

Wisconsin Department of Transportation



March 27, 2001

Department of Natural Resources
North East Region
625 East CTH Y, Suite 700
Oshkosh, WI 54901-9731

Division of Transportation
Infrastructure Development
Bureau of Highway Development
4802 Sheboygan Avenue, Rm 633
P O Box 7916
Madison, WI 53707-7916

Telephone: (608) 266-8491
Facsimile (FAX): (608) 261-6277

Attention: Bobbi Jo Reiser

SUBJECT: Project I.D. 1517-04-01
Structure B-70-190/191
USH 10 over Rat River
Winnebago County

The Wisconsin Department of Transportation, in cooperation with Town of Winchester, plans to construct new bridges on relocated USH 10 over Rat River. Plan sheets, which show the proposed construction, were previously forwarded to you.

The hydraulic characteristics computed for the bridge site are summarized below:

	<u>Est. Q₁₀₀</u>	<u>HW₁₀₀</u>
Existing Condition	2400 cfs	756.7 ft.
Proposed Bridge	2400 cfs	757.0 ft.
Downstream Elevation		756.6 ft.

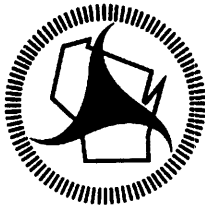
Final structure plans will be prepared by WisDOT. These structures are within a mapped flood hazard area. All effected landowners will be notified of the backwater increase associated with these new structures. Please send your comments to us, and a copy to the **District Contact Person** listed below.

Thank you;

David R. Genson, P.E.
Structures & Hydraulics Unit

DRG:mab

cc: Trans. District #3 - Bill Bertrand
Larry Larson - DNR WT/6



Wisconsin Department of Transportation



July 27, 2000

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Infrastructure Development
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Madison, WI 53707-7916

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Department of Natural Resources
North East Region
1125 N. Military Ave. PO Box 10448
Green Bay, WI 54307

Attention: ~~Kelley O'Connor~~ → BOBBI JO REISER

SUBJECT: Project I.D. 1517-04-01
Structure B-70-190/191
USH 10 over Rat River
Winnebago County

The Wisconsin Department of Transportation, in cooperation with Town of Winchester, plans to replace a bridge on USH 10 over Rat River. Enclosed are plan sheets which show the proposed construction.

The hydraulic characteristics computed for the bridge site are summarized below:

	<u>Est. Q₁₀₀</u>	<u>HW₁₀₀</u>
Existing Bridge	2400 cfs	756.7 ft.
Proposed Bridge	2400 cfs	757.0 ft.
Downstream Elevation		756.6 ft.

Final structure plans will be prepared by WisDOT. Please send your comments to us, and a copy to the **District Contact Person** listed below.

Thank you;

David R. Genson, P.E.
Structures & Hydraulics Unit

DRG:mab

cc: Trans. District #3 - Bill Bertrand
Larry Larson - DNR WT/6

Enc.

SAWC
OUT
COPY
2-27-01

WisDOT HYDRAULIC BRIDGE DESIGN

BRIDGE NUMBER: B-70-190
USH 10 WB/Rat River

HYDRAULICS BY: NK
DATE: 7-5-2000
FHA X (Y) (N) Zone A

HYDROLOGY
Q100= 2400 cfs

BY: NK

DRAINAGE AREA= 56.8 sq. mi.

DATE: 7-5-2000

METHOD: Regression Equations, Comparison to gauged streams, FIS

HYDRAULICS METHOD: (WSPRO, HEC-2, HYS, OTHER:)

ENERGY SLOPE: SSR= 0.00002 ft/ft ← questionable (used an average value of 0.00005)
USGS= ~ 0.00008 ft/ft
KNOWN TAILWATER= 756.7 HW 100 @ CHW

MANNING "N"

LEFT: 0.05
LEFT: 0.07

CHANNEL: 0.03
CHANNEL: 0.03

RIGHT: 0.05
RIGHT: 0.07

COMMENTS:

EXISTING CONDITIONS *****

QBR=

HW-100=

QRD=

NATURAL=

A(br)=

BACKWTR=

VEL=

FLOW=

EXIT=

PROPOSED CONDITIONS *****

QBR= 2400 cfs

HW-100= 756.95

QRD= n/a

NATURAL= 756.66

A(br)= 574.6 sq ft

BACKWTR= 0.29 ft

VEL= 4.2 ft/sec

FLOW= Type 1

SCOUR CODE 5

EXIT= 756.60

PROPOSED STRUCTURE: 2-span Haunched RB COST: \$ 213,000

COMMENTS: 45ft span length - 20 RHF skew

PSG not feasible as it would not provide adequate tieband -

T1 B-70-190/191, USH 10 OVER RAT RIVER, I.D. #1517-04-01
 T2 TOWN OF WINCHESTER, WINNEBAGO COUNTY
 T3 EXISTING/PROPOSED CONDITIONS-- BY NK OF WisDOT 07-17-2000
 *
 UT 8,7,2,26,28,25,5,*,1,42,12,36
 SI 0
 *
 SK .00005
 Q 2400
 *
 XS WXIT 1000
 GR 828.0,760.0 829.0,751.00 947.0,750.00 951.0,749.00
 GR 964.0,748.0 978.0,747.00 991.0,746.00 1007.0,746.0
 GR 1021.0,746.0 1035.0,748.00 1048.0,749.00 1053.0,750.0
 GR 1073.0,751.0 1199.0,752.00 1200.0,760.00
 N 0.05,0.030,0.05
 SA 951.0,1048
 *
 XS WFLV 1122.0
 *
 BR CTHW 1122.0,757.60,0
 GR 957.90,757.59 958.30,755.09 960.80,755.09 969.00,750.26
 GR 970.00,749.37 974.00,748.54 984.00,746.18 1014.00,746.24
 GR 1032.00,747.74 1034.00,749.59 1036.00,750.63 1039.20,755.27
 GR 1041.70,755.27 1042.10,757.77 957.90,757.59
 CD 3 34.0 2.5 760.24
 PD 1 746.20,1,1
 N 0.030
 SA
 *
 XS WAPP 1199
 GR 866.0,760.00 867.0,751.00 910.0,750.0 922.0,750.0
 GR 928.0,749.00 933.0,748.00 992.0,747.0 1000.0,746.6
 GR 1005.0,747.00 1015.0,748.00 1034.0,749.0 1046.0,750.0
 GR 1075.0,751.00 1172.0,752.00 1173.0,760.0
 N 0.5,0.030,0.5
 SA 928.0,1034.0
 FL 46,928,43,1034,37
 *
 XS EXIT 1200
 *
 XS FULV 1231.0
 *
 BR PRBR 1231.0,758.0,20
 GR 950.50,758.30 950.50,755.05 953.00,755.05 960.58,750.00
 GR 975.00,750.00 980.00,749.00 994.00,748.00 1000.00,747.64
 GR 1006.00,748.00 1026.00,749.00 1030.00,750.00 1031.50,750.05
 GR 1038.25,754.55 1040.75,754.55 1040.75,757.80 950.50,758.30
 CD 3 136.0 2.5 759.55
 PD 1 747.80,1,1
 N 0.030
 SA
 *
 XS APPR 1472
 GR 800.0,760.00 802.0,751.00 833.0,751.0 840.0,750.0
 GR 853.0,750.00 860.0,751.00 872.0,751.00 876.0,750.0
 GR 887.0,750.00 893.0,751.00 952.0,751.00 975.0,750.0
 GR 984.0,750.00 989.0,749.00 994.0,748.00 1000.0,747.09
 GR 1008.0,748.00 1015.0,749.00 1020.0,750.00 1038.0,751.00
 GR 1115.0,752.00 1168.0,753.00 1170.0,760.00
 N 0.07,0.030,0.07
 SA 984.0,1020.0
 FL 120,984,110,1020,110
 *
 HP 2 756.949 0.1 757.049 2400
 *
 DC 0 PRBR 950.5 1040.75 * * * 1.0
 *
 DC 1 PRBR 950.5 1040.75 * * .0004 1.0
 *
 DP PRBR 950.5 1040.75 1.0
 *
 DA PRBR 0.55
 *
 EX
 ER
 □

Scour depth

Contraction : 6.87
 Pier : 2.79

Total Scour 9.66

Say 10'

Scour

$D_{50} = 0.12 \text{ mm}$ (per Site Investigation Report) -
 $D_{50} = 0.0004'$

$$V_c = 6.19 y^{1/6} D_{50}^{1/3} \text{ (metric)}$$

$$\text{where } y = 9.70 \text{ ft} = 2.96 \text{ m}$$

$$V = 2.77 \text{ ft/sec} = 0.84 \text{ m/sec}$$

$$\Rightarrow V_c = 0.38 \text{ m/sec}$$

$$V_c < V \Rightarrow \text{live-bed scour}$$

***** W S P R O *****
 Federal Highway Administration - U. S. Geological Survey
 Model for Water-Surface Profile Computations.
 Run Date & Time: 7/17/2000 11:25 am Version V061698
 Input File: E70-190E.wsp Output File: B70-190p.OUT

-----*
 T1 B-70-190/191, USH 10 OVER RAT RIVER, I.D. #1517-04-01
 T2 TOWN OF WINCHESTER, WINNEBAGO COUNTY
 T3 EXISTING/PROPOSED CONDITIONS-- BY NK OF WISDOT 07-17-2000
 UT 8,7,2,26,28,25,5,*,1,42,12,36
 SI 0
 SK .00005
 Q 2400

*** Processing Flow Data; Placing Information into Sequence 1 ***

***** W S P R O *****
 Federal Highway Administration - U. S. Geological Survey
 Model for Water-Surface Profile Computations.
 Input Units: English / Output Units: English

-----*
 B-70-190/191, USH 10 OVER RAT RIVER, I.D. #1517-04-01
 TOWN OF WINCHESTER, WINNEBAGO COUNTY
 EXISTING/PROPOSED CONDITIONS-- BY NK OF WISDOT 07-17-2000

