

POLLUTION SITE ANALYSIS

Various occurrences of acid mine drainage in the Blacklick Creek watershed often share a common topographic setting and interrelated origin of pollution. As a result, all related occurrences have been grouped together for analysis into separate "sites" which are designated by letter. Each such site listed below is characterized according to its primary pollution sources and/or nearby pertinent sampling stations. "Pollution sources" as listed below refer to individual strip mines, coal waste banks and direct deep mine discharges (e.g., sampling station #5018 of site B below is described as pollution sources #5018 because a mine discharge was monitored directly by this sampling point). Where "sampling station" is listed, the respective site has been monitored indirectly at an adjacent receiving stream (e.g., sampling station #22 of site A).

The general location of the sites in the watershed is indicated on the Coal Mining Inventory Map Sheet Index preceding the detailed maps.

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POLLUTION SITE ANALYSIS

SITE A (Sampling Stations 22 and 22B) - Sub-basin 75 - Coal Mining Inventory Map 3 of 27 and 6 of 27

Site A produces an average acid load of 2,683 lb./day resulting from deep mine discharge and runoff and seepage from coal waste banks. The site accounts for approximately 1.0 percent of total acid mine drainage produced in the watershed.

The site is located approximately 0.4 mile northeast of the community of Josephine in Indiana County on the north side of Blacklick Creek. This is the location of the abandoned Bells Mill Coal Company's Bells Mill mine which became inactive in 1937 with a reported 352 acres having been mined out. The sources of acid mine drainage are one of three collapsed drift openings into the Lower Kittanning coal seam and runoff from coal refuse bank D12. Precipitation runoff and seepage produce an immeasurable amount of acid pollution from coal waste bank D11.

Sampling station 22 monitors flow from one of three drift openings of the mine and measures an average acid discharge of 2,279 lb./day. A small amount of flow also is contributed by the recently abandoned Josephine mine of the Willowbrook Coal Company which borders the Bells Mill mine on the west. The Josephine mine is flooded and its discharge is considered minor. The Josephine No. 2 mine is presently being reactivated and lies immediately to the east of the Bells Mill mine. (Mine entries located in strip mine No. 18).

In addition to the three drift openings, a slumped area exists to the northeast which reportedly had resulted when deep mining advanced too close to the outcrop. Also further to the northeast several mine shafts are reportedly located, one of which has been filled with coal preparation plant waste material. Strip mines No. 7 and No. 8 (code #I-12)* of the Upper Freeport coal seam are located over the Bells Mill mine. Surface Mine No. 111 of the Lower Kittanning coal seam is located immediately up-dip from the Bells Mill mine workings. One slumped area exists above the highwall of surface mine No. 111 and it is believed the underground workings have been intersected. Surface mine No. 111 is partially drained through its southwest end. It is likely the three surface mines are sources of infiltration into the Bells Mill workings. Also, subsurface mining of the Upper Freeport coal has been conducted by the Potter Coal and Coke Company partially overlies the northwest portion of the Bells Mill mine. The mine pool elevation of the overlying mine is unknown. The active operations of the Head No. 8 surface mine (code #874) are located immediately to the north of the site and work the Upper Freeport coal seam.

The site is located on the northwest limb of the Chestnut Ridge Anticline, thus indicating the flow of water in the mine is down-dip

*Note - Refer to Mining Permit Inventory in Appendix B for mineral rights information.
When no code number is given, that mine is unpermitted.

to the northwest. The approximate elevation of the three drift openings is 1,010 feet, while it appears that mining has advanced both down and up-dip to the 870 foot and 1,280 foot elevations, respectively. Water is flowing from one of the three drift openings at the present time indicating the mine is partially flooded.

The technical feasibility of hydraulically sealing the three drift openings is low under existing technology. The exact location of the two northeastern-most drift openings is unknown but appears to be in an area where overlying strata has been extensively regraded leaving approximately 35 feet to 40 feet of overburden. It appears that a significant increase in the mine pool elevation cannot be contained by the overburden and outcropping will result.

Diversion ditch construction, clay sealing, backfilling, regrading and revegetation of the overlying strip mines can reduce infiltration, into the deep mine workings and therefore reduce discharge. The combined drainage area of the three abandoned strip mines is approximately 82 acres and the approximate average precipitation for the area is 48 inches/year. Assuming 30 percent of the annual precipitation that would normally be considered as runoff infiltrates into the deep mine workings through surface mines 7 and 8 and 15 percent of the annual precipitation infiltrates through surface mine 111, strip mine clay sealing, backfilling, regrading, revegetation and diversion ditch construction can reduce acid mine drainage pollution from the Bells Mill mine by a maximum of 500 lb./day. Any further reduction in acid pollution appears feasible only by treatment.

Mine waste bank D12 covers an area of approximately 7 acres and produces an average of 404 lb./day of acid pollution. Reclamation in-place can be performed, however utilization of coal waste is feasible and should be encouraged (see discussion of General Abatement Measures).

Recommendations

The conducting of infiltration control measures at surface mine number, 7, 8 and 111 is recommended along with the encouragement of utilization of coal waste bank D12.

Cost Estimates

Surface Mine 7 (17.5 Acres)

Clearing and grubbing: 17.5 Acres @ \$300/Acre	\$ 5,300
Backfilling and grading: 17.5 Acres @ \$2,000/Acre	\$ 35,000

Revegetation; 17.5 Acres @ \$750/Acre	\$ 13,100
Total for Surface Mine 7	\$ 53,400
Surface Mine 8 (16.5 Acres)	
Clearing and grubbing: 16.5 Acres @ \$300/Acre	\$ 5,000
Backfilling and grading: 16.5 Acres @ \$2,000/Acre	\$ 33,000
Revegetation: 16.5 Acres @ \$750/Acre	\$ 12,400
Total for Surface Mine 8	\$ 50,400
Surface Mine 111 (2.8 Acres)	
Clearing and grubbing: 2.8 Acres @ \$300/Acre	\$ 800
Excavation to expose coal seam: 17,700 C.Y. @ \$1.50/C.Y.	\$ 26,600
Clay sealing: 900 L.F. @ \$4.15/L.F.	\$ 3,700
Backfilling and grading: 2.8 Acres @ \$2,000/Acre	\$ 5,600
Revegetation: 2.8 Acres @ \$750/Acre	\$ 2,100
Diversion ditch construction: 900 L.F. @ \$1.00/L.F.	\$900
Total for Surface Mine 111	\$ 39,700
Total cost for recommended abatement measures for Site A.	<u>\$143,500</u>

Cost Effectiveness

	Estimated Pollution Abated (lb./day)	Estimated Cost	Cost/lb./day Abatement
Surface Mine 7	352	\$ 53,400	\$ 152
Surface Mine 8	125	\$ 50,400	\$ 403

Surface Mine 111	<u>23</u>	<u>\$ 39,700</u>	\$1,726
<u>Total for Site A</u>	<u>500</u>	<u>\$143,500</u>	<u>\$ 287</u>
Mine Waste Bank D12	<u>404</u>	----	---
<u>Total for Site A with utilization of mine waste bank D12</u>	<u>904</u>	<u>\$143,500</u>	<u>\$ 159</u>

SITE B (Pollution Sources 5018 and 5026) - Sub-basins 19 and 75 –
Coal Mining Inventory Map 6 of 27

Site B produces an average acid load of 1,952 lb./day and consists mainly of mine drainage from collapsed drift openings 5017, 5018 and 5026. The site accounts for approximately 0.73 percent of the total acid mine drainage produced in the watershed.

The site is located immediately to the east of the community of Palmertown in Indiana County on the south side of Blacklick Creek and is the location of the abandoned Smith Coal Company's Jewell #3 Mine which operated from 1919 to 1931 in the Lower Kittanning seam. The total coal output was reported to be 513,000 tons with about 208 acres being mined. A total of 15 drift openings are located down-dip from the Jewell #3 Mine. A majority of these are believed to be connected to the deep mine workings. Coal waste bank D15 is located immediately to the north of the site but does not produce a measurable amount of pollution. Inactive surface mine #29 (code #I-26) is located immediately to the southeast of the site and is believed to have advanced very close to or have intersected the deep mine workings. Surface runoff and groundwaters entering the western lobe of the strip mine are believed to infiltrate into the deep mine workings. The inactive and partially reclaimed strip mine #15 (code # 685) lies over the southeastern part of the Jewell #3 workings. In this area the strip mine has been regraded and planted in grasses and trees. Beyond the Jewel #3 workings farther to the south, strip mine #15 remains unreclaimed. Active surface operations of the Lyda mine (code #684) of the North Cambria Fuel Company are continuing in the southern portion of strip mine #15.

Site B is located on the northwest limb of the Chestnut Ridge anticline which indicates water in the mine workings flows down-dip to the northwest. The drift openings on the northwest margin of the underground workings appear to drain most of the mine.

The feasibility of successfully constructing hydraulic mine seals at the Jewell #3 mine openings is unlikely under existing technology. Underground mine workings have advanced too close to the coal outcrop and sealing appears difficult or impossible, considering the many drift mine entries associated with this complex.

Infiltration control at surface mine #29 can reduce inflow into the underground workings and consequently reduce discharge. The drainage area intersected by the west lobe of the surface mine is approximately 100 acres and the approximate average precipitation for the area is 48 in./yr. Assuming the 30 percent of the annual precipitation that normally would be considered as runoff is intercepted by the surface mine and infiltrates into the underground workings and an average total acidity of 683 mg/l, dry clay sealing, backfilling, regrading and revegetation of the western lobe of surface mine #29 accompanied by construction of highwall diversion ditches can reduce acidic discharges a maximum of 571 lb./day. any further reduction in acid pollution from the site appears feasible only by treatment.

Recommendations

The conducting of infiltration control measures at the western section of surface mine 29 is recommended.

Cost Estimates

Western Section of Surface Mine 29 (38.60 Acres)

Clearing and grubbing: 38.60 Acres @ \$300/Acre	\$ 11,600
Excavation to expose coal seam: 114,000 C.Y. @ \$1.50/C.Y.	\$171,000
Clay sealing: 5,800 L.F. @ \$4.15/L.F.	\$ 24,100
Backfilling and grading: 38.60 Acres @ \$2,000/Acre	\$ 77,200
Revegetation: 38.60 Acres @ \$750/Acre	\$ 29,000
Diversion ditch construction: 5,800 L.F. @ \$1.00/L.F.	<u>\$ 5,800</u>

Total cost for recommended abatement measures for Site B	<u>\$318,700</u>
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Cost Effectiveness

	Estimated Pollution Abated (lb./day)	<u>Estimated Cost</u>	<u>Cost/lb./day Abatement</u>
Western section of surface mine 29	<u>571</u>	<u>\$318,700</u>	<u>\$558</u>
<u>Total for Site B</u>	<u>571</u>	<u>\$318,700</u>	<u>\$558</u>

SITE C (Pollution Sources 4890, 4893, 4897, 4898 and Sampling Stations 41 and 42) - Sub-basins 25, 26 and 75 - Coal Mining Inventory Map 9 of 27.

Site C produces an average acid load of 10,145 lb./day and consists of drainage from abandoned drift openings, 4890 and seepage points 4893 and 4898, strip mines 45 and 46, and coal waste bank D10. The site contributes approximately 3.79 percent of the total acid mine drainage in the watershed.

The site is located partially on Pennsylvania State Game Lands to the northwest of the community of Hesbon on the north side of Blacklick Creek in Indiana County. This is the location of the abandoned Virginian No. 14 deep mine which was opened in 1929 and was operated successively by Standard Bituminous Coal Company, Globe Coal Company, Franklin Coal Company and the L.C.S. Collieries Company. The mine operated in the Lower Kittanning coal seam and the total output up to and including 1952 was 1,876,000 tons with approximately 862 acres being mined. Two drift openings of pollution source 4890 drain the eastern part of the mine complex into Aulds Run and produce 5033 lb./day of acid drainage. Available information indicates at least two drift openings are present down-dip from the southwestern part of the complex. However, these have been destroyed and covered by strip mining activities of surface mine 46 (code #I-3) and later deposition of coal waste material. Pollution source 4899 is a seepage point from a destroyed drift opening at the southeast end of surface mine 46 and produces an average 1768 lb./day of acid drainage. Pollution source 4893 results from seepage from surface mine 45 (code #I-3) which has been used as a site for coal waste disposal and produces an average acid load of 381 lb./day. Whether surface mining has intersected the underground workings is not known with available information. An additional acid load of 1,365 lb./day finds its way into the main stream of sub-basin 25 below sampling station 40 in the vicinity of a small pond. This is believed to result from seepage or direct immeasurable discharge from the abandoned surface/subsurface operations. Pollution source 4897 consists of runoff and seepage from coal waste bank D10. The coal waste has been deposited in a strip mine site and the strip mine may intersect deep mine workings. The source produces an average of 1,558 lb./day of acid drainage. Surface mines 44, 47, 47A and 27 (code #678) all overlie the Virginian #14 mine, while surface mine 45 (code # 1-3) partially lies up-dip from the underground workings. The abandoned subsurface Aulds Run Mine of the Sunnycreek Coal Company, Inc. which operated in the Lower Freeport coal seam directly overlies the Virginian #14 mine. Surface mine 44, 47 and 47A have worked the Lower Freeport coal outcrop bordering the Aulds Run mine. Available information is not conclusive to determine whether the surface operations have intersected the underground workings. It is likely that surface mine 44 and the up-dip or northwestern portion of surface mine 47 provide a source of meteoric and surface water infiltration into the Aulds Run

mine and ultimately into the Virginian #14 mine. The down-dip portions of surface mines 47 and 47A and 27 also allow infiltration into the Virginian #14 mine.

