Executive Summary: Lake Delhi Dam

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On July 24, 2010, the Lake Delhi dam in Iowa failed catastrophically. The Lake Dalhi Dam, was located on the Maquoketa River, a tributary to the Mississippi River. Heavy rainfall in the basin the preceding days led to high flows into the reservoir. The peak breach outflow of 69,000 cfs demolished farms and property downstream, but, thanks to early warnings, no lives were lost.

The dam, constructed 1922-1929, was an earthen (sandy clay) embankment dam 59 ft. tall with an impermeable reinforced concrete core. The spillway was originally designed to 25,000 cfs for when the water level was about four feet below the top of the dam. The dam was built to generate power, but in 1968 that process was terminated and the 3790 acre-ft (at normal depth) reservoir became mostly recreational.

A major factor which contributed to the dam failure was damage and poor design of the dam and spillway gates. An earlier maintenance report had identified the gate as in need of repair. One gate malfunctioned often, preventing it from fully opening during flooding. However, it may have been fully open in the 2010 flood event. The same report, in 2009, found "dangerous scouring of the underwater rock armor." There was a hole in the pier of another spillway gate, which penetrated all the way through the pier to behind the gate. Woody vegetation and even poorly-anchored boats would pass through the gates in flood events, damaging and clogging the gates. Repairs were mandated to be completed by the end of 2009, and although they were underway in January 2010, they were still not completed when the dam breached later that year.

Ultimately, the cause of failure, identified by an independent panel of engineers, was a combination of three things: Internal erosion caused by piping, overtopping flows of the embankment, and failure of the inner concrete core wall. This panel of reviewers after the failure found that differential settling of the dam in the area of the cutoff wall, which was built on bedrock, may have created fractures which would then have led to higher seepage, meaning higher erosion. By modeling it was also determined that, had the third gate been fully open, the dam would not likely have overtopped, but as the water surface elevation would have been above the top of the core wall, the dam would likely still have failed due to internal seepage. The panel also found that even had the reservoir been lowered ten feet, the dame still likely would have overtopped as well as exceeded the core wall elevation.

References

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