DEFINITION OF THE PROBLEM

A . GENERAL

The Little Schuylkill River receives acid mine drainage directly from numerous sources as well as from two tributaries, the Wabash and Panther Creeks. A total of 24 primary sources of AMD contribute essentially all the pollution in the study area. Of these, 14 are discharges from deep mine workings, 9 are seeps from refuse storage banks, and one is the discharge from an active breaker. Access roads constructed of mine refuse are located adjacent to or within refuse dumps at the Silverbrook Basin, the Newkirk Mine and the active Greenwood Stripping Pit, and their contributions and/or reclamation are incorporated into the study as part of their associated refuse storage areas. One isolated mine refuse road is that leading north from Route 209 near the village of Newkirk to the base of Locust Mountain; but its presence is insignificant as no measurable AMD was found discharging from the material. The sources of AMD are shown on the map, Exhibit 9, following page 51.

On each affected water-course, mine drainage discharges begin near the streams's headwaters. Of the three objectionable mine water constituents, acid, sulfate and iron, the acid contribution is the most damaging to water quality .

Under average daily conditions, natural gravity discharges contribute 16,400 lbs. of acid to the basin. The Little Schuylkill River receives 6,900 lbs. of acid directly and another 4,500 lbs. and 5,000 lbs. from the Panther and Wabash Creeks, respectively. In addition to the gravity discharge, mine water is pumped intermittently, and contributes acid at a combined normal rate of 23,000 lbs. per day and sometimes greater.

The acid loads to the receiving streams are so located and of such magnitude that their pH levels are consistently below a value of 5.5, the minimum level judged to be acceptable, from their headwaters and throughout their entire length; and less than a value of 5.0 much of the time. In contrast to the unpolluted tributaries, which support a good flora and fauna and even propogate native trout and provide a public water supply in the case of Still Creek. the Little Schuylkill River. Panther Creek and Wabash Creek support no fish life and provide neither domestic nor industrial waters.

Details of the source pollution loads and their relative rank and their stream impact are presented in the report section Water Quality.

B. SOURCES OF ACID MINE DRAINAGE

For the purpose of this report section the areas which contribute AMD pollutants to the Little Schuylkill River have been divided into three source areas according to the receiving stream as follows: 1) Panther Valley: This area includes all AMD sources in the Panther Creek Watershed east of the Little Schuylkill River which discharge into Panther Creek; 2) Wabash Valley: This area includes all AMD sources in the Wabash Creek Watershed west of the Little Schuylkill River which discharge directly into Wabash Creek; and 3) The Little Schuylkill River Valley: This includes all AMD sources which discharge directly into the Little Schuylkill River.

1. WABASH VALLEY

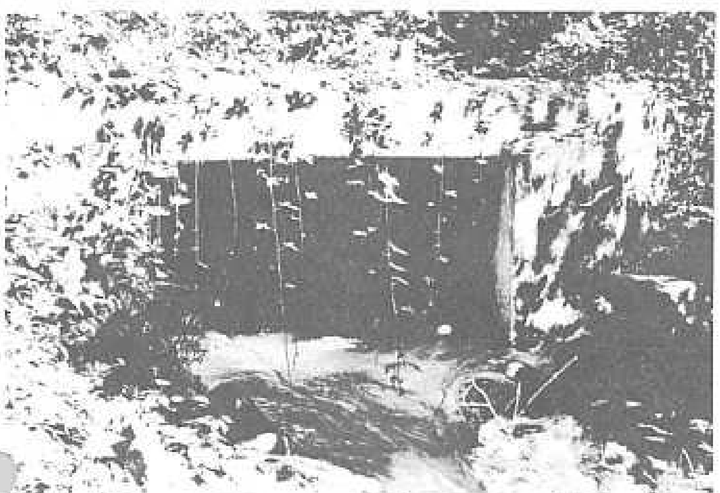
Wabash Valley is an area of approximately 5 square miles comprising less than 10% of the total study area. The valley extends west southwest from the Little Schuylkill River-Wabash Creek confluence for a distance of 3.2 miles and encompasses the watershed of Wabash Creek. The valley is 1-3/4 miles wide and is bordered on the south by Sharp Mountain and on the north by Locust Mountain. The towns of Tamaqua (west half). Newkirk and Reevesdale are located in this valley.

