APPENDIX C-1

Hydraulic Investigation Technical Memo

TRITON ENGINEERING SERVICES LIMITED
Consulting Engineers

Technical Memorandum

DATE:	October 3, 2016
TO:	CLASS EA FILE
FROM:	Chris Clark
RE:	Hillsburgh Dam and Bridge Preliminary Hydraulic Analysis/Assessment
FILE:	A4685E

INTRODUCTION

As part of the Hillsburgh Dam and Bridge Class Environmental Assessment (Class EA) Triton Engineering Services Limited (TESL) has completed the following preliminary hydraulic analysis to assess the existing dam and bridge hydraulics for various configurations. This Technical Memorandum is intended to provide a preliminary evaluation of hypothetical configurations for different scenarios. The Memo does not provide sufficient detail to confirm the feasibility of the configurations or identify any potential constraints.

The Hillsburgh Dam and Bridge are located on Station Street in Hillsbugh, Ontario approximately 50 metres west of Trafalgar Road along the Upper West Credit River Watershed. The Credit Valley Conservation Authority (CVC) has provided a hydraulic model (HEC-RAS) of the Upper West Credit River which was utilized in this analysis. This analysis has assessed the hydraulics of the various configurations of the dam and control structure including; the inline stop-log control structure, dam/road height and bridge opening. The HEC-RAS simulations examined the impacts the various configurations on upstream and downstream floodlines under the Regional Storm event. The findings of this analysis were used to evaluate the Class EA's alternative solutions.

BACKGROUND INFORMATION

In 2011 a sink hole formed directly over the Hillsburgh Dam's (Station Street) monk riser structure culvert. Investigation concluded that the culvert had failed causing the sink hole. As a result, the road was deemed unsafe for vehicular travel and was closed until a repair was completed.

Given the potential impact on the watercourse, floodlines and the adjacent natural environment the CVC and the Ministry of Natural Resources and Forestry (MNRF) were consulted.

The portion of Station Street adjacent the Hillsburgh Pond is considered an earthen dam. Therefore, under the Lakes and Rivers Improvement Act (LRIA), in order to perform work on the dam a Hazard Potential Classification (HPC) for the dam must be considered. Based on

the Ontario Dam Safety Guidelines (ODSG), published 1999, identifying an appropriate HPC is based on the selection of an Inflow Design Flood (IDF).

The Town of Erin recognized the importance of public access through Station Street. As such, their primary goal was to expedite a project that would see the road (Station Street) repaired and re-opened as quickly as possible. Prior to the Class EA, a temporary repair to the culvert/dam was completed under the LRIA's Non-Application Emergency Repair process with the understanding that a permanent solution for the dam and bridge eventually be implemented.

In March 2012, the Hillsburgh Pond was surveyed by TESL staff to estimate the overall pond shape and depth (bathymetry). Based on the TESL survey the average pond depth was estimated at 1.0 metre with a surface area of 90,000 m^2 which equates to a total estimated volume of 90,000 m^3.

As defined in the LRIA legislation, under "Normal Sunny Day" conditions the Hillsburgh Dam can be considered a small sized dam as it is retaining less than 100,000 m^3 water. Therefore, under the ODSG the appropriate Inflow Design Flood (IDF) for this dam is either the 25 or 100 year flood. Based on this volume, the Hillsburgh Dam would be considered to exhibit a "Low" HPC. Under a consequence (i.e. flooding event) the pond is assumed to be retaining more than 100,000 m^3 behind the Dam, as such considered a medium sized dam. Therefore, during a consequence event the appropriate IDF applied to the dam would then be either the 100 year or the Regional return period, whichever is greater.

It should be noted, a previous report and application under the LRIA was completed for the Ainsworth Pond, located immediately downstream of the Hillsburgh Dam, was submitted July 2007 and approved by the MNRF. The assessed HPC of the Ainsworth earthen berm dam was approved and considered "Significant" based on downstream impacts. Under today's current standards this classification is considered as a "High" HPC.

Due to the proximity of the Ainsworth Dam relative to the Hillsburgh Dam, under theLRIA and ODSG the following is applicable;

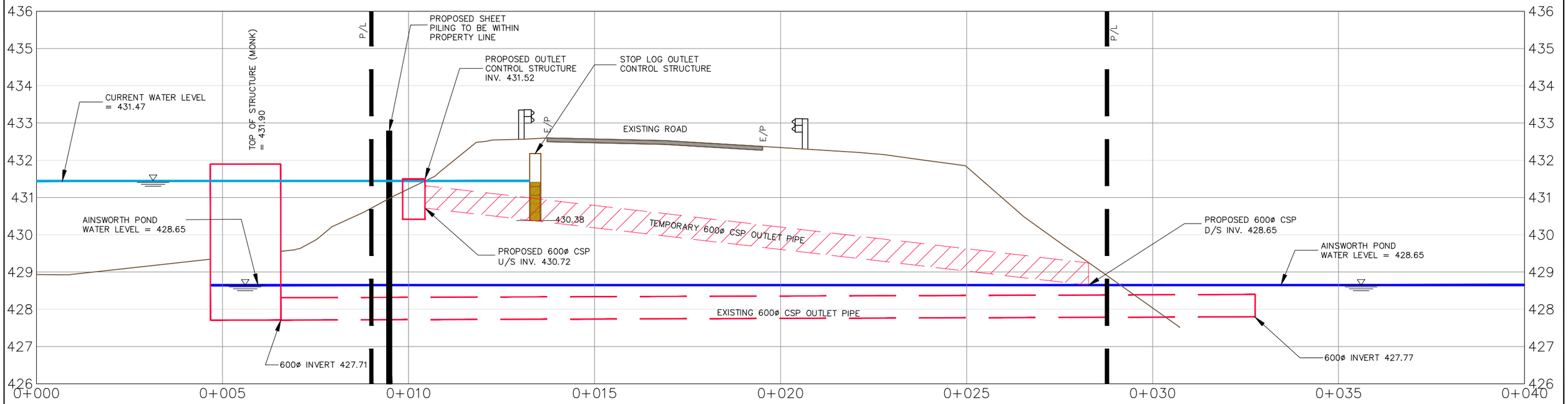
> "Where several dams are situated along the same watercourse, consideration must be given to the cascade effect of failures when classifying the structures. Such that if failure of an upstream dam could contribute to the failure of a downstream dam, the HPC of the upstream dam must be the same or greater than that of the downstream structure."

This implies the Hillsburgh Dam demonstrates a "High" HPC and therefore must be evaluated using the Regional Storm event return. Drawing 02 shows a section view of the current dam and bridge.

The existing conditions of the dam, bridge and surrounding area are as follows:

- Upstream/downstream watershed is mainly wooded/wetland area and farmland.
- Existing bridge is a narrow double-lane open bottom concrete rigid frame structure with a span of 4.30 metres, height of 2.85 metres and 7.40 metre inside deck width.
- Existing major spill occurs at an elevation of 432.55 m, over the earthen berm dam west of the bridge on Station Street roadway.

SECTION VIEW



NOTES

THE LOCATION OF UTILITIES IS APPROXIMATE ONLY AND SHOULD BE DETERMINED BY CONSULTING THE MUNICIPAL AUTHORITIES AND UTILITY COMPANIES CONCERNED. THE CONTRACTOR SHALL PROVE THE LOCATION OF UTILITIES AND SHALL BE RESPONSIBLE FOR ADEQUATE PROTECTION AGAINST DAMAGE.

No	DATE	REVISION	INITIAL
1.	<>	<>	<>

PRELIMINARY

REHABILITATION OF

STATION STREET

(HILLSBURGH)

TOWN OF ERIN

5684 WELLINGTON ROAD No. 24

R.R. #2 ERIN N0B 1Z0

EMERGENCY REPAIR WORKS

PROJECT No A4685

DRAWN BY: K.J.B. (AutoCAD)

CHECKED BY: C.P.C.

APPROVED BY: P.F.Z.

DATE: JUNE, 2012

TRITON ENGINEERING SERVICES LIMITED

Consulting Engineers

SCALES

1:100 HORIZONTAL

1:100 VERTICAL

DRAWING NUMBER 02

DESIGN FLOWS

Design flows utilized for the hydraulic analysis at the bridge and dam were provided by CVC as part of the HEC RAS model. Flows for various storm events are summarized in Table 1.

TABLE 1: UPPER WEST CREDIT RIVER DESIGN FLOW SUMMARY

EVENT	Q @ STRUCTURE 2064 (cms)
2	11
5	22.3
10	29.5
25	20.4
50	48.4
100	57.3
Regional	117.5

DESIGN CRITERIA

The design criteria for the bridge and dam structure crossing were developed through input from the CVC and MNRF under their associated regulatory policies. It should be noted, the current state of the bridge and dam do not meet the criteria, as follows;

- Due to the “High” HPC and the proximity of the local Fire Station (approximately 50 metres east of the bridge, the bridge must convey the Regional Storm event without overtopping the dam (i.e. roadway).

- Upstream and downstream floodlines must not be increased or decreased.

