APPENDIX E

HYDROLOGY REPORT

HYDROLOGY REPORT

BRIDGE 24 REPLACEMENT

TOWNSHIP OF BLANDFORD BLENHEIM

LOTS 8 &9, CONCESSIONS 11 & 12 (BLENHEIM)

MARCH 2025
REVISED FEBRUARY 2026
REVISED APRIL 2026

K. SMART ASSOCIATES LIMITED
85 McIntyre Drive
Kitchener ON N2R 1H6

INDEX

		Page
1.	Introduction	1
2	Location	1
3.	Background Information and References	1
4.	Existing Conditions	2
5.	Estimated Flows	3
6.	Design Criteria	5
7.	Proposed Structure	5
8.	Roadway Improvements	6
9.	Summary of Hydraulic Analysis	6
10.	Ice	8
11.	Erosion Protection	8
12.	Scour Protection	8
13.	Bridge Deck Drainage	9
14.	Erosion and Sediment Control During Construction	9
15.	Construction	9
16.	Conclusions	10

APPENDIX A

APPENDIX B

APPENDIX C

APPENDIX D

March 2025 File No. 22-145
Revised February 2026
Revised April 2026

BRIDGE 24 REPLACEMENT
TOWNSHIP OF BLANDFORD BLENHEIM
HYDROLOGY REPORT

1.0 INTRODUCTION

The Township of Blandford Blenheim intends to replace Bridge 24. The existing bridge is a single span steel through truss supported on concrete abutments. It is estimated the structure was built in 1929. There is no record of any previous hydrology studies being done at this structure.

The purpose of this study is to ensure that the new structure would have adequate hydraulic capacity and no significant changes to the level of the Regional Storm will occur upstream of the proposed new structure.

2.0 LOCATION

Bridge 24 is located on Township Road 12 over Nith River, approximately 2.4 km west of Oxford Road #3 at Lots 8 & 9 Concessions 11 & 12 (Blenheim), in the Township of Blandford Blenheim in the County of Oxford.

3.0 BACKGROUND INFORMATION AND REFERENCES

3.1 Background Information

The following background information was compiled to prepare this report

- 1:50,000 topographic maps for Brantford, Cambridge, Conestogo, Guelph, Lucan, Seaforth, St Marys, Stratford and Woodstock
- Soil maps for Oxford, Waterloo, Perth and Wellington Counties
- Record of flow from gauging station 02GA010 (Nith River near Canning) for the period 1913-2022
- Topographic engineering survey completed by KSAL in August 2020
- HEC RAS Model for Nith River supplied by GRCA

3.2 References

The following references were consulted:

- MTO Drainage Management Manual
- Canadian Highway Bridge Design Code 2019
- MTO Highway Drainage Design Standards published January 2008

4.0 EXISTING CONDITIONS

4.1 Roadway Classification

Township Road 12 is classified as a Rural Local Undivided with a design speed of 80 km/hr, otherwise known as RLU 80.

4.2 Watershed Characteristics

Area of Watershed = 725.1 km^2
Length of River = 107.63 km
Average Slope of Watershed = 0.001 %
CN (AMC II) = 73.8

4.3 Existing Structure

The existing structure is a single span steel through truss bridge with a span of 40.2m and an overall width of 4.7m. The bridge was constructed in 1929.

The existing stream bed elevation is approximately 290.30 and the soffit elevation is 294.84. The total effective opening area of the structure is approximately 158.0 square metres.

The elevation of the low point of the roadway, to the west of the structure, is 294.37.

4.4 Waterway Adequacy

The opening area is adequate to pass the 25 year design storm. The roadway overtops at flows beyond the 25 year storm.

4.5 Major Flood

It is reported that the west roadway approach overtops occasionally during the spring freshet. It is also reported that this overtopping is possibly due to capacity issues downstream (i.e. debris blockages or ice jamming) not due to Bridge 24 being undersized.

4.6 Relief Flows

Relief flow is mostly over the west roadway approach. At significant flow events the east roadway approach will provide relief flow.

4.7 Existing Roadside and Structure Drainage

Runoff from the roadway spills off the road and into low lying areas on either side of the road. Runoff eventually drains back into the river.

Runoff from the structure deck is directed to deck drains. These deck drains outlet directly into the river.

4.8 Upstream Structures

a) Approximately 3.5 km upstream, there is a 61.2m two span concrete girder bridge and a 5.7m wide concrete box culvert for overflow on Oxford Road #3 which were constructed around 1962.
Total Opening area of main structure = 206.9 m^2
Total Opening area of overflow structure = 24.5 m^2

b) Approximately 8.5 km upstream, there is a 39.6m single span steel truss bridge (Blandford Blenheim Bridge 25) on Township Road 12 which was constructed around 1937.
Total opening area = 165.6 m^2

4.9 Downstream Structures

a) Approximately 1.7 km downstream, there is a 48.2m three span concrete bridge (Blandford Blenheim Bridge 23) on Blenheim Road which was constructed in 1978.
Total opening area = 201.3 m^2

b) Approximately 6.5 km downstream, there is a 59.5m three span concrete bridge (Blandford Blenheim Bridge 20) on Township Road 12 which was constructed in 2019.
Total opening area = 246.5 m^2

5.0 ESTIMATED FLOWS

5.1 Flow Estimate Methods

The following methods were used to estimate the flows at this structure:

- Modified Index Flood Method
- Single Station Frequency Analysis
- PCSWMM (for Regional Storm only)
- GRCA HEC RAS Model*

* Flows were provided in the HEC RAS model

5.2 Summary of Estimated Flows

Storm	Method	Flows (m^3/s)
2 Year	Modified Index Flood Method	108.2
	Single Station Frequency Analysis	146.7
	GRCA HEC RAS Model	--
	PCSWMM	--
5 Year	Modified Index Flood Method	145.0
	Single Station Frequency Analysis	220.4
	GRCA HEC RAS Model	--
	PCSWMM	--
10 Year	Modified Index Flood Method	177.4
	Single Station Frequency Analysis	276.2
	GRCA HEC RAS Model	--
	PCSWMM	--
25 Year	Modified Index Flood Method	216.4
	Single Station Frequency Analysis	349.9
	GRCA HEC RAS Model*	416.0
	PCSWMM	--
50 Year	Modified Index Flood Method	244.5
	Single Station Frequency Analysis	405.7
	GRCA HEC RAS Model	--
	PCSWMM	--
100 Year	Modified Index Flood Method	274.8
	Single Station Frequency Analysis	461.5
	GRCA HEC RAS Model*	526.0
	PCSWMM	--
Regional	Modified Index Flood Method	--
	Single Station Frequency Analysis	--
	GRCA HEC RAS Model*	923.0
	PCSWMM	554.8

* These flow rates have been provided by GRCA for use in HEC RAS.

Design Flows

Reference is made to “Highway Drainage Design Standards” to determine the return period for the normal design flood for this structure. Based on Township Road 12 being classified as a local road and the proposed span exceeding 6.0m, a 25 year return period shall be used. A 100 year return period shall be used for the check flood for scour.

As the Nith River is a regulated watercourse, the Regional Storm shall also be considered.

As GRCA has requested HEC RAS modeling be completed and that the flows contained within the provided HEC RAS model not be changed, only the flows provided in the HEC RAS model will be used for design

Therefore the design flows shall be:

Q_{25} = 416.0 m^3/s
Q_{100} = 526.0 m^3/s
Q_{REG} = 923.0 m^3/s

6.0 DESIGN CRITERIA

The ideal replacement structure would be such that the following design criteria are met:

a) The opening of the proposed structure shall be adequate to convey the estimated design flow for a 25 year design storm without causing any flooding.

b) Consideration of scour adjacent to spread or strip footings.

c) There should not be an increase in the level of the Regional flood plain. Any increase would be considered a significant increase.

d) High water at the 25 year design storm shall have an average vertical clearance of 300mm below the soffit of the proposed structure.

e) The roadway approaches may provide relief flow for storms greater than a 25 year event if the geometry of the roadway profile would permit.

f) The freeboard between the high water level and the low point of the proposed roadway shall not be less than 300mm.

g) A navigable clearance envelope of at least 5.0m wide by 2.4m tall.

h) A longitudinal road grade of at least 0.5% across the structure.

7.0 PROPOSED STRUCTURE

The proposed structure shall be as follows:

3 span semi-continuous slab-on-girder bridge (prestressed concrete box girders)
Construction type to be semi-integral abutment style
Foundation to be conventional spread footings
Span = 63.7 m (18.9, 25.9, 18.9 m centre of bearings)
Skew = 0˚
Stream bed elevation = 290.30 (same as existing)
Low soffit elevation = 295.01
Elevation of low point of roadway = 294.35
Effective total opening area = 238.0 m^2
High water elevation at 25 year design storm = 293.11
Minimum clearance to soffit at 25 year design storm = 1900 mm
Freeboard at 25 year design storm = 1240 mm

8.0 ROADWAY IMPROVEMENTS

8.1 Horizontal Alignment

No changes to the horizontal alignment of Township Road 12 are required. The current straight alignment is ideal.

The location of the new bridge, however, will be moved slightly so that it is centred in the existing right-of-way.

8.2 Vertical Alignment

The vertical alignment of Township Road 12 will changed overtop the structure. This will involve creating 1.5% longitudinal grades up to the bridge and providing a crest vertical curve overtop the bridge. Tie-in sag vertical curves will be provided to connect the new roadway grades to the existing. An 80 km/hr design speed will be used. The changes to the vertical alignment are limited to the roadway approaches on either side of the proposed new structure.

8.3 Cross-Section Elements

Township Road 12 will be widened to provide 2 traffic lanes and shoulders over the structure and the roadway approaches adjacent to the structure. 2% cross-fall will be provided for positive roadway drainage, 1.5H to 1.0V sideslopes will be provided to support the roadway embankment and 1.5H to 1.0V backslopes will be used to tie-in to the existing ground.

Where necessary, roadside ditches will be provided.

9.0 SUMMARY OF HYDRAULIC ANALYSIS

9.1 Modeling

The HEC RAS Model used for the analysis was supplied by GRCA.

The following changes were made to the HEC RAS model to run the existing conditions:

- Channel and overbank Manning's roughness values were set to 0.035 and 0.08, respectively, in accordance with industry guidance;
- Expansion and contraction coefficients of 0.30 and 0.50, respectively were applied at XS 18645. XS 18570 and XS 18558;
- Expansion and contraction coefficients of 0.10 and 0.30 were applied to cross sections 20736 to 17546;
- Cross sections 18558 and 18570 were repositioned 6.0m away from the bridge to locate them outside the roadway right-of-way;
- Ineffective flow areas were defined upstream and downstream of the bridge, in accordance with standard HEC RAS guidance, using a 1:1 contraction and expansion slope to limit flow conveyance in areas not expected to actively contribute to channel flow;
- The existing bridge railing was modeled as part of the high chord to conservatively account for potential debris accumulation during larger storm events because the railing limits flows over the bridge deck;

- The existing bridge, located at River Station 18564, was updated based on survey information obtained in the field. The structure was modeled using the HEC RAS bridge and roadway modeling routine with a width of 4.7m, a span of 39.2m and an opening area of 158.0 m^2. The roadway low point elevation of 294.35 was set as the minimum weir flow elevation for roadway overtopping. Refer to Appendix A and B for details of the existing structure and roadway.

The proposed conditions model was created starting with the existing conditions model with the following changes:

- The proposed bridge railing was modeled as part of the high chord to conservatively account for potential debris accumulation during larger storm events because the railing limits flows over the bridge deck
- The proposed bridge was changed to reflect the proposed bridge. The structure was modeled using the HEC RAS bridge and roadway modeling routine with a width of 9.0m, a span of 61.0m and an opening area of 238.0 m^2. 2 piers, with a width of 0.9m, were included in the modeling. The roadway low point elevation of 294.35 was set as the minimum weir flow elevation for roadway overtopping. Refer to Appendix A and C for details of the proposed structure and roadway.

9.2 Summary of Results

The table below shows a comparison for the existing conditions and proposed conditions.

Location	Flow (m^3/s)	High Water Elevation (m)		Velocity (m/s)	
		Existing	Proposed	Existing	Proposed
156 Upstream (Sta 18720)	416.0	295.32	295.32	2.20	2.20
	526.0	295.73	295.73	2.37	2.37
	923.0	296.93	296.93	2.57	2.57
Bridge - Upstream (Sta 18564)	416.0	293.11	293.11	2.25	2.25
	526.0	293.50	293.50	2.36	2.36
	923.0	295.15	295.15	1.88	1.88
Bridge – Downstream (Sta 18564)	416.0	293.11	293.11	2.27	2.27
	526.0	293.50	293.50	2.41	2.41
	923.0	295.15	295.15	1.93	1.93
148m Downstream (Sta 18416)	416.0	294.97	294.97	1.40	1.40
	526.0	295.38	295.38	1.37	1.37
	923.0	296.59	296.59	1.31	1.31

For further details, see Appendix C

The modelling confirms there will be no changes to the hydrology under the proposed conditions.

The proposed structure also satisfies the stated design criteria.

10.0 ICE

Reference is made to both the MTO Drainage Management Manual as well as MTO Publication "Guide for Preparing Hydrology Reports for Water Crossings" which states that the design of a crossing should be checked for the potential impact of ice and debris on the flow through the structure. Given that ice jamming is a possibility at this location of Nith River, consideration of ice and debris is necessary.

With respect to the proposed structure:

- The proposed structure is quite a bit larger compared to the existing structure and the soffit elevation of the proposed structure is higher. This larger structure should eliminate the possibility of constricted flow through the bridge.

- A 3-span structure is proposed rather than a 2-span structure; a two-span structure would result in a pier being placed at the centre of the watercourse. A centre pier would create an obvious obstruction given that most of the flow occurs through the centre. A 3-span structure with the piers situated close to the existing river banks allows a large central opening to minimize any obstructions to the flow. It is also noted that a single span structure (i.e. no piers in the water) is not realistic for this location given the span and topography.

- A more elaborate scour protection system will be provided to protect the foundations of the proposed structure in case of scour due to waterway constrictions or relief flow paths.

- Ice impact and abrasion will be considered in the structural design and detailing of the structure.

- Bridge 24 has been in service for nearly a century; replacement of this structure will not significantly alter the probability of effects of upstream flooding, conveyance capacity due to channel icing, river surging or public safety as a result of ice jamming.

11.0 EROSION PROTECTION

To protect against erosion, rock protection will be placed on embankments underneath the structure and at the corners of the structure to above the 25 year water level. Rock protection will be laid on geotextile underlay.

Rock protection should have an average stone size of at least 300mm. This size is appropriate (based on Highway Drainage Design Standards WC-3) for a velocity not exceeding 3.0 m/s and assuming the check flow for scour is 100% of the 100 year design storm.

12.0 SCOUR PROTECTION

To protect against possible undermining of the structure foundations by scour, the underside of the abutments and pier footings will be located at least 1.5m below grade and the footings will be lined with sheet pile that extends a further 1.2m below the underside of footing.

Rock protection will be placed around the footings and piers as a final preventative measure against scour.

13.0 BRIDGE DECK DRAINAGE

Bridge deck drainage will be accomplished by the following:

a) Overtop the bridge, runoff will be directed to the curb line via 2% deck cross-fall. No deck drains will be provided.

b) Runoff will flow along the curb line via longitudinal grade to each side of the bridge.

c) Concrete curb and gutter as well as gutter outlets will be placed at each corner of the bridge to direct runoff to the roadside ditches. Rip rap spillways will be provided at the end of the gutter outlets to the bottom of the slope.

This methodology prevents salt or pollutant laden runoff from directly entering the Nith River. Directing runoff to roadside ditches allows the possibly of vegetation to filter the runoff prior to said runoff entering the watercourse.

14.0 EROSION AND SEDIMENT CONTROL DURING CONSTRUCTION

A detailed erosion and sediment control drawing will be prepared to control erosion and sedimentation during the construction. This same drawing will also show the proposed dewatering scheme.

15.0 CONSTRUCTION

It is recommended that construction of the proposed structure occur in single stage construction. Traffic can be detoured around the site using the existing network of roads.

Removal of the existing structure could be accomplished by first removing the concrete deck, steel stringers and railing system. The bridge could be lifted off of the abutments using a large crane and disassembled on dry land. The existing concrete abutments and foundations can be removed using a hydraulic excavator equipped with a hydraulic breaker.

Construction of the proposed structure will require in-water work. To minimize effects to the natural environment, all in-water work should be completed within the allowable in-water work timing windows. Sheet pile cofferdams would be constructed to isolate the watercourse from the construction and to permit work to proceed in the dry.

The new bridge would be constructed in stages starting with the east (or west) pier footing, east (or west) pier, east (or west) abutment and wingwalls to bearing seat level, west (or east) pier footing, west (or east) pier, west (or east) abutments and wingwalls to bearing seat level, placement of girders, construction of deck and remaining portions of wingwalls, construction of curbs and finally erection of the steel railing system.

The roadway would be constructed last so that it matches the bridge. Backfill adjacent to the new bridge would be placed in stages and only after the concrete deck was placed.

16.0 CONCLUSIONS

The hydraulic analysis has indicated that there would not be any changes in the hydrology for the proposed conditions.

The proposed structure also satisfies the stated design criteria.

Bridge deck drainage, erosion and sediment control during construction as well as construction details will be provided on the engineering drawings. These drawings are not included with this report.

It is our conclusion that the proposed structure would adequately serve the hydrology requirements.

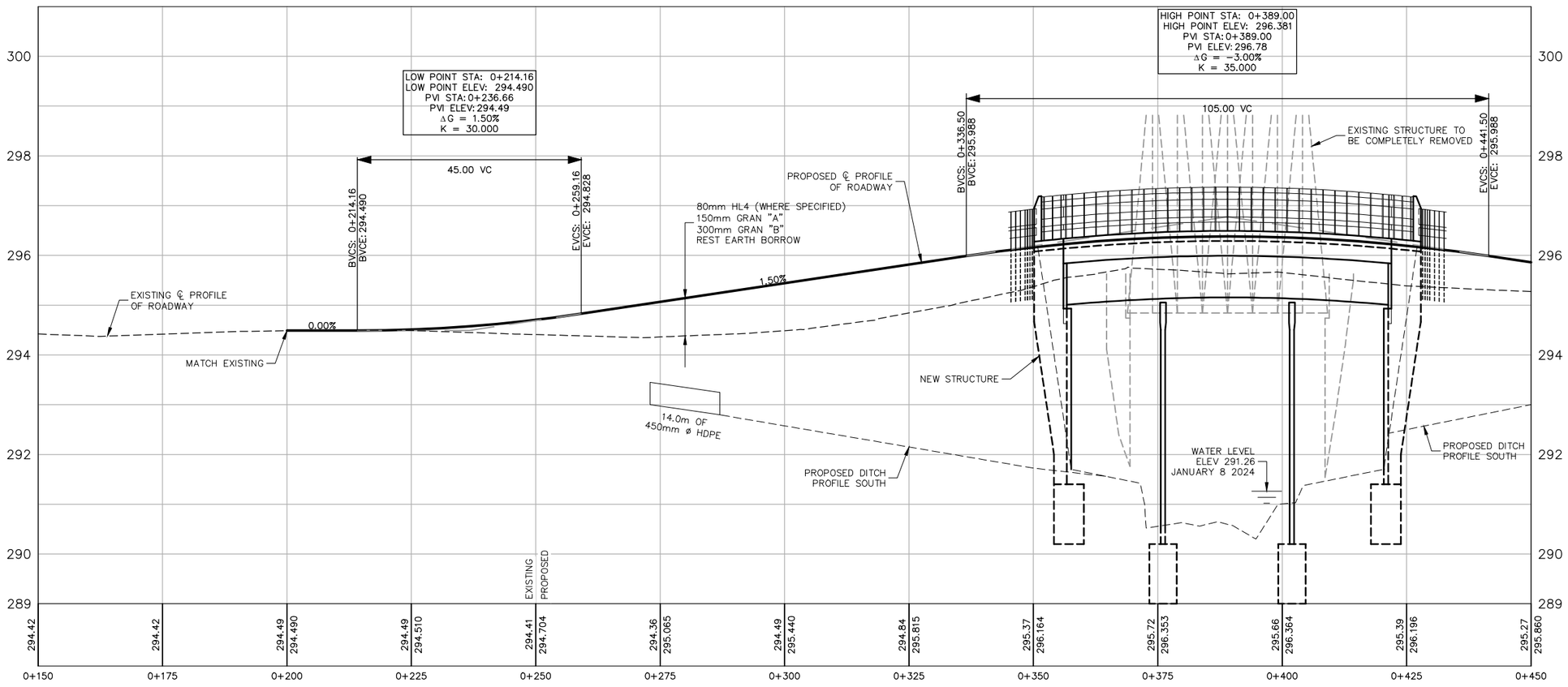
All of which is respectfully submitted.

Allan Garnham, P. Eng.



APPENDIX A

- Roadway Profile Drawings



No.	REVISION	DATE
1.	ISSUED FOR REPORT	FEB. 20/26
2.	REVISED FOR REPORT	APR. 1/26

DESIGNED BY: A.G.
CHECKED BY: D.H.
DRAWN BY: T.H.
CHECKED BY: A.G.
FIELD BOOK:

SCALE
HORIZ. 1:500
VERT. 1:50
5.0m 0 10.0m
(ON 24 x 36 PAPER)

BRIDGE 24 REPLACEMENT

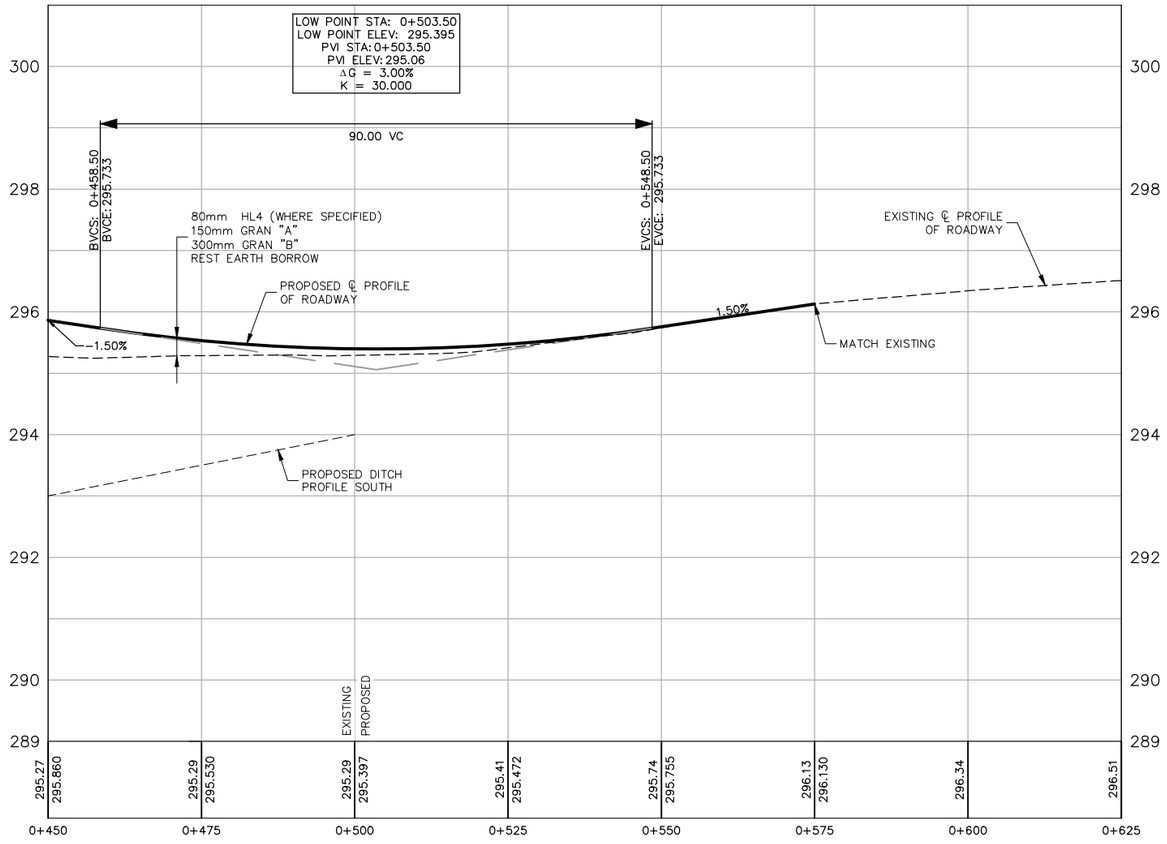
TOWNSHIP OF BLANDFORD–BLENHEIM

ROADWAY PROFILE 1

K. SMART ASSOCIATES LIMITED
CONSULTING ENGINEERS AND PLANNERS
KITCHENER SUDBURY

JOB NUMBER 22–264
DATE FEBRUARY 2026
DRAWING NUMBER SK–1

S:\2022\22-264\Drafting\22-264 – Bridge 24 – SITE PLAN.dwg Roadway 1 7–Apr–26 9:49:32 AM



No.	REVISION	DATE
1.	ISSUED FOR REPORT	FEB. 20/26
2.	REVISED FOR REPORT	APR. 1/26

DESIGNED BY: A.G.
CHECKED BY: D.H.
DRAWN BY: T.H.
CHECKED BY: A.G.
FIELD BOOK:

SCALE
HORIZ. 1:500
VERT. 1:50
5.0m 0 10.0m
(ON 24 x 36 PAPER)

BRIDGE 24 REPLACEMENT

TOWNSHIP OF BLANDFORD-BLENHEIM

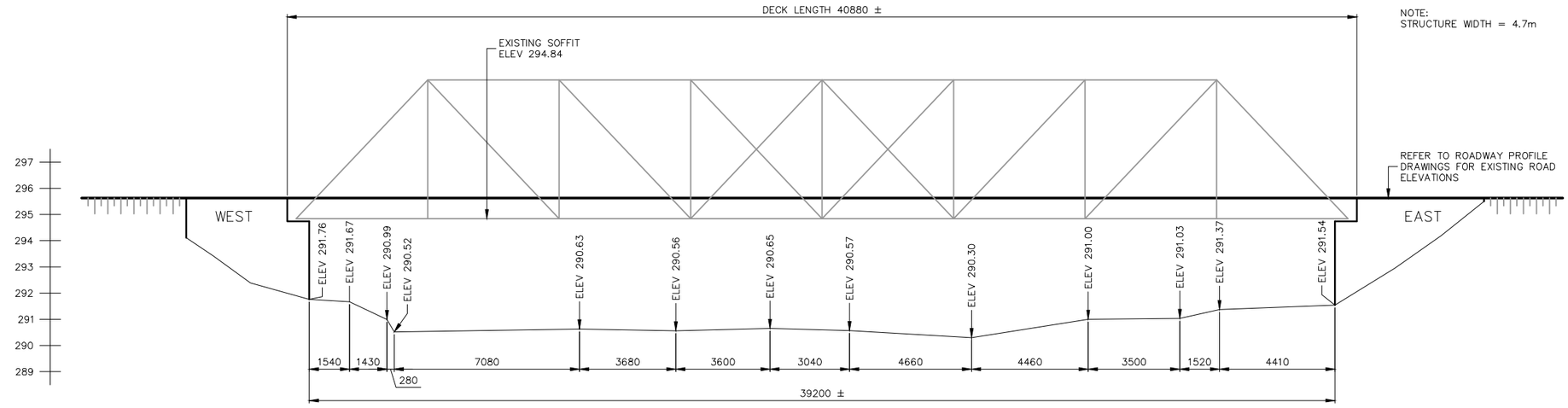
ROADWAY PROFILE 2

K. SMART ASSOCIATES LIMITED
CONSULTING ENGINEERS AND PLANNERS
KITCHENER SUDBURY

JOB NUMBER 22-264
DATE FEBRUARY 2026
DRAWING NUMBER SK-2

APPENDIX B

- Existing Structure



EXISTING STRUCTURE
SCALE 1:100

No.	REVISION	DATE
1.	ISSUED FOR REPORT	FEB. 20/26
2.	REVISED FOR REPORT	APR. 1/26

DESIGNED BY: A.G.
CHECKED BY: D.H.
DRAWN BY: T.H.
CHECKED BY: A.G.
FIELD BOOK:

SCALE
1:100
1.0m 0 2.0m
(ON 24 x 36 PAPER)

BRIDGE 24 REPLACEMENT

TOWNSHIP OF BLANDFORD-BLENHEIM

EXISTING STRUCTURE

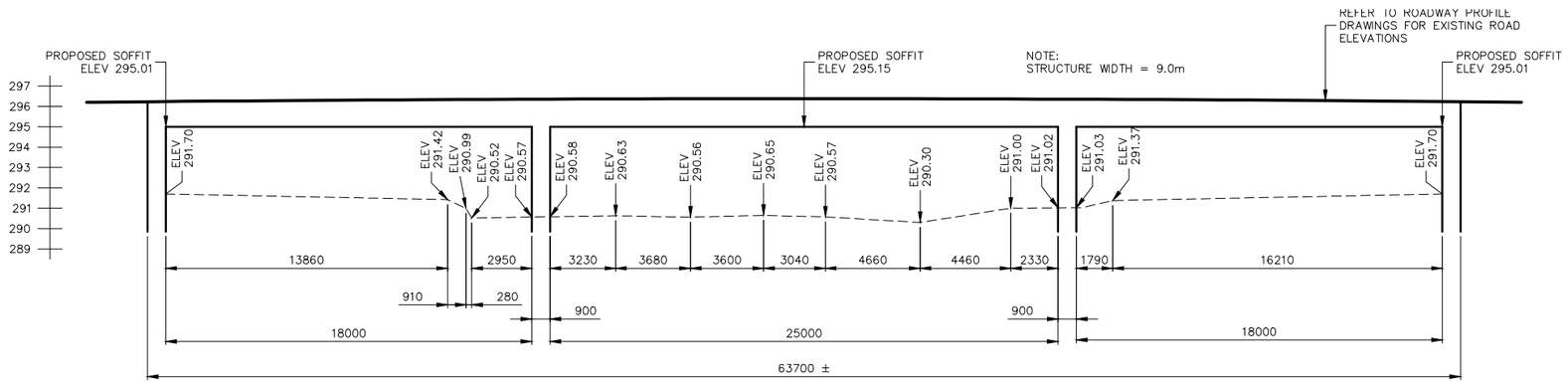
K. SMART ASSOCIATES LIMITED
CONSULTING ENGINEERS AND PLANNERS
KITCHENER SUDBURY

JOB NUMBER
22-264
DATE
FEBRUARY 2026
DRAWING NUMBER
SK-3

S:\2022\22-264\Drafting\22-264 - Bridge 24 - SITE PLAN.dwg Existing Structure 7-Apr-26 9:52:45 AM

APPENDIX C

- Proposed Structure



PROPOSED STRUCTURE
SCALE 1:150

No.	REVISION	DATE
1.	ISSUED FOR REPORT	FEB. 20/26
2.	REVISED FOR REPORT	APR. 1/26

DESIGNED BY: A.G.
CHECKED BY: D.H.
DRAWN BY: T.H.
CHECKED BY: A.G.
FIELD BOOK:

SCALE
1:150
2.0m 0 4.0m
(ON 24 x 36 PAPER)

BRIDGE 24 REPLACEMENT

TOWNSHIP OF BLANDFORD-BLENHEIM

PROPOSED STRUCTURE

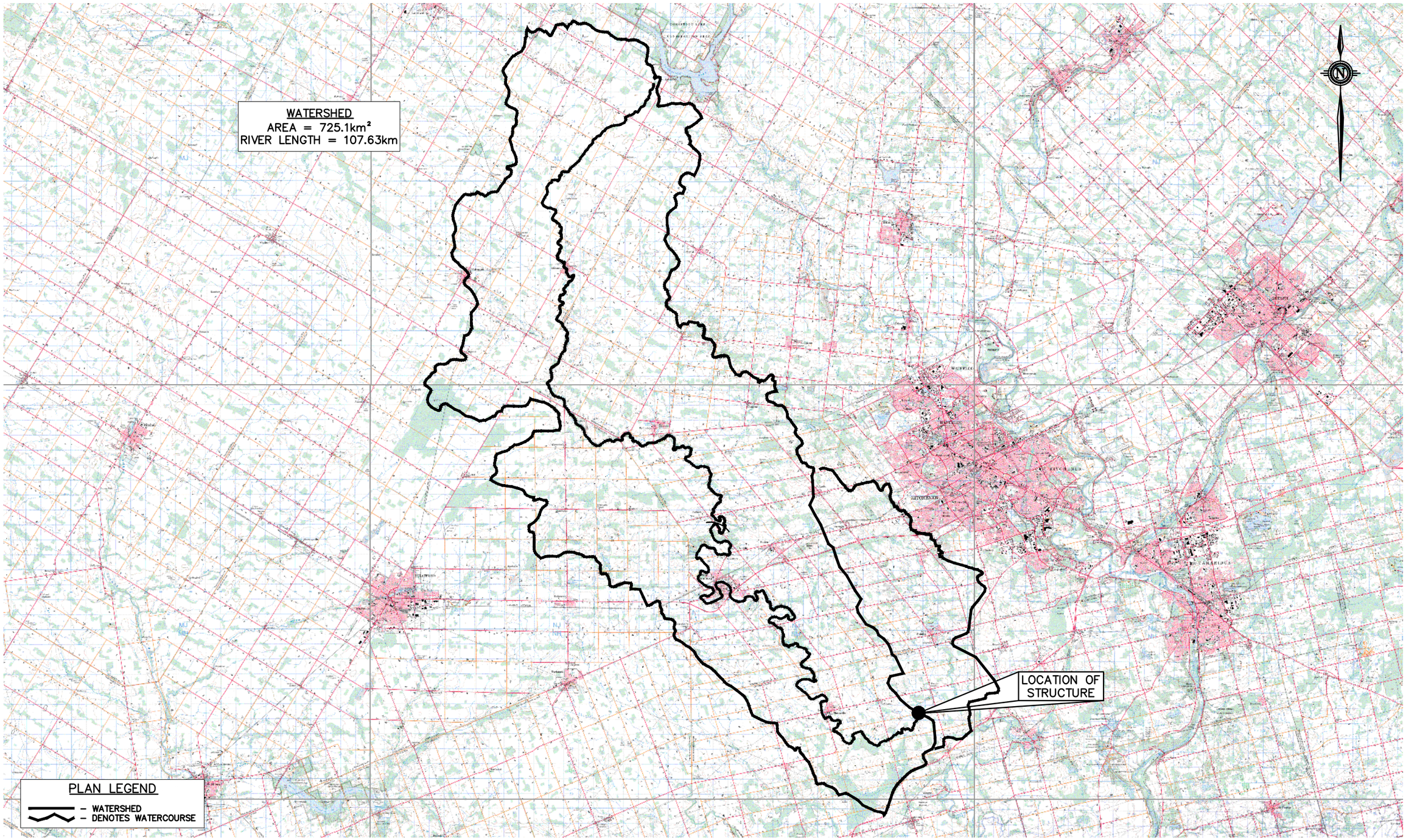
K. SMART ASSOCIATES LIMITED
CONSULTING ENGINEERS AND PLANNERS
KITCHENER SUDBURY

JOB NUMBER
22-264
DATE
FEBRUARY 2026
DRAWING NUMBER
SK-4

S:\2022\22-264\Drafting\22-264 - Bridge 24 - SITE PLAN.dwg Proposed Structure 7-Apr-26 9:53:07 AM

APPENDIX D

- Watershed Plan Area
- Soils Map
- Hydraulic Computations
- Excerpts from HEC RAS modeling output
  (Note – Full results available upon request)



No.	REVISION	DATE
1.	ISSUED FOR HYDROLOGY REPORT	MAR 4, 2025

DESIGNED BY: A.G.
CHECKED BY: D.H.
DRAWN BY: J.P.
CHECKED BY: A.G.
FIELD BOOK:

SCALE
1:125,000
1250m 0 2500m

BRIDGE 24 REPLACEMENT

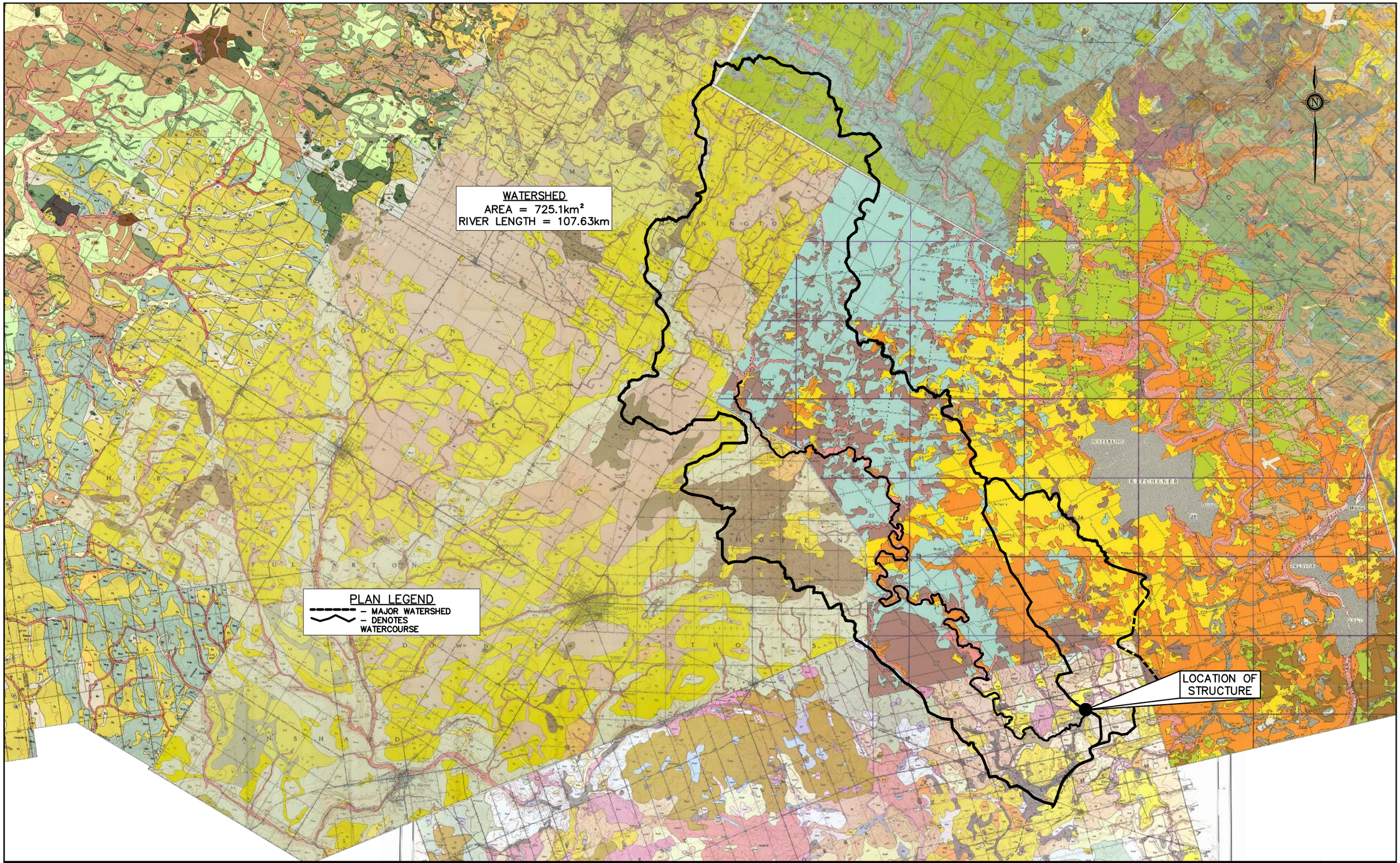
TOWNSHIP OF BLANDFORD–BLENHEIM

WATERSHED PLAN

K. SMART ASSOCIATES LIMITED
CONSULTING ENGINEERS AND PLANNERS
KITCHENER SUDBURY

JOB NUMBER
22–264
DATE
JANUARY 2024
DRAWING NUMBER
WSHED

S:\2022\22–264\Drafting\Hydrology Drawings\22–264 – BRIDGE 24 – WATERSHED PLAN.dwg TOPO 4–Mar–25 11:32:13 AM



No.	REVISION	DATE
1.	ISSUED FOR HYDROLOGY REPORT	MAR 4, 2025

DESIGNED BY: A.G.
CHECKED BY: D.H.
DRAWN BY: J.P.
CHECKED BY: A.G.
FIELD BOOK:

SCALE
1:125,000
1250m 0 2500m

BRIDGE 24 REPLACEMENT

TOWNSHIP OF BLANDFORD-BLENHEIM

SOIL MAP

K. SMART ASSOCIATES LIMITED
CONSULTING ENGINEERS AND PLANNERS
KITCHENER SUDBURY

JOB NUMBER
22-264
DATE
JANUARY 2024
DRAWING NUMBER
SOIL

S:\2022\22-264\Drafting\Hydrology Drawings\22-264 – BRIDGE 24 – SOILS MAP.dwg SOIL 4-Mar-25 11:26:17 AM

Bridge 24 Replacement - Hydrology Calculations
(KSAL Job Number 22-264)

Watershed Characteristics:

Watershed Area: **725.10** km² From AutoCAD

Length of River: **107.63** km From AutoCAD

Slope of the Main Channel:

By the 85/10 Method

Length at 10% = 107.63 x 0.10
Length at 10% = 10.76 km

Actual distance = **9772** m
Elevation= **300** m

Length at 85% = 107.63 x 0.85
Length at 85% = 91.49 km

Actual distance = **99366** m
Elevation= **390** m

$$\text{Slope} = \frac{\text{rise}}{\text{run}}$$

$$\text{Slope} = \frac{390 - 300}{99366 - 9772}$$

$$\text{Slope} = \frac{90}{89594}$$

Slope = 0.001 m/m

Land Use:

From MTC Chart H2-7

For Wellington County:

Crop:	61	%
Pasture:	30	%
Wood:	9	%

For County of Perth:

Crop:	68	%
Pasture:	26	%
Wood:	6	%

For Region of Waterloo:

Crop:	71	%
Pasture:	20	%
Wood:	9	%

For County of Oxford:

Crop:	69	%
Pasture:	24	%
Wood:	7	%

Average:

Crop:	67.25	%
Pasture:	25.00	%
Wood:	7.75	%

Soil Classification:

From Soil Maps of: Wellington County
Waterloo County
Perth County
Oxford County

and

From: MTC Drainage Manual Chart H2-6A

Soil Series	Map Symbol	Area	Hydraulic Soil Group
Perth Loam	Pl	**35.7** km²	**C**
Huron Loam	Hul	**9.9** km²	**BC**
Brookston Loam	Bnl	**10.4** km²	**C**
Perth Clay	Pc	**102.7** km²	**CD**
Brookston Clay	Bc	**22.8** km²	**C**
Brookston Silt	Bs	**17.6** km²	**C**
Huron Clay	Huc	**37.5** km²	**C**
Huron Silt	Ps	**10.2** km²	**B**
Harriston Silt Loam	His	**46.6** km²	**BC**
Waterloo Sandy Loam	Wsl	**15.1** km²	**A**
Muck (Perth County)	M	**21.5** km²	**BC**
Huron - St. Clements		**140.3** km²	**BC**
Bennington - Bookton		**112.7** km²	**AB**
Brant - Waterloo		**28.8** km²	**A**
Burford - Fox		**36.9** km²	**A**
Honeywood Silt Loam	Hosil	**20.1** km²	**BC**
Fox Loamy Sand	Fxls	**21.7** km²	**AB**
Burford Sandy Loam	Busl	**2.3** km²	**A**
Guelph Loam	Gl	**9.1** km²	**BC**
Bennington Silt Loam	Bnsil	**4.0** km²	**B**
Brisbane Sandy Loam	Bsxl	**10.4** km²	**B**
Embro Silt Loam	Emsil	**3.6** km²	**C**
Muck (Oxford County)	M	**5.2** km²	**B**
	Area Sum =	725.1	
	Watershed Area =	725.1	*check*

Soil Classification (Continued):

Summary

Hydraulic Soil Group	Area	% of Watershed
A	83.1 km²	11.46%
AB	134.4 km²	18.54%
B	29.8 km²	4.11%
BC	247.5 km²	34.13%
C	127.6 km²	17.60%
CD	102.7 km²	14.16%
Area Sum =	725.1	
Watershed Area =	725.1 km²	*check*

CN Calculation:

From MTO Drainage Design Manual Design Chart 1.09

		Crop		Pasture		Wood		
HSG	**Area (km²)**	**Area**	**CN**	**Area**	**CN**	**Area**	**CN**	**Σ Areas x CNs**
A	83.1	55.9	66	20.8	58	6.4	50	5215.4
AB	134.4	90.4	70	33.6	62	10.4	54	8972.5
B	29.8	20.0	74	7.5	65	2.3	58	2101.2
BC	247.5	166.4	78	61.9	71	19.2	65	18622.5
C	127.6	85.8	82	31.9	76	9.9	71	10163.0
CD	102.7	69.1	84	25.7	79	8.0	74	8418.8
							Total =	53493.5

$$\text{CNavg} = \frac{\text{Total}}{\text{WS Area}} = \frac{53493.5}{725.1}$$

= 73.8 (AMC II)

Estimated Flows:

Modified Index Flood Method:

Watershed Type:	Southern		
Watershed Area:	725.1	km²	
Watershed Slope:	0.001	m/m	
CN:	73.8		
Base Watershed Class:	8.42		(MTO Drainage Manual Design Chart 1.17)
	+		
Slope Adjustment:	**-0.95**		(Design Chart 1.18)
	=		
Net Watershed Class:	7.47		
Class Coefficient, C:	**1.549**		(Design Chart 1.15)

$Q_{25} = CA^{0.75}$

$Q_{25} = (1.55)(725.1)^{0.75}$

Q_{25} = 216.4 m³/s

$Q_2 = FCF_2 Q_{25}$ FCF_2= **0.50** Chart H5-9(a)

$Q_2 = (0.50)(216.4)$

Q_2 = 108.2 m³/s

$Q_5 = FCF_5 Q_{25}$ FCF_5= **0.67** Chart H5-9(a)

$Q_5 = (0.67)(216.4)$

Q_5 = 145.0 m³/s

$Q_{10} = FCF_{10} Q_{25}$ FCF_{10}= **0.82** Chart H5-9(a)

$Q_{10} = (0.82)(216.4)$

Q_{10} = 177.4 m³/s

$Q_{50} = FCF_{50} Q_{25}$ FCF_{50}= **1.13** Chart H5-9(a)

$Q_{50} = (1.13)(216.4)$

Q_{50} = 244.5 m³/s

$Q_{100} = FCF_{100} Q_{25}$ FCF_{10}= **1.27** Chart H5-9(a)

$Q_{100} = (1.27)(216.4)$

Q_{100} = 274.8 m³/s

Single Station Frequency Analysis:

Use gauging station 02GA010 - Nith River near Canning:

From a regression analysis, R^2= 0.919

$$y = 104.710 * \ln(x) + 118.25$$

For Q_2, $y = (104.710)*\ln(2) + (118.25)$
$= 190.8 \ m^3/s$

For Q_5, $y = (104.710)*\ln(5) + (118.25)$
$= 286.8 \ m^3/s$

For Q_{10}, $y = (104.710)*\ln(10) + (118.25)$
$= 359.4 \ m^3/s$

For Q_{25}, $y = (104.710)*\ln(25) + (118.25)$
$= 455.3 \ m^3/s$

For Q_{50}, $y = (104.710)*\ln(50) + (118.25)$
$= 527.9 \ m^3/s$

For Q_{100}, $y = (104.710)*\ln(100) + (118.25)$
$= 600.5 \ m^3/s$

Now transport this discharge back to Bridge 24:

$A_1 = 725.10 \ km^2$
$A_2 = 1030.00 \ km^2$

$A_1/A_2 = 0.70$

$Q_2 = Q_2 (A_1/A_2)^{0.75}$
$Q_2 = (190.8)(0.70)^{0.75}$
$Q_2 = 146.7 \ m^3/s$

$Q_5 = Q_5 (A_1/A_2)^{0.75}$
$Q_5 = (286.8)(0.70)^{0.75}$
$Q_5 = 220.4 \ m^3/s$

$Q_{10} = Q_{10} (A_1/A_2)^{0.75}$

$Q_{10} = (359.4)(0.70)^{0.75}$

$Q_{10} =$ 276.2 m^3/s

$Q_{25} = Q_{25} (A_1/A_2)^{0.75}$

$Q_{25} = (455.3)(0.70)^{0.75}$

$Q_{25} =$ 349.9 m^3/s

$Q_{50} = Q_{25} (A_1/A_2)^{0.75}$

$Q_{50} = (527.9)(0.70)$

$Q_{50} =$ 405.7 m^3/s

$Q_{100} = Q_{100} (A_1/A_2)^{0.75}$

$Q_{100} = (600.5)(0.70)^{0.75}$

$Q_{100} =$ 461.5 m^3/s

GRCA:

GRCA has provided the following flows to be used for this project where applicable:

$Q_{25} =$ 416 m^3/s

$Q_{100} =$ 526 m^3/s

$Q_{REG} =$ 923 m^3/s

Summary of Estimated Flows:

Design Storm (Years)	Modified Index (m^3/s)	Single Station Frequency Analysis (m^3/s)	GRCA (m^3/s)	PCSWMM (m^3/s)
2	108.2	146.7	--	--
5	145.0	220.4	--	--
10	177.4	276.2	--	--
25	216.4	349.9	416.0	--
50	244.5	405.7	--	--
100	274.8	461.5	526.0	--
Regional	--	--	923.0	554.8

Therefore, the design flows for this structure will be:

Q_2	**146.7**	m^3/s
Q_5	**220.4**	m^3/s
Q_{10}	**276.2**	m^3/s
Q_{25}	**349.9**	m^3/s
Q_{25}	**405.7**	m^3/s
Q_{100}	**461.5**	m^3/s
Q_{REG}	**923.0**	m^3/s