GREENWOOD REFUSEBANK

MANBECK REFUSE SEEPAGE

COALDALE NO. 7 MINE DISCHARGE

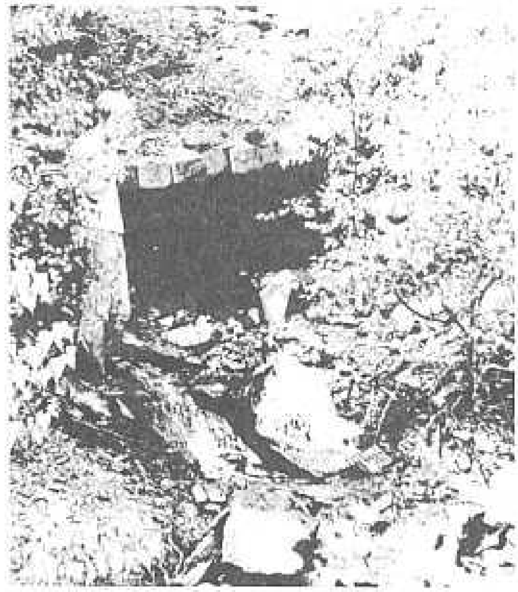
LANSCOAL NO. 9 MINE DISCHARGE



TAMAQUA NO. 14 PUMP(1) DISCHARGE AT HEADWALL

GREENWOOD NO. 10 PUMPS(2) DISCHARGE DITCH

SILVERBROOK MINE DISCHARGE



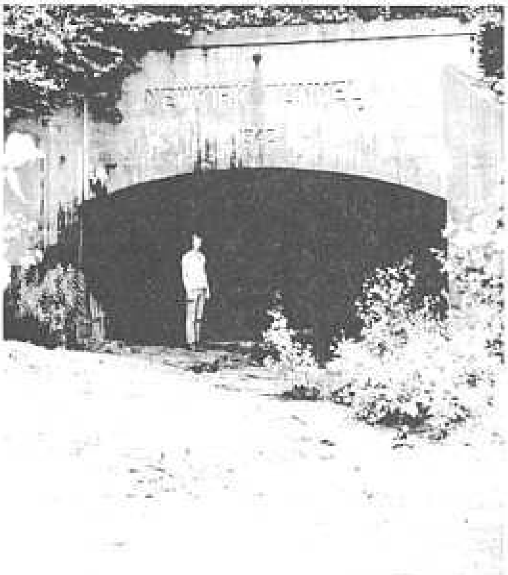
WEST LEHIGH MINE

MINE POOL IN SILVERBROOK STRIP PIT

ZAKREWSKY'S MINE AND PUMPAGE

GREENWOOD-EAST REFUSE SEEPAGE

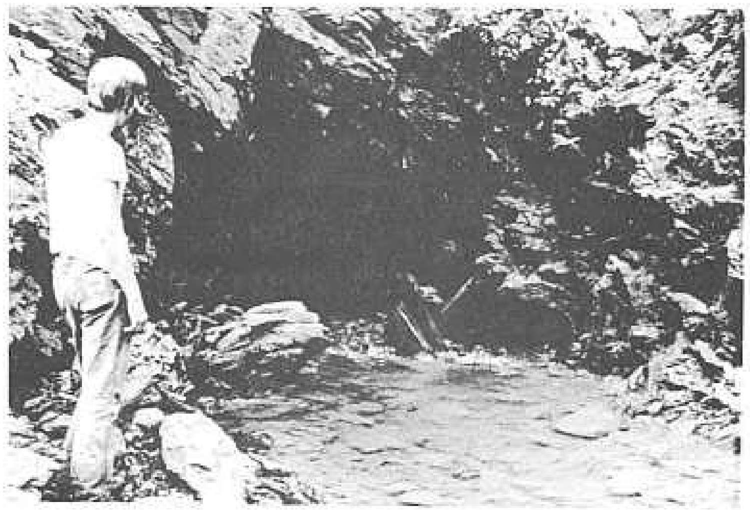
A&D MINE DISCHARGE



NEWKIRK MINE PORTAL

REEVESDALE NO. 2 DRIFT

NEWKIRK MINE DISCHARGE



REEVESDALE NO. 2 DRIFT

REEVESDALE NO. 1 DRIFT(COVERED)
AND DISCHARGE

NEWKIRK DRAINAGE TUNNEL DISCHARGE
AT CHURN HOLE

Extensive deep mining below the natural level of groundwater on both flanks of this valley has caused the formation of seven (7) pools of acid minewater. Each of these pools is constantly being recharged by groundwater and by direct rainfall percolation. The recharge area for these pools is bounded on the east and west by coal mine barrier pillars beneath the towns of Tamaqua and Tuscarora, respectively. Exhibit 32 presents the location of the mine pools and includes the extent of mining in the Wabash Valley.

The natural surface of this valley has been severely altered by strip mining on both flanks of the valley. Six hundred (600) acres within the valley have been destroyed in this manner. An additional 100 acres has been buried under refuse storage banks.

Seven discharges of acid pollution flow into Wabash Creek. Five of these are from deep mines and two are seeps from refuse storage areas. All of the deep mine discharges are from abandoned workings which contain two of the seven mine pools in the valley. The outflows from the remaining five mine pools flow directly into the Little Schuylkill River and are discussed in connection with that stream. The two seeps are from the refuse storage banks and de silting facilities of the Reevesdale and Newkirk Breakers (W: 1R and W: 2R - areas delineated on Exhibit 35).

a. <u>REEVESDALE #1 DRIFT</u>

The Reevesdale #1 Drift is an abandoned water level tunnel on the south side of Wabash Valley. The portal is located 1-1/2 miles southwest of Tamaqua and 1/2 mile southeast of Reevesdale. The portal elevation is 998 feet above sea level. The first few hundred feet of the tunnel have been removed, and the present opening is covered with rubble.

The Reevesdale #1 Drift extends on a southeast trend into Sharp Mountain for a distance of 1,450 feet. From this tunnel, gangways were driven west as far as Tuscarora and east as far as Newkirk. For nearly their entire extent, the workings had been undermined by subsequent work in the Newkirk Mine. Thus nearly all of Reevesdale #1 Drift is now drained by the lower workings of the Newkirk Mine. Only the small portion of the Reevesdale mine near the portal is drained by the old opening.

The surface above the Reevesdale workings is very heavily disturbed by strip mining. Examination of old mine maps and cross-sections indicates that the strip mining has in many cases intersected the deep mines. There is also evidence that extensive subsidence has occurred in these same areas. This combination of strip mining and subsidence has altered the surface drainage to such an extent that all runoff is intercepted and diverted into the deep mines.

The surface immediately above the tunnel entrance and the portion of the mine believed to drain into it is dominated by one large water-filled strip mine on the Holmes Seam (W: 18, Exhibit 35). The portion of the Holmes seam underlying this pit was not deep mined and accounts for the impounded water. The elevation at the bottom of this pit is concurrent with the elevation of the adjacent Reevesdale #1 Drift and it is suspected that infiltration into the tunnel from this pit is the main source of its drainage.

Since nearly all the water which finds its way into the Reevesdale #1 workings is subsequently drawn into the lower Newkirk Mine workings, the direct discharge from the Reevesdale #1 Drift is only an acid source of 3rd order impact on the Little Schuylkill River. It contributes only 100 lbs. of acid per day to the pollution of the main stem, less than 1% of the total.

b. REEVESDALE #2 DRIFT

The Reevesdale #2 Drift is an abandoned water level tunnel on the north side of Wabash Valley. It is located six hundred feet east of the town of Reevesdale, at a point 200 feet north of U . S. Rte. 209. The portal is partially open, but is subj ect to slabbing and caving due to the fractured nature of the surrounding rock. The elevation of the mine entrance is 949 feet above sea level.

The Drift extends north for 2,250 feet into Locust Mountain. Gangways were driven from the tunnel west as far as a barrier piller at Tuscarora, and east to gangway connections with the Newkirk Water Level Tunnel. The Newkirk Water Level Tunnel is, in turn, interconnected below water level to deeper workings mined from slopes at the Buckville and Newkirk Collieries. These portals have since been obliterated by strip mining and a large mine pool now inundates the lower workings. The Reevesdale #2 Drift is not directly connected to this mine pool according to mine maps. However, it is concluded that the largest portion of the flow from the pool is by way of Reevesdale #2 discharge.

This conclusion is based on the fact that the elevation of the mine pool is reported to be from 950 feet above sea level (Ash and Kynor) to approximately 960 feet above sea level. Although no known connection exists below water level between the Reevesdale #2 workings and the mine pool, the mine void containing the pool is, in many areas, subjacent or adjacent to the Reevesdale workings. The elevation of nearly all the Reevesdale gangways in these areas is between 949 and 968 feet above sea level, very close to the range for the pool elevation. Furthermore, outcrops of rock strata in the area of the Reevesdale Drift and the nearby pits exhibit strongly developed secondary porosity due to fracturing, jointing, and minor faulting.

The volume of flow from the mine pool is dependent upon the permeability of the rock strata, the elevation of the mine pool versus the elevation of the Reevesdale gangways (the hydraulic gradient) and the area of the Reevesdale workings which intersect the resultant water table.

A second source of recharge to Reevesdale #2 is seepage of water directly into the workings. The greatest portion of the workings is above water level and many of the breasts lie directly below strip mines.
It would be expected that the direct flow of surface runoff into the mines from these pits cause rapid peaking of the discharge during storms. Examination of the hydrograph in Exhibit 25 shows the behavior of the Reevesdale #2 discharge before, during, and following two intense storms on May 31, 1972. The expected rapid peak, however, did not appear. Instead, the

discharge showed a very broad flat peak that spread the storm discharge over 18 days, with peak flow occurring 6 days after the rainfall events. The only plausible explanation for this lag is the possibility that caving in the gangways has so restricted flow toward the portal that storm flows are stored and released over extended periods of time.

The surface above the workings of the Reevesdale #2 Drift has been almost completely destroyed by strip mining. Virtually all of the runoff that would normally enter Wabash Creek as surface flow is diverted through the strip mines, where it either infiltrates into the mine pool or flows directly into the Reevesdale #2 gangways.

Acid mine drainage from the Reevesdale #2 Drift comprises 2.63% of the average daily acid impact (lb. -mile basis) on the Little Schuylkill River. The average acid load from this source is 840 lbs. / day. As such it is the ninth largest acid source in the study area and ranks as a Second Order Source of acid impact on the main stem. (Pollution specifics begin on page 55).

c. NEWKIRK DRAINAGE TUNNEL

The Newkirk Drainage Tunnel is a short horizontal tunnel constructed on the north side of Wabash Valley, 1-1/4 miles west southwest of Tamaqua and 1/4 mile west of Newkirk. The tunnel was constructed to aid in the drainage of the mine pool of the Newkirk Slope workings. For a connection to the mine pool, two churn drill holes were bored from the surface directly above the mine tunnel (elevation 989') , down through the tunnel (elevation 957') and into the underlying mine workings. The first drill hole is 235 feet deep and intersects the workings of the First Lift of the Newkirk Slope on the Orchard Seam at 744 feet above sea level. The second is 391 feet deep and intersects the workings of the Second Lift of the Newkirk Slope on the Holmes Seam at about 598 feet above sea level. The first 100 feet of the tunnel has collapsed, leaving the remainder of the tunnel isolated at a maximum depth of 32 feet below the overlying surface.