HYDRAULICS

The existing conditions CVC HEC-RAS model, utilizing original TESL survey information, was used to provide baseline floodlines for the area upstream and downstream of the subject site. These floodlines were used as a benchmark for comparison against the various configurations considered. The HEC-RAS model outputs for all scenarios are found in Appendix A.

The Regional Storm floodlines were evaluated from the upstream section at Trafalgar Road culvert crossing (Section – 19425.62) through to just downstream of the Ainsworth Dam culvert outlet (Section – 18418.73). Table 2 provides a summary and comparison of the HEC-RAS inputs and outputs, respectively.

TABLE 2: SUMMARY & COMPARISON OF HEC-RAS FLOODLINE MODELLING

	Scenario / Section Description	INPUTS					OUTPUTS		
		Inline Structure/ Stop Log Length (m)	Inline Structure/ Invert Elev. (m)	Bridge Span (m)	Bridge Height (m)	Dam Min. Spill Elev. (m)	Section ID	Regional W/S Elev. (m)	Difference From Baseline (m)
1	**Existing Structures**	5.75	431.66*	4.33	2.85	432.55			
							19425.62	435.79	-
	UpstreamTrafalgar Rd Crossing						19324.66	435.01	-
	Hillsburgh Pond						19299.19	434.35	-
							19215.73	433.36	-
	Inside Spillway						18717.64	433.41	-
							18717.14	433.23	-
	Station Street						18702.66	433.23	-
	Downstream Pond						18688.00	431.89	-
							18508.07	430.15	-
							18418.73	428.06	-
2	**Existing Bridge / No Stop Log Control**	5.75	430.38**	4.33	2.85	432.55			
							19425.62	435.79	0
	UpstreamTrafalgar Rd Crossing						19324.66	435.01	0
	Hillsburgh Pond						19299.19	434.35	0
							19215.73	433.36	0
	Inside Spillway						18717.64	433.41	0
							18717.14	433.23	0
	Station Street/Dam						18702.66	433.23	0
	Downstream Pond						18688.00	431.89	0
							18508.07	430.15	0
							18418.73	428.06	0
3	**Increase in Bridge Span / With Stop Log Control**	9	431.66*	12	2.85	432.88			
							19425.62	435.79	0
	UpstreamTrafalgar Rd Crossing						19324.66	435.01	0
	Hillsburgh Pond						19299.19	434.35	0
							19215.73	432.93	-0.43
	Inside Spillway						18717.64	432.96	-0.45
							18717.14	432.77	-0.46
	Station Street						18702.66	432.78	-0.45
	Downstream Pond						18688.00	431.64	-0.25
							18508.07	430.15	0
							18418.73	428.06	0
4	**Increase in Bridge Span / No Stop Log Control**	NA	429.38***	12	2.85	432.88			
							19425.62	435.79	0
	UpstreamTrafalgar Rd Crossing						19324.66	435.01	0
	Hillsburgh Pond						19299.19	434.35	0
							19215.73	432.93	-0.43
	Inside Spillway						18717.64	432.96	-0.45
							18717.14	432.78	-0.45
	Station Street						18702.66	432.78	-0.45
	Downstream Pond						18688.00	431.64	-0.25
							18508.07	430.15	0
							18418.73	428.06	0

NOTES:

* Original TESL surveyed stop log elevation - Referred to as the Baseline for comparison use.

** Elevation at bottom of stop log control structure - Reflects removal of all stop logs but not entire structure.

*** Elevation at upstream invert of existing bridge - Reflects complete removal of stop log control structure and reconstruction of bridge

As seen in Table 2, the analysis encompassed four hydraulic configurations for different scenarios which are detailed as follows:

Scenario 1

Scenario 1 was used as the baseline for comparison purposes and reflects the state of the current bridge and dam hydraulics. With respect to the Class EA alternatives, Scenario 1 would be equivalent to Alternative *A – Do Nothing* as well as *B2 – Rehabilitate Dam and Rehabilitate Bridge* since the resultant floodlines would be the same.

Scenario 2

Scenario 2 reflects the removal of stop logs to the bottom of the existing structure. Scenario 2 is equivalent to Alternative *C1 – Rehabilitate Bridge and Decommission Dam* and *C2 – Rehabilitate Bridge and Decommission Dam Construct an Offline Pond.* In both cases the bridge will be rehabilitated therefore, the capacity of the bridge will remain the same, however; the stop log removal will drain the pond, decommissioning the dam.

Scenario 3

Scenario 3 reflects an increase to the bridges' hydraulic capacity by increasing the span of the bridge structure. The stop log structure will be reconstructed to with a wider opening and the elevation of the road increased to accommodate the new bridge. The dam capacity will be increased due to increased ponding depth and spill elevation resulting from the higher road. Scenario 3 is equivalent to Alternative *B1 – Rehabilitate Dam and Reconstruct Bridge.* This alternative encompasses the reconfiguration of the bridge and dam/road to accommodate the Regional Storm event. The Dam will be rehabilitated to an acceptable MNRF standard.

Scenario 4

Scenario 4 reflects an increase to the bridges' hydraulic capacity by increasing the span of the structure. The stop log control structure will be completely removed thereby allowing the normal water level upstream of the bridge to fall to the invert of the current bridge. The road elevation will be increased to accommodate the new bridge. The dam capacity will be increased due to the increased ponding depth and spill elevation resulting from the higher road. Scenario 4 is equivalent to Alternative *D1 – Reconstruct Bridge and Decommission Dam* and *D2 – Reconstruct Bridge and Decommission Dam Construct an Offline Pond.* In both situations the bridge will be reconstructed to accommodate the Regional Storm event without overtopping. The stop log control structure removal will drain the pond under normal conditions thereby eliminating the dam.

ANALYSIS AND INTERPRETATION

The HEC-RAS modelling indicates that removal of stop logs does not directly impact the Regional flood elevations. However, Regional flood elevations did change when the bridge span was increased from 4.30 m to 12.0 m as reflected in Scenarios 3 and 4. The 12.0 m bridge opening conveyed the Regional Storm event without overtopping the dam.

Floodlines upstream and downstream of the Hillsburgh Dam were only impacted by Scenario 3 and 4. The increase in the bridges' hydraulic capacity results in decreased floodlines immediately upstream and downstream of the Dam. Under existing conditions (i.e. Scenario 1), the majority of Regional flow is conveyed over the dam. Conversely, with Scenario 3 and 4, the road height and bridge opening was increased resulting in flows being conveyed through the bridge structure.

It is important to note, the upstream Regional floodlines at the Trafalgar Road crossing are not changed under any Scenario due to restrictions at the existing Trafalgar Road culvert crossing. Similarly, floodlines immediately upstream and downstream of the Ainsworth Dam also remained unchanged; indicating that alterations made to the Hillsburgh Dam will not have a floodline impact beyond these sections.
Therefore, unless the Trafalgar road crossing or Ainsworth Dam's hydraulic capacity was to be modified, floodlines upstream or downstream of both structures will not change regardless to scenario implemented at Hillsburgh Dam.

CONCLUSIONS

In order to evaluate the hydraulic characteristics of the Hillsburgh Dam and Bridge for the purposes of the Class EA's comparison of alternatives, the HEC-RAS hydraulic modeling software was utilized. Four scenarios were assessed which represent each Class EA Alternative. Based on this analysis, changes to the configuration of the dam and bridge only impact floodlines immediately upstream and downstream of the bridge and dam. When the bridge span and road/dam height were increased (i.e. Scenario 3 and 4), the Regional flows were conveyed through the bridge structure. Therefore, if measures were taken which would affect changes to the existing conditions (i.e. increase the hydraulic capacity of the bridge and/or rehabilitate the dam) there is potential to meet the regulatory requirements under the MNRF (LRIA) and CVC (Conservation Act).

Respectfully Submitted,

Triton Engineering Services Limited

Chris Clark, MA.Sc,P.Eng

APPENDIX A

HEC-RAS OUTPUTS

SCENARIO 1

EXISITING STRUCTURES

Plan: WestCredit Credit R. W. Credit R. RS: 19425.62 Profile: Regional

E.G. Elev (m)	435.82	Element	Left OB	Channel	Right OB
Vel Head (m)	0.03	Wt. n-Val.	0.080	0.035	0.054
W.S. Elev (m)	435.79	Reach Len. (m)	45.43	43.82	47.61
Crit W.S. (m)	433.54	Flow Area (m2)	26.62	62.65	64.05
E.G. Slope (m/m)	0.000196	Area (m2)	26.62	62.65	64.05
Q Total (m3/s)	80.70	Flow (m3/s)	4.66	52.42	23.62
Top Width (m)	80.00	Top Width (m)	25.74	17.88	36.38
Vel Total (m/s)	0.53	Avg. Vel. (m/s)	0.18	0.84	0.37
Max Chl Dpth (m)	3.60	Hydr. Depth (m)	1.03	3.50	1.76
Conv. Total (m3/s)	5769.1	Conv. (m3/s)	333.0	3747.7	1688.3
Length Wtd. (m)	44.43	Wetted Per. (m)	26.58	20.68	37.94
Min Ch El (m)	432.19	Shear (N/m2)	1.92	5.81	3.24
Alpha	1.79	Stream Power (N/m s)	0.34	4.86	1.19
Frctn Loss (m)	0.02	Cum Volume (1000 m3)	0.80	4.26	1.63
C & E Loss (m)	0.14	Cum SA (1000 m2)	1815.92	366.63	1400.78

