THE BUFFALO CREEK FLOOD AND DISASTER

OFFICIAL REPORT FROM THE GOVERNOR'S
AD HOC COMMISSION OF INQUIRY

Copy Number _____

In accordance with Executive Order No. 4-72, we the undersigned, attest and verify this to be the true and accurate report of the West Virginia Ad Hoc Commission of Inquiry into the Buffalo Creek Flood and further acknowledge that each commissioner agrees with and accepts as his own each portion of such report unless otherwise clearly stated and noted.

[Signed]
Dr. Jay Hilary Kelley, Chairman

[Signed]
Dr. Dan Keay

[Signed]
Charles D. Hylton, Jr

[Signed]
Elizabeth V. Hallanan

[Signed]
John Ashcraft

[Signed]
Julian F. Murrin

[Signed]
William E. Davies

[Signed]
Dr. Robert B. Erwin

[Signed]
Ira S. Latimer, Jr.

THE BUFFALO CREEK
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PREFACE

A bridge collapses. An airplane crashes. A coal mine explodes--and a dam fails.

And people die.

Such are the methods by which tragedy has, in recent years, traced a pattern of human misery and suffering in West Virginia's history.

The initial public reaction in each instance has been shock and sympathy. Then comes the questioning. Did it have to happen? What caused it? Who is responsible? Soon after, there is an outcry for an investigation to determine the facts, to separate rumor from truth.

On February 26, 1972, a sludge dam on the Middle Fork of Buffalo Creek in Logan County gave way, unloosening a torrent of thick, murky water that claimed at least 118 lives, left seven persons missing, destroyed hundreds of homes, and left thousands homeless.

Public reaction followed the customary pattern--first shock, then sorrow, then the questions, and finally an angry clamor for the causes, reasons, and responsibility.

in this instance, the accusing fingers were pointed, as might be expected--and rightfully so--to Buffalo Mining Company, owner of the dam, and its parent company, the Pittston Company.

After all, it was their dam, and the president of Pittston later testified that his company was responsible for the water being impounded behind it. He denied, however, that his company was guilty of criminal negligence.

In response to public demands for the facts, Governor Arch A. Moore, Jr., on March 1, 1972, appointed an ad hoc commission to investigate the Buffalo Creek disaster, to try to find the causes and origins', to determine if conditions existed elsewhere in the state for a similar disaster, and to recommend legislative actions to prevent such disasters in the future.

The Commission, in its diligent search for the facts, held 8 public hearings, interrogated 91 witnesses and compiled 9 volumes of testimony.

From the outset, the Commission was faced with the task of sifting through unofficial reports and rumors, some of which were proven by the resulting investigation to be factual, while others were found to be groundless. After weaving its way through this maze of information and misinformation, the Commission has compiled this report which it feels provides most–but not all--of the answers to the disaster.

Public opinion already has placed the basic responsibility for the tragedy at the doorstep of Pittston and Buffalo Mining. The Commission certainly does not dispute the people's right to voice their opinion and, in fact, does not mean to imply that the people are wrong.

But the investigation indicated that responsibility also must be shared by others, and sections of this report deal with these other areas of responsibility.

For example, it points out that the dam on Middle Fork was born out of a practice as old as the coal industry itself--disposing of solid-waste material by the most convenient and cheapest method possible. This has been done by dumping refuse on hillsides and in hollows in close proximity to cleaning plants in order to cut down on haulage costs.

Had the coal industry and the government given serious thought to improving means of waste disposal, and promoted research into practical uses of these waste materials, the refuse dump in Middle Fork might never have been built.

It was cheaper for Buffalo Mining Company and its predecessors to put the company's refuse in Middle Fork than in any other location in the valley. And when the time came that the company had to stop polluting the stream with effluent from its preparation plant further up Buffalo Creek, the refuse--or gob--pile happened to be convenient for *he construction of an impoundment that was to be used as a settling Basin.

Federal and State agencies did not escape the scrutiny of the Commission in regard to their authority over the impoundment and their duties as to inspections and enforcement of statutes relating to earthen dams.

These inquiries took the Commission on a search of Federal and State laws which might be applicable to such structures, and it was found that these laws are so loosely written they can be interpreted in many ways, making it almost impossible in most instances for the courts to rule which agency has what authority over water impoundments constructed by coal companies.

Some opinions hold that the people themselves should assume at least part of the responsibility for the disaster which struck them, since they had legal avenues available to them to correct the conditions which existed on Middle Fork. However, the Commission feels that these recourses were so deeply buried in statutory language that the people were not aware that they even existed. Therefore, the Commission has proposed legislative recommendations which will make the rights of the people more visible and explain in simple language the action that can be taken should similar conditions arise for another potential disaster.

Many employees of Buffalo Mining Company went by the impoundment daily on their way to and from work, yet they raised little alarm and made few complaints about its potential danger.

Witnesses testified before the Commission that they warned people up and down Buffalo Creek just hours before the dam broke that it was going to fail. Yet there were those who ignored the warnings, and some of them died.

It is doubtful that any investigatory body ever went about its prescribed duties with more diligence than the Governor's Ad Hoc Commission of inquiry into the Buffalo Creek Flood. The nine members gave unselfishly of their time and energy to complete their assignment.

The Commissioners realized that nothing they could do would restore to life those men, women and children who died in the flood, or ever make the Buffalo Creek valley the same place it was before February 26. But they harbor the prayerful hope that the work they have done over the past six months will not have been done in vain; that through their efforts, similar disasters may be prevented in the future, and that people will not die because of conditions which they had no part in creating.

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1.0 INTRODUCTION

1.1 SUMMARY OF THE DISASTER

A mine-waste impoundment located on the Middle Fork of the Buffalo Creek watershed in Logan County (see Figure 1-1) failed a minute or so before 8 a.m. February 26, 1972, causing the sudden release of 17.6 million cubic feet of water (132 million gallons) onto the Buffalo Creek Valley floor.

The instantaneous release of the water behind this impoundment immediately began a fall of 253 feet to Buffalo Creek, washing out two additional combination waste banks and impoundments in its path, and tore off the corner of a burning mine-refuse bank before cascading directly into the western slope of Buffalo Creek Valley, one-half mile away.

As the blackened water, filled with sludge and refuse from mining operations, turned southwesterly on its subsequent path of death, destruction and devastation, it promptly wiped out the small community of Saunders, located within several hundred yards of the burning bank.

Sixteen more Buffalo Creek Valley communities--Pardee, Lorado, Craneco, Lundale, Stowe, Crites, Latrobe, Robinette, Amherstdale, Becco, Fanco, Riley, Braeholm, Accoville, Crown, and Kistler--were either partially or totally destroyed before the flood wave finally

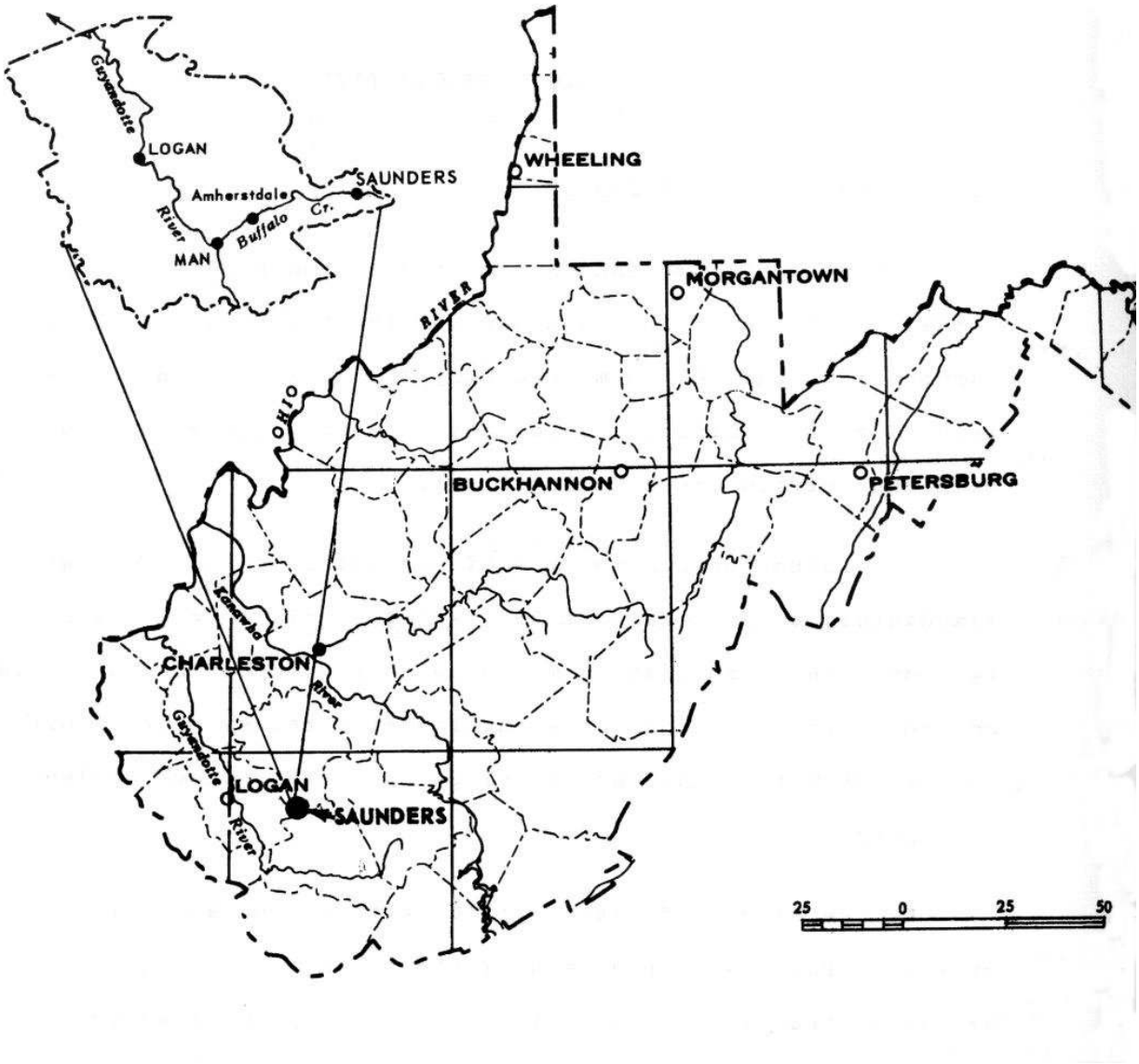


Figure 1-1 Map of West Virginia showing location of Buffalo Creek Area

traversed the winding, 17-mile course from the site of the impoundment and the confluence of Buffalo Creek with the Guyandotte River at Man (see Figure 1-2).

The 10-foot to 20-foot high flood wave traveled the valley at an average speed of better than 7 feet per second (5 miles per hour), reaching Man at 11 a.m. During those three hours at least 118 lives were lost with an additional seven persons still listed as missing by the West Virginia State Police. Besides the tragic loss of so many lives, an additional 1000 persons suffered injury.

Five hundred and seven houses were lost or demolished; 44 mobile homes were destroyed; another 273 houses were severely damaged; while nearly 663 more houses suffered damage to varying degrees. A total of 4000 people were thus left homeless by this flood.

In addition, 30 business establishments, 1000 automobiles and trucks, 10 bridges, and power, water and telephone lines were all destroyed, and the county road and the rail lines servicing the valley's coal mines were severely damaged. The photographs in Figure 1-3 are typical of the tremendous damage done by the flood.

Property damage was estimated in excess of $50,000,000, while highway damage exceeded $15,000,000.

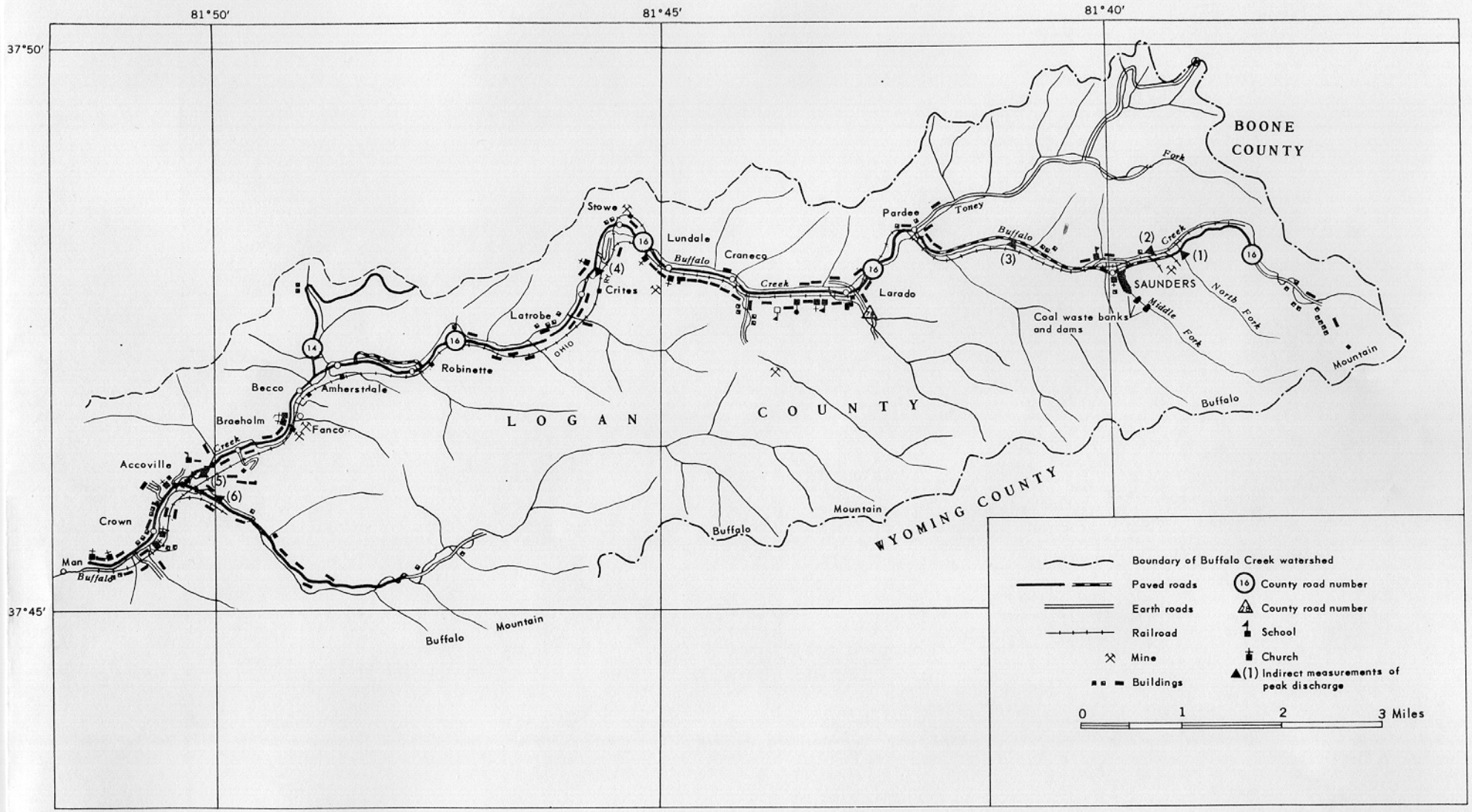
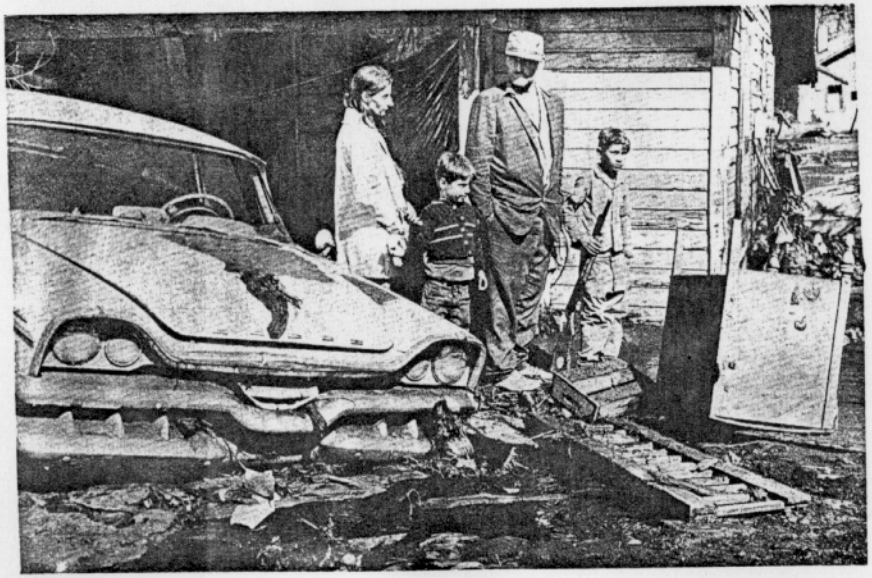
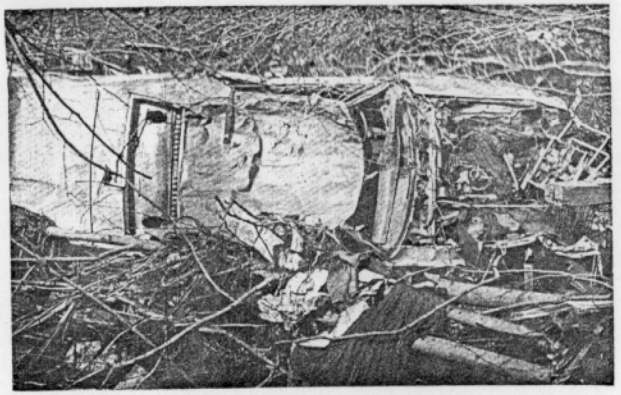


Figure 1-2. Map showing Buffalo Creek Valley





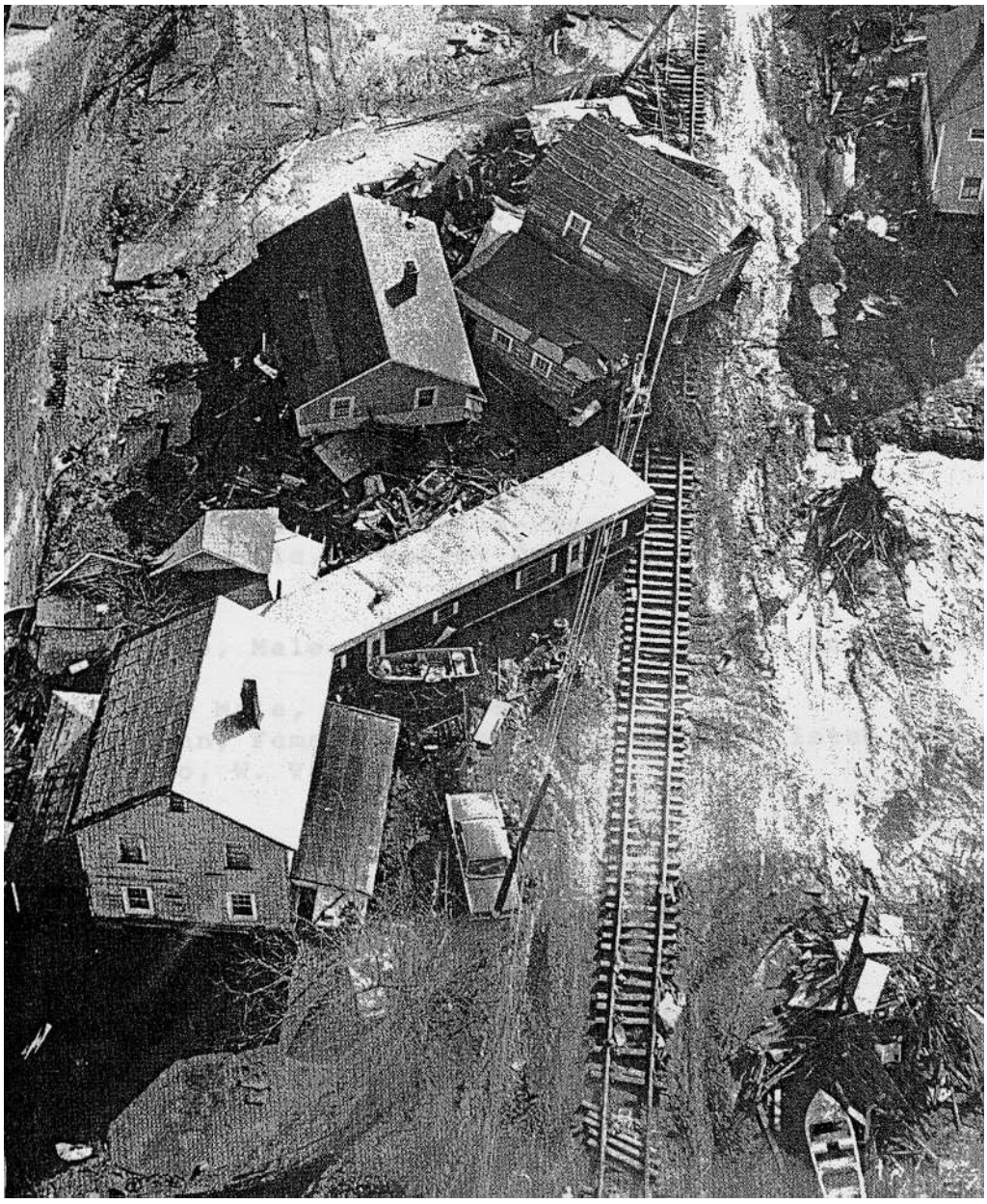


Figure 1-3 Typical Photographs of Flood Damage

Photographs on this page courtesy of the Associated Press; Charleston Gazette; and Logan Banner

It was, in the truest sense, the most destructive flood in West Virginia history.

1.2 LIST OF DECEASED

The Commission respectfully incorporates into this report the names of those men, women and children who lost their lives in the flood.

Adkins, Brookie Mae, Female, 31--Mother
Adkins, Lonnie Lee, Female, 7 months--Daughter
Adkins, Mary Jane, Female, 5 years--Daughter (all of Lundale, W.Va.)

Adkins, David Brooks, Male, 27--Father--electrician Buffalo Mining Company
Adkins, David, Jr., Male, 4 years--Son
Adkins, Dorinda Lynn, Female, 3 months--Daughter--listed as missing (all of Lorado, W. Va.)

Albright, Sylvia, Female, 39--Mother
Albright, Steven, Male, 17--Son (both of Lorado, W. Va.)

Bailey, Janice Juanita Osborne, Female, 32--Mother
Bailey, Kimberly Kay, Female, 6 years--Daughter
Bailey, Jason, Jr., Male, 11 years--Son
Bailey, Rhoda Rene, Female, 8 years--Daughter
Bailey, Carla Jeannene, Female, 1-1/2 years--Daughter (all of Saunders, W. Va.)

Bailey, James, Jr., Male, 16--Brother of Mrs. Diana McCoy, 18, whose daughter Kimberly, 3 years, perished. Son, Donald McCoy, 1-1/2 years, is listed as missing (all of Amherstdale, W. Va.)

Bailey, John H., Male, 58--Husband--disabled miner
Bailey, Eleanor, Female, 44--Wife
White, April Ellen, Female, 11--Daughter of Eleanor by previous marriage (all of Lundale, W. Va.)

Baker, Milton, Male, 71--Husband
Baker, Effie, Female, 68--Wife
Bartram, Mrs. Joyce, 40--Daughter--Payroll Office of Amherst Coal Company (all of Lundale, W. Va.)

Black, Betty Lee, Female, 51--Lundale, W. Va.

Blankenship, Edith, Female, 61--Lorado, W. Va.

Broady, Rebecca, Female, 15--Daughter of Ruth Broady Hatfield by a previous marriage--Lundale, W. Va.

Browning, Donna Sue Lauderback, Female, 21--Mother
Browning, Norman Bruce, Male, 3 years--Lundale, W. Va.

Brunty, James, Male, 82--Kistler, W. Va.

Butcher, Leonard, Male, 66--Husband
Butcher, Dessie, Female, 57--Wife--Lundale, W. Va.

Carter, Ballard, Male, 36--Husband--coal miner, Buffalo Mining Company, 8-C mine
Carter, Janice Hatfield, Female, 29--Wife
Carter, Matthew, Male, 6 years--Son
Carter, Lillian Sara, Female, 3 years--Daughter
Carter, Samuel, Male, 20 months--Son--listed as missing (all of Lundale, W. Va.)

Davis, Margaret Levanna, Female, 35--Mother
Davis, Mary Jane, Female, 8 years--Daughter
Davis, James Nevada, Male, 2 years--Son--listed as missing (all of Stowe, W. Va.)

Dempsey, Willie, Male, 42--Husband--Motorman, No. 5 mine, Buffalo Mining Company
Dempsey, Aletha V., Female, 38--Wife (adopted daughter Betty Frances Vernatter, Female, 4 years. Willie Dempsey was a brother of Mrs. Thelma Dillon)--all of Lorado, W. Va.

Dickerson, Berma Jo, Female, 20--Mother
Dickerson, Steven Todd, Male, 18 months--Son
Smith, Anita, Female, 17--Sister (all of Lundale, W. Va.)

Dillon, James, Male, 32--Husband--Shuttle car operator, No. 5 mine, Buffalo Mining Company
Dillon, Thelma, Female, 36--Wife (sister of Willie Dempsey)
Dillon, Curtis, Male, 10--Son
Dillon, Sharon, Female, 13--Daughter
Dillon, Darla, Female, 5--Daughter
Dillon, Howard, Male, 8--Son (all of Lorado, W. Va.)

Elkins, Ruth Ann, Female, 29--Lundale, W. Va.

Ferguson, Judy, Female, 27--Mother
Ferguson, Connie Sue, Female, 18 months--Daughter
(daughter and granddaughter of Etta Pearl Hatfield)--all of Lundale, W. Va.

Gunnells, Martha Elkins, Female, 21--Mother
Gunnells, David, Male, 3--Son
Gunnells, Jessie, Female, 1--Daughter (all of Robinette, W. Va.)

Hatfield, Etta Pearl, Female, 60 (daughter is Judy Ferguson and granddaughter is Connie Sue Ferguson)--Lundale, W. Va.

Hatfield, Layton Oscar, Male, 50--Husband--miner, Amherst Coal Company
Hatfield, Ruth Broady, Female, 53--Wife
Hatfield, Steven, Male, 16--Son
Broady, Rebecca, Female, 15--Daughter of Ruth by previous marriage (all of Lundale, W. Va.)

Hedinger, Albert 0., Male, 34--Preparation Engineer on tipple at Buffalo Mining Company, Godby, W. Va.--killed at Saunders

Hopson, Angela Jean, Female, 2 years
Hopson, Nancy, Female, 1 year--listed as missing (both of Crites, W. Va.)

Jarrell, Margaret Yanco, Female, 42--Mother
Jarrell, Karen, Female, 16--Daughter
Jarrell, Patrick, Male, 24--Son--miner, Amherst Coal Company
(all of Lundale, W. Va.)

Jarrell, William Lee, Male, 50--Husband--miner, Amherst Coal Company
Jarrell, Lottie May, Female, 45--Wife (both of Lundale, W. Va.)

Johnston, Andrew, Male, 73--Crites, W. Va.

Kennedy, Mrs. Grace, Female, 71--Easley, South Carolina (visiting sister-in-law, Macie Queen)

King, Gary Mike, Male, 24--miner, Amherst Coal Company--Lundale, W. Va.

Lester, Norman, Male, 24--Husband--miner
Lester, Sharon Ann, Female, 25--Wife
Lester, Denise, Female, 3 years--Daughter
Lester, Dennatta, Female, 5 to 7 years--Daughter
Lester, Opal, Female, 45--Mother of Sharon Ann Lester
Lester, Barry Keith, Male, 15--Son of Opal Lester
Lester, Rita Joann, Female, 16--Daughter of Opal Lester (all of Saunders, W. Va.)

Marcum, Mary Bowman, Female, 44--Latrobe, W. Va.

McCoy, Diana Lynn, Female, 18--Mother
McCoy, Kimberly, Female, 3 years--Daughter
McCoy, Donald, Jr., Male, 1-1/2 years--listed as missing (all of Amherstdale, W. Va.)

Messer, Jesse, Male, 35--Lorado, W. Va.

Miller, Augusta, Female, 69--Pardee, W. Va.

Murray, Robert, Male, 71--retired miner--Lundale, W. Va.

Osborne, Wandell, Male, 37--Husband--disabled miner
Osborne, Jeannette, Female, 35--Wife
Osborne, Regina, Female, 12--Daughter
Osborne, Carolyn, Female, 20 months--Daughter
Osborne, Geneva, Female, 11--Daughter
Osborne, Wandell, Jr., Male, 15--Son (all of Lundale, W. Va.)

Owens, Henrietta, Female, 22--Mother
Owens, Thomas, Male, 3 years--Son (both of Lundale, W. Va.)

Peters, Herbert, Male, 71--Husband
Peters, Martha, Female, 71--Wife (both of Pardee, W. Va.)

Perry, Callis, Female, 81--Pardee, W. Va.

Prince, Margie Marie, Female, 42--Amherstdale, W. Va.

Queen, Macie, Female, 54--Lorado, W. Va.