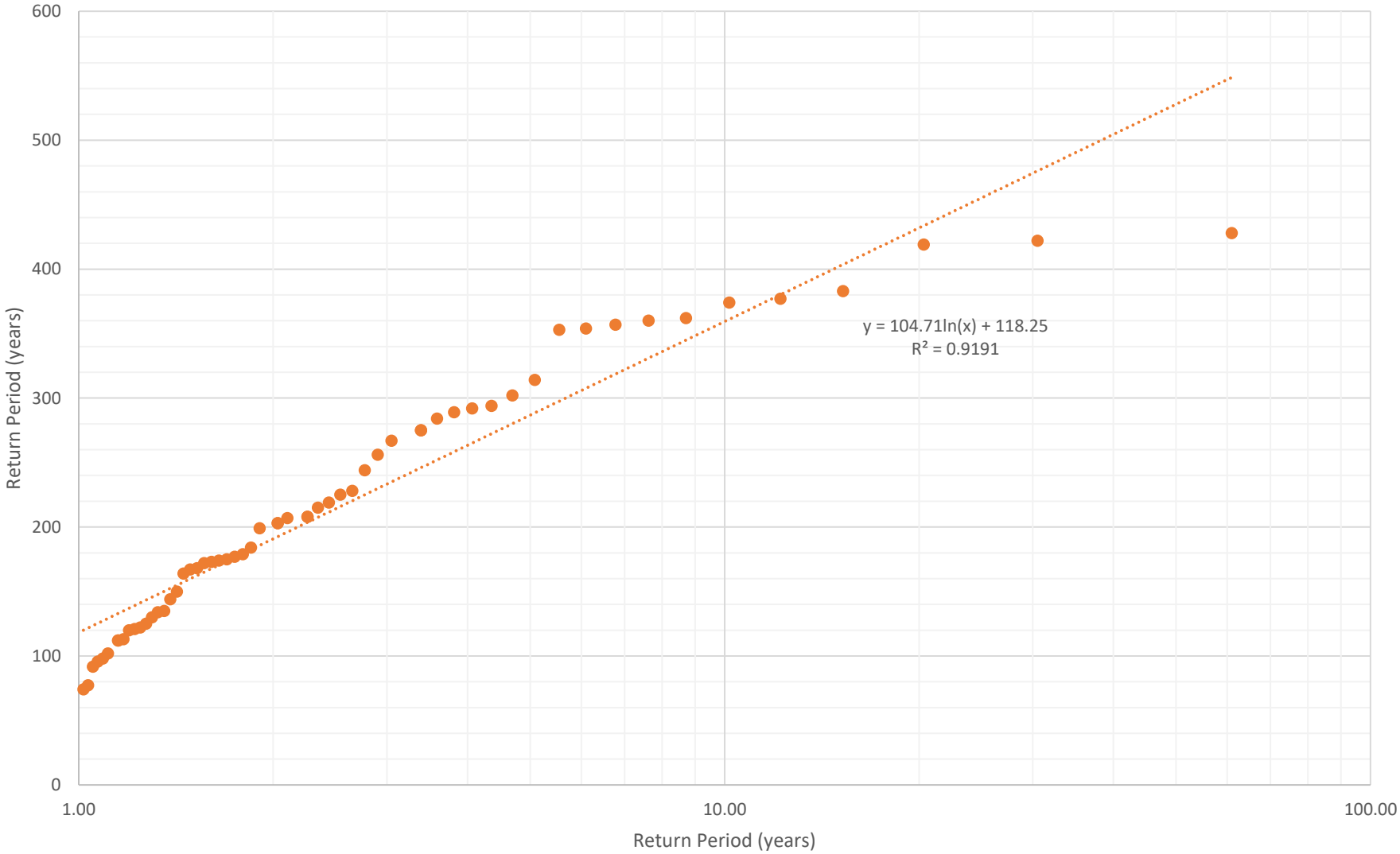
Single Station Frequency Analysis - Calculations

Year	Flow	Rank	Probability	Return Period
1948	422	2	0.033	30.50
1950	357	9	0.148	6.78
1954	428	1	0.016	61.00
1956	267	20	0.328	3.05
1957	179	34	0.557	1.79
1960	289	16	0.262	3.81
1961	184	33	0.541	1.85
1962	207	29	0.475	2.10
1963	292	15	0.246	4.07
1964	91.7	58	0.951	1.05
1965	354	10	0.164	6.10
1966	228	23	0.377	2.65
1967	294	14	0.230	4.36
1969	199	32	0.525	1.91
1970	144	44	0.721	1.39
1971	121	50	0.820	1.22
1972	208	27	0.443	2.26
1973	203	30	0.492	2.03
1974	275	18	0.295	3.39
1975	419	3	0.049	20.33
1976	314	12	0.197	5.08
1977	362	7	0.115	8.71
1978	225	24	0.393	2.54
1979	383	4	0.066	15.25
1980	275	18	0.295	3.39
1982	377	5	0.082	12.20
1983	112	53	0.869	1.15
1984	219	25	0.410	2.44
1986	284	17	0.279	3.59
1987	102	55	0.902	1.11
1988	120	51	0.836	1.20
1989	98.1	56	0.918	1.09
1990	173	38	0.623	1.61
1991	172	39	0.639	1.56
1992	244	22	0.361	2.77
1993	256	21	0.344	2.90
1995	134	46	0.754	1.33
1996	174	37	0.607	1.65
1998	150	43	0.705	1.42
1999	77.2	59	0.967	1.03
2000	175	36	0.590	1.69
2001	177	35	0.574	1.74
2002	113	52	0.852	1.17

2003	112	53	0.869	1.15
2004	302	13	0.213	4.69
2006	203	30	0.492	2.03
2007	135	45	0.738	1.36
2008	374	6	0.098	10.17
2010	168	40	0.656	1.53
2011	164	42	0.689	1.45
2012	74.1	60	0.984	1.02
2013	167	41	0.672	1.49
2014	208	27	0.443	2.26
2015	95.7	57	0.934	1.07
2016	130	47	0.770	1.30
2017	125	48	0.787	1.27
2018	360	8	0.131	7.63
2020	353	11	0.180	5.55
2021	215	26	0.426	2.35
2022	122	49	0.803	1.24

count 60

Single Station Frequency Analysis to Estimate Design Flows
Record from Nith River Near Canning
Station No. 02GA010, Drainage Area = 1030 km^2



Government of Canada Gouvernement du Canada

Annual Maximum and Minimum Instantaneous Discharge Data for NITH RIVER NEAR CANNING (02GA010) [ON]

All times are specified in Local Standard Time (LST). Add 1 hour to adjust for Daylight Saving Time where and when it is observed.

This table provides annual maximum and minimum instantaneous value for a station.

Maximum Instantaneous Discharge			Minimum Instantaneous Discharge		
Date/Time	Timezone	Value (m^3/s)	Date/Time	Timezone	Value (m^3/s)

		3	3
1913			1913
1914			1914
1915			1915
1916			1916
1917			1917
1920			1920
1921			1921
1922			1922
1923			1923
1924			1924
1925			1925
1926			1926
1947			1947
1948-03-21 03:00	EST	422	1948
1949			1949
1950-04-05 12:00	EST	357	1950
1951			1951
1952			1952
1953			1953
1954-10-17 11:00	EST	428	1954
1955			1955
1956-04-05 23:59	EST	267	1956
1957-12-22 11:00	EST	179	1957
1958			1958
1959			1959
1960-04-05 07:00	EST	289	1960
1961-02-23 23:30	EST	184	1961
1962-03-31 10:00	EST	207	1962
1963-03-27 12:00	EST	292	1963
1964-12-26 15:00	EST	91.7	1964
1965-02-11 22:30	EST	354	1965
1966-12-09 01:00	EST	228	1966
1967-04-04 12:00	EST	294	1967
1968			1968
1969-04-06 16:00	EST	199	1969
1970-04-10 13:07	EST	144	1970
1971-04-04 04:13	EST	121	1971
1972-04-14 22:18	EST	208	1972
1973-03-13 08:34	EST	203	1973
1974-03-06 13:38	EST	275	1974
1975-04-20 14:38	EST	419	1975
1976-03-22 12:46	EST	314	1976
1977-03-14 18:02	EST	362	1977
1978-04-13 00:57	EST	225	1978
1979-04-15 14:51	EST	383	1979
1980-03-23 01:46	EST	275	1980
1981			1981
1982-04-02 00:39	EST	377	1982
1983-05-04 03:52	EST	112	1983

		[3]			[3]
1984-02-16 07:09	EST	219	1984		
1985			1985		
1986-10-01 15:34	EST	284	1986		
1987-04-06 19:16	EST	102	1987		
1988-03-27 10:05	EST	120	1988		
1989-03-27 05:13	EST	98.1	1989		
1990-12-31 19:09	EST	173	1990		
1991-01-01 00:00	EST	172	1991		
1992-11-14 23:46	EST	244	1992		
1993-01-06 14:38	EST	256	1993		
1994			1994		
1995-11-13 18:23	EST	134	1995		
1996-01-21 06:15	EST	174	1996		
1997			1997		
1998-03-28 15:00	EST	150	1998		
1999-02-13 20:00	EST	77.2	1999-07-29 05:00	EST	1.32
2000-05-15 01:20	EST	175	2000-02-22 00:00	EST	2.46 B
2001-02-12 08:00	EST	177	2001-08-16 04:00	EST	1.48
2002-02-23 00:10	EST	113	2002-09-14 03:00	EST	1.71
2003-03-23 00:05	EST	112	2003-09-13 03:51	EST	1.76
2004-03-07 16:10	EST	302	2004-10-14 18:05	EST	2.01
2005			2005		
2006-03-12 08:59	EST	203	2006-09-12 01:45	EST	2.63
2007-03-24 16:50	EST	135	2007-09-04 21:33	EST	2.00
2008-12-29 23:15	EST	374	2008-09-03 18:59	EST	4.45
2009			2009-09-20 10:10	EST	2.80
2010-03-15 10:10	EST	168	2010-09-02 21:45	EST	2.21
2011-03-19 17:19	EST	164	2011-09-17 20:48	EST	1.90
2012-01-03 05:43	EST	74.1	2012-09-04 02:45	EST	1.46
2013-03-13 18:30	EST	167	2013-09-11 15:27	EST	3.03
2014-11-26 11:50	EST	208	2014-08-31 22:45	EST	2.94
2015-04-11 07:31	EST	95.7	2015-09-26 22:00	EST	2.30
2016-04-02 08:35	EST	130	2016-08-10 20:10	EST	1.97
2017-05-07 10:00	EST	125	2017-10-03 21:18	EST	2.64
2018-02-22 08:00	EST	360	2018-07-16 13:55	EST	2.35
2019			2019-08-15 21:10	EST	2.48
2020-01-13 15:00	EST	353	2020-09-27 02:10	EST	1.76
2021-03-13 18:25	EST	215	2021-06-25 09:05	EST	1.62
2022-03-08 15:30	EST	122	2022-08-01 10:40	EST	1.64

Station Information

Active or discontinued:	Active	**Province / Territory:**	Ontario
Latitude:	43° 11' 23" N	**Longitude:**	80° 27' 18" W
Gross drainage area:	1,030 km^2	**Effective drainage area:**	N/A
Record length:	90 Years	**Period of record:**	1913-1917; 1920-1926; 1947-2024
Regulation type:	Natural	**Regulation length:**	N/A
Real-time data available:	Yes	**Sediment data available:**	Yes
Type of water body:	River	**RHBN:**	Yes
EC Regional Office:	BURLINGTON	**Current Operation Schedule:**	Continuous
Data contributed by:	N/A	**Operation Period:**	JAN - DEC
Vertical datum of published data:	ASSUMED DATUM	**Datum Conversions:**	More information

Data Collection History

This table contains information pertaining to the historical changes of defined elements in the operation of a station.

	Type	Operation schedule	Gauge type
1913 - 1917	Flow	Continuous	Manual
1920 - 1923	Flow	Continuous	Manual
1924 - 1926	Flow	Seasonal	Manual
1947 - 1948	Flow	Continuous	Manual
1949 - 2001	Flow	Continuous	Recorder
2002 - 2024	Flow & Level	Continuous	Recorder

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.3)
  ------------------------------------------------------------

  WARNING 02: maximum depth increased for Node J1-07

  ****************
  Analysis Options
  ****************
  Flow Units ............... CMS
  Process Models:
    Rainfall/Runoff ........ YES
    RDII ................... NO
    Snowmelt ............... NO
    Groundwater ............ NO
    Flow Routing ........... YES
    Ponding Allowed ........ NO
    Water Quality .......... NO
  Infiltration Method ...... HORTON
  Flow Routing Method ...... DYNWAVE
  Surcharge Method ......... EXTRAN
  Starting Date ............ 02/07/2024 02:00:00
  Ending Date .............. 02/12/2024 02:00:00
  Antecedent Dry Days ...... 0.0
  Report Time Step ......... 00:01:00
  Wet Time Step ............ 00:05:00
  Dry Time Step ............ 00:05:00
  Routing Time Step ........ 5.00 sec
  Variable Time Step ....... YES
  Maximum Trials ........... 8
  Number of Threads ........ 1
  Head Tolerance ........... 0.001500 m

  **************************        Volume         Depth
  Runoff Quantity Continuity     hectare-m            mm
  **************************     ---------       -------
  Total Precipitation ......     17938.873       234.016
  Evaporation Loss .........         0.000         0.000
  Infiltration Loss ........     14769.600       192.672
  Surface Runoff ...........      3169.965        41.353
  Final Storage ............         0.000         0.000
  Continuity Error (%) .....        -0.004

  **************************        Volume        Volume
  Flow Routing Continuity        hectare-m     10^6 ltr
  **************************     ---------     ---------
  Dry Weather Inflow .......         0.000         0.000
  Wet Weather Inflow .......      3169.966     31699.989
  Groundwater Inflow .......         0.000         0.000
  RDII Inflow ..............         0.000         0.000
  External Inflow ..........         0.000         0.000
  External Outflow .........      3154.725     31547.583
  Flooding Loss ............         0.000         0.000
  Evaporation Loss .........         0.000         0.000
  Exfiltration Loss ........         0.000         0.000
  Initial Stored Volume ....         0.000         0.004
  Final Stored Volume ......        14.984       149.844
  Continuity Error (%) .....         0.008

  ************************
  Highest Continuity Errors
  ************************
  Node J1-07 (7.24%)
  Node J1-08 (-5.52%)
  Node J1-11 (-1.26%)

  **************************
  Time-Step Critical Elements
  **************************
  None

  ********************************
  Highest Flow Instability Indexes
  ********************************
  All links are stable.

  ********************************
  Most Frequent Nonconverging Nodes
  ********************************
  Convergence obtained at all time steps.

  ************************
  Routing Time Step Summary
  ************************
  Minimum Time Step           :     0.50 sec
  Average Time Step           :     5.00 sec
  Maximum Time Step           :     5.00 sec
  % of Time in Steady State   :     0.00
  Average Iterations per Step :     2.00
  % of Steps Not Converging   :     0.00
  Time Step Frequencies       :
      5.000 -  3.155 sec      :    99.98 %
      3.155 -  1.991 sec      :     0.01 %
      1.991 -  1.256 sec      :     0.00 %
      1.256 -  0.792 sec      :     0.00 %
      0.792 -  0.500 sec      :     0.00 %

  ***************************
```

Subcatchment Runoff Summary

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Imperv Runoff mm	Perv Runoff mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
S1-02	234.02	0.00	0.00	220.50	0.00	13.53	13.53	353.62	59.83	0.058
S1-03	234.02	0.00	0.00	199.94	0.00	34.09	34.09	700.23	90.76	0.146
S1-04_1	234.02	0.00	0.00	158.83	0.00	75.20	75.20	2813.30	240.91	0.321
S1-04_2	234.02	0.00	0.00	199.59	0.00	34.45	34.45	488.69	63.11	0.147
S1-05	234.02	0.00	0.00	212.59	0.00	21.45	21.45	1071.89	163.44	0.092
S1-06	234.02	0.00	0.00	230.62	0.00	3.40	3.40	77.11	15.90	0.015
S1-07_1	234.02	0.00	0.00	105.39	0.00	128.64	128.64	0.00	0.00	0.550
S1-07_2	234.02	0.00	0.00	224.70	0.00	9.32	9.32	318.56	56.42	0.040
S1-08	234.02	0.00	0.00	228.62	0.00	5.41	5.41	131.54	26.21	0.023
S1-09	234.02	0.00	0.00	233.54	0.00	0.48	0.48	35.53	10.86	0.002
S1-10	234.02	0.00	0.00	216.28	0.00	17.75	17.75	2429.91	356.56	0.076
S1-11	234.02	0.00	0.00	173.34	0.00	60.68	60.68	9229.52	605.08	0.259
S1-12_1	234.02	0.00	0.00	149.92	0.00	84.11	84.11	11258.55	685.87	0.359
S1-12_2	234.02	0.00	0.00	165.90	0.00	68.13	68.13	2791.40	230.59	0.291

Node Depth Summary

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
J1-02	JUNCTION	0.74	3.20	294.11	2 13:20	3.20
J1-03	JUNCTION	1.25	5.05	295.93	2 13:18	5.05
J1-04	JUNCTION	0.93	4.31	303.30	2 11:35	4.31
J1-05	JUNCTION	0.81	4.46	316.89	2 07:42	4.46
J1-06	JUNCTION	0.77	4.55	325.89	2 05:28	4.55
J1-07	JUNCTION	1.09	8.10	336.42	2 07:01	8.10
J1-08	JUNCTION	1.29	8.23	340.20	2 02:43	8.23
J1-09	JUNCTION	0.95	7.40	341.45	2 00:47	7.40
J1-10	JUNCTION	0.62	6.18	350.53	2 00:40	6.18
J1-11	JUNCTION	0.62	7.20	360.80	1 23:57	7.20
J1-12	JUNCTION	0.39	4.90	366.53	1 23:07	4.90
Out1-01	OUTFALL	0.64	3.01	292.77	2 13:21	3.01

Node Inflow Summary

Node	Type	Maximum Lateral Inflow CMS	Maximum Total Inflow CMS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
J1-02	JUNCTION	59.834	554.806	2 13:18	354	3.15e+04	0.005
J1-03	JUNCTION	90.762	556.265	2 12:00	700	3.14e+04	0.540
J1-04	JUNCTION	304.030	590.964	2 08:18	3.3e+03	3.07e+04	0.052
J1-05	JUNCTION	163.440	671.913	2 06:37	1.07e+03	2.75e+04	0.609
J1-06	JUNCTION	15.898	575.035	2 05:42	77.1	2.63e+04	-0.699
J1-07	JUNCTION	56.418	1190.917	2 03:50	319	2.83e+04	7.804
J1-08	JUNCTION	26.207	1415.575	2 01:17	132	2.65e+04	-5.236
J1-09	JUNCTION	10.864	1286.761	2 00:40	35.5	2.62e+04	-0.582
J1-10	JUNCTION	356.563	1426.596	1 23:28	2.43e+03	2.62e+04	0.001
J1-11	JUNCTION	605.081	1475.316	1 23:01	9.23e+03	2.34e+04	-1.248
J1-12	JUNCTION	916.460	916.460	1 23:00	1.4e+04	1.4e+04	-1.050
Out1-01	OUTFALL	0.000	554.803	2 13:21	0	3.15e+04	0.000

Node Surcharge Summary

No nodes were surcharged.

Node Flooding Summary

No nodes were flooded.

Outfall Loading Summary

Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
Out1-01	64.20	113.746	554.803	31547.439
System	64.20	113.746	554.803	31547.439

Link Flow Summary

	Maximum	Time of Max	Maximum	Max/	Max/

Link	Type	|Flow| CMS	Occurrence days	Occurrence hr:min	|Veloc| m/sec	Full Flow	Full Depth
C1-02	CHANNEL	554.803	2	13:21	18.69	0.25	0.56
C1-03	CHANNEL	554.806	2	13:18	2.05	2.77	0.74
C1-04	CHANNEL	556.265	2	12:00	47.14	0.45	0.84
C1-05	CHANNEL	590.964	2	08:18	2.12	0.46	0.77
C1-06	CHANNEL	671.913	2	06:37	1.87	0.40	0.79
C1-07	CHANNEL	575.035	2	05:42	2.89	1.15	0.97
C1-08	CHANNEL	1190.917	2	03:50	1.59	0.24	0.61
C1-09	CHANNEL	1415.575	2	01:17	2.57	0.23	0.63
C1-10	CHANNEL	1286.761	2	00:40	2.68	0.31	0.73
C1-11	CHANNEL	1254.262	2	00:22	2.61	1.05	1.00
C1-12	CHANNEL	880.229	1	23:07	1.90	0.21	0.70

****
Flow Classification Summary
****

	Adjusted	Fraction of Time in Flow Class							
Conduit	/Actual Length	Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
C1-02	1.00	0.35	0.00	0.00	0.64	0.00	0.00	0.00	0.00	0.00
C1-03	1.00	0.34	0.01	0.00	0.65	0.00	0.00	0.00	0.00	0.00
C1-04	1.00	0.34	0.00	0.00	0.66	0.00	0.00	0.00	0.62	0.00
C1-05	1.00	0.34	0.04	0.00	0.62	0.00	0.00	0.00	0.56	0.00
C1-06	1.00	0.38	0.00	0.00	0.62	0.00	0.00	0.00	0.58	0.00
C1-07	1.00	0.33	0.00	0.00	0.67	0.00	0.00	0.00	0.47	0.00
C1-08	1.00	0.33	0.04	0.00	0.64	0.00	0.00	0.00	0.11	0.00
C1-09	1.00	0.35	0.00	0.00	0.65	0.00	0.00	0.00	0.50	0.00
C1-10	1.00	0.34	0.00	0.00	0.65	0.01	0.00	0.00	0.61	0.00
C1-11	1.00	0.33	0.00	0.00	0.67	0.00	0.00	0.00	0.59	0.00
C1-12	1.00	0.33	0.00	0.00	0.66	0.01	0.00	0.00	0.64	0.00

****
Conduit Surcharge Summary
****

	Hours Full			Hours Above Full	Hours Capacity
Conduit	Both Ends	Upstream	Dnstream	Normal Flow	Limited
C1-03	0.01	0.01	0.01	17.20	0.01
C1-07	0.01	11.28	0.01	7.34	0.01
C1-11	0.19	2.69	0.19	1.60	0.19

Analysis begun on: Thu Feb 8 12:53:46 2024
Analysis ended on: Thu Feb 8 12:53:47 2024
Total elapsed time: 00:00:01

EXISTING CONDITIONS

HEC-RAS HEC-RAS 6.5 Beta Development
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X       X   X     X  X    X
X     X  X        X            X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X            X  X     X    X        X
X     X  X        X    X       X   X    X    X        X
X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: Middle Nith - Ayr to Philipsburg-KSmart
Project File : MiddleNithKSmart.prj
Run Date and Time:

Project in SI units

Project Description:
KSmart Revised - January 2026
Refer to Hydraulic Memo for
updates

NITH
RIVER FPM STUDY FOR GRAND RIVER C.A.
Original Study by Dillon 1985 - Combined
H2NITH1.DAT and H2NITH2.DAT
Updated to HEC-RAS - GRCA 2010
Bridge updates per
GRCA permits - Haysville, Bender - Bleams Road, New Hamburg Walkway, New
Hamburg Channel refinements 2006, Oxford Blanford Blenheim Road 11 P288/05,
Watson Factory Ineffective area Ayr
H2NITH1.DAT flows added November 2011.
Original Reg flows are best, GRHS flows U/S of Canning not documented (JSP)

PLAN DATA

EXISTING CONDITIONS

Plan Title:
Plan File :

Geometry Title: 8sept2006 r5 - KSmart Ex
Geometry File : s:\2022\22-264\Engineering\Hydrology\HEC-RAS Model Revisions (To K Smart)\HEC-RAS Model\MiddleNithKSmart.g01

Flow Title : Reg_100_20
Flow File : s:\2022\22-264\Engineering\Hydrology\HEC-RAS Model Revisions (To K Smart)\HEC-RAS Model\MiddleNithKSmart.f04

Plan Summary Information:
Number of: Cross Sections = 255 Multiple Openings = 0
Culverts = 0 Inline Structures = 1
Bridges = 29 Lateral Structures = 0

Computational Information
Water surface calculation tolerance = 0.003
Critical depth calculation tolerance = 0.003
Maximum number of iterations = 20
Maximum difference tolerance = 0.1
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Mixed Flow

FLOW DATA

Flow Title: Reg_100_20
Flow File : s:\2022\22-264\Engineering\Hydrology\HEC-RAS Model Revisions (To K Smart)\HEC-RAS Model\MiddleNithKSmart.f04

Flow Data (m3/s)

River	Reach	RS	20 yr	100 yr	Reg
RIVER-1	Reach-1	73584	379	522	923
RIVER-1	Reach-1	36588	414	531	923
RIVER-1	Reach-1	27396	416	526	923
RIVER-1	Reach-1	16084	419	518	923

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
RIVER-1	Reach-1	20 yr	Normal S = 0.001	Normal S = 0.001
RIVER-1	Reach-1	100 yr	Normal S = 0.001	Normal S = 0.001
RIVER-1	Reach-1	Reg	Normal S = 0.001	Normal S = 0.001

GEOMETRY DATA

Geometry Title: 8sept2006 r5 - KSmart Ex
Geometry File : s:\2022\22-264\Engineering\Hydrology\HEC-RAS Model Revisions (To K Smart)\HEC-RAS Model\MiddleNithKSmart.g01

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 73584

INPUT
Description:
Station Elevation Data num= 18

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	342.5	1029.26	341	1054.02	340.5	1089.14	339.5	1128.51	339
1256.04	338.5	1281.66	338	1314.84	338	1339.12	338	1367.01	337.5
1372.18	335.3	1372.94	335.2	1392.94	335.2	1395.05	336.1	1397.9	337
1400.27	338	1418.31	352	1433.94	351.8				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.06	1372.18	.04	1395.05	.06

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1372.18	1395.05	50	71	130	.3	.5

Sediment Elevation = 0

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 73509

INPUT
Description:
Station Elevation Data num= 19

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
900.0001	342968.8322	3411037.664	340.51066.344	340.51135.176	341				
1210.834	336.71210.891	336.71216.054	333.61221.216	333.71222.937	333.4				
1224.658	333.71226.379	334.61229.476	334.71230.107	334.11238.367	339.8				
1238.424	339.81249.896	3431269.972	343.51295.784	345					

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
900.0001	.061210.834	.041238.424	.06		

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 19835

INPUT
Description:
Station Elevation Data num= 24

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	296	1015.12	295.5	1029.01	295	1097.96	295	1138.28	294.5
1195.57	294	1227.08	293.5	1332.82	293.6	1445.08	294	1527.83	294
1534.18	293.5	1576.92	293.5	1600.05	294	1663.3	294	1668.59	292.5
1671.5	291.8	1684.5	291.8	1687.55	292.5	1692.04	293	1710.04	293
1713.67	293.5	1756.84	294	1795.88	294	1856.5	302		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.08	1668.59	.035	1687.55	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1668.59	1687.55	410	476	360	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 19359

INPUT
Description:
Station Elevation Data num= 20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1000	296	1042.11	295.5	1087.67	295	1118.47	294	1130.53	293.5
1226.85	293.5	1254.96	293.5	1257.42	291.9	1258.94	291.2	1281.94	291.2
1283.71	292	1285.95	292	1294.82	292.5	1303.51	293	1317.95	293
1334.26	296	1352.42	297	1384.03	300	1393.3	300.5	1421.94	301

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1000	.08	1257.42	.035	1283.71	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1257.42	1283.71	690	724	380	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 18720

EXISTING CONDITIONS

