IV GEOLOGY AND MINING HISTORY

A. GEOLOGY

1.0 History

The study area is underlain by the Monongahela Group of Pennsylvanian age. The group consists of cyclothems (cyclic deposits of coals, shales, sandstones, limestones) deposition of which was controlled by changes in the water level and type (marine, brackish, fresh) during the Pennsylvanian Period of geologic time. These various rock types were deposited in a nearly horizontal, slightly westward dipping attitude in a largely coastal environment (very low lying, seashore) where fresh water rivers from the east meandered, creating large, brackish swamps from the mingling of salt and fresh waters, much the same as the swamp lands of Virginia, Georgia and Florida today.

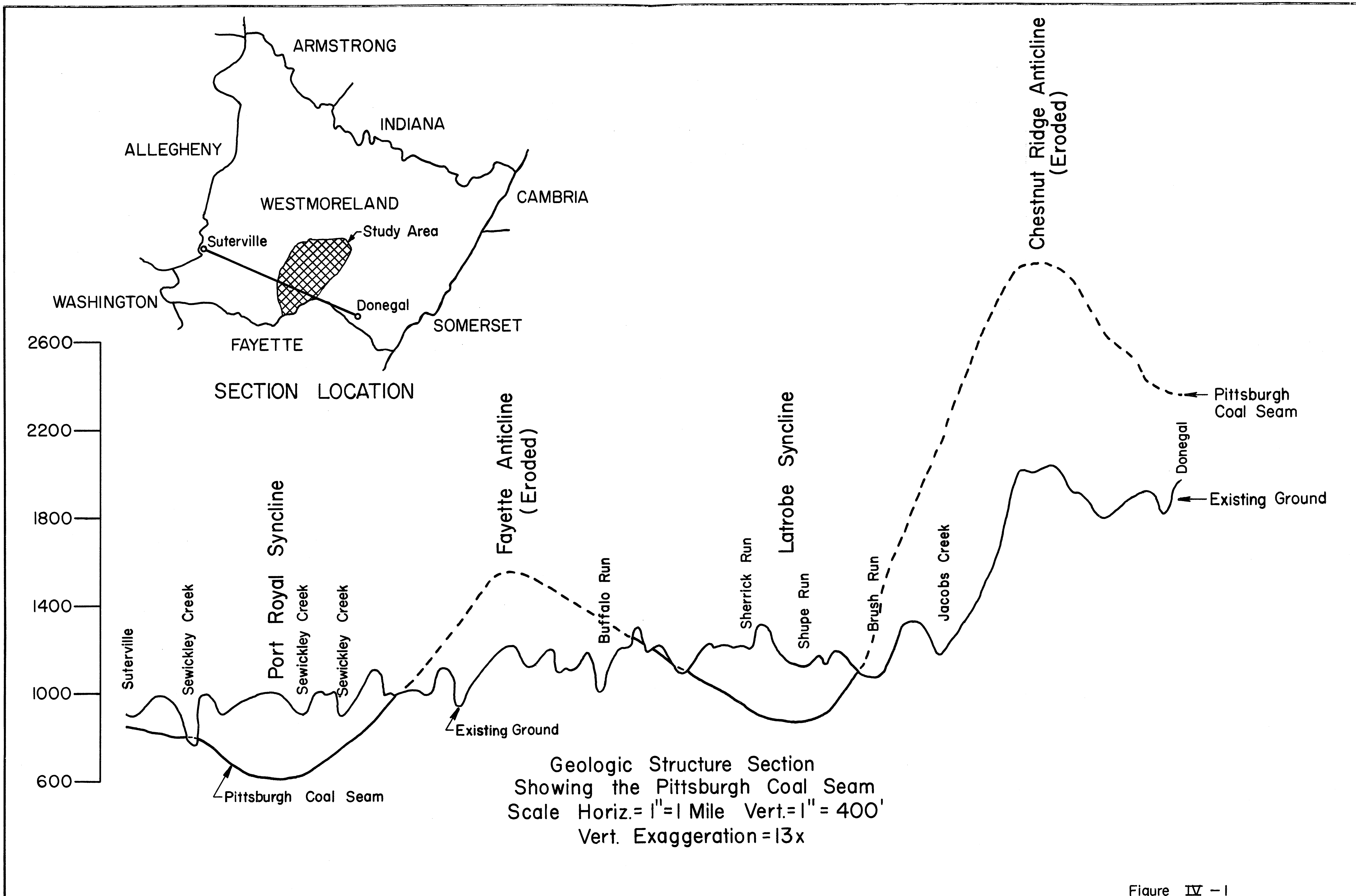
Gradual uplift with stress forces from the southeast caused folding of these rocks into anticlines (arches) and synclines (troughs), while erosion continued, leaving the younger strata only in the deeper part of the synclines. One such remnant is the Latrobe syncline. Figure IV-1 illustrates the original uplift and folding and also the subsequent erosion which has produced today's topography.

