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UC-88

Environmental Assessment Low Wall Conveyor Haulage Demonstration Program Lewis County, West Virginia

by

R. M. Ecker

Pacific Northwest Laboratory

Richland, Washington 99352

Operated for the

U.S. Department of Energy

by

Battelle Memorial Institute

June 1978

Battelle Memorial Institute

U. S. Department of Energy

Assistant Secretary for Energy Technology

Division of Solid Fuels Mining and Preparation

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ENVIRONMENTAL ASSESSMENT
LOW WALL CONVEYOR HAULAGE DEMONSTRATION PROGRAM
LEWIS COUNTY, WEST VIRGINIA

by

R. M. Ecker

Prepared for U.S. Department of Energy
Division of Solid Fuels Mining and Preparation
2401 E St. NW
Washington, DC 20241

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SUMMARY

The low wall conveyor haulage demonstration program is a new method for surface mining of coal developed by Skelly and Loy, engineers-consultants for the U.S. Department of the Interior, Bureau of Mines, and the U.S. Department of Energy. The purpose of the experimental demonstration project is to achieve improved production and better resource recovery while enhancing and facilitating reclamation and land restoration. Accordingly, an environmental assessment was conducted to describe the possible impacts of this technique.

The low wall conveyor haulage method incorporates portable conveyor units to transport overburden material, instead of using haul trucks as is practiced in most haulback surface mining activities. This method has potential economic, environmental and health advantages over other surface coal mining operations.

The potential environmental advantages of the conveyor haulback are: the length of open pit is less, thus decreasing the duration of time the pit is exposed to the elements; less heavy duty haulage equipment is used; routing of topsoil and burial of toxic materials becomes easier by use of a radial stacker; and backfilling and grading operations are more efficient with the use of a radial stacker. This mining method integrates mining and reclamation into a single unitized operation. Economically, investment in portable conveyors and maintenance of machinery should be less than costs associated with maintenance of haul trucks and scheduling should be somewhat less complicated. The inherent congestion of the pit area with the truck haulback method is greatly reduced using the conveyor haulage method, thereby reducing safety hazards.

The demonstration site is located in north-central West Virginia in Lewis County. The site is situated approximately 30 miles south of Clarksburg, West Virginia and 10 miles south of Weston, West Virginia on Little Skin Creek in Skin Creek District.

The principal environmental impacts from surface coal mining are erosion of soils in the area disturbed by mining activities; formation of acid or mineralized water drainage; aesthetic degradation; and disruption of biological resources. Mitigating measures to minimize adverse environmental impacts during the low wall conveyor haulage demonstration program include sediment and drainage control structures, backfilling mineral extraction area to original contour, restoration and revegetation of the disturbed area, decreasing the length of open pit, and no downslope placement of spoil. An environmental monitoring program will be conducted during the demonstration program to evaluate the environmental impacts of the program. Monitoring will include system monitoring, head-of-hollow fill stability monitoring, surface-water quality monitoring, ground-water monitoring, aquatic ecology surveys, wildlife surveys, and air quality monitoring.

Adverse impacts that cannot be avoided during the demonstration program include changing the character of 84 acres of land from a forest type habitat to a grassland type habitat; altering the topographic characteristics of about 5 acres of land for a valley fill; increasing sediment yield of the disturbed area to some extent; and disruption of wildlife movement patterns.

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INTRODUCTION

Environmental issues concerning surface coal mining in the Appalachian coal region of the United States have principally been centered on mining methods used in the past. To some extent, however, these issues have been remedied as a result of legislation limiting the use of the conventional contour mining method.

The two largest problems associated with contour mining are erosion of soils and the aesthetics of the worked-out pit. Because of the steep slopes, high relief, and moderate to heavy rainfall, erosion and sedimentation have been extensive in many areas, especially when the overburden material is placed on steep slopes immediately below the elevation of the coal seam being mined. The appearance of mined and reclaimed areas, particularly in mountainous areas, has been a concern. Permanently exposed highwalls, spoil on natural slopes, and changes of vegetation from trees to grass all contribute, in the view of some people, to the aesthetic degradation of mining areas. In addition, acid mine drainage may occur where medium and high sulfur coal are surface-mined, leading to water quality degradation problems.

Three mining methods have generally been used in steep slope areas of West Virginia. These are the contour mining method with downslope spoil placement, the haulback method and mountain-top removal method. The environmental problems caused by downslope spoil placement, primarily erosion, sedimentation, landslides, and aesthetic degradation, were severe and extensive. As a result this method is limited or prohibited by law in most states.

The low wall conveyor haulage demonstration program has been initiated to demonstrate and test a new method of contour mining. Incorporating portable belt conveyor units to transport overburden material, this new mining concept integrates mining and reclamation into a single unitized operation. The main purpose of this experimental demonstration project is to achieve improved production and better resource recovery while enhancing and facilitating reclamation and land restoration.

This environmental assessment evaluates the environmental impacts that could occur during the proposed low wall demonstration program. The environmental assessment includes the following:

1. a description of the proposed mining method
2. the environmental setting of the proposed demonstration site
3. general environmental impacts associated with contour mining methods in the Appalachian coal region
4. specific environmental impacts that could result from the proposed low wall conveyor haulage demonstration program and mitigating measures that will be employed to minimize adverse environmental impacts
5. adverse environmental impacts that cannot be avoided during operation of the demonstration program
6. alternatives to the low wall conveyor haulage demonstration program
7. other projects that could affect or be affected by the demonstration program, specifically the U.S. Army Corp of Engineers authorized Stonewall Jackson Lake project.

Information related to the methodology and operation of the proposed demonstration program has been obtained from low wall conveyor haulage feasibility reports developed by Skelly and Loy, Engineers-Consultants for the U.S. Department of Interior, Bureau of Mines, and the application for permit by Skelly and Loy and Grafton Coal Company to the West Virginia Department of Natural Resources. Available literature on the general impacts of surface coal mining was also reviewed (see Bibliography).

DESCRIPTION OF DEMONSTRATION

The low wall conveyor haulage demonstration site is located in north-central West Virginia in the County of Lewis (Figure 1). The site is situated approximately 30 miles south of Clarksburg, West Virginia and 10 miles south of Weston, West Virginia on Little Skin Creek in Skin Creek District.

The mine site shown in Figure 1 follows the Redstone Coal crop line along the ridge line for approximately 12,200 linear feet. The mineral extraction area encompasses 64 acres between the 1300-ft and 1400-ft elevation contours. In addition, a disturbed area of 20 acres will be present consisting of 10 acres for haulroads, 5 acres of valley fill and 5 acres for two sedimentation ponds.

MINING METHOD

The proposed low wall conveyor haulage demonstration program is scheduled to commence in calendar year 1978. The mine life for the entire area is from 24 to 36 months. Under the demonstration program, mining will be monitored for a 12 to 14 month period with environmental monitoring continuing for an additional 24 to 36 months.

The low wall conveyor technique of contour coal mining requires only slight modifications to present haulback mining procedures. The primary changes are related to equipment usage and material transport paths with minor variations of permit areas.

As practiced in most existing contour haulback mines, overburden excavation using the low wall conveyor haulback technique will progress along the coal crop line with excavated material placement following at some distance determined by law, site conditions or equipment capabilities. Generally, using the proposed technique, the open pit length will be less than with conventional haulback methods. Front end loaders, assisted by dozers, excavate and load overburden material into hoppers which distribute the load onto a series of portable conveyors. The conveyors transport the

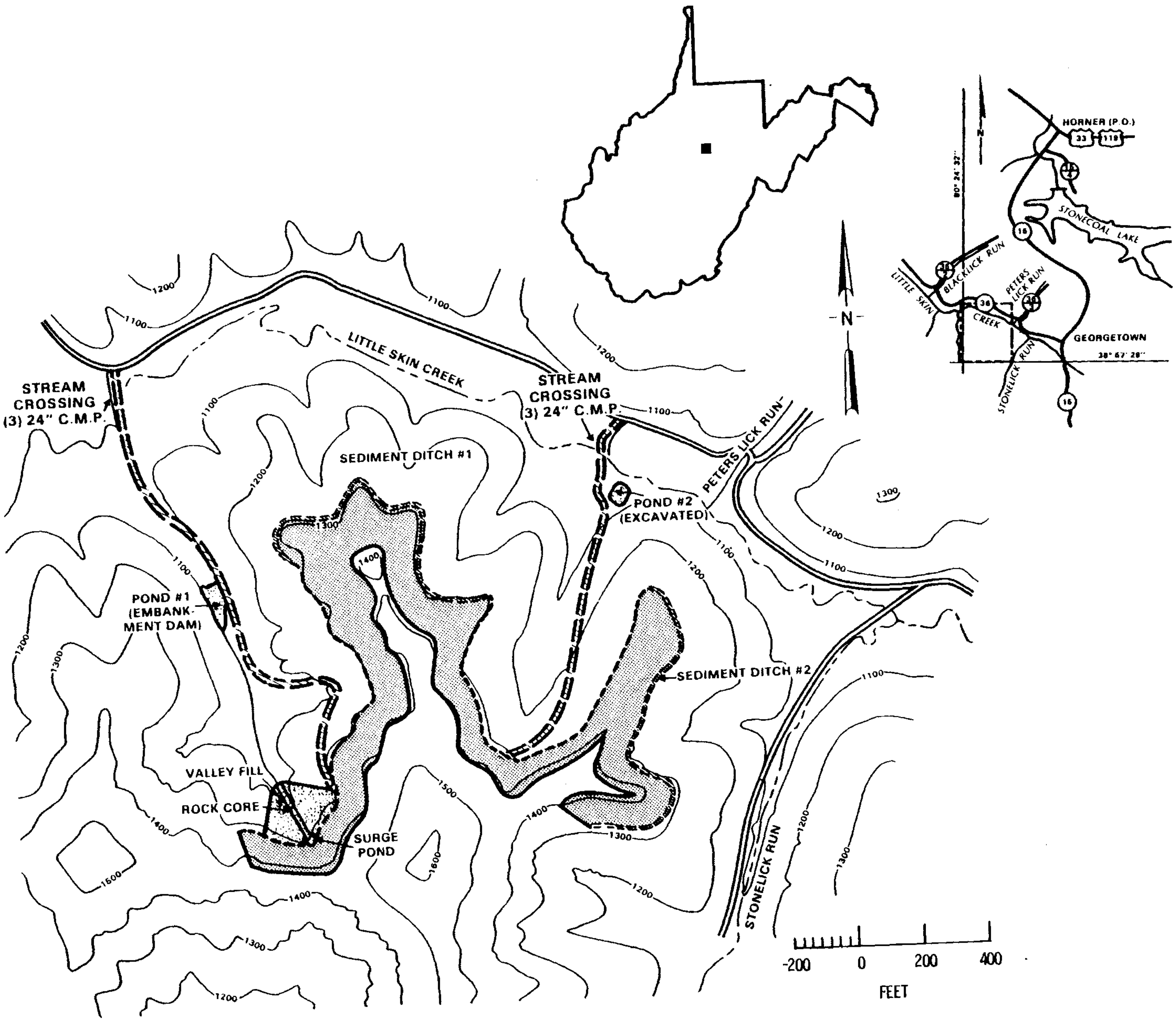


FIGURE 1. Location Map

material instead of trucks, scrapers, or dozers and loaders. Whereas overburden haulage routes under current technology are located within the pit boundaries, the low wall conveyor haulage technique allows placement of the transport paths outside the pit along the low wall.

Low wall conveyor haulage embodies placing portable conveyor sections along the outer edge of the working pit area as shown in Figure 2. Overburden is loaded onto the belts at the face of the cut and redeposited in the worked out pit area. The following paragraphs describe the unit operations that will be followed in the low wall conveyor haulage demonstration program.

Haulroad Construction

Two haulroads, a typical cross section of which is shown in Figure 3, will be constructed for the demonstration site. Haulroad Number 1 is located on the western end of the site and will be used as the principal access and haulroad. The haulroad is approximately eight-tenths of a mile long with an average grade of 6%. Maximum grade encountered will be 14.5%. Haulroad Number 2 is located towards the eastern end of the site and is about six-tenths of a mile in length. The average and maximum grades of Haulroad Number 2 are 8% and 10%, respectively. Both haulroads cross Little Skin Creek near State Route 36. The haulroads will be 40 ft in width and the road surface will be sloped toward a ditch on the upslope side for drainage control. Haulroads will be surfaced with materials from the permit area. The total area disturbed by haulroad construction is 10 acres or 12% of the total mineral and disturbed area.

Area Drainage Control

Drainage control structures consist of sediment ponds and dams and drainage diversion ditches to reroute drainage around the disturbed area and control the discharge of sediment to natural drainways. The proposed drainage plan for the demonstration site is given in Figure 4. The drainage plan is comprised of two sediment ditches, two sedimentation ponds, haulroad ditches and a rock core drain described in the section on initial cut.