The Newkirk Drainage Tunnel drains the same mine pool that supplies most of the flow from the Reevesdale #2 Drift discharge. The basic difference between the two discharges is that the Newkirk Drainage Tunnel is connected directly to the mine pool below water level by the two churn drill holes I whereas the Drift has no direct connection. In this respect, the Newkirk Drainage Tunnel discharge represents a restricted artesian flow from the mine pool through these churn drill holes, whereas the Reevesdale #2 Drift discharge is an unconfined groundwater flow from one mine void to another.

The relatively small variation in the rate of flow from the Newkirk Drainage Tunnel, as opposed to the greater fluctuation of the Reevesdale #2 discharge I reflects this basic difference. In the case of the Reevesdale #2 discharge, an increase in the level of the mine pool results in a rise in elevation of the unconfined water table between the pool and the Reevesdale gangways. This increases the area of the Reevesdale workings which intersects the water table and steepens the hydraulic gradient between the pool and the workings already receiving flow. Such an increase in head in the mine pool has a more limited effect on the Newkirk Drainage Tunnel discharge rate, due to the hydraulic limitations of the constricted flow able to pass the churn drill holes.

Acid mine drainage from this source represents 1.27% of the acid impact on the Little Schuylkill River with a quality very close to that of the Reevesdale #2 Drift discharge (acid concentration = 85mg/l).

d. NEWKIRK COLLIERY

The Newkirk Colliery comprises an abandoned mining area on the north side of Wabash Valley in the vicinity of the town of Newkirk. The area has four abandoned mine portals, including three slope entrances ranging from 995 to 1,038 feet above sea level, and the portal of the Newkirk Water Level Tunnel at 976 feet above sea level. All four en trances have been obliterated by strip mining, although a small section of the water level tunnel is still visible in the bottom rock of a strip pit that intersected it 500 feet north of the original portal location.

The three slopes in this area are associated directly with the workings containing the mine pool discussed in relation to the Newkirk Drainage Tunnel and the Reevesdale #2 Drift discharges. In addition, the Newkirk Water Level Tunnel is connected to these same workings above water level by a series of chutes.

The original, undisturbed elevations of these portals is from 16 to 78 feet above the maximum reported pool elevation of 960 feet and this would appear to eliminate the possibility of a direct gravity discharge from this source. There has been, however, extensive strip mining in the area and several of the lower strip mines have filled with water to the approximate elevation of the mine pool. Furthermore, flow at approximately 50 gpm from an adjacent mine spoils bank has been noted at this same elevation with some chemical characteristics identical to the flow from the Newkirk Drainage Tunnel. A minor direct discharge, then, appears to exist. The logical route is through some breach in the walls of one or more of the slopes. Excavation of the refuse covering the actual discharge point would be necessary to confirm this conclusion.

No figure for acid mine drainage from this location has. been included in the pollution level tabulation as it is insignificant due to the relatively low volume and concentration of the discharge. Only when the elevation of the mine pool was raised much higher than normal by Hurricane Agnes did this discharge exhibit flows in excess of 50 gallons per minute. The flow remained significant only as long as the two major discharges associated with this pool showed the effects of the storm, then subsided as the pool elevation decreased.

The surface above these workings is totally disturbed by strip mining. Literally all surface drainage is diverted into the strip pits and subsequently into the deep mine pool. Some deep mine refuse storage areas are in the vicinity of the colliery and the access road off from U. S. Rte. 209 is constructed of this same material.

e . NEWKIRK MINE

The Newkirk Mine is an abandoned water level tunnel southwest of Tamaqua on the south side of Wabash Valley. The portal elevation is 868 feet above sea level. The entrance is still open and is supported by a concrete head frame. Although the mine was in operation as recently as 1960, present plans for the relocation of the U. S. Rte. 209 will prevent re-opening of the mine from this portal.

The Newkirk Mine Tunnel extends south 2,250 feet into Sharp Mountain. Rock gangways were driven from this tunnel 7,900 feet west and 1,900 feet east. In nearly every case, mining was conducted below old workings of the Reevesdale #1 or Allen Collieries. In an area to the east, however, the rock gangways were driven over and only 30 to 40 feet above previous workings. In one place this practice reportedly caused caving of the Newkirk gangway floor into the lower workings.

In the main mining area, where the Newkirk workings are below older mines, every third chute was driven up to intersect and drain the higher gangways. This was a precaution taken against possible flooding of the mine if caving suddenly released impounded water from the higher level. The net effect is that the Newkirk Mine now drains by gravity nearly all the workings on the south side of Wabash Valley.

As the result of direct flow of surface runoff into the deep workings subjacent to strip mined areas, the Newkirk Mine discharge rate is subject to a rapid rise and high peaking. This rapid peaking was noted in flow observations made before, during and following intense rainfall on May 31, 1972, presented on Exhibit 29. The hydrograph shows an increase in the discharge rate to four (4) times the previous base flow in the 36 hours following the subsidence of rainfall. A concurrent rise in the acid concentration of the discharge increased its acid load by seven fold in the same period. Due to heavy rainfall over the entire basin, the flow in the Little Schuylkill River increased to five fold its previous base flow at the end of the same 36 hour period. The possibility exists, however, that an intense storm could be isolated in Wabash Valley or be more intense there than in the remainder of the basin. If so, this increase in pollution load from the Newkirk Mine could occur without a concurrent increase in the Little Schuylkill River. flow for dilution and thereby create a more severe impact than the normal discharge on the Little Schuylkill River, or possibly on the Schuylkill River.

In addition to drainage of nearly all of the percolating water in this area, the Newkirk Mine also drains a portion of the groundwater from the western end of the valley. The elevation of the Newkirk Mine at that point is as much as 50 to 60 feet below the headwaters of Wabash Creek. During dry periods when the flow of percolating water into the mines is diminished, groundwater supplies a constant base flow to the discharge. The gradient of Wabash Creek, however, is much steeper than the grade in the mine gangways so that the difference in elevation becomes less in the easterly direction, As a result of the difference in these two gradients, the drawdown imposed on the groundwater system by drainage thru the Newkirk workings becomes less severe in the direction of the mine entrance,

Part of the flow from this discharge is from a relatively small mine pool at the western end of the valley. This pool was formed in workings below water level in the immediate vicinity of the Reevesdale #1 Drift. The mining in this pool area was conducted from a slope at the Wabash Colliery and was later intersected by workings of the Newkirk Mine.

Acid discharged from this source represents 6.32% of the total acid impact on the Little Schuylkill River. It is the largest Second Order Source of AMD in the study area and the third largest source overall. The average acid concentration is 260 mg /1, yielding 2,030 lbs. of acid per day. The relatively high acid concentration probably is a reflection of the large amount of exposed reactive surfaces within the mine workings and the far distances the water must travel to reach the point of discharge.

The surface overlying the workings of the Newkirk Mine has been completely destroyed by strip mining and subsidence, This condition completely prevents any natural surface run-off from reaching the stream.

f. NEWKIRK SEEPS

The term Newkirk Seeps refer to a number of springs and seep lines that emanate from the refuse storage and desilting facilities of the former Newkirk Breaker. This refuse area is located immediately south of the town of Newkirk on the south side of Wabash Creek (W: 2R). Discharges occur in at least seven locations along the base of the refuse banks, The access road to the Newkirk Mine and the area surrounding the mine and the Breaker site are also covered with mine refuse. Much of this area will be excavated and refuse removed as part of new con struction of U. S. Rte. 209.