```
INPUT
Description:
Station Elevation Data    num=      37
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     297  15.469   296.5  35.798     296  85.931   295.5 163.026   295.5
 165.282     295 166.317   294.5 167.392     294 168.684   293.5 170.408     293
 173.171   292.5 174.491     292 176.258   291.5  179.42 290.096  186.42 290.096
 189.582   291.5 194.344     292 218.609     292 219.337   292.5 220.815     293
 222.341   293.5  224.68   293.5 228.273     293  231.04     293 239.898   293.5
 245.527   293.5 253.746     293  289.78     293 307.817   293.5 316.857   293.5
 354.142     294 362.705   294.5 367.052     295 372.035   295.5 373.924     296
  375.23   296.5 376.653     297

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08 174.491    .035 194.344     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       174.491 194.344         1126.956 116.395  25.372             .1       .3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 18645

INPUT
Description:
Station Elevation Data    num=      71
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     297   7.716   296.5  24.576     296  52.699     296  58.348   296.5
  62.711   296.5  64.088     296   67.58   295.5  72.034   295.5  78.902     296
 397.209     296 480.947   295.5 523.299   295.5 595.872     296 605.942     296
  614.48   295.5 666.496   295.5 724.808     296 767.877     296 781.621   296.5
 786.728   296.5 811.498     296 858.117   295.5 864.309   295.5 888.381     295
 900.698   294.5 921.988   294.5 925.188     295 958.683     295 961.053   294.5
 963.513     2941023.098     2941042.197   293.51043.224   293.51044.141     293
1046.501   293.51048.381     2941078.584     2941099.299   293.51101.821   293.5
1122.933     2941126.491     2941155.441   293.51173.753   293.51183.432     293
 1195.58     2931198.774   292.51200.707     2921203.258   291.51207.775 290.213
1215.775 290.2131220.291   291.51227.865     2921237.467     2921240.886   292.5
1242.479     2931245.129   293.51297.509   293.51304.578     2931315.666     293
1318.369   293.51432.424   293.51439.477     2941443.878     2941452.897   294.5
1463.572     2951470.177   295.51472.755     296 1475.18   296.51488.661   296.5
1490.363     297

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .081198.774    .0351240.886     .08
```

```
Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      1198.7741240.886          168.606  74.031  69.788             .3       .5

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 18570

INPUT
Description:
Station Elevation Data    num=      44
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     297 182.571     297 270.669   296.5 683.436     296 796.538 296.068
 821.538  295.66 846.538 295.134 871.538 294.806 896.538 294.624 921.538 294.501
 946.538 294.415 971.538 294.408 996.538 294.4621021.538 294.4741046.538 294.401
1071.538 294.3541096.538 294.4871121.538 294.8421146.538 295.3811166.057  291.71
 1166.06 291.7091169.162  290.991172.446  290.521176.525  290.631180.207  290.56
 1183.81  290.651186.847  290.571191.506   290.31195.964   290.51199.462  291.03
1200.986  291.371205.257  291.54 1205.26 291.5411221.538 295.3881246.538 295.273
1271.538 295.2871296.538 295.2911321.538 295.4051346.538 295.7141371.538 296.106
1396.538 296.3111421.538 296.4981446.538 296.6591471.538 296.917

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08 1166.06    .035 1205.26     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       1166.06 1205.26          126.814  20.696  35.209             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  1156.4  294.35       F
  1211.61471.538  294.35       F

BRIDGE


RIVER: RIVER-1
REACH: Reach-1            RS: 18564

INPUT
Description: Township Road 12 - Oxford - Bridge# 10
Distance from Upstream XS =       8
Deck/Roadway Width        =     4.7
Weir Coefficient          =     2.6
Upstream  Deck/Roadway Coordinates
    num=      13
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
    1135 295.142            1145 295.373            1155 295.593
  1164.4  295.75  294.84 1164.76 295.747  294.84 1167.67 298.815  294.84
 1200.33 298.815  294.84 1203.35 295.623  294.84  1203.6 295.623  294.84
```

```
  1209.3  295.63          1209.3 295.503            1215 295.439
 1221.54  295.39

Upstream Bridge Cross Section Data
Station Elevation Data    num=      44
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     297 182.571     297 270.669   296.5 683.436     296 796.538 296.068
 821.538  295.66 846.538 295.134 871.538 294.806 896.538 294.624 921.538 294.501
 946.538 294.415 971.538 294.408 996.538 294.4621021.538 294.4741046.538 294.401
1071.538 294.3541096.538 294.4871121.538 294.8421146.538 295.3811166.057  291.71
 1166.06 291.7091169.162  290.991172.446  290.521176.525  290.631180.207  290.56
 1183.81  290.651186.847  290.571191.506   290.31195.964   290.51199.462  291.03
1200.986  291.371205.257  291.54 1205.26 291.5411221.538 295.3881246.538 295.273
1271.538 295.2871296.538 295.2911321.538 295.4051346.538 295.7141371.538 296.106
1396.538 296.3111421.538 296.4981446.538 296.6591471.538 296.917

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08 1166.06    .035 1205.26     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
       1166.06 1205.26             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  1156.4  294.35       F
  1211.61471.538  294.35       F

Downstream  Deck/Roadway Coordinates
    num=      13
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
    1135 295.142            1145 295.373            1155 295.593
  1164.4  295.75  294.84 1164.76 295.747  294.84 1167.67 298.815  294.84
 1200.33 298.815  294.84 1203.35 295.623  294.84  1203.6 295.623  294.84
  1209.3  295.63          1209.3 295.503            1215 295.439
 1221.54  295.39

Downstream Bridge Cross Section Data
Station Elevation Data    num=      44
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     297 182.571     297 270.669   296.5 683.436     296 796.538 296.068
 821.538  295.66 846.538 295.134 871.538 294.806 896.538 294.624 921.538 294.501
 946.538 294.415 971.538 294.408 996.538 294.4621021.538 294.4741046.538 294.401
1071.538 294.3541096.538 294.4871121.538 294.8421146.538 295.3811166.057  291.71
 1166.06 291.7091169.162  290.991172.446  290.521176.525  290.631180.207  290.56
 1183.81  290.651186.847  290.571191.506   290.31195.964   290.51199.462  291.03
1200.986  291.371205.257  291.54 1205.26 291.5411221.538 295.3881246.538 295.273
1271.538 295.2871296.538 295.2911321.538 295.4051346.538 295.7141371.538 296.106
1396.538 296.3111421.538 296.4981446.538 296.6591471.538 296.917

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
```

```
       0     .08 1166.06    .035 1205.26     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
       1166.06 1205.26             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  1156.4  294.35       F
  1211.61471.538  294.35       F

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .98
Elevation at which weir flow begins         =  294.35
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
Selected Low Flow Methods = Energy

High Flow Method
       Energy Only

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 18558

INPUT
Description:
Station Elevation Data    num=      44
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     297 182.571     297 270.669   296.5 683.436     296 796.538 296.068
 821.538  295.66 846.538 295.134 871.538 294.806 896.538 294.624 921.538 294.501
 946.538 294.415 971.538 294.408 996.538 294.4621021.538 294.4741046.538 294.401
1071.538 294.3541096.538 294.4871121.538 294.8421146.538 295.3811166.057  291.71
 1166.06 291.7091169.162  290.991172.446  290.521176.525  290.631180.207  290.56
 1183.81  290.651186.847  290.571191.506   290.31195.964   290.51199.462  291.03
1200.986  291.371205.257  291.54 1205.26 291.5411221.538 295.3881246.538 295.273
1271.538 295.2871296.538 295.2911321.538 295.4051346.538 295.7141371.538 296.106
```

```
1396.538 296.3111421.538 296.4981446.538 296.6591471.538 296.917

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08 1166.06    .035 1205.26     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       1166.06 1205.26           75.842  69.884  68.709             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  1156.4  294.35       F
  1211.61471.538  294.35       F

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 18487

INPUT
Description:
Station Elevation Data    num=      46
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     297  98.503     297 113.908   296.5 132.537     296 169.868   295.5
  302.46   295.5 391.887     295 566.511     295  571.69   294.5 576.423   294.5
 577.631     295 579.504   295.5  581.84     296 584.452     296 587.351   295.5
 746.106   295.5 752.947     296 756.237     296 758.628   295.5 787.793   295.5
 788.504     295 809.899   294.5  844.55   294.5 856.954     294  864.07     294
1020.534     2941035.995   293.51049.813     2931159.854     2931161.393   292.5
1163.008     2921164.462   291.51172.416 290.3771187.416 290.377 1195.37   291.5
1199.022     2921200.957   292.51204.017     293 1212.52   293.51214.669     294
1216.327   294.51221.593     2951228.261   295.51379.555     2961398.045   296.5
1435.503   296.5

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .081159.854    .0351204.017     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      1159.8541204.017              71  71.019  76.092             .1       .3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 18416

INPUT
Description:
Station Elevation Data    num=      52
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
```

```
       0     297  48.113   296.5  68.211   296.5 143.736   296.5 221.889   296.5
  230.56   296.5 238.204     296 247.019   295.5  391.06     295 393.241     295
 433.909     295 462.384   294.5 465.706   294.5 507.854   294.5 530.247     295
 531.102   295.5 534.935   295.5 536.811     295 620.003     295 641.114   294.5
 658.547   294.5 665.358     294 762.395     294 779.721   293.5 885.951   293.5
 891.634     294 923.393     294 936.205   293.5 956.277     293 971.779     293
 991.358   293.51098.258   293.51099.057     2931099.815   292.51101.174     292
1107.469   291.51111.253 290.4471119.253 290.4481123.038   291.51124.423     292
 1133.84   292.51138.213     293 1145.44   293.51149.333   293.51151.288     294
1153.373   294.51154.346     2951155.523   295.51185.924     2961200.333   296.5
1264.707   296.51377.316     297

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .081098.258    .035 1145.44     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      1098.258 1145.44              405     421     355             .1       .3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 17995

INPUT
Description:
Station Elevation Data    num=      17
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    1000   298.5 1022.22   293.5 1062.34     293 1091.82     293  1163.7     293
 1173.32     293 1230.44     293 1241.81   291.5 1243.67   291.5 1246.74   290.1
 1270.74   290.1 1273.63   291.5 1275.02   291.5 1277.57     293 1284.26     294
 1290.67     297 1350.74     297

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    1000     .08 1243.67    .035 1273.63     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       1243.67 1273.63              305     349     325             .1       .3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 17546

INPUT
Description:
Station Elevation Data    num=      24
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
```

```
    1000     299 1066.85   298.5 1089.52     293 1100.95     292 1116.99     292
 1132.37     292 1136.72   292.5 1172.44   292.5 1183.19     293 1191.89     292
 1193.83   291.3 1197.34   289.7 1211.34   289.7 1214.36   291.1 1224.56     292
 1234.54   293.5 1242.03   294.5 1255.04     295 1323.82     295 1338.81   295.5
 1358.54     297 1373.24     297 1388.01   296.5 1479.34   296.5

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    1000     .08 1193.83    .035 1214.36     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       1193.83 1214.36              270     359     359             .1       .3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 17187

INPUT
Description:
Station Elevation Data    num=      12
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    1000   300.5  1029.7   299.5 1062.52   290.7  1065.7   289.4  1097.7   289.4
  1099.6   290.6 1105.34     292 1125.54   292.5 1224.25     293 1255.09   293.5
 1280.95     294  1348.7   295.5

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    1000     .06 1062.52     .04  1099.6     .06

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       1062.52  1099.6              223     240     236             .3       .5

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 16947

INPUT
Description:
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    1000   301.3  1007.3     301 1020.79     293 1060.97   292.5  1068.4   290.7
 1071.38   289.2 1155.88   289.2  1158.7   290.6 1163.51   292.5 1221.77     293
 1273.75     294 1280.26   294.5 1299.75     295 1313.88   295.5

