

Submitted to:  
**Delcan Corporation**

**BRITANNIA ROAD TRANSPORTATION  
CORRIDOR IMPROVEMENTS: TREMAINE  
ROAD TO HIGHWAY 407 CLASS EA STUDY**

**SUPPORTING TECHNICAL REPORT:  
HYDRAULIC ANALYSIS OF STREAM CROSSINGS &  
STORMWATER MANAGEMENT ALTERNATIVES  
ASSESSMENT**

FINAL REPORT

Submitted by:

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## 1.0 INTRODUCTION

Aquafor Beech Limited was retained by Delcan Corporation to provide technical support for the Britannia Road Transportation Corridor Improvement Class Environmental Assessment (EA) Study.

The proposed transportation corridor improvements include a widening of Britannia Road to an ultimate 6-lane cross-section, from Tremaine Road in the west, to Highway 407 in the east. The study section is located within the Town of Milton in Halton Region and is illustrated in Figure 1. Land uses within the project limits are predominantly agricultural with residential properties scattered throughout its length.

The EA Study has considered five transportation corridor improvement alternatives for Britannia Road, including a “do nothing” alternative and four widening alternatives. The widening alternatives varied according to the location. These were: widen to the north of the existing right-of-way, widen to the south, widen about the centerline, or a combination of the above. A separate screening exercise selected the later alternative that consists of widening to either the north, south or about the centerline, depending on the location along the corridor. The selected alternative is referred to as Alternative 5.

For Alternative 5, there are three alignment alternatives which differ only in the way Britannia Road will pass through the community of Omagh at the intersection of Britannia Road and Fourth Line. Here, the alternatives include:

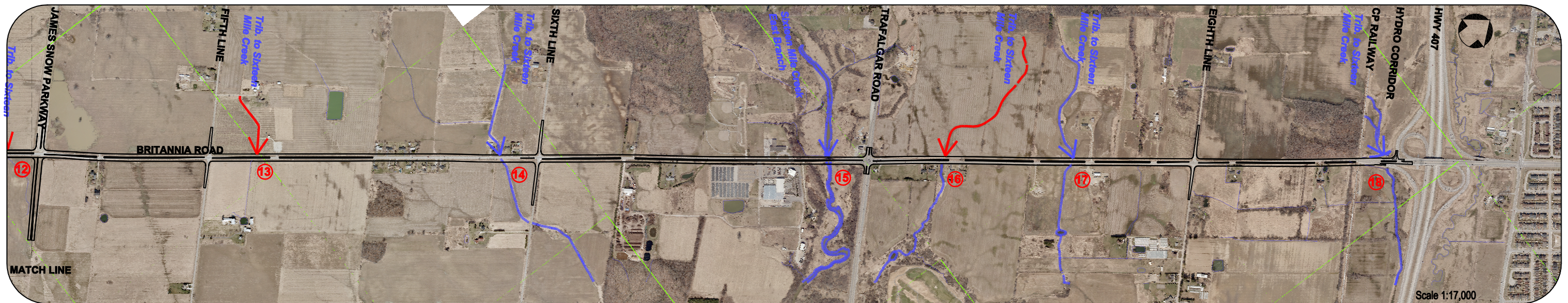
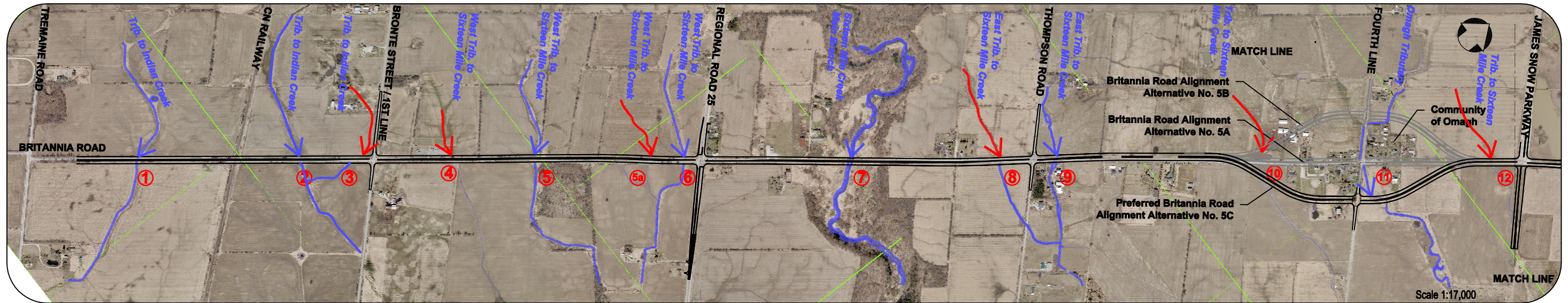
- **Alternative 5A** - widening along the existing alignment, through the community of Omagh;
- **Alternative 5B** – construction of a new road to by-pass Omagh to the north; or
- **Alternative 5C** – construction of a new road to by-pass Omagh to the south.

All three alternatives are identical to the east and west of Omagh. The EA Study has selected Alternative 5C as the preferred corridor improvement alternative.












**LEGEND**

-  CROSSING No.
-  REGULATED STREAM
-  UNREGULATED DRAINAGE FEATURE

**FIGURE 1. STUDY AREA STREAM CROSSINGS**

**BRITANNIA ROAD TRANSPORTATION CORRIDOR IMPROVEMENTS**



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This report has been undertaken to provide technical support and preliminary design information for the stream crossings and associated hydraulic structures within the study area impacted by the proposed road widening, together with an assessment of stormwater management alternatives and feasibility. The analyses and assessments include:

- compilation of an inventory of existing culvert and bridge structures at the stream crossings along the study corridor;
- hydrologic and hydraulic analyses in support of capacity assessments for these hydraulic structures;
- additional analyses to identify conveyance improvements and associated bridge/culvert sizing which would be necessary to meet hydraulic capacity, flooding and environmental targets;
- recommendations with respect to stormwater management measures which should be implemented with the road improvements.

## 2.0 STREAM CROSSING INVENTORY

The study area is drained by tributaries within both the Indian Creek and Sixteen Mile Creek Watersheds. In total, there are nineteen stream crossing locations along the study reach, numbered 1 to 18 and 5a (Figure 1). The first three crossings in the western limits of the study area are within the Indian Creek subwatershed, a tributary of Bronte Creek. The remaining crossings are within three main subwatersheds of Sixteen Mile Creek, including the West Branch subwatershed (also known as Subwatershed 2), the Lower Middle Branch subwatershed (also known as Subwatershed 7), and the East-Lisgar Branch subwatershed.

An inventory was compiled of the existing culvert and bridge structures associated with each of the stream crossings. Information about the structures was collected from the following:

- a draft report from an adjacent Secondary Plan Area in the Town of Milton entitled “Functional Stormwater and Environmental Management Strategy – Boyne Survey Secondary Plan Area” and related Conceptual Fisheries Compensation Plan (AMEC, March 2011);
- a Design Brief entitled “Regional Road 25 Widening From Britannia Road to Derry Road” by MMM Group.
- survey data and basemapping of the road corridor provided by Delcan; and
- field verification of structure locations and dimensions by Aquafor Beech staff.

Table 1 provides a summary of the existing hydraulic structures and their characteristics. As shown, there are two large bridge structures located at the Main Branch of Sixteen Mile Creek and the East Branch of Sixteen Mile Creek (crossing No. 7, and No. 15). The remaining structures consist of concrete box culverts and corrugated steel pipe (CSP) culverts of varying sizes. It should be noted that the culvert structure at crossing No. 6 was recently replaced during the course of this study, as part of road widening on Regional Road 25 in the summer of 2012. The data in Table 1 reflects design information for the new culvert (MMM).

Of the nineteen stream crossings in the study area, eleven are regulated by Conservation Halton upstream of Britannia Road, while the other eight are associated with smaller drainage features which are unregulated upstream of Britannia Road (Table 1).

**Table 1: Existing Hydraulic Structures**

Structure / Stream Crossing No.	Watercourse	Regulated upstream of Britannia Road?	Station	Road Elevation (m)	Culvert Type	Upstream Invert (m)	Downstream Invert (m)	Length (m)	Dia. (mm)	Span (mm)	Rise (mm)
1	Trib. of Indian Creek	yes	0 + 673	183.70	Concrete Box	182.15	181.98	7.2	-	2450	1200
2	Trib. of Indian Creek	yes	1 + 360	185.01	Steel Pipe Arch	183.77	183.73	10.8	-	1500	850
3	Trib. of Indian Creek	no	1 + 560	185.63	Concrete Open Footing	184.54	184.39	17.8	-	5250	800
4	West Trib. of Sixteen Mile Creek	no	2 + 000	186.29	C.S.P	185.23	184.99	11.7	420	-	-
5	West Trib. of Sixteen Mile Creek	yes	2 + 430	184.49	Conc. Open Footing	182.65	182.61	18.9	-	2480	1220
5a	West Trib. of Sixteen Mile Creek	no	2 + 800	184.06	C.S.P	183.13	182.98	12.9	400	-	-
6	West Trib. of Sixteen Mile Creek	yes	2 + 964	183.97	Concrete Box (Twin)	181.83	181.69	33.9	-	2400 (twin)	1200
7	Sixteen Mile Creek Main Branch	yes	3 + 660	177.02	Bridge	171.83	171.69	10.3	-	19,800	3650
8	East Trib. of Sixteen Mile Creek	no	4 + 300	190.11	C.S.P	188.44	188.15	19	500	-	-
9	East Trib. of Sixteen Mile Creek	yes	4 + 525	188.94	Concrete Box	187.22	187.00	17.5	-	3000	1200
10	Trib of Sixteen Mile Creek	no	5 + 371	193.53	Concrete Pipe	192.64	192.47	11.6	500	-	-
11	Omagh Tributary	yes	5 + 823	191.20	Conc. Open Footing	189.57	189.27	21.9	-	6000	1200
12	Trib of Sixteen Mile Creek	no	6 + 472	193.07	C.S.P	192.24	192.12	24.4	800	-	-
13	Trib of Sixteen Mile Creek	no	7 + 500	193.59	C.S.P	192.99	192.72	14.4	500	-	-
14	Trib of Sixteen Mile Creek	yes	8 + 540	190.00	Conc. Open Footing	188.66	188.45	10.4	-	1850	1000
15	Sixteen Mile Creek East Branch	yes	9 + 880	181.27	Bridge	175.78	175.75	10.4	-	24,400	4560
16	Trib of Sixteen Mile Creek	yes	10 + 400	186.42	C.S.P	184.79	184.75	11.4	1200	-	-
17	Trib of Sixteen Mile Creek	yes	10 + 900	187.20	C.S.P	185.59	185.40	11.5	900	-	-
18	Trib of Sixteen Mile Creek	yes	12 + 182	191.57	Concrete Box (Twin)	187.00	186.84	47	-	3500 (twin)	2940





In addition to the 19 stream crossing structures, other small CSP cross-culvert structures which convey drainage between the north and south roadside ditches were also noted within the study area, but are not associated with stream crossings. These small cross-culverts were noted primarily in east end of study area, between 8<sup>th</sup> Line and Highway 407, where topography is relatively flat and drainage is not well defined.

### **3.0 DESIGN CRITERIA FOR STREAM CROSSINGS**

Basic design criteria for the Britannia Road stream crossing structures can be classified into three categories:

- flow conveyance targets;
- flooding criteria; and
- environmental targets.

#### **3.1 Flow Conveyance Capacity Criteria**

In assessing the adequacy of the study area culverts and bridges, design criteria for hydraulic structures outlined in MTO Directive B-100 was referenced. Following construction of the proposed road improvements, Britannia Road is assumed to be classified as an Urban Arterial roadway. Based on this classification, MTO design standards for hydraulic structures are as follows:

- structures with a span of less than 6 metres should convey the 50-year design flow event with a minimum of 1.0 metres of freeboard; and
- structures with a span greater than 6 metres should convey the 100-year design flow event with a minimum of 1.0 metres of freeboard

In addition to the above, Halton Region requires that Britannia Road provide flood-free access during emergencies. Therefore, in addition to the above MTO hydraulic criteria, the stream crossing structures are also to be sized to convey the Regional Storm event without overtopping the road.

#### **3.2 Flooding Criteria**

Any proposed hydraulic structure modifications associated with the Britannia Road widening should not result in increases to existing flood levels. Although this was a requirement



throughout the study area, stream crossing location No. 11 is particularly sensitive. This watercourse is located in the Community of Omagh and existing modelling and floodplain mapping suggests that some of the existing properties and buildings in the area are flood-susceptible.

### **3.3 Environmental Criteria**

In addition to the flow conveyance and flooding criteria, proposed hydraulic structure modifications should also include other environmental considerations, where appropriate, such as:

- maintaining geomorphic processes;
- providing fish passage; and
- providing wildlife access.

For those stream crossings that are regulated by Conservation Halton, hydraulic structures should be designed with a minimum span of twice the stream bankfull width. Further, open-bottom designs using natural materials should be used for the hydraulic structures. These recommendations are consistent with the Conceptual Fisheries Compensation Plan developed for the Boyne Survey Area in Milton (AMEC, March 2011). These environmental design targets apply to streams which are regulated by Conservation Halton (Table 1).

## **4.0 HYDROLOGIC ASSESSMENT AND FLOOD FLOWS**

This section evaluates the existing and future hydrologic requirements at the study area stream crossings, including the hydrologic information and analyses used to define applicable flood flow rates.

### **4.1 Existing vs. Proposed Drainage Scenarios**

When estimating flood flow rates for use in the assessment and design of the stream crossing hydraulic structures, consideration was given to both the existing and future drainage conditions anticipated over the study area. Within the western portion of the study area, from Tremaine Road to James Snow Parkway, future urban development is planned on the north side of Britannia Road. This future development area is referred to as the Boyne Survey Secondary Plan Area.

A Functional Stormwater and Environmental Management Strategy has been developed by AMEC (March, 2011) for the Boyne Secondary Plan Area. Proposed changes to the drainage within the Boyne area which may impact the design of watercourse crossings at Britannia Road include:

- construction of stormwater management ponds on the north side of Britannia Road adjacent to stream crossings No. 1, 2, 5, 6, 9, and 11;
- elimination of unregulated features No. 3, 5a, 10, and 12 upstream of Britannia Road and diversion of the drainage from these features, via urban storm systems, to stormwater ponds which discharge to adjacent streams;
- elimination of unregulated features No. 4 and 8 upstream of Britannia Road and replacement with urban storm systems draining to stormwater ponds which discharge at the existing stream crossing locations at Britannia Road.

These proposed impacts to the drainage system noted above are illustrated conceptually in Figure 2. It should be noted that the proposed stormwater management facility locations, taken from the 2011 FSEMS, are conceptual in nature and subject to further change and refinement as planning and design of the development lands proceeds.

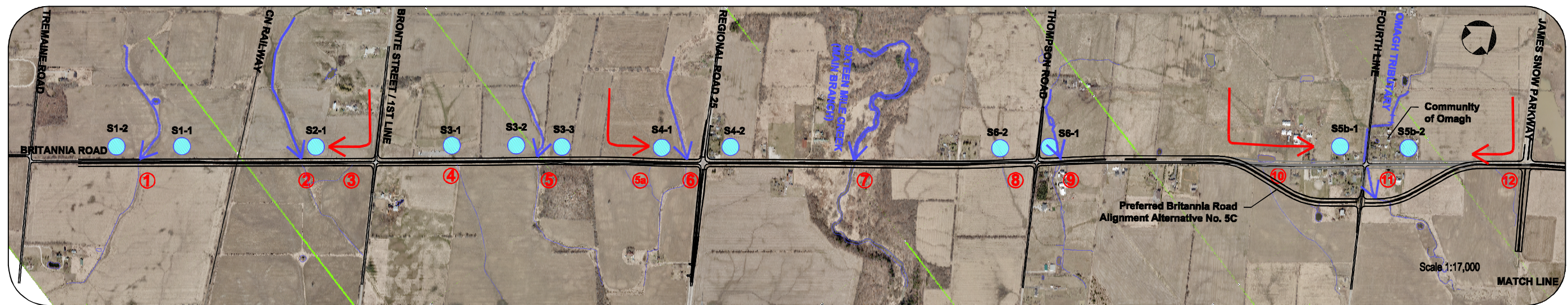
Through review of the draft AMEC document and discussions with Conservation Halton, it is understood that the proposed stormwater ponds will be designed to provide water quality control, erosion control, and post-to-pre flood control for the 2-year to 100-year storm events. Depending on further future grading and feasibility analyses, the stormwater ponds may also be required to provide quantity control storage for the Regional Storm event.

It is understood that the Britannia Road widening will take place prior to the development of the Boyne area. Therefore, any associated hydraulic structure improvements will need to meet the conveyance and flooding criteria using flow rates expected under both the existing and future development scenarios.





For the purposes of this report, the stream crossing structures along Britannia road have been classified into three categories according to their ultimate function in the future drainage scenario:

- ***permanent crossing structures*** – the regulated stream corridors at these locations will remain as open watercourses in the future, and therefore the hydraulic structures will need to accommodate the higher of the flood flow rates from both the existing and future landuse scenarios. Crossings No. 1, 2, 5, 6, 7, 9, and 11 adjacent to the Boyne area are classified as permanent crossings. Crossings No. 13 to 18 are located outside of the Boyne area will therefore also remain open.
- ***SWM pond crossing structures*** – two open unregulated drainage features upstream of Britannia Road at crossings No. 4 and 8 will ultimately be eliminated and replaced with stormwater ponds as part of the Boyne development. Therefore, the hydraulic structures at these crossing locations will need to accommodate existing flood flow rates until the stormwater ponds are constructed. Once the ponds are constructed on the north side of





**FIGURE 2. PROPOSED CHANGES TO DRAINAGE WITHIN BOYNE SECONDARY PLAN AREA**

-  CROSSING No.
-  REGULATED STREAM
-  S1-2 PROPOSED SWM POND
-  PROPOSED DIVERSION OF UNREGULATED DRAINAGE FEATURE

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Britannia Road, it is assumed that the crossing structures would continue to function as pond outlets. The same existing flood flow rates are assumed to apply in the future developed scenario, given that the stormwater ponds will control flows to pre-development levels.

- *optional temporary crossing structures* – these crossings are associated with unregulated drainage features No. 3, 5a, 10 and 12 which will ultimately be eliminated as part of the upstream Boyne development. Hydraulic structures could be constructed at these locations to convey existing flood flows until the upstream development takes place. If built, it is understood that these structures will ultimately be abandoned once the contributing upstream drainage is eliminated through the urban drainage diversions.

With respect to the last point above, it is recognized that temporary culverts are only one option at these locations and that other design options may also be investigated as future detailed design proceeds. Other options include diversion of the upstream drainage prior to the Boyne development via ditching on the north side of Britannia Road, or provision of ditch inlets to the future Britannia Road storm sewer system. The directions and outlets of any such diversions should be consistent with the ultimate drainage diversions planned in the Boyne area (Figure 2).

## 4.2 Flood Flows

Flood flow estimates for the subject stream crossings, including 2-year through 100-year and Regional Storm events, are summarized in Table 2.

Where available, documented flood flow estimates for the subject stream crossings were summarized from background sources. For stream crossings No. 1 through 11, most flood flow estimates were available from the Functional Stormwater and Environmental Management Strategy for the Boyne Secondary Plan Area (AMEC, March, 2011), or the Sixteen Mile Creek Areas 2 & 7 Subwatershed Study (AMEC, July, 2010). Flood flows for the Main Branch and East Branch of Sixteen Mile Creek (crossings No. 7 and 15) were provided by Conservation Halton.





Table 2: Summary of Estimated Flood Flow Rates

Structure / Stream Crossing No.	Watercourse		Crossing Structure Classification (based on future drainage/SWM scenario)		Drainage Area		Flood Flow Rates							
	Name	Regulated upstream of Britannia Road?	Classification	Notes	Area (ha)	Notes	2-yr (m <sup>3</sup> /s)	5-yr (m <sup>3</sup> /s)	10-yr (m <sup>3</sup> /s)	20-yr (m <sup>3</sup> /s)	50-yr (m <sup>3</sup> /s)	100-yr (m <sup>3</sup> /s)	Regional (m <sup>3</sup> /s)	Notes
1	Trib. of Indian Creek	yes	permanent		167	drainage area per Conservation Halton estimate based on future drainage from Mar'11 FSEMS and upstream area north of Louis St.Laurant.	1.62	2.62	3.37	4.14	5.21	6.08	21.00	Flow estimates taken from highest of existing and future landuse scenarios from FSEMS (AMEC, Mar'11)
2	Trib. of Indian Creek	yes	permanent	Mar'11 FSEMS proposes to divert drainage from crossing No.3 to this crossing.	143.7	drainage area per Conservation Halton estimate based on future drainage from Mar'11 FSEMS (includes diversion from crossing No.3) and upstream area north of Louis St.Laurant.	1.48	2.39	3.06	3.74	4.68	5.42	18.60	Flow estimates taken from highest of existing and future landuse scenarios from FSEMS (AMEC, Mar'11)
3	Trib. of Indian Creek	no	temporary (optional)	Mar'11 FSEMS proposes to eliminate this crossing and divert drainage to SWM pond at Crossing No.2. Flow estimates provided to size crossing in case interim culvert is necessary.	70	Existing drainage area per Conservation Halton estimate	0.72	1.16	1.49	1.82	2.28	2.64	9.06	Flow estimates developed proportionally from flows at Crossing No.2.
4	West Trib. of Sixteen Mile Creek	no	SWM pond outlet	Mar'11 FSEMS proposes to eliminate the upstream channel and replace with a SWM Pond outletting at Britannia Rd. Flow estimates provided to size crossing for interim scenario.	16.93	Existing drainage area per Mar'11 FSEMS	0.61	1.00	1.34	1.74	2.38	2.97	7.50	Existing flow estimates from Sixteen Mile Creek Area 2 & 7 Subwatershed Study Update (AMEC, Jul'10)
5	West Trib. of Sixteen Mile Creek	yes	permanent		163.7	drainage area per Conservation Halton estimate based on future drainage from Mar'11 FSEMS and upstream area north of Louis St.Laurant.	0.55	0.86	1.09	1.33	1.68	1.97	17.06	Flow estimates taken from highest of existing and future landuse scenarios from FSEMS (AMEC, Mar'11)
5a	West Trib. of Sixteen Mile Creek	no	temporary (optional)	Mar'11 FSEMS proposes to divert drainage to SWM pond at crossing No.6. Flow estimates provided to size crossing in case interim culvert is necessary.	16.15	Existing drainage area estimated from Mar'11 FSEMS	0.05	0.08	0.11	0.13	0.17	0.19	1.68	Flow estimates developed proportionally from flows at Crossing No.5.
6	West Trib. of Sixteen Mile Creek	yes	permanent	Mar'11 FSEMS proposes to divert drainage from crossing No.5a to this crossing.	224.8	drainage area from MMM Design Brief for Reg.Rd.25 Widening	1.48	3.04	4.34	6.03	7.22	8.60	20.07	Flow estimates from MMM Design Brief for Reg.Rd.25 Widening
7	Sixteen Mile Main Branch	yes	permanent		12,870	drainage area estimated from mapping	n/a	49.40	59.60	74.10	87.30	97.60	427.40	Flow estimates provided by Conservation Halton
8	East Trib. of Sixteen Mile Creek	no	SWM pond outlet	Mar'11 FSEMS proposes to eliminate the upstream channel and replace with a SWM Pond outletting at Britannia Rd. Flow estimates provided to size crossing for interim scenario.	36.22	drainage area estimate from Mar'11 FSEMS	0.35	0.60	0.81	1.06	1.47	1.84	4.03	Existing flow estimates from Sixteen Mile Creek Area 2 & 7 Subwatershed Study Update (AMEC, Jul'10)
9	East Trib. of Sixteen Mile Creek	yes	permanent		138	drainage area per Conservation Halton estimate based on future drainage from Mar'11 FSEMS and upstream area north of Louis St.Laurant.	1.03	1.73	2.34	3.06	4.21	5.26	18.75	Flow estimates taken from highest of existing and future landuse scenarios from FSEMS (AMEC, Mar'11)
10 Existing	Trib of Sixteen Mile Creek	no	to be abandoned	Mar'11 FSEMS proposes to divert drainage to SWM pond at crossing No.11. Flow estimates provided to size crossing in case interim culvert is necessary.	12.6	Existing drainage area estimated from Mar'11 FSEMS	0.10	0.15	0.18	0.22	0.27	0.31	0.97	Existing flow estimates from Sixteen Mile Creek Area 2 & 7 Subwatershed Study Update (AMEC, Jul'10)
10 South By-Pass (Alternative 5C)			temporary (optional)											
11 Existing	Omagh Tributary	yes	permanent	Mar'11 FSEMS proposes to divert drainage from crossing Nos.10 and 12 to this crossing.	299.0	drainage area estimated	1.71	2.62	3.35	4.17	5.40	6.46	20.50	Existing flow estimates from Sixteen Mile Creek Area 2 & 7 Subwatershed Study Update (AMEC, Jul'10)
11 South By-Pass (Alternative 5C)			permanent											
12	Trib of Sixteen Mile Creek	no	temporary (optional)	Mar'11 FSEMS proposes to divert drainage to SWM pond at crossing No.11. Flow estimates provided to size crossing in case interim culvert is necessary.	4.7	drainage area estimated	0.03	0.04	0.05	0.07	0.08	0.10	0.32	Flow estimates developed proportionally from flows at existing Crossing No.11 location.
13	Trib of Sixteen Mile Creek	no	permanent		6.9	drainage area estimated	0.04	0.06	0.08	0.10	0.12	0.15	0.47	Flow estimates developed proportionally from flows at existing Crossing No.11 location.
14	Trib of Sixteen Mile Creek	yes	permanent		107	drainage area per Conservation Halton estimate based on GIS mapping	1.10	1.78	2.28	2.78	3.48	4.04	13.85	Flow estimates developed proportionally from flows at Crossing No.11.
15	Sixteen Mile East Branch	yes	permanent		14,250	drainage area estimated from mapping	n/a	69.80	84.50	105.10	122.60	136.30	587.90	Flow estimates provided by Conservation Halton
16	Trib of Sixteen Mile Creek	yes	permanent		40	drainage area per Conservation Halton estimate based on GIS mapping	0.29	0.41	0.61	0.75	0.78	1.02	4.86	Flow estimates from Aquafor modelling (EPA SWMM)
17	Trib of Sixteen Mile Creek	yes	permanent		344	drainage area per Conservation Halton estimate based on GIS mapping	1.92	3.01	4.46	5.15	5.20	6.51	29.00	Flow estimates from Aquafor modelling (EPA SWMM)
18	Trib of Sixteen Mile Creek	yes	permanent		136	drainage area per Conservation Halton estimate based on GIS mapping	0.68	1.04	1.46	1.74	1.81	2.24	11.54	Flow estimates from Aquafor modelling (EPA SWMM)



For the remaining stream crossings where documented flows were not available through background reports, the flood flow rates were instead estimated as follows:

- ***Proportional Estimates*** – for several stream crossings, flows were estimated in proportion to the documented flows from other nearby crossings if the catchments were considered to have similar land cover, soils and runoff characteristics. This included:
  - for stream crossing No. 3 on Indian Creek, flows were estimated in proportion to those from adjacent crossing No. 2, also on Indian Creek;
  - for stream crossing No. 5a, on the west tributary of Sixteen Mile Creek, flows were estimated from adjacent crossing No. 5 in the same subwatershed;
  - for stream crossing Nos. 12, 13, and 14, flows were estimated proportionally from adjacent crossing No. 11, which is located within the same subwatershed.
- ***Model Estimates*** – for stream crossing Nos. 16, 17, and 18, the use of proportional flow estimates based on nearby crossing No. 15 was ruled out due to the significant difference in drainage area and drainage characteristics. Instead, the EPA SWM model was applied to estimate flood flow rates for these crossings. EPA SWM model information is provided in Appendix A.

## 5.0 CONVEYANCE CAPACITY ASSESSMENTS AND CROSSING SIZING

This Section reviews alternative drainage and conveyance improvements which will be necessary at the stream crossing locations to meet the conveyance, flooding and environmental targets for Britannia Road. Hydraulic analyses and results for bridge/culvert structure sizing are also presented.

### 5.1 Assessment of Existing Structures

Hydraulic analyses in support of culvert/bridge capacity estimates were performed using the following computer models:

- **HEC-RAS** – background HEC-RAS hydraulic models provided by Conservation Halton were used for conveyance capacity and flood assessments for the crossing structures at the Main Branch of Sixteen Mile Creek (crossing No. 7), the East Branch of Sixteen Mile Creek (crossing No. 15), and for the Omagh Tributary (crossing No. 11).
- **HY8** – for the other crossing structures, the HY8 model was applied to estimate flood levels and structure sizing requirements. The program can analyze single or multi-barrel culverts of any size with a variety of shapes, materials, and inlet conditions.

The hydraulic model assessment results for the existing bridge/culvert structures associated with the current 2-lane configuration of Britannia Road are summarized in Table 3. HEC-RAS and HY8 model details are provided in Appendix B and Appendix C, respectively. As shown in Table 3, many of the existing structures do not meet the capacity criteria outlined in Section 3, having less than 1.0 metres of freeboard for the 50-year event and/or are overtopped for the Regional Storm event. Only existing structure No. 18 has sufficient capacity to meet the conveyance capacity criteria for roadways.

It is important to note that existing structure No. 6 was just recently constructed in the summer of 2012. The criteria used in the design of this new structure was based on the current

Table 3: Existing Culvert/Bridge Performance

Structure / Stream Crossing No.	Drainage area (ha)	Existing Road Elevation (m)	50-yr Flow			100-yr Flow			Regional Storm Flow			Road Overtopped (Yes/No)	Freeboard > 1 m for the 50-Yr Flow (for spans < 6m)? (Yes/No)	Freeboard > 1 m for the 100-Yr Flow (for spans > 6m)? (Yes/No)	Culvert Meets Hydraulic Criteria? (Yes/No)
			Flow (m <sup>3</sup> /s)	Flood Elevation (m)	Freeboard (m)*	Flow (m <sup>3</sup> /s)	Flood Elevation (m)	Freeboard (m)*	Flow (m <sup>3</sup> /s)	Flood Elevation (m)	Freeboard (m)*				
1	167	183.70	5.21	183.46	0.24	6.08	183.60	0.10	21.00	184.52	Overtopping	Yes	No	-	No
2	143.7	185.01	4.68	185.30	Overtopping	5.42	185.36	Overtopping	18.60	185.97	Overtopping	Yes	No	-	No
3	70	185.63	2.28	185.53	Overtopping	2.64	185.61	0.02	9.06	186.22	Overtopping	Yes	No	-	No
4	16.93	186.29	2.38	186.54	Overtopping	2.97	186.58	Overtopping	7.50	186.86	Overtopping	Yes	No	-	No
5	163.7	184.49	1.68	183.32	1.17	1.97	183.40	1.09	17.06	185.21	Overtopping	Yes	Yes	-	No
5a	16.15	184.06	0.17	183.79	0.27	0.19	183.82	0.24	1.68	184.21	Overtopping	Yes	No	-	No
6**	224.8	183.97	7.22	183.12	0.85	8.60	183.35	0.62	20.07	184.20	Overtopping	Yes	Yes	-	No
7	12870	177.02	87.30	174.32	2.70	97.60	174.50	2.52	427.40	178.09	Overtopping	Yes	-	Yes	No
8	36.22	190.11	1.47	190.27	Overtopping	1.84	190.30	Overtopping	4.03	190.47	Overtopping	Yes	No	-	No
9	138	188.94	4.21	188.23	0.71	5.26	188.39	0.55	18.75	189.68	Overtopping	Yes	No	-	No
10	12.56	193.53	0.27	193.18	0.35	0.31	193.25	0.28	0.97	193.62	Overtopping	No	No	-	No
11	299.03	191.20	5.40	190.39	0.81	6.46	190.47	0.73	20.50	191.43	Overtopping	Yes	No	-	No
12	4.7	193.07	0.08	192.51	0.56	0.10	192.54	0.53	0.32	192.81	0.26	No	No	-	No
13	6.9	193.59	0.12	193.35	0.24	0.15	193.40	0.19	0.47	193.64	Overtopping	Yes	No	-	No
14	107	190.00	3.48	189.90	0.10	4.04	189.98	0.02	13.85	190.63	Overtopping	Yes	No	-	No
15	14250	181.27	122.60	179.22	2.05	136.30	179.34	1.93	587.90	182.32	Overtopping	Yes	-	Yes	No
16	40	186.42	0.78	185.57	0.85	1.02	185.72	0.70	4.86	186.65	Overtopping	Yes	No	-	No
17	344	187.20	5.20	187.51	Overtopping	6.51	187.56	Overtopping	29.00	188.41	Overtopping	Yes	No	-	No
18	136	191.57	1.81	187.61	3.96	2.24	187.67	3.90	11.54	188.46	3.11	No	Yes	-	Yes

\* Note: Freeboard defined as difference between roadway elevation and flood elevation. "Overtopping" means flood elevation > road elevation, i.e. the road floods.

\*\* Note: Flood elevations for newly constructed crossing No.6 estimated from hydraulic results in MMM Design Brief for Reg.Rd.25 Widening.



configuration of Britannia Road as a rural arterial roadway and did not require flood free access for the Regional Storm event (MMM).

## **5.2 Proposed Drainage Measures and Crossing Sizing**

Over the majority of the study area, the proposed roadway widening will require longer bridge/culvert structures than are currently in place. A minimum length of 47 metres was assumed for the future hydraulic structures beneath the widened 6-lane road. Given that most of the existing structures within this portion of the study area corridor do not meet the hydraulic capacity criteria (Table 3), most will require replacement with larger openings.

Figure 3 illustrates the recommended drainage measures at each of the study area stream crossings that should be undertaken as part of the Britannia Road improvement works. As shown, new crossing structures are recommended at most stream crossings locations. The proposed new hydraulic crossing sizes are summarized in Table 4 and discussed in detail below according to their classification as either permanent crossing structures, stormwater pond crossing structures, or optional temporary crossing structures. Additional general guidance with respect to other minor structures associated with roadside ditches is also discussed.

### **5.2.1 Permanent Crossing Structures**

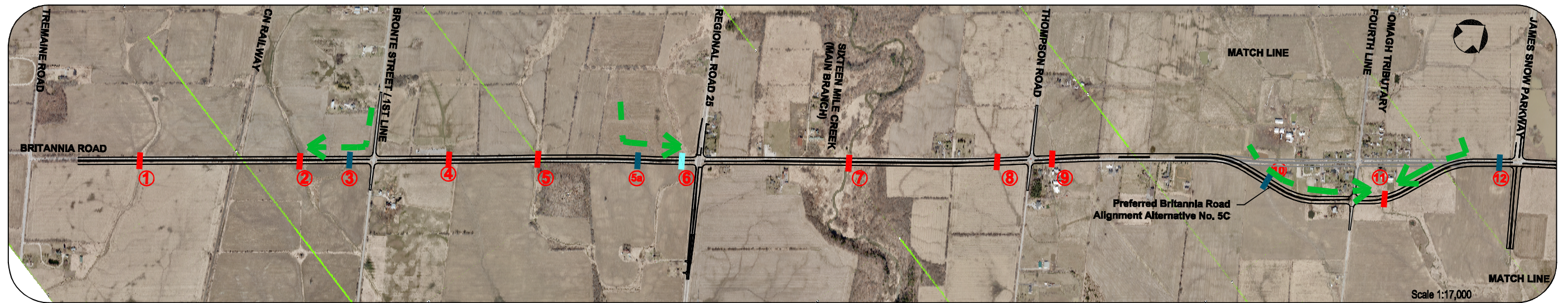
These crossing structures are generally associated with regulated stream corridors or drainage features which will remain as open watercourses following future adjacent urban development. The crossing locations and recommended actions are illustrated in Figure 3.

#### Crossing No. 1 – Tributary of Indian Creek

The regulated stream corridor at this location will remain as an open watercourse in the future. The existing concrete box culvert at this location is overtopped for the Regional Storm flow and













**FIGURE 3. RECOMMENDED DRAINAGE MEASURES**

**BRITANNIA ROAD TRANSPORTATION CORRIDOR IMPROVEMENTS**

**LEGEND**

-  CROSSING No.
-  EXISTING CULVERT STRUCTURE TO REMAIN (No.18)
-  NEW HYDRAULIC CROSSING STRUCTURE
-  OPTIONAL NEW HYDRAULIC CROSSING STRUCTURE (No.6)
-  OPTIONAL TEMPORARY CULVERT STRUCTURE
-  OPTIONAL TEMPORARY DIVERSION (DITCH, STM, SWR)

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Table 4: Proposed Culvert/Bridge Crossing Structures

Structure / Stream Crossing No.	Station	Existing Crossing Structure						Proposed Crossing Structure														
		Structure Type	Existing Length (m)	Dia. (mm)	Span (mm)	Rise (mm)	Road Elevation (m)	Crossing Structure Classification (based on future drainage/SWM scenario)	Proposed Action	Minimum Span Requirements		Height Constraints			Proposed Structure							
										Bankfull Width (BFW) (m)	Minimum Span Criteria (2 x BFW) (mm)	Ex. Channel Elevation (m)	Proposed Centre Road Elevation (m)	Available Rise (m)	Structure Type	Proposed Length (m)	Span (mm)	Rise (mm)	Upstream Invert Elevation (m)	Downstream Invert Elevation (m)	Approx. Cover (m)	
1	0 + 673	Concrete Box	7.2	-	2450	1200	183.70	permanent	replace with larger opening to meet conveyance, flooding & environmental criteria	2.4	4800	182.15	184.87	2.72	Conc. Box Open Footing	47	6000	1500	182.40	181.50	0.97	
2	1 + 360	Steel Pipe Arch	10.8	-	1500	850	185.01	permanent	replace with larger opening to meet conveyance, flooding & environmental criteria	3.7	7400	183.77	186.56	2.79	Conc. Box Open Footing	47	7400	1400	183.85	183.65	1.31	
3	1 + 556	Concrete Open Footing	17.8	-	5250	800	185.63	temporary (optional)	replace with larger opening to meet conveyance & flooding criteria*	Unregulated stream. No minimum span requirements.		184.54	186.30	1.76	Twin Conc. Box	47	3200	1000	184.58	184.30	0.72	
4	2 + 000	C.S.P	11.7	420	-	-	186.29	SWM pond outlet	replace with larger opening to meet conveyance & flooding criteria	Unregulated stream. No minimum span requirements.		185.23	187.32	2.09	Conc. Box	47	4400	1000	185.58	184.62	0.74	
5	2 + 358	Conc. Open Footing	18.9	-	2480	1220	184.49	permanent	replace with larger opening to meet conveyance, flooding & environmental criteria	3.8	7600	182.65	185.15	2.50	Conc. Box Open Footing	47	7600	1500	182.68	182.58	0.97	
5a	2 + 814	C.S.P	12.9	400	-	-	184.06	temporary (optional)	replace with larger opening to meet conveyance & flooding criteria*	Unregulated stream. No minimum span requirements.		183.13	185.16	2.03	Conc. Box	47	2000	1000	183.39	182.72	0.77	
6	2 + 964	Concrete Box (Twin)	33.9	-	2400 (twin)	1200	183.97	permanent	replace with larger opening to meet conveyance, flooding & environmental criteria	4.9	9,800	181.83	184.36	2.53	Conc. Box Open Footing	47	10,200	1200	182.15	182.00	1.01	
7	3 + 658	Bridge	10.3	-	49800	3650	177.02	permanent	replace with larger opening to meet conveyance, flooding & environmental criteria	13.6	27,200	171.83	176.85	5.02	Bridge	47	30,000	4100	171.73	171.58	1.02	
8	4 + 300	C.S.P	19	500	-	-	190.11	SWM pond outlet	replace with larger opening to meet conveyance & flooding criteria	Unregulated stream. No minimum span requirements.		188.44	190.00	1.56	Conc. Box	47	4500	1000	188.65	187.95	0.35	
9	4 + 525	Concrete Box	17.5	-	3000	1200	188.94	permanent	replace with larger opening to meet conveyance, flooding & environmental criteria	2.1	4200	187.22	189.19	1.97	Twin Conc. Box Open Footing	47	4800	1200	187.41	186.81	0.58	
10 Existing		Concrete Box	17.5	-	3000	1200	188.94	No change - existing culvert beneath current roadway to remain														
10 South By-Pass (Alternative 5C)	5 + 371	N/A	N/A	N/A	N/A	N/A	N/A	temporary (optional)	construct new opening to meet conveyance & flooding criteria*	Unregulated stream. No minimum span requirements.		192.64	194.10	1.46	Conc. Box	59	4000	750	192.96	192.15	0.39	
11 Existing		Conc. Open Footing	21.9	-	6000	1200	191.20	No change - existing culvert beneath current roadway to remain														
11 South By-Pass (Alternative 5C)	5 + 950	N/A	N/A	N/A	N/A	N/A	N/A	permanent	construct new structure to meet conveyance, flooding & environmental criteria	7	14,000	189.05	192.60	3.55	Conc. Box Open Footing	47	14,000	2600	189.05	189.00	0.95	
12	6 + 472	C.S.P	24.4	800	-	-	193.07	temporary (optional)	replace with larger opening to meet conveyance & flooding criteria*	Unregulated stream. No minimum span requirements.		192.24	193.70	1.46	Conc. Box	47	3000	750	192.43	191.93	0.52	
13	7 + 500	C.S.P	14.4	500	-	-	193.59	permanent	replace with larger opening to meet conveyance & flooding criteria	Unregulated stream. No minimum span requirements.		192.99	194.16	1.17	Conc. Box	47	2000	750	193.05	192.66	0.36	
14	8 + 540	Conc. Open Footing	10.4	-	1850	1000	190.00	permanent	replace with larger opening to meet conveyance, flooding & environmental criteria	3.6	7200	188.66	190.45	1.79	Conc. Box Open Footing	47	7200	1000	188.85	188.45	0.60	
15	9 + 821	Bridge	10.4	-	24400	4560	181.27	permanent	replace with larger opening to meet conveyance, flooding & environmental criteria	16	32,000	175.78	182.98	7.20	Bridge	47	32,000	4200	175.80	175.66	2.98	
16	10 + 400	C.S.P	11.4	1200	-	-	186.42	permanent	replace with larger opening to meet conveyance, flooding & environmental criteria	1.3	2600	184.79	187.00	2.21	Conc. Box Open Footing	47	2600	1000	184.85	184.69	1.15	
17	10 + 900	C.S.P	11.5	900	-	-	187.20	permanent	replace with larger opening to meet conveyance, flooding & environmental criteria	6.9	13,800	185.59	187.35	1.76	Conc. Box Open Footing	47	13,800	1000	185.80	185.20	0.55	
18	12 + 182	Concrete Box (Twin)	47	-	3500 (twin)	2940	191.57	permanent	No change - existing culvert to remain													

\* Note - for unregulated stream crossings 3, 5a, 10, and 12, consideration may also be given to smaller temporary culverts or temporary diversion of upstream drainage, until the upstream feature is eliminated as part of future urban development.



does not provide 1 meter of freeboard for the 50-year storm. Therefore, the existing culvert structure does not meet the hydraulic conveyance criteria for the roadway design (Table 3).

The existing culvert should therefore be replaced with a new crossing structure which meets the conveyance capacity, flooding and environmental criteria for the new roadway discussed in Section 3. As shown in Table 4, an open bottom box structure with an opening of approximately 6.0m wide by 1.5m high is recommended. The size was selected to meet the hydraulic and environmental criteria while also accounting for height restrictions related to the proposed road profile.

Conveyance Capacity Criteria and Flooding Criteria – As shown in Table 5, the proposed culvert can convey the 50-year storm with 1m of freeboard or more, and can convey the Regional storm flow without overtopping the road. As shown in Table 6, the proposed culvert would result in a decrease in flood levels. Model output is provided in Appendix C.

Environmental Criteria - As a minimum, the new replacement structure should have a span equivalent to two times the bankfull width to meet the environmental criteria. Given an average bankfull width of 2.4m at this location, a minimum span of 4.8m is recommended (Table 4). The proposed span of 6.0m is therefore sufficient.

#### Crossing No. 2 – Tributary of Indian Creek

The regulated stream corridor at this location will remain as an open watercourse in the future. The existing steel pipe arch culvert at this location is overtopped for the Regional Storm flow and does not provide 1 meter of freeboard for the 50-year storm. Therefore, the existing culvert structure does not meet the hydraulic conveyance criteria for the roadway design (Table 3).

The existing culvert should therefore be replaced with a new crossing structure which meets the conveyance capacity, flooding and environmental criteria for the new roadway discussed in Section 3. As shown in Table 4, an open bottom box structure with an opening of approximately 7.4m wide by 1.4m high is recommended. The size was selected to meet the hydraulic and



Table 5: Proposed Culvert/Bridge Performance

Structure / Stream Crossing No.	Drainage area (ha)	Existing Road Elevation (m)	Proposed Road Elevation (m)	50-yr Flow						100-yr Flow						Regional Storm Flow						Road Overtopped? (Yes/No)	Freeboard > 1 m for the 50-Yr Flow (for spans < 6m)? (Yes/No)	Freeboard > 1 m for the 100-Yr Flow (for spans > 6m)? (Yes/No)
				Flow (m3/s)	Flood Elevation (m)		Freeboard (m)			Flow (m3/s)	Flood Elevation (m)		Freeboard (m)			Flow (m3/s)	Flood Elevation (m)		Freeboard (m)					
					Existing	Proposed	Existing	Proposed	Change (m)		Existing	Proposed	Existing	Proposed	Change (m)		Existing	Proposed	Existing	Proposed	Change (m)			
1	167	183.70	184.87	5.21	183.46	183.12	0.24	1.75	1.51	6.08	183.60	183.20	0.10	1.67	1.57	21.00	184.52	184.42	-0.82	0.45	1.27	No	Yes	-
2	143.7	185.01	186.56	4.68	185.30	184.50	-0.29	2.06	2.35	5.42	185.36	184.55	-0.35	2.01	2.36	18.60	185.97	185.40	-0.96	1.16	2.12	No	-	Yes
3	70	185.63	186.30	2.28	185.53	185.17	0.10	1.13	1.03	2.64	185.61	185.22	0.02	1.08	1.06	9.06	186.22	186.11	-0.59	0.19	0.78	No	Yes	-
4	16.93	186.29	187.32	2.38	186.54	186.08	-0.25	1.24	1.49	2.97	186.58	186.13	-0.30	1.19	1.49	7.50	186.86	186.81	-0.58	0.51	1.09	No	Yes	-
5	163.7	184.49	185.15	1.68	183.32	183.07	1.17	2.08	0.91	1.97	183.40	183.12	1.09	2.03	0.94	17.06	185.21	184.79	-0.72	0.36	1.08	No	-	Yes
5a	16.15	184.06	185.16	0.17	183.79	183.55	0.27	1.61	1.34	0.19	183.82	183.56	0.24	1.60	1.36	1.68	184.21	184.11	-0.15	1.05	1.20	No	Yes	-
6	224.8	183.97	184.36	7.22	183.12	182.61	0.85	1.75	0.90	8.60	183.35	182.65	0.62	1.71	1.09	20.07	184.20	183.69	-0.23	0.67	0.90	No	-	Yes
7	12870	177.02	176.85	87.30	174.32	174.14	2.70	2.71	0.01	97.60	174.50	174.19	2.52	2.66	0.14	427.40	178.09	176.29	-1.07	0.56	1.63	No	-	Yes
8	36.22	190.11	190.00	1.47	190.27	189.00	-0.16	1.00	1.16	1.84	190.30	189.05	-0.19	0.95	1.14	4.03	190.47	189.34	-0.36	0.66	1.02	No	Yes	-
9	138	188.94	189.19	4.21	188.23	187.87	0.71	1.32	0.61	5.26	188.39	187.94	0.55	1.25	0.70	18.75	189.68	188.97	-0.74	0.22	0.96	No	Yes	-
10 South By-Pass (Alternative 5C)	12.56	N/A	194.10	0.27	193.18	193.09	N/A	1.01	N/A	0.31	193.25	193.10	N/A	1.00	N/A	0.97	193.62	193.25	N/A	0.85	N/A	No	Yes	-
11 South By-Pass (Alternative 5C)	303.18	N/A	192.60	5.40	190.16	190.10	N/A	2.50	N/A	6.46	190.23	190.18	N/A	2.42	N/A	20.50	190.79	190.78	N/A	1.82	N/A	No	-	Yes
12	4.7	193.07	193.70	0.08	192.51	192.51	0.56	1.19	0.63	0.10	192.54	192.52	0.53	1.18	0.65	0.32	192.81	192.61	0.26	1.09	0.83	No	Yes	-
13	6.9	193.59	194.16	0.12	193.35	193.15	0.24	1.01	0.77	0.15	193.40	193.19	0.19	0.97	0.78	0.47	193.64	193.35	-0.05	0.81	0.86	No	Yes	-
14	107	190.00	190.45	3.48	189.90	189.34	0.10	1.11	1.01	4.04	189.98	189.41	0.02	1.04	1.02	13.85	190.63	190.11	-0.63	0.34	0.97	No	-	Yes
15	14250	181.27	182.98	122.60	179.22	179.17	2.05	3.81	1.76	136.30	179.34	179.29	1.93	3.69	1.76	587.90	182.32	182.07	-1.05	0.91	1.96	No	-	Yes
16	40	186.42	187.00	0.78	185.57	185.29	0.85	1.71	0.86	1.02	185.72	185.37	0.70	1.63	0.93	4.86	186.65	186.54	-0.23	0.46	0.69	No	Yes	-
17	344	187.20	187.35	5.20	187.51	186.19	-0.31	1.16	1.47	6.51	187.56	186.24	-0.36	1.11	1.47	29.00	188.41	187.02	-1.21	0.33	1.54	No	-	Yes
18	136	191.57	191.57	1.81	187.61	187.61	3.96	3.96	0.00	2.24	187.67	187.67	3.90	3.90	0.00	11.54	188.46	188.46	3.11	3.11	0.00	No	Yes	-

Table 6: Flood Impacts of Proposed Culvert/Bridge Structures

Structure / Stream Crossing No.	Proposed Crossing Structure						50-yr Flood Elevation (m)				100-yr Flood Elevation (m)				Regional Flood Elevation (m)			
	Proposed Action	Structure Type	Proposed Length (m)	Span (mm)	Rise (mm)	Proposed Road Elevation (m)	Existing	Proposed	Change	Impact?	Existing	Proposed	Change	Impact?	Existing (m)	Proposed (m)	Change (m)	Impact?
1	replace with larger opening to meet conveyance, flooding & environmental criteria	Conc. Box Open Footing	47	6000	1500	184.87	183.46	183.12	-0.34	decrease	183.60	183.20	-0.40	decrease	184.52	184.42	-0.10	decrease
2	replace with larger opening to meet conveyance, flooding & environmental criteria	Conc. Box Open Footing	47	7400	1400	186.56	185.30	184.50	-0.80	decrease	185.36	184.55	-0.81	decrease	185.97	185.40	-0.57	decrease
3	replace with larger opening to meet conveyance & flooding criteria*	Twin Conc. Box	47	3200	1000	186.30	185.53	185.17	-0.36	decrease	185.61	185.22	-0.39	decrease	186.22	186.11	-0.11	decrease
4	replace with larger opening to meet conveyance & flooding criteria	Conc. Box	47	4400	1000	187.32	186.54	186.08	-0.46	decrease	186.58	186.13	-0.45	decrease	186.86	186.81	-0.05	decrease
5	replace with larger opening to meet conveyance, flooding & environmental criteria	Conc. Box Open Footing	47	7600	1500	185.15	183.32	183.07	-0.25	decrease	183.40	183.12	-0.28	decrease	185.21	184.79	-0.42	decrease
5a	replace with larger opening to meet conveyance & flooding criteria*	Conc. Box	47	2000	1000	185.16	183.79	183.55	-0.24	decrease	183.82	183.56	-0.26	decrease	184.21	184.11	-0.10	decrease
6	replace with larger opening to meet conveyance, flooding & environmental criteria	Conc. Box Open Footing	47	10,200	1200	184.36	183.12	182.61	-0.51	decrease	183.35	182.65	-0.70	decrease	184.20	183.69	-0.51	decrease
7	replace with larger opening to meet conveyance, flooding & environmental criteria	Bridge	47	30,000	4100	176.85	174.32	174.14	-0.18	decrease	174.50	174.19	-0.31	decrease	178.09	176.29	-1.80	decrease
8	replace with larger opening to meet conveyance & flooding criteria	Conc. Box	47	4500	1000	190.00	190.27	189.00	-1.27	decrease	190.30	189.05	-1.25	decrease	190.47	189.34	-1.13	decrease
9	replace with larger opening to meet conveyance, flooding & environmental criteria	Twin Conc. Box Open Footing	47	4800	1200	189.19	188.23	187.87	-0.36	decrease	188.39	187.94	-0.45	decrease	189.68	188.97	-0.71	decrease
10 Alternative 5C	construct new opening to meet conveyance & flooding criteria*	Conc. Box	59	4000	750	194.10	193.18	193.09	-0.09	decrease	193.25	193.10	-0.15	decrease	193.62	193.25	-0.37	decrease
11 Alternative 5C	construct new structure to meet conveyance, flooding & environmental criteria	Conc. Box Open Footing	47	14,000	2600	192.60	190.16	190.10	-0.06	decrease	190.23	190.18	-0.05	decrease	190.79	190.78	-0.01	decrease
12	replace with larger opening to meet conveyance & flooding criteria*	Conc. Box	47	3000	750	193.70	192.51	192.51	0.00	-	192.54	192.52	-0.02	decrease	192.81	192.61	-0.20	decrease
13	replace with larger opening to meet conveyance & flooding criteria	Conc. Box	47	2000	750	194.16	193.35	193.15	-0.20	decrease	193.40	193.19	-0.21	decrease	193.64	193.35	-0.29	decrease
14	replace with larger opening to meet conveyance, flooding & environmental criteria	Conc. Box Open Footing	47	7200	1000	190.45	189.90	189.34	-0.56	decrease	189.98	189.41	-0.57	decrease	190.63	190.11	-0.52	decrease
15	replace with larger opening to meet conveyance, flooding & environmental criteria	Bridge	47	32,000	4200	182.98	179.22	179.17	-0.05	decrease	179.34	179.29	-0.05	decrease	182.32	182.07	-0.25	decrease
16	replace with larger opening to meet conveyance, flooding & environmental criteria	Conc. Box Open Footing	47	2600	1000	187.00	185.57	185.29	-0.28	decrease	185.72	185.37	-0.35	decrease	186.65	186.54	-0.11	decrease
17	replace with larger opening to meet conveyance, flooding & environmental criteria	Conc. Box Open Footing	47	13,800	1000	187.35	187.51	186.19	-1.32	decrease	187.56	186.24	-1.32	decrease	188.41	187.02	-1.39	decrease
18	Existing culvert to remain						187.61	187.61	0.00	-	187.67	187.67	0.00	-	188.46	188.46	0.00	-

\* Note - for unregulated stream crossings 3, 5a, 10, and 12, consideration may also be given to smaller temporary culverts or temporary diversion of upstream drainage, until the upstream feature is eliminated as part of future urban development.



environmental criteria while also accounting for height restrictions related to the proposed road profile.

Conveyance Capacity Criteria and Flooding Criteria – As shown in Table 5, the proposed culvert can convey the 100-year storm with 1m of freeboard or more, and can convey the Regional storm flow without overtopping the road. As shown in Table 6, the proposed culvert would result in a decrease in flood levels. Model output is provided in Appendix C.

Environmental Criteria - As a minimum, the new replacement structure should have a span equivalent to two times the bankfull width to meet the environmental criteria. Given an average bankfull width of 3.7m at this location, a minimum span of 7.4m is recommended (Table 4). The proposed span of 7.4m is therefore sufficient.

#### Crossing No. 5 – West Tributary of Sixteen Mile Creek

The regulated stream corridor at this location will remain as an open watercourse in the future. The existing concrete box culvert at this location is overtopped for the Regional Storm flow and does not provide 1 meter of freeboard for the 50-year storm. Therefore, the existing culvert structure does not meet the hydraulic conveyance criteria for the roadway design (Table 3).

The existing culvert should therefore be replaced with a new crossing structure which meets the conveyance capacity, flooding and environmental criteria for the new roadway discussed in Section 3. As shown in Table 4, an open bottom box structure with an opening of approximately 7.6m wide by 1.5m high is recommended. The size was selected to meet the hydraulic and environmental criteria while also accounting for height restrictions related to the proposed road profile.

Conveyance Capacity Criteria and Flooding Criteria – As shown in Table 5, the proposed culvert can convey the 100-year storm with 1m of freeboard or more, and can convey the Regional storm flow without overtopping the road. As shown in Table 6, the proposed culvert would result in a decrease in flood levels. Model output is provided in Appendix C.

Environmental Criteria - As a minimum, the new replacement structure should have a span equivalent to two times the bankfull width to meet the environmental criteria. Given an average bankfull width of 3.8m at this location, a minimum span of 7.6m is recommended (Table 4). The proposed span of 7.6m is therefore sufficient.

#### Crossing No. 6 – West Tributary of Sixteen Mile Creek

The regulated stream corridor at this location will remain as an open watercourse in the future. The existing twin concrete box culvert at this location was just recently constructed in the summer of 2012. The criteria used in the design of this brand new structure was based on the current configuration of Britannia Road as a rural arterial roadway and did not required flood free access for the Regional Storm event (MMM), nor was it required to span a distance equal to twice the bankfull width. Therefore, this existing structure does not meet the environmental criteria or the hydraulic conveyance criteria applied to the improved roadway design consisting of a 6-lane urban arterial (Table 3).

There are three options at this location:

- ***Option 1 - Replace the existing culvert.*** To meet the conveyance capacity targets and objectives of flood-free access for the widened roadway, as well as the environmental goals, a new, larger crossing structure would be required. As shown in Table 4, if this option were chosen, an open bottom box structure with an opening of approximately 10.2m wide by 1.2m high is recommended. The size was selected to meet the hydraulic and environmental criteria while also accounting for height restrictions related to the proposed road profile.

Conveyance Capacity Criteria and Flooding Criteria – As shown in Table 5, the proposed culvert can convey the 100-year storm with 1m of freeboard or more, and can convey the Regional storm flow without overtopping the road. As shown in Table 6, the proposed culvert would result in a decrease in flood levels. Model output is provided in Appendix C.

Environmental Criteria - As a minimum, the new replacement structure should have a span equivalent to two times the bankfull width to meet the environmental criteria. Given an average bankfull width of 4.9m at this location, a minimum span of 9.8m is recommended (Table 4). The proposed span of 10.2m would therefore be sufficient.

- **Option 2 – Extend the existing culvert.** Rather than a complete replacement of the new structure that was just recently constructed at this location, consideration may be given to simply extending the new twin 2.4m wide by 1.2m high culvert to accommodate the widened 6-lane roadway. This would require the acceptance of increased risk as an extension would not meet the objectives of a flood-free roadway up to and including the Regional storm event. Further evaluation would need to demonstrate that the extended structure does not negatively impact flood levels on adjacent properties.
- **Option 3 – Extend the existing culvert and add an additional barrel opening.** This option is similar to Option 2 in that the existing recently constructed twin culvert at this location would be extended. However, consideration may be given to adding an additional barrel opening adjacent to the existing structure to increase the overall capacity of the crossing. This would provide an opportunity to potentially meet the hydraulic criteria and also improve terrestrial wildlife connectivity.

At this early planning stage it is recommended that Option 1 (culvert replacement) be implemented as it is the better long-term solution in terms of hydraulic conveyance, flood risk to the road and environmental functions. However, it is also understood that Option 2 (culvert extension) or Option 3 (additional barrel opening) could be further investigated working toward detailed design.

#### Crossing No. 7 –Sixteen Mile Creek Main Branch

This is the Main Branch of Sixteen Mile Creek. The existing concrete bridge at this location is overtopped for the Regional Storm flow. Therefore, the existing bridge structure does not meet the hydraulic conveyance criteria for the roadway design (Table 3).

The existing crossing should therefore be replaced with a new bridge structure which meets the conveyance capacity, flooding and environmental criteria for the new roadway discussed in Section 3. As shown in Table 4, a new bridge structure with an opening of approximately 30m wide by 4.1m high is recommended. The size was selected to meet the hydraulic and environmental criteria while also accounting for height restrictions related to the proposed road profile.

Conveyance Capacity Criteria and Flooding Criteria – As shown in Table 5, the proposed bridge can convey the 100-year storm with 1m of freeboard or more, and can convey the Regional storm flow without overtopping the road. As shown in Table 6, the proposed bridge would result in a decrease in flood levels. HEC-RAS model output is provided in Appendix B.

Environmental Criteria - As a minimum, the new replacement structure should have a span equivalent to two times the bankfull width to meet the environmental criteria. Given an average bankfull width of 13.6m at this location, a minimum span of 27.2m is recommended (Table 4). The proposed span of 30m is therefore sufficient.

#### Crossing No. 9 – East Tributary of Sixteen Mile Creek

The regulated stream corridor at this location will remain as an open watercourse in the future. The existing concrete box culvert at this location is overtopped for the Regional Storm flow and does not provide 1 meter of freeboard for the 50-year storm. Therefore, the existing culvert structure does not meet the hydraulic conveyance criteria for the roadway design (Table 3).

The existing culvert should therefore be replaced with a new crossing structure which meets the conveyance capacity, flooding and environmental criteria for the new roadway discussed in Section 3. As shown in Table 4, an open bottom box structure with twin openings of approximately 4.8m wide by 1.2m high is recommended. The size was selected to meet the hydraulic and environmental criteria while also accounting for height restrictions related to the proposed road profile.

Conveyance Capacity Criteria and Flooding Criteria – As shown in Table 5, the proposed culvert can convey the 50-year storm with 1m of freeboard or more, and can convey the Regional storm flow without overtopping the road. As shown in Table 6, the proposed culvert would result in a decrease in flood levels. Model output is provided in Appendix C.

Environmental Criteria - As a minimum, the new replacement structure should have a span equivalent to two times the bankfull width to meet the environmental criteria. Given an average bankfull width of 2.1m at this location, a minimum span of 4.2m is recommended (Table 4). The proposed span of 4.8m per twin box is therefore sufficient.

#### Crossing No. 11 – Omagh Tributary

This watercourse is located in the Community of Omagh and existing modelling and floodplain mapping suggests that some of the existing properties and buildings in the area are flood-susceptible. The regulated stream corridor at this location will remain as an open watercourse in the future. The preferred road alignment alternative (5C) requires that a brand new crossing structure be constructed south of the existing crossing location to convey the Omagh Tributary flows beneath the proposed new southern bypass.

The new culvert design will be required to meet the conveyance capacity, flooding and environmental criteria for the new roadway discussed in Section 3. As shown in Table 4, an open bottom box structure with an opening of approximately 14m wide by 2.6m high is recommended.

Environmental Criteria - As a minimum, the new replacement structure should have a span equivalent to two times the bankfull width to meet the environmental criteria. Given an average bankfull width of 7m at this location, a minimum span of 14m is recommended (Table 4). The proposed span is therefore sufficient.

Conveyance Capacity Criteria – As shown in Table 5, the proposed culvert can convey the 100-year storm with 1m of freeboard or more, and can convey the Regional storm flow without overtopping the road.

Flooding Criteria – A HEC-RAS hydraulic model was used to assess the potential impacts of the new crossing structure to instream flood elevations through the flood-susceptible community of Omagh. Table 7 compares the existing Regional Storm flood elevations at various locations along the tributary to the predicted elevations with the proposed new crossing structure in place at the south bypass. As shown, with the proposed crossing structure in place, no increases in Regional storm flood levels through Omagh are predicted. Similar results were also found for the 2-year through 100-year storm events. HEC-RAS model output is provided in Appendix B.

#### Crossing No. 13 – Tributary of Sixteen Mile Creek

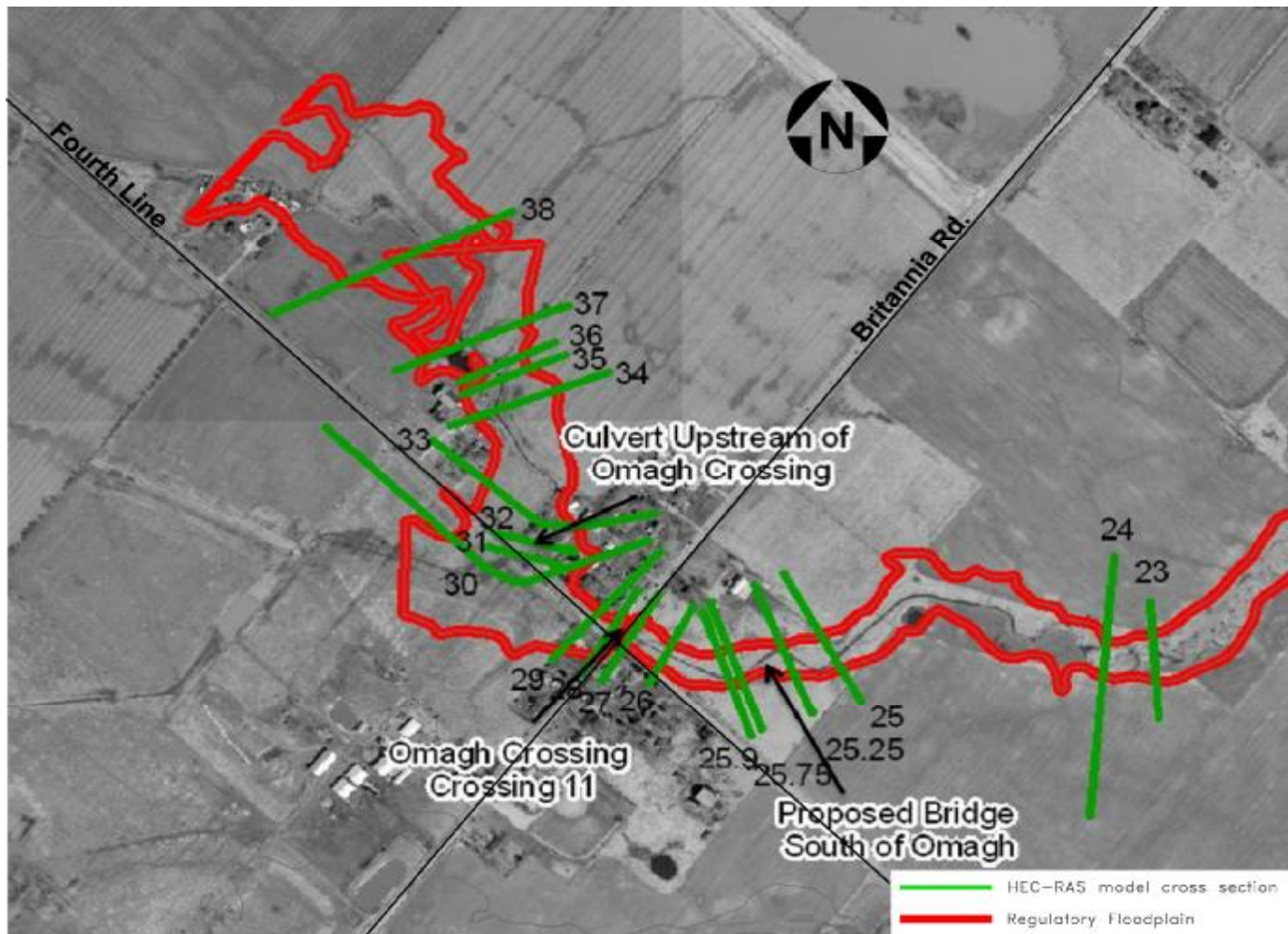
The small non-regulated drainage feature at this location will remain as an open watercourse in the future. The existing CSP culvert at this location is overtopped for the Regional Storm flow and does not provide 1 meter of freeboard for the 50-year storm. Therefore, the existing culvert structure does not meet the hydraulic conveyance criteria for the roadway design (Table 3).

The existing culvert should therefore be replaced with a new crossing structure which meets the conveyance capacity, and flooding criteria for the new roadway discussed in Section 3. No environmental criteria apply to the unregulated drainage feature. As shown in Table 4, a concrete box structure with an opening of approximately 2m wide by 0.75m high is recommended. The size was selected to meet the hydraulic criteria while also accounting for height restrictions related to the proposed road profile.

Conveyance Capacity Criteria and Flooding Criteria – As shown in Table 5, the proposed culvert can convey the 50-year storm with 1m of freeboard or more, and can convey the Regional storm flow without overtopping the road. As shown in Table 6, the proposed culvert would result in a decrease in flood levels. Model output is provided in Appendix C.

Table 7: Flood Impacts of Proposed New Crossing Structure within Flood-Susceptible Community of Omagh

HEC-RAS Hydraulic Model X-section No.	Location	Comparison of Regional Flood Elevation			
		Existing Flood Elevation (m)	New structure: 14000 x 2600 mm at South Bypass (Alternative 5C)		
			Flood Elevation (m)	Change (m)	Impact?
23		189.70	189.70	0.00	-
24		189.95	189.95	0.00	-
25	downstream of future bypass	190.66	190.66	0.00	-
25.25	downstream side of future bypass	190.71	190.70	-0.01	decrease
25.75	upstream side of future bypass	190.75	190.71	-0.04	decrease
25.9	upstream of future bypass	190.76	190.74	-0.02	decrease
26		190.80	190.78	-0.02	decrease
27	downstream of existing Britannia Road	190.83	190.73	-0.10	decrease
28	upstream of existing Britannia Road	191.39	191.37	-0.02	decrease
29		191.43	191.41	-0.02	decrease
30		191.45	191.43	-0.02	decrease
31	downstream of existing 4th Line	191.45	191.43	-0.02	decrease
32	upstream of existing 4th Line	191.50	191.49	-0.01	decrease



### Crossing No. 14 – Tributary of Sixteen Mile Creek

The regulated stream corridor at this location will remain as an open watercourse in the future. The existing concrete culvert at this location is overtopped for the Regional Storm flow and does not provide 1 meter of freeboard for the 50-year storm. Therefore, the existing culvert structure does not meet the hydraulic conveyance criteria for the roadway design (Table 3).

The existing culvert should therefore be replaced with a new crossing structure which meets the conveyance capacity, flooding and environmental criteria for the new roadway discussed in Section 3. As shown in Table 4, an open bottom box structure with an opening of approximately 7.2m wide by 1.0m high is recommended. The size was selected to meet the hydraulic and environmental criteria while also accounting for height restrictions related to the proposed road profile.

Conveyance Capacity Criteria and Flooding Criteria – As shown in Table 5, the proposed culvert can convey the 100-year storm with 1m of freeboard or more, and can convey the Regional storm flow without overtopping the road. As shown in Table 6, the proposed culvert would result in a decrease in flood levels. Model output is provided in Appendix C.

Environmental Criteria - As a minimum, the new replacement structure should have a span equivalent to two times the bankfull width to meet the environmental criteria. Given an average bankfull width of 3.6m at this location, a minimum span of 7.2m is recommended (Table 4). The proposed span of 7.2m is therefore sufficient.

### Crossing No. 15 – Sixteen Mile Creek East Branch

This is the East Branch of Sixteen Mile Creek. The existing concrete bridge at this location is overtopped for the Regional Storm flow. Therefore, the existing bridge structure does not meet the hydraulic conveyance criteria for the roadway design (Table 3).

The existing crossing should therefore be replaced with a new bridge structure which meets the conveyance capacity, flooding and environmental criteria for the new roadway discussed in



Section 3. As shown in Table 4, a new bridge structure with an opening of approximately 32m wide by 4.2m high is recommended. The size was selected to meet the hydraulic and environmental criteria.

Conveyance Capacity Criteria and Flooding Criteria – As shown in Table 5, the proposed bridge can convey the 100-year storm with 1m of freeboard or more, and can convey the Regional storm flow without overtopping the road. As shown in Table 6, the proposed bridge would result in a decrease in flood levels. HEC-RAS model output is provided in Appendix B.

Environmental Criteria - As a minimum, the new replacement structure should have a span equivalent to two times the bankfull width to meet the environmental criteria. Given an average bankfull width of 16m at this location, a minimum span of 32m is recommended (Table 4). The proposed span of 32m is therefore sufficient.

#### Crossing No. 16 – Tributary of Sixteen Mile Creek

The stream corridor at this location will remain as an open watercourse in the future. The existing CSP culvert at this location is overtopped for the Regional Storm flow and does not provide 1 meter of freeboard for the 50-year storm. Therefore, the existing culvert structure does not meet the hydraulic conveyance criteria for the roadway design (Table 3).

The existing culvert should therefore be replaced with a new crossing structure which meets the conveyance capacity, flooding and environmental criteria for the new roadway discussed in Section 3. As shown in Table 4, an open bottom box structure with an opening of approximately 2.6m wide by 1.0m high is recommended. The size was selected to meet the hydraulic and environmental criteria while also accounting for height restrictions related to the proposed road profile.

Conveyance Capacity Criteria and Flooding Criteria – As shown in Table 5, the proposed culvert can convey the 50-year storm with 1m of freeboard or more, and can convey the Regional storm flow without overtopping the road. As shown in Table 6, the proposed culvert would result in a decrease in flood levels. Model output is provided in Appendix C.

Environmental Criteria - As a minimum, the new replacement structure should have a span equivalent to two times the bankfull width to meet the environmental criteria. Given an average bankfull width of 1.3m at this location, a minimum span of 2.6m is recommended (Table 4). The proposed span of 2.6m is therefore sufficient.

#### Crossing No. 17 – Tributary of Sixteen Mile Creek

The regulated stream corridor at this location will remain as an open watercourse in the future. The existing CSP culvert at this location is overtopped for the Regional Storm flow and does not provide 1 meter of freeboard for the 50-year storm. Therefore, the existing culvert structure does not meet the hydraulic conveyance criteria for the roadway design (Table 3).

The existing culvert should therefore be replaced with a new crossing structure which meets the conveyance capacity, flooding and environmental criteria for the new roadway discussed in Section 3. As shown in Table 4, an open bottom box structure with an opening of approximately 13.8m wide by 1.0m high is recommended. The size was selected to meet the hydraulic and environmental criteria while also accounting for height restrictions related to the proposed road profile.

Conveyance Capacity Criteria and Flooding Criteria – As shown in Table 5, the proposed culvert can convey the 100-year storm with 1m of freeboard or more, and can convey the Regional storm flow without overtopping the road. As shown in Table 6, the proposed culvert would result in a decrease in flood levels. Model output is provided in Appendix C.

Environmental Criteria - As a minimum, the new replacement structure should have a span equivalent to two times the bankfull width to meet the environmental criteria. Given an average bankfull width of 6.9m at this location, a minimum span of 13.8m is recommended (Table 4). The proposed span of 13.8m is therefore sufficient.

### Crossing No. 18 – Tributary of Sixteen Mile Creek

The regulated stream corridor at this location will remain as an open watercourse in the future. The existing twin concrete box culvert at this location can convey the 50-year storm event and the roadway is flood-free for the Regional Storm event. Given that the existing crossing structure is already constructed to its ultimate length, and because the existing structure meets the hydraulic conveyance criteria for the roadway, no structure replacement is required here.

### **5.2.2 SWM Pond Crossing Structures**

As noted in Section 4.1, the two open unregulated drainage features upstream of Britannia Road at crossings No. 4 and 8 will ultimately be eliminated and replaced with stormwater ponds as part of the Boyne Secondary Plan Area development (Figure 2). Therefore, the hydraulic structures at these crossing locations will need to accommodate existing flood flow rates until the stormwater ponds are constructed. Once the ponds are constructed on the north side of Britannia Road, it is assumed that the crossing structures would continue to function as pond outlets.

### Crossing No. 4 – West Tributary of Sixteen Mile Creek

The existing CSP culvert at this location is overtopped for the Regional Storm flow and does not provide 1 meter of freeboard for the 50-year storm. Therefore, the existing culvert structure does not meet the hydraulic conveyance criteria for the roadway design (Table 3).

The existing culvert should therefore be replaced with a new crossing structure which meets the conveyance capacity and flooding criteria for the new roadway discussed in Section 3. No environmental criteria apply to the unregulated drainage feature. As shown in Table 4, a concrete box structure with an opening of approximately 4.4m wide by 1.0m high is recommended. The size was selected to meet the hydraulic criteria while also accounting for height restrictions related to the proposed road profile.

Conveyance Capacity Criteria and Flooding Criteria – As shown in Table 5, the proposed culvert can convey the 50-year storm with 1m of freeboard or more, and can convey the Regional storm flow without overtopping the road. As shown in Table 6, the proposed culvert would result in a decrease in flood levels. Model output is provided in Appendix C.

#### Crossing No. 8 – East Tributary of Sixteen Mile Creek

The existing CSP culvert at this location is overtopped for the Regional Storm flow and does not provide 1 meter of freeboard for the 50-year storm. Therefore, the existing culvert structure does not meet the hydraulic conveyance criteria for the roadway design (Table 3).

The existing culvert should therefore be replaced with a new crossing structure which meets the conveyance capacity and flooding criteria for the new roadway discussed in Section 3. No environmental criteria apply to the unregulated drainage feature. As shown in Table 4, a concrete box structure with an opening of approximately 4.5m wide by 1.0m high is recommended. The size was selected to meet the hydraulic criteria while also accounting for height restrictions related to the proposed road profile.

Conveyance Capacity Criteria and Flooding Criteria – As shown in Table 5, the proposed culvert can convey the 50-year storm with 1m of freeboard or more, and can convey the Regional storm flow without overtopping the road. As shown in Table 6, the proposed culvert would result in a decrease in flood levels. Model output is provided in Appendix C.

### **5.2.3 Optional Temporary Crossing Structures**

The crossings associated with unregulated drainage features No. 3, 5a, 10 and 12 will ultimately be eliminated as part of the upstream Boyne development (Figure 2). Hydraulic structures could be constructed at these locations to convey existing flood flows until the upstream development takes place. If built, it is understood that these structures will ultimately be abandoned once the

contributing upstream drainage is eliminated through the future urban drainage diversions. There are three general options at these temporary crossing locations:

- ***Option 1 - Full-sized temporary culverts which meet conveyance capacity criteria.*** This would involve construction of new culvert structures sized using the same conveyance capacity and flooding criteria as the permanent structures. No environmental criteria apply to the unregulated drainage features. As shown in Table 4, if this option were chosen, the following replacement structures would be recommended at temporary crossings No. 3, 5a, and 12 to meet the hydraulic criteria while also accounting for height restrictions related to the proposed road profile:
  - ***Crossing No. 3.*** A new concrete box culvert with twin openings of approximately 3.2m wide by 1.0m high would be recommended.
  - ***Crossing No. 5a.*** A new concrete box culvert with an opening of approximately 2.0m wide by 1.0m high would be recommended.
  - ***Crossing No. 12.*** A new concrete box culvert with an opening of approximately 3.0m wide by 1.0m high would be recommended.

Regarding crossing No. 10, a new culvert structure would be required beneath the Omagh bypass which is to be constructed south of the existing Britannia Road right-of-way. It is assumed that the current culvert crossing along the existing Britannia Road right-of-way will continue to convey flows until the Boyne lands on the north side of the road are developed. As shown in Table 4, a concrete box structure with an opening of approximately 4m wide by 0.75m high is recommended to meet the hydraulic criteria while also accounting for height restrictions related to the proposed road profile. Due to the angle between the existing channel and proposed bypass road, a culvert length of approximately 60m was assumed at this location.

As shown in Table 5, the proposed temporary culverts discussed above for crossings No. 3, 5a, 10 and 12 can convey the 50-year storm with 1m of freeboard or more, and can convey the Regional storm flow without overtopping the road. As shown in Table 6, the proposed culverts would also result in a decrease in flood levels. Model output is provided in Appendix C.

- ***Option 2 - Smaller temporary culverts sized with relaxed conveyance criteria.***  
Recognizing that these structures will be temporary in nature, the Region may consider relaxing the hydraulic conveyance targets that are applied. For example, rather than constructing a full-sized culvert that achieves the objective of a flood-free road for extreme storms as large as the Regional event, consideration may be given to a smaller structure with a reduced capacity.
- ***Option 3 – Temporary diversion of the upstream drainage and eliminate the crossing.***  
The third option reviewed at these temporary crossing locations would involve eliminating the crossing structure. Instead of a temporary culvert, the upstream drainage would be diverted prior to the Boyne development. This would be accomplished via temporary ditching on the north side of Britannia Road, or provision of ditch inlets to the future Britannia Road storm sewer system.

The directions and outlets of any such diversions should be consistent with the ultimate drainage diversions planned in the Boyne area (Figure 2). As such, a temporary diversion at crossing No. 3 should direct drainage westward to the east side of crossing No. 2, while a temporary diversion at crossing No. 5a should direct drainage eastward to the west side of crossing No. 6.

Diversions at crossing No. 10 and 12 would need to take place along the north side of the Omagh bypass, and discharge at the new crossing No. 11 location (Figure 3). For crossing No. 10, if a temporary ditch were to be used, an additional temporary culvert would also be required to convey the drainage eastward under Forth Line. Alternatively, the drainage from this small feature could be directed, via ditch inlet, into the future storm sewer system beneath the bypass road, thereby eliminating the need for an additional temporary culvert at Fourth Line.

Preliminary grading information from the overall road design EA study indicates that temporary diversions appear to be feasible at Crossing No. 3, 5a, and 12. As such, the preliminary recommendation for these crossings would be provision of temporary ditches (i.e. Option 3) on the north side of Britannia Road to divert the drainage features to their ultimate outlet locations.

The preliminary recommendation for crossing No 10 is the construction of a temporary culvert (i.e. Option 1) to continue to convey the drainage at the current location. At this early planning stage, this option is favoured over the construction of a lengthy diversion along the Omagh bypass, which, in turn, would require an additional temporary culvert or ditch inlet to convey flows under Fourth Line.

It is understood that the above recommendations for the temporary crossings are preliminary at this early stage of the planning and design process. The preferred options may change or Option 2 (smaller temporary culverts) could be further investigated as future detailed design proceeds.

#### **5.2.4 Minor Ditch Culverts**

In addition to the 19 stream crossing structures, other small CSP cross-culvert structures which convey drainage between the north and south roadside ditches were also noted within the study area, but are not associated with defined channels or stream crossings. These small cross-culverts were noted primarily in east end of study area, between 8<sup>th</sup> Line and Highway 407, where the topography is flat and drainage is not well defined.

Following the Britannia Road corridor improvements, the road will have an urban, curb-and-gutter cross-section and the roadside ditches will be eliminated. Therefore, it is recommended that future detailed design assess the proposed grading adjacent to the road and provide ditch inlets to the future storm sewer system, where required, to facilitate drainage at any low points, local depressions, or locations of poor drainage.

## **6.0 STORMWATER MANAGEMENT**

A number of techniques to provide stormwater management control for the proposed Britannia Road improvements were reviewed:

- infiltration / low impact development (LID) measures, including grassed swales/ditches or exfiltration systems
- stormwater management ponds;
- oil / grit separators;

### Infiltration / LID Measures

There are several types of LID stormwater management techniques which provide environmental benefits through infiltration of stormwater. Such techniques reduce runoff volumes and trap contaminants before discharging to the receiving streams. In addition to these water quality benefits, infiltration-type LID methods may also provide thermal benefits through heat transfer to the infiltration media, allowing stormwater runoff to cool. In the context of a road system, the techniques would be classified as “conveyance” controls, in which stormwater is infiltrated while being conveyed via the drainage system. This could include roadside swales/ditches, bio swales, or storm sewers designed to exfiltrate stormwater.

Given that the road is to be designed with an urban cross-section with a curb and gutter / storm sewer system, opportunities to infiltrate stormwater runoff via roadside ditches are expected to be limited. Further, due to the predominantly impermeable clay soils in this region, opportunities to utilize storm sewer exfiltration techniques may be also be limited. On their own, such techniques are therefore not considered suitable for this area.

Notwithstanding the above, opportunities to use LID methods in conjunction with other stormwater controls such as oil-grit separators (see below) should be explored as subsequent designs proceed, subject to feasibility and Region design standards. Priority would be given to those areas discharging to streams with more sensitive fisheries such as Silver Shiner.



### Stormwater Management Ponds

Stormwater ponds utilize a permanent pool of water to remove pollutants from stormwater runoff and have been found to be efficient in reducing particulate matter such as suspended solids, organic nutrients, heavy metals, and biological oxygen demand (BOD). A wet pond may also provide extended detention storage for erosion and flood control and can also enhance baseflow, thereby providing an opportunity to improve downstream aquatic habitat. Wet ponds were therefore considered as a feasible option, where space permits, to provide the necessary water quality, erosion and flood control.

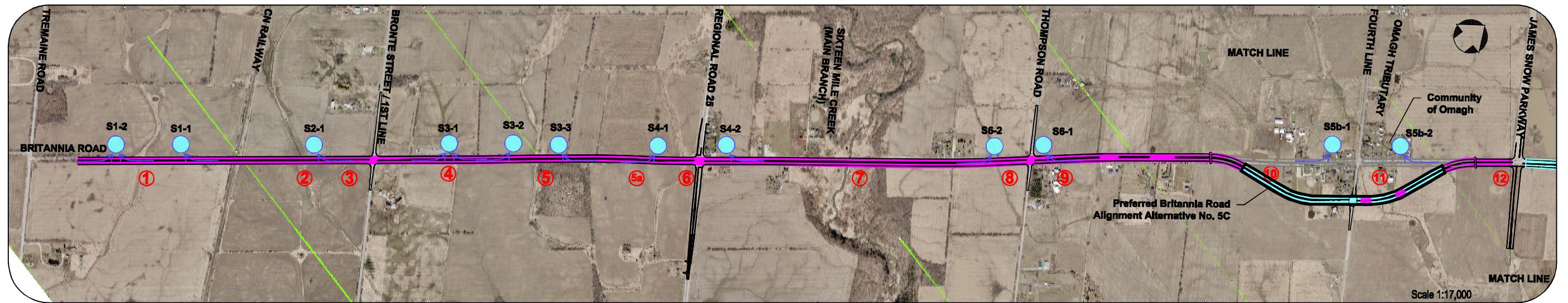
However, a significant limitation in the use of stormwater ponds is the size of the contributing drainage area. The MOE Stormwater Management Planning and Design Manual suggests a minimum drainage area of at least 5 ha to 10 ha for stormwater ponds. This target is often difficult to achieve for a roadway drainage system consisting of a long, narrow catchment with frequent stream crossings and drainage divides.

However, a portion of the Britannia Road study reach is adjacent to the Boyne Secondary Planning Area, where future urban development and associated stormwater ponds are planned. Therefore, there is an opportunity to overcome the drainage area limitations for Britannia Road by itself, by combining the future roadway drainage into the larger adjacent Boyne stormwater pond catchments. Figure 4 illustrates conceptual stormwater pond locations in the Boyne Secondary Plan Area (AMEC, 2011), and the adjacent portion of Britannia Road which could potentially be serviced by these ponds.

Through discussions with Halton Region and Conservation Halton staff, it is recognized that the Britannia Road improvements will likely be constructed in advance of the planned future urban development in the Boyne Secondary Plan Area. Therefore, it was recommended that planning and design of the Britannia Road storm sewer drainage system be undertaken to anticipate future connections to the proposed stormwater management ponds within the Boyne Secondary Plan Area. As such, for the portion of Britannia Road that is adjacent to the Secondary Plan area, the












**FIGURE 4. PROPOSED STORMWATER MANAGEMENT CONCEPT  
BRITANNIA ROAD TRANSPORTATION CORRIDOR IMPROVEMENTS**

**LEGEND**

-  CROSSING No.
-  PROPOSED STORMWATER MANAGEMENT FACILITY - BOYNE SECONDARY PLAN AREA (AMEC, 2011)
-  ROADWAY RUNOFF DIRECTED TO BOYNE SWM PONDS, WHERE GRADES PERMIT
-  OIL-GRIT SEPARATOR
-  ROADWAY RUNOFF DIRECTED TO OIL-GRIT SEPARATORS, WHERE GRADE PERMIT





storm sewer system should be designed with outlets on the north side of the road. Further, sizing for future stormwater management ponds should include sufficient storage to provide treatment for the future drainage from Britannia Road. It is assumed that the same water quality, erosion, and quantity control targets identified for lands in the Boyne Secondary Plan area would also be applied to any contributing lands from the Britannia Road right-of-way.

In addition to Level 1 water quality control, it is recommended that design of future stormwater ponds also include measures to minimize thermal impacts. Potential techniques which could be incorporated into the designs include:

- bottom-draw outlet pipes;
- gravel trenches / french drains at the outfalls;
- shade plantings.

#### Oil-Grit Separators

These devices typically service small drainage areas associated with roadways or parking areas, and provide water quality control by trapping oils on the surface and settling heavy sediment.

Oil-grit separators are recommended at the outlets from the storm sewer system for those segments of the road which will not be serviced by future adjacent stormwater ponds (Figure 4). This would include the area east of James Snow Parkway as well as the south bypass of Omagh. Devices within the study area should be sized to provide Level 1 water quality control. As noted above, opportunities to use LID methods to provide thermal benefits in conjunction with oil-grit separators should be explored as subsequent designs proceed, subject to feasibility and Region design standards. Priority would be given to those areas discharging to streams with more sensitive fisheries such as Silver Shiner.

