LEVEL II SCOUR ANALYSIS FOR BRIDGE 33 (BRIDTH00050033) on TOWN HIGHWAY 5, crossing the NORTH BRANCH OTTAUQUECHEE RIVER, BRIDGEWATER, VERMONT

U.S. Geological Survey
Open-File Report 96-385

Prepared in cooperation with
VERMONT AGENCY OF TRANSPORTATION
and
FEDERAL HIGHWAY ADMINISTRATION

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By SCOTT A. OLSON and DONALD L. SONG

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Pembroke, New Hampshire

1996

U.S. DEPARTMENT OF THE INTERIOR
BRUCE BABBITT, Secretary

U.S. GEOLOGICAL SURVEY
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CONVERSION FACTORS, ABBREVIATIONS, AND VERTICAL DATUM

Multiply	By	To obtain
	Length	
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Slope	
foot per mile (ft/mi)	0.1894	meter per kilometer (m/km)
	Area	
square mile (mi^2)	2.590	square kilometer (km^2)
	Volume	
cubic foot (ft^3)	0.02832	cubic meter (m^3)
	Velocity and Flow	
foot per second (ft/s)	0.3048	meter per second (m/s)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
cubic foot per second per square mile [(ft^3/s)/mi^2]	0.01093	cubic meter per second per square kilometer [(m^3/s)/km^2]

OTHER ABBREVIATIONS

BF	bank full	LWW	left wingwall
cfs	cubic feet per second	MC	main channel
D_{50}	median diameter of bed material	RAB	right abutment
DS	downstream	RABUT	face of right abutment
elev.	elevation	RB	right bank
f/p	flood plain	ROB	right overbank
ft^2	square feet	RWW	right wingwall
ft/ft	feet per foot	TH	town highway
JCT	junction	UB	under bridge
LAB	left abutment	US	upstream
LABUT	face of left abutment	USGS	United States Geological Survey
LB	left bank	VTAOT	Vermont Agency of Transportation
LOB	left overbank	WSPRO	water-surface profile model

In this report, the words “right” and “left” refer to directions that would be reported by an observer facing downstream.

Sea level: In this report, “sea level” refers to the National Geodetic Vertical Datum of 1929-- a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

In the appendices, the above abbreviations may be combined. For example, USLB would represent upstream left bank.

LEVEL II SCOUR ANALYSIS FOR BRIDGE 33 (BRIDTH00050033) ON TOWN HIGHWAY 5, CROSSING THE NORTH BRANCH OTTAUQUECHEE RIVER, BRIDGEWATER, VERMONT

By **Scott A. Olson and Donald L. Song**

INTRODUCTION AND SUMMARY OF RESULTS

This report provides the results of a detailed Level II analysis of scour potential at structure BRIDTH00050033 on town highway 5 crossing the North Branch Ottauquechee River, Bridgewater, Vermont (figures 1–8). A Level II study is a basic engineering analysis of the site, including a quantitative analysis of stream stability and scour (U.S. Department of Transportation, 1993). Results of a Level I scour investigation also are included in Appendix E of this report. A Level I investigation provides a qualitative geomorphic characterization of the study site. Information on the bridge, gleaned from Vermont Agency of Transportation (VTAOT) files, was compiled prior to conducting Level I and Level II analyses and is found in Appendix D.

The site is in the Green Mountain section of the New England physiographic province of central Vermont in the town of Bridgewater. The 5.01-mi^2 drainage area is in a predominantly rural and forested basin. In the vicinity of the study site, the downstream banks are forested and the upstream banks have dense woody brush; the upstream right overbank is an open field.

In the study area, the North Branch Ottauquechee River has an incised, sinuous channel with a slope of approximately 0.017 ft/ft, an average channel top width of 30 ft and an average channel depth of 3 ft. The predominant channel bed materials are gravel and cobble with a median grain size (D_{50}) of 83.2 mm (0.273 ft). The geomorphic assessment at the time of the Level I and Level II site visit on November 3, 1994, indicated that the reach was stable. Also at the time of the site visit, there was considerable backwater at the bridge site due to a three foot tall beaver dam 40 feet downstream. The beaver dam was assumed destroyed by flood flow and was ignored in the analyses.

The town highway 5 crossing of the North Branch Ottauquechee River is a 25-ft-long, one-lane bridge consisting of one 23-foot steel-beam span with a timber deck (Vermont Agency of Transportation, written communication, August 25, 1994). The bridge is supported by vertical, concrete abutments with wingwalls. The channel is skewed approximately 20 degrees to the opening while the opening-skew-to-roadway is 10 degrees.

A scour hole 1.0 ft deeper than the mean thalweg depth was observed along the right abutment and upstream right wingwall during the Level I assessment. Scour protection measures at the site include type-2 stone fill (less than 36 inches diameter) at the ends of all the wingwalls except the upstream left which has type-3 stone fill (less than 48 inches diameter). Additional details describing conditions at the site are included in the Level II Summary and Appendices D and E.

Scour depths and rock rip-rap sizes were computed using the general guidelines described in Hydraulic Engineering Circular 18 (Richardson and others, 1993). Total scour at a highway crossing is comprised of three components: 1) long-term streambed degradation; 2) contraction scour (due to accelerated flow caused by a reduction in flow area at a bridge) and; 3) local scour (caused by accelerated flow around piers and abutments). Total scour is the sum of the three components. Equations are available to compute depths for contraction and local scour and a summary of the results of these computations follows.

Contraction scour for all modelled flows ranged from 0.0 to 0.7 ft. The worst-case contraction scour occurred at the incipient-overtopping discharge, which was less than the 100-year discharge. Abutment scour ranged from 5.3 to 7.2 ft. The worst-case abutment scour occurred at the 500-year discharge. Additional information on scour depths and depths to armoring are included in the section titled “Scour Results”. Scoured-streambed elevations, based on the calculated scour depths, are presented in tables 1 and 2. A cross-section of the scour computed at the bridge is presented in figure 8. Scour depths were calculated assuming an infinite depth of erosive material and a homogeneous particle-size distribution.

It is generally accepted that the Froehlich equation (abutment scour) gives “excessively conservative estimates of scour depths” (Richardson and others, 1995, p. 47). Usually, computed scour depths are evaluated in combination with other information including (but not limited to) historical performance during flood events, the geomorphic stability assessment, existing scour protection measures, and the results of the hydraulic analyses. Therefore, scour depths adopted by VTAOT may differ from the computed values documented herein.

Delectable Mountain, VT. Quadrangle, 1:24,000, 1966
Photoinspected 1983

NORTH

Figure 1. Location of study area on USGS 1:24,000 scale map.

Figure 2. Location of study area on Vermont Agency of Transportation town highway map.

LEVEL II SUMMARY

Structure Number BRIDTH00050033 ***Stream*** North Br. Ottauquechee River

County Windsor ***Road*** TH005 ***District*** 4

Description of Bridge

Bridge length 25 ***ft*** ***Bridge width*** 14 ***ft*** ***Max span length*** 23 ***ft***

Alignment of bridge to road (on curve or straight) Mild curve

Abutment type Vertical ***Embankment type*** Sloping

Stone fill on abutment? No ***Date of inspection*** 11/03/94

Description of stone fill Type-2 at ends of all wingwalls except the upstream left which has type-3.

Brief description of piers/abutments Abutments and wingwalls are concrete. About 1.0 foot of scour was evident along the right abutment.

Is bridge skewed to flood flow according to Y ***survey?*** Y ***Angle*** 20

There is a mild channel bend through the local reach.

Debris accumulation on bridge at time of Level I or Level II site visit:

	Date of inspection	***Percent of channel blocked horizontally***	***Percent of channel blocked vertically***
Level I	11/03/94	0	0
Level II	11/04/94	0	0

Potential for debris Moderate. There is a beaver dam 85 feet upstream.