Plan: WestCredit Credit R. W. Credit R. RS: 19324.66 Profile: Regional

E.G. Elev (m)	435.27	Element	Left OB	Channel	Right OB
Vel Head (m)	0.27	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	435.01	Reach Len. (m)	25.82	25.47	25.60
Crit W.S. (m)	434.16	Flow Area (m2)	9.76	32.65	0.12
E.G. Slope (m/m)	0.002392	Area (m2)	9.76	32.65	0.12
Q Total (m3/s)	80.70	Flow (m3/s)	4.20	76.48	0.02
Top Width (m)	30.00	Top Width (m)	15.94	13.93	0.13
Vel Total (m/s)	1.90	Avg. Vel. (m/s)	0.43	2.34	0.14
Max Chl Dpth (m)	3.01	Hydr. Depth (m)	0.61	2.34	0.89
Conv. Total (m3/s)	1650.1	Conv. (m3/s)	85.9	1563.8	0.3
Length Wtd. (m)	25.47	Wetted Per. (m)	16.51	15.05	1.02
Min Ch El (m)	432.00	Shear (N/m2)	13.86	50.91	2.69
Alpha	1.45	Stream Power (N/m s)	5.97	119.24	0.39
Frctn Loss (m)		Cum Volume (1000 m3)		0.77	
C & E Loss (m)		Cum SA (1000 m2)	1814.69	365.14	1399.80

Plan: WestCredit Credit R. W. Credit R. RS: 19299.19 Profile: Regional

E.G. Elev (m)	435.14	Element	Left OB	Channel	Right OB
Vel Head (m)	0.79	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	434.35	Reach Len. (m)	80.00	83.46	88.70
Crit W.S. (m)	434.35	Flow Area (m2)	7.48	27.37	0.12
E.G. Slope (m/m)	0.008781	Area (m2)	7.48	27.37	0.12
Q Total (m3/s)	117.50	Flow (m3/s)	6.51	110.94	0.04
Top Width (m)	25.00	Top Width (m)	11.08	13.58	0.34
Vel Total (m/s)	3.36	Avg. Vel. (m/s)	0.87	4.05	0.36
Max Chl Dpth (m)	2.65	Hydr. Depth (m)	0.67	2.02	0.35
Conv. Total (m3/s)	1253.9	Conv. (m3/s)	69.5	1184.0	0.5
Length Wtd. (m)	84.85	Wetted Per. (m)	11.66	14.69	0.70
Min Ch El (m)	431.70	Shear (N/m2)	55.21	160.44	14.97
Alpha	1.38	Stream Power (N/m s)	48.08	650.39	5.46
Frctn Loss (m)	0.55	Cum Volume (1000 m3)	8.75	198.51	29.75
C & E Loss (m)	0.32	Cum SA (1000 m2)	1814.34	364.79	1399.80

Plan: WestCredit Credit R. W. Credit R. RS: 19215.73 Profile: Regional

E.G. Elev (m)	433.50	Element	Left OB	Channel	Right OB
Vel Head (m)	0.14	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	433.36	Reach Len. (m)	115.14	165.08	240.79
Crit W.S. (m)	433.20	Flow Area (m2)	11.16	14.93	94.34
E.G. Slope (m/m)	0.004979	Area (m2)	11.16	14.93	94.34
Q Total (m3/s)	117.50	Flow (m3/s)	6.51	40.09	70.90
Top Width (m)	149.43	Top Width (m)	20.24	9.26	119.93
Vel Total (m/s)	0.98	Avg. Vel. (m/s)	0.58	2.69	0.75
Max Chl Dpth (m)	2.23	Hydr. Depth (m)	0.55	1.61	0.79
Conv. Total (m3/s)	1665.1	Conv. (m3/s)	92.3	568.2	1004.7
Length Wtd. (m)	186.44	Wetted Per. (m)	20.74	9.70	119.97
Min Ch El (m)	431.13	Shear (N/m2)	26.27	75.10	38.40
Alpha	2.96	Stream Power (N/m s)	15.33	201.74	28.86
Frctn Loss (m)	0.02	Cum Volume (1000 m3)	8.00	196.75	25.56
C & E Loss (m)	0.04	Cum SA (1000 m2)	1813.09	363.84	1394.46

Plan: WestCredit Credit R. W. Credit R. RS: 18717.64 Profile: Regional

E.G. Elev (m)	433.42	Element	Left OB	Channel	Right OB
Vel Head (m)	0.01	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	433.41	Reach Len. (m)	0.50	0.50	0.50
Crit W.S. (m)	430.02	Flow Area (m2)	13.85	289.65	5.04
E.G. Slope (m/m)	0.000034	Area (m2)	13.85	289.65	5.04
Q Total (m3/s)	117.50	Flow (m3/s)	0.51	116.78	0.21
Top Width (m)	125.72	Top Width (m)	38.57	75.12	12.02
Vel Total (m/s)	0.38	Avg. Vel. (m/s)	0.04	0.40	0.04
Max Chl Dpth (m)	4.68	Hydr. Depth (m)	0.36	3.86	0.42
Conv. Total (m3/s)	20104.1	Conv. (m3/s)	87.3	19981.5	35.3
Length Wtd. (m)	0.50	Wetted Per. (m)	38.64	77.20	12.06
Min Ch El (m)	428.73	Shear (N/m2)	0.12	1.26	0.14
Alpha	1.11	Stream Power (N/m s)	0.00	0.51	0.01
Frctn Loss (m)	0.00	Cum Volume (1000 m3)	0.01	1.49	0.01
C & E Loss (m)	0.02	Cum SA (1000 m2)	1798.56	283.57	1348.24

Plan: WestCredit Credit R. W. Credit R. RS: 18717.14 Profile: Regional

E.G. Elev (m)	433.40	Element	Left OB	Channel	Right OB
Vel Head (m)	0.17	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	433.23	Reach Len. (m)	59.18	29.13	59.08
Crit W.S. (m)	432.51	Flow Area (m2)	14.63	52.46	30.67
E.G. Slope (m/m)	0.001363	Area (m2)	14.63	52.46	30.67
Q Total (m3/s)	117.50	Flow (m3/s)	4.69	101.53	11.29
Top Width (m)	88.19	Top Width (m)	25.24	19.91	43.04
Vel Total (m/s)	1.20	Avg. Vel. (m/s)	0.32	1.94	0.37
Max Chl Dpth (m)	3.85	Hydr. Depth (m)	0.58	2.63	0.71
Conv. Total (m3/s)	3182.3	Conv. (m3/s)	126.9	2749.7	305.6
Length Wtd. (m)	29.13	Wetted Per. (m)	25.32	21.11	43.08
Min Ch El (m)	429.38	Shear (N/m2)	7.73	33.22	9.52
Alpha	2.25	Stream Power (N/m s)	2.47	64.29	3.50
Frctn Loss (m)		Cum Volume (1000 m3)		1.40	
C & E Loss (m)		Cum SA (1000 m2)	1798.55	283.54	1348.23

Plan: WestCredit Credit R. W. Credit R. RS: 18688.00 Profile: Regional

E.G. Elev (m)	431.94	Element	Left OB	Channel	Right OB
Vel Head (m)	0.05	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	431.89	Reach Len. (m)	66.89	42.15	44.64
Crit W.S. (m)	431.89	Flow Area (m2)	64.20	11.78	80.75
E.G. Slope (m/m)	0.001348	Area (m2)	64.20	11.78	80.75
Q Total (m3/s)	117.50	Flow (m3/s)	46.46	21.48	49.56
Top Width (m)	88.47	Top Width (m)	32.11	4.25	52.10
Vel Total (m/s)	0.75	Avg. Vel. (m/s)	0.72	1.82	0.61
Max Chl Dpth (m)	2.77	Hydr. Depth (m)	2.00	2.77	1.55
Conv. Total (m3/s)	3199.9	Conv. (m3/s)	1265.3	584.9	1349.7
Length Wtd. (m)	47.57	Wetted Per. (m)	32.42	5.15	52.23
Min Ch El (m)	429.12	Shear (N/m2)	26.18	30.27	20.44
Alpha	1.73	Stream Power (N/m s)	18.95	55.18	12.55
Frctn Loss (m)	0.07	Cum Volume (1000 m3)	9.28	35.94	3.79
C & E Loss (m)	0.01	Cum SA (1000 m2)	1796.85	283.19	1345.42