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## **Appendix A: EPA SWM model input-output**





[TITLE]

[OPTIONS]

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INFILTRATION        GREEN_AMPT
FLOW_ROUTING        DYNWAVE
START_DATE          09/29/2011
START_TIME          00:00:00
REPORT_START_DATE   09/29/2011
REPORT_START_TIME   00:00:00
END_DATE            10/01/2011
END_TIME            01:00:00
SWEEP_START         01/01
SWEEP_END           12/31
DRY_DAYS            0
REPORT_STEP         01:00:00
WET_STEP            01:00:00
DRY_STEP            01:00:00
ROUTING_STEP        0:00:30
ALLOW_PONDING      NO
INERTIAL_DAMPING    PARTIAL
VARIABLE_STEP       0.75
LENGTHENING_STEP   0
MIN_SURFAREA       0
NORMAL_FLOW_LIMITED BOTH
SKIP_STEADY_STATE   NO
FORCE_MAIN_EQUATION H-W
LINK_OFFSETS        DEPTH
MIN_SLOPE           0
    
```

[EVAPORATION]

```

;;Type      Parameters
;;-----
CONSTANT    0.0
DRY_ONLY    NO
    
```

[RAINGAGES]

```

;;
;;Name      Rain      Time      Snow      Data
;;Type      Type      Intrvl   Catch     Source
;;-----
2-year     INTENSITY 0:15    1.0      TIMESERIES 2-year
5-year     INTENSITY 0:15    1.0      TIMESERIES 5-year
10-year    INTENSITY 0:15    1.0      TIMESERIES 10-year
25-year    INTENSITY 0:15    1.0      TIMESERIES 25-year
50-year    INTENSITY 0:15    1.0      TIMESERIES 50-year
100-year   INTENSITY 0:15    1.0      TIMESERIES 100-year
Hazel     INTENSITY 1:00    1.0      TIMESERIES Hazel
    
```

[SUBCATCHMENTS]

```

;;
;;Name      Raingage      Outlet      Total      Pcnt.      Pcnt.      Curb      Snow
;;Type      Type              Area        Imperv      Width      Slope     Length    Pack
;;-----
18          2-year           8            136        20         750       0.28     0
17          2-year           7            344        30         1000      0.47     0
16          2-year           4            40         20         1000      0.45     0
    
```

[SUBAREAS]

```

;;Subcatchment  N-Imperv  N-Perv  S-Imperv  S-Perv  PctZero  RouteTo  PctRouted
;;-----
18              0.01     0.1    1         3       25       OUTLET
17              0.01     0.1    1         3       25       OUTLET
16              0.01     0.1    1         3       25       OUTLET
    
```

[INFILTRATION]

```

;;Subcatchment  Suction  HydCon  IMDmax
;;-----
18              292.2   1       0.092
17              292.2   1       0.092
16              292.2   1       0.092
    
```

[OUTFALLS]

```

;;
;;Name      Invert      Outfall      Stage/Table      Tide
;;Elev.     Type        Time Series     Gate
;;-----
4           0           FREE         NO
7           0           FREE         NO
8           0           FREE         NO
    
```

[TIMESERIES]