Describe any features near or at the bridge that may affect flow (include observation date) As of November 3, 1994, there was a beaver dam, about three feet tall, downstream of the structure causing significant backwater through the bridge. There is another beaver dam about 85 feet upstream.

Description of the Geomorphic Setting

General topography The bridge crosses an upland stream with an irregular flood plain.

Geomorphic conditions at bridge site: downstream (DS), upstream (US)

Date of inspection 11/03/95

DS left: Steep valley wall.

DS right: Narrow, irregular flood plain to steep valley wall.

US left: Narrow, irregular flood plain to steep valley wall.

US right: Flood plain to steep valley wall.

Description of the Channel

Average top width 30 ft ***Average depth*** 3 ft

Predominant bed material Gravel / Cobbles ***Bank material*** Cobbles w/fines

Sinuous but stable

with semi-alluvial to non-alluvial channel boundaries and a narrow flood plain.

11/03/95

Vegetative co Forest

DS left: Forest except for gravel roadway.

DS right: Trees and brush

US left: Trees and brush on immediate bank with a field on the overbank.

US right: Y

Do banks appear stable? November 3, 1994 ***If not, describe location and type of instability and date of observation.***

As of November 3, 1994, there was a beaver dam, about three feet tall, downstream of the structure causing significant backwater through the bridge. There is another beaver dam about 85 feet upstream.

Describe any obstructions in channel and date of observation.

Hydrology

Drainage area 5.01 ***mi²***

Percentage of drainage area in physiographic provinces: (approximate)

Physiographic province/section	***Percent of drainage area***
New England / Green Mountain	100

Is drainage area considered rural or urban? Rural ***Describe any significant urbanization***: None.

Is there a USGS gage on the stream of interest? No

USGS gage description --

USGS gage number --

Gage drainage area -- ***mi²***

Is there a lake/p -- No

Calculated Discharges

Q100 1,460 ***ft³/s*** ***Q500*** 2,060 ***ft³/s***

The 100-year discharge is from the VTAOT database (VTAOT, written communication, May 1995). The 500-year discharge was selected from a range determined by several empirical methods (Potter, 1957a&b; Johnson and Tasker, 1974; FHWA, 1983; Talbot, 1887; Richardson and others, 1993).

Description of the Water-Surface Profile Model (WSPRO) Analysis

Datum for WSPRO analysis (USGS survey, sea level, VTAOT plans) USGS survey

Datum tie between USGS survey and VTAOT plans Add 403 feet to USGS survey to obtain VTAOT plans' datum to the nearest foot.

Description of reference marks used to determine USGS datum. RM1 is a chiseled X on top of the downstream end of the right abutment (elev. 99.65 ft, arbitrary survey datum). RM2 is a chiseled X on top of the upstream end of the left abutment (elev. 99.69 ft, arbitrary survey datum).

Cross-Sections Used in WSPRO Analysis

[1]*Cross-section*	*Section Reference Distance (SRD) in feet*	[2]*Cross-section development*	*Comments*
EXITX	-72	1	Exit section
FULLV	0	2	Downstream Full-valley section (Templated from EXITX)
BRIDG	0	1	Bridge section
RDWAY	11	1	Road Grade section
APPRO	49	2	Modelled Approach section (Templated from APTEM)
APTEM	61	1	Approach section as surveyed (Used as a template)

[1] For location of cross-sections see plan-view sketch included with Level I field form, Appendix E.
For more detail on how cross-sections were developed see WSPRO input file.

Data and Assumptions Used in WSPRO Model

Hydraulic analyses of the reach were done by use of the Federal Highway Administration's WSPRO step-backwater computer program (Shearman and others, 1986, and Shearman, 1990). The analysis reported herein reflects conditions existing at the site at the time of the study except for the beaver dam downstream of the bridge. The beaver dam was assumed destroyed during a flood event and ignored in the analysis. Furthermore, in the development of the model it was necessary to assume no accumulation of debris or ice at the site. Results of the hydraulic model are presented in the Bridge Hydraulic Summary, Appendix B, and figure 7.

Channel roughness factors (Manning's "n") used in the hydraulic model were estimated using field inspections at each cross section following the general guidelines described by Arcement and Schneider (1989). Final adjustments to the values were made during the modelling of the reach. Channel "n" values for the reach ranged from 0.050 to 0.065, and overbank "n" values ranged from 0.030 to 0.080.

Normal depth at the exit section (EXITX) was assumed as the starting water surface. This depth was computed by use of the slope-conveyance method outlined in the user's manual for WSPRO (Shearman, 1990). The slope used was 0.017 ft/ft which was determined from surveyed thalweg points downstream of the bridge.

The surveyed approach section (APTEM) was moved along the approach channel slope (0.022 ft/ft) to establish the modelled approach section (APPRO), one bridge length upstream of the upstream face as recommended by Shearman and others (1986). This approach also provides a consistent method for determining scour variables.

Bridge Hydraulics Summary

Average bridge embankment elevation 100.2 *ft*
Average low steel elevation 97.9 *ft*

100-year discharge 1,460 *ft³/s*
Water-surface elevation in bridge opening 97.9 *ft*
Road overtopping? Y *Discharge over road* 523 *ft³/s*
Area of flow in bridge opening 137 *ft²*
Average velocity in bridge opening 7.0 *ft/s*
Maximum WSPRO tube velocity at bridge 8.9 *ft/s*

Water-surface elevation at Approach section with bridge 99.0
Water-surface elevation at Approach section without bridge 97.5
Amount of backwater caused by bridge 1.5 *ft*

500-year discharge 2,060 *ft³/s*
Water-surface elevation in bridge opening 97.9 *ft*
Road overtopping? Y *Discharge over road* 966 *ft³/s*
Area of flow in bridge opening 137 *ft²*
Average velocity in bridge opening 8.0 *ft/s*
Maximum WSPRO tube velocity at bridge 10.2 *ft/s*

Water-surface elevation at Approach section with bridge 99.5
Water-surface elevation at Approach section without bridge 97.8
Amount of backwater caused by bridge 1.7

Incipient overtopping discharge 1,110 *ft³/s*
Water-surface elevation in bridge opening 95.9 *ft*
Area of flow in bridge opening 94.9 *ft²*
Average velocity in bridge opening 11.7 *ft/s*
Maximum WSPRO tube velocity at bridge 14.5 *ft/s*

Water-surface elevation at Approach section with bridge 99.0
Water-surface elevation at Approach section without bridge 96.5
Amount of backwater caused by bridge 2.5 *ft*

Scour Analysis Summary

Special Conditions or Assumptions Made in Scour Analysis

Scour depths were computed using the general guidelines described in Hydraulic Engineering Circular 18 (Richardson and others, 1993). Scour depths were calculated assuming an infinite depth of erosive material and a homogeneous particle-size distribution. The results of the scour analysis are presented in tables 1 and 2 and a graph of the scour depths is presented in figure 8.

Contraction scour was computed by use of Chang pressure-flow scour equation (Richardson and others, 1995, 0. 145-146) for the 100-year and 500-year modelled discharges where orifice flow occurred at the bridge. Contraction scour at bridges with orifice flow is best estimated by use of the Chang pressure-flow scour equation (oral communication, J. Sterling Jones, October 4, 1996). Contraction scour was computed for the incipient road-overflow model by use of clear-water contraction scour equation (Richardson and others, 1993, p. 35, equation 18). The results of Laursen's clear-water contraction scour equation (Richardson and others, 1995, p. 32, equation 20) were also computed for the 100-year and 500-year discharges and can be found in appendix F. For contraction scour computations, the average depth in the contracted section (AREA/TOPWIDTH) is subtracted from the depth of flow computed by the scour equation (Y2) to determine the actual amount of scour.