Ramey, Otis, Male, 49--Husband
Ramey, Mattie, Female, 45--Wife
Ramey, Virgie Albright, Female--Mother of Otis (all of Latrobe, W. Va.)

Scarberry, Mrs. Marvel Rosie, Female, 73--Lundale, W. Va.

Sipple, Goldie, Female, about 38--Lorado, W. Va.

Smith, Anita, Female, about 17--sister of Berma Jo Dickerson– Lundale, W. Va.

Sosa, Florencio, Male, 65--Husband
Sosa, Magdalene, Female, 46--Wife--Lorado, W. Va.

Staton, Gladys, Female, 25--Mother
Staton, Kevin, Male, 1 year--Son--Lundale, W. Va.

Trent, Della, Female, 69--Mother
Trent, Johnny, Male, 32--Son--miner Guyan Mine No. 1, Island Creek Coal Company
Trent, Gene, Male, 26--Son--truck driver for Buffalo Mining Company
Trent, Henry, Male, 49--Son--shuttle car operator for Buffalo Mining Company
Trent, Wanda, Female, 39--Daughter (all of Saunders, W. Va.)

Vernatter, Betty Frances, Female, 4 years (adopted daughter of Aletha V. Dempsey)--Lorado, W. Va.

Vernatter, Thomas, Male, 65--Husband
Vernatter, Ethel Black, Female, 65--Wife (both of Latrobe, W. Va.)

Waugh, Roby Leslie, Male, 45--Father--miner, Poweliton
Waugh, James Lewis, Male, 11--Son
Waugh, Grady Michael, Male, 18--Son
Waugh, Donald, Male, 20--Son
Waugh, Larry Keith, Male, 5 years--Son (all of Lundale, W. Va.)

White, April Ellen, Female, 11--daughter of Eleanor Bailey by previous marriage--Lundale, W. Va.

Wiley, Mrs. Dora, Female, 60--Latrobe, W. Va.

Wiley, Richard Dick, Male, 78--Crites, W. Va.

Workman, Frank Lee, Male, 69--Lorado, W. Va.

Missing

Adkins, Dorinda, Female, 3 months--Lorado, W. Va.
Carter, Samuel, Male, 20 months--Lundale, W. Va.
Clay, Roscoe, Male, 74--Lorado, W. Va.
Davis, James, Male, 2 years--Stowe, W. Va.
Hopson, Nancy, Female, 1 year--Crites, W. Va.

McCoy, Donald, Jr., Male, 1-1/2 years--Amherstdale, W. Va.
Waugh, Kathy, Female, 8 months--Lundale, W. Va.

Unidentified

Two white males, ages 18 months to three years
One white female, age approximately three years

* * * *

The Buffalo Creek Valley communities and the number of persons who lost their lives in those communities are listed below in order of their location downstream from Middle Fork:

Saunders, 18; Pardee, 4; Lorado, 21; Lundale, 52; Stowe, 2; Crites, 3; Latrobe, 7; Robinette, 3; Amherstdale, 4; Kistler, 1.

1.3 CHARGE TO THE COMMISSION

In the aftermath of the Buffalo Creek disaster, Governor Arch A. Moore, Jr. (Figure 1-4), by virtue of Executive Order No. 4-72, created an investigatory body known as The West Virginia Ad Hoc Commission of Inquiry into the Buffalo Creek Flood (hereinafter referred to as Commission). Pursuant to said Order, the `ollowing members were appointed to the Commission: Jay Hilary :ell-y, Dean, School of Mines, West Virginia University; John Jshcraft, Director, Department of Mines; Dr. Robert B. Erwin, :st Virginia State Geologist; Ira S. Latimer, Jr., Director,

Figure 1-4. Governor Arch A. Moore, Jr. (second from right) visits Buffalo Creek disaster area. Others in the photograph are (from left to right) : Unidentified site contractor; Mr. Norman Watson of HUD; Mr. T. K. Killen of Logan; Governor Moore; and Mr. Charles J. Lieberth, also of HUD.

Department of Natural Resources; Elizabeth V. Hallanan, Chairman, Public Service Commission; Dr. Dan Kealy, representative of the U. S. Bureau of Mines; William E. Davies, representative of the U. S. Geological Survey; Charles D. Hylton, Jr., Editor, Logan Banner, citizens' representative; Julian Murrin, citizens' representative. By subsequent letter, Governor Moore appointed Dean Jay Hilary Kelley Chairman of the Commission.

Governor Moore, through the Executive Order, delegated to the Commission the following duties: (a) To investigate the causes, origins, conditions and reasons which led to the disaster which occurred on February 26, 1972, in the area of Buffalo Creek, Logan County, West Virginia; (b) To assess, locate and identify other areas of the state where similar conditions and potentials for disaster may exist; (c) To make proper evaluation and legislative recommendations to provide authority to supervise and control such impoundments to prevent such a disaster from recurring; and (d) To submit a report of its findings, conclusions and recommendations for immediate as well as long-term action. The Commission was granted a six-month period (ending September 1, 1972) to complete the aforementioned duties. (The Order appears in Addendum A.)

During organizational meetings, the Commission decided to conduct extensive and exhaustive fact-finding hearings in order to comply with the mandates set forth in the Executive Order. Accordingly, eight formal public hearings (Figure 1-5) were held

Figure 1.5. Ad Hoc Commissioners conducting one of eight public hearings. They are (from left to right): Mr. Charles D. Hylton, Jr., Editor, Logan Banner; Dr. Robert B. Erwin, West Virginia State Geologist; Mr. Ira S. Latimer, Director, Department of Natural Resources; Mr. William E. Davies, Representative of the U. S. Geological Survey; Chairman Jay Hilary Kelley, Dean, School of Mines, West Virginia University; Miss Elizabeth Hallanan, Chairman, Public Service Commission; Mr. John Ashcraft, Director, Department of Mines; Dr. Dan Kealy, Representative of the U. S. Bureau of Mines; and Mr. Julian Murrin, Retired Executive of FMC.

at which time the testimony of 91 witnesses was heard and recorded in 9 volumes and 2019 pages. The Commission's policy was to entertain testimony of the following: Any party requesting to be heard; all persons directly or indirectly involved; any person deemed to have information or opinions that might assist the Commission in drawing valid conclusions and appropriate recommendations; and persons providing professional assistance in the interpretation of technical information. To this end, two hearings were held at Man High School to facilitate the testimony of local witnesses directly involved in the disaster. Additionally, six other public hearings were held in Charleston, at which time testimony was heard from many representatives including, but not limited to, the following: the Pittston Company, U. S. Department of Interior, U. S. Weather Service, various other U. S. Government agencies, West Virginia State agencies, and expert witnesses in the field of civil and mining engineering with particular expertise in dam construction and design, coal-refuse disposal and processing, water clarification, and professional registration of engineers. A detailed list of witnesses and a summary of testimony are given in Addenda B and C, respectively. It is important to note that, although the Commission did not have subpoena power, governmental agencies at both the State and Federal level, Pittston officials and the citizens of Buffalo Creek, were cooperative with the Commission in voluntarily testifying before the Commission at its request.

The Commission, in its official capacity, met 26 times to deliberate and evaluate the testimony and other facts submitted. Prior to the hearings, the Commission made at least two visits to the site of the former impoundment and to the communities affected by the disaster.

In an effort to avoid expensive duplication in the identification and assessment of the same or similar conditions existing in the State, the Commission initially decided to. await the pending pertinent reports by the Department of Natural Resources before instituting an independent survey. This position was further buttressed by cooperation and coordination with the Department of Natural Resources in compliance with the specific directive of the Executive Order. Subsequently, the Commission determined that said reports would constitute the base data upon which the Commission would, by an independently conducted, random spot check of the refuse banks, set forth qualifying parameters and conclusions.

The full conclusions and recommendations of the Commission are provided in Sections 6.0 and 7.0 of this report and are a result of months of exhaustive investigation and considerable deliberation of various related ancillary materials submitted to the Commission.

[Note: In this report, standard dam construction terminology is used when referring to right or left abutments. That is, when directions are used, unless otherwise specified, they are used "work wise" or facing downstream.]

2.0 INVESTIGATION

2.1 GENERAL

Logan County, West Virginia, is situated virtually in the heart of the southern West Virginia bituminous coal field. Like almost every county in the southern half of the state, Logan County is--as it has been for three-quarters of a century--closely aligned with the economy of the bituminous coal-mining industry.

According to the Department of Mines, 24 different deep-mine companies operate 45 mines in Logan County, while 14 auger-mine companies have 18 different operations, and five strip-mining (surface-mining) companies have 17 different strip-mine operations. Combined, these companies and their 80 different mines--deep, auger, and strip--produced 10,182,958 tons of coal in 1971, directly employing 4135 people to do so. Logan County's overall population, according to the 1970 census, is 46,269 people.

At the same time, according to the Department of Commerce only 21 different manufacturing firms are in the county, of which 12 are directly related or associated with the coal-mining industry, such as machine shops to repair or rebuild mining equipment.

Coal mining is by far the principal industry for the county and its people, and untouched but mineable coal reserves in this county lead to the prediction that coal mining will remain the chief industry in years ahead.

Buffalo Creek Valley itself is situated at the easternmost end of the county, with headwaters near the junction of Boone, Logan, and Wyoming County lines and roughly 75 miles southwest of Charleston. The stream flows in a west by southwesterly direction for 17 miles before reaching its confluence with the Guyandotte River at Man.

Development of the coal-mining industry in the region after 1900 was closely followed by construction of the spur line up Buffalo Creek by the Chesapeake & Ohio Railroad in 1914. Subsequently, by 1920, the valley was like a checkerboard of small but closely spaced mine camps, situated where the flood plain was widest. Towns such as Saunders, Lorado, Craneco, Crites, Amherstdale, Becco, Accoville, and Crown were built where the small flood plains of tributary streams joined the flood plain of Buffalo Creek. Towns such as Pardee, Stowe, and Robinette were built on the wider flatland around some of the loops in Buffalo Creek.

Wedged between steeply rising valley walls, the narrow flood plain of Buffalo Creek offers little opportunity to build above the level of the 50-year flood. Maximum width of the valley or its flood plain is 600 feet, while average width is but 400 feet. The tortuous :nurse of this creek (i.e., its tendency to twist and turn around ridges instead of flowing in a straight line) forced the stream to flow for some 17 miles from Saunders to Man--a straight-line distance less than 12 miles.

The steepness of the valley walls and the thinness of the soil cover contribute to the flood flows. in Buffalo Creek Valley, and these same conditions persist in virtually all other hollows or valleys south of the Kanawha River. Instead of thick soils that could absorb some of the precipitation runoff, soils on the uplands and valley walls in this entire region are thin, generally less than 3 feet thick and seldom as much as 5 feet thick..l* Additionally, soils in the region tend to a composition of low permeability and are dominantly a clay-like, silty sand with large quantities of stone varying from small chips to boulders a foot or so long. They are commonly underlain by clay layers up to an inch thick between the base of the soil zone and the underlying bedrock.

Thus, all of these factors--the tortuosity of the channel, the narrowness of the flood plain, the steepness and height of the valley's walls, and the thinness and relative impermeability of the soil--combine to make Buffalo Creek a hollow susceptible to damage from flooding and a valley without a chance when a torrent of water such as that unleashed by the failure of the dam descended upon it.

*A LIST OF REFERENCES appears in Section 10.0 of this report.

2.2 HISTORY OF THE DAMS ON MIDDLE FORK

Mining activities began in middle Fork in 1945 when the Lorado Coal Mining Company opened Mine No. 5 and accelerated when the No. 5 preparation plant was completed in 1947. At that time, the Lorado Coal Mining Company began dumping mine refuse from the No. 5 preparation plant in the mouth of Middle Fork Valley. The initial refuse, amounting to about 1000 tons a day, was dumped near the intersection of Middle Fork and Buffalo Creek. In the process, a large waste bank was constructed across the hollow. By February, 1972, the waste bank extended 1500 ft upstream, averaged 600 ft in width, and was 250 ft high.

2.2.1 Proposed Water Clarification System (1954-1959)

In the latter part of 1954, at the request of the W. Va. Water Resources Commission, Lorado Coal Mining Company began a study of its water-pollution problems and ways and means of "closing" the waste circuit at the No. 5 preparation plant.

West Virginia Water Resources Commission personnel met with the Lorado Coal Mining Company in January, 1955, to discuss tentative plans for waste control. In July of that year, the company reported was going ahead with the installation of disposal facilities, and drawings of the system were submitted with a request for a temporary permit. This permit was granted on August 19, 1955, for a six-month period; a permanent permit was issued on June 28, 1956.

In January, 1958, the General Manager of Mines stated, in a letter to the Water Resources Commission, that during the past summer (1957) bids were received to close the water circuit, but before one was accepted a delay was encountered. The thought at this time was to use froth flotation cells as a fine-coal recovery medium and the company would proceed along those lines.

Inspections made by the Water Resources Commission during August, October, and December, 1958, indicated washery waste was still being discharged into the stream and the General Manager was asked by letter on December 16 to submit a report on the company's plans and specifications to enable the company to comply with Permit No. 65 issued June 28, 1956, regulating such pollution. A report in March, 1959, stated that the company had been working with several manufacturing firms concerning waste-disposal facilities.

On August 27, 1959, a letter from the company stated that the company was working with a consulting firm to establish the size of filter needed and upon receipt of this information it would be able to proceed with construction plans. Then, on October 6, a letter from the President of Lorado Coal Mining Company discussed the various methods studied and stated that cost was an important factor in the installation of a filter at that time due to depressed market conditions and the then-current steel strike and that there were problems -f a technical nature that should be considered. He further stated that later the present coal seam would be replaced by a different

seam with different characteristics and that this change might alter the solution to the problem.

The Lorado Coal Company President asked that the company be granted a delay in installing the filter. This was a significant decision. Had such a filtration system been installed in the No. 5 preparation facilities, it would probably not have been necessary to construct the series of dams on middle Fork for filtration of the preparation-plant effluent.

2.2.2 Dam No. 1

In April, 1960, the Lorado Coal Mining Company proposed, as an alternative to the closed-circuit coal-preparation plant system, the construction of a series of dams for containing the No. 5 preparation-plant effluent. The original proposal was to contain water behind the then-existing refuse pile at the mouth of Middle Fork and to construct one (or possibly two) earth dams upstream from the refuse pile. Solids were to settle behind the earth dams and clear water was to be impounded behind the refuse pile. This proposal was submitted to the State Water Resources Commission as a part of the company's stream-pollution abatement program.

The original refuse dam was begun in May, 1960. It was constructed by placing the coal refuse partially across the valley at I point upstream from the then-existing refuse pile. Previous reports 2,3,4 have mistakenly stated that the construction of Dam

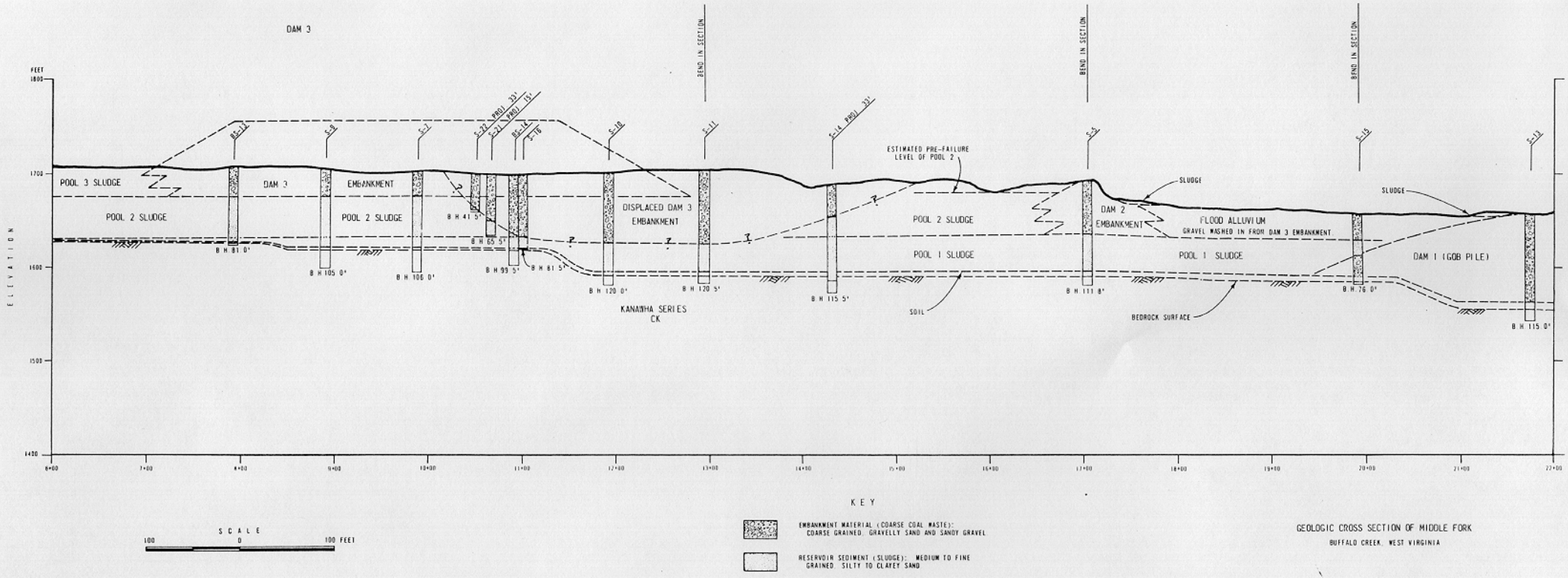
No. 1 began sometime in 1964. A search of the State Water Resources Commission records has established the accurate date as May, 1960. Preparation-plant waste water from the No. 5 preparation plant was pumped from a point on Buffalo Creek through the No. 5 mine and discharged into Middle Fork. Approximately 7400 feet of 6-inch-diameter pipe was used to carry the effluent through the mine. The discharge point was located approximately 3200 feet above Dam No. 1.

According to Davies, et al. l, "At first the water drained rapidly through the bank in spite of several attempts to create a reservoir for use in dry seasons. However, after 1960, coal from strip-mine operations was processed through the washer. The fine [clay] material from the strip mines made the bank less pervious, resulting in a large impoundment. Water was then decanted [removed] from the large settling pool that formed into smaller clear ponds for recycling in the preparation process. Between 400,000 and 500,000 gallons per day containing about 500 tons of solids were pumped to the settling pool."

The fact that Dam No. 1 was constructed in 1960 rather than in 1964 as previously indicated would help account for the large sludge deposits that lie underneath Dams No. 2 and 3 (see Figure 2-1).

In November, 1963, the Lorado Coal Mining Company shut down its mining operations and No. 5 preparation plant on Buffalo Creek. The plant remained idle until October, 1964, when the Buffalo Mining

Figure 2-1. Geologic Cross Section of Middle Fork



GEOLOGIC CROSS SECTION OF MIDDLE FORK
BUFFALO CREEK, WEST VIRGINIA

J. A. WAHLER
ASSOCIATES

Company began operating the plant, and Dam No. 1 was again used for filtration of the preparation-plant effluent.

2.2.2.1 U.S.G.S. Examination of Refuse Bank

At the request of the U. S. Bureau of Mines, the U. S. Geological Survey examined the coal-waste bank on Middle Fork December 9, 1966. On October 21, 1966, a large hillside waste bank at Aberfan, Wales, United Kingdom, had slumped, sending a mass of liquefied coal refuse 1600 feet down the hill. Concerned over the prospect that such a thing might occur in the United States, the U. S. Bureau of Mines prepared a list of all waste banks in the Appalachians that, because of their location and size, could cause loss of life or property if they slid in a manner similar to the bank at Aberfan. The refuse bank on Middle Fork was one of 38 waste banks in West Virginia that were examined in this regard. An inspector from the U. S. Bureau of Mines and a geologist from the Geological Survey examined ". . . the material and method of deposition. Additional time was spent examining the sides along the haul road down to the north face, the large pond (pool No. 1) behind the waste bank, the small dike on the east that added to the height of the impounding structure, the north face of the bank, and the seepage issuing near the base of the structure. It was concluded that the waste bank at Saunders was stable as far as large slides were concerned but was subject to large washout on the north side from overflow of the lake (pool No. 1)."[1] A report from U.S.G.S. was filed with the U. S. Bureau of Mines. No written

notification of these findings was ever made to Buffalo Mining Company.

2.2.3 Dam No. 2

Buffalo Mining Company constructed Dam No. 2 in 1966 to replace Pool No. 1, which had been rendered useless due to extensive silting in the reservoir behind Dam No. 1 and the need for the company to find an additional space for disposing of the refuse. Dam No. 2 was located approximately 600 feet upstream from Dam No. 1 and was constructed by dumping refuse across the width of the hollow on the deposits remaining in the reservoir behind Dam No. 1. No effort was made to clear vegetation or trees prior to this dumping. Clarified water from this second dam was flowed into the remaining area behind Dam No. 1.[3]

In March, 1967, Dam No. 2, which was nearing completion (Hearing Transcript, Vol. III, p. 166, q. 356), was overtopped and partially carried away by high water from a snowmelt. Dam No. 1 was also overtopped and partially carried away. A small flood occurred in Buffalo Creek as a result. Department of Natural Resources inspectors had warned Buffalo Mining Company officials of the possibility of a washout on at least four previous occasions arid no preventive action had been taken by the company. Subsequently, on March 16, 1967, a Notice to Comply with Water Pollution Control Permit was issued by the West Virginia Department of Natural Resources

against Buffalo Mining Company. One of the deficiencies noted that Dam No. 2 needed strengthening and additional facilities to handle excessive surface runoff. The company complied by widening the dam by dumping more refuse from the preparation plant and installing a 30-inch-diameter overflow pipe.

A Department of Natural Resources, Water Resources Division, inspection report dated June 21, 1967, states ill reference to Dam No. 2: "Careful engineering will have to be done on impoundment problems. We do not want any more washouts." However, testimony by E. J. Wood, former Vice-President, Buffalo Mining Company (Hearing Transcript, Vol. III, p. 115) to the Ad Roc Commission indicated that engineering plans used were quite modest and undocumented.

By December, 1967, Dam No. 2 had been completed and could impound water to a depth of about 20 feet above the sludge deposits created by Dam No. 1.

In February, 1968, Mr. Harold Snyder, Director, Engineering Division, West Virginia Public Service Commission, at the request of the Department of Natural Resources Deputy Director David Callaghan, inspected Dam No. 2 in response to a complaint to Governor Hulett C. Smith from Mrs. Pearl Woodrum, a Saunders' resident. Mr. D. S. Dasovich, Vice-President, Buffalo Mining Company, and Mr. Joseph C. Holly, Department of Natural Resources inspector, were present at this inspection. At that time, Mr. Snyder felt that there was no danger of a washout of the refuse dump. However, he did question the ability of the overflow

pipes in Dam No. 2 to handle excess surface runoff. Mr.- Snyder recommended that the company raise the level of the roadway over the drainpipes to reinforce that section of the dam.

In February 1968, a search of the Public Service Commission records failed to show that approval had ever been granted for the construction of Dams No. 1 or 2 as provided for in Chapter 61, Article 3, Section 47, of the Code of West Virginia. In a letter to Mr. Callaghan, dated February 28, 1968, Mr. Boyce Griffith, Chairman of the West Virginia Public Service Commission, set forth his position in regard to dams. Fie wrote as follows:

> . . . Legal Counsel feels that the Commission's jurisdiction extends merely to the safety of the design of a proposed construction. Also, the Code sets forth the violation as a misdemeanor and provides that such violation shall be deemed a nuisance abatable at the suit of any citizen or taxpayer or County Court of the County and that it seems that although the Commission has jurisdiction as to the safety of design the Legislature has not seen fit to grant enforcement power to the Commission. In this instance, it appears that no approval has ever been granted for a structure across this stream.
>
> It would undoubtedly be helpful in the future if stilling basins made across natural watercourses are confined to less than fifteen (15') feet in height and, in this way, permission would not need to be granted for such construction under existing law.
>
> We are glad to cooperate with your Department at any time and, in the case at hand, it would be well for the Mining Company to employ an engineer versed in hydrology and hydraulics to give it advice as to how to provide proper drainage to reduce the flood hazard.

A letter dated March 4,. 1968, from the Engineer, Coal Section, Water Resources Division, Department of Natural Resources, was sent

to Mr. Oval Damron, the Prosecuting Attorney, Logan County, informing him of Mrs. Woodrum's letter of complaint. No further action was taken. In testimony (Hearing Transcript, Vol. VI, p. 234) before this Ad Hoc Commission, the Logan County Prosecuting Attorney stated he had received a copy of the Woodrum letter of complaint along with the Department of Natural Resources correspondence. However, Mr. Damron stated that he did not take action because he believed that he would be further notified by the Department of Natural Resources if a hazard did indeed exist.

In February, 1971, Dam No. 2. cracked down the middle and slumped" (Hearing Transcript, Vol. III, p. 31). Black water entered Middle Fork and polluted Buffalo Creek below. More refuse was used to fill in and replace the material that was washed away and the dam was widened by dumping on the upstream side.

2.2.4 Dam No. 3

During the February, 1968, examination of the impoundment areas by Mr. Snyder and Mr. Holly, tentative plans were discussed for a new impoundment 600 feet up middle Fork. Mr. D. S. Dasovich, Vice-President, Buffalo Mining Company, made a drawing showing the procedure for constructing the new impoundment (Figure 2-2). As an alternative, he suggested that the most effective method to insure against a washout would be to widen Dam No. 2 by continuing to dump refuse on

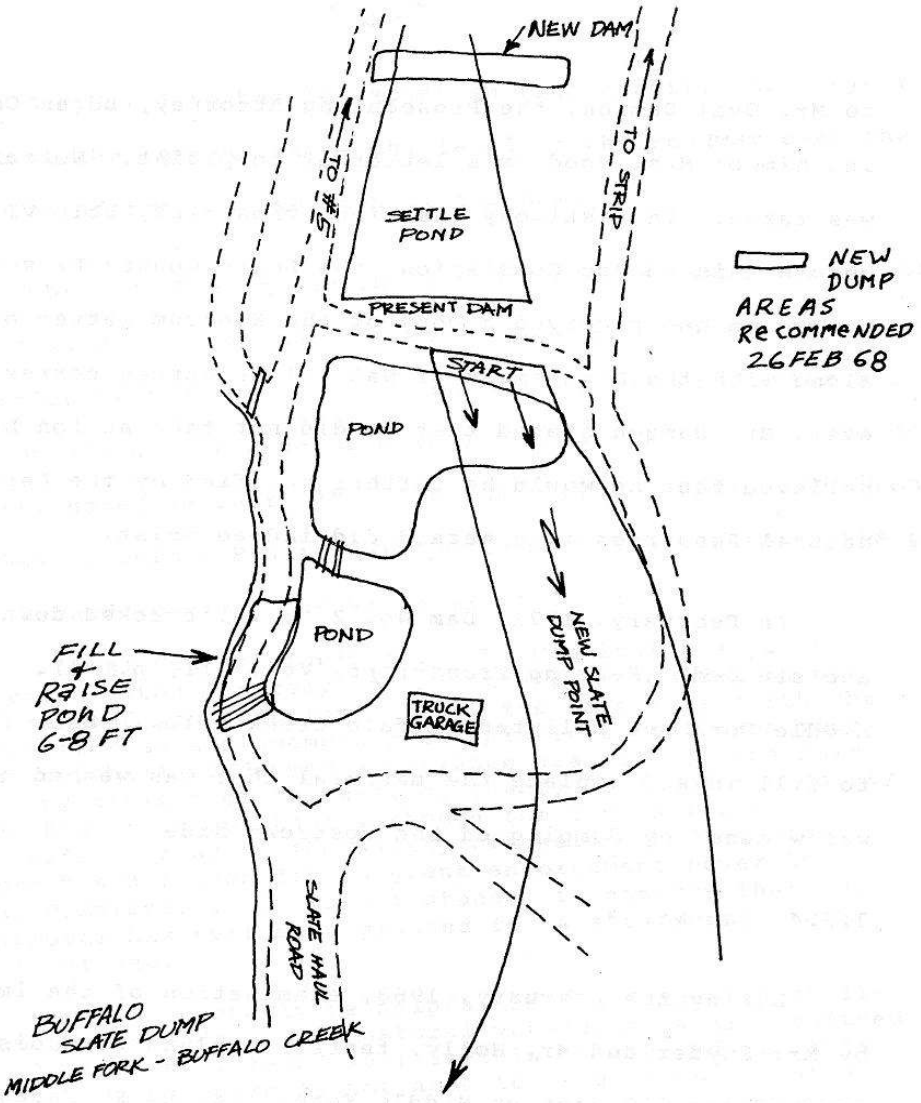


Figure 2-2 Saovich's sketch of dumping plan, dated February 26, 1968

the upstream side (Hearing Transcript, Vol. III, p. 25, q. 54). However, in a Notice to Comply with Water Pollution Control Permit, issued by the West Virginia Department of Natural Resources against Buffalo Mining Company, dated March 28, 1968, one of the deficiencies noted is as follows: . 9. Put in proposed refuse dump further up hollow behind impoundment to act as a retaining dam for solids in plant effluent ejected above and this refuse dump will also slow down surface runoff." In a letter of compliance dated May 29, 1968, Mr. Dasovich notified the West Virginia Department of Natural Resources that work had begun on Dam No. 3 and that it would ". . . be completed in the very near future."