2.0 Stratigraphy

A generalized geologic column of rocks present within the Latrobe Syncline is located in Volume II, Plate 24. The Pittsburgh coal is the basal member of the Monongahela Group. It is underlain by a 0-3 foot thick impervious clay. This clay zone acts as an aquaclude trapping the ground water. The clay zone commonly underlies coal zones.

Other major rock units within the Monongahela Group include:

1. The Pittsburgh sandstone - highly permeable but drained wherever the underlying Pittsburgh coal was mined and the roof of the entries collapsed (Piper 1933).



Geologic Structure Section
Showing the Pittsburgh Coal Seam
Scale Horiz.= 1"=1 Mile Vert.= 1" = 400'
Vert. Exaggeration = 13x

Figure IV - 1

2. The Redstone Coal seam - ranging from 50 to 70 feet above the Pittsburgh Coal seam, also broken where undermined (Sisler 1924).
3. Uniontown and Benwood Limestones - (130'-155' thick) fractured extensively during the mountain -building epoch, yields water from the fractures, joints and bedding planes erratically (Piper, 1933).

3.0 Photogeology.

Vertical aerial photographs were obtained for the Pittsburgh coal seam outcrop of the study area at a scale of 1"=570'. These photographs were used to supplement the physical outcrop inventory and delineate more closely the areas involved in the abatement plan.

Examination of these aerial photographs produced the following:

1. The drainage texture was judged to be medium to coarse textured in the outcrop area. This texture range typically indicates 1. medium to little runoff, 2. moderate to well drained permeable bedrock and 3. coarse permeable soils (Ways, 1973).

2. Tonal variations ranged from white to dark gray or black indicating soils ranging from well drained to poorly drained (Ways, 1973) in various areas near and on the outcrop.

3. The tonal uniformity or distribution of tones over the photographs could best be described as banded with some mottled areas. The banded areas indicated interbedded sedimentary rocks containing zones of different moisture availability and appear banded because of the distribution of vegetation. The sharp mottled areas indicate significant changes in soil moisture and/or texture within short distances

resulting in many puffy light and dark tones. Typically darker tones indicate higher moisture content and lighter tones slightly drier areas (Way, 1973). This mottling may be due in part to the past mining in this area.

B. MINING HISTORY

4.0 General

The beginning of bituminous coal mining in the Southern Latrobe Syncline basin is unknown, however, it is assumed that "country banks" for home heating were opened with the settlement of the area. Several lease agreements in the 1820's specified that "coll", "cole" or coal for boiler fires be supplied by the lessee. Coal was used in distilling whiskey ("Old Overholt" in West Overton), and grinding flour (Fountain Mills, now Scottdale) as well as for heating (Scottdale, 1974). The introduction of beehive ovens for production of coke in the 1840's accelerated the growth of the coal industry, and in turn, the railroads.