The source of these discharges is rainfall percolation through the material. The banks have a map area of 51 acres and, as such, receive an average of 204 acre-ft. of rainfall per year. As much as 90 to 95% of the precipitation is believed to infiltrate into the refuse material. Part of this water is discharged in springs at the interface between refuse and the natural surface. The remainder enters the natural unconsolidated material and reaches the stream by subsurface flow.

The Newkirk Seeps represent a Second Order acid impact on the Little Schuylkill River. They contribute an average of 1,400 lbs. of acid per day to Wabash Creek. The flow in these seeps exhibits very high concentrations, averaging near 1,650 mg/l. Therefore, even with their low flows of 70 to 100 gpm, the discharges still contribute 4.36% of the total acid impact in the study area.

g. <u>REEVESDALE SEEPS</u>

The Reevesdale Seeps emanate from the base of a storage ref use bank on the south side of Wabash Creek near the town of Reevesdale (W: 1R). The refuse is from the former Reevesdale Colliery, which serviced both the Reevesdale #1 and Reevesdale #2 Drifts. The discharge from the seeps collects in a ditch along the south side of an abandoned stretch of the Reading Railroad and flows east to join the Reevesdale #1 Drift discharge before entering Wabash Creek an additional 2,000 feet to the east.

The refuse bank above these seeps covers a map area of 51 acres. The top of the bank has been used as a de silting facility and collects all available precipitation and surface runoff. This water readily infiltrates through the refuse material until it makes contact with the underlying natural surface, and then flows along this surface to several small discharge points.

Acid drainage from this source represents the smallest individual impact tabulated on the Little Schuylkill River. It is a Third Order Source discharging only 80 lbs .1 day of acid. Measured concentrations from this discharge are low compared to concentrations from refuse in general. The average acid concentration is only 150 mg/l.

2. PANTHER VALLEY

Panther Valley is an area of approximately 11 square miles, which comprises nearly 20% of the total study area. The valley extends from the Little Schuylkill River - Panther Creek confluence at Tamaqua east northeast for a distance of 6.5 miles. It is 1-3/4 miles wide and is bordered by Nesquehoning Mountain on the north and by Pisgah Mountain on the south.

Extensive deep mining below the natural groundwater level on both sides of this valley has caused the formation of three large pools of acid mine water. The pool at the eastern end of the valley is separated from the other two by a coal mine barrier pillar and drains by gravity by way of the Lausanne Drainage Tunnel into Nesquehoning Creek, and then into the Lehigh River . As such the discharge from this pool is of no concern to this study. The other pools are two major sources of pollution in the Basin. They are pumped to maintain a desired water elevation and by this practice they absorb all or nearly all of the percolating water in the valley. Exhibit 31 presents the location of the mine pools and includes the extent of mining in the Panther Valley.

The natural condition of the surface of Panther Valley has been tremendously altered by coal mining activity. More than 1,000 acres of mountain-like refuse storage banks now dominate the north side of the valley. Strip mining activity on both sides of the valley has destroyed or covered another 950 acres. Subsidence of the surface due to lack of sub lateral support from deep mining has produced settling hazards to buildings in the towns of Coaldale and Lansford.

Panther Valley contains eight primary sources of AMD pollution, consisting of three deep mine discharges and five seeps or springs from refuse storage areas. Two of the three mine discharges are from the pumping of the mine pools and are directly related to the present operations of the Greenwood Stripping Corporation. The third, and smallest, is a natural gravity discharge from an abandoned water level tunnel.

Three of the five seeps are from refuse storage areas which are presently being utilized either in active refuse disposal or in the recovery of coal fines. The two remaining seeps are from refuse accumulations in areas where disposal activities have been discontinued.

a. TAMAQUA #14 PUMPS

The Tamaqua #14 Pumps is a set of two Federal-State owned pumps operated by the Greenwood Stripping Corporation to dewater its present surface mining operations, which extend below a mine pool formed in abandoned deep workings. Each pump is rated at 7500 gpm, providing a total pumping capacity of 15,000 gpm. The outfall from the pumps is located in Panther Valley 3000 feet upstream from the confluence of the Panther Creek and the Little Schuylkill River. The pumps were installed in 1960 in the abandoned Tamaqua #14 shaft of the Lehigh Navigation and Coal Company at an approximate elevation of 1020 feet above sea level. The discharge of AMD into Panther Creek is from an inclined rock drainage tunnel that intersects this shaft at 822 feet above sea level.

The water discharged by the pumps is from a mine pool in the deep workings that underlie the western end of Panther Valley, This mine pool partially inundates workings of the Rahn #11 mine, the Tamaqua #14 mine, Foster's Tunnel, Levan's Slope, the D-Slope, and the East Lehigh Drift at a present water elevation of approximately 660 feet above sea level. It is recharged primarily by direct surface runoff into strip mines and subsidence areas and by general groundwater movement into the mine void. This recharge area is bounded by barrier pillar #1 to the west; unmined ground between the Lanscoal #9 Mine and the Rahn #11 Mine and barrier pillar #33 to the east; and by the extent of mining to the north and south.

The Greenwood Stripping Corporation is presently required by the State to maintain the level of the pool below 700 feet in order to prevent flooding of a backfilling project in an exhausted surface mine. If allowed to rise naturally, the pool would drain by gravity from the East Lehigh Drift at an elevation of 782 feet above sea level. This slope entrance is presently buried on the east side of the Little Schuylkill River Water Gap south of Tamaqua, immediately adjacent to and one foot below U. S. Rte. 309. In the event that the #14 pumps ceased operation, it would be necessary to excavate this opening to provide adequate drainage under the highway from the mine to the river.

The surface overlying the #14 pool is characterized primarily by areas of refuse storage and strip mining. In the water gaps both north and south of Tamaqua, the surface overlying the workings of the Tamaqua #14 mine and the East Lehigh Drift have experienced extensive subsidence. Along the southern rim of Panther Valley, the steeply dipping beds of the Pottsville conglomerate, which underlie the coal measures, have failed due to the removal of sublateral support by mining, forming a massive escarpment.

These areas of subsidence and the extensive strip mining, deep mining and the refuse produced from them have combined to create a massive pool of acid mine water. This pool absorbs nearly all the available percolating water within its limits and discharges an average of 13,700 lbs. of acid per day at a concentration of 250 mg/l. This represents 42.9% of the daily acid impact on the Little Schuylkill River. Owing to the intermittent nature of the pumping, however, the actual impact of this discharge on the Little Schuylkill River is considerably greater than this average. Normal pumping employs one 7500 gpm pump discharging acid at the rate of 19,200 lbs. per day. During very wet periods, both 7500 gpm pumps operate and the total impact on the stream doubles to 38,400 lbs. per day. These figures represent a maximum slugging index of 305 times the average daily load and a minimum of 1.7 times average daily load.

The future surface mining plans of the Greenwood Stripping Corp. extend for 11 period of 25 years and will require the lowering of the mine pool elevation to 450 ft. above sea level. In order to reach this level, it will be necessary for the operator to overdraft the mine pool. Present Pennsylvania Department of Environmental Resources restrictions on the operation allow for only the base waste load that would otherwise flow from the pool by gravity to be freely discharged by pumping. Three aspects of this activity will cause the discharge of AMD to exceed this base load.

First, the above mentioned overdrafting to lower the pool elevation will require pumping in excess of the base flow from the mine pool. This will increase the flow during the time when the water level is being lowered.

Second, when the new level is attained, the prospect of increased groundwater flow into the mine pool is certain. This will cause an increase in the pumping in order to maintain the lower level.