Dam No. 3 was constructed by end dumping coal waste from trucks in closely spaced piles from 4 to 7 feet high and then graded in layers 2 to 4 feet thick. The dumping was carried across the valley from the right abutment on the No. 5 mine road toward the left abutment (Figure 2-3). The dumping was done in the form of a single lift (level of material) which ranged up to 60 feet thick. Once the dam had been completed across the valley, dumping was mainly across the back side of the dam which steadily grew upstream. "Trees in the path of the dam construction were not removed but were covered by dumping. The pool area also was not cleared of vegetation. The sludge on which the waste was dumped was only partially displaced and much of it formed the foundation of the dam."[1]

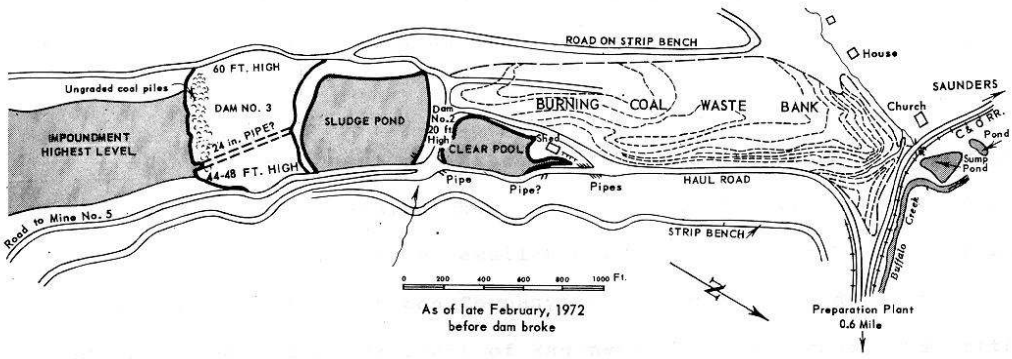


Figure 2-3. Sketch map of Middle Fork, February 1972, before dam broke

Original estimates by the U. S. Army Corps of Engineers and the U. S. Geological Survey indicated that the sludge deposits were 15 to 20 feet deep. Additional drilling in the area (W. A. Wahler and Associates) indicates that sludge deposits beneath Dam No. 3 range between 40 and 100 feet in thickness. Deposits under Dam No. 2 range between 50 and 100 feet in thickness.

In testimony before the Ad Hoc Commission, Mr. Dasovich stated (Hearing Transcript, Vol. III, p. 35, q. 90) that the method of constructing Dam No. 3 ". . . is common practice throughout the coal-mining regions." No engineering plans were ever made for the construction of the impoundment. The only plan was Mr. Dasovich's sketch (Figure 2-2) made on February 26, 1968. Mr. Dasovich stated in reference to the design of Dam No. 3 (Hearing Transcript, Vol. III, p. 35,

q. 91), "I wouldn't even begin to be able to engineer a thing like that. It has no . . . I know of no formula or any such method of so-called designing it."

Although Mr. Dasovich stated that he was not capable of engineering or designing the dam, higher company officials stated that additional engineering expertise was available to him from the Dante, Virginia, headquarters of The Pittston Company Coal Group. According to Mr. James E. Yates, Vice-President of Engineering, Coal Group, The Pittston Company (Hearing Transcript, Vol. IV, p. 122), Mr. Dasovich had asked for and received technical assistance on several previous occasions. He did not, however, seek advice on the construction and maintenance of Dam No. 3, which was still being constructed after The Pittston Company's acquisition.

During the construction of Dam No. 3, a major portion of the refuse sank and displaced some of the sludge upon which it was being built. This occurred in February, 1969. Mr. Dasovich stated that, "To me this was a good indication that we were getting the thing down on firm ground" (Hearing Transcript, Vol. III, p. 27, q. 60; p. 32, q. 76).

In June, 1970, The Pittston Company acquired the Buffalo Mining Company. Before acquisition, Pittston Company engineers surveyed the Buffalo Mining Company property. According to Nicholas T. Camicia, President, The Pittston Company, "Our reports had no indication

that there was any danger, or that anything was wrong with the impoundments . . ." (Hearing Transcript, Vol. VI, p. 77). At the time of The Pittston Company acquisition, Dam No. 3 was " . . . already under construction, or maybe 50 percent completed . . ." (Hearing Transcript, Vol. VI, p. 76).

Dam No. 3 was near its final height in February, 1971. Thereafter the dam was widened by dumping on the upstream side. According to Davies, et al. , "By early February, 1972, dam No. 3 extended 4651 feet across the valley along its front (downstream) crest, was 450 feet wide at the rear, and up to 550 feet wide along the center. From front to back along the compacted crest, it was 360 feet thick on the right and 480 feet thick on the left (looking downstream). On the right, the compacted crest rose 44 feet, and on the left, it rose 60 feet above the level of the sludge in pond No. 2. The compacted crest on the front (downstream) face was about 10 to 15 feet lower than the rear (upstream) face. All together, dam No. 3 contained about 10 million cubic feet of coal waste standing above the level of the sludge line of pool No. 2 and about 7 million cubic feet displacing the sludge below that line. About 800,000 tons of coal waste had been dumped to form the dam. The front face of the dam sloped 370, the angle of repose for most coal-waste material, and the back sloped 320, the angle of repose for such material where dumping was modified by impounded water. The front (northwest) face of the dam, based on an aerial photograph [Fig. 6 of Davies' report]

taken November 3, 1971, was concave in plan and contained four small concave hollows. The rear face was nearly straight, except near the right abutment where a re-entry cut diagonally into the dam."

The downstream side of the left abutment of Dam No. 3 slumped in February or March, 1971. Mr. Ben Tudor, General Superintendent, Buffalo Mining Company (Hearing Transcript, Vol. III, p. 127) estimated the size of the slump to be 150 to 200 feet wide across the face of the dam and 20 to 30 feet from the face back. At that time, Mr. Tudor, Mr. Dasovich, and several other witnesses observed black water boiling into Pool No. 2 from the downstream side of the dam. (This would be an indication of foundation displacement and/or piping* a year before the February 26 failure.) The pool level in the reservoir behind Dam No. 3 was 20 feet below the crest at that time.

Figure 2-4 is a reconstructed view of Dams No. 1, 2, and 3 and the coal-refuse bank and Figure 2-5 is an aerial view of the Buffalo Creek area showing the location of the dams and the preparation plant

2.2.4.1 Overflow Pipe on Dam No. 3

In a March 25, 1971, inspection report by a West Virginia Department of Natural Resources inspector, one of the deficiencies listed is the ". . . lack of emergency spillway or overflow system from upper impoundment." (In this instance, "upper impoundment" refers to Dam No. 3.) The inspector also noted the following: "New

*See Section 9.0, GLOSSARY OF TERMS.

Figure 2-5 Aerial photograph showing Buffalo Creek area, West Virginia (November 3, 1971)

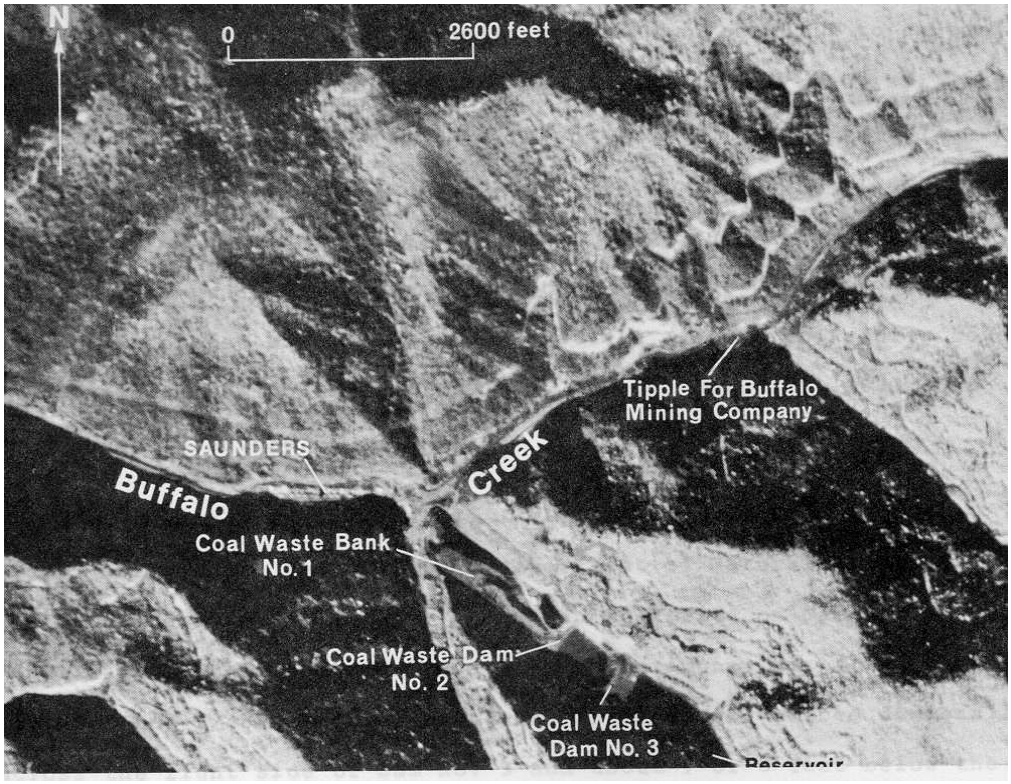


Figure 2-4 Reconstructed view of coal-waste banks on Middle Fork near Saunders, W. Va.

haulroad into refuse dump is needed so dump can be built to control runoff, reinforce impoundment, and supply needed emergency spillway for impoundment." Following this inspection, on April 16, 1971, a Notice to Comply with water Pollution Control Permit was issued by the West Virginia Department of Natural Resources against Buffalo Mining Company. The accompanying letter from the Department of Natural Resources also pointed out that all Inspection Reports covering a period from September 19, 1966, through March 25, 1971, had been "unsatisfactory."

In a letter dated June 24, 1971, Mr. Dasovich informed Mr. Edgar Henry of the West Virginia Department of Natural Resources that a "24-inch emergency spillway" had been installed on Dam No. 3. The "spillway," according to Mr. Dasovich's testimony, was a length of butt-welded, 1/4-inch pipe, 24 inches in diameter, placed diagonally across the right side of Dam No. 3 and about 7 or 8 feet below the graded crest. No collar or baffles were used (Hearing Transcript, Vol. III, p. 19).

No attempt appears to have been made to learn the expected runoff patterns from the watershed feeding Dam No. 3. Also, up to the time of the flood, an adequate spillway system had not been installed. Plans were to install a permanent spillway on the left bank of middle Fork (referred to in the March 25, 1971, Inspection Report) along the side of Pool No. 2.

2.2.5 Dam No. 4

Dam No. 4 was constructed in 1969 and is still in place. This dam, which is constructed mainly of shale with coal waste, rises 25 feet above the bed of Middle Fork. The dam is about 200 feet long and its crest ranges in width from 10 feet near the west side to over 40 feet on the east. The area behind the dam is filled with silt and coal waste and no water is impounded. A spillway on bedrock is on the left (west) side of the dam."[1]

2.3 EVENTS PRECEDING THE REFUSE DAM FAILURE

On Tuesday morning, February 22, 1972, Buffalo Mining Company became aware of the high-water problem behind Dam No. 3 when Mr. D. S. Dasovich visited the area to observe the condition of the roads to the various company mines, and while doing so drove onto the impoundments (Hearing Transcript, Vol. III, p. 40). The water level behind Dam No. 3 was several feet below the opening to the 24-inch drainpipe. He did not return to the area until Thursday, February 24, at which time he was in transit to the No. 8-1/2 mine. At that time, he observed water flowing from the downstream opening of the 24-inch drainpipe in Dam No. 3. According to Mr. Dasovich's observations, the water level behind Dam No. 3 had risen 2 or 3 feet during the two-day interval.

Also on Thursday, February 24, Mr. Jack Kent, Strip Mine Superintendent, Buffalo Mining Company, observed the water rising behind Dam No. 3. At 4:00 p.m. Thursday, February 24, Mr. Kent observed that the water was about 5 feet below the crest of the compacted portion of the dam. At that time, Mr. Kent placed a measuring stick (a limb from a tree) into the upstream bank of Dam No. 3 near the upstream opening to the 24-inch overflow pipe. It was placed in the embankment so that the top of the stick was approximately 1 foot below the top of the comtacted part of the dam (Hearing Transcript, Vol. I, p. 129). At that time, he was not able to actually see th_e upstream opening to the overflow pipe. Mr. Kent continued to make checks on the condition of the impoundment until about midnight Thursday. Shortly before 6:00 a.m.

Friday, February 25, Mr. Kent received a telephone call from Mr. Dasovich, who had just examined the dam. Mr. Dasovich. stated in this phone conversation that he considered Dam No. 3 to be "all right" (Vol. I, p. 128). Mr. Kent then proceeded to his regular job and did not return to the dam site until 4:00 p.m. Friday, February 25.

At about 10:30 a.m. Friday, February 25, Pittston and Buffalo Mining Company officials met at the Lorado office with representatives of the Department of Natural Resources to discuss Buffalo Mining Company's proposal for a surface-mining operation just south of Lorado. The meeting had been arranged a week earlier. Representing the company were I. C. Spotte, John Keblish, James White (Pittston reclamation specialist), and D. S. Dasovich.. Department of Natural Resources representatives were Ira S. Latimer, Jr., Director; Benjamin C. Greene, Chief, Division of Reclamation; James A. Pitsenbarger, Assistant Chief; Richard Frazier, District Reclamation Inspector; and McDonald Smith, Drainage Engineer. Also present were representatives of two construction companies. The proposed site was visited in the afternoon and the meeting concluded at about 4:30 p.m. I. C. Spotte testified (Hearing Transcript, Vol. IV, p. 82) that during the day-long meeting no problems concerning Dam No. 3 were brought to the State's attention, nor was it visited on the tour.

When Mr. Kent returned to the dam site at 4:00 p.m. Friday, February 25, he observed that the water level had risen 18 inches according to the markings on the measuring stick. Mr. Ben Tudor, General Superintendent, Buffalo Mining Company, also checked the water

level at about 5:30 p.m. Sometime Friday evening, Mr. Kent informed Mr. Dasovich that he would voluntarily check the water level behind Dam No. 3 throughout the night (Vol. I, p. 128). After his 4:00 p.m. visit, Mr. Kent continued to check the water level at regular intervals. At approximately 9:00 p.m. Friday, February 25, Mr. Kent was accompanied to the dam by Mr. Elmer Elswick, a foreman at the strip-mine operations. From approximately 9:00 p.m. Friday, February 25, until 6:30 a.m. Saturday, February 26, Mr. Kent was the only Buffalo Mining Company official known to have visited the dam site.

In his visits to the dam after 4:00 p.m. February 25, Mr. Kent recorded an increase in water level of an inch per hour until 3:30 a.m. Saturday, February 26, at which time he observed that the water was rising 2 inches per hour. At 4:30 a.m., Mr. Kent was accompanied to the site by two Saunders' residents, Mr. Denny Gibson and Mr. Harvey Pierson (Vol. II, p. 71).At that time, Mr. Kent and Mr. Gibson removed a tire from one of the drainpipes on Dam No. 1. Mr. Kent observed that the water behind Dam No. 3 had risen 3 inches within the preceding hour. Only 3 inches on the measuring stick remained uncovered. At 5:00 a.m. February 26, Mr. Kent telephoned Mr. Dasovich, informed him of the rising water behind the impoundment, and asked that he come and look at the dam.

On his way to the impoundment area, Mr. Dasovich stopped at a restaurant in Man where he met Deputy Sheriff Otto Mutters. Mr. Mutters had been called out to check the dams at 5:00 a.m. by Mr. Larry Spriggs,

the Logan County jailer. Mr. Spriggs had received a call from an unidentified woman in Lorado at 3:55 a.m. on Saturday, February 26, 1972, warning that the pool behind the dam on Middle Fork was rising at a rate of 6 to 8 inches per hour. Mr. Mutters drove on up Buffalo Creek alone and was passed by Mr. Dasovich at Lorado.

At approximately 6:00 a.m., Saturday, February 26 (Vol. III, p. 12), Mr. Dasovich and Mr. Kent examined Dam No. 3. At that time, according to Mr. Dasovich, water was coming through the overflow pipe. The rising water had covered Mr. Kent's measuring stick and was: nearly 1 foot below the crest of the compacted part of the dam (Vol. I, p. 129). But Mr. Dasovich ". . . wasn't alarmed about it. I have seen the water like that before, especially in the No. 2 impoundment" (Vol. III, p. 10). Mr. Kent and Mr. Dasovich walked the length of Dam No. 3 "front and back facing the thing" (Vol. III, p. 42). Mr. Dasovich observed several longitudinal cracks across the front of the dam near the left abutment, but did not become alarmed because this was an area of active dumping (Vol. III, p. 31). Also present at the 6:00 a.m. examination of the dam was Mr. Waldon Mullins, Superintendent, No. 5 mine. Mr. Mullins did not speak with Kent or Dasovich. Accompanied by an employee at the No. 5 mine, he walked from the right abutment halfway across Dam No. 3. According to his observations the surface was firm.

During the 6:00 a.m. examination of the dam, Mr. Dasovich and Mr. Kent discussed having a ditch dug from the No. 3 reservoir through the crest of the No. 3 dam to the diversion ditch along the No. 5 mine road.

There were two sections of 24-inch-diameter metal pipe available near the dam (Hearing Transcript, Vol. III, p. 219) and Mr. Dasovich intended to have these pipes welded together and placed into this ditch to act as an additional overflow from the No. 3 reservoir.

According to his testimony, Mr. Dasovich's only concern at that time was the possibility of the water overtopping Dam No. 3 and flooding the roadway below (Vol. V, p. 32).After examining the dam, Mr. Kent and Mr. Dasovich left the impoundment area. On his way to the Buffalo Mining Company offices in Lorado, Mr. Dasovich saw Deputy Sheriff Mutters and Deputy Sheriff Doty at the railroad crossing by the Lorado Grade School. At that time, Mr. Dasovich reports saying to Mutters, "Otto, the thing looks all right. We are going to do a little work on it" (Vol. III, p. 13). According to Mr. Mutters, Dasovich said, "We have ditched this (or channeled it) and it looks all right" (Hearing Transcript, Vol. II, p. 129). According to Mr. Mutters, his conversation with Dasovich took place at approximately 6:15 or 6:20 a.m. February 26. Mr. Dasovich testified that he also assured several Lorado residents that he ". . . could see nothing to be particularly alarmed about." Mr. Dasovich proceeded to his office in Lorado at about 6:30 a.m.

Having spoken with other Buffalo Creek residents who were still concerned about the dam, Deputy Mutters continued to warn residents in the area. In testimony before the Ad Hoc Cormission, Mr. Mutters stated, "If Steve (Dasovich) had known that dam was going to break,

and informed us of that, then, hell, I don't think anybody would have got drowned. Chances are we could have got everybody out, me and the other patrol car (Doty's)" (Hearing Transcript, Vol. II, p. 131).

After returning to the Buffalo Mining Company offices, Mr. Kent ordered Elmer Elswick to take two bulldozer operators, Mr. Junior Bays and Mr. Lester Weiss, to the strip-mine operations in order to transport bulldozers to the dam for installation of the additional overflow pipe. Before Mr. Bays and Mr. Weiss returned to the dam site, the failure had occurred. While in his office, Mr. Dasovich instructed Mr. Stanley Morris to make the necessary preparations for welding the two lengths of pipe together. At 6:45 a.m., Mr. Dasovich telephoned Mr. I. C. Spotte, President, Buffalo Mining Company, in Dante, Virginia, and ". . . advised him of the situation, told him about the intense rainfall and the concern of some of the people and what I planned to do to alleviate some of their fears on it" (Vol. V, p. 33). Mr. Dasovich then made further plans to install the additional pipe on Dam No. 3.

At approximately 7:00 a.m., Mr. Ben Tudor observed the No. 3 impoundment. This was the first observation he had made since 5:30 p.m. on Thursday, February 25, 1972. At 7:00 a.m. and again at approximately 7:30 a.m., Mr. Tudor observed the water level in the No. 3 reservoir to be approximately 8 feet below the crest. He made his visual observation from the No. 5 mine road. At this time, Mr. Tudor was "concerned about the people in Saunders and thought they should be

evacuated. But I wasn't worried about on downstream" (Vol. III, p. 142).

Meanwhile, after attempting to obtain raincoats for the engineers who would be running elevations for the ditch line on the impoundment, Mr. Dasovich was notified that a dam had "broken at the tipple" (Vol. III, p. 14). He proceeded to drive from Lundale up Buffalo Creek toward the No. 5 mine. His account of what he saw is as follows:

> As I got up to just above Craneco, on the straight stretch, I met this wall of water. I was just amazed.
>
> I pulled over to the side of the road, and my vehicle stalled out. I splashed some water on it, or something.
>
> I got out, and this wall of water come by me, possibly 10 or 15 feet high.
>
> I could hear all this loud noise in Lorado, so I went up on the bank to see what was going on up there, and the water was picking up the houses like tent pegs and throwing them back.
>
> There is a small backwash there where the kick back track is, going up to Lundale 2, and it w.-is pushing the houses over in there and debris and everything was going down.
>
> I saw the wall of water hit the briige there at the mouth of Dingess Branch, and turned. The whole thing went right down through Lundale, and just every house, it wiped them all out.
>
> After the water had gone by, it didn't seem like over 10 minutes, two or three people that work at Lorado come by, and we were going to drive down, and couldn't get in where the debris was in the road. So they jumped out and went on down the road.

Throughout the night of February 25-26, 1972, several residents from Saunders and other Buffalo Creek communities also visited the dam

Mr. Edgar Pierson (Hearing Transcript, Vol. II, p. 84) was on Dam No. 3 sometime between 10:00 and 11:00 p.m., Friday, February 25, 1972. At that time, Mr. Pierson observed a crack from 6 to 8 inches wide extending three-quarters of the way across the surface of the dam from the left toward the right abutment. It was possible for Mr. Pierson to see down into the crack which, to him, resembled a mine surface crack (Vol. II, p. 89). The water level behind Dam No. 3 was from 10 to 15 inches below the crest of the darn. The crest of the dam was soft, causing him to sink into the surface of the dam, nearly covering the tops of his boots. Mr. Pierson also observed black water seeping into Pool No. 2 at the toe of Dam No. 3 (Vol. II, p. 93). After completing his visit to the dam site, Mr. Pierson alerted other Saunders' residents to the possibility of the dam's failure and suggested that they evacuate their homes immediately. According to his testimony all of the people in Saunders had been notified by approximately 12:00 midnight, February 25, 1972 (Vol. II, p. 87).

Mr. Harvey Pierson, Edgar Pierson' son, also visited Dam No. 3 at 2:00 a.m. and again at approximately 4:30 a.m., Saturday, February 26. During the 2:00 a.m. visit, Mr. Pierson observed Mr. Kent's measuring stick and returned to the camp. At 4:30 a.m., he again went to the dam along with Mr. Denny Gibson and Mr. Kent. Water in Pool No. 1 was 4 inches from the crest of Dam No. l.. One of the drainpipes in Dam No. 1 was clogged with a tire. Mr. Kent and Mr. Gibson removed the tire from the drainpipe and the water level in Pool No. 1

dropped immediately. The water level in Pool No. 3 was at the crest of Dam No. 3 and at the base of the ungraded coal-waste piles. The surface of Dam No. 3 was, according to the witness, "sort of soft, slate-like."

Mr. Kenneth Osborne examined Dam No. 3 at 4:00 a.m. February 26, and again sometime near 7:00 a.m. On his 7:00 a.m. visit, Mr. Osborne reported seeing two sections of 24-inch-diameter corrugated steel pipe laid end to end to form a 40- to 60-foot section on the crest of the dam. On the 7:00 a.m. visit, he also reported seeing a crack 10 feet wide and 30 feet long (Vol. II, p. 35) on the downstream side of the left abutment of Dam No. 3. The crest of the dam was soft "like jelly" (Vol. II, p. 36) at that time.

Mr. Denny Gibson visited Dam No. 3 several times on the morning of Saturday, February 26, 1972, to observe the water level in the reservoir behind the impoundment. He also warned several Saunders' and Lorado residents of the possibility of the dam failure. He made his first visit to the dam at 12:30 or 1:00 a.m., February 26, with Mr. Kent. At 4:30 a.m., February 26, Mr. Gibson and Harvey Pierson accompanied Mr. Kent to the dam sites, at which time Mr. Gibson assisted Mr. Kent in removing the tire which was blocking the No. 1 impoundment overflow pipe. The witness returned to the dam at 6:00 a.m, February 26, with Kenneth Osborne. At that time, Mr. Gibson observed a 50-foot length of 24-inch-diameter, corrugated, galvanized pipe or. the crest of the dam, partially buried on the left quarter o

the dam. Later testimony from this witness revealed that he had seen this pipe on the dam at least one week prior to February 26. Mr. Gibson again visited the dam at 7:50 a.m., February 26. This time the witness was alone. He saw that Mr. Kent's measuring stick was submerged. The crest of the dam was soft, "real. soggy, like mush" (Vol. I, p. 189). Water was "oozing" through the loose refuse piles on the top of the dam. He also saw large cracks and slumps on the downstream face of Dam No. 3 near the center of the dam.

At approximately 7:45 a.m., February 26, Mr. Wayne Goodman, Chief Electrician, Buffalo Mining Company, examined Dam No. 3 and the overflow pipe on his way to the No. 5 mine portal. "The surface was firm. It was wet, but it was firm" (Vol. III, p. 232). ". . . I walked the road over toward the discharge end and [of] the overflow, because I saw something white, that was an old piece of yellow plastic braddish [brattice] over the overflow . . . there was between 8 and 10 inches standing through the overflow . . . The pool in back of Dam No. 3 liked [lacked] about 8 feet, I wouldsay between 6 and 8 feet, anyhow, of reaching the top of the dam" (Vol. III, pp. 232-233). Mr. Goodman also stated that, "There was nothing to indicate whatever that there was any failure." He proceeded to the No. 5 mine portal and was notified a few minutes later that, "The dam is gone."

2.4 EYEWITNESS OBSERVATIONS FOLLOWING THE FAILURE OF THE DAM

Apparently, there was no eyewitness to the actual failure of Dam No. 3, although a number of people were in the vicinity of the dam immediately prior to and following the failure.

Mr. Billy C. Linville (Hearing Transcript, Vol. IV, p. 159) left the storehouse at the tipple just before 8:00 a.m., Saturday, February 26, 1972, to check Dam No. 3 at the request of D. S. Dasovich. He went up the haulroad and stopped at the curve near the front of the refuse bank where he observed a 2- to 3-inch deep flow of black water coming over the road. The water flow rate increased. When the water reached the burning part of the refuse bank, there was an explosion that blew debris onto Mr. Linville and his truck. Other explosions followed. He returned to Buffalo Creek by backing down the haulroad and proceeded down the Buffalo Creek road nearly to the mouth of Middle Fork at 8:10 a.m. A large flow of black water (over 5 feet deep) was coming out of Middle Fork. It bounced off the hill on the opposite side of Buffalo Creek. Mr. Linville returned to the storehouse and informed Waldon Mullins, Ben Tudor, and William Baker of the water at Middle Fork. He then returned to the mouth of Middle Fork with Mr. Baker and Mr. Tudor. They then drove to a point near the curve in the No. 5 mine road near the mouth of Middle Fork and he observed the remnants of the town of Saunders.

At. about 8:00 a.m., February 26, Mr. John Wells (Hearing Transcript, Vol. I, p. 174) was driving down the No. 5 mine portal toward

the mouth of Middle Fork. At a point 300 feet above the upstream side of Dam No. 3, his car was showered with black water containing fine black material. Mr. Wells continued down the road and turned around on the road above Dam No. 3. There appeared to be a solid sheet of water across the valley below the dam. Mr. Wells returned to the No. 5 mine portal. The lights had gone out in part of the building. He attempted to phone some of the people in the valley, but the line was dead.

Mr. Herbert Pruitt (Vol. V, p. 103) left the No. 5 mine portal no later than 8:04 a.m., Saturday, February 26. He arrived at Dam No. 3 some 3 or 4 minutes later and was stopped by the washout of the road below Dam No. 3. He saw a smooth sheet of water stretching from the right abutment "going out at a tremendous speed" about 50 feet in width. The water level was 30 to 40 feet below the level of the No. 5 mine roadway. "The bigger part of the dam had gone, and I assumed the bigger part of the water had done gone, but there was still a tremendous amount of water going out of the dam" (Vol. V, p. 108). When Mr. Pruitt made his observations, several other men were present: "Johnny Wells, Wayne Goodman, Charles Lockhart, Earl Estrich, William Flowers . . . and William Peyton" CVol. V, p. 106).

Mr. William Peyton, Section Foreman, Buffalo Mining Company, left the No. 5 mine portal at appzoxi-mately 8:113 a.m. on Saturday, February 26. He was stopped at Dam No. 3 by the washout in the road above Dam No. 2. Mr. Peyton observed that 75 to 100 feet of the right

side of Dam No. 3 was gone, with the remainder of the dam sliding into the breach. He had difficulty in seeing across the valley because of the ashes and smoke from the explosion at the refuse bank. The water level was 10 to 15 feet below the level of the No. 5 mine road. The water level was down to the base of the dam within 20 to 25 minutes and the creek was flowing in the channel through the original dam site.

