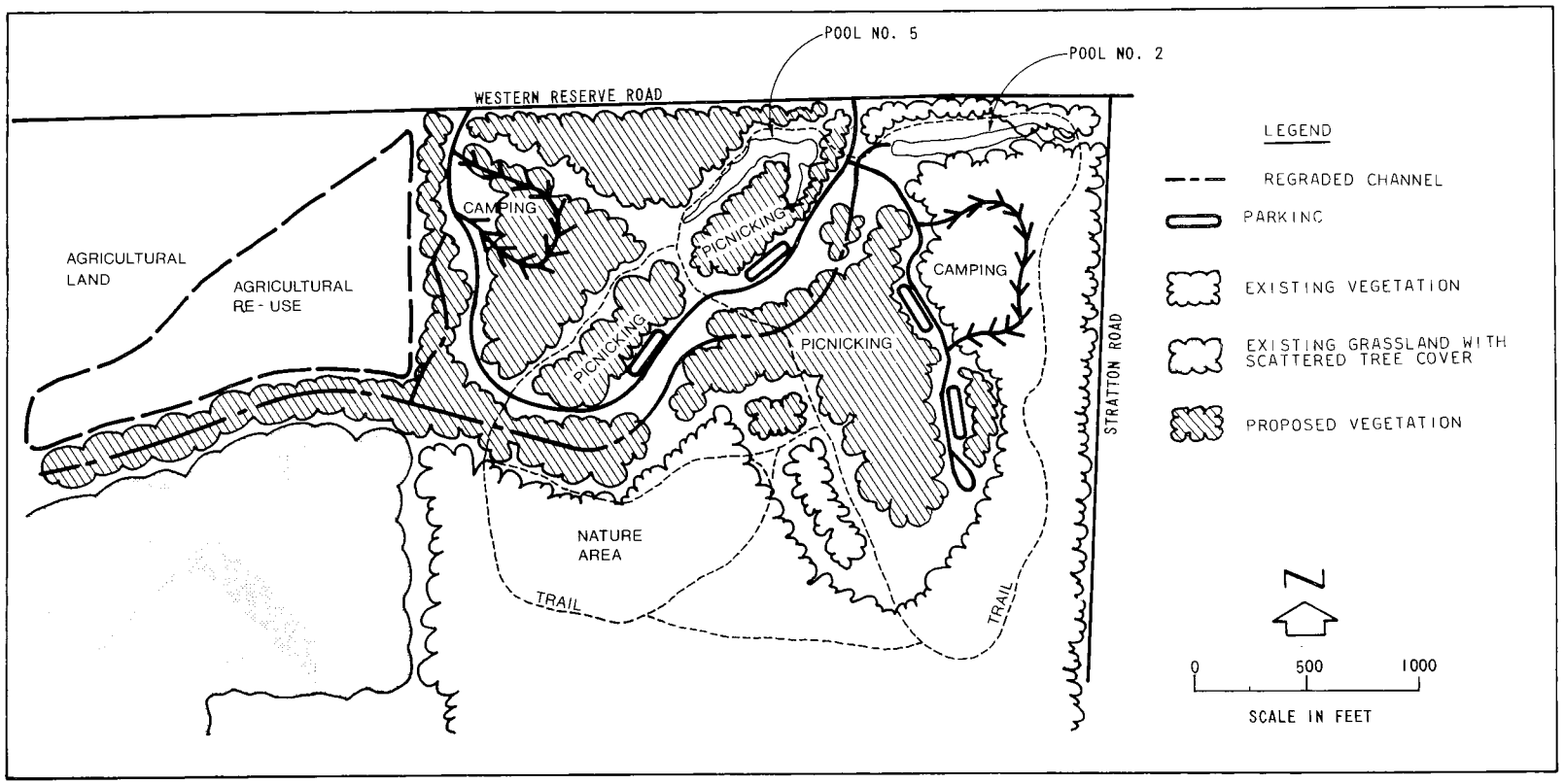

Figure 15 - Land Use Redevelopment

The Mahoning Valley Sanitary District Routinely patrols the Meander Creek Watershed to protect the integrity of the source of supply for their water treatment facility. It is recommended that the District be considered for responsibility for servicing of recording instruments and analysis of water samples.