```

;;Name      Date      Time      Value
;;-----
2-year     0:00     0
    
```

2-year	0:15	4
2-year	0:30	10
2-year	0:45	14
2-year	1:00	11
2-year	1:15	8
2-year	1:30	6
2-year	1:45	3
2-year	2:00	0
5-year	0:00	0
5-year	0:15	7
5-year	0:30	13
5-year	0:45	19
5-year	1:00	15
5-year	1:15	11
5-year	1:30	7
5-year	1:45	3
5-year	2:00	0
10-year	0:00	0
10-year	0:15	8
10-year	0:30	16
10-year	0:45	24
10-year	1:00	20
10-year	1:15	16
10-year	1:30	11
10-year	1:45	6
10-year	2:00	0
25-year	0	0
25-year	0:15	9
25-year	0:30	18
25-year	0:45	27
25-year	1:00	23
25-year	1:15	17
25-year	1:30	9
25-year	1:45	6
25-year	2:00	0
50-year	0:00	0
50-year	0:15	10
50-year	0:30	20
50-year	0:45	30
50-year	1:00	22
50-year	1:15	14
50-year	1:30	9
50-year	1:45	6
50-year	2:00	0
100-year	0:00	0
100-year	0:15	12
100-year	0:30	23
100-year	0:45	35
100-year	1:00	26
100-year	1:15	17
100-year	1:30	9
100-year	1:45	6
100-year	2:00	0
Hazel	09/29/2011 0:00	2
Hazel	09/29/2011 1:00	2
Hazel	09/29/2011 2:00	2
Hazel	09/29/2011 3:00	2
Hazel	09/29/2011 4:00	2
Hazel	09/29/2011 5:00	2
Hazel	09/29/2011 6:00	2
Hazel	09/29/2011 7:00	2
Hazel	09/29/2011 8:00	2
Hazel	09/29/2011 9:00	2
Hazel	09/29/2011 10:00	2
Hazel	09/29/2011 11:00	2
Hazel	09/29/2011 12:00	2
Hazel	09/29/2011 13:00	2
Hazel	09/29/2011 14:00	2
Hazel	09/29/2011 15:00	2
Hazel	09/29/2011 16:00	2
Hazel	09/29/2011 17:00	2
Hazel	09/29/2011 18:00	2
Hazel	09/29/2011 19:00	2
Hazel	09/29/2011 20:00	2
Hazel	09/29/2011 21:00	2
Hazel	09/29/2011 22:00	2

Hazel	09/29/2011	23:00	2
Hazel	09/30/2011	00:00	2
Hazel	09/30/2011	1:00	2
Hazel	09/30/2011	2:00	2
Hazel	09/30/2011	3:00	2
Hazel	09/30/2011	4:00	2
Hazel	09/30/2011	5:00	2
Hazel	09/30/2011	6:00	2
Hazel	09/30/2011	7:00	2
Hazel	09/30/2011	8:00	2
Hazel	09/30/2011	9:00	2
Hazel	09/30/2011	10:00	2
Hazel	09/30/2011	11:00	2
Hazel	09/30/2011	12:00	2
Hazel	09/30/2011	13:00	6
Hazel	09/30/2011	14:00	4
Hazel	09/30/2011	15:00	6
Hazel	09/30/2011	16:00	13
Hazel	09/30/2011	17:00	17
Hazel	09/30/2011	18:00	13
Hazel	09/30/2011	19:00	23
Hazel	09/30/2011	20:00	13
Hazel	09/30/2011	21:00	13
Hazel	09/30/2011	22:00	53
Hazel	09/30/2011	23:00	38
Hazel	10/01/2011	00:00	13

[REPORT]  
INPUT NO  
CONTROLS NO  
SUBCATCHMENTS ALL  
NODES ALL  
LINKS ALL

[TAGS]

[MAP]  
DIMENSIONS 0.000 0.000 10000.000 10000.000  
Units None

[COORDINATES]  
; ;Node X-Coord Y-Coord  
; ;-----  
4 1402.985 5925.373  
7 4462.687 5761.194  
8 7776.119 5940.299

[VERTICES]  
; ;Link X-Coord Y-Coord  
; ;-----

[Polygons]  
; ;Subcatchment X-Coord Y-Coord  
; ;-----  
18 7464.342 8066.561  
18 7511.886 6624.406  
18 9207.607 6735.341  
18 9001.585 8161.648  
18 7400.951 8082.409  
17 4104.596 8066.561  
17 4136.292 6465.927  
17 5768.621 6545.166  
17 5641.838 8114.105  
17 4088.748 8066.561  
16 706.815 8133.122  
16 738.510 6516.640  
16 2529.319 6389.857  
16 2481.775 8101.426  
16 675.119 8180.666

[SYMBOLS]  
; ;Gage X-Coord Y-Coord  
; ;-----  
2-year 0.000 5039.620  
5-year 1156.894 5118.859  
10-year 2694.136 5023.772  
25-year 5261.490 4976.228  
50-year 6909.667 5023.772  
100-year 8335.975 4992.076  
Hazel 9820.896 5104.478



EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.022)

\*\*\*\*\*  
 NOTE: The summary statistics displayed in this report are based on results found at every computational time step, not just on results from each reporting time step.  
 \*\*\*\*\*

\*\*\*\*\*  
 Analysis Options  
 \*\*\*\*\*

Flow Units ..... CMS  
 Process Models:  
   Rainfall/Runoff ..... YES  
   Snowmelt ..... NO  
   Groundwater ..... NO  
   Flow Routing ..... NO  
   Water Quality ..... NO  
 Infiltration Method ..... GREEN\_AMPT  
 Starting Date ..... SEP-29-2011 00:00:00  
 Ending Date ..... OCT-01-2011 01:00:00  
 Antecedent Dry Days ..... 0.0  
 Report Time Step ..... 01:00:00  
 Wet Time Step ..... 01:00:00  
 Dry Time Step ..... 01:00:00

WARNING 01: wet weather time step reduced to recording interval for Rain Gage 2-year

*****	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
*****	-----	-----
Total Precipitation .....	7.280	14.000
Evaporation Loss .....	0.000	0.000
Infiltration Loss .....	5.337	10.263
Surface Runoff .....	1.848	3.555
Final Surface Storage .....	0.109	0.209
Continuity Error (%) .....	-0.196	

*****	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	1.848	18.483
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	0.000	0.000
External Outflow .....	1.848	18.483
Internal Outflow .....	0.000	0.000
Storage Losses .....	0.000	0.000
Initial Stored Volume .....	0.000	0.000
Final Stored Volume .....	0.000	0.000
Continuity Error (%) .....	0.000	

\*\*\*\*\*  
 Subcatchment Runoff Summary  
 \*\*\*\*\*

2- year. txt

Total Runoff Subcatchment 10 <sup>6</sup> ltr	Peak Runoff CMS	Runoff Coeff	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm
18			14.00	0.00	0.00	11.19	2.68
3.65	0.68	0.192					
17			14.00	0.00	0.00	9.79	3.99
13.73	1.92	0.285					
16			14.00	0.00	0.00	11.15	2.75
1.10	0.29	0.197					

Analysis begun on: Fri Feb 08 11:18:31 2013  
 Analysis ended on: Fri Feb 08 11:18:31 2013  
 Total elapsed time: < 1 sec

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.022)

\*\*\*\*\*  
 NOTE: The summary statistics displayed in this report are based on results found at every computational time step, not just on results from each reporting time step.  
 \*\*\*\*\*

\*\*\*\*\*  
 Analysis Options  
 \*\*\*\*\*

Flow Units ..... CMS  
 Process Models:  
   Rainfall/Runoff ..... YES  
   Snowmelt ..... NO  
   Groundwater ..... NO  
   Flow Routing ..... NO  
   Water Quality ..... NO  
 Infiltration Method ..... GREEN\_AMPT  
 Starting Date ..... SEP-29-2011 00:00:00  
 Ending Date ..... OCT-01-2011 01:00:00  
 Antecedent Dry Days ..... 0.0  
 Report Time Step ..... 01:00:00  
 Wet Time Step ..... 01:00:00  
 Dry Time Step ..... 01:00:00

WARNING 01: wet weather time step reduced to recording interval for Rain Gage 2-year

*****	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
*****	-----	-----
Total Precipitation .....	9.750	18.750
Evaporation Loss .....	0.000	0.000
Infiltration Loss .....	7.033	13.525
Surface Runoff .....	2.630	5.058
Final Surface Storage .....	0.109	0.209
Continuity Error (%) .....	-0.227	

*****	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	2.630	26.303
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	0.000	0.000
External Outflow .....	2.630	26.303
Internal Outflow .....	0.000	0.000
Storage Losses .....	0.000	0.000
Initial Stored Volume .....	0.000	0.000
Final Stored Volume .....	0.000	0.000
Continuity Error (%) .....	0.000	

\*\*\*\*\*  
 Subcatchment Runoff Summary  
 \*\*\*\*\*

5-year. txt

Total Runoff Subcatchment 10 <sup>6</sup> ltr	Peak Runoff CMS	Runoff Coeff	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm
18			18.75	0.00	0.00	14.78	3.86
5.25	1.04	0.206					
17			18.75	0.00	0.00	12.97	5.58
19.19	3.01	0.297					
16			18.75	0.00	0.00	14.01	4.67
1.87	0.41	0.249					

Analysis begun on: Fri Feb 08 11:17:53 2013  
 Analysis ended on: Fri Feb 08 11:17:53 2013  
 Total elapsed time: < 1 sec



EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.022)

\*\*\*\*\*  
 NOTE: The summary statistics displayed in this report are based on results found at every computational time step, not just on results from each reporting time step.  
 \*\*\*\*\*

\*\*\*\*\*  
 Analysis Options  
 \*\*\*\*\*

Flow Units ..... CMS  
 Process Models:  
   Rainfall/Runoff ..... YES  
   Snowmelt ..... NO  
   Groundwater ..... NO  
   Flow Routing ..... NO  
   Water Quality ..... NO  
 Infiltration Method ..... GREEN\_AMPT  
 Starting Date ..... SEP-29-2011 00:00:00  
 Ending Date ..... OCT-01-2011 01:00:00  
 Antecedent Dry Days ..... 0.0  
 Report Time Step ..... 01:00:00  
 Wet Time Step ..... 01:00:00  
 Dry Time Step ..... 01:00:00

WARNING 01: wet weather time step reduced to recording interval for Rain Gage 2-year

*****	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
*****	-----	-----
Total Precipitation .....	13.130	25.250
Evaporation Loss .....	0.000	0.000
Infiltration Loss .....	9.064	17.431
Surface Runoff .....	3.990	7.673
Final Surface Storage .....	0.109	0.210
Continuity Error (%) .....	-0.252	

*****	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	3.990	39.901
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	0.000	0.000
External Outflow .....	3.990	39.901
Internal Outflow .....	0.000	0.000
Storage Losses .....	0.000	0.000
Initial Stored Volume .....	0.000	0.000
Final Stored Volume .....	0.000	0.000
Continuity Error (%) .....	0.000	

\*\*\*\*\*  
 Subcatchment Runoff Summary  
 \*\*\*\*\*

10-year.txt

Total Runoff Subcatchment 10 <sup>6</sup> ltr	Peak Runoff CMS	Runoff Coeff	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm
18			25.25	0.00	0.00	19.09	6.07
8.26	1.46	0.240					
17			25.25	0.00	0.00	16.89	8.18
28.15	4.46	0.324					
16			25.25	0.00	0.00	16.49	8.74
3.50	0.61	0.346					

Analysis begun on: Fri Feb 08 11:17:10 2013  
 Analysis ended on: Fri Feb 08 11:17:10 2013  
 Total elapsed time: < 1 sec

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.022)

\*\*\*\*\*  
 NOTE: The summary statistics displayed in this report are based on results found at every computational time step, not just on results from each reporting time step.  
 \*\*\*\*\*

\*\*\*\*\*  
 Analysis Options  
 \*\*\*\*\*

Flow Units ..... CMS  
 Process Models:  
   Rainfall/Runoff ..... YES  
   Snowmelt ..... NO  
   Groundwater ..... NO  
   Flow Routing ..... NO  
   Water Quality ..... NO  
 Infiltration Method ..... GREEN\_AMPT  
 Starting Date ..... SEP-29-2011 00:00:00  
 Ending Date ..... OCT-01-2011 01:00:00  
 Antecedent Dry Days ..... 0.0  
 Report Time Step ..... 01:00:00  
 Wet Time Step ..... 01:00:00  
 Dry Time Step ..... 01:00:00

WARNING 01: wet weather time step reduced to recording interval for Rain Gage 2-year

*****	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
*****	-----	-----
Total Precipitation .....	14.170	27.250
Evaporation Loss .....	0.000	0.000
Infiltration Loss .....	9.601	18.463
Surface Runoff .....	4.499	8.652
Final Surface Storage .....	0.109	0.210
Continuity Error (%) .....	-0.275	

*****	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	4.499	44.991
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	0.000	0.000
External Outflow .....	4.499	44.991
Internal Outflow .....	0.000	0.000
Storage Losses .....	0.000	0.000
Initial Stored Volume .....	0.000	0.000
Final Stored Volume .....	0.000	0.000
Continuity Error (%) .....	0.000	

\*\*\*\*\*  
 Subcatchment Runoff Summary  
 \*\*\*\*\*

25-year.txt

Total Runoff Subcatchment 10 <sup>6</sup> ltr	Peak Runoff CMS	Runoff Coeff	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm
18			27.25	0.00	0.00	20.22	6.95
9.45	1.74	0.255					
17			27.25	0.00	0.00	17.95	9.13
31.42	5.15	0.335					
16			27.25	0.00	0.00	16.95	10.30
4.12	0.75	0.378					

Analysis begun on: Fri Feb 08 11:16:05 2013  
 Analysis ended on: Fri Feb 08 11:16:05 2013  
 Total elapsed time: < 1 sec

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.022)

\*\*\*\*\*  
 NOTE: The summary statistics displayed in this report are based on results found at every computational time step, not just on results from each reporting time step.  
 \*\*\*\*\*

\*\*\*\*\*  
 Analysis Options  
 \*\*\*\*\*

Flow Units ..... CMS  
 Process Models:  
   Rainfall/Runoff ..... YES  
   Snowmelt ..... NO  
   Groundwater ..... NO  
   Flow Routing ..... NO  
   Water Quality ..... NO  
 Infiltration Method ..... GREEN\_AMPT  
 Starting Date ..... SEP-29-2011 00:00:00  
 Ending Date ..... OCT-01-2011 01:00:00  
 Antecedent Dry Days ..... 0.0  
 Report Time Step ..... 01:00:00  
 Wet Time Step ..... 01:00:00  
 Dry Time Step ..... 01:00:00

WARNING 01: wet weather time step reduced to recording interval for Rain Gage 2-year

*****	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
*****	-----	-----
Total Precipitation .....	14.430	27.750
Evaporation Loss .....	0.000	0.000
Infiltration Loss .....	9.728	18.708
Surface Runoff .....	4.635	8.913
Final Surface Storage .....	0.109	0.210
Continuity Error (%) .....	-0.290	

*****	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	4.635	46.350
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	0.000	0.000
External Outflow .....	4.635	46.350
Internal Outflow .....	0.000	0.000
Storage Losses .....	0.000	0.000
Initial Stored Volume .....	0.000	0.000
Final Stored Volume .....	0.000	0.000
Continuity Error (%) .....	0.000	

\*\*\*\*\*  
 Subcatchment Runoff Summary  
 \*\*\*\*\*

50-year.txt

Total Runoff Subcatchment 10 <sup>6</sup> ltr	Peak Runoff CMS	Runoff Coeff	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm
18			27.75	0.00	0.00	20.49	7.19
9.77	1.81	0.259					
17			27.75	0.00	0.00	18.20	9.39
32.29	5.20	0.338					
16			27.75	0.00	0.00	17.05	10.72
4.29	0.78	0.386					

Analysis begun on: Fri Feb 08 11:15:21 2013  
 Analysis ended on: Fri Feb 08 11:15:21 2013  
 Total elapsed time: < 1 sec

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.022)

\*\*\*\*\*  
 NOTE: The summary statistics displayed in this report are based on results found at every computational time step, not just on results from each reporting time step.  
 \*\*\*\*\*

\*\*\*\*\*  
 Analysis Options  
 \*\*\*\*\*

Flow Units ..... CMS  
 Process Models:  
   Rainfall/Runoff ..... YES  
   Snowmelt ..... NO  
   Groundwater ..... NO  
   Flow Routing ..... NO  
   Water Quality ..... NO  
 Infiltration Method ..... GREEN\_AMPT  
 Starting Date ..... SEP-29-2011 00:00:00  
 Ending Date ..... OCT-01-2011 01:00:00  
 Antecedent Dry Days ..... 0.0  
 Report Time Step ..... 01:00:00  
 Wet Time Step ..... 01:00:00  
 Dry Time Step ..... 01:00:00

WARNING 01: wet weather time step reduced to recording interval for Rain Gage 2-year

*****	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
*****	-----	-----
Total Precipitation .....	16.640	32.000
Evaporation Loss .....	0.000	0.000
Infiltration Loss .....	10.764	20.699
Surface Runoff .....	5.819	11.191
Final Surface Storage .....	0.109	0.210
Continuity Error (%) .....	-0.313	

*****	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	5.819	58.194
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	0.000	0.000
External Outflow .....	5.819	58.194
Internal Outflow .....	0.000	0.000
Storage Losses .....	0.000	0.000
Initial Stored Volume .....	0.000	0.000
Final Stored Volume .....	0.000	0.000
Continuity Error (%) .....	0.000	

\*\*\*\*\*  
 Subcatchment Runoff Summary  
 \*\*\*\*\*

100- year. txt

Total Runoff Subcatchment 10 <sup>6</sup> ltr	Peak Runoff CMS	Runoff Coeff	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm
18			32.00	0.00	0.00	22.65	9.29
12.63	2.24	0.290	32.00	0.00	0.00	20.25	11.60
17			32.00	0.00	0.00	20.25	11.60
39.90	6.51	0.362	32.00	0.00	0.00	17.90	14.15
16			32.00	0.00	0.00	17.90	14.15
5.66	1.02	0.442					

Analysis begun on: Fri Feb 08 11:11:08 2013  
 Analysis ended on: Fri Feb 08 11:11:08 2013  
 Total elapsed time: < 1 sec



\*\*\*\*\*  
 NOTE: The summary statistics displayed in this report are based on results found at every computational time step, not just on results from each reporting time step.  
 \*\*\*\*\*

\*\*\*\*\*  
 Analysis Options  
 \*\*\*\*\*

Flow Units ..... CMS  
 Process Models:  
   Rainfall/Runoff ..... YES  
   Snowmelt ..... NO  
   Groundwater ..... NO  
   Flow Routing ..... NO  
   Water Quality ..... NO  
 Infiltration Method ..... GREEN\_AMPT  
 Starting Date ..... SEP-29-2011 00:00:00  
 Ending Date ..... OCT-01-2011 01:00:00  
 Antecedent Dry Days ..... 0.0  
 Report Time Step ..... 01:00:00  
 Wet Time Step ..... 01:00:00  
 Dry Time Step ..... 01:00:00

WARNING 01: wet weather time step reduced to recording interval for Rain Gage 2-year

*****	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
*****	-----	-----
Total Precipitation .....	148.720	286.000
Evaporation Loss .....	0.000	0.000
Infiltration Loss .....	31.459	60.498
Surface Runoff .....	84.087	161.707
Final Surface Storage .....	34.286	65.935
Continuity Error (%) .....	-0.748	

*****	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	80.751	807.520
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	0.000	0.000
External Outflow .....	80.751	807.520
Internal Outflow .....	0.000	0.000
Storage Losses .....	0.000	0.000
Initial Stored Volume .....	0.000	0.000
Final Stored Volume .....	0.000	0.000
Continuity Error (%) .....	0.000	

\*\*\*\*\*  
 Subcatchment Runoff Summary  
 \*\*\*\*\*

Regional.txt

Total Runoff Subcatchment 10 <sup>6</sup> ltr	Peak Runoff CMS	Runoff Coeff	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm
18			286.00	0.00	0.00	65.95	153.86
209.25	11.54	0.538	286.00	0.00	0.00	57.74	160.25
17			286.00	0.00	0.00	65.66	200.89
551.27	29.00	0.560	286.00	0.00	0.00	65.66	200.89
16			286.00	0.00	0.00	65.66	200.89
80.36	4.86	0.702					

Analysis begun on: Fri Feb 08 11:10:05 2013  
 Analysis ended on: Fri Feb 08 11:10:05 2013  
 Total elapsed time: < 1 sec

## **Appendix B: HEC-RAS hydraulic model results**



## **Existing Hydraulic Structures**



HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-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	Shear Chan (N/m2)	Shear Total (N/m2)	Vel Chnl (m/s)	Vel Total (m/s)
Reach-1	7.92	PF 1	427.40	180.70	185.94		186.03	0.000692	1.86	365.94	125.49	0.27	32.30	19.55	1.86	1.17
Reach-1	7.92	PF 2	97.60	180.70	183.88		183.94	0.000702	1.30	126.13	103.52	0.25	19.03	8.31	1.30	0.77
Reach-1	7.92	PF 3	87.30	180.70	183.75		183.80	0.000726	1.29	112.67	97.22	0.25	18.76	8.18	1.29	0.77
Reach-1	7.92	PF 4	74.10	180.70	183.54		183.59	0.000806	1.28	92.92	87.16	0.26	19.19	8.35	1.28	0.80
Reach-1	7.92	PF 5	59.60	180.70	183.23		183.29	0.001026	1.32	68.15	72.58	0.29	21.40	9.35	1.32	0.87
Reach-1	7.92	PF 6	49.40	180.70	182.93		183.01	0.001432	1.42	48.67	58.62	0.33	25.81	11.52	1.42	1.02
Reach-1	7.81	PF 1	427.40	180.70	185.71		185.95	0.000589	2.84	303.48	95.90	0.41	27.17	17.97	2.84	1.41
Reach-1	7.81	PF 2	97.60	180.70	183.82		183.89	0.000288	1.42	129.10	84.18	0.27	8.03	4.29	1.42	0.76
Reach-1	7.81	PF 3	87.30	180.70	183.69		183.76	0.000278	1.35	118.60	80.52	0.26	7.42	3.98	1.35	0.74
Reach-1	7.81	PF 4	74.10	180.70	183.48		183.55	0.000277	1.28	102.55	74.57	0.26	6.83	3.70	1.28	0.72
Reach-1	7.81	PF 5	59.60	180.70	183.17		183.24	0.000302	1.23	81.05	65.76	0.26	6.56	3.62	1.23	0.74
Reach-1	7.81	PF 6	49.40	180.70	182.87		182.94	0.000370	1.24	62.45	57.05	0.28	6.95	3.93	1.24	0.79
Reach-1	7.767	PF 1	427.40	180.65	185.15	184.67	185.79	0.001811	4.84	205.06	83.44	0.73	79.98	43.08	4.84	2.08
Reach-1	7.767	PF 2	97.60	180.65	183.70	182.74	183.85	0.000578	2.11	96.71	62.67	0.39	17.30	8.63	2.11	1.01
Reach-1	7.767	PF 3	87.30	180.65	183.58	182.63	183.72	0.000555	2.01	89.33	60.39	0.37	15.94	7.93	2.01	0.98
Reach-1	7.767	PF 4	74.10	180.65	183.38	182.47	183.51	0.000551	1.91	77.50	56.55	0.37	14.74	7.30	1.91	0.96
Reach-1	7.767	PF 5	59.60	180.65	183.07	182.26	183.20	0.000613	1.86	60.77	50.62	0.38	14.52	7.10	1.86	0.98
Reach-1	7.767	PF 6	49.40	180.65	182.74	182.08	182.89	0.000803	1.93	45.10	44.35	0.43	16.43	7.87	1.93	1.10
Reach-1	7.763	PF 1	427.40	180.65	185.13	184.65	185.78	0.001847	4.87	203.47	83.24	0.73	81.23	43.71	4.87	2.10
Reach-1	7.763	PF 2	97.60	180.65	183.70	182.73	183.85	0.000581	2.11	96.50	62.61	0.39	17.37	8.66	2.11	1.01
Reach-1	7.763	PF 3	87.30	180.65	183.58	182.63	183.72	0.000557	2.01	89.13	60.33	0.38	16.00	7.96	2.01	0.98
Reach-1	7.763	PF 4	74.10	180.65	183.38	182.47	183.51	0.000554	1.91	77.32	56.49	0.37	14.80	7.33	1.91	0.96
Reach-1	7.763	PF 5	59.60	180.65	183.06	182.25	183.19	0.000617	1.86	60.58	50.55	0.38	14.60	7.14	1.86	0.98
Reach-1	7.763	PF 6	49.40	180.65	182.73	182.07	182.88	0.000812	1.94	44.86	44.25	0.43	16.58	7.94	1.94	1.10
Reach-1	7.761															
Reach-1	7.759	PF 1	427.40	180.30	184.30	184.30	185.31	0.003176	5.92	164.24	78.14	0.94	124.53	64.64	5.92	2.60
Reach-1	7.759	PF 2	97.60	180.30	182.60	182.38	183.02	0.002052	3.29	54.90	48.37	0.69	46.25	22.48	3.29	1.78
Reach-1	7.759	PF 3	87.30	180.30	182.52		182.90	0.001900	3.09	51.33	46.94	0.66	41.43	20.04	3.09	1.70
Reach-1	7.759	PF 4	74.10	180.30	182.41		182.74	0.001734	2.85	45.98	44.72	0.63	35.83	17.19	2.85	1.61
Reach-1	7.759	PF 5	59.60	180.30	182.26		182.54	0.001525	2.55	39.75	42.00	0.58	29.35	13.91	2.55	1.50
Reach-1	7.759	PF 6	49.40	180.30	182.15		182.38	0.001356	2.31	35.08	39.83	0.54	24.58	11.50	2.31	1.41
Reach-1	7.755	PF 1	427.40	180.30	184.43	183.89	184.91	0.004386	4.26	174.25	79.47	0.67	177.45	93.12	4.26	2.45
Reach-1	7.755	PF 2	97.60	180.30	182.67	182.30	182.92	0.003575	2.66	58.64	49.81	0.55	83.25	40.63	2.66	1.66
Reach-1	7.755	PF 3	87.30	180.30	182.59	182.21	182.82	0.003430	2.54	54.39	48.16	0.54	76.96	37.38	2.54	1.61
Reach-1	7.755	PF 4	74.10	180.30	182.46	182.08	182.67	0.003291	2.39	48.26	45.68	0.52	69.61	33.53	2.39	1.54
Reach-1	7.755	PF 5	59.60	180.30	182.30	181.86	182.48	0.003081	2.20	41.25	42.67	0.50	60.39	28.71	2.20	1.45
Reach-1	7.755	PF 6	49.40	180.30	182.17	181.68	182.34	0.002883	2.04	36.08	40.30	0.48	52.97	24.85	2.04	1.37
Reach-1	7.71	PF 1	427.40	180.20	184.36		184.67	0.002739	3.38	198.09	74.03	0.53	111.70	70.28	3.38	2.16
Reach-1	7.71	PF 2	97.60	180.20	182.61		182.74	0.002074	2.05	78.25	62.45	0.42	49.10	25.04	2.05	1.25
Reach-1	7.71	PF 3	87.30	180.20	182.53		182.65	0.002027	1.98	72.77	61.81	0.41	46.24	23.01	1.98	1.20
Reach-1	7.71	PF 4	74.10	180.20	182.39		182.50	0.002031	1.90	64.45	60.83	0.41	43.63	20.75	1.90	1.15
Reach-1	7.71	PF 5	59.60	180.20	182.22		182.33	0.002047	1.81	54.46	59.63	0.41	40.64	18.04	1.81	1.09
Reach-1	7.71	PF 6	49.40	180.20	182.09		182.20	0.002068	1.74	46.73	58.68	0.40	38.41	15.90	1.74	1.06
Reach-1	7.5	PF 1	427.40	179.80	183.59		184.00	0.003644	2.87	155.75	67.75	0.56	93.56	80.89	2.87	2.74
Reach-1	7.5	PF 2	97.60	179.80	182.10		182.22	0.003157	1.54	63.60	55.82	0.46	35.38	34.87	1.54	1.53
Reach-1	7.5	PF 3	87.30	179.80	182.00		182.12	0.003455	1.51	57.85	54.97	0.47	35.26	35.26	1.51	1.51
Reach-1	7.5	PF 4	74.10	179.80	181.84		181.96	0.003701	1.49	49.61	50.39	0.48	35.32	35.32	1.49	1.49
Reach-1	7.5	PF 5	59.60	179.80	181.65		181.76	0.004039	1.47	40.45	44.76	0.49	35.37	35.37	1.47	1.47
Reach-1	7.5	PF 6	49.40	179.80	181.50		181.61	0.004292	1.45	34.07	40.36	0.50	35.06	35.06	1.45	1.45
Reach-1	7.3	PF 1	427.40	179.40	182.79		183.23	0.004109	3.40	168.22	78.12	0.62	124.58	86.06	3.40	2.54
Reach-1	7.3	PF 2	97.60	179.40	181.78		181.85	0.001097	1.35	93.00	67.89	0.30	22.44	14.67	1.35	1.05
Reach-1	7.3	PF 3	87.30	179.40	181.66		181.73	0.001097	1.30	85.32	65.24	0.30	21.22	14.01	1.30	1.02
Reach-1	7.3	PF 4	74.10	179.40	181.49		181.56	0.001121	1.24	74.64	61.35	0.29	19.83	13.31	1.24	0.99
Reach-1	7.3	PF 5	59.60	179.40	181.27		181.34	0.001193	1.17	61.75	56.32	0.30	18.55	12.76	1.17	0.97
Reach-1	7.3	PF 6	49.40	179.40	181.09		181.15	0.001314	1.13	51.68	52.04	0.31	18.06	12.73	1.13	0.96
Reach-1	7.15	PF 1	427.40	179.10	182.63		182.91	0.000854	2.45	217.08	97.56	0.46	23.92	18.53	2.45	1.97
Reach-1	7.15	PF 2	97.60	179.10	181.75		181.78	0.000164	0.84	135.91	85.60	0.19	3.17	2.54	0.84	0.72
Reach-1	7.15	PF 3	87.30	179.10	181.63		181.66	0.000162	0.80	126.12	83.57	0.19	2.95	2.38	0.80	0.69
Reach-1	7.15	PF 4	74.10	179.10	181.46		181.49	0.000162	0.75	112.15	80.59	0.18	2.69	2.20	0.75	0.66
Reach-1	7.15	PF 5	59.60	179.10	181.24		181.26	0.000171	0.70	94.62	76.69	0.19	2.46	2.06	0.70	0.63
Reach-1	7.15	PF 6	49.40	179.10	181.05		181.07	0.000190	0.68	80.20	73.33	0.19	2.38	2.03	0.68	0.62
Reach-1	7.086	PF 1	427.40	178.85	182.61	181.49	182.81	0.001061	3.28	302.51	122.29	0.54	39.14	25.59	3.28	1.41
Reach-1	7.086	PF 2	97.60	178.85	181.74	180.47	181.77	0.000180	1.13	201.17	111.15	0.21	5.10	3.17	1.13	0.49
Reach-1	7.086	PF 3	87.30	178.85	181.63	180.41	181.65	0.000174	1.08	188.36	109.70	0.21	4.73	2.91	1.08	0.46
Reach-1	7.086	PF 4	74.10	178.85	181.46	180.35	181.48	0.000169	1.02	169.80	107.56	0.20	4.31	2.60	1.02	0.44
Reach-1	7.086	PF 5	59.60	178.85	181.23	180.26	181.25	0.000168	0.96	146.05	104.77	0.20	3.92	2.28	0.96	0.41
Reach-1	7.086	PF 6	49.40	178.85	181.04	180.19	181.06	0.000175	0.93	125.99	102.35	0.20	3.76	2.10	0.93	0.39
Reach-1	7.082															
Reach-1	7.08	PF 1	427.40	178.80	182.03		182.37	0.002084	4.16	239.57	115.40	0.74	66.02	42.19	4.16	1.78
Reach-1	7.08	PF 2	97.60	178.80	180.73		180.86	0.001305	2.33	99.79	99.10	0.54	24.68	12.84	2.33	0.98
Reach-1	7.08	PF 3	87.30	178.80	180.65		180.78	0.001280	2.25	92.60	98.18	0.53	23.28	11.79	2.25	0.94
Reach-1	7.08	PF 4	74.10	178.80	180.55		180.68	0.001247	2.14	82.73	96.92	0.52	21.44	10.40	2.14	0.90
Reach-1	7.08	PF 5	59.60	178.80	180.43		180.55									

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 (Continued)

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 (N/m2)	Shear Chan (N/m2)	Shear Total (N/m2)	Vel Chnl (m/s)	Vel Total (m/s)
Reach-1	7.02	PF 5	59.60	178.60	180.36	180.06	180.41	0.001847	1.44	76.15	107.25	0.36	28.05	12.80	12.80	1.44	0.78
Reach-1	7.02	PF 6	49.40	178.60	180.26	180.02	180.31	0.001952	1.42	65.39	105.48	0.37	27.80	11.81	11.81	1.42	0.76
Reach-1	6.92	PF 1	427.40	178.30	181.41		181.77	0.005080	3.60	199.91	133.57	0.68	143.32	74.37	74.37	3.60	2.14
Reach-1	6.92	PF 2	97.60	178.30	179.94	179.94	180.30	0.009126	3.01	47.51	72.16	0.80	126.87	58.78	58.78	3.01	2.05
Reach-1	6.92	PF 3	87.30	178.30	179.87	179.87	180.22	0.009211	2.93	42.72	67.66	0.80	121.91	56.88	56.88	2.93	2.04
Reach-1	6.92	PF 4	74.10	178.30	179.77	179.77	180.11	0.009474	2.82	36.22	61.05	0.80	116.10	54.97	54.97	2.82	2.05
Reach-1	6.92	PF 5	59.60	178.30	179.64	179.64	179.97	0.010134	2.71	28.61	52.24	0.81	110.94	54.25	54.25	2.71	2.08
Reach-1	6.92	PF 6	49.40	178.30	179.52	179.52	179.85	0.010999	2.63	23.04	44.72	0.83	108.13	55.39	55.39	2.63	2.14
Reach-1	6.76	PF 1	427.40	177.70	181.11		181.26	0.001659	2.27	283.36	127.80	0.40	53.98	35.94	35.94	2.27	1.51
Reach-1	6.76	PF 2	97.60	177.70	179.67		179.73	0.001221	1.33	110.25	103.14	0.31	22.56	12.79	12.79	1.33	0.89
Reach-1	6.76	PF 3	87.30	177.70	179.58		179.64	0.001208	1.28	101.33	98.90	0.31	21.27	12.13	12.13	1.28	0.86
Reach-1	6.76	PF 4	74.10	177.70	179.46		179.51	0.001189	1.21	89.50	92.98	0.30	19.49	11.21	11.21	1.21	0.83
Reach-1	6.76	PF 5	59.60	177.70	179.31		179.35	0.001160	1.13	75.97	85.72	0.29	17.30	10.07	10.07	1.13	0.78
Reach-1	6.76	PF 6	49.40	177.70	179.19		179.23	0.001134	1.05	66.01	79.94	0.28	15.58	9.18	9.18	1.05	0.75
Reach-1	6.6	PF 1	427.40	177.20	180.17	180.17	180.75	0.009284	4.48	170.49	125.15	0.89	231.19	123.32	123.32	4.48	2.51
Reach-1	6.6	PF 2	97.60	177.20	178.97	178.93	179.32	0.009566	2.98	49.19	69.26	0.82	126.12	66.25	66.25	2.98	1.98
Reach-1	6.6	PF 3	87.30	177.20	178.92	178.86	179.24	0.009018	2.82	45.80	66.61	0.79	114.52	60.46	60.46	2.82	1.91
Reach-1	6.6	PF 4	74.10	177.20	178.85	178.76	179.12	0.008271	2.60	41.22	62.86	0.75	99.34	52.88	52.88	2.60	1.80
Reach-1	6.6	PF 5	59.60	177.20	178.76	178.64	178.99	0.007362	2.34	35.84	58.15	0.70	82.06	44.24	44.24	2.34	1.66
Reach-1	6.6	PF 6	49.40	177.20	178.69		178.88	0.006603	2.12	31.88	54.42	0.65	69.08	37.71	37.71	2.12	1.55
Reach-1	6.44	PF 1	427.40	176.60	179.72		179.86	0.002689	2.50	292.31	153.05	0.48	70.63	50.11	50.11	2.50	1.46
Reach-1	6.44	PF 2	97.60	176.60	178.51		178.58	0.002536	1.64	111.88	144.56	0.43	36.97	19.19	19.19	1.64	0.87
Reach-1	6.44	PF 3	87.30	176.60	178.44		178.51	0.002618	1.62	102.19	144.09	0.43	36.48	18.16	18.16	1.62	0.85
Reach-1	6.44	PF 4	74.10	176.60	178.35		178.42	0.002727	1.58	89.31	143.47	0.43	35.64	16.60	16.60	1.58	0.83
Reach-1	6.44	PF 5	59.60	176.60	178.25		178.31	0.002875	1.54	74.01	142.72	0.44	34.61	14.59	14.59	1.54	0.81
Reach-1	6.44	PF 6	49.40	176.60	178.16		178.23	0.003055	1.51	61.75	142.12	0.45	34.24	12.99	12.99	1.51	0.80
Reach-1	6.28	PF 1	427.40	176.10	178.69	178.67	179.26	0.011771	4.98	153.84	111.66	1.00	287.46	158.53	158.53	4.98	2.78
Reach-1	6.28	PF 2	97.60	176.10	177.71	177.71	178.04	0.010092	3.33	53.76	81.64	0.85	150.87	65.01	65.01	3.33	1.82
Reach-1	6.28	PF 3	87.30	176.10	177.66	177.66	177.97	0.009807	3.20	49.38	77.74	0.84	141.39	60.93	60.93	3.20	1.77
Reach-1	6.28	PF 4	74.10	176.10	177.57	177.57	177.87	0.009767	3.07	42.79	71.49	0.83	132.45	57.17	57.17	3.07	1.73
Reach-1	6.28	PF 5	59.60	176.10	177.45	177.45	177.74	0.010045	2.93	34.71	62.98	0.83	124.53	54.13	54.13	2.93	1.72
Reach-1	6.28	PF 6	49.40	176.10	177.35	177.35	177.64	0.010227	2.80	28.95	56.13	0.82	117.20	51.56	51.56	2.80	1.71
Reach-1	6.21	PF 1	427.40	175.90	178.51		178.85	0.004160	2.90	194.08	119.26	0.60	98.35	66.26	66.26	2.90	2.20
Reach-1	6.21	PF 2	97.60	175.90	177.19		177.34	0.004740	1.82	61.21	76.04	0.56	50.57	37.38	37.38	1.82	1.59
Reach-1	6.21	PF 3	87.30	175.90	177.12		177.27	0.004729	1.75	56.46	73.54	0.55	47.51	35.57	35.57	1.75	1.55
Reach-1	6.21	PF 4	74.10	175.90	177.04		177.17	0.004740	1.65	50.08	70.04	0.54	43.49	33.21	33.21	1.65	1.48
Reach-1	6.21	PF 5	59.60	175.90	176.93		177.04	0.004751	1.52	42.80	65.82	0.53	38.60	30.27	30.27	1.52	1.39
Reach-1	6.21	PF 6	49.40	175.90	176.85		176.95	0.004693	1.41	37.64	62.66	0.52	34.43	27.63	27.63	1.41	1.31
Reach-1	6.05	PF 1	427.40	174.90	178.17		178.38	0.003141	3.02	236.99	101.15	0.54	97.43	71.28	71.28	3.02	1.80
Reach-1	6.05	PF 2	97.60	174.90	176.28		176.49	0.009151	2.82	62.07	83.65	0.79	115.00	66.24	66.24	2.82	1.57
Reach-1	6.05	PF 3	87.30	174.90	176.24		176.43	0.008683	2.69	58.54	83.24	0.77	105.53	59.58	59.58	2.69	1.49
Reach-1	6.05	PF 4	74.10	174.90	176.18		176.35	0.007947	2.49	53.90	82.70	0.73	92.23	50.55	50.55	2.49	1.37
Reach-1	6.05	PF 5	59.60	174.90	176.11		176.25	0.007112	2.26	48.11	82.02	0.68	77.65	40.72	40.72	2.26	1.24
Reach-1	6.05	PF 6	49.40	174.90	176.05		176.18	0.006999	2.11	42.98	81.41	0.66	69.03	34.54	34.54	2.11	1.15
Reach-1	5.87	PF 1	427.40	174.10	178.16		178.20	0.000350	1.10	500.97	168.33	0.18	12.42	10.15	10.15	1.10	0.85
Reach-1	5.87	PF 2	97.60	174.10	175.56		175.64	0.003344	1.47	91.43	138.72	0.46	33.61	21.59	21.59	1.47	1.07
Reach-1	5.87	PF 3	87.30	174.10	175.50		175.57	0.003543	1.45	82.85	136.86	0.47	33.45	21.01	21.01	1.45	1.05
Reach-1	5.87	PF 4	74.10	174.10	175.41		175.49	0.003917	1.43	71.14	134.27	0.49	33.67	20.33	20.33	1.43	1.04
Reach-1	5.87	PF 5	59.60	174.10	175.31		175.38	0.004423	1.41	58.00	131.30	0.51	33.72	19.14	19.14	1.41	1.03
Reach-1	5.87	PF 6	49.40	174.10	175.24		175.32	0.004743	1.37	48.89	129.20	0.52	32.92	17.58	17.58	1.37	1.01
Reach-1	5.76	PF 1	427.40	173.70	178.12		178.16	0.000430	1.37	635.67	191.55	0.21	18.16	13.94	13.94	1.37	0.67
Reach-1	5.76	PF 2	97.60	173.70	174.93		175.14	0.009132	2.57	78.01	139.32	0.78	100.21	50.13	50.13	2.57	1.25
Reach-1	5.76	PF 3	87.30	173.70	174.91		175.09	0.007992	2.38	75.02	136.54	0.72	86.00	43.05	43.05	2.38	1.16
Reach-1	5.76	PF 4	74.10	173.70	174.89		175.03	0.006274	2.08	72.26	133.93	0.64	66.26	33.19	33.19	2.08	1.03
Reach-1	5.76	PF 5	59.60	173.70	174.82	174.64	174.94	0.005393	1.85	63.79	125.57	0.59	53.50	26.86	26.86	1.85	0.93
Reach-1	5.76	PF 6	49.40	173.70	174.74	174.57	174.85	0.005465	1.76	53.71	114.85	0.58	49.73	25.06	25.06	1.76	0.92
Reach-1	5.68	PF 1	427.40	173.00	178.09		178.13	0.000231	1.21	627.14	178.41	0.18	10.58	7.93	7.93	1.21	0.68
Reach-1	5.68	PF 2	97.60	173.00	174.50		174.67	0.003853	1.87	62.53	95.76	0.57	41.03	24.65	24.65	1.87	1.56
Reach-1	5.68	PF 3	87.30	173.00	174.32		174.53	0.006018	2.07	46.52	77.46	0.69	53.20	36.41	36.41	2.07	1.88
Reach-1	5.68	PF 4	74.10	173.00	174.12	174.05	174.38	0.010153	2.28	33.17	57.94	0.87	70.14	56.94	56.94	2.28	2.23
Reach-1	5.68	PF 5	59.60	173.00	173.96	173.96	174.25	0.014738	2.37	25.16	44.50	1.01	81.59	81.59	2.37	2.27	
Reach-1	5.68	PF 6	49.40	173.00	173.88	173.88	174.14	0.015201	2.29	21.61	41.31	1.01	77.90	77.90	2.29	2.29	
Reach-1	5.627	PF 1	427.40	171.83	178.10	175.47	178.11	0.000072	0.82	1301.80	298.37	0.11	4.43	3.06	3.06	0.82	0.33
Reach-1	5.627	PF 2	97.60	171.83	174.36	173.19	174.55	0.001367	1.96	49.79	257.53	0.39	33.89	33.89	1.96	1.96	
Reach-1	5.627	PF 3	87.30	171.83	174.20	173.09	174.38	0.001346	1.87	46.78	255.60	0.39	31.35	31.35	1.87	1.71	
Reach-1	5.627	PF 4	74.10	171.83	174.03	172.96	174.18	0.001246	1.71	43.39	253.42	0.37	26.92	26.92	1.71	1.71	
Reach-1	5.627	PF 5	59.60	171.83	173.88	172.81	173.99	0.001027	1.48	40.35	225.27	0.33	20.64	20.64	1.48	1.48	
Reach-1	5.627	PF 6	49.40	171.83													



HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 (Continued)

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 (N/m2)	Shear Chan (N/m2)	Shear Total (N/m2)	Vel Chnl (m/s)	Vel Total (m/s)
Reach-1	5.44	PF 4	74.10	169.90	172.86	172.78	173.03	0.002542	2.23	71.96	163.08	0.47	48.14	10.88	2.23	1.03	
Reach-1	5.44	PF 5	59.60	169.90	172.78	172.65	172.93	0.002294	2.07	58.76	143.02	0.44	41.83	9.12	2.07	1.01	
Reach-1	5.44	PF 6	49.40	169.90	172.70		172.85	0.002068	1.92	49.07	126.30	0.42	36.50	7.77	1.92	1.01	
Reach-1	5.32	PF 1	427.40	171.40	174.07		174.15	0.001217	1.88	376.66	225.47	0.37	30.99	19.90	1.88	1.13	
Reach-1	5.32	PF 2	97.60	171.40	172.67		172.79	0.005081	2.30	81.00	158.03	0.67	59.72	25.51	2.30	1.20	
Reach-1	5.32	PF 3	87.30	171.40	172.61		172.74	0.005586	2.32	71.12	147.51	0.69	62.12	26.38	2.32	1.23	
Reach-1	5.32	PF 4	74.10	171.40	172.52		172.66	0.006292	2.34	59.13	133.66	0.73	64.73	27.27	2.34	1.25	
Reach-1	5.32	PF 5	59.60	171.40	172.43		172.57	0.006971	2.31	47.23	118.31	0.75	65.29	27.26	2.31	1.26	
Reach-1	5.32	PF 6	49.40	171.40	172.36		172.50	0.007126	2.23	39.93	107.82	0.75	62.24	25.85	2.23	1.24	
Reach-1	5.16	PF 1	427.40	170.70	173.86		174.02	0.001904	2.64	274.91	140.48	0.48	57.57	36.47	2.64	1.55	
Reach-1	5.16	PF 2	97.60	170.70	172.42		172.49	0.001886	1.73	98.52	105.49	0.43	30.48	17.26	1.73	0.99	
Reach-1	5.16	PF 3	87.30	170.70	172.34		172.41	0.001940	1.70	90.30	103.72	0.43	29.86	16.55	1.70	0.97	
Reach-1	5.16	PF 4	74.10	170.70	172.23		172.30	0.002060	1.67	78.89	101.21	0.44	29.46	15.73	1.67	0.94	
Reach-1	5.16	PF 5	59.60	170.70	172.10		172.17	0.002248	1.64	65.61	98.22	0.45	29.23	14.72	1.64	0.91	
Reach-1	5.16	PF 6	49.40	170.70	171.98		172.06	0.002562	1.64	54.53	94.65	0.48	30.45	14.46	1.64	0.91	
Reach-1	5.11	PF 1	427.40	170.50	173.54		173.88	0.002802	2.71	189.99	111.55	0.56	65.80	46.69	2.71	2.25	
Reach-1	5.11	PF 2	97.60	170.50	172.28		172.39	0.002163	1.45	68.94	71.57	0.43	24.11	20.40	1.45	1.42	
Reach-1	5.11	PF 3	87.30	170.50	172.21		172.31	0.002164	1.39	63.88	68.36	0.43	22.58	19.79	1.39	1.37	
Reach-1	5.11	PF 4	74.10	170.50	172.11		172.19	0.002212	1.31	56.93	63.71	0.43	20.81	19.35	1.31	1.30	
Reach-1	5.11	PF 5	59.60	170.50	171.98		172.06	0.002248	1.21	49.29	58.35	0.42	18.59	18.59	1.21	1.21	
Reach-1	5.11	PF 6	49.40	170.50	171.87		171.94	0.002225	1.15	43.00	54.55	0.41	17.17	17.17	1.15	1.15	
Reach-1	4.95	PF 1	427.40	169.80	172.85		173.27	0.005442	4.36	184.26	99.33	0.80	158.58	98.54	4.36	2.32	
Reach-1	4.95	PF 2	97.60	169.80	171.35	171.35	171.74	0.009216	3.57	49.80	65.89	0.93	133.99	68.20	3.57	1.96	
Reach-1	4.95	PF 3	87.30	169.80	171.28	171.28	171.66	0.009196	3.45	45.40	62.83	0.92	127.56	65.06	3.45	1.92	
Reach-1	4.95	PF 4	74.10	169.80	171.19	171.19	171.54	0.009047	3.28	39.82	58.72	0.91	117.38	60.06	3.28	1.86	
Reach-1	4.95	PF 5	59.60	169.80	171.07	171.07	171.39	0.009138	3.09	32.97	53.25	0.90	107.64	55.39	3.09	1.81	
Reach-1	4.95	PF 6	49.40	169.80	170.97	170.97	171.27	0.009302	2.94	27.87	48.78	0.89	100.51	52.04	2.94	1.77	
Reach-1	4.79	PF 1	427.40	169.10	172.48		172.78	0.002791	3.34	221.07	99.82	0.59	90.00	60.16	3.34	1.93	
Reach-1	4.79	PF 2	97.60	169.10	170.86		170.99	0.002664	2.07	77.00	71.84	0.51	43.47	27.89	2.07	1.27	
Reach-1	4.79	PF 3	87.30	169.10	170.78		170.90	0.002623	1.99	71.32	70.08	0.50	40.75	26.08	1.99	1.22	
Reach-1	4.79	PF 4	74.10	169.10	170.67		170.78	0.002548	1.87	63.87	67.70	0.49	36.88	23.49	1.87	1.16	
Reach-1	4.79	PF 5	59.60	169.10	170.54		170.64	0.002439	1.72	55.26	64.84	0.47	32.19	20.31	1.72	1.08	
Reach-1	4.79	PF 6	49.40	169.10	170.44		170.52	0.002337	1.60	48.85	62.63	0.46	28.55	17.82	1.60	1.01	
Reach-1	4.63	PF 1	427.40	168.40	171.52		172.11	0.005165	3.87	150.21	82.66	0.77	130.90	91.68	3.87	2.85	
Reach-1	4.63	PF 2	97.60	168.40	169.97		170.27	0.007657	2.58	45.57	52.18	0.80	78.90	65.44	2.58	2.14	
Reach-1	4.63	PF 3	87.30	168.40	169.88		170.17	0.008083	2.56	40.86	49.47	0.82	78.95	65.34	2.56	2.14	
Reach-1	4.63	PF 4	74.10	168.40	169.75	169.65	170.04	0.008838	2.54	34.68	45.67	0.84	79.56	65.68	2.54	2.14	
Reach-1	4.63	PF 5	59.60	168.40	169.59	169.53	169.88	0.010158	2.52	27.68	40.94	0.89	81.53	67.20	2.52	2.15	
Reach-1	4.63	PF 6	49.40	168.40	169.46	169.44	169.75	0.011790	2.53	22.54	37.09	0.94	85.03	70.11	2.53	2.19	
Reach-1	4.47	PF 1	427.40	167.20	171.08		171.47	0.002768	3.56	202.82	90.95	0.59	98.87	60.18	3.56	2.11	
Reach-1	4.47	PF 2	97.60	167.20	169.34		169.56	0.002769	2.32	62.14	60.64	0.53	52.01	27.72	2.32	1.57	
Reach-1	4.47	PF 3	87.30	167.20	169.26		169.46	0.002698	2.22	56.98	57.81	0.52	48.38	26.97	2.22	1.53	
Reach-1	4.47	PF 4	74.10	167.20	169.14		169.32	0.002586	2.08	50.23	53.89	0.51	43.35	23.55	2.08	1.48	
Reach-1	4.47	PF 5	59.60	167.20	168.99		169.15	0.002426	1.89	42.62	49.08	0.48	37.17	20.57	1.89	1.40	
Reach-1	4.47	PF 6	49.40	167.20	168.87		169.01	0.002273	1.74	37.16	45.32	0.46	32.27	18.20	1.74	1.33	
Reach-1	4.33	PF 1	427.40	167.00	170.63		171.09	0.003091	3.36	172.83	78.95	0.61	93.27	65.51	3.36	2.47	
Reach-1	4.33	PF 2	97.60	167.00	168.97		169.17	0.003215	2.05	55.32	53.83	0.55	44.81	32.25	2.05	1.76	
Reach-1	4.33	PF 3	87.30	167.00	168.89		169.08	0.003148	1.95	51.25	52.03	0.54	41.51	30.27	1.95	1.70	
Reach-1	4.33	PF 4	74.10	167.00	168.79		168.95	0.003056	1.82	45.83	49.52	0.52	37.11	27.62	1.82	1.62	
Reach-1	4.33	PF 5	59.60	167.00	168.66		168.79	0.002947	1.66	39.54	46.44	0.50	32.01	24.50	1.66	1.51	
Reach-1	4.33	PF 6	49.40	167.00	168.56		168.68	0.002758	1.52	35.33	44.26	0.48	27.46	21.50	1.52	1.40	
Reach-1	4.16	PF 1	427.40	166.70	169.42	169.42	170.33	0.010287	4.91	116.77	63.03	1.04	222.69	184.89	4.91	3.66	
Reach-1	4.16	PF 2	97.60	166.70	168.27		168.54	0.006054	2.60	49.67	53.13	0.73	75.07	55.17	2.60	1.96	
Reach-1	4.16	PF 3	87.30	166.70	168.19		168.45	0.006071	2.52	45.78	52.50	0.73	71.49	51.61	2.52	1.91	
Reach-1	4.16	PF 4	74.10	166.70	168.09		168.33	0.006056	2.39	40.63	51.65	0.72	66.22	46.47	2.39	1.82	
Reach-1	4.16	PF 5	59.60	166.70	167.98		168.19	0.005946	2.22	34.69	50.05	0.70	59.06	40.23	2.22	1.72	
Reach-1	4.16	PF 6	49.40	166.70	167.83		168.05	0.007060	2.21	27.92	45.17	0.75	61.35	42.60	2.21	1.77	
Reach-1	4	PF 1	427.40	165.60	168.54	168.45	169.16	0.006944	4.75	160.70	94.72	0.90	192.04	114.10	4.75	2.66	
Reach-1	4	PF 2	97.60	165.60	167.15	167.15	167.57	0.008683	3.38	45.73	58.74	0.90	121.64	65.69	3.38	2.13	
Reach-1	4	PF 3	87.30	165.60	167.08	167.08	167.48	0.008677	3.26	41.62	55.95	0.89	115.48	62.73	3.26	2.10	
Reach-1	4	PF 4	74.10	165.60	166.97	166.97	167.35	0.008797	3.11	36.00	51.88	0.89	108.11	59.33	3.11	2.06	
Reach-1	4	PF 5	59.60	165.60	166.84	166.84	167.19	0.009200	2.95	29.34	46.61	0.89	100.90	56.31	2.95	2.03	
Reach-1	4	PF 6	49.40	165.60	166.73	166.73	167.07	0.007479	2.59	27.31	44.88	0.80	78.78	44.25	2.59	1.81	
Reach-1	3.84	PF 1	427.40	164.70	168.20		168.55	0.002202	2.66	165.38	62.67	0.51	60.18	55.46	2.66	2.58	
Reach-1	3.84	PF 2	97.60	164.70	166.47		166.80	0.002891	1.60	61.13	58.22	0.50	30.21	29.54	1.60	1.60	
Reach-1	3.84	PF 3	87.30	164.70	166.39		166.51	0.003040	1.56	56.26	58.00	0.50	29.27	28.72	1.56	1.55	
Reach-1	3.84	PF 4	74.10	164.70	166.28		166.39	0.003260	1.49	49.86	57.71	0.51	27.87	27.48	1.49	1.49	
Reach-1	3.84	PF 5	59.60	164.70	166.14		166.24	0.003732	1.42	41.97	57.36	0.53	26.88	26.68	1.42	1.42	
Reach-1	3.84	PF 6	49.40	164.70	166.02		166.12	0.004579	1.40	35.25	57.06	0.57	27.72	27.68	1.40	1.40	
Reach-1	3.67	PF 1	427.40	163.60	167.03	167.03	168.00	0.008552	5.84	137.00	64.89	1.03	275.40	173.52	5.84	3.12	
Reach-1	3.67	PF 2	97.60	163.60	165.43	165.43	165.96	0.008475	3.74	43.37	45.52	0.91	140.80	78.14	3.74	2.25	
Reach-1	3.67	PF 3	87.30	163.60	165.33	165.33	165.84	0.008611									

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 (Continued)

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	Shear Chan (N/m2)	Shear Total (N/m2)	Vel Chnl (m/s)	Vel Total (m/s)
Reach-1	3.35	PF 5	59.60	161.60	162.92		163.12	0.004103	2.08	36.25	44.08	0.60	48.91	32.98	2.08	1.64
Reach-1	3.35	PF 6	49.40	161.60	162.83		163.00	0.003800	1.90	32.20	41.72	0.57	41.79	28.67	1.90	1.53
Reach-1	3.19	PF 1	427.40	161.00	164.75		165.11	0.001894	2.69	175.53	67.24	0.48	59.04	47.81	2.69	2.43
Reach-1	3.19	PF 2	97.60	161.00	162.80		162.94	0.002503	1.64	60.87	52.50	0.47	30.16	28.27	1.64	1.60
Reach-1	3.19	PF 3	87.30	161.00	162.71		162.84	0.002582	1.58	56.20	51.99	0.47	28.85	27.20	1.58	1.55
Reach-1	3.19	PF 4	74.10	161.00	162.59		162.71	0.002687	1.50	50.09	51.33	0.47	26.92	25.58	1.50	1.48
Reach-1	3.19	PF 5	59.60	161.00	162.45		162.55	0.002823	1.40	43.08	50.55	0.47	24.48	23.48	1.40	1.38
Reach-1	3.19	PF 6	49.40	161.00	162.34		162.43	0.003041	1.33	37.49	49.93	0.48	23.05	22.31	1.33	1.32
Reach-1	3.03	PF 1	427.40	160.30	164.22		164.74	0.002738	3.23	138.01	47.65	0.58	85.20	74.68	3.23	3.10
Reach-1	3.03	PF 2	97.60	160.30	162.39		162.54	0.002520	1.75	55.86	42.16	0.48	33.40	32.37	1.75	1.75
Reach-1	3.03	PF 3	87.30	160.30	162.29		162.43	0.002621	1.70	51.56	41.86	0.48	32.11	31.36	1.70	1.69
Reach-1	3.03	PF 4	74.10	160.30	162.14		162.28	0.002810	1.62	45.69	41.43	0.49	30.56	30.18	1.62	1.62
Reach-1	3.03	PF 5	59.60	160.30	161.97		162.09	0.003158	1.55	38.43	40.33	0.51	29.40	29.40	1.55	1.55
Reach-1	3.03	PF 6	49.40	160.30	161.83		161.94	0.003243	1.49	33.08	37.47	0.51	27.96	27.96	1.49	1.49
Reach-1	2.87	PF 1	427.40	159.60	163.01	163.01	164.01	0.009780	5.48	122.17	55.33	1.02	259.39	206.11	5.48	3.50
Reach-1	2.87	PF 2	97.60	159.60	161.51	161.38	161.94	0.006813	3.24	44.83	42.44	0.80	107.55	69.45	3.24	2.18
Reach-1	2.87	PF 3	87.30	159.60	161.44		161.83	0.006400	3.07	41.89	41.02	0.77	97.53	63.07	3.07	2.08
Reach-1	2.87	PF 4	74.10	159.60	161.35		161.68	0.005762	2.81	38.12	39.13	0.72	83.55	54.17	2.81	1.94
Reach-1	2.87	PF 5	59.60	159.60	161.28		161.52	0.004378	2.40	35.60	37.82	0.63	61.24	39.80	2.40	1.67
Reach-1	2.87	PF 6	49.40	159.60	161.10		161.34	0.004886	2.35	29.01	34.14	0.65	61.16	40.11	2.35	1.70
Reach-1	2.71	PF 1	427.40	158.70	162.15	161.80	162.77	0.006482	5.13	163.69	70.08	0.89	211.54	144.18	5.13	2.61
Reach-1	2.71	PF 2	97.60	158.70	160.65		160.97	0.005778	3.26	60.81	67.23	0.76	104.42	50.68	3.26	1.60
Reach-1	2.71	PF 3	87.30	158.70	160.57	160.53	160.89	0.005851	3.19	55.48	67.08	0.76	101.22	46.97	3.19	1.57
Reach-1	2.71	PF 4	74.10	158.70	160.45	160.44	160.78	0.006149	3.12	47.59	66.86	0.77	99.33	42.55	3.12	1.56
Reach-1	2.71	PF 5	59.60	158.70	160.28	159.96	160.66	0.007381	3.18	36.10	66.53	0.83	106.87	39.02	3.18	1.65
Reach-1	2.71	PF 6	49.40	158.70	160.26	160.26	160.54	0.005511	2.72	34.66	66.49	0.72	78.64	28.00	2.72	1.43
Reach-1	2.54	PF 1	427.40	157.60	160.62	160.62	161.37	0.009052	5.54	167.37	96.29	1.03	258.43	153.50	5.54	2.55
Reach-1	2.54	PF 2	97.60	157.60	159.30	159.30	159.74	0.008458	3.59	52.50	64.78	0.90	132.33	67.09	3.59	1.86
Reach-1	2.54	PF 3	87.30	157.60	159.21	159.21	159.64	0.008608	3.49	47.19	61.29	0.90	127.61	64.87	3.49	1.85
Reach-1	2.54	PF 4	74.10	157.60	159.10	159.10	159.51	0.008581	3.32	40.83	56.82	0.89	118.20	60.35	3.32	1.81
Reach-1	2.54	PF 5	59.60	157.60	159.00	158.97	159.34	0.007697	2.99	35.26	52.59	0.83	98.39	50.50	2.99	1.69
Reach-1	2.54	PF 6	49.40	157.60	158.93	158.85	159.21	0.006859	2.71	31.35	49.41	0.78	82.54	42.58	2.71	1.58
Reach-1	2.41	PF 1	427.40	156.80	160.14		160.63	0.003645	3.40	178.07	89.40	0.65	99.07	70.42	3.40	2.40
Reach-1	2.41	PF 2	97.60	156.80	158.40	158.28	158.70	0.007117	2.47	45.78	60.18	0.77	72.38	52.78	2.47	2.13
Reach-1	2.41	PF 3	87.30	156.80	158.32	158.22	158.61	0.007617	2.42	40.99	58.73	0.79	71.48	51.84	2.42	2.13
Reach-1	2.41	PF 4	74.10	156.80	158.21	158.14	158.48	0.008575	2.37	34.50	56.71	0.82	71.07	50.90	2.37	2.15
Reach-1	2.41	PF 5	59.60	156.80	158.06	158.02	158.34	0.010733	2.34	26.48	54.10	0.89	73.82	51.28	2.34	2.25
Reach-1	2.41	PF 6	49.40	156.80	157.95	157.91	158.22	0.012483	2.31	21.36	34.43	0.94	75.47	47.47	2.31	2.31
Reach-1	2.27	PF 1	427.40	156.00	160.07		160.27	0.001612	2.73	285.44	102.16	0.45	57.98	43.70	2.73	1.50
Reach-1	2.27	PF 2	97.60	156.00	158.19		158.28	0.001546	1.68	104.58	90.22	0.39	27.68	17.49	1.68	0.93
Reach-1	2.27	PF 3	87.30	156.00	158.08		158.17	0.001605	1.65	95.14	89.53	0.40	27.12	16.65	1.65	0.92
Reach-1	2.27	PF 4	74.10	156.00	157.94		158.03	0.001674	1.60	82.21	86.04	0.40	26.17	15.62	1.60	0.90
Reach-1	2.27	PF 5	59.60	156.00	157.75		157.84	0.001711	1.52	67.36	77.65	0.40	24.42	14.50	1.52	0.88
Reach-1	2.27	PF 6	49.40	156.00	157.61		157.69	0.001755	1.46	56.50	70.89	0.40	23.08	13.66	1.46	0.87
Reach-1	2.19	PF 1	427.40	155.60	159.08	159.08	160.01	0.009137	6.09	150.40	74.81	1.06	298.18	177.57	6.09	2.84
Reach-1	2.19	PF 2	97.60	155.60	157.52	157.52	158.04	0.008569	3.88	48.05	50.91	0.93	149.59	78.47	3.88	2.03
Reach-1	2.19	PF 3	87.30	155.60	157.44	157.44	157.93	0.008561	3.75	43.64	48.47	0.92	142.04	74.79	3.75	2.00
Reach-1	2.19	PF 4	74.10	155.60	157.31	157.31	157.77	0.008680	3.59	37.61	44.92	0.91	133.09	70.53	3.59	1.97
Reach-1	2.19	PF 5	59.60	155.60	157.14	157.14	157.58	0.008943	3.38	30.68	40.45	0.91	122.98	65.83	3.38	1.94
Reach-1	2.19	PF 6	49.40	155.60	157.02	157.02	157.42	0.009006	3.20	25.93	37.09	0.90	113.09	61.13	3.20	1.90
Reach-1	2.04	PF 1	427.40	154.00	157.45	157.45	158.51	0.007334	4.68	111.26	66.88	0.91	190.51	118.57	4.68	3.84
Reach-1	2.04	PF 2	97.60	154.00	155.69	155.69	156.23	0.012032	3.24	30.15	28.36	1.00	123.87	123.87	3.24	3.24
Reach-1	2.04	PF 3	87.30	154.00	155.60	155.60	156.11	0.012196	3.16	27.65	27.29	1.00	119.70	119.70	3.16	3.16
Reach-1	2.04	PF 4	74.10	154.00	155.48	155.48	155.95	0.012473	3.04	24.34	25.81	1.00	113.99	113.99	3.04	3.04
Reach-1	2.04	PF 5	59.60	154.00	155.32	155.32	155.76	0.013054	2.92	20.44	23.95	1.01	108.05	108.05	2.92	2.92
Reach-1	2.04	PF 6	49.40	154.00	155.22	155.20	155.60	0.012745	2.74	18.01	22.71	0.98	98.04	98.04	2.74	2.74
Reach-1	1.9	PF 1	427.40	153.00	156.29		156.82	0.003653	3.36	151.63	70.63	0.65	97.21	75.76	3.36	2.82
Reach-1	1.9	PF 2	97.60	153.00	154.65		154.87	0.004677	2.06	49.58	51.72	0.63	49.68	43.64	2.06	1.97
Reach-1	1.9	PF 3	87.30	153.00	154.58		154.78	0.004729	1.98	45.88	50.76	0.63	46.89	41.62	1.98	1.90
Reach-1	1.9	PF 4	74.10	153.00	154.48		154.66	0.004835	1.87	40.90	49.43	0.62	43.24	38.97	1.87	1.81
Reach-1	1.9	PF 5	59.60	153.00	154.36		154.51	0.005149	1.75	34.80	47.76	0.63	39.74	36.58	1.75	1.71
Reach-1	1.9	PF 6	49.40	153.00	154.26		154.40	0.005567	1.66	30.11	46.43	0.64	37.55	35.23	1.66	1.64
Reach-1	1.75	PF 1	427.40	152.10	155.03	155.03	155.99	0.009567	5.09	127.24	66.15	1.03	230.49	178.77	5.09	3.36
Reach-1	1.75	PF 2	97.60	152.10	153.87		154.15	0.005444	2.57	54.12	57.01	0.70	72.06	50.50	2.57	1.80
Reach-1	1.75	PF 3	87.30	152.10	153.77		154.04	0.005650	2.53	48.45	53.88	0.71	70.98	49.65	2.53	1.80
Reach-1	1.75	PF 4	74.10	152.10	153.63		153.89	0.005915	2.46	41.32	49.65	0.72	68.87	48.10	2.46	1.79
Reach-1	1.75	PF 5	59.60	152.10	153.48		153.72	0.005916	2.32	34.31	45.11	0.71	62.90	43.96	2.32	1.74
Reach-1	1.75	PF 6	49.40	152.10	153.37		153.59	0.005739	2.18	29.61	41.80	0.69	56.69	39.73	2.18	1.67
Reach-1	1.59	PF 1	427.40	151.10	153.88		154.33	0.006684	3.00	144.06	99.52	0.79	95.40	93.98	3.00	2.97
Reach-1	1.59	PF 2	97.60	151.10	152.85	152.75	153.04	0.009150	1.95	50.27	83.24	0.80	54.24	53.84	1.95	1.94
Reach-1	1.59	PF 3	87.30	151.10	152.85	152.60	153.00	0.007434	1.76	50.03	83.19	0.72	43.87	43.55	1.76	1

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 (Continued)

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	Shear Chan (N/m2)	Shear Total (N/m2)	Vel Chnl (m/s)	Vel Total (m/s)	
Reach-1	1.27	PF 6	49.40	149.40	150.77		150.80	0.000912	0.78	64.14	76.28	0.27	7.67		7.51	0.78	0.77
Reach-1	1.242	PF 1	427.40	149.30	153.45	152.00	153.53	0.000501	1.65	399.39	128.73	0.26	20.42		15.10	1.65	1.07
Reach-1	1.242	PF 2	97.60	149.30	151.07	150.66	151.47	0.004456	2.79	34.93	100.24	0.67	77.48		77.48	2.79	2.79
Reach-1	1.242	PF 3	87.30	149.30	150.95	150.56	151.32	0.004486	2.68	32.60	98.23	0.66	72.81		72.81	2.68	2.68
Reach-1	1.242	PF 4	74.10	149.30	150.80	150.43	151.12	0.004516	2.51	29.49	95.55	0.66	66.29		66.29	2.51	2.51
Reach-1	1.242	PF 5	59.60	149.30	150.61	150.27	150.88	0.004561	2.31	25.80	92.36	0.64	58.58		58.58	2.31	2.31
Reach-1	1.242	PF 6	49.40	149.30	150.47	150.16	150.70	0.004580	2.15	23.02	89.97	0.63	52.50		52.50	2.15	2.15
Reach-1	1.2385				Bridge												
Reach-1	1.235	PF 1	427.40	149.30	151.90	151.90	152.19	0.003487	3.19	209.94	114.30	0.63	88.92		62.43	3.19	2.04
Reach-1	1.235	PF 2	97.60	149.30	150.66	150.66	151.34	0.010849	3.65	26.75	93.18	1.00	144.45		144.45	3.65	3.65
Reach-1	1.235	PF 3	87.30	149.30	150.56	150.56	151.19	0.011092	3.51	24.85	91.54	1.00	137.21		137.21	3.51	3.51
Reach-1	1.235	PF 4	74.10	149.30	150.43	150.43	150.99	0.011531	3.33	22.26	89.31	1.00	127.78		127.78	3.33	3.33
Reach-1	1.235	PF 5	59.60	149.30	150.28	150.28	150.77	0.012026	3.09	19.29	86.74	1.00	115.48		115.48	3.09	3.09
Reach-1	1.235	PF 6	49.40	149.30	150.16	150.16	150.59	0.012702	2.91	16.96	84.73	1.00	107.21		107.21	2.91	2.91
Reach-1	1.2	PF 1	427.40	149.00	151.66		151.90	0.002106	2.15	203.64	102.36	0.47	43.46		40.82	2.15	2.10
Reach-1	1.2	PF 2	97.60	149.00	150.43		150.50	0.002158	1.21	81.24	95.40	0.41	18.35		17.98	1.21	1.20
Reach-1	1.2	PF 3	87.30	149.00	150.36		150.43	0.002289	1.18	74.55	95.00	0.42	17.90		17.58	1.18	1.17
Reach-1	1.2	PF 4	74.10	149.00	150.26		150.32	0.002548	1.14	65.32	94.46	0.43	17.49		17.25	1.14	1.13
Reach-1	1.2	PF 5	59.60	149.00	150.14		150.20	0.003098	1.11	53.97	93.78	0.46	17.60		17.46	1.11	1.10
Reach-1	1.2	PF 6	49.40	149.00	150.04		150.10	0.003855	1.09	45.13	93.25	0.50	18.33		18.28	1.09	1.09
Reach-1	1.09	PF 1	427.40	148.10	151.14		151.55	0.004045	3.17	176.30	106.32	0.66	91.40		65.38	3.17	2.42
Reach-1	1.09	PF 2	97.60	148.10	149.97		150.16	0.003905	1.95	55.66	92.68	0.58	43.62		22.94	1.95	1.75
Reach-1	1.09	PF 3	87.30	148.10	149.90		150.07	0.003878	1.88	49.68	79.20	0.57	41.16		23.79	1.88	1.76
Reach-1	1.09	PF 4	74.10	148.10	149.80		149.96	0.003768	1.76	43.04	60.88	0.56	37.08		26.03	1.76	1.72
Reach-1	1.09	PF 5	59.60	148.10	149.68		149.81	0.003658	1.62	36.84	40.47	0.54	32.49		32.49	1.62	1.62
Reach-1	1.09	PF 6	49.40	148.10	149.56		149.68	0.003533	1.52	32.41	37.93	0.53	29.46		29.46	1.52	1.52
Reach-1	0.93	PF 1	427.40	147.20	150.10	150.10	150.71	0.008158	4.27	160.27	115.62	0.84	208.11		110.69	4.27	2.67
Reach-1	0.93	PF 2	97.60	147.20	148.75	148.75	149.17	0.010849	3.03	41.04	57.09	0.86	133.79		76.29	3.03	2.38
Reach-1	0.93	PF 3	87.30	147.20	148.68	148.68	149.08	0.011143	2.95	36.87	53.59	0.86	129.22		74.99	2.95	2.37
Reach-1	0.93	PF 4	74.10	147.20	148.57	148.57	148.95	0.011980	2.86	31.08	48.30	0.88	126.63		75.39	2.86	2.38
Reach-1	0.93	PF 5	59.60	147.20	148.43	148.43	148.79	0.012986	2.72	25.00	42.04	0.90	119.12		75.50	2.72	2.38
Reach-1	0.93	PF 6	49.40	147.20	148.32	148.32	148.66	0.013945	2.61	20.79	37.10	0.91	113.47		76.40	2.61	2.38
Reach-1	0.77	PF 1	427.40	146.20	149.32		149.58	0.002807	2.26	190.69	87.97	0.48	61.50		59.01	2.26	2.24
Reach-1	0.77	PF 2	97.60	146.20	147.98		148.06	0.003138	1.31	74.73	82.79	0.44	27.72		27.72	1.31	1.31
Reach-1	0.77	PF 3	87.30	146.20	147.90		147.98	0.003167	1.28	68.40	79.00	0.44	26.83		26.83	1.28	1.28
Reach-1	0.77	PF 4	74.10	146.20	147.80		147.87	0.003088	1.22	60.94	74.27	0.43	24.80		24.80	1.22	1.22
Reach-1	0.77	PF 5	59.60	146.20	147.67		147.74	0.003032	1.15	51.95	68.14	0.42	22.62		22.62	1.15	1.15
Reach-1	0.77	PF 6	49.40	146.20	147.57		147.63	0.002986	1.09	45.24	63.17	0.41	20.93		20.93	1.09	1.09
Reach-1	0.61	PF 1	427.40	145.30	148.12	148.12	148.83	0.009554	4.59	136.41	86.66	0.91	241.10		146.85	4.59	3.13
Reach-1	0.61	PF 2	97.60	145.30	146.83	146.83	147.22	0.010453	3.03	42.32	57.03	0.85	132.16		75.82	3.03	2.31
Reach-1	0.61	PF 3	87.30	145.30	146.77	146.77	147.13	0.010266	2.91	38.98	55.56	0.83	123.84		70.39	2.91	2.24
Reach-1	0.61	PF 4	74.10	145.30	146.66	146.66	147.02	0.011012	2.83	33.04	51.88	0.85	121.04		68.55	2.83	2.24
Reach-1	0.61	PF 5	59.60	145.30	146.52	146.52	146.87	0.012003	2.71	26.45	45.32	0.87	116.05		68.46	2.71	2.25
Reach-1	0.61	PF 6	49.40	145.30	146.42	146.42	146.74	0.012915	2.61	21.88	40.15	0.89	111.39		68.77	2.61	2.26
Reach-1	0.45	PF 1	427.40	144.20	147.28		147.61	0.003839	2.58	171.39	88.12	0.56	80.73		72.46	2.58	2.49
Reach-1	0.45	PF 2	97.60	144.20	146.03		146.14	0.003609	1.41	69.31	76.32	0.47	32.13		31.99	1.41	1.41
Reach-1	0.45	PF 3	87.30	144.20	145.96		146.06	0.003660	1.36	63.99	74.38	0.47	30.74		30.74	1.36	1.36
Reach-1	0.45	PF 4	74.10	144.20	145.86		145.95	0.003679	1.31	56.40	69.63	0.47	29.10		29.10	1.31	1.31
Reach-1	0.45	PF 5	59.60	144.20	145.73		145.81	0.003696	1.25	47.72	63.77	0.46	27.00		27.00	1.25	1.25
Reach-1	0.45	PF 6	49.40	144.20	145.62		145.69	0.003779	1.20	41.02	58.85	0.46	25.71		25.71	1.20	1.20
Reach-1	0.34	PF 1	427.40	143.50	146.19	146.19	146.84	0.013889	4.42	142.56	105.93	1.04	250.31		182.64	4.42	3.00
Reach-1	0.34	PF 2	97.60	143.50	145.05	145.05	145.42	0.013002	3.06	44.33	60.66	0.92	141.85		92.77	3.06	2.20
Reach-1	0.34	PF 3	87.30	143.50	144.98	144.98	145.34	0.012910	2.98	40.37	57.61	0.91	135.84		88.31	2.98	2.16
Reach-1	0.34	PF 4	74.10	143.50	144.88	144.88	145.22	0.012952	2.87	34.93	53.15	0.90	128.83		83.09	2.87	2.12
Reach-1	0.34	PF 5	59.60	143.50	144.76	144.76	145.08	0.013147	2.75	28.62	47.44	0.90	120.95		77.40	2.75	2.08
Reach-1	0.34	PF 6	49.40	143.50	144.66	144.66	144.96	0.013113	2.62	24.22	43.01	0.89	112.90		72.02	2.62	2.04

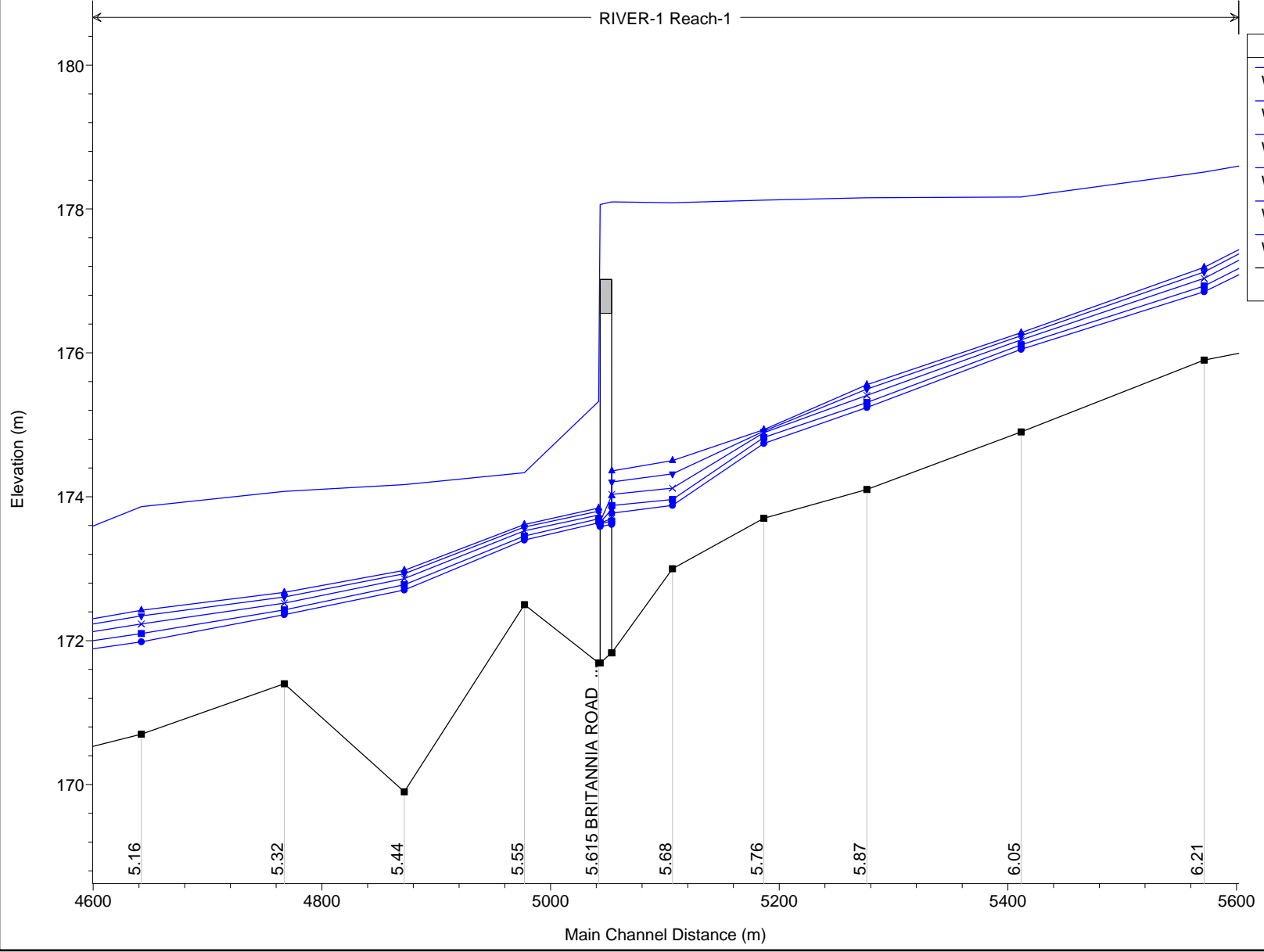


Crossing 07 16Mile Main Branch Existing Plan: Imported Plan 07 15/01/2013

RIVER-1 Reach-1

**Legend**

- WS PF 1
- WS PF 2
- WS PF 3
- WS PF 4
- WS PF 5
- WS PF 6
- Ground





HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-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	1	Regional	759.70	164.30	169.45	167.38	169.65	0.000833	2.00	389.88	110.42	0.33
Reach-1	1	100 YR	180.60	164.30	167.14	166.11	167.21	0.000865	1.18	153.64	91.97	0.29
Reach-1	1	50 YR	5.40	164.30	167.14	164.58	167.14	0.000001	0.04	153.64	91.97	0.01
Reach-1	1	20 YR	4.17	164.30	167.14	164.54	167.14	0.000000	0.03	153.64	91.97	0.01
Reach-1	1	10 YR	3.35	164.30	167.14	164.51	167.14	0.000000	0.02	153.64	91.97	0.01
Reach-1	1	5 YR	2.62	164.30	167.14	164.48	167.14	0.000000	0.02	153.64	91.97	0.00
Reach-1	1	2 YR	1.71	164.30	167.14	164.43	167.14	0.000000	0.01	153.64	91.97	0.00
Reach-1	2	Regional	36.60	165.20	169.71		169.72	0.000026	0.36	130.51	40.55	0.06
Reach-1	2	100 YR	8.50	165.20	167.27		167.27	0.000040	0.24	39.42	30.39	0.06
Reach-1	2	50 YR	5.40	165.20	167.14		167.14	0.000021	0.17	35.64	29.25	0.04
Reach-1	2	20 YR	4.17	165.20	167.14		167.14	0.000013	0.13	35.65	29.26	0.03
