

Appendix B: Hydrologic & Hydraulic Modeling Technical Memorandum

Memo

File	Recipient	Company
120114	Nathanael Couperus Tom Reeve Kenneth Cheney	City of Barrie (City) City Lake Simcoe Region Conservation Authority (LSRCA)
Date	Purpose	
April 21, 2021	Whiskey Creek at Minet's Point EA, City of Barrie Hydrologic/Hydraulic Model Updates	

Message

Hydrologic Updates

The LSRCA identified two issues with the hydrologic model prepared as part of the Barrie Drainage Master Plan to be addressed before receiving LSRCA approval for use of the model as follows:

1. The City's woodland land use shapefile included trees on manicured lawns that should not be modeled as woodland (should be modeled as lawn); and
2. All buildings were excluded from the directly connected impervious areas where buildings surrounded by parking areas, particularly those in commercial and industrial areas, should be considered directly connected.

To resolve these issues, we completed the following additional analysis:

1. The woodland land use shapefile was overlaid onto aerial imagery to confirm which woodland areas represent landscaped areas (trees mixed with lawns). In urban areas with dense trees (parks, minor drainage tributaries, etc.), aerial imagery and Google street view were used to confirm whether the woodland land use truly represented woodland or landscaped areas. The landscaped areas were removed from the woodland land use shapefile.
2. The commercial, institutional and industrial land use shapefiles were overlaid onto the directly connected impervious and buildings shapefiles. In commercial, institutional and industrial areas, the buildings were evaluated on a case-by-case basis to confirm whether they should be modeled as directly connected. All buildings that appeared to have a direct connection to the storm sewer/drainage outlet were added to the directly connected impervious shapefile.

To update the Visual OTTHYMO (VO) hydrologic model, we completed the following:

1. The woodland GIS shapefile was revised based on the discussion above and used to update the associated CN value and initial abstraction (IA) for each subcatchment. The area that was removed from woodland land use was added to the lawn land use. The VO model was then updated with the revised CN and initial abstraction values.

2. The directly connected impervious area GIS shapefile was revised based on the discussion above and used to calculate an updated directly connected impervious percentage for each catchment. The VO model was updated with the revised values.

The updated VO model was used to establish the revised peak flows for the various design storms and the Regional (Hurricane Hazel) Storm. The digital VO model is enclosed for review. A comparison of the peak flows generated in the LSRCA approved *Whiskey Creek Master Drainage Plan Update (2011)*, the *Drainage Master Plan (2019)* and from these most recent updates is enclosed for reference. A summary of the peak flows at key points of interest through the downstream reach of Whiskey Creek is provided in the following table for the 1:5-year and 1:100-year return frequency design storms:

Table 1: Peak Flow Comparison (LSRCA Approved versus DMP Updates)

LOCATION	1:5-YEAR PEAK FLOW (m ³ /s)			1:100-YEAR PEAK FLOW (m ³ /s)		
	LSRCA (2011)	DMP (2019)	EA (2021)	LSRCA (2011)	DMP (2019)	EA (2021)
Hurst Drive	19.42	13.70	15.74	52.03	38.33	40.90
The Boulevard	19.49	13.69	15.71	52.25	37.38	39.76
Brennan Avenue	19.56	13.73	15.76	52.50	37.46	39.84
Lake Simcoe	19.59	13.70	15.64	52.62	37.34	39.75

Existing Condition Spills Analysis

A change in the Whiskey Creek watershed that occurred since the models were prepared as part of the DMP is the construction of the Harvie Road overpass and the associated culvert crossing replacement at Highway 400 and Fairview Road. The previous Highway 400 culvert crossing conveyed the peak flows generated by the 1:100-year design storm under Highway 400. However, the culvert had insufficient capacity for the Regional (Hurricane Hazel) Storm peak flow resulting in a spill north from the main branch of Whiskey Creek into a tributary of Whiskey Creek and to Hotchkiss Creek. The previous design information provided for the Harvie Road overpass indicated that the Highway 400 culvert replacement would be sized to eliminate the spill.

To confirm impacts of the new construction, the HEC-RAS model at Highway 400 has been updated with the new grading of Harvie Road, Fairview Road and Highway 400 from surface files provided by the City, supplemented with the City's 2016 LiDAR data. The HEC-RAS model has also been updated to include the new culvert crossings under Harvie Road, the Harvie Road access road, Highway 400 and Fairview Road as detailed in the "Issued for Construction" drawings from Hatch Ltd. which are enclosed for reference.

The updated HEC-RAS model results demonstrate the new Highway 400 culvert crossing has sufficient capacity to convey the peak flows generated by the 1:2-year through 1:100-year return frequency design storms downstream without overtopping Highway 400 or a spill north. However, during the Regional Storm, the new culvert crossing will

convey approximately 13.6 m³/s to the reach of Whiskey Creek downstream of Highway 400 while approximately 7.7 m³/s will overtop Highway 400. Of the 7.7 m³/s, 4.1 m³/s drains back into Whiskey Creek while the remaining 3.6 m³/s spills north along Highway 400. The spills analysis completed as part of the DMP predicted a spill of 4.4 m³/s.

The existing condition spill from Whiskey Creek is characterized as follows:

- A flow of 2.4 m³/s drains north along Highway 400 and its roadside ditches into the Hotchkiss Creek watershed; and
- A flow of 1.2 m³/s drains north into a Tributary of Whiskey Creek which has been realigned through the Barrie-Simcoe Emergency Services Campus and converges with the main Branch of Whiskey Creek north of 279 Bayview Drive.

The spill from Whiskey Creek has been analysed using a one-dimensional (1D) steady state HEC-RAS model consistent with the analysis completed in support of the DMP. The results of the 1D HEC-RAS model have been verified through a two-dimensional (2D) PCSWMM model and discrete calculations at key locations (HY-8 culvert analysis and weir calculations). The digital models and supporting calculations are enclosed for review.

**Preferred
Solution
(Future
Condition)
Spills
Analysis**

The Whiskey Creek spills analysis has also been updated to include the MTO's proposed Highway 400 improvements (widening to 10 lanes). The spills analysis at Highway 400 has been updated to include the proposed Highway 400 widening based on the Highway 400 design provided during the preparation of the DMP. The proposed design of Highway 400 has significantly higher conveyance capacity within the right-of-way, impacting the spill from Whiskey Creek.

During the Regional Storm, the culvert crossing Highway 400 will convey approximately 15.9 m³/s to the reach of Whiskey Creek downstream of Highway 400 while approximately 5.5 m³/s will overtop Highway 400. Of the 5.5 m³/s, 0.1 m³/s drains back into Whiskey Creek while the remaining 5.4 m³/s spills north along Highway 400

The future condition spill from Whiskey Creek is characterized as follows:

- A flow of 4.9 m³/s drains north along Highway 400 and its roadside ditches into the Hotchkiss Creek watershed; and
- A flow of 0.5 m³/s drains north into a Tributary of Whiskey Creek which has been realigned through the Barrie-Simcoe Emergency Services Campus and converges with the main Branch of Whiskey Creek north of 279 Bayview Drive

As discussed, the spill from Whiskey Creek has been analysed using a one-dimensional (1D) steady state HEC-Ras model consistent with the analysis completed in support of the DMP. The results of the 1D HEC-RAS model have been verified through a two-dimensional (2D) PCSWMM model and discrete calculations at key locations (HY-8 culvert analysis and weir calculations). The digital models and supporting calculations are enclosed for review.

**Preferred
Solution
Visual
OTTHYMO
Model**

The preferred alternative solution VO hydrologic model has been updated consistent with the process described for the existing condition model. For the Regional (Hurricane Hazel) Storm scenario, the stormwater management facilities were removed from the model and the soil conditions were adjusted to reflect AMCIII conditions. The spill from Whiskey Creek at Highway 400 was also added to the model. The preferred alternative solution VO hydrologic model is enclosed for review.

**HEC-RAS
Model
Updates**

The updated Harvie Road overpass geometry, Barrie-Simcoe Emergency Services Campus channel realignment and the updated flows from the Visual OTTHYMO hydrologic model have been included in the overall existing and preferred alternative

solution HEC-RAS models. For the existing condition HEC-RAS model, the Whiskey Creek flows have been updated in accordance with the VO model. The new Highway 400 crossing is expected to reduce spills to Hotchkiss Creek during the Regional Storm, however the Hotchkiss Creek flows have not been updated (existing flows are more conservative). The spills analysis completed as part of the DMP predicted the elimination of the spill from Whiskey Creek to Hotchkiss Creek under the preferred solution. However, the updated spills analysis predicts the spill will continue to occur during the Regional Storm. As part of the HEC-RAS model updates, the Hotchkiss Creek flows downstream of Highway 400 have been updated.

Model Summary

The updated models submitted with this memo are as follows:

Visual OTTHYMO

- Whiskey Creek Existing No Spill (AMCII) Scenario;
- Whiskey Creek Existing No Spill (AMCIII without SWMF's) Scenario;**
- Whiskey Creek and Hotchkiss Creek (no parameter updates for Hotchkiss) Existing With Spill (AMCII) Scenario;
- Whiskey Creek and Hotchkiss Creek (no parameter updates for Hotchkiss) Existing With Spill (AMCIII without SWMF's) Scenario;
- Whiskey Creek Preferred Alternative No Spill (AMCII) Scenario;
- Whiskey Creek and Hotchkiss Creek (no parameter updates for Hotchkiss) Preferred Alternative With Spill (AMCII) Scenario; and
- Whiskey Creek and Hotchkiss Creek (no parameter updates for Hotchkiss) With Spill For Proposed Highway 400 Widening (AMCIII without SWMF's) Scenario.

***Whiskey Creek Existing No Spill (AMCIII without SWMF's) Scenario has same hydrology as Preferred Alternative with No Spill because of exclusion of SWMF's*

The Whiskey Creek watershed has been separated from the overall VO model for the Barrie Creeks Watershed as the hydrologic model updates have only been completed for Whiskey Creek.

Spills Analysis

- HEC-RAS model of upstream portion of Whiskey Creek to confirm Highway 400 overtopping and spill from north tributary;
- HEC-RAS model of existing Highway 400 spills conveyance;
- HEC-RAS model of proposed Highway 400 widening spills conveyance;
- PCSWMM 2D model of spills with existing Highway 400 geometry; and
- PCSWMM 2D model of spill with proposed Highway 400 widening geometry.

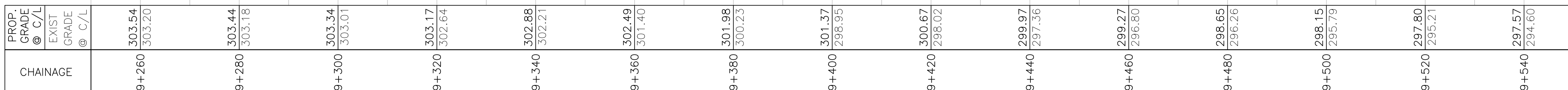
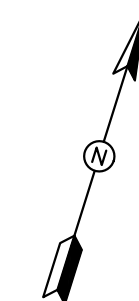
HEC-RAS

- Barrie Creeks Existing Condition with existing and future (+20%) flows updated with new Harvie Road overpass construction geometry, Barrie-Simcoe Emergency Services Campus channel realignment and updated Whiskey Creek hydrologic model results.
- Barrie Creeks Preferred Alternative with future (+20%) flows updated with new Harvie Road overpass construction geometry, Barrie-Simcoe Emergency Services Campus channel realignment and updated Whiskey Creek hydrologic model results including updated peak flows along Hotchkiss Creek downstream of Highway 400.

From

Daniel Twigger

Hatch Ltd.
Reference Drawings



5m 0 10m
HORIZONTAL

1m 0 2m
VERTICAL

24" X 36"
FULL SIZE DRAWING SCALE



PLAN AND PROFILE (4 OF 13)
HARVIE ROAD
STA. 9+250 TO STA. 9+550

SCALE	HOR. 1:500	VERT. 1:100	CONTRACT NO. 2018-002T
DESIGN	J.T.	DRAWN D.L.	
REVIEWED	S.M.	DATE 2018.09.06	
			SHEET NO. PP4

DOC: H351997-20-260-SEG1-0019-004

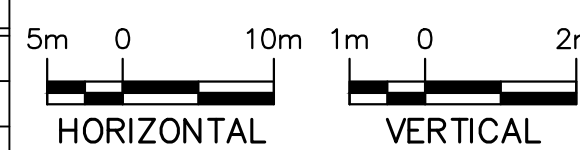
DATE PLOTTED: 9/5/2018 5:53:23 PM
FILE LOCATION: C:\pwworking\hi\kim77578\dms98026\H351997-20-260-SEG1-0019.dwg

DATE PLOTTED: 9/5/2018 5:53:57 PM
FILE LOCATION: C:\pwworking\hatch\h351997-20-260-SEG1-0019.dwg

HATCH



NO.	REVISIONS	DATE	APPROVED
0	ISSUED FOR CONSTRUCTION	2018.09.06	B.R.



24" X 36"
FULL SIZE DRAWING SCALE



**HARVIE AND BIG BAY POINT ROAD
NEW CROSSING - HIGHWAY 400**

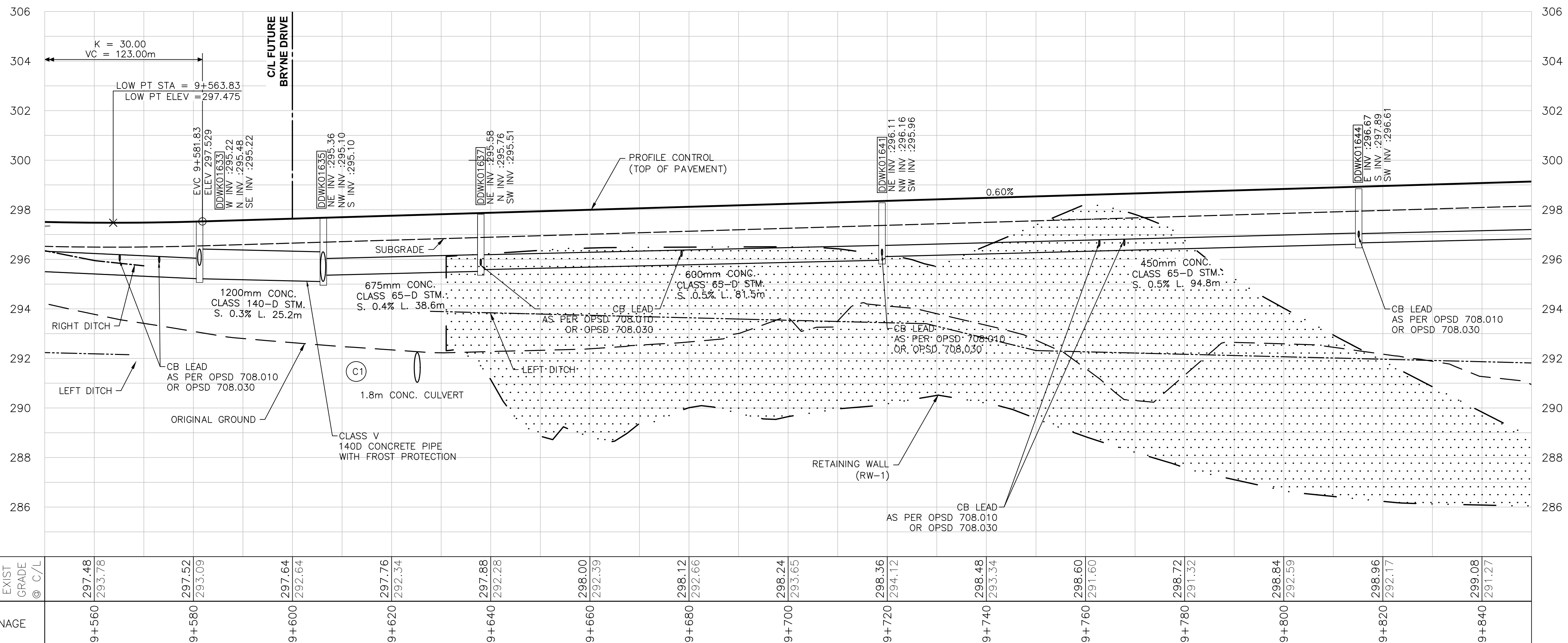
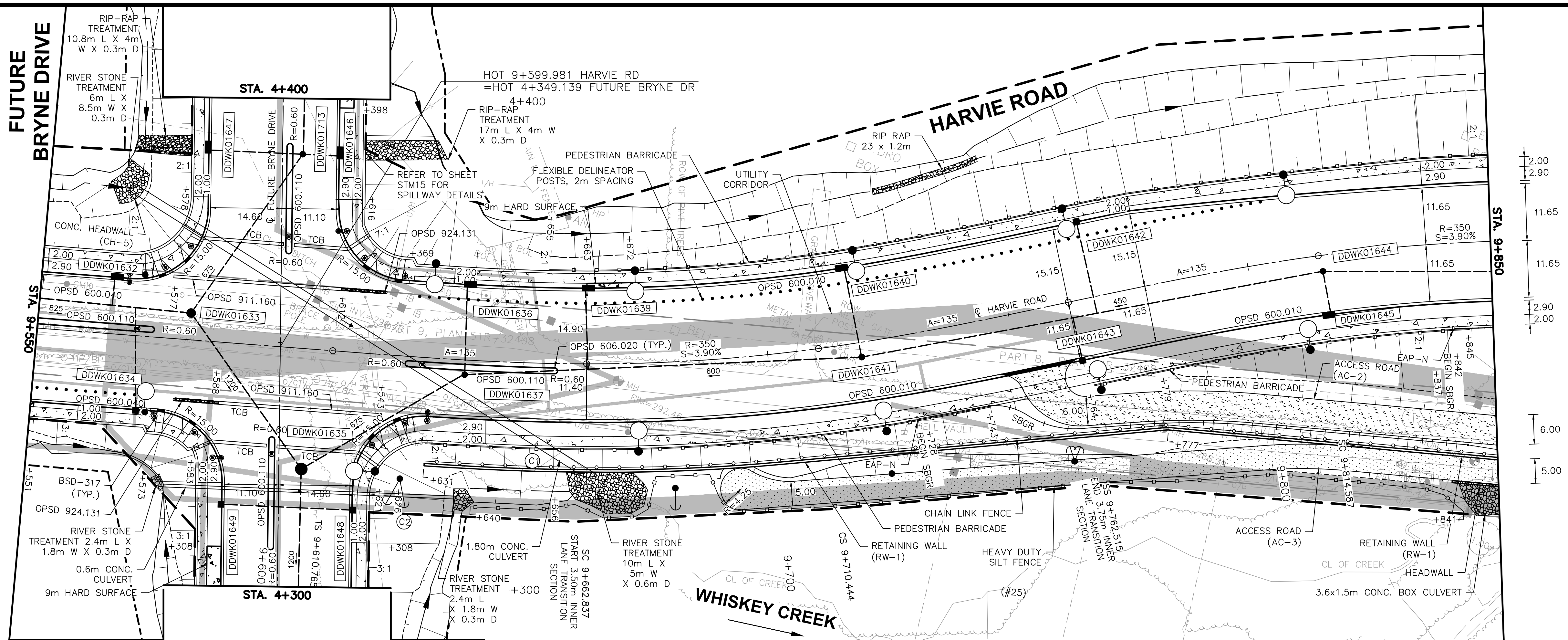
PLAN AND PROFILE (5 OF 13)
HARVIE ROAD
STA. 9+550 TO STA. 9+850

Barrie

ENGINEERING DEPARTMENT

SCALE HOR.	1:500	VERT.	1:100	CONTRACT NO.	2018-002T
DESIGN	J.T.	DRAWN	D.L.	SHEET NO.	PP5
REVIEWED	S.M.	DATE	2018.09.06		

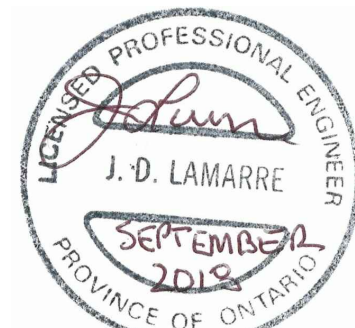
DOC: H351997-20-260-SEG1-0019-005



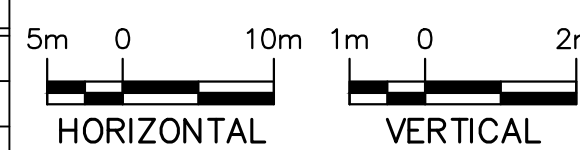
PROP. GRADE @ C/L	297.48	297.52	297.64	297.76	297.88	298.00	298.12	298.24	298.36	298.48	298.60	298.72	298.84	298.96	299.08
EXIST. GRADE @ C/L	293.78	293.09	292.64	292.34	292.28	292.39	292.66	293.65	294.12	293.34	291.60	291.32	292.59	292.17	291.27
CHAINAGE	9+560	9+580	9+600	9+620	9+640	9+660	9+680	9+700	9+720	9+740	9+760	9+780	9+800	9+820	9+840

DATE PLOTTED: 9/5/2018 5:54:24 PM
FILE LOCATION: C:\pwworking\hatch\1351997-20-260-SEG1-0019.dwg

HATCH



NO.	REVISIONS	DATE	APPROVED
0	ISSUED FOR CONSTRUCTION	2018.09.06	B.R.



24" X 36"
FULL SIZE DRAWING SCALE



**HARVIE AND BIG BAY POINT ROAD
NEW CROSSING - HIGHWAY 400**

PLAN AND PROFILE (6 OF 13)
HARVIE/BIG BAY POINT ROAD
STA. 9+850 TO STA. 10+150

Barrie

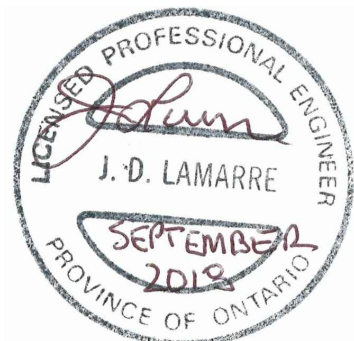
ENGINEERING DEPARTMENT

SCALE	HOR.	1:500	VERT.	1:100	CONTRACT NO.	2018-002T
DESIGN	J.T.	DRAWN	D.L.	SHEET NO.	PP6	
REVIEWED	S.M.	DATE	2018.09.06			

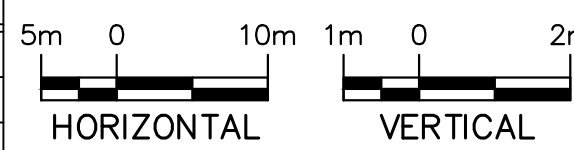
DOC: H351997-20-260-SEG1-0019-006

DATE PLOTTED: 9/5/2018 5:54:34 PM
FILE LOCATION: C:\pwworking\hatch\1351997-20-260-SEG1-0019.dwg

HATCH



NO.	REVISIONS	DATE	APPROVED
0	ISSUED FOR CONSTRUCTION	2018.09.06	B.R.



24" X 36"
FULL SIZE DRAWING SCALE



HARVIE AND BIG BAY POINT ROAD
NEW CROSSING - HIGHWAY 400

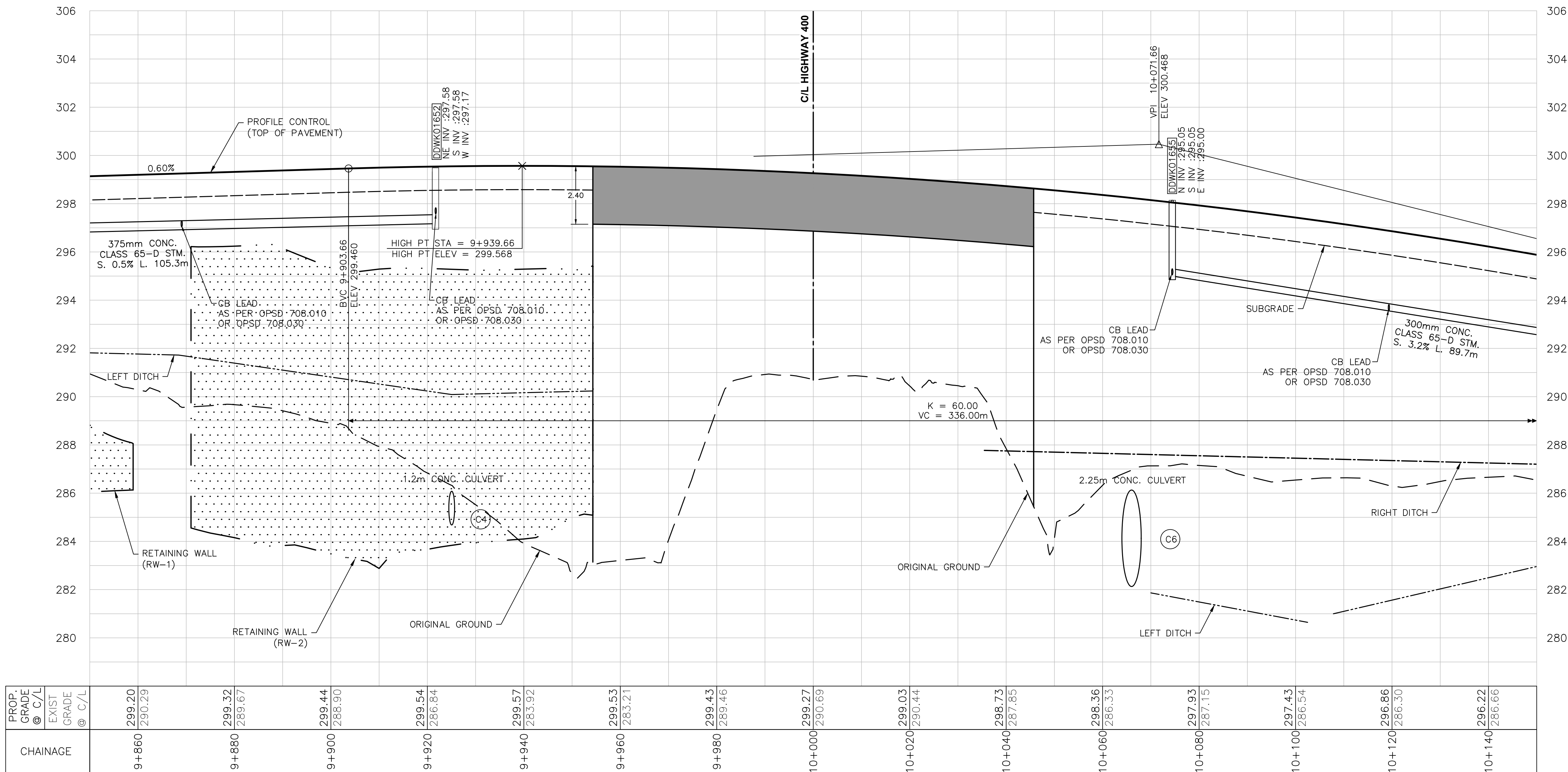
PLAN AND PROFILE (7 OF 13)
HARVIE/BIG BAY POINT ROAD
STA. 9+850 TO STA. 10+150

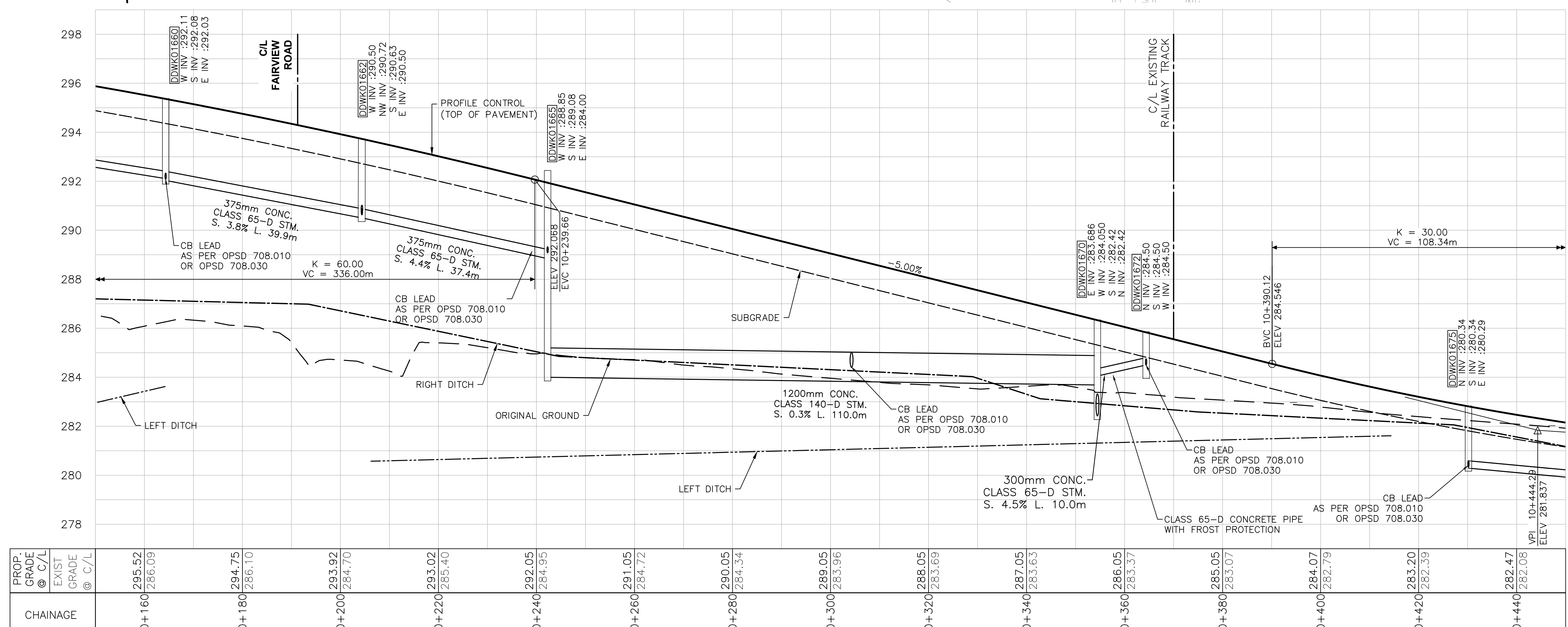
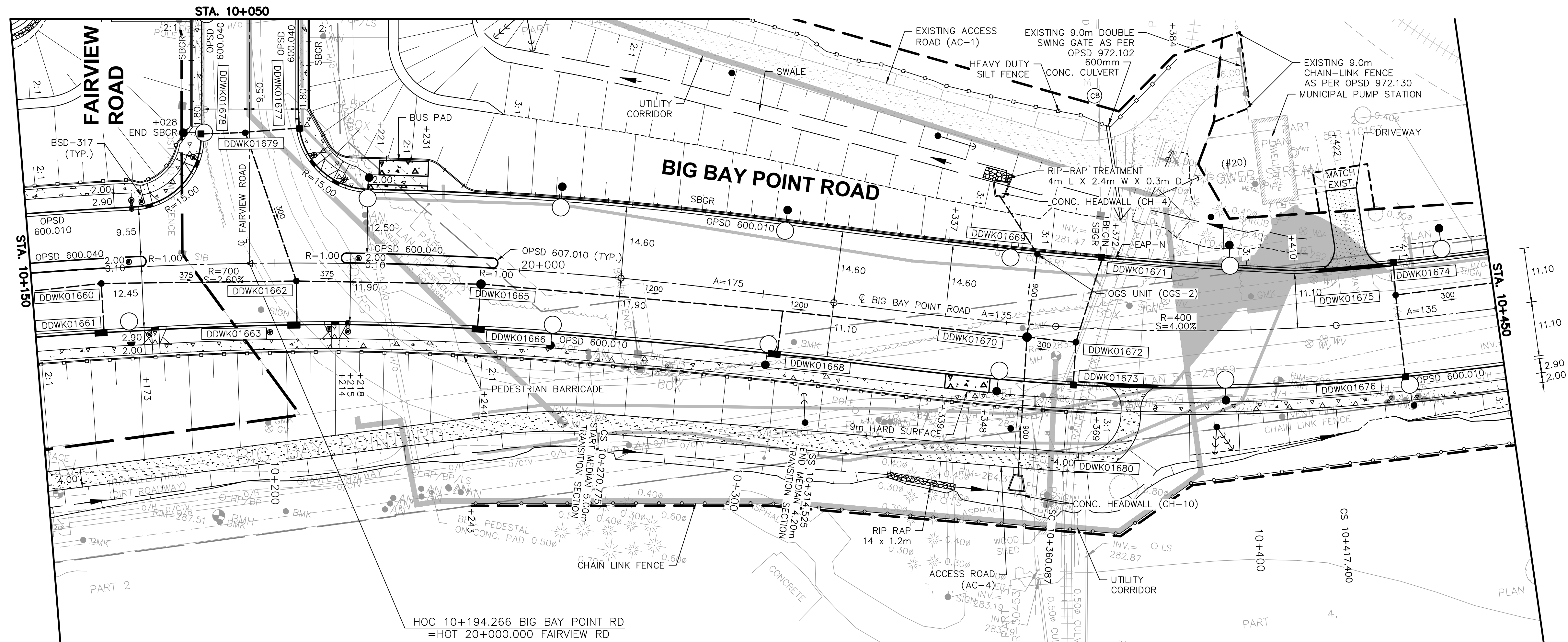
Barrie

ENGINEERING DEPARTMENT

SCALE HOR.	1:500	VERT.	1:100	CONTRACT NO.	2018-002T
DESIGN	J.T.	DRAWN	D.L.	SHEET NO.	PP7
REVIEWED	S.M.	DATE	2018.09.06		

DOC: H351997-20-260-SEG1-0019-007

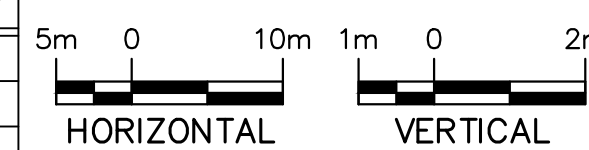




HATCH



NO.	REVISIONS	DATE	APPROVED
0	ISSUED FOR CONSTRUCTION	2018.09.06	B.R.



24" X 36"
FULL SIZE DRAWING SCALE



**HARVIE AND BIG BAY POINT ROAD
NEW CROSSING - HIGHWAY 400**

PLAN AND PROFILE (8 OF 13)
BIG BAY POINT ROAD
STA. 10+150 TO STA. 10+450

Barrie

ENGINEERING DEPARTMENT

SCALE HOR.	1:500	VERT.	1:100	CONTRACT NO.	2018-002T
DESIGN	J.T.	DRAWN	D.L.	SHEET NO.	PP8
REVIEWED	S.M.	DATE	2018.09.06		

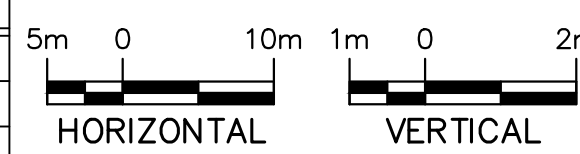
DOC: H351997-20-260-SEG1-0019-008

DATE PLOTTED: 9/5/2018 5:56:16 PM
FILE LOCATION: C:\pwworking\hatch\1351997-20-260-SEG1-0019.dwg

HATCH



NO.	REVISIONS	DATE	APPROVED
0	ISSUED FOR CONSTRUCTION	2018.09.06	B.R.



24" X 36"
FULL SIZE DRAWING SCALE



**HARVIE AND BIG BAY POINT ROAD
NEW CROSSING - HIGHWAY 400**

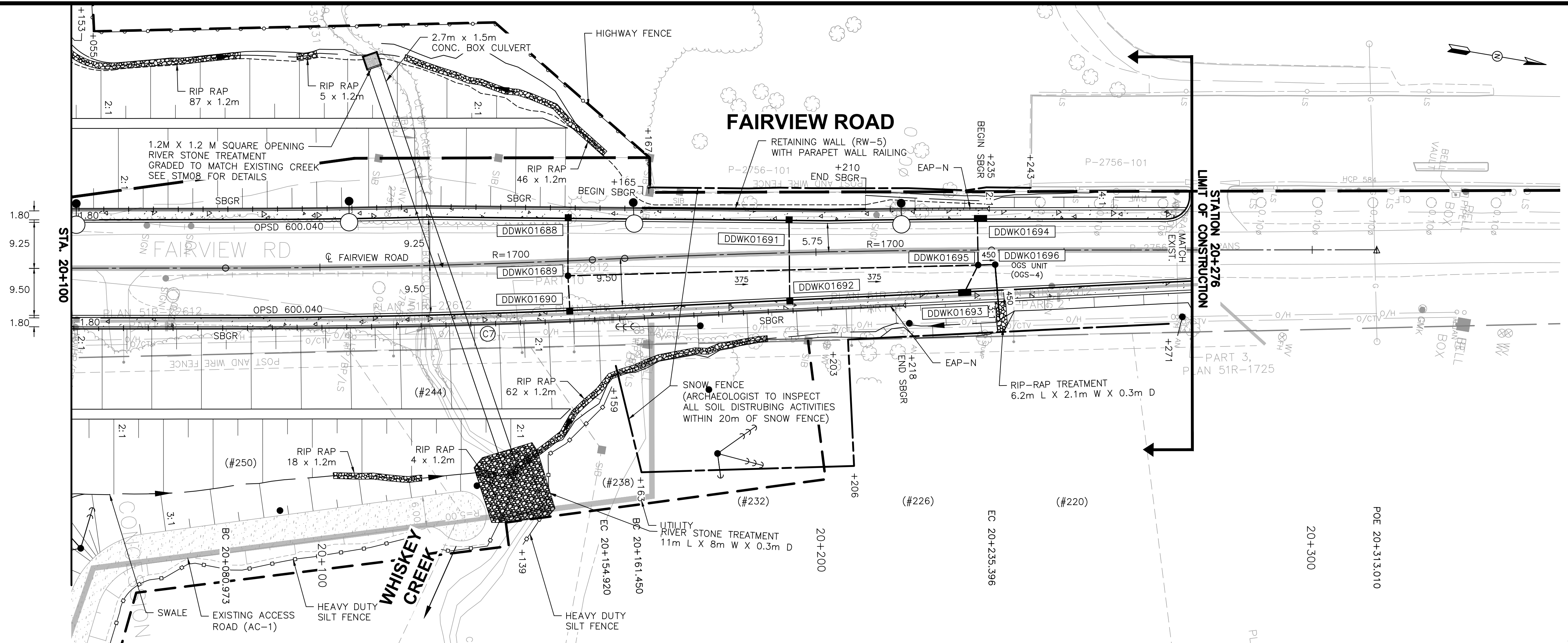
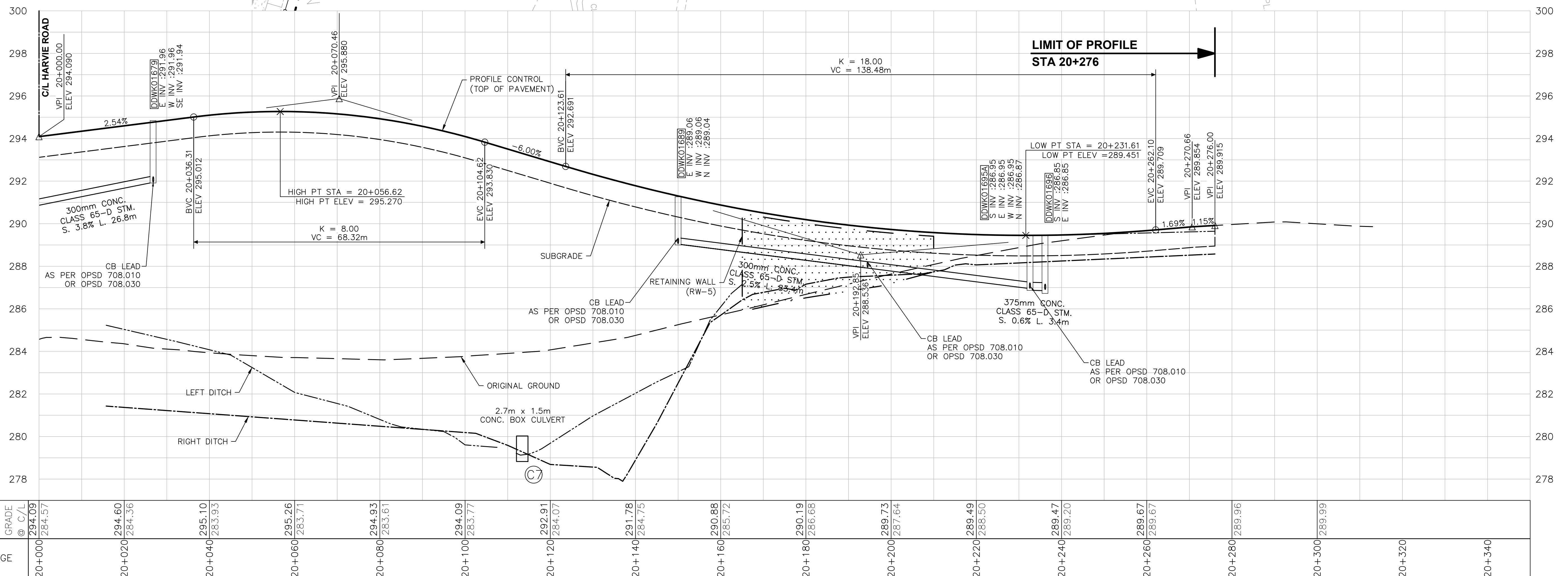
PLAN AND PROFILE (10 OF 13)
FAIRVIEW ROAD
STA. 20+050 TO STA. 20+276

Barrie

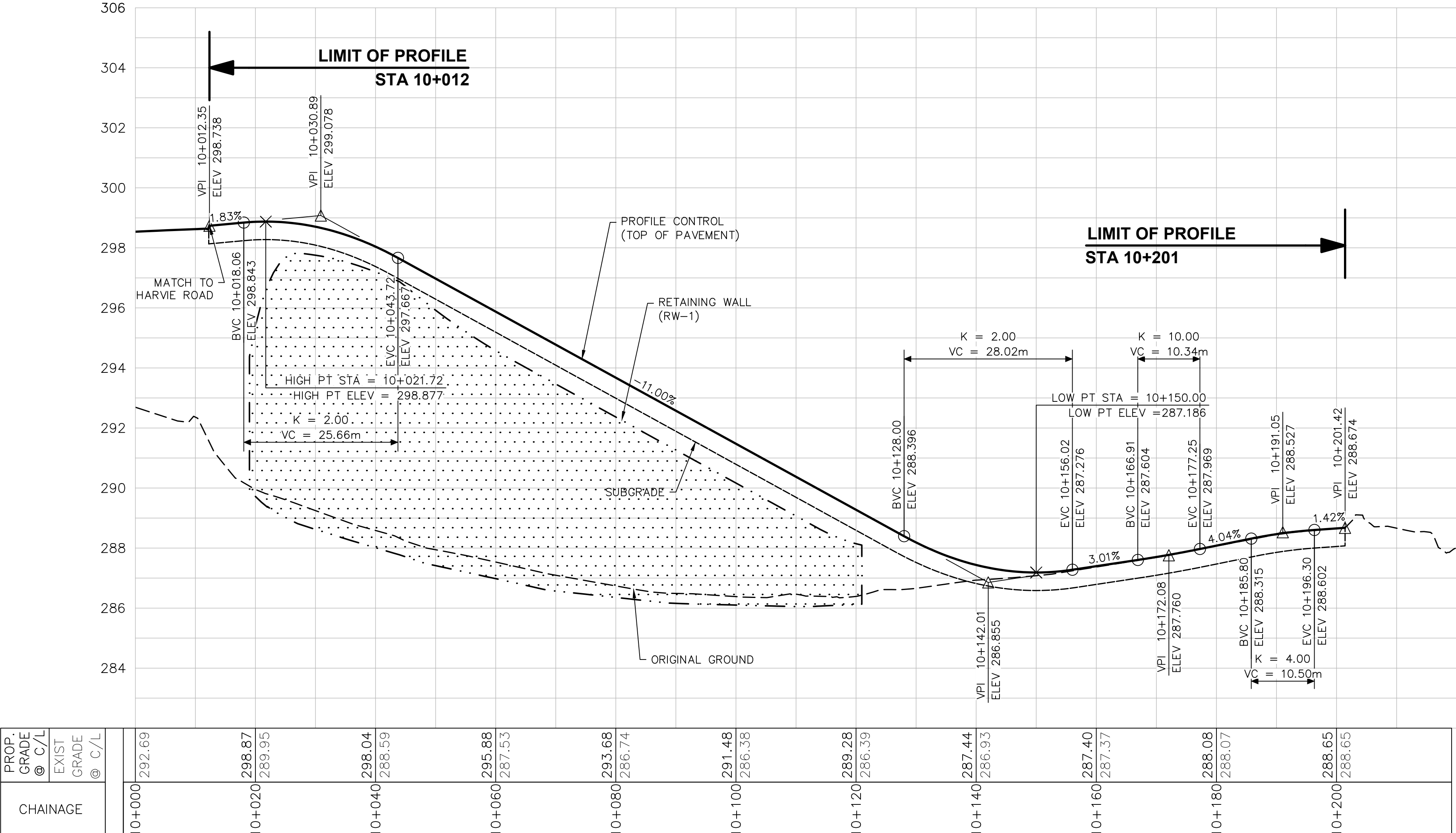
ENGINEERING DEPARTMENT

SCALE HOR.	1:500	VERT.	1:100	CONTRACT NO.	2018-002T
DESIGN	J.T.	DRAWN	D.L.	SHEET NO.	PP10
REVIEWED	S.M.	DATE	2018.09.06		

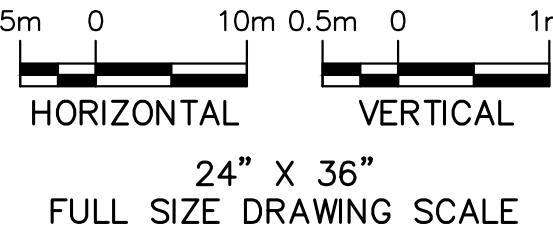
DOC: H351997-20-260-SEG1-0019-010



ACCESS ROAD (AC-2)



NO.	REVISIONS	DATE	APPROVED
0	ISSUED FOR CONSTRUCTION	2018.09.06	B.R.



HARVIE AND BIG BAY POINT ROAD NEW CROSSING – HIGHWAY 400

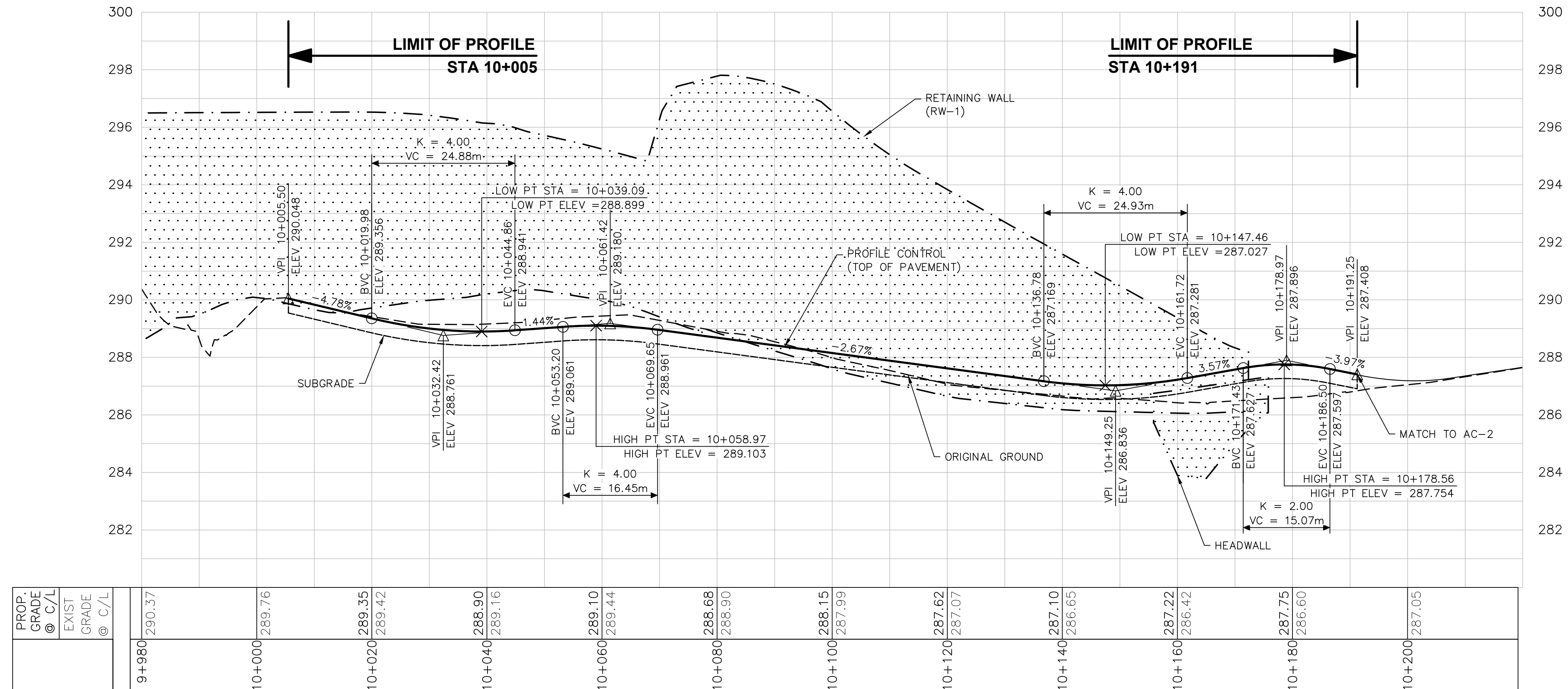
ENTRANCE AND ACCESS ROAD PROFILES
(3 OF 4)

ENGINEERING DEPARTMENT

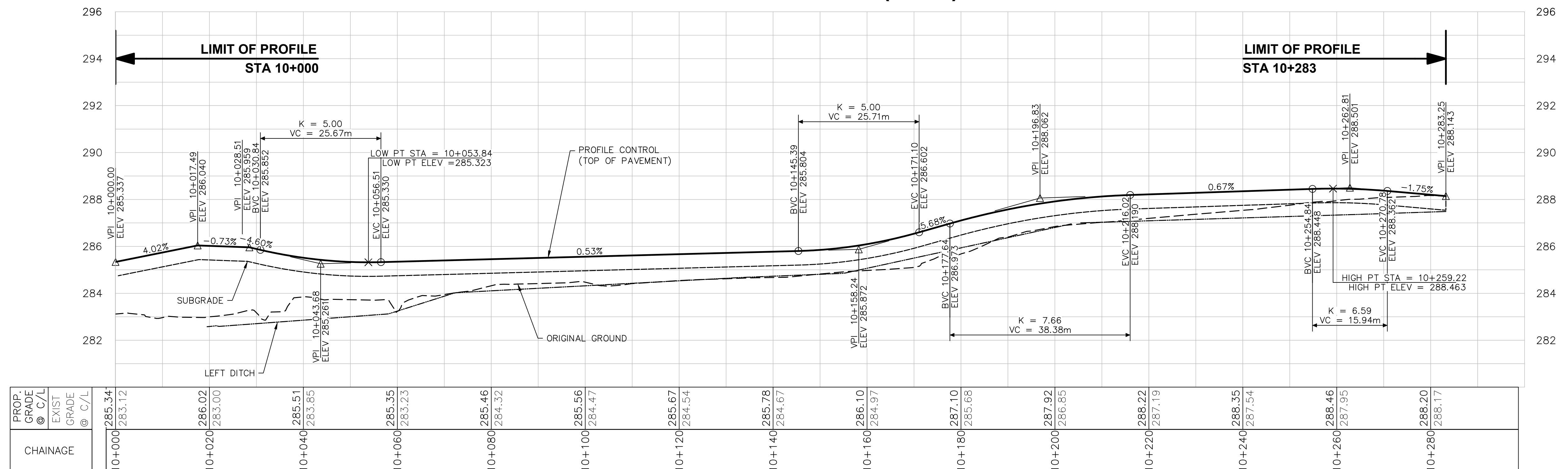
SCALE	HOR. 500	VERT.	50	CONTRACT NO. 2018-002T
DESIGN	J.T.	DRAWN	D.L.	
REVIEWED	S.M.	DATE	2018.09.06	
				SHEET NO. EP3

DOC: H351997-20-260-SEG1-0020-003

ACCESS ROAD (AC-3)

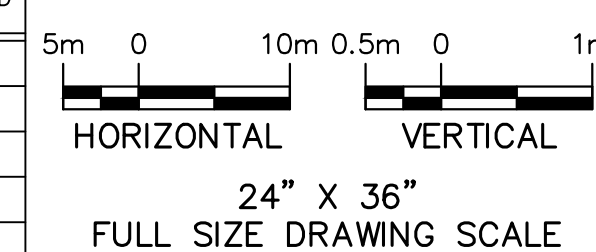


ACCESS ROAD (AC-4)



HATCH

NO.	REVISIONS	DATE	APPROVED
0	ISSUED FOR CONSTRUCTION	2018.09.06	B.R.



**HARVIE AND BIG BAY POINT ROAD
NEW CROSSING – HIGHWAY 400**

**ENTRANCE AND ACCESS ROAD PROFILES
(4 OF 4)**

Barrie

ENGINEERING DEPARTMENT

SCALE HOR.	500	VERT.	50	CONTRACT NO.	2018-002T
DESIGN	J.T.	DRAWN	D.L.	SHEET NO.	EP4
REVIEWED	S.M.	DATE	2018.09.06		

DOC: H351997-20-260-SEG1-0020-004



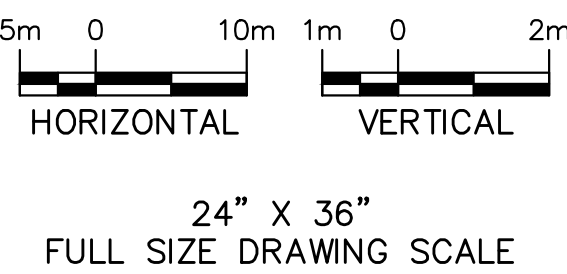
SUPPLEMENTAL LEGEND

- EXISTING CATCHMENT
- WHISKEY CREEK
- OVERLAND FLOW ARROW
- CATCHMENT IDENTIFIER
- FLOOD EXTENTS
- EXISTING CULVERT

DATE PLOTTED: 9/5/2018 4:53:50 PM
FILE LOCATION: C:\working\Hatch\3084\3084-0026.dwg



NO.	REVISIONS	DATE	APPROVED
0	ISSUED FOR CONSTRUCTION	2018.09.06	B.R.



HARVIE AND BIG BAY POINT ROAD
NEW CROSSING – HIGHWAY 400

DRAINAGE PLAN
HARVIE ROAD
EXISTING CATCHMENTS AREA



ENGINEERING DEPARTMENT

SCALE HOR.	1:5000	VERT.		CONTRACT NO.	2018-002T
DESIGN	D.J.	DRAWN	D.J.	SHEET NO.	STM1
REVIEWED	J.L.	DATE	2018.05.24		

DOC: H351997-70-260-SEG1-0026-001

DATE PLOTTED: 9/5/2018 5:30:05 PM
FILE LOCATION: C:\pwworking\hatch\3084\3084.dwg

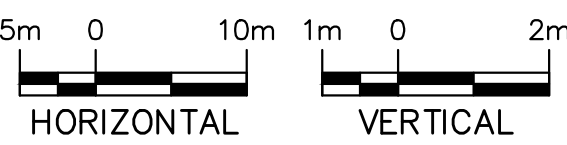


SUPPLEMENTAL LEGEND

- CATCHMENT
- WHISKEY CREEK
- OVERLAND FLOW ARROW
- CATCHMENT IDENTIFIER

HATCH

NO.	REVISIONS	DATE	APPROVED
0	ISSUED FOR CONSTRUCTION	2018.09.06	B.R.



24" X 36"
FULL SIZE DRAWING SCALE



HARVIE AND BIG BAY POINT ROAD
NEW CROSSING - HIGHWAY 400

DRAINAGE PLAN
HARVIE ROAD
POST DEVELOPMENT CATCHMENT AREAS

Barrie

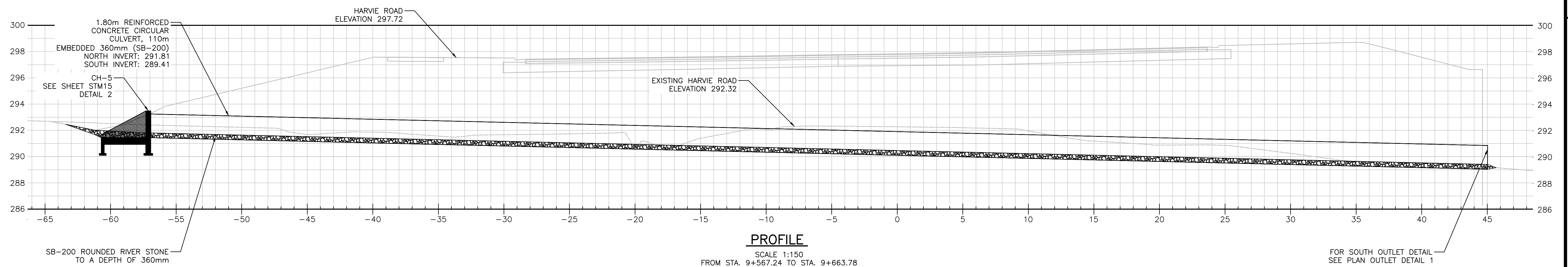
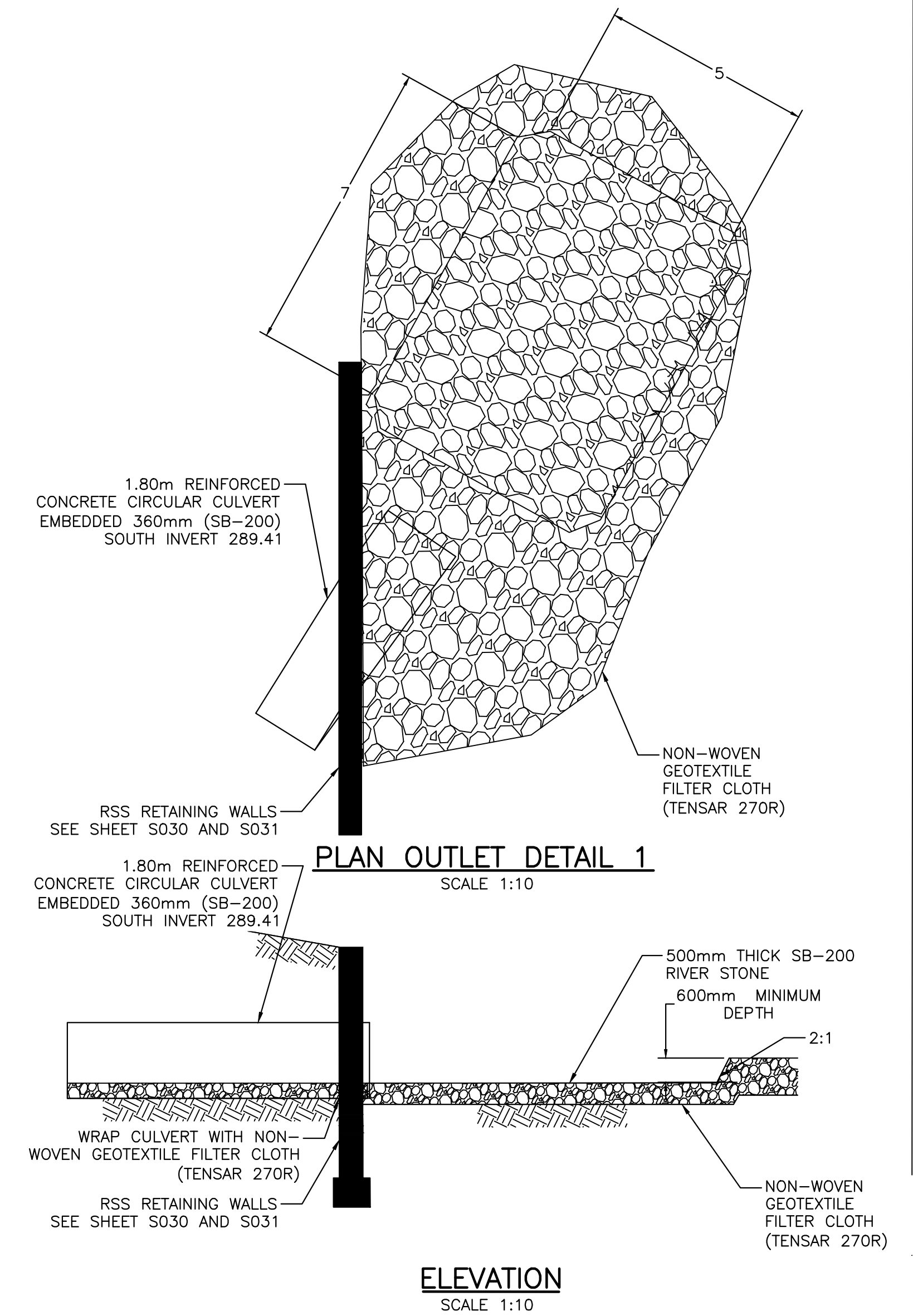
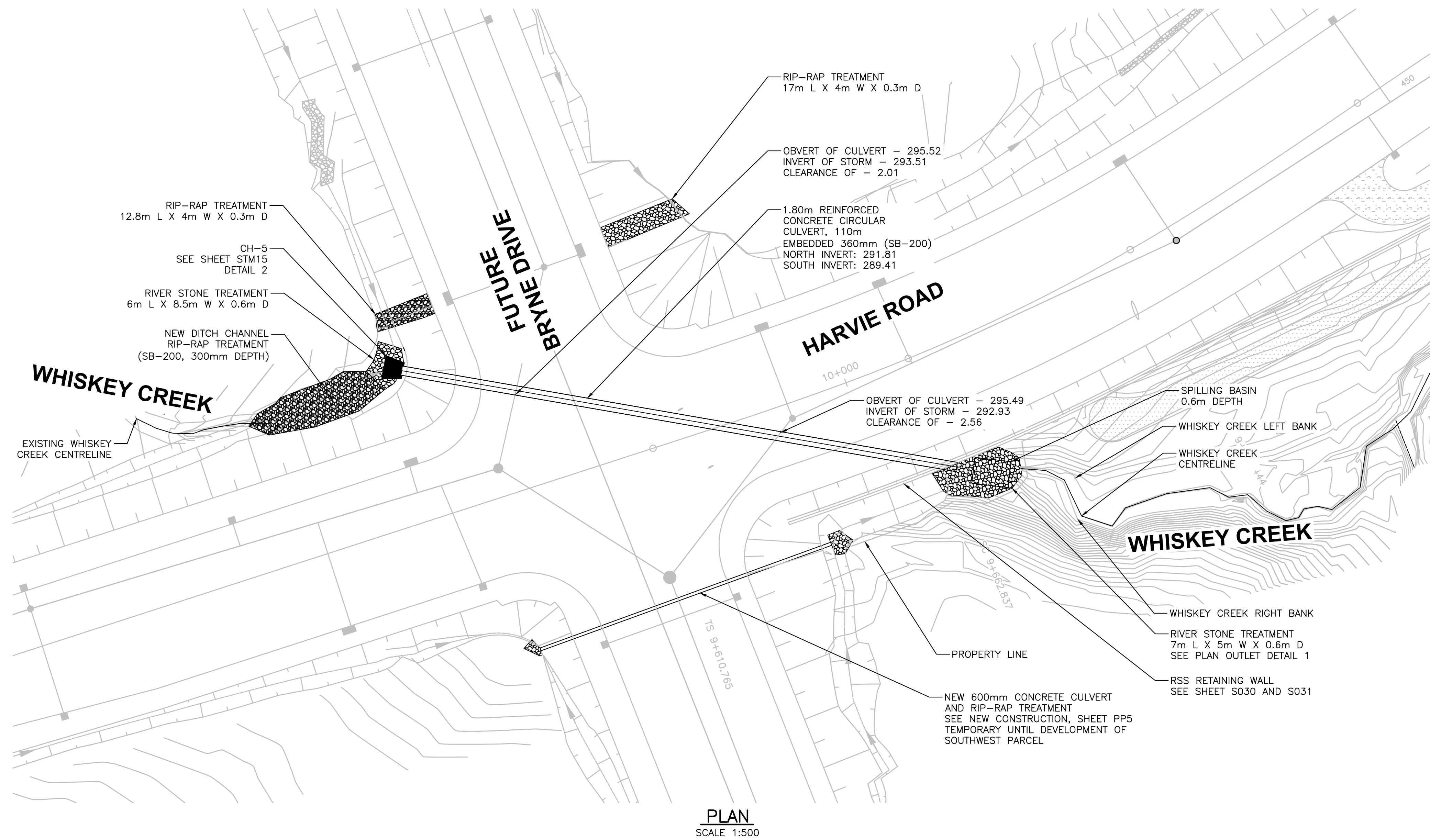
ENGINEERING DEPARTMENT

SCALE HOR: 1:5000	VERT. 1:5000	CONTRACT NO. 2018-002T
DESIGN D.J.	DRAWN D.J.	SHEET NO. STM2
REVIEWED J.L.	DATE 2018.05.24	

DOC: H351997-70-260-SEG1-0026-001

NOTE:

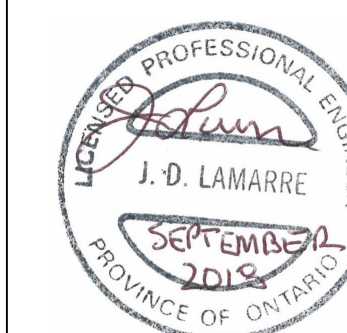
1. FOR GENERAL ENVIRONMENTAL NOTES, REFER TO DWG. No. STM 14.
2. CULVERT CROSSING DETAIL TO BE READ IN CONJUNCTION WITH POST DEVELOPMENT CATCHMENT PLAN (DWG. No. STM2).
3. RIP RAP/RIVER STONE TREATMENT DIMENSION, LENGTH (L) X WIDTH (W) X DEPTH (D)
4. ALL RIP RAP TREATMENT AND RIVER STONE SHALL BE ROUNDED GRANITE FIELDSTONE.



HATCH

NO.	REVISIONS	DATE	APPROVED
0	ISSUED FOR CONSTRUCTION	2018.09.06	B.R.

NOT TO SCALE



**HARVIE AND BIG BAY POINT ROAD
NEW CROSSING - HIGHWAY 400**

WHISKEY CREEK DETAIL DESIGN
HARVIE/BIG BAY POINT ROAD
HARVIE AND BRYNE CULVERT CROSSING

Barrie

ENGINEERING DEPARTMENT

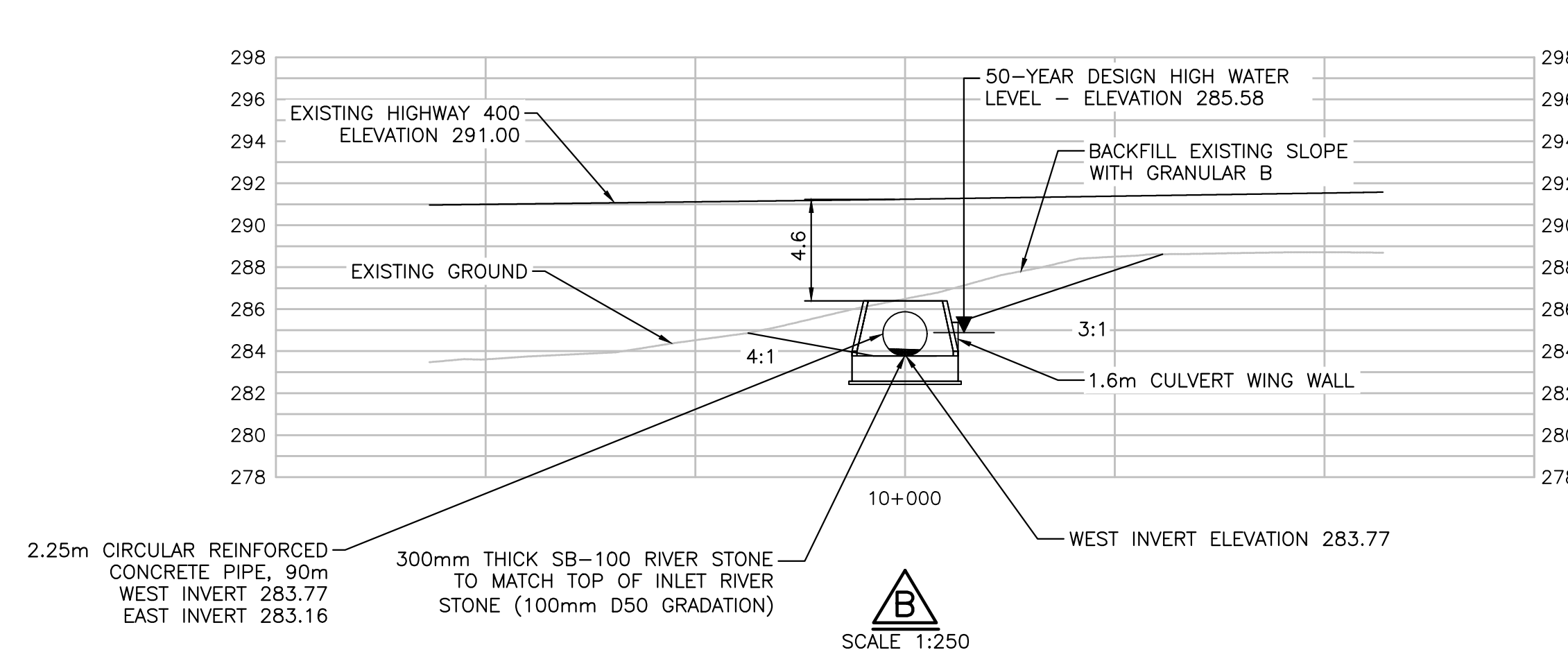
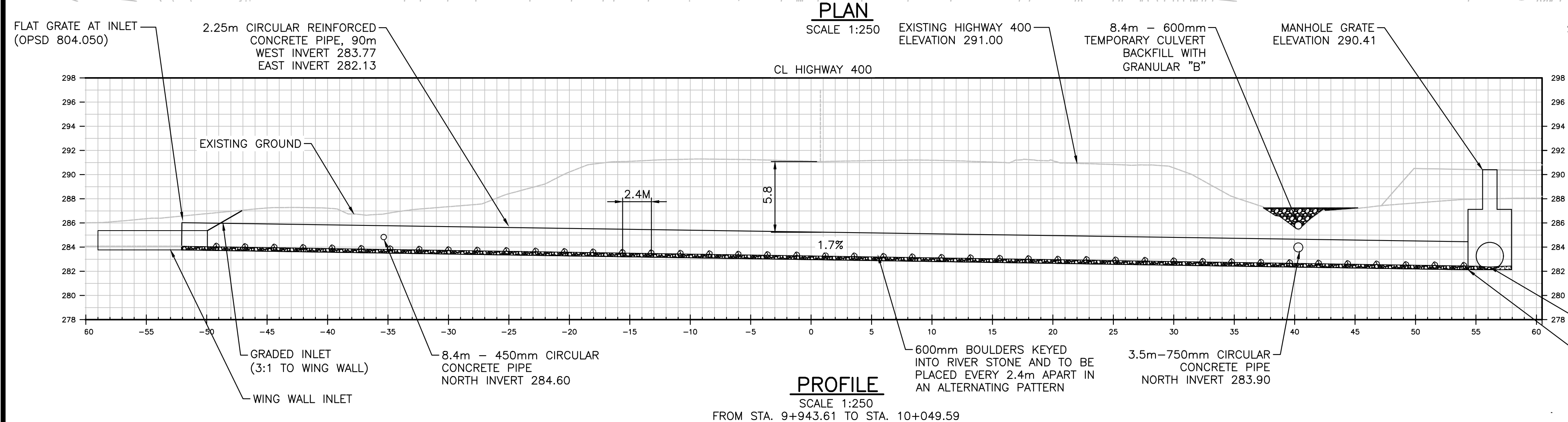
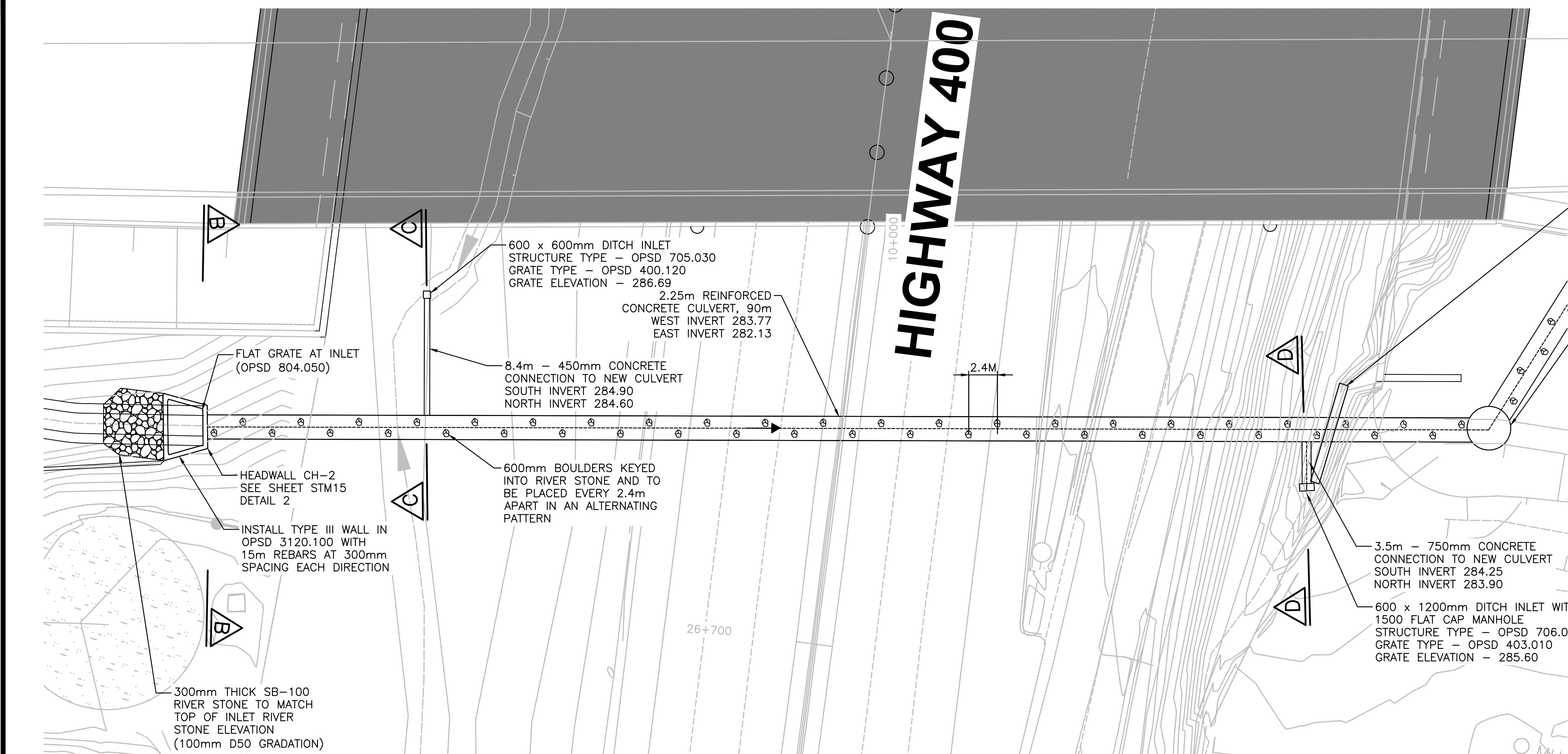
SCALE	HOR. 1:250	VERT.	CONTRACT NO. 2018-002T
DESIGN	D.J.	DRAWN	D.J.
REVIEWED	J.L.	DATE	2018.06.29
SHEET NO.	STM3		

DOC: H351997-70-260-SEG1-0021 REV-001

DATE PLOTTED: 9/5/2018 1:39:20 PM
FILE LOCATION: C:\working\h351997-70-260-SEG1-0021 Rev.dwg

NOTE:

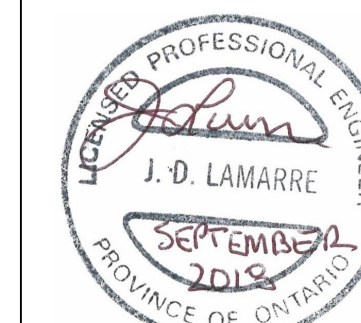
- FOR GENERAL ENVIRONMENTAL NOTES, PLEASE REFER TO DWG. No. STM 14
- CULVERT CROSSING DETAIL TO BE READ IN CONJUNCTION WITH POST DEVELOPMENT CATCHMENT PLAN (DWG. No. STM2).
- ALL RIP RAP TREATMENT, RIVER STONE AND BOULDERS SHALL BE ROUNDED GRANITE FIELDSTONE.



HATCH

NO.	REVISIONS	DATE	APPROVED
0	ISSUED FOR CONSTRUCTION	2018.09.06	B.R.

NOT TO SCALE



**HARVIE AND BIG BAY POINT ROAD
NEW CROSSING - HIGHWAY 400**

WHISKEY CREEK CULVERT DETAIL
HARVIE/BIG BAY POINT ROAD
HIGHWAY 400 CULVERT CROSSING (1 of 2)

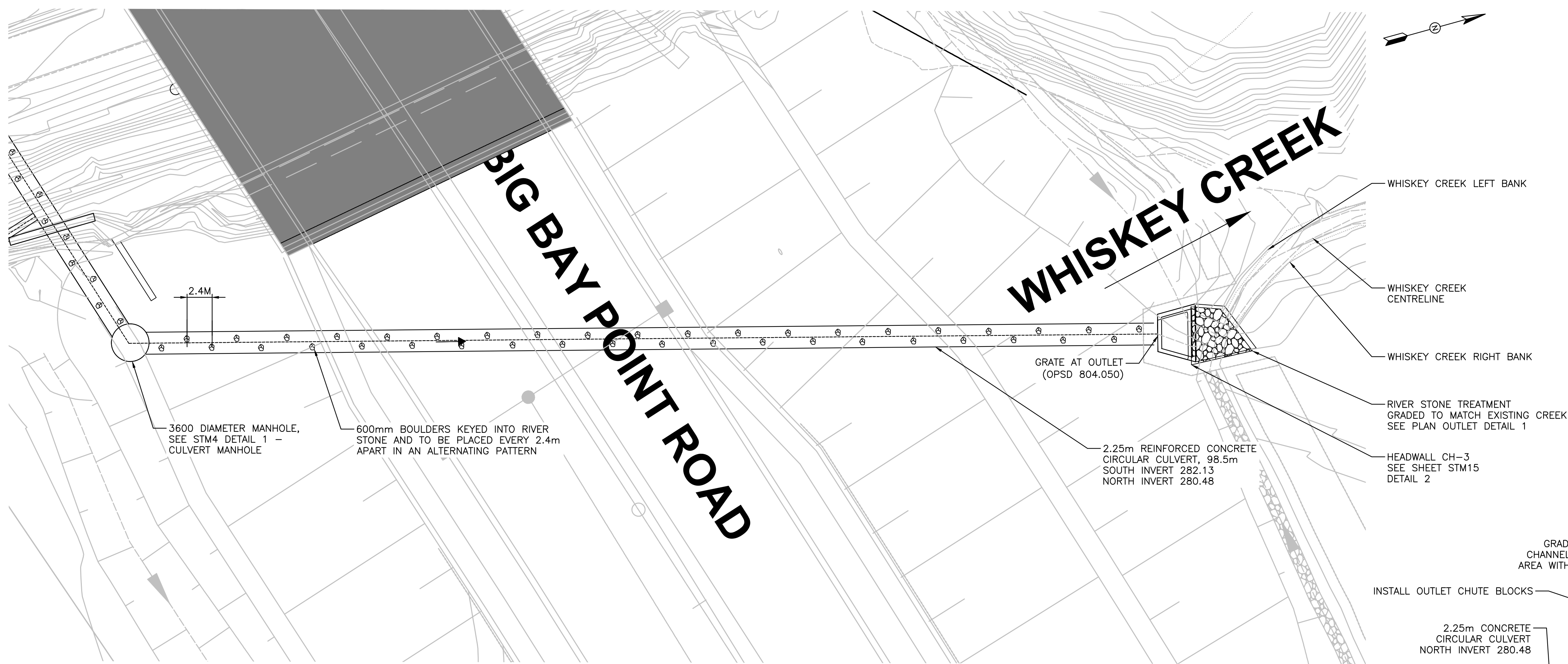
Barrie

ENGINEERING DEPARTMENT

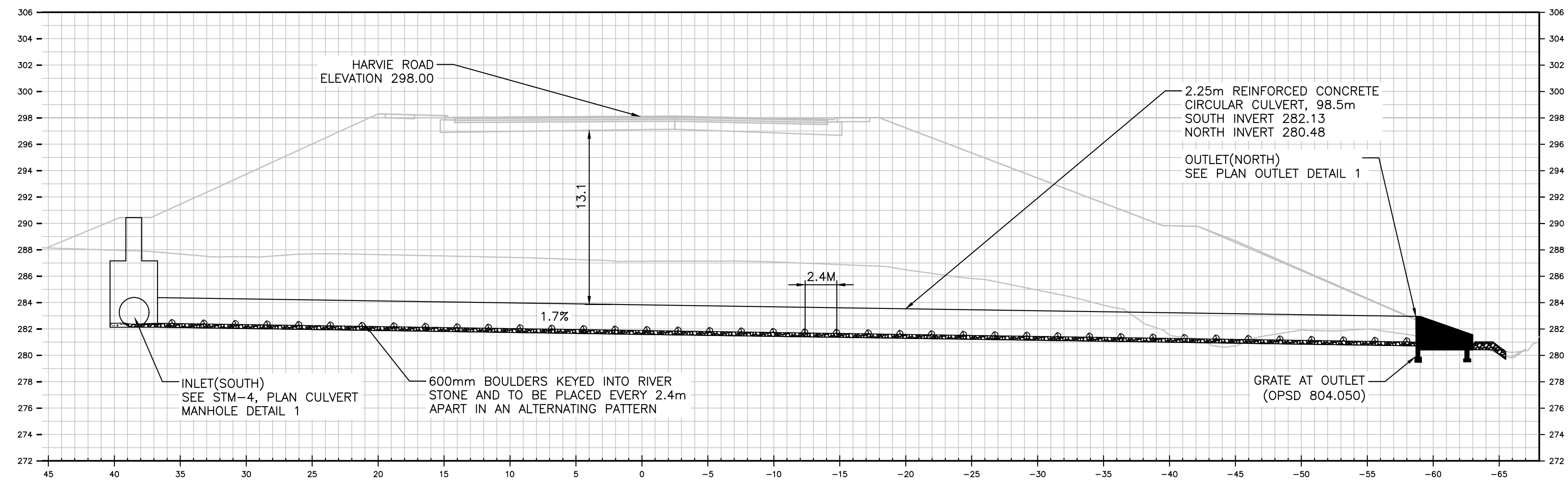
SCALE	HOR. 1:250	VERT.		CONTRACT NO.	2018-002T
DESIGN	D.J.	DRAWN	D.J.	SHEET NO.	STM4
REVIEWED	J.L.	DATE	2018.07.13		

DOC: H351997-70-260-SEG1-0021 REV-002

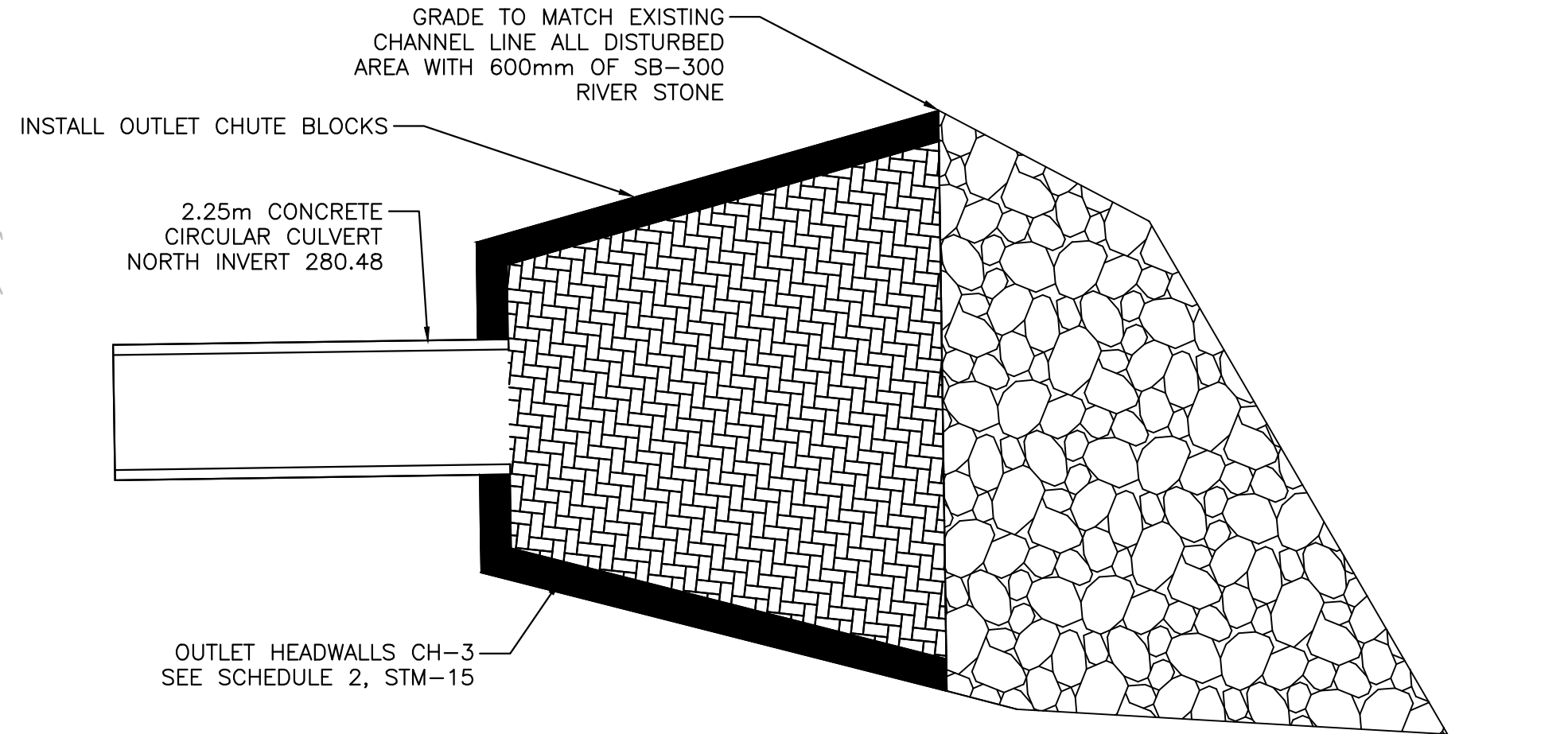
- NOTE:
1. FOR GENERAL ENVIRONMENTAL NOTES, PLEASE REFER TO DWG. No. STM 14.
 2. CULVERT CROSSING DETAIL TO BE READ IN CONJUNCTION WITH POST DEVELOPMENT CATCHMENT PLAN (DWG. No. STM2).
 3. ALL RIP RAP TREATMENT, RIVER STONE AND BOULDERS SHALL BE ROUNDED GRANITE FIELDSTONE.



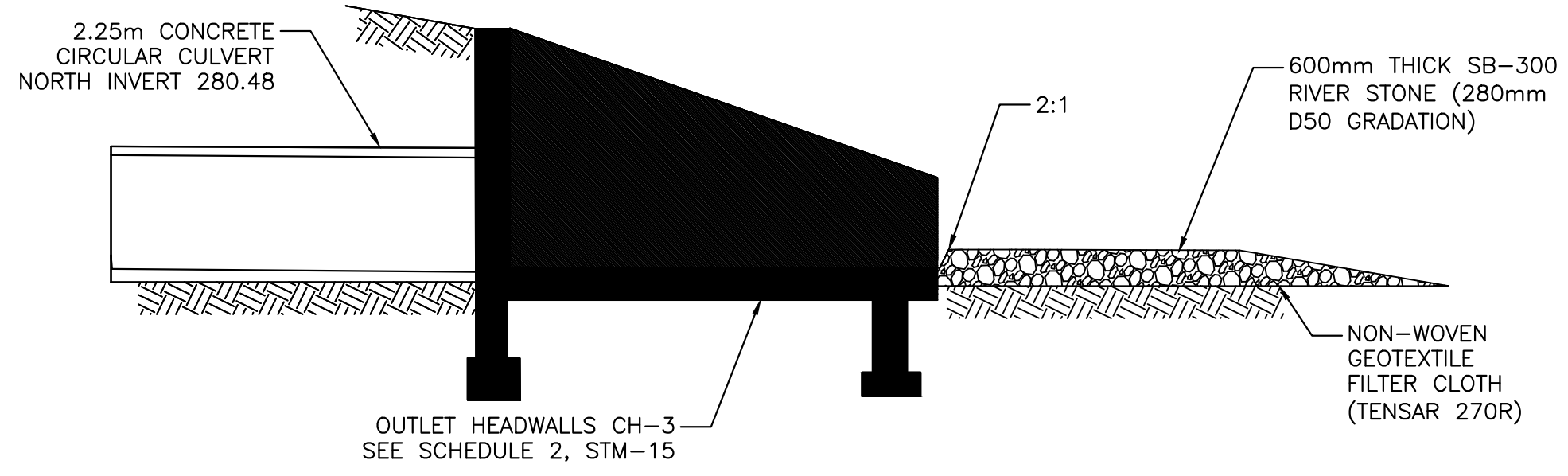
PLAN
SCALE 1:250



PROFILE
SCALE 1:250
FROM STA. 10+049.59 TO STA. 10+080.18



PLAN - OUTLET DETAIL 1
SCALE 1:10



ELEVATION
SCALE 1:10

HATCH

NO.	REVISIONS	DATE	APPROVED
0	ISSUED FOR CONSTRUCTION	2018.09.06	B.R.

NOT TO SCALE



HARVIE AND BIG BAY POINT ROAD
NEW CROSSING - HIGHWAY 400

WHISKEY CREEK CULVERT DETAIL
HARVIE/BIG BAY POINT ROAD
HIGHWAY 400 CULVERT CROSSING (2 OF 2)

Barrie

ENGINEERING DEPARTMENT

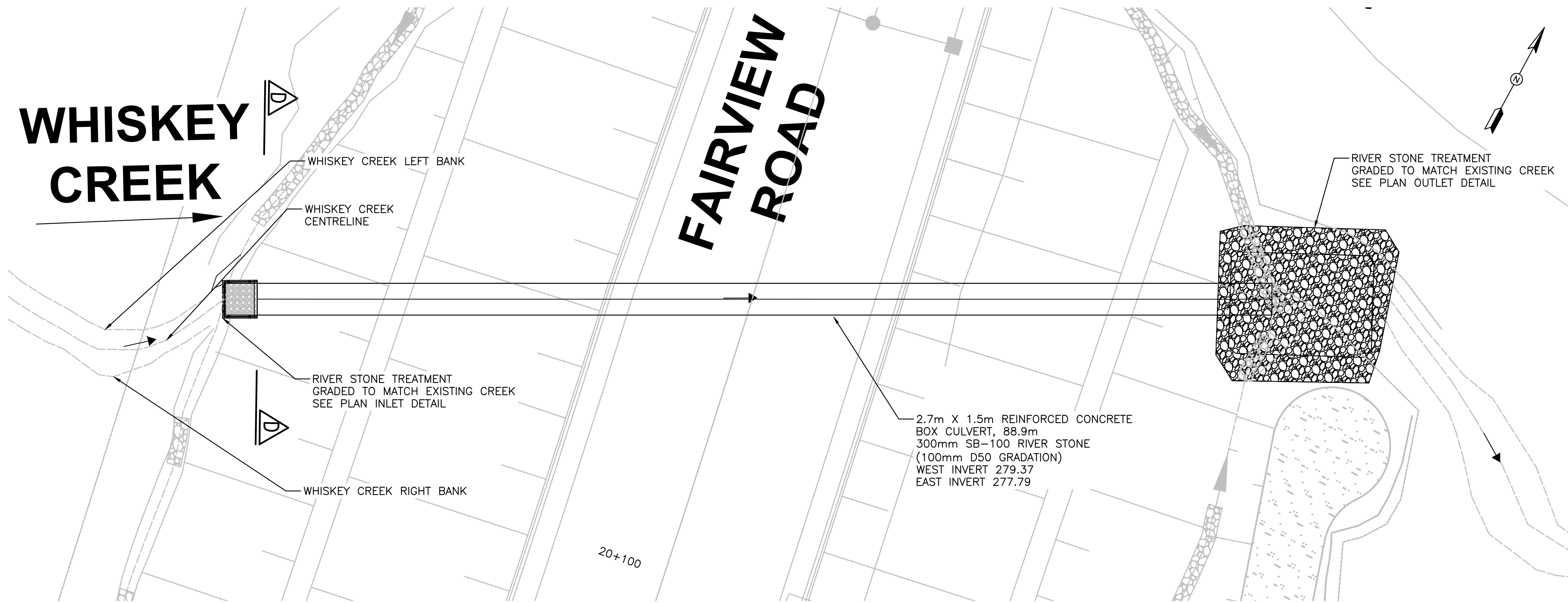
SCALE	HOR.	1:250	VERT.	
DESIGN	D.J.	DRAWN	D.J.	
REVIEWED	J.L.	DATE	2018.07.13	

CONTRACT NO.	2018-002T
SHEET NO.	STM5

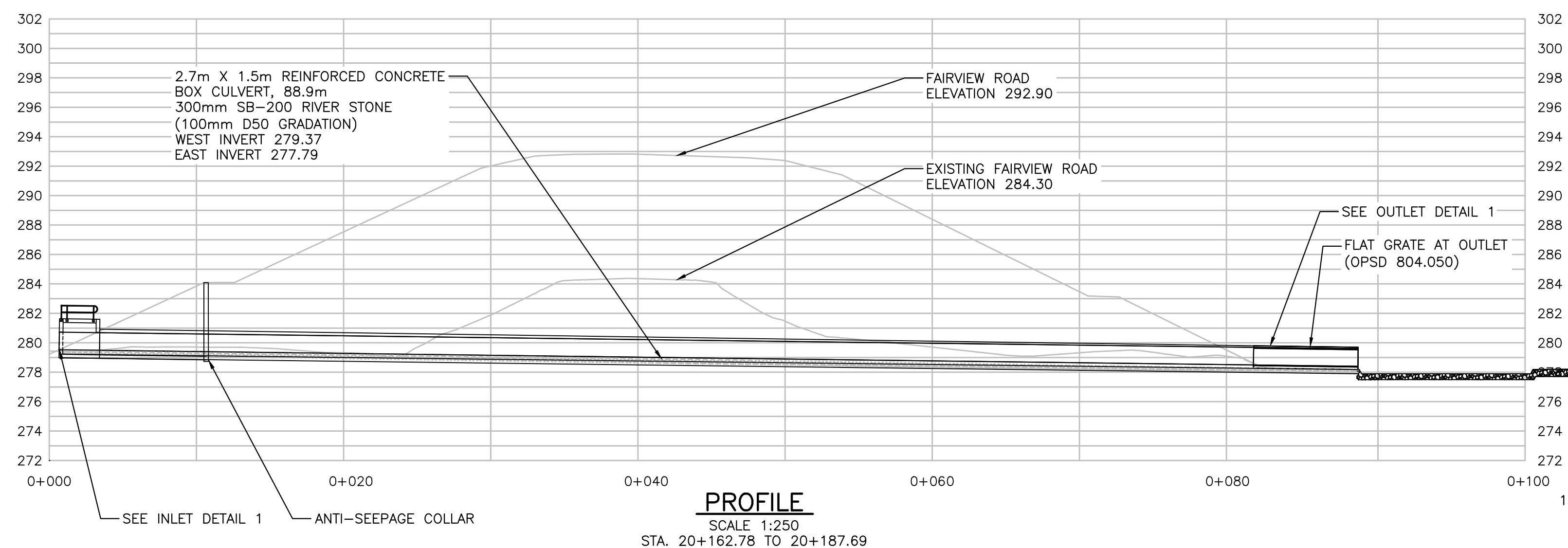
DOC: H351997-70-260-SEG1-0021 REV-002

WHISKEY CREEK

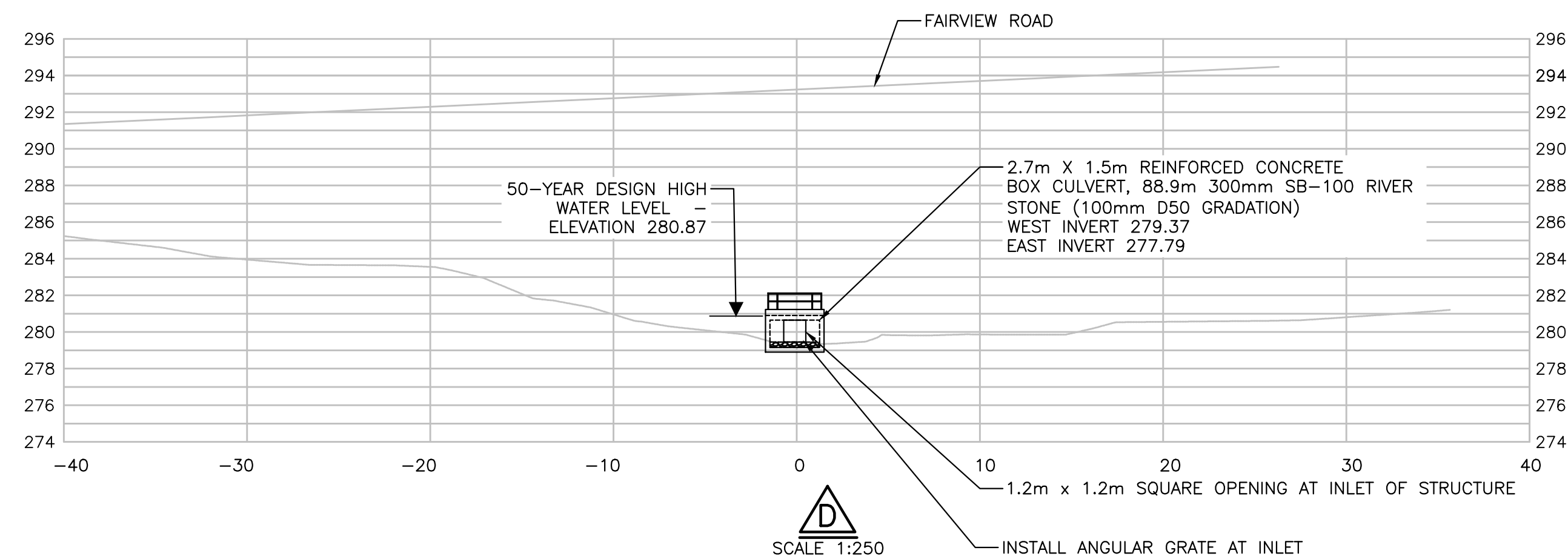
FAIRVIEW ROAD



PLAN
SCALE 1:250



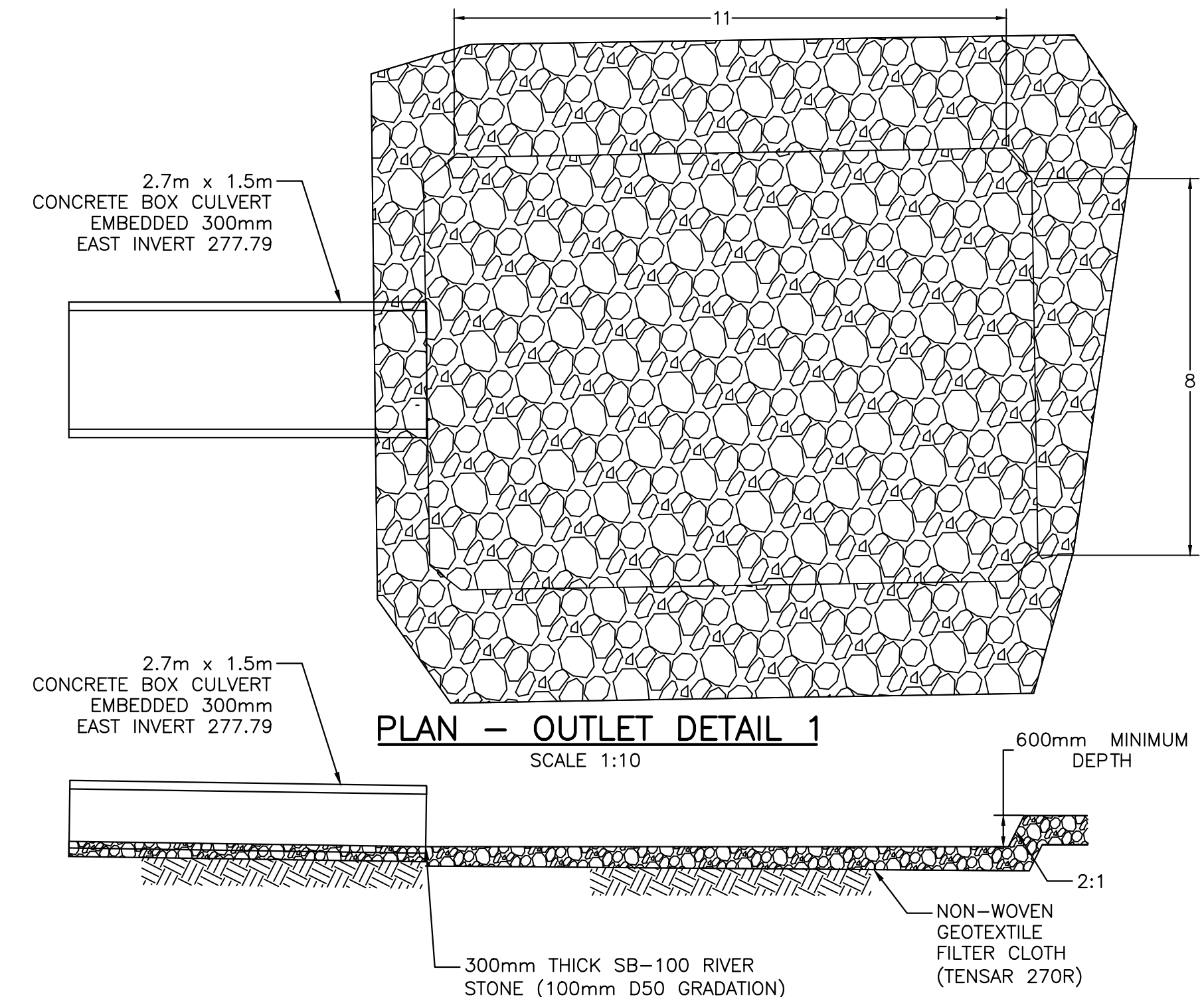
PROFILE
SCALE 1:250



SCALE 1:250

NOTE:

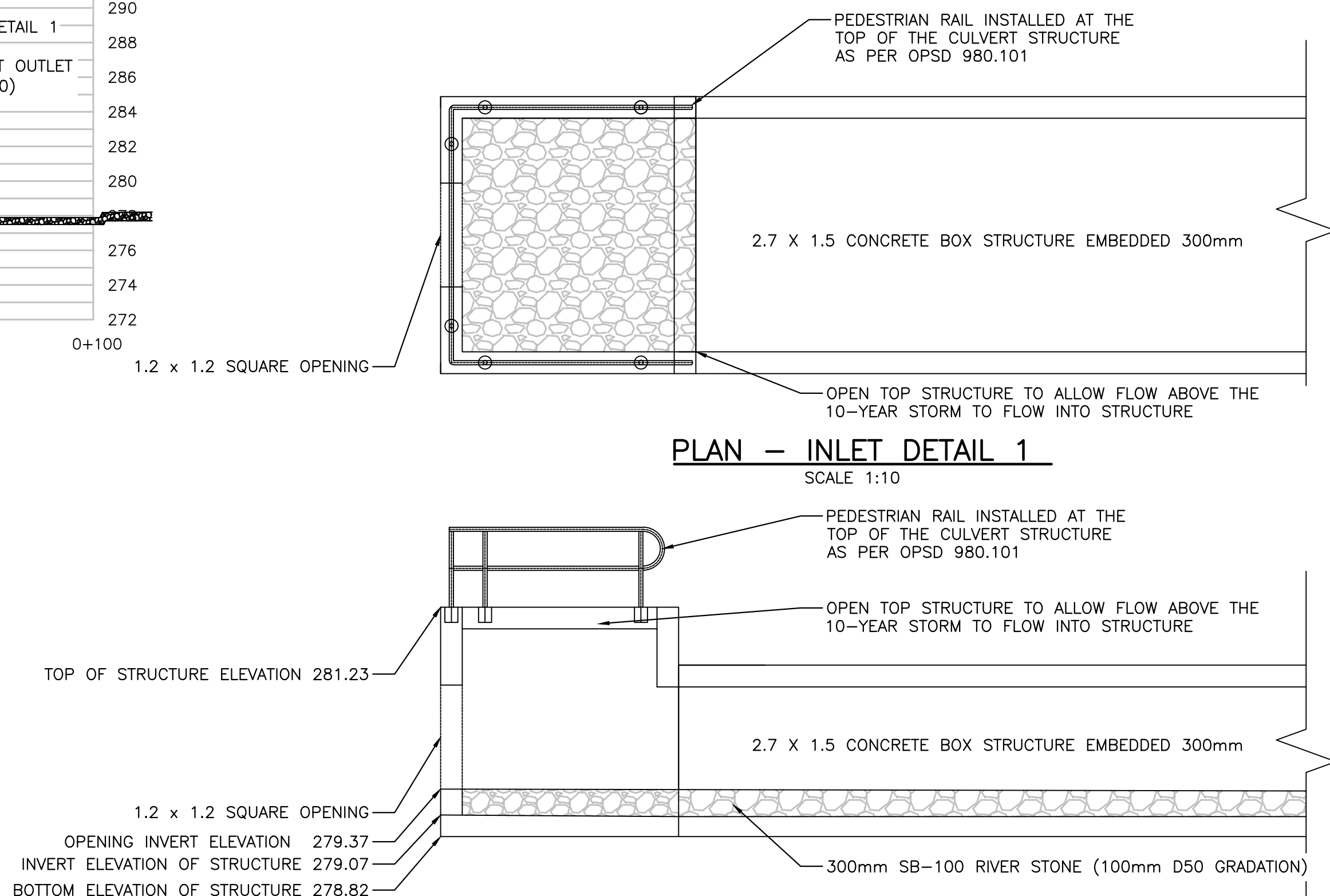
1. FOR GENERAL ENVIRONMENTAL NOTES, PLEASE REFER TO DWG. No. STM 14
2. CULVERT CROSSING DETAIL TO BE READ IN CONJUNCTION WITH POST DEVELOPMENT CATCHMENT PLAN (DWG. No. STM2).
3. ALL RIP RAP TREATMENT AND RIVER STONE SHALL BE ROUNDED GRANITE FIELDSTONE.



PLAN - OUTLET DETAIL 1
SCALE 1:10

ELEVATION

SCALE 1:10



PLAN - INLET DETAIL 1
SCALE 1:10

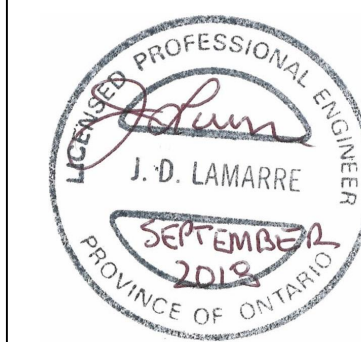
ELEVATION

SCALE 1:10

HATCH

NO.	REVISIONS	DATE	APPROVED
0	ISSUED FOR CONSTRUCTION	2018.06.06	B.R.

NOT TO SCALE



HARVIE AND BIG BAY POINT ROAD
NEW CROSSING - HIGHWAY 400

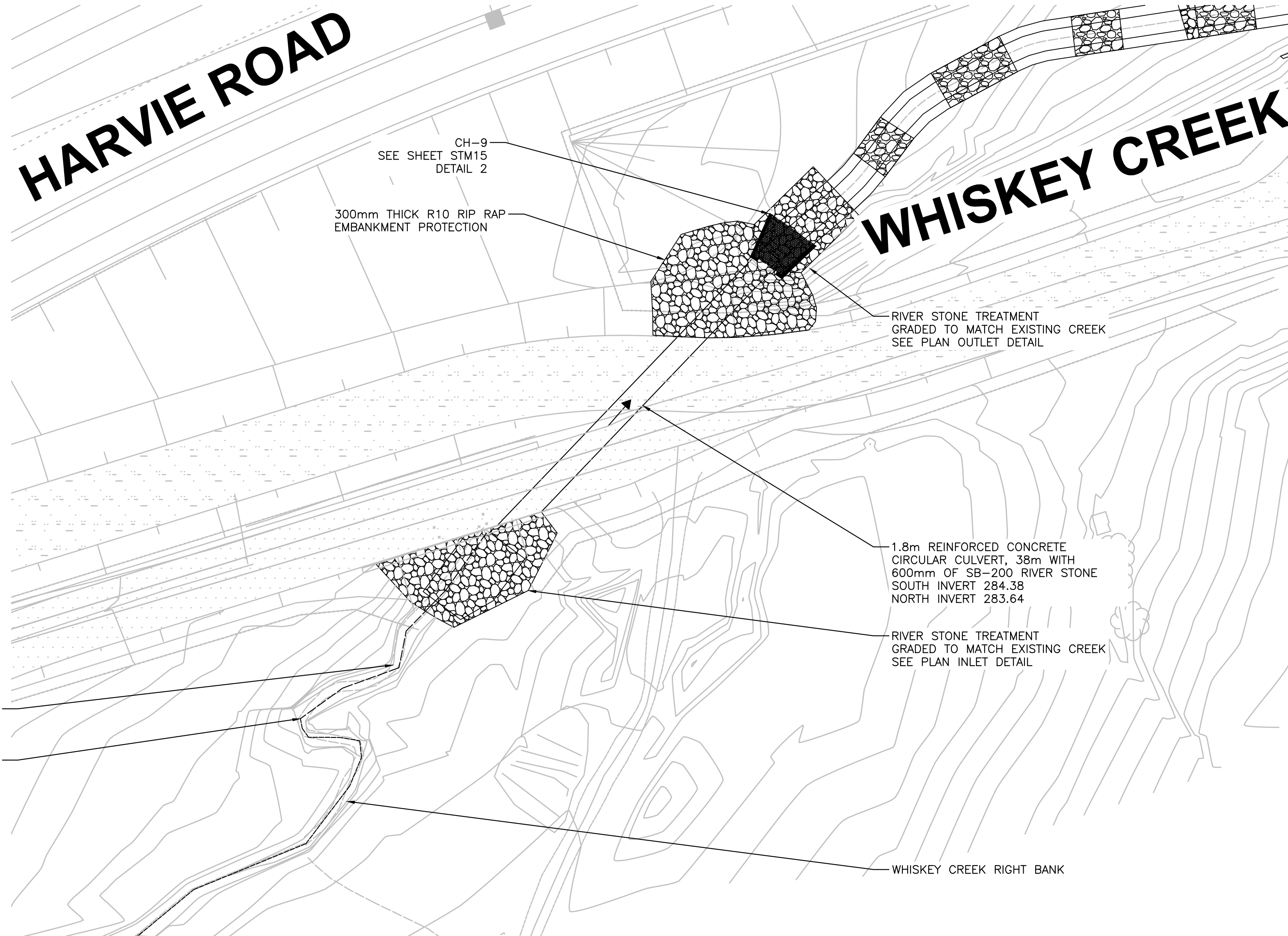
WHISKEY CREEK CULVERT DETAIL
HARVIE/BIG BAY POINT ROAD
FAIRVIEW ROAD CULVERT CROSSING

Barrie

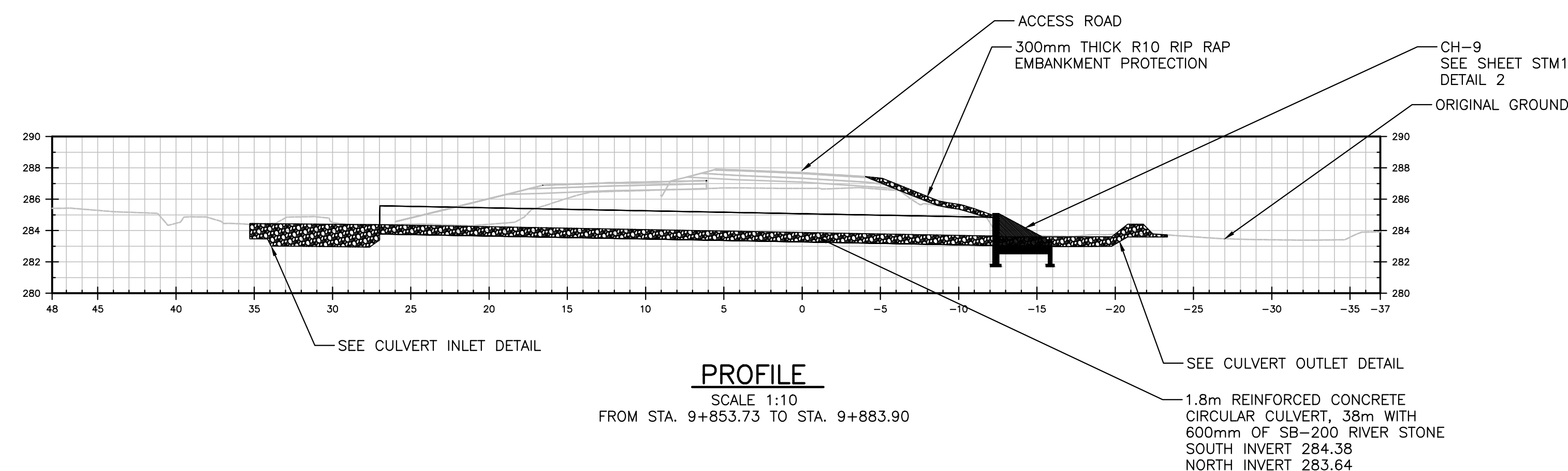
ENGINEERING DEPARTMENT

SCALE	HOR. 1:250	VERT.		CONTRACT NO.	2018-002T
DESIGN	D.J.	DRAWN	D.J.	SHEET NO.	STM7
REVIEWED	J.L.	DATE	2018.06.29		

DOC: H351997-70-260-SEG1-0021 REV-001



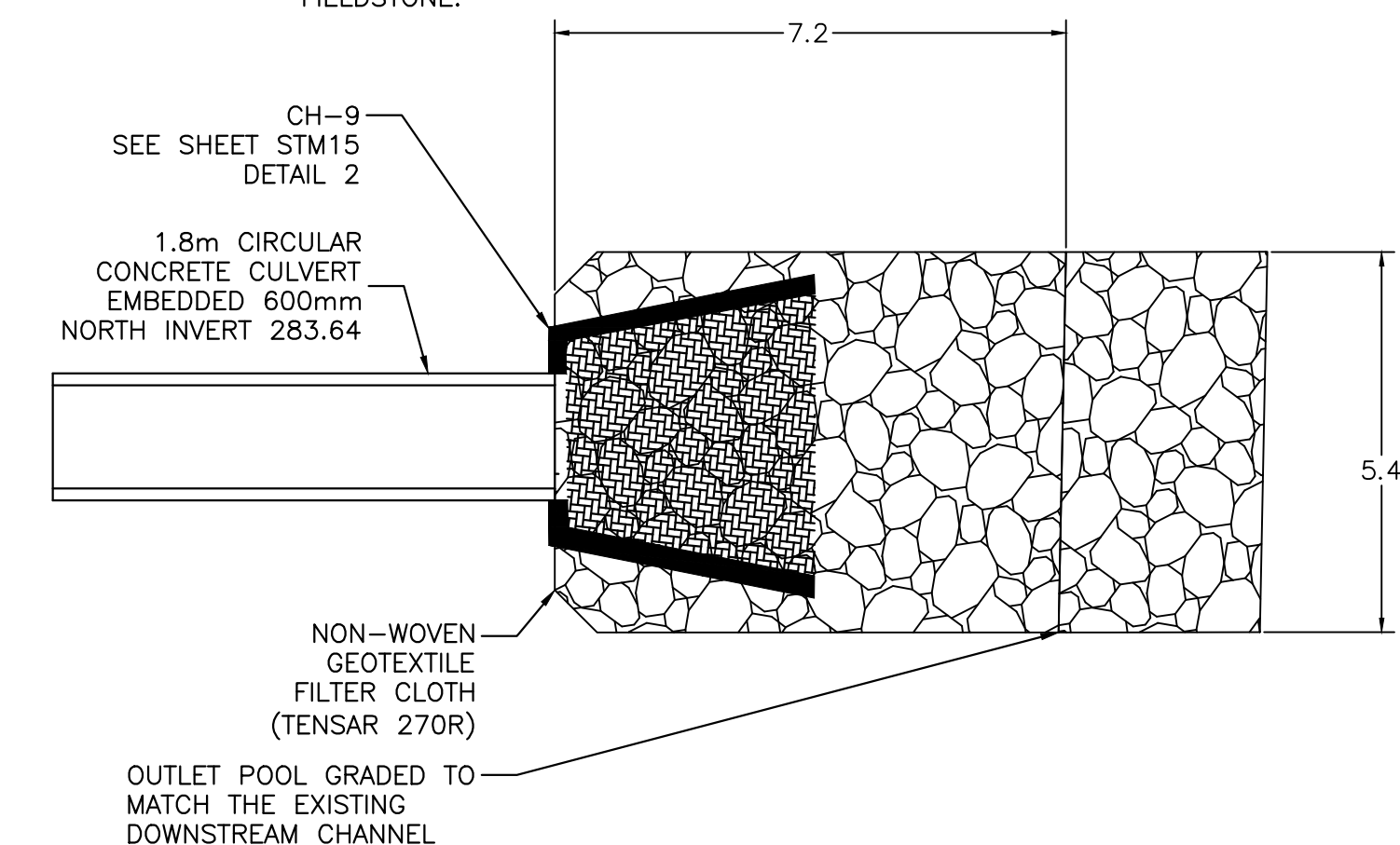
PLAN
SCALE 1:250



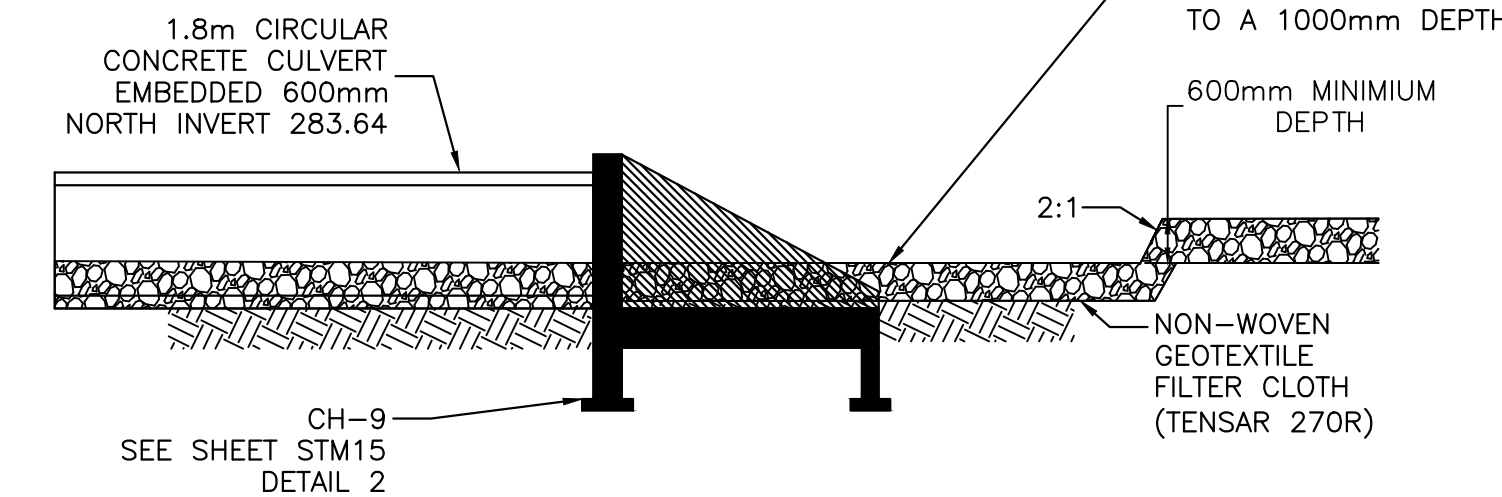
PROFILE
SCALE 1:10
FROM STA. 9+853.73 TO STA. 9+883.90

NOTE:

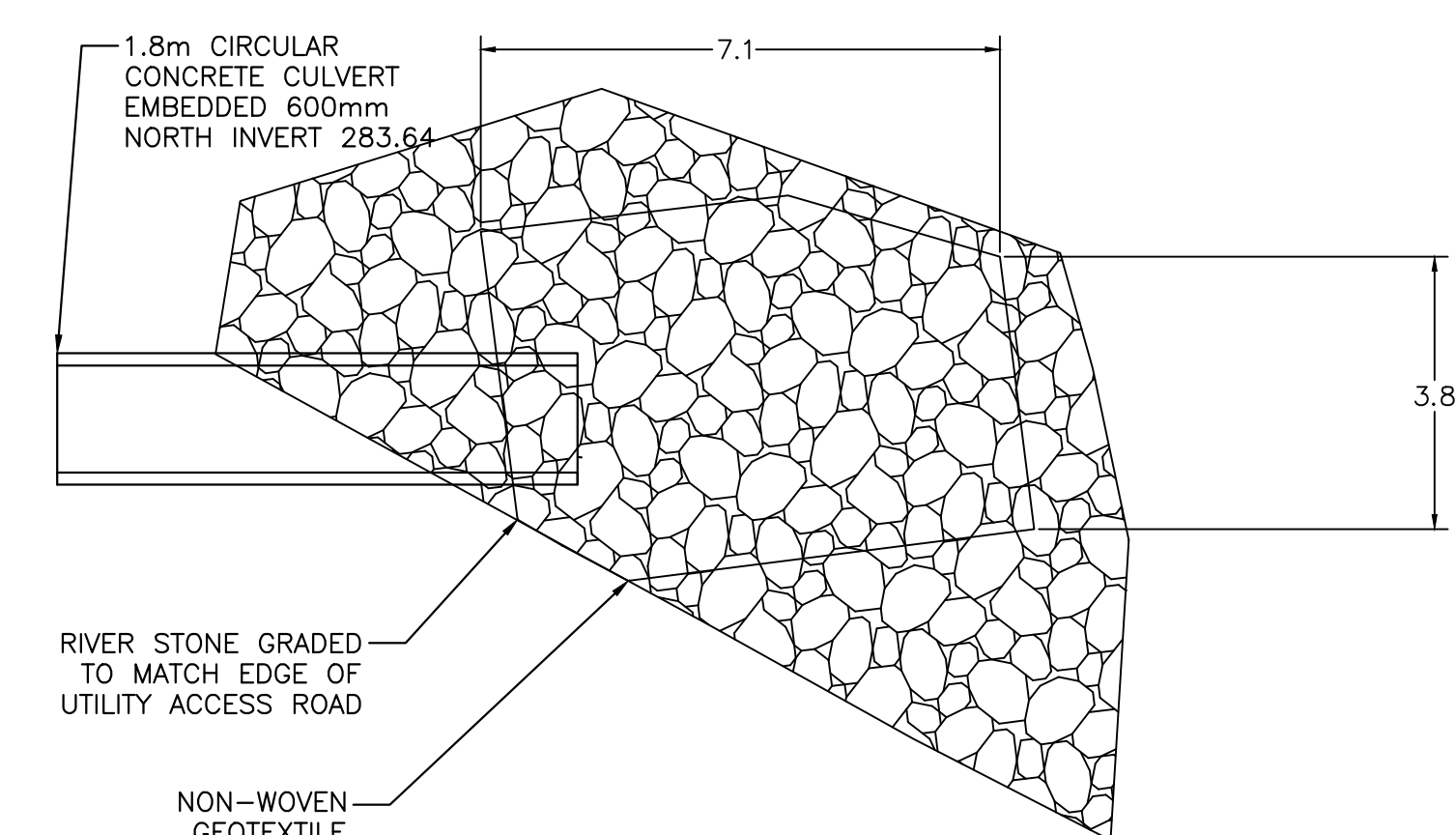
1. FOR GENERAL ENVIRONMENTAL NOTES, PLEASE REFER TO DWG. No. STM 14.
2. CULVERT CROSSING DETAIL TO BE READ IN CONJUNCTION WITH POST DEVELOPMENT CATCHMENT PLAN (DWG. No. STM2).
3. ALL RIP RAP TREATMENT AND RIVER STONE SHALL BE ROUNDED GRANITE FIELDSTONE.



