LEVEL II SCOUR ANALYSIS FOR BRIDGE 12 (BRAITH00230012) on TOWN HIGHWAY 23, crossing AYERS BROOK, BRAINTREE, VERMONT

U.S. Geological Survey
Open-File Report 96-390

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

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By SCOTT A. OLSON

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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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Denver, CO 80225

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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 12 (BRAITH00230012) ON TOWN HIGHWAY 23, CROSSING AYERS BROOK, BRAINTREE, VERMONT

***By* Scott A. Olson**

INTRODUCTION AND SUMMARY OF RESULTS

This report provides the results of a detailed Level II analysis of scour potential at structure BRAITH00230012 on town highway 23 crossing Ayers Brook, Braintree, 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). A Level I study is included in Appendix E of this report. A Level I study provides a qualitative geomorphic characterization of the study site. Information on the bridge available from VTAOT files was compiled prior to conducting Level I and Level II analyses and can be found in Appendix D.

The site is in the Green Mountain physiographic province of central Vermont in the town of Braintree. The 18.8-mi^2 drainage area is in a predominantly rural watershed. In the vicinity of the study site, the surface cover of the left and right banks is pasture .

In the study area, Ayers Brook has a meandering channel with a slope of approximately 0.003 ft/ft, an average channel top width of 46 ft and an average channel depth of 5 ft. The predominant channel bed material is sand and gravel (D_{50} is 6.15 mm or 0.0202 ft). The geomorphic assessment at the time of the Level I and Level II site visit on November 16, 1994, indicated that the reach was laterally unstable. Also at the time of the site visit, there was considerable backwater at the bridge site due to a beaver dam downstream. The beaver dam was ignored in the analyses.

The town highway 23 crossing of Ayers Brook is a 28-ft-long, one-lane bridge consisting of one 23-foot span (Vermont Agency of Transportation, written communication, August 24, 1994). The bridge is supported by vertical timber cribwork abutments with wingwalls on the upstream and downstream sides of the right abutment. The lower half of the right abutment and wingwalls are constructed of laid-up stone. The right abutment and wingwalls are also protected by stone fill. The channel is skewed approximately 45 degrees to the opening while the opening-skew-to-roadway is only 5 degrees. 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 4.2 to 9.4 ft. The worst-case contraction scour occurred at the incipient-overtopping discharge which was less than the 100-year discharge. Abutment scour ranged from 4.3 to 17.5 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, 1993, p. 48). 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.

Randolph, VT. Quadrangle, 1:24,000, 1966

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 BRAITH00230012 ***Stream*** Ayers Brook

County Orange ***Road*** TH023 ***District*** 04

Description of Bridge

Bridge length 28 ***ft*** ***Bridge width*** 16.5 ***ft*** ***Max span length*** 23 ***ft***

Alignment of bridge to road (on curve or straight) moderate curve on right approach

Abutment type Wood crib, laid-up stone ***Embankment type*** vertical (L), sloping(R)

Stone fill on abutment? on right ***Date of inspection*** 11/16/94

Description of stone fill There is type II protection on the right abutment and downstream right wingwall and type I protection on the upstream right wingwall. Stone fill appears to have slumped into the main channel from the banks and toes of the banks.

There is a stone laid-up wall extending from the upstream end of the left abutment to about 75 feet upstream. This is protecting the roadway from being cut into by the channel. Part of right abutment is laid-up stone.

Is bridge skewed to flood flow according to Y ***survey?*** Y ***Angle*** 45

Ayers Brook is a meandering channel and there is a severe bend in the channel at the entrance to the bridge opening.

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*
	11/16/94	0	0
Level I	same	-	-

Level II High due to severe bank cutting along channel meanders with some trees along the top of bank leaning over the brook.

Potential for debris

The lateral instability of the channel may cause the additional misalignment with the bridge.

Describe any features near or at the bridge that may affect flow (include observation date)

High debris potential could also affect flow.

Description of the Geomorphic Setting

General topography Moderate relief valley with wide floodplains; stream meanders and anabranches throughout the wide valley.

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

Date of inspection 11/16/94

DS left: wide floodplain

DS right: narrow flood plain to valley wall

US left: wide floodplain

US right: narrow flood plain to valley wall

Description of the Channel

Average top width 46 *ft*

Average depth 5 *ft*

Predominant bed material gravel

Bank material gravel

meandering, with wide flood plains. It is alluvial and laterally unstable.

11/16/94

Vegetative co Pasture

DS left: Pasture

DS right: Pasture

US left: Pasture

US right: N

Do banks appear stable? 11/16/94--Cut-banks are common along this reach of the brook. ***If not, describe location and type of instability and date of observation.***

Lateral instability is a concern especially due to the severe bend at the channel entrance to the bridge opening.

11/16/94--There is a beaver dam about 140 feet downstream of the bridge.

Describe any obstructions in channel and date of observation.

Hydrology

Drainage area 18.8 ***mi²***

Percentage of drainage area in physiographic provinces: (approximate)

Physiographic province	*Percent of drainage area*
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? Yes

USGS gage description Ayers Brook at Randolph, VT

USGS gage number 01142500

Gage drainage area 30.5 ***mi²***

Is there a lake/p No

Calculated Discharges

Q100 1,670 ***ft³/s*** ***Q500*** 2,360 ***ft³/s***

Discharges were determined from a drainage area relationship with flood frequency determinations at the Ayers Brook gaging station. The discharges at the gaging station were determined from a statistical analysis of the long term continuous flow record (Interagency Advisory Committee on Water Data, 1982).

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 N/A

Description of reference marks used to determine USGS datum. RM1 is near the downstream left corner of the bridge. It is the head of a spike in the top streamward end of the topmost log in the abutment cribwork. The arbitrary survey elevation is 999.86 feet

Cross-Sections Used in WSPRO Analysis

[1]*Cross-section*	*Section Reference Distance (SRD) in feet*	[2]*Cross-section development*	*Comments*
EXIT1	-52	1	Exit section
FULLV	0	2	Downstream Full-valley section (Templated from EXIT1)
BRIDG	0	1	Bridge section
RDWAY	10	1	Road Grade section
APPR	46	1	Approach section

[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. 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, Jr. and Schneider (1989). Final adjustments to the values were made during the modelling of the reach. Channel "n" values for the reach ranged from 0.034 to 0.050, and overbank "n" values ranged from 0.030 to 0.040.

Normal depth at the exit section (EXIT1) 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 0.003 ft/ft which was determined from surveyed thalweg points downstream of the bridge.

The surveyed approach section (APPR) was surveyed 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.

For the incipient overtopping model, WSPRO assumes critical depth at the bridge section. Further analysis, in which the water surface is shown to pass through critical depth in the bridge, suggests the critical depth assumption at the bridge section is a satisfactory solution.