Reach-1	2	10 YR	3.35	165.20	167.14		167.14	0.000008	0.11	35.65	29.26	0.03
Reach-1	2	5 YR	2.62	165.20	167.14		167.14	0.000005	0.08	35.66	29.26	0.02
Reach-1	2	2 YR	1.71	165.20	167.14		167.14	0.000002	0.05	35.66	29.26	0.01
Reach-1	3	Regional	36.60	167.60	169.69		169.75	0.000978	1.11	37.97	31.13	0.30
Reach-1	3	100 YR	8.50	167.60	168.10	168.10	168.30	0.016524	1.98	4.31	11.31	1.00
Reach-1	3	50 YR	5.40	167.60	167.99	167.99	168.14	0.018010	1.75	3.08	9.88	1.00
Reach-1	3	20 YR	4.17	167.60	167.93	167.93	168.07	0.018932	1.64	2.54	9.32	1.00
Reach-1	3	10 YR	3.35	167.60	167.89	167.89	168.01	0.019745	1.55	2.16	8.90	1.01
Reach-1	3	5 YR	2.62	167.60	167.85	167.85	167.96	0.020543	1.45	1.81	8.49	1.00
Reach-1	3	2 YR	1.71	167.60	167.79	167.79	167.88	0.022321	1.29	1.32	7.90	1.01
Reach-1	4	Regional	36.60	171.20	172.24	172.24	172.57	0.013430	2.55	14.52	22.94	0.99
Reach-1	4	100 YR	8.50	171.20	171.82	171.75	171.93	0.010355	1.46	5.83	16.30	0.78
Reach-1	4	50 YR	5.40	171.20	171.71	171.63	171.79	0.009819	1.29	4.17	13.40	0.74
Reach-1	4	20 YR	4.17	171.20	171.65	171.57	171.72	0.009519	1.21	3.44	11.89	0.72
Reach-1	4	10 YR	3.35	171.20	171.60	171.52	171.67	0.009249	1.15	2.91	10.68	0.70
Reach-1	4	5 YR	2.62	171.20	171.55	171.47	171.61	0.009008	1.09	2.40	9.36	0.69
Reach-1	4	2 YR	1.71	171.20	171.48	171.41	171.52	0.008517	0.97	1.76	7.75	0.65
Reach-1	5	Regional	36.60	175.30	176.34	176.34	176.64	0.011680	2.47	16.05	30.07	0.93
Reach-1	5	100 YR	8.50	175.30	175.85	175.85	176.01	0.018048	1.74	4.88	15.92	1.00
Reach-1	5	50 YR	5.40	175.30	175.75	175.75	175.88	0.019364	1.61	3.35	12.95	1.01
Reach-1	5	20 YR	4.17	175.30	175.70	175.70	175.82	0.019914	1.54	2.71	11.49	1.01
Reach-1	5	10 YR	3.35	175.30	175.66	175.66	175.77	0.020321	1.48	2.27	10.35	1.01
Reach-1	5	5 YR	2.62	175.30	175.61	175.61	175.71	0.020828	1.42	1.85	9.14	1.00
Reach-1	5	2 YR	1.71	175.30	175.54	175.54	175.63	0.021634	1.33	1.29	7.22	1.00
Reach-1	6	Regional	36.60	175.47	177.13	177.13	177.95	0.004743	4.02	9.11	53.23	1.00
Reach-1	6	100 YR	8.50	175.47	176.11	176.09	176.41	0.005956	2.40	3.54	23.37	0.95
Reach-1	6	50 YR	5.40	175.47	175.99	175.93	176.17	0.004788	1.87	2.88	19.83	0.83
Reach-1	6	20 YR	4.17	175.47	175.93	175.86	176.07	0.004316	1.64	2.55	18.17	0.77
Reach-1	6	10 YR	3.35	175.47	175.89	175.81	176.00	0.003960	1.46	2.29	16.91	0.72
Reach-1	6	5 YR	2.62	175.47	175.85	175.76	175.93	0.003296	1.25	2.09	15.91	0.65
Reach-1	6	2 YR	1.71	175.47	175.78	175.68	175.83	0.002693	1.00	1.72	14.08	0.57
Reach-1	6.5	Bridge										
Reach-1	7	Regional	36.60	175.49	178.32	177.15	178.32	0.000063	0.66	129.53	81.37	0.13
Reach-1	7	100 YR	8.50	175.49	176.30	176.11	176.49	0.002750	1.90	4.47	28.34	0.67
Reach-1	7	50 YR	5.40	175.49	176.01	175.95	176.19	0.004764	1.87	2.89	19.86	0.82
Reach-1	7	20 YR	4.17	175.49	175.95	175.88	176.09	0.004364	1.64	2.54	18.14	0.77
Reach-1	7	10 YR	3.35	175.49	175.90	175.82	176.01	0.004062	1.47	2.27	16.83	0.73
Reach-1	7	5 YR	2.62	175.49	175.86	175.78	175.95	0.003479	1.27	2.06	15.75	0.67
Reach-1	7	2 YR	1.71	175.49	175.79	175.71	175.85	0.002959	1.02	1.67	13.85	0.59
Reach-1	8	Regional	36.60	175.80	178.32		178.33	0.000268	0.60	61.25	45.42	0.16
Reach-1	8	100 YR	8.50	175.80	176.48		176.60	0.010422	1.53	5.54	14.46	0.79
Reach-1	8	50 YR	5.40	175.80	176.30	176.30	176.45	0.018785	1.69	3.20	11.27	1.01
Reach-1	8	20 YR	4.17	175.80	176.25	176.25	176.38	0.019229	1.58	2.63	10.35	1.00
Reach-1	8	10 YR	3.35	175.80	176.21	176.21	176.32	0.020207	1.52	2.21	9.60	1.01
Reach-1	8	5 YR	2.62	175.80	176.16	176.16	176.27	0.021067	1.44	1.82	8.87	1.01
Reach-1	8	2 YR	1.71	175.80	176.10	176.10	176.19	0.022475	1.30	1.31	7.81	1.01
Reach-1	9	Regional	36.60	177.50	178.42	178.42	178.78	0.012273	2.69	14.25	21.38	0.97
Reach-1	9	100 YR	8.50	177.50	177.92	177.91	178.07	0.017342	1.74	4.89	15.49	0.99
Reach-1	9	50 YR	5.40	177.50	177.87		177.96	0.010384	1.27	4.25	14.73	0.75
Reach-1	9	20 YR	4.17	177.50	177.83		177.90	0.010306	1.17	3.56	13.86	0.74
Reach-1	9	10 YR	3.35	177.50	177.79		177.85	0.010041	1.08	3.09	13.24	0.72
Reach-1	9	5 YR	2.62	177.50	177.76		177.81	0.009872	1.00	2.63	12.59	0.70
Reach-1	9	2 YR	1.71	177.50	177.70		177.74	0.009623	0.86	1.99	11.64	0.67
Reach-1	10	Regional	36.60	179.42	180.90	180.90	181.64	0.005384	3.81	9.61	43.47	1.00
Reach-1	10	100 YR	8.50	179.42	179.98	179.98	180.26	0.007449	2.34	3.63	29.20	1.00
Reach-1	10	50 YR	5.40	179.42	179.83	179.83	180.04	0.008167	2.01	2.69	23.82	1.00

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 (Continued)

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	10	20 YR	4.17	179.42	179.77	179.77	179.94	0.008531	1.83	2.27	21.43	0.99
Reach-1	10	10 YR	3.35	179.42	179.72	179.72	179.87	0.009247	1.72	1.95	19.56	1.00
Reach-1	10	5 YR	2.62	179.42	179.68	179.68	179.80	0.009582	1.58	1.66	17.93	1.00
Reach-1	10	2 YR	1.71	179.42	179.61	179.61	179.71	0.010807	1.38	1.24	15.52	1.01
Reach-1	10.5	Bridge										
Reach-1	11	Regional	36.60	179.50	180.98	180.98	181.72	0.005360	3.80	9.62	43.50	1.00
Reach-1	11	100 YR	8.50	179.50	180.06	180.06	180.34	0.007301	2.33	3.65	29.32	0.99
Reach-1	11	50 YR	5.40	179.50	179.92	179.91	180.12	0.008035	2.00	2.70	23.89	0.99
Reach-1	11	20 YR	4.17	179.50	179.85	179.85	180.02	0.008570	1.84	2.27	21.42	0.99
Reach-1	11	10 YR	3.35	179.50	179.80	179.80	179.95	0.008929	1.70	1.97	19.68	0.99
Reach-1	11	5 YR	2.62	179.50	179.76	179.76	179.88	0.009338	1.56	1.67	18.01	0.98
Reach-1	11	2 YR	1.71	179.50	179.70	179.69	179.79	0.009401	1.32	1.29	15.83	0.95
Reach-1	12	Regional	36.60	179.60	181.93		181.94	0.000137	0.57	71.16	39.06	0.12
Reach-1	12	100 YR	8.50	179.60	180.43		180.44	0.000375	0.44	19.72	29.71	0.17
Reach-1	12	50 YR	5.40	179.60	180.20		180.21	0.000563	0.42	13.09	28.28	0.19
Reach-1	12	20 YR	4.17	179.60	180.11		180.11	0.000726	0.40	10.33	27.66	0.21
Reach-1	12	10 YR	3.35	179.60	180.04		180.04	0.000910	0.40	8.45	27.23	0.23
Reach-1	12	5 YR	2.62	179.60	179.97		179.98	0.001135	0.39	6.70	25.84	0.25
Reach-1	12	2 YR	1.71	179.60	179.88		179.89	0.001466	0.38	4.51	22.12	0.27
Reach-1	13	Regional	36.60	180.80	181.91	181.91	182.21	0.012511	2.64	15.63	26.07	0.97
Reach-1	13	100 YR	8.50	180.80	181.38	181.38	181.55	0.013822	1.93	4.87	14.37	0.93
Reach-1	13	50 YR	5.40	180.80	181.26	181.26	181.41	0.014748	1.75	3.34	11.80	0.93
Reach-1	13	20 YR	4.17	180.80	181.20	181.20	181.34	0.015586	1.66	2.68	10.49	0.94
Reach-1	13	10 YR	3.35	180.80	181.16	181.16	181.28	0.016363	1.58	2.23	9.49	0.94
Reach-1	13	5 YR	2.62	180.80	181.11	181.11	181.22	0.017594	1.50	1.80	8.44	0.96
Reach-1	13	2 YR	1.71	180.80	181.04	181.04	181.14	0.020231	1.37	1.25	6.87	0.99
Reach-1	14	Regional	36.60	182.00	183.33	183.24	183.63	0.009724	2.42	15.11	18.67	0.86
Reach-1	14	100 YR	8.50	182.00	182.72	182.59	182.83	0.007320	1.49	5.72	11.91	0.68
Reach-1	14	50 YR	5.40	182.00	182.59	182.46	182.67	0.006807	1.28	4.22	10.44	0.64
Reach-1	14	20 YR	4.17	182.00	182.52	182.40	182.59	0.006482	1.17	3.57	9.72	0.62
Reach-1	14	10 YR	3.35	182.00	182.47	182.35	182.53	0.006240	1.08	3.09	9.16	0.60
Reach-1	14	5 YR	2.62	182.00	182.42	182.30	182.47	0.005949	0.99	2.63	8.60	0.57
Reach-1	14	2 YR	1.71	182.00	182.34	182.24	182.38	0.005507	0.85	2.00	7.75	0.54
Reach-1	15	Regional	36.60	182.84	184.72	184.72	184.85	0.001335	2.32	31.96	37.54	0.54
Reach-1	15	100 YR	8.50	182.84	183.71	183.71	184.14	0.005899	2.92	2.91	14.29	1.00
Reach-1	15	50 YR	5.40	182.84	183.48	183.48	183.80	0.006537	2.51	2.15	10.59	1.00
Reach-1	15	20 YR	4.17	182.84	183.38	183.38	183.65	0.006883	2.30	1.82	8.95	1.00
Reach-1	15	10 YR	3.35	182.84	183.31	183.31	183.54	0.007165	2.13	1.57	7.78	0.99
Reach-1	15	5 YR	2.62	182.84	183.24	183.24	183.43	0.007630	1.97	1.33	6.61	1.00
Reach-1	15	2 YR	1.71	182.84	183.14	183.14	183.29	0.008509	1.71	1.00	5.27	1.00
Reach-1	15.5	Bridge										
Reach-1	16	Regional	36.60	182.89	185.70	185.19	185.72	0.000154	1.03	77.75	61.38	0.20
Reach-1	16	100 YR	8.50	182.89	183.94	183.76	184.24	0.003180	2.42	3.51	17.17	0.76
Reach-1	16	50 YR	5.40	182.89	183.53	183.53	183.85	0.006645	2.52	2.14	10.54	1.01
Reach-1	16	20 YR	4.17	182.89	183.43	183.43	183.70	0.006801	2.29	1.82	8.99	0.99
Reach-1	16	10 YR	3.35	182.89	183.36	183.36	183.59	0.007151	2.13	1.57	7.78	0.99
Reach-1	16	5 YR	2.62	182.89	183.29	183.29	183.48	0.007528	1.96	1.34	6.64	0.99
Reach-1	16	2 YR	1.71	182.89	183.19	183.19	183.34	0.008258	1.70	1.01	5.30	0.99
Reach-1	17	Regional	36.60	182.70	185.71		185.72	0.000135	0.58	81.62	63.03	0.12
Reach-1	17	100 YR	8.50	182.70	184.41		184.42	0.000218	0.42	21.53	29.62	0.13
Reach-1	17	50 YR	5.40	182.70	184.05		184.06	0.000405	0.43	12.54	20.36	0.17
Reach-1	17	20 YR	4.17	182.70	183.87		183.88	0.000578	0.45	9.20	16.92	0.20
Reach-1	17	10 YR	3.35	182.70	183.74		183.76	0.000717	0.47	7.18	14.85	0.21
Reach-1	17	5 YR	2.62	182.70	183.62		183.63	0.000885	0.48	5.49	12.87	0.23
Reach-1	17	2 YR	1.71	182.70	183.46		183.47	0.001158	0.48	3.57	10.17	0.26
Reach-1	18	Regional	36.60	184.50	185.75		185.85	0.002980	1.74	28.68	45.51	0.51
Reach-1	18	100 YR	8.50	184.50	185.00	185.00	185.16	0.012680	1.84	5.06	17.32	0.89
Reach-1	18	50 YR	5.40	184.50	184.88	184.88	185.02	0.016173	1.69	3.29	12.91	0.96
Reach-1	18	20 YR	4.17	184.50	184.82	184.82	184.95	0.018913	1.60	2.62	10.78	1.00
Reach-1	18	10 YR	3.35	184.50	184.78	184.78	184.90	0.019946	1.50	2.23	9.77	1.00
Reach-1	18	5 YR	2.62	184.50	184.74	184.74	184.85	0.020760	1.41	1.86	9.25	1.00
Reach-1	18	2 YR	1.71	184.50	184.69	184.69	184.77	0.022480	1.26	1.36	8.50	1.01
Reach-1	19	Regional	36.60	185.60	186.69		186.78	0.003810	1.76	31.92	73.77	0.56
Reach-1	19	100 YR	8.50	185.60	186.33	186.14	186.37	0.002140	0.99	11.66	40.90	0.39
Reach-1	19	50 YR	5.40	185.60	186.23	185.99	186.26	0.002011	0.85	7.89	31.19	0.37
Reach-1	19	20 YR	4.17	185.60	186.17	185.93	186.20	0.001929	0.78	6.31	26.03	0.35



HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 (Continued)

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	19	10 YR	3.35	185.60	186.12	185.89	186.15	0.001898	0.72	5.17	21.60	0.35
Reach-1	19	5 YR	2.62	185.60	186.07	185.85	186.09	0.001870	0.66	4.17	16.76	0.34
Reach-1	19	2 YR	1.71	185.60	185.99	185.79	186.00	0.001806	0.56	3.08	9.88	0.32
Reach-1	20	Regional	36.60	186.20	187.41		187.45	0.001661	1.27	53.92	154.61	0.38
Reach-1	20	100 YR	8.50	186.20	186.91		186.95	0.002003	0.96	11.50	34.00	0.38
Reach-1	20	50 YR	5.40	186.20	186.79		186.83	0.002009	0.84	7.87	27.10	0.37
Reach-1	20	20 YR	4.17	186.20	186.73		186.76	0.002059	0.78	6.27	23.42	0.36
Reach-1	20	10 YR	3.35	186.20	186.68		186.71	0.002069	0.73	5.21	20.63	0.36
Reach-1	20	5 YR	2.62	186.20	186.63		186.65	0.002109	0.68	4.22	17.63	0.35
Reach-1	20	2 YR	1.71	186.20	186.55		186.57	0.002204	0.59	2.98	12.91	0.35
Reach-1	21	Regional	36.60	186.60	187.70		187.74	0.001423	1.12	45.38	75.91	0.35
Reach-1	21	100 YR	8.50	186.60	187.23		187.25	0.001287	0.72	16.02	49.14	0.30
Reach-1	21	50 YR	5.40	186.60	187.12		187.14	0.001426	0.66	11.01	42.95	0.30
Reach-1	21	20 YR	4.17	186.60	187.07		187.08	0.001524	0.63	8.84	39.96	0.31
Reach-1	21	10 YR	3.35	186.60	187.03		187.04	0.001626	0.61	7.28	37.67	0.31
Reach-1	21	5 YR	2.62	186.60	186.99		187.00	0.001740	0.59	5.79	34.48	0.32
Reach-1	21	2 YR	1.71	186.60	186.92		186.94	0.001893	0.54	3.82	26.05	0.32
Reach-1	22	Regional	36.60	187.40	188.27	188.25	188.45	0.009765	2.45	33.19	73.57	0.87
Reach-1	22	100 YR	8.50	187.40	187.90	187.90	188.03	0.010371	1.68	8.28	48.32	0.81
Reach-1	22	50 YR	5.40	187.40	187.80	187.79	187.92	0.012863	1.56	4.22	28.15	0.86
Reach-1	22	20 YR	4.17	187.40	187.77	187.72	187.86	0.010612	1.34	3.51	22.80	0.77
Reach-1	22	10 YR	3.35	187.40	187.74	187.68	187.81	0.008982	1.17	3.04	18.51	0.70
Reach-1	22	5 YR	2.62	187.40	187.72		187.77	0.007726	1.01	2.61	13.39	0.64
Reach-1	22	2 YR	1.71	187.40	187.67		187.70	0.006406	0.82	2.08	9.55	0.56
Reach-1	23	Regional	36.60	188.50	189.70	189.45	189.80	0.003556	1.82	42.54	67.42	0.55
Reach-1	23	100 YR	8.50	188.50	189.19	189.04	189.24	0.002860	1.09	13.71	46.43	0.45
Reach-1	23	50 YR	5.40	188.50	189.09	188.89	189.13	0.002572	0.92	9.31	42.32	0.41
Reach-1	23	20 YR	4.17	188.50	189.03		189.06	0.002810	0.88	6.63	39.60	0.42
Reach-1	23	10 YR	3.35	188.50	188.97		189.01	0.003028	0.84	4.68	30.71	0.43
Reach-1	23	5 YR	2.62	188.50	188.91		188.95	0.003257	0.78	3.38	14.20	0.43
Reach-1	23	2 YR	1.71	188.50	188.82		188.85	0.003542	0.70	2.45	9.21	0.43
Reach-1	24	Regional	36.60	188.70	189.95		190.06	0.003994	1.61	31.14	44.68	0.56
Reach-1	24	100 YR	8.50	188.70	189.45		189.50	0.005251	1.03	9.87	38.57	0.55
Reach-1	24	50 YR	5.40	188.70	189.36		189.40	0.006070	0.92	6.53	31.76	0.57
Reach-1	24	20 YR	4.17	188.70	189.32		189.35	0.006324	0.85	5.29	28.83	0.56
Reach-1	24	10 YR	3.35	188.70	189.29		189.32	0.006624	0.79	4.44	26.62	0.56
Reach-1	24	5 YR	2.62	188.70	189.25		189.28	0.007223	0.74	3.62	24.32	0.57
Reach-1	24	2 YR	1.71	188.70	189.21		189.23	0.008894	0.67	2.56	20.96	0.60
Reach-1	25	Regional	20.50	189.00	190.66		190.69	0.000659	0.86	39.70	50.71	0.24
Reach-1	25	100 YR	6.46	189.00	190.08		190.10	0.000656	0.57	15.57	33.53	0.22
Reach-1	25	50 YR	5.40	189.00	189.99		190.01	0.000773	0.57	12.66	30.76	0.23
Reach-1	25	20 YR	4.17	189.00	189.92		189.93	0.000712	0.51	10.52	27.99	0.22
Reach-1	25	10 YR	3.35	189.00	189.86		189.87	0.000668	0.46	8.98	25.82	0.21
Reach-1	25	5 YR	2.62	189.00	189.81		189.82	0.000615	0.41	7.58	23.66	0.20
Reach-1	25	2 YR	1.71	189.00	189.72		189.73	0.000531	0.34	5.67	20.38	0.18
Reach-1	25.25	Regional	20.50	189.00	190.71		190.74	0.000702	0.80	30.53	39.69	0.24
Reach-1	25.25	100 YR	6.46	189.00	190.14		190.16	0.000841	0.54	12.10	25.57	0.24
Reach-1	25.25	50 YR	5.40	189.00	190.06		190.08	0.000998	0.53	10.17	23.61	0.25
Reach-1	25.25	20 YR	4.17	189.00	189.99		190.00	0.001043	0.49	8.47	21.51	0.25
Reach-1	25.25	10 YR	3.35	189.00	189.93		189.94	0.000946	0.46	7.22	18.61	0.24
Reach-1	25.25	5 YR	2.62	189.00	189.86		189.87	0.000797	0.43	6.13	15.61	0.22
Reach-1	25.25	2 YR	1.71	189.00	189.76		189.77	0.000483	0.36	4.78	10.88	0.17
Reach-1	25.75	Regional	20.50	189.05	190.75		190.78	0.000642	0.78	31.80	40.67	0.23
Reach-1	25.75	100 YR	6.46	189.05	190.19		190.20	0.000697	0.51	12.94	26.66	0.22
Reach-1	25.75	50 YR	5.40	189.05	190.11		190.13	0.000769	0.49	11.09	24.87	0.22
Reach-1	25.75	20 YR	4.17	189.05	190.04		190.05	0.000781	0.45	9.34	23.04	0.22
Reach-1	25.75	10 YR	3.35	189.05	189.98		189.99	0.000814	0.42	7.92	20.95	0.22
Reach-1	25.75	5 YR	2.62	189.05	189.91		189.91	0.000747	0.40	6.55	17.64	0.21
Reach-1	25.75	2 YR	1.71	189.05	189.79		189.80	0.000548	0.36	4.81	12.20	0.18
Reach-1	25.9	Regional	20.50	189.10	190.76		190.79	0.000646	0.78	31.89	40.91	0.24
Reach-1	25.9	100 YR	6.46	189.10	190.20		190.21	0.000708	0.52	12.92	26.92	0.22
Reach-1	25.9	50 YR	5.40	189.10	190.13		190.14	0.000778	0.50	11.08	25.15	0.22
Reach-1	25.9	20 YR	4.17	189.10	190.05		190.06	0.000792	0.45	9.31	23.33	0.22
Reach-1	25.9	10 YR	3.35	189.10	189.99		190.00	0.000855	0.43	7.88	21.53	0.22
Reach-1	25.9	5 YR	2.62	189.10	189.92		189.93	0.000813	0.41	6.46	18.18	0.22
Reach-1	25.9	2 YR	1.71	189.10	189.80		189.81	0.000654	0.37	4.62	12.60	0.20
Reach-1	26	Regional	20.50	189.30	190.80		190.83	0.000652	0.78	32.45	41.97	0.24

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 (Continued)

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	26	100 YR	6.46	189.30	190.24		190.26	0.000731	0.52	13.00	28.09	0.22
Reach-1	26	50 YR	5.40	189.30	190.18		190.19	0.000788	0.50	11.19	26.43	0.23
Reach-1	26	20 YR	4.17	189.30	190.11		190.12	0.000801	0.45	9.36	24.63	0.22
Reach-1	26	10 YR	3.35	189.30	190.05		190.06	0.000861	0.42	7.94	23.15	0.23
Reach-1	26	5 YR	2.62	189.30	189.98		189.99	0.001002	0.41	6.40	20.90	0.24
Reach-1	26	2 YR	1.71	189.30	189.85		189.86	0.001158	0.41	4.17	15.14	0.25
Reach-1	27	Regional	20.50	189.27	190.83	190.31	190.89	0.001197	1.33	33.52	42.69	0.34
Reach-1	27	100 YR	6.46	189.27	190.27	189.75	190.33	0.001348	1.05	6.16	28.77	0.33
Reach-1	27	50 YR	5.40	189.27	190.21	189.70	190.25	0.001167	0.94	5.77	27.21	0.31
Reach-1	27	20 YR	4.17	189.27	190.14	189.63	190.17	0.000905	0.78	5.33	25.43	0.27
Reach-1	27	10 YR	3.35	189.27	190.08	189.58	190.10	0.000738	0.67	4.97	23.97	0.24
Reach-1	27	5 YR	2.62	189.27	190.01	189.53	190.03	0.000606	0.58	4.55	22.26	0.21
Reach-1	27	2 YR	1.71	189.27	189.89	189.47	189.90	0.000474	0.45	3.79	14.10	0.18
Reach-1	27.5	Bridge										
Reach-1	28	Regional	20.50	189.57	191.39	190.58	191.43	0.000602	1.05	45.77	51.75	0.25
Reach-1	28	100 YR	6.46	189.57	190.29	190.05	190.40	0.004074	1.46	4.42	21.18	0.55
Reach-1	28	50 YR	5.40	189.57	190.22	190.00	190.32	0.003886	1.34	4.02	16.69	0.53
Reach-1	28	20 YR	4.17	189.57	190.15	189.93	190.22	0.003458	1.17	3.57	11.51	0.49
Reach-1	28	10 YR	3.35	189.57	190.09	189.88	190.15	0.003223	1.05	3.20	7.96	0.46
Reach-1	28	5 YR	2.62	189.57	190.02	189.83	190.07	0.003188	0.95	2.77	7.72	0.45
Reach-1	28	2 YR	1.71	189.57	189.90	189.77	189.93	0.004015	0.86	2.00	7.29	0.48
Reach-1	29	Regional	20.50	189.60	191.43		191.44	0.000211	0.48	57.87	86.91	0.14
Reach-1	29	100 YR	6.46	189.60	190.48		190.50	0.001581	0.62	10.45	25.85	0.31
Reach-1	29	50 YR	5.40	189.60	190.40		190.42	0.001876	0.64	8.46	22.71	0.33
Reach-1	29	20 YR	4.17	189.60	190.29		190.32	0.002237	0.65	6.38	18.85	0.36
Reach-1	29	10 YR	3.35	189.60	190.22		190.24	0.002511	0.66	5.05	15.90	0.38
Reach-1	29	5 YR	2.62	189.60	190.14		190.16	0.002738	0.67	3.90	12.80	0.39
Reach-1	29	2 YR	1.71	189.60	190.01		190.03	0.002474	0.67	2.55	7.76	0.37
Reach-1	30	Regional	20.50	189.60	191.45		191.45	0.000056	0.27	163.59	269.49	0.07
Reach-1	30	100 YR	6.46	189.60	190.54		190.54	0.000269	0.31	28.37	86.97	0.13
Reach-1	30	50 YR	5.40	189.60	190.47		190.47	0.000322	0.31	22.28	79.54	0.14
Reach-1	30	20 YR	4.17	189.60	190.38		190.38	0.000402	0.30	15.95	64.32	0.16
Reach-1	30	10 YR	3.35	189.60	190.31		190.32	0.000488	0.30	12.17	53.18	0.17
Reach-1	30	5 YR	2.62	189.60	190.25		190.25	0.000627	0.29	9.11	42.07	0.18
Reach-1	30	2 YR	1.71	189.60	190.14		190.15	0.000946	0.31	5.55	26.62	0.22
Reach-1	31	Regional	20.50	189.71	191.45	190.65	191.45	0.000226	0.62	106.73	152.58	0.15
Reach-1	31	100 YR	6.46	189.71	190.50	190.17	190.58	0.002630	1.25	5.15	39.29	0.45
Reach-1	31	50 YR	5.40	189.71	190.44	190.12	190.50	0.002448	1.14	4.72	34.11	0.43
Reach-1	31	20 YR	4.17	189.71	190.36	190.06	190.41	0.002153	0.99	4.20	27.91	0.39
Reach-1	31	10 YR	3.35	189.71	190.30	190.01	190.34	0.001912	0.88	3.82	23.33	0.36
Reach-1	31	5 YR	2.62	189.71	190.24	189.96	190.27	0.001669	0.76	3.43	18.72	0.34
Reach-1	31	2 YR	1.71	189.71	190.14	189.90	190.16	0.001429	0.61	2.79	10.98	0.30
Reach-1	31.5	Bridge										
Reach-1	32	Regional	20.50	189.59	191.50	190.57	191.51	0.000136	0.51	135.95	184.22	0.12
Reach-1	32	100 YR	6.46	189.59	190.60	190.06	190.63	0.000744	0.79	15.09	69.12	0.25
Reach-1	32	50 YR	5.40	189.59	190.52	189.98	190.54	0.000753	0.75	12.37	57.78	0.25
Reach-1	32	20 YR	4.17	189.59	190.42	189.93	190.44	0.000719	0.68	9.62	44.11	0.24
Reach-1	32	10 YR	3.35	189.59	190.35	189.89	190.36	0.000666	0.61	7.98	36.33	0.22
Reach-1	32	5 YR	2.62	189.59	190.27	189.84	190.29	0.000598	0.54	6.57	30.85	0.21
Reach-1	32	2 YR	1.71	189.59	190.16	189.78	190.17	0.000495	0.44	4.75	22.26	0.19
Reach-1	33	Regional	20.50	189.60	191.51		191.51	0.000078	0.30	116.51	159.48	0.08
Reach-1	33	100 YR	6.46	189.60	190.64		190.65	0.000413	0.35	19.72	58.70	0.16
Reach-1	33	50 YR	5.40	189.60	190.56		190.57	0.000558	0.36	15.36	47.54	0.18
Reach-1	33	20 YR	4.17	189.60	190.46		190.47	0.000812	0.37	11.20	35.99	0.21
Reach-1	33	10 YR	3.35	189.60	190.39		190.39	0.000962	0.39	8.69	30.13	0.23
Reach-1	33	5 YR	2.62	189.60	190.31		190.32	0.001083	0.39	6.65	24.30	0.24
Reach-1	33	2 YR	1.71	189.60	190.19		190.20	0.001050	0.40	4.29	15.00	0.24
Reach-1	34	Regional	20.50	189.80	191.52		191.54	0.000465	0.76	76.93	130.81	0.20
Reach-1	34	100 YR	6.46	189.80	190.74		190.80	0.003099	1.15	8.82	39.22	0.46
Reach-1	34	50 YR	5.40	189.80	190.69		190.75	0.003020	1.08	7.11	33.05	0.45
Reach-1	34	20 YR	4.17	189.80	190.64		190.68	0.002680	0.95	5.48	25.88	0.42
Reach-1	34	10 YR	3.35	189.80	190.59		190.62	0.002536	0.86	4.32	19.18	0.40
Reach-1	34	5 YR	2.62	189.80	190.53		190.56	0.002430	0.78	3.43	11.66	0.38
Reach-1	34	2 YR	1.71	189.80	190.41		190.43	0.002489	0.69	2.48	7.11	0.37
Reach-1	35	Regional	20.50	189.90	191.55	191.15	191.56	0.000565	0.95	80.36	132.74	0.24
Reach-1	35	100 YR	6.46	189.90	190.85	190.66	191.09	0.006415	2.20	2.93	52.89	0.72

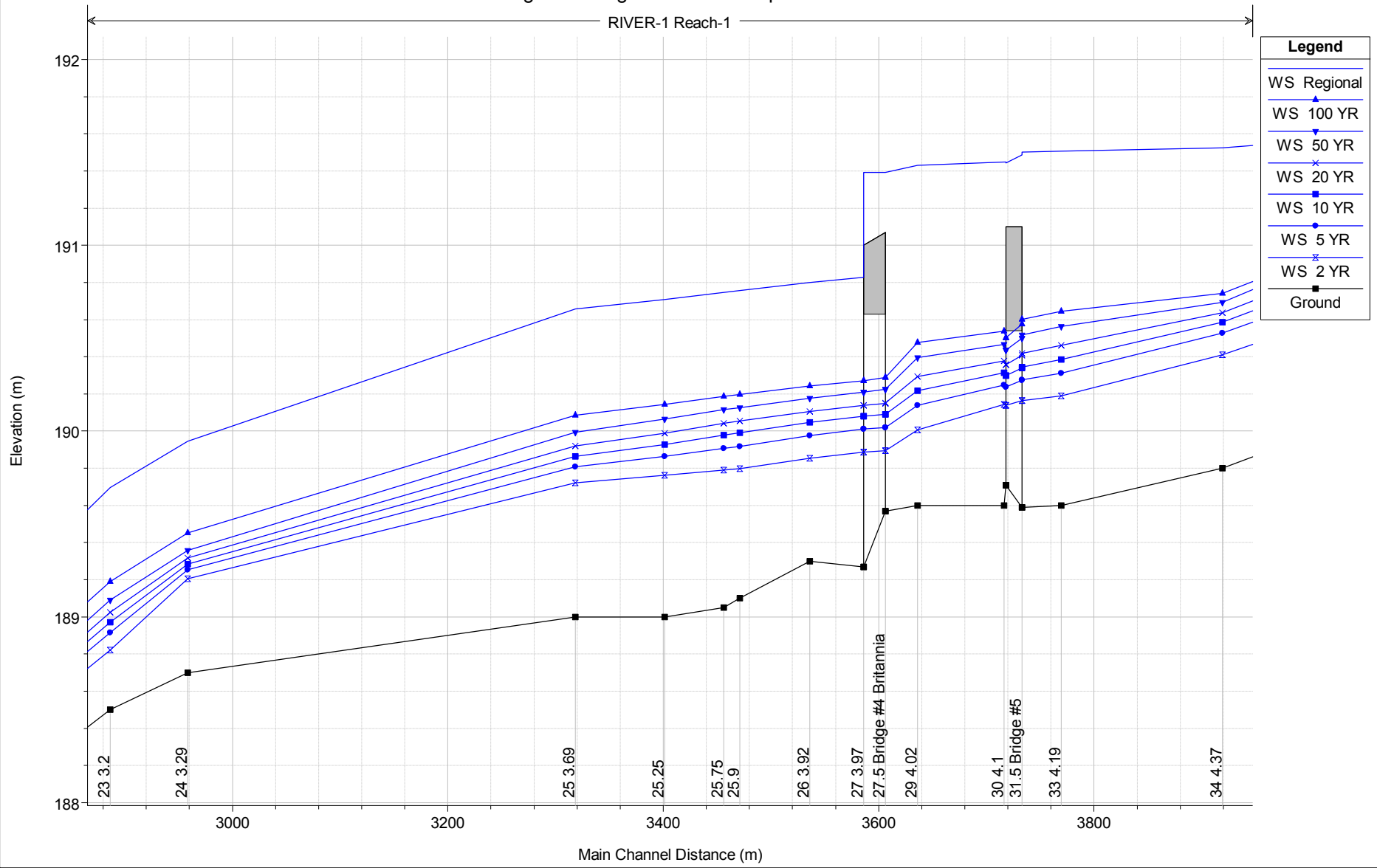
HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 (Continued)

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	35	50 YR	5.40	189.90	190.80	190.58	190.99	0.005187	1.93	2.81	47.62	0.65
Reach-1	35	20 YR	4.17	189.90	190.74	190.47	190.87	0.003918	1.60	2.61	39.56	0.55
Reach-1	35	10 YR	3.35	189.90	190.69	190.39	190.78	0.003176	1.37	2.44	32.32	0.49
Reach-1	35	5 YR	2.62	189.90	190.62	190.32	190.69	0.002572	1.17	2.24	24.06	0.44
Reach-1	35	2 YR	1.71	189.90	190.50	190.21	190.55	0.002004	0.91	1.87	8.47	0.38
Reach-1	35.5	Bridge										
Reach-1	36	Regional	20.50	189.90	191.56	191.20	191.57	0.000544	0.93	81.59	133.45	0.23
Reach-1	36	100 YR	6.46	189.90	190.93	190.66	191.14	0.004823	2.02	3.19	63.87	0.64
Reach-1	36	50 YR	5.40	189.90	190.86	190.58	191.03	0.004241	1.81	2.98	54.94	0.59
Reach-1	36	20 YR	4.17	189.90	190.78	190.47	190.90	0.003414	1.53	2.72	44.19	0.52
Reach-1	36	10 YR	3.35	189.90	190.71	190.39	190.80	0.002858	1.33	2.52	35.62	0.47
Reach-1	36	5 YR	2.62	189.90	190.64	190.32	190.71	0.002355	1.14	2.30	26.58	0.42
Reach-1	36	2 YR	1.71	189.90	190.52	190.21	190.56	0.001857	0.89	1.92	10.28	0.36
Reach-1	37	Regional	20.50	190.00	191.57		191.58	0.000254	0.41	73.90	154.36	0.14
Reach-1	37	100 YR	6.46	190.00	191.21		191.22	0.000194	0.25	29.33	89.86	0.11
Reach-1	37	50 YR	5.40	190.00	191.10		191.10	0.000337	0.28	20.21	68.18	0.14
Reach-1	37	20 YR	4.17	190.00	190.97		190.97	0.000733	0.33	12.81	46.79	0.20
Reach-1	37	10 YR	3.35	190.00	190.87		190.88	0.001255	0.38	8.81	38.12	0.25
Reach-1	37	5 YR	2.62	190.00	190.78		190.79	0.002318	0.46	5.73	29.78	0.33
Reach-1	37	2 YR	1.71	190.00	190.63		190.66	0.008760	0.73	2.34	16.18	0.62
Reach-1	38	Regional	20.50	190.50	191.63		191.64	0.000765	0.45	47.15	137.39	0.22
Reach-1	38	100 YR	6.46	190.50	191.28		191.29	0.002486	0.50	12.87	61.39	0.35
Reach-1	38	50 YR	5.40	190.50	191.21		191.23	0.004001	0.59	9.14	48.82	0.44
Reach-1	38	20 YR	4.17	190.50	191.17		191.19	0.003849	0.56	7.45	41.89	0.42
Reach-1	38	10 YR	3.35	190.50	191.15		191.16	0.003224	0.51	6.63	38.09	0.39
Reach-1	38	5 YR	2.62	190.50	191.14		191.14	0.002408	0.43	6.05	35.12	0.33
Reach-1	38	2 YR	1.71	190.50	191.10		191.11	0.001493	0.34	5.02	29.16	0.26



Omagh Crossing 11 Plan: Imported Plan 01

RIVER-1 Reach-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 (N/m2)	Shear Chan (N/m2)	Shear Total (N/m2)	Vel Chnl (m/s)	Vel Total (m/s)
Reach-1	37.014	Regional	261.96	187.70	191.13		191.13	0.00019	0.29	1306.58	539.00	0.05	0.53	0.45	0.29	0.20	
Reach-1	37.014	100 year	49.30	187.70	188.77		188.79	0.001559	0.86	106.81	406.08	0.38	8.05	4.10	0.86	0.45	
Reach-1	37.014	50 year	122.60	187.70	189.73		189.73	0.00061	0.34	565.24	514.69	0.09	0.88	0.66	0.34	0.22	
Reach-1	37.014	25 year	105.10	187.70	189.46		189.47	0.000106	0.39	430.81	506.00	0.11	1.27	0.89	0.39	0.24	
Reach-1	37.014	10 year	84.50	187.70	189.15		189.16	0.000269	0.51	277.59	476.35	0.17	2.38	1.54	0.51	0.30	
Reach-1	37.014	5 year	69.80	187.70	188.94		188.95	0.000687	0.68	180.46	447.69	0.26	4.67	2.72	0.68	0.39	
Reach-1	36.86	Regional	261.96	187.60	191.13		191.13	0.00016	0.36	1423.51	597.42	0.06	0.54	0.38	0.36	0.18	
Reach-1	36.86	100 year	49.30	187.60	188.62		188.65	0.001569	1.44	99.70	358.79	0.49	13.29	4.27	1.44	0.49	
Reach-1	36.86	50 year	122.60	187.60	189.72		189.72	0.000054	0.46	598.99	541.02	0.10	1.04	0.59	0.46	0.20	
Reach-1	36.86	25 year	105.10	187.60	189.46		189.46	0.000085	0.52	460.73	499.11	0.13	1.41	0.77	0.52	0.23	
Reach-1	36.86	10 year	84.50	187.60	189.13		189.14	0.000178	0.66	308.22	448.37	0.18	2.39	1.20	0.66	0.27	
Reach-1	36.86	5 year	69.80	187.60	188.90		188.91	0.000384	0.86	208.19	411.71	0.25	4.30	1.90	0.86	0.34	
Reach-1	36.635	Regional	261.96	187.00	191.11		191.12	0.000028	0.47	652.03	300.27	0.08	0.91	0.60	0.47	0.40	
Reach-1	36.635	100 year	49.30	187.00	188.55		188.56	0.000150	0.41	122.05	164.64	0.15	1.12	1.09	0.41	0.40	
Reach-1	36.635	50 year	122.60	187.00	189.70		189.71	0.000042	0.40	323.30	184.80	0.09	0.78	0.72	0.40	0.38	
Reach-1	36.635	25 year	105.10	187.00	189.43		189.44	0.000052	0.40	274.09	180.08	0.10	0.83	0.77	0.40	0.38	
Reach-1	36.635	10 year	84.50	187.00	189.10		189.11	0.000071	0.40	215.48	174.29	0.11	0.91	0.86	0.40	0.39	
Reach-1	36.635	5 year	69.80	187.00	188.86		188.87	0.000097	0.41	173.19	169.99	0.13	1.02	0.97	0.41	0.40	
Reach-1	36.3	Regional	261.96	186.20	191.10		191.12	0.000045	0.67	659.69	324.58	0.11	1.74	0.90	0.67	0.40	
Reach-1	36.3	100 year	49.30	186.20	188.53		188.54	0.000088	0.46	144.88	160.22	0.13	1.19	0.78	0.46	0.34	
Reach-1	36.3	50 year	122.60	186.20	189.69		189.70	0.000047	0.51	336.95	169.54	0.10	1.16	0.91	0.51	0.36	
Reach-1	36.3	25 year	105.10	186.20	189.42		189.43	0.000053	0.50	291.26	167.37	0.11	1.18	0.90	0.50	0.36	
Reach-1	36.3	10 year	84.50	186.20	189.09		189.10	0.000064	0.50	235.85	164.70	0.11	1.22	0.90	0.50	0.36	
Reach-1	36.3	5 year	69.80	186.20	188.84		188.85	0.000076	0.49	195.04	162.70	0.12	1.26	0.90	0.49	0.36	
Reach-1	36.26	Regional	261.96	186.10	191.05	189.41	191.10	0.000168	1.48	566.49	310.62	0.21	7.91	2.99	1.48	0.46	
Reach-1	36.26	100 year	49.30	186.10	188.37	187.26	188.49	0.000551	1.56	31.66	111.95	0.34	11.54	11.54	1.56	1.56	
Reach-1	36.26	50 year	122.60	186.10	189.17	188.14	189.58	0.001190	2.82	43.41	129.14	0.52	34.17	34.17	2.82	2.82	
Reach-1	36.26	25 year	105.10	186.10	188.98	187.95	189.32	0.001086	2.58	40.68	125.15	0.50	29.22	29.22	2.58	2.58	
Reach-1	36.26	10 year	84.50	186.10	188.75	187.72	189.01	0.000941	2.27	37.26	120.14	0.45	23.19	23.19	2.27	2.27	
Reach-1	36.26	5 year	69.80	186.10	188.57	187.53	188.78	0.000819	2.01	34.64	116.31	0.42	18.75	18.75	2.01	2.01	
Reach-1	36.2565			Bridge													
Reach-1	36.253	Regional	261.96	186.10	190.97	189.40	191.03	0.000183	1.52	542.38	299.70	0.22	8.48	3.24	1.52	0.48	
Reach-1	36.253	100 year	49.30	186.10	188.37	187.26	188.49	0.000555	1.56	31.59	111.85	0.34	11.60	11.60	1.56	1.56	
Reach-1	36.253	50 year	122.60	186.10	189.16	188.14	189.57	0.001206	2.84	43.24	128.90	0.53	34.48	34.48	2.84	2.84	
Reach-1	36.253	25 year	105.10	186.10	188.97	187.95	189.32	0.001099	2.59	40.53	124.93	0.50	29.47	29.47	2.59	2.59	
Reach-1	36.253	10 year	84.50	186.10	188.74	187.71	189.01	0.000952	2.28	37.13	119.96	0.46	23.37	23.37	2.28	2.28	
Reach-1	36.253	5 year	69.80	186.10	188.57	187.54	188.77	0.000827	2.02	34.54	116.16	0.42	18.89	18.89	2.02	2.02	
Reach-1	36.19	Regional	261.96	186.00	190.97	189.40	191.02	0.000171	1.29	533.17	299.52	0.21	6.47	2.96	1.29	0.49	
Reach-1	36.19	100 year	49.30	186.00	188.39	187.26	188.42	0.000357	0.91	101.92	112.40	0.25	4.66	3.15	0.91	0.48	
Reach-1	36.19	50 year	122.60	186.00	189.32	188.14	189.36	0.000275	1.14	215.54	132.36	0.24	6.05	4.36	1.14	0.57	
Reach-1	36.19	25 year	105.10	186.00	189.10	188.14	189.14	0.000300	1.11	187.17	127.67	0.25	5.96	4.28	1.11	0.56	
Reach-1	36.19	10 year	84.50	186.00	188.83	187.71	188.87	0.000338	1.07	153.35	121.84	0.26	5.84	4.14	1.07	0.55	
Reach-1	36.19	5 year	69.80	186.00	188.63	187.54	188.66	0.000374	1.04	128.88	117.44	0.26	5.73	4.00	1.04	0.54	
Reach-1	36.1	Regional	261.96	185.90	190.97	188.55	191.00	0.000147	1.06	522.82	289.44	0.19	4.65	2.58	1.06	0.50	
Reach-1	36.1	100 year	49.30	185.90	188.35	188.00	188.38	0.000848	0.90	84.12	116.49	0.34	5.67	5.93	0.90	0.59	
Reach-1	36.1	50 year	122.60	185.90	189.30	188.15	189.33	0.000321	0.98	204.61	136.93	0.24	5.06	4.64	0.98	0.60	
Reach-1	36.1	25 year	105.10	185.90	189.08	188.09	189.11	0.000382	0.97	174.77	132.16	0.26	5.21	4.88	0.97	0.60	
Reach-1	36.1	10 year	84.50	185.90	188.80	188.02	188.83	0.000503	0.97	138.90	126.19	0.29	5.53	5.35	0.97	0.61	
Reach-1	36.1	5 year	69.80	185.90	188.59	188.00	188.62	0.000665	0.97	112.62	121.63	0.32	5.96	5.96	0.97	0.62	
Reach-1	36.01	Regional	261.96	185.70	190.54	189.06	190.94	0.001043	3.05	141.86	90.00	0.50	37.13	15.81	3.05	1.85	
Reach-1	36.01	100 year	49.30	185.70	188.04	187.26	188.25	0.002023	2.05	24.04	19.71	0.58	24.16	23.31	2.05	2.05	
Reach-1	36.01	50 year	122.60	185.70	188.41	188.41	189.19	0.005210	3.91	32.82	27.20	0.98	80.66	59.66	3.91	3.74	
Reach-1	36.01	25 year	105.10	185.70	188.24	188.24	188.96	0.005509	3.75	28.58	23.88	0.99	76.65	62.49	3.75	3.68	
Reach-1	36.01	10 year	84.50	185.70	188.02	188.02	188.67	0.006141	3.55	23.80	19.46	1.01	72.63	70.94	3.55	3.55	
Reach-1	36.01	5 year	69.80	185.70	187.86	187.86	188.44	0.006144	3.37	20.70	17.88	1.00	67.18	67.18	3.37	3.37	
Reach-1	35.973	Regional	261.96	185.60	190.69	189.06	190.76	0.000230	1.60	403.69	267.84	0.24	9.66	3.38	1.60	0.65	
Reach-1	35.973	100 year	49.30	185.60	188.04	187.15	188.16	0.000753	1.56	31.67	75.18	0.38	12.47	12.47	1.56	1.56	
Reach-1	35.973	50 year	122.60	185.60	188.31	187.97	188.88	0.002878	3.35	36.59	83.49	0.76	55.06	55.06	3.35	3.35	
Reach-1	35.973	25 year	105.10	185.60	188.15	187.81	188.64	0.002776	3.12	33.73	78.65	0.73	48.95	48.95	3.12	3.12	
Reach-1	35.973	10 year	84.50	185.60	187.99	187.60	188.38	0.002413	2.74	30.86	29.92	0.67	38.93	38.93	2.74	2.74	
Reach-1	35.973	5 year	69.80	185.60	187.87	187.42	188.17	0.002137	2.45	28.54	28.43	0.63	31.88	31.88	2.45	2.45	
Reach-1	35.969			Bridge													
Reach-1	35.965	Regional	261.96	185.60	190.00	189.06	190.14	0.000520	2.15	247.62	174.03	0.36	18.42	7.20	2.15	1.06	
Reach-1	35.965	100 year	49.30	185.60	188.03	187.15	188.16	0.000764	1.56	31.54	74.95	0.38	12.59	12.59	1.56	1.56	
Reach-1	35.965	50 year	122.60	185.60	188.12	187.97	188.82	0.003989	3.70	33.18	77.72	0.88	69.19	69.19	3.70	3.70	
Reach-1	35.965	25 year	105.10	185.60	188.05	187.81	188.60	0.003344	3.30	31.89	75.55	0.80	55.77	55.77	3.30	3.30	
Reach-1	35.965	10 year	84.50	185.60	187.94	187.60	188.35	0.002691	2.83	29.86	29.28	0.71	42.02	42.02	2.83	2.83	
Reach-1	35.965	5 year	69.80	185.60	187.83	187.42	188.15	0.002320	2.51	27.84	27.98	0.65	33.77	33.77	2.51	2.51	
Reach-1	35.92	Regional	261.96	185.40	188.85	188.85	189.84	0.004306	4.44	64.78	41.64	0.93	92.91	63.50	4.44	4.04	
Reach-1	35.92	100 year	49.30	185.40	188.01	187.26	188.11	0.000721	1.34	36.69	25.27	0.35	9.89	9.79	1.34	1.34	
Reach-1	35.92	50 year	122.60	185.40	187.97	187.87	188.57	0.004900	3.45	35.49	24.70	0.92	65.84	65.84	3.45	3.4	

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 (Continued)

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 (N/m2)	Shear Chan (N/m2)	Shear Total (N/m2)	Vel Chnl (m/s)	Vel Total (m/s)
Reach-1	35.05	10 year	84.50	184.70	187.11	186.66	187.28	0.001352	2.00	74.82	186.10	0.50	21.07	5.32	2.00	1.13	
Reach-1	35.05	5 year	69.80	184.70	187.01	186.48	187.16	0.001281	1.86	55.19	180.80	0.48	18.66	3.82	1.86	1.26	
Reach-1	34.45	Regional	458.70	184.30	188.38		188.68	0.001524	3.14	278.42	147.73	0.59	42.64	27.98	3.14	1.65	
Reach-1	34.45	100 year	103.50	184.30	186.74		186.89	0.001920	2.03	89.85	104.68	0.58	23.42	16.06	2.03	1.15	
Reach-1	34.45	50 year	122.60	184.30	187.19		187.28	0.000799	1.60	137.88	108.73	0.39	13.22	9.87	1.60	0.89	
Reach-1	34.45	25 year	105.10	184.30	186.78		186.92	0.001755	1.98	93.84	105.03	0.55	22.05	15.28	1.98	1.12	
Reach-1	34.45	10 year	84.50	184.30	186.63		186.76	0.001865	1.88	78.30	103.68	0.56	20.75	13.73	1.88	1.08	
Reach-1	34.45	5 year	69.80	184.30	186.54	186.31	186.66	0.001782	1.74	69.01	102.88	0.54	18.29	11.66	1.74	1.01	
Reach-1	33.95	Regional	455.50	183.90	188.05		188.19	0.000659	2.37	410.85	180.74	0.40	22.70	14.62	2.37	1.11	
Reach-1	33.95	100 year	99.90	183.90	186.34		186.41	0.000576	1.44	137.34	140.56	0.34	10.36	5.49	1.44	0.73	
Reach-1	33.95	50 year	122.60	183.90	187.07		187.10	0.000188	1.03	247.03	157.14	0.20	4.71	2.88	1.03	0.50	
Reach-1	33.95	25 year	105.10	183.90	186.43		186.49	0.000509	1.40	150.19	142.61	0.32	9.60	5.24	1.40	0.70	
Reach-1	33.95	10 year	84.50	183.90	186.07		186.17	0.000864	1.59	100.82	134.59	0.40	13.34	6.32	1.59	0.84	
Reach-1	33.95	5 year	69.80	183.90	185.85		185.96	0.001182	1.68	72.12	116.17	0.46	15.70	7.17	1.68	0.97	
Reach-1	33.295	Regional	455.50	183.50	188.03		188.07	0.000132	1.00	615.02	234.28	0.18	4.17	3.37	1.00	0.74	
Reach-1	33.295	100 year	99.90	183.50	186.30		186.31	0.000099	0.52	239.54	203.81	0.14	1.47	1.14	0.52	0.42	
Reach-1	33.295	50 year	122.60	183.50	187.06		187.07	0.000334	0.40	399.87	216.03	0.08	0.75	0.61	0.40	0.31	
Reach-1	33.295	25 year	105.10	183.50	186.40		186.41	0.000087	0.51	259.17	205.34	0.13	1.38	1.08	0.51	0.41	
Reach-1	33.295	10 year	84.50	183.50	186.01		186.02	0.000157	0.57	180.26	199.10	0.16	1.88	1.39	0.57	0.47	
Reach-1	33.295	5 year	69.80	183.50	185.71		185.73	0.000286	0.64	125.09	173.22	0.21	2.60	2.02	0.64	0.56	
Reach-1	33.263	Regional	455.50	183.45	187.94	186.81	188.04	0.000467	2.33	507.38	233.55	0.35	20.28	9.92	2.33	0.90	
Reach-1	33.263	100 year	99.90	183.45	185.45	185.21	186.11	0.003299	3.59	27.83	80.69	0.82	63.20	63.20	3.59	3.59	
Reach-1	33.263	50 year	122.60	183.45	187.04	185.46	187.06	0.000124	1.03	310.10	206.66	0.18	4.29	1.82	1.03	0.40	
Reach-1	33.263	25 year	105.10	183.45	185.52	185.27	186.20	0.003291	3.66	28.70	89.53	0.82	65.05	65.05	3.66	3.66	
Reach-1	33.263	10 year	84.50	183.45	185.26	185.03	185.84	0.003320	3.36	25.12	53.48	0.81	57.42	57.42	3.36	3.36	
Reach-1	33.263	5 year	69.80	183.45	185.07	184.84	185.57	0.003338	3.12	22.36	25.79	0.79	51.39	51.39	3.12	3.12	
Reach-1	33.2575		Bridge														
Reach-1	33.252	Regional	455.50	183.30	186.64	186.64	187.18	0.002678	4.57	259.47	199.18	0.80	86.27	34.10	4.57	1.76	
Reach-1	33.252	100 year	99.90	183.30	185.14	185.14	185.86	0.004129	3.79	31.22	57.83	0.90	72.64	34.83	3.79	3.20	
Reach-1	33.252	50 year	122.60	183.30	185.50	185.50	186.13	0.003016	3.66	48.87	108.97	0.80	63.63	23.05	3.66	2.51	
Reach-1	33.252	25 year	105.10	183.30	185.25	185.25	185.93	0.003703	3.73	35.33	72.56	0.86	68.88	29.23	3.73	2.97	
Reach-1	33.252	10 year	84.50	183.30	184.93	184.87	185.60	0.004520	3.66	25.28	27.88	0.93	70.23	53.76	3.66	3.34	
Reach-1	33.252	5 year	69.80	183.30	184.82	184.69	185.34	0.003963	3.25	23.10	20.62	0.86	56.98	49.63	3.25	3.02	
Reach-1	33.22	Regional	455.50	183.20	186.49	186.49	187.05	0.002884	4.28	239.91	194.83	0.81	79.54	34.73	4.28	1.90	
Reach-1	33.22	100 year	99.90	183.20	185.04	185.04	185.59	0.004409	3.30	34.33	55.35	0.89	60.00	26.60	3.30	2.91	
Reach-1	33.22	50 year	122.60	183.20	185.30	185.30	185.80	0.003349	3.23	53.48	89.65	0.79	54.07	19.49	3.23	2.29	
Reach-1	33.22	25 year	105.10	183.20	185.11	185.11	185.64	0.004027	3.27	38.74	64.88	0.85	57.64	23.42	3.27	2.71	
Reach-1	33.22	10 year	84.50	183.20	184.81	184.81	185.40	0.005940	3.40	24.94	24.99	1.00	67.50	57.15	3.40	3.39	
Reach-1	33.22	5 year	69.80	183.20	184.65	184.65	185.18	0.006162	3.25	21.51	20.07	1.00	63.49	63.49	3.25	3.25	
Reach-1	33.03	Regional	455.50	182.80	185.89		186.21	0.001247	2.51	181.21	106.37	0.61	20.77	20.77	2.51	2.51	
Reach-1	33.03	100 year	99.90	182.80	184.84		184.91	0.000391	1.13	88.12	71.47	0.33	4.71	4.71	1.13	1.13	
Reach-1	33.03	50 year	122.60	182.80	184.94		185.02	0.000485	1.29	95.03	74.63	0.36	6.03	6.03	1.29	1.29	
Reach-1	33.03	25 year	105.10	182.80	184.87		184.94	0.000412	1.17	89.83	72.26	0.33	5.00	5.00	1.17	1.17	
Reach-1	33.03	10 year	84.50	182.80	184.77		184.83	0.000324	1.02	83.25	69.16	0.30	3.80	3.80	1.02	1.02	
Reach-1	33.03	5 year	69.80	182.80	184.54		184.60	0.000369	1.03	68.01	61.38	0.31	4.00	4.00	1.03	1.03	
Reach-1	32.802	Regional	455.50	182.40	185.90	184.89	186.01	0.000353	1.45	313.18	254.01	0.33	6.67	6.67	1.45	1.45	
Reach-1	32.802	100 year	99.90	182.40	184.79	184.12	184.82	0.000293	0.75	133.30	196.45	0.26	2.35	2.35	0.75	0.75	
Reach-1	32.802	50 year	122.60	182.40	184.89	184.21	184.92	0.000308	0.83	148.47	201.30	0.28	2.76	2.76	0.83	0.83	
Reach-1	32.802	25 year	105.10	182.40	184.82	184.15	184.85	0.000295	0.77	137.13	197.68	0.27	2.44	2.44	0.77	0.77	
Reach-1	32.802	10 year	84.50	182.40	184.73	184.06	184.75	0.000271	0.69	122.65	188.99	0.25	2.04	2.04	0.69	0.69	
Reach-1	32.802	5 year	69.80	182.40	184.45	183.99	184.49	0.000518	0.84	83.12	131.65	0.34	3.22	3.22	0.84	0.84	
Reach-1	32.632	Regional	455.50	182.00	185.86	184.81	185.95	0.000337	1.53	425.57	229.22	0.33	7.08	6.11	1.53	1.07	
Reach-1	32.632	100 year	99.90	182.00	184.76	184.11	184.78	0.000224	0.77	179.67	214.82	0.24	2.29	1.83	0.77	0.56	
Reach-1	32.632	50 year	122.60	182.00	184.85	184.24	184.88	0.000247	0.85	199.30	216.01	0.26	2.74	2.23	0.85	0.62	
Reach-1	32.632	25 year	105.10	182.00	184.78	184.14	184.80	0.000228	0.79	184.68	215.12	0.24	2.38	1.91	0.79	0.57	
Reach-1	32.632	10 year	84.50	182.00	184.69	183.99	184.71	0.000202	0.70	166.21	214.00	0.23	1.94	1.53	0.70	0.51	
Reach-1	32.632	5 year	69.80	182.00	184.26	183.89	184.35	0.001388	1.30	53.53	193.31	0.54	7.97	7.97	1.30	1.30	
Reach-1	32.524	Regional	455.50	182.00	185.64	185.16	185.87	0.000812	3.21	350.85	212.26	0.54	26.93	13.10	3.21	1.30	
Reach-1	32.524	100 year	99.90	182.00	184.67	183.70	184.74	0.000285	1.54	157.06	185.98	0.30	6.87	2.35	1.54	0.64	
Reach-1	32.524	50 year	122.60	182.00	184.73	184.31	184.83	0.000361	1.76	169.89	187.84	0.34	8.93	3.18	1.76	0.72	
Reach-1	32.524	25 year	105.10	182.00	184.68	183.75	184.77	0.000301	1.59	160.55	186.49	0.31	7.30	2.52	1.59	0.65	
Reach-1	32.524	10 year	84.50	182.00	184.62	183.52	184.68	0.000230	1.36	148.53	184.74	0.27	5.44	1.80	1.36	0.57	
Reach-1	32.524	5 year	69.80	182.00	183.68	183.35	184.08	0.001802	2.81	24.81	37.14	0.71	26.96	26.96	2.81	2.81	
Reach-1	32.5195		Bridge														
Reach-1	32.515	Regional	455.50	182.00	185.60	185.16	185.84	0.000872	3.30	341.74	211.10	0.56	28.55	13.76	3.30	1.33	
Reach-1	32.515	100 year	99.90	182.00	183.70	183.70	184.51	0.003587	3.99	25.02	37.48	1.00	54.14	54.14	3.99	3.99	
Reach-1	32.515	50 year	122.60	182.00	184.31	184.31	184.63	0.001165	2.82	92.32	176.33	0.60	24.22	5.95	2.82	1.33	
Reach-1	32.515	25 year	105.10	182.00	183.75	183.75	184.59	0.003535	4.06	25.91	38.90	1.00	55.24	55.24	4.06	4.06	
Reach-1	32.515	10 year	84.50	182.00	183.52	183.52	184.25	0.003718	3.77	22.39	33.26	1.00	50.21	50.21	3.77	3.77	
Reach-1	32.515	5 year	69.80	182.00	183.35	183.35	183.99	0.003884	3.54	19.71	28.96	1.00	46.16	46.16	3.54	3.54	
Reach-1	32.457	Regional	455.50	181.70	185.66		185.74	0.000199	1.28	395.51	203.19	0.26	4.77				



HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 (Continued)

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	Shear Chan (N/m2)	Shear Total (N/m2)	Vel Chnl (m/s)	Vel Total (m/s)
Reach-1	31.836	100 year	99.90	181.30	183.66		183.73	0.000308	1.40	160.21	158.44	0.31	6.10	3.05	1.40	0.62
Reach-1	31.836	50 year	122.60	181.30	183.94		184.01	0.000260	1.41	208.62	181.51	0.30	5.88	2.93	1.41	0.59
Reach-1	31.836	25 year	105.10	181.30	183.72		183.79	0.000297	1.41	170.64	163.69	0.31	6.07	3.03	1.41	0.62
Reach-1	31.836	10 year	84.50	181.30	183.58		183.64	0.000259	1.25	148.54	152.35	0.29	4.95	2.48	1.25	0.57
Reach-1	31.836	5 year	69.80	181.30	183.38		183.44	0.000282	1.22	119.43	136.01	0.29	4.83	2.43	1.22	0.58
Reach-1	31.76	Regional	455.50	181.10	185.48		183.95	0.000254	2.13	641.76	281.90	0.33	10.92	5.64	2.13	0.71
Reach-1	31.76	100 year	99.90	181.10	183.65		182.45	0.000179	1.25	211.46	184.87	0.25	4.48	1.99	1.25	0.47
Reach-1	31.76	50 year	122.60	181.10	183.94		182.64	0.000162	1.28	266.81	203.13	0.24	4.52	2.08	1.28	0.46
Reach-1	31.76	25 year	105.10	181.10	183.72		182.50	0.000176	1.26	223.59	189.02	0.25	4.51	2.02	1.26	0.47
Reach-1	31.76	10 year	84.50	181.10	183.43		182.31	0.000415	1.79	47.24	170.31	0.37	9.47	9.47	1.79	1.79
Reach-1	31.76	5 year	69.80	181.10	183.27		182.17	0.000357	1.58	44.06	160.29	0.34	7.60	7.60	1.58	1.58
Reach-1	31.756	Regional	455.50	181.10	185.48		183.96	0.000254	2.14	641.41	281.84	0.33	10.93	5.65	2.14	0.71
Reach-1	31.756	100 year	99.90	181.10	183.65		182.52	0.000179	1.25	211.30	184.82	0.25	4.49	2.00	1.25	0.47
Reach-1	31.756	50 year	122.60	181.10	183.94		182.71	0.000163	1.28	266.66	203.08	0.24	4.53	2.08	1.28	0.46
Reach-1	31.756	25 year	105.10	181.10	183.72		182.57	0.000176	1.26	223.43	188.97	0.25	4.52	2.03	1.26	0.47
Reach-1	31.756	10 year	84.50	181.10	183.48		182.37	0.000179	1.19	180.60	173.86	0.25	4.17	1.81	1.19	0.47
Reach-1	31.756	5 year	69.80	181.10	183.31		182.20	0.000175	1.12	151.59	162.83	0.24	3.78	1.58	1.12	0.46
Reach-1	31.7505				Bridge											
Reach-1	31.745	Regional	455.50	181.10	184.92		185.11	0.000504	2.74	490.89	253.44	0.45	18.87	9.52	2.74	0.93
Reach-1	31.745	100 year	99.90	181.10	183.50		183.57	0.000242	1.39	183.32	174.86	0.29	5.69	2.47	1.39	0.54
Reach-1	31.745	50 year	122.60	181.10	183.72		183.79	0.000237	1.46	224.34	189.28	0.29	6.10	2.74	1.46	0.55
Reach-1	31.745	25 year	105.10	181.10	183.55		183.62	0.000242	1.41	192.54	178.20	0.29	5.81	2.54	1.41	0.55
Reach-1	31.745	10 year	84.50	181.10	183.37		183.43	0.000227	1.30	160.91	166.46	0.28	5.04	2.14	1.30	0.53
Reach-1	31.745	5 year	69.80	181.10	183.23		183.28	0.000209	1.20	138.52	157.61	0.26	4.36	1.79	1.20	0.50
Reach-1	31.74	Regional	455.50	181.10	184.96		185.06	0.000667	2.12	501.55	255.55	0.34	25.25	12.77	2.12	0.91
Reach-1	31.74	100 year	99.90	181.10	183.23		182.45	0.001751	2.31	43.25	157.75	0.51	36.59	36.59	2.31	2.31
Reach-1	31.74	50 year	122.60	181.10	183.32		182.64	0.002284	2.71	45.16	163.76	0.58	49.83	49.83	2.71	2.71
Reach-1	31.74	25 year	105.10	181.10	183.26		182.50	0.001866	2.40	43.75	159.31	0.52	39.44	39.44	2.40	2.40
Reach-1	31.74	10 year	84.50	181.10	183.18		182.31	0.001360	2.00	42.20	154.43	0.44	27.73	27.73	2.00	2.00
Reach-1	31.74	5 year	69.80	181.10	183.10		182.17	0.001053	1.72	40.63	149.49	0.39	20.67	20.67	1.72	1.72
Reach-1	31.69	Regional	455.50	181.00	184.81		184.97	0.001098	2.36	369.18	198.87	0.42	33.62	19.93	2.36	1.23
Reach-1	31.69	100 year	99.90	181.00	183.24		183.33	0.001178	1.54	104.99	121.72	0.39	18.13	9.93	1.54	0.95
Reach-1	31.69	50 year	122.60	181.00	183.36		183.47	0.001294	1.70	120.27	130.22	0.42	21.44	11.69	1.70	1.02
Reach-1	31.69	25 year	105.10	181.00	183.27		183.37	0.001204	1.58	108.67	123.82	0.40	18.87	10.33	1.58	0.97
Reach-1	31.69	10 year	84.50	181.00	183.18		183.25	0.000997	1.38	97.62	117.41	0.36	14.75	8.11	1.38	0.87
Reach-1	31.69	5 year	69.80	181.00	183.09		183.15	0.000868	1.24	87.85	111.43	0.33	12.12	6.69	1.24	0.79
Reach-1	31.22	Regional	455.50	180.40	184.73		184.78	0.000301	1.34	551.17	238.49	0.23	10.38	6.78	1.34	0.83
Reach-1	31.22	100 year	99.90	180.40	182.82		182.91	0.001121	1.56	111.95	191.16	0.38	18.15	6.41	1.56	0.89
Reach-1	31.22	50 year	122.60	180.40	182.99		183.07	0.000985	1.55	145.82	223.89	0.36	17.50	6.27	1.55	0.84
Reach-1	31.22	25 year	105.10	180.40	182.82		182.92	0.001259	1.65	111.13	190.30	0.41	20.33	7.18	1.65	0.95
Reach-1	31.22	10 year	84.50	180.40	182.59		182.73	0.001801	1.79	73.14	144.85	0.47	25.18	8.88	1.79	1.16
Reach-1	31.22	5 year	69.80	180.40	182.42		182.58	0.002346	1.88	50.61	109.31	0.53	28.81	10.59	1.88	1.38
Reach-1	31.08	Regional	455.50	179.90	184.64		184.73	0.000496	1.80	483.23	306.48	0.29	18.38	7.64	1.80	0.94
Reach-1	31.08	100 year	99.90	179.90	182.68		182.79	0.000910	1.53	87.46	115.60	0.35	16.77	6.69	1.53	1.14
Reach-1	31.08	50 year	122.60	179.90	182.83		181.92	0.000980	1.67	105.25	133.52	0.37	19.38	7.51	1.67	1.16
Reach-1	31.08	25 year	105.10	179.90	182.65		182.78	0.001091	1.66	83.61	111.35	0.38	19.76	7.96	1.66	1.26
Reach-1	31.08	10 year	84.50	179.90	182.42		182.54	0.001227	1.61	61.25	82.37	0.40	19.53	8.83	1.61	1.38
Reach-1	31.08	5 year	69.80	179.90	182.23		182.35	0.001313	1.54	48.14	59.11	0.40	18.60	10.31	1.54	1.45
Reach-1	30.81	Regional	478.63	179.50	183.61		183.61	0.003742	4.30	165.64	124.83	0.78	112.26	48.34	4.30	2.89
Reach-1	30.81	100 year	109.90	179.50	181.76		182.23	0.005576	3.06	35.95	25.84	0.83	74.42	74.42	3.06	3.06
Reach-1	30.81	50 year	122.60	179.50	181.83		181.67	0.006095	3.25	37.73	26.45	0.87	83.40	83.40	3.25	3.25
Reach-1	30.81	25 year	105.10	179.50	181.73		182.18	0.005402	2.99	35.19	25.57	0.81	71.30	71.30	2.99	2.99
Reach-1	30.81	10 year	84.50	179.50	181.59		181.95	0.004634	2.67	31.67	24.31	0.75	57.93	57.93	2.67	2.67
Reach-1	30.81	5 year	69.80	179.50	181.46		181.76	0.004121	2.43	28.71	23.20	0.70	48.95	48.95	2.43	2.43
Reach-1	30.61	Regional	478.63	179.30	183.40		183.54	0.000739	2.21	332.99	128.51	0.36	27.61	18.49	2.21	1.44
Reach-1	30.61	100 year	109.90	179.30	181.77		181.83	0.000610	1.39	127.46	112.96	0.30	13.07	6.70	1.39	0.86
Reach-1	30.61	50 year	122.60	179.30	181.87		181.94	0.000613	1.43	139.23	118.26	0.30	13.74	7.03	1.43	0.88
Reach-1	30.61	25 year	105.10	179.30	181.73		181.79	0.000611	1.37	122.74	110.77	0.30	12.85	6.59	1.37	0.86
Reach-1	30.61	10 year	84.50	179.30	181.54		181.59	0.000608	1.28	102.60	100.87	0.29	11.65	6.02	1.28	0.82
Reach-1	30.61	5 year	69.80	179.30	181.38		181.43	0.000607	1.21	87.54	92.78	0.29	10.70	5.57	1.21	0.80
Reach-1	30.4	Regional	478.63	179.10	183.08		183.36	0.001724	3.15	269.47	160.74	0.54	58.11	28.13	3.15	1.78
Reach-1	30.4	100 year	109.90	179.10	181.41		181.63	0.002184	2.30	64.73	59.90	0.54	38.52	22.86	2.30	1.70
Reach-1	30.4	50 year	122.60	179.10	181.50		181.73	0.002243	2.41	69.99	62.34	0.56	41.42	24.40	2.41	1.75
Reach-1	30.4	25 year	105.10	179.10	181.37		181.58	0.002186	2.27	62.41	58.80	0.54	37.73	22.47	2.27	1.68
Reach-1	30.4	10 year	84.50	179.10	181.20		181.39	0.002113	2.09	53.00	54.08	0.52	33.08	20.06	2.09	1.59
Reach-1	30.4	5 year	69.80	179.10	181.06		181.23	0.002078	1.95	45.72	50.12	0.51	29.72	18.35	1.95	1.53
Reach-1	30.14	Regional	478.63	178.70	182.88		183.03	0.000884	2.35	451.44	237.52	0.39	31.62	16.33	2.35	1.06
Reach-1	30.14	100 year	109.90	178.70	180.80		181.04	0.002499	2.27	69.81	93.34	0.57	38.85	18.18	2.27	1.57
Reach-1	30.14	50 year	122.60	178.70	180.89		181.14	0.002466	2.34	78.69	100.91	0.57	40.53	18.71	2.34	1.56
Reach-1	30.14	25 year	105.10	178.70	180.79		181.01	0.002355	2.19	68.74	92.39	0.55	36.34	17.04	2.19	1.53
Reach-1	30.14	10 year	84.50	178.70	180.64		180.83	0.002300	2.02	55.48	79.64	0.54	32.06	15.59	2.02	1.52
Reach-1	30.14	5 year	69.80	178.70	180.53		180.69	0.002119	1.84	47.52	70.89	0.51	27.36	13.82	1.84	1.47
Reach-1	29.91	Regional	475.20	178.30	182.											

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 (Continued)

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	Shear Chan (N/m2)	Shear Total (N/m2)	Vel Chnl (m/s)	Vel Total (m/s)
Reach-1	28.97	Regional	475.20	177.70	182.55		182.61	0.000233	1.15	452.68	168.79	0.20	7.76	6.09	1.15	1.05
Reach-1	28.97	100 year	107.30	177.70	180.19		180.24	0.000754	0.95	113.30	111.52	0.29	7.83	7.48	0.95	0.95
Reach-1	28.97	50 year	122.60	177.70	180.28		180.33	0.000765	1.01	122.64	113.88	0.30	8.56	8.04	1.01	1.00
Reach-1	28.97	25 year	105.10	177.70	180.16		180.20	0.000816	0.97	109.15	110.45	0.30	8.17	7.87	0.97	0.96
Reach-1	28.97	10 year	84.50	177.70	179.92		179.97	0.000639	0.98	86.50	68.76	0.28	7.82	7.82	0.98	0.98
Reach-1	28.97	5 year	69.80	177.70	179.76		179.80	0.000616	0.92	75.93	64.45	0.27	7.08	7.08	0.92	0.92
Reach-1	28.75	Regional	475.20	177.40	182.43		182.54	0.000529	1.63	362.68	125.60	0.26	20.35	14.88	1.63	1.31
Reach-1	28.75	100 year	107.30	177.40	179.78		179.95	0.002666	1.80	63.37	76.10	0.49	35.22	21.68	1.80	1.69
Reach-1	28.75	50 year	122.60	177.40	179.80		180.00	0.003352	2.03	64.55	78.00	0.55	44.65	27.09	2.03	1.90
Reach-1	28.75	25 year	105.10	177.40	179.68		179.87	0.003265	1.92	56.47	63.87	0.54	40.77	28.16	1.92	1.86
Reach-1	28.75	10 year	84.50	177.40	179.53		179.69	0.003097	1.75	48.24	45.14	0.52	35.18	32.23	1.75	1.75
Reach-1	28.75	5 year	69.80	177.40	179.40		179.54	0.002896	1.63	42.94	39.21	0.50	30.87	30.87	1.63	1.63
Reach-1	28.59	Regional	475.20	177.30	182.37		182.46	0.000416	1.68	430.46	147.04	0.24	19.89	11.86	1.68	1.10
Reach-1	28.59	100 year	107.30	177.30	179.63		179.70	0.000856	1.40	108.83	83.05	0.30	18.17	10.93	1.40	0.99
Reach-1	28.59	50 year	122.60	177.30	179.56		179.66	0.001304	1.69	103.22	82.50	0.37	26.81	15.90	1.69	1.19
Reach-1	28.59	25 year	105.10	177.30	179.45		179.54	0.001249	1.60	94.16	81.62	0.36	24.35	14.05	1.60	1.12
Reach-1	28.59	10 year	84.50	177.30	179.30		179.38	0.001208	1.49	81.72	80.39	0.35	21.75	11.98	1.49	1.03
Reach-1	28.59	5 year	69.80	177.30	179.16		179.23	0.001233	1.43	70.68	79.29	0.35	20.55	10.73	1.43	0.99
Reach-1	28.51	Regional	475.20	177.20	182.38		182.43	0.000225	1.14	502.25	157.78	0.17	9.51	6.97	1.14	0.95
Reach-1	28.51	100 year	107.30	177.20	179.57		179.63	0.000951	1.17	109.61	104.94	0.30	14.26	9.71	1.17	0.98
Reach-1	28.51	50 year	122.60	177.20	179.46		179.55	0.001685	1.48	97.98	99.36	0.40	23.39	16.24	1.48	1.25
Reach-1	28.51	25 year	105.10	177.20	179.35		179.43	0.001696	1.41	87.35	93.97	0.39	21.72	15.40	1.41	1.20
Reach-1	28.51	10 year	84.50	177.20	179.19		179.27	0.001780	1.32	73.31	86.34	0.39	20.10	14.76	1.32	1.15
Reach-1	28.51	5 year	69.80	177.20	179.04		179.12	0.002028	1.29	61.08	79.10	0.41	19.98	15.30	1.29	1.14
Reach-1	28.47	Regional	587.90	177.00	182.35		182.41	0.000313	1.48	528.14	161.62	0.21	15.40	9.95	1.48	1.11
Reach-1	28.47	100 year	136.30	177.00	179.38		179.55	0.002280	2.23	92.33	108.30	0.49	46.62	19.00	2.23	1.48
Reach-1	28.47	50 year	122.60	177.00	179.25		179.45	0.002608	2.29	79.61	101.76	0.52	50.29	19.95	2.29	1.54
Reach-1	28.47	25 year	105.10	177.00	179.11		179.32	0.002988	2.33	65.36	93.89	0.55	53.39	20.34	2.33	1.61
Reach-1	28.47	10 year	84.50	177.00	178.92		179.15	0.003465	2.33	48.67	73.02	0.58	55.43	22.56	2.33	1.74
Reach-1	28.47	5 year	69.80	177.00	178.81		179.00	0.003088	2.10	41.74	53.52	0.54	46.12	23.50	2.10	1.67
Reach-1	28.356	Regional	587.90	176.70	182.37		182.38	0.000074	0.70	1062.72	289.12	0.10	3.53	2.64	0.70	0.55
Reach-1	28.356	100 year	136.30	176.70	179.42		179.44	0.000314	0.79	252.05	251.79	0.18	5.98	3.07	0.79	0.54
Reach-1	28.356	50 year	122.60	176.70	179.30		179.32	0.000360	0.81	222.18	248.99	0.19	6.46	3.14	0.81	0.55
Reach-1	28.356	25 year	105.10	176.70	179.15		179.17	0.000427	0.84	185.80	245.53	0.20	7.05	3.16	0.84	0.57
Reach-1	28.356	10 year	84.50	176.70	178.94		178.97	0.000584	0.90	135.25	212.75	0.23	8.53	3.63	0.90	0.62
Reach-1	28.356	5 year	69.80	176.70	178.80		178.83	0.000603	0.87	110.87	148.24	0.23	8.18	4.41	0.87	0.63
Reach-1	28.26	Regional	587.90	176.60	182.33		182.37	0.000214	1.19	958.52	250.41	0.17	10.11	7.99	1.19	0.61
Reach-1	28.26	100 year	136.30	176.60	179.36		179.40	0.000503	0.97	259.72	216.47	0.23	9.25	5.91	0.97	0.52
Reach-1	28.26	50 year	122.60	176.60	179.24		179.27	0.000543	0.97	233.29	214.63	0.23	9.33	5.77	0.97	0.53
Reach-1	28.26	25 year	105.10	176.60	179.09		179.12	0.000587	0.95	201.10	212.37	0.24	9.23	5.44	0.95	0.52
Reach-1	28.26	10 year	84.50	176.60	178.87		178.90	0.000727	0.95	154.49	200.67	0.26	9.84	5.47	0.95	0.55
Reach-1	28.26	5 year	69.80	176.60	178.73		178.76	0.000787	0.93	127.17	189.75	0.26	9.59	5.16	0.93	0.55
Reach-1	28.19	Regional	587.90	176.50	182.33		182.36	0.000136	0.78	785.78	187.97	0.12	5.87	5.50	0.78	0.75
Reach-1	28.19	100 year	136.30	176.50	179.35		179.36	0.000315	0.56	246.10	175.02	0.15	4.44	4.33	0.56	0.55
Reach-1	28.19	50 year	122.60	176.50	179.22		179.24	0.000346	0.56	224.33	174.84	0.16	4.44	4.33	0.56	0.55
Reach-1	28.19	25 year	105.10	176.50	179.07		179.09	0.000385	0.54	197.55	174.61	0.16	4.38	4.26	0.54	0.53
Reach-1	28.19	10 year	84.50	176.50	178.84		178.85	0.000512	0.54	157.45	170.56	0.18	4.74	4.62	0.54	0.54
Reach-1	28.19	5 year	69.80	176.50	178.69		178.71	0.000596	0.53	132.95	167.01	0.19	4.74	4.65	0.53	0.53
Reach-1	28.185	Regional	587.90	177.10	182.32		182.36	0.000153	0.82	766.62	206.93	0.13	6.49	5.51	0.82	0.77
Reach-1	28.185	100 year	136.30	177.10	179.34		179.36	0.000409	0.62	227.02	173.03	0.17	5.39	5.24	0.62	0.60
Reach-1	28.185	50 year	122.60	177.10	179.22		179.24	0.000458	0.61	205.44	172.65	0.18	5.48	5.33	0.61	0.60
Reach-1	28.185	25 year	105.10	177.10	179.06		179.08	0.000529	0.60	178.91	172.19	0.19	5.53	5.37	0.60	0.59
Reach-1	28.185	10 year	84.50	177.10	178.83		178.85	0.000763	0.62	139.06	167.94	0.21	6.34	6.18	0.62	0.61
Reach-1	28.185	5 year	69.80	177.10	178.68		178.70	0.000961	0.62	114.69	164.41	0.23	6.70	6.55	0.62	0.61
Reach-1	28.18	Regional	587.90	175.90	182.32		182.35	0.000119	0.75	832.02	205.28	0.11	5.33	4.66	0.75	0.71
Reach-1	28.18	100 year	136.30	175.90	179.34		179.36	0.000218	0.51	272.05	173.21	0.13	3.43	3.44	0.51	0.50
Reach-1	28.18	50 year	122.60	175.90	179.22		179.23	0.000231	0.49	250.45	172.77	0.13	3.36	3.27	0.49	0.49
Reach-1	28.18	25 year	105.10	175.90	179.07		179.08	0.000245	0.47	223.93	172.23	0.13	3.19	3.11	0.47	0.47
Reach-1	28.18	10 year	84.50	175.90	178.83		178.84	0.000302	0.46	183.90	170.49	0.14	3.24	3.18	0.46	0.46
Reach-1	28.18	5 year	69.80	175.90	178.69		178.70	0.000333	0.44	159.02	169.17	0.14	3.09	3.05	0.44	0.44
Reach-1	28.157	Regional	587.90	175.80	182.25		182.33	0.000434	1.76	686.84	174.75	0.23	26.38	16.51	1.76	0.86
Reach-1	28.157	100 year	136.30	175.80	179.13		179.30	0.001170	1.81	75.26	155.14	0.33	35.36	35.36	1.81	1.81
Reach-1	28.157	50 year	122.60	175.80	179.04		179.18	0.001052	1.68	72.92	154.33	0.31	30.80	30.80	1.68	1.68
Reach-1	28.157	25 year	105.10	175.80	178.92		179.04	0.000883	1.50	70.08	144.50	0.28	24.84	24.84	1.50	1.50
Reach-1	28.157	10 year	84.50	175.80	178.73		178.81	0.000723	1.29	65.28	120.50	0.25	18.94	18.94	1.29	1.29
Reach-1	28.157	5 year	69.80	175.80	178.61		178.69	0.000574	1.12	62.36	105.93	0.22	14.38	14.38	1.12	1.12
Reach-1	28.151	Bridge														
Reach-1	28.145	Regional	587.90	175.75	181.03		179.92	0.001215	2.55	476.80	171.10	0.36	59.61	32.90	2.55	1.23
Reach-1	28.145	100 year	136.30	175.75	179.11		177.50	0.001172	1.81	75.22	154.92	0.33	35.41	35.41	1.81	1.81
Reach-1	28.145	50 year	122.60	175.75	179.02		177.39	0.001050	1.68	72.96	154.13	0.31	30.76	30.76	1.68	1.68
Reach-1	28.145	25 year	105.10	175.75	178.90		179.02	0.000877	1.50	70.21	142.13	0.28	24.73	24.73	1.50	1.50
Reach-1	28.145	10 year	84.50	175.75	178.71		178.79	0.000715	1.29	65.50	118.58	0.25	18.79	18.79	1.29	1.29
Reach-1	28.145	5 year	69.80	175.75												

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 (Continued)

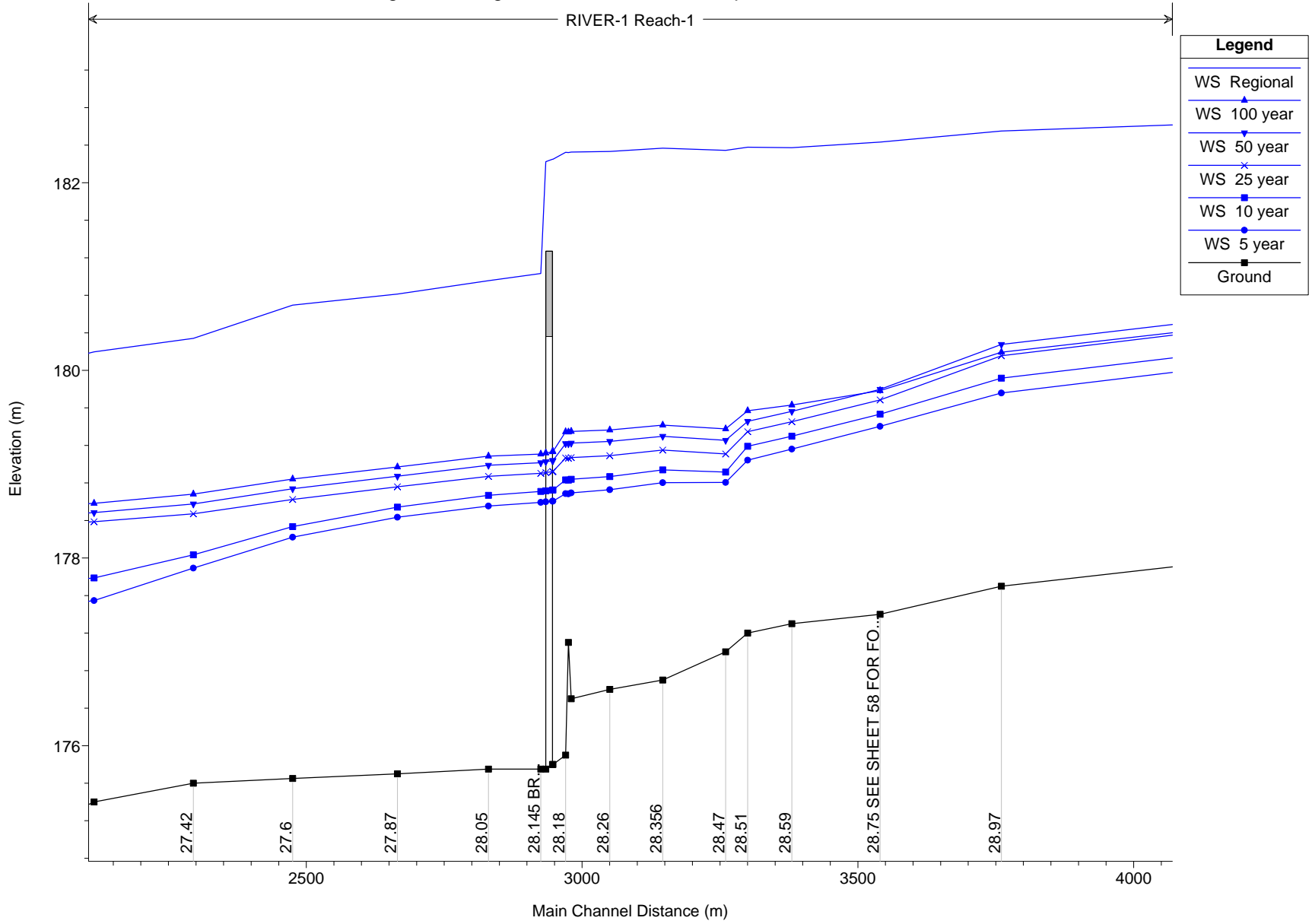
Reach	River Sta	Profile	Q Total (m <sup>3</sup> /s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m <sup>2</sup> )	Top Width (m)	Froude # Chl	Shear Chan (N/m <sup>2</sup> )	Shear Total (N/m <sup>2</sup> )	Vel Chnl (m/s)	Vel Total (m/s)
Reach-1	27.6	Regional	595.80	175.65	180.69		180.77	0.000685	1.71	525.49	179.32	0.26	28.45	19.44	1.71	1.13
Reach-1	27.6	100 year	136.60	175.65	178.84		178.88	0.000686	1.20	200.77	172.21	0.24	16.61	7.79	1.20	0.68
Reach-1	27.6	50 year	122.60	175.65	178.74		178.78	0.000722	1.19	182.85	171.69	0.24	16.78	7.49	1.19	0.67
Reach-1	27.6	25 year	105.10	175.65	178.62		178.66	0.000727	1.16	163.35	171.12	0.24	16.11	6.76	1.16	0.64
Reach-1	27.6	10 year	84.50	175.65	178.33		178.40	0.001189	1.36	114.03	169.67	0.30	23.14	7.79	1.36	0.74
