

APPENDIX P
HYDROLOGY & HYDRAULICS

*Feasibility Report with Integrated Environmental Assessment
Rip Rap Landing HREP*

INTENTIONALLY LEFT BLANK

**APPENDIX P
HYDROLOGY & HYDRAULICS**

1. LOCATION

The project features are located between Mississippi River Miles (RM) 260.5 and 267 along the Illinois side of the Mississippi River in Calhoun County, Illinois as indicated on Figure 2.1. Enhancement features and locations are identified in Plates 5-1 through 5-5.

2. HYDROLOGY & HYDRAULICS

Two major features control the hydrology and hydraulics associated with Rip Rap Landing, the Mississippi River and Sny Creek. Generally speaking the site is subjected to flood events associated with both water bodies.

SNY CREEK WATERSHED - Sny Creek was investigated to determine the engineering requirements for keeping storms within the banks of the Sny Creek. Table P.1 indicates the 50 year and the 2 year storm events associated with the Sny Creek and the required channel to keep the storm event within the creek banks.

Table P-1. Sny Runoff Calculations

	2-year storm	50-year storm	2-year storm	50-year storm
	Ac-ft/day		CFS	
Wildcat Watershed	295	480		
Bellview Watershed	818	1,297		
#2 watershed	77	130		
Infidel Watershed	187	303		
West Panther Watershed	500	794		
Crooked Creek Watershed	166	265		
Fox Creek Watershed	1,156	1,834		
Subtotal	3,199	5,103	1,613	2,573
Sny Ditch, 2-year storm				
Slope: 0.0005 ft/ft Hydraulic Radius: 5.13				
'n' value: 0.04 Area: 704.00 sq ft				
Velocity: 2.47 ft/sec				
Capacity: 1738.62 cfs				
Sideslope: 6:1				
Bottom Width: 40 ft				
Depth of Flow: 8 ft.				
Width @ surface 136 ft				

Sny Ditch, 50-Year storm				
Slope: 0.0005 ft/ft Hydraulic Radius: 6.19				
'n' value: 0.04 Area: 1000.00 sq ft				
Velocity: 2.80 ft/sec				
Capacity: 2799.12 cfs				
Side slope: 6:1				
Bottom Width: 40 ft				
Depth of Flow: 10 ft.				
Width @ surface 160 ft				

Based upon the above data, it was not deemed to be cost effective to try and increase the width and the depth of the Sny Creek to allow for major storm events to be kept within the banks of the channel. Therefore another analysis was undertaken to provide the required creek configuration to allow for overwintering of fish. This basic channel cross section then became the basis for developing cost estimates. Another analysis was undertaken to determine if the velocities within the Sny Creek during storm events would have a negative impact on the ability of over-wintering fish to remain in the creek and not be flushed out into the river

Based upon the cross section of the Sny proposed, it was determined that a 3.11 inch storm event would create velocities that might impact the ability of fish to stay with the Sny Creek. Based on ISWS/CIR-172/89, the data indicates that from 1940 – 2009 only 2 times during the months of November – February is the daily maximum precipitation over 3.11 inches.

Dec 1982 = 5.12 inches; Nov 2003 = 3.52 inches

The above analysis took into account 247 total measurements over this time period. Two out of 247 measurements exceeded the 3.11 inch design rainfall total, or 0.81% of total time fish would have been flushed out of the creek during over-wintering. Based upon this data it was decided that developing habitat for over-wintering of fish within the Sny Creek would produce successful results.

MISSISSIPPI RIVER - It was never deemed practical to try and keep all flood events out of Rip Rap Landing, but the river was analyzed to determine what historical water levels might be encountered during critical management months. Daily gage readings were reviewed from 1973 to 2009 to secure an idea of water levels. No data was available for 1995. 1973 was chosen as it was after the development of Mark Twain Lake in Missouri which would have some local impact on Rip Rap Landing. The information in Table P-2 was utilized to determine the required invert elevation of the proposed pump station to insure that adequate water depth would be available when the area is to be flooded in the fall.