-----*
 * Starting To Process Header Record WXIT *
 -----*

XS WXIT 1000
 GR 828.0,760.0 829.0,751.00 947.0,750.00 951.0,749.00
 GR 964.0,748.0 978.0,747.00 991.0,746.00 1007.0,746.0
 GR 1021.0,746.0 1035.0,748.00 1048.0,749.00 1053.0,750.0
 GR 1073.0,751.0 1199.0,752.00 1200.0,760.00
 N 0.05,0.030,0.05
 SA 951.0,1048

*** Completed Reading Data Associated With Header Record WXIT ***
 *** Storing X-Section Data In Temporary File As Record Number 1 ***

*** Data Summary For Header Record WXIT ***
 SRD Location: 1000. Cross-Section Skew: .0 Error Code 0
 Valley Slope: .00000 Averaging Conveyance By Geometric Mean.
 Energy Loss Coefficients -> Expansion: .50 Contraction: .00

X,Y-coordinates (15 pairs)					
X	Y	X	Y	X	Y
828.000	760.000	829.000	751.000	947.000	750.000
951.000	749.000	964.000	748.000	978.000	747.000
991.000	746.000	1007.000	746.000	1021.000	746.000
1035.000	748.000	1048.000	749.000	1053.000	750.000
1073.000	751.000	1199.000	752.000	1200.000	760.000

Minimum and Maximum X,Y-coordinates
 Minimum X-Station: 828.000 (associated Y-Elevation: 760.000)
 Maximum X-Station: 1200.000 (associated Y-Elevation: 760.000)
 Minimum Y-Elevation: 746.000 (associated X-Station: 1021.000)
 Maximum Y-Elevation: 760.000 (associated X-Station: 828.000)

Roughness Data (3 SubAreas)		
SubArea	Roughness Coefficient	Horizontal Breakpoint
1	.050	---
	---	951.000
2	.030	---
	---	1048.000
3	.050	---

-----*
 * Finished Processing Header Record WXIT *
 -----*

***** W S P R O *****
 Federal Highway Administration - U. S. Geological Survey
 Model for Water-Surface Profile Computations.
 Input Units: English / Output Units: English

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 B-70-190/191, USH 10 OVER RAT RIVER, I.D. #1517-04-01
 TOWN OF WINCHESTER, WINNEBAGO COUNTY
 EXISTING/PROPOSED CONDITIONS-- BY NK OF WISDOT 07-17-2000

-----*
 * Starting To Process Header Record WFLV *
 -----*

Maximum Y-Elevation: 760.000 (associated X-Station: 800.000)

SubArea	Roughness Coefficient	Horizontal Breakpoint
1	.070	---
	---	984.000
2	.030	---
	---	1020.000
3	.070	---

Section	Length	Breakpoint
1	120.000	---
	---	984.000
2	110.000	---
	---	1020.000
3	110.000	---

Bridge datum projection(s): XREFLT XREFRT FDSTLT FDSTRT

-----*
* Finished Processing Header Record APPR *
-----*

***** W S P R O *****
Federal Highway Administration - U. S. Geological Survey
Model for Water-Surface Profile Computations.
Input Units: English / Output Units: English
-----*

B-70-190/191, USH 10 OVER RAT RIVER, I.D. #1517-04-01
TOWN OF WINCHESTER, WINNEBAGO COUNTY
EXISTING/PROPOSED CONDITIONS-- BY NK OF WISDOT 07-17-2000
DC 0 PRBR 950.5 1040.75 * * * 1.0
DC 1 PRBR 950.5 1040.75 * * .0004 1.0
DP PRBR 950.5 1040.75 1.0
DA PRBR 0.55
EX

=====*

#	Reach Discharge	Water Surface Elevation	Friction Slope	Flow Regime
1	2400.00	*****	.0000	Sub-Critical

=====*

=====*

#	Reach Discharge	Water Surface Elevation	Friction Slope	Flow Regime
1	2400.00	*****	.0000	Sub-Critical

=====*

=====*

Beginning 1 Profile Calculation(s)

=====*

***** W S P R O *****
Federal Highway Administration - U. S. Geological Survey
Model for Water-Surface Profile Computations.
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-----*

B-70-190/191, USH 10 OVER RAT RIVER, I.D. #1517-04-01
TOWN OF WINCHESTER, WINNEBAGO COUNTY
EXISTING/PROPOSED CONDITIONS-- BY NK OF WISDOT 07-17-2000

<< Beginning Computations for Profile 1 >>

	WSEL EGEL CRWS	VHD HF HO	Q V FR #	AREA K SF	SRDL FLEN ALPHA	LEW REW ERR
Section: WXIT	756.489	.025	2400.000	2431.981	*****	828.390
Header Type: XS	756.514	*****	.987	339406.70	*****	1199.561
SRD: 1000.000	749.776	*****	.087	*****	1.645	*****
Section: WFLV	756.496	.025	2400.000	2434.500	122.000	828.389
Header Type: FV	756.521	.006	.986	339927.40	122.000	1199.562
SRD: 1122.000	749.776	.000	.087	.0000	1.644	.001

<<< The Preceding Data Reflect The "Unconstricted" Profile >>>

===135 CONVEYANCE RATIO OUTSIDE OF RECOMMENDED LIMITS AT SECID "WAPP".
KRATIO: .61

Section: WAPP	756.468	.088	2400.000	2053.140	77.000	866.392
Header Type: AS	756.556	.004	1.169	207855.50	43.053	1172.558
SRD: 1199.000	750.160	.032	.162	.0001	4.143	.000

<<< The Preceding Data Reflect The "Unconstricted" Profile >>>

<<< The Following Data Reflect The "Constricted" Profile >>>

<<< Beginning Bridge/Culvert Hydraulic Computations >>>

	WSEL EGEL CRWS	VHD HF HO	Q V FR #	AREA K SF	SRDL FLEN ALPHA	LEW REW ERR
Section: CTHW	756.424	.229	2400.000	679.847	122.000	958.087
Header Type: BR	756.654	.016	3.530	128306.10	122.000	1041.885
SRD: 1122.000	750.463	.123	.238	*****	1.183	-.001

Specific Bridge Information	C	P/A	PFELEV	BLN	XLAB	XRAB
Bridge Type 3 Flow Type 1	-----	-----	-----	-----	-----	-----
Pier/Pile Code 1	.9192	.015	757.600	*****	*****	*****

Unconstricted Full Valley Section Water Surface Elevation:	756.496
Downstream Bridge Section Water Surface Elevation:	756.424
Bridge DrawDown Distance:	.072

	WSEL EGEL CRWS	VHD HF HO	Q V FR #	AREA K SF	SRDL FLEN ALPHA	LEW REW ERR
Section: WAPP	756.594	.085	2400.000	2091.902	43.000	866.378
Header Type: AS	756.680	.011	1.147	212981.90	50.004	1172.574
SRD: 1199.000	750.160	.016	.158	.0001	4.173	.007

** Change in Approach Section Water Surface Elevation: .127 **

Approach Section WAPP Flow Contraction Information					
M (G)	M (K)	KQ	XLKQ	XRKQ	OTEL
.726	.217	166523.3	938.402	1022.200	756.594

<<< End of Bridge Hydraulics Computations >>>

Section: EXIT	756.596	.085	2400.000	2092.518	1.000	866.378
Header Type: XS	756.682	.000	1.147	213063.00	1.000	1172.575
SRD: 1200.000	750.160	.000	.158	.0001	4.173	.002

Section: FULV	756.602	.085	2400.000	2094.308	31.000	866.378
Header Type: FV	756.687	.004	1.146	213300.00	31.000	1172.575
SRD: 1231.000	750.160	.000	.158	.0001	4.174	.002

<<< The Preceding Data Reflect The "Unconstricted" Profile >>>

Section: APPR	756.659	.046	2400.000	2117.368	241.000	800.743
Header Type: AS	756.704	.017	1.133	178359.70	115.562	1169.045
SRD: 1472.000	752.537	.000	.126	.0002	2.295	.000

<<< The Preceding Data Reflect The "Unconstricted" Profile >>>

<<< The Following Data Reflect The "Constricted" Profile >>>

<<< Beginning Bridge/Culvert Hydraulic Computations >>>

	WSEL EGEL CRWS	VHD HF HO	Q V FR #	AREA K SF	SRDL FLEN ALPHA	LEW REW ERR
Section: PRBR	756.522	.335	2400.000	574.641	31.000	953.537
Header Type: BR	756.857	.010	4.177	96872.13	31.000	1038.349
SRD: 1231.000	752.319	.166	.314	*****	1.236	-.003

Specific Bridge Information	C	P/A	PFELEV	BLN	XLAB	XRAB
Bridge Type 3 Flow Type 1	-----	-----	-----	-----	-----	-----
Pier/Pile Code 1	.8995	.015	758.000	*****	*****	*****

Unconstricted Full Valley Section Water Surface Elevation:	756.602
Downstream Bridge Section Water Surface Elevation:	756.522
Bridge DrawDown Distance:	.080

	WSEL EGEL CRWS	VHD HF HO	Q V FR #	AREA K SF	SRDL FLEN ALPHA	LEW REW ERR
Section: APPR	756.949	.041	2400.000	2224.529	105.000	800.678
Header Type: AS	756.990	.043	1.079	192390.90	125.237	1169.128
SRD: 1472.000	752.537	.090	.116	.0002	2.258	.008

** Change in Approach Section Water Surface Elevation: .291 **

Approach	Section	APPR	Flow	Contraction	Information	
M (G)	M (K)	KQ	XLKQ	XRKQ	OTEL	
.770	.549	86667.8	949.340	1034.153	756.949	

<<< End of Bridge Hydraulics Computations >>>

<< Completed Computations of Profile 1 >>

***** W S P R O *****
 Federal Highway Administration - U. S. Geological Survey
 Model for Water-Surface Profile Computations.
 Input Units: English / Output Units: English