The final phase of program surveillance will involve an evaluation of the data collected and a summary report on the abatement project. This phase of activity will be deferred until adequate operating records are available to establish trends in mine drainage production from the project site. Routine flow monitoring and sample analysis will continue for a minimum of two and possibly as many as four or five years from the completion of construction to provide time for the system to stabilize and for adequate records to be accumulated.

Emergency Procedures

It has been previously indicated that all possible precautions will be taken during the period of actual regrading and reclamation work in the area to assure that no slugs of acid contaminated water are discharged to Meander Creek, or that any other adverse environmental conditions develop. Upon completion of the project, there will be no large standing bodies of water which could easily be released to cause damages downstream.

Discharges from the area will be routinely monitored. Any developing hazardous condition will be flagged and appropriate emergency procedures developed to cope with the particular situation. Beyond this effort, no specific emergency procedures are required for the project area.

Cost Estimate

A cost estimate has been prepared for each of the elements in the total mine drainage abatement program. These costs are summarized in Table 7.

TABLE 7

PROGRAM COST ESTIMATE

Neutralization		
Equipment and Set-up	$ 3,000	
Chemicals, Operation & Maintenance	8,000	
		11,000
Regrading		
Excavation	96,000	
Furrow Grading	15,000	
Fine Grading of Channel	10,000	
		121,000

Revegetation		
Surface Preparation, Liming and Fertilization	8,000	
Hydro-Seeding and Mulching	36,000	
Tree and Shrub Plantings	20,000	
		64,000
Program Surveillance		
Flow Control Structure and Equipment	5,000	
Routine Flow Monitoring	5,000	
Engineering and Resident Supervision of Construction	24,000	
Administration	5,000	
Final Project Report	10,000	
		49,000
Contingency		25,000
TOTAL ESTIMATED PROJECT COST		$270,000

No land acquisition costs have been included in the summary. It has been assumed that the land will be made available for public ownership. Water and mineral rights will accompany the land transfer.

The temporary neutralization system to be employed during the release of the presently impounded water has previously been described. Operation over a span of approximately four months has been anticipated with supervision of approximately four hours per day required. Since this work must be closely coordinated with the regrading operation, it would be advantageous for this activity to be handled by the same agency with responsibility for the earthmoving.

The single largest cost item in the proposed improvement program is for excavation. The $96,000 cost figure represents 320,000 cubic yards of excavation at a cost of 30 cents per yard. This relatively low unit price for earth moving assumes that the work will be done by a local public agency. The costs as presented, therefore, represent the actual costs incurred by the agency and do not include any provision for profit.

Furrow grading is separate and in addition to the general excavation costs. A unit cost of $300 per acre has been used for estimating purposes. The item for finish grading of the channel represents the cost necessary to return to the site after approximately one year to repair places of unequal settlement and to generally shape up the area.

Costs as presented for revegetation are typical of contract awards for this type of work. It has been assumed that surface preparation, liming, fertilization and all revegetation will be awarded as a single contract.

A flow control structure, flow recording equipment and a water sampler will be installed in the outlet channel near Stratton Road. Weekly servicing of the monitoring equipment is anticipated and a total of four manhours work per week over a three-year span have been allocated for this effort.

Minimal engineering design costs have been included in the project summary based on the assumption that work will generally be performed on a force account basis with a minimum of contract type plans and specifications. A resident engineer on the site for four months represents the majority of this cost item. This individual will have wide responsibility for seeing that the project is constructed in general conformance with the concepts outlined herein.

Lump sum allocations have been made for overall administration and for development of a final report on the demonstration project. Approximately ten percent has been included as a contingency.

Construction of recreational facilities conforming to the suggested developmental plan will be the responsibility of the agency retaining ultimate control over the site. Costs for this work have not been included in the project summary.

Cost Comparison

To provide a frame of reference for the recommended implementation approach, costs have also been estimated for completion of the necessary construction activity on a general contract basis rather than the previously recommended force account type of operation. Table 8 illustrates the comparison between the two approaches.

TABLE 8

COST COMPARISON

	Force Account	General Contract
Neutralization	$ 11,000	$ 16,000
Regrading	121,000	182,000
Revegetation	64,000	64,000
Program Surveillance	49,000	70,000
Contingency	25,000	48,000
TOTAL ESTIMATED PROJECT COST	$270,000	$380,000

The neutralization and regrading elements of the program have been increased to reflect inclusion of a contractor's normal profit and overhead costs. Job mobilization and move-in factors have also been considered. The revegetation element was previously estimated on a contract basis, so no change is indicated for this item. In the

program surveillance aspect, overhead and profit have likewise been included in the construction of the flow control structure. The routine flow monitoring and administration will not change significantly since these items will not be included in a general construction contract.