Upper Mississippi River Restoration

Rip Rap Landing HREP

Table P-2. Rip Rap Landing Stage II- Mosier Gage Reading

Year	April		May		June		July		August		September		October		November	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
1973	443.9	451.4	443.7	448.4	437.7	445.7	434.7	438.8	434.7	436.6	434.4	438.7	436.7	441.8	432.9	437.4
1974	436.6	441	438.3	447.7	442.5	447.5	434.3	445.6	434.2	435.6	434.3	435	434.3	434.9	434.5	435.8
1975	438.1	443.9	438.3	445.9	435.7	439.2	434.5	438.8	434	435.7	434.1	435.3	433.9	434.6	434.1	435.6
1976	436.6	446.7	434.5	444.5	434	435.4	434.1	435.5	433.8	434.4	433.9	434.6	434	434.7	433.9	434.6
1977	434	435.6	434	435.9	433.8	434.9	433.9	435.4	433.9	436.6	434.1	436.2	435	438.8	433.8	442.1
1978	436.5	443.3	435.2	443	434.1	439.1	434.4	438.8	434.3	438	434.4	439	434.2	436.4	434.4	435.7
1979	444.4	448.9	440.4	445.2	436.1	440.2	434.6	437.8	434.6	438.9	434.4	439.3	434.3	436.2	435.4	436.3
1980	434.9	438.8	434.1	435.3	434.5	440.6	433.9	435.3	434	439.4	435.7	439.6	434.3	438.9	434.2	435.5
1981	434.4	441.8	434.6	442.6	434.4	441.1	434.8	443.1	434.1	438.2	433.9	437.5	434.6	436.7	435	439.6
1982	441.1	446.5	439.7	443.9	435.7	443.0	435.6	443.6	434.1	437.1	434.3	436.2	434.3	437.1	436.3	439.6
1983	443.7	449.3	440.2	445.7	435.9	441.3	435.0	440.6	434.3	435.5	434.4	436.8	434.6	436.9	435.4	440.1
1984	438.8	443.5	441.2	444.4	439.0	444.5	436.1	444.7	436.0	436.0	434.4	435.4	434.7	438.2	435.6	443.2
1985	437.8	441.9	435.8	439.6	435.2	436.7	434.5	435.7	434.3	436.4	434.2	435.7	435.4	440.4	437.0	443.4
1986	441.6	444.5	440.7	447.2	436.7	445.2	437.1	443.4	435.2	437.6	435.2	443.0	443.7	449.1	436.4	444.0
1987	435.4	439.9	434.5	436.7	434.3	436.2	434.1	435.0	434.2	436.7	434.3	436.2	434.0	435.3	434.4	435.4
1988	435.0	436.8	434.0	435.2	434.1	434.6	434.0	434.4	433.9	434.4	433.3	434.3	433.6	434.3	434.0	434.8
1989	435.4	437.8	434.5	435.4	434.1	436.0	434.0	434.5	433.9	434.7	434.0	435.8	434.0	434.6	434.0	434.4
1990	434.2	435.4	435.5	444.3	435.7	446.7	432.7	444.1	435.2	440.2	434.8	440.4	434.5	435.4	434.1	435.7
1991	440.1	444.2	441.2	444.4	439.8	444.0	435.9	439.7	434.6	436.2	434.3	435.6	434.2	436.2	434.8	438.3
1992	437.3	442.8	435.7	434.4	434.4	435.8	434.9	439.0	434.4	437.4	434.4	438.5	434.8	436.3	435.0	442.5
1993	441.5	449.0	442.7	448.4	442.0	448.3	448.7	454.3	447.0	453.4	442.7	447.2	436.7	443.0	436.1	437.7
1994	437.0	442.0	436.4	442.0	436.2	438.6	435.8	437.9	435.0	435.9	434.6	437.0	435.4	436.9	435.2	436.2
1996	436.4	440.7	440.7	448.8	440.0	448.2	435.5	441.8	434.3	436.0	434.2	435.1	434.3	435.6	434.9	437.1
1997	439.0	446.7	437.3	445.3	434.5	437.4	435.7	437.7	435.1	436.8	434.5	435.7	434.2	435.6	434.1	435.6
1998	440.9	448.4	435.5	443.4	436.0	442.6	436.3	445.7	434.1	436.9	434.5	436.0	434.6	441.1	436.1	438.1
1999	435.7	445.4	439.5	445.7	438.7	444.7	436.9	440.9	435.0	441.3	434.8	435.9	434.5	435.1	434.3	434.9
2000	437.1	434.6	434.8	437.0	435.5	444.4	435.1	442.5	434.5	435.7	434.5	435.2	434.3	435.1	434.4	435.7
2001	438.1	448.3	443.4	450.7	441.9	446.5	435.7	442.1	434.0	436.1	434.5	435.7	434.5	436.6	434.8	435.8
2002	435.1	444.3	438.1	447.3	436.8	445.2	435.2	438.3	434.5	438.1	434.6	436.5	435.0	437.4	434.8	436.1
2003	435.0	438.5	438.6	442.9	434.4	440.9	434.4	439.9	434.1	435.0	434.3	435.4	434.1	435.1	434.2	435.3
2004	435.9	439.2	435.4	444.0	443.8	446.1	434.8	443.6	434.6	439.5	434.6	436.4	434.9	435.9	435.3	437.9
2005	436.1	442.0	436.0	438.9	436.2	437.7	434.6	437.4	434.3	435.2	434.3	435.1	434.7	436.7	434.8	435.4
2006	436.0	441.1	436.9	439.0	434.8	437.4	434.6	435.4	434.3	435.0	434.4	435.0	434.3	434.9	434.4	435.2
2007	439.1	444.1	436.1	442.7	434.5	439.5	434.6	436.6	434.5	443.9	435.4	443.2	435.5	440.3	435.3	439.2
2008	439.1	446.8	441.4	448.2	441.5	452.3	440.8	450.4	434.7	443.7	434.8	445.5	434.4	435.5	434.5	435.7
Min	434.0		434.0		433.8		432.7		433.8		433.3		433.6		432.9	
Max		451.4		450.7		452.3		454.3		453.4		447.2		449.1		444.0