Plan: WestCredit Credit R. W. Credit R. RS: 18508.07 Profile: Regional

E.G. Elev (m)	430.16	Element	Left OB	Channel	Right OB
Vel Head (m)	0.01	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	430.15	Reach Len. (m)	50.53	46.34	47.52
Crit W.S. (m)	428.31	Flow Area (m2)	229.37	37.59	84.22
E.G. Slope (m/m)	0.000169	Area (m2)	229.37	37.59	84.22
Q Total (m3/s)	117.50	Flow (m3/s)	66.52	30.66	20.33
Top Width (m)	153.31	Top Width (m)	95.95	11.05	46.32
Vel Total (m/s)	0.33	Avg. Vel. (m/s)	0.29	0.82	0.24
Max Chl Dpth (m)	4.13	Hydr. Depth (m)	2.39	3.40	1.82
Conv. Total (m3/s)	9025.5	Conv. (m3/s)	5109.5	2354.7	1561.3
Length Wtd. (m)	46.34	Wetted Per. (m)	96.41	11.58	46.64
Min Ch El (m)	426.02	Shear (N/m2)	3.95	5.40	3.00
Alpha	2.07	Stream Power (N/m s)	1.15	4.40	0.72
Frctn Loss (m)		Cum Volume (1000 m3)		10.28	
C & E Loss (m)		Cum SA (1000 m2)	1789.86	271.43	1342.24

Plan: WestCredit Credit R. W. Credit R. RS: 18418.73 Profile: Regional

E.G. Elev (m)	428.08	Element	Left OB	Channel	Right OB
Vel Head (m)	0.02	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	428.06	Reach Len. (m)	42.23	39.62	38.70
Crit W.S. (m)	427.05	Flow Area (m2)	237.52	35.80	24.23
E.G. Slope (m/m)	0.000384	Area (m2)	237.52	35.80	24.23
Q Total (m3/s)	117.50	Flow (m3/s)	74.12	37.38	6.00
Top Width (m)	202.24	Top Width (m)	165.06	13.39	23.78
Vel Total (m/s)	0.39	Avg. Vel. (m/s)	0.31	1.04	0.25
Max Chl Dpth (m)	3.59	Hydr. Depth (m)	1.44	2.67	1.02
Conv. Total (m3/s)	5997.7	Conv. (m3/s)	3783.5	1908.1	306.1
Length Wtd. (m)	41.00	Wetted Per. (m)	165.11	14.05	23.86
Min Ch El (m)	424.47	Shear (N/m2)	5.41	9.59	3.82
Alpha	2.64	Stream Power (N/m s)	1.69	10.01	0.95
Frctn Loss (m)	0.01	Cum Volume (1000 m3)	33.89	41.64	13.01
C & E Loss (m)	0.00	Cum SA (1000 m2)	1774.54	270.37	1338.38

Plan: WestCredit Credit R. W. Credit R. RS: 18702.66 Culv Group: Culvert #2 Profile: Regional

Q Culv Group (m3/s)	46.44	Culv Full Len (m)	
# Barrels	1	Culv Vel US (m/s)	4.72
Q Barrel (m3/s)	46.44	Culv Vel DS (m/s)	5.90
E.G. US. (m)	433.40	Culv Inv El Up (m)	429.38
W.S. US. (m)	433.23	Culv Inv El Dn (m)	429.16
E.G. DS (m)	431.94	Culv Frctn Ls (m)	0.04
W.S. DS (m)	431.89	Culv Exit Loss (m)	0.81
Delta EG (m)	1.46	Culv Entr Loss (m)	0.61
Delta WS (m)	1.34	Q Weir (m3/s)	70.05
E.G. IC (m)	433.40	Weir Sta Lft (m)	130.25
E.G. OC (m)	433.36	Weir Sta Rgt (m)	238.38
Culvert Control	Inlet	Weir Submerg	0.00
Culv WS Inlet (m)	431.65	Weir Max Depth (m)	0.85
Culv WS Outlet (m)	430.98	Weir Avg Depth (m)	0.54
Culv Nml Depth (m)	1.04	Weir Flow Area (m2)	58.41
Culv Crt Depth (m)	2.27	Min El Weir Flow (m)	432.55

SCENARIO 2

EXISITING BRIDGE / NO STOP-LOG CONTROL

Plan: WestCredit Credit R. W. Credit R. RS: 19425.62 Profile: Regional

E.G. Elev (m)	435.82	Element	Left OB	Channel	Right OB
Vel Head (m)	0.03	Wt. n-Val.	0.080	0.035	0.054
W.S. Elev (m)	435.79	Reach Len. (m)	45.43	43.82	47.61
Crit W.S. (m)	433.54	Flow Area (m2)	26.62	62.65	64.05
E.G. Slope (m/m)	0.000196	Area (m2)	26.62	62.65	64.05
Q Total (m3/s)	80.70	Flow (m3/s)	4.66	52.42	23.62
Top Width (m)	80.00	Top Width (m)	25.74	17.88	36.38
Vel Total (m/s)	0.53	Avg. Vel. (m/s)	0.18	0.84	0.37
Max Chl Dpth (m)	3.60	Hydr. Depth (m)	1.03	3.50	1.76
Conv. Total (m3/s)	5769.1	Conv. (m3/s)	333.0	3747.7	1688.3
Length Wtd. (m)	44.43	Wetted Per. (m)	26.58	20.68	37.94
Min Ch El (m)	432.19	Shear (N/m2)	1.92	5.81	3.24
Alpha	1.79	Stream Power (N/m s)	0.34	4.86	1.19
Frctn Loss (m)	0.02	Cum Volume (1000 m3)	0.80	4.26	1.63
C & E Loss (m)	0.14	Cum SA (1000 m2)	1815.92	366.63	1400.78

Plan: WestCredit Credit R. W. Credit R. RS: 19324.66 Profile: Regional

E.G. Elev (m)	435.27	Element	Left OB	Channel	Right OB
Vel Head (m)	0.27	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	435.01	Reach Len. (m)	25.82	25.47	25.60
Crit W.S. (m)	434.16	Flow Area (m2)	9.76	32.65	0.12
E.G. Slope (m/m)	0.002392	Area (m2)	9.76	32.65	0.12
Q Total (m3/s)	80.70	Flow (m3/s)	4.20	76.48	0.02
Top Width (m)	30.00	Top Width (m)	15.94	13.93	0.13
Vel Total (m/s)	1.90	Avg. Vel. (m/s)	0.43	2.34	0.14
Max Chl Dpth (m)	3.01	Hydr. Depth (m)	0.61	2.34	0.89
Conv. Total (m3/s)	1650.1	Conv. (m3/s)	85.9	1563.8	0.3
Length Wtd. (m)	25.47	Wetted Per. (m)	16.51	15.05	1.02
Min Ch El (m)	432.00	Shear (N/m2)	13.86	50.91	2.69
Alpha	1.45	Stream Power (N/m s)	5.97	119.24	0.39
Frctn Loss (m)		Cum Volume (1000 m3)		0.77	
C & E Loss (m)		Cum SA (1000 m2)	1814.69	365.14	1399.80

Plan: WestCredit Credit R. W. Credit R. RS: 19299.19 Profile: Regional

E.G. Elev (m)	435.14	Element	Left OB	Channel	Right OB
Vel Head (m)	0.79	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	434.35	Reach Len. (m)	80.00	83.46	88.70
Crit W.S. (m)	434.35	Flow Area (m2)	7.48	27.37	0.12
E.G. Slope (m/m)	0.008781	Area (m2)	7.48	27.37	0.12
Q Total (m3/s)	117.50	Flow (m3/s)	6.51	110.94	0.04
Top Width (m)	25.00	Top Width (m)	11.08	13.58	0.34
Vel Total (m/s)	3.36	Avg. Vel. (m/s)	0.87	4.05	0.36
Max Chl Dpth (m)	2.65	Hydr. Depth (m)	0.67	2.02	0.35
Conv. Total (m3/s)	1253.9	Conv. (m3/s)	69.5	1184.0	0.5
Length Wtd. (m)	84.85	Wetted Per. (m)	11.66	14.69	0.70
Min Ch El (m)	431.70	Shear (N/m2)	55.21	160.44	14.97
Alpha	1.38	Stream Power (N/m s)	48.08	650.39	5.46
Frctn Loss (m)	0.55	Cum Volume (1000 m3)	8.75	198.52	29.75
C & E Loss (m)	0.32	Cum SA (1000 m2)	1814.34	364.79	1399.80

Plan: WestCredit Credit R. W. Credit R. RS: 19215.73 Profile: Regional

E.G. Elev (m)	433.50	Element	Left OB	Channel	Right OB
Vel Head (m)	0.14	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	433.36	Reach Len. (m)	115.14	165.08	240.79
Crit W.S. (m)	433.20	Flow Area (m2)	11.16	14.93	94.34
E.G. Slope (m/m)	0.004979	Area (m2)	11.16	14.93	94.34
Q Total (m3/s)	117.50	Flow (m3/s)	6.51	40.09	70.90
Top Width (m)	149.43	Top Width (m)	20.24	9.26	119.93
Vel Total (m/s)	0.98	Avg. Vel. (m/s)	0.58	2.69	0.75
Max Chl Dpth (m)	2.23	Hydr. Depth (m)	0.55	1.61	0.79
Conv. Total (m3/s)	1665.1	Conv. (m3/s)	92.3	568.2	1004.7
Length Wtd. (m)	186.44	Wetted Per. (m)	20.74	9.70	119.97
Min Ch El (m)	431.13	Shear (N/m2)	26.27	75.10	38.40
Alpha	2.96	Stream Power (N/m s)	15.33	201.74	28.86
Frctn Loss (m)	0.02	Cum Volume (1000 m3)	8.00	196.76	25.56
C & E Loss (m)	0.04	Cum SA (1000 m2)	1813.09	363.84	1394.46