Abutment scour was computed by use of the HIRE equation (Richardson and others, 1993, p. 50, equation 25). Variables for the HIRE equation include the Froude number of the flow approaching the embankments, the length of the embankment blocking flow, and the depth of flow approaching the embankment less any roadway overtopping.

In this case, the incipient road-overflow model resulted in the worst case contraction scour and worst case total scour. Both the 100- and 500-year events had significant roadway overflow. This overflow acted as a relief channel reducing the scour results of the larger flow events.

Scour Results

Contraction scour:	100-yr discharge	500-yr discharge	Incipient overtopping discharge
	(Scour depths in feet)		
Main channel			
Live-bed scour	--	--	--
Clear-water scour	0.0	0.0	0.7
Depth to armoring	0.4	0.9	22.7
Left overbank	--	--	--
Right overbank	--	--	--

Local scour:	100-yr discharge	500-yr discharge	Incipient overtopping discharge
Abutment scour			
Left abutment	6.6	7.2	6.0
Right abutment	5.3	6.1	8.0
Pier scour			
Pier 1	--	--	--
Pier 2	--	--	--
Pier 3	--	--	--

Riprap Sizing

	100-yr discharge	500-yr discharge	Incipient overtopping discharge
	(D_{50} in feet)		
Abutments:			
Left abutment	0.9	1.2	1.9
Right abutment	0.9	1.2	1.9
Piers:	--	--	--
Pier 1	--	--	--
Pier 2	--	--	--

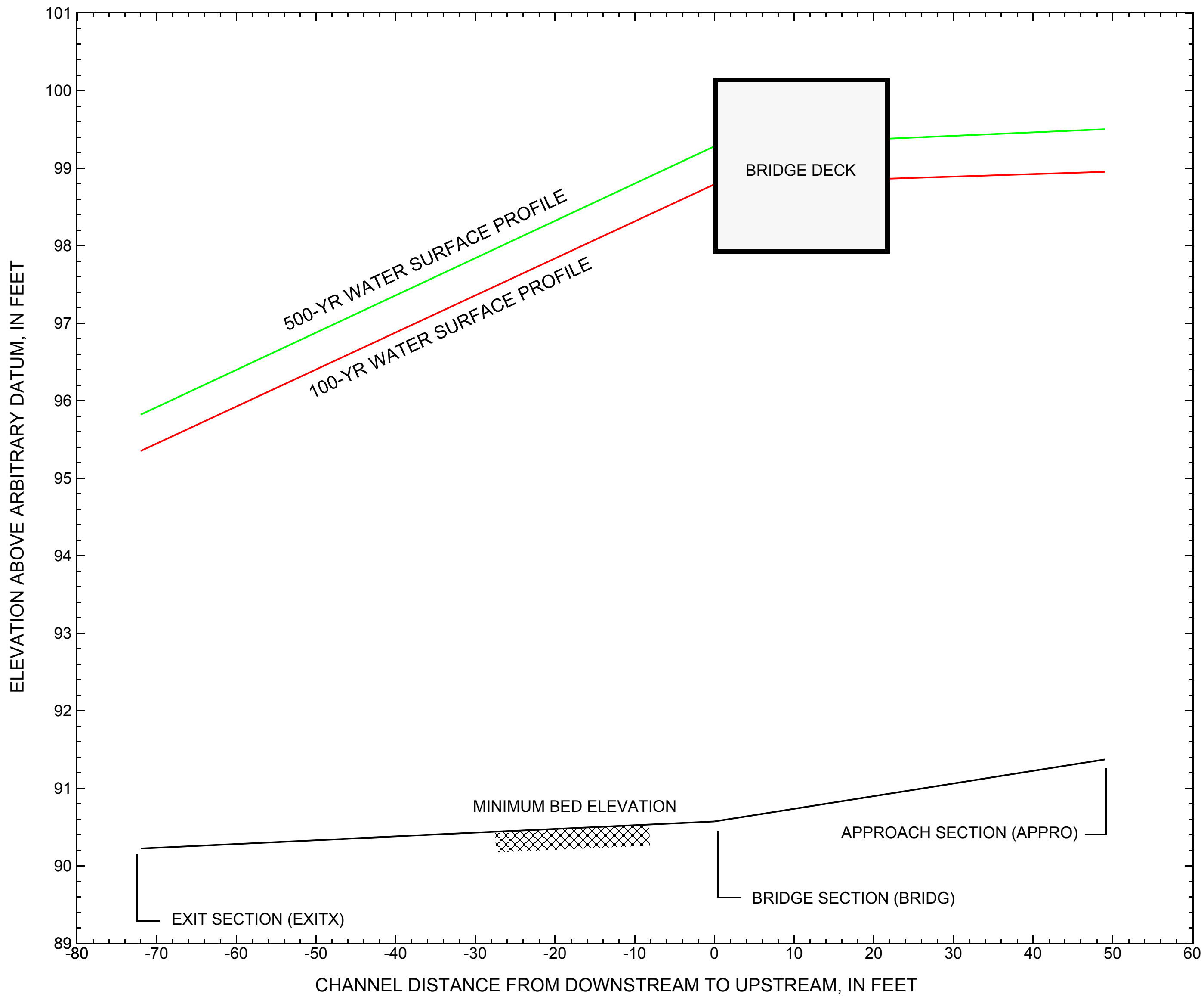

Figure 7. Water-surface profiles for the 100- and 500-yr discharges at structure BRIDTH00050033 on town highway 5, crossing the North Branch Ottauquechee River, Bridgewater, Vermont.