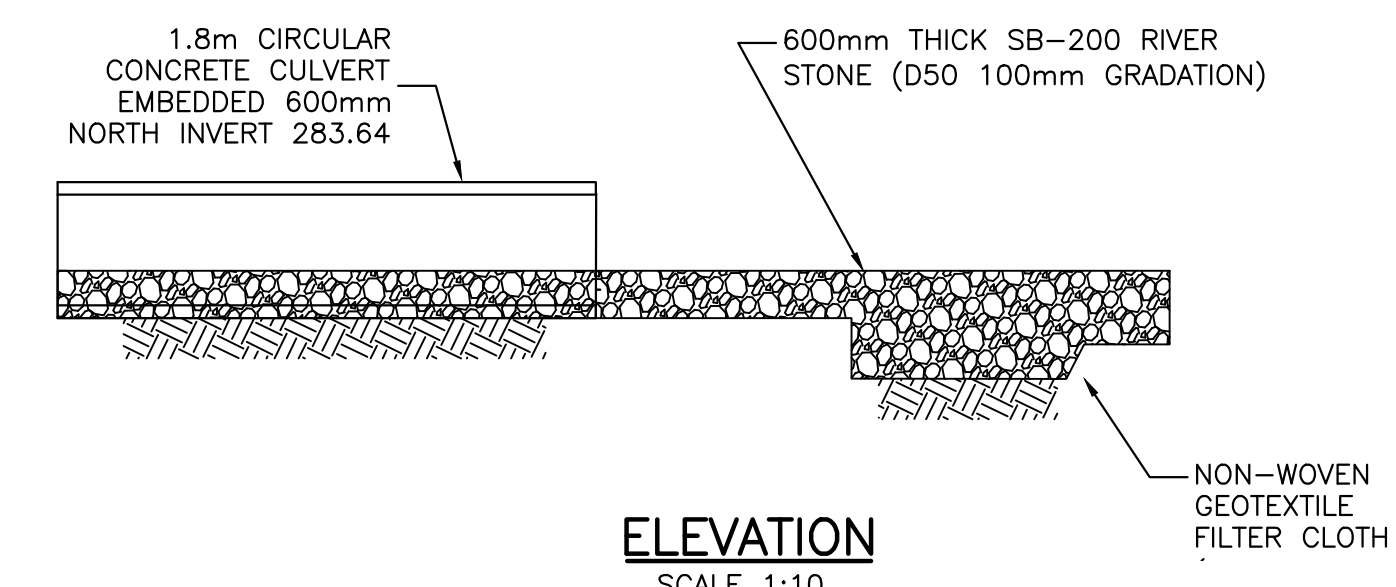
PLAN - CULVERT OUTLET
SCALE 1:10



ELEVATION
SCALE 1:10



PLAN - CULVERT INLET
SCALE 1:10

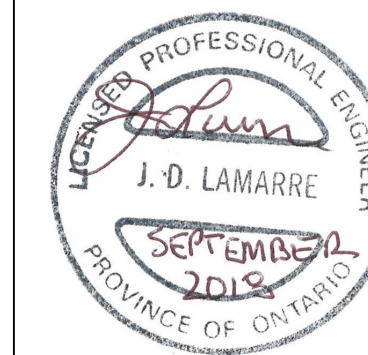


ELEVATION
SCALE 1:10

HATCH

NO.	REVISIONS	DATE	APPROVED
0	ISSUED FOR CONSTRUCTION	2018.09.06	B.R.

NOT TO SCALE



HARVIE AND BIG BAY POINT ROAD
NEW CROSSING - HIGHWAY 400

WHISKEY CREEK CULVERT DETAIL
HARVIE/BIG BAY POINT ROAD
ACCESS ROAD CULVERT CROSSING

Barrie

ENGINEERING DEPARTMENT

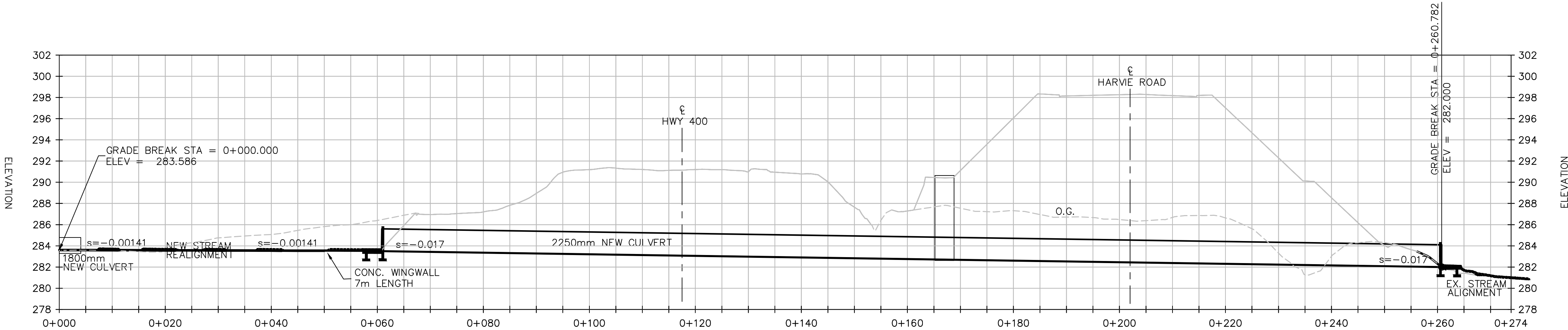
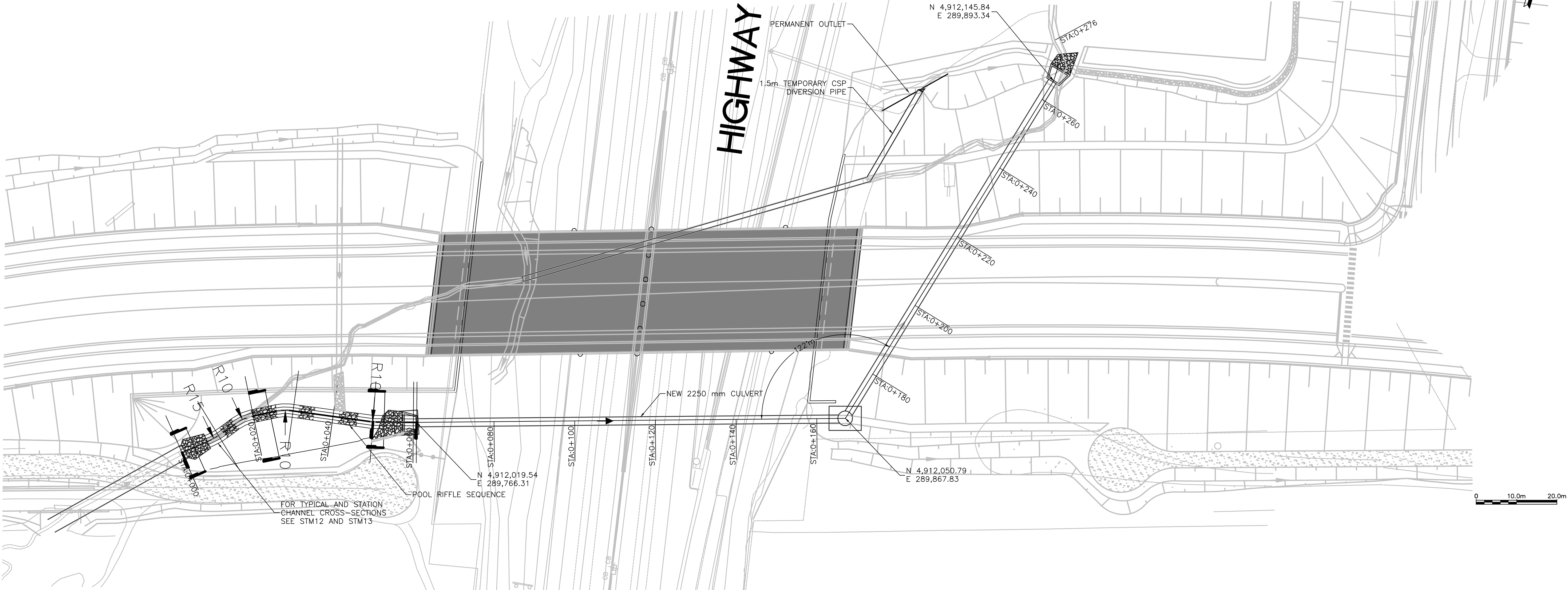
SCALE	HOR. 1:250	VERT.	CONTRACT NO. 2018-002T
DESIGN	D.J.	DRAWN	EM
REVIEWED	J.L.	DATE	2018.06.29
SHEET NO.	STM8		

DOC: H351997-70-260-SEG1-0021 REV-001

HARVIE ROAD

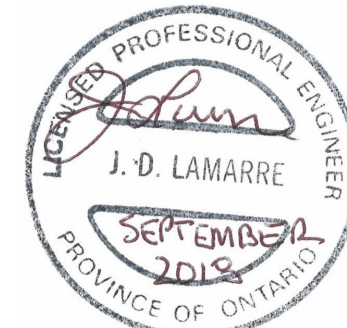
BIG BAY POINT ROAD

HIGHWAY 400



HATCH

NO.	REVISIONS	DATE	APPROVED
0	ISSUED FOR CONSTRUCTION	2018.09.06	B.R.



HARVIE AND BIG BAY POINT ROAD
NEW CROSSING - HIGHWAY 400

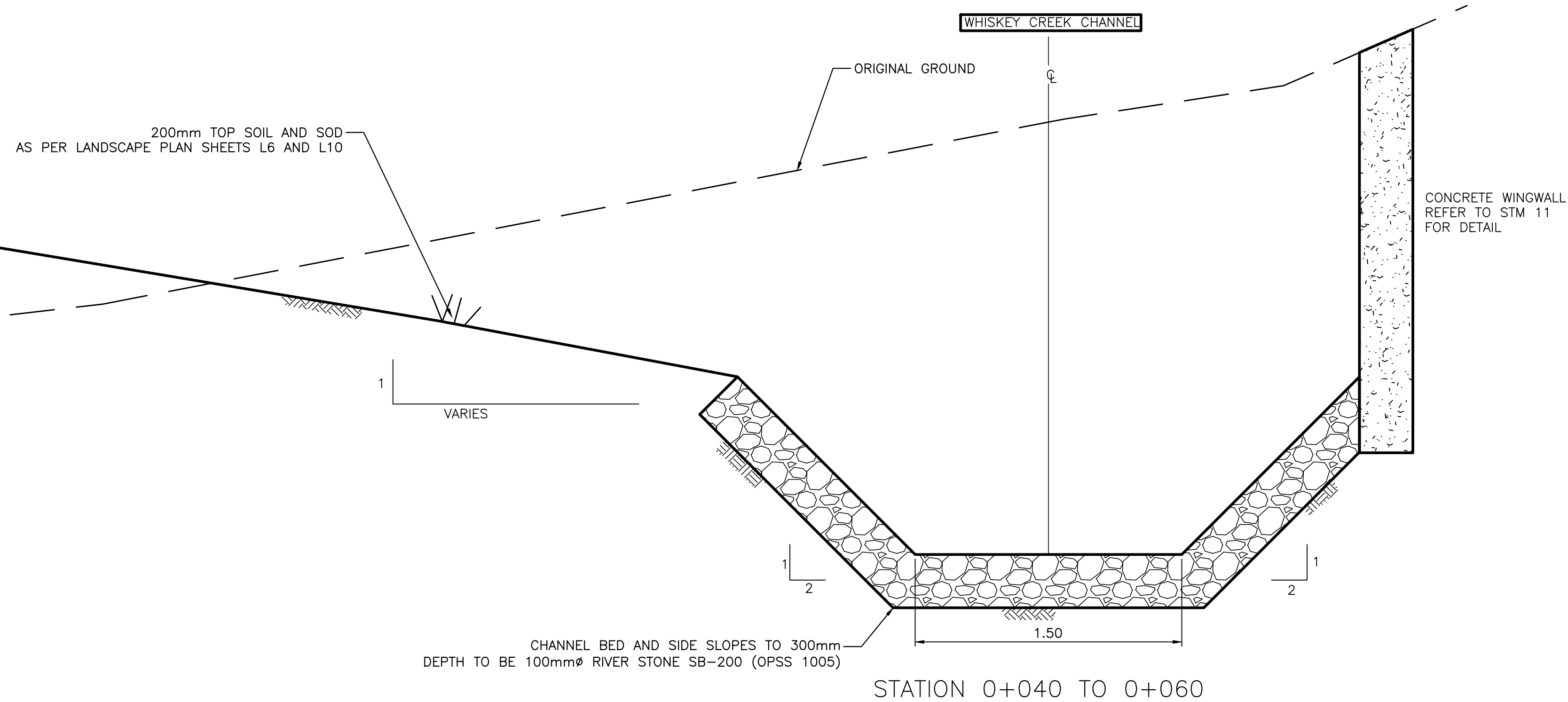
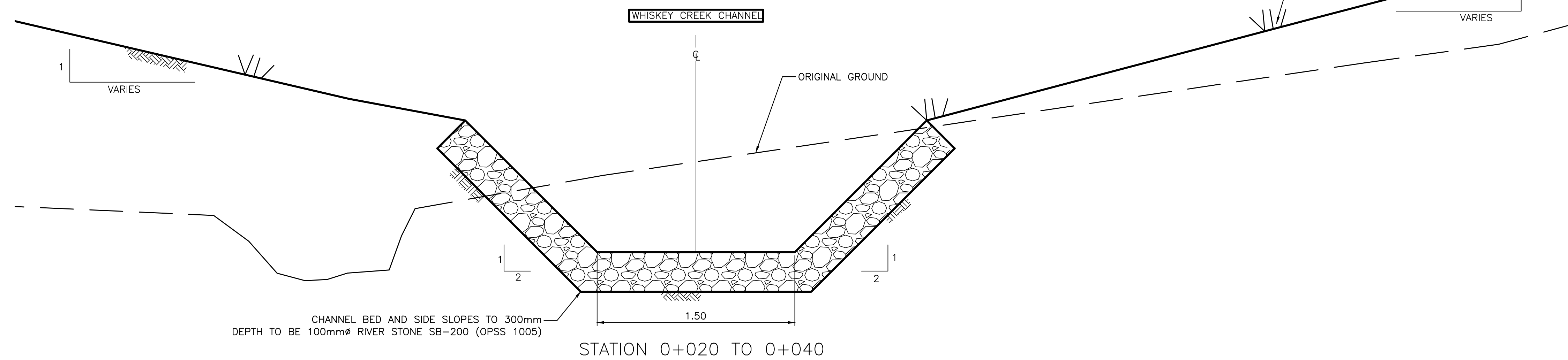
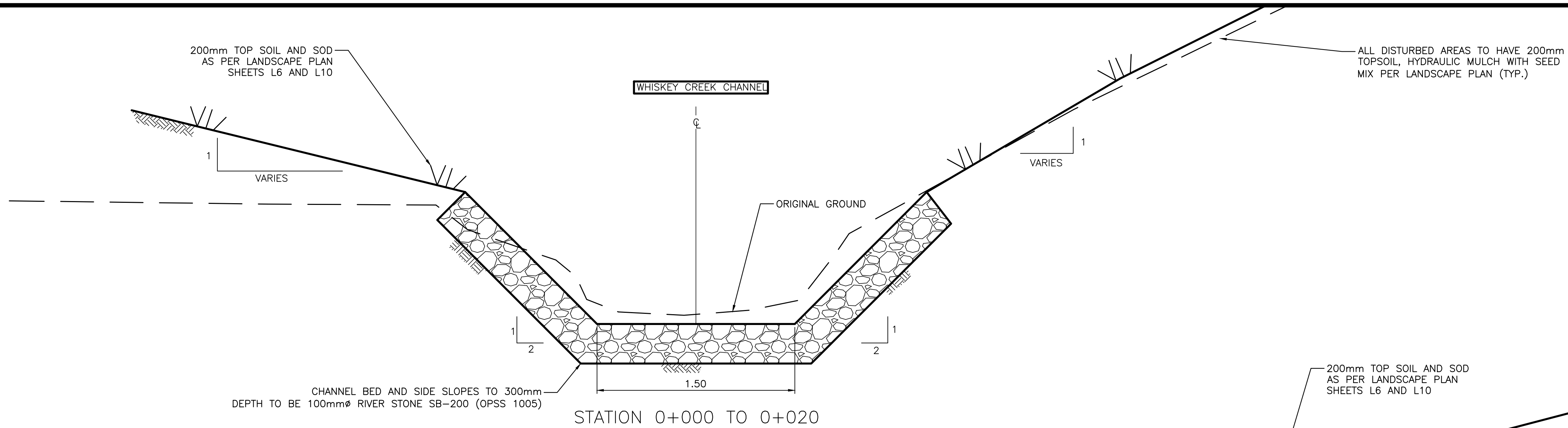
PLAN & PROFILE
HARVIE ROAD
STREAM REALIGNMENT

Barrie

ENGINEERING DEPARTMENT

SCALE	HOR. 1:500	VERT. 1:125	CONTRACT NO. 2018-002T
DESIGN	DJ	DRAWN CL	SHEET NO. STM11
REVIEWED	JL	DATE 2018.05.24	

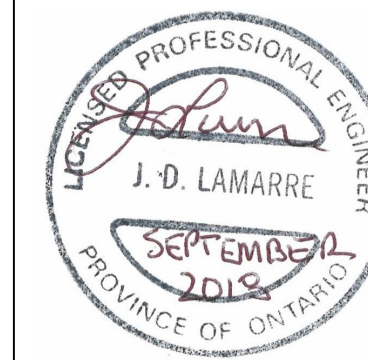
DOC: H351997-70-260-SEG1-0024-001



HATCH

NO.	REVISIONS	DATE	APPROVED
0	ISSUED FOR CONSTRUCTION	2018.09.06	B.R.

NOT TO SCALE



**HARVIE AND BIG BAY POINT ROAD
NEW CROSSING – HIGHWAY 400**

STREAM REALIGNMENT SECTIONS
HARVIE ROAD

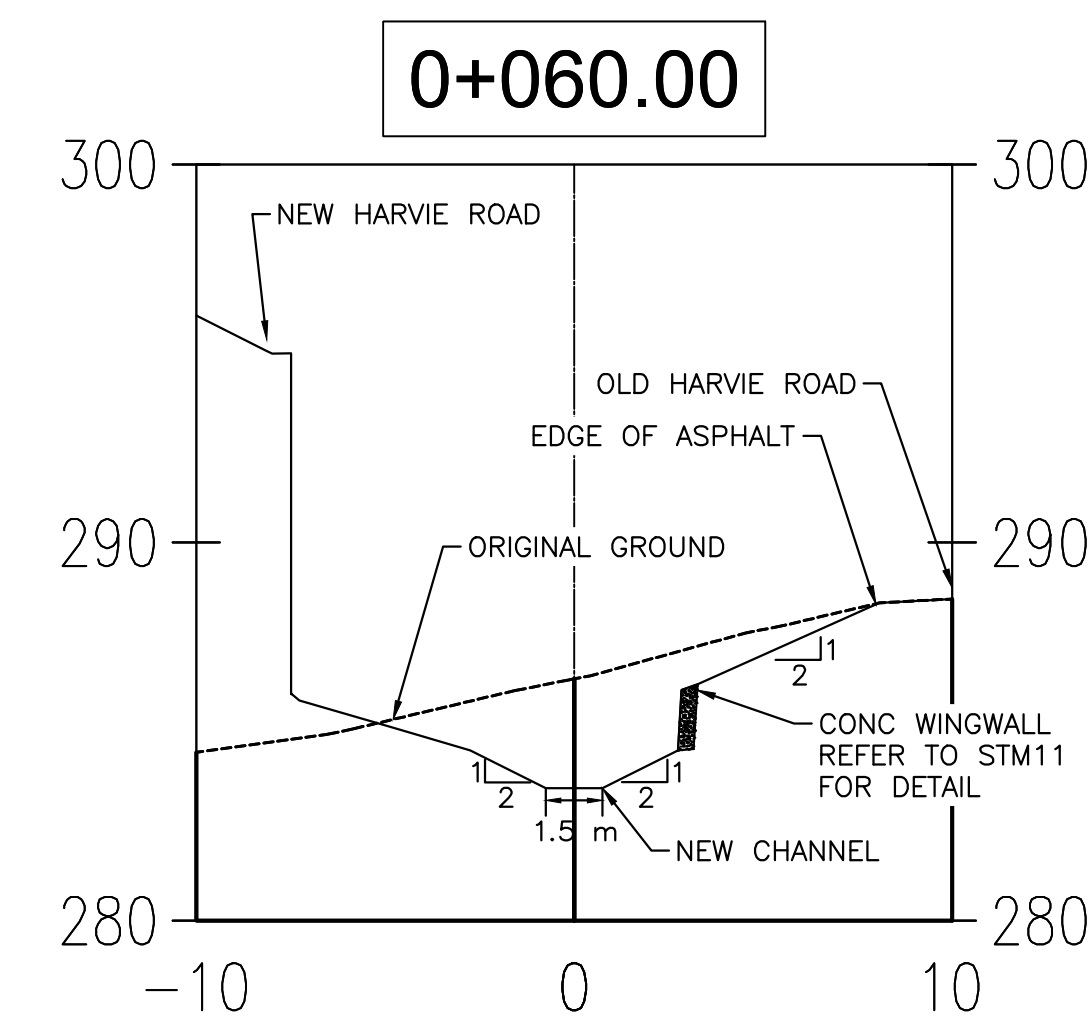
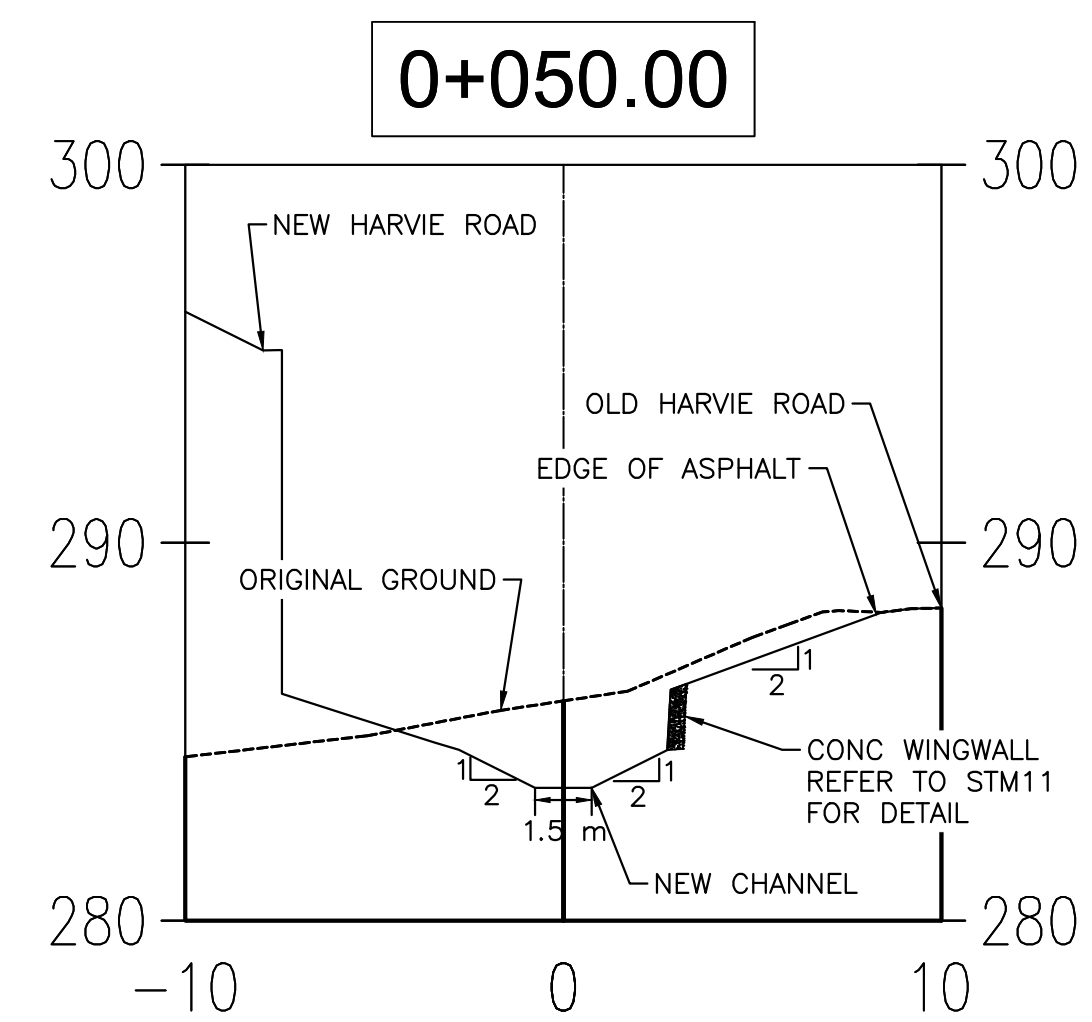
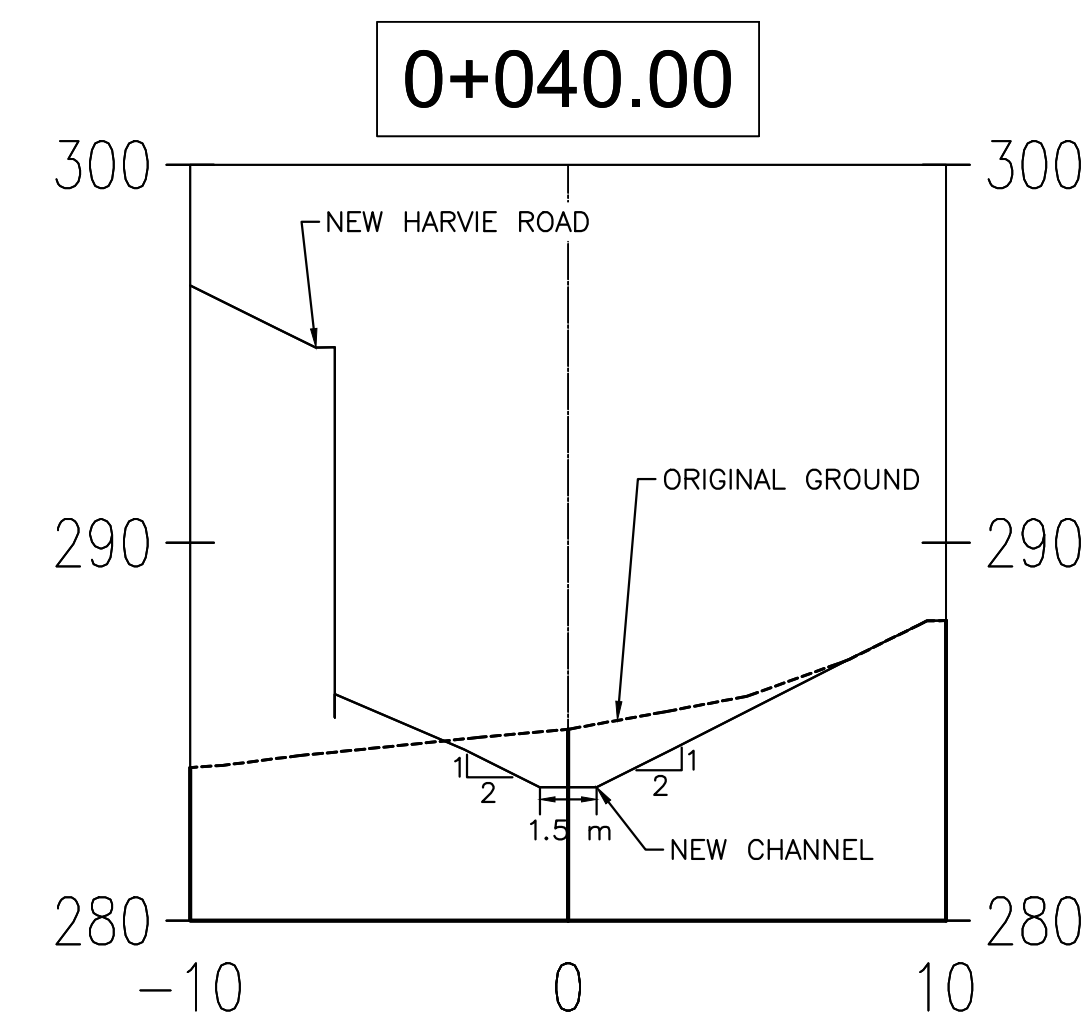
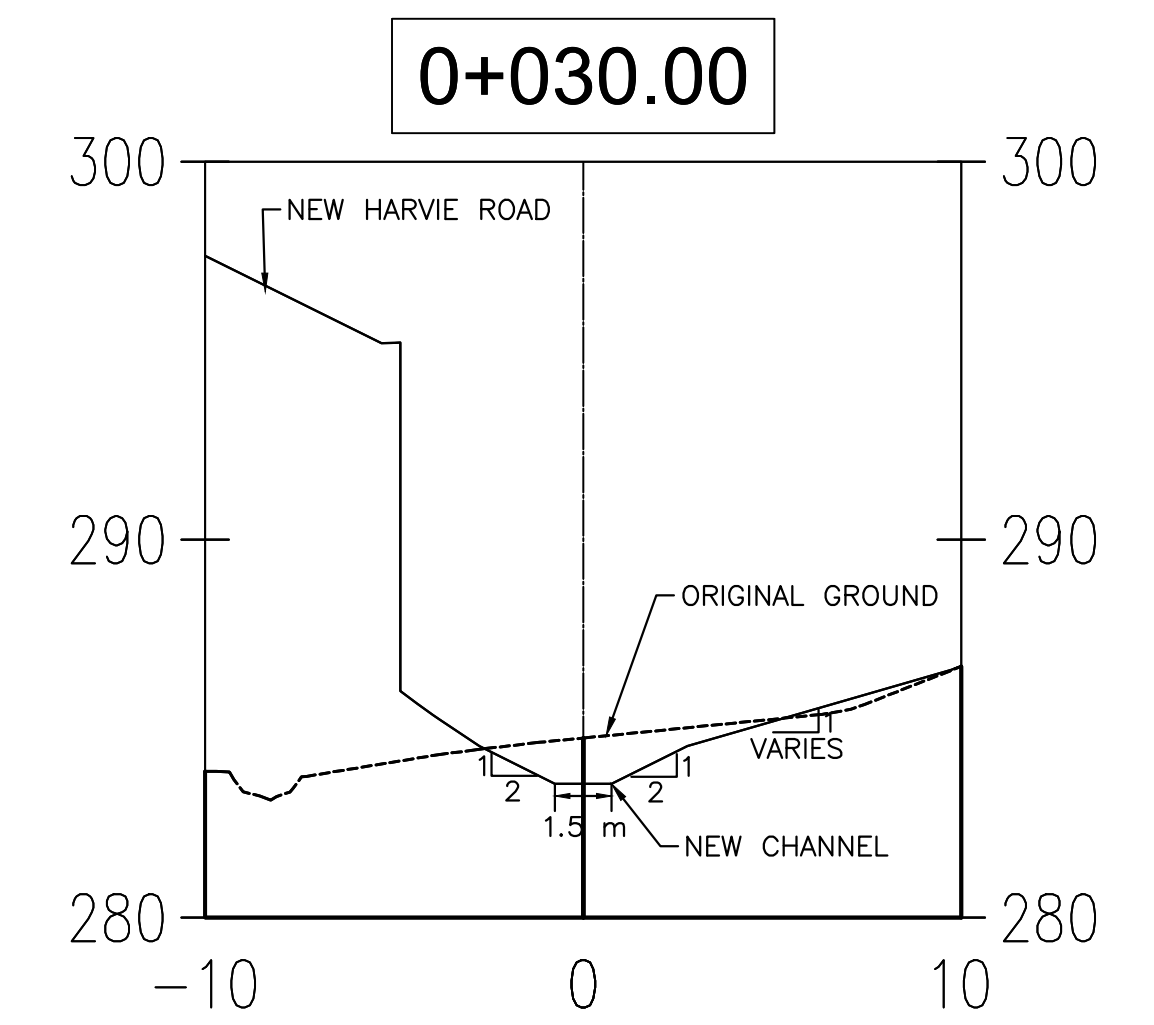
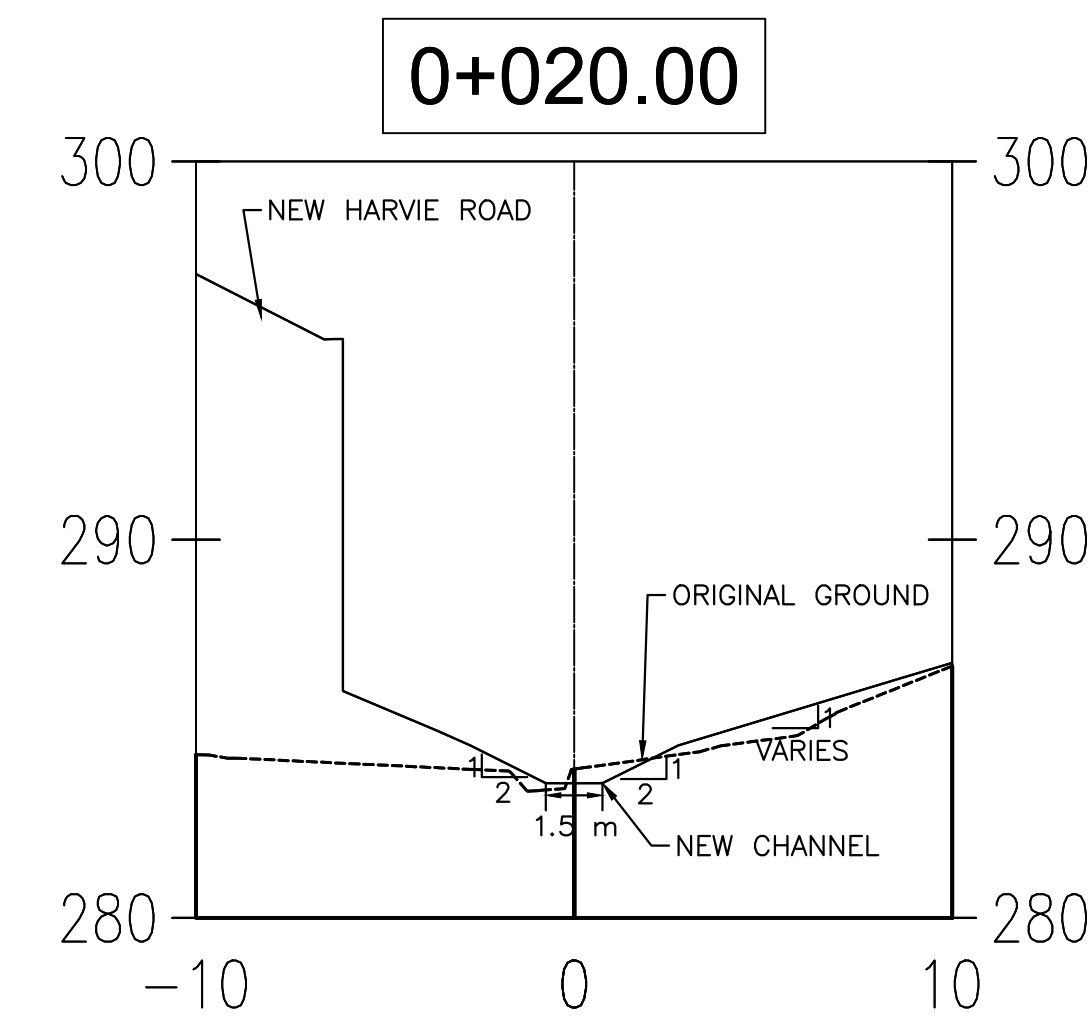
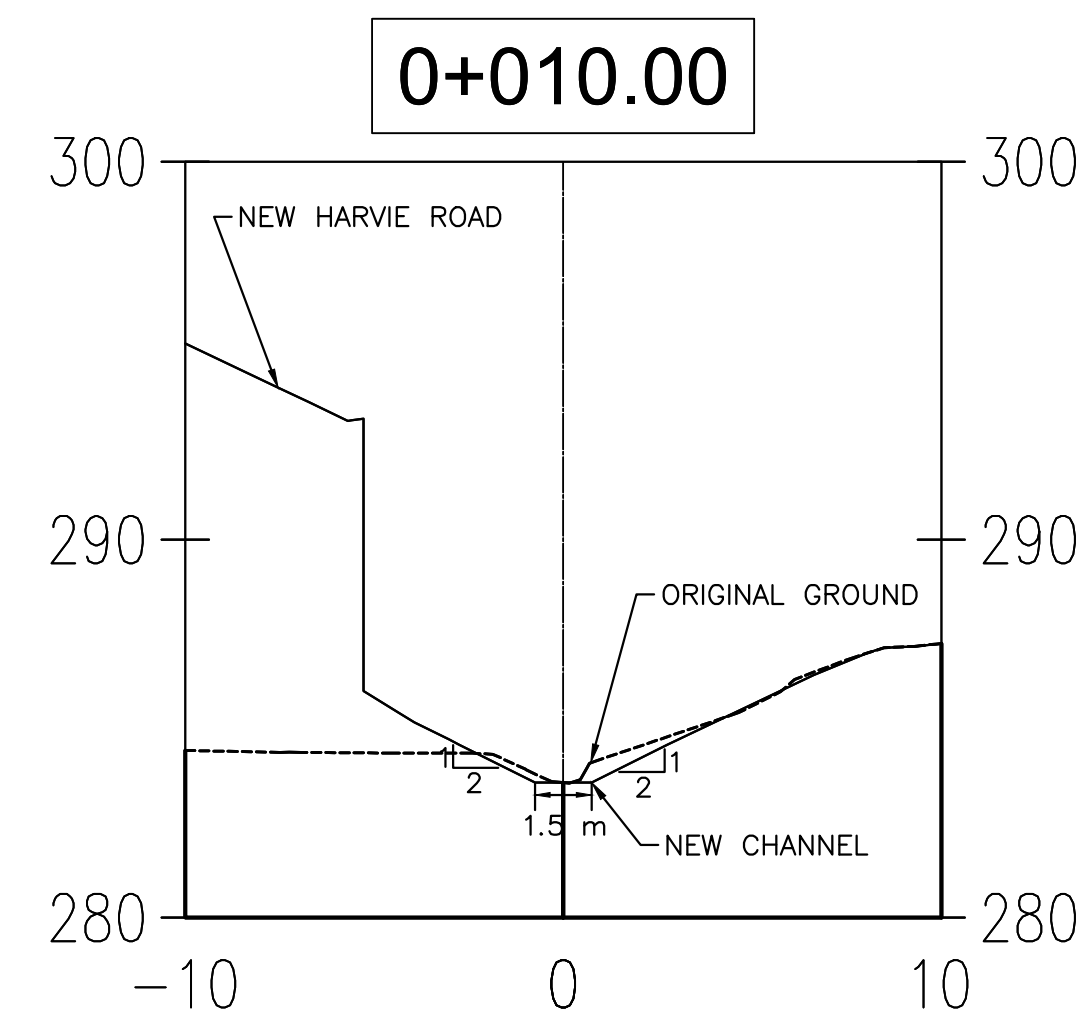
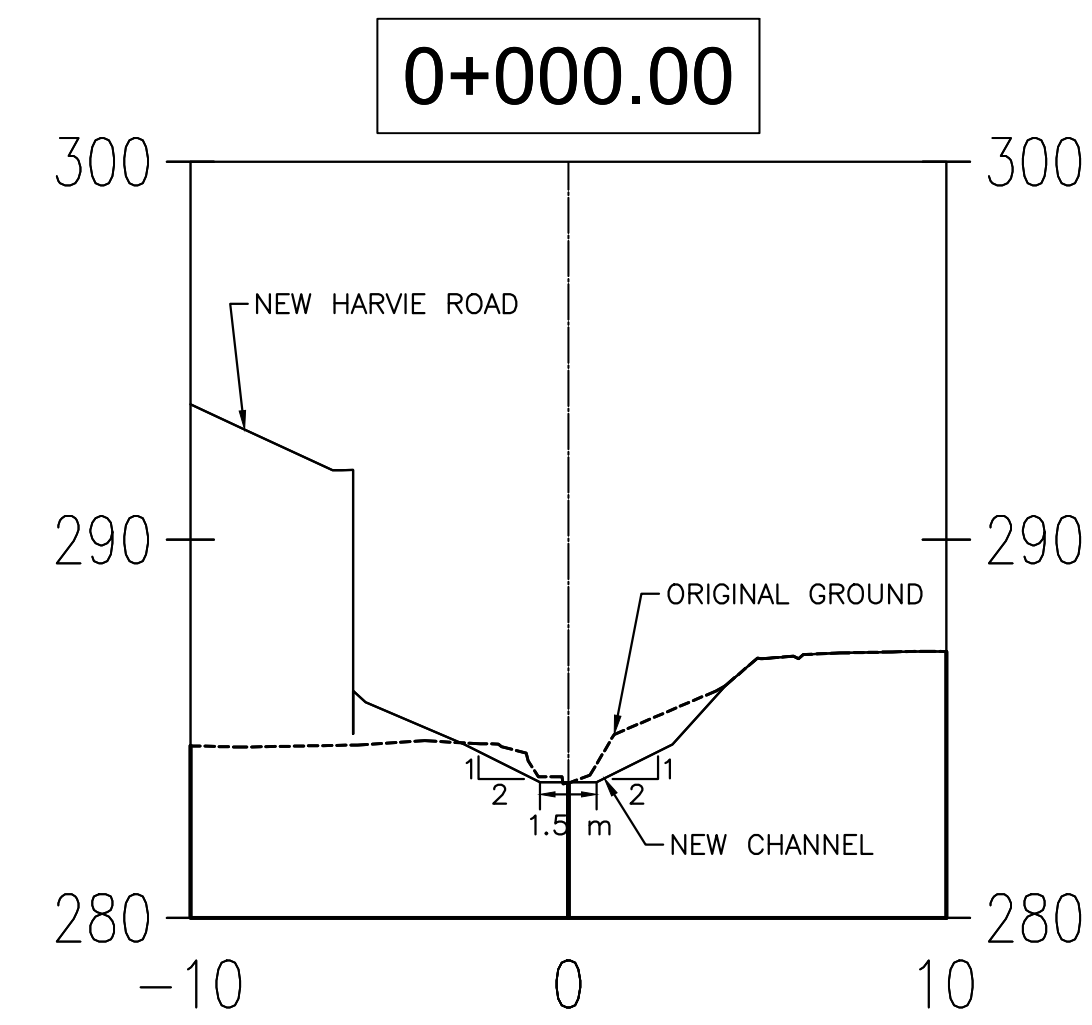
Barrie

ENGINEERING DEPARTMENT

SCALE	HOR. 1:200	VERT.	CONTRACT NO. 2018-002T
DESIGN	DJ	DRAWN	EM
REVIEWED	JL	DATE	2018.05.24
SHEET NO.	STM12		

DOC: H351997-70-260-SEG1-0023-001

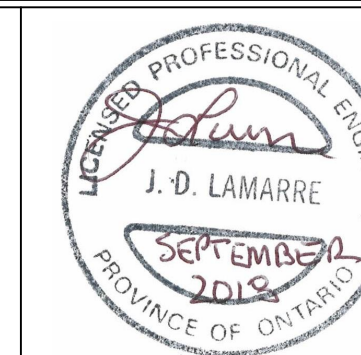
DATE PLOTTED: 9/5/2018 3:59:30 PM
FILE LOCATION: C:\working\h351997-70-260-SEG1-0023.dwg



HATCH

NO.	REVISIONS	DATE	APPROVED
0	ISSUED FOR CONSTRUCTION	2018.09.06	B.R.

NOT TO SCALE



**HARVIE AND BIG BAY POINT ROAD
NEW CROSSING – HIGHWAY 400**

**HARVIE ROAD
STREAM REALIGNMENT SECTIONS**

Barrie

ENGINEERING DEPARTMENT

SCALE	HOR. 1:75	VERT.	CONTRACT NO. 2018-002T
DESIGN	DJ	DRAWN	CL
REVIEWED	JL	DATE	2018.05.24
			SHEET NO. STM13

DOC: H351997-70-260-SEG1-0024-001

GENERAL ENVIRONMENTAL NOTES

1. FOR GENERAL ENVIRONMENTAL NOTES, REFER TO SHEET GN1 AND GN2.

GENERAL LANDSCAPING NOTES

1. REFER TO LANDSCAPING PLAN SHEET L6 AND L10 FOR SITE REVEGETATION AND LANDSCAPING DETAILS.

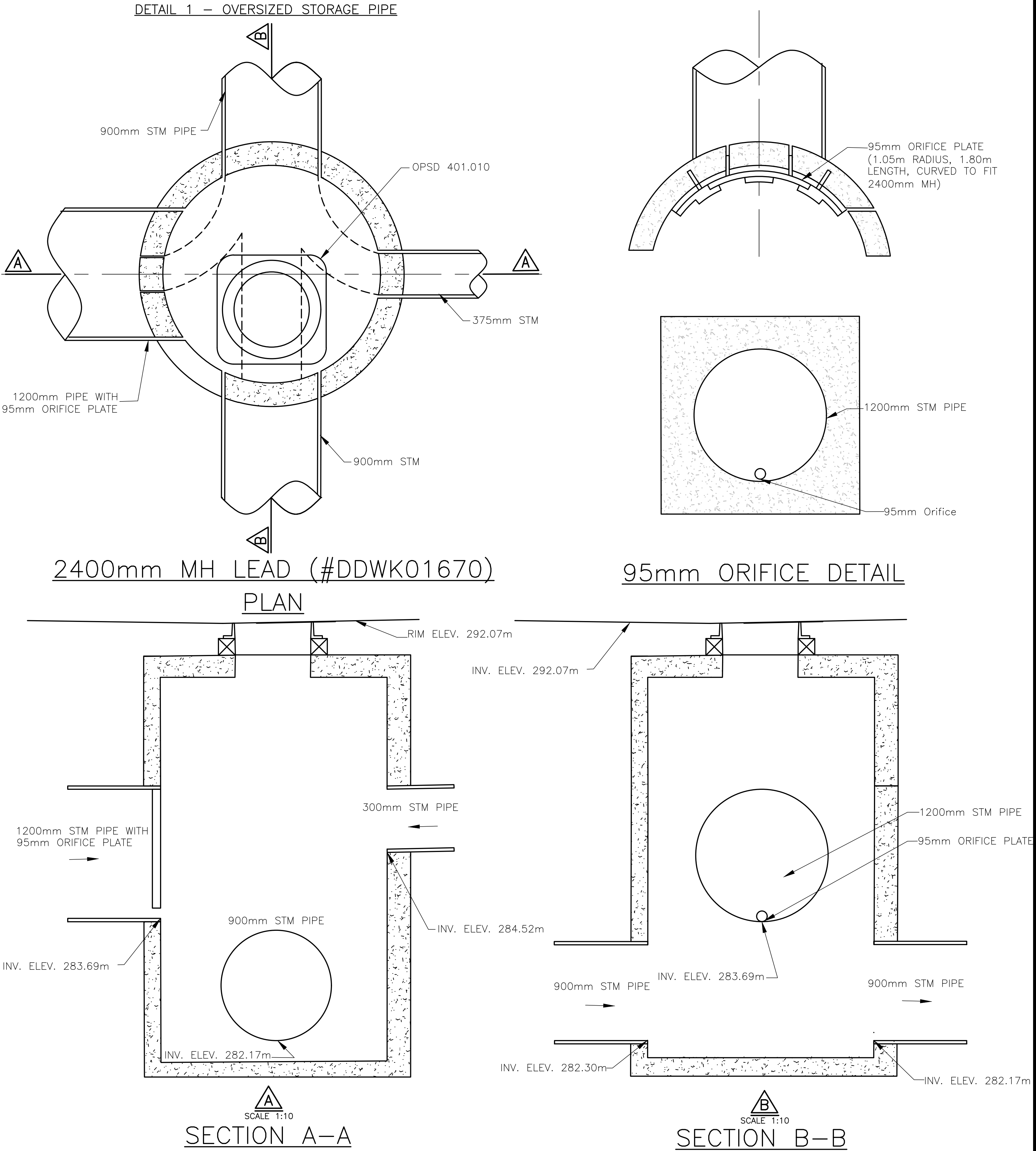
GENERAL CREEK NOTES

1. NEW BANKS TO BE INTEGRATED INTO EXISTING BANK HEIGHT IN BOTH UPSTREAM AND DOWNSTREAM DIRECTIONS AND BE KEYED IN FOR 2-5M.
2. ANY FILL MATERIAL IS TO BE COMPACTED TO 95% SPD AND CONFIRMED WITH COMPACTION TESTING.
3. PROPER EROSION AND SEDIMENT CONTROL MEASURES TO BE USED AT ALL LOCATIONS TO PREVENT SEDIMENT FROM ENTERING WATER COURSE.
4. BANKS TO BE REVEGETATED AS PER THE DESIGN DRAWINGS WITH ENVIROLOK, SEED AND STABILIZED WITH NATIVE VEGETATION AS PER SPECIFICATIONS.
5. BANKS TO BE FURTHER STABILIZED WITH EROSION CONTROL MATERIALS (ECM) WHILE VEGETATION IS ESTABLISHED.
6. CONTRACTOR TO RESTORE ANY DAMAGED AREAS TO THE EXISTING CONDITION OR TO THE SATISFACTION OF THE CLIENT AND PROJECT MANAGER.

STONE SIZING GRADATION 100mm RIFFLESTONE (mm)	
200-250	5%
150-200	15%
100-150	30%
50-100	25%
25-50	15%
WEEST Granular "B" TYPE II	10%
SUM	100%
ADD ADDITIONAL GRANULAR B TO FILL ANY INTERSTITIAL VOIDS AS NECESSARY	

CONSTRUCTION SEQUENCING AND STAGING NOTES

1. CONTRACTOR TO NOTIFY MUNICIPALITY, AGENCIES AND PROJECT MANAGER TWO (2) DAYS PRIOR TO ACTUAL CONSTRUCTION.
2. THE CONTRACTOR SHALL PROVIDE GENERAL ARRANGEMENT DRAWINGS AND A STAGING PLAN WITH THE PROPOSED BYPASS METHODOLOGY AND DEMONSTRATE THAT THE APPROACH CAN ADEQUATELY ADDRESS THE ENVIRONMENTAL AND EXISTING SITE CONDITIONS (VARYING FLOW CONDITIONS, CHANNEL CAPACITIES, WET WEATHER RESPONSE).
3. CONSTRUCTION STAGING MUST HAVE REGARD FOR THE ENVIRONMENTAL ASPECTS OF THE PROPOSED CONSTRUCTION. THIS WILL ENSURE THAT AMPLE TIME IS PROVIDED TO ENSURE THE TIMELY ARRIVAL OF REQUIRED EQUIPMENT AND MATERIALS AND THE APPROPRIATE ALLOCATION OF RESOURCES.
4. INSTALL CONSTRUCTION FENCING AND SILT FENCING AS PER SPECIFICATIONS. FENCE TO BE INSTALLED PRIOR TO CONSTRUCTION AND SHALL BE THE LIMIT OF CONSTRUCTION ACTIVITY.
5. STRIP TOPSOIL AND STOCKPILE ON SITE. STOCK PILE TO HAVE REINFORCED SILT FENCE INSTALLED CONTINUOUSLY ALONG PERIMETER.
6. CONSTRUCT PROPOSED CHANNEL BANKS AS PER THE DESIGN PLANS AND SPECIFICATIONS.
7. COMPLETE SEEDING AND PLANTING AS PER APPROVED PLANS AND SPECIFICATIONS.
8. STABILIZE ALL SLOPES AS NOTED ON PLAN.
9. AFTER STABILIZATION OF THE BANKS IS CONFIRMED, FLOW IS TO BE REINITIATED INTO CHANNEL UNDER SUPERVISION OF THE PROJECT FLUVIAL GEOMORPHOLOGIST.
10. CONTRACTOR SHALL ENSURE THAT CHANNEL REMAINS ISOLATED FROM FLOWS UNTIL THE BANK WORK IS COMPLETE.
11. REMOVE ALL EXCESS MATERIAL STOCKPILED ON SITE.
12. REMOVE ANY EROSION AND SEDIMENT CONTROLS ONCE ALL VEGETATION HAS BECOME SUFFICIENTLY ESTABLISHED.
13. SHAFT DIMENSIONS SHOWN AS ESTIMATES ONLY. CONTRACTOR SHALL PROVIDE THE MEANS AND METHODS TO CONSTRUCT THE CULVERT CONSTRUCTION OPERATIONS.
14. HIGHWAY 400 CULVERT CROSSING WILL BE COMPLETED IN THE DRY AND SHALL NOT IMPACT THE EXISTING WHISKEY CREEK MAIN BRANCH UNTIL THE TUNNEL IS INSTALLED. CHANNEL RE-ALIGNMENT HAS OCCURRED, AND THE DOWN STREAM CULVERT SECTIONS HAS BEEN CONSTRUCTED.
15. HIGHWAY 400 DRAINAGE SHALL BE MAINTAINED DURING CONSTRUCTION. ANY POTENTIAL IMPACTS TO THE HIGHWAY DRAINAGE SYSTEM SHALL BE IDENTIFIED AND MITIGATED THROUGH A DESIGN APPROVED BY MTO. POSITIVE DRAINAGE SHALL BE MAINTAINED FOR THE DURATION OF THE PROJECT.



HATCH

NO.	REVISIONS	DATE	APPROVED
0	ISSUED FOR CONSTRUCTION	2018.09.06	B.R.

NOT TO SCALE



HARVIE AND BIG BAY POINT ROAD
NEW CROSSING - HIGHWAY 400

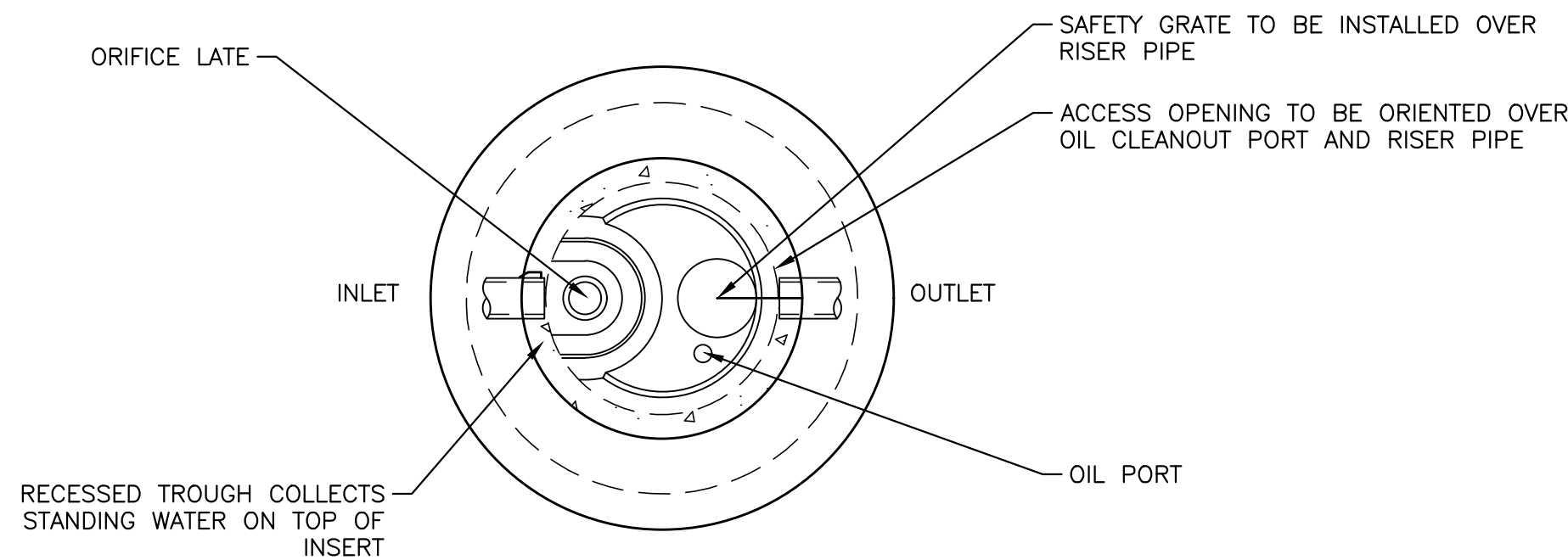
DRAINAGE NOTES AND DETAILS
HARVIE ROAD
GENERAL DRAINAGE NOTES AND DETAILS

Barrie

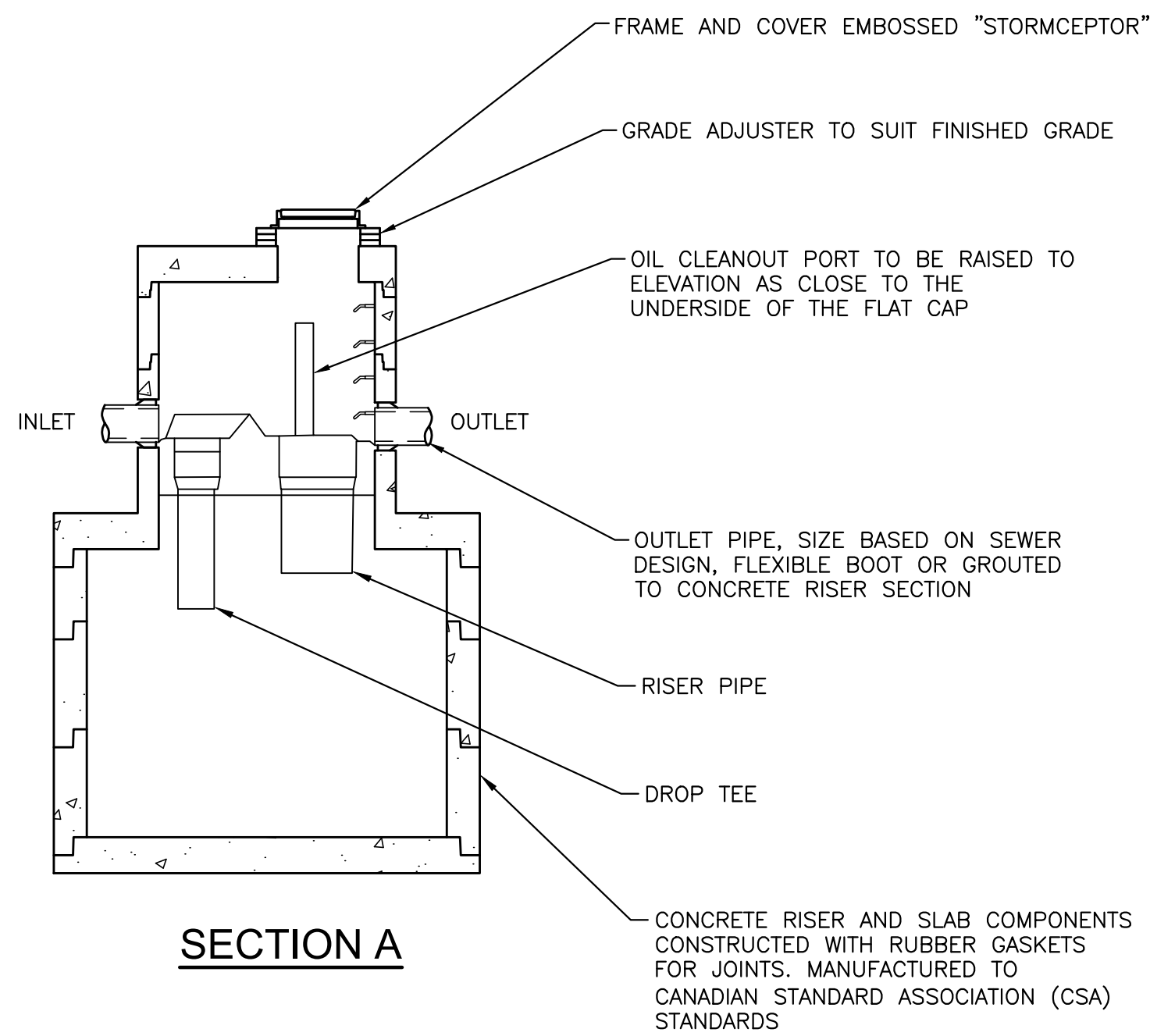
ENGINEERING DEPARTMENT

SCALE	HOR. 1:50	VERT.	CONTRACT NO. 2018-002T
DESIGN	EM	DRAWN	CL
REVIEWED	DJ	DATE	2018.08.02
			SHEET NO. STM14

DOC: H351997-70-260-SEG1-0024-002



PLAN OIL GRIT SEPARATOR (OGS)
TYPICAL DETAIL



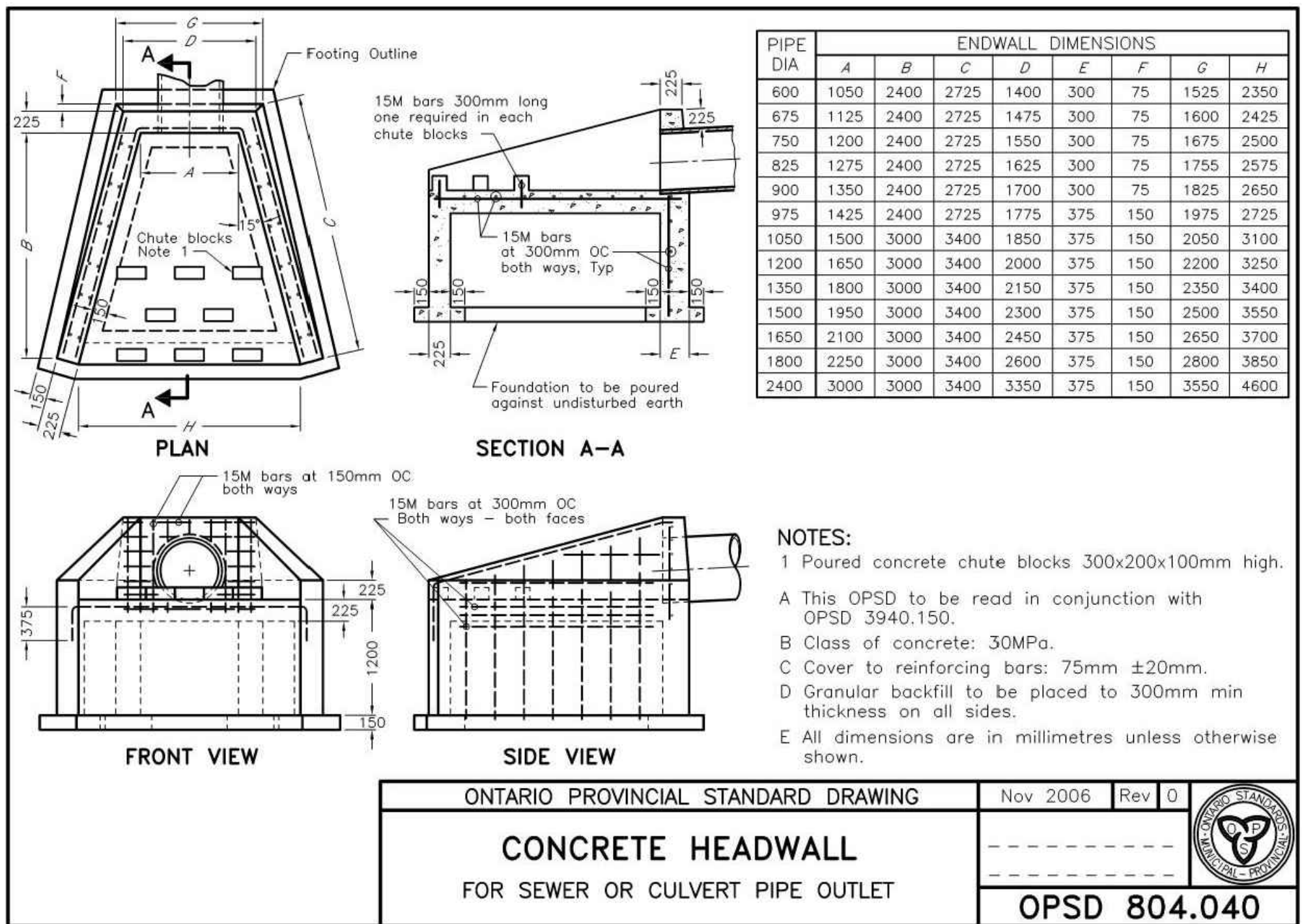
DETAIL 1 - OIL GRIT SEPARATOR (OGS)

Structure ID	OGS TYPE	STRUCTURE OD DIAMETER (mm)	STRUCTURE DEPTH BELOW INLET (mm)
OGS-1	2-EF 12 UNITS WITH FLOW U/S SPLITTING	4370	3913
OGS-2	EF/EFO8	2896	2616
OGS-3	EF/EFO8	2896	2616
OGS-4	EF/EFO6	2185	1956

SCHEDULE 1 - OIL GRIT SEPARATOR (OGS)

STORM EVENT	EXISTING				PROPOSED			
	INFLOW (M3/S)	STORAGE (M3)	OUTFLOW (M3/S)	WATER LEVEL (M)	INFLOW (M3/S)	STORAGE (M3)	OUTFLOW (M3/S)	WATER LEVEL (M)
2-YEAR	3.3	8077	1.0	293.09	3.3	8485	1.0	293.14
5-YEAR	8.8	19850	1.1	294.31	9.2	20510	1.1	294.36
10-YEAR	12.7	28750	1.2	295	13.4	29610	1.2	295.05
25-YEAR	17.3	41080	1.3	295.75	18.4	42170	1.3	295.82
50-YEAR	20.2	50550	1.4	296.28	21.4	51920	1.4	296.34
100-YEAR	23.1	60260	1.4	296.77	24.5	61910	1.4	296.85
REGIONAL	16.4	86720	14.5	297.93	16.9	87300	14.9	297.96

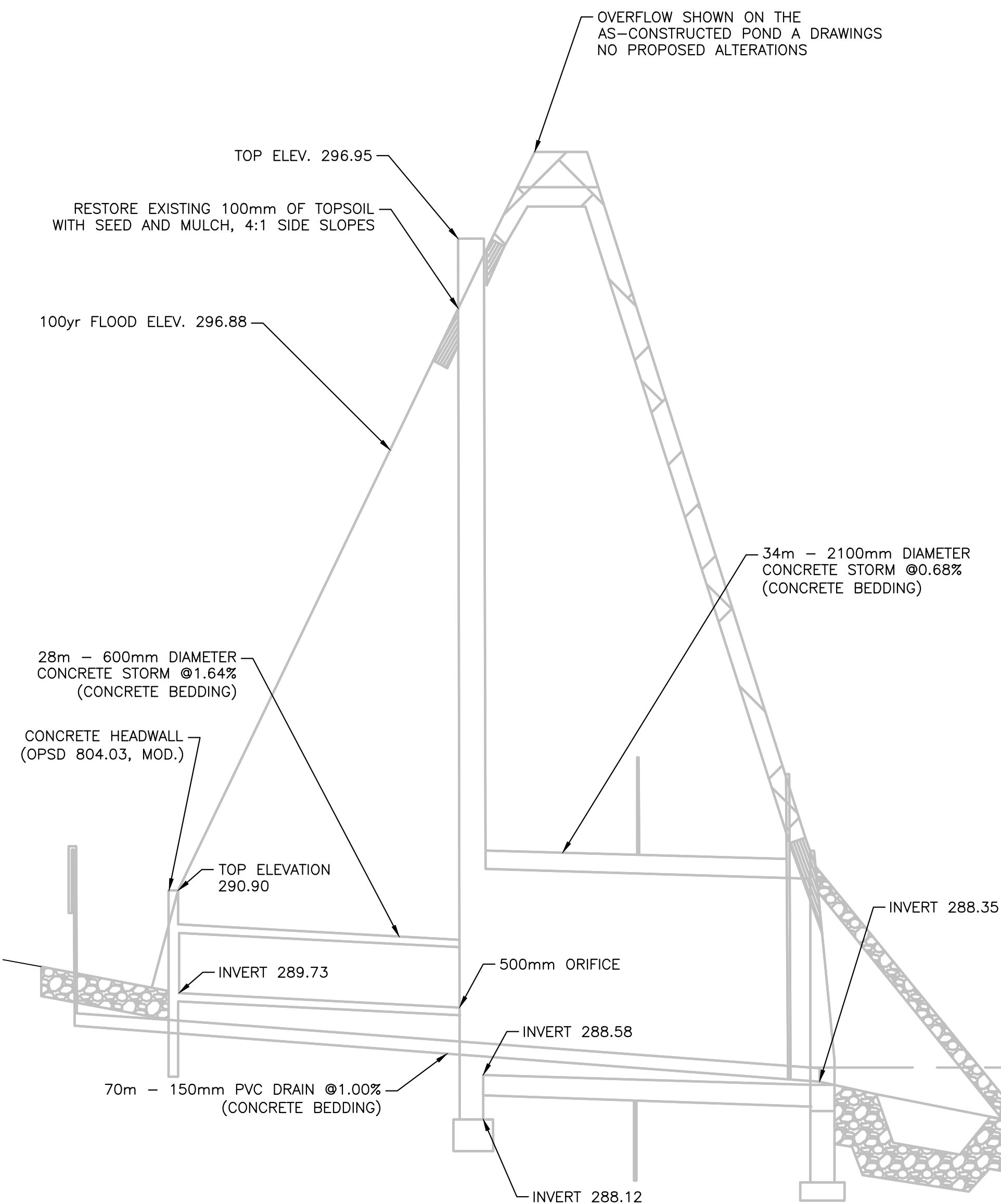
SCHEDULE 3 - POND A STAGE STORAGE



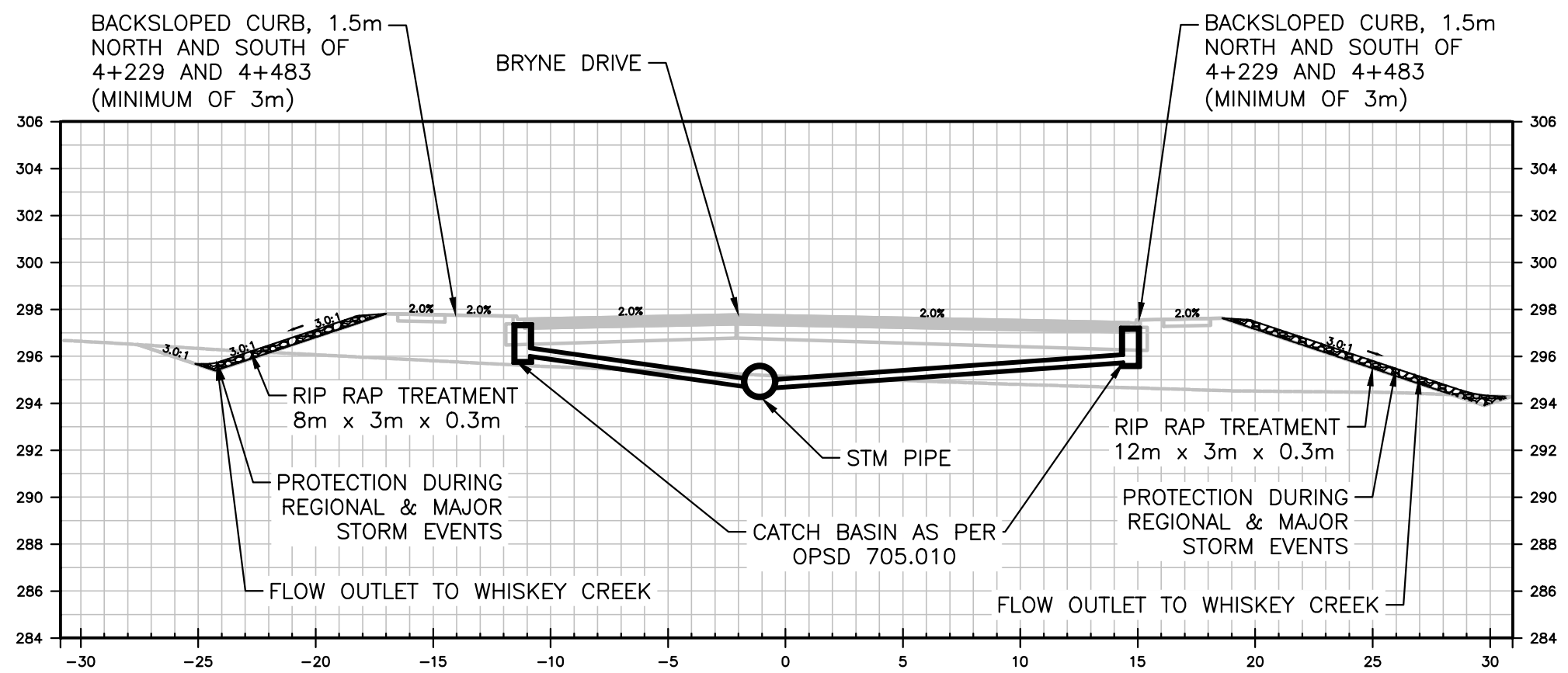
DETAIL 2 - HEADWALL OPSD 804.040

WALL ID	STATION	LOCATION	ENDWALL PIPE DIA. (mm)	OPSD 804.040 - ENDWALL DIMENSIONS							
				A	B	C	D	E	F	G	H
CH-1	9+550	POND A INLET	1200	1650	3000	3400	2000	375	150	2200	3250
CH-2	9+953	HWY 400 CULVERT INLET	2400	3000	3000	3400	3350	375	150	3550	4600
CH-3	10+080	HWY 400 CULVERT OUTLET	2400	3000	3000	3400	3350	375	150	3550	4600
CH-4	10+345	BIG BAY POINT ROAD OUTLET	900	1350	2400	2725	1700	300	75	1825	2650
CH-5	9+567	HARVIE INTERSECTION CULVERT INLET	1800	2250	3000	3400	2600	375	75	2800	3850
CH-7	9+924	HARVIE ROAD CULVERT INLET	1200	1650	3000	3400	2000	375	150	2200	3250
CH-9	9+884	ACCESS ROAD CULVERT OUTLET	1800	2250	3000	3400	2600	375	75	2800	3850
CH-10	10+355	BIG BAY POINT ROAD INLET	900	1350	2400	2725	1700	300	75	1825	2650

SCHEDULE 2 - HEADWALL OPSD 804.040



DETAIL 3 - POND OVERFLOW OUTLET



TYPICAL SECTION REFERENCE 4+229 AND
4+483

HATCH

NO.	REVISIONS	DATE	APPROVED
0	ISSUED FOR CONSTRUCTION	2018.09.06	B.R.

NOT TO SCALE



HARVIE AND BIG BAY POINT ROAD
NEW CROSSING - HIGHWAY 400

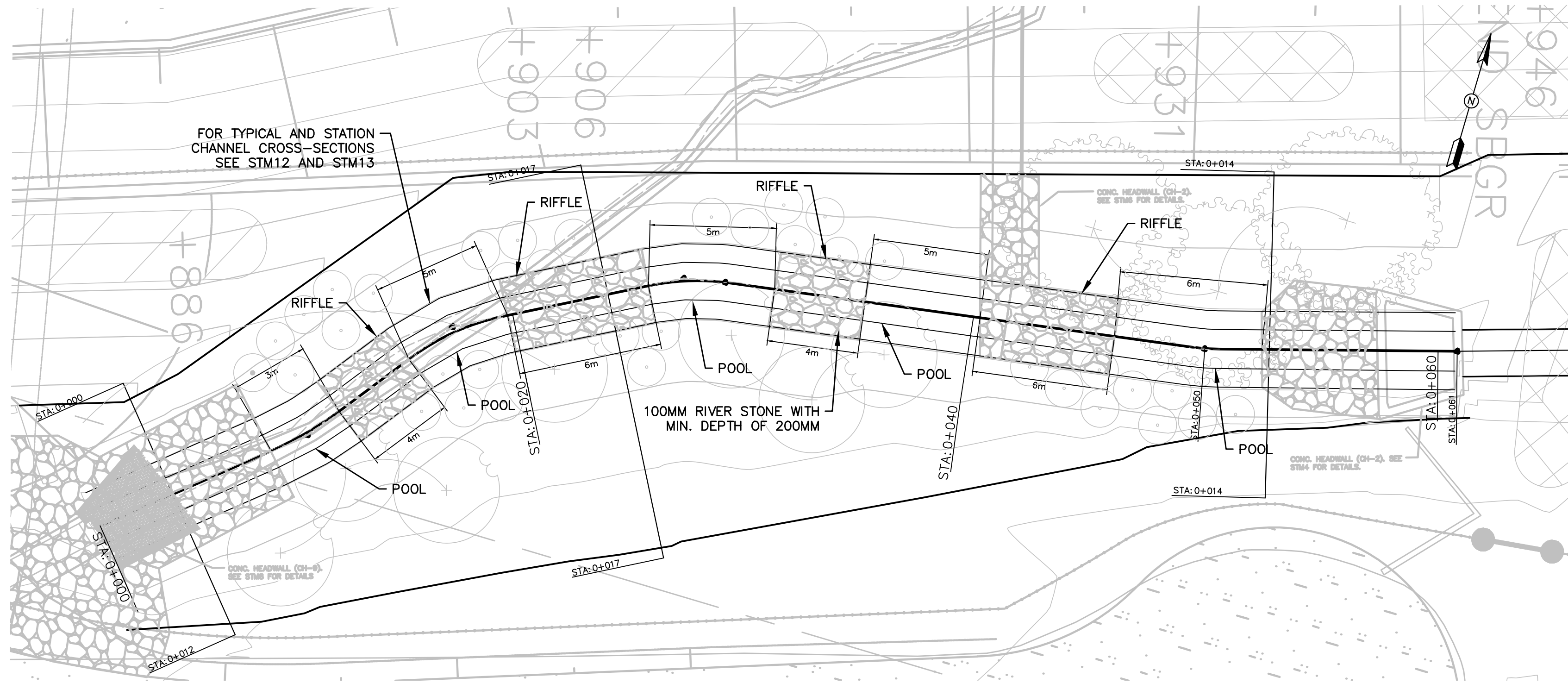
DRAINAGE NOTES AND DETAILS
HARVIE ROAD
DRAINAGE STRUCTURE DETAILS

Barrie

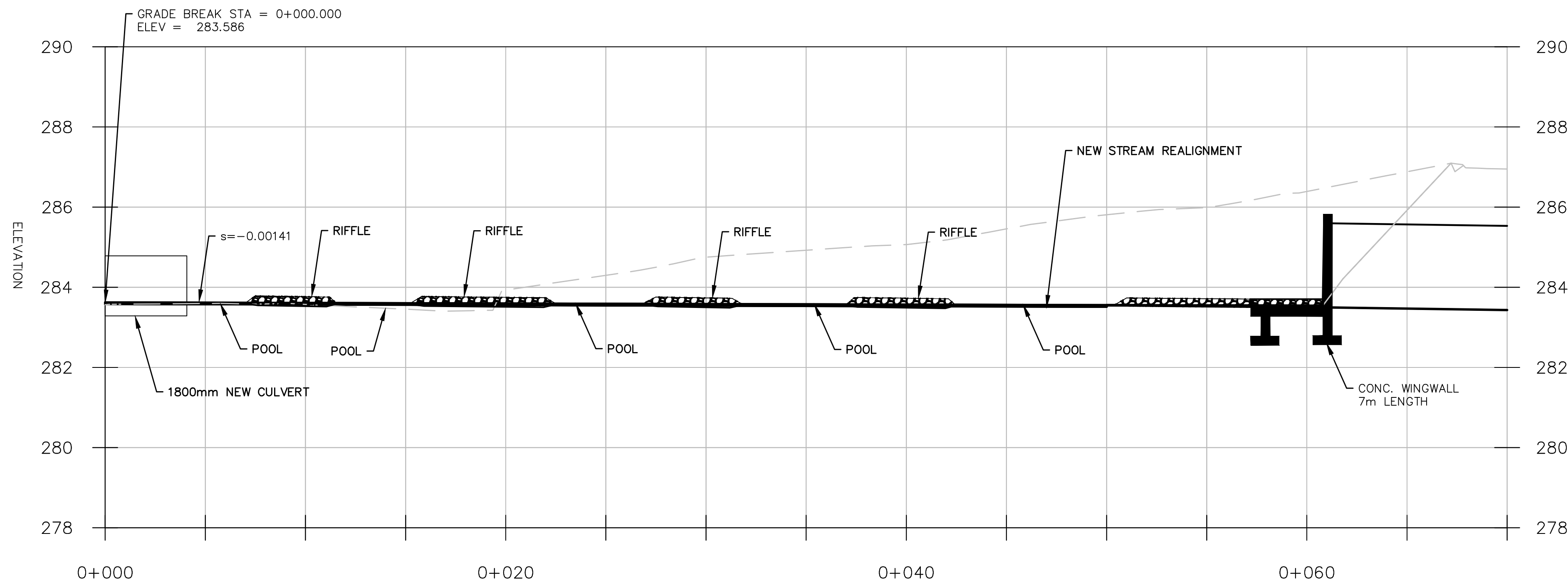
ENGINEERING DEPARTMENT

SCALE	HOR. 1:50	VERT.	CONTRACT NO.	2018-002T
DESIGN	DJ	DRAWN	CL	SHEET NO.
REVIEWED	JL	DATE	2018.08.02	STM15

DOC: H351997-70-260-SEG1-0024-002



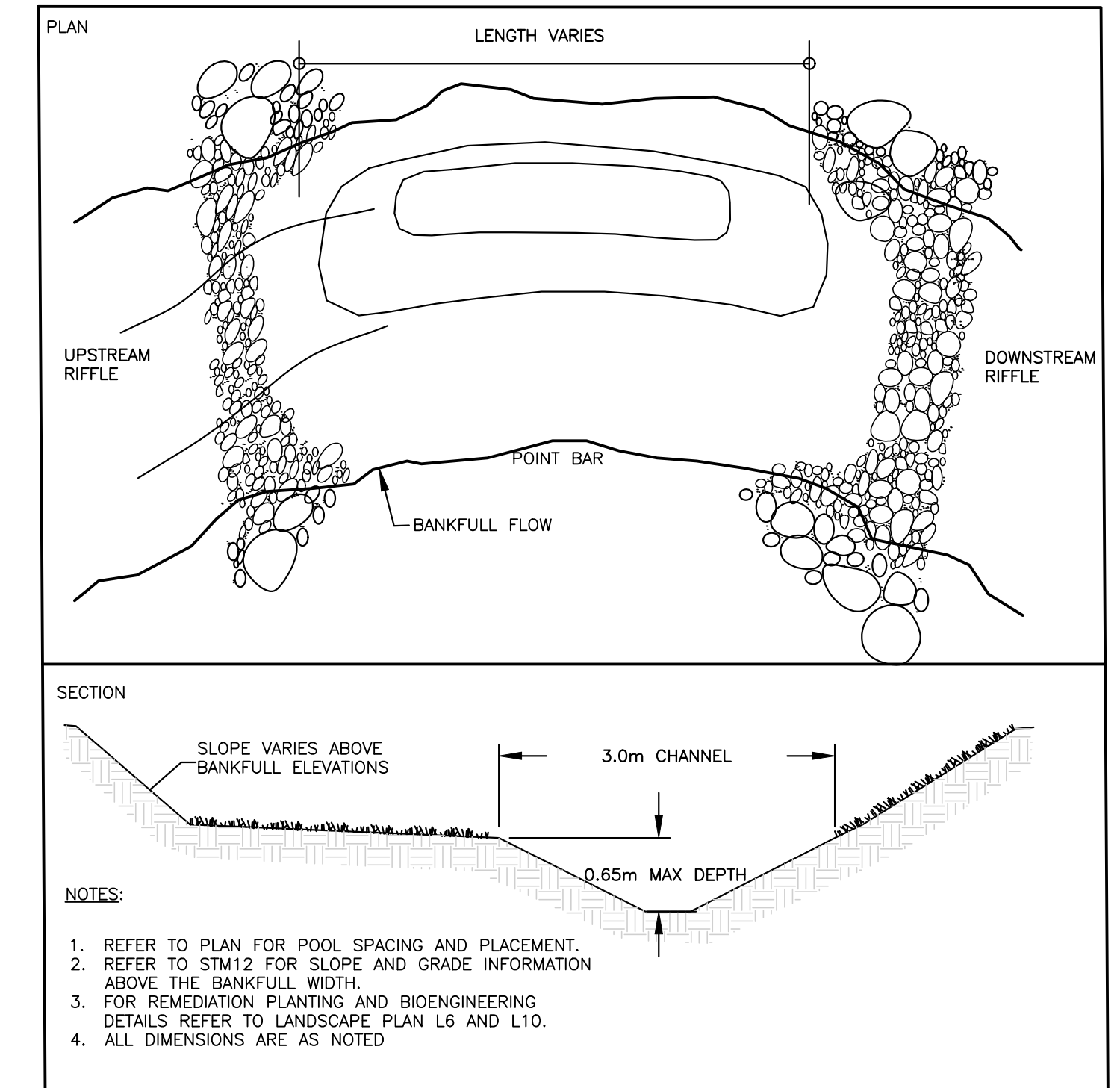
CHANNEL REALIGNMENT PLAN VIEW
SCALE 1:150



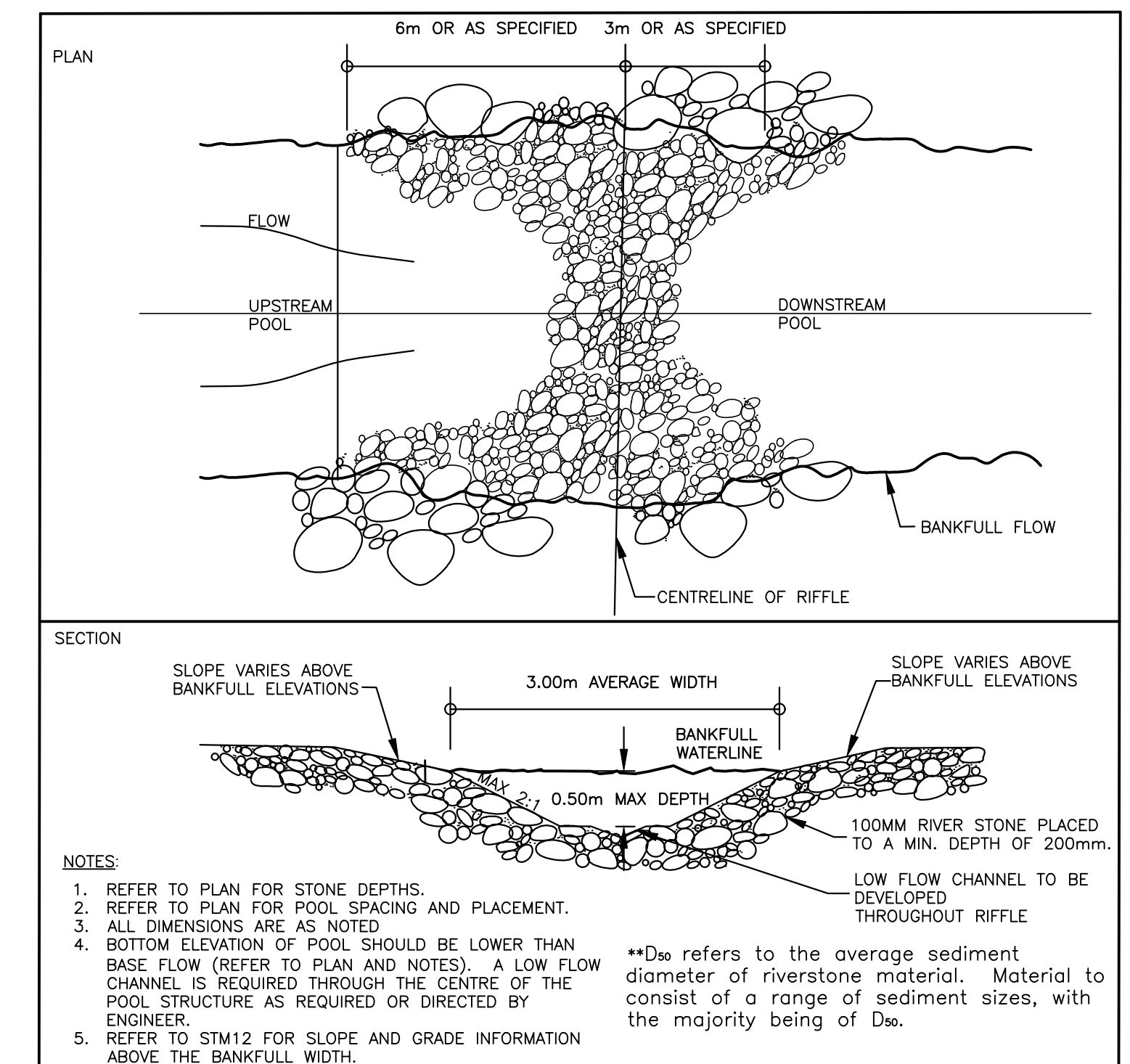
CHANNEL REALIGNMENT PROFILE VIEW
SCALE 1:500

LEGEND

- LIMIT OF EXISTING TREE CANOPY (APPROXIMATE)
- LARGE PLANTING BED
- SMALL PLANTING BED
- BOULEVARD TREES
- CONIFEROUS TREES
- VALLEYLAND/FOREST EDGE TREES
- VALLEYLAND/FOREST EDGE SHRUBS



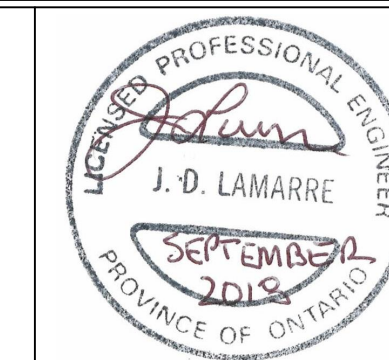
CHANNEL POOL (TYPICAL)
N.T.S.



CHANNEL RIFFLE (TYPICAL)
N.T.S.

HATCH

NO.	REVISIONS	DATE	APPROVED
0	ISSUED FOR CONSTRUCTION	2018.09.06	B.R.



HARVIE AND BIG BAY POINT ROAD
NEW CROSSING – HIGHWAY 400

PLAN & PROFILE DETAILS
HARVIE ROAD
STREAM REALIGNMENT

Barrie

ENGINEERING DEPARTMENT

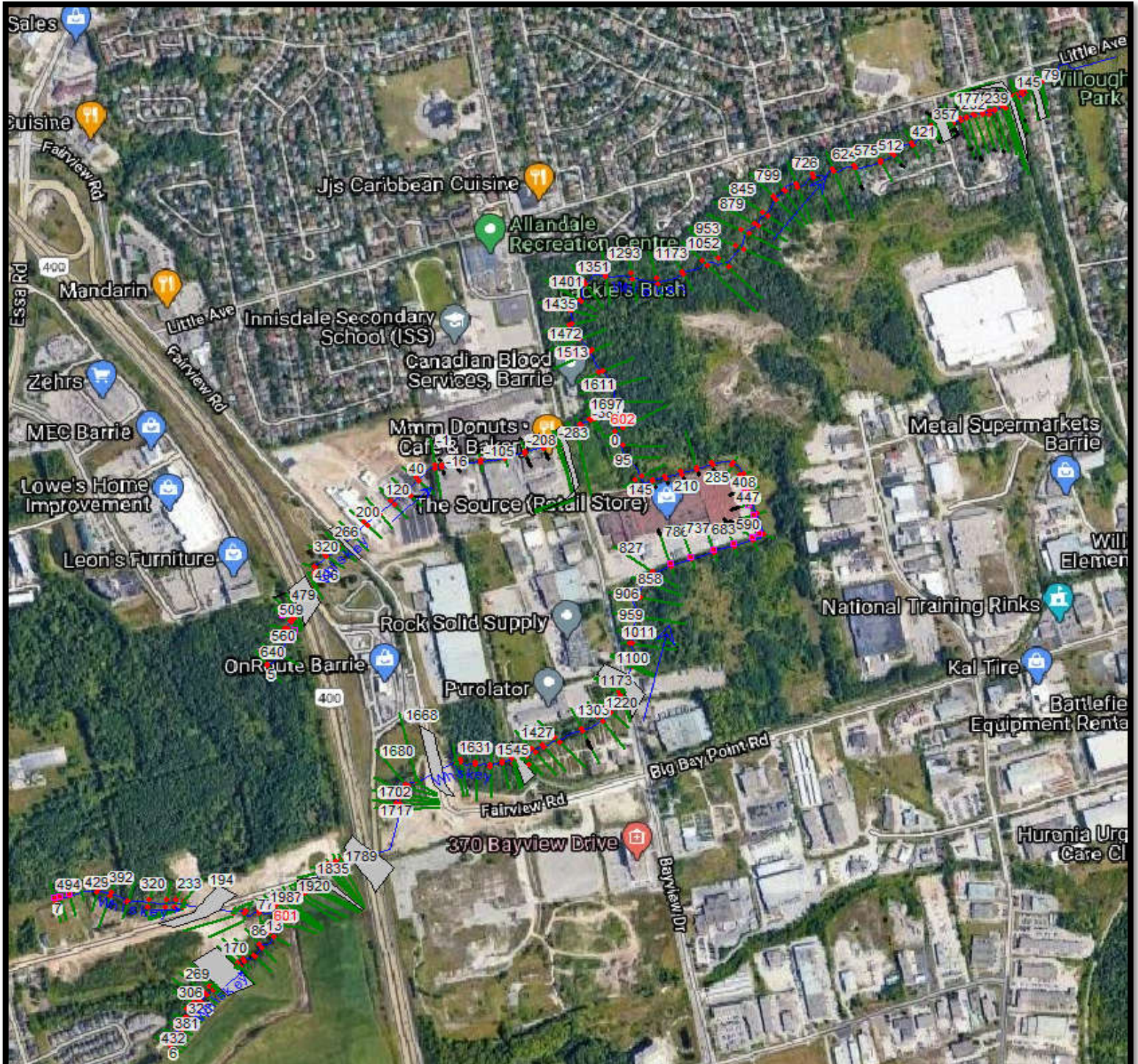
SCALE	HOR.	N.T.S.	VERT.	N.T.S.	CONTRACT NO.	2018-002T
DESIGN	DJ	DRAWN	DZ		SHEET NO.	STM18
REVIEWED	JL	DATE	2018.06.29			

DOC: H351997-70-260-SEG1-0027-001

Spills Analysis and Discrete Calculations

PROJECT	Whiskey Creek at Minet's Point EA	FILE	120114
		DATE	March 15, 2021
SUBJECT	Whiskey Creek Main Branch and North Tributary at Highway 400	NAME	DAM
		PAGE	1 OF 1

HEC-RAS Geometry For Whiskey Creek Main Branch and North Tributary at Highway 400 Crossings



HEC-RAS Plan: MajSpill

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
5	640	Hwy 400 - Cap. 1	0.90	288.10	288.31	288.31	288.39	0.024656	1.29	1.01	9.24	0.95
5	640	Hwy 400 - Cap. 2	1.00	288.10	288.33	288.33	288.40	0.020032	1.25	1.23	10.69	0.87
5	640	100 YR	0.55	288.10	288.26	288.26	288.33	0.028222	1.13	0.61	6.93	0.97
5	640	Regional	1.41	288.10	288.37	288.37	288.46	0.020056	1.40	1.66	11.33	0.90
5	640	Regional - Widen	1.41	288.10	288.37	288.37	288.46	0.020056	1.40	1.66	11.33	0.90
5	600	Hwy 400 - Cap. 1	0.90	286.85	287.07	287.07	287.14	0.025581	1.13	0.81	5.86	0.93
5	600	Hwy 400 - Cap. 2	1.00	286.85	287.09	287.08	287.16	0.025045	1.17	0.87	5.98	0.93
5	600	100 YR	0.55	286.85	287.04	287.03	287.08	0.021554	0.89	0.62	5.38	0.82
5	600	Regional	1.41	286.85	287.12	287.12	287.21	0.025567	1.35	1.09	6.44	0.97
5	600	Regional - Widen	1.41	286.85	287.12	287.12	287.21	0.025765	1.35	1.09	6.43	0.97
5	560	Hwy 400 - Cap. 1	0.90	285.90	286.08	286.07	286.13	0.024498	1.05	0.92	8.13	0.90
5	560	Hwy 400 - Cap. 2	1.00	285.90	286.08	286.08	286.15	0.025161	1.11	0.98	8.32	0.92
5	560	100 YR	0.55	285.90	286.04	286.03	286.08	0.029291	0.92	0.61	7.03	0.93
5	560	Regional	1.41	285.90	286.12	286.12	286.19	0.025072	1.26	1.27	9.09	0.95
5	560	Regional - Widen	1.41	285.90	286.12	286.12	286.19	0.024829	1.26	1.27	9.10	0.94
5	534	Hwy 400 - Cap. 1	0.90	285.52	285.72	285.68	285.75	0.009992	0.76	1.83	15.01	0.59
5	534	Hwy 400 - Cap. 2	1.00	285.52	285.73	285.69	285.76	0.009802	0.79	1.99	15.23	0.59
5	534	100 YR	0.55	285.52	285.69	285.65	285.70	0.008585	0.61	1.33	13.92	0.53
5	534	Regional	1.41	285.52	285.77	285.72	285.80	0.009964	0.89	2.53	15.96	0.62
5	534	Regional - Widen	1.41	285.52	285.77	285.72	285.80	0.010038	0.89	2.53	15.95	0.62
5	509	Hwy 400 - Cap. 1	0.90	285.23	285.41	285.41	285.45	0.024372	1.02	1.73	22.11	0.89
5	509	Hwy 400 - Cap. 2	1.00	285.23	285.42	285.42	285.46	0.025683	1.08	1.84	22.24	0.92
5	509	100 YR	0.55	285.23	285.38	285.38	285.41	0.031682	0.94	1.01	17.09	0.96
5	509	Regional	1.41	285.23	285.44	285.44	285.49	0.027042	1.22	2.34	22.91	0.97
5	509	Regional - Widen	1.41	285.23	285.44	285.44	285.49	0.027042	1.22	2.34	22.91	0.97
5	495	Hwy 400 - Cap. 1	0.90	284.55	284.78	284.78	284.84	0.022016	1.12	1.05	11.37	0.88
5	495	Hwy 400 - Cap. 2	1.00	284.55	284.79	284.79	284.85	0.021387	1.15	1.17	11.68	0.87
5	495	100 YR	0.55	284.55	284.73	284.73	284.78	0.029966	1.03	0.56	7.00	0.96
5	495	Regional	2.32	284.55	285.00	284.89	285.03	0.004794	0.92	5.26	33.64	0.47
5	495	Regional - Widen	1.76	284.55	284.85	284.85	284.93	0.020010	1.36	1.98	14.39	0.89
5	494		Lat Struct									
5	479	Hwy 400 - Cap. 1	0.90	283.69	284.27	284.10	284.31	0.005734	0.89	1.01	2.82	0.48
5	479	Hwy 400 - Cap. 2	1.00	283.69	284.32	284.12	284.36	0.004973	0.87	1.15	2.96	0.45
5	479	100 YR	0.55	283.69	284.00	284.00	284.11	0.028257	1.42	0.39	1.80	0.98
5	479	Regional	2.26	283.69	284.96	284.32	284.98	0.001040	0.58	3.91	51.63	0.23
5	479	Regional - Widen	1.76	283.69	284.65	284.25	284.68	0.002400	0.76	2.31	4.48	0.33
5	454		Culvert									
5	406	Hwy 400 - Cap. 1	0.90	283.21	283.55	283.55	283.67	0.021002	1.62	0.64	2.75	0.94
5	406	Hwy 400 - Cap. 2	1.00	283.21	283.57	283.57	283.70	0.020992	1.69	0.69	2.82	0.95
5	406	100 YR	0.55	283.21	283.47	283.47	283.56	0.023715	1.40	0.43	2.41	0.94
5	406	Regional	2.26	283.21	283.77	283.77	283.98	0.018007	2.16	1.35	3.68	0.95
5	406	Regional - Widen	1.76	283.21	283.69	283.69	283.88	0.019996	2.04	1.07	3.32	0.97
5	375	Hwy 400 - Cap. 1	0.90	281.90	282.35	282.35	282.49	0.020727	1.74	0.62	2.54	0.93
5	375	Hwy 400 - Cap. 2	1.00	281.90	282.37	282.37	282.52	0.020316	1.79	0.68	2.65	0.93
5	375	100 YR	0.55	281.90	282.25	282.25	282.37	0.023959	1.52	0.40	2.08	0.95
5	375	Regional	2.26	281.90	282.63	282.63	282.81	0.013767	2.09	1.70	5.91	0.84
5	375	Regional - Widen	1.76	281.90	282.52	282.52	282.72	0.017873	2.11	1.17	4.19	0.92
5	360	Hwy 400 - Cap. 1	0.90	281.54	281.90	281.90	281.99	0.028578	1.33	0.68	4.14	1.00
5	360	Hwy 400 - Cap. 2	1.00	281.54	281.92	281.92	282.01	0.027941	1.37	0.74	4.34	1.00
5	360	100 YR	0.55	281.54	281.86	281.84	281.92	0.024221	1.07	0.51	3.50	0.89
5	360	Regional	2.26	281.54	282.06	282.06	282.20	0.019515	1.67	1.56	7.04	0.92
5	360	Regional - Widen	1.76	281.54	282.01	282.01	282.13	0.021067	1.57	1.24	6.14	0.93
5	320	Hwy 400 - Cap. 1	0.90	280.52	280.73	280.73	280.79	0.031572	1.09	0.84	7.67	1.00
5	320	Hwy 400 - Cap. 2	1.00	280.52	280.74	280.74	280.80	0.028905	1.11	0.93	7.89	0.97
5	320	100 YR	0.55	280.52	280.69	280.69	280.74	0.036818	0.94	0.59	7.03	1.02
5	320	Regional	2.26	280.52	280.91		280.96	0.007509	0.98	2.79	13.18	0.57
5	320	Regional - Widen	1.76	280.52	280.82	280.80	280.89	0.017415	1.17	1.67	10.68	0.81
5	280	Hwy 400 - Cap. 1	2.52	279.72	280.70	280.15	280.71	0.000334	0.42	8.99	20.97	0.14
5	280	Hwy 400 - Cap. 2	2.62	279.72	280.73	280.16	280.73	0.000320	0.42	9.35	21.45	0.14
5	280	100 YR	2.17	279.72	280.61	280.12	280.61	0.000395	0.42	7.68	18.63	0.15
5	280	Regional	3.31	279.72	280.90	280.20	280.90	0.000255	0.42	11.71	24.44	0.13
5	280	Regional - Widen	2.93	279.72	280.81	280.18	280.81	0.000286	0.42	10.44	22.68	0.13
5	266		Culvert									
5	240	Hwy 400 - Cap. 1	2.52	279.16	279.49	279.45	279.55	0.011536	1.07	2.66	14.30	0.68
5	240	Hwy 400 - Cap. 2	2.62	279.16	279.50	279.46	279.56	0.011666	1.09	2.72	14.45	0.69
5	240	100 YR	2.17	279.16	279.48	279.43	279.52	0.011226	1.00	2.41	13.69	0.66
5	240	Regional	3.31	279.16	279.53	279.49	279.60	0.012209	1.20	3.15	15.28	0.72

HEC-RAS Plan: MajSpill (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
5	240	Regional - Widen	2.93	279.16	279.51	279.47	279.57	0.012084	1.15	2.91	14.82	0.70
5	200	Hwy 400 - Cap. 1	2.52	278.60	278.78	278.78	278.86	0.027811	1.20	2.26	17.09	0.97
5	200	Hwy 400 - Cap. 2	2.62	278.60	278.79	278.79	278.86	0.027418	1.21	2.33	17.22	0.97
5	200	100 YR	2.17	278.60	278.77	278.77	278.84	0.028601	1.14	2.02	16.68	0.97
5	200	Regional	3.31	278.60	278.81	278.81	278.90	0.026263	1.31	2.77	17.97	0.98
5	200	Regional - Widen	2.93	278.60	278.80	278.80	278.88	0.026406	1.25	2.54	17.57	0.97
5	160	Hwy 400 - Cap. 1	2.52	277.54	277.72	277.70	277.77	0.019917	1.01	2.61	18.77	0.82
5	160	Hwy 400 - Cap. 2	2.62	277.54	277.72	277.70	277.77	0.020200	1.03	2.66	18.83	0.83
5	160	100 YR	2.17	277.54	277.71	277.69	277.75	0.019203	0.94	2.40	18.57	0.80
5	160	Regional	3.31	277.54	277.74	277.73	277.81	0.021074	1.14	3.06	19.22	0.87
5	160	Regional - Widen	2.93	277.54	277.73	277.72	277.79	0.020654	1.08	2.84	19.01	0.85
5	120	Hwy 400 - Cap. 1	2.52	276.50	276.74	276.74	276.83	0.027776	1.26	2.05	14.16	0.99
5	120	Hwy 400 - Cap. 2	2.62	276.50	276.75	276.75	276.83	0.027252	1.27	2.12	14.30	0.98
5	120	100 YR	2.17	276.50	276.73	276.73	276.80	0.029310	1.21	1.82	13.60	1.00
5	120	Regional	3.31	276.50	276.78	276.78	276.87	0.025525	1.37	2.54	14.87	0.98
5	120	Regional - Widen	2.93	276.50	276.76	276.76	276.85	0.026350	1.32	2.31	14.60	0.98
5	80	Hwy 400 - Cap. 1	2.52	275.44	275.67	275.62	275.69	0.008701	0.68	3.95	28.61	0.55
5	80	Hwy 400 - Cap. 2	2.62	275.44	275.68	275.62	275.70	0.008335	0.68	4.11	28.96	0.54
5	80	100 YR	2.17	275.44	275.66	275.61	275.68	0.008412	0.63	3.62	28.14	0.53
5	80	Regional	3.31	275.44	275.70	275.64	275.72	0.008871	0.76	4.70	29.98	0.57
5	80	Regional - Widen	2.93	275.44	275.69	275.63	275.71	0.008568	0.71	4.39	29.48	0.55
5	40	Hwy 400 - Cap. 1	2.52	274.87	275.01	275.01	275.05	0.037322	1.15	3.09	32.81	1.08
5	40	Hwy 400 - Cap. 2	2.62	274.87	275.01	275.01	275.06	0.041090	1.21	3.07	32.77	1.13
5	40	100 YR	2.17	274.87	275.00	275.00	275.04	0.039839	1.12	2.74	31.96	1.10
5	40	Regional	3.31	274.87	275.03	275.03	275.08	0.036102	1.26	3.77	34.70	1.09
5	40	Regional - Widen	2.93	274.87	275.01	275.01	275.07	0.038639	1.23	3.39	33.77	1.11
5	-1	Hwy 400 - Cap. 1	3.83	272.67	273.39		273.48	0.008651	1.31	2.92	6.70	0.63
5	-1	Hwy 400 - Cap. 2	3.93	272.67	273.40		273.49	0.008591	1.32	2.98	6.76	0.63
5	-1	100 YR	3.87	272.67	273.39		273.48	0.008625	1.31	2.95	6.73	0.63
5	-1	Regional	5.48	272.67	273.54		273.63	0.007575	1.39	3.95	7.51	0.61
5	-1	Regional - Widen	5.10	272.67	273.50		273.60	0.007806	1.37	3.71	7.34	0.62
5	-16	Hwy 400 - Cap. 1	3.83	272.43	273.14	273.08	273.30	0.015374	1.79	2.14	4.89	0.84
5	-16	Hwy 400 - Cap. 2	3.93	272.43	273.14	273.09	273.31	0.015349	1.81	2.18	4.91	0.85
5	-16	100 YR	3.87	272.43	273.14	273.09	273.30	0.015379	1.80	2.16	4.90	0.85
5	-16	Regional	5.48	272.43	273.24	273.20	273.46	0.015975	2.09	2.66	5.31	0.89
5	-16	Regional - Widen	5.10	272.43	273.22	273.17	273.43	0.015773	2.03	2.55	5.22	0.88
5	-52	Hwy 400 - Cap. 1	3.83	271.90	272.43	272.43	272.64	0.022687	2.01	1.90	4.64	1.00
5	-52	Hwy 400 - Cap. 2	3.93	271.90	272.44	272.44	272.65	0.022709	2.03	1.94	4.66	1.00
5	-52	100 YR	3.87	271.90	272.43	272.43	272.64	0.022664	2.02	1.92	4.65	1.00
5	-52	Regional	5.48	271.90	272.54	272.54	272.80	0.021493	2.24	2.45	4.98	1.01
5	-52	Regional - Widen	5.10	271.90	272.52	272.52	272.76	0.021681	2.18	2.34	4.91	1.00
5	-105	Hwy 400 - Cap. 1	3.83	270.60	271.17	271.17	271.35	0.023501	1.86	2.05	5.90	1.01
5	-105	Hwy 400 - Cap. 2	3.93	270.60	271.18	271.18	271.36	0.023499	1.88	2.09	5.93	1.01
5	-105	100 YR	3.87	270.60	271.17	271.17	271.35	0.023488	1.87	2.07	5.92	1.01
5	-105	Regional	5.48	270.60	271.27	271.27	271.48	0.022204	2.05	2.67	6.31	1.01
5	-105	Regional - Widen	5.10	270.60	271.25	271.25	271.46	0.022509	2.02	2.53	6.22	1.01
5	-160	Hwy 400 - Cap. 1	3.83	269.40	270.83		270.85	0.000417	0.57	7.51	8.16	0.16
5	-160	Hwy 400 - Cap. 2	3.93	269.40	270.89		270.90	0.000373	0.55	7.97	8.36	0.16
5	-160	100 YR	3.87	269.40	271.15		271.16	0.000182	0.44	10.30	9.39	0.11
5	-160	Regional	5.48	269.40	271.19		271.21	0.000327	0.60	10.72	9.57	0.15
5	-160	Regional - Widen	5.10	269.40	270.97		270.99	0.000499	0.67	8.68	8.67	0.18
5	-208	Hwy 400 - Cap. 1	3.83	269.10	270.83		270.84	0.000061	0.25	20.35	19.28	0.07
5	-208	Hwy 400 - Cap. 2	3.93	269.10	270.89		270.89	0.000055	0.25	21.42	19.37	0.06
5	-208	100 YR	3.87	269.10	271.15		271.15	0.000028	0.20	26.54	19.83	0.05
5	-208	Regional	5.48	269.10	271.20		271.20	0.000051	0.27	27.48	19.92	0.06
5	-208	Regional - Widen	5.10	269.10	270.97		270.98	0.000075	0.30	23.07	19.52	0.07
5	-252	Hwy 400 - Cap. 1	3.83	269.00	270.83		270.83	0.000035	0.20	24.77	21.56	0.05
5	-252	Hwy 400 - Cap. 2	3.93	269.00	270.89		270.89	0.000032	0.19	25.98	21.65	0.05
5	-252	100 YR	3.87	269.00	271.15		271.15	0.000017	0.16	31.70	22.08	0.04
5	-252	Regional	5.48	269.00	271.20		271.20	0.000031	0.22	32.73	22.18	0.05
5	-252	Regional - Widen	5.10	269.00	270.97		270.98	0.000044	0.24	27.81	21.78	0.06
5	-283	Hwy 400 - Cap. 1	3.83	268.50	270.83		270.83	0.000011	0.13	69.59	151.82	0.03
5	-283	Hwy 400 - Cap. 2	3.93	268.50	270.89		270.89	0.000009	0.12	78.20	156.90	0.03
5	-283	100 YR	3.87	268.50	271.15		271.15	0.000003	0.08	126.90	197.63	0.02
5	-283	Regional	5.48	268.50	271.20		271.20	0.000005	0.10	136.18	198.28	0.02
5	-283	Regional - Widen	5.10	268.50	270.97		270.97	0.000011	0.14	92.81	180.51	0.03
5	-289	Hwy 400 - Cap. 1	5.76	268.40	270.82	269.09	270.83	0.000078	0.36	16.77	188.76	0.08
5	-289	Hwy 400 - Cap. 2	5.86	268.40	270.88	269.09	270.89	0.000074	0.36	17.22	192.63	0.08

HEC-RAS Plan: MajSpill (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
5	-289	100 YR	6.31	268.40	271.14	269.12	271.15	0.000058	0.35	19.35	214.95	0.07
5	-289	Regional	6.39	268.40	271.19	269.12	271.19	0.000056	0.34	19.73	217.60	0.07
5	-289	Regional - Widen	6.01	268.40	270.96	269.10	270.97	0.000068	0.36	17.91	200.88	0.07
5	-309	Culvert										
5	-330	Hwy 400 - Cap. 1	5.76	264.10	264.91	264.75	265.07	0.008619	1.75	3.30	5.82	0.67
5	-330	Hwy 400 - Cap. 2	5.86	264.10	264.92	264.75	265.08	0.008541	1.75	3.34	5.84	0.67
5	-330	100 YR	6.31	264.10	264.96	264.78	265.12	0.008235	1.79	3.53	5.97	0.66
5	-330	Regional	6.39	264.10	264.97	264.79	265.13	0.008191	1.79	3.56	5.99	0.66
5	-330	Regional - Widen	6.01	264.10	264.93	264.76	265.09	0.008430	1.76	3.41	5.89	0.67
5	-335	Hwy 400 - Cap. 1	5.76	263.70	264.63	264.63	264.92	0.020850	2.38	2.43	4.40	0.99
5	-335	Hwy 400 - Cap. 2	5.86	263.70	264.64	264.64	264.93	0.020728	2.39	2.46	4.42	0.99
5	-335	100 YR	6.31	263.70	264.67	264.67	264.97	0.020191	2.44	2.61	4.54	0.99
5	-335	Regional	6.39	263.70	264.68	264.68	264.98	0.020099	2.45	2.63	4.56	0.99
5	-335	Regional - Widen	6.01	263.70	264.65	264.65	264.94	0.020543	2.41	2.51	4.46	0.99
5	-356	Hwy 400 - Cap. 1	5.76	262.70	263.29	263.29	263.55	0.020415	2.23	2.62	5.51	0.99
5	-356	Hwy 400 - Cap. 2	5.86	262.70	263.30	263.30	263.56	0.020265	2.24	2.65	5.53	0.99
5	-356	100 YR	6.31	262.70	263.33	263.33	263.59	0.019892	2.29	2.80	5.62	0.99
5	-356	Regional	6.39	262.70	263.33	263.33	263.60	0.019806	2.30	2.82	5.63	0.99
5	-356	Regional - Widen	6.01	262.70	263.31	263.31	263.57	0.020147	2.25	2.70	5.56	0.99
5	-381	Hwy 400 - Cap. 1	5.76	261.50	262.22	262.22	262.47	0.016648	2.24	2.82	6.42	0.93
5	-381	Hwy 400 - Cap. 2	5.86	261.50	262.23	262.23	262.48	0.016517	2.25	2.86	6.46	0.93
5	-381	100 YR	6.31	261.50	262.26	262.26	262.51	0.016246	2.30	3.05	6.65	0.93
5	-381	Regional	6.39	261.50	262.26	262.26	262.52	0.016207	2.31	3.08	6.68	0.93
5	-381	Regional - Widen	6.01	261.50	262.24	262.24	262.49	0.016509	2.27	2.92	6.52	0.93
5	-390	Hwy 400 - Cap. 1	5.76	259.95	260.86	260.85	261.15	0.017668	2.41	2.52	4.87	0.94
5	-390	Hwy 400 - Cap. 2	5.86	259.95	260.86	260.86	261.16	0.017772	2.43	2.55	4.89	0.94
5	-390	100 YR	6.31	259.95	260.90	260.90	261.20	0.017058	2.46	2.73	5.08	0.93
5	-390	Regional	6.39	259.95	260.90	260.90	261.21	0.017206	2.48	2.74	5.10	0.94
5	-390	Regional - Widen	6.01	259.95	260.87	260.87	261.17	0.017745	2.45	2.59	4.95	0.95
7	494	Hwy 400 - Cap. 1	1.18	301.20	301.52	301.48	301.59	0.015478	1.25	0.98	4.40	0.79
7	494	Hwy 400 - Cap. 2	1.55	301.20	301.56	301.53	301.65	0.016178	1.41	1.16	4.69	0.82
7	494	100 YR	3.07	301.20	301.68	301.68	301.85	0.018270	1.89	1.81	5.79	0.93
7	494	Regional	2.41	301.20	301.63	301.62	301.77	0.017375	1.70	1.54	5.33	0.89
7	494	Regional - Widen	2.41	301.20	301.63	301.62	301.77	0.017375	1.70	1.54	5.33	0.89
7	480	Hwy 400 - Cap. 1	1.18	301.00	301.33	301.31	301.41	0.015615	1.27	1.04	5.86	0.79
7	480	Hwy 400 - Cap. 2	1.55	301.00	301.37	301.35	301.46	0.015315	1.39	1.30	6.41	0.80
7	480	100 YR	3.07	301.00	301.49	301.48	301.62	0.016122	1.78	2.14	7.59	0.87
7	480	Regional	2.41	301.00	301.44	301.43	301.56	0.015984	1.64	1.79	7.17	0.85
7	480	Regional - Widen	2.41	301.00	301.44	301.43	301.56	0.015984	1.64	1.79	7.17	0.85
7	457	Hwy 400 - Cap. 1	1.18	300.60	300.90	300.90	300.99	0.020140	1.48	0.96	5.12	0.91
7	457	Hwy 400 - Cap. 2	1.55	300.60	300.94	300.94	301.05	0.020359	1.63	1.18	5.51	0.93
7	457	100 YR	3.07	300.60	301.08	301.08	301.23	0.018000	1.97	2.05	6.81	0.93
7	457	Regional	2.41	300.60	301.02	301.02	301.16	0.018767	1.84	1.68	6.33	0.93
7	457	Regional - Widen	2.41	300.60	301.02	301.02	301.16	0.018767	1.84	1.68	6.33	0.93
7	429	Hwy 400 - Cap. 1	1.18	299.00	299.21		299.26	0.012672	0.93	1.35	8.68	0.68
7	429	Hwy 400 - Cap. 2	1.55	299.00	299.25		299.30	0.011637	1.00	1.68	9.31	0.67
7	429	100 YR	3.07	299.00	299.35	299.30	299.43	0.011592	1.28	2.74	11.15	0.71
7	429	Regional	2.41	299.00	299.32	299.26	299.38	0.011360	1.17	2.32	10.43	0.69
7	429	Regional - Widen	2.41	299.00	299.32	299.26	299.38	0.011360	1.17	2.32	10.43	0.69
7	392	Hwy 400 - Cap. 1	1.18	298.30	298.59	298.58	298.67	0.020161	1.24	1.01	6.14	0.87
7	392	Hwy 400 - Cap. 2	1.55	298.30	298.62	298.62	298.72	0.021721	1.41	1.20	6.73	0.92
7	392	100 YR	3.07	298.30	298.74	298.74	298.88	0.019060	1.73	2.17	9.21	0.93
7	392	Regional	2.41	298.30	298.69	298.69	298.82	0.020415	1.62	1.73	8.20	0.93
7	392	Regional - Widen	2.41	298.30	298.69	298.69	298.82	0.020415	1.62	1.73	8.20	0.93
7	362	Hwy 400 - Cap. 1	1.18	297.70	297.86	297.86	297.93	0.030644	1.12	1.05	8.40	0.99
7	362	Hwy 400 - Cap. 2	1.55	297.70	297.89	297.89	297.96	0.029037	1.21	1.29	9.00	0.99
7	362	100 YR	3.07	297.70	297.98	297.98	298.09	0.024378	1.50	2.15	10.43	0.98
7	362	Regional	2.41	297.70	297.94	297.94	298.04	0.026069	1.39	1.79	9.88	0.99
7	362	Regional - Widen	2.41	297.70	297.94	297.94	298.04	0.026069	1.39	1.79	9.88	0.99
7	320	Hwy 400 - Cap. 1	1.18	296.70	296.95	296.95	297.00	0.015200	1.13	1.63	17.57	0.76
7	320	Hwy 400 - Cap. 2	1.55	296.70	296.97	296.97	297.03	0.015923	1.24	2.06	17.95	0.80
7	320	100 YR	3.07	296.70	297.04	297.04	297.13	0.018041	1.57	3.41	19.16	0.88
7	320	Regional	2.41	296.70	297.01	297.01	297.09	0.017564	1.45	2.85	18.66	0.86
7	320	Regional - Widen	2.41	296.70	297.01	297.01	297.09	0.017564	1.45	2.85	18.66	0.86
7	271	Hwy 400 - Cap. 1	1.18	295.30	295.37	295.36	295.39	0.025888	0.69	2.05	30.46	0.83
7	271	Hwy 400 - Cap. 2	1.55	295.30	295.38	295.37	295.41	0.027159	0.78	2.40	30.94	0.87
7	271	100 YR	3.07	295.30	295.42	295.41	295.47	0.028744	1.03	3.65	33.84	0.95
7	271	Regional	2.41	295.30	295.41	295.40	295.44	0.028527	0.94	3.13	33.52	0.93

HEC-RAS Plan: MajSpill (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
7	271	Regional - Widen	2.41	295.30	295.41	295.40	295.44	0.028527	0.94	3.13	33.52	0.93
7	233	Hwy 400 - Cap. 1	1.18	294.34	294.45	294.43	294.46	0.023281	0.48	2.72	40.79	0.72
7	233	Hwy 400 - Cap. 2	1.55	294.34	294.47	294.44	294.48	0.022353	0.53	3.28	44.02	0.73
7	233	100 YR	3.07	294.34	294.51	294.47	294.53	0.021604	0.74	5.13	51.97	0.79
7	233	Regional	2.41	294.34	294.49	294.46	294.51	0.021529	0.66	4.38	48.17	0.76
7	233	Regional - Widen	2.41	294.34	294.49	294.46	294.51	0.021529	0.66	4.38	48.17	0.76
7	211	Hwy 400 - Cap. 1	1.18	293.66	293.48	293.48	293.53	0.089933		1.15	9.98	0.00
7	211	Hwy 400 - Cap. 2	1.55	293.66	293.50	293.50	293.56	0.093869		1.40	11.13	0.00
7	211	100 YR	3.07	293.66	293.58	293.58	293.66	0.087359		2.44	14.86	0.00
7	211	Regional	2.41	293.66	293.55	293.55	293.62	0.093602		1.98	13.41	0.00
7	211	Regional - Widen	2.41	293.66	293.55	293.55	293.62	0.093602		1.98	13.41	0.00
7	194	Hwy 400 - Cap. 1	1.37	292.00	292.40	292.40	292.53	0.026680	1.61	0.85	5.19	1.01
7	194	Hwy 400 - Cap. 2	1.80	292.00	292.46	292.46	292.61	0.025135	1.69	1.07	7.42	1.00
7	194	100 YR	3.59	292.00	293.12	292.65	293.15	0.001808	0.75	4.80	46.06	0.30
7	194	Regional	4.16	292.00	293.14	292.69	293.18	0.002156	0.84	4.98	46.81	0.33
7	194	Regional - Widen	4.16	292.00	293.14	292.69	293.18	0.002156	0.84	4.98	46.81	0.33
7	121	Culvert										
7	77	Hwy 400 - Cap. 1	1.37	289.29	290.01	289.69	290.02	0.001142	0.49	2.80	8.86	0.23
7	77	Hwy 400 - Cap. 2	1.80	289.29	291.13	289.73	291.13	0.000031	0.18	9.75	11.73	0.05
7	77	100 YR	3.59	289.29	289.87	289.87	290.04	0.023024	1.84	1.95	7.18	1.00
7	77	Regional	4.16	289.29	291.49	289.91	291.49	0.000082	0.35	11.99	12.90	0.08
7	77	Regional - Widen	4.16	289.29	291.41	289.91	291.42	0.000094	0.36	11.52	12.34	0.08
7	51	Hwy 400 - Cap. 1	1.37	288.19	290.01		290.01	0.000012	0.11	16.03	15.12	0.03
7	51	Hwy 400 - Cap. 2	1.80	288.19	291.13		291.13	0.000002	0.07	47.33	32.63	0.01
7	51	100 YR	3.59	288.19	288.80	288.75	288.92	0.014552	1.51	2.44	7.33	0.79
7	51	Regional	4.16	288.19	291.49		291.49	0.000006	0.12	59.25	33.65	0.02
7	51	Regional - Widen	4.16	288.19	291.41		291.41	0.000007	0.13	56.73	33.44	0.02
7	16	Hwy 400 - Cap. 1	1.37	287.73	290.01		290.01	0.000001	0.05	46.44	33.45	0.01
7	16	Hwy 400 - Cap. 2	1.80	287.73	291.13		291.13	0.000000	0.04	87.73	40.02	0.01
7	16	100 YR	3.59	287.73	288.04	288.04	288.17	0.024244	1.60	2.33	9.56	1.00
7	16	Regional	4.16	287.73	291.49		291.49	0.000001	0.07	102.38	41.41	0.01
7	16	Regional - Widen	4.16	287.73	291.41		291.41	0.000002	0.07	99.27	41.16	0.01
6	432	Hwy 400 - Cap. 1	5.50	293.40	294.01	294.01	294.17	0.012086	1.94	4.88	18.05	0.80
6	432	Hwy 400 - Cap. 2	7.33	293.40	294.09	294.09	294.26	0.012528	2.14	6.24	19.65	0.83
6	432	100 YR	14.60	293.40	294.45		294.57	0.006355	2.03	14.61	25.41	0.64
6	432	Regional	11.43	293.40	294.29		294.44	0.008582	2.11	10.72	23.71	0.72
6	432	Regional - Widen	11.43	293.40	294.29		294.44	0.008582	2.11	10.72	23.71	0.72
6	420	Hwy 400 - Cap. 1	5.50	292.60	293.50	293.50	293.81	0.015987	2.60	2.89	5.94	0.95
6	420	Hwy 400 - Cap. 2	7.33	292.60	293.65	293.65	293.99	0.014681	2.80	3.90	7.90	0.93
6	420	100 YR	14.60	292.60	294.12	294.12	294.42	0.009304	2.94	10.52	19.65	0.80
6	420	Regional	11.43	292.60	293.99	293.99	294.28	0.009430	2.77	8.10	17.10	0.79
6	420	Regional - Widen	11.43	292.60	293.99	293.99	294.28	0.009430	2.77	8.10	17.10	0.79
6	403	Hwy 400 - Cap. 1	5.50	292.70	293.43		293.52	0.006280	1.49	5.83	17.50	0.59
6	403	Hwy 400 - Cap. 2	7.33	292.70	293.62		293.69	0.003757	1.36	9.33	20.36	0.47
6	403	100 YR	14.60	292.70	293.98		294.06	0.003027	1.56	18.22	26.87	0.45
6	403	Regional	11.43	292.70	293.85		293.92	0.003183	1.47	14.66	25.16	0.45
6	403	Regional - Widen	11.43	292.70	293.85		293.92	0.003183	1.47	14.66	25.16	0.45
6	381	Hwy 400 - Cap. 1	5.50	292.20	293.45		293.47	0.000684	0.73	13.04	18.15	0.21
6	381	Hwy 400 - Cap. 2	7.33	292.20	293.62		293.64	0.000691	0.80	16.30	19.67	0.22
6	381	100 YR	14.60	292.20	293.97		294.01	0.001058	1.16	24.01	25.47	0.28
6	381	Regional	11.43	292.20	293.84		293.88	0.000903	1.02	20.90	22.44	0.26
6	381	Regional - Widen	11.43	292.20	293.84		293.88	0.000903	1.02	20.90	22.44	0.26
6	349	Hwy 400 - Cap. 1	5.50	292.30	293.09	293.09	293.38	0.016296	2.47	2.76	6.27	0.94
6	349	Hwy 400 - Cap. 2	7.33	292.30	293.25	293.25	293.56	0.013489	2.58	4.04	10.74	0.88
6	349	100 YR	14.60	292.30	293.64	293.64	293.92	0.009505	2.77	10.91	23.45	0.79
6	349	Regional	11.43	292.30	293.54	293.54	293.79	0.008893	2.54	8.74	20.55	0.75
6	349	Regional - Widen	11.43	292.30	293.54	293.54	293.79	0.008893	2.54	8.74	20.55	0.75
6	328	Hwy 400 - Cap. 1	5.50	291.50	291.93	291.93	292.08	0.027045	2.17	4.22	14.20	1.12
6	328	Hwy 400 - Cap. 2	7.33	291.50	291.99	291.99	292.17	0.026851	2.40	5.15	14.86	1.14
6	328	100 YR	14.60	291.50	293.33		293.35	0.000521	0.84	35.49	28.89	0.20
6	328	Regional	11.43	291.50	292.60		292.64	0.002658	1.33	16.43	22.26	0.41
6	328	Regional - Widen	11.43	291.50	292.60		292.64	0.002658	1.33	16.43	22.26	0.41
6	306	Hwy 400 - Cap. 1	5.50	291.00	291.73		291.78	0.003704	1.15	8.25	24.00	0.45
6	306	Hwy 400 - Cap. 2	7.33	291.00	291.89		291.93	0.002385	1.07	12.43	26.20	0.38
6	306	100 YR	14.60	291.00	293.33		293.34	0.000101	0.43	77.62	61.40	0.09
6	306	Regional	11.43	291.00	292.60		292.61	0.000388	0.65	38.13	48.49	0.17
6	306	Regional - Widen	11.43	291.00	292.60		292.61	0.000388	0.65	38.13	48.49	0.17

