BSDMS Summary Report

75 Mississippi River at I-255 (Jefferson Barracks Bridge) near St. Loui

Site Location:

Site ID: 75

Site Name: Mississippi River at I-255 (Jefferson Barracks Bridge) near St. Louis, MO

County: St. Louis

Nearest City: St. Louis

State: MO

Latitude: 382911

Longitude: 0901630

USGS Station ID:

Route Number: 255

Route Class: Interstate

Service Level: Mainline

Route Direction: NA

Highway Mile Point:

Stream Name: Mississippi River

River Mile:

Contact:

David Mueller
U.S. Geological Survey
9818 Bluegrass Parkway
Louisville, KY 40299

Publication:

Mueller, D.S., Landers, M.N., and Fischer, E.F., 1995, Scour measurements at bridge sites during 1993 Upper Mississippi River Basin flood: Transportation Research Record 1483, p. 47-55.

Foster, J.E., 1988, Jefferson Barracks Brige movable-bed model study: U.S. Army Corpse of Engineers Waterways Experiment

Site Description:

The I-255 (Jefferson Barracks Bridge) over the Mississippi River is located just south of St. Louis, Missouri. The river in this reach varies from 2,000 to 2,500 ft wide. The thalweg crosses from the left (Illinois) bank to the right (Missouri) bank upstream from the bridge and follows the right bank through the bridge and crosses back to the left bank downstream from the bridge. The channel alignment is a very gentle bend with a high bluff along the right upstream bank. The left floodplain is about a mile wide and is predominately farmland. A levee restricts the extent of the left floodplain. The bridge is 4,003 ft long and is supported by 14 piers. Piers are numbered from right to left (Missouri to Illinois). The navigation channel is along the right (Missouri) bank. Piers 12 and 13 support the navigation span of 910 ft. Piers 8 through 10 are set on a large sand bar along the left (Illinois) bank, which is exposed during very low flow. Dikes have been installed by the U.S. Army Corps of Engineers along the left bank both upstream and downstream of the bridge to maintain a sufficient depth in the navigation channel during low flow.

Elevation Reference

Datum: MSL

MSL (ft):

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Description of Reference Elevation:

The water-surface elevations were measured at a staff gage about 1,000 ft downstream from the bridge. The staff gage had a datum of 377.7 ft MSL. All elevations are presented in ft MSL.

Horizontal positioning of the velocity profiles and bathymetry was measured using a range-azimuth positioning system. The horizontal coordinates are in an arbitrary local grid. The bridge was correctly positioned in the grid by surveying 2 or more piers from each instrument setup location. All horizontal coordinates are in ft.

Stream Data

Drainage Area (sq mi):		**Floodplain Width:**	Narrow
Slope in Vicinity(ft/ft):	0.0001	**Natural Levees:**	Unknown
Flow Impact:	Straight	**Apparent Incision:**	None
Channel Evolution	Unknown	**Channel Boundary:**	Alluvial
Armoring:	Unknown	**Banks Tree Cover:**	Medium
Debris Frequency:	Occasional	**Sinuosity:**	Sinuous
Debris Effect:	Local	**Braiding:**	None
Stream Size:	Wide	**Anabranching:**	None
Flow Habit:	Perennial	**Bars:**	Wide
Bed Material:	Sand	**Stream Width Variability:**	Wider
Valley Setting:	Low		

Roughness Data

Manning's n Values

	Left Overbank	Channel	Right Overbank
High:	0.1		
Typical		0.028	0.1
Low:	0.03		

Bed Material

Measurement Number	Yr	Mo	Dy	Sampler	D95 (mm)	D84 (mm)	D50 (mm)	D16 (mm)	SP	Shape	Cohesion

1	1993	8		4.6	2.1	0.7	0.28	2.65	Non-Cohesive

Bed Material Comments

Measurement No: 1

No bed material samples were collected at this site. The boring logs show sand to be predominant. Bed material samples size distributions presented in Holmes, R.R., Jr., 1993, Sediment transport in the lower Missouri and the central Mississippi Rivers, June 26 through September 14: U.S. Geological Survey Circular 1120-I were fairly consistent for samples at St. Louis, Missouri and at Chester, Illinois. The bed material sizes reported herein were interpolated from this report.

