

BSDMS Summary Report

78 Pomme De Terre River at U.S. 12 near Holloway, MN

Site Location:

Site ID:	78	
Site Name:	Pomme De Terre River at U.S. 12 near Holloway, MN	
County:	Swift	
Nearest City:	Holloway	Contact:
State:	MN	David Mueller
Latitude:	451658	U.S. Geological Survey
Longitude:	0955845	9818 Bluegrass Parkway
USGS Station ID:		Louisville, KY 40299
Route Number:	12	
Route Class:	US	Publication:
Service Level:	Mainline	Mueller, D.S., and Hitchcock,
Route Direction:	NA	H.A., 1998, Scour measurements at
Highway Mile Point:		contracted highway crossings in
		Minnesota, 1997: ASCE, Water
		Resources Engineering '98,
		Memphis, TN, p. 210-215.
Stream Name:	Pomme De Terre River	
River Mile:		

Site Description:

Bridge 5359 is located 10.7 miles west of Danvers, Minnesota on U.S. Route 12 over the Pomme De Terre River. The single-span steel-truss structure was constructed in 1933 with a maximum span length of 88.3 ft. The upstream floodplain consists of a mixture of open agricultural land with scattered trees and brush. There is a park on the upstream left bank. The area downstream is more heavily wooded and is classified on the maps as a wetland area.

The bridge has vertical-wall abutments with wing walls. Each abutment and wing wall rest on concrete footings supported on timber piling. Neither abutment is riprapped nor do they have any other scour protection measures. A field investigation conducted by BRW, Inc. (during a scour evaluation) revealed no evidence of significant scour at the abutment face.

Regarding bed material, BRW reported the following:

The stream bed material in the vicinity of the bridge generally consists of fine grained organic silty sand. A sieve analysis of a field sample indicated a mean diameter of 0.00049 ft. Based on the soil borings and blow counts documented for the bridge construction, the river bed materials appear to become harder and denser as depth increases. Since the type of the soil was not recorded, it is difficult to ascertain the makeup of the soils at depth.

BRW noted minimal debris during their field investigation and the USGS note no

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debris during the flood measurements. There are trees located on the upstream floodplain so the potential for debris exists, but is probably low.

The nearest gaging station is located at Appleton, MN approximately 15 miles downstream. Station No. 05293960 has over 60 years of record. There is one small drainage noted between the site and Appleton on the right floodplain.

Summary of flood frequencies from BRW's scour analysis:

Return Period - Discharge (cfs)
10 yr - 2,075
50 yr - 3,925
100 yr - 4,880
390 yr - 7,130 overtopping flood
500 yr - 7,530

A scour-monitoring plan had been implemented by MNDOT and was available at the time of the flood. This bridge was scheduled to be replaced and has now been replaced with a new structure.

The stream data portion of the database only allows one set of Manning's n values. Below is the estimated upstream and downstream values.

	Upstream	Left	Main	Right	Downstream	Left	Main	Right
High		0.08	0.035	0.08		0.12	0.035	0.12
Typical			0.030			0.08	0.030	0.08
Low		0.05		0.05				

Elevation Reference

Datum: MSL

MSL (ft):

Description of Reference Elevation:

Elevations are referenced to MSL based on values provided by MNDOT on their scour monitoring plan. Plans for the new bridge developed by BRW showed elevations 30 ft higher. The scour report from BRW agreed with the MNDOT scour monitoring plan and thus, that elevation reference was used. The top of curb near the east abutment was used and was to have an elevation of 998.7 ft. The horizontal stationing of data collected from the bridge deck was referenced to the left abutment then adjusted in post-processing to be consistent with stationing used in the BRW WSPRO model. Distance of ADCP data from the bridge was visually estimated. Horizontal stationing for the ADCP is based on bottom tracking. The stationing was visually adjusted to agree with the BRW WSPRO model.