Engineering and resident supervision of construction would be increased somewhat if a general contract were awarded. More definitive construction documents would be required to satisfy necessary contractual arrangements. The contingency factor has been increased to 15 percent in the general contract situation.

Considering all of the foregoing elements, a cost savings of approximately $110,000 is indicated for the project if construction is implemented on a force account basis.

PART V - PROJECT EFFECTIVENESS

Demonstration Value

A successful mine drainage abatement project at the Upper Meander Creek site will provide a number of public benefits. The study area is presently of little value to anyone and has imposed inconvenience and expense on local private property owners, several governmental agencies, and approximately 275,000 residents of Mahoning and Trumbull Counties.

The proposed project will demonstrate a number of procedures for treatment of an acid mine drainage problem and reclamation a despoiled area. Following are the specific aspects of the program leading to resolution of the problems at the site.

1. Elimination of the standing pools of acidic water and partial filling of the old final cut area will demonstrate the effect of providing positive drainage for a mined region. Immediate reduction of the average rate of discharge from the area is anticipated.

2. Effective techniques for establishing vegetative cover on acidic spoil material will also be demonstrated. Furrow grading, applications of fertilizer and lime, and selective planting of trees, grasses, and shrubs will have immediate impact on water quality. Plants will utilize a significant portion of the precipitation falling on the area which now runs off rapidly. The grading techniques proposed will demonstrate the ability to retain water on the slopes and thereby reduce the transport of sediment into the stream channels.

3. The final phase of the program provides for demonstration of the beneficial use which may be derived from an area which, in its current unreclaimed state, is a detriment to the entire region.

The Upper Meander Creek site is an excellent candidate for a demonstration project; the area is small enough to easily observe and evaluate overall effectiveness, yet large enough to fully demonstrate mine drainage abatement and reclamation techniques.

Water Quality Improvements

In addition to the demonstration value afforded by the proposed project, a specific troublesome surface water pollution problem will be abated. Discharge from the area is presently in violation of adopted water quality criteria; the pH is too low and the dissolved solids concentration is excessive.

Procedures outlined herein for temporary neutralization of the impounded water will satisfy stream criteria with regard to pH level; however, dissolved solids in the stream leaving the area will remain high during the neutralization process.

Longer range water quantity characteristics are extremely difficult to predict. Immediate results of the regrading phase of the program should be a reduced volume of discharge of surface flow from the mine area. The complexities of the hydrologic system defy any rigorous calculation of the net reduction likely to be achieved. However, it would be reasonable to expect that the net outflow might be cut by up to one-half as soon as the ground water table has stabilized. Longer term it is possible that the discharge from the area will be reduced to an intermittent basis with flow occurring during and after precipitation events and during extended wet periods. At other times, there may be little or no water in the stream channel.

Water quality characteristics are similarly difficult to establish in advance. It is anticipated that during the construction phase, additional acidic material will be uncovered and the stream flow may exhibit a net increase in acid concentration for a period of time. However, after the initial rapid leaching and following the application of lime, fertilizer seed, and mulch, the quality of surface run-off should rapidly improve. This improvement will continue as plant growth is established to retain and utilize moisture on the surface of the spoil bank, and as a good soil mantel develops to reduce the exposure of new acidic material via erosion. Water quality characteristics may be improved by as much as 25 percent during the first full year following completion of the demonstration project. Longer term, 80 to 90 percent improvement in five to eight years is a reasonable objective.

Strict compliance with water quality criteria will not be immediate; however, the proposed demonstration program contains all necessary features to minimize immediate damage to the downstream aquatic environment and to provide long-term improvement in the discharge from the area.

Cost Savings

The most apparent public benefit to be derived from the proposed reclamation project is reduction of undesirable water entering Meander Creek Reservoir. The partial elimination of acidic influent water will immediately reduce water treatment costs to the Mahoney Valley Sanitary District.