 B-70-190/191, USH 10 OVER RAT RIVER, I.D. #1517-04-01
 TOWN OF WINCHESTER, WINNEBAGO COUNTY
 EXISTING/PROPOSED CONDITIONS-- BY NK OF WISDOT 07-17-2000

=== User Defined Table 1 of 2 ===

	SRD	Q	AREA	VEL	CRWS	EGL	WSEL
1 WXIT	1000.000	2400.000	2432.0	.987	749.776	756.514	756.489
2 WFLV	1122.000	2400.000	2434.5	.986	749.776	756.521	756.496
3 WAPP	1199.000	2400.000	2053.1	1.169	750.160	756.556	756.468
4 CTHW	1122.000	2400.000	679.8	3.530	750.463	756.654	756.424
5 WAPP	1199.000	2400.000	2091.9	1.147	750.160	756.680	756.594
6 EXIT	1200.000	2400.000	2092.5	1.147	750.160	756.682	756.596
7 FULV	1231.000	2400.000	2094.3	1.146	750.160	756.687	756.602
8 APPR	1472.000	2400.000	2117.4	1.133	752.537	756.704	756.659
9 PRBR	1231.000	2400.000	574.6	4.177	752.319	756.857	756.522
10 APPR	1472.000	2400.000	2224.5	1.079	752.537	756.990	756.949

=== User Defined Table 2 of 2 ===

	K	XSTW	YMIN	FLEN
1 WXIT	339407.	371.171	746.000	*****
2 WFLV	339927.	371.173	746.000	122.000
3 WAPP	207855.	306.166	746.600	43.053
4 CTHW	128306.	83.798	746.180	122.000
5 WAPP	212982.	306.196	746.600	50.004
6 EXIT	213063.	306.196	746.600	1.000
7 FULV	213300.	306.198	746.600	31.000
8 APPR	178360.	368.303	747.090	115.562
9 PRBR	96872.	84.813	747.640	31.000
10 APPR	192391.	368.451	747.090	125.237

***** W S P R O *****
 Federal Highway Administration - U. S. Geological Survey
 Model for Water-Surface Profile Computations.
 Input Units: English / Output Units: English

 B-70-190/191, USH 10 OVER RAT RIVER, I.D. #1517-04-01
 TOWN OF WINCHESTER, WINNEBAGO COUNTY
 EXISTING/PROPOSED CONDITIONS-- BY NK OF WISDOT 07-17-2000

*** Beginning Velocity Distribution For Header Record APPR ***
 SRD Location: 1472.000 Header Record Number 8

Water Surface Elevation: 756.949 Element # 1
 Flow: 2400.000 Velocity: 1.08 Hydraulic Depth: 6.037
 Cross-Section Area: 2224.35 Conveyance: 192367.80
 Bank Stations -> Left: 800.678 Right: 1169.128

X STA.	800.7	827.9	848.0	869.1	888.6	910.8
A (I)		157.8	131.2	134.1	130.5	133.9
V (I)		.76	.91	.90	.92	.90
D (I)		5.80	6.52	6.35	6.69	6.02
X STA.	910.8	934.2	957.6	976.9	988.3	994.0
A (I)		139.1	139.6	127.9	80.6	48.0
V (I)		.86	.86	.94	1.49	2.50
D (I)		5.95	5.98	6.61	7.11	8.37
X STA.	994.0	998.7	1003.2	1008.0	1013.5	1020.9
A (I)		44.2	43.3	44.5	47.0	55.2
V (I)		2.71	2.77	2.70	2.55	2.17
D (I)		9.31	9.70	9.22	8.55	7.51
X STA.	1020.9	1042.5	1067.0	1095.6	1126.7	1169.1
A (I)		136.5	140.6	153.9	155.1	181.4
V (I)		.88	.85	.78	.77	.66
D (I)		6.32	5.73	5.39	4.99	4.28

Water Surface Elevation: 757.049 Element # 2
Flow: 2400.000 Velocity: 1.06 Hydraulic Depth: 6.136
Gross-Section Area: 2261.20 Conveyance: 197289.80
Bank Stations -> Left: 800.656 Right: 1169.157

X STA.	800.7	827.8	848.0	869.1	888.6	910.8
A(I)		160.4	133.2	136.2	132.4	136.1
V(I)		.75	.90	.88	.91	.88
D(I)		5.90	6.62	6.45	6.79	6.12

X STA.	910.8	934.2	957.1	976.7	988.3	994.0
A(I)		141.5	139.0	131.2	83.8	48.1
V(I)		.85	.86	.91	1.43	2.49
D(I)		6.05	6.07	6.69	7.21	8.48

X STA.	994.0	998.8	1003.3	1008.2	1013.8	1021.6
A(I)		45.4	44.4	45.6	48.0	58.4
V(I)		2.64	2.70	2.63	2.50	2.05
D(I)		9.41	9.79	9.30	8.62	7.53

X STA.	1021.6	1043.0	1067.8	1095.6	1126.7	1169.2
A(I)		137.1	144.4	152.3	158.2	185.5
V(I)		.88	.83	.79	.76	.65
D(I)		6.39	5.82	5.48	5.09	4.37

***** W S P R O *****

Federal Highway Administration - U. S. Geological Survey
Model for Water-Surface Profile Computations.
Input Units: English / Output Units: English

-----*

B-70-190/191, USH 10 OVER RAT RIVER, I.D. #1517-04-01
TOWN OF WINCHESTER, WINNEBAGO COUNTY
EXISTING/PROPOSED CONDITIONS-- BY NK OF WISDOT 07-17-2000

*** Live-Bed Contraction Scour Calculations for Header Record PRBR ***

Constants and Input Variables

-----*

Bed Material Transport Mode Factor (K1):	.64
Total Pier Width Value (Pw):	1.000

-----*

#	Scour Depth	-- Flow --		-- Width --		--- X-Limits ---	
		Contract	Approach	Contract	Approach	Side	Contract Approach
1	6.866	2400.000	1111.515	89.250	90.250	Left:	950.500 950.500
		Approach Channel Depth:		7.310		Right:	1040.750 1040.750

***** W S P R O *****

Federal Highway Administration - U. S. Geological Survey
Model for Water-Surface Profile Computations.
Input Units: English / Output Units: English

-----*

B-70-190/191, USH 10 OVER RAT RIVER, I.D. #1517-04-01
TOWN OF WINCHESTER, WINNEBAGO COUNTY
EXISTING/PROPOSED CONDITIONS-- BY NK OF WISDOT 07-17-2000

*** Clear-Water Contraction Scour for Header Record PRBR ***

Constants and Input Variables

-----*

Bed Material D50 Value (D50):	.0004
Pier Width Value (Pw):	1.000

-----*

#	Scour Depth	-- Flow --		-- Width --		--- X-Limits ---	
		Contract	Approach	Contract	Approach	Side	Contract Approach
1	12.906	2400.000	1111.515	89.250	90.250	Left:	950.500 950.500
		Approach Channel Depth:		7.310		Right:	1040.750 1040.750

***** W S P R O *****

Federal Highway Administration - U. S. Geological Survey
Model for Water-Surface Profile Computations.
Input Units: English / Output Units: English

-----*

B-70-190/191, USH 10 OVER RAT RIVER, I.D. #1517-04-01
TOWN OF WINCHESTER, WINNEBAGO COUNTY
EXISTING/PROPOSED CONDITIONS-- BY NK OF WISDOT 07-17-2000

*** Pier Scour Calculations for Header Record PRBR ***

Constants and Input Variables

-----*

Pier Width:	1.000
Pier Shape Factor (K1):	1.00

-----*

Flow Angle of Attack Factor (K2): 1.00
 Bed Condition Factor (K3): 1.10
 Bed Material Factor (K4): 1.00
 Velocity Multiplier (VM): 1.00
 Depth Multiplier (YM): 1.00

#	Scour Depth	---- Localized Hydraulic Properties ----					-- X-Stations --	
		Flow	WSE	Depth	Velocity	Froude #	Left	Right
1	2.785	2400.000	756.612	8.972	4.932	.290	950.500	1040.750

□ ***** W S P R O *****
 Federal Highway Administration - U. S. Geological Survey
 Model for Water-Surface Profile Computations.
 Input Units: English / Output Units: English

B-70-190/191, USH 10 OVER RAT RIVER, I.D. #1517-04-01
 TOWN OF WINCHESTER, WINNEBAGO COUNTY
 EXISTING/PROPOSED CONDITIONS-- BY NK OF WISDOT 07-17-2000

*** Abutment Scour Calculations for Header Record PRBR ***

Constants and Input Variables

 Adjustment Factor (K1): .55
 Flow Angle of Attack Factor (K2): 1.00
 Factor of Safety (FS): 1.00

#	Abtmnt Side	Scour Depth	X-Statn	A-Prime	Ya	Qe	Overbank
							Froude #
1	Left	11.737	953.537	153.537	6.132	819.630	.062

No Right Abutment Scour. Right Edge of Water Inside of Abutment Toe.

Summary

Bridge Number: B-70-190/191
County: Winnebago
Township: Winchester
Location: Town of Winchester
Project ID: 1517-04-01
Waterway: Rat River
Roadway: USH 10

The 100 year flood value for the Conger regression equations is

Q100 =	9475 cfs
--------	----------

Based on the area transfers:

Comparison Station	Q100 (cfs)	Q100 (cms)
5423500	7687	219.07
5401535	11207	319.38
5401050	8214	234.10
4074850	3724	106.11
5400025	9372	267.09
0	0	0.00
AVERAGE	8041	229.15

Q100 =	2400 cfs
--------	----------

(FIS Winnebago Co.)

The regression equation value seems to be too high - see attached note from Hydrology for B-70-117 - a $Q_{100} = 2440$ cfs is obtained with the regression equation if an $SP = 0.85$ is used.