HEC-RAS Plan: MajSpill (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
6	290	Hwy 400 - Cap. 1	5.50	290.85	291.72		291.74	0.001153	0.75	10.84	17.84	0.26
6	290	Hwy 400 - Cap. 2	7.33	290.85	291.88		291.91	0.001036	0.80	13.84	18.79	0.26
6	290	100 YR	14.60	290.85	293.33		293.34	0.000112	0.48	65.54	53.55	0.10
6	290	Regional	11.43	290.85	292.59		292.61	0.000390	0.70	30.03	39.10	0.17
6	290	Regional - Widen	11.43	290.85	292.59		292.61	0.000390	0.70	30.03	39.10	0.17
6	269	Hwy 400 - Cap. 1	5.50	290.70	291.71		291.72	0.000362	0.48	13.70	15.94	0.15
6	269	Hwy 400 - Cap. 2	7.33	290.70	291.88		291.89	0.000381	0.54	16.85	22.22	0.16
6	269	100 YR	14.60	290.70	293.33		293.33	0.000057	0.36	72.91	48.01	0.07
6	269	Regional	11.43	290.70	292.59		292.60	0.000144	0.46	40.59	40.35	0.11
6	269	Regional - Widen	11.43	290.70	292.59		292.60	0.000144	0.46	40.59	40.35	0.11
6	249	Hwy 400 - Cap. 1	5.50	290.40	291.71		291.72	0.000108	0.29	27.76	32.64	0.09
6	249	Hwy 400 - Cap. 2	7.33	290.40	291.88		291.88	0.000118	0.33	33.30	34.71	0.09
6	249	100 YR	14.60	290.40	293.33		293.33	0.000028	0.26	95.37	49.82	0.05
6	249	Regional	11.43	290.40	292.59		292.60	0.000057	0.31	61.32	43.02	0.07
6	249	Regional - Widen	11.43	290.40	292.59		292.60	0.000057	0.31	61.32	43.02	0.07
6	241	Hwy 400 - Cap. 1	5.50	290.10	291.68	290.73	291.70	0.000485	0.70	9.23	29.68	0.19
6	241	Hwy 400 - Cap. 2	7.33	290.10	291.83	290.84	291.86	0.000614	0.84	10.25	31.09	0.21
6	241	100 YR	14.60	290.10	293.28	291.16	293.31	0.000271	0.86	20.13	42.23	0.16
6	241	Regional	11.43	290.10	292.54	291.03	292.58	0.000427	0.90	15.09	36.21	0.19
6	241	Regional - Widen	11.43	290.10	292.54	291.03	292.58	0.000427	0.90	15.09	36.21	0.19
6	204		Culvert									
6	170	Hwy 400 - Cap. 1	5.50	288.60	290.01	289.04	290.03	0.000376	0.60	9.17	21.28	0.16
6	170	Hwy 400 - Cap. 2	7.33	288.60	291.13	289.13	291.14	0.000093	0.44	16.56	48.79	0.09
6	170	100 YR	14.60	288.60	289.49	289.42	289.82	0.012915	2.57	5.70	14.63	0.88
6	170	Regional	11.43	288.60	291.49	289.30	291.51	0.000145	0.61	18.93	52.56	0.11
6	170	Regional - Widen	11.43	288.60	291.41	289.30	291.43	0.000159	0.62	18.43	51.76	0.12
6	164	Hwy 400 - Cap. 1	5.50	288.50	290.02		290.02	0.000067	0.27	26.35	23.75	0.07
6	164	Hwy 400 - Cap. 2	7.33	288.50	291.13		291.13	0.000014	0.18	65.88	48.86	0.04
6	164	100 YR	14.60	288.50	289.52		289.58	0.002025	1.11	15.58	19.49	0.36
6	164	Regional	11.43	288.50	291.49		291.49	0.000020	0.23	84.65	55.38	0.04
6	164	Regional - Widen	11.43	288.50	291.41		291.42	0.000022	0.24	80.54	54.16	0.04
6	150	Hwy 400 - Cap. 1	5.50	288.30	290.01		290.02	0.000112	0.37	26.50	33.74	0.09
6	150	Hwy 400 - Cap. 2	7.33	288.30	291.13		291.13	0.000016	0.20	76.31	52.45	0.04
6	150	100 YR	14.60	288.30	289.15	289.13	289.44	0.014003	2.59	7.37	12.95	0.91
6	150	Regional	11.43	288.30	291.49		291.49	0.000022	0.25	95.80	56.14	0.04
6	150	Regional - Widen	11.43	288.30	291.41		291.42	0.000024	0.26	91.62	55.29	0.05
6	119	Hwy 400 - Cap. 1	5.50	287.80	290.01		290.01	0.000039	0.26	44.80	41.75	0.06
6	119	Hwy 400 - Cap. 2	7.33	287.80	291.13		291.13	0.000009	0.16	99.80	56.25	0.03
6	119	100 YR	14.60	287.80	288.77	288.77	289.03	0.013411	2.60	8.98	18.25	0.90
6	119	Regional	11.43	287.80	291.49		291.49	0.000013	0.21	120.72	60.52	0.03
6	119	Regional - Widen	11.43	287.80	291.41		291.42	0.000014	0.21	116.21	59.44	0.04
6	86	Hwy 400 - Cap. 1	5.50	287.70	290.01		290.01	0.000010	0.14	68.25	49.90	0.03
6	86	Hwy 400 - Cap. 2	7.33	287.70	291.13		291.13	0.000003	0.10	128.78	57.85	0.02
6	86	100 YR	14.60	287.70	288.59		288.67	0.003505	1.34	14.07	22.73	0.46
6	86	Regional	11.43	287.70	291.49		291.49	0.000005	0.14	149.95	59.86	0.02
6	86	Regional - Widen	11.43	287.70	291.41		291.42	0.000005	0.14	145.47	59.42	0.02
6	43	Hwy 400 - Cap. 1	5.50	287.30	290.01		290.01	0.000005	0.11	75.54	50.05	0.02
6	43	Hwy 400 - Cap. 2	7.33	287.30	291.13		291.13	0.000002	0.09	140.11	66.67	0.01
6	43	100 YR	14.60	287.30	288.57		288.60	0.000749	0.79	22.69	25.88	0.23
6	43	Regional	11.43	287.30	291.49		291.49	0.000004	0.12	165.53	77.10	0.02
6	43	Regional - Widen	11.43	287.30	291.41		291.41	0.000004	0.13	159.75	76.88	0.02
6	13	Hwy 400 - Cap. 1	5.50	287.20	290.01		290.01	0.000007	0.13	101.47	73.33	0.02
6	13	Hwy 400 - Cap. 2	7.33	287.20	291.13		291.13	0.000002	0.09	195.61	91.92	0.01
6	13	100 YR	14.60	287.20	288.31	288.31	288.52	0.009440	2.38	11.51	29.81	0.77
6	13	Regional	11.43	287.20	291.49		291.49	0.000003	0.11	229.54	96.76	0.02
6	13	Regional - Widen	11.43	287.20	291.41		291.41	0.000004	0.12	222.31	95.76	0.02
6	0	Hwy 400 - Cap. 1	5.50	287.00	290.01		290.01	0.000003	0.08	157.42	99.06	0.01
6	0	Hwy 400 - Cap. 2	7.33	287.00	291.13		291.13	0.000001	0.06	279.08	117.16	0.01
6	0	100 YR	14.60	287.00	288.12	288.12	288.31	0.008063	2.18	12.29	39.01	0.70
6	0	Regional	11.43	287.00	291.49		291.49	0.000001	0.08	322.17	122.83	0.01
6	0	Regional - Widen	11.43	287.00	291.41		291.41	0.000002	0.08	313.00	121.43	0.01
4	1987	Hwy 400 - Cap. 1	12.00	285.98	290.01		290.01	0.000003	0.11	220.21	116.02	0.02
4	1987	Hwy 400 - Cap. 2	13.00	285.98	291.13		291.13	0.000001	0.07	359.22	133.46	0.01
4	1987	100 YR	5.58	285.98	287.34		287.38	0.001350	0.99	7.02	9.34	0.30
4	1987	Regional	18.52	285.98	291.49		291.49	0.000001	0.08	408.06	138.26	0.01
4	1987	Regional - Widen	18.52	285.98	291.41		291.41	0.000001	0.09	397.71	137.23	0.01
4	1968	Hwy 400 - Cap. 1	12.00	285.55	290.01		290.01	0.000003	0.11	222.82	113.97	0.02
4	1968	Hwy 400 - Cap. 2	13.00	285.55	291.13		291.13	0.000001	0.07	356.91	125.60	0.01

HEC-RAS Plan: MajSpill (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
4	1968	100 YR	5.58	285.55	287.33		287.36	0.000745	0.84	10.15	33.66	0.23
4	1968	Regional	18.52	285.55	291.49		291.49	0.000001	0.09	402.88	130.22	0.01
4	1968	Regional - Widen	18.52	285.55	291.41		291.41	0.000001	0.09	393.14	129.18	0.01
4	1951	Hwy 400 - Cap. 1	12.00	285.39	290.01		290.01	0.000002	0.09	241.41	111.87	0.01
4	1951	Hwy 400 - Cap. 2	13.00	285.39	291.13		291.13	0.000001	0.06	371.94	122.70	0.01
4	1951	100 YR	5.58	285.39	287.34		287.35	0.000177	0.41	22.70	39.04	0.11
4	1951	Regional	18.52	285.39	291.49		291.49	0.000001	0.08	416.95	127.71	0.01
4	1951	Regional - Widen	18.52	285.39	291.41		291.41	0.000001	0.08	407.39	126.65	0.01
4	1934	Hwy 400 - Cap. 1	12.00	285.01	290.01		290.01	0.000002	0.09	254.20	106.78	0.01
4	1934	Hwy 400 - Cap. 2	13.00	285.01	291.13		291.13	0.000001	0.07	381.69	120.97	0.01
4	1934	100 YR	5.58	285.01	287.34		287.35	0.000049	0.28	36.24	51.15	0.06
4	1934	Regional	18.52	285.01	291.49		291.49	0.000001	0.08	425.66	123.77	0.01
4	1934	Regional - Widen	18.52	285.01	291.41		291.41	0.000001	0.09	416.39	123.10	0.01
4	1920	Hwy 400 - Cap. 1	12.00	284.82	290.01		290.01	0.000001	0.08	272.70	99.02	0.01
4	1920	Hwy 400 - Cap. 2	13.00	284.82	291.13		291.13	0.000001	0.06	391.43	117.76	0.01
4	1920	100 YR	5.58	284.82	287.34		287.34	0.000030	0.22	51.57	51.95	0.05
4	1920	Regional	18.52	284.82	291.49		291.49	0.000001	0.08	435.72	129.08	0.01
4	1920	Regional - Widen	18.52	284.82	291.41		291.41	0.000001	0.09	426.15	126.11	0.01
4	1913	Hwy 400 - Cap. 1	12.00	285.07	290.01		290.01	0.000001	0.08	275.18	91.06	0.01
4	1913	Hwy 400 - Cap. 2	13.00	285.07	291.13		291.13	0.000001	0.07	387.80	119.37	0.01
4	1913	100 YR	5.58	285.07	287.34		287.34	0.000018	0.17	65.59	65.42	0.04
4	1913	Regional	18.52	285.07	291.49		291.49	0.000001	0.09	433.13	133.58	0.01
4	1913	Regional - Widen	18.52	285.07	291.41		291.41	0.000001	0.09	423.17	131.74	0.01
4	1894	Hwy 400 - Cap. 1	12.00	284.38	290.01		290.01	0.000001	0.07	302.10	91.20	0.01
4	1894	Hwy 400 - Cap. 2	13.00	284.38	291.13		291.13	0.000001	0.06	422.16	148.16	0.01
4	1894	100 YR	5.58	284.38	287.34		287.34	0.000006	0.11	87.08	70.04	0.02
4	1894	Regional	18.52	284.38	291.49		291.49	0.000001	0.08	476.38	153.65	0.01
4	1894	Regional - Widen	18.52	284.38	291.41		291.41	0.000001	0.08	464.89	152.40	0.01
4	1885	Hwy 400 - Cap. 1	12.00	284.40	290.01		290.01	0.000001	0.07	311.24	90.74	0.01
4	1885	Hwy 400 - Cap. 2	13.00	284.40	291.13		291.13	0.000001	0.06	433.02	146.91	0.01
4	1885	100 YR	5.58	284.40	287.34		287.34	0.000005	0.10	99.57	68.53	0.02
4	1885	Regional	18.52	284.40	291.49		291.49	0.000001	0.08	486.79	152.21	0.01
4	1885	Regional - Widen	18.52	284.40	291.41		291.41	0.000001	0.08	475.40	151.10	0.01
4	1883	Hwy 400 - Cap. 1	12.73	284.51	290.01	285.80	290.01	0.000001	0.07	307.31	89.68	0.01
4	1883	Hwy 400 - Cap. 2	13.73	284.51	291.13	285.86	291.13	0.000001	0.07	430.57	145.76	0.01
4	1883	100 YR	5.94	284.51	287.34	285.39	287.34	0.000006	0.11	98.34	68.17	0.02
4	1883	Regional	19.25	284.51	291.49	286.14	291.49	0.000001	0.08	483.92	151.01	0.01
4	1883	Regional - Widen	19.25	284.51	291.41	286.14	291.41	0.000001	0.08	472.63	149.90	0.01
4	1852	Culvert										
4	1841	Hwy 400 - Cap. 1	12.73	284.15	290.01	285.42	290.01	0.000001	0.09	232.34	89.70	0.01
4	1841	Hwy 400 - Cap. 2	13.73	284.15	291.13	285.48	291.13	0.000001	0.07	373.29	163.13	0.01
4	1841	100 YR	5.94	284.15	285.89	284.97	285.96	0.000866	1.11	5.34	15.70	0.28
4	1841	Regional	19.25	284.15	291.49	285.79	291.49	0.000001	0.09	433.64	171.82	0.01
4	1841	Regional - Widen	19.25	284.15	291.41	285.79	291.41	0.000001	0.09	420.80	170.31	0.01
4	1835	Hwy 400 - Cap. 1	12.73	284.14	290.01		290.01	0.000002	0.11	160.84	62.95	0.02
4	1835	Hwy 400 - Cap. 2	13.73	284.14	291.13		291.13	0.000001	0.09	271.92	132.67	0.01
4	1835	100 YR	5.94	284.14	285.89		285.92	0.000610	0.68	8.78	8.51	0.21
4	1835	Regional	19.25	284.14	291.49		291.49	0.000001	0.11	320.93	139.09	0.01
4	1835	Regional - Widen	19.25	284.14	291.41		291.41	0.000002	0.11	310.52	137.83	0.01
4	1823	Hwy 400 - Cap. 1	12.73	284.12	290.01		290.01	0.000003	0.12	142.89	56.06	0.02
4	1823	Hwy 400 - Cap. 2	13.73	284.12	291.13		291.13	0.000001	0.10	249.53	127.82	0.01
4	1823	100 YR	5.94	284.12	285.88		285.91	0.000592	0.67	8.87	8.56	0.21
4	1823	Regional	19.25	284.12	291.49		291.49	0.000002	0.11	296.68	133.64	0.01
4	1823	Regional - Widen	19.25	284.12	291.41		291.41	0.000002	0.12	286.68	132.29	0.02
4	1803	Hwy 400 - Cap. 1	12.73	284.09	290.01		290.01	0.000004	0.14	112.52	42.31	0.02
4	1803	Hwy 400 - Cap. 2	13.73	284.09	291.13		291.13	0.000002	0.11	212.93	121.47	0.01
4	1803	100 YR	5.94	284.09	285.87		285.90	0.000563	0.66	9.04	8.64	0.20
4	1803	Regional	19.25	284.09	291.49		291.49	0.000002	0.13	257.39	126.05	0.02
4	1803	Regional - Widen	19.25	284.09	291.41		291.41	0.000002	0.13	247.96	124.82	0.02
4	1789	Hwy 400 - Cap. 1	14.84	284.07	290.01	285.36	290.01	0.000014	0.30	55.02	73.58	0.04
4	1789	Hwy 400 - Cap. 2	15.84	284.07	291.13	285.40	291.13	0.000002	0.13	224.88	118.15	0.02
4	1789	100 YR	6.89	284.07	285.85	284.96	285.88	0.000743	0.82	8.40	7.12	0.24
4	1789	Regional	21.35	284.07	291.49	285.61	291.49	0.000003	0.14	268.28	123.45	0.02
4	1789	Regional - Widen	21.35	284.07	291.41	285.61	291.41	0.000003	0.15	259.04	122.26	0.02
4	1786.8	Culvert										
4	1717	Hwy 400 - Cap. 1	14.84	280.78	285.48	281.57	285.48	0.000021	0.31	54.29	91.87	0.05
4	1717	Hwy 400 - Cap. 2	15.84	280.78	286.18	281.60	286.18	0.000015	0.29	62.86	112.56	0.04

HEC-RAS Plan: MajSpill (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
4	1717	100 YR	6.89	280.78	281.28	281.28	281.48	0.021378	1.98	3.47	13.14	0.99
4	1717	Regional	17.83	280.78	287.69	281.65	287.69	0.000001	0.08	498.50	120.88	0.01
4	1717	Regional - Widen	15.90	280.78	286.24	281.60	286.24	0.000015	0.29	63.59	112.85	0.04
4	1709	Hwy 400 - Cap. 1	14.84	280.33	285.48		285.48	0.000003	0.12	280.33	87.27	0.02
4	1709	Hwy 400 - Cap. 2	15.84	280.33	286.18		286.18	0.000002	0.10	342.77	93.51	0.01
4	1709	100 YR	6.89	280.33	281.21		281.28	0.003803	1.20	7.32	15.34	0.46
4	1709	Regional	17.83	280.33	287.69		287.69	0.000001	0.08	513.87	121.71	0.01
4	1709	Regional - Widen	15.90	280.33	286.24		286.24	0.000002	0.10	348.46	96.05	0.01
4	1702	Hwy 400 - Cap. 1	14.84	280.17	285.48		285.48	0.000002	0.10	325.13	89.72	0.01
4	1702	Hwy 400 - Cap. 2	15.84	280.17	286.18		286.18	0.000001	0.09	389.16	93.44	0.01
4	1702	100 YR	6.89	280.17	281.19		281.22	0.001506	0.87	13.79	28.54	0.30
4	1702	Regional	17.83	280.17	287.69		287.69	0.000001	0.08	545.20	121.33	0.01
4	1702	Regional - Widen	15.90	280.17	286.24		286.24	0.000001	0.09	394.77	93.78	0.01
4	1690	Hwy 400 - Cap. 1	14.84	279.87	285.48		285.48	0.000002	0.10	325.99	102.54	0.01
4	1690	Hwy 400 - Cap. 2	15.84	279.87	286.18		286.18	0.000001	0.09	399.55	107.82	0.01
4	1690	100 YR	6.89	279.87	281.19		281.20	0.000470	0.56	19.38	32.80	0.17
4	1690	Regional	17.83	279.87	287.69		287.69	0.000001	0.07	572.18	123.63	0.01
4	1690	Regional - Widen	15.90	279.87	286.24		286.24	0.000001	0.09	406.03	108.27	0.01
4	1680	Hwy 400 - Cap. 1	14.84	279.78	285.48		285.48	0.000002	0.11	286.80	74.76	0.02
4	1680	Hwy 400 - Cap. 2	15.84	279.78	286.18		286.18	0.000001	0.10	340.94	80.15	0.01
4	1680	100 YR	6.89	279.78	281.18		281.19	0.000311	0.52	26.05	48.50	0.15
4	1680	Regional	17.83	279.78	287.69		287.69	0.000001	0.09	473.07	97.01	0.01
4	1680	Regional - Widen	15.90	279.78	286.24		286.24	0.000001	0.10	345.76	80.63	0.01
4	1668	Hwy 400 - Cap. 1	15.57	279.49	285.47	280.40	285.48	0.000014	0.30	72.28	59.92	0.04
4	1668	Hwy 400 - Cap. 2	16.57	279.49	286.17	280.43	286.18	0.000011	0.28	81.17	70.15	0.04
4	1668	100 YR	7.23	279.49	281.17	280.16	281.18	0.000308	0.57	17.57	27.94	0.15
4	1668	Regional	18.57	279.49	287.69	280.48	287.69	0.000007	0.26	100.38	96.94	0.03
4	1668	Regional - Widen	16.64	279.49	286.23	280.43	286.24	0.000010	0.28	81.93	72.03	0.04
4	1649	Culvert										
4	1631	Hwy 400 - Cap. 1	15.57	278.00	280.54	279.16	280.57	0.000619	0.98	22.06	59.12	0.20
4	1631	Hwy 400 - Cap. 2	16.57	278.00	280.58	279.20	280.62	0.000656	1.02	22.54	59.78	0.21
4	1631	100 YR	7.23	278.00	279.18	278.77	279.26	0.003147	1.29	7.57	25.14	0.39
4	1631	Regional	18.57	278.00	280.66	279.26	280.71	0.000732	1.10	23.40	61.07	0.22
4	1631	Regional - Widen	16.64	278.00	280.60	279.20	280.63	0.000649	1.02	22.68	59.83	0.21
4	1619	Hwy 400 - Cap. 1	15.57	278.27	280.54		280.55	0.000214	0.60	62.96	60.05	0.13
4	1619	Hwy 400 - Cap. 2	16.57	278.27	280.58		280.59	0.000217	0.62	65.69	60.83	0.13
4	1619	100 YR	7.23	278.27	279.13	278.99	279.21	0.004852	1.42	8.77	21.11	0.53
4	1619	Regional	18.57	278.27	280.67		280.68	0.000225	0.64	70.66	61.92	0.14
4	1619	Regional - Widen	16.64	278.27	280.60		280.61	0.000212	0.61	66.46	60.99	0.13
4	1580	Hwy 400 - Cap. 1	15.57	278.11	280.54		280.54	0.000094	0.43	78.64	55.18	0.09
4	1580	Hwy 400 - Cap. 2	16.57	278.11	280.58		280.59	0.000098	0.44	81.13	55.72	0.09
4	1580	100 YR	7.23	278.11	278.70	278.70	278.87	0.014907	1.94	5.27	18.30	0.87
4	1580	Regional	18.57	278.11	280.66		280.67	0.000106	0.47	85.67	56.61	0.10
4	1580	Regional - Widen	16.64	278.11	280.59		280.60	0.000097	0.44	81.84	55.88	0.09
4	1545	Hwy 400 - Cap. 1	15.57	277.06	280.53		280.54	0.000075	0.47	72.40	42.47	0.08
4	1545	Hwy 400 - Cap. 2	16.57	277.06	280.58		280.58	0.000080	0.49	74.30	42.87	0.09
4	1545	100 YR	7.23	277.06	278.73		278.76	0.000674	0.83	13.71	20.80	0.22
4	1545	Regional	18.57	277.06	280.66		280.66	0.000090	0.53	77.76	43.55	0.09
4	1545	Regional - Widen	16.64	277.06	280.59		280.60	0.000079	0.49	74.85	42.98	0.09
4	1514	Hwy 400 - Cap. 1	15.57	277.16	280.53		280.54	0.000027	0.29	113.49	55.17	0.05
4	1514	Hwy 400 - Cap. 2	16.57	277.16	280.58		280.58	0.000029	0.30	115.96	55.65	0.05
4	1514	100 YR	7.23	277.16	278.74		278.75	0.000211	0.48	27.97	38.74	0.12
4	1514	Regional	18.57	277.16	280.66		280.66	0.000033	0.32	120.46	56.47	0.06
4	1514	Regional - Widen	16.64	277.16	280.59		280.59	0.000029	0.30	116.67	55.79	0.05
4	1487	Hwy 400 - Cap. 1	15.57	276.96	280.53		280.53	0.000017	0.24	116.75	55.49	0.04
4	1487	Hwy 400 - Cap. 2	16.57	276.96	280.58		280.58	0.000018	0.25	119.23	55.80	0.04
4	1487	100 YR	7.23	276.96	278.74		278.74	0.000069	0.30	33.79	34.67	0.07
4	1487	Regional	18.57	276.96	280.66		280.66	0.000020	0.27	123.72	56.36	0.04
4	1487	Regional - Widen	16.64	276.96	280.59		280.59	0.000018	0.25	119.94	55.89	0.04
4	1481	Hwy 400 - Cap. 1	17.24	276.96	280.53	277.94	280.53	0.000034	0.34	116.30	74.75	0.06
4	1481	Hwy 400 - Cap. 2	18.24	276.96	280.58	277.97	280.58	0.000036	0.35	119.65	75.24	0.06
4	1481	100 YR	8.21	276.96	278.70	277.58	278.73	0.000483	0.77	10.90	28.22	0.19
4	1481	Regional	20.44	276.96	280.66	278.05	280.66	0.000040	0.37	125.70	76.33	0.06
4	1481	Regional - Widen	18.51	276.96	280.59	277.98	280.59	0.000036	0.35	120.60	75.37	0.06
4	1470	Culvert										
4	1459	Hwy 400 - Cap. 1	17.24	276.78	277.68	277.68	278.13	0.016157	2.96	5.82	30.21	1.00
4	1459	Hwy 400 - Cap. 2	18.24	276.78	277.72	277.72	278.18	0.016050	3.02	6.03	30.27	1.00

HEC-RAS Plan: MajSpill (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
4	1459	100 YR	8.21	276.78	277.33	277.33	277.61	0.019324	2.32	3.53	29.56	1.00
4	1459	Regional	20.44	276.78	277.79	277.79	278.29	0.015670	3.14	6.51	30.40	1.00
4	1459	Regional - Widen	18.51	276.78	277.73	277.73	278.20	0.016081	3.04	6.08	30.28	1.00
4	1452	Hwy 400 - Cap. 1	17.24	276.68	277.39	277.36	277.69	0.015613	2.45	7.33	11.31	0.94
4	1452	Hwy 400 - Cap. 2	18.24	276.68	277.41	277.38	277.72	0.015418	2.49	7.63	11.37	0.94
4	1452	100 YR	8.21	276.68	277.12	277.10	277.30	0.017716	1.89	4.43	10.74	0.92
4	1452	Regional	20.44	276.68	277.47	277.44	277.80	0.015053	2.59	8.27	11.49	0.94
4	1452	Regional - Widen	18.51	276.68	277.42	277.39	277.73	0.015365	2.50	7.71	11.39	0.94
4	1427	Hwy 400 - Cap. 1	17.24	276.39	277.25		277.39	0.005512	1.66	10.54	12.73	0.58
4	1427	Hwy 400 - Cap. 2	18.24	276.39	277.28		277.43	0.005479	1.69	10.93	12.75	0.58
4	1427	100 YR	8.21	276.39	276.93		277.01	0.006114	1.27	6.50	12.52	0.56
4	1427	Regional	20.44	276.39	277.35		277.50	0.005425	1.76	11.75	12.79	0.58
4	1427	Regional - Widen	18.51	276.39	277.29		277.44	0.005469	1.70	11.03	12.75	0.58
4	1403	Hwy 400 - Cap. 1	17.24	275.99	276.83	276.83	277.16	0.016260	2.65	7.53	12.60	0.97
4	1403	Hwy 400 - Cap. 2	18.24	275.99	276.85	276.85	277.20	0.016037	2.69	7.88	12.80	0.97
4	1403	100 YR	8.21	275.99	276.54	276.54	276.76	0.019317	2.10	4.22	10.53	0.98
4	1403	Regional	20.44	275.99	276.91	276.91	277.28	0.015580	2.78	8.65	13.23	0.97
4	1403	Regional - Widen	18.51	275.99	276.86	276.86	277.21	0.015998	2.70	7.97	12.85	0.97
4	1367	Hwy 400 - Cap. 1	17.24	275.68	276.29		276.45	0.010276	1.79	10.20	19.02	0.74
4	1367	Hwy 400 - Cap. 2	18.24	275.68	276.31		276.48	0.010252	1.83	10.59	19.15	0.75
4	1367	100 YR	8.21	275.68	276.09		276.18	0.009471	1.31	6.50	17.72	0.66
4	1367	Regional	20.44	275.68	276.35		276.54	0.010346	1.92	11.37	19.41	0.76
4	1367	Regional - Widen	18.51	275.68	276.32		276.49	0.010244	1.84	10.69	19.19	0.75
4	1303	Hwy 400 - Cap. 1	17.24	274.70	275.43	275.43	275.66	0.014757	2.43	10.53	23.30	0.92
4	1303	Hwy 400 - Cap. 2	18.24	274.70	275.45	275.45	275.69	0.014814	2.47	10.98	23.52	0.92
4	1303	100 YR	8.21	274.70	275.18	275.18	275.35	0.017718	2.00	5.37	16.84	0.93
4	1303	Regional	20.44	274.70	275.49	275.49	275.74	0.014683	2.56	12.01	24.01	0.93
4	1303	Regional - Widen	18.51	274.70	275.45	275.45	275.69	0.014831	2.49	11.10	23.58	0.92
4	1252	Hwy 400 - Cap. 1	17.24	273.80	274.26	274.26	274.48	0.020746	2.15	8.81	20.69	1.01
4	1252	Hwy 400 - Cap. 2	18.24	273.80	274.28	274.28	274.51	0.020498	2.19	9.17	20.79	1.01
4	1252	100 YR	8.21	273.80	274.09	274.09	274.22	0.024107	1.68	5.26	19.72	1.01
4	1252	Regional	20.44	273.80	274.31	274.31	274.56	0.020231	2.28	9.90	21.02	1.02
4	1252	Regional - Widen	18.51	273.80	274.28	274.28	274.51	0.020519	2.20	9.25	20.82	1.01
4	1220	Hwy 400 - Cap. 1	17.24	273.30	274.18		274.22	0.002089	1.05	20.41	26.49	0.36
4	1220	Hwy 400 - Cap. 2	18.24	273.30	274.20		274.25	0.002095	1.07	21.15	26.66	0.36
4	1220	100 YR	8.21	273.30	273.86		273.89	0.002286	0.81	12.24	24.71	0.35
4	1220	Regional	20.44	273.30	274.24		274.30	0.002297	1.15	22.12	26.90	0.38
4	1220	Regional - Widen	18.51	273.30	274.21		274.26	0.002100	1.08	21.34	26.71	0.36
4	1173	Hwy 400 - Cap. 1	17.24	272.40	274.17		274.18	0.000318	0.62	46.16	41.55	0.15
4	1173	Hwy 400 - Cap. 2	18.24	272.40	274.20		274.21	0.000333	0.64	47.33	42.11	0.16
4	1173	100 YR	8.21	272.40	273.86		273.86	0.000170	0.39	33.78	37.31	0.11
4	1173	Regional	20.44	272.40	274.24		274.25	0.000385	0.70	48.85	42.84	0.17
4	1173	Regional - Widen	18.51	272.40	274.21		274.22	0.000338	0.64	47.63	42.26	0.16
4	1160	Hwy 400 - Cap. 1	17.96	272.40	274.16	273.33	274.18	0.000484	0.73	44.61	57.01	0.19
4	1160	Hwy 400 - Cap. 2	18.96	272.40	274.19	273.35	274.21	0.000495	0.74	46.23	57.81	0.19
4	1160	100 YR	8.45	272.40	273.85	273.04	273.86	0.000303	0.49	28.33	45.07	0.14
4	1160	Regional	20.96	272.40	274.22	273.41	274.24	0.000543	0.79	48.30	58.73	0.20
4	1160	Regional - Widen	19.03	272.40	274.19	273.36	274.21	0.000487	0.74	46.69	58.03	0.19
4	1129	Culvert										
4	1100	Hwy 400 - Cap. 1	18.30	271.20	272.32	272.32	272.86	0.015224	3.25	5.63	34.08	1.00
4	1100	Hwy 400 - Cap. 2	19.30	271.20	272.36	272.36	272.92	0.015023	3.31	5.84	34.45	1.00
4	1100	100 YR	8.71	271.20	271.90	271.90	272.23	0.018038	2.54	3.43	29.49	1.00
4	1100	Regional	21.29	271.20	272.43	272.43	273.03	0.014890	3.43	6.21	35.81	1.00
4	1100	Regional - Widen	19.36	271.20	272.36	272.36	272.92	0.015048	3.31	5.84	34.46	1.00
4	1094	Hwy 400 - Cap. 1	18.30	271.00	271.76	271.76	271.93	0.022140	2.70	13.43	34.75	1.09
4	1094	Hwy 400 - Cap. 2	19.30	271.00	271.77	271.77	271.95	0.022227	2.75	13.91	34.94	1.09
4	1094	100 YR	8.71	271.00	271.61	271.61	271.72	0.018643	2.08	8.48	32.62	0.96
4	1094	Regional	21.29	271.00	271.80	271.79	271.98	0.022405	2.83	14.84	35.29	1.11
4	1094	Regional - Widen	19.36	271.00	271.77	271.77	271.95	0.022229	2.75	13.94	34.95	1.09
4	1039	Hwy 400 - Cap. 1	18.30	270.10	270.84	270.84	270.96	0.013031	2.13	18.30	61.02	0.84
4	1039	Hwy 400 - Cap. 2	19.30	270.10	270.85	270.85	270.98	0.013540	2.18	18.77	61.18	0.86
4	1039	100 YR	8.71	270.10	270.67	270.67	270.77	0.012974	1.73	9.62	43.46	0.80
4	1039	Regional	21.29	270.10	270.87	270.87	271.00	0.013823	2.25	20.04	61.58	0.87
4	1039	Regional - Widen	19.36	270.10	270.85	270.85	270.98	0.013536	2.19	18.82	61.19	0.86
4	1011	Hwy 400 - Cap. 1	18.30	269.10	270.33	270.33	270.52	0.009183	2.41	16.93	50.89	0.75
4	1011	Hwy 400 - Cap. 2	19.30	269.10	270.35	270.35	270.53	0.009139	2.43	17.97	53.50	0.75
4	1011	100 YR	8.71	269.10	270.12	270.12	270.28	0.007860	1.93	8.04	35.70	0.67
4	1011	Regional	21.29	269.10	270.39	270.39	270.57	0.008913	2.46	20.18	58.68	0.75

HEC-RAS Plan: MajSpill (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
4	1011	Regional - Widen	19.36	269.10	270.35	270.35	270.54	0.009136	2.43	18.03	53.65	0.75
4	959	Hwy 400 - Cap. 1	18.30	268.80	269.28	269.28	269.44	0.025147	2.20	12.99	44.46	1.09
4	959	Hwy 400 - Cap. 2	19.30	268.80	269.29	269.29	269.45	0.025642	2.25	13.41	45.15	1.11
4	959	100 YR	8.71	268.80	269.14	269.14	269.24	0.028353	1.76	7.40	35.23	1.08
4	959	Regional	21.29	268.80	269.31	269.31	269.49	0.024738	2.30	14.64	48.02	1.10
4	959	Regional - Widen	19.36	268.80	269.29	269.29	269.45	0.025637	2.25	13.44	45.20	1.11
4	906	Hwy 400 - Cap. 1	18.30	267.80	268.55		268.59	0.002996	1.06	25.43	62.94	0.41
4	906	Hwy 400 - Cap. 2	19.30	267.80	268.58		268.63	0.002626	1.03	27.89	63.56	0.39
4	906	100 YR	8.71	267.80	268.33		268.37	0.003146	0.84	13.00	48.75	0.39
4	906	Regional	21.29	267.80	268.66		268.70	0.002094	0.98	32.69	64.64	0.35
4	906	Regional - Widen	19.36	267.80	268.59		268.63	0.002604	1.02	28.05	63.60	0.39
4	858	Hwy 400 - Cap. 1	18.30	267.20	268.55		268.56	0.000163	0.39	69.99	71.92	0.11
4	858	Hwy 400 - Cap. 2	19.30	267.20	268.59		268.60	0.000163	0.40	72.65	72.23	0.11
4	858	100 YR	8.71	267.20	268.35		268.35	0.000070	0.23	55.30	66.93	0.07
4	858	Regional	21.29	267.20	268.66		268.67	0.000162	0.41	77.89	72.71	0.11
4	858	Regional - Widen	19.36	267.20	268.59		268.60	0.000163	0.40	72.82	72.25	0.11
4	827	Hwy 400 - Cap. 1	18.30	267.20	268.55		268.56	0.000046	0.20	104.32	127.33	0.06
4	827	Hwy 400 - Cap. 2	19.30	267.20	268.59		268.59	0.000045	0.20	109.06	128.38	0.06
4	827	100 YR	8.71	267.20	268.35		268.35	0.000025	0.13	78.44	118.03	0.04
4	827	Regional	21.29	267.20	268.66		268.67	0.000042	0.21	118.44	130.53	0.06
4	827	Regional - Widen	19.36	267.20	268.59		268.60	0.000045	0.20	109.36	128.45	0.06
4	786	Hwy 400 - Cap. 1	18.30	267.06	268.55	268.10	268.55	0.000037	0.19	91.52	87.04	0.05
4	786	Hwy 400 - Cap. 2	19.30	267.06	268.59	268.13	268.59	0.000036	0.19	94.74	87.11	0.05
4	786	100 YR	8.71	267.06	268.28	267.75	268.34	0.001753	1.16	8.84	10.21	0.34
4	786	Regional	21.29	267.06	268.66	268.19	268.66	0.000036	0.20	101.06	87.27	0.05
4	786	Regional - Widen	19.36	267.06	268.59	268.14	268.59	0.000036	0.20	94.95	87.11	0.05
4	737	Hwy 400 - Cap. 1	18.30	267.30	268.54	268.22	268.55	0.000162	0.36	52.79	64.11	0.10
4	737	Hwy 400 - Cap. 2	19.30	267.30	268.58	268.26	268.59	0.000156	0.36	55.17	64.19	0.10
4	737	100 YR	8.71	267.30	268.30	267.91	268.31	0.000114	0.26	37.41	63.61	0.08
4	737	Regional	21.29	267.30	268.65	268.30	268.66	0.000145	0.36	59.83	64.35	0.10
4	737	Regional - Widen	19.36	267.30	268.58	268.26	268.59	0.000156	0.36	55.32	64.20	0.10
4	683	Hwy 400 - Cap. 1	18.30	267.30	268.14	268.14	268.49	0.015768	2.68	7.34	11.01	0.96
4	683	Hwy 400 - Cap. 2	19.30	267.30	268.17	268.17	268.53	0.015388	2.72	7.67	11.16	0.96
4	683	100 YR	8.71	267.30	268.22	267.84	268.28	0.002530	1.15	8.24	11.44	0.39
4	683	Regional	21.29	267.30	268.22	268.22	268.60	0.015156	2.80	8.24	11.44	0.96
4	683	Regional - Widen	19.36	267.30	268.17	268.17	268.53	0.015463	2.72	7.67	11.17	0.96
4	635	Hwy 400 - Cap. 1	18.30	267.10	268.30	268.01	268.30	0.000100	0.27	59.27	61.36	0.08
4	635	Hwy 400 - Cap. 2	19.30	267.10	268.33	268.04	268.33	0.000100	0.28	61.19	61.43	0.08
4	635	100 YR	8.71	267.10	268.10	267.70	268.16	0.002434	1.18	8.17	11.16	0.39
4	635	Regional	21.29	267.10	268.39	268.10	268.39	0.000101	0.29	64.72	61.55	0.08
4	635	Regional - Widen	19.36	267.10	268.33	268.04	268.34	0.000100	0.28	61.30	61.43	0.08
4	590	Hwy 400 - Cap. 1	18.30	267.00	268.29	267.96	268.30	0.000075	0.25	68.47	71.71	0.07
4	590	Hwy 400 - Cap. 2	19.30	267.00	268.33	268.00	268.33	0.000075	0.25	70.72	71.78	0.07
4	590	100 YR	8.71	267.00	267.93	267.62	268.02	0.003851	1.40	6.68	9.42	0.48
4	590	Regional	21.29	267.00	268.38	268.05	268.39	0.000076	0.26	74.84	71.90	0.07
4	590	Regional - Widen	19.36	267.00	268.33	268.00	268.33	0.000075	0.25	70.84	71.78	0.07
4	562	Hwy 400 - Cap. 1	18.30	266.80	268.29	267.76	268.30	0.000098	0.30	65.92	78.72	0.08
4	562	Hwy 400 - Cap. 2	19.30	266.80	268.32	267.79	268.33	0.000097	0.30	68.38	78.78	0.08
4	562	100 YR	8.71	266.80	267.88	267.45	267.94	0.002001	1.07	8.85	11.93	0.35
4	562	Regional	21.29	266.80	268.38	267.84	268.39	0.000095	0.31	72.92	78.89	0.08
4	562	Regional - Widen	19.36	266.80	268.32	267.79	268.33	0.000096	0.30	68.52	78.79	0.08
4	521	Hwy 400 - Cap. 1	18.30	266.70	268.24	267.68	268.28	0.001148	1.09	23.21	39.05	0.29
4	521	Hwy 400 - Cap. 2	19.30	266.70	268.27	267.71	268.31	0.001097	1.08	24.49	39.11	0.28
4	521	100 YR	8.71	266.70	267.74	267.33	267.82	0.002563	1.23	7.68	9.92	0.40
4	521	Regional	21.29	266.70	268.33	267.77	268.37	0.001029	1.07	26.80	39.23	0.27
4	521	Regional - Widen	19.36	266.70	268.27	267.71	268.31	0.001095	1.08	24.56	39.11	0.28
4	482	Hwy 400 - Cap. 1	18.30	266.70	268.21	267.57	268.25	0.000924	0.98	24.98	38.90	0.26
4	482	Hwy 400 - Cap. 2	19.30	266.70	268.25	267.59	268.28	0.000888	0.98	26.29	39.00	0.25
4	482	100 YR	8.71	266.70	267.69	267.26	267.75	0.002175	1.12	8.36	10.48	0.37
4	482	Regional	21.29	266.70	268.31	267.65	268.34	0.000843	0.98	28.64	39.23	0.25
4	482	Regional - Widen	19.36	266.70	268.25	267.60	268.28	0.000886	0.98	26.37	39.01	0.25
4	447	Hwy 400 - Cap. 1	18.30	266.58	268.18	267.41	268.22	0.000817	0.95	25.41	39.39	0.24
4	447	Hwy 400 - Cap. 2	19.30	266.58	268.22	267.44	268.25	0.000788	0.95	26.79	39.46	0.24
4	447	100 YR	8.71	266.58	267.64	267.10	267.68	0.001482	0.96	9.59	11.27	0.31
4	447	Regional	21.29	266.58	268.28	267.49	268.31	0.000755	0.95	29.22	39.61	0.24
4	447	Regional - Widen	19.36	266.58	268.22	267.44	268.25	0.000787	0.95	26.86	39.46	0.24
4	408	Hwy 400 - Cap. 1	18.30	266.49	268.05		268.16	0.002261	1.51	15.04	38.71	0.40
4	408	Hwy 400 - Cap. 2	19.30	266.49	268.10		268.20	0.002109	1.48	16.74	38.82	0.39

HEC-RAS Plan: MajSpill (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
4	408	100 YR	8.71	266.49	267.54		267.61	0.002340	1.15	8.05	10.32	0.38
4	408	Regional	21.29	266.49	268.18		268.26	0.001871	1.45	19.72	39.02	0.37
4	408	Regional - Widen	19.36	266.49	268.10		268.20	0.002102	1.48	16.83	38.83	0.39
4	372	Hwy 400 - Cap. 1	18.30	266.25	267.98		268.09	0.001928	1.52	15.79	31.82	0.38
4	372	Hwy 400 - Cap. 2	19.30	266.25	268.03		268.13	0.001867	1.52	17.27	36.39	0.37
4	372	100 YR	8.71	266.25	267.49		267.54	0.001466	1.05	9.32	10.74	0.31
4	372	Regional	21.29	266.25	268.11		268.20	0.001640	1.47	20.43	36.84	0.35
4	372	Regional - Widen	19.36	266.25	268.03		268.13	0.001860	1.52	17.36	36.40	0.37
4	321	Hwy 400 - Cap. 1	18.30	266.10	267.76		267.94	0.003824	2.01	11.45	10.82	0.52
4	321	Hwy 400 - Cap. 2	19.30	266.10	267.79		267.99	0.003956	2.07	11.78	11.00	0.53
4	321	100 YR	8.71	266.10	267.34		267.44	0.002741	1.38	7.41	8.92	0.42
4	321	Regional	21.29	266.10	267.84		268.06	0.004249	2.20	12.38	11.31	0.55
4	321	Regional - Widen	19.36	266.10	267.79		267.99	0.003966	2.08	11.80	11.00	0.53
4	285	Hwy 400 - Cap. 1	18.30	266.30	267.76		267.81	0.001783	1.29	31.95	68.42	0.35
4	285	Hwy 400 - Cap. 2	19.30	266.30	267.80		267.85	0.001673	1.27	34.88	72.36	0.34
4	285	100 YR	8.71	266.30	267.28		267.33	0.002502	1.14	12.52	26.70	0.39
4	285	Regional	21.29	266.30	267.89		267.93	0.001392	1.21	40.95	73.84	0.32
4	285	Regional - Widen	19.36	266.30	267.80		267.85	0.001663	1.27	35.06	72.40	0.34
4	249	Hwy 400 - Cap. 1	18.30	266.10	267.19	267.19	267.63	0.016393	2.95	6.49	8.23	0.98
4	249	Hwy 400 - Cap. 2	19.30	266.10	267.23	267.23	267.68	0.015891	2.98	6.80	8.38	0.97
4	249	100 YR	8.71	266.10	266.83	266.83	267.11	0.020200	2.34	3.74	7.04	1.00
4	249	Regional	21.29	266.10	267.29	267.29	267.77	0.015429	3.07	7.35	8.63	0.97
4	249	Regional - Widen	19.36	266.10	267.23	267.23	267.68	0.015875	2.98	6.81	8.38	0.97
4	210	Hwy 400 - Cap. 1	18.30	264.50	265.70	265.70	266.16	0.014409	3.05	6.85	8.64	0.95
4	210	Hwy 400 - Cap. 2	19.30	264.50	265.74	265.74	266.20	0.014208	3.09	7.16	8.81	0.95
4	210	100 YR	8.71	264.50	265.30	265.30	265.60	0.017892	2.45	3.72	6.86	0.98
4	210	Regional	21.29	264.50	265.81	265.81	266.30	0.014018	3.20	7.75	9.11	0.95
4	210	Regional - Widen	19.36	264.50	265.74	265.74	266.21	0.014193	3.10	7.18	8.82	0.95
4	181	Hwy 400 - Cap. 1	18.30	263.10	264.29	264.29	264.78	0.014421	3.15	6.64	7.74	0.96
4	181	Hwy 400 - Cap. 2	19.30	263.10	264.33	264.33	264.83	0.014426	3.22	6.91	7.85	0.96
4	181	100 YR	8.71	263.10	263.92	263.87	264.20	0.014051	2.36	3.96	6.51	0.88
4	181	Regional	21.29	263.10	264.41	264.41	264.93	0.013897	3.30	7.52	8.11	0.96
4	181	Regional - Widen	19.36	263.10	264.33	264.33	264.83	0.014420	3.22	6.92	7.86	0.96
4	145	Hwy 400 - Cap. 1	18.30	262.90	263.57	263.57	263.81	0.018020	2.20	8.96	20.92	0.96
4	145	Hwy 400 - Cap. 2	19.30	262.90	263.59	263.59	263.84	0.017742	2.24	9.36	21.22	0.96
4	145	100 YR	8.71	262.90	263.36	263.36	263.52	0.022762	1.77	4.95	16.79	1.00
4	145	Regional	21.29	262.90	263.63	263.63	263.89	0.017320	2.31	10.13	21.82	0.96
4	145	Regional - Widen	19.36	262.90	263.59	263.59	263.84	0.017716	2.24	9.38	21.24	0.96
4	95	Hwy 400 - Cap. 1	18.30	261.70	262.18	262.18	262.36	0.022667	2.09	11.69	41.09	1.04
4	95	Hwy 400 - Cap. 2	19.30	261.70	262.19	262.19	262.38	0.023824	2.16	11.95	41.33	1.07
4	95	100 YR	8.71	261.70	262.04	262.04	262.16	0.023574	1.61	6.62	30.20	0.99
4	95	Regional	21.29	261.70	262.20	262.20	262.42	0.026541	2.31	12.36	41.69	1.13
4	95	Regional - Widen	19.36	261.70	262.19	262.19	262.38	0.023908	2.16	11.96	41.34	1.07
4	64	Hwy 400 - Cap. 1	18.30	260.20	260.82	260.82	261.05	0.020455	2.15	8.50	18.25	1.00
4	64	Hwy 400 - Cap. 2	19.30	260.20	260.83	260.83	261.08	0.020411	2.20	8.79	18.39	1.01
4	64	100 YR	8.71	260.20	260.61	260.61	260.77	0.023828	1.74	5.00	16.45	1.01
4	64	Regional	21.29	260.20	260.86	260.86	261.13	0.019920	2.27	9.40	18.69	1.01
4	64	Regional - Widen	19.36	260.20	260.83	260.83	261.08	0.020378	2.20	8.81	18.40	1.01
4	0	Hwy 400 - Cap. 1	18.30	259.35	260.49		260.52	0.000914	0.78	26.67	30.72	0.24
4	0	Hwy 400 - Cap. 2	19.30	259.35	260.50		260.53	0.001004	0.82	26.79	30.77	0.25
4	0	100 YR	8.71	259.35	260.27		260.28	0.000486	0.48	19.95	28.39	0.17
4	0	Regional	21.29	259.35	260.50		260.54	0.001193	0.90	27.02	30.86	0.28
4	0	Regional - Widen	19.36	259.35	260.50		260.53	0.001009	0.82	26.80	30.77	0.26

PROJECT	Whiskey Creek at Minet's Point EA	FILE	120114		
		DATE	March 15, 2021		
SUBJECT	Whiskey Creek Existing Highway 400 Spill Conveyance	NAME	DAM		
		PAGE	1	OF	1

HEC-RAS Geometry Plan For Existing Highway 400 Whiskey Creek Spill Conveyance



PROJECT	Whiskey Creek at Minet's Point EA	FILE	120114
		DATE	March 15, 2021
SUBJECT	Existing Highway 400 Spills Analysis	NAME	DAM
		PAGE	1 OF 1

Existing Whiskey Creek Spills Analysis at Highway 400

HEC-RAS Models For Analysis:

1. Whiskey Creek - Harvie Overpass Spills
2. Exist Hwy 400 Whiskey Spill Conveyance

Manual iterations confirm conveyance under Highway 400 via new culvert based on amount of flow that returns to main branch and contributes to Fairview Road crossing backwater condition.

Highway 400 overtopping from "Whiskey Creek - Harvie Overpass Spills" is routed through "Exist Hwy 400 Whiskey Spill Conveyance"

Spill to north tributary in "Exist Hwy 400 Whiskey Spill Conveyance" is routed to tributary (Reach 5) in "Whiskey Creek - Harvie Overpass Spills" model.

Water surface elevation from conveyance of Regional flow in tributary (Reach 5) in "Whiskey Creek - Harvie Overpass Spills" is set as boundary condition for the west ditch in "Exist Hwy 400 Whiskey Spill Conveyance." All other boundary conditions are normal depth.

HEC-RAS Model: Whiskey Creek - Harvie Overpass Spills

<u>Reach</u>	<u>Spills</u>	<u>Spill Modeling Method</u>	<u>Details</u>
4 (Main Branch)	To Highway 400 Model	Culvert Capacity	Weir Flow Determines Highway 400 Spill
5 (Tributary)	To Hotchkiss Creek	Lateral Structure	Broad Crested Weir

HEC-RAS Model: Exist Hwy 400 Whiskey Spill Conveyance

<u>Reach</u>	<u>Spills</u>	<u>Spill Modeling Method</u>	<u>Details</u>
Whiskey - Hwy 400 Spill 1	To Whiskey - Ditch to Hwy 400	Lateral Structures	Zero Height Weir Modeled With Hager's Equation
Whiskey - Ditch to Hwy 400	To Whiskey Main Branch	Lateral Structure	Broad Crested Weir
Whiskey - Ditch to Hwy 400	To Whiskey - Hwy 400 Spill 4	Hand Calculation	HY-8 Analysis and Weir Calculation

HEC-RAS Plan: Ex400WKSpill Profile: Hazel

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
Hwy 400 Spill 2	491.11	Hazel	1.50	289.18	289.40	289.40	289.43	0.004049	0.76	2.52	38.87	0.98
Hwy 400 Spill 2	456.11	Hazel	1.50	289.08	289.27	289.27	289.30	0.003278	0.78	2.18	31.88	0.91
Hwy 400 Spill 2	416.11	Hazel	1.50	288.86	289.05	289.00	289.08	0.003202	0.84	2.58	20.74	0.92
Hwy 400 Spill 1	512.11	Hazel	7.70	290.41	290.56		290.57	0.002237	0.57	21.69	85.32	0.73
Hwy 400 Spill 1	511.11		Lat Struct									
Hwy 400 Spill 1	480.11	Hazel	5.24	290.24	290.46		290.49	0.002894	0.96	11.41	61.65	0.92
Hwy 400 Spill 1	479.11		Lat Struct									
Hwy 400 Spill 1	440.11	Hazel	3.66	290.11	290.32	290.32	290.38	0.003311	1.12	4.21	36.21	1.00
Hwy 400 Spill 1	439.11		Lat Struct									
Hwy 400 Spill 1	400.11	Hazel	2.54	289.90	290.11	290.11	290.16	0.003505	1.01	2.76	28.02	1.00
Hwy 400 Spill 1	399.11		Lat Struct									
Hwy 400 Spill 1	360.11	Hazel	2.02	289.58	289.87	289.87	289.92	0.003824	0.97	2.15	24.86	1.02
Hwy 400 Spill 1	360		Lat Struct									
Hwy 400 Spill 1	320.11	Hazel	1.50	289.41	289.61	289.51	289.62	0.002752	0.62	4.15	37.49	0.81
Hwy 400 Spill 1	280.11	Hazel	1.50	289.26	289.45	289.44	289.48	0.004962	0.84	2.70	36.54	1.09
Ditch to Hwy 400	667.11	Hazel	4.06	288.62	289.52	289.46	289.73	0.013506	2.50	2.65	5.10	0.88
Ditch to Hwy 400	628.11	Hazel	5.16	287.97	289.57		289.60	0.000866	0.98	10.15	11.38	0.25
Ditch to Hwy 400	589.11	Hazel	5.68	288.26	289.55		289.56	0.000947	0.88	13.31	19.33	0.25
Ditch to Hwy 400	589		Lat Struct									
Ditch to Hwy 400	550.11	Hazel	6.16	288.36	289.51		289.52	0.001020	0.84	15.99	29.77	0.26
Ditch to Hwy 400	511.11	Hazel	5.41	288.25	289.42		289.46	0.002723	1.35	11.14	41.08	0.42
Ditch to Hwy 400	471.11	Hazel	3.04	288.24	289.37		289.38	0.000931	0.80	8.75	21.25	0.24
Ditch to Hwy 400	443.11	Hazel	2.04	288.19	289.35		289.36	0.000506	0.58	7.57	20.34	0.18
Ditch to Hwy 400	418.11	Hazel	2.04	288.37	289.32	288.87	289.34	0.001206	0.80	4.90	14.22	0.27
Ditch to Hwy 400	394.11	Hazel	2.04	288.40	289.25		289.30	0.002469	1.07	3.04	7.30	0.38
Ditch to Hwy 400	371.11	Hazel	2.04	288.30	288.95	288.89	289.10	0.011681	1.82	1.42	3.64	0.77
Ditch to Hwy 400	332.11	Hazel	2.04	288.09	288.68	288.63	288.82	0.012870	1.80	1.42	3.84	0.80
Ditch to Hwy 400	293.11	Hazel	2.04	287.66	288.33		288.43	0.007496	1.52	1.77	4.48	0.63
Ditch to Hwy 400	254.11	Hazel	2.04	287.46	288.10		288.17	0.005767	1.33	2.14	5.26	0.55
Ditch to Hwy 400	235.11	Hazel	2.04	286.49	288.12	287.06	288.13	0.000162	0.42	8.50	9.64	0.11
Ditch to Hwy 400	217.11	Hazel	2.04	286.13	288.12	286.72	288.13	0.000068	0.31	12.28	11.81	0.07
Ditch to Hwy 400	174.11	Hazel	2.04	286.02	288.12	286.55	288.13	0.000037	0.24	19.94	26.58	0.05
Ditch to Hwy 400	164.11	Hazel	2.04	285.90	288.12	286.48	288.12	0.000005	0.09	50.53	44.55	0.02
Ditch to Hwy 400	147.11		Culvert									
Ditch to Hwy 400	133.11	Hazel	0.34	285.42	285.65	285.60	285.67	0.008655	0.72	0.49	4.38	0.55
Ditch to Hwy 400	112.11	Hazel	0.34	285.15	285.37	285.37	285.44	0.028733	1.25	0.29	1.99	0.99
Ditch to Hwy 400	91.11	Hazel	0.34	284.69	284.87	284.84	284.91	0.016246	0.88	0.41	3.05	0.74
Hwy 400 Spill 3	376.11	Hazel	0.60	288.65	288.87	288.83	288.90	0.002711	0.39	1.03	8.59	0.31
Hwy 400 Spill 3	336.11	Hazel	0.60	288.45	288.68		288.70	0.009324	0.66	1.12	9.77	0.56
Hwy 400 Spill 3	296.11	Hazel	0.60	288.08	288.37	288.30	288.38	0.006937	0.65	1.14	9.10	0.50
Hwy 400 W Ditch	1000.11	Hazel	0.91	288.65	288.84	288.84	288.90	0.003765	1.02	0.88	8.72	1.03
Hwy 400 W Ditch	959.11	Hazel	0.91	288.42	288.61	288.61	288.66	0.003477	1.01	0.91	8.87	0.99
Hwy 400 W Ditch	919.11	Hazel	0.91	288.14	288.33	288.33	288.38	0.003467	1.02	0.89	8.50	0.99
Hwy 400 W Ditch	879.11	Hazel	0.91	287.46	287.51	287.50	287.53	0.061543	0.39	1.28	20.28	0.99
Hwy 400 W Ditch	837.11	Hazel	0.91	285.35	285.76	285.76	285.88	0.027298	1.51	0.60	2.56	1.00
Hwy 400 W Ditch	821.11	Hazel	0.91	284.82	285.20	285.20	285.31	0.003170	1.44	0.63	3.11	1.02
Hwy 400 Spill 4	277.11	Hazel	0.60	287.89	288.11	288.09	288.15	0.007176	0.57	0.80	7.79	0.48
Hwy 400 Spill 4	258.11	Hazel	0.60	287.65	287.87	287.87	287.93	0.022059	0.91	0.61	6.59	0.83
Hwy 400 Spill 4	215.11	Hazel	2.30	287.21	287.53	287.53	287.61	0.005935	0.73	2.15	12.66	0.48
Hwy 400 Spill 4	172.11	Hazel	2.30	286.45	286.81	286.81	286.91	0.009567	0.95	1.92	11.19	0.61
Hwy 400 Spill 4	129.11	Hazel	2.30	285.65	285.96	285.96	286.04	0.006164	0.73	2.14	12.90	0.49
Hwy 400 Spill 4	86.11	Hazel	2.30	284.61	284.96	284.96	285.05	0.006376	0.76	2.03	12.23	0.50
Hwy 400 Spill 4	43.11	Hazel	2.30	283.49	283.80	283.80	283.88	0.008940	0.87	2.04	12.85	0.59
Hwy 400 Spill 4	0.11	Hazel	2.30	282.19	282.50	282.50	282.59	0.009518	0.92	1.96	11.84	0.61

PROJECT	Whiskey Creek at Minet's Point EA	FILE	120114		
		DATE	March 15, 2021		
SUBJECT	Whiskey Creek Proposed Highway 400 Spill Conveyance	NAME	DAM		
		PAGE	1	OF	1

HEC-RAS Geometry For Proposed Highway 400 Widening Whiskey Creek Spill Conveyance



PROJECT	Whiskey Creek at Minet's Point EA	FILE	120114
		DATE	March 15, 2021
SUBJECT	Proposed Highway 400 Spills Analysis	NAME	DAM
		PAGE	1 OF 1

Proposed Whiskey Creek Spills Analysis for Highway 400 Widening

HEC-RAS Models For Analysis:

1. Whiskey Creek - Harvie Overpass Spills
2. Prop Hwy 400 Whiskey Spill Conveyance

"Whiskey Creek - Harvie Overpass Spills" model confirms conveyance under Highway 400 via new culvert based on Fairview Road crossing backwater condition. No overtopping flow returns to main branch.

Highway 400 overtopping from "Whiskey Creek - Harvie Overpass Spills" is routed through "Prop Hwy 400 Whiskey Spill Conveyance"

Spill to east service center ditch is marginal and will route to north tributary on the downstream side of the Highway 400 culvert crossing. Spill to west that contributes to north tributary is marginal and will route through culvert with no spill.

HEC-RAS Model: Prop Hwy 400 Whiskey Spill Conveyance

<u>Reach</u>	<u>Spills</u>	<u>Spill Modeling Method</u>	<u>Details</u>
Highway 400 - 1	East to Service Center Ditch	Lateral Structures	Zero Height Weir Modeled With Hager's Equation
	West to North Tributary	Lateral Structures	Zero Height Weir Modeled With Hager's Equation

HEC-RAS Plan: Pr400WKSpill River: Highway 400 Reach: 1 Profile: Hazel

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
1	1720	Hazel	5.45	290.47	290.92	290.92	291.00	0.001404	1.38	5.06	30.00	0.77
1	1719.5		Lat Struct									
1	1719		Lat Struct									
1	1690	Hazel	5.29	290.30	290.74	290.74	290.83	0.001518	1.41	4.68	26.53	0.79
1	1660	Hazel	5.13	290.13	290.58	290.58	290.65	0.001377	1.36	4.87	30.00	0.76
1	1659.8		Lat Struct									
1	1659		Lat Struct									
1	1630	Hazel	5.02	289.97	290.40	290.40	290.49	0.001509	1.39	4.51	26.77	0.79
1	1600	Hazel	4.99	289.82	290.25	290.25	290.33	0.001533	1.39	4.47	26.79	0.79
1	1570	Hazel	4.96	289.67	290.10	290.10	290.18	0.001538	1.40	4.45	26.81	0.79
1	1540	Hazel	4.94	289.51	289.94	289.94	290.03	0.001535	1.39	4.43	26.74	0.79
1	1510	Hazel	4.91	289.36	289.79	289.79	289.88	0.001521	1.39	4.42	26.54	0.79
1	1480	Hazel	4.88	289.21	289.64	289.64	289.72	0.001535	1.39	4.38	26.37	0.79
1	1450	Hazel	4.87	289.06	289.49	289.49	289.57	0.001526	1.38	4.39	26.42	0.79
1	1420	Hazel	4.86	288.90	289.33	289.33	289.41	0.001498	1.38	4.40	26.22	0.78
1	1390	Hazel	4.85	288.75	289.17	289.17	289.26	0.001589	1.40	4.30	26.26	0.80
1	1360	Hazel	4.85	288.59	289.02	289.02	289.10	0.001557	1.40	4.33	26.40	0.80
1	1330	Hazel	4.85	288.32	288.75	288.75	288.83	0.001560	1.40	4.33	26.37	0.80
1	1300	Hazel	4.85	287.99	288.42	288.42	288.50	0.001543	1.39	4.35	26.33	0.79
1	1270	Hazel	4.85	287.66	288.08	288.08	288.17	0.001582	1.40	4.30	26.22	0.80
1	1240	Hazel	4.85	287.23	287.66	287.66	287.74	0.001559	1.40	4.33	26.37	0.80
1	1210	Hazel	4.85	286.65	287.08	287.08	287.16	0.001608	1.41	4.27	26.17	0.81
1	1180	Hazel	4.85	286.07	286.49	286.49	286.58	0.001614	1.41	4.27	26.14	0.81
1	1150	Hazel	4.85	285.47	285.89	285.89	285.98	0.001573	1.40	4.32	26.34	0.80
1	1120	Hazel	4.85	284.64	285.06	285.06	285.14	0.001552	1.39	4.34	26.47	0.80
1	1090	Hazel	4.85	283.80	284.23	284.23	284.31	0.001557	1.39	4.33	26.30	0.80
1	1060	Hazel	4.85	282.97	283.39	283.39	283.48	0.001526	1.38	4.36	26.21	0.79
1	1030	Hazel	4.85	282.07	282.50	282.50	282.58	0.001522	1.38	4.36	26.01	0.79
1	1000	Hazel	4.85	281.16	281.59	281.59	281.67	0.001548	1.39	4.35	26.60	0.80

PROJECT	Whiskey Creek at Minet's Point EA	FILE	120114		
		DATE	March 15, 2021		
SUBJECT	PCSWMM Spills Analysis Verification Modelling	NAME	DAM		
		PAGE	1	OF	1

Regional Flows

Existing Highway 400

Model	1 - Whiskey Creek Main Branch (m ³ /s)	2 - Whiskey Creek Tributary (m ³ /s)	3 - To Hotchkiss Creek (m ³ /s)
VO No Spill	21.35	1.41	0.00
HEC-RAS Plus Spill	17.83	2.60	2.36
PCSWMM Plus Spill	17.20	3.02	2.54

Proposed Highway 400 Widening

Model	1 - Whiskey Creek Main Branch (m ³ /s)	2 - Whiskey Creek Tributary (m ³ /s)	3 - To Hotchkiss Creek (m ³ /s)
VO No Spill	21.35	1.41	0.00
HEC-RAS Plus Spill	16.04	1.88	4.85
PCSWMM Plus Spill	15.11	4.59	3.15

Whiskey Creek Spills Analysis for Existing Highway 400

HEC-RAS Analysis

Regional (Hurricane Hazel) Peak Flow at Main Branch

21.35 m³/s

Highway 400 Culvert Conveyance

13.62 m³/s

Highway 400 Overtopping

7.73 m³/s

Highway 400 Overtopping Return to Main Branch

4.11 m³/s

Net Spill From Main Branch

3.62 m³/s

Highway 400 Overtopping Spill to North Tributary

0.91 m³/s

Highway 400 Overtopping Spill to Service Center Culvert

2.04 m³/s

Highway 400 Overtopping Spill ROW Conveyance

0.60 m³/s

Service Center Culvert Conveyance****

0.34 m³/s

****Overtopping flow returns to Highway 400 ROW

Highway 400 ROW Conveyance To Hotchkiss Creek

2.30 m³/s

Regional (Hurricane Hazel) Peak Flow at North Tributary

1.41 m³/s

North Tributary Plus Spill to North Tributary

2.32 m³/s

Highway 400 Tributary Culvert Conveyance

2.26 m³/s

Tributary Spill to Hotchkiss Creek

0.06 m³/s

Total Spill to Hotchkiss Creek

2.36 m³/s

Flow in Whiskey Main Branch Downstream of Spill

17.83 m³/s

Flow in North Tributary Downstream of Spill

2.60 m³/s

Flow Balance

100.13%

PCSWMM Analysis

Highway 400 Culvert Conveyance

13.09 m³/s

Highway 400 Overtopping

8.26 m³/s

Highway 400 Overtopping Return to Main Branch

4.15 m³/s

Net Spill From Main Branch

4.11 m³/s

Highway 400 Overtopping Spill to Service Center Culvert

2.07 m³/s

Highway 400 Overtopping Spill ROW/Ditch Conveyance

1.61 m³/s

Service Center Culvert Conveyance****

0.29 m³/s

****Overtopping flow returns to Highway 400 ROW

Highway 400 ROW Conveyance To Hotchkiss Creek

2.38 m³/s

Highway 400 Tributary Culvert Conveyance

1.89 m³/s

Tributary Spill to Hotchkiss Creek

0.19 m³/s

Total Spill to Hotchkiss Creek

2.54 m³/s

Flow in Whiskey Main Branch Downstream of Spill

17.20 m³/s

Flow in North Tributary Downstream of Spill

3.02 m³/s

Flow Balance

100.00%

Whiskey Creek Spills Analysis for Proposed Highway 400 Widening

HEC-RAS Analysis

PCSWMM Analysis

Regional (Hurricane Hazel) Peak Flow at Main Branch

21.35 m³/s

Highway 400 Culvert Conveyance

15.9 m³/s

Highway 400 Culvert Conveyance

15.11

Highway 400 Overtopping

5.45 m³/s

Highway 400 Overtopping

6.32

Highway 400 Overtopping Return to Main Branch

0.14 m³/s

Highway 400 Overtopping Return to Main Branch

0

Net Spill From Main Branch

5.31 m³/s

Net Spill From Main Branch

6.24

Highway 400 Overtopping Spill to North Tributary

0.35 m³/s

Highway 400 Overtopping Spill to North Tributary

1.13 m³/s

Highway 400 Overtopping Spill to Service Center Culvert

0.12 m³/s

Highway 400 Overtopping Spill to Service Center Culvert

0.25 m³/s

Highway 400 ROW Conveyance To Hotchkiss Creek

4.85 m³/s

Highway 400 ROW Conveyance To Hotchkiss Creek

3.15 m³/s

Regional (Hurricane Hazel) Peak Flow at North Tributary

1.41 m³/s

Total Spill to Hotchkiss Creek

4.85 m³/s

Total Spill to Hotchkiss Creek

3.15 m³/s

Flow in Whiskey Main Branch Downstream of Spill

16.04 m³/s

Flow in Whiskey Main Branch Downstream of Spill

15.11 m³/s

Flow in North Tributary Downstream of Spill

1.88 m³/s

Flow in North Tributary Downstream of Spill

4.59 m³/s

Flow Balance

100.04%

Flow Balance

100.40%

PROJECT	Whiskey Creek at Minet's Point EA	FILE	120114
		DATE	March 15, 2021
SUBJECT	Service Road Weir Analysis	NAME	DAM
		PAGE	1 OF 1

Existing Conditions:

Upstream Flow	2.04 cms
Upstream Water Surface	287.72 m
Culvert Discharge	0.34 cms

Trapezoidal Broad Crested Weir

Source: Hydraulic Structures, C.D.Smith, University of Saskatchewan

Trapezoidal Weir

The trapezoidal weir is a combination of the rectangular weir and the triangular weir

Enter

W	Weir Bottom Width (m)	0.3
H	Head (m)	0.4
L	Weir Downstream Length	10
S	Side Slope (horizontal):1	15

Rectangular Weir $Q = CWH^{3/2}$

H/L	0.04
C	1.48873

Result

Q Rectangular Weir Flow (m³/s) 0.11299

Triangular Weir $Q = CH^{5/2} \tan(\theta/2)$

Notch Angle (one side)	86.1859 degrees
Notch Angle (one side)	1.50423 radians

$\tan(\theta/2)$ 15.00

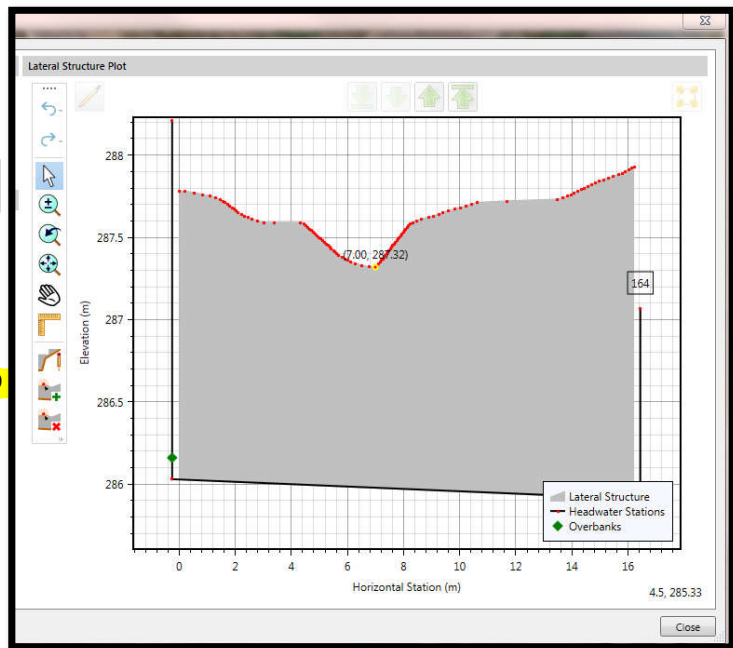
Triangular H/L	0.04
C	1.05

Result

Q Triangular Weir Flow (m³/s) 1.59379

Total Rectangular + Triangular Weir

Q Total Flow (m³/s) 1.71



HY-8 Culvert Analysis Report

Whiskey Main Branch Highway 400

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0.00 m³/s

Design Flow: 21.35 m³/s

Maximum Flow: 25.00 m³/s

Table 1 - Summary of Culvert Flows at Crossing: Whiskey Main Branch Highway 400

Headwater Elevation (m)	Total Discharge (cms)	2250 Conc Discharge (cms)	Roadway Discharge (cms)	Iterations
285.10	0.00	0.00	0.00	1
285.35	2.50	2.50	0.00	1
285.96	5.00	5.00	0.00	1
287.00	7.50	7.50	0.00	1
288.48	10.00	10.00	0.00	1
290.38	12.50	12.50	0.00	1
291.27	15.00	13.51	1.49	6
291.39	17.50	13.64	3.85	6
291.48	20.00	13.74	6.26	6
291.52	21.35	13.78	7.56	5
291.60	25.00	13.87	11.12	5
291.00	13.21	13.21	0.00	Overtopping

Rating Curve Plot for Crossing: Whiskey Main Branch Highway 400

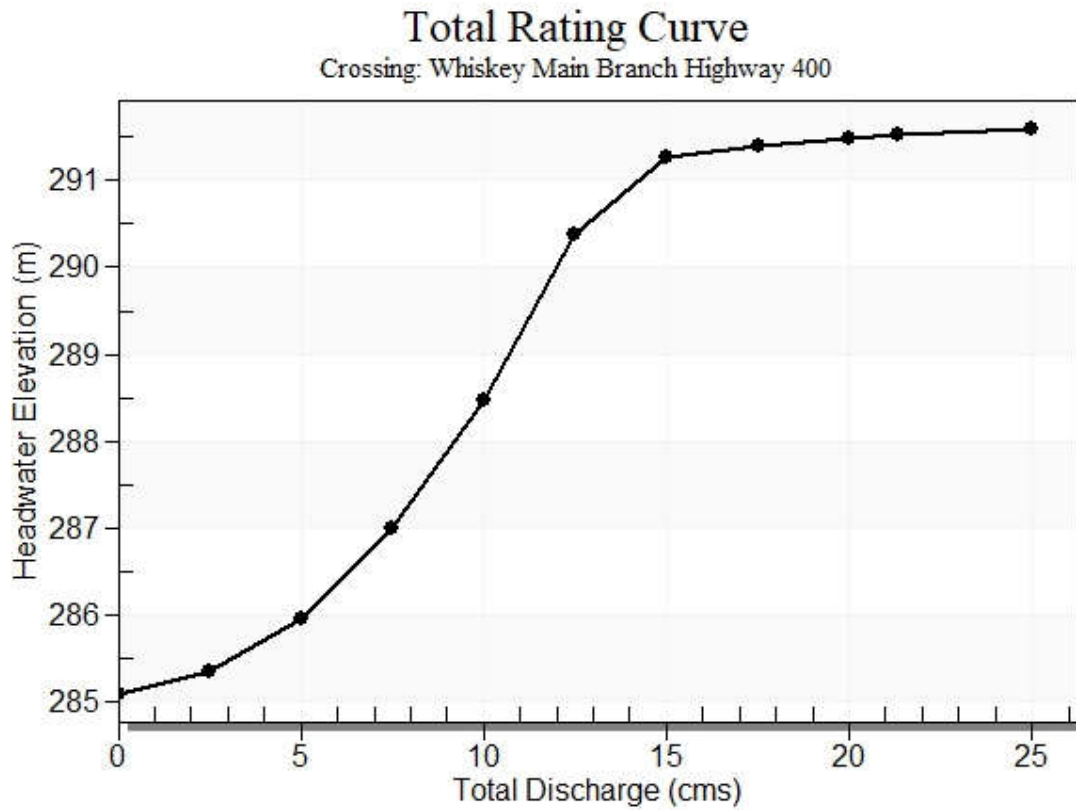
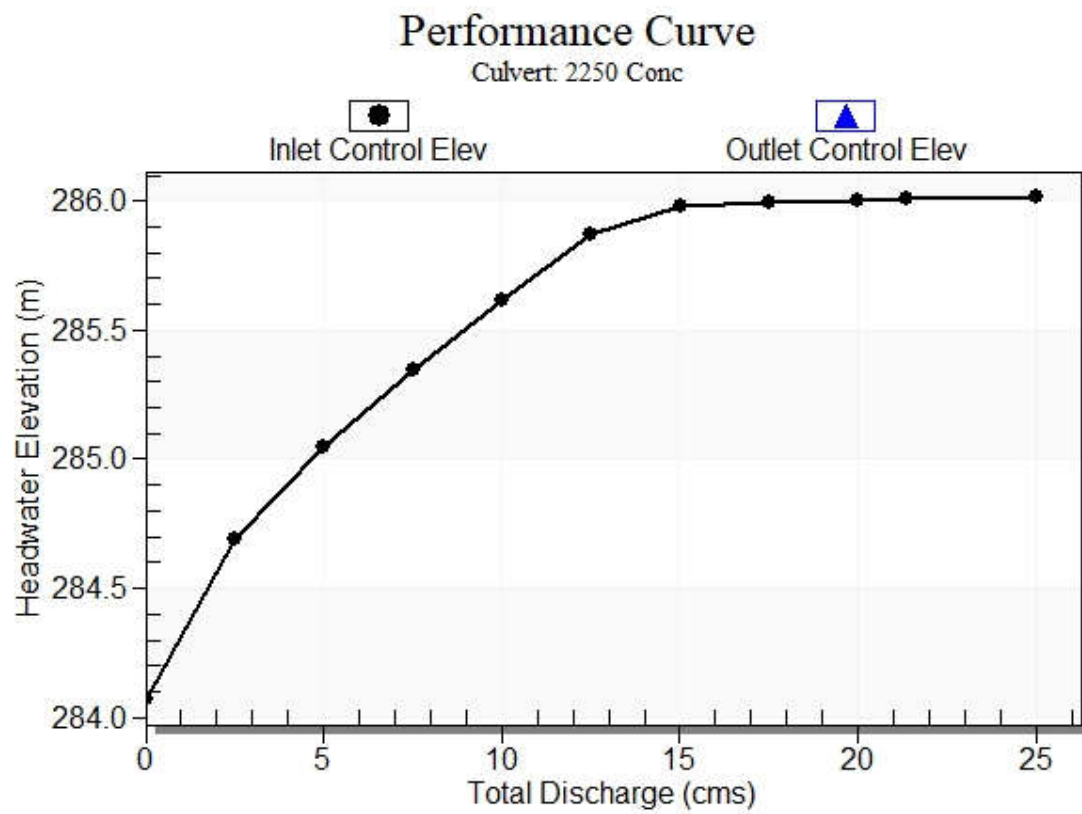


Table 2 - Culvert Summary Table: 2250 Conc

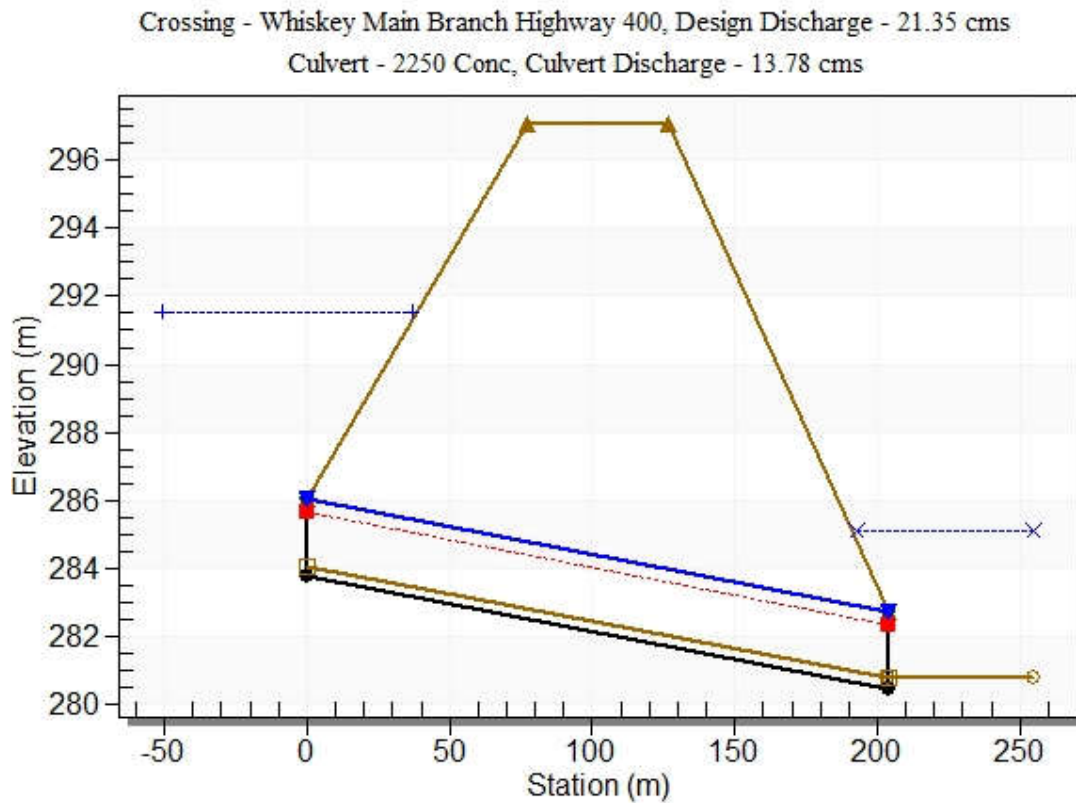
Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	285.10	0.000	1.030	0-NF	0.000	0.000	1.950	4.320	0.000	0.000
2.50	2.50	285.35	0.618	1.280	3-M1f	0.671	0.579	1.950	4.320	0.686	0.000
5.00	5.00	285.96	0.977	1.887	3-M1f	1.016	0.882	1.950	4.320	1.373	0.000
7.50	7.50	287.00	1.275	2.931	4-FFf	1.307	1.117	1.950	4.320	2.059	0.000
10.00	10.00	288.48	1.543	4.411	4-FFf	1.627	1.318	1.950	4.320	2.746	0.000
12.50	12.50	290.38	1.802	6.313	4-FFf	1.950	1.488	1.950	4.320	3.432	0.000
15.00	13.51	291.27	1.909	7.200	4-FFf	1.950	1.551	1.950	4.320	3.710	0.000
17.50	13.64	291.39	1.923	7.324	4-FFf	1.950	1.558	1.950	4.320	3.747	0.000
20.00	13.74	291.48	1.933	7.409	4-FFf	1.950	1.563	1.950	4.320	3.772	0.000
21.35	13.78	291.52	1.937	7.447	4-FFf	1.950	1.565	1.950	4.320	3.783	0.000
25.00	13.87	291.60	1.947	7.533	4-FFf	1.950	1.570	1.950	4.320	3.808	0.000

Straight Culvert
Inlet Elevation (invert): 284.07 m, Outlet Elevation (invert): 280.78 m
Culvert Length: 204.03 m, Culvert Slope: 0.0161

Culvert Performance Curve Plot: 2250 Conc



Water Surface Profile Plot for Culvert: 2250 Conc



Site Data - 2250 Conc

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 283.77 m

Outlet Station: 204.00 m

Outlet Elevation: 280.48 m

Number of Barrels: 1

Culvert Data Summary - 2250 Conc

Barrel Shape: Circular

Barrel Diameter: 2250.00 mm

Barrel Material: Concrete

Embedment: 300.00 mm

Barrel Manning's n: 0.0130 (top and sides)

Manning's n: 0.0400 (bottom)

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Channel Data - Whiskey Main Branch Highway 400

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 285.10 m

Roadway Data for Crossing: Whiskey Main Branch Highway 400

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

Irregular Roadway Cross-Section:

Coord No.	Station (m)	Elevation (m)
0	15.90	297.09
1	16.70	291.00
2	100.00	292.27

Roadway Surface: Paved

Roadway Top Width: 50.00 m

Whiskey Main Branch Fairview

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0.00 m³/s cfs

Design Flow: 18.57 m³/s

Maximum Flow: 25.00 m³/s

Table 1 - Summary of Culvert Flows at Crossing: Whiskey Main Branch Fairview

Headwater Elevation (m)	Total Discharge (cms)	2700 x 1500 Conc Discharge (cms)	Roadway Discharge (cms)	Iterations
280.66	0.00	0.00	0.00	1
280.81	2.50	2.50	0.00	1
281.14	5.00	5.00	0.00	1
281.74	7.50	7.50	0.00	1
282.57	10.00	10.00	0.00	1
283.65	12.50	12.50	0.00	1
284.97	15.00	15.00	0.00	1
286.52	17.50	17.50	0.00	1
287.26	18.57	18.57	0.00	1
289.73	22.50	21.76	0.72	17
289.77	25.00	21.81	3.16	6
289.70	21.73	21.73	0.00	Overtopping

Rating Curve Plot for Crossing: Whiskey Main Branch Fairview

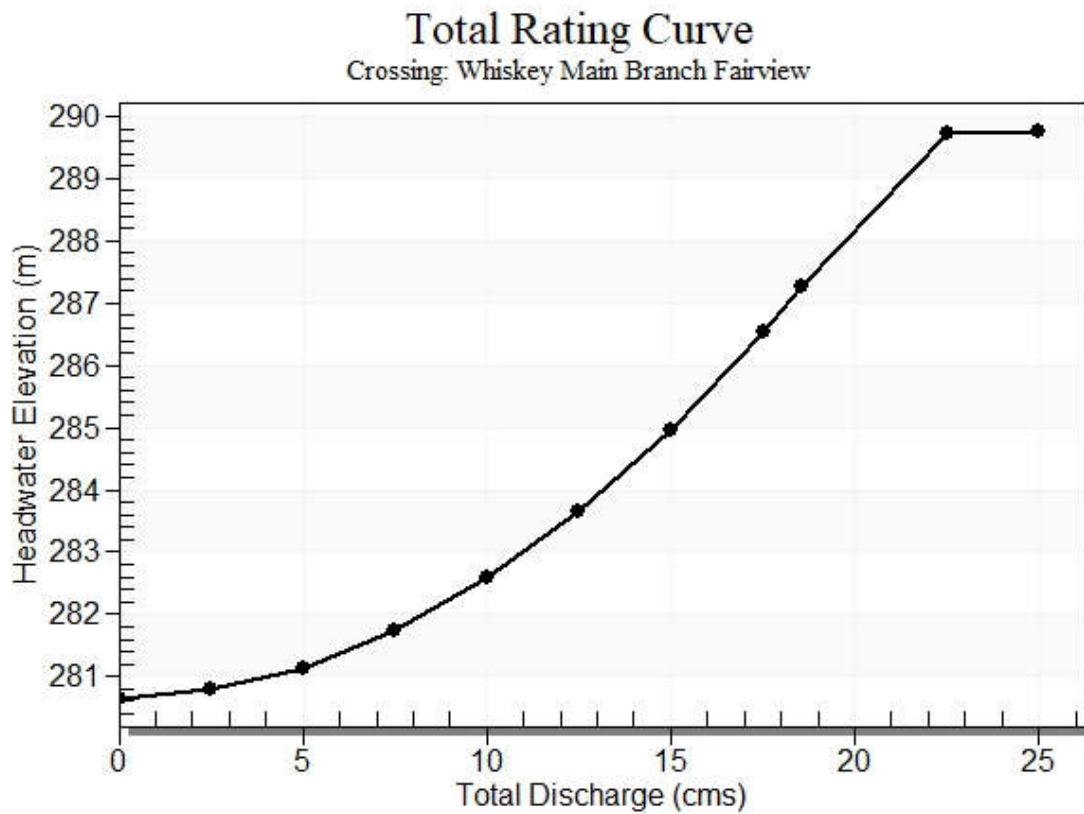
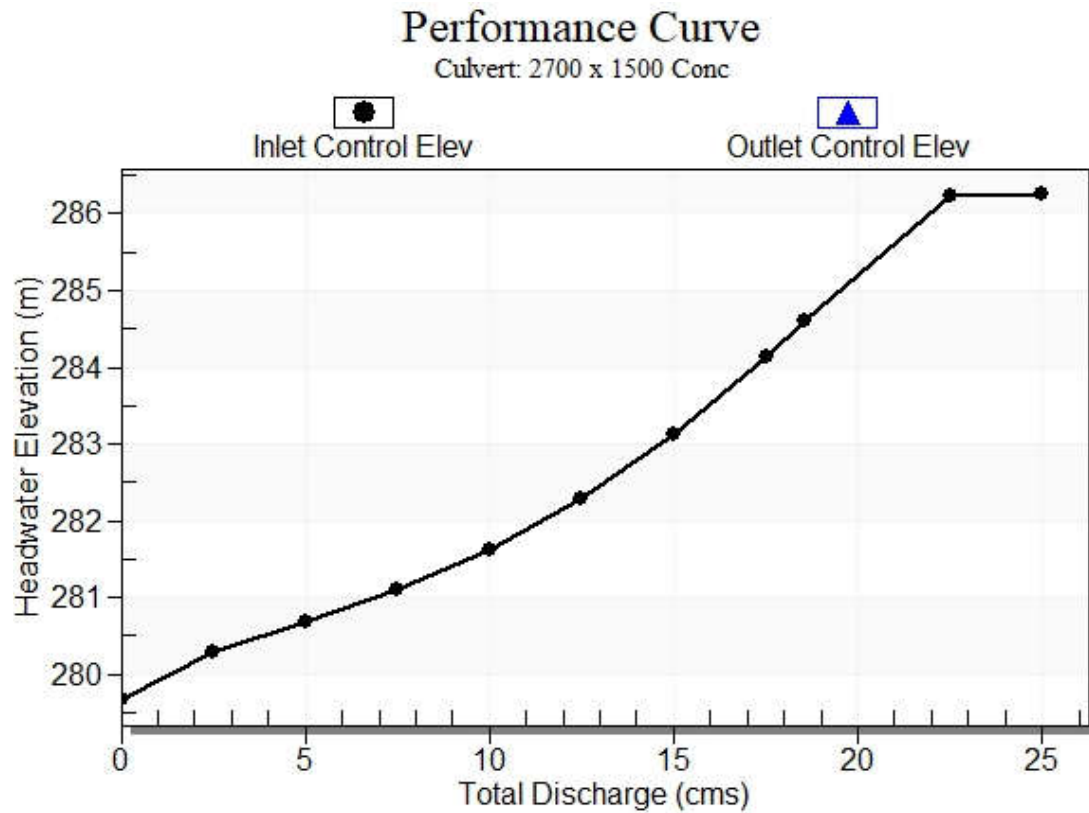


Table 2 - Culvert Summary Table: 2700 x 1500 Conc

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)
0.00	0.00	280.66	0.000	0.990	0-NF	0.000	0.000	1.200	2.391	0.000	0.000
2.50	2.50	280.81	0.631	1.140	3-M1f	0.467	0.446	1.200	2.391	0.772	0.000
5.00	5.00	281.14	1.018	1.469	4-FFf	0.708	0.702	1.200	2.391	1.543	0.000
7.50	7.50	281.74	1.439	2.067	4-FFf	0.903	0.920	1.200	2.391	2.315	0.000
10.00	10.00	282.57	1.949	2.905	4-FFf	1.074	1.115	1.200	2.391	3.086	0.000
12.50	12.50	283.65	2.629	3.982	4-FFf	1.200	1.200	1.200	2.391	3.858	0.000
15.00	15.00	284.97	3.449	5.299	4-FFf	1.200	1.200	1.200	2.391	4.630	0.000
17.50	17.50	286.52	4.456	6.855	4-FFf	1.200	1.200	1.200	2.391	5.401	0.000
18.57	18.57	287.26	4.941	7.594	4-FFf	1.200	1.200	1.200	2.391	5.731	0.000
22.50	21.76	289.73	6.561	10.057	4-FFf	1.200	1.200	1.200	2.391	6.716	0.000
25.00	21.81	289.77	6.590	10.102	4-FFf	1.200	1.200	1.200	2.391	6.732	0.000

Straight Culvert
Inlet Elevation (invert): 279.67 m, Outlet Elevation (invert): 278.09 m
Culvert Length: 88.91 m, Culvert Slope: 0.0178

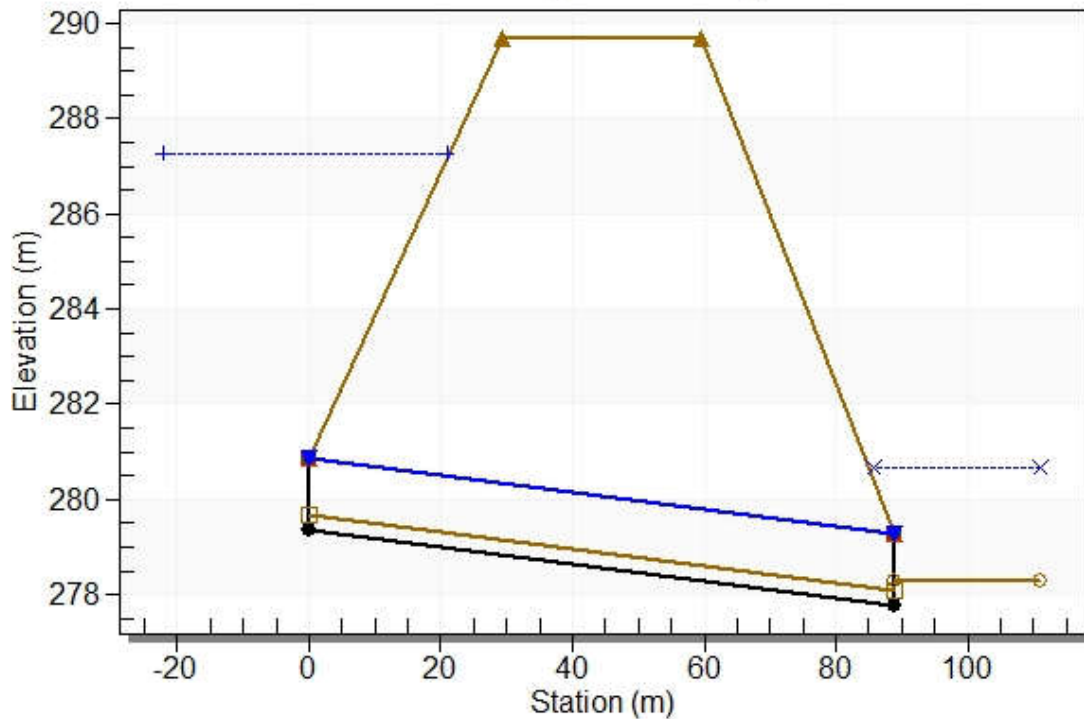
Culvert Performance Curve Plot: 2700 x 1500 Conc



Water Surface Profile Plot for Culvert: 2700 x 1500 Conc

Crossing - Whiskey Main Branch Fairview, Design Discharge - 18.57 cms

Culvert - 2700 x 1500 Conc, Culvert Discharge - 18.57 cms



Site Data - 2700 x 1500 Conc

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 279.37 m

Outlet Station: 88.90 m

Outlet Elevation: 277.79 m

Number of Barrels: 1

Culvert Data Summary - 2700 x 1500 Conc

Barrel Shape: Concrete Box

Barrel Span: 2700.00 mm

Barrel Rise: 1500.00 mm

Barrel Material: Concrete

Embedment: 300.00 mm

Barrel Manning's n: 0.0130 (top and sides)

Manning's n: 0.0350 (bottom)

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Channel Data - Whiskey Main Branch Fairview

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 280.66 m

Roadway Data for Crossing: Whiskey Main Branch Fairview

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 m

Crest Elevation: 289.70 m

Roadway Surface: Paved

Roadway Top Width: 30.00 m

Whiskey Trib Highway 400

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0.00 m³/s cfs

Design Flow: 2.31 m³/s

Maximum Flow: 4.50 m³/s

Table 1 - Summary of Culvert Flows at Crossing: Whiskey Trib Highway 400

Headwater Elevation (m)	Total Discharge (cms)	1200 x 900 Conc Discharge (cms)	Roadway Discharge (cms)	Iterations
283.64	0.00	0.00	0.00	1
284.06	0.45	0.45	0.00	1
284.29	0.90	0.90	0.00	1
284.52	1.35	1.35	0.00	1
284.70	1.80	1.80	0.00	1
284.91	2.25	2.25	0.00	1
284.94	2.31	2.31	0.00	1
285.49	3.15	3.15	0.00	1
285.86	3.60	3.60	0.00	1
285.97	4.05	3.72	0.33	9
286.03	4.50	3.79	0.71	8
286.11	3.87	3.87	0.00	Overtopping

Rating Curve Plot for Crossing: Whiskey Trib Highway 400

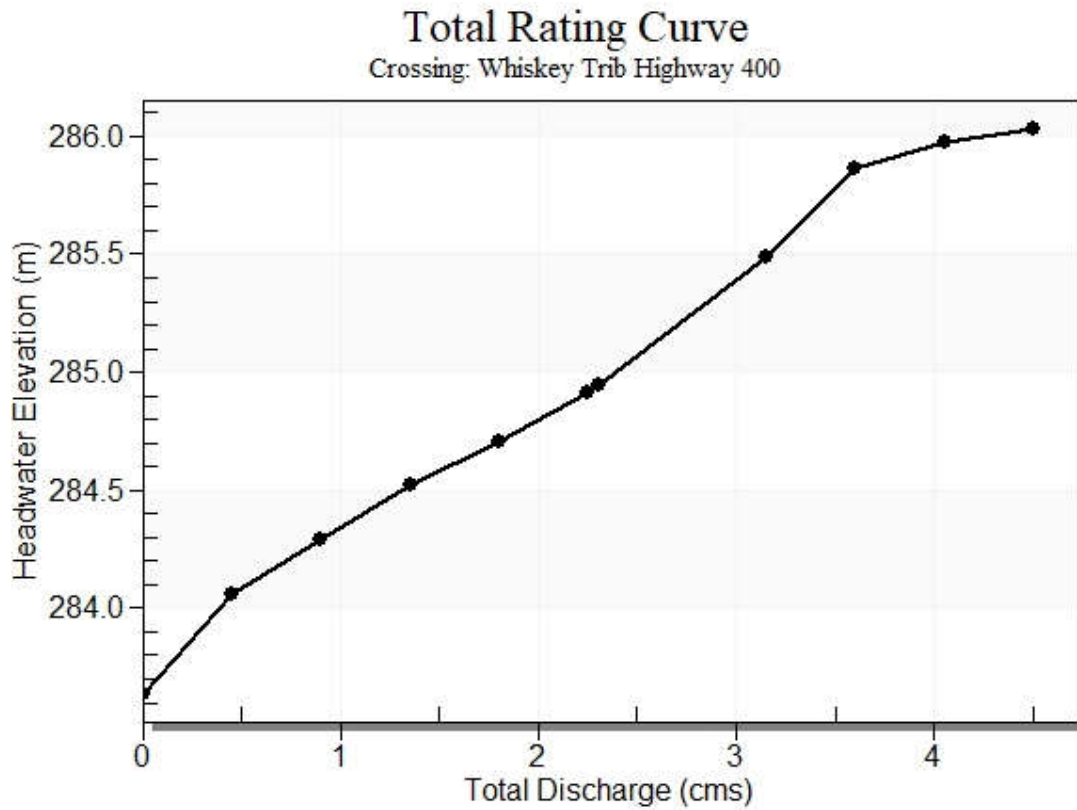


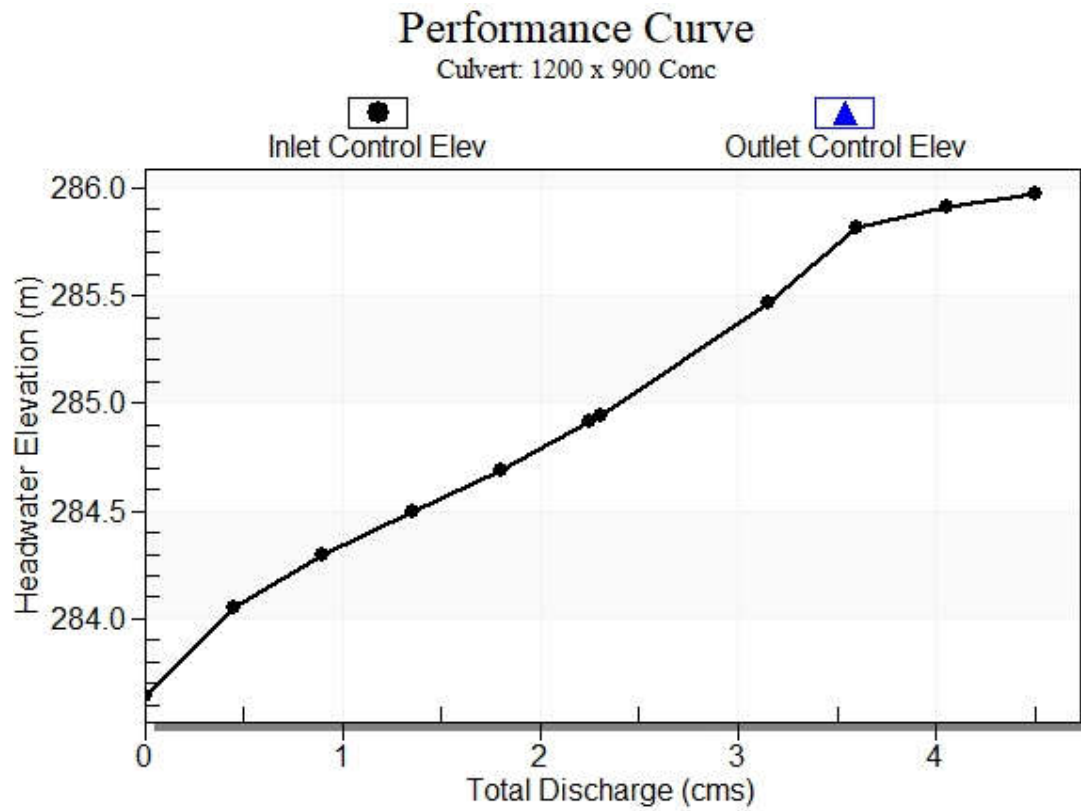
Table 2 - Culvert Summary Table: 1200 x 900 Conc

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)
0.00	0.00	283.64	0.000	0.000	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
0.45	0.45	284.06	0.415	0.0*	1-S2n	0.235	0.243	0.235	0.365	1.595	0.650
0.90	0.90	284.29	0.652	0.206	1-S2n	0.380	0.386	0.380	0.502	1.971	0.777
1.35	1.35	284.52	0.854	0.882	2-M2c	0.510	0.505	0.505	0.602	2.227	0.862
1.80	1.80	284.70	1.053	1.062	7-M2c	0.633	0.612	0.612	0.682	2.451	0.927
2.25	2.25	284.91	1.271	1.223	7-M2c	0.900	0.710	0.710	0.751	2.640	0.981
2.31	2.31	284.94	1.303	1.244	7-M2c	0.900	0.723	0.723	0.760	2.663	0.987
3.15	3.15	285.49	1.824	1.846	7-M2c	0.900	0.889	0.889	0.867	2.953	1.068
3.60	3.60	285.86	2.172	2.223	6-FFc	0.900	0.900	0.900	0.918	3.333	1.104
4.05	3.72	285.97	2.275	2.333	6-FFc	0.900	0.900	0.900	0.964	3.446	1.138
4.50	3.79	286.03	2.333	2.395	6-FFc	0.900	0.900	0.900	1.008	3.508	1.168

* Full Flow Headwater elevation is below inlet invert.

Straight Culvert
Inlet Elevation (invert): 283.64 m, Outlet Elevation (invert): 283.36 m
Culvert Length: 66.00 m, Culvert Slope: 0.0042

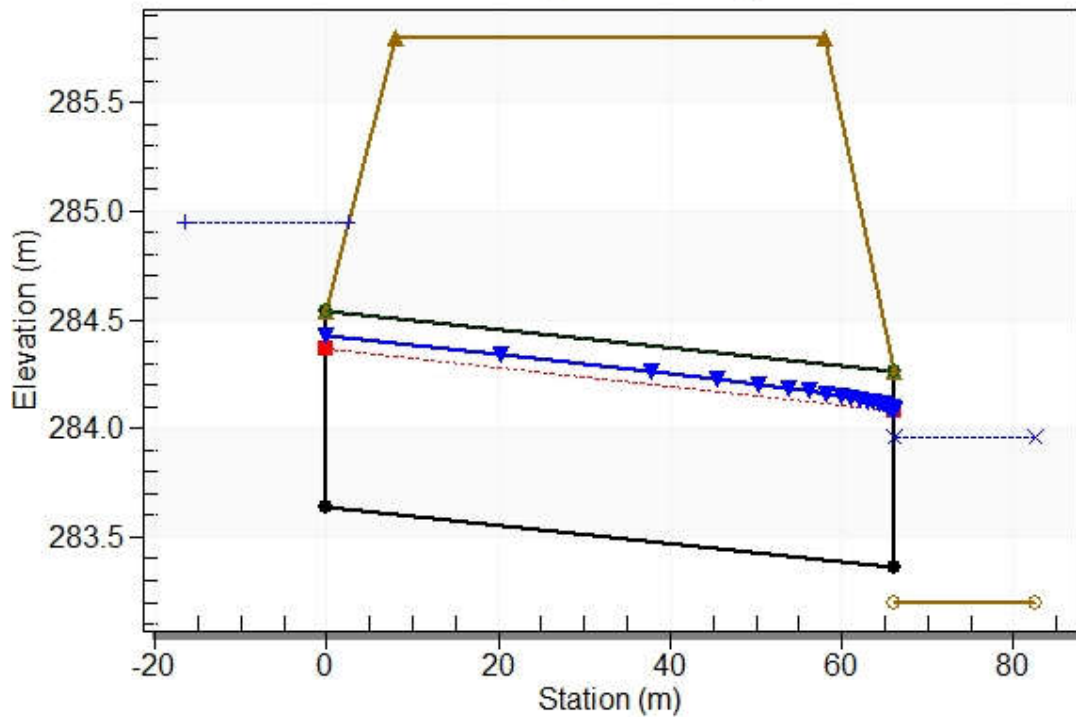
Culvert Performance Curve Plot: 1200 x 900 Conc



Water Surface Profile Plot for Culvert: 1200 x 900 Conc

Crossing - Whiskey Trib Highway 400, Design Discharge - 2.31 cms

Culvert - 1200 x 900 Conc, Culvert Discharge - 2.31 cms



Site Data - 1200 x 900 Conc

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 283.64 m

Outlet Station: 66.00 m

Outlet Elevation: 283.36 m

Number of Barrels: 1

Culvert Data Summary - 1200 x 900 Conc

Barrel Shape: Concrete Box

Barrel Span: 1200.00 mm

Barrel Rise: 900.00 mm

Barrel Material: Concrete

Embedment: 0.00 mm

Barrel Manning's n: 0.0130

Culvert Type: Straight

Inlet Configuration: Square Edge (90°) Headwall

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: Whiskey Trib Highway 400)

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
0.00	283.20	0.00	0.00	0.00	0.00
0.45	283.57	0.37	0.65	17.91	0.43
0.90	283.70	0.50	0.78	24.61	0.45
1.35	283.80	0.60	0.86	29.48	0.46
1.80	283.88	0.68	0.93	33.43	0.47
2.25	283.95	0.75	0.98	36.82	0.48
2.31	283.96	0.76	0.99	37.24	0.48
3.15	284.07	0.87	1.07	42.50	0.49
3.60	284.12	0.92	1.10	44.97	0.49
4.05	284.16	0.96	1.14	47.26	0.49
4.50	284.21	1.01	1.17	49.39	0.50

Tailwater Channel Data - Whiskey Trib Highway 400

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 0.80 m

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

Channel Slope: 0.0050

Channel Manning's n: 0.0400

Channel Invert Elevation: 283.20 m

Roadway Data for Crossing: Whiskey Trib Highway 400

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

Irregular Roadway Cross-Section:

Coord No.	Station (m)	Elevation (m)
0	0.00	285.80
1	14.00	286.11
2	30.00	286.50

Roadway Surface: Paved

Roadway Top Width: 50.00 m

Whiskey Spill Service Road Crossing

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0.30 m³/s cfs

Design Flow: 0.34 m³/s

Maximum Flow: 1.00 m³/s

Table 1 - Summary of Culvert Flows at Crossing: Whiskey Spill Service Road Crossing

Headwater Elevation (m)	Total Discharge (cms)	450 CSP Discharge (cms)	Roadway Discharge (cms)	Iterations
287.33	0.30	0.30	0.00	1
287.73	0.37	0.34	0.03	23
287.73	0.38	0.34	0.04	4
287.76	0.51	0.34	0.17	5
287.77	0.58	0.34	0.24	4
287.77	0.65	0.34	0.31	4
287.78	0.72	0.34	0.37	3
287.79	0.79	0.34	0.44	3
287.80	0.86	0.34	0.51	3
287.80	0.93	0.35	0.58	3
287.81	1.00	0.35	0.65	3
287.72	0.34	0.34	0.00	Overtopping

Rating Curve Plot for Crossing: Whiskey Spill Service Road Crossing

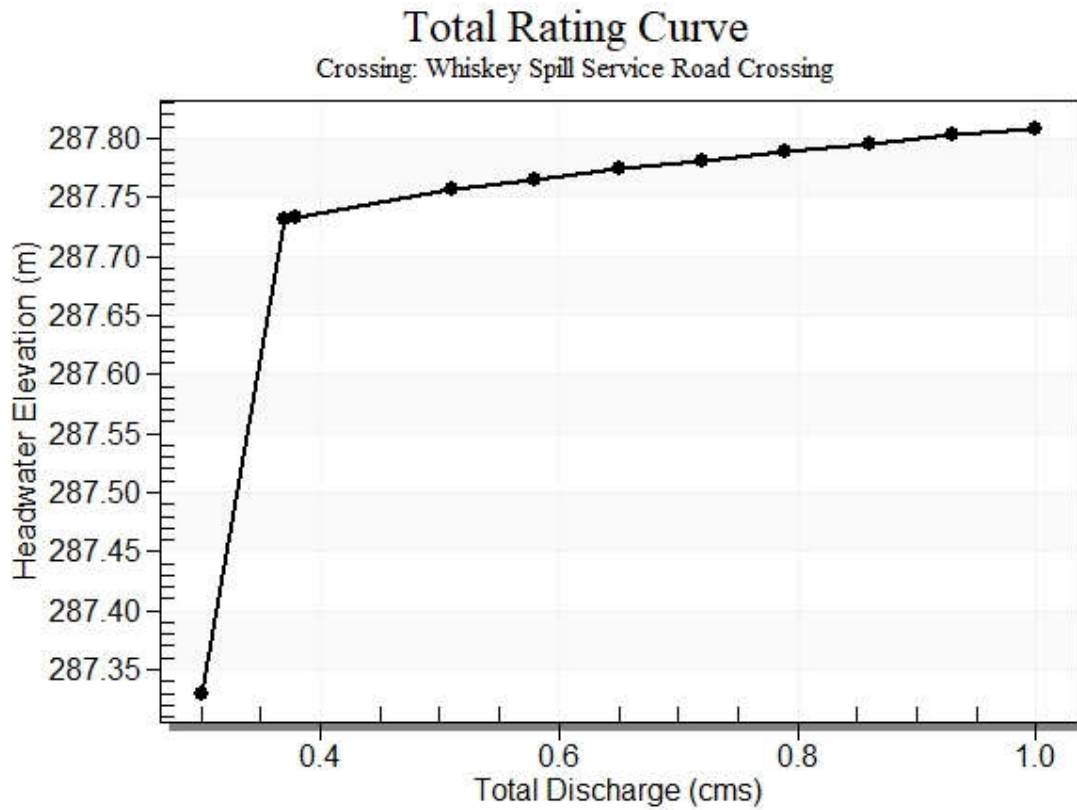
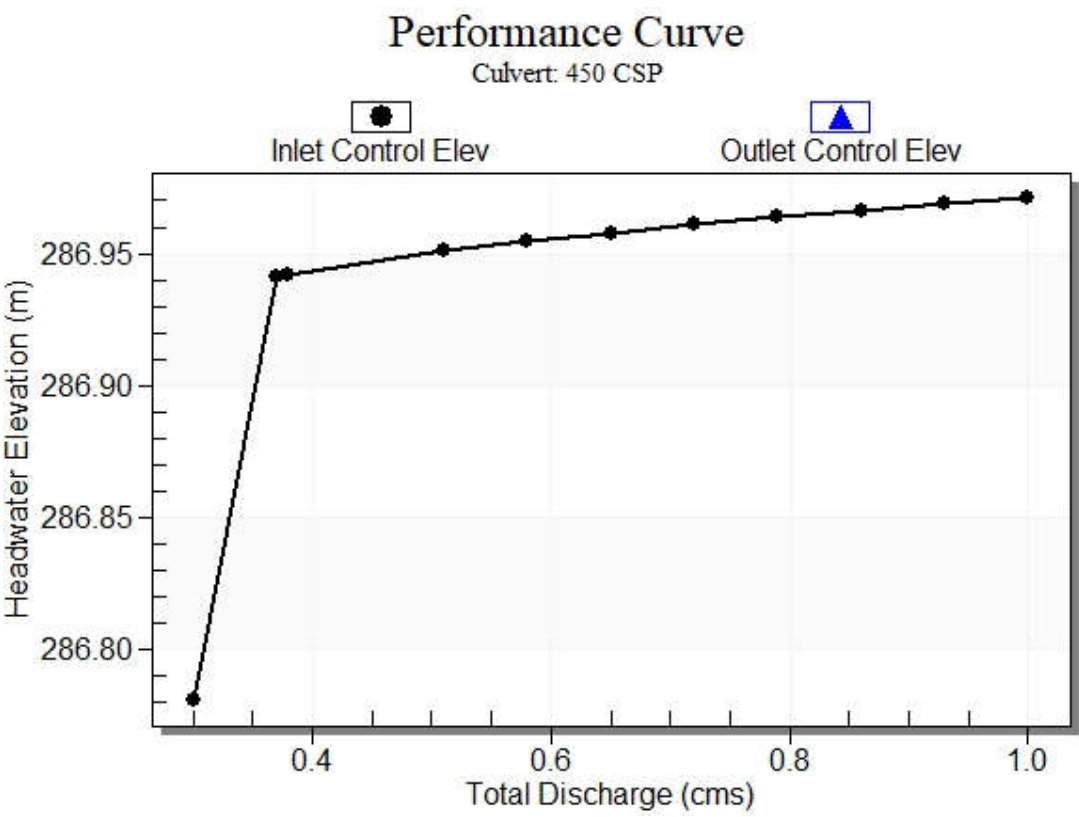


Table 2 - Culvert Summary Table: 450 CSP

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)
0.30	0.30	287.33	0.871	1.420	7-M2c	0.450	0.381	0.381	0.210	2.088	0.000
0.37	0.34	287.73	1.031	1.821	7-M2c	0.450	0.399	0.399	0.210	2.270	0.000
0.38	0.34	287.73	1.032	1.824	7-M2c	0.450	0.399	0.399	0.210	2.271	0.000
0.51	0.34	287.76	1.041	1.846	7-M2c	0.450	0.400	0.400	0.210	2.281	0.000
0.58	0.34	287.77	1.044	1.855	7-M2c	0.450	0.400	0.400	0.210	2.285	0.000
0.65	0.34	287.77	1.047	1.864	7-M2c	0.450	0.401	0.401	0.210	2.289	0.000
0.72	0.34	287.78	1.051	1.871	7-M2c	0.450	0.401	0.401	0.210	2.292	0.000
0.79	0.34	287.79	1.054	1.879	7-M2c	0.450	0.401	0.401	0.210	2.296	0.000
0.86	0.34	287.80	1.056	1.886	7-M2c	0.450	0.402	0.402	0.210	2.298	0.000
0.93	0.35	287.80	1.059	1.892	7-M2c	0.450	0.402	0.402	0.210	2.302	0.000
1.00	0.35	287.81	1.061	1.899	7-M2c	0.450	0.402	0.402	0.210	2.304	0.000

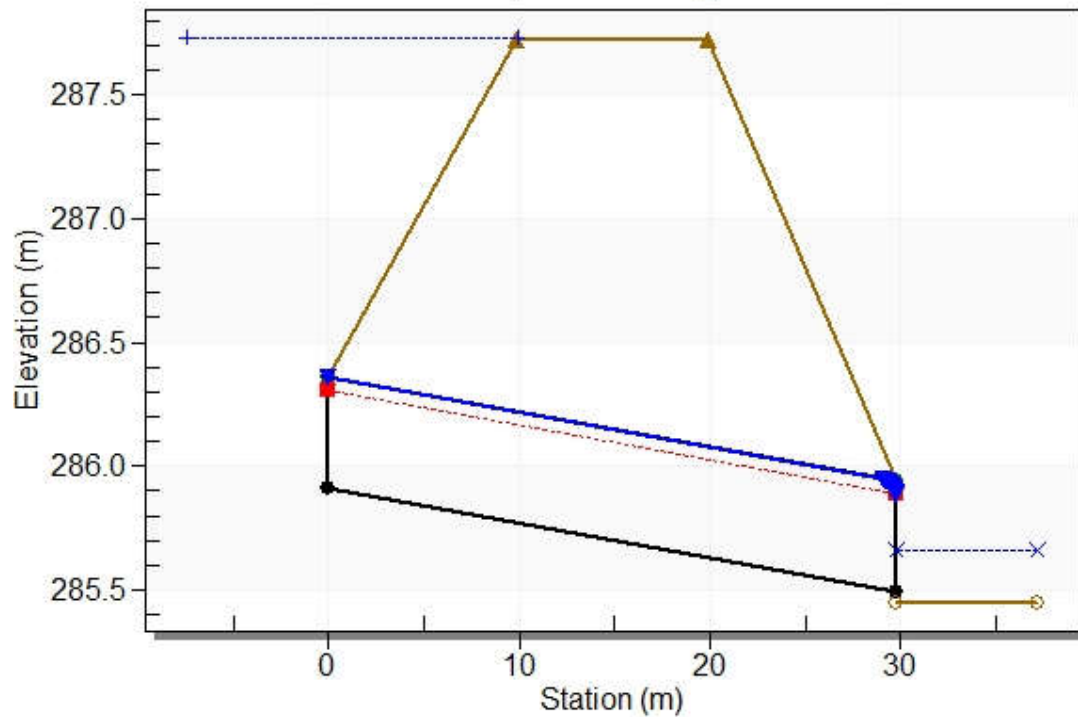
Straight Culvert
Inlet Elevation (invert): 285.91 m, Outlet Elevation (invert): 285.49 m
Culvert Length: 29.73 m, Culvert Slope: 0.0141

Culvert Performance Curve Plot: 450 CSP



Water Surface Profile Plot for Culvert: 450 CSP

Crossing - Whiskey Spill Service Road Crossing, Design Discharge - 0.38 cms
Culvert - 450 CSP, Culvert Discharge - 0.34 cms



Site Data - 450 CSP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 285.91 m

Outlet Station: 29.73 m

Outlet Elevation: 285.49 m

Number of Barrels: 1

Culvert Data Summary - 450 CSP

Barrel Shape: Circular

Barrel Diameter: 450.00 mm

Barrel Material: Corrugated Steel

Embedment: 0.00 mm

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: None

Tailwater Channel Data - Whiskey Spill Service Road Crossing

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 285.66 m

Roadway Data for Crossing: Whiskey Spill Service Road Crossing

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 15.00 m

Crest Elevation: 287.72 m

Roadway Surface: Paved

Roadway Top Width: 10.00

Hydrologic Update Summary

BARRIE DRAINAGE MASTER PLAN
MODEL UPDATES - ADJUSTMENTS PER LSRCA COMMENTS FOR WOODLAND AND PERCENT DIRECTLY CONNECTED
FEBRUARY 2021

WHISKEY CREEK FLOW COMPARISON

				Peak Flow (m³/s)							Comparison of Tatham Models vs. LSRCA Approved 2009 MDP							
VO3 Hydrograph	Location	WHISKEY CREEK		Tatham Engineering (2019 DMP)			2021 Adjustments Per LSRCA Comments (Woodland, XIMP)			LSRCA Approved (2009 MDP)		2019 DMP		2021 Adjustments		Comparison of Tatham 2021 Adjustments vs. 2019 DMP		
		River Reach	River Station	5 Year	100 Year	Hazel	5 Year	100 Year	Hazel	100 Year	Hazel	100 Year	Hazel	100 Year	Hazel	5 Year	100 Year	Hazel
23111		7	494	1.18	2.96	2.41	1.25	3.07	2.42							106%	104%	100%
23906		7	125	1.37	3.52	4.16	1.42	3.59	4.17							104%	102%	100%
23902		6	432	5.50	14.17	11.43	5.71	14.60	11.48							104%	103%	100%
23905		4	2254	2.66	5.51	18.46	2.71	5.58	18.52							102%	101%	100%
23907	Harvie Road	4	2142	2.79	5.88	19.19	2.84	5.94	19.25	14.70	20.07	40%	96%	40%	96%	102%	101%	100%
23908	Highway 400	4	2010	3.09	6.81	21.23	3.14	6.89	21.35	7.38	9.50	92%	223%	93%	225%	102%	101%	101%
23909	Fairview Road	4	1709	3.23	7.18	22.00	3.30	7.23	22.09	7.69	10.27	93%	214%	94%	215%	102%	101%	100%
23910	BCR Tracks	4	1481	3.56	8.14	23.68	3.63	8.21	23.76	10.66	12.21	76%	194%	77%	195%	102%	101%	100%
23911	Bayview Drive	4	1160	3.65	8.37	24.39	3.74	8.45	24.48	11.94	13.32	70%	183%	71%	184%	102%	101%	100%
23912		4	1100	3.76	8.62	24.75	3.86	8.71	24.81							103%	101%	100%
23913		5	389	1.54	4.00	4.54	1.48	3.87	4.63							96%	97%	102%
23914		5	101	2.41	6.24	5.52	2.64	6.31	5.54							110%	101%	100%
23915	West Tributary Convergence	3	1697	8.54	21.31	38.16	10.85	25.49	38.16	21.66	26.00	98%	147%	118%	147%	127%	120%	100%
23916	Middle of Lackie's Bush	3	1351	8.46	20.58	39.65	10.55	23.87	39.61	21.50	28.77	96%	138%	111%	138%	125%	116%	100%
23917		3	953	8.46	20.59	40.78	10.34	23.47	40.75							122%	114%	100%
23918		3	512	8.12	20.30	41.81	9.67	22.70	41.78							119%	112%	100%
23919	McConkey Place	3	352	8.22	20.54	42.34	9.70	22.86	42.31	20.19	32.04	102%	132%	113%	132%	118%	111%	100%
23940		3	222	10.95	27.15	49.53	13.57	30.92	49.43							124%	114%	100%
23002	BCR Tracks	3	169	7.64	25.09	49.53	8.10	28.71	49.43	26.14	40.07	96%	124%	110%	123%	106%	114%	100%
23920	Huronia Road	3	108	7.70	25.35	50.00	8.16	28.93	49.89	26.14	40.07	97%	125%	111%	125%	106%	114%	100%
23922		2	1332	1.88	4.38	2.92	2.21	4.94	2.92							117%	113%	100%
23923		2	1059	3.03	7.24	4.82	3.63	8.25	4.81							120%	114%	100%
23924		2	864	2.98	7.27	5.56	3.52	8.21	5.55							118%	113%	100%
23925		2	683	4.82	11.95	9.22	5.47	13.12	9.22							114%	110%	100%
23926		2	601	5.86	14.69	11.35	6.55	16.14	11.33							112%	110%	100%
23927		2	383	5.88	14.77	11.53	6.60	16.17	11.54							112%	109%	100%
23921		2	110	13.19	34.29	63.01	14.54	40.21	63.02							110%	117%	100%
23928	Little Avenue	1	1549	9.26	29.31	63.39	9.89	33.47	63.40	35.72	55.33	82%	115%	94%	115%	107%	114%	100%
23929		1	1515	9.27	29.22	63.31	9.90	33.23	63.31							107%	114%	100%
23930	Yonge Street	1	974	9.38	22.16	66.08	10.13	32.20	66.11	36.46	57.85	61%	114%	88%	114%	108%	145%	100%
23931		1	929	9.38	22.17	66.18	10.11	27.55	66.21							108%	124%	100%
23932	BCR Tracks	1	663	9.60	22.76	67.72	10.32	28.13	67.74	38.17	61.03	60%	111%	74%	111%	108%	124%	100%
23933		1	562	9.76	23.05	68.99	10.49	28.42	68.94							107%	123%	100%
23935	Tollendale Mill Road	1	495	9.78	23.09	69.27	10.51	28.50	69.24	39.07	62.67	59%	111%	73%	110%	107%	123%	100%
23934		1	451	9.76	21.77	69.56	10.51	23.94	69.40							108%	110%	100%
23936	The Boulevard	1	243	9.76	21.77	69.62	10.52	23.95	69.56	39.24	63.07	55%	110%	61%	110%	108%	110%	100%
23937		1	225	9.79	21.84	69.96	10.56	24.03	69.89							108%	110%	100%
23938	Brennan Avenue	1	180	9.78	21.84	70.07	10.56	24.01	69.96	39.43	63.44	55%	110%	61%	110%	108%	110%	100%
23939	Outlet to Kempenfelt Bay	1	30	9.75	21.78	70.04	10.54	23.95	69.98	39.51	63.59	55%	110%	61%	110%	108%	110%	100%

1) Hydrologic modelling assumes no inter-watershed spills.