Bridge Data

Structure No: C-98-075-76

Length(ft): 4003.75

Width(ft): 54

Number of Spans: 15

Vertical Configuration: Sloping

Low Chord Elev (ft): 423.3

Upper Chord Elev (ft): 464.3

Overtopping Elev (ft):

Skew (degrees): 0

Guide Banks: Elliptical

Waterway Classification: Main

Year Built:

Avg Daily Traffic:

Plans on File: Yes

Parallel Bridges Yes

Upstream/Downstream: Upstream

Continuous Abutment: Yes

Distance Between Centerlines: 103.5

Distance Between Pier Faces: 75.5

Bridge Description:

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All of the piers were surveyed during the flood, but scour holes were only identified at piers 8 and 9. Scans of the bridge plans have been included for piers 7 through 12. Pier 12 is part of the navigation span and has a different design than piers 7 through 11. Piers 7 through 11 are all similar in design, but the elevations of the various components of the piers are different. Each pier consists of two square caissons connected by a web wall near elevation 416 ft MSL. The piers are tapered slightly in the direction of flow. The caissons and web wall rest on a wider square-nosed pedestal, that rests on a wider square-nosed footing, that rests on a wider square-nosed seal, that is supported by H-piles.

Abutment Data

Left Station: 0

Right Station: 0

Left Skew (deg): 0

Right Skew (deg) 0

Left Abutment Length (ft):

Right Abutment Length (ft)

Left Abutment to Channel Bank (ft):

Right Abutment to Channel Bank (ft):

Left Abutment Protection:

Right Abutment Protection

Contracted Opening Type: Unknown

Embankment Skew (deg):

Embankment Slope (ft/ft):

Abutment Slope (ft/ft) 0

Wingwalls:

Wingwall Angle (deg):

Pier Data

Pier ID	Bridge Station(ft)	Alignment	Highway Station	PierType	# Of Piles	Pile Spacing(ft)
10	71262.04	0		Single		

11	71512.04	0	Single
12	71759.46	0	Single
7	70521.46	0	Single
8	70766.75	0	Single
9	71012.04	0	Single

Pier ID	Pier Width(ft)	Pier Shape	Shape Factor	Length(ft)	Protection	Foundation
10	9.46	Square		29.5	Unknown	Piles
11	9.62	Square		29.5	Unknown	Piles
12	12.08	Square		59.5	Unknown	Piles
7	8.58	Square		29.5	Unknown	Piles
8	9	Square		29.5	None	Piles
9	9.16	Square		29.5	None	Piles

Pier ID	Top Elevation(ft)	Bottom Elevation(ft)	Foot or Pile Cap Width(ft)	Cap Shape	Pile Tip Elevation(ft)
10	358	348	40	Square	
11	355	344	40	Square	
12	346	328	56	Square	
7	367	361	40	Square	
8	362	353	40	Square	
9	362	353	40	Square	

Pier Description

Pier ID 10

Pier ID 11

Pier ID 12

Pier ID 7

Pier ID 8

Pier ID 9

Pier Scour Data

Pier ID	Date	Time	USOrDS
8	7/14/93		Upstream
8	7/17/93		Upstream
8	7/19/93		Upstream
8	8/17/93		Upstream
8	9/16/93		Upstream
9	7/14/93		Upstream
9	7/17/93		Upstream

9	7/19/93	Upstream
9	8/17/93	Upstream
9	9/16/93	Upstream

Pier ID	Scour Depth	Accuracy (ft)	Side Slope (ft/ft)	TopWidth (ft)	Apprch Vel (ft/s)	Apprch Depth(ft)	Effective Pier Width	Skew to Flow(deg)
8	12	3				41.5	9.3	0
8	14	2			6.3	47	9.3	0
8	12.6	2			6.6	49.4	9.3	0
8	12.5	2			4	42.3	9.3	0
8	14	2			3.5	36.2	9.3	0
9	13	3				43.5	9.6	0
9	13	2			7.4	48	9.6	0
9	12.3	2			6.4	50.4	9.6	0
9	12	2			4.5	42.3	9.6	0
9	12	2			4	36.2	9.6	0