Plan: WestCredit Credit R. W. Credit R. RS: 18717.64 Profile: Regional

E.G. Elev (m)	433.42	Element	Left OB	Channel	Right OB
Vel Head (m)	0.01	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	433.41	Reach Len. (m)	0.50	0.50	0.50
Crit W.S. (m)	430.02	Flow Area (m2)	13.85	289.65	5.04
E.G. Slope (m/m)	0.000034	Area (m2)	13.85	289.65	5.04
Q Total (m3/s)	117.50	Flow (m3/s)	0.51	116.78	0.21
Top Width (m)	125.72	Top Width (m)	38.57	75.12	12.02
Vel Total (m/s)	0.38	Avg. Vel. (m/s)	0.04	0.40	0.04
Max Chl Dpth (m)	4.68	Hydr. Depth (m)	0.36	3.86	0.42
Conv. Total (m3/s)	20104.1	Conv. (m3/s)	87.3	19981.5	35.3
Length Wtd. (m)	0.50	Wetted Per. (m)	38.64	77.20	12.06
Min Ch El (m)	428.73	Shear (N/m2)	0.12	1.26	0.14
Alpha	1.11	Stream Power (N/m s)	0.00	0.51	0.01
Frctn Loss (m)	0.00	Cum Volume (1000 m3)	0.01	1.49	0.01
C & E Loss (m)	0.02	Cum SA (1000 m2)	1798.56	283.57	1348.24

Plan: WestCredit Credit R. W. Credit R. RS: 18717.14 Profile: Regional

E.G. Elev (m)	433.40	Element	Left OB	Channel	Right OB
Vel Head (m)	0.17	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	433.23	Reach Len. (m)	59.18	29.13	59.08
Crit W.S. (m)	432.51	Flow Area (m2)	14.63	52.46	30.67
E.G. Slope (m/m)	0.001363	Area (m2)	14.63	52.46	30.67
Q Total (m3/s)	117.50	Flow (m3/s)	4.69	101.53	11.29
Top Width (m)	88.19	Top Width (m)	25.24	19.91	43.04
Vel Total (m/s)	1.20	Avg. Vel. (m/s)	0.32	1.94	0.37
Max Chl Dpth (m)	3.85	Hydr. Depth (m)	0.58	2.63	0.71
Conv. Total (m3/s)	3182.3	Conv. (m3/s)	126.9	2749.7	305.6
Length Wtd. (m)	29.13	Wetted Per. (m)	25.32	21.11	43.08
Min Ch El (m)	429.38	Shear (N/m2)	7.73	33.22	9.52
Alpha	2.25	Stream Power (N/m s)	2.47	64.29	3.50
Frctn Loss (m)		Cum Volume (1000 m3)		1.40	
C & E Loss (m)		Cum SA (1000 m2)	1798.55	283.54	1348.23

Plan: WestCredit Credit R. W. Credit R. RS: 18688.00 Profile: Regional

E.G. Elev (m)	431.94	Element	Left OB	Channel	Right OB
Vel Head (m)	0.05	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	431.89	Reach Len. (m)	66.89	42.15	44.64
Crit W.S. (m)	431.89	Flow Area (m2)	64.20	11.78	80.75
E.G. Slope (m/m)	0.001348	Area (m2)	64.20	11.78	80.75
Q Total (m3/s)	117.50	Flow (m3/s)	46.46	21.48	49.56
Top Width (m)	88.47	Top Width (m)	32.11	4.25	52.10
Vel Total (m/s)	0.75	Avg. Vel. (m/s)	0.72	1.82	0.61
Max Chl Dpth (m)	2.77	Hydr. Depth (m)	2.00	2.77	1.55
Conv. Total (m3/s)	3199.9	Conv. (m3/s)	1265.3	584.9	1349.7
Length Wtd. (m)	47.57	Wetted Per. (m)	32.42	5.15	52.23
Min Ch El (m)	429.12	Shear (N/m2)	26.18	30.27	20.44
Alpha	1.73	Stream Power (N/m s)	18.95	55.18	12.55
Frctn Loss (m)	0.07	Cum Volume (1000 m3)	9.28	35.94	3.79
C & E Loss (m)	0.01	Cum SA (1000 m2)	1796.85	283.19	1345.42

Plan: WestCredit Credit R. W. Credit R. RS: 18508.07 Profile: Regional

E.G. Elev (m)	430.16	Element	Left OB	Channel	Right OB
Vel Head (m)	0.01	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	430.15	Reach Len. (m)	50.53	46.34	47.52
Crit W.S. (m)	428.31	Flow Area (m2)	229.37	37.59	84.22
E.G. Slope (m/m)	0.000169	Area (m2)	229.37	37.59	84.22
Q Total (m3/s)	117.50	Flow (m3/s)	66.52	30.66	20.33
Top Width (m)	153.31	Top Width (m)	95.95	11.05	46.32
Vel Total (m/s)	0.33	Avg. Vel. (m/s)	0.29	0.82	0.24
Max Chl Dpth (m)	4.13	Hydr. Depth (m)	2.39	3.40	1.82
Conv. Total (m3/s)	9025.5	Conv. (m3/s)	5109.5	2354.7	1561.3
Length Wtd. (m)	46.34	Wetted Per. (m)	96.41	11.58	46.64
Min Ch El (m)	426.02	Shear (N/m2)	3.95	5.40	3.00
Alpha	2.07	Stream Power (N/m s)	1.15	4.40	0.72
Frctn Loss (m)		Cum Volume (1000 m3)		10.28	
C & E Loss (m)		Cum SA (1000 m2)	1789.86	271.43	1342.24

Plan: WestCredit Credit R. W. Credit R. RS: 18418.73 Profile: Regional

E.G. Elev (m)	428.08	Element	Left OB	Channel	Right OB
Vel Head (m)	0.02	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	428.06	Reach Len. (m)	42.23	39.62	38.70
Crit W.S. (m)	427.05	Flow Area (m2)	237.52	35.80	24.23
E.G. Slope (m/m)	0.000384	Area (m2)	237.52	35.80	24.23
Q Total (m3/s)	117.50	Flow (m3/s)	74.12	37.38	6.00
Top Width (m)	202.24	Top Width (m)	165.06	13.39	23.78
Vel Total (m/s)	0.39	Avg. Vel. (m/s)	0.31	1.04	0.25
Max Chl Dpth (m)	3.59	Hydr. Depth (m)	1.44	2.67	1.02
Conv. Total (m3/s)	5997.7	Conv. (m3/s)	3783.5	1908.1	306.1
Length Wtd. (m)	41.00	Wetted Per. (m)	165.11	14.05	23.86
Min Ch El (m)	424.47	Shear (N/m2)	5.41	9.59	3.82
Alpha	2.64	Stream Power (N/m s)	1.69	10.01	0.95
Frctn Loss (m)	0.01	Cum Volume (1000 m3)	33.89	41.64	13.01
C & E Loss (m)	0.00	Cum SA (1000 m2)	1774.54	270.37	1338.38

Plan: WestCredit Credit R. W. Credit R. RS: 18702.66 Culv Group: Culvert #2 Profile: Regional

Q Culv Group (m3/s)	46.44	Culv Full Len (m)	
# Barrels	1	Culv Vel US (m/s)	4.72
Q Barrel (m3/s)	46.44	Culv Vel DS (m/s)	5.90
E.G. US. (m)	433.40	Culv Inv El Up (m)	429.38
W.S. US. (m)	433.23	Culv Inv El Dn (m)	429.16
E.G. DS (m)	431.94	Culv Frctn Ls (m)	0.04
W.S. DS (m)	431.89	Culv Exit Loss (m)	0.81
Delta EG (m)	1.46	Culv Entr Loss (m)	0.61
Delta WS (m)	1.34	Q Weir (m3/s)	70.05
E.G. IC (m)	433.40	Weir Sta Lft (m)	130.25
E.G. OC (m)	433.36	Weir Sta Rgt (m)	238.38
Culvert Control	Inlet	Weir Submerg	0.00
Culv WS Inlet (m)	431.65	Weir Max Depth (m)	0.85
Culv WS Outlet (m)	430.98	Weir Avg Depth (m)	0.54
Culv Nml Depth (m)	1.04	Weir Flow Area (m2)	58.41
Culv Crt Depth (m)	2.27	Min El Weir Flow (m)	432.55