(3/8/2000) Note: The elevations that were provided by MNDOT, and the elevations from the BRW scour report, when used to build a HEC-RAS model of the bridge section, were discovered to be inconsistent with the downstream gaging station (Appleton) elevations during the 1997 flood. MNDOT was again contacted and it was discovered that elevation 995 ft above MSL on the BRW scour report should actually be 1023.9 feet above MSL, thus validating the new bridge plan elevations. Therefore, the elevation of the top of curb near the east abutment should actually be 1027.6 ft, making the bridge section more consistent with elevations upstream at CR 22 bridge (see entry 73) and downstream at the Appleton gaging station. A correction of +28.9 ft should be made to MNDOT's reference elevation on their scour monitoring plan and all elevations from the BRW scour report. The April 1997 field data, found in the attached excel file (us12pdt-REV.xls), has already been corrected to reflect the new reference elevation.

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Stream Data

Drainage Area (sq mi):	845	Floodplain Width:	Wide
Slope in Vicinity(ft/ft):	0.0005	Natural Levees:	Unknown
Flow Impact:	Right	Apparent Incision:	None
Channel Evolution	Premodified	Channel Boundary:	Alluvial
Armoring:	Unknown	Banks Tree Cover:	Medium
Debris Frequency:	Rare	Sinuosity:	Straight
Debris Effect:	None	Braiding:	None
Stream Size:	Small	Anabranching:	None
Flow Habit:	Perennial	Bars:	Unknown
Bed Material:	Sand	Stream Width Variability:	Equiwidth
Valley Setting:	Low		

Roughness Data

Manning's n Values

	Left Overbank	Channel	Right Overbank
High:	0.08	0.035	0.08
Typical		0.03	
Low:	0.05		0.05

Bed Material

Measurement Number	Yr	Mo	Dy	Sampler	D95 (mm)	D84 (mm)	D50 (mm)	D16 (mm)	SP	Shape	Cohesion
1	1995	7	19	Unknown	0.28	0.2	0.15		2.65		Mildly

Bed Material Comments

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Measurement No: 1

Bed-material size distribution reported are from information provided the MnDOT. A review of the lithologic logs for the replacement bridge show that the subsurface material is primarily sands, silts, with some gravel. D16 was less than 0.062

Bridge Data

Structure No: 5359

Length(ft): 88.3

Width(ft): 27

Number of Spans: 1

Vertical Configuration: Sloping

Low Chord Elev (ft): 1023.85

Upper Chord Elev (ft): 1024.76

Overtopping Elev (ft): 1027.6

Skew (degrees): 0

Guide Banks: None

Waterway Classification: Main

Year Built: 1933

Avg Daily Traffic:

Plans on File: Yes

Parallel Bridges No

Upstream/Downstream: N/A

Continuous Abutment: No

Distance Between Centerlines:

Distance Between Pier Faces:

Bridge Description:

The bridge is an old truss bridge. The bridge and its approach embankments are perpendicular to the main channel. However, during the 1997 flood there was considerable skew as a significant amount of flow was coming from the left floodplain. The flow through the bridge opening in the center of the channel was skewed about 50 degrees.

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Abutment Data

Left Station: 956
Right Station: 1044
Left Skew (deg): 0
Right Skew (deg) 0
Left Abutment Length (ft): 33
Right Abutment Length (ft) 33
Left Abutment to Channel Bank (ft): 0
Right Abutment to Channel Bank (ft): 0
Left Abutment Protection:
Right Abutment Protection
Contracted Opening Type: IV
Embankment Skew (deg): 0
Embankment Slope (ft/ft): 3
Abutment Slope (ft/ft) 0
Wingwalls: Yes
Wingwall Angle (deg): 45

Pier Data

Pier Scour Data

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Abutment Scour

Measurement Number	Abutment	Date	Time	US/DS	Scour Depth (ft)	Accuracy	Sediment Transport
1	Right	4/9/1997	16:00	Downstream	8	2	Live-bed
2	Right	4/9/1997	14:00	Downstream	7	2	Live-bed
3	Right	4/9/1997	14:00	Upstream	11	2	Live-bed
4	Left	4/9/1997	16:00	Downstream	3	2	Live-bed
5	Left	4/9/1997	14:00	Downstream	1.5	2	Live-bed
6	Left	4/9/1997	14:00	Upstream	6	2	Live-bed

