Floodplain Mapping Analysis Report Farewell Heights Secondary Plan, Courtice

Municipality of Clarington

Floodplain Mapping Analysis Report Farewell Heights Secondary Plan, Courtice

Municipality of Clarington

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November 2024
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Distribution List

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-	Yes	Yes	Central Lake Ontario Conservation Authority (CLOCA)
-	Yes	Yes	Delta Urban

Record of Revisions

Revision	Date	Description
0	May 1, 2024	Initial Submission to Central Lake Ontario Conservation Authority
1	November 29, 2024	Final Phase 1 Submission to Municipality of Clarington and Farewell Heights Landowners Group

R.J. Burnside & Associates Limited

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1.0 Introduction

R.J. Burnside & Associates Limited (Burnside) has been retained by the Farewell Heights Landowners Group on behalf of the Municipality of Clarington to prepare a Floodplain Mapping Analysis Report in support of the Farewell Heights Secondary Plan being led by the Municipality of Clarington. The Secondary Plan Area (herein referred to as the subject lands) is generally located east of Tooley Road, south of Pebblestone Road, west of Courtice Road, and north of the Adelaide Avenue extension, in the community of Courtice, located within the Municipality of Clarington, Regional Municipality of Durham (Region). Figure 1 illustrates the location of the subject lands. The Secondary Plan Area is approximately 107 ha in size. The site is within the jurisdiction of Central Lake Ontario Conservation Authority (CLOCA) and the Ministry of the Environment, Conservation and Parks (MECP) - York-Durham District. Five tributaries of the Farewell Creek traverse the subject lands.

This report provides commentary and methodology used in the hydrological and hydraulic analysis for the floodplain limits delineation associated with the Farewell Creek tributaries within the site, in support of the future development of the Farewell Heights Secondary Plan Area.

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Client
TRUSTEE: FAREWELL HEIGHTS LANDOWNERS GROUP

FOR: MUNICIPALITY OF CLARINGTON

Project Name
FAREWELL HEIGHTS SECONDARY PLAN

Drawing Title
SITE LOCATION PLAN

Drawn	Checked	Date	Drawing No.
SF	JS	24/11/27	FIG1
Scale		Project No.	
N.T.S.		300056758	

File Name: 056758 - FIG1.dwg Date Plotted: November 27, 2024 - 10:27 AM

2.0 Background Information

To complete the floodplain analysis for the subject lands, the following background information was gathered, reviewed, and updated where applicable:

- Farewell Creek HEC-RAS Hydraulic Model, received from CLOCA
- Existing Watershed Visual OTTHYMO (VO) Hydrology Model for Farewell Creek, received from CLOCA
- Topographic Information:
  - Golden Horseshoe Digital Elevation Model DEM (dated 2002) was obtained from First Base Solutions. The vertical datum associated with the data is the CGVD-1928:1978. It should be noted that this topographic data is dated prior to the occurrence of some existing development in the study area, therefore additional topographic information was obtained to reflect the most recent changes in the study area.
  - Ontario Digital Terrain Model (DTM), derived from Light Direction and Ranging (LiDAR) topographic information provided by the Ministry of Natural Resources and Forestry (MNRF), were assembled by the Burnside GIS team. The original vertical datum associated with the data is the CGVD2013. The LiDAR has been adjusted and raised by 0.379 m to match the CGVD28, vertical datum associated with the DEM (2002). The offset difference was obtained from the COSINE Station Report (ID: 00820058015), closest station to the study area.
- Infrastructure inventory: Two culvert inventory surveys were completed by Burnside in September 2023 and March 2024 to collect the existing culverts information, located within the floodplain study area limits. The existing culverts information is summarized in Table 1. The elevation data were obtained through Laser Level measurements. Photos taken during the survey are attached in Appendix A for reference.

Table 1: Existing Structure Information

Structure ID	Structure Description	Upstream Invert Elevation (m)*	Downstream Invert Elevation (m)*	Embedment Depth (m)	Length (m)
Sherry Lane Culvert	0.6 m diameter Circular Culvert	144.04	144.08	0	9.89
George Reynolds Drive Culvert	1.8 m Span x 0.9 m Rise Concrete Box Culvert (2 barrels)	133.97	133.93	0.07 (west barrel) 0.13 (east barrel)	29

Structure ID	Structure Description	Upstream Invert Elevation (m)*	Downstream Invert Elevation (m)*	Embedment Depth (m)	Length (m)
Trulls Road Culvert	1.8 m Span x 0.9 m Rise Concrete Box Culvert	132.00	131.92	0.14	23.5
Devondale Street	1.7 m Span x 0.6 m Rise concrete Box Culvert	130.65	130.09	0	44

*Invert elevations are estimated from Laser level measurement relatively to a reference point on surface

3.0 Hydrology Analysis

The subject lands are located within the Farewell Creek watershed, part of the Black, Harmony and Farewell Creeks watershed. In order to update the HEC-RAS model to include the tributaries within the subject lands, the existing watershed hydrology VO model, obtained from CLOCA, was reviewed, and refined to reflect the discretized catchment characteristics within the subject lands.

3.1 Original Model Review

The original VO model included two land use scenarios, specifically, an existing conditions scenario and a future conditions scenario. The existing conditions land use scenario is dated 2005. The future land use scenario was then created using the existing scenario drainage areas but with updated input parameters to reflect proposed land uses per the Municipality of Clarington's and Oshawa's Official Plans.

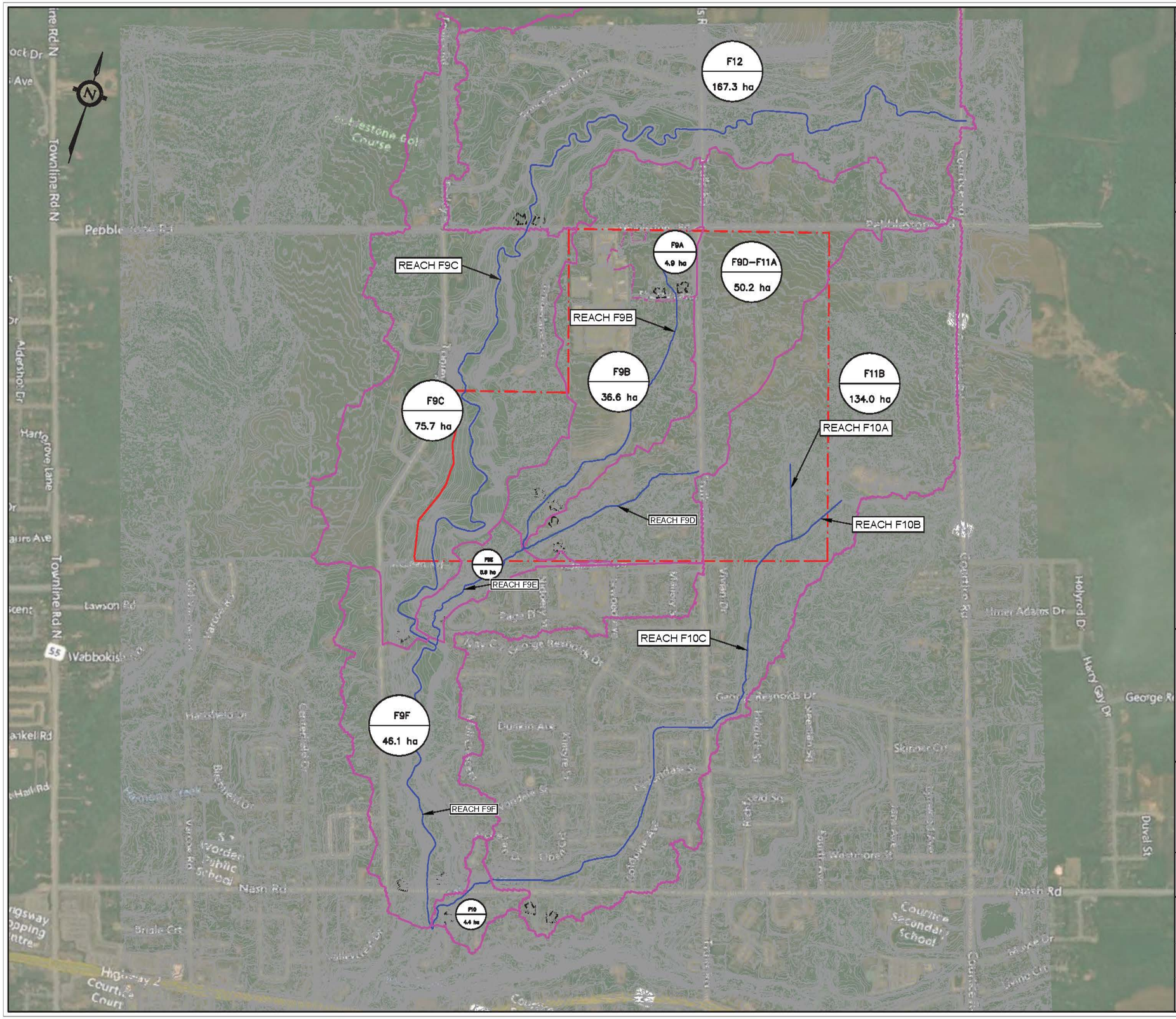
3.2 Model Parameters Revisions

As part of the background review, it was confirmed that the design flows used in the HEC-RAS model were those associated with the future land use scenario from the VO model. For this reason, only the future VO model scenario was revised, and the revised catchment parameters have been based on future land use conditions. The Farewell Heights Secondary Plan Land Use Option Map (dated November 2024), prepared by GHD, as well as the Future Land Use map, included in the Black, Harmony and Farewell Creeks Hydrologic Modelling Brief (dated June 5, 2015) were used to determine the catchment parameters. Specifically, the Secondary Plan Land Use Option Map has been used for the area within the subject lands, and the Future Land Use Map from the Black, Harmony and Farewell Creeks Hydrology Brief was used for the surrounding area. The figures are included in Appendix A for reference.

Drainage area catchments tributary to the subject lands were delineated based on the topographic information obtained. Catchments were further discretized within the subject lands. Figure 2 illustrates the refined existing drainage areas that were input into the updated model. Other parameters, such as percent impervious, SCS Curve Number, initial abstraction, and time to peak were adjusted accordingly. Table 2 summarizes the updated model catchment parameters. Detailed calculations are included in Appendix B for reference.

Table 2: Updated VO Model Parameters

Original Catchment ID	Original Area (ha)	Updated Catchment ID	Updated Area (ha)	VO Command	CN (II)	Ia (mm)	Tp (hrs)	TIMP (%)	XIMP (%)
F9	183.7	F9a	4.9	Standhyd	39	1.6	N/A	57	57
		F9b	36.6	Standhyd	58	4.8	N/A	24	23
		F9c	75.7	Nashyd	64	4.7	1.94	N/A	N/A
		F9e	5.9	Nashyd	68	8.4	0.69	N/A	N/A
		F9f	46.1	Nashyd	71	6.5	1.27	N/A	N/A
		F9d-F11a	50.2	Standhyd	55	4.6	N/A	25	25
F11	167.3								
		F11b	134.0	Standhyd	54	1.9	N/A	31	31
F10	4.37	F10	4.37	Standhyd	69	2.5	N/A	40	30
F12	169.3	F12	167.3	Nashyd	66	5.8	1.79	N/A	N/A



KEY PLAN
SCALE: N.T.S.

Notes

1. The contractor shall verify all dimensions, levels, and datums on site and report any discrepancies or omissions to this office prior to construction.
2. This drawing is to be read and understood in conjunction with all other plans and documents applicable to this project.

LEGEND:

- SITE PROPERTY LINE
- CATCHMENT AREAS
- OVERLAND FLOW ROUTE
- DRAINAGE AREA NUMBER
- F9F / 49.1 ha — DRAINAGE AREA (ha)
- RIVER REACHES

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Client
TRUSTEE: FAREWELL HEIGHTS LANDOWNERS GROUP

FOR: MUNICIPALITY OF CLARINGTON

Project Name
FAREWELL HEIGHTS SECONDARY PLAN

Drawing Title
EXISTING DRAINAGE CONDITIONS

Drawn	Checked	Date	Drawing No.
SF	JS	24/11/27	**FIG2**
Scale		Project No.	
1:12000		300056758	

File Name: 056758 - FIG2.dwg Date Plotted: November 27, 2024 - 11:54 AM

3.3 Updated Model Results

As part of the analysis, the updated future 100-year and Regional scenarios were run to confirm updated peak flow value inputs into the HEC-RAS model. Table 3 below summarizes the resulting peak flows at various locations within and in the vicinity of the subject lands.

Table 3: Updated VO Model Peak Flow Results

Reach	Location	VO Command ID	Drainage Area (ha)	Future 100-year Flow (m^3/s)	Future Regional Flow (m^3/s)
F9c West Reach	Pebblestone Road, northwest of subject lands	18	2651.27	46.89	180.63
	Approximately 250 m south of Adelaide Avenue	19	2726.97	47.604	184.125
F9b Middle Reach	Sherry Lane	73	4.9	1.819	0.595
	North of Adelaide Avenue	68	41.5	8.055	5.056
F9d Middle Reach	North of Adelaide Avenue	76	50.2	8.769	6.002
F9e Reach (downstream of confluence of Reaches F9b and F9d)	Approximately 250 m south of Adelaide Avenue	84	97.6	14.572	11.461
F9f Reach (south of subject lands)	North of Nash Road	72	2870.67	48.346	187.571
F10c Reach	Approximately 100 m south of Nash Road	20	138.37	22.931	16.023

In order to estimate the peak flows for Reaches F10a and F10b, which are located within the subject lands, east of Trulls Road, the total flows from Catchment F11b were prorated based on the drainage area and associated percent impervious to each reach. The peak flow results are summarized in Table 4 and the detailed calculation is included in Appendix B for reference.

Table 4: Prorated Peak Flow Results for Reaches F10a and F10b

Catchment	Drainage Area (ha)	Total Percent Impervious (%)	Future 100-year Flow (m^3/s)	Future Regional Flow (m^3/s)
Draining to Reach F10a	25.0	7	1.35	0.81
Draining to Reach F10b	19.6	7	1.06	0.64

4.0 Hydraulic Analysis

The Black, Harmony and Farewell Creeks HEC-RAS model was obtained from CLOCA. Upon review, it was confirmed that only the floodplain of the west tributary of Farewell Creek had been mapped while the remaining four tributary branches within the subject lands had not been mapped. The HEC-RAS model was therefore updated to include the remaining four unmapped tributary branches. Flow data information input into the HEC-RAS model were based on the updated hydrology model discussed in the previous section.

A number of input information is required in the application of the HEC-RAS model for the floodplain analysis. These include:

- Cross-section geometry information (including geometry, downstream reach lengths, identification of right / left overbanks, etc.)
- Hydraulic structures information (including sizes, lengths, inverts, embedment depths, etc.)
- Hydraulic Parameters (including manning's roughness, expansion / contraction coefficients, etc.)
- Boundary Conditions (including downstream known water surface elevation)

4.1 Cross-Sections

Floodplain boundaries and the lateral extension of flows along a natural stream are controlled by the topographic relief within which the stream flows. This relief is quantified in terms of ground surface elevations and / or contours. For utilization in the HEC-RAS program, it was necessary to convert this topographic relief into its geometric configuration represented by cross-sections of the valley taken perpendicular to the direction of flow. Furthermore, it was necessary to represent the linear topographic relief and variability by drawing repetitive cross-sections at various intervals throughout the length of the valley systems. The distance between the cross-sections required to represent the valley system is referred to as the reach length.

For the selection of digitized cross-sections which are representative of the watercourse and floodplain of the added tributaries of Farewell Creek, identified as Reach F9b, Reach F9d, Reach F9e, Reach F10a, Reach F10b and extension of Reach F10c (original CLOCA ID: F10), the following criteria were used.

4.1.1 Location and Orientation of Cross-Sections

A terrain was generated from the surface imported into HEC-RAS using the RAS Mapper tool. The digitized cross-sections were cut from the terrain in RAS Mapper from left to right looking in a downstream direction for the added tributaries. Cross-sections have been cut at key locations described below:

- Changes in channel and / or valley cross-sectional shape
- Rapid changes in channel or valley slope
- Significant changes in channel or valley roughness
- Upstream and downstream of bridges / culverts
- At all defined control points
- Upstream and downstream of all channel confluences

4.1.2 Determination of Reach Length

The reach lengths were computed based on the estimated direction of flow along the low flow channel and along the centroid of water moving through the floodplain. For each added reach, a minimum of three paths were drawn in RAS Mapper, defining the channel and right and left overbank flow paths. For the selection of the reach length direction, the topographic relief was analyzed to interpret the direction of flow in the particular reach of the watercourse.

4.2 Hydraulic Structures and Computation Routines

Hydraulic structures such as bridges, culverts and roadways have the greatest potential to change the flood elevation for a given reach assuming a constant flow. The location, orientation, elevation, and inlet / outlet characteristics of the culverts within the study area have been coded in based on the culvert information provided by the surveys completed by Burnside in September 2023 and March 2024. Please refer to Section 2 for the detailed culverts information.

In accordance with the HEC-RAS User's Manual, a minimum of four cross-sections have been applied to each culvert.

4.3 Hydraulic Parameters

Coefficients used in the model to evaluate head losses are as follows:

- Manning's n values are used to compute flow friction losses and have been referenced from Table 3-1 and Table 6-1 of the HEC-RAS Hydraulic Reference Manual.
- Embedded culvert structures have varying Manning's n values for their top and bottom. The top value was selected based on the structure material and the bottom was input as 0.035 to represent the stream bed.

- Contraction and expansion coefficients for the study area floodplains have been set at 0.1 and 0.3 respectively for all areas. For culvert sections, contraction and expansion coefficients have been estimated at 0.3 and 0.5 respectively, at the first two cross-sections upstream of the crossing, as well as the first cross-section downstream of the crossing.

4.4 Boundary Conditions

The downstream boundary conditions for the HEC-RAS hydraulic model directly influence the water surface profiles of the individual reaches of the study area. The known water surface elevation used in the updated model was maintained at 74.77 m, as in the original model received from CLOCA. This elevation corresponds to the mean annual water level for Lake Ontario at the outlet of Black, Harmony and Farewell Creek Creeks watershed, as per the Floodplain Mapping Study Report, associated with the HEC-RAS model provided by CLOCA.

4.5 Modelling Assumptions

The following modelling assumptions were made as part of the analysis completed.

- Flow data were input based on the future land use uncontrolled hydrology model scenario results for the 100-year and Regional events
- Manning's n values were assigned for each land use as per the following

Table 5: Manning's n Values per Land Use

Land Use	Manning's n
Main Channel	0.035
Pasture/Cultivated Area	0.05
Woodland/Dense Brush	0.08
Concrete/Asphalt	0.013

4.6 Hydraulic Model Results

The original CLOCA model generated floodline results using the Mixed Flow Regime. The updated HEC-RAS model was therefore run using the Mixed Flow Regime; however, the updated model was also run using the Subcritical Flow Regime. The results from both runs were compared and reviewed. With the exception of a few locations where the subcritical run generated slightly higher water surface elevations, the results indicated both flow regimes produced generally the same water surface elevations.

HEC-RAS output tables have been included in Appendix C of this report for both the original CLOCA model and the updated model. Since the subcritical run generated the most conservative results (i.e., highest water surface elevations), the subcritical flow

regime was used to general the floodplain. The mixed flow regime run is included in Appendix C for reference. Table 6 below summarizes the 100-year and Regional water surface elevations at flow change locations and within the subject lands.

Table 6: HEC-RAS Model Water Surface Elevation Results

Reach	Location	HEC-RAS Cross Section ID	Flows (m^3/s)*		100-year Water Elevation (masl)			Regional Water Elevation (masl)		
			Future 100-yr	Future Regional	Original Model Future (Mixed Flow Regime Run)	Original Model Future (Subcritical Run)	Updated Model Future (Subcritical Run)	Original Model Future (Mixed Flow Regime Run)	Original Model Future (Subcritical Run)	Updated Model Future (Subcritical Run)
West Reach F9c**	Courtice Road (northeast of Subject Lands)	5320.135	46.89	180.63	148.32	148.32	148.29	150.19	150.20	150.19
	Pebblestone Road (northwest of Subject Lands)	3076.132	47.60	184.13	140.98	140.91	140.88	142.48	142.49	142.45
	Subject Lands	2358.700	47.60	184.13	136.83	136.82	136.69	138.35	138.35	138.17
		2183.293			135.33	135.33	135.41	136.09	136.63	136.59
		2057.916			134.33	134.33	134.08	135.88	135.88	135.83
		1914.734			133.85	133.85	133.82	135.17	135.17	135.13
		1744.457			133.58	133.58	133.56	135.07	135.07	135.03
		1609.319			133.15	133.15	133.13	134.68	134.68	134.65
		1529.355			132.87	132.85	132.88	134.19	134.19	134.27
Middle Reach F9b	Subject Lands	11114.35	1.82	0.60	-	-	144.71	-	-	144.62
		11114.32			-	-	144.70	-	-	144.61
		11114.3			-	-	144.69	-	-	144.61
		11114.2			-	-	144.68	-	-	144.51
		11114.1			-	-	144.60	-	-	144.46
		10065.55	8.06	5.06	-	-	144.20	-	-	144.11
		10065.5			-	-	143.33	-	-	143.23
		9990			-	-	142.89	-	-	142.78
		9745			-	-	142.46	-	-	142.40
		9500			-	-	141.85	-	-	141.80
		9358.08			-	-	141.45	-	-	141.36
		9200			-	-	140.38	-	-	140.30
		9104.84			-	-	139.20	-	-	139.12
		9104.838			-	-	138.77	-	-	138.66
		9104.8			-	-	138.45	-	-	138.38
		9103.71			-	-	137.59	-	-	137.50
		9098.22			-	-	136.53	-	-	136.45
		8899.56			-	-	135.87	-	-	135.76
		8898.47			-	-	135.35	-	-	135.23
		8897.37			-	-	134.93	-	-	134.85

Reach	Location	HEC-RAS Cross Section ID	Flows (m^3/s)*		100-year Water Elevation (masl)			Regional Water Elevation (masl)		
			Future 100-yr	Future Regional	Original Model Future (Mixed Flow Regime Run)	Original Model Future (Subcritical Run)	Updated Model Future (Subcritical Run)	Original Model Future (Mixed Flow Regime Run)	Original Model Future (Subcritical Run)	Updated Model Future (Subcritical Run)
Middle Reach F9d	Subject Lands	9200	8.77	6.00	-	-	140.93	-	-	140.82
		9104.84			-	-	140.13	-	-	140.10
		9103.74			-	-	139.59	-	-	139.53
		9103.71			-	-	138.69	-	-	138.61
		9103.60			-	-	138.19	-	-	138.14
		9102.54			-	-	137.98	-	-	137.88
		9100.31			-	-	137.77	-	-	137.67
		8898.47			-	-	137.01	-	-	136.90
		8898.466			-	-	136.08	-	-	135.99
		8898.4			-	-	135.43	-	-	135.35
		8896.28			-	-	135.04	-	-	134.95
Reach F9e (downstream of confluence of Reaches F9b and F9d)	Subject Lands	8894.10	14.57	11.46	-	-	134.83	-	-	134.75
		8894.092			-	-	134.75	-	-	134.66
		8894.09			-	-	134.43	-	-	134.36
		8886.49			-	-	134.29	-	-	134.22
		8530.47			-	-	133.58	-	-	133.50
	South of Subject Lands	8515.13			-	-	132.61	-	-	132.53
		8503.16			-	-	131.99	-	-	131.91
		8282.69			-	-	130.91	-	-	130.90
		8281.61			-	-	130.47	-	-	130.86
		8170			-	-	129.41	-	-	130.92
Reach F9f (south of subject lands)**	South of Subject Lands	3400***	48.35	187.57	129.01	129.01	129.12	129.76	130.20	130.19
East Reach F10a	Subject Lands	9254.3	1.35	0.81	-	-	141.14	-	-	141.00
		9217.82			-	-	140.50	-	-	140.40
		9203.28			-	-	140.07	-	-	139.94
		9196.19			-	-	139.91	-	-	139.77
		9151.47			-	-	139.49	-	-	139.39
East Reach F10b	Subject Lands	9301.79	1.06	0.64	-	-	139.59	-	-	139.56
		9234.48			-	-	138.92	-	-	138.87
		9173.1			-	-	138.67	-	-	138.63

Reach	Location	HEC-RAS Cross Section ID	Flows (m^3/s)*		100-year Water Elevation (masl)			Regional Water Elevation (masl)		
			Future 100-yr	Future Regional	Original Model Future (Mixed Flow Regime Run)	Original Model Future (Subcritical Run)	Updated Model Future (Subcritical Run)	Original Model Future (Mixed Flow Regime Run)	Original Model Future (Subcritical Run)	Updated Model Future (Subcritical Run)
East Reach F10c		1960.69	22.93	16.02	-	-	138.16	-	-	138.07
		1948.7			-	-	137.94	-	-	137.85
		1930			-	-	137.71	-	-	137.62
	South of Subject Lands	1900			-	-	137.47	-	-	137.33
		1844.23			-	-	137.43	-	-	137.29
		1733.27			-	-	137.39	-	-	137.26
		1700			-	-	137.38	-	-	137.25

*Based on VO Model Updated by Burnside
**Name of Original Model River: F9
***ID of Original Model Cross Section: 1036.199

The floodplain limits within the subject lands were mapped, using the RAS Mapper tool, for the 100-year and Regional Storm events. It should be noted that the floodplain associated with the west reach already included in the original CLOCA model has been mapped using the 2002 topographic information obtained from First Base Solutions since the original CLOCA model cross sections haven't been re-cut from the updated terrain. The floodplain associated with the newly mapped tributary branches are mapped based on the 2018 Lidar topographic information, which have been adjusted as described in Section 2.0 to to match the CGVD28 vertical datum used in the original comprehensive Hec-RAS model. Please refer to the Floodplain Mapping drawings FP1 and FP2 included in Appendix D.