Site C is located on the northeast limb of the Chestnut Ridge anticline and the flow of water in the mine is to the northeast. The eastern section of the mine is flooded to an elevation of approximately 1,340 feet and drains through one of two drift openings at pollution source 4890. The southwestern section of the mine drains through pollution source 4898 which results from drainage from interconnections of strip mine 46 and the underground workings.

The feasibility of sealing the Virginian #14 drift openings at pollution source 4890 appears low with existing technology. Various depressions are located immediately to the northeast of the main drift openings and apparently are the result of subsidence caused by subsurface mining advancing too close to the coal outcrop. Since surface mining has intersected the drift mine openings of the southwestern part of the Virginian #14 mine, hydraulic sealing here also appears infeasible. The exact amount of acid pollution that can be attributed solely to the coal waste material deposited in surface mine 46 and mine waste bank D10 is unknown due to the probability of subsurface deep mine seepage into and through the coal waste material. Reclamation of the coal waste material in coal waste bank D10 and surface mine 46 will in all probability cause a significant reduction in acid pollution at the site. Reclamation of surface mine 45 along with its coal waste deposits will result in a maximum reduction of 381 lb./day of acid discharge into the main stream of sub-basin 25 and an unmeasured reduction will occur in sub-basin 26. In addition, infiltration reduction into the Virginian #14 mine will also result.

Assuming 30 percent of the annual precipitation (48 in./yr.) infiltrates into the deep mine workings while the drainage area of surface mine 45 is 36.73 acres, clay sealing, construction of diversion ditches, regrading and vegetation can reduce infiltration and discharge a maximum of 0.06 ft.³/sec. Assuming an average acidity of 1,484 mg/l, the maximum reduction in acid discharge from pollution source 4890 can be 480 lb./day. Similar reclamation measures of surface mines 27, 44, 47 and 47A can result in maximum reductions of acid discharges from pollution source 4890 of 1008, 472 and 1080 lb./day, respectively. Any further reduction in acid pollution appears feasible only by treatment.

Mine waste bank D10 covers an area of approximately 10 acres. The areas of coal waste material deposited in surface mines 45 and 46 is uncertain due to covering by a mixing with strip mine spoil. In-place reclamation methods can be employed, but utilization of the coal waste material is desirable and should be encouraged. This is especially important for mine waste bank D10 and surface mine 46 where the pyritic waste material is apparently supplied with water from intersected underground mines.

Recommendations

The encouragement of usage of coal waste material of mine waste bank D10 and that deposited in surface mines 45 and 46 is recommended. Infiltration control measures should be conducted at surface mines 27, 44, 45, 47 and 47A.

Cost Estimates

Surface Mine 27 (68 Acres)

Clearing and grubbing:
68 Acres @ \$300/Acre \$ 20,400

Backfilling and grading:
68 Acres @ \$2,000/Acre \$136,000

Revegetation:
68 Acres @ \$750/Acre \$ 51,000

Diversion ditch construction:
1,300 L.F. @ \$1.00/L.F. \$ 1,300
Total for Surface Mine 27 \$208,700

Surface Mine 44 (11.9 Acres)

Clearing and grubbing:
11.9 Acres @ \$300/Acre \$ 3,600

Backfilling and grading:
11.9 Acres @ \$2,000/Acre \$ 23,800

Revegetation:
11.9 Acres @ \$750/Acre \$ 8,900

Diversion ditch construction:
2,500 L.F. @ \$1.00/L.F. \$ 2,500
Total for Surface Mine 44 \$ 38,800

Surface Mine 45* (15.6 Acres)

Clearing and grubbing:
15.6 Acres @ \$300/Acre \$ 4,700

Clay sealing:
2,700 L.F. @ \$4.15/L.F. \$ 11,200

Backfilling and grading:
15.6 Acres @ \$2,000/Acre \$ 31,200

Revegetation:
15.6 Acres @ \$750/Acre \$ 11,700

Diversion ditch construction: 2,900 L.F. @ \$1.00/L.F.	<u>\$ 2,900</u>
Total for Surface Mine 45	\$ 61,700

*Cost estimates based on assumption coal waste material has been previously removed and coal seam is exposed at highwall.

Surface Mines 47 and 47A (44.1 Acres)	
Clearing and grubbing: 44.1 Acres @ \$300/Acre	\$ 13,200
Backfilling and grading: 44.1 Acres @ \$2,000/Acre	\$ 88,200
Revegetation: 44.1 Acres @ \$750/Acre	\$ 33,100
Diversion ditch construction: 4,500 L.F. @ \$1.00/L.F.	<u>\$ 4,500</u>
Total for Surface Mines 47 and 47A	\$139,000
Total cost for recommended abatement measures for Site C	<u>\$448,200</u>

Cost Effectiveness

	Estimated Pollution Abated (lb./day)	<u>Estimated Cost</u>	<u>Cost/lb./day Abatement</u>
Surface Mine 27	1,008	\$208,700	\$207
Surface Mine 44	472	\$ 38,800	\$ 82
Surface Mine 45	480	\$ 61,700	\$129
Surface Mines 47 and 47A	<u>1,080</u>	<u>\$139,000</u>	\$129
<u>Total for Site C</u>	<u>3,040</u>	<u>\$448,200</u>	<u>\$147</u>
Mine waste deposited in surface mine 45	<u>381</u>	---	---
<u>Total for Site C with utilization of mine waste in surface mine 45*</u>	<u>3,421</u>	<u>\$448,200</u>	<u>\$131</u>

*Additional abatement for the site can result in utilization of coal waste at waste bank D10 and surface mine 46.

SITE D (Pollution Sources D8 and D9)- Sub-basin 27 - Coal Mining Inventory Map 12 of 27.

Site D produces an average acid load of 3,016 lb./day contributed by acid seepage from mine waste banks D8 and D9. This acid load accounts for 1.13 percent of the total acid mine drainage produced within the watershed.

Mine dumps D8 and D9 are located south of Blacklick Creek approximately 0.85 mile south of the community of Heshbon and in subbasin 27. D8 was formed using layer piling construction on a gently sloping hillside. Sampling station #46A and #46 monitored streams flanking this pile which picked up any seepage contributed by the waste material. An average acid load of 1,902 lb./day was collectively measured at these stations. Some reprocessing for recoverable coal has already been done with much of the D8 pile having been trucked away. It is assumed that either all the material will be removed, meaning total alleviation of pollution effects from the area, or that reclamation will follow desired exploitation of the pile by the party involved. Mine waste bank D9 was also formed through layer piling construction on a hillside and is flanked by Ramsey Run to the immediate west. Sampling station #45 was established just downstream of the pile on Ramsey Run and caught all seepage contributed by the D9 waste material which had produced an average acid load of 1,114 lb./day. This mine waste material is presently smouldering and has been burning for a number of years. A previous attempt by the Commonwealth to extinguish this fire by injection and covering with sludge produced by acid mine drainage treatment apparently proved insufficient.

The feasibility for successful reclamation of the area is good, but no concern should be directed to mine waste bank D8 at this time because of the active reprocessing operation.

Methods to be considered in reclamation of mine dump D9 include: (1) utilization as highway construction material assuming too much of the material has already burned to consider reprocessing for recoverable coal; (2) removal to a nearby strip mine pit with subsequent grading, covering with soil, revegetating and surface water diversion; or (3) in-place reclamation using similar methods.

Recommendations

Utilization is recommended.

SITE E (Pollution Sources 4868, 4869 and Surface Mine 55) – Sub-basins 31 and 32 - Coal Mining Inventory Map 13 of 27.

Site E produces an average acid discharge of 6,773 lb./day and consists of drainage from pollution sources 4868 and 4869 and from surface mine 55. The site accounts for approximately 2.53 percent of the total acid mine drainage produced in the watershed.

The site is situated north and northeast of the intersection of Route 56 and Blacklick Creek in Indiana County and is the location of the abandoned Virginian No. 15 mine. The mine is believed to have been opened in 1919 by the Standard Bituminous Coal Company and also was known as the Buena Vista Mine from 1928 to 1932. The Lower Kittanning coal seam was mined.

Pollution source 4868 is a collapsed drift opening and discharges an average of 2,734 lb./day of acid drainage into the unnamed tributary of Blacklick Creek. Pollution source 4869 consists of a collapsed drift opening and an adjacent ventilation opening and produces an average of 1,154 lb./day of acid drainage. Surface mine 53 has also operated in the Lower Kittanning coal seam and mining occurred very close to the two openings of pollution source 4869. Seepage observed along the base of the partially filled highwall of the surface mine indicates surface mining has approached close to or has intersected the underground workings. Surface mine 54 which appears to have operated in both the Upper and Lower Freeport coal seams is partially revegetated with pine and deciduous trees and some ground cover. In the northern part of the strip mine water seeps over the spoil material and down slope out of the mine. Surface mine 55 is located up-dip to the southeast of pollution sources 4868 and 4869 and operated in the Lower Kittanning coal seam. Several ponds are located in the northeastern part of the strip mine with an additional pond located in the southwestern part. The surface mine is presently an active coal preparation waste disposal site and the waste material covers a large part of the area. An average of 2,885 lb./day of acid drainage cannot be attributed to the regularly sampled pollution sources in sub-basin 32. The major part of this is believed to result from seepage from the coal waste deposits of surface mine 55. It is unknown whether surface mine 55 is directly interconnected with the deep mine workings of the Virginian #15 mine. Deep mine workings approach very close to the ground surface at the northwestern part of the mine and the underground workings of the abandoned E & S Coal Company (drift entries in strip mine 57) border the Virginian #15 mine on the east. Since very little flow is produced by the openings to the E & S Coal Company mine, it is believed the two mines are interconnected. Surface mines 57 and 57A have operated in the coal outcrop adjacent to the E & S Coal Company mine. It is not known whether the surface mines and the underground workings are interconnected. The active Oneida Mining Company Mine No. 4 is located immediately to the east of the E & S Coal Company mine.

Site E is located on the northwest limb of the Nolo Anticline and drainage in the underground workings is to the northwest toward pollution sources 4868 and 4869.

Due to the probability of an insufficient barrier between surface mine 53 and the underground workings and the proximity of deep mine workings to the ground surface at the northwestern part of the mine, the feasibility of successfully sealing pollution sources 4868 and 4869 is low.

The coal waste material deposited in surface mine 55 can be successfully reclaimed or preferably utilized thereby substantially reducing the high acid load for sub-basin 32.

Measured flow from pollution sources 4868 and 4869 is presently that which can be expected from the combined mined areas of the Virginian #15 mine and the E & S Coal Company mine due to natural infiltration. As a result, infiltration from surface mines 54 and 55 may not be a factor. This should be verified by borings to determine whether surface mines 55, 57 and 57A have intersected underground workings.

At surface mine 55, in-place reclamation methods can be employed to abate pollution from the coal waste material. However, utilization of the coal waste material is desirable and should be encouraged. Should borings reveal surface mine and deep mine intersections at surface mines 55, 57 and 57A, infiltration controls can reduce inflow into the underground workings and consequently reduce discharge from the drift openings. The total drainage area intersected by the three surface mines is approximately 211 acres and the approximate average precipitation for the area is 45 in./yr. Assuming the 30 percent of the annual precipitation that normally would be considered as runoff is intercepted by the surface mines and infiltrates into the underground workings and an average total acidity of 2,053 mg/l, dry sealing, backfilling, regrading and revegetation of surface mines 55, 57 and 57A accompanied by construction of highwall diversion ditches can reduce acidic discharges a maximum of 3,630 lb./day. Since this figure is nearly equal to the total amount of acid discharge presently flowing from the Virginian No. 15 mine and is therefore questionable, the decision on implementation of infiltration control measures should not be made until an analysis of boring data is made. If it is determined infiltration control measures are not applicable at the site, any further abatement of acid pollution beyond that involving reclamation of coal waste material in surface mine 55 appears feasible only by treatment.

Recommendations

The encouragement of usage of coal waste material deposited in surface mine 55 is recommended. Also, exploratory boring should be undertaken above the highwalls of surface mines 55, 57 and 57A to determine the need for the types of infiltration control measures at the surface mines.

Cost Estimates*

<u>Exploratory Borings</u>	<u>Estimated Cost</u>
13 rotary borings: 600 L.F. @ \$6.00/L.F.	<u>\$ 3,600</u>
Total exploratory boring costs for Site E.*	<u>\$ 3,600</u>

*Does not include costs of site preparation and plugging of boreholes.

Cost Effectiveness

Usage of the coal waste material at surface mine 55 can abate a major part of the 2885 lb./day of acid drainage attributed to Site E in subbasin 32 at little or no cost to the Commonwealth of Pennsylvania. Additional abatement measures and their costs cannot be evaluated until exploratory boring results are analyzed.

SITE F (Pollution Sources 56B, 4857, 4858 and 4859 and Coal Waste Bank D24). - Sub-basins 34 and 75 - Coal Mining Inventory Map 13 of 27.

Site F produces an average acid load of 16.701 lb./day and primarily consists of mine drainage from drift openings 4857 and 4858 and subsidence area 4859 and coal waste bank D24. The site accounts for approximately 6.24 percent of the total acid mine drainage produced in the watershed.

The site is located on the south side of Blacklick Creek downstream from the community of Dilltown in Indiana County.

