

Incident Report

Yellowstone Club Storage Pond # 2 Failure

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Background

Storage pond #2 was constructed in 2005 at about 8200 feet in elevation on a ridge between Second and Third Yellow Mule Creeks within the Yellowstone Club (YC) property. The purpose of the pond is to store treated and disinfected domestic wastewater from both the YC and Big Sky County Water and Sewer District (Big Sky) to be used for spray irrigation of the YC golf course during the summer months at agronomic rates. The approximately 50-ft deep, 80 million gallon pond was constructed by excavating and blasting fractured rock material on the ridge, therefore, it is more of a depression than a constructed embankment. Because of the extensive rock material at the site, a decision was made during construction to jack and bore a casement pipe for the outfall line rather than the more conventional approach of excavation (without a casement pipe), compaction and backfilling.

The 30-inch diameter steel casement pipe contains two smaller high-density polyethylene (HDPE) pipes. One pipe is an 8-inch diameter underdrain pipe that conveys ground water collected beneath the pond liner (also made of HDPE) that discharges onto the slope outside of the pond about 50 feet from the outside end of the casement pipe. The other HDPE pipe within the casement pipe is the outfall line for the pond. It begins approximately 6 feet above the pond bottom, passes vertically through the pond liner through a water-tight boot, through a 90-degree bend, continues about 12 feet horizontally to the steel casement pipe, passes through the casement pipe and about 50 feet past the end of the casement pipe to a valve, then continues down the mountain to a control building for the golf course spray irrigation system. The inlet to this outfall line (within the pond interior) contains a stainless steel screen structure about 4-feet square that sits on top of the pipe via a slip coupling, allowing it to easily pull off the pipe. Additionally, a 'cutoff wall', constructed of bentonite (clay) and an HDPE water stop was constructed between the 10-inch outfall line and the 30-inch casement pipe

On August 10, 2012, DEQ was notified by YC personnel of a surfacing leak near the outfall of the casement pipe and underdrain pipe of approximately 15 gallons per minute (gpm). DEQ advised the YC to drain the pond down within a couple of years and evaluate and fix the problem. In the summer of 2014, the pond was completely emptied and inspected. The liner was inspected by a contractor using an electronic testing procedure which found several small punctures, most of them above the water line. Additionally, a tear was found in the liner boot at

the base of the outlet pipe. The punctures and tears were repaired by the original liner installation company.

During the summer of 2015, the pond was again drained due to the continuation of the aforementioned leak. The leak was estimated at about 4 gpm after the initial repairs. The liner was again inspected and a tear was found at the same location as that found the previous year –the boot at the base of the outfall pipe. The boot was significantly reinforced by a local pond contractor and he reported the previous fix may not have been done properly. At this time, the YC operator attached clamps to the inlet screen in an effort to eliminate the occasional process of retrieving and reinstalling the screen onto the top of the outlet pipe.

Immediate Sequence of Events Leading to Pond Failure

On approximately December 30, 2015, Big Sky began pumping treated and disinfected effluent from its wastewater treatment facility to storage pond 2. The water level in the pond at that time is unknown, but was probably below the inlet screen of the outfall line. About 14 to 18 inches of ice covered whatever water was present. The water level began to rise with the continual discharge from the YC and Big Sky.

As the pond level rose, the surface ice lifted the inlet screen, now firmly attached to the outfall line, vertically. The flexible HDPE pipe continued to be pulled vertically and as such began to pull on the liner around it, continuing to stress the liner and the pipe as the pond level rose. It is believed that the liner then torn significantly in the area of the outfall line penetration. Eventually, the saturation and head pressure caused the cutoff wall plug made of bentonite that was holding the aggregates from falling down the casing to weaken. When the plug could no longer hold all of the aggregate, it was forced into the 30" casing and the water scouring washed away material in its path creating a void. Once this occurred, the liner above this void tore, resulting in effluent having a direct path to flow down the 30" casing pipe. The tear at this location allowed the pond contents, with approximately 20 to 25 feet of hydraulic head, to be forced through the casement pipe where it scoured out the several feet of soil covering the outlet end of the casement pipe.

At this point, there was a 30-inch conduit to open air that allowed a significant and sustained discharge to occur. The water then ran down the steep slope, scouring out a portion of the hillside, carrying the sediment with it, and discharged into Second Yellow Mule Creek. From there, it continued to the South Fork of the West Fork of the West Gallatin River, then the West Fork and eventually reaching the West Gallatin River itself.