CLEARFIELD CREEK WATERSHED

ABATEMENT AREA K
NORTH OF UPPER MORGAN RUN

Location

These three small strip mines, #'s 32, 33, and 34, are located just north of Upper Morgan Run in the headwaters of three small tributaries to that stream, identified by sample stations 33.14, 37.14, and 40.13. The strips lie about 1 mile south of the town of Sanbourn, in Woodward Township, and have a combined area of 76 acres. The strip mines are the sole sources of acid to their respective tributaries.

Geology

Both strip mines #33 and 34 lie structurally just northwest of the axis of the Laurel Hill Anticline while strip #32 lies roughly on the anticlinal axis. The Lower Mercer clay of the Pottsville Group and the Clarion-Brookville, Lower and Middle Kittanning Coals of the Allegheny Group outcrop in the vicinity of these strip mines. The unfaulted strata here dip about 1° to the northwest in strip mine #33 and about 1° to the southwest in strip mine #34. A local northwest trending trough passes directly through strip mine #32, causing much local variation in the dip of the strata.

Mining

All three strip mines here are relatively small, generally consisting of only a few short cuts. The only deep cut in any of these mines is the one in strip mine #32, which presently contains a large pond. The primary objective of these stripping operations was the recovery of the Lower Mercer clays, which were up to three feet thick in the area. Some Clarion-Brookville "A" coal was also mined and has a thickness of one foot. Strip mines #32 and 34 removed both the clay and the coal while strip mine #33 was apparently limited to the clay.

Mine Drainage and Hydrology

The natural hydrologic systems in the vicinities of these small strip mines have been greatly altered by the mining activity. Strip mine #34, at sample station 33.15, is totally unreclaimed. and unvegetated spoil piles lie both above and be low the cut. Runoff from the adjacent hillside has been increased by the logging off of much of the vegetative cover. The runoff seeps through the acid spoil piled above the highwall and into the strip cut. The northern end of the cut contains a fairly large pond, and seepage from this combines with all other water entering the cut. The water flows over and through the acid producing spoil in the floor of the cut and exits from the southern end of the stripping, where the water sample was taken.

Strip mine #33, upstream from station 40.13, has already been partially reclaimed. The western half of that strip has been regraded, but is not vegetated, while the eastern half is completely unreclaimed. Runoff is trapped in numerous ponds in the unreclaimed portion of the mine, and seeps through the acid spoil material before exiting the area.

Strip mine #32 consists of a relatively deep, short, open strip cut that presently contains a large, acid pond. Runoff enters the mine from the surrounding vicinity and some water apparently seeps into the strip through the coal face. Prolonged contact with the acid clay and coal spoil material renders the water in this pond acid. The water exits the pond through a surface discharge.

Water Quality

The discharge from strip mine #34 was sampled only once during Skelly and Loy's Pilot Program, during an extremely dry period late in September. The acid load was adjusted to represent a yearly average and indicated nearly 2,900 lbs/ day acid emanating from this strip mine. Much of this acid was neutralized by alkaline water within the tributary, as the mouth of that stream, at Upper Morgan Run, revealed an adjusted acid load of only 169 lbs/day.

The acid discharging from strip mine #33 was sampled only at the mouth of the tributary, at sample station 40.13. This sample revealed an adjusted acid load of 900 lbs/day, all of which is attributed to the abatement area, the only strip mine along that tributary.

Strip mine #32 was sampled at two points, at the mouth of the polluted tributary and at a point of discharge directly into Wolf Run. These two stations, 37.14 and 37.13 respectively, showed an adjusted acid load of 250 lbs/day. This raised the total acid mine drainage load emanating from these three strip mines to 4045 lbs/day.

Recommended Abatement

Improvement of the local drainage networks in these strip mines will promote natural runoff, establish a good vegetative cover, eliminate seepage through acid producing spoil, provide drainage diversion ditches and channels to pass surface flow across and around strip mines, and generally raise the quality of the water exiting the area.

Surface restoration should be designed to fulfill the requirements of each strip mine. Limestone surface treatment will be applied to the acid spoil where needed. All regraded surfaces should be treated to obtain proper pH, fertilized, and seeded with grasses, trees, and legumes. Drainage ditches should be constructed above highwalls to collect and channel discharges directly to receiving streams, thereby minimizing contact with the acid spoil material. These steps should abate roughly 50% of the acid discharging from each strip mine.

North of Upper Morgan Run Mine Drainage Data

SAMPLE			ACID LOAD	
Station #	Description	Strip Mine #	Unadjusted	Adjusted
37.14	trib with acid seepage	32	14	82
37.13	seepage from	32	28	164
40.13	seepage from	33	155	900
33.15	seepage from	34	288	2900

Estimated Construction Cost

Strip Mine #32

Drain pond, backfill, regrade, fertilize, revegetate, and construct diversion ditches as required.