Bridge Hydraulics Summary

Average bridge embankment elevation 1000.1 *ft*
Average low steel elevation 999.3 *ft*

100-year discharge 1,670 *ft³/s*
Water-surface elevation in bridge opening 999.5 *ft*
Road overtopping? yes *Discharge over road* 700 *ft³/s*
Area of flow in bridge opening 148 *ft²*
Average velocity in bridge opening 6.6 *ft/s*
Maximum WSPRO tube velocity at bridge 8.4 *ft/s*

Water-surface elevation at Approach section with bridge 1000.2
Water-surface elevation at Approach section without bridge 996.2
Amount of backwater caused by bridge 4.0 *ft*

500-year discharge 2,360 *ft³/s*
Water-surface elevation in bridge opening 999.5 *ft*
Road overtopping? yes *Discharge over road* 1237 *ft³/s*
Area of flow in bridge opening 148 *ft²*
Average velocity in bridge opening 7.5 *ft/s*
Maximum WSPRO tube velocity at bridge 9.6 *ft/s*

Water-surface elevation at Approach section with bridge 1000.7
Water-surface elevation at Approach section without bridge 996.7
Amount of backwater caused by bridge 4.0

Incipient overtopping discharge 1,215 *ft³/s*
Water-surface elevation in bridge opening 995.5 *ft*
Area of flow in bridge opening 89.0 *ft²*
Average velocity in bridge opening 13.6 *ft/s*
Maximum WSPRO tube velocity at bridge 17.8 *ft/s*

Water-surface elevation at Approach section with bridge 998.9
Water-surface elevation at Approach section without bridge 995.7
Amount of backwater caused by bridge 3.2 *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.

The 100-year and 500-year discharges resulted in unsubmerged orifice flow. Contraction scour at bridges with orifice flow is best estimated by use of the Chang pressure-flow equation (oral communication, J. Sterling Jones, October 4, 1996). Therefore, contraction scour for the 100-year and 500-year discharges was computed by use of the Chang equation (Richardson and others, 1995, p. 145-146). The results of Laursen's clear-water contraction scour for the 100-year and 500-year events were also computed and can be found in appendix F. For the incipient road-overflow discharge, contraction scour was computed by use of the clear-water contraction scour equation (Richardson and others, 1993, p. 35, equation 18). Worst case contraction scour was at the incipient road overtopping discharge. The worst case total scour occurred at the 500-year discharge.

Because of the streambed's fine material composition, armoring was not applicable at this site, except for the 100-year discharge.

Abutment scour for the right abutment was computed by use of the Froehlich equation (Richardson and others, 1993, p. 49, equation 24). Variables for the Froehlich 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.

Scour at the left abutment was computed by use of the HIRE equation (Richardson and others, 1993, p. 50, equation 25) because the HIRE equation is recommended when the length to depth ratio of the embankment blocking flow exceeds 25. The variables used by the HIRE abutment-scour equation are defined the same as those defined for the Froehlich abutment-scour equation.

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	4.2	6.2	9.4
Depth to armoring	3.4	N/A	N/A
Left overbank	--	--	--
Right overbank	--	--	--

Local scour:	100-yr discharge	500-yr discharge	Incipient overtopping discharge
Abutment scour			
Left abutment	5.2	5.8	4.3
Right abutment	15.2	17.5	13.4
Pier scour			
Pier 1	--	--	--
Pier 2	--	--	--
Pier 3	--	--	--

Rock Riprap Sizing

	100-yr discharge	500-yr discharge	Incipient overtopping discharge
		(D_{50} in feet)	
Abutments:			
Left abutment	1.2	1.5	2.3
Right abutment	1.2	1.5	2.3
Piers:			
Pier 1	--	--	--
Pier 2	--	--	--

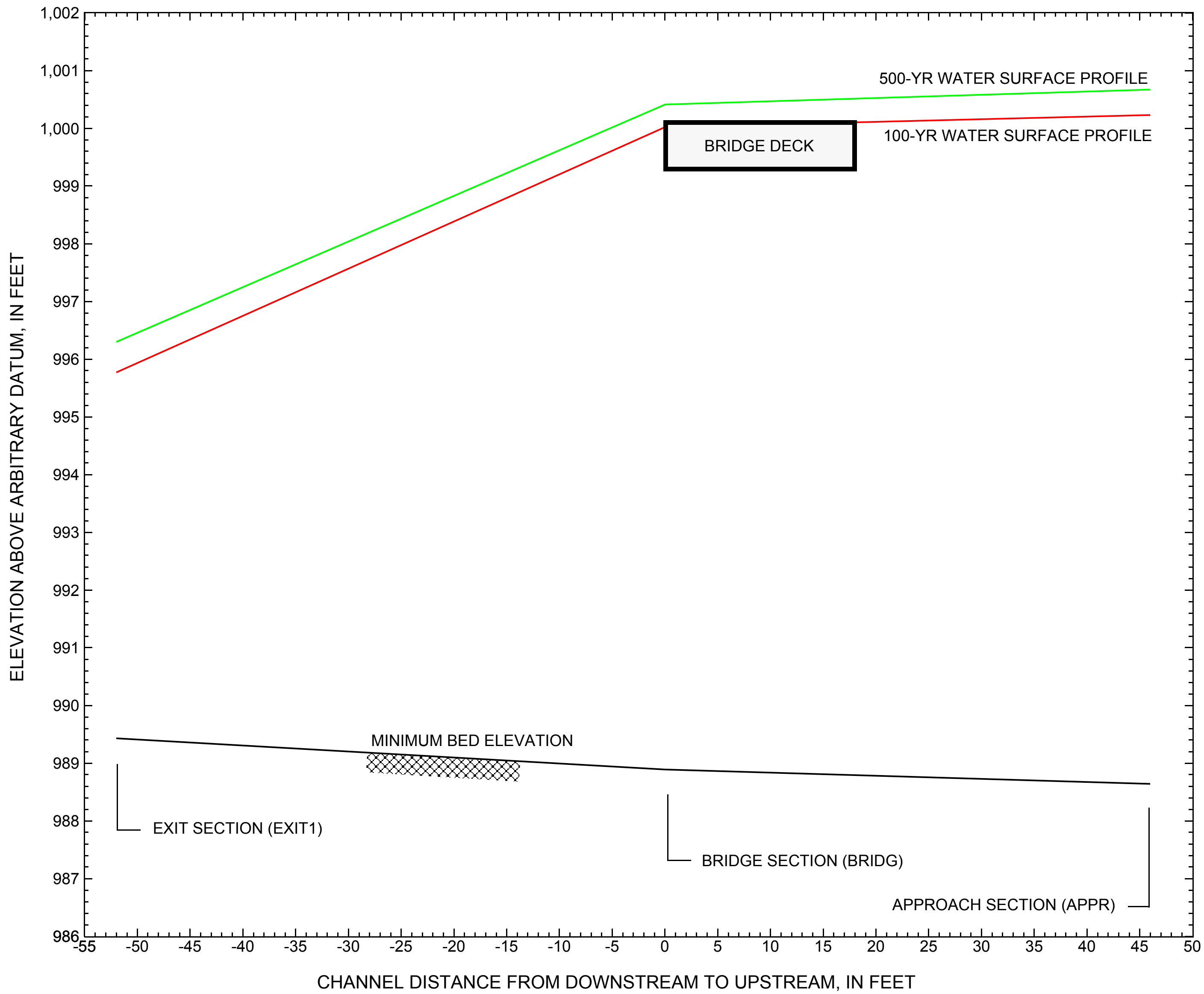

Figure 7. Water-surface profiles for the 100- and 500-yr discharges at structure BRAITH00230012 on town highway 23, crossing Ayers Brook, Braintree, Vermont.