Hydrologic Regression Analysis

Bridge Number:	B-70-190/191
County:	Winnebago
Township:	Winchester
Location:	Town of Winchester
Project ID:	1517-04-01
Waterway:	Rat River
Roadway:	USH 10

Please type parameter values in the appropriate cells.

Conger Region:	CA:		
Drainage Area	A:		sq. mi,
Slope	S:		ft/mi
Storage	ST:		%
Forest	FOR:		%
Snowfall	SN:		in/yr
Precipitation	124.2:		in
Soil Permeability	SP:		in/hr

	Standard (cfs)	Metric (m ³ /s)
Q ₂ =	4108	59.73
Q ₅ =	4152	109.77
Q ₁₀ =	4262	126.86
Q ₂₅ =	4818	180.06
Q ₅₀ =	8199	230.80
Q ₁₀₀ =	9475	270.02

Comparison Gages

1981 Conger Regression Region:

3

Index	Station Number	Station Name	Conger Region	County Name	County Number	Drainage Area	Slope	Storage	Forest	I 24,2	nowfa	Soil Perm	Q 100 Conger	Q100 LP-3	LPIII/REG # years
1	Site	Site	3	Winnebago	0	56.8	9	10	20	2.52	44	0.12	9475.0462	0	
190	5423500	South Branch Rock River at Waup	3	ond du Lac	20	63.6	8.33	8.2	1.5	2.57	39	1.51	2590	2080	0.803089
159	5401535	Big Roche A Cri Creek near Adam	3	Adams	1	62.8	4.83	1.5	38.7	2.69	45	7.28	455	542	1.191209
157	5401050	Tennile Creek near Nekoosa, WI	3	Wood	71	55.8	6.54	8	22.7	2.68	46	8.46	502	436	0.868526
37	4074850	Lily River near Lily, Wis.	3	Langlade	34	45.6	10.1	16.8	85.1	2.44	55	2.5	604	243	0.402318
153	5400025	Johnson Creek near Knowlton, WI	3	Marathon	37	25.1	32.6	2.55	56.4	2.67	50	0.41	7610	3140	0.412615
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

11761 6441

LPIII/REG = 0.5476575

(LPIII/REG)*QR = 5189.0802

REGR FACT

$Q_2 =$	2096	0.253	531 CFS
$Q_5 =$	3852	0.253	976 CFS
$Q_{10} =$	4452	0.253	1128 CFS
$Q_{25} =$	6318	0.253	1600 CFS
$Q_{50} =$	8099	0.253	2051 CFS
$Q_{100} =$	9475	0.253	2400 CFS

AVE = 8758

DESIGN FLOW = CFS

Comparison Station	Q100 (cfs)	Q100 (cms)
5423500	7687	219.07
5401535	11207	319.38
5401050	8214	234.10
4074850	3724	106.11
5400025	9372	267.09
0	0	0.00
AVERAGE	8041	229.15

Hydrologic Regression Analysis

Bridge Number:	B-70-190/191
County:	Winnebago
Township:	Winchester
Location:	Town of Winchester
Project ID:	1517-04-01
Waterway:	Rat River
Roadway:	USH 10

Please type parameter values in the appropriate cells.

Conger Region:	CA:	3	
Drainage Area	A:	56.8	sq. mi,
Slope	S:	9	ft/mi
Storage	ST:	10	%
Forest	FOR:	20	%
Snowfall	SN:	44	in/yr
Precipitation	I24,2:	2.52	in
Soil Permeability	SP:	0.12	in/hr

	Standard (cfs)	Metric (m ³ /s)
Q ₂ =	2096	59.73
Q ₅ =	3852	109.77
Q ₁₀ =	4452	126.86
Q ₂₅ =	6318	180.06
Q ₅₀ =	8099	230.80
Q ₁₀₀ =	9475	270.02

Comparison Gages

1981 Conger Regression Region:

3

Index	Station Number	Station Name	Conger Region	County Name	County Number	Drainage Area	Slope	Storage	Forest	I 24,2	nowfa	Soil Perm	Q 100 Conger	Q100 LP-3	LPIII/REG # years
1	Site	Site	3	Winnebago	0	56.8	9	10	20	2.52	44	0.12	9475.0462	0	
190	5423500	South Branch Rock River at Waup	3	ond du Lac	20	63.6	8.33	8.2	1.5	2.57	39	1.51	2590	2080	0.803089
159	5401535	Big Roche A Cri Creek near Adam	3	Adams	1	52.8	4.83	1.5	38.7	2.69	45	7.28	455	542	1.191209
157	5401050	Tennile Creek near Nekoosa, Wi	3	Wood	71	55.8	6.54	8	22.7	2.68	46	8.46	502	436	0.868526
37	4074850	Lily River near Lily, Wis.	3	Langlade	34	45.6	10.1	16.8	85.1	2.44	55	2.5	604	243	0.402318
153	5400025	Johnson Creek near Knowlton, W	3	Marathon	37	25.1	32.6	2.55	56.4	2.67	50	0.41	7610	3140	0.412615
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

11761 6441

LPIII/REG = 0.5476575

(LPIII)/(REG)*QR = 5189.0802

REGR FACT

$Q_2 =$	2096	0.253	531 CFS
$Q_5 =$	3852	0.253	976 CFS
$Q_{10} =$	4452	0.253	1128 CFS
$Q_{25} =$	6318	0.253	1600 CFS
$Q_{50} =$	8099	0.253	2051 CFS
$Q_{100} =$	9475	0.253	2400 CFS

AVE = 8758

DESIGN FLOW = 2400 CFS

Comparison Station	Q100 (cfs)	Q100 (cms)
5423500	7687	219.07
5401535	11207	319.38
5401050	8214	234.10
4074850	3724	106.11
5400025	9372	267.09
0	0	0.00
AVERAGE	8041	229.15

DESIGN/FINAL COMPUTATIONS

ED408 993

Site is in Conger's Area # 3.

Parameters needed for Regression Equations are
Drainage Area; Slope, Soil Permeability; Forest, Intensity.

(1) Drainage Area -

$$DA = 56.8 \text{ sq mi.}$$

(2) Slope -

Stream length $\approx 77,300$ feet ≈ 14.64 mi.

Station @ 10% = 7,730 ft ; Elevation @ 10% $\approx 750 \pm$

Station @ 85% = 65,705 ft ; Elevation @ 85% ≈ 849.6

$$\Rightarrow \text{Slope} \approx \frac{849.6 - 750}{14.64 \times 0.75} \approx 9.07 \text{ ft/mi} \\ \approx \underline{9 \text{ ft/mile}}$$

(3) Soil Permeability %

Based on Plate 2 $SP \approx 0.12 \text{ in/hr}$

(4) Forest -

$\sim 20\%$

(5) Intensity -

Intens ~ 2.52

Project/Structure No. B-70-190/191	Hwy. No. US# 10	County Winnebago	Computations by NK	Date 7-5-2000
Name of Road US# 10 over Red River - Project ID# 1517-01-04			Checked by	Date
Title/Item Parameters for Regression Equations -			Sheet 1	Of 1

2/29/88
RTV

HYDROLOGY FOR
WINNEBAGO CO. CTH W
over the
RAT RIVER.

Hydrology for B-71-117

OK
 $Q_{100} = \underline{2400} \text{ cfs}$

The soil permeability does not appear to be correct for this basin based on the soil survey maps of Winnebago and Outagamie Cos. There are sand and gravel operations all over the area which also indicate that the area is filled with glacial fill which has high soil permeability.

Based on ~~site~~ gage comparison it appears that 2400 cfs is a reasonable value.

Project No.	54 02.01 4N23	Remarks	Computation by ETW	Date 11-87
Project Name	WINNEBAGO CO CTH W RAT R		Checked by JTB	Date 12-87

TABLE 2 - SUMMARY OF DISCHARGES

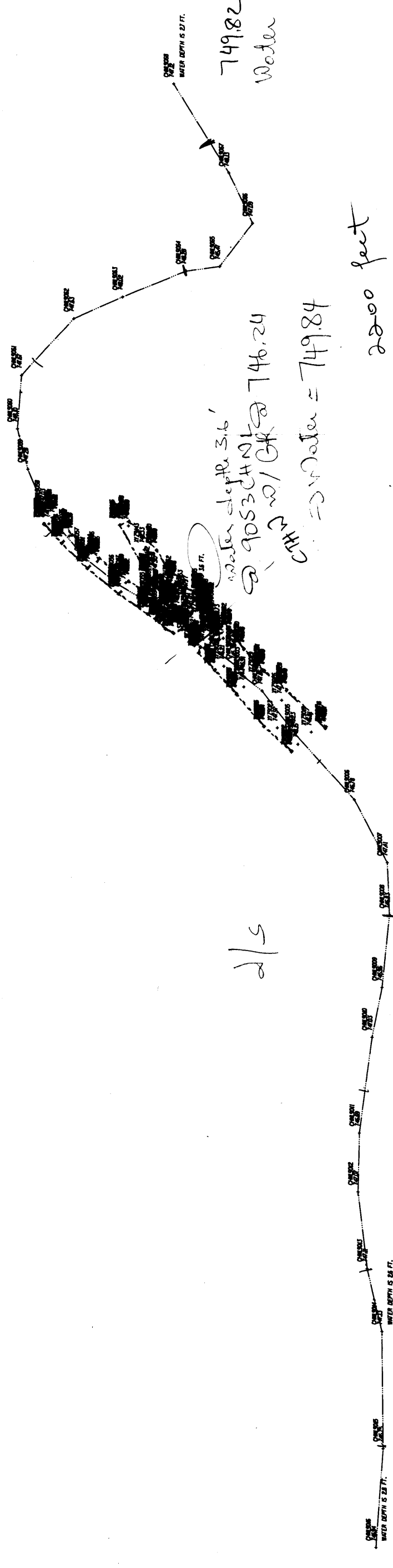
FLOODING SOURCE AND LOCATION	DRAINAGE AREA		PEAK DISCHARGES (CFS)			
	SQ MILES	10-YEAR	50-YEAR	100-YEAR	500-YEAR	
ARROWHEAD RIVER						
Downstream limit of study	30.20	1,015.00	1,800.00	2,200.00	3,070.00	
EIGHT MILE CREEK						
Downstream limit of study	25.60	600.00	1,090.00	1,325.00	2,000.00	
FOX RIVER						
Downstream limit of study	1,685.00	6,245.00	7,945.00	8,585.00	10,540.00	
MUD CREEK TRIBUTARY						
Downstream limit of study	5.25	597.40	1,109.50	1,365.50	2,133.60	
MUD CREEK						
Downstream limit of study	12.90	700.00	1,300.00	1,600.00	2,500.00	
RAT RIVER						
Downstream limit of study	64.00	1,000.00	1,920.00	2,400.00	3,800.00	
RUSH CREEK						
Downstream limit of study	58.50	1,750.00	3,200.00	4,000.00	6,100.00	