2) The hydrologic modelling completed by Tatham Engineering Limited uses the SCS Curve Number infiltration approach.

BARRIE DRAINAGE MASTER PLAN
MODEL UPDATES - ADJUSTMENTS PER LSRCA COMMENTS FOR WOODLAND AND PERCENT DIRECTLY CONNECTED
FEBRUARY 2021

WHISKEY CREEK WATERSHED - ORIGINAL PARAMETERS

CITY WIDE VISUAL OTTHYMO MODEL (2019)								
AMCII Parameters								
Catchment ID	Type	Area (ha)	Imperviousness (%)	A*IMP (ha)	Directly Connected Imperviousness (%)	A*XIMP (ha)	CN	A*CN
191182	NasHyd - HT118_2	15.8	-	-	-	-	49.60	781.7
23103	NasHyd - WK103	0.3	-	-	-	-	48.30	14.5
23104	NasHyd - WK104	3.3	-	-	-	-	49.80	163.3
23108	NasHyd - WK108	9.9	-	-	-	-	51.70	512.9
23109	NasHyd - WK109	14.8	-	-	-	-	49.40	730.1
23110	NasHyd - WK110	17.2	-	-	-	-	47.50	815.1
23112	NasHyd - WK112	7.0	-	-	-	-	48.90	343.8
23113	NasHyd - WK113	21.7	-	-	-	-	41.80	905.8
231142	NasHyd - WK114_2	7.9	-	-	-	-	50.00	395.3
23115	NasHyd - WK115	15.6	-	-	-	-	51.40	800.8
231222	NasHyd - WK122_2	11.0	-	-	-	-	53.10	582.0
23125	NasHyd - WK125	11.4	-	-	-	-	46.30	526.4
23127	NasHyd - WK127	10.7	-	-	-	-	47.30	506.6
23129	NasHyd - WK129	4.9	-	-	-	-	59.40	290.5
23131	NasHyd - WK131	0.9	-	-	-	-	56.70	50.5
23135	NasHyd - WK135	0.7	-	-	-	-	52.40	37.2
23137	NasHyd - WK137	8.3	-	-	-	-	62.40	517.3
23143	NasHyd - WK143	3.5	-	-	-	-	65.10	224.6
23144	NasHyd - WK144	6.2	-	-	-	-	69.90	430.6
23158	NasHyd - WK158	14.3	-	-	-	-	61.70	879.2
23160	NasHyd - WK160	1.0	-	-	-	-	66.00	68.6
23101	StandHyd - WK101	5.4	46.12%	2.5	28.84%	1.5	-	-
23102	StandHyd - WK102	1.8	38.71%	0.7	36.46%	0.6	-	-
23105	StandHyd - WK105	6.0	39.62%	2.4	25.28%	1.5	-	-
23106	StandHyd - WK106	77.4	48.01%	37.2	29.05%	22.5	-	-
23107	StandHyd - WK107	2.2	48.15%	1.1	32.78%	0.7	-	-
23111	StandHyd - WK111	19.9	36.80%	7.3	27.02%	5.4	-	-
231141	StandHyd - WK114_1	2.1	76.70%	1.6	76.70%	1.6	-	-
23116	StandHyd - WK116	7.4	32.75%	2.4	26.09%	1.9	-	-
23117	StandHyd - WK117	2.3	58.98%	1.4	28.69%	0.7	-	-
23118	StandHyd - WK118	1.0	64.65%	0.6	56.76%	0.6	-	-
23119	StandHyd - WK119	74.6	38.78%	28.9	22.20%	16.6	-	-
23120	StandHyd - WK120	7.3	87.05%	6.4	43.45%	3.2	-	-
23121	StandHyd - WK121	9.2	39.68%	3.6	22.99%	2.1	-	-
231221	StandHyd - WK122_1	3.7	37.37%	1.4	25.00%	0.9	-	-
23123	StandHyd - WK123	5.2	38.55%	2.0	35.34%	1.8	-	-
23124	StandHyd - WK124	16.7	36.51%	6.1	21.65%	3.6	-	-
23126	StandHyd - WK126	0.9	45.59%	0.4	37.49%	0.3	-	-
23128	StandHyd - WK128	1.2	35.59%	0.4	27.18%	0.3	-	-
23130	StandHyd - WK130	0.4	59.39%	0.2	36.70%	0.1	-	-
23132	StandHyd - WK132	1.7	38.10%	0.6	22.12%	0.4	-	-
23133	StandHyd - WK133	48.0	44.30%	21.3	26.10%	12.5	-	-
23134	StandHyd - WK134	15.2	34.83%	5.3	22.38%	3.4	-	-
23136	StandHyd - WK136	3.7	31.29%	1.2	23.29%	0.9	-	-
23138	StandHyd - WK138	3.0	40.32%	1.2	24.55%	0.7	-	-
23139	StandHyd - WK139	1.6	24.96%	0.4	0.10%	0.0	-	-
23140	StandHyd - WK140	8.0	30.98%	2.5	16.03%	1.3	-	-
23141	StandHyd - WK141	8.1	44.11%	3.6	23.76%	1.9	-	-
23142	StandHyd - WK142	24.2	48.41%	11.7	25.63%	6.2	-	-
23145	StandHyd - WK145	14.2	42.53%	6.0	29.69%	4.2	-	-
23146	StandHyd - WK146	21.0	41.87%	8.8	31.95%	6.7	-	-
23147	StandHyd - WK147	1.4	73.79%	1.0	65.38%	0.9	-	-
23148	StandHyd - WK148	9.5	48.54%	4.6	28.01%	2.7	-	-
23149	StandHyd - WK149	5.3	35.23%	1.9	22.83%	1.2	-	-
23150	StandHyd - WK150	1.2	32.97%	0.4	28.85%	0.4	-	-
23151	StandHyd - WK151	2.4	31.11%	0.7	24.58%	0.6	-	-
23152	StandHyd - WK152	0.3	35.38%	0.1	26.35%	0.1	-	-
23153	StandHyd - WK153	0.4	40.29%	0.2	28.49%	0.1	-	-

WHISKEY CREEK WATERSHED - WOODLAND AND PERCENT DIRECTLY CONNECTED ADJUSTMENTS

CITY WIDE VISUAL OTTHYMO MODEL (2021)								
AMCII Parameters								
Catchment ID	Type	Area (ha)	Imperviousness (%)	A*IMP (ha)	Directly Connected Imperviousness (%)	A*XIMP (ha)	CN	A*CN
191182	NasHyd - HT118_2	15.8	-	-	-	-	49.60	781.7
23103	NasHyd - WK103	0.3	-	-	-	-	48.30	14.4
23104	NasHyd - WK104	3.3	-	-	-	-	49.80	163.4
23108	NasHyd - WK108	9.9	-	-	-	-	51.70	512.8
23109	NasHyd - WK109	14.8	-	-	-	-	49.40	729.9
23110	NasHyd - WK110	17.2	-	-	-	-	47.70	818.4
23112	NasHyd - WK112	7.0	-	-	-	-	48.90	343.6
23113	NasHyd - WK113	21.7	-	-	-	-	41.80	906.0
23115	NasHyd - WK115	15.6	-	-	-	-	51.50	802.2
231222	NasHyd - WK122_2	11.0	-	-	-	-	55.20	604.8
23125	NasHyd - WK125	11.4	-	-	-	-	46.30	526.6
23127	NasHyd - WK127	10.7	-	-	-	-	47.30	506.5
23129	NasHyd - WK129	4.9	-	-	-	-	59.70	291.9
23131	NasHyd - WK131	0.9	-	-	-	-	57.80	51.5
23135	NasHyd - WK135	0.7	-	-	-	-	52.40	37.5
23137	NasHyd - WK137	8.3	-	-	-	-	62.80	520.5
23143	NasHyd - WK143	3.5	-	-	-	-	64.90	224.0
23144	NasHyd - WK144	6.2	-	-	-	-	69.90	430.9
23158	NasHyd - WK158	14.2	-	-	-	-	62.40	888.9
23160	NasHyd - WK160	1.0	-	-	-	-	66.10	68.5
23101	StandHyd - WK101	5.4	46.10%	2.5	28.82%	1.5	-	-
23102	StandHyd - WK102	1.8	43.85%	0.8	39.91%	0.7	-	-
23105	StandHyd - WK105	6.0	39.60%	2.4	26.17%	1.6	-	-
23106	StandHyd - WK106	77.4	47.98%	37.1	30.76%	23.8	-	-
23107	StandHyd - WK107	2.2	48.05%	1.1	32.71%	0.7	-	-
23111	StandHyd - WK111	19.9	36.78%	7.3	29.35%	5.8	-	-
231141	StandHyd - WK114_1	2.1	41.77%	0.9	41.77%	0.9	-	-
231142	StandHyd - WK114_2	7.9	23.05%	1.8	23.05%	1.8	-	-
23116	StandHyd - WK116	7.4	32.75%	2.4	32.57%	2.4	-	-
23117	StandHyd - WK117	2.3	58.98%	1.4	58.98%	1.4	-	-
23118	StandHyd - WK118	1.0	64.65%	0.6	64.65%	0.6	-	-
23119	StandHyd - WK119	74.6	38.78%	28.9	38.78%	28.9	-	-
23120	StandHyd - WK120	7.3	87.05%	6.4	87.05%	6.4	-	-
23121	StandHyd - WK121	9.2	39.61%	3.6	23.15%	2.1	-	-
231221	StandHyd - WK122_1	3.7	37.37%	1.4	20.27%	0.7	-	-
23123	StandHyd - WK123	5.2	38.51%	2.0	38.22%	2.0	-	-
23124	StandHyd - WK124	16.7	36.51%	6.1	35.29%	5.9	-	-
23126	StandHyd - WK126	0.9	45.59%	0.4	37.49%	0.3	-	-
23128	StandHyd - WK128	1.1	35.57%	0.4	27.17%	0.3	-	-
23130	StandHyd - WK130	0.4	59.37%	0.2	36.69%	0.1	-	-
23132	StandHyd - WK132	1.6	38.10%	0.6	22.12%	0.4	-	-
23133	StandHyd - WK133	48.0	44.30%	21.2	43.94%	21.1	-	-
23134	StandHyd - WK134	15.2	34.77%	5.3	24.58%	3.7	-	-
23136	StandHyd - WK136	3.7	31.29%	1.2	26.54%	1.0	-	-
23138	StandHyd - WK138	3.0	40.32%	1.2	24.55%	0.7	-	-
23139	StandHyd - WK139	1.6	24.96%	0.4	0.10%	0.0	-	-
23140	StandHyd - WK140	8.0	30.96%	2.5	21.66%	1.7	-	-
23141	StandHyd - WK141	8.1	44.07%	3.6	23.73%	1.9	-	-
23142	StandHyd - WK142	24.2	48.37%	11.7	26.83%	6.5	-	-
23145	StandHyd - WK145	14.2	42.50%	6.0	42.50%	6.0	-	-
23146	StandHyd - WK146	21.0	41.87%	8.8	41.60%	8.7	-	-
23147	StandHyd - WK147	1.3	73.74%	1.0	73.74%	1.0	-	-
23148	StandHyd - WK148	9.5	48.46%	4.6	27.96%	2.7	-	-
23149	StandHyd - WK149	5.3	35.19%	1.9	22.81%	1.2	-	-
23150	StandHyd - WK150	1.2	32.86%	0.4	28.75%	0.4	-	-
23151	StandHyd - WK151	2.4	31.07%	0.7	30.59%	0.7	-	-
23152	StandHyd - WK152	0.3	35.29%	0.1	26.28%	0.1	-	-
23153	StandHyd - WK153	0.4	40.05%	0.2	28.32%	0.1	-	-

BARRIE DRAINAGE MASTER PLAN
MODEL UPDATES - ADJUSTMENTS PER LSRCA COMMENTS FOR WOODLAND AND PERCENT DIRECTLY CONNECTED
FEBRUARY 2021

WHISKEY CREEK WATERSHED - ORIGINAL PARAMETERS

CITY WIDE VISUAL OTTHYMO MODEL (2019)								
AMCII Parameters								
Catchment ID	Type	Area (ha)	Imperviousness (%)	A*IMP (ha)	Directly Connected Imperviousness (%)	A*XIMP (ha)	CN	A*CN
23154	StandHyd - WK154	12.6	37.10%	4.7	20.97%	2.6	-	-
23155	StandHyd - WK155	10.6	42.28%	4.5	33.11%	3.5	-	-
23156	StandHyd - WK156	5.2	65.34%	3.4	54.90%	2.9	-	-
23157	StandHyd - WK157	0.9	51.72%	0.5	42.78%	0.4	-	-
23159	StandHyd - WK159	0.5	71.41%	0.3	67.76%	0.3	-	-
23161	StandHyd - WK161	11.3	37.37%	4.2	26.05%	3.0	-	-
23162	StandHyd - WK162	1.7	57.06%	1.0	43.46%	0.7	-	-
23163	StandHyd - WK163	1.6	27.18%	0.4	17.29%	0.3	-	-
23164	StandHyd - WK164	2.0	23.41%	0.5	12.65%	0.2	-	-
23165	StandHyd - WK165	0.6	45.45%	0.3	45.34%	0.3	-	-
23166	StandHyd - WK166	2.4	42.11%	1.0	27.21%	0.7	-	-
23167	StandHyd - WK167	0.2	20.77%	0.0	12.56%	0.0	-	-
23168	StandHyd - WK168	0.7	31.96%	0.2	19.40%	0.1	-	-
23169	StandHyd - WK169	1.1	26.99%	0.3	18.28%	0.2	-	-

ORIGINAL

STANDHYD Catchments	
Total Area (ha)	465.1
Total Impervious Area (ha)	199.3
Imperviousness (%)	42.9%
Total XIMP Area (ha)	125.4
XIMP Area (%)	27.0%

NASHYD Catchments	
Total Area (ha)	186.1
CN (weighted average)	51.5

TOTAL WATERSHED	
Area (ha)	651.2

WHISKEY CREEK WATERSHED - WOODLAND AND PERCENT DIRECTLY CONNECTED ADJUSTMENTS

CITY WIDE VISUAL OTTHYMO MODEL (2021)								
AMCII Parameters								
Catchment ID	Type	Area (ha)	Imperviousness (%)	A*IMP (ha)	Directly Connected Imperviousness (%)	A*XIMP (ha)	CN	A*CN
23154	StandHyd - WK154	12.6	37.10%	4.7	23.93%	3.0	-	-
23155	StandHyd - WK155	10.6	42.27%	4.5	35.54%	3.8	-	-
23156	StandHyd - WK156	5.2	65.26%	3.4	61.44%	3.2	-	-
23157	StandHyd - WK157	0.9	51.72%	0.5	49.73%	0.4	-	-
23159	StandHyd - WK159	0.5	71.05%	0.3	70.16%	0.3	-	-
23161	StandHyd - WK161	11.3	37.35%	4.2	26.03%	2.9	-	-
23162	StandHyd - WK162	1.7	56.98%	1.0	50.71%	0.8	-	-
23163	StandHyd - WK163	1.6	27.18%	0.4	17.29%	0.3	-	-
23164	StandHyd - WK164	2.0	23.41%	0.5	12.65%	0.2	-	-
23165	StandHyd - WK165	0.6	45.38%	0.3	45.27%	0.3	-	-
23166	StandHyd - WK166	2.4	42.10%	1.0	27.20%	0.7	-	-
23167	StandHyd - WK167	0.2	20.77%	0.0	19.75%	0.0	-	-
23168	StandHyd - WK168	0.7	31.94%	0.2	19.39%	0.1	-	-
23169	StandHyd - WK169	1.1	26.53%	0.3	18.75%	0.2	-	-

UPDATED

STANDHYD Catchments	
Total Area (ha)	472.9
Total Impervious Area (ha)	200.4
Imperviousness (%)	42.4%
Total XIMP Area (ha)	162.5
XIMP Area (%)	34.4%

NASHYD Catchments	
Total Area (ha)	178.2
CN (weighted average)	51.8

TOTAL WATERSHED	
Area (ha)	651.1

WHISKEY CREEK
VISUAL OTTHYMO PEAK FLOW SUMMARY

BARRIE DRAINAGE MASTER PLAN
WHISKEY CREEK MODEL UPDATES
HYDROLOGY UPDATES MARCH 2021 - WORST CASE SPILL

VO	WHISKEY CREEK		Chicago 4 Hour Design Storms						SCS Design Storms						Hurricane Hazel	
			2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	with SWMF's	without SWMF's
Hydrograph	River Reach	River Station	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	AMCII	AMCIII
23111	7	494	0.68	1.02	1.26	1.63	2.00	2.26	0.74	1.25	1.63	2.17	2.63	3.07	2.04	2.42
23906	7	125	0.68	1.04	1.31	1.75	2.16	2.47	0.82	1.42	1.86	2.51	3.06	3.59	3.27	4.17
23902	6	432	2.82	4.42	5.91	7.75	8.93	10.69	3.27	5.71	7.61	10.24	12.52	14.60	10.02	11.48
23905	4	2254	1.62	2.14	2.51	3.09	3.58	3.99	1.88	2.71	3.30	4.16	4.87	5.58	11.15	18.52
23907	4	2142	1.66	2.21	2.61	3.22	3.74	4.19	1.94	2.84	3.48	4.42	5.20	5.94	11.60	19.25
23908	4	2010	1.73	2.35	2.83	3.53	4.13	4.67	2.09	3.14	3.92	5.05	5.96	6.89	12.75	21.35
23909	4	1709	1.78	2.46	2.98	3.73	4.36	4.95	2.17	3.30	4.10	5.28	6.24	7.23	13.05	22.09
23910	4	1481	1.86	2.64	3.24	4.11	4.83	5.51	2.33	3.63	4.57	5.93	7.04	8.21	13.99	23.76
23911	4	1160	1.91	2.72	3.36	4.28	5.03	5.76	2.38	3.74	4.72	6.15	7.27	8.45	14.26	24.48
23912	4	1100	1.96	2.83	3.49	4.44	5.24	6.02	2.46	3.86	4.87	6.35	7.53	8.71	14.42	24.81
23943	5	640	0.05	0.10	0.15	0.21	0.26	0.32	0.09	0.19	0.26	0.36	0.45	0.55	1.03	2.04
23941	5	280	0.39	0.62	0.79	1.01	1.33	1.60	0.46	0.79	1.03	1.54	1.87	2.17	1.92	3.58
23913	5	-1	0.71	1.11	1.41	1.81	2.27	2.68	0.86	1.48	1.93	2.72	3.27	3.87	3.61	5.84
23914	5	-289	1.60	2.26	2.84	3.50	4.01	4.64	1.65	2.64	3.34	4.54	5.42	6.31	4.45	6.65
23915	3	1697	6.11	8.99	11.43	14.17	16.63	18.92	6.86	10.85	13.67	18.47	21.75	25.49	23.06	38.16
23916	3	1351	5.98	8.58	10.76	13.47	15.50	17.60	6.72	10.55	13.19	17.54	20.53	23.87	23.70	39.61
23917	3	953	5.83	8.39	10.55	13.21	15.26	17.35	6.59	10.34	12.98	17.28	20.25	23.47	24.42	40.75
23918	3	512	5.04	7.49	9.80	12.84	14.62	16.63	5.92	9.67	12.69	16.64	19.59	22.70	25.09	41.78
23919	3	352	5.03	7.50	9.81	12.84	14.66	16.71	5.96	9.70	12.71	16.73	19.71	22.86	25.45	42.31
23940	3	222	7.11	10.76	13.78	17.89	20.49	23.23	8.17	13.57	17.77	23.01	26.91	30.92	31.14	49.43
23002	3	169	5.94	7.32	8.14	9.16	13.54	18.55	6.45	8.10	8.98	18.09	23.63	28.71	31.13	49.43
23920	3	108	5.99	7.39	8.22	9.24	13.72	18.79	6.51	8.16	9.05	18.24	23.92	28.93	31.52	49.89
23922	2	1332	1.47	2.12	2.55	3.17	3.60	4.04	1.43	2.21	2.87	3.62	4.32	4.94	2.54	2.92
23923	2	1059	2.39	3.45	4.02	5.19	5.92	6.67	2.33	3.63	4.75	6.04	7.20	8.25	4.20	4.81
23924	2	864	2.21	3.15	3.77	4.82	5.53	6.27	2.26	3.52	4.71	5.93	7.11	8.21	4.82	5.55
23925	2	683	3.08	4.48	5.47	7.17	8.41	9.61	3.36	5.47	7.12	9.47	11.18	13.12	8.07	9.22
23926	2	601	3.66	5.17	6.42	8.50	9.92	11.42	4.03	6.55	8.56	11.54	13.69	16.14	9.92	11.33
23927	2	383	3.62	5.19	6.46	8.51	10.02	11.53	3.98	6.60	8.57	11.55	13.66	16.17	10.05	11.54
23921	2	110	9.19	12.26	14.32	17.27	19.45	25.46	10.26	14.54	17.61	24.25	32.35	40.21	43.14	63.02
23928	1	1549	6.60	8.73	10.06	11.63	15.95	20.87	7.37	9.89	11.46	19.95	26.73	33.47	43.03	63.40
23929	1	1515	6.61	8.73	10.07	11.63	15.97	20.87	7.37	9.90	11.47	19.88	26.59	33.23	42.87	63.31
23930	1	974	6.77	8.97	10.37	12.00	16.00	20.66	7.48	10.13	11.77	19.40	25.69	32.20	45.26	66.11
23931	1	929	6.77	8.94	10.36	11.93	15.07	17.77	7.40	10.11	11.73	16.99	20.24	27.55	45.32	66.21
23932	1	663	6.86	9.09	10.57	12.21	15.44	18.22	7.52	10.32	12.05	17.41	20.75	28.13	46.59	67.74
23933	1	562	6.97	9.23	10.75	12.42	15.71	18.52	7.64	10.49	12.29	17.68	21.05	28.42	47.65	68.94
23935	1	495	6.99	9.25	10.79	12.46	15.76	18.58	7.66	10.51	12.33	17.72	21.10	28.50	47.89	69.24
23934	1	451	7.00	9.26	10.78	12.45	15.47	18.01	7.67	10.51	12.28	17.17	20.12	23.94	45.24	69.40
23936	1	243	7.01	9.26	10.79	12.47	15.48	18.01	7.67	10.52	12.28	17.17	20.11	23.95	45.26	69.56
23937	1	225	7.04	9.29	10.83	12.51	15.54	18.07	7.70	10.56	12.32	17.22	20.19	24.03	45.44	69.89
23938	1	180	7.04	9.30	10.84	12.52	15.55	18.06	7.69	10.56	12.32	17.20	20.17	24.01	45.46	69.96
23939	1	30	7.02	9.27	10.83	12.52	15.52	18.05	7.68	10.54	12.31	17.18	20.13	23.95	45.40	69.98

BARRIE DRAINAGE MASTER PLAN
WHISKEY CREEK PREFERRED ALTERNATIVE MODEL UPDATES
HYDROLOGY UPDATES MARCH 2021 - WORST CASE SPILL

VO	WHISKEY CREEK		Chicago 4 Hour Design Storms							SCS Design Storms							Hurricane Hazel	
Hydrograph	River Reach	River Station	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	with SWMF's	without SWMF's		
23111	7	494	0.68	1.02	1.26	1.63	2.00	2.26	0.74	1.25	1.63	2.17	2.63	3.07	2.04	2.42		
23906	7	125	0.13	0.21	0.31	0.78	1.17	1.57	0.20	0.38	0.98	1.77	2.42	3.09	3.24	4.17		
23902	6	432	2.82	4.42	5.91	7.75	8.93	10.69	3.27	5.71	7.61	10.24	12.52	14.60	10.02	11.48		
23905	4	2254	1.19	1.44	1.62	2.24	2.76	3.29	1.33	1.72	2.50	3.53	4.34	5.18	11.22	18.52		
23907	4	2142	1.22	1.51	1.72	2.36	2.93	3.51	1.39	1.84	2.65	3.78	4.67	5.60	11.66	19.25		
23908	4	2010	1.29	1.66	1.95	2.62	3.31	3.99	1.53	2.15	3.00	4.36	5.44	6.57	12.81	21.35		
23909	4	1709	1.33	1.74	2.06	2.73	3.46	4.17	1.60	2.27	3.11	4.51	5.65	6.79	13.08	22.09		
23910	4	1481	1.41	1.90	2.29	2.97	3.83	4.66	1.74	2.58	3.44	5.09	6.37	7.70	14.02	23.76		
23911	4	1160	1.46	1.98	2.40	3.07	3.94	4.81	1.79	2.68	3.52	5.21	6.56	7.89	14.29	24.48		
23912	4	1100	1.49	2.06	2.51	3.16	4.06	4.95	1.85	2.79	3.61	5.34	6.74	8.11	14.45	24.81		
23943	5	640	0.05	0.10	0.15	0.21	0.26	0.32	0.09	0.19	0.26	0.36	0.45	0.55	1.03	1.41		
23941	5	280	0.39	0.62	0.79	1.01	1.33	1.60	0.46	0.79	1.03	1.54	1.87	2.17	1.92	2.83		
23913	5	-1	0.71	1.11	1.41	1.81	2.27	2.68	0.86	1.48	1.93	2.72	3.27	3.87	3.61	5.09		
23914	5	-289	1.60	2.26	2.84	3.50	4.01	4.64	1.65	2.64	3.34	4.54	5.42	6.31	4.45	5.93		
23915	3	1697	6.10	8.93	11.35	14.04	16.48	18.73	6.76	10.69	13.45	18.08	21.24	24.94	23.09	38.16		
23916	3	1351	5.95	8.53	10.68	13.32	15.35	17.41	6.63	10.40	12.99	17.25	20.13	23.38	23.73	39.61		
23917	3	953	5.81	8.33	10.47	13.06	15.09	17.13	6.50	10.18	12.76	16.96	19.82	22.91	24.44	40.75		
23918	3	512	5.00	7.41	9.65	12.62	14.42	16.35	5.82	9.47	12.39	16.26	19.04	22.08	25.11	41.78		
23919	3	352	4.99	7.41	9.65	12.60	14.45	16.40	5.84	9.49	12.40	16.34	19.14	22.18	25.47	42.31		
23940	3	222	7.08	10.70	13.67	17.75	20.37	23.07	8.08	13.41	17.58	22.82	26.63	30.54	31.01	49.43		
23002	3	169	6.96	10.47	13.23	16.90	19.22	21.45	7.87	13.00	16.70	21.18	23.97	26.87	30.61	49.43		
23920	3	108	7.04	10.60	13.37	17.09	19.44	21.70	7.96	13.16	16.91	21.42	24.25	27.16	30.94	49.89		
23922	2	1332	1.47	2.12	2.55	3.17	3.60	4.04	1.43	2.21	2.87	3.62	4.32	4.94	2.54	2.92		
23923	2	1059	2.39	3.45	4.02	5.19	5.92	6.67	2.33	3.63	4.75	6.04	7.20	8.25	4.20	4.81		
23924	2	864	2.21	3.15	3.77	4.82	5.53	6.27	2.26	3.52	4.71	5.93	7.11	8.21	4.82	5.55		
23925	2	683	3.08	4.48	5.47	7.17	8.41	9.61	3.36	5.47	7.12	9.47	11.18	13.12	8.07	9.22		
23926	2	601	3.66	5.17	6.42	8.50	9.92	11.42	4.03	6.55	8.56	11.54	13.69	16.14	9.92	11.33		
23927	2	383	3.62	5.19	6.46	8.51	10.02	11.53	3.98	6.60	8.57	11.55	13.66	16.17	10.05	11.54		
23921	2	110	10.45	15.80	19.67	24.93	28.73	32.51	11.93	19.73	25.39	32.41	37.15	42.16	41.33	63.02		
23928	1	1549	6.83	9.89	13.07	18.72	22.50	26.99	7.85	12.78	18.63	26.35	31.41	36.29	41.53	63.40		
23929	1	1515	6.84	9.88	13.06	18.71	22.49	26.93	7.76	12.75	18.60	25.51	31.13	36.17	41.58	63.31		
23930	1	974	6.97	10.05	12.95	18.31	22.04	26.93	7.84	12.58	18.08	24.71	30.58	35.90	44.02	66.11		
23931	1	929	6.97	10.06	12.93	18.26	21.94	26.15	7.85	12.56	18.04	24.58	29.19	32.67	43.84	66.21		
23932	1	663	7.07	10.24	13.19	18.61	22.36	26.65	7.99	12.82	18.40	25.13	29.85	33.46	45.08	67.74		
23933	1	562	7.21	10.45	13.46	19.02	22.85	27.23	8.12	13.08	18.78	25.61	30.34	34.01	46.10	68.94		
23935	1	495	7.24	10.48	13.51	19.10	22.95	27.34	8.15	13.12	18.84	25.70	30.43	34.08	46.28	69.24		
23934	1	451	7.23	10.49	13.46	18.93	22.57	26.60	8.15	13.09	18.61	25.25	29.66	33.15	45.34	69.40		
23936	1	243	7.25	10.50	13.47	18.93	22.57	26.60	8.16	13.10	18.61	25.21	29.66	33.13	45.37	69.56		
23937	1	225	7.26	10.55	13.53	19.01	22.67	26.69	8.17	13.13	18.68	25.29	29.77	33.28	45.56	69.89		
23938	1	180	7.27	10.53	13.54	19.03	22.69	26.69	8.17	13.13	18.69	25.31	29.72	33.20	45.51	69.96		
23939	1	30	7.24	10.50	13.42	18.87	22.45	26.50	8.13	13.03	18.50	25.05	29.72	33.12	45.48	69.98		

BARRIE DRAINAGE MASTER PLAN
WHISKEY CREEK MODEL UPDATES
HYDROLOGY UPDATES MARCH 2021 - NO SPILL

VO3		WHISKEY CREEK		Chicago 4 Hour Design Storms					SCS Design Storms					Hurricane Hazel		
Hydrograph	River Reach	River Station	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	with SWMF's	without SWMF's
23111	7	494	0.68	1.02	1.26	1.63	2.00	2.26	0.74	1.25	1.63	2.17	2.63	3.07	2.04	2.42
23906	7	125	0.68	1.04	1.31	1.75	2.16	2.47	0.82	1.42	1.86	2.51	3.06	3.59	3.27	4.17
23902	6	432	2.82	4.42	5.91	7.75	8.93	10.69	3.27	5.71	7.61	10.24	12.52	14.60	10.02	11.48
23905	4	2254	1.62	2.14	2.51	3.09	3.58	3.99	1.88	2.71	3.30	4.16	4.87	5.58	11.15	18.52
23907	4	2142	1.66	2.21	2.61	3.22	3.74	4.19	1.94	2.84	3.48	4.42	5.20	5.94	11.60	19.25
23908	4	2010	1.73	2.35	2.83	3.53	4.13	4.67	2.09	3.14	3.92	5.05	5.96	6.89	12.75	21.35
23909	4	1709	1.78	2.46	2.98	3.73	4.36	4.95	2.17	3.30	4.10	5.28	6.24	7.23	13.05	22.09
23910	4	1481	1.86	2.64	3.24	4.11	4.83	5.51	2.33	3.63	4.57	5.93	7.04	8.21	13.99	23.76
23911	4	1160	1.91	2.72	3.36	4.28	5.03	5.76	2.38	3.74	4.72	6.15	7.27	8.45	14.26	24.48
23912	4	1100	1.96	2.83	3.49	4.44	5.24	6.02	2.46	3.86	4.87	6.35	7.53	8.71	14.42	24.81
191182	5	640	0.05	0.10	0.15	0.21	0.26	0.32	0.09	0.19	0.26	0.36	0.45	0.55	1.03	1.41
23941	5	280	0.39	0.62	0.79	1.01	1.33	1.60	0.46	0.79	1.03	1.54	1.87	2.17	1.92	2.46
23913	5	-1	0.71	1.11	1.41	1.81	2.27	2.68	0.86	1.48	1.93	2.72	3.27	3.87	3.61	4.63
23914	5	-289	1.60	2.26	2.84	3.50	4.01	4.64	1.65	2.64	3.34	4.54	5.42	6.31	4.45	5.54
23915	3	1697	6.11	8.99	11.43	14.17	16.63	18.92	6.86	10.85	13.67	18.47	21.75	25.49	23.06	38.16
23916	3	1351	5.98	8.58	10.76	13.47	15.50	17.60	6.72	10.55	13.19	17.54	20.53	23.87	23.70	39.61
23917	3	953	5.83	8.39	10.55	13.21	15.26	17.35	6.59	10.34	12.98	17.28	20.25	23.47	24.42	40.75
23918	3	512	5.04	7.49	9.80	12.84	14.62	16.63	5.92	9.67	12.69	16.64	19.59	22.70	25.09	41.78
23919	3	352	5.03	7.50	9.81	12.84	14.66	16.71	5.96	9.70	12.71	16.73	19.71	22.86	25.45	42.31
23940	3	222	7.11	10.76	13.78	17.89	20.49	23.23	8.17	13.57	17.77	23.01	26.91	30.92	31.14	49.43
23002	3	169	5.94	7.32	8.14	9.16	13.54	18.55	6.45	8.10	8.98	18.09	23.63	28.71	31.13	49.43
23920	3	108	5.99	7.39	8.22	9.24	13.72	18.79	6.51	8.16	9.05	18.24	23.92	28.93	31.52	49.89
23922	2	1332	1.47	2.12	2.55	3.17	3.60	4.04	1.43	2.21	2.87	3.62	4.32	4.94	2.54	2.92
23923	2	1059	2.39	3.45	4.02	5.19	5.92	6.67	2.33	3.63	4.75	6.04	7.20	8.25	4.20	4.81
23924	2	864	2.21	3.15	3.77	4.82	5.53	6.27	2.26	3.52	4.71	5.93	7.11	8.21	4.82	5.55
23925	2	683	3.08	4.48	5.47	7.17	8.41	9.61	3.36	5.47	7.12	9.47	11.18	13.12	8.07	9.22
23926	2	601	3.66	5.17	6.42	8.50	9.92	11.42	4.03	6.55	8.56	11.54	13.69	16.14	9.92	11.33
23927	2	383	3.62	5.19	6.46	8.51	10.02	11.53	3.98	6.60	8.57	11.55	13.66	16.17	10.05	11.54
23921	2	110	9.19	12.26	14.32	17.27	19.45	25.46	10.26	14.54	17.61	24.25	32.35	40.21	43.14	63.02
23928	1	1549	6.60	8.73	10.06	11.63	15.95	20.87	7.37	9.89	11.46	19.95	26.73	33.47	43.03	63.40
23929	1	1515	6.61	8.73	10.07	11.63	15.97	20.87	7.37	9.90	11.47	19.88	26.59	33.23	42.87	63.31
23930	1	974	6.77	8.97	10.37	12.00	16.00	20.66	7.48	10.13	11.77	19.40	25.69	32.20	45.25	66.11
23931	1	929	6.77	8.94	10.36	11.93	15.07	17.77	7.40	10.11	11.73	16.99	20.24	27.55	45.32	66.21
23932	1	663	6.86	9.09	10.57	12.21	15.44	18.22	7.52	10.32	12.05	17.41	20.75	28.13	46.59	67.74
23933	1	562	6.97	9.23	10.75	12.42	15.71	18.52	7.64	10.49	12.29	17.68	21.05	28.42	47.64	68.94
23935	1	495	6.99	9.25	10.79	12.46	15.76	18.58	7.66	10.51	12.33	17.72	21.10	28.50	47.89	69.24
23934	1	451	7.00	9.26	10.78	12.45	15.47	18.01	7.67	10.51	12.28	17.17	20.12	23.94	45.24	69.40
23936	1	243	7.01	9.26	10.79	12.47	15.48	18.01	7.67	10.52	12.28	17.17	20.11	23.95	45.26	69.56
23937	1	225	7.04	9.29	10.83	12.51	15.54	18.07	7.70	10.56	12.32	17.22	20.19	24.03	45.43	69.89
23938	1	180	7.04	9.30	10.84	12.52	15.55	18.06	7.69	10.56	12.32	17.20	20.17	24.01	45.46	69.96
23939	1	30	7.02	9.27	10.83	12.52	15.52	18.05	7.68	10.54	12.31	17.18	20.13	23.95	45.40	69.98

BARRIE DRAINAGE MASTER PLAN
WHISKEY CREEK PREFERRED ALTERNATIVE MODEL UPDATES
HYDROLOGY UPDATES MARCH 2021 - NO SPILL

VO3		WHISKEY CREEK		Chicago 4 Hour Design Storms								SCS Design Storms								Hurricane Hazel	
Hydrograph	River Reach	River Station	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	with SWMF's	without SWMF's					
															AMCII	AMCIII					
23111	7	494	0.68	1.02	1.26	1.63	2.00	2.26	0.74	1.25	1.63	2.17	2.63	3.07	2.04	2.42					
23906	7	125	0.13	0.21	0.31	0.78	1.17	1.57	0.20	0.38	0.98	1.77	2.42	3.09	3.24	4.17					
23902	6	432	2.82	4.42	5.91	7.75	8.93	10.69	3.27	5.71	7.61	10.24	12.52	14.60	10.02	11.48					
23905	4	2254	1.19	1.44	1.62	2.24	2.76	3.29	1.33	1.72	2.50	3.53	4.34	5.18	11.22	18.52					
23907	4	2142	1.22	1.51	1.72	2.36	2.93	3.51	1.39	1.84	2.65	3.78	4.67	5.60	11.66	19.25					
23908	4	2010	1.29	1.66	1.95	2.62	3.31	3.99	1.53	2.15	3.00	4.36	5.44	6.57	12.81	21.35					
23909	4	1709	1.33	1.74	2.06	2.73	3.46	4.17	1.60	2.27	3.11	4.51	5.65	6.79	13.08	22.09					
23910	4	1481	1.41	1.90	2.29	2.97	3.83	4.66	1.74	2.58	3.44	5.09	6.37	7.70	14.02	23.76					
23911	4	1160	1.46	1.98	2.40	3.07	3.94	4.81	1.79	2.68	3.52	5.21	6.56	7.89	14.29	24.48					
23912	4	1100	1.49	2.06	2.51	3.16	4.06	4.95	1.85	2.79	3.61	5.34	6.74	8.11	14.45	24.81					
191182	5	640	0.05	0.10	0.15	0.21	0.26	0.32	0.09	0.19	0.26	0.36	0.45	0.55	1.03	1.41					
23941	5	280	0.39	0.62	0.79	1.01	1.33	1.60	0.46	0.79	1.03	1.54	1.87	2.17	1.92	2.46					
23913	5	-1	0.71	1.11	1.41	1.81	2.27	2.68	0.86	1.48	1.93	2.72	3.27	3.87	3.61	4.63					
23914	5	-289	1.60	2.26	2.84	3.50	4.01	4.64	1.65	2.64	3.34	4.54	5.42	6.31	4.45	5.54					
23915	3	1697	6.10	8.93	11.35	14.04	16.48	18.73	6.76	10.69	13.45	18.08	21.24	24.94	23.09	38.16					
23916	3	1351	5.95	8.53	10.68	13.32	15.35	17.41	6.63	10.40	12.99	17.25	20.13	23.38	23.73	39.61					
23917	3	953	5.81	8.33	10.47	13.06	15.09	17.13	6.50	10.18	12.76	16.96	19.82	22.91	24.44	40.75					
23918	3	512	5.00	7.41	9.65	12.62	14.42	16.35	5.82	9.47	12.39	16.26	19.04	22.08	25.11	41.78					
23919	3	352	4.99	7.41	9.65	12.60	14.45	16.40	5.84	9.49	12.40	16.34	19.14	22.18	25.47	42.31					
23940	3	222	7.08	10.70	13.67	17.75	20.37	23.07	8.08	13.41	17.58	22.82	26.63	30.54	31.01	49.43					
23002	3	169	6.96	10.47	13.23	16.90	19.22	21.45	7.87	13.00	16.70	21.18	23.97	26.87	30.61	49.43					
23920	3	108	7.04	10.60	13.37	17.09	19.44	21.70	7.96	13.16	16.91	21.42	24.25	27.16	30.94	49.89					
23922	2	1332	1.47	2.12	2.55	3.17	3.60	4.04	1.43	2.21	2.87	3.62	4.32	4.94	2.54	2.92					
1487	2	1059	2.39	3.45	4.02	5.19	5.92	6.67	2.33	3.63	4.75	6.04	7.20	8.25	4.20	4.81					
23924	2	864	2.21	3.15	3.77	4.82	5.53	6.27	2.26	3.52	4.71	5.93	7.11	8.21	4.82	5.55					
23925	2	683	3.08	4.48	5.47	7.17	8.41	9.61	3.36	5.47	7.12	9.47	11.18	13.12	8.07	9.22					
23926	2	601	3.66	5.17	6.42	8.50	9.92	11.42	4.03	6.55	8.56	11.54	13.69	16.14	9.92	11.33					
23927	2	383	3.62	5.19	6.46	8.51	10.02	11.53	3.98	6.60	8.57	11.55	13.66	16.17	10.05	11.54					
23921	2	110	10.45	15.80	19.67	24.93	28.73	32.51	11.93	19.73	25.39	32.41	37.15	42.16	41.33	63.02					
23928	1	1549	6.83	9.89	13.07	18.72	22.50	26.99	7.85	12.78	18.63	26.35	31.41	36.29	41.53	63.40					
23929	1	1515	6.84	9.88	13.06	18.71	22.49	26.93	7.76	12.75	18.60	25.51	31.13	36.17	41.58	63.31					
23930	1	974	6.97	10.05	12.95	18.31	22.04	26.31	7.84	12.58	18.08	24.71	30.58	35.90	44.02	66.11					
23931	1	929	6.97	10.06	12.93	18.26	21.94	26.15	7.85	12.56	18.04	24.58	29.19	32.67	43.84	66.21					
23932	1	663	7.07	10.24	13.19	18.61	22.36	26.65	7.99	12.82	18.40	25.13	29.85	33.46	45.08	67.74					
23933	1	562	7.21	10.45	13.46	19.02	22.85	27.23	8.12	13.08	18.78	25.61	30.34	34.01	46.10	68.94					
23935	1	495	7.24	10.48	13.51	19.10	22.95	27.34	8.15	13.12	18.84	25.70	30.43	34.08	46.28	69.24					
23934	1	451	7.23	10.49	13.46	18.93	22.57	26.60	8.15	13.09	18.61	25.25	29.66	33.15	45.34	69.40					
23936	1	243	7.25	10.50	13.47	18.93	22.57	26.60	8.16	13.10	18.61	25.21	29.66	33.13	45.37	69.56					
23937	1	225	7.26	10.55	13.53	19.01	22.67	26.69	8.17	13.13	18.68	25.29	29.77	33.28	45.56	69.89					
23938	1	180	7.27	10.53	13.54	19.03	22.69	26.69	8.17	13.13	18.69	25.31	29.72	33.20	45.51	69.96					
23939	1	30	7.24	10.50	13.42	18.87	22.45	26.50	8.13	13.03	18.50	25.05	29.72	33.12	45.48	69.98					

**BARRIE DRAINAGE MASTER PLAN
WHISKEY CREEK MODEL UPDATES
HYDROLOGY UPDATES MARCH 2021 - PLUS SPILL**

VO3	WHISKEY CREEK		Chicago 4 Hour Design Storms							SCS Design Storms					Hurricane Hazel	
			2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	with SWMF's	without SWMF's
Hydrograph	River Reac	River Stati													AMCII	AMCIII
23111	7	494	0.68	1.02	1.26	1.63	2.00	2.26	0.74	1.25	1.63	2.17	2.63	3.07	2.04	2.42
23906	7	125	0.68	1.04	1.31	1.75	2.16	2.47	0.82	1.42	1.86	2.51	3.06	3.59	3.27	4.17
23902	6	432	2.82	4.42	5.91	7.75	8.93	10.69	3.27	5.71	7.61	10.24	12.52	14.60	10.02	11.48
23905	4	2254	1.62	2.14	2.51	3.09	3.58	3.99	1.88	2.71	3.30	4.16	4.87	5.58	11.15	18.52
23907	4	2142	1.66	2.21	2.61	3.22	3.74	4.19	1.94	2.84	3.48	4.42	5.20	5.94	11.60	19.25
23908	4	2010	1.73	2.35	2.83	3.53	4.13	4.67	2.09	3.14	3.92	5.05	5.96	6.89	12.75	21.35
23909	4	1709	1.78	2.46	2.98	3.73	4.36	4.95	2.17	3.30	4.10	5.28	6.24	7.23	13.05	18.57
23910	4	1481	1.86	2.64	3.24	4.11	4.83	5.51	2.33	3.63	4.57	5.93	7.04	8.21	13.99	20.24
23911	4	1160	1.91	2.72	3.36	4.28	5.03	5.76	2.38	3.74	4.72	6.15	7.27	8.45	14.26	20.99
23912	4	1100	1.96	2.83	3.49	4.44	5.24	6.02	2.46	3.86	4.87	6.35	7.53	8.71	14.42	21.33
23943	5	640	0.05	0.10	0.15	0.21	0.26	0.32	0.09	0.19	0.26	0.36	0.45	0.55	1.03	2.04
23941	5	280	0.39	0.62	0.79	1.01	1.33	1.60	0.46	0.79	1.03	1.54	1.87	2.17	1.92	3.58
23913	5	-1	0.71	1.11	1.41	1.81	2.27	2.68	0.86	1.48	1.93	2.72	3.27	3.87	3.61	5.84
23914	5	-289	1.60	2.26	2.84	3.50	4.01	4.64	1.65	2.64	3.34	4.54	5.42	6.31	4.45	6.65
23915	3	1697	6.11	8.99	11.43	14.17	16.63	18.92	6.86	10.85	13.67	18.47	21.75	25.49	23.06	36.40
23916	3	1351	5.98	8.58	10.76	13.47	15.50	17.60	6.72	10.55	13.19	17.54	20.53	23.87	23.70	37.91
23917	3	953	5.83	8.39	10.55	13.21	15.26	17.35	6.59	10.34	12.98	17.28	20.25	23.47	24.42	39.02
23918	3	512	5.04	7.49	9.80	12.84	14.62	16.63	5.92	9.67	12.69	16.64	19.59	22.70	25.09	40.05
23919	3	352	5.03	7.50	9.81	12.84	14.66	16.71	5.96	9.70	12.71	16.73	19.71	22.86	25.45	40.59
23940	3	222	7.11	10.76	13.78	17.89	20.49	23.23	8.17	13.57	17.77	23.01	26.91	30.92	31.14	47.98
23002	3	169	5.94	7.32	8.14	9.16	13.54	18.55	6.45	8.10	8.98	18.09	23.63	28.71	31.13	47.98
23920	3	108	5.99	7.39	8.22	9.24	13.72	18.79	6.51	8.16	9.05	18.24	23.92	28.93	31.52	48.47
23922	2	1332	1.47	2.12	2.55	3.17	3.60	4.04	1.43	2.21	2.87	3.62	4.32	4.94	2.54	2.92
23923	2	1059	2.39	3.45	4.02	5.19	5.92	6.67	2.33	3.63	4.75	6.04	7.20	8.25	4.20	4.81
23924	2	864	2.21	3.15	3.77	4.82	5.53	6.27	2.26	3.52	4.71	5.93	7.11	8.21	4.82	5.55
23925	2	683	3.08	4.48	5.47	7.17	8.41	9.61	3.36	5.47	7.12	9.47	11.18	13.12	8.07	9.22
23926	2	601	3.66	5.17	6.42	8.50	9.92	11.42	4.03	6.55	8.56	11.54	13.69	16.14	9.92	11.33
23927	2	383	3.62	5.19	6.46	8.51	10.02	11.53	3.98	6.60	8.57	11.55	13.66	16.17	10.05	11.54
23921	2	110	9.19	12.26	14.32	17.27	19.45	25.46	10.26	14.54	17.61	24.25	32.35	40.21	43.14	62.24
23928	1	1549	6.60	8.73	10.06	11.63	15.95	20.87	7.37	9.89	11.46	19.95	26.73	33.47	43.03	62.66
23929	1	1515	6.61	8.73	10.07	11.63	15.97	20.87	7.37	9.90	11.47	19.88	26.59	33.23	42.87	62.59
23930	1	974	6.77	8.97	10.37	12.00	16.00	20.66	7.48	10.13	11.77	19.40	25.69	32.20	45.26	65.17
23931	1	929	6.77	8.94	10.36	11.93	15.07	17.77	7.40	10.11	11.73	16.99	20.24	27.55	45.32	65.27
23932	1	663	6.86	9.09	10.57	12.21	15.44	18.22	7.52	10.32	12.05	17.41	20.75	28.13	46.59	66.78
23933	1	562	6.97	9.23	10.75	12.42	15.71	18.52	7.64	10.49	12.29	17.68	21.05	28.42	47.65	68.15
23935	1	495	6.99	9.25	10.79	12.46	15.76	18.58	7.66	10.51	12.33	17.72	21.10	28.50	47.89	68.40
23934	1	451	7.00	9.26	10.78	12.45	15.47	18.01	7.67	10.51	12.28	17.17	20.12	23.94	45.24	68.55
23936	1	243	7.01	9.26	10.79	12.47	15.48	18.01	7.67	10.52	12.28	17.17	20.11	23.95	45.26	68.72
23937	1	225	7.04	9.29	10.83	12.51	15.54	18.07	7.70	10.56	12.32	17.22	20.19	24.03	45.44	69.09
23938	1	180	7.04	9.30	10.84	12.52	15.55	18.06	7.69	10.56	12.32	17.20	20.17	24.01	45.46	69.13
23939	1	30	7.02	9.27	10.83	12.52	15.52	18.05	7.68	10.54	12.31	17.18	20.13	23.95	45.40	69.13

**BARRIE DRAINAGE MASTER PLAN
WHISKEY CREEK PREFERRED ALTERNATIVE MODEL UPDATES
HYDROLOGY UPDATES MARCH 2021 - PLUS SPILL**

VO3		WHISKEY CREEK		Chicago 4 Hour Design Storms							SCS Design Storms							Hurricane Hazel		
Hydrograph	River Reach	River Station	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	with SWMF's	without SWMF's	AMCII			
23111	7	494	0.68	1.02	1.26	1.63	2.00	2.26	0.74	1.25	1.63	2.17	2.63	3.07	2.04	2.42				
23906	7	125	0.13	0.21	0.31	0.78	1.17	1.57	0.20	0.38	0.98	1.77	2.42	3.09	3.24	4.17				
23902	6	432	2.82	4.42	5.91	7.75	8.93	10.69	3.27	5.71	7.61	10.24	12.52	14.60	10.02	11.48				
23905	4	2254	1.19	1.44	1.62	2.24	2.76	3.29	1.33	1.72	2.50	3.53	4.34	5.18	11.22	18.52				
23907	4	2142	1.22	1.51	1.72	2.36	2.93	3.51	1.39	1.84	2.65	3.78	4.67	5.60	11.66	19.25				
23908	4	2010	1.29	1.66	1.95	2.62	3.31	3.99	1.53	2.15	3.00	4.36	5.44	6.57	12.81	21.35				
23909	4	1709	1.33	1.74	2.06	2.73	3.46	4.17	1.60	2.27	3.11	4.51	5.65	6.79	13.08	16.85				
23910	4	1481	1.41	1.90	2.29	2.97	3.83	4.66	1.74	2.58	3.44	5.09	6.37	7.70	14.02	18.56				
23911	4	1160	1.46	1.98	2.40	3.07	3.94	4.81	1.79	2.68	3.52	5.21	6.56	7.89	14.29	19.35				
23912	4	1100	1.49	2.06	2.51	3.16	4.06	4.95	1.85	2.79	3.61	5.34	6.74	8.11	14.45	19.71				
191182	5	640	0.05	0.10	0.15	0.21	0.26	0.32	0.09	0.19	0.26	0.36	0.45	0.55	1.03	1.41				
23941	5	280	0.39	0.62	0.79	1.01	1.33	1.60	0.46	0.79	1.03	1.54	1.87	2.17	1.92	2.83				
23913	5	-1	0.71	1.11	1.41	1.81	2.27	2.68	0.86	1.48	1.93	2.72	3.27	3.87	3.61	5.09				
23914	5	-289	1.60	2.26	2.84	3.50	4.01	4.64	1.65	2.64	3.34	4.54	5.42	6.31	4.45	5.93				
23915	3	1697	6.10	8.93	11.35	14.04	16.48	18.73	6.76	10.69	13.45	18.08	21.24	24.94	23.09	34.63				
23916	3	1351	5.95	8.53	10.68	13.32	15.35	17.41	6.63	10.40	12.99	17.25	20.13	23.38	23.73	36.07				
23917	3	953	5.81	8.33	10.47	13.06	15.09	17.13	6.50	10.18	12.76	16.96	19.82	22.91	24.44	37.15				
23918	3	512	5.00	7.41	9.65	12.62	14.42	16.35	5.82	9.47	12.39	16.26	19.04	22.08	25.11	38.16				
23919	3	352	4.99	7.41	9.65	12.60	14.45	16.40	5.84	9.49	12.40	16.34	19.14	22.18	25.47	38.70				
23940	3	222	7.08	10.70	13.67	17.75	20.37	23.07	8.08	13.41	17.58	22.82	26.63	30.54	31.01	46.35				
23002	3	169	6.96	10.47	13.23	16.90	19.22	21.45	7.87	13.00	16.70	21.18	23.97	26.87	30.61	46.35				
23920	3	108	7.04	10.60	13.37	17.09	19.44	21.70	7.96	13.16	16.91	21.42	24.25	27.16	30.93	46.85				
23922	2	1332	1.47	2.12	2.55	3.17	3.60	4.04	1.43	2.21	2.87	3.62	4.32	4.94	2.54	2.92				
1487	2	1059	2.39	3.45	4.02	5.19	5.92	6.67	2.33	3.63	4.75	6.04	7.20	8.25	4.20	4.81				
23924	2	864	2.21	3.15	3.77	4.82	5.53	6.27	2.26	3.52	4.71	5.93	7.11	8.21	4.82	5.55				
23925	2	683	3.08	4.48	5.47	7.17	8.41	9.61	3.36	5.47	7.12	9.47	11.18	13.12	8.07	9.22				
23926	2	601	3.66	5.17	6.42	8.50	9.92	11.42	4.03	6.55	8.56	11.54	13.69	16.14	9.92	11.33				
23927	2	383	3.62	5.19	6.46	8.51	10.02	11.53	3.98	6.60	8.57	11.55	13.66	16.17	10.05	11.54				
23921	2	110	10.45	15.80	19.67	24.93	28.73	32.51	11.93	19.73	25.39	32.41	37.15	42.16	41.33	61.18				
23928	1	1549	6.83	9.89	13.07	18.72	22.50	26.99	7.85	12.78	16.63	26.35	31.41	36.29	41.53	61.60				
23929	1	1515	6.84	9.88	13.06	18.71	22.49	26.93	7.76	12.75	16.60	25.51	31.13	36.17	41.58	61.46				
23930	1	974	6.97	10.05	12.95	18.31	22.04	26.31	7.84	12.58	16.08	24.71	30.58	35.90	44.02	63.87				
23931	1	929	6.97	10.06	12.93	18.26	21.94	26.15	7.85	12.56	16.04	24.58	29.19	32.67	43.84	63.97				
23932	1	663	7.07	10.24	13.19	18.61	22.36	26.65	7.99	12.82	16.80	25.13	29.85	33.46	45.08	65.47				
23933	1	562	7.21	10.45	13.46	19.02	22.85	27.23	8.12	13.08	18.78	25.61	30.34	34.01	46.10	66.87				
23935	1	495	7.24	10.48	13.51	19.10	22.95	27.34	8.15	13.12	18.84	25.70	30.43	34.08	46.28	67.15				
23934	1	451	7.23	10.49	13.46	18.93	22.57	26.80	8.15	13.09	18.61	25.25	29.66	33.15	45.34	67.37				
23936	1	243	7.25	10.50	13.47	18.93	22.57	26.60	8.16	13.10	18.61	25.21	29.66	33.13	45.37	67.50				
23937	1	225	7.26	10.55	13.53	19.01	22.67	26.69	8.17	13.13	18.68	25.29	29.77	33.28	45.56	67.81				
23938	1	180	7.27	10.53	13.54	19.03	22.69	26.69	8.17	13.13	18.69	25.31	29.72	33.20	45.51	67.94				
23939	1	30	7.24	10.50	13.42	18.87	22.45	26.50	8.13	13.03	18.50	25.05	29.72	33.12	45.48	67.76				



Enhancing our communities



Whiskey Creek Drainage Improvements at Minet's Point

HYDROLOGIC & HYDRAULIC MODELING TECHNICAL MEMORANDUM

City of Barrie

Document Control

File:

120114

Date:

April
21, 2021

Prepared by:

Tatham Engineering Limited
115 Sandford Fleming Drive, Suite 200
Collingwood, Ontario L9Y 5A6
T 705-444-2565
tathameng.com

Prepared for:

City of Barrie
70 Collier Street
Barrie, Ontario L4M 4T5

Authored by:	Reviewed by:
FINAL DRAFT	FINAL DRAFT
David Marshall, B.A.Sc., P.Eng. Intermediate Engineer	Daniel Twigger, B.Sc.Eng., P.Eng. Senior Engineer, Group Leader

Disclaimer	Copyright
The information contained in this document is solely for the use of the Client identified on the cover sheet for the purpose for which it has been prepared and Tatham Engineering Limited undertakes no duty to or accepts any responsibility to any third party who may rely upon this document.	This document may not be used for any purpose other than that provided in the contract between the Owner/Client and the Engineer nor may any section or element of this document be removed, reproduced, electronically stored or transmitted in any form without the express written consent of Tatham Engineering Limited.

Issue	Date	Description
1	October 9, 2020	Draft - First Submission
2	December 11, 2020	Final Draft - Second Submission
3	April 21, 2021	Final - Third Submission

Document Contents

1	Introduction	1
1.1	Study Area	1
1.2	Background.....	1
1.3	Objectives	2
2	Existing Conditions.....	4
3	Alternative Solutions.....	5
3.1	Existing (Baseline) Conditions	5
3.2	Hydraulic Improvements	5
3.3	Flow Diversions.....	7
4	Hydrology.....	9
4.1	LSRCA Approved Hydrology	9
4.2	Drainage Master Plan Hydrology.....	9
4.3	Results Comparison.....	10
5	Hydraulic Modeling.....	12
5.1	Model Updates.....	13
5.2	Hydraulic Model Parameters	13
6	Hydraulic Modeling Results.....	16
6.1	Existing (Baseline) Conditions	16
6.2	Hydraulic Improvements	16
6.3	Flow Diversions.....	27
6.4	Results Summary	29
6.5	Property/Infrastructure Impact Summary.....	29
6.6	HEC-RAS Model Scenarios	32
7	Summary.....	33



Tables

Table 1: Approved LSRCA Flow Summary	9
Table 2: Peak Flow Comparison (LSRCA Approved versus DMP)	11
Table 3: Alternative 7 Flow Split Summary	28
Table 4: Hydraulic Model Results Summary	30
Table 5: Property/Infrastructure Impact Summary	31
Table 6: HEC-RAS Model Scenario Summary	32

Figures

Figure 1: Study Area Location Plan	34
--	----

Appendices

Appendix A: Conceptual Design Drawings
Appendix B: Meeting Minutes
Appendix C: Hydrologic Model Results Summary
Appendix D: Topographic Survey / LiDAR Data Background Information
Appendix E: HEC-RAS Model Comparison
Appendix F: Hydraulic Model Results – Existing Conditions
Appendix G: Hydraulic Model Results – 1:100-Year Return Frequency Design Storm Capacity
Appendix H: Hydraulic Model Results – 1:50-Year Return Frequency Design Storm Capacity
Appendix I: Hydraulic Model Results – 1:25-Year Return Frequency Design Storm Capacity
Appendix J: Hydraulic Model Results – 1:10-Year Return Frequency Design Storm Capacity
Appendix K: Hydraulic Model Results – Alternative 7 (Flow Diversion)
Appendix L: Digital HEC-RAS Files



1 Introduction

Tatham Engineering Limited has been retained by the City of Barrie to complete a Schedule “B” Municipal Class Environmental Assessment (Class EA) under the Municipal Class Environmental Assessment Planning Process to assess alternative solutions to reduce the frequency of flooding in Whiskey Creek at Minet's Point. Alternative solutions include changes to the existing road network, culvert crossings, creek cross-sections, and other infrastructure in the area to reduce flooding downstream of The Boulevard to Kempenfelt Bay. The purpose of this Technical Memorandum is to summarize the hydrologic and hydraulic modeling completed to assess the flood impacts under each alternative solution.

1.1 STUDY AREA

The study area encompasses the Whiskey Creek floodplain from the outlet at Kempenfelt Bay to just upstream of The Boulevard. This reach of Whiskey Creek includes both public and private property within the Whiskey Creek floodplain. The Study Area is illustrated on Figure 1: Study Area Location Plan enclosed.

1.2 BACKGROUND

The subject reach of Whiskey Creek from the outlet at Kempenfelt Bay to just upstream of The Boulevard has been subject to historic flooding and has been the subject of several technical studies to identify deficiencies along the drainage system and recommend preferred solutions for implementation. The past technical studies providing recommendations for the subject reach of Whiskey Creek which were reviewed for this Class EA are summarized in the following sections.

1.2.1 Whiskey Creek Master Drainage Plan Update (adopted by the City of Barrie in 2011)

The *Whiskey Creek Master Drainage Plan Update Environmental Assessment Document* prepared by AECOM (October 2009, Brief Technical Addendum August 2011) was adopted by the City of Barrie in 2011. The preferred alternative solution determined through the Class EA process was Alternative 5 – Increase hydraulic capacity to 1:100-year storm conveyance for creek channel and culvert crossings with specific locations for Regional storm conveyance. The individual projects recommended for implementation under the preferred alternative solution included culvert improvements at The Boulevard and Brennan Avenue to convey the 1:100-year return frequency design storm peak flows (greater than the City design guidelines for Local road crossings, 1:50-year) and watercourse improvements from The Boulevard to Kempenfelt Bay.



1.2.2 Drainage Master Plan (2019)

The *Drainage Master Plan* (DMP) prepared by Tatham Engineering Limited (Tatham) in March 2019 evaluated alternative solutions to address the drainage issues along the subject reach of Whiskey Creek. Individual projects recommended for implementation through the DMP included culvert improvements at The Boulevard and Brennan Avenue and watercourse improvements from The Boulevard to Kempenfelt Bay, which are consistent with the recommendations of the previous Master Drainage Plan. Specifically, the DMP recommended:

- The existing culvert crossing The Boulevard be replaced with a 10.67 m open bottom span structure with capacity to convey the 1:100-year return frequency design storm peak flows;
- The Whiskey Creek watercourse between Brennan Avenue and The Boulevard be widened and deepened to convey the 1:100-year return frequency design storm peak flows;
- The existing culvert crossing Brennan Avenue be replaced with twin 9.14 m open bottom span structures with capacity to convey the 1:100-year return frequency design storm peak flows and Brennan Avenue be raised to accommodate minimum cover requirements over the structure; and
- The Whiskey Creek watercourse between Kempenfelt Bay and Brennan Avenue be widened and deepened to convey the 1:100-year return frequency design storm peak flow. To provide this capacity, the watercourse would need to be graded at 0% slope from Kempenfelt Bay to Brennan Avenue and the existing sewage pumping station, a building in Minet's Point Park and the entrance to the park relocated.

The DMP also noted that Whiskey Creek is a coldwater fishery and a low flow channel must be incorporated into the design of the watercourse improvements.

During the DMP, changes to the road network were identified as alternative solutions to address flooding along Whiskey Creek. However, the DMP focused on drainage improvements and the changes to the local road network fell outside the scope of the study. As such, it was recommended through the DMP that the preferred solution through the subject reach of Whiskey Creek be re-evaluated in a subsequent Class EA.

1.3 OBJECTIVES

The 2019 DMP identified a preferred solution to address drainage deficiencies from The Boulevard to Kempenfelt Bay which includes significant culvert and watercourse improvements, relocation of a sewage pumping station, property acquisition, and raising Brennan Avenue. Several constructability issues were identified with the culvert improvements such that the City has initiated this Municipal Class EA to identify and evaluate additional drainage improvement options based on impacts to the physical, natural, social, cultural and economic environments.



The primary objective of this technical memorandum is to present the hydraulic analysis of the various improvement alternatives to assess the reduction in the frequency of flooding that can be achieved with each alternative.



2 Existing Conditions

The reach of Whiskey Creek from The Boulevard to Kempenfelt Bay is within a residential area in the City of Barrie. The low flow channel follows White Oaks Road to Kempenfelt Bay and there is evidence of erosion along its length. Above the low flow channel, the banks are heavily vegetated including mature trees. The watercourse has limited capacity and is further constrained by an existing 1800 mm x 1070 mm CSP arch culvert crossing The Boulevard and an existing 3650 mm x 1500 mm concrete box culvert crossing Brennan Avenue. Through the analysis completed in support of this EA, The Boulevard culvert crossing has been identified as having the limiting capacity of the conveyance system downstream of Hurst Drive. The Boulevard culvert crossing has a capacity of approximately 3.5 m³/s before water overtops the road which is equivalent to a design flood frequency less than the 1:2-year peak flow.

Significant flooding has been documented between The Boulevard and Kempenfelt Bay including roadway overtopping and flow along White Oaks Road. On the west side of the watercourse, significant flows are conveyed along White Oaks Road and through private properties to Kempenfelt Bay. On the east side of the watercourse, flow can spill through private properties starting just downstream of The Boulevard continuing to Kempenfelt Bay. The flooding issues identified through a hydraulic analysis of Whiskey Creek are described in Section 6.



3 Alternative Solutions

Several alternative solutions have been developed to reduce the frequency of flooding along Whiskey Creek at Minet's Point. Each alternative will ultimately be evaluated considering impacts to the physical, natural, social, cultural and economic environments. Each alternative solution is described in the following section and conceptual design drawings for each alternative are included in Appendix A for reference.

3.1 EXISTING (BASELINE) CONDITIONS

3.1.1 Alternative 1 – Do Nothing

The “Do Nothing” alternative allows for the consideration of not making any changes to Whiskey Creek from The Boulevard to Kempenfelt Bay. This alternative is being considered to provide a benchmark to gauge the physical, natural, social, cultural and economic implications of the other alternatives. To comply with the City of Barrie Drainage Policies, if this alternative were selected, consideration should be given to the fact that the City may acquire private property or interests therein (easements) impacted by flooding.

Under Alternative 1, the existing culverts and watercourse will remain unchanged from existing conditions. The existing watercourse is described as follows:

- The watercourse downstream of Brennan Avenue to Kempenfelt Bay is approximately 1 - 2 m deep and 8 - 15 m wide between the main channel banks. The low flow channel geometry is variable;
- The culvert crossing Brennan Avenue is a 3650 mm x 1500 mm concrete box culvert;
- The watercourse between The Boulevard and Brennan Avenue is approximately 1 - 1.5 m deep and 8 - 10 m wide between the main channel banks. The low flow channel geometry is variable; and
- The culvert crossing The Boulevard is an 1800 mm x 1070 mm CSP arch culvert.

3.2 HYDRAULIC IMPROVEMENTS

3.2.1 Alternative 2 – Improve Culverts/Watercourse to Convey 1:100-Year Design Storm

An opportunity exists to replace the culvert crossings of Brennan Avenue and The Boulevard with culverts sized to convey the 1:100-year return frequency design storm peak flow. There is also an opportunity to improve Whiskey Creek from The Boulevard to Kempenfelt Bay to increase its conveyance capacity to the 1:100-year return frequency design storm peak flow. Alternative



2 is consistent with the recommendations of the previous *Whiskey Creek Master Drainage Plan Update (2011)* and *Drainage Master Plan (2019)*.

3.2.2 Alternative 3 – Improve Culvert/Watercourse to Convey Less Than 1:100-Year Design Storm

The same opportunity exists to improve the culvert crossings and watercourse described under Alternative 2 to a reduced level of service (designed to convey less than the 1:100-year return frequency design storm peak flow). An opportunity exists to improve the culvert crossings and watercourse from The Boulevard to Kempenfelt Bay to reduce the frequency of flooding while reducing/eliminating the conflicts, relocations and constructability issues identified under Alternative 2.

3.2.3 Alternative 4 – Remove Brennan Avenue at Whiskey Creek

Under Alternative 4, two options are being considered as described in the following sections:

Alternative 4A – Remove Brennan Avenue at Whiskey Creek

An opportunity exists to remove Brennan Avenue, including the culvert crossing, at Whiskey Creek daylighting the watercourse and removing a restriction to flow. An opportunity also exists to improve Whiskey Creek from Kempenfelt Bay to The Boulevard along with The Boulevard culvert crossing to increase the conveyance capacity of the drainage system and reduce the frequency of flooding in the area. To maintain pedestrian access, a pedestrian span bridge would replace the Brennan Avenue culvert crossing.

Alternative 4B – Remove Brennan Avenue at Whiskey Creek and Connect Brennan Avenue and The Boulevard

An opportunity exists to complete the works described under Alternative 4A and construct a new transportation linkage between Brennan Avenue and The Boulevard. A new section of road can be constructed through 7 Brennan Avenue connecting Brennan Avenue to The Boulevard improving the transportation network in the area under Alternative 4.

3.2.4 Alternative 5 – Remove The Boulevard at Whiskey Creek

Under Alternative 5, two options are being considered similar to Alternative 4 as described in the following sections:

Alternative 5A – Remove The Boulevard at Whiskey Creek

An opportunity exists to remove The Boulevard, including the culvert crossing, at Whiskey Creek daylighting the watercourse and removing a restriction to flow. Under Alternative 5A, Whiskey Creek would be improved from Kempenfelt Bay to The Boulevard and the Brennan Avenue



culvert crossing would be improved to increase the conveyance capacity of the drainage system and reduce the frequency of flooding in the area. To maintain pedestrian access, a pedestrian span bridge would replace The Boulevard culvert crossing.

Alternative 5B – Remove The Boulevard at Whiskey Creek and Connect Brennan Avenue and The Boulevard

An opportunity exists to complete the works described under Alternative 5A and construct the new transportation linkage between Brennan Avenue and The Boulevard described under Alternative 4B.

3.2.5 Alternative 6 – Remove Brennan Avenue and The Boulevard at Whiskey Creek

Under Alternative 6, three options are being considered as described in the following sections:

Alternative 6A – Remove Brennan Avenue and The Boulevard at Whiskey Creek

An opportunity exists to remove Brennan Avenue and The Boulevard, including the culvert crossings, at Whiskey Creek daylighting the watercourse and removing the two flow restrictions. Under Alternative 6A, Whiskey Creek would be improved from Kempenfelt Bay to The Boulevard to increase the conveyance capacity of the watercourse and reduce the frequency of flooding in the area. To maintain pedestrian access, pedestrian span bridges would replace the Brennan Avenue and The Boulevard culvert crossings.

Alternative 6B – Remove Brennan Avenue and The Boulevard at Whiskey Creek and Connect Brennan Avenue and The Boulevard

An opportunity exists to complete the works described under Alternative 6A and construct the new transportation linkage between Brennan Avenue and The Boulevard described under Alternative 4B.

Alternative 6C – Remove Brennan Avenue and The Boulevard at Whiskey Creek and Connect Brennan Avenue and The Boulevard and New Connection to Hurst Drive

An opportunity exists to complete the works described under Alternative 6A and construct a second new transportation linkage between Southview Road and Hurst Drive. A new section of road can be constructed through 205 and 207 Southview Road connecting Southview Road and Hurst Drive further improving the transportation network in the area under Alternative 6.

3.3 FLOW DIVERSIONS

3.3.1 Alternative 7 – Additional Conveyance Route (Flow Diversion) Through 36 White Oaks Road

A diversion structure can be constructed under White Oaks Road upstream of The Boulevard to redirect a portion of the Whiskey Creek flow to a new channel constructed through 36 White



Oaks Road to Kempenfelt Bay. During storm and freshet events, a portion of the flow within Whiskey Creek would be redirected through the diversion structure and proposed channel, reducing flows and the frequency of flooding along Whiskey Creek.



4 Hydrology

A hydrologic analysis of the Whiskey Creek watershed was completed as part of the *Whiskey Creek Master Drainage Plan Update (2011)* and *Drainage Master Plan (2019)*. A summary of the hydrologic models previously prepared is provided in the following sections.

4.1 LSRCA APPROVED HYDROLOGY

The LSRCA approved the hydrologic model prepared in support of the *Whiskey Creek Master Drainage Plan Update (2011)*. The hydrologic model was later updated in accordance with the changes described in the *Whiskey Creek Master Drainage Plan Revisions Brief Technical Addendum (2011)*. The LSRCA approved flows represent future land use conditions. However, they do not account for climate change. The LSRCA approved flows are summarized in the following table.

Table 1: Approved LSRCA Flow Summary

STORM	PEAK FLOW (m ³ /s)		
	The Boulevard	Brennan Avenue	Kempenfelt Bay
1:2-Year	10.03	10.06	10.08
1:5-Year	19.49	19.56	19.59
1:10-Year	27.27	27.38	27.43
1:25-Year	35.03	35.17	35.24
1:50-Year	42.04	42.20	42.29
1:100-Year	52.25	52.50	52.62
Hurricane Hazel	73.32	73.66	73.82

4.2 DRAINAGE MASTER PLAN HYDROLOGY

As part of the 2019 DMP, city-wide minor and major drainage system hydrologic models were created using the best information available. The updated hydrology has not been approved by the LSRCA for the purpose of floodplain mapping or for use in this study.



For the DMP, the future land use condition was not analyzed, only existing land use conditions. Instead, the existing condition peak flows were increased by 20% to account for future development and/or intensification, climate change and as a safety factor (for partial culvert obstruction, storm sewer sizing, etc.).

Proactively, the City of Barrie currently applies a simple approach to adapting to climate change by applying a 15% increase (adjustment factor) to the City's rainfall intensity-duration-frequency (IDF) relationships developed from historic rainfall data. The updated IDF relationships are presented in the City of Barrie *Storm Drainage and Stormwater Management Policies and Design Guidelines* (October 2020). The climate change adjusted rainfall IDF data was used to generate the return frequency design storms in the DMP hydrologic models.

4.3 RESULTS COMPARISON

The DMP peak flows have not been approved by the LSRCA and it was agreed the LSRCA approved flows would be used in this study (see meeting minutes provided in Appendix B). However, the DMP hydrologic model was generated using the best information available and calibrated to historic streamflow data. As such, the City hopes to use the DMP hydrologic models in the future, once approved by the LSRCA. To determine which hydrologic model (LSRCA approved versus DMP) produces the most conservative results, a comparison of the peak flows was completed. The peak flow comparison is presented in Table 2 provided overleaf. As illustrated in Table 2, the LSRCA approved peak flows are more conservative relative to the DMP peak flows. A summary of both the LSRCA approved and DMP peak flows is provided in Appendix C for reference.

The 1:50-year return frequency design storm peak flow was excluded from the *Whiskey Creek Master Drainage Plan Update* (2011) hydrologic model results. For this study, the 1:50-year return frequency design storm peak flows were estimated by applying the relative difference (120%) between the DMP 1:25-year and 1:50-year return frequency design storm peak flows to determine the LSRCA 1:50-year return frequency design storm peak flow.



Table 2: Peak Flow Comparison (LSRCA Approved versus DMP)

LOCATION	PEAK FLOW (m³/s)													
	1:2-YEAR		1:5-YEAR		1:10-YEAR		1:25-YEAR		1:50-YEAR		1:100-YEAR		HURRICANE HAZEL	
	LSRCA (2011)	DMP (2019)	LSRCA (2011)	DMP (2019)	LSRCA (2011)	DMP (2019)	LSRCA (2011)	DMP (2019)	LSRCA (2011)	DMP (2019)	LSRCA (2011)	DMP (2019)	LSRCA (2011)	DMP (2019)
Hurst Drive	10.00	8.66	19.42	13.70	27.16	19.39	34.88	27.42	41.86	33.64	52.03	38.33	72.99	69.27
The Boulevard	10.03	8.68	19.49	13.69	27.27	19.26	35.03	27.07	42.04	32.90	52.25	37.38	73.32	69.62
Brennan Avenue	10.06	8.72	19.56	13.73	27.38	19.33	35.17	27.14	42.20	32.95	52.50	37.46	73.66	70.07
Lake Simcoe	10.08	8.68	19.59	13.70	27.43	19.19	35.24	26.88	42.29	32.80	52.62	37.34	73.82	70.04

Note: 1:50-year return frequency design storm peak flows were excluded from Whiskey Creek Master Drainage Plan Update. 1:50-year LSRCA flows were estimated using relative difference between 1:25-year and 1:50-year DMP flows.



5 Hydraulic Modeling

Like the hydrologic models, there are currently two existing hydraulic models of Whiskey Creek. A HEC-RAS model was prepared and approved by the LSRCA as part of the *Whiskey Creek Master Drainage Plan Update (2011)* and an updated model was prepared in 2015 as part of the City's minor/major stormwater model development project. The 2015 model was further updated as part of the *Drainage Master Plan (2019)*. At the outset of the City's minor/major stormwater model development project, the LSRCA expressed concerns regarding the accuracy of the existing cross-section data in their approved HEC-RAS models. Updates to the LSRCA approved HEC-RAS models were ultimately deemed necessary after minor model issues and notable differences between approved cross-section geometry and cross-sections extracted from the City's detailed 2007 LiDAR data were identified. As such, the HEC-RAS models were updated as part of the City's minor/major stormwater model development project and again as part of the *Drainage Master Plan (2019)*. The LSRCA has provided comments regarding the updated models, however they have not been approved for use.

As a first step for this project, the appropriate hydraulic model for use in this study was discussed. A comparison of the LSRCA approved model cross-sections against the updated Drainage Master Plan model cross-sections was presented. Though the locations of the cross-sections are not consistent between the two models, the results clearly showed that the cross-sections in the updated HEC-RAS model includes a higher level of detail/accuracy along Whiskey Creek (see Appendix D).

As the assessment of alternatives does not involve updating floodplain mapping for Whiskey Creek, the LSRCA advised that the HEC-RAS model updated as part of the DMP may be used as long as any changes/deviations from the LSRCA approved HEC-RAS model are fully documented in a supporting report (see meeting minutes provided in Appendix B). Therefore, the DMP HEC-RAS model has been used for this study.

The development of the HEC-RAS hydraulic models through the minor/major stormwater model development project and *Drainage Master Plan* were fully documented in reports prepared in support of these projects. Also, a training session was held at the City of Barrie, which LSRCA staff attended, to review the model development, calibration and verification process. The previous reports should be reviewed for additional information regarding the development of the Whiskey Creek HEC-RAS model developed through the DMP.

A summary of the model updates completed as part of this study and a comparison of the updated model to the LSRCA approved model is provided in the following sections.



5.1 MODEL UPDATES

The City obtained updated LiDAR data in 2016 for the entire City and in August 2020 a topographic survey of Whiskey Creek from approximately 60 m upstream of The Boulevard to the outlet at Kempenfelt Bay was completed in support of this study. Information regarding the topographic survey and LiDAR data is provided in Appendix D for reference. A new surface was created in GeoHEC-RAS for this study from Hurst Drive to Kempenfelt Bay using the updated LiDAR and topographic survey data. Using the new surface, the DMP HEC-RAS model has been updated as follows:

- the cross-section alignment and spacing was refined from cross-section 299 upstream of The Boulevard to cross-section 30;
- the cross-section geometry was updated from Hurst Drive to Kempenfelt Bay by extracting the geometry from the updated surface in GeoHEC-RAS;
- Manning's roughness coefficients were updated based on aerial imagery, the City's land use shapefiles and field observations from Hurst Drive to Kempenfelt Bay;
- the culvert crossing The Boulevard was updated from a 1790 mm x 1000 mm CSP arch culvert complete with a headwall to an 1800 mm x 1070 mm CSP arch culvert mitered to conform to the embankment slope and partially embedded based on the topographic survey data and site photos;
- the culvert crossing Brennan Avenue was updated from a 3650 mm x 1800 mm concrete box culvert to a 3650 mm x 1500 mm concrete box culvert based on the topographic survey data and review of the available background as-built construction drawings; and
- a lateral structure and spill reach were added to model flow that overtops the east bank of the main channel of Whiskey Creek downstream of The Boulevard (detailed analysis of the topographic data confirmed that water will overtop the east bank of the main channel downstream of The Boulevard and drain through private properties to Kempenfelt Bay).

5.2 HYDRAULIC MODEL PARAMETERS

A description of the updated hydraulic model parameters is provided in the following sections.

5.2.1 Boundary Conditions

The downstream boundary condition water surface elevation has been set to the Lake Simcoe average high level of 219.15 m for the return frequency design storms (1:2-year though 1:100-year) and to the historic high level of 219.50 m for the Regulatory event (Hurricane Hazel).



5.2.2 Cross-Section Geometry

As described in Section 5.2, the cross-section geometry was updated from Hurst Drive to Kempenfelt Bay based on 2016 LiDAR data and the August 2020 topographic survey of Whiskey Creek. The reach lengths were determined based on the distance between consecutive cross-sections along the river centerline. The overbank reach lengths were determined based on the anticipated path of the center of mass of the overbank flow.

For proposed conditions, the cross-section geometry was updated in accordance with the various improvement alternatives described in Section 3.

5.2.3 Manning's Roughness Coefficient

The Manning's roughness coefficient depends on several factors including surface roughness, vegetation, channel irregularities and obstructions. The HEC-RAS Reference Manual provides standard values for various channel and floodplain types. Based on field observations, the Manning's roughness coefficients were set as follows:

- 0.040 for the main channel as it is generally free of heavy vegetation with relatively high sinuosity and some pooled areas;
- 0.100 for the channel overbanks through dense wooded areas;
- 0.060 within the floodplain through residential backyards and areas with less dense tree cover; and
- 0.015 for the channel overbanks where flow is along a paved surface, specifically roadways.

5.2.4 Contraction and Expansion Coefficients

Energy losses occur due to the contraction and expansion of flow between cross-sections. This is most significant at culverts or bridges. Contraction and expansion coefficients have been set according to Table 5-2 of the HEC-RAS Reference Manual. Entrance losses for culverts have been set according to Tables 6-3 and 6-4 of the HEC-RAS Reference Manual and exit losses have been set to 1.0 which is typical for an abrupt transition.

5.2.5 Culverts

The culvert shape, size, length and inverts were determined from field observations and topographic survey data. Manning's roughness coefficients of 0.024 and 0.013 were used for CSP arch culverts and concrete box culverts, respectively. A culvert bottom roughness of 0.040 was used for culverts partially embedded or partially filled with native streambed material.



5.2.6 Bridges

Under proposed conditions, concrete span structures are required to meet conveyance requirements. The span structure geometry has been included in the model in accordance with the various improvement alternatives described in Section 3.

5.2.7 Lateral Structure

The lateral structure geometry has been extracted from the topographic survey data where water first spills east. The lateral structure is set to spill from the rightmost station of the main branch cross-sections to the leftmost station of the adjacent spill reach cross-sections. The lateral weir flow coefficient has been set to 0.47 which is the default value for a natural high ground barrier that does not act like a weir.

Under proposed conditions, the lateral structure geometry has been updated for the alternatives including the new transportation linkage between Brennan Avenue and The Boulevard to reflect the proposed grading of the roadway.



6 Hydraulic Modeling Results

A summary of the hydraulic Modeling results for each alternative is provided in the following section. The HEC-RAS Modeling results and supporting calculations are provided in Appendix E through Appendix I. Digital copies of the models have been submitted with this Technical Memorandum and the detailed model results may be accessed from the digital models.

6.1 EXISTING (BASELINE) CONDITIONS

6.1.1 Alternative 1 – Do Nothing

The existing conditions (Alternative 1) hydraulic model results for Alternative 1 are summarized as follows:

- The existing 1800 mm x 1070 mm CSP arch culvert crossing The Boulevard has a conveyance capacity of 3.4 m³/s which is less than the 1:2-year return frequency design storm peak flow. The depth of road overtopping during the Regulatory Storm is greater than 1.3 m;
- The existing 3650 mm x 1500 mm concrete box culvert crossing Brennan Avenue has a conveyance capacity of 10.4 m³/s which is less than the 1:5-year return frequency design storm peak flow. The depth of road overtopping during the Regulatory Storm is approximately 0.8 m;
- Downstream of The Boulevard the channel capacity is less than the 1:2-year return frequency design storm peak flow. On the west side of the watercourse flow is conveyed along White Oaks Road and through private properties to Kempenfelt Bay. On the east side of the watercourse flow will spill east across Brennan Avenue, through Minet's Point Park and across Lismer Boulevard and drain through private properties to Kempenfelt Bay;
- The cumulative spill east between The Boulevard and Kempenfelt Bay during the 1:2-year return frequency design storm and during the Regulatory Storm are 0.7 m³/s (approximately 7% of flow) and 15.9 m³/s (approximately 22% of flow), respectively.

6.2 HYDRAULIC IMPROVEMENTS

6.2.1 Alternative 2 – Improve Culverts/Watercourse to Convey 1:100-Year Design Storm

Under Alternative 2, the main channel of Whiskey Creek must be re-graded and widened from its outlet to Kempenfelt Bay (elevation of approximately 218.00 m) at 0% grade to Brennan Avenue to convey the 1:100-year return frequency design storm peak flow. The existing Brennan Avenue culvert crossing would be replaced with an 11 m wide concrete span structure complete with an open bottom to satisfy the 1:100-year design flood frequency criteria. Similarly, the main



channel of Whiskey Creek must be re-graded and widened from Brennan Avenue to The Boulevard and the existing culvert crossing of The Boulevard replaced with an 11 m wide concrete span structure complete with an open bottom to provide the same capacity as the downstream channel/structure. The Alternative 2 hydraulic model results are summarized as follows:

- The proposed 11 m concrete span structure crossing The Boulevard has a conveyance capacity greater than the 1:100-year return frequency design storm peak flow (52.3 m³/s). The depth of road overtopping during the Regulatory event is approximately 0.5 m, which is a reduction of approximately 0.8 m compared to existing conditions;
- The proposed 11 m concrete span structure crossing Brennan Avenue has a conveyance capacity greater than the 1:100-year return frequency design storm peak flow (52.5 m³/s). The depth of road overtopping during the Regulatory storm is approximately 0.3 m, which is a reduction of approximately 0.5 m compared to existing conditions;
- Between The Boulevard and Brennan Avenue, the channel capacity is greater than the 1:100-year return frequency design storm peak flow. Flows are conveyed through the overbank along White Oaks Road at depths less than 0.3 m during the Regulatory Storm;
- Downstream of Brennan Avenue, the channel capacity is greater than the 1:100-year return frequency design storm peak flow. Flows are conveyed through Minet's Point Park with minor spill during the Regulatory Storm; and
- During the Regulatory Storm, the spill from the east overbank starts approximately 20 m upstream of the Brennan Avenue culvert crossing and continues for approximately 60 m downstream of Brennan Avenue. The cumulative spill east is approximately 1.8 m³/s (approximately 2% of the total flow).

To accommodate the watercourse and channel improvements, the washroom/generator building in Minet's Point Park, a hydro transformer and the entrance to the park west of Lismer Boulevard must be relocated along with various utilities (gas and hydro). Also, the road profile above the Brennan Avenue culvert crossing must be revised to provide sufficient cover over the proposed concrete span structure. Furthermore, a sanitary force main crossing Whiskey Creek at Brennan Avenue would need to be lowered or relocated and the existing sanitary sewer and water main at both crossings would need to be protected. The entire 7 Brennan Avenue property and a portion of 199 The Boulevard would need to be acquired by the City to accommodate the proposed improvements.

The re-grading of Whiskey Creek from Kempenfelt Bay to Brennan Avenue at 0% grade would make this reach of Whiskey Creek an extension of the lake, negating the requirement for a low flow channel for fish passage through this area. However, a low flow channel would need to be



incorporated into Whiskey Creek between Brennan Avenue and The Boulevard. Also, it is anticipated that the main channel banks will need to be armoured with erosion protection measures to prevent further erosion of the watercourse.

The capacity of Whiskey Creek from The Boulevard to Kempenfelt Bay can only be increased to equal the 1:100-year return frequency design storm peak flow if Whiskey Creek is re-graded at 0% grade. Maintaining a grade of 0.4%, which is similar to existing conditions, can only convey the 1:50-year return frequency design storm peak flow.

6.2.2 Alternative 3 – Improve Culvert/Watercourse to Convey Less Than 1:100-Year Design Storm

The capacity of Whiskey Creek from The Boulevard to Kempenfelt Bay can be increased to convey design storms less than the 1:100-year return frequency design storm peak flow as described in the following sections.

1:50-Year Return Frequency Conveyance Capacity

The main channel of Whiskey Creek can be re-graded and widened from its outlet to Kempenfelt Bay (elevation of approximately 218.00 m) at 0% grade to Brennan Avenue to convey the 1:50-year return frequency design storm peak flow. The existing Brennan Avenue culvert crossing would be replaced with a 9.8 m wide concrete span structure complete with an open bottom to satisfy the 1:50-year design flood frequency criteria. Similarly, the main channel of Whiskey Creek must be re-graded and widened from Brennan Avenue to The Boulevard and the existing culvert crossing of The Boulevard replaced with a 7.9 m wide concrete span structure complete with an open bottom to provide the same capacity as the downstream channel/structure. The hydraulic model results for this scenario are summarized as follows:

- The proposed 7.9 m concrete span structure crossing The Boulevard has a conveyance capacity equal to the 1:50-year return frequency design storm peak flow (42.0 m³/s). The depth of road overtopping during the Regulatory event is approximately 0.8 m, which is a reduction of approximately 0.5 m compared to existing conditions;
- The proposed 9.8 m concrete span structure crossing Brennan Avenue has a conveyance capacity greater than the 1:50-year return frequency design storm peak flow (42.2 m³/s). The depth of road overtopping during the Regulatory storm is approximately 0.4 m, which is a reduction of approximately 0.4 m compared to existing conditions;
- Between The Boulevard and Brennan Avenue, the channel capacity is greater than the 1:50-year return frequency design storm peak flow. Flows are conveyed through the overbank along White Oaks Road at depths less than 0.4 m during the Regulatory Storm;



- Downstream of Brennan Avenue, the channel capacity is greater than the 1:100-year return frequency design storm peak flow. Flows are conveyed through Minet's Point Park with minor spill during the Regulatory Storm; and
- The cumulative spill from the east overbank between The Boulevard and Kempenfelt Bay during the 1:100-year return frequency design storm and during the Regulatory Storm are $0.1 \text{ m}^3/\text{s}$ (approximately 0.2% of flow) and $2.4 \text{ m}^3/\text{s}$ (approximately 3% of flow), respectively.

To accommodate the watercourse and channel improvements, the washroom/generator building in Minet's Point Park, a hydro transformer and the entrance to the park west of Lismer Boulevard must be relocated along with various utilities (gas and hydro). Also, the road profile above the Brennan Avenue culvert crossing must be revised to provide sufficient cover over the proposed concrete span structure. Furthermore, a sanitary force main crossing Whiskey Creek at Brennan Avenue would need to be lowered or relocated and the existing sanitary sewer and water main at both crossings would need to be protected. The entire 7 Brennan Avenue property and a portion of 199 The Boulevard would need to be acquired by the City to accommodate the proposed improvements.

The re-grading of Whiskey Creek from Kempenfelt Bay to Brennan Avenue at 0% grade would make this reach of Whiskey Creek an extension of the lake, negating the requirement for a low flow channel for fish passage through this area. However, a low flow channel would need to be incorporated into Whiskey Creek between Brennan Avenue and The Boulevard. Also, it is anticipated that the main channel banks will need to be armoured with erosion protection measures to prevent further erosion of the watercourse.

The main channel of Whiskey Creek can also be re-graded and widened from its outlet to Kempenfelt Bay (elevation of approximately 218.00 m) at 0.4% grade to Brennan Avenue to convey the 1:50-year return frequency design storm peak flow. Under this option, both culvert crossings must be widened along with the channel from Kempenfelt Bay to The Boulevard to convey the 1:50-year return frequency design storm peak flow. The hydraulic model results for this scenario are summarized as follows:

- The proposed 11 m concrete span structure crossing The Boulevard has a conveyance capacity greater than the 1:50-year return frequency design storm peak flow ($42.0 \text{ m}^3/\text{s}$). The depth of road overtopping during the Regulatory event is approximately 0.8 m, which is a reduction of approximately 0.5 m compared to existing conditions;
- The proposed 13.4 m concrete span structure crossing Brennan Avenue has a conveyance capacity approximately equal to the 1:50-year return frequency design storm peak flow ($42.1 \text{ m}^3/\text{s}$). The depth of road overtopping during the Regulatory storm is approximately 0.5 m, which is a reduction of approximately 0.3 m compared to existing conditions;



- Between The Boulevard and Brennan Avenue, the channel capacity is greater than the 1:50-year return frequency design storm peak flow. Flows are conveyed through the overbank along White Oaks Road at depths less than 0.5 m during the Regulatory Storm;
- Downstream of Brennan Avenue, the channel capacity is greater than the 1:50-year return frequency design storm peak flow. Flows are conveyed through Minet's Point Park with minor spill during the Regulatory Storm; and
- The cumulative spill from the east overbank between The Boulevard and Kempenfelt Bay during the 1:100-year return frequency design storm and during the Regulatory Storm are 1.0 m³/s (approximately 2% of flow) and 5.2 m³/s (approximately 7% of flow), respectively.

Under this scenario, the washroom/generator building in Minet's Point Park, a hydro transformer and the entrance to the park west of Lismer Boulevard must be relocated. The road profile above the Brennan Avenue culvert crossing must be revised to provide sufficient cover over the proposed concrete span structures. The sanitary force main crossing Whiskey Creek at Brennan Avenue and the existing sanitary sewer and water main at both crossings would need to be protected. The entire 7 Brennan Avenue property and a portion of 199 The Boulevard would need to be acquired by the City to accommodate the proposed improvements.

1:25-Year Return Frequency Conveyance Capacity

Alternatively, the main channel of Whiskey Creek can be re-graded and widened from its outlet to Kempenfelt Bay (elevation of approximately 218.00 m) at 0% grade to Brennan Avenue to convey the 1:25-year return frequency design storm peak flow. The existing Brennan Avenue culvert crossing would be replaced with a 9.8 m wide concrete span structure complete with an open bottom to satisfy the 1:25-year design flood frequency criteria. Similarly, the main channel of Whiskey Creek must be re-graded and widened from Brennan Avenue to The Boulevard and the existing culvert crossing of The Boulevard replaced with a 7.3 m wide concrete span structure complete with an open bottom to provide the same capacity as the downstream channel/structure. The hydraulic model results for this scenario are summarized as follows:

- The proposed 7.3 m concrete span structure crossing The Boulevard has a conveyance capacity greater than the 1:25-year return frequency design storm peak flow (35.0 m³/s). The depth of road overtopping during the Regulatory Storm is approximately 0.8 m, which is a reduction of 0.5 m compared to existing conditions;
- The proposed 9.8 m concrete span structure crossing Brennan Avenue has a conveyance capacity approximately equal to the 1:25-year return frequency design storm peak flow (35.1 m³/s). The depth of road overtopping during the Regulatory Storm is approximately 0.5 m, which is a reduction of approximately 0.3 m compared to existing conditions;



- Between The Boulevard and Brennan Avenue, the channel capacity is greater than the 1:25-year return frequency design storm peak flow. Flows are conveyed through the overbank along White Oaks Road at depths less than 0.5 m during the Regulatory Storm;
- Downstream of Brennan Avenue, the channel capacity is less than the 1:25-year return frequency design storm peak flow. Flows are conveyed through Minet's Point Park with minor spill during flows greater than the 1:10-year return frequency design storm peak flow; and
- The cumulative spill from the east overbank between The Boulevard and Kempenfelt Bay during the 1:25-year return frequency design storm and during the Regulatory Storm are 0.5 m³/s (approximately 1% of flow) and 5.8 m³/s (approximately 8% of flow), respectively. The 1:25-year return frequency design storm spill occurs downstream of the Brennan Avenue crossing and would be conveyed along the park entrance road.

To accommodate the watercourse and channel improvements, only the hydro transformer must be relocated. The existing washroom/generator building and entrance to the park may remain in their current location. Also, the road profile above both the Brennan Avenue and The Boulevard culvert crossings may remain as is. The sanitary force main crossing Whiskey Creek at Brennan Avenue would need to be lowered or relocated and the existing sanitary sewer and water main at both crossings would need to be protected. The entire 7 Brennan Avenue property and a portion of 199 The Boulevard would need to be acquired by the City to accommodate the proposed improvements.

The re-grading of Whiskey Creek from Kempenfelt Bay to Brennan Avenue at 0% grade would make this reach of Whiskey Creek an extension of the lake, negating the requirement for a low flow channel for fish passage through this area. However, a low flow channel would need to be incorporated into Whiskey Creek between Brennan Avenue and The Boulevard. Also, it is anticipated that the main channel banks will need to be armoured with erosion protection measures to prevent further erosion of the watercourse.

The main channel of Whiskey Creek can also be re-graded and widened from its outlet to Kempenfelt Bay (elevation of approximately 218.00 m) at 0.4% grade to Brennan Avenue to convey the 1:25-year return frequency design storm peak flow. Under this option, both culvert crossings must be widened along with the channel from Kempenfelt Bay to The Boulevard to convey the 1:25-year return frequency design storm peak flow. The hydraulic model results for this scenario are summarized as follows:

- The proposed 7.9 m concrete span structure crossing The Boulevard has a conveyance capacity approximately equal to the 1:25-year return frequency design storm peak flow (35.0 m³/s). The depth of road overtopping during the Regulatory event is approximately 0.9 m, which is a reduction of approximately 0.4 m compared to existing conditions;



- The proposed 11 m concrete span structure crossing Brennan Avenue has a conveyance capacity greater than the 1:25-year return frequency design storm peak flow (35.2 m³/s). The depth of road overtopping during the Regulatory storm is approximately 0.5 m, which is a reduction of approximately 0.3 m compared to existing conditions;
- Between The Boulevard and Brennan Avenue, the channel capacity is greater than the 1:25-year return frequency design storm peak flow. Flows are conveyed through the overbank along White Oaks Road at depths less than 0.6 m during the Regulatory Storm;
- Downstream of Brennan Avenue, the channel capacity is greater than the 1:50-year return frequency design storm peak flow. Flows are conveyed through Minet's Point Park with minor spill during the Regulatory Storm; and
- The cumulative spill from the east overbank between The Boulevard and Kempenfelt Bay during the 1:50-year return frequency design storm and during the Regulatory Storm are 0.8 m³/s (approximately 2% of flow) and 5.6 m³/s (approximately 7% of flow), respectively.

Under this scenario, the washroom/generator building in Minet's Point Park, a hydro transformer and the entrance to the park west of Lismer Boulevard must be relocated. The road profile above the Brennan Avenue culvert crossing must be revised to provide sufficient cover over the proposed concrete span structure. The sanitary force main crossing Whiskey Creek at Brennan Avenue and the existing sanitary sewer and water main at both crossings would need to be protected. The entire 7 Brennan Avenue property and a portion of 199 The Boulevard would need to be acquired by the City to accommodate the proposed improvements.

1:10-Year Return Frequency Conveyance Capacity

Alternatively, the main channel of Whiskey Creek can be re-graded and widened from its outlet to Kempenfelt Bay (elevation of approximately 218.00 m) at 0% grade to Brennan Avenue to convey the 1:10-year return frequency design storm peak flow. The existing Brennan Avenue culvert crossing would be replaced with a 6401 mm x 2438 mm concrete box culvert (400 mm of substrate placed in bottom of culvert) to satisfy the 1:10-year design flood frequency criteria. Similarly, the main channel of Whiskey Creek must be re-graded and widened from Brennan Avenue to The Boulevard and the existing culvert crossing of The Boulevard replaced with a 6096 mm x 2134 mm concrete box culvert (400 mm of substrate placed in bottom of culvert) to provide the same capacity as the downstream channel/structure. The Alternative 3 1:10-year return frequency design storm hydraulic model results are summarized as follows:

- The proposed 6096 mm x 2134 mm concrete box culvert crossing The Boulevard has a conveyance capacity greater than the 1:10-year return frequency design storm peak flow



(27.3 m³/s). The depth of road overtopping during the Regulatory Storm is approximately 1.1 m, which is a reduction of 0.2 m compared to existing conditions;

- The proposed 6401 mm x 2438 mm concrete box culvert crossing Brennan Avenue has a conveyance capacity approximately equal to the 1:10-year return frequency design storm peak flow (27.3 m³/s). The depth of road overtopping during the Regulatory Storm is approximately 0.7 m, which is a reduction of approximately 0.1 m compared to existing conditions;
- Between The Boulevard and Brennan Avenue, the channel capacity is greater than the 1:10-year return frequency design storm peak flow. Flows are conveyed through the overbank along White Oaks Road at depths less than 0.8 m during the Regulatory Storm;
- Downstream of Brennan Avenue, the channel capacity is greater than the 1:10-year return frequency design storm peak flow. Flows are conveyed through Minet's Point Park with minor spill during flows greater than the 1:10-year return frequency design storm peak flow; and
- The cumulative spill from the east overbank between The Boulevard and Kempenfelt Bay during the 1:25-year return frequency design storm and during the Regulatory Storm are 0.8 m³/s (approximately 2% of flow) and 10.4 m³/s (approximately 14% of flow), respectively.

To accommodate the watercourse and channel improvements, only the hydro transformer must be relocated. The existing washroom/generator building and entrance to the park may remain in their current locations. Also, the road profile above both the Brennan Avenue and The Boulevard culvert crossings may remain as is. The sanitary force main crossing Whiskey Creek at Brennan Avenue would need to be lowered or relocated and the existing sanitary sewer and water main at both crossings would need to be protected. The entire 7 Brennan Avenue property and a portion of 199 The Boulevard would need to be acquired by the City to accommodate the proposed improvements.

The re-grading of Whiskey Creek from Kempenfelt Bay to Brennan Avenue at 0% grade would make this reach of Whiskey Creek an extension of the lake, negating the requirement for a low flow channel for fish passage through this area. However, a low flow channel would need to be incorporated into Whiskey Creek between Brennan Avenue and The Boulevard. Also, it is anticipated that the main channel banks will need to be armoured with erosion protection measures to prevent further erosion of the watercourse.

The main channel of Whiskey Creek can also be re-graded and widened from its outlet to Kempenfelt Bay (elevation of approximately 218.00 m) at 0.4% grade to Brennan Avenue to convey the 1:10-year return frequency design storm peak flow. Under this option, both culvert crossings must be widened along with the channel from Kempenfelt Bay to The Boulevard to



convey the 1:10-year return frequency design storm peak flow. The hydraulic model results for this scenario are summarized as follows:

- The proposed 7.3 m concrete span structure crossing The Boulevard has a conveyance capacity greater than the 1:10-year return frequency design storm peak flow (27.3 m³/s). The depth of road overtopping during the Regulatory Storm is approximately 0.9 m, which is a reduction of 0.4 m compared to existing conditions;
- The proposed 9.8 m concrete span structure crossing Brennan Avenue has a conveyance capacity greater than the 1:10-year return frequency design storm peak flow (27.4 m³/s). The depth of road overtopping during the Regulatory Storm is approximately 0.7 m, which is a reduction of approximately 0.1 m compared to existing conditions;
- Between The Boulevard and Brennan Avenue, the channel capacity is greater than the 1:10-year return frequency design storm peak flow. Flows are conveyed through the overbank along White Oaks Road at depths less than 0.7 m during the Regulatory Storm;
- Downstream of Brennan Avenue, the channel capacity is less than the 1:25-year return frequency design storm peak flow. Flows are conveyed through Minet's Point Park with minor spill during flows greater than the 1:10-year return frequency design storm peak flow; and
- The cumulative spill from the east overbank between The Boulevard and Kempenfelt Bay during the 1:25-year return frequency design storm and during the Regulatory Storm are 0.7 m³/s (approximately 2% of flow) and 10.1 m³/s (approximately 14% of flow), respectively.

Under this scenario, only the hydro transformer must be relocated. The existing washroom/generator building and entrance to the park may remain in their current locations. Also, the road profile above both the Brennan Avenue and The Boulevard culvert crossings may remain as is. The sanitary force main crossing Whiskey Creek at Brennan Avenue and the existing sanitary sewer and water main at both crossings would need to be protected. The entire 7 Brennan Avenue property and a portion of 199 The Boulevard would need to be acquired by the City to accommodate the proposed improvements.

6.2.3 Alternative 4A – Remove Brennan Avenue at Whiskey Creek

An opportunity exists to remove Brennan Avenue, including the culvert crossing, at Whiskey Creek daylighting the watercourse and removing a restriction to flow. The capacity of Whiskey Creek can be increased from Kempenfelt Bay to The Boulevard to convey the 1:10-year, 1:25-year, 1:50-year or 1:100-year return frequency design storm peak flows, depending on the improvements implemented. The watercourse improvements required to increase the conveyance capacity of Whiskey Creek to equal the respective return frequency design storm peak flows are described under Alternatives 2 and 3.



Likewise, the existing culvert crossing under The Boulevard can be replaced with a structure sized to convey the 1:10-year, 1:25-year, 1:50-year or 1:100-year return frequency design storm peak flows, depending on the improvements implemented. The culvert crossing improvements required to increase the conveyance capacity of The Boulevard culvert crossing to equal the respective return frequency design storm peak flows are described under Alternatives 2 and 3.

The hydraulic model results for Alternative 4A remain consistent with the results presented under Alternatives 2 and 3.

6.2.4 Alternative 4B – Remove Brennan Avenue at Whiskey Creek and Connect Brennan Avenue and The Boulevard

The only difference between Alternative 4A and 4B is the inclusion of the new transportation linkage (new local road) between Brennan Avenue and The Boulevard under Alternative 4B. As such, the watercourse and culvert crossing improvements described under Alternative 4A are consistent with those required for Alternative 4B. As the spill east starts within 20 m of the Brennan Avenue culvert crossing where the grade of the new road will have to tie into the existing grade of Brennan Avenue, the new section of road has only a minor impact on the spill east and frequency of flooding in the area.

6.2.5 Alternative 5A – Remove The Boulevard at Whiskey Creek

An opportunity exists to remove The Boulevard, including the culvert crossing, at Whiskey Creek daylighting the watercourse and removing a restriction to flow. The capacity of Whiskey Creek can be increased from Kempenfelt Bay to The Boulevard to convey the 1:10-year, 1:25-year, 1:50-year or 1:100-year return frequency design storm peak flows, depending on the improvements implemented. The watercourse improvements required to increase the conveyance capacity of Whiskey Creek to equal the respective return frequency design storm peak flows are described under Alternatives 2 and 3.

Likewise, the existing culvert crossing under Brennan Avenue can be replaced with a structure sized to convey the 1:10-year, 1:25-year, 1:50-year or 1:100-year return frequency design storm peak flows, depending on the improvements implemented. The culvert crossing improvements required to increase the conveyance capacity of the Brennan Avenue culvert crossing to equal the respective return frequency design storm peak flows are described under Alternatives 2 and 3.

The hydraulic model results for Alternative 5A remain consistent with the results presented under Alternatives 2 and 3.



6.2.6 Alternative 5B – Remove The Boulevard at Whiskey Creek and Connect Brennan Avenue and The Boulevard

The only difference between Alternative 5A and 5B is the inclusion of the new transportation linkage (new local road) between Brennan Avenue and The Boulevard under Alternative 5B. As such, the watercourse and culvert crossing improvements described under Alternative 5A are consistent with those required for Alternative 5B. As the spill east starts within 20 m of the Brennan Avenue culvert crossing where the grade of the new road will have to tie into the existing grade of Brennan Avenue, the new section of road has only a minor impact on the spill east and frequency of flooding in the area.

6.2.7 Alternative 6A – Remove Brennan Avenue and The Boulevard at Whiskey Creek

An opportunity exists to remove both Brennan Avenue and The Boulevard, including both culvert crossings, at Whiskey Creek daylighting the watercourse and removing two restrictions to flow. The capacity of Whiskey Creek can be increased from Kempenfelt Bay to The Boulevard to convey the 1:10-year, 1:25-year, 1:50-year or 1:100-year return frequency design storm peak flows, depending on the improvements implemented. The watercourse improvements required to increase the conveyance capacity of Whiskey Creek to equal the respective return frequency design storm peak flows are described under Alternatives 2 and 3.

The hydraulic model results for Alternative 6A remain consistent with the results presented under Alternatives 2 and 3.

6.2.8 Alternative 6B – Remove Brennan Avenue and The Boulevard at Whiskey Creek and Connect Brennan Avenue and The Boulevard

The only difference between Alternative 6A and 6B is the inclusion of the new transportation linkage (new local road) between Brennan Avenue and The Boulevard under Alternative 6B. As such, the watercourse and culvert crossing improvements described under Alternative 6A are consistent with those required for Alternative 6B. As the spill east starts within 20 m of the Brennan Avenue culvert crossing where the grade of the new road will have to tie into the existing grade of Brennan Avenue, the new section of road has only a minor impact on the spill east and frequency of flooding in the area.

6.2.9 Alternative 6C – Remove Brennan Avenue and The Boulevard at Whiskey Creek, Connect Brennan Avenue and The Boulevard and New Connection to Hurst Drive

Under Alternative 6C, the works described under Alternative 6B are proposed along with a second new transportation linkage (new local road) between Southview Road and Hurst Drive. This second transportation linkage is located outside the Whiskey Creek Regulatory floodplain



and will have no impact on flooding along Whiskey Creek. As such, the hydraulic model results for Alternative 6C are consistent with those of Alternative 6B.

6.3 FLOW DIVERSIONS

6.3.1 Alternative 7 – Additional Conveyance Route (Flow Diversion) Through 36 White Oaks Road

A diversion structure can be constructed under White Oaks Road upstream of The Boulevard to redirect a portion of the Whiskey Creek flow to a new channel constructed through 36 White Oaks Road to Kempenfelt Bay. A 6401 mm x 1829 mm concrete box culvert installed under White Oaks Road upstream of The Boulevard can divert approximately 28.4 m³/s of the 1:100-year return frequency design storm peak flow in Whiskey Creek to a new channel constructed through 36 White Oaks Road. The Alternative 7 hydraulic model results are summarized as follows:

- Baseflows will continue to drain through Whiskey Creek as they currently do with no diversion of baseflow out of the watercourse;
- Only a portion of the peak flow will be diverted from Whiskey Creek during storm and freshet events and a portion of the peak flow will continue to be conveyed by Whiskey Creek to Kempenfelt Bay;
- With the diversion, the existing 1800 mm x 1070 mm CSP arch culvert crossing The Boulevard has a conveyance capacity of 3.4 m³/s which is less than the 1:5-year return frequency design storm peak flow. The depth of road overtopping during the Regulatory event is 1.1 m, which is a reduction of approximately 0.2 m compared to existing conditions;
- With the diversion, the existing 3650 mm x 1500 mm concrete box culvert crossing Brennan Avenue has a conveyance capacity of 10.4 m³/s which is less than the 1:25-year return frequency design storm peak flow. The depth of overtopping during the Regulatory event is approximately 0.5 m, which is a reduction of approximately 0.3 m compared to existing conditions;
- With the diversion, the channel capacity between The Boulevard and Brennan Avenue is less than the 1:10-year return frequency design storm peak flow;
- Downstream of Brennan Avenue, the channel capacity is less than the 1:25-year return frequency design storm peak flow;
- Between The Boulevard and Brennan Avenue, flows are conveyed through the overbank on the west side of the watercourse along White Oaks Road at depths less than 0.5 m during the Regulatory storm; and



- The cumulative spill from the east overbank between The Boulevard and Kempenfelt Bay during the 1:10-year return frequency design storm and during the Regulatory Storm are 0.1 m³/s (approximately 1% of flow) and 6.3 m³/s (approximately 15% of flow), respectively.

The flow split between Whiskey Creek and the proposed drainage channel through 36 White Oaks Road under Alternative 7 is summarized in the following table.

Table 3: Alternative 7 Flow Split Summary

STORM	FLOW (m ³ /s)		DEPTH OF OVERTOPPING (m)	
	Whiskey Creek	Diversion	Brennan Ave	The Boulevard
1:2-Year	2.5	7.6	0.00	0.00
1:5-Year	4.2	15.3	0.00	0.2
1:10-Year	7.6	19.7	0.00	0.4
1:25-Year	12.1	23.0	0.2	0.6
1:50-Year	16.8	25.3	0.3	0.7
1:100-Year	23.4	28.4	0.3	0.8
Hurricane Hazel	40.2	33.2	0.5	1.1

Under Alternative 7, 36 White Oaks Road would need to be acquired by the City in full to accommodate the proposed new drainage channel. Also, an existing sanitary sewer, sanitary force main and water main on White Oaks Road would have to be lowered to accommodate the construction of the diversion structure (concrete box culvert). However, the road profile of White Oaks Road may remain as is.

The hydraulic model results presented above exclude improvements to Whiskey Creek at The Boulevard through to Kempenfelt Bay. Implementing the watercourse and culvert crossing improvements described under Alternatives 3 in combination with the flow diversion would further reduce the frequency of flooding along whiskey Creek. For example, if the watercourse and culvert crossing improvements required to increase the conveyance capacity of Whiskey Creek to the 1:10-year return frequency design storm peak flow described under Alternative 3 were implemented in combination with the flow diversion, the overall capacity of the drainage system would be increased to equal the 1:100-year return frequency design storm peak flow. However, the same implications to the infrastructure in the study area would apply and the hydro transformer must be relocated, the sanitary force main crossing Whiskey Creek at Brennan



Avenue would need to be lowered or relocated and the existing sanitary sewer and water main at both crossings would need to be protected. Also, the entire 7 Brennan Avenue property and a portion of 199 The Boulevard would need to be acquired by the City to accommodate the proposed improvements.

6.4 RESULTS SUMMARY

A summary of the hydraulic model results for the various alternative solutions during the Regulatory Storm is presented in Table 4.

6.5 PROPERTY/INFRASTRUCTURE IMPACT SUMMARY

A summary of the property and infrastructure impacts identified for each alternative solution is provided in Table 5.



Table 4: Hydraulic Model Results Summary

ALTERNATIVE	DESIGN FLOOD FREQUENCY		BRENNAN AVENUE CULVERT CROSSING				THE BOULEVARD CULVERT CROSSING				SPILL	
	LSRCA (2011)	DMP (2019)	Structure Size	Culvert Flow (m³/s)	Weir Flow (m³/s)	Depth of Overtopping (m)	Structure Size	Culvert Flow (m³/s)	Weir Flow (m³/s)	Depth of Overtopping (m)	Peak Flow (m³/s)	% of Flow
1	<1:2	<1:2	3650 x 1500 mm Conc. Box	17.3	46.4	0.80	1800 x 1070 mm CSPA Culvert	4.1	69.3	1.31	15.9	21.5
2	1:100	>1:100	11 m x 2.0 m Span Structure	65.8	6.6	0.29	11 m x 2.3 m Span Structure	62.9	10.4	0.50	1.8	2.4
3	1:50	>1:100	13.4 m x 1.5 m Span Structure	53.6	16.8	0.46	11 m x 1.9 m Span Structure	51.2	22.1	0.78	5.2	7.1
	1:25	>1:50	11 m x 1.5 m Span Structure	49.4	19.4	0.54	7.9 m x 1.9 m Span Structure	45.6	27.8	0.89	5.6	7.5
	1:10	>1:25	9.8 m x 1.7 m Span Structure	39.0	28.9	0.66	7.3 m x 1.9 m Span Structure	43.3	30.1	0.92	10.1	13.6
Alternatives 4 through 6 can be designed to satisfy the 1:10-year, 1:25-year, 1:50-year and 1:100-year Design Flood Frequency (LSRCA approved flows) consistent with Alternatives 2 and 3 (see results presented above)												
7	<1:5	>1:5	3650 x 1500 mm Conc. Box	15.9	21.0	0.47	1800 x 1070 mm CSPA Culvert	3.7	36.5	1.07	6.3	15.4

Notes:

- 1. Results are presented for the Regulatory Storm. Capacities for the culverts/structures are under head during the Regulatory Storm.
- 2. Alternative 3 hydraulic model results presented for scenario where Whiskey Creek is regraded from Kempenfelt Bay to Brennan Avenue at 0.4%.



Table 5: Property/Infrastructure Impact Summary

ALTERNATIVE	DESIGN FLOOD FREQUENCY	PROPERTY ACQUISITION	INFRASTRUCTURE IMPACTS
1	<1:2	None	None
2	1:100	Brennan Avenue 199 The Boulevard (portion of)	Relocate: Washroom/generator building, hydro transformer, park entrance, various utilities. Adjust: Brennan Avenue road profile. Lower/Relocate: Sanitary force main. Protect/Relocate: Sanitary sewer and watermain at Brennan Avenue and The Boulevard.
3	1:50	Brennan Avenue 199 The Boulevard (portion of)	Relocate: Washroom/generator building, hydro transformer, various utilities. Adjust: Brennan Avenue road profile. Lower/Relocate: Sanitary force main. Protect/Relocate: Sanitary sewer and watermain at Brennan Avenue and The Boulevard.
	1:25	Brennan Avenue 199 The Boulevard (portion of)	Relocate: Washroom/generator building, hydro transformer, various utilities. Adjust: Brennan Avenue road profile. Lower/Relocate: Sanitary force main. Protect/Relocate: Sanitary sewer and watermain at Brennan Avenue and The Boulevard.
	1:10	Brennan Avenue 199 The Boulevard (portion of)	Relocate: Hydro transformer, various utilities. Lower/Relocate: Sanitary force main. Protect/Relocate: Sanitary sewer and watermain at Brennan Avenue and The Boulevard.
	1:5	Brennan Avenue 199 The Boulevard (portion of)	Relocate: Hydro transformer, various utilities. Lower/Relocate: Sanitary force main. Protect/Relocate: Sanitary sewer and watermain at Brennan Avenue and The Boulevard.
4A	1:10	Brennan Avenue 199 The Boulevard (portion of)	Relocate: Hydro transformer, various utilities. Lower/Relocate: Sanitary force main. Protect/Relocate: Sanitary sewer and watermain at Brennan Avenue and The Boulevard.
4B	1:10	Brennan Avenue 199 The Boulevard (portion of)	Relocate: Hydro transformer, various utilities. Lower/Relocate: Sanitary force main. Protect/Relocate: Sanitary sewer and watermain at Brennan Avenue and The Boulevard.
5A	1:10	Brennan Avenue 199 The Boulevard (portion of)	Relocate: Hydro transformer, various utilities. Lower/Relocate: Sanitary force main. Protect/Relocate: Sanitary sewer and watermain at Brennan Avenue and The Boulevard. Create: Dead end requiring vehicle turn around at The Boulevard.
5B	1:10	Brennan Avenue 199 The Boulevard (portion of)	Relocate: Hydro transformer, various utilities. Lower/Relocate: Sanitary force main. Protect/Relocate: Sanitary sewer and watermain at Brennan Avenue and The Boulevard.
6A	1:10	Brennan Avenue 199 The Boulevard (portion of)	Relocate: Hydro transformer, various utilities. Lower/Relocate: Sanitary force main. Protect/Relocate: Sanitary sewer and watermain at Brennan Avenue and The Boulevard. Create: Dead end requiring vehicle turn around at The Boulevard.
6B	1:10	Brennan Avenue 199 The Boulevard (portion of)	Relocate: Hydro transformer, various utilities. Lower/Relocate: Sanitary force main. Protect/Relocate: Sanitary sewer and watermain at Brennan Avenue and The Boulevard.
6C	1:10	Brennan Avenue 199 The Boulevard (portion of) 207 Shoreview Road 205 Shoreview Road	Relocate: Hydro transformer, various utilities. Lower/Relocate: Sanitary force main. Protect/Relocate: Sanitary sewer and watermain at Brennan Avenue and The Boulevard.
7	< 1:5	36 White Oaks Road	Lower: Sanitary force main, sanitary sewer, watermain.



6.6 HEC-RAS MODEL SCENARIOS

To aid in the review of the various HEC-RAS model scenarios developed for the various alternative solutions, we provide the following HEC-RAS model scenario summary:

Table 6: HEC-RAS Model Scenario Summary

ALTERNATIVE	DESIGN FLOOD FREQUENCY	HEC-RAS MODEL SCENARIO NAME
1	<1:2	Alternative 1 - Do Nothing
2	1:100	Alternative 2 - 1:100-Year
3	1:50	Alternative 3 - 1:50-Year Alternative 3 - 1:50-Year Sloped
	1:25	Alternative 3 - 1:25-Year Alternative 3 - 1:25-Year Sloped
	1:10	Alternative 3 - 1:10-Year Alternative 3 - 1:10-Year Sloped
	1:5	Alternative 3 - 1:5-Year Alternative 3 - 1:5-Year Sloped
4A	Varies	Not Modelled - Variations of Alternatives 2 and 3
4B	Varies	Not Modelled - Variations of Alternatives 2 and 3
5A	Varies	Not Modelled - Variations of Alternatives 2 and 3
5B	Varies	Not Modelled - Variations of Alternatives 2 and 3
6A	Varies	Not Modelled - Variations of Alternatives 2 and 3
6B	Varies	Not Modelled - Variations of Alternatives 2 and 3
6C	Varies	Not Modelled - Variations of Alternatives 2 and 3
7	1.5	Alternative 7 - White Oaks Diversion



7 Summary

The existing HEC-RAS hydraulic model of Whiskey Creek has been updated and revised to assess the reduction in the frequency of flooding that can be achieved with each alternative solution being evaluated as part of the Whiskey Creek Drainage Improvements at Minet's Point Environmental Assessment. To establish existing (baseline) conditions in the area, the Whiskey Creek HEC-RAS hydraulic model was updated using the 2016 LiDAR data obtained by the City and topographic survey data collected in August 2020 for this study. The LSRCA approved peak flows for Whiskey Creek were routed through the hydraulic model to establish the existing flood conditions along Whiskey Creek at Minet's Point. The existing conditions HEC-RAS model provides a benchmark to gauge the impacts the alternative solutions have on the frequency of flooding in the area.