Reach-1	27.6	5 year	69.80	175.65	178.22		178.29	0.001234	1.34	94.91	169.11	0.30	22.71	6.75	1.34	0.74
Reach-1	27.42	Regional	595.80	175.60	180.34		180.61	0.001941	2.41	272.99	93.22	0.43	61.55	54.48	2.41	2.18
Reach-1	27.42	100 year	136.60	175.60	178.68		178.75	0.001220	1.19	123.83	87.07	0.30	19.03	16.82	1.19	1.10
Reach-1	27.42	50 year	122.60	175.60	178.58		178.64	0.001249	1.15	114.66	86.59	0.30	18.20	16.04	1.15	1.07
Reach-1	27.42	25 year	105.10	175.60	178.47		178.53	0.001185	1.07	105.62	86.12	0.29	16.06	14.10	1.07	1.00
Reach-1	27.42	10 year	84.50	175.60	178.03		178.12	0.002895	1.30	68.42	84.15	0.42	26.96	22.89	1.30	1.24
Reach-1	27.42	5 year	69.80	175.60	177.89		177.97	0.003442	1.27	56.74	80.13	0.45	27.33	23.70	1.27	1.23
Reach-1	27.15	Regional	617.20	175.40	180.20		180.31	0.001093	2.11	490.35	157.21	0.33	43.75	33.12	2.11	1.26
Reach-1	27.15	100 year	141.70	175.40	178.58		178.61	0.000470	1.00	247.92	143.67	0.20	11.52	7.91	1.00	0.57
Reach-1	27.15	50 year	122.60	175.40	178.48		178.51	0.000421	0.92	233.66	142.87	0.19	9.92	6.72	0.92	0.52
Reach-1	27.15	25 year	105.10	175.40	178.39		178.41	0.000372	0.84	219.85	142.09	0.18	8.42	5.62	0.84	0.48
Reach-1	27.15	10 year	84.50	175.40	177.79		177.83	0.000969	1.12	136.53	134.55	0.27	16.34	9.60	1.12	0.62
Reach-1	27.15	5 year	69.80	175.40	177.55		177.59	0.001376	1.21	104.68	129.48	0.31	20.00	10.86	1.21	0.67
Reach-1	26.9	Regional	617.20	175.00	179.98		180.15	0.001023	1.98	383.27	119.01	0.32	39.23	31.97	1.98	1.61
Reach-1	26.9	100 year	141.70	175.00	178.53		178.56	0.000298	0.79	215.83	110.70	0.16	7.19	5.66	0.79	0.66
Reach-1	26.9	50 year	122.60	175.00	178.44		178.46	0.000257	0.71	205.71	110.05	0.15	5.97	4.68	0.71	0.60
Reach-1	26.9	25 year	105.10	175.00	178.35		178.37	0.000218	0.64	195.85	109.43	0.13	4.87	3.80	0.64	0.54
Reach-1	26.9	10 year	84.50	175.00	177.70		177.73	0.000481	0.76	127.09	100.36	0.19	7.72	5.95	0.76	0.66
Reach-1	26.9	5 year	69.80	175.00	177.43		177.46	0.000629	0.77	100.80	94.42	0.21	8.43	6.56	0.77	0.69
Reach-1	26.8	Regional	617.20	174.90	179.43		179.95	0.003505	4.28	253.10	131.28	0.67	138.53	65.63	4.28	2.44
Reach-1	26.8	100 year	141.70	174.90	178.41		178.50	0.000819	1.71	138.17	93.22	0.31	24.29	11.77	1.71	1.03
Reach-1	26.8	50 year	122.60	174.90	178.34		178.41	0.000694	1.55	131.44	90.50	0.29	20.12	9.78	1.55	0.93
Reach-1	26.8	25 year	105.10	174.90	178.26		178.33	0.000580	1.39	124.94	87.79	0.26	16.39	8.00	1.39	0.84
Reach-1	26.8	10 year	84.50	174.90	177.50		177.64	0.001585	1.88	67.95	62.21	0.41	33.14	16.78	1.88	1.24
Reach-1	26.8	5 year	69.80	174.90	177.17		177.34	0.002261	2.02	49.06	51.76	0.47	40.05	20.75	2.02	1.42
Reach-1	26.785	Regional	617.20	174.80	179.43	178.90	179.88	0.002921	4.26	286.21	142.08	0.64	131.07	57.14	4.26	2.16
Reach-1	26.785	100 year	141.70	174.80	178.41	177.17	178.49	0.000632	1.67	160.23	104.84	0.28	22.04	9.37	1.67	0.88
Reach-1	26.785	50 year	122.60	174.80	178.33	177.01	178.40	0.000530	1.51	152.70	102.18	0.26	18.12	7.69	1.51	0.80
Reach-1	26.785	25 year	105.10	174.80	178.26	176.85	178.32	0.000437	1.35	145.40	99.54	0.23	14.63	6.20	1.35	0.72
Reach-1	26.785	10 year	84.50	174.80	177.49	176.62	177.61	0.001069	1.78	79.72	70.94	0.35	27.68	11.62	1.78	1.06
Reach-1	26.785	5 year	69.80	174.80	177.16	176.40	177.30	0.001417	1.88	58.08	58.38	0.39	32.05	13.60	1.88	1.20
Reach-1	26.7825		Bridge													
Reach-1	26.78	Regional	617.20	174.80	178.90	178.90	179.72	0.005824	5.54	216.10	122.76	0.88	231.12	99.53	5.54	2.86
Reach-1	26.78	100 year	141.70	174.80	177.26	177.17	177.74	0.000478	3.54	63.98	62.06	0.73	112.66	47.56	3.54	2.21
Reach-1	26.78	50 year	122.60	174.80	177.14	177.01	177.59	0.004502	3.33	57.25	57.85	0.70	101.20	42.98	3.33	2.14
Reach-1	26.78	25 year	105.10	174.80	177.04	176.85	177.43	0.004090	3.08	51.61	54.07	0.66	87.90	37.62	3.08	2.04
Reach-1	26.78	10 year	84.50	174.80	176.90		177.23	0.003588	2.76	44.38	48.80	0.62	72.16	31.39	2.76	1.90
Reach-1	26.78	5 year	69.80	174.80	176.78		177.06	0.003204	2.51	38.80	44.30	0.58	60.67	26.94	2.51	1.80
Reach-1	26.75	Regional	617.20	174.70	178.87		179.36	0.003337	3.81	260.41	135.12	0.65	114.80	62.79	3.81	2.37
Reach-1	26.75	100 year	141.70	174.70	177.30		177.51	0.002371	2.18	88.24	80.48	0.49	45.51	25.79	2.18	1.61
Reach-1	26.75	50 year	122.60	174.70	177.18		177.37	0.002322	2.06	78.60	75.40	0.48	41.79	23.64	2.06	1.56
Reach-1	26.75	25 year	105.10	174.70	177.07		177.24	0.002200	1.93	70.47	70.84	0.47	37.20	21.36	1.93	1.49
Reach-1	26.75	10 year	84.50	174.70	176.92		177.06	0.002063	1.75	60.07	64.54	0.44	31.81	18.73	1.75	1.41
Reach-1	26.75	5 year	69.80	174.70	176.79		176.91	0.001971	1.62	52.02	59.21	0.43	27.90	16.89	1.62	1.34
Reach-1	26.66	Regional	631.10	174.50	178.78		179.00	0.002089	2.72	331.79	168.61	0.45	75.23	40.02	2.72	1.90
Reach-1	26.66	100 year	144.20	174.50	176.99		177.23	0.003913	2.41	79.39	90.17	0.55	73.42	33.51	2.41	1.62
Reach-1	26.66	50 year	122.60	174.50	176.87		177.09	0.003872	2.30	68.85	81.97	0.54	68.08	31.63	2.30	1.78
Reach-1	26.66	25 year	105.10	174.50	176.76		177.09	0.003760	2.17	60.59	74.92	0.53	62.30	29.57	2.17	1.73
Reach-1	26.66	10 year	84.50	174.50	176.63		176.81	0.003514	1.99	51.09	65.88	0.50	53.65	26.48	1.99	1.65
Reach-1	26.66	5 year	69.80	174.50	176.52		176.67	0.003264	1.83	44.28	58.54	0.48	46.38	23.97	1.83	1.58
Reach-1	26.52	Regional	631.10	174.20	178.62		178.81	0.001377	2.11	348.25	134.98	0.36	46.24	34.49	2.11	1.81
Reach-1	26.52	100 year	144.20	174.20	176.80		176.88	0.001529	1.35	122.20	107.39	0.34	24.20	16.96	1.35	1.18
Reach-1	26.52	50 year	122.60	174.20	176.66		176.74	0.001592	1.29	107.34	104.57	0.34	23.03	15.94	1.29	1.14
Reach-1	26.52	25 year	105.10	174.20	176.54		176.61	0.001662	1.25	94.58	102.08	0.34	22.04	15.02	1.25	1.11
Reach-1	26.52	10 year	84.50	174.20	176.38		176.45	0.001777	1.19	78.45	98.84	0.35	20.79	13.77	1.19	1.08
Reach-1	26.52	5 year	69.80	174.20	176.24		176.31	0.001944	1.14	65.17	96.10	0.35	20.15	12.87	1.14	1.07
Reach-1	26.36	Regional	631.10	173.90	177.98		178.46	0.003786	3.26	224.18	111.29	0.59	114.54	74.24	3.26	2.82
Reach-1	26.36	100 year	144.20	173.90	176.45		176.59	0.002472	1.68	88.11	67.03	0.43	38.00	31.65	1.68	1.64
Reach-1	26.36	50 year	122.60	173.90	176.32		176.45	0.002387	1.56	79.82	63.35	0.41	33.75	29.31	1.56	1.54
Reach-1	26.36	25 year	105.10	173.90	176.21		176.32	0.002314	1.45	72.82	60.06	0.40	30.16	27.34	1.45	1.44
Reach-1	26.36	10 year	84.50	173.90	176.06		176.15	0.002244	1.32	64.03	55.65	0.39	25.91	25.16	1.32	1.32
Reach-1	26.36	5 year	69.80	173.90	175.92		176.00	0.002141	1.23	56.87	51.73	0.37	22.95	22.95	1.23	1.23
Reach-1	26.2	Regional	631.10	173.60	177.47		177.86	0.003999	3.44	251.00	105.51	0.61	125.65	92.26	3.44	2.51
Reach-1	26.2	100 year	144.20	173.60	175.81		176.04	0.005325	2.51	81.76	89.65	0.63	84.39	47.41	2.51	1.76
Reach-1	26.2	50 year	122.60	173.60	175.72		175.92	0.004909	2.34	73.71	84.68	0.60	74.41	41.71	2.34	1.66
Reach-1	26.2	25 year	105.10	173.60	175.61		175.81	0.004849	2.24	64.92	78.89	0.59	69.56	38.95	2.24	1.62
Reach-1	26.2	10 year	84.50	173.60	175.47		175.65	0.004742	2.10	54.26	71.25	0.57	62.8			

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 (Continued)

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	Shear Chan (N/m2)	Shear Total (N/m2)	Vel Chnl (m/s)	Vel Total (m/s)
Reach-1	25.93	5 year	69.80	172.80	174.12		174.23	0.006300	1.49	46.84	71.67	0.59	40.23	39.99	1.49	1.49
Reach-1	25.79	Regional	722.50	172.10	176.86		177.01	0.000472	1.75	429.26	125.70	0.29	17.42	15.59	1.75	1.68
Reach-1	25.79	100 year	169.60	172.10	174.28		174.36	0.001207	1.31	129.78	108.52	0.38	14.22	14.03	1.31	1.31
Reach-1	25.79	50 year	122.60	172.10	173.95		174.04	0.001763	1.29	94.88	106.09	0.44	15.34	15.34	1.29	1.29
Reach-1	25.79	25 year	105.10	172.10	173.84		173.92	0.001970	1.27	82.97	103.91	0.45	15.30	15.30	1.27	1.27
Reach-1	25.79	10 year	84.50	172.10	173.70		173.78	0.002316	1.23	68.61	101.21	0.48	15.28	15.28	1.23	1.23
Reach-1	25.79	5 year	69.80	172.10	173.59		173.67	0.002689	1.20	58.02	99.18	0.50	15.31	15.31	1.20	1.20
Reach-1	25.63	Regional	722.50	171.50	176.74		176.93	0.000577	2.09	400.10	108.68	0.32	23.81	20.56	2.09	1.81
Reach-1	25.63	100 year	169.60	171.50	174.07		174.18	0.001132	1.50	126.72	97.30	0.38	17.23	14.43	1.50	1.34
Reach-1	25.63	50 year	122.60	171.50	173.68		173.79	0.001433	1.50	90.42	83.99	0.42	18.15	15.10	1.50	1.36
Reach-1	25.63	25 year	105.10	171.50	173.56		173.66	0.001397	1.42	80.86	79.24	0.41	16.74	13.95	1.42	1.30
Reach-1	25.63	10 year	84.50	171.50	173.43		173.51	0.001273	1.30	70.61	73.82	0.39	14.25	11.91	1.30	1.20
Reach-1	25.63	5 year	69.80	171.50	173.34		173.40	0.001110	1.17	64.10	70.15	0.36	11.83	9.92	1.17	1.09
Reach-1	25.47	Regional	722.50	170.80	176.66		176.83	0.000741	2.40	505.14	130.75	0.33	39.31	27.64	2.40	1.43
Reach-1	25.47	100 year	169.60	170.80	173.95		174.04	0.000801	1.57	175.35	112.80	0.30	21.32	12.11	1.57	0.97
Reach-1	25.47	50 year	122.60	170.80	173.54		173.62	0.000835	1.44	131.89	100.03	0.30	18.92	10.72	1.44	0.93
Reach-1	25.47	25 year	105.10	170.80	173.43		173.50	0.000746	1.32	121.63	96.77	0.28	16.14	9.13	1.32	0.86
Reach-1	25.47	10 year	84.50	170.80	173.32		173.37	0.000599	1.15	111.08	93.30	0.25	12.32	6.95	1.15	0.76
Reach-1	25.47	5 year	69.80	170.80	173.25		173.29	0.000471	0.99	104.68	91.14	0.22	9.36	5.27	0.99	0.67
Reach-1	25.31	Regional	722.50	170.10	176.16		176.64	0.001691	3.63	309.09	86.07	0.49	90.01	57.57	3.63	2.34
Reach-1	25.31	100 year	169.60	170.10	173.69		173.88	0.001161	2.03	111.67	68.39	0.37	34.36	18.21	2.03	1.52
Reach-1	25.31	50 year	122.60	170.10	173.33		173.47	0.000996	1.73	88.63	58.88	0.33	26.02	14.40	1.73	1.38
Reach-1	25.31	25 year	105.10	170.10	173.27		173.38	0.000801	1.53	85.00	57.24	0.30	20.45	11.42	1.53	1.24
Reach-1	25.31	10 year	84.50	170.10	173.20		173.28	0.000667	1.27	81.52	55.63	0.25	14.13	7.98	1.27	1.04
Reach-1	25.31	5 year	69.80	170.10	173.17		173.22	0.000408	1.07	79.52	54.68	0.21	10.04	5.70	1.07	0.88
Reach-1	25.15	Regional	722.50	169.50	176.34		176.44	0.000260	1.45	521.20	101.91	0.20	14.19	12.70	1.45	1.39
Reach-1	25.15	100 year	169.60	169.50	173.77		173.79	0.000115	0.64	269.92	93.67	0.12	3.38	3.20	0.64	0.63
Reach-1	25.15	50 year	122.60	169.50	173.38		173.40	0.000095	0.53	234.27	92.44	0.10	2.44	2.33	0.53	0.52
Reach-1	25.15	25 year	105.10	169.50	173.31		173.32	0.000077	0.47	227.35	92.20	0.09	1.92	1.84	0.47	0.46
Reach-1	25.15	10 year	84.50	169.50	173.23		173.24	0.000055	0.39	220.42	91.96	0.08	1.33	1.28	0.39	0.38
Reach-1	25.15	5 year	69.80	169.50	173.19		173.19	0.000040	0.33	216.32	91.81	0.07	0.95	0.91	0.33	0.32
Reach-1	25.05	Regional	722.50	169.30	176.22		176.40	0.000397	1.90	384.77	82.75	0.27	18.83	17.69	1.90	1.88
Reach-1	25.05	100 year	169.60	169.30	173.73		173.77	0.000171	0.86	196.26	69.11	0.16	4.68	4.68	0.86	0.86
Reach-1	25.05	50 year	122.60	169.30	173.36		173.39	0.000136	0.72	170.73	67.14	0.14	3.35	3.35	0.72	0.72
Reach-1	25.05	25 year	105.10	169.30	173.29		173.31	0.000109	0.63	166.04	66.77	0.13	2.62	2.62	0.63	0.63
Reach-1	25.05	10 year	84.50	169.30	173.22		173.23	0.000077	0.52	161.40	66.40	0.11	1.81	1.81	0.52	0.52
Reach-1	25.05	5 year	69.80	169.30	173.18		173.19	0.000055	0.44	158.69	66.19	0.09	1.28	1.28	0.44	0.44
Reach-1	25.02	Regional	722.50	169.30	175.94	173.80	176.33	0.000772	3.17	360.59	105.47	0.40	47.86	25.49	3.17	2.00
Reach-1	25.02	100 year	169.60	169.30	173.60	171.22	173.74	0.000368	1.61	105.30	66.08	0.26	14.43	14.43	1.61	1.61
Reach-1	25.02	50 year	122.60	169.30	173.28	170.91	173.36	0.000255	1.27	96.81	60.44	0.21	9.17	9.17	1.27	1.27
Reach-1	25.02	25 year	105.10	169.30	173.23	170.78	173.29	0.000196	1.10	95.48	59.55	0.18	6.96	6.96	1.10	1.10
Reach-1	25.02	10 year	84.50	169.30	173.18	170.62	173.22	0.000133	0.90	94.17	58.68	0.15	4.65	4.65	0.90	0.90
Reach-1	25.02	5 year	69.80	169.30	173.15	170.50	173.18	0.000093	0.75	93.41	58.17	0.13	3.23	3.23	0.75	0.75
Reach-1	25.015	Bridge														
Reach-1	25.01	Regional	722.50	169.30	175.87	173.72	176.27	0.000807	3.22	353.77	104.38	0.41	49.52	26.41	3.22	2.04
Reach-1	25.01	100 year	169.60	169.30	173.53	171.22	173.62	0.000299	1.43	154.92	64.69	0.23	11.49	6.93	1.43	1.09
Reach-1	25.01	50 year	122.60	169.30	173.28	170.91	173.36	0.000255	1.27	96.74	60.39	0.21	9.19	9.19	1.27	1.27
Reach-1	25.01	25 year	105.10	169.30	173.23	170.78	173.29	0.000196	1.10	95.43	59.52	0.18	6.97	6.97	1.10	1.10
Reach-1	25.01	10 year	84.50	169.30	173.18	170.62	173.22	0.000133	0.90	94.14	58.66	0.15	4.65	4.65	0.90	0.90
Reach-1	25.01	5 year	69.80	169.30	173.15	170.50	173.18	0.000093	0.75	93.38	58.16	0.13	3.23	3.23	0.75	0.75
Reach-1	24.94	Regional	722.50	169.20	175.85		176.20	0.001179	2.66	278.64	79.32	0.45	41.00	39.11	2.66	2.59
Reach-1	24.94	100 year	169.60	169.20	173.44		173.58	0.001129	1.65	103.72	57.55	0.39	19.85	19.27	1.65	1.64
Reach-1	24.94	50 year	122.60	169.20	173.25		173.34	0.000755	1.33	93.19	52.97	0.32	12.92	12.55	1.33	1.32
Reach-1	24.94	25 year	105.10	169.20	173.20		173.27	0.000588	1.17	90.85	51.90	0.28	10.00	9.72	1.17	1.16
Reach-1	24.94	10 year	84.50	169.20	173.16		173.21	0.000401	0.96	88.68	50.89	0.23	6.79	6.60	0.96	0.95
Reach-1	24.94	5 year	69.80	169.20	173.14		173.17	0.000282	0.80	87.49	50.33	0.19	4.76	4.63	0.80	0.80
Reach-1	24.87	Regional	733.50	169.20	175.22	174.69	175.95	0.004071	4.42	230.97	81.07	0.63	184.08	109.42	4.42	3.18
Reach-1	24.87	100 year	173.60	169.20	173.09	172.06	173.41	0.002867	2.56	79.01	50.67	0.48	74.53	41.93	2.56	2.20
Reach-1	24.87	50 year	122.60	169.20	173.09	171.60	173.25	0.001430	1.81	79.01	50.67	0.34	37.17	20.91	1.81	1.55
Reach-1	24.87	25 year	105.10	169.20	173.09	171.42	173.21	0.001051	1.55	79.01	50.67	0.29	27.32	15.37	1.55	1.33
Reach-1	24.87	10 year	84.50	169.20	173.09	171.18	173.16	0.000679	1.25	79.01	50.67	0.23	17.66	9.93	1.25	1.07
Reach-1	24.87	5 year	69.80	169.20	173.09	170.99	173.14	0.000463	1.03	79.01	50.67	0.19	12.05	6.78	1.03	0.88

Crossing 15 Existing East Branch Plan: Imported Plan 06 15/01/2013

RIVER-1 Reach-1





## **Proposed Hydraulic Structures**





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	Shear Chan (N/m2)	Shear Total (N/m2)	Vel Chnl (m/s)	Vel Total (m/s)
Reach-1	7.92	Regional	427.40	180.70	185.94		186.03	0.000692	1.86	365.94	125.49	0.27	32.30	19.55	1.86	1.17
Reach-1	7.92	100 year	97.60	180.70	183.88		183.94	0.000702	1.30	126.13	103.53	0.25	19.02	8.31	1.30	0.77
Reach-1	7.92	50 year	87.30	180.70	183.75		183.81	0.000726	1.29	112.68	97.23	0.25	18.76	8.18	1.29	0.77
Reach-1	7.92	20 year	74.10	180.70	183.54		183.59	0.000806	1.28	92.93	87.16	0.26	19.18	8.35	1.28	0.80
Reach-1	7.92	10 year	59.60	180.70	183.23		183.29	0.001026	1.32	68.16	72.59	0.29	21.39	9.35	1.32	0.87
Reach-1	7.92	5 year	49.40	180.70	182.93		183.01	0.001431	1.42	48.68	58.63	0.33	25.80	11.52	1.42	1.01
Reach-1	7.81	Regional	427.40	180.70	185.71		185.95	0.000589	2.84	303.47	95.90	0.41	27.17	17.97	2.84	1.41
Reach-1	7.81	100 year	97.60	180.70	183.82		183.89	0.000288	1.42	129.10	84.19	0.27	8.03	4.29	1.42	0.76
Reach-1	7.81	50 year	87.30	180.70	183.69		183.76	0.000278	1.35	118.61	80.52	0.26	7.42	3.98	1.35	0.74
Reach-1	7.81	20 year	74.10	180.70	183.48		183.55	0.000277	1.28	102.57	74.57	0.26	6.83	3.70	1.28	0.72
Reach-1	7.81	10 year	59.60	180.70	183.17		183.24	0.000302	1.23	81.06	65.76	0.26	6.56	3.62	1.23	0.74
Reach-1	7.81	5 year	49.40	180.70	182.87		182.94	0.000370	1.24	62.46	57.05	0.28	6.95	3.93	1.24	0.79
Reach-1	7.767	Regional	427.40	180.65	185.15	184.67	185.79	0.001811	4.84	205.05	83.44	0.73	79.98	43.08	4.84	2.08
Reach-1	7.767	100 year	97.60	180.65	183.70	182.74	183.85	0.000578	2.11	96.71	62.67	0.39	17.30	8.63	2.11	1.01
Reach-1	7.767	50 year	87.30	180.65	183.58	182.63	183.72	0.000554	2.01	89.33	60.40	0.37	15.94	7.93	2.01	0.98
Reach-1	7.767	20 year	74.10	180.65	183.38	182.47	183.51	0.000551	1.91	77.51	56.55	0.37	14.74	7.30	1.91	0.96
Reach-1	7.767	10 year	59.60	180.65	183.07	182.26	183.20	0.000612	1.86	60.78	50.62	0.38	14.52	7.10	1.86	0.98
Reach-1	7.767	5 year	49.40	180.65	182.74	182.08	182.89	0.000803	1.93	45.12	44.36	0.43	16.43	7.87	1.93	1.09
Reach-1	7.763	Regional	427.40	180.65	185.13	184.65	185.78	0.001847	4.87	203.46	83.24	0.73	81.24	43.71	4.87	2.10
Reach-1	7.763	100 year	97.60	180.65	183.70	182.73	183.85	0.000581	2.11	96.51	62.61	0.39	17.37	8.66	2.11	1.01
Reach-1	7.763	50 year	87.30	180.65	183.58	182.63	183.72	0.000557	2.01	89.14	60.34	0.38	16.00	7.96	2.01	0.98
Reach-1	7.763	20 year	74.10	180.65	183.38	182.47	183.51	0.000554	1.91	77.33	56.49	0.37	14.80	7.32	1.91	0.96
Reach-1	7.763	10 year	59.60	180.65	183.06	182.25	183.19	0.000617	1.86	60.58	50.55	0.38	14.59	7.14	1.86	0.98
Reach-1	7.763	5 year	49.40	180.65	182.73	182.07	182.88	0.000812	1.94	44.88	44.25	0.43	16.57	7.94	1.94	1.10
Reach-1	7.761															
Reach-1	7.759	Regional	427.40	180.30	184.30	184.30	185.31	0.003176	5.92	164.24	78.14	0.94	124.53	64.64	5.92	2.60
Reach-1	7.759	100 year	97.60	180.30	182.60	182.38	183.02	0.002052	3.29	54.90	48.37	0.69	46.25	22.48	3.29	1.78
Reach-1	7.759	50 year	87.30	180.30	182.52		182.90	0.001900	3.09	51.33	46.94	0.66	41.43	20.04	3.09	1.70
Reach-1	7.759	20 year	74.10	180.30	182.41		182.74	0.001734	2.85	45.98	44.72	0.63	35.83	17.19	2.85	1.61
Reach-1	7.759	10 year	59.60	180.30	182.26		182.54	0.001525	2.55	39.75	42.00	0.58	29.35	13.91	2.55	1.50
Reach-1	7.759	5 year	49.40	180.30	182.15		182.38	0.001356	2.31	35.08	39.83	0.54	24.58	11.50	2.31	1.41
Reach-1	7.755	Regional	427.40	180.30	184.43	183.89	184.91	0.004386	4.26	174.25	79.47	0.67	177.45	93.12	4.26	2.45
Reach-1	7.755	100 year	97.60	180.30	182.67	182.30	182.92	0.003575	2.66	58.64	49.81	0.55	83.25	40.63	2.66	1.66
Reach-1	7.755	50 year	87.30	180.30	182.59	182.21	182.82	0.003430	2.54	54.39	48.16	0.54	76.96	37.38	2.54	1.61
Reach-1	7.755	20 year	74.10	180.30	182.46	182.08	182.67	0.003291	2.39	48.26	45.68	0.52	69.61	33.53	2.39	1.54
Reach-1	7.755	10 year	59.60	180.30	182.30	181.86	182.48	0.003081	2.20	41.25	42.67	0.50	60.39	28.71	2.20	1.45
Reach-1	7.755	5 year	49.40	180.30	182.17	181.68	182.34	0.002883	2.04	36.08	40.30	0.48	52.97	24.85	2.04	1.37
Reach-1	7.71	Regional	427.40	180.20	184.36		184.67	0.002739	3.38	198.09	74.03	0.53	111.70	70.28	3.38	2.16
Reach-1	7.71	100 year	97.60	180.20	182.61		182.74	0.002074	2.05	78.25	62.45	0.42	49.10	25.04	2.05	1.25
Reach-1	7.71	50 year	87.30	180.20	182.53		182.65	0.002027	1.98	72.77	61.81	0.41	46.24	23.01	1.98	1.20
Reach-1	7.71	20 year	74.10	180.20	182.39		182.50	0.002031	1.90	64.45	60.83	0.41	43.63	20.75	1.90	1.15
Reach-1	7.71	10 year	59.60	180.20	182.22		182.33	0.002047	1.81	54.46	59.63	0.41	40.64	18.04	1.81	1.09
Reach-1	7.71	5 year	49.40	180.20	182.09		182.20	0.002068	1.74	46.73	58.68	0.40	38.41	15.90	1.74	1.06
Reach-1	7.5	Regional	427.40	179.80	183.59		184.00	0.003644	2.87	155.75	67.75	0.56	93.56	80.89	2.87	2.74
Reach-1	7.5	100 year	97.60	179.80	182.10		182.22	0.003157	1.54	63.60	55.82	0.46	35.38	34.87	1.54	1.53
Reach-1	7.5	50 year	87.30	179.80	182.00		182.12	0.003455	1.51	57.85	54.97	0.47	35.26	35.26	1.51	1.51
Reach-1	7.5	20 year	74.10	179.80	181.84		181.96	0.003701	1.49	49.61	50.39	0.48	35.32	35.32	1.49	1.49
Reach-1	7.5	10 year	59.60	179.80	181.65		181.76	0.004039	1.47	40.45	44.76	0.49	35.37	35.37	1.47	1.47
Reach-1	7.5	5 year	49.40	179.80	181.50		181.61	0.004292	1.45	34.07	40.36	0.50	35.06	35.06	1.45	1.45
Reach-1	7.3	Regional	427.40	179.40	182.79		183.23	0.004109	3.40	168.22	78.12	0.62	124.58	86.06	3.40	2.54
Reach-1	7.3	100 year	97.60	179.40	181.78		181.85	0.001097	1.35	93.00	67.89	0.30	22.44	14.67	1.35	1.05
Reach-1	7.3	50 year	87.30	179.40	181.66		181.73	0.001097	1.30	85.32	65.24	0.30	21.22	14.01	1.30	1.02
Reach-1	7.3	20 year	74.10	179.40	181.49		181.56	0.001121	1.24	74.64	61.35	0.29	19.83	13.31	1.24	0.99
Reach-1	7.3	10 year	59.60	179.40	181.27		181.34	0.001193	1.17	61.75	56.32	0.30	18.55	12.76	1.17	0.97
Reach-1	7.3	5 year	49.40	179.40	181.09		181.15	0.001314	1.13	51.68	52.04	0.31	18.06	12.73	1.13	0.96
Reach-1	7.15	Regional	427.40	179.10	182.63		182.91	0.000854	2.45	217.08	97.56	0.46	23.92	18.53	2.45	1.97
Reach-1	7.15	100 year	97.60	179.10	181.75		181.78	0.000164	0.84	135.91	85.60	0.19	3.17	2.54	0.84	0.72
Reach-1	7.15	50 year	87.30	179.10	181.63		181.66	0.000162	0.80	126.12	83.57	0.19	2.95	2.38	0.80	0.69
Reach-1	7.15	20 year	74.10	179.10	181.46		181.49	0.000162	0.75	112.15	80.59	0.18	2.69	2.20	0.75	0.66
Reach-1	7.15	10 year	59.60	179.10	181.24		181.26	0.000171	0.70	94.62	76.69	0.19	2.46	2.06	0.70	0.63
Reach-1	7.15	5 year	49.40	179.10	181.05		181.07	0.000190	0.68	80.20	73.33	0.19	2.38	2.03	0.68	0.62
Reach-1	7.086	Regional	427.40	178.85	182.61	181.49	182.81	0.001061	3.28	302.51	122.29	0.54	39.14	25.59	3.28	1.41
Reach-1	7.086	100 year	97.60	178.85	181.74	180.47	181.77	0.000180	1.13	201.17	111.15	0.21	5.10	3.17	1.13	0.49
Reach-1	7.086	50 year	87.30	178.85	181.63	180.41	181.65	0.000174	1.08	188.36	109.70	0.21	4.73	2.91	1.08	0.46
Reach-1	7.086	20 year	74.10	178.85	181.46	180.35	181.48	0.000169	1.02	169.80	107.56	0.20	4.31	2.60	1.02	0.44
Reach-1	7.086	10 year	59.60	178.85	181.23	180.26	181.25	0.000168	0.96	146.05	104.77	0.20	3.92	2.28	0.96	0.41
Reach-1	7.086	5 year	49.40	178.85	181.04	180.19	181.06	0.000175	0.93	125.99	102.35	0.20	3.76	2.10	0.93	0.39
Reach-1	7.082															
Reach-1	7.08	Regional	427.40	178.80	182.03		182.37	0.002084	4.16	239.57	115.40	0.74	66.02	42.19	4.16	1.78
Reach-1	7.08	100 year	97.60	178.80	180.73		180.86	0.001305	2.33	99.79	99.10	0.54	24.68	12.84	2.33	0.98
Reach-1	7.08	50 year	87.30	178.80	180.65		180.78	0.001280	2.25	92.60	98.18	0.53	23.28	11.79	2.25	0.94
Reach-1	7.08	20 year	74.10	178.80	180.55		180.68	0.001247	2.14	82.73	96.92	0.52	21.44	10.40	2.14	0.90
Reach-1	7.08	10 year	59.60	178.80	180.43		180.55	0.001198	2.00							

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 (Continued)

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 (N/m2)	Shear Chan (N/m2)	Shear Total (N/m2)	Vel Chnl (m/s)	Vel Total (m/s)
Reach-1	7.02	10 year	59.60	178.60	180.36	180.06	180.41	0.001847	1.44	76.15	107.25	0.36	28.05	12.80	1.44	0.78	
Reach-1	7.02	5 year	49.40	178.60	180.26	180.02	180.31	0.001952	1.42	65.39	105.48	0.37	27.80	11.81	1.42	0.76	
Reach-1	6.92	Regional	427.40	178.30	181.41		181.77	0.005080	3.60	199.91	133.58	0.68	143.32	74.37	3.60	2.14	
Reach-1	6.92	100 year	97.60	178.30	179.94	179.94	180.30	0.009126	3.01	47.51	72.16	0.80	126.87	58.78	3.01	2.05	
Reach-1	6.92	50 year	87.30	178.30	179.87	179.87	180.22	0.009211	2.93	42.72	67.66	0.80	121.91	56.88	2.93	2.04	
Reach-1	6.92	20 year	74.10	178.30	179.77	179.77	180.11	0.009474	2.82	36.22	61.05	0.80	116.10	54.97	2.82	2.05	
Reach-1	6.92	10 year	59.60	178.30	179.64	179.64	179.97	0.010134	2.71	28.61	52.24	0.81	110.94	54.25	2.71	2.08	
Reach-1	6.92	5 year	49.40	178.30	179.52	179.52	179.85	0.010999	2.63	23.04	44.72	0.83	108.13	55.39	2.63	2.14	
Reach-1	6.76	Regional	427.40	177.70	181.11		181.26	0.001659	2.27	283.36	127.80	0.40	53.97	35.94	2.27	1.51	
Reach-1	6.76	100 year	97.60	177.70	179.67		179.73	0.001222	1.33	110.24	103.14	0.31	22.57	12.80	1.33	0.89	
Reach-1	6.76	50 year	87.30	177.70	179.58		179.64	0.001212	1.29	101.20	98.84	0.31	21.32	12.16	1.29	0.86	
Reach-1	6.76	20 year	74.10	177.70	179.46		179.51	0.001189	1.21	89.50	92.98	0.30	19.49	11.21	1.21	0.83	
Reach-1	6.76	10 year	59.60	177.70	179.31		179.35	0.001160	1.13	75.97	85.72	0.29	17.30	10.08	1.13	0.78	
Reach-1	6.76	5 year	49.40	177.70	179.19		179.23	0.001134	1.05	66.01	79.94	0.28	15.58	9.18	1.05	0.75	
Reach-1	6.6	Regional	427.40	177.20	180.17	180.17	180.75	0.009284	4.48	170.49	125.15	0.89	231.19	123.32	4.48	2.51	
Reach-1	6.6	100 year	97.60	177.20	178.97	178.93	179.32	0.009549	2.98	49.23	69.29	0.82	125.95	66.16	2.98	1.98	
Reach-1	6.6	50 year	87.30	177.20	178.92	178.86	179.24	0.008995	2.82	45.85	66.65	0.79	114.30	60.34	2.82	1.90	
Reach-1	6.6	20 year	74.10	177.20	178.85	178.76	179.12	0.008268	2.60	41.23	62.87	0.75	99.32	52.87	2.60	1.80	
Reach-1	6.6	10 year	59.60	177.20	178.76	178.64	178.99	0.007354	2.34	35.86	58.16	0.70	82.00	44.20	2.34	1.66	
Reach-1	6.6	5 year	49.40	177.20	178.69		178.88	0.006603	2.12	31.88	54.42	0.65	69.08	37.71	2.12	1.55	
Reach-1	6.44	Regional	427.40	176.60	179.73		179.87	0.002654	2.49	293.55	153.11	0.48	69.91	49.64	2.49	1.46	
Reach-1	6.44	100 year	97.60	176.60	178.51		178.58	0.002544	1.64	111.76	144.56	0.43	37.06	19.23	1.64	0.87	
Reach-1	6.44	50 year	87.30	176.60	178.44		178.51	0.002629	1.62	102.04	144.09	0.43	36.60	18.21	1.62	0.86	
Reach-1	6.44	20 year	74.10	176.60	178.35		178.42	0.002729	1.58	89.29	143.47	0.43	35.66	16.61	1.58	0.83	
Reach-1	6.44	10 year	59.60	176.60	178.25		178.31	0.002879	1.54	73.97	142.72	0.44	34.65	14.60	1.54	0.81	
Reach-1	6.44	5 year	49.40	176.60	178.16		178.23	0.003055	1.51	61.75	142.12	0.45	34.24	12.99	1.51	0.80	
Reach-1	6.28	Regional	427.40	176.10	178.67	178.67	179.26	0.012416	5.08	151.07	111.31	1.03	300.22	164.72	5.08	2.83	
Reach-1	6.28	100 year	97.60	176.10	177.71	177.71	178.04	0.010092	3.33	53.76	81.64	0.85	150.87	65.01	3.33	1.82	
Reach-1	6.28	50 year	87.30	176.10	177.66	177.66	177.97	0.009807	3.20	49.38	77.74	0.84	141.39	60.93	3.20	1.77	
Reach-1	6.28	20 year	74.10	176.10	177.57	177.57	177.87	0.009767	3.07	42.79	71.49	0.83	132.45	57.17	3.07	1.73	
Reach-1	6.28	10 year	59.60	176.10	177.45	177.45	177.74	0.010045	2.93	34.71	62.98	0.83	124.53	54.13	2.93	1.72	
Reach-1	6.28	5 year	49.40	176.10	177.35	177.35	177.64	0.010227	2.80	28.95	56.13	0.82	117.20	51.56	2.80	1.71	
Reach-1	6.21	Regional	427.40	175.90	178.41		178.79	0.004966	3.08	181.87	116.99	0.65	112.38	75.58	3.08	2.35	
Reach-1	6.21	100 year	97.60	175.90	177.16		177.33	0.005256	1.88	58.94	74.85	0.58	54.52	40.54	1.88	1.66	
Reach-1	6.21	50 year	87.30	175.90	177.10		177.25	0.005200	1.80	54.54	72.50	0.58	50.90	38.32	1.80	1.60	
Reach-1	6.21	20 year	74.10	175.90	177.02		177.15	0.005113	1.69	48.73	69.28	0.56	45.94	35.24	1.69	1.52	
Reach-1	6.21	10 year	59.60	175.90	176.92		177.03	0.005007	1.55	42.01	65.35	0.55	40.08	31.54	1.55	1.42	
Reach-1	6.21	5 year	49.40	175.90	176.84		176.94	0.004951	1.44	36.94	62.22	0.53	35.78	28.80	1.44	1.34	
Reach-1	6.05	Regional	427.40	174.90	177.22	177.11	177.82	0.013866	5.01	144.87	92.73	1.07	301.61	210.50	5.01	2.95	
Reach-1	6.05	100 year	97.60	174.90	176.34		176.52	0.007256	2.59	67.17	84.24	0.71	95.50	56.43	2.59	1.45	
Reach-1	6.05	50 year	87.30	174.90	176.29		176.45	0.007086	2.49	62.77	83.73	0.70	89.62	51.81	2.49	1.39	
Reach-1	6.05	20 year	74.10	174.90	176.22		176.37	0.006785	2.35	56.93	83.05	0.68	81.18	45.38	2.35	1.30	
Reach-1	6.05	10 year	59.60	174.90	176.13		176.26	0.006436	2.18	49.83	82.22	0.65	71.59	38.07	2.18	1.20	
Reach-1	6.05	5 year	49.40	174.90	176.07		176.19	0.006102	2.04	44.45	81.59	0.63	63.95	32.46	2.04	1.11	
Reach-1	5.87	Regional	427.40	174.10	176.71		176.86	0.002595	2.14	264.92	157.29	0.46	55.27	42.73	2.14	1.61	
Reach-1	5.87	100 year	97.60	174.10	175.48		175.58	0.004797	1.67	80.55	136.35	0.55	44.50	27.76	1.67	1.21	
Reach-1	5.87	50 year	87.30	174.10	175.43		175.53	0.004840	1.62	74.17	134.94	0.54	42.66	26.06	1.62	1.18	
Reach-1	5.87	20 year	74.10	174.10	175.36		175.46	0.004997	1.56	65.13	132.91	0.55	40.75	23.99	1.56	1.14	
Reach-1	5.87	10 year	59.60	174.10	175.28		175.37	0.005216	1.49	54.49	130.49	0.55	38.41	21.34	1.49	1.09	
Reach-1	5.87	5 year	49.40	174.10	175.22		175.31	0.005432	1.44	46.32	128.60	0.55	36.64	19.17	1.44	1.07	
Reach-1	5.76	Regional	427.40	173.70	176.53		176.64	0.001910	2.13	341.61	177.79	0.41	50.90	35.93	2.13	1.25	
Reach-1	5.76	100 year	97.60	173.70	175.01		175.13	0.005005	2.00	89.76	148.34	0.58	58.91	29.69	2.00	1.09	
Reach-1	5.76	50 year	87.30	173.70	174.95		175.07	0.005243	1.97	80.52	141.61	0.59	58.45	29.23	1.97	1.08	
Reach-1	5.76	20 year	74.10	173.70	174.87		174.98	0.005334	1.90	69.73	131.50	0.59	55.34	27.74	1.90	1.06	
Reach-1	5.76	10 year	59.60	173.70	174.77		174.88	0.005589	1.81	56.95	118.41	0.59	52.38	26.36	1.81	1.05	
Reach-1	5.76	5 year	49.40	173.70	174.69	174.55	174.79	0.005818	1.74	47.76	108.01	0.60	49.90	25.22	1.74	1.03	
Reach-1	5.68	Regional	427.40	173.00	176.29		176.51	0.001228	2.36	322.11	162.49	0.44	34.60	23.82	2.36	1.33	
Reach-1	5.68	100 year	97.60	173.00	174.19	174.19	174.57	0.009214	2.71	37.74	65.29	0.98	70.35	52.18	2.71	2.59	
Reach-1	5.68	50 year	87.30	173.00	174.14	174.14	174.49	0.009499	2.62	34.25	59.75	0.98	67.33	53.34	2.62	2.55	
Reach-1	5.68	20 year	74.10	173.00	174.05	174.05	174.38	0.010440	2.52	29.51	51.30	1.01	65.27	58.81	2.52	2.51	
Reach-1	5.68	10 year	59.60	173.00	173.96	173.96	174.25	0.010822	2.37	25.16	44.51	1.01	59.91	59.91	2.37	2.37	
Reach-1	5.68	5 year	49.40	173.00	173.88	173.88	174.14	0.011168	2.29	21.61	41.31	1.01	57.23	57.23	2.29	2.29	
Reach-1	5.65	Regional	427.40	171.72	175.31	174.70	176.23	0.003260	4.24	100.79	270.95	0.74	106.33	106.33	4.24	4.24	
Reach-1	5.65	100 year	97.60	171.72	174.02	172.98	174.14	0.008633	1.58	61.91	254.54	0.35	17.28	17.28	1.58	1.58	
Reach-1	5.65	50 year	87.30	171.72	173.97	172.89	174.07	0.007748	1.44	60.45	253.92	0.32	14.63	14.63	1.44	1.44	
Reach-1	5.65	20 year	74.10	171.72	173.89	172.78	173.98	0.006010	1.27	58.24	252.74	0.29	11.49	11.49	1.27	1.27	
Reach-1	5.65	10 year	59.60	171.72	173.80	172.64	173.86	0.004466	1.08	55.41	231.23	0.25	8.35	8.35	1.08	1.08	
Reach-1	5.65	5 year	49.40	171.72	173.72	172.54	173.76	0.003372	0.93	52.94	212.47	0.22	6.38	6.38	0.93	0.93	
Reach-1	5.63		Bridge														
Reach-1	5.6	Regional	427.40	171.58	174.54	174.54	175.93	0.006477	5.21	82.03	263.03	1.01	171.91	171.91	5.21	5.21	
Reach-1	5.6	100 year	97.60	171.58	173.99	172.84	174.10	0.00724	1.50	65.27	255.96	0.32	15.28	15.28	1.50	1.50	
Reach-1	5.6	50 year	87.30	171.58	173.94	172.7											

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 (Continued)

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 (N/m2)	Shear Chan (N/m2)	Shear Total (N/m2)	Vel Chnl (m/s)	Vel Total (m/s)
Reach-1	5.44	20 year	74.10	169.90	172.86	172.78	173.03	0.002542	2.23	71.96	163.08	0.47	48.14	10.88	2.23	1.03	
Reach-1	5.44	10 year	59.60	169.90	172.78	172.65	172.93	0.002294	2.07	58.76	143.02	0.44	41.83	9.12	2.07	1.01	
Reach-1	5.44	5 year	49.40	169.90	172.70		172.85	0.002068	1.92	49.07	126.30	0.42	36.50	7.77	1.92	1.01	
Reach-1	5.32	Regional	427.40	171.40	174.07		174.15	0.001217	1.88	376.66	225.47	0.37	30.99	19.90	1.88	1.13	
Reach-1	5.32	100 year	97.60	171.40	172.67		172.79	0.005081	2.30	81.00	158.03	0.67	59.72	25.51	2.30	1.20	
Reach-1	5.32	50 year	87.30	171.40	172.61		172.74	0.005586	2.32	71.12	147.51	0.69	62.12	26.38	2.32	1.23	
Reach-1	5.32	20 year	74.10	171.40	172.52		172.66	0.006292	2.34	59.13	133.66	0.73	64.73	27.27	2.34	1.25	
Reach-1	5.32	10 year	59.60	171.40	172.43		172.57	0.006971	2.31	47.23	118.31	0.75	65.29	27.26	2.31	1.26	
Reach-1	5.32	5 year	49.40	171.40	172.36		172.50	0.007126	2.23	39.93	107.82	0.75	62.24	25.85	2.23	1.24	
Reach-1	5.16	Regional	427.40	170.70	173.86		174.02	0.001904	2.64	274.91	140.48	0.48	57.57	36.47	2.64	1.55	
Reach-1	5.16	100 year	97.60	170.70	172.42		172.49	0.001886	1.73	98.52	105.49	0.43	30.48	17.26	1.73	0.99	
Reach-1	5.16	50 year	87.30	170.70	172.34		172.41	0.001940	1.70	90.30	103.72	0.43	29.86	16.55	1.70	0.97	
Reach-1	5.16	20 year	74.10	170.70	172.23		172.30	0.002060	1.67	78.89	101.21	0.44	29.46	15.73	1.67	0.94	
Reach-1	5.16	10 year	59.60	170.70	172.10		172.17	0.002248	1.64	65.61	98.22	0.45	29.23	14.72	1.64	0.91	
Reach-1	5.16	5 year	49.40	170.70	171.98		172.06	0.002562	1.64	54.53	94.65	0.48	30.45	14.46	1.64	0.91	
Reach-1	5.11	Regional	427.40	170.50	173.54		173.88	0.002802	2.71	189.99	111.55	0.56	65.80	46.69	2.71	2.25	
Reach-1	5.11	100 year	97.60	170.50	172.28		172.39	0.002163	1.45	68.94	71.57	0.43	24.11	20.40	1.45	1.42	
Reach-1	5.11	50 year	87.30	170.50	172.21		172.31	0.002164	1.39	63.88	68.36	0.43	22.58	19.79	1.39	1.37	
Reach-1	5.11	20 year	74.10	170.50	172.11		172.19	0.002212	1.31	56.93	63.71	0.43	20.81	19.35	1.31	1.30	
Reach-1	5.11	10 year	59.60	170.50	171.98		172.06	0.002248	1.21	49.29	58.35	0.42	18.59	18.59	1.21	1.21	
Reach-1	5.11	5 year	49.40	170.50	171.87		171.94	0.002225	1.15	43.00	54.55	0.41	17.17	17.17	1.15	1.15	
Reach-1	4.95	Regional	427.40	169.80	172.85		173.27	0.005442	4.36	184.26	99.33	0.80	158.58	98.54	4.36	2.32	
Reach-1	4.95	100 year	97.60	169.80	171.35	171.35	171.74	0.009216	3.57	49.80	65.89	0.93	133.99	68.20	3.57	1.96	
Reach-1	4.95	50 year	87.30	169.80	171.28	171.28	171.66	0.009196	3.45	45.40	62.83	0.92	127.56	65.06	3.45	1.92	
Reach-1	4.95	20 year	74.10	169.80	171.19	171.19	171.54	0.009047	3.28	39.82	58.72	0.91	117.38	60.06	3.28	1.86	
Reach-1	4.95	10 year	59.60	169.80	171.07	171.07	171.39	0.009138	3.09	32.97	53.25	0.90	107.64	55.39	3.09	1.81	
Reach-1	4.95	5 year	49.40	169.80	170.97	170.97	171.27	0.009302	2.94	27.87	48.78	0.89	100.51	52.04	2.94	1.77	
Reach-1	4.79	Regional	427.40	169.10	172.48		172.78	0.002791	3.34	221.07	99.82	0.59	90.00	60.16	3.34	1.93	
Reach-1	4.79	100 year	97.60	169.10	170.86		170.99	0.002664	2.07	77.00	71.84	0.51	43.47	27.89	2.07	1.27	
Reach-1	4.79	50 year	87.30	169.10	170.78		170.90	0.002623	1.99	71.32	70.08	0.50	40.75	26.08	1.99	1.22	
Reach-1	4.79	20 year	74.10	169.10	170.67		170.78	0.002548	1.87	63.87	67.70	0.49	36.88	23.49	1.87	1.16	
Reach-1	4.79	10 year	59.60	169.10	170.54		170.64	0.002439	1.72	55.26	64.84	0.47	32.19	20.31	1.72	1.08	
Reach-1	4.79	5 year	49.40	169.10	170.44		170.52	0.002337	1.60	48.85	62.63	0.46	28.55	17.82	1.60	1.01	
Reach-1	4.63	Regional	427.40	168.40	171.52		172.11	0.005165	3.87	150.21	82.66	0.77	130.90	91.68	3.87	2.85	
Reach-1	4.63	100 year	97.60	168.40	169.97		170.27	0.007657	2.58	45.57	52.18	0.80	78.90	65.44	2.58	2.14	
Reach-1	4.63	50 year	87.30	168.40	169.88		170.17	0.008083	2.56	40.86	49.47	0.82	78.95	65.34	2.56	2.14	
Reach-1	4.63	20 year	74.10	168.40	169.75	169.65	170.04	0.008838	2.54	34.68	45.67	0.84	79.56	65.68	2.54	2.14	
Reach-1	4.63	10 year	59.60	168.40	169.59	169.53	169.88	0.010158	2.52	27.68	40.94	0.89	81.53	67.20	2.52	2.15	
Reach-1	4.63	5 year	49.40	168.40	169.46	169.44	169.75	0.011790	2.53	22.54	37.09	0.94	85.03	70.11	2.53	2.19	
Reach-1	4.47	Regional	427.40	167.20	171.08		171.47	0.002768	3.56	202.82	90.95	0.59	98.87	60.18	3.56	2.11	
Reach-1	4.47	100 year	97.60	167.20	169.34		169.56	0.002769	2.32	62.14	60.64	0.53	52.01	27.72	2.32	1.57	
Reach-1	4.47	50 year	87.30	167.20	169.26		169.46	0.002698	2.22	56.98	57.81	0.52	48.38	26.97	2.22	1.53	
Reach-1	4.47	20 year	74.10	167.20	169.14		169.32	0.002586	2.08	50.23	53.89	0.51	43.35	23.55	2.08	1.48	
Reach-1	4.47	10 year	59.60	167.20	168.99		169.15	0.002426	1.89	42.62	49.08	0.48	37.17	20.57	1.89	1.40	
Reach-1	4.47	5 year	49.40	167.20	168.87		169.01	0.002273	1.74	37.16	45.32	0.46	32.27	18.20	1.74	1.33	
Reach-1	4.33	Regional	427.40	167.00	170.63		171.09	0.003091	3.36	172.83	78.95	0.61	93.27	65.51	3.36	2.47	
Reach-1	4.33	100 year	97.60	167.00	168.97		169.17	0.003215	2.05	55.32	53.83	0.55	44.81	32.25	2.05	1.76	
Reach-1	4.33	50 year	87.30	167.00	168.89		169.08	0.003148	1.95	51.25	52.03	0.54	41.51	30.27	1.95	1.70	
Reach-1	4.33	20 year	74.10	167.00	168.79		168.95	0.003056	1.82	45.83	49.52	0.52	37.11	27.62	1.82	1.62	
Reach-1	4.33	10 year	59.60	167.00	168.66		168.79	0.002947	1.66	39.54	46.44	0.50	32.01	24.50	1.66	1.51	
Reach-1	4.33	5 year	49.40	167.00	168.56		168.68	0.002758	1.52	35.33	44.26	0.48	27.46	21.50	1.52	1.40	
Reach-1	4.16	Regional	427.40	166.70	169.42	169.42	170.33	0.010287	4.91	116.77	63.03	1.04	222.69	184.89	4.91	3.66	
Reach-1	4.16	100 year	97.60	166.70	168.27		168.54	0.006054	2.60	49.67	53.13	0.73	75.07	55.17	2.60	1.96	
Reach-1	4.16	50 year	87.30	166.70	168.19		168.45	0.006071	2.52	45.78	52.50	0.73	71.49	51.61	2.52	1.91	
Reach-1	4.16	20 year	74.10	166.70	168.09		168.33	0.006056	2.39	40.63	51.65	0.72	66.22	46.47	2.39	1.82	
Reach-1	4.16	10 year	59.60	166.70	167.98		168.19	0.005946	2.22	34.69	50.05	0.70	59.06	40.23	2.22	1.72	
Reach-1	4.16	5 year	49.40	166.70	167.83		168.05	0.007060	2.21	27.92	45.17	0.75	61.35	42.60	2.21	1.77	
Reach-1	4	Regional	427.40	165.60	168.54	168.45	169.16	0.006944	4.75	160.70	94.72	0.90	192.04	114.10	4.75	2.66	
Reach-1	4	100 year	97.60	165.60	167.15	167.15	167.57	0.008683	3.38	45.73	58.74	0.90	121.64	65.69	3.38	2.13	
Reach-1	4	50 year	87.30	165.60	167.08	167.08	167.48	0.008677	3.26	41.62	55.95	0.89	115.48	62.73	3.26	2.10	
Reach-1	4	20 year	74.10	165.60	166.97	166.97	167.35	0.008797	3.11	36.00	51.88	0.89	108.11	59.33	3.11	2.06	
Reach-1	4	10 year	59.60	165.60	166.84	166.84	167.19	0.009200	2.95	29.34	46.61	0.89	100.90	56.31	2.95	2.03	
Reach-1	4	5 year	49.40	165.60	166.79	166.73	167.07	0.007479	2.59	27.31	44.88	0.80	78.78	44.25	2.59	1.81	
Reach-1	3.84	Regional	427.40	164.70	168.20		168.55	0.002202	2.66	165.38	62.67	0.51	60.18	55.46	2.66	2.58	
Reach-1	3.84	100 year	97.60	164.70	166.47		166.80	0.002891	1.60	61.13	58.22	0.50	30.21	29.54	1.60	1.60	
Reach-1	3.84	50 year	87.30	164.70	166.39		166.51	0.003040	1.56	56.26	58.00	0.50	29.27	28.72	1.56	1.55	
Reach-1	3.84	20 year	74.10	164.70	166.28		166.39	0.003260	1.49	49.86	57.71	0.51	27.87	27.48	1.49	1.49	
Reach-1	3.84	10 year	59.60	164.70	166.14		166.24	0.003732	1.42	41.97	57.36	0.53	26.88	26.68	1.42	1.42	
Reach-1	3.84	5 year	49.40	164.70	166.02		166.12	0.004579	1.40	35.25	57.06	0.57	27.72	27.68	1.40	1.40	
Reach-1	3.67	Regional	427.40	163.60	167.03	167.03	168.00	0.008552	5.84	137.00	64.89	1.03	275.40	173.52	5.84	3.12	
Reach-1	3.67	100 year	97.60	163.60	165.43	165.43	165.96	0.008475	3.74	43.37	45.52	0.91	140.80	78.14	3.74	2.25	
Reach-1	3.67	50 year	87.30	163.60	165.33	165.33	165.84	0.008611	3.63	39.16	43						

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 (Continued)

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	Shear Chan (N/m2)	Shear Total (N/m2)	Vel Chnl (m/s)	Vel Total (m/s)
Reach-1	3.35	10 year	59.60	161.60	162.92		163.12	0.004103	2.08	36.25	44.08	0.60	48.91	32.98	2.08	1.64
Reach-1	3.35	5 year	49.40	161.60	162.83		163.00	0.003800	1.90	32.20	41.72	0.57	41.79	28.67	1.90	1.53
Reach-1	3.19	Regional	427.40	161.00	164.75		165.11	0.001894	2.69	175.53	67.24	0.48	59.04	47.81	2.69	2.43
Reach-1	3.19	100 year	97.60	161.00	162.80		162.94	0.002503	1.64	60.87	52.50	0.47	30.16	28.27	1.64	1.60
Reach-1	3.19	50 year	87.30	161.00	162.71		162.84	0.002582	1.58	56.20	51.99	0.47	28.85	27.20	1.58	1.55
Reach-1	3.19	20 year	74.10	161.00	162.59		162.71	0.002687	1.50	50.09	51.33	0.47	26.92	25.58	1.50	1.48
Reach-1	3.19	10 year	59.60	161.00	162.45		162.55	0.002823	1.40	43.08	50.55	0.47	24.48	23.48	1.40	1.38
Reach-1	3.19	5 year	49.40	161.00	162.34		162.43	0.003041	1.33	37.49	49.93	0.48	23.05	22.31	1.33	1.32
Reach-1	3.03	Regional	427.40	160.30	164.22		164.74	0.002738	3.23	138.01	47.65	0.58	85.20	74.68	3.23	3.10
Reach-1	3.03	100 year	97.60	160.30	162.39		162.54	0.002520	1.75	55.86	42.16	0.48	33.40	32.37	1.75	1.75
Reach-1	3.03	50 year	87.30	160.30	162.29		162.43	0.002621	1.70	51.56	41.86	0.48	32.11	31.36	1.70	1.69
Reach-1	3.03	20 year	74.10	160.30	162.14		162.28	0.002810	1.62	45.69	41.43	0.49	30.56	30.18	1.62	1.62
Reach-1	3.03	10 year	59.60	160.30	161.97		162.09	0.003158	1.55	38.43	40.33	0.51	29.40	29.40	1.55	1.55
Reach-1	3.03	5 year	49.40	160.30	161.83		161.94	0.003243	1.49	33.08	37.47	0.51	27.96	27.96	1.49	1.49
Reach-1	2.87	Regional	427.40	159.60	163.01	163.01	164.01	0.009780	5.48	122.17	55.33	1.02	259.39	206.11	5.48	3.50
Reach-1	2.87	100 year	97.60	159.60	161.51	161.38	161.94	0.006813	3.24	44.83	42.44	0.80	107.55	69.45	3.24	2.18
Reach-1	2.87	50 year	87.30	159.60	161.44		161.83	0.006400	3.07	41.89	41.02	0.77	97.53	63.07	3.07	2.08
Reach-1	2.87	20 year	74.10	159.60	161.35		161.68	0.005762	2.81	38.12	39.13	0.72	83.55	54.17	2.81	1.94
Reach-1	2.87	10 year	59.60	159.60	161.28		161.52	0.004378	2.40	35.60	37.82	0.63	61.24	39.80	2.40	1.67
Reach-1	2.87	5 year	49.40	159.60	161.10		161.34	0.004886	2.35	29.01	34.14	0.65	61.16	40.11	2.35	1.70
Reach-1	2.71	Regional	427.40	158.70	162.15	161.80	162.77	0.006482	5.13	163.69	70.08	0.89	211.54	144.18	5.13	2.61
Reach-1	2.71	100 year	97.60	158.70	160.65		160.97	0.005778	3.26	60.81	67.23	0.76	104.42	50.68	3.26	1.60
Reach-1	2.71	50 year	87.30	158.70	160.57	160.53	160.89	0.005851	3.19	55.48	67.08	0.76	101.22	46.97	3.19	1.57
Reach-1	2.71	20 year	74.10	158.70	160.45	160.44	160.78	0.006149	3.12	47.59	66.86	0.77	99.33	42.55	3.12	1.56
Reach-1	2.71	10 year	59.60	158.70	160.28	159.96	160.66	0.007381	3.18	36.10	66.53	0.83	106.87	39.02	3.18	1.65
Reach-1	2.71	5 year	49.40	158.70	160.26	160.26	160.54	0.005511	2.72	34.66	66.49	0.72	78.64	28.00	2.72	1.43
Reach-1	2.54	Regional	427.40	157.60	160.62	160.62	161.37	0.009052	5.54	167.37	96.29	1.03	258.43	153.50	5.54	2.55
Reach-1	2.54	100 year	97.60	157.60	159.30	159.30	159.74	0.008458	3.59	52.50	64.78	0.90	132.33	67.09	3.59	1.86
Reach-1	2.54	50 year	87.30	157.60	159.21	159.21	159.64	0.008608	3.49	47.19	61.29	0.90	127.61	64.87	3.49	1.85
Reach-1	2.54	20 year	74.10	157.60	159.10	159.10	159.51	0.008581	3.32	40.83	56.82	0.89	118.20	60.35	3.32	1.81
Reach-1	2.54	10 year	59.60	157.60	159.00	158.97	159.34	0.007697	2.99	35.26	52.59	0.83	98.39	50.50	2.99	1.69
Reach-1	2.54	5 year	49.40	157.60	158.93	158.85	159.21	0.006859	2.71	31.35	49.41	0.78	82.54	42.58	2.71	1.58
Reach-1	2.41	Regional	427.40	156.80	160.14		160.63	0.003645	3.40	178.07	89.40	0.65	99.07	70.42	3.40	2.40
Reach-1	2.41	100 year	97.60	156.80	158.40	158.28	158.70	0.007117	2.47	45.78	60.18	0.77	72.38	52.78	2.47	2.13
Reach-1	2.41	50 year	87.30	156.80	158.32	158.22	158.61	0.007617	2.42	40.99	58.73	0.79	71.48	51.84	2.42	2.13
Reach-1	2.41	20 year	74.10	156.80	158.21	158.14	158.48	0.008575	2.37	34.50	56.71	0.82	71.07	50.90	2.37	2.15
Reach-1	2.41	10 year	59.60	156.80	158.06	158.02	158.34	0.010733	2.34	26.48	54.10	0.89	73.82	51.28	2.34	2.25
Reach-1	2.41	5 year	49.40	156.80	157.95	157.91	158.22	0.012483	2.31	21.36	34.43	0.94	75.47	47.47	2.31	2.31
Reach-1	2.27	Regional	427.40	156.00	160.07		160.27	0.001612	2.73	285.44	102.16	0.45	57.98	43.70	2.73	1.50
Reach-1	2.27	100 year	97.60	156.00	158.19		158.28	0.001546	1.68	104.58	90.22	0.39	27.68	17.49	1.68	0.93
Reach-1	2.27	50 year	87.30	156.00	158.08		158.17	0.001605	1.65	95.14	89.53	0.40	27.12	16.65	1.65	0.92
Reach-1	2.27	20 year	74.10	156.00	157.94		158.03	0.001674	1.60	82.21	86.04	0.40	26.17	15.62	1.60	0.90
Reach-1	2.27	10 year	59.60	156.00	157.75		157.84	0.001711	1.52	67.36	77.65	0.40	24.42	14.50	1.52	0.88
Reach-1	2.27	5 year	49.40	156.00	157.61		157.69	0.001755	1.46	56.50	70.89	0.40	23.08	13.66	1.46	0.87
Reach-1	2.19	Regional	427.40	155.60	159.08	159.08	160.01	0.009137	6.09	150.40	74.81	1.06	298.18	177.57	6.09	2.84
Reach-1	2.19	100 year	97.60	155.60	157.52	157.52	158.04	0.008569	3.88	48.05	50.91	0.93	149.59	78.47	3.88	2.03
Reach-1	2.19	50 year	87.30	155.60	157.44	157.44	157.93	0.008561	3.75	43.64	48.47	0.92	142.04	74.79	3.75	2.00
Reach-1	2.19	20 year	74.10	155.60	157.31	157.31	157.77	0.008680	3.59	37.61	44.92	0.91	133.09	70.53	3.59	1.97
Reach-1	2.19	10 year	59.60	155.60	157.14	157.14	157.58	0.008943	3.38	30.68	40.45	0.91	122.98	65.83	3.38	1.94
Reach-1	2.19	5 year	49.40	155.60	157.02	157.02	157.42	0.009006	3.20	25.93	37.09	0.90	113.09	61.13	3.20	1.90
Reach-1	2.04	Regional	427.40	154.00	157.45	157.45	158.51	0.007334	4.68	111.26	66.88	0.91	190.51	118.57	4.68	3.84
Reach-1	2.04	100 year	97.60	154.00	155.69	155.69	156.23	0.012032	3.24	30.15	28.36	1.00	123.87	123.87	3.24	3.24
Reach-1	2.04	50 year	87.30	154.00	155.60	155.60	156.11	0.012196	3.16	27.65	27.29	1.00	119.70	119.70	3.16	3.16
Reach-1	2.04	20 year	74.10	154.00	155.48	155.48	155.95	0.012473	3.04	24.34	25.81	1.00	113.99	113.99	3.04	3.04
Reach-1	2.04	10 year	59.60	154.00	155.32	155.32	155.76	0.013054	2.92	20.44	23.95	1.01	108.05	108.05	2.92	2.92
Reach-1	2.04	5 year	49.40	154.00	155.22	155.20	155.60	0.012745	2.74	18.01	22.71	0.98	98.04	98.04	2.74	2.74
Reach-1	1.9	Regional	427.40	153.00	156.29		156.82	0.003653	3.36	151.63	70.63	0.65	97.21	75.76	3.36	2.82
Reach-1	1.9	100 year	97.60	153.00	154.65		154.87	0.004677	2.06	49.58	51.72	0.63	49.68	43.64	2.06	1.97
Reach-1	1.9	50 year	87.30	153.00	154.58		154.78	0.004729	1.98	45.88	50.76	0.63	46.89	41.62	1.98	1.90
Reach-1	1.9	20 year	74.10	153.00	154.48		154.66	0.004835	1.87	40.90	49.43	0.62	43.24	38.97	1.87	1.81
Reach-1	1.9	10 year	59.60	153.00	154.36		154.51	0.005149	1.75	34.80	47.76	0.63	39.74	36.58	1.75	1.71
Reach-1	1.9	5 year	49.40	153.00	154.26		154.40	0.005567	1.66	30.11	46.43	0.64	37.55	35.23	1.66	1.64
Reach-1	1.75	Regional	427.40	152.10	155.03	155.03	155.99	0.009567	5.09	127.24	66.15	1.03	230.49	178.77	5.09	3.36
Reach-1	1.75	100 year	97.60	152.10	153.87		154.15	0.005444	2.57	54.12	57.01	0.70	72.06	50.50	2.57	1.80
Reach-1	1.75	50 year	87.30	152.10	153.77		154.04	0.005650	2.53	48.45	53.88	0.71	70.98	49.65	2.53	1.80
Reach-1	1.75	20 year	74.10	152.10	153.63		153.89	0.005915	2.46	41.32	49.65	0.72	68.87	48.10	2.46	1.79
Reach-1	1.75	10 year	59.60	152.10	153.48		153.72	0.005916	2.32	34.31	45.11	0.71	62.90	43.96	2.32	1.74
Reach-1	1.75	5 year	49.40	152.10	153.37		153.59	0.005739	2.18	29.61	41.80	0.69	56.69	39.73	2.18	1.67
Reach-1	1.59	Regional	427.40	151.10	153.88		154.33	0.006884	3.00	144.06	99.52	0.79	95.40	93.98	3.00	2.97
Reach-1	1.59	100 year	97.60	151.10	152.85	152.75	153.04	0.009150	1.95	50.27	83.24	0.80	54.24	53.84	1.95	1.94
Reach-1	1.59	50 year	87.30	151.10	152.85	152.60	153.00	0.007434	1.76	50.03	83.19	0.72	43.87	43.55	1.76	1.74
Reach-1	1.5															

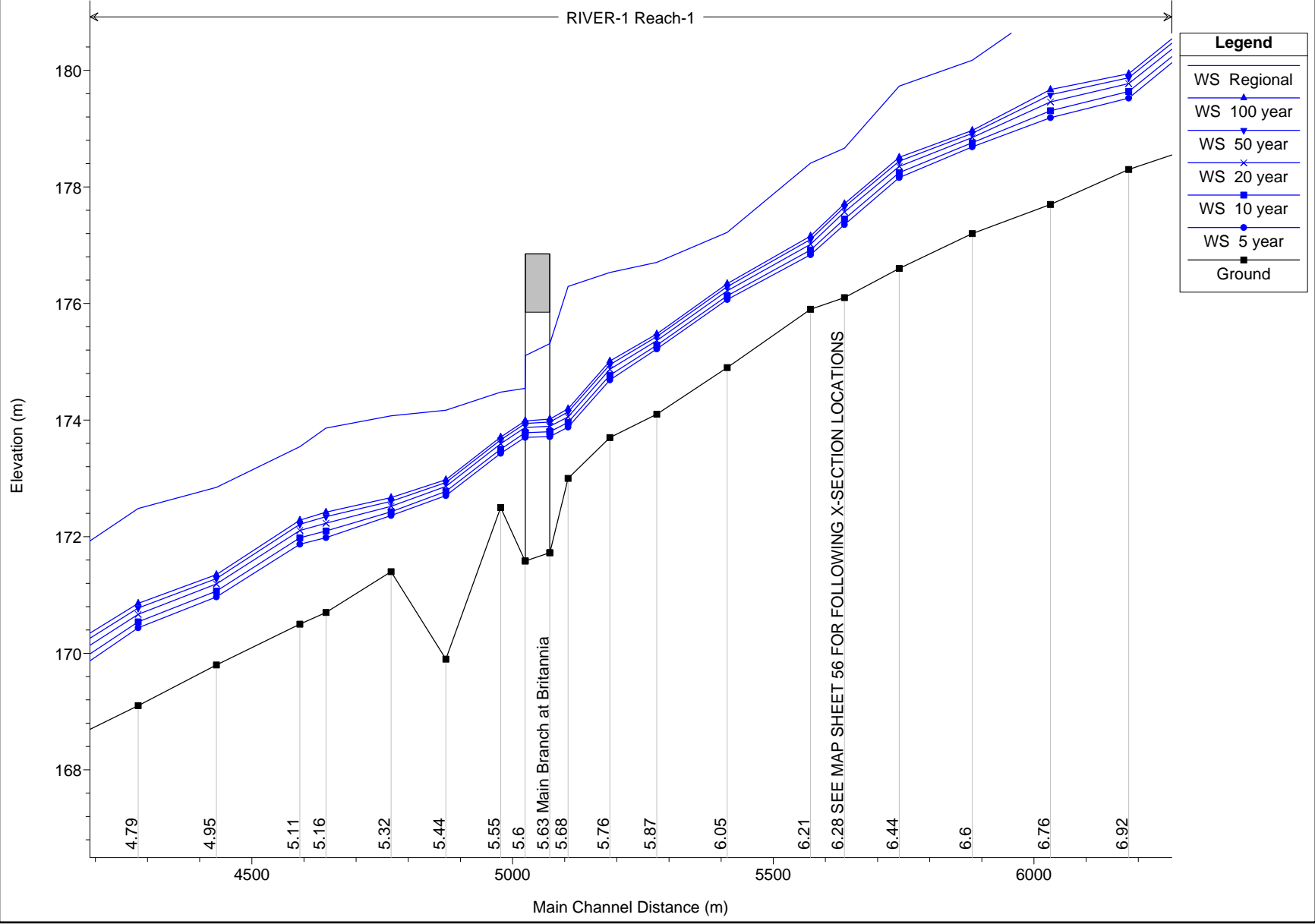
HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 (Continued)

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	Shear Chan (N/m2)	Shear Total (N/m2)	Vel Chnl (m/s)	Vel Total (m/s)
Reach-1	1.27	5 year	49.40	149.40	150.77		150.80	0.000912	0.78	64.14	76.28	0.27	7.67	7.51	0.78	0.77
Reach-1	1.242	Regional	427.40	149.30	153.45	152.00	153.53	0.000501	1.65	399.39	128.73	0.26	20.42	15.10	1.65	1.07
Reach-1	1.242	100 year	97.60	149.30	151.07	150.66	151.47	0.004456	2.79	34.93	100.24	0.67	77.48	77.48	2.79	2.79
Reach-1	1.242	50 year	87.30	149.30	150.95	150.56	151.32	0.004486	2.68	32.60	98.23	0.66	72.81	72.81	2.68	2.68
Reach-1	1.242	20 year	74.10	149.30	150.80	150.43	151.12	0.004516	2.51	29.49	95.55	0.66	66.29	66.29	2.51	2.51
Reach-1	1.242	10 year	59.60	149.30	150.61	150.27	150.88	0.004561	2.31	25.80	92.36	0.64	58.58	58.58	2.31	2.31
Reach-1	1.242	5 year	49.40	149.30	150.47	150.16	150.70	0.004580	2.15	23.02	89.97	0.63	52.50	52.50	2.15	2.15
Reach-1	1.2385	Bridge														
Reach-1	1.235	Regional	427.40	149.30	151.90	151.90	152.19	0.003487	3.19	209.94	114.30	0.63	88.92	62.43	3.19	2.04
Reach-1	1.235	100 year	97.60	149.30	150.66	150.66	151.34	0.010849	3.65	26.75	93.18	1.00	144.45	144.45	3.65	3.65
Reach-1	1.235	50 year	87.30	149.30	150.56	150.56	151.19	0.011092	3.51	24.85	91.54	1.00	137.21	137.21	3.51	3.51
Reach-1	1.235	20 year	74.10	149.30	150.43	150.43	150.99	0.011531	3.33	22.26	89.31	1.00	127.78	127.78	3.33	3.33
Reach-1	1.235	10 year	59.60	149.30	150.28	150.28	150.77	0.012026	3.09	19.29	86.74	1.00	115.48	115.48	3.09	3.09
Reach-1	1.235	5 year	49.40	149.30	150.16	150.16	150.59	0.012702	2.91	16.96	84.73	1.00	107.21	107.21	2.91	2.91
Reach-1	1.2	Regional	427.40	149.00	151.66		151.90	0.002106	2.15	203.64	102.36	0.47	43.46	40.82	2.15	2.10
Reach-1	1.2	100 year	97.60	149.00	150.43		150.50	0.002158	1.21	81.24	95.40	0.41	18.35	17.98	1.21	1.20
Reach-1	1.2	50 year	87.30	149.00	150.36		150.43	0.002289	1.18	74.55	95.00	0.42	17.90	17.58	1.18	1.17
Reach-1	1.2	20 year	74.10	149.00	150.26		150.32	0.002548	1.14	65.32	94.46	0.43	17.49	17.25	1.14	1.13
Reach-1	1.2	10 year	59.60	149.00	150.14		150.20	0.003098	1.11	53.97	93.78	0.46	17.60	17.46	1.11	1.10
Reach-1	1.2	5 year	49.40	149.00	150.04		150.10	0.003855	1.09	45.13	93.25	0.50	18.33	18.28	1.09	1.09
Reach-1	1.09	Regional	427.40	148.10	151.14		151.55	0.004045	3.17	176.30	106.32	0.66	91.40	65.38	3.17	2.42
Reach-1	1.09	100 year	97.60	148.10	149.97		150.16	0.003905	1.95	55.66	92.68	0.58	43.62	22.94	1.95	1.75
Reach-1	1.09	50 year	87.30	148.10	149.90		150.07	0.003878	1.88	49.68	79.20	0.57	41.16	23.79	1.88	1.76
Reach-1	1.09	20 year	74.10	148.10	149.80		149.96	0.003768	1.76	43.04	60.88	0.56	37.08	26.03	1.76	1.72
Reach-1	1.09	10 year	59.60	148.10	149.68		149.81	0.003658	1.62	36.84	40.47	0.54	32.49	32.49	1.62	1.62
Reach-1	1.09	5 year	49.40	148.10	149.56		149.68	0.003533	1.52	32.41	37.93	0.53	29.46	29.46	1.52	1.52
Reach-1	0.93	Regional	427.40	147.20	150.10	150.10	150.71	0.008158	4.27	160.27	115.62	0.84	208.11	110.69	4.27	2.67
Reach-1	0.93	100 year	97.60	147.20	148.75	148.75	149.17	0.010849	3.03	41.04	57.09	0.86	133.79	76.29	3.03	2.38
Reach-1	0.93	50 year	87.30	147.20	148.68	148.68	149.08	0.011143	2.95	36.87	53.59	0.86	129.22	74.99	2.95	2.37
Reach-1	0.93	20 year	74.10	147.20	148.57	148.57	148.95	0.011980	2.86	31.08	48.30	0.88	126.63	75.39	2.86	2.38
Reach-1	0.93	10 year	59.60	147.20	148.43	148.43	148.79	0.012986	2.72	25.00	42.04	0.90	119.12	75.50	2.72	2.38
Reach-1	0.93	5 year	49.40	147.20	148.32	148.32	148.66	0.013945	2.61	20.79	37.10	0.91	113.47	76.40	2.61	2.38
Reach-1	0.77	Regional	427.40	146.20	149.32		149.58	0.002807	2.26	190.69	87.97	0.48	61.50	59.01	2.26	2.24
Reach-1	0.77	100 year	97.60	146.20	147.98		148.06	0.003138	1.31	74.73	82.79	0.44	27.72	27.72	1.31	1.31
Reach-1	0.77	50 year	87.30	146.20	147.90		147.98	0.003167	1.28	68.40	79.00	0.44	26.83	26.83	1.28	1.28
Reach-1	0.77	20 year	74.10	146.20	147.80		147.87	0.003088	1.22	60.94	74.27	0.43	24.80	24.80	1.22	1.22
Reach-1	0.77	10 year	59.60	146.20	147.67		147.74	0.003032	1.15	51.95	68.14	0.42	22.62	22.62	1.15	1.15
Reach-1	0.77	5 year	49.40	146.20	147.57		147.63	0.002986	1.09	45.24	63.17	0.41	20.93	20.93	1.09	1.09
Reach-1	0.61	Regional	427.40	145.30	148.12	148.12	148.83	0.009554	4.59	136.41	86.66	0.91	241.10	146.85	4.59	3.13
Reach-1	0.61	100 year	97.60	145.30	146.83	146.83	147.22	0.010453	3.03	42.32	57.03	0.85	132.16	75.82	3.03	2.31
Reach-1	0.61	50 year	87.30	145.30	146.77	146.77	147.13	0.010266	2.91	38.98	55.56	0.83	123.84	70.39	2.91	2.24
Reach-1	0.61	20 year	74.10	145.30	146.66	146.66	147.02	0.011012	2.83	33.04	51.88	0.85	121.04	68.55	2.83	2.24
Reach-1	0.61	10 year	59.60	145.30	146.52	146.52	146.87	0.012003	2.71	26.45	45.32	0.87	116.05	68.46	2.71	2.25
Reach-1	0.61	5 year	49.40	145.30	146.42	146.42	146.74	0.012915	2.61	21.88	40.15	0.89	111.39	68.77	2.61	2.26
Reach-1	0.45	Regional	427.40	144.20	147.28		147.61	0.003839	2.58	171.39	88.12	0.56	80.73	72.46	2.58	2.49
Reach-1	0.45	100 year	97.60	144.20	146.03		146.14	0.003609	1.41	69.31	76.32	0.47	32.13	31.99	1.41	1.41
Reach-1	0.45	50 year	87.30	144.20	145.96		146.06	0.003660	1.36	63.99	74.38	0.47	30.74	30.74	1.36	1.36
Reach-1	0.45	20 year	74.10	144.20	145.86		145.95	0.003679	1.31	56.40	69.63	0.47	29.10	29.10	1.31	1.31
Reach-1	0.45	10 year	59.60	144.20	145.73		145.81	0.003696	1.25	47.72	63.77	0.46	27.00	27.00	1.25	1.25
Reach-1	0.45	5 year	49.40	144.20	145.62		145.69	0.003779	1.20	41.02	58.85	0.46	25.71	25.71	1.20	1.20
Reach-1	0.34	Regional	427.40	143.50	146.19	146.19	146.84	0.013889	4.42	142.56	105.93	1.04	250.31	182.64	4.42	3.00
Reach-1	0.34	100 year	97.60	143.50	145.05	145.05	145.42	0.013002	3.06	44.33	60.66	0.92	141.85	92.77	3.06	2.20
Reach-1	0.34	50 year	87.30	143.50	144.98	144.98	145.34	0.012910	2.98	40.37	57.61	0.91	135.84	88.31	2.98	2.16
Reach-1	0.34	20 year	74.10	143.50	144.88	144.88	145.22	0.012952	2.87	34.93	53.15	0.90	128.83	83.09	2.87	2.12
Reach-1	0.34	10 year	59.60	143.50	144.76	144.76	145.08	0.013147	2.75	28.62	47.44	0.90	120.95	77.40	2.75	2.08
Reach-1	0.34	5 year	49.40	143.50	144.66	144.66	144.96	0.013113	2.62	24.22	43.01	0.89	112.90	72.02	2.62	2.04



Crossing 07 16Mile Main Branch Proposed Plan: Imported Plan 07 15/01/2013

RIVER-1 Reach-1







HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-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	1	Regional	759.70	164.30	169.45	167.38	169.65	0.000833	2.00	389.88	110.42	0.33
Reach-1	1	100 YR	180.60	164.30	167.14	166.11	167.21	0.000865	1.18	153.64	91.97	0.29
Reach-1	1	50 YR	5.40	164.30	167.14	164.58	167.14	0.000001	0.04	153.64	91.97	0.01
Reach-1	1	20 YR	4.17	164.30	167.14	164.54	167.14	0.000000	0.03	153.64	91.97	0.01
Reach-1	1	10 YR	3.35	164.30	167.14	164.51	167.14	0.000000	0.02	153.64	91.97	0.01
Reach-1	1	5 YR	2.62	164.30	167.14	164.48	167.14	0.000000	0.02	153.64	91.97	0.00
Reach-1	1	2 YR	1.71	164.30	167.14	164.43	167.14	0.000000	0.01	153.64	91.97	0.00
Reach-1	2	Regional	36.60	165.20	169.71		169.72	0.000026	0.36	130.51	40.55	0.06
Reach-1	2	100 YR	8.50	165.20	167.27		167.27	0.000040	0.24	39.42	30.39	0.06
Reach-1	2	50 YR	5.40	165.20	167.14		167.14	0.000021	0.17	35.64	29.25	0.04
Reach-1	2	20 YR	4.17	165.20	167.14		167.14	0.000013	0.13	35.65	29.26	0.03
Reach-1	2	10 YR	3.35	165.20	167.14		167.14	0.000008	0.11	35.65	29.26	0.03
Reach-1	2	5 YR	2.62	165.20	167.14		167.14	0.000005	0.08	35.66	29.26	0.02
Reach-1	2	2 YR	1.71	165.20	167.14		167.14	0.000002	0.05	35.66	29.26	0.01
Reach-1	3	Regional	36.60	167.60	169.69		169.75	0.000978	1.11	37.97	31.13	0.30
Reach-1	3	100 YR	8.50	167.60	168.10	168.10	168.30	0.016524	1.98	4.31	11.31	1.00
Reach-1	3	50 YR	5.40	167.60	167.99	167.99	168.14	0.018010	1.75	3.08	9.88	1.00
Reach-1	3	20 YR	4.17	167.60	167.93	167.93	168.07	0.018932	1.64	2.54	9.32	1.00
Reach-1	3	10 YR	3.35	167.60	167.89	167.89	168.01	0.019745	1.55	2.16	8.90	1.01
Reach-1	3	5 YR	2.62	167.60	167.85	167.85	167.96	0.020543	1.45	1.81	8.49	1.00
Reach-1	3	2 YR	1.71	167.60	167.79	167.79	167.88	0.022321	1.29	1.32	7.90	1.01
Reach-1	4	Regional	36.60	171.20	172.24	172.24	172.57	0.013430	2.55	14.52	22.94	0.99
Reach-1	4	100 YR	8.50	171.20	171.82	171.75	171.93	0.010355	1.46	5.83	16.30	0.78
Reach-1	4	50 YR	5.40	171.20	171.71	171.63	171.79	0.009819	1.29	4.17	13.40	0.74
Reach-1	4	20 YR	4.17	171.20	171.65	171.57	171.72	0.009519	1.21	3.44	11.89	0.72
Reach-1	4	10 YR	3.35	171.20	171.60	171.52	171.67	0.009249	1.15	2.91	10.68	0.70
Reach-1	4	5 YR	2.62	171.20	171.55	171.47	171.61	0.009008	1.09	2.40	9.36	0.69
Reach-1	4	2 YR	1.71	171.20	171.48	171.41	171.52	0.008517	0.97	1.76	7.75	0.65
Reach-1	5	Regional	36.60	175.30	176.34	176.34	176.64	0.011680	2.47	16.05	30.07	0.93
Reach-1	5	100 YR	8.50	175.30	175.85	175.85	176.01	0.018048	1.74	4.88	15.92	1.00
Reach-1	5	50 YR	5.40	175.30	175.75	175.75	175.88	0.019364	1.61	3.35	12.95	1.01
Reach-1	5	20 YR	4.17	175.30	175.70	175.70	175.82	0.019914	1.54	2.71	11.49	1.01
Reach-1	5	10 YR	3.35	175.30	175.66	175.66	175.77	0.020321	1.48	2.27	10.35	1.01
Reach-1	5	5 YR	2.62	175.30	175.61	175.61	175.71	0.020828	1.42	1.85	9.14	1.00
Reach-1	5	2 YR	1.71	175.30	175.54	175.54	175.63	0.021634	1.33	1.29	7.22	1.00
Reach-1	6	Regional	36.60	175.47	177.13	177.13	177.95	0.004743	4.02	9.11	53.23	1.00
Reach-1	6	100 YR	8.50	175.47	176.11	176.09	176.41	0.005956	2.40	3.54	23.37	0.95
Reach-1	6	50 YR	5.40	175.47	175.99	175.93	176.17	0.004788	1.87	2.88	19.83	0.83
Reach-1	6	20 YR	4.17	175.47	175.93	175.86	176.07	0.004316	1.64	2.55	18.17	0.77