1 in = 300 ft

↑ N

w/s

d/s



2780 ft

$$S = \frac{749.82 - 749.74}{(2780 + 2200)} \approx 0.00016 \text{ ft/ft}$$

Qued = Oshkosh
NW
Project ID # 1517-04-01

WisDOT HYDRAULIC BRIDGE DESIGN

BRIDGE NUMBER: B-70-191
USH 10 EB / Rat River

HYDRAULICS BY: NK
DATE: 7-5-2000
FHA X (Y) — (N) Zone A

HYDROLOGY
Q100= 2400 cfs

BY: NK

DRAINAGE AREA= 56.8 sq mi

DATE: 7-5-2000

METHOD: Regression Equations, Comparison to rated bridges, FIS

HYDRAULICS METHOD: (WSPRO), HEC-2, HY8, OTHER: —

ENERGY SLOPE: SSR= 0.00002 ft/ft questionable - used an average value
USGS= ~ 0.00008 ft/ft of 0.00005
KNOWN TAILWATER= 756.7 HW 100 @ CTH W

MANNING "N" LEFT: 0.05 CHANNEL: 0.03 RIGHT: 0.05
LEFT: 0.07 CHANNEL: 0.03 RIGHT: 0.07

COMMENTS:

EXISTING CONDITIONS *****

QBR= — HW-100= —
QRD= — NATURAL= —
A(br)= — BACKWTR= —
VEL= — EXIT= —
FLOW= —

N/A
New Alignment

PROPOSED CONDITIONS *****

QBR= 2400 cfs HW-100= 756.95
QRD= N/A NATURAL= 756.66
A(br)= 574.6 sq ft BACKWTR= 0.29 ft
VEL= 4.2 ft/sec
FLOW= Type 1 SCOUR CODE 5 EXIT= 756.60

PROPOSED STRUCTURE: 2-span Haunched Slab COST: \$ 213,000
COMMENTS: 45 ft span length - 20° RHF skew

- PSC not feasible as it would not provide adequate freeboard -

T1 B-70-190/191, USH 10 OVER RAT RIVER, I.D. #1517-04-01
T2 TOWN OF WINCHESTER, WINNEBAGO COUNTY
T3 EXISTING/PROPOSED CONDITIONS-- BY NK OF WisDOT 07-17-2000
*
UT
SI 0
*
SK
Q
*
XS WXIT 1000
GR 828.0,760.0 829.0,751.00 947.0,750.00 951.0,749.00
GR 964.0,748.0 978.0,747.00 991.0,746.00 1007.0,746.0
GR 1021.0,746.0 1035.0,748.00 1048.0,749.00 1053.0,750.0
GR 1073.0,751.0 1199.0,752.00 1200.0,760.00
N 0.05,0.030,0.05
SA 951.0,1048
*
XS WFLV 1122.0
*
BR CTHW 1122.0,757.60,0
GR 957.90,757.59 958.30,755.09 960.80,755.09 969.00,750.26
GR 970.00,749.37 974.00,748.54 984.00,746.18 1014.00,746.24
GR 1032.00,747.74 1034.00,749.59 1036.00,750.63 1039.20,755.27
GR 1041.70,755.27 1042.10,757.77 957.90,757.59
CD 3 34.0 2.5 760.24
PD 1 746.20,1,1
N 0.030
SA
*
XS WAPP 1199
GR 866.0,760.00 867.0,751.00 910.0,750.0 922.0,750.0
GR 928.0,749.00 933.0,748.00 992.0,747.0 1000.0,746.6
GR 1005.0,747.00 1015.0,748.00 1034.0,749.0 1046.0,750.0
GR 1075.0,751.00 1172.0,752.00 1173.0,760.0
N 0.5,0.030,0.5
SA 928.0,1034.0
FL 46,928,43,1034,37
*
XS EXIT 1200
*
XS FULV 1231.0
*
BR PRBR 1231.0,758.0,20
GR 950.50,758.30 950.50,755.05 953.00,755.05 960.58,750.00
GR 975.00,750.00 980.00,749.00 994.00,748.00 1000.00,747.64
GR 1006.00,748.00 1026.00,749.00 1030.00,750.00 1031.50,750.05
GR 1038.25,754.55 1040.75,754.55 1040.75,757.80 950.50,758.30
CD 3 136.0 2.5 759.55
PD 1 747.80,1,1
N 0.030
SA
*
XS APPR 1472
GR 800.0,760.00 802.0,751.00 833.0,751.0 840.0,750.0
GR 853.0,750.00 860.0,751.00 872.0,751.00 876.0,750.0
GR 887.0,750.00 893.0,751.00 952.0,751.00 975.0,750.0
GR 984.0,750.00 989.0,749.00 994.0,748.00 1000.0,747.09
GR 1008.0,748.00 1015.0,749.00 1020.0,750.00 1038.0,751.00
GR 1115.0,752.00 1168.0,753.00 1170.0,760.00
N 0.07,0.030,0.07
SA 984.0,1020.0
FL 120,984,110,1020,110
*
HP 2 756.949 0.1 757.049 2400
*
DC 0 PRBR 950.5 1040.75 * * * 1.0
*
DC 1 PRBR 950.5 1040.75 * * .0004 1.0
*
DP PRBR 950.5 1040.75 1.0
*
DA PRBR 0.55
*
EX
ER
]

Scour depth

Contraction : 6.87

Pier : 2.79

Total Scour 9.66

Say 10'

Scour -

$D_{50} = 0.12 \text{ mm}$ (per Site Investigation Report) -
 $D_{50} = 0.0004'$

$$V_c = 6.19 y^{1/6} D_{50}^{1/3} \text{ (metric)}$$

$$\text{where } y = 9.70 \text{ ft} = 2.96 \text{ m}$$

$$V = 2.77 \text{ ft/sec} = 0.84 \text{ m/sec}$$

$$\Rightarrow V_c = 0.38 \text{ m/sec}$$

$$V_c < V \Rightarrow \text{live-bed scour}$$

***** W S P R O *****

Federal Highway Administration - U. S. Geological Survey

Model for Water-Surface Profile Computations.

Run Date & Time: 7/17/2000 11:25 am Version V061698

Input File: E70-190E.wsp Output File: B70-190p.OUT

T1 B-70-190/191, USH 10 OVER RAT RIVER, I.D. #1517-04-01
T2 TOWN OF WINCHESTER, WINNEBAGO COUNTY
T3 EXISTING/PROPOSED CONDITIONS-- BY NK OF WISDOT 07-17-2000
UT 8,7,2,26,28,25,5,*,1,42,12,36
SI 0
SK .00005
Q 2400

*** Processing Flow Data; Placing Information into Sequence 1 ***

***** W S P R O *****

Federal Highway Administration - U. S. Geological Survey

Model for Water-Surface Profile Computations.

Input Units: English / Output Units: English

B-70-190/191, USH 10 OVER RAT RIVER, I.D. #1517-04-01
TOWN OF WINCHESTER, WINNEBAGO COUNTY
EXISTING/PROPOSED CONDITIONS-- BY NK OF WISDOT 07-17-2000

* Starting To Process Header Record WXIT *

XS WXIT 1000
GR 828.0,760.0 829.0,751.00 947.0,750.00 951.0,749.00
GR 964.0,748.0 978.0,747.00 991.0,746.00 1007.0,746.0
GR 1021.0,746.0 1035.0,748.00 1048.0,749.00 1053.0,750.0
GR 1073.0,751.0 1199.0,752.00 1200.0,760.00
N 0.05,0.030,0.05
SA 951.0,1048

*** Completed Reading Data Associated With Header Record WXIT ***

*** Storing X-Section Data In Temporary File As Record Number 1 ***

*** Data Summary For Header Record WXIT ***

SRD Location: 1000. Cross-Section Skew: .0 Error Code 0

Valley Slope: .00000 Averaging Conveyance By Geometric Mean.

Energy Loss Coefficients -> Expansion: .50 Contraction: .00

X,Y-coordinates (15 pairs)

X	Y	X	Y	X	Y
828.000	760.000	829.000	751.000	947.000	750.000
951.000	749.000	964.000	748.000	978.000	747.000
991.000	746.000	1007.000	746.000	1021.000	746.000
1035.000	748.000	1048.000	749.000	1053.000	750.000
1073.000	751.000	1199.000	752.000	1200.000	760.000

Minimum and Maximum X,Y-coordinates

Minimum X-Station: 828.000 (associated Y-Elevation: 760.000)

Maximum X-Station: 1200.000 (associated Y-Elevation: 760.000)

Minimum Y-Elevation: 746.000 (associated X-Station: 1021.000)

Maximum Y-Elevation: 760.000 (associated X-Station: 828.000)

Roughness Data (3 SubAreas)

SubArea	Roughness Coefficient	Horizontal Breakpoint
1	.050	---
	---	951.000
2	.030	---
	---	1048.000
3	.050	---

* Finished Processing Header Record WXIT *

***** W S P R O *****

Federal Highway Administration - U. S. Geological Survey

Model for Water-Surface Profile Computations.