14 Ac @ $2600/ Ac = $36,400

Strip Mine #33

Drain pond, backfill, regrade, fertilize, revegetate, and construct divers ion ditches.

13 Ac @ $2600/ Ac = $33,800

Revegetate previously reclaimed stripping.

19 Ac @ $400/Ac = $7,600

Strip Mine #34

Backfill, regrade, fertilize, revegetate and construct diversion ditches.

30 Ac @ $2600/ Ac = $78,000

Total Estimated Cost, Abatement Area K = $155,800
Call: $156,000

Cost Effectiveness

Strip Mine #32

$36,400 per 125 lbs/day acid = $291 per lb/day acid abated

Strip M in e #33

$41 ,400 per 458 lbs/day acid = $90 per lb/day acid abated

Strip Mine #34

$78,780 per 1440 lbs/day acid = $54 per lb/day acid abated

Overall Cost Effectiveness

$156,000 per 2000 lbs/day acid = $78 per lb/day acid abated

CLEARFIELD CREEK WATERSHED

ABATEMENT AREA L
LOST RUN
(INCLUDED IN INTERIM REPORT II)

Location

Abatement Area L, which was discussed in Interim Report II as Abatement Area No.2, is situated in the headwaters of Lost Run four miles northwest of Madera, Pennsylvania in the Clearfield Creek Watershed. This area is in Knox Township, Clearfield County, Pennsylvania.

The abatement area is a 245 acre "U"-shaped strip mine that intercepts a large amount of surface flow and discharges large quantities of acid to Lost Run.

Geology

This abatement area is structurally situated in a small basin near the crest of the Laurel Hill Anticline. Rocks of the Allegheny Group from the Clarion-Brookville Coal through the Upper Kittanning Coal dip gently from 1/2° to 3° eastward in the abatement area. No large scale faulting is present within this area.

Mining

There has been extensive strip mining in the area, but

there is no physical evidence of any deep mining. Local strip mine operators and other sources of deep mine information are unaware of any deep mining in the area. All Allegheny Group coal seams below the Upper Kittanning, or "C"', have been extensively stripped with little reclamation. Backfilling and spoil pile regrading are minimal, and most of the area is unvegetated. Highwalls are exposed and stream valleys are filled with strip mine spoil.

The "A" and" B" coal seam strippings and associated bony account for most of the acid production in the abatement area.

Presently, J. W. Hess (Engineer) in Clearfield, Pennsylvania, is applying for a strip mine permit that includes a small northeastern portion of the abatement area. Discussions with the mine operator relative to his proposed stripping and subsequent reclamation reveal that his work will not be affected by nor will it affect reclamation by the Pennsylvania Department of Environmental Resources should this permit be granted.

Mine Drainage and Hydrology

The natural hydrologic system of the Lost Run area was extensively altered by the strip mining. No reclamation work was done, and both stream valleys in the area were left filled with spoil. The

stripping occupies 245 acres or 12% of the 2,023 acre Lost Run Watershed. However, it collects and temporarily retains 33% of all runoff in the watershed. The runoff collects in several large ponds that have pH's in the 3.0 - 3.5 range. Water then seeps downward through the highly acid spoil material to the impermeable "A" seam underclay, then laterally along the underclay to the limits of the strip area. This extended contact with the acid "A" and "B" spoil renders the water extremely acid. Kill areas have formed and erosion has increased at points where this acid water seeps out of the spoil material. There are also some surface discharges from ponded areas.

Water Quality

Stream quality data was obtained from five different sources, all of which established the Lost Run abatement area as a major source of pollution to the Lost Run Watershed. The accumulated data revealed low pH's and high acid loads for all water flowing from the area.

The oldest data was obtained from a water quality and mine drainage study conducted by the EPA between 1964 and 1967. EPA measurements at the mouth of Lost Run, monitored on five separate occasions, revealed that Lost Run was contributing an unadjusted average of 7,700 lbs/day acid to Clearfield Creek.

One EPA water sample, at station 28.1, monitoring only the abatement area, showed an acid load of 3,600 lbs/day, which comprised 95% of the 3,800 lbs/day acid load measured at the mouth of Lost Run on that same day. This value, together with Skelly and Loy's sample data, discussed below, indicated that the abatement area is at all times contributing at least 80% of the total acid load of Lost Run.