5.0 Recommendations and Conclusions

The hydraulic analysis presented herein has been completed in support of the Farewell Heights Secondary Plan Area being led by the municipality of Clarington. The methodology, analysis and results outlined in this report have been based on the best available information and correspondence at the time of preparing this report. The CLOCA existing hydrology and hydraulic models, topographic data and available background information have been collected for the study. Two field surveys were conducted to assess the hydraulic structures present on site to support the modelling. The hydrologic analysis completed included review and revisions to the original VO model obtained from CLOCA. The updated hydrology model confirmed the peak flows to be used in the HEC-RAS model. The original HEC-RAS model, obtained from CLOCA, was also reviewed, and revised to reflect the hydrology model revisions and include the unmapped tributaries.

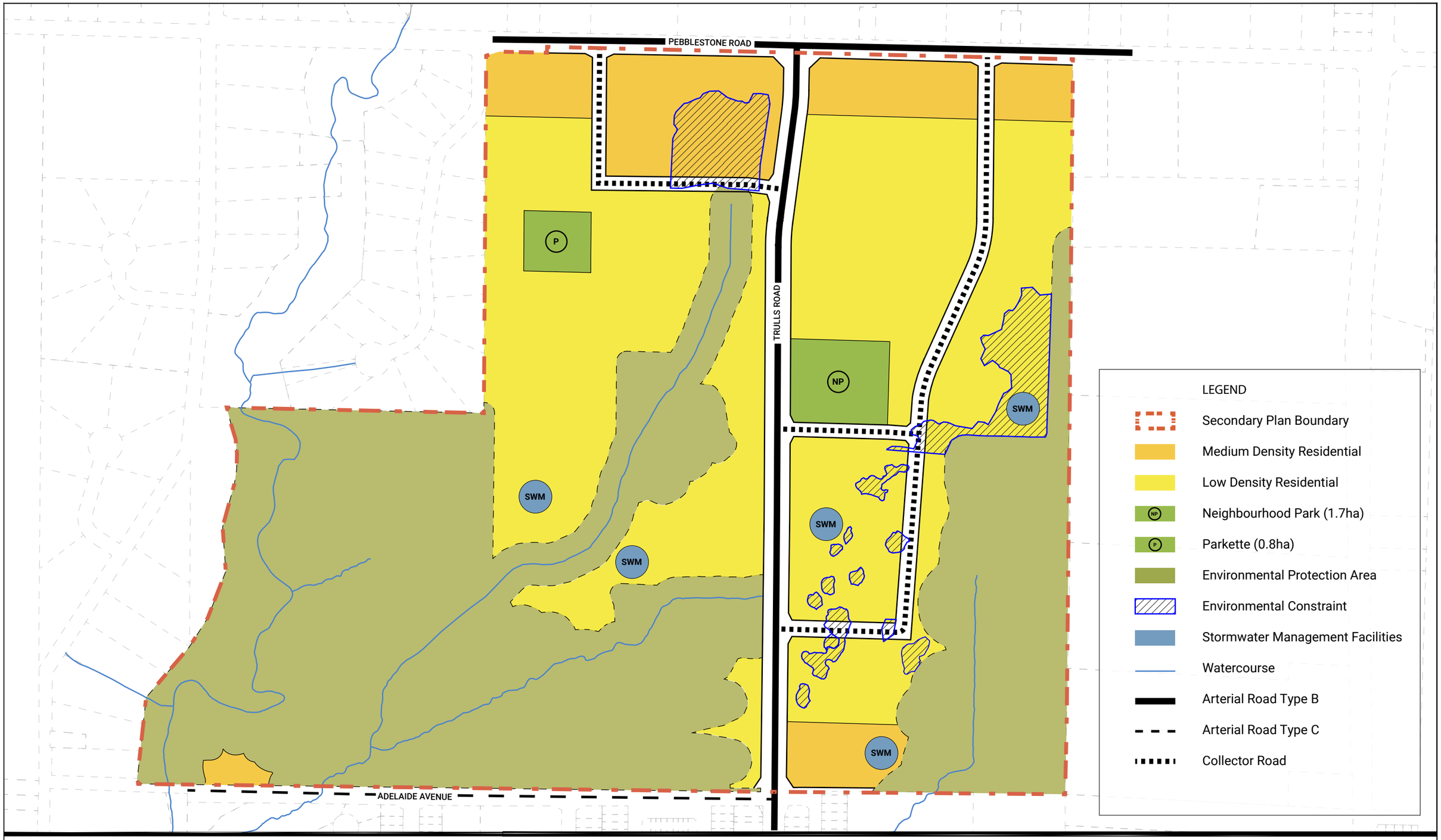
The floodline limits for the 100-year and Regional storm events within the subject lands, resulting from the hydraulic model analysis were mapped and are included in the Floodplain Mapping drawings FP1 and FP2 attached in Appendix D.

BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix A

Background Information



FAREWELL HEIGHTS SECONDARY PLAN - LAND USE OPTION

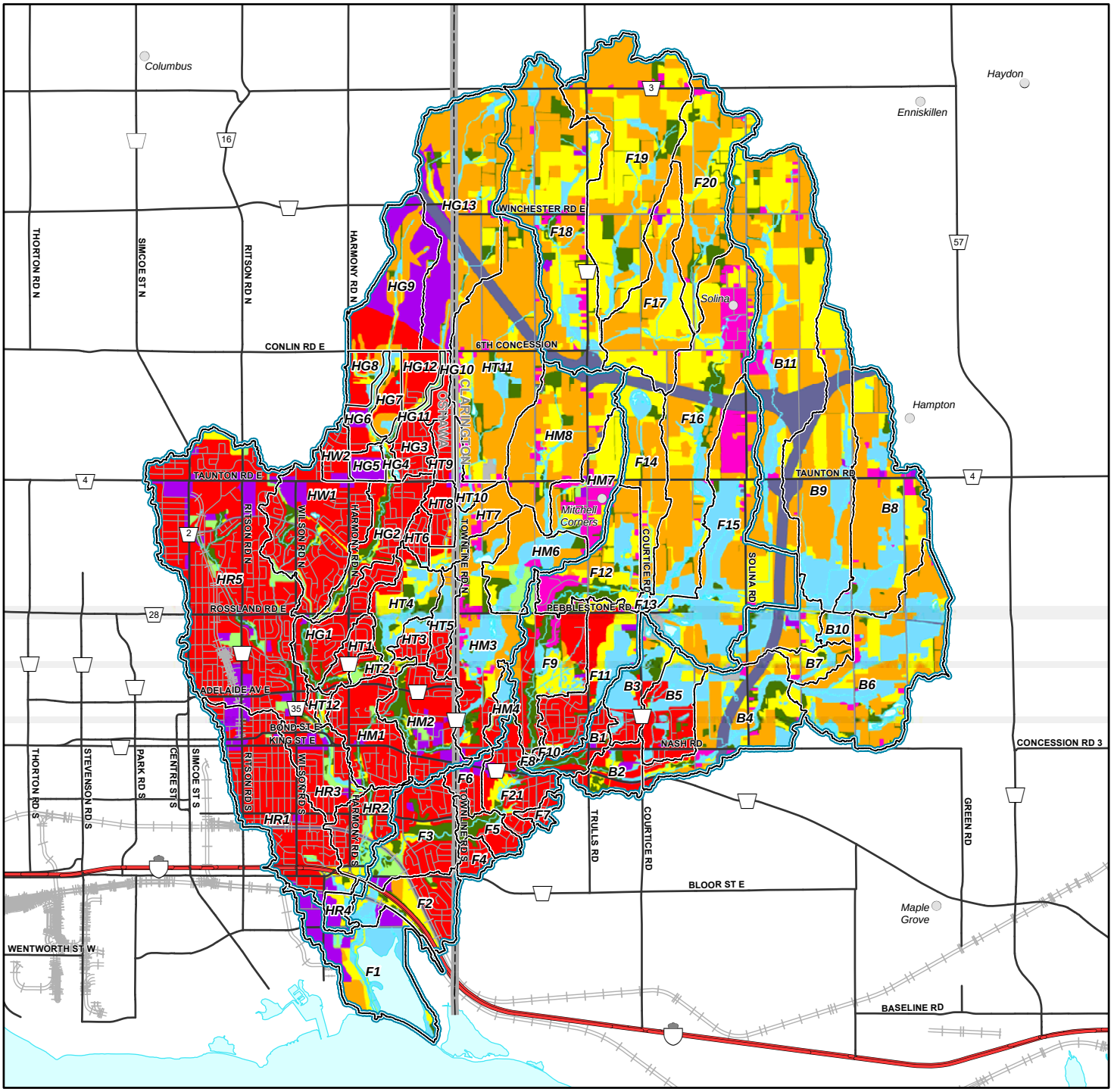
N

FAREWELL HEIGHTS LANDOWNERS GROUP

Project No. **11227682**
Revision
Date **NOV 2024**

GHD

File Location G:\662\11227682\Tech\Planning\Secondary Plan Land Use Map\Illustrator Files



Legend

- Catchment
- Creek

Future Land Use

- Crop & Improved
- Industrial & Commercial
- Landfill & Aggregate
- Lakes & Wetland
- Manicured Greenspace
- Pasture & Unimproved
- Rural Residential
- Transportation & Utility
- Urban Residential
- Woodlots & Forest

Black/Harmony/Farewell Creek Watershed

Future Land Use

0 0.5 1 2 3 4

Kilometres

Map Compiled by the Central Lake Ontario Conservation Authority: 100 Whiting Ave., Oshawa, Ontario, L1H 3T3

This map is for information purposes only and the Central Lake Ontario Conservation Authority takes no responsibility for, nor guarantees, the accuracy of all the information contained within the map.

Source: CLOCA, 2009; MNR, 2009; Regional Municipality of Durham, 2009.

Burnside Culverts Survey Photos

Sherry Lane Culvert North Side (upstream inlet)

Sherry Lane Culvert South Side (downstream outlet)

George Reynolds Drive Culvert North Side (upstream inlet)

George Reynolds Drive Culvert South Side (downstream outlet)

Trulls Road Culvert East Side (upstream inlet)

Trulls Road Culvert West Side (downstream outlet)

Devondale Street Culvert North Side (upstream inlet)

Devondale Street Culvert South Side (downstream outlet)

BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

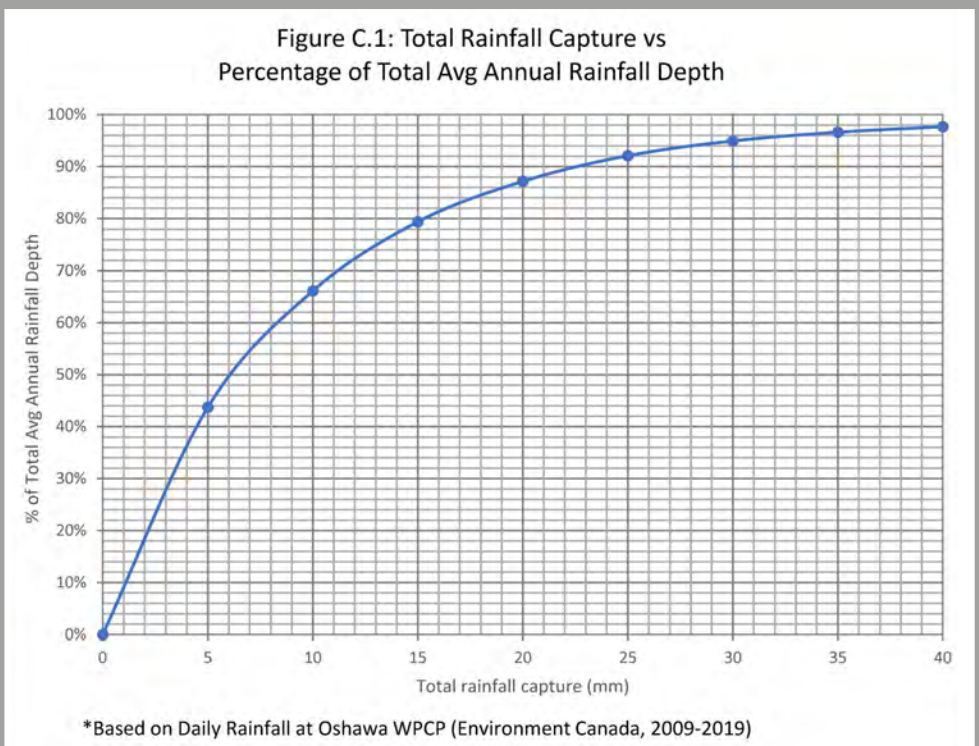
Appendix B

Hydrology Model Parameters and Results

TOTAL IMPERVIOUS / DIRECTLY CONNECTED IMPERVIOUS VALUES[1]

Landuse and Description	TIMP	XIMP
Parks/Open Space	0%	0%
Low-density Residential	45%	45%
Medium-density Residential	60%	60%
High-density Residential	80%	80%
Industrial/Commercial/Institutional	90%	90%
Urban Residential – Mixed Use	90%	90%
Transportation/Utility – Parking Lot	90%	90%
Transportation/Utility – Corridor	50%	50%
Transportation/Utility – Greenspace	0%	0%
Transportation/Utility – Utility Transfer Station	90%	90%
Landfill/Aggregate	50%	50%
Gravel Areas	90%	90%

[1] *CLOCA's typical imperviousness values used for watershed studies.*



Project Name: Farewell Heights Secondary Plan
Project No: 900056758.1000
Location: Municipality of Clarington
Designer: SF
Date: 23-Aug-2023
Date Modified: 28-Nov-2024

SCS Curve Number, Initial Abstraction, and Time of Concentration Reference Sheet

SCS Curve Number (AMCII) Data - for NasHyd

Land Use	Hdyrologic Soils Group						
	A	AB	B	BC	C	CD	D
Crop & Improved	66	70	74	78	82	84	86
Pasture & Unimproved	58	62	65	71	76	79	81
Urban Residential	77	81	85	88	90	91	92
Rural Residential	51	60	68	74	79	82	84
Industrial & Commercial	85	88	90	92	93	94	94
Wetland	50	50	50	50	50	50	50
Woodlot & Forest	36	48	60	67	73	76	79
Manicured Greenspace	39	50	61	68	74	77	80
Landfill and Aggregate	50	50	50	50	50	50	50
Transportation & Utility	98	98	98	98	98	98	98

CN (I)= 4.2CN(II)/(10-0.058CN(II)) CN (III)= 23CN(II)/(10+0.13CN(II))

Source: US Soil Conservation Services, US Department of Agriculture, MTO Drainage Manual

SCS Curve Number (AMCII) Data - for standHyd

Land Use	Hdyrologic Soils Group						
	A	AB	B	BC	C	CD	D
Crop & Improved	66	70	74	78	82	84	86
Pasture & Unimproved	58	62	65	71	76	79	81
Urban Residential	39	50	61	68	74	77	80
Rural Residential	39	50	61	68	74	77	80
Industrial & Commercial	58	62	65	71	76	78	80
Wetland	50	50	50	50	50	50	50
Woodlot & Forest	50	54	58	65	71	74	79
Manicured Greenspace	39	50	61	68	74	77	80
Landfill and Aggregate	50	50	50	50	50	50	50
Transportation & Utility	58	62	65	71	76	79	81

CN (I)= 4.2CN(II)/(10-0.058CN(II)) CN (III)= 23CN(II)/(10+0.13CN(II))

Source: US Soil Conservation Services, US Department of Agriculture, MTO Drainage Manual

Project Name: Farewell Heights Secondary Plan
Project No: 900056758.1000
Location: Municipality of Clarington
Designer: SF
Date: 23-Aug-2023
Date Modified: 27-Nov-2024

Runoff Coefficient Data

Land Use	Hdyrologic Soils Group						
	A	AB	B	BC	C	CD	D
Crop & Improved	0.3	0.39	0.48	0.57	0.65	0.71	0.76
Pasture & Unimproved	0.09	0.15	0.2	0.25	0.29	0.32	0.34
Urban Residential	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Rural Residential	0.19	0.2	0.21	0.23	0.25	0.27	0.29
Industrial & Commercial	0.7	0.7	0.7	0.71	0.71	0.71	0.71
Wetland	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Woodlot & Forest	0.07	0.09	0.11	0.12	0.13	0.14	0.15
Manicured Greenspace	0.12	0.14	0.16	0.18	0.19	0.22	0.24
Landfill and Aggregate	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Transportation & Utility	0.9	0.9	0.9	0.9	0.9	0.9	0.9

Source: MTO Drainage Manual, Maryland State Highway Administration

Initial Abstraction Data

Land Use	Initial Abstraction
Crop & Improved	7
Industrial & Commercial	1.5
Landfill & Aggregate	10
Lakes and Wetlands	0
Manicured Greenspace	5
Pasture & Unimproved	8
Rural Residential	1.5
Transportation & Utility	1.5
Urban Residential	1.5
Woodlot & Forest	10

Percent Impervious Data

Land Use	Total (%)	Connected (%)
Crop & Improved	0%	0%
Industrial & Commercial	85%	85%
Landfill & Aggregate	50%	0%
Lakes and Wetlands	0%	0%
Manicured Greenspace	0%	0%
Pasture & Unimproved	0%	0%
Rural Residential	20%	10%
Transportation & Utility	50%	25%
Urban Residential - Low Density	45%	45%
Urban Residential - Medium Density	60%	60%
Woodlot & Forest	0%	0%

Project Name: Farewell Heights Secondary Plan
Project No: 900056758.1000
Location: Municipality of Clarington
Designer: SF
Date: 23-Aug-2023
Date Modified: 27-Nov-2024

Estimating Travel Velocity Using Bransby Williams and Aiport Method

Bransby Williams Formula - For 'C' greater than or equal to 0.40

$$t_c = \frac{0.057 * L}{S^{0.2} * A^{0.1}}$$

t_c = Time of Concentration
L = Length of Longest Flow Pat
S = Slope
A = Catchment Area

Airport Formula - For 'C' less than 0.40

$$t_c = \frac{3.26 * (1.1 - C) * L^{0.5}}{S^{0.33}}$$

t_c = Time of Concentration
L = Length of Longest Flow Pat
S = Slope

C = Runoff Coefficient

Estimating Travel Velocity Using Uplands Method

$V = (x)(S)^{0.5}$ (Refer to Fig 3.12 Velocities for Upland method for estimating travel time for overland flow)

V= Velocity
S= Slope
x = Land Cover Coefficient **(see below)**

x =	0.6	Forest with Heavy Ground Litter, hay meadow (overland flow)
	1.5	Trash Fallow or Minimum Tillage cultivation, strip cropped woodland(overland flow)
	2.3	Short grass pasture (overland flow)
	2.7	Cultivated Straight row (overland flow)
	3.0	Nearly bare untilled (overland flow) or alluvial fans located in the Western mountain Regions
	4.6	Grassed Waterway
	6.1	Paved Areas (sheet flow); small upland gullies

Time of Concentration for One Land Use on Flow Path

$Tc_1 = L_1 / V_1$ $Tp_1 = 0.67 \times Tc_1$

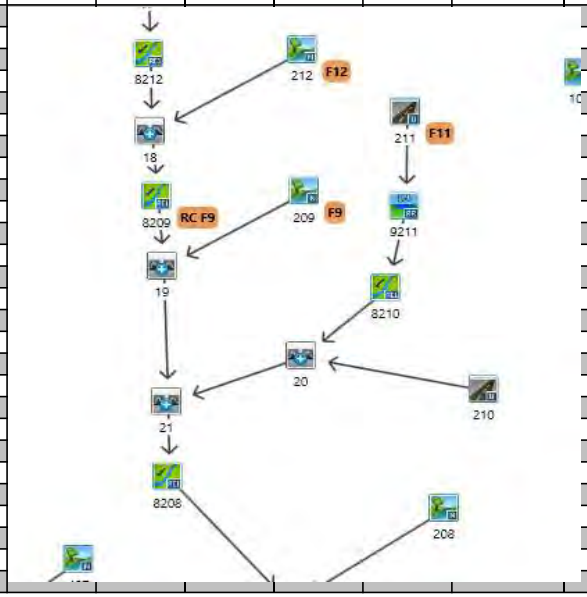
Total Time of Concentration for Multiple Land Uses on Flow Path

$Tc_{total} = Tc_1 + Tc_2 + Tc_3 + Tc_4 + Tc_5$ $Tp_{total} = Tp_1 + Tp_2 + Tp_3 + Tp_4 + Tp_5$

Project Name: Farewell Heights Secondary Plan
Project No: 900056758.1000
Location: Municipality of Clarington
Designer: SF
Date: 8/23/2023
Date Modified: 11/28/2024

VO INPUT TABLE - Original Model - Future Scenario

AREA No.	VO Command	AREA (ha)	CN (II)	CN (III)	TIMP (%)	XIMP (%)	Tp (hr)	laper (mm)	SLPP (%)	LGP (m)	MNP	laimp (mm)	SLPI (%)	LGI (m)	MNI
F9	NasHyd	183.7	69	84	N/A	N/A	1.82	4.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F11	StandHyd	167.3	54	73	26%	20%	N/A	2.8	0.8	40	0.25	1.0	2.0	1056	0.013
F12	NasHyd	169.3	66	82	N/A	N/A	1.79	5.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F10	StandHyd	4.37	69	84	40%	30%	N/A	2.5	3.7	40	0.25	1.0	2.0	171	0.013

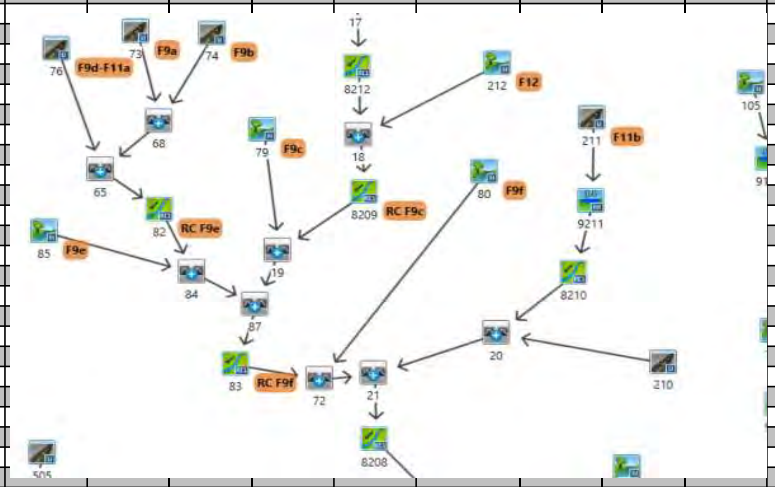


AREA The total catchment area (ha)
CN (II)/CN(III) The composite SCS Curve Number for NASHYD commands, and the pervious SCS Curve Number for STANDHYD commands
XIMP The ratio of the directly connected impervious area
TIMP The ratio of the total impervious area
Tp The time of peak of the unit hydrograph (hrs)
laper The composite intital abstraction for NASHYD commands, and the pervious intial abstraction for STANDHYD commands (mm)
SLPP The average pervious surface slope over which runoff travels (%)
LGP The average lot depth or pervious length over which surface water travels along the longest flow path (m)
MNP The representative roughness coefficient for the pervious surface over which water travels before reaching the street or sewer system
laimp The impervious intial abstraction for STANDHYD commands (mm)
SLPI The average impervious surface slope over which runoff travels (%)
LGI The impervious travel length of the longest flow path (m)
MNI The average roughness coefficient for the impervious surface over which water travels

Project Name: Farewell Heights Secondary Plan
Project No: 900056758.1000
Location: Municipality of Clarington
Designer: SF
Date: 8/23/2023
Date Modified: 11/28/2024

VO INPUT TABLE - RJB Updated Model - Future Scenario

AREA No.	VO Command	AREA (ha)	CN (II)	CN (III)	TIMP (%)	XIMP (%)	Tp (hr)	laper (mm)	SLPP (%)	LGP (m)	MNP	laimp (mm)	SLPI (%)	LGI (m)	MNI
F9a	StandHyd	4.9	39	60	57%	57%	N/A	1.6	1.0	40	0.25	1.0	2.0	181	0.013
F9b	StandHyd	36.6	58	76	24%	23%	N/A	4.8	1.0	40	0.25	1.0	2.0	494	0.013
F9c	NasHyd	75.7	64	80	N/A	N/A	1.94	4.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F9d-F11a	StandHyd	50.2	55	74	25%	25%	N/A	4.6	1.0	40	0.25	1.0	2.0	579	0.013
F9e	NasHyd	5.9	68	83	N/A	N/A	0.69	8.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F9f	NasHyd	46.1	71	85	N/A	N/A	1.27	6.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F11b	StandHyd	134.0	54	73	31%	31%	N/A	1.9	0.8	40	0.25	1.0	2.0	945	0.013
F12	NasHyd	167.3	66	82	N/A	N/A	1.79	5.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F10	StandHyd	4.37	69	84	40%	30%	N/A	2.5	3.7	40	0.25	1.0	2.0	171	0.013