By 1875 the Baltimore and Ohio Railroad and the Pennsylvania Railroad had branch lines and spurs running through the area following the Pittsburgh Coal Seam outcrop to haul coke from the "mine mouth" coke ovens. At least 14 firms were reported coking coal taken from the Southern Latrobe Syncline, with a total of 749 beehive bank or block ovens shipping approximately 336,000 tons of coke yearly to Pittsburgh, "Chicago and West" (Platt, 1875).

> "...Messrs. Dillinger & Suttle are operating the Enterprise Works at Hawk Eye station. They work the Pittsburg Coal Bed, nine feet thick, with the small slate binder three feet above the floor....
>
> "...Messrs. Hurst, Stoner & Co., are operating at Stonersville. (Alverton)
>
> "Samuel Warden & Co. are also operating close by Stonerville.
>
> "Messrs. Stoner, Hitchman & Co. are operating at Farr's (Tarrs) station....
>
> "Messrs. Painter & Co. are operating at West Overton station.

"Messrs. Lomanson and Sauft are operating half a mile north of West Overton station.

"Messrs. A.S.R. Overholt & Co., are operating at the West Overton mines.

"Messrs. Markle & Co., operating at the Rising Sun Coke works, one-third of a mile north from Iron Bridge station.

"Mr. I.F. Overholt is operating just opposite to the Rising Sun Coke works.

"Messrs. Cochran & Ewing are operating the Buckeye coke works at Bridgeport station.

"Messrs. J.F. Stauffer & Co. are operating at Bridgeport station.

"Mr. Wm. D. Mullin operates north of Bridgeport station.

"Messrs. Boyle and Hazlett are operating on the west side of the railroad, opposite to Mullin's works.

"Messrs. Duncan & Bro. are operating at the north terminus of the Mount Pleasant Branch of the Pittsburg and Connellsville railroad."

Using Platt's conversion factor for beehive ovens (1.6 ton of coal to 1 ton of coke), coal tonnage from the Southern Latrobe Syncline in 1875 was approximately 538,000 tons for coking alone.

The peak years for mining and coke manufacture within the study area ranged from 1910 to 1930 with minor fluctuations dependent on the nation's general economy and prices of coal, coke and steel. Minor economic booms saw many small mines come into existence taking advantage of the higher prices paid for coal. These same mines were abandoned quickly when coal prices dropped.

The depression of 1929 caused the abandonment of most of the larger mines. The last large mine operating in the study area, the United Mine (H.C. Frick Coke Corp.) closed in 1933. Undoubtedly, water problems from the abandoned mines played a large part in raising the cost of coal extraction beyond economical reach.

Surface mining along the outcrop began in the early 1900's and continues to the present day. Most of the present day surface mining consists of recovering pillars and stumps from the old mine workings.

Several deep mines were reopened during periods of large coal demand and in the war years. No deep mines are operating in the study area at the present time.

5.0 Mining Methods and Losses

The United States Coal Fact Finding Commission appointed by President Warren G. Harding investigated all phases of the coal mining industry and reported to Congress. Coal losses and mining methods in the bituminous coal fields of Pennsylvania were investigated by James D. Sisler, Coal Geologist of the Pennsylvania Geological Survey. His findings were published in 1924 by the Pennsylvania Geological Survey.

Regarding the Pittsburgh bed between the Youghiogheny and Conemaugh Rivers he stated;

> "The mines in this part of the (Pittsburgh Coking Coal) district are not as well managed as those in the vicinity of Connellsville and Uniontown, and the engineering methods are mediocre. The larger companies employ efficient engineers and run their rooms and headings on sights. The smaller companies have driven in their headings and turned off their rooms in a haphazard manner, in order to recover the most coal in the least time at the lowest cost. In these smaller mines the loss in handling and preparation is excessive. The pillars are too thin to withstand the crushing weight of heavy cover, and large areas are lost in creeps. Too many rooms are turned off the butt headings in order to increase tonnage, and are allowed to stand and cave when demand is slack. Operating companies not having enough capital to clean up rooms and put them into producing shape abandon them and the coal is lost."