Third, the exposure of more of the mine surface to oxidation will increase the production of AMD pollutants. The net result of all these factors will be greater volume and higher concentration of AMD discharged by the Tamaqua #14 pumps.

b. GREENWOOD #10 PUMPS

The Greenwood #10 Pumps is a second set of Federal State owned pumps operated by Greenwood Stripping Corporation to de-water its surface mining operations. The set of two pumps was installed in the Greenwood #10 Shaft in 1960 - one rated at 3850 gpm and the other at 3100 gpm. Together they provide a total pumping capacity of 6950 gpm. The pumps discharge AMD pollutants into Panther Creek at a point 1-3/4 miles upstream from the Panther Creek-Little Schuylkill River confluence. The elevation of this discharge is approximately 890 feet above sea level. A secondary pumping system located at the #10 Shaft periodically transfers some of this discharge to a nearby water supply pond for the Greenwood #12 Fine Coal Plant.

The Greenwood #10 Pumps drain a deep mine pool located in the abandoned mine workings below the Greenwood #10 shaft. The pool lies in the interconnected workings of the Coaldale #7 and #8 Mines, the Lanscoal #9 Mine, and the Greenwood #10 Mine. The Green wood Stripping Corporation is required by the state to maintain the elevation of this pool below 700 feet. If pumping ceased, and the pool elevation were allowed to rise, water would flow from #10 through the gob of the previously mentioned backfilling project and into the workings of the Tamaqua #14 Mine. If both the #10 pool and the pool in the Tamaqua #14 Mine were allowed to rise, the workings of the #7, #8, #9, #10, #11 and #14 mines, Foster's Tunnel, Levan's Slope, the D-Slope, and the East Lehigh Drift would all be drained by a natural gravity discharge from the buried East Lehigh Drift portal south of Tamaqua. The elevation of this discharge would be 782 ft. above sea level and the approximate average daily flow, determined by combining the #14 and #10 rates, would be 13 MGD.

Presently, the sources of recharge to the #10 pool are primarily from surface runoff into strip mines and overall groundwater flow into the mine void. The latter of these is made even more significant by the elevation of the mine pool. This elevation is between 240 and 340 feet below the channel of Panther Creek. As So result, it exerts a substantial drawdown effect on the ground water in the basin. It is believed, therefore, that only shallow perched ground water in the natural unconsolidated material and mine refuse provides any base flow runoff into Panther Creek.

The recharge area for this pool is bounded on the east by barrier pillar #32; on the west by unmined ground between the Lanscoal #9 Mine and the Rahn #11 Mine and barrier pillar #34; and on the north and south by the extent of mining and the basin limits. The #10 pool is immediately adjacent to the east boundary of the #14 pool.

The AMD discharge from the Greenwood #10 Pumps is unlike any other in the study area. Its pH is almost constantly greater than 6.0 and the alkalinity normally exceeds the acidity. However, concurrent with this abnormally favorable acid quality, the discharge exhibits very high concentrations of sulfate and iron. As such, the #10 pumps are the largest source of sulfate pollution in the study area, discharging an average of 111,850 lbs. / day, nearly 60% of the total.

Field and laboratory tests on the acid quality of this flow have shown that the acidity of the water at the outflow point is as much as 280 mg/l. Subsequent testing showed that following a period of aeration of these same samples, the acidity values are reduced to between 40 and 50 mg/l and quite often the alkalinity exceeds the acidity. This same change in quality can be noted between samples taken at the outflow point and samples taken at the confluence of the discharge with Panther Creek, a few hundred yards away. It is believed that the change results from the presence of carbon dioxide. Much of this carbon dioxide is liberated from the discharge by natural aeration as it flows toward the stream and, as a result, the effect of this portion of the acidity in the #10 pool is never imposed on Panther Creek.

In an effort to determine the source of this carbon dioxide, it was learned that mine fires had been prevalent in the workings that contain the #10 pool and that, in fact, the possibility exists that there is present mine fire activity in the abandoned workings.

As in the case of the Tamaqua #14 Pumps, the average load figures for the #10 discharge are not truly representative of the instantaneous impact of this flow on the Little Schuylkill River. This, again, is due to the intermittent nature of the pumping, which causes the immediate effect of this flow to be greater than the average flow figures would imply. In terms of pH and acidity, this discharge appears to be beneficial to stream quality; however, the high concentralions of sulfate and iron are disastrous in terms of stream quality goals.

The future plans of the Greenwood Stripping Corporation over the next 25 year period call for the lowering of the #10 mine pool, as well as the #14 mine pool. Both pool levels will be lowered from approximately 660 ft. to 450 ft. as development of a new surface mine proceeds. This activity will produce the same results in the no pool as were discussed in relation to the #14 discharge. The ultimate effect of these activities will be the discharge of AMD pollutants in excess of the present and allowable rate.

In addition to this AMD increase from subsurface factors, the strip mining activity proposed will constantly be unearthing fresh AMD producing materials. This activity will add to the large volumes of these materials now stockpiled in this area and will also delay the reclamation of large refuse storage areas now producing AMD pollutants. The activities of the Greenwood Stripping Corporation will, therefore, affect for a period of at least 25 years the reclamation of a major portion of Panther Valley and thereby eliminate completely any possibility that the Little Schuylkill River below Tamaqua can be reclaimed during that time period.

c. COALDALE #7 MINE

The #7 Mine of the Coaldale Colliery is a natural gravity discharge from an abandoned water level tunnel on the north side of Panther Creek. The mine portal is located 3-1/2 miles northeast of Tamaqua near the town of Coaldale, and is partially blocked by piled earth. A drainage ditch at its entrance provides an outlet for mine water at approximately 970 feet above sea level.

The #7 tunnel is interconnected with workings of the #7 and #8 shafts and the #8 water level tunnel. These workings, in turn, are connected at a lower elevation to the mine pool drained by the #10 pumps. The discharge from the #7 mine represents the drainage of an undeterminable portion of these interconnected workings that are not open to flow into the mine pool.

Exhibit 23 is a hydrograph of the observed flow before, during, and immediately following two very intense storms on May 31, 1972. Nearly two weeks of dry, warm weather preceding these storms isolated this analysis from interference of other rainfall.

Two aspects of the curve suggest probable paths of flow into the #7 tunnel. The first and most prominent characteristic of the #7 discharge is its rapid peaking and subsiding in immediate and direct response to both storms. A large abandoned strip mine on the Mamoth Seam (P: 3N) directly overlies the mineward end of the #7 tunnel and appears to intersect the deep mine workings of the #7 Mamoth Gangway, as indicated on Exhibit 5.

Surface runoff into the strip mine from the south slope of Nesquehoning Mountain is believed to flow directly into deep workings in the bottom of the pit and into the tunnel, to produce the rapid swelling of the #7 discharge.

The second notable aspect of this hydrograph is the gradual increase in the discharge rate following each peak flow. This "rising base flow" suggests another, perhaps slower, recharge path into the tunnel. Examination of the surface above the #7 tunnel and adjacent areas reveals extensive accumulation and storage of deep mine refuse. Infiltration into the material may have been as high as 95% of the available precipitation, particularly where compaction has been minimal and runoff channels are restricted or non-existent. This infiltration rate could result in a substantial increase in the percolating water above the #7 tunnel. It is believed that this water increase accelerates the flow of water into the tunnel from the overlying strata, resulting in a gradual rise in the flow from the portal.

The Coaldale #7 Mine is only a Third Order Source of acid impact on the Little Schuylkill River. It represents only 140 lbs. / day of acid which is much less than 1% of the total. However, as is noted in the discussion above, the discharge is capable of providing acid at a rate equal to 10 times its normal rate during storm discharges.

d . COALDALE SEEP

The Coaldale Seep flows from the base of a very large refuse storage bank (P: 3R) on the north side of Panther Creek near the western end of Coaldale. This bank is located between the openings of the Coaldale #8 Mine and the Greenwood #10 Mine and has a map area of 320 acres. The bank is sparsely vegetated with no prominent run-off channels. The top of the bank has been developed as a de silting and tailings basins.