The following table is a structure inventory of all the current drainage structures on the site. It is provided for informational purposes.

Table P-3. Current Drainage Structures

Structure Location	Name	Invert Elev.	Outlet Elev.	Length	Size	Purpose/Notes
WATER CONTROL STRUCTURES						
Sny Sand Levee	Waverly Lake Supply Pipe	436.1	436	40	36	Water from the existing pump station flows under the Sny Dike to Waverly Lake through this structure. Sluice gate. Headwater elev = 440, tailwater = 439. Capacity = 37.2 cfs
NRCS Structure 1	Drainage pipe	441.8	441.8	86	24	6' tall in-line water control structure
NRCS Structure 2	Drainage pipe	444.2	440	60	24	4' tall in-line water control structure
NRCS Structure 3	Drainage pipe	445.2	445	75	24	5' tall in-line water control structure
NRCS Structure 4	Drainage pipe	446.1	445.6	50	24	5' tall in-line water control structure
NRCS Structure 5	Drainage pipe	442.9	442.4	60	24	4' tall in-line water control structure
NRCS Structure 6	Drainage pipe	442.9	442.4	55	24	4' tall in-line water control structure
NRCS Structure 7	Drainage pipe	444	443.5	45	24	3' tall in-line water control structure
NRCS Structure 8	Drainage pipe	444.6	444	35	24	2' tall in-line water control structure
PUMP STATIONS						
Miss. River Pump Station						Installed 1993.
WATER IMPOUNDMENTS						
Waverly Lake						Surface elevation = 440.2
EXISTING DITCHES & DIKES						
Pump Ditch		441.65 at Pump	440.16 at Slough	1,400'		Slope = 0.001, Design Q = 23.5 cfs, depth = 2.5', bottom width = 4', starts 2' off the edge of the road, width at flow = 9' 1:1 side slopes
Ditch to Waverly Lake				1,800'		Slope = 0.0001, bottom width = 4' 1:1 side slopes, depth = 4.5 feet.
NRCS Structure 1		447.7 top	10' width	1000'		Proposed water level = 446.7, 6:1 side slopes
NRCS Structure 2		447.7 top	10' width	115'		Proposed water level = 446.8, 6:1 side slopes
NRCS Structure 3		450.3 top	10' width	120'		Proposed water level = 449.3, 6:1 side slopes
NRCS Structure 4		448.8 top	10' width	125'		Proposed water level = 447.83, 6:1 side slopes
NRCS Structure 5		446.5 top	10' width	37'		Proposed water level = 445.5, 6:1 side slopes
NRCS Structure 6		446.3 top	10' width	60'		Proposed water level = 445.3, 6:1 side slopes
NRCS Structure 7		446.3 top	10' width	140'		Proposed water level = 445.3, 6:1 side slopes
NRCS Structure 8		446.2 top	10' width	82'		Proposed water level = 445.2, 6:1 side slopes