Input Units: English / Output Units: English

B-70-190/191, USH 10 OVER RAT RIVER, I.D. #1517-04-01
TOWN OF WINCHESTER, WINNEBAGO COUNTY
EXISTING/PROPOSED CONDITIONS-- BY NK OF WISDOT 07-17-2000

* Starting To Process Header Record WFLV *

Maximum Y-Elevation: 760.000 (associated X-Station: 800.000)

SubArea	Roughness Coefficient	Horizontal Breakpoint
1	.070	---
	---	984.000
2	.030	---
	---	1020.000
3	.070	---

Section	Length	Breakpoint
1	120.000	---
	---	984.000
2	110.000	---
	---	1020.000
3	110.000	---

Bridge datum projection(s): XREFLT XREFRT FDSLT FDSRT

* Finished Processing Header Record APPR *

***** W S P R O *****
Federal Highway Administration - U. S. Geological Survey
Model for Water-Surface Profile Computations.
Input Units: English / Output Units: English

B-70-190/191, USH 10 OVER RAT RIVER, I.D. #1517-04-01
TOWN OF WINCHESTER, WINNEBAGO COUNTY
EXISTING/PROPOSED CONDITIONS-- BY NK OF WISDOT 07-17-2000
DC 0 PRBR 950.5 1040.75 * * * 1.0
DC 1 PRBR 950.5 1040.75 * * .0004 1.0
DP PRBR 950.5 1040.75 1.0
DA PRBR 0.55
EX

=====

#	Reach Discharge	Water Surface Elevation	Friction Slope	Flow Regime
1	2400.00	*****	.0000	Sub-Critical

=====

=====

* Beginning 1 Profile Calculation(s) *

=====

***** W S P R O *****
Federal Highway Administration - U. S. Geological Survey
Model for Water-Surface Profile Computations.
Input Units: English / Output Units: English

B-70-190/191, USH 10 OVER RAT RIVER, I.D. #1517-04-01
TOWN OF WINCHESTER, WINNEBAGO COUNTY
EXISTING/PROPOSED CONDITIONS-- BY NK OF WISDOT 07-17-2000

<< Beginning Computations for Profile 1 >>

	WSEL EGEL CRWS	VHD HF HO	Q V FR #	AREA K SF	SRDL FLEN ALPHA	LEW REW ERR
Section: WXIT	756.489	.025	2400.000	2431.981	*****	828.390
Header Type: XS	756.514	*****	.987	339406.70	*****	1199.561
SRD: 1000.000	749.776	*****	.087	*****	1.645	*****
Section: WFLV	756.496	.025	2400.000	2434.500	122.000	828.389
Header Type: FV	756.521	.006	.986	339927.40	122.000	1199.562
SRD: 1122.000	749.776	.000	.087	.0000	1.644	.001

<<< The Preceding Data Reflect The "Unconstricted" Profile >>>

---135 CONVEYANCE RATIO OUTSIDE OF RECOMMENDED LIMITS AT SECID "WAPP".
KRATIO: .61

Section: WAPP	756.468	.088	2400.000	2053.140	77.000	866.392
Header Type: AS	756.556	.004	1.169	207855.50	43.053	1172.558
SRD: 1199.000	750.160	.032	.162	.0001	4.143	.000

<<< The Preceding Data Reflect The "Unconstricted" Profile >>>

<<< The Following Data Reflect The "Constricted" Profile >>>

<<< Beginning Bridge/Culvert Hydraulic Computations >>>

	WSEL EGEL CRWS	VHD HF HO	Q V FR #	AREA K SF	SRDL FLEN ALPHA	LEW REW ERR
Section: CTHW	756.424	.229	2400.000	679.847	122.000	958.087
Header Type: BR	756.654	.016	3.530	128306.10	122.000	1041.885
SRD: 1122.000	750.463	.123	.238	*****	1.183	-.001

Specific Bridge Information	C	P/A	PFELEV	BLEN	XLAB	XRAB
Bridge Type 3 Flow Type 1						
Pier/Pile Code 1	.9192	.015	757.600	*****	*****	*****

Unconstricted Full Valley Section Water Surface Elevation: 756.496
 Downstream Bridge Section Water Surface Elevation: 756.424
 Bridge DrawDown Distance: .072

	WSEL EGEL CRWS	VHD HF HO	Q V FR #	AREA K SF	SRDL FLEN ALPHA	LEW REW ERR
Section: WAPP	756.594	.085	2400.000	2091.902	43.000	866.378
Header Type: AS	756.680	.011	1.147	212981.90	50.004	1172.574
SRD: 1199.000	750.160	.016	.158	.0001	4.173	.007

** Change in Approach Section Water Surface Elevation: .127 **

Approach Section WAPP Flow Contraction Information					
M (G)	M (K)	KQ	XLKQ	XRKQ	OTEL
.726	.217	166523.3	938.402	1022.200	756.594

<<< End of Bridge Hydraulics Computations >>>

Section: EXIT	756.596	.085	2400.000	2092.518	1.000	866.378
Header Type: XS	756.682	.000	1.147	213063.00	1.000	1172.575
SRD: 1200.000	750.160	.000	.158	.0001	4.173	.002

Section: FULV	756.602	.085	2400.000	2094.308	31.000	866.378
Header Type: FV	756.687	.004	1.146	213300.00	31.000	1172.575
SRD: 1231.000	750.160	.000	.158	.0001	4.174	.002

<<< The Preceding Data Reflect The "Unconstricted" Profile >>>

Section: APPR	756.659	.046	2400.000	2117.368	241.000	800.743
Header Type: AS	756.704	.017	1.133	178359.70	115.562	1169.045
SRD: 1472.000	752.537	.000	.126	.0002	2.295	.000

<<< The Preceding Data Reflect The "Unconstricted" Profile >>>

<<< The Following Data Reflect The "Constricted" Profile >>>

<<< Beginning Bridge/Culvert Hydraulic Computations >>>

	WSEL EGEL CRWS	VHD HF HO	Q V FR #	AREA K SF	SRDL FLEN ALPHA	LEW REW ERR
Section: PRBR	756.522	.335	2400.000	574.641	31.000	953.537
Header Type: BR	756.857	.010	4.177	96872.13	31.000	1038.349
SRD: 1231.000	752.319	.166	.314	*****	1.236	-.003

Specific Bridge Information	C	P/A	PFELEV	BLEN	XLAB	XRAB
Bridge Type 3 Flow Type 1						
Pier/Pile Code 1	.8995	.015	758.000	*****	*****	*****

Unconstricted Full Valley Section Water Surface Elevation: 756.602
 Downstream Bridge Section Water Surface Elevation: 756.522
 Bridge DrawDown Distance: .080

	WSEL EGEL CRWS	VHD HF HO	Q V FR #	AREA K SF	SRDL FLEN ALPHA	LEW REW ERR
Section: APPR	756.949	.041	2400.000	2224.529	105.000	800.678
Header Type: AS	756.990	.043	1.079	192390.90	125.237	1169.128
SRD: 1472.000	752.537	.090	.116	.0002	2.258	.008

** Change in Approach Section Water Surface Elevation: .291 **

Approach	Section	APPR	Flow	Contraction	Information
M(G)	M(K)	KQ	XLKQ	XRKQ	OTEL
.770	.549	86667.8	949.340	1034.153	756.949

<<< End of Bridge Hydraulics Computations >>>

<< Completed Computations of Profile 1 >>

***** W S P R O *****
 Federal Highway Administration - U. S. Geological Survey
 Model for Water-Surface Profile Computations.
 Input Units: English / Output Units: English
 -----*
 B-70-190/191, USH 10 OVER RAT RIVER, I.D. #1517-04-01
 TOWN OF WINCHESTER, WINNEBAGO COUNTY
 EXISTING/PROPOSED CONDITIONS-- BY NK OF WISDOT 07-17-2000

=== User Defined Table 1 of 2 ===

	SRD	Q	AREA	VEL	CRWS	EGL	WSEL
1 WXIT	1000.000	2400.000	2432.0	.987	749.776	756.514	756.489
2 WFLV	1122.000	2400.000	2434.5	.986	749.776	756.521	756.496
3 WAPP	1199.000	2400.000	2053.1	1.169	750.160	756.556	756.468
4 CTHW	1122.000	2400.000	679.8	3.530	750.463	756.654	756.424
5 WAPP	1199.000	2400.000	2091.9	1.147	750.160	756.680	756.594
6 EXIT	1200.000	2400.000	2092.5	1.147	750.160	756.682	756.596
7 FULV	1231.000	2400.000	2094.3	1.146	750.160	756.687	756.602
8 APPR	1472.000	2400.000	2117.4	1.133	752.537	756.704	756.659
9 PRBR	1231.000	2400.000	574.6	4.177	752.319	756.857	756.522
10 APPR	1472.000	2400.000	2224.5	1.079	752.537	756.990	756.949

=== User Defined Table 2 of 2 ===

	K	XSTW	YMIN	FLEN
1 WXIT	339407.	371.171	746.000	*****
2 WFLV	339927.	371.173	746.000	122.000
3 WAPP	207855.	306.166	746.600	43.053
4 CTHW	128306.	83.798	746.180	122.000
5 WAPP	212982.	306.196	746.600	50.004
6 EXIT	213063.	306.196	746.600	1.000
7 FULV	213300.	306.198	746.600	31.000
8 APPR	178360.	368.303	747.090	115.562
9 PRBR	96872.	84.813	747.640	31.000
10 APPR	192391.	368.451	747.090	125.237

***** W S P R O *****
 Federal Highway Administration - U. S. Geological Survey
 Model for Water-Surface Profile Computations.
 Input Units: English / Output Units: English
 -----*
 B-70-190/191, USH 10 OVER RAT RIVER, I.D. #1517-04-01
 TOWN OF WINCHESTER, WINNEBAGO COUNTY
 EXISTING/PROPOSED CONDITIONS-- BY NK OF WISDOT 07-17-2000