Pollution source 4857 discharges an average acid load of 445 lb./day from the abandoned Amerford mine of the Amerford Coal Mining Company. The mine reportedly operated from 1913 to 1927 and produced approximately 1,017,000 tons of Lower Kittanning Coal. Three drift openings existed at the northeastern part of the mine, but several of these have been destroyed by later surface mining operations. Pollution source 4857 is one of four drift openings into the mine at the west outcrop according to the available mine map. Two of these drifts appear to also have been destroyed by surface mining. Available information indicates the supporting coal pillars have been drawn adjacent to the western drift openings. The abandoned Brush Valley mine (also known as the Scottglen mine) of the Kiskiminetis Coal Company exists to the south and west of the Amerford mine and the workings appear to be interconnected. Abandoned surface mine 117 (codes 1-18 and 1-22) is located along sections of the north and west margins of the Amerford mine. Stripping operations appear to have intersected the underground workings in various areas. Surface waters appear to infiltrate into the Amerford mine and the Brush Valley mine from the northern section and in part from the southern section of the surface mine.

Pollution source 4858 produces an average of 7,064 lb./day of acid drainage from the abandoned Brush Valley mine (Scottglen mine) of the Kiskiminetis Coal Company. The mine reportedly operated from 1905 to 1928 with an approximate output of 1,511,000 tons. The Lower Kittanning coal was mined here. Two additional collapsed drift openings into the mine are located adjacent to pollution source 4858. Available information shows the Brush Valley mine is interconnected with the abandoned Amerford mine to the northeast, the abandoned Marldis Run mine to the north, and is interconnected directly or indirectly through the Marldis Run mine with the abandoned Thompson

No. 1 mine to the north and the active Mine #1, Blacklick Portal of the Florence Mining Company to the north and west. Bulkheads reportedly have been established between the intersected sections of the Thompson No. 1 - Marldis Run mine complex and the active Mine No. 1 Blacklick Portal, but available information indicates the effectiveness of the bulkheads in keeping water from the abandoned underground workings has not been evaluated in recent years. Abandoned surface mine 67 (codes #675 and #675A) is located along the up-dip outcrops of the Marldis Run mine and the Thompson No. 1 mine. This mine operated in the Lower Kittanning seam and consisted of strip and auger mining activities which reportedly intersected the underground workings. The mine has been terraced-backfilled, graded and planted with pine trees but very little ground cover is present. The southeast end of the strip mine appears to have intersected and destroyed the Old Amerford mine which was a small country mine located northwest of drift mine 4858. The Old Amerford mine was reportedly interconnected with the underground workings of the Marldis Run mine. Since regraded surface mine 67 is only sparsely vegetated, it can still be considered as a source of surface water infiltration into the deep mines.

Pollution source 4859 produces an average acid load of 290 lb./day and consists of mine discharge from two mine openings which appear to result from mine subsidence resulting from the advancement of subsurface mining too close to the coal outcrop. Marldis Run appears to have been diverted away from the area of subsidence. Available information shows the underground mine workings of pollution source 4859 are connected to the west with Mine #1, a part of which is presently active in the Lower Kittanning coal seam. Records indicate the pollution source is also connected with the Marldis Run mine and in turn connected with the Brush Valley mine and the Amerford mine.

Coal waste bank D24 is located immediately to the northeast of pollution source 4859 and consists of coal waste material deposited in abandoned surface mine 64. It appears coal waste material may be actively deposited at this location. Northern sections of the strip mine are presently being used as a mine equipment and material storage area. Immediately to the west of coal waste bank D24 lies the underground workings of Mine #1, an active operation. Surface mine 64 operated in the Lower Kittanning seam and stripped the northern and eastern outcrops and operations reportedly have intersected the underground workings. Surface waters appear to infiltrate through the northern parts of surface mine 64 into the deep mine workings and appear to outlet in part into the southeast section of the same strip mine and seep through the coal waste material of coal waste bank D24. Surface and deep mine intersection and acid seepage is not noticeable at the southeastern highwall of surface mine 64 due to a cover of mine spoil and coal waste material. This infiltration and seepage combined with surface water runoff appears to account for 8.840 lb./day of acid pollution into Marldis Run. Discharge from the active Mine #1 supposedly is via a borehole and is reportedly treated and released into Marldis Run approximately 0.90 miles to the southwest of waste bank D24. The underground openings of the active

Dias #2 mine are located here also. Surface mines 65 and 66 lie immediately to the west and southwest, respectively, of the Dias #2 openings. The surface mines have operated in the Upper Freeport coal seam and are partially reclaimed. Both the Dias #2 underground mine and surface mines 65 and 66 overlie the deep mine workings of Mine #1. In their present state partially reclaimed surface mines 65 and 66 provide a source of infiltration into the underlying deep mine.

All of the pollution sources of the site lie on the southeast limb of the Nolo Anticline and are down-dip from large underground workings. Thus water entering the underground workings migrates toward each of the pollution sources. All of the underground mine workings appear to be interconnected and pollution source 4858, with an elevation of 1,329 feet, appears to be the lowest opening and appears to drain the large mine complex. The large flow here tends to verify this.

The technical feasibility of successfully hydraulically sealing the mine openings of pollution sources 4857, 4858 and 4859 is low under existing technology. In each case underground mine workings appear to have advanced very close to the coal outcrop and successful sealing is therefore very unlikely.

Infiltration control at surface mine 117 can reduce inflow into the Amerford and Brush Valley mines. The drainage area intersected by the surface mine is approximately 41 acres and the approximate average precipitation for the area is 48 in./yr. Assuming the 30 percent of the annual precipitation that normally runs off infiltrates through the northern part of surface mine 117, 15 percent infiltration in the southern part of the strip mine and an average total acidity of 604 mg/l, clay sealing, backfilling, regrading and revegetation of surface mine 117 accompanied by construction of highwall diversion ditches can reduce acidic discharges a maximum of 157 lb./day from pollution sources 4857 and 4858.

Although surface mine 67 has been regraded and planted with pine, very little ground cover is present. The drainage area intersected by the mine is approximately 142 acres. Runoff from the area reaches surface mine 67 and likely infiltrates into the underground workings. It is estimated that fertilization and seeding (without disturbing established pine trees) accompanied by construction of highwall diversion ditches and minor grading to promote drainage from the existing terrace can reduce acidic discharge from pollution source 4858 a maximum of 1,236 lb./day.

Infiltration control measures at surface mine 64 can reduce inflow into and consequently suspected seepage from Mine #1. Clay sealing, backfilling and grading, revegetation and construction of highwall diversion ditches at strip mine 64 accompanied by utilization of coal waste bank D24 in preference to relocation to a more suitable site, can reduce acid pollution into Marldis Run an estimated maximum of 8,840 lb./day. Any further reduction in acid pollution at the site appears feasible only by treatment. However, no action regarding

surface mine 64 or coal waste bank D24 is possible at this immediate time because these areas are part of an active mine operation.

Recommendations

The conducting of infiltration control measures at surface mine 67 and 117 along with the encouragement of future usage of the coal waste material of coal waste bank D24 is recommended. Confirmation should be made that waters from active operations are not seeping into and through coal waste bank D24 and that bulkheads between abandoned and active operations are in place and are functioning properly.

Cost Estimates

Surface Mine 117 (13.8 Acres)	
Clearing and grubbing: 13.8 Acres @ \$300/Acre	\$ 4,100
Excavation to expose coal seam: 57,000 C.Y. @ \$1.50/C.Y.	\$ 85,500
Clay sealing: 2,900 L.F. @ \$4.15/L.F.	\$ 12,000
Backfilling and grading: 13.8 Acres @ \$2,000/Acre	\$ 27,600
Revegetation: 13.8 Acres @ \$750/Acre	\$ 10,400
Diversion ditch construction: 3,100 L.F. @ \$1.00/L.F.	<u>\$ 3,100</u>
Total for Surface Mine 117	<u>\$142,700</u>
Surface Mine 67 (50.5 Acres)	
Clearing and grubbing of brush (existing pine and deciduous trees to remain unaffected): 50.5 Acres @ \$300/Acre	\$ 15,200
Revegetation: 50.5 Acres @ \$750/Acre	\$ 37,900
Diversion ditch construction: 6,200 L.F. @ \$1.00/L.F.	<u>\$ 6,200</u>
Total for Surface Mine 67	<u>\$ 59,300</u>
Total cost for recommended abatement measures for Site F	<u>\$202,000</u>

Cost Effectiveness

	Estimated Pollution Abated (lb./day)	Estimated Cost	Cost/lb./day Abatement
Surface Mine 117	157	\$142,700	\$909
Surface Mine 67	1,236	\$ 59,300	\$ 48
<u>Total for Site F*</u>	<u>1,393</u>	<u>\$202,000</u>	<u>\$145</u>

*Additional acid pollution abatement can result from usage of coal waste bank D24. The exact amount of reduction cannot be determined at the present time due to the possibility of flow into and through the waste bank from the adjacent active underground mine.

SITE G (Pollution Sources 4748 and 4874 and Sampling Stations 57, 4870 and 4874A) - Sub-basins 35 and 75 - Coal Mining Inventory Map 13 of 27.

Site G produces an average acid load of 1,111 lb./day and consists of acid drainage from drift opening 4748, intersected and collapsed drift 4874, sampling stations 4870, 4871, 4873 and 4874A and coal waste bank D28. The site accounts for approximately 0.42 percent of the total acid mine drainage produced in the watershed.

The site is located on the north side of Blacklick Creek immediately to the northwest of the community of Dilltown in Indiana County and is the location of the abandoned Thermal No. 15 mine. The mine opened in 1915 and was operated successively by Dilltown Smokeless Coal Company, Toash Coal Company, Lennox Coal Company and Cosgrove-Meehan Coal Company. Mining was discontinued in 1938 with approximately three million tons of Lower Kittanning coal having been mined. A total of five additional openings are located adjacent to drift opening 4748 on the down-dip side of the mine. Pollution source 4748 produces an average acid discharge of 274 lb./day. At least eight drift openings into the mine were thought to be located along the southern coal outcrop but most of these have been destroyed by surface mine 68 (code #I-6) which operated in the Lower Kittanning seam along the southern and western margins of the Thermal #15 mine. One such drift, pollution source 4874, produces an average acid discharge of 119 lb./day. Surface operations are believed to have intersected the underground workings in various locations. Several acid discharges are monitored down-slope from the spoil material of the surface mine and flow into Blacklick Creek. Of these, sampling stations 4870 and 4874A measure an average of 152 lb./day and 486 lb./day of acid drainage, respectively. Coal waste bank D28 located south, of pollution source 4748 produces an average acid discharge of

43 lb./day by runoff and seepage.

Site G is located on the southeast limb of the Nolo Anticline which indicates water in the Thermal #15 mine flows down-dip to the southeast. The drift openings at pollution sources 4748 and 4874 appear to drain the mine.

The feasibility of successfully sealing the discharging drift openings of the Thermal #15 mine is very low with existing technology. Underground mining appears to have approached very close to the coal outcrop near the drift openings at the southeast margin of the mine and the operations of surface mine 68 appear to have intersected the deep mine workings in various places along the southeastern and southern margins of the site. Reclamation of surface mine 68 is feasible but since drainage from the subsurface workings of the Thermal #15 mine would continue, reduction in acid discharge would be insignificant. Infiltration into the main underground workings from the northwestern section of surface mine 68 does not appear significant since the major extent of the strip mine highwall runs parallel to the dip of the coal. Thus drainage in the surface mine would tend to parallel the deep mine workings rather than seep into them. This appears to be verified by the very low amount of acid pollution at sampling station 4871. Reclamation of coal waste bank D28 is possible by in-place methods but usage of the coal waste is preferred and should be encouraged. A maximum reduction of 43 lb./day of acid discharge may be achieved by reclaiming the coal waste bank. Any further acid pollution reduction at the site appears feasible only by treatment.

Recommendations

Encouragement of the usage of the coal waste material in mine waste bank D28 is recommended.

SITE H (Pollution Source 4746 and Sampling Stations 69, 69A (4745), 69B, 72, 75 and 4743) - Sub-basins 44, 45, 46 and 75 - Coal Mining Inventory Maps 11 of 27, 14 of 27 and 25 of 27.

Site H produces an average acid discharge of 13,426 lb./day and consists of mine drainage pollution from mine shaft 4746 (measured at sampling station 68), coal waste banks D5, D6 and D7 measured by sampling stations 69, 69A, 69B and 4743 and from combined strip and deep-mined areas measured by sampling stations 72 and 75. The site accounts for approximately 5.02 percent of the total acid mine drainage produced in the watershed.

Pollution source 4746 is located approximately 0.6 mile southwest of the abandoned community of Wehrum in eastern Indiana County and produces an average acid discharge of 8704 lb./day. Coal waste banks D5, D6 and D7 are located approximately 1.2 miles northeast of Wehrum and produce an average acid discharge of 4451 lb./day. Sampling

stations 72 and 75 monitor discharge from areas of combined surface and subsurface mining and record pollution loads of 241 lb./day and 33 lb./day, respectively.

The site is the location of a large abandoned deep mine and surface mine complex in eastern Indiana County and western Cambria County in the Lower Kittanning coal seam. Pollution source 4746 is a ventilation shaft into the abandoned Lackawanna No. 3 and No. 4 mine complex and is one of five mine shafts at the site. The elevation of the top of the shaft at the pollution source is approximately 1,358 feet. The Lackawanna No. 3 mine shaft and accompanying air shaft are located northeast of Wehrum adjacent to coal waste banks D5 and D7. The shafts are partially filled with debris and are flooded. The Lackawanna No. 4 mine shaft and accompanying air shaft are located at Wehrum and are also partially filled with debris and flooded. Coal waste banks D5 and D6 are each intersected by unnamed tributary streams which flow through the waste material and enter Blacklick Creek. Additional acid pollution enters Blacklick Creek from precipitation runoff from coal waste bank D7 as well as from D5 and D6. Coal waste from bank D7 was being preprocessed at the time of this study.