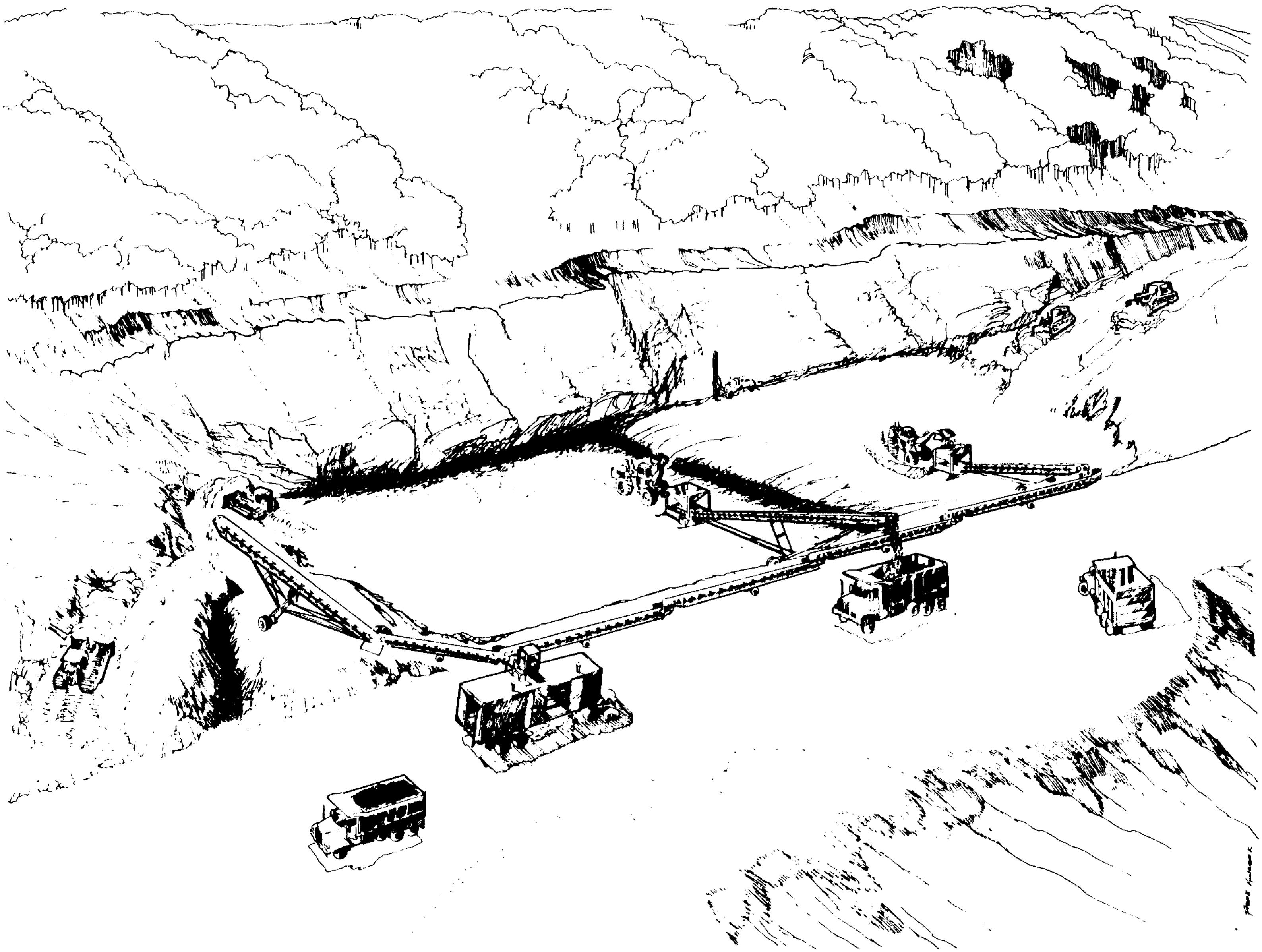
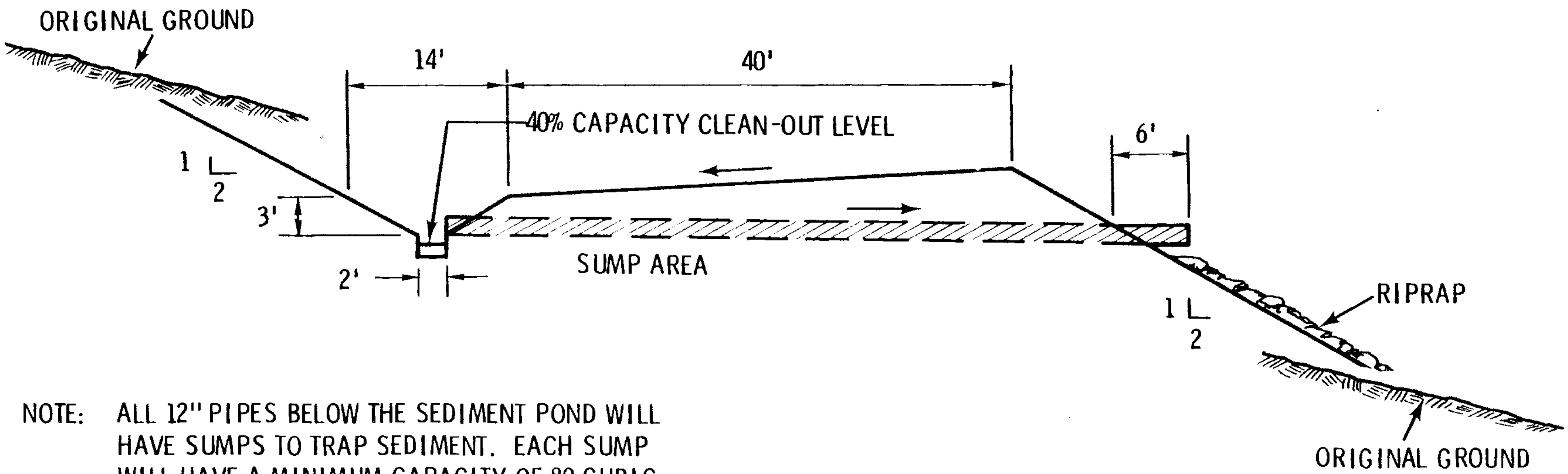
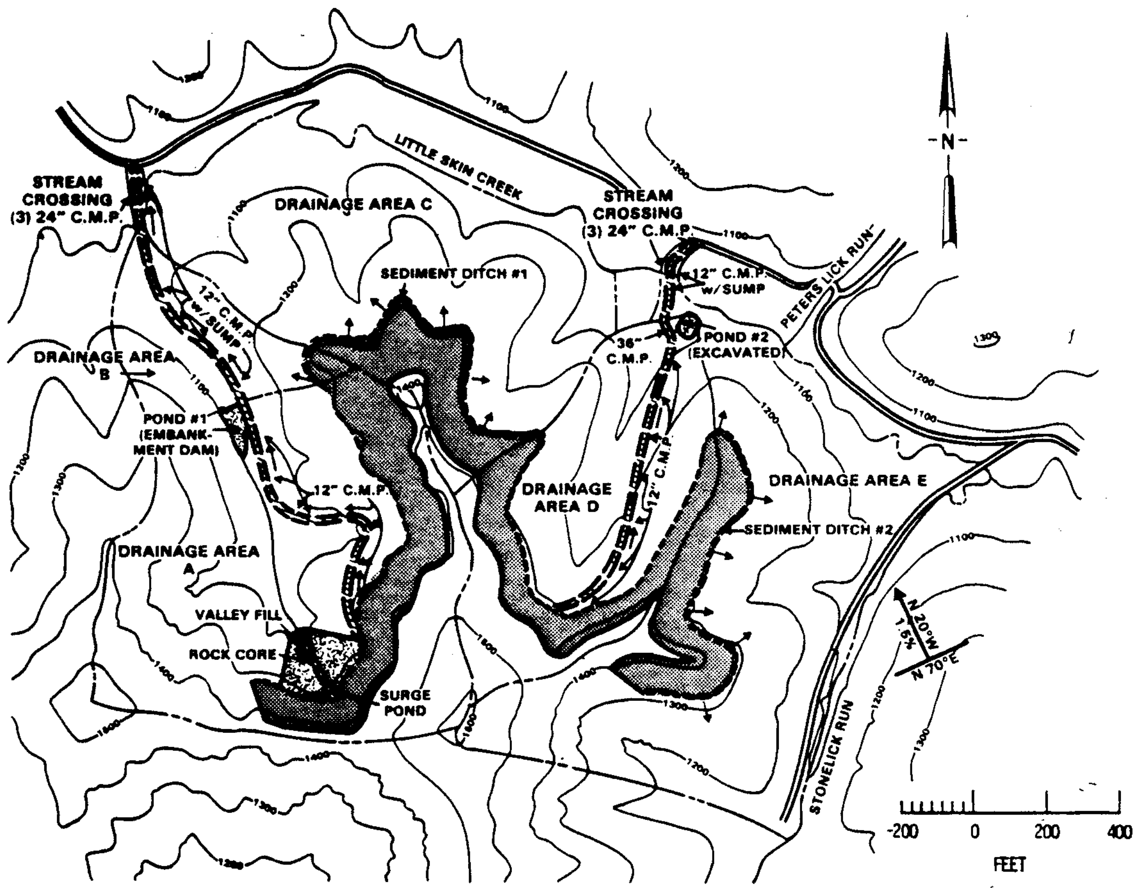


FIGURE 2. Low Wall Conveyor Haulage



NOTE: ALL 12" PIPES BELOW THE SEDIMENT POND WILL HAVE SUMPS TO TRAP SEDIMENT. EACH SUMP WILL HAVE A MINIMUM CAPACITY OF 80 CUBIC FEET OF STORAGE AND WILL BE CLEANED WHEN ACCUMULATED SEDIMENT VOLUME REACHES 40% OF CAPACITY

<u>FIGURE 3</u>. Typical Cross Section of Haul Road



COMPONENT DRAINAGE AREAS		
DRAINAGE AREA	ACRES	ACRES DISTURBED
A	130	30
B	27	3
C	115	17
D	73	18
E	124	16
TOTAL	469	84

SEDIMENT CONTROL STRUCTURE	TOTAL CONTRIBUTING DRAINAGE AREA TO STRUCTURE, (AC.)	DISTURBED ACREAGE CONTROLLED BY STRUCTURE (AC.)	REQUIRED STORAGE CAPACITY
POND #1 (EMBANKMENT)	130	30	3.75 Ac.-ft
POND #2 (EXCAVATED)	73	18	2.25
SEDIMENT DITCH #1	18.5	16.4	2.05
SEDIMENT DITCH #2	17.7	15.1	1.89
HAUL ROAD #1 DITCH	41	3.6	0.45
HAUL ROAD #2 DITCH	3.8	0.9	0.11
	TOTALS	84	10.5

FIGURE 4. Drainage Plan

The two sediment ditches are designed to intercept drainage from areas that would not ordinarily drain into the two sediment ponds and trap sediments from this acreage. These ditches will be constructed on the out-slope side of the pit and have a 1° slope. Check dams with risers will be located at designated locations to control the flow.

Two sediment ponds will be constructed adjacent to Haulroads 1 and 2 to capture sediment from the disturbed area. These ponds will conform to Federal regulations(1) and are designed to retain the discharged water and sediment for a long enough period for sediment to settle out and be deposited in the ponds.

Clearing and Grubbing

All trees and brush will be cleared from the site prior to commencing the mining operation (Figure 5). This material will be temporarily placed along the limit of the outslope to aid in drainage control. Before final grading all brush material will be buried in the pit area. Dozers will be used to prepare a drill bench for the initial cut and a safety bench will be constructed above the highwall to limit sloughing of material into the pit and also divert surface water runoff away from the pit.

Initial Cut

The initial cut will be made on the western end of the demonstration site. The excavated material from the initial cut will be used for construction of a valley fill shown in Figures 1 and 6. The capacity of the valley fill will be approximately 230,000 yd^3 at 10% compaction. A rock core for drainage of the fill will be progressively constructed as layers are brought up through the valley fill. Construction of the valley fill will be conducted with trucks, loaders and dozers. Valley fill will be constructed in 4 ft lifts beginning at the toe of the fill. The top of the fill will be graded to drain back to the head of the fill. The outer slope of the fill will be no steeper than 2 on 1; 20-ft benches will be constructed at a minimum of every 50 ft in vertical height. Topsoil will be spread over the entire surface of the fill after construction and seeded to minimize erosion.