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    1000     .06  1068.4     .04  1158.7     .06
```

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1022	1059	14	14	.3	.5

SUMMARY OF MANNING'S N VALUES

River:RIVER-1

Reach	River Sta.	n1	n2	n3	n4	n5	n6	n7	n8	n9	n10
Reach-1	73584	.06	.04	.06							
Reach-1	73509	.06	.04	.06							
Reach-1	73504	Bridge									
Reach-1	73499	.06	.04	.06							
Reach-1	73456	.06	.04	.06							
Reach-1	73181	.06	.04	.06							
Reach-1	72326	.06	.04	.06							
Reach-1	71741	.06	.04	.06							
Reach-1	70297	.06	.04	.06							
Reach-1	69979	.06	.04	.06							
Reach-1	69929	.06	.04	.06							
Reach-1	69923.5	Bridge									
Reach-1	69918	.06	.04	.06							
Reach-1	69883	.06	.04	.06							
Reach-1	68850	.06	.04	.06							
Reach-1	68041	.06	.04	.06							
Reach-1	67000	.06	.04	.06							
Reach-1	66442	.06	.04	.06							
Reach-1	66227	.06	.04	.06							
Reach-1	66225	Bridge									
Reach-1	66223	.06	.04	.06							
Reach-1	65772	.06	.04	.06							
Reach-1	65144	.06	.04	.06							
Reach-1	64938	.06	.04	.06							
Reach-1	64682	.06	.04	.06							
Reach-1	64679	Bridge									
Reach-1	64676	.06	.04	.06							
Reach-1	64643	.06	.04	.06							
Reach-1	63937	.06	.04	.06							
Reach-1	63310	.06	.04	.06							
Reach-1	62996	.06	.04	.06							
Reach-1	62949	.06	.04	.06							
Reach-1	62944	Bridge									
Reach-1	62939	.06	.04	.06							
Reach-1	62868	.06	.04	.06							
Reach-1	62518	.06	.04	.06							
Reach-1	62170	.06	.04	.06							
Reach-1	61680	.06	.04	.06							
Reach-1	61212	.06	.04	.06							
Reach-1	60230	.06	.04	.06							

Reach-1	33576	.06	.04	.06		
Reach-1	33324	.06	.04	.06		
Reach-1	33218	.06	.04	.06		
Reach-1	33210	Bridge				
Reach-1	33208	.06	.04	.06		
Reach-1	33063	.06	.04	.06		
Reach-1	32933	.06	.04	.06		
Reach-1	32645	.06	.04	.06		
Reach-1	32362	.06	.04	.06		
Reach-1	31748	.06	.04	.06		
Reach-1	31104	.06	.04	.06		
Reach-1	30840	.06	.04	.06		
Reach-1	30468	.06	.04	.06		
Reach-1	30340	.06	.04	.06	.04	.06
Reach-1	30335	Bridge				
Reach-1	30329	.06	.04	.06	.04	.06
Reach-1	30267	.06	.04	.06		
Reach-1	30009	.06	.04	.06		
Reach-1	29855	.06	.04	.06		
Reach-1	29736	.06	.04	.06	.04	.06
Reach-1	29730	Bridge				
Reach-1	29726	.06	.04	.06	.04	.06
Reach-1	29650	.06	.04	.06		
Reach-1	29212	.06	.04	.06		
Reach-1	28650	.06	.04	.06		
Reach-1	28559	.06	.04	.06		
Reach-1	28167	.06	.04	.06		
Reach-1	27688	.06	.04	.06		
Reach-1	27536	.06	.04	.06		
Reach-1	27533	Bridge				
Reach-1	27530	.06	.04	.06		
Reach-1	27396	.06	.04	.06		
Reach-1	27070	.06	.04	.06		
Reach-1	26631	.06	.04	.06		
Reach-1	26210	.06	.04	.06		
Reach-1	25880	.06	.04	.06		
Reach-1	25344	.06	.04	.06		
Reach-1	24900	.06	.04	.06		
Reach-1	24348	.06	.04	.06		
Reach-1	23888	.06	.04	.06		
Reach-1	23500	.06	.04	.06		
Reach-1	22900	.06	.04	.06		
Reach-1	22315	.06	.04	.06		
Reach-1	22202	.06	.04	.06		
Reach-1	22195	Bridge				
Reach-1	22192	.06	.04	.06		
Reach-1	21930	.06	.04	.06		
Reach-1	20736	.08	.035	.08		
Reach-1	19835	.08	.035	.08		
Reach-1	19359	.08	.035	.08		
Reach-1	18720	.08	.035	.08		

Reach-1	18645	.08	.035	.08
Reach-1	18570	.08	.035	.08
Reach-1	18564	Bridge		
Reach-1	18558	.08	.035	.08
Reach-1	18487	.08	.035	.08
Reach-1	18416	.08	.035	.08
Reach-1	17995	.08	.035	.08
Reach-1	17546	.08	.035	.08
Reach-1	17187	.06	.04	.06
Reach-1	16947	.06	.04	.06
Reach-1	16859	.06	.04	.06
Reach-1	16855	Bridge		
Reach-1	16850	.06	.04	.06
Reach-1	16612	.06	.04	.06
Reach-1	16084	.06	.04	.06
Reach-1	15077	.06	.04	.06
Reach-1	13725	.06	.04	.06
Reach-1	13116	.06	.04	.06
Reach-1	12382	.06	.04	.06
Reach-1	12310	.06	.04	.06
Reach-1	12305	Bridge		
Reach-1	12304	.06	.04	.06
Reach-1	11825	.06	.04	.06
Reach-1	11368	.06	.04	.06
Reach-1	11068	.06	.04	.06
Reach-1	10988	.06	.04	.06
Reach-1	10953	.06	.04	.06
Reach-1	10903	.06	.04	.06
Reach-1	10863	.06	.04	.06
Reach-1	10826	.06	.04	.06
Reach-1	10825	Bridge		
Reach-1	10820	.06	.04	.06
Reach-1	10780	.06	.04	.06
Reach-1	10745	.06	.04	.06
Reach-1	10690	.06	.04	.06
Reach-1	10671	.06	.04	.06
Reach-1	10570	.06	.04	.06
Reach-1	10550	Bridge		
Reach-1	10536	.06	.04	.06
Reach-1	10443	.06	.04	.06
Reach-1	9727	.06	.04	.06
Reach-1	9160	.06	.04	.06
Reach-1	9087	.06	.04	.06
Reach-1	9080	Bridge		
Reach-1	9077	.06	.04	.06
Reach-1	9024	.06	.04	.06
Reach-1	8887	.06	.04	.06
Reach-1	8570	.06	.04	.06
Reach-1	8288	.06	.04	.06
Reach-1	8278	.06	.04	.06
Reach-1	8000	.06	.04	.06

Reach-1	7474		.06	.04	.06
Reach-1	7059		.06	.04	.06
Reach-1	5736		.06	.04	.06
Reach-1	5163		.06	.04	.06
Reach-1	4905		.06	.04	.06
Reach-1	4861.5		.06	.04	.06
Reach-1	4858		.06	.04	.06
Reach-1	4780		.06	.04	.06
Reach-1	4514		.06	.04	.06
Reach-1	4188		.06	.04	.06
Reach-1	3976		.06	.04	.06
Reach-1	3942		.06	.04	.06
Reach-1	3935	Bridge			
Reach-1	3930		.06	.04	.06
Reach-1	3830		.06	.04	.06
Reach-1	3387		.06	.04	.06
Reach-1	2822		.06	.04	.06
Reach-1	2262		.06	.04	.06
Reach-1	1733		.06	.04	.06
Reach-1	1685		.06	.04	.06
Reach-1	1682	Bridge			
Reach-1	1680		.06	.04	.06
Reach-1	1632		.06	.04	.06
Reach-1	1509		.06	.04	.06
Reach-1	1204		.06	.04	.06
Reach-1	895		.06	.04	.06
Reach-1	665		.06	.04	.06
Reach-1	331		.06	.04	.06
Reach-1	262		.06	.04	.06
Reach-1	260	Bridge			
Reach-1	257		.06	.04	.06
Reach-1	140		.06	.04	.06
Reach-1	1		.06	.04	.06
Reach-1	0.23	Bridge			
Reach-1	0.2		.06	.04	.06
Reach-1	0.15		.06	.04	.06
Reach-1	0.14		.06	.04	.06
Reach-1	0.13		.06	.04	.06
Reach-1	0.12		.06	.04	.06
Reach-1	0.11		.06	.04	.06
Reach-1	0.1		.06	.04	.06

SUMMARY OF REACH LENGTHS

River: RIVER-1

Reach	River Sta.	Left	Channel	Right

Reach-1	30840	375	372	380
Reach-1	30468	150	128	110
Reach-1	30340	13	13	13
Reach-1	30335	Bridge		
Reach-1	30329	80	62	60
Reach-1	30267	280	259	205
Reach-1	30009	285	153	1
Reach-1	29855	155	119	175
Reach-1	29736	12	12	12
Reach-1	29730	Bridge		
Reach-1	29726	50	56	70
Reach-1	29650	285	438	438
Reach-1	29212	562	562	615
Reach-1	28650	1	91	195
Reach-1	28559	305	392	325
Reach-1	28167	467	479	190
Reach-1	27688	100	152	95
Reach-1	27536	8	8	8
Reach-1	27533	Bridge		
Reach-1	27530	130	154	120
Reach-1	27396	439	426	485
Reach-1	27070	440	439	380
Reach-1	26631	460	421	260
Reach-1	26210	400	314	180
Reach-1	25880	300	536	310
Reach-1	25344	205	444	492
Reach-1	24900	255	552	552
Reach-1	24348	510	460	425
Reach-1	23888	485	398	345
Reach-1	23500	580	624	460
Reach-1	22900	490	551	480
Reach-1	22315	185	113	200
Reach-1	22202	12	12	12
Reach-1	22195	Bridge		
Reach-1	22192	105	262	175
Reach-1	21930	970	1194	970
Reach-1	20736	752	901	580
Reach-1	19835	410	476	360
Reach-1	19359	690	724	380
Reach-1	18720	1126.956	116.395	25.372
Reach-1	18645	168.606	74.031	69.788
Reach-1	18570	126.814	20.696	35.209
Reach-1	18564	Bridge		
Reach-1	18558	75.842	69.884	68.709
Reach-1	18487	71	71.019	76.092
Reach-1	18416	405	421	355
Reach-1	17995	305	349	325
Reach-1	17546	270	359	359
Reach-1	17187	223	240	236
Reach-1	16947	90	88	92
Reach-1	16859	11	11	11

Reach-1	3942		14	14	14
Reach-1	3935	Bridge			
Reach-1	3930		80	100	80
Reach-1	3830		320	443	475
Reach-1	3387		220	565	565
Reach-1	2822		290	560	560
Reach-1	2262		475	529	330
Reach-1	1733		60	47	25
Reach-1	1685		7.4	7.4	7.4
Reach-1	1682	Bridge			
Reach-1	1680		50	50	50
Reach-1	1632		60	123	155
Reach-1	1509		230	305	175
Reach-1	1204		206	309	265
Reach-1	895		232	230	199
Reach-1	665		315	334	320
Reach-1	331		47	69	49
Reach-1	262		7	7	7
Reach-1	260	Bridge			
Reach-1	257		115	117	116
Reach-1	140		105	140	165
Reach-1	1		15	15	15
Reach-1	0.23	Bridge			
Reach-1	0.2		15	15	15
Reach-1	0.15		1	1	1
Reach-1	0.14		1	1	1
Reach-1	0.13		1	1	1
Reach-1	0.12		1	1	1
Reach-1	0.11		1	1	1
Reach-1	0.1		14	14	14

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: RIVER-1

Reach	River Sta.		Contr.	Expan.
Reach-1	73584		.3	.5
Reach-1	73509		.3	.5
Reach-1	73504	Bridge		
Reach-1	73499		.3	.5
Reach-1	73456		.3	.5
Reach-1	73181		.3	.5
Reach-1	72326		.3	.5
Reach-1	71741		.3	.5
Reach-1	70297		.3	.5
Reach-1	69979		.3	.5
Reach-1	69929		.3	.5

Reach-1	29650		.3	.5
Reach-1	29212		.3	.5
Reach-1	28650		.3	.5
Reach-1	28559		.3	.5
Reach-1	28167		.3	.5
Reach-1	27688		.3	.5
Reach-1	27536		.3	.5
Reach-1	27533	Bridge		
Reach-1	27530		.3	.5
Reach-1	27396		.3	.5
Reach-1	27070		.3	.5
Reach-1	26631		.3	.5
Reach-1	26210		.3	.5
Reach-1	25880		.3	.5
Reach-1	25344		.3	.5
Reach-1	24900		.3	.5
Reach-1	24348		.3	.5
Reach-1	23888		.3	.5
Reach-1	23500		.3	.5
Reach-1	22900		.3	.5
Reach-1	22315		.3	.5
Reach-1	22202		.3	.5
Reach-1	22195	Bridge		
Reach-1	22192		.3	.5
Reach-1	21930		.3	.5
Reach-1	20736		.1	.3
Reach-1	19835		.1	.3
Reach-1	19359		.1	.3
Reach-1	18720		.1	.3
Reach-1	18645		.3	.5
Reach-1	18570		.3	.5
Reach-1	18564	Bridge		
Reach-1	18558		.3	.5
Reach-1	18487		.1	.3
Reach-1	18416		.1	.3
Reach-1	17995		.1	.3
Reach-1	17546		.1	.3
Reach-1	17187		.3	.5
Reach-1	16947		.3	.5
Reach-1	16859		.3	.5
Reach-1	16855	Bridge		
Reach-1	16850		.3	.5
Reach-1	16612		.3	.5
Reach-1	16084		.3	.5
Reach-1	15077		.3	.5
Reach-1	13725		.3	.5
Reach-1	13116		.3	.5
Reach-1	12382		.3	.5
Reach-1	12310		.3	.5
Reach-1	12305	Bridge		
Reach-1	12304		.3	.5

Reach-1	1632		.3	.5
Reach-1	1509		.3	.5
Reach-1	1204		.3	.5
Reach-1	895		.3	.5
Reach-1	665		.3	.5
Reach-1	331		.3	.5
Reach-1	262		.3	.5
Reach-1	260	Bridge		
Reach-1	257		.3	.5
Reach-1	140		.3	.5
Reach-1	1		.3	.5
Reach-1	0.23	Bridge		
Reach-1	0.2		.1	.3
Reach-1	0.15		.3	.5
Reach-1	0.14		.3	.5
Reach-1	0.13		.3	.5
Reach-1	0.12		.3	.5
Reach-1	0.11		.3	.5
Reach-1	0.1		.3	.5

Profile Output Table - Standard Table 1

Reach	River Sta		Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Reach-1	73584		20 yr	379.00	335.20	340.52	338.49	340.55	0.000234	1.15	738.45	350.44	0.16
Reach-1	73584		100 yr	522.00	335.20	341.42	339.13	341.44	0.000163	1.07	1070.80	383.54	0.14
Reach-1	73584		Reg	923.00	335.20	342.60	339.67	342.63	0.000179	1.26	1539.65	406.20	0.15
Reach-1	73509		20 yr	379.00	333.40	340.01	337.51	340.41	0.001718	2.79	135.83	86.56	0.40
Reach-1	73509		100 yr	522.00	333.40	341.13	338.25	341.36	0.000957	2.39	411.08	283.54	0.31
Reach-1	73509		Reg	923.00	333.40	342.40	339.94	342.57	0.000747	2.40	815.47	347.76	0.28
Reach-1	73504	Erbs Road		Bridge									
Reach-1	73499		20 yr	379.00	333.40	339.90	337.51	340.32	0.001849	2.85	132.87	84.29	0.42
Reach-1	73499		100 yr	522.00	333.40	340.68	338.25	340.94	0.001211	2.55	302.65	177.88	0.34
Reach-1	73499		Reg	923.00	333.40	342.28	339.94	342.47	0.000839	2.51	784.99	347.32	0.30
Reach-1	73456		20 yr	379.00	335.10	340.05		340.11	0.000390	1.43	491.08	209.69	0.21
Reach-1	73456		100 yr	522.00	335.10	340.75		340.81	0.000356	1.49	638.76	211.17	0.20
Reach-1	73456		Reg	923.00	335.10	342.32		342.39	0.000322	1.67	972.60	214.49	0.20
Reach-1	73181		20 yr	379.00	335.00	339.98		340.00	0.000240	1.13	796.22	389.37	0.16
Reach-1	73181		100 yr	522.00	335.00	340.70		340.72	0.000182	1.07	1076.50	390.88	0.14
Reach-1	73181		Reg	923.00	335.00	342.28		342.30	0.000135	1.09	1699.23	394.21	0.13
Reach-1	72326		20 yr	379.00	334.20	339.81		339.85	0.000272	1.30	703.03	339.67	0.18
Reach-1	72326		100 yr	522.00	334.20	340.57		340.60	0.000210	1.24	996.91	433.63	0.16
Reach-1	72326		Reg	923.00	334.20	342.21		342.23	0.000137	1.17	1753.61	473.01	0.13

EXISTING CONDITIONS

Reach-1	23888		Reg	923.00	294.50	299.90		299.96	0.000807	1.99	1082.78	617.99	0.28
Reach-1	23500		20 yr	416.00	294.20	298.61		298.72	0.000775	1.82	484.93	379.85	0.28
Reach-1	23500		100 yr	526.00	294.20	298.81		298.93	0.000895	2.01	560.28	386.12	0.30
Reach-1	23500		Reg	923.00	294.20	299.41		299.57	0.001157	2.48	797.23	405.23	0.35
Reach-1	22900		20 yr	416.00	293.70	298.07		298.11	0.001383	1.85	603.06	591.58	0.32
Reach-1	22900		100 yr	526.00	293.70	298.20		298.25	0.001549	2.01	678.75	595.43	0.34
Reach-1	22900		Reg	923.00	293.70	298.76		298.81	0.001425	2.13	1019.58	631.79	0.34
Reach-1	22315		20 yr	416.00	293.30	297.13		297.28	0.001795	2.48	487.26	624.07	0.41
Reach-1	22315		100 yr	526.00	293.30	297.45		297.54	0.001237	2.18	688.70	657.43	0.35
Reach-1	22315		Reg	923.00	293.30	298.30		298.35	0.000649	1.79	1344.98	774.11	0.26
Reach-1	22202		20 yr	416.00	293.20	296.94	295.34	297.07	0.001152	1.69	338.08	253.70	0.31
Reach-1	22202		100 yr	526.00	293.20	297.19	295.60	297.34	0.001321	1.89	404.38	289.19	0.34
Reach-1	22202		Reg	923.00	293.20	298.04	296.62	298.18	0.001243	2.07	874.91	769.69	0.33
Reach-1	22195			Bridge									
Reach-1	22192		20 yr	416.00	293.20	296.80		296.95	0.001407	1.82	303.10	232.79	0.34
Reach-1	22192		100 yr	526.00	293.20	296.99		297.18	0.001725	2.09	350.34	260.62	0.38
Reach-1	22192		Reg	923.00	293.20	297.82		298.04	0.001833	2.44	711.10	739.91	0.40
Reach-1	21930		20 yr	416.00	293.00	296.50		296.60	0.001586	2.16	598.87	850.04	0.38
Reach-1	21930		100 yr	526.00	293.00	296.78		296.84	0.001023	1.84	839.24	854.42	0.31
Reach-1	21930		Reg	923.00	293.00	297.78		297.80	0.000381	1.32	1692.08	860.78	0.20
Reach-1	20736		20 yr	416.00	292.70	296.06		296.07	0.000220	0.94	1502.29	1027.96	0.16
Reach-1	20736		100 yr	526.00	292.70	296.46		296.47	0.000171	0.89	1912.16	1047.80	0.15
Reach-1	20736		Reg	923.00	292.70	297.59		297.60	0.000119	0.89	3139.23	1122.89	0.13
Reach-1	19835		20 yr	416.00	291.80	295.94		295.95	0.000145	0.87	1585.94	808.65	0.14
Reach-1	19835		100 yr	526.00	291.80	296.35		296.36	0.000127	0.86	1923.77	813.71	0.13
Reach-1	19835		Reg	923.00	291.80	297.51		297.52	0.000110	0.94	2869.97	822.47	0.13
Reach-1	19359		20 yr	416.00	291.20	295.75		295.83	0.000507	1.74	620.44	312.07	0.26
Reach-1	19359		100 yr	526.00	291.20	296.17		296.26	0.000508	1.85	758.41	337.40	0.27
Reach-1	19359		Reg	923.00	291.20	297.33		297.42	0.000502	2.11	1160.67	355.90	0.27
Reach-1	18720		20 yr	416.00	290.10	295.32		295.44	0.000849	2.20	467.74	206.33	0.33
Reach-1	18720		100 yr	526.00	290.10	295.73		295.86	0.000873	2.37	573.43	309.61	0.34
Reach-1	18720		Reg	923.00	290.10	296.93		297.06	0.000763	2.57	993.25	374.18	0.33
Reach-1	18645		20 yr	416.00	290.21	295.28		295.31	0.000302	1.22	944.42	592.07	0.20
Reach-1	18645		100 yr	526.00	290.21	295.70		295.73	0.000264	1.22	1230.88	822.76	0.19
Reach-1	18645		Reg	923.00	290.21	296.90		296.92	0.000172	1.16	2804.48	1488.39	0.16
Reach-1	18570		20 yr	416.00	290.30	295.02	293.03	295.22	0.000827	2.15	354.46	345.71	0.33
Reach-1	18570		100 yr	526.00	290.30	295.41	293.40	295.63	0.000858	2.32	509.97	488.71	0.34
Reach-1	18570		Reg	923.00	290.30	296.71	295.15	296.85	0.000567	2.22	1516.39	1216.69	0.29

EXISTING CONDITIONS

Reach-1	18564		Bridge									
Reach-1	18558	20 yr	416.00	290.30	294.97	293.03	295.18	0.000881	2.20	336.92	338.94	0.34
Reach-1	18558	100 yr	526.00	290.30	295.36	293.40	295.58	0.000870	2.32	484.02	467.22	0.35
Reach-1	18558	Reg	923.00	290.30	296.56	295.15	296.75	0.000705	2.44	1345.20	1171.96	0.32
Reach-1	18487	20 yr	416.00	290.38	294.99		295.07	0.000497	1.55	648.50	443.40	0.25
Reach-1	18487	100 yr	526.00	290.38	295.39		295.46	0.000430	1.54	910.28	695.82	0.24
Reach-1	18487	Reg	923.00	290.38	296.61		296.65	0.000248	1.39	2332.97	1324.91	0.19
Reach-1	18416	20 yr	416.00	290.45	294.97		295.02	0.000549	1.40	786.67	626.33	0.25
Reach-1	18416	100 yr	526.00	290.45	295.38		295.42	0.000443	1.37	1111.56	868.25	0.23
Reach-1	18416	Reg	923.00	290.45	296.59		296.63	0.000270	1.31	2280.51	1246.98	0.19
Reach-1	17995	20 yr	416.00	290.10	294.67		294.78	0.000605	1.87	525.35	268.66	0.28
Reach-1	17995	100 yr	526.00	290.10	295.09		295.20	0.000587	1.96	640.16	271.46	0.28
Reach-1	17995	Reg	923.00	290.10	296.34		296.46	0.000564	2.23	982.72	279.64	0.29
Reach-1	17546	20 yr	416.00	289.70	294.22		294.47	0.001446	2.80	330.05	155.45	0.43
Reach-1	17546	100 yr	526.00	289.70	294.63		294.90	0.001487	3.02	394.05	162.47	0.45
Reach-1	17546	Reg	923.00	289.70	295.85		296.16	0.001449	3.48	675.54	265.71	0.46
Reach-1	17187	20 yr	416.00	289.40	293.95		294.08	0.000776	1.87	378.89	227.69	0.28
Reach-1	17187	100 yr	526.00	289.40	294.37		294.51	0.000754	1.95	479.94	248.78	0.28
Reach-1	17187	Reg	923.00	289.40	295.67		295.80	0.000622	2.08	845.80	304.73	0.27
Reach-1	16947	20 yr	416.00	289.20	293.92		293.96	0.000167	0.90	588.37	250.32	0.13
Reach-1	16947	100 yr	526.00	289.20	294.34		294.38	0.000184	1.00	695.11	259.59	0.14
Reach-1	16947	Reg	923.00	289.20	295.63		295.69	0.000212	1.25	1056.33	297.52	0.16
Reach-1	16859	20 yr	416.00	289.10	293.61	291.60	293.86	0.001441	2.23	187.59	63.34	0.36
Reach-1	16859	100 yr	526.00	289.10	293.91	291.98	294.26	0.001788	2.59	213.39	104.58	0.41
Reach-1	16859	Reg	923.00	289.10	295.17	293.09	295.55	0.001667	2.96	485.17	294.19	0.41
Reach-1	16855		Bridge									
Reach-1	16850	20 yr	416.00	289.10	293.54		293.80	0.001521	2.27	183.76	54.63	0.37
Reach-1	16850	100 yr	526.00	289.10	293.82		294.18	0.001935	2.66	203.95	91.67	0.42
Reach-1	16850	Reg	923.00	289.10	294.76	293.09	295.31	0.002541	3.46	373.00	250.54	0.50
Reach-1	16612	20 yr	416.00	289.00	293.23		293.37	0.001618	2.46	376.73	243.08	0.39
Reach-1	16612	100 yr	526.00	289.00	293.49		293.64	0.001724	2.64	440.97	255.97	0.41
Reach-1	16612	Reg	923.00	289.00	294.45		294.62	0.001769	3.07	729.77	394.87	0.43
Reach-1	16084	20 yr	419.00	288.50	292.68		292.80	0.001153	2.09	440.10	308.47	0.33
Reach-1	16084	100 yr	518.00	288.50	292.96		293.07	0.001097	2.13	525.55	311.45	0.33
Reach-1	16084	Reg	923.00	288.50	294.01		294.11	0.000889	2.23	899.34	380.21	0.31
Reach-1	15077	20 yr	419.00	287.80	291.87		291.95	0.000616	1.54	527.11	378.19	0.25
Reach-1	15077	100 yr	518.00	287.80	292.22		292.29	0.000544	1.54	660.40	382.15	0.24

Reach-1	1	20 yr	419.00	274.10	278.54	276.79	278.71	0.001254	1.83	229.19	75.78	0.34
Reach-1	1	100 yr	518.00	274.10	278.89	277.06	279.10	0.001343	2.02	256.42	76.42	0.35
Reach-1	1	Reg	923.00	274.10	279.96	277.96	280.34	0.001772	2.72	339.15	78.36	0.42
Reach-1	0.23		Bridge									
Reach-1	0.2	20 yr	419.00	274.10	278.50		278.67	0.001305	1.85	226.32	75.71	0.34
Reach-1	0.2	100 yr	518.00	274.10	278.85		279.06	0.001399	2.05	253.11	76.35	0.36
Reach-1	0.2	Reg	923.00	274.10	279.89		280.28	0.001868	2.77	333.45	78.23	0.43
Reach-1	0.15	20 yr	419.00	274.10	278.48		278.65	0.000994	2.05	327.13	192.14	0.32
Reach-1	0.15	100 yr	518.00	274.10	278.86		279.04	0.000993	2.17	402.98	214.41	0.32
Reach-1	0.15	Reg	923.00	274.10	280.00		280.20	0.000994	2.51	687.56	282.65	0.33
Reach-1	0.14	20 yr	419.00	274.10	278.48		278.65	0.000995	2.05	326.90	192.07	0.32
Reach-1	0.14	100 yr	518.00	274.10	278.86		279.04	0.000995	2.17	402.71	214.34	0.32
Reach-1	0.14	Reg	923.00	274.10	280.00		280.20	0.000996	2.51	687.21	282.63	0.33
Reach-1	0.13	20 yr	419.00	274.10	278.48		278.65	0.000997	2.05	326.67	191.99	0.32
Reach-1	0.13	100 yr	518.00	274.10	278.85		279.03	0.000996	2.17	402.46	214.27	0.32
Reach-1	0.13	Reg	923.00	274.10	280.00		280.20	0.000997	2.52	686.85	282.60	0.33
Reach-1	0.12	20 yr	419.00	274.10	278.48		278.65	0.000998	2.06	326.43	191.92	0.32
Reach-1	0.12	100 yr	518.00	274.10	278.85		279.03	0.000997	2.17	402.19	214.19	0.32
Reach-1	0.12	Reg	923.00	274.10	280.00		280.20	0.000998	2.52	686.51	282.53	0.33
Reach-1	0.11	20 yr	419.00	274.10	278.48		278.65	0.000999	2.06	326.19	191.85	0.32
Reach-1	0.11	100 yr	518.00	274.10	278.85		279.03	0.000999	2.17	401.93	214.12	0.32
Reach-1	0.11	Reg	923.00	274.10	280.00		280.20	0.000999	2.52	686.16	282.45	0.33
Reach-1	0.1	20 yr	419.00	274.10	278.48	276.59	278.65	0.001001	2.06	325.97	191.78	0.32
Reach-1	0.1	100 yr	518.00	274.10	278.85	276.91	279.03	0.001000	2.18	401.62	214.03	0.32
Reach-1	0.1	Reg	923.00	274.10	280.00	278.34	280.20	0.001000	2.52	685.76	282.37	0.33

Profile Output Table - Standard Table 2

Reach	River Sta	Profile	E.G. Elev (m)	W.S. Elev (m)	Vel Head (m)	Frctn Loss (m)	C & E Loss (m)	Q Left (m3/s)	Q Channel (m3/s)	Q Right (m3/s)	Top Width (m)
Reach-1	73584	20 yr	340.55	340.52	0.03	0.03	0.11	229.78	139.10	10.12	350.44
Reach-1	73584	100 yr	341.44	341.42	0.02	0.02	0.06	358.16	151.00	12.84	383.54
Reach-1	73584	Reg	342.63	342.60	0.03	0.02	0.04	690.31	211.52	21.17	406.20
Reach-1	73509	20 yr	340.41	340.01	0.40	0.00	0.02		379.00		86.56
Reach-1	73509	100 yr	341.36	341.13	0.23	0.00	0.14	123.54	398.46		283.54
Reach-1	73509	Reg	342.57	342.40	0.17	0.00	0.02	439.19	483.81		347.76
Reach-1	73504 Erbs Road		Bridge								

EXISTING CONDITIONS

Reach-1	19359	20 yr	295.83	295.75	0.08	0.39	0.00	143.91	206.07	66.02	312.07
Reach-1	19359	100 yr	296.26	296.17	0.09	0.39	0.01	205.66	239.38	80.97	337.40
Reach-1	19359	Reg	297.42	297.33	0.09	0.36	0.00	454.67	338.18	130.16	355.90
Reach-1	18720	20 yr	295.44	295.32	0.13	0.10	0.03	9.57	194.66	211.77	206.33
Reach-1	18720	100 yr	295.86	295.73	0.14	0.10	0.03	8.50	228.65	288.86	309.61
Reach-1	18720	Reg	297.06	296.93	0.13	0.11	0.03	91.02	308.77	523.21	374.18
Reach-1	18645	20 yr	295.31	295.28	0.04	0.04	0.05	99.54	199.23	117.23	592.07
Reach-1	18645	100 yr	295.73	295.70	0.03	0.04	0.06	146.56	221.44	158.00	822.76
Reach-1	18645	Reg	296.92	296.90	0.02	0.03	0.04	390.70	268.90	263.41	1488.39
Reach-1	18570	20 yr	295.22	295.02	0.20	0.01	0.01	43.94	359.01	13.05	345.71
Reach-1	18570	100 yr	295.63	295.41	0.22	0.01	0.00	94.57	423.78	7.65	488.71
Reach-1	18570	Reg	296.85	296.71	0.14	0.01	0.04	322.05	518.65	82.30	1216.69
Reach-1	18564		Bridge								
Reach-1	18558	20 yr	295.18	294.97	0.22	0.05	0.07	40.02	363.04	12.94	338.94
Reach-1	18558	100 yr	295.58	295.36	0.22	0.04	0.08	90.14	418.42	17.44	467.22
Reach-1	18558	Reg	296.75	296.56	0.19	0.03	0.07	290.51	555.40	77.10	1171.96
Reach-1	18487	20 yr	295.07	294.99	0.08	0.04	0.01	145.70	264.27	6.02	443.40
Reach-1	18487	100 yr	295.46	295.39	0.07	0.03	0.01	227.88	289.84	8.28	695.82
Reach-1	18487	Reg	296.65	296.61	0.04	0.02	0.00	552.72	335.21	35.07	1324.91
Reach-1	18416	20 yr	295.02	294.97	0.05	0.24	0.01	208.63	204.34	3.03	626.33
Reach-1	18416	100 yr	295.42	295.38	0.04	0.21	0.01	296.10	225.54	4.36	868.25
Reach-1	18416	Reg	296.63	296.59	0.03	0.15	0.01	625.14	290.17	7.69	1246.98
Reach-1	17995	20 yr	294.78	294.67	0.11	0.30	0.01	160.34	248.10	7.56	268.66
Reach-1	17995	100 yr	295.20	295.09	0.11	0.29	0.02	230.53	284.77	10.71	271.46
Reach-1	17995	Reg	296.46	296.34	0.12	0.28	0.02	491.96	407.96	23.08	279.64
Reach-1	17546	20 yr	294.47	294.22	0.25	0.35	0.03	139.81	246.48	29.71	155.45
Reach-1	17546	100 yr	294.90	294.63	0.27	0.35	0.04	196.75	290.57	38.69	162.47
Reach-1	17546	Reg	296.16	295.85	0.31	0.31	0.05	401.42	422.88	98.70	265.71
Reach-1	17187	20 yr	294.08	293.95	0.14	0.07	0.05	12.30	308.60	95.10	227.69
Reach-1	17187	100 yr	294.51	294.37	0.14	0.08	0.05	16.82	353.79	155.39	248.78
Reach-1	17187	Reg	295.80	295.67	0.13	0.08	0.03	34.42	477.22	411.36	304.73
Reach-1	16947	20 yr	293.96	293.92	0.04	0.03	0.06	16.71	378.74	20.54	250.32
Reach-1	16947	100 yr	294.38	294.34	0.04	0.04	0.09	27.52	459.07	39.41	259.59
Reach-1	16947	Reg	295.69	295.63	0.06	0.04	0.09	73.89	717.64	131.46	297.52
Reach-1	16859	20 yr	293.86	293.61	0.25	0.00	0.01		415.93	0.07	63.34
Reach-1	16859	100 yr	294.26	293.91	0.34	0.00	0.02		523.16	2.84	104.58
Reach-1	16859	Reg	295.55	295.17	0.38	0.00	0.05	0.69	779.87	142.44	294.19
Reach-1	16855		Bridge								

EXISTING CONDITIONS

Profile Output Table - Six XS Bridge

Reach	River Sta			Profile	E.G. Elev (m)	W.S. Elev (m)	Crit W.S. (m)	Frctn Loss (m)	C & E Loss (m)	Top Width (m)	Q Left (m3/s)	Q Channel (m3/s)	Q Right (m3/s)	Vel Chnl (m/s)
Reach-1	73584			20 yr	340.55	340.52	338.49	0.03	0.11	350.44	229.78	139.10	10.12	1.15
Reach-1	73584			100 yr	341.44	341.42	339.13	0.02	0.06	383.54	358.16	151.00	12.84	1.07
Reach-1	73584			Reg	342.63	342.60	339.67	0.02	0.04	406.20	690.31	211.52	21.17	1.26
Reach-1	73509			20 yr	340.41	340.01	337.51	0.00	0.02	86.56		379.00		2.79
Reach-1	73509			100 yr	341.36	341.13	338.25	0.00	0.14	283.54	123.54	398.46		2.39
Reach-1	73509			Reg	342.57	342.40	339.94	0.00	0.02	347.76	439.19	483.81		2.40
Reach-1	73504	Erbs Road	BR U	20 yr	340.38	339.92	337.65	0.03	0.00	26.28		379.00		3.01
Reach-1	73504	Erbs Road	BR U	100 yr	341.22	340.53	338.41	0.05	0.01	61.95	0.08	521.92		3.68
Reach-1	73504	Erbs Road	BR U	Reg	342.55	342.33	341.66	0.04	0.01	302.36	499.46	423.54		2.70
Reach-1	73504	Erbs Road	BR D	20 yr	340.35	339.88	337.65	0.00	0.03	26.29		379.00		3.04
Reach-1	73504	Erbs Road	BR D	100 yr	341.16	340.45	338.41	0.00	0.23	26.25		522.00		3.73
Reach-1	73504	Erbs Road	BR D	Reg	342.50	342.25	341.66	0.00	0.03	298.30	475.83	447.17		2.85
Reach-1	73499			20 yr	340.32	339.90	337.51	0.03	0.18	84.29		379.00		2.85
Reach-1	73499			100 yr	340.94	340.68	338.25	0.03	0.10	177.88	128.73	393.27		2.55
Reach-1	73499			Reg	342.47	342.28	339.94	0.02	0.06	347.32	418.42	498.58	6.00	2.51
Reach-1	73456			20 yr	340.11	340.05		0.09	0.02	209.69	157.77	201.94	19.29	1.43
Reach-1	73456			100 yr	340.81	340.75		0.07	0.02	211.17	253.80	240.67	27.53	1.49
Reach-1	73456			Reg	342.39	342.32		0.06	0.03	214.49	526.60	344.42	51.98	1.67
Reach-1	69979			20 yr	339.50	339.45		0.02	0.04	136.82	176.30	179.79	22.90	1.27
Reach-1	69979			100 yr	340.28	340.22		0.02	0.06	139.34	259.70	228.31	34.00	1.44
Reach-1	69979			Reg	341.91	341.82		0.02	0.02	144.59	495.52	357.95	69.54	1.83
Reach-1	69929			20 yr	339.44	339.24	336.61	0.00	0.01	148.43		379.00		1.95
Reach-1	69929			100 yr	340.20	339.93	337.21	0.00	0.02	180.45		522.00		2.29
Reach-1	69929			Reg	341.87	341.71	338.51	0.00	0.05	287.73	262.66	660.34		2.07
Reach-1	69923.5	Naftziger Rd.	BR U	20 yr	339.43	339.20	336.71	0.02	0.00	46.15		379.00		2.09
Reach-1	69923.5	Naftziger Rd.	BR U	100 yr	340.18	339.86	337.33	0.03	0.00	32.99		522.00		2.51
Reach-1	69923.5	Naftziger Rd.	BR U	Reg	341.82	341.49	338.68	0.06	0.02	230.26	247.80	675.21		2.88
Reach-1	69923.5	Naftziger Rd.	BR D	20 yr	339.41	339.19	336.72	0.00	0.01	46.12		379.00		2.10
Reach-1	69923.5	Naftziger Rd.	BR D	100 yr	340.15	339.83	337.33	0.00	0.02	33.65		522.00		2.52
Reach-1	69923.5	Naftziger Rd.	BR D	Reg	341.74	341.35	338.69	0.00	0.10	215.54	207.16	715.84		3.08
Reach-1	69918			20 yr	339.40	339.20	336.61	0.02	0.07	146.34		379.00		1.97
Reach-1	69918			100 yr	340.13	339.85	337.21	0.02	0.11	176.68		522.00		2.33
Reach-1	69918			Reg	341.64	341.44	338.52	0.02	0.07	266.39	241.65	681.35		2.24
Reach-1	69883			20 yr	339.31	339.25		0.52	0.03	257.25	207.24	150.45	21.31	1.56

EXISTING CONDITIONS

Reach-1	22202		100 yr	297.34	297.19	295.60	0.00	0.04	289.19		411.73	114.28	1.89
Reach-1	22202		Reg	298.18	298.04	296.62	0.00	0.03	769.69	33.24	573.14	316.62	2.07
Reach-1	22195	BR U	20 yr	297.03	296.79	295.54	0.03	0.00	196.24		383.34	32.66	2.24
Reach-1	22195	BR U	100 yr	297.29	297.00	295.84	0.03	0.01	223.39		464.79	61.21	2.54
Reach-1	22195	BR U	Reg	298.15	297.91	297.11	0.03	0.03	718.52	27.55	609.50	285.96	2.59
Reach-1	22195	BR D	20 yr	297.00	296.75	295.54	0.00	0.05	190.21		386.60	29.40	2.29
Reach-1	22195	BR D	100 yr	297.25	296.93	295.84	0.00	0.07	214.18		471.76	54.24	2.64
Reach-1	22195	BR D	Reg	298.09	297.77	297.11	0.00	0.05	695.65	11.17	665.84	245.99	2.93
Reach-1	22192		20 yr	296.95	296.80		0.32	0.03	232.79		349.19	66.81	1.82
Reach-1	22192		100 yr	297.18	296.99		0.27	0.07	260.62		427.25	98.75	2.09
Reach-1	22192		Reg	298.04	297.82		0.14	0.10	739.91	12.64	639.26	271.11	2.44
Reach-1	21930		20 yr	296.60	296.50		0.48	0.04	850.04	115.27	146.34	154.40	2.16
Reach-1	21930		100 yr	296.84	296.78		0.35	0.02	854.42	189.44	134.81	201.75	1.84
Reach-1	21930		Reg	297.80	297.78		0.20	0.01	860.78	443.64	123.77	355.59	1.32
Reach-1	18645		20 yr	295.31	295.28		0.04	0.05	592.07	99.54	199.23	117.23	1.22
Reach-1	18645		100 yr	295.73	295.70		0.04	0.06	822.76	146.56	221.44	158.00	1.22
Reach-1	18645		Reg	296.92	296.90		0.03	0.04	1488.39	390.70	268.90	263.41	1.16
Reach-1	18570		20 yr	295.22	295.02	293.03	0.01	0.01	345.71	43.94	359.01	13.05	2.15
Reach-1	18570		100 yr	295.63	295.41	293.40	0.01	0.00	488.71	94.57	423.78	7.65	2.32
Reach-1	18570		Reg	296.85	296.71	295.15	0.01	0.04	1216.69	322.05	518.65	82.30	2.22
Reach-1	18564	BR U	20 yr	295.21	294.99	293.11	0.01	0.00	267.58	42.73	354.54	18.73	2.25
Reach-1	18564	BR U	100 yr	295.62	295.41	293.50	0.03	0.00	274.35	122.56	385.90	17.54	2.36
Reach-1	18564	BR U	Reg	296.81	296.74	295.15	0.02	0.00	1138.02	514.96	307.47	100.56	1.88
Reach-1	18564	BR D	20 yr	295.19	294.97	293.11	0.01	0.01	264.66	41.23	356.11	18.66	2.27
Reach-1	18564	BR D	100 yr	295.59	295.36	293.50	0.01	0.00	254.25	115.49	392.67	17.84	2.41
Reach-1	18564	BR D	Reg	296.79	296.71	295.15	0.01	0.03	1131.11	508.32	315.51	99.16	1.93
Reach-1	18558		20 yr	295.18	294.97	293.03	0.05	0.07	338.94	40.02	363.04	12.94	2.20
Reach-1	18558		100 yr	295.58	295.36	293.40	0.04	0.08	467.22	90.14	418.42	17.44	2.32
Reach-1	18558		Reg	296.75	296.56	295.15	0.03	0.07	1171.96	290.51	555.40	77.10	2.44
Reach-1	18487		20 yr	295.07	294.99		0.04	0.01	443.40	145.70	264.27	6.02	1.55
Reach-1	18487		100 yr	295.46	295.39		0.03	0.01	695.82	227.88	289.84	8.28	1.54
Reach-1	18487		Reg	296.65	296.61		0.02	0.00	1324.91	552.72	335.21	35.07	1.39
Reach-1	16947		20 yr	293.96	293.92		0.03	0.06	250.32	16.71	378.74	20.54	0.90
Reach-1	16947		100 yr	294.38	294.34		0.04	0.09	259.59	27.52	459.07	39.41	1.00
Reach-1	16947		Reg	295.69	295.63		0.04	0.09	297.52	73.89	717.64	131.46	1.25
Reach-1	16859		20 yr	293.86	293.61	291.60	0.00	0.01	63.34		415.93	0.07	2.23
Reach-1	16859		100 yr	294.26	293.91	291.98	0.00	0.02	104.58		523.16	2.84	2.59

PROPOSED CONDITIONS

HEC-RAS HEC-RAS 6.5 Beta Development
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X       X   X     X  X    X
X     X  X        X            X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X            X  X     X    X        X
X     X  X        X    X       X   X    X    X        X
X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: Middle Nith - Ayr to Philipsburg-KSmart
Project File : MiddleNithKSmart.prj
Run Date and Time: 2026-02-18 12:04:57 PM

Project in SI units

Project Description:
KSmart Revised - January 2026
Refer to Hydraulic Memo for
updates

NITH
RIVER FPM STUDY FOR GRAND RIVER C.A.
Original Study by Dillon 1985 - Combined
H2NITH1.DAT and H2NITH2.DAT
Updated to HEC-RAS - GRCA 2010
Bridge updates per
GRCA permits - Haysville, Bender - Bleams Road, New Hamburg Walkway, New
Hamburg Channel refinements 2006, Oxford Blanford Blenheim Road 11 P288/05,
Watson Factory Ineffective area Ayr
H2NITH1.DAT flows added November 2011.
Original Reg flows are best, GRHS flows U/S of Canning not documented (JSP)

PLAN DATA

Plan Title: Prop Reg
Plan File : s:\2022\22-264\Engineering\Hydrology\HEC-RAS Model Revisions (To K Smart)\HEC-RAS Model\MiddleNithKSmart.p07