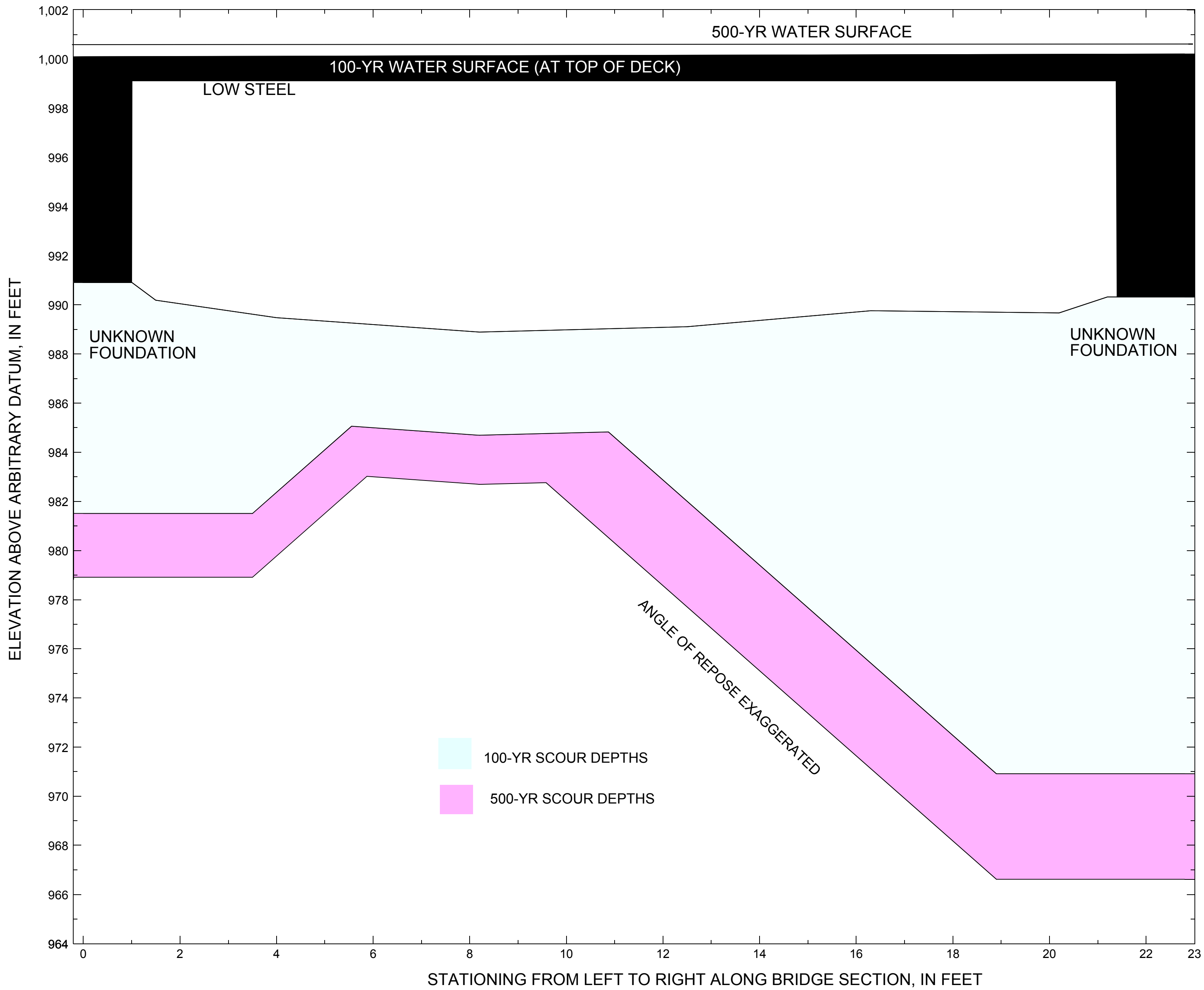

Figure 8. Scour elevations for the 100-yr and 500-yr discharges at structure BRAITH00230012 on town highway 23, crossing Ayers Brook, Braintree, Vermont.

Table 1. Remaining footing/pile depth at abutments for the 100-year discharge at structure BRAITH00230012 on Town Highway 23, crossing Ayers Brook, Braintree, Vermont.

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

Description	Station[1]	VTAOT minimum low-chord 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 1,670 cubic-feet per second											
Left abutment	1.0	--	999.5	--	990.9	4.2	5.2	--	9.4	981.5	--
Right abutment	21.4	--	999.1	--	990.3	4.2	15.2	--	19.4	970.9	--

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 BRAITH00230012 on Town Highway 23, crossing Ayers Brook, Braintree, Vermont.

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

Description	Station[1]	VTAOT minimum low-chord 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 2,360 cubic-feet per second											
Left abutment	1.0	--	999.5	--	990.9	6.2	5.8	--	12.0	978.9	--
Right abutment	21.4	--	999.1	--	990.3	6.2	17.5	--	23.7	966.6	--

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

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Shearman, J.O., Kirby, W.H., Schneider, V.R., and Flippo, H.N., 1986, Bridge waterways analysis model; research report: Federal Highway Administration Publication FHWA-RD-86-108, 112 p.

U.S. Department of Transportation, 1993, Stream stability and scour at highway bridges, Participant Workbook: Federal Highway Administration Publication FHWA HI-91-011.