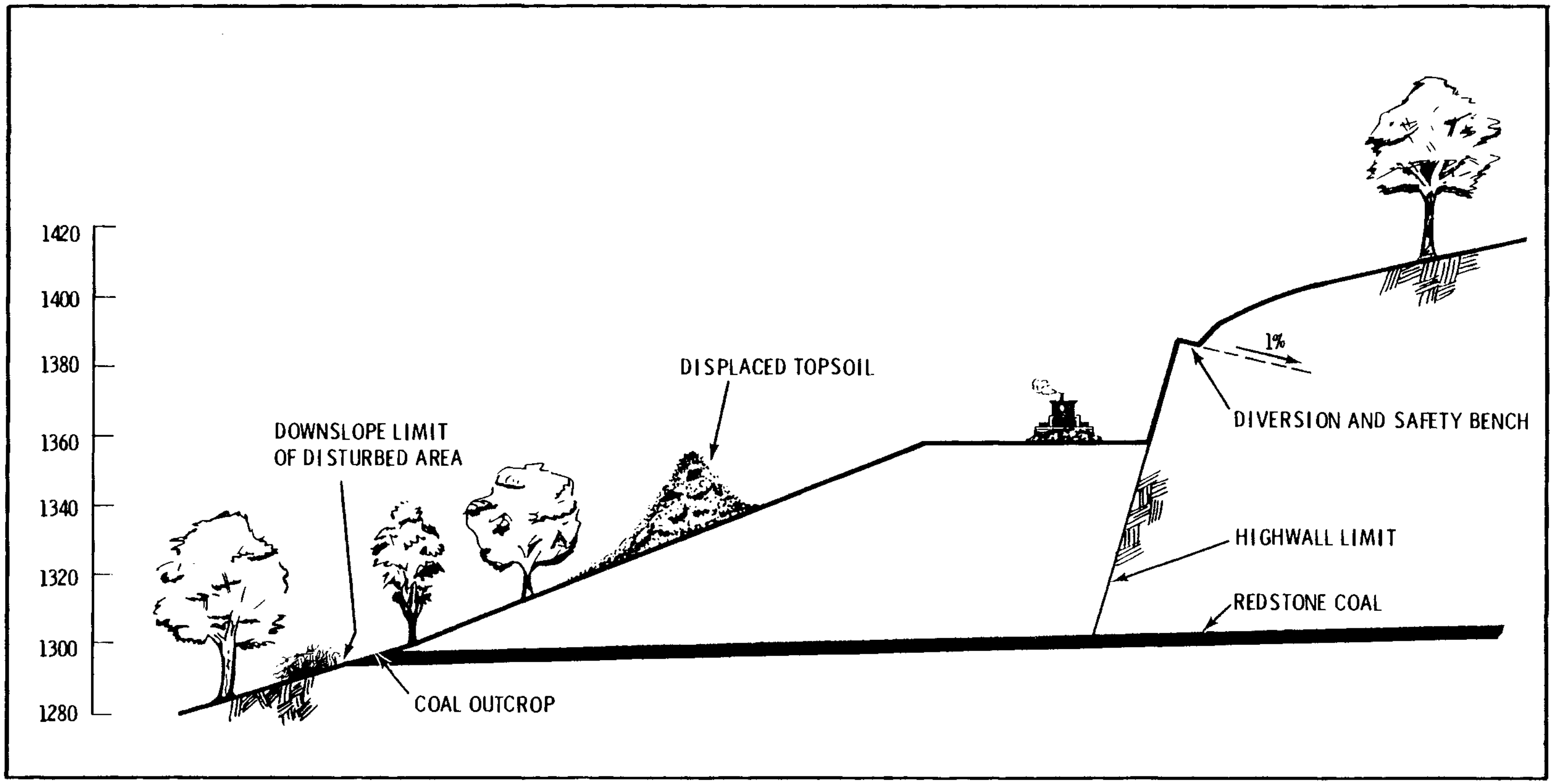


FIGURE 5. Clearing and Grubbing

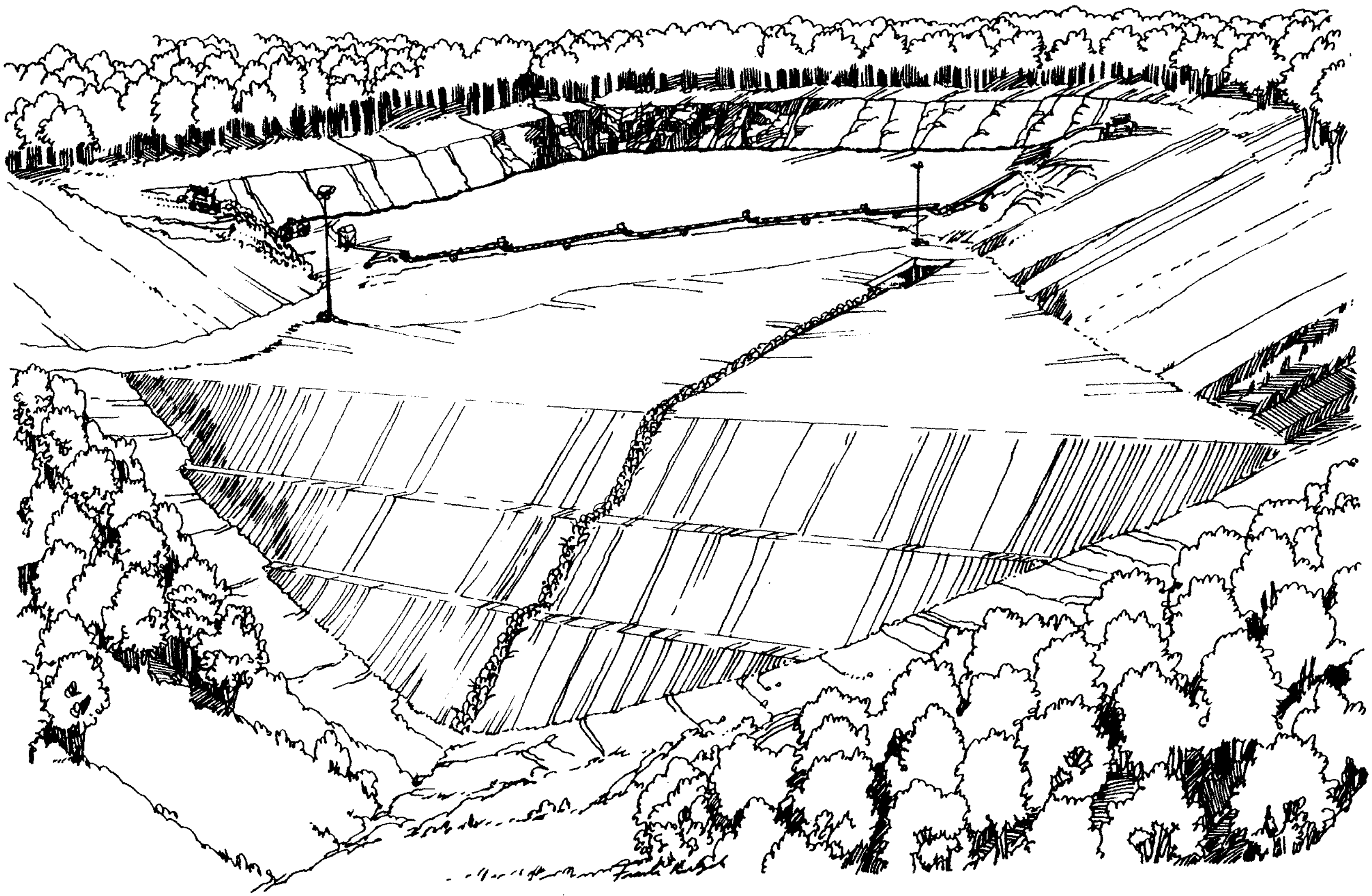


FIGURE 6. Valley Fill

Drilling and Blasting

The drilling and blasting operation is shown in Figure 7. Prior to drilling and blasting of a block, dozers will push displaced topsoil to an overburden loading point for immediate replacement on the backfilled area via conveyor. Therefore, except for the initial cut topsoil storage, no additional topsoil storage will be necessary. Drills will prepare blast holes on 12-ft centers. An ammonium nitrate fuel oil composition (ANFO), fired by primacord, will be used as the blasting explosive. Drilling and blasting activities will conform to the regulations promulgated by the Office of Surface Mining (Section 715.19 of Reference 1). The maximum weight of explosive to be detonated will be determined by utilizing the equation $W = (D/60)^2$, where W = maximum weight of explosive (lb) that can be detonated in any 8 millisecond period and D = distance (ft) to nearest building. Blasting techniques will be employed to achieve fragmentation of the overburden to a size readily handled by the conveyor (i.e., less than 18 in. rock fragments). No blasting will be done prior to sunrise, after sunset, or on Sundays.

Overburden Removal

Overburden removal and transport shown in Figure 8 will be accomplished using a dozer to push blasted overburden down the working face to a front end loader. The loader will then place spoil meterial into a hopper-feeder. This device will provide controlled feed to an 80-ft-long conveyor/elevator. Spoil material will be transported out of the pit to another portable belt conveyor located along the low wall of the mine. Material will then cascade from one 80-ft conveyor to another until it reaches the worked-out pit and reclamation area. There it will be transferred to a radial stacker which will deposit material where required. Using this method, toxic or acid producing material can easily be directed toward the back of the pit. As topsoil is excavated it will be immediately loaded onto conveyors and directed to the near final graded areas.

Coal Removal

The coal extraction and loading operation is illustrated in Figure 9. Coal will be extracted with a 6-1/2 yd^3 front end loader and loaded into

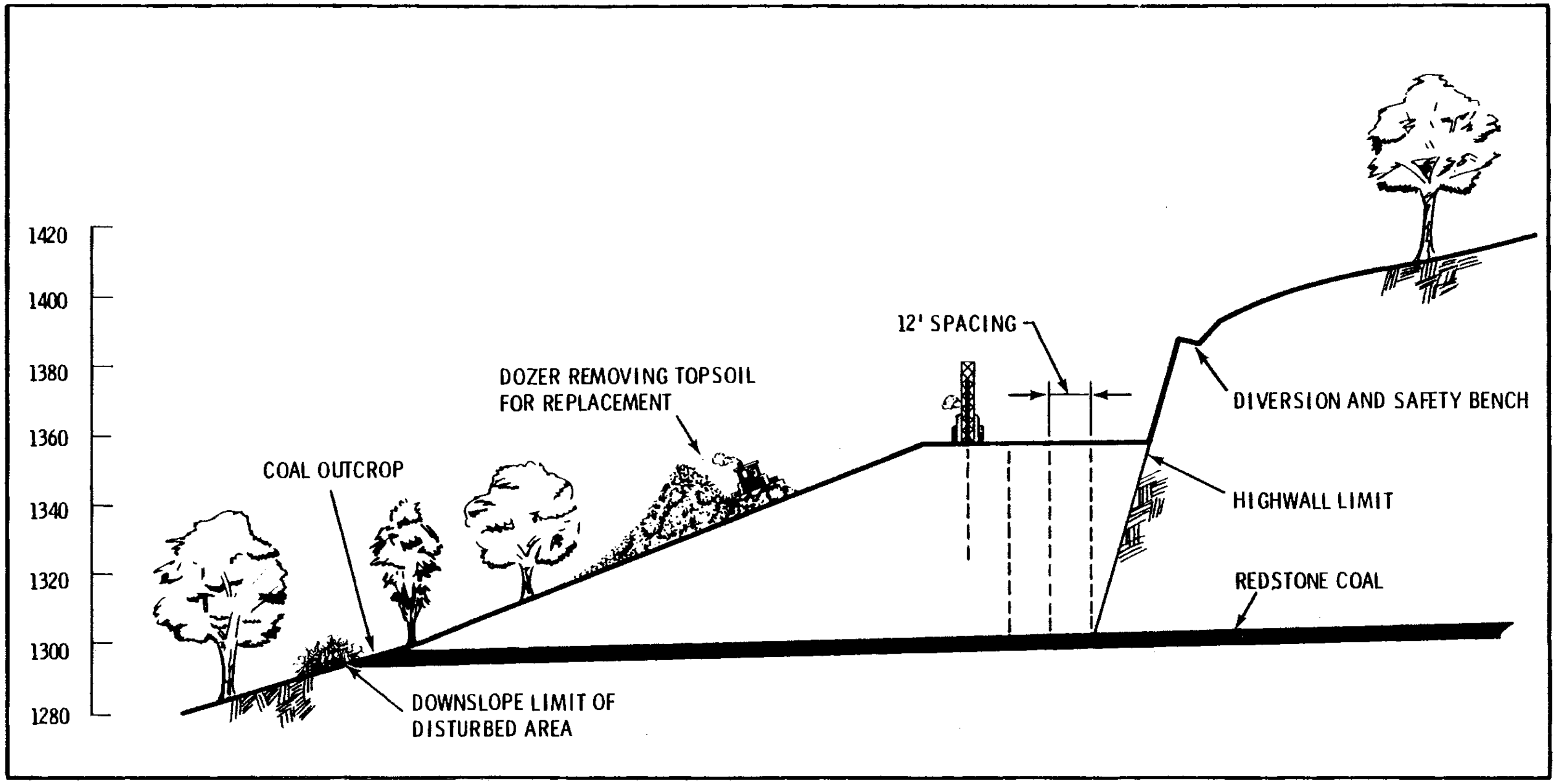


FIGURE 7. Drilling and Blasting

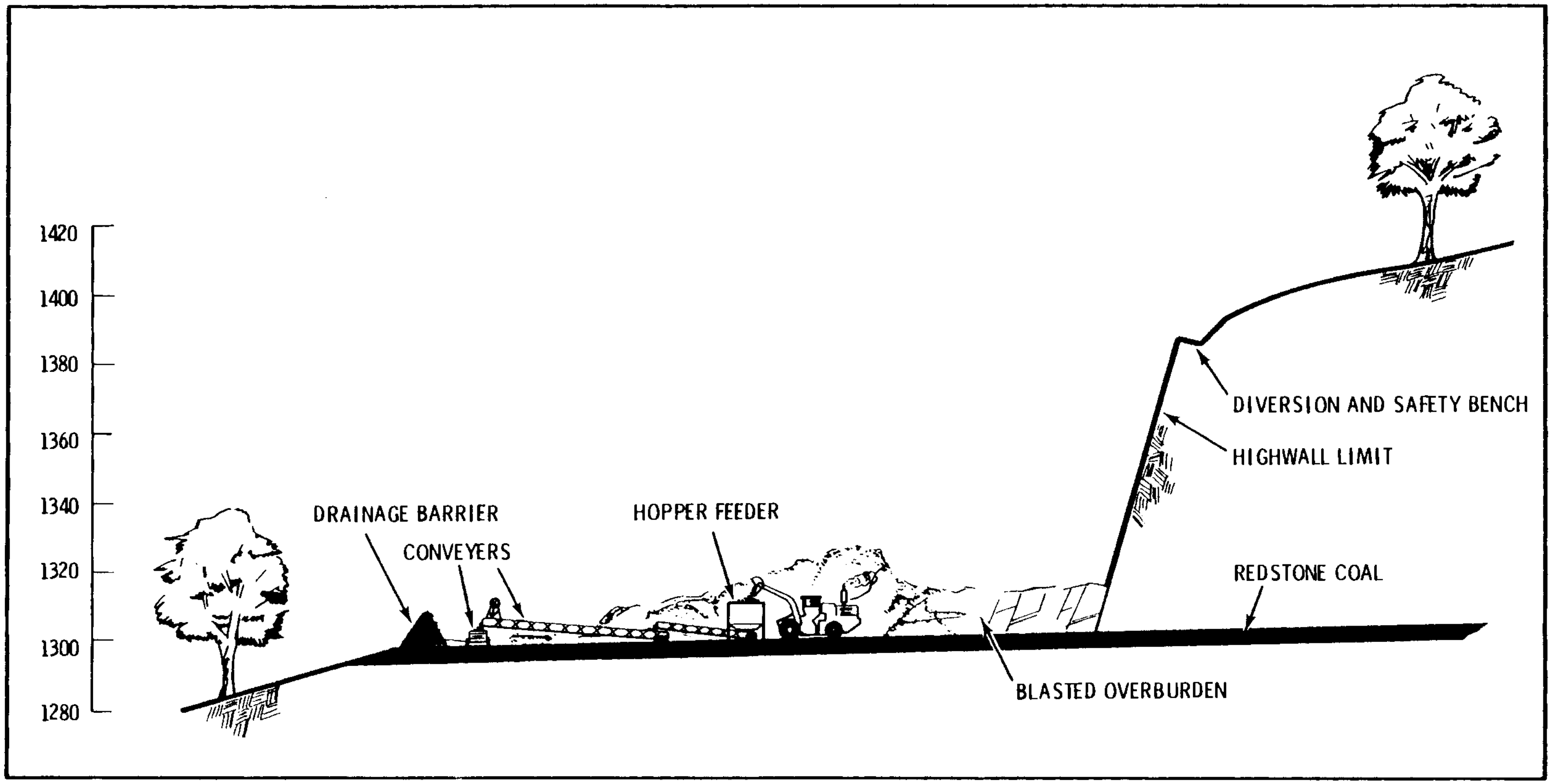


FIGURE 8. Overburden Removal

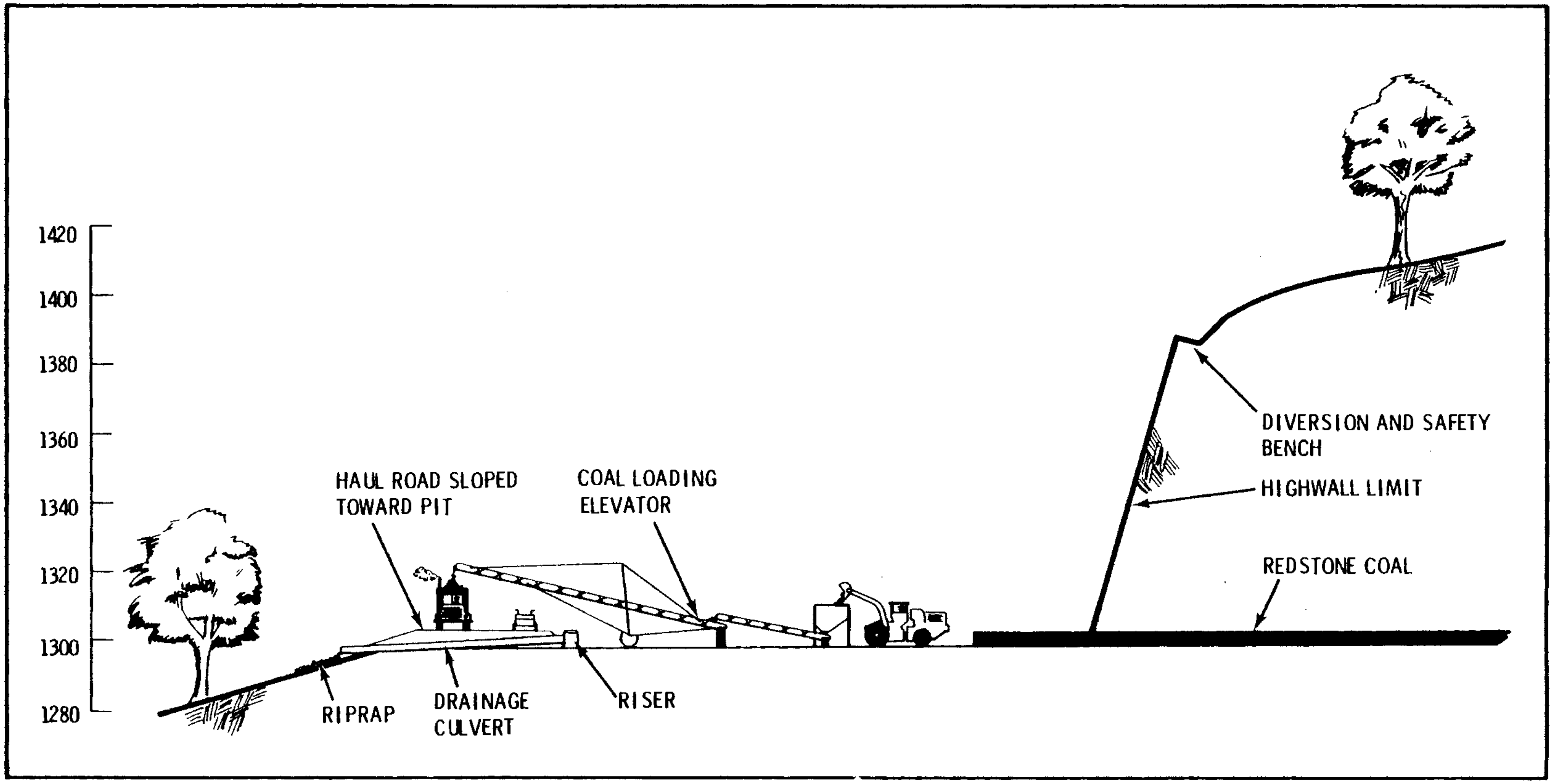


FIGURE 9. Coal Removal

contracted haul trucks via a hopper-feeder and coal loading elevator. At the planned stripping ratio of 12:1 approximately 190,000 tons of coal will be removed yielding an 80% recovery rate.