Sanitary District personnel have calculated that the treatment of acidity and hardness in the water originating in the study area represents a total annual cost in excess of $35,700. On the basis of previously presented assessments of mine drainage characteristics and improvements, water treatment savings approaching $9,000 per year may be realized by the second year following completion of the demonstration project.

Further water quality improvements should ultimately result in annual savings of over $30,000 as the full effectiveness of the demonstration techniques are realized. The savings to the district will undoubtedly influence water rates for the entire water service area.

Other direct monetary benefits will result from the project but these accrue more to private property owners and less to the general public. Considerable expense and concern to the owners of the recreational impoundments in the downstream watershed has occurred in the past. Improved water quality in Meander Creek will reduce the cost for damage prevention measures and allow the owners of the recreational facilities to assure potential patrons of good water quality. Elimination of the large impoundments at the Sheban site also eliminates the present flood threat and therefore further adds to the general benefits for the downstream public.

Aesthetics, Fish and Wildlife

Reclamation of the project area will improve the aesthetics of the presently derelict land and remove a scar from the Goshen Township landscape. Reclamation will provide recreational opportunities, create wildlife habitat, and ultimately provide social benefits for the entire Mahoning County area.

The improved water quality downstream from the mined site will restore and rehabilitate the aquatic environment of Meander Creek. The improved water will again sustain fish and aquatic plant life. Soil conditions should also improve, thus allowing land plants (trees, shrubs, and grasses) to be re-established along the stream. The improved water quality and vegetative cover will encourage the return of wildlife to the Meander Creek area and improve the aesthetics of the entire natural corridor.

Project Responsibility

Designation of specific individuals and agencies to carry forward with the proposed project has not been possible pending resolution of property ownership difficulties. Although no specific delegation of authority or responsibility can be made at the present time, following is a breakdown of project work elements to the three agencies having the most direct interest and concern with the demonstration program.

1. Ohio Department of Natural Resources - This agency should maintain responsibility for development of financial arrangement, submission of an application for federal demonstration grant funds, and overall administration of the demonstration program. Financial participation may also be provided.

2. Mahoning County - Ultimate ownership of the property and the development of long-range utilization potential should be the responsibility of Mahoning County through the Board of Commissioners. Interest has also been expressed by the Commissioners in financial participation by providing personnel and equipment for all or part of the regrading portion of the program. The temporary water neutralization facilities could logically be handled by the same personnel.

3. Mahoning County Sanitary District - Routine monitoring of water quality and servicing of recording instruments might easily be provided by the Sanitary District. Some consideration might also be given to having this agency provide for neutralization of the impounded water as an alternative to having this work element performed by county forces.

From the foregoing, it is apparent that two key factors must take place if the demonstration program is to move ahead. First, the private property must be transferred to public ownership so that the State can legally request partial federal financing. This is an Ohio requirement and not a stipulation of the federal demonstration program. Secondly, an agency or individual must take the initiative in developing the necessary administrative and financing structure to move forward with the program.

Program Schedule

Figure 16 outlines a schedule under which the various elements of the program may be undertaken. As shown, July and August of 1971 have been allotted for transfer of the property to the necessary public ownership, for finalizing funding arrangements at local and federal levels, and to establish the necessary administrative and construction features for full implementation of the program.