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

APPENDIX A:

WSPRO INPUT FILE

WSPRO INPUT FILE

```
T1        U.S. GEOLOGICAL SURVEY WSPRO INPUT FILE brai012.wsp
T2        CREATED ON 27-APR-95 FOR BRIDGE BRAITH00230012 USING FILE brai012.dca
T3        HYDRAULIC ANALYSIS OF BRAI012 OVER AYERS BROOK IN BRAINTREE, VT
*
J3         6 29 30 552 553 551 5 16 17 13 3 * 15 14 23 21 11 12 4 7 3
*
Q          1670 2360 1215
SK         0.003 0.003 0.003
*
XS   EXIT1    -52
GR         -257.5,1001.94   -201.7, 997.43   -157.4, 995.11
GR            0.0, 995.33      4.8, 994.75      8.2, 992.10      8.7, 989.84
GR           11.3, 989.43     19.3, 989.99     29.4, 990.56     34.4, 991.37
GR           47.7, 991.76     56.7, 991.31     58.8, 992.04     65.8, 994.91
GR           80.8, 994.45     81.7, 994.21     87.4, 995.46    101.4, 996.54
GR          149.5, 996.94    169.4,1004.29
N           0.032         0.040         0.032
SA                  4.8          65.8
*
*             Expansion coefficient increased from default 0.5 to 1.0
*             between the full valley section and the approach due to
*             approach being much more constricting than the exit section.
*             This will only affect the unconstricted model run and will not
*             change the results of the profile through the bridge.
*
XS   FULLV      0 * 1.0 * 0.003
*
BR   BRIDG     0 999.3 45
GR            0.0, 999.46      1.0, 990.91      1.5, 990.19      4.0, 989.48
GR            8.2, 988.89     12.5, 989.11     16.3, 989.76     20.2, 989.67
GR           21.2, 990.32     21.4, 992.09     22.8, 999.12      0.0, 999.46
N            0.034
CD            1 19 * * 17.5 2.5
*
XR   RDWAY    10 16 2
GR         -257.5,1001.94   -207.3, 999.12
GR          -60.2, 998.86    -10.9,1000.48      0.0,1000.02     26.1,1000.27
GR           48.3,1001.65    100.3,1003.51    154.1,1006.67    209.0,1009.36
BP            0
*
*           actual approach stationing was 86 feet but bed from bridge to
*           approach was 0 grade so changing SRD to 46.  Also changing the
*           graphical estimate of BP=65 to value below for curvilinear flow
*
AS   APPR      46
GR           -257,1001.9    -168.9, 997.15   -122.6, 998.33
GR            0.0, 996.50      2.4, 992.17      6.9, 989.73     11.8, 990.16
GR           19.1, 988.64     23.0, 988.79     24.9, 989.29     27.8, 992.14
GR           30.7, 995.47     38.2, 995.33     99.3, 995.31    126.8, 996.78
GR          154.6,1008.81
N            0.040 0.050 0.030
SA                0     30.7
BP           2.4 27.8 14 62
*
HP 2 BRIDG   999.46  * * 971
HP 2 RDWAY   1000.02 * * 700
HP 1 APPR    1000.23 1 1000.23
HP 2 APPR    1000.23 * * 1670
*
HP 1 BRIDG   999.46  1  999.46
HP 2 BRIDG   999.46  * * 1112
HP 2 RDWAY   1000.41 * * 1237
```

APPENDIX B:

WSPRO OUTPUT FILE

WSPRO OUTPUT FILE

```
        U.S. GEOLOGICAL SURVEY WSPRO INPUT FILE brai012.wsp
        CREATED ON 27-APR-95 FOR BRIDGE BRAITH00230012 USING FILE brai012.dca
        HYDRAULIC ANALYSIS OF BRAI012 OVER AYERS BROOK IN BRAINTREE, VT
           *** RUN DATE & TIME: 06-09-95  09:00
    CROSS-SECTION PROPERTIES:  ISEQ =  3;  SECID = BRIDG;  SRD =       0.
     WSEL  SA#     AREA        K   TOPW   WETP  ALPH    LEW    REW     QCR
             1     148.   13619.     0.    49.                          0.
   999.46          148.   13619.     0.    49.  1.00     0.    23.      0.

    VELOCITY DISTRIBUTION:  ISEQ =  3;  SECID = BRIDG;  SRD =       0.
        WSEL     LEW     REW    AREA        K        Q    VEL
      999.46     0.0    22.8   148.3   13619.     971.   6.55

X STA.        0.0         2.8         4.0         5.1         6.0         6.9
  A(I)             14.7         8.6         7.3         6.9         6.4
  V(I)             3.29        5.64        6.67        7.00        7.56

X STA.        6.9         7.8         8.6         9.4        10.2        11.0
  A(I)              6.1         5.9         6.0         5.9         5.8
  V(I)             7.91        8.19        8.15        8.29        8.33

X STA.       11.0        11.8        12.6        13.4        14.3        15.2
  A(I)              5.8         6.0         5.9         6.2         6.3
  V(I)             8.36        8.15        8.27        7.81        7.71

X STA.       15.2        16.2        17.2        18.4        19.7        22.8
  A(I)              6.6         6.9         7.5         8.6        14.7
  V(I)             7.31        7.06        6.44        5.62        3.30

    VELOCITY DISTRIBUTION:  ISEQ =  4;  SECID = RDWAY;  SRD =      10.
        WSEL     LEW     REW    AREA        K        Q    VEL
     1000.02  -223.3   -24.9   179.2    7795.     700.   3.91

X STA.     -223.3      -201.6      -191.3      -181.6      -172.3      -163.5
  A(I)             12.4         9.4         9.1         8.9         8.6
  V(I)             2.82        3.72        3.84        3.95        4.09

X STA.     -163.5      -154.7      -146.3      -138.0      -130.0      -122.1
  A(I)              8.6         8.4         8.5         8.2         8.3
  V(I)             4.07        4.16        4.14        4.27        4.22

X STA.     -122.1      -114.4      -106.8       -99.3       -92.0       -84.7
  A(I)              8.1         8.2         8.1         8.0         8.1
  V(I)             4.32        4.27        4.32        4.38        4.32

X STA.      -84.7       -77.4       -70.1       -62.6       -54.1       -24.9
  A(I)              8.2         8.3         8.5         9.2        14.0
  V(I)             4.25        4.21        4.10        3.79        2.49
      CROSS-SECTION PROPERTIES:  ISEQ =  5;  SECID = APPR ;  SRD =      46.
     WSEL  SA#     AREA        K   TOPW   WETP  ALPH    LEW    REW     QCR
             1     548.   36870.   226.   226.                       4847.
             2     298.   35766.    31.    37.                       5262.
             3     465.   62364.   104.   105.                       5579.
  1000.23         1311.  135000.   361.   368.  1.26  -226.   135.  12633.

    VELOCITY DISTRIBUTION:  ISEQ =  5;  SECID = APPR ;  SRD =      46.
        WSEL     LEW     REW    AREA        K        Q    VEL
     1000.23  -226.0   134.8  1311.2  135000.    1670.   1.27

X STA.     -226.0      -156.7      -108.7       -66.2       -35.1       -10.2
  A(I)            123.7       107.4       103.1        92.2        84.7
  V(I)             0.67        0.78        0.81        0.91        0.99

X STA.      -10.2         5.7        10.9        15.7        19.9        24.0
  A(I)             81.2        53.0        50.3        47.1        47.7
  V(I)             1.03        1.57        1.66        1.77        1.75

X STA.       24.0        33.1        42.8        52.5        62.0        71.7
  A(I)             67.1        47.0        48.0        46.6        47.5
  V(I)             1.24        1.78        1.74        1.79        1.76

X STA.       71.7        81.6        91.4       101.3       113.1       134.8
  A(I)             48.6        47.8        48.9        53.2        65.8
  V(I)             1.72        1.75        1.71        1.57        1.27
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        U.S. GEOLOGICAL SURVEY WSPRO INPUT FILE brai012.wsp
        CREATED ON 27-APR-95 FOR BRIDGE BRAITH00230012 USING FILE brai012.dca
        HYDRAULIC ANALYSIS OF BRAI012 OVER AYERS BROOK IN BRAINTREE, VT
           *** RUN DATE & TIME: 06-09-95  09:00
    CROSS-SECTION PROPERTIES:  ISEQ =  3;  SECID = BRIDG;  SRD =       0.
     WSEL  SA#     AREA        K   TOPW   WETP  ALPH    LEW    REW     QCR
             1     148.   13619.     0.    49.                          0.
   999.46          148.   13619.     0.    49.  1.00     0.    23.      0.

    VELOCITY DISTRIBUTION:  ISEQ =  3;  SECID = BRIDG;  SRD =       0.
         WSEL     LEW     REW    AREA        K        Q    VEL
       999.46     0.0    22.8   148.3   13619.    1112.   7.50

X STA.         0.0         2.8         4.0         5.1         6.0         6.9
  A(I)             14.7         8.6         7.3         6.9         6.4
  V(I)             3.77        6.46        7.64        8.01        8.65

X STA.         6.9         7.8         8.6         9.4        10.2        11.0
  A(I)              6.1         5.9         6.0         5.9         5.8
  V(I)             9.06        9.38        9.34        9.50        9.55

X STA.        11.0        11.8        12.6        13.4        14.3        15.2
  A(I)              5.8         6.0         5.9         6.2         6.3
  V(I)             9.57        9.33        9.47        8.94        8.83

X STA.        15.2        16.2        17.2        18.4        19.7        22.8
