UPPER MISSISSIPPI RIVER RESTORATION
FEASIBILITY REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

KEITHSBURG DIVISION
HABITAT REHABILITATION AND ENHANCEMENT PROJECT

POOL 18, UPPER MISSISSIPPI RIVER
RIVER MILES 428.0 THROUGH 431.0
MERCER COUNTY, ILLINOIS

APPENDIX M

STRUCTURAL ENGINEERING

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STRUCTURAL ENGINEERING

I. GENERAL

This appendix presents the design of the structures in the *Keithsburg Division Habitat Rehabilitation and Enhancement Project* (Project) to illustrate typical calculations that will be undertaken to complete the structural design for final Plans and Specifications. Computations are shown for the pump station and water inlet/outlet structures.

II. CRITERIA

The reinforced concrete hydraulic structures in the Project will be designed following the current ACI *Building Code Requirements for Structural Concrete* (ACI 318-14) dated 2014 and Engineering Manual (EM) 1110-2-2104, *Strength Design for Reinforced Concrete Hydraulic Structures* dated 30 June 1992. The structural steel components in the Project will be designed following the current AISC *Steel Construction Manual 14th Edition* dated 2011. Additional analysis will require EM 1110-2-2100 *Stability Analysis of Concrete Structures* dated 01 December, 2005, EM 1110-2-2502 *Retaining and Flood Walls* dated 29 September 1989, EM 1110-2-2902 *Conduits Culverts and Pipes* dated 31 March 1998, EM 1110-2-2906 *Design of Pile Foundations* 15 January 1991, and EM 1110-2-3104 *Structural and Architectural Design of Pumping Stations* dated 30 June 1989.

III. MATERIAL SELECTION

Concrete structures will be designed for 28-day compressive strength of 4,500 psi. Concrete reinforcement will be deformed billet-steel bars conforming to ACI 615, grade 60 requirements. Structural steel will meet ASTM-A36 requirements. Grating will be designed to McNichols Co. grating capacity and load tables.

IV. DOWNSTREAM GATED STRUCTURE AND PUMP STATION

This structure will be located near station 177+00. The pump station is a bi-directional system designed to pump both to and from the Mississippi River when free flow water elevations are not desirable; it will have a gate on either side of the pump. A single 5-foot by 5-foot gated free-flow culvert opening will be provided adjacent to the pump station as an integral concrete structure. The two openings—the pump station and one gated free flow culvert—will be located on the protected side and channel into a single 10-foot by 6-foot box culvert to span the width of the berm. The pump station gates will be utilized as system redundancy in a surge event. The gates will be cast iron. The pump station will be designed such that the maximum elevation at which the pumps can operate is the 500-yr flood elevation (546.19 feet NAVD88). The invert elevation will be designed at a depth that will allow the pumps to remain submersed and will be at Elevation 521.0 NAVD88.

Channels leading to the downstream gate and pump station will be excavated to Elevation 523.5 NAVD88. This difference in elevations from interior bottom to invert introduces a siltation concern for both the free flow culvert and the pumps. Silt mitigation is not yet included in the design. Trash racks will be provided on both the river side and protected side to protect the structure from debris. The structure was designed to allow for a minimum interior managed water level of Elevation 529.0 NAVD88 and the maximum interior managed water level of Elevation 532.5 NAVD88. The minimum water level management cycle was set at 529, however, this design will allow for lower drawdowns if deemed necessary by the sponsor. The river side of the culvert will have a stoplog structure for water management and dewatering capabilities. The sluice gates will be operated by mechanically driven motors, and the stoplog structures will be manually installed. The pump station and outlet structure will be designed for heavy machinery, such as a backhoe, in order to clean the trash racks and operate the stoplogs. The design of the pump station is similar to the design used for the Ventura Marsh Aquatic Ecosystem Restoration Project in Clear Lake, Iowa (Contract No. W912EK-10-B-0008)

V. UPSTREAM GATED STRUCTURE

This structure will be located near station 68+00. Two culvert openings will be provided on the upstream side as an integral concrete structure. The two openings will channel into one 10-foot by 6-foot box culvert to span the width of the berm. The sluice gates will be operated by mechanically driven motors, and the stoplog structures will be manually installed. Two culvert openings are provided for system redundancy and to reduce the size of stoplog and trash rack structures. Channels leading to the upstream gate and pump station will be excavated to Elevation 521.0 NAVD88. This difference in elevations from interior bottom to invert introduces a siltation concern for the gated free flow culverts. Silt mitigation is not yet included in the design. Trash racks will be provided on both the river side and protected side to protect the structure from debris. Stoplog closures will be provided on the river side. The structure was designed to allow for a minimum interior managed water level of Elevation 529.0 NAVD88 and the maximum interior managed water level of Elevation 532.5 NAVD88. The river side of the culvert will have a stoplog structure for water management and dewatering capabilities. The gated culvert structure will be designed for heavy machinery, such as a backhoe, in order to clean the trash racks and operate the stoplogs.