Backfilling

A radial stacker (Figure 10) will be positioned at the tail of the conveyor assembly in the storage area for distribution of spoil. The stacker is designed to deposit spoil in radial windrows for dozers to level and compact. Spoil will be discharged concurrently with, and about 200 to 500 ft behind, overburden excavation. Backfilling will be conducted at two levels to permit topsoil to be immediately relocated.

Final Reclamation

Final reclamation is shown in Figure 11. All final grading, backblading, or disking will be perfomed as needed with bulldozers or other equipment suited to the purpose. All slopes will be seeded after topsoil and seed beds are prepared. The seed mixture to be used will be as follows:

- Kentucky - 30 lb/acre
- fescue - 15 lb/acre
- birds foot treefoil - 10 lb/acre
- rye - 10 lb/acre
- orchard grass - 10 lb/acre

This seed mixture, in the past, has been demonstrated to establish a quick cover and stabilize the slopes. Fertilizer (10-20-10) will be applied at the rate of 500 lb/acre. The reclaimed area will be covered with a hay, straw mulch at 2000 to 4000 lb/acre.

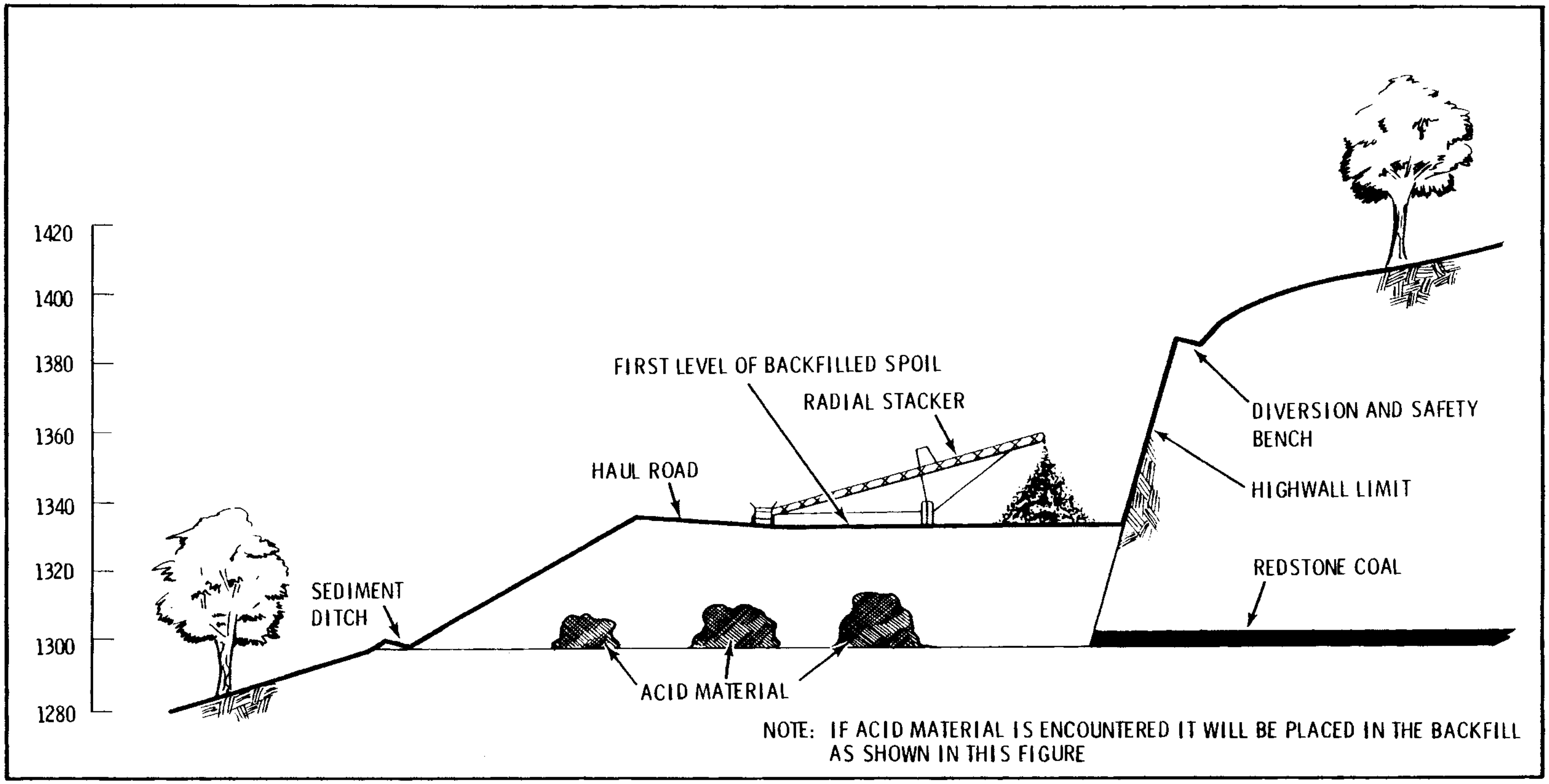


FIGURE 10. Backfilling

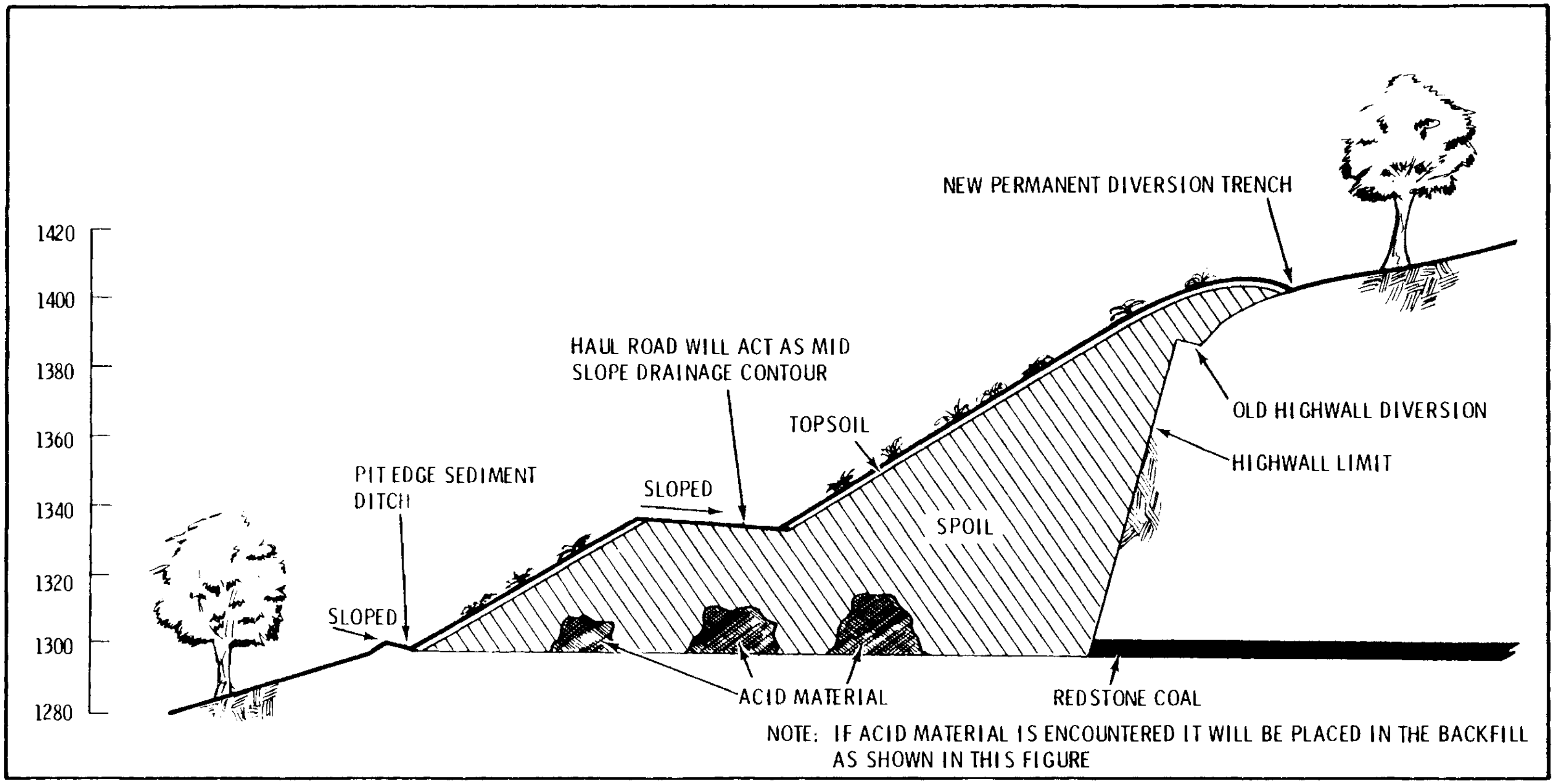


FIGURE 11. Final Reclamation

ENVIRONMENTAL SETTING

Several environmental characteristics were considered for this demonstration.

GEOGRAPHY AND TOPOGRAPHY

The low wall conveyor haulage demonstration site is located in north-central West Virginia in the County of Lewis. The site is situated on the southern flank of the Little Skin Creek drainage basin which is a subunit of the Skin Creek Basin. The demonstration site is 0.75 miles west of Georgetown along State Route 36, 3.2 miles south of Horner, and 2 miles north of Vandalia. The nearest large town is Weston located approximately 10 miles to the north.

The general topographic features of this area are characterized by a regular succession of ridges separated by long creeks. The relief of the area is moderate with maximum elevation differences between the valley floors and ridge crests on the order of 400 to 600 ft. The hills and ridges are the remains of an old peneplain that existed in Cretaceous time which has subsequently been sculptured by stream erosion. The stream erosion that followed the Cretaceous epoch has long continued and shows that the cycle is well advanced. Most of the creeks have nearly reached base level as is indicated by the fact that they have little fall even near their headwaters and by their meandering courses through broad valleys.

GEOLOGY

Surface rocks of Lewis County, with the exception of Quanternary sands and gravels along the streams, are all of Paleozoic Age with only the Pennsylvania Period being represented. The Dunkard Series, the uppermost series of the Pennsylvanian Period consists mainly of alternating beds of brown, micaeous sandstone, sometimes massive and sometimes flaggy, and red and sandy shales. The only coal of general occurrence, the Washington, is thin and slaty, seldom being more than 2 ft thick. The Monongahela Series, lying below the Dunkard Series, consists mainly of sandstone beds, greenish or gray in color, alternating with red or sandy shales. The Monongahela Series contains two important coal seams, the Pittsburgh and Redstone Coal.

CLIMATE

The climate of north-central West Virginia is temperate with an appreciable seasonal variation in temperature. This area is geographically in a region of variable air mass activity, being subjected alternately to both polar and tropical, continental and maritime air masses.

The average annual precipitation at Weston, West Virginia, based on 78 years of record, is 48.56 in. The low annual precipitation is 26.35 in. and the high is 71.19 in. Snowfall at Weston averages 39.4 in. per year.

Based on 71 years of record at Weston, the average annual temperature is 53.9°F, ranging from a low annual temperature of 41.6°F to a high of 66.3°F. Average monthly temperatures range from a low of 34.2°F in January and February to a high of 74.4°F in July.

HYDROLOGIC FEATURES

The demonstration site is located within the West Fork River watershed. There are three principal tributaries to the West Fork River; Skin Creek with a drainage area of 33 square miles; Sand Fork with a drainage area of about 12 square miles; and the main stem West Fork River with about 57 square miles of drainage area. The demonstration site is situated on Little Skin Creek within the Skin Creek drainage basin. Little Skin Creek watershed is about 9.1 square miles.

Surface-Water Quality

Surface-water quality in West Fork River is degraded by mine drainage, domestic wastes and sediment to the extent that the river is very highly mineralized.(2) Generally, these pollutants become more severe as the river flows downstream, indicating that the primary sources are in the lower reaches. In the upper reaches of the basin, including Skin Creek and Little Skin Creek, sources of mine drainage are small and scattered. Water quality monitoring of Skin Creek and Little Skin Creek by the Corps of

Engineers during the months of April through October 1973 and 1974 indicate that these two water courses exhibit the best water quality conditions of the West Fork River drainage basin. Table 1 is a summary of the water quality measurements made on Skin Creek and Little Skin Creek in 1973 and 1974. With the exception of CO_2, total iron, and total manganese concentrations, surface water quality in Little Skin Creek appears to be favorable for public water supply and preservation of aquatic life.

TABLE 1. Water Quality Monitoring of Skin Creek and Little Skin Creek in 1973 and 1974 Corps of Engineers, Pittsburgh District

	Skin Creek		
Water Quality Parameter	Above Little Skin Creek Range of Means	Below Little Skin Creek Range of Means	Little Skin Creek Range of Means
Specific Conductance (umhos/cm)	116-224	205-418	163-363
Color (Pt-Co units)	25.4-47.4	14.6-52.0	24.6-39.1
Turbidity (JTU)	10.6-15.4	2.2-15.4	11.4-14.6
Hardness (EDTA) (as mg/ℓ of $CaCO_3$)	59.7-87.9	87.7-227.8	67.1-121.3
Total Alkalinity (as mg/ℓ of $CaCO_3$)	36.0-42.2	26.8-29.5	29.9-38.5
Total Acidity (as mg/ℓ of $CaCO_3$)	5.0-9.2	5.3-5.0	6.4-15.3
CO_2 (as mg/ℓ of $CaCO_3$)	5.0-9.2	4.3-5.0	5.2-6.4
Mineral Acidity (as mg/ℓ of $CaCO_3$)	0.0	0.0	0.0-2.0
Hot Mineral Acidity (as mg/ℓ of $CaCO_3$)	0.0	0.0	0.0-3.9
pH		6.8-7.0	6.3-7.0
Total Fe (mg/ℓ)	1.4	1.4	1.6
Total Mn (mg/ℓ)	0.3	0.4	0.4

Surface-water quality samples shown on Figure 12 were taken from Little Skin Creek and lateral drainways on 22 July 1977. The results of analyses are shown in Table 2 and described in the following paragraphs.

pH - The pH of pure water at 25°C is 7.0. Most river waters in areas not influenced by pollution generally have a pH between 6.5 and 8.5.

The waters of Little Skin Creek and its tributaries are near neutral or slightly basic, with pH varying between 6.9 and 7.7.

Alkalinity and Acidity - Alkalinity and acidity are measures of resistance of a water sample to pH changes or buffering capacity of a sample. The alkalinity of water is its quantitative capacity to neutralize a strong acid to a designated pH. Conversely, the acidity of water is its quantitative capacity to neutralize a strong base to a designated pH.

The alkalinity and acidity of Little Skin Creek vary substantially from station to station as shown in Table 2. The total alkalinity, expressed as mg/ℓ of $CaCO_3$ varies from 40 mg/ℓ to 358 mg/ℓ, but is generally around 40 mg/ℓ of $CaCO_3$. The hot acidity also expressed as mg/ℓ of $CaCO_3$ varies from 44 mg/ℓ to -202 mg/ℓ. Generally, the hot acidity is around 40 mg/ℓ of $CaCO_3$.