  A(I)              6.6         6.9         7.5         8.6        14.7
  V(I)             8.37        8.08        7.37        6.44        3.78
    VELOCITY DISTRIBUTION:  ISEQ =  4;  SECID = RDWAY;  SRD =      10.
         WSEL     LEW     REW    AREA        K        Q    VEL
      1000.41  -230.3    28.4   269.1   13481.    1237.   4.60

X STA.      -230.3      -204.6      -194.3      -184.7      -175.5      -166.7
  A(I)             18.3        13.5        12.6        12.3        11.9
  V(I)             3.38        4.58        4.89        5.03        5.19

X STA.      -166.7      -157.8      -149.3      -140.9      -132.6      -124.3
  A(I)             12.2        11.8        11.7        11.7        11.8
  V(I)             5.05        5.26        5.27        5.28        5.22

X STA.      -124.3      -116.2      -108.2      -100.3       -92.3       -84.3
  A(I)             11.7        11.8        11.6        11.9        12.0
  V(I)             5.31        5.26        5.33        5.20        5.17

X STA.       -84.3       -76.2       -67.9       -59.2       -46.8        28.4
  A(I)             12.2        12.8        13.3        16.3        27.6
  V(I)             5.06        4.83        4.64        3.79        2.24

    CROSS-SECTION PROPERTIES:  ISEQ =  5;  SECID = APPR ;  SRD =      46.
     WSEL  SA#     AREA        K   TOPW   WETP  ALPH    LEW    REW     QCR
             1     650.   47756.   234.   234.                       6140.
             2     311.   38511.    31.    37.                       5624.
             3     511.   72474.   105.   106.                       6396.
  1000.67         1472.  158741.   370.   377.  1.25  -234.   136.  14910.

    VELOCITY DISTRIBUTION:  ISEQ =  5;  SECID = APPR ;  SRD =      46.
         WSEL     LEW     REW    AREA        K        Q    VEL
      1000.67  -234.2   135.8  1472.0  158741.    2360.   1.60

X STA.      -234.2      -161.8      -122.7       -80.5       -48.1       -22.4
  A(I)            139.4       110.9       112.0       104.2        93.5
  V(I)             0.85        1.06        1.05        1.13        1.26

X STA.       -22.4        -0.2         8.5        13.9        18.8        23.3
  A(I)             88.6        77.4        58.2        55.5        54.3
  V(I)             1.33        1.52        2.03        2.13        2.17

X STA.        23.3        32.1        42.0        51.8        61.7        71.5
  A(I)             74.2        52.7        52.3        52.9        52.4
  V(I)             1.59        2.24        2.25        2.23        2.25

X STA.        71.5        81.5        91.4       101.4       113.4       135.8
  A(I)             53.5        52.7        53.8        58.9        74.5
  V(I)             2.20        2.24        2.19        2.00        1.58
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        U.S. GEOLOGICAL SURVEY WSPRO INPUT FILE brai012.wsp
        CREATED ON 27-APR-95 FOR BRIDGE BRAITH00230012 USING FILE brai012.dca
        HYDRAULIC ANALYSIS OF BRAI012 OVER AYERS BROOK IN BRAINTREE, VT
           *** RUN DATE & TIME: 06-09-95  09:00
    CROSS-SECTION PROPERTIES:  ISEQ =  3;  SECID = BRIDG;  SRD =       0.
     WSEL  SA#     AREA        K   TOPW   WETP  ALPH    LEW    REW     QCR
             1      89.    9066.    15.    25.                        1219.
   995.52           89.    9066.    15.    25.  1.00     0.    22.   1219.
      VELOCITY DISTRIBUTION:  ISEQ =  3;  SECID = BRIDG;  SRD =       0.
         WSEL     LEW     REW    AREA        K        Q    VEL
       995.52     0.5    22.1    89.0    9066.    1215.  13.65

X STA.         0.5        3.2        4.4        5.4        6.3        7.2
  A(I)            9.2        5.1        4.5        4.0        3.9
  V(I)           6.63      11.87      13.61      15.04      15.77

X STA.         7.2        7.9        8.7        9.4       10.2       10.9
  A(I)            3.7        3.5        3.5        3.4        3.4
  V(I)          16.51      17.45      17.39      17.70      17.80

X STA.        10.9       11.7       12.4       13.2       14.1       14.9
  A(I)            3.5        3.4        3.6        3.7        3.8
  V(I)          17.60      17.71      17.11      16.62      16.15

X STA.        14.9       15.9       16.9       18.0       19.2       22.1
  A(I)            3.9        4.2        4.5        5.2        9.3
  V(I)          15.71      14.52      13.46      11.65       6.55

    CROSS-SECTION PROPERTIES:  ISEQ =  5;  SECID = APPR ;  SRD =      46.
     WSEL  SA#     AREA        K   TOPW   WETP  ALPH    LEW    REW     QCR
             1     260.   11506.   201.   201.                        1679.
             2     256.   27860.    31.    37.                        4203.
             3     327.   35385.   101.   101.                        3335.
   998.88          843.   74751.   333.   339.  1.31  -201.   132.   6667.

    VELOCITY DISTRIBUTION:  ISEQ =  5;  SECID = APPR ;  SRD =      46.
         WSEL     LEW     REW    AREA        K        Q    VEL
       998.88  -201.0   131.7   843.1   74751.    1215.   1.44

X STA.      -201.0      -91.1      -34.5       -2.4        6.6       10.2
  A(I)          105.2       81.7       67.4       49.8       32.5
  V(I)           0.58       0.74       0.90       1.22       1.87

X STA.        10.2       13.7       16.8       19.7       22.5       25.8
  A(I)           30.8       29.5       29.0       28.7       31.9
  V(I)           1.97       2.06       2.10       2.12       1.90

X STA.        25.8       35.1       44.4       53.5       62.7       71.8
  A(I)           45.1       32.9       32.2       32.7       32.6
  V(I)           1.35       1.85       1.89       1.86       1.86

X STA.        71.8       81.1       90.2       99.7      111.0      131.7
  A(I)           33.1       32.3       34.0       36.7       45.0
  V(I)           1.84       1.88       1.79       1.65       1.35