The HEC-RAS hydraulic model of Whiskey Creek was updated to include the various alternative solutions being evaluated and their impact on the frequency of flooding has been summarized in this technical memorandum along with the implication of each alternative on the existing infrastructure in the area. The results of this hydrologic and hydraulic analysis will be used as part of the overall evaluation of the various alternative solutions to identify a preferred alternative solution to the existing drainage issues along Whiskey Creek at Minet's Point.



Figure 1: Study Area Location Plan



Appendix A: Conceptual Design Drawings



KEMPENFELT BAY LAKE SIMCOE

WHISKEY CREEK (TO REMAIN UNALTERED)

MINET'S POINT PARK

LISMER BLVD.

KEMPVIEW LN.

BRENNAN AVE.

BRENNAN AVE. CULVERT CROSSING:
3650mm x 1500mm CONC. BOX CULVERT
(CAPACITY = 10.4cms; 1:2 YEAR PEAK
FLOW)

THE BOULEVARD CULVERT CROSSING: 1800mm x 1070mm CSPA
CULVERT (CAPACITY = 3.4cms; < 1:2 YEAR PEAK FLOW)

WHITE OAKS RD.

THE BLVD.

CLIFF RD.



KEY PLAN

LEGEND

- EX. PROPERTY LINE
- ██████████ STUDY AREA
- 250.00 - EX CONTOUR
- ██████████ PROPOSED PROPERTY ACQUISITION
- ██████████ ROAD TO BE REMOVED
- ██████████ PROPOSED TRANSPORTATION LINKAGE
- ██████████ WHISKEY CREEK



WHISKEY CREEK DRAINAGE IMPROVEMENTS

ALTERNATIVE 1 – DO NOTHING ("EXISTING CONDITIONS")

SCALE: 1:1500

DRAWN: JGH

DATE: SEPT./20

DWG. No.

ALT-1

JOB NO. 120114



KEMPENFELT BAY LAKE SIMCOE

WHISKEY CREEK WATERCOURSE
IMPROVEMENTS: TO CONVEY
1:100-YEAR RETURN FREQUENCY
DESIGN STORM PEAK FLOW
(CAPACITY = 52.6cms)

MINET'S POINT PARK

REGRADE WHISKEY CREEK
@ 0.0% (INV. 218.00)

EXISTING WASHROOM/GENERATOR
BUILDING TO BE RELOCATED.

LISMER BLVD.

KEMPVIEW LN.

EXISTING ENTRANCE TO BE RELOCATED
TO LISMER BLVD.

BRENNAN AVE.

7 BRENNAN AVE

EXISTING RESIDENTIAL DWELLING TO
BE REMOVED.

REGRADE WHISKEY
CREEK @ 0.7%

BRENNAN AVE. CULVERT CROSSING:
REMOVE AND REPLACE EX. CULVERT
WITH A 11000mm x 2000mm CONC.
SPAN STRUCTURE DESIGNED TO
CONVEY THE 1:100-YEAR RETURN
FREQUENCY DESIGN STORM PEAK
FLOW (CAPACITY = 52.5cms)

THE BOULEVARD CULVERT CROSSING:
REMOVE AND REPLACE EX. CULVERT
WITH A 11000mm x 2400mm CONC.
SPAN STRUCTURE DESIGNED TO
CONVEY THE 1:100-YEAR RETURN
FREQUENCY DESIGN STORM PEAK
FLOW (CAPACITY = 52.3cms)

WHITE OAKS RD.

THE BLVD.

199 THE BOULEVARD

CLIFF RD.



KEY PLAN

LEGEND

- EX. PROPERTY LINE
- STUDY AREA
- 250.00 - EX CONTOUR
- PROPOSED PROPERTY ACQUISITION
- ROAD TO BE REMOVED
- PROPOSED TRANSPORTATION LINKAGE
- WHISKEY CREEK

PROPERTY ACQUISITION:

- A) 7 BRENNAN AVE.
- B) 199 THE BOULEVARD (PORTION OF)



WHISKEY CREEK DRAINAGE IMPROVEMENTS

ALTERNATIVE 2 – CULVERT/WATERCOURSE IMPROVEMENTS
TO CONVEY 1:100-YEAR DESIGN STORM

SCALE: 1:1500

DRAWN: JGH

DATE: SEPT./20

DWG. No.

ALT-2

JOB NO. 120114



KEMPENFELT BAY LAKE SIMCOE

WHISKEY CREEK WATERCOURSE IMPROVEMENTS: LOW FLOW CHANNEL WHERE FEASIBLE (6m WIDE x 0.4m DEEP BANKFULL CHANNEL) USING NATURAL CHANNEL DESIGN PRINCIPLES TO CONVEY BASEFLOW AND FLOODPLAIN IMPROVEMENTS TO CONVEY 1:10-YEAR RETURN FREQUENCY DESIGN STORM PEAK FLOW (27.4 cms)

MINET'S POINT PARK

REGRADE WHISKEY CREEK @ 0.4%

MINET'S POINT PUMP STATION

LISMER BLDV.

KEMPVIEW LN.

BRENNAN AVE.

7 BRENNAN AVE

EXISTING RESIDENTIAL DWELLING TO BE REMOVED

REGRADE WHISKEY CREEK @ 0.4%

199 THE BOULEVARD

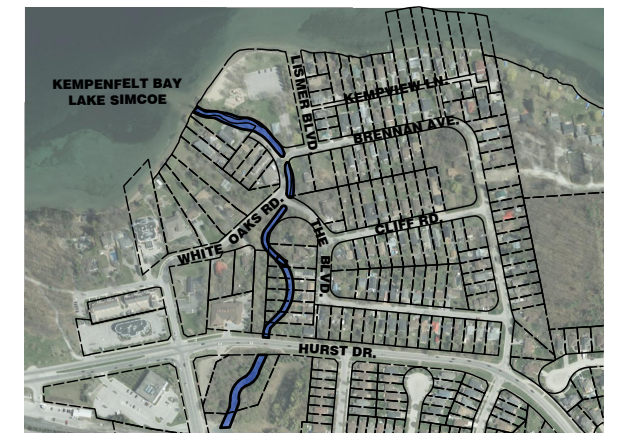
WHITE OAKS RD.

THE BLVD.

CLIFF RD.

BRENNAN AVE CULVERT CROSSING: REMOVE AND REPLACE EX. CULVERT WITH 9800 mm x 1650 mm CONC. SPAN STRUCTURE DESIGNED TO CONVEY 1:10-YEAR RETURN FREQUENCY DESIGN STORM PEAK FLOW (27.4 cms)

THE BOULEVARD CULVERT CROSSING: REMOVE AND REPLACE EX. CULVERT WITH 7300 mm x 1950 mm CONC. SPAN STRUCTURE DESIGNED TO CONVEY 1:10-YEAR RETURN FREQUENCY DESIGN STORM PEAK FLOW (27.3 cms)



KEY PLAN

LEGEND

- EX. PROPERTY LINE
- █ STUDY AREA
- 250.00 - EX CONTOUR
- PROPOSED PROPERTY ACQUISITION
- █ ROAD TO BE REMOVED
- █ PROPOSED TRANSPORTATION LINKAGE
- WHISKEY CREEK

PROPERTY ACQUISITION:

- A) 7 BRENNAN AVE.
- B) 199 THE BOULEVARD (PORTION OF)



WHISKEY CREEK DRAINAGE IMPROVEMENTS

ALTERNATIVE 3 - CULVERT/WATERCOURSE IMPROVEMENTS TO CONVEY LESS THAN 1:100-YEAR DESIGN STORM

SCALE: 1:1500

DRAWN: JGH

DATE: SEPT./20

DWG. No.

ALT-3A

JOB NO. 120114



KEMPENFELT BAY LAKE SIMCOE

WHISKEY CREEK WATERCOURSE IMPROVEMENTS: LOW FLOW CHANNEL WHERE FEASIBLE (6m WIDE x 0.4m DEEP BANKFULL CHANNEL) USING NATURAL CHANNEL DESIGN PRINCIPLES TO CONVEY BASEFLOW AND FLOODPLAIN IMPROVEMENTS TO CONVEY 1:50-YEAR RETURN FREQUENCY DESIGN STORM PEAK FLOW (42.3 cms)

REGRADE WHISKEY CREEK @ 0.4%

MINET'S POINT PUMP STATION

BRENNAN AVE CULVERT CROSSING: REMOVE AND REPLACE EX. CULVERT WITH 13400 mm x 1650 mm CONC. SPAN STRUCTURE DESIGNED TO CONVEY 1:50-YEAR RETURN FREQUENCY DESIGN STORM PEAK FLOW (42.1 cms)

THE BOULEVARD CULVERT CROSSING: REMOVE AND REPLACE EX. CULVERT WITH 11000 mm x 1950 mm CONC. SPAN STRUCTURE DESIGNED TO CONVEY 1:50-YEAR RETURN FREQUENCY DESIGN STORM PEAK FLOW (42.0 cms)

WHITE OAKS RD.

LISMER BLDV.

KEMPVIEW LN.

BRENNAN AVE.

7 BRENNAN AVE

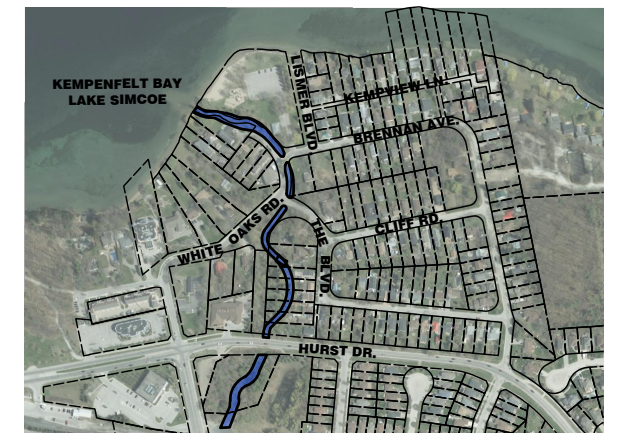
EXISTING RESIDENTIAL DWELLING TO BE REMOVED

REGRADE WHISKEY CREEK @ 0.4%

199 THE BOULEVARD

THE BLVD.

CLIFF RD.



KEY PLAN

LEGEND

- EX. PROPERTY LINE
- STUDY AREA
- EX CONTOUR
- PROPOSED PROPERTY ACQUISITION
- ROAD TO BE REMOVED
- PROPOSED TRANSPORTATION LINKAGE
- WHISKEY CREEK

PROPERTY ACQUISITION:

- A) 7 BRENNAN AVE.
- B) 199 THE BOULEVARD (PORTION OF)



WHISKEY CREEK DRAINAGE IMPROVEMENTS

ALTERNATIVE 3 - CULVERT/WATERCOURSE IMPROVEMENTS TO CONVEY LESS THAN 1:100-YEAR DESIGN STORM

SCALE: 1:1500

DRAWN: JGH

DATE: SEPT./20

DWG. No.

ALT-3B

JOB NO. 120114



KEMPENFELT BAY LAKE SIMCOE

WHISKEY CREEK WATERCOURSE IMPROVEMENTS: LOW FLOW CHANNEL WHERE FEASIBLE (6m WIDE x 0.4m DEEP BANKFULL CHANNEL) USING NATURAL CHANNEL DESIGN TO CONVEY BASEFLOW AND FLOODPLAIN IMPROVEMENTS TO CONVEY 1:10-YEAR RETURN FREQUENCY DESIGN STORM PEAK FLOW (27.4 cms)

MINET'S POINT PARK

REGRADE WHISKEY CREEK @ 0.4%

MINET'S POINT PUMP STATION

WHISKEY CREEK

REMOVE SECTION OF BRENNAN AVE. DAYLIGHTING WATERCOURSE

THE BOULEVARD CULVERT CROSSING: REMOVE AND REPLACE EX. CULVERT WITH 7300 mm x 1950 mm CONC. SPAN STRUCTURE DESIGNED TO CONVEY 1:10-YEAR RETURN FREQUENCY DESIGN STORM PEAK FLOW (27.3cms)

LISMER BLDV.

KEMPVIEW LN.

BRENNAN AVE.

25m PEDESTRIAN BRIDGE

7 BRENNAN AVE

REGRADE WHISKEY CREEK @ 0.4%

199 THE BOULEVARD

WHITE OAKS RD.

THE BLVD.

CLIFF RD.



KEY PLAN

LEGEND

- EX. PROPERTY LINE
- ████████ STUDY AREA
- 250.00 - EX CONTOUR
- PROPOSED PROPERTY ACQUISITION
- ████████ ROAD TO BE REMOVED
- ████████ PROPOSED TRANSPORTATION LINKAGE
- WHISKEY CREEK

PROPERTY ACQUISITION:

- A) 7 BRENNAN AVE.
- B) 199 THE BOULEVARD (PORTION OF)



**WHISKEY CREEK
DRAINAGE IMPROVEMENTS**
ALTERNATIVE 4A – REMOVE BRENNAN AVENUE AT WHISKEY CREEK

DWG. No.
ALT-4A
JOB NO. 120114

SCALE: 1:1500 DRAWN: JGH DATE: SEPT./20



KEMPENFELT BAY LAKE SIMCOE

WHISKEY CREEK WATERCOURSE
IMPROVEMENTS: LOW FLOW CHANNEL WHERE
FEASIBLE (6m WIDE x 0.4m DEEP BANKFULL
CHANNEL) USING NATURAL CHANNEL DESIGN
TO CONVEY BASEFLOW AND FLOODPLAIN
IMPROVEMENTS TO CONVEY 1:10-YEAR
RETURN FREQUENCY DESIGN STORM PEAK
FLOW (27.4 cms)

MINET'S POINT PARK

REGRADE WHISKEY CREEK
@ 0.4%

MINET'S POINT
PUMP STATION

WHISKEY CREEK

10.0m

REMOVE SECTION OF BRENNAN AVE.
DAYLIGHTING WATERCOURSE

THE BOULEVARD CULVERT CROSSING:
REMOVE AND REPLACE EX. CULVERT
WITH 7300 mm x 1950 mm CONC.
SPAN STRUCTURE DESIGNED TO
CONVEY 1:10-YEAR RETURN
FREQUENCY DESIGN STORM PEAK FLOW
(27.3cms)

LISMER BLDV.

KEMPVIEW LN.

BRENNAN AVE.

25m PEDESTRIAN BRIDGE

7 BRENNAN AVE

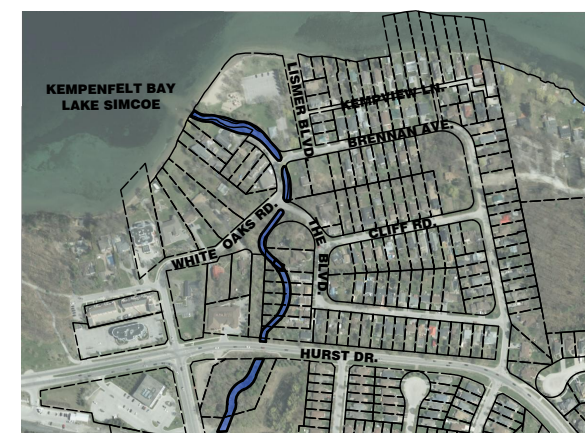
REGRADE WHISKEY CREEK
@ 0.4%

199 THE BOULEVARD

WHITE OAKS RD.

THE BLDV.

CLIFF RD.



KEY PLAN

LEGEND

- EX. PROPERTY LINE
- STUDY AREA
- 250.00 - EX CONTOUR
- PROPOSED PROPERTY ACQUISITION
- ROAD TO BE REMOVED
- PROPOSED TRANSPORTATION LINKAGE
- WHISKEY CREEK

PROPERTY ACQUISITION:

- A) 7 BRENNAN AVE.
- B) 199 THE BOULEVARD (PORTION OF)



WHISKEY CREEK DRAINAGE IMPROVEMENTS

ALTERNATIVE 4B – REMOVE BRENNAN AVE. AT WHISKEY
CREEK AND CONNECT BRENNAN AVE. AND THE BOULEVARD

SCALE: 1:1500

DRAWN: JGH

DATE: SEPT./20

JOB NO. 120114

DWG. No.

ALT-4B



KEMPENFELT BAY LAKE SIMCOE

WHISKEY CREEK WATERCOURSE
IMPROVEMENTS: LOW FLOW CHANNEL WHERE
FEASIBLE (6m WIDE x 0.4m DEEP BANKFULL
CHANNEL) USING NATURAL CHANNEL DESIGN
TO CONVEY BASEFLOW AND FLOODPLAIN
IMPROVEMENTS TO CONVEY 1:10-YEAR
RETURN FREQUENCY DESIGN STORM PEAK
FLOW (27.4 cms)

REGRADE WHISKEY CREEK
@ 0.4%

MINET'S POINT
PUMP STATION

WHISKEY CREEK

10.0m

BRENNAN AVE CULVERT CROSSING:
REMOVE AND REPLACE EX. CULVERT WITH
9800 mm x 1650 mm CONC. SPAN
STRUCTURE DESIGNED TO CONVEY
1:10-YEAR RETURN FREQUENCY DESIGN
STORM PEAK FLOW (27.4cms)

15m PEDESTRIAN BRIDGE

REMOVE SECTION OF THE BOULEVARD
DAYLIGHTING WATERCOURSE

7 BRENNAN AVE

EXISTING RESIDENTIAL DWELLING TO
BE REMOVED

REGRADE WHISKEY CREEK
@ 0.4%

199 THE BOULEVARD

VEHICLE TURN AROUND

WHITE OAKS RD.

LISMER BLVD.

KEMPVIEW LN.

BRENNAN AVE.

THE BLVD.

CLIFF RD.



KEY PLAN

LEGEND

- EX. PROPERTY LINE
- ████████ STUDY AREA
- 250.00 - EX CONTOUR
- ████████ PROPOSED PROPERTY ACQUISITION
- ████████ ROAD TO BE REMOVED
- ████████ PROPOSED TRANSPORTATION LINKAGE
- ████████ WHISKEY CREEK

PROPERTY ACQUISITION:

- A) 7 BRENNAN AVE.
- B) 199 THE BOULEVARD (PORTION OF)



WHISKEY CREEK DRAINAGE IMPROVEMENTS

ALTERNATIVE 5A – REMOVE THE BOULEVARD AT WHISKEY
CREEK

DWG. No.

ALT-5A

SCALE: 1:1500

DRAWN: JGH

DATE: SEPT./20

JOB NO. 120114



KEMPENFELT BAY LAKE SIMCOE

WHISKEY CREEK WATERCOURSE
IMPROVEMENTS: LOW FLOW CHANNEL WHERE
FEASIBLE (6m WIDE x 0.4m DEEP BANKFULL
CHANNEL) USING NATURAL CHANNEL DESIGN
TO CONVEY BASEFLOW AND FLOODPLAIN
IMPROVEMENTS TO CONVEY 1:10-YEAR
RETURN FREQUENCY DESIGN STORM PEAK
FLOW (27.4 cms)

BRENNAN AVE CULVERT CROSSING:
REMOVE AND REPLACE EX. CULVERT WITH
9800 mm x 1650 mm CONC. SPAN
STRUCTURE DESIGNED TO CONVEY
1:10-YEAR RETURN FREQUENCY DESIGN
STORM PEAK FLOW (27.4cms)

REMOVE SECTION OF THE BOULEVARD
DAYLIGHTING WATERCOURSE

MINET'S POINT PARK

REGRADE WHISKEY CREEK
@ 0.4%

MINET'S POINT
PUMP STATION

WHISKEY CREEK

REGRADE WHISKEY CREEK
@ 0.4%

15m PEDESTRIAN BRIDGE

WHITE OAKS RD.

LISMER BLDV.

KEMPVIEW LN.

BRENNAN AVE.

7 BRENNAN AVE

EXISTING RESIDENTIAL DWELLING TO
BE REMOVED

199 THE BOULEVARD

THE BLDV.

CLIFF RD.



KEY PLAN

LEGEND

- EX. PROPERTY LINE
- ████████ STUDY AREA
- 250.00 - EX CONTOUR
- PROPOSED PROPERTY ACQUISITION
- ████████ ROAD TO BE REMOVED
- ████████ PROPOSED TRANSPORTATION LINKAGE
- WHISKEY CREEK

PROPERTY ACQUISITION:

- A) 7 BRENNAN AVE.
- B) 199 THE BOULEVARD (PORTION OF)



WHISKEY CREEK DRAINAGE IMPROVEMENTS

ALTERNATIVE 5B - REMOVE THE BOULEVARD AT WHISKEY
CREEK AND CONNECT BRENNAN AVE. AND THE BOULEVARD

SCALE: 1:1500

DRAWN: JGH

DATE: SEPT./20

JOB NO. 120114

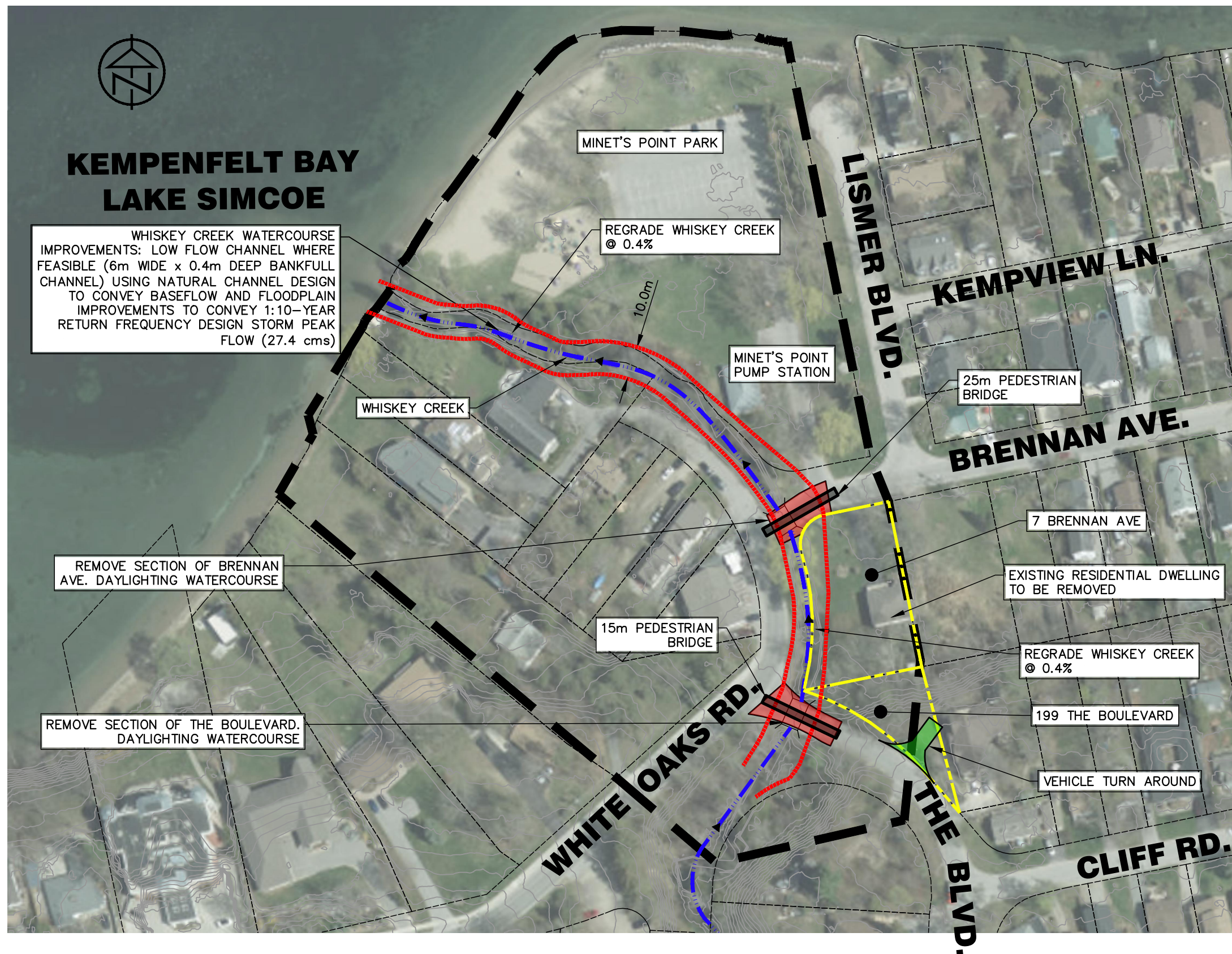
DWG. No.

ALT-5B



KEMPENFELT BAY LAKE SIMCOE

WHISKEY CREEK WATERCOURSE
IMPROVEMENTS: LOW FLOW CHANNEL WHERE
FEASIBLE (6m WIDE x 0.4m DEEP BANKFULL
CHANNEL) USING NATURAL CHANNEL DESIGN
TO CONVEY BASEFLOW AND FLOODPLAIN
IMPROVEMENTS TO CONVEY 1:10-YEAR
RETURN FREQUENCY DESIGN STORM PEAK
FLOW (27.4 cms)



REMOVE SECTION OF BRENNAN
AVE. DAYLIGHTING WATERCOURSE

REMOVE SECTION OF THE BOULEVARD.
DAYLIGHTING WATERCOURSE

REGRADE WHISKEY CREEK
@ 0.4%

MINET'S POINT
PUMP STATION

WHISKEY CREEK

15m PEDESTRIAN
BRIDGE

25m PEDESTRIAN
BRIDGE

7 BRENNAN AVE

EXISTING RESIDENTIAL DWELLING
TO BE REMOVED

REGRADE WHISKEY CREEK
@ 0.4%

199 THE BOULEVARD

VEHICLE TURN AROUND

KEY PLAN



LEGEND

- EX. PROPERTY LINE
- ████████ STUDY AREA
- 250.00 - EX CONTOUR
- ████████ PROPOSED PROPERTY ACQUISITION
- ████████ ROAD TO BE REMOVED
- ████████ PROPOSED TRANSPORTATION LINKAGE
- ████████ WHISKEY CREEK

PROPERTY ACQUISITION:

- A) 7 BRENNAN AVE.
- B) 199 THE BOULEVARD (PORTION OF)



WHISKEY CREEK DRAINAGE IMPROVEMENTS

ALTERNATIVE 6A – REMOVE BRENNAN AVE. AND THE
BOULEVARD AT WHISKEY CREEK

SCALE: 1:1500

DRAWN: JGH

DATE: SEPT./20

DWG. No.

ALT-6A

JOB NO. 120114



KEMPENFELT BAY LAKE SIMCOE

WHISKEY CREEK WATERCOURSE
IMPROVEMENTS: LOW FLOW CHANNEL WHERE
FEASIBLE (6m WIDE x 0.4m DEEP BANKFULL
CHANNEL) USING NATURAL CHANNEL DESIGN
TO CONVEY BASEFLOW AND FLOODPLAIN
IMPROVEMENTS TO CONVEY 1:10-YEAR
RETURN FREQUENCY DESIGN STORM PEAK
FLOW (27.4 cms)

MINET'S POINT PARK

REGRADE WHISKEY CREEK
@ 0.4%

MINET'S POINT
PUMP STATION

WHISKEY CREEK

15m PEDESTRIAN
BRIDGE

REMOVE SECTION OF BRENNAN AVE.
DAYLIGHTING WATERCOURSE

REMOVE SECTION OF THE BOULEVARD
DAYLIGHTING WATERCOURSE

LISMER BLDV.

KEMPVIEW LN.

BRENNAN AVE.

7 BRENNAN AVE

EXISTING RESIDENTIAL DWELLING
TO BE REMOVED

REGRADE WHISKEY CREEK
@ 0.4%

199 THE BOULEVARD

WHITE OAKS RD.

THE BLDV.

CLIFF RD.



KEY PLAN

LEGEND

- EX. PROPERTY LINE
- ████████ STUDY AREA
- 250.00 - EX CONTOUR
- ████████ PROPOSED PROPERTY ACQUISITION
- ████████ ROAD TO BE REMOVED
- ████████ PROPOSED TRANSPORTATION LINKAGE
- ████████ WHISKEY CREEK

PROPERTY ACQUISITION:

- A) 7 BRENNAN AVE.
- B) 199 THE BOULEVARD (PORTION OF)



**WHISKEY CREEK
DRAINAGE IMPROVEMENTS**
ALTERNATIVE 6B - REMOVE BRENNAN AVE. AND THE
BOULEVARD AT WHISKEY CREEK AND CONNECT BRENNAN
AVE. AND THE BOULEVARD

DWG. No.

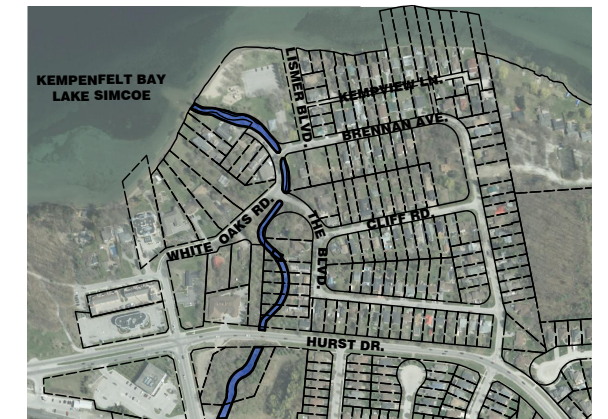
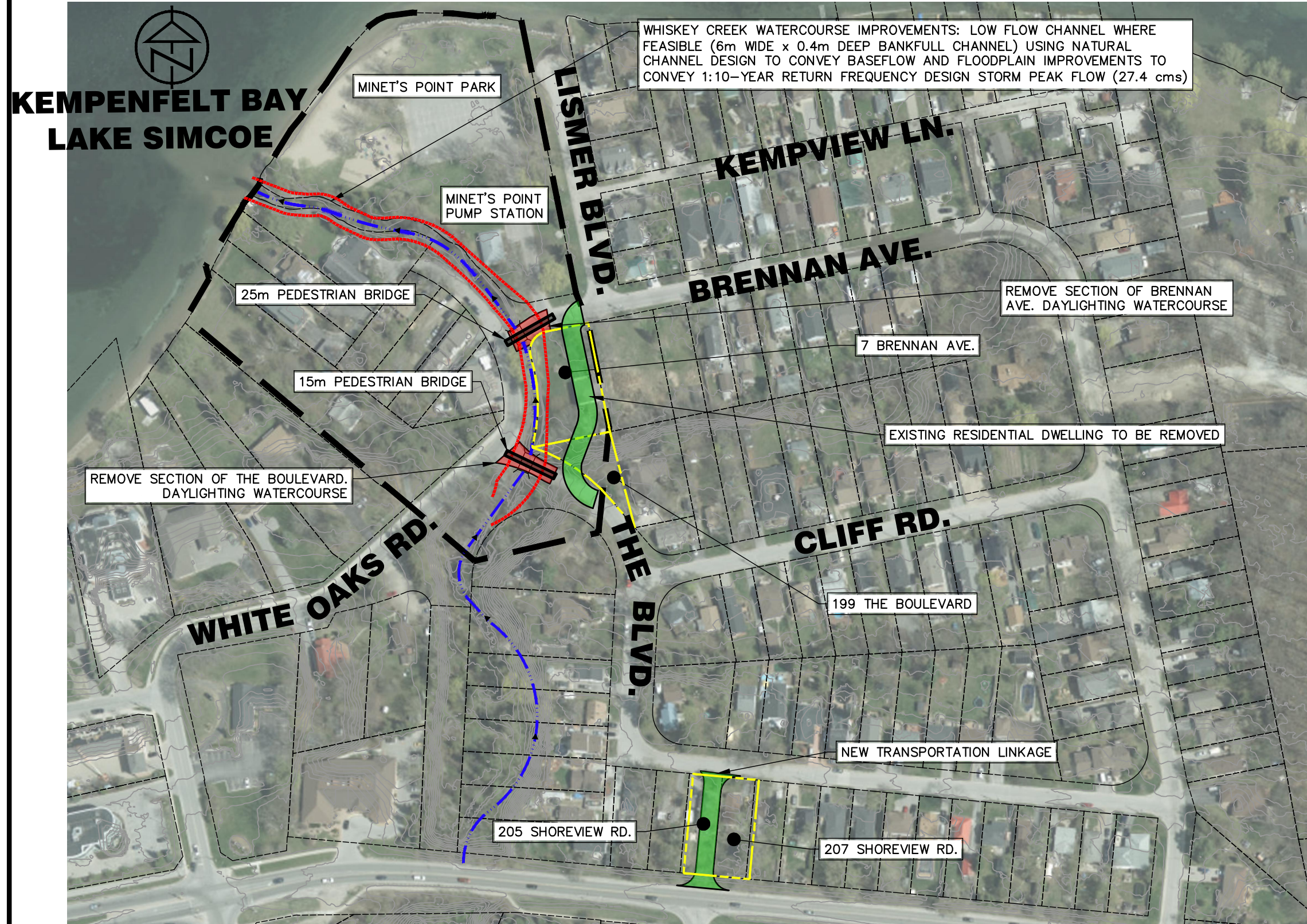
ALT-6B

SCALE: 1:1500

DRAWN: JGH

DATE: SEPT./20

JOB NO. 120114



KEY PLAN

LEGEND	
-----	EX. PROPERTY LINE
████████	STUDY AREA
- 250.00 -	EX CONTOUR
-----	PROPOSED PROPERTY ACQUISITION
████████	ROAD TO BE REMOVED
████████	PROPOSED TRANSPORTATION LINKAGE
-----	WHISKEY CREEK

PROPERTY ACQUISITION:

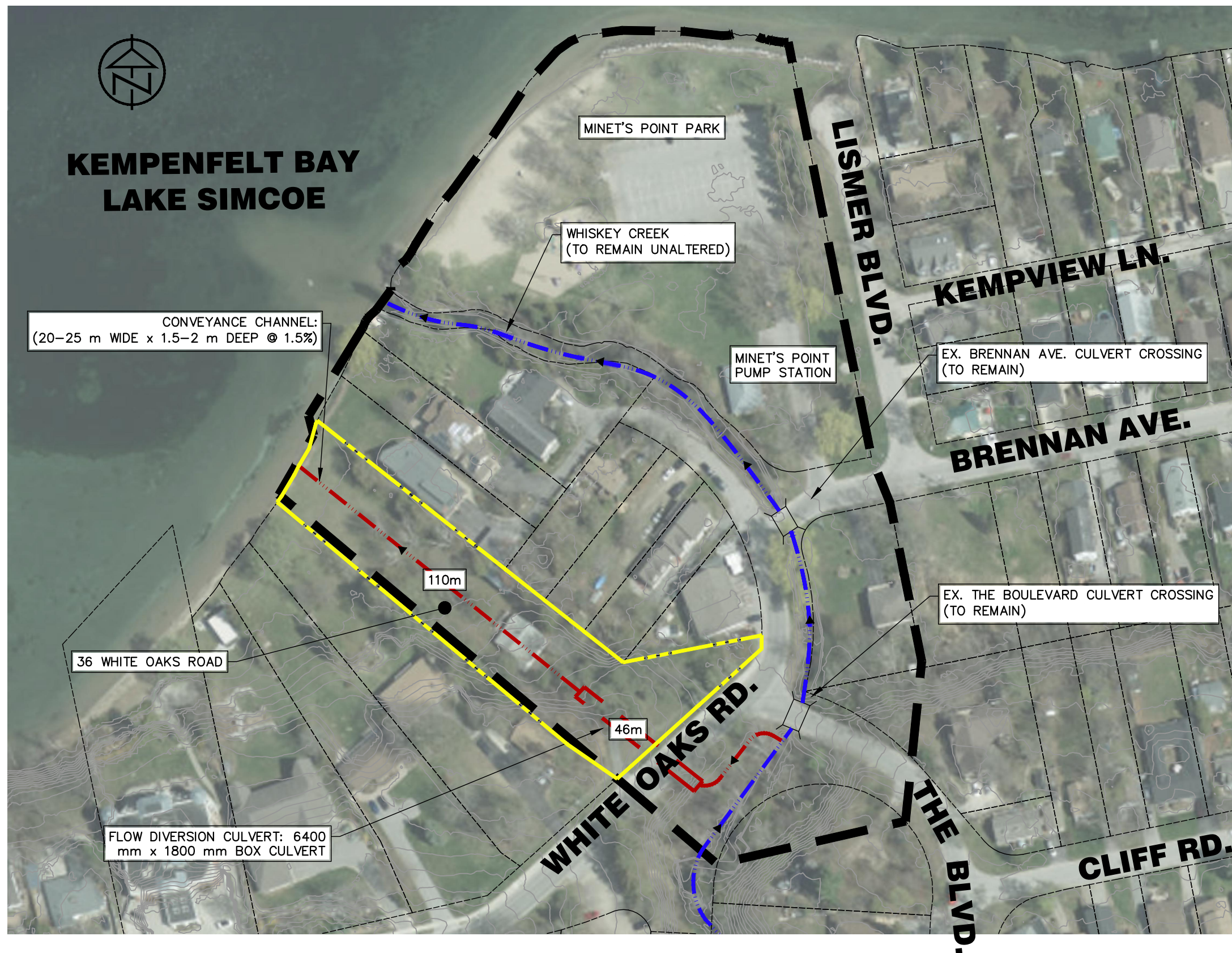
- A) 7 BRENNAN AVE.
- B) 199 THE BOULEVARD (PORTION OF)
- C) 207 SHOREVIEW RD.
- D) 205 SHOREVIEW RD.



**WHISKEY CREEK
DRAINAGE IMPROVEMENTS**
ALTERNATIVE 6C – REMOVE BRENNAN AVE. AND THE BOULEVARD AT WHISKEY CREEK AND CONNECT BRENNAN AVE. AND THE BOULEVARD AND NEW CONNECTION TO

DWG. No.
ALT-6C

SCALE: 1:2000 DRAWN: JGH DATE: SEPT./20 JOB NO. 120114



KEY PLAN

LEGEND

- EX. PROPERTY LINE
- STUDY AREA
- 250.00 - EX CONTOUR
- PROPOSED PROPERTY ACQUISITION
- ROAD TO BE REMOVED
- PROPOSED TRANSPORTATION LINKAGE
- WHISKEY CREEK

PROPERTY ACQUISITION:
A) 36 WHITE OAKS ROAD



**WHISKEY CREEK
 DRAINAGE IMPROVEMENTS**
 ALTERNATIVE 7 - ADDITIONAL CONVEYANCE ROUTE (FLOW
 DIVERSION) THROUGH 26 WHITE OAKS ROAD

DWG. No.

ALT-7

SCALE: 1:1500

DRAWN: JGH

DATE: SEPT./20

JOB NO. 120114

Appendix B: Meeting Minutes

Minutes

File	Attendees	Company
D03-WH2 / 120114	Ralph Scheunemann Nathanael Couperus Kenneth Cheney Marianne Maertens Daniel Twigger David Marshall	City of Barrie (City) City Lake Simcoe Region Conservation Authority (LSRCA) LSRCA Tatham Engineering Limited (Tatham) Tatham

Meeting Date	Purpose	Time & Place
September 2, 2020	Whiskey Creek at Minet's Point EA Modelling Meeting	11:00 a.m. – 12:00 p.m. Microsoft Teams Meeting

Item	Agenda Item	Action
1.	Design Flows	

Tatham presented a comparison of the LSRCA approved hydrologic model results against the results of the hydrologic model prepared as part of the Barrie Drainage Master Plan. The LSRCA provided Tatham with the future condition peak flows for the 1:2-year and 1:100-year return frequency design storms and Regional (Hurricane Hazel) Storm for the comparison. The LSRCA approved hydrologic model results (peak flows) are greater than the results of the Barrie DMP under future conditions (+20% over existing conditions). It was agreed that the LSRCA approved peak flows would be used to assess the alternative solutions. The LSRCA agreed to provide the signed and sealed engineering reports supporting the approved hydrologic model which includes the results for the outstanding return frequency design storms.

Post Meeting Note: The LSRCA provided a summary of the reports prepared in support of the approved hydrologic models. Tatham has confirmed that they have copies of these reports.

The City noted that the municipal criteria for design storm conveyance may not be feasible based on site constraints. It is expected that the maximum design capacity for each solution will be related to a design storm that will not meet municipal criteria. The LSRCA confirmed that they agreed with this approach and their primary concern is that the design solution does not adversely impact floodlines. The reporting for the EA must clearly document the justification for any deviation from municipal design criteria.

Item	Agenda Item	Action
------	-------------	--------

2. **Hydraulic Model**

Tatham presented a comparison of the HEC-RAS cross-sections from the Barrie Drainage Master Plan hydraulic model against the HEC-RAS cross-sections in the LSRCA approved hydraulic model. The locations of the cross-sections are not consistent between the models, however, the comparison clearly shows that the updated Barrie Drainage Master Plan cross-sections include a higher level of detail/accuracy. This is because the Barrie Drainage Master Plan cross-sections were updated using the City's detailed 2007 LiDAR data. Furthermore, deficiencies in the LSRCA approved hydraulic model (lack of obstructions, cross-sections not containing flow, etc.) were addressed as part of the Drainage Master Plan model updates.

Tatham requested the LSRCA clarify whether the hydraulic updates for this project should be applied to the LSRCA model through the subject area or if the Barrie Drainage Master Plan hydraulic model can be used. As the assessment of alternatives does not involve updating the floodplain mapping for Whiskey Creek, the LSRCA advised that the Barrie Drainage Master Plan HEC-RAS model may be used as long as any changes/deviations from the approved model are fully documented in a supporting report. The LSRCA noted that if the model is to be used in the future to delineate the Whiskey Creek floodplain, it will need to be scrutinized by the LSRCA and revised to the appropriate standards.

Tatham advised that the Barrie DMP model will be used for the EA and noted that the cross-sections downstream of Hurst Drive will be updated with the topographic survey collected for this project. The model updates will be documented in a Hydrologic and Hydraulic Modelling Technical Memorandum prepared in support of the EA.

Errors & Omissions

Please report any errors or omissions to the author within 7 days of receipt of these minutes otherwise they will be deemed correct.

Prepared by

Daniel Twigger, B.Sc.Eng., P.Eng.

Distributed to

all present

Appendix C: Hydrologic Model Results Summary

Table 1C-10
Future Conditions
Swmhymo
Peak Flow Summary Table

Peak Flow Location	Culvert Size & Type	Total Culvert(s) Capacity (m³/s)	SWMHYMO Hydrograph Number	PEAK FLOWS											Hazel Regional (m³/s)
				SCS 24 Hour					Chicago - 4 Hour						
				2 Year (m³/s)	5 Year (m³/s)	10 Year (m³/s)	25 Year (m³/s)	100 Year (m³/s)	2 Year (m³/s)	5 Year (m³/s)	10 Year (m³/s)	25 Year (m³/s)	100 Year (m³/s)		
Outlet of Future Pond A			155	0.92	1.11	1.19	1.26	1.36	0.94	1.19	1.25	1.31	1.37	14.34	
Bryne Drive Culvert	3.6m x 1.5m Concrete Box	1.36	155	0.92	1.11	1.19	1.26	1.36	0.94	1.19	1.25	1.31	1.37	14.34	
Harvie Road Culvert (East of Bryne)	1.2m Dia. CSP	3.06	157	2.09	2.76	2.94	3.06	3.21	2.26	2.74	2.92	3.03	3.17	16.25	
Outlet of Future Pond B			251	0.32	0.45	0.56	0.63	0.75	0.32	0.53	0.61	0.67	0.76	3.58	
Harvie Road Storm Sewer	1200mm Dia. Concrete Sewer	4.22	252	0.41	0.71	0.92	1.11	1.52	0.35	0.59	0.72	0.84	1.10	4.22	
Highway 400	1.2m x 1.2m Concrete Box	9.26	257	2.87	4.09	4.65	5.10	5.94	2.84	3.82	4.33	4.68	5.17	22.02	
Bayview Drive Storm Sewer	Up to 1350mm Dia. Concrete Sewer	3.66	307	1.26	1.92	2.41	2.71	3.66	1.42	2.11	2.57	2.89	3.69	1.95	
Fairview Road	1.2m x 1.2m Concrete Box	7.87	349	3.57	5.37	6.30	6.92	8.27	3.45	5.12	5.78	6.25	7.34	23.20	
BCR Tracks (west of Bayview Drive)	Twin 1.5m Dia. CSP	15.15	351	5.25	7.86	9.49	10.69	13.28	5.14	7.83	9.15	10.10	12.37	25.31	
Bayview Drive (North of Big Bay Point Rd)	Twin 1.63m x 1.12m CSP Arch	9.34	352	5.82	8.83	10.83	12.36	15.76	5.62	8.62	10.25	11.55	14.40	26.39	
Bayview Drive (North of Mollard Ct)	Ex. 1.2m Dia. CSP		358	4.20	6.39	7.95	9.31	12.18	4.69	6.98	8.48	9.61	12.20	7.08	
Channel around Radio Shack	± 5m Wide Flat Bottom, 1.3m Deep		1003	5.49	8.37	10.12	11.43	14.93	5.51	8.63	10.22	11.47	14.26	26.45	
South end of Lackies Bush			354	6.51	10.46	13.17	15.63	20.83	6.47	10.30	12.49	14.41	18.06	30.80	
Convergence with West Tributary			359	10.71	16.85	21.12	24.94	33.01	10.41	16.77	20.50	23.42	29.75	36.92	
Middle of Lackies Bush			361	8.80	14.27	18.47	22.36	30.91	8.74	14.61	18.27	21.59	28.20	39.94	
Lackies Bush (South of Wilson Ct)			363	8.12	13.21	17.41	21.54	30.42	8.24	14.11	17.73	21.19	27.83	42.62	
McConkey Place	3.65m x 1.8m Concrete Box	19.16	365	7.62	12.44	16.33	20.24	29.21	7.81	13.49	17.05	20.46	26.75	43.60	
BCR Tracks (west of Huronia Road)	1.2m Dia. Concrete Pipe	7.93	367	10.17	15.78	20.23	24.14	35.12	9.53	16.39	20.66	25.11	33.36	51.19	
Huronia Road	Twin 1.8m Dia. CSP	14.83	367	10.17	15.78	20.23	24.14	35.12	9.53	16.39	20.66	25.11	33.36	51.19	
Little Avenue	6m Hy-Span Concrete Box	26.03	453	8.96	14.86	21.47	30.33	47.61	9.37	17.84	25.11	32.08	43.28	65.88	
Yonge Street	2.4m x 1.8m Concrete Box	26.70	550	9.05	15.02	21.47	30.61	48.84	9.53	18.33	25.55	32.72	44.53	68.39	
BCR Tracks (south of Tollendal Mill Rd.)	1.5m Dia. Conc. outlet 1.5m Dia. CSP inlet	9.31	551	9.28	15.42	22.00	31.61	50.70	9.84	19.03	26.60	34.12	46.52	71.32	
Tollendal Mill Road	1.8m Dia. CSP and 1.2m Dia. CSP	22.20	552	9.42	15.65	22.30	32.17	52.03	10.00	19.42	27.16	34.88	47.61	72.99	
The Boulevard	1.79m x 1.35m CSP Arch	5.68	553	9.44	15.69	22.35	32.27	52.25	10.03	19.49	27.27	35.03	47.82	73.32	
Brennan Avenue	3.65 x 1.8m Concrete Box	12.46	554	9.46	15.72	22.41	32.38	52.50	10.06	19.56	27.38	35.17	48.03	73.66	
Outlet to Kempenfelt Bay			555	9.47	15.74	22.43	32.43	52.62	10.08	19.59	27.43	35.24	48.13	73.82	

Notes:

1. Storage at Highway 400 was not modeled.
2. All dimensions are span x rise and in m unless otherwise noted.
3. All capacities are calculated under inlet control and assumed that the pipe is clear (i.e. No sedimentation or blockage of pipe).
4. Culvert capacities taken from HEC-RAS Hydraulic modeling

Barrie Drainage Master Plan
Hydrologic & Hydraulic Modeling Technical Memorandum
Existing Conditions Future Peak Flow Summary
March 2019

Barrie Creeks Watershed

Project No.	Description	HEC RAS			VO5	Peak Flow (m³/s)						
		River	River Reach	River Station	Hydrograph	1:2 Year	1:5 Year	1:10 Year	1:25 Year	1:50 Year	1:100 Year	Regional
Whiskey Creek (24 Hour SCS Type II Design Storm)												
-	Upstream of Highway 4000 (Reach Wh-5)	Whiskey	5	640	23943	0.11	0.22	0.31	0.44	0.54	0.65	2.55
-	Fairview Rd.	Whiskey	5	280	23941	0.68	1.10	1.58	2.13	2.48	2.89	3.37
-	D/S of Fairview Rd. and U/S of Bayview Dr. (Reach Wh-5)	Whiskey	5	-1	23913	1.12	1.85	2.54	3.44	4.06	4.80	5.59
-	Bayview Dr.	Whiskey	5	-289	23914	1.73	2.89	3.84	5.39	6.37	7.48	6.55
67	Start of Reach Wh-2	Whiskey	7	494	23111	0.83	1.42	1.86	2.50	3.04	3.55	2.41
68	Harvie Rd.	Whiskey	7	125	23906	0.95	1.64	2.16	2.94	3.59	4.23	4.16
-	Downstream of SWMF WK05 (Reach Wh-1)	Whiskey	6	432	23902	3.74	6.59	8.79	11.86	14.57	17.01	11.43
-	Upstream of Harvie Rd. (Reach Wh-3)	Whiskey	4	2254	23905	2.21	3.19	3.90	4.92	5.77	6.61	18.46
171	Harvie Rd.	Whiskey	4	2142	23907	2.29	3.35	4.11	5.24	6.15	7.06	19.19
172	Highway 400	Whiskey	4	2010	23908	2.47	3.71	4.62	5.97	7.05	8.17	21.23
71	Fairview Rd.	Whiskey	4	1709	23909	2.55	3.87	4.84	6.25	7.42	8.61	22.00
-	Railway Crossing	Whiskey	4	1481	23910	2.73	4.27	5.40	7.02	8.38	9.77	23.68
72	Bayview Dr.	Whiskey	4	1160	23911	2.79	4.38	5.57	7.28	8.66	10.04	24.39
73	Downstream of Bayview Dr. (Reach Wh-4a)	Whiskey	4	1100	23912	2.85	4.51	5.73	7.48	8.93	10.35	24.75
-	Start of Reach Wh-6	Whiskey	3	1697	23915	6.10	10.24	13.33	17.91	21.84	25.57	38.16
-	South of Tamarack Rd. (Reach Wh-6)	Whiskey	3	1351	23916	6.06	10.15	13.02	17.44	21.11	24.70	39.65
77	South of Wilson Ct. (Reach Wh-6)	Whiskey	3	953	23917	6.04	10.15	13.05	17.44	21.10	24.70	40.78
-	Upstream of McConkey Pl. (Reach Wh-6)	Whiskey	3	512	23918	5.64	9.75	12.87	17.29	20.76	24.36	41.81
-	McConkey Pl.	Whiskey	3	352	23919	5.71	9.87	13.02	17.50	21.01	24.65	42.34
-	Upstream of Railway Crossing (Reach Wh-7a)	Whiskey	3	222	23940	7.61	13.14	17.34	23.40	27.88	32.58	49.53
78	Railway Crossing	Whiskey	3	169	23002	6.84	9.17	10.31	17.36	24.22	30.11	49.53
80	Huron Rd.	Whiskey	3	108	23920	6.90	9.24	10.38	17.43	24.44	30.42	50.00
-	Start of Reach Wh-8	Whiskey	2	1332	23922	1.41	2.25	2.89	3.79	4.44	5.26	2.92
-	Huron North Park (Reach Wh-8)	Whiskey	2	1059	23923	2.22	3.64	4.71	6.09	7.28	8.68	4.82
-	Upstream of Herrell Ave. (Reach Wh-8)	Whiskey	2	864	23924	2.20	3.57	4.66	6.13	7.31	8.72	5.56
-	Herrell Ave.	Whiskey	2	683	23925	3.52	5.78	7.37	10.10	11.89	14.34	9.22
-	Downstream of Herrell Ave. (Reach Wh-8)	Whiskey	2	601	23926	4.24	7.03	9.00	12.43	14.78	17.63	11.35
-	Upstream of SWMF WK01 (Reach Wh-8)	Whiskey	2	383	23927	4.22	7.06	9.04	12.44	14.80	17.73	11.53
83	SWMF WK01	Whiskey	2	110	23921	10.75	15.83	19.07	24.04	32.33	41.14	63.01
84	Little Ave.	Whiskey	1	1549	23928	7.97	11.12	12.99	19.56	27.03	35.18	63.39
81	Reach Wh-7b	Whiskey	1	1515	23929	7.97	11.12	13.00	19.54	26.98	35.07	63.31
85	Yonge St.	Whiskey	1	974	23930	8.11	11.25	13.21	18.10	22.16	26.59	66.08
-	Downstream of Yonge St. (Reach Wh-9)	Whiskey	1	929	23931	8.12	11.26	13.22	18.11	22.16	26.60	66.18
86	Railway Crossing	Whiskey	1	663	23932	8.28	11.52	13.60	18.58	22.74	27.31	67.72
-	D/S of Railway Crossing and U/S of Hurst Dr. (Reach Wh-9)	Whiskey	1	562	23933	8.43	11.72	13.87	18.84	23.03	27.66	68.99
88	Hurst Dr.	Whiskey	1	495	23935	8.45	11.74	13.90	18.88	23.06	27.71	69.27
89	Downstream of Hurst Dr. (Reach Wh-10)	Whiskey	1	451	23934	8.46	11.72	13.83	18.46	22.20	26.13	69.56
174	The Boulevard	Whiskey	1	243	23936	8.46	11.72	13.83	18.46	22.20	26.13	69.62

Note: Regional Storm - Hurricane Hazel; Regional storm peak flows generated under AMC III soil conditions with SWMFs removed (uncontrolled Regional storm peak flow); peak flows are worst case (with or without spills).

Barrie Drainage Master Plan
 Hydrologic & Hydraulic Modeling Technical Memorandum
 Existing Conditions Future Peak Flow Summary
 March 2019

Barrie Creeks Watershed

Project No.	Description	HEC RAS			VO5	Peak Flow (m ³ /s)						
		River	River Reach	River Station	Hydrograph	1:2 Year	1:5 Year	1:10 Year	1:25 Year	1:50 Year	1:100 Year	Regional
Whiskey Creek (24 Hour SCS Type II Design Storm)												
175	Downstream of The Boulevard (Reach Wh-10)	Whiskey	1	225	23937	8.49	11.75	13.87	18.51	22.27	26.21	69.96
176	Brennan Ave.	Whiskey	1	180	23938	8.47	11.74	13.87	18.49	22.27	26.20	70.07
-	Downstream of Brennan Ave. (Reach Wh-10)	Whiskey	1	30	23939	8.46	11.70	13.86	18.43	22.24	26.14	70.04

Note: Regional Storm - Hurricane Hazel; Regional storm peak flows generated under AMC III soil conditions with SWMFs removed (uncontrolled Regional storm peak flow); peak flows are worst case (with or without spills).

Appendix D: Topographic Survey / LiDAR Data Background Information

	Ontario Ministry of Natural Resources and Forestry	COSINE Station Report
	Control Survey Information Exchange	Retrieval Date: 2020-Dec-10
AKA Names:		Station: 03120030011
Number of Ref Sketches: 1		Known Status: Existing
Networks [usage]: 0250V [FREE]		Last Reported Visit:
		Monument Type: CAP
		Station Type: GPS

Location Description:	No Photo
-----------------------	-----------------

Horizontal (Ellipsoidal) Control Data

Datum: NAD-1983:ORIG	Horiz Order: Unclassified	Ellipsoidal Order:
Latitude: N44° 22' 32.2xxxxx"	Longitude: W79° 40' 02.6xxxxx"	Ellipsoidal elev:
*UTM Zone: 17 E: E606164.xxx	N: N4914456.xxx	c. s. f.: 0.99973861
		Mrdl Conv: 0° 55' 55.4"
*MTM Zone: 10 E: E291460.xxx	N: N4915080.xxx	c. s. f.: 0.99990218
		Mrdl Conv: -0° 07' 01.4"

Vertical (Geoidal) Control Data

Datum: CGVD28:78	Vert Order: Second Order	Elevation: 220.048
Meridional defl:	Prime vert defl:	Undulation:

Maintenance / History

No maintenance data found.

Reference Sketches

Sketch 1 of 1



MINISTRY OF NATURAL RESOURCES
SURVEYS AND MAPPING BRANCH
QUEEN'S PARK, TORONTO, ONTARIO

Bench Mark No: 03120030011

VERTICAL CONTROL MONUMENT RECORD

Inscription On Monument Found: 03120030011

Topo Number: N/A

CITY OF BARRIE



Monument Type: Brass Tablet

Order: 2nd. Order Spirit Leveling

Relation To Grade: Above
Below
Flush

Description of Location: Minets Point Pump Station - 2 Lismer Blvd
The vertical Control Monument is set flush in the concrete foundation wall at northeast corner of the pumping station. The tablet is 310 mm south of the northeast corner and 110 mm below the brickwork.

WARNING: NAD 83 U.T.M. COORDINATES ARE APPROXIMATE & SHOULD NOT BE USED FOR HORIZONTAL CONTROL PURPOSES.

EASTING 606163 Metres NORTHING 4914457 Metres

Survey Method: 2nd.Order Spirit Leveling Survey Firm: METRES

Established By: Date: N/A

Mon. Record Form Completed By: Date: Field Check: Date

LiDAR INFORMATION

The LiDAR data was captured on April 23rd, 2016 and took two missions to complete. The LiDAR data was captured with the following parameters:

- Flying Height = 1500m
- Flying Speed = 180 knots
- Pulse Rate – 300 kHz
- Scan Frequency = 47 Hz
- Scan Angle (degree) = 50
- Sidelap % = 50
- Point Density(pts/m2) = 20

The LiDAR was referenced to UTM NAD83 CSRS (z17), CGVD28, HT2.0.

A local geodetic network was established and fixed to the following control:

Station ID	Lat	Long	Ellp Height
A535	43 27 18.74003	-80 23 19.24411	275.719
BTFD	43 09 37.42194	-80 19 45.02479	215.730

A complete calibration was then performed on each LiDAR mission. The data is acquired over a calibration site flown with at least two passes in opposite directions before and after the flight. Any error in the attitude of the aircraft (roll, pitch and heading) can be observed and corrected within system specifications. To statistically quantify the accuracy, the LiDAR data is compared to independently surveyed ground points. A GPS mounted truck collects data while driving on an open road. The kinematic positions on the road are post-processed from a nearby base station (common to the aerial survey)

The supplied Lidar was accurate to the following:

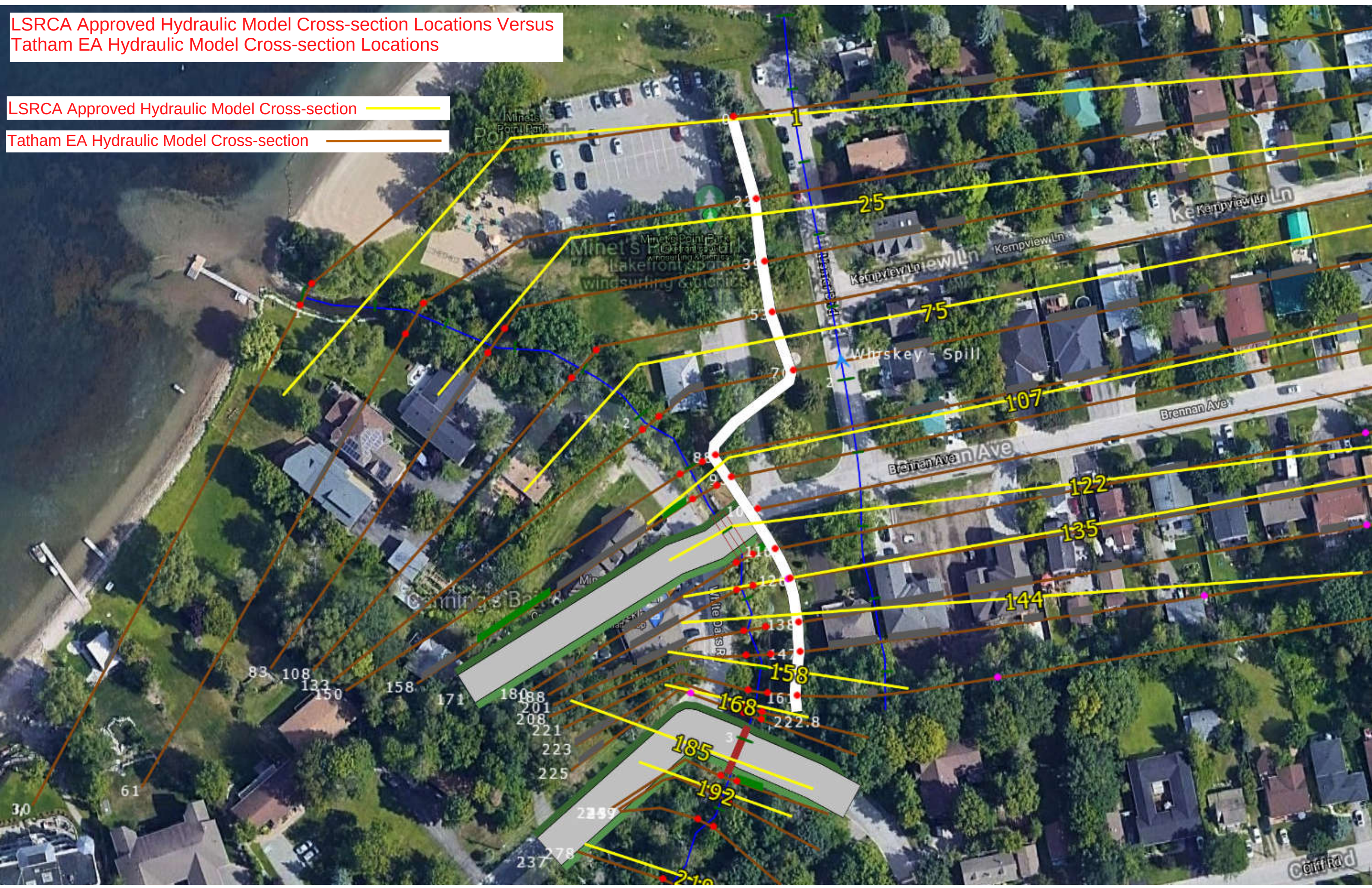
- Horizontal Accuracy, 95% 40cm
- Vertical Accuracy (on flat hard surfaces), 95% 18cm

Appendix E: HEC-RAS Model Comparison

LSRCA Approved Hydraulic Model Cross-section Locations Versus
Tatham EA Hydraulic Model Cross-section Locations

LSRCA Approved Hydraulic Model Cross-section

Tatham EA Hydraulic Model Cross-section

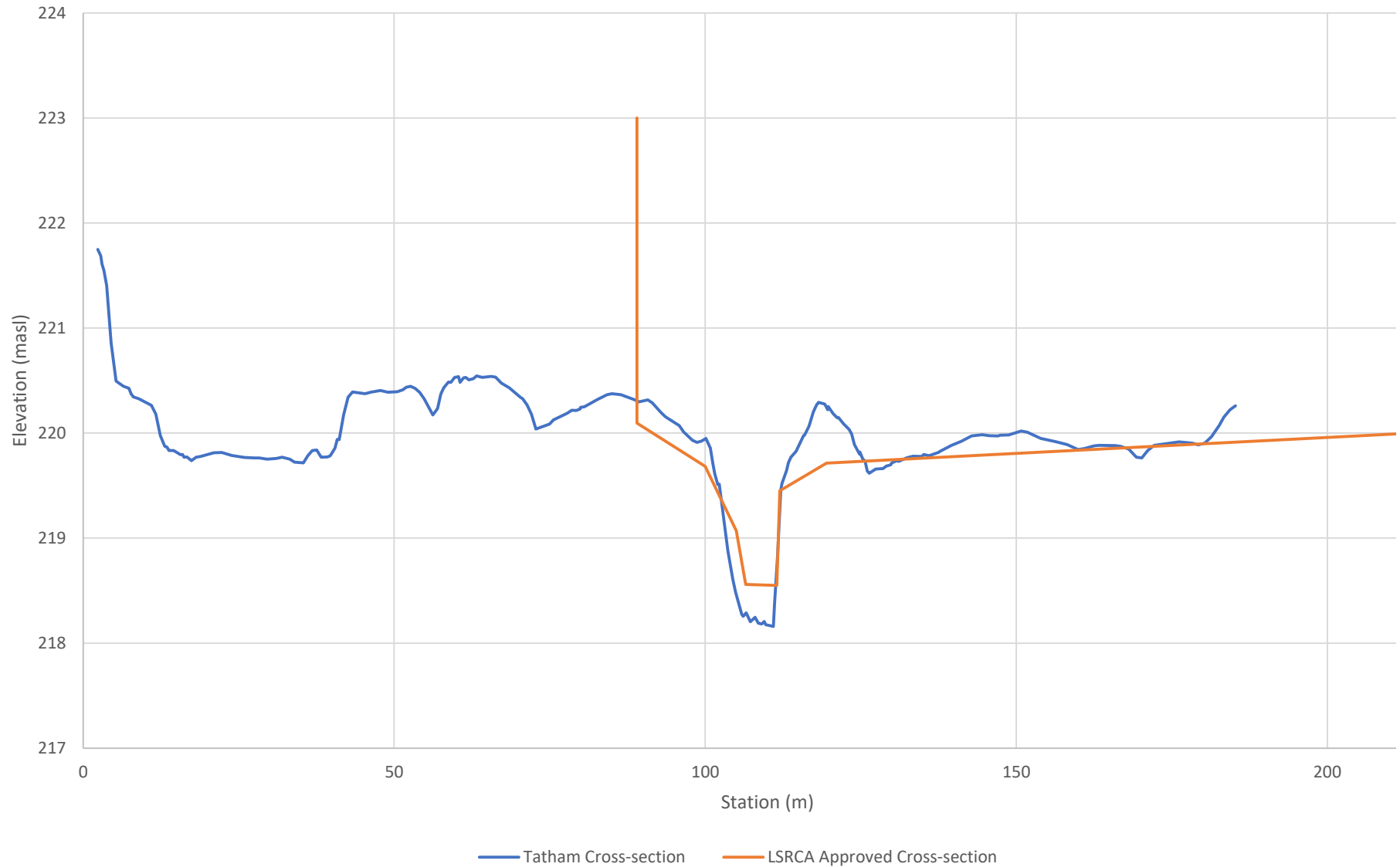


HEC-RAS Hydraulic Model Cross-section Comparison
LSRCA Approved Model Cross-section No. 1 Versus Tatham Cross-section No. 30



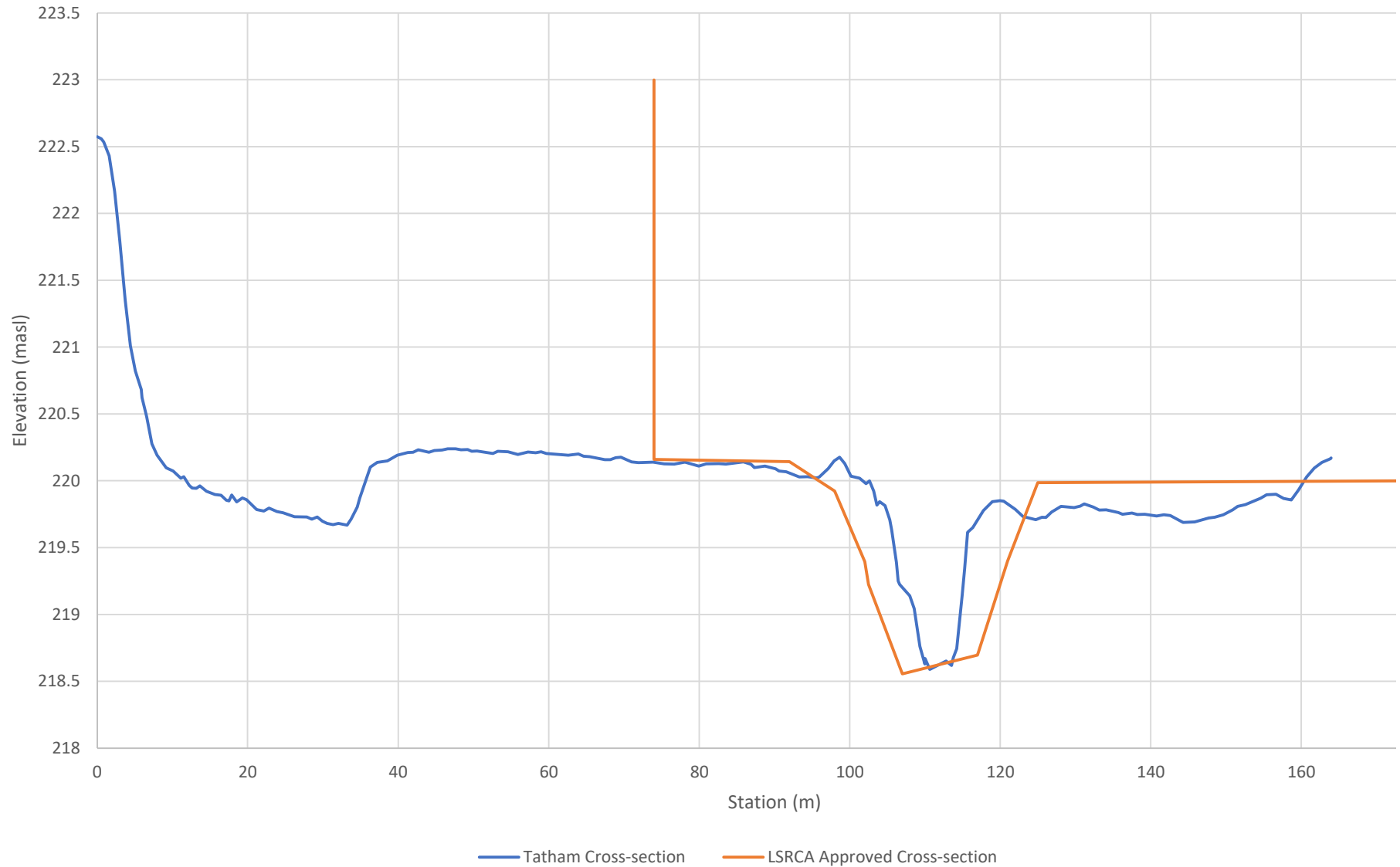
HEC-RAS Hydraulic Model Cross-section Comparison

LSRCA Approved Model Cross-section No. 25 Versus Tatham Cross-section No. 83



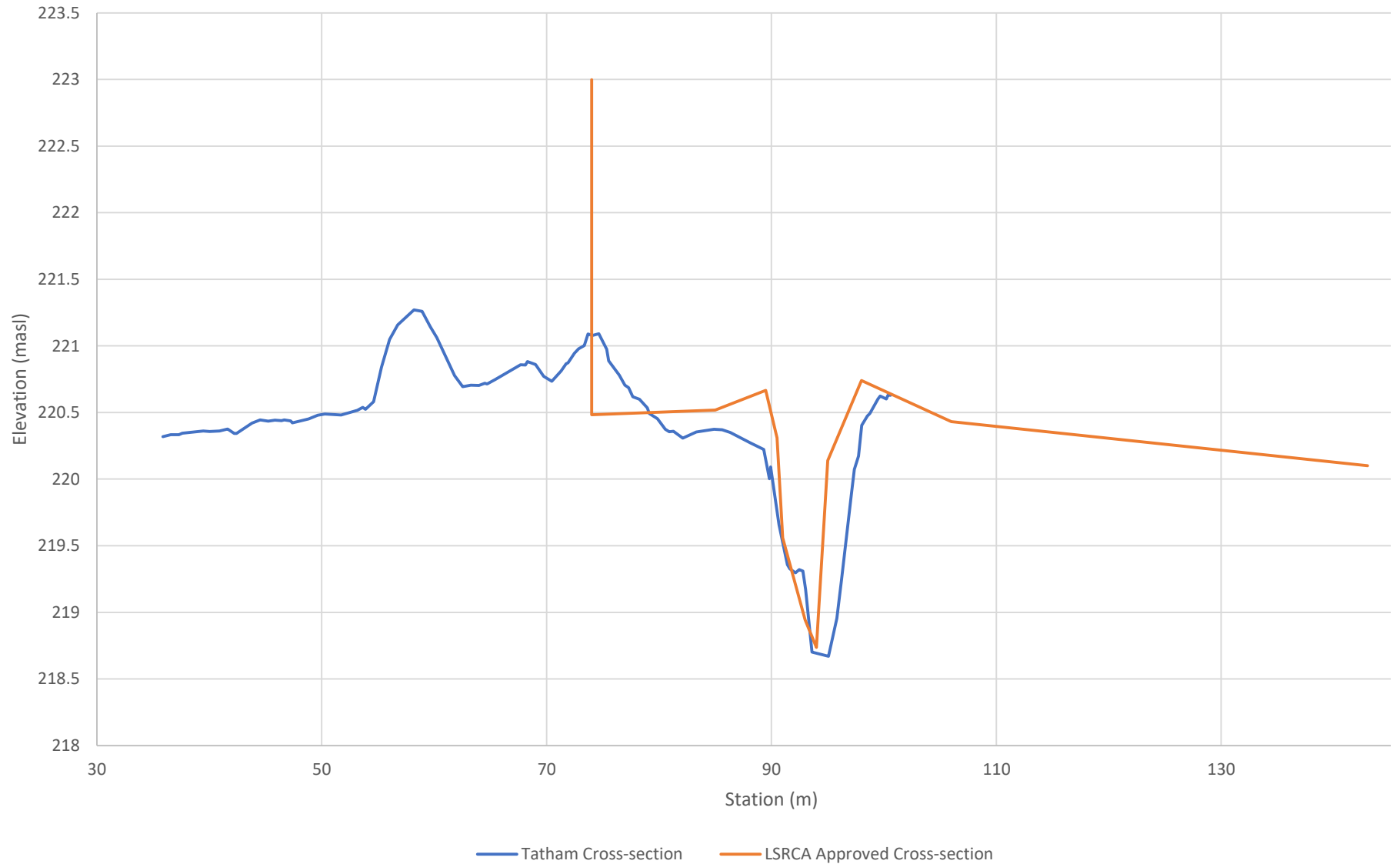
HEC-RAS Hydraulic Model Cross-section Comparison

LSRCA Approved Model Cross-section No. 75 Versus Tatham Cross-section No. 108

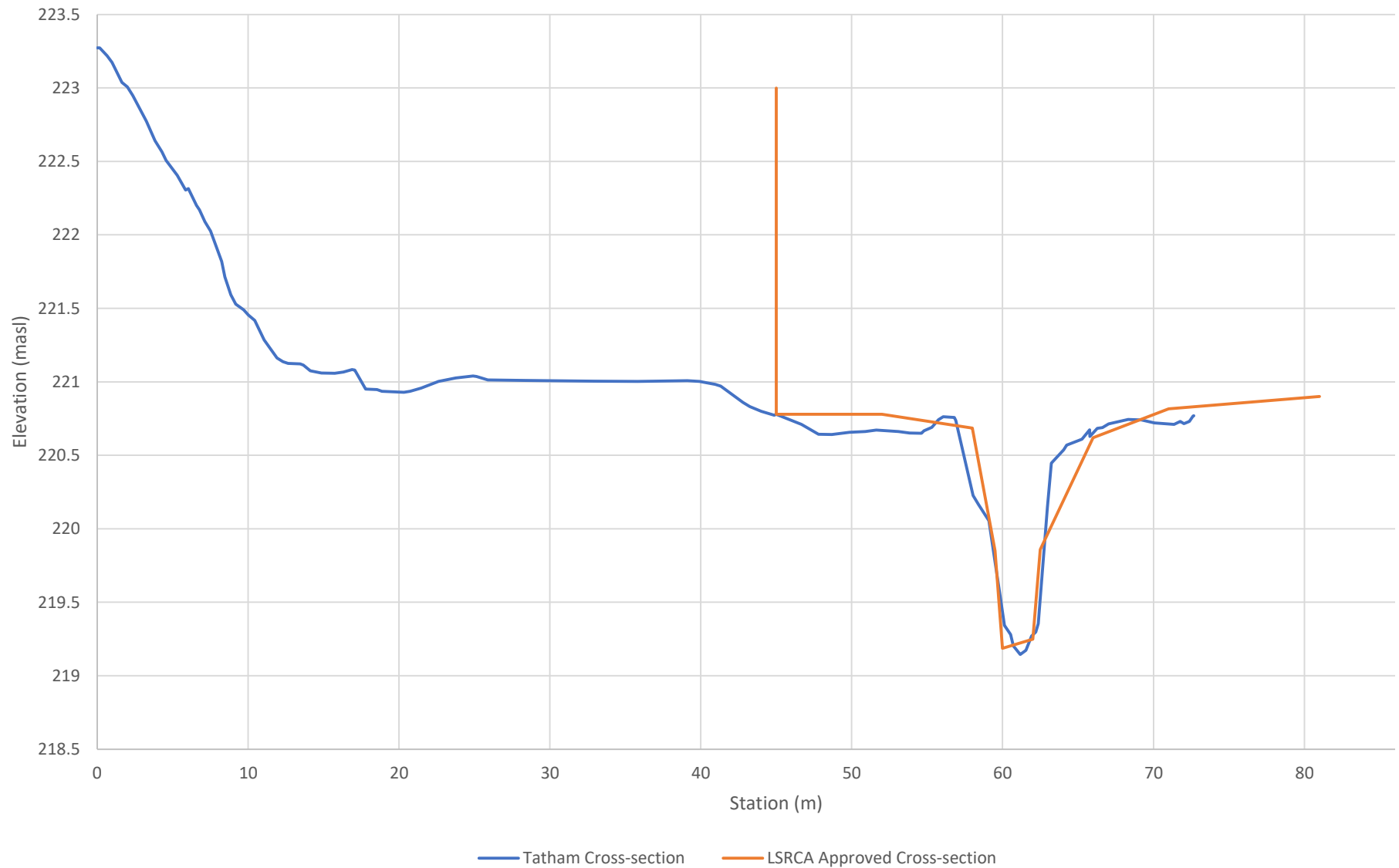


HEC-RAS Hydraulic Model Cross-section Comparison

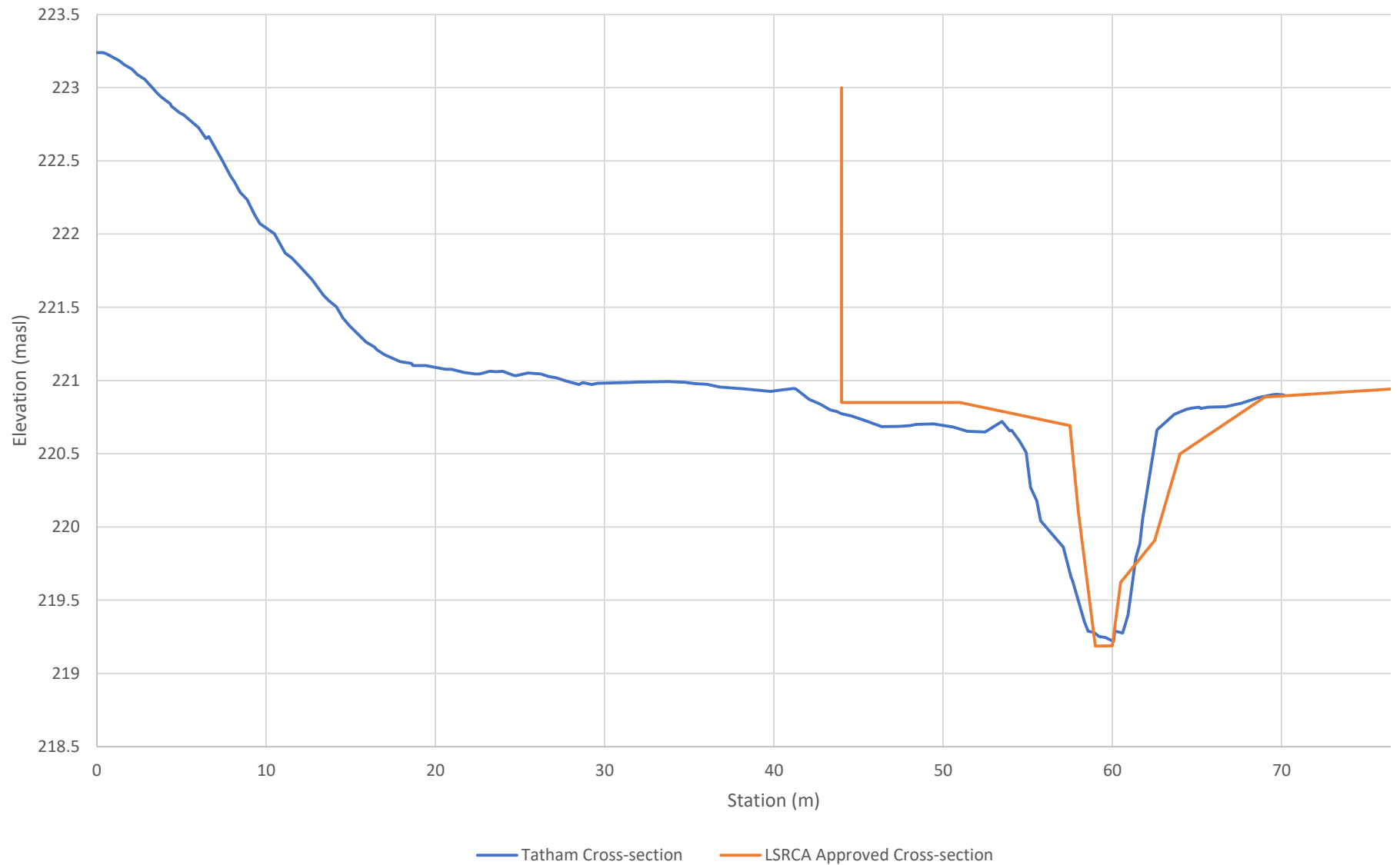
LSRCA Approved Model Cross-section No. 107 Versus Tatham Cross-section No. 158



HEC-RAS Hydraulic Model Cross-section Comparison
LSRCA Approved Model Cross-section No. 135 Versus Tatham Cross-section No. 188

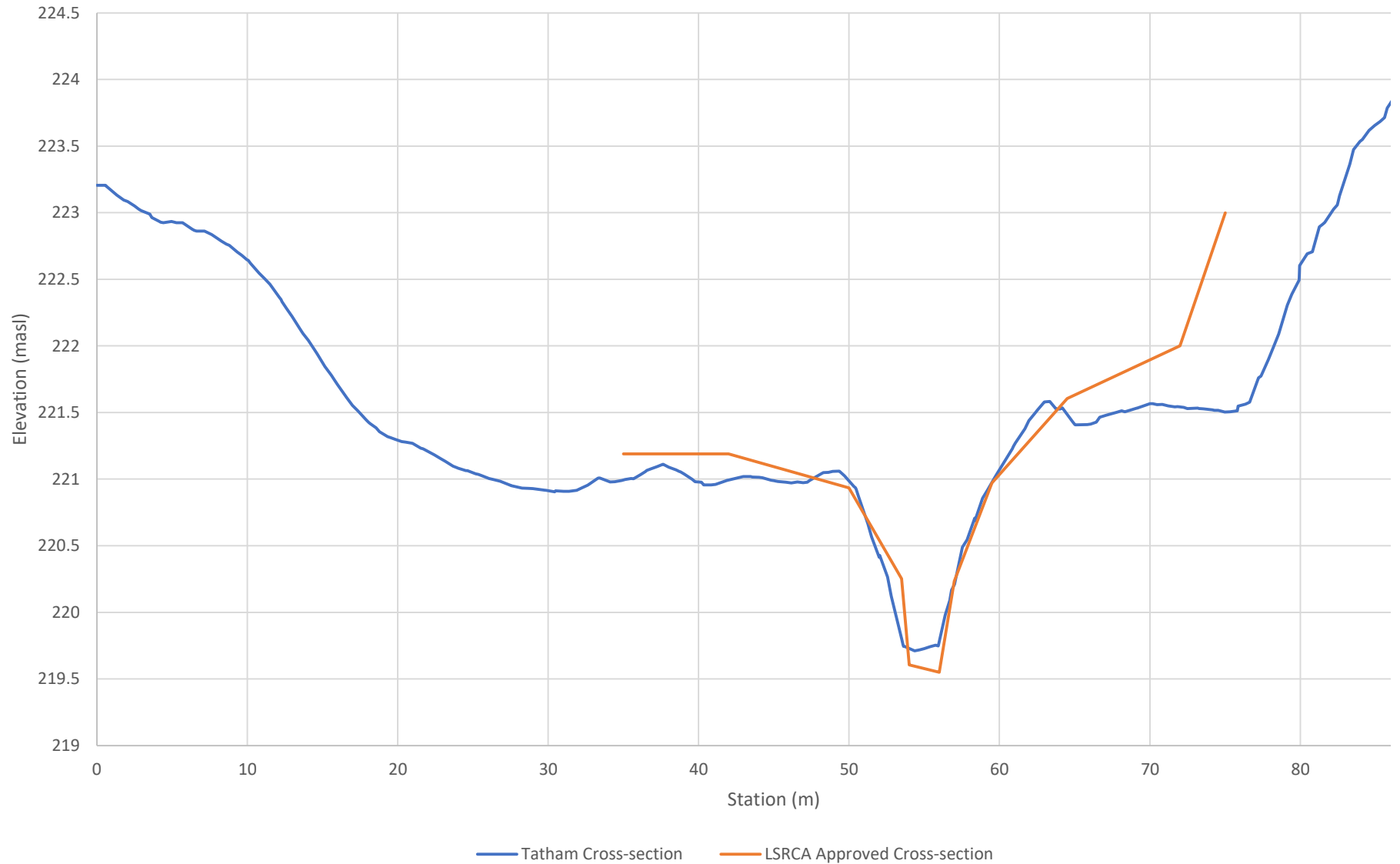


HEC-RAS Hydraulic Model Cross-section Comparison
LSRCA Approved Model Cross-section No. 144 Versus Tatham Cross-section No. 201



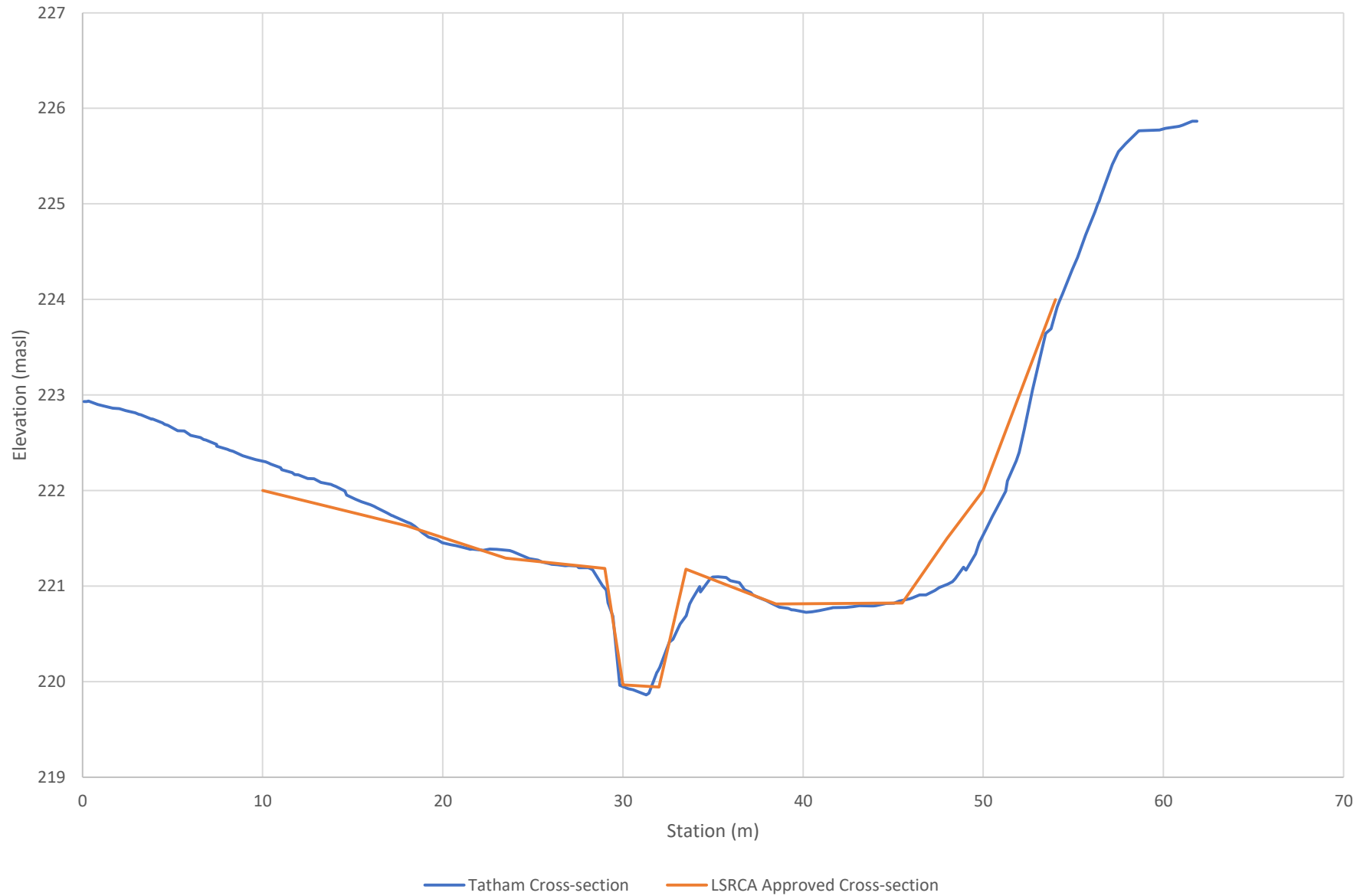
HEC-RAS Hydraulic Model Cross-section Comparison

LSRCA Approved Model Cross-section No. 168 Versus Tatham Cross-section No. 223



HEC-RAS Hydraulic Model Cross-section Comparison

LSRCA Approved Model Cross-section No. 192 Versus Tatham Cross-section No. 249



Appendix F: Hydraulic Model Results – Existing Conditions



HEC-RAS Plan: Alt1 Locations: User Defined

River	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
Whiskey	1	299	2 YR	10.00	220.47	221.87		221.91	0.001503	1.09	13.89	18.07	0.32
Whiskey	1	299	5 YR	19.42	220.47	222.12		222.21	0.002583	1.62	18.63	19.46	0.43
Whiskey	1	299	10 YR	27.16	220.47	222.27		222.40	0.003404	1.99	21.58	20.29	0.50
Whiskey	1	299	25 YR	34.88	220.47	222.40		222.57	0.004050	2.28	24.35	20.93	0.55
Whiskey	1	299	50 YR	41.86	220.47	222.49		222.71	0.004717	2.55	26.33	21.29	0.60
Whiskey	1	299	100 YR	52.03	220.47	222.61		222.89	0.005672	2.92	28.87	21.75	0.66
Whiskey	1	299	Regional	72.99	220.47	222.82		223.22	0.007510	3.58	33.38	22.58	0.78
Whiskey	1	278	2 YR	10.00	219.98	221.86		221.89	0.000543	0.74	23.15	30.67	0.19
Whiskey	1	278	5 YR	19.42	219.98	222.12		222.17	0.001059	1.13	31.04	31.64	0.27
Whiskey	1	278	10 YR	27.16	219.98	222.27		222.34	0.001463	1.40	35.84	32.11	0.32
Whiskey	1	278	25 YR	34.88	219.98	222.40		222.50	0.001802	1.63	40.30	32.57	0.36
Whiskey	1	278	50 YR	41.86	219.98	222.50		222.62	0.002140	1.83	43.48	32.91	0.39
Whiskey	1	278	100 YR	52.03	219.98	222.63		222.78	0.002618	2.10	47.60	33.35	0.44
Whiskey	1	278	Regional	72.99	219.98	222.85		223.07	0.003514	2.58	55.09	34.18	0.51
Whiskey	1	257	2 YR	10.00	220.07	221.85		221.87	0.000584	0.81	27.52	35.38	0.20
Whiskey	1	257	5 YR	19.42	220.07	222.10		222.14	0.001108	1.22	36.44	36.93	0.28
Whiskey	1	257	10 YR	27.16	220.07	222.24		222.31	0.001512	1.50	41.85	37.46	0.34
Whiskey	1	257	25 YR	34.88	220.07	222.38		222.46	0.001839	1.72	46.93	37.98	0.37
Whiskey	1	257	50 YR	41.86	220.07	222.47		222.57	0.002184	1.93	50.49	38.60	0.41
Whiskey	1	257	100 YR	52.03	220.07	222.59		222.72	0.002659	2.21	55.14	39.10	0.46
Whiskey	1	257	Regional	72.99	220.07	222.80		222.99	0.003563	2.70	63.65	40.46	0.54
Whiskey	1	249	2 YR	10.00	219.86	221.85		221.87	0.000575	0.75	28.77	34.86	0.19
Whiskey	1	249	5 YR	19.42	219.86	222.09		222.13	0.001098	1.14	37.68	38.21	0.27
Whiskey	1	249	10 YR	27.16	219.86	222.24		222.29	0.001498	1.40	43.39	40.68	0.32
Whiskey	1	249	25 YR	34.88	219.86	222.37		222.44	0.001806	1.61	49.04	43.17	0.35
Whiskey	1	249	50 YR	41.86	219.86	222.47		222.55	0.002107	1.79	53.17	44.62	0.38
Whiskey	1	249	100 YR	52.03	219.86	222.59		222.69	0.002509	2.02	58.69	46.31	0.42
Whiskey	1	249	Regional	72.99	219.86	222.81		222.95	0.003168	2.41	69.36	49.55	0.48
Whiskey	1	243	2 YR	10.03	219.75	221.83	220.87	221.86	0.000667	0.88	20.88	31.73	0.21
Whiskey	1	243	5 YR	19.49	219.75	222.05	221.34	222.11	0.001349	1.36	28.35	36.77	0.31
Whiskey	1	243	10 YR	27.27	219.75	222.17	221.61	222.26	0.001900	1.68	33.06	39.67	0.37
Whiskey	1	243	25 YR	35.03	219.75	222.29	221.81	222.40	0.002291	1.92	38.01	41.95	0.41
Whiskey	1	243	50 YR	42.04	219.75	222.37	221.93	222.50	0.002720	2.14	41.30	43.19	0.45
Whiskey	1	243	100 YR	52.25	219.75	222.46	222.07	222.63	0.003381	2.45	45.35	45.00	0.51
Whiskey	1	243	Regional	73.32	219.75	222.61	222.34	222.86	0.004790	3.03	52.20	48.08	0.61
Whiskey	1	237		Culvert									
Whiskey	1	225	2 YR	10.03	219.67	221.01	220.66	221.15	0.004451	1.69	6.91	12.10	0.52
Whiskey	1	225	5 YR	19.49	219.67	221.24	221.24	221.40	0.004989	2.04	14.62	36.86	0.57
Whiskey	1	225	10 YR	27.27	219.67	221.33	221.33	221.52	0.005714	2.28	18.07	39.18	0.62
Whiskey	1	225	25 YR	35.03	219.67	221.49	221.41	221.63	0.004055	2.07	24.79	45.47	0.53
Whiskey	1	225	50 YR	42.04	219.67	221.55	221.47	221.71	0.004414	2.21	27.55	48.19	0.56
Whiskey	1	225	100 YR	52.25	219.67	221.64	221.54	221.82	0.004700	2.36	31.77	51.40	0.58
Whiskey	1	225	Regional	73.32	219.67	221.68	221.68	221.99	0.007932	3.11	33.73	53.61	0.75
Whiskey	1	223	2 YR	10.03	219.71	220.96	220.68	221.13	0.005210	1.86	6.68	15.57	0.57
Whiskey	1	223	5 YR	19.49	219.71	221.22	221.22	221.37	0.004936	2.08	15.01	38.98	0.57
Whiskey	1	223	10 YR	27.27	219.71	221.31	221.31	221.48	0.005739	2.34	18.52	41.61	0.62
Whiskey	1	223	25 YR	35.03	219.71	221.37	221.37	221.58	0.006650	2.60	21.23	42.96	0.67
Whiskey	1	223	50 YR	42.04	219.71	221.43	221.43	221.66	0.006891	2.72	24.04	45.57	0.69
Whiskey	1	223	100 YR	52.25	219.71	221.50	221.50	221.76	0.007651	2.95	27.25	48.44	0.73
Whiskey	1	223	Regional	73.32	219.71	221.66	221.64	221.95	0.007699	3.14	36.20	60.58	0.75
Whiskey	1	222.8		Lat Struct									
Whiskey	1	221	2 YR	10.03	219.69	221.00		221.08	0.002222	1.32	9.63	23.79	0.38
Whiskey	1	221	5 YR	19.49	219.69	221.08	221.08	221.28	0.005663	2.19	12.10	34.87	0.62
Whiskey	1	221	10 YR	27.27	219.69	221.21	221.21	221.41	0.005691	2.34	17.22	42.04	0.63
Whiskey	1	221	25 YR	35.03	219.69	221.29	221.29	221.52	0.006453	2.59	20.56	44.55	0.67
Whiskey	1	221	50 YR	42.03	219.69	221.36	221.36	221.60	0.006626	2.70	23.95	46.80	0.69
Whiskey	1	221	100 YR	52.21	219.69	221.44	221.44	221.71	0.007203	2.91	27.74	47.39	0.72
Whiskey	1	221	Regional	73.11	219.69	221.66		221.91	0.006241	2.94	38.10	48.64	0.69
Whiskey	1	208	2 YR	9.98	219.44	221.01		221.05	0.000971	0.89	13.43	29.85	0.25
Whiskey	1	208	5 YR	19.38	219.44	221.05		221.16	0.003050	1.61	14.68	35.05	0.44
Whiskey	1	208	10 YR	26.98	219.44	221.12		221.28	0.004255	1.97	17.18	36.43	0.53
Whiskey	1	208	25 YR	34.54	219.44	221.17	221.14	221.38	0.005538	2.30	19.10	38.56	0.60
Whiskey	1	208	50 YR	41.35	219.44	221.22	221.21	221.47	0.006431	2.53	21.12	42.13	0.65
Whiskey	1	208	100 YR	50.98	219.44	221.37		221.59	0.005387	2.47	27.60	44.41	0.61
Whiskey	1	208	Regional	70.52	219.44	221.64		221.84	0.004147	2.39	40.11	46.36	0.55
Whiskey	1	201	2 YR	9.87	219.22	221.01		221.04	0.000643	0.78	15.45	30.13	0.21
Whiskey	1	201	5 YR	19.19	219.22	221.05		221.13	0.001971	1.39	16.66	31.05	0.36
Whiskey	1	201	10 YR	26.64	219.22	221.12		221.25	0.002692	1.67	18.83	31.65	0.43
Whiskey	1	201	25 YR	34.01	219.22	221.17		221.34	0.003488	1.94	20.39	32.18	0.49
Whiskey	1	201	50 YR	40.73	219.22	221.20		221.43	0.004278	2.18	21.51	32.18	0.54
Whiskey	1	201	100 YR	50.02	219.22	221.26	221.19	221.55	0.004984	2.41	23.45	32.70	0.59

HEC-RAS Plan: Alt1 Locations: User Defined (Continued)

River	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
Whiskey	1	201	Regional	68.80	219.22	221.36	221.36	221.78	0.006402	2.84	26.69	33.57	0.67
Whiskey	1	188	2 YR	9.56	219.15	221.00		221.03	0.000764	0.81	15.45	37.25	0.21
Whiskey	1	188	5 YR	18.80	219.15	221.01		221.11	0.002896	1.58	15.57	37.42	0.42
Whiskey	1	188	10 YR	26.11	219.15	221.03	221.00	221.20	0.004889	2.08	16.38	38.71	0.54
Whiskey	1	188	25 YR	33.10	219.15	221.09	221.09	221.29	0.005291	2.22	19.16	43.79	0.57
Whiskey	1	188	50 YR	39.76	219.15	221.16	221.14	221.37	0.005290	2.29	22.12	45.74	0.57
Whiskey	1	188	100 YR	48.63	219.15	221.26		221.47	0.004739	2.25	26.77	46.30	0.55
Whiskey	1	188	Regional	66.60	219.15	221.44		221.66	0.004086	2.24	35.12	46.38	0.52
Whiskey	1	180	2 YR	9.37	219.07	220.51	220.51	220.83	0.018472	2.54	3.81	7.35	0.94
Whiskey	1	180	5 YR	18.12	219.07	220.90	220.90	221.05	0.006219	1.96	12.08	36.67	0.58
Whiskey	1	180	10 YR	25.26	219.07	220.99	220.99	221.15	0.006459	2.10	15.49	42.52	0.60
Whiskey	1	180	25 YR	32.04	219.07	221.05	221.05	221.24	0.006743	2.21	18.19	43.96	0.62
Whiskey	1	180	50 YR	38.43	219.07	221.12	221.10	221.31	0.006111	2.18	21.42	44.29	0.60
Whiskey	1	180	100 YR	46.74	219.07	221.23	221.16	221.41	0.004969	2.07	26.26	45.00	0.55
Whiskey	1	180	Regional	63.73	219.07	221.42	221.27	221.60	0.003917	1.99	35.20	48.96	0.49
Whiskey	1	171		Culvert									
Whiskey	1	158	2 YR	9.37	218.67	220.17	219.72	220.26	0.003533	1.33	7.08	17.13	0.44
Whiskey	1	158	5 YR	18.12	218.67	220.30	220.08	220.55	0.008323	2.23	8.28	24.16	0.69
Whiskey	1	158	10 YR	25.26	218.67	220.58	220.49	220.69	0.003425	1.67	22.18	47.65	0.46
Whiskey	1	158	25 YR	32.04	218.67	220.56	220.56	220.75	0.006171	2.22	21.20	47.22	0.61
Whiskey	1	158	50 YR	38.43	218.67	220.62	220.62	220.82	0.006561	2.35	23.90	49.33	0.64
Whiskey	1	158	100 YR	46.74	218.67	220.68	220.68	220.90	0.007083	2.52	26.99	50.25	0.67
Whiskey	1	158	Regional	63.73	218.67	220.79	220.79	221.05	0.007888	2.79	32.56	51.54	0.71
Whiskey	1	150	2 YR	9.37	218.81	220.15		220.22	0.002366	1.21	9.63	19.63	0.38
Whiskey	1	150	5 YR	18.12	218.81	220.26	220.06	220.45	0.005792	2.03	12.50	33.28	0.60
Whiskey	1	150	10 YR	25.26	218.81	220.40	220.40	220.60	0.005756	2.18	19.31	61.11	0.61
Whiskey	1	150	25 YR	32.02	218.81	220.51	220.51	220.69	0.005329	2.22	26.75	72.17	0.59
Whiskey	1	150	50 YR	38.36	218.81	220.56	220.56	220.76	0.006057	2.41	29.94	73.66	0.64
Whiskey	1	150	100 YR	46.61	218.81	220.64	220.64	220.83	0.006079	2.50	35.89	80.77	0.64
Whiskey	1	150	Regional	63.40	218.81	220.73	220.73	220.96	0.007194	2.83	43.89	88.70	0.71
Whiskey	1	133	2 YR	9.37	218.78	219.98	219.98	220.13	0.008020	1.83	8.38	44.90	0.66
Whiskey	1	133	5 YR	17.81	218.78	220.18	220.18	220.30	0.006595	1.94	22.35	107.18	0.63
Whiskey	1	133	10 YR	24.19	218.78	220.26	220.26	220.37	0.006334	2.00	31.18	114.51	0.62
Whiskey	1	133	25 YR	30.38	218.78	220.29	220.29	220.42	0.007821	2.26	34.64	116.07	0.69
Whiskey	1	133	50 YR	36.04	218.78	220.34	220.34	220.46	0.007594	2.30	40.35	118.48	0.69
Whiskey	1	133	100 YR	43.46	218.78	220.37	220.37	220.51	0.009076	2.55	43.50	118.69	0.76
Whiskey	1	133	Regional	59.07	218.78	220.43	220.43	220.60	0.011154	2.92	50.58	119.61	0.84
Whiskey	1	108	2 YR	9.37	218.59	219.82		219.87	0.001731	0.95	12.95	59.70	0.32
Whiskey	1	108	5 YR	17.81	218.59	220.03		220.07	0.001589	1.04	28.20	85.55	0.31
Whiskey	1	108	10 YR	24.19	218.59	220.12		220.16	0.001607	1.10	36.65	101.88	0.32
Whiskey	1	108	25 YR	30.30	218.59	220.19		220.23	0.001633	1.15	44.85	131.04	0.33
Whiskey	1	108	50 YR	35.81	218.59	220.24		220.29	0.001601	1.18	53.14	156.41	0.33
Whiskey	1	108	100 YR	43.14	218.59	220.32		220.36	0.001503	1.18	64.62	156.82	0.32
Whiskey	1	108	Regional	58.35	218.59	220.43		220.48	0.001487	1.24	82.67	157.21	0.32
Whiskey	1	83	2 YR	9.37	218.16	219.81		219.84	0.000590	0.77	15.53	49.78	0.20
Whiskey	1	83	5 YR	17.81	218.16	219.96		220.03	0.001259	1.20	26.74	94.10	0.30
Whiskey	1	83	10 YR	24.19	218.16	220.02		220.11	0.001840	1.48	32.23	107.63	0.36
Whiskey	1	83	25 YR	30.26	218.16	220.05		220.17	0.002492	1.74	35.52	109.79	0.42
Whiskey	1	83	50 YR	35.69	218.16	220.08	219.61	220.22	0.003041	1.94	38.55	112.70	0.47
Whiskey	1	83	100 YR	42.97	218.16	220.10	220.09	220.29	0.003964	2.23	41.05	113.95	0.54
Whiskey	1	83	Regional	57.88	218.16	220.19	220.19	220.40	0.004618	2.50	51.91	118.74	0.58
Whiskey	1	61	2 YR	9.37	218.45	219.75	219.26	219.81	0.003003	1.15	10.47	60.62	0.40
Whiskey	1	61	5 YR	17.81	218.45	219.88	219.81	219.98	0.004558	1.56	19.92	91.80	0.51
Whiskey	1	61	10 YR	24.19	218.45	219.94	219.94	220.05	0.004904	1.69	27.04	126.25	0.54
Whiskey	1	61	25 YR	30.26	218.45	220.00	219.99	220.09	0.004546	1.69	34.81	152.18	0.52
Whiskey	1	61	50 YR	35.69	218.45	220.04	220.01	220.12	0.004451	1.71	40.71	160.40	0.52
Whiskey	1	61	100 YR	42.97	218.45	220.08	220.06	220.16	0.004365	1.73	47.59	174.66	0.52
Whiskey	1	61	Regional	57.88	218.45	220.14	220.11	220.22	0.004183	1.76	58.52	177.02	0.51
Whiskey	1	30	2 YR	9.39	218.62	219.57	219.57	219.64	0.013126	1.57	11.84	79.44	0.73
Whiskey	1	30	5 YR	17.84	218.62	219.66	219.66	219.74	0.015067	1.87	20.32	108.33	0.80
Whiskey	1	30	10 YR	24.24	218.62	219.70	219.70	219.79	0.017390	2.09	24.47	113.66	0.87
Whiskey	1	30	25 YR	30.33	218.62	219.73	219.73	219.84	0.019456	2.30	28.34	125.31	0.93
Whiskey	1	30	50 YR	35.78	218.62	219.76	219.76	219.88	0.019711	2.39	32.43	141.26	0.94
Whiskey	1	30	100 YR	43.09	218.62	219.80	219.80	219.92	0.019436	2.46	38.37	156.18	0.95
Whiskey	1	30	Regional	58.04	218.62	219.86	219.86	219.99	0.019616	2.62	49.28	190.40	0.96

HEC-RAS Plan: Alt1 Locations: User Defined

River	Reach	River Sta	Profile	E.G. US.	W.S. US.	E.G. IC	E.G. OC	Min El Weir Flow	Q Culv Group	Q Weir	Delta WS	Culv Vel US	Culv Vel DS	
				(m)	(m)	(m)	(m)	(m)	(m3/s)	(m3/s)	(m)	(m/s)	(m/s)	
Whiskey	1	237	Culvert #1	2 YR	221.86	221.83	221.83	221.86	221.31	3.47	6.56	0.82	2.52	2.52
Whiskey	1	237	Culvert #1	5 YR	222.11	222.05	222.09	222.11	221.31	3.51	15.98	0.80	2.54	2.54
Whiskey	1	237	Culvert #1	10 YR	222.26	222.17	222.24	222.26	221.31	3.63	23.64	0.83	2.63	2.63
Whiskey	1	237	Culvert #1	25 YR	222.40	222.29	222.38	222.40	221.31	3.60	31.43	0.80	2.61	2.61
Whiskey	1	237	Culvert #1	50 YR	222.50	222.37	222.48	222.50	221.31	3.68	38.36	0.81	2.67	2.67
Whiskey	1	237	Culvert #1	100 YR	222.63	222.46	222.62	222.63	221.31	3.76	48.49	0.82	2.73	2.73
Whiskey	1	237	Culvert #1	Regional	222.86	222.61	222.84	222.86	221.31	4.11	69.26	0.93	2.98	2.98
Whiskey	1	171	Culvert #1	2 YR	220.54	220.51	220.54	220.51	220.62	9.37		0.34	2.25	1.96
Whiskey	1	171	Culvert #1	5 YR	220.98	220.90	220.98	220.95	220.62	13.26	4.87	0.60	3.01	2.52
Whiskey	1	171	Culvert #1	10 YR	221.12	220.99	221.13	221.12	220.62	14.09	11.17	0.40	2.57	2.57
Whiskey	1	171	Culvert #1	25 YR	221.22	221.05	221.24	221.22	220.62	15.55	16.49	0.49	2.84	2.84
Whiskey	1	171	Culvert #1	50 YR	221.31	221.12	221.34	221.31	220.62	16.00	22.43	0.50	2.92	2.92
Whiskey	1	171	Culvert #1	100 YR	221.42	221.23	221.43	221.42	220.62	16.45	30.29	0.55	3.00	3.00
Whiskey	1	171	Culvert #1	Regional	221.61	221.42	221.61	221.61	220.62	17.34	46.39	0.63	3.17	3.17

HEC-RAS Plan: Alt1 Locations: User Defined

River	Reach	River Sta	Profile	Q US (m3/s)	Q Leaving Total (m3/s)	Q DS (m3/s)	Q Weir (m3/s)	Q Gates (m3/s)	Wt Top Wdth (m)	Weir Max Depth (m)	Weir Avg Depth (m)	Min El Weir Flow (m)	E.G. US. (m)	W.S. US. (m)	E.G. DS (m)	W.S. DS (m)
Whiskey	1	222.8	2 YR	10.03	0.69	9.39	0.69		33.06	0.28	0.12	220.05	221.11	220.97	219.65	219.58
Whiskey	1	222.8	5 YR	19.49	1.76	17.84	1.76		68.66	0.33	0.14	220.05	221.35	221.18	219.75	219.67
Whiskey	1	222.8	10 YR	27.27	3.25	24.24	3.25		96.85	0.42	0.18	220.05	221.46	221.28	219.80	219.70
Whiskey	1	222.8	25 YR	35.03	4.87	30.33	4.87		118.69	0.48	0.19	220.05	221.56	221.35	219.85	219.74
Whiskey	1	222.8	50 YR	42.04	6.58	35.78	6.58		135.30	0.55	0.22	220.05	221.64	221.41	219.88	219.77
Whiskey	1	222.8	100 YR	52.25	9.55	43.09	9.55		139.27	0.66	0.29	220.05	221.75	221.48	219.93	219.81
Whiskey	1	222.8	Regional	73.32	15.91	58.04	15.91		143.59	0.85	0.40	220.05	221.94	221.66	220.00	219.87



Project:	Whiskey Creek at Minet's Point	Prepared By:	DAM
File No.:	120114	Reviewed By:	DRT
Revision:	-	Date:	07-Dec-20
Description:	Lateral Weir Calculation Check		

Rectangular Weir Formula

$$Q = CWH^{3/2}$$

Existing Conditions - Lateral Weir 222.8 - Regulatory Storm

Weir Coefficient = 0.47

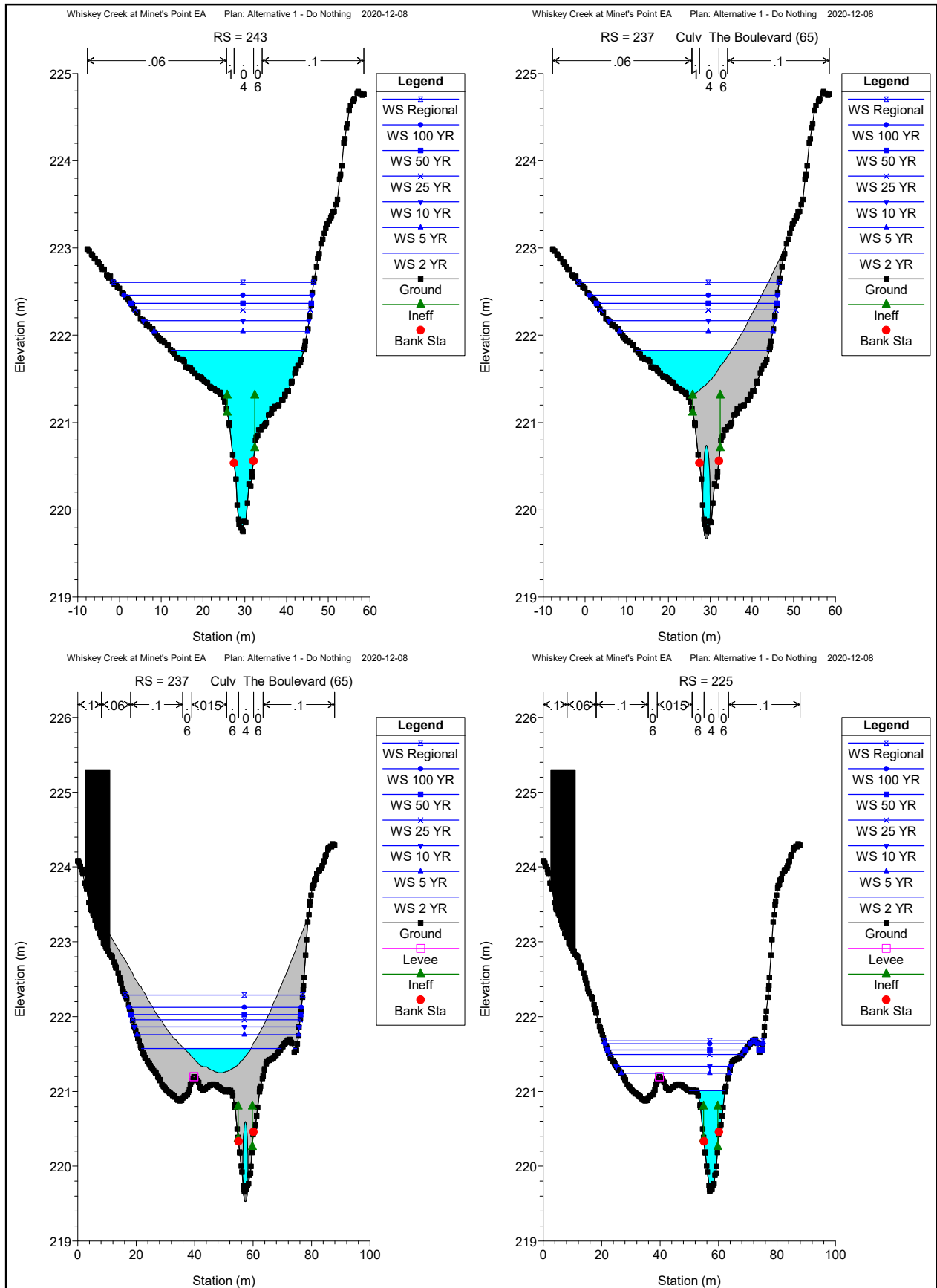
Weir Width = 131.5 m

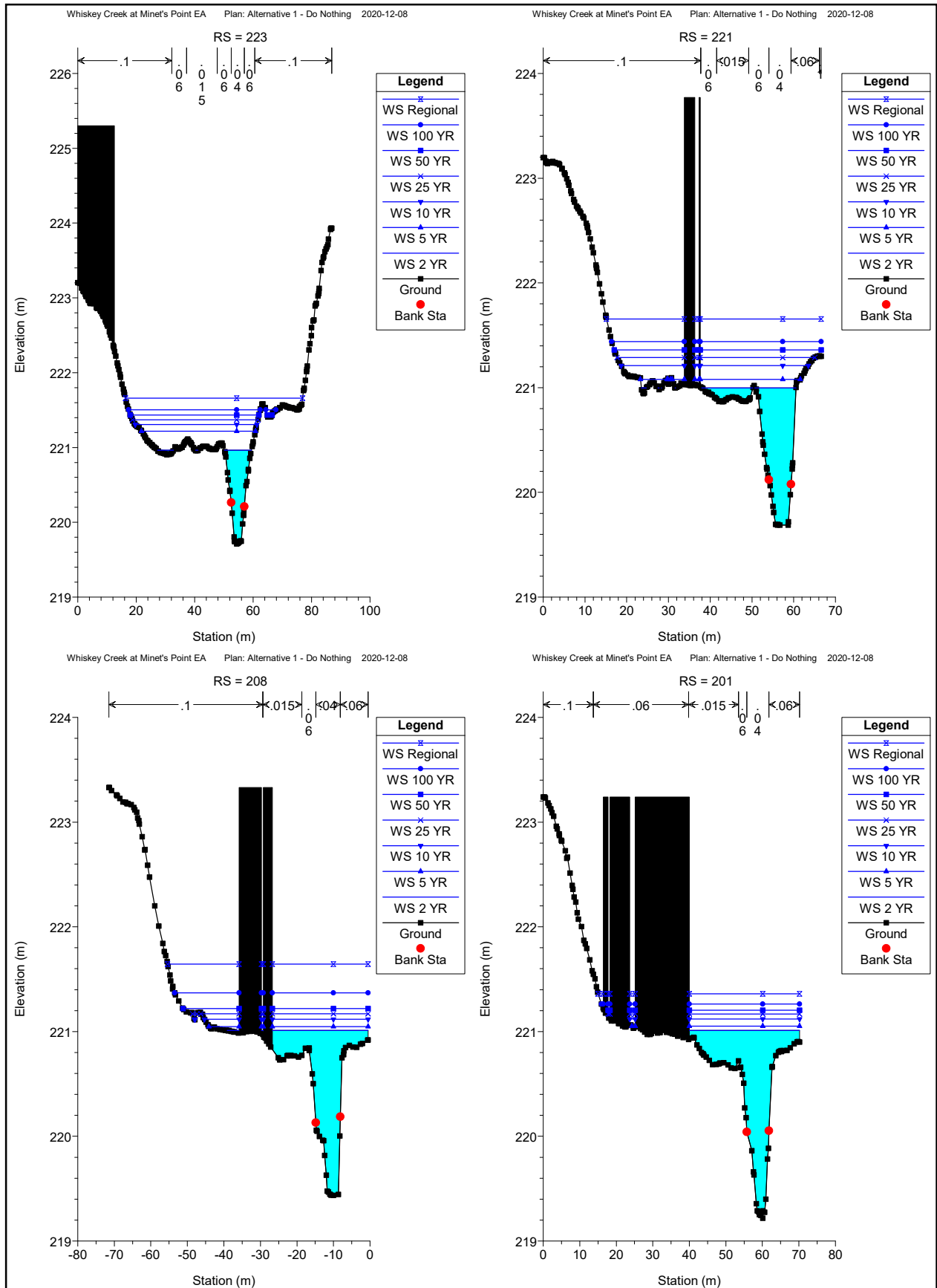
Average Depth = 0.40 m

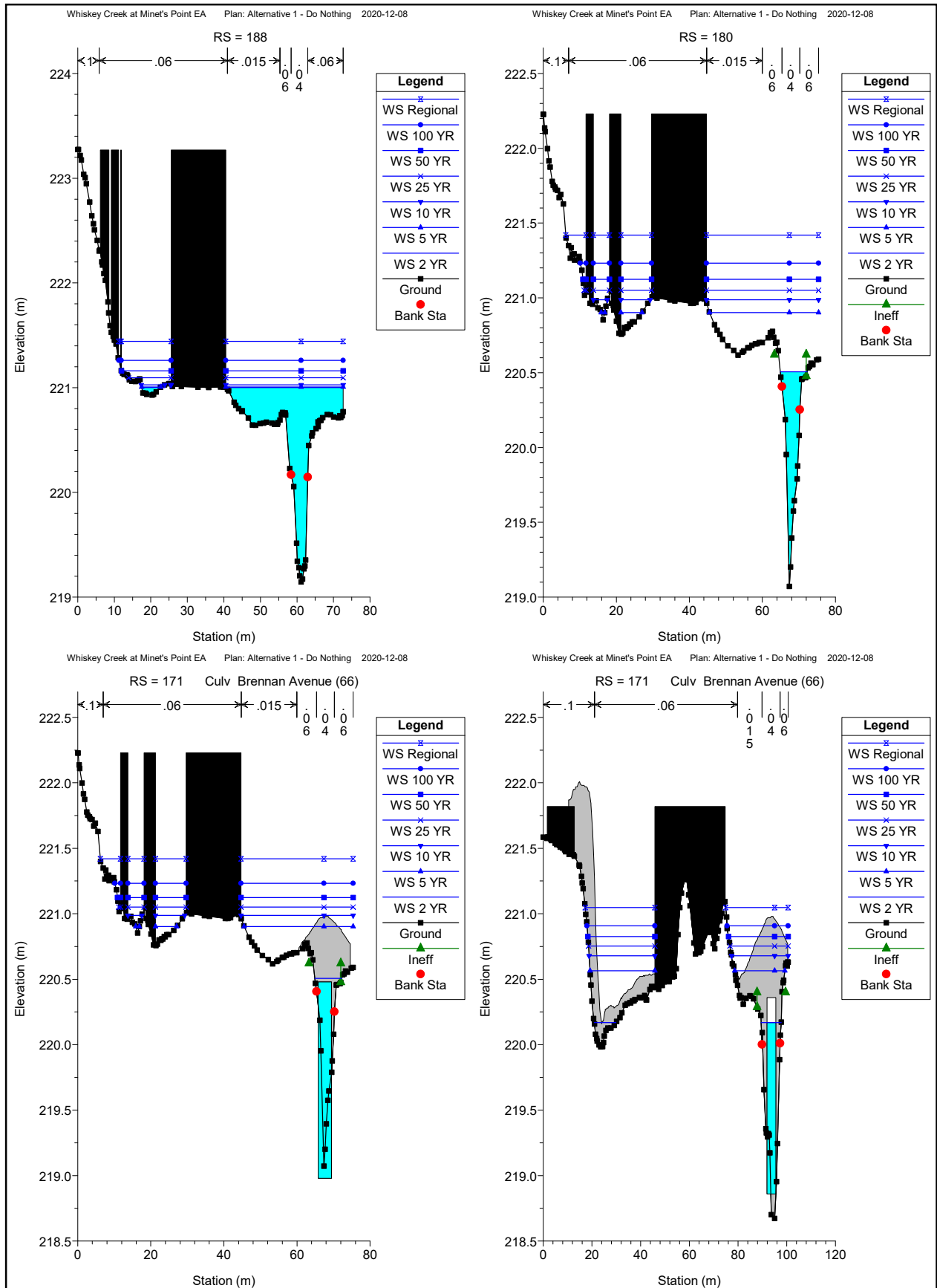
$$Q = 0.47 \times 131.5 \times 0.40^{3/2}$$

