Yerkes

Yerkes Associates, Inc. Consulting Engineers / Site Planners / Land Surveyors

September 15, 2009

East Goshen Township
1580 Paoli Pike
West Chester, PA 19380-6199

Attn: Rick Smith, Township Manager

Re: Hershey's Mill Dam / Draining & Storage Volume

Dear Rick,

On August 20, 2009, Township Public Works Department personnel, under authorization received by application to DEP for a temporary Drawdown Permit, opened the drain valve to the Hershey's Mill Dam reservoir to drain the reservoir so that the depth of accumulated silt could be evaluated. It was estimated that the drawdown would take 9 to 10 hours to drain the reservoir to the point of permitted minimum pond depth to support the remaining fish life. The drawdown took only 45 minutes when the valve had to be closed down sufficiently to maintain minimum pond level and required stream flow.

The enclosed photo exhibits illustrate the pond in its normal flow condition (upper photo) and after drawdown (lower photo). The degree of silt deposit that was found that had accumulated was vastly greater than anyone had expected. The previous flow and reservoir storage studies that had been done were based on an average reservoir water depth of four feet. The actual depth determined after draining was estimated at two feet or less.

Average Pond Depth & 100-Year Volume

Assuming an average depth of two feet, the total volume of water retained in the reservoir during normal spillway flow conditions is a maximum of 192,500 cubic feet. The calculated wetted surface area of the pond is 96,248 SF (2.21 acres) and the elevation of the water surface is 447.0' based on our site survey. In a 100-year storm event, assuming runoff reached the top of the existing berm, the depth of water above daily pond elevation would be 3-feet. That would amount to 288,744 cubic feet of storage above normal pond level and 481,240 cubic feet total water storage behind the dam.

Volume & Average Depth Based on Actual Discharge

A more accurate reservoir volume can be calculated from the known time it took to drain the impounded water. The outlet pipe is an 18" diameter steel pipe approximately 70-feet in length with its downstream outlet end submerged almost 100%. No original drawings exist for this dam, but it is assumed that the drain valve is an 18" valve to match the diameter of the discharge pipe, which is typical of other local dams whose design drawings still exist.

Using a pipe flow chart for an aged full-flowing steel culvert (n=.012) under an average of 10-feet of head, the discharge of the pipe with the valve fully opened is approximately 28 CFS. In the actual 45 minute period it took to drain the reservoir, therefore, the volume discharged would be 75,600 cubic feet assuming constant head. The head actually dropped an estimated 2-feet during the drawdown period, but the assumption of constant head yields the larger volume result which is the safest to work with. Using that volume and knowing the water surface area is 96,248 SF, the average pond depth is the volume discharged divided by the area of the reservoir which yields only 0.79 feet (9 ½"). This average depth may be realistic based on the visual observations made when the pond was drained.

Silt Accumulation

From the accumulated silt observations made after the reservoir was drained, the back slope of the dam was seen to have a slope of 1 vertical to 10 horizontal or flatter. It could be determined from the amount of accumulated silt in the reservoir that the potential for a catastrophic failure of the dam is remote, but there is no precise method of determining the odds that that will occur. By Public Works Department personnel walking out onto the silt nearest the drained waterline, it was seen to be fairly compact approximately four to six inches below the exposed surface of the reservoir bottom.

Potential Dam Failure

If the dam is left in its current condition with no upgrades, the most likely scenario for failure during a storm will be overtopping at the lowest elevation of the earthen embankment during flood flow buildup behind the dam and channel erosion of an initially narrow area of the dam berm. As the erosion caused by the velocity of the flow through the breach increases, the breach will widen along the face of the dam and the accumulated silt behind the breach will begin to erode in a radial pattern of increasing diameter.

The earthen dam material carried downstream will most likely follow the streambed if the breach is near the existing spillway. If it is well east of the spillway, the material will wash out onto the lawn area downstream from the dam and the heavier pieces crossing the flat

lawn area will most likely stop short of Greenhill Road as the depth of the moving water spreads out. There is a substantial possibility that the debris carried in the stream channel will block the culverts under Greenhill Road, especially if one of the large trees on the dam topples and is carried downstream.

Recommended Upgrade

On August 20th, the reservoir was intentionally drained through an 18-inch diameter pipe in 45-minutes or less. During a large storm event, the time duration of the flow will be substantially longer due to the excess volume of runoff behind the dam that would have to be released. To prevent any potential for breaching and dam failure through erosion of the breach, it is recommended that the dam be fortified with sheet piling driven into the dam substrata on the upstream side of the dam in close proximity to the upstream waterline on the north side of the embankment. The sheet piling should be designed to the appropriate elevation necessary to contain the 100-year storm within the reservoir, while allowing the usual flow through the existing spillway. The piling can be faced on the upstream side so that it is aesthetically acceptable and the area between the piling and existing dam can be backfilled with earth to provide additional mass to the dam.

Preliminary Cost

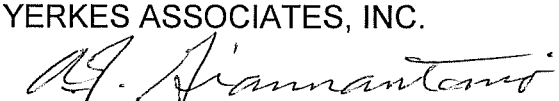
The proposed piling upgrade will contain approximately 400 LF of piling to reach the elevation of 451.65 on each end of the dam for the 100-year storm event which was the maximum high water calculated by DEP. Test borings should be done to determine if the piling can be driven satisfactorily into the substrata behind the dam. It is estimated that 15-foot piling lengths will have to be used which will project approximately 5-feet above existing water level. If they can't be driven, they can be installed by trenching and placement in concrete with earth backfill. A stone access and working surface will have to be installed and removed.

Without any test data nor a design in hand, a best-guess, preliminary cost estimate for the installation is on the order of $115,000.00 to 145,000.00. Design & permitting could cost an additional $20,000.00 to $40,000.00.

Please do not hesitate to call us if you have any questions.

Sincerely,

YERKES ASSOCIATES, INC.



Albert J. Giannantonio, P.E.
President