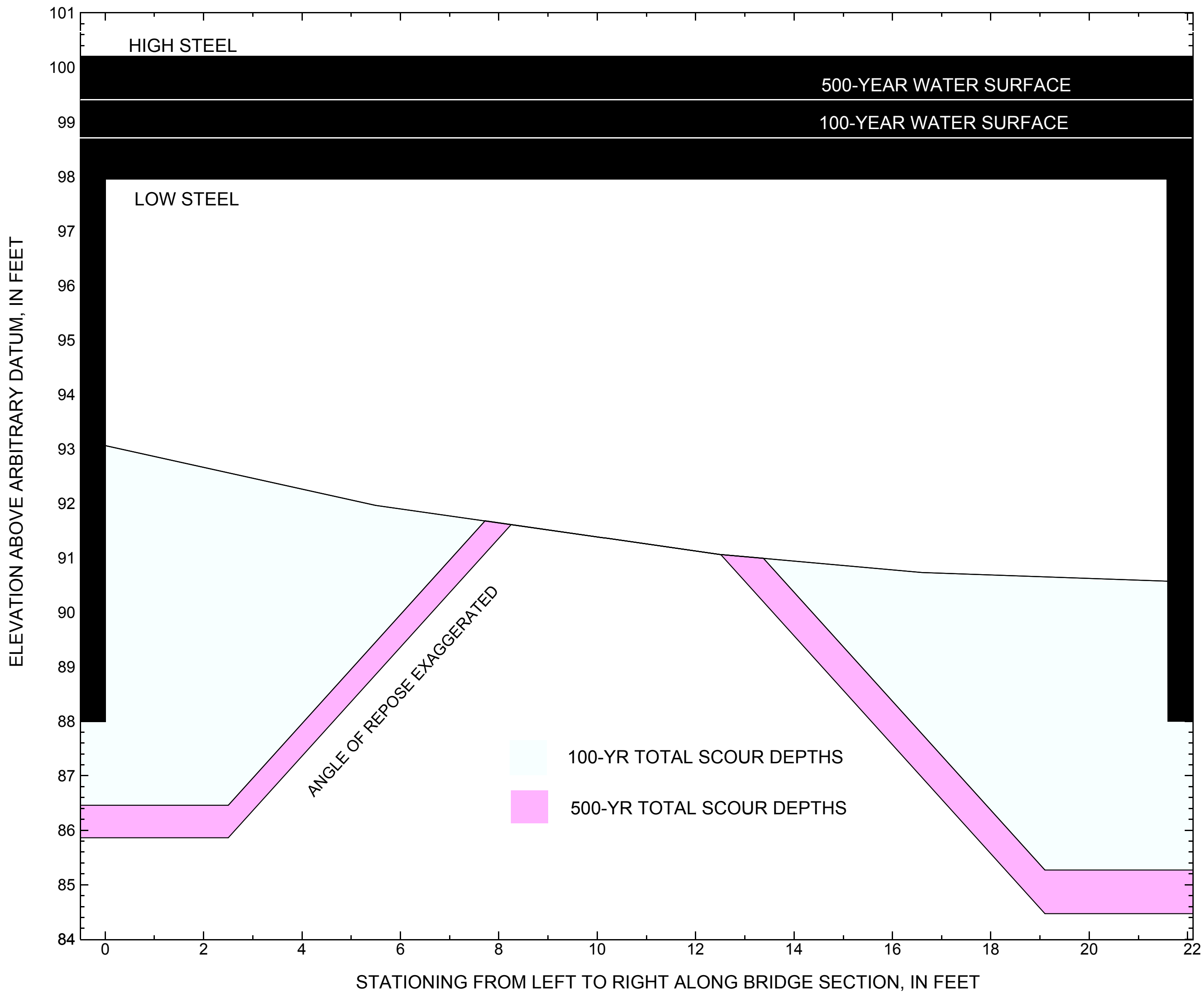

Figure 8. Scour elevations for the 100-yr and 500-yr discharges at structure BRIDTH00050033 on town highway 5, crossing the North Branch Ottauquechee River, Bridgewater, Vermont.

Table 1. Remaining footing/pile depth at abutments for the 100-year discharge at structure BRIDTH00050033 on Town Highway 5, crossing the North Branch Ottauquechee River, Bridgewater, Vermont.

[VTAOT, Vermont Agency of Transportation; --,no data]

Description	Station[1]	VTAOT plans' bridge seat elevation (feet)	Surveyed minimum low-chord elevation[2] (feet)	Bottom of footing elevation[2] (feet)	Channel elevation at abutment/ pier[2] (feet)	Contraction scour depth (feet)	Abutment scour depth (feet)	Pier scour depth (feet)	Depth of total scour (feet)	Elevation of scour[2] (feet)	Remaining footing/pile depth (feet)
100-yr. discharge is 1,460 cubic-feet per second											
Left abutment	0.0	501.4	97.9	88	93.1	0.0	6.6	--	6.6	86.5	-2
Right abutment	21.6	501.4	98.0	88	90.6	0.0	5.3	--	5.3	85.3	-3

1. Measured along the face of the most constricting side of the bridge.
2. Arbitrary datum for this study.

Table 2. Remaining footing/pile depth at abutments for the 500-year discharge at structure BRIDTH00050033 on Town Highway 5, crossing the North Branch Ottauquechee River, Bridgewater, Vermont.

[VTAOT, Vermont Agency of Transportation; --, no data]

Description	Station[1]	VTAOT plans' bridge seat elevation (feet)	Surveyed minimum low-chord elevation[2] (feet)	Bottom of footing elevation[2] (feet)	Channel elevation at abutment/ pier[2] (feet)	Contraction scour depth (feet)	Abutment scour depth (feet)	Pier scour depth (feet)	Depth of total scour (feet)	Elevation of scour[2] (feet)	Remaining footing/pile depth (feet)
500-yr. discharge is 2,060 cubic-feet per second											
Left abutment	0.0	501.4	97.9	88	93.1	0.0	7.2	--	7.2	85.9	-2
Right abutment	21.6	501.4	98.0	88	90.6	0.0	6.1	--	6.1	84.5	-4

1. Measured along the face of the most constricting side of the bridge.
2. Arbitrary datum for this study.

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U.S. Geological Survey, 1966, Delectable Mountain, Vermont 7.5 Minute Series quadrangle map: U.S. Geological Survey Topographic Maps, Photoinspected 1983, Scale 1:24,000.

APPENDIX A:

WSPRO INPUT FILE

WSPRO INPUT FILE

```
T1        U.S. GEOLOGICAL SURVEY WSPRO INPUT FILE brid033.wsp
T2        CREATED ON 09-NOV-95 FOR BRIDGE BRIDTH00050033 USING FILE brid033.dca
T3        HYDRAULIC ANALYSIS OF BRID033     SAO
*
J3         6 29 30 552 553 551 5 16 17 13 3 * 15 14 23 21 11 12 4 7 3
*
Q          1460 2060 1110
SK         0.017 0.017 0.017
*
XS   EXITX   -72
GR          -90.0, 100       -37.8,  94.31     -7.7,  93.56      0.0,  93.74
GR            3.9,  90.96     12.1,  90.22     18.4,  90.58     22.0,  91.03
GR           28.3,  92.91     31.8,  94.95     35.1,  93.81     53.6,  94.21
GR          164.0,  94.30    164.0, 100
N             0.080      0.065           0.080
SA                0.0            31.8
*
XS   FULLV      0 * * * 0.0113
*
BR   BRIDG   0      97.9      10.0
GR            0.0,  97.93      0.0,  93.06      5.5,  91.96     12.5,  91.06
GR           16.6,  90.73     21.6,  90.57     21.6,  97.96      0.0,  97.93
N             0.050
CD           1 27.6 * * 40 7.6
*
XR   RDWAY    11 14.0 2
GR         -101.4, 100.01    -46.2,  99.38      0.0, 100.20     21.6, 100.20
GR           74.8,  97.69    184.8,  97.70    184.8, 103.00
*
XT   APTEM     61
GR         -121.1, 103.18    -90.0, 100.26    -70.3, 100.10    -15.7,  97.61
GR            0.0,  95.77      2.4,  94.66     11.4,  91.91     21.4,  91.63
GR           26.6,  92.23     29.3,  94.73     31.8,  95.52     38.1,  97.44
GR          111.3,  97.27    148.8,  96.91    198.8,  97.00    198.8, 104.00
*
AS   APPRO     49
GT            -0.26
N            0.080      0.060       0.030
SA                 0.0        38.1
BP           10
*
HP 1 BRIDG    97.90 1 97.90
HP 2 BRIDG    97.90 * * 958
HP 2 RDWAY    98.79 * * 523
HP 1 APPRO    98.95 1 98.95
HP 2 APPRO    98.95 * * 1460
*
HP 1 BRIDG    97.90 1 97.90
HP 2 BRIDG    97.90 * * 1095
HP 2 RDWAY    99.28 * * 966
HP 1 APPRO    99.50 1 99.50
HP 2 APPRO    99.50 * * 2060
*
```

APPENDIX B:

WSPRO OUTPUT FILE

WSPRO OUTPUT FILE

```
        U.S. GEOLOGICAL SURVEY WSPRO INPUT FILE brid033.wsp
        CREATED ON 09-NOV-95 FOR BRIDGE BRIDTH00050033 USING FILE brid033.dca
        HYDRAULIC ANALYSIS OF BRID033     SAO
           *** RUN DATE & TIME: 11-27-95  12:03
    CROSS-SECTION PROPERTIES:  ISEQ =  3;  SECID = BRIDG;  SRD =       0.
     WSEL  SA#     AREA        K   TOPW   WETP  ALPH    LEW    REW     QCR
             1     137.  10443.    21.    34.                         1978.
    97.90          137.  10443.    21.    34.  1.00     0.    22.   1978.

    VELOCITY DISTRIBUTION:  ISEQ =  3;  SECID = BRIDG;  SRD =       0.
         WSEL     LEW     REW    AREA        K        Q    VEL
        97.90     0.0    21.6   137.2  10443.     958.   6.98
X STA.         0.0         2.6         4.0         5.2         6.3         7.3
  A(I)            12.9         7.8         6.9         6.5         6.1
  V(I)            3.71        6.17        6.98        7.42        7.81

X STA.         7.3         8.3         9.2        10.1        10.9        11.7
  A(I)             5.8         5.8         5.6         5.4         5.5
  V(I)            8.22        8.30        8.58        8.84        8.70

X STA.        11.7        12.6        13.4        14.2        15.0        15.8
  A(I)             5.4         5.4         5.6         5.6         5.7
  V(I)            8.90        8.80        8.61        8.60        8.36

X STA.        15.8        16.6        17.5        18.5        19.6        21.6
  A(I)             5.9         6.2         6.9         7.9        14.4
  V(I)            8.10        7.70        6.91        6.08        3.33

    VELOCITY DISTRIBUTION:  ISEQ =  4;  SECID = RDWAY;  SRD =      11.
         WSEL     LEW     REW    AREA        K        Q    VEL
        98.79    51.5   184.8   133.3    2468.     523.   3.92
X STA.        51.5        72.9        79.7        85.9        91.8        97.8
  A(I)            10.9         7.3         6.9         6.5         6.6
  V(I)            2.41        3.58        3.81        4.03        3.97

X STA.        97.8       103.7       109.5       115.3       121.0       126.7
  A(I)             6.4         6.3         6.4         6.3         6.3
  V(I)            4.06        4.14        4.11        4.16        4.16

X STA.       126.7       132.5       138.2       144.0       149.7       155.4
  A(I)             6.3         6.3         6.3         6.3         6.2
  V(I)            4.17        4.18        4.13        4.16        4.19

X STA.       155.4       161.2       166.9       172.6       178.4       184.8
  A(I)             6.3         6.2         6.3         6.4         6.9
  V(I)            4.13        4.24        4.18        4.09        3.78

    CROSS-SECTION PROPERTIES:  ISEQ =  5;  SECID = APPRO;  SRD =      49.
     WSEL  SA#     AREA        K   TOPW   WETP  ALPH    LEW    REW     QCR
             1      68.   1522.    51.    51.                          443.
             2     218.  16722.    38.    40.                         2960.
             3     328.  25979.   161.   163.                         2660.
    98.95          614.  44223.   250.   254.  1.14   -51.   199.   5112.

    VELOCITY DISTRIBUTION:  ISEQ =  5;  SECID = APPRO;  SRD =      49.
         WSEL     LEW     REW    AREA        K        Q    VEL
        98.95   -50.8   198.8   613.7  44223.    1460.   2.38
X STA.       -50.8         2.8         8.3        12.0        15.4        18.6
  A(I)            79.0        30.6        25.5        24.7        24.3
  V(I)            0.92        2.38        2.86        2.96        3.01

X STA.        18.6        21.8        25.3        31.5        50.9        67.4
  A(I)            23.7        25.5        34.1        41.1        30.1
  V(I)            3.08        2.86        2.14        1.78        2.42

X STA.        67.4        83.3        98.6       113.8       127.4       139.9
  A(I)            29.4        29.0        29.4        27.6        26.8
  V(I)            2.48        2.51        2.48        2.65        2.72

X STA.       139.9       151.3       162.5       174.2       185.7       198.8
  A(I)            26.0        25.5        26.4        25.9        29.1
  V(I)            2.81        2.87        2.76        2.82        2.51
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        U.S. GEOLOGICAL SURVEY WSPRO INPUT FILE brid033.wsp
        CREATED ON 09-NOV-95 FOR BRIDGE BRIDTH00050033 USING FILE brid033.dca
        HYDRAULIC ANALYSIS OF BRID033     SAO
           *** RUN DATE & TIME: 11-27-95  12:03
    CROSS-SECTION PROPERTIES:  ISEQ =  3;  SECID = BRIDG;  SRD =       0.
     WSEL  SA#     AREA        K   TOPW   WETP  ALPH    LEW    REW     QCR
             1     137.   10443.    21.    34.                        1978.
    97.90          137.   10443.    21.    34.  1.00     0.    22.   1978.

    VELOCITY DISTRIBUTION:  ISEQ =  3;  SECID = BRIDG;  SRD =       0.
         WSEL     LEW     REW    AREA        K       Q    VEL
        97.90     0.0    21.6   137.2   10443.    1095.   7.98
X STA.         0.0         2.6         4.0         5.2         6.3         7.3
  A(I)            12.9         7.8         6.9         6.5         6.1
  V(I)            4.24        7.05        7.97        8.48        8.93

X STA.         7.3         8.3         9.2        10.1        10.9        11.7
  A(I)             5.8         5.8         5.6         5.4         5.5
  V(I)            9.39        9.49        9.81       10.11        9.94

X STA.        11.7        12.6        13.4        14.2        15.0        15.8
  A(I)             5.4         5.4         5.6         5.6         5.7
  V(I)           10.18       10.06        9.85        9.83        9.55

X STA.        15.8        16.6        17.5        18.5        19.6        21.6
  A(I)             5.9         6.2         6.9         7.9        14.4
  V(I)            9.26        8.80        7.90        6.95        3.81

    VELOCITY DISTRIBUTION:  ISEQ =  4;  SECID = RDWAY;  SRD =      11.
         WSEL     LEW     REW    AREA        K       Q    VEL