PierID	Sediment Transport	Bed Material	BedForm	Trough (ft)	Crest (ft)	Sigma	Debris Effects
8	Live-bed	Non-cohesive	Dune			2.7	Insignificant
8	Live-bed	Non-cohesive	Dune			2.7	Insignificant
8	Live-bed	Unknown	Dune			2.7	Insignificant
8	Live-bed	Non-cohesive	Dune			2.7	Insignificant
8	Live-bed	Non-cohesive	Dune			2.7	Insignificant
9	Live-bed	Non-cohesive	Dune			2.7	Insignificant
9	Live-bed	Non-cohesive	Dune			2.7	Insignificant
9	Live-bed	Non-cohesive	Dune			2.7	Insignificant
9	Live-bed	Non-cohesive	Dune			2.7	Insignificant
9	Live-bed	Non-cohesive	Dune			2.7	Insignificant

PierID	D95 (mm)	D84 (mm)	D50 (mm)	D16 (mm)
8	4.6	2.1	0.7	0.28
8	4.6	2.1	0.7	0.28
8	4.6	2.1	0.7	0.28
8	4.6	2.1	0.7	0.28
8	4.6	2.1	0.7	0.28

9	4.6	2.1	0.7	0.28
9	4.6	2.1	0.7	0.28
9	4.6	2.1	0.7	0.28
9	4.6	2.1	0.7	0.28
9	4.6	2.1	0.7	0.28

Pier Scour Comments

Pier ID 8 **Time:** **US/DS:** Upstream

An initial check survey of the bridge on July 14, 1993 resulted in the establishment of this site as a detailed study site. Detailed bathymetric data were collected on July 17 and 19, 1993; however, only average approach velocities were measured on these dates because of the inability of a 1,200 kHz BB-ADCP to measure velocities accurately under these extreme conditions. Detailed bathymetric and three-dimensional velocities were measured at this site on August 17 and September 16, 1993. No times are recorded with the measurements as a detailed measurement takes a half to a full day to complete.

The water-surface elevations initially peaked at an elevation of 420.7 on July 19, but additional rain resulted in a slightly higher peak in the following weeks. No scour data were collected during this second peak.

The sediment transport upstream from pier 9 was characterized by 6 to 8 ft dunes; upstream from pier 8 dunes were somewhat smaller.

The depth of scour for each measurement was measured from a reference surface that was subjectively established based on a visual analysis of a 3-dimensional representation of the site. The presence of dunes made identification of the reference surface difficult and uncertainty is the major contributing factor to the accuracy presented for each measurement.

The configuration of the piers may have reduced scour due the stair-stepped design. However, scour reached several feet below the top of the seals at piers 8 and 9 but did not threaten the stability of the bridge.

Pier ID 8 **Time:** **US/DS:** Upstream

See comments pier 8 on 7/14/1993.

Pier ID 8 **Time:** **US/DS:** Upstream

See comments pier 8 on 7/14/1993.

Pier ID 8 **Time:** **US/DS:** Upstream

See comments pier 8 on 7/14/1993.

Pier ID 8 **Time:** **US/DS:** Upstream

See comments pier 8 on 7/14/1993.

Pier ID 9 **Time:** **US/DS:** Upstream

See comments pier 8 on 7/14/1993.

Pier ID 9 **Time:** **US/DS:** Upstream

See comments pier 8 on 7/14/1993.

Pier ID 9 **Time:** **US/DS:** Upstream

See comments pier 8 on 7/14/1993.

Pier ID 9 **Time:** **US/DS:** Upstream

See comments pier 8 on 7/14/1993.

Pier ID 9 **Time:** **US/DS:** Upstream

See comments pier 8 on 7/14/1993.