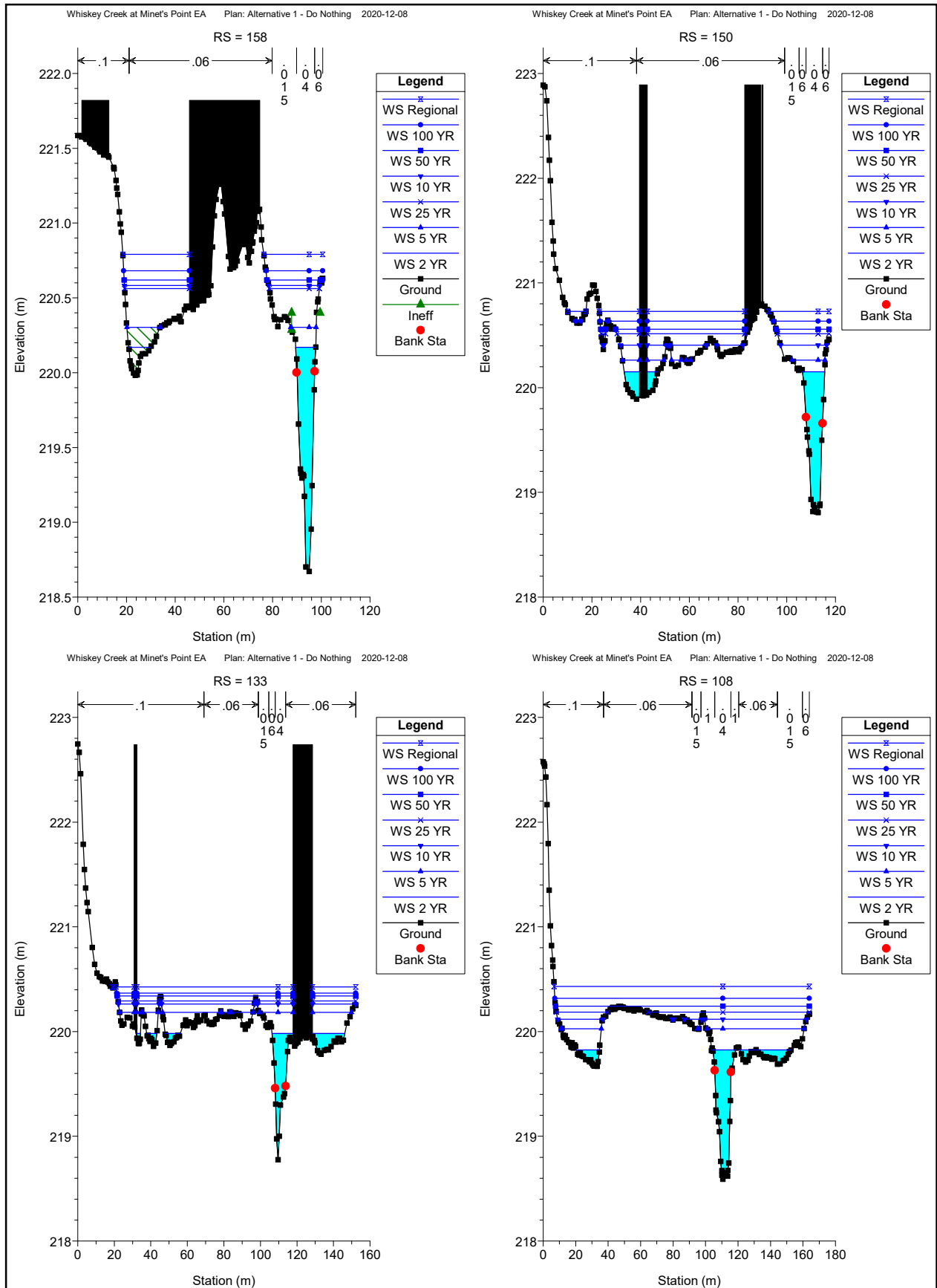
$$Q = 15.64 \text{ m}^3/\text{s}$$

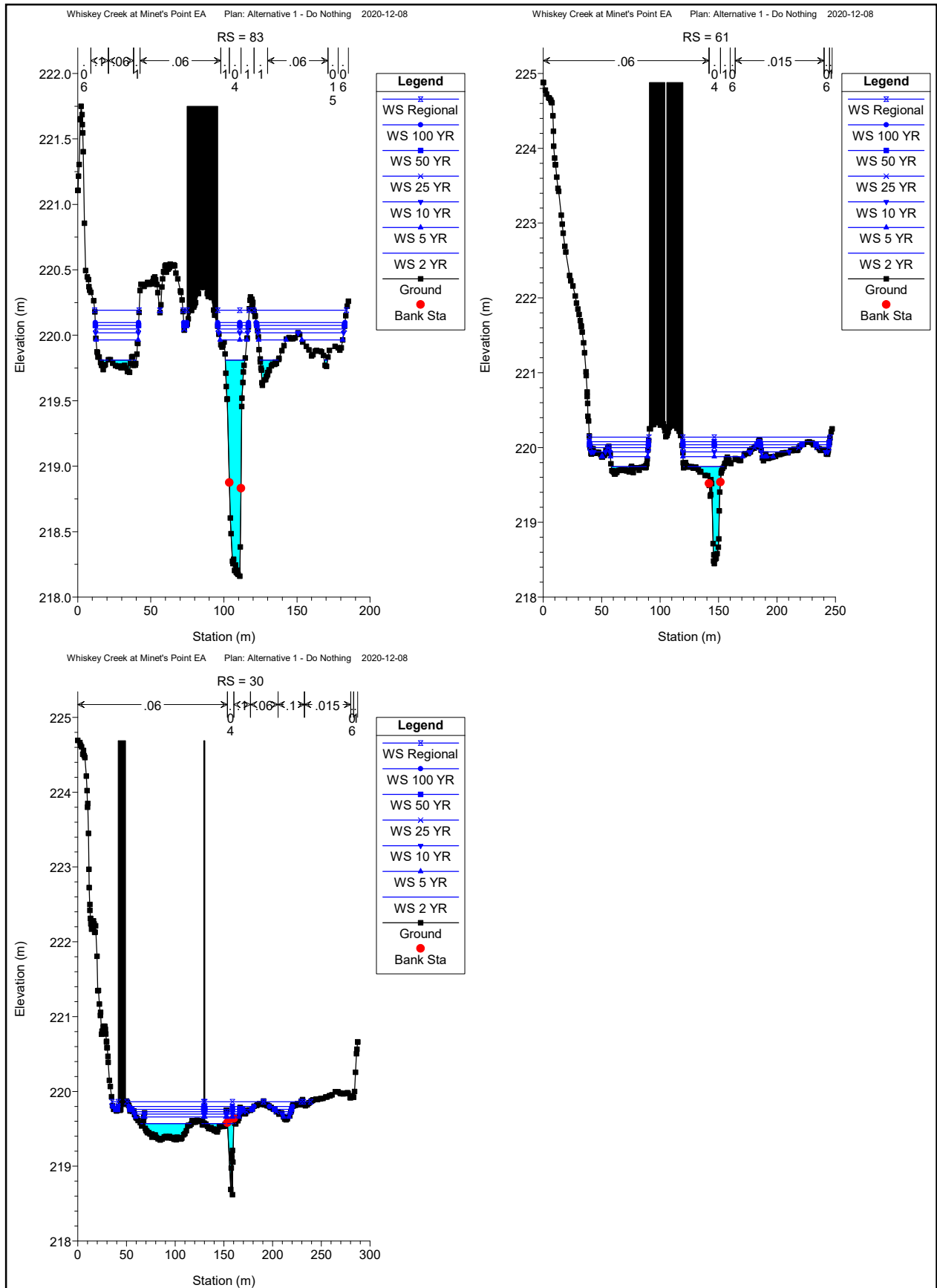
HEC-RAS Computation = 15.91 m³/s - OK











**Appendix G:
Hydraulic Model Results – 1:100-
Year Return Frequency Design
Storm Capacity**



HEC-RAS Plan: Alt2-100 Locations: User Defined

River	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
Whiskey	1	299	2 YR	10.00	220.47	221.37	221.37	221.61	0.013705	2.34	5.90	13.73	0.87
Whiskey	1	299	5 YR	19.42	220.47	221.65	221.65	221.96	0.012909	2.81	10.16	16.78	0.90
Whiskey	1	299	10 YR	27.16	220.47	221.81	221.81	222.18	0.013310	3.16	12.96	17.76	0.93
Whiskey	1	299	25 YR	34.88	220.47	221.95	221.95	222.38	0.013766	3.46	15.44	18.54	0.97
Whiskey	1	299	50 YR	41.86	220.47	222.07	222.07	222.54	0.013749	3.66	17.70	19.18	0.98
Whiskey	1	299	100 YR	52.03	220.47	222.22	222.22	222.76	0.014008	3.95	20.67	20.02	1.01
Whiskey	1	299	Regional	72.99	220.47	222.51	222.51	223.15	0.013758	4.39	26.73	21.36	1.03
Whiskey	1	278	2 YR	10.00	219.98	220.84	220.84	221.15	0.021401	2.46	4.06	6.68	1.01
Whiskey	1	278	5 YR	19.42	219.98	221.20	221.20	221.64	0.017993	2.96	6.79	9.80	0.98
Whiskey	1	278	10 YR	27.16	219.98	221.55	221.55	221.93	0.010564	2.81	13.81	28.86	0.79
Whiskey	1	278	25 YR	34.88	219.98	221.71	221.71	222.12	0.010227	3.00	18.67	29.93	0.79
Whiskey	1	278	50 YR	41.86	219.98	221.83	221.83	222.27	0.010424	3.18	22.18	30.52	0.81
Whiskey	1	278	100 YR	52.03	219.98	221.99	221.99	222.46	0.010438	3.40	27.07	31.22	0.83
Whiskey	1	278	Regional	72.99	219.98	222.24	222.24	222.81	0.011103	3.84	35.13	32.04	0.87
Whiskey	1	257	2 YR	10.00	219.08	219.77	219.77	220.07	0.020681	2.40	4.17	7.17	1.01
Whiskey	1	257	5 YR	19.42	219.08	220.12	220.12	220.52	0.018811	2.83	6.87	8.55	1.01
Whiskey	1	257	10 YR	27.16	219.08	220.34	220.34	220.82	0.017837	3.05	8.90	9.45	1.00
Whiskey	1	257	25 YR	34.88	219.08	220.53	220.53	221.07	0.017320	3.24	10.77	10.21	1.01
Whiskey	1	257	50 YR	41.86	219.08	220.77	220.69	221.27	0.013949	3.15	13.31	11.16	0.92
Whiskey	1	257	100 YR	52.03	219.08	220.89	220.89	221.53	0.016490	3.55	14.67	11.64	1.01
Whiskey	1	257	Regional	72.99	219.08	221.74		222.08	0.005059	2.68	36.58	34.20	0.60
Whiskey	1	249	2 YR	10.00	218.74	219.50		219.67	0.011639	1.82	5.50	9.29	0.76
Whiskey	1	249	5 YR	19.42	218.74	219.93		220.14	0.007871	2.02	9.64	10.14	0.66
Whiskey	1	249	10 YR	27.16	218.74	220.20		220.44	0.007259	2.19	12.39	10.67	0.65
Whiskey	1	249	25 YR	34.88	218.74	220.42		220.70	0.007024	2.35	14.85	11.12	0.65
Whiskey	1	249	50 YR	41.86	218.74	220.93		221.13	0.003744	2.02	21.45	18.46	0.49
Whiskey	1	249	100 YR	52.03	218.74	221.09		221.35	0.004273	2.27	24.71	20.11	0.53
Whiskey	1	249	Regional	72.99	218.74	221.80		222.02	0.002580	2.17	44.33	34.12	0.43
Whiskey	1	243	2 YR	10.03	218.50	219.52	219.15	219.59	0.003409	1.19	8.43	10.60	0.43
Whiskey	1	243	5 YR	19.49	218.50	219.95	219.42	220.06	0.003320	1.48	13.18	11.46	0.44
Whiskey	1	243	10 YR	27.27	218.50	220.22	219.61	220.36	0.003436	1.67	16.33	12.00	0.46
Whiskey	1	243	25 YR	35.03	218.50	220.45	219.77	220.62	0.003561	1.83	19.13	12.46	0.47
Whiskey	1	243	50 YR	42.04	218.50	220.94	219.91	221.08	0.002222	1.65	25.54	13.45	0.38
Whiskey	1	243	100 YR	52.25	218.50	221.11	220.09	221.29	0.002672	1.87	27.87	13.79	0.42
Whiskey	1	243	Regional	73.32	218.50	221.80	220.44	221.99	0.001938	1.92	42.25	31.06	0.37
Whiskey	1	234.33		Bridge									
Whiskey	1	225	2 YR	10.03	218.36	219.49	218.88	219.54	0.001559	0.94	10.68	10.56	0.30
Whiskey	1	225	5 YR	19.49	218.36	219.92	219.16	220.00	0.002004	1.27	15.35	11.41	0.35
Whiskey	1	225	10 YR	27.27	218.36	220.18	219.35	220.29	0.002323	1.48	18.37	11.93	0.38
Whiskey	1	225	25 YR	35.03	218.36	220.39	219.52	220.53	0.002612	1.67	20.98	12.36	0.41
Whiskey	1	225	50 YR	42.04	218.36	220.56	219.66	220.73	0.002833	1.82	23.16	12.71	0.43
Whiskey	1	225	100 YR	52.25	218.36	220.78	219.86	220.99	0.003114	2.02	25.92	13.14	0.46
Whiskey	1	225	Regional	73.32	218.36	221.24	220.21	221.47	0.003018	2.18	37.35	39.26	0.46
Whiskey	1	223	2 YR	10.03	218.34	219.49		219.53	0.001210	0.84	11.87	11.45	0.26
Whiskey	1	223	5 YR	19.49	218.34	219.92		219.99	0.001578	1.15	16.95	12.30	0.31
Whiskey	1	223	10 YR	27.27	218.34	220.18		220.27	0.001840	1.35	20.23	12.82	0.34
Whiskey	1	223	25 YR	35.03	218.34	220.40		220.52	0.002076	1.52	23.05	13.26	0.37
Whiskey	1	223	50 YR	42.04	218.34	220.57		220.71	0.002258	1.65	25.41	13.61	0.39
Whiskey	1	223	100 YR	52.25	218.34	220.79		220.96	0.002535	1.84	28.40	14.04	0.41
Whiskey	1	223	Regional	73.32	218.34	221.26		221.44	0.002334	1.95	42.04	42.57	0.40
Whiskey	1	221	2 YR	10.03	218.30	219.40		219.50	0.004525	1.42	7.08	8.64	0.50
Whiskey	1	221	5 YR	19.49	218.30	219.77		219.94	0.005588	1.84	10.59	10.14	0.58
Whiskey	1	221	10 YR	27.27	218.30	219.99		220.22	0.006323	2.11	12.92	11.02	0.62
Whiskey	1	221	25 YR	35.03	218.30	220.17		220.45	0.006994	2.34	14.96	11.73	0.66
Whiskey	1	221	50 YR	42.04	218.30	220.32		220.64	0.007402	2.51	16.75	12.33	0.69
Whiskey	1	221	100 YR	52.25	218.30	220.48		220.88	0.008317	2.78	18.83	12.98	0.74
Whiskey	1	221	Regional	73.32	218.30	220.86	220.52	221.33	0.008555	3.07	23.92	14.47	0.76
Whiskey	1	219		Lat Struct									
Whiskey	1	208	2 YR	10.03	218.22	219.23		219.42	0.011479	1.93	5.20	8.17	0.77
Whiskey	1	208	5 YR	19.49	218.22	219.58	219.45	219.85	0.011943	2.32	8.39	10.25	0.82
Whiskey	1	208	10 YR	27.27	218.22	219.79	219.67	220.12	0.012202	2.55	10.68	11.52	0.85
Whiskey	1	208	25 YR	35.03	218.22	219.97	219.85	220.35	0.012216	2.72	12.87	12.60	0.86
Whiskey	1	208	50 YR	42.04	218.22	220.18		220.55	0.010585	2.70	15.56	13.83	0.81
Whiskey	1	208	100 YR	52.25	218.22	220.37		220.78	0.010538	2.85	18.34	14.98	0.82
Whiskey	1	208	Regional	73.32	218.22	220.82	220.51	221.23	0.008281	2.83	26.23	26.28	0.75
Whiskey	1	201	2 YR	10.03	218.16	219.16		219.34	0.010546	1.86	5.38	8.38	0.74
Whiskey	1	201	5 YR	19.49	218.16	219.36	219.36	219.74	0.018425	2.72	7.16	9.57	1.01
Whiskey	1	201	10 YR	27.27	218.16	219.57	219.57	220.01	0.017432	2.91	9.37	10.87	1.00
Whiskey	1	201	25 YR	35.03	218.16	219.75	219.75	220.23	0.017138	3.08	11.36	11.92	1.01
Whiskey	1	201	50 YR	42.04	218.16	220.12		220.46	0.009555	2.60	16.19	14.14	0.78
Whiskey	1	201	100 YR	52.25	218.16	220.31		220.70	0.009552	2.74	19.04	15.30	0.79

HEC-RAS Plan: Alt2-100 Locations: User Defined (Continued)

River	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
Whiskey	1	201	Regional	73.32	218.16	220.80		221.16	0.006827	2.64	28.31	28.24	0.69
Whiskey	1	188	2 YR	10.03	218.05	219.23		219.26	0.001052	0.78	12.94	13.28	0.25
Whiskey	1	188	5 YR	19.49	218.05	219.42		219.50	0.002345	1.26	15.52	14.04	0.38
Whiskey	1	188	10 YR	27.27	218.05	219.61		219.72	0.002897	1.50	18.22	14.79	0.43
Whiskey	1	188	25 YR	35.03	218.05	219.80		219.94	0.003125	1.66	21.15	15.56	0.45
Whiskey	1	188	50 YR	42.04	218.05	220.24		220.35	0.001983	1.49	28.29	17.31	0.37
Whiskey	1	188	100 YR	52.25	218.05	220.44		220.58	0.002197	1.64	31.86	18.12	0.39
Whiskey	1	188	Regional	73.09	218.05	220.91		221.06	0.001911	1.73	43.58	33.37	0.38
Whiskey	1	180	2 YR	10.06	218.00	219.23	218.40	219.25	0.000516	0.59	17.02	15.02	0.18
Whiskey	1	180	5 YR	19.56	218.00	219.43	218.62	219.47	0.001208	0.98	19.92	15.40	0.28
Whiskey	1	180	10 YR	27.38	218.00	219.61	218.77	219.69	0.001561	1.20	22.86	15.78	0.32
Whiskey	1	180	25 YR	35.17	218.00	219.81	218.91	219.90	0.001725	1.36	25.95	16.17	0.34
Whiskey	1	180	50 YR	42.20	218.00	220.24	219.02	220.32	0.001131	1.28	32.86	17.03	0.29
Whiskey	1	180	100 YR	52.50	218.00	220.44	219.17	220.55	0.001284	1.46	36.06	17.43	0.31
Whiskey	1	180	Regional	72.42	218.00	220.91	219.44	221.03	0.001307	1.55	48.84	41.48	0.31
Whiskey	1	170.36	Bridge										
Whiskey	1	158	2 YR	10.06	218.00	219.21	218.34	219.22	0.000340	0.52	19.29	21.39	0.15
Whiskey	1	158	5 YR	19.56	218.00	219.35	218.54	219.39	0.000897	0.91	21.49	22.08	0.25
Whiskey	1	158	10 YR	27.38	218.00	219.49	218.67	219.55	0.001266	1.15	23.72	22.78	0.30
Whiskey	1	158	25 YR	35.17	218.00	219.63	218.80	219.72	0.001531	1.35	26.03	23.50	0.34
Whiskey	1	158	50 YR	42.20	218.00	219.76	218.89	219.88	0.001708	1.50	28.10	24.15	0.36
Whiskey	1	158	100 YR	52.50	218.00	219.94	219.03	220.09	0.001912	1.70	30.97	25.05	0.39
Whiskey	1	158	Regional	72.42	218.00	220.26	219.29	220.38	0.001796	1.53	47.39	27.23	0.36
Whiskey	1	150	2 YR	10.06	218.00	219.21	218.32	219.22	0.000265	0.41	24.31	23.22	0.13
Whiskey	1	150	5 YR	19.56	218.00	219.35	218.50	219.38	0.000684	0.71	27.60	23.95	0.21
Whiskey	1	150	10 YR	27.38	218.00	219.49	218.62	219.53	0.000942	0.88	31.07	24.69	0.25
Whiskey	1	150	25 YR	35.17	218.00	219.64	218.73	219.69	0.001110	1.01	34.83	25.46	0.28
Whiskey	1	150	50 YR	42.20	218.00	219.78	218.82	219.84	0.001222	1.10	38.30	26.39	0.29
Whiskey	1	150	100 YR	52.50	218.00	219.96	218.94	220.04	0.001353	1.21	43.42	28.08	0.31
Whiskey	1	150	Regional	72.26	218.00	220.26	219.15	220.35	0.001534	1.39	52.20	33.64	0.34
Whiskey	1	133	2 YR	10.06	218.00	219.21	218.33	219.21	0.000277	0.42	24.12	23.63	0.13
Whiskey	1	133	5 YR	19.56	218.00	219.34	218.51	219.36	0.000727	0.72	27.27	24.42	0.22
Whiskey	1	133	10 YR	27.38	218.00	219.47	218.63	219.51	0.001006	0.89	30.70	25.25	0.26
Whiskey	1	133	25 YR	35.17	218.00	219.62	218.74	219.67	0.001183	1.02	34.46	26.12	0.28
Whiskey	1	133	50 YR	42.20	218.00	219.75	218.83	219.82	0.001278	1.11	38.02	29.71	0.30
Whiskey	1	133	100 YR	52.50	218.00	219.94	218.95	220.02	0.001329	1.21	44.59	40.97	0.31
Whiskey	1	133	Regional	71.89	218.00	220.23	219.16	220.32	0.001356	1.36	58.00	52.95	0.32
Whiskey	1	108	2 YR	10.06	218.00	219.19	218.39	219.20	0.000472	0.53	19.10	19.62	0.17
Whiskey	1	108	5 YR	19.56	218.00	219.29	218.60	219.34	0.001328	0.93	21.14	20.24	0.29
Whiskey	1	108	10 YR	27.38	218.00	219.41	218.74	219.48	0.001911	1.16	23.51	20.93	0.35
Whiskey	1	108	25 YR	35.17	218.00	219.54	218.87	219.63	0.002293	1.34	26.27	21.70	0.39
Whiskey	1	108	50 YR	42.20	218.00	219.66	218.97	219.77	0.002500	1.46	28.94	22.43	0.41
Whiskey	1	108	100 YR	52.50	218.00	219.83	219.11	219.96	0.002665	1.59	33.24	32.33	0.43
Whiskey	1	108	Regional	71.88	218.00	220.16	219.34	220.28	0.002194	1.61	50.97	66.92	0.40
Whiskey	1	83	2 YR	10.06	218.00	219.18	218.41	219.19	0.000544	0.56	18.02	18.85	0.18
Whiskey	1	83	5 YR	19.56	218.00	219.25	218.62	219.30	0.001663	1.01	19.39	19.28	0.32
Whiskey	1	83	10 YR	27.38	218.00	219.34	218.77	219.42	0.002539	1.30	21.13	19.82	0.40
Whiskey	1	83	25 YR	35.17	218.00	219.45	218.90	219.56	0.003151	1.51	23.32	20.47	0.45
Whiskey	1	83	50 YR	42.20	218.00	219.55	219.00	219.69	0.003481	1.65	25.58	21.12	0.48
Whiskey	1	83	100 YR	52.50	218.00	219.72	219.14	219.88	0.003724	1.80	29.12	22.10	0.50
Whiskey	1	83	Regional	71.88	218.00	220.03	219.38	220.21	0.003491	1.92	41.72	73.13	0.50
Whiskey	1	61	2 YR	10.06	218.00	219.16	218.44	219.18	0.000716	0.63	16.06	17.35	0.21
Whiskey	1	61	5 YR	19.56	218.00	219.18	218.66	219.25	0.002544	1.19	16.41	17.47	0.39
Whiskey	1	61	10 YR	27.38	218.00	219.21	218.82	219.34	0.004571	1.62	16.91	17.64	0.53
Whiskey	1	61	25 YR	35.17	218.00	219.25	218.96	219.45	0.006695	2.00	17.62	17.88	0.64
Whiskey	1	61	50 YR	42.20	218.00	219.29	219.06	219.56	0.008400	2.28	18.49	18.17	0.72
Whiskey	1	61	100 YR	52.50	218.00	219.38	219.22	219.73	0.010177	2.61	20.14	18.71	0.80
Whiskey	1	61	Regional	71.88	218.00	219.64	219.46	220.06	0.010168	2.86	25.13	23.30	0.82
Whiskey	1	30	2 YR	10.08	218.00	219.15	218.33	219.16	0.000332	0.44	22.68	23.17	0.14
Whiskey	1	30	5 YR	19.59	218.00	219.15	218.51	219.19	0.001255	0.86	22.68	23.17	0.28
Whiskey	1	30	10 YR	27.43	218.00	219.15	218.64	219.22	0.002460	1.21	22.68	23.17	0.39
Whiskey	1	30	25 YR	35.24	218.00	219.15	218.74	219.27	0.004060	1.55	22.68	23.17	0.50
Whiskey	1	30	50 YR	42.29	218.00	219.15	218.84	219.33	0.005846	1.86	22.68	23.17	0.60
Whiskey	1	30	100 YR	52.62	218.00	219.15	218.96	219.42	0.009051	2.32	22.68	23.17	0.75
Whiskey	1	30	Regional	72.04	218.00	219.50	219.17	219.77	0.006637	2.31	31.16	25.27	0.66

HEC-RAS Plan: Alt2-100 Locations: User Defined

River	Reach	River Sta	Profile	E. G. US.	Min El Prs	BR Open Area	Prs O WS	Q Total	Min El Weir Flow	Q Weir	Delta EG	BR Sluice Coef
				(m)	(m)	(m2)	(m)	(m3/s)	(m)	(m3/s)	(m)	
Whiskey	1	234.33	2 YR	219.59	220.70	20.54		10.03	221.30		0.06	
Whiskey	1	234.33	5 YR	220.06	220.70	20.54		19.49	221.30		0.06	
Whiskey	1	234.33	10 YR	220.36	220.70	20.54		27.27	221.30		0.07	
Whiskey	1	234.33	25 YR	220.62	220.70	20.54		35.03	221.30		0.09	
Whiskey	1	234.33	50 YR	221.08	220.70	20.54	220.94	42.04	221.30		0.35	0.40
Whiskey	1	234.33	100 YR	221.29	220.70	20.54	221.11	52.25	221.30		0.31	
Whiskey	1	234.33	Regional	221.99	220.70	20.54		73.32	221.30	10.42	0.52	
Whiskey	1	170.36	2 YR	219.25	220.00	21.15		10.06	220.62		0.03	
Whiskey	1	170.36	5 YR	219.47	220.00	21.15		19.56	220.62		0.08	
Whiskey	1	170.36	10 YR	219.69	220.00	21.15		27.38	220.62		0.13	
Whiskey	1	170.36	25 YR	219.90	220.00	21.15		35.17	220.62		0.18	
Whiskey	1	170.36	50 YR	220.32	220.00	21.15	220.24	42.20	220.62		0.45	0.39
Whiskey	1	170.36	100 YR	220.55	220.00	21.15	220.44	52.50	220.62		0.46	0.45
Whiskey	1	170.36	Regional	221.03	220.00	21.15		72.42	220.62	6.59	0.65	

HEC-RAS Plan: Alt2-100 River: Whiskey Reach: 1

Reach	River Sta	Profile	Q US (m3/s)	Q Leaving Total (m3/s)	Q DS (m3/s)	Q Weir (m3/s)	Q Gates (m3/s)	Wr Top Width (m)	Weir Max Depth (m)	Weir Avg Depth (m)	Min El Weir Flow (m)	E.G. US. (m)	W.S. US. (m)	E.G. DS (m)	W.S. DS (m)
1	219	2 YR	10.03	0.00	10.08	0.00					220.07	219.49	219.37	219.16	219.15
1	219	5 YR	19.49	0.00	19.59	0.00					220.07	219.93	219.74	219.19	219.15
1	219	10 YR	27.27	0.00	27.43	0.00					220.07	220.20	219.96	219.23	219.15
1	219	25 YR	35.03	0.00	35.24	0.00					220.07	220.43	220.14	219.28	219.15
1	219	50 YR	42.04	0.00	42.29	0.00					220.07	220.62	220.29	219.33	219.15
1	219	100 YR	52.25	0.00	52.62	0.00					220.07	220.86	220.46	219.43	219.15
1	219	Regional	73.32	1.80	72.04	1.80		75.82	0.42	0.19	220.07	221.32	220.85	219.78	219.50



Project:	Whiskey Creek at Minet's Point	Prepared By:	DAM
File No.:	120114	Reviewed By:	DRT
Revision:	-	Date:	07-Dec-20
Description:	Lateral Weir Calculation Check		

Rectangular Weir Formula

$$Q = CWH^{3/2}$$

Alternative 2 - Lateral Weir 222.8 - Regulatory Storm

Weir Coefficient = 0.47

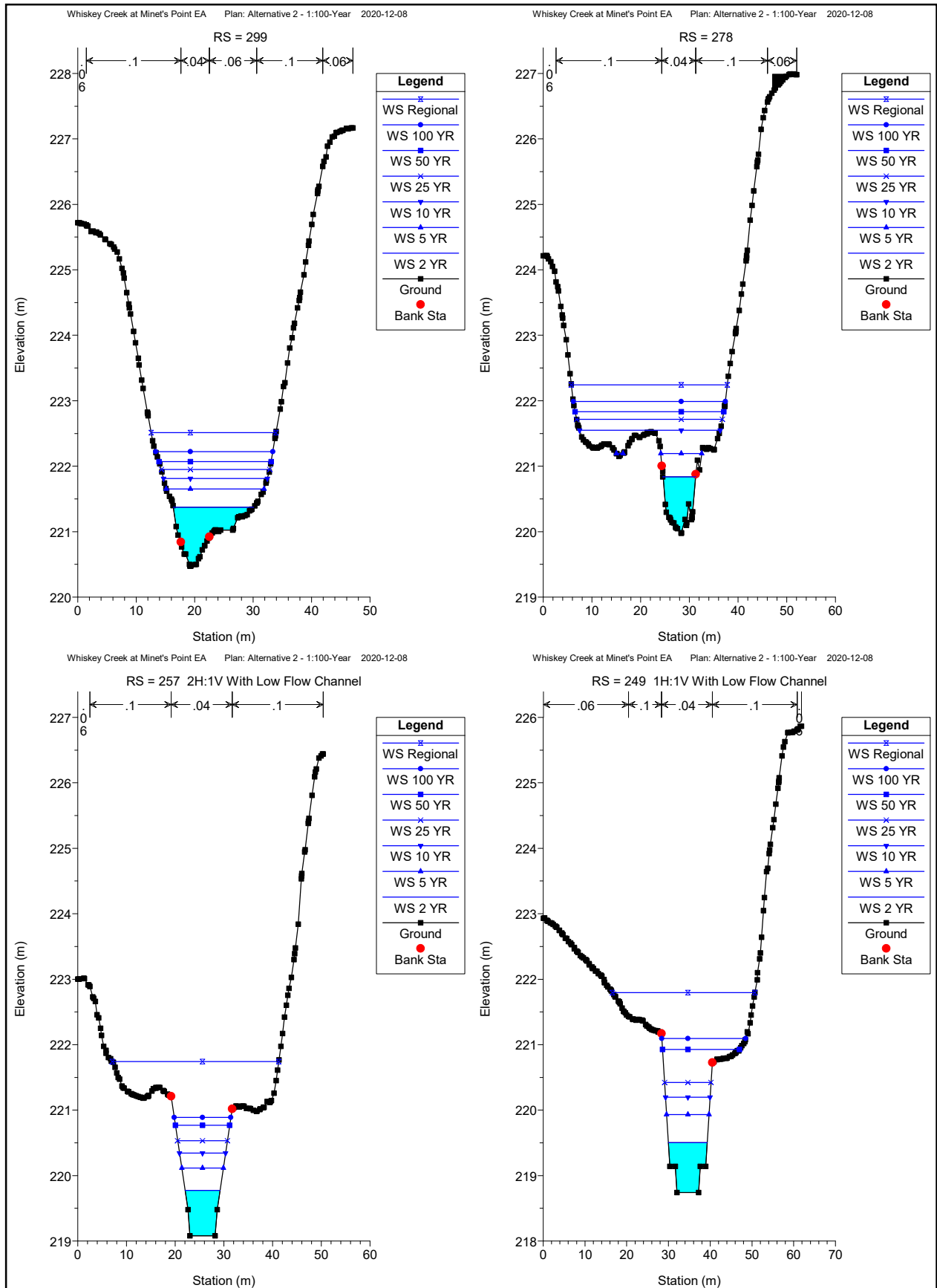
Weir Width = 58.0 m

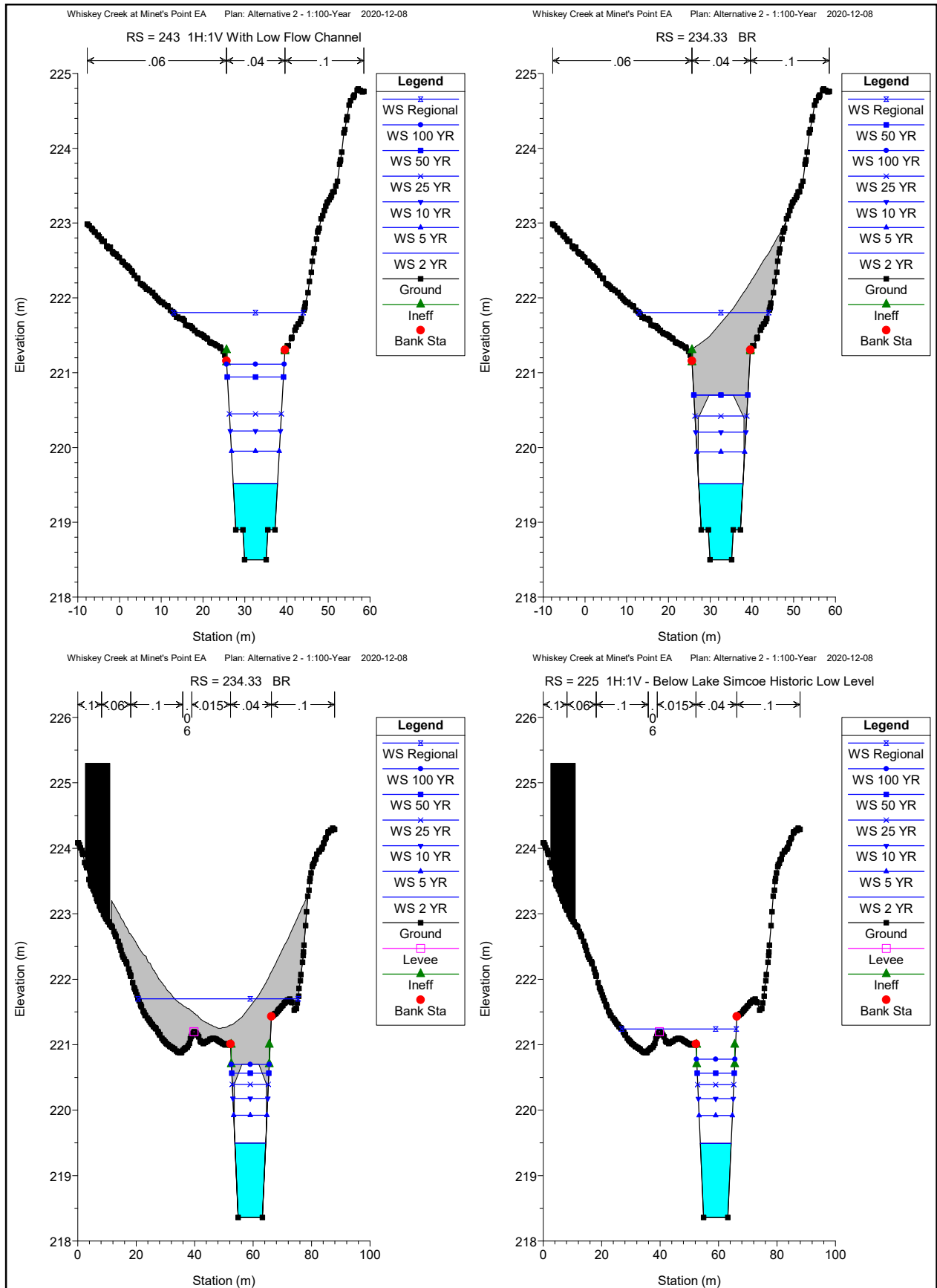
Average Depth = 0.18 m

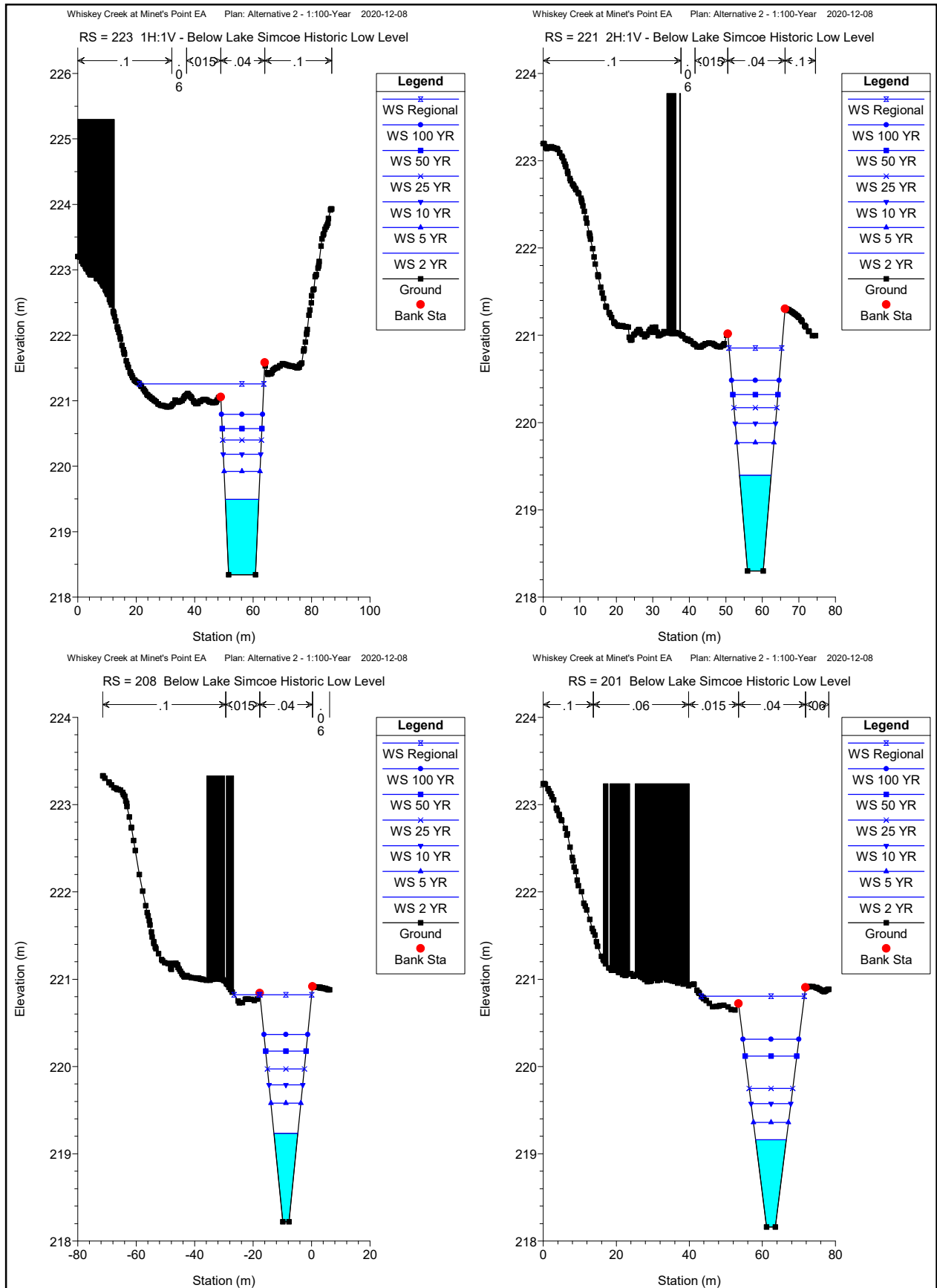
$$Q = 0.47 \times 59.0 \times 0.19^{3/2}$$

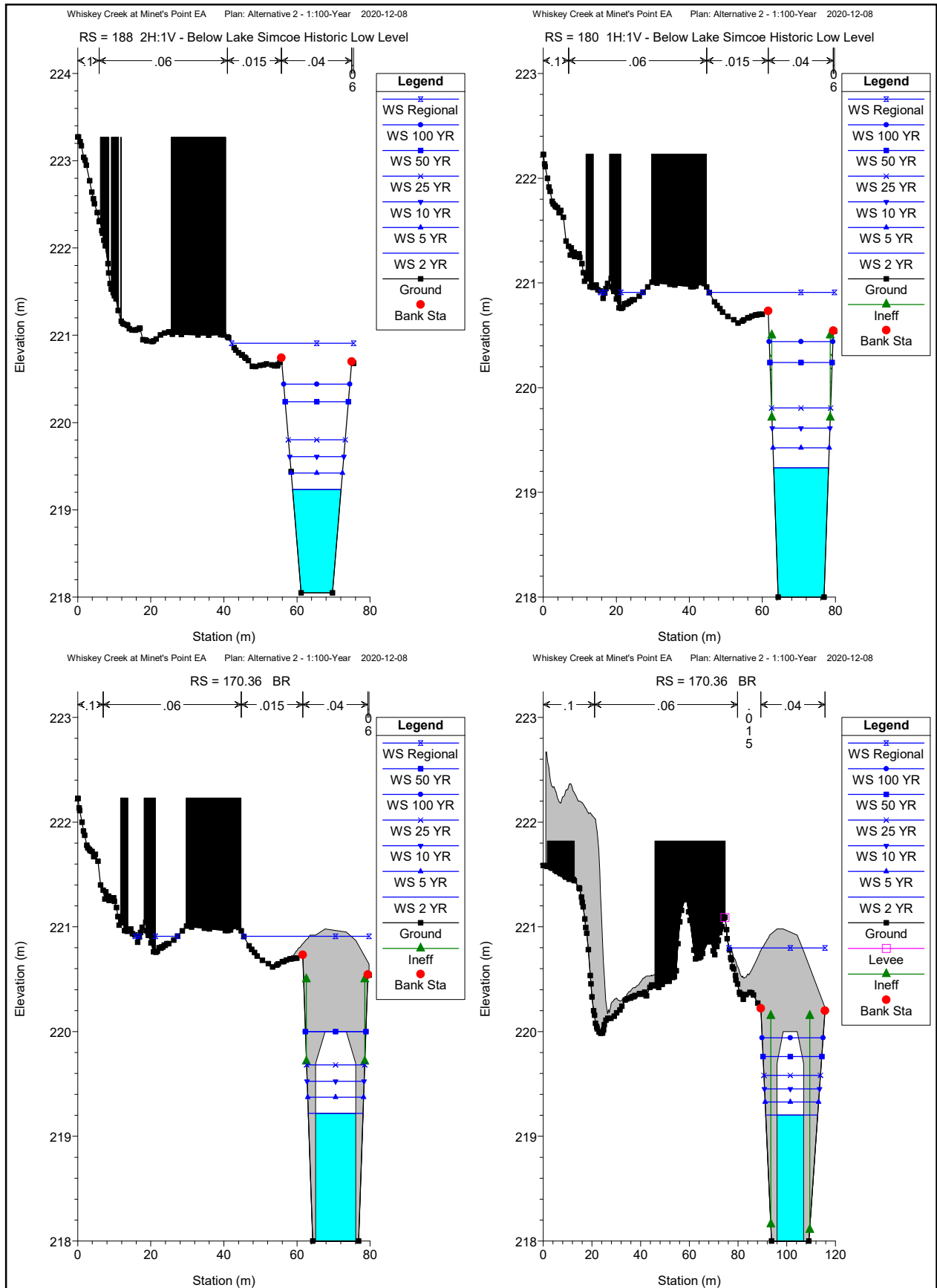
$$Q = 2.21 \text{ m}^3/\text{s}$$

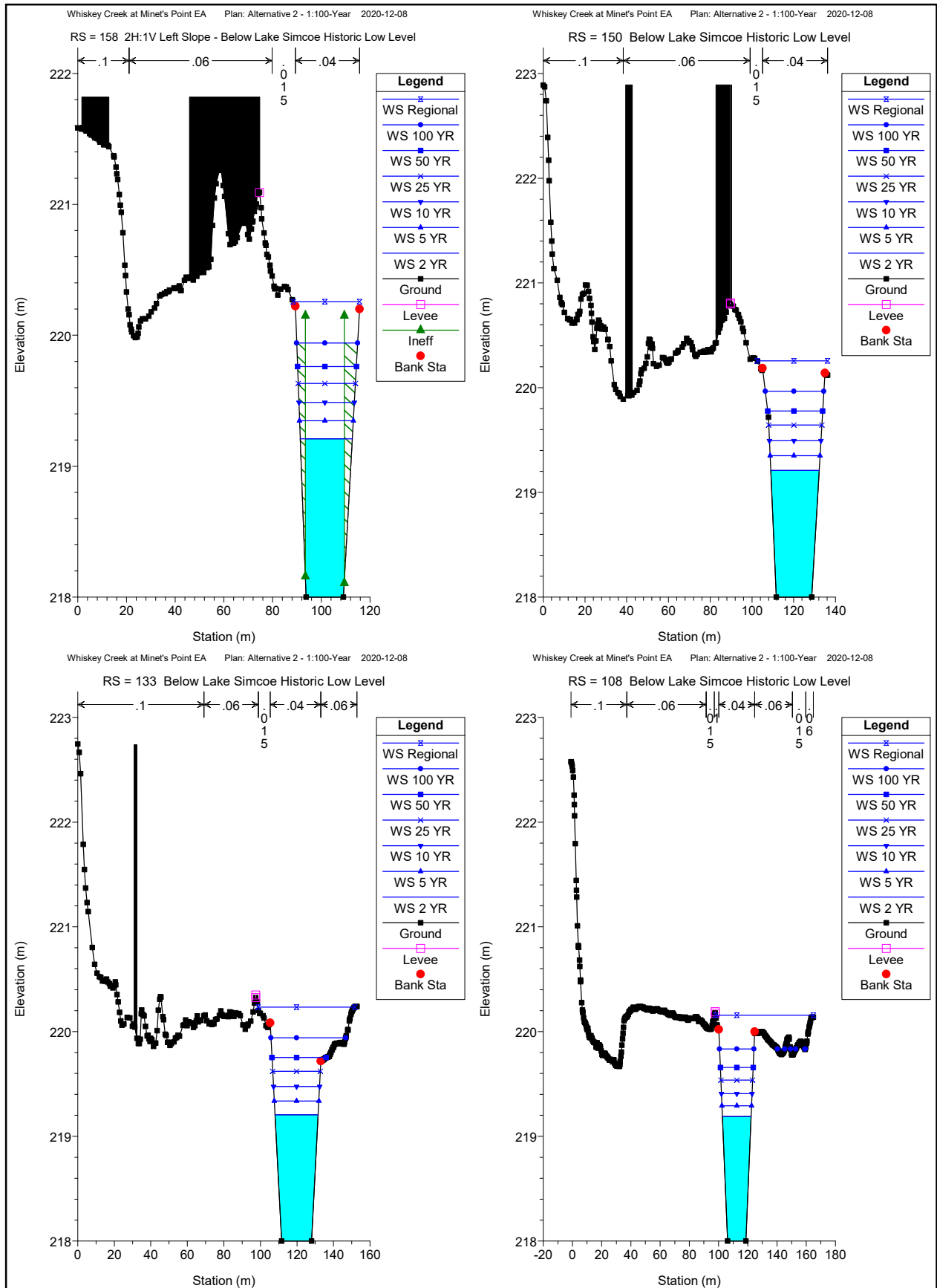
HEC-RAS Computation = 1.80 m³/s - OK

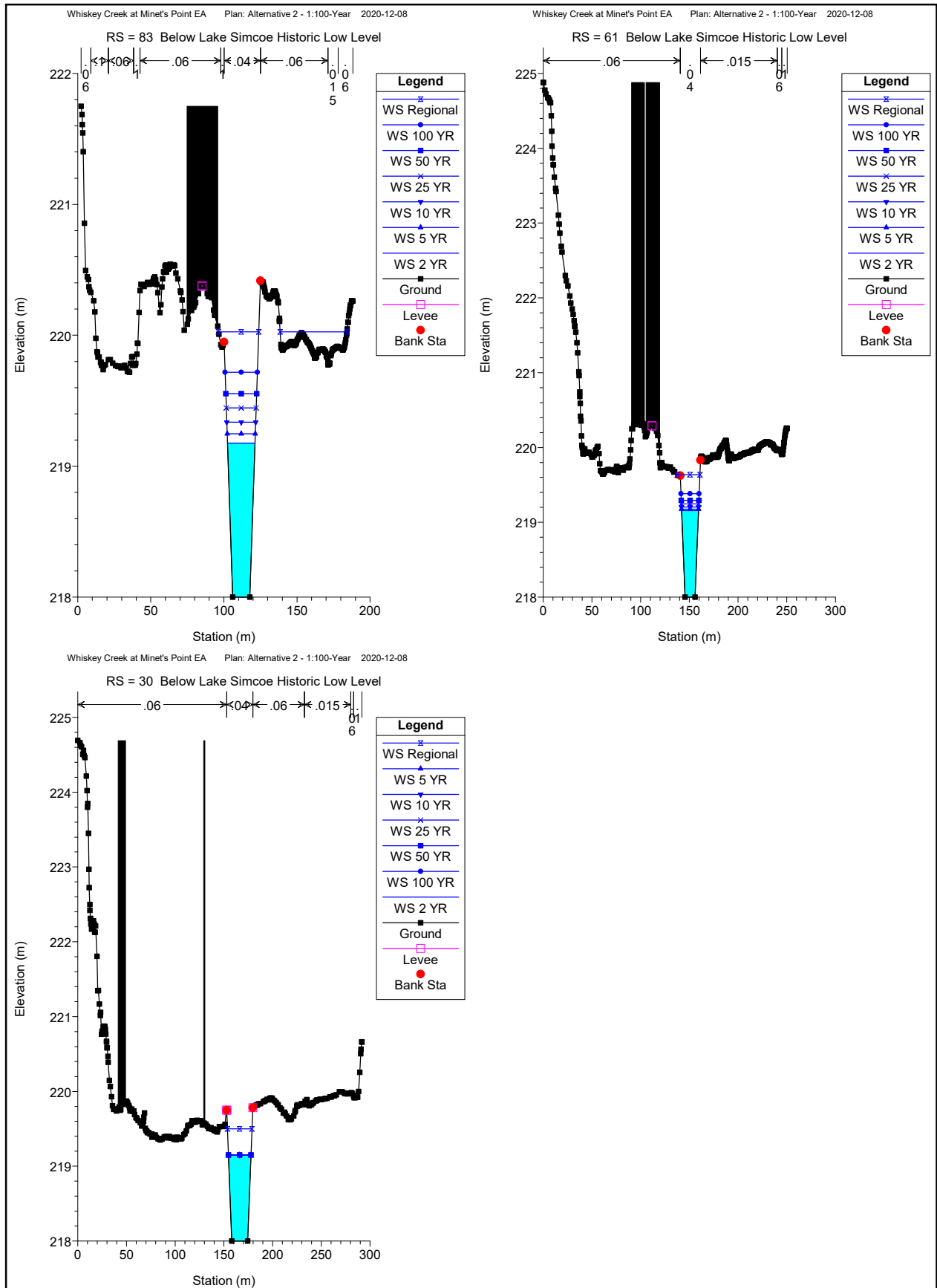












**Appendix H:
Hydraulic Model Results – 1:50-
Year Return Frequency Design
Storm Capacity**



HEC-RAS Plan: Alt3-50 Locations: User Defined

River	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
Whiskey	1	299	2 YR	10.00	220.47	221.37	221.37	221.61	0.013705	2.34	5.90	13.73	0.87
Whiskey	1	299	5 YR	19.42	220.47	221.65	221.65	221.96	0.012909	2.81	10.16	16.78	0.90
Whiskey	1	299	10 YR	27.16	220.47	221.81	221.81	222.18	0.013310	3.16	12.96	17.76	0.93
Whiskey	1	299	25 YR	34.88	220.47	221.95	221.95	222.38	0.013766	3.46	15.44	18.54	0.97
Whiskey	1	299	50 YR	41.86	220.47	222.07	222.07	222.54	0.013749	3.66	17.70	19.18	0.98
Whiskey	1	299	100 YR	52.03	220.47	222.22	222.22	222.76	0.014008	3.95	20.67	20.02	1.01
Whiskey	1	299	Regional	72.99	220.47	222.51	222.51	223.15	0.013758	4.39	26.73	21.36	1.03
Whiskey	1	278	2 YR	10.00	219.98	220.84	220.84	221.15	0.021401	2.46	4.06	6.68	1.01
Whiskey	1	278	5 YR	19.42	219.98	221.20	221.20	221.64	0.017993	2.96	6.79	9.80	0.98
Whiskey	1	278	10 YR	27.16	219.98	221.55	221.55	221.93	0.010564	2.81	13.81	28.86	0.79
Whiskey	1	278	25 YR	34.88	219.98	221.71	221.71	222.12	0.010227	3.00	18.67	29.93	0.79
Whiskey	1	278	50 YR	41.86	219.98	221.84	221.84	222.27	0.010173	3.16	22.44	30.56	0.80
Whiskey	1	278	100 YR	52.03	219.98	221.99	221.99	222.46	0.010445	3.40	27.07	31.22	0.83
Whiskey	1	278	Regional	72.99	219.98	222.24	222.24	222.81	0.011103	3.84	35.13	32.04	0.87
Whiskey	1	257	2 YR	10.00	219.08	219.77	219.77	220.07	0.020681	2.40	4.17	7.17	1.01
Whiskey	1	257	5 YR	19.42	219.08	220.12	220.12	220.52	0.018811	2.83	6.87	8.55	1.01
Whiskey	1	257	10 YR	27.16	219.08	220.34	220.34	220.82	0.017837	3.05	8.90	9.45	1.00
Whiskey	1	257	25 YR	34.88	219.08	220.94		221.21	0.006630	2.28	15.28	11.85	0.64
Whiskey	1	257	50 YR	41.86	219.08	221.16		221.43	0.005927	2.32	18.88	20.58	0.62
Whiskey	1	257	100 YR	52.03	219.08	221.46		221.72	0.004671	2.32	27.09	32.08	0.56
Whiskey	1	257	Regional	72.99	219.08	222.02		222.25	0.003029	2.26	46.49	36.61	0.48
Whiskey	1	249	2 YR	10.00	218.74	219.56		219.70	0.008871	1.67	6.00	9.40	0.67
Whiskey	1	249	5 YR	19.42	218.74	220.03		220.20	0.005772	1.82	10.69	10.35	0.57
Whiskey	1	249	10 YR	27.16	218.74	220.34		220.53	0.005111	1.95	13.96	10.96	0.55
Whiskey	1	249	25 YR	34.88	218.74	221.01		221.14	0.002239	1.60	22.99	19.39	0.38
Whiskey	1	249	50 YR	41.86	218.74	221.22		221.37	0.002203	1.69	27.40	22.96	0.38
Whiskey	1	249	100 YR	52.03	218.74	221.51		221.67	0.002086	1.80	35.00	30.61	0.38
Whiskey	1	249	Regional	72.99	218.74	222.05		222.22	0.001768	1.91	53.35	37.31	0.36
Whiskey	1	243	2 YR	10.03	218.50	219.57	219.15	219.63	0.002814	1.12	8.97	10.70	0.39
Whiskey	1	243	5 YR	19.49	218.50	220.05	219.42	220.15	0.002394	1.37	14.18	11.66	0.39
Whiskey	1	243	10 YR	27.27	218.50	220.36	219.61	220.48	0.002310	1.56	17.53	12.27	0.39
Whiskey	1	243	25 YR	35.03	218.50	221.01	219.77	221.11	0.001216	1.42	24.69	13.58	0.30
Whiskey	1	243	50 YR	42.04	218.50	221.22	219.89	221.35	0.001299	1.56	27.01	14.25	0.32
Whiskey	1	243	100 YR	52.25	218.50	221.51	220.08	221.64	0.001484	1.56	34.50	22.15	0.32
Whiskey	1	243	Regional	73.32	218.50	222.05	220.41	222.19	0.001374	1.71	50.70	36.87	0.32
Whiskey	1	234.33		Bridge									
Whiskey	1	225	2 YR	10.03	218.36	219.49	218.88	219.54	0.001437	0.95	10.59	10.56	0.29
Whiskey	1	225	5 YR	19.49	218.36	219.91	219.16	220.00	0.001793	1.32	14.76	11.41	0.35
Whiskey	1	225	10 YR	27.27	218.36	220.17	219.34	220.30	0.002072	1.58	17.29	11.92	0.38
Whiskey	1	225	25 YR	35.03	218.36	220.38	219.51	220.55	0.002341	1.81	19.37	12.33	0.41
Whiskey	1	225	50 YR	42.04	218.36	220.57	219.65	220.77	0.002467	1.98	21.27	12.72	0.43
Whiskey	1	225	100 YR	52.25	218.36	220.82	219.84	221.07	0.002624	2.20	23.79	13.23	0.45
Whiskey	1	225	Regional	73.32	218.36	221.26	220.19	221.48	0.002886	2.14	38.20	39.71	0.45
Whiskey	1	223	2 YR	10.03	218.34	219.50		219.53	0.001203	0.84	11.89	11.45	0.26
Whiskey	1	223	5 YR	19.49	218.34	219.92		219.99	0.001578	1.15	16.95	12.30	0.31
Whiskey	1	223	10 YR	27.27	218.34	220.18		220.27	0.001840	1.35	20.23	12.82	0.34
Whiskey	1	223	25 YR	35.03	218.34	220.40		220.52	0.002076	1.52	23.05	13.26	0.37
Whiskey	1	223	50 YR	42.04	218.34	220.60		220.73	0.002180	1.63	25.72	13.65	0.38
Whiskey	1	223	100 YR	52.25	218.34	220.86		221.02	0.002294	1.78	29.41	14.18	0.39
Whiskey	1	223	Regional	73.32	218.34	221.28		221.46	0.002239	1.92	42.92	43.33	0.40
Whiskey	1	221	2 YR	10.03	218.30	219.40		219.50	0.004486	1.41	7.10	8.65	0.50
Whiskey	1	221	5 YR	19.49	218.30	219.77		219.94	0.005588	1.84	10.59	10.14	0.58
Whiskey	1	221	10 YR	27.27	218.30	219.99		220.22	0.006323	2.11	12.92	11.02	0.62
Whiskey	1	221	25 YR	35.03	218.30	220.17		220.45	0.006994	2.34	14.96	11.73	0.66
Whiskey	1	221	50 YR	42.04	218.30	220.37		220.67	0.006745	2.43	17.33	12.51	0.66
Whiskey	1	221	100 YR	52.25	218.30	220.64		220.96	0.006278	2.50	20.88	13.60	0.64
Whiskey	1	221	Regional	73.32	218.30	220.91	220.52	221.36	0.007836	2.97	24.86	22.20	0.73
Whiskey	1	219		Lat Struct									
Whiskey	1	208	2 YR	10.03	218.22	219.24		219.43	0.011045	1.90	5.27	8.23	0.76
Whiskey	1	208	5 YR	19.49	218.22	219.58	219.45	219.85	0.011943	2.32	8.39	10.25	0.82
Whiskey	1	208	10 YR	27.27	218.22	219.79	219.67	220.12	0.012202	2.55	10.68	11.52	0.85
Whiskey	1	208	25 YR	35.03	218.22	219.97	219.85	220.35	0.012216	2.72	12.87	12.60	0.86
Whiskey	1	208	50 YR	42.04	218.22	220.28		220.59	0.008223	2.46	17.10	14.48	0.72
Whiskey	1	208	100 YR	52.25	218.22	220.59		220.88	0.006578	2.39	21.87	16.34	0.66
Whiskey	1	208	Regional	73.31	218.22	220.91	220.51	221.25	0.006677	2.61	28.67	32.05	0.68
Whiskey	1	201	2 YR	10.03	218.16	219.18		219.34	0.009853	1.82	5.52	8.48	0.72
Whiskey	1	201	5 YR	19.49	218.16	219.36	219.36	219.74	0.018425	2.72	7.16	9.57	1.01
Whiskey	1	201	10 YR	27.27	218.16	219.57	219.57	220.01	0.017432	2.91	9.37	10.87	1.00
Whiskey	1	201	25 YR	35.03	218.16	219.75	219.75	220.23	0.017138	3.08	11.36	11.92	1.01
Whiskey	1	201	50 YR	42.04	218.16	220.25		220.53	0.007101	2.32	18.08	14.92	0.67
Whiskey	1	201	100 YR	52.25	218.16	220.57		220.83	0.005647	2.25	23.18	16.85	0.61

HEC-RAS Plan: Alt3-50 Locations: User Defined (Continued)

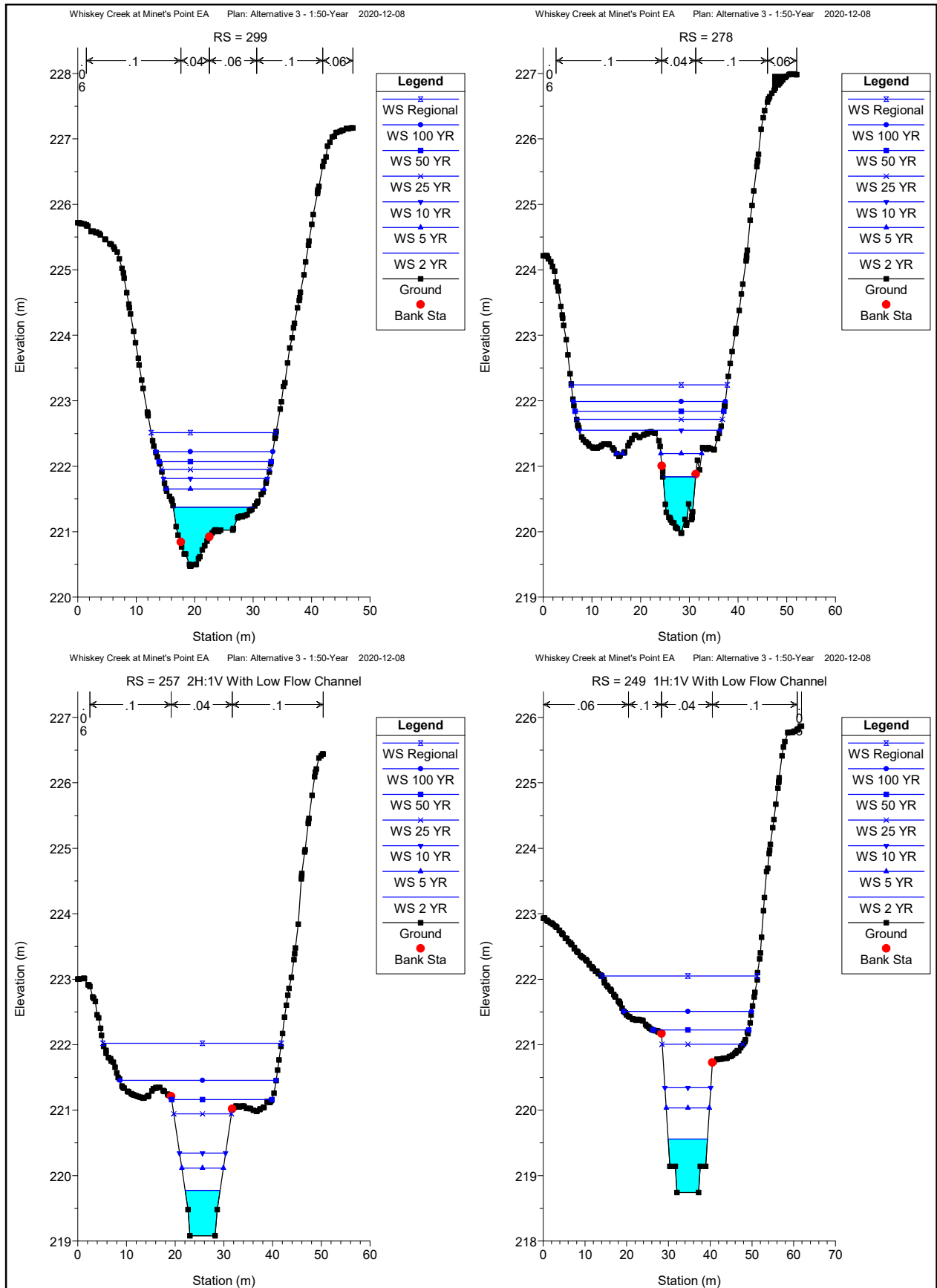
River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Whiskey	1	201	Regional	73.28	218.16	220.90		221.19	0.005293	2.40	31.34	33.58	0.61
Whiskey	1	188	2 YR	10.03	218.05	219.25		219.28	0.001015	0.77	13.10	13.33	0.25
Whiskey	1	188	5 YR	19.49	218.05	219.46		219.54	0.002130	1.21	16.05	14.19	0.36
Whiskey	1	188	10 YR	27.27	218.05	219.67		219.78	0.002516	1.42	19.14	15.04	0.40
Whiskey	1	188	25 YR	35.03	218.05	219.89		220.01	0.002615	1.56	22.52	15.91	0.42
Whiskey	1	188	50 YR	42.04	218.05	220.34		220.44	0.001677	1.40	30.04	17.71	0.34
Whiskey	1	188	100 YR	52.25	218.05	220.64		220.75	0.001609	1.47	35.64	19.78	0.34
Whiskey	1	188	Regional	72.83	218.05	220.98		221.11	0.001625	1.63	46.27	39.04	0.35
Whiskey	1	180	2 YR	10.06	218.00	219.25	218.40	219.26	0.000485	0.59	17.18	15.05	0.17
Whiskey	1	180	5 YR	19.56	218.00	219.46	218.62	219.51	0.001041	0.96	20.37	15.48	0.26
Whiskey	1	180	10 YR	27.38	218.00	219.67	218.77	219.74	0.001265	1.16	23.50	15.90	0.29
Whiskey	1	180	25 YR	35.17	218.00	219.89	218.91	219.98	0.001361	1.32	26.72	16.34	0.31
Whiskey	1	180	50 YR	42.20	218.00	220.34	219.02	220.42	0.000944	1.27	33.27	17.23	0.27
Whiskey	1	180	100 YR	52.37	218.00	220.64	219.17	220.73	0.001064	1.30	40.24	20.53	0.28
Whiskey	1	180	Regional	71.83	218.00	220.99	219.43	221.09	0.001112	1.46	52.15	46.75	0.29
Whiskey	1	170.36	Bridge										
Whiskey	1	158	2 YR	10.06	218.00	219.21	218.36	219.23	0.000397	0.56	17.83	21.39	0.16
Whiskey	1	158	5 YR	19.56	218.00	219.34	218.57	219.39	0.001054	0.99	19.82	22.06	0.27
Whiskey	1	158	10 YR	27.38	218.00	219.48	218.71	219.56	0.001493	1.25	21.85	22.75	0.33
Whiskey	1	158	25 YR	35.17	218.00	219.62	218.84	219.73	0.001813	1.47	23.95	23.46	0.37
Whiskey	1	158	50 YR	42.20	218.00	219.75	218.94	219.89	0.002029	1.63	25.84	24.10	0.39
Whiskey	1	158	100 YR	52.37	218.00	219.93	219.09	220.10	0.002276	1.84	28.41	24.97	0.42
Whiskey	1	158	Regional	71.83	218.00	220.25	219.34	220.37	0.001786	1.52	47.22	27.09	0.36
Whiskey	1	150	2 YR	10.06	218.00	219.21	218.32	219.22	0.000265	0.41	24.31	23.22	0.13
Whiskey	1	150	5 YR	19.56	218.00	219.35	218.50	219.38	0.000684	0.71	27.60	23.95	0.21
Whiskey	1	150	10 YR	27.38	218.00	219.49	218.62	219.53	0.000942	0.88	31.07	24.69	0.25
Whiskey	1	150	25 YR	35.17	218.00	219.64	218.73	219.69	0.001110	1.01	34.83	25.46	0.28
Whiskey	1	150	50 YR	42.20	218.00	219.78	218.82	219.84	0.001222	1.10	38.30	26.39	0.29
Whiskey	1	150	100 YR	52.37	218.00	219.96	218.94	220.04	0.001351	1.21	43.36	28.06	0.31
Whiskey	1	150	Regional	71.68	218.00	220.25	219.15	220.35	0.001528	1.38	51.99	33.41	0.34
Whiskey	1	133	2 YR	10.06	218.00	219.21	218.33	219.21	0.000277	0.42	24.12	23.63	0.13
Whiskey	1	133	5 YR	19.56	218.00	219.34	218.51	219.36	0.000727	0.72	27.27	24.42	0.22
Whiskey	1	133	10 YR	27.38	218.00	219.47	218.63	219.51	0.001006	0.89	30.70	25.25	0.26
Whiskey	1	133	25 YR	35.17	218.00	219.62	218.74	219.67	0.001183	1.02	34.46	26.12	0.28
Whiskey	1	133	50 YR	42.20	218.00	219.75	218.83	219.82	0.001278	1.11	38.02	29.71	0.30
Whiskey	1	133	100 YR	52.37	218.00	219.94	218.96	220.01	0.001328	1.21	44.50	40.93	0.31
Whiskey	1	133	Regional	71.33	218.00	220.23	219.16	220.32	0.001352	1.36	57.68	52.45	0.32
Whiskey	1	108	2 YR	10.06	218.00	219.19	218.39	219.20	0.000472	0.53	19.10	19.62	0.17
Whiskey	1	108	5 YR	19.56	218.00	219.29	218.60	219.34	0.001328	0.93	21.14	20.24	0.29
Whiskey	1	108	10 YR	27.38	218.00	219.41	218.74	219.48	0.001911	1.16	23.51	20.93	0.35
Whiskey	1	108	25 YR	35.17	218.00	219.54	218.87	219.63	0.002293	1.34	26.27	21.70	0.39
Whiskey	1	108	50 YR	42.20	218.00	219.66	218.97	219.77	0.002500	1.46	28.94	22.43	0.41
Whiskey	1	108	100 YR	52.37	218.00	219.83	219.11	219.96	0.002664	1.59	33.17	31.84	0.43
Whiskey	1	108	Regional	71.33	218.00	220.15	219.34	220.27	0.002205	1.61	50.50	66.82	0.40
Whiskey	1	83	2 YR	10.06	218.00	219.18	218.41	219.19	0.000544	0.56	18.02	18.85	0.18
Whiskey	1	83	5 YR	19.56	218.00	219.25	218.62	219.30	0.001663	1.01	19.39	19.28	0.32
Whiskey	1	83	10 YR	27.38	218.00	219.34	218.77	219.42	0.002539	1.30	21.13	19.82	0.40
Whiskey	1	83	25 YR	35.17	218.00	219.45	218.90	219.56	0.003151	1.51	23.32	20.47	0.45
Whiskey	1	83	50 YR	42.20	218.00	219.55	219.00	219.69	0.003481	1.65	25.58	21.12	0.48
Whiskey	1	83	100 YR	52.37	218.00	219.72	219.14	219.88	0.003722	1.80	29.07	22.09	0.50
Whiskey	1	83	Regional	71.33	218.00	220.02	219.37	220.20	0.003514	1.92	41.12	72.51	0.50
Whiskey	1	61	2 YR	10.06	218.00	219.16	218.44	219.18	0.000716	0.63	16.06	17.35	0.21
Whiskey	1	61	5 YR	19.56	218.00	219.18	218.66	219.25	0.002544	1.19	16.41	17.47	0.39
Whiskey	1	61	10 YR	27.38	218.00	219.21	218.82	219.34	0.004571	1.62	16.91	17.64	0.53
Whiskey	1	61	25 YR	35.17	218.00	219.25	218.96	219.45	0.006695	2.00	17.62	17.88	0.64
Whiskey	1	61	50 YR	42.20	218.00	219.29	219.06	219.56	0.008400	2.28	18.49	18.17	0.72
Whiskey	1	61	100 YR	52.37	218.00	219.38	219.21	219.73	0.010161	2.60	20.11	18.70	0.80
Whiskey	1	61	Regional	71.33	218.00	219.64	219.46	220.05	0.010079	2.85	25.07	23.10	0.82
Whiskey	1	30	2 YR	10.08	218.00	219.15	218.33	219.16	0.000332	0.44	22.68	23.17	0.14
Whiskey	1	30	5 YR	19.59	218.00	219.15	218.51	219.19	0.001255	0.86	22.68	23.17	0.28
Whiskey	1	30	10 YR	27.43	218.00	219.15	218.64	219.22	0.002460	1.21	22.68	23.17	0.39
Whiskey	1	30	25 YR	35.24	218.00	219.15	218.74	219.27	0.004060	1.55	22.68	23.17	0.50
Whiskey	1	30	50 YR	42.29	218.00	219.15	218.84	219.33	0.005846	1.86	22.68	23.17	0.60
Whiskey	1	30	100 YR	52.49	218.00	219.15	218.96	219.42	0.009007	2.31	22.68	23.17	0.75
Whiskey	1	30	Regional	71.49	218.00	219.50	219.16	219.77	0.006535	2.29	31.16	25.27	0.66

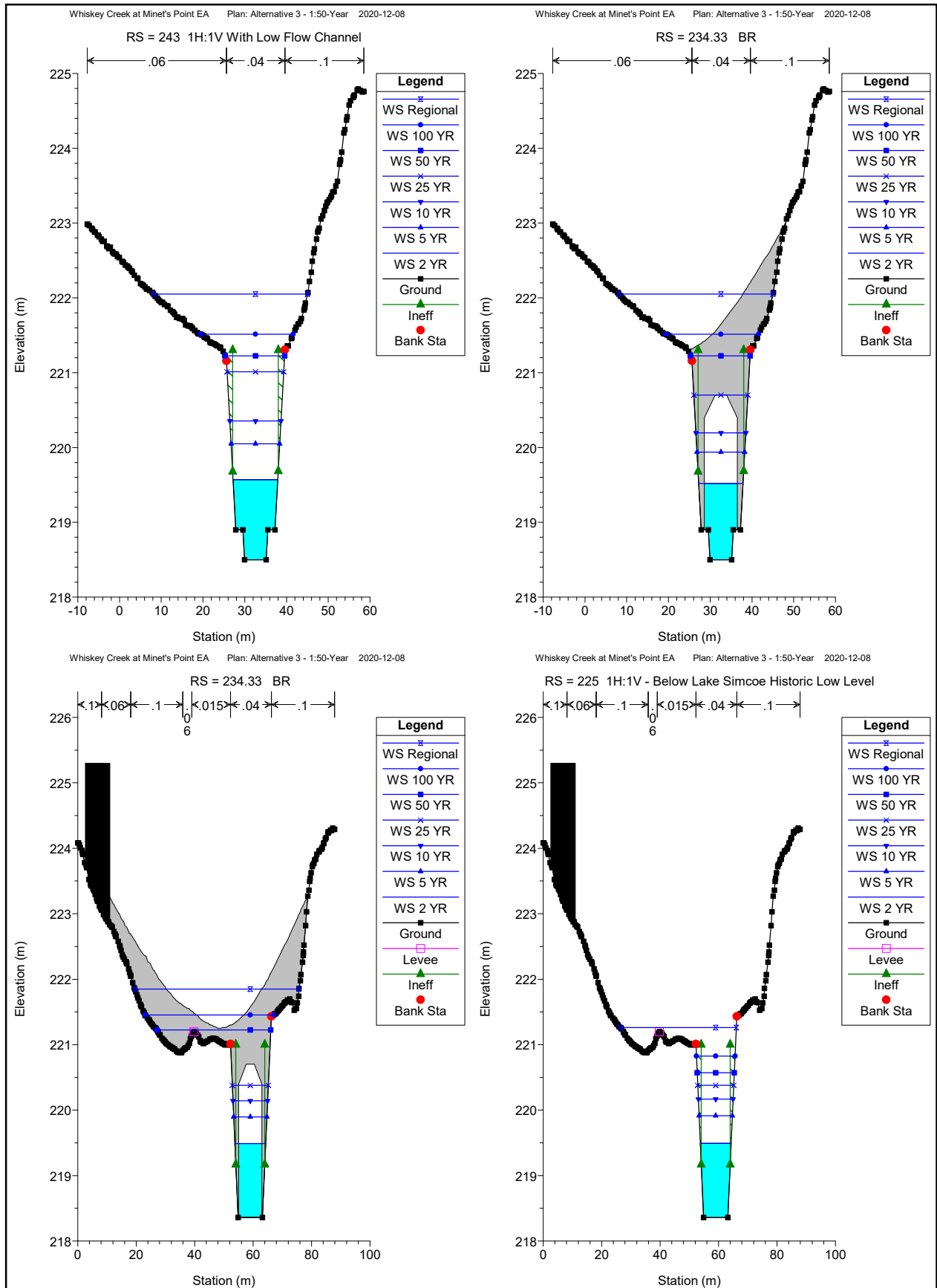
HEC-RAS Plan: Alt3-50 Locations: User Defined

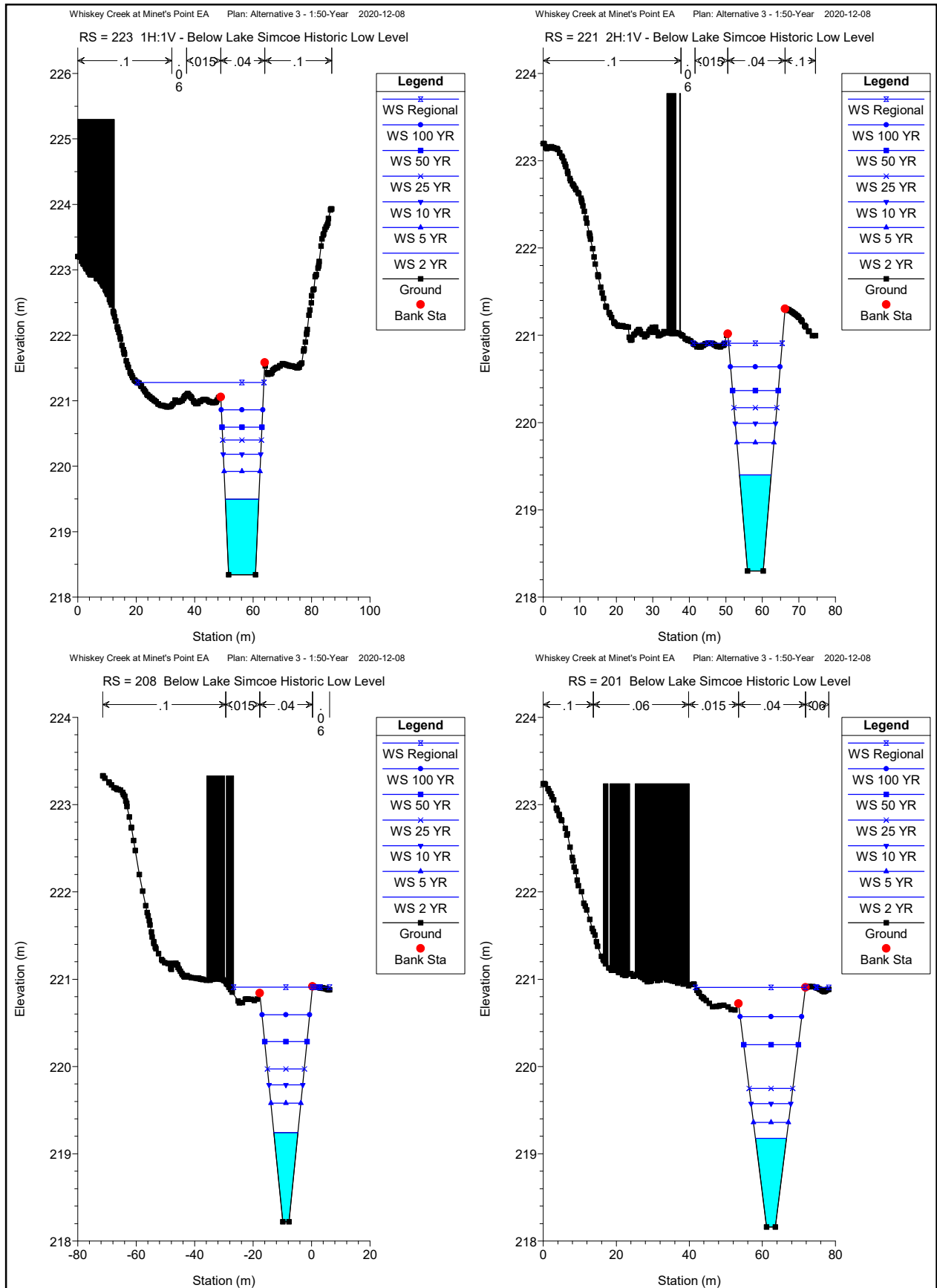
River	Reach	River Sta	Profile	E. G. US.	Min El Prs	BR Open Area	Prs O WS	Q Total	Min El Weir Flow	Q Weir	Delta EG	BR Sluice Coef
				(m)	(m)	(m2)	(m)	(m3/s)	(m)	(m3/s)	(m)	
Whiskey	1	234.33	2 YR	219.63	220.70	15.71		10.03	221.30		0.10	
Whiskey	1	234.33	5 YR	220.15	220.70	15.71		19.49	221.30		0.14	
Whiskey	1	234.33	10 YR	220.48	220.70	15.71		27.27	221.30		0.18	
Whiskey	1	234.33	25 YR	221.11	220.70	15.71	221.01	35.03	221.30		0.57	0.41
Whiskey	1	234.33	50 YR	221.35	220.70	15.71	221.22	42.04	221.30	0.02	0.58	0.46
Whiskey	1	234.33	100 YR	221.64	220.70	15.71		52.25	221.30	2.04	0.57	
Whiskey	1	234.33	Regional	222.19	220.70	15.71		73.32	221.30	19.55	0.71	
Whiskey	1	170.36	2 YR	219.26	220.00	18.72		10.06	220.54		0.04	
Whiskey	1	170.36	5 YR	219.51	220.00	18.72		19.56	220.54		0.12	
Whiskey	1	170.36	10 YR	219.74	220.00	18.72		27.38	220.54		0.18	
Whiskey	1	170.36	25 YR	219.98	220.00	18.72		35.17	220.54		0.25	
Whiskey	1	170.36	50 YR	220.42	220.00	18.72	220.34	42.20	220.54		0.53	0.43
Whiskey	1	170.36	100 YR	220.73	220.00	18.72	220.66	52.37	220.54	0.45	0.63	0.48
Whiskey	1	170.36	Regional	221.09	220.00	18.72		71.83	220.54	11.11	0.72	

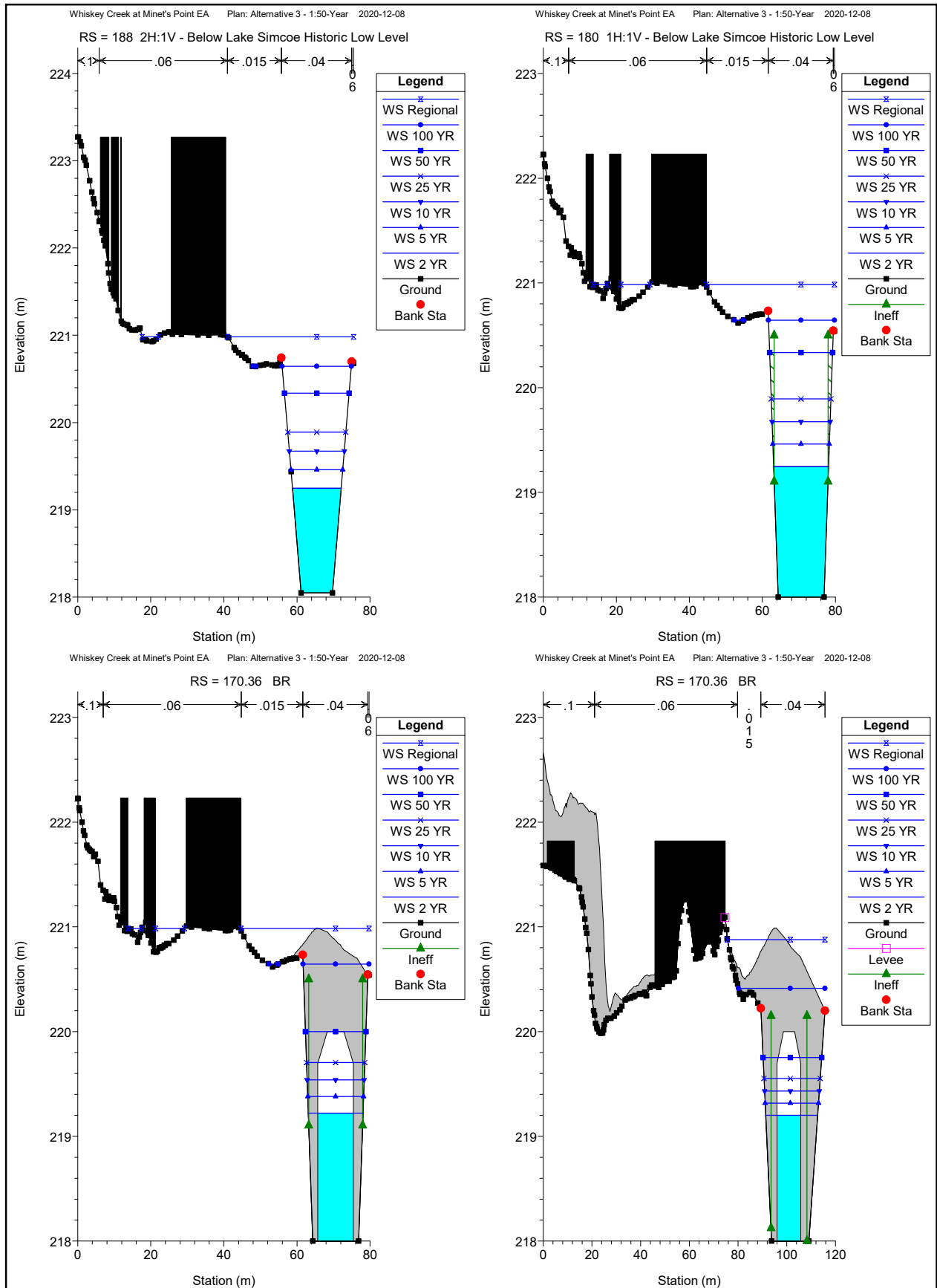
HEC-RAS Plan: Alt3-50 Locations: User Defined

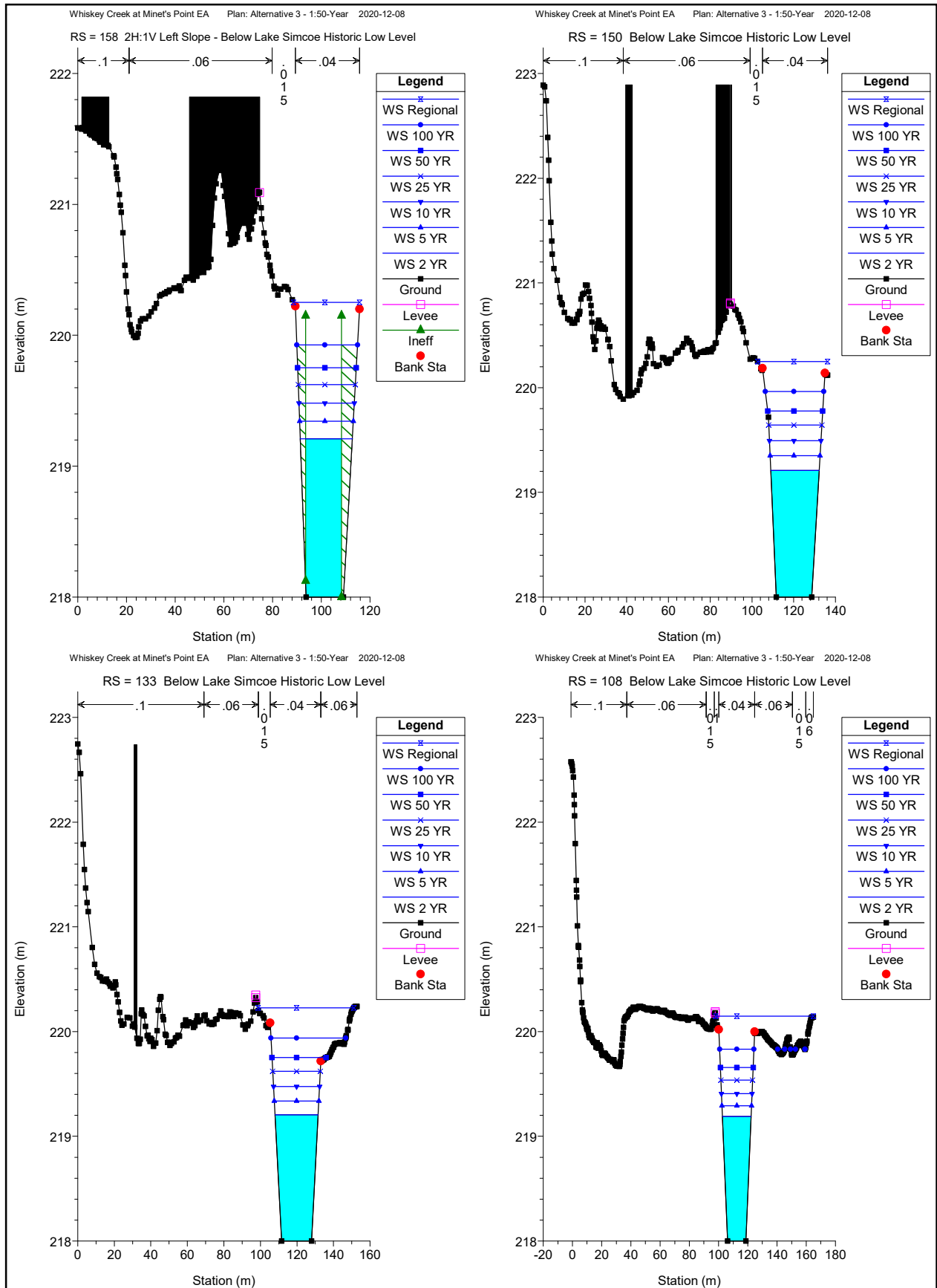
River	Reach	River Sta	Profile	Q US (m3/s)	Q Leaving Total (m3/s)	Q DS (m3/s)	Q Weir (m3/s)	Q Gates (m3/s)	Wt Top Wdth (m)	Weir Max Depth (m)	Weir Avg Depth (m)	Min El Weir Flow (m)	E.G. US. (m)	W.S. US. (m)	E.G. DS (m)	W.S. DS (m)
Whiskey	1	219	2 YR	10.03	0.00	10.08	0.00					220.07	219.49	219.37	219.16	219.15
Whiskey	1	219	5 YR	19.49	0.00	19.59	0.00					220.07	219.93	219.74	219.19	219.15
Whiskey	1	219	10 YR	27.27	0.00	27.43	0.00					220.07	220.20	219.96	219.23	219.15
Whiskey	1	219	25 YR	35.03	0.00	35.24	0.00					220.07	220.43	220.14	219.28	219.15
Whiskey	1	219	50 YR	42.04	0.00	42.29	0.00					220.07	220.65	220.35	219.33	219.15
Whiskey	1	219	100 YR	52.25	0.13	52.49	0.13		20.97	0.15	0.08	220.07	220.94	220.63	219.43	219.15
Whiskey	1	219	Regional	73.32	2.37	71.49	2.37		93.86	0.49	0.18	220.07	221.34	220.91	219.77	219.50

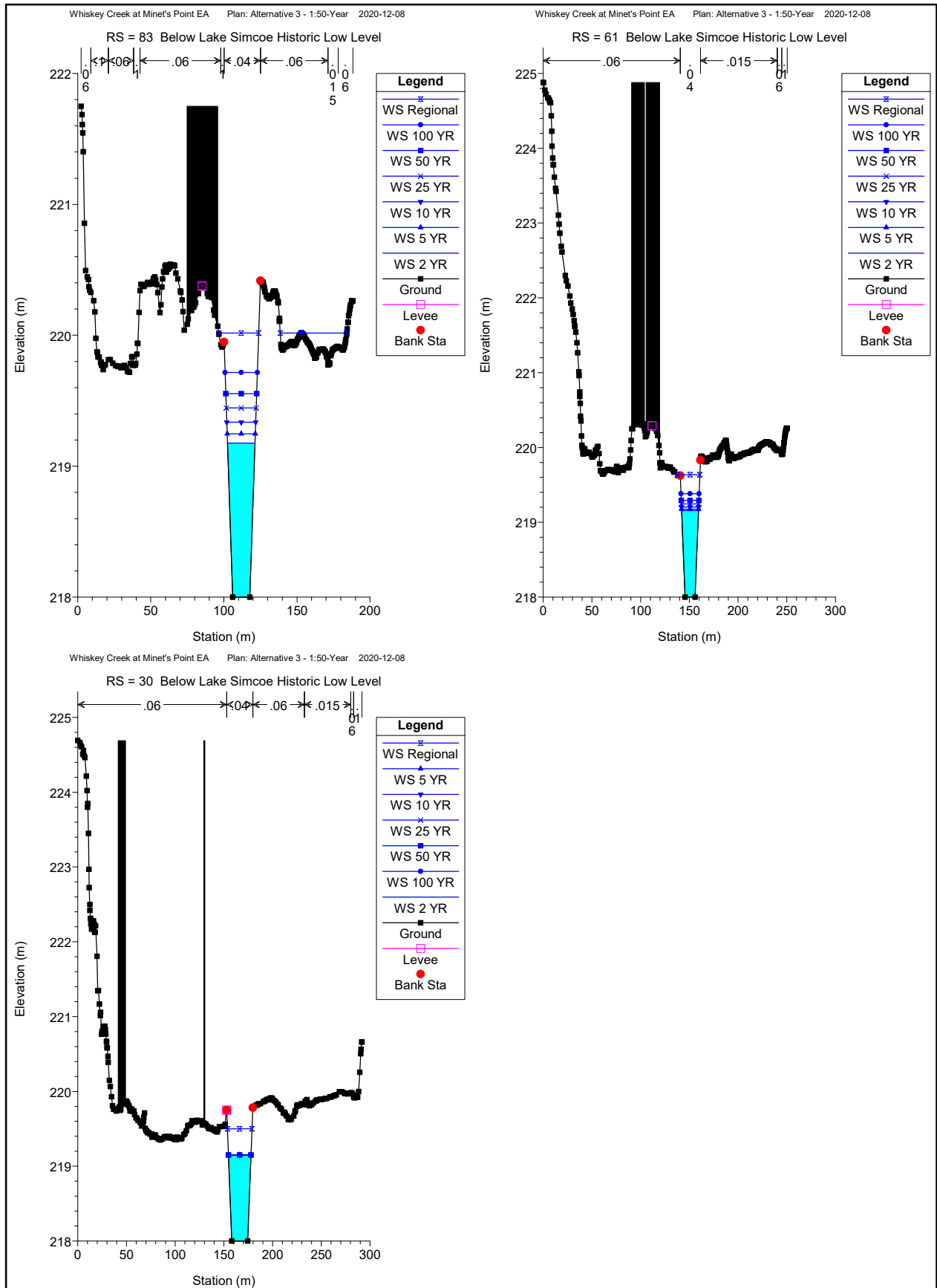














HEC-RAS Plan: Alt3-50 Sloped Locations: User Defined

River	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
Whiskey	1	299	2 YR	10.00	220.47	221.37	221.37	221.61	0.013705	2.34	5.90	13.73	0.87
Whiskey	1	299	5 YR	19.42	220.47	221.65	221.65	221.96	0.012909	2.81	10.16	16.78	0.90
Whiskey	1	299	10 YR	27.16	220.47	221.81	221.81	222.18	0.013310	3.16	12.96	17.76	0.93
Whiskey	1	299	25 YR	34.88	220.47	221.95	221.95	222.38	0.013766	3.46	15.44	18.54	0.97
Whiskey	1	299	50 YR	41.86	220.47	222.07	222.07	222.54	0.013749	3.66	17.70	19.18	0.98
Whiskey	1	299	100 YR	52.03	220.47	222.22	222.22	222.76	0.014008	3.95	20.67	20.02	1.01
Whiskey	1	299	Regional	72.99	220.47	222.51	222.51	223.15	0.013758	4.39	26.73	21.36	1.03
Whiskey	1												
Whiskey	1	278	2 YR	10.00	219.98	220.84	220.84	221.15	0.021407	2.46	4.06	6.67	1.01
Whiskey	1	278	5 YR	19.42	219.98	221.20	221.20	221.64	0.017986	2.96	6.79	9.81	0.98
Whiskey	1	278	10 YR	27.16	219.98	221.55	221.55	221.93	0.010558	2.81	13.82	28.86	0.79
Whiskey	1	278	25 YR	34.88	219.98	221.72	221.72	222.12	0.010010	2.97	18.88	29.97	0.79
Whiskey	1	278	50 YR	41.86	219.98	221.83	221.83	222.27	0.010427	3.19	22.17	30.51	0.81
Whiskey	1	278	100 YR	52.03	219.98	221.99	221.99	222.46	0.010438	3.40	27.07	31.22	0.83
Whiskey	1	278	Regional	72.99	219.98	222.24	222.24	222.81	0.011103	3.84	35.13	32.04	0.87
Whiskey	1												
Whiskey	1	257	2 YR	10.00	219.30	219.98	219.98	220.25	0.021036	2.32	4.32	8.00	1.01
Whiskey	1	257	5 YR	19.42	219.30	220.30	220.30	220.68	0.018988	2.75	7.06	9.27	1.01
Whiskey	1	257	10 YR	27.16	219.30	220.51	220.51	220.96	0.018020	2.99	9.09	10.11	1.01
Whiskey	1	257	25 YR	34.88	219.30	220.83		221.22	0.011988	2.78	12.55	11.39	0.85
Whiskey	1	257	50 YR	41.86	219.30	220.95	220.84	221.41	0.012873	3.00	13.94	11.87	0.89
Whiskey	1	257	100 YR	52.03	219.30	221.50		221.78	0.005198	2.40	27.07	32.52	0.59
Whiskey	1	257	Regional	72.99	219.30	222.08		222.31	0.003153	2.28	47.10	36.84	0.49
Whiskey	1												
Whiskey	1	249	2 YR	10.00	219.00	219.81		219.96	0.009679	1.71	5.86	9.61	0.70
Whiskey	1	249	5 YR	19.42	219.00	220.20		220.40	0.007907	1.97	9.87	11.15	0.67
Whiskey	1	249	10 YR	27.16	219.00	220.50		220.71	0.006481	2.03	13.37	12.34	0.62
Whiskey	1	249	25 YR	34.88	219.00	220.94		221.10	0.003702	1.81	20.04	20.64	0.49
Whiskey	1	249	50 YR	41.86	219.00	221.08		221.28	0.003866	1.95	23.19	22.27	0.51
Whiskey	1	249	100 YR	52.03	219.00	221.56		221.71	0.002251	1.77	35.70	31.22	0.40
Whiskey	1	249	Regional	72.99	219.00	222.11		222.27	0.001714	1.82	54.86	38.45	0.37
Whiskey	1												
Whiskey	1	243	2 YR	10.03	218.85	219.82	219.48	219.89	0.003294	1.11	9.01	11.87	0.41
Whiskey	1	243	5 YR	19.49	218.85	220.22	219.72	220.32	0.003332	1.42	13.70	11.99	0.42
Whiskey	1	243	10 YR	27.27	218.85	220.51	219.88	220.64	0.003197	1.58	17.25	12.07	0.42
Whiskey	1	243	25 YR	35.03	218.85	220.94	220.03	221.07	0.002367	1.56	22.45	12.20	0.37
Whiskey	1	243	50 YR	42.04	218.85	221.08	220.15	221.24	0.002725	1.74	24.19	12.24	0.39
Whiskey	1	243	100 YR	52.25	218.85	221.55	220.32	221.70	0.002103	1.73	31.90	23.49	0.35
Whiskey	1	243	Regional	73.32	218.85	222.08	220.64	222.25	0.001935	1.90	48.28	37.39	0.35
Whiskey	1												
Whiskey	1	234.33		Bridge									
Whiskey	1												
Whiskey	1	225	2 YR	10.03	218.76	219.75	219.40	219.81	0.003355	1.13	8.85	12.09	0.42
Whiskey	1	225	5 YR	19.49	218.76	220.13	219.66	220.23	0.003313	1.43	13.62	13.22	0.44
Whiskey	1	225	10 YR	27.27	218.76	220.42	219.82	220.54	0.002942	1.57	17.34	14.07	0.43
Whiskey	1	225	25 YR	35.03	218.76	220.61	219.98	220.77	0.003101	1.77	19.83	14.64	0.46
Whiskey	1	225	50 YR	42.04	218.76	220.77	220.10	220.96	0.003187	1.92	21.94	15.12	0.47
Whiskey	1	225	100 YR	52.25	218.76	221.06	220.26	221.25	0.003239	1.92	27.39	21.69	0.47
Whiskey	1	225	Regional	73.32	218.76	221.56	220.56	221.69	0.001917	1.70	49.17	47.29	0.37
Whiskey	1												
Whiskey	1	223	2 YR	10.03	218.75	219.67		219.79	0.006288	1.51	6.63	9.33	0.57
Whiskey	1	223	5 YR	19.49	218.75	219.99		220.19	0.007646	1.99	9.79	10.48	0.66
Whiskey	1	223	10 YR	27.27	218.75	220.27		220.50	0.006862	2.12	12.86	11.49	0.64
Whiskey	1	223	25 YR	35.03	218.75	220.43		220.72	0.007738	2.38	14.71	12.06	0.69
Whiskey	1	223	50 YR	42.04	218.75	220.57		220.90	0.008101	2.55	16.48	12.58	0.71
Whiskey	1	223	100 YR	52.25	218.75	220.84		221.19	0.007384	2.62	19.91	13.53	0.69
Whiskey	1	223	Regional	73.32	218.75	221.01	220.80	221.55	0.010600	3.28	22.94	29.91	0.84
Whiskey	1												
Whiskey	1	221	2 YR	10.03	218.73	219.65	219.40	219.75	0.005876	1.44	6.98	10.16	0.55
Whiskey	1	221	5 YR	19.49	218.73	219.97	219.69	220.15	0.006863	1.87	10.43	11.44	0.63
Whiskey	1	221	10 YR	27.27	218.73	220.26	219.88	220.45	0.005905	1.96	13.89	12.59	0.60
Whiskey	1	221	25 YR	35.03	218.73	220.42	220.05	220.66	0.006601	2.20	15.94	13.23	0.64
Whiskey	1	221	50 YR	42.04	218.73	220.56	220.19	220.84	0.006840	2.35	17.92	13.81	0.66
Whiskey	1	221	100 YR	52.25	218.73	220.83	220.38	221.12	0.006115	2.40	21.78	14.89	0.63
Whiskey	1	221	Regional	73.32	218.73	221.03	220.70	221.44	0.007908	2.87	26.52	35.07	0.73
Whiskey	1												
Whiskey	1	219		Lat Struct									
Whiskey	1												
Whiskey	1	208	2 YR	10.03	218.69	219.55		219.68	0.008275	1.60	6.26	10.09	0.65
Whiskey	1	208	5 YR	19.49	218.69	219.85		220.06	0.009540	2.04	9.54	11.88	0.73
Whiskey	1	208	10 YR	27.27	218.69	220.20		220.39	0.006420	1.95	14.02	13.96	0.62
Whiskey	1	208	25 YR	35.03	218.69	220.35		220.59	0.007027	2.15	16.28	14.90	0.66
Whiskey	1	208	50 YR	42.04	218.69	220.51		220.77	0.006989	2.26	18.63	15.82	0.66
Whiskey	1	208	100 YR	52.25	218.69	220.81		221.05	0.005612	2.20	23.95	25.63	0.61
Whiskey	1	208	Regional	73.05	218.69	221.06	220.63	221.34	0.005408	2.39	32.01	41.81	0.61
Whiskey	1												
Whiskey	1	201	2 YR	10.03	218.66	219.46		219.61	0.010360	1.71	5.87	10.20	0.72
Whiskey	1	201	5 YR	19.49	218.66	219.71		219.97	0.013165	2.27	8.60	11.70	0.84
Whiskey	1	201	10 YR	27.27	218.66	220.16		220.34	0.006085	1.89	14.40	14.37	0.60
Whiskey	1	201	25 YR	35.03	218.66	220.31		220.54	0.006712	2.10	16.66	15.28	0.64
Whiskey	1	201	50 YR	42.04	218.66	220.47		220.71	0.006615	2.20	19.12	16.22	0.65
Whiskey	1	201	100 YR	52.25	218.66	220.78		221.01	0.004919	2.09	25.42	27.62	0.57

HEC-RAS Plan: Alt3-50 Sloped Locations: User Defined (Continued)

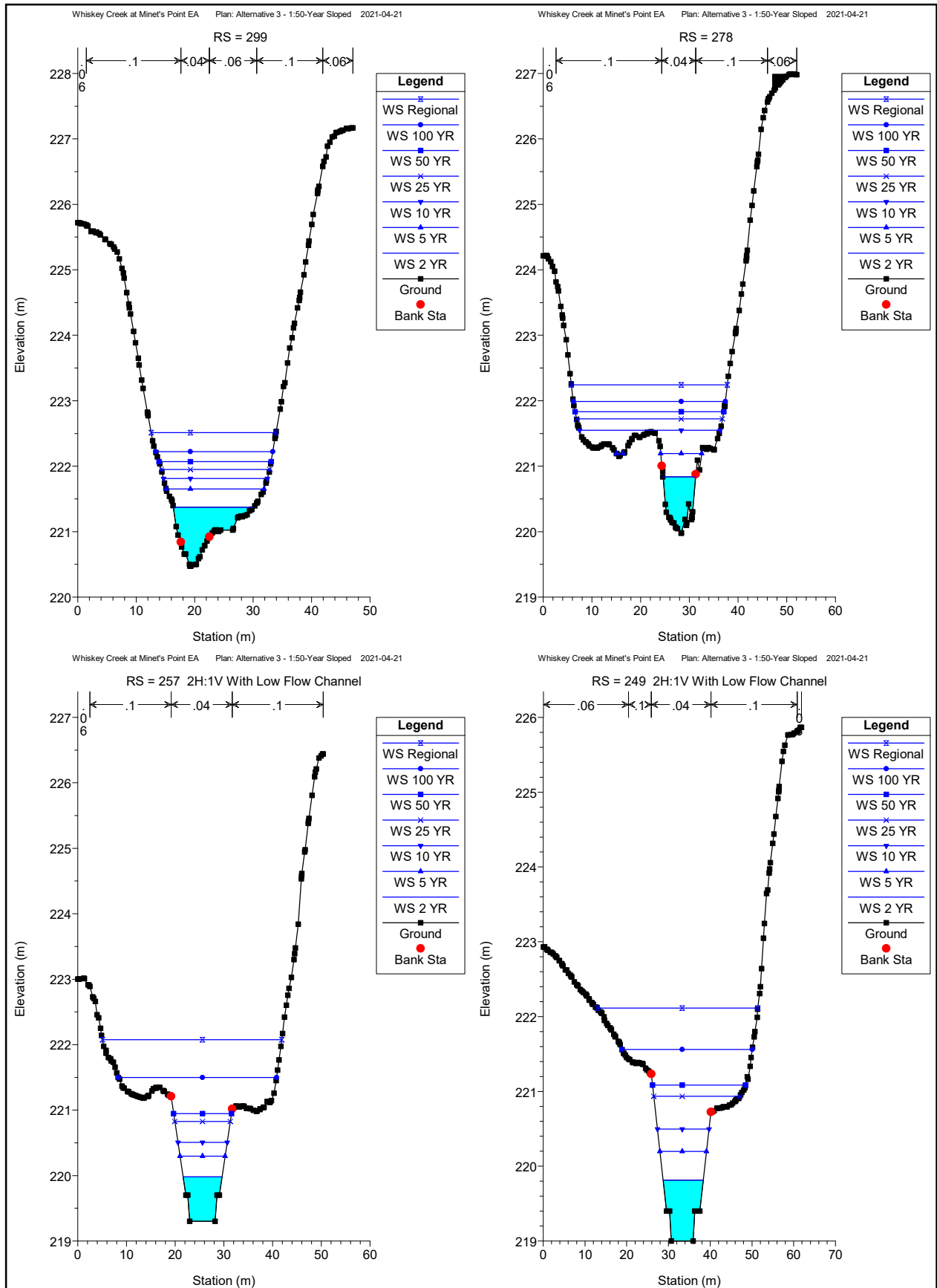
River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Whiskey	1	201	Regional	72.70	218.66	221.05		221.29	0.004320	2.19	34.55	39.05	0.55
Whiskey	1	188	2 YR	10.03	218.62	219.39		219.49	0.008070	1.40	7.14	13.93	0.63
Whiskey	1	188	5 YR	19.49	218.62	219.68		219.83	0.007434	1.73	11.28	15.07	0.64
Whiskey	1	188	10 YR	27.27	218.62	220.17		220.27	0.002981	1.43	19.12	17.03	0.43
Whiskey	1	188	25 YR	35.03	218.62	220.32		220.45	0.003316	1.60	21.86	17.66	0.46
Whiskey	1	188	50 YR	42.04	218.62	220.48		220.63	0.003328	1.70	24.73	18.30	0.47
Whiskey	1	188	100 YR	52.16	218.62	220.80		220.94	0.002547	1.66	32.17	31.35	0.42
Whiskey	1	188	Regional	71.78	218.62	221.08		221.23	0.002310	1.76	42.23	45.82	0.41
Whiskey	1	180	2 YR	10.06	218.59	219.37	219.09	219.43	0.003552	1.06	9.52	15.29	0.43
Whiskey	1	180	5 YR	19.56	218.59	219.66	219.30	219.76	0.003950	1.40	14.02	15.87	0.47
Whiskey	1	180	10 YR	27.38	218.59	220.16	219.44	220.24	0.001863	1.23	22.20	16.87	0.34
Whiskey	1	180	25 YR	35.17	218.59	220.32	219.57	220.42	0.002176	1.41	24.87	17.18	0.38
Whiskey	1	180	50 YR	42.20	218.59	220.47	219.67	220.59	0.002279	1.53	27.62	17.50	0.39
Whiskey	1	180	100 YR	51.84	218.59	220.80	219.81	220.91	0.001829	1.53	34.90	32.98	0.36
Whiskey	1	180	Regional	70.32	218.59	221.08	220.05	221.20	0.001675	1.60	46.79	48.19	0.35
Whiskey	1	170.36		Bridge									
Whiskey	1	158	2 YR	10.06	218.50	219.31	218.86	219.34	0.001336	0.74	13.55	18.26	0.27
Whiskey	1	158	5 YR	19.56	218.50	219.57	219.04	219.62	0.001956	1.08	18.13	19.26	0.35
Whiskey	1	158	10 YR	27.38	218.50	219.76	219.18	219.84	0.002098	1.26	21.72	20.04	0.37
Whiskey	1	158	25 YR	35.17	218.50	219.94	219.29	220.04	0.002185	1.41	24.94	20.74	0.39
Whiskey	1	158	50 YR	42.20	218.50	220.08	219.39	220.20	0.002249	1.53	27.58	21.32	0.40
Whiskey	1	158	100 YR	51.84	218.50	220.22	219.51	220.36	0.002710	1.63	31.78	21.81	0.43
Whiskey	1	158	Regional	70.32	218.50	220.37	219.72	220.57	0.003649	2.01	35.27	29.12	0.51
Whiskey	1	150	2 YR	10.06	218.47	219.31	218.82	219.33	0.001161	0.69	14.67	20.03	0.26
Whiskey	1	150	5 YR	19.56	218.47	219.56	219.01	219.61	0.001776	0.99	19.82	21.52	0.33
Whiskey	1	150	10 YR	27.38	218.47	219.75	219.14	219.82	0.001932	1.13	24.18	22.70	0.35
Whiskey	1	150	25 YR	35.17	218.47	219.93	219.25	220.01	0.002009	1.24	28.31	23.77	0.36
Whiskey	1	150	50 YR	42.20	218.47	220.08	219.35	220.17	0.002050	1.32	31.86	24.65	0.37
Whiskey	1	150	100 YR	51.73	218.47	220.22	219.47	220.33	0.002222	1.46	35.97	32.71	0.39
Whiskey	1	150	Regional	69.82	218.47	220.37	219.67	220.52	0.002805	1.75	41.39	38.29	0.45
Whiskey	1	133	2 YR	10.06	218.41	219.28	218.79	219.31	0.001322	0.74	13.60	18.22	0.27
Whiskey	1	133	5 YR	19.56	218.41	219.51	219.00	219.57	0.002225	1.10	17.85	19.58	0.37
Whiskey	1	133	10 YR	27.38	218.41	219.69	219.13	219.77	0.002487	1.27	21.62	20.70	0.40
Whiskey	1	133	25 YR	35.17	218.41	219.87	219.26	219.97	0.002471	1.38	26.92	34.43	0.40
Whiskey	1	133	50 YR	42.20	218.41	220.02	219.36	220.12	0.002323	1.43	33.18	42.45	0.40
Whiskey	1	133	100 YR	51.51	218.41	220.18	219.48	220.29	0.002252	1.50	40.30	50.32	0.40
Whiskey	1	133	Regional	68.92	218.41	220.33	219.69	220.47	0.002644	1.74	48.29	55.39	0.44
Whiskey	1	108	2 YR	10.06	218.31	219.23	218.76	219.27	0.001742	0.86	11.75	15.53	0.31
Whiskey	1	108	5 YR	19.56	218.31	219.40	218.99	219.49	0.003634	1.36	14.42	16.52	0.46
Whiskey	1	108	10 YR	27.38	218.31	219.56	219.15	219.69	0.004349	1.60	17.10	17.47	0.52
Whiskey	1	108	25 YR	35.17	218.31	219.72	219.29	219.87	0.004604	1.76	19.97	18.43	0.54
Whiskey	1	108	50 YR	42.20	218.31	219.86	219.40	220.03	0.004632	1.86	22.66	19.28	0.55
Whiskey	1	108	100 YR	51.51	218.31	220.06	219.53	220.21	0.003617	1.78	33.44	63.36	0.49
Whiskey	1	108	Regional	68.59	218.31	220.30	219.76	220.39	0.002209	1.55	71.20	158.70	0.40
Whiskey	1	83	2 YR	10.06	218.21	219.20	218.66	219.23	0.001353	0.79	12.81	15.93	0.28
Whiskey	1	83	5 YR	19.56	218.21	219.32	218.89	219.41	0.003425	1.33	14.71	16.63	0.45
Whiskey	1	83	10 YR	27.38	218.21	219.45	219.04	219.58	0.004462	1.62	16.95	17.42	0.52
Whiskey	1	83	25 YR	35.17	218.21	219.59	219.18	219.76	0.004861	1.79	19.60	18.31	0.55
Whiskey	1	83	50 YR	42.20	218.21	219.74	219.30	219.92	0.004888	1.90	22.23	19.15	0.56
Whiskey	1	83	100 YR	51.51	218.21	219.90	219.44	220.11	0.004871	2.01	26.28	41.08	0.57
Whiskey	1	83	Regional	68.49	218.21	220.10	219.66	220.31	0.004728	2.13	38.83	72.11	0.57
Whiskey	1	61	2 YR	10.06	218.12	219.17	218.57	219.20	0.001077	0.73	13.86	16.32	0.25
Whiskey	1	61	5 YR	19.56	218.12	219.24	218.80	219.33	0.003280	1.31	14.93	16.71	0.44
Whiskey	1	61	10 YR	27.38	218.12	219.33	218.96	219.47	0.004853	1.66	16.46	17.25	0.54
Whiskey	1	61	25 YR	35.17	218.12	219.46	219.09	219.64	0.005558	1.88	18.70	18.01	0.59
Whiskey	1	61	50 YR	42.20	218.12	219.59	219.21	219.80	0.005542	1.98	21.27	18.85	0.60
Whiskey	1	61	100 YR	51.51	218.12	219.77	219.35	219.99	0.005260	2.08	25.88	39.14	0.59
Whiskey	1	61	Regional	68.49	218.12	220.07	219.57	220.21	0.002969	1.79	49.03	122.69	0.46
Whiskey	1	30	2 YR	10.08	218.00	219.15	218.45	219.17	0.000787	0.65	15.47	16.90	0.22
Whiskey	1	30	5 YR	19.59	218.00	219.15	218.68	219.23	0.002974	1.27	15.47	16.90	0.42
Whiskey	1	30	10 YR	27.43	218.00	219.15	218.84	219.31	0.005830	1.77	15.47	16.90	0.59
Whiskey	1	30	25 YR	35.24	218.00	219.15	218.98	219.41	0.009623	2.28	15.47	16.90	0.76
Whiskey	1	30	50 YR	42.29	218.00	219.15	219.09	219.53	0.013858	2.73	15.47	16.90	0.91
Whiskey	1	30	100 YR	51.63	218.00	219.23	219.23	219.71	0.016239	3.07	16.81	17.37	1.00
Whiskey	1	30	Regional	68.65	218.00	219.50	219.45	220.01	0.013771	3.16	21.75	19.00	0.94

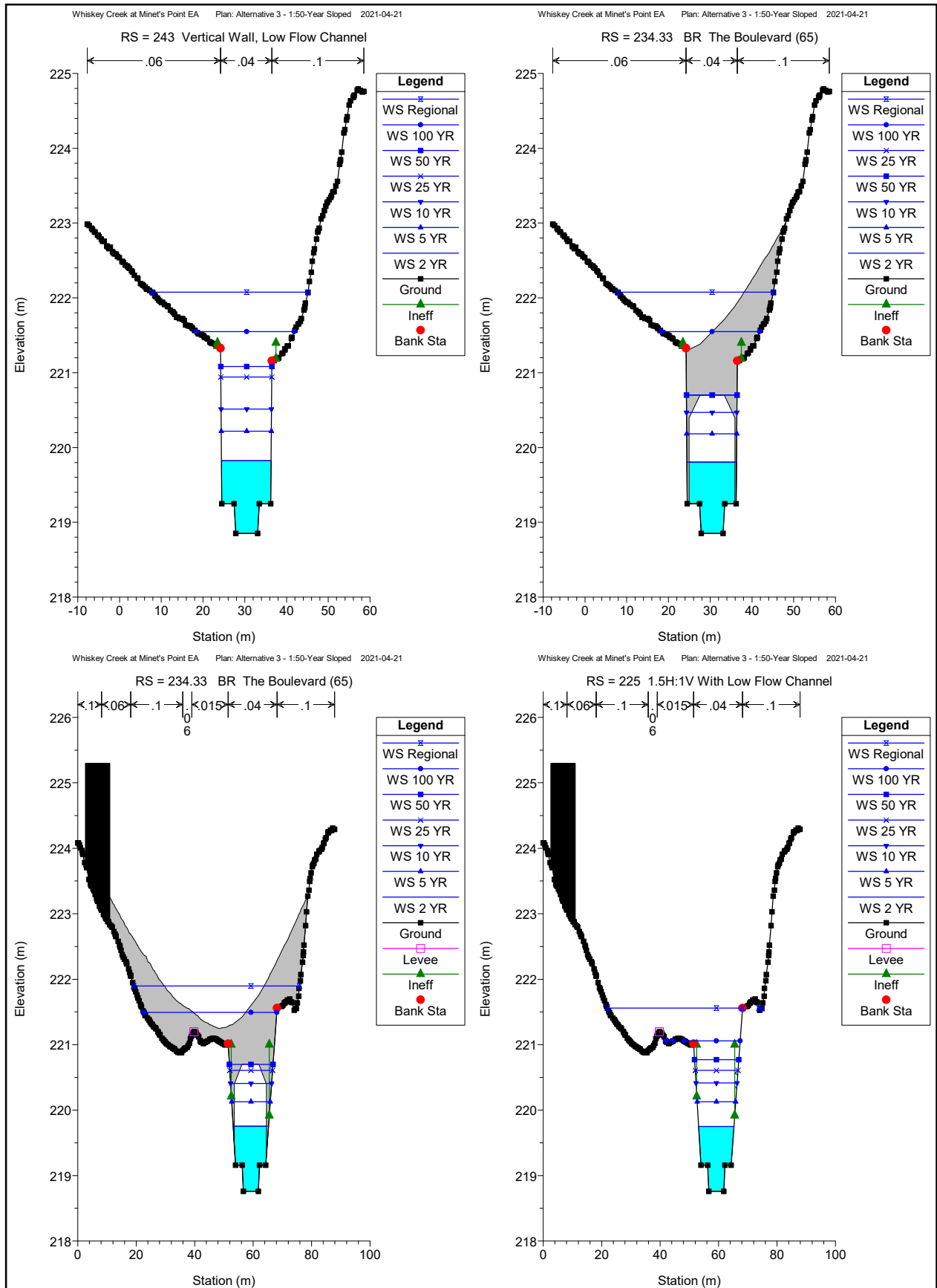
HEC-RAS Plan: Alt3-50_Sloped_River: Whiskey Reach: 1

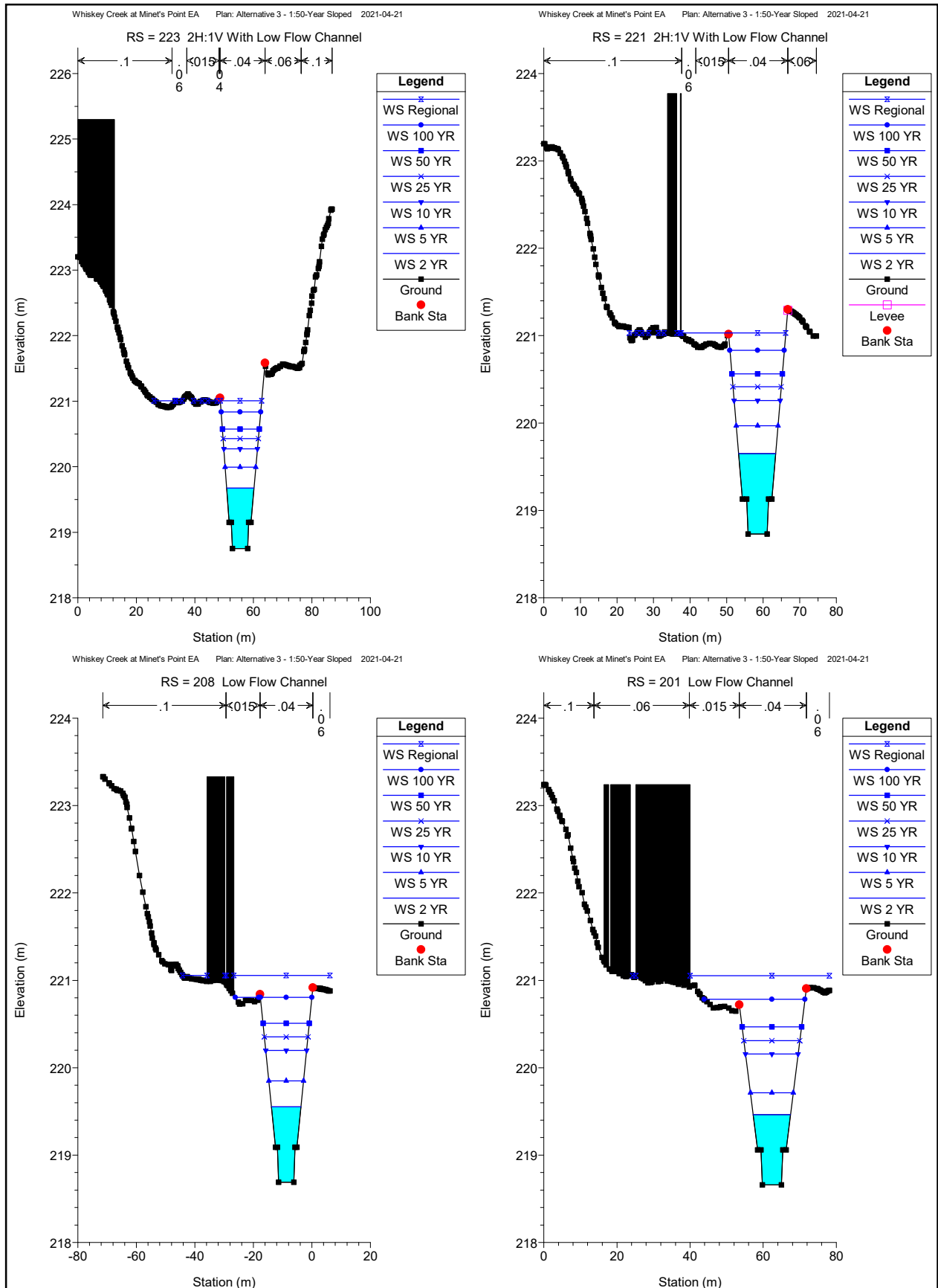
Reach	River Sta	Profile	E.G. US.	Min El Prs	BR Open Area	Prs O WS	Q Total	Min El Weir Flow	Q Weir	Delta EG	BR Sluice Coef
			(m)	(m)	(m2)	(m)	(m3/s)	(m)	(m3/s)	(m)	
1	234.33	2 YR	219.89	220.70	17.36		10.03	221.30		0.07	
1	234.33	5 YR	220.32	220.70	17.36		19.49	221.30		0.09	
1	234.33	10 YR	220.64	220.70	17.36		27.27	221.30		0.10	
1	234.33	25 YR	221.07	220.70	17.36	220.94	35.03	221.30		0.30	0.40
1	234.33	50 YR	221.24	220.70	17.36	221.08	42.04	221.30		0.28	
1	234.33	100 YR	221.70	220.70	17.36		52.25	221.30	2.90	0.46	
1	234.33	Regional	222.25	220.70	17.36		73.32	221.30	22.13	0.56	
1	170.36	2 YR	219.43	220.00	16.59		10.06	220.59		0.08	
1	170.36	5 YR	219.76	220.00	16.59		19.56	220.59		0.13	
1	170.36	10 YR	220.24	220.00	16.59	220.16	27.38	220.59		0.40	0.39
1	170.36	25 YR	220.42	220.00	16.59	220.32	35.17	220.59		0.38	0.45
1	170.36	50 YR	220.59	220.00	16.59	220.47	42.20	220.59		0.40	
1	170.36	100 YR	220.91	220.00	16.59		51.84	220.59	3.13	0.55	
1	170.36	Regional	221.20	220.00	16.59		70.32	220.59	16.77	0.62	