AREA The total catchment area (ha)
CN (II)/CN(III) The composite SCS Curve Number for NASHYD commands, and the pervious SCS Curve Number for STANDHYD commands
XIMP The ratio of the directly connected impervious area
TIMP The ratio of the total impervious area
Tp The time of peak of the unit hydrograph (hrs)
laper The composite intital abstraction for NASHYD commands, and the pervious intial abstraction for STANDHYD commands (mm)
SLPP The average pervious surface slope over which runoff travels (%)
LGP The average lot depth or pervious length over which surface water travels along the longest flow path (m)
MNP The representative roughness coefficient for the pervious surface over which water travels before reaching the street or sewer system
laimp The impervious intial abstraction for STANDHYD commands (mm)
SLPI The average impervious surface slope over which runoff travels (%)
LGI The impervious travel length of the longest flow path (m)
MNI The average roughness coefficient for the impervious surface over which water travels

Project Name:	Farewell Heights Secondary Plan
Project No.:	900056758.1000
Location:	Municipality of Clarington
Designed By:	SF
Checked By:	JS
Date Created:	23-Aug-2023
Date Modified:	28-Nov-2024

VO STANDHYD Hydrologic Modeling Parameters - Urban Land Use

CATCHMENT: **F9a**

Composite Curve Number

Land Use	Hdyrologic Soils Group						
	A	AB	B	BC	C	CD	D
Crop & Improved							
Pasture & Unimproved	0.1						
Urban Residential	4.8						
Rural Residential							
Industrial & Commercial							
Wetland							
Woodlot & Forest							
Manicured Greenspace/Parks							
Landfill and Aggregate							
Transportation & Utility//Right-of-Way							

Total area (ha): 4.9

Pervious CN (AMCI): 21
Pervious CN (AMCII): 39
Pervious CN (AMCIII): 60

Slope and Initial Abstraction

Pervious Area		Impervious Area	
Length (m)	40	Length (m)	180.74
h_1 (m)		h_1 (m)	
h_2 (m)		h_2 (m)	
Δh (m)		Δh (m)	
Slope (%)	1.0	Slope (%)	2.0
Ia (mm)	1.6	Ia (mm)	1.0
Manning's n	0.25	Manning's n	0.013

TIMP & XIMP

Land Use	Area (ha)
Crop & Improved	0
Industrial & Commercial	0
Landfill & Aggregate	0
Lakes and Wetlands	0
Manicured Greenspace/Parks	0
Pasture & Unimproved	0.1
Rural Residential	0
Transportation & Utility/Right-of-Way	0
Urban Residential - Low Density	0.5
Urban Residential - Medium Density	4.3
Woodlot & Forest	0

Total area (ha): 4.9
TIMP (%): 57%
XIMP (%): 57%

Project Name: Farewell Heights Secondary Plan
Project No.: 900056758.1000
Location: Municipality of Clarington
Designed By: SF
Checked By: JS
Date Created: 23-Aug-2023
Date Modified: 28-Nov-2024

VO STANDHYD Hydrologic Modeling Parameters - Urban Land Use

CATCHMENT: **F9b**

Composite Curve Number

Land Use	Hdyrologic Soils Group						
	A	AB	B	BC	C	CD	D
Crop & Improved							
Pasture & Unimproved	3.0		8.8				
Urban Residential	4.2		13.7				
Rural Residential	0.2		1.0				
Industrial & Commercial							
Wetland							
Woodlot & Forest	5.0						
Manicured Greenspace/Parks			0.8				
Landfill and Aggregate							
Transportation & Utility/Right-of-way							

Total area (ha): 36.6

Pervious CN (AMCI): 36
Pervious CN (AMCII): 58
Pervious CN (AMCIII): 76

Slope and Initial Abstraction

Pervious Area		Impervious Area	
Length (m)	40	Length (m)	493.96
h_1 (m)		h_1 (m)	
h_2 (m)		h_2 (m)	
Δh (m)		Δh (m)	
Slope (%)	1.0	Slope (%)	2.0
Ia (mm)	4.8	Ia (mm)	1.0
Manning's n	0.25	Manning's n	0.013

TIMP & XIMP

Land Use	Area (ha)
Crop & Improved	0
Industrial & Commercial	0
Landfill & Aggregate	0
Lakes and Wetlands	0
Manicured Greenspace/Parks	0.8
Pasture & Unimproved	11.8
Rural Residential	1.2
Transportation & Utility/Right-of-Way	0.0
Urban Residential-Low Density	15.2
Urban Residential-Medium Density	2.66
Woodlot & Forest	5

Total area (ha): 36.6
TIMP (%): 24%
XIMP (%): 23%

Project Name: Farewell Heights Secondary Plan
Project No.: 900056758.1000
Location: Municipality of Clarington
Desgined By: SF
Checked By: JS
Date Created: 8/23/2023
Date Modified: 11/28/2024

VO NASHYD Hydrologic Modeling Parameters - Rural Land Use

CATCHMENT: **F9c**

Composite Curve Number

Land Use	Hdyrologic Soils Group						
	A	AB	B	BC	C	CD	D
Crop & Improved		7.1					
Pasture & Unimproved		3.2	2.5				
Urban Residential		17.9					
Rural Residential	2.6	0.9	4				
Industrial & Commercial							
Wetland		1.5	2.9				6.8
Woodlot & Forest	3.4	4.4	1.2				8.8
Manicured Greenspace/Park		8.5					
Landfill and Aggregate							
Transportation & Utility/Right-of-Way							

Total area (ha):	75.7	**Composite CN (AMCI):**	43	**Ia (mm):**	4.7
		Composite CN (AMCII):	**64**		
		Composite CN (AMCIII):	80		

Composite Runoff Coefficient

Land Use	Hdyrologic Soils Group						
	A	AB	B	BC	C	CD	D
Crop & Improved	0	7.1	0	0	0	0	0
Pasture & Unimproved	0	3.2	2.5	0	0	0	0
Urban Residential	0	17.9	0	0	0	0	0
Rural Residential	2.6	0.9	4	0	0	0	0
Industrial & Commercial	0	0	0	0	0	0	0
Wetland	0	1.5	2.9	0	0	0	6.8
Woodlot & Forest	3.4	4.4	1.2	0	0	0	8.8
Manicured Greenspace/Park	0	8.5	0	0	0	0	0
Landfill and Aggregate	0	0	0	0	0	0	0
Transportation & Utility/Right-of-Way	0	0	0	0	0	0	0

Time of Concentration Input Parameters	
Total Area (ha)	75.70
Runoff Coefficient	0.23
Length (m)	2661
h_1 (m)	
h_2 (m)	
Dh (m)	
Slope (%)	0.60

Tc Method	Bransby Williams	Airport	MTC	Williams	Kirpich	Watt & Chow
Tc (min)		174.14				
Tp (hr)		1.94				

Project Name:	Farewell Heights Secondary Plan
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Location:	Municipality of Clarington
Designed By:	SF
Checked By:	JS
Date Created:	23-Aug-2023
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VO STANDHYD Hydrologic Modeling Parameters - Urban Land Use

CATCHMENT: **F9d-F11a**

Composite Curve Number

Land Use	Hdyrologic Soils Group						
	A	AB	B	BC	C	CD	D
Crop & Improved							
Pasture & Unimproved	11.80		11.31				
Urban Residential	13.06		12.40				
Rural Residential							
Industrial & Commercial							
Wetland							
Woodlot & Forest							
Manicured Greenspace/Park			1.63				
Landfill and Aggregate							
Transportation & Utility/Right-of-Way							

Total area (ha): 50.2

Pervious CN (AMCI): 34
Pervious CN (AMCII): **55**
Pervious CN (AMCIII): 74

Slope and Initial Abstraction

Pervious Area		Impervious Area	
Length (m)	40	Length (m)	551.36
h_1 (m)		h_1 (m)	
h_2 (m)		h_2 (m)	
Δh (m)		Δh (m)	
Slope (%)	1.0	Slope (%)	2.0
Ia (mm)	4.6	Ia (mm)	1.0
Manning's n	0.25	Manning's n	0.013

TIMP & XIMP

Land Use	Area (ha)
Crop & Improved	0
Industrial & Commercial	0
Landfill & Aggregate	0
Lakes and Wetlands	0
Manicured Greenspace/Parks	1.6
Pasture & Unimproved	23.1
Rural Residential	0
Transportation & Utility/Right-of-Way	0
Urban Residential-Low Density	17.9
Urban Residential-Medium Density	7.5
Woodlot & Forest	0

Total area (ha): 50.2
TIMP (%): 25%
XIMP (%): 25%

Project Name: Farewell Heights Secondary Plan
Project No.: 900056758.1000
Location: Municipality of Clarington
Desgined By: SF
Checked By: JS
Date Created: 8/23/2023
Date Modified: 11/28/2024

VO NASHYD Hydrologic Modeling Parameters - Rural Land Use

CATCHMENT: F9e

Composite Curve Number

Land Use	Hdyrologic Soils Group						
	A	AB	B	BC	C	CD	D
Crop & Improved							
Pasture & Unimproved			4.6				
Urban Residential							
Rural Residential							
Industrial & Commercial							
Wetland							
Woodlot & Forest							1.3
Manicured Greenspace/Park							
Landfill and Aggregate							
Transportation & Utility/Right-of-Way							

Total area (ha): 5.9

Composite CN (AMCI): 47
Composite CN (AMCII): 68
Composite CN (AMCIII): 83

Ia (mm): 8.4

Composite Runoff Coefficient

Land Use	Hdyrologic Soils Group						
	A	AB	B	BC	C	CD	D
Crop & Improved	0	0	0	0	0	0	0
Pasture & Unimproved	0	0	4.6	0	0	0	0
Urban Residential	0	0	0	0	0	0	0
Rural Residential	0	0	0	0	0	0	0
Industrial & Commercial	0	0	0	0	0	0	0
Wetland	0	0	0	0	0	0	0
Woodlot & Forest	0	0	0	0	0	0	1.3
Manicured Greenspace/Park	0	0	0	0	0	0	0
Landfill and Aggregate	0	0	0	0	0	0	0
Transportation & Utility/Right-of-Way	0	0	0	0	0	0	0

Time of Concentration Input Parameters	
Total Area (ha)	5.90
Runoff Coefficient	0.19
Length (m)	432
h_1 (m)	134.28
h_2 (m)	130
Dh (m)	4.28
Slope (%)	0.99

Tc Method	Bransby Williams	Airport	MTC	Williams	Kirpich	Watt & Chow
Tc (min)		61.92				
Tp (hr)		0.69				

Project Name: Farewell Heights Secondary Plan
Project No.: 900056758.1000
Location: Municipality of Clarington
Desgined By: SF
Checked By: JS
Date Created: 8/23/2023
Date Modified: 11/28/2024

VO NASHYD Hydrologic Modeling Parameters - Rural Land Use

CATCHMENT: F9f

Composite Curve Number

Land Use	Hdyrologic Soils Group						
	A	AB	B	BC	C	CD	D
Crop & Improved							
Pasture & Unimproved			13.4				
Urban Residential	11.9			4.1			
Rural Residential							
Industrial & Commercial							
Wetland							
Woodlot & Forest	4.1		1.4	0.4			10.8
Manicured Greenspace/Park							
Landfill and Aggregate							
Transportation & Utility/Right-of-Way							

Total area (ha):	46.1	Composite CN (AMCI):	50	Ia (mm):	6.5
		Composite CN (AMCII):	71		
		Composite CN (AMCIII):	85		

Composite Runoff Coefficient

Land Use	Hdyrologic Soils Group						
	A	AB	B	BC	C	CD	D
Crop & Improved	0	0	0	0	0	0	0
Pasture & Unimproved	0	0	13.4	0	0	0	0
Urban Residential	11.9	0	0	4.1	0	0	0
Rural Residential	0	0	0	0	0	0	0
Industrial & Commercial	0	0	0	0	0	0	0
Wetland	0	0	0	0	0	0	0
Woodlot & Forest	4.1	0	1.4	0.4	0	0	10.8
Manicured Greenspace/Park	0	0	0	0	0	0	0
Landfill and Aggregate	0	0	0	0	0	0	0
Transportation & Utility/Right-of-Way	0	0	0	0	0	0	0

Time of Concentration Input Parameters	
Total Area (ha)	46.10
Runoff Coefficient	0.26
Length (m)	1219
h_1 (m)	
h_2 (m)	
Dh (m)	
Slope (%)	0.60

Tc Method	Bransby Williams	Airport	MTC	Williams	Kirpich	Watt & Chow
Tc (min)		113.35				
Tp (hr)		1.27				

Project Name:	Farewell Heights Secondary Plan
Project No.:	900056758.1000
Location:	Municipality of Clarington
Designed By:	SF
Checked By:	JS
Date Created:	23-Aug-2023
Date Modified:	28-Nov-2024

VO STANDHYD Hydrologic Modeling Parameters - Urban Land Use

CATCHMENT: **F11b**

Composite Curve Number

Land Use	Hdyrologic Soils Group						
	A	AB	B	BC	C	CD	D
Crop & Improved	1.5						
Pasture & Unimproved	6.1		3.9				
Urban Residential	29.0		45	11.2			
Rural Residential							
Industrial & Commercial	2.5		0.5				
Wetland			30.8				
Woodlot & Forest	2						
Manicured Greenspace/Park	0.6		0.6				
Landfill and Aggregate							
Transportation & Utility/Right-of-Way							

Total area (ha): 134.0

Pervious CN (AMCI): 33
Pervious CN (AMCII): 54
Pervious CN (AMCIII): 73

Slope and Initial Abstraction

Pervious Area		Impervious Area	
Length (m)	40	Length (m)	961.6
h_1 (m)		h_1 (m)	
h_2 (m)		h_2 (m)	
Δh (m)		Δh (m)	
Slope (%)	0.8	Slope (%)	2.0
Ia (mm)	1.9	Ia (mm)	1.0
Manning's n	0.25	Manning's n	0.013

TIMP & XIMP

Land Use	Area (ha)
Crop & Improved	1.5
Industrial & Commercial	3
Landfill & Aggregate	0
Lakes and Wetlands	30.8
Manicured Greenspace/Parks	1.2
Pasture & Unimproved	10.0
Rural Residential	0
Transportation & Utility/Right-of-Way	0
Urban Residential-Low Density	84.1
Urban Residential-Medium Density	1.4
Woodlot & Forest	2

Total area (ha): 134
TIMP (%): 31%
XIMP (%): 31%

Project Name: Farewell Heights Secondary Plan
Project No: 900056758.1000
Location: Municipality of Clarington
Designer: SF
Date: 8/23/2023
Date Modified: 28-Nov-2024

Route Channel Hydrologic Modeling Parameters

Original Model

RC	Length (m)	Channel Slope (%)	Floodplain Slope (%)	Channel n	Floodplain n
RC F9	3146	0.7%	2.0%	0.03	0.05

F9	
Station	Elevation
0	136
31	134
51	133
71	126
79	125
84	124.7
85	124.7
90	125
97	126
140	132

RJB Updated Model

Channel ID	Length (m)	Slope (%)	Floodplain Slope (%)	Channel n	Floodplain n
RC F9c	1927	0.6%	2.0%	0.03	0.05
RC F9e	432	1.0%	2.0%	0.03	0.05
RC F9f	1219	0.6%	2.0%	0.03	0.05

Cross sections

F9c	
Station	Elevation
0	142.7
40	138.6
51	137.2
52	137.2
59	137.9
88	138.6
90	138.8

F9e	
Station	Elevation
0	135.4
20	133.8
32	133.3
33	133.3
48	134.2
58	135.1
64	135.7
68	136.1

F9f	
Station	Elevation
0	136
31	134
51	133
71	126
79	125
84	124.7
85	124.7
90	125
97	126
140	132

Project Name:	Farewell Heights Secondary Plan
Project No.:	900056758.1000
Location:	Municipality of Clarington
Designed By:	SF
Checked By:	JS
Date Created:	23-Aug-2023
Date Modified:	28-Nov-2024

Original Model

Reach	HEC RAS Change Flow Location Cross Section	VO command ID	Total Area (ha)	Uncontrolled Future 100-year Flow (m3/s)	Uncontrolled Future Regional Flow (m3/s)
F9	5320.135	18	2653.2	46.922	180.77
	3076.132	19	2836.9	49.261	192.64
F10	819.5935	211	167.3	22.90	18.90

Updated Model

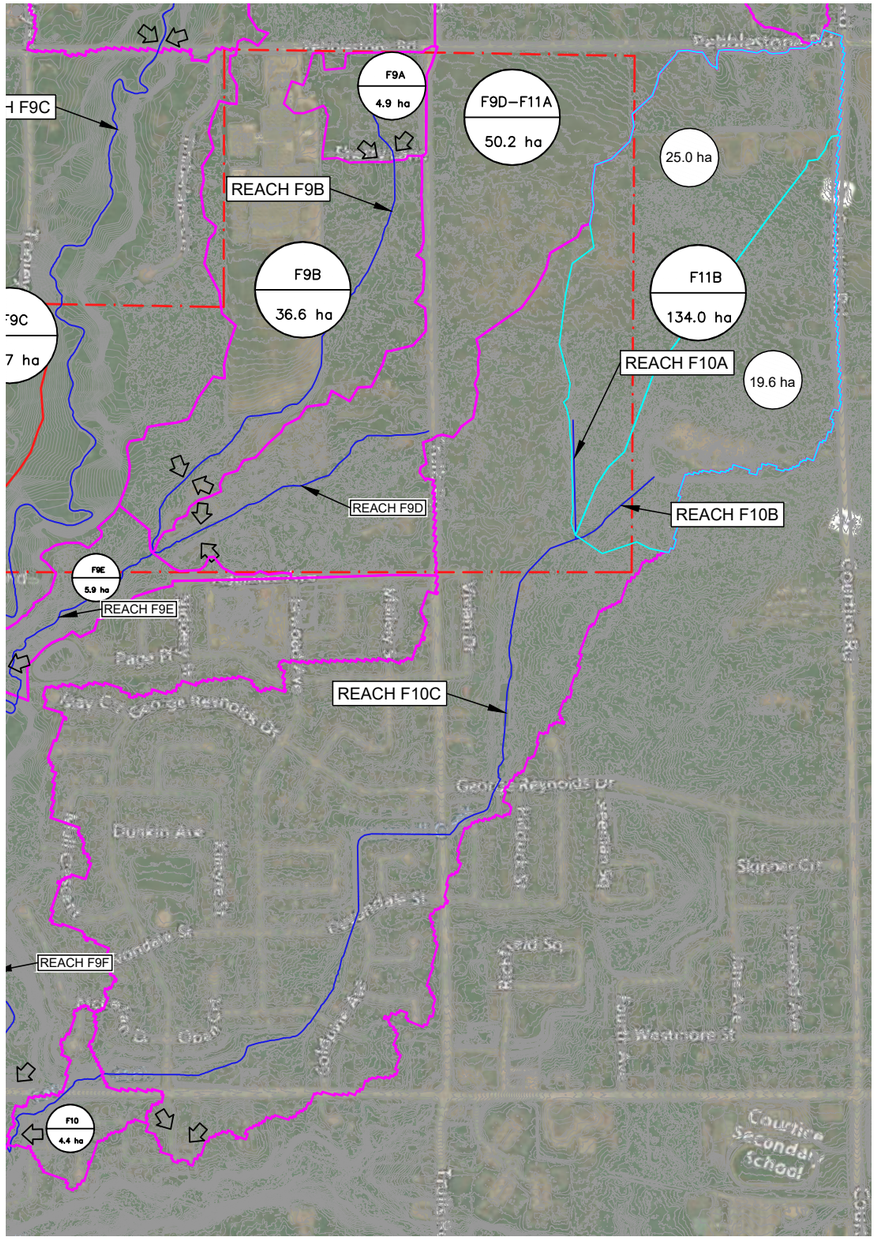
Reach	HEC RAS Flow Change Location Cross Section	VO command ID	Total Area (ha)	Future 100-year Flow (m3/s)	Future Regional Flow (m3/s)
West Reach F9c	5320	18	2651.27	46.89	180.63
	3076	19	2726.97	47.604	184.125
Middle Reach F9b	11114.35	73	4.9	1.819	0.595
	10065.55	68	41.5	8.055	5.056
Middle Reach F9d	9200	76	50.2	8.769	6.002
Reach F9e (downstream of confluence of Reaches F9b & F9d)	8894.10	84	97.6	14.572	11.461
Reach F9f (south of subject site)	3400	72	2870.67	48.346	187.571
Reach F10c	1960.69	20	138.37	22.931	16.023

Project Name:	Farewell Heights Secondary Plan
Project No:	900056758.1000
Location:	Municipality of Clarington
Designer:	SF
Date:	8/23/2023
Date Modified:	11/28/2024

Flow Calculation based on Weighted Average Area x Impervious - Flows for Tributaries East of Trulls Rd - Reaches F10a & F10b

				100 YR	Regional
			Total Q* (cms) =	25.909	15.519
Catchment	Area (ha)	Impervious (%)	axi	Q100YR	Regional
Draining to F10a	25	7%	1.75	1.35	0.81
Draining to F10b	19.6	7%	1.372	1.06	0.64
Draining to F10c	89.4	34%	30.378	23.49	14.07
Total*	134	25%	33.5	25.909	15.519

**Catchment F11b total flows from VO*



KEY PLAN
SCALE: N.T.S.

Notes

1. The contractor shall verify all dimensions, levels, and datums on site and report any discrepancies or omissions to this office prior to construction.
2. This drawing is to be read and understood in conjunction with all other plans and documents applicable to this project.

LEGEND:

- SITE PROPERTY LINE
- CATCHMENT AREAS
- DISCRETIZED DRAINAGE AREAS
- OVERLAND FLOW ROUTE
- DRAINAGE AREA NUMBER
- F9F / 49.1 ha — DRAINAGE AREA (ha)
- RIVER REACHES
- 25.8 ha — AREA WITHIN DISCRETIZED DRAINAGE BOUNDARY

BURNSIDE

R.J. Burnside & Associates Limited
1465 Pickering Parkway
Pickering, Ontario, L1V 7G7
telephone (905) 420-5777 **fax** (905) 420-5247
web www.rjburnside.com

Client

TRUSTEE: FAREWELL HEIGHTS LANDOWNERS GROUP

FOR: MUNICIPALITY OF CLARINGTON

Project Name

FAREWELL HEIGHTS SECONDARY PLAN

Drawing Title

REACHES F10A AND F10B DRAINAGE AREA

Drawn	Checked	Date	Drawing No.
SF	JS	24/11/27	**B1**
Scale		Project No.	
1:12000		300056758	

