Estabrook Dam
Structural and Environmental Evaluation

Prepared for Milwaukee County Board
Prepared by AECOM – September 21, 2010

Milwaukee County has retained AECOM, a global engineering firm with offices in Milwaukee, to investigate the overall condition and structural integrity of Estabrook Dam in Estabrook Park on the Milwaukee River. The study, which is underway, includes evaluation of dam rehabilitation and estimating the related construction costs. In addition, the environmental aspects of the dam have been studied. The dam is currently drawn down as directed by a Wisconsin DNR Directive until the structural evaluation and repairs of the dam are completed. Sediment has accumulated behind the dam and environmental sampling has been performed to evaluate sediment handling and disposal alternatives and associated costs.

Estabrook Dam has been in service for about 70 years. Structural evaluation of the dam and environmental monitoring of the sediment is underway. A project update to the County Board is scheduled for September 21, 2010. The study will address restoration alternatives for the dam, based on the structural integrity, stability and associated costs. It will also evaluate the extent of contaminated sediments upstream of the dam and associated costs for proper removal and landfilling of the sediments.

In 2006, STS Consultants Ltd., now doing business as AECOM, prepared a structural condition assessment report for Estabrook Dam. The current 2010 study is updating the structural information from the 2006 report, based on more recent structural testing of the dam, plus an accompanying environmental evaluation.

Structural Assessment

Preliminary results from the structural assessment are summarized as follows:

- The concrete and masonry components have weathered over 70 years. All the deterioration is repairable. One concrete ice breaker and a portion of a second ice breaker will require replacement. All the rest will require repairs.
- The gated spillway structure is currently stable under normal pool loading. However, it requires upstream tie down anchoring to resist full pool conditions with ice loading to meet a suitable factor of safety
- The fixed overflow spillway with stoplogs is stable during full pool with and without ice loading.
- There is no bedrock scour or undercutting of the dam, based on the 2006 dive inspection.
- Riprap along the shore is proposed in limited areas and stretches for erosion protection. Clearing the vegetation along the shore and island is proposed to reduce the potential of large trees from uprooting and accelerating erosion.
- The County is required to submit the Stability Analysis and Condition Report on the dam by October 1, 2010.

Sediment Investigation

Preliminary results from the sediment investigation are summarized as follows:

- A sediment survey was performed in July 2010 prior to the July floods. There were 15 sediment sample locations upstream of the spillway. In addition, past sampling data from USEPA and Milwaukee County were also reviewed.
- Samples were analyzed for PCBs as well as waste characterization and dredging profiles. Multiple depth intervals were sampled.
- The goal is to develop a three-dimensional distribution of PCB concentrations in the sediment immediately upstream of the spillway.

- The sediment thickness averaged about 30 inches. The sediment did contain PCBs in varying amounts. The higher PCB concentrations tended to be in the upper half of the sediment column.
- The sediment volume is estimated at about 3,200 cubic yards. Approximately 1,800 cubic yards could be disposed of at a local landfill. About 1,400 cubic yards of sediment would require disposal at an out-of-state landfill because of the high PCB levels and is classified as hazardous waste.
- Debris including trees, branches, and solid waste tends to collect behind the spillway. Debris removal is an ongoing maintenance issue. The July 2010 flood caused most of the debris to flow over the spillway.
- DNR requires removal of the debris so it does not interfere with the dam operation and to the extent necessary to implement structural repairs. If sediment is disturbed while removing the debris, it must be properly managed. Debris removal could entail removal of the sediment which can be very costly when elevated PCB levels are found and out-of-state disposal is required.
- It is in the County's best interests to remove the debris frequently to avoid a large buildup and to likewise avoid disturbance of the sediment.

Sediment Removal Cost Estimate

Sediment removal can be very costly when the sediment has high PCB levels. The following three scenarios are provided:

- If sediment is removed and disposed for the area where debris is currently located, the estimated sediment volume is 630 cy and the approximate cost is $1,000,000.
- The estimated cost to remove and properly dispose of all estimated sediment at off-site locations is $2,000,000, based on 3,200 cubic yards of sediment. Portions would be sent to either a local landfill or out-of-state landfill, depending on measured PCB levels. The sediment volume is based on a recent preliminary survey and includes the volume behind the spillway.

  Note: These sediment/debris removal options do not include potential costs for access rights, purchase/lease.

Dam Restoration Costs

Preliminary dam rehabilitation recommendations have been prepared, based on the recent condition survey and testing of the three main dam structures. These three structures are 1) the gated spillway, 2) the fixed overflow spillway with stoplogs and 3) the 24 ice breakers upstream of the gated spillway. The majority of the restoration effort will be on the gated spillway piers below the low level water line. The overflow spillway section will require some spot concrete restoration on the crest, above the sedimentation level upstream. One ice breaker failed during a recent winter and a second ice breaker is missing one of its three legs. These ice breakers will be replaced and the remaining ice breakers will be rehabilitated, mainly at the low water line and the tops of each. Besides repairing the structures, we also recommend adding a geotextile fabric on the shoreline at the gated spillway section and covering these eroded areas with large riprap for erosion control.

Based upon the recommended repairs, a preliminary budget of $1.5 million was developed for structural and shoreline repairs.

The design of the improvements is anticipated to begin in early 2011 with construction scheduled for 2011, pending sufficient funding.

Summary

- Rehabilitation of the dam is possible to extend its life for another 20 years or so. Annual dam operation and maintenance is required. Annual O&M cost is about $80,000. Over 20 years, this cost is $1,308,000 based on net present value basis of 2%. Note: The $80,000 for annual O&M is based on all the sediment removed. If partial sediment removal is performed, this will increase the annual O&M cost.

- A preliminary budget of $1,500,000 was developed for structural repair costs of the gated spillway, the overflow spillway and the ice breaker structures.
- If O&M is stopped, the dam life can be adversely affected.
- The recent flood washed out much of the debris behind the spillway. Some debris still needs to be removed.
- Sediment removal can be costly due to disposal out of state for sediment with high PCB levels.
- DNR requires the County to remove sediment if necessary to repair the dam or if it is disturbed during debris removal.
- Access from the south bank needs to be negotiated with the property owners and long-term access rights need to be secured to remove sediment.
- Structural improvements are bondable, sediment/debris cleanup is not bondable.
- Two sediment removal options can be considered:
  (1) Remove/dispose current debris and associated sediment 630 cy, approximately $1,000,000
  (2) Remove/dispose sediment behind spillway, 3,200 cy, approximately $2,000,000

Note: a. Option 2 considers sediment in current contact with debris or likely deposition area for future debris.
b. Potential additional costs for all sediment removal options could include access purchase/lease/rights procurement.

If you have any questions regarding the study, please contact Karl Stave, Milwaukee County Department of Transportation and Public Works at 414.278.4863, or Kevin Haley, Milwaukee County Parks Department at 414.257.6242.

marketing/presentation/MilwCtyEstabrookDam0910/Estabrook Dam Eval_Board.docx