TABLE 2. Water Quality Results of 22 July 1977, Skelly and Loy

Sample Number	pH Units	Alk-Total mg/l As $CaCO_3$	Acid Free mg/l as $CaCO_3$	Acid Hot mg/l as $CaCO_3$	Turbidity JTU	SO_4 mg/l	Cl mg/l	Residue Total mg/l at 103°	Residue Non-Filt. mg/l at 103°	Residue Filter-able mg/l at 180°	Al mg/l	Fe-Total mg/l	Mn mg/l	Na mg/l
1	6.9	64	0	8	230	28	16	542	346	180	1.3	1.4	0.31	9.1
2	7.0	40	0	42	8.0	15	4.1	198	30	92	0.1	0.22	0.01	3.0
3	6.9	64	0	0	220	28	20	590	334	190	1.1	1.3	0.29	9.5
4	6.9	44	0	44	200	45	15	552	284	284	0.9	1.4	0.19	6.3
5	6.0	43	0	42	110	50	13	398	146	146	1.7	1.4	0.13	5.6
6	7.0	44	0	44	120	50	12	352	162	214	0.6	0.9	0.12	5.6
7	7.7	358	0	-202	220	33	9.3	868	596	220	0.7	1.5	0.49	2.1

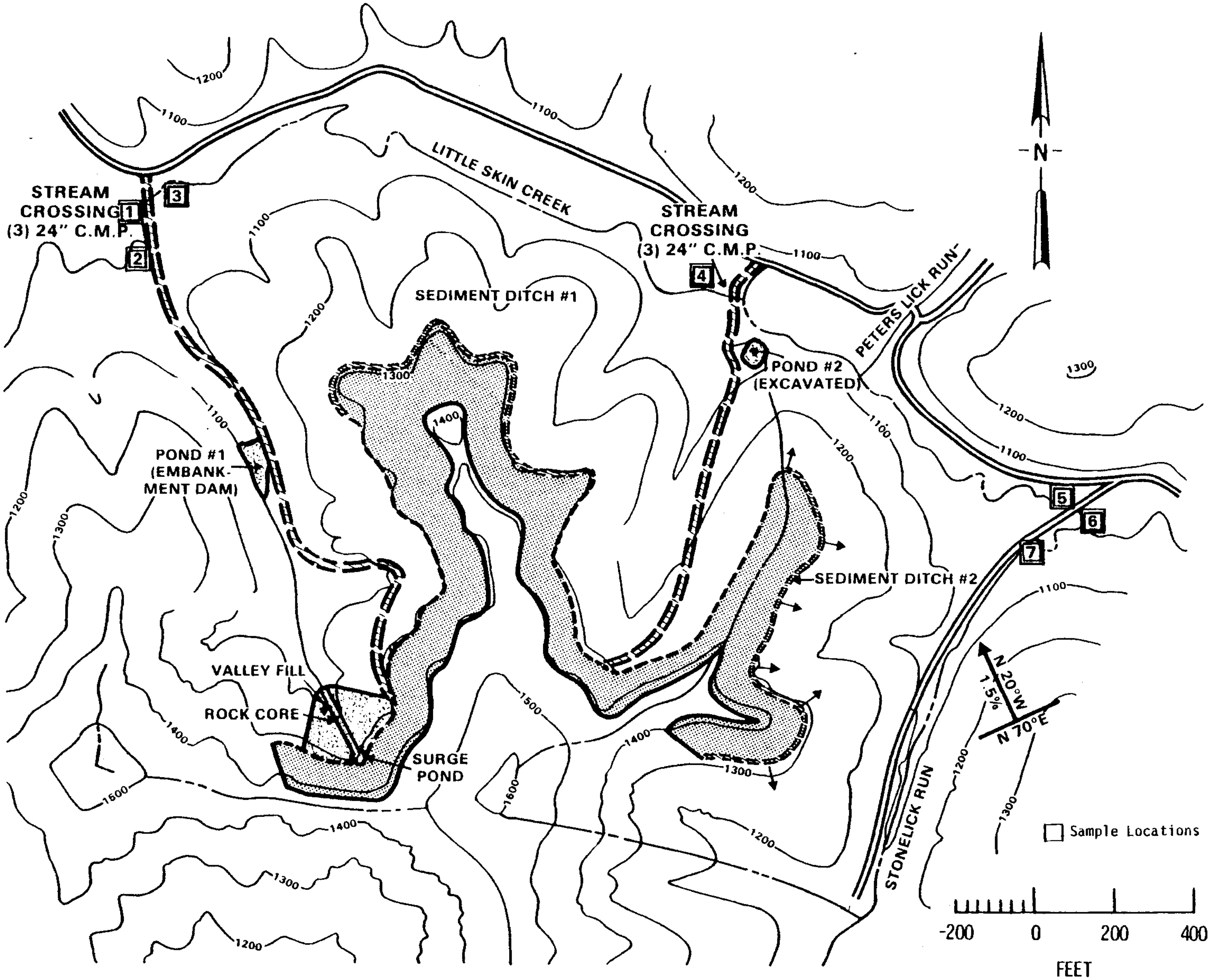


FIGURE 12. Water Quality Sampling

Turbidity - Turbidity in water is caused by the presence of suspended matter, such as clay, silt, finely divided organic and inorganic matter, plankton, and other microscopic organisms. Turbidity is an expression of the optical property that causes light to be scattered and adsorbed rather than transmitted in straight lines through a sample. Turbidity of water samples taken in Little Skin Creek watershed on 22 July 1977 are reported as Jackson Turbidity Units (JTU), a measurement based on a light path through a suspension that just causes the image of the flame from a candle turbidimeter to disappear.

JTUs in the Little Skin Creek watershed varied from 8 to 230, being lowest (most clear) in the lateral drainway on the west end of the demonstration site. The turbidity generally increased in the downstream direction within the vicinity of the site.

Sulfate - Sulfate is widely distributed in nature and may be present in natural waters in concentrations ranging from a few to several milligrams per liter. In many cases drainage from mines may contribute high sulfate by virtue of pyrite oxidation.

Sulfate levels of little Skin Creek in the vicinity of the demonstration site vary from 15 mg/ℓ to 50 mg/ℓ. The lowest levels were found in the lateral drainways (Samples 2 and 7) and along the western end of the site. Sulfate concentrations in Little Skin Creek decreased in the downstream direction in the vicinity of the demonstration site.

Chloride - Chloride in the form of Cl ion is one of the major inorganic anions in water. In potable water the salty taste produced may be detectable at concentrations around 250 mg/ℓ if the sodium cation is present. On the other hand, the typical salty taste may be absent in waters containing as much as 1,000 mg/ℓ when the predominant cations are calcium and magnesium.

The chloride levels in Little Skin Creek watershed are very low varying from less than 10 mg/ℓ in the lateral drainways to between 12 mg/ℓ and 20 mg/ℓ in Little Skin Creek proper.

Residue - The term "residue" refers to solid matter suspended or dissolved in water. Total residue is the term applied to the material left in a vessel after evaporation of a sample and its subsequent drying in an oven at a defined temperature. Total residue includes "nonfilterable residue," that is, the portion of the total residue retained by a filter, and "filterable residue," the portion of the total residue that passes through a filter. Residue may affect water quality adversely in a number of ways. Waters with high residue are generally of inferior palatability and may induce an unfavorable physiological reaction in the consumer. Highly mineralized water is also unsuitable for many industrial applications. For these reasons, a limit of 500 mg/ℓ residue is desirable for drinking. Waters with very high levels of nonfilterable residue may be aesthetically unsatisfactory for purposes such as bathing.

Total residue levels in Little Skin Creek watershed vary between 198 mg/ℓ and 868 mg/ℓ. The lowest and highest levels were found on the lateral drainways near the demonstration site. The western end of Little Skin Creek (downstream) had lower levels of residues than did the eastern end in the vicinity of the site. The percent of filterable and nonfilterable residues were quite variable.

Aluminum - Aluminum is the third most abundant element of the earths crust, occurring in minerals, rocks and clay. However, it rarely occurs in natural waters in concentrations greater than a few tenths of a milligram per liter unless the water has a very low pH.

Aluminum levels in Little Skin Creek watershed varied from 0.1 mg/ℓ to 1.7 mg/ℓ, being lowest in the lateral drainways. The levels in Little Skin Creek proper varied between 0.6 mg/ℓ and 1.7 mg/ℓ.

Iron - The element iron is an abundant and widespread constituent of rocks and soils. In filtered samples of oxygenated surface waters iron concentrations seldom reach 1 mg/ℓ. Some acid surface drainage, however, may contain considerably more iron. Iron in water can cause staining of laundry and porcelain, and also produces a bittersweet astringent taste detectable by some persons at levels above 1 or 2 mg/ℓ.

Total iron in Little Skin Creek watershed varied from 0.22 mg/ℓ to 1.5 mg/ℓ. The highest and lowest levels were found in the lateral drainways and levels in Little Skin Creek proper ranged from 0.9 mg/ℓ to 1.4 mg/ℓ.

Manganese - Although rarely present in surface waters at concentrations in excess of 1 mg/ℓ, manganese imparts objectionable and tenacious stains to laundry and plumbing fixtures. Low manganese limits imposed on acceptable water (0.05 mg/ℓ) stem from these, rather than toxicological considerations.

Manganese levels in Little Skin Creek watershed in the vicinity of the demonstration site range from 0.01 mg/ℓ to 0.49 mg/ℓ. As with many of the other water quality parameters, the lowest and highest manganese concentrations were found in the lateral drainways. In Little Skin Creek proper manganese levels ranged from 0.12 mg/ℓ to 0.31 mg/ℓ.

Sodium - Sodium ranks sixth among the elements in order of abundance; therefore, it is present in most natural waters. The levels may vary from negligible to appreciable. In Little Skin Creek watershed sodium concentrations range from 2.1 mg/ℓ to 9.5 mg/ℓ.

Sediment Yield

Sediment yields in the West Fork River and many of its tributaries have been indicated as a water quality problem although the yield is not considered critical. The amount of sediment carried reflects the amount of erosion in the drainage basin and is a function of characteristics such as exposed geologic strata and precipitation patterns. The average annual sediment yield rate of the West Fork River drainage basin for the period of October 1970 to September 1972, as measured by the Corps of Engineers, was 117 tons per square mile. Based on the Corps sediment yield estimate the average annual yield from Little Skin Creek would be 1,065 tons of sediment.

Ground Water

Topographic, physiographic, geologic and precipitation patterns control the general behavior of ground water in this area. Commonly the ground water is perched in the intra-valley areas. Yields of ground water to wells varies widely with generally low yields, averaging less than 10 gal per min. In some localized areas in valley bottoms, where underlain by thick sandstone, the ground water yield may be in excess of 100 gal per min.

FISH AND WILDLIFE RESOURCES

Harvestable wildlife resources, both forest and farmland species, are generally found in low to moderate abundance in the West Fork River basin. Cottontail rabbits are abundant on farmed bottom lands and support much of the hunting. Other game species present are white-tailed deer, ruffed grouse, squirrels, bobwhite, raccoon, opossum, foxes and woodchuck. Muskrat is the principal fur animal. Other animals harvested for their fur value are mink, skunk, raccoon, and opossum.

Fishery resources in West Fork River and its major tributaries are limited by prolonged periods of high turbidity, sedimentation, generally sluggish flow conditions, periodic extreme low flows and water quality degradation. The West Fork River does support a warmwater fishery, which includes large-mouth, spotted and smallmouth bass, muskellunge, black and white crappies, channel, flathead and bullhead catfishes and sunfishes. Although water quality conditions on Little Skin Creek are favorable to supporting a fishery resource, the generally low flow conditions would substantially limit the fishery.

NATURAL RESOURCES

Coal

The most important economic resource in the West Fork River basin since the 1860s has been coal. The coals in this region are classified as highly volatile Type A Bituminous Coal with an average sulfur content of about 3%.

The coal seam of interest in the low wall conveyor haulage demonstration program is the Redstone Coal. In Lewis and Gilmer Counties there are eight mineable seams of coal and 19 seams too thin, impure or irregular to be of more than local value. These mineable coals, as described by Reger in the 1916 West Virginia Geological Survey County Report, are in descending order; Washington of the Dunkard Series, the Redstone and Pittsburg of the Monogahela, the Elk Lick and Bakerstown of the Conemaugh, and the Upper Freeport, Upper Kittanning and Lower Kittanning of the Allegheny.

The Redstone coal occurs generally throughout Lewis County, varying in thickness from 3 to 6 ft. Its chemical composition shows it to be a fine coal for steam and domestic fuel and in some areas the sulfur content is low enough to permit its use for coke manufacture. In Skin Creek District the Redstone Coal crops along all the principal streams. Coal quality analyses of Redstone Coal in the vicinity of the demonstration site is as follows:

- Moisture - 2.3% (as received)
- Ash - 8.7% (as received), 9.0% (dry)
- Sulfur - 3.1% (as received), 3.2 (dry), 3.5% (moisture and ash free)
- Btu - 13,100 (as received), 13,410 (dry), 14,750 (moisture and ash free)

Coal production records in the West Fork River Basin show that approximately 7.5 million tons of coal are produced annually. The majority of this production occurs in the lower basin. Lewis County in the upper West Fork River Basin produced 687,000 tons of coal in 1970 and only 276,000 tons in 1973. Since 1973 coal production in Lewis County has been increasing and is expected to continue increasing in response to increased demand and more favorable market conditions. Major production of coal in Lewis County has been by surface mining, the most prominant of these being the Redstone and Elk Lick seams.

Petroleum and Gas

Lewis County, like many other counties in the central and western parts of West Virginia, has been prolific in its yield of natural gas and high grade petroleum. The oil is of the famous Pennsylvania grade, having a paraffin base and being high in volatile oils. Reservoirs that contain it, as well as gas, are the sandstone members of the Pennsylvanian, Mississippian and Devonian Rock. Wells range in depth from 1500 to 3000 feet. In recent years there has been a substantial decline in oil and gas reserves in this area.

Other Resources

Other resources found in varying quantities on a commercial level are clays for making bricks and tile, river and creek gravel, limestone and building stone.

SOCIO-ECONOMIC CHARACTERISTICS

Historical Development

Permanent settlement of the West Fork River Basin began in the 1770s. Settlers found the area readily adaptable to agriculture, especially the raising of sheep and cattle. By the early 1900s as much as 8% of the area had been cleared for agriculture. Development of the extensive oil and gas deposits began shortly after 1890. This was followed shortly by commercial coal mining which led to increases in population and industrial development. The greatest concentration of industrial expansion occurred at Clarksburg which became the center of population, employment and economic activity. Coal mining and coal related industries became the largest employer and the most important influence in the region's economy during the 1920s and 1930s. Since that time the dependency of the economy on coal has made it very sensitive to changes and trends in the national coal industry.

Land Use

Land use is dictated to a great extent by local topographic conditions. Level or nearly level land of sufficient area to support most of the intensive land uses is generally confined to flood plains and terraces of the major streams. Thus, the intensive agricultural, industrial, commercial and residential uses are commonly confined to stream valleys.

Of the total 250,890 acres in Lewis County about 7% is cropland, 29% is pasture, 54% is forest, 2% is urban and built-up, and 9% is of miscellaneous usage.

Population Characteristics

The 1970 population of Lewis County was 17,847 which has consistently decreased since the 1940 census year when the population was 22,271. Population declines in Lewis County have been associated with declining employment opportunities and generally reflect an out-migration of young adults seeking employment elsewhere. In 1970, 16.6% of the Lewis County population was 65 years of age or older.

GENERAL ENVIRONMENTAL IMPACTS FROM SURFACE COAL MINING

The low wall conveyor haulage demonstration program is an adaptation of the haulback mining method. The haulback method has become a successful technique for surface coal mining throughout the Appalachian region. It offers many advantages environmentally and will meet the two stringent provisions in the Surface Mining Control and Reclamation Act of 1977, Public Law 95-87: the requirement that surface mined land be returned to the approximate original contour, and the requirement that no spoil be pushed over the mining bench on the slopes below. Instead of casting overburden from above the coal seam down the hillside as occurs in the conventional contour mining method, the overburden is hauled back and placed in the pit of the previous cut. In this method, no spoil is deposited on the downslope below the coal seam; topsoil is saved; overburden is removed in blocks and deposited in prior cuts; the outcrop barrier is left intact; and reclamation is integrated with mining.