SCENARIO 3

INCREASE BRIDGE SPAN / WITH STOP-LOG CONTROL

Plan: Plan 06 Credit R. W. Credit R. RS: 19425.62 Profile: Regional

E.G. Elev (m)	435.82	Element	Left OB	Channel	Right OB
Vel Head (m)	0.03	Wt. n-Val.	0.080	0.035	0.054
W.S. Elev (m)	435.79	Reach Len. (m)	45.43	43.82	47.61
Crit W.S. (m)	433.55	Flow Area (m2)	26.62	62.65	64.05
E.G. Slope (m/m)	0.000196	Area (m2)	26.62	62.65	64.05
Q Total (m3/s)	80.70	Flow (m3/s)	4.66	52.42	23.62
Top Width (m)	80.00	Top Width (m)	25.74	17.88	36.38
Vel Total (m/s)	0.53	Avg. Vel. (m/s)	0.18	0.84	0.37
Max Chl Dpth (m)	3.60	Hydr. Depth (m)	1.03	3.50	1.76
Conv. Total (m3/s)	5769.2	Conv. (m3/s)	333.0	3747.8	1688.4
Length Wtd. (m)	44.43	Wetted Per. (m)	26.58	20.68	37.94
Min Ch El (m)	432.19	Shear (N/m2)	1.92	5.81	3.24
Alpha	1.79	Stream Power (N/m s)	0.34	4.86	1.19
Frctn Loss (m)	0.02	Cum Volume (1000 m3)	0.80	4.26	1.63
C & E Loss (m)	0.14	Cum SA (1000 m2)	1783.34	366.64	1396.31

Plan: Plan 06 Credit R. W. Credit R. RS: 19324.66 Profile: Regional

E.G. Elev (m)	435.27	Element	Left OB	Channel	Right OB
Vel Head (m)	0.27	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	435.01	Reach Len. (m)	25.82	25.47	25.60
Crit W.S. (m)	434.16	Flow Area (m2)	9.76	32.65	0.12
E.G. Slope (m/m)	0.002392	Area (m2)	9.76	32.65	0.12
Q Total (m3/s)	80.70	Flow (m3/s)	4.20	76.48	0.02
Top Width (m)	30.00	Top Width (m)	15.94	13.93	0.13
Vel Total (m/s)	1.90	Avg. Vel. (m/s)	0.43	2.34	0.14
Max Chl Dpth (m)	3.01	Hydr. Depth (m)	0.61	2.34	0.89
Conv. Total (m3/s)	1650.1	Conv. (m3/s)	85.9	1563.9	0.3
Length Wtd. (m)	25.47	Wetted Per. (m)	16.51	15.05	1.02
Min Ch El (m)	432.00	Shear (N/m2)	13.86	50.90	2.69
Alpha	1.45	Stream Power (N/m s)	5.97	119.23	0.39
Frctn Loss (m)		Cum Volume (1000 m3)		0.77	
C & E Loss (m)		Cum SA (1000 m2)	1782.12	365.16	1395.33

Plan: Plan 06 Credit R. W. Credit R. RS: 19299.19 Profile: Regional

E.G. Elev (m)	435.14	Element	Left OB	Channel	Right OB
Vel Head (m)	0.79	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	434.35	Reach Len. (m)	80.00	83.46	88.70
Crit W.S. (m)	434.35	Flow Area (m2)	7.48	27.37	0.12
E.G. Slope (m/m)	0.008781	Area (m2)	7.48	27.37	0.12
Q Total (m3/s)	117.50	Flow (m3/s)	6.51	110.94	0.04
Top Width (m)	25.00	Top Width (m)	11.08	13.58	0.34
Vel Total (m/s)	3.36	Avg. Vel. (m/s)	0.87	4.05	0.36
Max Chl Dpth (m)	2.65	Hydr. Depth (m)	0.67	2.02	0.35
Conv. Total (m3/s)	1253.9	Conv. (m3/s)	69.5	1184.0	0.5
Length Wtd. (m)	84.55	Wetted Per. (m)	11.66	14.69	0.70
Min Ch El (m)	431.70	Shear (N/m2)	55.21	160.44	14.97
Alpha	1.38	Stream Power (N/m s)	48.08	650.39	5.46
Frctn Loss (m)	0.76	Cum Volume (1000 m3)	3.20	167.03	12.63
C & E Loss (m)	0.27	Cum SA (1000 m2)	1781.77	364.81	1395.33

Plan: Plan 06 Credit R. W. Credit R. RS: 19215.73 Profile: Regional

E.G. Elev (m)	433.82	Element	Left OB	Channel	Right OB
Vel Head (m)	0.89	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	432.93	Reach Len. (m)	115.14	165.08	240.79
Crit W.S. (m)	433.20	Flow Area (m2)	2.57	11.00	44.61
E.G. Slope (m/m)	0.032989	Area (m2)	2.57	11.00	44.61
Q Total (m3/s)	117.50	Flow (m3/s)	1.47	62.03	54.00
Top Width (m)	144.06	Top Width (m)	20.24	9.26	114.55
Vel Total (m/s)	2.02	Avg. Vel. (m/s)	0.57	5.64	1.21
Max Chl Dpth (m)	1.80	Hydr. Depth (m)	0.13	1.19	0.39
Conv. Total (m3/s)	646.9	Conv. (m3/s)	8.1	341.5	297.3
Length Wtd. (m)	185.52	Wetted Per. (m)	20.32	9.70	114.57
Min Ch El (m)	431.13	Shear (N/m2)	40.91	366.60	125.95
Alpha	4.28	Stream Power (N/m s)	23.40	2067.85	152.47
Frctn Loss (m)	1.29	Cum Volume (1000 m3)	2.80	165.43	10.65
C & E Loss (m)	0.03	Cum SA (1000 m2)	1780.51	363.85	1390.23

Plan: Plan 06 Credit R. W. Credit R. RS: 18717.64 Profile: Regional

E.G. Elev (m)	432.97	Element	Left OB	Channel	Right OB
Vel Head (m)	0.01	Wt. n-Val.		0.035	0.080
W.S. Elev (m)	432.96	Reach Len. (m)	0.50	0.50	0.50
Crit W.S. (m)	430.01	Flow Area (m2)		255.95	1.24
E.G. Slope (m/m)	0.000052	Area (m2)		255.95	1.24
Q Total (m3/s)	117.50	Flow (m3/s)		117.46	0.04
Top Width (m)	80.47	Top Width (m)		74.87	5.60
Vel Total (m/s)	0.46	Avg. Vel. (m/s)		0.46	0.03
Max Chl Dpth (m)	4.23	Hydr. Depth (m)		3.42	0.22
Conv. Total (m3/s)	16310.4	Conv. (m3/s)		16304.7	5.7
Length Wtd. (m)	0.50	Wetted Per. (m)		76.88	5.61
Min Ch El (m)	428.73	Shear (N/m2)		1.69	0.11
Alpha	1.01	Stream Power (N/m s)		0.78	0.00
Frctn Loss (m)	0.00	Cum Volume (1000 m3)	0.00	0.51	0.00
C & E Loss (m)	0.02	Cum SA (1000 m2)	1770.75	283.59	1361.91

Plan: Plan 06 Credit R. W. Credit R. RS: 18717.14 Profile: Regional

E.G. Elev (m)	432.95	Element	Left OB	Channel	Right OB
Vel Head (m)	0.18	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	432.77	Reach Len. (m)	59.18	29.13	59.08
Crit W.S. (m)	431.18	Flow Area (m2)	5.19	59.95	12.08
E.G. Slope (m/m)	0.001238	Area (m2)	5.19	59.95	12.08
Q Total (m3/s)	117.50	Flow (m3/s)	0.95	114.05	2.50
Top Width (m)	76.64	Top Width (m)	19.33	19.91	37.39
Vel Total (m/s)	1.52	Avg. Vel. (m/s)	0.18	1.90	0.21
Max Chl Dpth (m)	3.38	Hydr. Depth (m)	0.27	3.01	0.32
Conv. Total (m3/s)	3339.8	Conv. (m3/s)	26.9	3241.8	71.1
Length Wtd. (m)	29.13	Wetted Per. (m)	19.36	23.03	37.41
Min Ch El (m)	429.39	Shear (N/m2)	3.25	31.60	3.92
Alpha	1.52	Stream Power (N/m s)	0.59	60.12	0.81
Frctn Loss (m)		Cum Volume (1000 m3)		0.43	
C & E Loss (m)		Cum SA (1000 m2)	1770.75	283.57	1361.90

Plan: Plan 06 Credit R. W. Credit R. RS: 18688.00 Profile: Regional

E.G. Elev (m)	432.68	Element	Left OB	Channel	Right OB
Vel Head (m)	1.04	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	431.64	Reach Len. (m)	66.89	42.15	44.64
Crit W.S. (m)	431.64	Flow Area (m2)	11.09	10.71	11.20
E.G. Slope (m/m)	0.015251	Area (m2)	56.17	10.71	68.00
Q Total (m3/s)	117.50	Flow (m3/s)	27.73	61.57	28.19
Top Width (m)	84.57	Top Width (m)	31.26	4.25	49.06
Vel Total (m/s)	3.56	Avg. Vel. (m/s)	2.50	5.75	2.52
Max Chl Dpth (m)	2.52	Hydr. Depth (m)	2.06	2.52	2.08
Conv. Total (m3/s)	951.4	Conv. (m3/s)	224.6	498.6	228.3
Length Wtd. (m)	45.58	Wetted Per. (m)	5.38	5.15	5.38
Min Ch El (m)	429.12	Shear (N/m2)	308.50	311.16	311.55
Alpha	1.60	Stream Power (N/m s)	771.69	1789.24	784.43
Frctn Loss (m)	0.15	Cum Volume (1000 m3)	9.45	40.93	3.57
C & E Loss (m)	0.47	Cum SA (1000 m2)	1769.25	283.22	1359.34