Reach-1	6	10 YR	3.35	175.47	175.89	175.81	176.00	0.003960	1.46	2.29	16.91	0.72
Reach-1	6	5 YR	2.62	175.47	175.85	175.76	175.93	0.003296	1.25	2.09	15.91	0.65
Reach-1	6	2 YR	1.71	175.47	175.78	175.68	175.83	0.002693	1.00	1.72	14.08	0.57
Reach-1	6.5	Bridge										
Reach-1	7	Regional	36.60	175.49	178.32	177.15	178.32	0.000063	0.66	129.53	81.37	0.13
Reach-1	7	100 YR	8.50	175.49	176.30	176.11	176.49	0.002750	1.90	4.47	28.34	0.67
Reach-1	7	50 YR	5.40	175.49	176.01	175.95	176.19	0.004764	1.87	2.89	19.86	0.82
Reach-1	7	20 YR	4.17	175.49	175.95	175.88	176.09	0.004364	1.64	2.54	18.14	0.77
Reach-1	7	10 YR	3.35	175.49	175.90	175.82	176.01	0.004062	1.47	2.27	16.83	0.73
Reach-1	7	5 YR	2.62	175.49	175.86	175.78	175.95	0.003479	1.27	2.06	15.75	0.67
Reach-1	7	2 YR	1.71	175.49	175.79	175.71	175.85	0.002959	1.02	1.67	13.85	0.59
Reach-1	8	Regional	36.60	175.80	178.32		178.33	0.000268	0.60	61.25	45.42	0.16
Reach-1	8	100 YR	8.50	175.80	176.48		176.60	0.010422	1.53	5.54	14.46	0.79
Reach-1	8	50 YR	5.40	175.80	176.30	176.30	176.45	0.018785	1.69	3.20	11.27	1.01
Reach-1	8	20 YR	4.17	175.80	176.25	176.25	176.38	0.019229	1.58	2.63	10.35	1.00
Reach-1	8	10 YR	3.35	175.80	176.21	176.21	176.32	0.020207	1.52	2.21	9.60	1.01
Reach-1	8	5 YR	2.62	175.80	176.16	176.16	176.27	0.021067	1.44	1.82	8.87	1.01
Reach-1	8	2 YR	1.71	175.80	176.10	176.10	176.19	0.022475	1.30	1.31	7.81	1.01
Reach-1	9	Regional	36.60	177.50	178.42	178.42	178.78	0.012273	2.69	14.25	21.38	0.97
Reach-1	9	100 YR	8.50	177.50	177.92	177.91	178.07	0.017342	1.74	4.89	15.49	0.99
Reach-1	9	50 YR	5.40	177.50	177.87		177.96	0.010384	1.27	4.25	14.73	0.75
Reach-1	9	20 YR	4.17	177.50	177.83		177.90	0.010306	1.17	3.56	13.86	0.74
Reach-1	9	10 YR	3.35	177.50	177.79		177.85	0.010041	1.08	3.09	13.24	0.72
Reach-1	9	5 YR	2.62	177.50	177.76		177.81	0.009872	1.00	2.63	12.59	0.70
Reach-1	9	2 YR	1.71	177.50	177.70		177.74	0.009623	0.86	1.99	11.64	0.67
Reach-1	10	Regional	36.60	179.42	180.90	180.90	181.64	0.005384	3.81	9.61	43.47	1.00
Reach-1	10	100 YR	8.50	179.42	179.98	179.98	180.26	0.007449	2.34	3.63	29.20	1.00
Reach-1	10	50 YR	5.40	179.42	179.83	179.83	180.04	0.008167	2.01	2.69	23.82	1.00

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 (Continued)

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	10	20 YR	4.17	179.42	179.77	179.77	179.94	0.008531	1.83	2.27	21.43	0.99
Reach-1	10	10 YR	3.35	179.42	179.72	179.72	179.87	0.009247	1.72	1.95	19.56	1.00
Reach-1	10	5 YR	2.62	179.42	179.68	179.68	179.80	0.009582	1.58	1.66	17.93	1.00
Reach-1	10	2 YR	1.71	179.42	179.61	179.61	179.71	0.010807	1.38	1.24	15.52	1.01
Reach-1	10.5	Bridge										
Reach-1	11	Regional	36.60	179.50	180.98	180.98	181.72	0.005360	3.80	9.62	43.50	1.00
Reach-1	11	100 YR	8.50	179.50	180.06	180.06	180.34	0.007301	2.33	3.65	29.32	0.99
Reach-1	11	50 YR	5.40	179.50	179.92	179.91	180.12	0.008035	2.00	2.70	23.89	0.99
Reach-1	11	20 YR	4.17	179.50	179.85	179.85	180.02	0.008570	1.84	2.27	21.42	0.99
Reach-1	11	10 YR	3.35	179.50	179.80	179.80	179.95	0.008929	1.70	1.97	19.68	0.99
Reach-1	11	5 YR	2.62	179.50	179.76	179.76	179.88	0.009338	1.56	1.67	18.01	0.98
Reach-1	11	2 YR	1.71	179.50	179.70	179.69	179.79	0.009401	1.32	1.29	15.83	0.95
Reach-1	12	Regional	36.60	179.60	181.93		181.94	0.000137	0.57	71.16	39.06	0.12
Reach-1	12	100 YR	8.50	179.60	180.43		180.44	0.000375	0.44	19.72	29.71	0.17
Reach-1	12	50 YR	5.40	179.60	180.20		180.21	0.000563	0.42	13.09	28.28	0.19
Reach-1	12	20 YR	4.17	179.60	180.11		180.11	0.000726	0.40	10.33	27.66	0.21
Reach-1	12	10 YR	3.35	179.60	180.04		180.04	0.000910	0.40	8.45	27.23	0.23
Reach-1	12	5 YR	2.62	179.60	179.97		179.98	0.001135	0.39	6.70	25.84	0.25
Reach-1	12	2 YR	1.71	179.60	179.88		179.89	0.001466	0.38	4.51	22.12	0.27
Reach-1	13	Regional	36.60	180.80	181.91	181.91	182.21	0.012511	2.64	15.63	26.07	0.97
Reach-1	13	100 YR	8.50	180.80	181.38	181.38	181.55	0.013822	1.93	4.87	14.37	0.93
Reach-1	13	50 YR	5.40	180.80	181.26	181.26	181.41	0.014748	1.75	3.34	11.80	0.93
Reach-1	13	20 YR	4.17	180.80	181.20	181.20	181.34	0.015586	1.66	2.68	10.49	0.94
Reach-1	13	10 YR	3.35	180.80	181.16	181.16	181.28	0.016363	1.58	2.23	9.49	0.94
Reach-1	13	5 YR	2.62	180.80	181.11	181.11	181.22	0.017594	1.50	1.80	8.44	0.96
Reach-1	13	2 YR	1.71	180.80	181.04	181.04	181.14	0.020231	1.37	1.25	6.87	0.99
Reach-1	14	Regional	36.60	182.00	183.33	183.24	183.63	0.009724	2.42	15.11	18.67	0.86
Reach-1	14	100 YR	8.50	182.00	182.72	182.59	182.83	0.007320	1.49	5.72	11.91	0.68
Reach-1	14	50 YR	5.40	182.00	182.59	182.46	182.67	0.006807	1.28	4.22	10.44	0.64
Reach-1	14	20 YR	4.17	182.00	182.52	182.40	182.59	0.006482	1.17	3.57	9.72	0.62
Reach-1	14	10 YR	3.35	182.00	182.47	182.35	182.53	0.006240	1.08	3.09	9.16	0.60
Reach-1	14	5 YR	2.62	182.00	182.42	182.30	182.47	0.005949	0.99	2.63	8.60	0.57
Reach-1	14	2 YR	1.71	182.00	182.34	182.24	182.38	0.005507	0.85	2.00	7.75	0.54
Reach-1	15	Regional	36.60	182.84	184.72	184.72	184.85	0.001335	2.32	31.96	37.54	0.54
Reach-1	15	100 YR	8.50	182.84	183.71	183.71	184.14	0.005899	2.92	2.91	14.29	1.00
Reach-1	15	50 YR	5.40	182.84	183.48	183.48	183.80	0.006537	2.51	2.15	10.59	1.00
Reach-1	15	20 YR	4.17	182.84	183.38	183.38	183.65	0.006883	2.30	1.82	8.95	1.00
Reach-1	15	10 YR	3.35	182.84	183.31	183.31	183.54	0.007165	2.13	1.57	7.78	0.99
Reach-1	15	5 YR	2.62	182.84	183.24	183.24	183.43	0.007630	1.97	1.33	6.61	1.00
Reach-1	15	2 YR	1.71	182.84	183.14	183.14	183.29	0.008509	1.71	1.00	5.27	1.00
Reach-1	15.5	Bridge										
Reach-1	16	Regional	36.60	182.89	185.70	185.19	185.72	0.000154	1.03	77.75	61.38	0.20
Reach-1	16	100 YR	8.50	182.89	183.94	183.76	184.24	0.003180	2.42	3.51	17.17	0.76
Reach-1	16	50 YR	5.40	182.89	183.53	183.53	183.85	0.006645	2.52	2.14	10.54	1.01
Reach-1	16	20 YR	4.17	182.89	183.43	183.43	183.70	0.006801	2.29	1.82	8.99	0.99
Reach-1	16	10 YR	3.35	182.89	183.36	183.36	183.59	0.007151	2.13	1.57	7.78	0.99
Reach-1	16	5 YR	2.62	182.89	183.29	183.29	183.48	0.007528	1.96	1.34	6.64	0.99
Reach-1	16	2 YR	1.71	182.89	183.19	183.19	183.34	0.008258	1.70	1.01	5.30	0.99
Reach-1	17	Regional	36.60	182.70	185.71		185.72	0.000135	0.58	81.62	63.03	0.12
Reach-1	17	100 YR	8.50	182.70	184.41		184.42	0.000218	0.42	21.53	29.62	0.13
Reach-1	17	50 YR	5.40	182.70	184.05		184.06	0.000405	0.43	12.54	20.36	0.17
Reach-1	17	20 YR	4.17	182.70	183.87		183.88	0.000578	0.45	9.20	16.92	0.20
Reach-1	17	10 YR	3.35	182.70	183.74		183.76	0.000717	0.47	7.18	14.85	0.21
Reach-1	17	5 YR	2.62	182.70	183.62		183.63	0.000885	0.48	5.49	12.87	0.23
Reach-1	17	2 YR	1.71	182.70	183.46		183.47	0.001158	0.48	3.57	10.17	0.26
Reach-1	18	Regional	36.60	184.50	185.75		185.85	0.002980	1.74	28.68	45.51	0.51
Reach-1	18	100 YR	8.50	184.50	185.00	185.00	185.16	0.012680	1.84	5.06	17.32	0.89
Reach-1	18	50 YR	5.40	184.50	184.88	184.88	185.02	0.016173	1.69	3.29	12.91	0.96
Reach-1	18	20 YR	4.17	184.50	184.82	184.82	184.95	0.018913	1.60	2.62	10.78	1.00
Reach-1	18	10 YR	3.35	184.50	184.78	184.78	184.90	0.019946	1.50	2.23	9.77	1.00
Reach-1	18	5 YR	2.62	184.50	184.74	184.74	184.85	0.020760	1.41	1.86	9.25	1.00
Reach-1	18	2 YR	1.71	184.50	184.69	184.69	184.77	0.022480	1.26	1.36	8.50	1.01
Reach-1	19	Regional	36.60	185.60	186.69		186.78	0.003810	1.76	31.92	73.77	0.56
Reach-1	19	100 YR	8.50	185.60	186.33	186.14	186.37	0.002140	0.99	11.66	40.90	0.39
Reach-1	19	50 YR	5.40	185.60	186.23	185.99	186.26	0.002011	0.85	7.89	31.19	0.37
Reach-1	19	20 YR	4.17	185.60	186.17	185.93	186.20	0.001929	0.78	6.31	26.03	0.35

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 (Continued)

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	19	10 YR	3.35	185.60	186.12	185.89	186.15	0.001898	0.72	5.17	21.60	0.35
Reach-1	19	5 YR	2.62	185.60	186.07	185.85	186.09	0.001870	0.66	4.17	16.76	0.34
Reach-1	19	2 YR	1.71	185.60	185.99	185.79	186.00	0.001806	0.56	3.08	9.88	0.32
Reach-1	20	Regional	36.60	186.20	187.41		187.45	0.001661	1.27	53.92	154.61	0.38
Reach-1	20	100 YR	8.50	186.20	186.91		186.95	0.002003	0.96	11.50	34.00	0.38
Reach-1	20	50 YR	5.40	186.20	186.79		186.83	0.002009	0.84	7.87	27.10	0.37
Reach-1	20	20 YR	4.17	186.20	186.73		186.76	0.002059	0.78	6.27	23.42	0.36
Reach-1	20	10 YR	3.35	186.20	186.68		186.71	0.002069	0.73	5.21	20.63	0.36
Reach-1	20	5 YR	2.62	186.20	186.63		186.65	0.002109	0.68	4.22	17.63	0.35
Reach-1	20	2 YR	1.71	186.20	186.55		186.57	0.002204	0.59	2.98	12.91	0.35
Reach-1	21	Regional	36.60	186.60	187.70		187.74	0.001423	1.12	45.38	75.91	0.35
Reach-1	21	100 YR	8.50	186.60	187.23		187.25	0.001287	0.72	16.02	49.14	0.30
Reach-1	21	50 YR	5.40	186.60	187.12		187.14	0.001426	0.66	11.01	42.95	0.30
Reach-1	21	20 YR	4.17	186.60	187.07		187.08	0.001524	0.63	8.84	39.96	0.31
Reach-1	21	10 YR	3.35	186.60	187.03		187.04	0.001626	0.61	7.28	37.67	0.31
Reach-1	21	5 YR	2.62	186.60	186.99		187.00	0.001740	0.59	5.79	34.48	0.32
Reach-1	21	2 YR	1.71	186.60	186.92		186.94	0.001893	0.54	3.82	26.05	0.32
Reach-1	22	Regional	36.60	187.40	188.27	188.25	188.45	0.009765	2.45	33.19	73.57	0.87
Reach-1	22	100 YR	8.50	187.40	187.90	187.90	188.03	0.010371	1.68	8.28	48.32	0.81
Reach-1	22	50 YR	5.40	187.40	187.80	187.79	187.92	0.012863	1.56	4.22	28.15	0.86
Reach-1	22	20 YR	4.17	187.40	187.77	187.72	187.86	0.010612	1.34	3.51	22.80	0.77
Reach-1	22	10 YR	3.35	187.40	187.74	187.68	187.81	0.008982	1.17	3.04	18.51	0.70
Reach-1	22	5 YR	2.62	187.40	187.72		187.77	0.007726	1.01	2.61	13.39	0.64
Reach-1	22	2 YR	1.71	187.40	187.67		187.70	0.006406	0.82	2.08	9.55	0.56
Reach-1	23	Regional	36.60	188.50	189.70	189.45	189.80	0.003556	1.82	42.54	67.42	0.55
Reach-1	23	100 YR	8.50	188.50	189.19	189.04	189.24	0.002860	1.09	13.71	46.43	0.45
Reach-1	23	50 YR	5.40	188.50	189.09	188.89	189.13	0.002572	0.92	9.31	42.32	0.41
Reach-1	23	20 YR	4.17	188.50	189.03		189.06	0.002810	0.88	6.63	39.60	0.42
Reach-1	23	10 YR	3.35	188.50	188.97		189.01	0.003028	0.84	4.68	30.71	0.43
Reach-1	23	5 YR	2.62	188.50	188.91		188.95	0.003257	0.78	3.38	14.20	0.43
Reach-1	23	2 YR	1.71	188.50	188.82		188.85	0.003542	0.70	2.45	9.21	0.43
Reach-1	24	Regional	36.60	188.70	189.95		190.06	0.003994	1.61	31.14	44.68	0.56
Reach-1	24	100 YR	8.50	188.70	189.45		189.50	0.005251	1.03	9.87	38.57	0.55
Reach-1	24	50 YR	5.40	188.70	189.36		189.40	0.006070	0.92	6.53	31.76	0.57
Reach-1	24	20 YR	4.17	188.70	189.32		189.35	0.006324	0.85	5.29	28.83	0.56
Reach-1	24	10 YR	3.35	188.70	189.29		189.32	0.006624	0.79	4.44	26.62	0.56
Reach-1	24	5 YR	2.62	188.70	189.25		189.28	0.007223	0.74	3.62	24.32	0.57
Reach-1	24	2 YR	1.71	188.70	189.21		189.23	0.008894	0.67	2.56	20.96	0.60
Reach-1	25	Regional	20.50	189.00	190.66		190.69	0.000659	0.86	39.70	50.71	0.24
Reach-1	25	100 YR	6.46	189.00	190.08		190.10	0.000656	0.57	15.57	33.53	0.22
Reach-1	25	50 YR	5.40	189.00	189.99		190.01	0.000773	0.57	12.66	30.76	0.23
Reach-1	25	20 YR	4.17	189.00	189.92		189.93	0.000712	0.51	10.52	27.99	0.22
Reach-1	25	10 YR	3.35	189.00	189.86		189.87	0.000668	0.46	8.98	25.82	0.21
Reach-1	25	5 YR	2.62	189.00	189.81		189.82	0.000615	0.41	7.58	23.66	0.20
Reach-1	25	2 YR	1.71	189.00	189.72		189.73	0.000531	0.34	5.67	20.38	0.18
Reach-1	25.25	Regional	20.50	189.00	190.70	189.60	190.74	0.000511	0.86	23.76	39.43	0.21
Reach-1	25.25	100 YR	6.46	189.00	190.12	189.28	190.13	0.000204	0.41	15.66	24.97	0.12
Reach-1	25.25	50 YR	5.40	189.00	190.03	189.25	190.04	0.000187	0.37	14.43	22.77	0.12
Reach-1	25.25	20 YR	4.17	189.00	189.95	189.21	189.96	0.000145	0.31	13.33	20.73	0.10
Reach-1	25.25	10 YR	3.35	189.00	189.89	189.18	189.89	0.000117	0.27	12.48	19.10	0.09
Reach-1	25.25	5 YR	2.62	189.00	189.83	189.15	189.83	0.000091	0.23	11.62	17.46	0.08
Reach-1	25.25	2 YR	1.71	189.00	189.74	189.11	189.74	0.000057	0.17	10.32	14.99	0.06
Reach-1	25.5	Bridge										
Reach-1	25.75	Regional	20.50	189.05	190.71	189.65	190.75	0.000541	0.88	23.31	39.87	0.22
Reach-1	25.75	100 YR	6.46	189.05	190.13	189.33	190.13	0.000231	0.43	15.05	25.13	0.13
Reach-1	25.75	50 YR	5.40	189.05	190.04	189.30	190.04	0.000215	0.39	13.81	22.91	0.13
Reach-1	25.75	20 YR	4.17	189.05	189.96	189.26	189.96	0.000169	0.33	12.70	20.85	0.11
Reach-1	25.75	10 YR	3.35	189.05	189.89	189.23	189.90	0.000139	0.28	11.83	19.19	0.10
Reach-1	25.75	5 YR	2.62	189.05	189.83	189.20	189.84	0.000109	0.24	10.96	17.54	0.09
Reach-1	25.75	2 YR	1.71	189.05	189.74	189.16	189.74	0.000071	0.18	9.64	15.04	0.07
Reach-1	25.9	Regional	20.50	189.10	190.74		190.77	0.000543	0.74	32.99	40.48	0.22
Reach-1	25.9	100 YR	6.46	189.10	190.13		190.14	0.000656	0.51	12.94	25.22	0.21
Reach-1	25.9	50 YR	5.40	189.10	190.04		190.05	0.000803	0.50	10.79	22.99	0.23
Reach-1	25.9	20 YR	4.17	189.10	189.96		189.97	0.000805	0.46	9.02	20.85	0.22
Reach-1	25.9	10 YR	3.35	189.10	189.90		189.91	0.000762	0.43	7.77	19.09	0.22
Reach-1	25.9	5 YR	2.62	189.10	189.83		189.84	0.000696	0.40	6.63	17.34	0.20
Reach-1	25.9	2 YR	1.71	189.10	189.74		189.74	0.000565	0.33	5.11	14.69	0.18

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 (Continued)

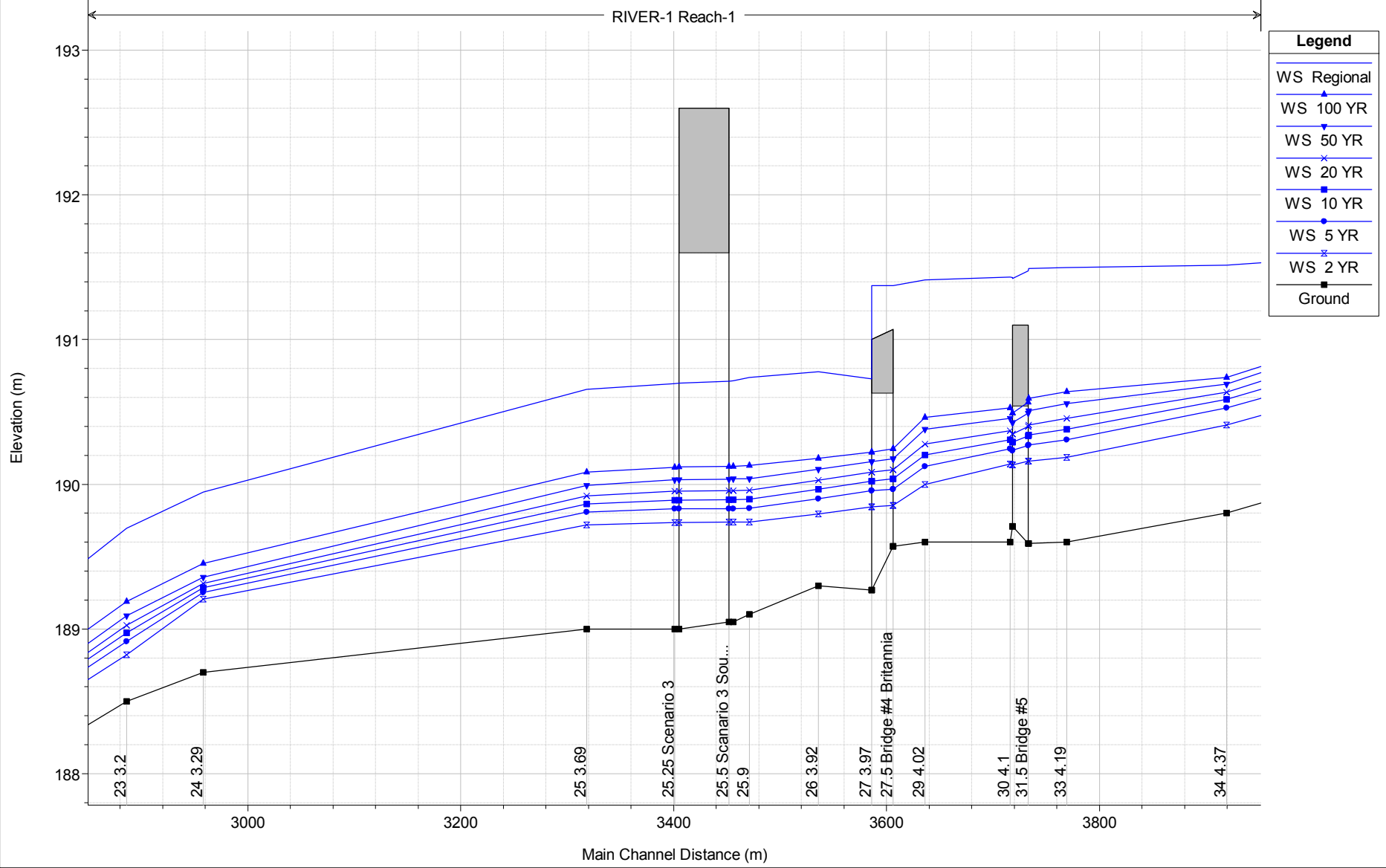
Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Reach-1	26	Regional	20.50	189.30	190.78		190.81	0.000702	0.80	31.52	41.42	0.24
Reach-1	26	100 YR	6.46	189.30	190.18		190.20	0.001105	0.59	11.27	26.50	0.27
Reach-1	26	50 YR	5.40	189.30	190.10		190.12	0.001364	0.59	9.31	24.58	0.29
Reach-1	26	20 YR	4.17	189.30	190.03		190.04	0.001594	0.56	7.52	22.69	0.30
Reach-1	26	10 YR	3.35	189.30	189.96		189.98	0.001798	0.54	6.16	20.36	0.32
Reach-1	26	5 YR	2.62	189.30	189.90		189.91	0.001875	0.53	4.91	17.28	0.32
Reach-1	26	2 YR	1.71	189.30	189.79		189.81	0.001821	0.51	3.36	12.41	0.31
Reach-1	27	Regional	20.50	189.27	190.73	190.31	190.99	0.003877	2.29	8.96	40.19	0.60
Reach-1	27	100 YR	6.46	189.27	190.22	189.75	190.29	0.001583	1.10	5.86	27.59	0.36
Reach-1	27	50 YR	5.40	189.27	190.16	189.70	190.21	0.001410	0.99	5.45	25.92	0.34
Reach-1	27	20 YR	4.17	189.27	190.08	189.63	190.12	0.001118	0.83	5.01	24.10	0.29
Reach-1	27	10 YR	3.35	189.27	190.02	189.58	190.05	0.000938	0.72	4.63	22.56	0.27
Reach-1	27	5 YR	2.62	189.27	189.95	189.53	189.97	0.000787	0.62	4.21	18.81	0.24
Reach-1	27	2 YR	1.71	189.27	189.84	189.47	189.86	0.000601	0.48	3.53	11.12	0.20
Reach-1	27.5	Bridge										
Reach-1	28	Regional	20.50	189.57	191.37	190.61	191.41	0.000629	1.06	44.77	50.74	0.25
Reach-1	28	100 YR	6.46	189.57	190.25	190.05	190.37	0.005008	1.56	4.15	18.16	0.60
Reach-1	28	50 YR	5.40	189.57	190.18	190.00	190.28	0.004990	1.45	3.73	13.38	0.59
Reach-1	28	20 YR	4.17	189.57	190.10	189.93	190.18	0.004649	1.28	3.26	8.06	0.56
Reach-1	28	10 YR	3.35	189.57	190.04	189.88	190.11	0.004592	1.17	2.87	7.78	0.54
Reach-1	28	5 YR	2.62	189.57	189.97	189.83	190.03	0.004819	1.07	2.44	7.54	0.54
Reach-1	28	2 YR	1.71	189.57	189.85	189.77	189.90	0.006231	0.98	1.75	7.15	0.58
Reach-1	29	Regional	20.50	189.60	191.41		191.42	0.000223	0.49	56.34	85.22	0.14
Reach-1	29	100 YR	6.46	189.60	190.46		190.48	0.001746	0.64	10.05	25.25	0.33
Reach-1	29	50 YR	5.40	189.60	190.38		190.40	0.002093	0.67	8.10	22.08	0.35
Reach-1	29	20 YR	4.17	189.60	190.28		190.30	0.002523	0.69	6.07	18.20	0.38
Reach-1	29	10 YR	3.35	189.60	190.20		190.23	0.002835	0.70	4.79	15.26	0.40
Reach-1	29	5 YR	2.62	189.60	190.12		190.15	0.003013	0.70	3.73	12.27	0.41
Reach-1	29	2 YR	1.71	189.60	190.00		190.02	0.002531	0.68	2.50	7.51	0.38
Reach-1	30	Regional	20.50	189.60	191.43		191.43	0.000059	0.27	159.05	264.43	0.07
Reach-1	30	100 YR	6.46	189.60	190.53		190.53	0.000290	0.32	27.47	86.57	0.14
Reach-1	30	50 YR	5.40	189.60	190.46		190.46	0.000349	0.32	21.47	77.76	0.15
Reach-1	30	20 YR	4.17	189.60	190.37		190.37	0.000436	0.31	15.40	62.80	0.16
Reach-1	30	10 YR	3.35	189.60	190.31		190.31	0.000526	0.31	11.80	51.98	0.17
Reach-1	30	5 YR	2.62	189.60	190.24		190.25	0.000663	0.30	8.93	41.31	0.19
Reach-1	30	2 YR	1.71	189.60	190.14		190.14	0.000981	0.31	5.45	26.17	0.22
Reach-1	31	Regional	20.50	189.71	191.43	190.65	191.44	0.000240	0.63	104.14	150.84	0.15
Reach-1	31	100 YR	6.46	189.71	190.49	190.17	190.57	0.002759	1.27	5.08	38.30	0.46
Reach-1	31	50 YR	5.40	189.71	190.43	190.12	190.49	0.002577	1.16	4.65	33.25	0.44
Reach-1	31	20 YR	4.17	189.71	190.35	190.06	190.40	0.002259	1.01	4.14	27.19	0.40
Reach-1	31	10 YR	3.35	189.71	190.29	190.01	190.33	0.001993	0.89	3.77	22.77	0.37
Reach-1	31	5 YR	2.62	189.71	190.23	189.96	190.26	0.001717	0.77	3.41	18.37	0.34
Reach-1	31	2 YR	1.71	189.71	190.13	189.90	190.15	0.001471	0.62	2.76	10.69	0.30
Reach-1	31.5	Bridge										
Reach-1	32	Regional	20.50	189.59	191.49	190.57	191.50	0.000140	0.52	134.05	182.01	0.12
Reach-1	32	100 YR	6.46	189.59	190.59	190.06	190.62	0.000770	0.79	14.81	68.02	0.25
Reach-1	32	50 YR	5.40	189.59	190.51	189.98	190.53	0.000782	0.76	12.12	56.64	0.25
Reach-1	32	20 YR	4.17	189.59	190.41	189.93	190.43	0.000744	0.68	9.44	43.13	0.24
Reach-1	32	10 YR	3.35	189.59	190.34	189.89	190.36	0.000687	0.62	7.85	35.87	0.23
Reach-1	32	5 YR	2.62	189.59	190.27	189.84	190.29	0.000611	0.55	6.50	30.57	0.21
Reach-1	32	2 YR	1.71	189.59	190.16	189.78	190.17	0.000505	0.44	4.70	22.01	0.19
Reach-1	33	Regional	20.50	189.60	191.50		191.50	0.000080	0.31	114.90	157.67	0.09
Reach-1	33	100 YR	6.46	189.60	190.64		190.64	0.000434	0.35	19.34	57.81	0.17
Reach-1	33	50 YR	5.40	189.60	190.56		190.56	0.000591	0.36	15.06	46.65	0.19
Reach-1	33	20 YR	4.17	189.60	190.46		190.46	0.000850	0.38	10.99	35.54	0.22
Reach-1	33	10 YR	3.35	189.60	190.38		190.39	0.000999	0.39	8.55	29.77	0.23
Reach-1	33	5 YR	2.62	189.60	190.31		190.32	0.001110	0.40	6.57	24.06	0.24
Reach-1	33	2 YR	1.71	189.60	190.19		190.20	0.001064	0.40	4.25	14.78	0.24
Reach-1	34	Regional	20.50	189.80	191.51		191.53	0.000483	0.77	75.66	130.06	0.21
Reach-1	34	100 YR	6.46	189.80	190.74		190.80	0.003132	1.15	8.76	39.02	0.46
Reach-1	34	50 YR	5.40	189.80	190.69		190.75	0.003014	1.08	7.11	33.09	0.45
Reach-1	34	20 YR	4.17	189.80	190.64		190.68	0.002670	0.95	5.49	25.94	0.42
Reach-1	34	10 YR	3.35	189.80	190.59		190.62	0.002533	0.86	4.32	19.20	0.40
Reach-1	34	5 YR	2.62	189.80	190.53		190.56	0.002425	0.78	3.43	11.69	0.38
Reach-1	34	2 YR	1.71	189.80	190.41		190.43	0.002498	0.69	2.47	7.10	0.37

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 (Continued)

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	35	Regional	20.50	189.90	191.54	191.15	191.55	0.000587	0.96	79.20	132.06	0.24
Reach-1	35	100 YR	6.46	189.90	190.85	190.66	191.09	0.006415	2.20	2.93	52.89	0.72
Reach-1	35	50 YR	5.40	189.90	190.80	190.58	190.99	0.005186	1.92	2.81	47.62	0.65
Reach-1	35	20 YR	4.17	189.90	190.74	190.47	190.87	0.003917	1.60	2.61	39.58	0.55
Reach-1	35	10 YR	3.35	189.90	190.69	190.39	190.78	0.003176	1.37	2.44	32.32	0.49
Reach-1	35	5 YR	2.62	189.90	190.62	190.32	190.69	0.002570	1.17	2.24	24.07	0.44
Reach-1	35	2 YR	1.71	189.90	190.50	190.21	190.55	0.002006	0.91	1.87	8.44	0.38
Reach-1	35.5	Bridge										
Reach-1	36	Regional	20.50	189.90	191.55	191.20	191.56	0.000560	0.94	80.64	132.90	0.23
Reach-1	36	100 YR	6.46	189.90	190.93	190.66	191.14	0.004823	2.02	3.19	63.87	0.64
Reach-1	36	50 YR	5.40	189.90	190.86	190.58	191.03	0.004241	1.81	2.98	54.94	0.59
Reach-1	36	20 YR	4.17	189.90	190.78	190.47	190.90	0.003413	1.53	2.72	44.20	0.52
Reach-1	36	10 YR	3.35	189.90	190.71	190.39	190.80	0.002857	1.33	2.52	35.62	0.47
Reach-1	36	5 YR	2.62	189.90	190.64	190.32	190.71	0.002354	1.14	2.30	26.59	0.42
Reach-1	36	2 YR	1.71	189.90	190.52	190.21	190.56	0.001859	0.89	1.91	10.26	0.36
Reach-1	37	Regional	20.50	190.00	191.57		191.57	0.000262	0.42	72.89	153.44	0.14
Reach-1	37	100 YR	6.46	190.00	191.21		191.22	0.000194	0.25	29.33	89.86	0.11
Reach-1	37	50 YR	5.40	190.00	191.10		191.10	0.000337	0.28	20.21	68.18	0.14
Reach-1	37	20 YR	4.17	190.00	190.97		190.97	0.000733	0.33	12.81	46.80	0.20
Reach-1	37	10 YR	3.35	190.00	190.87		190.88	0.001255	0.38	8.81	38.12	0.25
Reach-1	37	5 YR	2.62	190.00	190.78		190.79	0.002317	0.46	5.73	29.78	0.33
Reach-1	37	2 YR	1.71	190.00	190.63		190.66	0.008776	0.73	2.33	16.17	0.62
Reach-1	38	Regional	20.50	190.50	191.63		191.64	0.000793	0.46	46.53	136.20	0.22
Reach-1	38	100 YR	6.46	190.50	191.28		191.29	0.002486	0.50	12.87	61.39	0.35
Reach-1	38	50 YR	5.40	190.50	191.21		191.23	0.004001	0.59	9.14	48.82	0.44
Reach-1	38	20 YR	4.17	190.50	191.17		191.19	0.003849	0.56	7.45	41.89	0.42
Reach-1	38	10 YR	3.35	190.50	191.15		191.16	0.003224	0.51	6.63	38.09	0.39
Reach-1	38	5 YR	2.62	190.50	191.14		191.14	0.002408	0.43	6.05	35.12	0.33
Reach-1	38	2 YR	1.71	190.50	191.10		191.11	0.001496	0.34	5.01	29.12	0.26



Omagh Crossing 11 Scenario3 Nov 2011 Plan: Imported Plan 01







HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-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 (N/m2)	Shear Chan (N/m2)	Shear Total (N/m2)	Vel Chnl (m/s)	Vel Total (m/s)
Reach-1	37.014	Regional	261.96	187.70	191.13		191.13	0.00019	0.29	1306.58	539.00	0.05	0.53	0.45	0.29	0.20	
Reach-1	37.014	100 year	49.30	187.70	188.77		188.79	0.001559	0.86	106.81	406.08	0.38	8.05	4.10	0.86	0.45	
Reach-1	37.014	50 year	122.60	187.70	189.73		189.73	0.00061	0.34	565.24	514.69	0.09	0.88	0.66	0.34	0.22	
Reach-1	37.014	25 year	105.10	187.70	189.46		189.47	0.00106	0.39	430.81	506.00	0.11	1.27	0.89	0.39	0.24	
Reach-1	37.014	10 year	84.50	187.70	189.15		189.16	0.00269	0.51	277.59	476.35	0.17	2.38	1.54	0.51	0.30	
Reach-1	37.014	5 year	69.80	187.70	188.94		188.95	0.00687	0.68	180.46	447.69	0.26	4.67	2.72	0.68	0.39	
Reach-1	36.86	Regional	261.96	187.60	191.13		191.13	0.00016	0.36	1423.51	597.42	0.06	0.54	0.38	0.36	0.18	
Reach-1	36.86	100 year	49.30	187.60	188.62		188.65	0.001569	1.44	99.70	358.79	0.49	13.29	4.27	1.44	0.49	
Reach-1	36.86	50 year	122.60	187.60	189.72		189.72	0.00054	0.46	598.99	541.02	0.10	1.04	0.59	0.46	0.20	
Reach-1	36.86	25 year	105.10	187.60	189.46		189.46	0.00085	0.52	460.73	499.11	0.13	1.41	0.77	0.52	0.23	
Reach-1	36.86	10 year	84.50	187.60	189.13		189.14	0.00178	0.66	308.22	448.37	0.18	2.39	1.20	0.66	0.27	
Reach-1	36.86	5 year	69.80	187.60	188.90		188.91	0.00384	0.86	208.19	411.71	0.25	4.30	1.90	0.86	0.34	
Reach-1	36.635	Regional	261.96	187.00	191.11		191.12	0.00028	0.47	652.03	300.27	0.08	0.91	0.60	0.47	0.40	
Reach-1	36.635	100 year	49.30	187.00	188.55		188.56	0.00150	0.41	122.05	164.64	0.15	1.12	1.09	0.41	0.40	
Reach-1	36.635	50 year	122.60	187.00	189.70		189.71	0.00042	0.40	323.30	184.80	0.09	0.78	0.72	0.40	0.38	
Reach-1	36.635	25 year	105.10	187.00	189.43		189.44	0.00052	0.40	274.09	180.08	0.10	0.83	0.77	0.40	0.38	
Reach-1	36.635	10 year	84.50	187.00	189.10		189.11	0.00071	0.40	215.48	174.29	0.11	0.91	0.86	0.40	0.39	
Reach-1	36.635	5 year	69.80	187.00	188.86		188.87	0.00097	0.41	173.19	169.99	0.13	1.02	0.97	0.41	0.40	
Reach-1	36.3	Regional	261.96	186.20	191.10		191.12	0.00045	0.67	659.69	324.58	0.11	1.74	0.90	0.67	0.40	
Reach-1	36.3	100 year	49.30	186.20	188.53		188.54	0.00088	0.46	144.88	160.22	0.13	1.19	0.78	0.46	0.34	
Reach-1	36.3	50 year	122.60	186.20	189.69		189.70	0.00047	0.51	336.95	169.54	0.10	1.16	0.91	0.51	0.36	
Reach-1	36.3	25 year	105.10	186.20	189.42		189.43	0.00053	0.50	291.26	167.37	0.11	1.18	0.90	0.50	0.36	
Reach-1	36.3	10 year	84.50	186.20	189.09		189.10	0.00064	0.50	235.85	164.70	0.11	1.22	0.90	0.50	0.36	
Reach-1	36.3	5 year	69.80	186.20	188.84		188.85	0.00076	0.49	195.04	162.70	0.12	1.26	0.90	0.49	0.36	
Reach-1	36.26	Regional	261.96	186.10	191.05	189.41	191.10	0.00168	1.48	566.49	310.62	0.21	7.91	2.99	1.48	0.46	
Reach-1	36.26	100 year	49.30	186.10	188.37	187.26	188.49	0.000551	1.56	31.66	111.95	0.34	11.54	11.54	1.56	1.56	
Reach-1	36.26	50 year	122.60	186.10	189.17	188.14	189.58	0.001190	2.82	43.41	129.14	0.52	34.17	34.17	2.82	2.82	
Reach-1	36.26	25 year	105.10	186.10	188.98	187.95	189.32	0.001086	2.58	40.68	125.15	0.50	29.22	29.22	2.58	2.58	
Reach-1	36.26	10 year	84.50	186.10	188.75	187.72	189.01	0.000941	2.27	37.26	120.14	0.45	23.19	23.19	2.27	2.27	
Reach-1	36.26	5 year	69.80	186.10	188.57	187.53	188.78	0.000819	2.01	34.64	116.31	0.42	18.75	18.75	2.01	2.01	
Reach-1	36.2565			Bridge													
Reach-1	36.253	Regional	261.96	186.10	190.97	189.40	191.03	0.00183	1.52	542.38	299.70	0.22	8.48	3.24	1.52	0.48	
Reach-1	36.253	100 year	49.30	186.10	188.37	187.26	188.49	0.000555	1.56	31.59	111.85	0.34	11.60	11.60	1.56	1.56	
Reach-1	36.253	50 year	122.60	186.10	189.16	188.14	189.57	0.001206	2.84	43.24	128.90	0.53	34.48	34.48	2.84	2.84	
Reach-1	36.253	25 year	105.10	186.10	188.97	187.95	189.32	0.001099	2.59	40.53	124.93	0.50	29.47	29.47	2.59	2.59	
Reach-1	36.253	10 year	84.50	186.10	188.74	187.71	189.01	0.000952	2.28	37.13	119.96	0.46	23.37	23.37	2.28	2.28	
Reach-1	36.253	5 year	69.80	186.10	188.57	187.54	188.77	0.000827	2.02	34.54	116.16	0.42	18.89	18.89	2.02	2.02	
Reach-1	36.19	Regional	261.96	186.00	190.97		191.02	0.000171	1.29	533.17	299.52	0.21	6.47	2.96	1.29	0.49	
Reach-1	36.19	100 year	49.30	186.00	188.39		188.42	0.000357	0.91	101.92	112.40	0.25	4.66	3.15	0.91	0.48	
Reach-1	36.19	50 year	122.60	186.00	189.32		189.36	0.000275	1.14	215.54	132.36	0.24	6.05	4.36	1.14	0.57	
Reach-1	36.19	25 year	105.10	186.00	189.10		189.14	0.000300	1.11	187.17	127.67	0.25	5.96	4.28	1.11	0.56	
Reach-1	36.19	10 year	84.50	186.00	188.83		188.87	0.000338	1.07	153.35	121.84	0.26	5.84	4.14	1.07	0.55	
Reach-1	36.19	5 year	69.80	186.00	188.63		188.66	0.000374	1.04	128.88	117.44	0.26	5.73	4.00	1.04	0.54	
Reach-1	36.1	Regional	261.96	185.90	190.97	188.55	191.00	0.00147	1.06	522.82	289.44	0.19	4.65	2.58	1.06	0.50	
Reach-1	36.1	100 year	49.30	185.90	188.35	188.00	188.38	0.000848	0.90	84.12	116.49	0.34	5.67	5.93	0.90	0.59	
Reach-1	36.1	50 year	122.60	185.90	189.30	188.15	189.33	0.000321	0.98	204.61	136.93	0.24	5.06	4.64	0.98	0.60	
Reach-1	36.1	25 year	105.10	185.90	189.08	188.09	189.11	0.000382	0.97	174.77	132.16	0.26	5.21	4.88	0.97	0.60	
Reach-1	36.1	10 year	84.50	185.90	188.80	188.02	188.83	0.000503	0.97	138.90	126.19	0.29	5.53	5.35	0.97	0.61	
Reach-1	36.1	5 year	69.80	185.90	188.59	188.00	188.62	0.000665	0.97	112.62	121.63	0.32	5.96	5.96	0.97	0.62	
Reach-1	36.01	Regional	261.96	185.70	190.54		190.94	0.001043	3.05	141.86	90.00	0.50	37.13	15.81	3.05	1.85	
Reach-1	36.01	100 year	49.30	185.70	188.04		188.25	0.002023	2.05	24.04	19.71	0.58	24.16	23.31	2.05	2.05	
Reach-1	36.01	50 year	122.60	185.70	188.41	188.41	189.19	0.005210	3.91	32.82	27.20	0.98	80.66	59.66	3.91	3.74	
Reach-1	36.01	25 year	105.10	185.70	188.24	188.24	188.96	0.005509	3.75	28.58	23.88	0.99	76.65	62.49	3.75	3.68	
Reach-1	36.01	10 year	84.50	185.70	188.02	188.02	188.67	0.006141	3.55	23.80	19.46	1.01	72.63	70.94	3.55	3.55	
Reach-1	36.01	5 year	69.80	185.70	187.86	187.86	188.44	0.006144	3.37	20.70	17.88	1.00	67.18	67.18	3.37	3.37	
Reach-1	35.973	Regional	261.96	185.60	190.69	189.06	190.76	0.000230	1.60	403.69	267.84	0.24	9.66	3.38	1.60	0.65	
Reach-1	35.973	100 year	49.30	185.60	188.04	187.15	188.16	0.000753	1.56	31.67	75.18	0.38	12.47	12.47	1.56	1.56	
Reach-1	35.973	50 year	122.60	185.60	188.31	187.97	188.88	0.002878	3.35	36.59	83.49	0.76	55.06	55.06	3.35	3.35	
Reach-1	35.973	25 year	105.10	185.60	188.15	187.81	188.64	0.002776	3.12	33.73	78.65	0.73	48.95	48.95	3.12	3.12	
Reach-1	35.973	10 year	84.50	185.60	187.99	187.60	188.38	0.002413	2.74	30.86	29.92	0.67	38.93	38.93	2.74	2.74	
Reach-1	35.973	5 year	69.80	185.60	187.87	187.42	188.17	0.002137	2.45	28.54	28.43	0.63	31.88	31.88	2.45	2.45	
Reach-1	35.969			Bridge													
Reach-1	35.965	Regional	261.96	185.60	190.00	189.06	190.14	0.000520	2.15	247.62	174.03	0.36	18.42	7.20	2.15	1.06	
Reach-1	35.965	100 year	49.30	185.60	188.03	187.15	188.16	0.000764	1.56	31.54	74.95	0.38	12.59	12.59	1.56	1.56	
Reach-1	35.965	50 year	122.60	185.60	188.12	187.97	188.82	0.003989	3.70	33.18	77.72	0.88	69.19	69.19	3.70	3.70	
Reach-1	35.965	25 year	105.10	185.60	188.05	187.81	188.60	0.003344	3.30	31.89	75.55	0.80	55.77	55.77	3.30	3.30	
Reach-1	35.965	10 year	84.50	185.60	187.94	187.60	188.35	0.002691	2.83	29.86	29.28	0.71	42.02	42.02	2.83	2.83	
Reach-1	35.965	5 year	69.80	185.60	187.83	187.42	188.15	0.002320	2.51	27.84	27.98	0.65	33.77	33.77	2.51	2.51	
Reach-1	35.92	Regional	261.96	185.40	188.85	188.85	189.84	0.004306	4.44	64.78	41.64	0.93	92.91	63.50	4.44	4.04	
Reach-1	35.92	100 year	49.30	185.40	188.01		188.11	0.000721	1.34	36.69	25.27	0.35	9.89	9.79	1.34	1.34	
Reach-1	35.92	50 year	122.60	185.40	187.97	187.87	188.57	0.004900	3.45	35.49	24.70	0.92	65.84	65.84	3.45	3.45	
Reach-1	35.92	25 year	105.10	185.40	187.93		188.40	0.0									

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 (Continued)

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 (N/m2)	Shear Chan (N/m2)	Shear Total (N/m2)	Vel Chnl (m/s)	Vel Total (m/s)
Reach-1	35.05	10 year	84.50	184.70	187.11	186.66	187.28	0.001352	2.00	74.82	186.10	0.50	21.07	5.32	2.00	1.13	
Reach-1	35.05	5 year	69.80	184.70	187.01	186.48	187.16	0.001281	1.86	55.19	180.80	0.48	18.66	3.82	1.86	1.26	
Reach-1	34.45	Regional	458.70	184.30	188.38		188.68	0.001524	3.14	278.42	147.73	0.59	42.64	27.98	3.14	1.65	
Reach-1	34.45	100 year	103.50	184.30	186.74		186.89	0.001920	2.03	89.85	104.68	0.58	23.42	16.06	2.03	1.15	
Reach-1	34.45	50 year	122.60	184.30	187.19		187.28	0.000799	1.60	137.88	108.73	0.39	13.22	9.87	1.60	0.89	
Reach-1	34.45	25 year	105.10	184.30	186.78		186.92	0.001755	1.98	93.84	105.03	0.55	22.05	15.28	1.98	1.12	
Reach-1	34.45	10 year	84.50	184.30	186.63		186.76	0.001865	1.88	78.30	103.68	0.56	20.75	13.73	1.88	1.08	
Reach-1	34.45	5 year	69.80	184.30	186.54	186.31	186.66	0.001782	1.74	69.01	102.88	0.54	18.29	11.66	1.74	1.01	
Reach-1	33.95	Regional	455.50	183.90	188.05		188.19	0.000659	2.37	410.85	180.74	0.40	22.70	14.62	2.37	1.11	
Reach-1	33.95	100 year	99.90	183.90	186.34		186.41	0.000576	1.44	137.34	140.56	0.34	10.36	5.49	1.44	0.73	
Reach-1	33.95	50 year	122.60	183.90	187.07		187.10	0.000188	1.03	247.03	157.14	0.20	4.71	2.88	1.03	0.50	
Reach-1	33.95	25 year	105.10	183.90	186.43		186.49	0.000509	1.40	150.19	142.61	0.32	9.60	5.24	1.40	0.70	
Reach-1	33.95	10 year	84.50	183.90	186.07		186.17	0.000864	1.59	100.82	134.59	0.40	13.34	6.32	1.59	0.84	
Reach-1	33.95	5 year	69.80	183.90	185.85		185.96	0.001182	1.68	72.12	116.17	0.46	15.70	7.17	1.68	0.97	
Reach-1	33.295	Regional	455.50	183.50	188.03		188.07	0.000132	1.00	615.02	234.28	0.18	4.17	3.37	1.00	0.74	
Reach-1	33.295	100 year	99.90	183.50	186.30		186.31	0.000099	0.52	239.54	203.81	0.14	1.47	1.14	0.52	0.42	
Reach-1	33.295	50 year	122.60	183.50	187.06		187.07	0.000334	0.40	399.87	216.03	0.08	0.75	0.61	0.40	0.31	
Reach-1	33.295	25 year	105.10	183.50	186.40		186.41	0.000087	0.51	259.17	205.34	0.13	1.38	1.08	0.51	0.41	
Reach-1	33.295	10 year	84.50	183.50	186.01		186.02	0.000157	0.57	180.26	199.10	0.16	1.88	1.39	0.57	0.47	
Reach-1	33.295	5 year	69.80	183.50	185.71		185.73	0.000286	0.64	125.09	173.22	0.21	2.60	2.02	0.64	0.56	
Reach-1	33.263	Regional	455.50	183.45	187.94	186.81	188.04	0.000467	2.33	507.38	233.55	0.35	20.28	9.92	2.33	0.90	
Reach-1	33.263	100 year	99.90	183.45	185.45	185.21	186.11	0.003299	3.59	27.83	80.69	0.82	63.20	63.20	3.59	3.59	
Reach-1	33.263	50 year	122.60	183.45	187.04	185.46	187.06	0.000124	1.03	310.10	206.66	0.18	4.29	1.82	1.03	0.40	
Reach-1	33.263	25 year	105.10	183.45	185.52	185.27	186.20	0.003291	3.66	28.70	89.53	0.82	65.05	65.05	3.66	3.66	
Reach-1	33.263	10 year	84.50	183.45	185.26	185.03	185.84	0.003320	3.36	25.12	53.48	0.81	57.42	57.42	3.36	3.36	
Reach-1	33.263	5 year	69.80	183.45	185.07	184.84	185.57	0.003338	3.12	22.36	25.79	0.79	51.39	51.39	3.12	3.12	
Reach-1	33.2575		Bridge														
Reach-1	33.252	Regional	455.50	183.30	186.64	186.64	187.18	0.002678	4.57	259.47	199.18	0.80	86.27	34.10	4.57	1.76	
Reach-1	33.252	100 year	99.90	183.30	185.14	185.14	185.86	0.004129	3.79	31.22	57.83	0.90	72.64	34.83	3.79	3.20	
Reach-1	33.252	50 year	122.60	183.30	185.50	185.50	186.13	0.003016	3.66	48.87	108.97	0.80	63.63	23.05	3.66	2.51	
Reach-1	33.252	25 year	105.10	183.30	185.25	185.25	185.93	0.003703	3.73	35.33	72.56	0.86	68.88	29.23	3.73	2.97	
Reach-1	33.252	10 year	84.50	183.30	184.93	184.87	185.60	0.004520	3.66	25.28	27.88	0.93	70.23	53.76	3.66	3.34	
Reach-1	33.252	5 year	69.80	183.30	184.82	184.69	185.34	0.003963	3.25	23.10	20.62	0.86	56.98	49.63	3.25	3.02	
Reach-1	33.22	Regional	455.50	183.20	186.49	186.49	187.05	0.002884	4.28	239.91	194.83	0.81	79.54	34.73	4.28	1.90	
Reach-1	33.22	100 year	99.90	183.20	185.04	185.04	185.59	0.004409	3.30	34.33	55.35	0.89	60.00	26.60	3.30	2.91	
Reach-1	33.22	50 year	122.60	183.20	185.30	185.30	185.80	0.003349	3.23	53.48	89.65	0.79	54.07	19.49	3.23	2.29	
Reach-1	33.22	25 year	105.10	183.20	185.11	185.11	185.64	0.004027	3.27	38.74	64.88	0.85	57.64	23.42	3.27	2.71	
Reach-1	33.22	10 year	84.50	183.20	184.81	184.81	185.40	0.005940	3.40	24.94	24.99	1.00	67.50	57.15	3.40	3.39	
Reach-1	33.22	5 year	69.80	183.20	184.65	184.65	185.18	0.006162	3.25	21.51	20.07	1.00	63.49	63.49	3.25	3.25	
Reach-1	33.03	Regional	455.50	182.80	185.89		186.21	0.001247	2.51	181.21	106.37	0.61	20.77	20.77	2.51	2.51	
Reach-1	33.03	100 year	99.90	182.80	184.84		184.91	0.000391	1.13	88.12	71.47	0.33	4.71	4.71	1.13	1.13	
Reach-1	33.03	50 year	122.60	182.80	184.94		185.02	0.000485	1.29	95.03	74.63	0.36	6.03	6.03	1.29	1.29	
Reach-1	33.03	25 year	105.10	182.80	184.87		184.94	0.000412	1.17	89.83	72.26	0.33	5.00	5.00	1.17	1.17	
Reach-1	33.03	10 year	84.50	182.80	184.77		184.83	0.000324	1.02	83.25	69.16	0.30	3.80	3.80	1.02	1.02	
Reach-1	33.03	5 year	69.80	182.80	184.54		184.60	0.000369	1.03	68.01	61.38	0.31	4.00	4.00	1.03	1.03	
Reach-1	32.802	Regional	455.50	182.40	185.90	184.89	186.01	0.000353	1.45	313.18	254.01	0.33	6.67	6.67	1.45	1.45	
Reach-1	32.802	100 year	99.90	182.40	184.79	184.12	184.82	0.000293	0.75	133.30	196.45	0.26	2.35	2.35	0.75	0.75	
Reach-1	32.802	50 year	122.60	182.40	184.89	184.21	184.92	0.000308	0.83	148.47	201.30	0.28	2.76	2.76	0.83	0.83	
Reach-1	32.802	25 year	105.10	182.40	184.82	184.15	184.85	0.000295	0.77	137.13	197.68	0.27	2.44	2.44	0.77	0.77	
Reach-1	32.802	10 year	84.50	182.40	184.73	184.06	184.75	0.000271	0.69	122.65	188.99	0.25	2.04	2.04	0.69	0.69	
Reach-1	32.802	5 year	69.80	182.40	184.45	183.99	184.49	0.000518	0.84	83.12	131.65	0.34	3.22	3.22	0.84	0.84	
Reach-1	32.632	Regional	455.50	182.00	185.86	184.81	185.95	0.000337	1.53	425.57	229.22	0.33	7.08	6.11	1.53	1.07	
Reach-1	32.632	100 year	99.90	182.00	184.76	184.11	184.78	0.000224	0.77	179.67	214.82	0.24	2.29	1.83	0.77	0.56	
Reach-1	32.632	50 year	122.60	182.00	184.85	184.24	184.88	0.000247	0.85	199.30	216.01	0.26	2.74	2.23	0.85	0.62	
Reach-1	32.632	25 year	105.10	182.00	184.78	184.14	184.80	0.000228	0.79	184.68	215.12	0.24	2.38	1.91	0.79	0.57	
Reach-1	32.632	10 year	84.50	182.00	184.69	183.99	184.71	0.000202	0.70	166.21	214.00	0.23	1.94	1.53	0.70	0.51	
Reach-1	32.632	5 year	69.80	182.00	184.26	183.89	184.35	0.001388	1.30	53.53	193.31	0.54	7.97	7.97	1.30	1.30	
Reach-1	32.524	Regional	455.50	182.00	185.64	185.16	185.87	0.000812	3.21	350.85	212.26	0.54	26.93	13.10	3.21	1.30	
Reach-1	32.524	100 year	99.90	182.00	184.67	183.70	184.74	0.000285	1.54	157.06	185.98	0.30	6.87	2.35	1.54	0.64	
Reach-1	32.524	50 year	122.60	182.00	184.73	184.31	184.83	0.000361	1.76	169.89	187.84	0.34	8.93	3.18	1.76	0.72	
Reach-1	32.524	25 year	105.10	182.00	184.68	183.75	184.77	0.000301	1.59	160.55	186.49	0.31	7.30	2.52	1.59	0.65	
Reach-1	32.524	10 year	84.50	182.00	184.62	183.52	184.68	0.000230	1.36	148.53	184.74	0.27	5.44	1.80	1.36	0.57	
Reach-1	32.524	5 year	69.80	182.00	183.68	183.35	184.08	0.001802	2.81	24.81	37.14	0.71	26.96	26.96	2.81	2.81	
Reach-1	32.5195		Bridge														
Reach-1	32.515	Regional	455.50	182.00	185.60	185.16	185.84	0.000872	3.30	341.74	211.10	0.56	28.55	13.76	3.30	1.33	
Reach-1	32.515	100 year	99.90	182.00	183.70	183.70	184.51	0.003587	3.99	25.02	37.48	1.00	54.14	54.14	3.99	3.99	
Reach-1	32.515	50 year	122.60	182.00	184.31	184.31	184.63	0.001165	2.82	92.32	176.33	0.60	24.22	5.95	2.82	1.33	
Reach-1	32.515	25 year	105.10	182.00	183.75	183.75	184.59	0.003535	4.06	25.91	38.90	1.00	55.24	55.24	4.06	4.06	
Reach-1	32.515	10 year	84.50	182.00	183.52	183.52	184.25	0.003718	3.77	22.39	33.26	1.00	50.21	50.21	3.77	3.77	
Reach-1	32.515	5 year	69.80	182.00	183.35	183.35	183.99	0.003884	3.54	19.71	28.96	1.00	46.16	46.16	3.54	3.54	
Reach-1	32.457	Regional	455.50	181.70	185.66		185.74	0.000199	1.28	395.51	203.19	0.26	4				

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 (Continued)

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	Shear Chan (N/m2)	Shear Total (N/m2)	Vel Chnl (m/s)	Vel Total (m/s)
Reach-1	31.836	100 year	99.90	181.30	183.66		183.73	0.000308	1.40	160.21	158.44	0.31	6.10	3.05	1.40	0.62
Reach-1	31.836	50 year	122.60	181.30	183.94		184.01	0.000260	1.41	208.62	181.51	0.30	5.88	2.93	1.41	0.59
Reach-1	31.836	25 year	105.10	181.30	183.72		183.79	0.000297	1.41	170.64	163.69	0.31	6.07	3.03	1.41	0.62
Reach-1	31.836	10 year	84.50	181.30	183.58		183.64	0.000259	1.25	148.54	152.35	0.29	4.95	2.48	1.25	0.57
Reach-1	31.836	5 year	69.80	181.30	183.38		183.44	0.000282	1.22	119.43	136.01	0.29	4.83	2.43	1.22	0.58
Reach-1	31.76	Regional	455.50	181.10	185.48		183.95	0.000254	2.13	641.76	281.90	0.33	10.92	5.64	2.13	0.71
Reach-1	31.76	100 year	99.90	181.10	183.65		182.45	0.000179	1.25	211.46	184.87	0.25	4.48	1.99	1.25	0.47
Reach-1	31.76	50 year	122.60	181.10	183.94		182.64	0.000162	1.28	266.81	203.13	0.24	4.52	2.08	1.28	0.46
Reach-1	31.76	25 year	105.10	181.10	183.72		182.50	0.000176	1.26	223.59	189.02	0.25	4.51	2.02	1.26	0.47
Reach-1	31.76	10 year	84.50	181.10	183.43		182.31	0.000415	1.79	47.24	170.31	0.37	9.47	9.47	1.79	1.79
Reach-1	31.76	5 year	69.80	181.10	183.27		182.17	0.000357	1.58	44.06	160.29	0.34	7.60	7.60	1.58	1.58
Reach-1	31.756	Regional	455.50	181.10	185.48		183.96	0.000254	2.14	641.41	281.84	0.33	10.93	5.65	2.14	0.71
Reach-1	31.756	100 year	99.90	181.10	183.65		182.52	0.000179	1.25	211.30	184.82	0.25	4.49	2.00	1.25	0.47
Reach-1	31.756	50 year	122.60	181.10	183.94		182.71	0.000163	1.28	266.65	203.08	0.24	4.53	2.08	1.28	0.46
Reach-1	31.756	25 year	105.10	181.10	183.72		182.57	0.000176	1.26	223.43	188.97	0.25	4.52	2.03	1.26	0.47
Reach-1	31.756	10 year	84.50	181.10	183.48		182.37	0.000179	1.19	180.60	173.86	0.25	4.17	1.81	1.19	0.47
Reach-1	31.756	5 year	69.80	181.10	183.31		182.20	0.000175	1.12	151.59	162.83	0.24	3.78	1.58	1.12	0.46
Reach-1	31.7505				Bridge											
Reach-1	31.745	Regional	455.50	181.10	184.92		185.11	0.000504	2.74	490.89	253.44	0.45	18.87	9.52	2.74	0.93
Reach-1	31.745	100 year	99.90	181.10	183.50		183.57	0.000242	1.39	183.32	174.86	0.29	5.69	2.47	1.39	0.54
Reach-1	31.745	50 year	122.60	181.10	183.72		183.79	0.000237	1.46	224.34	189.28	0.29	6.10	2.74	1.46	0.55
Reach-1	31.745	25 year	105.10	181.10	183.55		183.62	0.000242	1.41	192.54	178.20	0.29	5.81	2.54	1.41	0.55
Reach-1	31.745	10 year	84.50	181.10	183.37		183.43	0.000227	1.30	160.91	166.46	0.28	5.04	2.14	1.30	0.53
Reach-1	31.745	5 year	69.80	181.10	183.23		183.28	0.000209	1.20	138.52	157.61	0.26	4.36	1.79	1.20	0.50
Reach-1	31.74	Regional	455.50	181.10	184.96		185.06	0.000667	2.12	501.55	255.55	0.34	25.25	12.77	2.12	0.91
Reach-1	31.74	100 year	99.90	181.10	183.23		182.45	0.001751	2.31	43.25	157.75	0.51	36.59	36.59	2.31	2.31
Reach-1	31.74	50 year	122.60	181.10	183.32		182.64	0.002284	2.71	45.16	163.76	0.58	49.83	49.83	2.71	2.71
Reach-1	31.74	25 year	105.10	181.10	183.26		182.50	0.001866	2.40	43.75	159.31	0.52	39.44	39.44	2.40	2.40
Reach-1	31.74	10 year	84.50	181.10	183.18		182.31	0.001360	2.00	42.20	154.43	0.44	27.73	27.73	2.00	2.00
Reach-1	31.74	5 year	69.80	181.10	183.10		182.17	0.001053	1.72	40.63	149.49	0.39	20.67	20.67	1.72	1.72
Reach-1	31.69	Regional	455.50	181.00	184.81		184.97	0.001098	2.36	369.18	198.87	0.42	33.62	19.93	2.36	1.23
Reach-1	31.69	100 year	99.90	181.00	183.24		183.33	0.001178	1.54	104.99	121.72	0.39	18.13	9.93	1.54	0.95
Reach-1	31.69	50 year	122.60	181.00	183.36		183.47	0.001294	1.70	120.27	130.22	0.42	21.44	11.69	1.70	1.02
Reach-1	31.69	25 year	105.10	181.00	183.27		183.37	0.001204	1.58	108.67	123.82	0.40	18.87	10.33	1.58	0.97
Reach-1	31.69	10 year	84.50	181.00	183.18		183.25	0.000997	1.38	97.62	117.41	0.36	14.75	8.11	1.38	0.87
Reach-1	31.69	5 year	69.80	181.00	183.09		183.15	0.000868	1.24	87.85	111.43	0.33	12.12	6.69	1.24	0.79
Reach-1	31.22	Regional	455.50	180.40	184.73		184.78	0.000301	1.34	551.17	238.49	0.23	10.38	6.78	1.34	0.83
Reach-1	31.22	100 year	99.90	180.40	182.82		182.91	0.001121	1.56	111.95	191.16	0.38	18.15	6.41	1.56	0.89
Reach-1	31.22	50 year	122.60	180.40	182.99		183.07	0.000986	1.55	145.82	223.89	0.36	17.50	6.27	1.55	0.84
Reach-1	31.22	25 year	105.10	180.40	182.82		182.92	0.001259	1.65	111.13	190.30	0.41	20.33	7.18	1.65	0.95
Reach-1	31.22	10 year	84.50	180.40	182.59		182.73	0.001801	1.79	73.14	144.85	0.47	25.18	8.88	1.79	1.16
Reach-1	31.22	5 year	69.80	180.40	182.42		182.58	0.002346	1.88	50.61	109.31	0.53	28.81	10.59	1.88	1.38
Reach-1	31.08	Regional	455.50	179.90	184.64		184.73	0.000496	1.80	483.23	306.48	0.29	18.38	7.64	1.80	0.94
Reach-1	31.08	100 year	99.90	179.90	182.68		182.79	0.000910	1.53	87.46	115.60	0.35	16.77	6.69	1.53	1.14
Reach-1	31.08	50 year	122.60	179.90	182.83		181.92	0.000980	1.67	105.25	133.52	0.37	19.38	7.51	1.67	1.16
Reach-1	31.08	25 year	105.10	179.90	182.65		182.78	0.001091	1.66	83.61	111.35	0.38	19.76	7.96	1.66	1.26
Reach-1	31.08	10 year	84.50	179.90	182.42		182.54	0.001227	1.61	61.25	82.37	0.40	19.53	8.83	1.61	1.38
Reach-1	31.08	5 year	69.80	179.90	182.23		182.35	0.001313	1.54	48.14	59.11	0.40	18.60	10.31	1.54	1.45
Reach-1	30.81	Regional	478.63	179.50	183.61		183.61	0.003742	4.30	165.64	124.83	0.78	112.26	48.34	4.30	2.89
Reach-1	30.81	100 year	109.90	179.50	181.76		182.23	0.005576	3.06	35.95	25.84	0.83	74.42	74.42	3.06	3.06
Reach-1	30.81	50 year	122.60	179.50	181.83		181.67	0.006095	3.25	37.73	26.45	0.87	83.40	83.40	3.25	3.25
Reach-1	30.81	25 year	105.10	179.50	181.73		182.18	0.005401	2.99	35.19	25.58	0.81	71.30	71.30	2.99	2.99
Reach-1	30.81	10 year	84.50	179.50	181.59		181.95	0.004634	2.67	31.67	24.31	0.75	57.93	57.93	2.67	2.67
Reach-1	30.81	5 year	69.80	179.50	181.46		181.76	0.004121	2.43	28.71	23.20	0.70	48.95	48.95	2.43	2.43
Reach-1	30.61	Regional	478.63	179.30	183.37		183.51	0.000773	2.25	328.20	128.42	0.37	28.59	19.08	2.25	1.46
Reach-1	30.61	100 year	109.90	179.30	181.77		181.83	0.000610	1.39	127.46	112.96	0.30	13.07	6.70	1.39	0.86
Reach-1	30.61	50 year	122.60	179.30	181.87		181.94	0.000613	1.43	139.23	118.26	0.30	13.74	7.02	1.43	0.88
Reach-1	30.61	25 year	105.10	179.30	181.73		181.79	0.000611	1.37	122.74	110.77	0.30	12.85	6.59	1.37	0.86
Reach-1	30.61	10 year	84.50	179.30	181.54		181.59	0.000608	1.28	102.60	100.87	0.29	11.65	6.02	1.28	0.82
Reach-1	30.61	5 year	69.80	179.30	181.38		181.43	0.000607	1.21	87.54	92.78	0.29	10.70	5.57	1.21	0.80
Reach-1	30.4	Regional	478.63	179.10	182.99		183.31	0.001974	3.32	255.82	158.28	0.57	64.93	31.06	3.32	1.87
Reach-1	30.4	100 year	109.90	179.10	181.41		181.63	0.002184	2.30	64.74	59.91	0.54	38.52	22.86	2.30	1.70
Reach-1	30.4	50 year	122.60	179.10	181.50		181.73	0.002243	2.41	69.99	62.34	0.56	41.42	24.40	2.41	1.75
Reach-1	30.4	25 year	105.10	179.10	181.37		181.58	0.002186	2.27	62.41	58.80	0.54	37.73	22.47	2.27	1.68
Reach-1	30.4	10 year	84.50	179.10	181.20		181.39	0.002113	2.09	53.00	54.08	0.52	33.08	20.06	2.09	1.59
Reach-1	30.4	5 year	69.80	179.10	181.06		181.23	0.002078	1.95	45.72	50.12	0.51	29.72	18.35	1.95	1.53
Reach-1	30.14	Regional	478.63	178.70	182.75		182.93	0.001081	2.53	419.07	236.35	0.43	37.24	18.64	2.53	1.14
Reach-1	30.14	100 year	109.90	178.70	180.80		181.04	0.002501	2.27	69.78	93.32	0.57	38.87	18.19	2.27	1.57
Reach-1	30.14	50 year	122.60	178.70	180.89		181.14	0.002467	2.34	78.68	100.90	0.57	40.54	18.71	2.34	1.56
Reach-1	30.14	25 year	105.10	178.70	180.79		181.01	0.002355	2.19	68.73	92.39	0.55	36.34	17.04	2.19	1.53
Reach-1	30.14	10 year	84.50	178.70	180.64		180.83	0.002301	2.02	55.48	79.64	0.54	32.06	15.59	2.02	1.52
Reach-1	30.14	5 year	69.80	178.70	180.53		180.69	0.002120	1.84	47.51	70.88	0.51	27.36	13.82	1.84	1.47
Reach-1	29.91	Regional	475.20	178.30	182											

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 (Continued)

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	Shear Chan (N/m2)	Shear Total (N/m2)	Vel Chnl (m/s)	Vel Total (m/s)
Reach-1	28.97	Regional	475.20	177.70	182.35		182.42	0.000292	1.24	419.41	166.70	0.22	9.18	7.17	1.24	1.13
Reach-1	28.97	100 year	107.30	177.70	180.19		180.24	0.000761	0.95	112.97	111.43	0.30	7.88	7.53	0.95	0.95
Reach-1	28.97	50 year	122.60	177.70	180.28		180.33	0.000767	1.01	122.55	113.86	0.30	8.57	8.05	1.01	1.00
Reach-1	28.97	25 year	105.10	177.70	180.16		180.20	0.000817	0.97	109.12	110.44	0.30	8.17	7.87	0.97	0.96
Reach-1	28.97	10 year	84.50	177.70	179.92		179.97	0.000640	0.98	86.46	68.75	0.28	7.83	7.83	0.98	0.98
Reach-1	28.97	5 year	69.80	177.70	179.76		179.80	0.000616	0.92	75.90	64.44	0.27	7.09	7.09	0.92	0.92
Reach-1	28.75	Regional	475.20	177.40	182.21		182.33	0.000675	1.77	334.33	124.24	0.29	24.46	17.69	1.77	1.42
Reach-1	28.75	100 year	107.30	177.40	179.77		179.94	0.002735	1.82	62.59	74.82	0.50	35.92	22.34	1.82	1.71
Reach-1	28.75	50 year	122.60	177.40	179.79		180.00	0.003382	2.04	64.27	77.56	0.56	44.96	27.37	2.04	1.91
Reach-1	28.75	25 year	105.10	177.40	179.68		179.87	0.003277	1.92	56.38	63.70	0.54	40.88	28.30	1.92	1.86
Reach-1	28.75	10 year	84.50	177.40	179.53		179.69	0.003109	1.76	48.17	44.96	0.52	35.29	32.44	1.76	1.75
Reach-1	28.75	5 year	69.80	177.40	179.40		179.54	0.002903	1.63	42.90	39.19	0.50	30.93	30.93	1.63	1.63
Reach-1	28.59	Regional	475.20	177.30	182.13		182.23	0.000525	1.82	394.80	144.72	0.27	23.83	13.94	1.82	1.20
Reach-1	28.59	100 year	107.30	177.30	179.61		179.68	0.000890	1.42	107.41	82.91	0.31	18.73	11.23	1.42	1.00
Reach-1	28.59	50 year	122.60	177.30	179.55		179.65	0.001330	1.70	102.51	82.43	0.37	27.24	16.12	1.70	1.20
Reach-1	28.59	25 year	105.10	177.30	179.45		179.54	0.001261	1.60	93.87	81.59	0.36	24.53	14.14	1.60	1.12
Reach-1	28.59	10 year	84.50	177.30	179.29		179.37	0.001222	1.50	81.40	80.36	0.35	21.95	12.07	1.50	1.04
Reach-1	28.59	5 year	69.80	177.30	179.16		179.23	0.001246	1.43	70.40	79.26	0.35	20.72	10.80	1.43	0.99
Reach-1	28.51	Regional	475.20	177.20	182.13		182.19	0.000286	1.23	463.94	155.34	0.19	11.41	8.32	1.23	1.02
Reach-1	28.51	100 year	107.30	177.20	179.55		179.61	0.001003	1.19	107.48	103.94	0.31	14.84	10.14	1.19	1.00
Reach-1	28.51	50 year	122.60	177.20	179.44		179.54	0.001743	1.49	96.78	98.77	0.40	23.98	16.68	1.49	1.27
Reach-1	28.51	25 year	105.10	177.20	179.34		179.43	0.001721	1.41	86.88	93.72	0.39	21.96	15.59	1.41	1.21
Reach-1	28.51	10 year	84.50	177.20	179.18		179.26	0.001815	1.33	72.80	86.05	0.40	20.39	15.00	1.33	1.16
Reach-1	28.51	5 year	69.80	177.20	179.04		179.11	0.002069	1.30	60.65	78.83	0.41	20.28	15.55	1.30	1.15
Reach-1	28.47	Regional	587.90	177.00	182.09		182.17	0.000400	1.62	487.60	159.78	0.24	18.72	11.89	1.62	1.21
Reach-1	28.47	100 year	136.30	177.00	179.33		179.52	0.002625	2.35	86.97	105.59	0.52	52.41	21.14	2.35	1.57
Reach-1	28.47	50 year	122.60	177.00	179.21		179.43	0.002961	2.41	75.32	99.45	0.55	55.87	21.93	2.41	1.63
Reach-1	28.47	25 year	105.10	177.00	179.08		179.31	0.003315	2.43	62.32	92.12	0.58	58.19	21.92	2.43	1.69
Reach-1	28.47	10 year	84.50	177.00	178.90		179.14	0.003632	2.37	47.40	69.86	0.59	57.48	24.07	2.37	1.78
Reach-1	28.47	5 year	69.80	177.00	178.80		178.99	0.003167	2.12	41.18	52.22	0.55	46.98	24.37	2.12	1.69
Reach-1	28.356	Regional	587.90	176.70	182.12		182.14	0.000092	0.76	991.12	286.67	0.11	4.16	3.08	0.76	0.59
Reach-1	28.356	100 year	136.30	176.70	179.37		179.39	0.000356	0.83	240.81	250.74	0.19	6.64	3.34	0.83	0.57
Reach-1	28.356	50 year	122.60	176.70	179.26		179.28	0.000405	0.85	212.79	248.10	0.20	7.12	3.40	0.85	0.58
Reach-1	28.356	25 year	105.10	176.70	179.12		179.15	0.000473	0.87	178.58	244.84	0.21	7.68	3.38	0.87	0.59
Reach-1	28.356	10 year	84.50	176.70	178.92		178.95	0.000624	0.92	131.05	203.12	0.24	9.01	3.94	0.92	0.64
Reach-1	28.356	5 year	69.80	176.70	178.79		178.82	0.000631	0.89	108.88	145.78	0.24	8.48	4.60	0.89	0.64
Reach-1	28.26	Regional	587.90	176.60	182.08		182.12	0.000263	1.27	894.94	248.18	0.19	11.76	9.24	1.27	0.66
Reach-1	28.26	100 year	136.30	176.60	179.31		179.35	0.000565	1.01	248.76	215.71	0.24	10.11	6.38	1.01	0.55
Reach-1	28.26	50 year	122.60	176.60	179.20		179.23	0.000605	1.00	223.93	213.98	0.24	10.13	6.19	1.00	0.55
Reach-1	28.26	25 year	105.10	176.60	179.06		179.09	0.000646	0.98	193.66	211.85	0.25	9.93	5.78	0.98	0.54
Reach-1	28.26	10 year	84.50	176.60	178.84		178.88	0.000788	0.98	149.33	198.65	0.27	10.48	5.80	0.98	0.57
Reach-1	28.26	5 year	69.80	176.60	178.71		178.75	0.000839	0.95	123.74	188.33	0.27	10.07	5.40	0.95	0.56
Reach-1	28.19	Regional	587.90	176.50	182.07		182.10	0.000166	0.83	737.74	186.81	0.13	6.77	6.35	0.83	0.80
Reach-1	28.19	100 year	136.30	176.50	179.30		179.31	0.000358	0.59	236.82	174.94	0.16	4.85	4.73	0.59	0.58
Reach-1	28.19	50 year	122.60	176.50	179.18		179.19	0.000390	0.58	216.26	174.77	0.16	4.84	4.71	0.58	0.57
Reach-1	28.19	25 year	105.10	176.50	179.03		179.05	0.000430	0.56	190.98	174.55	0.17	4.73	4.61	0.56	0.55
Reach-1	28.19	10 year	84.50	176.50	178.81		178.83	0.000566	0.56	152.52	169.85	0.19	5.09	4.97	0.56	0.55
Reach-1	28.19	5 year	69.80	176.50	178.67		178.69	0.000650	0.55	129.41	166.49	0.20	5.04	4.94	0.55	0.54
Reach-1	28.185	Regional	587.90	177.10	182.06		182.10	0.000190	0.88	713.52	205.39	0.14	7.55	6.39	0.88	0.82
Reach-1	28.185	100 year	136.30	177.10	179.29		179.31	0.000469	0.64	217.73	172.87	0.18	5.93	5.76	0.64	0.63
Reach-1	28.185	50 year	122.60	177.10	179.17		179.19	0.000523	0.64	197.34	172.51	0.19	6.01	5.84	0.64	0.62
Reach-1	28.185	25 year	105.10	177.10	179.03		179.05	0.000598	0.62	172.30	172.08	0.20	6.03	5.86	0.62	0.61
Reach-1	28.185	10 year	84.50	177.10	178.80		178.82	0.000857	0.64	134.05	167.22	0.23	6.89	6.72	0.64	0.63
Reach-1	28.185	5 year	69.80	177.10	178.66		178.68	0.001065	0.64	111.05	163.88	0.24	7.21	7.06	0.64	0.63
Reach-1	28.18	Regional	587.90	175.90	182.07		182.10	0.000145	0.80	779.41	203.87	0.12	6.12	5.36	0.80	0.75
Reach-1	28.18	100 year	136.30	175.90	179.29		179.30	0.000245	0.52	262.77	173.02	0.13	3.72	3.62	0.52	0.52
Reach-1	28.18	50 year	122.60	175.90	179.17		179.19	0.000258	0.51	242.38	172.61	0.14	3.62	3.53	0.51	0.51
Reach-1	28.18	25 year	105.10	175.90	179.03		179.04	0.000270	0.49	217.35	172.10	0.14	3.41	3.33	0.49	0.48
Reach-1	28.18	10 year	84.50	175.90	178.80		178.81	0.000331	0.47	178.84	170.23	0.15	3.45	3.40	0.47	0.47
Reach-1	28.18	5 year	69.80	175.90	178.66		178.67	0.000360	0.45	155.30	168.98	0.15	3.26	3.23	0.45	0.45
Reach-1	28.15	Regional	587.90	175.84	181.08	179.66	181.87	0.003294	3.93	149.65	171.13	0.58	146.34	146.34	3.93	3.93
Reach-1	28.15	100 year	136.30	175.84	179.14	177.56	179.27	0.001053	1.55	87.65	154.89	0.30	27.41	27.41	1.55	1.55
Reach-1	28.15	50 year	122.60	175.84	179.05	177.46	179.15	0.000962	1.45	84.51	154.05	0.28	24.14	24.14	1.45	1.45
Reach-1	28.15	25 year	105.10	175.84	178.93	177.33	179.01	0.000826	1.30	80.68	140.15	0.26	19.77	19.77	1.30	1.30
Reach-1	28.15	10 year	84.50	175.84	178.73	177.16	178.79	0.000702	1.14	74.31	115.85	0.24	15.49	15.49	1.14	1.14
Reach-1	28.15	5 year	69.80	175.84	178.61	177.03	178.66	0.000571	0.99	70.49	101.29	0.21	11.95	11.95	0.99	0.99
Reach-1	28.142		Bridge													
Reach-1	28.14	Regional	587.90	175.66	180.65	179.54	181.56	0.004144	4.21	139.72	168.39	0.64	171.81	171.81	4.21	4.21
Reach-1	28.14	100 year	136.30	175.66	179.10	177.43	179.21	0.000967	1.52	89.94	155.17	0.29	25.81	25.81	1.52	1.52
Reach-1	28.14	50 year	122.60	175.66	179.00	177.34	179.11	0.000875	1.41	86.97	154.38	0.27	22.58	22.58	1.41	1.41
Reach-1	28.14	25 year	105.10	175.66	178.89	177.20	178.97	0.000740	1.26	83.37	145.76	0.25	18.32	18.32	1.26	1.26
Reach-1	28.14	10 year	84.50	175.66	178.70	177.03	178.76	0.000618	1.09	77.21	122.28	0.22	14.16	14		

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 (Continued)

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	Shear Chan (N/m2)	Shear Total (N/m2)	Vel Chnl (m/s)	Vel Total (m/s)
Reach-1	27.87	Regional	595.80	175.70	180.81		180.92	0.000905	1.86	447.56	148.25	0.30	34.42	26.41	1.86	1.33
Reach-1	27.87	100 year	136.60	175.70	178.97		179.01	0.000756	1.13	181.17	140.26	0.24	15.58	9.49	1.13	0.75
Reach-1	27.87	50 year	122.60	175.70	178.87		178.91	0.000758	1.09	167.47	137.80	0.24	14.91	8.95	1.09	0.73
Reach-1	27.87	25 year	105.10	175.70	178.76		178.79	0.000727	1.03	152.08	134.98	0.24	13.53	7.96	1.03	0.69
Reach-1	27.87	10 year	84.50	175.70	178.54		178.58	0.000830	1.02	123.41	129.55	0.25	13.75	7.68	1.02	0.68
Reach-1	27.87	5 year	69.80	175.70	178.43		178.47	0.000777	0.95	109.63	126.87	0.24	12.07	6.52	0.95	0.64
Reach-1	27.6	Regional	595.80	175.65	180.69		180.77	0.000685	1.71	525.49	179.32	0.26	28.45	19.44	1.71	1.13
Reach-1	27.6	100 year	136.60	175.65	178.84		178.88	0.000686	1.20	200.77	172.21	0.24	16.61	7.79	1.20	0.68
Reach-1	27.6	50 year	122.60	175.65	178.74		178.78	0.000722	1.19	182.85	171.69	0.24	16.78	7.49	1.19	0.67
Reach-1	27.6	25 year	105.10	175.65	178.62		178.66	0.000727	1.16	163.35	171.12	0.24	16.11	6.76	1.16	0.64
Reach-1	27.6	10 year	84.50	175.65	178.33		178.40	0.001189	1.36	114.03	169.67	0.30	23.14	7.79	1.36	0.74
Reach-1	27.6	5 year	69.80	175.65	178.22		178.29	0.001234	1.34	94.91	169.11	0.30	22.71	6.75	1.34	0.74
Reach-1	27.42	Regional	595.80	175.60	180.34		180.61	0.001941	2.41	272.99	93.22	0.43	61.55	54.48	2.41	2.18
Reach-1	27.42	100 year	136.60	175.60	178.68		178.75	0.001220	1.19	123.83	87.07	0.30	19.03	16.82	1.19	1.10
Reach-1	27.42	50 year	122.60	175.60	178.58		178.64	0.001249	1.15	114.66	86.59	0.30	18.20	16.04	1.15	1.07
Reach-1	27.42	25 year	105.10	175.60	178.47		178.53	0.001185	1.07	105.62	86.12	0.29	16.06	14.10	1.07	1.00
Reach-1	27.42	10 year	84.50	175.60	178.03		178.12	0.002895	1.30	68.42	84.15	0.42	26.96	22.89	1.30	1.24
Reach-1	27.42	5 year	69.80	175.60	177.89		177.97	0.003442	1.27	56.74	80.13	0.45	27.33	23.70	1.27	1.23
Reach-1	27.15	Regional	617.20	175.40	180.20		180.31	0.001093	2.11	490.35	157.21	0.33	43.75	33.12	2.11	1.26
Reach-1	27.15	100 year	141.70	175.40	178.58		178.61	0.000470	1.00	247.92	143.67	0.20	11.52	7.91	1.00	0.57
Reach-1	27.15	50 year	122.60	175.40	178.48		178.51	0.000421	0.92	233.66	142.87	0.19	9.92	6.72	0.92	0.52
Reach-1	27.15	25 year	105.10	175.40	178.39		178.41	0.000372	0.84	219.85	142.09	0.18	8.42	5.62	0.84	0.48
Reach-1	27.15	10 year	84.50	175.40	177.79		177.83	0.000969	1.12	136.53	134.55	0.27	16.34	9.60	1.12	0.62
Reach-1	27.15	5 year	69.80	175.40	177.55		177.59	0.001376	1.21	104.68	129.48	0.31	20.00	10.86	1.21	0.67
Reach-1	26.9	Regional	617.20	175.00	179.98		180.15	0.001023	1.98	383.27	119.01	0.32	39.23	31.97	1.98	1.61
Reach-1	26.9	100 year	141.70	175.00	178.53		178.56	0.000298	0.79	215.83	110.70	0.16	7.19	5.66	0.79	0.66
