

City of Winterset Municipal Utilities

Flood Mitigation Program Project Executive Summary

Problem

The public drinking water supply for the City of Winterset is provided via surface water impoundment - the Cedar Lake Reservoir (constructed in 1939). This water source provides drinking water to over five thousand (5,000) residents and businesses in the City. Inspections of Cedar Lake Dam performed by the Iowa Department of Natural Resources (IDNR) have identified deficiencies in the primary outfall structure requiring immediate attention. The primary outfall structure for Cedar Lake is a concrete chute spillway, trapezoidal in shape, approximately seven hundred and fifty (750) feet long, with a sixty (60) foot bottom width and 2H:1V concrete sidewalls. The control device used to regulate flow through the spillway is an "L" shaped overflow crest (weir) approximately two hundred and eighty (280) feet in length. The primary impairment in the spillway is severe concrete deterioration and failure causing significant subgrade erosion and instability. Entire slab sections in the spillway floor have broken away revealing seepage in a few locations. Due to the severity of the spillway deficiencies the IDNR is recommending monthly inspections until improvements are complete. The IDNR is also recommending inspections after each rainfall event that produces a discharge from Cedar Lake. Because of the amount of hard concrete armoring missing, a substantial flood event through the concrete spillway would cause significant erosion and head cutting in the spillway. Sustained discharges and significant head cutting adjacent to the dam or overflow crest will lead to failure of the dam if the spillway is not reconstructed.

A topographic survey, geotechnical investigation, stability analysis, and engineering assessment were completed to assist with reconstruction of the spillway. The assessment included verification that the earthen dam meets current stability criteria and minimum factor of safety requirements. The stability analysis utilized soil parameters identified from borings acquired from the center of dam and water levels measured with piezometers installed in the dam. Input of this field data into the stability analysis yielded a factor of safety for the downstream slope (steady state seepage without seismic forces) of 1.09 and 0.96 with seismic forces. Current minimum factor of safety requirements for an earthen dam, recognized by IDNR as described in the publication "Earth Dams and Reservoirs TR-60 (USDA), is 1.5 (steady state seepage without seismic forces) and 1.1 (steady state seepage with seismic forces). Although the Cedar Lake Dam likely never met the current criteria, sudden changes in reservoir levels, effective stresses, overburden, or lateral pressure could lead to lateral movement of the dam and/or failure.

Loss of Winterset's water supply would be detrimental to the City's economy. Businesses, hospitals, schools, and residents would be forced to make difficult decisions. Property values would decrease, some businesses would relocate and recovery would be difficult. In the event of a sudden failure and loss of water, emergency government aid and relief may be required until action plans could be implemented. Reconstruction of the dam post-failure would take significantly more time and money than rehabilitation of the existing dam and spillway. It is anticipated the project cost (not including emergency aid) would be double the project cost for rehabilitation.

Solution

The primary objective of the City of Winterset and the Municipal Utilities is to establish a sustainable, quality water supply to meet tomorrow's needs at the lowest cost to their citizens. In an effort to achieve this goal many different options were analyzed for alternative sources of water. Alternatives included new reservoir locations, new dams constructed downstream, wells, and purchasing water from a larger municipality. Water supply studies began in 1990 and were revisited periodically over the last twenty

(20) years. Each option explored was either determined unfeasible or resulted in increased costs to the citizens of Winterset when compared to rehabilitation of the existing dam and spillway. The existing public water supply when evaluated against alternatives needed to include additional improvements in order to meet the primary objective of a sustainable, quality drinking water supply. A reverse osmosis system was required at the treatment plant to meet current regulatory requirements regarding nitrate removal. This upgrade was completed in 2008 for approximately one and a half million dollars (\$1,500,000.00). With these improvements the water treatment plant can provide over two million (2,000,000) gallons of finished drinking water per day. Current population demand requires treatment of approximately six hundred thousand (600,000) gallons per day. Therefore the water treatment plant can provide quality drinking water for more than three hundred percent (300%) population growth. In order to be a sustainable supply source water volume in the reservoir needed evaluated. The permanent storage volume in the lake had been reduced by half since 1939 when comparing the original bottom to the current sediment bottom. This significant sedimentation is associated with a twelve thousand six hundred (12,600) acre drainage basin (150:1 watershed ratio) composed primarily of agricultural land use. Hydraulic dredging will begin in December, 2013 to excavate the lake back to the original 1939 bottom and will cost approximately five and a half million dollars (\$5,500,000.00). The new volume will sustain a population growth of two hundred and fifty percent (250%). Initiatives like the Cedar Lake Watershed Project (initiated in 2004) will help preserve the dredging efforts. The Watershed Project was created for public watershed awareness and to collaborate with landowners on implementation of land conservation practices to reduce nitrates and soil loss in the Cedar Lake watershed. Since the early 1970's soil loss per acre of land (tons/acre/year) in the watershed has been reduced by more than four. This reduction was from watershed study results completed by the Madison County Soil and Water Conservation District in 1973, 1993, and 2002. Since the 2002 study an additional one thousand six hundred ten (1,610) acres have seen soil loss reductions from six (6) tons/acre/year to two and a half (2.5) tons/acre/year.