Immediately to the east of the Lackawanna No. 3 and No. 4 mine workings lies the abandoned subsurface Vinton Collieries Vinton No. 1 mine. The Lackawanna and Vinton Collieries mines are located adjacent to each other in the Lower Kittanning seam and are believed to be interconnected. Drift openings into the Vinton No. 1 mine are located along the northern, eastern and southeastern outcrops of the Lower Kittanning seam. Sections of the eastern and southeastern outcrops (monitored by sampling stations 72 and 75) have been stripmined (surface mines 76, 81 and 82 - codes I-39 and SC-5) and some of the drift mine openings have been destroyed. Surface water runoff through mine spoil material of surface mines 81 and 82 accompanied by seepage from the underground workings discharges into the tributary streams of Rummel Run. Surface water infiltration into the Vinton No. 1 mine also appears to be occurring at parts of surface mines 81 and 82. A small pond exists within surface mine 82 and reportedly is maintained for fire protection by a local resident. This pond appears to be providing infiltration into the deep mine workings. The southern part of surface mine 82 is presently being used as a sanitary landfill site. Surface water infiltration into the underground workings from surface mine 76 appears insignificant.

The Vinton Collieries Mine No. 6 lies adjacent to the northeast boundary of the Lackawanna No. 3 and No. 4 mine complex. Available records and information indicate the two mines are not directly interconnected.

Pollution source 4746 lies almost directly along the axis of the Barnesboro syncline. This structure plunges to the southwest and the discharging air shaft is down-dip from the major portions of the deep mine complex. Structural dip in the Vinton No. 1 mine is to the northwest and the combined surface and deep mine workings in the

vicinities of surface mine 76, 81 and 82 are located up-dip from the major part of the mine. Water in the deep mine workings migrates down-dip toward pollution source 4746.

It appears the five shaft openings into the Lackawanna No. 3 and No. 4 mine complex can be sealed. However, sealing these openings would not eliminate or even significantly reduce acid pollution from the site. The mine water pool is presently at an elevation of at least 1,358 feet, the elevation of the top of the discharging air shaft. However, the actual pool elevation is probably significantly greater than this and is very close to the northernmost drift mine opening of the Vinton No. 1 mine just west of Vintondale. If the Lackawanna No. 3 and No. 4 mine complex were successfully sealed water would outlet from the Vinton No. 1 opening. Sealing of the openings of the Vinton No. 1 mine is not appropriate due to the unknown thickness of the coal barrier and the potential danger such action might impose on the community of Vintondale.

Infiltration control measures can successfully reduce surface water inflow into surface mines 81 and 82 and consequently reduce flow from pollution source 4746 as well as some local flow from a drift opening in the northwestern part of surface mine 81. Assuming the 30 percent of the total annual rainfall for the area (45 inches/year) that would normally be considered as runoff is intersected by the surface mines and infiltrates into the underground workings and an average total acidity of 927 mg/l, clay sealing, backfilling and regrading, revegetation and highwall diversion ditch construction can reduce acid discharge from pollution source 4746 by amounts of 120 lb./day and 315 lb./day for surface mines 81 and 82, respectively. The same actions can result in a reduced pollution load of 241 lb./day in the tributary to Rummel Run, the sub-basin of which surface mines 81 and 82 are a part.

Successful reclamation of coal waste banks D5, D6 and D7 can result in a maximum acid pollution reduction of 4451 lb./day. Although reclamation can be conducted by in-place methods (regrading, covering with soil or other suitable material, revegetation and stream diversion), utilization is feasible and should be encouraged. A part of coal waste bank D7 has already been removed from the site and plans call for complete removal followed by soil conditioning and planting of grasses. There are indications other mine waste banks in the area are being considered for use or processing also. Any further abatement of acid pollution at the site appears feasible only by treatment.

Recommendations

The conducting of infiltration control measures at surface mines 81 and 82 is recommended. It is also recommended that usage of coal waste banks D5, D6 and D7 be encouraged.

Cost Estimates

Surface Mine 81 (15.6 Acres)

Clearing and grubbing: 15.6 Acres @ \$300/Acre	\$ 4,700
Excavation to expose coal seam: 29,500 C.Y. @ \$1.50/C.Y.	\$ 44,300
Clay sealing: 1,500 L.F. @ \$4.15/L.F.	\$ 6,200
Backfilling and grading: 15.6 Acres @ \$2,000/Acres	\$ 31,200
Revegetation: 15.6 Acres @ \$750/Acre	<u>\$ 11,700</u>
Total Cost for Surface Mine 81	<u>\$ 98,100</u>
Surface Mine 82 (20.2 Acres)	
Clearing and grubbing: 20.2 Acres @ \$300/Acre	\$ 6,100
Excavation to expose coal seam: 35,400 C.Y. @ \$1.50/C.Y.	\$ 53,100
Clay sealing: 1,800 L.F. @ \$4.15/L.F.	\$ 7,500
Backfilling and grading: 20.2 Acres @ \$2,000/Acre	\$ 40,400
Revegetation: 20.2 Acres @ \$750/Acre	\$ 15,200
Diversion ditch construction: 3,900 L.F. @ \$1.00/L.F.	<u>\$ 3,900</u>
Total Cost for Surface Mine 82	<u>\$126,200</u>
Total cost for recommended abatement measures for Site H.	<u>\$224,300</u>

Cost Effectiveness

	Estimated Pollution Abated (lb./day)	Estimated Cost	Cost/lb./day Abatement
Surface Mine 81	240	\$ 98,100	\$409
Surface Mine 82	<u>436</u>	<u>\$126,200</u>	\$289

<u>Total for Site H</u>	<u>676</u>	<u>\$224,300</u>	<u>\$331</u>
Mine Waste Banks D5, D6 and D7	4,451	---	---
<u>Total for Site H with utilization of mine waste banks D5, D6 and D7</u>	<u>5,127</u>	<u>\$224,300</u>	<u>\$ 44</u>

SITE I (Pollution Sources D3 and D4) - Sub-basins 60 and 76 - Coal
Mining Inventory Map 26 of 27.

Site I contributes an average acid load of 19,294 lb./day produced by acidic seepage from coal mine refuse banks D3 and D4. This acid load represents 7.21 percent of the total acid contribution to the Blacklick Creek Watershed. Pollution sources D3 and D4 are located directly south of the community of Nanty Glo and South Branch Blacklick Creek in sub-basin 60. Sampling station #119 monitored the acid discharge of source D3 and had been established slightly downstream of the pile and on the stream flanking its north end. Seepage points along the northeastern toe of waste bank D4 were monitored by sampling stations #5039 and #5040. Also, a discharge believed to be a covered and consequently now contaminated natural spring was monitored at sampling station #5076 along the western toe of the pile. Any additional seepage from waste pile D4 was noted at station #120 after subtracting the figures for unrelated acid loads further upstream. The collective acid contribution of refuse dump D4 was 6,071 lb./day while D3 discharged an average acid load of 13,223 lb./day. Part of the acid load attributed to D3 may be covered artesian bore hole discharges into the base of the pile from the Webster #14 mine (Site L) which underlies this location.

Mine refuse bank D4 is presently being reprocessed by Universal Minerals, Inc., for recoverable coal with pile D3 slated to follow (Mining Permit #1116-1, Drainage Permit #4274SM2). The permit specifications state that the material will be run through a cleaning plant immediately adjacent to each pile. Approximately 35 percent recovery is expected with the reject material being ultimately returned to the worked out areas, compacted and covered with impervious material.

Recommendations

Complete utilization is encouraged.

SITE J (Pollution Sources D1 and D2) - Sub-basin 64B - Coal
Mining Inventory Map 24 of 27.

Site J contributes an average acid load of 8,196 lb./day or 3.06 percent of the total acid load produced within the Blacklick Creek Watershed.

The site consists of coal mine refuse banks D1 and D2 immediately adjacent to South Branch Blacklick Creek and southeast of the community of Revloc in sub-basin 64B. Refuse pile D1, the larger of the two, was formed using tippler form construction on a relatively flat area. At least part of this pile is smouldering, smoke having been observed near its northern end. Refuse pile D2 was formed using layer piling construction and lies on a gently westward dipping hillside. Considerable seepage had been noted along the base of both piles and the total average acid load was measured using sampling stations #134 and #135 downstream and upstream respectfully of the two piles.

It is understood that utilization of piles D1 and D2 for road construction material for U.S. Route 219 has been undertaken by the Pennsylvania Department of Transportation.

Recommendations

Utilization is recommended.

SITE K (Pollution Sources D13 and D14) - Sub-basin 48B - Coal Mining Inventory Map 20 of 27.

This site contributes an average acid load of 53,958 lb./day or 20.16 percent of the total amount of acid produced within the watershed.

Site K consists of coal mine refuse banks D13 and D14 situated northwest of the community of Colver in Cambria County in sub-basin 48B. Acidic seepage, from these piles was collected immediately downstream on Elk Creek at Preisser Crossing where sampling station #101 had been established to monitor the collective effect. Both mine refuse piles are believed owned by Eastern Associated Coal Corporation whose Colver Mine is actively operating in this same area. Refuse pile D14 is presently being reprocessed by Bentley Coal Company (Drainage Permit #4274SM4) and it is likely pile D13 will similarly be reprocessed in the future.

Recommendations

Utilization is encouraged.

SITE L - (Pollution Sources 119A, 111A-111E, 115, 115A, 117A and Seepage in Surface Mine #98) - Sub-basins 52, 55, 57, 58, 60 and 76 - Coal Mining Inventory Maps 22 of 27, 25 of 27 and 26 of 27.

Site L produces an average acid load of 5,380 lb./day or 2.01 percent of the total acid contribution to the Blacklick Creek watershed. Nearly all of this load was accounted for by mine drainage from collapsed drift mine openings of which 70.4 percent was measured at sampling station #119A of sub-basin 60.

This site lies immediately to the west of the community of Nanty Glo in Jackson Township on the south side of South Branch Blacklick Creek and consists primarily of two abandoned deep mines within the Lower Kittanning coal seam. The Webster Coal and Coke Company's Nanty Glo Mine No. 14 which opened before 1910 comprises the southern portion of Site L. This mine was later operated as the Webster No. 14 mine of the Pennsylvania Coal and Coke Company followed by extraction by the Dorsch Coal Company from 1943 until it was abandoned in 1950. The Nanty Glo Coal Mining Company's Mine No. 1, immediately north and adjacent to the Webster No. 14 mine workings, must have operated during the late 1910's. This mine is connected with the Webster No. 14 mine complex in the vicinity of the drift mine discharge monitored by sampling station #119A. Strip mine #98 (Code #I-36 for north end and SC-2 for main part) and strip mine #119 (Code #862), located along the western boundary of the site in sub-basin 52, appear to have intersected the deep mine workings of the Nanty Glo No. 1 mine along much of its western edge. Strip mine #119 is as yet actively advancing eastward even further into the deep mine workings. These strip mines lie up-dip of the deep mine and likely serve as points of increased infiltration for surface waters into the underground workings. The workings of the Pergrin Mine No. 1 (mined approximately 1920) within the Lower Freeport coal overlie the northern end of the Webster #14 mine in sub-basin 60. These workings have at least been partially intersected by strip mine #108 (Code #I-40) along the immediate southern outcrop. Strip mine #108 and any flooded portions of the deep mine workings probably serve as points of infiltration for surface and ground waters into the Webster #14 complex.

Site L extends across the axis of the northeast plunging Laurel Ridge Anticline indicating water in the Nanty Glo Mine No. 1 and Webster No. 14 on the eastern limb of the axis flows northeast to southeast. Flow in the Nancy Glo Mine No. 1 on the western limb of the anticlinal axis is down-dip to the north or northwest. Sampling stations 111A through 111E in sub-basin 76 measured combined discharges of eight collapsed drift mines and three small mine waste banks at the northwest margin of the Nanty Glo Mine No. 1. This flow is the total discharge of the up-dip portions of the mine to the south on the west flank of the Laurel Ridge anticlinal axis which are likely charged by surface water infiltration along part of surface mine #98. A total of 477 lb./day of acid discharged from this portion of Site L, only 4 lb./day of which were contributed by the mine waste material. Lack of flow from the areas of drift mine 5014 and the adjacent drift to the immediate southwest in sub-basin 55 may indicate that these openings are connected with the mined area down-dip to the north. Sampling station #115A in sub-basin 55 monitored the discharge of a buried drift mine opening which is now drained via a pipe. No mine maps available showed the extent of mining for this immediate area, but because there was a discharge it may be assumed that either the mining is separate from the areas to the north and south or it is a section of the Nanty Glo Mine No. 1 draining directly along the northeast dipping structural axis. An additional slight acid load noted at stream sampling station #115 may be related to this local condition.

The total average acid contribution for both of these locations was 453 lb./day.

Two collapsed drift mine opening discharges in sub-basin 57 were monitored primarily by sampling station #117 and later by station #117A. The area drained was a small lobe of the Nanty Glo Mine No. 1 producing an acid load of 173 lb./day. An air shaft approximately 800 feet to the southwest lies up-dip of drainage as does a drift mine entry driven southward located immediately to the east of the air shaft.