```
           Geometry Title: 8sept2006 r5 - KSmart Prop
           Geometry File : s:\2022\22-264\Engineering\Hydrology\HEC-RAS Model Revisions (To K Smart)\HEC-RAS Model\MiddleNithKSmart.g02

           Flow Title    : Reg_100_20
           Flow File     : s:\2022\22-264\Engineering\Hydrology\HEC-RAS Model Revisions (To K Smart)\HEC-RAS Model\MiddleNithKSmart.f04

Plan Summary Information:
Number of:  Cross Sections =  255    Multiple Openings  =    0
            Culverts       =    0    Inline Structures  =    1
            Bridges        =   29    Lateral Structures =    0

Computational Information
    Water surface calculation tolerance  =  0.003
    Critical depth calculation tolerance =  0.003
    Maximum number of iterations         =  20
    Maximum difference tolerance         =  0.1
    Flow tolerance factor                =  0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method:         Average Conveyance
    Computational Flow Regime:     Mixed Flow



FLOW DATA

Flow Title: Reg_100_20
Flow File : s:\2022\22-264\Engineering\Hydrology\HEC-RAS Model Revisions (To K Smart)\HEC-RAS Model\MiddleNithKSmart.f04

Flow Data (m3/s)

  River           Reach           RS                  20 yr          100 yr            Reg
  RIVER-1         Reach-1         73584                 379             522            923
  RIVER-1         Reach-1         36588                 414             531            923
  RIVER-1         Reach-1         27396                 416             526            923
  RIVER-1         Reach-1         16084                 419             518            923


Boundary Conditions

  River           Reach           Profile                      Upstream                Downstream

  RIVER-1         Reach-1         20 yr                    Normal S = 0.001        Normal S = 0.001
  RIVER-1         Reach-1         100 yr                   Normal S = 0.001        Normal S = 0.001
  RIVER-1         Reach-1         Reg                      Normal S = 0.001        Normal S = 0.001



GEOMETRY DATA
```

PROPOSED CONDITIONS

```
Geometry Title: 8sept2006 r5 - KSmart Prop
Geometry File : s:\2022\22-264\Engineering\Hydrology\HEC-RAS Model Revisions (To K Smart)\HEC-RAS Model\MiddleNithKSmart.g02

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 73584

INPUT
Description:
Station Elevation Data    num=      18
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    1000   342.5 1029.26     341 1054.02   340.5 1089.14   339.5 1128.51     339
 1256.04   338.5 1281.66     338 1314.84     338 1339.12     338 1367.01   337.5
 1372.18   335.3 1372.94   335.2 1392.94   335.2 1395.05   336.1  1397.9     337
 1400.27     338 1418.31     352 1433.94   351.8

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    1000     .06 1372.18     .04 1395.05     .06

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       1372.18 1395.05               50      71     130             .3       .5
Sediment Elevation = 0

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 73509

INPUT
Description:
Station Elevation Data    num=      19
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
900.0001     342968.8322     3411037.664   340.51066.344   340.51135.176     341
1210.834   336.71210.891   336.71216.054   333.61221.216   333.71222.937   333.4
1224.658   333.71226.379   334.61229.476   334.71230.107   334.11238.367   339.8
1238.424   339.81249.896     3431269.972   343.51295.784     345

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
900.0001     .061210.834     .041238.424     .06

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      1210.8341238.424               10      10      10             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
900.00011210.834   340.5       F
1238.4241295.784   342.9       F
Sediment Elevation = 0

BRIDGE
```

```
RIVER: RIVER-1
REACH: Reach-1            RS: 20736

INPUT
Description:
Station Elevation Data    num=      24
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
     240   298.5  278.33   297.5318.6899     297339.1699     295450.5499   294.5
  495.76   294.5554.1899   294.5  557.48   293.3  558.84   292.7  583.84   292.7
  585.37   293.2  594.25   294.5  618.63   294.5  653.84   294.5  853.84   294.8
  923.84   294.5  983.84   294.7 1023.84   294.5 1053.84     294 1238.84   294.5
 1270.84   295.5 1353.84     296 1393.84     297 1413.84     300

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
     240     .08  557.48    .035  585.37     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        557.48  585.37              752     901     580             .1       .3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 19835

INPUT
Description:
Station Elevation Data    num=      24
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    1000     296 1015.12   295.5 1029.01     295 1097.96     295 1138.28   294.5
 1195.57     294 1227.08   293.5 1332.82   293.6 1445.08     294 1527.83     294
 1534.18   293.5 1576.92   293.5 1600.05     294  1663.3     294 1668.59   292.5
  1671.5   291.8  1684.5   291.8 1687.55   292.5 1692.04     293 1710.04     293
 1713.67   293.5 1756.84     294 1795.88     294  1856.5     302

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    1000     .08 1668.59    .035 1687.55     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       1668.59 1687.55              410     476     360             .1       .3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 19359

INPUT
Description:
Station Elevation Data    num=      20
```

```
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    1000     296 1042.11   295.5 1087.67     295 1118.47     294 1130.53   293.5
 1226.85   293.5 1254.96   293.5 1257.42   291.9 1258.94   291.2 1281.94   291.2
 1283.71     292 1285.95     292 1294.82   292.5 1303.51     293 1317.95     293
 1334.26     296 1352.42     297 1384.03     300  1393.3   300.5 1421.94     301

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    1000     .08 1257.42    .035 1283.71     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       1257.42 1283.71              690     724     380             .1       .3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 18720

INPUT
Description:
Station Elevation Data    num=      37
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     297  15.469   296.5  35.798     296  85.931   295.5 163.026   295.5
 165.282     295 166.317   294.5 167.392     294 168.684   293.5 170.408     293
 173.171   292.5 174.491     292 176.258   291.5  179.42 290.096  186.42 290.096
 189.582   291.5 194.344     292 218.609     292 219.337   292.5 220.815     293
 222.341   293.5  224.68   293.5 228.273     293  231.04     293 239.898   293.5
 245.527   293.5 253.746     293  289.78     293 307.817   293.5 316.857   293.5
 354.142     294 362.705   294.5 367.052     295 372.035   295.5 373.924     296
  375.23   296.5 376.653     297

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08 174.491    .035 194.344     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       174.491 194.344         1126.956 116.395  25.372             .1       .3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 18645

INPUT
Description:
Station Elevation Data    num=      71
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     297   7.716   296.5  24.576     296  52.699     296  58.348   296.5
  62.711   296.5  64.088     296   67.58   295.5  72.034   295.5  78.902     296
 397.209     296 480.947   295.5 523.299   295.5 595.872     296 605.942     296
  614.48   295.5 666.496   295.5 724.808     296 767.877     296 781.621   296.5
 786.728   296.5 811.498     296 858.117   295.5 864.309   295.5 888.381     295
```

```
 900.698   294.5 921.988   294.5 925.188     295 958.683     295 961.053   294.5
 963.513     2941023.098     2941042.197   293.51043.224   293.51044.141     293
1046.501   293.51048.381     2941078.584     2941099.299   293.51101.821   293.5
1122.933     2941126.491     2941155.441   293.51173.753   293.51183.432     293
 1195.58     2931198.774   292.51200.707     2921203.258   291.51207.775 290.213
1215.775 290.2131220.291   291.51227.865     2921237.467     2921240.886   292.5
1242.479     2931245.129   293.51297.509   293.51304.578     2931315.666     293
1318.369   293.51432.424   293.51439.477     2941443.878     2941452.897   294.5
1463.572     2951470.177   295.51472.755     296 1475.18   296.51488.661   296.5
1490.363     297

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .081198.774    .0351240.886     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      1198.7741240.886          168.606  74.031  69.788             .3       .5

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 18570

INPUT
Description:
Station Elevation Data    num=      44
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     297 182.571     297 270.669   296.5 683.436     296 796.538 296.068
 821.538  295.66 846.538 295.134 871.538 294.806 896.538 294.624 921.538 294.501
 946.538 294.415 971.538 294.408 996.538 294.4621021.538 294.4741046.538 294.401
1071.538 294.3541096.538 294.4871121.538 294.8421146.538 295.3811166.057  291.71
 1166.06 291.7091169.162  290.991172.446  290.521176.525  290.631180.207  290.56
 1183.81  290.651186.847  290.571191.506   290.31195.964   290.51199.462  291.03
1200.986  291.371205.257  291.54 1205.26 291.5411221.538 295.3881246.538 295.273
1271.538 295.2871296.538 295.2911321.538 295.4051346.538 295.7141371.538 296.106
1396.538 296.3111421.538 296.4981446.538 296.6591471.538 296.917

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08 1166.06    .035 1205.26     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       1166.06 1205.26          126.814  20.696  35.209             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  1144.6  294.41       F
  1223.41471.538  294.41       F

BRIDGE


RIVER: RIVER-1
REACH: Reach-1            RS: 18564
```

PROPOSED CONDITIONS

```
INPUT
Description: Township Road 12 - Oxford - Bridge# 10
Distance from Upstream XS =    6.03
Deck/Roadway Width        =       9
Weir Coefficient          =     2.6
Upstream  Deck/Roadway Coordinates
    num=      88
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
     995  294.49          995.77  294.49            1005  294.49
 1009.16  294.49            1015 294.496            1025 294.532
    1035 294.601            1045 294.704         1054.16 294.828
    1055  294.84            1065  294.99         1069.34 295.055
    1070 295.065         1070.67 295.075            1075  295.14
    1085  295.29            1095  295.44            1105  295.59
    1115  295.74            1125  295.89          1131.5 295.988
    1135 296.038         1140.44  296.11         1140.44 296.875
 1145.15  296.93         1145.15  296.95         1146.05 297.185
 1146.64 297.192         1146.65 297.172            1149 297.196
  1152.6297.2296   291.7  1152.6297.2296 295.014  1153.5 297.238 295.022
 1155.75297.2557 295.041 1159.21297.2828 295.068 1160.25 297.291 295.074
  1165.5 297.322 295.106 1170.45297.3424 295.129 1171.65297.3474 295.134
 1173.75 297.356  295.14    1176297.3601 295.146 1180.82297.3689 295.154
    1182 297.371 295.154    1184 297.371 295.154 1187.67297.3692 295.153
    1188 297.369 295.152 1190.83297.3637 295.148 1193.25297.3593 295.143
    1195 297.356 295.137 1195.14297.3554 295.137 1196.35297.3503 295.133
 1197.55297.3453 295.129    1200 297.335 295.118 1202.31297.3217 295.108
 1207.13297.2941 295.078  1207.5 297.292 295.075 1212.33297.2572 295.038
 1214.57 297.241  295.02  1215.4297.2325 295.014  1215.4297.2325   291.7
 1221.35 297.172         1221.35 297.192         1221.95 297.185
 1222.85  296.95         1222.85 296.931         1227.56 296.875
 1227.56  296.11            1235  296.01          1236.5 295.988
    1245  295.86          1253.5 295.733            1255  295.71
    1265 295.582            1275 295.487            1285 295.425
 1293.87 295.399            1295 295.397         1296.13 295.396
  1298.5 295.395            1305 295.402            1315  295.44
    1325 295.512            1335 295.617          1343.5 295.733
    1345 295.755            1355 295.905            1365 296.055
    1370  296.13

Upstream Bridge Cross Section Data
Station Elevation Data    num=      44
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     297 182.571     297 270.669   296.5 683.436     296 796.538 296.068
 821.538  295.66 846.538 295.134 871.538 294.806 896.538 294.624 921.538 294.501
 946.538 294.415 971.538 294.408 996.538 294.4621021.538 294.4741046.538 294.401
1071.538 294.3541096.538 294.4871121.538 294.8421146.538 295.3811166.057  291.71
 1166.06 291.7091169.162  290.991172.446  290.521176.525  290.631180.207  290.56
 1183.81  290.651186.847  290.571191.506   290.31195.964   290.51199.462  291.03
1200.986  291.371205.257  291.54 1205.26 291.5411221.538 295.3881246.538 295.273
1271.538 295.2871296.538 295.2911321.538 295.4051346.538 295.7141371.538 296.106
1396.538 296.3111421.538 296.4981446.538 296.6591471.538 296.917

Manning's n Values        num=       3
```

```
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08 1166.06    .035 1205.26     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
       1166.06 1205.26             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  1144.6  294.41       F
  1223.41471.538  294.41       F

Downstream  Deck/Roadway Coordinates
    num=      88
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
     995  294.49          995.77  294.49            1005  294.49
 1009.16  294.49            1015 294.496            1025 294.532
    1035 294.601            1045 294.704         1054.16 294.828
    1055  294.84            1065  294.99         1069.34 295.055
    1070 295.065         1070.67 295.075            1075  295.14
    1085  295.29            1095  295.44            1105  295.59
    1115  295.74            1125  295.89          1131.5 295.988
    1135 296.038         1140.44  296.11         1140.44 296.875
 1145.15  296.93         1145.15  296.95         1146.05 297.185
 1146.64 297.192         1146.65 297.172            1149 297.196
  1152.6297.2296   291.7  1152.6297.2296 295.014  1153.5 297.238 295.022
 1155.75297.2557 295.041 1159.21297.2828 295.068 1160.25 297.291 295.074
  1165.5 297.322 295.106 1170.45297.3424 295.129 1171.65297.3474 295.134
 1173.75 297.356  295.14    1176297.3601 295.146 1180.82297.3689 295.154
    1182 297.371 295.154    1184 297.371 295.154 1187.67297.3692 295.153
    1188 297.369 295.152 1190.83297.3637 295.148 1193.25297.3593 295.143
    1195 297.356 295.137 1195.14297.3554 295.137 1196.35297.3503 295.133
 1197.55297.3453 295.129    1200 297.335 295.118 1202.31297.3217 295.108
 1207.13297.2941 295.078  1207.5 297.292 295.075 1212.33297.2572 295.038
 1214.57 297.241  295.02  1215.4297.2325 295.014  1215.4297.2325   291.7
 1221.35 297.172         1221.35 297.192         1221.95 297.185
 1222.85  296.95         1222.85 296.931         1227.56 296.875
 1227.56  296.11            1235  296.01          1236.5 295.988
    1245  295.86          1253.5 295.733            1255  295.71
    1265 295.582            1275 295.487            1285 295.425
 1293.87 295.399            1295 295.397         1296.13 295.396
  1298.5 295.395            1305 295.402            1315  295.44
    1325 295.512            1335 295.617          1343.5 295.733
    1345 295.755            1355 295.905            1365 296.055
    1370  296.13

Downstream Bridge Cross Section Data
Station Elevation Data    num=      44
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     297 182.571     297 270.669   296.5 683.436     296 796.538 296.068
 821.538  295.66 846.538 295.134 871.538 294.806 896.538 294.624 921.538 294.501
 946.538 294.415 971.538 294.408 996.538 294.4621021.538 294.4741046.538 294.401
1071.538 294.3541096.538 294.4871121.538 294.8421146.538 295.3811166.057  291.71
 1166.06 291.7091169.162  290.991172.446  290.521176.525  290.631180.207  290.56
 1183.81  290.651186.847  290.571191.506   290.31195.964   290.51199.462  291.03
1200.986  291.371205.257  291.54 1205.26 291.5411221.538 295.3881246.538 295.273
```

```
1271.538 295.2871296.538 295.2911321.538 295.4051346.538 295.7141371.538 296.106
1396.538 296.3111421.538 296.4981446.538 296.6591471.538 296.917

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08 1166.06    .035 1205.26     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
       1166.06 1205.26             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  1144.6  294.41       F
  1223.41471.538  294.41       F

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .98
Elevation at which weir flow begins         =  294.41
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Piers =  2

Pier Data
Pier Station     Upstream= 1171.05    Downstream= 1171.05
Upstream     num=       2
    Width   Elev    Width   Elev
      .9   294.5     1.2  294.65
Downstream     num=       2
    Width   Elev    Width   Elev
      .9   294.5     1.2  294.65

Pier Data
Pier Station     Upstream= 1196.95    Downstream= 1196.95
Upstream     num=       2
    Width   Elev    Width   Elev
      .9   294.5     1.2  294.65
Downstream     num=       2
    Width   Elev    Width   Elev
      .9   294.5     1.2  294.65

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
Selected Low Flow Methods = Energy