Measurement Number	Velocity at Abut (ft/s)	Depth at Abut (ft)	Discharge Blocked (cfs)	Avg Velocity Blocked (ft/s)	Avg Depth Blocked (ft)
1	4.2	30			
2	4.2	31			
3	4.2	27			
4	3.8	25			
5	3.8	25			
6	3.8	22			

Measurement Number	Embankment Length (ft)	Bed Material	D50 (mm)	Sigma	Debris Effect
1	396	Unknown	0.15	1.5	Insignificant
2	396	Unknown	0.15	1.5	Insignificant
3	396	Unknown	0.15	1.5	Insignificant
4	1006	Unknown	0.15	1.5	Insignificant
5	1006	Unknown	0.15	1.5	Insignificant
6	1006	Unknown	0.15	1.5	Insignificant

Abutment Scour Comments

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MeasurementNo 1

The reference surface used to determine the depth of abutment scour was the concurrent ambient bed. Therefore, the depth of abutment scour reported is additional local scour below the depth of contraction scour. For this site, it appears that the scour holes may interact as there is only one or two depth measurement between the holes that define the ambient bed.

There was significant flow from the left upstream flood plain through the bridge opening. This flow from the left flood plain significantly skewed the flow through the bridge opening, about 50 degrees on the average. Refer to maps and sketches included in Other Detailed Data.

Measurements numbers 1 and 4 were made during a discharge measurement along the upstream face of the bridge. The depths were measured with a sounding weight. All other measurements were made using an echo sounded mounted on a knee-board. The board was floated from upstream to downstream under the bridge. The measurements reflect the depths at the upstream or downstream face of the bridge.

All hydraulic information is from the one discharge measurement.

The velocity at the abutments was much higher on 4/5/97:

Left - 5.1 ft /sec
Right - 5.9 ft/sec

Embankment lengths were determined by projecting the measured water surface elevation onto the approach section from the BRW WSPRO model.

MeasurementNo 2

See comments on measurement no. 1.

MeasurementNo 3

See comments on measurement no. 1.

MeasurementNo 4

See comments on measurement no. 1.

MeasurementNo 5

See comments on measurement no. 1.

MeasurementNo 6

See comments on measurement no. 1.

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ContractionScour

Measurement Number	Contracted Date	Contracted Time	Uncontracted Date	Uncontracted Time	US/DS	Scour Depth(ft)
1	4/5/1997	11:30	4/5/1997			3.1
2	4/9/1997	16:00	4/5/1997			10.5
3	4/9/1997	14:00	4/5/1997			12.5
4	4/9/1997	14:00	4/5/1997			4.5

Measurement Number	Accuracy	Contracted Avg Vel(ft/s)	Contracted Discharge(cfs)	Contracted Depth(ft)	Contracted Width(ft)
1	2	4.8	5000	12.1	88
2	2	2.7	5750	24	88
3	2	2.8	5750	23.6	88
4	2	3.8	5750	17.3	88

Measurement Number	Uncontracted Avg Vel(ft/s)	Uncontracted Discharge(cfs)	Uncontracted Depth(ft)	Uncontracted Width(ft)	Channel Contraction Ratio
1	3.4	1800	7.9	70	0.64
2					
3					
4					

Measurement Number	Pier Contraction Ratio	Scour Location	Eccentricity	Sediment Transport	Bed Form	Debris Effects
1		Main Channel		Live-bed	Unknown	Unknown
2		Main Channel		Live-bed	Unknown	Unknown
3		Main Channel		Live-bed	Unknown	Unknown
4		Main Channel		Live-bed	Unknown	Unknown

Measurement Number	D95 (mm)	D84 (mm)	D50 (mm)	D16 (mm)	Sigma Bed Material	Bed Material
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1	0.28	0.23	0.15	1.5	Mildly
2	0.28	0.23	0.15	1.5	Mildly
3	0.28	0.23	0.15	1.5	Mildly
4	0.28	0.23	0.15	1.5	Mildly

Contraction Scour Comments

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Measurement No. 1

Contraction scour was computed as the difference in average bed elevation between uncontracted and contracted sections, adjusted for bed slope.