At approximately 8:00 a.m., February 26, 1972, Mr. Ozzie Adkins (Vol. I, p. 58), who lives in a house 200 feet up Lee Fork (at the right center of Figure 2-4), heard several explosions that occurred in the direction of the front of the refuse bank on Middle Fork. At about the same time, he observed a wall of water coming out of Middle Fork into Buffalo Creek. The water carried away the church that stood at the mouth of Lee Fork. The flood flow lasted approximately 15 minutes.

At 8:02 a.m., February 26, Mr. WiLJiam Baker (Vol. III, p. 238) was driving down the Buffalo Creek road _rom the No. 5 preparation plant toward Saunders (bottom center of Figure 2-4) when he was stopped by a wall of water 8 to 10 feet high flowing from the mouth of Middle Fork. Sludge was hurled onto his windshield. He saw a trailer in the Saunders' camp flung into the air by the water. There were several puff-like explosions at the front of the refuse bank which formed mushroom-shaped clouds extending 200 to 300 feet up Middle Fork.

Mr. Baker immediately returned to the supply house at the No. 5 preparation plant where he met Mr. Ben Tudor and Mr. Waldon Mullins. The men drove back down the Buffalo Creek road where the wall of water flowing from Middle Fork had risen to between 18 and 20 feet in height. They then drove up the No. 5 mine road (also shown on Figure 2-4) until they were stopped by water at the bend in the road opposite the front of the refuse pile. From this point, Mr. Baker could observe what remained of the Saunders' area. Islands of debris protruded from a sheet of water extending from one side of the valley to the other.

2.5 WEATHER CONDITIONS CONTRIBUTING TO THE BUFFALO CREEK FLOOD*

Three weather reporting stations are located near Buffalo Creek hollow: (1) Logan, approximately 15.5 miles west northwest of Lorado; (2) Madison, approximately 18.8 miles north northwest of Lorado; and (3) Pineville, approximately 17.3 miles southeast of Lorado. Average values of temperature, total precipitation, and total snow for these stations for January and February, 1972, are tabulated below.

Weather Conditions, January and February, 1972

January	Logan	Madison	Pineville
Average maximum temp., °F	47.60	46.50	45.80
Average minimum temp.,°F	26.90	25.20	24.00
Average temp.,°F	37.30	35.90	34.90
Total precipitation, inches	6.08	4.96	6.55
Total snow, inches	- -	1.00	0.50
February			
Average maximum temp.,°F	45.00	44.40	43.10
Average minimum temp.,°F	23.70	22.70	21.10
Average temp.,°F	34.40	33.60	32.10
Total precipitation, inches	6.56	6.26	7.30
Total snow, inches	2.50	3.20	10.60

Although similar figures are not available for Madison and Pineville, the records indicate that in 1972 the total precipitation at Logan was 2.32 inches (62 percent) greater than normal for January and

*Data shown in this section are taken from Climatological Data, West Virginia, Vol. 80, No. 1 and 2, January and February, 1972, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Environmental Data Service.

3.06 inches (86 percent) greater than normal for February. Daily precipitation and maximum and minimum temperatures for the three stations are tabulated below.

Daily Weather Conditions, January 1972*

Date	Logan			Madison			Pineville		
	Max. Temp.	Min. Temp.	Precip	Max. temp.	Min. Temp.	Precip	Max. temp.	Min. temp.	Precip
1	44	23	- -	42	22	- -	43	21	- -
2	50	24	0.80	50	23	0.58	52	22	1.08
3	50	29	0.19	50	28	0.19	47	28	0.06
4	55	30	0.23	46	28	0.24	53	27	0.42
5	49	33	1.30	50	30	1.07	47	32	1.22
6	34	24	T	32	21	0.03	33	20	- -
7	35	21	- -	34	20	- -	34	17	- -
8	44	20	- -	42	20	- -	42	17	- -
9	49	21	- -	47	20	- -	47	21	- -
10	50	41	0.61	55	40	0.53	40	32	0.53
11	60	44	0.04	61	45	0.10	54	39	- -
12	53	31	0.22	50	28	0.15	60	30	- -
13	62	31	- -	56	30	- -	61	30	- -
14	72	29	0.35	71	28	0.25	57	30	0.49
15	32	17	T	35	16	- -	31	14	0.02
16	19	-5	- -	23	-8	- -	20	-7	T
17	15	2	- -	15	-7	- -	12	-7	- -
18	44	11	- -	40	12	- -	40	5	- -
19	59	17	0.10	53	18	0.08	50	13	0.05
20	48	39	0.05	52	38	0.09	42	34	0.10
21	57	40	0.65	58	40	0.39	46	36	1.37
22	51	45	0.02	48	41	T	59	38	0.06
23	67	43	0.04	65	40	0.03	63	42	0.04
24	58	46	0.30	62	48	0.34	57	43	0.03
25	76	41	0.33	72	38	0.29	72	38	0.24
26	43	19	- -	40	17	- -	41	19	- -
27	50	19	- -	45	17	- -	48	18	- -
28	42	26	0.85	37	23	0.60	46	19	1.00
29	39	26	T	37	23	- -	42	26	T
30	35	26	- -	38	23	- -	46	26	- -
31	35	20	- -	34	20	T	34	21	T

*Note: T denotes trace of precipitation. Temperatures shown are degrees Fahrenheit. Precipitation shown is in inches.

Daily Weather Conditions, February1972*

Date	Logan			Madison			Pineville		
	Max. Temp.	Min. Temp.	Precip	Max. temp.	Min. Temp.	Precip	Max. temp.	Min. temp.	Precip
1	39	18	- -	37	17	- -	36	17	- -
2	42	18	- -	42	17	- -	43	18	T
3	55	31	0.09	54	29	0.04	45	29	0.12
4	45	18	0.52	44	17	0.42	42	15	0.29
5	22	11	- -	22	10	T	21	11	- -
6	35	11	- -	33	11	- -	31	12	- -
7	39	27	0.27	40	24	0.22	35	24	0.32
8	29	10	T	25	7	- -	29	3	- -
9	32	12	- -	30	7	- -	29	4	0.34
10	37	24	- -	34	17	- -	37	16	- -
11	45	23	- -	41	18	- -	41	10	- -
12	57	12	- -	51	23	- -	52	20	- -
13	40	28	0.92	59	25	0.81	58	24	0.78
14	57	30	0.29	40	32	0.28	38	31	0.34
15	45	32	- -	53	32	- -	53	23	- -
16	49	28	- -	54	25	- -	45	27	- -
17	50	25	0.06	47	2683	0.29	46	26	0.18
18	43	31	0.10	40	1	0.10	41	32	0.70
19	41	24	0.34	42	2371	0.30	41	22	0.22
20	28	19	0.04	27	6	0.10	25	15	0.14
21	36	18	- -	33	16	- -	29	9	- -
22	55	18+	0.14	56	18	0.16	49	9	0.15
23	45	28	- -	42	22	- -	42	25	- -
24	49	27	1.41	51	24	1.27	47	26	1.33
25	**	**	0.41	53	39	0.52	49	40	0.86
26	68	40	1.90	65	40	1.87	68	41	1.54
27	50	29	0.05	46	28	0.08	56	26	0.03
28	71	28	- -	57	28	- -	56	28	- -
29	50	31	- -	69	36	- -	65	29	- -

*Note: T denotes trace of precipitation. Temperatures shown are degrees Fahrenheit. Precipitation shown is in inches. ** Not reported

No information is available on snowfall or snow on the ground at Logan. At Madison, the maximum snowfall during the two-month period was 2 inches on February 4, 1972, and the sow on the ground there never

exceeded 1 inch. The maximum snowfall at Pineville was 8 inches on February 20, 1972. This new snow plus the small amount which had fallen the previous day made a total on the ground of 9 inches. By February 21, however, only 2 inches remained and from February 22 until the end of the month, the ground was bare.

Total precipitation during the three-day period of February 24-26, 1972, was 3.72 inches at Logan, 3.66 inches at Madison, and 3.73 inches at Pineville. The close agreement between these values indicates the general and widespread nature of the rain and, by implication, gives evidence that amounts of precipitation were not significantly greater in isolated locations within the area. Total precipitation for the seven-day period ending February 26, 1972 also varied by only 0.12 inch in the three locations.

Temperatures were well above freezing at the three stations on February 25-26, and reached 68°F at Logan and Pineville on February 26 (65°F at Madison). Minimum temperatures were only slightly below freezing on February 23-24.

Considering both the precipitation in the form of rain and the warm temperatures, it is unlikely that any significant amount of snow could have existed on the ground during the four-day period preceding the failure of the dam on Middle Fork. It is also unlikely that any ice had frozen or accumulated on the downstream face of the dam.

2.6 SOURCE OF FLOODWATER*

Three possible sources of water could have contributed significantly to the Buffalo Creek flood: heavy runoff from melting snow, heavy runoff from locally intense cloudburst rainfall in any of the streams tributary to Buffalo Creek, and water released from the reservoir on Middle Fork following failure of coal-waste Dam No. 3. As will be shown, the failure of Dam No. 3 on Middle Fork contributed almost all of the peak floodflow in Buffalo Creek; direct runoff from snowmelt or rainfall and inflow from tributaries other than Middle Fork were not significant.

2.6.1 Snowmelt

Residents of the Buffalo Creek hollow discount the importance of the snow cover in producing the floodflow. They report that by the end of February snow cover was limited to scattered drifts mainly on the northern slopes of the higher hills. According to the National Weather Service, the last snowstorm reported prior to the flood dropped about 1.5 inches of snow at Logan on February 19-20. On February 25, the day before the flood, very little snow was visible in the hills.

*The text in all of Section 2.6 is quoted from Geological Survey Circular 667, West Virginia Buffalo Creek Flood: A Study of the Hydrology and Engineering Geology, by William E. Davies, James F. Bailey, and Donovan B. Kelly.

2.6.2 Precipitation

During the 72-hour period immediately preceding the flood, precipitation averaged 3.7 inches at Logan and at other stations 15-20 miles south and east of Buffalo Creek, according to the National Weather Service (Figure 2-6). About half of the rainfall (1.9 in.) at Logan fell in the 24 hours that preceded the flood. Precipitation tapered off to the north during the 3-day period, measuring 2.35 inches in Charleston. Maximum precipitation during the storm was 4.5 inches produced at Williamson, 22 miles west of Buffalo Creek. A bucket survey in the Buffalo Creek hollow conducted by field parties during the week following the flood revealed no catchment of precipitation in open cans and other available containers that exceeded 3.7 inches recorded at Logan.

According to National Weather Service estimates, 3.7 inches of rain in 3 days is about a 2-year rainfall; that is, southwestern West Virginia can expect precipitation to equal or exceed 3.7 inches in a 3-day period over a long-term average of once every 2 years. In fact, precipitation exceeding 3.7 inches in a 2- or 3-day period has been measured at Logan eight times in the last 17 years. Indirect measurements of peak discharges of streams tributary to Buffalo Creek and inspection of streams near the Buffalo Creek basin produced no evidence of sudden high flows from cloudburst rainfall.

In conclusion, February was a slightly wetter month than normal;

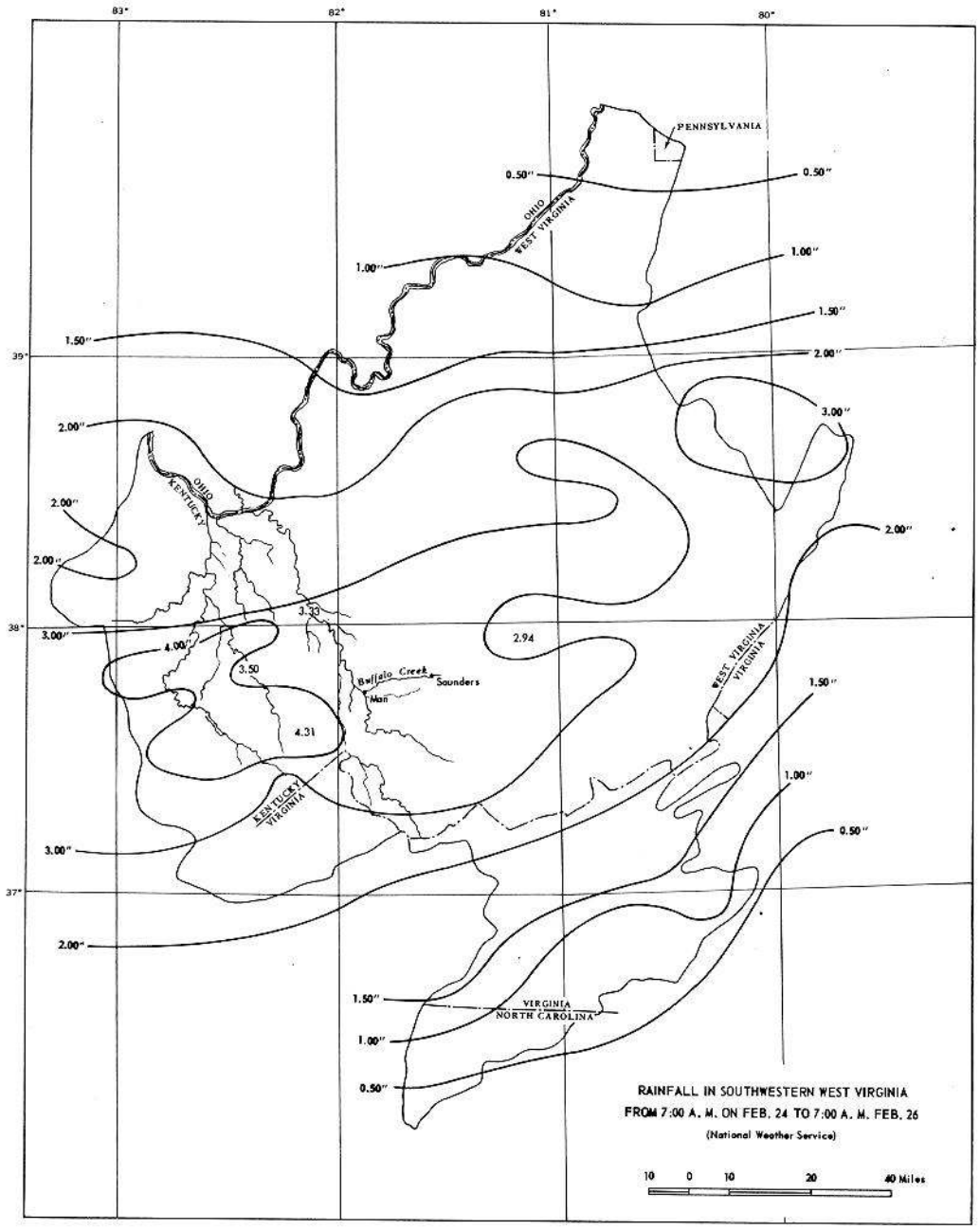


Figure 2-6 Map showing rainfall in southwestern West Virginia February 24 to February 26, 1972

total precipitation at Logan during the month was 4.56 inches, 1.2 inches above the 30-year average. Although the storm of February 24-26 dumped most of its precipitation during the 24 hours immediately preceding the flood, no evidence was found of large cloudburst rainfalls that could contribute the large volume of water needed to produce the flash flood on Middle Fork and Buffalo Creek. The only available source of water large enough to produce the flood was the pool of water behind coal-waste Dam No. 3 on the Middle Fork.

2.6.3 Pool on Middle Fork

Information on inflow and characteristics of the pool behind coal-waste Dam No. 3 were determined from field surveys and interviews with local residents. The pool reached its maximum volume, about 17.6 million cubic feet of water and sludge, around 8:00 a.m. on Saturday, February 26 (Figure 2-7). At that time the water-surface elevation had risen to 1,753.1 feet above mean sea level, and the depth of water in the pool just upstream of the coal-waste dam was 47.3 feet above the level of sludge remaining after failure of the dam. The surface area of the pool at the time of the dam failure was 14.2 acres (Figure 2-8), and the pool extended 2,100 feet up the Middle Fork valley.

The highest sludge line behind Dam No. 3 was at an elevation of 1,733.6 feet m.s.l. (mean sea level). At that elevation, the volume of sludge was 8.4 million cubic feet and the surface area was 10.3 acres.

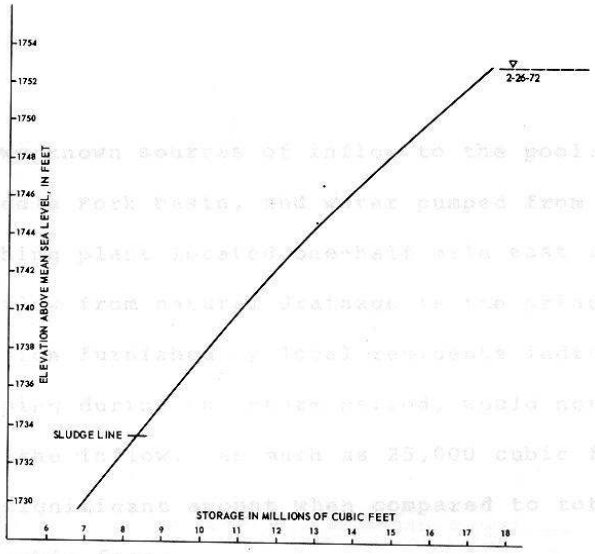


Figure 2-7 Graph showing height of the pool behind coal-waste Dame no 3

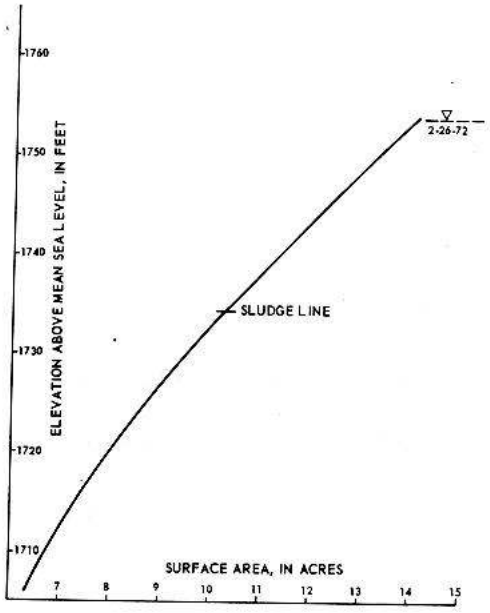


Figure 2-8 Area covered by the pool behind Dam no. 3

There are two known sources of inflow to the pool: natural drainage from middle Fork basin, and water pumped from nearby mines and from the washing plant located one-half mile east of the mouth of Middle Fork. Inflow from natural drainage is the principal source of inflow. Information furnished by local residents indicates that pumping, if there was pumping during the storm period, would not contribute significantly to the inflow. As much as 25,000 cubic feet per day might be pumped, an insignificant amount when compared to total pool volume of 17.6 million cubic feet.

Middle Fork drains an area of 1.18 square miles, 1.1 square miles of which is above coal-waste Dam No. 3. Peak inflow during the storm period and rate of rise of pool contents are estimated from interviews with mine-company personnel and from indirect measurements on other small drainage areas in the Buffalo Creek basin near Middle Fork.

Analysis of Mr. Kent's observations from Thursday, February 24 through Saturday, February 26, indicate a rise of slightly less than 1 inch per hour on Thursday afternoon, increasing to about 3 inches per hour by 3:00 a.m. Saturday. Using the stage-volume curve shown in Figure 2-6 and the observations made on the measuring stick, the rate of rise of the pool is shown in Figure 2-9.

Outflow from the reservoir cannot be reliably established from the information available. A 24-inch drain pipe (or pipes) is reported to have been in place and carrying flow at the time of the dam failure.

The exact position of this drain pipe in the darn and the true head on the pipe have not been ascertained. However, computations based on its location as reported by eyewitnesses yield a peak flow through the pipe of about 10 cfs* (4,500 gpm*).

Using the rate of change in contents relation developed in Figure 2-9 and adjusting for outflow, the inflow graph shown in Figure 2-10 was developed for the period 6:00 p.m. Thursday, February 24, to 4:00 a.m. Saturday, February 26, when observations on the elevation of the impounded water were discontinued. The inflow curve does not include seepage through the dam. Maximum seepage, estimated at less than 10 cfs (4,500 gpm), would have occurred just prior to failure when the hydraulic gradient through the dam was the greatest.

Peak inflow for the storm is estimated as 70 cfs (31,000 gpm) on the basis of yield per square mile determined for several small tributaries in the Buffalo Creek basin near Middle Fork. Data collected at gaging stations on surrounding streams show peaks on February 25 and 26 of nearly the same magnitude; however, the peak discharge on Middle Fork is believed to have occurred on February 26.

*See Section 9.0, GLOSSARY OF TERMS.

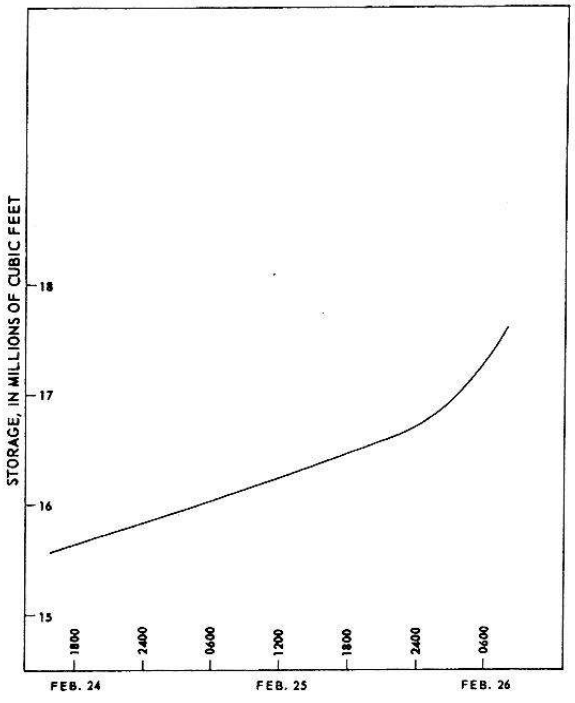


Figure 2-9 Graph showing increase in volume of water in the pool behind coal-waste dam no. 3

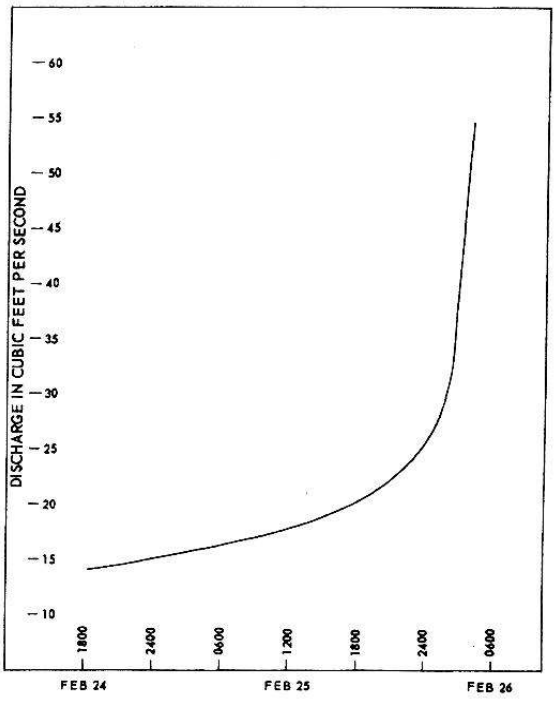


Figure 2-10 Graph showing rate of inflow to the pool behind coal-waste Dame no. 3

2.7 ENGINEERING ANALYSIS OF THE DAM FAILURE

2.7.1 Evidence of Foundation Seepage (Piping)

Within a year prior to the failure of Dam No. 3, Paul Lankas, a Buffalo Mining Company employee, reported black water boiling up from the bottom of Pool No. 2 near the downstream toe (Hearing Transcript, Vol. IV, p. 151). Mr. Dasovich and Mr. Tudor observed black water boiling up from Pool No. 2 near the downstream toe during the February, 1971, slump of Dam No. 3.

Mr. Edgar Pierson also observed black water seeping into Pool No. 2 sometime between 10:00 and 11:00 p.m. on Friday, February 25. These observations are indicative of sludge displacement and/or piping through the foundation of Dam No. 3, which would have contributed significantly to the weakening of an already unstable foundation.

2.7.2 Evidence of Slumping

A large dome-shaped mound not eroded or scoured by water action remained at the toe of Dam No. 3 about 120 feet from the left abutment (Figure 2-11 and 2-12). The mound is apparently a remnant of a slump that moved diagonally to the left of the downstream side. Throughout the night of February 25-26, several eyewitnesses reported seeing cracks across the surface of the dam and slumps on the downstream face (Vol. I, p. 189; Vol. II, pp. 35, 89; Vol. III, p. 31).

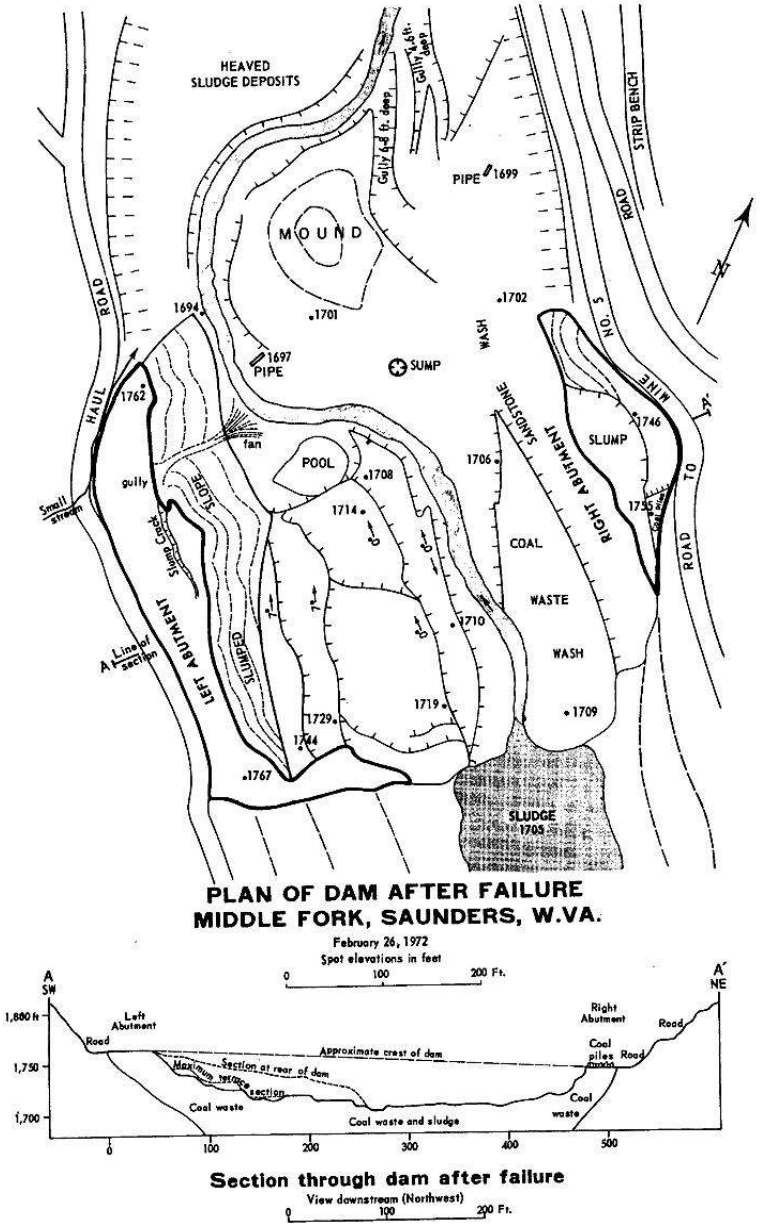


Figure 2-11 Diagram showing plan and cross-section through coal-waste Dam No. 3

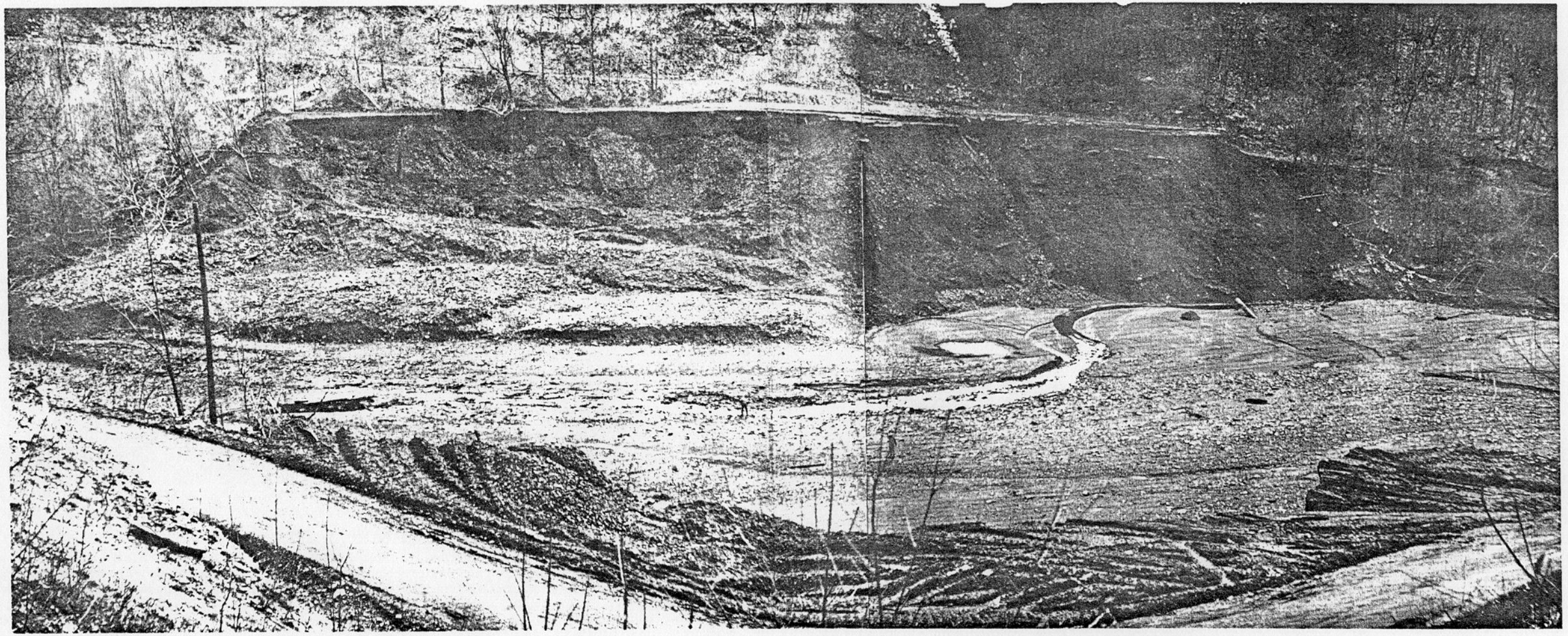


Figure 2-12. Looking upstream at the left abutment of coal-waste Dam No. 3

Figure 2-1 (W. A. Wahler and Associates) is a geologic cross-section of Middle Fork based on field investigations made following the February 26 dam failure and is the most significant evidence that can be used to describe the mode of failure. As can be seen in Figure 2-1, the reservoir sediment (or sludge) that formerly underlaid the downstream portion of Dam No. 3 and Pool No. 2 has been displaced by Dam No. 3 embankment material. The reservoir sediment has been pushed forward against the back side of Dam No. 2 and now forms a series of ridges up to 10 feet high and 20 feet wide. This indicates that Pool No. 2 sediment had been forced against Dam No. 2 by a shear failure on the downstream side of Dam No. 3. When total failure of the dam occurred, a portion of the Dam No. 3 material slipped down into the void created by the displacement of the Pool No. 2 sludge and water (Figure 2-1).