        99.28    41.1   184.8   201.1    4653.     966.   4.80
X STA.        41.1        68.4        76.4        82.9        89.2        95.4
  A(I)            17.6        11.8        10.3        10.0         9.9
  V(I)            2.75        4.11        4.68        4.83        4.90

X STA.        95.4       101.5       107.6       113.6       119.4       125.3
  A(I)             9.6         9.8         9.4         9.3         9.3
  V(I)            5.01        4.95        5.12        5.19        5.19

X STA.       125.3       131.2       137.2       143.0       148.8       154.7
  A(I)             9.4         9.4         9.2         9.3         9.3
  V(I)            5.14        5.14        5.26        5.18        5.21

X STA.       154.7       160.5       166.4       172.3       178.1       184.8
  A(I)             9.1         9.4         9.3         9.1        10.7
  V(I)            5.29        5.14        5.20        5.29        4.53

    CROSS-SECTION PROPERTIES:  ISEQ =  5;  SECID = APPRO;  SRD =      49.
     WSEL  SA#     AREA        K   TOPW   WETP  ALPH    LEW    REW     QCR
             1      99.    2487.    63.    63.                         704.
             2     239.   19485.    38.    40.                        3397.
             3     416.   38578.   161.   163.                        3804.
    99.50          754.   60550.   262.   267.  1.18   -63.   199.   6678.

    VELOCITY DISTRIBUTION:  ISEQ =  5;  SECID = APPRO;  SRD =      49.
         WSEL     LEW     REW    AREA        K       Q    VEL
        99.50   -62.8   198.8   754.3   60550.    2060.   2.73
X STA.       -62.8         2.0         8.4        12.9        16.8        20.8
  A(I)           108.0        38.0        33.9        31.3        31.7
  V(I)            0.95        2.71        3.04        3.29        3.25

X STA.        20.8        24.8        31.9        49.1        63.8        77.9
  A(I)            32.0        42.5        46.2        34.6        34.0
  V(I)            3.22        2.42        2.23        2.98        3.03

X STA.        77.9        91.8       105.6       118.6       131.1       142.4
  A(I)            33.6        34.0        32.7        32.6        31.0
  V(I)            3.07        3.03        3.15        3.16        3.32

X STA.       142.4       153.3       164.1       175.1       186.1       198.8
  A(I)            30.8        30.5        30.9        30.7        35.3
  V(I)            3.34        3.38        3.33        3.36        2.92
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        U.S. GEOLOGICAL SURVEY WSPRO INPUT FILE brid033.wsp
        CREATED ON 09-NOV-95 FOR BRIDGE BRIDTH00050033 USING FILE brid033.dca
        HYDRAULIC ANALYSIS OF BRID033     SAO
           *** RUN DATE & TIME: 11-27-95  12:03
    CROSS-SECTION PROPERTIES:  ISEQ =  3;  SECID = BRIDG;  SRD =       0.
     WSEL  SA#     AREA        K   TOPW   WETP  ALPH    LEW    REW     QCR
             1      95.    6142.    21.    30.                       1137.
    95.91           95.    6142.    21.    30.  1.00     0.    22.   1137.

    VELOCITY DISTRIBUTION:  ISEQ =  3;  SECID = BRIDG;  SRD =       0.
         WSEL     LEW     REW    AREA        K        Q    VEL
        95.91     0.0    21.6    94.9    6142.    1110.  11.70
X STA.         0.0         2.7        4.3        5.6        6.7        7.8
  A(I)             8.3         5.5        4.9        4.6        4.3
  V(I)            6.70       10.06      11.41      12.03      12.87

X STA.         7.8         8.8        9.7       10.6       11.5       12.3
  A(I)             4.2         4.1        4.1        3.9        4.0
  V(I)           13.16       13.48      13.51      14.29      13.96

X STA.        12.3        13.1       13.9       14.7       15.5       16.3
  A(I)             3.8         3.9        3.8        4.0        4.0
  V(I)           14.48       14.29      14.44      14.04      13.93

X STA.        16.3        17.1       17.9       18.8       19.9       21.6
  A(I)             4.1         4.3        4.6        5.5        9.1
  V(I)           13.60       13.03      12.15      10.09       6.10

    CROSS-SECTION PROPERTIES:  ISEQ =  5;  SECID = APPRO;  SRD =      49.
     WSEL  SA#     AREA        K   TOPW   WETP  ALPH    LEW    REW     QCR
             1      70.    1581.    52.    52.                        459.
             2     220.   16917.    38.    40.                       2991.
             3     334.   26829.   161.   163.                       2738.
    98.99          624.   45328.   250.   255.  1.14   -52.   199.   5222.

    VELOCITY DISTRIBUTION:  ISEQ =  5;  SECID = APPRO;  SRD =      49.
         WSEL     LEW     REW    AREA        K        Q    VEL
        98.99   -51.7   198.8   623.7   45328.    1110.   1.78
X STA.       -51.7         2.8        8.3       12.1       15.4       18.8
  A(I)            81.0        30.6       27.0       24.4       24.8
  V(I)            0.69        1.82       2.06       2.27       2.23

X STA.        18.8        22.1       25.5       32.9       52.3       68.4
  A(I)            25.0        25.3       37.5       39.6       30.0
  V(I)            2.22        2.20       1.48       1.40       1.85

X STA.        68.4        84.3       99.6      114.3      127.7      140.0
  A(I)            30.0        29.7       29.0       27.8       27.0
  V(I)            1.85        1.87       1.92       1.99       2.05

X STA.       140.0       151.7      162.8      174.1      185.6      198.8
  A(I)            27.0        25.7       26.2       26.1       29.9
  V(I)            2.05        2.16       2.12       2.12       1.85
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        U.S. GEOLOGICAL SURVEY WSPRO INPUT FILE brid033.wsp
        CREATED ON 09-NOV-95 FOR BRIDGE BRIDTH00050033 USING FILE brid033.dca
        HYDRAULIC ANALYSIS OF BRID033     SAO
           *** RUN DATE & TIME: 11-27-95  12:03

 XSID:CODE   SRDL    LEW     AREA   VHD    HF     EGL    CRWS       Q    WSEL
       SRD   FLEN    REW        K  ALPH    HO     ERR     FR#     VEL

EXITX:XS   ******   -47.     335.  0.53 *****   95.89   95.23   1460.   95.35
