Engineering Ethics: The Buffalo Creek Dam Failure

An Online Continuing Education Course for Engineers

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Engineering Ethics: The Buffalo Creek Dam Failure

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Logan County, West Virginia, includes a small area known as Buffalo Creek Hollow, which, like the rest of West Virginia, is known for its long, winding hollow, with steep ridges on either side. 1970 was a very prosperous year for coal, which prompted new mining companies to seek a presence by buying out already-existing companies.

One such company, The Pittston Company, acquired the Buffalo Mining Company and completed the construction of the Buffalo Creek Dam, which was not exactly a pillar of engineering marvels. In fact, the dam was built with very little engineering at all, even after The Pittston Company acquired it, so it is not at all surprising that the dam failed on the morning of February 26, 1972, flooding the Buffalo Creek valley and leaving a trail of carnage that stretched for 15 miles.

Disaster Foreshadowed

The coal mining history of this particular hollow can be traced back to the 1940s. Future problems were unforeseen in 1945 when the Lorado Coal Mining Company opened Mine #5 near the top of Buffalo Hollow near Saunders, West Virginia. The dumping of the sludge from Mine #5 took place at the mouth of Middle Fork. The Sludge dump functioned much like a dam and was treated in this respect without much thought.

The Buffalo Mining Company bought out Lorado in 1964 (the same year in which the NSPE adopted the Code of Ethics) and began dumping behind the first "dam" at the Middle Fork stream. The old one proved to be questionable when it failed in 1967. There was no considerable damage, but the threat remained. However, the threat was not taken seriously as the coal company continued to pile waste. To add to the danger, when Pittston Coal took over in 1970, a third dam was constructed behind the first two. The streams behind were completely blocked by this network of sledge dams. (University of Michigan, n.d.)

Heavy Rain—the Harbinger of Disaster

As heavy rain continuously fell on the days preceding February 26, 1972, Buffalo mining officials kept an eye on Buffalo Creek Dam, a local coal refuse dam in Logan County, West Virginia. The company measured water levels every two hours on the night of February 25, 1972, and alerted officials in the nearby communities of the increased risk of flooding. However, when two sheriff's deputies arrived to help with evacuations, the company sent them away. None of the local inhabitants were warned. Yet, despite the lack of information, some residents sensed the danger and moved to higher ground. (Davies et al.., 1972)

At 8:00 a.m. on February 26, heavy equipment operator Denny Gibson noticed that the water had risen and the dam was "real soggy." Just five minutes later, Coal Slurry Retaining Dam #3 at the Buffalo Creek coal mine in Logan County, West Virginia, gave way, sending 132 million gallons of black wastewater and millions of cubic yards of coal slurry down the Buffalo Creek. (Gee, n.d.) The 10- to 20-foot flood wave traveled through the 15-mile Buffalo Creek valley at an average speed of about 7 feet per second (5 miles per hour) and reached the town of Man at the mouth of Buffalo Creek on the Guyandotte River at around 11:00 a.m. (Davies et al.., 1972)

The Carnage

In a matter of just three hours, the dam failure left 125 people, including a number of children, dead, 1,100 injured, and over 4,000 homeless. The flooding also destroyed about 1,000 automobiles and trucks, highway, and railway bridges, sections of railroad tracks and the Macadam Highway, public utility power cables and poles, telephone lines and poles, and other installations. Mine refuse, silt, and debris were scattered for miles along Buffalo Creek. Property damage exceeded $50 million and highway damage alone exceeded $15 million. (Davies et al., 1972) About 60 persons who resided in the Buffalo Creek area remain on the missing list. (U.S. Mine Rescue Association)

Lack of Engineering and Unaddressed Deficiencies

Dam #3 was used as a settling pond for mining operations and was the third impoundment in that valley. Dams #1 and #2 were downstream of Retaining Dam #3, and they subsequently failed as well. It must be noted that all three impoundments had been built with almost no engineering involvement.

Although the parties involved in the Buffalo Creek Dam Failure were not engineers, throughout this course, we will examine actions and decisions that were made in this incident through the lens of the current NSPE Code of Ethics. The fact of the matter is that the dams located at this facility *should* have been designed by engineers. Thus, it is appropriate to consider the Canons of the NSPE Code of Ethics as they relate to ethical lapses in this case.