The following water quality data are from sampling runs made under widely varying flow conditions between June and November, 1972. The modular system of study used was designed to give the best possible results for a large number of widely scattered samples in a minimal amount of time. Weirs and surveyed stream cross sections were not used; but average widths, depths and flow velocities were measured as accurately as possible. From this data stream channel cross sectional areas, flows in cfs, and stream loadings were computed.

The first modular sample run was designed to point to areas that would require further study. For this reason, only the mouth of Lost Run was sampled. This sample run was made shortly after the flooding caused by tropical storm Agnes, when stream flows were still extremely high. At that time, Lost Run was contributing 15,200 lbs/day acid to Clearfield Creek. Approximately 80% of this amount, or 12,200 lbs/day acid, can be attributed to the abatement area. It accounts for 5%

of the total acid load appearing at the mouth of Clearfield Creek. This abnormally high value gives a good picture of the effects of extreme high flow and the flushing of AMD within the area.

The second modular sampling run, in early July, was an expanded version of the first modular run, covering selected portions of the entire watershed with the purpose of further isolating major mine drainage pollution sources. Streams were still at above-average mid-summer flows. The two headwater tributaries of Lost Run, which carry most of the mine drainage from the abatement area, were sampled. At this time the abatement area was contributing an unadjusted 4,500 lbs/day acid (12,150 adjusted) to Lost Run, considerably more than 80% of the total acid load of Lost Run at the mouth, and roughly 6% of the total acid load at the mouth of Clearfield Creek.

The third sample run was directed specifically at locating and measuring the major pollution sources within this hot module. This was accomplished by walking all streams within the module and sampling every measurable pollution source originating in this area. This was performed in mid-October under fairly normal fall (low flow) water conditions. Samples were again taken at the mouths of the two Lost Run tributaries in the abatement area. This data revealed an acid load of 4,000 lbs/day unadjusted and 10,400 lbs/day adjusted. The sum of all of

the pollution sources sampled in the abatement area was somewhat higher, totaling 5,600 lbs/day acid (14,560 unadjusted), and comprising 8% of the total load at the mouth of Clearfield Creek.

A fourth series of samples, taken in the abatement area in late October, showed an unadjusted 5,400 lbs/day (14,000 adjusted) acid discharging from the pollution sources, while the mouths of the two tributaries in the abatement area indicated a somewhat lower total 4,100 lbs/day acid (unadjusted) and 10,660 lbs/day adjusted.

In addition to the measured stream loading, it was felt that the slugging effect of the 8.5 acres of bony roads leading to and within the strip mine should be analyzed. Direct rainfall and runoff, after only a short reaction time with the bony, is degraded to pH's in the 1.8 - 2.3 range with acidities as high as 3,350 ppm. In order to evaluate the acid contribution of this bony material, a "bony pile constant, " was developed from the following equation:

43,560 ft^2/A **X** 41 in./yr. **X** ft./12 in. **X** yr./365 days **X** day/24 hrs. **X** min./60 sec. = 0.00472 cfs/acre

Bony pile loading values we re computed for the bony roads in the area using the following equations:

Bony Pile Constant (0.00472 cfs/acre) X Area of Bony Roadway (8.5 acres) X Acidity (3,350 ppm) X 5.39 = Average Acid Load (724 lbs/day).

The acidity (ppm) of the bony was obtained from an analysis of a water sample taken directly from the bony on a rainy day.

This method of bony pile acid load computation indicates the 8.5 acres of bony roads produce an approximate average of 724 lbs/day acid.

There is, also, a large amount of bony material scattered about the surface of the mine spoil that is responsible for a large portion of the acid discharged from this area.

The Lost Run abatement area averages 4,500 lbs/day acid unadjusted and an adjusted 11,700 lbs/day acid at the source. This is based on the average of an loadings presented above, with the exception of the post-Agnes value. This, of course, represents an extreme case and was not included with the average. Flow measurement and sampling at the mouth of Lost Run from July to December 1972 indicated Lost Run contributes an unadjusted yearly average acid load of 3,530 lbs/day and an adjusted yearly average load of 9,600 lbs/day to Clearfield Creek. The acid produced within this abatement area comprises an average of 7% of the total load measured at the mouth of Clearfield Creek.

Recommended Abatement

The abatement plan for Abatement Area L concerns two related items: the bony roads and the strip mines. The plan involves the improvement of the Lost Run Watershed drainage network to promote natural runoff. This will be accomplished by eliminating seepage through the spoil material, thus raising the quality of the water exiting from the area.

The first portion of the abatement plan requires the removal of all highly acidic bony material, particularly the bony roads, and burial in a pre-selected bony disposal pit within the area. This bony material would then be covered by the less acidic strip mine spoil, graded and planted in a manner that would effectively eliminate acid production by the bony.