Advantages of the haulback method over conventional contour mining have been demonstrated at producing mines under varying conditions. These advantages are as follows:

- Spoil on the downslope is eliminated and since no fill bench is produced, landslide hazards have been greatly reduced.
- Mined area is completely backfilled and no highwall is left exposed, making the area more aesthetically acceptable.
- The amount of disturbed land is cut down by two-thirds at any given time reducing the amount of unreclaimed area requiring bonds to be posted.
- Reclamation costs are lower since the overburden is handled only once.
- Slope is not a limiting factor.
- Regular explosives are used, but blasting techniques had to be developed to keep shot material on the permit area.

- Size of disturbed area drainage is generally smaller normally allowing size and number of control structures to be reduced, and total life of structure usefulness to be increased.
- Backfilling and seeding are on a continuous cycle, sharing the same production schedule as the coal-stripping functions.
- Acid mine drainage, siltation and erosion may be significantly reduced because of concurrent reclamation with mining.
- Overburden can be segregated, topsoil can be saved and toxic materials can be deeply buried.
- Equipment, materials and manpower are concentrated, making for a more efficient operation.

Certain disadvantages can be attributed to the haulback method. These are:

- Complicated and time-consuming methods of drilling and blasting are involved to maintain control of the overburden and get proper fragmentation for the particular types of equipment being used in spoil removal.
- Economics may limit use of haulback method to low overburden-to-coal ratios.
- Logistics of timing the blasting, stripping, mining, and hauling sequences in the truck haulback method can become complicated.
- Investment costs for special haulage equipment are increased.
- Pit congestion in the truck haulback method is increased, which could increase safety hazards.

The low wall conveyor haulage technique is an experimental program to demonstrate the use of portable conveyors as a refinement of the haulback method of surface coal mining. As such, this technique has potential environmental, economic and safety advantages over the truck haulback method. The potential environmental advantages of the conveyor haulback over the truck haulback are: the length of open pit is less, thus decreasing the duration of time the pit is exposed to the elements; less heavy duty haulage equipment is used; routing of topsoil and burial of toxic materials becomes easier by use of a radial stacker; and backfilling and grading operations are more efficient with the use of a radial stacker. Economically, investment in portable conveyors and maintenance of the machinery should be less than the costs associated with the purchase and maintenance of haul trucks and scheduling should be somewhat less complicated. The inherent congestion of the pit area with the truck haulback method is greatly reduced using the conveyor haulage method, thus, reducing safety hazards.

Generally, environmental impacts could result from any one of the sequential phases of the conveyor haulback surface mining program. The degree to which they impact the environment depends to a great extent on the preliminary planning and setup of the mining operation, care in constructing and maintaining environmental safeguards, adhering to operational guidelines to minimize environmental damages, and timeliness in reclamation and revegetation of the worked-out pit area. The following discussion will focus on general impacts resulting from surface mining operations.

HAULROAD CONSTRUCTION

Environmental impacts due to haulroads can occur during the initial construction, during usage by haul trucks and after cessation of mining operations. Haulroads constitute 10% or more of the area directly disturbed by the surface mining operation. In many cases haulroads are found to be a large contributor of sediment. Poor alignment, excessive grades, insufficient strength and durability, and poor drainage all lead to increased sediment yield. There are four distinct areas on haulroads from which the movement of material can occur. These are the roadway surface, the cut slope, the roadway ditch and the fill slope.

Wildlife movement may become disrupted by construction of the haulroad and traffic usage. Haulroads could in some cases provide a barrier to wildlife movement along established game trails. Clearing vegetation along the road right-of-way also removes some of the wildlife habitat.

Fugitive dust could become a problem during dry spells if care is not taken to keep the road surface watered down.

EROSION AND SEDIMENTATION

Erosion and sedimentation are natural processes that are usually gentle actions releasing controlled amounts of silt from watersheds to receiving streams. Surface mining activities could accelerate these natural processes and short duration, high intensity storms could become a violent force moving thousands of tons of soil in a brief period of time. Damages from increased sediment yields are reflected in the reduced carrying capacity of streams, clogged reservoirs, destroyed habitat for fish and other aquatic life, filled navigation channels, increased flood crests, degraded facilities for water-oriented recreation, increased industrial and domestic water treatment facilities, nutrient enrichment of lakes that promote algae growth, destroy crops, and reduce productivity of flood plain soils.

The susceptibility of surface-mined land to erosion depends on the physical characteristics of the overburden, degree and length of slope, climate, amount of rainfall, and type and percent of vegetative cover. Sediment yield from the mined watershed is the result of erosion from the disturbed area and the movement of this eroded material from the watershed. Sediment yield varies, not only with the extent of disturbance within the watershed, but also with the proximity of the disturbed area to natural stream channels.

Drainage diversion and sediment control structures are normally used to decrease or eliminate accelerated sediment yield from surface mining operations. These structures are in the form of sediment ditches, sedimentation ponds, check dams, culverts, and diversion ditches.

CLEARING AND GRUBBING

Clearing and grubbing result in the loss of habitat for wildlife over the disturbed area. Because the vegetative cover is stripped, the wildlife inhabiting the area will be displaced. The loss of vegetative cover also exposes the disturbed area to erosion unless the subsequent phases of the surface mining operation follow close behind. Generally, the timber is harvested commercially prior to clearing of brush and grubbing of stumps and roots. As the mining operation advances along the coal seam the brush and stumps are pushed downslope and stockpiled along the outer edge of the disturbed area. This material is later placed in the worked out pit and covered with overburden during the backfilling operation. Stockpiling of brush and stumps on the lower slopes of the disturbed area has proven to be an effective filtering device to trap sediment eroded from the disturbed area. However, the aesthetic quality of such practices may be somewhat negative.

INITIAL CUT

The initial cut could potentially result in one of the larger environmental impacts of the surface mining operation. This arises because the initial cut spoil must be placed in an area which would not otherwise be disturbed by the surface mining operation. Unless a previously disturbed area is available, the initial cut spoil is placed in a hollow or a valley fill is constructed. This not only increases the disrupted area, but if the fill is not properly constructed drainage problems could result in erosion and sedimentation impacts.

BLASTING

When a blast is detonated the bulk of the energy is consumed by fragmentation and some permanent displacement of rock close to the location of the drilled holes containing the explosive occurs. This activity normally occurs within a few tens of feet of the blast hole. Leftover energy is dissipated in the form of waves traveling outward from the blast, either through the ground or atmosphere. Ground waves produce oscillations in the soil or rock which they pass, with the intensity of these oscillations decreasing as distance from the blast increases.

In cases where structures are built on property adjacent to surface mining operations damage from blasting vibrations could occur. However, advances in blasting technology and a more knowledgeable blasting profession have minimized real structural damages. Vibration levels that are completely safe for structures may be annoying and unpleasant. Though no actual damage occurs, air blast pressures may cause windows to rattle and the loud noise can be intolerable.(3)

Weather conditions can increase airborne noise from blasting. When temperature inversions prevail noise levels are much higher. This condition exists frequently in early dawn and after sundown. On foggy, hazy, or smokey days blasting noise is amplified, and noise will be carried in the direction of the wind.

When blasting is done in congested areas or close to a structure, stream, highway, or other installation, fragments thrown by the blast may also be a problem.

Other significant but less notable impacts from blasting are disruption of wildlife, formation of blasting residues, disruption of aquifers, surface water alterations, formation of landslides, and generation of fugitive dust.

OVERBURDEN REMOVAL AND BACKFILLING

In overburden removal, transportation and backfilling operations, the shorter the length of the open pit and duration that the open pit is exposed, the less will be the environmental damage. The primary reason is that revegetation can follow closely behind the stripping operation and the exposed area is smaller at any given time, decreasing the area susceptible to erosion and transport of sediment, and leaching and movement of toxic substances.

During this phase of the operation the topographic features and characteristics are changed, and the original geologic overburden profiles are destroyed. Backfill material is generally a hetrogeneous mixture of rock fragments, rock particles and soil-sized material derived from the overburden strata. If care is not taken to selectively place undesirable material, establishing vegetation in later phases may be difficult. Also, toxic materials, subject to being leached from the fill, may be placed near the surface of the fill.

Care must also be taken in stabilizing the fill and providing adequate drainage around the fill to minimize the sediment yield or prevent massive failures.

Equipment usage is heavy during overburden removal; hauling and backfilling could disrupt wildlife and exhaust emissions could result in degradation of the air quality.

COAL REMOVAL

Coal removal and hauling could result in about the same environmental impacts as overburden removal. These impacts include exposing toxic materials that can be leached from the pit area, generation of dust, and disruption of wildlife from equipment noise and traffic. Coal haul trucks traveling on the haulroad could also be a source of sediment to the area drainage.

RECLAMATION AND REVEGETATION

Reclamation should follow closely behind the mining operation because the freshly placed backfill material is easier to grade, handle and plant. During the planning stages the reclamation plan should have the same priority as the mining plan. Reclamation should be planned even to the extent that it controls the mining methods and equipment to be used to do the total job.

Revegetation of the reclaimed area is one of the most important operations in surface coal mining to minimize the environmental impact. Experience has shown that natural revegetation is a very slow process. Native vegetation may not even be compatible with the environment on the mined area, because of the possibility of low nutrient levels or toxic spoils. Furthermore, the surrounding vegetation may not have pioneer- or primary-invader-type cover.

The main factors associated with the establishment and growth of vegetation on reclaimed surface mines are the chemical properties, topographic factors and physical properties. High acidity or alkalinity in mine spoil when placed too near the surface of the reclaimed area could be toxic to vegetation. Steepness and length of the reclaimed slope are also important. As the steepness and length of the slope increase, the amount of erosion and soil loss increases, making it difficult to revegetate. Steepness of the slope also affects land uses and machinery operation. A 30% slope is the maximum for farm use such as pasture, hayland or row crops. Physical properties of the spoil such as stoniness, texture, color, and nutrients could have an effect on revegetation efforts. Stoniness and texture influence vegetation mainly through their effects on spoil moisture, aeration and compaction. Color differences have an effect on soil temperature and moisture.

SPECIFIC ENVIRONMENTAL IMPACTS FROM THE PROPOSED DEMONSTRATION PROGRAM

IMPACTS ON THE NATURAL ENVIRONMENT

The low wall conveyor haulage demonstration program will disrupt 84 acres of existing hardwood forest and meadow land. The disturbed land consists of 64 acres for mineral extraction, 10 acres for haulroads, 5 acres for valley fill and 5 acres for sedimentation ponds. All trees, brush, grass and topsoil will be removed from the disturbed area. Topsoil will be temporarily stockpiled, to be replaced during reclamation. The existing climax type forest vegetation will be replaced during reclamation by grass type vegetation.

Since the land will be reclaimed to approximately its original contour, no radical topographic alterations will be apparent. However, construction of the valley fill, which is small by valley fill standards, will alter the topographic characteristics of 5 acres of land. The valley fill will increase the slope at the head of the valley and shorten the valley to some extent.

The original geologic structure along the coal crop line in the mineral extraction area, consisting of 64 acres, will be totally disrupted. Surface texture, however, will not be noticeably affected due to topsoil replacement and grading.

The appearance of the surface mine site will be changed due to substitution of grass type vegetation for a climax type forest vegetation. Land use potential of the disturbed area will also be changed for the same reason. The reclaimed and valley fill areas will be more amenable to grazing as a result of surface mining activities.

The 15 acres involved in haulroads and sedimentation ponds will permanently alter existing usage if they remain after mining activities have ceased. After completion of mining the haulroads will be reclaimed unless the landowner requests they be left intact, in which case they can be used for access to a previously inaccessible area.

Among the objectives of state and Federal surface mining reclamation legislation is to minimize the aesthetic impact and to return the disturbed land to a potentially viable land use. As such, aesthetic quality and potential land use of surface mined areas are given much attention during review of permit applications.

SURFACE-WATER QUALITY IMPACTS

Surface-water quality impacts could arise from the disturbance of 84 acres of the Little Skin Creek watershed. These impacts would be in the form of increased sediment yield and/or addition of chemical constituents to the surface waters, thereby, degrading its quality.

Sedimentation and Erosion

As described in the General Impacts section increased sediment yield from the surface mined watershed is the result of erosion from the disturbed area and the movement of this eroded material from the watershed. Little Skin Creek would be the initial receptor of any eroded material, but eventually Skin Creek and West Fork River could also receive some of the sediment load. Increases in sediment yield from the surface mining operation could alter the hydrologic regime of these streams, thus affecting downstream water uses and aquatic resources.

The primary sources of sediment will be the mineral extraction area during the mining operation and prior to establishment of vegetation; the valley fill during construction and prior to establishment of vegetation; and, the haulroad during all phases of surface mining activities.

The physical characteristics of the overburden is such that during blasting, overburden removal and backfilling, a large portion of the material will be fractured or pulverized to the extent that it is readily transportable by surface water runoff. The overburden material is comprised almost exclusively of soft shale and sandstone which is easily broken down into silt and sand size particles. Degree and length of slope, and vegetation between

Little Skin Creek and the disturbed area are conducive to the entrapment of sediment that might be eroded from the disturbed area. Maximum slopes encountered at the site are on the order of 30%, however, drainage from these moderately steep slopes would be naturally directed into secondary drainages with slopes of 10° or less. The shortest downslope distance to Little Skin Creek from the mineral extraction area occurs along the eastern end of the site (Figure 2), where the distance to Little Skin Creek is 800 ft and the slope is about 15%. Along most of the surface mining area the distances to Little Skin Creek are 1000 ft or greater and the degree of slope is less than 15%, thus providing a large buffer zone between the disturbed area and Little Skin Creek where run-off velocities will not become excessive and where the length of slope will enable material to be trapped before reaching Little Skin Creek.

Vegetation below the mineral extraction area will not be destroyed during surface mining operations and experience has shown that such a protective, vegetated area between the disturbed area and natural drainways usually prevents sediment-laden water from reaching streams.

In addition to these natural barriers to increased sediment yields, structural measures will also be taken at the demonstration site to control water flowing into, within and from the surface mining area. The entire disturbed area drainage will be controlled by drainage or sediment control structures. These structures described in the Description of Demonstration section include drainage diversion ditches along the highwall, sediment ditches along the outslope side of the pit area, sedimentation ponds and a stone drainage structure in the valley fill. Two sedimentation ponds with a combined storage capacity of 6 ac-ft will control drainage from 48 acres of disturbed area. Two sediment ditches on the outslope side of the mine pit have a combined storage capacity of 3.94 ac-ft and control drainage from 31.5 acres of disturbed land. The haulroad ditches have a combined storage capacity of 0.56 ac-ft and control the drainage from 4.5 acres of disturbed land.

The mining method employed should also minimize impacts from increased sediment yield. Although the total mineral extraction area will encompass 64 acres, only about 500 ft of mine pit will be open at any given time, greatly reducing the area's susceptibility to erosion of mine spoil. Backfilling, grading, topsoil replacement and revegetation will follow closely behind overburden removal. Using the conveyor haulage system, reclamation of the worked out pit becomes an integral part of the entire mining operation and cannot lag behind overburden removal because of the restricted length of conveyor sections.