*** Beginning Velocity Distribution For Header Record APPR ***
 SRD Location: 1472.000 Header Record Number 8

Water Surface Elevation: 756.949 Element # 1
 Flow: 2400.000 Velocity: 1.08 Hydraulic Depth: 6.037
 Cross-Section Area: 2224.35 Conveyance: 192367.80
 Bank Stations -> Left: 800.678 Right: 1169.128

X STA.	800.7	827.9	848.0	869.1	888.6	910.8
A(I)		157.8	131.2	134.1	130.5	133.9
V(I)		.76	.91	.90	.92	.90
D(I)		5.80	6.52	6.35	6.69	6.02
X STA.	910.8	934.2	957.6	976.9	988.3	994.0
A(I)		139.1	139.6	127.9	80.6	48.0
V(I)		.86	.86	.94	1.49	2.50
D(I)		5.95	5.98	6.61	7.11	8.37
X STA.	994.0	998.7	1003.2	1008.0	1013.5	1020.9
A(I)		44.2	43.3	44.5	47.0	55.2
V(I)		2.71	2.77	2.70	2.55	2.17
D(I)		9.31	9.70	9.22	8.55	7.51
X STA.	1020.9	1042.5	1067.0	1095.6	1126.7	1169.1
A(I)		136.5	140.6	153.9	155.1	181.4
V(I)		.88	.85	.78	.77	.66
D(I)		6.32	5.73	5.39	4.99	4.28

Water Surface Elevation: 757.049 Element # 2
Flow: 2400.000 Velocity: 1.06 Hydraulic Depth: 6.136
Cross-Section Area: 2261.20 Conveyance: 197289.80
Bank Stations -> Left: 800.656 Right: 1169.157

X STA.	800.7	827.8	848.0	869.1	888.6	910.8
A (I)		160.4	133.2	136.2	132.4	136.1
V (I)		.75	.90	.88	.91	.88
D (I)		5.90	6.62	6.45	6.79	6.12

X STA.	910.8	934.2	957.1	976.7	988.3	994.0
A (I)		141.5	139.0	131.2	83.8	48.1
V (I)		.85	.86	.91	1.43	2.49
D (I)		6.05	6.07	6.69	7.21	8.48

X STA.	994.0	998.8	1003.3	1008.2	1013.8	1021.6
A (I)		45.4	44.4	45.6	48.0	58.4
V (I)		2.54	2.70	2.63	2.50	2.05
D (I)		9.41	9.79	9.30	8.62	7.53

X STA.	1021.6	1043.0	1067.8	1095.6	1126.7	1169.2
A (I)		137.1	144.4	152.3	158.2	185.5
V (I)		.88	.83	.79	.76	.65
D (I)		6.39	5.82	5.48	5.09	4.37

***** W S P R O *****
Federal Highway Administration - U. S. Geological Survey
Model for Water-Surface Profile Computations.
Input Units: English / Output Units: English

B-70-190/191, USH 10 OVER RAT RIVER, I.D. #1517-04-01
TOWN OF WINCHESTER, WINNEBAGO COUNTY
EXISTING/PROPOSED CONDITIONS-- BY NK OF WISDOT 07-17-2000

*** Live-Bed Contraction Scour Calculations for Header Record PRBR ***

Constants and Input Variables

Bed Material Transport Mode Factor (k1): .64
Total Pier Width Value (Pw): 1.000

#	Scour Depth	-- Flow --		-- Width --		--- X-Limits ---	
		Contract	Approach	Contract	Approach	Side	Contract Approach
1	6.866	2400.000	1111.515	89.250	90.250	Left:	950.500 950.500
		Approach Channel Depth:		7.310		Right:	1040.750 1040.750

***** W S P R O *****
Federal Highway Administration - U. S. Geological Survey
Model for Water-Surface Profile Computations.
Input Units: English / Output Units: English

B-70-190/191, USH 10 OVER RAT RIVER, I.D. #1517-04-01
TOWN OF WINCHESTER, WINNEBAGO COUNTY
EXISTING/PROPOSED CONDITIONS-- BY NK OF WISDOT 07-17-2000

*** Clear-Water Contraction Scour for Header Record PRBR ***

Constants and Input Variables

Bed Material D50 Value (D50): .0004
Pier Width Value (Pw): 1.000

#	Scour Depth	-- Flow --		-- Width --		--- X-Limits ---	
		Contract	Approach	Contract	Approach	Side	Contract Approach
1	12.906	2400.000	1111.515	89.250	90.250	Left:	950.500 950.500
		Approach Channel Depth:		7.310		Right:	1040.750 1040.750

***** W S P R O *****
Federal Highway Administration - U. S. Geological Survey
Model for Water-Surface Profile Computations.
Input Units: English / Output Units: English

B-70-190/191, USH 10 OVER RAT RIVER, I.D. #1517-04-01
TOWN OF WINCHESTER, WINNEBAGO COUNTY
EXISTING/PROPOSED CONDITIONS-- BY NK OF WISDOT 07-17-2000

*** Pier Scour Calculations for Header Record PRBR ***

Constants and Input Variables

Pier Width: 1.000

Pier Shape Factor (K1): 1.00

Flow Angle of Attack Factor (K2): 1.00
 Bed Condition Factor (K3): 1.10
 Bed Material Factor (K4): 1.00
 Velocity Multiplier (VM): 1.00
 Depth Multiplier (YM): 1.00

#	Scour Depth	---- Localized Hydraulic Properties ----					-- X-Stations --	
		Flow	WSE	Depth	Velocity	Froude #	Left	Right
1	2.785	2400.000	756.612	8.972	4.932	.290	950.500	1040.750

□ ***** W S P R O *****
 Federal Highway Administration - U. S. Geological Survey
 Model for Water-Surface Profile Computations.
 Input Units: English / Output Units: English

B-70-190/191, USH 10 OVER RAT RIVER, I.D. #1517-04-01
 TOWN OF WINCHESTER, WINNEBAGO COUNTY
 EXISTING/PROPOSED CONDITIONS-- BY NK OF WISDOT 07-17-2000

*** Abutment Scour Calculations for Header Record PRBR ***

Constants and Input Variables

 Adjustment Factor (K1): .55
 Flow Angle of Attack Factor (K2): 1.00
 Factor of Safety (FS): 1.00

#	Abtmnt Scour		X-Statn	A-Prime	Ya	Qe	Overbank Froude #
	Side	Depth					
1	Left	11.737	953.537	153.537	6.132	819.630	.062

No Right Abutment Scour. Right Edge of Water Inside of Abutment Toe.

Summary

Bridge Number: B-70-190/191
County: Winnebago
Township: Winchester
Location: Town of Winchester
Project ID: 1517-04-01
Waterway: Rat River
Roadway: USH 10

The 100 year flood value for the Conger regression equations is

Q100 =	9475 cfs
--------	----------

Based on the area transfers:

Comparison Station	Q100 (cfs)	Q100 (cms)
5423500	7687	219.07
5401535	11207	319.38
5401050	8214	234.10
4074850	3724	106.11
5400025	9372	267.09
0	0	0.00
AVERAGE	8041	229.15

Q100 =	2400 cfs
--------	----------

(FIS Winnebago Co.)
The regression equation value seems to be too high - see
attached note from Hydrology for B-70-117 - a $Q_{100} = 2440$ cfs
is obtained with the regression equation if an $SP = 0.85$ is used.

Hydrologic Regression Analysis

Bridge Number:	B-70-190/191
County:	Winnebago
Township:	Winchester
Location:	Town of Winchester
Project ID:	1517-04-01
Waterway:	Rat River
Roadway:	USH 10

Please type parameter values in the appropriate cells.

Conger Region:	CA:		
Drainage Area	A:		sq. mi,
Slope	S:		ft/mi
Storage	ST:		%
Forest	FOR:		%
Snowfall	SN:		in/yr
Precipitation	124,2:		in
Soil Permeability	SP:		in/hr

	Standard (cfs)	Metric (m ³ /s)
Q ₂ =	200.16	59.73
Q ₅ =	311.52	109.77
Q ₁₀ =	407.2	126.86
Q ₂₅ =	531.8	180.06
Q ₅₀ =	819.0	230.80
Q ₁₀₀ =	901.2	270.02

3

[illegible]
$$\text{LPIII/REG} = 0.5476575$$
$$(LP_{III})/(REG)*QR = 5189.0802$$

Comparison Station	Q100 (cfs)	Q100 (cms)
5423500	7687	219.07
5401535	11207	319.38
5401050	8214	234.10
4074850	3724	106.11
5400025	9372	267.09
0	0	0.00
AVERAGE	8041	229.15

$Q_2 =$	2096	0.253	531	CFS
$Q_6 =$	3552	0.253	976	CFS
$Q_{10} =$	4452	0.253	1128	CFS
$Q_{25} =$	6318	0.253	1600	CFS
$Q_{60} =$	8099	0.253	2051	CFS
$Q_{100} =$	9475	0.253	2400	CFS

DESIGN FLOW = CFS

Hydrologic Regression Analysis

Bridge Number:

B-70-190/191

County:

Winnebago

Township:

Winchester

Location:

Town of Winchester

Project ID:

1517-04-01

Waterway:

Rat River

Roadway:

USH 10

Please type parameter values in the appropriate cells.