Concerning the Redstone Coal, he wrote:

> "The Redstone Coal is mined in a few localities by farmers for local use. Only a few mines are producing coal for shipment. These mines were opened within the last few years and practically no pillars have been pulled. The operating companies are small and little attention is paid to mining

methods. The chief aim is to obtain large production at minimum cost. The recovery in this bed is probably about 60 percent.

"The great loss is in the pillars, which are too narrow, and although the overburden is quite thin is most places, are already being squeezed. In these mines many rooms have been turned off of each heading, the easily mineable coal taken out, and the rest abandoned. The bed is thin and subject to great irregularities in thickness. Large areas have been abandoned because of prohibitive production costs. In mines not having natural drainage, large areas have been lost by flooding when the mines are idle.

"The Redstone coal lies from 50 to 70 feet above the Pittsburgh, and has been ruined in large areas by the Pittsburgh coal being mined out beneath it. The roof and bottom are fractured and the coal crushed. Companies operating where the Pittsubrgh coal has already been mined find that in large areas it is impossible to timber the roof safely enough for miners to work."

He listed 42 principal causes of coal losses in Pennsylvania. A partial listing of pertinent causes in the study area follows:

"(2) Rooms are driven too wide and pillars are too narrow to support the heavy overburden and squeezes are induced.

(3) Too many rooms are turned off the headings in order to increase production temporarily. Mining stops in these rooms before they are worked out, the coal is squeezed, the roof caves, and the rooms are abandoned.

(5) Many mines lack competent engineering supervision. The rooms and headings are not run on sights, and future development is not planned.

(6) Irregular and unsystematic break lines cause losses of extensive areas of coal.

(8) Retreat mining is delayed in an effort to produce coal at a minimum cost from virgin areas.

(12) The small operator buys a few acres of coal, groundhogs it, mining only the thickest part of the bed and leaving the thin coal and large pillars. In this way thousands of acres of coal in Pennsylvania have been ruined.

(20) Squeezes induced by rib gouging in both machine and pick mines are common cause of loss.

(21) Prohibitive cost of unwatering low areas in mines flooded during idle periods causes loss of pillars and solid coal.

(22) Small companies often abandon areas of coal because retreat plans have been delayed and timbers have rotted. The cost of cleaning up roof falls and retimbering is prohibitive to recovery of the coal.

(27) Unnecessarily large quantities of coal are left on the top to hold up bad roof. Adequate timbering would eliminate much of this loss.

(28) In some districts, where top coal is left in place, it is supposed to be recovered when pillars are pulled. Miners neglect to pick it down and the break comes before it is recovered.

(30) When pillars are pulled, unnecessarily large stumps are left; if they are not drawn at once, they are crushed by the break and the coal is lost.

(31) Lack of uniformity in size of rooms and pillars often causes local squeezes and heaves.

(35) Unsystematic pillar pulling or pillar grabbing in some mines has caused large areas to squeeze, and the roof to ride over large areas of solid pillars.

(40) Some binders or partings are water carriers. In mines having a water carrier parting or binder near the bottom, adjacent coal is left in place to avoid the water."

6.0 Drainage

Water encountered in mines comes from several different sources. In areas of low cover and without a firm solid roof, rain may seep directly into the workings. In deeper mines where pillar falls or squeezes have broken the roof to the surface, water may also enter, from either the surface or from aquifers fractured by the fall, i.e. the Pittsburgh sandstone.

The roof under all season streams is generally broken, fractured and allows water to pass. Deeper mines are usually overlain by water-bearing strata where pillar breaks and faulty roof admit water. Other sources are core borings from coal exploration, boreholes for water discharge from the old workings and old water from abandoned workings or abandoned adjacent mines. (Cassidy, 1973)

"In all cases, except where passing under a year-round stream, the amount of water made is usually pretty closely connected with the weather -- more water during the rainy season, less in the dry, although the deeper a mine is, the longer it is before changes in rainfall are felt." (Cassidy 1973)

Tracy (1922) stated that the Calumet Mine pumped an average of 1,000,000 gallons of mine water every 24 hours. In a discussion to Eavenson's paper (1922) J.R. Campbell stated;

"In the Connellsville coke region it has been customary to express run-off and mine drainage in terms of tonnage mined; for instance, we figure that from 4 to 7 tons of water are pumped for every ton of coal mined, depending on the local conditions."