Following the disposal of the bony, the 245 acres of strip mine within the Lost Run abatement area would be regraded and receive surface restoration to achieve the following results:

1. Increase runoff from strip mines.
2. Restore surface sufficiently to establish good vegetative cover.
3. Provide drainage diversion ditches and reconstruct surface channel areas to pass surface flow across and around strip mines, thereby minimizing seepage through strip mine spoil materials.

Contour, swale and terrace backfilling will be used as appropriate to decrease the permeability of the mine surface and effect quick runoff from the mine.

Surface restoration should be suited to the requirements of each particular portion of the abatement area. Limestone surface

treatment is recommended for the "A" and "B" seam stripping because of associated high acidities. All regraded strip mine surfaces should be treated to obtain proper pH, then fertilized and seeded with grasses and legumes. Trees should be planted with the grasses where slope stability may be a problem on steep bank areas.

Highwalls should have drainage diversion ditches constructed above them. These ditches would have their discharges collected and channeled directly to the receiving tributaries, thus eliminating contact with mine spoil.

These steps can effectively eliminate the interception of surface runoff by the strip mined area, which will greatly reduce the amount of acid production by reducing the amount of water passing through acidic materials.

This abatement plan should eliminate 80% of the adjusted acid load (9,360 lbs/day) presently discharged from the abatement area. This 80% acid abatement will eliminate 6.5% of the total acid load at the mouth of Clearfield Creek.

Estimated Construction Cost

Strip Mine #36
Regrade, fertilize, revegetate, construct
diversion ditches and flumes as necessary
245 Ac @ $2,900/Ac = $710,500

Total Estimated Cost, Abatement Area L = $710,500

Cost Effectiveness

$710,500 per 9,360 lbs/day acid = $75 per lb/day acid abated.

CLEARFIELD CREEK WATERSHED

ABATEMENT AREA M
NORTHERN LOST RUN

Location

Abatement Area M consists of 87 acres of stripping just north-east of Abatement Area L, which was submitted as a Quick Start project in Interim Report II. Strip mines #37 and 38 lie just north of Lost Run's headwaters, in Knox Township, Clearfield County, are important acid contributors to Lost Run.

Geology

This abatement area lies just northwest of the axis of the Laurel Hill Anticline, on the southern slope of a small structural ridge. Allegheny Group rocks from the Clarion-Brookville to the Upper Kittanning outcrop in the vicinity, but only the Clarion-Brookville and Lower Kittanning coals were stripped. Local strata strike northeast-southwest and dip less than 1° to the south toward a small coal basin just south of Lost Run. No major faulting was found within the Lost Run Watershed.

Mining History

No direct evidence of deep mining was observed in the area

but old mapping and information from local engineers suggests that the "A" seam Potts Run #3 mine, discussed in greater detail with Abatement Area N, extends southwest into the Lost Run Watershed. Stripping on the Clarion-Brookville and Lower Kittanning coals could have eliminated any evidence of deep mining that did exist. The "A" and "B" coals and their associated spoil are extremely acid in this vicinity, as mentioned in the Lost Run Quick Start discussion. The strip mines are unreclaimed and largely unvegetated.

These strip mines were originally scheduled for inclusion in the Lost Run Quick Start area, but news of an impending strip mining permit there prompted Skelly and Lay to eliminate this area from further consideration. The mentioned strip mining permit, sought by the Empire Coal Company, was obtained in March, 1973, and did not include this portion of Lost Run Watershed, as shown on the MOD. This area has now been recommended for abatement work.

Mine Drainage and Hydrology

The natural hydrologic system of the entire region has been altered by deep and strip mining activities. The discharges from this abatement area are probably due to both types of mines. Water flowing downdip in the deep mine which is thought to exist in this area discharges

into the acid strip mine material where its acidity further increases.

In addition, the 87 acres of unreclaimed stripping intercept surface run-off from a 413 acre drainage area. Pro longed contact between intercepted water and the acid "A" and "B" seam spoil material renders the water extremely acid before it discharges into Lost Run.

Water Quality

Intensive sampling in this abatement area was completed in mid-October by Skelly and Loy. Samples taken at stations 27.2 and 28.02, adjusted to represent a yearly average flow, revealed the area to be the source of 1,763 lbs/day acid. This was a substantial portion of the acid mine drainage entering Lost Run at the time of sampling.

Recommended Abatement

The abatement scheme for this area involves surface restoration of the unreclaimed strip mines to minimize run-off and rainfall contact with acid producing "A" and "B" seam spoil material. Cuts should be backfilled and regraded only as necessary to obtain the fastest possible drainage from the area. The spoil should be treated with limestone and fertilizers, and grasses, legumes and trees should be planted as dictated by slope stability requirements.