The two primary sources of recharge for the seep are rainfall infiltration into the mine refuse and seepage from active desilting basins directly above the discharge serving the Greenwood #12 Fine Coal Plant. The path of flow to the seep area is along the contact between the stored mine refuse and the original ground surface.

The future operation of the #12 Fine Coal Plant may not include the use of the desilting facility as steps are being taken to redirect the wastewater into a new facility constructed in an adjacent strip mine pit. Furthermore, officials of the Greenwood Stripping Corporation have offered the use of the desilting basin above the seep to the Pennsylvania Department of Environmental Resources for the disposal of material dredged from its desilting dam south of Tamaqua. Such a change would reduce the seepage rate, however, the portion of the discharge from rainfall infiltration would maintain the seepage.

The Coaldale seep is a Second Order Source of acid impact on the Little Schuylkill River, with an average acid load of 1500 lbs./day. Little of this acid load is from visible surface flow. The major portion of the 1500 lbs. is from subsurface flow of contaminated ground water from the refuse bank into Panther Creek. The acid load was calculated from a material balance of creek flows and concentrations above and below the Coaldale Seeps. Acid from this source represents 4.72% of the total daily acid impact on the Little Schuylkill River.

e. MANBECK SEEPS

The Manbeck Seeps are a series of small springs and seep lines at the base of a deep mine refuse bank (P: 5R) associated with the Lansford #4, #5 and #6 mines. They are located on the north side of Panther Creek near Lansford Pa. The discharge flows west in a ditch along the Lehigh and New England Railroad and into Panther Creek at a point 2200 feet east of the entrance to the Lansford-Hauto Railroad Tunnel. Part of this discharge is from the overflow of a nearby desilting basin, which is part of the Manbeck Fine Coal Plant operation.

The source of the flow is the movement of shallow perched ground water along a buried mine refuse - original surface interface. The map area of this mine refuse bank is 87 acres, however, it is difficult to estimate the portion of this area that is directly involved in recharging the seepage at the exit point. Seepage from the active de silting basins in the vicinity and rainfall infiltration into the refuse bank would appear to be the two primary sources of recharge.

Any future activities of the Manbeck Fine Coal Plant will continue to contribute to the recharge of the Manbeck Seeps, particularly the portion from the de silting basin overflow. However, even with the halting of these operations, it is expected that rainfall recharge would continue to maintain flow from the banks.

The visible fraction of the Manbeck Seeps is but a surface indication of the ground water contamination of Panther Creek by subsurface flows from the refuse material. The measured surface flow and acid from the seeps averages 480 lbs. / day. However, the analysis of creek flows and concentrations above and below the seeps shows a total contribution of 1500 lbs./day and can only be attributable to shallow subsurface flow of contaminated ground water. As such, this area represents a Second Order Source of acid impact on the Little Schuylkill River contributing 4.69% of the average daily impact.

f. TAMAQUA SEEPS

Less than 1 mile east of Tamaqua, two separate seeps are located, one on either side of the road servicing the Greenwood Breaker. They are termed accordingly, the Greenwood West Seep and the Greenwood East Seep. Both are flows from seep lines comprised of many small, individual springs. The discharge from the East Seep accumulates on the north side of the Arlington Yards of the Lehigh and New England Railroad, at the base of a mountain-like refuse storage bank. It then flows west under the Greenwood Breaker Road and into Panther Creek. The West Seep discharges directly into Panther Creek from the base of a sixty-five acre refuse storage bank.

The refuse bank above the East Seep is a mixture of breaker refuse and strip mine spoils. It exhibits a maximum relief of 400 feet and is greater than one mile long. In the past, it has been a major disposal area for the Greenwood Stripping Corporation's surface mine and the refuse from the Greenwood Breaker. Two desilting facilities have been constructed at its western end to service the fluid discharge from the Greenwood Breaker. The top of the refuse pile above the West Seep has been similarly developed, but is no longer used in the desilting process.

Rainfall infiltration through these refuse areas is believed to be the principal source of recharge for both seeps. In addition to this, seepage from the active de silting facilities above the East Seep periodically augments this natural source.

Both seeps at the Greenwood Road are Second Order Sources- of acid impact on the Little Schuylkill River. A material balance of flows and concentrations in the stream above and below these two discharges reveals a combined acid load of 1860 lbs./day. Since the two discharge points are so close together, it was not possible to clearly separate the acid contributions from the two sources, Measured surface flows and concentrations from the East Seep show an acid discharge rate of 360 lbs. /day from visible sources into the stream, Since the refuse area which feeds this flow is not immediately adjacent to Panther Creek, it is probable that subsurface flow from this source to the stream is minimal. On the other hand, the refuse area which contributes to the West Seep discharge is immediately adjacent to Panther Creek for a distance of at least 1000 yds. In some places, in fact, this refuse material comprises the bed material in the stream. Engineers at the Greenwood Stripping Corporation have confirmed that the stream course along this bank has been altered. This West Bank, then, it is believed, is the source of the additional 1500 lbs. / day of acid. Measured concentrations of some visible flows show that the acidity of the West Seep flow is approximately twice that of the East Seep.

g. SLUM CREEK

Slum Creek is one of two perennial tributaries to Panther Creek. It drains the south side of Panther Valley in the area of the Rahn #11 Mine. Its confluence with Panther Creek is one mile northwest of Tamaqua near the mid point of the Arlington Yards.

The present source of the stream is a spring discharge at the base of a refuse storage area. This spring is located on the south side of U. S. Rte. 209 seven hundred feet upstream from the confluence of the Creek and Panther Creek. During wet periods, additional runoff has been observed from a desilting basin overflow pipe a few hundred feet east of this spring discharge. The desilting facility behind this pipe is abandoned and has filled with solids to the level of the pipe. As a result, water flowing from this basin carries a very high concentration of suspended solids. Most of the runoff from the Slum Creek watershed flows through this basin and the adjoining mine refuse before entering Panther Creek. All base flow runoff in Slum Creek is from perched ground water in the mine refuse and natural unconsolidated material.

The average discharge of acid into Panther Creek from Slum Creek is only 80 lbs./day. This represents well under 1% of the total acid impact on the Little Schuylkill River. The stream does, however, carry a very large quantity of black coal silt into the main stem.

3. <u>LITTLE SCHUYLKILL RIVER VALLEY</u>

Only two portions of the Little Schuylkill River Valley contain sources of AMD, (1) the Silverbrook Basin, which forms the headwaters of the Little Schuylkill River, and (2) the Tamaqua Basin, which is partially drained by this river. The first of these areas contains less than one mile of the stream, and is characterized by intermittent flow. The second, which begins approximately 7.2 miles downstream from the first, contains a 1.5 mile reach of stream.

Acid mine drainage into this valley is primarily from six deep mine pools, both abandoned and active mines. The largest of these pools is the Silverbrook Mine pool which underlies most of the Silverbrook Basin. It is located in the abandoned workings of the Candlemas Colliery. This pool is shown on the basin structure map, Exhibit 8.

The other five mine pools are much smaller. They are situated on the west side of the Little Schuylkill River at the water gaps north and south of Tamaqua Borough. All five pools extend for some distance into the Wabash Valley and, therefore, drain a portion of the groundwater from this valley. Exhibit 32 shows the location of these five mine pools.

In addition to the six mine pools, there are three other sources. Two of these are seeps from mine refuse areas and one is a gravity flow from an abandoned water level drift. One seep is located in the Silverbrook Basin and the other is the discharge from a refuse area at the western end of Panther Valley. The flow from the abandoned water level drift is located on the west side of the Little Schuylkill River water gap south of Tamaqua.