7.0 Problems

The history of deep mining in the Southern Latrobe Syncline presents a complex and confusing picture. Acquisition of mining interests and small companies by the larger (in particular the H.C. Frick Coke Co.) leads to several questions of major importance that may be answered by inference only.

1. Most of the smaller companies were drift mines. When these were acquired by companies mining down dip were the barriers left in place? Ex. The Ruff, (H. C. F. Coke Co.) drift mine was abandoned in 1902 with the following comment by the District Inspector: "The remaining coal will be taken out by the way of South West Mine No. 3" (Southwest Connellsville Coke Co. ownership until 1903).

2. Some mines were ventilated by fans of other mines. Does this mean that no barrier was left or that the barrier was breached only at certain areas and later blocked by masonry or block when no longer needed? If so are these barriers, at present, effectively retarding the flow of the mine pool between the mines?

3. Some mines were idle for a year or longer before work resumed. Were the workings de-watered or were new areas opened and flooded areas ignored? The 1903 district inspector report stated for the Heal No. 1 Mine "… pulling pillars from old workings … considerable trouble (from) black-damp and water ... opening new portions…"

4. Provisions of the mining law at the time allowed up-dip mine barriers to be breached in order to eliminate the danger of flooding when work neared these barriers. This breaching needed the approval of the district inspector, yet no record of approval was found in the annual reports (page F - 8) - does this mean that it was never used or was it so commonplace it wasn't worth mentioning.

5. No records were found covering the study area between 1876 and 1899. What mines operated, difficulties encountered and/or provisions for drainage are unknown.

6. Roof falls were reported only when injury or death resulted. Falls in abandoned areas were not reported. Yet over 50% of all accidents were attributed to falls of roof coal, slate or roof.

7. Mines in one section of the Syncline (the area over which Sewickley Creek flows) were reported as having a "wet, soft bottom" and "very soft dangerous roof". Mining in this area should have required much closer timber spacing for safety and extra large pillars left in place to prevent squeezes. A mine map Vol. II, Plate 14 however, shows no special precautions were taken, even directly under the creek within 75' of the surface.

8. Names of mines were changed or retained when ownership changed hands, also when some mines were worked out and abandoned, another mine was opened using the same mine name, making mine correlations difficult.

   For example the Bessemer No. 1 and No. 2 mines were owned by the H.C. Frick Coke Company; The Bessemer Coke Company owned the Empire and Humphreys mines.

For this report assumptions were made regarding the above problems. It was assumed that only the barriers shown on the Works Progress Administration (W.P.A.) mine map were present within the syncline. The average barrier width was assumed to be ineffective after mining was completed due to the much larger hydrostatic head of water now present. Where ventilation was shared by two mines it was assumed that the mine barrier was breeched. It was also assumed that extensive roof falls occurred throughout the mined area.

As a rule of thumb it was assumed that the cheapest methods of dealing with drainage problems were used in all cases.

C. MINE POOL CHARACTERISTICS

8.0 Pool Recharge and Discharges

In simplified terms the Latrobe Syncline may be considered as a spoon, with the long axis lying in a northeast-southwest direction, and a general tilt toward the northwest. This slight tilt causes discharges from the mine pool to be concentrated on the northwest side of the syncline.

The mine pool is recharged by water percolating from the surface. Rainfall runoff is captured by many areas near the outcrop where subsidence holes form an almost continuous ring around the periphery of the syncline. This water flows, almost directly, into the mine pool. Large portions of the outcrop were surface mined and the unreclaimed pits and exposed highwalls serve as traps and access routes for surface water into the mine pool. In the center of the syncline the ground surface is underlain by fractured limestones, shales and sandstones. These fractures permit a large amount of rainfall to percolate to the mine pool, as evidenced by the many underfit streams flowing through the syncline. It is estimated that 20-30% of the mine pool recharge comes from the outcrop through subsidence holes and unreclaimed surface mines; the remainder coming from percolation through the fractures and joints within the syncline area. The large extent of mine pool permits a large storage capacity and is a major factor in minimizing the height and extending the duration of flucturations in elevation of the mine pool.