A drift mine entry is indicated on mine maps at the lowest portion of the Nanty Glo Mine No. 1, 300 feet north of pollution source #119A, but could not be located in the field, nor was there a discharge from the vicinity. The same mine maps though, show that the Nanty Glo No. 1 mine is connected with the Webster No. 14 mine slightly southwest of this point indicating that drainage is down-dip into the Webster No. 14 mine away from this entry.

Sampling station #119A, with an acid load of 3,788 lb./day, measured a discharge from the area of two drift mines and an air shaft on the eastern mining limit of the Webster No. 14 mine. This point appears to drain much of the Nanty Glo No. 1 mine complex and the Webster mine and indicates water is pooled in the Webster mine to an elevation of approximately 1,725 feet. The Webster mine workings extend further down-dip to an elevation of 1,400 feet and up-dip to a maximum elevation of approximately 2,100 feet. The Bethlehem Mines Corporation - Nanty Glo No. 31 mine borders the southern and eastern lower limits of the Webster mine and appears to be separated by a minimum 120 foot barrier pillar. Provided the Webster workings are flooded to the 119A pollution source level, a head of 325 feet exists above this pillar.

The feasibility of safely constructing hydraulic seals on either the Nanty Glo Mine No. 1 or Webster No. 14 mine openings is low considering local conditions. Increasing the already large head present on the pillar between the Webster No. 14 mine and Nanty Glo No. 31 mine could be dangerous. Also, in both the case of the Webster No. 14 mine as well as the Nanty Glo Mine No. 1, good potentials for break-outs exist considering the proximity of mining in relation to the Lower Kittanning outcrop. Subsidence was noted along the outcrop in both the #117A and #119A pollution source areas.

Infiltration controls at surface mine #98 can reduce discharges from Site L. Approximately 86 acres of drainage area is intercepted by the northern segment of surface mine #98 in sub-basin 52 which helps to charge the northernmost workings of the Nanty Glo No. 1 mine. Assuming ten percent of the average annual precipitation of 43 inches that is normally runoff infiltrates the deep mine workings and an average total acidity of 227 mg/l, a maximum reduction of 54 lb./day acid load from this area may be achieved by reclamation with clay sealing, backfilling, regrading, planting and surface water diversion. The 800 foot segment of surface mine #98 along the Laurel

ridge anticlinal axis, believed to charge the segment of the Nanty Glo Mine No. 1 workings drained by pollution source 115A, intercepts a drainage area of approximately 15 acres. A maximum reduction in acid load of 17 lb./day from this source may be expected after reclamation assuming an average total acidity of 446 mg/l and again utilizing ten percent of the average annual precipitation. Reclaiming of the remainder of surface mine #98, excluding the recently stripped segment which has already been backfilled, would cut down discharge from the Webster No. 14 mine complex. Infiltrating waters from this area would flow through the Nanty Glo No. 1 mine workings and into the Webster No. 14 mine. Nearly 57 acres of drainage area is intercepted by this section of strip mine #98. Assuming the infiltration figure previously mentioned and an average total acidity of 786 mg/l, a maximum reduction in acid load of 123 lb./day at the #119A source may be expected with reclamation. A reduction of 489 lb./day along, produced by seepage from the spoil of strip mine #98 in sub-basin 52, could be expected with similar actions.

Infiltration controls may also be employed in relation to surface mine #108 and the intersected Pergrin Mine No. 1 which overlie the Webster No. 14 mine. The Pergrin mine workings appear to be draining freely but could be partially flooded because the openings are caved. Surface drainage of approximately 74 acres is intercepted by strip mine #108. Assuming again that an additional ten percent of the average annual precipitation infiltrates into the deep mine workings and an average total acidity of 786 mg/l, reclamation measures may reduce the acid load at pollution source #119A by 161 lb./day. In order to effectively reclaim strip mine #108, pipes or some other means of keeping the Pergrin mine drained would be necessary. Discharges of the Pergrin mine are alkaline, so no detrimental effects of allowing the mine to freely drain are expected.

Additional reduction of acid discharge will require treatment.

Recommendations

Infiltration controls at strip mines #98 and #108 are recommended.

Cost Estimates

Strip Mine #98 (59.7 Acres)		
Clearing and grubbing:		
59.7 Acres @ \$300/Acre		\$ 17,900
Excavation to expose coal seam:		
132,750 C.Y. @ \$1.50/C.Y.		\$199,100
Clay sealing:		
6,750 L.F. @ \$4.15/L.F.		\$ 28,000

Backfilling and grading: 59.7 Acres @ \$2,000/Acre	\$119,400
Revegetation: 59.7 Acres @ \$750/Acre	\$ 44,800
Diversion ditch construction: 7,500 L.F. @ \$1.00/L.F.	<u>\$ 7,500</u>
Total for Strip Mine #98	\$416,700
Strip Mine #108 (22 Acres)	
Clearing and Grubbing: 22 Acres @ \$300/Acre	\$ 6,600
Backfilling and grading: 22 Acres @ \$2,000/Acre	\$ 44,000
Revegetation: 22 Acres @ \$750/Acre	\$ 16,500
Diversion ditch construction: 3,500 L.F. @ \$1.00/L.F.	<u>\$ 3,500</u>
Total for Strip Mine #108	\$ 70,600
Total for Site L	<u>\$487,300</u>

Cost Effectiveness

	Estimated Pollution Abated (lb./day)	Estimated Cost	Cost/lb./day Abatement
Strip Mine #98	683	\$416,700	\$610
Strip Mine #108	161	\$ 70,600	\$439
<u>Total for Site L</u>	<u>844</u>	<u>\$487,300</u>	<u>\$577</u>

SITE M (Pollution Source 80A) Sub-basin 48 - Coal Mining Inventory
Map 22 of 27.

Site M produces an average pollution load of 15,194 lb./day and consists of acid drainage from an abandoned slope opening. The site accounts for approximately 5.68 percent of the total acid mine drainage produced in the watershed.

The site is located along the east side of North Branch Blacklick Creek approximately 2.27 miles upstream from the mouth. This is the

location of the abandoned Commercial Coal Mining Company Mine No. 16 which operated in the Lower Kittanning coal seam. Pollution source 80A is a slope opening into the mine which discharges an average of 15,194 lb./day of acid drainage. The discharge flows through an area of coal waste material and empties into the North Branch Blacklick Creek. The Commercial No. 16 mine partially underlies Pennsylvania State Game Lands No. 79.

At least six additional drift openings into the mine exist along the southern and southeastern coal outcrops. Some of these have collapsed or have been destroyed by surface mining operations. Abandoned surface mines 101, 102, 103 and 118 (Code #I34) are located along the southern outcrop of the Lower Kittanning seam and are generally up-dip from the main mine workings.

The Commercial Mine No. 16 is bordered on the west by the abandoned Vinton Collieries Mine No. 6 and on the east by the abandoned Nonpareil Mine of the Big Bend Coal Mining Company (later known as the Renglo Mine and operated by Rochester and Pittsburgh Coal Company). The Commercial Mine No. 16 is directly connected with both of these mines. The Commercial Coal Mining Company Mine No. 5 and the Imperial Cardiff Coal Company, Cardiff No. 1 mine lie immediately to the east of the Nonpareil Mine. Although discharge occurs at the main openings of the Commercial No. 5 and the Cardiff No. 1 mines, available information shows the two mines are interconnected and may be joined with the Nonpareil Mine. The active operations of the Colver Mine of Eastern Associated Coal Corporation lie to the north of the Commercial-Cardiff-Nonpareil mine complex and may be considered as a possible area of outlet for waters from the abandoned mines. All of the above workings are located in the Lower Kittanning coal seam.

Pollution source 80A is at an elevation of approximately 1,475 feet indicating the mine workings are flooded to this level. Available information indicates the pool elevation is either presently sufficiently high to drain into the abandoned Vinton No. 6 mine of Site N thereby contributing to the discharge at pollution source 106B or only a slight rise in the mine pool elevation will cause this condition to exist. Abandoned surface mines 101, 102, 103 and 118 collect approximately 30 percent of the precipitation of their corresponding drainage areas that would normally be considered as runoff. It is likely water enters the underground workings by seepage through the coal barrier or directly where surface mining has intersected the underground workings.

Site M is located on the northwest limb of the Laurel Hill anticline and water in the mine complex generally flows to the northwest toward pollution source 80A.

The possibility of successfully sealing the slope opening of pollution source 80A is good due to the likelihood of competent strata surrounding the mine opening. However, such action would produce unsatisfactory results in that any significant increase in

the pool level within the Commercial No. 16 mine would cause water to outlet into the adjacent abandoned Vinton No. 6 mine, if this condition does not already exist. The Vinton No. 6 mine appears difficult or impossible to hydraulically seal with existing technology.

Infiltration controls at surface mines 101, 102, 103 and 118 can reduce inflow into the deep mine workings and consequently reduce discharges. The collective drainage area of the surface mines is approximately 108 acres and the approximate average precipitation for the area is 45 in./yr. Assuming the 30 percent of the annual precipitation that would normally be considered as runoff infiltrates into the deep mine workings and an average total acidity of 454 mg/l, clay sealing, backfilling, regrading and revegetation accompanied by the construction of highwall diversion ditches can reduce acidic discharges from pollution source 80A a maximum of 125 lb./day, 232 lb./day, 15 lb./day and 39 lb./day for surface mines 101, 102, 103 and 118, respectively. The total estimated acid pollution abatement is 411 lb./day. Any further reduction in acid pollution from the site appears feasible only by treatment.

Recommendations

The conducting of infiltration control measures is recommended for surface mines 101, 102, 103 and 118.

Cost Estimates

Surface Mine 101 (8.3 Acres)

Clearing and grubbing: 8.3 Acres @ \$300/Acre	\$ 2,500
Excavation to expose coal seam: 33,400 C.Y. @ \$1.50/C.Y.	\$50,100
Clay sealing: 1,700 L.F. @ \$4.15/L.F.	\$ 7,100
Backfilling and grading: 8.3 Acres @ \$2,000/Acre	\$16,600
Revegetation: 8.3 Acres @ \$750/Acre	\$ 6,200
Diversion ditch construction: 1,600 L.F. @ \$1.00/L.F.	<u>\$ 1,600</u>
Total for Surface Mine 101	\$84,100

Surface Mine 102 (9.2 Acres)

Clearing and grubbing: 9.2 Acres @ \$300/Acre	\$ 2,800
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Excavation to expose coal seam: 25,500 C.Y. @ \$1.50/C.Y.	\$38,300
Clay sealing: 1,300 L.F. @ \$4.15/L.F.	\$ 5,400
Backfilling and grading: 9.2 Acres @ \$2,000/Acre	\$18,400
Revegetation: 9.2 Acres @ \$750/Acre	\$ 6,900
Diversion ditch construction: 1,600 L.F. @ \$1.00/L.F.	<u>\$ 1,600</u>
Total for Surface Mine 102	\$73,400
Surface Mine 103 (1.8 Acres)	
Clearing and grubbing: 1.8 Acres @ \$300/Acre	\$500
Excavation to expose coal seam: 7,800 C.Y. @ \$1.50/C.Y.	\$11,700
Clay sealing: 400 L.F. @ \$4.15/L.F.	\$ 1,700
Backfilling and grading: 1.8 Acres @ \$2,000/Acre	\$ 3,600
Revegetation: 1.8 Acres @ \$750/Acre	\$ 1,400
Diversion ditch construction: 800 L.F. @ \$1.00/L.F.	<u>\$800</u>
Total for Surface Mine 103	\$19,700
Surface Mine 118 (4.5 Acres)	
Clearing and grubbing: 4.5 Acres @ \$300/Acre	\$ 1,400
Excavation to expose coal seam 19,600 C.Y. @ \$1.50/C.Y.	\$29,400
Clay sealing: 1,000 L.F. @ \$4.15/L.F.	\$ 4,200
Backfilling and grading: 4.5 Acres @ \$2,000/Acre	\$ 9,000

Revegetation:
4.5 Acres @ \$750/Acre \$ 3,400

Diversion ditch construction:
1,000 L.F. @ \$1.00/L.F. \$ 1,000
Total for Surface Mine 118 \$48,400

Total cost for recommended abatement measures for Site M. \$225,600

Cost Effectiveness

	Estimated Pollution Abated (lb./day)	Estimated Cost	Cost/lb./day Abatement
Surface Mine 101	125	\$ 84,100	\$ 673
Surface Mine 102	232	\$ 73,400	\$ 316
Surface Mine 103	15	\$ 19,700	\$1,313
Surface Mine 118	<u>39</u>	<u>\$ 48,400</u>	\$1,241
<u>Total for Site M</u>	<u>411</u>	<u>\$225,600</u>	<u>\$ 549</u>

SITE N (Pollution Source 106B, Coal Waste Banks D34, D35 and D36)
Sub-basin 76 - Coal Mining Inventory maps 11 of 27 and 22 of 27.

Site N produces an average pollution load of approximately 72,743 lb./day and consists of acid drainage from the abandoned underground Vinton Collieries Vinton No. 6 mine and runoff and seepage from coal waste banks D34, D35 and D36. The site accounts for approximately 27.18 percent of the total acid mine drainage produced in the watershed.

The site is located on the north side of South Branch Blacklick Creek opposite the community of Vintondale and partially underlies Pennsylvania State Game Lands No. 79. The Vinton No. 6 mine opened in 1906 in the Lower Kittanning coal and operated until the 1950's. The mine was reopened in the early 1960's and continued until 1967. During its life of operation the site was also known as the Driscoll No. 4 mine and was operated by the Johnstown Coke and Coal Company.