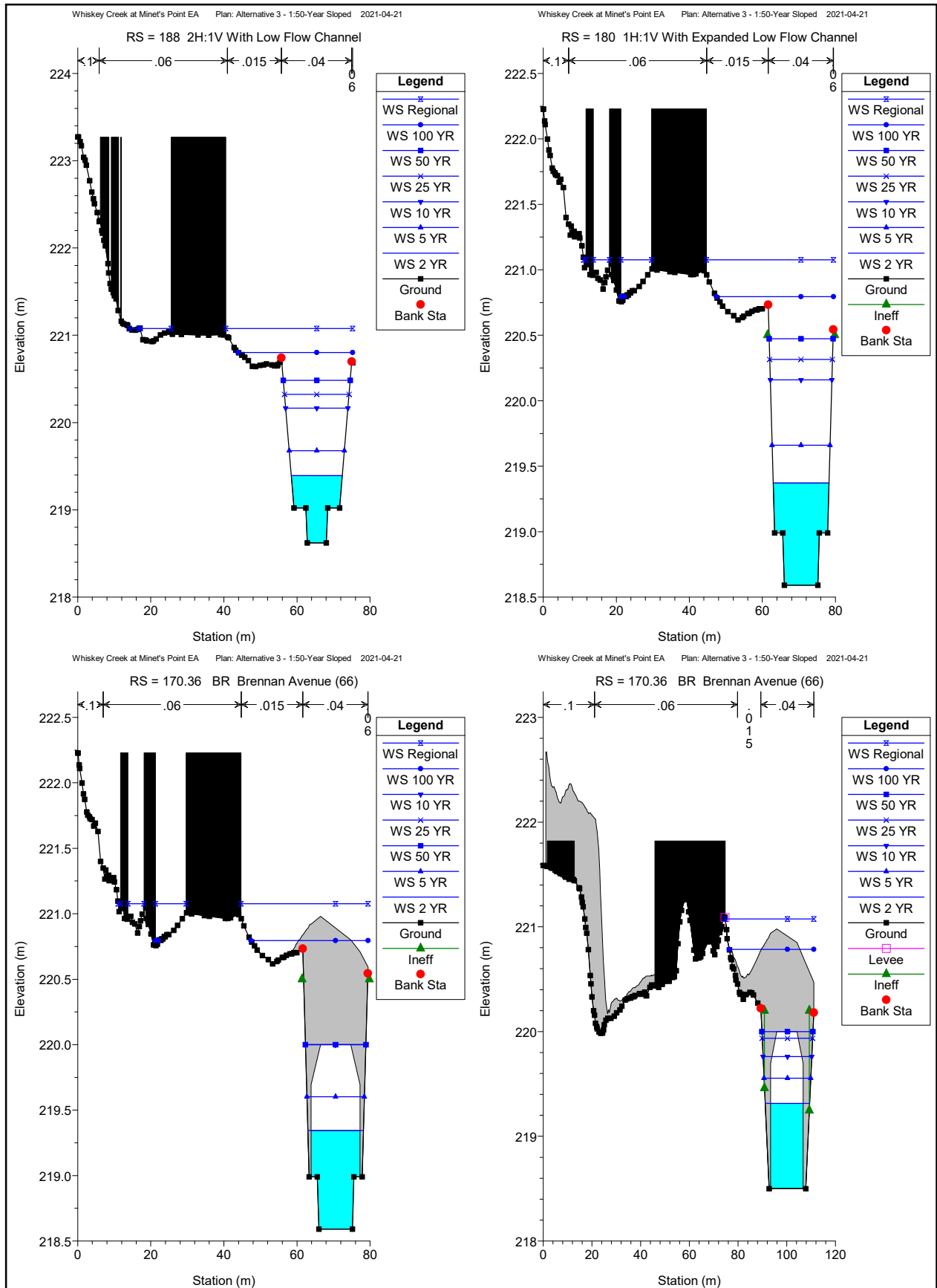
HEC-RAS Plan: Alt3-50_Sloped River: Whiskey Reach: 1

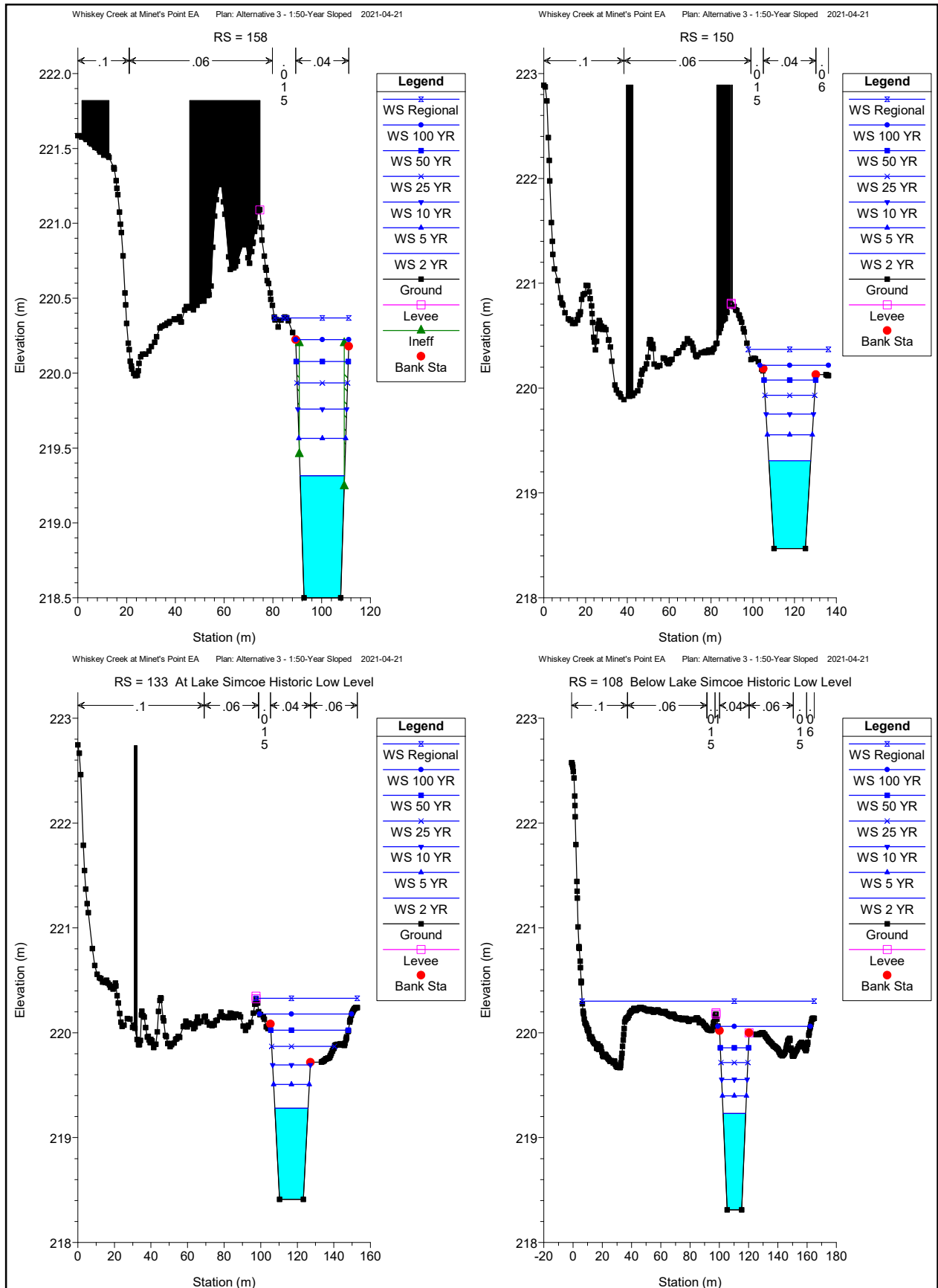
Reach	River Sta	Profile	Q US (m3/s)	Q Leaving Total (m3/s)	Q DS (m3/s)	Q Weir (m3/s)	Q Gates (m3/s)	Wr Top Width (m)	Weir Max Depth (m)	Weir Avg Depth (m)	Min El Weir Flow (m)	E.G. US. (m)	W.S. US. (m)	E.G. DS (m)	W.S. DS (m)
1	219	2 YR	10.03	0.00	10.08	0.00					220.07	219.74	219.63	219.17	219.15
1	219	5 YR	19.49	0.00	19.59	0.00					220.07	220.13	219.95	219.23	219.15
1	219	10 YR	27.27	0.00	27.43	0.00					220.07	220.44	220.25	219.31	219.15
1	219	25 YR	35.03	0.00	35.24	0.00					220.07	220.65	220.40	219.42	219.15
1	219	50 YR	42.04	0.00	42.29	0.00		0.76	0.02	0.01	220.07	220.83	220.55	219.53	219.16
1	219	100 YR	52.25	1.00	51.63	1.00		62.52	0.30	0.14	220.07	221.11	220.83	219.71	219.24
1	219	Regional	73.32	5.23	68.65	5.23		116.40	0.58	0.25	220.07	221.42	221.03	220.01	219.51

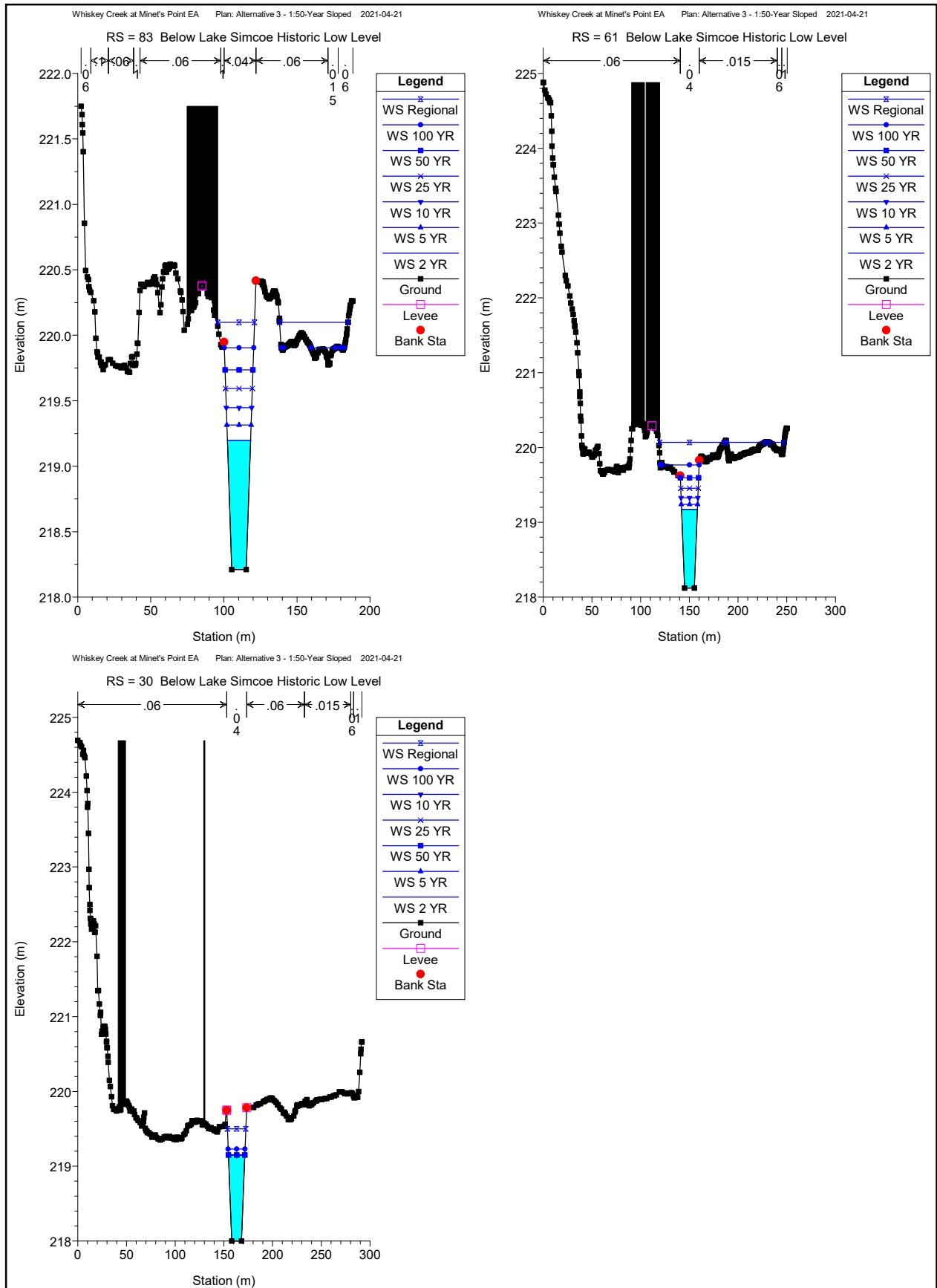












**Appendix I:
Hydraulic Model Results – 1:25-
Year Return Frequency Design
Storm Capacity**



HEC-RAS Plan: Alt3-25 Locations: User Defined

River	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
Whiskey	1	299	2 YR	10.00	220.47	221.37	221.37	221.61	0.013705	2.34	5.90	13.73	0.87
Whiskey	1	299	5 YR	19.42	220.47	221.65	221.65	221.96	0.012909	2.81	10.16	16.78	0.90
Whiskey	1	299	10 YR	27.16	220.47	221.81	221.81	222.18	0.013310	3.16	12.96	17.76	0.93
Whiskey	1	299	25 YR	34.88	220.47	221.95	221.95	222.38	0.013766	3.46	15.44	18.54	0.97
Whiskey	1	299	50 YR	41.86	220.47	222.07	222.07	222.54	0.013749	3.66	17.70	19.18	0.98
Whiskey	1	299	100 YR	52.03	220.47	222.22	222.22	222.76	0.014008	3.95	20.67	20.02	1.01
Whiskey	1	299	Regional	72.99	220.47	222.51	222.51	223.15	0.013758	4.39	26.73	21.36	1.03
Whiskey	1	278	2 YR	10.00	219.98	220.84	220.84	221.15	0.021392	2.46	4.06	6.68	1.01
Whiskey	1	278	5 YR	19.42	219.98	221.20	221.20	221.64	0.017993	2.96	6.79	9.80	0.98
Whiskey	1	278	10 YR	27.16	219.98	221.55	221.55	221.93	0.010564	2.81	13.81	28.86	0.79
Whiskey	1	278	25 YR	34.88	219.98	221.71	221.71	222.12	0.010227	3.00	18.67	29.93	0.79
Whiskey	1	278	50 YR	41.86	219.98	221.83	221.83	222.27	0.010424	3.18	22.18	30.52	0.81
Whiskey	1	278	100 YR	52.03	219.98	221.99	221.99	222.46	0.010438	3.40	27.07	31.22	0.83
Whiskey	1	278	Regional	72.99	219.98	222.24	222.24	222.81	0.011103	3.84	35.13	32.04	0.87
Whiskey	1	257	2 YR	10.00	219.08	219.77	219.77	220.07	0.020578	2.40	4.17	7.17	1.00
Whiskey	1	257	5 YR	19.42	219.08	220.12	220.12	220.52	0.018726	2.82	6.88	8.55	1.00
Whiskey	1	257	10 YR	27.16	219.08	220.45	220.34	220.83	0.013170	2.74	9.93	9.87	0.87
Whiskey	1	257	25 YR	34.88	219.08	221.04		221.27	0.005319	2.11	16.65	16.49	0.58
Whiskey	1	257	50 YR	41.86	219.08	221.23		221.48	0.005089	2.21	20.38	24.42	0.58
Whiskey	1	257	100 YR	52.03	219.08	221.60		221.82	0.003398	2.09	31.93	33.14	0.49
Whiskey	1	257	Regional	72.99	219.08	222.09		222.30	0.002697	2.17	48.96	36.89	0.45
Whiskey	1	249	2 YR	10.00	218.74	219.60		219.73	0.007169	1.56	6.43	9.49	0.60
Whiskey	1	249	5 YR	19.42	218.74	220.15		220.28	0.004201	1.63	11.89	10.58	0.49
Whiskey	1	249	10 YR	27.16	218.74	220.57		220.71	0.003092	1.64	16.57	11.43	0.43
Whiskey	1	249	25 YR	34.88	218.74	221.10		221.21	0.001908	1.52	24.79	20.13	0.35
Whiskey	1	249	50 YR	41.86	218.74	221.28		221.42	0.001983	1.64	28.81	24.45	0.37
Whiskey	1	249	100 YR	52.03	218.74	221.64		221.77	0.001683	1.68	39.11	31.93	0.35
Whiskey	1	249	Regional	72.99	218.74	222.11		222.27	0.001616	1.85	55.73	38.40	0.35
Whiskey	1	243	2 YR	10.03	218.50	219.60	219.17	219.68	0.003334	1.26	7.97	8.89	0.42
Whiskey	1	243	5 YR	19.49	218.50	220.14	219.48	220.25	0.002939	1.49	13.07	9.98	0.42
Whiskey	1	243	10 YR	27.27	218.50	220.57	219.69	220.69	0.002339	1.57	17.42	10.83	0.38
Whiskey	1	243	25 YR	35.03	218.50	221.08	219.88	221.20	0.001585	1.54	22.75	11.86	0.33
Whiskey	1	243	50 YR	42.04	218.50	221.25	220.04	221.40	0.001785	1.72	24.49	14.51	0.36
Whiskey	1	243	100 YR	52.25	218.50	221.61	220.25	221.76	0.001851	1.74	32.41	24.93	0.36
Whiskey	1	243	Regional	73.32	218.50	222.06	220.61	222.25	0.001873	1.97	46.88	37.06	0.37
Whiskey	1	234.51		Bridge									
Whiskey	1	225	2 YR	10.03	218.36	219.54	218.95	219.59	0.001592	1.01	9.90	11.08	0.31
Whiskey	1	225	5 YR	19.49	218.36	220.04	219.24	220.13	0.001666	1.34	14.54	13.07	0.34
Whiskey	1	225	10 YR	27.27	218.36	220.43	219.44	220.55	0.001545	1.50	18.20	14.64	0.34
Whiskey	1	225	25 YR	35.03	218.36	220.63	219.61	220.78	0.001859	1.75	20.00	15.42	0.38
Whiskey	1	225	50 YR	42.04	218.36	220.74	219.75	220.95	0.002238	1.99	21.11	15.89	0.42
Whiskey	1	225	100 YR	52.25	218.36	220.88	219.95	221.16	0.002843	2.33	22.38	16.44	0.48
Whiskey	1	225	Regional	73.32	218.36	221.24	220.33	221.44	0.002845	2.02	39.81	41.59	0.46
Whiskey	1	223	2 YR	10.03	218.34	219.52		219.58	0.002548	1.13	8.86	9.87	0.38
Whiskey	1	223	5 YR	19.49	218.34	220.03		220.13	0.002448	1.35	14.47	11.93	0.39
Whiskey	1	223	10 YR	27.27	218.34	220.44		220.53	0.002082	1.39	19.59	13.54	0.37
Whiskey	1	223	25 YR	35.03	218.34	220.64		220.76	0.002381	1.56	22.40	14.34	0.40
Whiskey	1	223	50 YR	42.04	218.34	220.76		220.92	0.002762	1.73	24.25	14.85	0.43
Whiskey	1	223	100 YR	52.25	218.34	220.92		221.11	0.003337	1.97	26.55	17.51	0.48
Whiskey	1	223	Regional	73.32	218.34	221.13		221.41	0.004472	2.39	33.13	41.17	0.56
Whiskey	1	222.8		Lat Struct									
Whiskey	1	221	2 YR	10.03	218.30	219.50		219.57	0.002873	1.19	8.40	9.41	0.40
Whiskey	1	221	5 YR	19.49	218.30	220.01		220.11	0.002771	1.42	13.73	11.46	0.41
Whiskey	1	221	10 YR	27.27	218.30	220.41		220.52	0.002328	1.46	18.70	13.08	0.39
Whiskey	1	221	25 YR	35.03	218.30	220.61		220.75	0.002682	1.64	21.34	13.86	0.42
Whiskey	1	221	50 YR	42.04	218.30	220.73		220.90	0.003148	1.83	23.01	14.34	0.46
Whiskey	1	221	100 YR	52.25	218.30	220.86		221.09	0.003869	2.09	25.04	14.89	0.51
Whiskey	1	221	Regional	73.32	218.30	221.05	220.46	221.38	0.005342	2.55	30.01	37.31	0.61
Whiskey	1	208	2 YR	10.03	218.22	219.50		219.54	0.001312	0.87	11.49	11.54	0.28
Whiskey	1	208	5 YR	19.49	218.22	220.02		220.08	0.001403	1.08	17.99	13.60	0.30
Whiskey	1	208	10 YR	27.27	218.22	220.42		220.49	0.001255	1.14	23.86	15.23	0.29
Whiskey	1	208	25 YR	35.03	218.22	220.62		220.71	0.001476	1.30	26.98	16.03	0.32
Whiskey	1	208	50 YR	42.04	218.22	220.75		220.85	0.001747	1.45	29.00	18.26	0.35
Whiskey	1	208	100 YR	52.25	218.22	220.90		221.03	0.002047	1.63	32.72	26.02	0.38
Whiskey	1	208	Regional	73.14	218.22	221.11		221.30	0.002529	1.93	39.28	36.07	0.43
Whiskey	1	201	2 YR	10.03	218.16	219.49		219.53	0.001246	0.86	11.63	11.40	0.27
Whiskey	1	201	5 YR	19.49	218.16	220.01		220.07	0.001375	1.08	18.04	13.46	0.30
Whiskey	1	201	10 YR	27.27	218.16	220.41		220.48	0.001243	1.14	23.86	15.09	0.29
Whiskey	1	201	25 YR	35.03	218.16	220.61		220.70	0.001473	1.30	26.92	15.88	0.32
Whiskey	1	201	50 YR	42.04	218.16	220.73		220.84	0.001734	1.45	29.27	24.63	0.35
Whiskey	1	201	100 YR	52.25	218.16	220.89		221.02	0.001952	1.61	33.37	28.23	0.37

HEC-RAS Plan: Alt3-25 Locations: User Defined (Continued)

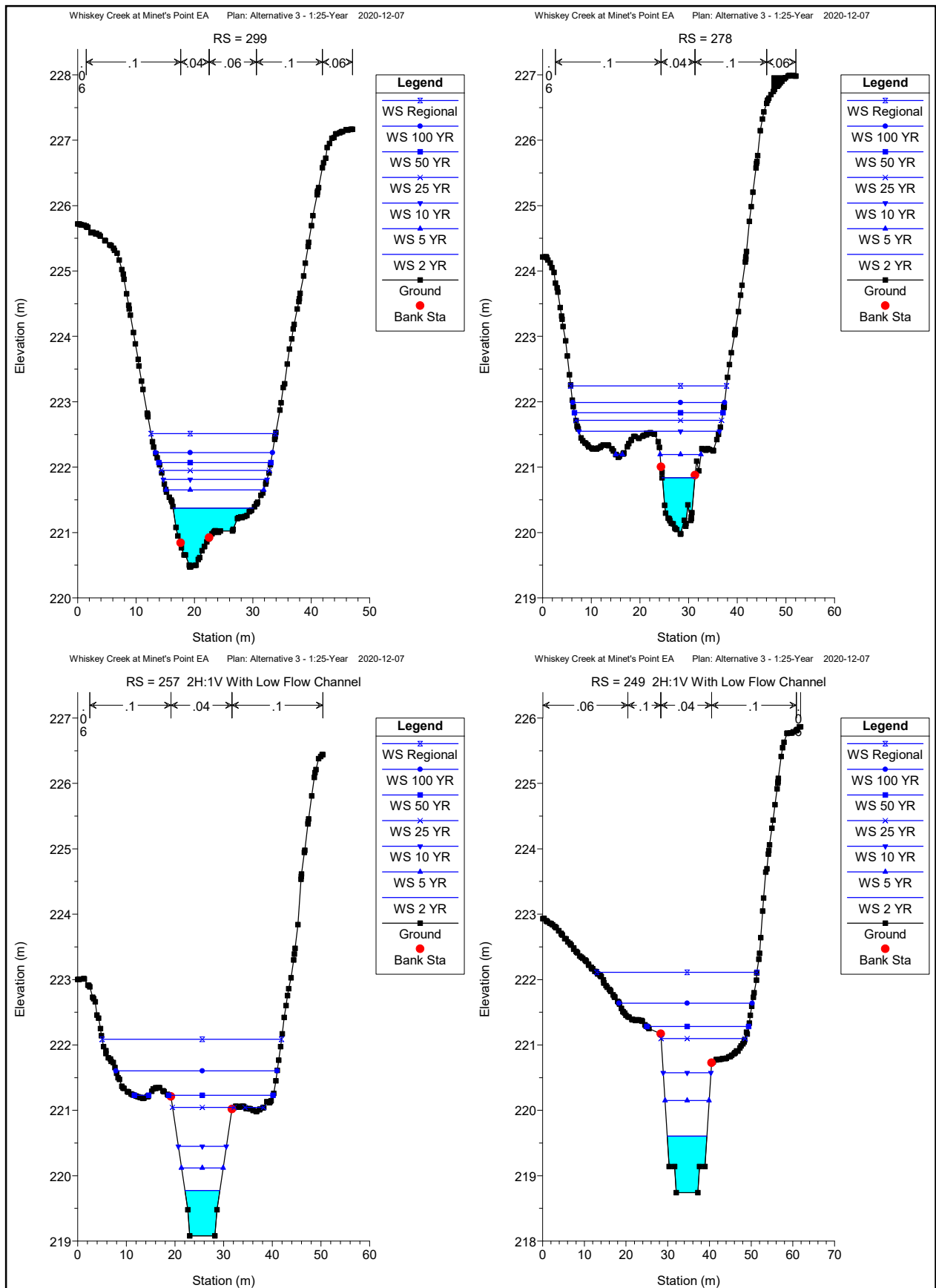
River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Whiskey	1	201	Regional	72.82	218.16	221.11		221.28	0.002298	1.86	39.93	31.65	0.41
Whiskey	1	188	2 YR	10.03	218.05	219.50		219.52	0.000434	0.58	17.20	13.33	0.16
Whiskey	1	188	5 YR	19.49	218.05	220.02		220.05	0.000583	0.80	24.38	14.36	0.20
Whiskey	1	188	10 YR	27.27	218.05	220.42		220.46	0.000601	0.90	30.39	15.18	0.20
Whiskey	1	188	25 YR	35.03	218.05	220.62		220.68	0.000752	1.05	33.44	15.58	0.23
Whiskey	1	188	50 YR	42.04	218.05	220.75		220.82	0.000908	1.18	36.14	25.75	0.25
Whiskey	1	188	100 YR	52.18	218.05	220.90		220.99	0.001062	1.33	40.61	30.34	0.27
Whiskey	1	188	Regional	72.13	218.05	221.13		221.24	0.001293	1.54	49.16	44.91	0.30
Whiskey	1	180	2 YR	10.06	218.00	219.49	218.47	219.51	0.000500	0.63	15.93	11.44	0.17
Whiskey	1	180	5 YR	19.56	218.00	220.00	218.73	220.04	0.000731	0.89	21.90	11.95	0.21
Whiskey	1	180	10 YR	27.38	218.00	220.40	218.90	220.46	0.000795	1.02	26.77	12.35	0.22
Whiskey	1	180	25 YR	35.17	218.00	220.59	219.07	220.67	0.001027	1.21	29.13	12.54	0.25
Whiskey	1	180	50 YR	42.13	218.00	220.70	219.20	220.80	0.001278	1.38	30.91	22.85	0.28
Whiskey	1	180	100 YR	51.96	218.00	220.85	219.37	220.97	0.001523	1.55	35.01	33.01	0.31
Whiskey	1	180	Regional	71.09	218.00	221.08	219.69	221.22	0.001755	1.74	44.13	44.09	0.33
Whiskey	1	171.38		Bridge									
Whiskey	1	158	2 YR	10.06	218.00	219.47	218.50	219.49	0.000673	0.72	14.06	10.30	0.20
Whiskey	1	158	5 YR	19.56	218.00	219.95	218.78	220.00	0.001027	1.02	19.09	10.78	0.25
Whiskey	1	158	10 YR	27.38	218.00	220.28	218.97	220.35	0.001204	1.21	22.75	25.19	0.27
Whiskey	1	158	25 YR	35.17	218.00	220.37	219.15	220.48	0.001713	1.47	23.98	42.06	0.32
Whiskey	1	158	50 YR	42.13	218.00	220.39	219.29	220.55	0.002378	1.75	24.25	43.57	0.38
Whiskey	1	158	100 YR	51.96	218.00	220.42	219.48	220.63	0.003209	2.05	29.98	44.58	0.44
Whiskey	1	158	Regional	71.09	218.00	220.50	219.81	220.82	0.005011	2.61	33.59	47.87	0.55
Whiskey	1	150	2 YR	10.06	218.00	219.46		219.49	0.000733	0.74	13.65	10.81	0.21
Whiskey	1	150	5 YR	19.56	218.00	219.94		219.99	0.001056	1.03	19.12	14.68	0.26
Whiskey	1	150	10 YR	27.38	218.00	220.27		220.34	0.001124	1.16	26.83	36.13	0.27
Whiskey	1	150	25 YR	35.17	218.00	220.37		220.46	0.001498	1.38	31.38	57.04	0.31
Whiskey	1	150	50 YR	42.13	218.00	220.39		220.52	0.002041	1.62	32.66	60.16	0.37
Whiskey	1	150	100 YR	51.96	218.00	220.41		220.59	0.002945	1.95	34.00	63.03	0.44
Whiskey	1	150	Regional	71.09	218.00	220.48	219.86	220.77	0.004711	2.52	38.44	71.00	0.56
Whiskey	1	133	2 YR	10.06	218.00	219.26		219.42	0.007620	1.79	5.63	6.99	0.64
Whiskey	1	133	5 YR	19.56	218.00	219.43	219.39	219.84	0.016512	2.83	6.91	7.69	0.95
Whiskey	1	133	10 YR	27.38	218.00	219.64	219.64	220.16	0.017878	3.18	8.62	8.53	1.01
Whiskey	1	133	25 YR	34.68	218.00	220.15	220.15	220.38	0.006163	2.25	25.40	92.85	0.62
Whiskey	1	133	50 YR	41.12	218.00	220.26	220.26	220.44	0.005237	2.18	36.89	114.27	0.58
Whiskey	1	133	100 YR	50.55	218.00	220.32	220.32	220.52	0.005728	2.35	44.15	117.43	0.61
Whiskey	1	133	Regional	68.58	218.00	220.43	220.43	220.64	0.006108	2.54	57.26	119.73	0.64
Whiskey	1	108	2 YR	10.06	218.00	219.25		219.30	0.001970	0.98	10.26	11.95	0.34
Whiskey	1	108	5 YR	19.56	218.00	219.46		219.58	0.003967	1.51	12.91	13.21	0.49
Whiskey	1	108	10 YR	27.38	218.00	219.66		219.81	0.004688	1.76	15.55	14.36	0.54
Whiskey	1	108	25 YR	34.68	218.00	219.86	219.35	220.01	0.004202	1.78	23.45	66.51	0.52
Whiskey	1	108	50 YR	41.12	218.00	220.05		220.15	0.002493	1.50	38.90	90.51	0.41
Whiskey	1	108	100 YR	50.50	218.00	220.19		220.27	0.001940	1.41	54.17	131.79	0.37
Whiskey	1	108	Regional	68.14	218.00	220.32		220.40	0.001963	1.50	73.31	156.82	0.37
Whiskey	1	83	2 YR	10.06	218.00	219.21		219.26	0.001702	0.92	10.96	12.67	0.32
Whiskey	1	83	5 YR	19.56	218.00	219.37		219.49	0.003992	1.50	13.03	13.61	0.49
Whiskey	1	83	10 YR	27.38	218.00	219.54		219.70	0.004971	1.78	15.36	14.61	0.56
Whiskey	1	83	25 YR	34.68	218.00	219.71		219.90	0.005214	1.93	18.12	19.73	0.58
Whiskey	1	83	50 YR	41.12	218.00	219.87	219.39	220.06	0.004885	1.96	24.79	65.43	0.56
Whiskey	1	83	100 YR	50.49	218.00	220.06	219.55	220.20	0.003687	1.82	42.89	111.49	0.50
Whiskey	1	83	Regional	67.95	218.00	220.12	220.09	220.32	0.005099	2.19	50.23	115.57	0.59
Whiskey	1	61	2 YR	10.06	218.00	219.18		219.22	0.001603	0.89	11.32	13.14	0.31
Whiskey	1	61	5 YR	19.56	218.00	219.26		219.39	0.004687	1.58	12.41	13.63	0.53
Whiskey	1	61	10 YR	27.38	218.00	219.37		219.56	0.006702	1.97	13.90	14.27	0.64
Whiskey	1	61	25 YR	34.68	218.00	219.52	219.21	219.76	0.007093	2.15	16.15	15.18	0.66
Whiskey	1	61	50 YR	41.12	218.00	219.67	219.33	219.92	0.006567	2.22	18.88	26.45	0.65
Whiskey	1	61	100 YR	50.49	218.00	219.86	219.49	220.09	0.005613	2.21	30.03	82.64	0.61
Whiskey	1	61	Regional	67.95	218.00	220.05	220.05	220.21	0.003993	2.04	54.52	166.25	0.53
Whiskey	1	30	2 YR	10.08	218.00	219.15	218.49	219.18	0.001025	0.73	13.80	15.45	0.25
Whiskey	1	30	5 YR	19.59	218.00	219.15	218.74	219.25	0.003872	1.42	13.80	15.45	0.48
Whiskey	1	30	10 YR	27.43	218.00	219.15	218.90	219.35	0.007591	1.99	13.80	15.45	0.67
Whiskey	1	30	25 YR	34.75	218.00	219.15	219.04	219.47	0.012183	2.52	13.80	15.45	0.85
Whiskey	1	30	50 YR	41.21	218.00	219.15	219.15	219.60	0.017018	2.98	13.83	15.46	1.01
Whiskey	1	30	100 YR	50.61	218.00	219.30	219.30	219.80	0.016352	3.12	16.20	16.35	1.00
Whiskey	1	30	Regional	68.11	218.00	219.74	219.74	219.97	0.006430	2.35	47.72	131.90	0.66

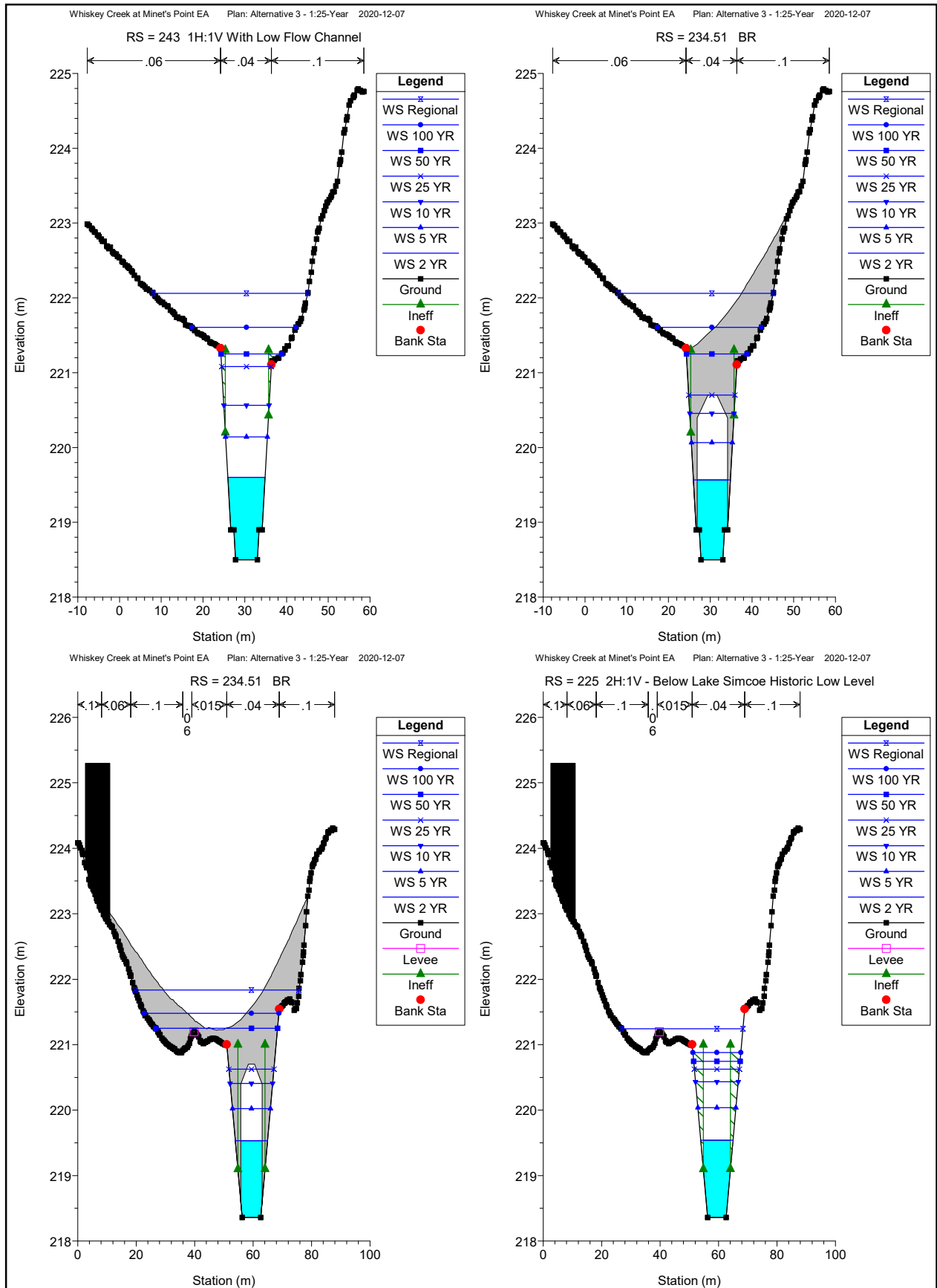
HEC-RAS Plan: Alt3-25 Locations: User Defined

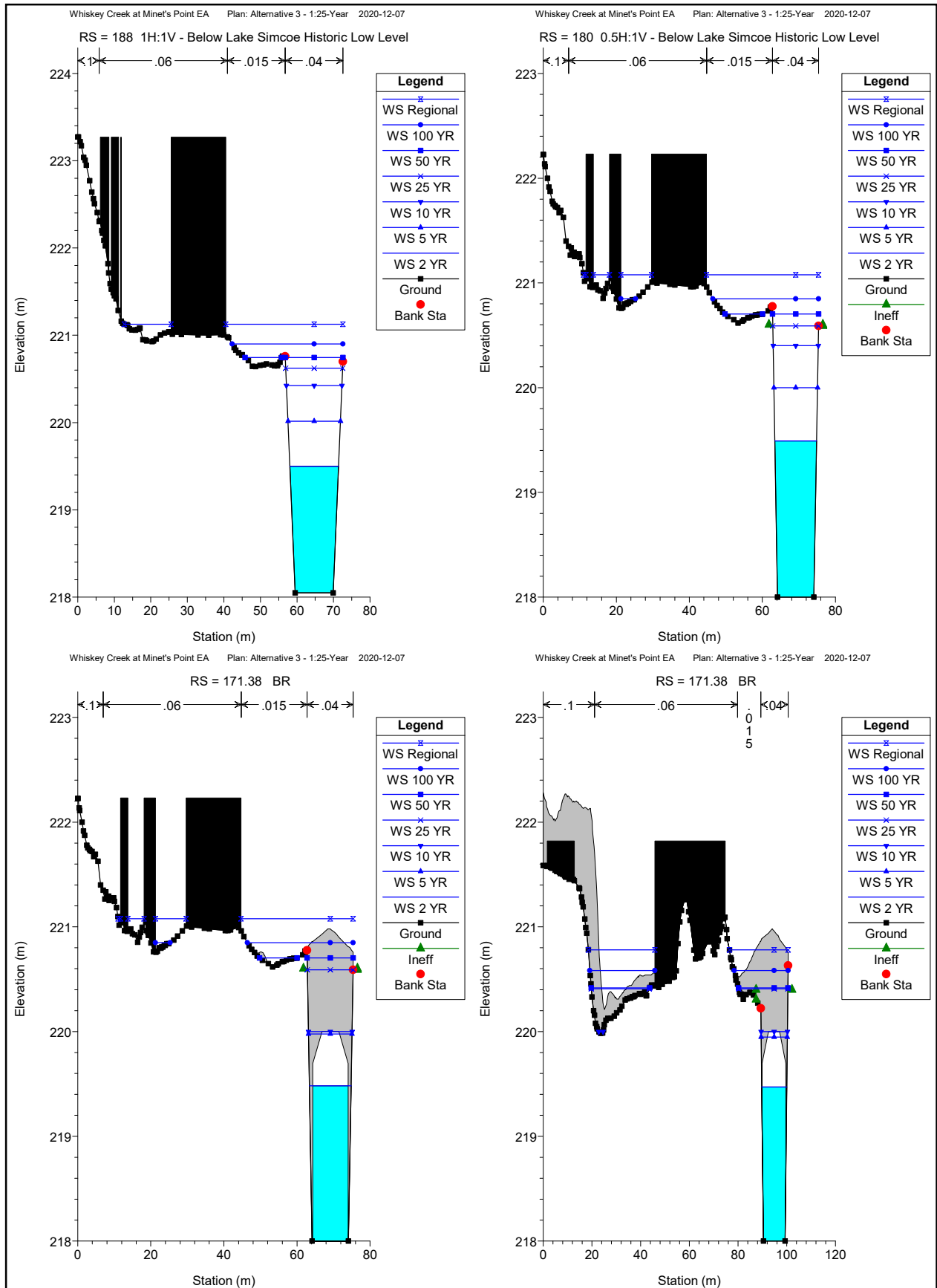
River	Reach	River Sta	Profile	E. G. US.	Min El Prs	BR Open Area	Prs O WS	Q Total	Min El Weir Flow	Q Weir	Delta EG	BR Sluice Coef
				(m)	(m)	(m2)	(m)	(m3/s)	(m)	(m3/s)	(m)	
Whiskey	1	234.51	2 YR	219.68	220.70	14.61		10.03	221.30		0.09	
Whiskey	1	234.51	5 YR	220.25	220.70	14.61		19.49	221.30		0.12	
Whiskey	1	234.51	10 YR	220.69	220.70	14.61		27.27	221.30		0.14	
Whiskey	1	234.51	25 YR	221.20	220.70	14.61	221.08	35.03	221.30		0.42	0.43
Whiskey	1	234.51	50 YR	221.40	220.70	14.61		42.04	221.30	0.09	0.45	
Whiskey	1	234.51	100 YR	221.76	220.70	14.61		52.25	221.30	3.83	0.60	
Whiskey	1	234.51	Regional	222.25	220.70	14.61		73.32	221.30	21.42	0.81	
Whiskey	1	171.38	2 YR	219.51	220.00	18.28		10.06	220.62		0.02	
Whiskey	1	171.38	5 YR	220.04	220.00	18.28	220.00	19.56	220.62		0.04	0.27
Whiskey	1	171.38	10 YR	220.46	220.00	18.28	220.40	27.38	220.62		0.10	
Whiskey	1	171.38	25 YR	220.67	220.00	18.28		35.17	220.62	0.03	0.18	
Whiskey	1	171.38	50 YR	220.80	220.00	18.28		42.13	220.62	0.74	0.25	
Whiskey	1	171.38	100 YR	220.97	220.00	18.28		51.96	220.62	4.22	0.34	
Whiskey	1	171.38	Regional	221.22	220.00	18.28		71.09	220.62	16.24	0.40	

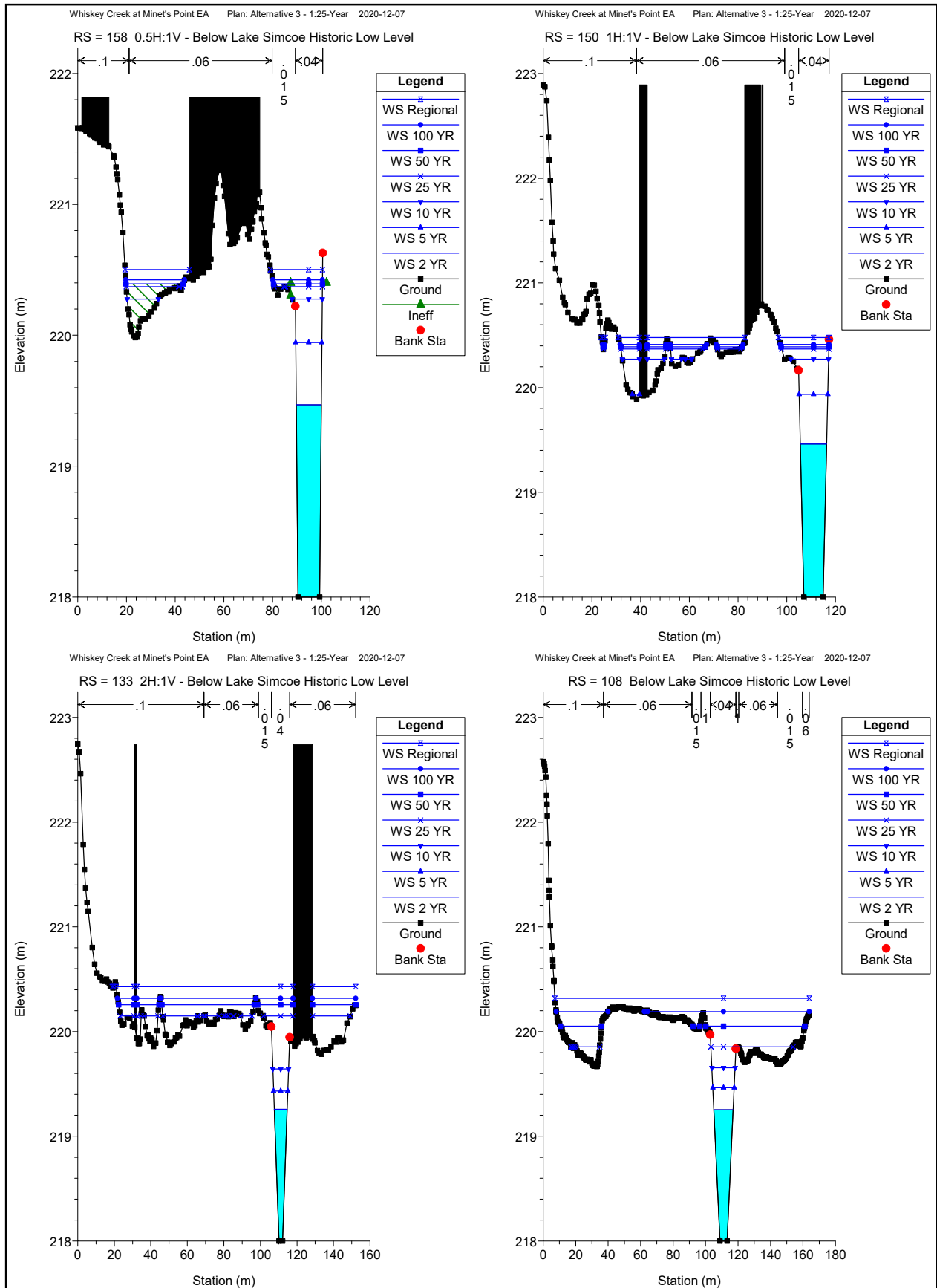
HEC-RAS Plan: Alt3-25 Locations: User Defined

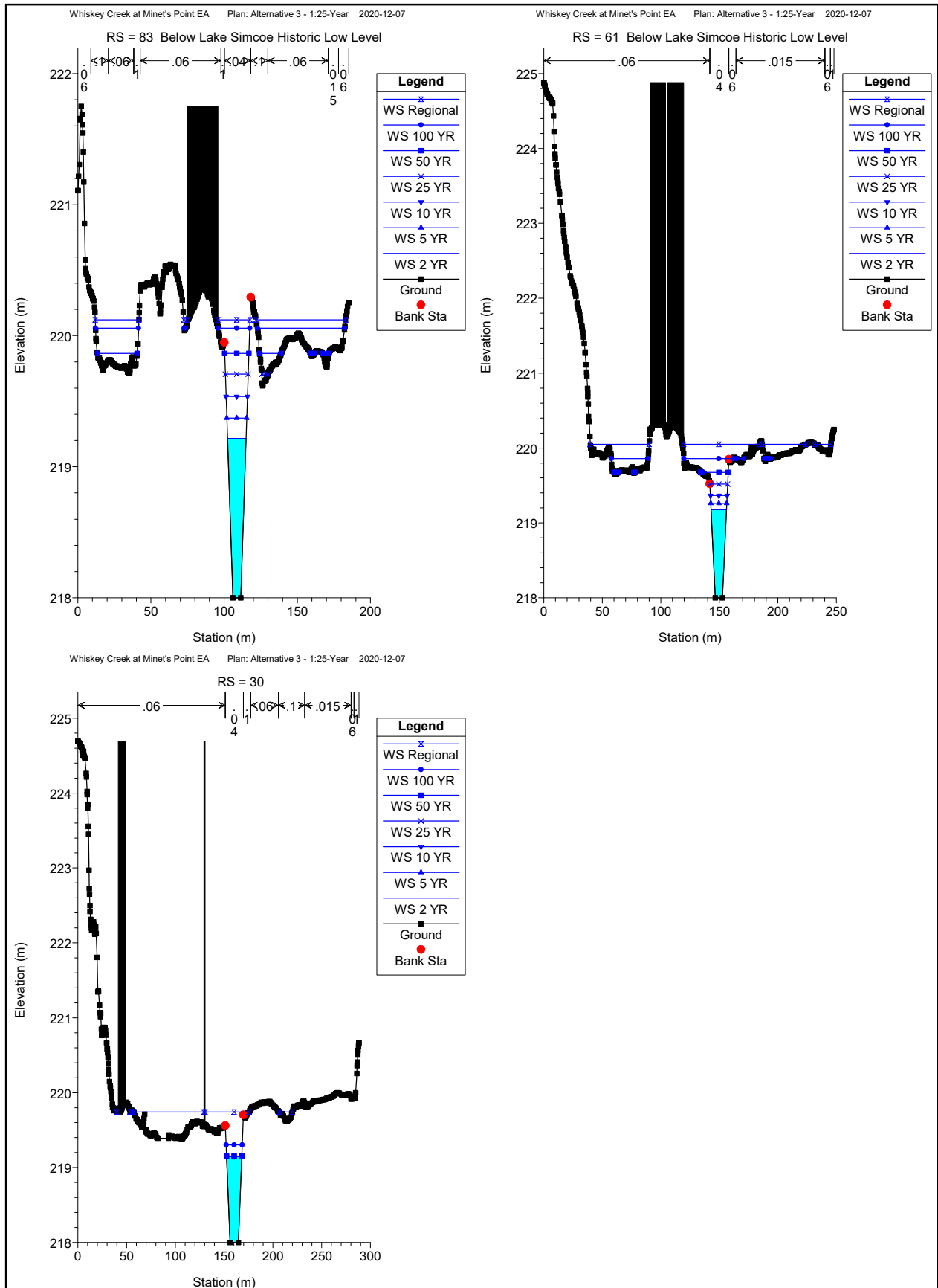
River	Reach	River Sta	Profile	Q US (m3/s)	Q Leaving Total (m3/s)	Q DS (m3/s)	Q Weir (m3/s)	Q Gates (m3/s)	Wr Top Width (m)	Weir Max Depth (m)	Weir Avg Depth (m)	Min El Weir Flow (m)	E.G. US. (m)	W.S. US. (m)	E.G. DS (m)	W.S. DS (m)
Whiskey	1	222.8	2 YR	10.03	0.00	10.08	0.00					220.05	219.58	219.51	219.18	219.15
Whiskey	1	222.8	5 YR	19.49	0.00	19.59	0.00					220.05	220.12	220.03	219.26	219.15
Whiskey	1	222.8	10 YR	27.27	0.00	27.43	0.00					220.05	220.53	220.43	219.36	219.15
Whiskey	1	222.8	25 YR	35.03	0.50	34.75	0.50		32.35	0.19	0.09	220.05	220.76	220.63	219.48	219.16
Whiskey	1	222.8	50 YR	42.04	1.08	41.21	1.08		51.40	0.26	0.12	220.05	220.91	220.75	219.61	219.16
Whiskey	1	222.8	100 YR	52.25	2.04	50.61	2.04		83.53	0.31	0.13	220.05	221.11	220.90	219.81	219.31
Whiskey	1	222.8	Regional	73.32	5.75	68.11	5.75		119.17	0.50	0.22	220.05	221.40	221.10	219.98	219.75













HEC-RAS Plan: Alt3-25 Sloped Locations: User Defined

River	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
Whiskey	1	299	2 YR	10.00	220.47	221.37	221.37	221.61	0.013705	2.34	5.90	13.73	0.87
Whiskey	1	299	5 YR	19.42	220.47	221.65	221.65	221.96	0.012909	2.81	10.16	16.78	0.90
Whiskey	1	299	10 YR	27.16	220.47	221.81	221.81	222.18	0.013310	3.16	12.96	17.76	0.93
Whiskey	1	299	25 YR	34.88	220.47	221.95	221.95	222.38	0.013766	3.46	15.44	18.54	0.97
Whiskey	1	299	50 YR	41.86	220.47	222.07	222.07	222.54	0.013749	3.66	17.70	19.18	0.98
Whiskey	1	299	100 YR	52.03	220.47	222.22	222.22	222.76	0.014008	3.95	20.67	20.02	1.01
Whiskey	1	299	Regional	72.99	220.47	222.51	222.51	223.15	0.013758	4.39	26.73	21.36	1.03
Whiskey	1	278	2 YR	10.00	219.98	220.84	220.84	221.15	0.021410	2.46	4.06	6.67	1.01
Whiskey	1	278	5 YR	19.42	219.98	221.20	221.20	221.64	0.017993	2.96	6.79	9.80	0.98
Whiskey	1	278	10 YR	27.16	219.98	221.55	221.55	221.93	0.010556	2.81	13.82	28.86	0.79
Whiskey	1	278	25 YR	34.88	219.98	221.72	221.72	222.12	0.010008	2.97	18.88	29.97	0.79
Whiskey	1	278	50 YR	41.86	219.98	221.84	221.84	222.27	0.010173	3.16	22.44	30.56	0.80
Whiskey	1	278	100 YR	52.03	219.98	221.99	221.99	222.46	0.010445	3.40	27.07	31.22	0.83
Whiskey	1	278	Regional	72.99	219.98	222.24	222.24	222.81	0.011103	3.84	35.13	32.04	0.87
Whiskey	1	257	2 YR	10.00	219.30	219.98	219.98	220.25	0.021036	2.32	4.32	8.00	1.01
Whiskey	1	257	5 YR	19.42	219.30	220.30	220.30	220.68	0.018988	2.75	7.06	9.27	1.01
Whiskey	1	257	10 YR	27.16	219.30	220.96		221.15	0.005293	1.93	14.06	11.91	0.57
Whiskey	1	257	25 YR	34.88	219.30	221.30		221.48	0.003774	1.88	20.87	28.22	0.50
Whiskey	1	257	50 YR	41.86	219.30	221.50		221.68	0.003339	1.92	27.18	32.54	0.48
Whiskey	1	257	100 YR	52.03	219.30	221.86		222.02	0.002425	1.86	39.10	35.40	0.42
Whiskey	1	257	Regional	72.99	219.30	222.24		222.43	0.002388	2.08	53.04	37.44	0.43
Whiskey	1	249	2 YR	10.00	219.00	219.84		219.98	0.008408	1.63	6.14	9.72	0.65
Whiskey	1	249	5 YR	19.42	219.00	220.28		220.45	0.006084	1.80	10.81	11.48	0.59
Whiskey	1	249	10 YR	27.16	219.00	221.00		221.09	0.001936	1.34	21.43	21.45	0.36
Whiskey	1	249	25 YR	34.88	219.00	221.34		221.43	0.001567	1.36	29.26	25.45	0.33
Whiskey	1	249	50 YR	41.86	219.00	221.54		221.64	0.001519	1.44	35.02	31.00	0.33
Whiskey	1	249	100 YR	52.03	219.00	221.88		221.99	0.001269	1.47	46.34	35.47	0.31
Whiskey	1	249	Regional	72.99	219.00	222.26		222.39	0.001363	1.69	60.84	41.10	0.33
Whiskey	1	243	2 YR	10.03	218.85	219.83	219.51	219.92	0.004639	1.36	7.35	9.45	0.49
Whiskey	1	243	5 YR	19.49	218.85	220.26	219.80	220.41	0.004368	1.67	11.67	10.32	0.50
Whiskey	1	243	10 YR	27.27	218.85	220.98	220.00	221.08	0.001728	1.40	19.41	11.75	0.34
Whiskey	1	243	25 YR	35.03	218.85	221.30	220.18	221.42	0.001823	1.49	23.76	15.38	0.34
Whiskey	1	243	50 YR	42.04	218.85	221.49	220.33	221.62	0.001922	1.62	27.12	21.24	0.36
Whiskey	1	243	100 YR	52.25	218.85	221.82	220.53	221.96	0.001723	1.70	36.05	31.54	0.35
Whiskey	1	243	Regional	73.32	218.85	222.19	220.86	222.37	0.001923	1.97	49.07	40.12	0.38
Whiskey	1	234.33		Bridge									
Whiskey	1	225	2 YR	10.03	218.76	219.69	219.40	219.78	0.004361	1.34	7.49	16.30	0.49
Whiskey	1	225	5 YR	19.49	218.76	220.02	219.67	220.19	0.004845	1.80	10.81	16.64	0.55
Whiskey	1	225	10 YR	27.27	218.76	220.36	219.85	220.55	0.003883	1.93	14.13	16.97	0.52
Whiskey	1	225	25 YR	35.03	218.76	220.63	220.02	220.85	0.003612	2.09	16.78	17.24	0.51
Whiskey	1	225	50 YR	42.04	218.76	220.84	220.15	221.09	0.003511	2.23	18.88	17.45	0.52
Whiskey	1	225	100 YR	52.25	218.76	221.07	220.35	221.19	0.001869	1.53	34.38	24.19	0.35
Whiskey	1	225	Regional	73.32	218.76	221.38	220.71	221.52	0.001906	1.69	48.38	44.94	0.36
Whiskey	1	223	2 YR	10.03	218.75	219.69		219.76	0.003866	1.18	8.52	12.13	0.45
Whiskey	1	223	5 YR	19.49	218.75	220.04		220.16	0.004076	1.52	12.86	12.82	0.48
Whiskey	1	223	10 YR	27.27	218.75	220.38		220.51	0.003189	1.57	17.40	13.51	0.44
Whiskey	1	223	25 YR	35.03	218.75	220.66		220.80	0.002907	1.65	21.22	14.07	0.43
Whiskey	1	223	50 YR	42.04	218.75	220.88		221.03	0.002778	1.72	24.37	14.51	0.42
Whiskey	1	223	100 YR	52.25	218.75	220.93		221.15	0.003963	2.09	25.09	17.79	0.51
Whiskey	1	223	Regional	73.32	218.75	221.16	220.54	221.46	0.004834	2.46	32.82	40.89	0.57
Whiskey	1	221	2 YR	10.03	218.73	219.68	219.36	219.74	0.003326	1.09	9.21	13.24	0.42
Whiskey	1	221	5 YR	19.49	218.73	220.03	219.58	220.13	0.003420	1.39	13.98	13.94	0.44
Whiskey	1	221	10 YR	27.27	218.73	220.38	219.74	220.49	0.002632	1.44	18.98	14.64	0.40
Whiskey	1	221	25 YR	35.03	218.73	220.66	219.89	220.78	0.002388	1.51	23.15	15.20	0.39
Whiskey	1	221	50 YR	42.04	218.73	220.88	220.00	221.01	0.002279	1.58	26.62	19.39	0.39
Whiskey	1	221	100 YR	52.25	218.73	220.93	220.16	221.11	0.003226	1.91	27.69	25.00	0.46
Whiskey	1	221	Regional	73.32	218.73	221.18	220.46	221.41	0.003654	2.18	36.76	44.77	0.50
Whiskey	1	219		Lat Struct									
Whiskey	1	208	2 YR	10.03	218.69	219.55		219.68	0.008304	1.61	6.25	10.08	0.65
Whiskey	1	208	5 YR	19.49	218.69	219.85		220.06	0.009473	2.04	9.56	11.89	0.73
Whiskey	1	208	10 YR	27.27	218.69	220.28		220.44	0.005164	1.80	15.17	14.45	0.56
Whiskey	1	208	25 YR	35.03	218.69	220.58		220.74	0.004089	1.77	19.84	16.27	0.51
Whiskey	1	208	50 YR	42.04	218.69	220.83		220.98	0.003463	1.74	24.49	26.46	0.48
Whiskey	1	208	100 YR	52.25	218.69	220.84		221.07	0.005199	2.14	24.80	26.77	0.59
Whiskey	1	208	Regional	72.69	218.69	221.14		221.37	0.004221	2.19	35.50	43.93	0.55
Whiskey	1	201	2 YR	10.03	218.66	219.46		219.61	0.010464	1.71	5.85	10.19	0.72
Whiskey	1	201	5 YR	19.49	218.66	219.73		219.98	0.012419	2.22	8.78	11.79	0.82
Whiskey	1	201	10 YR	27.27	218.66	220.25		220.40	0.004755	1.73	15.75	14.92	0.54
Whiskey	1	201	25 YR	35.03	218.66	220.56		220.71	0.003692	1.69	20.71	16.80	0.49
Whiskey	1	201	50 YR	42.04	218.66	220.82		220.95	0.002921	1.63	26.31	28.44	0.44
Whiskey	1	201	100 YR	52.25	218.66	220.82		221.03	0.004449	2.02	26.45	28.54	0.55

HEC-RAS Plan: Alt3-25 Sloped Locations: User Defined (Continued)

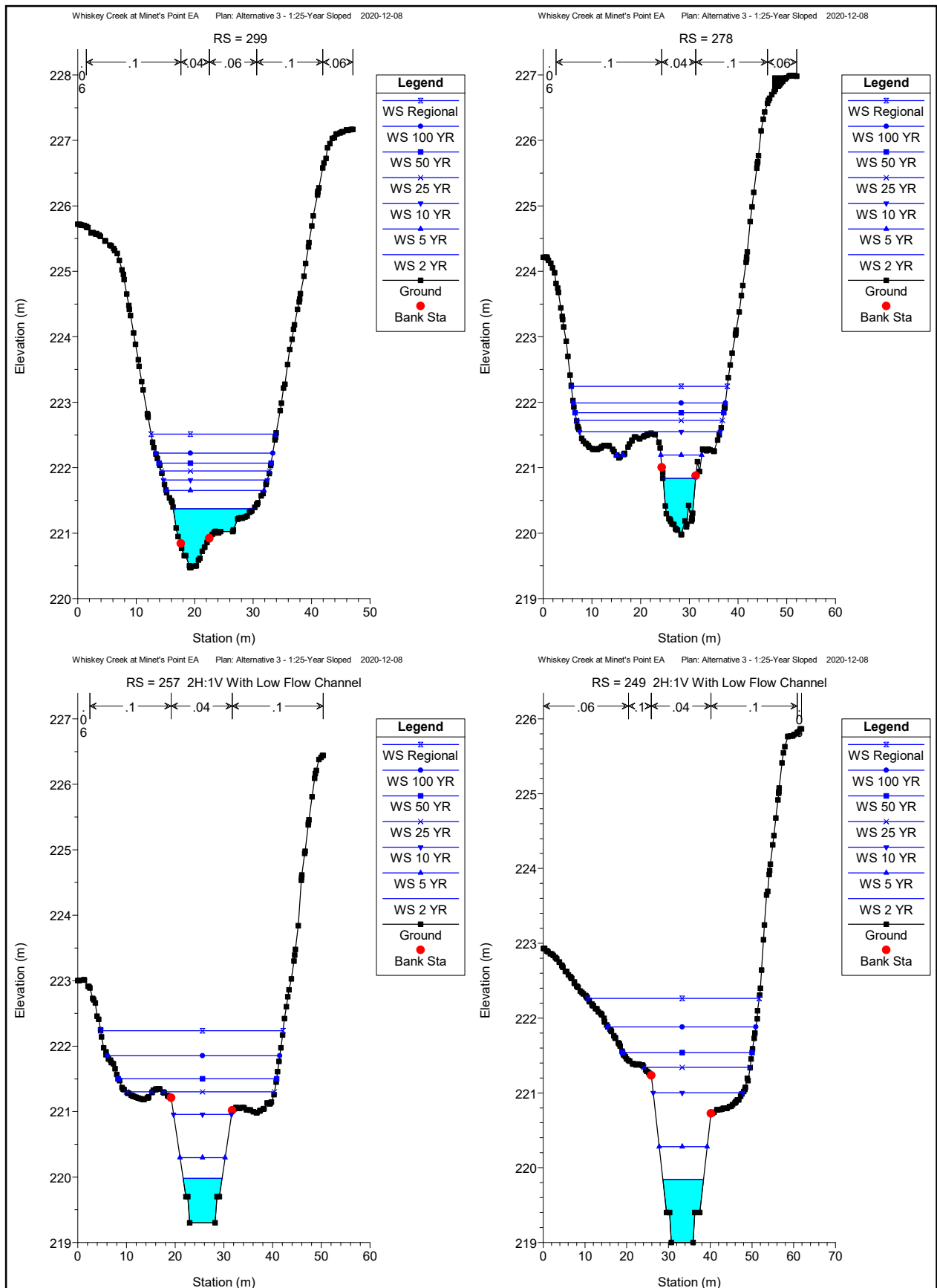
River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Whiskey	1	201	Regional	72.10	218.66	221.14		221.33	0.003290	1.97	37.84	40.11	0.48
Whiskey	1	188	2 YR	10.03	218.62	219.39		219.49	0.008304	1.42	7.08	13.91	0.63
Whiskey	1	188	5 YR	19.49	218.62	219.70		219.84	0.006802	1.68	11.61	15.16	0.61
Whiskey	1	188	10 YR	27.27	218.62	220.26		220.35	0.002359	1.32	20.70	17.39	0.39
Whiskey	1	188	25 YR	35.03	218.62	220.57		220.66	0.001918	1.33	26.36	18.65	0.36
Whiskey	1	188	50 YR	41.92	218.62	220.83		220.91	0.001547	1.31	32.91	31.91	0.33
Whiskey	1	188	100 YR	52.11	218.62	220.84		220.97	0.002318	1.61	33.29	32.13	0.40
Whiskey	1	188	Regional	70.77	218.62	221.16		221.28	0.001797	1.59	46.11	48.35	0.36
Whiskey	1	180	2 YR	10.06	218.59	219.37	219.09	219.42	0.003654	1.07	9.44	15.28	0.43
Whiskey	1	180	5 YR	19.56	218.59	219.68	219.30	219.78	0.003631	1.36	14.40	15.92	0.46
Whiskey	1	180	10 YR	27.38	218.59	220.25	219.44	220.32	0.001458	1.16	23.63	17.06	0.31
Whiskey	1	180	25 YR	35.15	218.59	220.57	219.57	220.64	0.001329	1.20	29.24	17.75	0.30
Whiskey	1	180	50 YR	41.41	218.59	220.82	219.66	220.89	0.001096	1.19	35.83	34.96	0.28
Whiskey	1	180	100 YR	51.64	218.59	220.83	219.81	220.94	0.001667	1.48	36.16	35.66	0.34
Whiskey	1	180	Regional	68.86	218.59	221.16	220.03	221.26	0.001295	1.45	50.86	48.54	0.31
Whiskey	1	170.36	Bridge										
Whiskey	1	158	2 YR	10.06	218.50	219.25	218.84	219.28	0.001683	0.84	11.92	21.64	0.31
Whiskey	1	158	5 YR	19.56	218.50	219.42	219.04	219.51	0.003136	1.33	14.74	22.52	0.44
Whiskey	1	158	10 YR	27.38	218.50	219.58	219.17	219.71	0.003679	1.59	17.20	23.29	0.49
Whiskey	1	158	25 YR	35.15	218.50	219.72	219.29	219.89	0.003945	1.80	19.56	24.03	0.52
Whiskey	1	158	50 YR	41.41	218.50	219.84	219.38	220.03	0.004075	1.94	21.37	24.59	0.53
Whiskey	1	158	100 YR	51.64	218.50	220.01	219.52	220.24	0.004243	2.14	24.11	25.45	0.56
Whiskey	1	158	Regional	68.86	218.50	220.28	219.74	220.43	0.002871	1.73	39.87	27.82	0.45
Whiskey	1	150	2 YR	10.06	218.47	219.25	218.76	219.26	0.000912	0.60	16.84	23.59	0.23
Whiskey	1	150	5 YR	19.56	218.47	219.43	218.93	219.47	0.001678	0.92	21.23	24.48	0.32
Whiskey	1	150	10 YR	27.38	218.47	219.59	219.04	219.65	0.001926	1.08	25.26	25.27	0.35
Whiskey	1	150	25 YR	35.15	218.47	219.75	219.14	219.82	0.002030	1.20	29.32	26.17	0.36
Whiskey	1	150	50 YR	41.41	218.47	219.87	219.21	219.95	0.002098	1.27	32.56	27.26	0.37
Whiskey	1	150	100 YR	51.64	218.47	220.06	219.33	220.15	0.002155	1.37	37.76	28.93	0.38
Whiskey	1	150	Regional	68.65	218.47	220.28	219.49	220.40	0.002320	1.54	44.74	35.59	0.41
Whiskey	1	133	2 YR	10.06	218.41	219.23	218.71	219.25	0.000804	0.57	17.53	23.79	0.21
Whiskey	1	133	5 YR	19.56	218.41	219.40	218.88	219.44	0.001596	0.90	21.64	24.81	0.31
Whiskey	1	133	10 YR	27.38	218.41	219.56	218.99	219.62	0.001874	1.07	25.63	25.75	0.34
Whiskey	1	133	25 YR	35.15	218.41	219.71	219.09	219.79	0.001980	1.18	29.72	26.69	0.36
Whiskey	1	133	50 YR	41.41	218.41	219.84	219.17	219.92	0.001975	1.25	33.47	33.43	0.36
Whiskey	1	133	100 YR	51.64	218.41	220.02	219.28	220.11	0.001914	1.34	40.79	42.43	0.36
Whiskey	1	133	Regional	68.20	218.41	220.25	219.44	220.36	0.001906	1.47	51.63	54.31	0.37
Whiskey	1	108	2 YR	10.06	218.31	219.20	218.67	219.22	0.001013	0.66	15.19	19.70	0.24
Whiskey	1	108	5 YR	19.56	218.31	219.33	218.86	219.39	0.002418	1.10	17.70	20.45	0.38
Whiskey	1	108	10 YR	27.38	218.31	219.46	219.00	219.55	0.003075	1.34	20.48	21.25	0.43
Whiskey	1	108	25 YR	35.15	218.31	219.60	219.11	219.72	0.003361	1.49	23.54	22.10	0.46
Whiskey	1	108	50 YR	41.41	218.31	219.72	219.20	219.84	0.003449	1.59	26.10	22.78	0.47
Whiskey	1	108	100 YR	51.64	218.31	219.90	219.33	220.04	0.003420	1.69	31.57	45.25	0.48
Whiskey	1	108	Regional	68.18	218.31	220.17	219.52	220.30	0.002586	1.65	47.87	67.14	0.43
Whiskey	1	83	2 YR	10.06	218.21	219.18	218.59	219.20	0.000898	0.65	15.49	18.88	0.23
Whiskey	1	83	5 YR	19.56	218.21	219.26	218.79	219.33	0.002542	1.15	17.08	19.38	0.39
Whiskey	1	83	10 YR	27.38	218.21	219.37	218.93	219.47	0.003574	1.43	19.11	20.00	0.47
Whiskey	1	83	25 YR	35.15	218.21	219.49	219.05	219.62	0.004099	1.62	21.64	20.74	0.51
Whiskey	1	83	50 YR	41.41	218.21	219.60	219.15	219.75	0.004269	1.73	23.88	21.38	0.52
Whiskey	1	83	100 YR	51.64	218.21	219.77	219.28	219.95	0.004343	1.87	27.65	22.41	0.54
Whiskey	1	83	Regional	68.17	218.21	220.03	219.48	220.22	0.003881	1.94	39.74	73.41	0.52
Whiskey	1	61	2 YR	10.06	218.12	219.16	218.54	219.18	0.000948	0.68	14.75	17.34	0.24
Whiskey	1	61	5 YR	19.56	218.12	219.17	218.76	219.26	0.003375	1.30	15.05	17.45	0.45
Whiskey	1	61	10 YR	27.38	218.12	219.20	218.91	219.36	0.006063	1.77	15.51	17.61	0.60
Whiskey	1	61	25 YR	35.15	218.12	219.24	219.04	219.48	0.008810	2.17	16.19	17.84	0.73
Whiskey	1	61	50 YR	41.41	218.12	219.28	219.14	219.58	0.010700	2.44	16.95	18.09	0.81
Whiskey	1	61	100 YR	51.64	218.12	219.37	219.29	219.76	0.012717	2.78	18.60	18.63	0.89
Whiskey	1	61	Regional	68.17	218.12	219.60	219.50	220.05	0.011898	2.95	23.09	20.02	0.88
Whiskey	1	30	2 YR	10.08	218.00	219.15	218.33	219.16	0.000332	0.44	22.68	23.17	0.14
Whiskey	1	30	5 YR	19.59	218.00	219.15	218.51	219.19	0.001255	0.86	22.68	23.17	0.28
Whiskey	1	30	10 YR	27.43	218.00	219.15	218.64	219.22	0.002460	1.21	22.68	23.17	0.39
Whiskey	1	30	25 YR	35.22	218.00	219.15	218.75	219.27	0.004056	1.55	22.68	23.17	0.50
Whiskey	1	30	50 YR	41.50	218.00	219.15	218.83	219.32	0.005630	1.83	22.68	23.17	0.59
Whiskey	1	30	100 YR	51.76	218.00	219.15	218.95	219.42	0.008758	2.28	22.68	23.17	0.74
Whiskey	1	30	Regional	68.33	218.00	219.50	219.13	219.75	0.005971	2.19	31.16	25.27	0.63

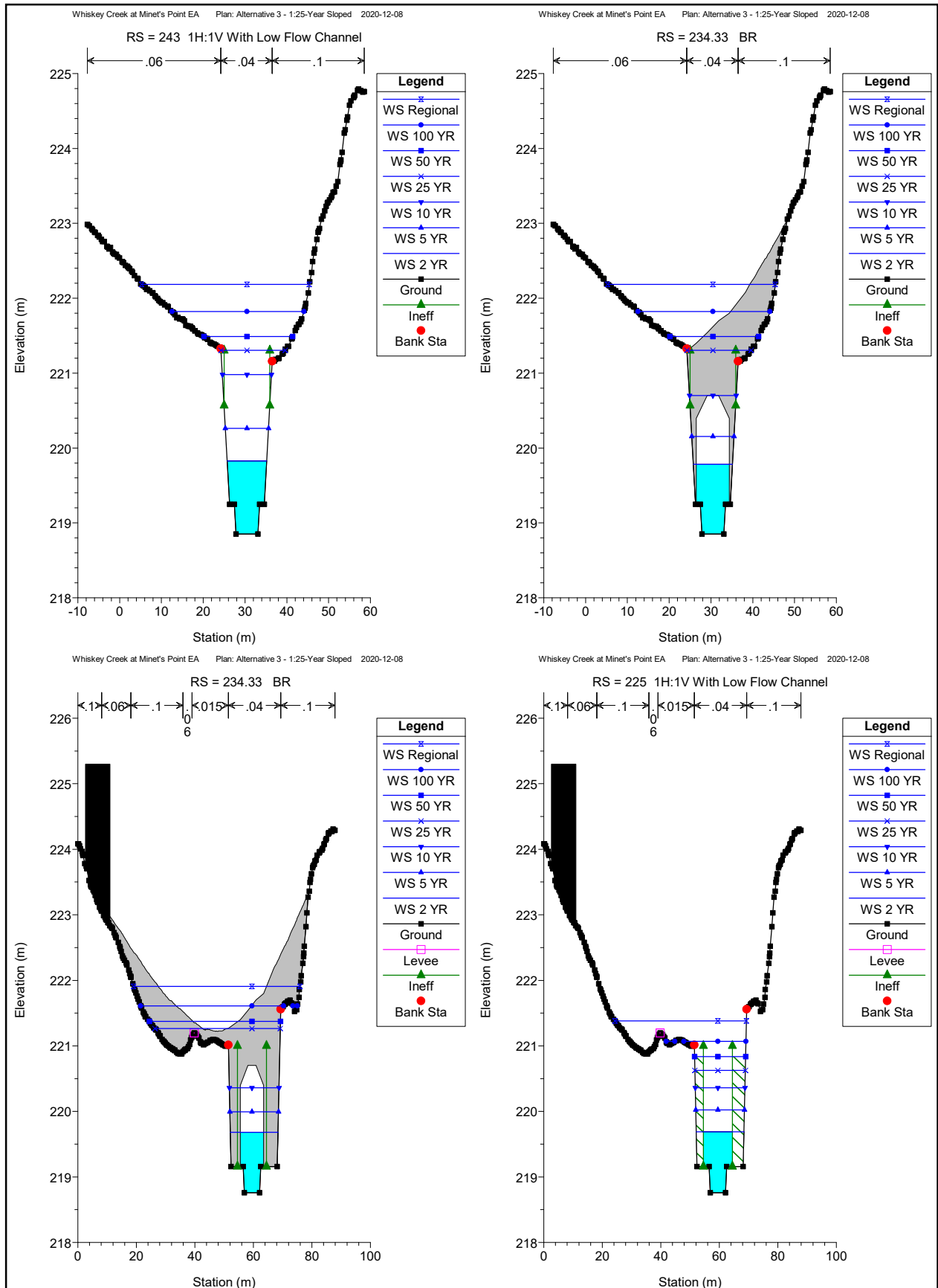
HEC-RAS Plan: Alt3-25 Sloped Locations: User Defined

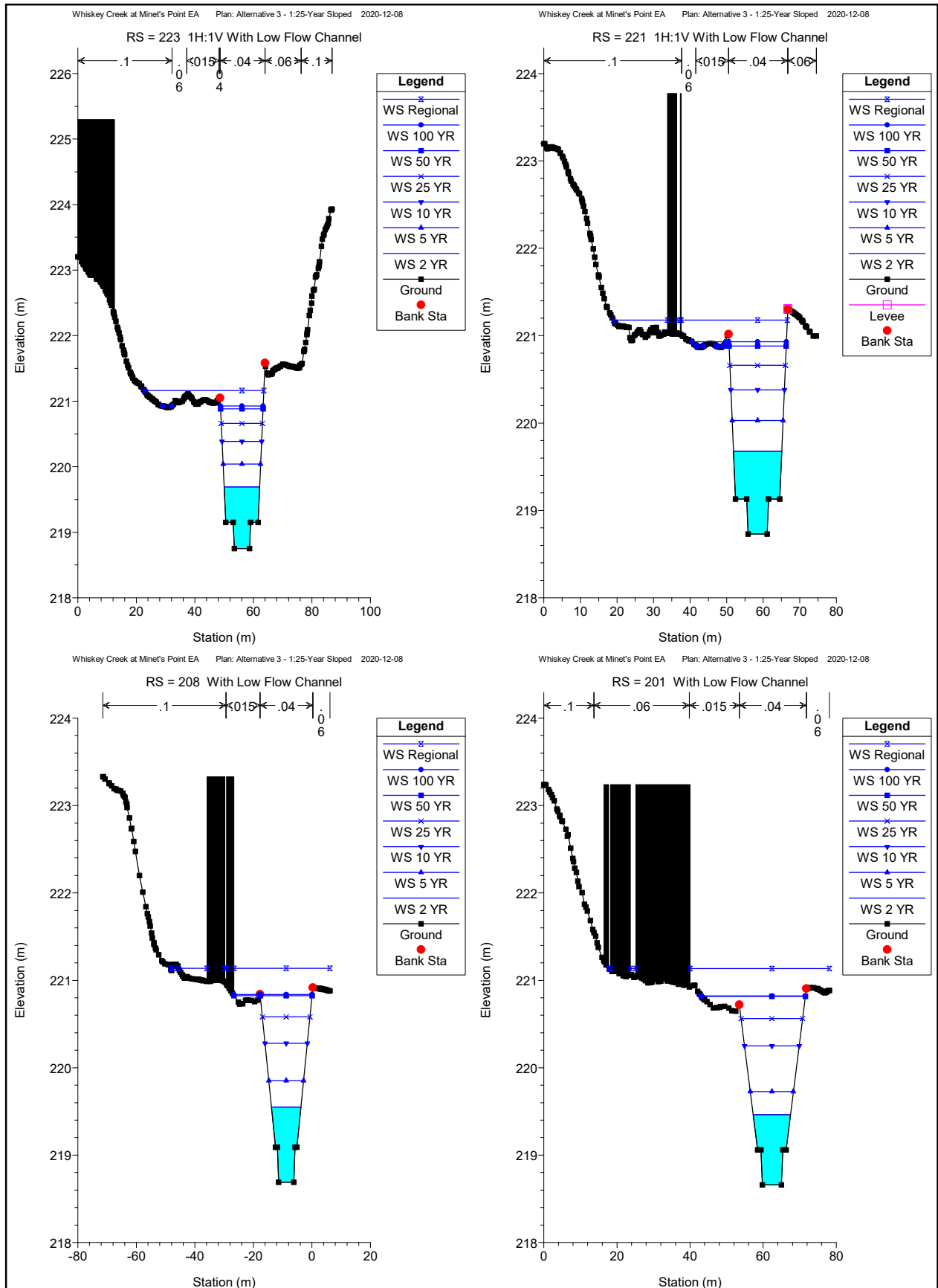
River	Reach	River Sta	Profile	E. G. US.	Min El Prs	BR Open Area	Prs O WS	Q Total	Min El Weir Flow	Q Weir	Delta EG	BR Sluice Coef
				(m)	(m)	(m2)	(m)	(m3/s)	(m)	(m3/s)	(m)	
Whiskey	1	234.33	2 YR	219.92	220.70	12.94		10.03	221.30		0.14	
Whiskey	1	234.33	5 YR	220.41	220.70	12.94		19.49	221.30		0.22	
Whiskey	1	234.33	10 YR	221.08	220.70	12.94	220.98	27.27	221.30		0.53	0.42
Whiskey	1	234.33	25 YR	221.42	220.70	12.94	221.31	35.03	221.30	0.10	0.57	0.48
Whiskey	1	234.33	50 YR	221.62	220.70	12.94		42.04	221.30	1.44	0.53	
Whiskey	1	234.33	100 YR	221.96	220.70	12.94		52.25	221.30	8.82	0.78	
Whiskey	1	234.33	Regional	222.37	220.70	12.94		73.32	221.30	27.76	0.85	
Whiskey	1	170.36	2 YR	219.42	220.00	14.13		10.06	220.62		0.14	
Whiskey	1	170.36	5 YR	219.78	220.00	14.13		19.56	220.62		0.27	
Whiskey	1	170.36	10 YR	220.32	220.00	14.13	220.25	27.38	220.62		0.62	0.43
Whiskey	1	170.36	25 YR	220.64	220.00	14.13	220.57	35.15	220.62	0.00	0.75	0.49
Whiskey	1	170.36	50 YR	220.89	220.00	14.13	221.00	41.41	220.62	2.23	0.86	0.50
Whiskey	1	170.36	100 YR	220.94	220.00	14.13		51.64	220.62	3.32	0.70	
Whiskey	1	170.36	Regional	221.26	220.00	14.13		68.86	220.62	19.43	0.82	

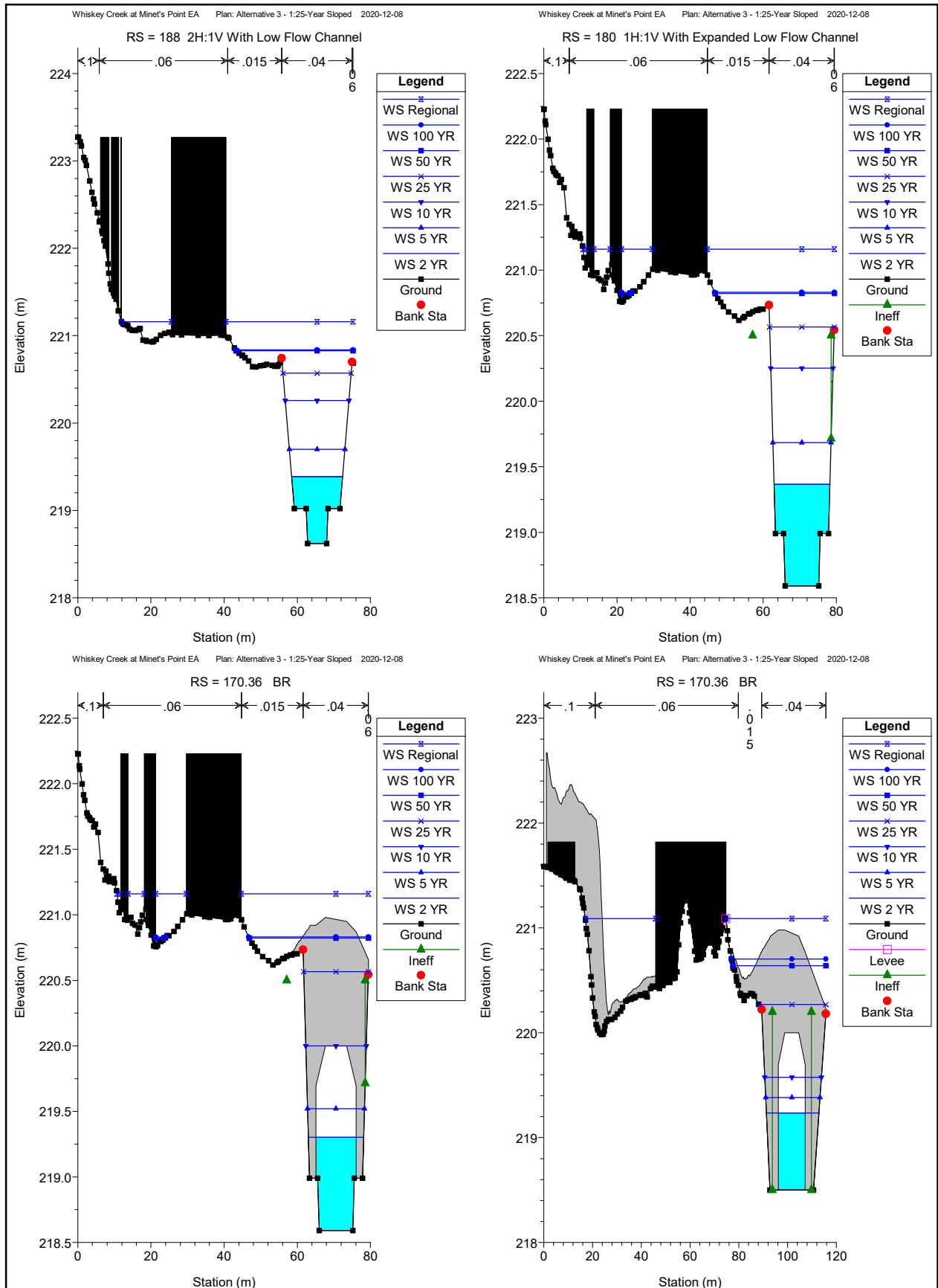
HEC-RAS Plan: Alt3-25_Sloped Locations: User Defined

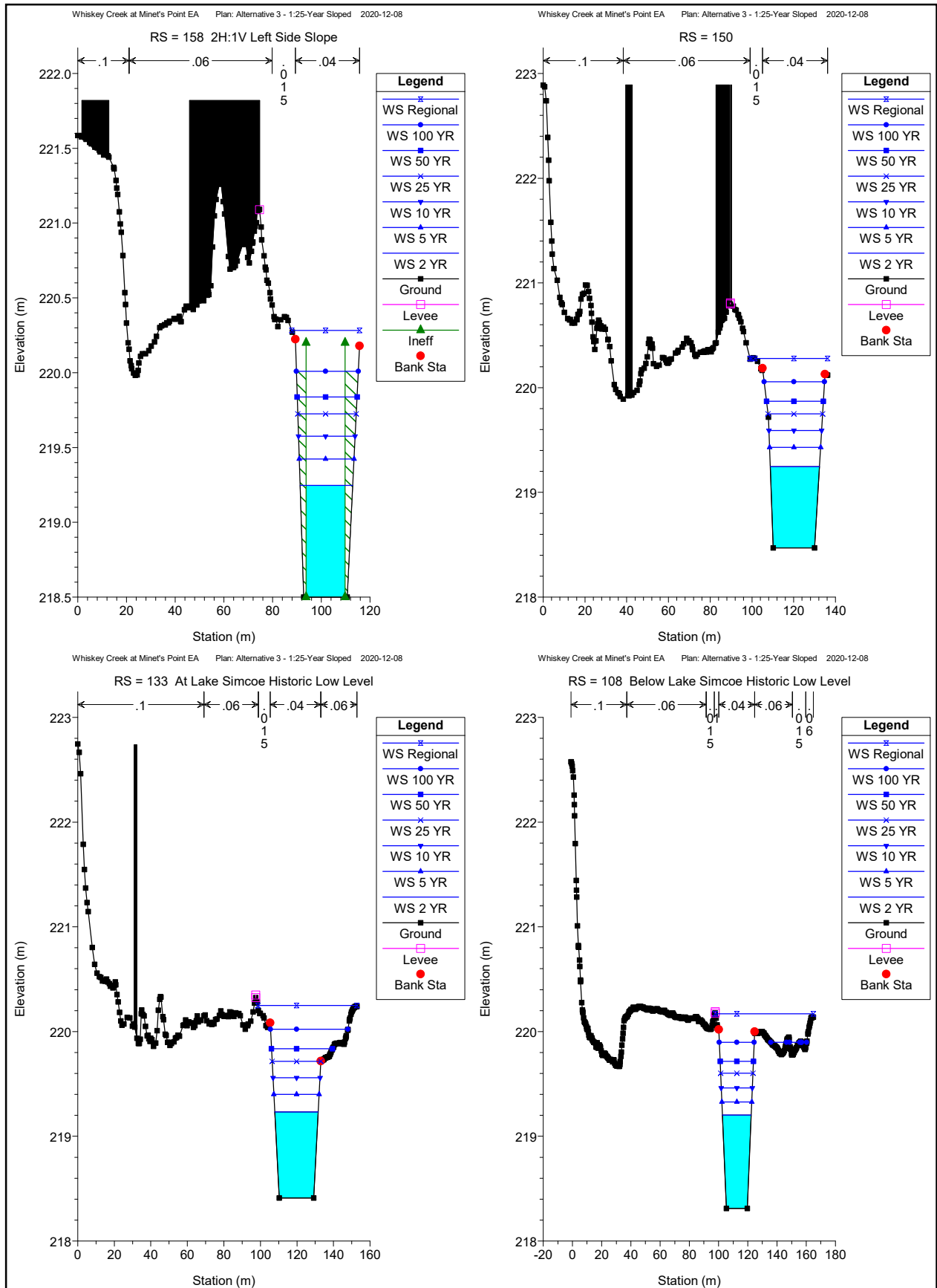
River	Reach	River Sta	Profile	Q US (m3/s)	Q Leaving Total (m3/s)	Q DS (m3/s)	Q Weir (m3/s)	Q Gates (m3/s)	Wt Top Width (m)	Weir Max Depth (m)	Weir Avg Depth (m)	Min El Weir Flow (m)	E.G. US. (m)	W.S. US. (m)	E.G. DS (m)	W.S. DS (m)
Whiskey	1	219	2 YR	10.03	0.00	10.08	0.00					220.07	219.73	219.66	219.16	219.15
Whiskey	1	219	5 YR	19.49	0.00	19.59	0.00					220.07	220.12	220.00	219.19	219.15
Whiskey	1	219	10 YR	27.27	0.00	27.43	0.00					220.07	220.48	220.36	219.23	219.15
Whiskey	1	219	25 YR	35.03	0.02	35.22	0.02		10.07	0.07	0.03	220.07	220.77	220.65	219.28	219.15
Whiskey	1	219	50 YR	42.04	0.80	41.50	0.80		30.18	0.33	0.18	220.07	221.00	220.87	219.32	219.15
Whiskey	1	219	100 YR	52.25	0.86	51.76	0.86		37.01	0.34	0.18	220.07	221.11	220.91	219.42	219.15
Whiskey	1	219	Regional	73.32	5.55	68.33	5.55		105.09	0.67	0.28	220.07	221.40	221.17	219.75	219.50

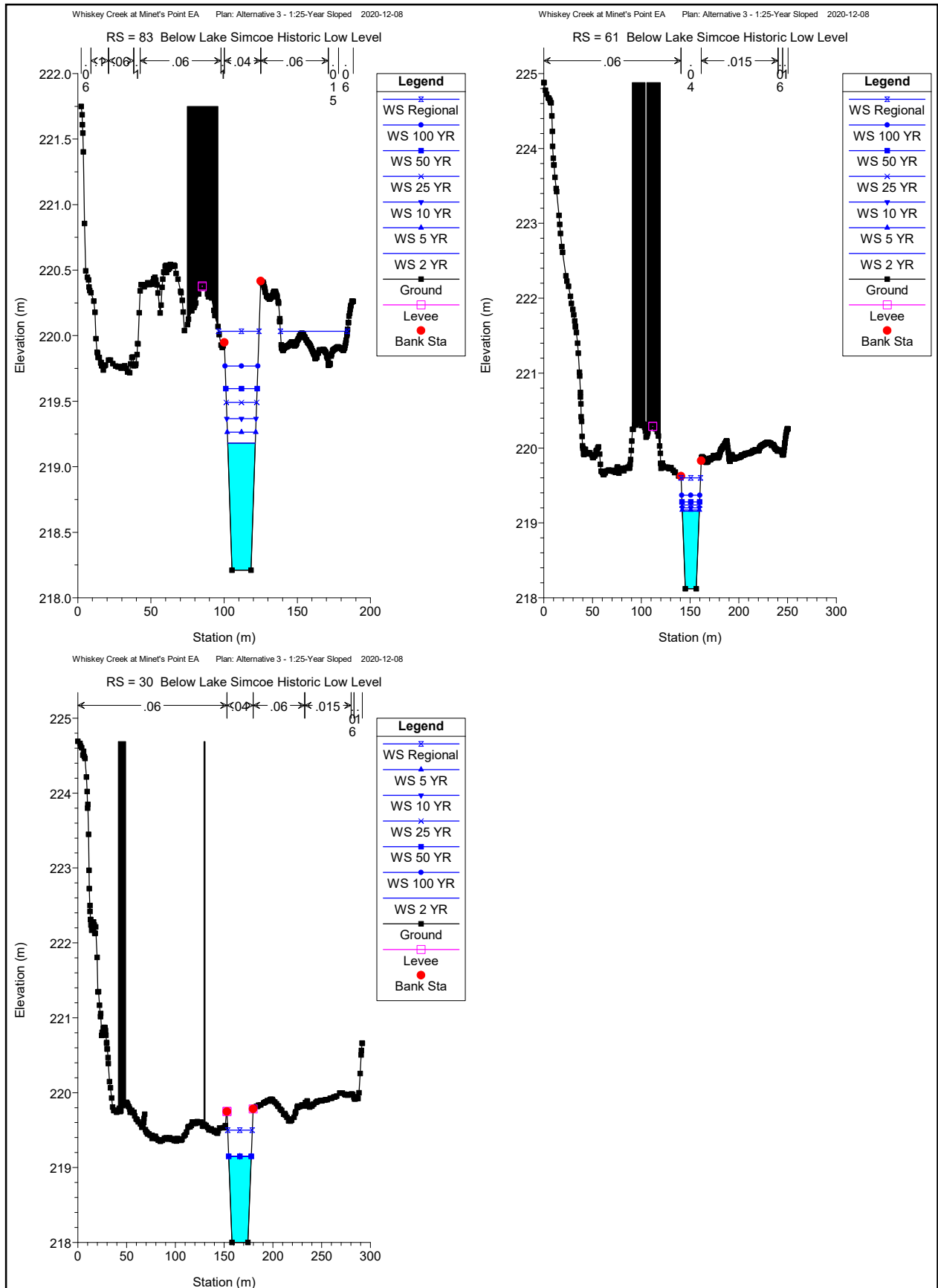












**Appendix J:
Hydraulic Model Results – 1:10-
Year Return Frequency Design
Storm Capacity**



HEC-RAS Plan: Alt3-10 Locations: User Defined

River	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
Whiskey	1	299	2 YR	10.00	220.47	221.37	221.37	221.61	0.013705	2.34	5.90	13.73	0.87
Whiskey	1	299	5 YR	19.42	220.47	221.65	221.65	221.96	0.012909	2.81	10.16	16.78	0.90
Whiskey	1	299	10 YR	27.16	220.47	221.81	221.81	222.18	0.013310	3.16	12.96	17.76	0.93
Whiskey	1	299	25 YR	34.88	220.47	221.95	221.95	222.38	0.013766	3.46	15.44	18.54	0.97
Whiskey	1	299	50 YR	41.86	220.47	222.07	222.07	222.54	0.013749	3.66	17.70	19.18	0.98
Whiskey	1	299	100 YR	52.03	220.47	222.22	222.22	222.76	0.014008	3.95	20.67	20.02	1.01
Whiskey	1	299	Regional	72.99	220.47	222.51	222.51	223.15	0.013758	4.39	26.73	21.36	1.03
Whiskey	1												
Whiskey	1	278	2 YR	10.00	219.98	220.84	220.84	221.15	0.021392	2.46	4.06	6.68	1.01
Whiskey	1	278	5 YR	19.42	219.98	221.20	221.20	221.64	0.017993	2.96	6.79	9.80	0.98
Whiskey	1	278	10 YR	27.16	219.98	221.55	221.55	221.93	0.010564	2.81	13.81	28.86	0.79
Whiskey	1	278	25 YR	34.88	219.98	221.71	221.71	222.12	0.010227	3.00	18.67	29.93	0.79
Whiskey	1	278	50 YR	41.86	219.98	221.83	221.83	222.27	0.010424	3.18	22.18	30.52	0.81
Whiskey	1	278	100 YR	52.03	219.98	221.99	221.99	222.46	0.010438	3.40	27.07	31.22	0.83
Whiskey	1	278	Regional	72.99	219.98	222.24	222.24	222.81	0.011103	3.84	35.13	32.04	0.87
Whiskey	1												
Whiskey	1	257	2 YR	10.00	219.08	219.77	219.77	220.07	0.020578	2.40	4.17	7.17	1.00
Whiskey	1	257	5 YR	19.42	219.08	220.35		220.59	0.008907	2.16	8.98	9.48	0.71
Whiskey	1	257	10 YR	27.16	219.08	221.22		221.32	0.002196	1.44	20.13	23.53	0.38
Whiskey	1	257	25 YR	34.88	219.08	221.66		221.74	0.001371	1.36	33.67	33.44	0.31
Whiskey	1	257	50 YR	41.86	219.08	221.88		221.97	0.001279	1.41	41.45	35.63	0.31
Whiskey	1	257	100 YR	52.03	219.08	222.10		222.21	0.001345	1.54	49.36	36.94	0.32
Whiskey	1	257	Regional	72.99	219.08	222.39		222.54	0.001650	1.85	60.44	38.05	0.36
Whiskey	1												
Whiskey	1	249	2 YR	10.00	218.74	219.74		219.83	0.004030	1.29	7.76	9.76	0.46
Whiskey	1	249	5 YR	19.42	218.74	220.42		220.51	0.002163	1.30	14.89	11.13	0.36
Whiskey	1	249	10 YR	27.16	218.74	221.24		221.30	0.000902	1.09	27.77	23.36	0.25
Whiskey	1	249	25 YR	34.88	218.74	221.67		221.73	0.000720	1.11	40.09	32.34	0.23
Whiskey	1	249	50 YR	41.86	218.74	221.89		221.96	0.000733	1.18	47.67	35.61	0.23
Whiskey	1	249	100 YR	52.03	218.74	222.11		222.19	0.000822	1.32	55.68	38.39	0.25
Whiskey	1	249	Regional	72.99	218.74	222.41		222.52	0.001072	1.61	67.92	43.61	0.29
Whiskey	1												
Whiskey	1	243	2 YR	10.03	218.50	219.73	219.17	219.79	0.002151	1.10	9.15	9.16	0.35
Whiskey	1	243	5 YR	19.49	218.50	220.42	219.48	220.50	0.001460	1.27	15.31	10.53	0.31
Whiskey	1	243	10 YR	27.27	218.50	221.21	219.70	221.28	0.000798	1.21	22.45	13.87	0.25
Whiskey	1	243	25 YR	35.03	218.50	221.65	219.87	221.72	0.000775	1.14	33.66	27.17	0.23
Whiskey	1	243	50 YR	42.04	218.50	221.87	220.02	221.95	0.000809	1.24	40.24	32.63	0.24
Whiskey	1	243	100 YR	52.25	218.50	222.08	220.22	222.18	0.000922	1.39	47.70	37.60	0.26
Whiskey	1	243	Regional	73.32	218.50	222.37	220.61	222.50	0.001210	1.69	59.44	43.26	0.30
Whiskey	1												
Whiskey	1	234.51		Culvert									
Whiskey	1												
Whiskey	1	225	2 YR	10.03	218.36	219.61	218.94	219.67	0.001364	1.03	9.76	11.37	0.30
Whiskey	1	225	5 YR	19.49	218.36	220.19	219.25	220.28	0.001410	1.35	14.39	13.66	0.32
Whiskey	1	225	10 YR	27.27	218.36	220.67	219.46	220.78	0.001239	1.49	18.30	15.59	0.32
Whiskey	1	225	25 YR	35.03	218.36	220.88	219.65	221.03	0.001525	1.75	19.98	16.42	0.36
Whiskey	1	225	50 YR	42.04	218.36	221.03	219.81	221.12	0.001411	1.34	31.30	19.78	0.32
Whiskey	1	225	100 YR	52.25	218.36	221.19	220.02	221.31	0.001623	1.51	35.45	28.36	0.34
Whiskey	1	225	Regional	73.32	218.36	221.42	220.44	221.56	0.001949	1.74	47.31	45.09	0.38
Whiskey	1												
Whiskey	1	223	2 YR	10.03	218.34	219.61		219.66	0.001933	1.03	9.77	10.24	0.34
Whiskey	1	223	5 YR	19.49	218.34	220.19		220.26	0.001750	1.19	16.34	12.54	0.33
Whiskey	1	223	10 YR	27.27	218.34	220.67		220.75	0.001354	1.19	22.93	14.49	0.30
Whiskey	1	223	25 YR	35.03	218.34	220.89		220.98	0.001572	1.34	26.08	15.34	0.33
Whiskey	1	223	50 YR	42.04	218.34	220.99		221.11	0.001924	1.52	28.10	27.57	0.37
Whiskey	1	223	100 YR	52.25	218.34	221.15		221.29	0.002126	1.66	34.33	41.65	0.39
Whiskey	1	223	Regional	73.32	218.34	221.37		221.54	0.002541	1.92	43.61	46.21	0.43
Whiskey	1												
Whiskey	1	222.8		Lat Struct									
Whiskey	1												
Whiskey	1	221	2 YR	10.03	218.30	219.59		219.65	0.002139	1.07	9.33	9.80	0.35
Whiskey	1	221	5 YR	19.49	218.30	220.17		220.25	0.001940	1.25	15.64	12.11	0.35
Whiskey	1	221	10 YR	27.27	218.30	220.66		220.74	0.001486	1.24	22.06	14.07	0.32
Whiskey	1	221	25 YR	35.03	218.30	220.87		220.97	0.001732	1.40	25.07	15.21	0.34
Whiskey	1	221	50 YR	42.04	218.30	220.97		221.09	0.002082	1.56	27.41	27.44	0.38
Whiskey	1	221	100 YR	52.25	218.30	221.14		221.28	0.002185	1.68	33.81	44.05	0.39
Whiskey	1	221	Regional	73.32	218.30	221.35		221.52	0.002612	1.94	43.27	46.74	0.43
Whiskey	1												
Whiskey	1	208	2 YR	10.03	218.22	219.60		219.63	0.001004	0.79	12.63	11.92	0.25
Whiskey	1	208	5 YR	19.49	218.22	220.18		220.22	0.001015	0.96	20.21	14.24	0.26
Whiskey	1	208	10 YR	27.27	218.22	220.67		220.72	0.000833	0.98	27.69	16.21	0.24
Whiskey	1	208	25 YR	35.03	218.22	220.88		220.94	0.000955	1.11	32.25	25.99	0.26
Whiskey	1	208	50 YR	42.01	218.22	220.99		221.06	0.001093	1.22	35.07	27.02	0.28
Whiskey	1	208	100 YR	51.93	218.22	221.16		221.25	0.001147	1.32	41.12	37.82	0.29
Whiskey	1	208	Regional	72.26	218.22	221.37		221.49	0.001445	1.56	50.00	44.30	0.33
Whiskey	1												
Whiskey	1	201	2 YR	10.03	218.16	219.59		219.62	0.000955	0.79	12.77	11.79	0.24
Whiskey	1	201	5 YR	19.49	218.16	220.17		220.22	0.000994	0.96	20.28	14.11	0.26
Whiskey	1	201	10 YR	27.27	218.16	220.66		220.71	0.000825	0.98	27.72	17.56	0.24
Whiskey	1	201	25 YR	35.03	218.16	220.88		220.94	0.000900	1.09	33.04	28.07	0.25
Whiskey	1	201	50 YR	41.95	218.16	220.98		221.05	0.001014	1.19	36.20	30.13	0.27
Whiskey	1	201	100 YR	51.47	218.16	221.16		221.24	0.001009	1.25	41.71	32.18	0.27

HEC-RAS Plan: Alt3-10 Locations: User Defined (Continued)

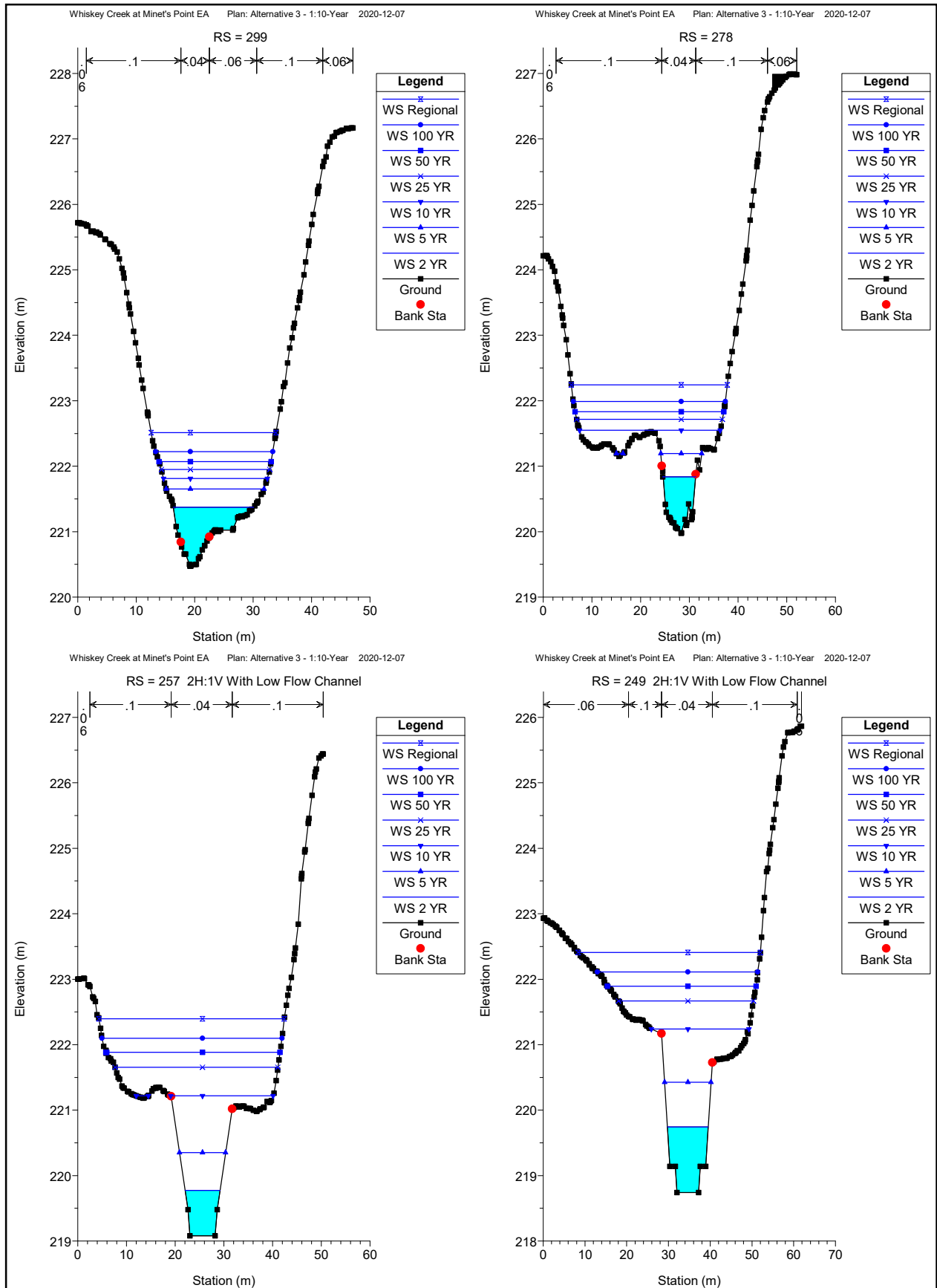
River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Whiskey	1	201	Regional	71.10	218.16	221.37		221.48	0.001221	1.45	48.44	33.62	0.30
Whiskey	1	188	2 YR	10.03	218.05	219.60		219.61	0.000349	0.54	18.51	13.52	0.15
Whiskey	1	188	5 YR	19.49	218.05	220.18		220.20	0.000447	0.73	26.70	14.68	0.17
Whiskey	1	188	10 YR	27.27	218.05	220.67		220.70	0.000429	0.80	34.23	22.13	0.17
Whiskey	1	188	25 YR	34.98	218.05	220.88		220.92	0.000495	0.90	40.04	30.09	0.19
Whiskey	1	188	50 YR	41.69	218.05	220.99		221.04	0.000570	0.99	43.63	36.79	0.20
Whiskey	1	188	100 YR	50.56	218.05	221.17		221.22	0.000578	1.04	51.21	45.71	0.20
Whiskey	1	188	Regional	69.10	218.05	221.39		221.45	0.000692	1.19	61.17	46.31	0.22
Whiskey	1	180	2 YR	10.06	218.00	219.58	218.56	219.60	0.000662	0.72	13.94	10.42	0.20
Whiskey	1	180	5 YR	19.56	218.00	220.14	218.87	220.19	0.000848	0.97	20.17	11.55	0.23
Whiskey	1	180	10 YR	27.38	218.00	220.63	219.08	220.69	0.000825	1.05	26.05	13.89	0.23
Whiskey	1	180	25 YR	34.69	218.00	220.84	219.25	220.91	0.000922	1.16	31.14	32.55	0.25
Whiskey	1	180	50 YR	41.05	218.00	220.95	219.39	221.03	0.001010	1.25	35.08	39.91	0.26
Whiskey	1	180	100 YR	49.16	218.00	221.14	219.55	221.21	0.000895	1.23	43.39	44.36	0.24
Whiskey	1	180	Regional	66.60	218.00	221.36	219.87	221.44	0.000960	1.33	53.48	48.34	0.25
Whiskey	1	171.38		Culvert									
Whiskey	1	158	2 YR	10.06	218.00	219.50	218.61	219.54	0.000988	0.85	11.90	9.41	0.24
Whiskey	1	158	5 YR	19.56	218.00	219.99	218.93	220.06	0.001420	1.17	16.69	11.45	0.30
Whiskey	1	158	10 YR	27.38	218.00	220.30	219.16	220.39	0.001659	1.37	19.99	26.03	0.32
Whiskey	1	158	25 YR	34.69	218.00	220.37	219.34	220.51	0.002364	1.67	20.80	40.73	0.39
Whiskey	1	158	50 YR	41.05	218.00	220.39	219.49	220.59	0.003177	1.95	21.08	43.45	0.45
Whiskey	1	158	100 YR	49.16	218.00	220.63	219.66	220.76	0.002237	1.74	36.81	49.81	0.38
Whiskey	1	158	Regional	66.60	218.00	220.79	220.00	220.95	0.002580	1.95	45.18	51.58	0.41
Whiskey	1	150	2 YR	10.06	218.00	219.45		219.51	0.002297	1.13	8.91	9.05	0.36
Whiskey	1	150	5 YR	19.56	218.00	219.92		220.02	0.002750	1.44	13.64	13.55	0.41
Whiskey	1	150	10 YR	27.38	218.00	220.25		220.36	0.002541	1.52	20.74	32.80	0.40
Whiskey	1	150	25 YR	34.69	218.00	220.33		220.48	0.003341	1.79	23.75	46.04	0.47
Whiskey	1	150	50 YR	41.05	218.00	220.32	219.78	220.54	0.004815	2.14	23.29	44.50	0.56
Whiskey	1	150	100 YR	49.16	218.00	220.36	220.00	220.65	0.005990	2.43	25.74	56.32	0.63
Whiskey	1	150	Regional	66.46	218.00	220.54	220.54	220.84	0.006150	2.61	37.73	73.12	0.64
Whiskey	1	133	2 YR	10.06	218.00	219.26		219.42	0.007620	1.79	5.63	6.99	0.64
Whiskey	1	133	5 YR	19.56	218.00	219.43	219.39	219.84	0.016512	2.83	6.91	7.69	0.95
Whiskey	1	133	10 YR	27.38	218.00	219.64	219.64	220.16	0.017870	3.18	8.62	8.53	1.01
Whiskey	1	133	25 YR	34.41	218.00	220.11	220.11	220.37	0.007048	2.37	22.39	80.21	0.66
Whiskey	1	133	50 YR	40.39	218.00	220.24	220.24	220.44	0.005403	2.21	35.31	112.79	0.59
Whiskey	1	133	100 YR	47.98	218.00	220.32	220.32	220.50	0.005218	2.24	43.89	117.30	0.58
Whiskey	1	133	Regional	63.75	218.00	220.40	220.40	220.61	0.006088	2.51	53.72	118.88	0.63
Whiskey	1	108	2 YR	10.06	218.00	219.25		219.30	0.001970	0.98	10.26	11.95	0.34
Whiskey	1	108	5 YR	19.56	218.00	219.46		219.58	0.003967	1.51	12.91	13.21	0.49
Whiskey	1	108	10 YR	27.38	218.00	219.66		219.81	0.004688	1.76	15.54	14.36	0.54
Whiskey	1	108	25 YR	34.41	218.00	219.85	219.35	220.00	0.004278	1.79	22.87	63.86	0.52
Whiskey	1	108	50 YR	40.39	218.00	220.03		220.13	0.002618	1.52	37.30	88.60	0.42
Whiskey	1	108	100 YR	47.95	218.00	220.16		220.24	0.001988	1.41	50.66	125.54	0.37
Whiskey	1	108	Regional	63.43	218.00	220.29		220.37	0.001966	1.48	68.39	156.72	0.37
Whiskey	1	83	2 YR	10.06	218.00	219.21		219.26	0.001702	0.92	10.96	12.67	0.32
Whiskey	1	83	5 YR	19.56	218.00	219.37		219.49	0.003992	1.50	13.03	13.61	0.49
Whiskey	1	83	10 YR	27.38	218.00	219.54		219.70	0.004971	1.78	15.36	14.60	0.56
Whiskey	1	83	25 YR	34.41	218.00	219.70		219.89	0.005213	1.93	18.00	19.61	0.58
Whiskey	1	83	50 YR	40.39	218.00	219.85	219.38	220.04	0.004980	1.97	23.56	60.87	0.57
Whiskey	1	83	100 YR	47.94	218.00	220.02	219.51	220.17	0.003926	1.85	38.49	108.55	0.51
Whiskey	1	83	Regional	63.30	218.00	220.11	220.05	220.29	0.004738	2.10	48.35	114.98	0.57
Whiskey	1	61	2 YR	10.06	218.00	219.18		219.22	0.001603	0.89	11.32	13.14	0.31
Whiskey	1	61	5 YR	19.56	218.00	219.26		219.39	0.004687	1.58	12.41	13.63	0.53
Whiskey	1	61	10 YR	27.38	218.00	219.37		219.56	0.006701	1.97	13.89	14.27	0.64
Whiskey	1	61	25 YR	34.41	218.00	219.51	219.20	219.75	0.007097	2.14	16.06	15.15	0.66
Whiskey	1	61	50 YR	40.39	218.00	219.66	219.32	219.91	0.006637	2.21	18.46	22.53	0.65
Whiskey	1	61	100 YR	47.94	218.00	219.80	219.45	220.05	0.006134	2.26	25.86	68.97	0.64
Whiskey	1	61	Regional	63.30	218.00	220.03	220.03	220.19	0.003824	1.98	51.83	160.07	0.52
Whiskey	1	30	2 YR	10.08	218.00	219.15	218.49	219.18	0.001025	0.73	13.80	15.45	0.25
Whiskey	1	30	5 YR	19.59	218.00	219.15	218.74	219.25	0.003872	1.42	13.80	15.45	0.48
Whiskey	1	30	10 YR	27.43	218.00	219.15	218.90	219.35	0.007589	1.99	13.80	15.45	0.67
Whiskey	1	30	25 YR	34.48	218.00	219.15	219.04	219.47	0.011996	2.50	13.80	15.45	0.84
Whiskey	1	30	50 YR	40.48	218.00	219.15	219.14	219.59	0.016536	2.93	13.80	15.45	0.99
Whiskey	1	30	100 YR	48.06	218.00	219.26	219.26	219.75	0.016418	3.08	15.60	16.13	1.00
Whiskey	1	30	Regional	63.46	218.00	219.70	219.70	219.94	0.006540	2.32	43.05	122.45	0.66

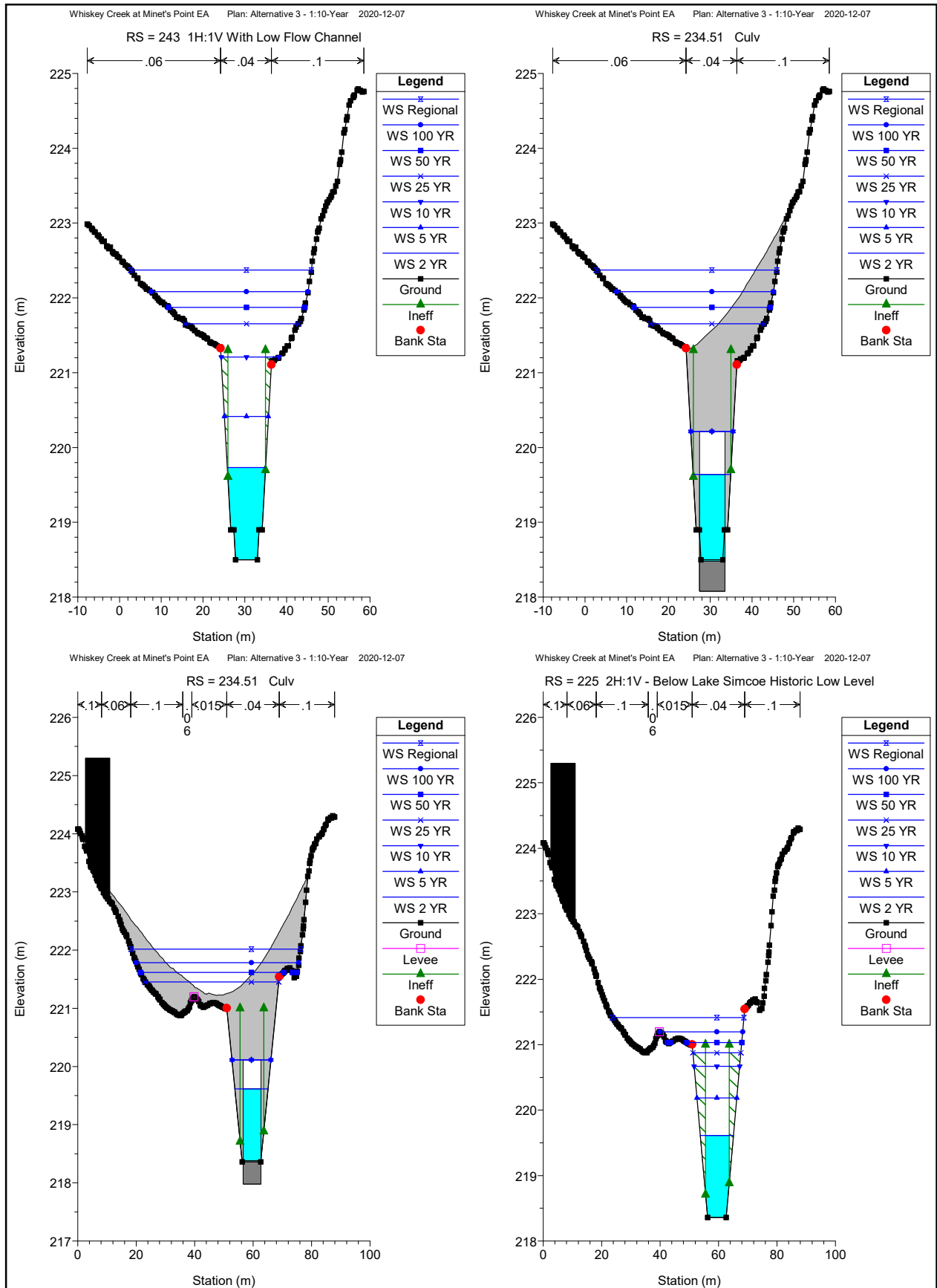
HEC-RAS Plan: Alt3-10 Locations: User Defined