The last significant improvement required to ensure a sustainable water supply in the future is rehabilitation of the dam and spillway. This project will bring the dam into compliance with current standards, remove Cedar Lake from the state dam deficiency list, and protect the dam from the effects of floodwaters through the spillway. A Topographic Survey, Geotechnical Engineering Report, Phase I Cultural Resource Survey, Wetland Determination, Structural Stability Analysis, Engineering Assessment and Construction Documents have been prepared for an anticipated bidding date early in 2014 (aforementioned documents included in **Appendix B**). The project will include subgrade preparation under the spillway, complete replacement of the concrete spillway, reconstruction of the plunge pool and the construction of a toe berm on the downstream face of dam. These improvements will be in accordance with current standards and should provide sufficient infrastructure to sustain another seventy-five (75) years of providing quality water to the citizens of Winterset and protecting the public drinking water supply from the effects of floodwaters. The repair to the dam and spillway are scheduled to start July, 2014 and be completed by November, 2014. Time is of the essence and the project cannot be postponed due to the aforementioned risk.

Maintenance Plan

Maintenance of Cedar Lake will include continued collaboration in the watershed to implement agricultural practices utilizing current conservation techniques. The dam will be inspected every five (5) years by IDNR in accordance with 567-73.21 (1) "d", Iowa Administrative Code as part of the Department's regular dam safety inspection program. The general intent of this inspection will be to evaluate the construction, operation and maintenance of the dam, to identify problems or potential problems with the dam and appurtenances, and to identify flood plain structure or uses which may affect the hazard class of the dam or use of the associated impoundment. The Winterset Municipal Utility staff will perform annual clearing of unwanted vegetation from the embankment and will visually inspect discharges from subdrains and review spillway concrete performance. Concrete maintenance is not

expected for the next twenty (20) years. After twenty (20) years construction joints are expected to be routed and resealed to prevent water penetration at joint locations. Maintenance cost will be included in the Municipal Utility General Maintenance and Operation Budget and is expected to be less than five thousand dollars (\$5,000) annually.

Past Mitigation Measures Completed

Previous mitigation efforts were completed in 1978 which included spillway repairs and modifications to the overflow crest (weir). The spillway improvements included removal and replacement of deteriorated concrete on the southwest slope of the spillway and installation of weep holes to relieve the buildup of hydrostatic pressure above the shale. It appears isolated locations received a thin structural concrete overlay. The weir section was raised in elevation and supported by steel sheet pile driven into hard clay shale. The interconnected sheet pile driven into hard clay shale was also intended to provide an effective seepage cutoff.

Budget Summary / Request for Funding

The total cost associated with obtaining the primary goal of a sustainable, quality water supply sufficient to meet tomorrow's needs include approximately one and a half million dollars (\$1,500,000.00) for reverse osmosis in 2008, dredging Cedar Lake for approximately five and a half million dollars (\$5,500,000.00) to be completed in 2014, and rehabilitation of Cedar Lake Dam and Spillway for approximately three million eight hundred thousand dollars (\$3,800,000.00) to be completed in 2014. The total cost for improvements completed in 2013 and 2014 is approximately nine million three hundred thousand dollars (\$9,300,000.00). The anticipated start date for the rehabilitation of Cedar Lake Dam and Spillway is July, 2014. Improvements for Cedar Lake are bonded and paid by water users. A partner to assist the citizens of Winterset with the cost burden associated with the Cedar Lake dam improvements and safely conveying floodwaters through the spillway would be greatly appreciated and would provide benefit to over five thousand (5,000) residents and businesses. **The City of Winterset would request the Flood Mitigation Board consider providing a grant for one million nine hundred thousand dollars (\$1,900,000.00, 50/50 match) for reconstruction of the Cedar Lake dam and spillway that is necessary for the protection of property (The Primary Water Supply, Cedar Lake) from the effects of floodwaters.** Secondary benefits of Cedar Lake include economic benefits, recreational opportunities, educational resources, and wildlife refuges.