Reach-1	26.9	50 year	122.60	175.00	178.44		178.46	0.000257	0.71	205.71	110.05	0.15	5.97	4.68	0.71	0.60
Reach-1	26.9	25 year	105.10	175.00	178.35		178.37	0.000218	0.64	195.85	109.43	0.13	4.87	3.80	0.64	0.54
Reach-1	26.9	10 year	84.50	175.00	177.70		177.73	0.000481	0.76	127.09	100.36	0.19	7.72	5.95	0.76	0.66
Reach-1	26.9	5 year	69.80	175.00	177.43		177.46	0.000629	0.77	100.80	94.42	0.21	8.43	6.56	0.77	0.69
Reach-1	26.8	Regional	617.20	174.90	179.43		179.95	0.003505	4.28	253.10	131.28	0.67	138.53	65.63	4.28	2.44
Reach-1	26.8	100 year	141.70	174.90	178.41		178.50	0.000819	1.71	138.17	93.22	0.31	24.29	11.77	1.71	1.03
Reach-1	26.8	50 year	122.60	174.90	178.34		178.41	0.000694	1.55	131.44	90.50	0.29	20.12	9.78	1.55	0.93
Reach-1	26.8	25 year	105.10	174.90	178.26		178.33	0.000580	1.39	124.94	87.79	0.26	16.39	8.00	1.39	0.84
Reach-1	26.8	10 year	84.50	174.90	177.50		177.64	0.001585	1.88	67.95	62.21	0.41	33.14	16.78	1.88	1.24
Reach-1	26.8	5 year	69.80	174.90	177.17		177.34	0.002261	2.02	49.06	51.76	0.47	40.05	20.75	2.02	1.42
Reach-1	26.785	Regional	617.20	174.80	179.43	178.90	179.88	0.002921	4.26	286.21	142.08	0.64	131.07	57.14	4.26	2.16
Reach-1	26.785	100 year	141.70	174.80	178.41	177.17	178.49	0.000632	1.67	160.23	104.84	0.28	22.04	9.37	1.67	0.88
Reach-1	26.785	50 year	122.60	174.80	178.33	177.01	178.40	0.000530	1.51	152.70	102.18	0.26	18.12	7.69	1.51	0.80
Reach-1	26.785	25 year	105.10	174.80	178.26	176.85	178.32	0.000437	1.35	145.40	99.54	0.23	14.63	6.20	1.35	0.72
Reach-1	26.785	10 year	84.50	174.80	177.49	176.62	177.61	0.001069	1.78	79.72	70.94	0.35	27.68	11.62	1.78	1.06
Reach-1	26.785	5 year	69.80	174.80	177.16	176.40	177.30	0.001417	1.88	58.08	58.38	0.39	32.05	13.60	1.88	1.20
Reach-1	26.7825		Bridge													
Reach-1	26.78	Regional	617.20	174.80	178.90	178.90	179.72	0.005824	5.54	216.10	122.76	0.88	231.12	99.53	5.54	2.86
Reach-1	26.78	100 year	141.70	174.80	177.26	177.17	177.74	0.004778	3.54	63.98	62.06	0.73	112.66	47.56	3.54	2.21
Reach-1	26.78	50 year	122.60	174.80	177.14	177.01	177.59	0.004502	3.33	57.25	57.85	0.70	101.20	42.98	3.33	2.14
Reach-1	26.78	25 year	105.10	174.80	177.04	176.85	177.43	0.004090	3.08	51.61	54.07	0.66	87.90	37.62	3.08	2.04
Reach-1	26.78	10 year	84.50	174.80	176.90		177.23	0.003588	2.76	44.38	48.80	0.62	72.16	31.39	2.76	1.90
Reach-1	26.78	5 year	69.80	174.80	176.78		177.06	0.003204	2.51	38.80	44.30	0.58	60.67	26.94	2.51	1.80
Reach-1	26.75	Regional	617.20	174.70	178.87		179.36	0.003337	3.81	260.41	135.12	0.65	114.80	62.79	3.81	2.37
Reach-1	26.75	100 year	141.70	174.70	177.30		177.51	0.002371	2.18	88.24	80.48	0.49	45.51	25.39	2.18	1.61
Reach-1	26.75	50 year	122.60	174.70	177.18		177.37	0.002322	2.06	78.60	75.40	0.48	41.79	23.64	2.06	1.56
Reach-1	26.75	25 year	105.10	174.70	177.07		177.24	0.002200	1.93	70.47	70.84	0.47	37.20	21.36	1.93	1.49
Reach-1	26.75	10 year	84.50	174.70	176.92		177.06	0.002063	1.75	60.07	64.54	0.44	31.81	18.73	1.75	1.41
Reach-1	26.75	5 year	69.80	174.70	176.79		176.91	0.001971	1.62	52.02	59.21	0.43	27.90	16.89	1.62	1.34
Reach-1	26.66	Regional	631.10	174.50	178.78		179.00	0.002089	2.72	331.79	168.61	0.45	75.23	40.02	2.72	1.90
Reach-1	26.66	100 year	144.20	174.50	176.99		177.23	0.003913	2.41	79.39	90.17	0.55	73.42	33.51	2.41	1.82
Reach-1	26.66	50 year	122.60	174.50	176.87		177.09	0.003872	2.30	68.85	81.97	0.54	68.08	31.63	2.30	1.78
Reach-1	26.66	25 year	105.10	174.50	176.76		176.97	0.003760	2.17	60.59	74.92	0.53	62.30	29.57	2.17	1.73
Reach-1	26.66	10 year	84.50	174.50	176.63		176.81	0.003514	1.99	51.09	65.88	0.50	53.65	26.48	1.99	1.65
Reach-1	26.66	5 year	69.80	174.50	176.52		176.67	0.003264	1.83	44.28	58.54	0.48	46.38	23.97	1.83	1.58
Reach-1	26.52	Regional	631.10	174.20	178.62		178.81	0.001377	2.11	348.25	134.98	0.36	46.24	34.49	2.11	1.81
Reach-1	26.52	100 year	144.20	174.20	176.80		176.88	0.001529	1.35	122.20	107.39	0.34	24.20	16.96	1.35	1.18
Reach-1	26.52	50 year	122.60	174.20	176.66		176.74	0.001592	1.29	107.34	104.57	0.34	23.03	15.94	1.29	1.14
Reach-1	26.52	25 year	105.10	174.20	176.54		176.61	0.001662	1.25	94.58	102.08	0.34	22.04	15.02	1.25	1.11
Reach-1	26.52	10 year	84.50	174.20	176.38		176.45	0.001777	1.19	78.45	98.84	0.35	20.79	13.77	1.19	1.08
Reach-1	26.52	5 year	69.80	174.20	176.24		176.31	0.001944	1.14	65.17	96.10	0.35	20.15	12.87	1.14	1.07
Reach-1	26.36	Regional	631.10	173.90	177.98		178.46	0.003786	3.26	224.18	111.29	0.59	114.54	74.24	3.26	2.82
Reach-1	26.36	100 year	144.20	173.90	176.45		176.59	0.002472	1.68	88.11	67.03	0.43	38.00	31.65	1.68	1.64
Reach-1	26.36	50 year	122.60	173.90	176.32		176.45	0.002387	1.56	79.82	63.35	0.41	33.75	29.31	1.56	1.54
Reach-1	26.36	25 year	105.10	173.90	176.21		176.32	0.002314	1.45	72.82	60.06	0.40	30.16	27.34	1.45	1.44
Reach-1	26.36	10 year	84.50	173.90	176.06		176.15	0.002244	1.32	64.03	55.65	0.39	25.91	25.16		

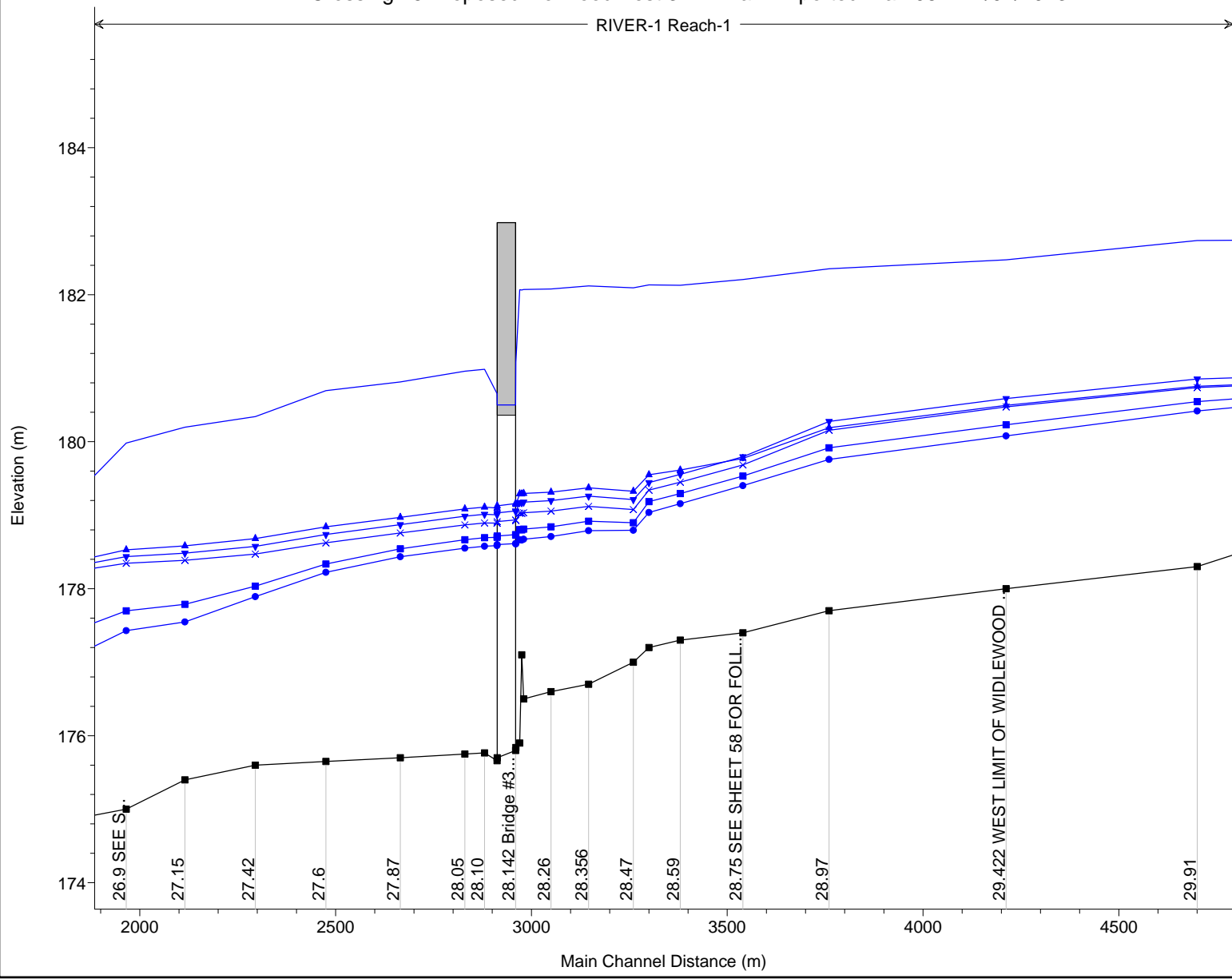
HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 (Continued)

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	Shear Chan (N/m2)	Shear Total (N/m2)	Vel Chnl (m/s)	Vel Total (m/s)
Reach-1	26.04	5 year	69.80	173.20	174.63		174.74	0.005020	1.47	48.10	65.35	0.54	37.08	36.11	1.47	1.45
Reach-1	25.93	Regional	722.50	172.80	176.88		177.17	0.002041	2.42	307.44	103.65	0.43	62.65	58.47	2.42	2.35
Reach-1	25.93	100 year	169.60	172.80	174.53		174.76	0.008129	2.13	79.87	87.49	0.71	73.40	72.09	2.13	2.12
Reach-1	25.93	50 year	122.60	172.80	174.34		174.53	0.008066	1.93	63.83	80.70	0.69	62.83	61.98	1.93	1.92
Reach-1	25.93	25 year	105.10	172.80	174.27		174.43	0.007727	1.81	58.11	77.77	0.67	56.74	56.08	1.81	1.81
Reach-1	25.93	10 year	84.50	172.80	174.18		174.32	0.007009	1.64	51.58	74.30	0.63	47.67	47.26	1.64	1.64
Reach-1	25.93	5 year	69.80	172.80	174.12		174.23	0.006300	1.49	46.84	71.67	0.59	40.23	39.99	1.49	1.49
Reach-1	25.79	Regional	722.50	172.10	176.86		177.01	0.000472	1.75	429.26	125.70	0.29	17.42	15.59	1.75	1.68
Reach-1	25.79	100 year	169.60	172.10	174.28		174.36	0.001207	1.31	129.78	108.52	0.38	14.22	14.03	1.31	1.31
Reach-1	25.79	50 year	122.60	172.10	173.95		174.04	0.001763	1.29	94.88	106.09	0.44	15.34	15.34	1.29	1.29
Reach-1	25.79	25 year	105.10	172.10	173.84		173.92	0.001970	1.27	82.97	103.91	0.45	15.30	15.30	1.27	1.27
Reach-1	25.79	10 year	84.50	172.10	173.70		173.78	0.002316	1.23	68.61	101.21	0.48	15.28	15.28	1.23	1.23
Reach-1	25.79	5 year	69.80	172.10	173.59		173.67	0.002689	1.20	58.02	99.18	0.50	15.31	15.31	1.20	1.20
Reach-1	25.63	Regional	722.50	171.50	176.74		176.93	0.000577	2.09	400.10	108.68	0.32	23.81	20.56	2.09	1.81
Reach-1	25.63	100 year	169.60	171.50	174.07		174.18	0.001132	1.50	126.72	97.30	0.38	17.23	14.43	1.50	1.34
Reach-1	25.63	50 year	122.60	171.50	173.68		173.79	0.001433	1.50	90.42	83.99	0.42	18.15	15.10	1.50	1.36
Reach-1	25.63	25 year	105.10	171.50	173.56		173.66	0.001397	1.42	80.86	79.24	0.41	16.74	13.95	1.42	1.30
Reach-1	25.63	10 year	84.50	171.50	173.43		173.51	0.001273	1.30	70.61	73.82	0.39	14.25	11.91	1.30	1.20
Reach-1	25.63	5 year	69.80	171.50	173.34		173.40	0.001110	1.17	64.10	70.15	0.36	11.83	9.92	1.17	1.09
Reach-1	25.47	Regional	722.50	170.80	176.66		176.83	0.000741	2.40	505.14	130.75	0.33	39.31	27.64	2.40	1.43
Reach-1	25.47	100 year	169.60	170.80	173.95		174.04	0.000801	1.57	175.35	112.80	0.30	21.32	12.11	1.57	0.97
Reach-1	25.47	50 year	122.60	170.80	173.54		173.62	0.000835	1.44	131.89	100.03	0.30	18.92	10.72	1.44	0.93
Reach-1	25.47	25 year	105.10	170.80	173.43		173.50	0.000746	1.32	121.63	96.77	0.28	16.14	9.13	1.32	0.86
Reach-1	25.47	10 year	84.50	170.80	173.32		173.37	0.000599	1.15	111.08	93.30	0.25	12.32	6.95	1.15	0.76
Reach-1	25.47	5 year	69.80	170.80	173.25		173.29	0.000471	0.99	104.68	91.14	0.22	9.36	5.27	0.99	0.67
Reach-1	25.31	Regional	722.50	170.10	176.16		176.64	0.001691	3.63	309.09	86.07	0.49	90.01	57.57	3.63	2.34
Reach-1	25.31	100 year	169.60	170.10	173.69		173.88	0.001161	2.03	111.67	68.39	0.37	34.36	18.21	2.03	1.52
Reach-1	25.31	50 year	122.60	170.10	173.33		173.47	0.000996	1.73	88.63	58.88	0.33	26.02	14.40	1.73	1.38
Reach-1	25.31	25 year	105.10	170.10	173.27		173.38	0.000801	1.53	85.00	57.24	0.30	20.45	11.42	1.53	1.24
Reach-1	25.31	10 year	84.50	170.10	173.20		173.28	0.000567	1.27	81.52	55.63	0.25	14.13	7.98	1.27	1.04
Reach-1	25.31	5 year	69.80	170.10	173.17		173.22	0.000408	1.07	79.52	54.68	0.21	10.04	5.70	1.07	0.88
Reach-1	25.15	Regional	722.50	169.50	176.34		176.44	0.000260	1.45	521.20	101.91	0.20	14.19	12.70	1.45	1.39
Reach-1	25.15	100 year	169.60	169.50	173.77		173.79	0.000115	0.64	269.92	93.67	0.12	3.38	3.20	0.64	0.63
Reach-1	25.15	50 year	122.60	169.50	173.38		173.40	0.000095	0.53	234.27	92.44	0.10	2.44	2.33	0.53	0.52
Reach-1	25.15	25 year	105.10	169.50	173.31		173.32	0.000077	0.47	227.35	92.20	0.09	1.92	1.84	0.47	0.46
Reach-1	25.15	10 year	84.50	169.50	173.23		173.24	0.000055	0.39	220.42	91.96	0.08	1.33	1.28	0.39	0.38
Reach-1	25.15	5 year	69.80	169.50	173.19		173.19	0.000040	0.33	216.32	91.81	0.07	0.95	0.91	0.33	0.32
Reach-1	25.05	Regional	722.50	169.30	176.22		176.40	0.000397	1.90	384.77	82.75	0.27	18.83	17.69	1.90	1.88
Reach-1	25.05	100 year	169.60	169.30	173.73		173.77	0.000171	0.86	196.26	69.11	0.16	4.68	4.68	0.86	0.86
Reach-1	25.05	50 year	122.60	169.30	173.36		173.39	0.000136	0.72	170.73	67.14	0.14	3.35	3.35	0.72	0.72
Reach-1	25.05	25 year	105.10	169.30	173.29		173.31	0.000109	0.63	166.04	66.77	0.13	2.62	2.62	0.63	0.63
Reach-1	25.05	10 year	84.50	169.30	173.22		173.23	0.000077	0.52	161.40	66.40	0.11	1.81	1.81	0.52	0.52
Reach-1	25.05	5 year	69.80	169.30	173.18		173.19	0.000055	0.44	158.69	66.19	0.09	1.28	1.28	0.44	0.44
Reach-1	25.02	Regional	722.50	169.30	175.94	173.80	176.33	0.000772	3.17	360.59	105.47	0.40	47.86	25.49	3.17	2.00
Reach-1	25.02	100 year	169.60	169.30	173.60	171.22	173.74	0.000368	1.61	105.30	66.08	0.26	14.43	14.43	1.61	1.61
Reach-1	25.02	50 year	122.60	169.30	173.28	170.91	173.36	0.000255	1.27	96.81	60.44	0.21	9.17	9.17	1.27	1.27
Reach-1	25.02	25 year	105.10	169.30	173.23	170.78	173.29	0.000196	1.10	95.48	59.55	0.18	6.96	6.96	1.10	1.10
Reach-1	25.02	10 year	84.50	169.30	173.18	170.62	173.22	0.000133	0.90	94.17	58.68	0.15	4.65	4.65	0.90	0.90
Reach-1	25.02	5 year	69.80	169.30	173.15	170.50	173.18	0.000093	0.75	93.41	58.17	0.13	3.23	3.23	0.75	0.75
Reach-1	25.015															
Reach-1	25.01	Regional	722.50	169.30	175.87	173.72	176.27	0.000807	3.22	353.77	104.38	0.41	49.52	26.41	3.22	2.04
Reach-1	25.01	100 year	169.60	169.30	173.53	171.22	173.62	0.000299	1.43	154.92	64.69	0.23	11.49	6.93	1.43	1.09
Reach-1	25.01	50 year	122.60	169.30	173.28	170.91	173.36	0.000255	1.27	96.74	60.39	0.21	9.19	9.19	1.27	1.27
Reach-1	25.01	25 year	105.10	169.30	173.23	170.78	173.29	0.000196	1.10	95.43	59.52	0.18	6.97	6.97	1.10	1.10
Reach-1	25.01	10 year	84.50	169.30	173.18	170.62	173.22	0.000133	0.90	94.14	58.66	0.15	4.65	4.65	0.90	0.90
Reach-1	25.01	5 year	69.80	169.30	173.15	170.50	173.18	0.000093	0.75	93.38	58.16	0.13	3.23	3.23	0.75	0.75
Reach-1	24.94	Regional	722.50	169.20	175.85		176.20	0.001179	2.66	278.64	79.32	0.45	41.00	39.11	2.66	2.59
Reach-1	24.94	100 year	169.60	169.20	173.44		173.58	0.001129	1.65	103.72	57.55	0.39	19.85	19.27	1.65	1.64
Reach-1	24.94	50 year	122.60	169.20	173.25		173.34	0.000755	1.33	93.19	52.97	0.32	12.92	12.55	1.33	1.32
Reach-1	24.94	25 year	105.10	169.20	173.20		173.27	0.000588	1.17	90.85	51.90	0.28	10.00	9.72	1.17	1.16
Reach-1	24.94	10 year	84.50	169.20	173.16		173.21	0.000401	0.96	88.68	50.89	0.23	6.79	6.60	0.96	0.95
Reach-1	24.94	5 year	69.80	169.20	173.14		173.17	0.000282	0.80	87.49	50.33	0.19	4.76	4.63	0.80	0.80
Reach-1	24.87	Regional	733.50	169.20	175.22	174.69	175.95	0.004071	4.42	230.97	81.07	0.63	184.08	109.42	4.42	3.18
Reach-1	24.87	100 year	173.60	169.20	173.09	172.06	173.41	0.002867	2.56	79.01	50.67	0.48	74.53	41.93	2.56	2.20
Reach-1	24.87	50 year	122.60	169.20	173.09	171.60	173.25	0.001430	1.81	79.01						

Crossing 15 Proposed No Flood Test 3 Plan: Imported Plan 06 12/01/2013

RIVER-1 Reach-1

Legend	
WS Regional	—
WS 100 year	▲
WS 50 year	◆
WS 25 year	×
WS 10 year	■
WS 5 year	●
Ground	■







## **Appendix C: HY8 hydraulic model results**



## **Existing Hydraulic Structures**



# HY-8 Culvert Analysis Report

Crossing Notes: Crossing 1 Existing

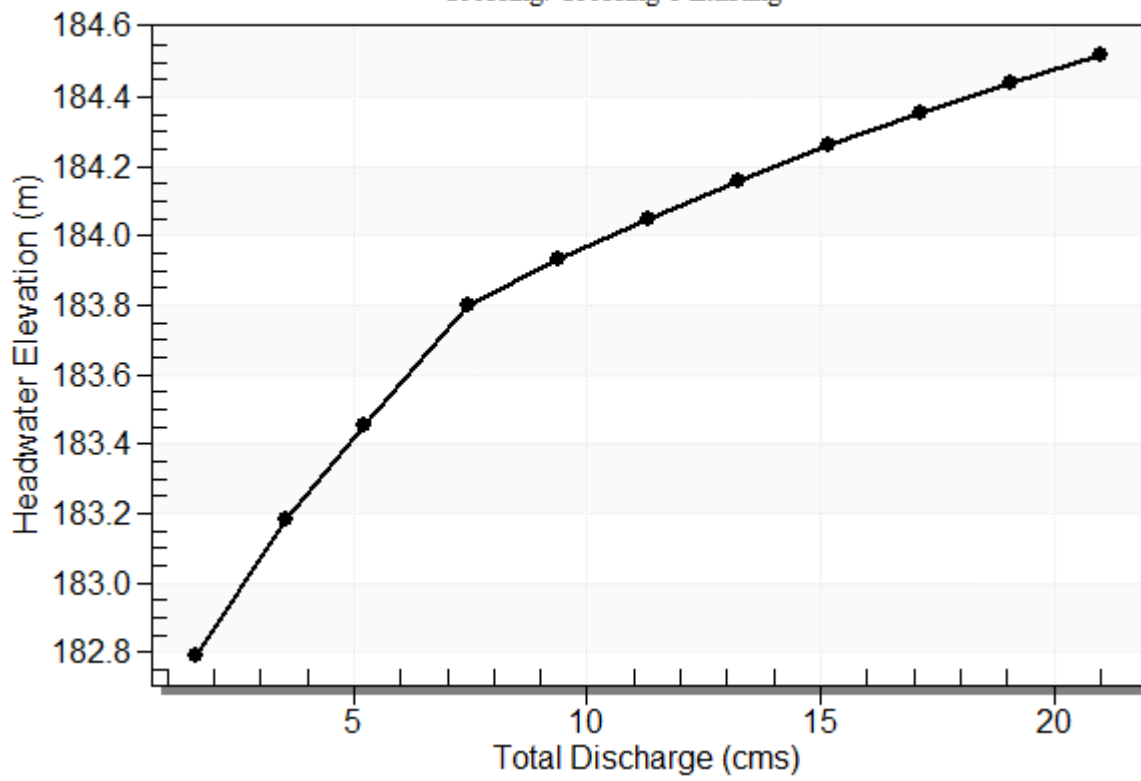
**Table 1 - Summary of Culvert Flows at Crossing: Crossing 1 Existing**

Headwater Elevation (m)	Total Discharge (cms)	Culvert 1 Discharge (cms)	Roadway Discharge (cms)	Iterations
182.79	1.62	1.62	0.00	1
183.18	3.56	3.56	0.00	1
183.46	5.21	5.21	0.00	1
183.80	7.43	6.91	0.52	6
183.93	9.37	7.50	1.86	4
184.05	11.31	7.87	3.44	3
184.16	13.25	8.01	5.23	4
184.26	15.19	8.13	7.05	4
184.36	17.12	8.24	8.88	4
184.44	19.06	8.34	10.72	4
184.52	21.00	8.44	12.56	4
183.70	6.45	6.45	0.00	Overtopping

# Rating Curve Plot for Crossing: Crossing 1 Existing

## Total Rating Curve

Crossing: Crossing 1 Existing



**Table 2 - Culvert Summary Table: Culvert 1**

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
1.62	1.62	182.79	0.595	0.644	1-S1t	0.173	0.355	0.722	0.722	0.916	0.777
3.56	3.56	183.18	0.999	1.031	1-S1t	0.292	0.600	0.969	0.969	1.498	0.946
5.21	5.21	183.46	1.306	0.0*	5-S2n	0.378	0.774	0.565	1.119	3.766	1.041
7.43	6.91	183.80	1.649	1.550	4-FFf	0.457	0.935	0.457	1.278	6.181	1.138
9.37	7.50	183.93	1.781	1.744	4-FFf	0.484	0.987	0.484	1.394	6.335	1.206
11.31	7.87	184.05	1.868	1.899	4-FFf	0.499	1.019	1.200	1.496	2.678	1.264
13.25	8.01	184.16	1.903	2.011	4-FFf	0.505	1.031	1.200	1.587	2.726	1.315
15.19	8.13	184.26	1.932	2.112	4-FFf	0.510	1.042	1.200	1.671	2.767	1.360
17.12	8.24	184.36	1.959	2.205	4-FFf	0.514	1.051	1.200	1.748	2.803	1.402
19.06	8.34	184.44	1.985	2.293	4-FFf	0.519	1.059	1.200	1.819	2.838	1.440
21.00	8.44	184.52	2.010	2.375	4-FFf	0.523	1.068	1.200	1.887	2.871	1.475



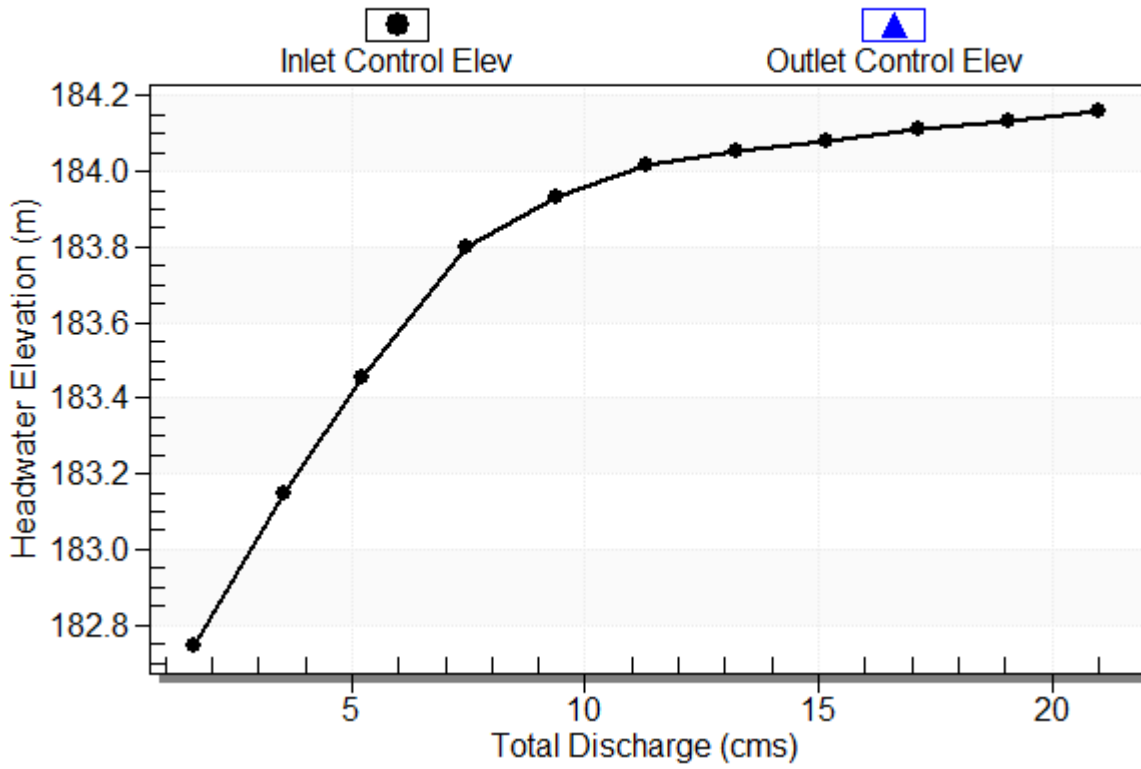
\* theoretical depth is impractical. Depth reported is corrected.

\*\*\*\*\*  
Inlet Elevation (invert): 182.15 m, Outlet Elevation (invert): 181.98 m  
Culvert Length: 7.20 m, Culvert Slope: 0.0236  
\*\*\*\*\*

### Culvert Performance Curve Plot: Culvert 1

## Performance Curve

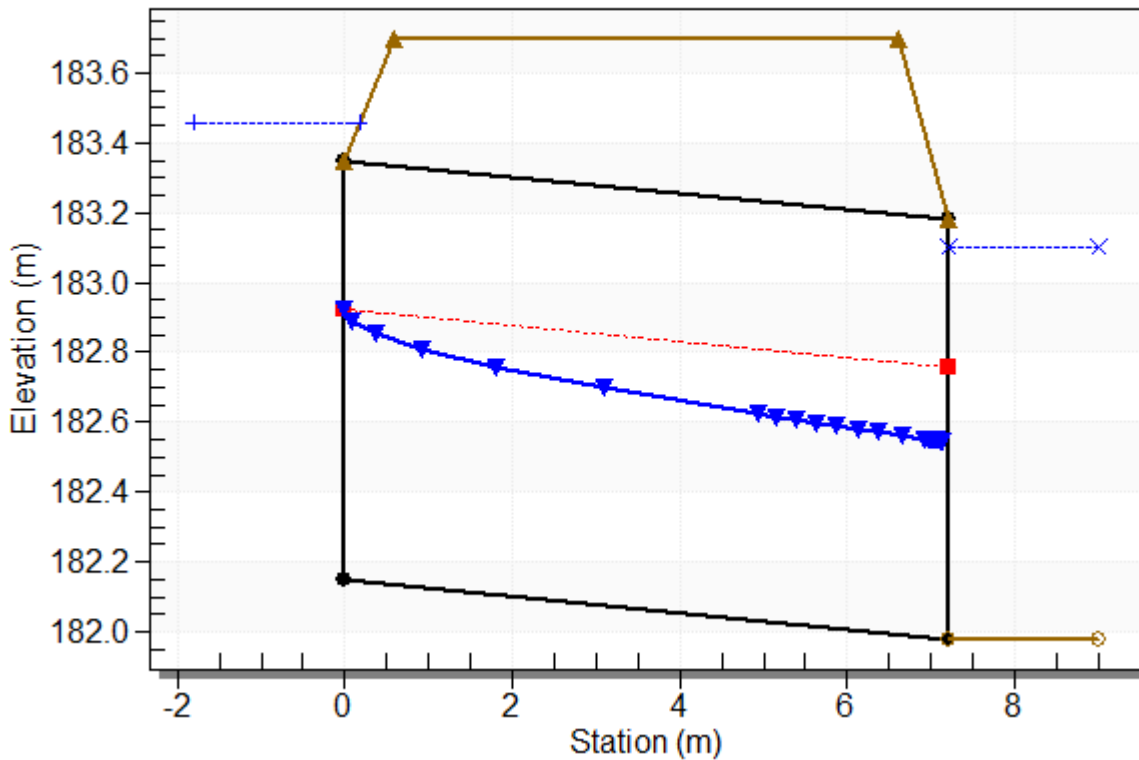
Culvert: Culvert 1



## Water Surface Profile Plot for Culvert: Culvert 1

Crossing - Crossing 1 Existing, Design Discharge - 5.21 cms

Culvert - Culvert 1, Culvert Discharge - 5.21 cms



### Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 182.15 m

Outlet Station: 7.20 m

Outlet Elevation: 181.98 m

Number of Barrels: 1

### Culvert Data Summary - Culvert 1

Barrel Shape: Concrete Box

Barrel Span: 2450.00 mm

Barrel Rise: 1200.00 mm

Barrel Material: Concrete

Embedment: 0.00 mm

Barrel Manning's n: 0.0120

Inlet Type: Conventional

Inlet Edge Condition: Square Edge (90°) Headwall

Inlet Depression: NONE

**Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 1 Existing)**

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
1.62	182.70	0.72	0.78	21.22	0.41
3.56	182.95	0.97	0.95	28.51	0.43
5.21	183.10	1.12	1.04	32.89	0.44
7.43	183.26	1.28	1.14	37.58	0.45
9.37	183.37	1.39	1.21	40.99	0.46
11.31	183.48	1.50	1.26	43.99	0.47
13.25	183.57	1.59	1.31	46.67	0.47
15.19	183.65	1.67	1.36	49.13	0.48
17.12	183.73	1.75	1.40	51.39	0.48
19.06	183.80	1.82	1.44	53.50	0.48
21.00	183.87	1.89	1.48	55.48	0.48

### **Tailwater Channel Data - Crossing 1 Existing**

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 4.00 (4:1)

Channel Slope: 0.0030

Channel Manning's n: 0.0350

Channel Invert Elevation: 181.98 m

### **Roadway Data for Crossing: Crossing 1 Existing**

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 10.00 m

Crest Elevation: 183.70 m

Roadway Surface: Paved

Roadway Top Width: 6.00 m

# HY-8 Culvert Analysis Report

Crossing Notes: Crossing 2 Existing

**Table 1 - Summary of Culvert Flows at Crossing: Crossing 2 Existing**

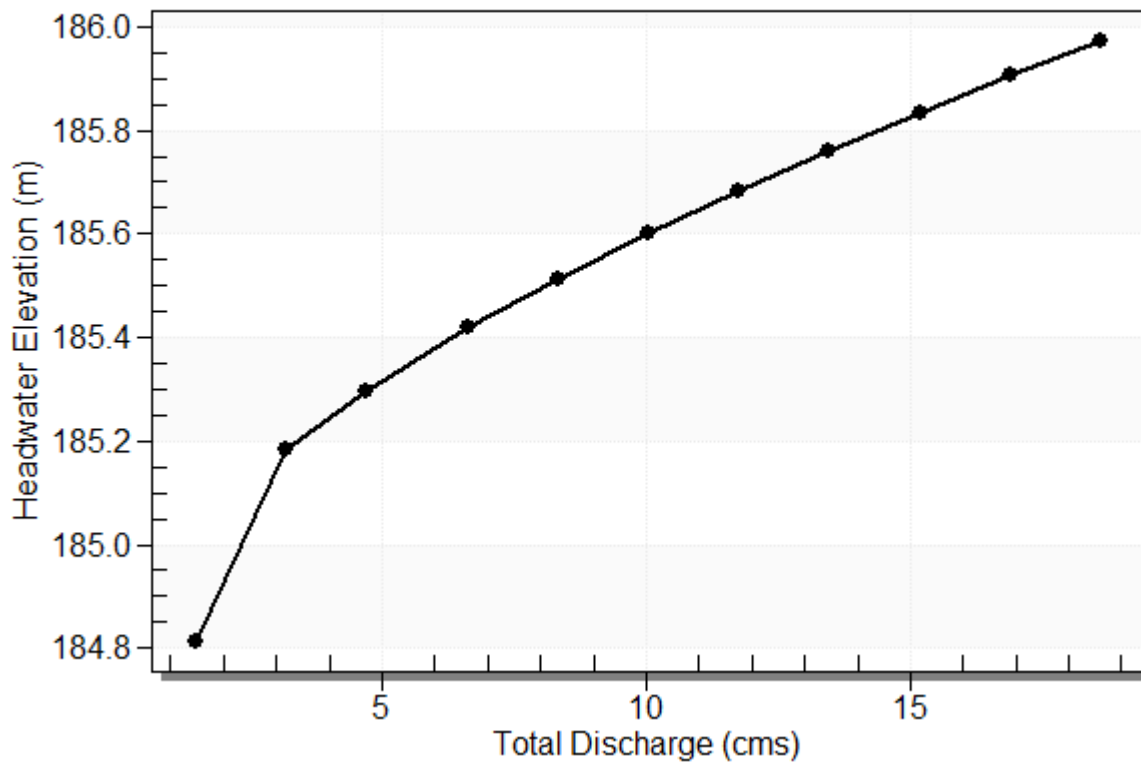
Headwater Elevation (m)	Total Discharge (cms)	Culvert 2 Discharge (cms)	Roadway Discharge (cms)	Iterations
184.81	1.48	1.48	0.00	1
185.18	3.19	1.99	1.20	6
185.30	4.68	2.13	2.55	4
185.42	6.62	2.25	4.36	4
185.51	8.33	2.34	5.99	4
185.60	10.04	2.42	7.62	4
185.68	11.75	2.50	9.25	4
185.76	13.46	2.57	10.89	3
185.83	15.18	2.63	12.54	4
185.91	16.89	2.68	14.20	3
185.97	18.60	2.71	15.88	3
185.01	1.78	1.78	0.00	Overtopping



# Rating Curve Plot for Crossing: Crossing 2 Existing

## Total Rating Curve

Crossing: Crossing 2 Existing



**Table 2 - Culvert Summary Table: Culvert 2**

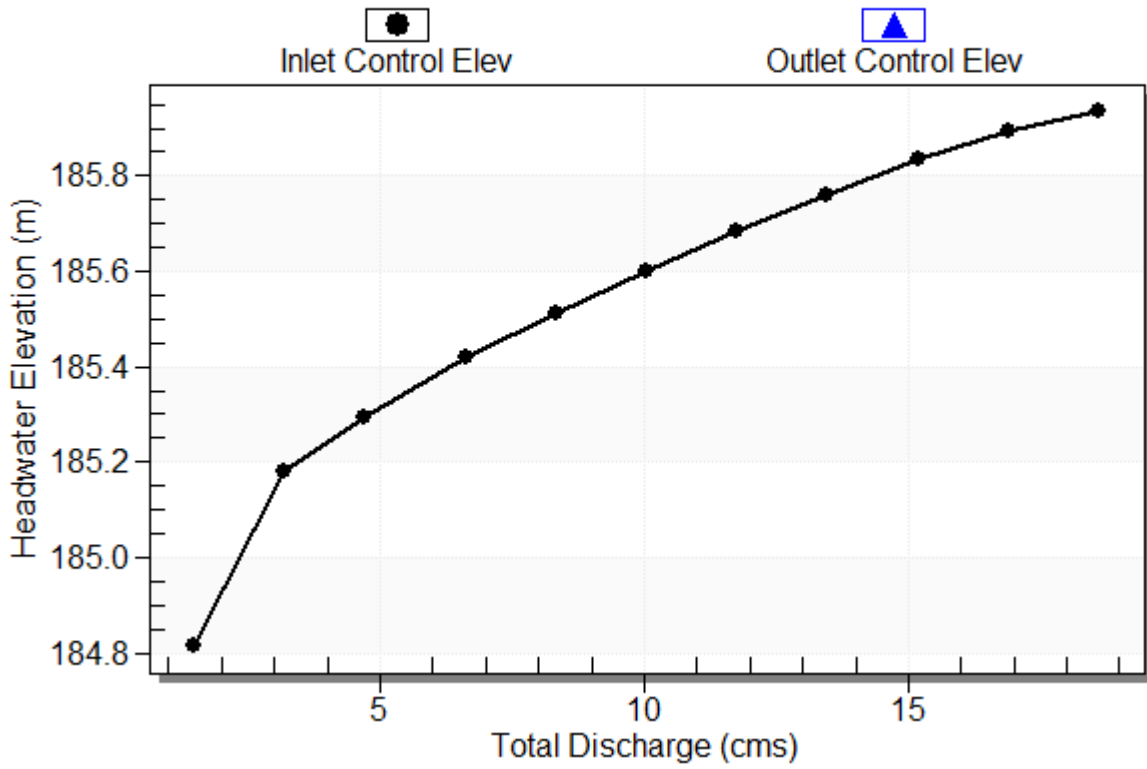
Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
1.48	1.48	184.81	1.045	1.000	2-M2c	0.850	0.471	0.472	0.333	2.404	0.438
3.19	1.99	185.18	1.412	1.335	2-M2c	0.850	0.563	0.564	0.466	2.828	0.533
4.68	2.13	185.30	1.525	1.443	2-M2c	0.850	0.586	0.587	0.549	2.939	0.588
6.62	2.25	185.42	1.648	1.553	7-M2t	0.850	0.605	0.636	0.636	2.956	0.642
8.33	2.34	185.51	1.744	1.646	7-M2t	0.850	0.618	0.700	0.700	2.912	0.680
10.04	2.42	185.60	1.831	1.744	7-M2t	0.850	0.630	0.756	0.756	2.910	0.713
11.75	2.50	185.68	1.913	1.851	7-M2t	0.850	0.641	0.807	0.807	2.960	0.742
13.46	2.57	185.76	1.990	1.952	4-FFf	0.850	0.651	0.850	0.853	3.018	0.768
15.18	2.63	185.83	2.064	2.052	4-FFf	0.850	0.660	0.850	0.896	3.092	0.791
16.89	2.68	185.91	2.123	2.135	4-FFf	0.850	0.667	0.850	0.936	3.148	0.813
18.60	2.71	185.97	2.166	2.204	4-FFf	0.850	0.672	0.850	0.973	3.188	0.833

\*\*\*\*\*  
Inlet Elevation (invert): 183.77 m, Outlet Elevation (invert): 183.73 m  
Culvert Length: 10.80 m, Culvert Slope: 0.0037  
\*\*\*\*\*

### Culvert Performance Curve Plot: Culvert 2

## Performance Curve

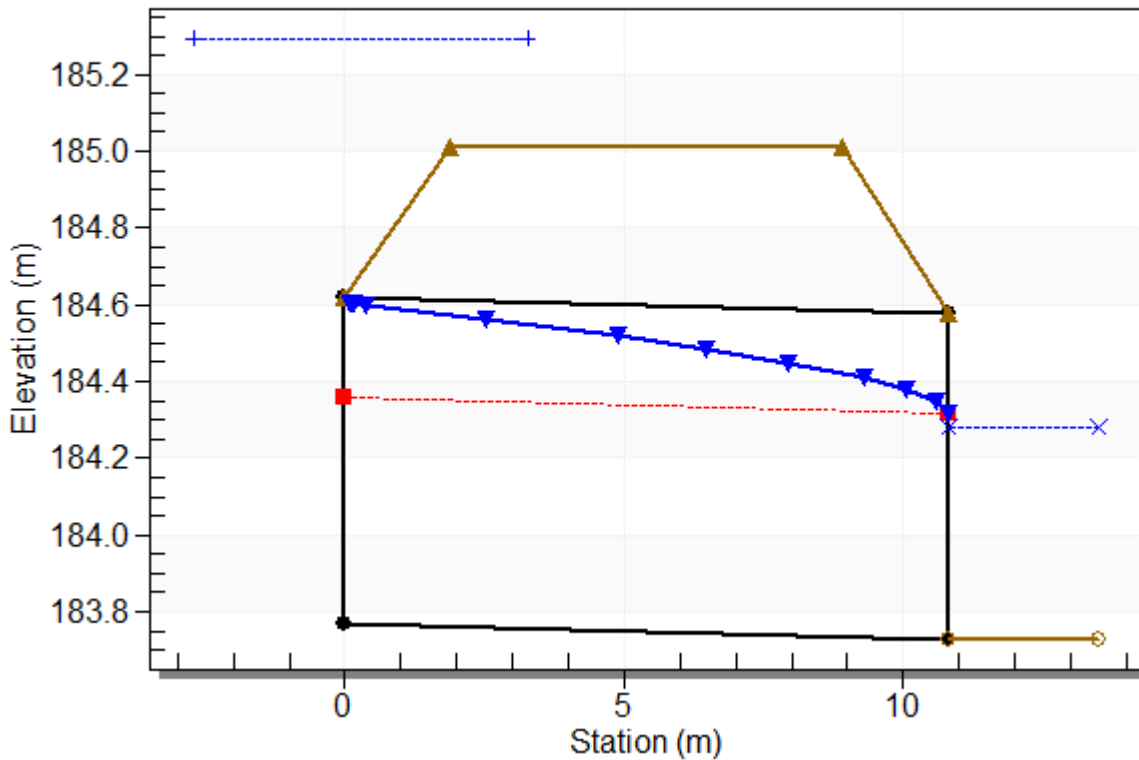
Culvert: Culvert 2



## Water Surface Profile Plot for Culvert: Culvert 2

Crossing - Crossing 2 Existing, Design Discharge - 4.68 cms

Culvert - Culvert 2, Culvert Discharge - 2.13 cms



### Site Data - Culvert 2

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 183.77 m

Outlet Station: 10.80 m

Outlet Elevation: 183.73 m

Number of Barrels: 1

### Culvert Data Summary - Culvert 2

Barrel Shape: User Defined

Barrel Span: 1500.00 mm

Barrel Rise: 850.00 mm

Barrel Material: Corrugated Metal Riveted or Welded

Embedment: 0.00 mm

Barrel Manning's n: 0.0190 (top and sides)

Manning's n: 0.0350 (bottom)

Inlet Type: Conventional

Inlet Edge Condition: Thin Edge Projecting

Inlet Depression: NONE

**Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 2 Existing)**

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
1.48	184.06	0.33	0.44	6.52	0.31
3.19	184.20	0.47	0.53	9.14	0.33
4.68	184.28	0.55	0.59	10.77	0.34
6.62	184.37	0.64	0.64	12.46	0.34
8.33	184.43	0.70	0.68	13.72	0.35
10.04	184.49	0.76	0.71	14.82	0.35
11.75	184.54	0.81	0.74	15.82	0.36
13.46	184.58	0.85	0.77	16.72	0.36
15.18	184.63	0.90	0.79	17.56	0.36
16.89	184.67	0.94	0.81	18.34	0.36
18.60	184.70	0.97	0.83	19.07	0.37

### **Tailwater Channel Data - Crossing 2 Existing**

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 3.50 m

Side Slope (H:V): 20.00 (1:1)

Channel Slope: 0.0020

Channel Manning's n: 0.0350

Channel Invert Elevation: 183.73 m

### **Roadway Data for Crossing: Crossing 2 Existing**

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 10.00 m

Crest Elevation: 185.01 m

Roadway Surface: Paved

Roadway Top Width: 7.00 m

# HY-8 Culvert Analysis Report

Crossing Notes: Crossing 3 Existing



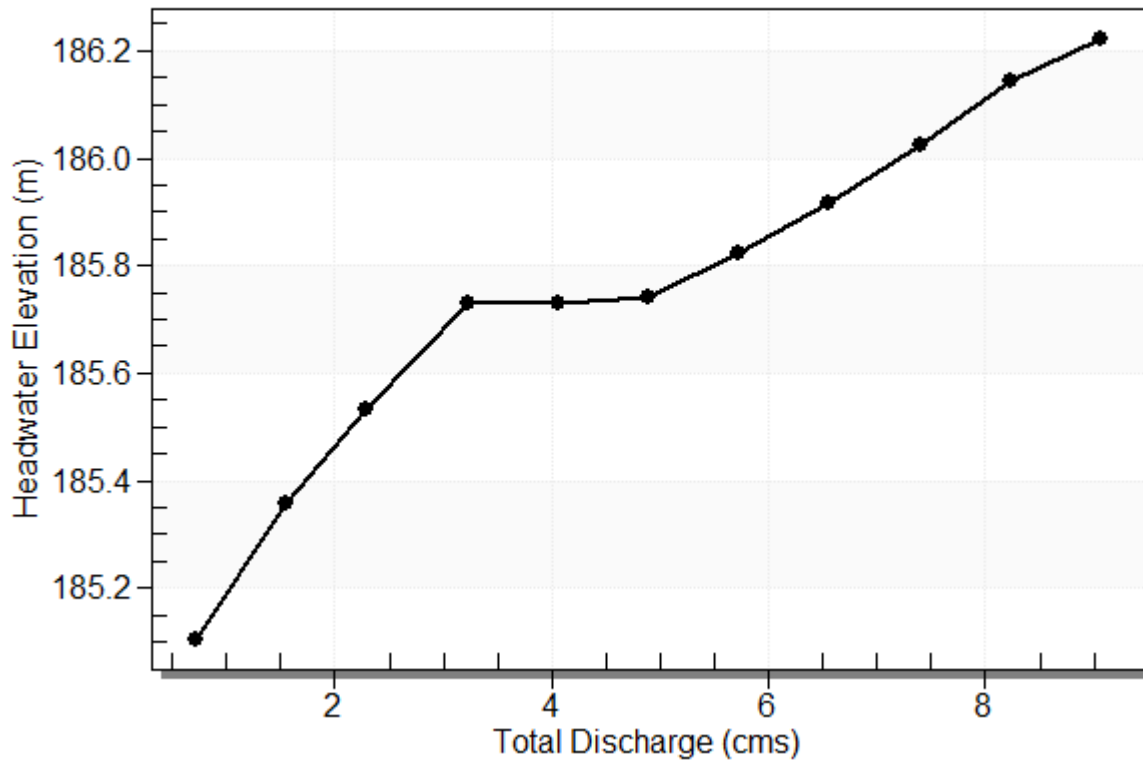
**Table 1 - Summary of Culvert Flows at Crossing: Crossing 3 Existing**

Headwater Elevation (m)	Total Discharge (cms)	Culvert 3 Discharge (cms)	Roadway Discharge (cms)	Iterations
185.11	0.72	0.72	0.00	1
185.36	1.55	1.55	0.00	1
185.53	2.28	2.28	0.00	1
185.73	3.22	3.22	0.00	1
185.73	4.06	4.79	0.00	11
185.74	4.89	4.91	0.00	13
185.82	5.72	5.72	0.00	13
185.92	6.56	6.55	0.00	19
186.03	7.39	7.38	0.00	27
186.14	8.23	8.19	0.00	43
186.22	9.06	8.70	0.36	25
185.63	3.47	3.47	0.00	Overtopping

# Rating Curve Plot for Crossing: Crossing 3 Existing

## Total Rating Curve

Crossing: Crossing 3 Existing



**Table 2 - Culvert Summary Table: Culvert 3**

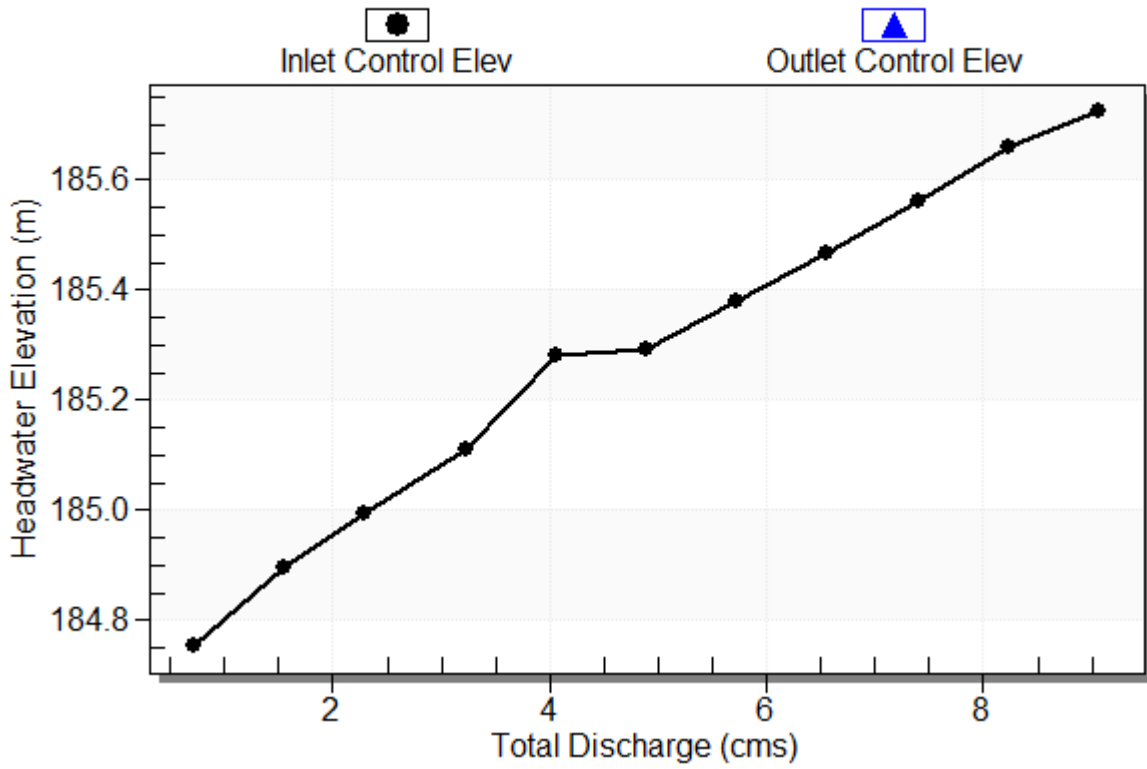
Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.72	0.72	185.11	0.213	0.566	3-M1t	0.173	0.124	0.709	0.709	0.193	0.716
1.55	1.55	185.36	0.354	0.819	4-FFf	0.279	0.208	0.800	0.946	0.370	0.867
2.28	2.28	185.53	0.454	0.991	4-FFf	0.356	0.268	0.800	1.093	0.543	0.955
3.22	3.22	185.73	0.569	1.191	4-FFf	0.444	0.338	0.800	1.244	0.767	1.041
4.06	4.79	185.73	0.741	1.422	4-FFf	0.574	0.441	0.800	1.356	1.141	1.103
4.89	4.91	185.74	0.754	1.531	4-FFf	0.583	0.448	0.800	1.455	1.170	1.155
5.72	5.72	185.82	0.838	1.699	4-FFf	0.643	0.495	0.800	1.543	1.361	1.202
6.56	6.55	185.92	0.928	1.876	4-FFf	0.703	0.542	0.800	1.624	1.559	1.243
7.39	7.38	186.03	1.022	2.058	4-FFf	0.800	0.587	0.800	1.699	1.756	1.281
8.23	8.19	186.14	1.121	2.247	4-FFf	0.800	0.630	0.800	1.768	1.951	1.316
9.06	8.70	186.22	1.186	2.392	4-FFf	0.800	0.655	0.800	1.833	2.070	1.348

\*\*\*\*\*  
Inlet Elevation (invert): 184.54 m, Outlet Elevation (invert): 184.39 m  
Culvert Length: 17.80 m, Culvert Slope: 0.0084  
\*\*\*\*\*

### Culvert Performance Curve Plot: Culvert 3

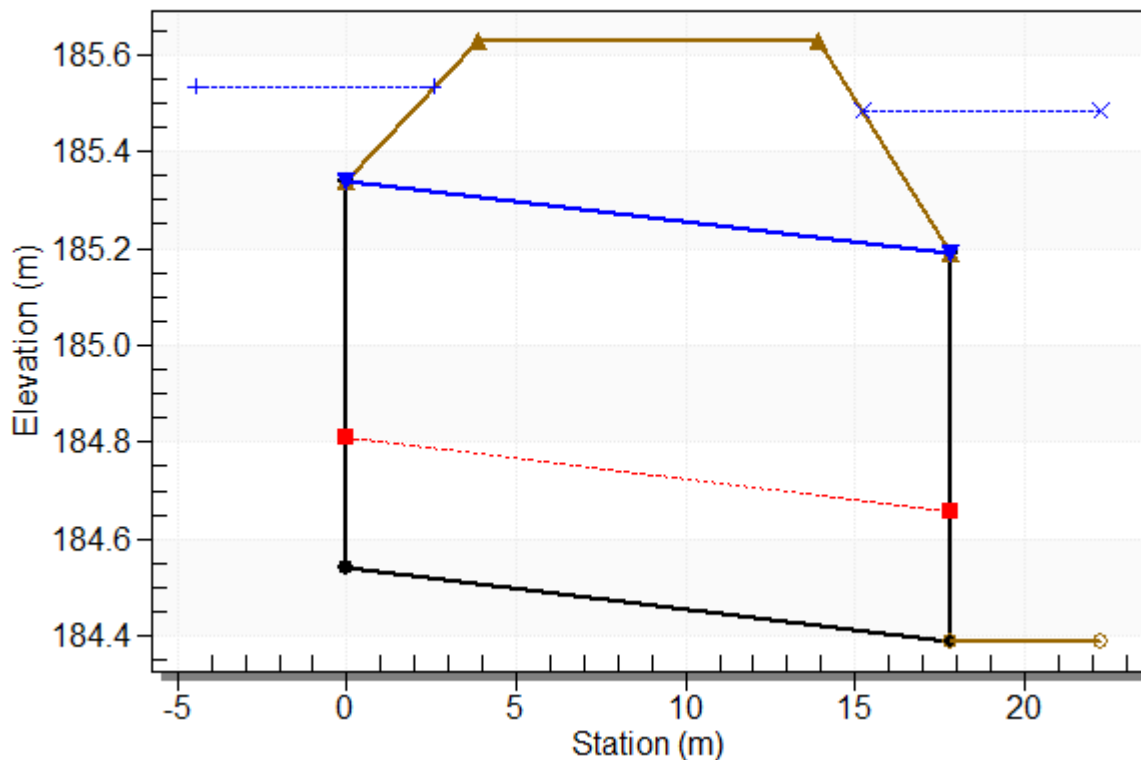
## Performance Curve

Culvert: Culvert 3



## Water Surface Profile Plot for Culvert: Culvert 3

Crossing - Crossing 3 Existing, Design Discharge - 2.28 cms  
Culvert - Culvert 3, Culvert Discharge - 2.28 cms



### Site Data - Culvert 3

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 184.54 m

Outlet Station: 17.80 m

Outlet Elevation: 184.39 m

Number of Barrels: 1

### Culvert Data Summary - Culvert 3

Barrel Shape: Concrete Box

Barrel Span: 5250.00 mm

Barrel Rise: 800.00 mm

Barrel Material: Concrete

Embedment: 0.00 mm

Barrel Manning's n: 0.0350

Inlet Type: Conventional

Inlet Edge Condition: Square Edge (90°) Headwall

Inlet Depression: NONE

**Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 3 Existing)**

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
0.72	185.10	0.71	0.72	20.16	0.38
1.55	185.34	0.95	0.87	26.90	0.40
2.28	185.48	1.09	0.95	31.06	0.41
3.22	185.63	1.24	1.04	35.36	0.42
4.06	185.75	1.36	1.10	38.55	0.43
4.89	185.84	1.45	1.16	41.35	0.43
5.72	185.93	1.54	1.20	43.87	0.44
6.56	186.01	1.62	1.24	46.17	0.44
7.39	186.09	1.70	1.28	48.28	0.44
8.23	186.16	1.77	1.32	50.26	0.45
9.06	186.22	1.83	1.35	52.11	0.45

### **Tailwater Channel Data - Crossing 3 Existing**

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 2.00 (2:1)

Channel Slope: 0.0029

Channel Manning's n: 0.0350

Channel Invert Elevation: 184.39 m

### **Roadway Data for Crossing: Crossing 3 Existing**

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 14.00 m

Crest Elevation: 185.63 m

Roadway Surface: Paved

Roadway Top Width: 10.00 m



# HY-8 Culvert Analysis Report

Crossing Notes: Crossing 4 Existing

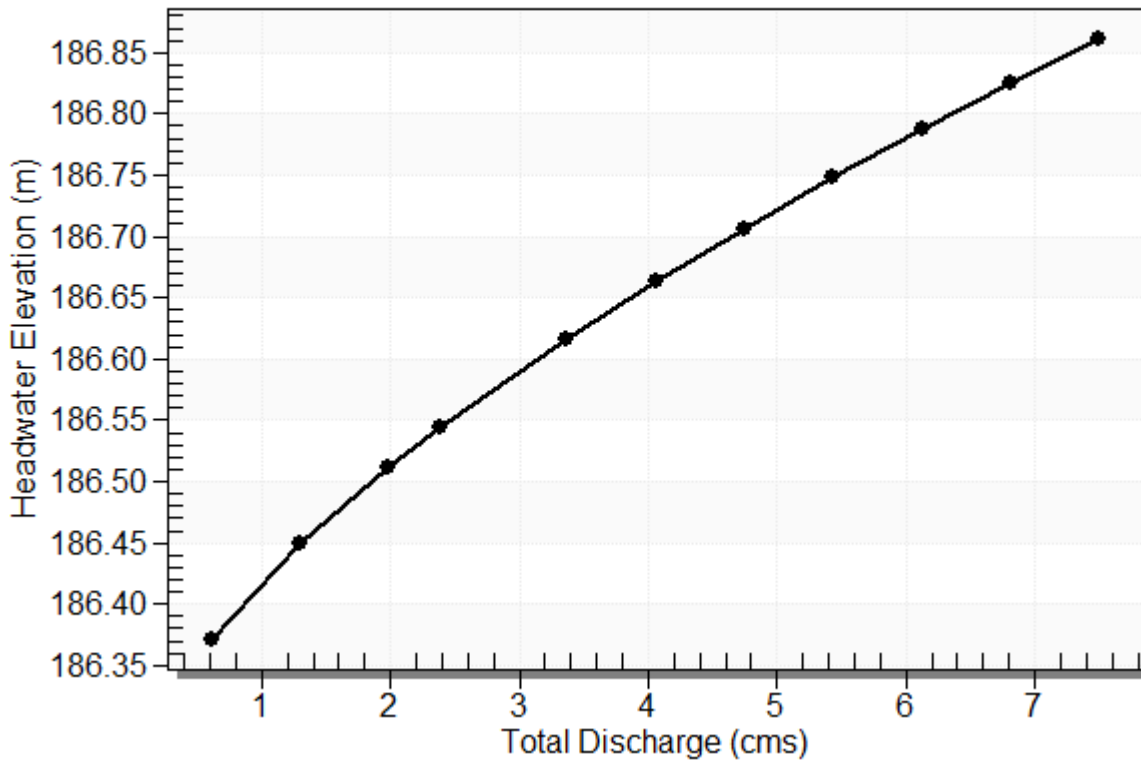
**Table 1 - Summary of Culvert Flows at Crossing: Crossing 4 Existing**

Headwater Elevation (m)	Total Discharge (cms)	Culvert 4 Discharge (cms)	Roadway Discharge (cms)	Iterations
186.37	0.61	0.22	0.38	9
186.45	1.30	0.23	1.06	5
186.51	1.99	0.24	1.75	5
186.54	2.38	0.24	2.14	4
186.62	3.37	0.24	3.12	4
186.66	4.05	0.24	3.81	4
186.71	4.74	0.25	4.50	4
186.75	5.43	0.25	5.18	3
186.79	6.12	0.25	5.87	3
186.83	6.81	0.25	6.56	3
186.86	7.50	0.25	7.24	2
186.29	0.21	0.21	0.00	Overtopping

# Rating Curve Plot for Crossing: Crossing 4 Existing

## Total Rating Curve

Crossing: Crossing 4 Existing



**Table 2 - Culvert Summary Table: Culvert 4**

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.61	0.22	186.37	0.723	1.172	7-M2c	0.420	0.337	0.338	0.232	1.873	0.565
1.30	0.23	186.45	0.756	1.249	7-M2c	0.420	0.342	0.343	0.309	1.912	0.682
1.99	0.24	186.51	0.782	1.312	7-M2t	0.420	0.345	0.362	0.362	1.873	0.759
2.38	0.24	186.54	0.793	1.343	7-M2t	0.420	0.347	0.387	0.387	1.801	0.794
3.37	0.24	186.62	0.806	1.416	4-FFf	0.420	0.348	0.420	0.441	1.756	0.866
4.05	0.24	186.66	0.812	1.463	4-FFf	0.420	0.349	0.420	0.473	1.766	0.907
4.74	0.25	186.71	0.819	1.506	4-FFf	0.420	0.350	0.420	0.502	1.777	0.943
5.43	0.25	186.75	0.826	1.547	4-FFf	0.420	0.351	0.420	0.528	1.788	0.976
6.12	0.25	186.79	0.833	1.587	4-FFf	0.420	0.352	0.420	0.552	1.800	1.005
6.81	0.25	186.83	0.840	1.625	4-FFf	0.420	0.352	0.420	0.574	1.811	1.032
7.50	0.25	186.86	0.847	1.662	4-FFf	0.420	0.353	0.420	0.596	1.822	1.057

\*\*\*\*\*

Inlet Elevation (invert): 185.20 m, Outlet Elevation (invert): 184.99 m

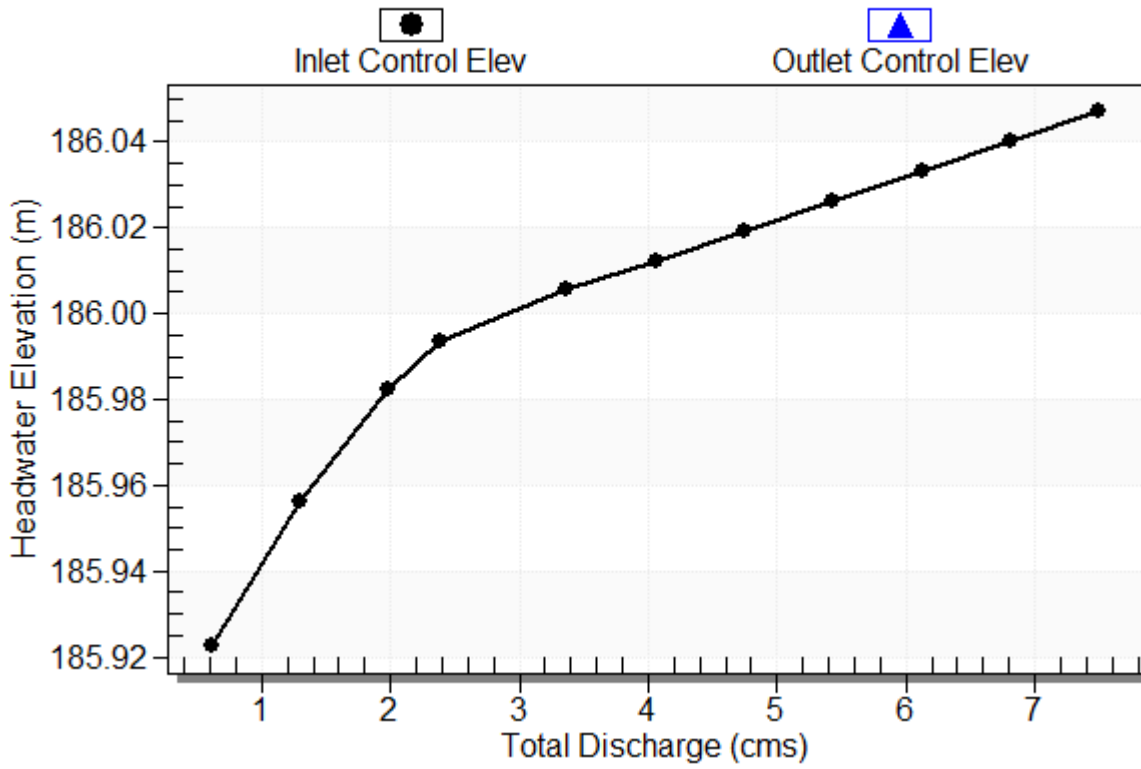
Culvert Length: 11.70 m, Culvert Slope: 0.0179

\*\*\*\*\*

### Culvert Performance Curve Plot: Culvert 4

## Performance Curve

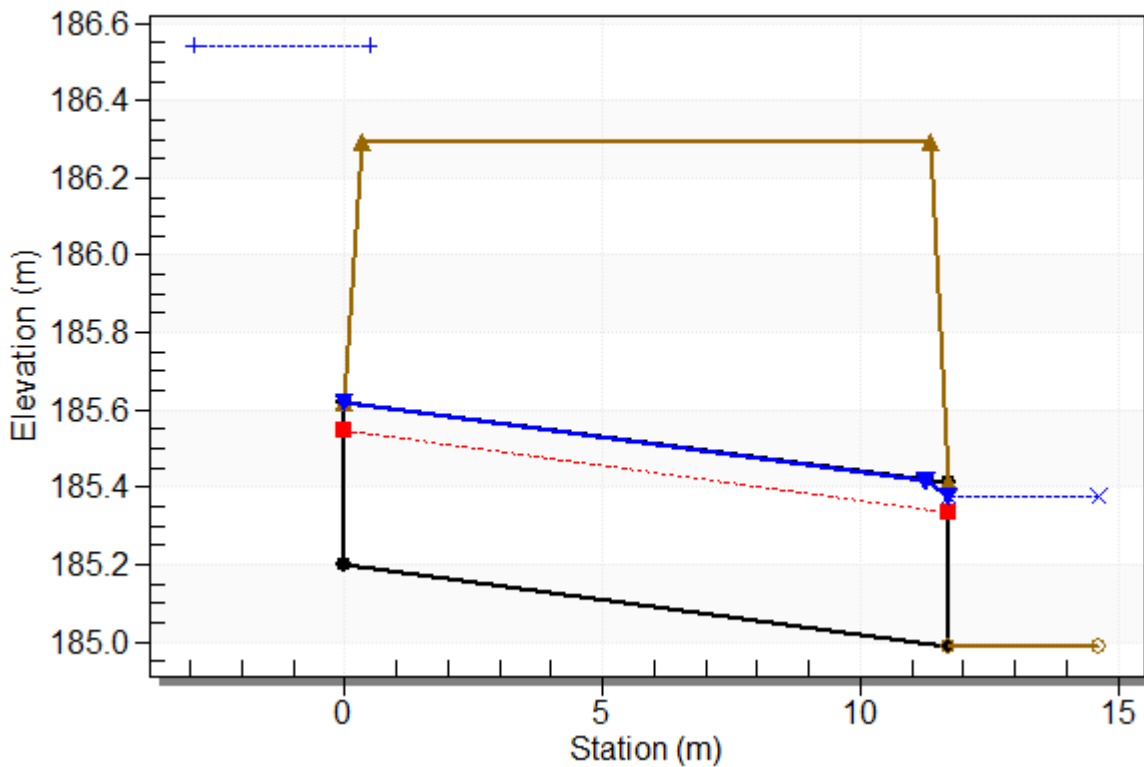
Culvert: Culvert 4



## Water Surface Profile Plot for Culvert: Culvert 4

Crossing - Crossing 4 Existing, Design Discharge - 2.38 cms

Culvert - Culvert 4, Culvert Discharge - 0.24 cms



### Site Data - Culvert 4

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 185.20 m

Outlet Station: 11.70 m

Outlet Elevation: 184.99 m

Number of Barrels: 1

### Culvert Data Summary - Culvert 4

Barrel Shape: Circular

Barrel Diameter: 420.00 mm

Barrel Material: Corrugated Steel

Embedment: 0.00 mm

Barrel Manning's n: 0.0350

Inlet Type: Conventional

Inlet Edge Condition: Thin Edge Projecting

Inlet Depression: NONE

**Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 4 Existing)**

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
0.61	185.22	0.23	0.56	15.72	0.53
1.30	185.30	0.31	0.68	20.87	0.55
1.99	185.35	0.36	0.76	24.48	0.57
2.38	185.38	0.39	0.79	26.19	0.58
3.37	185.43	0.44	0.87	29.82	0.59
4.05	185.46	0.47	0.91	31.98	0.60
4.74	185.49	0.50	0.94	33.92	0.60
5.43	185.52	0.53	0.98	35.69	0.61
6.12	185.54	0.55	1.01	37.32	0.61
6.81	185.56	0.57	1.03	38.85	0.61
7.50	185.59	0.60	1.06	40.28	0.62



### **Tailwater Channel Data - Crossing 4 Existing**

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 20.00 (1:1)

Channel Slope: 0.0069

Channel Manning's n: 0.0350

Channel Invert Elevation: 184.99 m

### **Roadway Data for Crossing: Crossing 4 Existing**

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 10.00 m

Crest Elevation: 186.29 m

Roadway Surface: Paved

Roadway Top Width: 11.00 m

# HY-8 Culvert Analysis Report

Crossing Notes: Crossing 5a

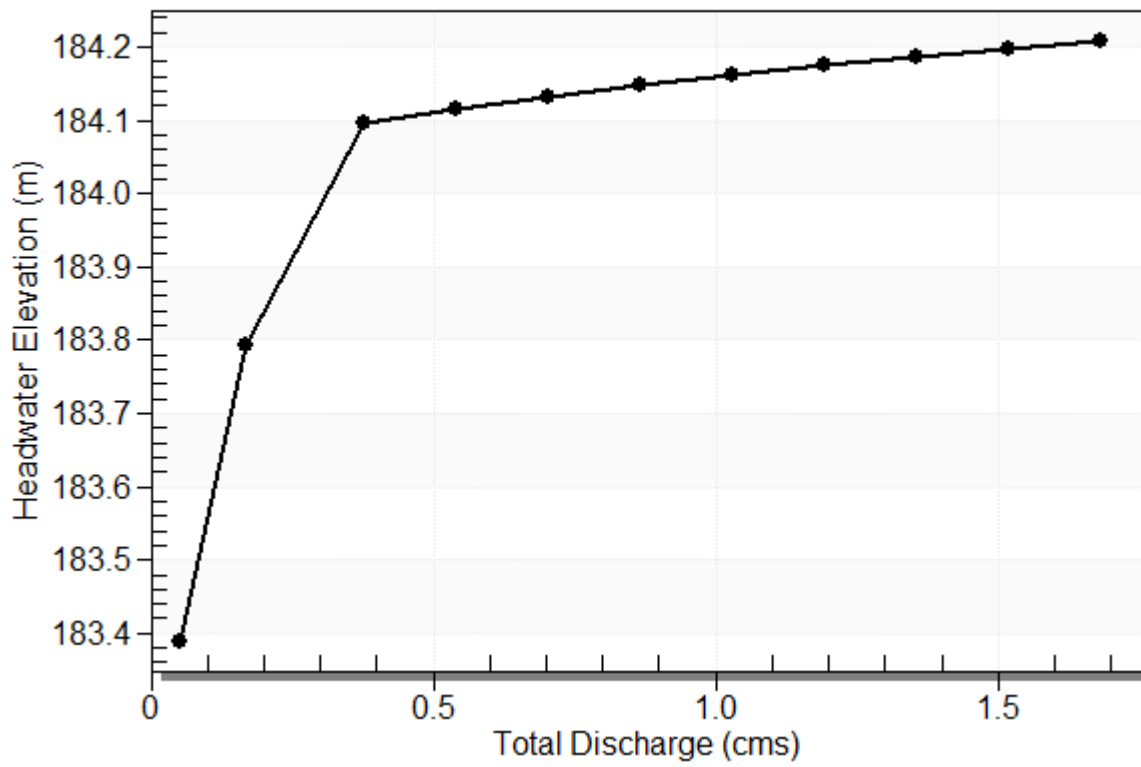
**Table 1 - Summary of Culvert Flows at Crossing: Crossing 5a**

Headwater Elevation (m)	Total Discharge (cms)	Culvert 5a Discharge (cms)	Roadway Discharge (cms)	Iterations
183.39	0.05	0.05	0.00	1
183.79	0.17	0.17	0.00	1
184.10	0.38	0.21	0.16	4
184.12	0.54	0.22	0.32	5
184.13	0.70	0.22	0.48	4
184.15	0.86	0.22	0.64	4
184.16	1.03	0.22	0.80	3
184.17	1.19	0.22	0.96	3
184.19	1.35	0.23	1.13	3
184.20	1.52	0.23	1.29	3
184.21	1.68	0.23	1.45	3
184.06	0.21	0.21	0.00	Overtopping

### Rating Curve Plot for Crossing: Crossing 5a

## Total Rating Curve

Crossing: Crossing 5a

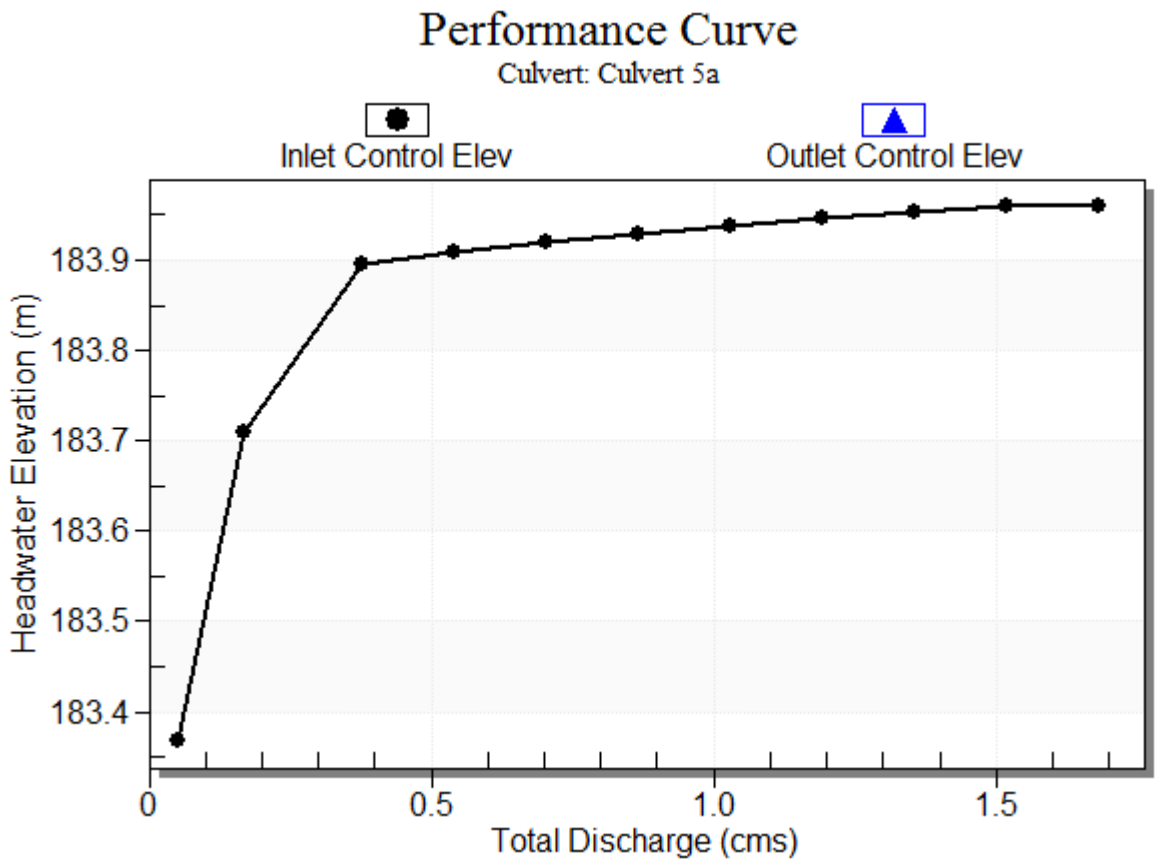


**Table 2 - Culvert Summary Table: Culvert 5a**

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.05	0.05	183.39	0.238	0.260	2-M2c	0.178	0.158	0.158	0.102	1.079	0.480
0.17	0.17	183.79	0.579	0.664	7-M2c	0.400	0.298	0.299	0.162	1.687	0.652
0.38	0.21	184.10	0.766	0.965	7-M2c	0.400	0.331	0.333	0.218	1.919	0.795
0.54	0.22	184.12	0.779	0.985	7-M2c	0.400	0.333	0.335	0.249	1.935	0.870
0.70	0.22	184.13	0.791	1.002	7-M2c	0.400	0.334	0.337	0.275	1.948	0.929
0.86	0.22	184.15	0.798	1.018	7-M2c	0.400	0.335	0.338	0.297	1.957	0.979
1.03	0.22	184.16	0.807	1.031	7-M2c	0.400	0.336	0.339	0.317	1.967	1.022
1.19	0.22	184.17	0.816	1.044	7-M2c	0.400	0.337	0.340	0.335	1.977	1.060
1.35	0.23	184.19	0.823	1.057	7-M2t	0.400	0.338	0.352	0.352	1.934	1.095
1.52	0.23	184.20	0.830	1.068	7-M2t	0.400	0.339	0.367	0.367	1.886	1.126
1.68	0.23	184.21	0.830	1.080	7-M2t	0.400	0.339	0.381	0.381	1.843	1.155

\*\*\*\*\*  
Inlet Elevation (invert): 183.13 m, Outlet Elevation (invert): 182.98 m  
Culvert Length: 12.90 m, Culvert Slope: 0.0116  
\*\*\*\*\*

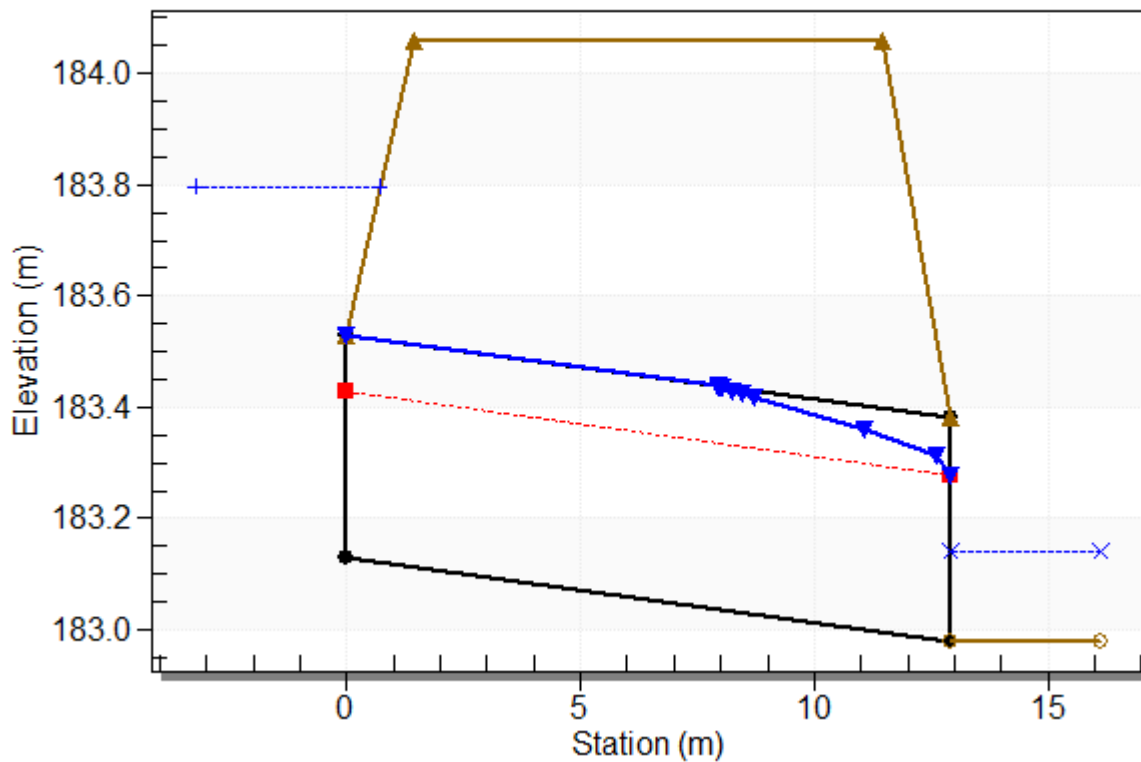
### Culvert Performance Curve Plot: Culvert 5a



## Water Surface Profile Plot for Culvert: Culvert 5a

Crossing - Crossing 5a, Design Discharge - 0.17 cms

Culvert - Culvert 5a, Culvert Discharge - 0.17 cms



### Site Data - Culvert 5a

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 183.13 m

Outlet Station: 12.90 m

Outlet Elevation: 182.98 m

Number of Barrels: 1

### Culvert Data Summary - Culvert 5a

Barrel Shape: Circular

Barrel Diameter: 400.00 mm

Barrel Material: Corrugated Steel

Embedment: 0.00 mm

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Thin Edge Projecting

Inlet Depression: NONE



**Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 5a)**

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
0.05	183.08	0.10	0.48	15.01	0.68
0.17	183.14	0.16	0.65	23.75	0.73
0.38	183.20	0.22	0.79	31.98	0.77
0.54	183.23	0.25	0.87	36.61	0.79
0.70	183.25	0.27	0.93	40.42	0.80
0.86	183.28	0.30	0.98	43.71	0.81
1.03	183.30	0.32	1.02	46.63	0.82
1.19	183.32	0.34	1.06	49.28	0.83
1.35	183.33	0.35	1.09	51.71	0.83
1.52	183.35	0.37	1.13	53.96	0.84
1.68	183.36	0.38	1.16	56.07	0.84

### **Tailwater Channel Data - Crossing 5a**

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 10.00 (1:1)

Channel Slope: 0.0150

Channel Manning's n: 0.0350

Channel Invert Elevation: 182.98 m

### **Roadway Data for Crossing: Crossing 5a**

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 15.00 m

Crest Elevation: 184.06 m

Roadway Surface: Paved

Roadway Top Width: 10.00 m

# HY-8 Culvert Analysis Report

Crossing Notes: Crossing 8 Existing

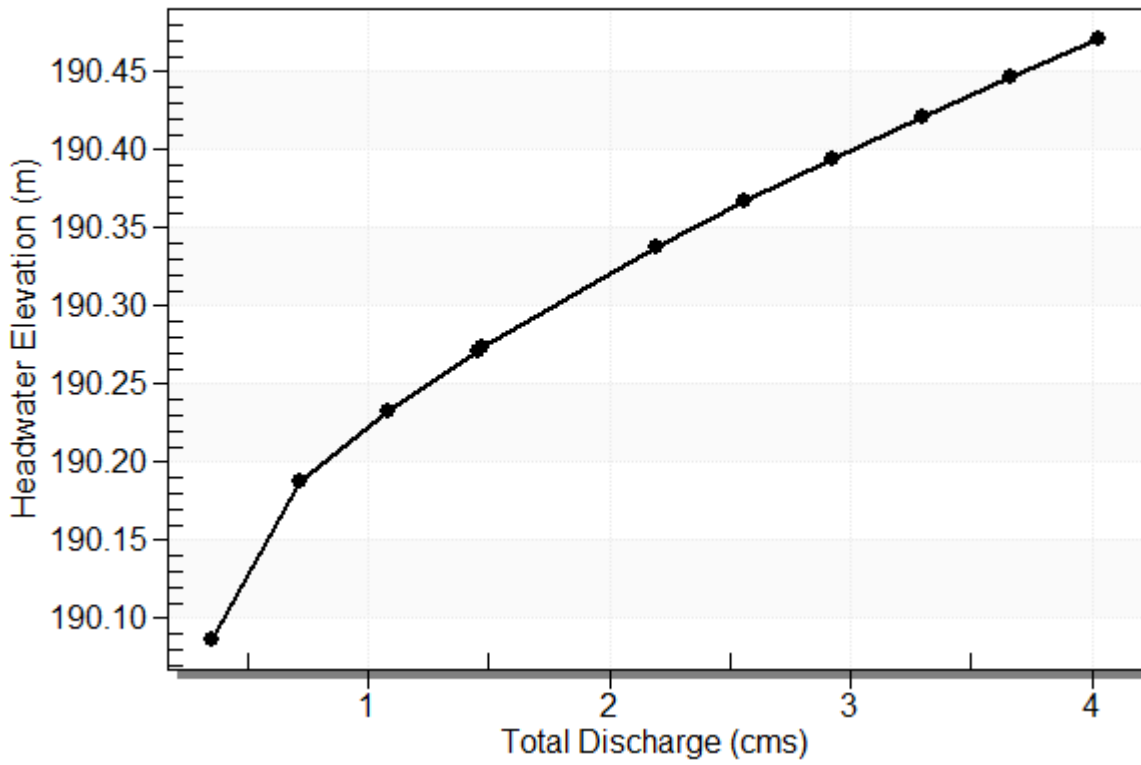
**Table 1 - Summary of Culvert Flows at Crossing: Crossing 8 Existing**

Headwater Elevation (m)	Total Discharge (cms)	Culvert 8 Discharge (cms)	Roadway Discharge (cms)	Iterations
190.09	0.35	0.35	0.00	1
190.19	0.72	0.36	0.35	7
190.23	1.09	0.37	0.72	5
190.27	1.45	0.37	1.08	5
190.27	1.47	0.37	1.10	3
190.34	2.19	0.38	1.81	4
190.37	2.56	0.38	2.18	4
190.39	2.93	0.38	2.54	3
190.42	3.29	0.39	2.91	3
190.45	3.66	0.39	3.27	3
190.47	4.03	0.39	3.64	3
190.11	0.35	0.35	0.00	Overtopping

# Rating Curve Plot for Crossing: Crossing 8 Existing

## Total Rating Curve

Crossing: Crossing 8 Existing



**Table 2 - Culvert Summary Table: Culvert 8**

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.35	0.35	190.09	0.875	1.647	7-M2c	0.500	0.403	0.404	0.141	2.058	0.702
0.72	0.36	190.19	0.910	1.747	7-M2c	0.500	0.408	0.410	0.185	2.096	0.840
1.09	0.37	190.23	0.926	1.793	7-M2c	0.500	0.410	0.412	0.216	2.114	0.932
1.45	0.37	190.27	0.940	1.831	7-M2c	0.500	0.412	0.414	0.241	2.128	1.002
1.47	0.37	190.27	0.941	1.833	7-M2c	0.500	0.412	0.414	0.242	2.129	1.005
2.19	0.38	190.34	0.964	1.897	7-M2c	0.500	0.415	0.418	0.281	2.154	1.110
2.56	0.38	190.37	0.974	1.927	7-M2c	0.500	0.416	0.419	0.298	2.164	1.154
2.93	0.38	190.39	0.984	1.954	7-M2c	0.500	0.417	0.420	0.313	2.174	1.194
3.29	0.39	190.42	0.994	1.981	7-M2c	0.500	0.419	0.422	0.327	2.184	1.229
3.66	0.39	190.45	1.003	2.007	7-M2c	0.500	0.420	0.423	0.341	2.194	1.262
4.03	0.39	190.47	1.012	2.031	7-M2c	0.500	0.421	0.424	0.353	2.203	1.293

\*\*\*\*\*

Inlet Elevation (invert): 188.44 m, Outlet Elevation (invert): 188.15 m

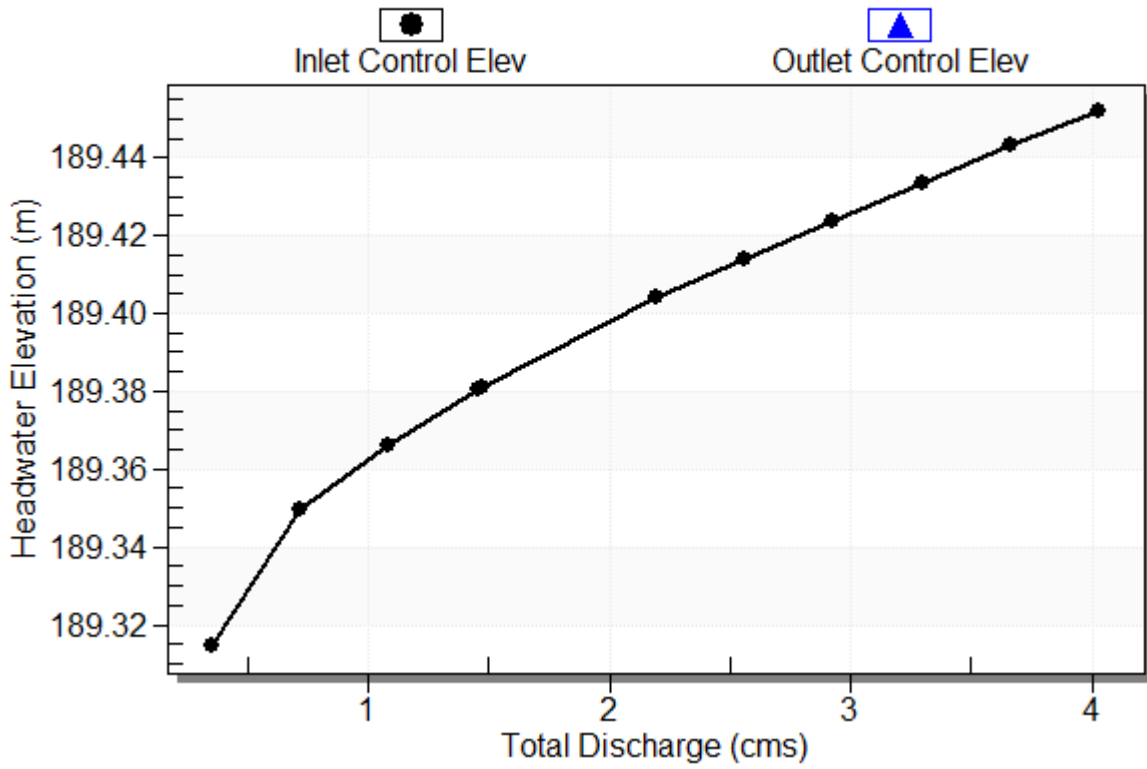
Culvert Length: 19.00 m, Culvert Slope: 0.0153

\*\*\*\*\*

### Culvert Performance Curve Plot: Culvert 8

## Performance Curve

Culvert: Culvert 8

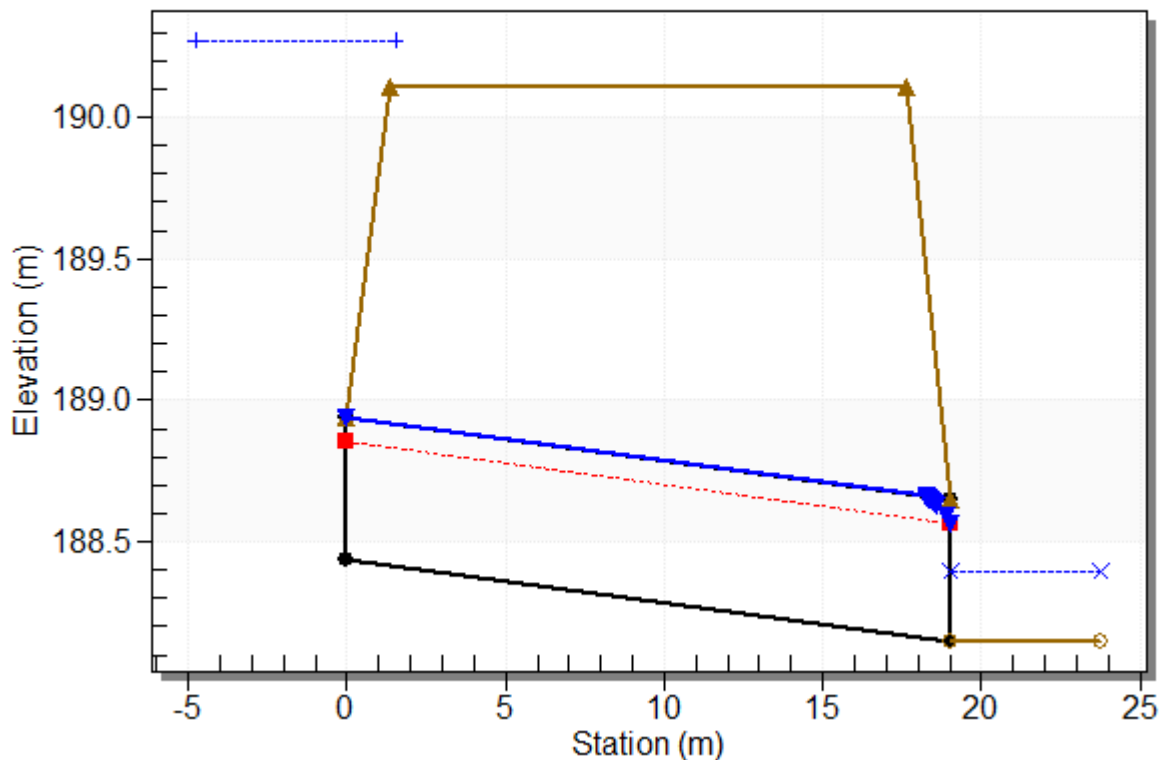




## Water Surface Profile Plot for Culvert: Culvert 8

Crossing - Crossing 8 Existing, Design Discharge - 1.47 cms

Culvert - Culvert 8, Culvert Discharge - 0.37 cms



### Site Data - Culvert 8

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 188.44 m

Outlet Station: 19.00 m

Outlet Elevation: 188.15 m

Number of Barrels: 1

### Culvert Data Summary - Culvert 8

Barrel Shape: Circular

Barrel Diameter: 500.00 mm

Barrel Material: Corrugated Steel

Embedment: 0.00 mm

Barrel Manning's n: 0.0350

Inlet Type: Conventional

Inlet Edge Condition: Thin Edge Projecting

Inlet Depression: NONE

**Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 8 Existing)**

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
0.35	188.29	0.14	0.70	28.66	0.84
0.72	188.33	0.18	0.84	37.52	0.88
1.09	188.37	0.22	0.93	43.81	0.91
1.45	188.39	0.24	1.00	48.88	0.92
1.47	188.39	0.24	1.00	49.08	0.92
2.19	188.43	0.28	1.11	57.00	0.95
2.56	188.45	0.30	1.15	60.42	0.95
2.93	188.46	0.31	1.19	63.54	0.96
3.29	188.48	0.33	1.23	66.42	0.97
3.66	188.49	0.34	1.26	69.12	0.98
4.03	188.50	0.35	1.29	71.64	0.98

### **Tailwater Channel Data - Crossing 8 Existing**

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 25.00 (1:1)

Channel Slope: 0.0207

Channel Manning's n: 0.0350

Channel Invert Elevation: 188.15 m

### **Roadway Data for Crossing: Crossing 8 Existing**

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 10.00 m

Crest Elevation: 190.11 m

Roadway Surface: Paved

Roadway Top Width: 16.30 m

# HY-8 Culvert Analysis Report

Crossing Notes: Crossing 9 Existing

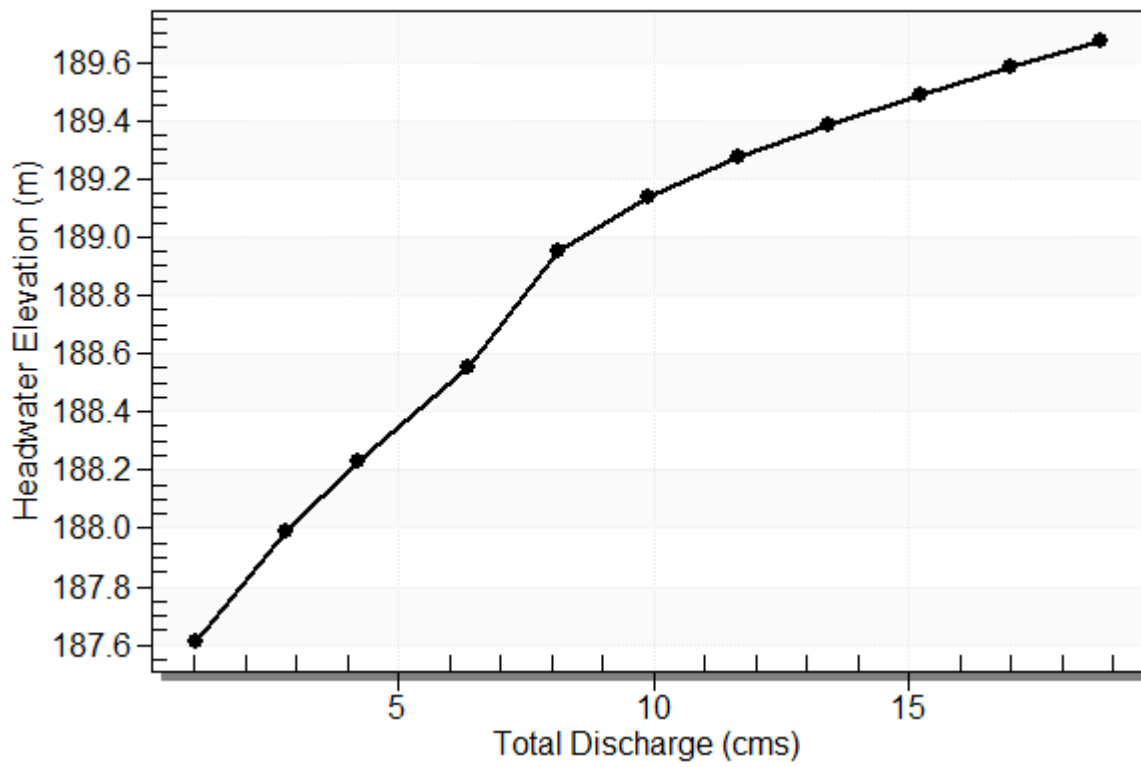
**Table 1 - Summary of Culvert Flows at Crossing: Crossing 9 Existing**

Headwater Elevation (m)	Total Discharge (cms)	Culvert 9 Discharge (cms)	Roadway Discharge (cms)	Iterations
187.61	1.03	1.03	0.00	1
187.99	2.80	2.80	0.00	1
188.23	4.21	4.21	0.00	1
188.56	6.35	6.35	0.00	1
188.95	8.12	8.10	0.02	9
189.14	9.89	8.11	1.78	5
189.27	11.66	7.84	3.81	4
189.38	13.43	7.48	5.95	4
189.49	15.21	7.06	8.14	4
189.58	16.98	6.59	10.39	4
189.68	18.75	6.06	12.69	4
188.94	8.09	8.09	0.00	Overtopping

# Rating Curve Plot for Crossing: Crossing 9 Existing

## Total Rating Curve

Crossing: Crossing 9 Existing



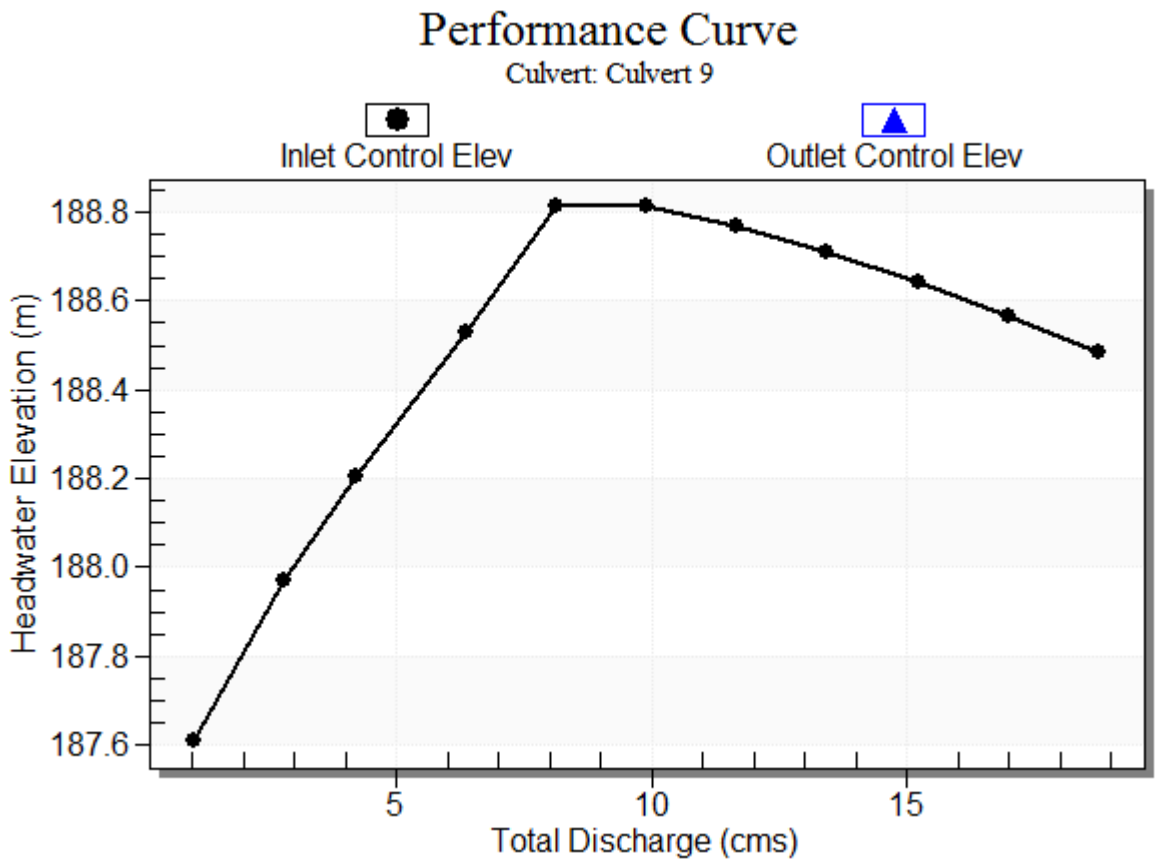
**Table 2 - Culvert Summary Table: Culvert 9**

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
1.03	1.03	187.61	0.389	0.395	3-M1t	0.277	0.230	0.312	0.312	1.102	0.826
2.80	2.80	187.99	0.753	0.770	3-M1t	0.538	0.447	0.595	0.595	1.570	1.177
4.21	4.21	188.23	0.983	1.012	3-M1t	0.711	0.587	0.781	0.781	1.797	1.348
6.35	6.35	188.56	1.308	1.335	7-M1t	0.947	0.771	1.035	1.035	2.045	1.534
8.12	8.10	188.95	1.591	1.730	4-FFf	1.200	0.907	1.200	1.229	2.249	1.651
9.89	8.11	189.14	1.594	1.919	4-FFf	1.200	0.909	1.200	1.415	2.254	1.747
11.66	7.84	189.27	1.548	2.051	4-FFf	1.200	0.888	1.200	1.595	2.179	1.828
13.43	7.48	189.38	1.488	2.165	4-FFf	1.065	0.861	1.200	1.769	2.078	1.898
15.21	7.06	189.49	1.420	2.268	4-FFf	1.021	0.828	1.200	1.940	1.962	1.959
16.98	6.59	189.58	1.345	2.364	4-FFf	0.972	0.791	1.200	2.107	1.830	2.014
18.75	6.06	189.68	1.264	2.456	4-FFf	0.916	0.748	1.200	2.272	1.684	2.063

\*\*\*\*\*  
Inlet Elevation (invert): 187.22 m, Outlet Elevation (invert): 187.00 m  
Culvert Length: 17.50 m, Culvert Slope: 0.0126  
\*\*\*\*\*



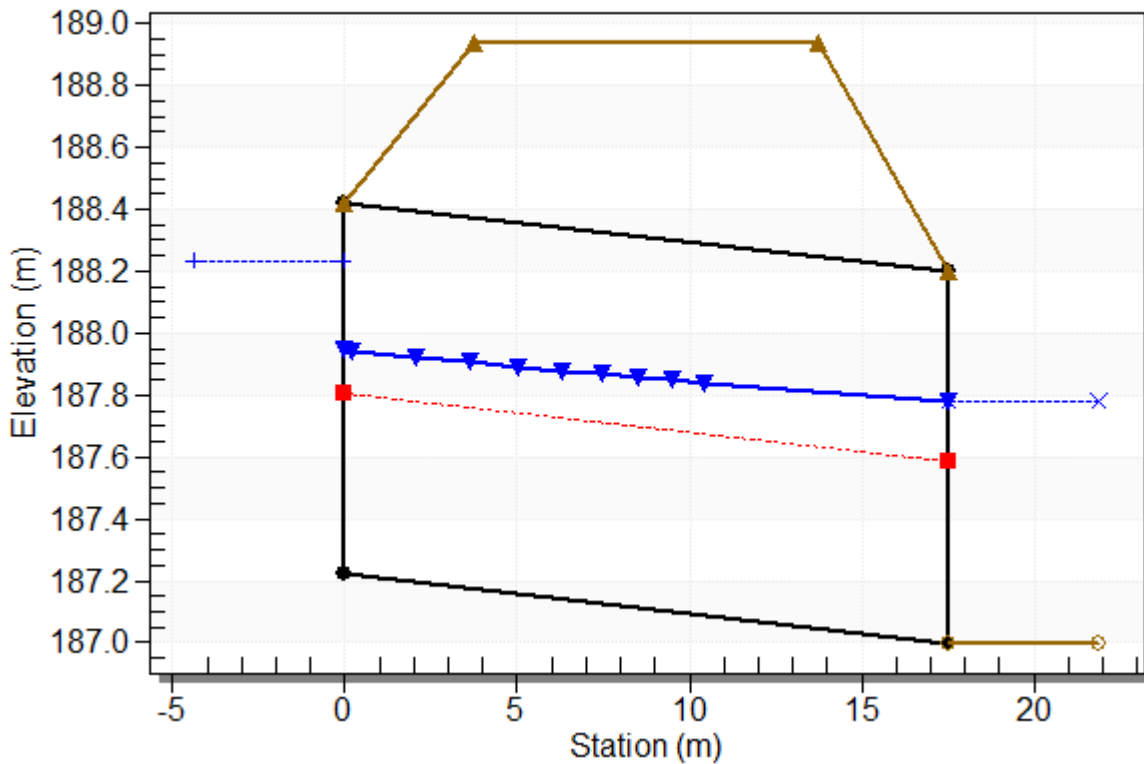
### Culvert Performance Curve Plot: Culvert 9



## Water Surface Profile Plot for Culvert: Culvert 9

Crossing - Crossing 9 Existing , Design Discharge - 4.21 cms

Culvert - Culvert 9, Culvert Discharge - 4.21 cms



### Site Data - Culvert 9

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 187.22 m

Outlet Station: 17.50 m

Outlet Elevation: 187.00 m

Number of Barrels: 1

### Culvert Data Summary - Culvert 9

Barrel Shape: Concrete Box

Barrel Span: 3000.00 mm

Barrel Rise: 1200.00 mm

Barrel Material: Concrete

Embedment: 0.00 mm

Barrel Manning's n: 0.0350

Inlet Type: Conventional

Inlet Edge Condition: Square Edge (90°) Headwall

Inlet Depression: NONE

**Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 9 Existing )**

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
1.03	187.31	0.31	0.83	14.66	0.47
2.80	187.60	0.60	1.18	28.00	0.49
4.21	187.78	0.78	1.35	36.75	0.49
6.35	188.03	1.03	1.53	48.68	0.48
8.12	188.23	1.23	1.65	57.85	0.48
9.89	188.42	1.42	1.75	66.60	0.47
11.66	188.59	1.59	1.83	75.04	0.46
13.43	188.77	1.77	1.90	83.25	0.46
15.21	188.94	1.94	1.96	91.28	0.45
16.98	189.11	2.11	2.01	99.16	0.44
18.75	189.27	2.27	2.06	106.92	0.44

### **Tailwater Channel Data - Crossing 9 Existing**

Tailwater Channel Option: Rectangular Channel

Bottom Width: 4.00 m

Channel Slope: 0.0048

Channel Manning's n: 0.0350

Channel Invert Elevation: 187.00 m

### **Roadway Data for Crossing: Crossing 9 Existing**

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 12.00 m

Crest Elevation: 188.94 m

Roadway Surface: Paved

Roadway Top Width: 10.00 m

# HY-8 Culvert Analysis Report

Crossing Notes: Crossing 10 Existing

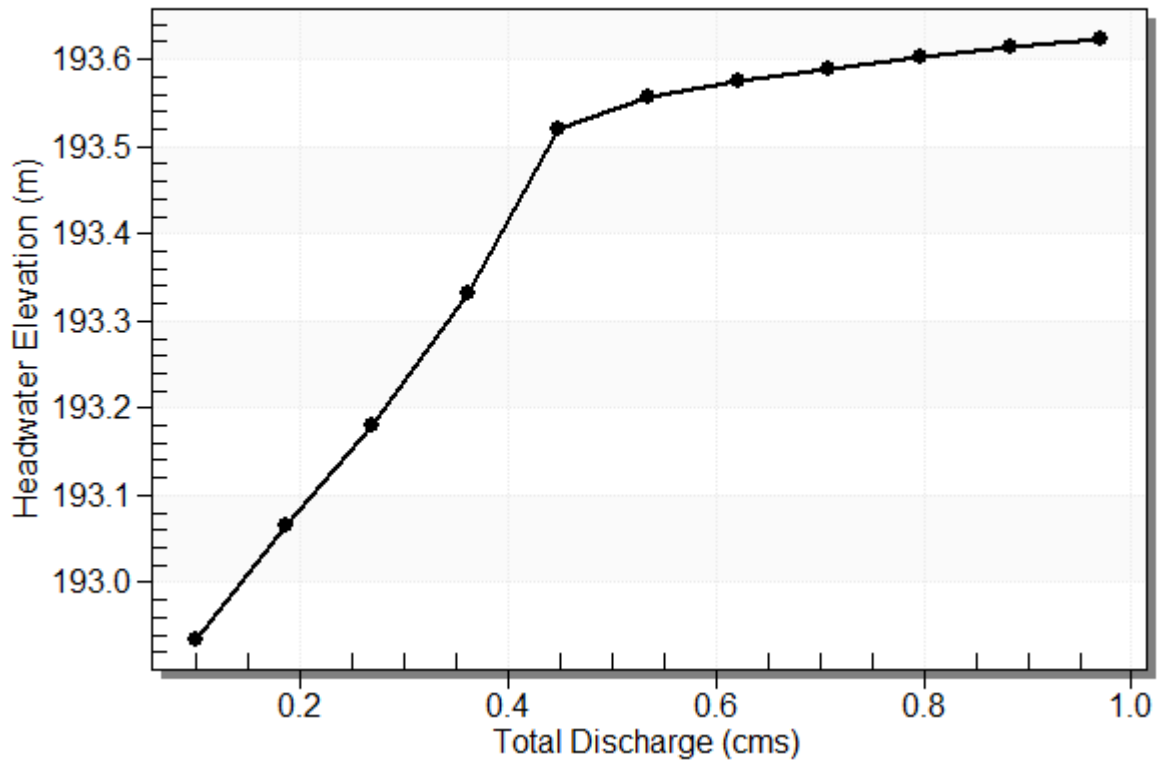
**Table 1 - Summary of Culvert Flows at Crossing: Crossing 10 Existing**

Headwater Elevation (m)	Total Discharge (cms)	Culvert 10 Discharge (cms)	Roadway Discharge (cms)	Iterations
192.94	0.10	0.10	0.00	1
193.07	0.19	0.19	0.00	1
193.18	0.27	0.27	0.00	1
193.33	0.36	0.36	0.00	1
193.52	0.45	0.45	0.00	1
193.56	0.54	0.46	0.07	7
193.57	0.62	0.47	0.15	5
193.59	0.71	0.47	0.23	4
193.60	0.80	0.48	0.32	4
193.61	0.88	0.48	0.40	3
193.62	0.97	0.49	0.48	3
193.53	0.45	0.45	0.00	Overtopping

# Rating Curve Plot for Crossing: Crossing 10 Existing

## Total Rating Curve

Crossing: Crossing 10 Existing



**Table 2 - Culvert Summary Table: Culvert 10**

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.10	0.10	192.94	0.296	0.0*	1-S2n	0.152	0.212	0.152	0.110	1.977	0.413
0.19	0.19	193.07	0.425	0.0*	1-S2n	0.212	0.295	0.214	0.139	2.340	0.483
0.27	0.27	193.18	0.539	0.0*	5-S2n	0.263	0.356	0.278	0.160	2.408	0.529
0.36	0.36	193.33	0.692	0.008	5-S2n	0.317	0.408	0.318	0.178	2.748	0.569
0.45	0.45	193.52	0.881	0.023	5-S2n	0.373	0.445	0.389	0.193	2.737	0.601
0.54	0.46	193.56	0.917	0.036	5-S2n	0.384	0.451	0.397	0.206	2.763	0.628
0.62	0.47	193.57	0.934	0.048	5-S2n	0.389	0.454	0.402	0.218	2.775	0.652
0.71	0.47	193.59	0.948	0.059	5-S2n	0.393	0.457	0.405	0.229	2.784	0.674
0.80	0.48	193.60	0.962	0.070	5-S2n	0.396	0.459	0.408	0.240	2.793	0.694
0.88	0.48	193.61	0.973	0.079	5-S2n	0.399	0.461	0.410	0.249	2.800	0.712
0.97	0.49	193.62	0.984	0.088	5-S2n	0.404	0.462	0.404	0.258	2.873	0.729



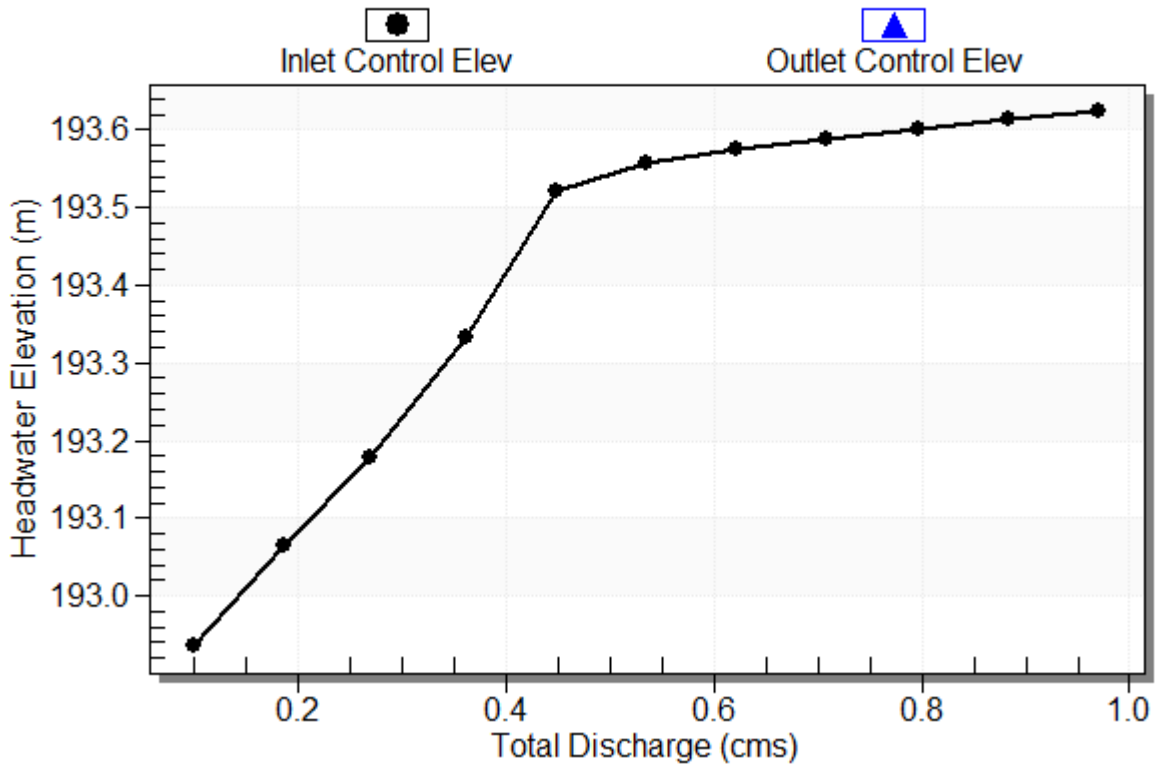
\* theoretical depth is impractical. Depth reported is corrected.

\*\*\*\*\*  
Inlet Elevation (invert): 192.64 m, Outlet Elevation (invert): 192.47 m  
Culvert Length: 11.60 m, Culvert Slope: 0.0147  
\*\*\*\*\*

### Culvert Performance Curve Plot: Culvert 10

## Performance Curve

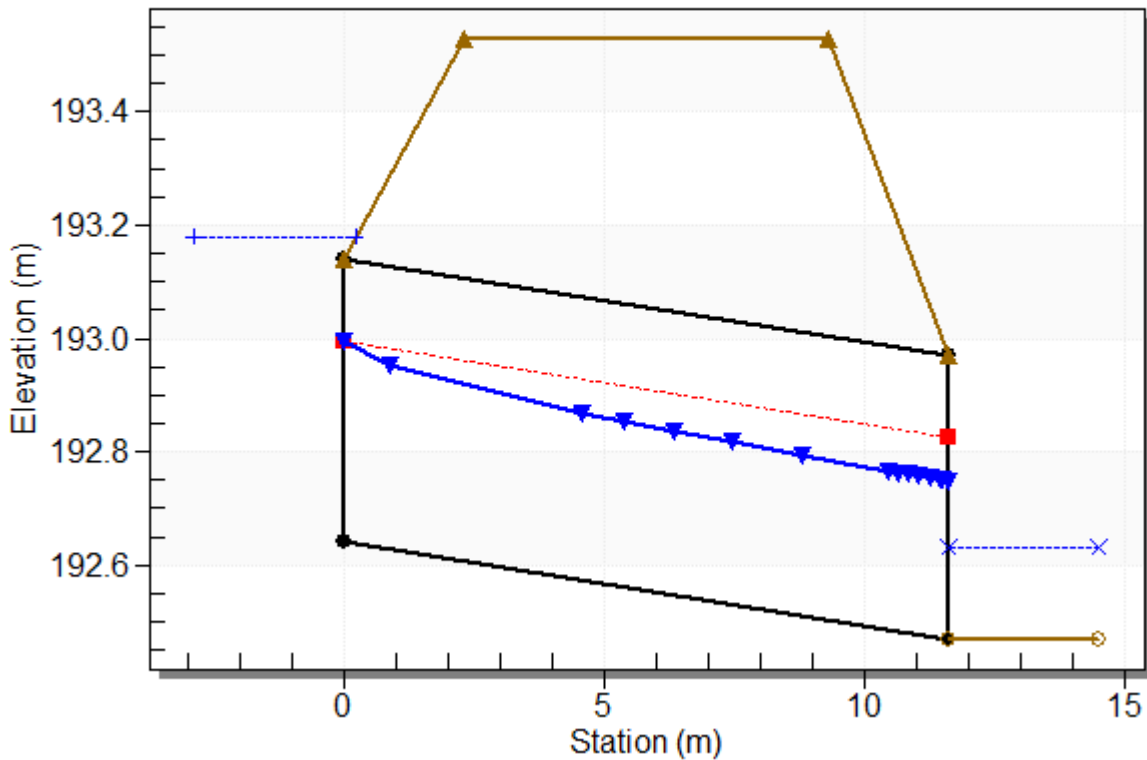
Culvert: Culvert 10



## Water Surface Profile Plot for Culvert: Culvert 10

Crossing - Crossing 10 Existing, Design Discharge - 0.27 cms

Culvert - Culvert 10 , Culvert Discharge - 0.27 cms



### Site Data - Culvert 10

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 192.64 m

Outlet Station: 11.60 m

Outlet Elevation: 192.47 m

Number of Barrels: 1

### Culvert Data Summary - Culvert 10

Barrel Shape: Circular

Barrel Diameter: 500.00 mm

Barrel Material: Concrete

Embedment: 0.00 mm

Barrel Manning's n: 0.0120

Inlet Type: Conventional

Inlet Edge Condition: Grooved End Projecting

Inlet Depression: NONE

**Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 10 Existing)**

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
0.10	192.58	0.11	0.41	10.79	0.56
0.19	192.61	0.14	0.48	13.64	0.58
0.27	192.63	0.16	0.53	15.65	0.60
0.36	192.65	0.18	0.57	17.45	0.61
0.45	192.66	0.19	0.60	18.93	0.62
0.54	192.68	0.21	0.63	20.23	0.62
0.62	192.69	0.22	0.65	21.41	0.63
0.71	192.70	0.23	0.67	22.48	0.64
0.80	192.71	0.24	0.69	23.48	0.64
0.88	192.72	0.25	0.71	24.41	0.64
0.97	192.73	0.26	0.73	25.29	0.65

### **Tailwater Channel Data - Crossing 10 Existing**

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 20.00 (1:1)

Channel Slope: 0.0100

Channel Manning's n: 0.0350

Channel Invert Elevation: 192.47 m

### **Roadway Data for Crossing: Crossing 10 Existing**

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 10.00 m

Crest Elevation: 193.53 m

Roadway Surface: Paved

Roadway Top Width: 7.00 m

# HY-8 Culvert Analysis Report

Crossing Notes: Crossing 12 Existing

**Table 1 - Summary of Culvert Flows at Crossing: Crossing 12 Existing**

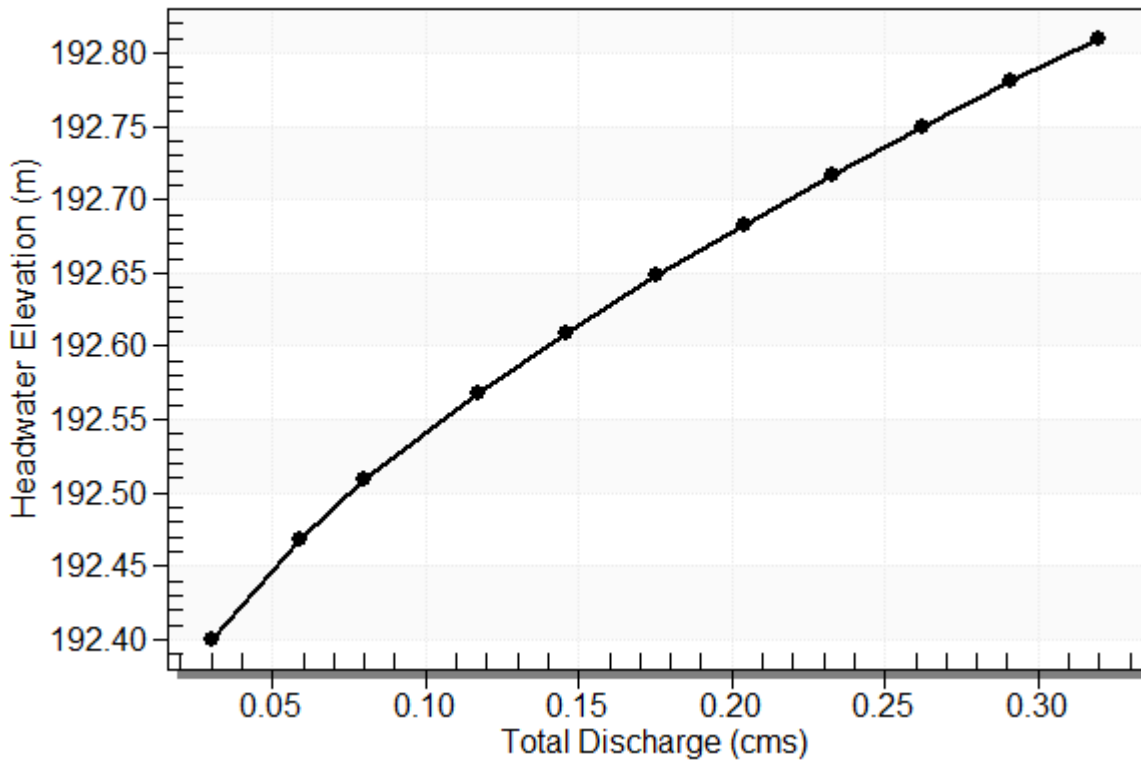
Headwater Elevation (m)	Total Discharge (cms)	Culvert 12 Discharge (cms)	Roadway Discharge (cms)	Iterations
192.40	0.03	0.03	0.00	1
192.47	0.06	0.06	0.00	1
192.51	0.08	0.08	0.00	1
192.57	0.12	0.12	0.00	1
192.61	0.15	0.15	0.00	1
192.65	0.17	0.17	0.00	1
192.68	0.20	0.20	0.00	1
192.72	0.23	0.23	0.00	1
192.75	0.26	0.26	0.00	1
192.78	0.29	0.29	0.00	1
192.81	0.32	0.32	0.00	1
193.07	0.59	0.59	0.00	Overtopping



Rating Curve Plot for Crossing: Crossing 12 Existing

Total Rating Curve

Crossing: Crossing 12 Existing



**Table 2 - Culvert Summary Table: Culvert 12**

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.03	0.03	192.40	0.146	0.160	3-M1t	0.126	0.096	0.183	0.183	0.347	0.450
0.06	0.06	192.47	0.206	0.229	3-M1t	0.182	0.137	0.235	0.235	0.478	0.533
0.08	0.08	192.51	0.244	0.269	3-M1t	0.213	0.164	0.264	0.264	0.554	0.575
0.12	0.12	192.57	0.296	0.328	3-M1t	0.261	0.197	0.304	0.304	0.667	0.632
0.15	0.15	192.61	0.333	0.369	3-M1t	0.293	0.223	0.331	0.331	0.745	0.668
0.17	0.17	192.65	0.367	0.408	3-M1t	0.325	0.246	0.354	0.354	0.816	0.699
0.20	0.20	192.68	0.398	0.443	3-M1t	0.354	0.265	0.375	0.375	0.883	0.727
0.23	0.23	192.72	0.428	0.477	3-M1t	0.382	0.284	0.394	0.394	0.946	0.751
0.26	0.26	192.75	0.457	0.509	3-M1t	0.410	0.303	0.412	0.412	1.006	0.773
0.29	0.29	192.78	0.486	0.540	3-M2t	0.436	0.322	0.428	0.428	1.063	0.794
0.32	0.32	192.81	0.514	0.570	3-M2t	0.463	0.337	0.444	0.444	1.118	0.813

\*\*\*\*\*

Inlet Elevation (invert): 192.24 m, Outlet Elevation (invert): 192.12 m

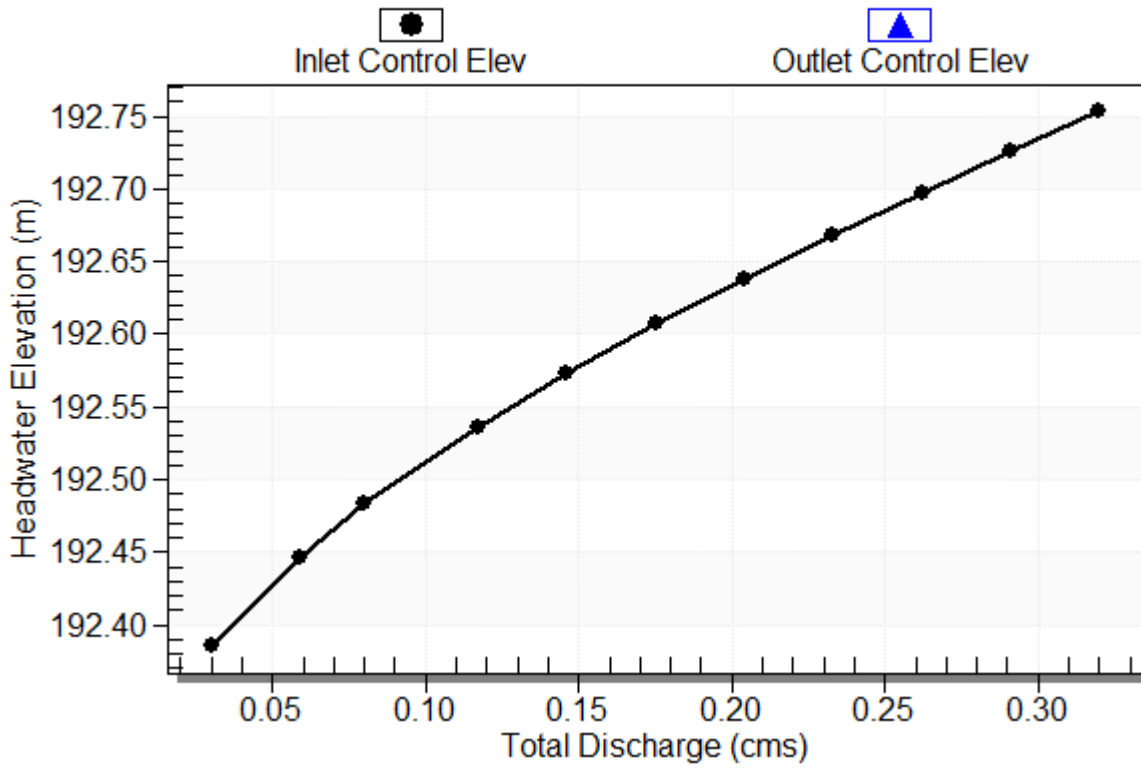
Culvert Length: 24.40 m, Culvert Slope: 0.0049

\*\*\*\*\*

### Culvert Performance Curve Plot: Culvert 12

## Performance Curve

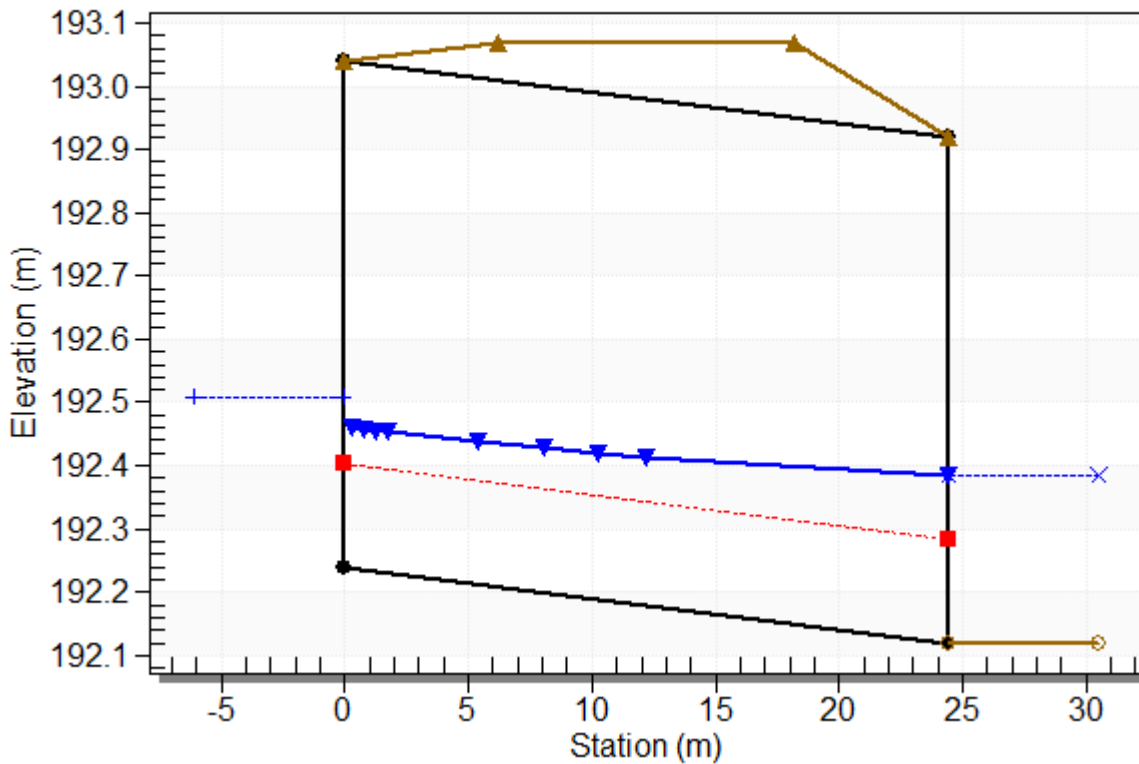
Culvert: Culvert 12



## Water Surface Profile Plot for Culvert: Culvert 12

Crossing - Crossing 12 Existing, Design Discharge - 0.08 cms

Culvert - Culvert 12, Culvert Discharge - 0.08 cms



### Site Data - Culvert 12

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 192.24 m

Outlet Station: 24.40 m

Outlet Elevation: 192.12 m

Number of Barrels: 1

### Culvert Data Summary - Culvert 12

Barrel Shape: Circular

Barrel Diameter: 800.00 mm

Barrel Material: Corrugated Steel

Embedment: 0.00 mm

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Thin Edge Projecting

Inlet Depression: NONE

**Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 12 Existing)**

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
0.03	192.30	0.18	0.45	12.53	0.48
0.06	192.36	0.24	0.53	16.14	0.50
0.08	192.38	0.26	0.57	18.10	0.51
0.12	192.42	0.30	0.63	20.87	0.52
0.15	192.45	0.33	0.67	22.68	0.52
0.17	192.47	0.35	0.70	24.27	0.53
0.20	192.49	0.37	0.73	25.71	0.54
0.23	192.51	0.39	0.75	27.02	0.54
0.26	192.53	0.41	0.77	28.24	0.54
0.29	192.55	0.43	0.79	29.37	0.55
0.32	192.56	0.44	0.81	30.44	0.55

### **Tailwater Channel Data - Crossing 12 Existing**

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 2.00 (1:1)

Channel Slope: 0.0070

Channel Manning's n: 0.0350

Channel Invert Elevation: 192.12 m

### **Roadway Data for Crossing: Crossing 12 Existing**

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 10.00 m

Crest Elevation: 193.07 m

Roadway Surface: Paved

Roadway Top Width: 12.00 m

# HY-8 Culvert Analysis Report

Crossing Notes: Crossing 13 Existing



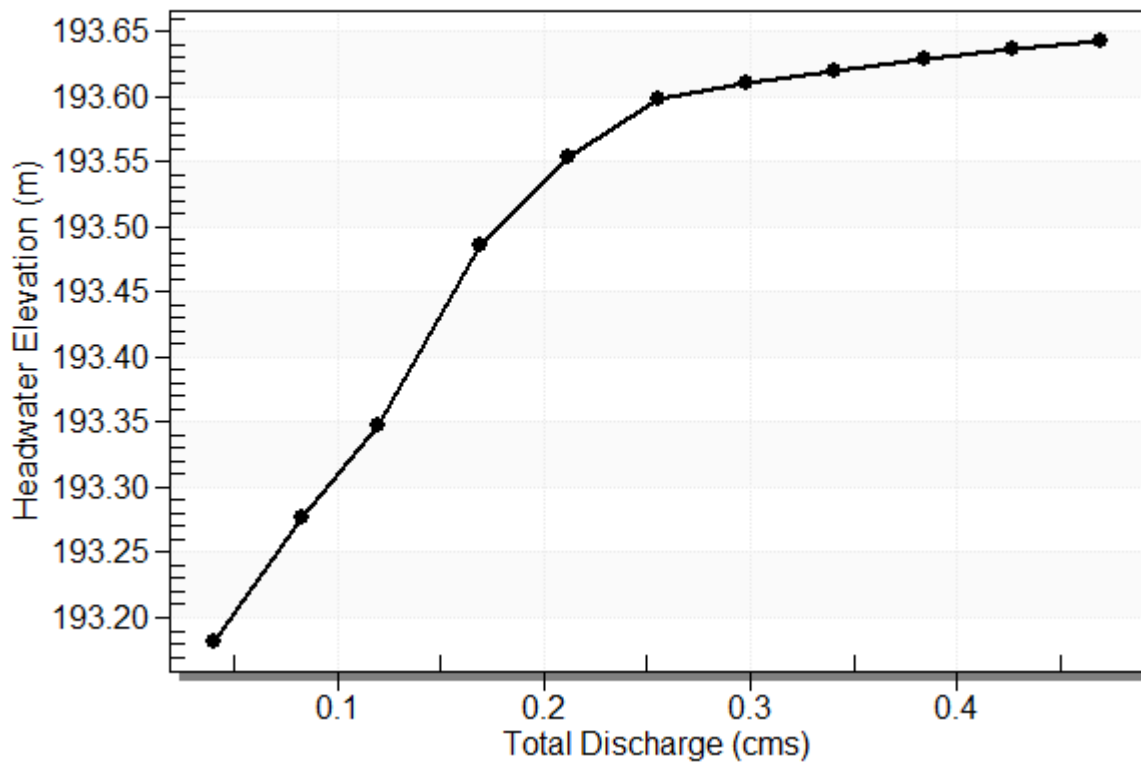
**Table 1 - Summary of Culvert Flows at Crossing: Crossing 13 Existing**

Headwater Elevation (m)	Total Discharge (cms)	Culvert 13 Discharge (cms)	Roadway Discharge (cms)	Iterations
193.18	0.04	0.04	0.00	1
193.28	0.08	0.08	0.00	1
193.35	0.12	0.12	0.00	1
193.49	0.17	0.17	0.00	1
193.55	0.21	0.21	0.00	1
193.60	0.25	0.24	0.01	11
193.61	0.30	0.25	0.05	5
193.62	0.34	0.26	0.08	4
193.63	0.38	0.26	0.12	3
193.64	0.43	0.27	0.16	3
193.64	0.47	0.27	0.20	3
193.59	0.24	0.24	0.00	Overtopping

# Rating Curve Plot for Crossing: Crossing 13 Existing

## Total Rating Curve

Crossing: Crossing 13 Existing



**Table 2 - Culvert Summary Table: Culvert 13**

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.04	0.04	193.18	0.192	0.0*	1-S2n	0.125	0.130	0.127	0.179	1.008	0.417
0.08	0.08	193.28	0.287	0.0*	1-S2n	0.185	0.192	0.186	0.235	1.247	0.500
0.12	0.12	193.35	0.357	0.0*	1-S2n	0.228	0.233	0.230	0.270	1.362	0.548
0.17	0.17	193.49	0.447	0.496	3-M1t	0.280	0.279	0.307	0.307	1.336	0.597
0.21	0.21	193.55	0.529	0.563	7-M1t	0.325	0.314	0.334	0.334	1.519	0.632
0.25	0.24	193.60	0.592	0.608	3-M2t	0.359	0.337	0.358	0.358	1.608	0.662
0.30	0.25	193.61	0.609	0.620	7-M1t	0.369	0.342	0.380	0.380	1.562	0.688
0.34	0.26	193.62	0.623	0.630	7-M1t	0.377	0.347	0.400	0.400	1.523	0.712
0.38	0.26	193.63	0.636	0.638	7-M1t	0.384	0.351	0.418	0.418	1.493	0.733
0.43	0.27	193.64	0.646	0.644	7-M1t	0.389	0.353	0.435	0.435	1.472	0.753
0.47	0.27	193.64	0.653	0.648	7-M1t	0.393	0.355	0.451	0.451	1.444	0.771

\* theoretical depth is impractical. Depth reported is corrected.

\*\*\*\*\*

Inlet Elevation (invert): 192.99 m, Outlet Elevation (invert): 192.72 m

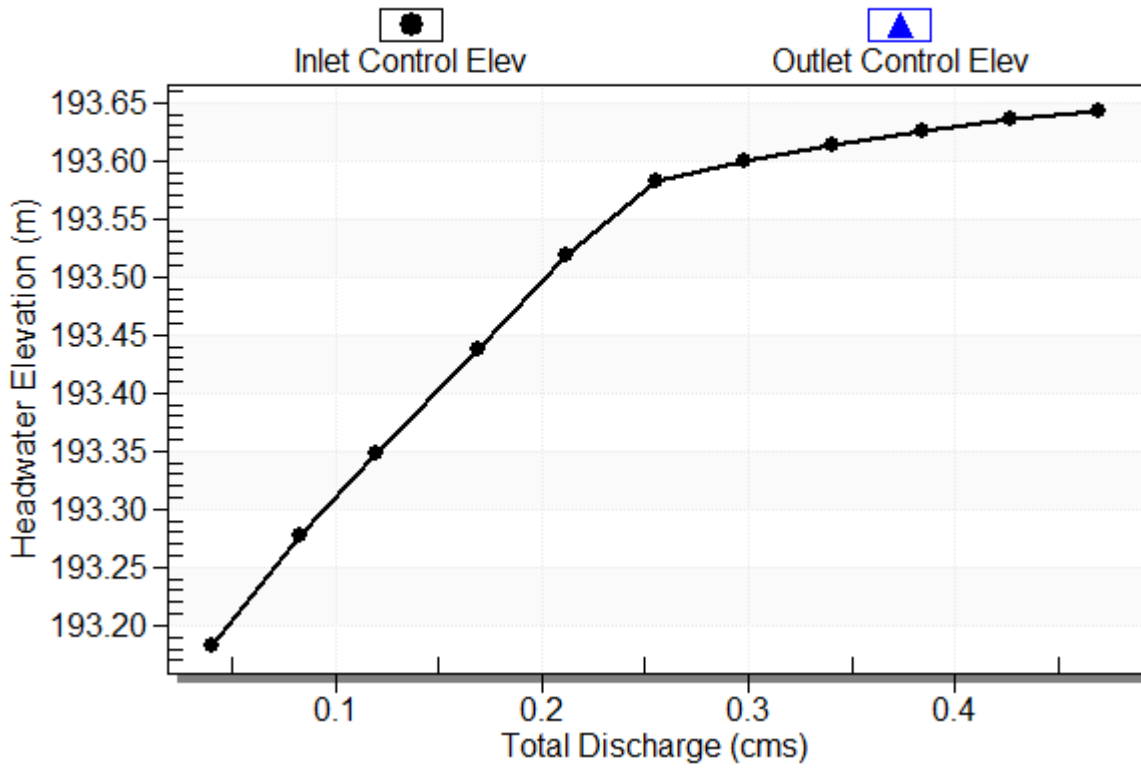
Culvert Length: 14.40 m, Culvert Slope: 0.0187

\*\*\*\*\*

### Culvert Performance Curve Plot: Culvert 13

## Performance Curve

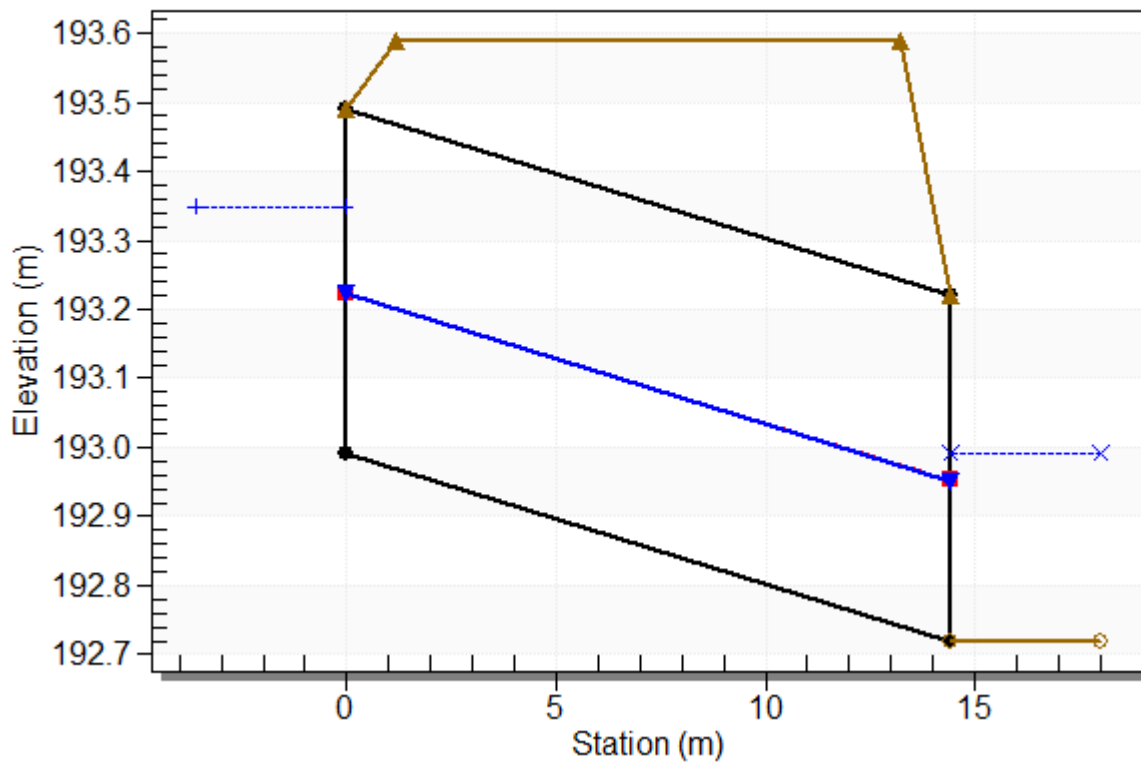
Culvert: Culvert 13



## Water Surface Profile Plot for Culvert: Culvert 13

Crossing - Crossing 13 Existing, Design Discharge - 0.12 cms

Culvert - Culvert 13, Culvert Discharge - 0.12 cms



### Site Data - Culvert 13

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 192.99 m

Outlet Station: 14.40 m

Outlet Elevation: 192.72 m

Number of Barrels: 1

### Culvert Data Summary - Culvert 13

Barrel Shape: Circular

Barrel Diameter: 500.00 mm

Barrel Material: Corrugated Steel

Embedment: 0.00 mm

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Thin Edge Projecting

Inlet Depression: NONE

**Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 13 Existing)**

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
0.04	192.90	0.18	0.42	10.00	0.44
0.08	192.96	0.24	0.50	13.14	0.47
0.12	192.99	0.27	0.55	15.09	0.48
0.17	193.03	0.31	0.60	17.16	0.49
0.21	193.05	0.33	0.63	18.68	0.49
0.25	193.08	0.36	0.66	20.02	0.50
0.30	193.10	0.38	0.69	21.23	0.50
0.34	193.12	0.40	0.71	22.33	0.51
0.38	193.14	0.42	0.73	23.34	0.51
0.43	193.15	0.43	0.75	24.29	0.52
0.47	193.17	0.45	0.77	25.18	0.52



### **Tailwater Channel Data - Crossing 13 Existing**

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 3.00 (1:1)

Channel Slope: 0.0057

Channel Manning's n: 0.0350

Channel Invert Elevation: 192.72 m

### **Roadway Data for Crossing: Crossing 13 Existing**

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 10.00 m

Crest Elevation: 193.59 m

Roadway Surface: Paved

Roadway Top Width: 12.00 m

# HY-8 Culvert Analysis Report

Crossing Notes: Crossing 14 Existing

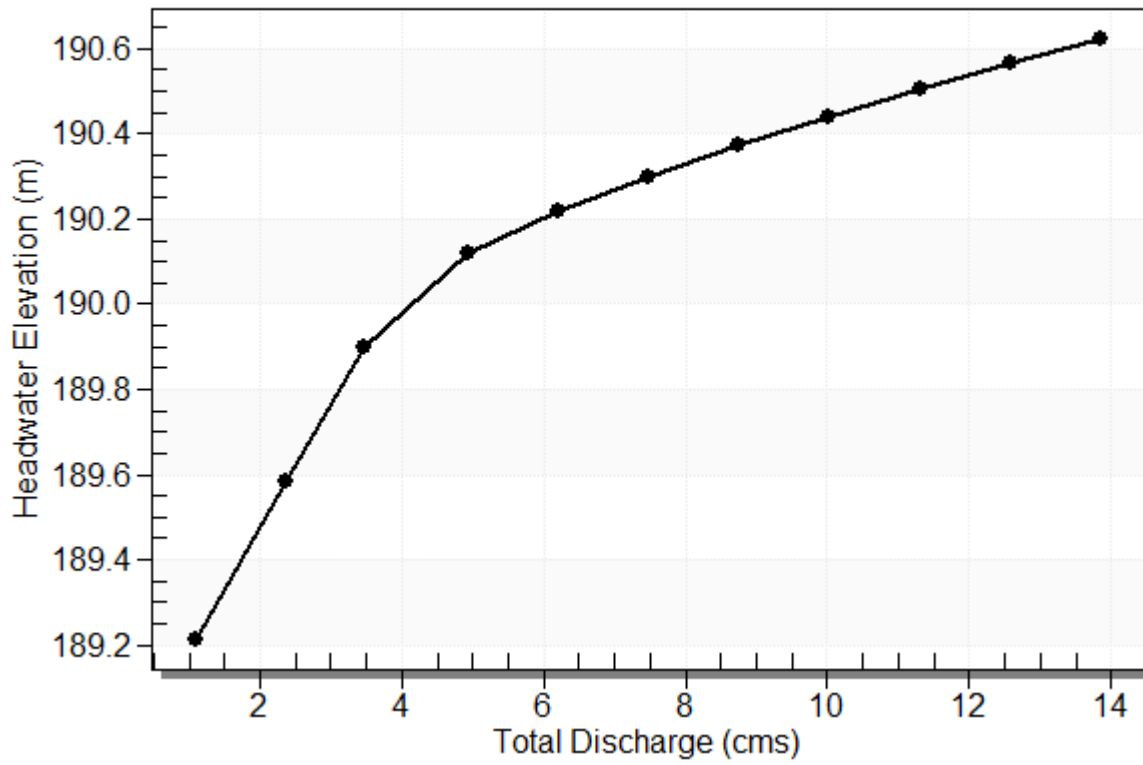
**Table 1 - Summary of Culvert Flows at Crossing: Crossing 14 Existing**

Headwater Elevation (m)	Total Discharge (cms)	Culvert 14 Discharge (cms)	Roadway Discharge (cms)	Iterations
189.21	1.10	1.10	0.00	1
189.58	2.38	2.38	0.00	1
189.90	3.48	3.48	0.00	1
190.12	4.92	4.23	0.69	5
190.22	6.20	4.51	1.68	4
190.30	7.47	4.74	2.73	4
190.37	8.75	4.94	3.81	4
190.44	10.02	5.12	4.90	4
190.51	11.30	5.28	6.02	4
190.57	12.57	5.43	7.15	4
190.63	13.85	5.56	8.28	3
190.00	3.86	3.86	0.00	Overtopping

# Rating Curve Plot for Crossing: Crossing 14 Existing

## Total Rating Curve

Crossing: Crossing 14 Existing



**Table 2 - Culvert Summary Table: Culvert 14**

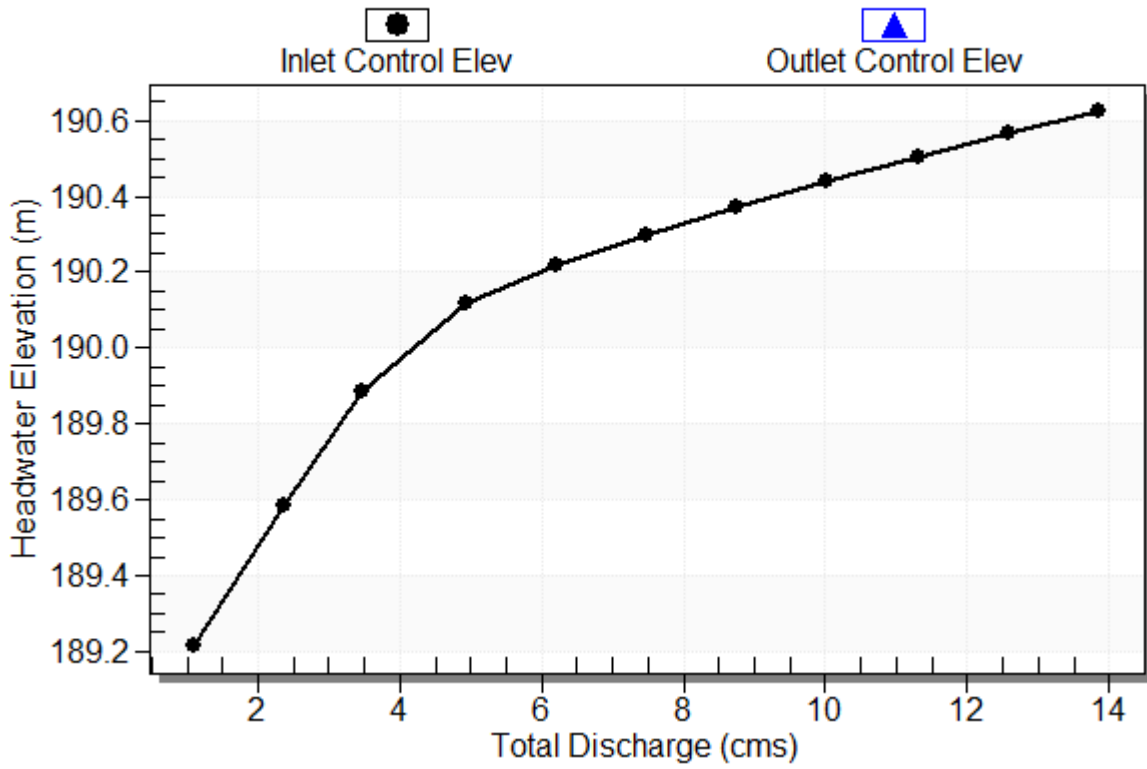
Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
1.10	1.10	189.21	0.555	0.085	1-S2n	0.323	0.331	0.325	0.295	1.832	0.632
2.38	2.38	189.58	0.924	0.184	1-S2n	0.549	0.553	0.550	0.394	2.335	0.767
3.48	3.48	189.90	1.227	1.240	2-M2c	0.723	0.713	0.711	0.454	2.644	0.843
4.92	4.23	190.12	1.460	1.406	2-M2c	0.834	0.813	0.810	0.517	2.824	0.920
6.20	4.51	190.22	1.556	1.468	2-M2c	0.876	0.848	0.846	0.564	2.886	0.974
7.47	4.74	190.30	1.638	1.517	2-M2c	1.000	0.877	0.875	0.605	2.931	1.021
8.75	4.94	190.37	1.712	1.558	2-M2c	1.000	0.901	0.899	0.642	2.972	1.062
10.02	5.12	190.44	1.781	1.594	2-M2c	1.000	0.923	0.920	0.675	3.007	1.099
11.30	5.28	190.51	1.845	1.626	2-M2c	1.000	0.942	0.939	0.706	3.038	1.132
12.57	5.43	190.57	1.907	1.768	7-M2c	1.000	0.959	0.957	0.735	3.066	1.163
13.85	5.56	190.63	1.965	1.850	7-M2c	1.000	0.975	0.973	0.762	3.092	1.191

\*\*\*\*\*  
Inlet Elevation (invert): 188.66 m, Outlet Elevation (invert): 188.45 m  
Culvert Length: 10.40 m, Culvert Slope: 0.0202  
\*\*\*\*\*

# Culvert Performance Curve Plot: Culvert 14

## Performance Curve

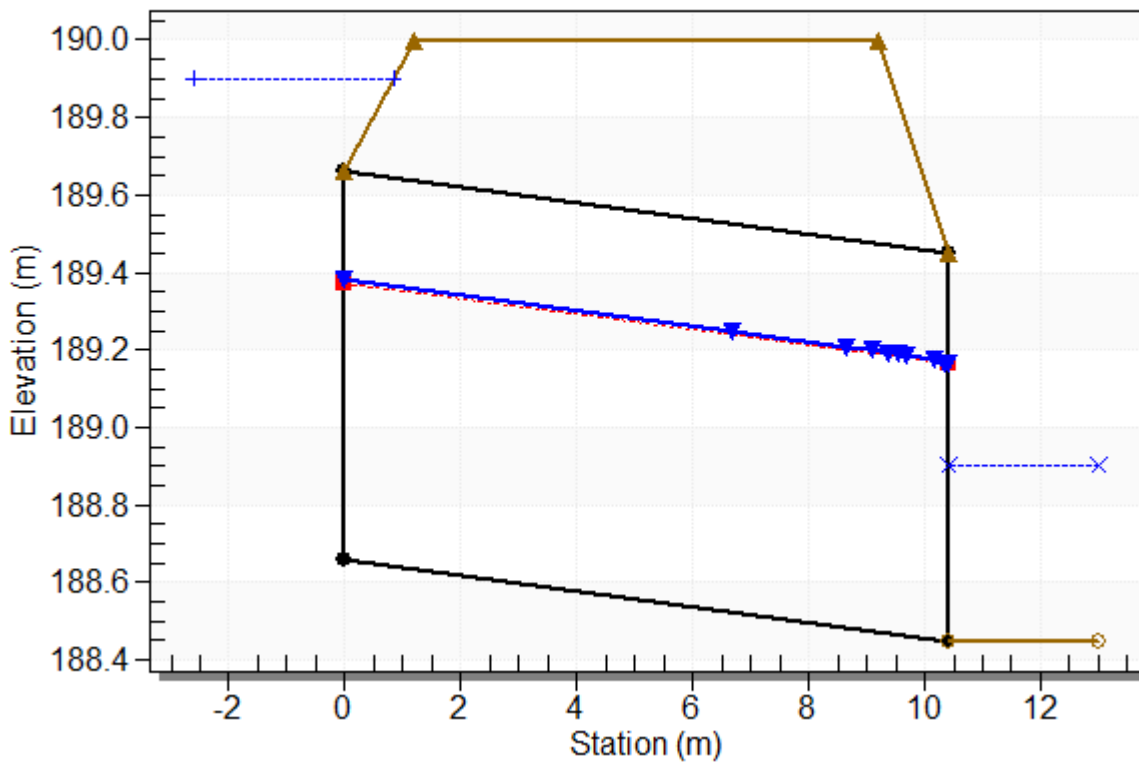
Culvert: Culvert 14



## Water Surface Profile Plot for Culvert: Culvert 14

Crossing - Crossing 14 Existing, Design Discharge - 3.48 cms

Culvert - Culvert 14, Culvert Discharge - 3.48 cms



### Site Data - Culvert 14

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 188.66 m

Outlet Station: 10.40 m

Outlet Elevation: 188.45 m

Number of Barrels: 1

### Culvert Data Summary - Culvert 14

Barrel Shape: Concrete Box

Barrel Span: 1850.00 mm

Barrel Rise: 1000.00 mm

Barrel Material: Concrete

Embedment: 0.00 mm

Barrel Manning's n: 0.0300

Inlet Type: Conventional

Inlet Edge Condition: Square Edge (90°) Headwall

Inlet Depression: NONE



**Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 14 Existing)**

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
1.10	188.74	0.29	0.63	18.21	0.53
2.38	188.84	0.39	0.77	24.30	0.55
3.48	188.90	0.45	0.84	28.05	0.56
4.92	188.97	0.52	0.92	31.95	0.58
6.20	189.01	0.56	0.97	34.83	0.59
7.47	189.05	0.60	1.02	37.36	0.59
8.75	189.09	0.64	1.06	39.63	0.60
10.02	189.13	0.68	1.10	41.71	0.60
11.30	189.16	0.71	1.13	43.62	0.61
12.57	189.19	0.74	1.16	45.41	0.61
13.85	189.21	0.76	1.19	47.08	0.62

### **Tailwater Channel Data - Crossing 14 Existing**

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 20.00 (1:1)

Channel Slope: 0.0063

Channel Manning's n: 0.0350

Channel Invert Elevation: 188.45 m

### **Roadway Data for Crossing: Crossing 14 Existing**

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 10.00 m

Crest Elevation: 190.00 m

Roadway Surface: Paved

Roadway Top Width: 8.00 m

# HY-8 Culvert Analysis Report

Crossing Notes: Crossing 16 Existing

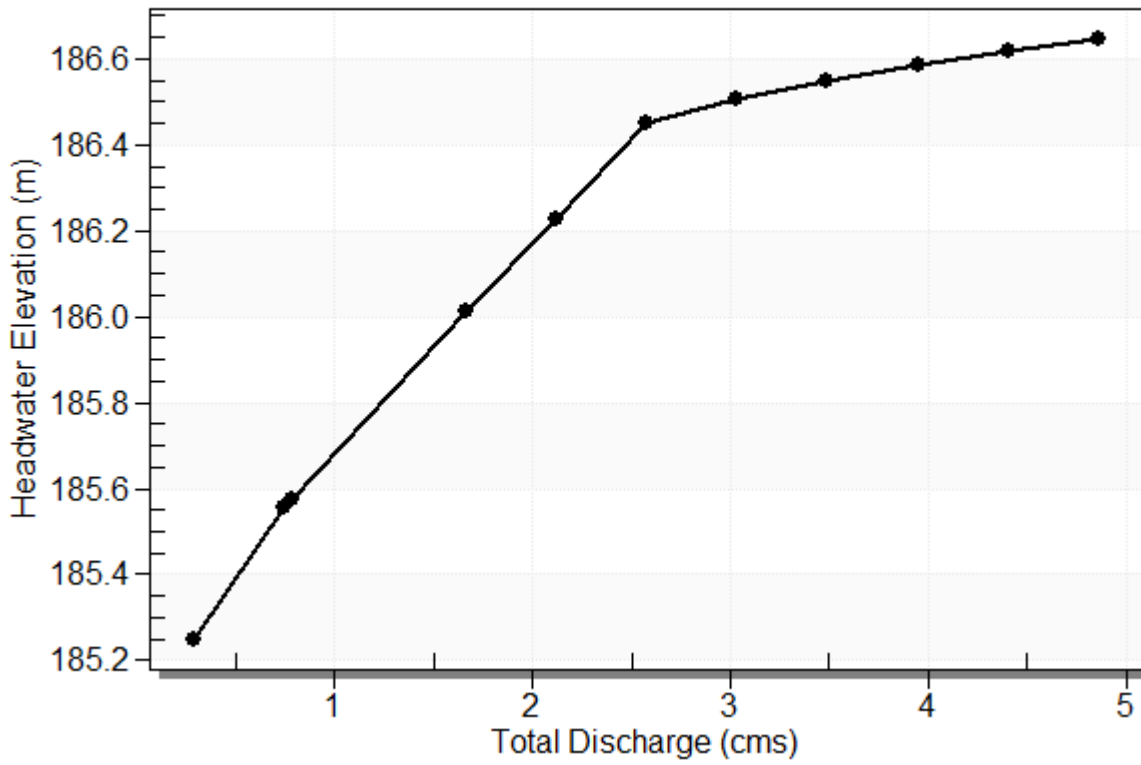
**Table 1 - Summary of Culvert Flows at Crossing: Crossing 16 Existing**

Headwater Elevation (m)	Total Discharge (cms)	Culvert 16 Discharge (cms)	Roadway Discharge (cms)	Iterations
185.25	0.29	0.29	0.00	1
185.55	0.75	0.75	0.00	1
185.57	0.78	0.78	0.00	1
186.01	1.66	1.66	0.00	1
186.23	2.12	2.12	0.00	1
186.45	2.57	2.53	0.05	10
186.51	3.03	2.61	0.42	6
186.55	3.49	2.67	0.81	5
186.58	3.95	2.72	1.22	5
186.62	4.40	2.77	1.63	4
186.65	4.86	2.81	2.05	4
186.43	2.50	2.50	0.00	Overtopping

# Rating Curve Plot for Crossing: Crossing 16 Existing

## Total Rating Curve

Crossing: Crossing 16 Existing



**Table 2 - Culvert Summary Table: Culvert 16**

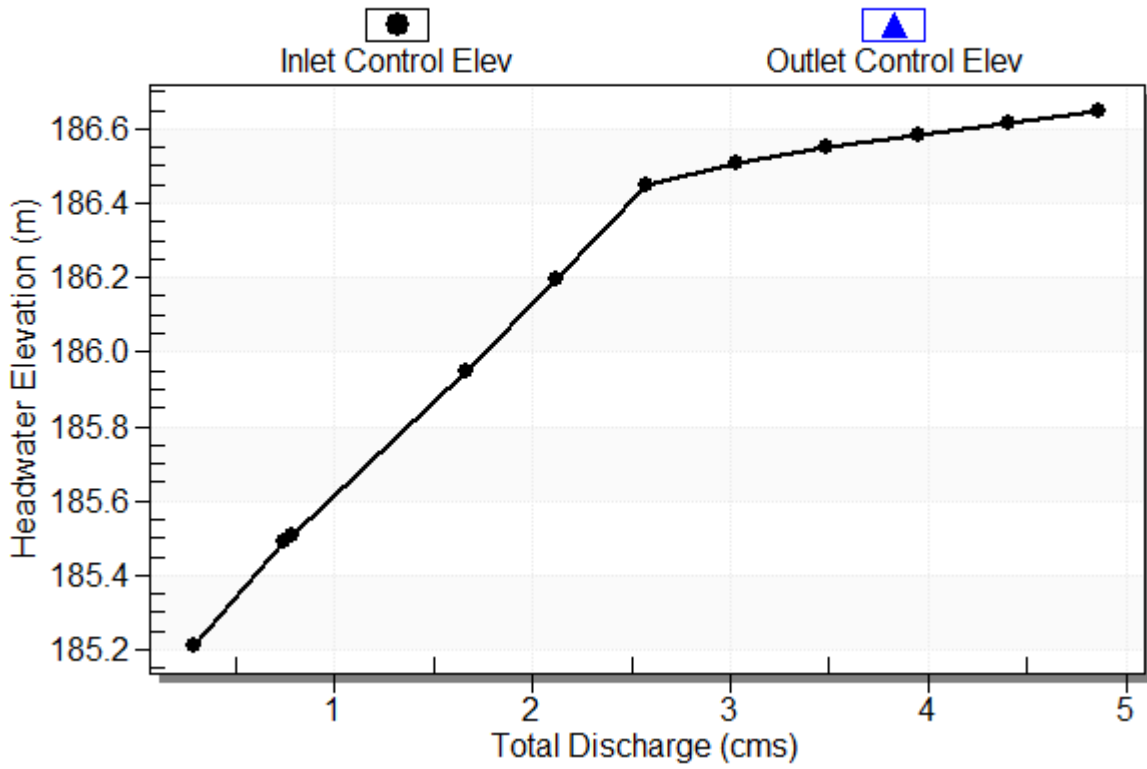
Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.29	0.29	185.25	0.420	0.461	3-M2t	0.390	0.280	0.297	0.297	1.332	0.471
0.75	0.75	185.55	0.700	0.764	2-M2c	0.667	0.464	0.465	0.423	1.844	0.596
0.78	0.78	185.57	0.718	0.783	2-M2c	0.685	0.475	0.476	0.430	1.868	0.603
1.66	1.66	186.01	1.159	1.222	2-M2c	1.200	0.705	0.706	0.571	2.399	0.728
2.12	2.12	186.23	1.405	1.437	2-M2c	1.200	0.799	0.801	0.625	2.640	0.774
2.57	2.53	186.45	1.658	1.647	2-M2c	1.200	0.873	0.876	0.673	2.861	0.812
3.03	2.61	186.51	1.716	1.696	2-M2c	1.200	0.888	0.891	0.715	2.908	0.846
3.49	2.67	186.55	1.758	1.731	2-M2c	1.200	0.897	0.901	0.754	2.941	0.876
3.95	2.72	186.58	1.795	1.761	2-M2c	1.200	0.906	0.909	0.790	2.969	0.904
4.40	2.77	186.62	1.828	1.793	7-M2c	1.200	0.913	0.917	0.823	2.994	0.929
4.86	2.81	186.65	1.858	1.821	7-M2c	1.200	0.920	0.923	0.854	3.016	0.952

\*\*\*\*\*  
Inlet Elevation (invert): 184.79 m, Outlet Elevation (invert): 184.75 m  
Culvert Length: 11.40 m, Culvert Slope: 0.0035  
\*\*\*\*\*

# Culvert Performance Curve Plot: Culvert 16

## Performance Curve

Culvert: Culvert 16

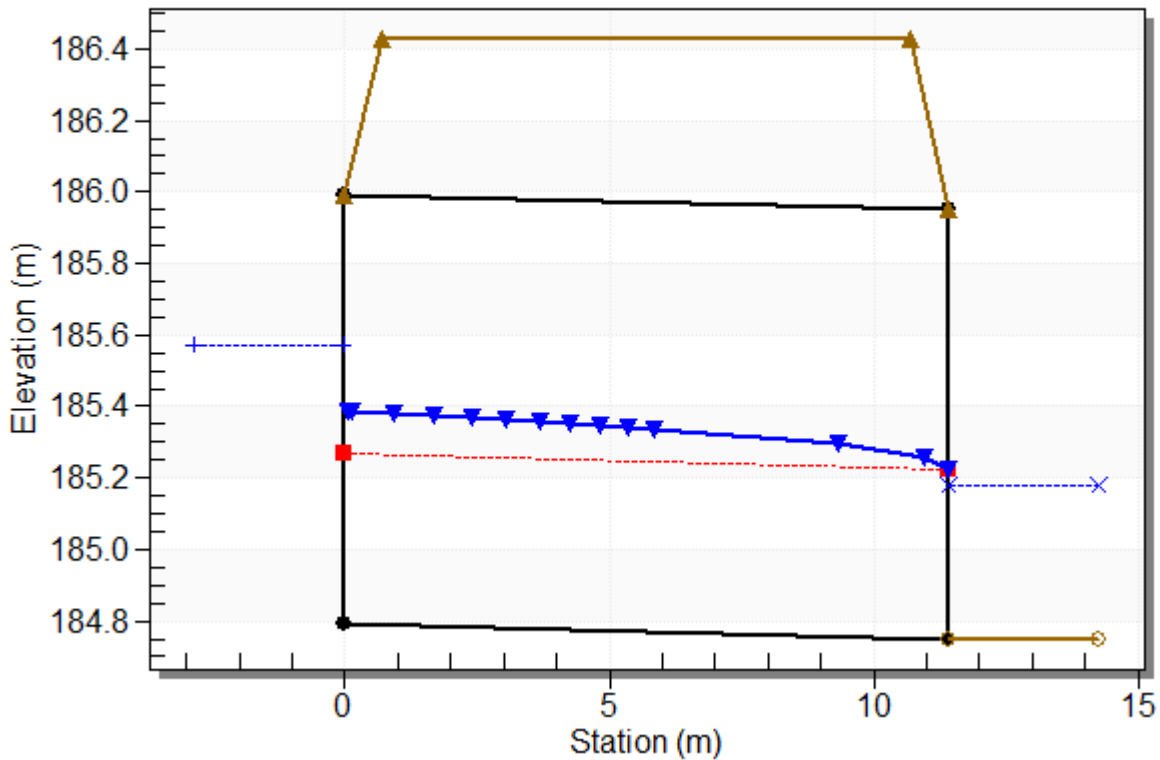




## Water Surface Profile Plot for Culvert: Culvert 16

Crossing - Crossing 16 Existing, Design Discharge - 0.78 cms

Culvert - Culvert 16, Culvert Discharge - 0.78 cms



### Site Data - Culvert 16

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 184.79 m

Outlet Station: 11.40 m

Outlet Elevation: 184.75 m

Number of Barrels: 1

### Culvert Data Summary - Culvert 16

Barrel Shape: Circular

Barrel Diameter: 1200.00 mm

Barrel Material: Corrugated Steel

Embedment: 0.00 mm

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Thin Edge Projecting

Inlet Depression: NONE

**Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 16 Existing)**

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
0.29	185.05	0.30	0.47	10.18	0.39
0.75	185.17	0.42	0.60	14.52	0.41
0.78	185.18	0.43	0.60	14.75	0.41
1.66	185.32	0.57	0.73	19.59	0.43
2.12	185.38	0.63	0.77	21.46	0.44
2.57	185.42	0.67	0.81	23.09	0.45
3.03	185.47	0.72	0.85	24.55	0.45
3.49	185.50	0.75	0.88	25.87	0.46
3.95	185.54	0.79	0.90	27.10	0.46
4.40	185.57	0.82	0.93	28.23	0.46
4.86	185.60	0.85	0.95	29.30	0.47

### **Tailwater Channel Data - Crossing 16 Existing**

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 7.00 (7:1)

Channel Slope: 0.0035

Channel Manning's n: 0.0350

Channel Invert Elevation: 184.75 m

### **Roadway Data for Crossing: Crossing 16 Existing**

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 12.00 m

Crest Elevation: 186.43 m

Roadway Surface: Paved

Roadway Top Width: 10.00 m

# HY-8 Culvert Analysis Report

Crossing Notes: Crossing 17 Existing

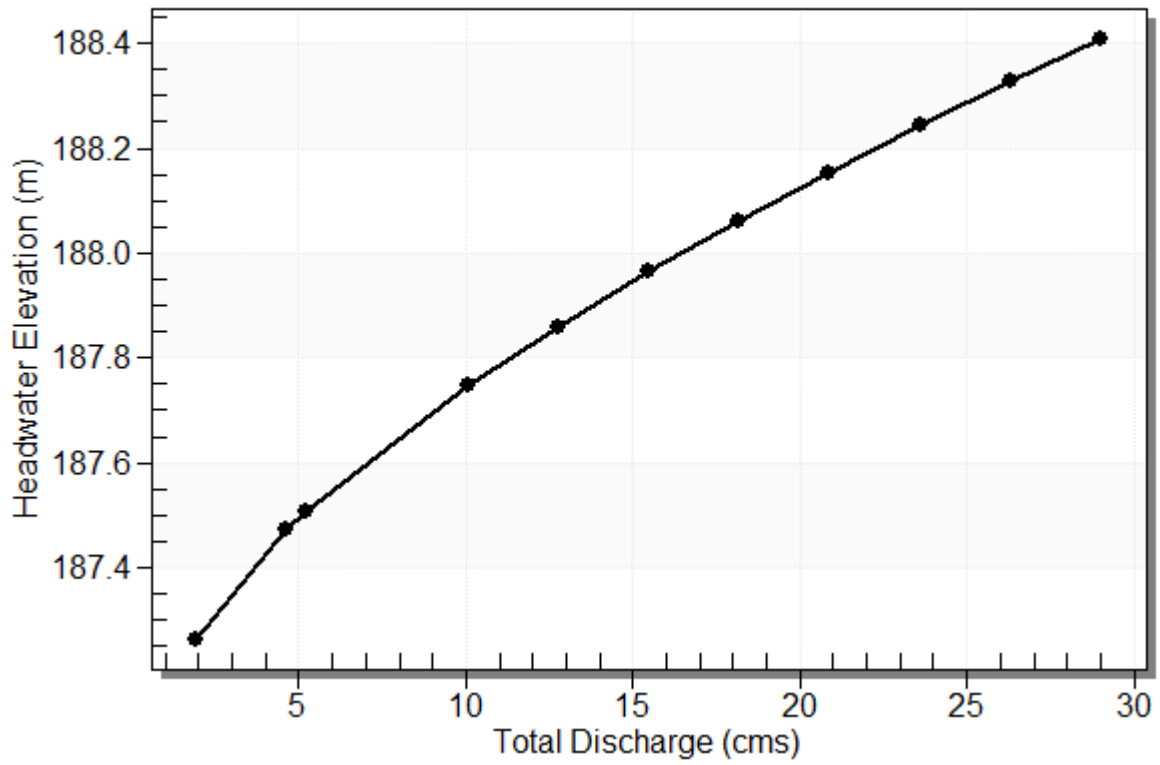
**Table 1 - Summary of Culvert Flows at Crossing: Crossing 17 Existing**

Headwater Elevation (m)	Total Discharge (cms)	Culvert 17 Discharge (cms)	Roadway Discharge (cms)	Iterations
187.26	1.92	1.60	0.32	12
187.47	4.63	1.74	2.88	4
187.51	5.20	1.76	3.43	4
187.75	10.04	1.91	8.13	3
187.86	12.75	1.97	10.78	4
187.96	15.46	2.03	13.43	4
188.06	18.17	2.08	16.08	3
188.15	20.88	2.11	18.75	3
188.24	23.58	2.14	21.44	3
188.33	26.29	2.16	24.13	3
188.41	29.00	2.18	26.82	3
187.20	1.55	1.55	0.00	Overtopping

# Rating Curve Plot for Crossing: Crossing 17 Existing

## Total Rating Curve

Crossing: Crossing 17 Existing



**Table 2 - Culvert Summary Table: Culvert 17**

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