At least two drift openings exist at the main entrance to the mine immediately north of Vintondale. These discharge an average acid load of 14,012 lb./day. Mining exists over a large area and extends to the north, northwest and northeast from the main entrance and underlies a large stretch of the North Branch Blacklick Creek. To the west and east of the main entrance, underground mining has advanced close to the coal outcrop. The mine is bound on the east by the

abandoned Commercial Coal Mining Company, Mine No. 16 and on the west by the abandoned Lackawanna No. 3 and No. 4 mine complex. Both mines are in the Lower Kittanning coal. The abandoned Cambridge mine lies at the southeastern section of the Vinton No. 6 mine and at the southwestern part of the Commercial Mine No. 16 complex and connects the workings of the two mines. Available information indicates the Vinton No. 6 mine and the Lackawanna No. 3 and No. 4 mine complex are not directly interconnected. Three additional shaft openings are located to the north and northwest of the main drift openings of the Vinton No. 6 mine at elevations of approximately 1,450 feet, 1,630 feet and 1,805 feet. Various boreholes into the mine also exist.

The main drift openings of the Vinton No. 6 mine are at an elevation of approximately 1,410 feet and the underground workings are flooded to this level. As a result approximately 70 percent of the underground workings are inundated. Discharge from the drift openings flows through an area of abandoned mine buildings and equipment and across coal waste material into the South Branch Blacklick Creek. Surface runoff and seepage also occur from coal waste banks D34, D35 and D36 and flow into the stream. Acid seepage from the coal waste material is probably significantly increased as discharge from the Vinton No. 6 mine flows across the western part of coal waste bank D34. An average of 58,731 lb./day of acid discharge is attributed to coal waste banks D34, D35 and D36.

Site N is located on both limbs of the southwest-plunging Barnesboro syncline and drainage in the mine on the outer fringes of the workings is generally toward the synclinal axis and then towards the southwest in the direction of plunge.

The technical feasibility of successfully sealing the Vinton No. 6 mine is low under existing technology. The proximity of the deep mine workings to the coal outcrop indicates the elevation of the present mine pool cannot be significantly increased should the main drift openings be sealed. The Vinton No. 6 (Driscoll No. 4) mine was the location of an experimental project that attempted to utilize in situ precipitation of ferric hydroxide as a means of establishing a hydraulic mine seal in 1969 and 1970. The experiment did not achieve the desired results and the project was abandoned.

Successful reclamation of coal waste banks D34, D35 and D36 can reduce acid pollution by an average amount of 58,731 lb./day. Although reclamation can be conducted by in-place methods, utilization of the coal waste material is feasible and should be encouraged. Coal waste bank D35 was being reprocessed at the time of the study and it is possible the remaining banks will be reprocessed also. Any further reduction of acid pollution at the site appears feasible only by treatment.

Recommendations

Encouragement of the usage of coal waste material in coal waste banks D34, D35 and D36 is recommended.

SITE O (Pollution Sources 114A, 1148, 5079, Commercial No. 5 Mine and Coal Waste Bank D45) - Sub-basin 54 - Coal Mining Inventory Maps 20 of 27, 22 of 27 and 23 of 27.

Site O produces an average pollution load of 794 lb./day and consists of acid drainage from the abandoned Cardiff No. 1 mine of the Imperial Cardiff Coal Company, the abandoned Commercial No. 5 mine of the Commercial Coal Mining Company and from coal waste bank D45. The site accounts for approximately 0.30 percent of the total acid mine drainage produced in the watershed.

The site is located along Coalpit Run east of the community of Twin Rocks in Cambria County. The abandoned Cardiff No. 1 mine is located in the Lower Kittanning coal seam and produces an average acid discharge of 220 lb./day. Flow from the mine outlets through three drift openings and discharges into Coalpit Run. Two of the drift openings have collapsed and the third drains through a pipe in a masonry block seal. The abandoned Commercial No. 5 mine is located in the Lower Kittanning coal seam and produces an estimated acid discharge of 90 lb./day. Acid water outlets from one of three main drift openings of the mine and discharges into Coalpit Run. Coal waste bank D45 is located immediately to the southwest of the main openings of the Cardiff No. 1 mine and produces an average acid load of 484 lb./day by seepage and precipitation runoff.

Available information indicates at least two additional drift openings exist to the northeast of the main openings of the Cardiff No. 1 mine and possibly four or more drift openings exist to the east of the main openings of the Commercial No. 5 mine. The underground workings extend very close to the coal outcrop in both mines and the two mines are interconnected over a large section of their common boundary. The Cardiff No. 1 and Commercial No. 5 mine complex is bound on the west by the abandoned Nonpareil mine (also known as the Renglo mine and operated by the Rochester and Pittsburgh Coal, Company), on the north by the Ebensburg No. 1 mine (now a part of the active workings of Eastern Associated Coal Corporation's Colver Mine), on the east by the Monroe Coal Mining Company's Mine No. 1 (now a part of the active Bethlehem Mines Corporation Revloc No. 32 Mine) and on the south by the abandoned Lincoln mine of the Lincoln Coal Company. Available information indicates the Cardiff No. 1 - Commercial No. 5 mine complex is interconnected with the Colver mine and the Lincoln mine. There is a strong possibility that the complex is also interconnected with the Nonpareil mine and the Revloc No. 32 mine. All of Commercial No. 5 mine and the northwestern two-thirds of the Cardiff No. 1 mine lie on the northwest limb of the Laurel Hill anticline indicating drainage here is to the northwest.

The feasibility of successfully sealing the drift openings of the Cardiff No. 1 and the Commercial No. 5 mines is low due to the close proximity of the deep mine workings to the coal outcrop in each case. Flow from the main mine openings of the Cardiff No. 1 mine represents drainage from only a part of the underground workings. The remainder of the Cardiff No. 1 discharge northwest of the anticlinal axis appears to flow into the Commercial No. 5 mine. However, the amount of flow from the Commercial No. 5 mine openings does not appear to be of sufficient quantity for a large deep mine complex. This indicates the possibility of flow from the Commercial No. 5 - Cardiff No. 1 mine complex into the Nonpareil mine and/or the Colver mine. As a result it is possible any increase in the mine pool elevation due to mine sealing would allow additional flow into the adjacent mine workings.

In-place abatement measures can be successful in reducing acid pollution from coal waste bank D45. However, utilization of the coal waste material is feasible and should be encouraged. A maximum acid pollution reduction of 484 lb./day can be achieved by utilizing the coal waste bank. Any further reduction in acid pollution at the site appears feasible only by treatment.

Recommendations

Encouragement of the usage of coal waste material in mine waste bank D45 is recommended.

SITE P (Pollution Sources D51, D52, D53) - Sub-basin 59 - Coal Mining Inventory Map 23 of 27.

Site P produces an average acid contribution of 151 lb./day by acid seepage from coal mine refuse piles D51, D52 and D53. This acid load accounts for 0.06 percent of the total acid production within the Blacklick Creek watershed.

Mine waste banks D51, D52 and D53 are located northeast of the community of Nanty Glo in sub-basin 59. Each was formed using layer piling construction on gently southwestward dipping slopes. The total acid contribution, 151 lb./day, likely discharged mainly by D51, was measured at sampling stations #122 and #122A flanking the west and south sides of the piles. D51 is very rough in character and retains precipitation, consequently increasing percolation and acid discharge.

The feasibility for reclamation of Site P is very good, either through in-place abatement or utilization.

Recommendations

Utilization is recommended.

SITE Q (Pollution Sources D38, D39, D40) - Sub-basin 76 - Coal Mining
Inventory Map 22 of 27.

Site Q contributes an average acid load of 526 lb./day produced by acidic seepage from coal waste banks D38, D39 and D40. This acid load accounts for 0.20 percent of the total acid production within the Blacklick Creek watershed.

Coal mine refuse banks D38, D39 and D40 are located just southwest of the community of Twin Rocks and immediately adjacent to South Branch Blacklick Creek. Their collective pollution contribution was calculated using the sampling results of station #110B and subtracting all acid discharges upstream.

The feasibility for successful reclamation of this site by regrading, covering with impermeable material and planting is good, but utilization is encouraged and could be expected in the future.

Recommendations

Utilization is recommended.

SITE R (Pollution Sources 4878A, 4878B, 4879A, 4879B, 52B)
Sub-basin 75 Coal Mining Inventory Map 13 of 27.

Site R contributes an average acid load of 4,464 lb./day produced by combined acid mine drainage from coal mine refuse in strip mine pit #115 and suspected deep mine discharges of the Vinton No. 16 mine. This acid load accounts for approximately 1.67 percent of the total acid production within the Blacklick Creek watershed.

Site R is situated immediately north and adjacent to Blacklick Creek in sub-basin 75 just northwest of the intersection of Blacklick Creek with PA Route 56. This is the location of the abandoned Vinton Colliery Company's Vinton No. 16 mine which operated from 1918 to 1923 and reportedly developed an area of approximately 140 acres with nearly 286,000 tons of Lower Kittanning coal having been produced. Strip mine #115 (Code #I-1B) borders the southern limits of the Vinton No. 16 mine and is believed to have intersected at least part of these workings. Strip pit #115 though, is almost totally filled with mine waste prohibiting an inspection of the lower highwall for signs of intersections and monitoring of any deep mine discharges. Sampling stations #4878A, #4878B, #4879A, #4879B and #52B established immediately adjacent to Blacklick Creek collected the acid discharges of the combined sources.

The Vinton No. 16 mine is situated near the nose and on the west to northwest dipping limb of the Nolo Anticline. Thus, water in the mine workings is indicated as flowing to the west or northwest. Deep mine discharges are believed to seep through the mine waste material in strip mine #115, but this assumption cannot be supported nor can the pollution contribution from the deep mine source alone be separated

from the mine waste seepage.

The likelihood for successful reclamation of this site is very low. It appears a good deal of the Vinton No. 16 mine workings have been intersected by strip mine #115 making sealing difficult or impossible. Infiltration controls to reduce discharge from the mine waste are conceivable, but an expected reduction in acid cannot be computed with available information nor are such measures recommended at this time because of the potential for utilization. Provided utilization did occur, treatment would likely be necessary to totally eliminate acid discharge from the area because of deep mine discharges.

Recommendations

Utilization of the mine refuse is encouraged.

SITE S (Pollution Sources - Strip Mines #29, #31, #32, #33 and #34) - Sub-basin 22 - Coal Mining Inventory Map 6 of 27.

Site S produces an average acid load of 210 lb./day contributed by seepage from strip mine spoil. This load accounts for 0.08 percent of the total acid production within the confines of the Blacklick Creek watershed.

Site S coincides with sub-basin 22 which lies south of Blacklick Creek between the communities of Josephine and Heshbon and consists of strip mines #29 (Code #I-26), #31 (Code #I-29), #32 (Code #2142), #33 (Code #I-32A) and #34 (Code #I-32A). Sampling stations #29 and #30, on the main tributaries of sub-basin 22, monitored pollution contributions produced by seepage from the spoil of these surface mines. Individual contributions though, could not be determined because of sporadic drainage and the vast extent of stripping. None of the strip pits have been backfilled and the general terrain is very rough. Impoundments are common and aid in increasing percolation through the spoil material. Strip mine #29 is heavily overgrown and has a very good ground cover as well as tree canopy. Surface mines #31, #32, #33 and #34 have moderate tree canopies but little ground cover. Strip mine #29 may have contained a deep mine opening or intersected deep mine workings near the center of the western lobe (likely point of infiltration as discussed in Site B). Strip mine #33 had been heavily deep mined and is more suspect than the other stripped areas. Seepage near the northern tip of strip mine #33 may be related to these underground workings.

The technical feasibility for reclamation of the area with backfilling, grading and planting is good, but costs will be outstanding in relation to amount of pollution actually eliminated.

Recommendations

Reclamation is recommended in strip mines #29, #31, #32, #33, and #34.

Cost Analysis

Strip Mines 29, 31, 32, 33, 34 (381.1 Acres)

Clearing and grubbing: 381.1 Acres @ \$300/Acre	\$114,300
Backfilling and grading: 381.1 Acres @ \$2,000/Acre	\$762,200
Revegetation: 381.1 Acres @ \$750/Acre	\$285,800
Diversion ditch construction: 16,875 L.F. @ \$1.00/L.F.	<u>\$ 16,900</u>
Total for Site S	<u>\$1,179,200</u>

Cost Effectiveness

	<u>Estimated Pollution Abated (lb./day)</u>	<u>Estimated Cost</u>	<u>Cost/lb./day Abatement</u>
Strip mines 29, 31, 32, 33, 34	<u>210</u>	<u>\$1,179,200</u>	<u>\$5,615</u>
<u>Total for Site S</u>	<u>210</u>	<u>\$1,179,200</u>	<u>\$5,615</u>

SITE T Pollution Sources #4853, #4854, #4855 and Strip Mine #79)
Sub-basin 44 - Coal Mining Inventory Maps 14 of 27 and 25 of 27

Site T produces an average acid load of 460 lb./day from combined surface and sub-surface sources in the Lower Kittanning coal. This load accounts for 0.17 percent of the total acid contribution to the Blacklick Creek watershed.

The site is located in sub-basin 44 directly south of the community of Vintondale and consists of acid mine drainage from drift mine discharges monitored by sampling stations #4853, #4854 and #4855 plus seepage associated with strip mine #79 (Code #SC-5) collectively measured just north and downstream at sampling stations #72A, #73, #74 and #74A. The measured deep mine contributions (+114 lb./day) appear negligible in themselves, but may in fact be larger considering the difficulty in sampling experienced in the field.