Plan: Plan 06 Credit R. W. Credit R. RS: 18508.07 Profile: Regional

E.G. Elev (m)	430.16	Element	Left OB	Channel	Right OB
Vel Head (m)	0.01	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	430.15	Reach Len. (m)	50.53	46.34	47.52
Crit W.S. (m)	428.31	Flow Area (m2)	229.37	37.59	84.22
E.G. Slope (m/m)	0.000169	Area (m2)	229.37	37.59	84.22
Q Total (m3/s)	117.50	Flow (m3/s)	66.52	30.66	20.33
Top Width (m)	153.31	Top Width (m)	95.95	11.05	46.32
Vel Total (m/s)	0.33	Avg. Vel. (m/s)	0.29	0.82	0.24
Max Chl Dpth (m)	4.13	Hydr. Depth (m)	2.39	3.40	1.82
Conv. Total (m3/s)	9025.5	Conv. (m3/s)	5109.5	2354.7	1561.3
Length Wtd. (m)	46.34	Wetted Per. (m)	96.41	11.58	46.64
Min Ch El (m)	426.02	Shear (N/m2)	3.95	5.40	3.00
Alpha	2.07	Stream Power (N/m s)	1.15	4.40	0.72
Frctn Loss (m)		Cum Volume (1000 m3)		10.28	
C & E Loss (m)		Cum SA (1000 m2)	1761.67	270.79	1356.05

Plan: Plan 06 Credit R. W. Credit R. RS: 18418.73 Profile: Regional

E.G. Elev (m)	428.08	Element	Left OB	Channel	Right OB
Vel Head (m)	0.02	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	428.06	Reach Len. (m)	42.23	39.62	38.70
Crit W.S. (m)	427.06	Flow Area (m2)	237.01	35.76	24.16
E.G. Slope (m/m)	0.000386	Area (m2)	237.01	35.76	24.16
Q Total (m3/s)	117.50	Flow (m3/s)	74.09	37.42	5.99
Top Width (m)	202.17	Top Width (m)	165.02	13.39	23.76
Vel Total (m/s)	0.40	Avg. Vel. (m/s)	0.31	1.05	0.25
Max Chl Dpth (m)	3.59	Hydr. Depth (m)	1.44	2.67	1.02
Conv. Total (m3/s)	5980.1	Conv. (m3/s)	3770.7	1904.5	304.8
Length Wtd. (m)	41.00	Wetted Per. (m)	165.07	14.05	23.83
Min Ch El (m)	424.47	Shear (N/m2)	5.44	9.64	3.84
Alpha	2.64	Stream Power (N/m s)	1.70	10.08	0.95
Frctn Loss (m)	0.01	Cum Volume (1000 m3)	33.80	41.87	13.02
C & E Loss (m)	0.00	Cum SA (1000 m2)	1746.35	269.73	1352.18

Plan: Plan 06 Credit R. W. Credit R. RS: 18702.66 Culv Group: Culvert #2 Profile: Regional

Q Culv Group (m3/s)	107.36	Culv Full Len (m)	7.58
# Barrels	1	Culv Vel US (m/s)	3.22
Q Barrel (m3/s)	107.36	Culv Vel DS (m/s)	3.14
E.G. US. (m)	432.95	Culv Inv El Up (m)	429.38
W.S. US. (m)	432.77	Culv Inv El Dn (m)	429.16
E.G. DS (m)	432.68	Culv Frctn Ls (m)	0.01
W.S. DS (m)	431.64	Culv Exit Loss (m)	0.00
Delta EG (m)	0.28	Culv Entr Loss (m)	0.26
Delta WS (m)	1.13	Q Weir (m3/s)	1.07
E.G. IC (m)	432.61	Weir Sta Lft (m)	169.61
E.G. OC (m)	432.95	Weir Sta Rgt (m)	210.60
Culvert Control	Outlet	Weir Submerg	0.00
Culv WS Inlet (m)	432.16	Weir Max Depth (m)	0.07
Culv WS Outlet (m)	432.17	Weir Avg Depth (m)	0.07
Culv Nml Depth (m)		Weir Flow Area (m2)	2.73
Culv Crt Depth (m)	2.01	Min El Weir Flow (m)	432.88

SCENARIO 4

INCREASE BRIDGE SPAN / NO STOP-LOG CONTROL

Plan: Plan 06 Credit R. W. Credit R. RS: 19425.62 Profile: Regional

E.G. Elev (m)	435.82	Element	Left OB	Channel	Right OB
Vel Head (m)	0.03	Wt. n-Val.	0.080	0.035	0.054
W.S. Elev (m)	435.79	Reach Len. (m)	45.43	43.82	47.61
Crit W.S. (m)	433.55	Flow Area (m2)	26.62	62.65	64.05
E.G. Slope (m/m)	0.000196	Area (m2)	26.62	62.65	64.05
Q Total (m3/s)	80.70	Flow (m3/s)	4.66	52.42	23.62
Top Width (m)	80.00	Top Width (m)	25.74	17.88	36.38
Vel Total (m/s)	0.53	Avg. Vel. (m/s)	0.18	0.84	0.37
Max Chl Dpth (m)	3.60	Hydr. Depth (m)	1.03	3.50	1.76
Conv. Total (m3/s)	5769.2	Conv. (m3/s)	333.0	3747.8	1688.4
Length Wtd. (m)	44.43	Wetted Per. (m)	26.58	20.68	37.94
Min Ch El (m)	432.19	Shear (N/m2)	1.92	5.81	3.24
Alpha	1.79	Stream Power (N/m s)	0.34	4.86	1.19
Frctn Loss (m)	0.02	Cum Volume (1000 m3)	0.80	4.26	1.63
C & E Loss (m)	0.14	Cum SA (1000 m2)	1782.62	366.64	1394.85

Plan: Plan 06 Credit R. W. Credit R. RS: 19324.66 Profile: Regional

E.G. Elev (m)	435.27	Element	Left OB	Channel	Right OB
Vel Head (m)	0.27	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	435.01	Reach Len. (m)	25.82	25.47	25.60
Crit W.S. (m)	434.16	Flow Area (m2)	9.76	32.65	0.12
E.G. Slope (m/m)	0.002392	Area (m2)	9.76	32.65	0.12
Q Total (m3/s)	80.70	Flow (m3/s)	4.20	76.48	0.02
Top Width (m)	30.00	Top Width (m)	15.94	13.93	0.13
Vel Total (m/s)	1.90	Avg. Vel. (m/s)	0.43	2.34	0.14
Max Chl Dpth (m)	3.01	Hydr. Depth (m)	0.61	2.34	0.89
Conv. Total (m3/s)	1650.1	Conv. (m3/s)	85.9	1563.9	0.3
Length Wtd. (m)	25.47	Wetted Per. (m)	16.51	15.05	1.02
Min Ch El (m)	432.00	Shear (N/m2)	13.86	50.90	2.69
Alpha	1.45	Stream Power (N/m s)	5.97	119.23	0.39
Frctn Loss (m)		Cum Volume (1000 m3)		0.77	
C & E Loss (m)		Cum SA (1000 m2)	1781.39	365.15	1393.88

Plan: Plan 06 Credit R. W. Credit R. RS: 19299.19 Profile: Regional

E.G. Elev (m)	435.14	Element	Left OB	Channel	Right OB
Vel Head (m)	0.79	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	434.35	Reach Len. (m)	80.00	83.46	88.70
Crit W.S. (m)	434.35	Flow Area (m2)	7.48	27.37	0.12
E.G. Slope (m/m)	0.008781	Area (m2)	7.48	27.37	0.12
Q Total (m3/s)	117.50	Flow (m3/s)	6.51	110.94	0.04
Top Width (m)	25.00	Top Width (m)	11.08	13.58	0.34
Vel Total (m/s)	3.36	Avg. Vel. (m/s)	0.87	4.05	0.36
Max Chl Dpth (m)	2.65	Hydr. Depth (m)	0.67	2.02	0.35
Conv. Total (m3/s)	1253.9	Conv. (m3/s)	69.5	1184.0	0.5
Length Wtd. (m)	84.55	Wetted Per. (m)	11.66	14.69	0.70
Min Ch El (m)	431.70	Shear (N/m2)	55.21	160.44	14.97
Alpha	1.38	Stream Power (N/m s)	48.08	650.39	5.46
Frctn Loss (m)	0.76	Cum Volume (1000 m3)	2.66	162.62	11.72
C & E Loss (m)	0.27	Cum SA (1000 m2)	1781.04	364.80	1393.87