File Name: 056758 - FIGB1.dwg Date Plotted: November 27, 2024 - 12:30 PM

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Appendix C

Hydraulic Modelling Outputs

Original CLOCA HEC-RAS Model Results - Subcritical Regime Run

HEC-RAS Plan: Sub-O

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)	
F10	819.5935	100 year	22.90	129.08	130.83		130.85	0.000714	0.96	65.88	133.85	0.25
F10	819.5935	Regional	18.90	129.08	130.78		130.80	0.000608	0.86	59.40	127.97	0.23
F10	819.5935	Regulatory	22.90	129.08	130.83		130.85	0.000714	0.96	65.88	133.85	0.25
F10	779.2915	100 year	22.90	128.84	130.71	130.27	130.79	0.001581	1.40	33.53	97.62	0.37
F10	779.2915	Regional	18.90	128.84	130.69	130.27	130.75	0.001166	1.19	31.71	94.70	0.32
F10	779.2915	Regulatory	22.90	128.84	130.71	130.27	130.79	0.001581	1.40	33.53	97.62	0.37
F10	764.3998 53		Culvert									
F10	751.2088	100 year	22.90	128.72	130.31	130.28	130.51	0.005276	2.19	19.00	58.78	0.65
F10	751.2088	Regional	18.90	128.72	130.26	130.15	130.43	0.004530	1.97	16.27	52.58	0.60
F10	751.2088	Regulatory	22.90	128.72	130.31	130.28	130.51	0.005276	2.19	19.00	58.78	0.65
F10	693.3237	100 year	22.90	127.48	130.23	129.04	130.26	0.000416	0.88	45.98	67.18	0.20
F10	693.3237	Regional	18.90	127.48	130.19	128.92	130.22	0.000309	0.75	43.65	64.00	0.17
F10	693.3237	Regulatory	22.90	127.48	130.23	129.04	130.26	0.000416	0.88	45.98	67.18	0.20
F10	610.6965	100 year	22.90	127.27	130.23	128.75	130.23	0.000084	0.43	123.72	132.23	0.09
F10	610.6965	Regional	18.90	127.27	130.19	128.63	130.19	0.000062	0.37	119.09	130.16	0.08
F10	610.6965	Regulatory	22.90	127.27	130.23	128.75	130.23	0.000084	0.43	123.72	132.23	0.09
F10	527.8495	100 year	22.90	126.90	130.22	128.06	130.23	0.000016	0.23	166.82	103.06	0.04
F10	527.8495	Regional	18.90	126.90	130.19	128.00	130.19	0.000012	0.19	163.24	102.27	0.04
F10	527.8495	Regulatory	22.90	126.90	130.22	128.06	130.23	0.000016	0.23	166.82	103.06	0.04
F10	457.5944	100 year	22.90	126.64	130.22	127.87	130.22	0.000023	0.29	138.62	100.96	0.05
F10	457.5944	Regional	18.90	126.64	130.19	127.81	130.19	0.000016	0.24	135.19	99.07	0.04
F10	457.5944	Regulatory	22.90	126.64	130.22	127.87	130.22	0.000023	0.29	138.62	100.96	0.05
F10	435.4679	100 year	22.90	126.56	130.22	128.86	130.22	0.000048	0.43	94.65	79.92	0.08
F10	435.4679	Regional	18.90	126.56	130.18	128.59	130.19	0.000035	0.36	92.03	78.01	0.06
F10	435.4679	Regulatory	22.90	126.56	130.22	128.86	130.22	0.000048	0.43	94.65	79.92	0.08
F10	421.0022 52		Culvert									
F10	385.7476	100 year	22.90	126.53	128.68	128.68	128.71	0.000590	1.05	33.54	28.31	0.24
F10	385.7476	Regional	18.90	126.53	128.52	128.52	129.51	0.009582	4.42	4.28	27.03	1.00
F10	385.7476	Regulatory	22.90	126.53	128.68	128.68	128.71	0.000590	1.05	33.54	28.31	0.24
F10	351.8758	100 year	22.90	125.37	127.06	126.69	127.23	0.004137	1.87	12.88	16.53	0.58
F10	351.8758	Regional	18.90	125.37	126.96	126.57	127.11	0.003786	1.71	11.41	14.41	0.55
F10	351.8758	Regulatory	22.90	125.37	127.06	126.69	127.23	0.004137	1.87	12.88	16.53	0.58
F10	317.0175	100 year	22.90	124.18	127.06	125.70	127.11	0.000629	1.01	26.43	29.60	0.24
F10	317.0175	Regional	18.90	124.18	126.96	125.57	127.00	0.000535	0.89	23.66	24.80	0.22
F10	317.0175	Regulatory	22.90	124.18	127.06	125.70	127.11	0.000629	1.01	26.43	29.60	0.24
F10	275.5658	100 year	22.90	123.29	127.01	125.21	127.08	0.000779	1.18	20.64	13.45	0.24
F10	275.5658	Regional	18.90	123.29	126.92	125.04	126.98	0.000604	1.02	19.52	12.52	0.21
F10	275.5658	Regulatory	22.90	123.29	127.01	125.21	127.08	0.000779	1.18	20.64	13.45	0.24
F10	216.2351	100 year	22.90	121.83	127.01	124.53	127.03	0.000132	0.63	51.92	36.10	0.11
F10	216.2351	Regional	18.90	121.83	126.92	124.21	126.94	0.000100	0.54	48.82	34.65	0.09
F10	216.2351	Regulatory	22.90	121.83	127.01	124.53	127.03	0.000132	0.63	51.92	36.10	0.11
F10	194.6252 51		Culvert									
F10	165.0067	100 year	22.90	121.46	124.96	123.20	125.03	0.000825	1.17	19.86	10.42	0.25
F10	165.0067	Regional	18.90	121.46	124.89	123.03	124.94	0.000621	1.00	19.11	10.02	0.22
F10	165.0067	Regulatory	22.90	121.46	124.96	123.20	125.03	0.000825	1.17	19.86	10.42	0.25
F10	148.6980	100 year	22.90	120.65	124.98	122.42	125.00	0.000160	0.75	50.63	24.08	0.12
F10	148.6980	Regional	18.90	120.65	124.90	122.23	124.91	0.000119	0.64	48.78	23.66	0.11
F10	148.6980	Regulatory	22.90	120.65	124.98	122.42	125.00	0.000160	0.75	50.63	24.08	0.12
F10	128.4539	100 year	22.90	120.08	124.98	121.87	124.99	0.000096	0.68	67.42	28.84	0.10
F10	128.4539	Regional	18.90	120.08	124.90	121.69	124.91	0.000070	0.57	65.21	27.83	0.09
F10	128.4539	Regulatory	22.90	120.08	124.98	121.87	124.99	0.000096	0.68	67.42	28.84	0.10
F10	113.7455	100 year	22.90	120.60	124.97	123.15	124.99	0.000664	0.81	47.19	40.24	0.13
F10	113.7455	Regional	18.90	120.60	124.89	122.84	124.91	0.000517	0.70	44.19	38.32	0.11
F10	113.7455	Regulatory	22.90	120.60	124.97	123.15	124.99	0.000664	0.81	47.19	40.24	0.13
F10	104.7621 50		Culvert									
F10	88.59648	100 year	22.90	120.08	121.32	121.32	121.73	0.017436	4.36	12.18	15.58	1.25
F10	88.59648	Regional	18.90	120.08	121.29	121.29	121.59	0.012768	3.69	11.84	15.34	1.07
F10	88.59648	Regulatory	22.90	120.08	121.32	121.32	121.73	0.017436	4.36	12.18	15.58	1.25
F10	52.90113	100 year	22.90	118.80	119.93	119.93	120.16	0.010966	3.05	19.09	38.55	0.95
F10	52.90113	Regional	18.90	118.80	120.98		120.98	0.000215	0.68	73.50	60.50	0.15

HEC-RAS Plan: Sub-O (Continued)

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)	
F10	52.90113	Regulatory	22.90	118.80	120.98		120.99	0.000312	0.81	73.80	60.55	0.18
F9	5320.135	100 year	46.92	144.92	148.32	146.74	148.58	0.001228	2.26	20.73	88.11	0.39
F9	5320.135	Regional	180.77	144.92	150.20	149.33	150.21	0.000139	0.85	342.94	194.88	0.13
F9	5320.135	Regulatory	180.77	144.92	150.19	149.33	150.21	0.000139	0.85	342.27	194.75	0.13
F9	5304.525 56		Culvert									
F9	5284.122	100 year	46.92	145.36	147.96	147.18	148.40	0.005025	2.96	15.84	31.29	0.59
F9	5284.122	Regional	180.77	145.36	149.21	148.91	149.77	0.006112	4.25	79.95	57.44	0.69
F9	5284.122	Regulatory	180.77	145.36	149.21	148.91	149.77	0.006106	4.24	79.99	57.46	0.69
F9	5218.666	100 year	46.92	145.35	147.89	147.53	148.01	0.002064	2.19	50.16	50.35	0.46
F9	5218.666	Regional	180.77	145.35	149.15	148.45	149.29	0.002020	2.89	154.28	97.51	0.49
F9	5218.666	Regulatory	180.77	145.35	149.15	148.45	149.29	0.002017	2.89	154.36	97.53	0.49
F9	5130.550	100 year	46.92	145.24	147.60	147.29	147.79	0.003060	2.47	40.75	46.38	0.55
F9	5130.550	Regional	180.77	145.24	149.03	148.42	149.13	0.001480	2.43	191.73	145.74	0.41
F9	5130.550	Regulatory	180.77	145.24	149.03	148.42	149.13	0.001477	2.43	191.90	145.80	0.41
F9	5023.220	100 year	46.92	144.84	147.44	146.52	147.54	0.001102	1.46	49.40	52.63	0.33
F9	5023.220	Regional	180.77	144.84	148.79	147.90	148.96	0.001397	2.33	146.42	85.01	0.41
F9	5023.220	Regulatory	180.77	144.84	148.79	147.90	148.96	0.001394	2.33	146.56	85.04	0.41
F9	4886.696	100 year	46.92	144.52	146.80	146.66	147.25	0.006141	3.32	24.72	27.66	0.76
F9	4886.696	Regional	180.77	144.52	148.65	148.09	148.76	0.001353	2.43	211.16	154.85	0.40
F9	4886.696	Regulatory	180.77	144.52	148.65	148.09	148.76	0.001346	2.43	211.53	154.89	0.40
F9	4777.492	100 year	46.92	143.95	146.20	146.20	146.57	0.005829	3.00	26.73	39.92	0.72
F9	4777.492	Regional	180.77	143.95	148.62	147.06	148.64	0.000285	1.18	389.17	185.12	0.18
F9	4777.492	Regulatory	180.77	143.95	148.62	147.06	148.64	0.000284	1.18	389.64	185.18	0.18
F9	4666.765	100 year	46.92	143.42	145.99	145.52	146.03	0.001802	1.32	80.59	115.66	0.29
F9	4666.765	Regional	180.77	143.42	148.60	146.17	148.61	0.000183	0.71	450.75	168.40	0.10
F9	4666.765	Regulatory	180.77	143.42	148.61	146.17	148.62	0.000183	0.71	451.19	168.45	0.10
F9	4547.600	100 year	46.92	142.87	145.40	144.99	145.67	0.006288	2.45	28.90	59.09	0.61
F9	4547.600	Regional	180.77	142.87	148.58	146.25	148.59	0.000116	0.67	483.65	188.08	0.10
F9	4547.600	Regulatory	180.77	142.87	148.59	146.25	148.60	0.000116	0.67	484.15	188.20	0.10
F9	4434.975	100 year	46.92	142.39	145.16	144.70	145.20	0.000749	1.27	102.01	137.96	0.27
F9	4434.975	Regional	180.77	142.39	148.58	145.35	148.58	0.000040	0.54	767.34	228.65	0.07
F9	4434.975	Regulatory	180.77	142.39	148.58	145.35	148.59	0.000040	0.54	767.95	228.69	0.07
F9	4289.926	100 year	46.92	141.68	145.10	143.61	145.12	0.000247	0.80	124.58	118.10	0.16
F9	4289.926	Regional	180.77	141.68	148.57	144.92	148.58	0.000045	0.61	652.72	189.88	0.08
F9	4289.926	Regulatory	180.77	141.68	148.57	144.92	148.58	0.000044	0.61	653.23	189.90	0.08
F9	4216.177	100 year	46.92	141.61	144.81	143.27	145.03	0.001144	2.10	22.37	73.68	0.37
F9	4216.177	Regional	180.77	141.61	147.11	145.70	148.24	0.002785	4.70	38.49	165.96	0.64
F9	4216.177	Regulatory	180.77	141.61	147.12	145.69	148.24	0.002775	4.69	38.53	166.13	0.64
F9	4200.041 55		Culvert									
F9	4176.723	100 year	46.92	141.83	144.15	143.49	144.57	0.003327	2.89	16.24	52.32	0.61
F9	4176.723	Regional	180.77	141.83	145.13	145.13	145.41	0.003536	3.21	126.49	135.12	0.58
F9	4176.723	Regulatory	180.77	141.83	145.13	145.13	145.41	0.003536	3.21	126.49	135.12	0.58
F9	4051.653	100 year	46.92	141.33	143.76	143.76	143.97	0.004939	2.59	48.79	115.42	0.64
F9	4051.653	Regional	180.77	141.33	144.84	144.24	144.89	0.001345	1.89	237.95	184.29	0.37
F9	4051.653	Regulatory	180.77	141.33	144.84	144.24	144.89	0.001346	1.89	237.94	184.29	0.37
F9	3974.777	100 year	46.92	140.92	143.59	143.14	143.67	0.001661	1.91	77.71	125.31	0.40
F9	3974.777	Regional	180.77	140.92	144.75	144.00	144.80	0.001113	2.05	266.51	176.15	0.35
F9	3974.777	Regulatory	180.77	140.92	144.75	144.00	144.80	0.001113	2.05	266.50	176.15	0.35
F9	3851.504	100 year	46.92	140.40	143.08	142.67	143.37	0.003716	2.76	38.31	79.85	0.60
F9	3851.504	Regional	180.77	140.40	144.45	143.88	144.61	0.002152	2.91	168.77	105.32	0.49
F9	3851.504	Regulatory	180.77	140.40	144.45	143.88	144.61	0.002153	2.91	168.76	105.32	0.49
F9	3728.048	100 year	46.92	139.85	142.75		142.96	0.002501	2.35	39.92	53.47	0.49
F9	3728.048	Regional	180.77	139.85	143.93		144.26	0.003494	3.65	118.11	72.07	0.62
F9	3728.048	Regulatory	180.77	139.85	143.93		144.26	0.003497	3.66	118.07	72.06	0.63
F9	3636.840	100 year	46.92	139.60	142.52	141.97	142.73	0.002540	2.26	43.57	80.56	0.49
F9	3636.840	Regional	180.77	139.60	143.77		143.96	0.002192	2.84	159.93	100.72	0.49
F9	3636.840	Regulatory	180.77	139.60	143.77		143.96	0.002195	2.84	159.84	100.71	0.49
F9	3482.029	100 year	46.92	139.07	141.92	141.41	142.23	0.004269	2.51	23.07	40.69	0.61
F9	3482.029	Regional	180.77	139.07	143.48		143.65	0.001786	2.48	169.22	111.02	0.44
F9	3482.029	Regulatory	180.77	139.07	143.48		143.64	0.001791	2.49	169.05	111.01	0.44

HEC-RAS Plan: Sub-O (Continued)

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)	
F9	3351.153	100 year	46.92	138.48	141.58	140.79	141.78	0.002087	2.04	35.08	50.51	0.44
F9	3351.153	Regional	180.77	138.48	143.19	142.47	143.41	0.001741	2.70	144.10	81.71	0.44
F9	3351.153	Regulatory	180.77	138.48	143.19	142.47	143.41	0.001748	2.71	143.88	81.67	0.45
F9	3200.228	100 year	46.92	137.89	141.25		141.37	0.003243	1.70	36.08	29.17	0.35
F9	3200.228	Regional	180.77	137.89	142.62		142.98	0.006315	3.21	91.26	58.20	0.53
F9	3200.228	Regulatory	180.77	137.89	142.61		142.98	0.006375	3.22	90.86	58.03	0.53
F9	3116.725	100 year	46.92	137.07	141.16		141.18	0.000539	0.83	101.25	93.74	0.16
F9	3116.725	Regional	180.77	137.07	142.55		142.59	0.000794	1.31	238.08	103.61	0.20
F9	3116.725	Regulatory	180.77	137.07	142.54		142.58	0.000802	1.32	237.27	103.56	0.21
F9	3076.132	100 year	49.26	136.98	140.91	138.80	141.11	0.000958	1.94	25.35	80.34	0.31
F9	3076.132	Regional	192.63	136.98	142.49	141.32	142.55	0.000808	1.52	247.56	123.07	0.22
F9	3076.132	Regulatory	192.63	136.98	142.48	141.32	142.54	0.000816	1.53	246.53	122.82	0.23
F9	3062.288 54		Culvert									
F9	3044.979	100 year	49.26	137.38	140.37	139.20	140.46	0.000967	1.56	64.48	73.04	0.30
F9	3044.979	Regional	192.63	137.38	141.88	140.87	142.01	0.001177	2.30	199.00	102.70	0.35
F9	3044.979	Regulatory	192.63	137.38	141.88	140.87	142.01	0.001177	2.30	199.00	102.70	0.35
F9	2947.645	100 year	49.26	137.14	139.96	139.96	140.25	0.004422	2.75	40.79	79.56	0.59
F9	2947.645	Regional	192.63	137.14	141.79		141.87	0.001202	2.15	214.92	105.30	0.34
F9	2947.645	Regulatory	192.63	137.14	141.79		141.87	0.001202	2.15	214.91	105.30	0.34
F9	2815.047	100 year	49.26	136.61	139.26		139.57	0.003963	2.51	21.87	21.52	0.60
F9	2815.047	Regional	192.63	136.61	140.62	140.62	141.52	0.006365	4.62	68.51	47.17	0.83
F9	2815.047	Regulatory	192.63	136.61	140.62	140.62	141.52	0.006365	4.62	68.51	47.17	0.83
F9	2726.468	100 year	49.26	136.31	138.75	138.45	139.14	0.006161	2.79	21.24	35.66	0.72
F9	2726.468	Regional	192.63	136.31	139.95	139.95	140.66	0.007081	4.39	77.43	57.22	0.85
F9	2726.468	Regulatory	192.63	136.31	139.95	139.95	140.66	0.007057	4.38	77.54	57.26	0.85
F9	2611.818	100 year	49.26	135.67	138.14	138.02	138.46	0.005373	2.61	26.42	45.60	0.67
F9	2611.818	Regional	192.63	135.67	139.52		139.89	0.003942	3.40	116.47	86.01	0.64
F9	2611.818	Regulatory	192.63	135.67	139.52		139.89	0.003941	3.40	116.48	86.01	0.64
F9	2459.970	100 year	49.26	134.82	137.57		137.78	0.003129	2.14	32.12	41.66	0.52
F9	2459.970	Regional	192.63	134.82	139.00		139.35	0.003149	3.16	113.86	71.59	0.58
F9	2459.970	Regulatory	192.63	134.82	139.00		139.35	0.003147	3.16	113.89	71.59	0.58
F9	2358.700	100 year	49.26	134.48	136.82	136.62	137.30	0.008233	3.05	16.30	14.55	0.82
F9	2358.700	Regional	192.63	134.48	138.35	138.35	138.93	0.005099	3.85	68.06	58.41	0.73
F9	2358.700	Regulatory	192.63	134.48	138.35	138.35	138.93	0.005108	3.85	68.01	58.40	0.73
F9	2183.293	100 year	49.26	133.07	135.33	135.27	135.84	0.008283	3.23	16.35	18.34	0.84
F9	2183.293	Regional	192.63	133.07	136.63		136.92	0.003369	3.12	94.06	80.00	0.59
F9	2183.293	Regulatory	192.63	133.07	136.63		136.92	0.003382	3.12	93.93	79.97	0.59
F9	2057.916	100 year	49.26	131.98	134.33		134.80	0.008126	3.03	16.25	11.61	0.82
F9	2057.916	Regional	192.63	131.98	135.88	135.88	136.41	0.004756	3.75	75.39	71.79	0.71
F9	2057.916	Regulatory	192.63	131.98	135.88	135.88	136.41	0.004725	3.75	75.62	71.92	0.70
F9	1914.734	100 year	49.26	130.99	133.85		133.98	0.001955	1.78	38.56	71.66	0.42
F9	1914.734	Regional	192.63	130.99	135.17		135.24	0.000733	1.56	180.21	128.48	0.28
F9	1914.734	Regulatory	192.63	130.99	135.17		135.24	0.000733	1.56	180.21	128.48	0.28
F9	1744.457	100 year	49.26	130.82	133.58	132.96	133.67	0.001470	1.61	57.12	94.61	0.37
F9	1744.457	Regional	192.63	130.82	135.07	134.01	135.12	0.000612	1.52	229.18	132.96	0.26
F9	1744.457	Regulatory	192.63	130.82	135.07	134.01	135.12	0.000612	1.52	229.18	132.96	0.26
F9	1609.319	100 year	49.26	130.43	133.15	132.59	133.40	0.002897	2.33	34.37	52.85	0.52
F9	1609.319	Regional	192.63	130.43	134.68	134.07	134.96	0.002452	3.12	125.36	66.48	0.53
F9	1609.319	Regulatory	192.63	130.43	134.68	134.07	134.96	0.002452	3.12	125.36	66.48	0.53
F9	1529.355	100 year	49.26	130.23	132.85	132.39	133.14	0.003463	2.49	29.06	39.85	0.57
F9	1529.355	Regional	192.63	130.23	134.19	133.95	134.69	0.004330	3.93	107.23	76.05	0.69
F9	1529.355	Regulatory	192.63	130.23	134.19	133.95	134.69	0.004331	3.93	107.22	76.05	0.69
F9	1409.454	100 year	49.26	129.59	132.05	132.05	132.53	0.008736	3.49	24.68	30.99	0.81
F9	1409.454	Regional	192.63	129.59	133.37	133.19	133.99	0.008521	4.92	95.38	74.26	0.88
F9	1409.454	Regulatory	192.63	129.59	133.37	133.19	133.99	0.008517	4.92	95.40	74.27	0.88
F9	1325.243	100 year	49.26	129.18	131.69	131.19	131.90	0.002975	2.17	38.38	62.69	0.52
F9	1325.243	Regional	192.63	129.18	133.21	132.48	133.42	0.002093	2.75	147.74	81.37	0.48
F9	1325.243	Regulatory	192.63	129.18	133.21	132.48	133.42	0.002092	2.75	147.77	81.37	0.48
F9	1209.205	100 year	49.26	128.92	130.80	130.80	131.34	0.009515	3.31	17.41	22.15	0.90
F9	1209.205	Regional	192.63	128.92	132.27	132.27	133.00	0.006715	4.49	81.81	61.84	0.85
F9	1209.205	Regulatory	192.63	128.92	132.27	132.27	133.00	0.006733	4.50	81.71	61.80	0.85

HEC-RAS Plan: Sub-O (Continued)

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)	
F9	1036.199	100 year	49.26	126.79	129.01		129.29	0.004274	2.34	21.01	13.90	0.61
F9	1036.199	Regional	192.63	126.79	130.20	130.18	130.80	0.006044	3.82	87.26	78.88	0.78
F9	1036.199	Regulatory	192.63	126.79	130.20	130.18	130.80	0.006044	3.82	87.26	78.88	0.78
F9	922.7108	100 year	49.26	126.08	128.18		128.49	0.019701	2.50	20.10	21.41	0.65
F9	922.7108	Regional	192.63	126.08	129.71		129.90	0.007939	2.40	119.65	95.89	0.46
F9	922.7108	Regulatory	192.63	126.08	129.71		129.90	0.007938	2.40	119.65	95.89	0.46
F9	815.0424	100 year	49.26	124.65	127.00		127.23	0.003228	2.11	23.33	14.62	0.53
F9	815.0424	Regional	192.63	124.65	128.52	128.16	129.17	0.004730	3.71	66.99	42.96	0.71
F9	815.0424	Regulatory	192.63	124.65	128.52	128.16	129.17	0.004734	3.71	66.97	42.95	0.71
F9	697.7309	100 year	49.26	124.35	126.40	126.03	126.74	0.005640	2.59	19.03	13.39	0.69
F9	697.7309	Regional	192.63	124.35	128.19	127.76	128.62	0.003395	3.24	95.98	62.25	0.60
F9	697.7309	Regulatory	192.63	124.35	128.19	127.76	128.62	0.003402	3.25	95.89	62.23	0.61
F9	607.2597	100 year	49.26	123.81	125.66		126.12	0.008430	3.00	16.44	12.59	0.84
F9	607.2597	Regional	192.63	123.81	127.27	127.23	128.16	0.007195	4.40	58.08	36.03	0.87
F9	607.2597	Regulatory	192.63	123.81	127.28	127.23	128.16	0.007138	4.39	58.27	36.08	0.86
F9	482.3789	100 year	49.26	122.25	124.11	124.10	124.83	0.012627	3.74	13.17	8.93	0.98
F9	482.3789	Regional	192.63	122.25	126.39	126.26	127.28	0.006864	4.50	60.69	33.05	0.80
F9	482.3789	Regulatory	192.63	122.25	126.39	126.26	127.28	0.006926	4.52	60.43	32.98	0.81
F9	367.9135	100 year	49.26	121.09	122.77	122.77	123.37	0.012287	3.43	14.34	11.91	1.00
F9	367.9135	Regional	192.63	121.09	126.54	124.33	126.62	0.000451	1.61	234.30	87.49	0.24
F9	367.9135	Regulatory	192.63	121.09	126.53	124.34	126.62	0.000454	1.62	233.67	87.43	0.24
F9	277.6287	100 year	49.26	119.85	121.97		122.28	0.004750	2.46	20.36	19.20	0.64
F9	277.6287	Regional	192.63	119.85	126.55		126.58	0.000160	1.15	335.90	88.49	0.15
F9	277.6287	Regulatory	192.63	119.85	126.54		126.57	0.000161	1.15	335.27	88.45	0.15
F9	175.0127	100 year	49.26	119.07	121.82		121.91	0.001246	1.58	60.62	59.18	0.33
F9	175.0127	Regional	192.63	119.07	126.55		126.56	0.000087	0.88	475.60	112.44	0.11
F9	175.0127	Regulatory	192.63	119.07	126.54		126.56	0.000087	0.88	474.80	112.37	0.11
F9	145.0469	100 year	49.26	118.66	121.45	120.39	121.79	0.002030	2.55	19.29	34.91	0.49
F9	145.0469	Regional	192.63	118.66	126.54	122.96	126.56	0.000103	0.95	449.31	122.17	0.11
F9	145.0469	Regulatory	192.63	118.66	126.53	122.96	126.55	0.000103	0.95	448.44	122.07	0.11
F9	123.5135 49		Culvert									
F9	99.04380	100 year	49.26	118.63	120.35	120.35	121.22	0.010057	4.13	11.93	20.68	1.00
F9	99.04380	Regional	192.63	118.63	121.91	121.91	122.71	0.006460	4.64	74.99	47.23	0.84
F9	99.04380	Regulatory	192.63	118.63	121.91	121.91	122.71	0.006447	4.63	75.06	47.23	0.84
F9	59.03692	100 year	49.26	118.30	119.96	119.96	120.40	0.007616	3.29	26.12	36.22	0.84
F9	59.03692	Regional	192.63	118.30	121.18	121.18	121.84	0.007615	4.82	88.87	61.56	0.92
F9	59.03692	Regulatory	192.63	118.30	121.18	121.18	121.84	0.007612	4.82	88.88	61.56	0.92