Very porous spoil material immediately adjacent to the drift mine openings promoted immediate percolation of discharges thus reducing measured flows. Part of the remaining 346 lb./day measured below strip mine #79 then, may be related to these discharges instead of being contributed directly by spoil seepage.

Site T lies along the northwest dipping limb of the Laurel Ridge Anticline indicating that water in the up-dip parts of the deep mine workings will naturally drain via the drift openings. Most of the acid deep mine discharge appears to occur at #4854 where the openings are caved and very obscure. The entries at #4853 and #4855 are still partially open.

The feasibility of constructing hydraulic seals at the drift mine openings is unlikely. The local strip mine highwall conditions indicate that strata adjacent to the openings are too fractured to expect successful sealing results.

Also it is suspected that the deep mine workings have been intersected by the stripping operations or that they lie too closely to the highwall. No mine maps could be found though, to support this assumption. Backfilling and grading of strip mine #79 may reduce some of the acid discharge, but it is not known how much of a reduction could be expected.

Methods to be considered for reclamation include: (1) daylighting of the deep mine workings followed by grading and planting of the entire site or (2) reclamation of the strip mine areas alone.

Recommendations

Reclamation of strip mine #79 is recommended.

Cost Estimates

Strip Mine #79 (53.3 Acres)

Clearing and grubbing: 53.3 Acres @ \$300/Acre	\$ 16,000
Backfilling and grading: 53.3 Acres @ \$2,000/Acre	\$106,600
Revegetation: 53.3 Acres @ \$750/Acre	\$ 40,000
Diversion ditch construction: 4,375 L.F. @ \$1.00/L.F.	<u>\$ 4,400</u>
Total for Site T	<u>\$167,000</u>

Cost Effectiveness

	<u>Estimated Pollution Abated (lb./day)</u>	<u>Estimated Cost</u>	<u>Cost/lb./day Abatement</u>
Strip Mine #79	less than <u>346</u>	<u>\$167,000</u>	<u>\$483</u>
<u>Total for Site T</u>	<u>346</u>	<u>\$167,000</u>	<u>\$483</u>

SITE U (Pollution Source #4542) - Sub-basins 50, 52 and 76 - Coal Mining Inventory Map 25 of 27.

Site U contributes an average acid load of 1,180 lb./day or 0.44 percent of the total acid production within the Blacklick Creek watershed through deep mine discharges measured at sampling station #4542.

The site is located immediately east of the community of Vintondale in Cambria county adjacent to South Branch Blacklick Creek and consists of the Vinton No. 3 deep mine workings and strip mines #99 and #100 (Code #I-41). The Vinton No. 3 mine was opened sometime prior to 1910 by the Vinton Colliery within the Lower Kittanning coal seam. Present operations at the site are within the same deep mine limits and appear to be retreating toward the main openings removing pillars. Strip mine #100 appears to have intersected part of the deep mine workings in the vicinity of old up-dip entries to the mine. Strip mine #97 borders the southern edge of the deep mine and with available information does not appear to have intersected the workings. A drift mine opening though, near the center of strip mine #97, may be connected with upper portions of the Vinton No. 3 mine. Strip mine #99 overlies the deep mine workings within the Lower Freeport coal and may serve as a point of increased infiltration for surface waters into the underground mine.

The Vinton No. 3 mine workings lie along the northwest dipping limb of the Laurel Ridge Anticline indicating water within the mine will flow down-dip toward sampling point #4542. Strip mines #97 and #100 lie fundamentally up-dip of the underground workings, but because of their orientation directly along the dip and their unconfined drainage are not likely sites of increased surface water infiltration.

The feasibility of sealing the Vinton No. 3 mine openings after operations cease seems unlikely considering the proximity of mining in relation to outcrops and the strip mine #97 highwall. Reclamation of strip mine #99 by backfilling, grading, planting and surface water diversion may lessen infiltration of runoff to the underground workings and consequently reduce discharge. Approximately 24 acres of drainage is intercepted by strip mine #99. Assuming ten percent of

the average annual rainfall of 43 inches that is normally runoff infiltrates into the deep mine workings and an average total acidity of 879 mg/l, a maximum reduction in acid load of 57 lb./day may be expected with abatement. Because strip mine #99 is very heavily overgrown, this figure may be in excess and reclamation may not significantly change infiltration conditions. Any further reduction in acid discharge would require treatment.

Recommendations

Reclamation of strip mine #99 is recommended as an infiltration control.

Cost Estimates

Strip Mine #99 (12.9 Acres)

Clearing and grubbing: 12.9 Acres @ \$300/Acre	\$ 3,900
Backfilling and grading: 12.9 Acres @ \$2,000/Acre	\$25,800
Revegetation: 12.9 Acres @ \$750/Acre	\$ 9,700
Diversion ditch construction: 2,000 L.F. @ \$1.00/L.F.	<u>\$ 2,000</u>
Total for Site U	<u>\$41,400</u>

Cost Effectiveness

	Estimated Pollution Abated (lb./day)	<u>Estimated Cost</u>	<u>Cost/lb./day Abatement</u>
Strip Mine #99	<u>57</u>	<u>\$41,400</u>	<u>\$726</u>
<u>Total for Site U</u>	<u>57</u>	<u>\$41,400</u>	<u>\$726</u>

SITE V (Pollution Sources #32C and additional discharge picked up at Sampling Station #32) - Sub-basins 16 and 21 - Coal Mining Inventory Map 9 of 27

Site V produces an average acid load of 2,039 lb./day contributed by discharges from deep mine workings monitored by sampling station #32 C with an additional discharge picked up at sampling station #32 which is assumed related to the same mine source. This pollution

contribution accounts for 0.76 percent of the total acid produced within the Blacklick Creek watershed.

The site is situated directly east of the community of Coral and south of Luciusboro in Indiana County and lies north of Blacklick Creek mainly in Center Township. This is the location of an abandoned deep mine in the Lower Kittanning coal which was at least in part operated by the Crichton Coal and Coke Company. Mining, with available information, appears to have occurred mainly from 1959-1967 and had been originally initiated by a farmer as a country bank. Sampling station #32C of sub-basin 21 monitored a discharge from the area of the four main drift entries on the northwest end of strip mine #26, originally believed to be the only discharge point for the mine workings. However, a large acid load, unaccounted for between sampling stations #32 and #33, prompted a much more detailed investigation of the area. Another discharge was found approximately 800 feet to the immediate south of sampling station #32C and is assumed to be of the same source. Four other drift mine entries are located up-dip of these discharge points driven from the northeast end of strip mine #20 (Code #I-15). Much of the local surface drainage from this immediate vicinity was observed flowing directly into these openings. Strip mines #21, #22 and #23 (Code #681 and #913), located north of sampling station #32C, overlie the deep mine workings. Above normal infiltration of surface waters into the deep mine workings likely occurs to varying degrees because of these strip mines, but portions of the mines are either still active and should be satisfactorily reclaimed or have been recently reclaimed and are just establishing vegetative covers.

The deep mine workings are located along the axis of the Chestnut Ridge Anticline dipping both to the northwest and northeast with waters in the mine flowing accordingly. The area near the drift openings monitored by sampling station #32C appears to drain the mine indicating the deep mine workings may be approximately 70 percent flooded already.

Constructing hydraulic seals at the drift mine openings on the northwest tip of strip mine #26 appears highly feasible. Ideally, this could result in total flooding of the mine workings with subsequent complete elimination of acid discharge. To achieve total flooding though, a head of approximately 67 feet on the seals would be necessary. Judging by the successfulness of prior mine sealing projects, such a head may not be possible. In fact, the suitability for any sealing measures needs to be determined by an exploratory drilling program or visual inspection, but partial flooding of the deep mine workings appears promising. With reference to recent mine maps, the deep mine workings appear to have been kept sufficiently far from coal outcrops to allow sealing and strip mining has not intersected the underground workings nor approached too closely. Also, sufficient ground cover exists near boreholes or weak roof areas to maintain control over discharges from such locations. It appears possible that seals may be constructed at the drift openings in conjunction with an emergency dewatering system and a borehole or

other outlet to control the flood pool level. Attaining a head of thirty feet above the mine seals would flood approximately 80 percent of the remaining mine void with an expected reduction in acid load of 1,631 lb./day. A borehole could easily be established in the local vicinity to maintain this pool level at a discharge elevation of approximately 1,490 feet.

Many methods to control the inflow at the drift mine openings in strip mine #20 are possible. Approximately 21 acres of surface drainage area are intercepted by the eastern tip of the strip mine which channels water into the deep mine openings. Assuming 30 percent of the average annual precipitation of 48 inches that would normally be runoff is directed into the deep mine and using an average total acidity of 194 mg/l, a reduction in acid load of up to 36 lb./day could be expected eliminating this flow. Methods to be considered to reduce this inflow include: (1) dry seals at the drift openings (clay or masonry) (2) collapsing of the openings and backfilling of the surface mine area or (3) rechannelization of surface drainage alone (surface water diversion should be used along with first two methods).

Additional reduction in acid load contribution will require treatment.

Recommendations

Installation of hydraulic mine seals at the lower drift openings and a control to maintain a maximum head of 30 feet are recommended in addition to clay barriers along the eastern end of strip mine #20 with backfilling and surface water diversion.

Cost Estimates

Drift mine openings on northwest tip of strip mine #26

4 grouted double bulkhead hydraulic mine seals including 100 L.F. of grout curtain/seal @ \$30,000	<u>\$120,000</u>
Total for drift mine seals	\$120,000

Infiltration controls on east end of Strip Mine #20 (15.6 Acres)

Excavation to expose coal seam: 3,400 C.Y. @ \$1.50/C.Y.	\$ 5,100
Clay sealing: 900 L.F. @ \$4.15/L.F.	\$ 3,700

Backfilling and grading: 15.6 Acres @ \$2,000/Acre	\$31,200
Revegetation: 15.6 Acres @ \$750/Acre	\$11,700
Diversion ditch construction: 3,250 L.F. @ \$1.00/L.F.	<u>\$ 3,300</u>
Total for Strip Mine #20	\$55,000
Total for Site V	<u>\$175,000</u>

Cost Effectiveness

	Estimated Pollution Abated (lb./day)	Estimated Cost	Cost/lb./day Abatement
Drift Mine Seals	1,631	\$120,000	\$74
Strip Mine #20	<u>36</u>	<u>\$ 55,000</u>	\$1,528
<u>Total for Site V</u>	<u>1,667</u>	<u>\$175,000</u>	<u>\$105</u>

SITE W (Pollution Source #4889) - Sub-basin 75 - Coal Mining Inventory
Map 12 of 27.

Site W produces an average acid contribution of 239 lb./day supplied by acid mine drainage from drift opening #4889. This acid load accounts for 0.09 percent of the total acid production within the watershed.

The site lies along the north side of Blacklick Creek just northeast of the community of Heshbon and consists of mine workings known as either the Caldwell No. 2 or Superior No. 1 mines. Workings began as the Caldwell No. 2 mine of the Caldwell Smokeless Coal Company and operated from 1917 to 1921 producing about 37,000 tons of Lower Kittanning coal. Historical data between 1921 and 1941 is not clear, but from 1941 to 1951 the mine was operated as a Superior No. 1 mine of the Superior Smokeless Coal Company producing approximately 229,000 tons of coal. Five drift mine openings are known to exist along the southeast end of the mine, most of which are collapsed. Mine discharges were monitored at sampling station #4889, the furthest down-dip entry of the mine.

Site W is situated at the nose of the Brush Valley Syncline with the local dip being directly to the north and water within the mine workings flowing accordingly. Four drift mine entries are located up-dip of collapsed drift opening #4889 which appears to drain the mine.

The feasibility of successfully constructing hydraulic seals at mine openings of the Superior No. 1 mine seems highly unlikely. Underground workings have advanced too closely to coal outcrops along much of the southeastern portion of the mine and sealing appears to be inconceivable considering existing technology. Treatment then, may be the only means of abating this pollution.

Recommendations

None.

SITE X (Pollution Source #4922) - Sub-basin 21 - Coal Mining Inventory Maps 7 of 27 and 9 of 27.

Site X produces an average acid load of 676 lb./day and consists of abandoned deep mine workings which discharge at sampling station #4922. This contribution is 0.25 percent of the total acid production within the watershed.

The site is located immediately east and northeast of the community of Luciusboro in Center Township of Indiana County and consists of the abandoned Luciusboro Mine workings in the Upper Freeport coal of the Rochester and Pittsburgh Coal Company. Discharges of this mine occur at the northernmost drift entry of two situated in sub-basin 21 just north of strip mine #23, monitored as sampling station #4922. Seven other drift mine openings are located up-dip of this discharge point in sub-basin 16. Three entries lie immediately west of Luciusboro and the remaining four are located approximately a mile to the northeast.

The Luciusboro Mine workings are located along the axis of the Chestnut Ridge Anticline indicating local water flow within the mine is to the northwest and southeast. It is likely the western portion of the workings across the axis is totally flooded and nearly 50 percent of the remaining mine area to the east is flooded with discharges occurring at the lowest drift mine opening or #4922.