Diversion ditches should be constructed above highwalls and flumed across strip mine surfaces to rapidly route run-off around or over the strip mine surfaces.

The successful implementation of these abatement recommendations will abate roughly 40% of the acid presently emanating from this area, or 700 lbs/day.

Northern Lost Run Mine Drainage Data

SAMPLE			ACID LOAD	
Station #	Description	Strip Mine #	Unadjusted	Adjusted
28.02	seepage from	37	459	1129
27.2	trib draining	38	257	632

Estimated Construction Cost

Strip Mines #37 and 38

Backfill, regrade, add limestone and fertilizers, revegetate, construct diversion ditches and flumes as required.

87 Ac @ $2,600/ Ac = $226,200

Total Estimated Cost, Abatement Area M = $226,220

Call = $226,000

Cost Effectiveness

$226,200 per 700 lbs/day = $323 per lb/day acid abated.

CLEARFIELD CREEK WATERSHED

ABATEMENT AREA N
POTTS RUN

Location

The Potts Run abatement area consists of two extensive contour strip mines, #'s 40 and 41 between Potts and Little Potts Runs, and a smaller strip mine, #39, south of Potts Run. Both portions of the abatement area are in the vicinity of Boardman in Knox Township, Clearfield County, and both are associated with acid producing deep mine discharges that severely pollute the lower reaches of Potts Run.

Geology

The two abatement areas are structurally situated on the northern flank of the Laurel Hill Anticline. Allegheny Group rock units from the Clarion to the Upper Kittanning outcrop throughout the vicinity. The strata within the hill north of Potts Run generally strike northeast-southwest and dip shallowly to the northwest.

A local structural depression exists in the southern and southeastern portions of the large hill south of Potts Run. Here the strata dip and apparently drain toward the Lost Run Watershed, but strata in the remainder of the hill, including the actual abatement area, dip shallowly to the west. No large scale faulting is present in either portion of the abatement area.

Mining

The entire hill north of Potts Run has been extensively deep mined on the "A" coal by the Boardman No.4 and Kelly No.2 mines. No evidence of deep mines in the higher seams of the hill was found. The "A" and "B" coal outcrops have been completely stripped out since the deep mines ceased operation. Much of the stripping is unreclaimed, with large, open cuts and several large ponds. Some portions are very old and are now well-vegetated, but most is sparsely vegetated. No active mines are operating within this area.

South of Potts Run the large Potts Run No.3 mine on the "A" seam is presently the source of several deep mine discharges. WPA mapping and the numerous drifts observed along the "A" seam outcrop around the hill suggest that this deep mine may be much more extensive than shown on the MOD. There is also evidence of several small deep mines on higher seams within this hill. The "A" coal outcrop was extensively stripped with only minimal reclamation. Recently, however, the Empire Coal Company and Edward M. Brown Company have obtained new strip mining permits that encompass most of the existing stripping on the southern and eastern portions of the hill. Careful reclamation work by these two firms should be effective in minimizing the amount of water entering the deep mines from these strips, thus decreasing the size of the deep mine discharges to Potts Run.

Mine Drainage and Hydrology

The acid mine drainage observed north of Potts Run is emanating from two deep mire discharges on the Little Potts Run side of the area, where the downdip end of the Kelly No.2 mine has been stripped out. There are 174 acres of contour stripping around the hill, of which only the western 53 acres has been reclaimed. This western portion of the strip area is sufficiently regraded, but very poorly vegetated. The most recent active mining permit here was completed in 1966. This poorly vegetated portion of strip mine #40 and the remaining 121 acres of unreclaimed stripping intercepts drainage from a total area of 462 acres. The relatively few ponds and seeps observed suggest that much of the trapped runoff may be entering the deep mine workings. These workings act as an underdrain that channels all infiltrating ground water downdip through the acid producing "A" seam material. The locations of the major discharges in relation to the "A" coal contours indicates that the northwestern portion of the mine may already be flooded to the level of the discharge at station 45.05. The Water emanating from the deep mine on the eastern end of the hill enters a fairly large strip mine pond from which it flows into Little Potts Run.

In the vicinity of strip mine #39, south of Potts Run, the acid IS emanating from the "A" seam Potts Run No.3 mine. This mine serves as an underdrain that collects and channels most of the ground water infiltrating

into the mine from above or from the adjacent strip cuts. This water flows downdip through the mine and appears along the northwestern edge of the deep mine as six discharges. Most of the "A" seam stripping around the hill is unreclaimed and intercepts surface runoff from a large drainage area. Recently issued mining permits, however, eliminate much of the contour stripping from abatement considerations. The remaining strip mine, #39, is fairly large and unreclaimed. Runoff entering the deep mine workings here flows downdip to the western end of this strip mine, which is one of the major discharge areas along Potts Run.