2.7.3 Summary of Failure

Figure 2-13 illustrates the sequence of failure of Dam No. 3. The increased water head due to the rain increased the rate of piping through the base of the dam. As piping action increased, the flow path was shortened and the exiting pressure was increased. The piping action and sludge displacement was the initial mechanism of failure (Trigger 1 or T1 in Figure 2-13) and resulted in further weakening of the already unstable foundation.

As the water level rose rapidly behind Dam No. 3, the dam was becoming super-saturated, thus increasing its weight and adding to th

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See Section 8.0, MINORITY OPINION, Jay Hilary Kelley

load on the foundation. The increased weight of the downstream portion of the dam was a second initiating mechanism (T_2, Figure 2-13) and in combination with T_1 resulted in a large rotational shear failure of the downstream portion of the dam.

The downstream portion of the dam failed, simultaneously causing the particles in the remainder of the dam to re-orient themselves in an attempt to re-establish equilibrium, thus decreasing their void spaces and increasing their neutral stress resulting in liquefaction. Then the driving force established by the water head in the pool and the near-zero shear strength of the material within the dam caused sudden total collapse of the dam.

The torrent of water released by the failure overtopped Dams No. 1 and 2 and came into contact with the burning coal-waste bank, increasing the hydrostatic pressure within the bank and causing explosions of steam and producer-type gas. Moments later, the water entered Buffalo Creek.

2.7.4 Conditions That Led to the Failure

2.7.4.1 Improper Construction of Dam No. 3

Dam No. 3 was not built using engineering practice standard in earth-dam construction; no foundation preparation was done and no attempt at compaction of the fill material was made other than occasional grading by bulldozer.

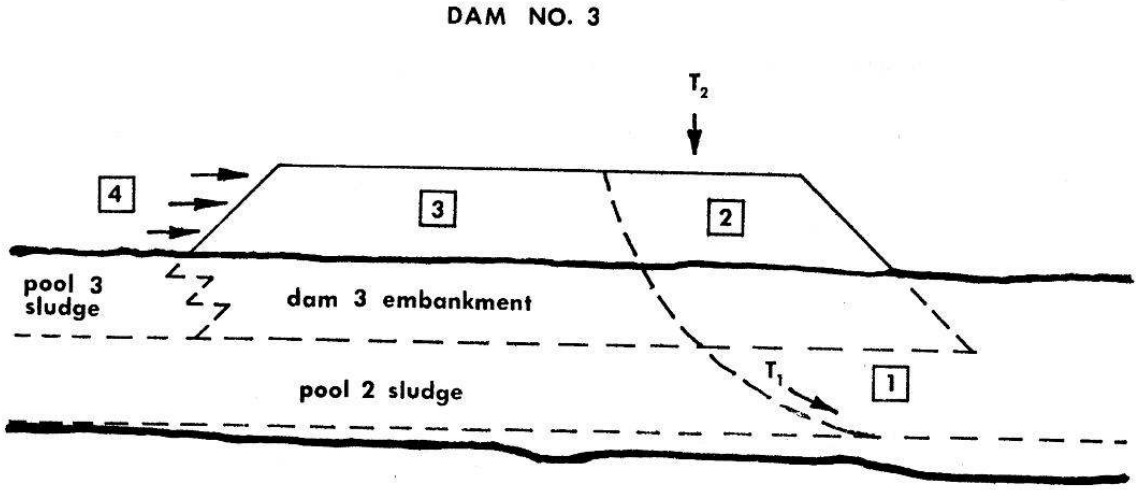

Figure 2-13 Sequence of Failure of Dam no. 3

Whatever the intention was at the time of dumping, the fill impounded water and functioned as a dam. A normal practice in the construction of such a dam would have been: first, the removal of all vegetation, diversion of the drainage, scarification of the surface to a 6- to 12-inch depth, and then the placement of fill material compacted at 'least to 90% of maximum relative density in a maximum lift of about 12 inches. Considering that the unit weight of the coal wastes is far less than that of the ordinary earth-fill material, a more careful site preparation should have been made to prevent surface erosion and improve overall stability. Zoning of the dam material for water-seepage control should have been considered.

2.7.4.2 Weak Foundation Material

The dam was built on the thick sludge layer 40 to 100 feet in thickness which had been impounded by Dams No. 1 and 2. The sludge is a weak material having negligible shear strength.

2.7.4.3 Inadequate Overflow System

A 24-inch overflow pipe for high-water conditions was placed in the dam approximately 7 to 10 feet below the level of the compacted crest. However, this pipe was not of a sufficient size to handle the water increase at the time of failure. Furthermore, the pipe should have been placed lower in the dam to be effective. The dam should have had a fool-proof decant system or spillway designed by and

constructed under the direction of a registered professional engineer with a knowledge of dam construction.

2.7.4.4 Properties of Refuse Material Used to Construct Dam

The strength of refuse material is about the same as loose sand, but the most critical property of the material is its low unit weight. The average unit weight is about 78 pcf*whereas that for ordinary sands is about 100 pcf. The lightness of the material needs to be considered in the dam design because it provides less confining pressure than an equivalent volume of more usual material. The strength of earth material generally increases linearly with the confining pressure. The probability of liquefaction and piping is also inversely proportional to the unit weight of the material. For example, only 0.25 ft/ft of hydraulic gradient would be required to give rise to piping for Dam No. 3, whereas 0.92 ft/ft would be required for sand of the same compaction. Because of improper installation of the spillway pipe, seepage probably developed around it, thus increasing the effective hydraulic gradient in the downstream side of the dam.

*See section 9.0, GLOSSARY OF TERMS.

2.8 ANALYSIS OF OTHER REPORTED MODES OF FAILURE*

Several other causes of the failure of coal-waste Dam No. 3 have been cited elsewhere, but eyewitness accounts and geological-engineering evidence refute them. The causes cited and refuted are explosions within the dam, ditching, and dynamiting.

2.8.1 Explosions Within the Dam

The remnants of the dam show no evidence of combustion. No red dog (the common by-product of burning coal waste) except that derived from wash from the haul road is in or directly below the remains of Dam No. 3. No part of the remains of Dam No. 3 was burning immediately after the flood. "Smoke" reported issuing from the dam at the time of failure was probably warm moist air driven from the fractures by increasing hydraulic pressure. The explosion that occurred immediately following the failure was in the burning coal-waste bank No. 1 at the mouth of the hollow, about 2,600 feet downstream from Dam No. 3.

2. 8. 2 Dynamiting

A press story attributed the failure of the dam to company personnel dynamiting the top of the dam in an attempt to drain off the pool. Evidence cited included blasting wire and drill holes at the

*The text in all of Sections 2.8 and 2.9 is quoted from Geological Survey Circular 667, West Virginia Buffalo Creek Flood: A Study of the Hydrology and Engineering Geology, by William E. Davies, James F. Bailey, and Donovan B. Kelly.

site. All wire seen at the site was telephone wire or used waste-blasting wire deposited in the banks along with other refuse from mines. The drill holes were in sandstone and were remnants of blasting operations during construction of the haul road several years ago.

Television pictures of the reported site of dynamiting were made at the canyon cut in coal-waste bank No. 1 and were about 2,600 feet downstream from the site of the actual dam failure at coal-waste dam No. 3. Wire at this point shown in the television film is telephone wire; blasting holes were those related to building the haul road.

2.8.3 Ditching

There is no conclusive evidence that alteration at the surface of Dam No. 3 was made by ditching or scraping, either during or immediately before the failure of Dam No. 3. At 4:30 a.m., February 26, Mr. Kent ordered Mr. Brady Elswick, front-end loader operator, to clear the ditch along the No. 5 mine road. The ditching was done on the haul road at the right abutment of Dam No. 2. The work was done to divert water from a side hollow and the haul road around Dam No. 2.

The pipes seen by Mr. Osborne and Mr. Gibson at 6:00 a.m. had been placed on the dam a week prior to the failure. There is no evidence to indicate that these pipes were being used to drain the impoundment.

Mr. Bays and Mr. Weiss, the bulldozer operators who were sent

to the strip job for equipment at 6:30 a.m. by Mr. Kent, did not return to the dam site until after the dam failure had occurred.

2.9 THE FLOOD

2.9.1 Flood Conditions in the Guyandotte River Basin

Precipitation occurring February 24-26 in the southwestern corner of West Virginia resulted in slightly higher than bankfull stages for most streams and in flows generally bearing recurrence intervals of 10 years or less. Peak flows for the storm of February 24-26, 1972, were not unusually high, except for sites on Buffalo Creek below the mouth of Middle Fork (Table 2-1).

High water on the Guyandotte River at Man, based on records of the gaging station located 500 feet upstream from the mouth of Buffalo Creek had peak stages of 18.65 feet on February 25 and 19.34 and 19.02 feet on February 26. The peak discharge for February 25 was 29,600 cfs, an 8-year flood, from drainage of the upper Guyandotte River only. The peak stage of 19.34 feet was a direct result of inflow from Buffalo Creek following the failure of the dam on Middle Fork (Figure 2-26), but the peak discharge of 31,600 cfs related to this stage may not be reliable due to variable backwater. The peak discharge of 30,700 cfs occurring at gage height 19.02 was the result of natural drainage primarily from the upper part of the Guyandotte River.

Peak flows, on the order of a 2-year flood, were produced on the North Fork above Middle Fork, on Buffalo Creek above Middle Fork, and on Right Fork at Accoville (Table 2-1). These are all streams lying

Station Number	State Name and Location	Period of Record	Drainage Area (Sq Mi)	Discharge Date							
				Maximum Floods of Record				February 1972 Flood (Preliminary)			
				Date	G. Ht. (ft)	Discharge cfs	Recurrence interval (years)	Date	G. Ht. (ft)	Discharge cfs	Recurrence interval (years)
1985	Big Coal River at Ashford	1908-16 1930-71	393	8-9-16	36.3	35,800	> 50	2-26-72	23.28	20,600	18
1990	Little Coal River at Danville	1930-71	270	2-3-39	30.2	42,800	> 50	2-26-72	21.45	14,300	9
2024	Guyandotte River at Baileyville	1968-71	208	12-31-69	16.22	16,300		2-26-72	17.25	18,500	
2024.8	Briar Creek at Fanrock	1969-71	7.20	12-30-69	5.46	485		2-24-72	5.57	512	
								2-26-72	5.21	422	
b/ (1)	North Fork above Middle Fork		0.85					2-26-72		80	2
b/ (2)	Buffalo Creek above Middle Fork		3.16					2-26-72		200	2
b/ (3)	Buffalo Creek below Sounders		6.05					2-26-72		50,000	a/ 40
b/ (4)	Buffalo Creek below Stowe		21.0					2-26-72		13,000	a/ 4
b/ (5)	Buffalo Creek above Accoville		30.8					2-26-72		8,800	a/ 2
b/ (6)	Right Fork at Accovil le		9.49					2-26-72		500	2
2030	Guyandotte River at Man	1928-71	762	3-12-63	24.78	49,000	>50	2-25-72	18.65	29,600	8
								2-26-72	19.34	31,600	10
								2-26-72	19.02	30,700	9
2036	Guyandotte River at L ogon	1960-71	836	3-12-63	34.98	55,000	> 50	2-25-72	26.31	33,900	10
								2-26-72	27.28	36,100	13
2040	Guyandotte River at Bronchland	1915-17 1928-71	1226	3-13-63	43.83	44,500	27	2-27-72	41.63	40,800	20
2070.2	Twelvepole Cr. below Wayne	1928-31 1946-71	300	2-4-39		22,000	> 50	2-26-72	23.19	7,210	2
2137	Tug Fork at Williamson	1967-71	932	3-12-63	44.5			2-25-72	29.75	23,000	3
2140	Tug Fork at Kermit	1934-71	1185	3-13-63	45.65	69,600	50	2-26-72	40.25	46800	8

a/ Ratio of peak discharge to 50 year flood
b/ Corresponds to site number shown on map (fig. 2)

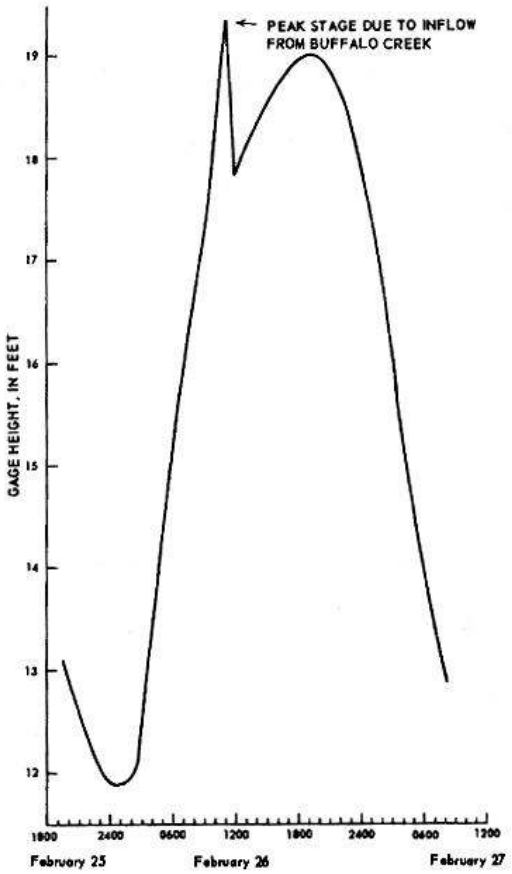

Figure 2-14 Graph showing the sudden high peak of 19.34 feet produced on the gaging station *record for Guyandotte River at Man by the flood inflow from Buffalo Creek.*

within Buffalo Creek basin but outside the influence of the large discharge produced by failure of the Middle Fork dam. These peak flows suggest that yields of from 60-100 cfs per mile of drainage basin could have been anticipated on Euffalo Creek had the dam on Middle Fork not failed. For example, it is estimated that the peak flow for Buffalo Creek below Saunders would have been approximately 400 cfs (180,000 gpm) instead of the 50,000 cfs (22 million gpm) that was produced. A peak of this order of magnitude would also have been consistent with that produced by surrounding basins of the same size experiencing natural yields.

2.9.2 Previous Floods

Data given in Table 2-1 show that peak flows for February 1972 for streams in southwestern West Virginia were quite low in comparison with previous maximum floods that have been recorded. Except for Buffalo Creek, peak discharges for February 1972 at stations in the Guyandotte River basin were generally well below those experienced in March 1963.

2.9.3 The Flood on Buffalo Creek

At about 8:00 a.m. on February 26, following the failure of coal-waste Dam No. 3, 17.6 million cubic feet (132 million gal.) of impounded water and sludge were released into Buffalo Creek. Eyewitnesses reported that the contents of the dam were emptied into Buffalo Creek in 15 minutes or less. At the time of the. dam failure, flow in Buffalo Creek

was well below bankfull stage.

Indirect measurements were made on Buffalo Creek below Saunders, below Stowe, above Accoville and near Man to determine peak flows resulting from the release of water following the dam failure (Figure 1-2 and Table 2-1). At Buffalo Creek below Saunders, 4,500 feet downstream from the mouth of the middle Fork, the peak flow was computed as 50,000 cfs (22 million gpm). Because this peak was not a natural occurrence, comparisons between it and other natural occurring flood peaks are not valid. However, it is interesting to note that, at this site, a flood of this magnitude would be approximately 40 times that of a naturally occurring 50-year flood.

Peak discharges were greatly reduced due to valley storage as the flood wave moved downstream. This effect is shown in Figure 2-15, where flood hydrographs were estimated on the basis of peak flow information obtained at indirect measuring sites and from flow duration information. furnished by local residents. Attenuation due to valley storage reduced the peak flow to 13,000 cfs (5.8 million gpm) by the time the flood crest reached Stowe 6 miles downstream from the mouth of middle Fork; although the total discharge past Stowe was slightly greater than the total flow past Saunders, the floodflow took more than three times longer to travel past Stowe. The same attenuating effect from valley storage stretched out the floodflow all the way down Buffalo Creek; the floodflow that

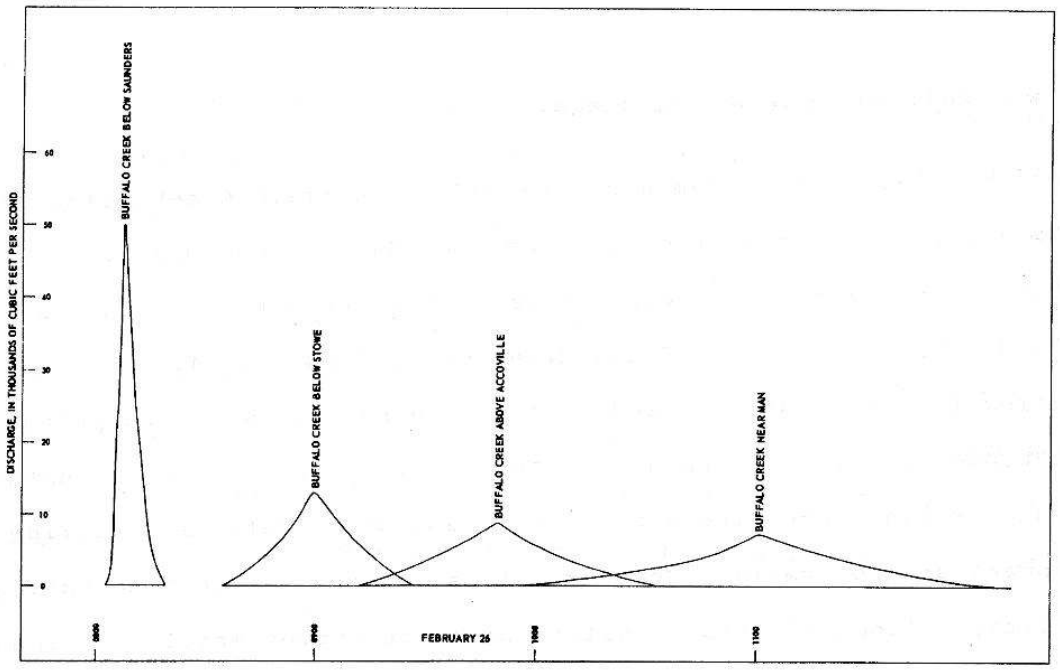

Figure 2-15 Estimated flood hydographs for Buffalo Creel below Saunders, below Stowe, above Accoville, and near Man on February 26, 1972

took only 15 minutes to pass Saunders took 2 hours to pass Man. Despite the attenuation, peak flow at Stowe was still unusually high, approximately four times that of a naturally occurring 50-year flood.

The effect of valley storage was less pronounced above Accoville, 12 miles downstream from the mouth of Middle Fork, where the peak flow was determined as 8,800 cfs (3.9 million gpm). A peak flow of this magnitude, however, would still be approximately twice that of a naturally occurring 50-year flood. The peak flow at Man near the mouth of Buffalo Creek was estimated to be 7,500 cfs (3.4 million gpm), slightly greater than the 50-year flood.

2.9.4 Time of Travel of the Flood Wave

Estimates of time of travel of the flood peak were made based on information furnished by local residents. The flood wave passed through the Buffalo Creek valley in almost exactly 3 hours, reaching the mouth of Buffalo Creek at Man at 11:00 a.m. on February 26. The traveltime versus distance relation for the flood wave is shown in Figure 2-16. Mean velocities are estimated at 20 feet per second from Saunders to Pardee, 15-20 feet per second below Pardee to Lorado, and diminishing to about 10 feet per second near Accoville and to 5 feet per second or less near Man.

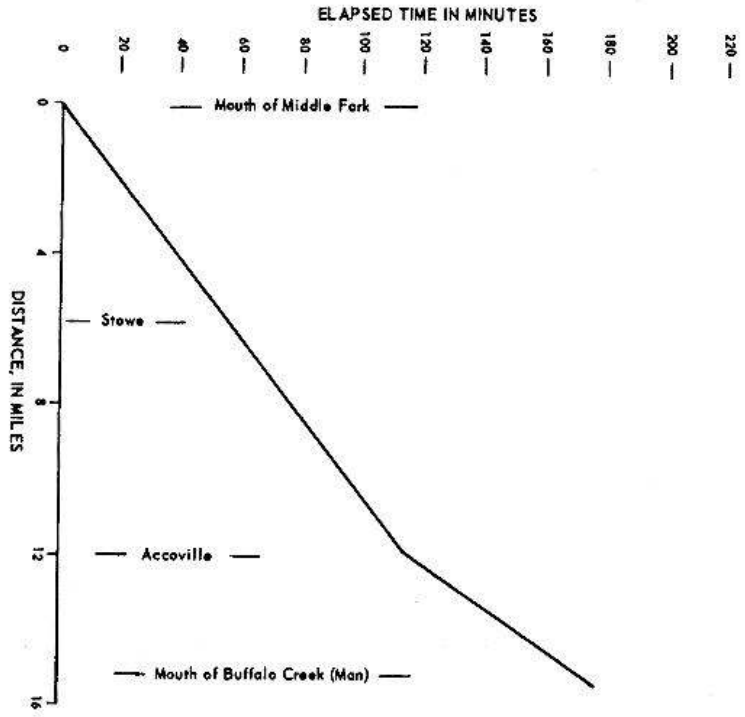

Figure 2-16 Graph showing time of travel of the flood wave down Buffalo Creek

2.9.5 Profiles

Profiles of the flood wave and of the streambed were obtained for the 17-mile reach of Buffalo Creek from the mouth of middle Fork to Man, from a survey of high-water marks at many sites throughout the reach (Figure 2-17). The fall, or total drop in elevation, from Saunders to Man is approximately 750 feet. The slope of the flood profile ranges from an average of 96 feet per mile in the reach from Saunders to Pardee to 33 feet per mile in the reach from Accoville to Man.

2.9.6 Depth of Flow

The depth of flow in the stream channel at points along Buffalo Creek can be estimated from Figure 2-17 by subtracting the bed elevation from the flood profile. The flood plain of Buffalo Creek ranges from 200 to 500 feet wide throughout the reach from Saunders to Man. Ground elevations on this flood plain can be determined by surveying to selected points on the flood plain from nearby bench marks. The depth of flooding on the flood plain can then be estimated by subtracting the ground elevation from the flood profile shown in Figure 2-17. At the time of the peak, the depth of flow on the flood plain was approximately 12-10 feet deep from Saunders to Lorado, 9-6 feet deep from Craneco to Latrobe, and 5-2 feet deep from Robinette to Kistler.

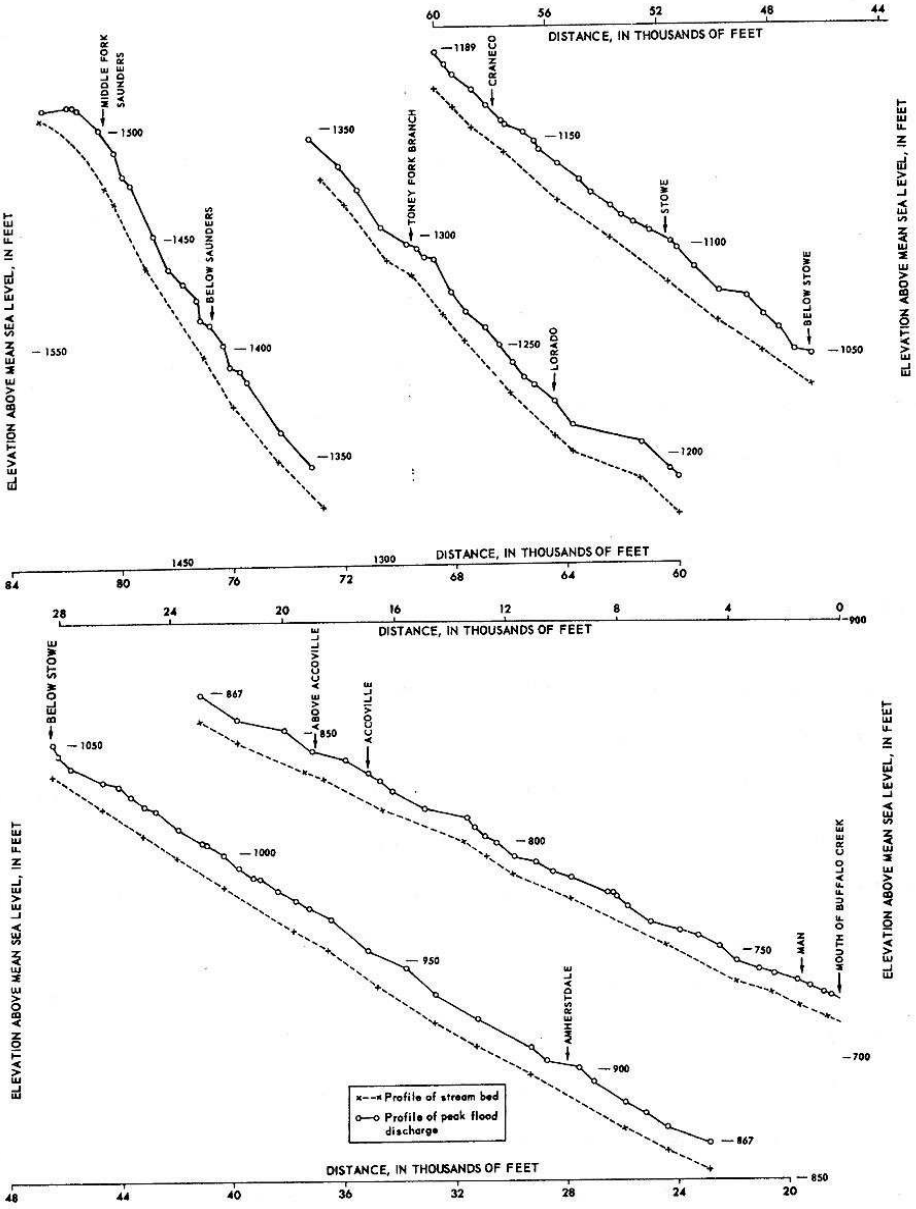

Figure 2-17 Profile of the peak flood discharge an of the streambed, Buffalo Creek, Middle Fork to Man

2.9.7 Scour and Deposition

An estimated 6 million cubic feet of material were transported by the flood water from the coal-waste banks in Middle Fork hollow and deposited downstream. Most of this material, consisting of coal waste, red dog, and slag, apparently was deposited in the reach from Saunders to Pardee. (The only significant signs of scours were also found in this reach, although there was evidence of scour at some bridge crossings farther downstream.) The streambanks and overflow plain from Saunders to Man were covered with a thin film of black sediment by the passage of the sludge-bearing water.