Original CLOCA HEC-RAS Model Results - Mixed Flow Regime Run

HEC-RAS Plan: BHF

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)	
F10	819.5935	100 year	22.90	129.08	130.83	130.38	130.85	0.000710	0.96	66.06	134.02	0.25
F10	819.5935	Regional	18.90	129.08	130.78	130.32	130.80	0.000604	0.86	59.56	128.11	0.23
F10	819.5935	Regulatory	22.90	129.08	130.83	130.38	130.85	0.000710	0.96	66.06	134.02	0.25
F10	779.2915	100 year	22.90	128.84	130.72	130.27	130.80	0.001563	1.40	33.80	98.02	0.37
F10	779.2915	Regional	18.90	128.84	130.70	130.27	130.76	0.001156	1.19	31.90	95.02	0.32
F10	779.2915	Regulatory	22.90	128.84	130.72	130.27	130.80	0.001563	1.40	33.80	98.02	0.37
F10	764.3998 53		Culvert									
F10	751.2088	100 year	22.90	128.72	130.32	130.28	130.51	0.005078	2.16	19.48	59.88	0.64
F10	751.2088	Regional	18.90	128.72	130.27	130.16	130.43	0.004384	1.95	16.64	53.63	0.59
F10	751.2088	Regulatory	22.90	128.72	130.32	130.28	130.51	0.005078	2.16	19.48	59.88	0.64
F10	693.3237	100 year	22.90	127.48	130.24	129.04	130.27	0.000405	0.87	46.72	68.16	0.20
F10	693.3237	Regional	18.90	127.48	130.20	128.92	130.22	0.000303	0.75	44.22	64.80	0.17
F10	693.3237	Regulatory	22.90	127.48	130.24	129.04	130.27	0.000405	0.87	46.72	68.16	0.20
F10	610.6965	100 year	22.90	127.27	130.24	128.75	130.24	0.000081	0.43	125.19	132.88	0.09
F10	610.6965	Regional	18.90	127.27	130.20	128.63	130.20	0.000061	0.37	120.26	130.69	0.08
F10	610.6965	Regulatory	22.90	127.27	130.24	128.75	130.24	0.000081	0.43	125.19	132.88	0.09
F10	527.8495	100 year	22.90	126.90	130.24	128.06	130.24	0.000016	0.23	167.97	103.33	0.04
F10	527.8495	Regional	18.90	126.90	130.20	128.00	130.20	0.000012	0.19	164.17	102.47	0.04
F10	527.8495	Regulatory	22.90	126.90	130.24	128.06	130.24	0.000016	0.23	167.97	103.33	0.04
F10	457.5944	100 year	22.90	126.64	130.23	127.87	130.24	0.000022	0.29	139.75	101.56	0.05
F10	457.5944	Regional	18.90	126.64	130.20	127.81	130.20	0.000016	0.24	136.09	99.60	0.04
F10	457.5944	Regulatory	22.90	126.64	130.23	127.87	130.24	0.000022	0.29	139.75	101.56	0.05
F10	435.4679	100 year	22.90	126.56	130.23	128.86	130.23	0.000047	0.43	95.55	80.56	0.07
F10	435.4679	Regional	18.90	126.56	130.19	128.59	130.20	0.000034	0.36	92.74	78.53	0.06
F10	435.4679	Regulatory	22.90	126.56	130.23	128.86	130.23	0.000047	0.43	95.55	80.56	0.07
F10	421.0022 52		Culvert									
F10	385.7476	100 year	22.90	126.53	128.68	128.68	128.71	0.000590	1.05	33.54	28.31	0.24
F10	385.7476	Regional	18.90	126.53	128.52	128.52	129.51	0.009518	4.41	4.28	27.06	1.00
F10	385.7476	Regulatory	22.90	126.53	128.68	128.68	128.71	0.000590	1.05	33.54	28.31	0.24
F10	351.8758	100 year	22.90	125.37	126.33	126.69	127.45	0.054627	4.70	4.88	7.96	1.91
F10	351.8758	Regional	18.90	125.37	126.14	126.57	127.64	0.092344	5.42	3.49	6.84	2.42
F10	351.8758	Regulatory	22.90	125.37	126.33	126.69	127.45	0.054627	4.70	4.88	7.96	1.91
F10	317.0175	100 year	22.90	124.18	127.06	125.70	127.11	0.000639	1.01	26.24	29.35	0.24
F10	317.0175	Regional	18.90	124.18	126.96	125.57	127.00	0.000531	0.89	23.76	24.99	0.22
F10	317.0175	Regulatory	22.90	124.18	127.06	125.70	127.11	0.000639	1.01	26.24	29.35	0.24
F10	275.5658	100 year	22.90	123.29	127.00	125.21	127.07	0.000787	1.19	20.55	13.38	0.24
F10	275.5658	Regional	18.90	123.29	126.93	125.04	126.98	0.000600	1.01	19.57	12.56	0.21
F10	275.5658	Regulatory	22.90	123.29	127.00	125.21	127.07	0.000787	1.19	20.55	13.38	0.24
F10	216.2351	100 year	22.90	121.83	127.00	124.53	127.02	0.000133	0.63	51.66	35.99	0.11
F10	216.2351	Regional	18.90	121.83	126.93	124.20	126.94	0.000100	0.54	48.97	34.72	0.09
F10	216.2351	Regulatory	22.90	121.83	127.00	124.53	127.02	0.000133	0.63	51.66	35.99	0.11
F10	194.6252 51		Culvert									
F10	165.0067	100 year	22.90	121.46	124.96	123.20	125.03	0.000821	1.17	19.90	10.44	0.25
F10	165.0067	Regional	18.90	121.46	124.90	123.03	124.95	0.000610	0.99	19.24	10.09	0.21
F10	165.0067	Regulatory	22.90	121.46	124.96	123.20	125.03	0.000821	1.17	19.90	10.44	0.25
F10	148.6980	100 year	22.90	120.65	124.98	122.42	125.00	0.000159	0.75	50.73	24.10	0.12
F10	148.6980	Regional	18.90	120.65	124.91	122.23	124.93	0.000117	0.63	49.08	23.73	0.11
F10	148.6980	Regulatory	22.90	120.65	124.98	122.42	125.00	0.000159	0.75	50.73	24.10	0.12
F10	128.4539	100 year	22.90	120.08	124.98	121.87	125.00	0.000096	0.68	67.53	28.88	0.10
F10	128.4539	Regional	18.90	120.08	124.91	121.69	124.92	0.000069	0.57	65.56	27.98	0.09
F10	128.4539	Regulatory	22.90	120.08	124.98	121.87	125.00	0.000096	0.68	67.53	28.88	0.10
F10	113.7455	100 year	22.90	120.60	124.97	123.14	124.99	0.000660	0.80	47.35	40.34	0.13
F10	113.7455	Regional	18.90	120.60	124.90	122.84	124.92	0.000505	0.70	44.69	38.65	0.11
F10	113.7455	Regulatory	22.90	120.60	124.97	123.14	124.99	0.000660	0.80	47.35	40.34	0.13
F10	104.7621 50		Culvert									
F10	88.59648	100 year	22.90	120.08	121.32	121.32	121.73	0.017249	4.34	12.23	15.61	1.24
F10	88.59648	Regional	18.90	120.08	121.30	121.30	121.59	0.012643	3.67	11.88	15.37	1.06
F10	88.59648	Regulatory	22.90	120.08	121.32	121.32	121.73	0.017249	4.34	12.23	15.61	1.24
F10	52.90113	100 year	22.90	118.80	119.69	119.93	120.50	0.044866	5.19	10.56	31.43	1.83
F10	52.90113	Regional	18.90	118.80	120.97	119.86	120.98	0.000215	0.68	73.48	60.50	0.15

HEC-RAS Plan: BHF (Continued)

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)	
F10	52.90113	Regulatory	22.90	118.80	120.98	119.93	120.99	0.000312	0.81	73.78	60.55	0.18
F9	5320.135	100 year	46.94	144.92	148.32	146.74	148.58	0.001229	2.26	20.73	88.11	0.39
F9	5320.135	Regional	180.77	144.92	150.19	149.33	150.21	0.000140	0.85	341.70	194.65	0.13
F9	5320.135	Regulatory	180.77	144.92	150.19	149.33	150.21	0.000140	0.85	341.70	194.65	0.13
F9	5304.525 56		Culvert									
F9	5284.122	100 year	46.94	145.36	147.96	147.18	148.40	0.005026	2.96	15.85	31.29	0.59
F9	5284.122	Regional	180.77	145.36	149.21	148.91	149.77	0.006097	4.24	80.05	57.48	0.69
F9	5284.122	Regulatory	180.77	145.36	149.21	148.91	149.77	0.006097	4.24	80.05	57.48	0.69
F9	5218.666	100 year	46.94	145.35	147.89	147.53	148.01	0.002064	2.19	50.17	50.35	0.46
F9	5218.666	Regional	180.77	145.35	149.15	148.45	149.30	0.002014	2.89	154.46	97.55	0.48
F9	5218.666	Regulatory	180.77	145.35	149.15	148.45	149.30	0.002014	2.89	154.46	97.55	0.48
F9	5130.550	100 year	46.94	145.24	147.60	147.29	147.79	0.003061	2.47	40.76	46.39	0.55
F9	5130.550	Regional	180.77	145.24	149.03	148.42	149.13	0.001473	2.42	192.09	145.88	0.41
F9	5130.550	Regulatory	180.77	145.24	149.03	148.42	149.13	0.001473	2.42	192.09	145.88	0.41
F9	5023.220	100 year	46.94	144.84	147.44	146.52	147.54	0.001103	1.46	49.41	52.63	0.33
F9	5023.220	Regional	180.77	144.84	148.79	147.90	148.96	0.001390	2.33	146.73	85.06	0.41
F9	5023.220	Regulatory	180.77	144.84	148.79	147.90	148.96	0.001390	2.33	146.73	85.06	0.41
F9	4886.696	100 year	46.94	144.52	146.80	146.66	147.25	0.006145	3.33	24.72	27.66	0.76
F9	4886.696	Regional	180.77	144.52	148.66	148.09	148.76	0.001338	2.42	211.99	154.94	0.40
F9	4886.696	Regulatory	180.77	144.52	148.66	148.09	148.76	0.001338	2.42	211.99	154.94	0.40
F9	4777.492	100 year	46.94	143.95	146.20	146.20	146.57	0.005821	3.00	26.76	39.93	0.72
F9	4777.492	Regional	180.77	143.95	148.63	147.06	148.65	0.000283	1.18	390.20	185.24	0.18
F9	4777.492	Regulatory	180.77	143.95	148.63	147.06	148.65	0.000283	1.18	390.20	185.24	0.18
F9	4666.765	100 year	46.94	143.42	145.99	145.52	146.03	0.001802	1.32	80.61	115.67	0.29
F9	4666.765	Regional	180.77	143.42	148.61	146.17	148.62	0.000182	0.71	451.70	168.51	0.10
F9	4666.765	Regulatory	180.77	143.42	148.61	146.17	148.62	0.000182	0.71	451.70	168.51	0.10
F9	4547.600	100 year	46.94	142.87	145.40	144.99	145.67	0.006282	2.44	28.93	59.12	0.61
F9	4547.600	Regional	180.77	142.87	148.59	146.25	148.60	0.000116	0.67	484.73	188.34	0.10
F9	4547.600	Regulatory	180.77	142.87	148.59	146.25	148.60	0.000116	0.67	484.73	188.34	0.10
F9	4434.975	100 year	46.94	142.39	145.16	144.70	145.20	0.000748	1.27	102.11	138.00	0.27
F9	4434.975	Regional	180.77	142.39	148.59	145.35	148.59	0.000040	0.54	768.66	228.74	0.07
F9	4434.975	Regulatory	180.77	142.39	148.59	145.35	148.59	0.000040	0.54	768.66	228.74	0.07
F9	4289.926	100 year	46.94	141.68	145.10	143.61	145.12	0.000247	0.80	124.67	118.11	0.16
F9	4289.926	Regional	180.77	141.68	148.58	144.92	148.58	0.000044	0.61	653.82	189.94	0.08
F9	4289.926	Regulatory	180.77	141.68	148.58	144.92	148.58	0.000044	0.61	653.82	189.94	0.08
F9	4216.177	100 year	46.94	141.61	144.81	143.27	145.03	0.001144	2.10	22.38	73.72	0.37
F9	4216.177	Regional	180.77	141.61	147.13	145.70	148.24	0.002760	4.68	38.59	166.41	0.64
F9	4216.177	Regulatory	180.77	141.61	147.13	145.70	148.24	0.002760	4.68	38.59	166.41	0.64
F9	4200.041 55		Culvert									
F9	4176.723	100 year	46.94	141.83	144.15	143.49	144.58	0.003322	2.89	16.25	52.41	0.60
F9	4176.723	Regional	180.77	141.83	145.13	145.13	145.41	0.003512	3.20	126.89	135.28	0.57
F9	4176.723	Regulatory	180.77	141.83	145.13	145.13	145.41	0.003512	3.20	126.89	135.28	0.57
F9	4051.653	100 year	46.94	141.33	143.76	143.32	143.97	0.005027	2.61	48.37	115.13	0.65
F9	4051.653	Regional	180.77	141.33	144.84	144.24	144.89	0.001346	1.89	237.92	184.29	0.37
F9	4051.653	Regulatory	180.77	141.33	144.84	144.24	144.89	0.001346	1.89	237.92	184.29	0.37
F9	3974.777	100 year	46.94	140.92	143.59	143.14	143.67	0.001662	1.91	77.73	125.32	0.40
F9	3974.777	Regional	180.77	140.92	144.75	144.00	144.80	0.001114	2.05	266.48	176.15	0.35
F9	3974.777	Regulatory	180.77	140.92	144.75	144.00	144.80	0.001114	2.05	266.48	176.15	0.35
F9	3851.504	100 year	46.94	140.40	143.08	142.67	143.37	0.003715	2.76	38.34	79.89	0.60
F9	3851.504	Regional	180.77	140.40	144.45	143.88	144.61	0.002153	2.91	168.75	105.32	0.49
F9	3851.504	Regulatory	180.77	140.40	144.45	143.88	144.61	0.002153	2.91	168.75	105.32	0.49
F9	3728.048	100 year	46.94	139.85	142.75		142.96	0.002502	2.35	39.93	53.49	0.49
F9	3728.048	Regional	180.77	139.85	143.93		144.26	0.003496	3.66	118.09	72.06	0.62
F9	3728.048	Regulatory	180.77	139.85	143.93		144.26	0.003496	3.66	118.09	72.06	0.62
F9	3636.840	100 year	46.94	139.60	142.52		142.73	0.002540	2.26	43.58	80.57	0.49
F9	3636.840	Regional	180.77	139.60	143.77		143.96	0.002194	2.84	159.86	100.71	0.49
F9	3636.840	Regulatory	180.77	139.60	143.77		143.96	0.002194	2.84	159.86	100.71	0.49
F9	3482.029	100 year	46.94	139.07	141.93		142.23	0.004183	2.49	23.48	41.20	0.60
F9	3482.029	Regional	180.77	139.07	143.48		143.64	0.001790	2.49	169.09	111.01	0.44
F9	3482.029	Regulatory	180.77	139.07	143.48		143.64	0.001790	2.49	169.09	111.01	0.44

HEC-RAS Plan: BHF (Continued)

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)	
F9	3351.153	100 year	46.94	138.48	141.61	140.79	141.79	0.001977	2.00	36.36	50.93	0.43
F9	3351.153	Regional	180.77	138.48	143.19	142.47	143.41	0.001746	2.71	143.94	81.68	0.44
F9	3351.153	Regulatory	180.77	138.48	143.19	142.47	143.41	0.001746	2.71	143.94	81.68	0.44
F9	3200.228	100 year	46.94	137.89	141.30		141.42	0.002964	1.65	37.57	29.88	0.34
F9	3200.228	Regional	180.77	137.89	142.61		142.98	0.006354	3.21	91.00	58.09	0.53
F9	3200.228	Regulatory	180.77	137.89	142.61		142.98	0.006354	3.21	91.00	58.09	0.53
F9	3116.725	100 year	46.94	137.07	141.22		141.24	0.000472	0.79	106.96	94.22	0.15
F9	3116.725	Regional	180.77	137.07	142.54		142.58	0.000799	1.32	237.53	103.58	0.21
F9	3116.725	Regulatory	180.77	137.07	142.54		142.58	0.000799	1.32	237.53	103.58	0.21
F9	3076.132	100 year	49.28	136.98	140.98	138.79	141.17	0.000905	1.91	25.79	82.32	0.30
F9	3076.132	Regional	192.64	136.98	142.48	141.32	142.55	0.000814	1.53	246.86	122.90	0.23
F9	3076.132	Regulatory	192.64	136.98	142.48	141.32	142.55	0.000814	1.53	246.86	122.90	0.23
F9	3062.288 54		Culvert									
F9	3044.979	100 year	49.28	137.38	140.43	139.20	140.51	0.000852	1.49	69.05	74.59	0.28
F9	3044.979	Regional	192.64	137.38	141.88	140.86	142.01	0.001177	2.30	199.00	102.70	0.35
F9	3044.979	Regulatory	192.64	137.38	141.88	140.86	142.01	0.001177	2.30	199.00	102.70	0.35
F9	2947.645	100 year	49.28	137.14	139.86		140.27	0.006089	3.14	33.26	76.74	0.69
F9	2947.645	Regional	192.64	137.14	141.79		141.87	0.001202	2.15	214.91	105.30	0.34
F9	2947.645	Regulatory	192.64	137.14	141.79		141.87	0.001202	2.15	214.91	105.30	0.34
F9	2815.047	100 year	49.28	136.61	139.26		139.57	0.003964	2.51	21.88	21.52	0.60
F9	2815.047	Regional	192.64	136.61	140.62	140.62	141.52	0.006395	4.63	68.35	47.10	0.83
F9	2815.047	Regulatory	192.64	136.61	140.62	140.62	141.52	0.006395	4.63	68.35	47.10	0.83
F9	2726.468	100 year	49.28	136.31	138.75	138.45	139.14	0.006162	2.79	21.25	35.67	0.72
F9	2726.468	Regional	192.64	136.31	139.69	139.95	140.73	0.011183	5.16	63.43	52.51	1.05
F9	2726.468	Regulatory	192.64	136.31	139.69	139.95	140.73	0.011183	5.16	63.43	52.51	1.05
F9	2611.818	100 year	49.28	135.67	138.14		138.46	0.005372	2.61	26.43	45.60	0.67
F9	2611.818	Regional	192.64	135.67	139.52	139.18	139.89	0.003942	3.40	116.48	86.01	0.64
F9	2611.818	Regulatory	192.64	135.67	139.52	139.18	139.89	0.003942	3.40	116.48	86.01	0.64
F9	2459.970	100 year	49.28	134.82	137.57		137.78	0.003129	2.14	32.14	41.67	0.52
F9	2459.970	Regional	192.64	134.82	139.00		139.35	0.003149	3.16	113.87	71.59	0.58
F9	2459.970	Regulatory	192.64	134.82	139.00		139.35	0.003149	3.16	113.87	71.59	0.58
F9	2358.700	100 year	49.28	134.48	136.83	136.62	137.30	0.008235	3.05	16.30	14.56	0.82
F9	2358.700	Regional	192.64	134.48	138.35	138.35	138.93	0.005106	3.85	68.02	58.40	0.73
F9	2358.700	Regulatory	192.64	134.48	138.35	138.35	138.93	0.005106	3.85	68.02	58.40	0.73
F9	2183.293	100 year	49.28	133.07	135.33	135.27	135.84	0.008282	3.23	16.36	18.35	0.84
F9	2183.293	Regional	192.64	133.07	136.09	136.44	137.18	0.014200	5.54	53.39	69.31	1.17
F9	2183.293	Regulatory	192.64	133.07	136.09	136.44	137.18	0.014200	5.54	53.39	69.31	1.17
F9	2057.916	100 year	49.28	131.98	134.33		134.80	0.008125	3.03	16.25	11.61	0.82
F9	2057.916	Regional	192.64	131.98	135.88	135.88	136.41	0.004747	3.75	75.45	71.82	0.71
F9	2057.916	Regulatory	192.64	131.98	135.88	135.88	136.41	0.004747	3.75	75.45	71.82	0.71
F9	1914.734	100 year	49.28	130.99	133.85		133.98	0.001954	1.78	38.59	72.01	0.42
F9	1914.734	Regional	192.64	130.99	135.17	134.36	135.24	0.000733	1.56	180.18	128.47	0.28
F9	1914.734	Regulatory	192.64	130.99	135.17	134.36	135.24	0.000733	1.56	180.18	128.47	0.28
F9	1744.457	100 year	49.28	130.82	133.58	132.96	133.68	0.001466	1.61	57.22	94.64	0.37
F9	1744.457	Regional	192.64	130.82	135.07	134.01	135.12	0.000612	1.52	229.14	132.95	0.26
F9	1744.457	Regulatory	192.64	130.82	135.07	134.01	135.12	0.000612	1.52	229.14	132.95	0.26
F9	1609.319	100 year	49.28	130.43	133.15	132.60	133.40	0.002863	2.32	34.64	52.90	0.52
F9	1609.319	Regional	192.64	130.43	134.68	134.07	134.96	0.002453	3.12	125.35	66.48	0.53
F9	1609.319	Regulatory	192.64	130.43	134.68	134.07	134.96	0.002453	3.12	125.35	66.48	0.53
F9	1529.355	100 year	49.28	130.23	132.87		133.15	0.003347	2.46	29.70	40.67	0.56
F9	1529.355	Regional	192.64	130.23	134.19		134.69	0.004333	3.93	107.20	76.04	0.69
F9	1529.355	Regulatory	192.64	130.23	134.19		134.69	0.004333	3.93	107.20	76.04	0.69
F9	1409.454	100 year	49.28	129.59	132.00		132.53	0.009703	3.62	23.40	29.89	0.85
F9	1409.454	Regional	192.64	129.59	133.37		133.99	0.008512	4.91	95.43	74.29	0.88
F9	1409.454	Regulatory	192.64	129.59	133.37		133.99	0.008512	4.91	95.43	74.29	0.88
F9	1325.243	100 year	49.28	129.18	131.69	131.19	131.90	0.002975	2.17	38.39	62.69	0.52
F9	1325.243	Regional	192.64	129.18	133.21	132.48	133.42	0.002091	2.75	147.78	81.37	0.48
F9	1325.243	Regulatory	192.64	129.18	133.21	132.48	133.42	0.002091	2.75	147.78	81.37	0.48
F9	1209.205	100 year	49.28	128.92	130.80	130.80	131.34	0.009522	3.31	17.41	22.15	0.90
F9	1209.205	Regional	192.64	128.92	132.26	132.26	133.00	0.006763	4.51	81.55	61.74	0.85
F9	1209.205	Regulatory	192.64	128.92	132.26	132.26	133.00	0.006763	4.51	81.55	61.74	0.85

HEC-RAS Plan: BHF (Continued)

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)	
F9	1036.199	100 year	49.28	126.79	129.01	128.49	129.29	0.004274	2.34	21.02	13.90	0.61
F9	1036.199	Regional	192.64	126.79	129.76	130.18	131.06	0.015036	5.33	54.59	68.14	1.19
F9	1036.199	Regulatory	192.64	126.79	129.76	130.18	131.06	0.015036	5.33	54.59	68.14	1.19
F9	922.7108	100 year	49.28	126.08	128.18		128.49	0.019700	2.50	20.11	21.44	0.65
F9	922.7108	Regional	192.64	126.08	129.71	129.34	129.90	0.007942	2.40	119.63	95.89	0.46
F9	922.7108	Regulatory	192.64	126.08	129.71	129.34	129.90	0.007942	2.40	119.63	95.89	0.46
F9	815.0424	100 year	49.28	124.65	127.01		127.23	0.003228	2.11	23.34	14.62	0.53
F9	815.0424	Regional	192.64	124.65	128.52		129.17	0.004736	3.71	66.96	42.95	0.71
F9	815.0424	Regulatory	192.64	124.65	128.52		129.17	0.004736	3.71	66.96	42.95	0.71
F9	697.7309	100 year	49.28	124.35	126.40	126.03	126.74	0.005640	2.59	19.03	13.39	0.69
F9	697.7309	Regional	192.64	124.35	128.19	127.76	128.62	0.003409	3.25	95.81	62.21	0.61
F9	697.7309	Regulatory	192.64	124.35	128.19	127.76	128.62	0.003409	3.25	95.81	62.21	0.61
F9	607.2597	100 year	49.28	123.81	125.66		126.12	0.008441	3.00	16.43	12.59	0.84
F9	607.2597	Regional	192.64	123.81	127.28		128.16	0.007100	4.38	58.40	36.11	0.86
F9	607.2597	Regulatory	192.64	123.81	127.28		128.16	0.007100	4.38	58.40	36.11	0.86
F9	482.3789	100 year	49.28	122.25	124.12	124.10	124.83	0.012604	3.74	13.18	8.93	0.98
F9	482.3789	Regional	192.64	122.25	126.38		127.28	0.006966	4.53	60.26	32.94	0.81
F9	482.3789	Regulatory	192.64	122.25	126.38		127.28	0.006966	4.53	60.26	32.94	0.81
F9	367.9135	100 year	49.28	121.09	122.77	122.77	123.37	0.012322	3.44	14.33	11.90	1.00
F9	367.9135	Regional	192.64	121.09	126.53	124.34	126.61	0.000456	1.62	233.23	87.39	0.24
F9	367.9135	Regulatory	192.64	121.09	126.53	124.34	126.61	0.000456	1.62	233.23	87.39	0.24
F9	277.6287	100 year	49.28	119.85	121.97	121.53	122.28	0.004751	2.46	20.36	19.22	0.64
F9	277.6287	Regional	192.64	119.85	126.53		126.57	0.000161	1.15	334.83	88.42	0.15
F9	277.6287	Regulatory	192.64	119.85	126.53		126.57	0.000161	1.15	334.83	88.42	0.15
F9	175.0127	100 year	49.28	119.07	121.82		121.91	0.001247	1.58	60.63	59.18	0.33
F9	175.0127	Regional	192.64	119.07	126.54		126.55	0.000088	0.88	474.24	112.32	0.11
F9	175.0127	Regulatory	192.64	119.07	126.54		126.55	0.000088	0.88	474.24	112.32	0.11
F9	145.0469	100 year	49.28	118.66	121.45	120.39	121.79	0.002032	2.56	19.29	34.91	0.49
F9	145.0469	Regional	192.64	118.66	126.53	122.96	126.55	0.000103	0.95	447.82	121.99	0.11
F9	145.0469	Regulatory	192.64	118.66	126.53	122.96	126.55	0.000103	0.95	447.82	121.99	0.11
F9	123.5135 49		Culvert									
F9	99.04380	100 year	49.28	118.63	120.36	120.36	121.22	0.010037	4.13	11.94	20.89	1.00
F9	99.04380	Regional	192.64	118.63	121.91	121.91	122.71	0.006433	4.63	75.13	47.24	0.84
F9	99.04380	Regulatory	192.64	118.63	121.91	121.91	122.71	0.006433	4.63	75.13	47.24	0.84
F9	59.03692	100 year	49.28	118.30	119.63	119.96	120.59	0.020402	4.61	15.95	26.71	1.32
F9	59.03692	Regional	192.64	118.30	120.76	121.17	122.09	0.016934	6.46	64.42	57.17	1.34
F9	59.03692	Regulatory	192.64	118.30	120.76	121.17	122.09	0.016934	6.46	64.42	57.17	1.34