Conger Region:	CA:	3	
Drainage Area	A:	56.8	sq. mi,
Slope	S:	9	ft/mi
Storage	ST:	10	%
Forest	FOR:	20	%
Snowfall	SN:	44	in/yr
Precipitation	I24,2:	2.52	in
Soil Permeability	SP:	0.12	in/hr

	Standard (cfs)	Metric (m ³ /s)
Q ₂ =	2096	59.73
Q ₅ =	3852	109.77
Q ₁₀ =	4452	126.86
Q ₂₅ =	6318	180.06
Q ₅₀ =	8099	230.80
Q ₁₀₀ =	9475	270.02

Hydrologic Regression Analysis

Bridge Number:

County:

Township:

Location:

Project ID:

Waterway:

Roadway:

B-70-190/191
Winnebago
Winchester
Town of Winchester
1517-04-01
Rat River
USH 10

Please type parameter values in the appropriate cells.

Conger Region:	CA:	3	
Drainage Area	A:	56.8	sq. mi,
Slope	S:	9	ft/mi
Storage	ST:	10	%
Forest	FOR:	20	%
Snowfall	SN:	44	in/yr
Precipitation	I24,2:	2.52	in
Soil Permeability	SP:	0.12	in/hr

	Standard (cfs)	Metric (m ³ /s)
Q ₂ =	2096	59.73
Q ₅ =	3852	109.77
Q ₁₀ =	4452	126.86
Q ₂₅ =	6318	180.06
Q ₅₀ =	8099	230.80
Q ₁₀₀ =	9475	270.02

Comparison Gages

3

1981 Conger Regression Region:

Index	Station Number	Station Name	Conger Region	County Name	County Number	Drainage Area	Slope	Storage	Forest	I 24,2	nowfa	Soil Perm	Q 100 Conger	Q100 LP-3	LPIII/REG # years
1	Site	Site	3	Winnebago	0	56.8	9	10	20	2.52	44	0.12	9475.0462	0	
190	5423500	South Branch Rock River at Waup	3	ond du Lac	20	63.6	8.33	8.2	1.5	2.57	39	1.51	2590	2080	0.803089
159	5401535	Big Roche A Cri Creek near Adam	3	Adams	1	52.8	4.83	1.5	38.7	2.69	45	7.28	455	542	1.191209
157	5401050	Tennille Creek near Nekoosa, W	3	Wood	71	55.8	6.54	8	22.7	2.68	46	8.46	502	436	0.868526
37	4074850	Lily River near Lily, Wis.	3	Langlade	34	45.6	10.1	16.8	85.1	2.44	55	2.5	604	243	0.402318
153	5400025	Johnson Creek near Knowlton, W	3	Marathon	37	25.1	32.6	2.55	56.4	2.67	50	0.41	7610	3140	0.412615
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

11761 6441

LPIII/REG = 0.5476575

(LPIII)/(REG)*QR = 5189.0802

REGR FACT

$Q_2 =$	2096	0.253	531 CFS
$Q_5 =$	3852	0.253	976 CFS
$Q_{10} =$	4452	0.253	1128 CFS
$Q_{25} =$	6318	0.253	1600 CFS
$Q_{50} =$	8099	0.253	2051 CFS
$Q_{100} =$	9475	0.253	2400 CFS

AVE = 8758

DESIGN FLOW = 2400 CFS

Comparison Station	Q100 (cfs)	Q100 (cms)
5423500	7687	219.07
5401535	11207	319.38
5401050	8214	234.10
4074850	3724	106.11
5400025	9372	267.09
0	0	0.00
AVERAGE	8041	229.15

DESIGN/FINAL COMPUTATIONS

ED408 993

Wisconsin Department of Transportation

Site is in Conger's Area # 3.

Parameters needed for Regression Equations are
Drainage Area; Slope, Soil Permeability; Forest, Intensity

(1) Drainage Area -

$$DA = 56.8 \text{ sq mi}$$

(2) Slope -

$$\text{Stream length} \approx 77,300 \text{ feet} \approx 14.64 \text{ mi}$$

$$\text{Station @ } 10\% = 7,730 \text{ ft} ; \text{ Elevation @ } 10\% \approx 750 \text{ ft}$$

$$\text{Station @ } 85\% = 65,705 \text{ ft} ; \text{ Elevation @ } 85\% \approx 849.6$$

$$\Rightarrow \text{Slope} = \frac{849.6 - 750}{14.64 \times 0.75} \approx 9.07 \text{ ft/mi} \\ \approx 9 \text{ ft/mile}$$

(3) Soil Permeability %

$$\text{Based on Plate 2} \quad SP \approx 0.12 \text{ in/hr}$$

(4) Forest -

$$\approx 20\%$$

(5) Intensity -

$$\text{Intensity} \approx 2.52$$

Project/Structure No. B-70-190/191	Hwy. No. US 10	County Winnebago	Computations by NK	Date 7-5-2000
Name of Road US 10 over Rat River - Project ID# 1517-01-04	Checked by		Date	
Title/Item Parameters for Regression Equations -	Sheet 1	Of 1		

HYDROLOGY FOR ^{2/29/88} RTV
WINNEBAGO CO. CTH W
over the
RAT RIVER.

Hydrology for B-71-117

OK
 $Q_{100} = \underline{2400} \text{ cfs}$

The soil permeability does not appear to be correct for this basin based on the soil survey maps of Winnebago and Outagamie Cos. There are sand and gravel operations all over the area which also indicate that the area is filled with glacial till which has high soil permeability.

Based on ~~slope~~ gage comparison it appears that 2400 cfs is a reasonable value.

Project No.	54 02.01 4N35	Remarks	Computation by	Date
Project Name	WINNEBAGO CO CTH W RAT R		ETN	11-87
			Checked by	Date
			JB	12-15

TABLE 2 - SUMMARY OF DISCHARGES

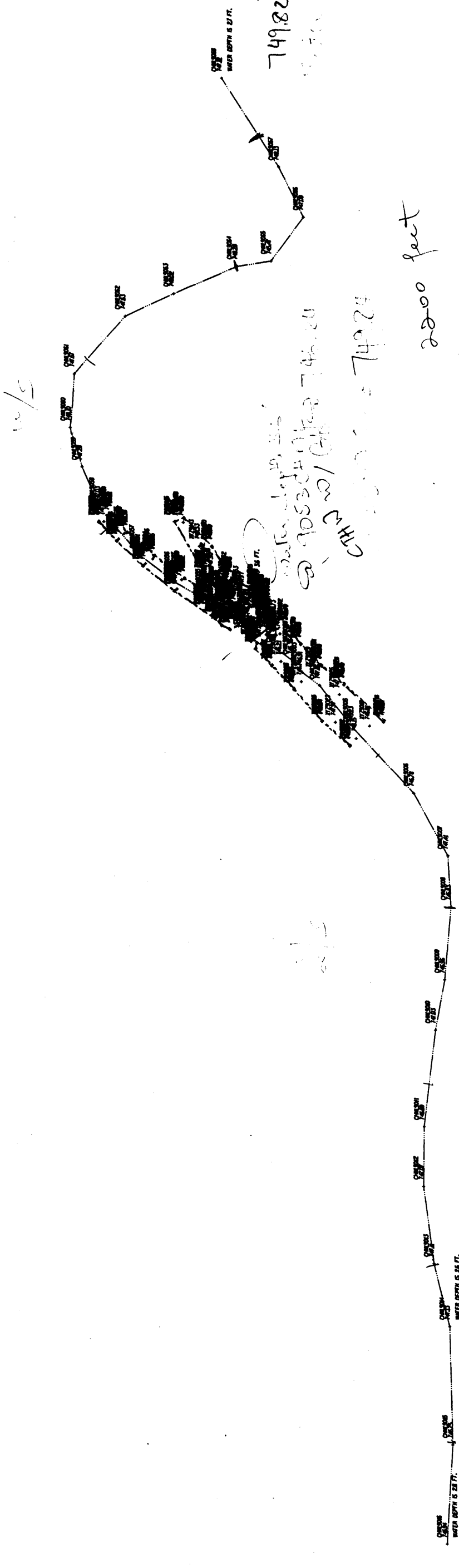
FLOODING SOURCE AND LOCATION	DRAINAGE AREA SQ MILES	PEAK DISCHARGES (CFS)			
		10-YEAR	50-YEAR	100-YEAR	500-YEAR
ARROWHEAD RIVER					
Downstream limit of study	30.20	1,015.00	1,800.00	2,200.00	3,070.00
EIGHT MILE CREEK					
Downstream limit of study	25.60	600.00	1,090.00	1,325.00	2,000.00
FOX RIVER					
Downstream limit of study	1,685.00	6,245.00	17,945.00	18,585.00	40,540.00
MUD CREEK TRIBUTARY					
Downstream limit of study	5.25	597.40	1,109.50	1,365.50	2,133.60
MUD CREEK					
Downstream limit of study	12.90	700.00	1,300.00	1,600.00	2,500.00
RAT RIVER					
Downstream limit of study	64.00	1,000.00	1,920.00	2,400.00	3,800.00
RUSH CREEK					
Downstream limit of study	58.50	1,750.00	3,200.00	4,000.00	6,100.00

TABLE 2 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA SQ MILES	PEAK DISCHARGES (CFS)			
		10-YEAR	50-YEAR	100-YEAR	500-YEAR
ARROWHEAD RIVER					
Downstream limit of study	30.20	1,015.00	1,800.00	2,200.00	3,070.00
EIGHT MILE CREEK					
Downstream limit of study	25.60	600.00	1,090.00	1,325.00	2,000.00
FOX RIVER					
Downstream limit of study	1,685.00	6,245.00	17,945.00	28,585.00	107,540.00
MUD CREEK TRIBUTARY					
Downstream limit of study	5.25	597.40	1,109.50	1,365.50	2,133.60
MUD CREEK					
Downstream limit of study	12.90	700.00	1,300.00	1,600.00	2,500.00
RAT RIVER					
Downstream limit of study	64.00	1,000.00	1,920.00	2,400.00	3,800.00
RUSH CREEK					
Downstream limit of study	58.50	1,750.00	3,200.00	4,000.00	6,100.00

1 in = 300 ft

↑ N



2720 ft

$$S = \frac{749.82 - 749.74}{(2720 + 2200)} = 0.00016 \text{ ft/ft}$$