Regarding the lack of engineering involvement on the project, NSPE Canon II.2.a states: *Engineers shall undertake assignments only when qualified by education or experience in the specific technical fields involved.*

The essence of Canon II.2.a was violated because the non-engineer that designed Dam #3 – the dam that failed – clearly undertook an assignment he was not qualified to complete. It should be noted here that the NSPE Code of Ethics does not apply to non-engineers. There is no language in the code that prohibits unlicensed practice, although there is language that prohibits engineers from aiding or abetting unlicensed practice by another person. The individual state licensing boards have promulgated rules to address unlicensed practice.

The only plan for Dam #3 was a sketch that had been drawn by the onsite vice president, Steve Dasovich. Yet, at the time and still today, the state's Public Services Commission, responsible for dams blocking streams, required detailed plans for any structure over 15 feet high that obstructed a waterway. In the case of dams above Buffalo Creek, no plans were submitted. (Goodman, 2012).

This violated NSPE Canon III.2.b, which states: *Engineers shall not complete, sign, or seal plans and/or specifications that are not in conformity with applicable engineering standards.* By not submitting detailed plans, Dasovich violated the spirit of Canon III.2.b.

"They just ignored the law," said Jack Spadaro, a 23-year-old engineer teaching at West Virginia University's School of Mines when Governor Arch Moore formed a commission to investigate the causes of the Buffalo Creek flood. "But the Public Service Commission and the prosecutor in Logan County decided that since the dam was already built, they couldn't do anything about it." (Goodman, 2012)

Inspections had been performed intermittently by the West Virginia Department of Natural Resources. They regularly found deficiencies that were left unaddressed, and they stated in an April 1971 letter that all inspections covering a period from September 19, 1966 to March 25, 1971 had been unsatisfactory. (Gee, n.d.)

One of the concerns was the lack of ability to handle large amounts of surface runoff, and the Department called for an emergency spillway to be installed. The mine did install a largely inadequate 24-inch pipe that they called the "emergency spillway." It appears that there was little to no engineering involved in the design or installation of this spillway pipe, as well. (Gee, n.d.)

What Caused this Disaster?

The Buffalo Mining Company operated five underground mines, a strip mine, and two auger mines near Buffalo Creek in West Virginia. All of the coal from the mines was processed through a central preparation plant. The plant operated two shifts, five or six days a week. The plant processed about 5,200 tons of run-of-mine (raw) coal a day, which generated 1,000 tons of refuse. The refuse was removed from the raw product and transported to a storage bank. Much of the refuse was then used to make retaining dams for the processing plant's wastewater. (Davies et al., 1972) Between 1964 and 1970, the three aforementioned retaining dams were constructed.

Beginning on February 22, 1972, significant rainfall began to fall in the area. Over the next four days, 3.7 to 3.84 inches of rain were estimated to have fallen. Federal Coal-Mine Inspector Earl Reedy and Mario Varrassi, company safety engineer, drove by the refuse bank and retaining dams on a road parallel to the bank and dams en route to the No. 5 mine on Tuesday and Wednesday, February 22 and 23, 1972. Inspector Reedy observed that the bank and dams were stable and apparently in satisfactory condition. Reedy estimated that

the water impounded upstream was about 15 feet below the top of the upper dam on Wednesday, February 23. (Gee, n.d.)

The water impounded by the upper dam continued to rise on Thursday, February 24, and Vice President Dasovich and Jack Kent, superintendent of the company's stripping operations, traveled to and examined the upper dam. At 4 p.m., Thursday, February 24, Kent observed that the water was about 5 feet below the crest of the compacted portion of the dam. Kent placed a measuring stick 3 feet 9 inches in length at the lowest side of the dam to measure the rise of the water. (Gee, n.d.)

About 4 p.m., Friday, February 25, Ken turned to the dam and found that the water level had risen between one and 1 1 arkings on the measuring stick. s began to fall and continued throug m at two-hour intervals and note 0 a.m., Saturday, February 26, Kent f two inches per hour. Kent asked D made about 6 a.m., February 26. During er had covered the measuring stick and he dam. Many other company emplo ams on Friday and Saturday, Februar

Other persons v d the upper dam to be from 6 to 10 feet b day, February 25 and on the morning of Saturday, Fe The judgments were made from cursory examinations or from walking on the dam. These men did not use Kent's measuring stick or similar means to make their determinations. (U.S. Mine Rescue Association)

Between February 24 and 26, the National Weather Service measured precipitation of 3.84 inches in the general area of Logan County and Buffalo Creek. Other estimations clocked in at 3.7 inches. Either way, that amount of precipitation is about a two-year rainfall, meaning that southwestern West Virginia can expect precipitation to equal or exceed 3.7 inches in a three-day period on the average of once every two years. Streams similar to Buffalo Creek in and around Logan County responded to the three days of