RJB Updated HEC-RAS Model Results – Subcritical Regime Run

HEC-RAS Plan: Sub

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)	
F10b	9301.79	100 year	1.06	139.38	139.59	139.53	139.61	0.006596	0.69	1.84	14.26	0.55
F10b	9301.79	Regional	0.64	139.38	139.56	139.51	139.57	0.004891	0.52	1.43	13.39	0.46
F10b	9234.48	100 year	1.06	138.76	138.92	138.90	138.96	0.014759	0.88	1.20	9.30	0.79
F10b	9234.48	Regional	0.64	138.76	138.87	138.87	138.91	0.027281	0.90	0.71	8.62	0.99
F10b	9173.1	100 year	1.06	138.36	138.67	138.54	138.68	0.002161	0.48	2.22	10.27	0.33
F10b	9173.1	Regional	0.64	138.36	138.63	138.50	138.64	0.001440	0.35	1.81	9.69	0.26
F10a	9254.3	100 year	1.35	140.27	141.14	140.93	141.20	0.005145	1.10	1.23	2.58	0.51
F10a	9254.3	Regional	0.81	140.27	141.00	140.81	141.04	0.004612	0.92	0.89	2.30	0.47
F10a	9217.82	100 year	1.35	140.02	140.50	140.50	140.64	0.020450	1.68	0.80	2.87	1.01
F10a	9217.82	Regional	0.81	140.02	140.40	140.40	140.51	0.021973	1.51	0.54	2.38	1.02
F10a	9203.28	100 year	1.35	139.46	140.07	139.96	140.15	0.008227	1.26	1.07	2.81	0.66
F10a	9203.28	Regional	0.81	139.46	139.94	139.85	140.01	0.008162	1.10	0.74	2.40	0.63
F10a	9196.19	100 year	1.35	139.22	139.91	139.74	139.95	0.005202	0.89	1.52	6.24	0.52
F10a	9196.19	Regional	0.81	139.22	139.77	139.62	139.81	0.005233	0.85	0.95	3.39	0.51
F10a	9151.47	100 year	1.35	139.04	139.49	139.49	139.64	0.020401	1.72	0.78	2.64	1.01
F10a	9151.47	Regional	0.81	139.04	139.39	139.39	139.51	0.021483	1.53	0.53	2.24	1.00
F10c	1960.69	100 year	22.93	137.58	138.16	138.02	138.22	0.005086	1.09	24.79	66.59	0.56
F10c	1960.69	Regional	16.02	137.58	138.07	137.96	138.12	0.005838	0.99	19.01	62.89	0.57
F10c	1948.7	100 year	22.93	137.31	137.94		138.01	0.004301	1.19	21.37	56.26	0.53
F10c	1948.7	Regional	16.02	137.31	137.85		137.91	0.004168	1.03	16.64	49.84	0.51
F10c	1930	100 year	22.93	136.99	137.71	137.68	137.85	0.011706	1.69	14.72	51.00	0.85
F10c	1930	Regional	16.02	136.99	137.62	137.59	137.74	0.013522	1.55	10.40	34.36	0.88
F10c	1900	100 year	22.93	136.65	137.47		137.51	0.002170	1.11	37.29	72.44	0.41
F10c	1900	Regional	16.02	136.65	137.33		137.37	0.002375	1.01	27.41	66.54	0.41
F10c	1844.23	100 year	22.93	136.13	137.43		137.46	0.000858	0.92	45.31	67.69	0.27
F10c	1844.23	Regional	16.02	136.13	137.29		137.32	0.000704	0.77	36.46	63.00	0.24
F10c	1733.27	100 year	22.93	136.05	137.39		137.41	0.000579	0.79	52.42	69.83	0.23
F10c	1733.27	Regional	16.02	136.05	137.26		137.28	0.000433	0.64	43.99	64.73	0.19
F10c	1700	100 year	22.93	135.82	137.38		137.39	0.000352	0.67	54.73	63.35	0.18
F10c	1700	Regional	16.02	135.82	137.25		137.27	0.000250	0.53	47.08	61.56	0.15
F10c	1671.72	100 year	22.93	136.67	137.17	137.17	137.35	0.016649	1.90	12.07	32.58	1.00
F10c	1671.72	Regional	16.02	136.67	137.08	137.08	137.23	0.018446	1.72	9.34	31.72	1.01
F10c	1656.25	100 year	22.93	135.54	136.84	136.09	136.88	0.000829	0.80	29.76	79.60	0.26
F10c	1656.25	Regional	16.02	135.54	136.75	135.98	136.77	0.000495	0.62	26.00	26.86	0.20
F10c	1628.94	100 year	22.93	135.76	136.85		136.85	0.000444	0.40	92.79	161.04	0.17
F10c	1628.94	Regional	16.02	135.76	136.75		136.76	0.000360	0.35	77.98	147.25	0.15
F10c	1601.83	100 year	22.93	134.80	136.83	135.53	136.84	0.000243	0.55	67.26	110.58	0.15
F10c	1601.83	Regional	16.02	134.80	136.74	135.39	136.75	0.000160	0.42	57.61	108.50	0.12
F10c	1575.58	100 year	22.93	136.39	136.67	136.67	136.81	0.103464	2.56	14.47	62.31	2.12
F10c	1575.58	Regional	16.02	136.39	136.61	136.61	136.72	0.095779	2.21	11.00	50.48	1.98
F10c	1561.41	100 year	22.93	135.30	136.32		136.37	0.001437	1.04	28.62	41.61	0.34
F10c	1561.41	Regional	16.02	135.30	136.21		136.24	0.001098	0.84	24.16	39.88	0.29
F10c	1537.16	100 year	22.93	134.94	136.32	135.50	136.34	0.000412	0.67	42.54	52.70	0.19
F10c	1537.16	Regional	16.02	134.94	136.21	135.40	136.23	0.000284	0.52	36.82	50.63	0.16
F10c	1507.9	100 year	22.93	134.51	136.29		136.33	0.000784	1.15	44.97	40.52	0.28
F10c	1507.9	Regional	16.02	134.51	136.19		136.21	0.000484	0.87	41.05	38.92	0.22
F10c	1483.96	100 year	22.93	134.31	136.29		136.31	0.000437	0.90	53.89	44.06	0.21
F10c	1483.96	Regional	16.02	134.31	136.19		136.21	0.000260	0.67	49.69	41.73	0.16
F10c	1476.53	100 year	22.93	134.23	136.29	135.26	136.31	0.000437	0.95	64.69	72.75	0.21
F10c	1476.53	Regional	16.02	134.23	136.19	135.08	136.20	0.000243	0.68	57.34	51.19	0.16
F10c	1455		Culvert									

HEC-RAS Plan: Sub (Continued)

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)	
F10c	1442.84	100 year	22.93	134.06	135.05	135.05	135.41	0.011735	2.95	11.94	17.89	0.98
F10c	1442.84	Regional	16.02	134.06	134.93	134.88	135.18	0.009660	2.44	9.82	16.91	0.86
F10c	1427.43	100 year	22.93	134.08	135.05	134.94	135.29	0.008926	2.52	14.69	20.63	0.85
F10c	1427.43	Regional	16.02	134.08	134.92		135.09	0.007835	2.12	11.98	19.87	0.77
F10c	1417	100 year	22.93	134.05	134.87	134.87	135.17	0.015883	2.91	13.23	23.23	1.09
F10c	1417	Regional	16.02	134.05	134.74	134.74	134.98	0.016072	2.56	10.28	22.19	1.06
F10c	1367.55	100 year	22.93	133.23	134.31	134.31	134.55	0.008326	2.38	15.94	38.88	0.81
F10c	1367.55	Regional	16.02	133.23	134.11	134.11	134.36	0.011122	2.33	9.40	23.85	0.90
F10c	1341.92	100 year	22.93	132.74	134.19	133.76	134.27	0.002298	1.64	33.35	51.03	0.46
F10c	1341.92	Regional	16.02	132.74	134.07	133.71	134.13	0.001768	1.35	27.56	48.32	0.39
F10c	1317.36	100 year	22.93	132.72	134.14	133.80	134.23	0.003048	1.91	28.24	34.59	0.53
F10c	1317.36	Regional	16.02	132.72	134.05	133.67	134.10	0.002035	1.49	25.10	33.27	0.43
F10c	1315.69	100 year	22.93	132.53	134.13		134.20	0.002338	1.78	31.06	35.08	0.47
F10c	1315.69	Regional	16.02	132.53	134.04		134.08	0.001472	1.36	28.08	33.37	0.37
F10c	1313.49	100 year	22.93	132.31	134.13	133.42	134.17	0.000810	0.99	40.05	70.40	0.27
F10c	1313.49	Regional	16.02	132.31	134.04	133.26	134.07	0.000547	0.78	33.77	70.40	0.22
F10c	1300		Culvert									
F10c	1285.86	100 year	22.93	132.31	133.60	133.52	133.92	0.010383	2.51	9.14	11.02	0.88
F10c	1285.86	Regional	16.02	132.31	133.34	133.31	133.65	0.012750	2.47	6.49	9.35	0.95
F10c	1279.75	100 year	22.93	132.21	133.71	133.21	133.77	0.001679	1.44	32.07	34.70	0.39
F10c	1279.75	Regional	16.02	132.21	133.44	133.15	133.50	0.002032	1.37	23.01	32.22	0.42
F10c	1251.13	100 year	22.93	132.19	133.69	133.02	133.72	0.001203	1.24	41.62	46.77	0.33
F10c	1251.13	Regional	16.02	132.19	133.41	133.02	133.44	0.001326	1.12	30.81	37.21	0.34
F10c	1198.12	100 year	22.93	132.10	133.61	133.07	133.68	0.001347	1.24	30.24	49.28	0.35
F10c	1198.12	Regional	16.02	132.10	133.32	132.89	133.39	0.001929	1.25	17.42	35.71	0.40
F10c	1167.38	100 year	22.93	131.81	133.39	132.92	133.57	0.003825	2.31	20.52	27.25	0.60
F10c	1167.38	Regional	16.02	131.81	133.10	132.76	133.26	0.004031	2.06	14.06	18.49	0.60
F10c	1135.87	100 year	22.93	131.40	133.34		133.45	0.001607	1.55	22.69	42.23	0.39
F10c	1135.87	Regional	16.02	131.40	133.04		133.14	0.001734	1.40	13.38	16.93	0.39
F10c	1106.82	100 year	22.93	131.33	133.19		133.38	0.002648	2.03	15.56	19.61	0.50
F10c	1106.82	Regional	16.02	131.33	132.94		133.07	0.002331	1.71	11.75	12.24	0.46
F10c	1075.17	100 year	22.93	131.23	132.68	132.68	133.19	0.010721	3.47	10.09	12.20	0.97
F10c	1075.17	Regional	16.02	131.23	132.73		132.96	0.004497	2.31	10.77	12.81	0.64
F10c	1050.33	100 year	22.93	131.10	132.91	132.33	132.95	0.000719	0.95	28.45	57.42	0.25
F10c	1050.33	Regional	16.02	131.10	132.76	132.15	132.85	0.001507	1.28	14.14	16.87	0.36
F10c	993.63	100 year	22.93	131.12	132.91	132.15	132.93	0.000372	0.71	42.77	75.03	0.19
F10c	993.63	Regional	16.02	131.12	132.75	131.99	132.80	0.000826	0.98	20.06	35.19	0.27
F10c	987.32	100 year	22.93	130.80	132.84	131.86	132.91	0.000113	1.17	28.16	60.74	0.28
F10c	987.32	Regional	16.02	130.80	132.75	131.69	132.79	0.000066	0.86	23.68	40.98	0.21
F10c	950		Culvert									
F10c	922.26	100 year	22.93	130.39	131.73	131.73	132.07	0.009884	2.66	10.82	21.63	0.88
F10c	922.26	Regional	16.02	130.39	131.57	131.52	131.84	0.009558	2.32	7.72	16.63	0.84
F10c	914.42	100 year	22.93	130.45	131.52	131.52	131.87	0.010441	2.83	12.56	22.23	0.92
F10c	914.42	Regional	16.02	130.45	131.33	131.33	131.64	0.011992	2.62	8.66	18.37	0.95
F10c	896.1	100 year	22.93	130.37	131.25	131.25	131.56	0.011631	2.58	11.49	22.03	0.94
F10c	896.1	Regional	16.02	130.37	131.10	131.10	131.36	0.012584	2.32	8.38	19.19	0.94
F10c	874.03	100 year	22.93	130.15	130.85	130.84	131.08	0.013190	2.17	11.61	26.59	0.94
F10c	874.03	Regional	16.02	130.15	130.74	130.72	130.92	0.013370	1.90	8.97	24.49	0.92
F10c	843.86	100 year	22.93	129.92	130.84	130.50	130.90	0.001983	1.07	24.61	40.84	0.39
F10c	843.86	Regional	16.02	129.92	130.74	130.41	130.78	0.001563	0.87	20.72	37.84	0.34
F10c	819.59	100 year	22.93	129.08	130.84		130.86	0.000674	0.94	67.74	135.54	0.25

HEC-RAS Plan: Sub (Continued)

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)	
F10c	819.59	Regional	16.02	129.08	130.74		130.75	0.000530	0.79	54.26	123.20	0.22
F10c	779.29	100 year	22.93	128.84	130.74	130.28	130.81	0.001439	1.35	35.79	100.28	0.36
F10c	779.29	Regional	16.02	128.84	130.67	130.18	130.72	0.000924	1.05	29.53	91.08	0.29
F10c	764.3998		Culvert									
F10c	751.21	100 year	22.93	128.72	130.28	130.28	130.51	0.006065	2.31	17.35	55.41	0.70
F10c	751.21	Regional	16.02	128.72	130.04	130.03	130.32	0.009036	2.40	8.04	24.66	0.82
F10c	693.32	100 year	22.93	127.48	130.23	129.04	130.26	0.000411	0.88	46.37	67.69	0.20
F10c	693.32	Regional	16.02	127.48	130.13	128.82	130.14	0.000262	0.68	39.60	58.06	0.16
F10c	610.69	100 year	22.93	127.27	130.24	128.75	130.24	0.000081	0.43	125.49	133.01	0.09
F10c	610.69	Regional	16.02	127.27	130.13	128.54	130.13	0.000053	0.33	111.20	125.72	0.07
F10c	527.85	100 year	22.93	126.90	130.24	128.06	130.24	0.000016	0.22	168.36	103.42	0.04
F10c	527.85	Regional	16.02	126.90	130.13	127.96	130.13	0.000009	0.17	157.11	101.00	0.03
F10c	457.59	100 year	22.93	126.64	130.24	127.87	130.24	0.000022	0.29	140.14	101.76	0.05
F10c	457.59	Regional	16.02	126.64	130.13	127.77	130.13	0.000013	0.21	129.35	95.47	0.04
F10c	435.47	100 year	22.93	126.56	130.23	128.87	130.24	0.000047	0.43	95.85	80.78	0.07
F10c	435.47	Regional	16.02	126.56	130.13	128.39	130.13	0.000028	0.33	82.08	42.49	0.06
F10c	421.0022		Culvert									
F10c	385.75	100 year	22.93	126.53	128.68	128.68	128.72	0.000589	1.05	33.60	28.33	0.24
F10c	385.75	Regional	16.02	126.53	128.31	128.31	129.20	0.009932	4.18	3.83	25.38	1.00
F10c	351.88	100 year	22.93	125.37	127.01	126.69	127.21	0.004791	1.97	12.14	15.25	0.62
F10c	351.88	Regional	16.02	125.37	126.84	126.48	126.98	0.003939	1.64	9.86	12.45	0.55
F10c	317.02	100 year	22.93	124.18	127.06	125.70	127.11	0.000631	1.01	26.44	29.60	0.24
F10c	317.02	Regional	16.02	124.18	126.88	125.46	126.91	0.000455	0.80	21.86	21.74	0.20
F10c	275.57	100 year	22.93	123.29	127.01	125.22	127.08	0.000782	1.19	20.63	13.45	0.24
F10c	275.57	Regional	16.02	123.29	126.85	124.89	126.89	0.000482	0.89	18.67	11.77	0.19
F10c	216.24	100 year	22.93	121.83	127.02	124.54	127.04	0.000131	0.62	52.31	36.26	0.11
F10c	216.24	Regional	16.02	121.83	126.86	123.96	126.87	0.000078	0.47	46.69	33.56	0.08
F10c	194.6252		Culvert									
F10c	165.01	100 year	22.93	121.46	124.96	123.20	125.03	0.000827	1.17	19.86	10.43	0.25
F10c	165.01	Regional	16.02	121.46	124.82	122.89	124.86	0.000492	0.88	18.41	9.63	0.19
F10c	148.7	100 year	22.93	120.65	124.98	122.42	125.00	0.000160	0.75	50.72	24.10	0.12
F10c	148.7	Regional	16.02	120.65	124.83	122.08	124.84	0.000093	0.55	47.09	23.27	0.09
F10c	128.45	100 year	22.93	120.08	124.98	121.87	125.00	0.000096	0.68	67.53	28.88	0.10
F10c	128.45	Regional	16.02	120.08	124.83	121.55	124.84	0.000054	0.50	63.22	27.41	0.08
F10c	113.75	100 year	22.93	120.60	124.97	123.15	124.99	0.000662	0.81	47.33	40.33	0.13
F10c	113.75	Regional	16.02	120.60	124.82	122.60	124.83	0.000414	0.62	41.58	35.48	0.10
F10c	104.7621		Culvert									
F10c	88.6	100 year	22.93	120.08	121.32	121.32	121.73	0.017302	4.35	12.23	15.61	1.24
F10c	88.6	Regional	16.02	120.08	121.30	121.30	121.51	0.009108	3.12	11.87	15.36	0.90
F10c	52.9	100 year	22.93	118.80	120.14		120.24	0.004374	2.17	27.76	45.05	0.62
F10c	52.9	Regional	16.02	118.80	121.17		121.18	0.000100	0.49	85.75	63.00	0.10
F9b	11114.35	100 year	1.82	144.45	144.71	144.57	144.71	0.001798	0.26	7.07	42.29	0.20
F9b	11114.35	Regional	0.60	144.45	144.62	144.52	144.62	0.001580	0.17	3.47	34.69	0.17
F9b	11114.32	100 year	1.82	144.26	144.70	144.41	144.70	0.000474	0.13	16.77	81.02	0.07
F9b	11114.32	Regional	0.60	144.26	144.61	144.35	144.61	0.000177	0.07	9.67	49.82	0.04
F9b	11114.3	100 year	1.82	144.16	144.69	144.37	144.69	0.000162	0.09	23.20	85.52	0.04
F9b	11114.3	Regional	0.60	144.16	144.61	144.27	144.61	0.000040	0.04	16.79	74.15	0.02
F9b	11114.25		Culvert									
F9b	11114.2	100 year	1.82	144.17	144.68	144.61	144.68	0.000644	0.27	16.27	115.36	0.18
F9b	11114.2	Regional	0.60	144.17	144.51	144.42	144.54	0.006703	0.78	0.76	3.86	0.56

HEC-RAS Plan: Sub (Continued)

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)	
F9b	11114.1	100 year	1.82	143.93	144.60	144.40	144.64	0.004406	0.87	2.08	6.48	0.49
F9b	11114.1	Regional	0.60	143.93	144.46	144.20	144.47	0.001272	0.45	1.33	4.39	0.26
F9b	10065.55	100 year	8.06	143.49	144.20	144.20	144.35	0.015705	2.18	7.64	30.22	1.00
F9b	10065.55	Regional	5.06	143.49	144.11	144.11	144.23	0.015009	1.85	5.18	23.66	0.94
F9b	10065.5	100 year	8.06	142.59	143.33	143.22	143.39	0.004344	1.18	11.43	48.31	0.53
F9b	10065.5	Regional	5.06	142.59	143.23	143.10	143.28	0.004492	1.03	6.97	37.44	0.52
F9b	9990	100 year	8.06	142.25	142.89	142.89	143.03	0.018252	1.68	4.79	16.61	1.00
F9b	9990	Regional	5.06	142.25	142.78	142.78	142.90	0.019569	1.57	3.22	13.04	1.01
F9b	9745	100 year	8.06	141.91	142.46	142.36	142.48	0.002979	0.88	21.33	96.23	0.43
F9b	9745	Regional	5.06	141.91	142.40	142.33	142.42	0.003077	0.80	12.75	59.36	0.43
F9b	9500	100 year	8.06	141.57	141.85	141.85	141.94	0.022171	1.33	6.07	34.89	1.01
F9b	9500	Regional	5.06	141.57	141.80	141.80	141.87	0.021943	1.11	4.56	33.98	0.97
F9b	9358.08	100 year	8.06	140.96	141.45	141.31	141.48	0.013486	0.77	12.27	47.62	0.40
F9b	9358.08	Regional	5.06	140.96	141.36	141.25	141.38	0.015121	0.68	8.34	38.52	0.40
F9b	9200	100 year	8.06	139.76	140.38	140.34	140.49	0.011192	1.56	6.57	22.98	0.82
F9b	9200	Regional	5.06	139.76	140.30	140.24	140.38	0.010402	1.29	4.83	21.18	0.76
F9b	9104.84	100 year	8.06	138.74	139.20	139.20	139.32	0.012350	1.69	6.24	25.13	0.87
F9b	9104.84	Regional	5.06	138.74	139.12	139.12	139.22	0.012582	1.47	4.31	23.37	0.84
F9b	9104.838	100 year	8.06	137.95	138.77	138.55	138.80	0.002097	1.00	12.44	34.32	0.39
F9b	9104.838	Regional	5.06	137.95	138.66	138.45	138.69	0.001814	0.83	9.02	30.37	0.35
F9b	9104.8	100 year	8.06	138.02	138.45	138.45	138.57	0.013746	1.58	5.95	26.48	0.89
F9b	9104.8	Regional	5.06	138.02	138.38	138.37	138.47	0.015340	1.38	4.00	22.50	0.89
F9b	9103.71	100 year	8.06	136.96	137.59	137.52	137.67	0.007009	1.40	8.98	29.30	0.67
F9b	9103.71	Regional	5.06	136.96	137.50	137.43	137.56	0.006615	1.18	6.45	27.83	0.63
F9b	9098.22	100 year	8.06	136.12	136.53	136.53	136.67	0.015510	1.75	5.66	21.97	0.95
F9b	9098.22	Regional	5.06	136.12	136.45	136.45	136.56	0.016984	1.53	3.91	19.87	0.95
F9b	8899.56	100 year	8.06	135.31	135.87	135.77	135.93	0.005271	1.19	10.37	37.52	0.58
F9b	8899.56	Regional	5.06	135.31	135.76	135.69	135.82	0.006100	1.07	6.64	33.71	0.59
F9b	8898.47	100 year	8.06	134.78	135.35	135.35	135.52	0.012755	1.96	5.70	19.61	0.91
F9b	8898.47	Regional	5.06	134.78	135.23	135.22	135.37	0.013960	1.70	3.68	15.65	0.91
F9b	8897.37	100 year	8.06	134.36	134.93	134.92	135.05	0.011941	1.87	8.92	37.30	0.88
F9b	8897.37	Regional	5.06	134.36	134.85	134.83	134.94	0.010570	1.55	6.17	29.88	0.80
F9d	9200	100 year	8.77	140.17	140.93	140.93	141.12	0.010903	2.17	6.74	19.98	0.88
F9d	9200	Regional	6.00	140.17	140.82	140.82	140.99	0.011052	1.93	4.76	17.46	0.86
F9d	9104.84	100 year	8.77	139.79	140.13	140.10	140.16	0.011133	1.08	13.44	52.90	0.74
F9d	9104.84	Regional	6.00	139.79	140.10	140.10	140.11	0.008378	0.83	11.56	51.93	0.63
F9d	9103.74	100 year	8.77	139.20	139.59	139.55	139.68	0.022684	1.63	9.56	51.30	1.08
F9d	9103.74	Regional	6.00	139.20	139.53	139.53	139.60	0.027179	1.51	6.54	40.98	1.13
F9d	9103.71	100 year	8.77	138.14	138.69	138.64	138.83	0.012679	1.72	6.58	21.44	0.87
F9d	9103.71	Regional	6.00	138.14	138.61	138.57	138.71	0.011534	1.50	4.96	17.63	0.82
F9d	9103.60	100 year	8.77	137.79	138.19	138.19	138.33	0.018939	1.66	5.57	22.69	1.01
F9d	9103.60	Regional	6.00	137.79	138.14	138.14	138.24	0.019242	1.44	4.33	21.47	0.98
F9d	9102.54	100 year	8.77	137.45	137.98	137.76	138.01	0.002179	0.78	11.92	31.50	0.37
F9d	9102.54	Regional	6.00	137.45	137.88	137.71	137.90	0.002519	0.71	8.79	28.56	0.38
F9d	9100.31	100 year	8.77	136.96	137.77	137.54	137.83	0.003633	1.09	8.09	17.41	0.49
F9d	9100.31	Regional	6.00	136.96	137.67	137.44	137.71	0.003258	0.93	6.46	15.12	0.45
F9d	8898.47	100 year	8.77	136.33	137.01	137.01	137.18	0.011842	2.01	6.36	22.22	0.89
F9d	8898.47	Regional	6.00	136.33	136.90	136.90	137.06	0.014334	1.89	4.19	16.80	0.94
F9d	8898.466	100 year	8.77	135.55	136.08	136.00	136.18	0.007753	1.42	6.45	17.56	0.70
F9d	8898.466	Regional	6.00	135.55	135.99	135.92	136.07	0.008218	1.25	4.91	16.25	0.69
F9d	8898.4	100 year	8.77	134.86	135.43	135.42	135.58	0.011549	2.00	7.66	22.86	0.88