High Flow Method
       Energy Only

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
```

```
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 18558

INPUT
Description:
Station Elevation Data    num=      44
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     297 182.571     297 270.669   296.5 683.436     296 796.538 296.068
 821.538  295.66 846.538 295.134 871.538 294.806 896.538 294.624 921.538 294.501
 946.538 294.415 971.538 294.408 996.538 294.4621021.538 294.4741046.538 294.401
1071.538 294.3541096.538 294.4871121.538 294.8421146.538 295.3811166.057  291.71
 1166.06 291.7091169.162  290.991172.446  290.521176.525  290.631180.207  290.56
 1183.81  290.651186.847  290.571191.506   290.31195.964   290.51199.462  291.03
1200.986  291.371205.257  291.54 1205.26 291.5411221.538 295.3881246.538 295.273
1271.538 295.2871296.538 295.2911321.538 295.4051346.538 295.7141371.538 296.106
1396.538 296.3111421.538 296.4981446.538 296.6591471.538 296.917

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08 1166.06    .035 1205.26     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       1166.06 1205.26           75.842  69.884  68.709             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  1144.6  294.41       F
  1223.41471.538  294.41       F

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 18487

INPUT
Description:
Station Elevation Data    num=      46
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     297  98.503     297 113.908   296.5 132.537     296 169.868   295.5
  302.46   295.5 391.887     295 566.511     295  571.69   294.5 576.423   294.5
 577.631     295 579.504   295.5  581.84     296 584.452     296 587.351   295.5
 746.106   295.5 752.947     296 756.237     296 758.628   295.5 787.793   295.5
 788.504     295 809.899   294.5  844.55   294.5 856.954     294  864.07     294
1020.534     2941035.995   293.51049.813     2931159.854     2931161.393   292.5
1163.008     2921164.462   291.51172.416 290.3771187.416 290.377 1195.37   291.5
1199.022     2921200.957   292.51204.017     293 1212.52   293.51214.669     294
1216.327   294.51221.593     2951228.261   295.51379.555     2961398.045   296.5
```

```
1435.503   296.5

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .081159.854    .0351204.017     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      1159.8541204.017               71  71.019  76.092             .1       .3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 18416

INPUT
Description:
Station Elevation Data    num=      52
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     297  48.113   296.5  68.211   296.5 143.736   296.5 221.889   296.5
  230.56   296.5 238.204     296 247.019   295.5  391.06     295 393.241     295
 433.909     295 462.384   294.5 465.706   294.5 507.854   294.5 530.247     295
 531.102   295.5 534.935   295.5 536.811     295 620.003     295 641.114   294.5
 658.547   294.5 665.358     294 762.395     294 779.721   293.5 885.951   293.5
 891.634     294 923.393     294 936.205   293.5 956.277     293 971.779     293
 991.358   293.51098.258   293.51099.057     2931099.815   292.51101.174     292
1107.469   291.51111.253 290.4471119.253 290.4481123.038   291.51124.423     292
 1133.84   292.51138.213     293 1145.44   293.51149.333   293.51151.288     294
1153.373   294.51154.346     2951155.523   295.51185.924     2961200.333   296.5
1264.707   296.51377.316     297

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .081098.258    .035 1145.44     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      1098.258 1145.44              405     421     355             .1       .3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 17995

INPUT
Description:
Station Elevation Data    num=      17
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    1000   298.5 1022.22   293.5 1062.34     293 1091.82     293  1163.7     293
 1173.32     293 1230.44     293 1241.81   291.5 1243.67   291.5 1246.74   290.1
 1270.74   290.1 1273.63   291.5 1275.02   291.5 1277.57     293 1284.26     294
 1290.67     297 1350.74     297

Manning's n Values        num=       3
```

```
     Sta   n Val     Sta   n Val     Sta   n Val
    1000     .08 1243.67    .035 1273.63     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       1243.67 1273.63              305     349     325             .1       .3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 17546

INPUT
Description:
Station Elevation Data    num=      24
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    1000     299 1066.85   298.5 1089.52     293 1100.95     292 1116.99     292
 1132.37     292 1136.72   292.5 1172.44   292.5 1183.19     293 1191.89     292
 1193.83   291.3 1197.34   289.7 1211.34   289.7 1214.36   291.1 1224.56     292
 1234.54   293.5 1242.03   294.5 1255.04     295 1323.82     295 1338.81   295.5
 1358.54     297 1373.24     297 1388.01   296.5 1479.34   296.5

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    1000     .08 1193.83    .035 1214.36     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       1193.83 1214.36              270     359     359             .1       .3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 17187

INPUT
Description:
Station Elevation Data    num=      12
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    1000   300.5  1029.7   299.5 1062.52   290.7  1065.7   289.4  1097.7   289.4
  1099.6   290.6 1105.34     292 1125.54   292.5 1224.25     293 1255.09   293.5
 1280.95     294  1348.7   295.5

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    1000     .06 1062.52    .04  1099.6     .06

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       1062.52  1099.6              223     240     236             .3       .5

CROSS SECTION


RIVER: RIVER-1
```

```
Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    1000     .06    1022     .04    1059     .06

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          1022    1059                1       1       1             .3       .5

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 0.1

INPUT
Description:
Station Elevation Data    num=       9
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    1000   288.5    1022   275.5    1024   274.1    1056   274.1    1059   275.5
    1077     277    1152   277.5    1297     280    1352   284.5

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    1000     .06    1022     .04    1059     .06

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          1022    1059                14      14      14             .3       .5



SUMMARY OF MANNING'S N VALUES

River:RIVER-1

      Reach          River Sta.       n1        n2        n3        n4        n5        n6        n7        n8        n9        n10