Water Quality

The deep mine discharges north of Potts Run were sampled by Skelly and Loy during their intensive sampling program. Stations 45.03, 45.05 and 47.9 showed that deep mine complex to be the source of 2,000 lbs/day acid (adjusted).

Intensive sampling of the Potts Run No.3 mine discharges, around strip mine #39, was done by Skelly and Loy. The only discharges relevant to this portion of the abatement area are those on the western end of the deep mine. Analysis of a sample taken at station 46.12 indicates that "A" seam deep mine discharges pass through "A" seam refuse and become highly acid (1140 ppm). Similar acid-forming materials are contained in this seam's strip mine spoil, and could produce AMD upon contact with intercepted surface runoff, direct precipitation, and any adjacent deep mine discharge. Since it was felt based on field observations that this area's

flows and pollution loadings were not accurately reflected by the point source sample data, main stream station 46.0 was chosen for calculation of representative acid loads. Of the 2,000 unadjusted lbs/day acid emanating from the area, 200 lbs is judged to be forming in strip mine #39 spoil and exposed deep mine refuse. Thus Abatement Area N is the source of about 4,000 lbs/day acid (adjusted) to Potts Run, which had marginal water quality prior to entering the abatement area.

Recommended Abatement

The abatement scheme for the Potts Run abatement area involves the improvement of the drainage networks above and adjacent to the previously discussed deep mines. This can be accomplished by minimal regrading as required to rapidly drain runoff around or through the strip mines, thus minimizing infiltration into deep mine workings and seepage through acid spoil material. This minimal backfilling and regrading, accompanied by fertilization and treatment to obtain proper pH, will restore the strip mine surfaces sufficiently to establish a good vegetative cover. These surfaces should then be seeded with grasses, legumes, and trees as dictated by slope stability.

Drainage ditches should be constructed above highwalls and the ditch discharges should be collected and channeled directly to the receiving tributaries, minimizing flow into the strip mines and contact with the spoil

and refuse material. Completion of the recommended abatement should successfully eliminate 5% of the acid mine drainage entering Potts Run from the western discharge of the Potts Run No.3 mine or 200 lbs/day acid, and 35% of the acid emanating from the deep mine complex between Potts and Little Potts Runs, or 900 lbs/day acid. This abatement represents a total of 1100 lbs/day acid.

Alternative Abatement Measure

Strip Mine #40

This strip mine has been at least partially backfilled and revegetated. Assuming that such backfilling has occurred and that the highwalls are no longer completely exposed, a slurry trench would probably be best suited for use in this strip mine. The type of slurry trench referred to here is placed from the regraded spoil surface. A narrow 2 to 3 foot wide trench is excavated using a backhoe or other equipment with suitable boom length. The high density bentonite slurry is placed as the trench is excavated, preventing collapse of the walls of the narrow, deep trench. Upon completion, this trench forms a continuous impermeable barrier' within the spoil itself adjacent to the highwall. Such a trench has already been designed for another mine reclamation project, and was bid at $4.11 per profile square foot of trench. That figure is used in the slurry trench cost computations here, along with the approximate lengths of the affected areas and very rough estimates of the average slurry trench height, which would

be slightly greater than the anticipated hydraulic head at a given point. Since a continuous impermeable seal is required for effective mine drainage abatement, the slurry trench will have to be tied directly into the clay liner, if used in the southwest end of strip mine #41. This can be accomplished by simply continuing the trench for several feet into the clay liner.

Approx. cut length = 4250 feet
Average ht. of required slurry trench = 30 ft.
Profile area of slurry trench = 127,500 $ft.^2$
Cost @ $4.11/profile ft. = $524,000

Strip Mine #41

A large portion of strip mine #41 appears to be suited for either slurry trench or clay liner use. The considerations applicable to the slurry trench were discussed above. The clay liner consists of a barrier of compacted, impermeable clay material placed against the strip mine highwall and buried by the regraded spoil to form an impervious clay dam, flooding the mine workings. A major problem with the use of the clay liner is this area is the location of a suitable source of clay. The on-site clay at the base of the highwall would probably be suitable for use in the liner, but extracting that clay would probably require a major spoil-moving effort, making the cost prohibitive. Over twenty other potential clay sources in the area - most of them active strip miners who might have some fire clay available - were contacted to obtain clay and haulage prices. Unfortunately, only one of these companies, the

Avery Coal Co. of Wallaceton, expressed any interest in supplying clay for this type of project. The price quoted by this company was approximately $4.50 per cubic yard, delivered from a site 30 miles away. It might be possible to reduce this cost somewhat by establishing a clay "borrow pit" in one of the abandoned unreclaimed strip mines in the vicinity of Abatement Area N. Based on the $4.50 per cubic yard cost quoted, cost estimates for clay liner purchase and placement are presented below. Also presented are cost estimates for slurry trench placement in the same areas.