HEC-RAS Plan: Sub (Continued)

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)	
F9d	8898.4	Regional	6.00	134.86	135.35	135.33	135.47	0.010710	1.72	5.86	21.52	0.82
F9d	8896.28	100 year	8.77	134.58	135.04	135.04	135.20	0.014648	1.82	5.34	18.91	0.94
F9d	8896.28	Regional	6.00	134.58	134.95	134.95	135.09	0.016959	1.64	3.82	15.39	0.97
F9c	5320.135	100 year	46.89	144.92	148.29	146.74	148.56	0.001260	2.28	20.56	86.67	0.40
F9c	5320.135	Regional	180.63	144.92	150.19	149.33	150.21	0.000140	0.85	341.63	194.63	0.13
F9c	5304.525		Culvert									
F9c	5284.122	100 year	46.89	145.36	147.92	147.18	148.38	0.005257	3.00	15.62	31.05	0.60
F9c	5284.122	Regional	180.63	145.36	149.13	148.91	149.75	0.006860	4.43	75.33	55.77	0.73
F9c	5218.666	100 year	46.89	145.35	147.88	147.53	148.01	0.002080	2.20	49.97	50.30	0.46
F9c	5218.666	Regional	180.63	145.35	149.14	148.45	149.28	0.002059	2.91	153.17	97.28	0.49
F9c	5130.550	100 year	46.89	145.24	147.58	147.29	147.78	0.003226	2.52	39.79	45.55	0.56
F9c	5130.550	Regional	180.63	145.24	149.02	148.43	149.12	0.001513	2.45	190.03	145.07	0.42
F9c	5023.220	100 year	46.89	144.84	147.48	146.52	147.56	0.001027	1.43	51.08	53.77	0.32
F9c	5023.220	Regional	180.63	144.84	148.77	147.91	148.95	0.001431	2.35	145.00	84.80	0.41
F9c	4886.696	100 year	46.89	144.52	146.80	146.66	147.25	0.006140	3.32	24.70	27.64	0.76
F9c	4886.696	Regional	180.63	144.52	148.63	148.08	148.74	0.001421	2.48	207.32	154.43	0.41
F9c	4777.492	100 year	46.89	143.95	146.20	146.20	146.57	0.005801	3.00	26.78	39.94	0.72
F9c	4777.492	Regional	180.63	143.95	148.63	147.06	148.65	0.000281	1.18	390.73	185.30	0.18
F9c	4666.765	100 year	46.89	143.42	146.04	145.62	146.08	0.001460	1.21	87.39	117.15	0.26
F9c	4666.765	Regional	180.63	143.42	148.61	146.17	148.62	0.000181	0.71	452.36	168.59	0.10
F9c	4547.600	100 year	46.89	142.87	144.99	144.99	145.61	0.015883	3.49	14.19	13.44	0.95
F9c	4547.600	Regional	180.63	142.87	148.60	146.25	148.61	0.000115	0.67	485.62	188.55	0.10
F9c	4434.975	100 year	46.89	142.39	145.15	144.70	145.19	0.000775	1.29	100.49	137.27	0.27
F9c	4434.975	Regional	180.63	142.39	148.59	145.35	148.60	0.000039	0.54	770.12	228.84	0.07
F9c	4289.926	100 year	46.89	141.68	145.11	143.60	145.13	0.000244	0.80	125.10	118.17	0.16
F9c	4289.926	Regional	180.63	141.68	148.58	144.92	148.59	0.000044	0.61	655.05	190.00	0.08
F9c	4216.177	100 year	46.89	141.61	144.81	143.27	145.03	0.001142	2.10	22.38	73.72	0.37
F9c	4216.177	Regional	180.63	141.61	147.13	145.69	148.25	0.002743	4.67	38.64	166.65	0.64
F9c	4200.041		Culvert									
F9c	4176.723	100 year	46.89	141.83	144.15	143.49	144.58	0.003306	2.88	16.27	52.51	0.60
F9c	4176.723	Regional	180.63	141.83	145.13	145.13	145.41	0.003512	3.20	126.79	135.24	0.57
F9c	4051.653	100 year	46.89	141.33	143.76	143.76	143.97	0.004927	2.58	48.82	115.44	0.64
F9c	4051.653	Regional	180.63	141.33	144.84	144.24	144.90	0.001337	1.88	238.31	184.31	0.36
F9c	3974.777	100 year	46.89	140.92	143.60	143.15	143.68	0.001603	1.88	79.10	126.69	0.40
F9c	3974.777	Regional	180.63	140.92	144.75	144.00	144.80	0.001104	2.04	267.09	176.18	0.35
F9c	3851.504	100 year	46.89	140.40	143.07	142.66	143.37	0.003845	2.80	37.31	78.22	0.61
F9c	3851.504	Regional	180.63	140.40	144.45	143.88	144.61	0.002153	2.91	168.65	105.31	0.49
F9c	3728.048	100 year	46.89	139.85	142.76		142.96	0.002484	2.34	40.05	53.63	0.49
F9c	3728.048	Regional	180.63	139.85	143.91		144.25	0.003620	3.70	116.46	71.88	0.64
F9c	3636.840	100 year	46.89	139.60	142.53	141.95	142.74	0.002464	2.23	44.40	81.18	0.48
F9c	3636.840	Regional	180.63	139.60	143.76		143.95	0.002248	2.87	158.33	100.58	0.50
F9c	3482.029	100 year	46.89	139.07	141.87	141.40	142.21	0.004744	2.61	21.07	38.12	0.64
F9c	3482.029	Regional	180.63	139.07	143.46		143.63	0.001868	2.53	166.29	110.81	0.45
F9c	3351.153	100 year	46.89	138.48	141.54	140.79	141.75	0.002297	2.11	32.87	49.78	0.46
F9c	3351.153	Regional	180.63	138.48	143.15	142.47	143.38	0.001849	2.76	140.49	81.03	0.46
F9c	3200.228	100 year	46.89	137.89	141.13		141.28	0.003990	1.83	32.87	27.59	0.39
F9c	3200.228	Regional	180.63	137.89	142.36		142.83	0.008585	3.57	77.74	47.72	0.61
F9c	3116.725	100 year	46.89	137.07	141.12		141.14	0.000595	0.86	97.08	93.38	0.17
F9c	3116.725	Regional	180.63	137.07	142.50		142.54	0.000845	1.34	232.93	103.29	0.21
F9c	3076.132	100 year	47.60	136.98	140.88	138.75	141.07	0.000918	1.89	25.16	79.45	0.31
F9c	3076.132	Regional	184.13	136.98	142.45	141.43	142.51	0.000778	1.48	242.20	121.76	0.22

HEC-RAS Plan: Sub (Continued)

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)	
F9c	3062.288		Culvert									
F9c	3044.979	100 year	47.60	137.38	140.38	139.16	140.46	0.000888	1.50	65.10	73.25	0.29
F9c	3044.979	Regional	184.13	137.38	141.83	140.81	141.96	0.001141	2.24	194.39	101.94	0.35
F9c	2947.645	100 year	47.60	137.14	139.92	139.92	140.23	0.004625	2.79	38.07	78.60	0.60
F9c	2947.645	Regional	184.13	137.14	141.75		141.83	0.001167	2.10	210.46	104.86	0.34
F9c	2815.047	100 year	47.60	136.61	139.23		139.54	0.003898	2.46	21.33	21.12	0.59
F9c	2815.047	Regional	184.13	136.61	140.55	140.55	141.44	0.006418	4.57	65.21	45.84	0.83
F9c	2726.468	100 year	47.60	136.31	138.74	138.41	139.11	0.005918	2.72	20.82	35.37	0.71
F9c	2726.468	Regional	184.13	136.31	139.90	139.90	140.60	0.007042	4.32	74.63	56.31	0.85
F9c	2611.818	100 year	47.60	135.67	138.08	137.77	138.43	0.005923	2.68	23.65	44.45	0.71
F9c	2611.818	Regional	184.13	135.67	139.48		139.84	0.003869	3.34	113.05	85.39	0.63
F9c	2459.970	100 year	47.60	134.82	137.57		137.77	0.002938	2.07	32.03	41.62	0.51
F9c	2459.970	Regional	184.13	134.82	139.03		139.33	0.002769	2.98	115.68	72.03	0.54
F9c	2358.700	100 year	47.60	134.48	136.69	136.57	137.23	0.009999	3.25	14.66	11.05	0.90
F9c	2358.700	Regional	184.13	134.48	138.17	138.17	138.88	0.006577	4.18	57.76	50.24	0.82
F9c	2183.293	100 year	47.60	133.07	135.41	135.21	135.82	0.006279	2.91	18.30	30.30	0.74
F9c	2183.293	Regional	184.13	133.07	136.59		136.88	0.003346	3.08	91.18	79.31	0.59
F9c	2057.916	100 year	47.60	131.98	134.08	134.08	134.72	0.012617	3.54	13.44	10.60	1.00
F9c	2057.916	Regional	184.13	131.98	135.83	135.83	136.36	0.004823	3.74	71.81	69.64	0.71
F9c	1914.734	100 year	47.60	130.99	133.82		133.96	0.001970	1.77	36.92	67.52	0.42
F9c	1914.734	Regional	184.13	130.99	135.13		135.20	0.000721	1.53	175.40	127.34	0.28
F9c	1744.457	100 year	47.60	130.82	133.56	132.92	133.66	0.001469	1.60	55.30	93.99	0.37
F9c	1744.457	Regional	184.13	130.82	135.03	133.98	135.08	0.000593	1.48	224.65	132.30	0.26
F9c	1609.319	100 year	47.60	130.43	133.13	132.56	133.37	0.002805	2.28	33.60	52.73	0.51
F9c	1609.319	Regional	184.13	130.43	134.65	134.03	134.92	0.002332	3.02	123.49	66.10	0.51
F9c	1529.355	100 year	47.60	130.23	132.88	132.34	133.14	0.003024	2.35	30.31	41.41	0.53
F9c	1529.355	Regional	184.13	130.23	134.27	133.89	134.68	0.003497	3.59	113.34	77.95	0.62
F9c	1409.454	100 year	47.60	129.59	131.95	131.95	132.50	0.010258	3.65	21.96	28.58	0.87
F9c	1409.454	Regional	184.13	129.59	133.09	133.09	133.93	0.012114	5.52	76.47	61.69	1.03
F9c	1325.243	100 year	47.60	129.18	131.69	131.15	131.89	0.002745	2.09	38.64	62.74	0.50
F9c	1325.243	Regional	184.13	129.18	133.18	132.44	133.38	0.001999	2.67	145.29	81.09	0.47
F9c	1209.205	100 year	47.60	128.92	130.76	130.76	131.30	0.010046	3.32	16.43	20.89	0.92
F9c	1209.205	Regional	184.13	128.92	132.19	132.19	132.93	0.006926	4.49	77.32	60.14	0.86
F9e	8894.10	100 year	14.57	134.05	134.83	134.56	134.87	0.002707	1.16	27.63	60.20	0.45
F9e	8894.10	Regional	11.46	134.05	134.75	134.52	134.78	0.002728	1.07	23.00	55.98	0.44
F9e	8894.092	100 year	14.57	134.07	134.75	134.58	134.80	0.003937	1.30	20.97	49.68	0.53
F9e	8894.092	Regional	11.46	134.07	134.66	134.52	134.71	0.004309	1.24	16.95	46.57	0.54
F9e	8894.09	100 year	14.57	133.80	134.43	134.42	134.63	0.011972	2.02	8.92	25.12	0.89
F9e	8894.09	Regional	11.46	133.80	134.36	134.34	134.53	0.012382	1.86	7.25	22.29	0.89
F9e	8886.49	100 year	14.57	133.49	134.29		134.38	0.004490	1.41	13.29	28.20	0.57
F9e	8886.49	Regional	11.46	133.49	134.22		134.29	0.004148	1.26	11.44	27.09	0.53
F9e	8530.47	100 year	14.57	132.88	133.58	133.58	133.78	0.013652	2.11	8.86	24.24	0.95
F9e	8530.47	Regional	11.46	132.88	133.50	133.50	133.69	0.015931	2.03	6.94	21.87	1.00
F9e	8515.13	100 year	14.57	131.54	132.61	132.51	132.80	0.007431	1.98	8.60	19.49	0.74
F9e	8515.13	Regional	11.46	131.54	132.53	132.41	132.68	0.007013	1.77	7.14	15.79	0.70
F9e	8503.16	100 year	14.57	131.12	131.99	131.99	132.26	0.013913	2.28	6.60	14.23	0.97
F9e	8503.16	Regional	11.46	131.12	131.91	131.91	132.14	0.015313	2.14	5.42	12.66	0.99
F9e	8282.69	100 year	14.57	129.77	130.91	130.90	131.16	0.011737	2.42	8.49	16.63	0.91
F9e	8282.69	Regional	11.46	129.77	130.90	130.82	131.06	0.007661	1.94	8.32	16.59	0.74
F9e	8281.61	100 year	14.57	129.29	130.47	130.47	130.83	0.013421	2.68	5.84	9.36	0.98
F9e	8281.61	Regional	11.46	129.29	130.86		130.95	0.001959	1.35	9.92	11.57	0.40

HEC-RAS Plan: Sub (Continued)

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)	
F9e	8170	100 year	14.57	128.58	129.41	129.41	129.70	0.014586	2.42	6.08	10.97	1.00
F9e	8170	Regional	11.46	128.58	130.92	129.31	130.92	0.000024	0.23	117.64	89.06	0.05
F9f	3400	100 year	48.35	126.79	129.12		129.36	0.003406	2.15	22.53	14.32	0.55
F9f	3400	Regional	187.57	126.79	130.19	130.15	130.76	0.005905	3.76	86.03	78.54	0.77
F9f	3027	100 year	48.35	126.08	127.74	127.74	128.34	0.050853	3.43	14.10	11.82	1.00
F9f	3027	Regional	187.57	126.08	129.64		129.84	0.008766	2.48	113.19	94.77	0.48
F9f	2674	100 year	48.35	124.65	126.99		127.21	0.003177	2.09	23.15	14.57	0.53
F9f	2674	Regional	187.57	124.65	128.47	128.12	129.12	0.004799	3.69	64.94	42.34	0.71
F9f	2289	100 year	48.35	124.35	126.38	126.01	126.72	0.005587	2.57	18.83	13.33	0.69
F9f	2289	Regional	187.57	124.35	128.14	127.73	128.58	0.003492	3.25	92.61	61.54	0.61
F9f	1992	100 year	48.35	123.81	125.64		126.09	0.008381	2.98	16.25	12.53	0.83
F9f	1992	Regional	187.57	123.81	127.33	127.19	128.12	0.006278	4.17	60.15	36.51	0.81
F9f	1583	100 year	48.35	122.25	124.10	124.07	124.80	0.012459	3.70	13.06	8.90	0.98
F9f	1583	Regional	187.57	122.25	126.21	126.21	127.22	0.008011	4.74	54.91	31.42	0.86
F9f	1207	100 year	48.35	121.09	122.75	122.75	123.35	0.012447	3.43	14.08	11.82	1.00
F9f	1207	Regional	187.57	121.09	126.51	124.30	126.58	0.000443	1.59	231.14	87.19	0.24
F9f	911	100 year	48.35	119.85	121.84		122.20	0.006011	2.64	18.31	13.31	0.71
F9f	911	Regional	187.57	119.85	126.51		126.55	0.000155	1.13	333.13	88.32	0.15
F9f	574	100 year	48.35	119.07	121.77		121.87	0.001322	1.61	58.07	58.46	0.34
F9f	574	Regional	187.57	119.07	126.52		126.53	0.000084	0.86	472.17	112.14	0.10
F9f	476	100 year	48.35	118.66	121.42	120.37	121.75	0.002038	2.54	19.05	33.65	0.49
F9f	476	Regional	187.57	118.66	126.51	122.88	126.53	0.000099	0.93	445.61	121.73	0.11
F9f	400		Culvert									
F9f	325	100 year	48.35	118.63	120.34	120.34	121.19	0.010038	4.09	11.81	18.83	1.00
F9f	325	Regional	187.57	118.63	121.87	121.87	122.67	0.006470	4.60	73.27	47.05	0.84
F9f	194	100 year	48.35	118.30	119.94	119.94	120.38	0.007792	3.30	25.35	35.59	0.85
F9f	194	Regional	187.57	118.30	121.15	121.15	121.80	0.007560	4.77	87.27	61.28	0.92

RJB Updated HEC-RAS Model Results – Mixed Flow Regime Run

HEC-RAS Plan: MF

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)	
F10b	9301.79	100 year	1.06	139.38	139.59	139.54	139.61	0.006659	0.69	1.83	14.25	0.55
F10b	9301.79	Regional	0.64	139.38	139.56	139.51	139.57	0.004958	0.52	1.42	13.38	0.46
F10b	9234.48	100 year	1.06	138.76	138.92	138.90	138.96	0.014882	0.89	1.20	9.30	0.79
F10b	9234.48	Regional	0.64	138.76	138.87	138.87	138.91	0.027281	0.90	0.71	8.62	0.99
F10b	9173.1	100 year	1.06	138.36	138.67	138.54	138.68	0.002142	0.48	2.23	10.28	0.33
F10b	9173.1	Regional	0.64	138.36	138.63	138.50	138.64	0.001481	0.36	1.79	9.67	0.26
F10a	9254.3	100 year	1.35	140.27	141.14	140.93	141.20	0.005203	1.10	1.22	2.58	0.51
F10a	9254.3	Regional	0.81	140.27	141.00	140.81	141.04	0.004675	0.92	0.88	2.30	0.47
F10a	9217.82	100 year	1.35	140.02	140.50	140.50	140.64	0.019858	1.66	0.81	2.88	1.00
F10a	9217.82	Regional	0.81	140.02	140.40	140.40	140.51	0.021131	1.49	0.54	2.39	1.00
F10a	9203.28	100 year	1.35	139.46	140.07	139.96	140.15	0.008219	1.26	1.07	2.81	0.66
F10a	9203.28	Regional	0.81	139.46	139.94	139.85	140.01	0.008194	1.10	0.74	2.40	0.64
F10a	9196.19	100 year	1.35	139.22	139.91	139.73	139.95	0.005239	0.90	1.51	6.18	0.52
F10a	9196.19	Regional	0.81	139.22	139.77	139.63	139.81	0.005078	0.84	0.96	3.42	0.51
F10a	9151.47	100 year	1.35	139.04	139.49	139.49	139.64	0.020112	1.72	0.79	2.64	1.00
F10a	9151.47	Regional	0.81	139.04	139.39	139.39	139.51	0.021504	1.53	0.53	2.24	1.00
F10c	1960.69	100 year	22.93	137.58	138.16	138.02	138.22	0.005082	1.09	24.80	66.59	0.56
F10c	1960.69	Regional	16.02	137.58	138.07	137.96	138.12	0.005800	0.99	19.05	62.91	0.57
F10c	1948.7	100 year	22.93	137.31	137.94		138.01	0.004316	1.19	21.34	56.23	0.53
F10c	1948.7	Regional	16.02	137.31	137.85		137.91	0.004149	1.03	16.67	49.86	0.51
F10c	1930	100 year	22.93	136.99	137.71	137.68	137.85	0.011542	1.68	14.81	51.09	0.84
F10c	1930	Regional	16.02	136.99	137.62	137.59	137.74	0.013702	1.56	10.35	34.31	0.88
F10c	1900	100 year	22.93	136.65	137.47		137.51	0.002170	1.11	37.29	72.44	0.41
F10c	1900	Regional	16.02	136.65	137.33		137.37	0.002379	1.01	27.39	66.53	0.41
F10c	1844.23	100 year	22.93	136.13	137.43		137.46	0.000857	0.92	45.32	67.69	0.27
F10c	1844.23	Regional	16.02	136.13	137.29		137.32	0.000705	0.77	36.44	62.99	0.24
F10c	1733.27	100 year	22.93	136.05	137.39		137.41	0.000579	0.79	52.43	69.83	0.23
F10c	1733.27	Regional	16.02	136.05	137.26		137.28	0.000433	0.64	43.97	64.72	0.19
F10c	1700	100 year	22.93	135.82	137.38		137.40	0.000352	0.67	54.74	63.35	0.18
F10c	1700	Regional	16.02	135.82	137.25		137.27	0.000250	0.53	47.06	61.55	0.15
F10c	1671.72	100 year	22.93	136.67	137.16	137.16	137.35	0.016791	1.90	12.04	32.57	1.00
F10c	1671.72	Regional	16.02	136.67	137.08	137.08	137.23	0.017889	1.70	9.43	31.76	1.00
F10c	1656.25	100 year	22.93	135.54	136.84	136.09	136.88	0.000829	0.80	29.75	79.60	0.26
F10c	1656.25	Regional	16.02	135.54	136.75	135.98	136.77	0.000496	0.62	25.98	26.84	0.20
F10c	1628.94	100 year	22.93	135.76	136.85		136.85	0.000444	0.40	92.79	161.04	0.17
F10c	1628.94	Regional	16.02	135.76	136.75		136.75	0.000361	0.35	77.91	147.19	0.15
F10c	1601.83	100 year	22.93	134.80	136.83	135.53	136.84	0.000243	0.55	67.26	110.58	0.15
F10c	1601.83	Regional	16.02	134.80	136.74	135.39	136.75	0.000160	0.42	57.56	108.48	0.12
F10c	1575.58	100 year	22.93	136.39	136.67	136.67	136.81	0.103464	2.56	14.47	62.31	2.12
F10c	1575.58	Regional	16.02	136.39	136.61	136.61	136.72	0.091600	2.17	11.18	51.65	1.94
F10c	1561.41	100 year	22.93	135.30	136.31	135.87	136.36	0.001491	1.06	28.22	41.41	0.35
F10c	1561.41	Regional	16.02	135.30	136.21	135.77	136.24	0.001088	0.84	24.24	39.91	0.29
F10c	1537.16	100 year	22.93	134.94	136.31	135.50	136.34	0.000424	0.68	42.06	52.53	0.19
F10c	1537.16	Regional	16.02	134.94	136.21	135.40	136.23	0.000282	0.52	36.93	50.68	0.16
F10c	1507.9	100 year	22.93	134.51	136.28		136.32	0.000802	1.16	44.58	40.34	0.28
F10c	1507.9	Regional	16.02	134.51	136.20		136.22	0.000481	0.87	41.14	38.95	0.22
F10c	1483.96	100 year	22.93	134.31	136.28		136.30	0.000446	0.91	53.46	43.84	0.21
F10c	1483.96	Regional	16.02	134.31	136.20		136.21	0.000259	0.67	49.79	41.79	0.16
F10c	1476.53	100 year	22.93	134.23	136.28	135.26	136.30	0.000447	0.95	63.97	72.37	0.22
F10c	1476.53	Regional	16.02	134.23	136.19	135.09	136.20	0.000242	0.68	57.46	51.30	0.16
F10c	1455		Culvert									

HEC-RAS Plan: MF (Continued)