 Reach-1              73584              .06       .04       .06
 Reach-1              73509              .06       .04       .06
 Reach-1              73504        Bridge
 Reach-1              73499              .06       .04       .06
 Reach-1              73456              .06       .04       .06
 Reach-1              73181              .06       .04       .06
 Reach-1              72326              .06       .04       .06
 Reach-1              71741              .06       .04       .06
 Reach-1              70297              .06       .04       .06
 Reach-1              69979              .06       .04       .06
 Reach-1              69929              .06       .04       .06
 Reach-1              69923.5      Bridge
 Reach-1              69918              .06       .04       .06
 Reach-1              69883              .06       .04       .06
 Reach-1              68850              .06       .04       .06
 Reach-1              68041              .06       .04       .06
 Reach-1              67000              .06       .04       .06
 Reach-1              66442              .06       .04       .06
```

Reach-1	24348	.06	.04	.06
Reach-1	23888	.06	.04	.06
Reach-1	23500	.06	.04	.06
Reach-1	22900	.06	.04	.06
Reach-1	22315	.06	.04	.06
Reach-1	22202	.06	.04	.06
Reach-1	22195	Bridge		
Reach-1	22192	.06	.04	.06
Reach-1	21930	.06	.04	.06
Reach-1	20736	.08	.035	.08
Reach-1	19835	.08	.035	.08
Reach-1	19359	.08	.035	.08
Reach-1	18720	.08	.035	.08
Reach-1	18645	.08	.035	.08
Reach-1	18570	.08	.035	.08
Reach-1	18564	Bridge		
Reach-1	18558	.08	.035	.08
Reach-1	18487	.08	.035	.08
Reach-1	18416	.08	.035	.08
Reach-1	17995	.08	.035	.08
Reach-1	17546	.08	.035	.08
Reach-1	17187	.06	.04	.06
Reach-1	16947	.06	.04	.06
Reach-1	16859	.06	.04	.06
Reach-1	16855	Bridge		
Reach-1	16850	.06	.04	.06
Reach-1	16612	.06	.04	.06
Reach-1	16084	.06	.04	.06
Reach-1	15077	.06	.04	.06
Reach-1	13725	.06	.04	.06
Reach-1	13116	.06	.04	.06
Reach-1	12382	.06	.04	.06
Reach-1	12310	.06	.04	.06
Reach-1	12305	Bridge		
Reach-1	12304	.06	.04	.06
Reach-1	11825	.06	.04	.06
Reach-1	11368	.06	.04	.06
Reach-1	11068	.06	.04	.06
Reach-1	10988	.06	.04	.06
Reach-1	10953	.06	.04	.06
Reach-1	10903	.06	.04	.06
Reach-1	10863	.06	.04	.06
Reach-1	10826	.06	.04	.06
Reach-1	10825	Bridge		
Reach-1	10820	.06	.04	.06
Reach-1	10780	.06	.04	.06
Reach-1	10745	.06	.04	.06
Reach-1	10690	.06	.04	.06
Reach-1	10671	.06	.04	.06
Reach-1	10570	.06	.04	.06
Reach-1	10550	Bridge		
Reach-1	10536	.06	.04	.06
Reach-1	10443	.06	.04	.06
Reach-1	9727	.06	.04	.06

SUMMARY OF REACH LENGTHS

River: RIVER-1

Reach	River Sta.	Left	Channel	Right
Reach-1	73584	50	71	130
Reach-1	73509	10	10	10
Reach-1	73504	Bridge		
Reach-1	73499	52	43	34
Reach-1	73456	300	275	100
Reach-1	73181	600	855	380
Reach-1	72326	360	585	610
Reach-1	71741	560	1445	1380
Reach-1	70297	306	327	240
Reach-1	69979	48	44	25
Reach-1	69929	11	11	11
Reach-1	69923.5	Bridge		
Reach-1	69918	35	35	35
Reach-1	69883	1060	1060	670
Reach-1	68850	860	810	540
Reach-1	68041	840	1040	1040
Reach-1	67000	220	555	555
Reach-1	66442	230	215	150
Reach-1	66227	3.6	3.6	3.6
Reach-1	66225	Bridge		
Reach-1	66223	300	451	380
Reach-1	65772	530	628	530
Reach-1	65144	200	206	210
Reach-1	64938	200	252	225
Reach-1	64682	6	6	6
Reach-1	64679	Bridge		
Reach-1	64676	40	33	45
Reach-1	64643	710	706	480
Reach-1	63937	630	627	300
Reach-1	63310	180	314	260
Reach-1	62996	45	47	120
Reach-1	62949	10	10	10
Reach-1	62944	Bridge		
Reach-1	62939	100	71	30
Reach-1	62868	345	350	350
Reach-1	62518	220	348	370
Reach-1	62170	235	490	490
Reach-1	61680	470	468	320
Reach-1	61212	980	982	650
Reach-1	60230	46	85	170
Reach-1	60145	5	5	5
Reach-1	60140	75	54	90
Reach-1	60086	310	318	150
Reach-1	59768	39	69	109
Reach-1	59720	40	40	40
Reach-1	59700	Bridge		
Reach-1	59680	20	20	20

Reach-1	30340	13	13	13
Reach-1	30335	Bridge		
Reach-1	30329	80	62	60
Reach-1	30267	280	259	205
Reach-1	30009	285	153	1
Reach-1	29855	155	119	175
Reach-1	29736	12	12	12
Reach-1	29730	Bridge		
Reach-1	29726	50	56	70
Reach-1	29650	285	438	438
Reach-1	29212	562	562	615
Reach-1	28650	1	91	195
Reach-1	28559	305	392	325
Reach-1	28167	467	479	190
Reach-1	27688	100	152	95
Reach-1	27536	8	8	8
Reach-1	27533	Bridge		
Reach-1	27530	130	154	120
Reach-1	27396	439	426	485
Reach-1	27070	440	439	380
Reach-1	26631	460	421	260
Reach-1	26210	400	314	180
Reach-1	25880	300	536	310
Reach-1	25344	205	444	492
Reach-1	24900	255	552	552
Reach-1	24348	510	460	425
Reach-1	23888	485	398	345
Reach-1	23500	580	624	460
Reach-1	22900	490	551	480
Reach-1	22315	185	113	200
Reach-1	22202	12	12	12
Reach-1	22195	Bridge		
Reach-1	22192	105	262	175
Reach-1	21930	970	1194	970
Reach-1	20736	752	901	580
Reach-1	19835	410	476	360
Reach-1	19359	690	724	380
Reach-1	18720	1126.956	116.395	25.372
Reach-1	18645	168.606	74.031	69.788
Reach-1	18570	126.814	20.696	35.209
Reach-1	18564	Bridge		
Reach-1	18558	75.842	69.884	68.709
Reach-1	18487	71	71.019	76.092
Reach-1	18416	405	421	355
Reach-1	17995	305	349	325
Reach-1	17546	270	359	359
Reach-1	17187	223	240	236
Reach-1	16947	90	88	92
Reach-1	16859	11	11	11
Reach-1	16855	Bridge		
Reach-1	16850	205	238	250
Reach-1	16612	350	528	315
Reach-1	16084	1007	1007	1007
Reach-1	15077	1352	1352	1352

Reach-1	1685		7.4	7.4	7.4
Reach-1	1682	Bridge			
Reach-1	1680		50	50	50
Reach-1	1632		60	123	155
Reach-1	1509		230	305	175
Reach-1	1204		206	309	265
Reach-1	895		232	230	199
Reach-1	665		315	334	320
Reach-1	331		47	69	49
Reach-1	262		7	7	7
Reach-1	260	Bridge			
Reach-1	257		115	117	116
Reach-1	140		105	140	165
Reach-1	1		15	15	15
Reach-1	0.23	Bridge			
Reach-1	0.2		15	15	15
Reach-1	0.15		1	1	1
Reach-1	0.14		1	1	1
Reach-1	0.13		1	1	1
Reach-1	0.12		1	1	1
Reach-1	0.11		1	1	1
Reach-1	0.1		14	14	14

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: RIVER-1

Reach	River Sta.	Contr.	Expan.
Reach-1	73584	.3	.5
Reach-1	73509	.3	.5
Reach-1	73504	Bridge	
Reach-1	73499	.3	.5
Reach-1	73456	.3	.5
Reach-1	73181	.3	.5
Reach-1	72326	.3	.5
Reach-1	71741	.3	.5
Reach-1	70297	.3	.5
Reach-1	69979	.3	.5
Reach-1	69929	.3	.5
Reach-1	69923.5	Bridge	
Reach-1	69918	.3	.5
Reach-1	69883	.3	.5
Reach-1	68850	.3	.5
Reach-1	68041	.3	.5
Reach-1	67000	.3	.5
Reach-1	66442	.3	.5
Reach-1	66227	.3	.5
Reach-1	66225	Bridge	
Reach-1	66223	.3	.5
Reach-1	65772	.3	.5

Reach-1	22315		.3	.5
Reach-1	22202		.3	.5
Reach-1	22195	Bridge		
Reach-1	22192		.3	.5
Reach-1	21930		.3	.5
Reach-1	20736		.1	.3
Reach-1	19835		.1	.3
Reach-1	19359		.1	.3
Reach-1	18720		.1	.3
Reach-1	18645		.3	.5
Reach-1	18570		.3	.5
Reach-1	18564	Bridge		
Reach-1	18558		.3	.5
Reach-1	18487		.1	.3
Reach-1	18416		.1	.3
Reach-1	17995		.1	.3
Reach-1	17546		.1	.3
Reach-1	17187		.3	.5
Reach-1	16947		.3	.5
Reach-1	16859		.3	.5
Reach-1	16855	Bridge		
Reach-1	16850		.3	.5
Reach-1	16612		.3	.5
Reach-1	16084		.3	.5
Reach-1	15077		.3	.5
Reach-1	13725		.3	.5
Reach-1	13116		.3	.5
Reach-1	12382		.3	.5
Reach-1	12310		.3	.5
Reach-1	12305	Bridge		
Reach-1	12304		.3	.5
Reach-1	11825		.3	.5
Reach-1	11368		.3	.5
Reach-1	11068		.1	.3
Reach-1	10988		.1	.3
Reach-1	10953		.1	.3
Reach-1	10903		.3	.5
Reach-1	10863		.1	.3
Reach-1	10826		.3	.5
Reach-1	10825	Bridge		
Reach-1	10820		.3	.5
Reach-1	10780		.1	.3
Reach-1	10745		.1	.3
Reach-1	10690		.1	.3
Reach-1	10671		.3	.5
Reach-1	10570		.3	.5
Reach-1	10550	Bridge		
Reach-1	10536		.3	.5
Reach-1	10443		.3	.5
Reach-1	9727		.3	.5
Reach-1	9160		.3	.5
Reach-1	9087		.3	.5
Reach-1	9080	Bridge		
Reach-1	9077		.3	.5

Reach-1	9024		.3	.5
Reach-1	8887		.3	.5
Reach-1	8570		.3	.5
Reach-1	8288		.3	.5
Reach-1	8278		.3	.5
Reach-1	8000		.3	.5
Reach-1	7474		.3	.5
Reach-1	7059		.3	.5
Reach-1	5736		.3	.5
Reach-1	5163		.3	.5
Reach-1	4905		.3	.5
Reach-1	4861.5		.3	.5
Reach-1	4858		.3	.5
Reach-1	4780		.3	.5
Reach-1	4514		.3	.5
Reach-1	4188		.3	.5
Reach-1	3976		.3	.5
Reach-1	3942		.3	.5
Reach-1	3935	Bridge		
Reach-1	3930		.3	.5
Reach-1	3830		.3	.5
Reach-1	3387		.3	.5
Reach-1	2822		.3	.5
Reach-1	2262		.3	.5
Reach-1	1733		.3	.5
Reach-1	1685		.3	.5
Reach-1	1682	Bridge		
Reach-1	1680		.3	.5
Reach-1	1632		.3	.5
Reach-1	1509		.3	.5
Reach-1	1204		.3	.5
Reach-1	895		.3	.5
Reach-1	665		.3	.5
Reach-1	331		.3	.5
Reach-1	262		.3	.5
Reach-1	260	Bridge		
Reach-1	257		.3	.5
Reach-1	140		.3	.5
Reach-1	1		.3	.5
Reach-1	0.23	Bridge		
Reach-1	0.2		.1	.3
Reach-1	0.15		.3	.5
Reach-1	0.14		.3	.5
Reach-1	0.13		.3	.5
Reach-1	0.12		.3	.5
Reach-1	0.11		.3	.5
Reach-1	0.1		.3	.5

Profile Output Table - Standard Table 1

Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl

PROPOSED CONDITIONS

Reach-1	22202	20 yr	416.00	293.20	296.94	295.34	297.07	0.001152	1.69	338.08	253.70	0.31
Reach-1	22202	100 yr	526.00	293.20	297.19	295.60	297.34	0.001321	1.89	404.38	289.19	0.34
Reach-1	22202	Reg	923.00	293.20	298.04	296.62	298.18	0.001243	2.07	874.91	769.69	0.33
Reach-1	22195		Bridge									
Reach-1	22192	20 yr	416.00	293.20	296.80		296.95	0.001407	1.82	303.10	232.79	0.34
Reach-1	22192	100 yr	526.00	293.20	296.99		297.18	0.001725	2.09	350.34	260.62	0.38
Reach-1	22192	Reg	923.00	293.20	297.82		298.04	0.001833	2.44	711.10	739.91	0.40
Reach-1	21930	20 yr	416.00	293.00	296.50		296.60	0.001586	2.16	598.87	850.04	0.38
Reach-1	21930	100 yr	526.00	293.00	296.78		296.84	0.001023	1.84	839.24	854.42	0.31
Reach-1	21930	Reg	923.00	293.00	297.78		297.80	0.000381	1.32	1692.08	860.78	0.20
Reach-1	20736	20 yr	416.00	292.70	296.06		296.07	0.000220	0.94	1502.29	1027.96	0.16
Reach-1	20736	100 yr	526.00	292.70	296.46		296.47	0.000171	0.89	1912.16	1047.80	0.15
Reach-1	20736	Reg	923.00	292.70	297.59		297.60	0.000119	0.89	3139.23	1122.89	0.13
Reach-1	19835	20 yr	416.00	291.80	295.94		295.95	0.000145	0.87	1585.94	808.65	0.14
Reach-1	19835	100 yr	526.00	291.80	296.35		296.36	0.000127	0.86	1923.77	813.71	0.13
Reach-1	19835	Reg	923.00	291.80	297.51		297.52	0.000110	0.94	2869.97	822.47	0.13
Reach-1	19359	20 yr	416.00	291.20	295.75		295.83	0.000507	1.74	620.44	312.07	0.26
Reach-1	19359	100 yr	526.00	291.20	296.17		296.26	0.000508	1.85	758.41	337.40	0.27
Reach-1	19359	Reg	923.00	291.20	297.33		297.42	0.000502	2.11	1160.67	355.90	0.27
Reach-1	18720	20 yr	416.00	290.10	295.32		295.44	0.000849	2.20	467.74	206.33	0.33
Reach-1	18720	100 yr	526.00	290.10	295.73		295.86	0.000873	2.37	573.43	309.61	0.34
Reach-1	18720	Reg	923.00	290.10	296.93		297.06	0.000763	2.57	993.25	374.18	0.33
Reach-1	18645	20 yr	416.00	290.21	295.28		295.31	0.000302	1.22	944.42	592.07	0.20
Reach-1	18645	100 yr	526.00	290.21	295.70		295.73	0.000264	1.22	1230.88	822.76	0.19
Reach-1	18645	Reg	923.00	290.21	296.90		296.92	0.000172	1.16	2804.48	1488.39	0.16
Reach-1	18570	20 yr	416.00	290.30	295.02	293.03	295.22	0.000827	2.15	354.46	345.71	0.33
Reach-1	18570	100 yr	526.00	290.30	295.41	293.40	295.63	0.000858	2.32	509.97	488.71	0.34
Reach-1	18570	Reg	923.00	290.30	296.71	295.15	296.85	0.000567	2.22	1516.39	1216.69	0.29
Reach-1	18564		Bridge									
Reach-1	18558	20 yr	416.00	290.30	294.97	293.03	295.18	0.000881	2.20	336.92	338.94	0.34
Reach-1	18558	100 yr	526.00	290.30	295.36	293.40	295.58	0.000870	2.32	484.02	467.22	0.35
Reach-1	18558	Reg	923.00	290.30	296.56	295.15	296.75	0.000705	2.44	1345.20	1171.96	0.32
Reach-1	18487	20 yr	416.00	290.38	294.99		295.07	0.000497	1.55	648.50	443.40	0.25
Reach-1	18487	100 yr	526.00	290.38	295.39		295.46	0.000430	1.54	910.28	695.82	0.24
Reach-1	18487	Reg	923.00	290.38	296.61		296.65	0.000248	1.39	2332.97	1324.91	0.19
Reach-1	18416	20 yr	416.00	290.45	294.97		295.02	0.000549	1.40	786.67	626.33	0.25
Reach-1	18416	100 yr	526.00	290.45	295.38		295.42	0.000443	1.37	1111.56	868.25	0.23
Reach-1	18416	Reg	923.00	290.45	296.59		296.63	0.000270	1.31	2280.51	1246.98	0.19
Reach-1	17995	20 yr	416.00	290.10	294.67		294.78	0.000605	1.87	525.35	268.66	0.28
Reach-1	17995	100 yr	526.00	290.10	295.09		295.20	0.000587	1.96	640.16	271.46	0.28

PROPOSED CONDITIONS

Profile Output Table - Standard Table 2

Reach	River Sta	Profile	E.G. Elev (m)	W.S. Elev (m)	Vel Head (m)	Frctn Loss (m)	C & E Loss (m)	Q Left (m3/s)	Q Channel (m3/s)	Q Right (m3/s)	Top Width (m)
Reach-1	73584	20 yr	340.55	340.52	0.03	0.03	0.11	229.78	139.10	10.12	350.44
Reach-1	73584	100 yr	341.44	341.42	0.02	0.02	0.06	358.16	151.00	12.84	383.54
Reach-1	73584	Reg	342.63	342.60	0.03	0.02	0.04	690.31	211.52	21.17	406.20
Reach-1	73509	20 yr	340.41	340.01	0.40	0.00	0.02		379.00		86.56
Reach-1	73509	100 yr	341.36	341.13	0.23	0.00	0.14	123.54	398.46		283.54
Reach-1	73509	Reg	342.57	342.40	0.17	0.00	0.02	439.19	483.81		347.76
Reach-1	73504 Erbs Road	Bridge									
Reach-1	73499	20 yr	340.32	339.90	0.41	0.03	0.18		379.00		84.29
Reach-1	73499	100 yr	340.94	340.68	0.26	0.03	0.10	128.73	393.27		177.88
Reach-1	73499	Reg	342.47	342.28	0.19	0.02	0.06	418.42	498.58	6.00	347.32
Reach-1	73456	20 yr	340.11	340.05	0.06	0.09	0.02	157.77	201.94	19.29	209.69
Reach-1	73456	100 yr	340.81	340.75	0.06	0.07	0.02	253.80	240.67	27.53	211.17
Reach-1	73456	Reg	342.39	342.32	0.07	0.06	0.03	526.60	344.42	51.98	214.49
Reach-1	73181	20 yr	340.00	339.98	0.02	0.15	0.00	269.03	97.52	12.45	389.37
Reach-1	73181	100 yr	340.72	340.70	0.02	0.11	0.00	400.24	106.31	15.45	390.88
Reach-1	73181	Reg	342.30	342.28	0.02	0.08	0.00	759.56	138.05	25.39	394.21
Reach-1	72326	20 yr	339.85	339.81	0.03	0.11	0.01	15.48	125.35	238.17	339.67
Reach-1	72326	100 yr	340.60	340.57	0.03	0.10	0.00	13.61	136.34	372.05	433.63
Reach-1	72326	Reg	342.23	342.21	0.02	0.08	0.00	90.45	160.85	671.70	473.01
Reach-1	71741	20 yr	339.73	339.70	0.02	0.17	0.00	146.50	129.07	103.44	236.40
Reach-1	71741	100 yr	340.50	340.48	0.03	0.16	0.00	203.76	157.07	161.18	240.20
Reach-1	71741	Reg	342.14	342.11	0.04	0.16	0.01	365.23	232.81	324.96	248.22
Reach-1	70297	20 yr	339.56	339.54	0.02	0.05	0.01	27.66	127.86	223.48	341.58
Reach-1	70297	100 yr	340.34	340.32	0.02	0.05	0.01	32.60	149.88	339.52	366.47
Reach-1	70297	Reg	341.98	341.96	0.02	0.05	0.02	65.73	207.75	649.52	429.37
Reach-1	69979	20 yr	339.50	339.45	0.05	0.02	0.04	176.30	179.79	22.90	136.82
Reach-1	69979	100 yr	340.28	340.22	0.06	0.02	0.06	259.70	228.31	34.00	139.34
Reach-1	69979	Reg	341.91	341.82	0.09	0.02	0.02	495.52	357.95	69.54	144.59
Reach-1	69929	20 yr	339.44	339.24	0.19	0.00	0.01		379.00		148.43
Reach-1	69929	100 yr	340.20	339.93	0.27	0.00	0.02		522.00		180.45
Reach-1	69929	Reg	341.87	341.71	0.16	0.00	0.05	262.66	660.34		287.73
Reach-1	69923.5 Naftziger Rd.	Bridge									
Reach-1	69918	20 yr	339.40	339.20	0.20	0.02	0.07		379.00		146.34
Reach-1	69918	100 yr	340.13	339.85	0.28	0.02	0.11		522.00		176.68
Reach-1	69918	Reg	341.64	341.44	0.19	0.02	0.07	241.65	681.35		266.39

PROPOSED CONDITIONS

Reach-1	22900	Reg	298.81	298.76	0.06	0.46	0.00	637.01	84.26	201.73	631.79
Reach-1	22315	20 yr	297.28	297.13	0.15	0.20	0.02	112.53	192.50	110.96	624.07
Reach-1	22315	100 yr	297.54	297.45	0.09	0.19	0.02	173.86	183.20	168.94	657.43
Reach-1	22315	Reg	298.35	298.30	0.05	0.14	0.03	350.75	183.38	388.87	774.11
Reach-1	22202	20 yr	297.07	296.94	0.12	0.00	0.03		340.79	75.21	253.70
Reach-1	22202	100 yr	297.34	297.19	0.15	0.00	0.04		411.73	114.28	289.19
Reach-1	22202	Reg	298.18	298.04	0.14	0.00	0.03	33.24	573.14	316.62	769.69
Reach-1	22195		Bridge								
Reach-1	22192	20 yr	296.95	296.80	0.14	0.32	0.03		349.19	66.81	232.79
Reach-1	22192	100 yr	297.18	296.99	0.18	0.27	0.07		427.25	98.75	260.62
Reach-1	22192	Reg	298.04	297.82	0.22	0.14	0.10	12.64	639.26	271.11	739.91
Reach-1	21930	20 yr	296.60	296.50	0.09	0.48	0.04	115.27	146.34	154.40	850.04
Reach-1	21930	100 yr	296.84	296.78	0.05	0.35	0.02	189.44	134.81	201.75	854.42
Reach-1	21930	Reg	297.80	297.78	0.02	0.20	0.01	443.64	123.77	355.59	860.78
Reach-1	20736	20 yr	296.07	296.06	0.01	0.13	0.00	74.34	87.48	254.18	1027.96
Reach-1	20736	100 yr	296.47	296.46	0.01	0.10	0.00	98.35	92.95	334.70	1047.80
Reach-1	20736	Reg	297.60	297.59	0.01	0.08	0.00	172.28	120.46	630.27	1122.89
Reach-1	19835	20 yr	295.95	295.94	0.01	0.10	0.01	285.13	66.05	64.81	808.65
Reach-1	19835	100 yr	296.36	296.35	0.01	0.10	0.01	372.46	72.86	80.68	813.71
Reach-1	19835	Reg	297.52	297.51	0.01	0.09	0.01	685.10	99.65	138.24	822.47
Reach-1	19359	20 yr	295.83	295.75	0.08	0.39	0.00	143.91	206.07	66.02	312.07
Reach-1	19359	100 yr	296.26	296.17	0.09	0.39	0.01	205.66	239.38	80.97	337.40
Reach-1	19359	Reg	297.42	297.33	0.09	0.36	0.00	454.67	338.18	130.16	355.90
Reach-1	18720	20 yr	295.44	295.32	0.13	0.10	0.03	9.57	194.66	211.77	206.33
Reach-1	18720	100 yr	295.86	295.73	0.14	0.10	0.03	8.50	228.65	288.86	309.61
Reach-1	18720	Reg	297.06	296.93	0.13	0.11	0.03	91.02	308.77	523.21	374.18
Reach-1	18645	20 yr	295.31	295.28	0.04	0.04	0.05	99.54	199.23	117.23	592.07
Reach-1	18645	100 yr	295.73	295.70	0.03	0.04	0.06	146.56	221.44	158.00	822.76
Reach-1	18645	Reg	296.92	296.90	0.02	0.03	0.04	390.70	268.90	263.41	1488.39
Reach-1	18570	20 yr	295.22	295.02	0.20	0.01	0.01	43.94	359.01	13.05	345.71
Reach-1	18570	100 yr	295.63	295.41	0.22	0.01	0.00	94.57	423.78	7.65	488.71
Reach-1	18570	Reg	296.85	296.71	0.14	0.01	0.04	322.05	518.65	82.30	1216.69
Reach-1	18564		Bridge								
Reach-1	18558	20 yr	295.18	294.97	0.22	0.05	0.07	40.02	363.04	12.94	338.94
Reach-1	18558	100 yr	295.58	295.36	0.22	0.04	0.08	90.14	418.42	17.44	467.22
Reach-1	18558	Reg	296.75	296.56	0.19	0.03	0.07	290.51	555.40	77.10	1171.96
Reach-1	18487	20 yr	295.07	294.99	0.08	0.04	0.01	145.70	264.27	6.02	443.40
Reach-1	18487	100 yr	295.46	295.39	0.07	0.03	0.01	227.88	289.84	8.28	695.82
Reach-1	18487	Reg	296.65	296.61	0.04	0.02	0.00	552.72	335.21	35.07	1324.91

PROPOSED CONDITIONS

Reach-1	18416	20 yr	295.02	294.97	0.05	0.24	0.01	208.63	204.34	3.03	626.33
Reach-1	18416	100 yr	295.42	295.38	0.04	0.21	0.01	296.10	225.54	4.36	868.25
Reach-1	18416	Reg	296.63	296.59	0.03	0.15	0.01	625.14	290.17	7.69	1246.98
Reach-1	17995	20 yr	294.78	294.67	0.11	0.30	0.01	160.34	248.10	7.56	268.66
Reach-1	17995	100 yr	295.20	295.09	0.11	0.29	0.02	230.53	284.77	10.71	271.46
Reach-1	17995	Reg	296.46	296.34	0.12	0.28	0.02	491.96	407.96	23.08	279.64
Reach-1	17546	20 yr	294.47	294.22	0.25	0.35	0.03	139.81	246.48	29.71	155.45
Reach-1	17546	100 yr	294.90	294.63	0.27	0.35	0.04	196.75	290.57	38.69	162.47
Reach-1	17546	Reg	296.16	295.85	0.31	0.31	0.05	401.42	422.88	98.70	265.71
Reach-1	17187	20 yr	294.08	293.95	0.14	0.07	0.05	12.30	308.60	95.10	227.69
Reach-1	17187	100 yr	294.51	294.37	0.14	0.08	0.05	16.82	353.79	155.39	248.78
Reach-1	17187	Reg	295.80	295.67	0.13	0.08	0.03	34.42	477.22	411.36	304.73
Reach-1	16947	20 yr	293.96	293.92	0.04	0.03	0.06	16.71	378.74	20.54	250.32
Reach-1	16947	100 yr	294.38	294.34	0.04	0.04	0.09	27.52	459.07	39.41	259.59
Reach-1	16947	Reg	295.69	295.63	0.06	0.04	0.09	73.89	717.64	131.46	297.52
Reach-1	16859	20 yr	293.86	293.61	0.25	0.00	0.01		415.93	0.07	63.34
Reach-1	16859	100 yr	294.26	293.91	0.34	0.00	0.02		523.16	2.84	104.58
Reach-1	16859	Reg	295.55	295.17	0.38	0.00	0.05	0.69	779.87	142.44	294.19
Reach-1	16855		Bridge								
Reach-1	16850	20 yr	293.80	293.54	0.26	0.37	0.06		415.99	0.01	54.63
Reach-1	16850	100 yr	294.18	293.82	0.36	0.43	0.11		524.54	1.46	91.67
Reach-1	16850	Reg	295.31	294.76	0.56	0.50	0.19	0.00	841.36	81.64	250.54
Reach-1	16612	20 yr	293.37	293.23	0.13	0.56	0.01	96.36	149.85	169.78	243.08
Reach-1	16612	100 yr	293.64	293.49	0.15	0.55	0.02	123.88	171.68	230.45	255.97
Reach-1	16612	Reg	294.62	294.45	0.17	0.47	0.04	236.33	244.04	442.63	394.87
Reach-1	16084	20 yr	292.80	292.68	0.12	0.83	0.02	177.46	195.84	45.70	308.47
Reach-1	16084	100 yr	293.07	292.96	0.11	0.75	0.02	244.11	213.70	60.19	311.45
Reach-1	16084	Reg	294.11	294.01	0.10	0.59	0.02	519.95	278.30	124.75	380.21
Reach-1	15077	20 yr	291.95	291.87	0.08	0.76	0.01	146.44	267.26	5.30	378.19
Reach-1	15077	100 yr	292.29	292.22	0.07	0.67	0.01	221.32	289.26	7.42	382.15
Reach-1	15077	Reg	293.50	293.44	0.06	0.54	0.00	522.08	382.20	18.72	424.89
Reach-1	13725	20 yr	291.18	291.13	0.06	0.31	0.00	13.20	192.68	213.12	265.42
Reach-1	13725	100 yr	291.62	291.56	0.06	0.27	0.00	19.83	213.57	284.60	271.58
Reach-1	13725	Reg	292.96	292.90	0.06	0.25	0.00	53.14	302.22	567.64	290.49
Reach-1	13116	20 yr	290.87	290.82	0.05	0.42	0.01	104.58	145.22	169.20	238.19
Reach-1	13116	100 yr	291.34	291.29	0.05	0.36	0.00	133.73	160.85	223.42	240.58
Reach-1	13116	Reg	292.71	292.65	0.06	0.32	0.00	256.37	237.77	428.86	259.17
Reach-1	12382	20 yr	290.45	290.38	0.07	0.05	0.03	11.78	170.45	236.78	234.96
Reach-1	12382	100 yr	290.98	290.91	0.07	0.05	0.05	15.87	188.23	313.90	260.66
Reach-1	12382	Reg	292.40	292.33	0.07	0.05	0.08	32.32	255.95	634.74	291.48

Reach-1	0.11		Reg	280.20	280.00	0.20	0.00	0.00	14.01	540.57	368.42	282.45
Reach-1	0.1		20 yr	278.65	278.48	0.17			4.67	326.22	88.11	191.78
Reach-1	0.1		100 yr	279.03	278.85	0.18			6.40	374.83	136.77	214.03
Reach-1	0.1		Reg	280.20	280.00	0.20			14.00	540.70	368.29	282.37

Profile Output Table - Six XS Bridge

Reach	River Sta			Profile	E.G. Elev (m)	W.S. Elev (m)	Crit W.S. (m)	Frctn Loss (m)	C & E Loss (m)	Top Width (m)	Q Left (m3/s)	Q Channel (m3/s)	Q Right (m3/s)	Vel Chnl (m/s)
Reach-1	73584			20 yr	340.55	340.52	338.49	0.03	0.11	350.44	229.78	139.10	10.12	1.15
Reach-1	73584			100 yr	341.44	341.42	339.13	0.02	0.06	383.54	358.16	151.00	12.84	1.07
Reach-1	73584			Reg	342.63	342.60	339.67	0.02	0.04	406.20	690.31	211.52	21.17	1.26
Reach-1	73509			20 yr	340.41	340.01	337.51	0.00	0.02	86.56		379.00		2.79
Reach-1	73509			100 yr	341.36	341.13	338.25	0.00	0.14	283.54	123.54	398.46		2.39
Reach-1	73509			Reg	342.57	342.40	339.94	0.00	0.02	347.76	439.19	483.81		2.40
Reach-1	73504	Erbs Road	BR U	20 yr	340.38	339.92	337.65	0.03	0.00	26.28		379.00		3.01
Reach-1	73504	Erbs Road	BR U	100 yr	341.22	340.53	338.41	0.05	0.01	61.95	0.08	521.92		3.68
Reach-1	73504	Erbs Road	BR U	Reg	342.55	342.33	341.66	0.04	0.01	302.36	499.46	423.54		2.70
Reach-1	73504	Erbs Road	BR D	20 yr	340.35	339.88	337.65	0.00	0.03	26.29		379.00		3.04
Reach-1	73504	Erbs Road	BR D	100 yr	341.16	340.45	338.41	0.00	0.23	26.25		522.00		3.73
Reach-1	73504	Erbs Road	BR D	Reg	342.50	342.25	341.66	0.00	0.03	298.30	475.83	447.17		2.85
Reach-1	73499			20 yr	340.32	339.90	337.51	0.03	0.18	84.29		379.00		2.85
Reach-1	73499			100 yr	340.94	340.68	338.25	0.03	0.10	177.88	128.73	393.27		2.55
Reach-1	73499			Reg	342.47	342.28	339.94	0.02	0.06	347.32	418.42	498.58	6.00	2.51
Reach-1	73456			20 yr	340.11	340.05		0.09	0.02	209.69	157.77	201.94	19.29	1.43
Reach-1	73456			100 yr	340.81	340.75		0.07	0.02	211.17	253.80	240.67	27.53	1.49
Reach-1	73456			Reg	342.39	342.32		0.06	0.03	214.49	526.60	344.42	51.98	1.67
Reach-1	69979			20 yr	339.50	339.45		0.02	0.04	136.82	176.30	179.79	22.90	1.27
Reach-1	69979			100 yr	340.28	340.22		0.02	0.06	139.34	259.70	228.31	34.00	1.44
Reach-1	69979			Reg	341.91	341.82		0.02	0.02	144.59	495.52	357.95	69.54	1.83
Reach-1	69929			20 yr	339.44	339.24	336.61	0.00	0.01	148.43		379.00		1.95
Reach-1	69929			100 yr	340.20	339.93	337.21	0.00	0.02	180.45		522.00		2.29
Reach-1	69929			Reg	341.87	341.71	338.51	0.00	0.05	287.73	262.66	660.34		2.07
Reach-1	69923.5	Naftziger Rd.	BR U	20 yr	339.43	339.20	336.71	0.02	0.00	46.15		379.00		2.09
Reach-1	69923.5	Naftziger Rd.	BR U	100 yr	340.18	339.86	337.33	0.03	0.00	32.99		522.00		2.51
Reach-1	69923.5	Naftziger Rd.	BR U	Reg	341.82	341.49	338.68	0.06	0.02	230.26	247.80	675.21		2.88
Reach-1	69923.5	Naftziger Rd.	BR D	20 yr	339.41	339.19	336.72	0.00	0.01	46.12		379.00		2.10
Reach-1	69923.5	Naftziger Rd.	BR D	100 yr	340.15	339.83	337.33	0.00	0.02	33.65		522.00		2.52
Reach-1	69923.5	Naftziger Rd.	BR D	Reg	341.74	341.35	338.69	0.00	0.10	215.54	207.16	715.84		3.08
Reach-1	69918			20 yr	339.40	339.20	336.61	0.02	0.07	146.34		379.00		1.97

PROPOSED CONDITIONS

Reach-1	29650		100 yr	304.80	304.70		0.35	0.03	372.08	183.19	168.61	179.20	2.22
Reach-1	29650		Reg	305.50	305.37		0.38	0.04	437.42	353.39	237.87	331.73	2.72
Reach-1	27688		20 yr	302.99	302.94		0.11	0.08	543.14	206.59	182.57	24.83	1.47
Reach-1	27688		100 yr	303.42	303.39		0.10	0.11	657.65	312.65	185.25	33.10	1.37
Reach-1	27688		Reg	304.35	304.31		0.07	0.05	761.67	634.22	229.68	59.10	1.45
Reach-1	27536		20 yr	302.80	302.48	300.54	0.00	0.00	117.73	0.25	413.75		2.52
Reach-1	27536		100 yr	303.22	302.80	300.95	0.00	0.00	260.30	16.84	514.16		2.90
Reach-1	27536		Reg	304.22	304.01	302.08	0.00	0.06	487.73	314.28	569.90	38.82	2.53
Reach-1	27533	BR U	20 yr	302.80	302.47	300.55	0.01	0.00	115.30	0.23	413.77		2.52
Reach-1	27533	BR U	100 yr	303.21	302.80	300.96	0.01	0.00	258.86	16.53	514.47		2.91
Reach-1	27533	BR U	Reg	304.17	304.07	303.37	0.02	0.00	489.83	496.19	362.52	64.29	1.82
Reach-1	27533	BR D	20 yr	302.79	302.46	300.55	0.00	0.00	100.69	0.13	413.87		2.53
Reach-1	27533	BR D	100 yr	303.20	302.77	300.96	0.00	0.00	247.97	14.24	516.76		2.94
Reach-1	27533	BR D	Reg	304.15	304.04	303.37	0.00	0.06	488.91	492.81	367.62	62.57	1.85
Reach-1	27530		20 yr	302.78	302.46		0.16	0.14	98.45	0.12	413.88		2.53
Reach-1	27530		100 yr	303.20	302.77	300.95	0.17	0.19	246.76	13.99	517.01		2.94
Reach-1	27530		Reg	304.09	303.79		0.15	0.12	478.80	270.71	626.95	25.34	2.90
Reach-1	27396		20 yr	302.49	302.44		0.31	0.02	287.69	209.26	105.54	101.20	1.74
Reach-1	27396		100 yr	302.84	302.78		0.33	0.03	291.51	281.44	117.29	127.27	1.79
Reach-1	27396		Reg	303.82	303.75		0.39	0.06	302.11	543.57	159.40	220.03	2.03
Reach-1	22315		20 yr	297.28	297.13		0.20	0.02	624.07	112.53	192.50	110.96	2.48
Reach-1	22315		100 yr	297.54	297.45		0.19	0.02	657.43	173.86	183.20	168.94	2.18
Reach-1	22315		Reg	298.35	298.30		0.14	0.03	774.11	350.75	183.38	388.87	1.79
Reach-1	22202		20 yr	297.07	296.94	295.34	0.00	0.03	253.70		340.79	75.21	1.69
Reach-1	22202		100 yr	297.34	297.19	295.60	0.00	0.04	289.19		411.73	114.28	1.89
Reach-1	22202		Reg	298.18	298.04	296.62	0.00	0.03	769.69	33.24	573.14	316.62	2.07
Reach-1	22195	BR U	20 yr	297.03	296.79	295.54	0.03	0.00	196.24		383.34	32.66	2.24
Reach-1	22195	BR U	100 yr	297.29	297.00	295.84	0.03	0.01	223.39		464.79	61.21	2.54
Reach-1	22195	BR U	Reg	298.15	297.91	297.11	0.03	0.03	718.52	27.55	609.50	285.96	2.59
Reach-1	22195	BR D	20 yr	297.00	296.75	295.54	0.00	0.05	190.21		386.60	29.40	2.29
Reach-1	22195	BR D	100 yr	297.25	296.93	295.84	0.00	0.07	214.18		471.76	54.24	2.64
Reach-1	22195	BR D	Reg	298.09	297.77	297.11	0.00	0.05	695.65	11.17	665.84	245.99	2.93
Reach-1	22192		20 yr	296.95	296.80		0.32	0.03	232.79		349.19	66.81	1.82
Reach-1	22192		100 yr	297.18	296.99		0.27	0.07	260.62		427.25	98.75	2.09
Reach-1	22192		Reg	298.04	297.82		0.14	0.10	739.91	12.64	639.26	271.11	2.44
Reach-1	21930		20 yr	296.60	296.50		0.48	0.04	850.04	115.27	146.34	154.40	2.16
Reach-1	21930		100 yr	296.84	296.78		0.35	0.02	854.42	189.44	134.81	201.75	1.84
Reach-1	21930		Reg	297.80	297.78		0.20	0.01	860.78	443.64	123.77	355.59	1.32

PROPOSED CONDITIONS

Reach-1	18645		20 yr	295.31	295.28		0.04	0.05	592.07	99.54	199.23	117.23	1.22
Reach-1	18645		100 yr	295.73	295.70		0.04	0.06	822.76	146.56	221.44	158.00	1.22
Reach-1	18645		Reg	296.92	296.90		0.03	0.04	1488.39	390.70	268.90	263.41	1.16
Reach-1	18570		20 yr	295.22	295.02	293.03	0.01	0.01	345.71	43.94	359.01	13.05	2.15
Reach-1	18570		100 yr	295.63	295.41	293.40	0.01	0.00	488.71	94.57	423.78	7.65	2.32
Reach-1	18570		Reg	296.85	296.71	295.15	0.01	0.04	1216.69	322.05	518.65	82.30	2.22
Reach-1	18564	BR U	20 yr	295.21	294.99	293.11	0.01	0.00	267.58	42.73	354.54	18.73	2.25
Reach-1	18564	BR U	100 yr	295.62	295.41	293.50	0.03	0.00	274.35	122.56	385.90	17.54	2.36
Reach-1	18564	BR U	Reg	296.81	296.74	295.15	0.02	0.00	1138.02	514.96	307.47	100.56	1.88
Reach-1	18564	BR D	20 yr	295.19	294.97	293.11	0.01	0.01	264.66	41.23	356.11	18.66	2.27
Reach-1	18564	BR D	100 yr	295.59	295.36	293.50	0.01	0.00	254.25	115.49	392.67	17.84	2.41
Reach-1	18564	BR D	Reg	296.79	296.71	295.15	0.01	0.03	1131.11	508.32	315.51	99.16	1.93
Reach-1	18558		20 yr	295.18	294.97	293.03	0.05	0.07	338.94	40.02	363.04	12.94	2.20
Reach-1	18558		100 yr	295.58	295.36	293.40	0.04	0.08	467.22	90.14	418.42	17.44	2.32
Reach-1	18558		Reg	296.75	296.56	295.15	0.03	0.07	1171.96	290.51	555.40	77.10	2.44
Reach-1	18487		20 yr	295.07	294.99		0.04	0.01	443.40	145.70	264.27	6.02	1.55
Reach-1	18487		100 yr	295.46	295.39		0.03	0.01	695.82	227.88	289.84	8.28	1.54
Reach-1	18487		Reg	296.65	296.61		0.02	0.00	1324.91	552.72	335.21	35.07	1.39
Reach-1	16947		20 yr	293.96	293.92		0.03	0.06	250.32	16.71	378.74	20.54	0.90
Reach-1	16947		100 yr	294.38	294.34		0.04	0.09	259.59	27.52	459.07	39.41	1.00
Reach-1	16947		Reg	295.69	295.63		0.04	0.09	297.52	73.89	717.64	131.46	1.25
Reach-1	16859		20 yr	293.86	293.61	291.60	0.00	0.01	63.34		415.93	0.07	2.23
Reach-1	16859		100 yr	294.26	293.91	291.98	0.00	0.02	104.58		523.16	2.84	2.59
Reach-1	16859		Reg	295.55	295.17	293.09	0.00	0.05	294.19	0.69	779.87	142.44	2.96
Reach-1	16855	BR U	20 yr	293.85	293.56	291.71	0.02	0.00	54.27		415.98	0.02	2.39
Reach-1	16855	BR U	100 yr	294.24	293.84	292.09	0.03	0.00	92.41		523.73	2.27	2.79
Reach-1	16855	BR U	Reg	295.50	294.95	293.24	0.09	0.04	179.68		755.31	167.69	3.57
Reach-1	16855	BR D	20 yr	293.82	293.53	291.71	0.00	0.02	50.37		416.00	0.00	2.40
Reach-1	16855	BR D	100 yr	294.20	293.80	292.09	0.00	0.02	86.65		524.39	1.61	2.82
Reach-1	16855	BR D	Reg	295.37	294.71	293.24	0.00	0.06	144.73		810.85	112.15	3.83
Reach-1	16850		20 yr	293.80	293.54		0.37	0.06	54.63		415.99	0.01	2.27
Reach-1	16850		100 yr	294.18	293.82		0.43	0.11	91.67		524.54	1.46	2.66
Reach-1	16850		Reg	295.31	294.76	293.09	0.50	0.19	250.54	0.00	841.36	81.64	3.46
Reach-1	16612		20 yr	293.37	293.23		0.56	0.01	243.08	96.36	149.85	169.78	2.46
Reach-1	16612		100 yr	293.64	293.49		0.55	0.02	255.97	123.88	171.68	230.45	2.64
Reach-1	16612		Reg	294.62	294.45		0.47	0.04	394.87	236.33	244.04	442.63	3.07
Reach-1	12382		20 yr	290.45	290.38		0.05	0.03	234.96	11.78	170.45	236.78	1.70
Reach-1	12382		100 yr	290.98	290.91		0.05	0.05	260.66	15.87	188.23	313.90	1.68
Reach-1	12382		Reg	292.40	292.33		0.05	0.08	291.48	32.32	255.95	634.74	1.79