The following table describes the syncline discharges and gives their approximate elevations as determined from Vol. II Plates 1 and 2.

TABLE IV-1-DISCHARGES

Discharge Number	Elevation	Location	Description
M05	1078	See Vol. II-Plate 5	Drain from Southwest No. 3 mine, partially submerged rectangular concrete opening
M06	1030	See Vol. II-Plate 11	Drain from Central mine, partially submerged rectangular concrete opening
M07	1035	See Vol. II-Plate 11	Drain from Standard mine, submerged rectangular concrete opening
M08	980	See Vol. II-Plate 14	Breakout(?) Concealed source surfaces at stream level and flows in a "made" channel a short distance before entering Boyer Run
M08A	980	See Vol. II-Plate 14	Breakout(?) Concealed source surfaces at stream level a short distance downstream from M08
M09	980	See Vol. II-Plate 14	Breakout(?) Concealed source surfaces near stream level in a swampy area on the other side of Boyer Run from M08 and M08A
M10	965	See Vol. II-Plate 14	Breakout, at stream level See page IV-16 for detailed description
M11	965	See Vol. II-Plate 14	Breakout and drain, several concealed sources surface in a large shallow pond. Mine maps indicate two possible drains could be flowing into this area.
M12	970	See Vol. II-Plate 14	Drain, identified on mine map as Drain Ditch
M62A M62B M62C	1140 1140 1124	See Vol. II-Plate 5	Air seals, discussion with land owner indicated the discharges were piped from the outcrop to their position in and near the stream

TABLE IV-1-DISCHARGES (Con't)

Discharge Number	Elevation	Location	Description
M63	1155	See Vol. II-Plate 5	Two air seals located at stream level, one of the seals is for a mine drain as indicated on Plate 5
M100	1080	See Vol. II-Plate 4	Seep from marsh on old strip bench
M101	1170	See Vol. II-Plate 5	Air Seal, piped from outcrop after stripping operation
M102	1190	See Vol. II-Plate 5	Inability to contact property owner prevented monitoring and direct determination as to type of discharge, i.e. seep or air seal
M103	1180	See Vol. II-Plate 5	Air Seal, rectangular concrete opening
M104	1070	See Vol. II-Plate 8	Drain, submerged rectangular concrete opening, piped from outcrop into stream
M105	1030	See Vol. II-Plate 16	Seep from coal island. A stripping operation began during the second month of monitoring and the seep was destroyed. Only one sample of the seep was analysed (Appendix B-23). The other sample listed (Appendix B-23 August) came from water within a deep mine opening uncovered during the stripping operation. No active discharge was found following completion of the surface mining operation.
M106	1020	See Vol. II-Plate 16	Seep at base of highwall on unreclaimed surface mine
M107	1030	See Vol. II-Plate 16	Seep from caved drift mine entrance evidenced by old timbers and signs of excavation
M108	1060	See Vol. II-Plate 16	Air Seal, discharge from stone weir

TABLE IV-1-DISCHARGES (Con't)

Discharge Number	Elevation	Location	Description
M109	1080	See Vol. II-Plate 16	Discharge from 3" PVC pipe from a tile field on an old strip bench on coal island
M110	1100	See Vol. II-Plate 19	Seep from down dip side of island
M111	1115	See Vol. II-Plate 19	Seep from marsh on old surface mine approximately 100 yards North of M110