2.10 THE PITTSTON COMPANY

Prior to February 26, 1972, Buffalo Mining Company, a subsidiary of The Pittston Company, operated four underground mines, a strip mine, and two auger mines in the Buffalo Creek area near Saunders, West Virginia. All coal from the mines was processed through the No. 5 coal-preparation plant located on Buffalo Creek about one-half mile north of Middle Fork and the town of Saunders. A total of 350 men were employed by Buffalo Mining Company prior to the dam failure. Buffalo Mining Company presently operates three underground mines, a strip mine, and one auger mine in the area. A total of 310 men are now employed.

The Pittston Company acquired Buffalo Mining Company in June, 1970. At that time, according to Nicholas T. Camicia, President, The Pittston Company, Dam No. 3 was". . . already under construction, or maybe fifty percent completed . . . " (Hearing Transcript, Vol. VI, p. 76). Prior to the acquisition, a survey of the Buffalo Mining Company property was made by Pittston Company, Coal Group, engineers. According to Mr. Camicia, the "assessment report" made no indication ". . . that there was any danger, or that anything was wrong with the impoundments . . ."

Although Dam No. 3 was still under construction in June, 1970, The Pittston Company did not apply to the Public Service Commission of West Virginia for a permit to construct the dam, as required by Chapter 61, Article 3, Section 47, of the West Virginia Code. According to

testimony by Mr. Camicia (Hearing Transcript, Vol. VI, p. 81), The Pittston Company as a legal entity had knowledge that such a law does exist. The record shows that in 1964, The Pittston Company had applied to the Public Service Commission of West Virginia for approval of an earth-fill dam to be constructed in Sardis District, Harrison County, West Virginia. [Note: The record also shows that other coal-mining companies in West Virginia have applied to the West Virginia Public Service Commission for approval of construction of coal-refuse dams. In August, 1971, Pocahontas Fuel Company applied for approval of the design, construction, and safety of a coal-refuse dam on Joe's Branch in Wyoming County. In February, 1972, United Pocahontas Coal Company applied for approval of the design, construction, and safety of a coal-refuse dam on Pinnacle Creek also in Wyoming County. Approval from the West Virginia Public Service Commission for 19 earth-fill, one concrete and earth-fill, and two coal-refuse dams has been sought by several coal-mining companies in West Virginia.]

According to Mr. Camicia (Hearing Transcript, Vol. VI, p. 75), Buffalo Mining Company was responsible for maintaining the dams on Middle Fork and had ". . . full responsibility for consideration of the people who lived in this community (Buffalo Creek), as well as the people in the coal mines" (Hearing Transcript, Vol. VI, p. 76). Mr. I. C. Spotte, President, Buffalo Mining Company, has stated that ". . . the Buffalo Mining organization, as such, operated the mines and preparation plants and all the other facilities and were

responsibile for the safety, the well-being, the profitability of the organization" (Hearing Transcript, Vol. IV, p. 64).

Mr. Ben Tudor, General Superintendent, Buffalo Mining Company, has outlined his personal responsibility as well as the company's responsibility by stating, "I would say I would be as much responsible for the safety of the dam as anyone" (Hearing Transcript, Vol. III, p. 136). [Also, according to his testimony (Vol. III, p. 124) , Mr. Tudor inspected the dams on Middle Fork regularly at least once a day . . ."]

2.10.1 Engineering Staff and Capabilities

Mr. Dasovich and Mr. Tudor were the only registered professional engineers at the Buffalo Mining Company offices in Lorado. Both Mr. Dasovich and Mr. Tudor are registered mining engineers in the State of West Virginia. Mr. Dasovich was registered by test in 1954 (Registration No. 2881). Mr. Tudor is registered by test in the State of Illinois and has been registered in West Virginia through reciprocity with the State of Illinois (Registration No. 3173).

Mr. John Nagle, Engineer, Buffalo Mining Company, is ". . . in the process of being registered in the state now" (Vol. I, p. 32). A map of the No. 5 Mine submitted to the West Virginia Department of Mines and dated February 25, 1972, iss signed by Mr. Dasovich and Mr. Nagle and stamped with Mr. Dasovich's seal.

Mr. Dasovich and Mr. Tudor were both working in an administrative capacity rather than an engineering capacity. According to his testimony, Mr. Dasovich spent less than five percent of his time dealing with problems outside of underground coal mining (Vol. V, p. 23). Mr. Tudor inspected the dams daily, "Normally we would drive out on the dam and look at it and make sure there are no cracks in it, and like that, like the compaction was doing a good job" (Vol. III, p. 125), but made no request from any source for acceptable specifications or plans for dams.

According to James E. Yates, Vice President, Engineering, The Pittston Company, the company's offices in Dante are staffed with 40 to 50 engineers whose primary function is in design work "for the design of structures, steel, plants, and so forth. We have really no soils or hydrology experts. We must go to outside firms for that type" (Vol. IV, p. 131). However, The Pittston Company did not solicit any outside help in regard to the construction of Dam No. 3. Also, according to Mr. Yates (Vol. IV, p. 133), The Pittston Company did not request nor require systematic inspections of the impoundments nor did The Pittston Company make ". . . an effort to send anyone to a special class on impoundments.

According to Mr. I. C. Spotte, The Pittston Company did not make any inquiries as to how Dam No. 3 was built. "The bank was there. It was functioning properly, for the use it was intended, to clarify water.

It appeared stable. We accepted it as such" (Vol. IV, p. 66).

2.10.2 No. 5 Mine Coal-Preparation Plant

At the time of the flood, the No. 5 mine coal-preparation plant was operating two shifts a day and five to six days a week. It was processing over 5,000 tons of run-of-mine or raw coal a day, producing over 4,000 tons of clean coal and about 1,000 tons of refuse. This refuse was hauled to storage banks on Middle Fork in 30-ton trucks.

Water consumption by the washing plant was approximately 500,000 gallons per day. The effluent from the preparation plant was pumped into the sedimentation pond behind Dam No. 3 at the rate of 500 gallons per minute for about 10 hours each day. The effluent contained 18.5 percent solid material. Approximately 21 tons of solid material per hour were deposited in the pond. This solid material had an ash content of approximately 28 percent.

2.10.3 New Coal-Preparation Plant Facilities

New water-clarification facilities utilizing a spiral classifier* and static thickener" are being installed at the No. 5 preparation plant to avoid the continuous pumping of refuse slurry to the settling pond and to recover a marketable product that has heretofore been lost as refuse.

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*See Section 9.0, GLOSSARY OF TERMS.

From the existing drag-tank pump, the refuse slurry will be diverted to a new spiral classifier where the larger sizes of solids in the slurry are allowed to settle to the bottom of the tank and be conveyed by means of an integral screw conveyor to discharge to a centrifugal dryer.

A fresh-water pump will be used to provide make-up water to replace that which is lost in the process. The settling pond will be used for emergency only in case of equipment malfunction, overflows, etc. According to testimony from company officials and coal-preparation experts, if such a clarification system had been installed in the No. 5 preparation facilities, it would not have been necessary to construct the large filtration dams on Middle Fork.

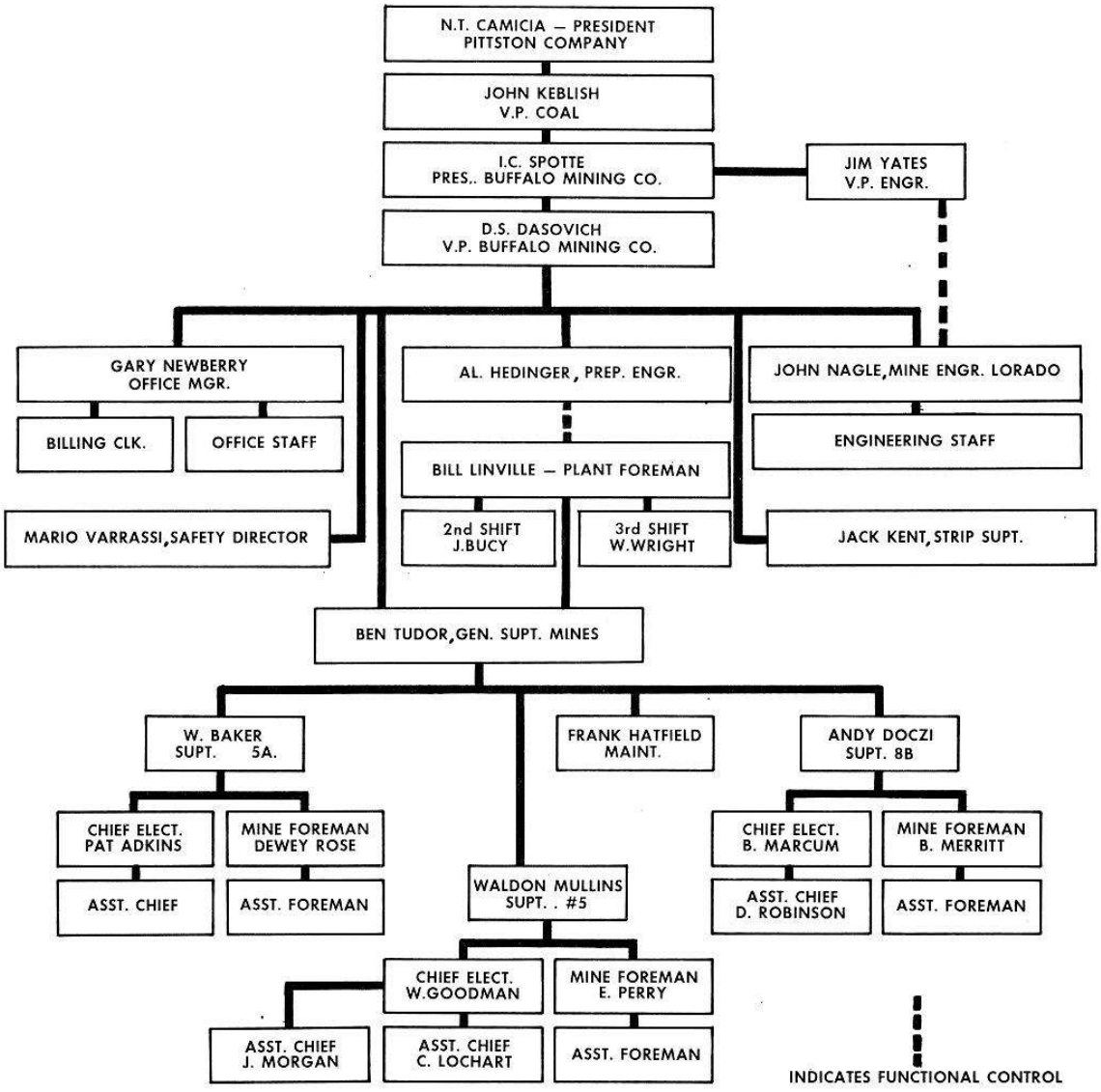

Figure 2-18 Buffalo Creek Mining Compnay - Pittston Company Organization Chart

3.0 LEGAL

3.1 APPLICABLE WEST VIRGINIA STATUTORY PROVISIONS

After a review of the State's regulatory powers regarding dams, it is apparent that there are deficiencies due to the general vagueness of the statutory language and due to the lack of enforcement powers with regard to continual surveillance of maintenance of such structures within the alleged purview of the statutes.

3.1.1 Public Service Commission

The Public Service Commission has authority over dams where they are either 15 feet in height or 10 feet in height and water covering 10 or more acres by virtue of Section 47, Article 3, Chapter 61, of the West Virginia Code of 1931, as amended. The pertinent provision of this section is as follows:

> . . . No person shall construct any dam or other obstruction more than fifteen feet in height across any stream or watercourse unless the design and proposed construction shall have been declared to be safe by an order entered by the Public Service Commission after full investigation; Provided, that no dam or other obstruction more than ten feet in height shall be constructed across any stream or watercourse if such dam or other obstruction would create a body of water covering ten or more acres, unless the design and proposed construction of such dam or other obstruction shall have been declared to be safe by an order entered by the Public Service Commission after full investigation. . .

This statute makes filing obligatory on the part of any person who wishes to construct a dam or other obstruction across any watercourse. It should be noted that this requirement appears in the

Criminal Code relating to claims against property and is not in Chapter 24, which creates and defines duties of the Public Service Commission. It appears that no action is required on behalf of the Public Service Commission until the application is received from the person constructing a dam or other obstruction as defined by the statute. The only mandate to the Public Service Commission is that, if such an application is submitted, the design and construction of the proposed dam or obstruction be evaluated for safety only. If the proposed structure is deemed safe after full investigation, an order to that effect must be entered by the Public Service Commission. The statute makes no provisions to assure compliance with the proposed plans subsequent to submission and approval, nor are there provisions that would allow for the continual monitoring and surveillance of structures after their completion.

Additionally, the statute does not grant the Public Service Commission authority to issue rules or regulations for the safety of such structures; thus, it appears that each application is to be considered on an ad hoc basis. The Public Service Commission has by its own initiative set guidelines for the evaluation of such proposed structures.

In 1952, at the request of Mr. N. F. Wright, Jr., Secretary of the Public Service Commission, the Attorney General issued an opinion that interpreted the pertinent section of the statute with regard to the jurisdiction of the Public Service Commission in terms of continual

inspection as to safety subsequent to approval of the initial application. The Attorney General opined as follows:

> We are unable to find anything in the language of the statute which justifies an inference that there was legislative intent for the Commission to exercise a continuing supervision over dams once construction is completed. It is perhaps possible for the Commission to inspect the dam to see that it is being, or has been, constructed in accordance with the order. In fact, it would seem proper to condition the order subject to such approval of the Commission. 42 Am Jur, Public Administrative Law, Sec. 53. However, we believe that there is no authority for the Commission to go further in an attempt to exercise continual jurisdiction over such dams. 44 Op's Atty. Gen. 330

This opinion basically evolves from the distinction between the words construction and maintenance. Applicable case law and common usage argue against the words being employed as synonyms for one another. The West Virginia State Legislature apparently recognizes this distinction since that part of the statute delegating authority to the Public Service Commission with respect to dams omitted the word maintenance while in a subsequent paragraph concerning the passage of fish, the Legislature employed the words, "" . . . no person shall maintain or construct any dam or other structure in any stream or watercourse, which shall in any way prevent or obstruct the free and easy passage of fish.

Another portion of the same Attorney General's opinion pertinent to this inquiry reads as follows:

> However, whenever a dam is enlarged or extended so as to make it more than ten feet in height, or if already in excess of that height, to make it a greater height, we believe it comes within the scope of the statute, and such

> construction is subject to the approval of the Commission.

Consequently, one may conclude that any additions to the height of any dam or other obstruction would require approval of the Public Service Commission. Thus, the Public Service Commission might be able to exercise continuing jurisdiction if, and only if, the dam were being continually enlarged or expanded so as to make it greater in height.

The penal provision of this section reads as follows:

> Any person who shall violate any of the provisions of this section shall be guilty of a misdemeanor, and, upon conviction thereof, shall be fined not exceeding one thousand dollars, or imprisoned in the county jail not exceeding one year, or both fined and imprisoned, and, whether conviction be had under this section or not, such violation shall be deemed a nuisance, which may be abated at the suit of any citizen or taxpayer, the county court of the county, or, as to fish ladders, at the suit of the natural resources commission, and, if the same endangers county roads, the county court may abate such nuisance peaceably without such suit.

Since the Public Service Commission does not have prosecution powers, its only recourse upon notice of any violation would be to request prosecution by the county prosecutor in such county where a violation occurred. It should be noted that any citizen or taxpayer or the county court could have brought an action to abate the nuisance (in this case the impoundment on Middle Fork) since violation of the statute is a nuisance per se.

The controversy as to whether the impoundment known as Dam No. 3 on Middle Fork was technically considered a dam is a moot question

since the structure falls within the purview of the statute which reads in part as follows:

> . . . no obstruction more than fifteen feet in height across any stream or watercourse . . .

3.1.2 Department of Natural Resources

Prior to March 11, 1972, the Department of Natural Resources had no direct authority to regulate the design, construction or maintenance of dams. However, the Division of Water Resources within the Department of Natural Resources indirectly had powers to regulate dams when such structure posed a threat to the waters of the State. Subsection a, Section 3, Article 5a, Chapter 20, requires the filing of information regarding entities polluting or who may pollute the waters of the State and reads in part as follows:

> (a) In addition to all other powers and duties of the chief of the department's division of water resources, as prescribed in this article or elsewhere by law, the chief, under the supervision of the director, shall have and may exercise the following powers and authority and shall perform the following duties:
>
> (12) To require any and all persons directly or indirectly discharging, depositing or disposing of treated or untreated sewage, industrial wastes, or other wastes, or the effluent therefrom, into or near any waters of the State or into any underground strata, and any and all persons operating an establishment which produces or which may produce or from which escapes, releases or emanates or may escape, release or emanate treated or untreated sewage, industrial wastes or other wastes or the effluent therefrom, into or near any waters of the State or into any underground strata, to file with the division of water resources such information as the chief may require in a form or manner prescribed by him for such purpose, including, but not limited to, data as to the kind, character-

istics, amount and rate of flow of any such discharge, deposit, escape, release or disposition. (Emphasis added.)

Additionally and more specifically, it is mandatory that any person engaging in certain activities have a permit as required in Subsection a, Section 5, Article 5a. Subsection a, Section 5, Article 5a, Chapter 20, states in part as follows:

> (a) It shall be unlawful for any person, unless he holds a permit therefor from the department, which is in full force and effect, to:
>
> (6) Open, reopen, operate or abandon any mine, quarry or preparation plant, or dispose of any refuse or industrial wastes or other wastes from any such mine or quarry or preparation plant: Provided, that the department's permit shall only be required wherever the aforementioned activities cause, may cause or might reasonably be expected to cause a discharge into or pollution of waters of the State; . . . (Emphasis added.)

The permits issued pursuant to the aforementioned sections are issued and regulated in accordance with rules and regulations promulgated by the Water Resources Board. Said Board is charged with preventing, controlling, and abating pollution and establishing standards of quality for the waters of the State. The division has the power to employ inspectors to enforce the rules and regulations and policies of the Water Resources Board.

By virtue of another indirect source, the Department of Natural Resources has authority to abate any nuisance which evolves from a violation of Section 47, Article 3, Chapter 61. Said section states that no person shall construct or maintain any dam or other structure in any stream or watercourse that prevents the free and easy passage of fish to provide a suitable fish ladder, way, or flume unless the

Director of the Department of Natural Resources provides an exemption from such duties in writing. Persons who violate the provisions of this section shall be guilty of a misdemeanor and shall be fined not exceeding $1000 or imprisoned in the county jail not exceeding one year, or both fined and imprisoned. In addition, such violation shall constitute a nuisance that may be abated by suit of the Department of Natural Resources.

Following the disaster on Buffalo Creek, the Legislature gave the Department of Natural Resources authority over refuse piles generally, and particularly refuse piles that impound water or may impound water. This authority was granted by virtue of Senate Bill 404, known as the Coal Refuse Disposal Control Act. Section 4 of said act requires the Director of the Department of Natural Resources to conduct surveys of disposal piles and to make findings based on competent engineering evaluations and opinions concerning the stability and safety of coal-refuse piles that may cause water impoundments or otherwise pose a hazard to human life. Further, the section provides that: ". . . The authority, powers and duties of the Director shall not be limited by any time period stated herein but shall be on a continuing basis."

Section 5 of the aforementioned Act gives the director the power to take all remedial action as may be necessary or expedient to secure any coal-refuse disposal pile that constitutes imminent danger to human life.

Section 6 of said Act reads, in part, as follows: "When the director makes a finding of a dangerous condition not imminently dangerous with respect to any new coal refuse disposal pile created hereafter or any part of an existing coal refuse disposal pile which is presently being operated, then the director shall order the operator to take all remedial action at his own expense, as may be necessary or expedient to prevent or correct the condition, and it shall be the duty of such operator to take such action.

As the law stands now, it appears that the Department of Natural Resources has the duty to inspect structures impounding, or ones that might impound, water when such structures are composed of coal refuse. The inspections are to determine the safety and structural stability of such structures. The director is given wide remedial powers; however, there appears to be no authority for him to act in a prospective manner since there are no requirements for filing prior to construction of a refuse pile or water impoundment.

3.1.3 Department of Mines

The Department of Mines is given no powers or duties that authorize it to regulate water impoundments of any size or any nature located on mining property. Since the Department of Mines does not have authority to issue rules and regulations pursuant to its statutory authority, it cannot even indirectly assume the power to regulate such impoundments. The only reference to bodies of water is in Section 1, Article 2, Chapter 22, in regard to the mandatory submission

of an accurate map of a mine and mine surface. Subsections 21 and 22 require that the map show water pools above and the location of the principal streams and bodies of water on the surface of a mine area. Failure to file such accurate map is a misdemeanor and upon conviction provides that a person shall be fined not less than $500 nor more than $5,000.

3.1.4 Engineering Registration

By virtue of Article 13, Chapter 30, the West Virginia Code of 1931, as amended, requires the registration of professional engineers practicing within the state. Section 2 of the aforementioned article defines the practice of professional engineering and reads in part as follows:

> The practice of professional engineering within the meaning and intent of this article includes any professional service, such as consultation, investigation, evaluation, planning, design, or responsible supervision of construction or operation in connection with any public or private utilities, structures, buildings, machines, equipment, processes, work, or projects, wherein the public welfare, or the safeguarding of life, health or property is concerned or involved, when such professional service requires the application of engineering principles and data.

In addition, the Legislature has granted the State Board of Registration for Professional Engineers, as well as other registration boards, the authority to promulgate and issue rules and regulations (30-1-4). Although the statute concerning the registration of engineers in the State of West Virginia is silent as to the areas in which a registered engineer may practice, the rules and regulations

duly promulgated more closely define these areas. Regulation 2.11 reads as follows:

> 2.11 Civil Engineer: Civil engineering is the most diverse branch of engineering. It includes all engineers engaged in the planning, designing, construction, engineering economics and maintenance of bridges, buildings, waterways, dams railroads, airport terminals, pipe lines, highways, sanitary systems, foundations, hydro electric installations, irrigation systems and similar systems and structures of modern civilization. Recently civil engineering has been broadened to include community planning and in addition to traditional surveying and mapping has encompassed photogrammetric methods.

This regulation appears to authorize only those men who are granted registration to practice civil engineering the right to engage in the planning, designing, construction and maintenance of dams. The regulations defining other fields of engineering practice do not mention specifically or indirectly the word dam.

Section 5.02 of the regulations reads in part as follows:

> 5.02 The board may suspend for a period not to exceed two years or may revoke the certificate, license, or registration of any professional engineer registered hereunder whom it finds guilty of:
>
> 1. Unprofessional conduct in the practice of professional engineering which shall include, but not be limited to, the following acts or omissions to act:
>
> . . .(i) Practicing or offering to practice in a field of engineering in which he has not been classified by registration unless he is able by reason of education and experience to demonstrate competency therein.

Under the aforementioned regulation, the State Board of Registration for Professional Engineers has adequate authority to censure any engineer appropriately licensed by the State who violates regulations duly authorized and promulgated by the Board.

3.2 APPLICABLE FEDERAL STATUTORY PROVISIONS

None of the Federal statutes surveyed gives sufficient authority to any Federal agency to regulate dams in regard to the maintenance and safety of such structures.

3.2.1 Soil Conservation and Domestic Allotment Act

The Soil Conservation and Domestic Allotment Act authorizes the U. S. Soil Conservation Service to provide technical assistance to farmers and others in order to more efficiently utilize their land and water resources. This Act provides that the Service shall provide engineering for the design and construction for any dam or reservoir needed to fulfill these objectives. In addition, the Service provides instruction for the proper maintenance and operation of such structure, but has no enforcement authority.

3.2.2 Department of Agriculture

The Secretary of Agriculture, under the watershed Protection and Flood Prevention Act of 1954, is authorized to cooperate with states or their political subdivisions in the preparation and implementation of plans for dams to prevent damage due to flood water. Again this agency has no regulatory or enforcement powers even though the plans for such projects must be approved by the Secretary of Agriculture.

3.2.3 Corps of Engineers

The Corps of Engineers has the responsibility for the protection and preservation of all navigable waters in the United States under the River and Harbor Act of 1899. This Act requires that plans for any dam in any navigable river or navigable waters in the United States must be submitted and approved by the Chief of Engineers and by the Secretary of War. In addition, Congressional consent is needed for any such structure. If any such navigable stream or navigable waters lie wholly within any one state, plans must be submitted to and approved by the Chief of Engineers and by the Secretary of War. Again this does not provide for any regulatory enforcement during or subsequent to construction.

On July 25, 1972, Congress passed H.R. 15951 sponsored by Representative John A. Blatnick (D-Minn.). This bill, which has recently been signed by the President, would authorize the Secretary of the Army acting through the Chief of Engineers'to carry out a national program of inspection of dams which are over 25 feet in height or have an impounding capacity of 50 acre-feet. This inventory is to be presented to Congress on'or before July 1, 1974. After the inspections are made, the Secretary must furnish the Governor of the State a recommendation as to each dam and information as to the implementation of such recommendation. Further, the Secretary is required to submit recommendations for a comprehensive national program for inspection and regulation. Even if this legislation is adequately funded for the

purposes intended, it does not appear to be as useful in the regulation of dams in West Virginia since the federal regulation defines a dam as a structure much greater in size than the West Virginia law currently defines it. This law would not affect the majority of dams in West Virginia.

3.2.4 U. S. Bureau of Mines

The U. S. Bureau of Mines indirectly has authority to prevent dams to be constructed from refuse piles. Under the Federal Coal Mine Health and Safety Act of 1969 (Public Law No. 91-173), the Director is authorized to promulgate rules and regulations consistent with the intent and purposes of the Act. Accordingly, Regulation 77.216 in regard to retaining dams reads as follows:

> a. If failure of a water or silt retaining dam will create a hazard it shall be of substantial construction and shall be inspected at least once each week.
>
> b. Weekly inspections conducted pursuant to paragraph (a) of this 977.216 shall be reported and the report shall be countersigned by any of the persons listed in paragraph (d) of 977.1713.

It should be noted that the U. S. Bureau of Mines subsequent to the disaster cited Buffalo Mining Company for a violation of this section. Such violation was issued March 14 on Form 104B and required that the violation be abated by 8:00 a.m., March 21, 1972.

In addition to this prohibition, Regulation 77.215(e) reads as follows:

> Refuse piles shall not be constructed so as to impede drainage or impound water.

The Bureau of Mines has not seen fit to cite Buffalo Mining Company for violation of this section.

4.0 TECHNOLOGY

Technology is readily available for the proper development and design of coal mine refuse dams. Mr. E. T. Hummer, Senior Project Engineer, U. S. Steel Corporation, Pittsburgh, Pennsylvania (Hearing Transcript, Vol VI, p. 182) outlined his company's efforts in proper refuse dam construction.

U. S. Steel has constructed two coal mine refuse dams near Gary, W. Va. Prior to construction, the foundation area is cleared of vegetation. During construction the refuse is compacted in layers and zoned with clay to prevent internal combustion of the material. One dam is 260 feet in height, the second 280 feet in height. Both are kept well drained by a thirty-inch diameter pipe designed to control 100% of the runoff from a four-inch rainfall. The dams are constructed of material coarser than 48 mesh size, with large rocks being placed at the toe of the dam near the indentation of the spillway.

Several expert witnesses have testified to this Commission concerning the availability of technology in earth dam construction. A considerable amount of literature has been written on the subject and this literature is available to anyone seriously interested in properly constructing a dam.

5.0 ASSESSMENT, LOCATION, AND IDENTIFICATION OF SIMILAR REFUSE BANKS

The West Virginia Ad Hoc Commission of Inquiry into the Buffalo Creek Flood was charged, in part, by the Executive Order that created it, to ". . . assess, locate, and identify other areas of the State where similar conditions and potentials for disaster may exist." The West Virginia Department of Natural Resources was charged by a Legislative Order to survey the mine-refuse banks in the State, and the U. S. Department of Interior Task Force was created to ". . . identify other potentially hazardous sites." Not wishing to duplicate the efforts of these agencies, the Commission has given intensive consideration to the preliminary results of these studies. Particular attention has been given to the Department of Natural Resources investigation.

The preliminary phase of the Department of Natural Resources study was made through aerial reconnaissance over 654 mine-refuse banks. Each bank was visually examined, photographed, mapped, and assessed from the air. Because of the method of study, detailed data are not presently available and completely accurate assessment is not possible. Of the banks observed, 141 were deemed worthy of immediate on-site attention to determine whether they possess potential hazard to human life and health. The remaining banks will be more closely examined at a future time. The Ad Hoc Commission, assisted by three geologists

from the West Virginia Geologic and Economic Survey, can report that possibly two-thirds of these refuse banks are candidates for more thorough inspections for assessing similarity to the Buffalo Creek dam. The on-site survey of those banks requiring immediate attention is currently being conducted by an inter-agency team consisting of two men from the Department of Natural Resources, two men from the U. S. Army Corps of Engineers, one man from the soil Conservation Service, and one man from the Department of Mines. An example of the data form used in the on-site survey which is included in the support material indicates the depth of this study.