The surface in the Silverbrook Basin has been almost completely destroyed by surface mining activity and deep mine refuse storage. Similar activities on both sides of the water gaps at Tamaqua have destroyed the surface in these areas as well. In addition, extensive subsidence in these water gaps has also disturbed much of the surface.

a. <u>SILVERBROOK BASIN</u>

The Silverbrook Basin is both a structural and a topographic basin, covering a map area of approximately 2 square miles. A variety of springs, seep lines and mine related discharges in this basin form the source of the main stem of the Little Schuylkill River. The actual location of the headwaters varies seasonally among three separate discharge areas. Two of these have been very strongly influenced by the mining activity in the basin and are the two and only sources of AMD pollution contaminating the Little Schuylkill River between its headwaters and the Tamaqua Basin, a distance of 7.2 stream miles.

The Silverbrook Basin has been an area of very extensive deep mining below present water level. As a result of abandonment, 80 to 90% of the deep mine workings are now inundated, forming a huge pool of acid mine water underlying much of the basin. A portion of this pool can be observed in a large deep strip mine pit which extends below the elevation of the mine pool, near the center of the basin. Deep mine workings were intersected by this operation and its impounded water is now an integral part of the pool. A staff gauge established in this pit has shown variations in the pool elevation roughly from 1540 to 1560 feet above sea level.

Exhibit 8 shows the structure contour lines in the workings of the lowermost Buck Mountain seam. The extent of innundation as reflected by the 1540 contour, is noteworthy. Recharge of this mine pool is from surface water flow into the deep workings through the overlying strip mines and from infiltration into the mine voids from the surrounding rock strata.

Two other, although much smaller, surface pools lie in the basin, with water elevations within the same range as the large strip pit. They are located adjacent to each other on the east side of U. S. Rte. 309 and are associated with a strip mine pit that had been utilized as a desilting facility. Staff gauges installed in these two ponds showed a less severe fluctuation in level than was observed in the large pit, probably due to the lack of a direct connection between these small ponds and the Silverbrook Mine Pool. In all cases, however, the levels of these two ponds fluctuated togather, indicating unrestricted flow from one to the other through the refuse material which separates them.

There are two sources of acid mine water pollution from the Silverbrook Basin, (1) a large gravity flow from the mine pool, and (2) seepage from mine refuse to both the mine pool and the surface at several points. The headwaters of the Little Schuylkill River are in the Silver brook Basin and during severely dry weather conditions, the sole source of the River is the overflow from the mine pool. The point of discharge is on the bank of the stream 200 feet east of U. S. Route 309. The mine flow emanates from the base of a refuse bank, which conceals a possible portal, at a surveyed elevation of 1,537 feet above sea level. A notation on a Reading Company mine map indicated the presence of a breach hole buried beneath the refuse area, approximately 200 feet east of the point of visible discharge. The approximate original elevation of this breach was between 1.540 and 1,550 feet, which correlates well with the level of the mine pool and is probably the water's outlet.

The acid contributed from this mine pool represents one of two First Order Sources of acid impact on the Little Schuylkill River. Under drought conditions a flow rate as low as 690 gallons per minute, contributing 675 pounds of acid, have been measured. Under average conditions, however, a discharge rate of 2,000 gallons per minute is typical with an acid load of 2,640 pounds per day.

During average weather conditions, the source of the Little Schuylkill River shifts upstream approximately one mile, west of the village of Haddock. The flow is comprised of springs from Pottsville-Type conglomerate and exhibits the low acidity and the pH values typical of uncontaminated stream water found on the watershed.

This headwater flow is detained by a small pond lying at the southwest corner of the intersection of U. S. Route 309 and the secondary road to Lofty, approximately 300 feet upstream of the main Silverbrook Mine discharge. This pond also receives acid mine drainage from two sources, seepage from breaker refuse and artesian springs from the Silverbrook Mine pool. On one occasion, under rather normal conditions, the acid load discharged from the pond was measured at 500 lbs. per day and a material balance estimated that 60% of the load was derived from the breaker refuse.

Springs similar to those within the pond are visible at numerous locations along the U. S. Route 309 highway cut, generally at surveyed elevations of 1,533 to 1,541 feet. The quality of these discharges is comparatively good, at 50 to 60 mg/l acidity. This is in contrast to the seeps from the nearby refuse storage areas, where acidities were measured at 300 to 700 mg/l. This high acidity from the refuse seepage, we believe, is indicative of the deterioration of rainwater percolation through the expansive refuse. Nearly all this water infiltrates into and significantly contaminates the Silverbrook Mine pool.

Relative to surface conditions, strip mining in this basin was much less extensive than in the Tamaqua Basin. However, an area of approximately 200 acres along side of and east of U. S. Route 309 has been totally covered by breaker refuse and desilting basins. No active mining of any type is presently being pursued; however, the material in several of the desilting basins is being hauled away for the recovery of fine coal.

b . ZAKREWSKY MINES

AMD discharges occur from two mines operated by the Zakrewsky Coal Company of Tamaqua on the property of the Ashton Coal Company. They are both located in the northwest corner of (

Tamaqua Borough on the west side of the Little Schuylkill River water gap, between Locust Mountain and Nesquehoning Mountain, The elevations of the two portals are 837 feet and 904 feet above sea level. Both mines are operated from slopes to workings that are below previously mined levels in the same seams,

Inundated lower workings of these two mines have formed two separate, relatively small pools of acid mine water, which must be pumped during mining operations, Only one mine is in operation at anyone time, and consequently only one pool is pumped at any one time, No gravity flow has been noted from the higher portal, which may indicate that the drawdown from pumping of the lower pool and/or drawdown from the nearby Little Schuylkill River maintains the water level of the higher pool below the elevation of the higher portal.

In the fall of 1972 mining was shifted to the high portal and with the cessation of pumping from the lower portal, the water level rose sufficiently to result in a gravity flow from the lowest opening, This discharge is referred to herein as the "Zakrewsky Mine: Gravity", The concurrent pumping from the high portal during mining operations produced another source of AMD, referred to herein as the "Zakrewsky Mine: Pump".

Both pools are recharged from natural groundwater flow into the mine voids and from seepage and direct flow of surface water through the strip mines overlying the workings. A portion of both of these deep mines is below the elevation of the nearby Little Schuylkill River channel.

Acid discharged from the Zakrewsky Mine: Pump and the Zakrewsky Mine: Gravity represent Second Order and Third Order acid impact sources, respectively. They contribute a combined acid total of 805 lbs. per day, which amounts to 2.51 % of the total acid impact on the Little Schuylkill River.

These figures are representative of average values for the pump age from the Zakrewsky Mine: Pump and, as in the cases of the Tamaqua #14 Pumps and the Greenwood #10 Pumps, these figures do not accurately reflect the instantaneous impact of the actual pump discharge due to the intermittent nature of the pumping. The normal rate of pumping, 980 gpm, contributes acid to the stream at a rate nearly four times greater than the average. In this respect, the Zakrewsky Mine: Pump actually represents a third First Order acid impact source on the stream, with pollution levels nearly equal to those of the Silverbrook Mine.

Future mining activity from this portal will require a continuation of pumping at the rate noted. If mining activity and pumping ceases the mine pool will reestablish its pre-pumping level and although this action will not result in a gravity flow from the portal, it would, however, increase or re-establish the flow of groundwater from the mine pool to the Little Schuylkill River.

Two benefits would be derived from the cessation of pumping. First, by increasing the level of the mine pool, the quantity of groundwater drawn into the mine void would be reduced. Second, the remaining flow from the mine would not be the intermittent, slugging discharge from the pumps, but a steady ground water flow from the mine pool to the stream. This would eliminate the instantaneous impact of this discharge on the Little Schuylkill River.

The surface above both of these mines has been strip mined to the point where no natural surface drainage remains. All surface run-off from these areas is absorbed by the strip pits and is diverted into the deep mines. The operator of this mine has reported rapid flooding during heavy rainstorms as a result of this condition.

c. EAST ELM STREET SEEP

The East Elm Street Seep is located in the northwest corner of Tamaqua Borough, 100 ft. north of East Elm Street. The point of discharge is at the base of a large refuse storage bank associated with the operation of the Greenwood Breaker. The discharge enters the Little Schuylkill River by way of a nearby storm sewer.