      -72. ******   164.   11192.  1.81 ***** *******    0.82    4.36

FULLV:FV      72.   -50.     407.  0.34  0.95   96.84 *******   1460.   96.51
        0.    72.   164.   14426.  1.68  0.00    0.00    0.59    3.59
         <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

 ===125 FR# EXCEEDS FNTEST AT SECID "APPRO":  TRIALS CONTINUED.
              FNTEST,FR#,WSEL,CRWS =  0.80    1.55      96.72      97.52

 ===110 WSEL NOT FOUND AT SECID "APPRO":  REDUCED DELTAY.
                   WSLIM1,WSLIM2,DELTAY =    96.01     103.74    0.50

 ===115 WSEL NOT FOUND AT SECID "APPRO":  USED WSMIN = CRWS.
                   WSLIM1,WSLIM2,CRWS =    96.01     103.74      97.52

 ===130 CRITICAL WATER-SURFACE ELEVATION  A _ S _ S _ U _ M _ E _ D  !!!!!
              ENERGY EQUATION  N_O_T  B_A_L_A_N_C_E_D  AT SECID "APPRO"
                   WSBEG,WSEND,CRWS =     97.52     103.74      97.52

APPRO:AS      49.   -19.     279.  0.54 *****   98.06   97.52   1460.   97.52
       49.    49.   199.   14125.  1.27 ***** *******    0.92    5.24
         <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

 ===215 FLOW CLASS 1 SOLUTION INDICATES POSSIBLE ROAD OVERFLOW.
           WS1,WSSD,WS3,RGMIN =   100.38       0.00      96.71      97.69

 ===260 ATTEMPTING FLOW CLASS 4 SOLUTION.

 ===240 NO DISCHARGE BALANCE IN 15 ITERATIONS.
                   WS,QBO,QRD =   100.05         0.      1460.

 ===280 REJECTED FLOW CLASS 4 SOLUTION.

 ===245 ATTEMPTING FLOW CLASS 2 (5) SOLUTION.

            <<<<<RESULTS REFLECTING THE CONSTRICTED FLOW FOLLOW>>>>>

 XSID:CODE   SRDL    LEW     AREA   VHD    HF     EGL    CRWS       Q    WSEL
       SRD   FLEN    REW        K  ALPH    HO     ERR     FR#     VEL

BRIDG:BR      72.     0.     137.  0.76 *****   98.66   95.44    958.   97.90
        0. ******    22.   10443.  1.00 ***** *******    0.48    6.98

     TYPE PPCD FLOW      C    P/A    LSEL   BLEN   XLAB   XRAB
       1. ****   5.  0.424  0.000   97.90 ****** ****** ******

    XSID:CODE    SRD   FLEN    HF   VHD     EGL     ERR       Q    WSEL
   RDWAY:RG      11.    35.  0.04  0.10   99.01    0.02    523.   98.79

            Q   WLEN    LEW    REW  DMAX  DAVG  VMAX  VAVG  HAVG  CAVG
   LT:     0.   113.  -101.    12.   0.9   0.5   4.4   5.9   1.1   2.9
   RT:   523.   133.    51.   185.   1.1   1.0   4.8   3.9   1.2   2.9

 XSID:CODE   SRDL    LEW     AREA   VHD    HF     EGL    CRWS       Q    WSEL
       SRD   FLEN    REW        K  ALPH    HO     ERR     FR#     VEL

APPRO:AS      21.   -51.     614.  0.10  0.10   99.05   97.52   1460.   98.95
       49.    33.   199.   44206.  1.14  0.00    0.02    0.29    2.38

  FIRST USER DEFINED TABLE.
    XSID:CODE    SRD    LEW    REW       Q        K     AREA     VEL    WSEL
   EXITX:XS     -72.   -47.   164.   1460.   11192.     335.    4.36   95.35
   FULLV:FV       0.   -50.   164.   1460.   14426.     407.    3.59   96.51
   BRIDG:BR       0.     0.    22.    958.   10443.     137.    6.98   97.90
   RDWAY:RG      11.*******     0.    523.       0.*********    2.00   98.79
   APPRO:AS      49.   -51.   199.   1460.   44206.     614.    2.38   98.95

 SECOND USER DEFINED TABLE.
    XSID:CODE     CRWS     FR#    YMIN    YMAX    HF    HO   VHD      EGL    WSEL
   EXITX:XS      95.23    0.82   90.22  100.00************  0.53    95.89   95.35
   FULLV:FV   ********    0.59   91.03  100.81  0.95  0.00  0.34    96.84   96.51
   BRIDG:BR      95.44    0.48   90.57   97.96************  0.76    98.66   97.90
   RDWAY:RG   ****************   97.69  103.00  0.04******  0.10    99.01   98.79
   APPRO:AS      97.52    0.29   91.37  103.74  0.10  0.00  0.10    99.05   98.95
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        U.S. GEOLOGICAL SURVEY WSPRO INPUT FILE brid033.wsp
        CREATED ON 09-NOV-95 FOR BRIDGE BRIDTH00050033 USING FILE brid033.dca
        HYDRAULIC ANALYSIS OF BRID033      SAO
           *** RUN DATE & TIME: 11-27-95  12:03

 XSID:CODE   SRDL    LEW     AREA   VHD    HF     EGL    CRWS       Q    WSEL
       SRD   FLEN    REW        K  ALPH    HO     ERR     FR#     VEL

EXITX:XS   ******   -52.     435.  0.57 *****   96.39   95.60   2060.   95.82
      -72. ******   164.   15790.  1.63 ***** *******    0.75    4.73

FULLV:FV      72.   -55.     512.  0.39  0.98   97.38 *******   2060.   96.99
        0.    72.   164.   19751.  1.53  0.00    0.00    0.57    4.02
         <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

 ===125 FR# EXCEEDS FNTEST AT SECID "APPRO":  TRIALS CONTINUED.
              FNTEST,FR#,WSEL,CRWS =  0.80    2.07      97.06      97.81

 ===110 WSEL NOT FOUND AT SECID "APPRO":  REDUCED DELTAY.
                   WSLIM1,WSLIM2,DELTAY =    96.49     103.74    0.50

 ===115 WSEL NOT FOUND AT SECID "APPRO":  USED WSMIN = CRWS.
                   WSLIM1,WSLIM2,CRWS =    96.49     103.74      97.81

 ===130 CRITICAL WATER-SURFACE ELEVATION  A _ S _ S _ U _ M _ E _ D  !!!!!
              ENERGY EQUATION  N_O_T  B_A_L_A_N_C_E_D  AT SECID "APPRO"
                   WSBEG,WSEND,CRWS =    97.81     103.74      97.81

APPRO:AS      49.   -26.     342.  0.66 *****   98.47   97.81   2060.   97.81
       49.    49.   199.   18573.  1.18 ***** *******    0.93    6.02
         <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

 ===215 FLOW CLASS 1 SOLUTION INDICATES POSSIBLE ROAD OVERFLOW.
           WS1,WSSD,WS3,RGMIN =   102.69       0.00      97.94      97.69

 ===260 ATTEMPTING FLOW CLASS 4 SOLUTION.

 ===240 NO DISCHARGE BALANCE IN 15 ITERATIONS.
                   WS,QBO,QRD =   100.45         0.      2060.

 ===280 REJECTED FLOW CLASS 4 SOLUTION.

 ===245 ATTEMPTING FLOW CLASS 2 (5) SOLUTION.

            <<<<<RESULTS REFLECTING THE CONSTRICTED FLOW FOLLOW>>>>>

 XSID:CODE   SRDL    LEW     AREA   VHD    HF     EGL    CRWS       Q    WSEL
       SRD   FLEN    REW        K  ALPH    HO     ERR     FR#     VEL

BRIDG:BR      72.     0.     137.  0.99 *****   98.89   95.79   1095.   97.90
        0. ******    22.   10443.  1.00 ***** *******    0.55    7.98

     TYPE PPCD FLOW      C    P/A    LSEL   BLEN   XLAB   XRAB