After the on-site study of each bank is completed, the team returns from the field to draw conclusions and make recommendations for that bank. When work has been completed for a group of refuse banks, a Board of Review is convened to reach final conclusions and recommendations. This Board of Review consists of one man from each of the following agencies: Department of Natural Resources, Soil Conservation Service, U. S. Army Corps of Engineers, U. S. Geological Survey, Environmental Protection Agency, and the U. S. Bureau of Mines.

Since the on-site survey by the inter-agency team will not be completed for several months, an Ad Hoc Commission team was formed through the courtesy of the West Virginia Geological and Economic Survey. This team was composed of three geologists who were released from their normal duties with the Survey for this task.

Twenty-five coal-refuse banks were randomly selected from the 654 banks that had been studied from the air. On-site investigations of these 25 banks were made by the Commission team. The results of this survey are shown in Table 5-1.

The published Interim Report Emergency Investigations of Coal-Mine Waste Embankments by U. S. Department of Interior Task Force to Study Coal Waste Hazard was released too late for a complete evaluation by the Commission. Of 52 West Virginia sites examined, 6 received a review priority rating I. This rating signifies imminent hazard or requiring immediate corrective measures.

It may be seen from Table 5-1 that of the 25 refuse banks studied, 6 banks designated by the Department of Natural Resources as banks requiring immediate attention from the aerial survey were found to be of intermediate priority and 2 banks initially assigned an intermediate priority were reclassified in the low-priority group. In no case did the Ad Hoc Commission team find a bank to require re-classification to a higher priority.

The inter-agency team has made on-site surveys of 38 refuse banks to date. A few have been reclassified in a lower priority group than indicated by the aerial survey. Again, in no case was a bank found to require a higher priority of investigation than that originally assigned. It may be concluded that the preliminary phase of the Department of Natural Resources study has been quite conservative. Perhaps as

many as one-third of the coal-refuse banks will actually be found by the inter-agency team to be less hazardous than they appeared to be from the aerial survey.

In every case, the refuse-hank location and identification made by the Department of Natural Resources team was found by the Ad Hoc Commission team to be entirely accurate and adequate.

In summary, it appears that the assessment, location, and identification of all coal-refuse banks in the State will be completely accomplished on completion of the inter-agency study. Many of the refuse banks have also been studied by the Department of Interior Task Force. It is beyond the scope of time or resources allocated to the Ad Hoc Commission and an entirely unnecessary duplication of effort to make another study of the same subject.

Table 5-1. West Virginia Geological and Economic Survey
On-Site Study of Coal-Refuse Banks

SITE OR OWNER, LOCATION	DNR NUMBER	DNR PRIORITY	REMARKS
No. 93, Mountaineer Coal Co., Marion County, 1 mi from Rivesville, W.Va. on US 19. Rivesville Quad	598	Lowest	Slopes are re-vegetated with trees, etc. Appears stable. Flat area on top of refuse pile is at least 5 acres with sparse vegetation. Recommend lowest priority.
Petitte No. 1, Petitte Mining Co., Monongalia County, 1/2 mi NW of Maidsville, W.Va. on Route 100. Morgantown North Quad	586	Intermediate	Large (50 acres) mine-refuse dump combined with strip-mine spoil areas. SE part is burned to "red dog."* Appears stable. 10-acre impoundment if reservoir were filled. Dam 1000' wide. Recommend lowest priority because of small drainage basin, gentle slope, and sufficient dam width to insure safe impoundment.
Robinhood Mines, 8 & 9. Armco Steel Corp., Boone County, 1 mi SE of Twilight, W.Va. on Spruce Fork. Whitesville Quad.	157	Highest	Impoundment on SW Branch of Spruce Lick Fork is filled. Spruce Lick Fork Impoundment on Main (S) Fork is active and drains upstream. Impoundment dam is only 10' wide. Culvert 2' above fine waste surface and 3' below top of dam. Impoundment is small 75' x 1200' x 8'. Dam will fail before impoundment is filled. Recommend intermediate priority.

*"Red dog"--burned out coal refuse.

Table 5-1 (Continued)

SITE OR OWNER, LOCATION	DNR NUMBER	DNR PRIORITY	REMARKS
Eastern Assoc. Coal Corp., Boone County, 1-1/2 mi W of Barrett on Cow Creek. Wharton Quad.	460	Highest	Gigantic waste site. 60° front slope. Numerous slump fractures on upper surface of waste. Small culvert drains impoundment 100' or more below top of dam. Impoundment is smaller than Buffalo Creek Dam failure (14,000,000 gals). Engineering study being conducted by Dapallonia, Inc. Pittsburgh, Pa. Drilling of coarse waste and wash borings in impoundment. Recommend highest priority.
Amherst Coal Co., Logan County, W end of Slagle, W.Va. on Rum Creek. Amherstdale Quad.	26	Highest	Impoundment is filled and abandoned. Active strip-mine road across dam. Culvert installed at slurry level. Appears stable. Second small dam at lower elevation for slurry disposal. Small drainage basin above dam. Recommend intermediate priority.
Island Creek, Logan County, 2 mi SE of Blair on Little White Oak Branch of Spruce Fork. Amherstdale Quad.	32	Highest	Gigantic waste pile--active. Steep walled channel constructed to drain impoundment; these walls could slump. Burning. If channel remains open recommend intermediate priority. If closed, a large drainage basin is impounded and failure is likely; highest priority in that case.

Table 5-1 (Continued)

SITE OR OWNER, LOCATION	DNR NUMBER	DNR PRIORITY	REMARKS
Island Creek, Logan County, Buffalo Creek at Stowe. Amherstdale Quad.	8	Intermediate	Large dump. No impoundment. Not burned. Developed on steep slope. Minor slide potential. Recommend lowest priority.
Youngstown Mines, Logan County, Right Fork of Rum Creek at Dehue, W.Va. Logan Quad.	23	Highest	Large impoundment. ' Slump fractures in dam. Dam 20' in width. Burning. Very steep slopes. Impoundment 20' deep if filled. Small drainage basin. Culvert installed at slurry level. City directly below waste area. Very bad situation. Recommend highest priority.
Island Creek, Logan County 1/2 mi up Rich Creek from Mouth Guyandotte River. Logan Quad.	21	Lowest	Small waste dumps along valley wall. Recommend lowest priority.
Keystone #1, Eastern Assoc. Coal Co., McDowell Co. 1/4 mi N of Keystone. Keystone Quad.	388	Highest	Gigantic waste pile 400' high with two impoundments. Burning. Front largely burned out. Active. Large drainage basin. Directly above town of Keystone. Upper impoundment opened by potentially unstable steep walled channel In small sub-dam. Recommend highest priority.

Table 5-1 (Continued)

SITE OR OWNER, LOCATION	DNR NUMBER	DNR PRIORITY	REMARKS
Ridgeview Coal Co., Boone County, Ridgeville, W.Va. Julian Quad.	439	Lowest	Abandoned, burned to red dog. V-shaped channel 25' high drains relatively small impoundment. Large drainage basin. Recommend lowest priority.
Bethlehem Mines Corp., Boone County, 2-3/4 mi NW of Bandytown on Rt. 78 Wharton Quad.	450	Highest	Narrow dam 8' high impounds slurry waste. Burning. Culvert at NW end. Small drainage basin. Recommend intermediate priority.
Island Creek, Logan County Buffalo Creek, at Robinette. Amherstdale Quad.	11	Highest	Abandoned, burned to red dog. Slumped. No impoundment. Possible slight future slumping. May lead to some property damage. Recommend intermediate priority.
Elkay Mining Co., Logan County, NE end of Earling, W.Va. Logan Quad.	19	Intermediate	Active waste-disposal site on point of slope above mine. 150-200 feet high embankment. Recommend intermediate priority.
Unknown, McDowell Co. 1/2 mi NW of Ilartwell. Pounding Mill Quad.	365	Lowest	Small waste pile burned to "red dog." 40' maximum height. Covers less than 5 acres. Recommend lowest priority.

Table 5-1 (Continued)

SITE OR OWNER, LOCATION	DNR NUMBER	DNR PRIORITY	REMARKS
Pocahontas Fuel Co., McDowell Co. 3/4 mi SE Berwind on Rt. 9/4. War Quad.	361	Lowest	Burned to "red dog." High dump, moderate slope. No impoundment. Possible slide problem but not an inhabited area. Recommend lowest priority.
Royalty Smokeless Coal Co., McDowell Co. 2 mi SW of Welch on Rt. 16. Welch Quad.	383	Highest	Impoundment at upper end of narrow valley less than one acre and less than 10' deep. Dam is 150' wide on cross-section. Burning dump on valley side of dam downstream. Houses below not endangered unless size of impoundment greatly increased. Recommend intermediate priority.
U.S. Steel Corp., McDowell County, 1 mi NE Wilcoe on Grapevine Branch, Welch Quad.	375	Highest	Gigantic waste pile 500' high. Active slurry pond on NE side of dump. Approx. 20 acres. Dam 75' wide. Trees planted on top. Burlap filter visible on face of dam. Small fractures in dam on impoundment side. Dam face graded to moderate slope. Recommend highest priority because of huge size.
Island Creek, Nicholas County, 1/4 mi NW Marybill across Gauley River. Craigsville Quad.	473	Lowest	Small waste piles along valley bank. Burning. 75' high. Recommend lowest priority.

Table 5-1 (Continued)

SITE OR OWNER, LOCATION	DNR NUMBER	DNR PRIORITY	REMARKS
Island Creek Coal Co., Armco Steel Corp. Nicholas County, Big Laurel Creek, W.Va., Raleigh County, Montcoal, W.Va. Whitesville Quad.	152	Highest	Gigantic waste pile. Minimum 400' high. Not burning. Impoundment drained by 20' x 20' channel with vertical walls; some slumped. Dump is slumped and deeply eroded from top to bottom because of lack of habitation for several miles downstream. Recommend intermediate priority.
#9 Coal Mountain, Island Creek Coal, Wyoming County 1/2 mi E of Coal Mountain. Oceana Quad.	261	Lowest	Large refuse pile 150' high. Burned to "red dog." Small impoundment (1/4 acre) on north side of waste pile. Recommend lowest priority.
Parde & Curtins Coal & Lumber Co. Bolair Prep. Plant, Webster County, Bolair, W.Va. Webster Springs Quad.	645	Lowest	Small ancient dump. Revegetated. Recommend lowest priority.
Pittsburgh & Redstone Fuel Co., Webster County, 3/4 mi S of Bergoo on Leatherwood Creek. Bergoo Quad.	648	Lowest	Small waste pile along valley. 500' long, 50' high. No danger. Recommend lowest priority.
Eastern Assoc. Coal Corp. Wyoming County 3/4 mi NE Kopperston on Rt. 85	252	i	Large refuse pile impounding 10 acres. Dam is 15' high, 50' wide. Base of front slope is undercut. No visible drain. No immediate

Table 5-1 (Continued)

SITE OR OWNER, LOCATION	DNR NUMBER	DNR PRIORITY	REMARKS
			danger except to cleaning plant. Recommend highest priority.
Lynco Dump Pocahontas Fuel Co., Wyoming County 1-1/2 mi SE Lynco on Rt. 7/1. Oceana Quad.	264	Lowest	Recently terraced lower elevations of dump covered by soil. Older pile on slope. No impoundment. Small impoundment on lower slope drained by 36-inch culvert. Recommend lowest priority.

6.0 CONCLUSIONS

Based on the testimony obtained from hearings, technical reports and our own field inspection, the Commission concludes that: Dam No. 3 on the Middle Fork was born out of the age-old practice in the coal fields of disposing of waste material and was constructed without utilizing technology developed for earthen dams and without using or consulting with professional persons qualified to design and build such a structure. The physical conditions leading to the failure of the dam are complex and involve a weak foundation and saturated embankment giving rise to failure of the downstream portion of the dam and a sudden total collapse of the remainder of the dam due to liquefaction. The failure occurred a minute or so before 8:00 a.m. February 26, 1972, and was solely the cause of the Buffalo Creek flood. No evidence of an act of God was found by the Commission.

6.1 CONDITIONS THAT LED TO THE FAILURE

6.1.1 Improper Construction of Dam No. 3

Dam No. 3 was not built using engineering practices that are standard in earth-dam construction; no foundation preparation was done and no attempt at compaction of the fill material was made other than occasional grading by bulldozer. Whatever the intention was at the time of dumping, the refuse bank impounded water and functioned as a dam.

6.1.2 Weak Foundation Material

The dam was built on the thick sludge layer, 40 to 100 feet in thickness, that had been impounded by Dams No. 1 and 2. This sludge is a weak material having negligible shear strength and thus was a major initiating mechanism which precipitated the failure.

6.1.3 Inadequate Overflow system

In June, 1971, a 24-inch overflow pipe for high-water conditions was placed in the dam approximately 7 to 10 feet below the final level of the compacted crest. However, this pipe was not of a sufficient size to handle the water increase at the time of failure. Furthermore, the pipe should have been placed lower in the dam to be effective. The dam should have had a fool-proof decant system or spillway designed by and constructed under the direction of a professional engineer with a knowledge of dam construction. Such a system would have provided positive control of the water level behind the dam.

6.1.4 Lack of Monitoring System

Dam No. 3 was not instrumented with piezometers and slope indicators. Such instruments are readily available to persons engaged in the construction of dams. If the instruments had been monitored, it would have been apparent prior to the failure of the dam that it was in imminent danger of collapse.

6.2 THE PITTSTON COMPANY

The Pittston Company as owner of Dam No. 3 was responsible for its safety and the safety of the people in Buffalo Creek Valley as far as the dam was concerned. It failed to meet these responsibilities in several ways:

1. The Pittston Company did not make an adequate engineering analysis of the stability of Dam No. 3 when it took over from the Buffalo Vining Company. Even though the dam was under construction and partially completed at the time Pittston became the owner, the Pittston Company cannot be excused fror responsibility for faulty construction of the dam.

2. Communications within the Pittston Company, especially with regard to subsidiaries such as Buffalo Mining Company, were extremely inadequate as far as determining needs for engineering services and furnishing such services for refuse disposal

3. The Pittston Compary allowed technicians to perform tasks in building and maintaining the dam even though these persons were not qualified nor registered to perform such duties. Pittston had no training program to correct these deficiencies.

4. Neither the original Buffalo Mining Company nor its successor, the Pittston Company, presented plans for construction of this dam to the West Virginia Public Service Commission for approval as required by law.

5. Mr. D. S. Dasovich, Vice-President of the Buffalo Mining Company and therefore an agent of the Pittston Company, was directly responsible for the dam. He testified he was not technically qualified by virtue of his education, training, or experience to build safe impounding structures; yet he did not solicit aid or advice in such construction; the record shows he committed a serious error in judgment concerning the stability of the dam just before it failed; and he compounded this error by failing to take a fail-safe position and order an alert or evacuation

of Buffalo Valley pending the alleviation of the crisis at the dam. These acts negated the possibility of any effective warning of the dangers facing the residents of Buffalo Creek Valley.*

6. Mr. Ben Tudor, as General Superintendent of the Buffalo Mining Company, passed judgment through daily inspections of tt.e stability of the dam. Like Mr. Dasovich, Mr. Tudor also erred on the stability of the dam just before its failure.

7. The Pittston Company was in violation of Regulations 77.215(e) and 77.216 as promulgated under the authority of the Federal Coal Mine Health and Safety Act of 1969. (See Section 3.2.4 of this Report.)

8. The Pittston Company c'id not have an adequate water-clarification system within the No. 5 preparation-plant facilities. Had such a system been installed, it would not have beer necessary for the company to maintain the series of filtration dams on Middle Fork.

9. Pittston officials testified that, in their opinion, adequate engineering expertise was available within their corporate structure. Further testimony indicated that if such engineering expertise did exist, it was not employee at any time during the construction or maintenance of Dam No. 3 nor was it employed for the maintenanc of any other of the impoundments on Middle Fork. It appears that the highest-ranking corporate official acting on behalf of Pittston did not request nor dig he receive engineering assistance from the home office in Dante, Virginia. Additionally neither of the registered engineers in the employ of Pittston in the Buffalo Creek Division appears to have had the prerequisite engineering abilities in the construction or maintenance of dams.

10. The Pittston Company has indicated indifference to the victims of the Buffalo Creek flood by failing to provide this Commission with pertinent information. Mr. Nicholas T. Camicia, President, The Pittston Company, assured this Commission that a copy of the "assessment

analysis" of Buffalo Mining Company property made by Pittston Company Coal Group engineers prior to the June, 1970, acquisition would be made available to this Commission. Such a report has not been received. Other information requested from the Pittston Company Coal Group headquarters in Dante, Virginia, and the offices of Buffalo Mining Company lawyers in Williamson, West Virginia, has not been received.

11. The Pittston Company, through its officials, has shown flagrant disregard for the safety of residents of Buffalo Creek and other persons who live near coal-refuse impoundments. This attitude appears to be prevalent throughout much of the coal industry.

6.3 STATE GOVERNMENT

6.3.1 Public Service Commission

Neither the Pittston Company nor any of the preceding owners or lessees who constructed a dam or dams or any other obstruction on Middle Fork has ever submitted plans for their design or construction to the Public Service Commission for approval. Failure to submit such plans constituted a violation of Section 47, Article 3, Chapter 61 of the West Virginia Code of 1931, as amended. The records of the Public Service Commission show that the Pittston Company sought and obtained approval in 1964 of plans for an earth-fill dam that it constructed in Sardis District, Harrison County. The company, therefore, was aware of the existence of the statute.

The Public Service Commission had no notice of the existence of Dam No. 3 on Middle Fork prior to its failure and, therefore, was not aware of the statutory violation.

Assuming that the Attorney General's opinion previously cited (see Section 3.11) is a proper interpretation of the statute, the Public Service Commission had no authority to exercise continuing supervision over dams or other obstructions once construction is completed. Consequently, the only remedy the Public Service Commission would have had after it was put on notice of such violation would be to directly notify the county prosecutor and strongly urge that the case be taken up for immediate prosecution.

The Public Service Commission was aware of the existence of Dam No. 2 pursuant to an investigation initiated in 1968 as a result of a letter of complaint by Mrs. Pearl Woodrum to Governor Hulett C. Smith. Notwithstanding the fact that the Public Service Commission does not have prosecution powers, the Commission should have at that time directly notified the prosecuting attorney in Logan County of the violation and strongly urged the prosecution of the Buffalo Mining Company. If that remedy was not satisfactory, i,Irs. Pearl Woodrum should have been advised of her right to abate the nuisance in her capacity as a citizen. It should be noted, however, that the Department of Natural Resources sent the county prosecutor a copy of the Commission's investigation that set forth the violation.

Dam No. 3 was a nuisance per se since a proper order had not been entered to approve the structure as to safety. Therefore, it could have been abated by the action of any taxpayer, citizen, or the county court. It appears that fe~i, if any, people were aware of their legal rights in this regard. At least in retrospect, appears that the Public Service Commission should have made a serious effort to inform the public and the legislature of its complete lack of enforcement authority, according to it; reliance on the Attorney General's opinion.

If the corresponding recommendation discussed in Section 7.2.2 of this report is not adopted and the Public Service Commission, therefore, is to continue to regulate dams and other obstructions across the watercourse, under current law, that law should be amended to make it a continuing violation in that each day shall constitute a new offense. The penalties should remain the same for each offense.

If the Public Service Commission is to continue to regulate dams and other obstructions across the watercourse, under current law, and that law is to be continued unchanged, some sort of governmental arrangement should be made among the Department of Natural Resources, Department of Mines, the U. S. Bureau of Mines, and other appropriate Federal agencies so that the Public Service Commission may be put on notice as to the existence of such dams or other obstructions. Thus, the Public Service Commission may verify those structures that have proper administrative approval and directly urge prosecution of those without such approval. The foregoing assumptions would presume that the Public Service Commission would be given budgetary increases necessary to employ a proper engineering staff.

6.3.2 Department of Natural Resources

The Pittston Company did have a valid water-pollution control permit in full force and effect for its operation on Middle Fork at the time of the disaster. The records show that an inspector acting on behalf of the Division of Water Resources made regular, periodic inspections of the impoundment on Middle Fork. The inspector did recommend the construction of another impoundment on Middle Fork because, in his judgment, the existing impoundment constituted a potential hazard to the waters of the State. his recommendation was adopted; however, his recommendation as to the construction of spillways on Middle Fork was not adopted. (It should be noted that the Pittston Company in testimony indicated that future plans for the impoundment on Middle

Fork included the construction of spillways in accordance with the inspector's recommendation.) The testimony of expert witnesses in the field of dam design and construction indicated that it would be difficult, if not impossible, for the State inspector to adequately judge or determine the safety of any impoundment on Middle Fork since he was a layman and, by reason of his education and training, did not have the expertise required to make such a judgment. The inspector did not at any time participate, directly or indirectly, in the design or construction of any impoundments on Middle Fork nor did he indicate in any manner that he was qualified to make technical or professional opinions, nor did he make the same, regarding the design or construction of dams. The Commission concludes that the inspector, acting on behalf of the Water Resources Division, was not able to adequately judge or determine the stability of the impoundments and was only concerned with, and made his recommendation in light of, the potential hazard of water pollution in the area. The Commission concludes further that in the future inspectors should have available to them experts in the field of engineering so that questions of safety or stability may be judged and determined by engineering standards.

Neither the Pittston Company nor any of the preceding owners or lessees who constructed or maintained any dam or other obstruction on Middle Fork complied with Section 47, Article 3, Chapter 61 of the West Virginia Code in regard to providing a suitable fish ladder, way,

or flume or in the alternative failed to secure an exemption, in writing, from the Director of the Department of Natural Resources. This constitutes violation of the aforementioned section that could have been abated by the Director of the Department of Natural Resources.

The Director of Natural Resources, by virtue of Senate Bill 404 (dated March 11, 1972), has power to alleviate dangers presented by coal-refuse banks. The Director's powers are remedial in that he may only act after such refuse ban}_s have been created. It seems that a better law would require the Director to approve the creation of coal-refuse banks and to have the power to promulgate rules and regulations to serve as guidelines in the areas of structural stability, air pollution, and water pollution. In addition, if the Department of Natural Resources is to continually monitor coal-refuse banks that impound water, it seems more appropriate that it should issue approval as to the design and construction of such structures prior to their creation. In this way, future structures will be under the direct regulatory control of only one State governmental agency.

6.3.3 Department of Mines

The mining map filed by the Pittston Company for its operations on Middle Fork on February 25, 1972, certified by D. S. Dasovich, mining engineer, did not show any bodies of water such as the water-impounded dams on Middle Fork. Such failure constitutes a violation of Section 1, Article 2, Chapter 22.*

*See Section 8.0, MINORITY OPINION by Dr. Jay Hilary Kelley.

6.4 FEDERAL GOVERNMENT

The Commission concludes the following with regard to the Federal government:

1. As previously stated in Section 3.2 of this report, no federal agency had sufficient authority to regulate non-federally owned dams. However, many federal agencies--including but not limited to the U. S. Bureau of Mines, Environmental Protection Agency, and Appalachian Regional Commission--have responsibility and authority to conduct research and development programs in areas directly related to coal refuse. It does not appear that any of these federal agencies have conducted sufficiently extensive research programs to alleviate insufficient technological knowledge. Where some of these agencies had some color of authority, no matter how slight, it appears that they did not take aggressive action to inform State enforcement agencies of any problem that they might have or could have been aware of. The Commission concludes that the authority to closely regulate dams should lie with the appropriate State agency as recommended herein and that all federal agencies should endeavor to cooperate with this regulatory agency in matters of safety enforcement.

2. The U. S. Bureau of Mines, although alerted to the problems of sludge impoundments in 1966, failed to take the initiative to police coal-refuse structures, thus contributing to the causes underlying the disaster.*

3. The U. S. Bureau of Mines indirectly has authority to prevent dams to be constructed from refuse piles. Subsequent-to the disaster, Buffalo Mining Company was cited for a violation of Regulation 77.216 of the Federal Coal Mine Health and Safety Act of 1969. In addition to this prohibition, Regulation 77.215(e) reads as follows:

   > Refuse piles shall not be constructed so as to impede drainage or impound water.

   The Bureau of Mines should have cited Buffalo Mining Company for violation of Section 77.215(e).

*See Section 8.0, MINORITY OPINION by Dr. Jay Hilary Kelley.

6.5 GENERAL

The following general conclusions were arrived at by the Commission:

1. The lack of definitive, clear-cut, and enforceable laws with regard to safety of mine-refuse banks and impounding structures, both at the Federal and State levels, was a major shortcoming that contributed to the disaster.

2. The membership of the West Virginia Society of Professional Engineers apparently did not insist upon rigid enforcement of the Registration Act, thus permitting hazardous construction practices to be followed. Similarly, its members, some of whor^ were cognizant of the type of structures that impounded water in the coal areas, failed in their moral responsibilities to point out the dangers inherent in these structures. Such an attitude contributed indirectly to the causes underlying the disaster.*

3. The lack of planning, zoning, and engineering expertise at the county level allowed impounding structures such as the one on Midile Fork to develop without adequate guidance and policing.

4. The failure of Federal and State agencies to initiate research on utilization and safe disposal of coal waste, as the British dii after the Aberfan disaster in 1966, also is an underlying cause of the disaster. Agencies within these governments, with demonstrated competency for such research, failed to formulate or vigorously support the needs for such research even after 1966 when the needs were brought to general public attention.

5. In a lesser--yet significant--aspect, educational institutions in many cases have not provided a sufficient number of technical personnel with the training in subjects such as soils mechanics and engineering geology essential to proper performance of their work in coal mining and its related problems of waste disposal.*

6. Engineering knowledge does exist to build safe dams to hold back shallow bodies of water to serve as settling basins. This knowledge is sufficient to serve until further research will eliminate the problem of disposal of coal refuse. The existing

*See Section 8.0, MINORITY OPINION by Dr. Jay Hilary Kelley

problem is the proper application of engineering technology now available.

7. Dams or impoundments can be safely constructed of coal refuse if the material is properly zoned to control seepage, given other sound engineering practices.

8. One of the most poignant facts learned by the Commission was the complete lack of emergency functions immediately following the dam failure on February 26, 1972. Of several agencies--at Federal, State, and local levels--charged with public safety in emergency situations, none proved effective in preventing further deaths and property damage. The most noticable deficiency appeared to be communications. With the failure of telephone communications in the Buffalo Creek area, only personal contact, citizens-band radio, and commercial-radio communications were remaining. However, with the lack of a unified communications or command system, the full effectiveness of these emergency communication media was greatly limited. It is believed that the combination of the mass communications, coupled with a recognized command communications network, may have saved many more lives than were saved in the Buffalo Creek area.

   The specific deficiences appear to be threefold: (1) there is no reliable system for disaster intelligence or alerting of command-decision makers; (2) the organizations charged with emergency activities do not control or own an emergency-communications-network operations; and (3) several overlapping authorities are charged with similar emergency responsibilities.

7.0 RECOMMENDATIONS

7.1 GENERAL RECOMMENDATIONS

7.1.1 The Commission has not been able to resolve adequately some of the conflicting testimony. Nor has it been able to corroborate some of the testimony. All of the opinions, conclusions, and recommendations were made in light of what appears to be the weight of the evidence as voluntarily presented to this Commission We are unable to properly assess many points of interest since some of the witnesses called chose not to appear. We could not press this issue since we were without subpoena power. It should also be noted that this Commission has no authority to prosecute for perjury or contempt and, therefore, the witnesses, although under oath, had no fear of subsequent legal action for statements which were intentionally misleading or untruthful.

We recommend that the proper judicial authority'with subpoena power, after considering our report and any other pertinent information, determine if grand jury or other appropriate legal action should be taken in order to more closely scrutinize testimony and to discover if factual data is missing due to the reluctance of certain persons involved in this specific tragedy to testify. Such a process would be better able to determine the appropriate action to be taken. Our scope of study is explicitly expressed in the mandates of the Executive Order, which did not contemplate any judicial process. It is obvious that none could be taken by this Commission due to constitutional conflicts. Accordingly, this Commission makes no judicial determinations of any type or kind whatsoever and nothing in this report shall be construed to be a legal determination, nor is it the intention of the Commission that anything contained herein shall be construed to be a judicial determination.*

7.1.2 The flagrant disregard shown by the Pittston Company and the coal industry for the safety of the persons living on Buffalo Creek and others who live near coal refuse impoundments should be publicly recognized.

7.1.3 The coal industry should, for once, take a look at those practices which affect public safety and the environment and take the lead in exploring all possible methods of using coal waste materials for practical purposes, such as land fills,

*See Section 8.0, MINORITY OPINIONS, Dr. Jay Hilary Kelley

highway construction, etc., and solicit the aid of Federal and State agencies for this research.

7.1.4 The coal industry should explain publicly why mines in the United States cannot, for economic and other reasons, put waste material back into worked-out sections of mines, although this method of disposal is used in several European countries.