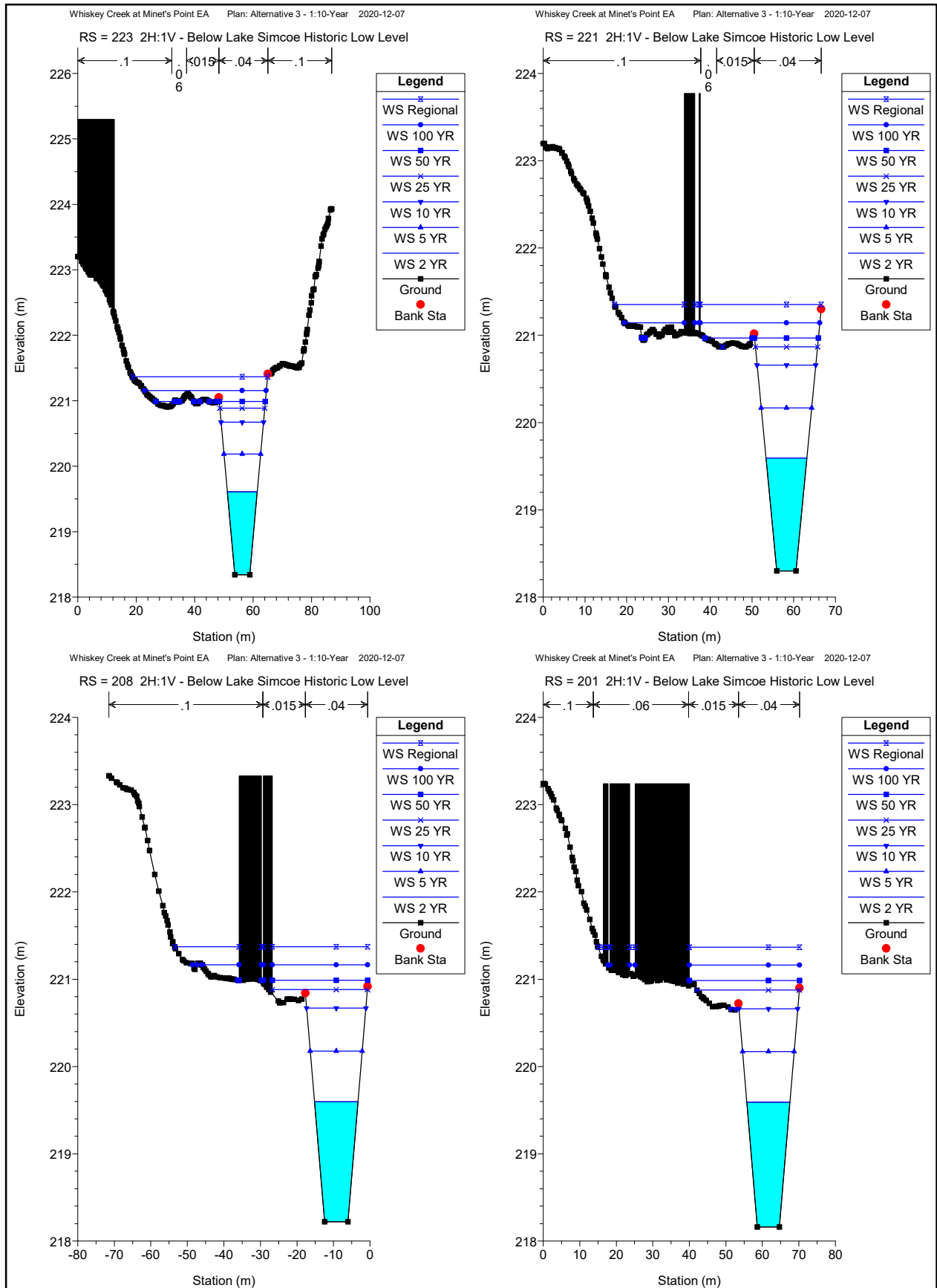
River	Reach	River Sta	Profile	E.G. US.	W.S. US.	E.G. IC	E.G. OC	Min El Weir Flow	Q Culv Group	Q Weir	Delta WS	Culv Vel US	Culv Vel DS
				(m)	(m)	(m)	(m)	(m)	(m3/s)	(m3/s)	(m)	(m/s)	(m/s)
Whiskey	1	234.51 Culvert #1	2 YR	219.79	219.73	219.51	219.79	221.30	10.03		0.12	1.42	1.33
Whiskey	1	234.51 Culvert #1	5 YR	220.50	220.42	220.11	220.50	221.30	19.49		0.23	1.84	1.84
Whiskey	1	234.51 Culvert #1	10 YR	221.29	221.21	220.55	221.29	221.30	27.27		0.54	2.58	2.58
Whiskey	1	234.51 Culvert #1	25 YR	221.72	221.65	221.22	221.72	221.30	31.91	3.12	0.78	3.02	3.02
Whiskey	1	234.51 Culvert #1	50 YR	221.95	221.87	221.63	221.95	221.30	33.27	8.77	0.84	3.15	3.15
Whiskey	1	234.51 Culvert #1	100 YR	222.18	222.08	221.94	222.18	221.30	34.41	17.84	0.89	3.26	3.26
Whiskey	1	234.51 Culvert #1	Regional	222.50	222.37	222.32	222.50	221.30	36.23	37.09	0.96	3.43	3.43
Whiskey	1	171.38 Culvert #1	2 YR	219.60	219.58	219.00	219.60	220.62	10.06		0.07	1.03	1.05
Whiskey	1	171.38 Culvert #1	5 YR	220.19	220.14	219.58	220.19	220.62	19.56		0.16	1.51	1.54
Whiskey	1	171.38 Culvert #1	10 YR	220.69	220.63	219.99	220.69	220.62	27.31	0.07	0.34	2.09	2.09
Whiskey	1	171.38 Culvert #1	25 YR	220.91	220.84	220.34	220.91	220.62	32.09	2.61	0.47	2.46	2.46
Whiskey	1	171.38 Culvert #1	50 YR	221.03	220.95	220.80	221.03	220.62	34.71	6.34	0.56	2.66	2.66
Whiskey	1	171.38 Culvert #1	100 YR	221.21	221.14	221.01	221.21	220.62	33.33	15.84	0.51	2.55	2.55
Whiskey	1	171.38 Culvert #1	Regional	221.44	221.36	221.27	221.44	220.62	35.08	31.52	0.57	2.69	2.69

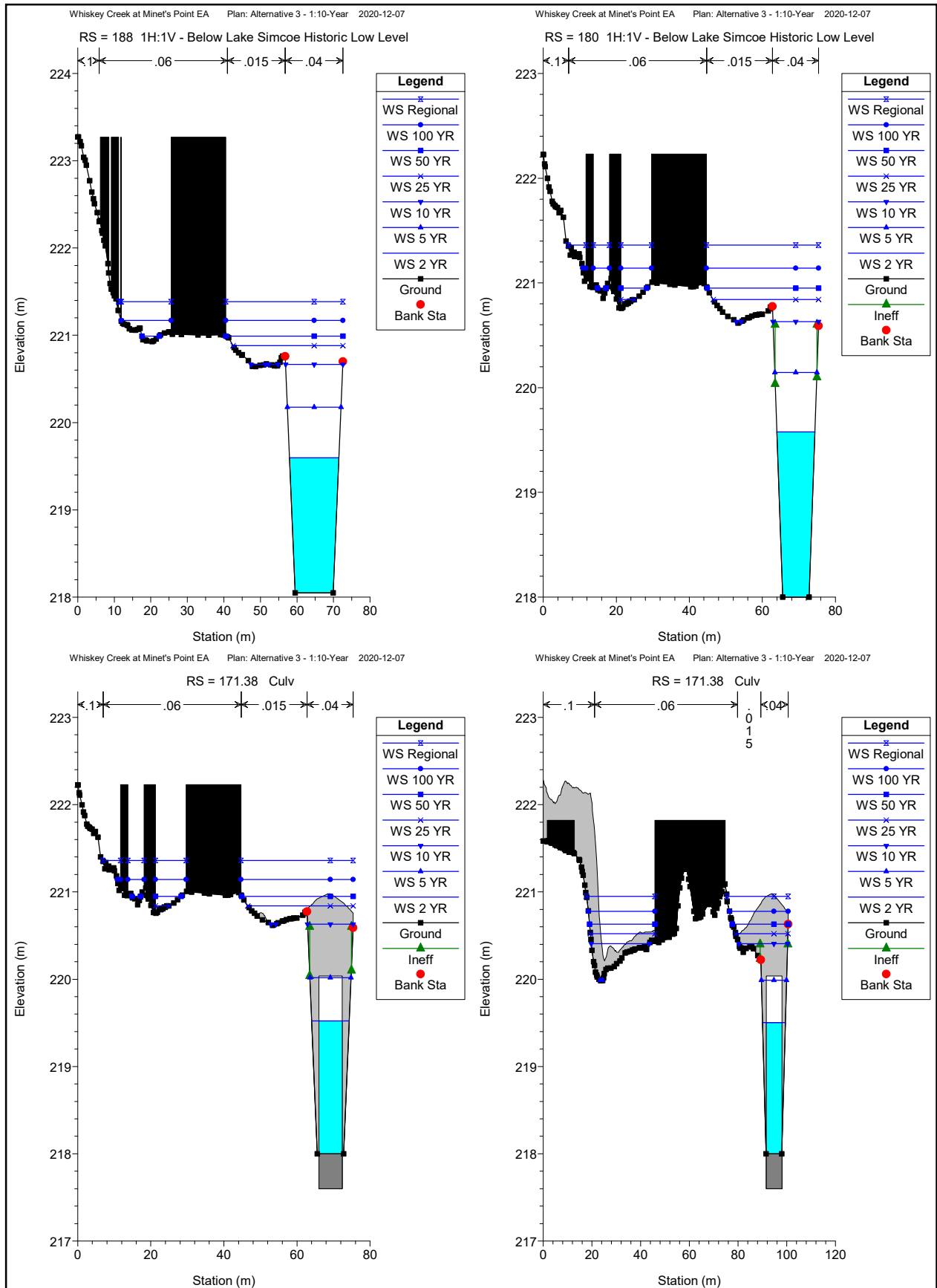
HEC-RAS Plan: Alt3-10 Locations: User Defined

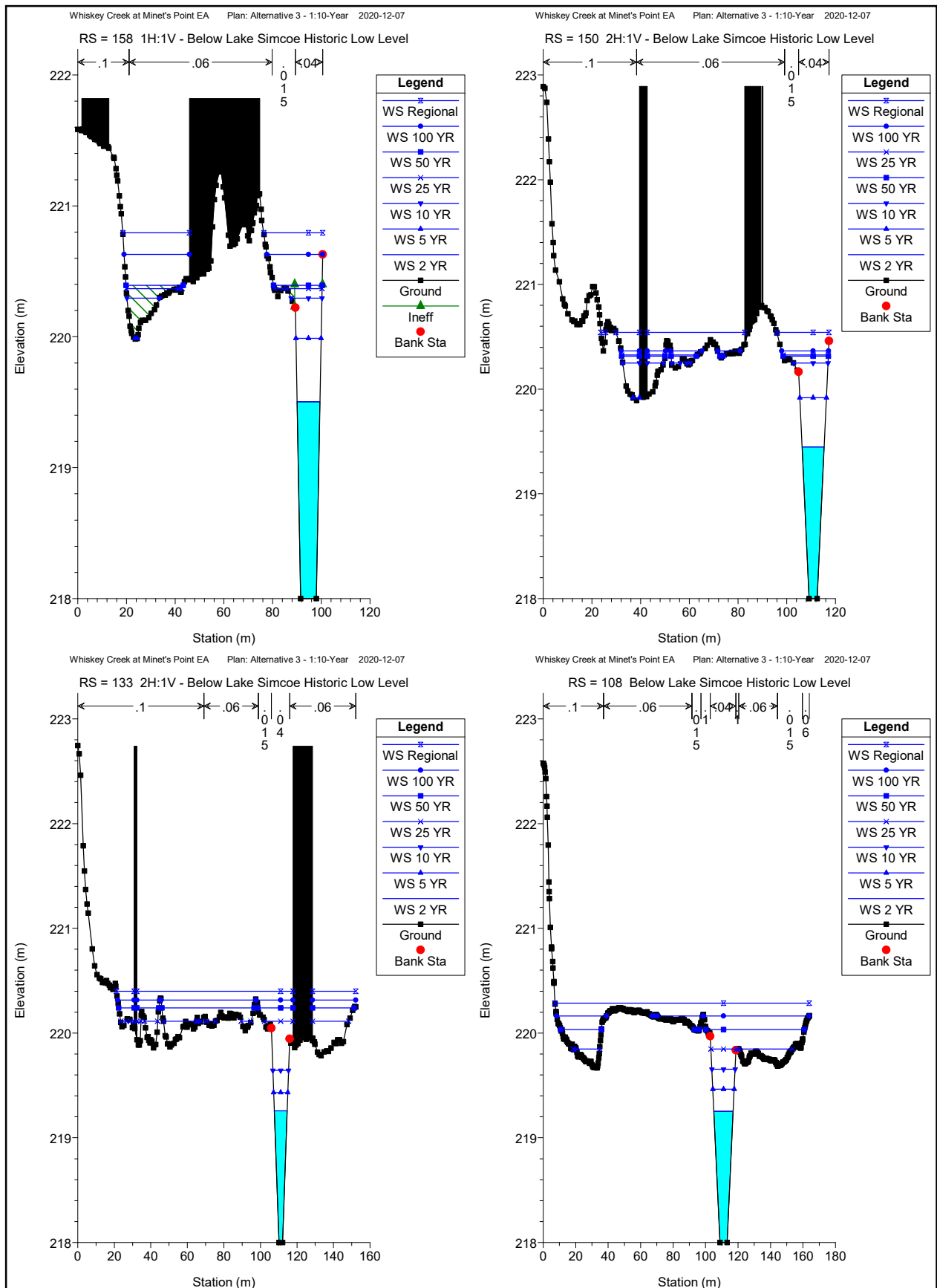
River	Reach	River Sta	Profile	Q US	Q Leaving Total	Q DS	Q Weir	Q Gates	Wr Top Width	Weir Max Depth	Weir Avg Depth	Min El Weir Flow	E.G. US	W.S. US	E.G. DS	W.S. DS
				(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
Whiskey	1	222.8	2 YR	10.03	0.00	10.08	0.00						220.05	219.66	219.61	219.18
Whiskey	1	222.8	5 YR	19.49	0.00	19.59	0.00						220.05	220.26	220.18	219.26
Whiskey	1	222.8	10 YR	27.27	0.00	27.43	0.00		5.22	0.06	0.03		220.05	220.74	220.67	219.36
Whiskey	1	222.8	25 YR	35.03	0.76	34.48	0.76		46.71	0.27	0.11		220.05	220.97	220.88	219.47
Whiskey	1	222.8	50 YR	42.04	1.83	40.48	1.83		74.90	0.38	0.14		220.05	221.10	220.98	219.60
Whiskey	1	222.8	100 YR	52.25	4.58	48.06	4.58		108.24	0.57	0.21		220.05	221.29	221.15	219.76
Whiskey	1	222.8	Regional	73.32	10.43	63.46	10.43		138.14	0.79	0.32		220.05	221.53	221.36	219.94

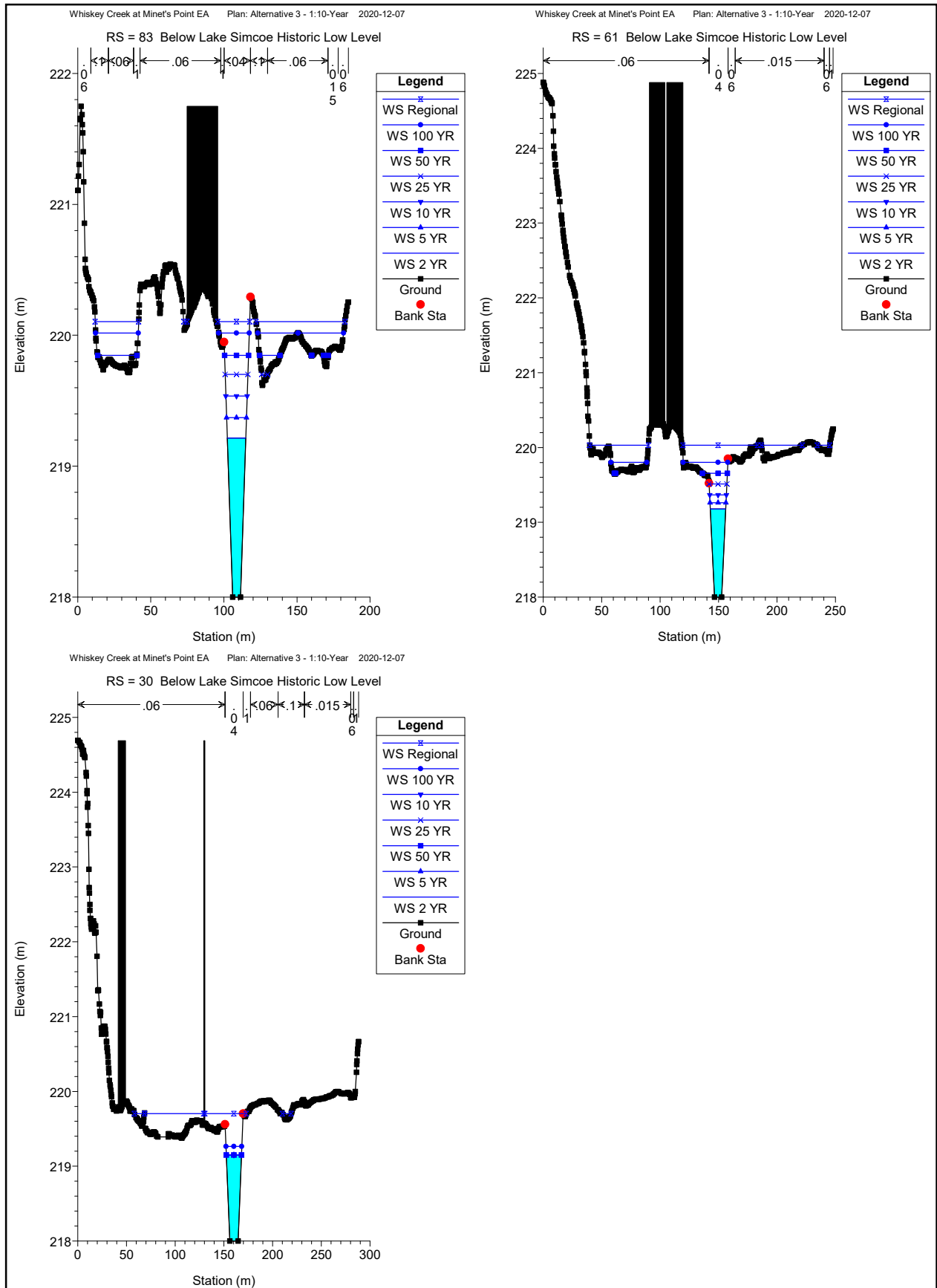














HEC-RAS Plan: Alt3-10 Sloped Locations: User Defined

River	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
Whiskey	1	299	2 YR	10.00	220.47	221.37	221.37	221.61	0.013705	2.34	5.90	13.73	0.87
Whiskey	1	299	5 YR	19.42	220.47	221.65	221.65	221.96	0.012909	2.81	10.16	16.78	0.90
Whiskey	1	299	10 YR	27.16	220.47	221.81	221.81	222.18	0.013310	3.16	12.96	17.76	0.93
Whiskey	1	299	25 YR	34.88	220.47	221.95	221.95	222.38	0.013766	3.46	15.44	18.54	0.97
Whiskey	1	299	50 YR	41.86	220.47	222.07	222.07	222.54	0.013749	3.66	17.70	19.18	0.98
Whiskey	1	299	100 YR	52.03	220.47	222.22	222.22	222.76	0.014008	3.95	20.67	20.02	1.01
Whiskey	1	299	Regional	72.99	220.47	222.51	222.51	223.15	0.013758	4.39	26.73	21.36	1.03
Whiskey	1	278	2 YR	10.00	219.98	220.84	220.84	221.15	0.021400	2.46	4.06	6.68	1.01
Whiskey	1	278	5 YR	19.42	219.98	221.20	221.20	221.64	0.017993	2.96	6.79	9.80	0.98
Whiskey	1	278	10 YR	27.16	219.98	221.55	221.55	221.93	0.010564	2.81	13.81	28.86	0.79
Whiskey	1	278	25 YR	34.88	219.98	221.71	221.71	222.12	0.010227	3.00	18.67	29.93	0.79
Whiskey	1	278	50 YR	41.86	219.98	221.83	221.83	222.27	0.010424	3.18	22.18	30.52	0.81
Whiskey	1	278	100 YR	52.03	219.98	221.99	221.99	222.46	0.010438	3.40	27.07	31.22	0.83
Whiskey	1	278	Regional	72.99	219.98	222.24	222.24	222.81	0.011103	3.84	35.13	32.04	0.87
Whiskey	1	257	2 YR	10.00	219.30	219.98	219.98	220.25	0.020932	2.31	4.33	8.00	1.00
Whiskey	1	257	5 YR	19.42	219.30	220.45		220.72	0.010965	2.27	8.55	9.89	0.78
Whiskey	1	257	10 YR	27.16	219.30	221.04		221.21	0.004367	1.81	15.14	16.23	0.52
Whiskey	1	257	25 YR	34.88	219.30	221.40		221.55	0.002977	1.74	23.80	31.67	0.45
Whiskey	1	257	50 YR	41.86	219.30	221.72		221.84	0.002079	1.65	34.28	33.83	0.38
Whiskey	1	257	100 YR	52.03	219.30	221.96		222.10	0.001990	1.75	42.80	36.30	0.38
Whiskey	1	257	Regional	72.99	219.30	222.29		222.47	0.002176	2.01	55.14	37.65	0.41
Whiskey	1	249	2 YR	10.00	219.00	219.93		220.04	0.005605	1.42	7.05	10.09	0.54
Whiskey	1	249	5 YR	19.42	219.00	220.52		220.62	0.003111	1.42	13.67	12.44	0.43
Whiskey	1	249	10 YR	27.16	219.00	221.08		221.16	0.001579	1.25	23.14	22.26	0.32
Whiskey	1	249	25 YR	34.88	219.00	221.44		221.51	0.001159	1.22	31.93	29.44	0.29
Whiskey	1	249	50 YR	41.86	219.00	221.75		221.81	0.000881	1.18	41.77	33.52	0.26
Whiskey	1	249	100 YR	52.03	219.00	222.00		222.07	0.000868	1.26	50.42	36.69	0.26
Whiskey	1	249	Regional	72.99	219.00	222.34		222.43	0.000965	1.45	64.03	42.57	0.28
Whiskey	1	243	2 YR	10.03	218.85	219.92	219.51	220.00	0.003291	1.22	8.21	9.54	0.42
Whiskey	1	243	5 YR	19.49	218.85	220.51	219.81	220.61	0.002343	1.38	14.09	10.71	0.38
Whiskey	1	243	10 YR	27.27	218.85	221.04	220.01	221.14	0.001522	1.39	19.62	11.78	0.32
Whiskey	1	243	25 YR	35.03	218.85	221.38	220.19	221.49	0.001613	1.44	24.89	17.91	0.33
Whiskey	1	243	50 YR	42.04	218.85	221.68	220.33	221.79	0.001414	1.48	31.76	27.75	0.31
Whiskey	1	243	100 YR	52.25	218.85	221.91	220.52	222.04	0.001516	1.63	38.78	33.65	0.33
Whiskey	1	243	Regional	73.32	218.85	222.22	220.87	222.40	0.001849	1.95	50.30	40.73	0.37
Whiskey	1	234.51		Bridge									
Whiskey	1	225	2 YR	10.03	218.76	219.81	219.41	219.88	0.002859	1.21	8.29	12.16	0.41
Whiskey	1	225	5 YR	19.49	218.76	220.37	219.68	220.47	0.002141	1.45	13.48	14.38	0.38
Whiskey	1	225	10 YR	27.27	218.76	220.74	219.88	220.87	0.001968	1.61	16.91	15.86	0.38
Whiskey	1	225	25 YR	35.03	218.76	220.83	220.05	221.03	0.002720	1.96	17.83	16.25	0.45
Whiskey	1	225	50 YR	42.04	218.76	221.02	220.19	221.15	0.002285	1.56	27.04	19.11	0.39
Whiskey	1	225	100 YR	52.25	218.76	221.15	220.39	221.31	0.002693	1.76	30.23	27.35	0.43
Whiskey	1	225	Regional	73.32	218.76	221.37	220.76	221.56	0.003054	2.00	41.26	44.13	0.47
Whiskey	1	223	2 YR	10.03	218.75	219.81		219.88	0.003245	1.16	8.62	11.02	0.42
Whiskey	1	223	5 YR	19.49	218.75	220.38		220.46	0.002235	1.25	15.54	13.30	0.37
Whiskey	1	223	10 YR	27.27	218.75	220.75		220.84	0.001905	1.31	20.86	14.81	0.35
Whiskey	1	223	25 YR	35.03	218.75	220.87		220.99	0.002530	1.55	22.54	15.26	0.41
Whiskey	1	223	50 YR	42.04	218.75	220.98		221.13	0.002932	1.73	24.71	26.44	0.44
Whiskey	1	223	100 YR	52.25	218.75	221.11		221.30	0.003403	1.93	29.32	40.93	0.48
Whiskey	1	223	Regional	73.32	218.75	221.32		221.54	0.003808	2.18	38.43	45.57	0.52
Whiskey	1	222.8		Lat Struct									
Whiskey	1	221	2 YR	10.03	218.73	219.78	219.40	219.86	0.003519	1.21	8.27	10.56	0.44
Whiskey	1	221	5 YR	19.49	218.73	220.36	219.69	220.44	0.002411	1.30	15.00	12.86	0.38
Whiskey	1	221	10 YR	27.27	218.73	220.74	219.89	220.83	0.002052	1.35	20.17	14.38	0.36
Whiskey	1	221	25 YR	35.03	218.73	220.84	220.06	220.97	0.002766	1.62	21.69	14.79	0.43
Whiskey	1	221	50 YR	42.04	218.73	220.95	220.19	221.11	0.003259	1.80	23.31	15.23	0.47
Whiskey	1	221	100 YR	52.25	218.73	221.09	220.39	221.28	0.003474	1.94	28.70	40.20	0.49
Whiskey	1	221	Regional	73.32	218.73	221.30	220.72	221.52	0.003884	2.19	38.09	46.30	0.52
Whiskey	1	208	2 YR	10.03	218.69	219.77	219.34	219.82	0.002454	1.02	9.86	12.61	0.37
Whiskey	1	208	5 YR	19.49	218.69	220.35	219.59	220.41	0.001603	1.09	17.95	14.95	0.32
Whiskey	1	208	10 YR	27.27	218.69	220.74	219.77	220.80	0.001369	1.14	23.98	16.49	0.30
Whiskey	1	208	25 YR	35.03	218.69	220.85	219.92	220.94	0.001797	1.34	26.50	25.92	0.35
Whiskey	1	208	50 YR	42.03	218.69	220.97	220.05	221.07	0.001912	1.45	29.62	26.16	0.36
Whiskey	1	208	100 YR	52.05	218.69	221.11	220.21	221.23	0.002017	1.57	34.37	36.03	0.37
Whiskey	1	208	Regional	72.49	218.69	221.32	220.51	221.47	0.002359	1.81	42.85	43.61	0.41
Whiskey	1	201	2 YR	10.03	218.66	219.75	219.31	219.80	0.002415	1.02	9.86	12.43	0.36
Whiskey	1	201	5 YR	19.49	218.66	220.34	219.57	220.40	0.001589	1.09	17.93	14.80	0.32
Whiskey	1	201	10 YR	27.27	218.66	220.73	219.75	220.79	0.001364	1.14	23.93	16.33	0.30
Whiskey	1	201	25 YR	35.03	218.66	220.84	219.90	220.92	0.001705	1.32	27.10	27.27	0.34
Whiskey	1	201	50 YR	41.99	218.66	220.96	220.03	221.06	0.001786	1.41	30.53	30.13	0.35
Whiskey	1	201	100 YR	51.74	218.66	221.11	220.19	221.22	0.001787	1.49	35.09	31.65	0.35

HEC-RAS Plan: Alt3-10 Sloped Locations: User Defined (Continued)

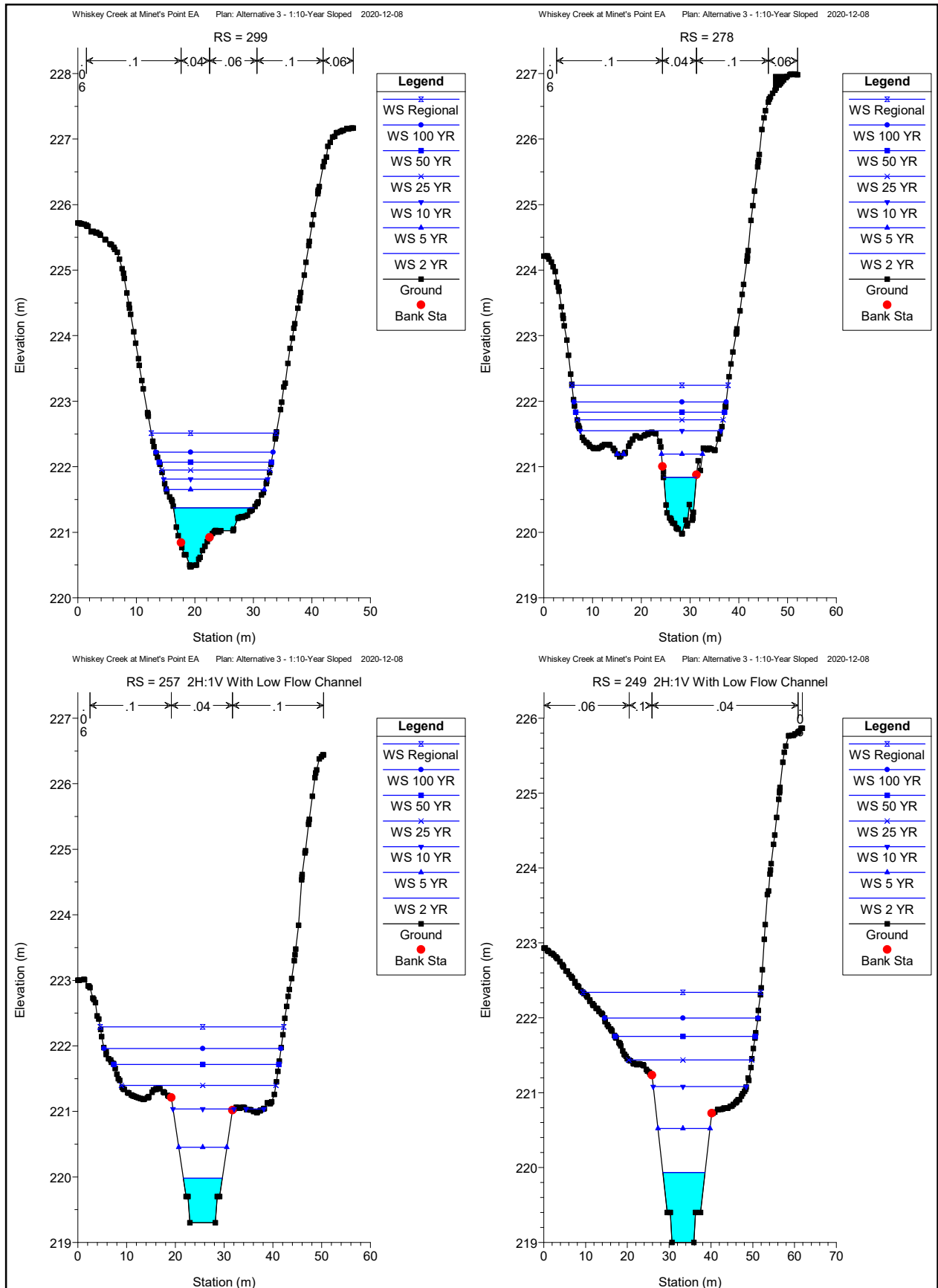
River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Whiskey	1	201	Regional	71.55	218.66	221.31	220.48	221.46	0.002013	1.68	41.59	33.09	0.38
Whiskey	1	188	2 YR	10.03	218.62	219.74	219.25	219.78	0.001633	0.86	11.63	13.81	0.30
Whiskey	1	188	5 YR	19.49	218.62	220.34	219.47	220.38	0.001121	0.96	20.25	15.00	0.26
Whiskey	1	188	10 YR	27.27	218.62	220.72	219.63	220.78	0.001014	1.04	26.19	15.75	0.26
Whiskey	1	188	25 YR	35.02	218.62	220.83	219.76	220.90	0.001289	1.22	29.66	29.30	0.29
Whiskey	1	188	50 YR	41.82	218.62	220.95	219.88	221.03	0.001347	1.29	33.38	34.46	0.30
Whiskey	1	188	100 YR	51.08	218.62	221.10	220.02	221.19	0.001330	1.35	39.40	43.85	0.30
Whiskey	1	188	Regional	69.91	218.62	221.32	220.28	221.43	0.001398	1.47	49.34	46.31	0.31
Whiskey	1	180	2 YR	10.06	218.59	219.69	219.24	219.75	0.002586	1.09	9.21	10.65	0.38
Whiskey	1	180	5 YR	19.56	218.59	220.29	219.52	220.36	0.001900	1.23	15.89	11.83	0.34
Whiskey	1	180	10 YR	27.35	218.59	220.67	219.71	220.75	0.001750	1.33	20.53	12.52	0.33
Whiskey	1	180	25 YR	34.96	218.59	220.73	219.87	220.87	0.002534	1.63	21.39	12.59	0.40
Whiskey	1	180	50 YR	41.40	218.59	220.86	220.00	221.00	0.002467	1.68	25.97	34.11	0.40
Whiskey	1	180	100 YR	50.07	218.59	221.05	220.15	221.17	0.002060	1.62	33.25	43.95	0.37
Whiskey	1	180	Regional	67.85	218.59	221.28	220.45	221.41	0.001837	1.63	43.76	46.81	0.35
Whiskey	1	171.38	Bridge										
Whiskey	1	158	2 YR	10.06	218.50	219.63	219.17	219.69	0.002764	1.15	8.72	9.66	0.39
Whiskey	1	158	5 YR	19.56	218.50	220.10	219.46	220.20	0.002863	1.45	13.47	10.60	0.41
Whiskey	1	158	10 YR	27.35	218.50	220.38	219.66	220.52	0.002918	1.63	16.90	43.20	0.42
Whiskey	1	158	25 YR	34.96	218.50	220.32	219.84	220.56	0.005533	2.19	16.02	13.24	0.58
Whiskey	1	158	50 YR	41.40	218.50	220.36	219.97	220.68	0.007095	2.52	16.55	14.30	0.66
Whiskey	1	158	100 YR	50.07	218.50	220.50	220.50	220.78	0.006162	2.47	26.19	47.79	0.62
Whiskey	1	158	Regional	67.85	218.50	220.66	220.66	220.95	0.006456	2.66	33.88	50.05	0.64
Whiskey	1	150	2 YR	10.06	218.47	219.59		219.67	0.003379	1.24	8.11	9.61	0.43
Whiskey	1	150	5 YR	19.56	218.47	220.07		220.18	0.003172	1.47	14.29	20.88	0.44
Whiskey	1	150	10 YR	27.35	218.47	220.38		220.48	0.002491	1.46	24.67	58.94	0.40
Whiskey	1	150	25 YR	34.96	218.47	220.29	219.86	220.51	0.005478	2.10	20.25	41.98	0.59
Whiskey	1	150	50 YR	41.40	218.47	220.34	220.07	220.60	0.006705	2.36	22.11	47.88	0.65
Whiskey	1	150	100 YR	50.07	218.47	220.41	220.41	220.71	0.007475	2.56	26.57	63.06	0.69
Whiskey	1	150	Regional	67.75	218.47	220.61	220.61	220.88	0.006456	2.58	41.03	77.69	0.65
Whiskey	1	133	2 YR	10.06	218.41	219.31		219.53	0.012594	2.08	4.85	7.19	0.81
Whiskey	1	133	5 YR	19.56	218.41	219.57	219.57	219.98	0.018184	2.86	6.85	8.23	1.00
Whiskey	1	133	10 YR	27.35	218.41	219.81	219.81	220.28	0.016890	3.05	9.01	12.10	0.99
Whiskey	1	133	25 YR	34.44	218.41	220.22	220.22	220.40	0.005414	2.09	31.58	111.24	0.58
Whiskey	1	133	50 YR	40.51	218.41	220.28	220.28	220.45	0.005477	2.16	38.09	115.24	0.59
Whiskey	1	133	100 YR	48.58	218.41	220.33	220.33	220.51	0.005916	2.30	44.17	117.95	0.62
Whiskey	1	133	Regional	64.32	218.41	220.43	220.43	220.61	0.006145	2.46	55.99	119.65	0.64
Whiskey	1	108	2 YR	10.06	218.31	219.28		219.35	0.003143	1.13	8.94	12.12	0.42
Whiskey	1	108	5 YR	19.56	218.31	219.52		219.65	0.005237	1.64	11.96	13.53	0.56
Whiskey	1	108	10 YR	27.35	218.31	219.71		219.89	0.005724	1.86	14.92	23.44	0.59
Whiskey	1	108	25 YR	34.44	218.31	219.93	219.50	220.06	0.003971	1.69	27.24	77.44	0.50
Whiskey	1	108	50 YR	40.50	218.31	220.09		220.17	0.002395	1.43	41.08	96.27	0.40
Whiskey	1	108	100 YR	48.51	218.31	220.20		220.27	0.002003	1.38	53.55	135.99	0.37
Whiskey	1	108	Regional	63.89	218.31	220.31		220.38	0.002027	1.45	70.26	156.79	0.38
Whiskey	1	83	2 YR	10.06	218.21	219.22		219.28	0.002453	1.02	9.82	12.73	0.37
Whiskey	1	83	5 YR	19.56	218.21	219.40		219.53	0.005135	1.61	12.11	13.77	0.55
Whiskey	1	83	10 YR	27.35	218.21	219.57		219.75	0.005948	1.87	14.60	14.81	0.60
Whiskey	1	83	25 YR	34.44	218.21	219.73		219.94	0.006088	2.01	17.41	22.87	0.62
Whiskey	1	83	50 YR	40.50	218.21	219.88	219.48	220.08	0.005461	2.01	24.86	73.75	0.59
Whiskey	1	83	100 YR	48.49	218.21	220.07	219.61	220.21	0.003787	1.79	42.72	112.56	0.50
Whiskey	1	83	Regional	63.73	218.21	220.12	220.09	220.31	0.005281	2.16	48.21	115.32	0.60
Whiskey	1	61	2 YR	10.06	218.12	219.18		219.22	0.002024	0.95	10.54	13.13	0.34
Whiskey	1	61	5 YR	19.56	218.12	219.26		219.40	0.005768	1.68	11.65	13.63	0.58
Whiskey	1	61	10 YR	27.35	218.12	219.37		219.59	0.008007	2.08	13.15	14.28	0.69
Whiskey	1	61	25 YR	34.44	218.12	219.51	219.27	219.77	0.008370	2.26	15.27	15.14	0.72
Whiskey	1	61	50 YR	40.50	218.12	219.66	219.38	219.93	0.007586	2.31	17.79	22.99	0.69
Whiskey	1	61	100 YR	48.49	218.12	219.82	219.51	220.08	0.006758	2.33	26.01	71.08	0.67
Whiskey	1	61	Regional	63.73	218.12	220.04	220.04	220.19	0.003877	1.97	53.08	165.04	0.52
Whiskey	1	30	2 YR	10.08	218.00	219.15	218.49	219.18	0.001025	0.73	13.80	15.45	0.25
Whiskey	1	30	5 YR	19.59	218.00	219.15	218.74	219.25	0.003872	1.42	13.80	15.45	0.48
Whiskey	1	30	10 YR	27.40	218.00	219.15	218.90	219.35	0.007572	1.99	13.80	15.45	0.67
Whiskey	1	30	25 YR	34.51	218.00	219.15	219.04	219.47	0.012017	2.50	13.80	15.45	0.85
Whiskey	1	30	50 YR	40.59	218.00	219.15	219.14	219.59	0.016625	2.94	13.80	15.45	0.99
Whiskey	1	30	100 YR	48.61	218.00	219.27	219.27	219.76	0.016413	3.09	15.73	16.18	1.00
Whiskey	1	30	Regional	63.89	218.00	219.71	219.71	219.94	0.006528	2.33	43.47	123.16	0.66

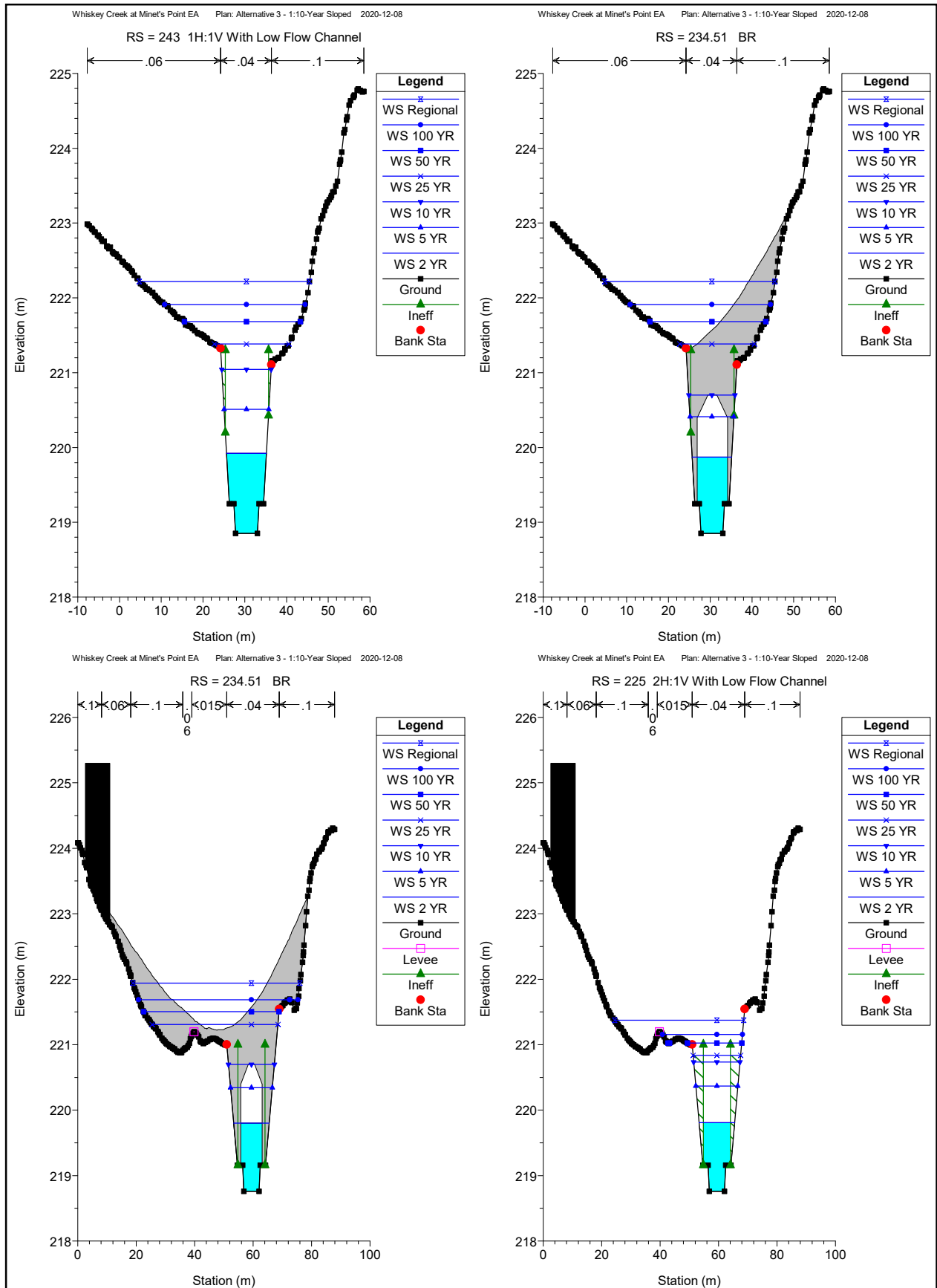
HEC-RAS Plan: Alt3-10 Sloped Locations: User Defined

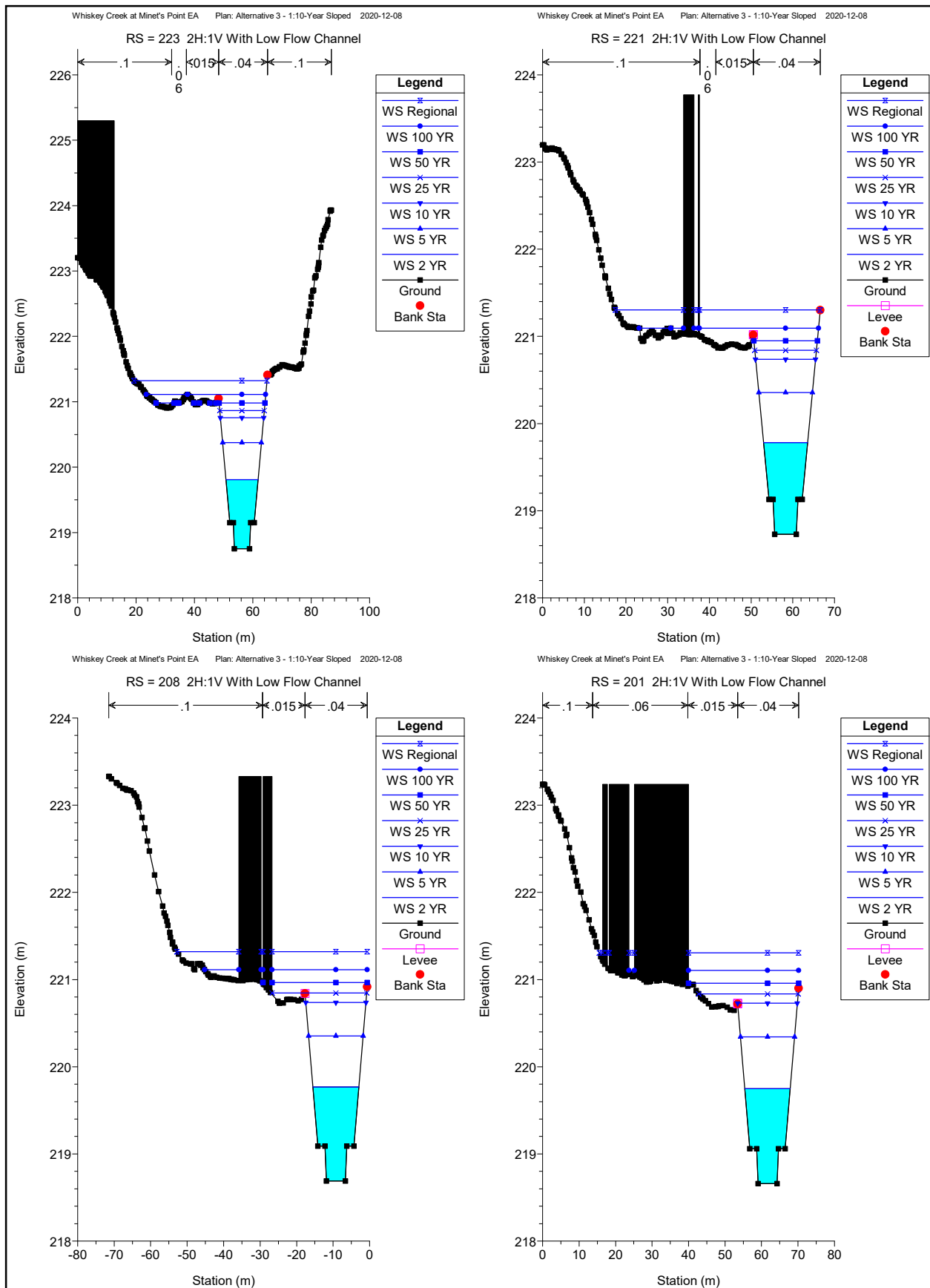
River	Reach	River Sta	Profile	E. G. US.	Min El Prs	BR Open Area	Prs O WS	Q Total	Min El Weir Flow	Q Weir	Delta EG	BR Sluice Coef
				(m)	(m)	(m2)	(m)	(m3/s)	(m)	(m3/s)	(m)	
Whiskey	1	234.51	2 YR	220.00	220.70	12.05		10.03	221.30		0.11	
Whiskey	1	234.51	5 YR	220.61	220.70	12.05		19.49	221.30		0.13	
Whiskey	1	234.51	10 YR	221.14	220.70	12.05	221.04	27.27	221.30		0.28	
Whiskey	1	234.51	25 YR	221.49	220.70	12.05		35.03	221.30	0.45	0.46	
Whiskey	1	234.51	50 YR	221.79	220.70	12.05		42.04	221.30	4.57	0.65	
Whiskey	1	234.51	100 YR	222.04	220.70	12.05		52.25	221.30	12.03	0.73	
Whiskey	1	234.51	Regional	222.40	220.70	12.05		73.32	221.30	30.06	0.84	
Whiskey	1	171.38	2 YR	219.75	220.15	12.70		10.06	220.58		0.06	
Whiskey	1	171.38	5 YR	220.36	220.15	12.70	220.29	19.56	220.58		0.16	0.37
Whiskey	1	171.38	10 YR	220.75	220.15	12.70		27.35	220.58	0.00	0.23	
Whiskey	1	171.38	25 YR	220.87	220.15	12.70		34.96	220.58	1.68	0.30	
Whiskey	1	171.38	50 YR	221.00	220.15	12.70		41.40	220.58	5.34	0.32	
Whiskey	1	171.38	100 YR	221.17	220.15	12.70		50.07	220.58	13.20	0.39	
Whiskey	1	171.38	Regional	221.41	220.15	12.70		67.85	220.58	28.89	0.46	

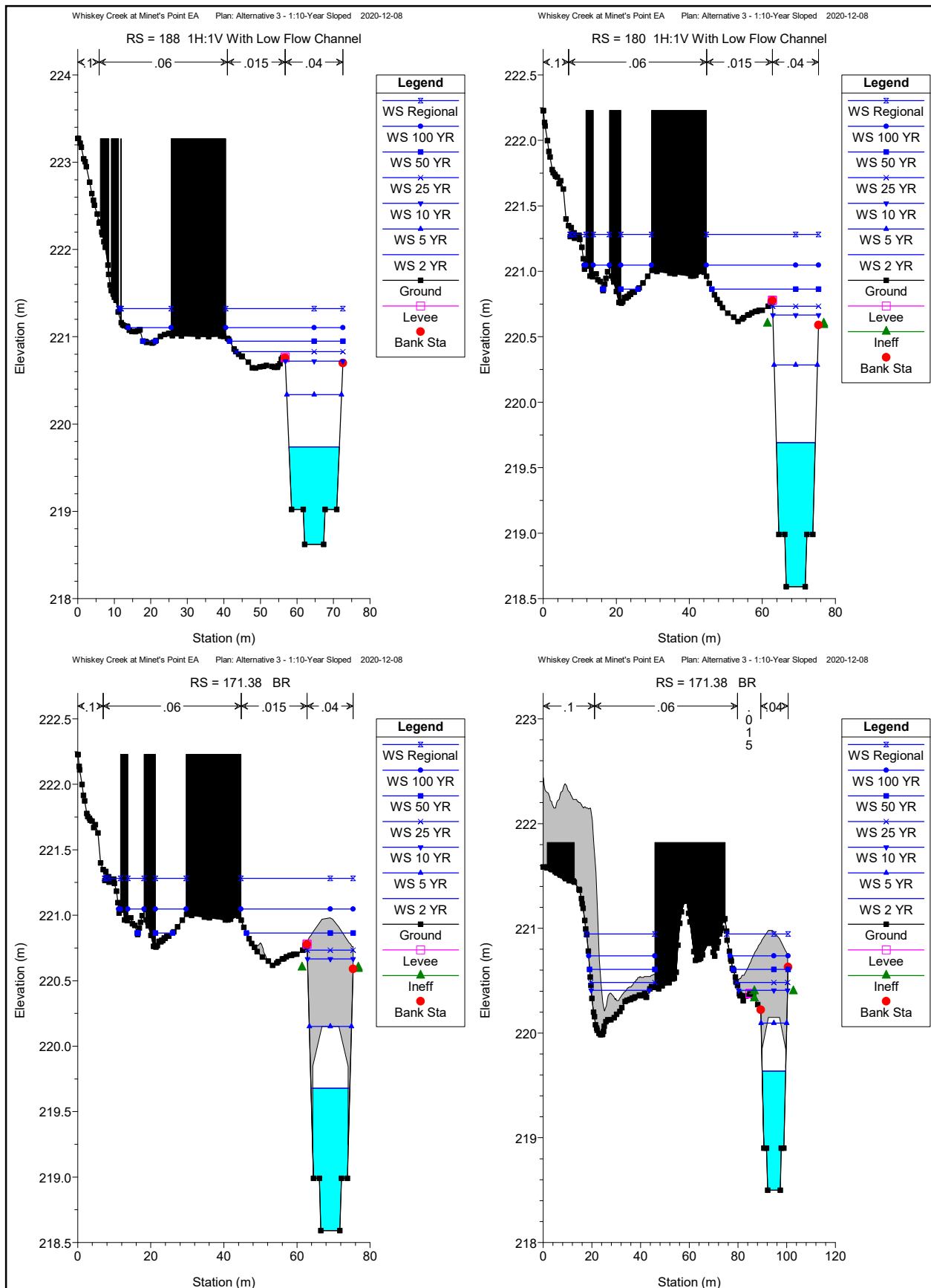
HEC-RAS Plan: Alt3-10_Sloped Locations: User Defined

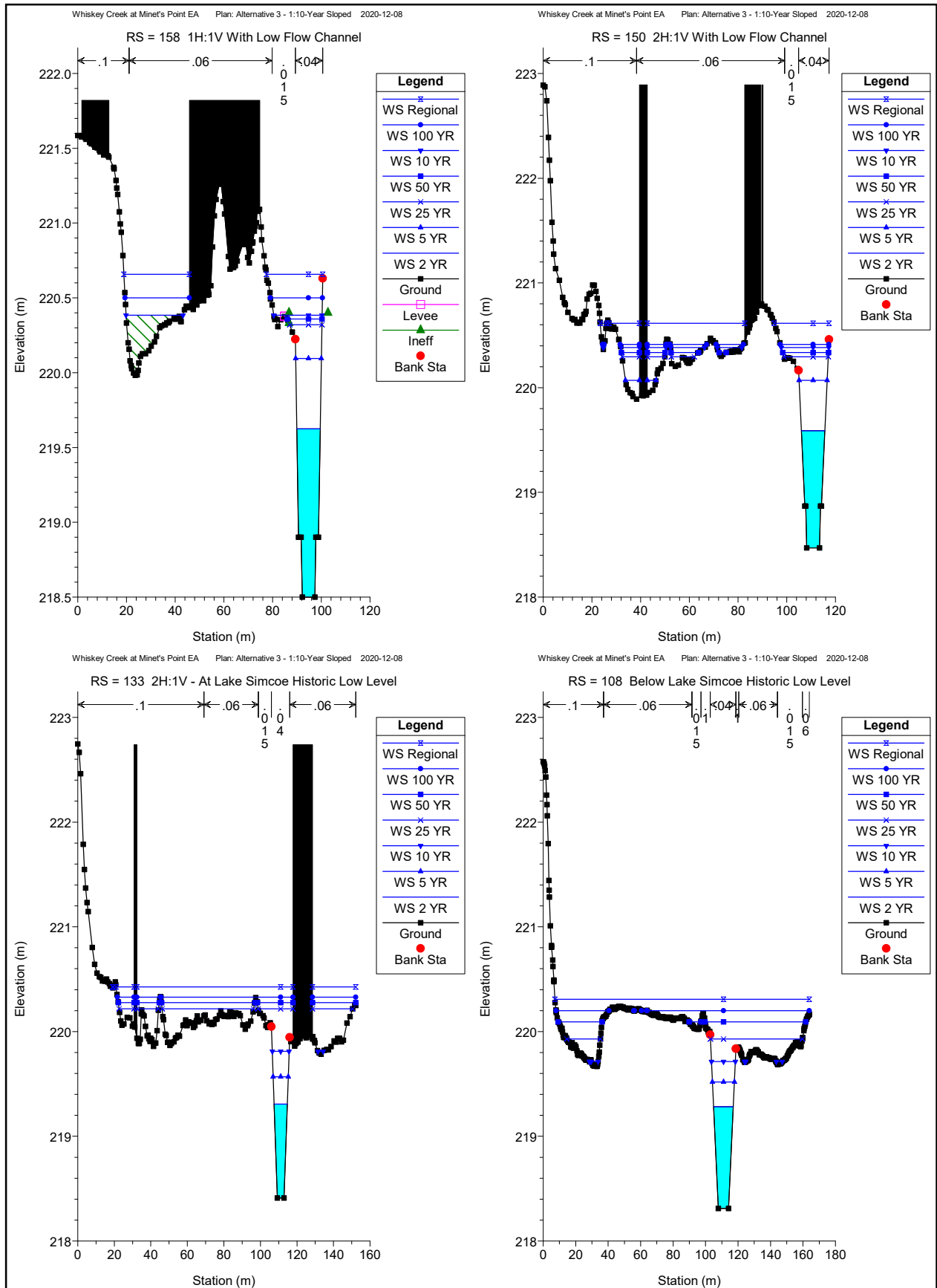
River	Reach	River Sta	Profile	Q US (m3/s)	Q Leaving Total (m3/s)	Q DS (m3/s)	Q Weir (m3/s)	Q Gates (m3/s)	Wt Top Width (m)	Weir Max Depth (m)	Weir Avg Depth (m)	Min El Weir Flow (m)	E.G. US. (m)	W.S. US. (m)	E.G. DS (m)	W.S. DS (m)
Whiskey	1	222.8	2 YR	10.03	0.00	10.08	0.00					220.05	219.87	219.80	219.18	219.15
Whiskey	1	222.8	5 YR	19.49	0.00	19.59	0.00					220.05	220.45	220.37	219.26	219.15
Whiskey	1	222.8	10 YR	27.27	0.03	27.40	0.03		16.16	0.09	0.03	220.05	220.84	220.75	219.36	219.15
Whiskey	1	222.8	25 YR	35.03	0.72	34.51	0.72		45.80	0.20	0.10	220.05	220.98	220.86	219.48	219.16
Whiskey	1	222.8	50 YR	42.04	1.69	40.59	1.69		76.05	0.29	0.13	220.05	221.13	220.97	219.60	219.16
Whiskey	1	222.8	100 YR	52.25	4.02	48.61	4.02		113.01	0.47	0.18	220.05	221.29	221.11	219.77	219.28
Whiskey	1	222.8	Regional	73.32	10.07	63.89	10.07		136.46	0.71	0.30	220.05	221.54	221.32	219.95	219.71

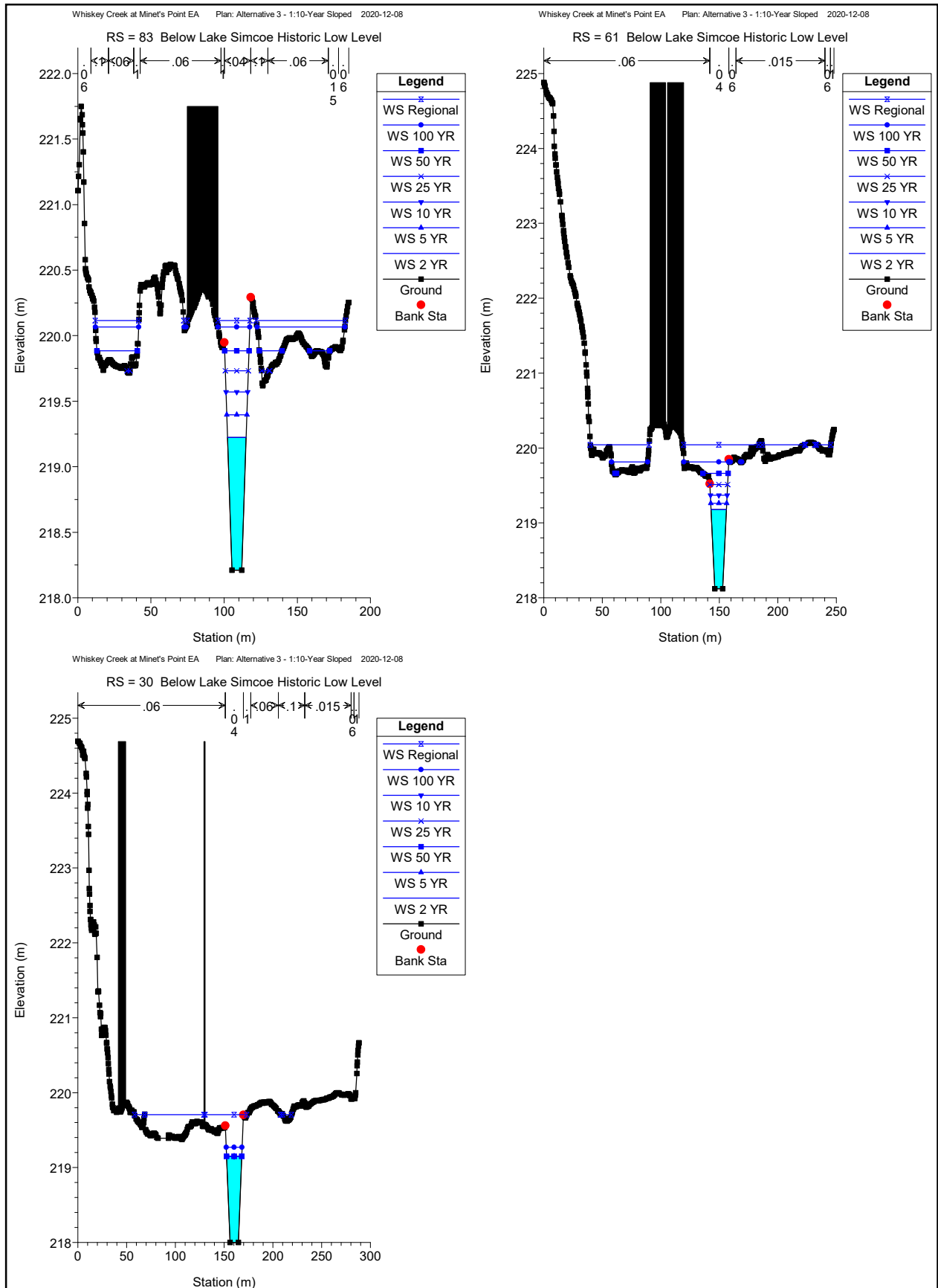












Appendix K:
Hydraulic Model Results –
Alternative 7 (Flow Diversion)



HEC-RAS Plan: Alt7 Locations: User Defined

River	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
Whiskey	1	299	2 YR	10.00	220.47	221.37	221.37	221.61	0.013705	2.34	5.90	13.73	0.87
Whiskey	1	299	5 YR	19.42	220.47	221.65	221.65	221.96	0.012909	2.81	10.16	16.78	0.90
Whiskey	1	299	10 YR	27.16	220.47	221.81	221.81	222.18	0.013310	3.16	12.96	17.76	0.93
Whiskey	1	299	25 YR	34.88	220.47	221.95	221.95	222.38	0.013766	3.46	15.44	18.54	0.97
Whiskey	1	299	50 YR	41.86	220.47	222.07	222.07	222.54	0.013749	3.66	17.70	19.18	0.98
Whiskey	1	299	100 YR	52.03	220.47	222.22	222.22	222.76	0.014008	3.95	20.67	20.02	1.01
Whiskey	1	299	Regional	72.99	220.47	222.51	222.51	223.15	0.013758	4.39	26.73	21.36	1.03
Whiskey	1	278	2 YR	10.00	219.98	220.91	220.84	221.16	0.015442	2.19	4.57	6.94	0.86
Whiskey	1	278	5 YR	19.42	219.98	221.40	221.19	221.69	0.008939	2.38	9.60	21.74	0.71
Whiskey	1	278	10 YR	27.16	219.98	221.66	221.56	221.95	0.007532	2.51	16.70	30.77	0.68
Whiskey	1	278	25 YR	34.88	219.98	221.83	221.73	222.14	0.007300	2.67	22.19	32.16	0.68
Whiskey	1	278	50 YR	41.86	219.98	221.99	221.85	222.30	0.006773	2.74	27.37	33.09	0.67
Whiskey	1	278	100 YR	52.03	219.98	222.11	222.00	222.48	0.007734	3.06	31.32	33.67	0.72
Whiskey	1	278	Regional	72.99	219.98	222.37	222.25	222.82	0.008473	3.49	40.11	34.94	0.77
Whiskey	1-DS-0	257	2 YR	2.43	220.07	220.90		220.93	0.004438	0.73	3.46	5.69	0.28
Whiskey	1-DS-0	257	5 YR	4.11	220.07	221.49		221.50	0.000704	0.45	14.72	30.93	0.13
Whiskey	1-DS-0	257	10 YR	7.44	220.07	221.76		221.76	0.000728	0.52	23.22	32.44	0.13
Whiskey	1-DS-0	257	25 YR	11.92	220.07	221.94		221.95	0.000981	0.66	29.31	33.26	0.16
Whiskey	1-DS-0	257	50 YR	16.61	220.07	222.07		222.08	0.001305	0.80	33.50	33.88	0.19
Whiskey	1-DS-0	257	100 YR	23.65	220.07	222.22		222.25	0.001751	0.97	38.80	35.06	0.22
Whiskey	1-DS-0	257	Regional	39.82	220.07	222.50		222.55	0.002523	1.28	49.58	39.19	0.27
Whiskey	1-DS-0	249	2 YR	2.43	219.86	220.87		220.90	0.002288	0.80	3.64	13.06	0.32
Whiskey	1-DS-0	249	5 YR	4.11	219.86	221.48		221.49	0.000340	0.49	16.83	30.14	0.14
Whiskey	1-DS-0	249	10 YR	7.44	219.86	221.75		221.76	0.000439	0.63	25.21	33.47	0.16
Whiskey	1-DS-0	249	25 YR	11.92	219.86	221.93		221.95	0.000655	0.83	31.46	36.11	0.20
Whiskey	1-DS-0	249	50 YR	16.61	219.86	222.04		222.07	0.000915	1.02	35.79	37.25	0.24
Whiskey	1-DS-0	249	100 YR	23.65	219.86	222.19		222.23	0.001274	1.27	41.35	38.68	0.29
Whiskey	1-DS-0	249	Regional	39.82	219.86	222.45		222.53	0.001956	1.71	51.62	39.17	0.37
Whiskey	1-DS-0	243	2 YR	2.46	219.75	220.86	220.35	220.89	0.001116	0.67	3.85	6.54	0.24
Whiskey	1-DS-0	243	5 YR	4.18	219.75	221.47	220.51	221.49	0.000347	0.55	11.45	20.93	0.15
Whiskey	1-DS-0	243	10 YR	7.55	219.75	221.73	220.73	221.75	0.000510	0.74	17.86	29.32	0.19
Whiskey	1-DS-0	243	25 YR	12.07	219.75	221.90	220.97	221.93	0.000783	0.98	23.18	33.22	0.23
Whiskey	1-DS-0	243	50 YR	16.79	219.75	222.00	221.19	222.06	0.001125	1.22	26.82	35.89	0.28
Whiskey	1-DS-0	243	100 YR	23.87	219.75	222.13	221.52	222.21	0.001610	1.53	31.53	38.61	0.34
Whiskey	1-DS-0	243	Regional	40.15	219.75	222.37	221.89	222.49	0.002422	2.02	40.82	39.31	0.43
Whiskey	1-DS-0	237		Culvert									
Whiskey	1-DS-0	225	2 YR	2.46	219.67	220.30	220.18	220.39	0.008751	1.26	1.95	4.76	0.63
Whiskey	1-DS-0	225	5 YR	4.18	219.67	220.53	220.32	220.63	0.005980	1.38	3.03	6.00	0.55
Whiskey	1-DS-0	225	10 YR	7.55	219.67	220.88	220.53	220.99	0.004006	1.47	5.71	8.47	0.48
Whiskey	1-DS-0	225	25 YR	12.07	219.67	221.26	220.76	221.32	0.001718	1.21	15.28	37.35	0.34
Whiskey	1-DS-0	225	50 YR	16.79	219.67	221.17	221.17	221.38	0.006025	2.16	9.98	22.63	0.62
Whiskey	1-DS-0	225	100 YR	23.87	219.67	221.38	221.30	221.49	0.003442	1.81	19.77	40.09	0.48
Whiskey	1-DS-0	225	Regional	40.15	219.67	221.54	221.45	221.69	0.004366	2.18	26.71	47.05	0.55
Whiskey	1-DS-0	223	2 YR	2.46	219.71	220.27		220.36	0.010367	1.35	1.82	4.57	0.68
Whiskey	1-DS-0	223	5 YR	4.18	219.71	220.51		220.61	0.006048	1.42	3.10	6.00	0.56
Whiskey	1-DS-0	223	10 YR	7.55	219.71	220.85		220.97	0.004482	1.60	5.47	8.14	0.52
Whiskey	1-DS-0	223	25 YR	12.07	219.71	220.88	220.78	221.17	0.010120	2.47	5.74	8.40	0.78
Whiskey	1-DS-0	223	50 YR	16.79	219.71	221.17	221.17	221.33	0.004886	2.03	13.26	37.98	0.56
Whiskey	1-DS-0	223	100 YR	23.87	219.71	221.26	221.26	221.44	0.005649	2.28	16.76	39.95	0.61
Whiskey	1-DS-0	223	Regional	40.15	219.71	221.42	221.42	221.64	0.006780	2.68	23.35	45.00	0.68
Whiskey	1-DS-0	222.8		Lat Struct									
Whiskey	1-DS-0	221	2 YR	2.46	219.69	220.28		220.32	0.003579	0.92	2.75	6.39	0.42
Whiskey	1-DS-0	221	5 YR	4.18	219.69	220.53		220.58	0.002504	1.01	4.50	7.56	0.37
Whiskey	1-DS-0	221	10 YR	7.55	219.69	220.87		220.93	0.002158	1.20	7.25	8.93	0.37
Whiskey	1-DS-0	221	25 YR	12.07	219.69	220.94		221.08	0.004204	1.75	8.34	18.86	0.52
Whiskey	1-DS-0	221	50 YR	16.79	219.69	220.97	220.77	221.21	0.007130	2.32	8.94	21.54	0.68
Whiskey	1-DS-0	221	100 YR	23.87	219.69	221.16	221.16	221.36	0.005568	2.27	15.23	40.69	0.62
Whiskey	1-DS-0	221	Regional	40.14	219.69	221.34	221.34	221.58	0.006521	2.66	23.17	46.68	0.68
Whiskey	1-DS-0	208	2 YR	2.46	219.44	220.27		220.29	0.001520	0.64	3.86	7.05	0.27
Whiskey	1-DS-0	208	5 YR	4.18	219.44	220.52		220.55	0.001256	0.74	5.76	7.76	0.26
Whiskey	1-DS-0	208	10 YR	7.55	219.44	220.87		220.91	0.001114	0.89	9.73	23.74	0.26
Whiskey	1-DS-0	208	25 YR	12.06	219.44	220.96		221.02	0.001818	1.19	12.05	26.24	0.34
Whiskey	1-DS-0	208	50 YR	16.74	219.44	221.02		221.12	0.002561	1.46	13.85	32.56	0.40
Whiskey	1-DS-0	208	100 YR	23.66	219.44	221.09		221.23	0.003725	1.82	16.17	35.86	0.49
Whiskey	1-DS-0	208	Regional	39.49	219.44	221.21	221.19	221.45	0.006095	2.45	20.74	41.93	0.64
Whiskey	1-DS-0	201	2 YR	2.46	219.22	220.26		220.28	0.000941	0.58	4.31	6.87	0.22
Whiskey	1-DS-0	201	5 YR	4.18	219.22	220.52		220.54	0.000935	0.71	6.16	7.58	0.23
Whiskey	1-DS-0	201	10 YR	7.55	219.22	220.87		220.90	0.000783	0.80	11.32	26.09	0.22
Whiskey	1-DS-0	201	25 YR	12.03	219.22	220.96		221.01	0.001267	1.07	13.88	30.13	0.29
Whiskey	1-DS-0	201	50 YR	16.61	219.22	221.03		221.10	0.001683	1.27	15.89	30.13	0.33
Whiskey	1-DS-0	201	100 YR	23.38	219.22	221.09		221.20	0.002368	1.55	17.98	31.65	0.40
Whiskey	1-DS-0	201	Regional	38.91	219.22	221.20		221.41	0.004003	2.11	21.33	32.18	0.53
Whiskey	1-DS-0	188	2 YR	2.46	219.15	220.23		220.26	0.001940	0.78	3.16	5.01	0.30
Whiskey	1-DS-0	188	5 YR	4.18	219.15	220.48		220.52	0.001958	0.97	4.50	6.03	0.32
Whiskey	1-DS-0	188	10 YR	7.52	219.15	220.84		220.88	0.001268	0.97	10.32	29.63	0.27

HEC-RAS Plan: Alt7 Locations: User Defined (Continued)

River	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
Whiskey	1-DS-0	188	25 YR	11.87	219.15	220.93		220.99	0.001851	1.22	12.86	30.78	0.33
Whiskey	1-DS-0	188	50 YR	16.30	219.15	220.99		221.07	0.002443	1.44	14.90	36.60	0.38
Whiskey	1-DS-0	188	100 YR	22.87	219.15	221.04		221.17	0.003417	1.75	16.99	40.42	0.46
Whiskey	1-DS-0	188	Regional	38.00	219.15	221.13	221.13	221.35	0.005672	2.34	20.79	45.20	0.59
Whiskey	1-DS-0	180	2 YR	2.49	219.07	219.92	219.92	220.12	0.026406	1.98	1.26	3.16	1.00
Whiskey	1-DS-0	180	5 YR	4.25	219.07	220.11	220.11	220.36	0.024596	2.24	1.90	3.75	1.00
Whiskey	1-DS-0	180	10 YR	7.59	219.07	220.38	220.38	220.70	0.021823	2.48	3.08	5.11	0.99
Whiskey	1-DS-0	180	25 YR	11.58	219.07	220.79	220.79	220.93	0.005780	1.77	8.53	28.84	0.55
Whiskey	1-DS-0	180	50 YR	15.80	219.07	220.87	220.87	221.01	0.006108	1.90	10.87	34.39	0.58
Whiskey	1-DS-0	180	100 YR	22.20	219.07	220.95	220.95	221.11	0.006480	2.06	14.00	40.02	0.60
Whiskey	1-DS-0	180	Regional	36.92	219.07	221.09	221.09	221.29	0.007004	2.30	19.86	44.14	0.64
Whiskey	1-DS-0	171		Culvert									
Whiskey	1-DS-0	158	2 YR	2.49	218.67	219.69	219.21	219.72	0.001609	0.67	3.72	6.23	0.28
Whiskey	1-DS-0	158	5 YR	4.25	218.67	219.87	219.42	219.91	0.002199	0.88	4.83	6.76	0.33
Whiskey	1-DS-0	158	10 YR	7.59	218.67	220.13	219.62	220.20	0.002669	1.13	6.77	14.99	0.38
Whiskey	1-DS-0	158	25 YR	11.58	218.67	220.22	219.81	220.34	0.004532	1.56	7.49	19.61	0.50
Whiskey	1-DS-0	158	50 YR	15.80	218.67	220.27	219.99	220.48	0.007073	2.02	7.96	22.33	0.63
Whiskey	1-DS-0	158	100 YR	22.20	218.67	220.56	220.45	220.65	0.002954	1.54	21.21	46.99	0.43
Whiskey	1-DS-0	158	Regional	36.92	218.67	220.60	220.60	220.80	0.006581	2.34	23.11	47.85	0.64
Whiskey	1-DS-0	150	2 YR	2.49	218.81	219.68		219.70	0.001254	0.61	4.10	6.80	0.25
Whiskey	1-DS-0	150	5 YR	4.25	218.81	219.85		219.89	0.001625	0.81	5.31	7.52	0.30
Whiskey	1-DS-0	150	10 YR	7.59	218.81	220.12		220.17	0.001766	1.03	8.98	18.64	0.32
Whiskey	1-DS-0	150	25 YR	11.58	218.81	220.20		220.29	0.003079	1.42	10.54	23.25	0.43
Whiskey	1-DS-0	150	50 YR	15.80	218.81	220.24	219.91	220.39	0.004901	1.84	11.58	28.54	0.55
Whiskey	1-DS-0	150	100 YR	22.20	218.81	220.33	220.33	220.55	0.006339	2.21	15.19	44.91	0.63
Whiskey	1-DS-0	150	Regional	36.89	218.81	220.56	220.56	220.74	0.005620	2.32	28.97	67.55	0.61
Whiskey	1-DS-0	133	2 YR	2.49	218.78	219.47	219.47	219.61	0.026989	1.66	1.50	5.61	1.02
Whiskey	1-DS-0	133	5 YR	4.25	218.78	219.68		219.80	0.011288	1.56	2.82	6.93	0.72
Whiskey	1-DS-0	133	10 YR	7.59	218.78	219.78	219.78	220.04	0.018846	2.29	3.53	7.54	0.97
Whiskey	1-DS-0	133	25 YR	11.56	218.78	220.03	220.03	220.19	0.008274	1.94	10.83	48.54	0.68
Whiskey	1-DS-0	133	50 YR	15.62	218.78	220.14	220.14	220.27	0.006884	1.93	18.01	81.82	0.63
Whiskey	1-DS-0	133	100 YR	21.53	218.78	220.23	220.23	220.35	0.006796	2.03	26.10	103.09	0.64
Whiskey	1-DS-0	133	Regional	34.59	218.78	220.32	220.32	220.46	0.008209	2.36	36.33	108.20	0.71
Whiskey	1-DS-0	108	2 YR	2.49	218.59	219.52		219.53	0.000521	0.41	6.09	9.64	0.16
Whiskey	1-DS-0	108	5 YR	4.25	218.59	219.71		219.73	0.000634	0.53	8.23	16.99	0.19
Whiskey	1-DS-0	108	10 YR	7.59	218.59	219.86		219.88	0.000962	0.72	13.47	52.58	0.24
Whiskey	1-DS-0	108	25 YR	11.56	218.59	219.97		220.00	0.001077	0.83	19.89	59.85	0.26
Whiskey	1-DS-0	108	50 YR	15.62	218.59	220.05		220.08	0.001148	0.90	24.97	68.06	0.27
Whiskey	1-DS-0	108	100 YR	21.53	218.59	220.13		220.17	0.001268	0.99	31.28	88.40	0.29
Whiskey	1-DS-0	108	Regional	34.43	218.59	220.28		220.32	0.001364	1.10	47.80	131.15	0.30
Whiskey	1-DS-0	83	2 YR	2.49	218.16	219.52		219.52	0.000091	0.26	10.13	10.33	0.08
Whiskey	1-DS-0	83	5 YR	4.25	218.16	219.71		219.72	0.000157	0.38	12.55	16.27	0.10
Whiskey	1-DS-0	83	10 YR	7.59	218.16	219.85		219.86	0.000356	0.60	15.75	32.73	0.16
Whiskey	1-DS-0	83	25 YR	11.56	218.16	219.94		219.97	0.000629	0.84	20.30	63.79	0.21
Whiskey	1-DS-0	83	50 YR	15.62	218.16	220.00		220.05	0.000937	1.05	24.48	77.52	0.26
Whiskey	1-DS-0	83	100 YR	21.53	218.16	220.06		220.13	0.001417	1.31	28.96	83.31	0.32
Whiskey	1-DS-0	83	Regional	34.31	218.16	220.12		220.26	0.002721	1.87	34.55	87.35	0.45
Whiskey	1-DS-0	61	2 YR	2.49	218.45	219.50		219.51	0.000636	0.45	5.58	8.73	0.18
Whiskey	1-DS-0	61	5 YR	4.25	218.45	219.69		219.71	0.000811	0.57	7.94	19.59	0.21
Whiskey	1-DS-0	61	10 YR	7.59	218.45	219.81		219.85	0.001439	0.84	11.70	41.22	0.28
Whiskey	1-DS-0	61	25 YR	11.56	218.45	219.90		219.95	0.002026	1.06	16.36	67.25	0.34
Whiskey	1-DS-0	61	50 YR	15.62	218.45	219.97		220.02	0.002196	1.15	21.89	95.96	0.36
Whiskey	1-DS-0	61	100 YR	21.53	218.45	220.03		220.08	0.002259	1.22	28.84	112.69	0.37
Whiskey	1-DS-0	61	Regional	34.31	218.45	220.13		220.18	0.002343	1.31	40.30	129.31	0.38
Whiskey	1-DS-0	30	2 YR	2.51	218.62	219.29	219.29	219.44	0.030795	1.72	1.46	4.96	1.02
Whiskey	1-DS-0	30	5 YR	4.28	218.62	219.43	219.43	219.62	0.026883	1.95	2.20	5.72	1.00
Whiskey	1-DS-0	30	10 YR	7.64	218.62	219.65	219.65	219.75	0.010718	1.56	8.69	58.25	0.68
Whiskey	1-DS-0	30	25 YR	11.63	218.62	219.72	219.72	219.82	0.011334	1.74	13.01	70.70	0.71
Whiskey	1-DS-0	30	50 YR	15.71	218.62	219.77	219.77	219.88	0.012354	1.91	16.93	88.40	0.75
Whiskey	1-DS-0	30	100 YR	21.65	218.62	219.85	219.85	219.95	0.011074	1.95	24.85	122.99	0.72
Whiskey	1-DS-0	30	Regional	34.47	218.62	219.94	219.94	220.04	0.011587	2.15	36.82	150.56	0.75
Whiskey	White Oaks Div.	159	2 YR	7.58	220.00	220.88	220.43	220.93	0.001978	1.02	7.45	12.79	0.35
Whiskey	White Oaks Div.	159	5 YR	15.32	220.00	221.41	220.69	221.49	0.001675	1.28	11.94	14.91	0.35
Whiskey	White Oaks Div.	159	10 YR	19.73	220.00	221.66	220.82	221.76	0.001583	1.40	14.14	15.94	0.35
Whiskey	White Oaks Div.	159	25 YR	22.97	220.00	221.84	220.90	221.95	0.001530	1.47	15.65	16.65	0.35
Whiskey	White Oaks Div.	159	50 YR	25.26	220.00	221.96	220.97	222.08	0.001498	1.52	16.67	17.14	0.35
Whiskey	White Oaks Div.	159	100 YR	28.39	220.00	222.21	221.05	222.25	0.000770	0.94	30.21	18.11	0.23
Whiskey	White Oaks Div.	159	Regional	33.18	220.00	222.50	221.15	222.54	0.000639	0.93	35.87	19.98	0.22
Whiskey	White Oaks Div.	150		Culvert									
Whiskey	White Oaks Div.	110.3	2 YR	7.58	219.44	219.97	219.97	220.21	0.020750	2.18	3.48	7.87	1.00
Whiskey	White Oaks Div.	110.3	5 YR	15.32	219.44	220.26	220.26	220.63	0.018176	2.68	5.72	9.06	1.00
Whiskey	White Oaks Div.	110.3	10 YR	19.73	219.44	220.41	220.41	220.83	0.017176	2.87	6.87	9.64	1.00
Whiskey	White Oaks Div.	110.3	25 YR	22.97	219.44	220.50	220.50	220.96	0.016818	3.00	7.66	10.02	1.00
Whiskey	White Oaks Div.	110.3	50 YR	25.26	219.44	220.57	220.57	221.05	0.016695	3.09	8.17	10.27	1.00
Whiskey	White Oaks Div.	110.3	100 YR	28.39	219.44	220.65	220.65	221.17	0.016278	3.20	8.87	10.60	1.00

HEC-RAS Plan: Alt7 Locations: User Defined (Continued)

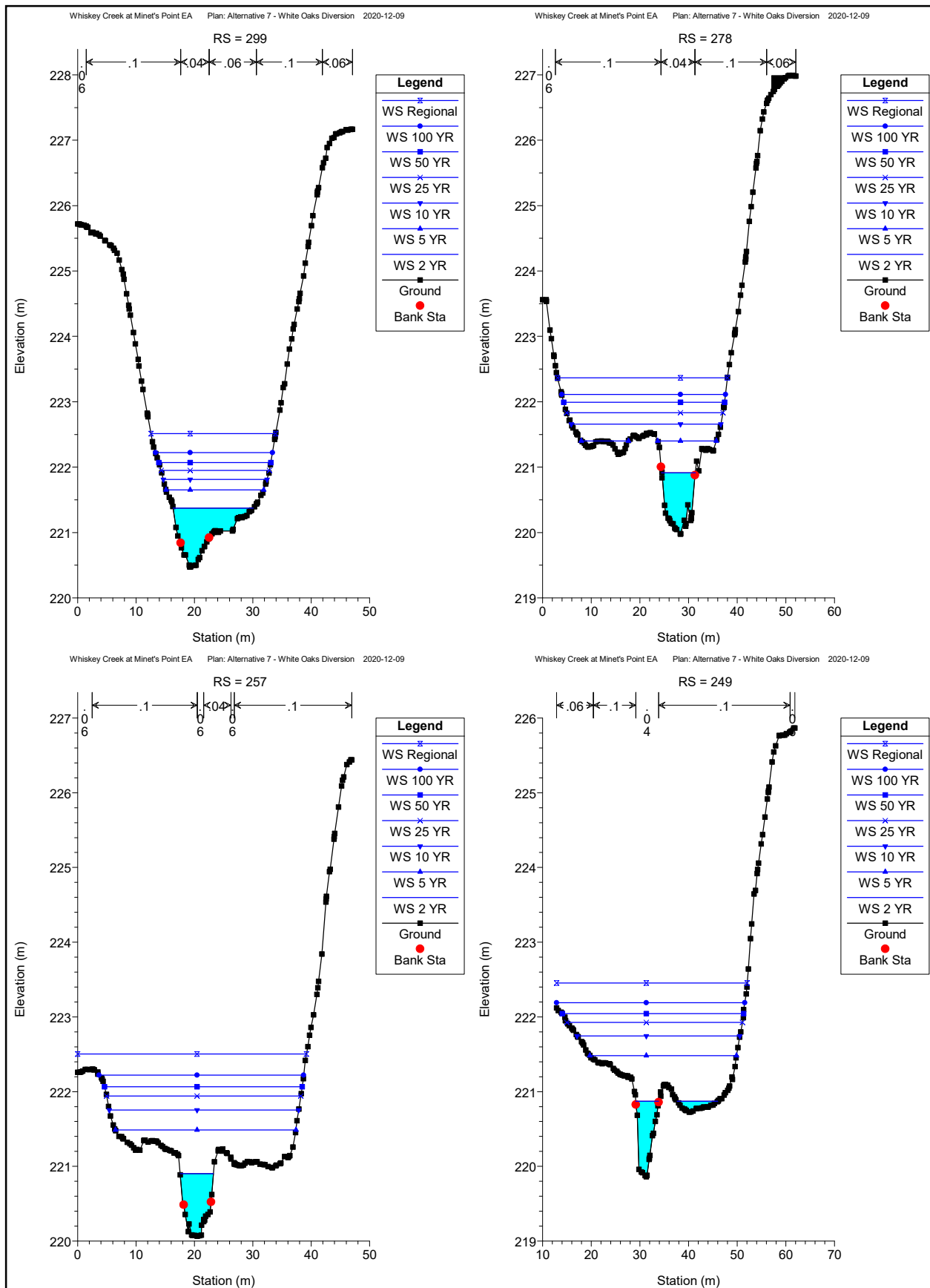
River	Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Whiskey	White Oaks Div.	110.3	Regional	33.18	219.44	220.77	220.77	221.34	0.015571	3.36	9.87	11.07	1.00
Whiskey	White Oaks Div.	105	2 YR	7.58	219.35	219.84	219.82	220.03	0.019122	1.95	3.88	8.92	0.94
Whiskey	White Oaks Div.	105	5 YR	15.32	219.35	220.08	220.08	220.40	0.019196	2.48	6.19	9.90	1.00
Whiskey	White Oaks Div.	105	10 YR	19.73	219.35	220.21	220.21	220.57	0.018556	2.66	7.43	10.39	1.00
Whiskey	White Oaks Div.	105	25 YR	22.97	219.35	220.29	220.29	220.68	0.018101	2.76	8.31	10.72	1.00
Whiskey	White Oaks Div.	105	50 YR	25.26	219.35	220.35	220.35	220.76	0.017681	2.82	8.95	10.95	1.00
Whiskey	White Oaks Div.	105	100 YR	28.39	219.35	220.42	220.42	220.85	0.017435	2.91	9.74	11.24	1.00
Whiskey	White Oaks Div.	105	Regional	33.18	219.35	220.53	220.53	220.99	0.016942	3.03	10.96	11.67	1.00
Whiskey	White Oaks Div.	84	2 YR	7.58	219.01	219.41	219.41	219.59	0.022534	1.87	4.05	11.37	1.00
Whiskey	White Oaks Div.	84	5 YR	15.32	219.01	219.63	219.63	219.90	0.019600	2.27	6.75	12.71	1.00
Whiskey	White Oaks Div.	84	10 YR	19.73	219.01	219.74	219.74	220.04	0.018956	2.44	8.09	13.33	1.00
Whiskey	White Oaks Div.	84	25 YR	22.97	219.01	219.80	219.80	220.13	0.018625	2.55	9.02	13.74	1.00
Whiskey	White Oaks Div.	84	50 YR	25.26	219.01	219.85	219.85	220.20	0.018199	2.60	9.70	14.04	1.00
Whiskey	White Oaks Div.	84	100 YR	28.39	219.01	219.92	219.92	220.28	0.017794	2.68	10.59	14.41	1.00
Whiskey	White Oaks Div.	84	Regional	33.18	219.01	220.00	220.00	220.40	0.017581	2.80	11.84	14.92	1.00
Whiskey	White Oaks Div.	63	2 YR	7.58	218.68	219.17		219.21	0.004100	0.93	8.15	18.22	0.44
Whiskey	White Oaks Div.	63	5 YR	15.32	218.68	219.23		219.37	0.011238	1.66	9.26	18.58	0.75
Whiskey	White Oaks Div.	63	10 YR	19.73	218.68	219.28		219.47	0.013208	1.91	10.34	18.93	0.82
Whiskey	White Oaks Div.	63	25 YR	22.97	218.68	219.34		219.55	0.013589	2.03	11.31	19.23	0.85
Whiskey	White Oaks Div.	63	50 YR	25.26	218.68	219.37		219.60	0.013534	2.10	12.05	19.46	0.85
Whiskey	White Oaks Div.	63	100 YR	28.39	218.68	219.43		219.67	0.013047	2.16	13.16	19.80	0.84
Whiskey	White Oaks Div.	63	Regional	33.18	218.68	219.58		219.79	0.009492	2.05	16.20	20.70	0.74
Whiskey	White Oaks Div.	42	2 YR	7.58	218.34	219.15		219.17	0.000903	0.59	12.89	18.36	0.22
Whiskey	White Oaks Div.	42	5 YR	15.32	218.34	219.15		219.22	0.003727	1.19	12.85	18.35	0.45
Whiskey	White Oaks Div.	42	10 YR	19.73	218.34	219.15		219.27	0.006200	1.54	12.84	18.34	0.59
Whiskey	White Oaks Div.	42	25 YR	22.97	218.34	219.15		219.31	0.008385	1.79	12.85	18.35	0.68
Whiskey	White Oaks Div.	42	50 YR	25.26	218.34	219.15		219.34	0.010080	1.96	12.87	18.36	0.75
Whiskey	White Oaks Div.	42	100 YR	28.39	218.34	219.15		219.40	0.012496	2.19	12.95	18.38	0.83
Whiskey	White Oaks Div.	42	Regional	33.18	218.34	219.48		219.63	0.005223	1.72	19.27	20.34	0.56
Whiskey	White Oaks Div.	21	2 YR	7.58	218.00	219.15		219.15	0.000258	0.38	19.69	20.61	0.13
Whiskey	White Oaks Div.	21	5 YR	15.32	218.00	219.14		219.17	0.001087	0.79	19.49	20.55	0.26
Whiskey	White Oaks Div.	21	10 YR	19.73	218.00	219.13		219.18	0.001854	1.02	19.31	20.50	0.34
Whiskey	White Oaks Div.	21	25 YR	22.97	218.00	219.12		219.19	0.002582	1.20	19.13	20.45	0.40
Whiskey	White Oaks Div.	21	50 YR	25.26	218.00	219.11		219.20	0.003195	1.33	18.98	20.40	0.44
Whiskey	White Oaks Div.	21	100 YR	28.39	218.00	219.10		219.22	0.004190	1.52	18.74	20.33	0.50
Whiskey	White Oaks Div.	21	Regional	33.18	218.00	219.46		219.54	0.002059	1.25	26.56	23.70	0.37
Whiskey	White Oaks Div.	0	2 YR	7.58	218.00	219.15	218.15	219.15	0.000032	0.14	52.61	51.50	0.05
Whiskey	White Oaks Div.	0	5 YR	15.32	218.00	219.15	218.24	219.15	0.000133	0.29	52.61	51.50	0.09
Whiskey	White Oaks Div.	0	10 YR	19.73	218.00	219.15	218.29	219.16	0.000220	0.38	52.61	51.50	0.12
Whiskey	White Oaks Div.	0	25 YR	22.97	218.00	219.15	218.32	219.16	0.000298	0.44	52.61	51.50	0.14
Whiskey	White Oaks Div.	0	50 YR	25.26	218.00	219.15	218.34	219.16	0.000361	0.48	52.61	51.50	0.15
Whiskey	White Oaks Div.	0	100 YR	28.39	218.00	219.15	218.36	219.16	0.000456	0.54	52.61	51.50	0.17
Whiskey	White Oaks Div.	0	Regional	33.18	218.00	219.50	218.40	219.51	0.000248	0.47	71.24	55.00	0.13

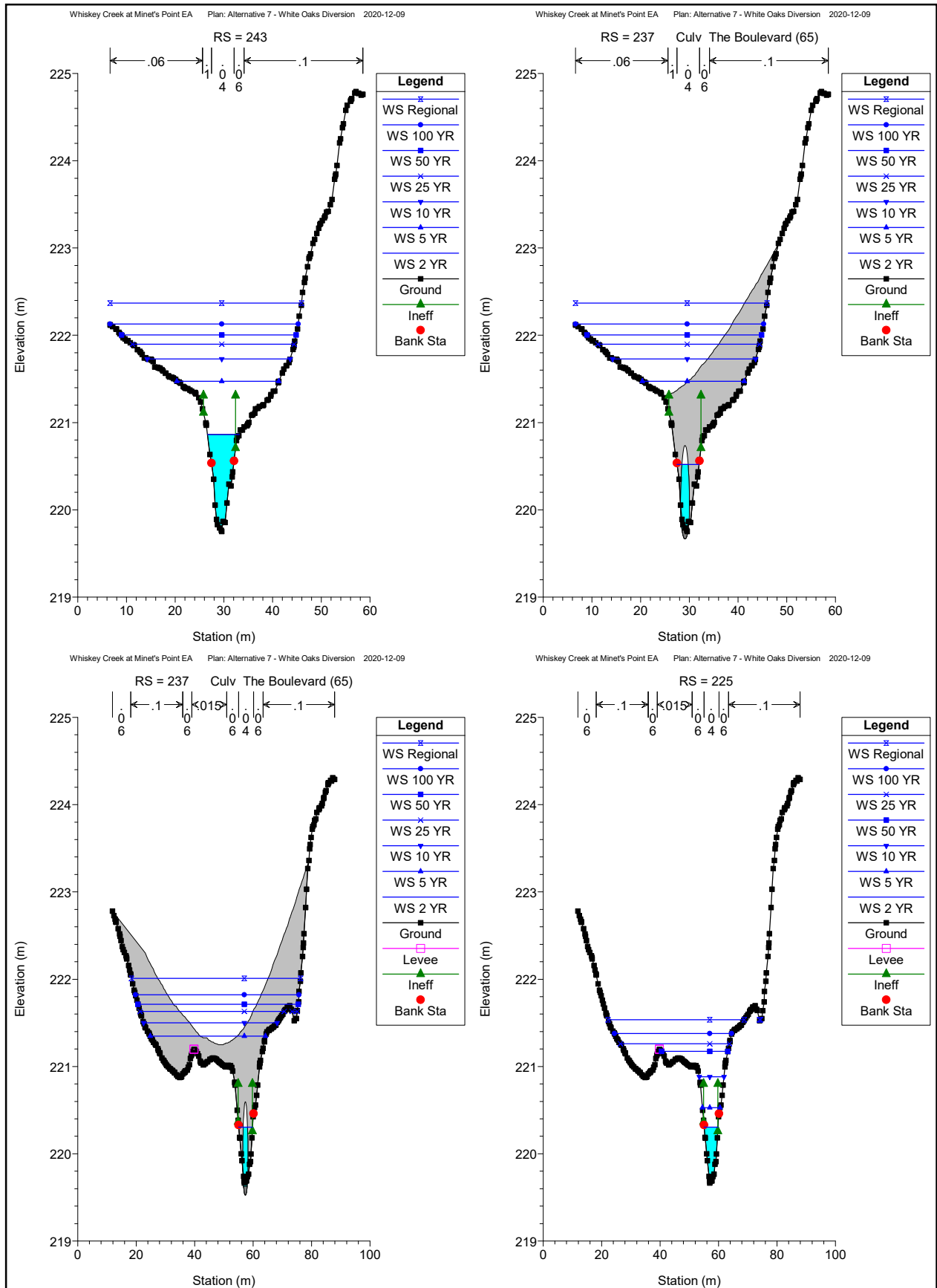
HEC-RAS Plan: Alt7 Locations: User Defined

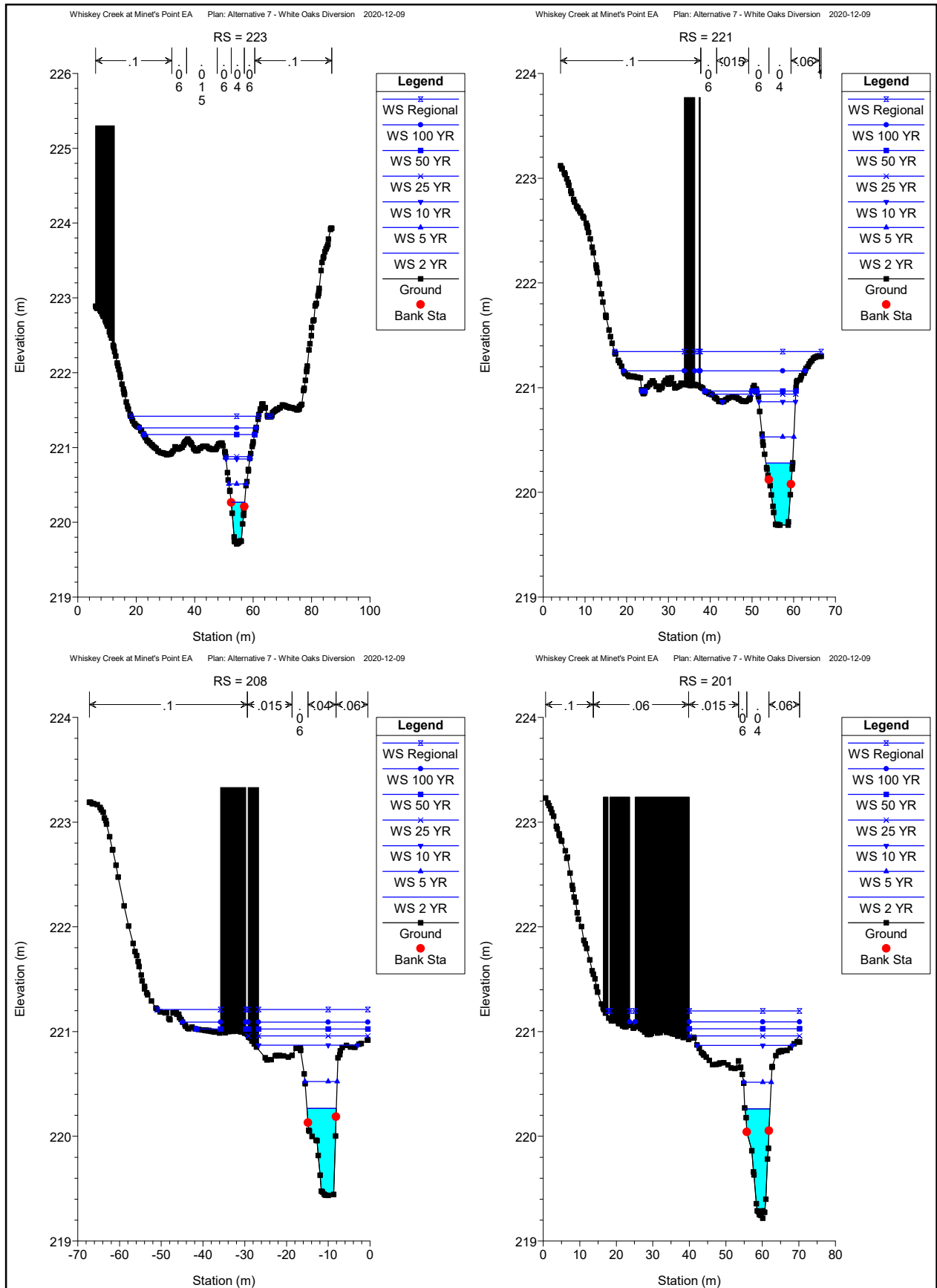
River	Reach	River Sta	Profile	E.G. US. (m)	W.S. US. (m)	E.G. IC (m)	E.G. OC (m)	Min El Weir Flow (m)	Q Culv Group (m3/s)	Q Weir (m3/s)	Delta WS (m)	Culv Vel US (m/s)	Culv Vel DS (m/s)
Whiskey	1-DS-0	237 Culvert #1	2 YR	220.89	220.86	220.78	220.89	221.31	2.46		0.56	2.05	2.23
Whiskey	1-DS-0	237 Culvert #1	5 YR	221.49	221.47	221.50	221.49	221.31	3.66	0.52	0.94	2.65	2.73
Whiskey	1-DS-0	237 Culvert #1	10 YR	221.75	221.73	221.73	221.75	221.31	3.52	4.03	0.85	2.55	2.55
Whiskey	1-DS-0	237 Culvert #1	25 YR	221.94	221.90	221.90	221.94	221.31	3.10	8.97	0.64	2.25	2.25
Whiskey	1-DS-0	237 Culvert #1	50 YR	222.06	222.00	222.03	222.06	221.31	3.54	13.24	0.83	2.57	2.57
Whiskey	1-DS-0	237 Culvert #1	100 YR	222.21	222.13	222.19	222.21	221.31	3.44	20.43	0.75	2.49	2.49
Whiskey	1-DS-0	237 Culvert #1	Regional	222.49	222.37	222.47	222.49	221.31	3.68	36.46	0.83	2.67	2.67
Whiskey	1-DS-0	171 Culvert #1	2 YR	219.76	219.92	219.62	219.76	220.62	2.49		0.23	0.97	0.82
Whiskey	1-DS-0	171 Culvert #1	5 YR	219.99	220.11	219.90	219.99	220.62	4.25		0.24	1.34	1.16
Whiskey	1-DS-0	171 Culvert #1	10 YR	220.37	220.38	220.34	220.37	220.62	7.59		0.25	1.85	1.64
Whiskey	1-DS-0	171 Culvert #1	25 YR	220.74	220.79	220.74	220.70	220.62	11.24	0.34	0.58	2.65	2.27
Whiskey	1-DS-0	171 Culvert #1	50 YR	220.91	220.87	220.91	220.90	220.62	12.93	2.87	0.60	3.06	2.51
Whiskey	1-DS-0	171 Culvert #1	100 YR	221.08	220.95	221.08	221.08	220.62	13.73	8.47	0.39	2.51	2.51
Whiskey	1-DS-0	171 Culvert #1	Regional	221.29	221.09	221.32	221.29	220.62	15.93	21.00	0.49	2.91	2.91
Whiskey	White Oaks Div.	150 Culvert #1	2 YR	220.93	220.88	220.93	220.92	222.32	7.58		0.91	2.26	3.53
Whiskey	White Oaks Div.	150 Culvert #1	5 YR	221.49	221.41	221.49	221.46	222.32	15.32		1.14	2.86	4.33
Whiskey	White Oaks Div.	150 Culvert #1	10 YR	221.76	221.66	221.76	221.73	222.32	19.73		1.25	3.12	4.63
Whiskey	White Oaks Div.	150 Culvert #1	25 YR	221.95	221.84	221.95	221.92	222.32	22.97		1.34	3.28	4.82
Whiskey	White Oaks Div.	150 Culvert #1	50 YR	222.08	221.96	222.08	222.04	222.32	25.26		1.40	3.38	4.94
Whiskey	White Oaks Div.	150 Culvert #1	100 YR	222.25	222.21	222.25	222.21	222.32	28.39		1.56	3.52	5.09
Whiskey	White Oaks Div.	150 Culvert #1	Regional	222.55	222.50	222.55	222.40	222.32	32.23	0.95	1.73	3.67	5.25

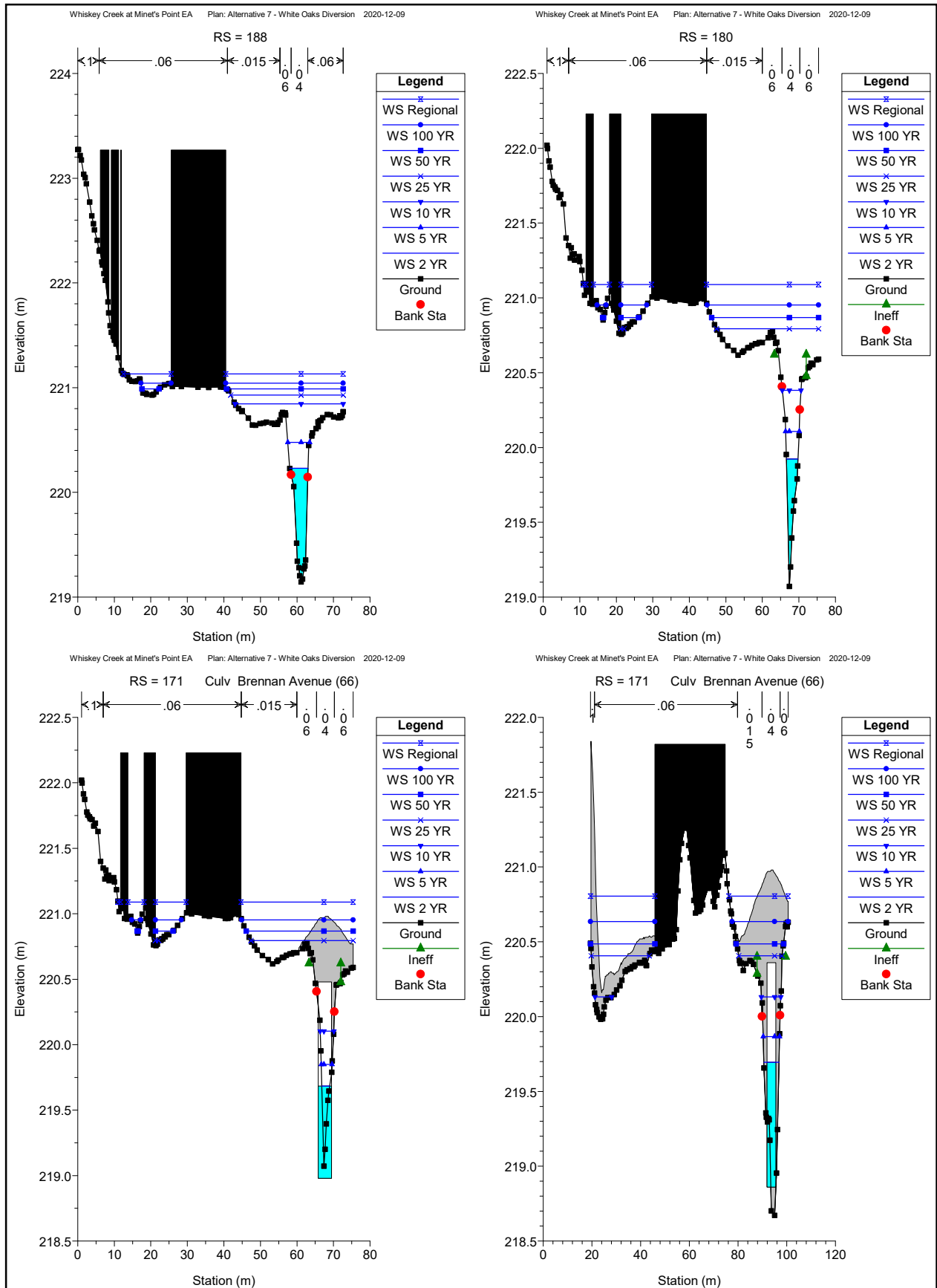
HEC-RAS Plan: Alt7 Locations: User Defined

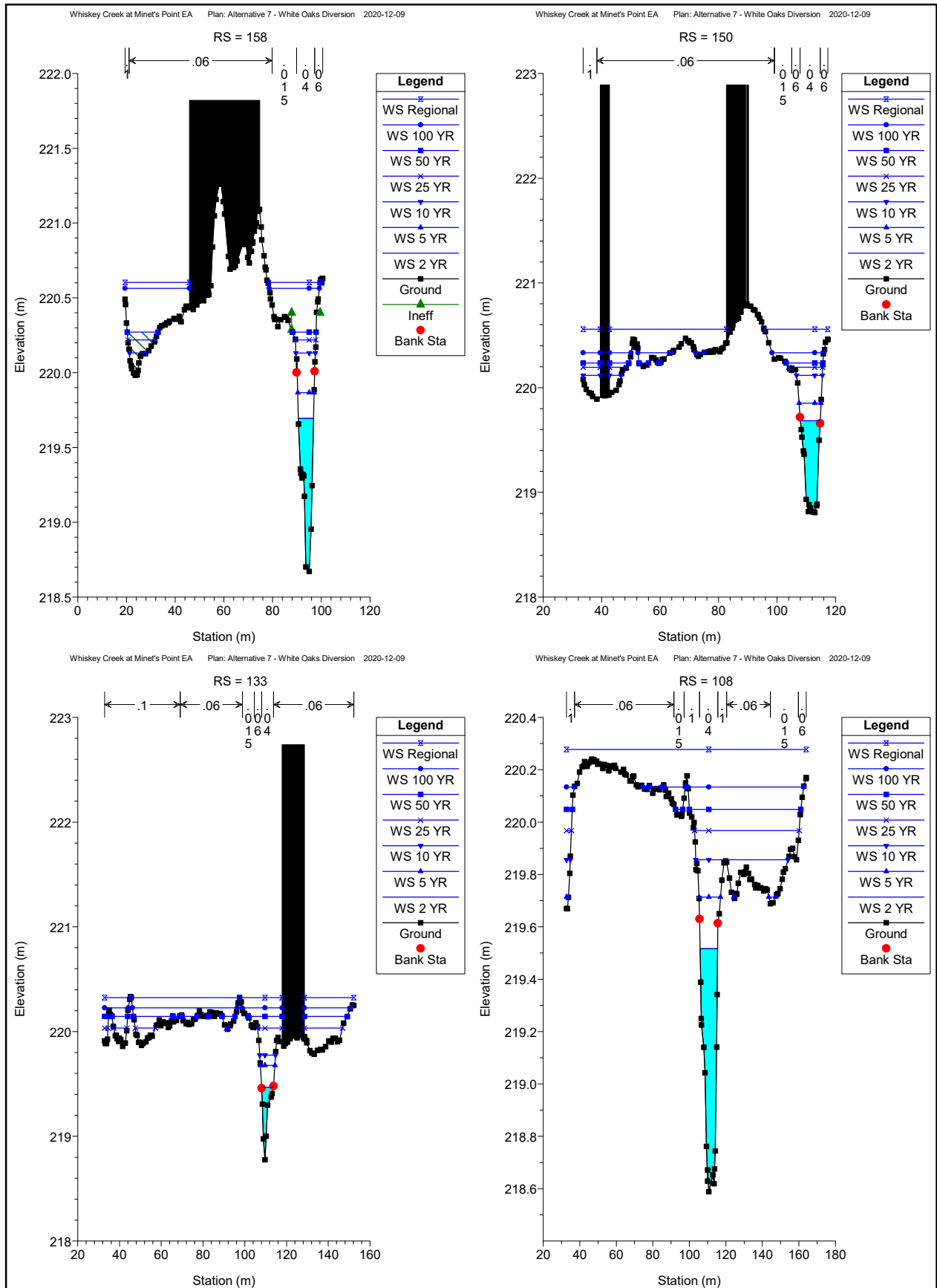
River	Reach	River Sta	Profile	Q US (m3/s)	Q Leaving Total (m3/s)	Q DS (m3/s)	Q Weir (m3/s)	Q Gates (m3/s)	Wt Top Width (m)	Weir Max Depth (m)	Weir Avg Depth (m)	Min El Weir Flow (m)	E.G. US. (m)	W.S. US. (m)	E.G. DS (m)	W.S. DS (m)
Whiskey	1-DS-0	222.8	2 YR	2.46	0.00	2.51	0.00					220.05	220.35	220.27	219.44	219.29
Whiskey	1-DS-0	222.8	5 YR	4.18	0.00	4.28	0.00					220.05	220.60	220.52	219.62	219.43
Whiskey	1-DS-0	222.8	10 YR	7.55	0.07	7.64	0.07		9.41	0.12	0.06	220.05	220.96	220.85	219.75	219.66
Whiskey	1-DS-0	222.8	25 YR	12.07	0.65	11.63	0.65		44.86	0.23	0.09	220.05	221.14	220.90	219.83	219.73
Whiskey	1-DS-0	222.8	50 YR	16.79	1.35	15.71	1.35		58.76	0.30	0.13	220.05	221.29	221.11	219.89	219.78
Whiskey	1-DS-0	222.8	100 YR	23.87	2.60	21.65	2.60		84.72	0.38	0.16	220.05	221.41	221.23	219.95	219.85
Whiskey	1-DS-0	222.8	Regional	40.15	6.25	34.47	6.25		134.22	0.52	0.21	220.05	221.62	221.40	220.05	219.94

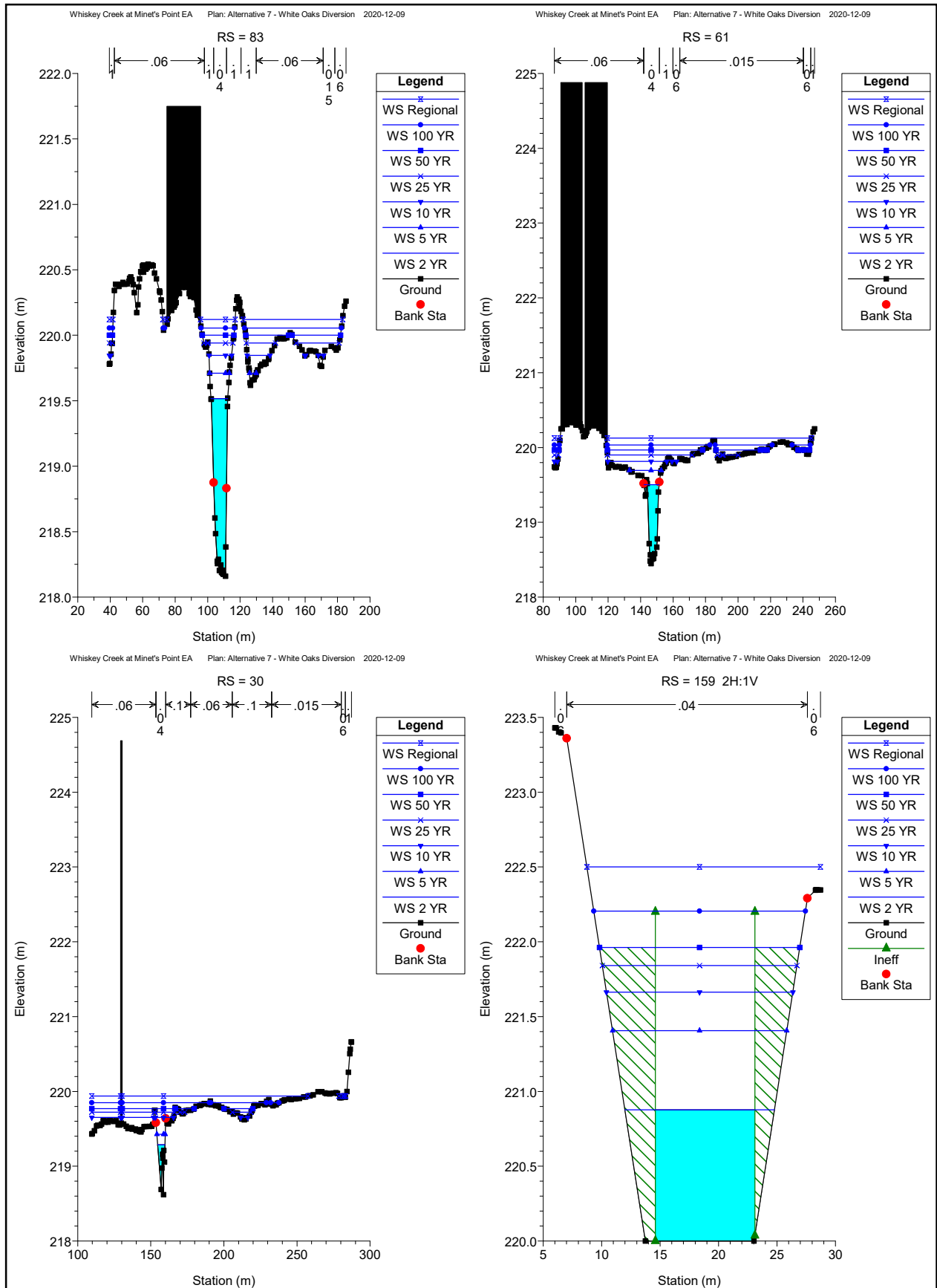


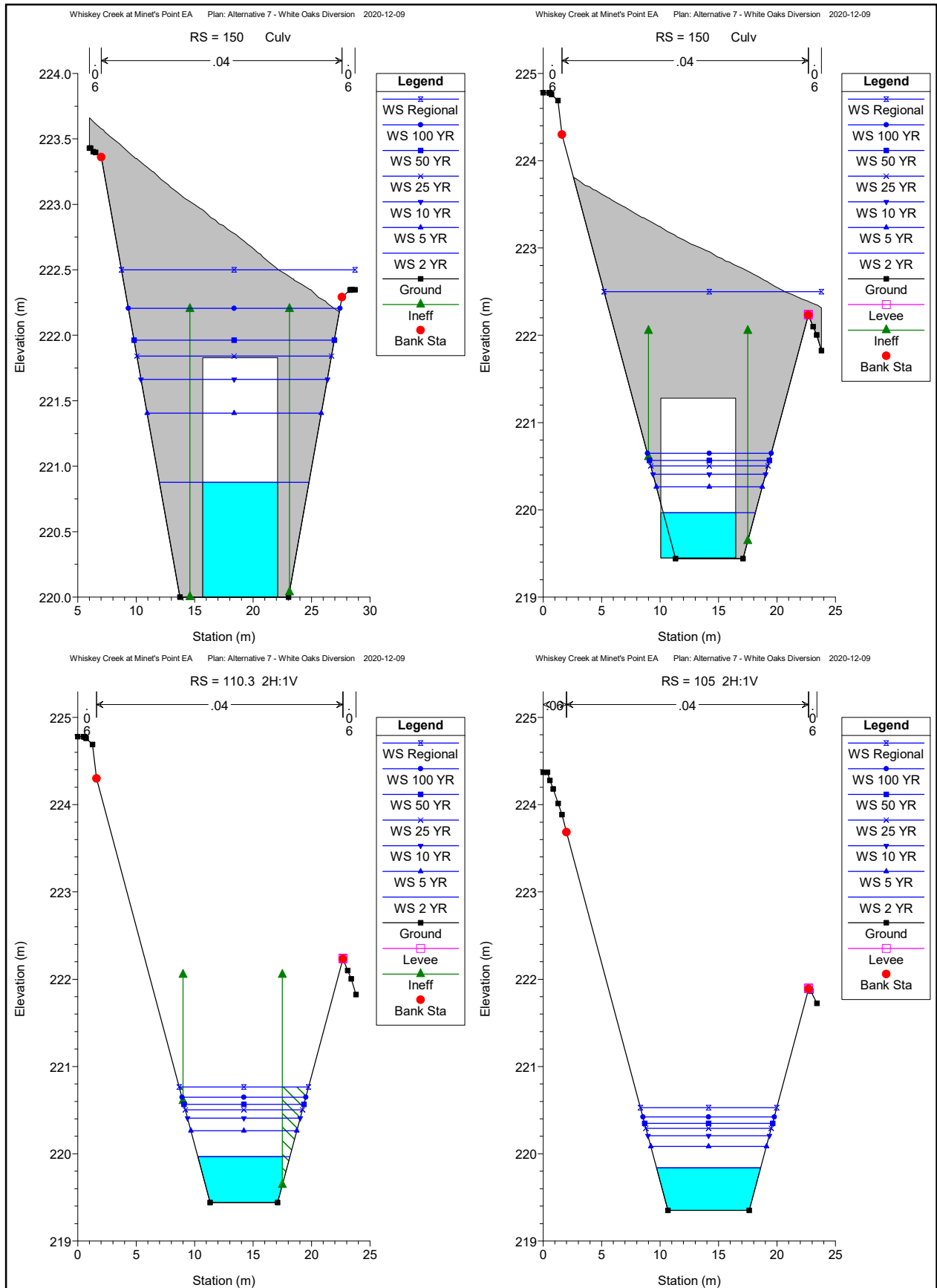


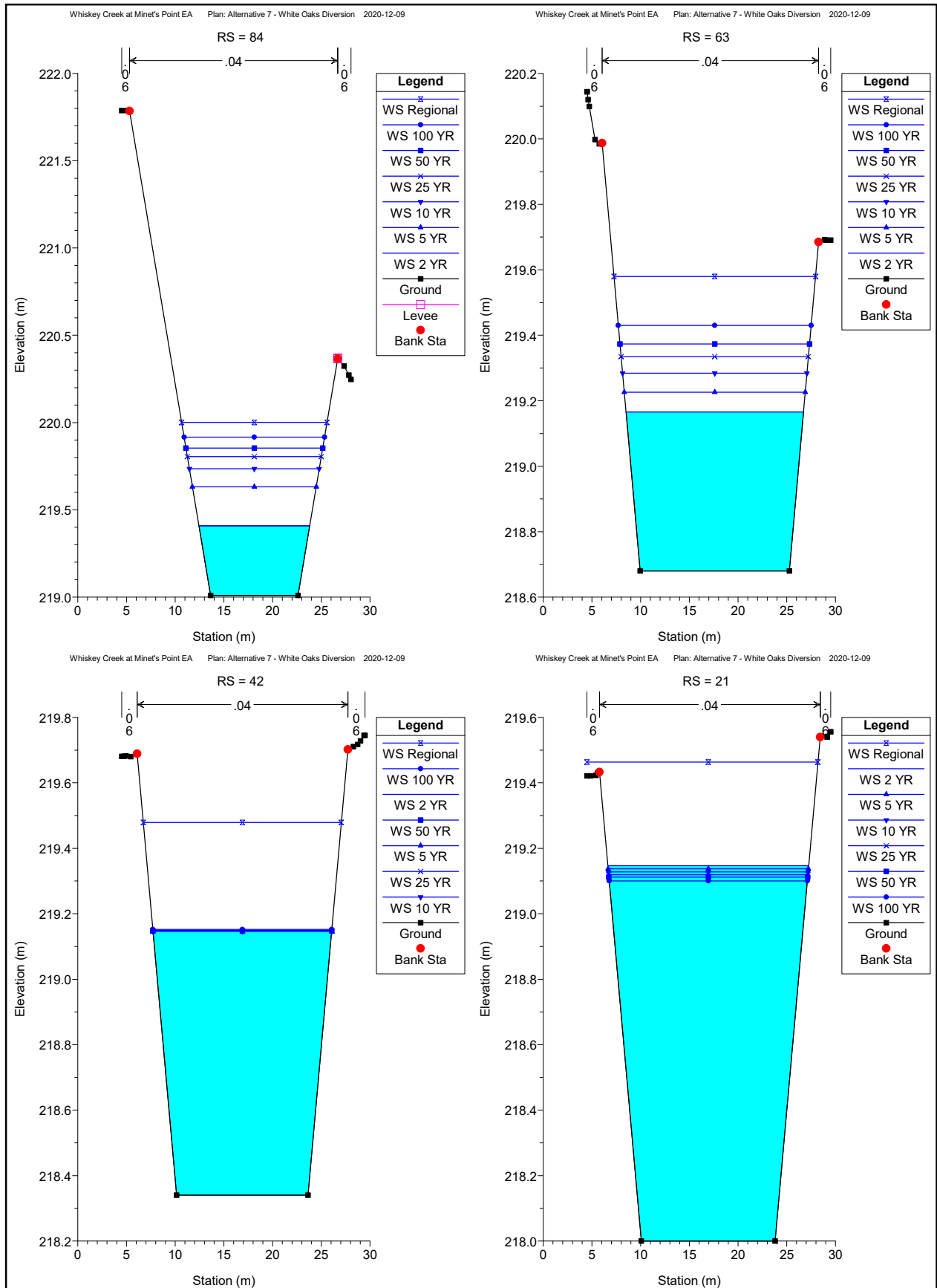


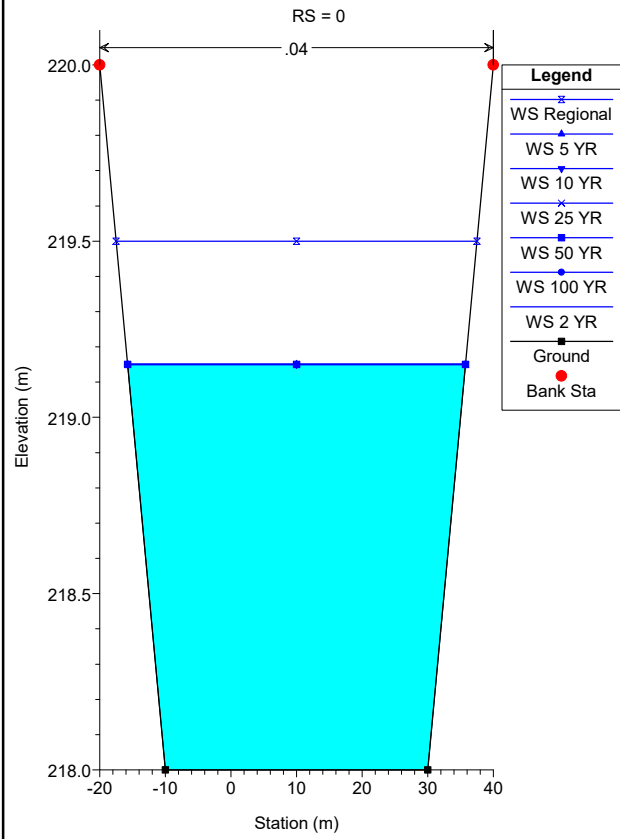












Appendix L: Digital HEC-RAS Files