Successfully installing hydraulic seals to further flood the mine workings seems conceivable, but exploratory drilling would be necessary to support this assumption. It appears that four hydraulic mine seals, established at the two drift mine openings immediately north of strip mine #23 and the two eastern openings of the four on the north end of the mine, would flood all but approximately ten percent of the remaining mine workings. A head of approximately 80 feet on the lower seals would be necessary to achieve this amount of flooding, and discharge would occur at an elevation of 1,630 feet at either the remaining northern drift mines location or near Luciusboro. Provided such a head could be maintained, a reduction in acid load of approximately 608 lb./day could be expected. A lesser head of approximately 30 feet though, is more feasible considering present technology. Sealing the lowermost two drift openings near 4922 and allowing discharge to occur at the drift openings on the northeastern end of the mine would create a head of approximately 30

feet. This would flood 50 percent of the remaining mine void with a respective acid reduction of 338 lb./day. Additional reduction in acid load would require treatment.

Recommendations

Partial flooding of the mine workings is recommended by installing hydraulic seals at the two lowermost drift openings pending successful results of an exploratory boring program.

Cost Estimates

Drift mine openings immediately north of strip mine #23

2 grouted double bulkhead hydraulic mine seals including 100 L.F. of grout curtain/seal @ \$30,000	<u>\$60,000</u>
Total for Site X	<u>\$60,000</u>

Cost Effectiveness

	<u>Estimated Pollution Abated (lb./day)</u>	<u>Estimated Cost</u>	<u>Cost/lb./day Abatement</u>
Drift mine entries	<u>338</u>	<u>\$60,000</u>	<u>\$178</u>
<u>Total for Site X</u>	<u>338</u>	<u>\$60,000</u>	<u>\$178</u>

SITE Y (Pollution Source - Strip Mine #97) - Sub-basin 50 - Coal Mining Inventory Map 25 of 27.

Site Y contributes an average acid load of 292 lb./day generated by the spoil of abandoned strip mine #97. This acid load accounts for 0.11 percent of the total acid production within the watershed.

The source area is located mainly in sub-basin 50 just southeast of the community of Vintondale and consists of strip mine #97 (Code #I-38). Pollution from this source was monitored at the mouth of the sub-basin at sampling station #107. The strip mine was not backfilled and terrain is fairly rough slowing down runoff. Approximately 50 percent of the area is vegetated with small trees and some grasses. Runoff from above the highwall and from spoil sloping toward the highwall is channeled along its base and flows

northwestward emptying into Bracken Run or sub-basin 50. A drift mine entry lies near the center of the strip mine, but no discharge was observed.

Reclamation of strip mine #97 by backfilling and grading with planting and surface water diversion is technically highly feasible.

Recommendations

Reclamation of strip mine #97 is recommended.

Cost Estimates

Strip Mine #97 (44.1 Acres)

Clearing and grubbing: 44.1 Acres @ \$300/Acre	\$13,200
Backfilling and grading: 44.1 Acres @ \$2,000/Acre	\$88,200
Revegetation: 44.1 Acres @ \$750/Acre	\$33,100
Diversion ditch construction: 7,500 L.F. @ \$1.00/L.F.	<u>\$ 7,500</u>
Total for Site Y	<u>\$142,000</u>

Cost Effectiveness

	Estimated Pollution Abated (lb./day)	<u>Estimated Cost</u>	<u>Cost/lb./day Abatement</u>
Strip Mine #97	<u>292</u>	<u>\$142,000</u>	<u>\$486</u>
<u>Total for Site Y</u>	<u>292</u>	<u>\$142,000</u>	<u>\$486</u>

SITE Z (Pollution Source - Commercial No. 2 mine) - Sub-basins 54, 56 and 76 - Coal Mining Inventory Maps 22 of 27 and 23 of 27.

Site Z produces an estimated average acid load of 279 lb./day through deep mine discharges in sub-basins 54 and 56. This contribution accounts for 0.10 percent of the total acid production within the Blacklick Creek watershed.

The site is located between the communities of Twin Rocks and Cardiff just north of South Branch Blacklick Creek in Cambria County. The source area consists of: the abandoned deep mine workings of the Blacklick No. 2 mine more recently known as the Commercial Coal Mining Company's Commercial No. 2; the Cardiff No. 6 mine; and strip mines #105, #106 and #107.

The Commercial No. 2 mine workings within the Lower Kittanning coal were initiated prior to 1910 and were worked out some time before 1920. The Cardiff No. 6 mine of the Warren Collieries, located immediately west of Cardiff, is linked with the No. 2 mine and operated at about the same time. Strip mines #105 and #106 (Code #I-32) appear to have intersected a portion of the underground workings destroying three openings to the Commercial NO. 2 mine. Strip mine #107 lies along the southern coal outcrop and also appears to have partially intersected the deep mine, but is not considered a significant area for increased infiltration.

The workings of the Commercial No. 2 mine are situated on the northwest dipping limb of the Laurel Ridge Anticline indicating water within the mine will flow accordingly. Discharges occur at two locations on the down-dip end of the mine. An obscure drainage point is located between strip mines #105 and #106 and is likely the location of one of the original drift entries. An obvious drift mine discharge is located further to the east where a pipe drains the now caved entry forming an apparent air seal. A third discharge occurs at what appears to be a subsidence area near the northeast tip of strip mine #107 in sub-basin 56. Though the overall drainage is to the northwest, it appears at least a portion of the extreme southern deep mined area may be discharging at this point.

The feasibility of successfully abating pollution associated with this source area through flooding seems minimal considering local conditions. A considerable down-dip portion of the Commercial No. 2 mine workings has been intersected in the area of strip mines #105 and #106, and what is considered as subsidence along the outcrop had been noted in the region between the strip mines and the community of Cardiff. Treatment maybe the only means of abating pollution at this site.

Recommendations

None.

SITE AA Pollution Sources #53A and #4866) - Sub-basins 32 and 75 – Coal Mining Inventory Map 13 of 27.

Site AA contributes a minimum average acid load of 551 lb./day produced by combined surface and sub-surface sources. This discharge is 0.21 percent of the total amount of acid produced within the watershed.

The site is located immediately north of Blacklick Creek just east of route 56 at Dias and consists of: strip mines #59 (Code #I-4), #60, #61 and #116; the deep mine workings of the abandoned Caldwell No. 1 mine; and a deep mine located immediately to the northeast of the Caldwell mine workings.

The Caldwell No. 1 mine was operated from 1917 to 1930 by the Caldwell Smokeless Coal Company mining approximately 70 acres and producing 247,000 tons of Lower Kittanning coal. Much of the Lower Kittanning coal bordering this mine was later stripped (strip mine #59) seemingly intersecting a good length of the northwestern edge of the Caldwell deep mine workings. Another deep mine operation was initiated from the mid-northern end of strip mine #59 and may be connected with the Caldwell mine workings, but little is known about this operation. Strip mines #60, #61 and #116 (within the Lower Freeport coal) overlie the Caldwell workings and may serve as points of increased infiltration for surface waters into the deep mine.

Discharges of Site AA were monitored primarily by sampling stations #53A in sub-basin 32 and station #4866 of sub-basin 75. These sampling stations are situated at the base of strip mine #59 and measure acid contributions which are assumed to be combined products of seepage from the strip mine spoil and discharges of the intersected deep mine workings.

The site is located along the structural axis of the Nolo Anticline indicating waters within the underground workings will flow toward the west and southwest. Strip mine #59 lies fundamentally down-dip of the deep mine workings and appears to have intersected much of the west and northwest limits of the Caldwell No. 1 mine. Most of the discharge of the Caldwell No. 1, plus seepage from strip mine #59 increased by impounded surface waters along the highwall, occurs at the extreme lower western end of the strip mine.

Little potential exists for sealing of the Caldwell No. 1 mine workings with present day technology considering that much of the western end has been intersected by stripping operations. It is possible that seepage associated with the spoil of unreclaimed strip mine #59 could be eliminated by appropriate measures, but action at this time may be impractical. The Oneida Mining Company, which is presently operating a deep mine immediately north of the site, has constructed a coal conveyor system along the entire western length of strip mine #59 on the spoil crest to transport coal to storage silos located near sampling station #4866. Controls could be implemented at strip mines #60, #61 and #116 to reduce other than normal infiltration of surface waters into the deep mine workings. It appears though, that strip mine #59 which is the largest and most significant of the three may be used as a site for coal waste disposal and surface mines #60 and #116 are insignificant alone considering their vegetative covers.

Recommendations

None.

MISCELLANEOUS SOURCES

The following are pollution sources which independently produced less than 150 lb./day and contributed insignificantly to stream degradation in the watershed. No recommendations for abatement at these locations is given because of their relative insignificance to water quality in the watershed. These sources are listed with respect to sampling stations involved or other applicable reference:

#4906 - Sub-basin 11 - 144 lb./day - drift mine or simple drainway which appears to keep drift openings #4911 through #4914 (immediately to west of 4906) drained - all openings collapsed and many sunken areas in the vicinity - mining within the Pittsburgh coal - Coal Mining Inventory Map 5 of 27.

Strip mines #18 and #20 - Sub-basin 21 - 132 lb./day - seepage from spoil and some deep mine waste in strip mine #18 (38 lb./day) - seepage related to strip mine #20 (94 lb./day) in part believed produced by waste of present sanitary landfill - Lower Kittanning coal - Coal Mining Inventory Map 6 of 27.

#4835 - Sub-basin 30 - 113 lb./day - drift mine discharge - Pittsburgh coal - Coal Mining Inventory Map 7 of 27.

#4794 - Sub-basin 76 - 111 lb./day - 3 drift mine openings - Lower Kittanning coal - Coal Mining Inventory Map 25 of 27.

#4797 - Sub-basin 52 - 98 lb./day - 2 drift mine openings which likely drain immediate deep mine workings to the southwest - area all around and overlying workings has been stripped - Lower Kittanning coal - Coal Mining Inventory Map 25 of 27.

#4863 and #4863A Sub-basin 32 - 90 lb./day - seepage from spoil of strip mine #57 plus seepage from mine waste in same vicinity - Lower Kittanning coal - Coal Mining Inventory Map 13 of 27.

#4910 - Sub-basin 6 - 87 lb./day - drift mine discharge which may be partially fed by infiltration in strip mine #1 Pittsburgh coal - Coal Mining Inventory Map 4 of 27.

#4773 - Sub-basin 8 - 85 lb./day - 2 drift mine openings - Pittsburgh coal - Coal Mining Inventory Map 5 of 27.

#78 - Sub-basin 48 - 81 lb./day - natural acidity - Coal Mining Inventory Map 22 of 27.

#4772 - Sub-basin 8 - 80 lb./day - drift mine - Pittsburgh coal - Coal Mining Inventory Map 5 of 27.

#126 - Sub-basin 63 - 78 lb./day - natural acidity - Coal Mining Inventory Maps 23 and 26 of 27.

#24A - Sub-basin 18 - 75 lb./day - 2 drift mine openings - flow may be partially charged by infiltration at strip mine #12 to the southeast - Upper Freeport coal - Coal Mining Inventory Map 5 of 27.

#4866A - Sub-basin 75 - 60 lb./day - drift mine - Brookville coal - Coal Mining Inventory Map 13 of 27.

#54 - Sub-basin 33 - 56 lb./day - drift mine discharges #4875 and #4877 plus additional unseen seepage in the sub-basin (strip mine or mine waste seepage) - Lower Kittanning coal - Coal Mining Inventory Map 13 of 27.

Strip mines #35 and #36 - Sub-basin 24 - 54 lb./day - seepage from spoil - stream runs through strip mine #36 - Upper and Lower Freeport and Lower Kittanning coal - Coal Mining Inventory Map 12 of 27.

#4902 - Sub-basin 11 - 50 lb./day - combination drift and strip mine discharge - Pittsburgh coal - Coal Mining Inventory Map 5 of 27.

#4903 - Sub-basin 11 - 47 lb./day - drift mine discharge - Pittsburgh coal - Coal Mining Inventory Map 5 of 27.

#4750 - Sub-basin 76 - 45 lb./day - 2 drift mine openings - Lower Kittanning coal - Coal Mining Inventory Map 25 of 27.

#4774 - Sub-basin 9 - 44 lb./day - drift mine discharge - Pittsburgh coal - Coal Mining Inventory Map 5 of 27.

#106 - Sub-basin 49 - 44 lb./day - natural acidity - Coal Mining Inventory Map 25 of 27.

#5019 - Sub-basin 19 - 37 lb./day - drift mine discharge - Lower Kittanning coal - Coal Mining Inventory Map 6 of 27.

#4905 - Sub-basin 11 - 28 lb./day - drift mine discharge - may drain immediate deep mine workings to the north - Pittsburgh coal - Coal Mining Inventory Map 5 of 27.

Strip mine #122 - Sub-basin 48A - 24 lb./day - seepage from spoil - Lower Freeport - Coal Mining Inventory Map 23 of 27.

Strip mines #102 and #103 - Sub-basin 53 - 22 lb./day - seepage from spoil - Lower Kittanning coal - Coal Mining Inventory Map 22 of 27.

#79 - Sub-basin 48 - 19 lb./day - natural acidity - Coal Mining Inventory Map 22 of 27.

#13A - Sub-basin 9 - 11 lb./day - 2 drift mine openings - Pittsburgh coal - Coal Mining Inventory Map 5 of 27.

#4800 - Sub-basin 8 - 11 lb./day - 2 drift mine openings - Pittsburgh coal - Coal Mining Inventory Map 3 of 27.

#47 - Sub-basin 29 - 10 lb./day - natural acidity - Coal Mining Inventory Map 12 of 27.

#5043A - Sub-basin 76 - 10 lb./day - seepage from small mine waste piles southeast of community of Nanty Glo - Coal Mining Inventory Map 26 of 27.

#4900 - Sub-basin 13 - 5 lb./day - 3 drift mine openings - Upper Freeport coal - Coal Mining Inventory Map 6 of 27.