7.1 5 The Legislature should immediately study the feasibility of enacting a law which would regulate coal refuse banks in a prospective manner as welL as a curative manger. Such a IWA must require a permit to construct new refuse banks in accordance with specifications for prevention of air and water pollution and for structural stability and public safety. In addition, existing coal refuse banks must be regulated to prevent air and water pollution and to insure structural stability and public safety. The Legislature should take notice of laws of our sister Sates concerning regulation of coal refuse banks as well as consider the following in regard to construction of new refuse banks that would be made up of slate, bony, rock and/or other coarse refuse material not otherwise involved or discharged through water from the cleaning or preparation plant operations:

a. This material is to be deposited at a site generally agreed upon by and among a representative of the mining company; a representative of the State Department of Mines; a representative of the Department of Natural Resources; and a representative of the Federal Bureau of Mines.

b. Once the site is agreed upon, then the company should be required to level and spread the material deposited in layers from four to six feet in thickness. On top of each of these refuse layers, an amount of clay and/or other impervious material is to be deposited to a depth of two feet. Each combined layer of refuse and clay or impervious material is then to be compacted by heavy equipment (crawler, standand roller, vibratory roller or rubber-tired front-end loader). Continued construction of the refuse bank would be built up in a system of terraces, with the sidewalls of each terraced level made gentle or gradual enough to permit safe access by either the dumping and/or compaction equipment and their operators. Continued construction of the refuse bank. would be allowed to reach a maximum height of between 300 to 400 feet.

When this height is reached, then dumping and compacting is to stop, and the entire bank is to be covered with clay, seeded and fertilized on the top and sidewalls with suitable grasses or vines such as crown vetch. The company must also ensure success of the seeding, whatever cover' is used.

c. New sites are to be selected in the same manner prescribed upon maturity of the previous bank.

d. In the event that suitable impervious material would be in short supply nearby to the mining or refuse disposal site, and would otherwise pose an economic hardship on the producer or company to find and deliver such material for this purpose, it is further recommended that the company be allowed to deposit their slate, rock, bony or otherwise coarse and larger refuse material without the impervious layers, but that such material be spread out, compacted to a maximum degree and terraced as previously mentioned.

7.1.6 The Legislature should also immediately consider the eradication of abandoned coal refuse banks. The Legislature should determine (1) what authority is needed, (2) who should be delegated the duty to eradicate such banks, and (3) what mechanisms be employed to finance such an undertaking.

7.1.7 All abandoned coal refuse impoundments should be drained and then breached so that they will not block natural drainage.

7.1.8 Before final site selection is made for the disposition of mine refuse that would subsequently impound any suspected amount of water, all coal mining companies should be required to inspect the proposed site in company with a citizen representative of the nearest incorporated or unincorporated residential community located downstream from the proposed site; a representative of the State's Department of Mines; a representative of the State's Department of Natural Resources; a representative of the U. S. Bureau of mines; and a registered professional engineer.

7.1.9 The Department of Natural Resources, upon the conclusion of their survey, should furnish the Public Service Commission information on those impoundments exceeding the statutory limit. If the Public Service Commission finds that these impoundments have not been duly authorized, they should notify the county prosecutor in the county in which the impoundments are located and urge prosecution to the fullest extent. This is an interim measure, pending enactment of the laws recommended in Sections 7.2.1 and 7.2.2.

7.2 STATE GOVERNMENT

7.2.1 Public Service Commission

The Public Service Commission should be relieved of its duties in regard to its regulatory powers over dams and other obstructions in water courses and such duties should be delegated to the Department of Natural Resources. (See Department of Natural Resources Recommendations, Section 7.2.2 below.)

7.2.2 Department of Natural Resources

The Legislature should immediately enact a dam-safety law in order to fulfill its responsibilities to the citizens of the State and to protect private and public property from potential failure of a dam.

The Department of Natural Resources should be delegated the duty to regulate and control nonfederally owned dams within the State of West Virginia. Such power and duty shall be in the form identical or similar to the following:

SECTION 1. Legislative Findings.

The Legislature hereby finds that dams may consitute a potential hazard to the lives of people of the State and may constitute a sufficient danger to private and public property and as such need to be more closely regulated and controlled.

SECTION 2. Definitions.

Definitions as used in this article:

(a) 'Alterations', or 'repairs', or either of them, mean only such alterations or repairs that may affect the safety of the dam or reservoir as determined by the Director;

(b) 'Coal refuse' means any waste coal, rock, shale, slurry, culm, gob, honey, slate, clay, and related materials, associated with or near a coal seam, that are either brought above ground or otherwise removed from a coal mine in the process of mining coal, or that are separated from coal during the cleaning or preparation operations;

©) 'Dam' means any artificial barrier, together with appurtenant works, that does or may impound or divert water;

(d) 'Days' mean calendar days, including Sundays and holidays;

(e) 'Director' means the Director of the Department of Natural Resources, his authorized delegatees, representatives, and agents;

(f) 'Enlargement' means any change in or addition to an existing dam or reservoir, that does or may raise the water storage elevation of the water impounded by the dam;

(g) 'Independent engineer' means an engineer not in the regular or permanent employ of a person constructing, maintaining, or operating a dam;

(h) 'Operate' means to enter upon a coal-refuse disposal pile, or part thereof, for the purpose of disposing, depositing or dumping coal refuse thereon, or to employ a coal-refuse disposal pile for retarding the flow of or the impoundment of water;

(i) 'Operator' means any person operating any coal-refuse disposal pile, or part thereof;

(j) 'Owner' means any person who owns an interest in, controls, or operates a dam;

(k) 'Person' means any individual, firm, association, organization, partnership, business trust corporation, company, county, municipal or quasi-municipal corporation, public utility, utility or other district, the State and its departments, divisions, institutions, and agencies, and the duly authorized officers, agents, and representatives thereof, or any combination of any of the above; "Person does not include the United States Government nor any agency thereof, those who operate and maintain dams or reservoirs owned by the United

States or an agency thereof.

(l) 'Reservoir' means any basin which contains or will contain the water impounded by a dam;

(m) 'Water' means that liquid including solids or other matter therein that is or will be impounded; and

(n) 'Water storage elevation' means the maximum elevation of water surface that can be obtained by the dam or reservoir.

SECTION 3. Director Powers and Duties

The Director shall have the following duties:

1. Set reasonable fees for the certificate of approval based on the amount of water that may be impounded by any proposed or existing structure;
2. Promulgate rules and regulations consistent with the purposes of this article in accordance with the applicable provisions of Chapter 29A of this Code;
3. Grant, modify, amend, revoke, or place restrictions on any certificate of approval;
4. Employ such persons as may be necessary to enforce the provisions of this article including, but not limited to, qualified professional consultants;

5. Cooperate and coordinate with any agency, department, or political subdivisions of the Federal, State or local government to improve, secure, study, or enforce dam safety and dam technology within the state; and
6. Conduct independent inspections without warning of any dam within the purview of this statute.

SECTION 4.Form for Certificate of Approval Required

On and after July 1, 1973, no person shall construct, enlarge, repair, alter, remove, maintain, or operate a dam constructed of any material whatsoever, including coal refuse, in the State that is or will be fifteen (15) feet or more in height from the natural bed of the stream or watercourse at the downstream toe of the barrier, or from the lowest elevation of the outside limit of the barrier, as determined by the Director, or is or will be ten (10) feet or more in height from the natural bed of the stream or watercourse at the downstream toe of the barrier, or from the lowest elevation of the outside limit of the barrier, as determined by the Director, and has or will have an impounding capacity at maximum water storage elevation of fifteen (15) acre-feet or more without first obtaining from the State a certificate of approval and, in order to obtain said certificate, shall file with the Director, on a form to be made available by the Director, the following information:

1. The name under which said person is doing business in the State;
2. The legal address of said person;
3. The location of the proposed or existing dam and reservoir;
4. The type, size, and height of the proposed or existing dam and reservoir and appurtenant works;
5. The storage capacity and reservoir surface areas for normal pool and maximum highwater;
6. The fall (that is, elevation difference) of the first 1000 feet from the toe of the dam;
7. The purpose or purposes for which the dam or reservoir is to be used;
8. Materials used or to be used in the construction of the dam;
9. In the case of an application by an owner or lessee of a dam, the names and addresses of all persons having a real property interest in such dams; and
10. Such other plans and detailed information as the Director may deem reasonable and necessary to fulfill his responsibilities hereunder.

SECTION 5. Plans and Specifications

Plans and specifications for construction, enlargement, alteration, repair or removal of dams and reservoirs shall be in the charge of an

engineer, licensed by the State and experienced in the design and construction of dams, as determined by the Director. Any plans or specifications submitted to the Director shall bear the seal of an engineer licensed by the State and experienced in the design and construction of dams as determined by the Director.

SECTION 6. Inspections

Any person issued a certificate of approval shall have the dam inspected as to safety at least twice in every calendar year by an independent engineer licensed by the state and experienced in the design and construction of dams as determined by the director. Such inspection form shall be in the form and manner designed by the director and shall have the seal of the engineer inspecting the same.

SECTION _7_. Whenever the Director determines that any person to which a certificate of approval has been issued has failed to comply with the conditions in said certificate or whenever the Director determines that life or property are/or may be endangered by the failure or incapacity of any dam or reservoir or by other cause related to a dam or reservoir, irrespective of any conditions or the lack thereof in the certificate of approval for said dam or reservoir, the Director shall and is hereby empowered to order the owner thereof to take such action as is necessary to render the dam or reservoir safe. Where the owner fails in the judgment of the Director to take satisfactory action toward compliance with such order, or to maintain a satisfactory rate of progress toward full compliance therewith, or where in the judgment

of the Director the danger to life or property will not permit delay, the Director shall take such action as he deems necessary to render the dam or reservoir safe, which action may include:

(a) Taking full charge and control of the dam or reservoir

(b) Lowering the water level by releasing water from the reservoir

(c) Completely emptying the reservoir

(d) Performing any necessary remedial or protective work at the site

(e) Taking such other steps as may be necessary in the opinion of the Director to safeguard life and property.

The Director may continue such action until the dam or reservoir involved are rendered safe or the emergency occasioning the action has ceased. All contracts by the Director for work under this Section are hereby authorized.

SECTION _8_. Whenever the Director takes action authorized by the preceding Section, the owner or owners of the dam or the dam creating the impoundment, at which such action was taken, shall be jointly and severally liable for the costs of taking such action, including applicable overheads, and a lien in the amount of such costs shall be automatically created on all property owned by any such owner at or proximate to such dam or reservoir. The Director shall file an action in any Circuit Court having jurisdiction over any dam for the recovery of such costs, and may join all other owners in such action irrespective of any statutes to the contrary relating to jurisdiction or venue. Following the conclusion of such action the Director may make appli-

cation to the Court for foreclosure sale of the property to satisfy

any judgment obtained by the Director.

SECTION _9_. Orders of the Director; injunctive relief. When the Director makes a finding of a dangerous condition not imminently dangerous with respect to any new dam created hereafter or any part of an existing dam which is presently being operated, then the Director shall order the operator to take all remedial action at his own expense, as may be necessary or expedient to prevent or correct the condition, and it shall be the duty of such operator to take such action. Any such order shall be served by certified or registered mail, return receipt requested, on the operator involved.

The Director may apply to the circuit court of the county in which any such dam so operated is located for an injunction to enforce the orders of the Director.

SECTION _10_. Hearing upon orders of the Director; costs and bond; judicial review; appeal; legal assistance for Director.

Any operator adversely affected by any order of the Director shall have a right to a hearing thereon before the Director, providing that demand in writing for such hearing is served upon the Director, within ten days following the receipt by such applicant or licensee of a certified copy of said order. The service of such demand for a hearing upon the Director shall operate to suspend the execution of the order with respect to which a hearing is being demanded. The person demanding a hearing shall either establish sufficient financial responsibility

or give security for the cost of such hearing in such form and amount as the Director may reasonably require. If the person demanding such hearing does not substantially prevail in such hearing or upon judicial review thereof as hereinafter provided, then the costs of such hearing shall be assessed against him by the Director and may be collected by an action at law or other proper remedy. The Director shall immediately set a date for such hearing and notify the person demanding such hearing thereof, which hearing shall be held within thirty days after receipt of said demand. At such hearing the Director shall hear evidence and thereafter make and enter an order supported by findings of facts affirming, modifying or vacating the order with respect to which such hearing was held, which order shall be final unless vacated or modified upon judicial review thereof.

Such hearing and the administrative procedure prior to, during, and following the same shall be governed by and be in accordance with the provisions of article five, chapter twenty-nine-a of this code in like manner as if the provisions of article five were set forth in extenso in this section.

Any person adversely affected by an order entered following such hearing shall have the right of judicial review thereof in accordance with the provisions of section four, article five, chapter twenty-nine-a of this code with like effect as if the provisions of said section four were set forth in extenso herein.

The judgment of a circuit court reviewing such order of the Director shall be final unless reversed, vacated or modified on appeal to the supreme court of appeals in accordance with the provisions of section one, article six, chapter twenty-nine-a of this code. Legal counsel and services for the Director in all such proceedings in any circuit court and the supreme court of appeals shall be provided by the attorney general or his assistants and in any proceedings in any circuit court by the prosecuting attorney of that county as well, all without additional compensation.

SECTION _11_. No municipality, county, nor any group of counties, or other person, shall regulate, supervise, or provide for the regulation or supervision of any dams or reservoirs within their jurisdiction, including the construction, maintenance, operation, removal or abandonment thereof, nor to limit the size of a dam or reservoir or the amount of water which may be stored therein, where the exercise of such authority would conflict with the powers and authority vested in the Director of this article.

SECTION _12_. No action may be brought against the State or its agents or employees on account of the partial or total failure of any dam or reservoir or through the operation of any dam or reservoir or for any action taken by such defendant pursuant to this act or for the failure of such defendant to act.

SECTION _13_. Nothing in this article shall be construed to relieve the owner or owners of a dam or reservoir of the legal duties, obligations or liabilities incident to the ownership or operation of the dam or reservoir.

SECTION _14_. Any person who shall violate any of the provisions of this article shall be guilty of a misdemeanor, and shall be punished by a fine of not less than Five Hundred Dollars ($500.00) nor more than One Thousand Dollars ($1,000.00). Each day of violation shall be considered a separate offense.

SECTION _15_. Severability.

If any article, section, subsection, provision, clause or phrase of this article or the application thereof to any person or circumstance is held unconstitutional or invalid, such unconstitutionality or invalidity shall not affect other articles, sections, subsections, provisions, clauses or phrases or applications of the chapter, and to this end each and every article, section, subsection, provision, clause and phrase of this chapter is declared to be severable. The Legislature hereby declares that would have enacted the remaining articles, sections, subsections, provisions, clauses and phrases of this chapter even if it had known that any articles, sections, subsections, provisions, clauses and phrases thereof would be declared to be unconstitutional or invalid, and that it would have enacted this chapter even if it had known that the application thereof to any person or circumstance would be held to be unconstitutional or invalid.

7.2.2.1 Rules and Regulations

The rules and regulations authorized in the preceeding statutory recommendation should take under consideration the following:

1. Requiring all dams or impoundments constructed of coal refuse to be properly zoned for the control of seepage rates;

2. Requiring all dams or impoundments higher than 10 feet to be instrumented and monitored on a regular and frequent basis. Minimal instrumentation should include piezometers and slope indicators; and

3. Requiring all dams or impoundments to have fool-proof decant systems and/or spillways designed by and constructed under the direction of a registered professional engineer with a competence in the design and construction of dams.

7.2.3 West Virginia State Board of Registration for Professional Engineers

The State Board of Registration for Professional Engineers in conjuction with the West Virginia Society of Professional Engineers should make recommendations to the Legislature to revamp the present statutory language to more closely reflect some of the rules and regulations adopted since the statute was originally enacted. It appears that there are widespread violations of the engineer registration act due to some confusion as to what activities are considered practice. Additionally, it appears that there are other violations within the ranks of registered engineers who are practicing outside of their registration specialty. If the enforcement powers of the boards are not sufficient then the board should be granted greater powers or funds, or both, to accomplish its objectives of safeguarding life, health, and property within the State. If the board is unable or unwilling to regulate this critical profession then alternate measures for regulation and control should be adopted by the Legislature to assure the safety of our citizens. In this instance, the Legislature should review the registration laws of other states.

7.2.4 Safety and Regulatory Laws

Both the State Legislature and Congress should provide clear-cut policing powers for agencies charged with enforcing safety and regulatory legislation. Each paragraph and section of laws pertaining to safety should be precise, complete and capable of standing alone without cross reference to other portions of a law.

7.3 LONG TERM RECOMMENDATIONS

1. The Legislature should take under advisement the feasibility of creating an independent state resource and environmental protection agency. Such an agency should have the power and duties to control and regulate in areas affecting air and water pollution and land use. It should have the further authority to require impact statements on all projects undertaken within the state that would or might affect our environmental, resource and economic factors. In addition, they should have separate prosecution powers in order to enforce duties delegated to such an agency.

2. The Legislature should take under advisement the creation of an environmental public safety court. Such a court would have jurisdiction only over cases involving environmental and related public safety litigation. The creation of a separate court would alleviate the difficulties encountered in the prosecution of environmental cases created by the heavy docket of the current court system.

3. The Legislature should determine ways to remedy the lack of planning, zoning, and engineering expertise at the county level which allowed impounding structures such as the one on Middle Fork to develop without adequate guidance and policing.

4. Appropriate State and Federal agencies should design a coordinated disaster plan that would include warning systems, communications, evacuation, temporary housing, food centers, medical attention and other types of emergency services for areas where conditions exist that might result in a disaster from any cause.

5. Immediate appropriate research and action programs should be undertaken to find suitable, acceptable utilization technology for the massive tonnages of coal refuse that exist in the State from both active and abandoned mining.

    a. Successful coal refuse utilization practices experienced in Great Britain and other European countries should be immediately investigated with the objective of employing the same methods of utilization in West Virginia.

    b. Rehabilitation and reclamation of the areas where coal mining has been predominant for many years should be accelerated, with an ongoing mine area reclamation

program designed to facilitate elimination of mine-related environmental problems such as abandoned refuse banks and abandoned mine drainage pollution sources.

c. In order to finance such a comprehensive reclamation program, serious consideration should be given to establishment of an environmental tax on minerals production, providing such a tax would not be undue or prohibitive to the future economic stability of either the oil, gas or coal industries in the State.

6. Our Congressional delegation should be urged to promote establishment of a concise national energy policy as well as a concise national coal policy. Each policy should include guidance on safety of surface problems, disposal of wastes, and research in support of safety and environmental enhancement.

7. As an alternate method of financing an ongoing reclamation program within the State, and in order to expedite rehabilitation of the areas of heavy minerals production, our Congressional Delegation should also be urged to place before the Congress the following for consideration:

   a. A tax be placed on all electricity consumed

   b. The money from this tax to be apportioned to the states producing the basic energy sources (coal, oil, gas, nuclear, etc.) from which the power was generated

   c. The basis for distribution to be that portion of the power generated from materials obtained from the state in question

   d. All apportioned money to be applied only to rehabilitation of the environment and improve safety within the energy producing area. Money may be used for research, physical reclamation of the environment, development of parkland in rehabilitated areas, and other related operations.

   e. Before distribution of the apportioned money a plan for the utilization of the money must be produced by the State and approved by an appropriate Federal agency.

8.0 MINORITY OPINIONS

MINORITY OPINION NO. 1 - By Jay Hilary Kelley

Reference Section 2.7.3

Some controversy still exists on the mechanism of failure of the dam in Middle Fork. For example, the majority view holds that direct rainfall on the dam contributed to the added weight which caused the displacement of the sludge foundation. However, a simple observation shows that the direct rainfall amounted to only a few inches of water, which does not compare with truck loads of refuse in lift after lift on the dam.

The procedure for refuse dam construction appears to have developed as follows: When a refuse dam was built (assuming a solid foundation), the dirty water would filter through the refuse and eventually seal the inside layer of the dam creating an impervious film. As the impervious film rose, it was necessary to continue adding height to the dam to keep the normal pool at safe levels below the crest. But as this was done, the pool depth became too deep for safety or for water cleaning requirements.

In the case of the Middle Fork dam system, as opposed to other refuse dams observed by the Commission in Southern West Virginia, the sludge-laden water was introduced to the pool far upstream from the impoundment structures, thus causing heavy depositions of coarse sands

upstream from the dam causing in turn a reduction in total pool area, whereas discharging of black water nearer the dam would have caused a shallowing of the pool and an enlargement of the pool as the dams and filming rose in height.

It may have been partly for this reason, i.e., deepening of the pond and lessening of pond area, which led Buffalo Mining Company and Department of Natural Resources officials to favor the construction of new impoundments upstream during 1968. Thus Dam No. 3 was built in the No. 2 pond over the sludge that had by then deposited to 60-100 feet. It is now known after a most comprehensive analysis, that the decision to construct a dam on cleaning plant sludge was a fatal mistake at Buffalo Creek. Following the usual procedure, the company built Dam No. 3 higher and higher to keep the breast well above the pool level. The added weight of the refuse, plus the weight of water which overtopped the pervious film of the dam, proved to be too heavy for the heavily saturated sludge underneath the refuse. The sludge gave at the toe of the dam and failure began. What appeared to be a formidable structure collapsed due to a weak foundation. Even in retrospect, a competent engineer might have gained considerable confidence in the cross-sectional view of the dam. Thus, it is understandable how Buffalo Mining officials might have been misled.

While there is a unanimous consensus of the Commission regarding the mode of dam failure, there remain two versions of the contributing causes of failure. Both versions agree that both the increased weight

and excessive flow of water in the sludge at the toe of dam were necessary causes. The difference lies in the sources of the water.

One version which has been advanced by several experts is that the water seeped through the sludge foundation and eventually developed "Pipes" or channels eroded through the sludge. Both versions agree that seepage of water through the sludge occurred. The question is how much flowed in the sludge and how much flowed through the refuse.

The second version is that the important flow of water was through the refuse. The reasoning for this is as follows: (1) Refuse is ten times more permeable than sludge - meaning that given similar conditions of pressure, distance, and cross-sectional area, refuse will carry 10 times more water. (2) The "Gain" factor of flow in each path relative to a rise in pool level from 1733 ft. to 1753 ft. was perhaps 100 times higher for the refuse path. That is: Flowing through sludge the amount of water would increase linearly with height - at most doubling with the 20 ft. pool rise; flowing through refuse the amount of water would increase much greater than linearly considering that the pool rise above elevation 1733 ft. the normal height above which there would have been an impervious film and the water would have flowed freely once the water was in contact with fresh refuse.

MINORITY OPINION NO. 2 - By Jay Hilary Kelley

Reference Section 7.1.1

Disasters will happen again in West Virginia unless bold,positive steps are taken to change the ground rules by which industry, government and the citizens interrelate. To suggest any legal action based on the old rules is not a proper response to the charge to this Commission and will probably not affect the future conditions toward the prevention of further disasters. Rather the minority view is that somehow the root causes of the Buffalo Creek flood should be eliminated. The root causes are:

a. A long history of low profit margins in the coal industry
b. A need for more technical talent in West Virginia and in the coal fields

The profitability picture can he addressed through such economic measures as an energy-wide system of equitable taxation or other effective means of extracting economic rents.

The technology problem can be addressed by

a. Correcting the past imbalance in Federal R & D funding in West Virginia and the operating coal industry and
b. Laws which will strengthen engineering professionalism

The state of professional engineering is one of the national problems today. Engineering has not had the public respect, or the

recognition by governmental bodies, as has the other professions, such as law and medicine.

It seems patently clear that the public welfare must be protected from faulty structures and design. One measure that can assist this is to strengthen professional registration of engineers. Although the registration of engineers has been a common practice for several years in several states including West Virginia, these laws do not effect the objective desired. It is, of course, very difficult to establish competence in every applicable field of engineering since there are so many specialties and the specialties are ever increasing. Moreover, many engineering designs and structures require several different specialties. For example, to read into law the specific names of all specialties would be a disservice to engineering progress since there would be no coverage of new specialties. Obviously there are not specialists with which to judge competence for new specialties just beginning. How then would one judge competence? Most fields of engineering are very broad within themselves and it is not uncommon to find engineering graduates in the same field of engineering not having had any common courses in that field.

In suggesting new legislation for professional registration, one must also take cognizance of the fact that the engineering profession as a whole appears to be experiencing some marked changes, suggesting that a new set of disciplines may replace the old.

The Buffalo Creek flood provides a case study where the present registration system failed. To begin with the specialty required by any engineer designing and constructing such a dam as that which failed, is not covered in any of the categories mentioned by the West Virginia State Registration Board. Moreover, since the technology of building such dams as this had not been developed, there was no way of judging any competence in the persons constructing such dams. Indeed since the practice of making dams from coal refuse had evolved mainly in the southern West Virginia coal fields, the pragmatically developed expertise for the construction of this type of dam existed nearly nowhere else except in southern West Virginia. Thus, according to the code of the West Virginia State Registration Board, technical personnel of the Buffalo Mining Company would be considered representative of any expertise that did exist, and would be considered competent to construct a dam out of refuse.

Then the problem becomes one of responsibility for the public safety of those who build structures based upon innovative design and technology. If it would be left up to the innovator to insure the safety of all new designs then technological developments may be greatly depressed over what would be considered ideal.

If the government is to protect public welfare and safety, through the use of registration of engineers, then it follows that the law must provide some protection for those in the engineering practice so that they can remain an economic entity. Thus, registration laws should not only insure that engineers practicing engineering are ethical, but

also insure that non-registered engineers are prevented from practice. This has the effect of doing two things: (1) It is a way for the government to have some control over the competence; and (2) it insures the integrity of the engineering professional. Generally speaking, the applicability to registration laws to non-registered engineers has been weak. Good strong legislation on the registration of engineers, therefore, make engineering more attractive for entering students and, also stimulate the learning of scarce, but needed specialties, such as soil mechanics, small dam construction, and coal refuse processing.

This opinion holds that one of the problems in putting teeth into engineering registration is that enforcement occurs only in response to a specific complaint or only when a disaster such as Buffalo Creek flood occurs. In order for a state registration law to be effective, the Commission feels that enforcement must be continuous and that the operations of the registration law be monitored for a much routine engineering activity. To implement this would require a small cadre of enforcement officers, professional engineers themselves whose duty it is to make spot checks on the workings of the registration laws and regulations. This perhaps could be performed in conjunction with the professional societies.

Since the Federal government has dominated the research and development industry in the U. S. with about 80% of the total dollars spent, the Federal agencies are able to arbitrarily determine which regions of the nation will have high technology and low technology.

Technical manpower will be drawn to some states and some industries and it seems that some get more than their share. Others, like West Virginia, received much less than their share. Data from the National Science Foundation*shows that California received $197.50 per capita while West Virginia received $11.32 per capita of Federal R & D funds. The national average is $75.00 per capita. The significance of this maldistribution is not only that technical competence is not being developed in West Virginia but also that young West Virginians who become educated are attracted away to the states that have heavy R & D funding. This leaves West Virginia technically poor. It means also that the average West Virginian is contributing $7.93 per year to Federally supported R & D in other states.

There is hardly a region in the U. S. that has problems more severe and one more in need of a technical uplift, than Logan County, West Virginia. However, those R & D funds earmarked for the coal mining related areas do not seem to reach Logan County or any other counties of West Virginia. For example, the Department of Interior (including the Bureau of Mines, Office of Coal Research, Geological Survey, Bureau of Reclamation, Office, of Water Resources Research and other) allocates only $0.005 per ton of coal mined, to West Virginia for R & D, while then national average is $0.095 per ton of coal mined. In terms of total mineral produced, Interior allocates $.76 for each $1,000 of mineral produced in West Virginia while the national average is over $2.00 for each $1,000 of minerals produced.

*Federal Funds for Research, Development and other Scientific activities. National Science Foundation. NSF 71-35, Vol. XX, Washington, 1971

Clearly, this is a situation that must be changed if we are to infuse technology into the problem areas of West Virginia. We believe the situation will change now that the coal industry problems have been brought to the attention of the nation and to Federal agencies.

MINORITY OPINION NO. 3 - By Jay Hilary Kelley

Reference: Conclusion 6.3.3

The minority view is genuinely hesitant to highlight the incidental violations of the State and Federal mining laws when, in fact, these laws are intended to relate to occupational health and safety, not public safety.

The minority view is that the Commission can, by stressing this violation, further the self-defeating practice of diagnosing technical violations of any party to a disaster after the fact. Herein is a great danger to our system of justice where there is (a) a proliferation of complex technical regulations which admittedly invite widespread non-compliance followed by (b) the indictment of almost any party to a disaster on any one of these violations.

Moreover, we should not add to the proliferation of laws and regulations related to the environmental and social area; for we already live in a sea of non-compliance. To do this would simply add to the problem, not the solution.

9.0 GLOSSARY OF TERMS

1. Decant - An overflow system designed to drain an impoundment without stirring up the sediment.

2. Liquefaction - A condition under which a material behaves as a liquid.

3. Piezometer - An instrument used to measure pressures in fluids.

4. Piping - The formation of natural fluid flow lines or "pipes through the foundation of a dam; this process will eventually weaken the foundation.

5. Shear strength - The forces tending to hold two contacting parts together, preventing slippage along the plane of contact.

6. Spiral classifier - A screw-type conveyor in which larger sizes of solids in a coal slurry are allowed to settle to the bottom of a tank during the processing of fine coal.

7. Static thickener - A unit in the coal preparation plant where the fine coal waste material is settled by the addition of a chemical agent.

10.0 LIST OF REFERENCES

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3. Preliminary Analysis of the Coal Refuse Dam Failure at Saunders, West Virginia February 26, 1972 by U. S. Department of Interior Task Force to Study Coal Waste Hazards (Washington, D. C., March 12, 1972)

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