Chemical Quality

Chemical quality of surface waters of Little Skin Creek and, to some extent, Skin Creek could be adversely affected by the surface mining operations. The chemical quality impact would result from exposing pyritic material during overburden removal which when in contact with air oxidizes to produce ferrous iron and sulfuric acid. Consequently, a low pH water is produced (2 to 4.5). At low pH levels, heavy metals such as iron, manganese, aluminum, copper and zinc, which are found at low concentrations in water, go into solution and can further pollute the water. Water of this type supports only limited aquatic plants and will not support fish life. It also corrodes metal piers, culverts, increases the cost of water treatment for municipal and industrial uses, and leaves the water unacceptable for recreation uses.

The amount and rate of acid formation, and the quality of water discharged depend on the amount and type of pyrite in the overburden and coal, time of exposure, characteristics of overburden, and amount and pattern of run-off. Since oxidation due to exposure to the atmosphere is the primary reaction during early acid formation, the less time pyritic material is exposed to air the less acid is formed. A positive preventive measure is to cover pyritic materials as soon as possible with earth, which serves as an oxygen barrier.

Chemical treatment from the low wall conveyor mining operations will not be required since the overburden is alkaline in nature. Additionally, other surface mines in the area do not currently require water treatment. In case unexpected pollution problems should arise soda ash briquettes will be kept in supply for emergency situations. The mining method, the low wall conveyor haulage, also minimizes the length of time overburden material is exposed and the length of pit is small, thus, further decreasing the possibility of acid mine drainage.

GROUND-WATER QUALITY IMPACTS

The low wall conveyor haulage demonstration program can alter ground-water characteristics in three ways: it can intercept the water table with the possible affect of lowering it; the recharge characteristics can be altered after mining and reclamation; and the chemical quality of the ground water can be affected from percolation through the soil material.

If the demonstration site is located in a ground-water recharge area, that is, an area in which surface waters percolate into the ground-water system, the recharge characteristics may be affected after backfilling and reclamation, either because the coal seam has been removed or because the spoil has different permeability characteristics than the overburden.

Oxidation of acid-producing materials, if present, is unlikely because of the relative lack of air in the spoil profile, but flow of the ground water through spoil materials could result in chemical changes due to dissolution of soluble minerals or trace elements.

Surface mining activities are expected to intercept ground water which could result in lowering of the water table in the mining and adjacent areas. This lowering of water table could adversely affect domestic water wells by decreasing supply in areas adjacent to the demonstration site. The extent of this lowering of the water table, if any, is believed to be minor because of the relatively small area to be disturbed, the abundance of surface water, and the coal seams in this area are too thin to act as aquifers.

Because of the relative lack of information on surface mining effects on ground water, a ground-water monitoring program will be conducted during and after surface mining operations. This program is discussed in the Environmental Monitoring section of this report.[3]

AIR QUALITY IMPACTS

Air quality impacts from the low wall conveyor haulage demonstration program could result from the generation of noise and air pressure during over-burden blasting, increase in particulate matter in air from generation of fugitive dust, and increase in air pollution emissions from equipment usage.

Noise and air pressure from blasting can be loosely classified as air quality impacts. Blasting noise and air shock can be troublesome if people live within a radius of a few miles of the blasting site, and wildlife patterns in the vicinity of the site can be disrupted. The magnitude of the problem is dependent primarily upon the depth and type of overburden being blasted, the powder factor (pounds of explosive used per bank cubic yard of overburden), the amount of explosive detonated at a given instant, the population density in the vicinity of the blasting site and the time of day blasting takes place.

Blasting procedures used and precautions taken during the low wall conveyor demonstration program should minimize any adverse impacts from blasting. Overburden material to be blasted is comprised of fractured sandstone and soft shale which greatly reduces the required explosive loadings. The demonstration site is located far from any high density population areas and the noise level from blasting will be decreased due to restriction of blasting to daylight hours after sunrise and before sunset. Warnings of blasting will also be posted around the demonstration site. Millisecond delays in detonating rows of explosives will be employed to further decrease the noise level and air shock.

Drilling and blasting, and movement of heavy equipment during the surface mining operation can generate fugitive dust which increases particulate matter in air. Generation of fugitive dust in an operation of this size, however, is considered to be insignificant. The low wall conveyor haulage demonstration site is located far from any high-use areas and the climate (precipitation) is not generally conducive to generation of fugitive dust. Wind erosion of spoil and topsoil in the disturbed area will also be minimized as a result of the conveyor haulage method where the length of open pit is smaller than conventional surface mining methods and reclamation and revegetation follow closely behind overburden removal. Use of conveyors for transportation of spoil material to the backfilled area could also decrease generation of fugitive dust because haul truck movement in this operation is greatly reduced.

As with generation of fugitive dust, increased air pollution emissions from equipment usage is considered insignificant and will not adversely affect air quality. Use of the conveyor haulback method will likely result in less air pollution emissions when compared to truck haulback methods because a single power generation plant will be used to power conveyors instead of using haul trucks for spoil haulback.

BIOLOGICAL RESOURCES IMPACTS

Terrestrial

Removal of 84 acres of existing forest will have an impact on local wildlife. The land configuration will be altered and the established vegetation will be modified for decades. Reclamation will produce a new ecosystem, that is, vegetation will go from climax forest to new grass lands, each providing a different habitat for wildlife. These changes are known to have effects on wildlife populations, movement patterns and community structure.

Important species that will be affected by the surface mining operations are local deer population, gray fox, and raccoon. The gray fox is a major predator in the area of the demonstration program and any impact to its population structure or movement patterns could be reflected in other trophic levels. The ruffed grouse, an important game bird, is found at the demonstration site. Since it is primarily a forest species removal of its principal habitat will impact its population structure.

The removal of 84 acres of forest from the demonstration site will also impact the breeding birds by totally removing their habitat. The birds may move to adjoining areas which would have a magnifying effect on these areas caused by crowding and location of suitable nesting sites.

Aquatic

Relatively small changes in water quality can alter stream habitats, resulting in population and community structure shifts. The magnitude of these changes is usually dependent on the stability and stress levels being exerted on the stream community before the new (mining) conditions are applied. The existing water quality of Little Skin Creek is generally good, so that any changes in water quality due to the low wall conveyor haulage demonstration program could result in associated impacts on the aquatic ecosystem of Little Skin Creek. Acid mine drainage and generation of mineralized water from the mining site are not considered to be significant because of the lack of acid drainage in other mining sites in the area. Use of the conveyor haulage method should also minimize any adverse effects to water chemistry because the open pit is exposed to the elements for only a short time.

The physical components of the stream also have a major influence on the type, number, diversity and health of organisms living there. In addition to water chemistry, stream flow, bathymetry and stream bed characteristics play a very important role in determining the biotic makeup of the stream. Drainage patterns from the demonstration site into Little Skin Creek will not be materially changed, so that flow conditions of Little Skin Creek will not be altered as a result of surface mining activities. Sediment yield rates from the disturbed area will be controlled by construction of drainage and sediment control structures, thus minimizing adverse effects of increased sediment yields on the biotic makeup of Little Skin Creek.

SOCIO-ECONOMIC IMPACTS

It is improbable that the low wall conveyor haulage demonstration program would affect the population size or distribution of Lewis County, nor would it have an effect on age structure or population mobility. Because the demonstration program would result in comparatively few workers, the impact on employment would be negligible.

CULTURAL RESOURCES IMPACTS

No archaeological or historical resources are known to exist within or immediately adjacent to the demonstration site, and it is unlikely that any such resources would be encountered during surface mining activities.

ENVIRONMENTAL MONITORING PROGRAM

A comprehensive environmental monitoring program will be conducted during the low wall conveyor haulage demonstration to evaluate the environmental impacts.[4] The monitoring program is divided into three phases, each consisting of several tasks. Phase I is a 1-year effort to obtain background data on environmental conditions during the first year of the demonstration program. Phase II will monitor environmental changes in unaffected areas, active mining areas, and reclaimed areas. Phase III will be concerned with post mining effects on wildlife movement and habitat. Phase I and Phase II are described in the following paragraphs.

SYSTEM MONITORING

Unit operations of the surface mining activities will be monitored in terms of shifts worked, equipment utilized, manpower, fuel consumed, downtime, and cycle times. Operations include clearing and topsoil storage, drilling and blasting, overburden removal, haulroad construction, coal removal, grading, and revegetation.

HEAD-OF-HOLLOW FILL STABILITY MONITORING

The environmental integrity and stability of the valley fill will be monitored for 1 year with the use of settling plates at four locations in the fill.

SURFACE-WATER QUALITY

Surface-water quality monitoring of the two sedimentation ponds and Little Skin Creek will be conducted. Continuous water samplers of influent and effluent of each sedimentation pond will be established to obtain daily, weekly, and monthly composite samples. Weekly composite samples of influent and effluent will be analyzed for pH, total suspended solids, alkalinity (total), acidity (hot), total iron, sulfate, and turbidity. In addition to chemical parameters described above, monthly composite effluent samples will be analyzed for total solids, calcium, magnesium, manganese, aluminum, copper, zinc, cadmium, nickel, dissolved iron, and specific conductance. Analyses of sedimentation pond data will include the evaluation of baseline water quality and quantity; surface runoff rates before, during and after mining; measurement of sedimentation ponds' removal efficiency and runoff control; and, assessment of silt and chemical loading reaching Little Skin Creek.

Monitoring of Little Skin Creek is designed to assess the impact of the demonstration program on Little Skin Creek watershed. Monthly samples at five stations will be taken to obtain data on flow and chemical characteristics. Three samples will be taken at each station. Chemical analyses of water grab samples will be the same as those for the monthly composite samples from the sedimentation ponds.

GROUND-WATER MONITORING

Three monitoring wells will be drilled for the purposes of defining aquifers, defining ground-water productivity and monitoring water table level. Each well will be pumped at least on a quarterly basis for a 4 hr period to determine the static water level (twice per month), pumping rate, drawdown rate, water level at end of pumping, time for recovery, specific capacity, specific capacity index, transmissivity, permeability and saturated thickness.

Water quality samples will be taken on a monthly basis from each monitoring well and analyzed for the same chemical parameters as the monthly composite surface-water samples.

In addition, domestic wells will be monitored where possible on a quarterly basis for the same parameters as the site wells.

AQUATIC ECOLOGY

An aquatic ecology survey will be taken to evaluate the influence of mining on the physical conditions of the stream and benthic and fish community of Little Skin Creek.

The physical survey consists of obtaining velocity profiles, bathymetric profiles and stream bed characteristics at five sampling stations on Little Skin Creek. Bathymetry and flow data will be obtained on a quarterly basis and stream bed characteristics will be qualitatively analyzed on a monthly basis.

The quarterly benthic survey will be conducted at five stations (three samples per station) and will consist of an analysis of species composition, relative abundance, dominance, density, diversity index, biotic index, and equitability.

The fishery survey will also be conducted on a quarterly basis and will consist of electroshocking a 100 m zone at each of five stations. The analysis will include species composition, weight-length, condition factor, diversity index, dominance, biomass, redundancy, equitability and population estimate.

WILDLIFE SURVEY

A wildlife survey will be conducted to include deer movement and patterns, ruffed grouse survey, radio telemetry of gray fox and raccoon, and a breeding bird survey.

The deer movement and patterns monitoring survey will consist of monitoring and mapping deer trails on a quarterly basis by walking the mine site; establishing three transect lines and recording deer movement activity nine times during the winter; and, making an aerial survey once during the winter to determine the deer population.

A survey will be conducted to determine ruffed grouse population estimates and location of the "drumming logs" during three days in spring.

The movement and activity of the gray fox and raccoon will be monitored by fitting three animals of each species with radio transmitters and tracking them with receivers. The location of these animals will be plotted once every hour during the night, three to four nights a week from August to

February. The analyses will include the movement patterns for each species; influence of active mining on animals activity and movement; influence of reclamation and final land form on animals activity and movement; effects of ponds; and, establishment of any changes in food, habits, daily activity caused by mining, and/or reclamation, land form or site vegetation.

The location and number of breeding birds will be mapped on a weekly basis during the spring.

AIR QUALITY MONITORING

Air quality monitoring in terms of fugitive dust will be conducted during the demonstration program. High volume air samplers and cyclone separators will be used during three 24-hr periods per month to evaluate fugitive dust generated from drilling and blasting, overburden removal, conveyor systems, coal loading, and haulroads. Fugitive dust generated from the mine site, as a whole, will be evaluated by means of placing dust fall buckets at six locations on the mine site and six offsite locations during three 24-hr periods per month.

One onsite and one offsite biological-vegetative test plot will be established to evaluate vegetative damage from the mining activities.

One recording rain gage will be established on the site to record frequency and rate of precipitation.

AERIAL PHOTOGRAPHY

Prior to any mining on the site, low-level black-and-white stereo and color infrared aerial photographs with a scale of 1 in. equals 200 ft will be taken.

ADVERSE IMPACTS THAT CANNOT BE AVOIDED SHOULD THE PROPOSED DEMONSTRATION PROGRAM BE CONDUCTED

Table 3 is a summary of possible adverse environmental impacts, causal factors and specific mitigating measures employed in the low wall conveyor demonstration program. In some cases adverse environmental impacts cannot be identified or quantified. The environmental monitoring program to be conducted before, during and after surface mining activities is designed to provide the information necessary to evaluate the environmental impacts in these "gray" areas. It should be noted that the adverse impacts described are similar in nature to those that would occur with truck haulback, but the magnitude of these impacts would generally be less. The following paragraphs summarize known and possible adverse impacts that will result from the low wall conveyor haulage demonstration program.

NATURAL ENVIRONMENT

The primary adverse impacts of the low wall conveyor haulage demonstration program on existing natural environmental conditions will be in the form of changes in topography, disruption (temporary or permanent) of natural drainage patterns, removal of vegetation, loss or change in viable land uses, and change in appearance of the land. The valley fill which will be constructed of initial cut spoil will slightly alter the topographic characteristics of 5 acres of land. Temporary diversion of natural drainage patterns will occur during the mining operation and some permanent diversion and temporary storage of runoff from 84 acres of disturbed area will occur to prevent sediment yield increases. Eighty-four acres of existing climax forest type vegetation will be replaced by grass type vegetation which will change the appearance of the area and could also change the existing land use from a forest habitat to an open grass habitat. Approximately 15 acres of existing forest and grass land, to be used for haulroads and sedimentation ponds, may or may not be reclaimed after mining activities have ceased, depending on land owners preference.