Northeast side:

Clay liner

Cut length = 3500 ft.
Avg. ht. cf required liner = 25 ft.
Avg. width of liner = 10ft.
Clay required for liner.=: 32,400 yd^3
Cost of clay liner @ $4. 50/$yd^3$ =$146,000

Slurry trench

Profile area of slurry trench= 87,500 $ft.^2$
Cost of slurry trench @ $4.11/$ft.^2$ = $360,000

Southeast side:

Clay liner

Cut length = 5750 ft - (This length will decrease if the liner is not placed along the entire length of the outcrop in this area)
Avg. ht. of required liner = 7 ft.
Avg. width of liner = 10ft.
Clay required for liner = 15,000 $yd.^3$
Cost of clay liner @ $4.50/$yd^3$ = $67,500

Slurry trench

Profile area of slurry trench = 40,250 $ft.^2$

Cost of slurry trench @ $4.11/$ft.^2$ = $165,000

It is important to remember in the case of strip mine #41 that the reclamation work originally recommended will still be required. In the case of the slurry trench, the spoil must be regraded prior to trench construction; and in the case of the clay liner, spoil must be backfilled against the liner as it is placed and compacted. This additional cost is considered in the following cost summary for the entire project.

Cost effectiveness values are also computed, assuming a 90% pollution reduction, or 21000 lbs/day acid.

1. Slurry trench alone

Mine #40 - slurry trench	=	$524,000
Mine #40 - minimal reclamation	=	37,000
Mine #41 - NE - slurry trench:::		360,000
Mine #41 - SE - slurry trench:::		165,000
Mine #41 - minimal reclamation	=	342,000
TOTAL		$1,428,000

COST EFFECTIVEN ESS $680 per lb/day acid abated

2. Slurry trench and clay liner, as required

Mine #40 - slurry trench	=	$524,000
Mine #40 - minimal reclamation	=	37,000
Mine #41 - N E - clay liner	=	146,000
Mine #41 - SE - clay liner	=	67,500
Mine #41 - minimal reclamation	=	342,000
TOTAL		$1,116,500

COST EFFECTIVEN ESS $530 per lb/day acid abated

Potts Run Mine Drainage Data

SAMPLE			ACID LOAD	
Station #	Description	Strip Mine #	Unadjusted	Adjusted
45.03	bony discharge	41	38	89
45.05	strip & deep mine discharge	41	768	1812
47.9	deep mine discharge	40,41	87	87
46.0	deep, refuse	39	2000	2000
47.0	Potts Run	40	243	573

Estimated Construction Cost

South of Potts Run

Strip Mine #39

Drain ponds, backfill, regrade, fertilize, revegetate, construct diversion ditches and flumes as required.

59 Ac @ $2600/Ac = $153,400

North of Potts Run

Strip Mine #40

Drain ponds, backfill, regrade, fertilize, revegetate, construct diversion ditches flumes as necessary.

7 Ac @ $2600/Ac = $18,200

Fertilize and revegetate as required.

52 Ac @ $355/Ac = $18,460

Strip Mine #41

Drain ponds, backfill and regrade only as required to obtain rapid runoff from strip mines, fertilize, revegetate, construct diversion ditches and flumes as necessary.

114 Ac @ $3000/ Ac = $342,000

Total Estimated Cost, Abatement Area N = $532,060
Call: $532,000

Cost Effectiveness

Strip Mine #39

$153,400 per 200 lbs/day =$766 per lb/day acid abated.

Strip Mine #40

$18,200 per 115 lbs/day = $158 per lb/day acid abated.

$18,460 per 100 lbs/day = $185 per lb/day acid abated.

Strip Mine #41

$342,000 per 680 lbs/day =$503 per lb/day acid abated.

Overall Cost Effectiveness

$532,000 per 1100 lbs/day = $410 per lb/day acid abated.

CLEARFIELD CREEK WATERSHED

ABATEMENT AREA O
PASSMORE CLAY MINE

Location

The Passmore Clay Mine is located near the headwaters of Morgan Run in Decatur Township, Clearfield County. The mine underlies L. R. 17050 one-half mile southwest of Newtown, and is the largest source of acid mine drainage to Morgan Run.