The source of this discharge is rainfall percolation through the refuse material to the original surface - mine refuse interface. Flow along this contact to an ephemeral stream channel buried beneath the refuse bank results in the discharge at East Elm Street, The refuse storage area forms an arcuate ridge extending west from the area of this ephemeral channel. All run-off from this enclosed area flows under the refuse bank and augments the flow of acid water at the discharge.

The East Elm Street Seep is the eleventh largest source of acid impact on the Little Schuylkill River. It contributes an average of 660 lbs. of acid per day and 2.08% of the total impact on the stream. Concentrations have been sampled from this source as high as 2500 mg/l. The average acid concentration is one of the largest in the study area at 2000 mg/l. All these factors combine to make the East Elm Street Seep a Second Order Source of acid impact.

d. FIRST NORTH SEEP

The drainage point from the First North Seep is located south of Tamaqua on the west side of the Little Schuylkill River water gap between Pisgah and Sharp Mountains. The point is immediately adjacent to and north of the West Lehigh Shaft and is believed to be an abandoned water level tunnel. Its actual opening is concealed by rock debris.

Mine maps of this area show a water level drift immediately north of the West Lehigh Shaft. The drift extends into Wabash Valley for less than 2000 ft., with no obvious connections to other workings (although a connection with the workings of the West Lehigh Shaft at a lower level in this same seam is possible). The elevation of the portal on the maps is 790 ft. above sea level, which compares closely with a surveyed elevation of 790.32 ft. for the First North Seep.

If, as these facts would indicate, the First North Seep is located at the outlet from the abandoned drift, then the source of the discharge is ground water infiltration into this drift. If this is not the case, then the discharge is simply seepage from the surrounding mine refuse.

The acid discharged from this source represents a Third Order Source of acid impact on the Little Schuylkill River. It discharges an average of 100 lbs. of acid per day, which represents only 0.31% of the acid impact on the stream.

The surface above the workings of the First North Seep is all undisturbed. There may, however, be some influence exerted on the quality of the discharge by adjacent mine refuse on Sharp Mountain. Infiltration of rainfall through this material and into the ground water surrounding the drift could provide a source for contaminated flow into the working.

e. <u>WEST LEHIGH SHAFT</u>

The West Lehigh Shaft and an adjoining, unnamed water level drift are located south of Tamaqua on the west side of the water gap between Sharp Mountain and Pisgah Mountain. Both mines are adjacent to and north of the A & D Mine with the unnamed water level drift lying between the shaft and the A & D Mine. The elevation of the shaft entrance is 846 feet above sea level. It is presently buried under mine refuse from later workings. The adjoining water level drift has an open portal elevation of 784 feet above sea level and drains both the shaft and the drift.

The workings of the West Lehigh Shaft begin 354 feet below the top of the shaft at an elevation of 492 feet above sea level. The workings extend 6,400 feet west into the Wabash Valley and form a long, narrow mine pool below this part of the valley. Mining was conducted in at least five seams. In some areas, these workings are below the Newkirk Mine workings, but there is no indication that they are interconnected.

The adjoining water level drift extends into the valley only 1,400 feet. It is connected to the shaft workings by a series of chutes and airways. The primary sources for the discharge from this drift are the flow of groundwater into the West Lehigh Shaft pool and the infiltration of surface and ground water into the drift.

AMD from this source exhibits relatively high acid concentrations. This high acidity combined with normal flow makes the West Lehigh Shaft a Second Order Source of Acid impact on the Little Schuylkill River. It contributes 1,175 lbs. of acid per day and represents 3.64% of the total acid impact.

The surface above the West Lehigh Shaft has in many areas been extensively strip mined. In these areas, however, most of the flow of surface water into the mines is intercepted by the higher Newkirk Mine gangways and flows from the Newkirk portal. The remainder of the surface above these workings is undisturbed.

The surface overlying the adjoining water level drift has all been affected by surface mining. However, there is no evidence of direct flow of surface run-off into the mines.

f. <u>A & D MINE</u>

The A & D Mine is located south of Tamaqua on the west side of the water gap between Sharp Mountain and Pisgah Mountain. The elevation of the portal is 791 feet above sea level. It is an abandoned slope and drift which was operated during the early 1960's. The discharge of AMD is from the abandoned portal which is presently covered by rock debris. The flow joins that from the Smith Mine and West Lehigh Shaft and is conveyed through a culvert under a railroad into the Little Schuylkill River.

A portion of the workings in this mine are below water level and have been inundated by a relatively small pool of acid mine water. This pool is recharged by groundwater flow into the mines and by runoff of surface water through strip mines and into the deep workings. Two older, abandoned drift gangways at higher levels in this same seam drain a portion of the mountain above the A & D Mine. This drainage, in turn, filters down to the A & D pool through chute connections between the levels. The higher of these two levels (portal elevation of 941 feet) has been obliterated in part by a large open-pit mine. It provides at least one direct route for flow of surface water from strip mines into the deep workings above the A & D pool.

The lower of these two levels (elevation of 838 feet) with a portal extends into the mountain to the west, where the gangway is only 30 - 40 feet under the Newkirk Mine's East Bottom Split Rock Gangway. This is the location of a possible connection between these two mines as a result of the reported caving of the higher gangway into the lower one. It is the only known connection of the A & D Mine with any other mine workings. As a result, the quality and rate of flow from this discharge are relatively independent of conditions in adjacent workings.

The surface above the A & D Mine has been completely destroyed by open pit and strip mining and the storage of the mine refuse related to these operations. Part of the area may also contain deep mine breaker refuse from the abandoned Allen Colliery which is reported to have operated in this area.

The acid quality of the discharge from this mine is the poorest in the study area, with an average concentration of 3300 mg/I. Opposed to this concentration, however, is a low rate, which considerably lessens its impact on the Little Schuylkill River, As a result, it supplies an average daily acid load having a 2.17% impact in the study area.

g. SMITH MINE

The Smith Mine is located in the water gap south of Tamaqua on the west side of the Little Schuylkill River. It is immediately adjacent to and south of the A & D Mine. The mine was operated from a slope with a portal elevation of 786 feet above sea level. A portion of the workings is below water level and it now too contains a small pool of acid mine water. The portal is presently covered with slumped and piled rock debris.

The Smith Mine workings extend west into Sharp Mountain for a distance of 1300 feet. The workings were driven below at least two other levels on the same seam. Chute connections with these higher levels allow all gravitational water in them to filter down to the Smith pool. The pool is recharged by both this gravitational water and by groundwater flow from the adjacent rock strata.

The workings of the Smith Mine are indirectly connected above water level to the workings of the Newkirk Mine through a series of gangway-chute connections. These connections are between the Newkirk Mine's East Buck Mountain Rock Gangway at approximately 875 feet above sea level and a drift gangway at approximately 950 feet above sea level, in one of the interconnected levels above the Smith Mine.

The AMD discharge from the Smith Mine is only a Third Order Source of acid impact on the Little Schuylkill River. It contributes only 0.16% of the total acid impact with an average daily acid load of 50 lbs. per day.

The surface above the Smith Mine has been extensively strip mined. Subsidence above the highest level on the seam (portal at 1024 feet above sea level) has caused the surface to collapse into the workings of this level, forming a very sharp, deep scar at the eastern end of Sharp Mountain.

LITTLE SCHUYLKILL RIVER BASIN ACID MINE DRAINAGE STUDY

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INDEX TO ROUTINE SAMPLING STATIONS & SOURCES OF ACID MINE DRAINAGE

EXHIBIT 9