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WSPRO OUTPUT FILE (continued)

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       U.S. GEOLOGICAL SURVEY WSPRO INPUT FILE brai012.wsp
       CREATED ON 27-APR-95 FOR BRIDGE BRAITH00230012 USING FILE brai012.dca
       HYDRAULIC ANALYSIS OF BRAI012 OVER AYERS BROOK IN BRAINTREE, VT

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

EXIT1:XS   ******  -170.     390.  0.39 *****  996.16  994.10   1670.  995.77
      -52. ******    91.   30471.  1.38 ***** *******    0.73    4.28

FULLV:FV      52.  -170.     394.  0.39  0.15  996.32 *******   1670.  995.94
        0.    52.    92.   30810.  1.38  0.00    0.01    0.71    4.23
         <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

 ===125 FR# EXCEEDS FNTEST AT SECID "APPR ":  TRIALS CONTINUED.
              FNTEST,FR#,WSEL,CRWS =  0.80    0.93     996.18     996.13

 ===110 WSEL NOT FOUND AT SECID "APPR ":  REDUCED DELTAY.
                   WSLIM1,WSLIM2,DELTAY =   995.44    1008.81    0.50

 ===115 WSEL NOT FOUND AT SECID "APPR ":  USED WSMIN = CRWS.
                   WSLIM1,WSLIM2,CRWS =   995.44    1008.81     996.13

 ===135 CONVEYANCE RATIO OUTSIDE OF RECOMMENDED LIMITS.
                        "APPR "     KRATIO =  0.56

APPR :AS      46.     0.     239.  0.90  0.24  997.08  996.13   1670.  996.18
       46.    46.   116.   17364.  1.19  0.52    0.00    0.93    6.99
         <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

 ===215 FLOW CLASS 1 SOLUTION INDICATES POSSIBLE ROAD OVERFLOW.
           WS1,WSSD,WS3,RGMIN =  1000.92       0.00     996.91     998.86

 ===260 ATTEMPTING FLOW CLASS 4 SOLUTION.

 ===220 FLOW CLASS 1 (4) SOLUTION INDICATES POSSIBLE PRESSURE FLOW.
           WS3,WSIU,WS1,LSEL =   996.06     999.51     999.70     999.30

 ===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      52.     0.     148.  0.67 ***** 1000.13  994.67    971.  999.46
        0. ******    23.   13619.  1.00 ***** *******    0.45    6.55

     TYPE PPCD FLOW      C    P/A    LSEL   BLEN   XLAB   XRAB
       1. ****   5.  0.402  0.000  999.30 ****** ****** ******

    XSID:CODE    SRD   FLEN    HF   VHD     EGL     ERR       Q    WSEL
   RDWAY:RG      10.    30.  0.00  0.03 1000.26    0.00    700. 1000.02

            Q   WLEN    LEW    REW  DMAX  DAVG  VMAX  VAVG  HAVG  CAVG
   LT:    700.   199.  -223.     0.   1.2   0.9   4.6   3.9   1.1   2.9
   RT:      0.    12.    11.    23.   0.1   0.1   2.3   8.9   0.3   2.6
 XSID:CODE   SRDL    LEW     AREA   VHD    HF     EGL    CRWS       Q    WSEL
       SRD   FLEN    REW        K  ALPH    HO     ERR     FR#     VEL

APPR :AS      27.  -226.    1311.  0.03  0.09 1000.26  996.13   1670. 1000.23
       46.    93.   135.  134936.  1.26  0.35    0.00    0.13    1.27

       M(G)   M(K)       KQ   XLKQ   XRKQ    OTEL
     ****** ****** ******** ****** ****** ********

                     <<<<<END OF BRIDGE COMPUTATIONS>>>>>
  FIRST USER DEFINED TABLE.
    XSID:CODE    SRD    LEW    REW       Q        K     AREA     VEL    WSEL
   EXIT1:XS     -52.  -170.    91.   1670.   30471.     390.    4.28  995.77
   FULLV:FV       0.  -170.    92.   1670.   30810.     394.    4.23  995.94
   BRIDG:BR       0.     0.    23.    971.   13619.     148.    6.55  999.46
   RDWAY:RG      10.*******   700.    700.*********       0.    2.00 1000.02
   APPR :AS      46.  -226.   135.   1670.  134936.    1311.    1.27 1000.23

    XSID:CODE   XLKQ   XRKQ       KQ
   APPR :AS  ***********************

 SECOND USER DEFINED TABLE.
   XSID:CODE     CRWS      FR#    YMIN    YMAX     HF     HO  VHD      EGL    WSEL
  EXIT1:XS     994.10     0.73  989.43 1004.29************  0.39  996.16  995.77
  FULLV:FV   ********     0.71  989.59 1004.45  0.15  0.00  0.39  996.32  995.94
  BRIDG:BR     994.67     0.45  988.89  999.46************  0.67 1000.13  999.46
  RDWAY:RG   ***************  998.86 1009.36  0.00******  0.03 1000.26 1000.02
  APPR :AS     996.13     0.13  988.64 1008.81  0.09  0.35  0.03 1000.26 1000.23
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WSPRO OUTPUT FILE (continued)

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

EXIT1:XS   ******  -180.     534.  0.41 *****  996.71  995.77   2360.  996.30
      -52. ******    98.   43073.  1.35 ***** *******    0.65    4.42

FULLV:FV      52.  -180.     538.  0.40  0.15  996.88 *******   2360.  996.47
        0.    52.    98.   43488.  1.35  0.00    0.01    0.65    4.38
         <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

 ===125 FR# EXCEEDS FNTEST AT SECID "APPR ":  TRIALS CONTINUED.
              FNTEST,FR#,WSEL,CRWS =  0.80    0.98     996.73     996.71

 ===110 WSEL NOT FOUND AT SECID "APPR ":  REDUCED DELTAY.
                   WSLIM1,WSLIM2,DELTAY =   995.97    1008.81    0.50

 ===115 WSEL NOT FOUND AT SECID "APPR ":  USED WSMIN = CRWS.
                   WSLIM1,WSLIM2,CRWS =   995.97    1008.81     996.71

 ===135 CONVEYANCE RATIO OUTSIDE OF RECOMMENDED LIMITS.
                             "APPR "     KRATIO =  0.53

APPR :AS      46.   -14.     304.  1.06  0.25  997.77  996.71   2360.  996.71
       46.    46.   125.   23174.  1.14  0.66   -0.02    0.99    7.76
         <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

 ===215 FLOW CLASS 1 SOLUTION INDICATES POSSIBLE ROAD OVERFLOW.
           WS1,WSSD,WS3,RGMIN =  1003.66       0.00     998.82     998.86

 ===260 ATTEMPTING FLOW CLASS 4 SOLUTION.

 ===220 FLOW CLASS 1 (4) SOLUTION INDICATES POSSIBLE PRESSURE FLOW.
           WS3,WSIU,WS1,LSEL =   997.02    1000.11    1000.35     999.30

 ===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      52.     0.     148.  0.87 ***** 1000.33  995.17   1112.  999.46
        0. ******    23.   13619.  1.00 ***** *******    0.52    7.50

     TYPE PPCD FLOW      C     P/A    LSEL   BLEN   XLAB   XRAB