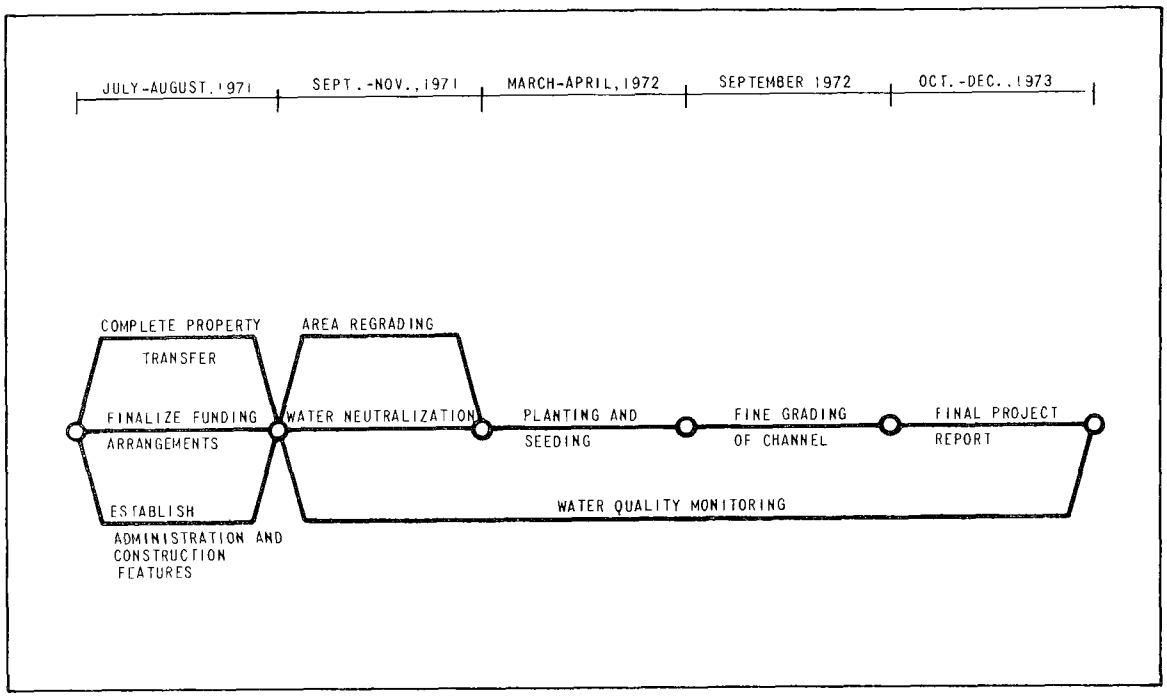

Figure 16 - Program Schedule

Regrading of the area and concurrent neutralization of the impounded water has been scheduled for September, October, and November of 1971. This is a key interval in the program. For best results, planting must be done in the spring, therefore, regrading activity should be completed the preceding fall to allow a period for stabilization of the soil surface prior to planting. If preliminary efforts cannot be moved forward rapidly enough to permit regrading in the fall of 1971, it may be necessary to defer the planting activity, which is scheduled for March and April of 1972, for a full year.

Establishment of a flow monitoring station and the necessary procedures for routine servicing of the station should be initiated with the start of the regrading activities or earlier if possible. This effort should continue as long as necessary to fully demonstrate the effectiveness of the project.

Final grading of the channel to dress up the area and remove the points of unequal settlement has been scheduled for the fall of 1972. Depending on actual conditions at that time, it may be desirable to defer this activity for another year.

The last item scheduled is preparation of a final report on the demonstration project. This has been scheduled for late 1973. It may, however, be desirable to allow an additional year or more for data accumulation prior to producing this final document.

PART VII - ACKNOWLEDGMENTS

During the course of the preparation of this feasibility study, a number of agencies and individuals have been contacted. The willingness on the part of all persons contacted to discuss the problem and to cooperate in developing a workable solution attests to the desirability of undertaking a demonstration program in the area. Contacts have included:

1. Ohio Department of Natural Resources.
2. Ohio Department of Health.
3. Mahoning County Board of Commissioners.
4. Mahoning Valley Sanitary District.
5. Mahoning County Soil and Water Conservation District.
6. Mahoning County Regional Planning Commission.

Dr. C. V. Riley of Kent State University served as a special consultant to Stanley Consultants during the feasibility study.

* * *

A significant objective of this project was to prepare a pilot feasibility study in accordance with the EPA manual "Feasibility Study Manual - Mine Water Pollution Control Demonstrations". Such feasibility studies are required by Section 14 of the Water Pollution Control Act, as amended. Thus, this report will serve as a guide to future feasibility studies. This project of EPA was conducted under the direction of the Pollution Control Analysis Program, Ernst P. Hall, Chief, and Donald J. O'Bryan, Jr., Project Officer.

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27 Abstract

This report presents an evaluation of the feasibility of a mine drainage control demonstration project for the Upper Meander Creek site which has been extensively surfaced mined for coal in Mahoning County, Ohio.

The general features of the recommended program include the following steps:

1. Elimination of standing pools of acidic water.
2. Regrading of the final cut to provide positive drainage from the area.
3. Preparation of a suitable seed bed and planting of acid tolerant grasses, plants, and trees.
4. Implementation of beneficial land use features following successful reclamation. This phase will be the responsibility of the agency retaining permanent control of the area and has not been included as part of the federally-aided demonstration.

Abstractor	Institution
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