       1. ****   5.  0.455  0.000   97.90 ****** ****** ******

    XSID:CODE    SRD   FLEN    HF   VHD     EGL     ERR       Q    WSEL
   RDWAY:RG      11.    35.  0.04  0.14   99.59    0.00    966.   99.28

            Q    WLEN    LEW    REW  DMAX  DAVG  VMAX  VAVG  HAVG  CAVG
   LT:     0.     11.   -53.   -42.   0.1   0.0   2.5  16.5   0.4   2.6
   RT:   966.    144.    41.   185.   1.6   1.4   5.9   4.8   1.7   3.0

 XSID:CODE   SRDL    LEW     AREA   VHD    HF     EGL    CRWS       Q    WSEL
       SRD   FLEN    REW        K  ALPH    HO     ERR     FR#     VEL

APPRO:AS      21.   -63.     753.  0.14  0.14   99.63   97.81   2060.   99.50
       49.    36.   199.   60451.  1.18  0.00    0.00    0.31    2.73

  FIRST USER DEFINED TABLE.

    XSID:CODE    SRD    LEW    REW       Q        K     AREA     VEL    WSEL
   EXITX:XS     -72.   -52.   164.   2060.   15790.     435.    4.73   95.82
   FULLV:FV       0.   -55.   164.   2060.   19751.     512.    4.02   96.99
   BRIDG:BR       0.     0.    22.   1095.   10443.     137.    7.98   97.90
   RDWAY:RG      11.*******     0.    966.       0.*********    2.00   99.28
   APPRO:AS      49.   -63.   199.   2060.   60451.     753.    2.73   99.50

 SECOND USER DEFINED TABLE.
    XSID:CODE    CRWS     FR#    YMIN    YMAX    HF    HO   VHD     EGL    WSEL
   EXITX:XS     95.60    0.75   90.22  100.00************  0.57   96.39   95.82
   FULLV:FV  ********    0.57   91.03  100.81  0.98  0.00  0.39   97.38   96.99
   BRIDG:BR     95.79    0.55   90.57   97.96************  0.99   98.89   97.90
   RDWAY:RG  ****************   97.69  103.00  0.04******  0.14   99.59   99.28
   APPRO:AS     97.81    0.31   91.37  103.74  0.14  0.00  0.14   99.63   99.50
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        U.S. GEOLOGICAL SURVEY WSPRO INPUT FILE brid033.wsp
        CREATED ON 09-NOV-95 FOR BRIDGE BRIDTH00050033 USING FILE brid033.dca
        HYDRAULIC ANALYSIS OF BRID033     SAO
           *** RUN DATE & TIME: 11-27-95  12:03
 XSID:CODE   SRDL    LEW     AREA   VHD    HF     EGL    CRWS       Q    WSEL
       SRD   FLEN    REW        K  ALPH    HO     ERR     FR#     VEL

EXITX:XS   ******   -44.     267.  0.52 *****   95.55   94.99   1110.   95.03
      -72. ******   164.    8513.  1.93 ***** *******    0.90    4.16

FULLV:FV      72.   -47.     336.  0.31  0.93   96.48 *******   1110.   96.17
        0.    72.   164.   11238.  1.80  0.00    0.00    0.62    3.30
         <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

 ===125 FR# EXCEEDS FNTEST AT SECID "APPRO":  TRIALS CONTINUED.
              FNTEST,FR#,WSEL,CRWS =  0.80    0.90      96.49      96.08

 ===110 WSEL NOT FOUND AT SECID "APPRO":  REDUCED DELTAY.
                   WSLIM1,WSLIM2,DELTAY =    95.67     103.74    0.50

 ===115 WSEL NOT FOUND AT SECID "APPRO":  USED WSMIN = CRWS.
                   WSLIM1,WSLIM2,CRWS =    95.67     103.74      96.08

 ===135 CONVEYANCE RATIO OUTSIDE OF RECOMMENDED LIMITS.
                             "APPRO"     KRATIO =  0.62

APPRO:AS      49.    -8.     130.  1.19  0.77   97.69   96.08   1110.   96.50
       49.    49.    36.    6972.  1.05  0.44    0.00    0.90    8.57
         <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

 ===215 FLOW CLASS 1 SOLUTION INDICATES POSSIBLE ROAD OVERFLOW.
           WS1,WSSD,WS3,RGMIN =    98.98       0.00      95.91      97.69

 ===260 ATTEMPTING FLOW CLASS 4 SOLUTION.

 ===240 NO DISCHARGE BALANCE IN 15 ITERATIONS.
                   WS,QBO,QRD =    99.73         0.      1110.

 ===280 REJECTED FLOW CLASS 4 SOLUTION.

 ===245 ATTEMPTING FLOW CLASS 2 (5) SOLUTION.

 ===250 INSUFFICIENT HEAD FOR PRESSURE FLOW.
                        YU/Z,WSIU,WS = 1.10      98.53      98.58

 ===270 REJECTED FLOW CLASS 2 (5) SOLUTION.

            <<<<<RESULTS REFLECTING THE CONSTRICTED FLOW FOLLOW>>>>>

 XSID:CODE   SRDL    LEW     AREA   VHD    HF     EGL    CRWS       Q    WSEL
       SRD   FLEN    REW        K  ALPH    HO     ERR     FR#     VEL

BRIDG:BR      72.     0.      95.  2.13  1.70   98.04   90.77   1110.   95.91
        0.    72.    22.    6140.  1.00  0.79    0.00    0.98   11.70

     TYPE PPCD FLOW      C    P/A    LSEL   BLEN   XLAB   XRAB
       1. ****   1.  1.000 ******   97.90 ****** ****** ******

    XSID:CODE     SRD   FLEN    HF   VHD      EGL     ERR       Q    WSEL
   RDWAY:RG      11.         <<<<<EMBANKMENT IS NOT OVERTOPPED>>>>>

 XSID:CODE   SRDL    LEW     AREA   VHD    HF     EGL    CRWS       Q    WSEL
       SRD   FLEN    REW        K  ALPH    HO     ERR     FR#     VEL

APPRO:AS      21.   -52.     623.  0.06  0.10   99.04   96.08   1110.   98.99
       49.    23.   199.   45214.  1.14  0.90    0.00    0.21    1.78

       M(G)   M(K)       KQ   XLKQ   XRKQ    OTEL
      0.512  0.696   13738.     4.    26.    98.96

  FIRST USER DEFINED TABLE.
    XSID:CODE     SRD    LEW    REW       Q        K     AREA     VEL    WSEL
   EXITX:XS     -72.   -44.   164.   1110.    8513.     267.    4.16   95.03
   FULLV:FV       0.   -47.   164.   1110.   11238.     336.    3.30   96.17
   BRIDG:BR       0.     0.    22.   1110.    6140.      95.   11.70   95.91
   RDWAY:RG      11.**************      0.       0.*********    2.00********
   APPRO:AS      49.   -52.   199.   1110.   45214.     623.    1.78   98.99

 SECOND USER DEFINED TABLE.
    XSID:CODE    CRWS     FR#    YMIN    YMAX    HF    HO   VHD     EGL    WSEL
   EXITX:XS     94.99    0.90   90.22  100.00************  0.52   95.55   95.03
   FULLV:FV  ********    0.62   91.03  100.81  0.93  0.00  0.31   96.48   96.17
   BRIDG:BR     90.77    0.98   90.57   97.96  1.70  0.79  2.13   98.04   95.91
   RDWAY:RG  ****************   97.69  103.00************  0.08   98.63********
   APPRO:AS     96.08    0.21   91.37  103.74  0.10  0.90  0.06   99.04   98.99
```
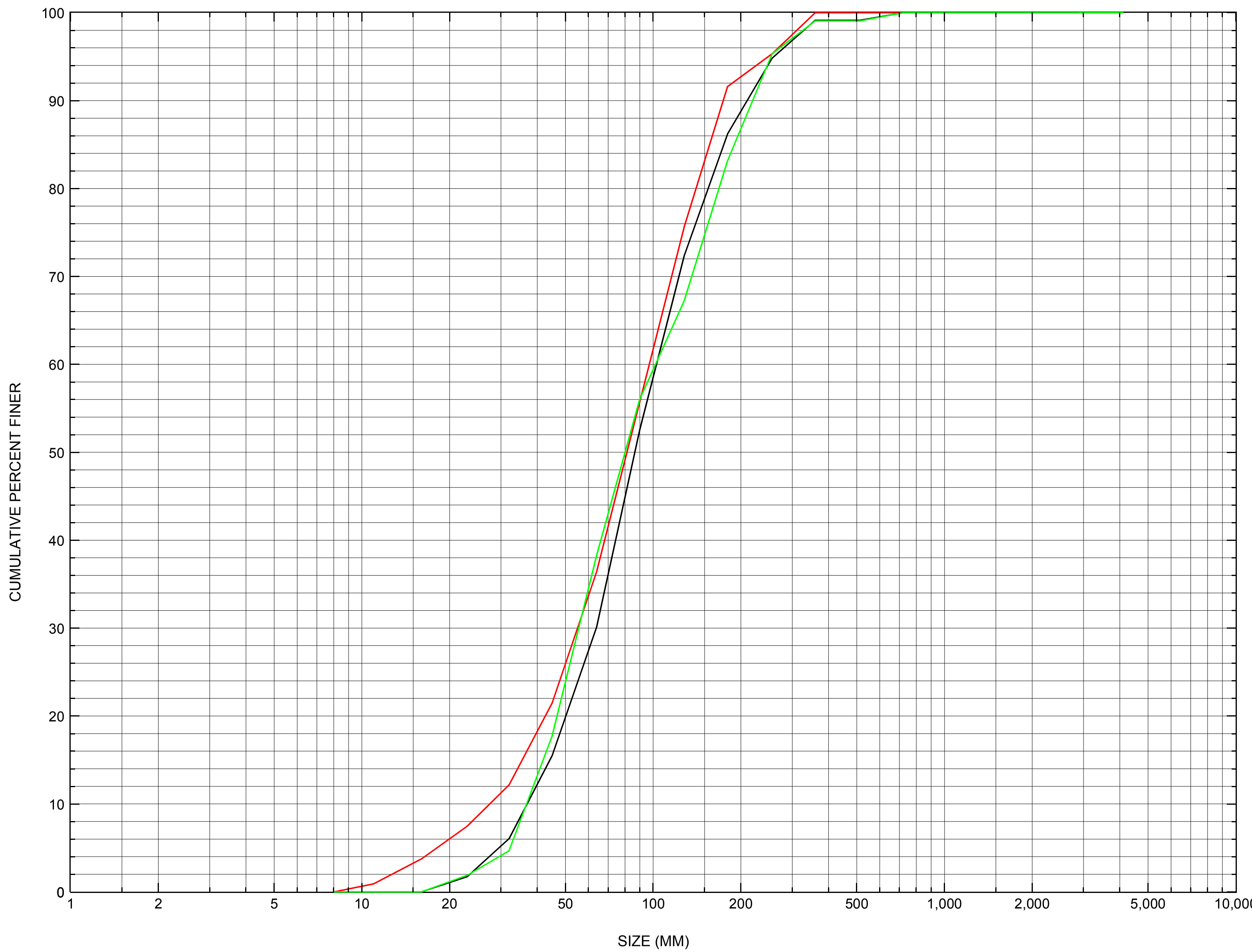

APPENDIX C:

BED-MATERIAL PARTICAL-SIZE DISTRIBUTION



Appendix C. Bed material particle-size distributions for three pebble count transects at the approach cross-section for structure BRIDTH00050033, in Bridgewater, Vermont.

APPENDIX D:

HISTORICAL DATA FORM