       1. ****   5.  0.440  0.000  999.30 ****** ****** ******

    XSID:CODE     SRD   FLEN    HF    VHD     EGL     ERR       Q    WSEL
   RDWAY:RG      10.    30.  0.01  0.05 1000.72    0.00   1237. 1000.41

              Q   WLEN    LEW    REW  DMAX  DAVG  VMAX  VAVG  HAVG  CAVG
   LT:   1220.   237.  -230.    11.   1.5   1.1   5.4   4.6   1.4   3.0
   RT:     17.    17.    11.    28.   0.3   0.2   2.9   5.0   0.5   2.7

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

APPR :AS      27.  -234.    1474.  0.05  0.16 1000.72  996.71   2360. 1000.67
       46.   112.   136.  158995.  1.25  0.29    0.00    0.16    1.60

       M(G)   M(K)       KQ   XLKQ   XRKQ    OTEL
     ****** ****** ******** ****** ****** ********

                     <<<<<END OF BRIDGE COMPUTATIONS>>>>>
  FIRST USER DEFINED TABLE.
    XSID:CODE    SRD    LEW    REW       Q        K     AREA     VEL    WSEL
   EXIT1:XS     -52.  -180.    98.   2360.   43073.     534.    4.42  996.30
   FULLV:FV       0.  -180.    98.   2360.   43488.     538.    4.38  996.47
   BRIDG:BR       0.     0.    23.   1112.   13619.     148.    7.50  999.46
   RDWAY:RG      10.******* 1220.   1237.*********       0.    2.00 1000.41
   APPR :AS      46.  -234.   136.   2360.  158995.    1474.    1.60 1000.67

    XSID:CODE   XLKQ   XRKQ       KQ
   APPR :AS  **********************

 SECOND USER DEFINED TABLE.
   XSID:CODE    CRWS     FR#    YMIN    YMAX    HF    HO  VHD      EGL    WSEL
  EXIT1:XS    995.77    0.65  989.43 1004.29************  0.41  996.71  996.30
  FULLV:FV  ********    0.65  989.59 1004.45  0.15  0.00  0.40  996.88  996.47
  BRIDG:BR    995.17    0.52  988.89  999.46************  0.87 1000.33  999.46
  RDWAY:RG  ****************  998.86 1009.36  0.01******  0.05 1000.72 1000.41
  APPR :AS    996.71    0.16  988.64 1008.81  0.16  0.29  0.05 1000.72 1000.67
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 XSID:CODE   SRDL    LEW     AREA   VHD    HF     EGL    CRWS       Q    WSEL
       SRD   FLEN    REW        K  ALPH    HO     ERR     FR#     VEL

EXIT1:XS   ******  -160.     263.  0.37 *****  995.63  993.48   1215.  995.26
      -52. ******    86.   22170.  1.11 ***** *******    0.74    4.63

FULLV:FV      52.  -161.     267.  0.36  0.15  995.80 *******   1215.  995.43
        0.    52.    87.   22407.  1.13  0.00    0.02    0.75    4.56
         <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

 ===125 FR# EXCEEDS FNTEST AT SECID "APPR ":  TRIALS CONTINUED.
             FNTEST,FR#,WSEL,CRWS =  0.80    0.97     995.66     993.99

 ===110 WSEL NOT FOUND AT SECID "APPR ":  REDUCED DELTAY.
                  WSLIM1,WSLIM2,DELTAY =   994.93    1008.81    0.50

 ===115 WSEL NOT FOUND AT SECID "APPR ":  USED WSMIN = CRWS.
                  WSLIM1,WSLIM2,CRWS =   994.93    1008.81     993.99

 ===135 CONVEYANCE RATIO OUTSIDE OF RECOMMENDED LIMITS.
                            "APPR "     KRATIO =  0.59

APPR :AS      46.     0.     182.  0.81  0.23  996.48  993.99   1215.  995.66
       46.    46.   106.   13186.  1.17  0.45    0.00    0.97    6.68
         <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

 ===215 FLOW CLASS 1 SOLUTION INDICATES POSSIBLE ROAD OVERFLOW.
          WS1,WSSD,WS3,RGMIN =  998.88       0.00     995.52     998.86

 ===260 ATTEMPTING FLOW CLASS 4 SOLUTION.

 ===285 CRITICAL WATER-SURFACE ELEVATION  A _ S _ S _ U _ M _ E _ D !!!!!
                  SECID "BRIDG"     Q,CRWS =    1215.      995.52

            <<<<<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      52.     0.      89.  2.89 *****  998.42  995.52   1215.  995.52
        0.    52.    22.    9068.  1.00 ***** *******    1.00   13.64

     TYPE PPCD FLOW      C    P/A    LSEL   BLEN   XLAB   XRAB
       1. ****   4.  1.000 ******  999.30 ****** ****** ******

    XSID:CODE     SRD   FLEN    HF   VHD     EGL     ERR       Q    WSEL
   RDWAY:RG      10.    30.  0.01  0.04  998.91    0.00      0.  998.88

            Q    WLEN    LEW     REW  DMAX  DAVG  VMAX  VAVG  HAVG  CAVG
   LT:      0.    12.   -71.    -60.   0.0   0.0   0.8   2.4   0.0   2.5
   RT:      0.    26.    11.     37.   0.8   0.6   4.3   4.9   1.0   2.9

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

APPR :AS      27.  -201.     842.  0.04  0.16  998.92  993.99   1215.  998.88
       46.    74.   132.   74619.  1.31  0.34    0.00    0.18    1.44

      M(G)   M(K)       KQ   XLKQ   XRKQ    OTEL
     0.795  0.662   25191.     6.    28. ********

                     <<<<<END OF BRIDGE COMPUTATIONS>>>>>

  FIRST USER DEFINED TABLE.
    XSID:CODE     SRD    LEW    REW       Q        K     AREA     VEL    WSEL
   EXIT1:XS     -52.  -160.    86.   1215.   22170.     263.    4.63  995.26
   FULLV:FV       0.  -161.    87.   1215.   22407.     267.    4.56  995.43
   BRIDG:BR       0.     0.    22.   1215.    9068.      89.   13.64  995.52
   RDWAY:RG      10.*******     0.      0.*********       0.    2.00  998.88
   APPR :AS      46.  -201.   132.   1215.   74619.     842.    1.44  998.88

    XSID:CODE   XLKQ   XRKQ       KQ
   APPR :AS       6.    28.   25191.

 SECOND USER DEFINED TABLE.
   XSID:CODE    CRWS     FR#    YMIN    YMAX    HF    HO   VHD      EGL    WSEL
  EXIT1:XS    993.48    0.74  989.43 1004.29************  0.37   995.63  995.26
  FULLV:FV  ********    0.75  989.59 1004.45  0.15  0.00  0.36   995.80  995.43
  BRIDG:BR    995.52    1.00  988.89  999.46************  2.89   998.42  995.52
  RDWAY:RG  ****************  998.86 1009.36  0.01******  0.04   998.91  998.88
  APPR :AS    993.99    0.18  988.64 1008.81  0.16  0.34  0.04   998.92  998.88
```
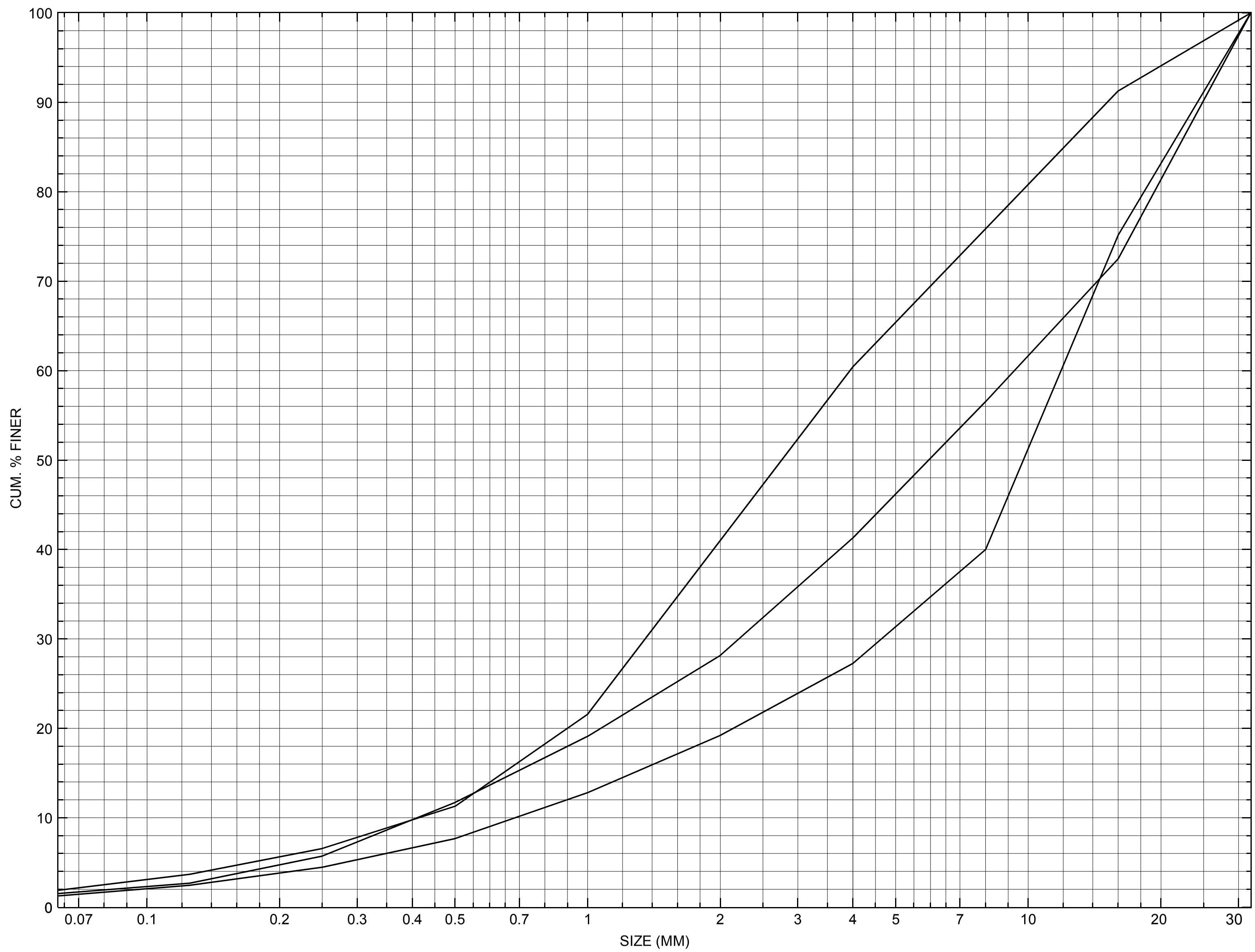

APPENDIX C:

BED-MATERIAL PARTICAL-SIZE DISTRIBUTION



Appendix C. Bed material particle-size distribution for a sample taken at the approach cross-section for structure BRAITH00230012, in Braintree, Vermont.

APPENDIX D:

HISTORICAL DATA FORM