The appropriate reference surface was determined from an analysis of cross sections collected by BRW on 6/5/95 and the USGS during the flood on 4/5/97. Cross sections on these two dates collected approximately 300 ft upstream from the bridge show only about 0.5 difference the channel bottom elevation. The flood section was the lower of the two. Downstream from the bridge the cross section surveyed on 6/5/95 (approximately 75 ft downstream) and the cross section surveyed on 4/5/97 (approximately 200 ft downstream) are similar, with less than 1 ft in variation in the channel bottom elevations. The 4/5/97 cross section 100 ft downstream was about 1.5 below the 6/5/97 cross section at 75 ft downstream. It was assumed that the 4/5/97 cross section could have been effected by the scour at the bridge section. Thus, it was not considered in the setting of the reference surface. The WSPRO bridge section surveyed by BRW on 6/5/95 showed from 1 to 2 ft of abutment scour in the cross-section. However, the center of the channel at the bridge appears to be representative of consistent channel slope from the upstream section to the downstream section. Since little general scour was observed at the upstream and downstream sections the mean elevation of the unscoured portion of the WSPRO bridge section will be used as the contraction scour reference surface, elevation 981.5 ft.

The contracted section on 4/5/97 was measured under the bridge from data collected by an acoustic Doppler current profiler. The depths represent a weighted average of the four beam depths. Because a weighted-average was used it is possible that the local abutment scour was not detected. The maximum lowering of the stream bed was actually 7.5 ft, however, when the entire bed below the bridge was averaged the depth of contraction scour was only 3.1 ft. The hydraulic data presented for measurement number 1 were collected with the ADCP. The ADCP data showed many missing ensembles that were estimated in the final processing. There was not clear delineation of the channel banks in the approach section, creating a degree of uncertainty in the approach discharge. Overall it is expected that the approach discharge is +/- 20% and the total discharge is +/- 10%.

Measurements number 2 was made during a discharge measurement along the upstream face of the bridge. The depths were measured with a sounding weight. Measurements 3 and 4 were made using an echo sounded mounted on a knee-board. The board was floated from upstream to downstream under the bridge. The measurements reflect the depths at the upstream or downstream face of the bridge.

The cross sections measured on 4/9/97 all showed a similar pattern with abutment scour holes on each side and a sharp mound in between the scour holes but skewed towards the left bank. It appears that the abutment scour holes may have overlapped. The highest elevation in the center of the cross section was subtracted from the reference surface to obtain the depth of contraction scour. No data in the approach section was collected on 4/9/97.

Measurement No. 2

See comments on measurement no. 1.

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Measurement No. 3

See comments on measurement no. 1.

Measurement No. 4

See comments on measurement no. 1.

Stage and Discharge Data

Peak Discharge					Flow (cfs)	Qacc	Peak Stage					Stage (ft)	Water Temp (C)	Return Period(yr)
year	mo	dy	hr	mi			year	mo	dy	hr	mi			
					5750		1997	4	9			1021.9		
							1997	4	5			1019.4		

Hydrograph

Supporting Files

usl2pdt-REV.xls - contains the following data:
Summary - Summary of basic site and scour data
Hydrograph - Hydrograph from nearest USGS gaging station
X-Sec - cross section data

Site Photos/Sketches

The following photos were scanned from a black and white copy of the
bridge scour evaluation report completed by BRW:

pdt12-scrprt-ds-channel.jpg
pdt12-scrprt-abuts.jpg
pdt12-scrprt-bridge.jpg
pdt12-scrprt-nwcorner-bridge.jpg
pdt12-scrprt-us-channel.jpg
pdt12-scrprt-us-dam.jpg

pdt12-brgpln-siteplan.jpg is a site plan scanned from the bridge plans
provided by MnDOT.

pdt12-flood-us-bridge.jpg is a photo taken during the flood, from the
right bank looking across the face of the bridge to the left
floodplain. Note the slump in the foreground.

pdt12-flowfield.jpg - sketch of flow field observed on 4-9-97

pdt12-rwingwall - photo of data collection along the right upstream
wingwall. Note the slump in the embankment.

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HEC-RAS Files

PreFlood_US12.zip - HEC-RAS model files with pre-flood bathymetry,
includes scour computations.

Flood_US12.zip - HEC-RAS model files with main channel bathymetry
collected during flooding on April 9, 1997; used as calibration model.