Geology

The abatement area is structurally adjacent to the crest of the Laurel Hill Anticline and is bounded on the northeast by one of the numerous northwest trending wrench faults commonly associated with the folding. Rocks from the Pottsville Group's Lower Mercer clay through the Allegheny Group's Upper Kittanning coal outcrop in the area and have all been mined to some extent. The strata here strike northwest-southeast, and dips range from nearly 50 near the fault to 10 within part of the deep mine itself.

Mining

All of the mining in the northwestern half of the abatement area

is fairly old. Several Mercer clay mines are located in the area but only the Passmore Mine mapping could be located. The other local mines were probably interconnected with the Passmore workings. Stripping in this northwestern half of the abatement area was confined to the outcrop adjacent to the deep mine workings. These strips were not reclaimed but are now generally heavily vegetated.

South of L. R. 17050, a large "B", "G", and "G' " strip mine of somewhat more recent origin overlies the deep mine. This strip mine is poorly reclaimed and sparsely vegetated.

Mine Drainage and Hydrology

The deep and strip mining within the abatement area have greatly altered the natural hydrologic system. The strip mines, both old and more recent, trap surface runoff and allow it to infiltrate into the underlying deep mines. The water in strip mine #42 seeps through the mine spoil downdip to the area overlying the Passmore Mine, then infiltrates down ward into the mine.

All water infiltrating downward enters the deep mine workings, which act as an underdrain to channel all water down dip toward the fault. The Lower Mercer rocks within the mine are apparently pyritic in nature, as both deep mine discharges from this seam are highly acid. The

relative location of the major discharge indicates that the northeastern half of the Passmore Mine is already flooded to an elevation of 1770 feet. The location of the smaller discharge suggests that the Mease No.2 and Osceola Fire Brick mines were probably not connected to the structurally down dip Passmore Mine.

There are bony areas in the vicinities of both discharges in the abatement area, and since water is becoming acid within the mines, this bony must also be acid in nature. A large, flat bony area is located north of the main drift discharge at station 43.35 and a smaller pile lies near the Passmore Mine's western drift. These bony areas probably produce slugs of add during wet weather periods. The location of the northern bony area adjacent to Morgan Run is also such that coal or clay fines could frequently be washed into the stream, causing both sedimentation and increased acid production. These fines will be transported downstream along the streambed and will completely react to form acid, which will be evident only far downstream from the actual limits of the abatement area.

Water Quality

Environmental Protection Agency data obtained during the mid-1960' s, in the midst of an extended dry period" revealed an acid load of nearly 240 lbs/day discharge from the Passmore Mine with a pH of

2.6 and acid concentration of 446 mg/l.

Skelly and Loy acquired data for this area during the intensive sampling program. Flows were not adjusted in this instance because the discharges were of deep mine origin, and probably did not show daily fluctuations that coincided with those of surface streams. The total acid load for Abatement Area O was about 5,210 lbs/day. This was the only major acid load found to be discharging into Morgan Run, and is largely responsible for that stream's poor water quality.

Recommended Abatement

Skelly and Loy's recommended abatement plan involves two phases -- immediate surface reclamation work to limit the amount of water entering the deep mines, and a feasibility study aimed at eliminating the deep mine discharges.

The phase of the abatement plan, which can be begun immediately, is the surface restoration of the two bony areas, with a combined area of 7.6 Ac, and a large 148 Ac strip mine# 42. The bony areas should be regraded in place to save the expense of loading and transporting the material. Limestone crusher waste should be roto-tilled into the top 10 inches of bony and fertilizers should be added to bring the pH and nutrient content of the bony to a level sufficient to sustain plant growth. Grasses,

legumes and trees should be planted as dictated by slope stability.

The strip mine should be backfilled and regraded as necessary to rapidly channel run-off from the strip mine area, thus minimizing infiltration of water into the Passmore Mine. The spoil surface should be limed and fertilized as necessary, then planted with grasses, legumes, or trees. These immediate reclamation steps will probably have singularly unimpressive results, abating perhaps 10% of the acid emanating from the deep mine; but they will be very important if the feasibility study shows that the deep mine workings can be inundated.

The second phase of the abatement plan will be a feasibility study aimed at determining the practicality and best possible method of eliminating the Passmore Mine discharge. Two possible abatement techniques should be investigated. Based on mine mapping already obtained, the downdip end of the mine, adjacent to the fault, is already flooded. Seals designed to completely flood the mine would have to withstand only 50 feet of hydraulic head. Seal placement, however, would be complicated by the stripping that has occurred on the northwest end of the mine.

Daylighting of the northwest end of the mine is also a possibility and might successfully be combined with some mine sealing technique to daylight part of the mine and flood the remainder.