Plan: Plan 06 Credit R. W. Credit R. RS: 19215.73 Profile: Regional

E.G. Elev (m)	433.82	Element	Left OB	Channel	Right OB
Vel Head (m)	0.89	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	432.93	Reach Len. (m)	115.14	165.08	240.79
Crit W.S. (m)	433.20	Flow Area (m2)	2.57	11.00	44.61
E.G. Slope (m/m)	0.032989	Area (m2)	2.57	11.00	44.61
Q Total (m3/s)	117.50	Flow (m3/s)	1.47	62.03	54.00
Top Width (m)	144.06	Top Width (m)	20.24	9.26	114.55
Vel Total (m/s)	2.02	Avg. Vel. (m/s)	0.57	5.64	1.21
Max Chl Dpth (m)	1.80	Hydr. Depth (m)	0.13	1.19	0.39
Conv. Total (m3/s)	646.9	Conv. (m3/s)	8.1	341.5	297.3
Length Wtd. (m)	185.53	Wetted Per. (m)	20.32	9.70	114.57
Min Ch El (m)	431.13	Shear (N/m2)	40.91	366.60	125.95
Alpha	4.28	Stream Power (N/m s)	23.40	2067.85	152.47
Frctn Loss (m)	1.29	Cum Volume (1000 m3)	2.26	161.02	9.74
C & E Loss (m)	0.03	Cum SA (1000 m2)	1779.79	363.85	1388.78

Plan: Plan 06 Credit R. W. Credit R. RS: 18717.64 Profile: Regional

E.G. Elev (m)	432.97	Element	Left OB	Channel	Right OB
Vel Head (m)	0.01	Wt. n-Val.		0.035	0.080
W.S. Elev (m)	432.96	Reach Len. (m)	0.50	0.50	0.50
Crit W.S. (m)	430.01	Flow Area (m2)		255.93	1.24
E.G. Slope (m/m)	0.000052	Area (m2)		255.93	1.24
Q Total (m3/s)	117.50	Flow (m3/s)		117.46	0.04
Top Width (m)	80.47	Top Width (m)		74.87	5.59
Vel Total (m/s)	0.46	Avg. Vel. (m/s)		0.46	0.03
Max Chl Dpth (m)	4.23	Hydr. Depth (m)		3.42	0.22
Conv. Total (m3/s)	16308.6	Conv. (m3/s)		16303.0	5.7
Length Wtd. (m)	0.50	Wetted Per. (m)		76.88	5.61
Min Ch El (m)	428.73	Shear (N/m2)		1.69	0.11
Alpha	1.01	Stream Power (N/m s)		0.78	0.00
Frctn Loss (m)	0.00	Cum Volume (1000 m3)	0.00	0.51	0.00
C & E Loss (m)	0.02	Cum SA (1000 m2)	1770.75	283.59	1361.91

Plan: Plan 06 Credit R. W. Credit R. RS: 18717.14 Profile: Regional

E.G. Elev (m)	432.95	Element	Left OB	Channel	Right OB
Vel Head (m)	0.18	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	432.78	Reach Len. (m)	59.18	29.13	59.08
Crit W.S. (m)	431.17	Flow Area (m2)	5.22	60.24	12.14
E.G. Slope (m/m)	0.001222	Area (m2)	5.22	60.24	12.14
Q Total (m3/s)	117.50	Flow (m3/s)	0.95	114.04	2.51
Top Width (m)	76.66	Top Width (m)	19.34	19.91	37.41
Vel Total (m/s)	1.51	Avg. Vel. (m/s)	0.18	1.89	0.21
Max Chl Dpth (m)	3.38	Hydr. Depth (m)	0.27	3.02	0.32
Conv. Total (m3/s)	3360.6	Conv. (m3/s)	27.2	3261.7	71.7
Length Wtd. (m)	29.13	Wetted Per. (m)	19.37	23.09	37.43
Min Ch El (m)	429.40	Shear (N/m2)	3.23	31.28	3.89
Alpha	1.52	Stream Power (N/m s)	0.59	59.22	0.80
Frctn Loss (m)		Cum Volume (1000 m3)		0.43	
C & E Loss (m)		Cum SA (1000 m2)	1770.75	283.57	1361.90

Plan: Plan 06 Credit R. W. Credit R. RS: 18688.00 Profile: Regional

E.G. Elev (m)	432.68	Element	Left OB	Channel	Right OB
Vel Head (m)	1.04	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	431.64	Reach Len. (m)	66.89	42.15	44.64
Crit W.S. (m)	431.64	Flow Area (m2)	11.09	10.71	11.20
E.G. Slope (m/m)	0.015251	Area (m2)	56.17	10.71	68.00
Q Total (m3/s)	117.50	Flow (m3/s)	27.73	61.57	28.19
Top Width (m)	84.57	Top Width (m)	31.26	4.25	49.06
Vel Total (m/s)	3.56	Avg. Vel. (m/s)	2.50	5.75	2.52
Max Chl Dpth (m)	2.52	Hydr. Depth (m)	2.06	2.52	2.08
Conv. Total (m3/s)	951.4	Conv. (m3/s)	224.6	498.6	228.3
Length Wtd. (m)	45.58	Wetted Per. (m)	5.38	5.15	5.38
Min Ch El (m)	429.12	Shear (N/m2)	308.50	311.16	311.55
Alpha	1.60	Stream Power (N/m s)	771.69	1789.24	784.43
Frctn Loss (m)	0.15	Cum Volume (1000 m3)	9.45	40.93	3.57
C & E Loss (m)	0.47	Cum SA (1000 m2)	1769.25	283.22	1359.34

Plan: Plan 06 Credit R. W. Credit R. RS: 18508.07 Profile: Regional

E.G. Elev (m)	430.16	Element	Left OB	Channel	Right OB
Vel Head (m)	0.01	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	430.15	Reach Len. (m)	50.53	46.34	47.52
Crit W.S. (m)	428.31	Flow Area (m2)	229.37	37.59	84.22
E.G. Slope (m/m)	0.000169	Area (m2)	229.37	37.59	84.22
Q Total (m3/s)	117.50	Flow (m3/s)	66.52	30.66	20.33
Top Width (m)	153.31	Top Width (m)	95.95	11.05	46.32
Vel Total (m/s)	0.33	Avg. Vel. (m/s)	0.29	0.82	0.24
Max Chl Dpth (m)	4.13	Hydr. Depth (m)	2.39	3.40	1.82
Conv. Total (m3/s)	9025.5	Conv. (m3/s)	5109.5	2354.7	1561.3
Length Wtd. (m)	46.34	Wetted Per. (m)	96.41	11.58	46.64
Min Ch El (m)	426.02	Shear (N/m2)	3.95	5.40	3.00
Alpha	2.07	Stream Power (N/m s)	1.15	4.40	0.72
Frctn Loss (m)		Cum Volume (1000 m3)		10.28	
C & E Loss (m)		Cum SA (1000 m2)	1761.67	270.79	1356.05

Plan: Plan 06 Credit R. W. Credit R. RS: 18418.73 Profile: Regional

E.G. Elev (m)	428.08	Element	Left OB	Channel	Right OB
Vel Head (m)	0.02	Wt. n-Val.	0.080	0.035	0.080
W.S. Elev (m)	428.06	Reach Len. (m)	42.23	39.62	38.70
Crit W.S. (m)	427.06	Flow Area (m2)	237.01	35.76	24.16
E.G. Slope (m/m)	0.000386	Area (m2)	237.01	35.76	24.16
Q Total (m3/s)	117.50	Flow (m3/s)	74.09	37.42	5.99
Top Width (m)	202.17	Top Width (m)	165.02	13.39	23.76
Vel Total (m/s)	0.40	Avg. Vel. (m/s)	0.31	1.05	0.25
Max Chl Dpth (m)	3.59	Hydr. Depth (m)	1.44	2.67	1.02
Conv. Total (m3/s)	5980.1	Conv. (m3/s)	3770.7	1904.5	304.8
Length Wtd. (m)	41.00	Wetted Per. (m)	165.07	14.05	23.83
Min Ch El (m)	424.47	Shear (N/m2)	5.44	9.64	3.84
Alpha	2.64	Stream Power (N/m s)	1.70	10.08	0.95
Frctn Loss (m)	0.01	Cum Volume (1000 m3)	33.80	41.87	13.02
C & E Loss (m)	0.00	Cum SA (1000 m2)	1746.35	269.73	1352.18

Plan: Plan 06 Credit R. W. Credit R. RS: 18702.66 Culv Group: Culvert #2 Profile: Regional

Q Culv Group (m3/s)	107.36	Culv Full Len (m)	7.58
# Barrels	1	Culv Vel US (m/s)	3.22
Q Barrel (m3/s)	107.36	Culv Vel DS (m/s)	3.14
E.G. US. (m)	432.95	Culv Inv El Up (m)	429.38
W.S. US. (m)	432.78	Culv Inv El Dn (m)	429.16
E.G. DS (m)	432.68	Culv Frctn Ls (m)	0.01
W.S. DS (m)	431.64	Culv Exit Loss (m)	0.00
Delta EG (m)	0.28	Culv Entr Loss (m)	0.26
Delta WS (m)	1.14	Q Weir (m3/s)	1.07
E.G. IC (m)	432.61	Weir Sta Lft (m)	169.61
E.G. OC (m)	432.95	Weir Sta Rgt (m)	210.60
Culvert Control	Outlet	Weir Submerg	0.00
Culv WS Inlet (m)	432.16	Weir Max Depth (m)	0.07
Culv WS Outlet (m)	432.17	Weir Avg Depth (m)	0.07
Culv Nml Depth (m)		Weir Flow Area (m2)	2.73
Culv Crt Depth (m)	2.01	Min El Weir Flow (m)	432.88