TABLE 3. Summary of Possible Adverse Impacts, Causal Factors and Mitigating Measures in Low Wall Conveyor Haulage Demonstration Program

Environment	Environmental Impact Category	Specific Environmental Impact	Uncontrollable Causal Factors	Controllable Causal Factors	Specific Mitigating Measures Employed	Possible Adverse Impacts That Cannot Be Avoided
Natural Environment	Topography	Major change in topography	•Natural topography •Spoil swell factor	•Method of spoil placement	•Restoration of original contour of mineral extraction area (64.05 acres) •No downslope spoil placement •Construction of valley fill for initial cut to account for spoil swell (4.85 acres)	•Valley fill will slightly alter topography of 4.85 acres
	Drainage	Disruption of natural drainage patterns	•Natural drainage patterns •Precipitation	•Method of spoil placement	•Site will be restored to original contour •Culverts and drainways will be used to prevent disruption of natural drainage patterns across haulroads	•Some permanent diversion and temporary storage of runoff to prevent sediment yield increases
	Vegetation	Removal of native vegetation	•Native vegetation	•Overburden removal •Backfilling and revegetation	•Topsoil will be replaced •Area will be revegetated with grass type vegetation	•Climax forest type vegetation will be replaced by grass type vegetation •Haulroads and sedimentation ponds may not be reclaimed (15.10 acres)
	Land-use	Loss or change of viable use	•Natural topography •Native vegetation •Original land-use	•Reclamation practices	•Mineral extraction area will be restored to original contour •Disturbed area will be revegetated •Haulroads will continue to provide access to previously inaccessible area	•Disturbed area (84 acres) will be changed from forest type habitat to grassland type habitat
	Appearance	Changed appearance	•Natural topography •Native vegetation	•Mining practices •Reclamation practices	•Open pit will be only 500 feet in length •Backfilling, grading and revegetation will be performed simultaneously with overburden removal	•Valley fill will alter appearance of 4.85 acres •Vegetation substitution will change appearance of 84 acres
Surface Water	Physical Quality	Sedimentation and erosion	•Precipitation •Natural topography •Natural drainage patterns •Natural vegetative density •Physical characteristics of overburden	•Length of open pit •Overburden fracturing •Spoil placement and handling method •Length of time between overburden removal and reclamation •Runoff in disturbed area •Revegetation practices	•Maximum open pit length will be 500 feet •Mine pit will be backfilled to original contour •Overburden removal, backfilling, grading and revegetation are conducted simultaneously •Natural filter zone between disturbed area and Little Skin Creek will not be disturbed •Sediment and drainage control structures will be constructed to intercept entire disturbed area drainage •Topsoil replacement and revegetation of reclaimed area will be integral part of mining operation •Sediment yield monitoring of influent and effluent in sediment ponds and Little Skin Creek will be conducted during and after mining activities	•Although extensive precautions will be taken to control sediment yield from the disturbed area it is inevitable that some sediments will be discharged to natural drainways during operation and for some time after operation of the surface mine. No determination has been made as to the quantity of yield. The monitoring program, however has been designed to quantify the yield and determine its environmental impact.
	Chemical Quality	Acid or mineralized surface water	•Precipitation •Runoff •Physical characteristics of overburden •Presence of acid forming materials	•Spoil placement practices •Length of time between overburden removal and reclamation •Change in permeability of spoil	•Maximum open pit length will be 500 feet •Backfilling and reclamation are integral part of mining operation •Sodium ash briquettes will be on hand for emergency situations •Sedimentation pond and Little Skin Creek chemical quality monitoring will be conducted during and after mining activities •Drainage control structures will be constructed to intercept entire disturbed area drainage •Water quality monitoring will be conducted	•The presence of acid forming materials is doubtful; however, there is a slight possibility that acid mine drainage could occur. The environmental monitoring program should detect changes in chemical quality of surface waters so steps can be taken to correct the situation should it occur.

TABLE 3. (contd)

Environment	Environmental Impact Category	Specific Environmental Impact	Uncontrollable Causal Factors	Controllable Causal Factors	Specific Mitigating Measures Employed	Possible Adverse Impacts That Cannot Be Avoided
Ground Water	Quantity and movement	Lowering of water table	•Natural height of water table •Rates and directions of natural ground-water flow	•Interception of ground water by open cut	•Length of open pit will be only 500 feet •Ground-water levels will be monitored	•Unknown but ground-water monitoring program should provide a quantitative assessment
		Altered flow rates	•Overburden characteristics •Aquifer characteristics	•Replacement of coal seam by spoil material •Differences in percolation rates for overburden and spoil	•Spoil material will be selectively placed •Topsoil will be replaced •Original contour will be restored •Groundwater recharge rates will be monitored	•Unknown but groundwater monitoring program should provide a quantitative assessment
	Quality	Mineralized ground water	•Chemical characteristics of spoil •Precipitation •Aquifer characteristics	•Same as above	•Same as above	•Unknown but ground-water monitoring program should provide a quantitative assessment
Air	Noise levels	Blasting noise	•Overburden characteristics	•Spacing and loading of blast holes •Blasting sequence	•Restricting blasting to daylight hours •Delays in detonation sequence •Use of ANFO explosives •Posting warnings •Noise levels will be monitored	•Disruption of wildlife movement patterns
	Air Quality	Fugitive Dust	•Overburden characteristics •Wind •Precipitation	•Blasting practices •Equipment usage	•Conveyor haulage method •Use of ANFO explosives •Fugitive dust levels will be monitored	•None
		Air pollution emissions	•Wind •Existing air quality	•Equipment type and usage	•Use of conveyors	•None
Biological Resources	Terrestrial	Loss of habitat	•Natural vegetation •Existing wildlife density and community structure	•Reclamation practices	•Disturbed area will be restored to original contour •Grass revegation will provide feed for local deer population •Ruffed grouse and breeding birds surveys will be conducted	•84 acres of ruffed grouse and breeding birds habitat will be lost
		Disruption of wildlife movement patterns	•Existing wildlife movement patterns	•Extent of disturbed area •Reclamation practices	•Local deer movements and patterns will be monitored •Gray fox and raccoon movement and activity survey will be conducted	•Disruption of movement patterns of local deer population, gray fox and raccoon could occur during and after surface mining activities have ceased
	Aquatic	Loss or change in aquatic community	•Stream flow characteristics •Existing aquatic community	•Drainage patterns •Sediment yield •Acid and mineralized water	•Drainage and sediment control structures will be constructed •Stream characteristics will be monitored and, benthic and fishery surveys will be conducted	•Unknown but Little Skin Creek will be monitored to determine any specific adverse aquatic impacts

WATER QUALITY

Degradation of water quality is one of the principal environmental concerns from surface mining of coal. Adverse water quality impacts result specifically from increases in sediment yield from the disturbed area and addition of acid or mineralized water to local drainages. Extensive precautions will be taken during the low wall conveyor haulage demonstration program to control runoff and trap sediment before reaching Little Skin Creek. However, some increase in sediment yield from the disturbed area during and for some period of time after surface mining activities will likely occur. Increased sediment yield from the disturbed area could alter the physical characteristics of Little Skin Creek and adversely affect the aquatic ecosystem of the creek. Increases in sediment yield, however, are expected to be small and of short duration so that the associated adverse impacts will be small. Based on the alkaline nature of soils, existing water quality and experience of other surface mining activities in the vicinity of the demonstration site, acid and mineralized drainage from surface mining activities will be slight.

BIOLOGICAL RESOURCES

Loss of 84 acres of existing forest will adversely affect the local wildlife population by depriving them of their natural habit. The habitat loss will affect the local whitetail deer population, gray fox, raccoon, ruffed grouse and breeding birds that presently inhabit the area. This adverse effect will be mitigated to some extent by substitution of the destroyed forest habit by creation of a grass land habitat during reclamation.

Noise from drilling and blasting, and equipment usage could result in short-term disruption of wildlife in the area adjacent to the demonstration site.

ALTERNATIVES TO THE PROJECT

The low wall conveyor haulage technique is the result of an extensive research effort to aid mine operators in increasing production by reducing pit congestion while improving land restoration capabilities. The low wall conveyor haulage technique has been developed by Skelly and Loy, Engineers-Consultants for the United States Department of the Interior, Bureau of Mines, and United States Department of Energy. The demonstration program is the final phase of a multi-phase program including the following; development concepts for block-cut mining systems; engineering evaluation to determine economic and technical feasibility; detailed designs and specifications of recommended concepts; and site selection and field test specifications.

The No Action alternative generally involves "do nothing", however, in this case it indicates only that the low wall conveyor haulage technique will not be used at this site. This site was selected through a screening process of seven coal companies in three states. Implementation of the No Action alternative would result in the selection of an alternate site for the demonstration program.

The low wall conveyor haulage demonstration program is a research project, whereby Grafton Coal Company of Clarksburg, West Virginia will incorporate into its mining operation the use of a portable belt conveyor system for the purpose of hauling overburden material. The surface mining site selected for the demonstration program, under the No Action alternative, would more than likely be mined by Grafton Coal Company using the truck haulback method.

Environmental impacts from surface mining the site with the truck haulback method would be generally of the same nature as with the conveyor haulback method, but the magnitude of these impacts could be different. The principal differences of the conveyor method as described in the section General Environmental Impacts are: the length of the open pit would be less decreasing the length of time the open pit is exposed; less heavy duty haulage equipment is used; routing of topsoil and burial of toxic material becomes easier with use of the radial stacker; and backfilling and grading operations are more efficient with the use of a radial stacker. Congestion in the pit area would also be greatly reduced using the conveyor haulback method, thus reducing safety hazards. Use of haul trucks would generally increase fugitive dust and air pollution emissions; however, these impacts are not considered significant. Increased length of the open pit and duration of time it is open using truck haulback could result in increased sediment yield from the disturbed area with its associated downstream water use and aquatic impacts. Lack of toxic materials excludes low pH waters as a concern for both alternatives. Slight increases in the width of the low wall bench would occur from implementation of the conveyor haulage technique over that of the truck haulback method, but this increase is very slight.

Other mining concepts that were investigated by Skelly and Loy during the Development of New Mining Systems for Highway or Outbound Haulage of Overburden Program were; low wall haulage with in-pit conveyors; highwall haulage with single-lift elevator, double-lift elevator, Z-loda elevator, pipe arch tunnel, and truss overpass; highwall haulage with cross-pit elevator; and, highwall haulage with dragline excavation. In their investigations Skelly and Loy found that conveyor haulage is a technique which reduces costs and inefficiencies while maintaining a high reclamation standard. The low wall conveyor haulage shows a high potential for acceptance by the surface mining industry.

OTHER PROJECTS THAT COULD AFFECT OR BE AFFECTED BY THE LOW WALL CONVEYOR HAULAGE DEMONSTRATION PROGRAM

The only project that could affect or be affected by the low wall conveyor haulage demonstration program is an authorized Corps of Engineers project for construction of Stonewall Jackson Lake on West Fork River at Brownsville, West Virginia. The Stonewall Jackson Lake project for flood protection, water quality control, water supply, and recreation in the West Fork Basin was authorized for construction by the Flood Control Act of 1966, Public Law 89-789, 89th Congress, second session. The project site is located about 3 miles north of the low wall conveyor demonstration site. The pool elevation when the reservoir is full will be at an elevation of 1082.0 ft above mean sea level. At this pool elevation all the upper West Fork River basin low lands in the vicinity of the low wall conveyor haulage demonstration site will be inundated with water, however, none of the disturbed areas would be inundated with water.

Stonewall Jackson Dam will be located at Brownsville. The dam will be a concrete gravity structure, consisting of a non-overflow abutment section on each side of an uncontrolled overflow spillway section, for an overall length of 620 ft, and a maximum height of approximately 95 ft above the streambed. Approximately 20,000 acres of land will be acquired for water storage and for a 5-ft freeboard above the full pool elevation or as necessary to assure a 300-ft horizontal access area around the reservoir. Included in the acquisition would be 1,000 acres to mitigate the loss of wildlife habitat and about 1,140 acres for public recreation.

Environmental impacts which have been identified include the inundation of 3,470 acres of land, the loss of 35 miles of free flowing stream, the probable trend towards expansion in areas surrounding the project, a high degree of recreation potential, improved water quality and flood control, and water supply for downstream areas. Identified adverse environmental effects include inundation of farmland and wildlife habitat, loss of stream fishery, disruption of social services through the relocation of churches, schools and cemeteries, and loss of private residences.

The Stonewall Jackson Lake project is presently in the real estate acquisition phase. The Corps of Engineers anticipates to begin construction in 5 to 7 years. Construction of the project will take at least an additional 5 years before pool storage can begin. The duration of surface mining activities associated with the low-wall conveyor haulage demonstration program is expected to be from 24 to 36 months, commencing in calendar year 1978. Thus, the time schedules of these two projects preclude any conflict that could arise since the low wall conveyor demonstration program will have been completed prior to construction activities of Stonewall Jackson Reservoir.

REFERENCES

1. Federal Register, Tuesday, December 13, 1977, Part II, Department of the Interior, Office of Surface Mining Reclamation and Enforcement, "Surface Mining Reclamation and Enforcement Provisions."

2. U.S. Army Corps of Engineers, Pittsburgh District, November 1975. Review of Environmental Features of the West Fork River Basin Relating to Stonewall Jackson Lake Project.

3. Grimm, E. C. and R. D. Hill, October 1974. Environmental Protection Surface Mining of Coal, National Environmental Research Center, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, OH, Report No. EPA-67012-74-093.

4. Skelly and Loy, Engineers-Consultants, November 1977. Development of New Mining Systems for Highwall or Outbound Haulage of Overburden-Proposed Environmental Monitoring Program for Conveyor Haulback Systems, Prepared for U.S. Department of Energy, Contract No. J0155039.

BIBLIOGRAPHY

American Public Health Association, 1975. Standard Methods for Examination of Water and Wastewater, 14th Edition.

Bisselle et al., August 1975. Resource and Land Investigations (RALL) Program: An Approach to Environmental Assessment with Application to Western Coal Development, Mitre Corporation.

Grier, W. F., C. F. Miller, and J. D. Womach, 1976. Demonstration of Coal Mine Haul Road Sediment Control Techniques, Industrial Environmental Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio, Report No. EPA-600/2-76-196.

Grimm, E. C. and R. D. Hill, October 1974. Environmental Protection Surface Mining of Coal, National Environmental Research Center, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, OH, Report No. EPA-67012-74-093.

Haulback Reclaims Naturally, July 1977, Coal Age, pp. 70-82.

Hem, J. D., 1971. Study and Interpretation of the Chemical Characteristics of Natural Waters, U.S. Geological Survey, Water-Supply Paper 1473, 2nd Edition.

Mathematica, Inc., Mathtech Division, December 1974. Evaluation of Current Surface Coal Mining Overburden Handling Techniques and Reclamation Practices, Prepared for U.S. Department of the Interior, Bureau of Mines, Final Report on Contract No. S0144081, Bureau of Mines Open File Report 28-77.

Reger, D. B., 1916. West Virginia Geological Survey, County Reports, Lewis and Gilmer Counties.

Skelly and Loy, Engineers-Consultants, December 1975. Development of New Mining Systems for Highwall or Outbound Haulage of Overburden-Phase I Report, Develop Concepts for Block-Cut Mining Systems, U.S. Department of the Interior, Bureau of Mines, Contract No. J-155039.

Skelly and Loy, Engineers-Consultants, June 1976. Development of New Mining Systems for Highwall or Outbound Haulage of Overburden-Phase II, Engineering Evaluation to Determine Concept Economic and Technical Feasibility, U.S. Department of the Interior, Bureau of Mines, Contract No. JO 155039.

Skelly and Loy, Engineers-Consultants, December 1976. Development of New Mining Systems for Highwall or Outbound Haulage of Overburden-Phase III Report, Detailed Designs and Specifications of Recommended Concepts, U.S. Department of the Interior, Bureau of Mines, Contract No. JO 155039.

Skelly and Loy, Engineers-Consultants, April 1977. Development of New Mining Systems for Highwall or Outbound Haulage of Overburden-Phase IV Report, Site Selection and Field Test Specifications, U.S. Department of the Interior, Bureau of Mines, Contract No. JO 155039.

Skelly and Loy, Engineers-Consultants, November 1977. Development of New Mining Systems for Highwall or Outbound Haulage of Overburden-Proposed Environmental Monitoring Program for Conveyor Haulback Systems, Prepared for U.S. Department of Energy, Contract No. J0155039.

U.S. Army Corps of Engineers, Pittsburg District, July 1971. Final Environmental Impact Statement, Stonewall Jackson Lake, West Fork River, West Virginia.

U.S. Army Corps of Engineers, Pittsburg District, November 1975. Review of Environmental Features of the West Fork River Basin Relating to Stonewall Jackson Lake Project.

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