1.92	1.60	187.26	1.674	1.546	7-M2c	0.900	0.739	0.743	0.472	2.849	0.863
4.63	1.74	187.47	1.884	1.741	7-M2c	0.900	0.765	0.770	0.656	3.015	1.075
5.20	1.76	187.51	1.918	1.771	7-M2c	0.900	0.769	0.775	0.685	3.038	1.107
10.04	1.91	187.75	2.157	2.006	7-M2t	0.900	0.795	0.877	0.877	3.043	1.305
12.75	1.97	187.86	2.270	2.166	4-FFf	0.900	0.806	0.900	0.959	3.104	1.385
15.46	2.03	187.96	2.374	2.320	4-FFf	0.900	0.816	0.900	1.031	3.195	1.454
18.17	2.08	188.06	2.471	2.461	4-FFf	0.900	0.825	0.900	1.096	3.276	1.513
20.88	2.11	188.15	2.527	2.564	4-FFf	0.900	0.831	0.900	1.154	3.322	1.567
23.58	2.14	188.24	2.572	2.653	4-FFf	0.900	0.835	0.900	1.208	3.358	1.615
26.29	2.16	188.33	2.617	2.738	4-FFf	0.900	0.839	0.900	1.259	3.394	1.660
29.00	2.18	188.41	2.662	2.820	4-FFf	0.900	0.843	0.900	1.306	3.429	1.701

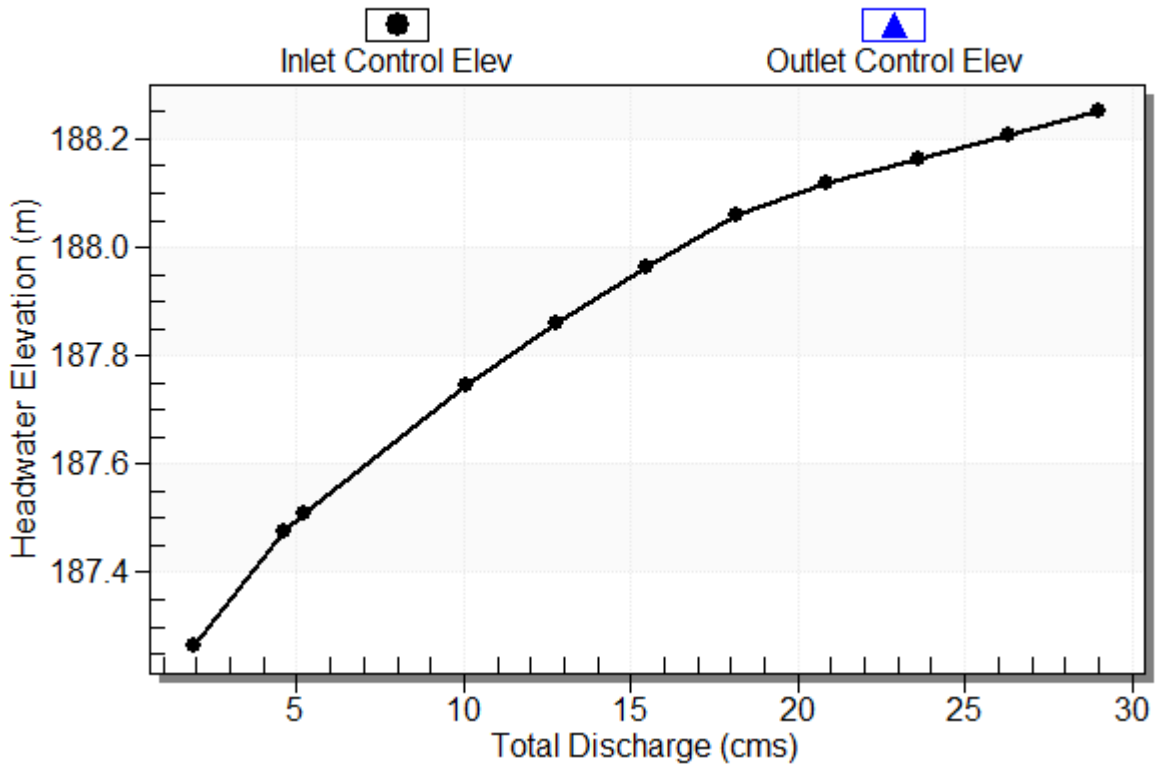
\*\*\*\*\*  
Inlet Elevation (invert): 185.59 m, Outlet Elevation (invert): 185.40 m  
Culvert Length: 11.50 m, Culvert Slope: 0.0165  
\*\*\*\*\*



### Culvert Performance Curve Plot: Culvert 17

## Performance Curve

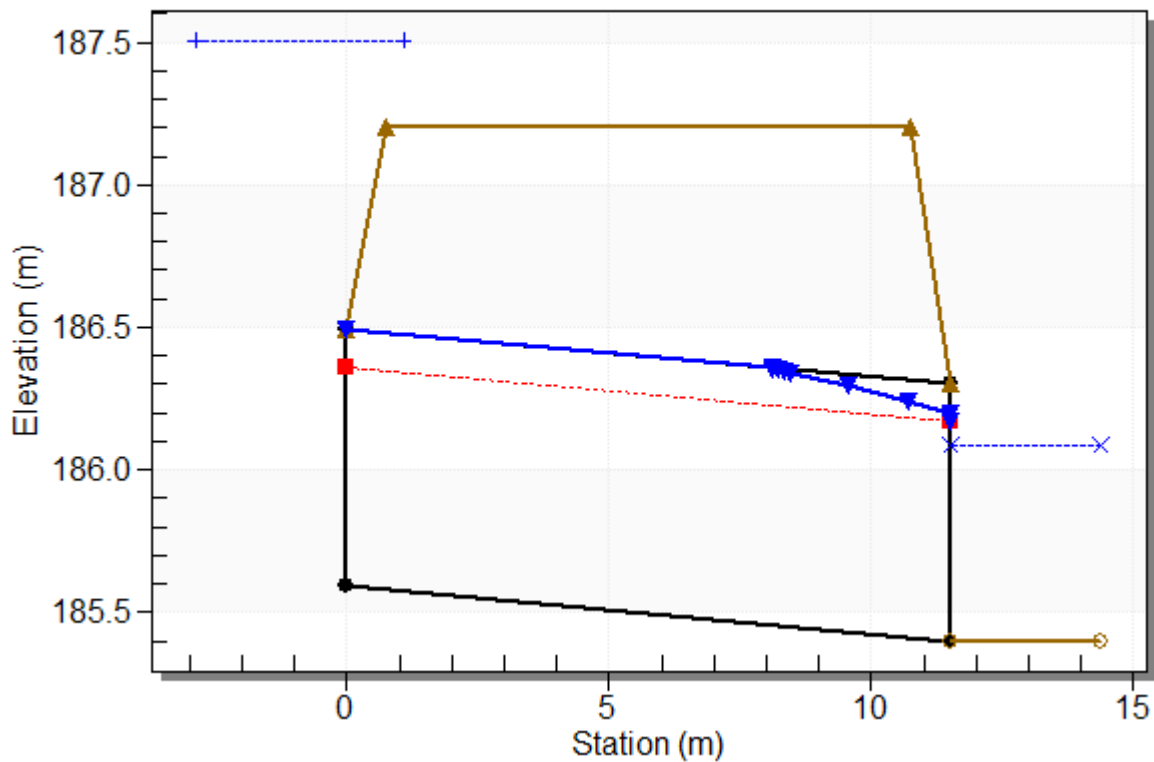
Culvert: Culvert 17



## Water Surface Profile Plot for Culvert: Culvert 17

Crossing - Crossing 17 Existing , Design Discharge - 5.20 cms

Culvert - Culvert 17, Culvert Discharge - 1.76 cms



### Site Data - Culvert 17

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 185.59 m

Outlet Station: 11.50 m

Outlet Elevation: 185.40 m

Number of Barrels: 1

### Culvert Data Summary - Culvert 17

Barrel Shape: Circular

Barrel Diameter: 900.00 mm

Barrel Material: Corrugated Steel

Embedment: 0.00 mm

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Thin Edge Projecting

Inlet Depression: NONE

**Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 17 Existing )**

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
1.92	185.87	0.47	0.86	29.13	0.57
4.63	186.06	0.66	1.08	40.52	0.60
5.20	186.09	0.69	1.11	42.33	0.60
10.04	186.28	0.88	1.30	54.18	0.63
12.75	186.36	0.96	1.39	59.25	0.64
15.46	186.43	1.03	1.45	63.69	0.65
18.17	186.50	1.10	1.51	67.66	0.65
20.88	186.55	1.15	1.57	71.28	0.66
23.58	186.61	1.21	1.62	74.62	0.66
26.29	186.66	1.26	1.66	77.72	0.67
29.00	186.71	1.31	1.70	80.63	0.67

### **Tailwater Channel Data - Crossing 17 Existing**

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 10.00 (1:1)

Channel Slope: 0.0063

Channel Manning's n: 0.0350

Channel Invert Elevation: 185.40 m

### **Roadway Data for Crossing: Crossing 17 Existing**

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 12.00 m

Crest Elevation: 187.20 m

Roadway Surface: Paved

Roadway Top Width: 10.00 m

# HY-8 Culvert Analysis Report

Crossing Notes: Crossing 18 Existing

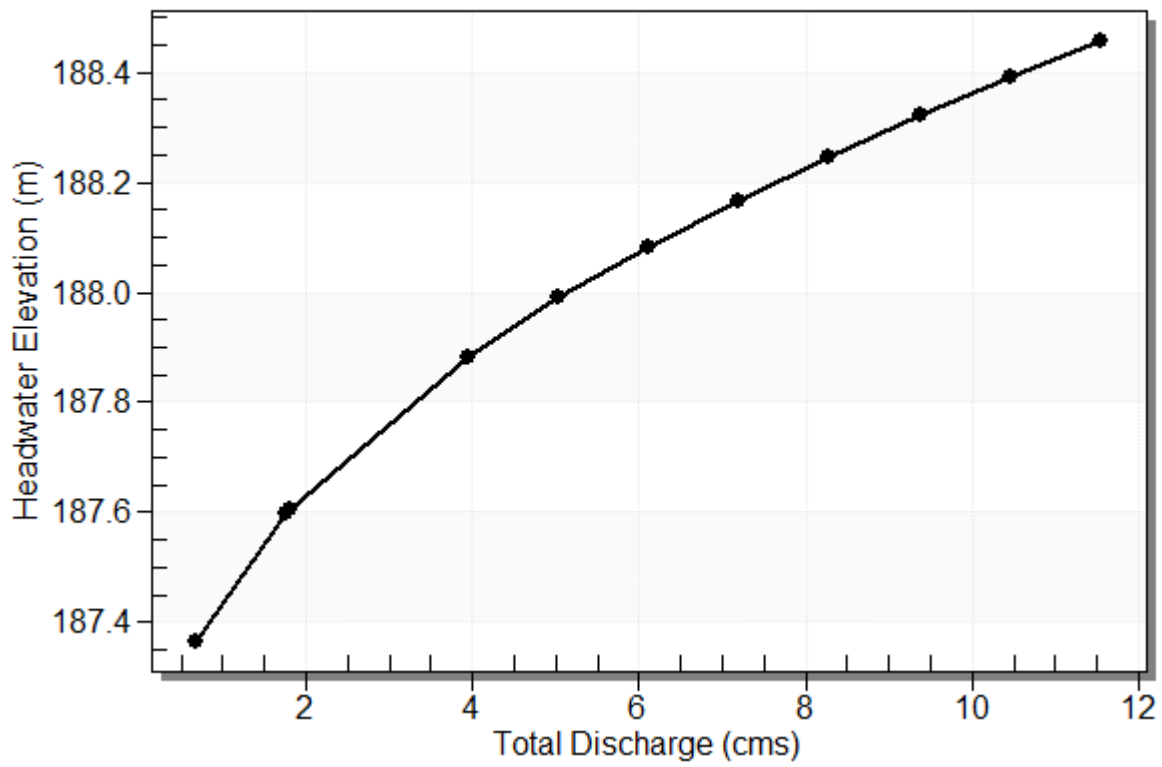
**Table 1 - Summary of Culvert Flows at Crossing: Crossing 18 Existing**

Headwater Elevation (m)	Total Discharge (cms)	Culvert 18 Discharge (cms)	Roadway Discharge (cms)	Iterations
187.37	0.68	0.68	0.00	1
187.60	1.77	1.77	0.00	1
187.61	1.81	1.81	0.00	1
187.88	3.94	3.94	0.00	1
187.99	5.02	5.02	0.00	1
188.08	6.11	6.11	0.00	1
188.17	7.20	7.20	0.00	1
188.25	8.28	8.28	0.00	1
188.32	9.37	9.37	0.00	1
188.39	10.45	10.45	0.00	1
188.46	11.54	11.54	0.00	1
191.57	55.64	55.64	0.00	Overtopping

# Rating Curve Plot for Crossing: Crossing 18 Existing

## Total Rating Curve

Crossing: Crossing 18 Existing



**Table 2 - Culvert Summary Table: Culvert 18**

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.68	0.68	187.37	0.267	0.367	1-S1t	0.049	0.099	0.521	0.521	0.187	0.501
1.77	1.77	187.60	0.358	0.599	1-S1t	0.128	0.187	0.745	0.745	0.339	0.636
1.81	1.81	187.61	0.362	0.607	1-S1t	0.131	0.190	0.752	0.752	0.344	0.640
3.94	3.94	187.88	0.547	0.883	1-S1t	0.285	0.319	1.006	1.006	0.559	0.778
5.02	5.02	187.99	0.646	0.990	1-S1t	0.331	0.375	1.103	1.103	0.651	0.827
6.11	6.11	188.08	0.736	1.081	1-S1t	0.372	0.427	1.187	1.187	0.736	0.868
7.20	7.20	188.17	0.820	1.167	1-S1t	0.413	0.477	1.262	1.262	0.815	0.904
8.28	8.28	188.25	0.898	1.246	1-S1t	0.454	0.524	1.330	1.330	0.890	0.937
9.37	9.37	188.32	0.973	1.321	1-S1t	0.496	0.568	1.393	1.393	0.961	0.966
10.45	10.45	188.39	1.046	1.392	1-S1t	0.537	0.612	1.451	1.451	1.029	0.993
11.54	11.54	188.46	1.118	1.459	1-S1t	0.578	0.653	1.506	1.506	1.095	1.018

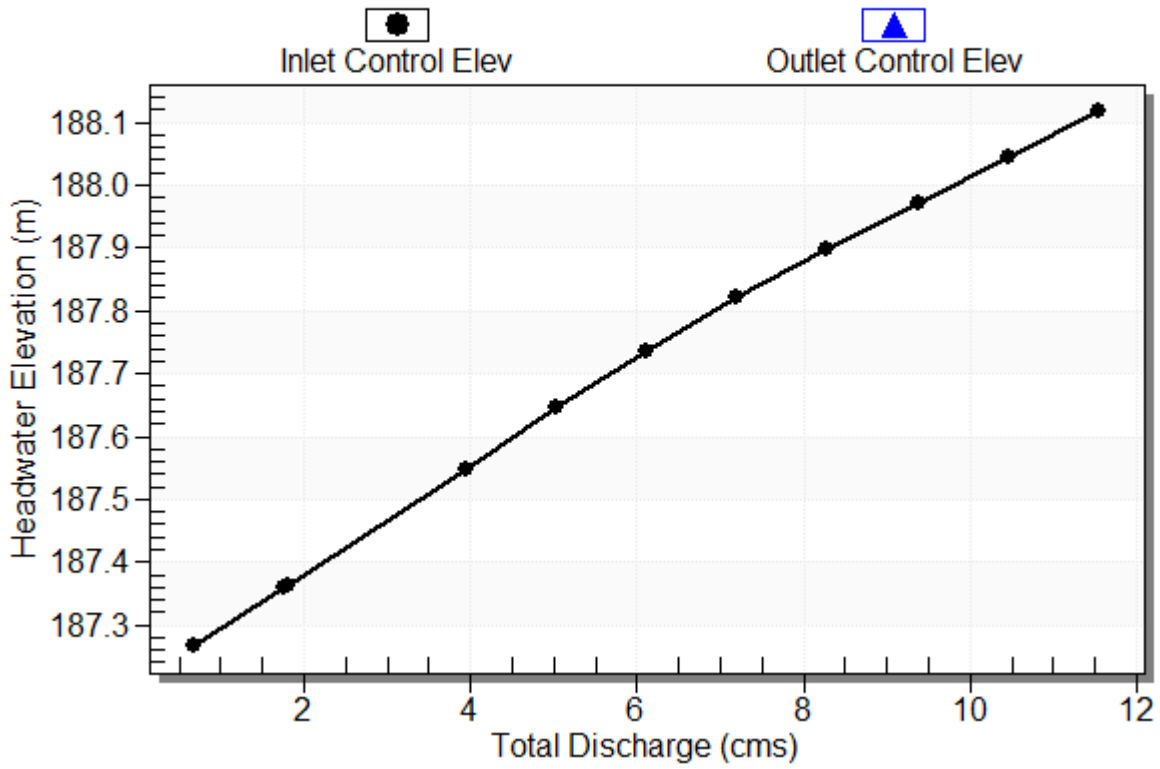


\*\*\*\*\*  
Inlet Elevation (invert): 187.00 m, Outlet Elevation (invert): 186.84 m  
Culvert Length: 45.50 m, Culvert Slope: 0.0035  
\*\*\*\*\*

# Culvert Performance Curve Plot: Culvert 18

## Performance Curve

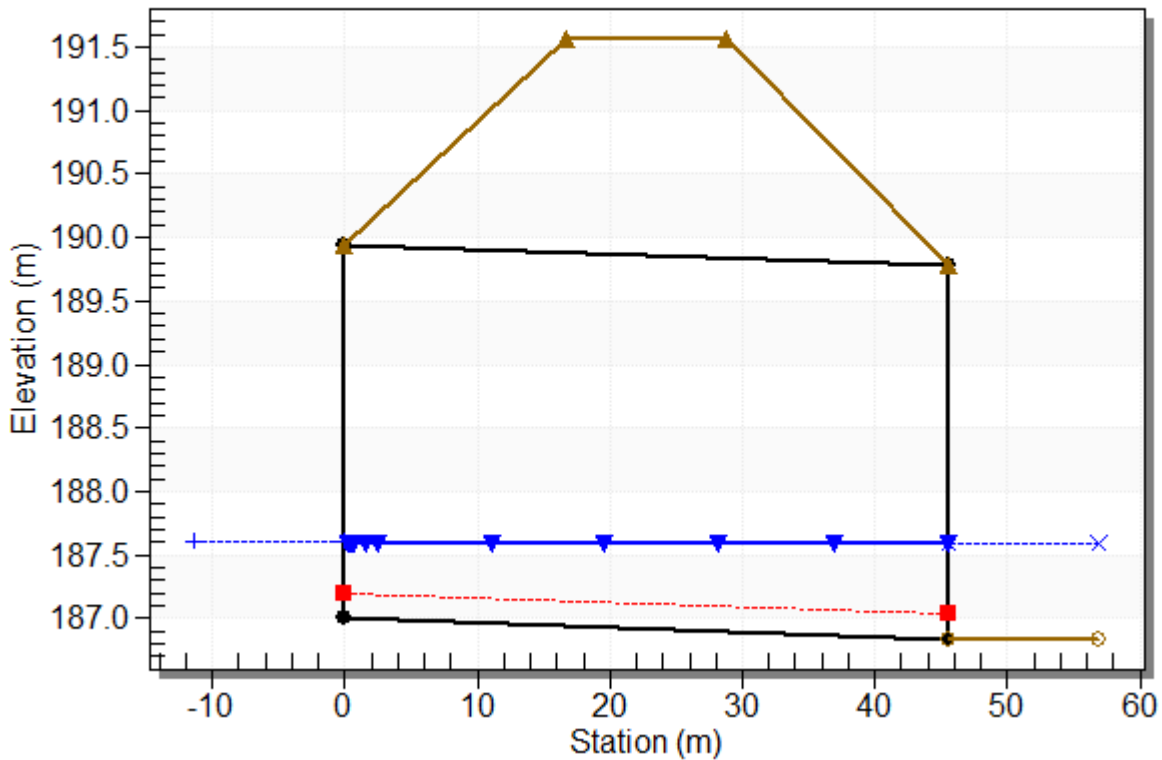
Culvert: Culvert 18



## Water Surface Profile Plot for Culvert: Culvert 18

Crossing - Crossing 18 Existing, Design Discharge - 1.81 cms

Culvert - Culvert 18, Culvert Discharge - 1.81 cms



### Site Data - Culvert 18

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 187.00 m

Outlet Station: 45.50 m

Outlet Elevation: 186.84 m

Number of Barrels: 2

### Culvert Data Summary - Culvert 18

Barrel Shape: Concrete Box

Barrel Span: 3500.00 mm

Barrel Rise: 2940.00 mm

Barrel Material: Concrete

Embedment: 0.00 mm

Barrel Manning's n: 0.0120

Inlet Type: Conventional

Inlet Edge Condition: Square Edge (90°) Headwall

Inlet Depression: NONE

**Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 18 Existing)**

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
0.68	187.36	0.52	0.50	9.70	0.31
1.77	187.58	0.74	0.64	13.87	0.33
1.81	187.59	0.75	0.64	14.00	0.33
3.94	187.85	1.01	0.78	18.74	0.35
5.02	187.94	1.10	0.83	20.53	0.36
6.11	188.03	1.19	0.87	22.10	0.36
7.20	188.10	1.26	0.90	23.50	0.36
8.28	188.17	1.33	0.94	24.77	0.37
9.37	188.23	1.39	0.97	25.94	0.37
10.45	188.29	1.45	0.99	27.03	0.37
11.54	188.35	1.51	1.02	28.05	0.37

### **Tailwater Channel Data - Crossing 18 Existing**

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 5.00 (1:1)

Channel Slope: 0.0019

Channel Manning's n: 0.0350

Channel Invert Elevation: 186.84 m

### **Roadway Data for Crossing: Crossing 18 Existing**

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 10.00 m

Crest Elevation: 191.57 m

Roadway Surface: Paved

Roadway Top Width: 12.00 m

## **Proposed Hydraulic Structures**

# HY-8 Culvert Analysis Report

Crossing Notes: Crossing 1 Proposed

**Table 1 - Summary of Culvert Flows at Crossing: Crossing 1 Proposed**

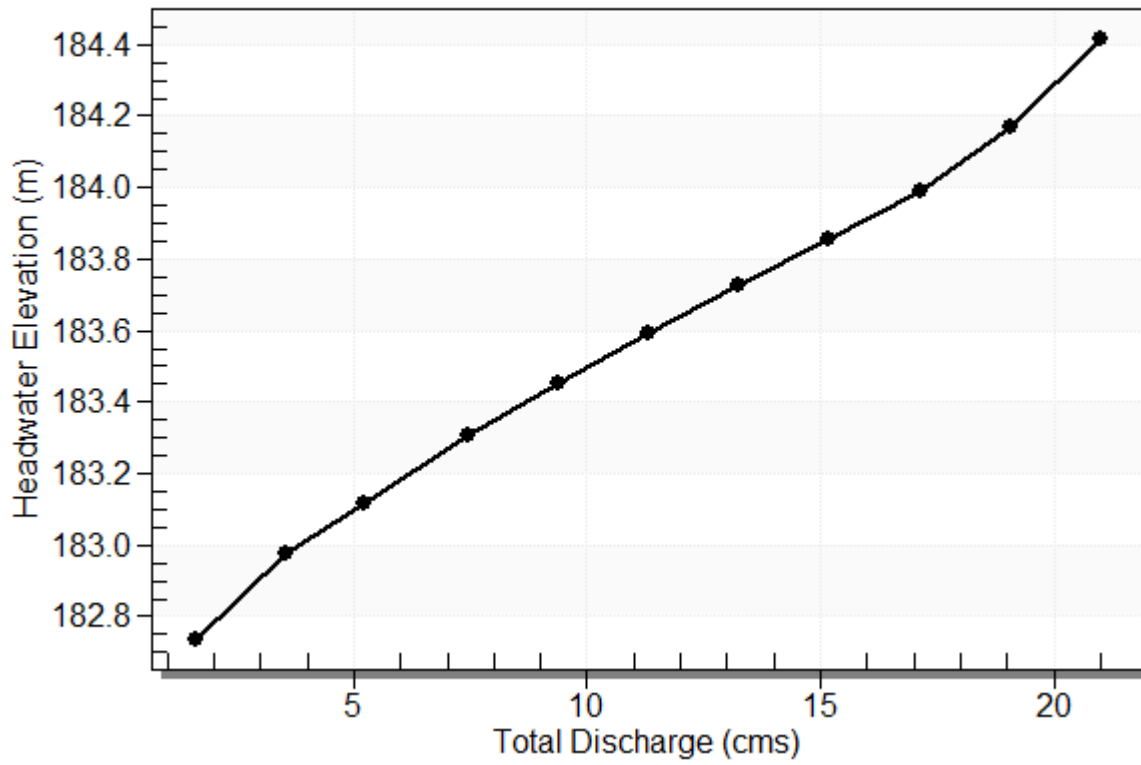
Headwater Elevation (m)	Total Discharge (cms)	Culvert 1 Discharge (cms)	Roadway Discharge (cms)	Iterations
182.74	1.62	1.62	0.00	1
182.97	3.56	3.56	0.00	1
183.12	5.21	5.21	0.00	1
183.30	7.43	7.43	0.00	1
183.45	9.37	9.37	0.00	1
183.59	11.31	11.31	0.00	1
183.73	13.25	13.25	0.00	1
183.86	15.19	15.19	0.00	1
183.99	17.12	17.12	0.00	1
184.17	19.06	19.06	0.00	1
184.42	21.00	21.00	0.00	1
184.87	24.27	24.27	0.00	Overtopping



# Rating Curve Plot for Crossing: Crossing 1 Proposed

## Total Rating Curve

Crossing: Crossing 1 Proposed



**Table 2 - Culvert Summary Table: Culvert 1**

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
1.62	1.62	182.74	0.331	0.338	3-M1t	0.198	0.196	0.722	0.722	0.374	0.777
3.56	3.56	182.97	0.556	0.575	3-M1t	0.331	0.330	0.969	0.969	0.612	0.946
5.21	5.21	183.12	0.717	0.0*	1-S2n	0.422	0.426	0.423	1.119	2.053	1.041
7.43	7.43	183.30	0.904	0.0*	1-S2n	0.529	0.540	0.531	1.278	2.336	1.138
9.37	9.37	183.45	1.053	0.0*	1-S2n	0.616	0.630	0.618	1.394	2.529	1.206
11.31	11.31	183.59	1.192	0.0*	1-S2n	0.694	0.714	0.696	1.496	2.710	1.264
13.25	13.25	183.73	1.326	1.326	1-S1f	0.771	0.794	0.794	1.587	2.782	1.315
15.19	15.19	183.86	1.457	1.457	5-S1f	0.842	0.869	0.869	1.671	2.912	1.360
17.12	17.12	183.99	1.588	1.534	4-FFf	0.913	0.942	0.913	1.748	3.126	1.402
19.06	19.06	184.17	1.722	1.769	4-FFf	0.980	1.012	1.500	1.819	2.118	1.440
21.00	21.00	184.42	1.861	2.018	4-FFf	1.046	1.079	1.500	1.887	2.333	1.475

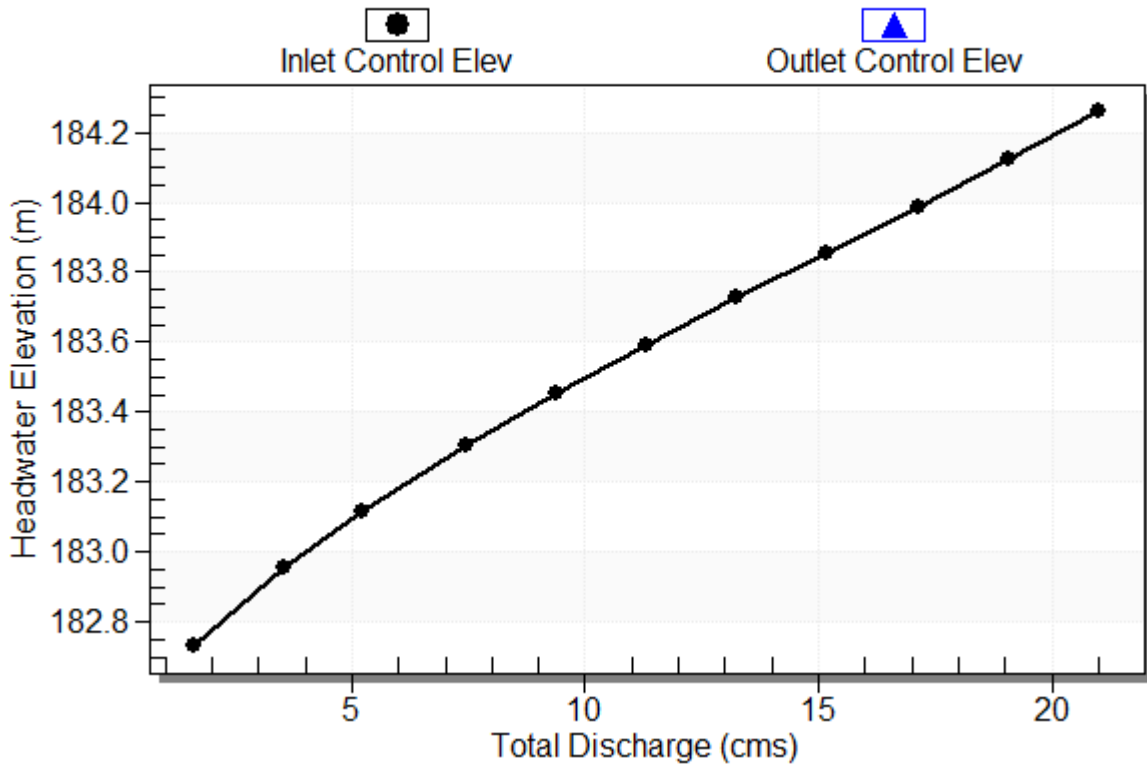
\* theoretical depth is impractical. Depth reported is corrected.

\*\*\*\*\*  
Inlet Elevation (invert): 182.40 m, Outlet Elevation (invert): 181.50 m  
Culvert Length: 47.01 m, Culvert Slope: 0.0191  
\*\*\*\*\*

### Culvert Performance Curve Plot: Culvert 1

## Performance Curve

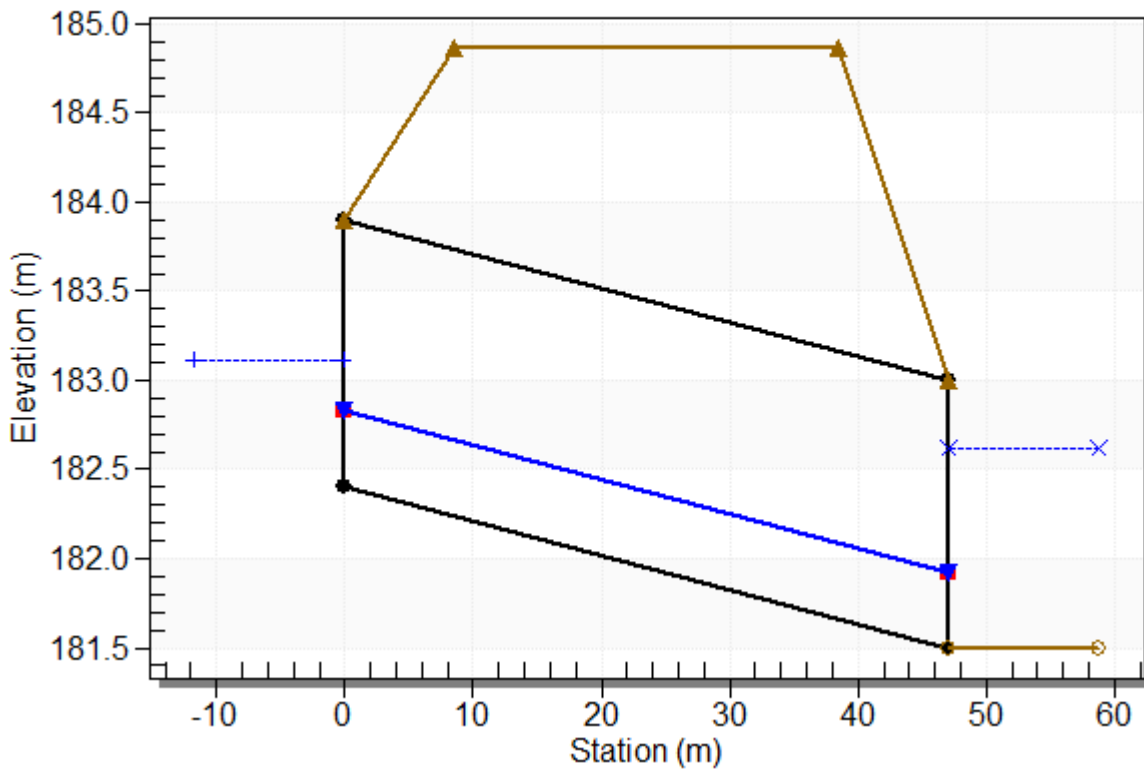
Culvert: Culvert 1



## Water Surface Profile Plot for Culvert: Culvert 1

Crossing - Crossing 1 Proposed, Design Discharge - 5.21 cms

Culvert - Culvert 1, Culvert Discharge - 5.21 cms



### Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 182.40 m

Outlet Station: 47.00 m

Outlet Elevation: 181.50 m

Number of Barrels: 1

### Culvert Data Summary - Culvert 1

Barrel Shape: Concrete Box

Barrel Span: 6000.00 mm

Barrel Rise: 1500.00 mm

Barrel Material: Concrete

Embedment: 0.00 mm

Barrel Manning's n: 0.0350

Inlet Type: Conventional

Inlet Edge Condition: Square Edge (90°) Headwall

Inlet Depression: NONE

**Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 1 Proposed)**

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
1.62	182.22	0.72	0.78	21.22	0.41
3.56	182.47	0.97	0.95	28.51	0.43
5.21	182.62	1.12	1.04	32.89	0.44
7.43	182.78	1.28	1.14	37.58	0.45
9.37	182.89	1.39	1.21	40.99	0.46
11.31	183.00	1.50	1.26	43.99	0.47
13.25	183.09	1.59	1.31	46.67	0.47
15.19	183.17	1.67	1.36	49.13	0.48
17.12	183.25	1.75	1.40	51.39	0.48
19.06	183.32	1.82	1.44	53.50	0.48
21.00	183.39	1.89	1.48	55.48	0.48

### **Tailwater Channel Data - Crossing 1 Proposed**

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 4.00 (1:1)

Channel Slope: 0.0030

Channel Manning's n: 0.0350

Channel Invert Elevation: 181.50 m

### **Roadway Data for Crossing: Crossing 1 Proposed**

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 10.00 m

Crest Elevation: 184.87 m

Roadway Surface: Paved

Roadway Top Width: 30.00 m



# HY-8 Culvert Analysis Report

Crossing Notes: Crossing 2 Proposed

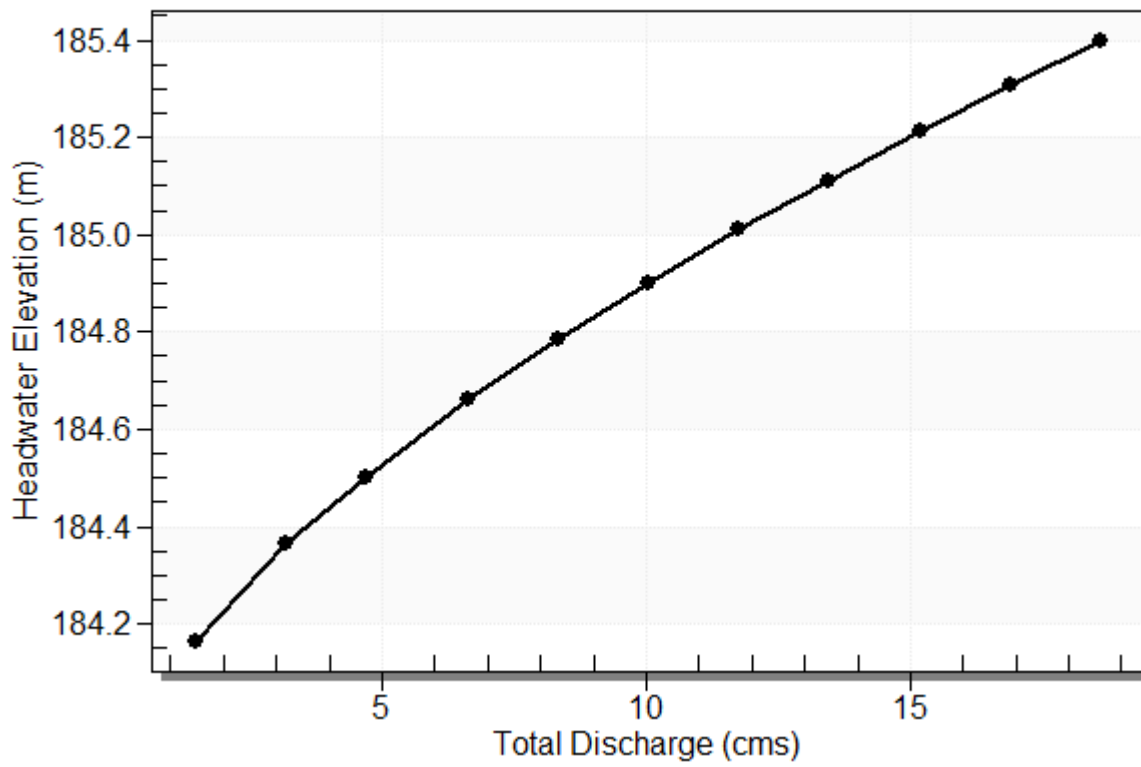
**Table 1 - Summary of Culvert Flows at Crossing: Crossing 2 Proposed**

Headwater Elevation (m)	Total Discharge (cms)	Culvert 2 Discharge (cms)	Roadway Discharge (cms)	Iterations
184.17	1.48	1.48	0.00	1
184.36	3.19	3.19	0.00	1
184.50	4.68	4.68	0.00	1
184.66	6.62	6.62	0.00	1
184.78	8.33	8.33	0.00	1
184.90	10.04	10.04	0.00	1
185.01	11.75	11.75	0.00	1
185.11	13.46	13.46	0.00	1
185.21	15.18	15.18	0.00	1
185.31	16.89	16.89	0.00	1
185.40	18.60	18.60	0.00	1
186.56	29.98	29.98	0.00	Overtopping

# Rating Curve Plot for Crossing: Crossing 2 Proposed

## Total Rating Curve

Crossing: Crossing 2 Proposed



**Table 2 - Culvert Summary Table: Culvert 2**

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
1.48	1.48	184.17	0.275	0.316	3-M1t	0.267	0.160	0.333	0.333	0.601	0.438
3.19	3.19	184.36	0.457	0.514	3-M1t	0.433	0.267	0.466	0.466	0.925	0.533
4.68	4.68	184.50	0.590	0.652	3-M2t	0.551	0.345	0.549	0.549	1.151	0.588
6.62	6.62	184.66	0.740	0.809	3-M2t	0.688	0.434	0.636	0.636	1.406	0.642
8.33	8.33	184.78	0.859	0.934	3-M2t	0.797	0.506	0.700	0.700	1.608	0.680
10.04	10.04	184.90	0.969	1.050	3-M2t	0.899	0.574	0.756	0.756	1.794	0.713
11.75	11.75	185.01	1.074	1.160	3-M2t	0.998	0.637	0.807	0.807	1.968	0.742
13.46	13.46	185.11	1.175	1.262	3-M2t	1.091	0.698	0.853	0.853	2.133	0.768
15.18	15.18	185.21	1.273	1.363	3-M2t	1.181	0.756	0.896	0.896	2.290	0.791
16.89	16.89	185.31	1.370	1.459	3-M2t	1.400	0.811	0.936	0.936	2.439	0.813
18.60	18.60	185.40	1.467	1.550	3-M2t	1.400	0.865	0.973	0.973	2.583	0.833

\*\*\*\*\*

Inlet Elevation (invert): 183.85 m, Outlet Elevation (invert): 183.65 m

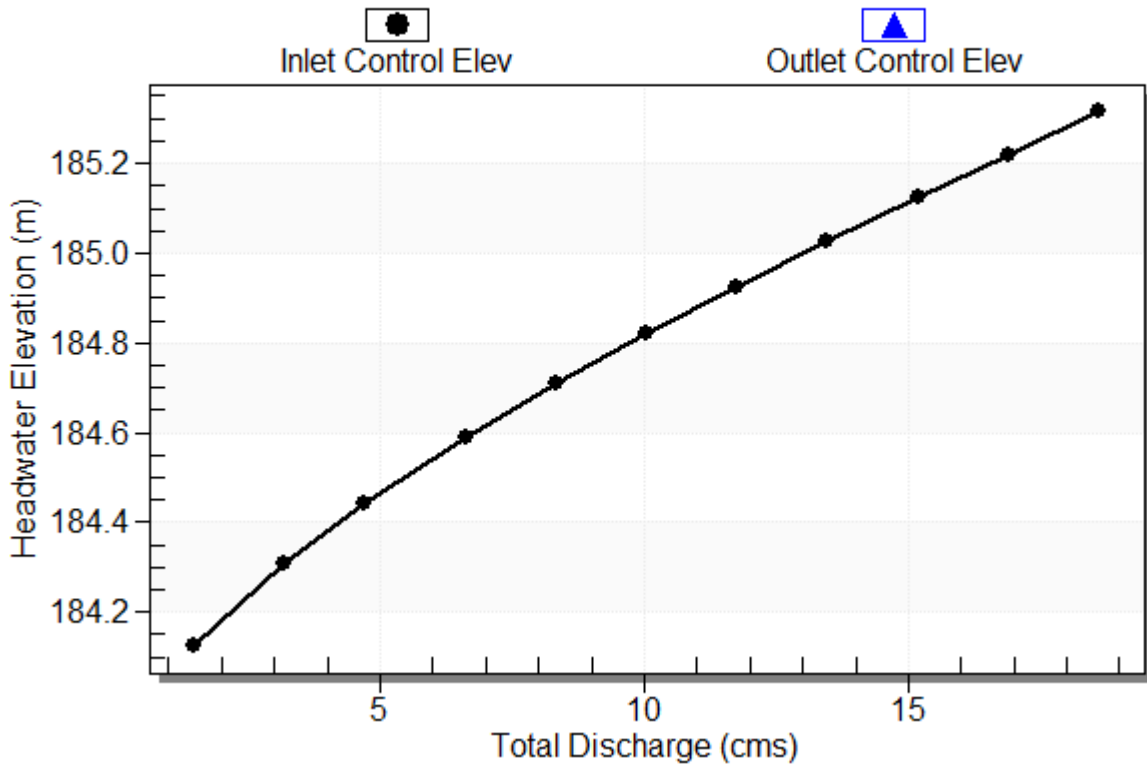
Culvert Length: 47.00 m, Culvert Slope: 0.0043

\*\*\*\*\*

### Culvert Performance Curve Plot: Culvert 2

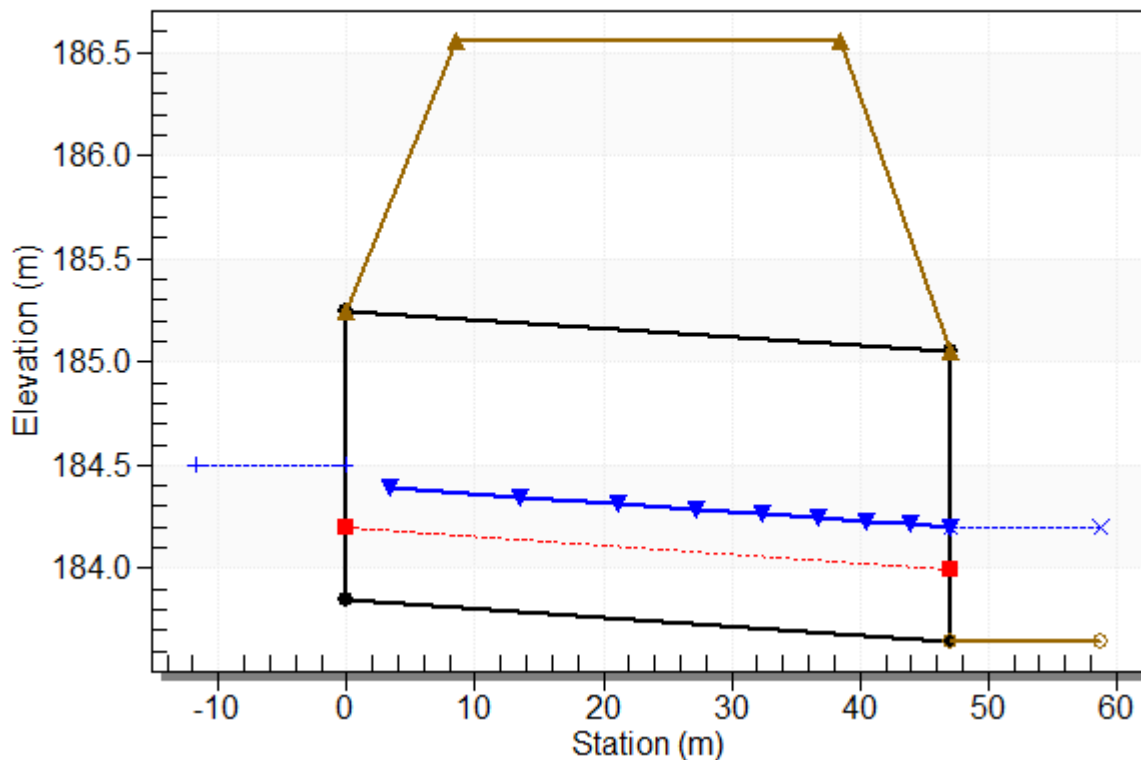
## Performance Curve

Culvert: Culvert 2



## Water Surface Profile Plot for Culvert: Culvert 2

Crossing - Crossing 2 Proposed, Design Discharge - 4.68 cms  
Culvert - Culvert 2, Culvert Discharge - 4.68 cms



### Site Data - Culvert 2

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 183.85 m

Outlet Station: 47.00 m

Outlet Elevation: 183.65 m

Number of Barrels: 1

### Culvert Data Summary - Culvert 2

Barrel Shape: Concrete Box

Barrel Span: 7400.00 mm

Barrel Rise: 1400.00 mm

Barrel Material: Concrete

Embedment: 0.00 mm

Barrel Manning's n: 0.0350

Inlet Type: Conventional

Inlet Edge Condition: Square Edge (90°) Headwall

Inlet Depression: NONE

**Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 2 Proposed)**

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
1.48	183.98	0.33	0.44	6.52	0.31
3.19	184.12	0.47	0.53	9.14	0.33
4.68	184.20	0.55	0.59	10.77	0.34
6.62	184.29	0.64	0.64	12.46	0.34
8.33	184.35	0.70	0.68	13.72	0.35
10.04	184.41	0.76	0.71	14.82	0.35
11.75	184.46	0.81	0.74	15.82	0.36
13.46	184.50	0.85	0.77	16.72	0.36
15.18	184.55	0.90	0.79	17.56	0.36
16.89	184.59	0.94	0.81	18.34	0.36
18.60	184.62	0.97	0.83	19.07	0.37



### **Tailwater Channel Data - Crossing 2 Proposed**

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 3.50 m

Side Slope (H:V): 20.00 (1:1)

Channel Slope: 0.0020

Channel Manning's n: 0.0350

Channel Invert Elevation: 183.65 m

### **Roadway Data for Crossing: Crossing 2 Proposed**

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 10.00 m

Crest Elevation: 186.56 m

Roadway Surface: Paved

Roadway Top Width: 30.00 m

# HY-8 Culvert Analysis Report

Crossing Notes: Crossing 3 Proposed

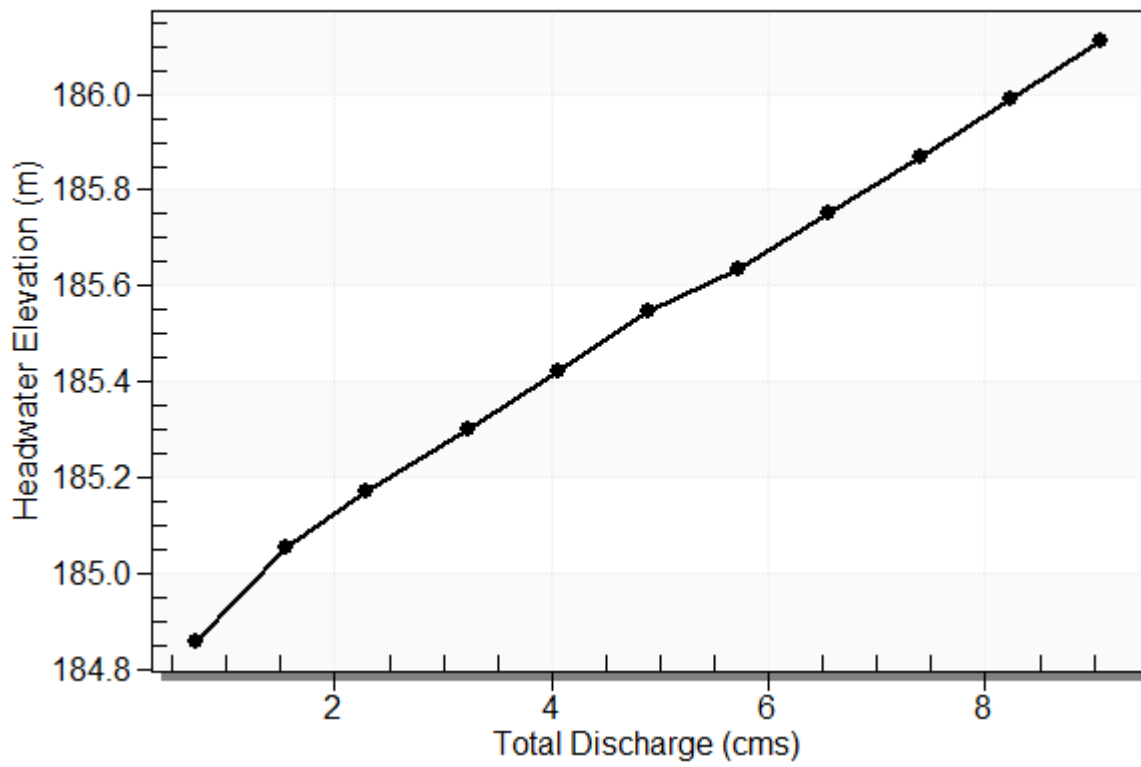
**Table 1 - Summary of Culvert Flows at Crossing: Crossing 3 Proposed**

Headwater Elevation (m)	Total Discharge (cms)	Culvert 3 Discharge (cms)	Roadway Discharge (cms)	Iterations
184.86	0.72	0.72	0.00	1
185.05	1.55	1.55	0.00	1
185.17	2.28	2.28	0.00	1
185.30	3.22	3.22	0.00	1
185.42	4.06	4.06	0.00	1
185.55	4.89	4.89	0.00	1
185.64	5.72	5.72	0.00	1
185.75	6.56	6.56	0.00	1
185.87	7.39	7.39	0.00	1
185.99	8.23	8.23	0.00	1
186.11	9.06	9.06	0.00	1
186.30	10.26	10.26	0.00	Overtopping

# Rating Curve Plot for Crossing: Crossing 3 Proposed

## Total Rating Curve

Crossing: Crossing 3 Proposed



**Table 2 - Culvert Summary Table: Culvert 3**

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.72	0.72	184.86	0.162	0.281	3-M1t	0.154	0.109	0.536	0.536	0.210	0.627
1.55	1.55	185.05	0.270	0.473	3-M1t	0.255	0.182	0.715	0.715	0.340	0.760
2.28	2.28	185.17	0.349	0.594	3-M1t	0.327	0.235	0.826	0.826	0.431	0.836
3.22	3.22	185.30	0.439	0.723	3-M1t	0.411	0.296	0.940	0.940	0.536	0.912
4.06	4.06	185.42	0.513	0.843	3-M1f	0.478	0.345	1.000	1.025	0.634	0.966
4.89	4.89	185.55	0.586	0.966	3-M1f	0.541	0.391	1.000	1.099	0.764	1.012
5.72	5.72	185.64	0.655	1.057	4-FFf	0.602	0.434	1.000	1.166	0.894	1.052
6.56	6.56	185.75	0.722	1.171	4-FFf	0.659	0.476	1.000	1.227	1.025	1.089
7.39	7.39	185.87	0.787	1.288	4-FFf	0.716	0.515	1.000	1.283	1.155	1.122
8.23	8.23	185.99	0.850	1.409	4-FFf	0.770	0.553	1.000	1.336	1.285	1.152
9.06	9.06	186.11	0.913	1.533	4-FFf	0.824	0.590	1.000	1.385	1.416	1.180

\*\*\*\*\*

Inlet Elevation (invert): 184.58 m, Outlet Elevation (invert): 184.30 m

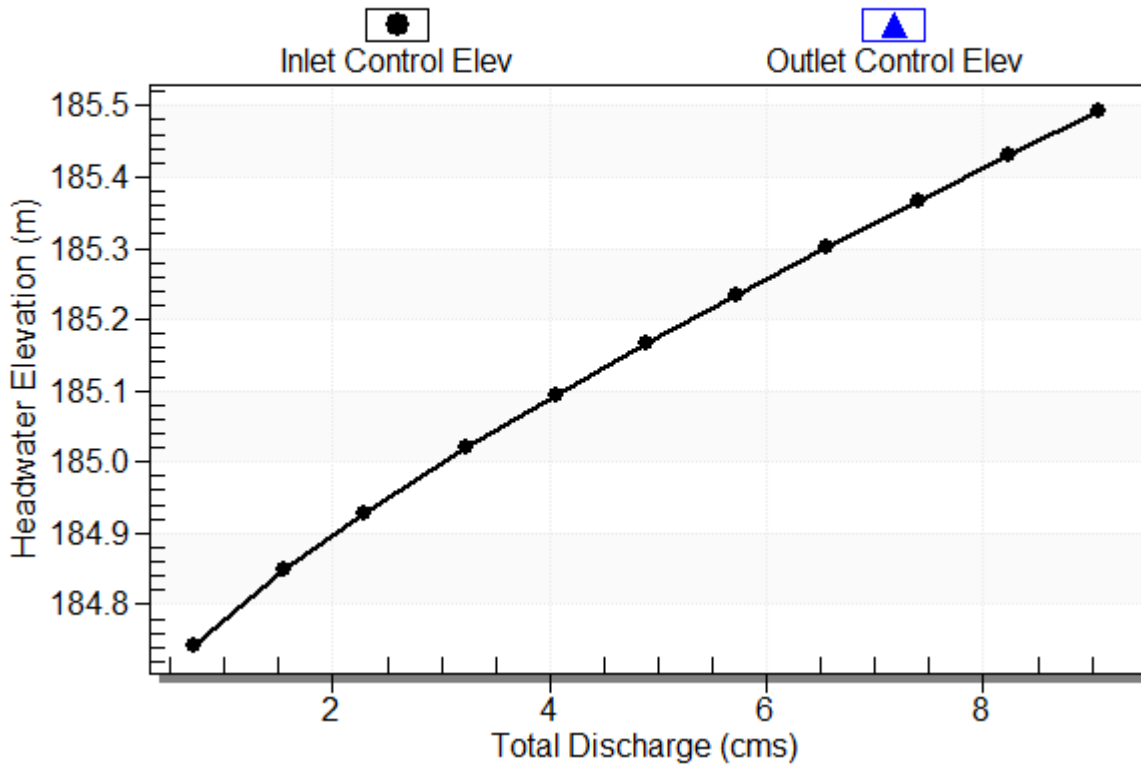
Culvert Length: 47.00 m, Culvert Slope: 0.0060

\*\*\*\*\*

### Culvert Performance Curve Plot: Culvert 3

## Performance Curve

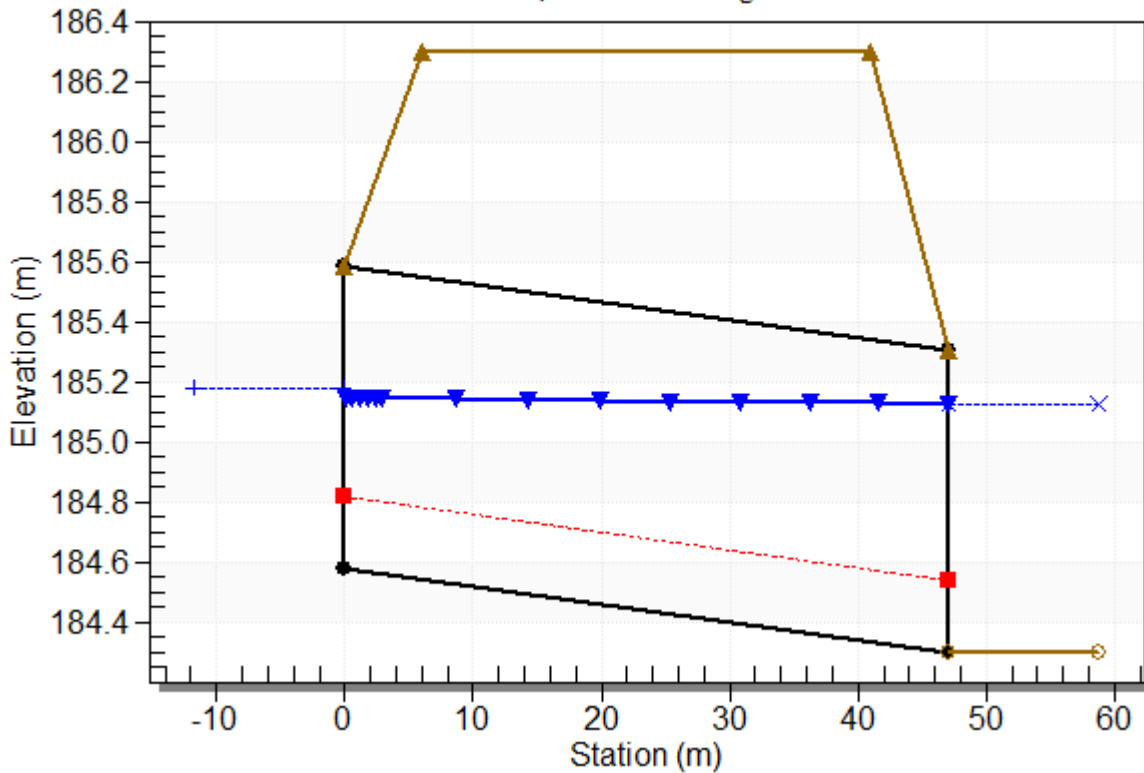
Culvert: Culvert 3



### Water Surface Profile Plot for Culvert: Culvert 3

Crossing - Crossing 3 Proposed, Design Discharge - 2.28 cms

Culvert - Culvert 3, Culvert Discharge - 2.28 cms



### Site Data - Culvert 3

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 184.58 m

Outlet Station: 47.00 m

Outlet Elevation: 184.30 m

Number of Barrels: 2

### Culvert Data Summary - Culvert 3

Barrel Shape: Concrete Box

Barrel Span: 3200.00 mm

Barrel Rise: 1000.00 mm

Barrel Material: Concrete

Embedment: 0.00 mm

Barrel Manning's n: 0.0300

Inlet Type: Conventional

Inlet Edge Condition: 1:1 Bevel (45° flare) Wingwall

Inlet Depression: NONE



**Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 3 Proposed)**

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
0.72	184.84	0.54	0.63	15.23	0.39
1.55	185.02	0.72	0.76	20.33	0.41
2.28	185.13	0.83	0.84	23.47	0.42
3.22	185.24	0.94	0.91	26.72	0.42
4.06	185.32	1.02	0.97	29.13	0.43
4.89	185.40	1.10	1.01	31.25	0.44
5.72	185.47	1.17	1.05	33.15	0.44
6.56	185.53	1.23	1.09	34.88	0.44
7.39	185.58	1.28	1.12	36.48	0.45
8.23	185.64	1.34	1.15	37.98	0.45
9.06	185.69	1.39	1.18	39.38	0.45

### **Tailwater Channel Data - Crossing 3 Proposed**

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 4.00 (4:1)

Channel Slope: 0.0029

Channel Manning's n: 0.0350

Channel Invert Elevation: 184.30 m

### **Roadway Data for Crossing: Crossing 3 Proposed**

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 14.00 m

Crest Elevation: 186.30 m

Roadway Surface: Paved

Roadway Top Width: 35.00 m

# HY-8 Culvert Analysis Report

Crossing Notes: Crossing 4 Proposed

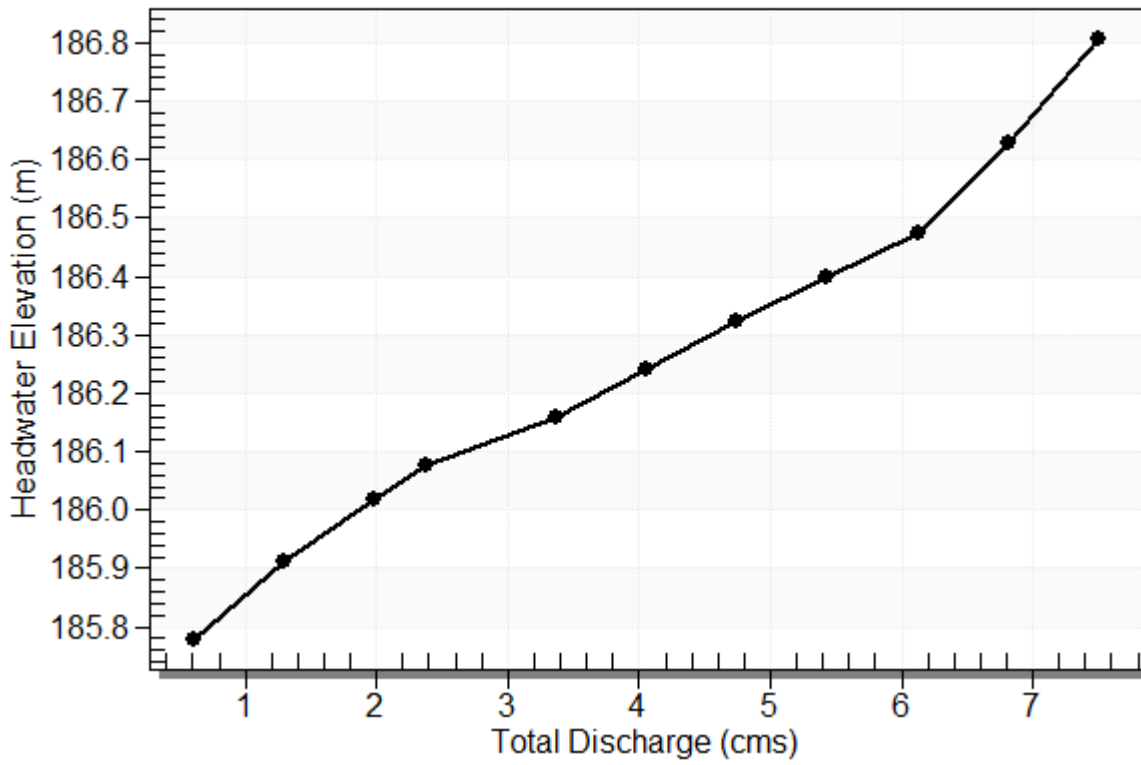
**Table 1 - Summary of Culvert Flows at Crossing: Crossing 4 Proposed**

Headwater Elevation (m)	Total Discharge (cms)	Culvert 4 Discharge (cms)	Roadway Discharge (cms)	Iterations
185.78	0.61	0.61	0.00	1
185.91	1.30	1.30	0.00	1
186.02	1.99	1.99	0.00	1
186.08	2.38	2.38	0.00	1
186.16	3.37	3.37	0.00	1
186.24	4.05	4.05	0.00	1
186.32	4.74	4.74	0.00	1
186.40	5.43	5.43	0.00	1
186.47	6.12	6.12	0.00	1
186.63	6.81	6.81	0.00	1
186.81	7.50	7.50	0.00	1
187.32	9.29	9.29	0.00	Overtopping

# Rating Curve Plot for Crossing: Crossing 4 Proposed

## Total Rating Curve

Crossing: Crossing 4 Proposed



**Table 2 - Culvert Summary Table: Culvert 4**

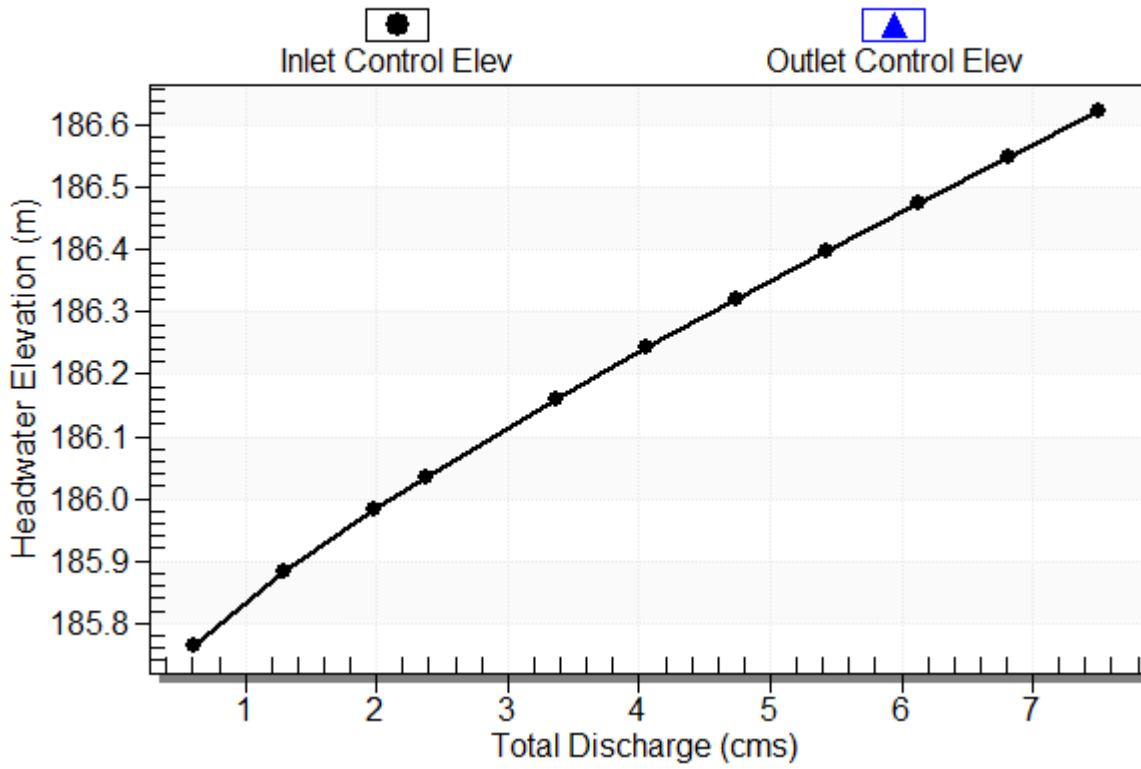
Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.61	0.61	185.78	0.183	0.199	3-M1t	0.130	0.125	0.570	0.570	0.243	0.470
1.30	1.30	185.91	0.304	0.330	3-M1t	0.213	0.208	0.757	0.757	0.390	0.567
1.99	1.99	186.02	0.403	0.439	3-M1t	0.278	0.276	0.888	0.888	0.509	0.631
2.38	2.38	186.08	0.455	0.496	3-M1t	0.312	0.311	0.949	0.949	0.570	0.660
3.37	3.37	186.16	0.579	0.579	1-S1f	0.390	0.392	0.392	1.081	1.954	0.720
4.05	4.05	186.24	0.662	0.662	1-S1f	0.438	0.443	0.443	1.160	2.079	0.754
4.74	4.74	186.32	0.742	0.742	1-S1f	0.486	0.492	0.492	1.230	2.191	0.784
5.43	5.43	186.40	0.819	0.819	1-S1f	0.530	0.539	0.539	1.294	2.292	0.811
6.12	6.12	186.47	0.894	0.894	1-S1f	0.574	0.583	0.583	1.353	2.385	0.836
6.81	6.81	186.63	0.969	1.049	4-FFf	0.616	0.626	1.000	1.408	1.548	0.858
7.50	7.50	186.81	1.044	1.228	4-FFf	0.656	0.668	1.000	1.460	1.705	0.879

\*\*\*\*\*  
Inlet Elevation (invert): 185.58 m, Outlet Elevation (invert): 184.62 m  
Culvert Length: 47.01 m, Culvert Slope: 0.0204  
\*\*\*\*\*

### Culvert Performance Curve Plot: Culvert 4

## Performance Curve

Culvert: Culvert 4

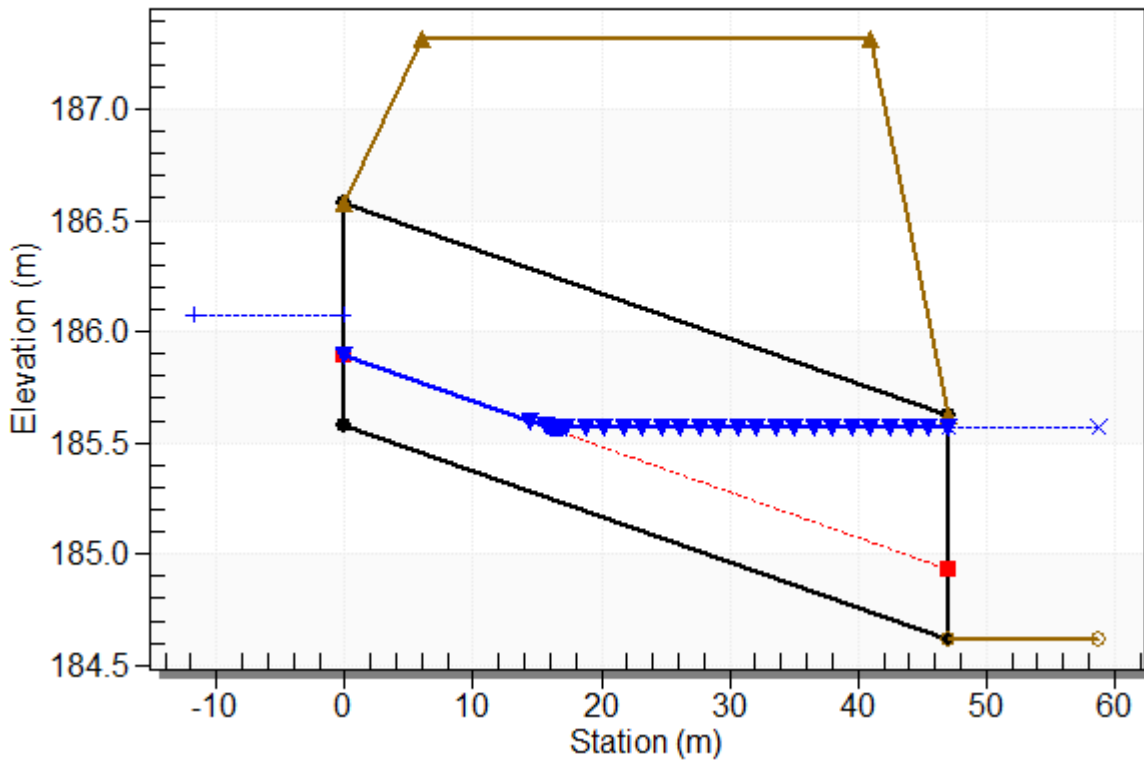




## Water Surface Profile Plot for Culvert: Culvert 4

Crossing - Crossing 4 Proposed , Design Discharge - 2.38 cms

Culvert - Culvert 4, Culvert Discharge - 2.38 cms



### Site Data - Culvert 4

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 185.58 m

Outlet Station: 47.00 m

Outlet Elevation: 184.62 m

Number of Barrels: 1

### Culvert Data Summary - Culvert 4

Barrel Shape: Concrete Box

Barrel Span: 4400.00 mm

Barrel Rise: 1000.00 mm

Barrel Material: Concrete

Embedment: 0.00 mm

Barrel Manning's n: 0.0350

Inlet Type: Conventional

Inlet Edge Condition: 1:1 Bevel (45° flare) Wingwall

Inlet Depression: NONE

**Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 4 Proposed )**

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
0.61	185.19	0.57	0.47	8.38	0.28
1.30	185.38	0.76	0.57	11.12	0.29
1.99	185.51	0.89	0.63	13.05	0.30
2.38	185.57	0.95	0.66	13.96	0.31
3.37	185.70	1.08	0.72	15.90	0.31
4.05	185.78	1.16	0.75	17.05	0.32
4.74	185.85	1.23	0.78	18.08	0.32
5.43	185.91	1.29	0.81	19.03	0.32
6.12	185.97	1.35	0.84	19.90	0.32
6.81	186.03	1.41	0.86	20.71	0.33
7.50	186.08	1.46	0.88	21.47	0.33

### **Tailwater Channel Data - Crossing 4 Proposed**

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 4.00 (4:1)

Channel Slope: 0.0015

Channel Manning's n: 0.0350

Channel Invert Elevation: 184.62 m

### **Roadway Data for Crossing: Crossing 4 Proposed**

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 10.00 m

Crest Elevation: 187.32 m

Roadway Surface: Paved

Roadway Top Width: 35.00 m

# HY-8 Culvert Analysis Report

Crossing Notes: Crossing 5 Proposed

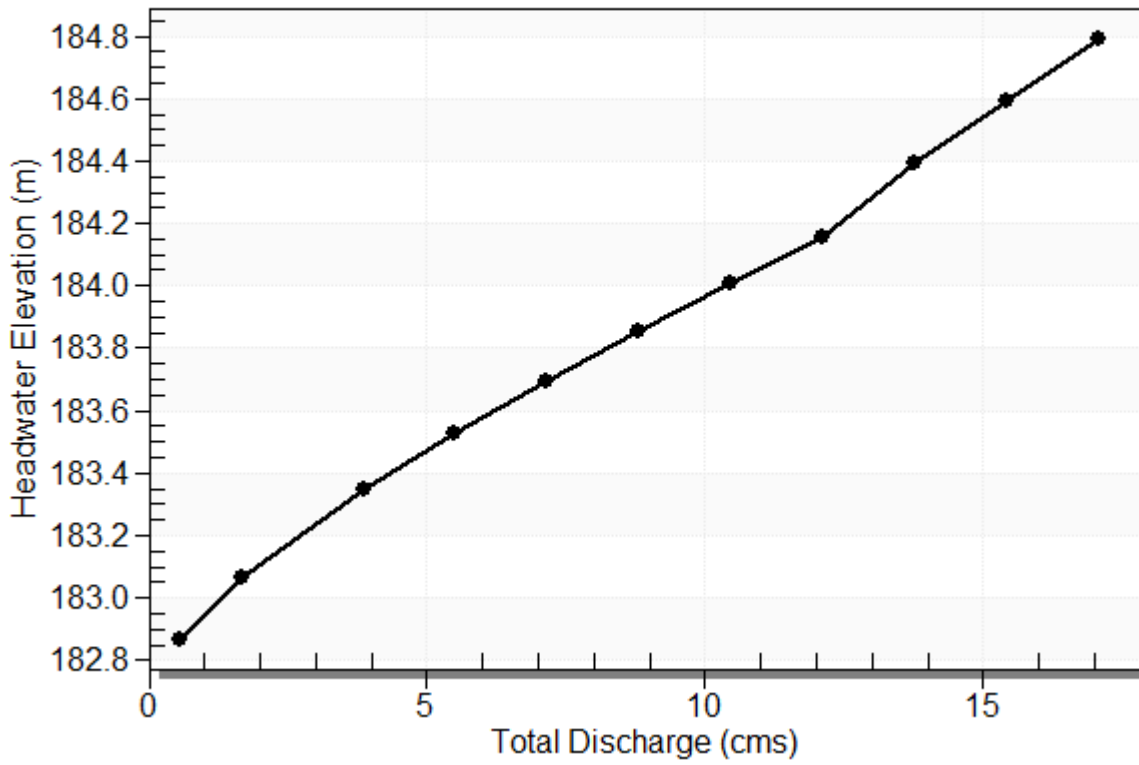
**Table 1 - Summary of Culvert Flows at Crossing: Crossing 5 Proposed**

Headwater Elevation (m)	Total Discharge (cms)	Culvert 1 Discharge (cms)	Roadway Discharge (cms)	Iterations
182.87	0.55	0.55	0.00	1
183.07	1.68	1.68	0.00	1
183.35	3.85	3.85	0.00	1
183.53	5.50	5.50	0.00	1
183.70	7.15	7.15	0.00	1
183.86	8.80	8.80	0.00	1
184.01	10.46	10.46	0.00	1
184.16	12.11	12.11	0.00	1
184.39	13.76	13.76	0.00	1
184.59	15.41	15.41	0.00	1
184.79	17.06	17.06	0.00	1
185.15	19.85	19.85	0.00	Overtopping

# Rating Curve Plot for Crossing: Crossing 5 Proposed

## Total Rating Curve

Crossing: Crossing 5 Proposed



**Table 2 - Culvert Summary Table: Culvert 1**

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.55	0.55	182.87	0.139	0.189	3-M1t	0.173	0.081	0.185	0.185	0.390	0.781
1.68	1.68	183.07	0.262	0.386	3-M1t	0.351	0.171	0.375	0.375	0.589	1.179
3.85	3.85	183.35	0.455	0.666	3-M1t	0.597	0.298	0.645	0.645	0.785	1.571
5.50	5.50	183.53	0.577	0.849	3-M1t	0.749	0.377	0.821	0.821	0.882	1.764
7.15	7.15	183.70	0.687	1.017	3-M1t	0.887	0.450	0.984	0.984	0.957	1.914
8.80	8.80	183.86	0.790	1.176	3-M1t	1.015	0.516	1.138	1.138	1.018	2.037
10.46	10.46	184.01	0.887	1.328	3-M1t	1.137	0.579	1.285	1.285	1.070	2.141
12.11	12.11	184.16	0.980	1.476	3-M1t	1.253	0.638	1.428	1.428	1.115	2.231
13.76	13.76	184.39	1.067	1.712	4-FFf	1.500	0.695	1.500	1.568	1.207	2.309
15.41	15.41	184.59	1.151	1.911	4-FFf	1.500	0.750	1.500	1.704	1.352	2.379
17.06	17.06	184.79	1.232	2.114	4-FFf	1.500	0.802	1.500	1.838	1.496	2.442

\*\*\*\*\*

Inlet Elevation (invert): 182.68 m, Outlet Elevation (invert): 182.58 m

Culvert Length: 47.00 m, Culvert Slope: 0.0021

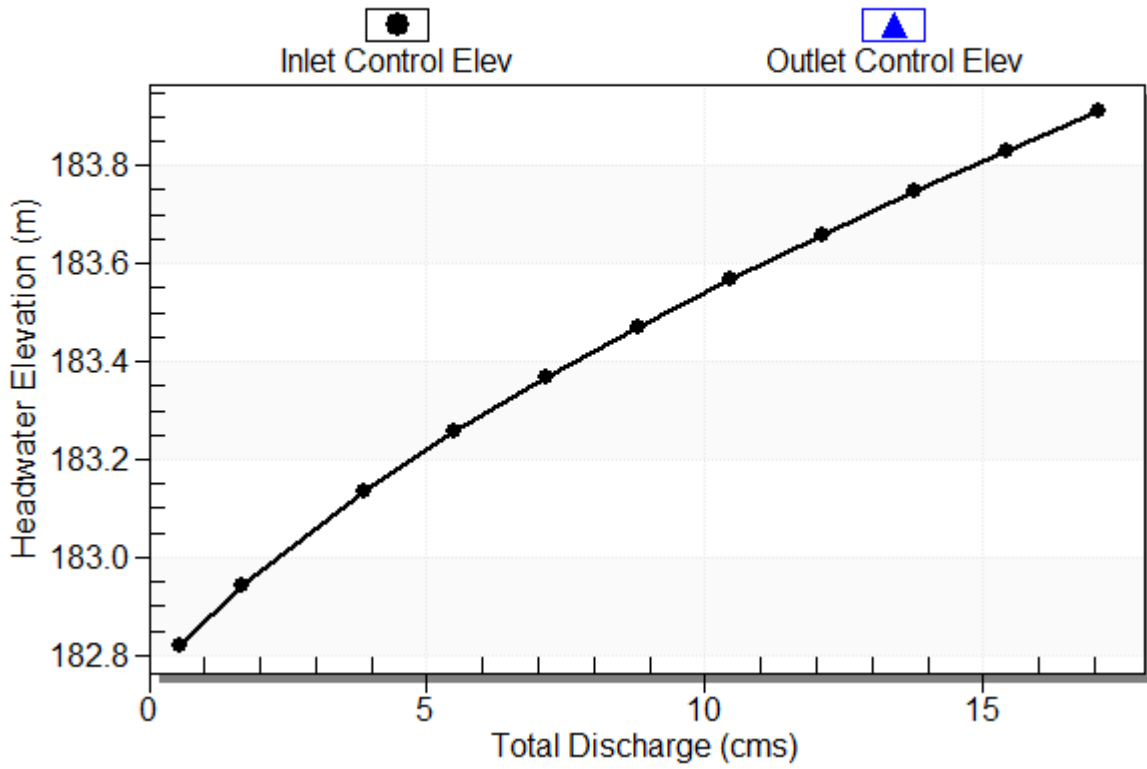
\*\*\*\*\*



### Culvert Performance Curve Plot: Culvert 1

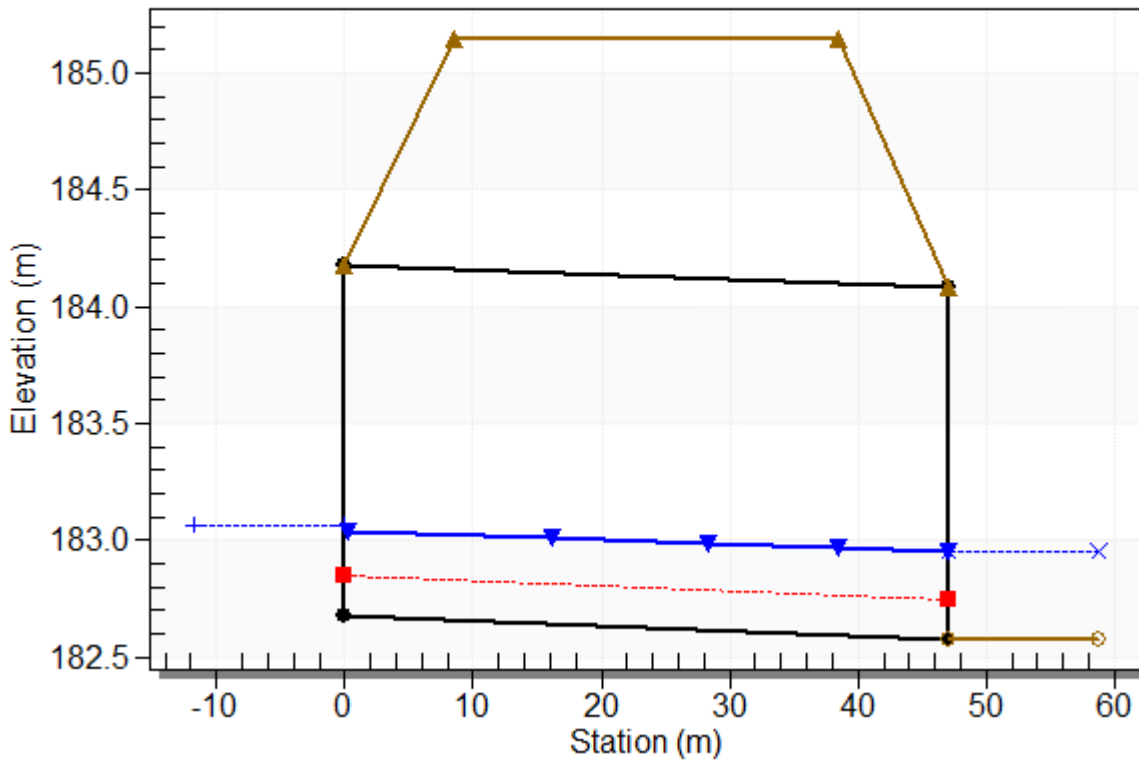
## Performance Curve

Culvert: Culvert 1



## Water Surface Profile Plot for Culvert: Culvert 1

Crossing - Crossing 5 Proposed, Design Discharge - 1.68 cms  
Culvert - Culvert 1, Culvert Discharge - 1.68 cms



### Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 182.68 m

Outlet Station: 47.00 m

Outlet Elevation: 182.58 m

Number of Barrels: 1

### Culvert Data Summary - Culvert 1

Barrel Shape: Concrete Box

Barrel Span: 7600.00 mm

Barrel Rise: 1500.00 mm

Barrel Material: Concrete

Embedment: 0.00 mm

Barrel Manning's n: 0.0350

Inlet Type: Conventional

Inlet Edge Condition: 1.5:1 Bevel (90°) Headwall

Inlet Depression: NONE

**Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 5 Proposed)**

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
0.55	182.77	0.19	0.78	14.54	0.58
1.68	182.96	0.38	1.18	29.41	0.61
3.85	183.23	0.65	1.57	50.61	0.62
5.50	183.40	0.82	1.76	64.39	0.62
7.15	183.56	0.98	1.91	77.13	0.62
8.80	183.72	1.14	2.04	89.20	0.61
10.46	183.87	1.29	2.14	100.79	0.60
12.11	184.01	1.43	2.23	112.01	0.60
13.76	184.15	1.57	2.31	122.94	0.59
15.41	184.28	1.70	2.38	133.64	0.58
17.06	184.42	1.84	2.44	144.14	0.58

### **Tailwater Channel Data - Crossing 5 Proposed**

Tailwater Channel Option: Rectangular Channel

Bottom Width: 3.80 m

Channel Slope: 0.0080

Channel Manning's n: 0.0350

Channel Invert Elevation: 182.58 m

### **Roadway Data for Crossing: Crossing 5 Proposed**

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 10.00 m

Crest Elevation: 185.15 m

Roadway Surface: Paved

Roadway Top Width: 30.00 m

# HY-8 Culvert Analysis Report

Crossing Notes: Crossing 6 Proposed

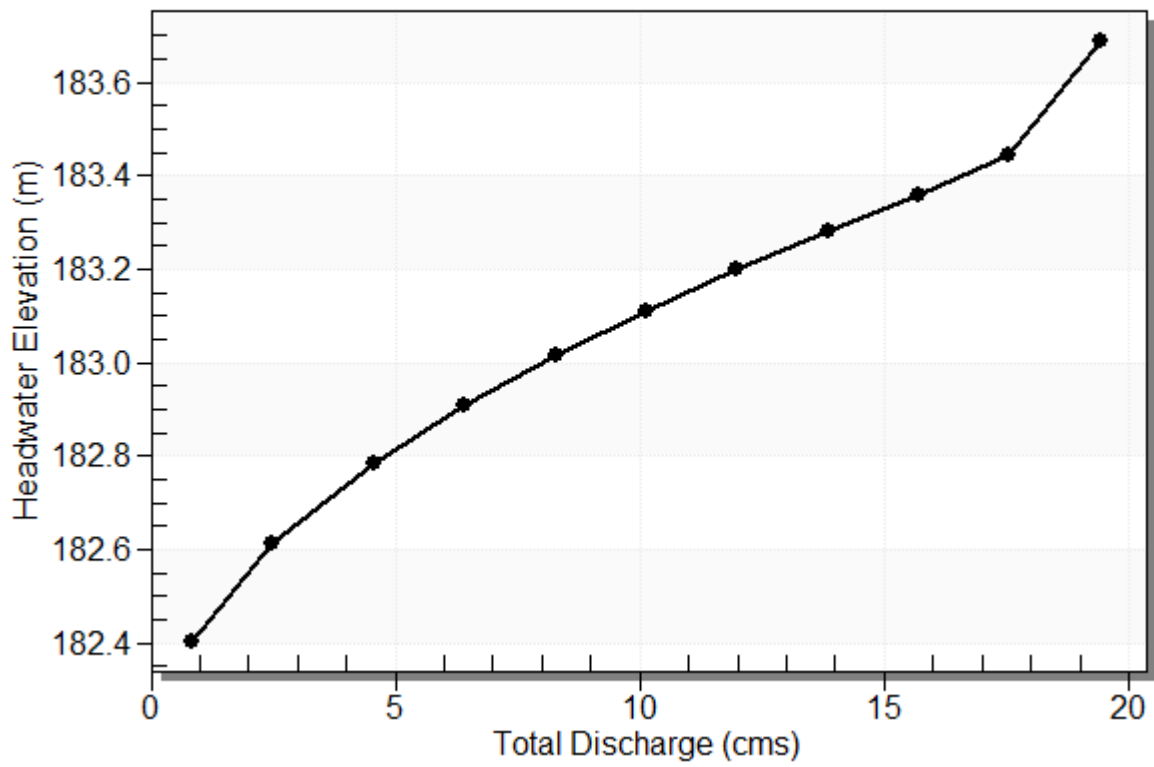
**Table 1 - Summary of Culvert Flows at Crossing: Crossing 6 Proposed**

Headwater Elevation (m)	Total Discharge (cms)	Culvert 6 Discharge (cms)	Roadway Discharge (cms)	Iterations
182.41	0.85	0.85	0.00	1
182.61	2.49	2.49	0.00	1
182.79	4.56	4.56	0.00	1
182.91	6.42	6.42	0.00	1
183.02	8.28	8.28	0.00	1
183.11	10.14	10.14	0.00	1
183.20	11.99	11.99	0.00	1
183.28	13.85	13.85	0.00	1
183.36	15.71	15.71	0.00	1
183.45	17.56	17.56	0.00	1
183.69	19.42	19.42	0.00	1
184.36	27.65	27.65	0.00	Overtopping

# Rating Curve Plot for Crossing: Crossing 6 Proposed

## Total Rating Curve

Crossing: Crossing 6 Proposed



**Table 2 - Culvert Summary Table: Culvert 6**

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.85	0.85	182.41	0.140	0.255	3-M1t	0.165	0.089	0.373	0.373	0.223	0.610
2.49	2.49	182.61	0.280	0.463	3-M1t	0.327	0.183	0.559	0.559	0.437	0.798
4.56	4.56	182.79	0.418	0.636	3-M1t	0.479	0.274	0.701	0.701	0.638	0.928
6.42	6.42	182.91	0.525	0.759	3-M1t	0.593	0.344	0.797	0.797	0.790	1.011
8.28	8.28	183.02	0.622	0.865	3-M1t	0.695	0.407	0.877	0.877	0.926	1.077
10.14	10.14	183.11	0.714	0.961	3-M1t	0.790	0.466	0.946	0.946	1.051	1.133
11.99	11.99	183.20	0.800	1.050	3-M1t	0.879	0.521	1.007	1.007	1.167	1.182
13.85	13.85	183.28	0.881	1.133	3-M1t	0.965	0.574	1.063	1.063	1.277	1.225
15.71	15.71	183.36	0.958	1.211	7-M1t	1.045	0.624	1.114	1.114	1.382	1.265
17.56	17.56	183.45	1.031	1.296	3-M2t	1.200	0.672	1.162	1.162	1.482	1.300
19.42	19.42	183.69	1.103	1.541	4-FFf	1.200	0.719	1.200	1.207	1.587	1.333

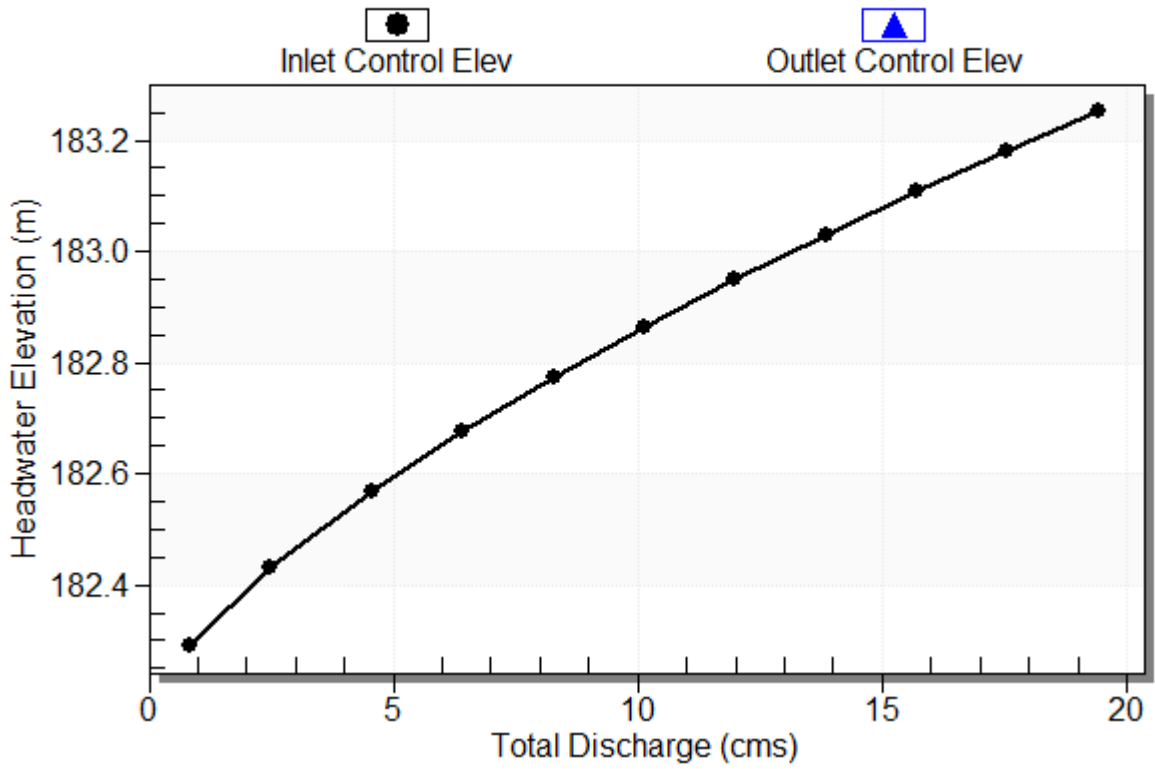


\*\*\*\*\*  
Inlet Elevation (invert): 182.15 m, Outlet Elevation (invert): 182.00 m  
Culvert Length: 47.00 m, Culvert Slope: 0.0032  
\*\*\*\*\*

### Culvert Performance Curve Plot: Culvert 6

## Performance Curve

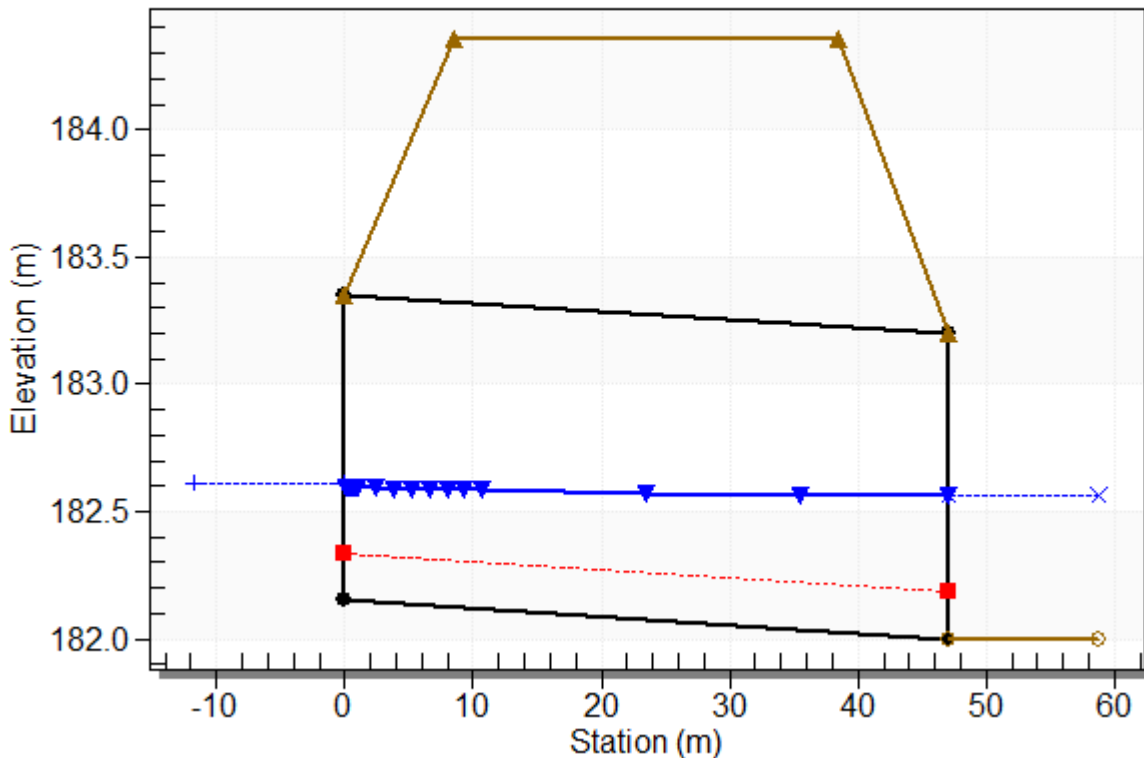
Culvert: Culvert 6



## Water Surface Profile Plot for Culvert: Culvert 6

Crossing - Crossing 6 Proposed, Design Discharge - 2.49 cms

Culvert - Culvert 6, Culvert Discharge - 2.49 cms



### Site Data - Culvert 6

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 182.15 m

Outlet Station: 47.00 m

Outlet Elevation: 182.00 m

Number of Barrels: 1

### Culvert Data Summary - Culvert 6

Barrel Shape: Concrete Box

Barrel Span: 10200.00 mm

Barrel Rise: 1200.00 mm

Barrel Material: Concrete

Embedment: 0.00 mm

Barrel Manning's n: 0.0350

Inlet Type: Conventional

Inlet Edge Condition: 1.5:1 Bevel (90°) Headwall

Inlet Depression: NONE

**Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 6 Proposed)**

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
0.85	182.37	0.37	0.61	15.73	0.45
2.49	182.56	0.56	0.80	23.55	0.48
4.56	182.70	0.70	0.93	29.55	0.50
6.42	182.80	0.80	1.01	33.59	0.51
8.28	182.88	0.88	1.08	36.94	0.52
10.14	182.95	0.95	1.13	39.86	0.53
11.99	183.01	1.01	1.18	42.45	0.53
13.85	183.06	1.06	1.23	44.81	0.54
15.71	183.11	1.11	1.26	46.97	0.54
17.56	183.16	1.16	1.30	48.98	0.54
19.42	183.21	1.21	1.33	50.87	0.55

### **Tailwater Channel Data - Crossing 6 Proposed**

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 10.00 (1:1)

Channel Slope: 0.0043

Channel Manning's n: 0.0350

Channel Invert Elevation: 182.00 m

### **Roadway Data for Crossing: Crossing 6 Proposed**

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 47.00 m

Crest Elevation: 184.36 m

Roadway Surface: Paved

Roadway Top Width: 30.00 m

# HY-8 Culvert Analysis Report

Crossing Notes: Crossing 8 Proposed

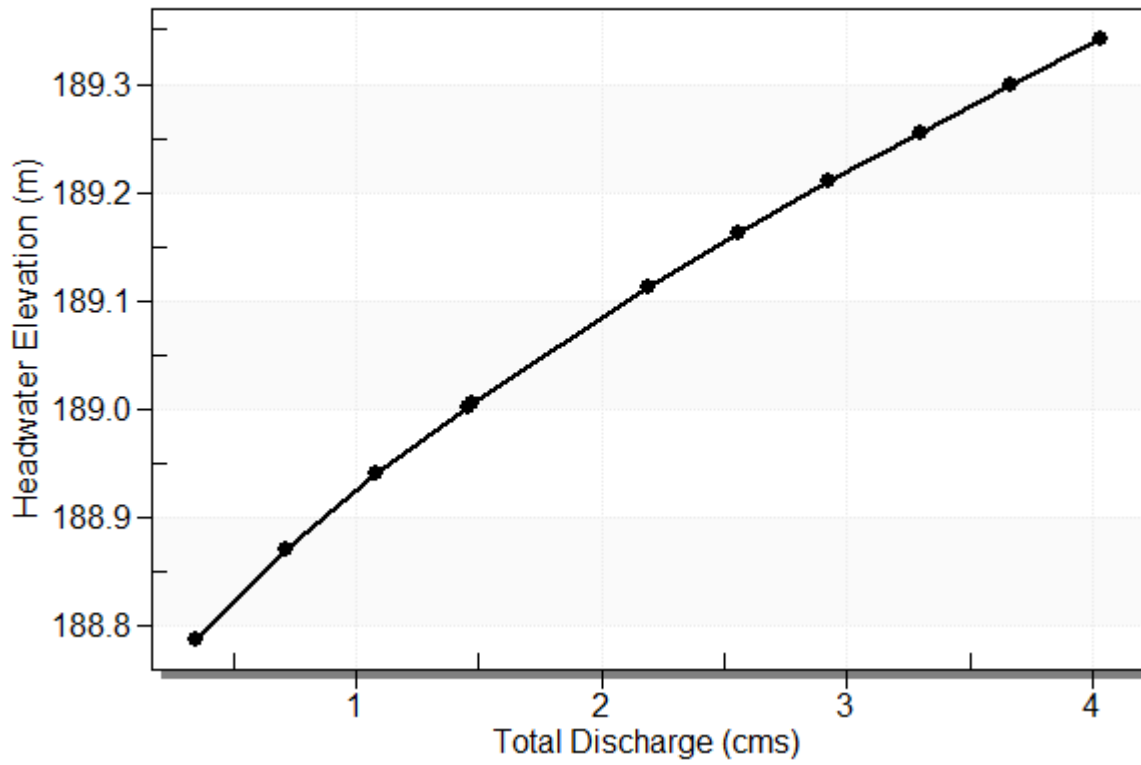
**Table 1 - Summary of Culvert Flows at Crossing: Crossing 8 Proposed**

Headwater Elevation (m)	Total Discharge (cms)	Culvert 8 Discharge (cms)	Roadway Discharge (cms)	Iterations
188.79	0.35	0.35	0.00	1
188.87	0.72	0.72	0.00	1
188.94	1.09	1.09	0.00	1
189.00	1.45	1.45	0.00	1
189.00	1.47	1.47	0.00	1
189.11	2.19	2.19	0.00	1
189.16	2.56	2.56	0.00	1
189.21	2.93	2.93	0.00	1
189.26	3.29	3.29	0.00	1
189.30	3.66	3.66	0.00	1
189.34	4.03	4.03	0.00	1
190.00	10.40	10.40	0.00	Overtopping

# Rating Curve Plot for Crossing: Crossing 8 Proposed

## Total Rating Curve

Crossing: Crossing 8 Proposed





**Table 2 - Culvert Summary Table: Culvert 8**

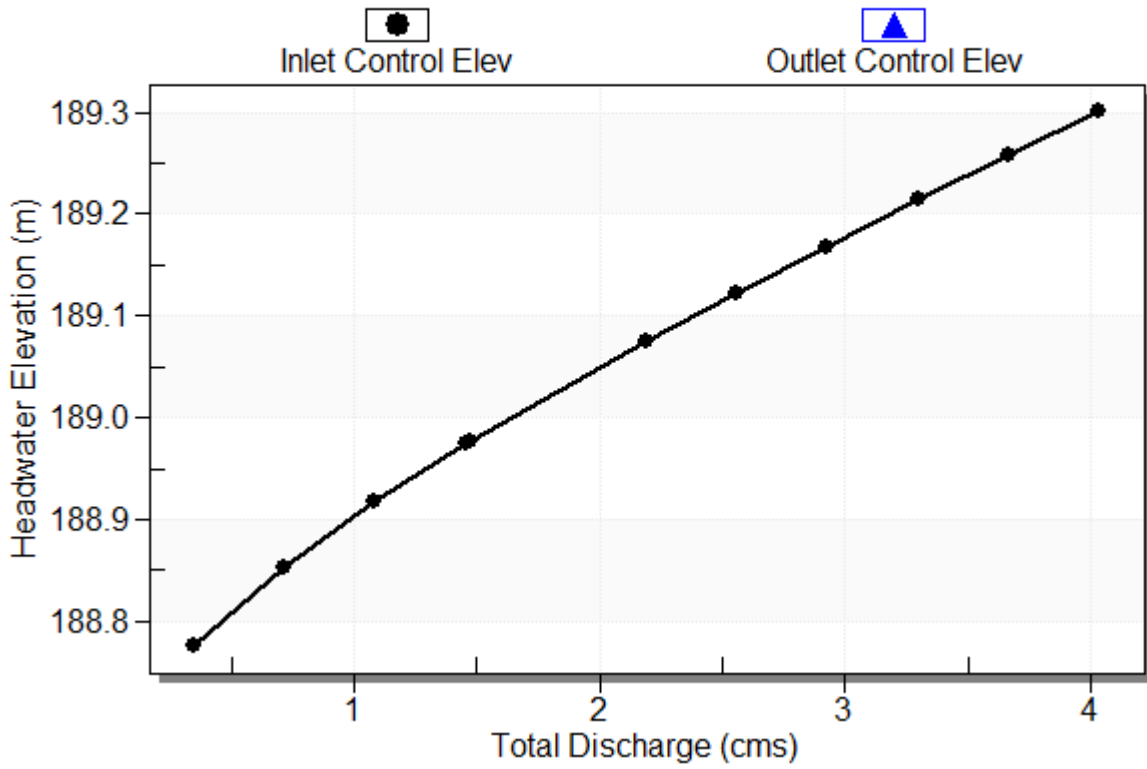
Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.35	0.35	188.79	0.126	0.138	3-M1t	0.103	0.085	0.198	0.198	0.393	0.746
0.72	0.72	188.87	0.203	0.221	3-M1t	0.157	0.138	0.259	0.259	0.616	0.893
1.09	1.09	188.94	0.267	0.290	3-M1t	0.208	0.181	0.302	0.302	0.798	0.991
1.45	1.45	189.00	0.324	0.352	3-M1t	0.247	0.220	0.337	0.337	0.958	1.066
1.47	1.47	189.00	0.326	0.355	3-M1t	0.249	0.222	0.339	0.339	0.965	1.068
2.19	2.19	189.11	0.426	0.462	3-M1t	0.322	0.290	0.393	0.393	1.238	1.180
2.56	2.56	189.16	0.472	0.512	3-M1t	0.355	0.321	0.417	0.417	1.364	1.227
2.93	2.93	189.21	0.518	0.560	3-M1t	0.388	0.351	0.438	0.438	1.483	1.269
3.29	3.29	189.26	0.564	0.606	3-M1t	0.418	0.380	0.458	0.458	1.597	1.307
3.66	3.66	189.30	0.608	0.650	3-M1t	0.447	0.408	0.477	0.477	1.707	1.342
4.03	4.03	189.34	0.652	0.693	3-M1t	0.476	0.435	0.494	0.494	1.812	1.375

\*\*\*\*\*  
Inlet Elevation (invert): 188.65 m, Outlet Elevation (invert): 187.95 m  
Culvert Length: 47.01 m, Culvert Slope: 0.0149  
\*\*\*\*\*

### Culvert Performance Curve Plot: Culvert 8

## Performance Curve

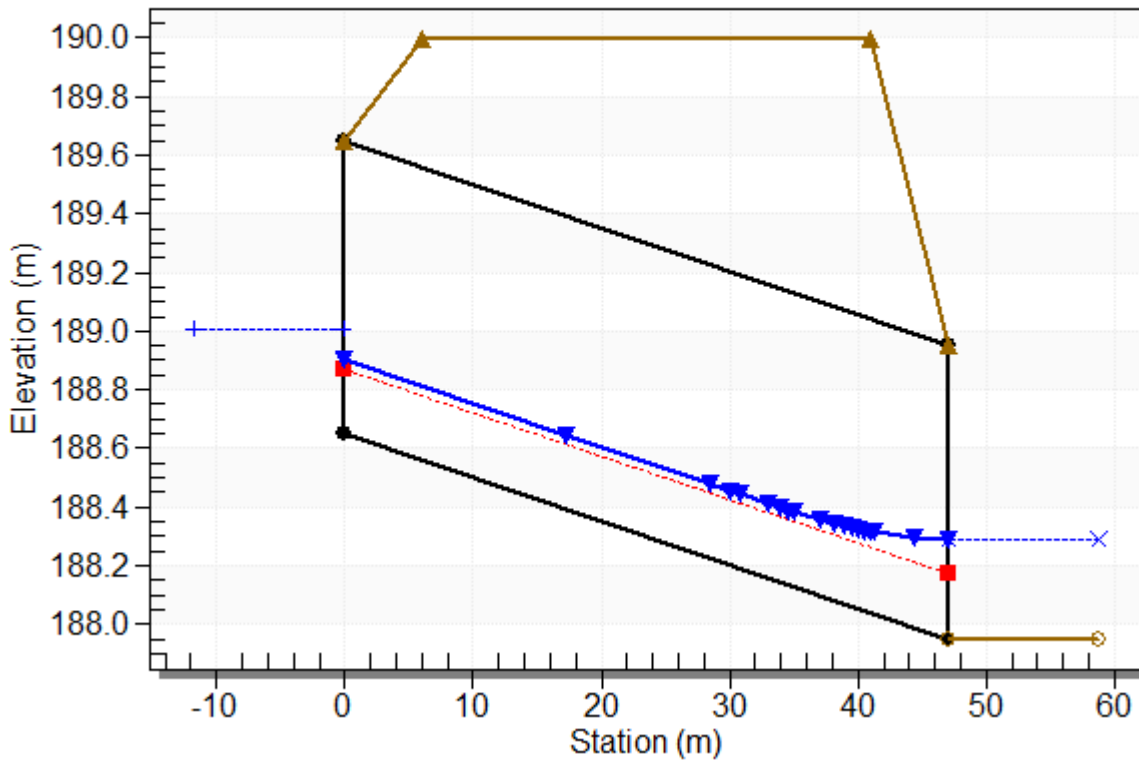
Culvert: Culvert 8



## Water Surface Profile Plot for Culvert: Culvert 8

Crossing - Crossing 8 Proposed, Design Discharge - 1.47 cms

Culvert - Culvert 8, Culvert Discharge - 1.47 cms



### Site Data - Culvert 8

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 188.65 m

Outlet Station: 47.00 m

Outlet Elevation: 187.95 m

Number of Barrels: 1

### Culvert Data Summary - Culvert 8

Barrel Shape: Concrete Box

Barrel Span: 4500.00 mm

Barrel Rise: 1000.00 mm

Barrel Material: Concrete

Embedment: 0.00 mm

Barrel Manning's n: 0.0350

Inlet Type: Conventional

Inlet Edge Condition: 1:1 Bevel (45° flare) Wingwall

Inlet Depression: NONE

**Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 8 Proposed)**

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
0.35	188.15	0.20	0.75	29.07	0.76
0.72	188.21	0.26	0.89	38.05	0.79
1.09	188.25	0.30	0.99	44.44	0.81
1.45	188.29	0.34	1.07	49.58	0.83
1.47	188.29	0.34	1.07	49.79	0.83
2.19	188.34	0.39	1.18	57.81	0.85
2.56	188.37	0.42	1.23	61.28	0.86
2.93	188.39	0.44	1.27	64.45	0.87
3.29	188.41	0.46	1.31	67.38	0.87
3.66	188.43	0.48	1.34	70.11	0.88
4.03	188.44	0.49	1.37	72.67	0.88

### **Tailwater Channel Data - Crossing 8 Proposed**

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 12.00 (1:1)

Channel Slope: 0.0150

Channel Manning's n: 0.0350

Channel Invert Elevation: 187.95 m

### **Roadway Data for Crossing: Crossing 8 Proposed**

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 10.00 m

Crest Elevation: 190.00 m

Roadway Surface: Paved

Roadway Top Width: 35.00 m

# HY-8 Culvert Analysis Report

Crossing Notes: Crossing 9 Proposed

**Table 1 - Summary of Culvert Flows at Crossing: Crossing 9 Proposed**

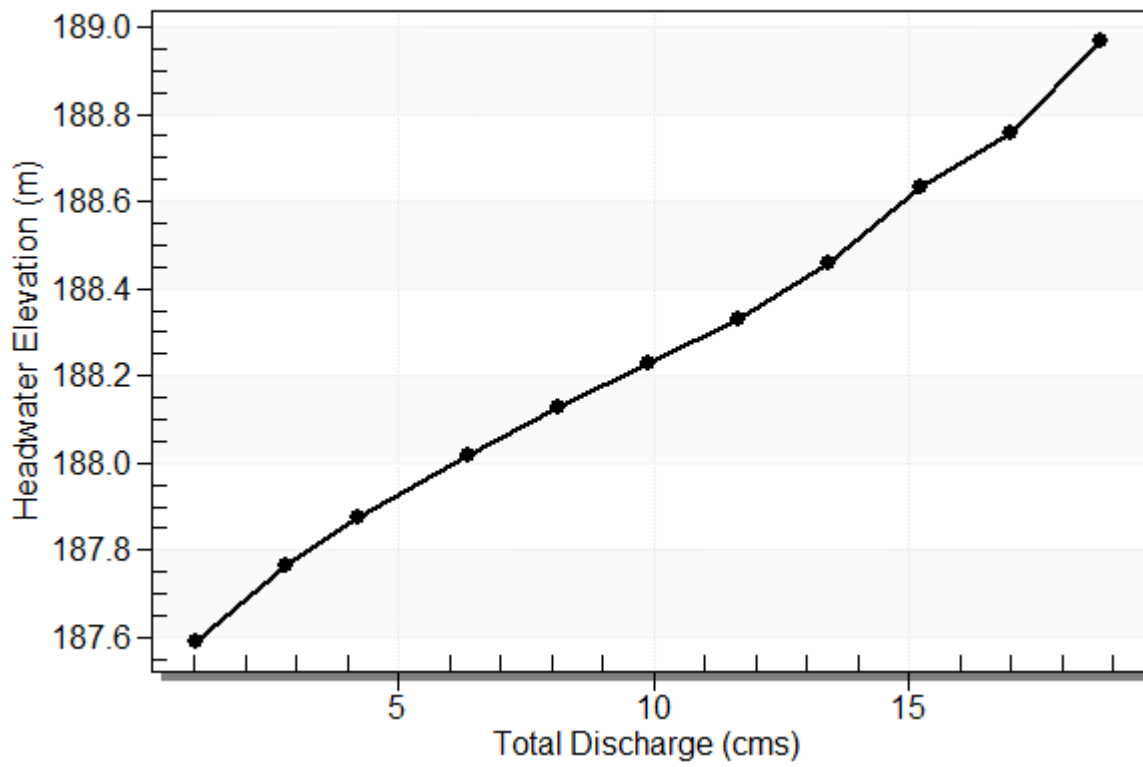
Headwater Elevation (m)	Total Discharge (cms)	Culvert 9 Discharge (cms)	Roadway Discharge (cms)	Iterations
187.59	1.03	1.03	0.00	1
187.76	2.80	2.80	0.00	1
187.87	4.21	4.21	0.00	1
188.02	6.35	6.35	0.00	1
188.13	8.12	8.12	0.00	1
188.23	9.89	9.89	0.00	1
188.33	11.66	11.66	0.00	1
188.46	13.43	13.43	0.00	1
188.63	15.21	15.21	0.00	1
188.76	16.98	16.98	0.00	1
188.97	18.75	18.75	0.00	1
189.19	20.51	20.51	0.00	Overtopping



# Rating Curve Plot for Crossing: Crossing 9 Proposed

## Total Rating Curve

Crossing: Crossing 9 Proposed



**Table 2 - Culvert Summary Table: Culvert 9**

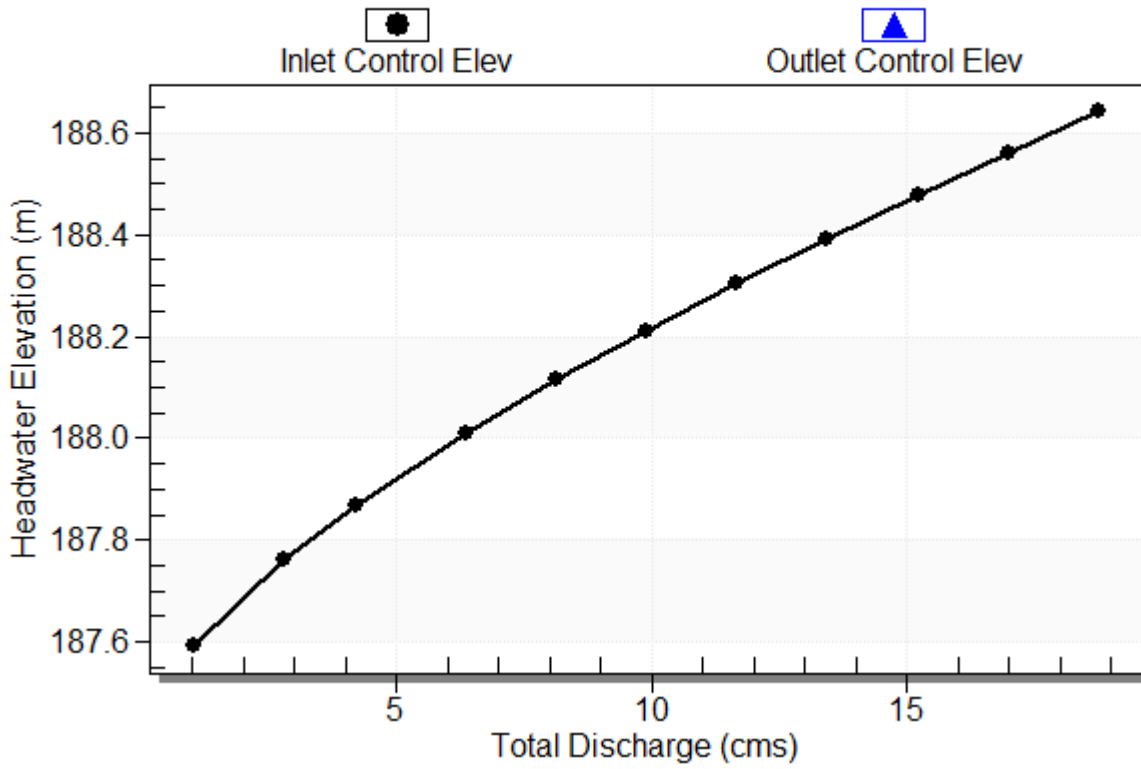
Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
1.03	1.03	187.59	0.182	0.183	3-M1t	0.130	0.106	0.238	0.238	0.451	0.722
2.80	2.80	187.76	0.350	0.354	3-M1t	0.245	0.206	0.444	0.444	0.657	1.051
4.21	4.21	187.87	0.458	0.463	3-M1t	0.314	0.270	0.576	0.576	0.762	1.219
6.35	6.35	188.02	0.601	0.609	3-M1t	0.409	0.355	0.751	0.751	0.881	1.409
8.12	8.12	188.13	0.705	0.717	3-M1t	0.481	0.419	0.882	0.882	0.958	1.534
9.89	9.89	188.23	0.802	0.819	3-M1t	0.545	0.477	1.006	1.006	1.024	1.639
11.66	11.66	188.33	0.894	0.918	3-M1t	0.608	0.533	1.123	1.123	1.082	1.730
13.43	13.43	188.46	0.981	1.046	3-M1f	0.666	0.586	1.200	1.236	1.166	1.811
15.21	15.21	188.63	1.066	1.222	3-M1f	0.724	0.636	1.200	1.345	1.320	1.884
16.98	16.98	188.76	1.150	1.348	4-FFf	0.778	0.685	1.200	1.451	1.474	1.950
18.75	18.75	188.97	1.233	1.560	4-FFf	0.832	0.731	1.200	1.554	1.628	2.011

\*\*\*\*\*  
Inlet Elevation (invert): 187.41 m, Outlet Elevation (invert): 186.81 m  
Culvert Length: 47.00 m, Culvert Slope: 0.0128  
\*\*\*\*\*

### Culvert Performance Curve Plot: Culvert 9

## Performance Curve

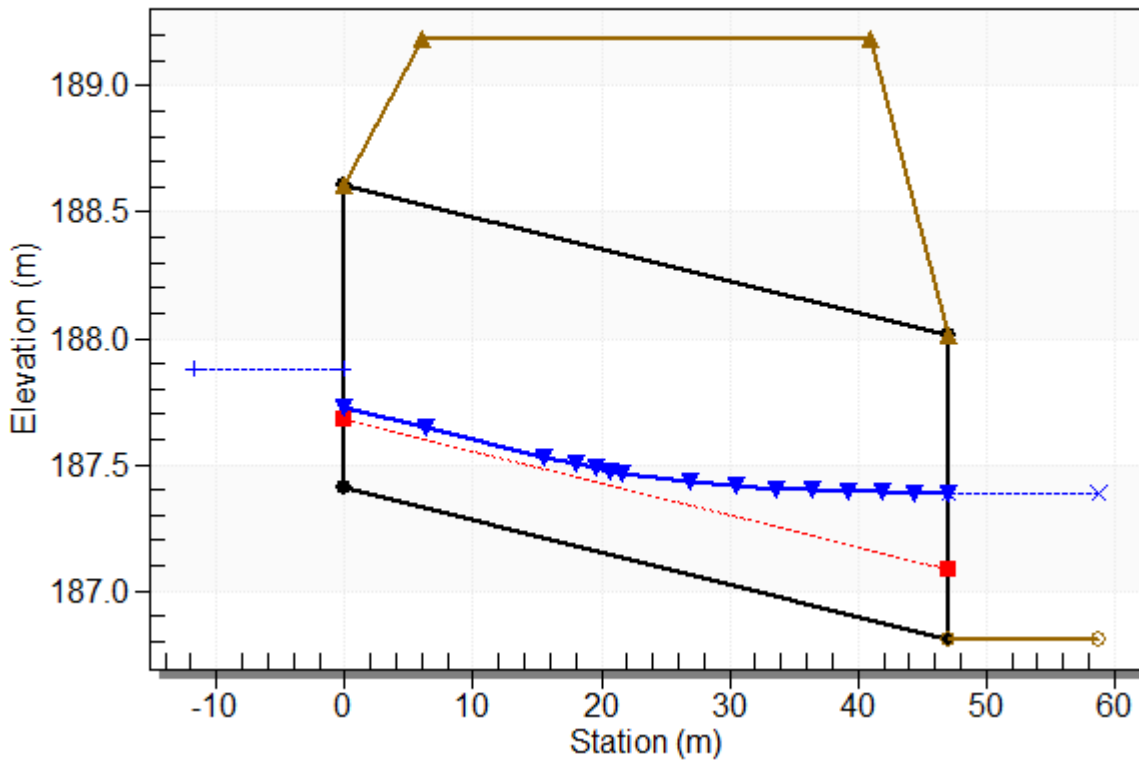
Culvert: Culvert 9



## Water Surface Profile Plot for Culvert: Culvert 9

Crossing - Crossing 9 Proposed, Design Discharge - 4.21 cms

Culvert - Culvert 9, Culvert Discharge - 4.21 cms



### Site Data - Culvert 9

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 187.41 m

Outlet Station: 47.00 m

Outlet Elevation: 186.81 m

Number of Barrels: 2

### Culvert Data Summary - Culvert 9

Barrel Shape: Concrete Box

Barrel Span: 4800.00 mm

Barrel Rise: 1200.00 mm

Barrel Material: Concrete

Embedment: 0.00 mm

Barrel Manning's n: 0.0350

Inlet Type: Conventional

Inlet Edge Condition: Square Edge (90°) Headwall

Inlet Depression: NONE

**Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 9 Proposed)**

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
1.03	187.05	0.24	0.72	11.19	0.47
2.80	187.25	0.44	1.05	20.90	0.50
4.21	187.39	0.58	1.22	27.09	0.51
6.35	187.56	0.75	1.41	35.32	0.52
8.12	187.69	0.88	1.53	41.51	0.52
9.89	187.82	1.01	1.64	47.32	0.52
11.66	187.93	1.12	1.73	52.85	0.52
13.43	188.05	1.24	1.81	58.15	0.52
15.21	188.15	1.34	1.88	63.28	0.52
16.98	188.26	1.45	1.95	68.26	0.52
18.75	188.36	1.55	2.01	73.12	0.51

### **Tailwater Channel Data - Crossing 9 Proposed**

Tailwater Channel Option: Rectangular Channel

Bottom Width: 6.00 m

Channel Slope: 0.0048

Channel Manning's n: 0.0350

Channel Invert Elevation: 186.81 m

### **Roadway Data for Crossing: Crossing 9 Proposed**

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 12.00 m

Crest Elevation: 189.19 m

Roadway Surface: Paved

Roadway Top Width: 35.00 m

# HY-8 Culvert Analysis Report

Crossing Notes: Crossing 10 Scenario 3 Proposed



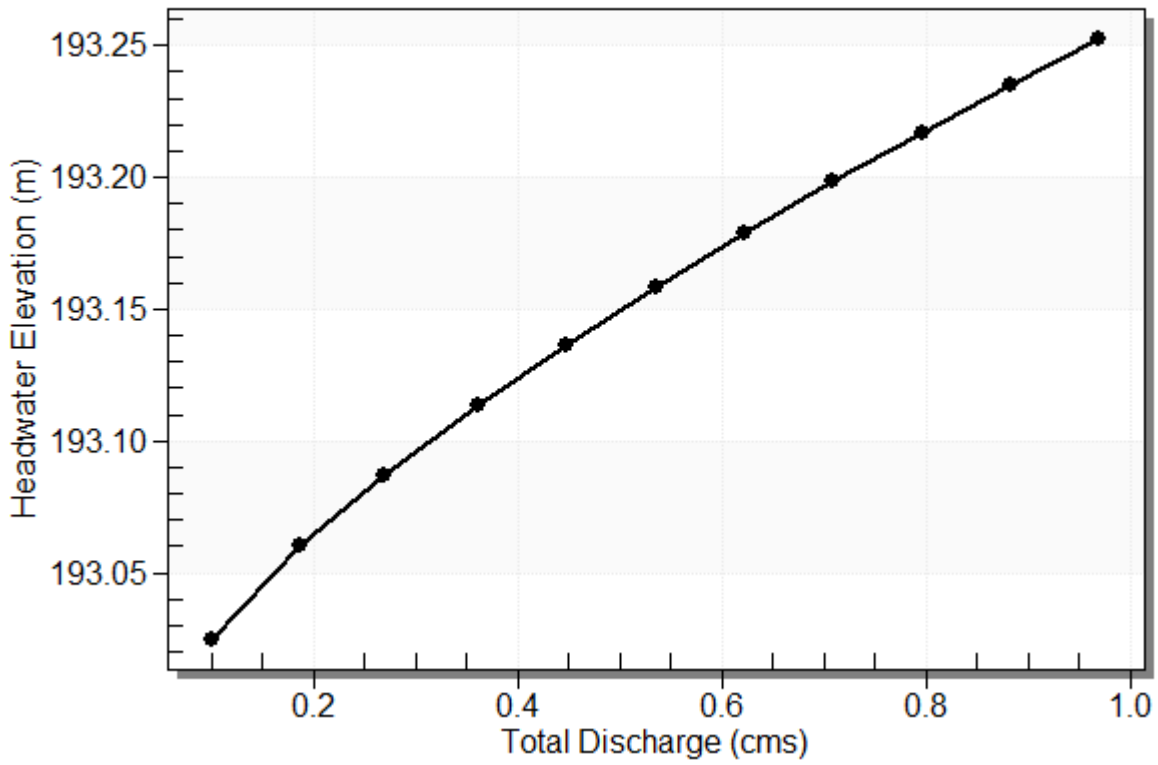
**Table 1 - Summary of Culvert Flows at Crossing: Crossing 10 Scenario 3 Proposed**

Headwater Elevation (m)	Total Discharge (cms)	Culvert 10 Scenario3 Discharge (cms)	Roadway Discharge (cms)	Iterations
193.02	0.10	0.10	0.00	1
193.06	0.19	0.19	0.00	1
193.09	0.27	0.27	0.00	1
193.11	0.36	0.36	0.00	1
193.14	0.45	0.45	0.00	1
193.16	0.54	0.54	0.00	1
193.18	0.62	0.62	0.00	1
193.20	0.71	0.71	0.00	1
193.22	0.80	0.80	0.00	1
193.24	0.88	0.88	0.00	1
193.25	0.97	0.97	0.00	1
194.00	5.82	5.82	0.00	Overtopping

# Rating Curve Plot for Crossing: Crossing 10 Scenario 3 Proposed

## Total Rating Curve

Crossing: Crossing 10 Scenario 3 Proposed



**Table 2 - Culvert Summary Table: Culvert 10 Scenario3**

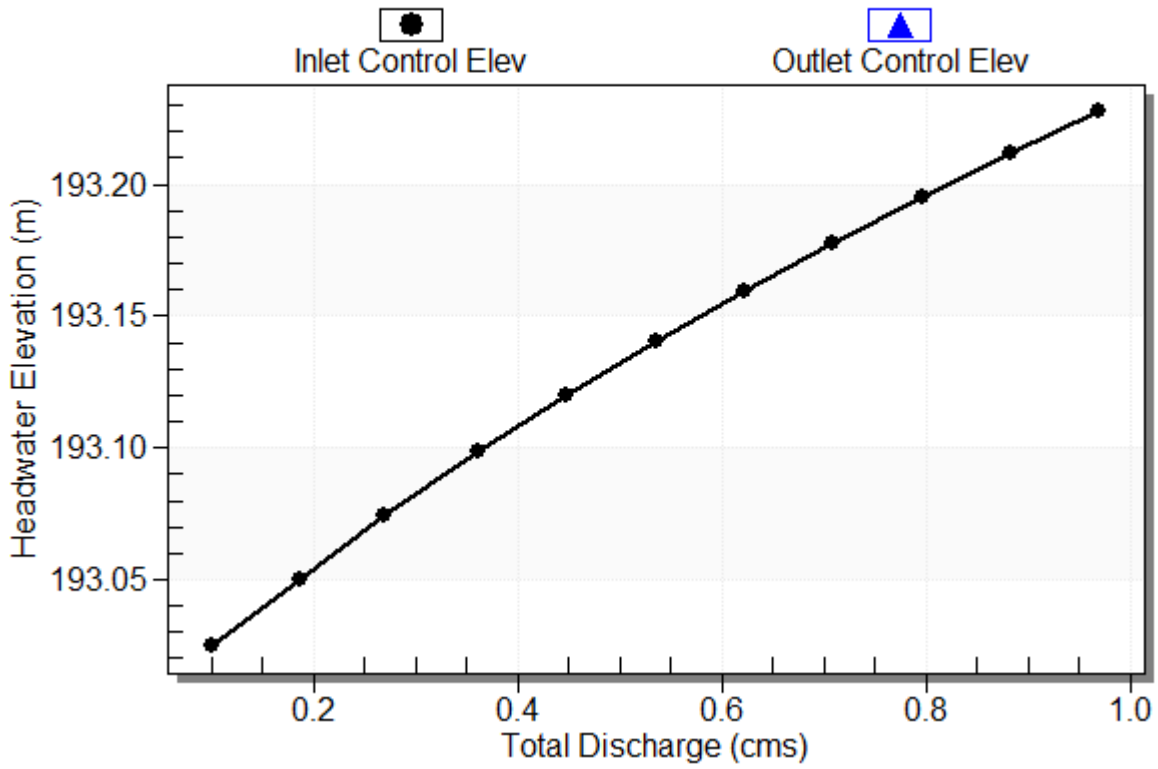
Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.10	0.10	193.02	0.065	0.065	3-M1t	0.043	0.040	0.110	0.110	0.227	0.413
0.19	0.19	193.06	0.090	0.100	3-M1t	0.077	0.061	0.139	0.139	0.336	0.483
0.27	0.27	193.09	0.114	0.127	3-M1t	0.094	0.078	0.160	0.160	0.423	0.529
0.36	0.36	193.11	0.139	0.153	3-M1t	0.113	0.094	0.178	0.178	0.507	0.569
0.45	0.45	193.14	0.160	0.176	3-M1t	0.131	0.109	0.193	0.193	0.580	0.601
0.54	0.54	193.16	0.180	0.198	3-M1t	0.148	0.122	0.206	0.206	0.648	0.628
0.62	0.62	193.18	0.199	0.219	3-M1t	0.162	0.135	0.218	0.218	0.712	0.652
0.71	0.71	193.20	0.217	0.238	3-M1t	0.175	0.148	0.229	0.229	0.773	0.674
0.80	0.80	193.22	0.235	0.257	3-M1t	0.188	0.160	0.240	0.240	0.831	0.694
0.88	0.88	193.24	0.252	0.275	3-M1t	0.201	0.171	0.249	0.249	0.886	0.712
0.97	0.97	193.25	0.268	0.293	3-M1t	0.214	0.182	0.258	0.258	0.940	0.729

\*\*\*\*\*  
Inlet Elevation (invert): 192.96 m, Outlet Elevation (invert): 192.15 m  
Culvert Length: 58.61 m, Culvert Slope: 0.0138  
\*\*\*\*\*

### Culvert Performance Curve Plot: Culvert 10 Scenario3

## Performance Curve

Culvert: Culvert 10 Scenario3





**Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 10 Scenario 3**

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
0.10	192.26	0.11	0.41	10.79	0.56
0.19	192.29	0.14	0.48	13.64	0.58
0.27	192.31	0.16	0.53	15.65	0.60
0.36	192.33	0.18	0.57	17.45	0.61
0.45	192.34	0.19	0.60	18.93	0.62
0.54	192.36	0.21	0.63	20.23	0.62
0.62	192.37	0.22	0.65	21.41	0.63
0.71	192.38	0.23	0.67	22.48	0.64
0.80	192.39	0.24	0.69	23.48	0.64
0.88	192.40	0.25	0.71	24.41	0.64
0.97	192.41	0.26	0.73	25.29	0.65

### **Tailwater Channel Data - Crossing 10 Scenario 3 Proposed**

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 20.00 (1:1)

Channel Slope: 0.0100

Channel Manning's n: 0.0350

Channel Invert Elevation: 192.15 m

### **Roadway Data for Crossing: Crossing 10 Scenario 3 Proposed**

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 10.00 m

Crest Elevation: 194.00 m

Roadway Surface: Paved

Roadway Top Width: 35.00 m



# HY-8 Culvert Analysis Report

Crossing Notes: Crossing 12 Proposed

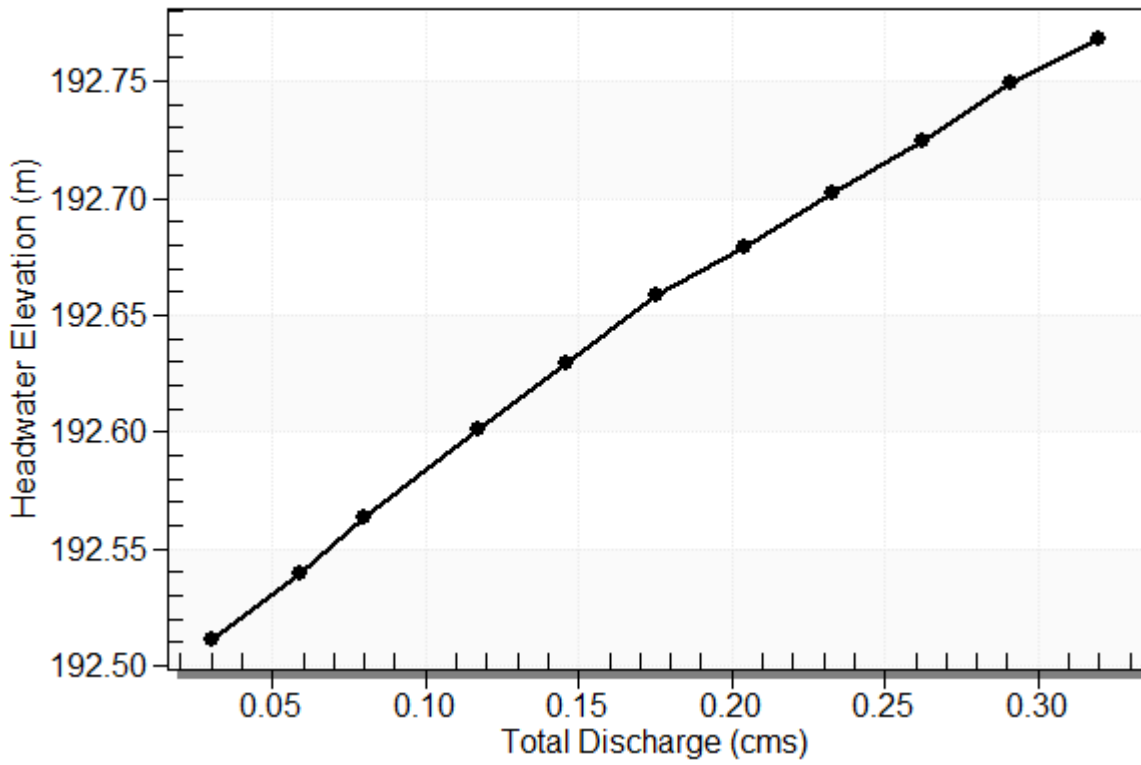
**Table 1 - Summary of Culvert Flows at Crossing: Crossing 12 Proposed**

Headwater Elevation (m)	Total Discharge (cms)	Culvert 12 Discharge (cms)	Roadway Discharge (cms)	Iterations
192.51	0.03	0.03	0.00	1
192.54	0.06	0.06	0.00	1
192.56	0.08	0.08	0.00	1
192.60	0.12	0.12	0.00	1
192.63	0.15	0.15	0.00	1
192.66	0.17	0.17	0.00	1
192.68	0.20	0.20	0.00	1
192.70	0.23	0.23	0.00	1
192.72	0.26	0.26	0.00	1
192.75	0.29	0.29	0.00	1
192.77	0.32	0.32	0.00	1
193.70	1.59	1.59	0.00	Overtopping

# Rating Curve Plot for Crossing: Crossing 12 Proposed

## Total Rating Curve

Crossing: Crossing 12 Proposed



**Table 2 - Culvert Summary Table: Culvert 12**

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.03	0.03	192.51	0.082	0.070	3-M1t	0.044	0.040	0.075	0.075	0.334	0.267
0.06	0.06	192.54	0.110	0.109	3-M1t	0.081	0.063	0.097	0.097	0.509	0.317
0.08	0.08	192.56	0.131	0.134	3-M1t	0.097	0.077	0.108	0.108	0.616	0.342
0.12	0.12	192.60	0.169	0.171	3-M1t	0.125	0.099	0.125	0.125	0.781	0.376
0.15	0.15	192.63	0.196	0.200	3-M2t	0.146	0.115	0.136	0.136	0.897	0.397
0.17	0.17	192.66	0.221	0.228	3-M2t	0.164	0.130	0.145	0.145	1.005	0.416
0.20	0.20	192.68	0.244	0.249	3-M2t	0.181	0.144	0.154	0.154	1.106	0.432
0.23	0.23	192.70	0.266	0.272	3-M2t	0.198	0.157	0.162	0.162	1.202	0.446
0.26	0.26	192.72	0.288	0.294	2-M2c	0.215	0.170	0.170	0.169	1.287	0.460
0.29	0.29	192.75	0.309	0.319	2-M2c	0.232	0.182	0.182	0.176	1.332	0.472
0.32	0.32	192.77	0.330	0.339	2-M2c	0.246	0.194	0.194	0.182	1.374	0.483

\*\*\*\*\*

Inlet Elevation (invert): 192.43 m, Outlet Elevation (invert): 191.93 m

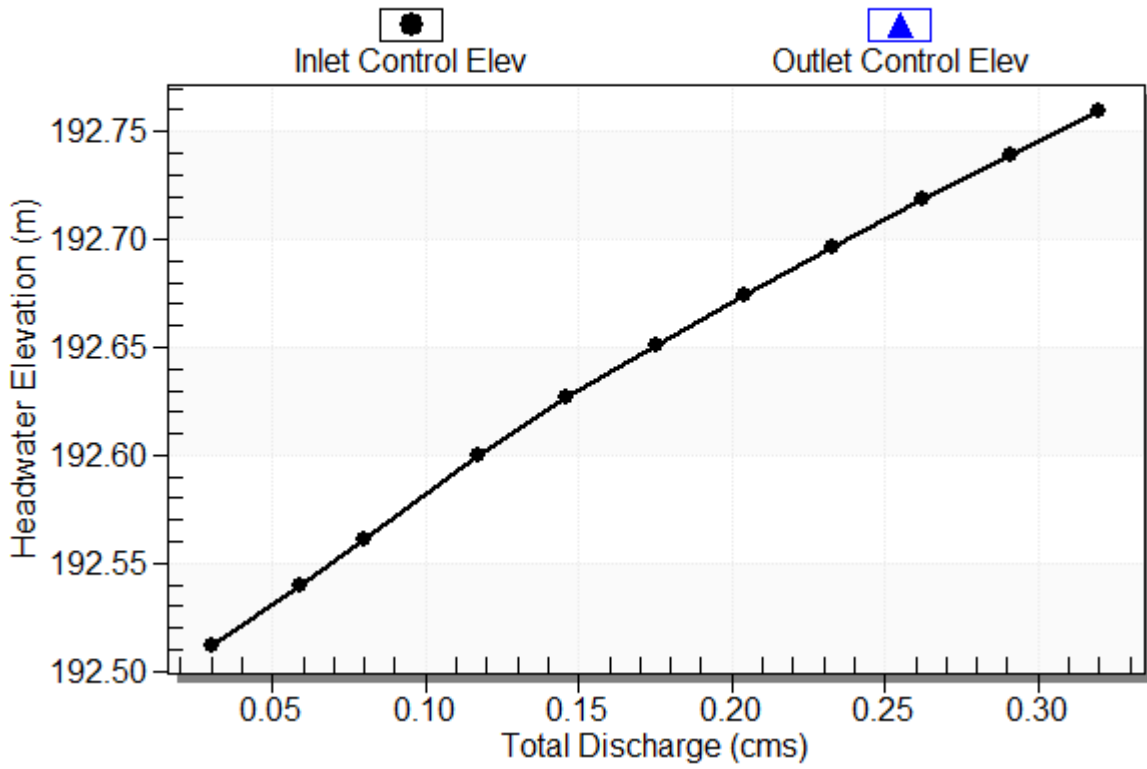
Culvert Length: 47.00 m, Culvert Slope: 0.0106

\*\*\*\*\*

### Culvert Performance Curve Plot: Culvert 12

## Performance Curve

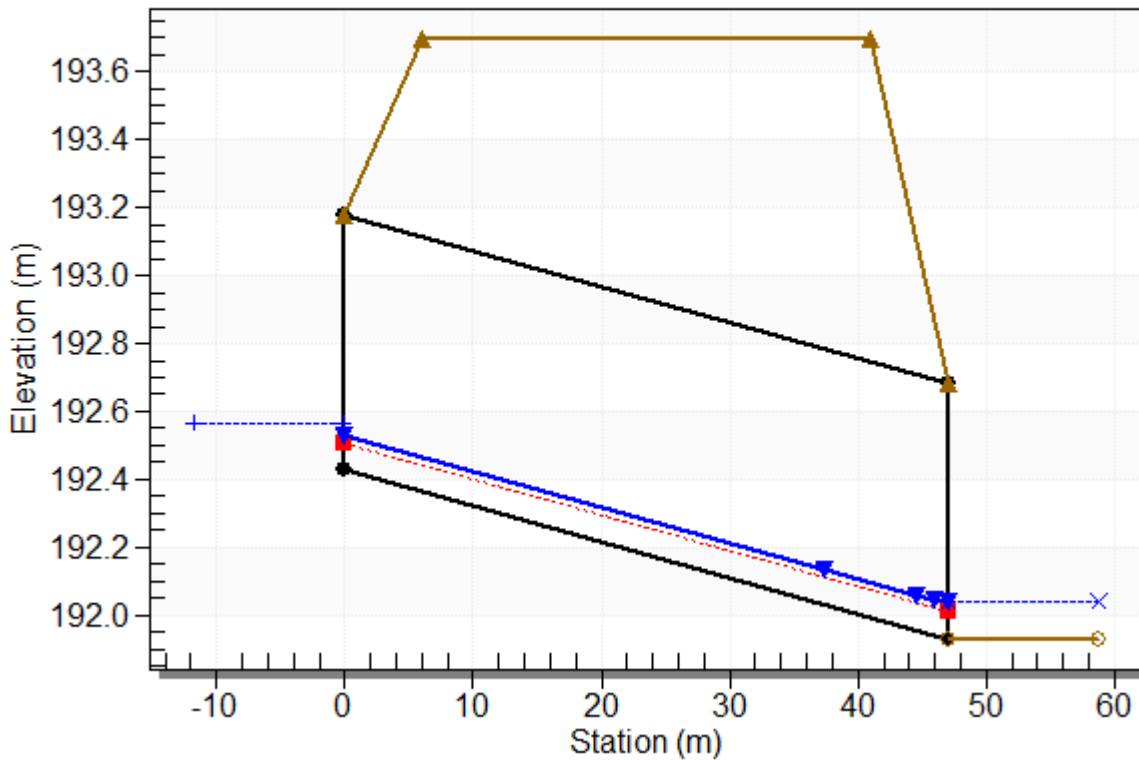
Culvert: Culvert 12



## Water Surface Profile Plot for Culvert: Culvert 12

Crossing - Crossing 12 Proposed, Design Discharge - 0.08 cms

Culvert - Culvert 12, Culvert Discharge - 0.08 cms



### Site Data - Culvert 12

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 192.43 m

Outlet Station: 47.00 m

Outlet Elevation: 191.93 m

Number of Barrels: 1

### Culvert Data Summary - Culvert 12

Barrel Shape: Concrete Box

Barrel Span: 1200.00 mm

Barrel Rise: 750.00 mm

Barrel Material: Concrete

Embedment: 0.00 mm

Barrel Manning's n: 0.0300

Inlet Type: Conventional

Inlet Edge Condition: Square Edge (90°) Headwall

Inlet Depression: NONE

**Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 12 Proposed)**

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
0.03	192.00	0.07	0.27	5.14	0.44
0.06	192.03	0.10	0.32	6.62	0.46
0.08	192.04	0.11	0.34	7.42	0.47
0.12	192.05	0.12	0.38	8.56	0.48
0.15	192.07	0.14	0.40	9.30	0.49
0.17	192.08	0.15	0.42	9.96	0.49
0.20	192.08	0.15	0.43	10.55	0.50
0.23	192.09	0.16	0.45	11.09	0.50
0.26	192.10	0.17	0.46	11.58	0.50
0.29	192.11	0.18	0.47	12.05	0.51
0.32	192.11	0.18	0.48	12.49	0.51



### **Tailwater Channel Data - Crossing 12 Proposed**

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 20.00 (1:20)

Channel Slope: 0.0070

Channel Manning's n: 0.0350

Channel Invert Elevation: 191.93 m

### **Roadway Data for Crossing: Crossing 12 Proposed**

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 10.00 m

Crest Elevation: 193.70 m

Roadway Surface: Paved

Roadway Top Width: 35.00 m

# HY-8 Culvert Analysis Report

Crossing Notes: Crossing 13 Proposed

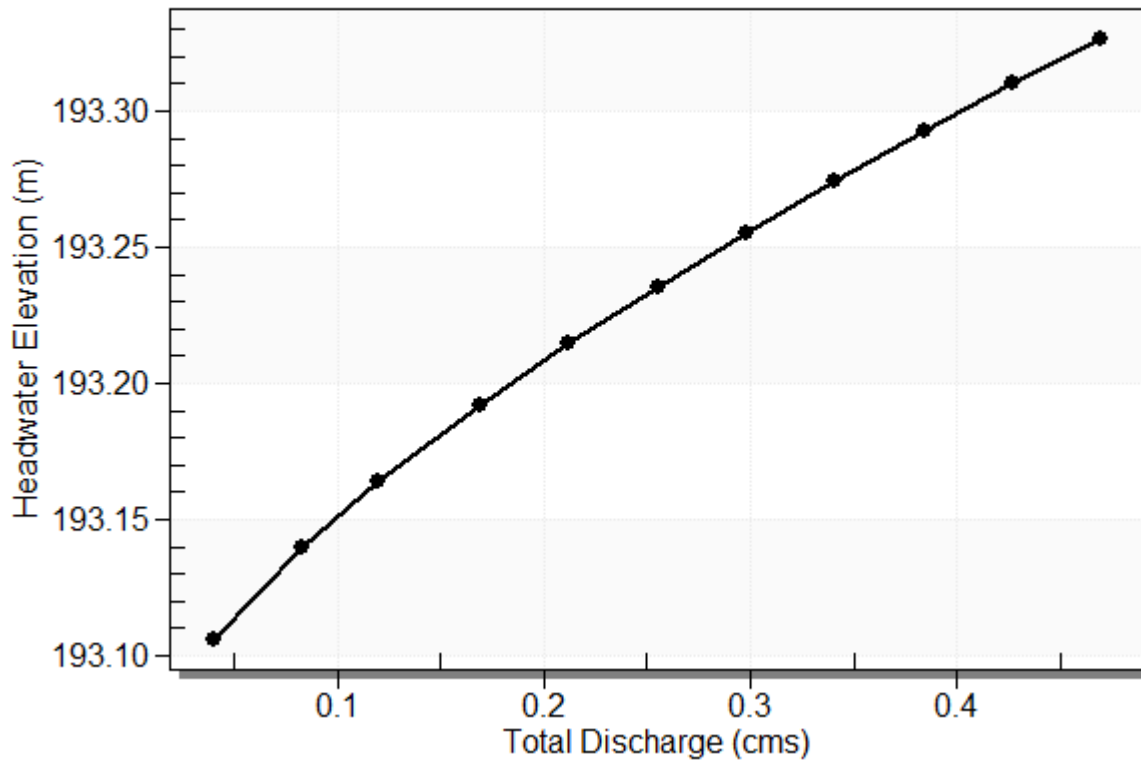
**Table 1 - Summary of Culvert Flows at Crossing: Crossing 13 Proposed**

Headwater Elevation (m)	Total Discharge (cms)	Culvert 13 Discharge (cms)	Roadway Discharge (cms)	Iterations
193.11	0.04	0.04	0.00	1
193.14	0.08	0.08	0.00	1
193.16	0.12	0.12	0.00	1
193.19	0.17	0.17	0.00	1
193.21	0.21	0.21	0.00	1
193.24	0.25	0.25	0.00	1
193.26	0.30	0.30	0.00	1
193.27	0.34	0.34	0.00	1
193.29	0.38	0.38	0.00	1
193.31	0.43	0.43	0.00	1
193.33	0.47	0.47	0.00	1
194.16	1.78	1.78	0.00	Overtopping

# Rating Curve Plot for Crossing: Crossing 13 Proposed

## Total Rating Curve

Crossing: Crossing 13 Proposed



**Table 2 - Culvert Summary Table: Culvert 13**

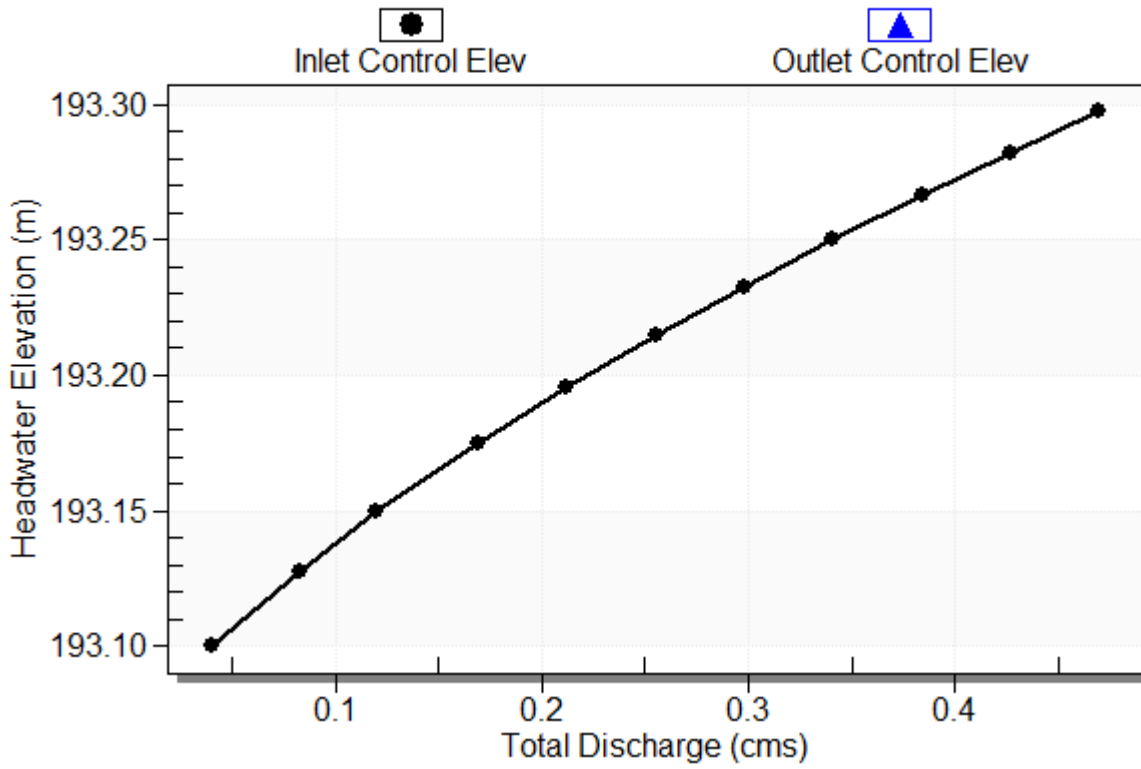
Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.04	0.04	193.11	0.050	0.056	3-M1t	0.045	0.032	0.087	0.087	0.210	0.266
0.08	0.08	193.14	0.078	0.090	3-M1t	0.071	0.053	0.114	0.114	0.331	0.319
0.12	0.12	193.16	0.100	0.114	3-M1t	0.091	0.067	0.131	0.131	0.417	0.350
0.17	0.17	193.19	0.125	0.142	3-M1t	0.113	0.085	0.149	0.149	0.516	0.381
0.21	0.21	193.21	0.146	0.164	3-M1t	0.131	0.098	0.162	0.162	0.595	0.404
0.25	0.25	193.24	0.165	0.186	3-M1t	0.148	0.111	0.174	0.174	0.667	0.423
0.30	0.30	193.26	0.183	0.205	3-M1t	0.163	0.123	0.184	0.184	0.736	0.439
0.34	0.34	193.27	0.200	0.224	3-M1t	0.177	0.135	0.194	0.194	0.800	0.455
0.38	0.38	193.29	0.216	0.243	3-M1t	0.191	0.146	0.202	0.202	0.862	0.468
0.43	0.43	193.31	0.232	0.260	3-M1t	0.205	0.157	0.211	0.211	0.921	0.481
0.47	0.47	193.33	0.248	0.277	3-M1t	0.218	0.167	0.218	0.218	0.978	0.492

\*\*\*\*\*  
Inlet Elevation (invert): 193.05 m, Outlet Elevation (invert): 192.66 m  
Culvert Length: 47.00 m, Culvert Slope: 0.0083  
\*\*\*\*\*

### Culvert Performance Curve Plot: Culvert 13

## Performance Curve

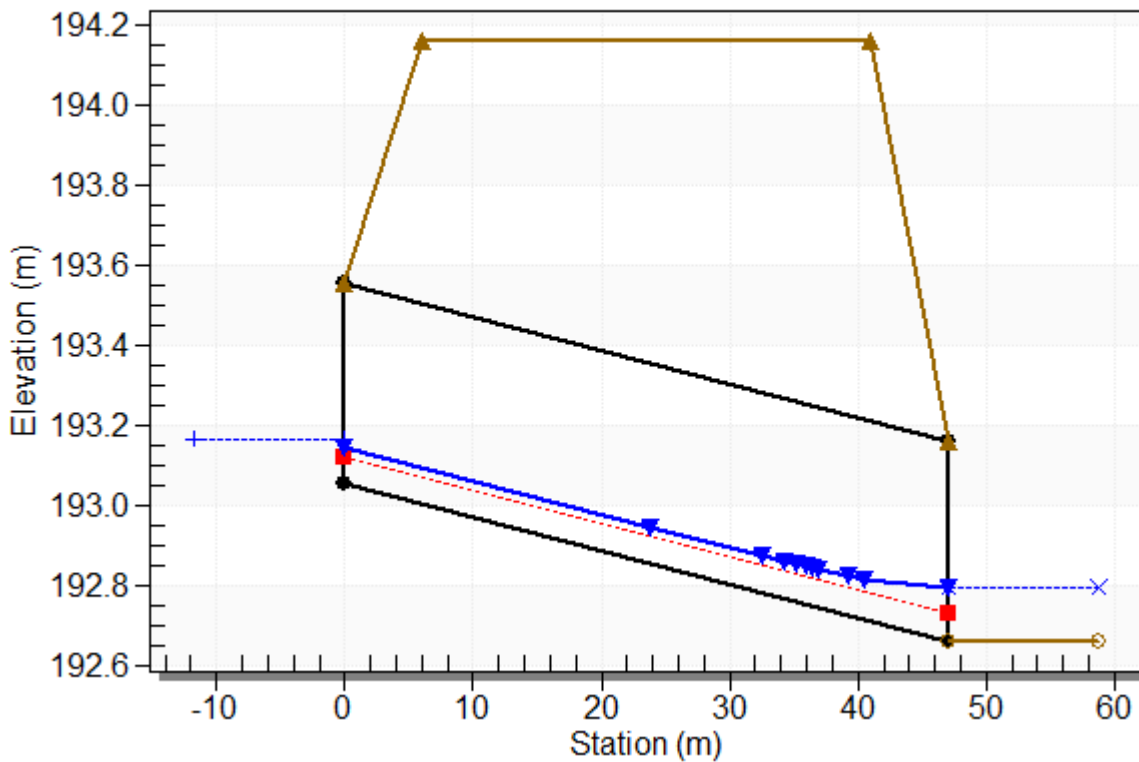
Culvert: Culvert 13



## Water Surface Profile Plot for Culvert: Culvert 13

Crossing - Crossing 13 Proposed, Design Discharge - 0.12 cms

Culvert - Culvert 13, Culvert Discharge - 0.12 cms



### Site Data - Culvert 13

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 193.05 m

Outlet Station: 47.00 m

Outlet Elevation: 192.66 m

Number of Barrels: 1

### Culvert Data Summary - Culvert 13

Barrel Shape: Concrete Box

Barrel Span: 2200.00 mm

Barrel Rise: 500.00 mm

Barrel Material: Concrete

Embedment: 0.00 mm

Barrel Manning's n: 0.0300

Inlet Type: Conventional

Inlet Edge Condition: 1:1 Bevel (45° flare) Wingwall

Inlet Depression: NONE



**Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 13 Proposed)**

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
0.04	192.75	0.09	0.27	4.84	0.41
0.08	192.77	0.11	0.32	6.37	0.43
0.12	192.79	0.13	0.35	7.31	0.44
0.17	192.81	0.15	0.38	8.32	0.45
0.21	192.82	0.16	0.40	9.05	0.45
0.25	192.83	0.17	0.42	9.70	0.46
0.30	192.84	0.18	0.44	10.29	0.46
0.34	192.85	0.19	0.45	10.82	0.47
0.38	192.86	0.20	0.47	11.31	0.47
0.43	192.87	0.21	0.48	11.77	0.47
0.47	192.88	0.22	0.49	12.20	0.48

### **Tailwater Channel Data - Crossing 13 Proposed**

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 20.00 (1:20)

Channel Slope: 0.0057

Channel Manning's n: 0.0350

Channel Invert Elevation: 192.66 m

### **Roadway Data for Crossing: Crossing 13 Proposed**

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 10.00 m

Crest Elevation: 194.16 m

Roadway Surface: Paved

Roadway Top Width: 35.00 m

# HY-8 Culvert Analysis Report

Crossing Notes: Crossing 14 Proposed

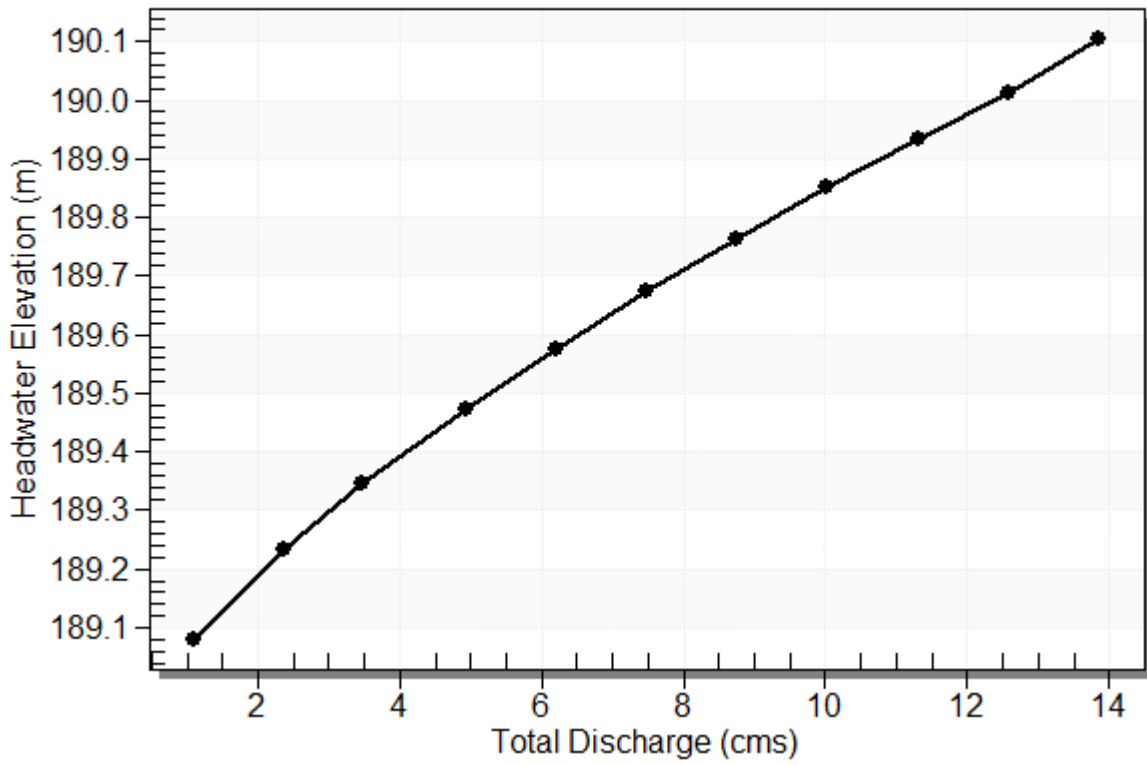
**Table 1 - Summary of Culvert Flows at Crossing: Crossing 14 Proposed**

Headwater Elevation (m)	Total Discharge (cms)	Culvert 14 Discharge (cms)	Roadway Discharge (cms)	Iterations
189.08	1.10	1.10	0.00	1
189.23	2.38	2.38	0.00	1
189.34	3.48	3.48	0.00	1
189.47	4.92	4.92	0.00	1
189.58	6.20	6.20	0.00	1
189.67	7.47	7.47	0.00	1
189.76	8.75	8.75	0.00	1
189.85	10.02	10.02	0.00	1
189.93	11.30	11.30	0.00	1
190.01	12.57	12.57	0.00	1
190.11	13.85	13.85	0.00	1
190.45	17.99	17.99	0.00	Overtopping

# Rating Curve Plot for Crossing: Crossing 14 Proposed

## Total Rating Curve

Crossing: Crossing 14 Proposed



**Table 2 - Culvert Summary Table: Culvert 14**

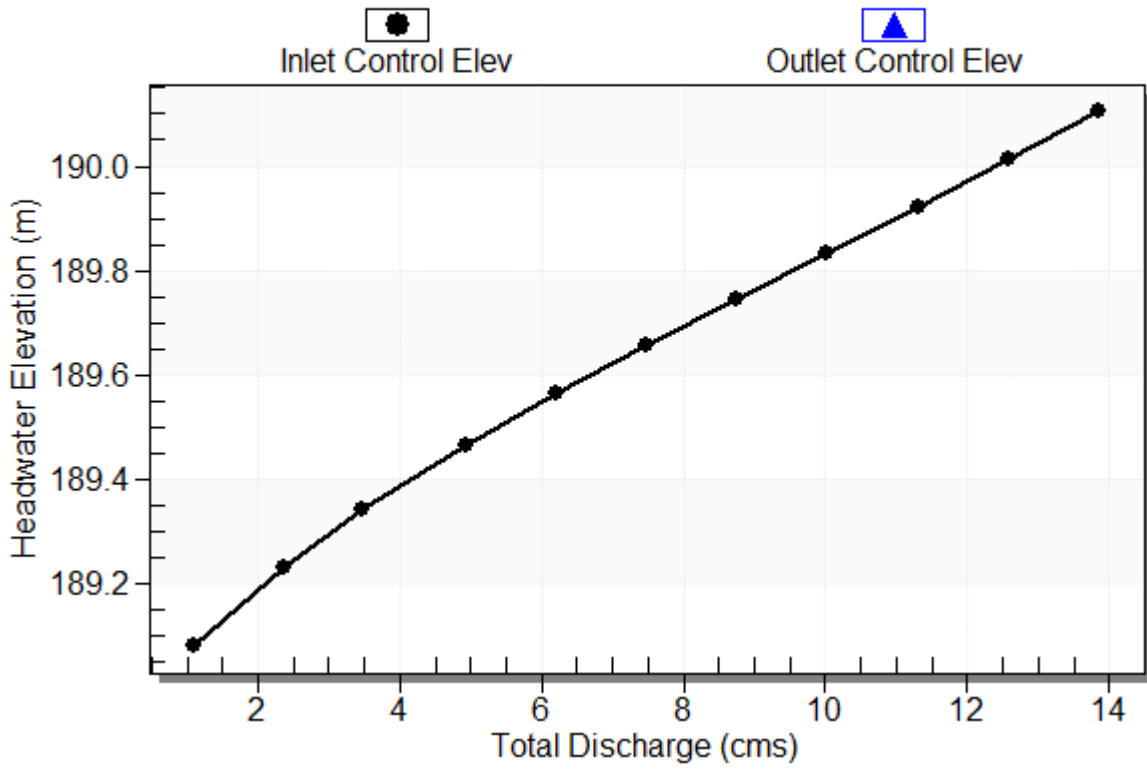
Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
1.10	1.10	189.08	0.229	0.231	3-M1t	0.163	0.134	0.295	0.295	0.518	0.632
2.38	2.38	189.23	0.381	0.384	3-M1t	0.267	0.223	0.394	0.394	0.838	0.767
3.48	3.48	189.34	0.490	0.495	3-M1t	0.339	0.288	0.454	0.454	1.064	0.843
4.92	4.92	189.47	0.614	0.623	3-M1t	0.423	0.363	0.517	0.517	1.322	0.920
6.20	6.20	189.58	0.713	0.726	3-M1t	0.489	0.424	0.564	0.564	1.527	0.974
7.47	7.47	189.67	0.806	0.822	3-M1t	0.550	0.480	0.605	0.605	1.716	1.021
8.75	8.75	189.76	0.896	0.913	3-M1t	0.609	0.533	0.642	0.642	1.894	1.062
10.02	10.02	189.85	0.984	1.000	7-M1t	0.663	0.584	0.675	0.675	2.062	1.099
11.30	11.30	189.93	1.072	1.083	3-M2t	0.717	0.632	0.706	0.706	2.222	1.132
12.57	12.57	190.01	1.162	1.163	3-M2t	0.768	0.679	0.735	0.735	2.375	1.163
13.85	13.85	190.11	1.256	1.240	3-M2t	0.818	0.724	0.762	0.762	2.523	1.191

\*\*\*\*\*  
Inlet Elevation (invert): 188.85 m, Outlet Elevation (invert): 188.45 m  
Culvert Length: 47.00 m, Culvert Slope: 0.0085  
\*\*\*\*\*

# Culvert Performance Curve Plot: Culvert 14

## Performance Curve

Culvert: Culvert 14

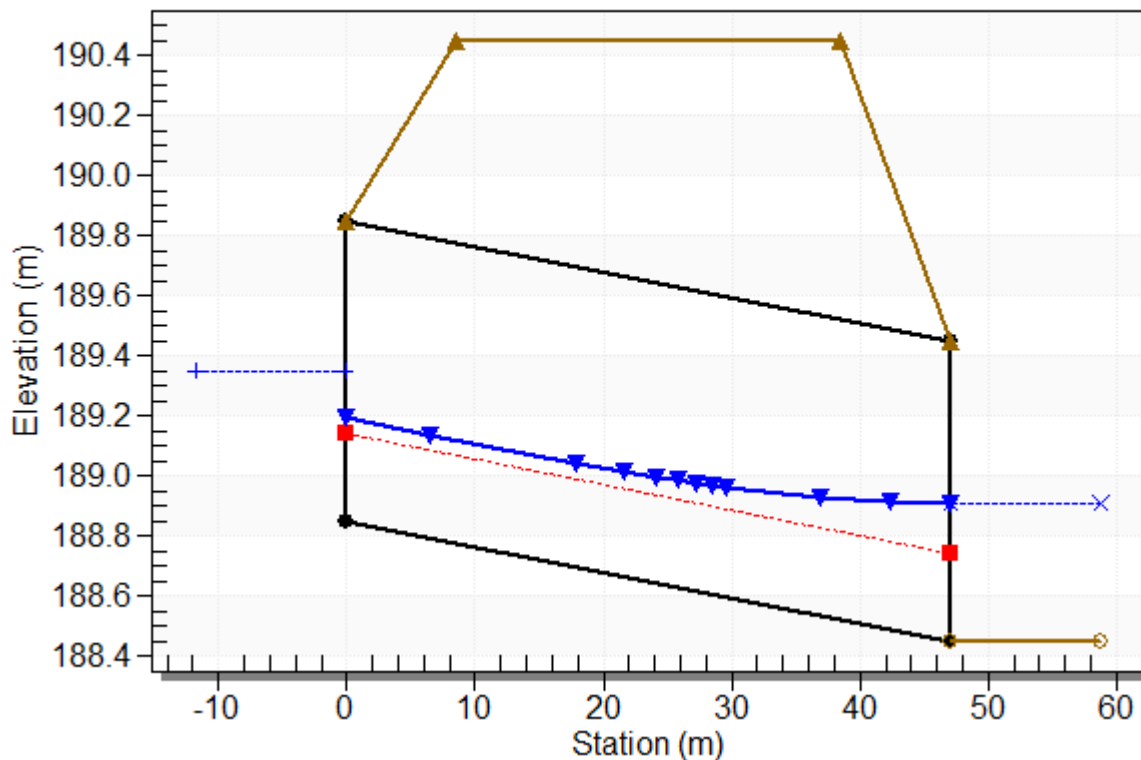




## Water Surface Profile Plot for Culvert: Culvert 14

Crossing - Crossing 14 Proposed, Design Discharge - 3.48 cms

Culvert - Culvert 14, Culvert Discharge - 3.48 cms



### Site Data - Culvert 14

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 188.85 m

Outlet Station: 47.00 m

Outlet Elevation: 188.45 m

Number of Barrels: 1

### Culvert Data Summary - Culvert 14

Barrel Shape: Concrete Box

Barrel Span: 7200.00 mm

Barrel Rise: 1000.00 mm

Barrel Material: Concrete

Embedment: 0.00 mm

Barrel Manning's n: 0.0300

Inlet Type: Conventional

Inlet Edge Condition: Square Edge (90°) Headwall

Inlet Depression: NONE

**Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 14 Proposed)**

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
1.10	188.74	0.29	0.63	18.21	0.53
2.38	188.84	0.39	0.77	24.30	0.55
3.48	188.90	0.45	0.84	28.05	0.56
4.92	188.97	0.52	0.92	31.95	0.58
6.20	189.01	0.56	0.97	34.83	0.59
7.47	189.05	0.60	1.02	37.36	0.59
8.75	189.09	0.64	1.06	39.63	0.60
10.02	189.13	0.68	1.10	41.71	0.60
11.30	189.16	0.71	1.13	43.62	0.61
12.57	189.19	0.74	1.16	45.41	0.61
13.85	189.21	0.76	1.19	47.08	0.62

### **Tailwater Channel Data - Crossing 14 Proposed**

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 20.00 (1:20)

Channel Slope: 0.0063

Channel Manning's n: 0.0350

Channel Invert Elevation: 188.45 m

### **Roadway Data for Crossing: Crossing 14 Proposed**

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 10.00 m

Crest Elevation: 190.45 m

Roadway Surface: Paved

Roadway Top Width: 30.00 m

# HY-8 Culvert Analysis Report

Crossing Notes: Crossing 16 Proposed

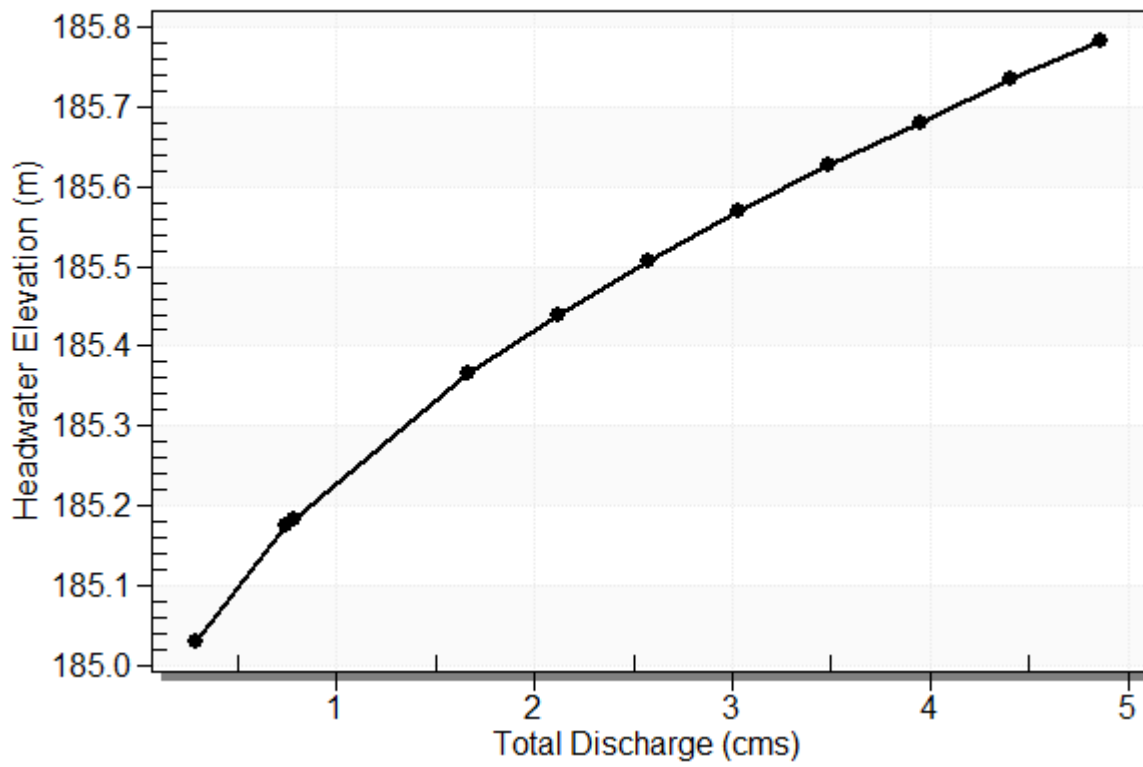
**Table 1 - Summary of Culvert Flows at Crossing: Crossing 16 Proposed**

Headwater Elevation (m)	Total Discharge (cms)	Culvert 16 Discharge (cms)	Roadway Discharge (cms)	Iterations
185.03	0.29	0.29	0.00	1
185.18	0.75	0.75	0.00	1
185.18	0.78	0.78	0.00	1
185.37	1.66	1.66	0.00	1
185.44	2.12	2.12	0.00	1
185.51	2.57	2.57	0.00	1
185.57	3.03	3.03	0.00	1
185.63	3.49	3.49	0.00	1
185.68	3.95	3.95	0.00	1
185.73	4.40	4.40	0.00	1
185.78	4.86	4.86	0.00	1
186.42	8.07	8.07	0.00	Overtopping

# Rating Curve Plot for Crossing: Crossing 16 Proposed

## Total Rating Curve

Crossing: Crossing 16 Proposed



**Table 2 - Culvert Summary Table: Culvert 16**

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.29	0.29	185.03	0.114	0.182	3-M1t	0.135	0.072	0.297	0.297	0.204	0.471
0.75	0.75	185.18	0.207	0.326	3-M1t	0.248	0.135	0.423	0.423	0.368	0.596
0.78	0.78	185.18	0.213	0.334	3-M1t	0.255	0.139	0.430	0.430	0.378	0.603
1.66	1.66	185.37	0.352	0.517	3-M1t	0.414	0.231	0.571	0.571	0.606	0.728
2.12	2.12	185.44	0.414	0.589	3-M1t	0.483	0.271	0.625	0.625	0.706	0.774
2.57	2.57	185.51	0.472	0.656	3-M1t	0.548	0.309	0.673	0.673	0.797	0.812
3.03	3.03	185.57	0.526	0.718	3-M1t	0.611	0.345	0.715	0.715	0.883	0.846
3.49	3.49	185.63	0.579	0.776	3-M1t	0.669	0.378	0.754	0.754	0.964	0.876
3.95	3.95	185.68	0.629	0.830	3-M1t	0.726	0.411	0.790	0.790	1.041	0.904
4.40	4.40	185.73	0.678	0.883	3-M1t	0.781	0.442	0.823	0.823	1.115	0.929
4.86	4.86	185.78	0.724	0.933	3-M1t	0.834	0.472	0.854	0.854	1.186	0.952

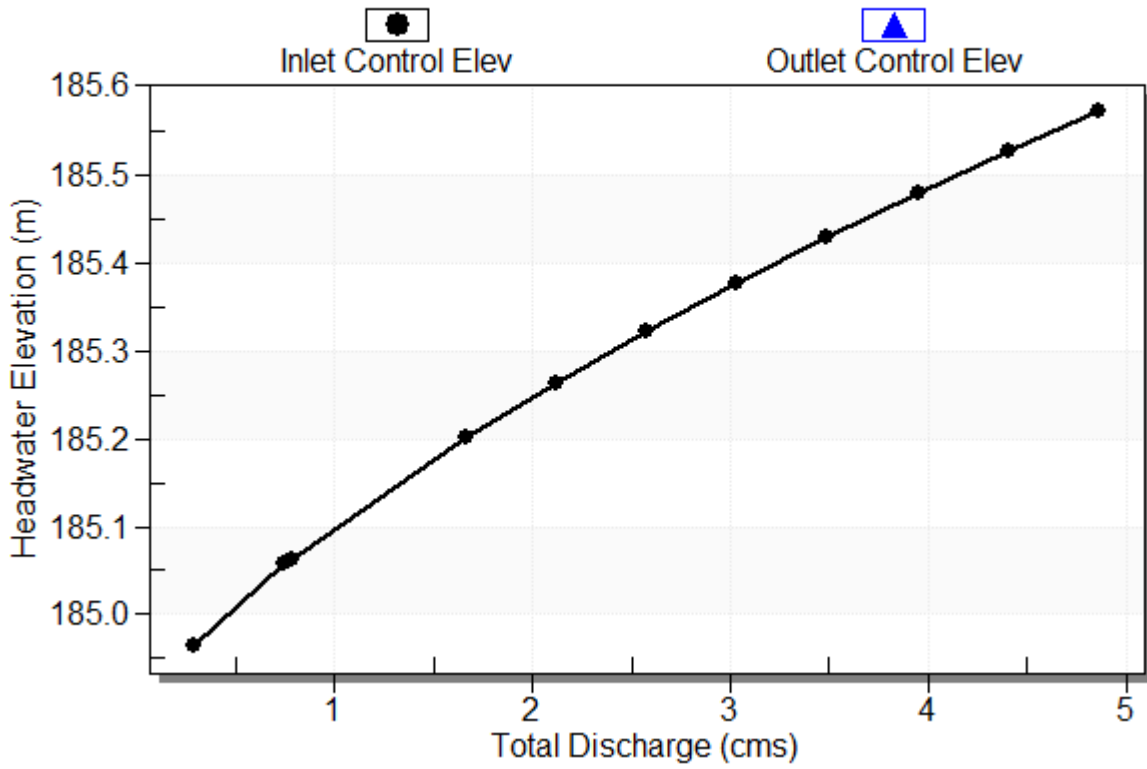
\*\*\*\*\*  
Inlet Elevation (invert): 184.85 m, Outlet Elevation (invert): 184.69 m  
Culvert Length: 47.00 m, Culvert Slope: 0.0034  
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# Culvert Performance Curve Plot: Culvert 16

## Performance Curve

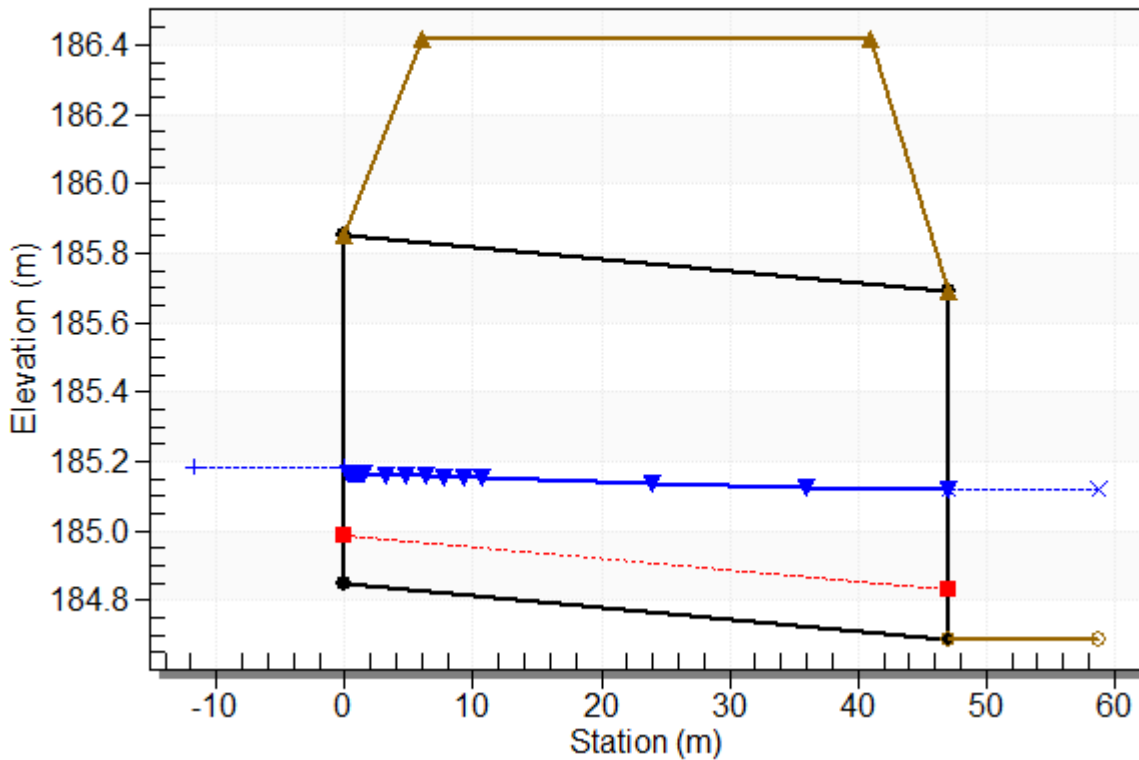
Culvert: Culvert 16



## Water Surface Profile Plot for Culvert: Culvert 16

Crossing - Crossing 16 Proposed, Design Discharge - 0.78 cms

Culvert - Culvert 16, Culvert Discharge - 0.78 cms



### Site Data - Culvert 16

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 184.85 m

Outlet Station: 47.00 m

Outlet Elevation: 184.69 m

Number of Barrels: 1

### Culvert Data Summary - Culvert 16

Barrel Shape: Concrete Box

Barrel Span: 4800.00 mm

Barrel Rise: 1000.00 mm

Barrel Material: Concrete

Embedment: 0.00 mm

Barrel Manning's n: 0.0350

Inlet Type: Conventional

Inlet Edge Condition: 1.5:1 Bevel (90°) Headwall

Inlet Depression: NONE

**Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 16 Proposed)**

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
0.29	184.99	0.30	0.47	10.18	0.39
0.75	185.11	0.42	0.60	14.52	0.41
0.78	185.12	0.43	0.60	14.75	0.41
1.66	185.26	0.57	0.73	19.59	0.43
2.12	185.32	0.63	0.77	21.46	0.44
2.57	185.36	0.67	0.81	23.09	0.45
3.03	185.41	0.72	0.85	24.55	0.45
3.49	185.44	0.75	0.88	25.87	0.46
3.95	185.48	0.79	0.90	27.10	0.46
4.40	185.51	0.82	0.93	28.23	0.46
4.86	185.54	0.85	0.95	29.30	0.47

### **Tailwater Channel Data - Crossing 16 Proposed**

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 7.00 (7:1)

Channel Slope: 0.0035

Channel Manning's n: 0.0350

Channel Invert Elevation: 184.69 m

### **Roadway Data for Crossing: Crossing 16 Proposed**

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 12.00 m

Crest Elevation: 186.42 m

Roadway Surface: Paved

Roadway Top Width: 35.00 m

# HY-8 Culvert Analysis Report

Crossing Notes: Crossing 17 Proposed

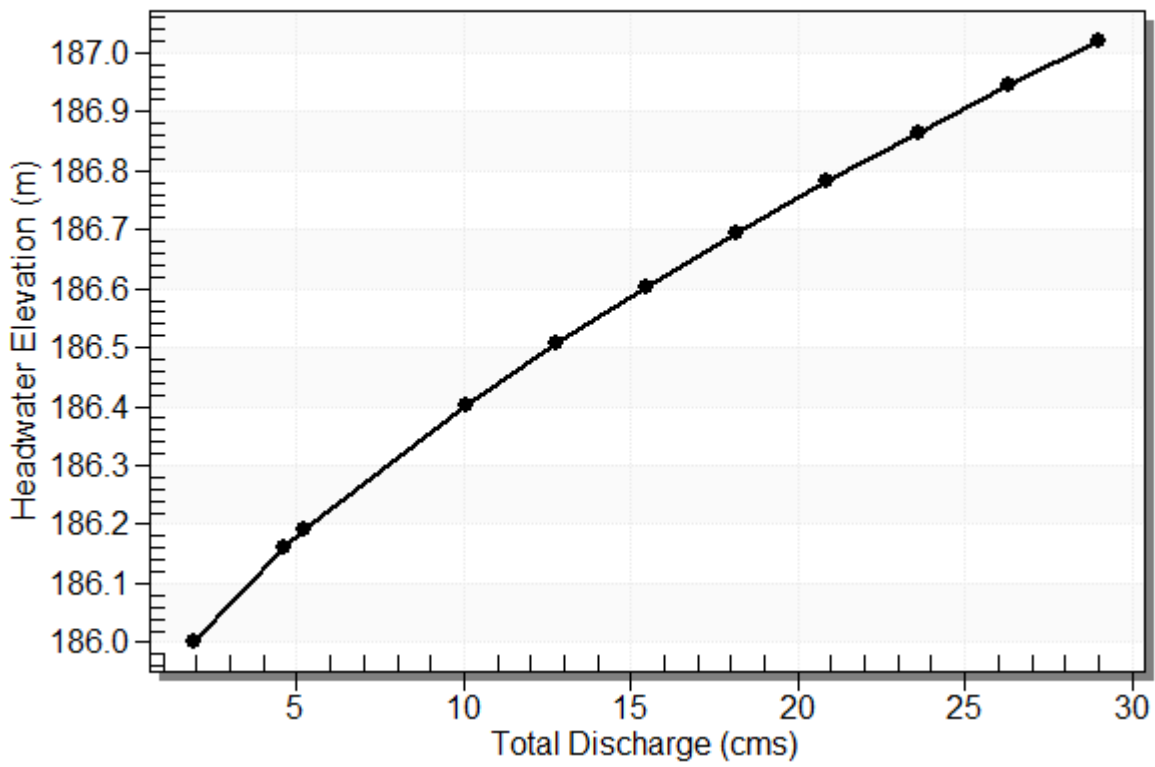
**Table 1 - Summary of Culvert Flows at Crossing: Crossing 17 Proposed**

Headwater Elevation (m)	Total Discharge (cms)	Culvert 17 Discharge (cms)	Roadway Discharge (cms)	Iterations
186.00	1.92	1.92	0.00	1
186.16	4.63	4.63	0.00	1
186.19	5.20	5.20	0.00	1
186.40	10.04	10.04	0.00	1
186.51	12.75	12.75	0.00	1
186.60	15.46	15.46	0.00	1
186.69	18.17	18.17	0.00	1
186.78	20.88	20.88	0.00	1
186.86	23.58	23.58	0.00	1
186.94	26.29	26.29	0.00	1
187.02	29.00	29.00	0.00	1
187.35	35.92	35.92	0.00	Overtopping

# Rating Curve Plot for Crossing: Crossing 17 Proposed

## Total Rating Curve

Crossing: Crossing 17 Proposed



**Table 2 - Culvert Summary Table: Culvert 17**

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
1.92	1.92	186.00	0.190	0.203	3-M1t	0.147	0.126	0.273	0.363	0.509	0.727
4.63	4.63	186.16	0.342	0.362	3-M1t	0.258	0.226	0.415	0.505	0.807	0.906
5.20	5.20	186.19	0.369	0.391	3-M1t	0.278	0.244	0.438	0.528	0.860	0.933
10.04	10.04	186.40	0.575	0.603	3-M1t	0.417	0.379	0.586	0.676	1.242	1.099
12.75	12.75	186.51	0.676	0.707	3-M1t	0.484	0.444	0.649	0.739	1.423	1.167
15.46	15.46	186.60	0.770	0.803	3-M1t	0.544	0.505	0.705	0.795	1.590	1.225
18.17	18.17	186.69	0.858	0.894	3-M1t	0.603	0.562	0.754	0.844	1.746	1.275
20.88	20.88	186.78	0.941	0.981	3-M1t	0.656	0.617	0.799	0.889	1.893	1.320
23.58	23.58	186.86	1.023	1.064	7-M1t	0.709	0.669	0.841	0.931	2.032	1.361
26.29	26.29	186.94	1.104	1.144	7-M1t	0.758	0.719	0.880	0.970	2.166	1.398
29.00	29.00	187.02	1.185	1.222	7-M1t	0.807	0.768	0.916	1.006	2.294	1.433

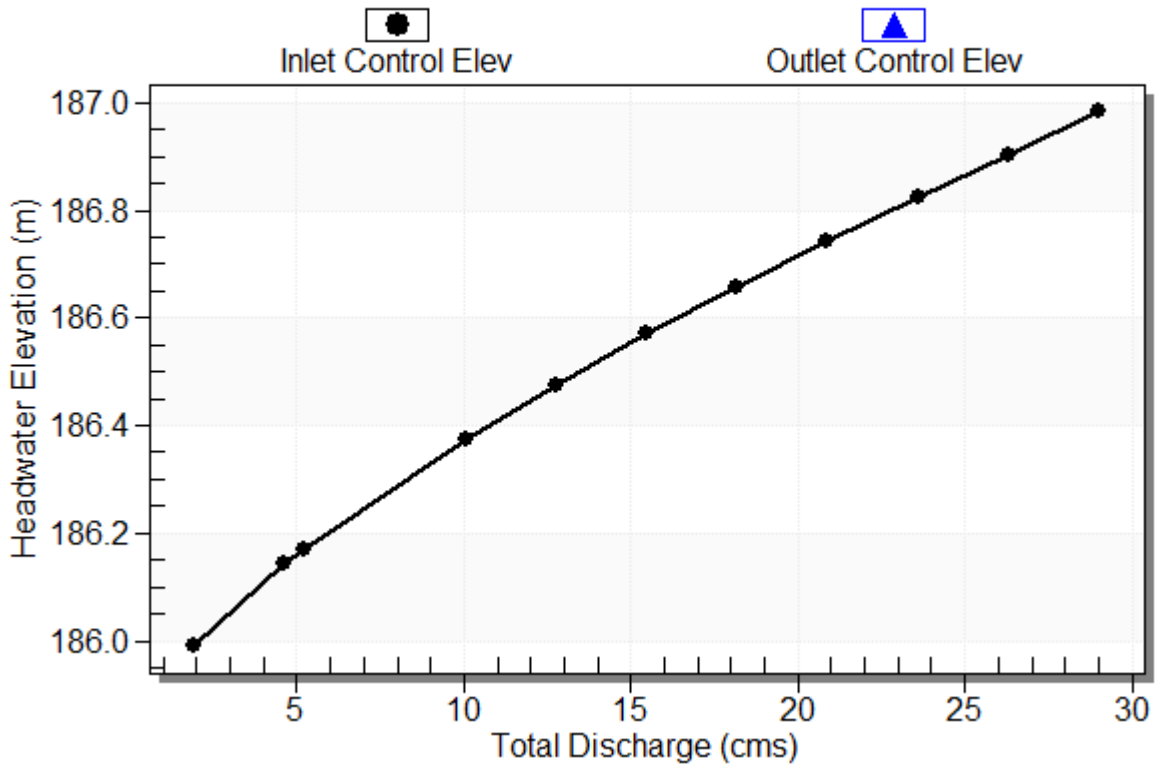


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Inlet Elevation (invert): 185.80 m, Outlet Elevation (invert): 185.20 m  
Culvert Length: 47.00 m, Culvert Slope: 0.0128  
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# Culvert Performance Curve Plot: Culvert 17

## Performance Curve

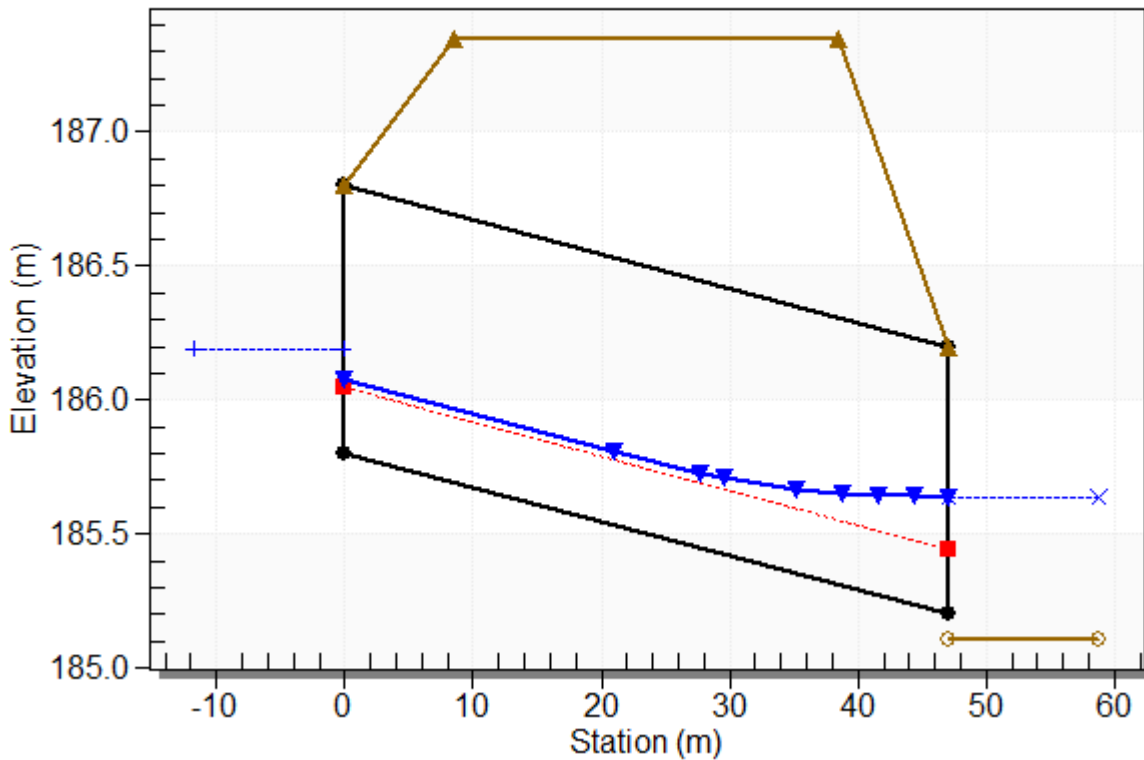
Culvert: Culvert 17



## Water Surface Profile Plot for Culvert: Culvert 17

Crossing - Crossing 17 Proposed, Design Discharge - 5.20 cms

Culvert - Culvert 17, Culvert Discharge - 5.20 cms



### Site Data - Culvert 17

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 185.80 m

Outlet Station: 47.00 m

Outlet Elevation: 185.20 m

Number of Barrels: 1

### Culvert Data Summary - Culvert 17

Barrel Shape: Concrete Box

Barrel Span: 13800.00 mm

Barrel Rise: 1000.00 mm

Barrel Material: Concrete

Embedment: 0.00 mm

Barrel Manning's n: 0.0350

Inlet Type: Conventional

Inlet Edge Condition: 1.5:1 Bevel (90°) Headwall

Inlet Depression: NONE

**Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 17 Proposed)**

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
1.92	185.47	0.36	0.73	22.44	0.54
4.63	185.62	0.51	0.91	31.21	0.58
5.20	185.64	0.53	0.93	32.61	0.58
10.04	185.79	0.68	1.10	41.74	0.60
12.75	185.85	0.74	1.17	45.65	0.61
15.46	185.90	0.79	1.22	49.06	0.62
18.17	185.95	0.84	1.27	52.13	0.63
20.88	186.00	0.89	1.32	54.91	0.63
23.58	186.04	0.93	1.36	57.48	0.64
26.29	186.08	0.97	1.40	59.87	0.64
29.00	186.12	1.01	1.43	62.12	0.65

### **Tailwater Channel Data - Crossing 17 Proposed**

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 20.00 (1:20)

Channel Slope: 0.0063

Channel Manning's n: 0.0350

Channel Invert Elevation: 185.11 m

### **Roadway Data for Crossing: Crossing 17 Proposed**

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 40.00 m

Crest Elevation: 187.35 m

Roadway Surface: Paved

Roadway Top Width: 30.00 m