The discharges may be divided into four groups as indicated in the description section of the above table. The first group is the main drains, whose discharge elevations are not mine pool dependent. These drains were dug below the coal seam during the active mining period with major emphasis placed on dewatering the up-dip portion of the mine by gravity flow. These ditches were dug in main headings at an angle to the dip of the coal seam and continued to the coal outcrop. From the outcrop they were dug through the underlying strata to emerge near a stream. The discharges of this group fluctuate in response to precipitation more so than the mine pool dependent ones (see below). The mine pool acts as a large reservoir which tends to dampen the fluctuations because of its large storage capacity. The size of the recharge area supplying the drain also induces, to some degree, a dampening of the response to precipitation. The larger the area, the less sharp is the response to the precipitation, because of the longer time needed for the larger system to respond to the change. Recognition of the independent sources for these main drains led to the formulation of an abatement plan, which considered the individual sources in relation to the syncline as a whole. Examples of the Main Drains are M05, M06, M07, M12, M104 and possibly M11.

The second grouping is the seeps from coal islands (outliers). Examples are M105, M106, M107, M108, M109, M110 and M111.

The third grouping are the air seals. These are secondary discharges, possibly the result of later surface mining along the outcrop which caused a weakening of the outcrop barrier left after deep mining. These discharges were not directly caused by the mine pool. Examples of air seals are M62A, M62B, M6C, M63, M101, M103, and M108.

The fourth group, the largest discharges, are labeled breakouts at approximate elevations ranging from 964 to 980. These discharges are for the most part the result of mine pool "breakout" through sections of the outcrop where surface mining weakened the barrier and it was no longer able to withstand the head of the water. In the case of discharge M10 deep mining was continued under cover so thin that the mine pool has forced its way to the surface through subsidence holes as the level of the mine pool rose. These various water filled subsidence holes have joined together to form one large pond with an outlet to Sewickley Creek. Several smaller ponds are currently forming upstream from this large pond, and will eventually merge with it.

9.0 Test Borings

Eight test borings were planned to determine if the southern mine pool was compartmented by barriers as Gibbs and Hill (1972) theorized. As discussed (IV-11) the mine barriers are assumed to be ineffective. The test borings (located in Volume II Plate 1) were positioned to be on either side of mine barriers shown on the W.P.A. or other available mine maps. Table IV-2 lists the five test borings actually drilled with pertinent information and water elevations.

TABLE IV-2

Test Boring Data

Test Boring Number	Date Drilled	Ground Elevation	Approx. Bottom of Coal Elev.	Aver. Water Elev.	Elev. of Nearest Discharge	Mine	Nearest Barrier
2	8/14/74	1121.9	1072	1085.9	1078(M05)	S.W. #3	S.W.Acme
3	8/ 5/74	1048.6	939**	1038.6	1035(M07)	Standard	Cent-Std Std-Hecla
4	8/20/74	1079.7	1041	1044.7	1030(M06)	Central	Cent-Std
5	8/15/74	1092.1	1051	1059.6*	980(M08)	Boyer	Stewart?
7A	8/01/74	1022.1	947**	989.1	965(M10)	Hecla#3	Hecla#3 Brinker Run

* Possible Surface Water Infiltration

**Redstone Coal

As indicated in the table, the average water elevations agree closely with the nearest discharge, with one exception where surface water interference is suspected. In two cases, the drilling was stopped just below the Redstone coal seam. In both cases the holes were located near streams and the natural ground water table was penetrated.

A major constraint to locating the test borings was the need to locate them on township road right-of-ways.

The test borings were drilled by L. Robert Kimball, Consulting Engineers using a truck mounted Acker AD II Drill rig. The test borings were advanced using a six and three-fourths (6 3/4") inch tricone bit with water. This large diameter was necessary to accomodate the sampler with which PennDER personnel were to obtain mine pool samples for chemical analysis. These samples could have been compared to the nearest discharge and with each other to more completely determine the effect and presence of barriers. No samples were taken, however, before the test borings were filled in, as required by the drilling permits.

A problem developed during drilling of some borings when rock fractures, joints, etc., within the rock units caused the loss of wash water to the surface. When this happened the test boring descriptions were based on the drillers' experience with "blind" drilling.

Visual classification drill logs for the test borings are located in Volume I, Appendix E.