Abutment Scour

ContractionScour

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Stage and Discharge Data

Peak Discharge					Flow		Peak Stage					Stage	Water	Return
year	mo	dy	hr	mi	(cfs)	Qacc	year	mo	dy	hr	mi	(ft)	Temp (C)	Period(yr)
1993	8	1			1050000		1993	8	1			429.5		>100
1993	7	19			980000		1993	7	19			420.4		
1993	7	17			927000		1993	7	17			419		
1993	7	14			794000		1993	7	14			416.5		
1993	8	17			655000		1993	8	17			411.3		
1993	9	16			534000		1993	9	16			407.2		

Hydrograph

Supporting Files

JB.XLS - Contains the following worksheets:
Summary - Summary of bridge and scour characterists
Hydrograph - Hydrograph from gage at downtown St. Louis
071493 - Bathymetry for July 14, 1993
071793 - Bathymetry for July 17, 1993
071993 - Bathymetry for July 19, 1993
081793 - Bathymetry for August 17, 1993
081793-3D - 3-dimensional velocities collected on August 17, 1993
081793-DI - depth integrated velocities collected on August 17, 1993
091693- Bathymetry for September 16, 1993
091693-3D - 3-dimensional velocities collected on September 16, 1993
091693-DI - depth integrated velocities collected on September 16, 1993
Definition of heading for ADCP files
Transect - transect file number
Ensemble - ensemble number (averaged every 5 ensembles)
BinElev - Elevation to center of depth cell in ft MSL
BinDepth - Depth to center of depth cell in ft
U - u-velocity component (east) in ft/sec
V - v-velocity component (north) in ft/sec
W - vertical velocity component in ft/sec
X-SP - x location in State Plane coordinates Missouri East NAD-27
Y-SP - y location in State Plane coordinate Missouri East NAD-27
Mag - velocity magnitude in ft/sec
Dir - velocity direction referenced to north
UnitQ - discharge contain in depth cell
BotElev - Elevation of streambed in ft MSL
X-Loc - x location in local coordinate system
Y-Loc - y location in local coordinate system
U-Loc - u-velocity component in x direction in local coordinate system
V-Loc - v-velocity component in y direction in local coordinate system
Dir-Loc - velocity direction referenced to the local coordinate system

Aerial-1.jpg - Satellite image of river reach
Aerial-2.jpg - Satellite image of study area

Topo.jpg - scan of USGS topographic map
Profile.jpg - profile view of bridge from bridge plans
Plan.jpg - plan view of bridge from bridge plans
Pier12W-1.jpg - Pier details for pier 12
Pier12W-2.jpg - Pier details for pier 12
Pier12W-3.jpg - Pier details for pier 12
Pier12W-4.jpg - Pier details for pier 12
Pier11W-1.jpg - Pier details for pier 11
Pier11W-2.jpg - Pier details for pier 11
Pier10W-1.jpg - Pier details for pier 10
Pier10W-2.jpg - Pier details for pier 10
Pier9W-1.jpg - Pier details for pier 9
Pier9W-2.jpg - Pier details for pier 9
Pier8W-1.jpg - Pier details for pier 8
Pier8W-2.jpg - Pier details for pier 8
Pier7W.jpg - Pier details for pier 7
Photo-1.jpg - Photograph looking from left descending abutment across upstream face of bridge.
Photo-2.jpg - Photograph from left descending abutment looking across stream between bridges.
Photo-2.jpg - Photograph of pier 12 during flood
P8-BoringB-10.jpg - Soils boring at downstream bridge near pier 8
P8-BoringH-11.jpg - Soils boring at upstream bridge near pier 8
P9-BoringB-11.jpg - Soils boring at downstream bridge near pier 9
P9-BoringH-10.jpg - Soils boring at upstream bridge near pier 9
Bridge-Loc.dxf - DXF file of bridge (piers 7-13) in local coordinates
Pier9.jpg - 3-dimensional graphic showing streambed and pier
Pier8.jpg - 3-dimensional graphic showing streambed and pier