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)	
F10c	1442.84	100 year	22.93	134.06	135.05	135.05	135.41	0.011998	2.97	11.84	17.85	0.99
F10c	1442.84	Regional	16.02	134.06	134.93	134.88	135.18	0.009663	2.44	9.82	16.91	0.86
F10c	1427.43	100 year	22.93	134.08	135.05	134.94	135.29	0.009156	2.54	14.56	20.59	0.86
F10c	1427.43	Regional	16.02	134.08	134.92		135.09	0.007839	2.12	11.98	19.87	0.77
F10c	1417	100 year	22.93	134.05	134.87	134.87	135.17	0.015883	2.91	13.23	23.23	1.09
F10c	1417	Regional	16.02	134.05	134.74	134.74	134.98	0.016072	2.56	10.28	22.19	1.06
F10c	1367.55	100 year	22.93	133.23	134.24	134.31	134.56	0.011578	2.67	13.50	37.10	0.94
F10c	1367.55	Regional	16.02	133.23	134.10	134.11	134.36	0.011796	2.37	9.16	23.43	0.92
F10c	1341.92	100 year	22.93	132.74	134.18	133.76	134.26	0.002368	1.66	32.95	50.97	0.46
F10c	1341.92	Regional	16.02	132.74	134.07	133.71	134.12	0.001770	1.35	27.19	47.02	0.39
F10c	1317.36	100 year	22.93	132.72	134.13	133.80	134.22	0.003149	1.94	27.88	34.41	0.54
F10c	1317.36	Regional	16.02	132.72	134.04	133.67	134.09	0.002116	1.51	24.73	33.12	0.43
F10c	1315.69	100 year	22.93	132.53	134.12		134.19	0.002413	1.80	30.68	34.90	0.47
F10c	1315.69	Regional	16.02	132.53	134.03		134.07	0.001524	1.37	27.70	33.20	0.37
F10c	1313.49	100 year	22.93	132.31	134.12	133.41	134.16	0.000843	1.01	39.27	70.40	0.28
F10c	1313.49	Regional	16.02	132.31	134.03	133.26	134.06	0.000571	0.79	32.95	70.40	0.23
F10c	1300		Culvert									
F10c	1285.86	100 year	22.93	132.31	133.60	133.52	133.92	0.010555	2.52	9.08	10.98	0.89
F10c	1285.86	Regional	16.02	132.31	133.33	133.31	133.65	0.013067	2.49	6.43	9.32	0.96
F10c	1279.75	100 year	22.93	132.21	133.71	133.21	133.77	0.001683	1.44	32.05	34.69	0.39
F10c	1279.75	Regional	16.02	132.21	133.44	133.15	133.50	0.002035	1.37	23.00	32.22	0.42
F10c	1251.13	100 year	22.93	132.19	133.69	133.02	133.72	0.001205	1.24	41.59	46.75	0.33
F10c	1251.13	Regional	16.02	132.19	133.41	133.02	133.44	0.001326	1.12	30.81	37.21	0.34
F10c	1198.12	100 year	22.93	132.10	133.61	133.07	133.68	0.001350	1.24	30.21	49.24	0.35
F10c	1198.12	Regional	16.02	132.10	133.32	132.89	133.39	0.001929	1.25	17.41	35.71	0.40
F10c	1167.38	100 year	22.93	131.81	133.38	132.92	133.57	0.003839	2.31	20.48	27.20	0.60
F10c	1167.38	Regional	16.02	131.81	133.10	132.75	133.26	0.004032	2.06	14.06	18.48	0.60
F10c	1135.87	100 year	22.93	131.40	133.34		133.45	0.001611	1.55	22.66	42.20	0.39
F10c	1135.87	Regional	16.02	131.40	133.04		133.14	0.001735	1.40	13.38	16.93	0.39
F10c	1106.82	100 year	22.93	131.33	133.19		133.38	0.002657	2.03	15.53	19.57	0.50
F10c	1106.82	Regional	16.02	131.33	132.93		133.07	0.002339	1.71	11.73	12.21	0.46
F10c	1075.17	100 year	22.93	131.23	132.68	132.68	133.19	0.010583	3.45	10.14	12.23	0.97
F10c	1075.17	Regional	16.02	131.23	132.73		132.95	0.004534	2.31	10.73	12.77	0.64
F10c	1050.33	100 year	22.93	131.10	132.91	132.33	132.95	0.000735	0.96	28.13	57.40	0.26
F10c	1050.33	Regional	16.02	131.10	132.76	132.15	132.85	0.001515	1.29	14.11	16.81	0.36
F10c	993.63	100 year	22.93	131.12	132.90	132.15	132.92	0.000379	0.71	42.40	74.41	0.19
F10c	993.63	Regional	16.02	131.12	132.75	131.99	132.80	0.000832	0.98	19.97	35.14	0.27
F10c	987.32	100 year	22.93	130.80	132.84	131.87	132.90	0.000114	1.17	27.83	60.09	0.28
F10c	987.32	Regional	16.02	130.80	132.75	131.69	132.79	0.000066	0.87	23.57	40.56	0.21
F10c	950		Culvert									
F10c	922.26	100 year	22.93	130.39	131.73	131.73	132.07	0.009859	2.66	10.83	21.65	0.88
F10c	922.26	Regional	16.02	130.39	131.56	131.52	131.84	0.010170	2.36	7.50	16.25	0.86
F10c	914.42	100 year	22.93	130.45	131.50	131.53	131.87	0.011716	2.94	11.95	21.71	0.97
F10c	914.42	Regional	16.02	130.45	131.35	131.35	131.64	0.011294	2.56	8.88	18.60	0.93
F10c	896.1	100 year	22.93	130.37	131.07	131.25	131.67	0.030893	3.52	7.80	18.80	1.47
F10c	896.1	Regional	16.02	130.37	130.95	131.10	131.44	0.033865	3.16	5.71	15.71	1.48
F10c	874.03	100 year	22.93	130.15	130.84	130.84	131.08	0.013935	2.21	11.39	26.46	0.97
F10c	874.03	Regional	16.02	130.15	130.74	130.73	130.92	0.013753	1.91	8.89	24.40	0.93
F10c	843.86	100 year	22.93	129.92	130.83	130.50	130.89	0.002081	1.08	24.18	40.28	0.40
F10c	843.86	Regional	16.02	129.92	130.74	130.41	130.78	0.001597	0.87	20.56	37.76	0.34
F10c	819.59	100 year	22.93	129.08	130.83		130.85	0.000707	0.96	66.24	134.18	0.25

HEC-RAS Plan: MF (Continued)

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)	
F10c	819.59	Regional	16.02	129.08	130.73		130.75	0.000540	0.80	53.75	122.86	0.22
F10c	779.29	100 year	22.93	128.84	130.72	130.27	130.80	0.001575	1.40	33.68	97.87	0.37
F10c	779.29	Regional	16.02	128.84	130.67	130.18	130.71	0.000946	1.06	29.01	90.20	0.29
F10c	764.3998		Culvert									
F10c	751.21	100 year	22.93	128.72	130.28	130.28	130.51	0.005959	2.29	17.56	55.79	0.69
F10c	751.21	Regional	16.02	128.72	130.04	130.03	130.32	0.009036	2.40	8.04	24.66	0.82
F10c	693.32	100 year	22.93	127.48	130.22	129.04	130.26	0.000420	0.89	45.77	66.90	0.20
F10c	693.32	Regional	16.02	127.48	130.13	128.82	130.14	0.000262	0.68	39.61	58.06	0.16
F10c	610.69	100 year	22.93	127.27	130.23	128.76	130.24	0.000083	0.43	124.32	132.49	0.09
F10c	610.69	Regional	16.02	127.27	130.13	128.54	130.13	0.000053	0.33	111.20	125.72	0.07
F10c	527.85	100 year	22.93	126.90	130.23	128.06	130.23	0.000016	0.23	167.45	103.21	0.04
F10c	527.85	Regional	16.02	126.90	130.13	127.96	130.13	0.000009	0.17	157.11	101.00	0.03
F10c	457.59	100 year	22.93	126.64	130.23	127.87	130.23	0.000022	0.29	139.24	101.29	0.05
F10c	457.59	Regional	16.02	126.64	130.13	127.77	130.13	0.000013	0.21	129.36	95.47	0.04
F10c	435.47	100 year	22.93	126.56	130.22	128.87	130.23	0.000048	0.43	95.13	80.27	0.08
F10c	435.47	Regional	16.02	126.56	130.13	128.38	130.13	0.000028	0.33	82.08	42.49	0.06
F10c	421.0022		Culvert									
F10c	385.75	100 year	22.93	126.53	128.68	128.68	128.71	0.000592	1.05	33.54	28.31	0.24
F10c	385.75	Regional	16.02	126.53	128.31	128.31	129.20	0.009925	4.18	3.83	25.38	1.00
F10c	351.88	100 year	22.93	125.37	126.18	126.69	128.09	0.111669	6.11	3.75	7.06	2.68
F10c	351.88	Regional	16.02	125.37	126.00	126.48	128.01	0.156718	6.28	2.55	5.95	3.07
F10c	317.02	100 year	22.93	124.18	127.05	125.70	127.10	0.000654	1.02	25.95	29.00	0.24
F10c	317.02	Regional	16.02	124.18	126.89	125.46	126.93	0.000444	0.79	22.11	21.98	0.20
F10c	275.57	100 year	22.93	123.29	126.99	125.22	127.06	0.000801	1.19	20.41	13.27	0.25
F10c	275.57	Regional	16.02	123.29	126.87	124.89	126.91	0.000473	0.89	18.82	11.90	0.19
F10c	216.24	100 year	22.93	121.83	127.00	124.54	127.02	0.000133	0.63	51.72	36.01	0.11
F10c	216.24	Regional	16.02	121.83	126.87	123.96	126.88	0.000077	0.47	47.11	33.78	0.08
F10c	194.6252		Culvert									
F10c	165.01	100 year	22.93	121.46	124.96	123.20	125.03	0.000827	1.17	19.85	10.42	0.25
F10c	165.01	Regional	16.02	121.46	124.84	122.89	124.88	0.000477	0.87	18.64	9.76	0.19
F10c	148.7	100 year	22.93	120.65	124.98	122.42	125.00	0.000160	0.75	50.71	24.10	0.12
F10c	148.7	Regional	16.02	120.65	124.85	122.08	124.86	0.000091	0.55	47.63	23.39	0.09
F10c	128.45	100 year	22.93	120.08	124.98	121.87	125.00	0.000096	0.68	67.51	28.87	0.10
F10c	128.45	Regional	16.02	120.08	124.85	121.55	124.86	0.000053	0.50	63.85	27.54	0.07
F10c	113.75	100 year	22.93	120.60	124.97	123.15	124.99	0.000663	0.81	47.30	40.31	0.13
F10c	113.75	Regional	16.02	120.60	124.84	122.61	124.86	0.000397	0.61	42.42	35.93	0.10
F10c	104.7621		Culvert									
F10c	88.6	100 year	22.93	120.08	121.32	121.32	121.73	0.017209	4.34	12.25	15.63	1.24
F10c	88.6	Regional	16.02	120.08	121.29	121.29	121.51	0.009175	3.12	11.84	15.34	0.90
F10c	52.9	100 year	22.93	118.80	120.14	119.93	120.24	0.004385	2.17	27.74	45.03	0.62
F10c	52.9	Regional	16.02	118.80	121.17	119.81	121.18	0.000100	0.49	85.76	63.00	0.10
F9b	11114.35	100 year	1.82	144.45	144.70	144.57	144.71	0.002040	0.27	6.78	41.86	0.21
F9b	11114.35	Regional	0.60	144.45	144.63	144.53	144.63	0.001343	0.16	3.82	39.02	0.16
F9b	11114.32	100 year	1.82	144.26	144.69	144.41	144.69	0.000529	0.14	16.10	80.00	0.08
F9b	11114.32	Regional	0.60	144.26	144.62	144.36	144.62	0.000153	0.06	10.19	50.46	0.04
F9b	11114.3	100 year	1.82	144.16	144.69	144.37	144.69	0.000176	0.09	22.46	85.00	0.05
F9b	11114.3	Regional	0.60	144.16	144.62	144.26	144.62	0.000036	0.04	17.56	74.70	0.02
F9b	11114.25		Culvert									
F9b	11114.2	100 year	1.82	144.17	144.68	144.62	144.69	0.000624	0.27	16.47	116.04	0.18
F9b	11114.2	Regional	0.60	144.17	144.51	144.42	144.54	0.006632	0.78	0.77	3.88	0.56

HEC-RAS Plan: MF (Continued)

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)	
F9b	11114.1	100 year	1.82	143.93	144.60	144.40	144.64	0.004370	0.87	2.10	6.53	0.49
F9b	11114.1	Regional	0.60	143.93	144.46	144.20	144.47	0.001246	0.44	1.34	4.41	0.26
F9b	10065.55	100 year	8.06	143.49	144.20	144.20	144.35	0.015784	2.18	7.62	30.17	1.00
F9b	10065.55	Regional	5.06	143.49	144.11	144.11	144.23	0.015334	1.87	5.13	23.56	0.95
F9b	10065.5	100 year	8.06	142.59	143.33	143.22	143.39	0.004423	1.19	11.32	47.86	0.54
F9b	10065.5	Regional	5.06	142.59	143.15	143.11	143.24	0.010136	1.35	4.52	27.33	0.76
F9b	9990	100 year	8.06	142.25	142.89	142.89	143.03	0.018353	1.69	4.77	16.42	1.00
F9b	9990	Regional	5.06	142.25	142.92	142.78	142.95	0.004274	0.83	8.03	35.11	0.49
F9b	9745	100 year	8.06	141.91	142.46	142.36	142.48	0.002952	0.87	21.40	96.31	0.43
F9b	9745	Regional	5.06	141.91	142.33	142.33	142.46	0.016951	1.63	3.35	14.76	0.96
F9b	9500	100 year	8.06	141.57	141.85	141.85	141.94	0.021573	1.32	6.12	34.91	1.00
F9b	9500	Regional	5.06	141.57	141.80	141.80	141.87	0.024399	1.15	4.41	33.88	1.01
F9b	9358.08	100 year	8.06	140.96	141.45	141.30	141.47	0.014004	0.78	12.10	47.34	0.40
F9b	9358.08	Regional	5.06	140.96	141.36	141.25	141.38	0.014783	0.68	8.42	38.80	0.40
F9b	9200	100 year	8.06	139.76	140.38	140.34	140.49	0.010587	1.54	6.71	23.13	0.80
F9b	9200	Regional	5.06	139.76	140.30	140.24	140.38	0.010529	1.29	4.81	21.16	0.76
F9b	9104.84	100 year	8.06	138.74	139.20	139.20	139.32	0.012908	1.72	6.14	25.04	0.88
F9b	9104.84	Regional	5.06	138.74	139.12	139.12	139.22	0.012582	1.47	4.31	23.37	0.84
F9b	9104.838	100 year	8.06	137.95	138.77	138.55	138.81	0.002041	0.99	12.58	34.45	0.38
F9b	9104.838	Regional	5.06	137.95	138.66	138.45	138.69	0.001819	0.83	9.01	30.35	0.35
F9b	9104.8	100 year	8.06	138.02	138.45	138.45	138.57	0.013867	1.58	5.93	26.45	0.89
F9b	9104.8	Regional	5.06	138.02	138.38	138.37	138.47	0.015166	1.38	4.02	22.54	0.89
F9b	9103.71	100 year	8.06	136.96	137.59	137.52	137.67	0.007020	1.41	8.98	29.29	0.67
F9b	9103.71	Regional	5.06	136.96	137.50	137.44	137.56	0.006671	1.18	6.43	27.81	0.63
F9b	9098.22	100 year	8.06	136.12	136.53	136.53	136.67	0.015510	1.75	5.66	21.97	0.95
F9b	9098.22	Regional	5.06	136.12	136.45	136.45	136.56	0.016984	1.53	3.91	19.87	0.95
F9b	8899.56	100 year	8.06	135.31	135.87	135.78	135.93	0.005468	1.21	10.22	37.43	0.59
F9b	8899.56	Regional	5.06	135.31	135.77	135.69	135.82	0.005981	1.06	6.70	33.74	0.59
F9b	8898.47	100 year	8.06	134.78	135.35	135.35	135.52	0.012699	1.95	5.72	19.62	0.91
F9b	8898.47	Regional	5.06	134.78	135.24	135.23	135.37	0.013846	1.70	3.69	15.69	0.90
F9b	8897.37	100 year	8.06	134.36	134.91	134.93	135.05	0.014821	2.02	8.12	35.91	0.97
F9b	8897.37	Regional	5.06	134.36	134.85	134.83	134.94	0.010678	1.56	6.14	29.83	0.80
F9d	9200	100 year	8.77	140.17	140.93	140.93	141.12	0.010999	2.18	6.71	19.95	0.88
F9d	9200	Regional	6.00	140.17	140.83	140.83	140.99	0.010905	1.92	4.79	17.50	0.85
F9d	9104.84	100 year	8.77	139.79	140.13	140.09	140.16	0.011367	1.08	13.35	52.86	0.75
F9d	9104.84	Regional	6.00	139.79	140.09	140.09	140.11	0.009083	0.84	11.27	51.77	0.65
F9d	9103.74	100 year	8.77	139.20	139.60	139.55	139.68	0.022164	1.62	9.65	51.59	1.07
F9d	9103.74	Regional	6.00	139.20	139.52	139.52	139.60	0.031238	1.58	6.22	40.05	1.21
F9d	9103.71	100 year	8.77	138.14	138.69	138.64	138.83	0.012944	1.73	6.52	21.34	0.88
F9d	9103.71	Regional	6.00	138.14	138.61	138.57	138.71	0.010953	1.47	5.07	17.83	0.80
F9d	9103.60	100 year	8.77	137.79	138.20	138.20	138.33	0.017999	1.63	5.67	22.78	0.99
F9d	9103.60	Regional	6.00	137.79	138.13	138.13	138.24	0.020026	1.46	4.27	21.41	1.00
F9d	9102.54	100 year	8.77	137.45	137.98	137.77	138.01	0.002145	0.78	11.99	31.54	0.37
F9d	9102.54	Regional	6.00	137.45	137.87	137.71	137.90	0.002528	0.71	8.78	28.55	0.38
F9d	9100.31	100 year	8.77	136.96	137.77	137.54	137.83	0.003626	1.09	8.09	17.41	0.49
F9d	9100.31	Regional	6.00	136.96	137.67	137.43	137.71	0.003314	0.93	6.42	15.05	0.45
F9d	8898.47	100 year	8.77	136.33	137.01	137.01	137.18	0.011596	2.00	6.42	22.35	0.88
F9d	8898.47	Regional	6.00	136.33	136.90	136.90	137.06	0.013951	1.87	4.24	16.99	0.93
F9d	8898.466	100 year	8.77	135.55	136.08	136.00	136.18	0.007865	1.43	6.42	17.54	0.70
F9d	8898.466	Regional	6.00	135.55	135.99	135.92	136.07	0.008441	1.26	4.86	16.20	0.70
F9d	8898.4	100 year	8.77	134.86	135.44	135.42	135.58	0.011315	1.98	7.72	22.90	0.87

HEC-RAS Plan: MF (Continued)

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)	
F9d	8898.4	Regional	6.00	134.86	135.36	135.33	135.47	0.010322	1.70	5.95	21.61	0.81
F9d	8896.28	100 year	8.77	134.58	135.04	135.04	135.20	0.015004	1.83	5.30	18.86	0.95
F9d	8896.28	Regional	6.00	134.58	134.95	134.95	135.09	0.017233	1.65	3.80	15.35	0.97
F9c	5320.135	100 year	46.89	144.92	148.29	146.74	148.56	0.001260	2.28	20.56	86.67	0.40
F9c	5320.135	Regional	180.63	144.92	150.17	149.33	150.19	0.000143	0.86	338.99	194.13	0.13
F9c	5304.525		Culvert									
F9c	5284.122	100 year	46.89	145.36	147.92	147.18	148.38	0.005258	3.00	15.62	31.05	0.60
F9c	5284.122	Regional	180.63	145.36	149.12	148.91	149.75	0.006893	4.44	75.15	55.70	0.73
F9c	5218.666	100 year	46.89	145.35	147.88	147.53	148.01	0.002081	2.20	49.96	50.30	0.46
F9c	5218.666	Regional	180.63	145.35	149.14	148.45	149.28	0.002074	2.92	152.79	97.20	0.49
F9c	5130.550	100 year	46.89	145.24	147.58	147.29	147.78	0.003234	2.52	39.75	45.51	0.56
F9c	5130.550	Regional	180.63	145.24	149.01	148.42	149.11	0.001528	2.46	189.29	144.78	0.42
F9c	5023.220	100 year	46.89	144.84	147.48	146.52	147.56	0.001026	1.43	51.10	53.78	0.32
F9c	5023.220	Regional	180.63	144.84	148.76	147.91	148.94	0.001447	2.36	144.34	84.71	0.42
F9c	4886.696	100 year	46.89	144.52	146.80	146.66	147.25	0.006123	3.32	24.74	27.70	0.76
F9c	4886.696	Regional	180.63	144.52	148.62	148.09	148.73	0.001456	2.51	205.49	154.23	0.41
F9c	4777.492	100 year	46.89	143.95	146.19	146.19	146.57	0.005875	3.01	26.61	39.89	0.73
F9c	4777.492	Regional	180.63	143.95	148.62	147.06	148.64	0.000285	1.18	388.87	185.09	0.18
F9c	4666.765	100 year	46.89	143.42	146.04	145.52	146.08	0.001460	1.21	87.39	117.15	0.26
F9c	4666.765	Regional	180.63	143.42	148.60	146.17	148.61	0.000183	0.71	450.64	168.39	0.10
F9c	4547.600	100 year	46.89	142.87	144.99	144.99	145.61	0.015882	3.49	14.19	13.44	0.95
F9c	4547.600	Regional	180.63	142.87	148.58	146.25	148.59	0.000116	0.67	483.65	188.09	0.10
F9c	4434.975	100 year	46.89	142.39	145.15	144.70	145.19	0.000775	1.29	100.48	137.27	0.28
F9c	4434.975	Regional	180.63	142.39	148.58	145.35	148.59	0.000040	0.54	767.73	228.68	0.07
F9c	4289.926	100 year	46.89	141.68	145.11	143.60	145.13	0.000244	0.80	125.10	118.17	0.16
F9c	4289.926	Regional	180.63	141.68	148.57	144.92	148.58	0.000044	0.61	653.04	189.89	0.08
F9c	4216.177	100 year	46.89	141.61	144.81	143.27	145.03	0.001142	2.10	22.38	73.72	0.37
F9c	4216.177	Regional	180.63	141.61	147.11	145.69	148.23	0.002780	4.69	38.49	165.97	0.64
F9c	4200.041		Culvert									
F9c	4176.723	100 year	46.89	141.83	144.15	143.49	144.58	0.003306	2.88	16.27	52.51	0.60
F9c	4176.723	Regional	180.63	141.83	145.13	145.13	145.41	0.003531	3.21	126.49	135.12	0.58
F9c	4051.653	100 year	46.89	141.33	143.76	143.76	143.97	0.004927	2.58	48.82	115.44	0.64
F9c	4051.653	Regional	180.63	141.33	144.84	144.24	144.90	0.001337	1.88	238.31	184.31	0.36
F9c	3974.777	100 year	46.89	140.92	143.60	143.14	143.68	0.001603	1.88	79.09	126.68	0.40
F9c	3974.777	Regional	180.63	140.92	144.75	144.00	144.80	0.001104	2.04	267.10	176.18	0.35
F9c	3851.504	100 year	46.89	140.40	143.07	142.67	143.37	0.003838	2.80	37.35	78.30	0.61
F9c	3851.504	Regional	180.63	140.40	144.45	143.88	144.61	0.002153	2.91	168.66	105.31	0.49
F9c	3728.048	100 year	46.89	139.85	142.76		142.96	0.002484	2.34	40.05	53.63	0.49
F9c	3728.048	Regional	180.63	139.85	143.91		144.25	0.003620	3.70	116.45	71.88	0.64
F9c	3636.840	100 year	46.89	139.60	142.53	141.94	142.74	0.002464	2.23	44.41	81.18	0.48
F9c	3636.840	Regional	180.63	139.60	143.76		143.95	0.002249	2.87	158.31	100.57	0.50
F9c	3482.029	100 year	46.89	139.07	141.86	141.40	142.21	0.004749	2.61	21.05	38.10	0.64
F9c	3482.029	Regional	180.63	139.07	143.46		143.63	0.001867	2.53	166.30	110.81	0.45
F9c	3351.153	100 year	46.89	138.48	141.54	140.79	141.75	0.002302	2.12	32.82	49.77	0.46
F9c	3351.153	Regional	180.63	138.48	143.15	142.47	143.38	0.001847	2.76	140.55	81.04	0.46
F9c	3200.228	100 year	46.89	137.89	141.13		141.28	0.004008	1.83	32.80	27.56	0.39
F9c	3200.228	Regional	180.63	137.89	142.37		142.83	0.008566	3.57	77.84	47.83	0.61
F9c	3116.725	100 year	46.89	137.07	141.11		141.14	0.000599	0.86	96.81	93.36	0.17
F9c	3116.725	Regional	180.63	137.07	142.50		142.54	0.000842	1.34	233.13	103.30	0.21
F9c	3076.132	100 year	47.60	136.98	140.88	138.75	141.06	0.000921	1.89	25.13	79.36	0.31
F9c	3076.132	Regional	184.13	136.98	142.45	141.43	142.51	0.000776	1.48	242.46	121.83	0.22

HEC-RAS Plan: MF (Continued)

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)	
F9c	3062.288		Culvert									
F9c	3044.979	100 year	47.60	137.38	140.37	139.15	140.46	0.000893	1.50	64.89	73.18	0.29
F9c	3044.979	Regional	184.13	137.38	141.84	140.82	141.96	0.001140	2.24	194.47	101.95	0.35
F9c	2947.645	100 year	47.60	137.14	139.93	139.93	140.23	0.004546	2.77	38.47	78.74	0.60
F9c	2947.645	Regional	184.13	137.14	141.75		141.83	0.001165	2.10	210.56	104.87	0.34
F9c	2815.047	100 year	47.60	136.61	139.23	138.71	139.54	0.003897	2.46	21.33	21.12	0.59
F9c	2815.047	Regional	184.13	136.61	140.55	140.55	141.44	0.006463	4.59	64.98	45.75	0.83
F9c	2726.468	100 year	47.60	136.31	138.74	138.41	139.11	0.005919	2.72	20.82	35.37	0.71
F9c	2726.468	Regional	184.13	136.31	139.63	139.90	140.68	0.011518	5.14	60.16	51.35	1.06
F9c	2611.818	100 year	47.60	135.67	138.08	137.77	138.43	0.005920	2.68	23.66	44.45	0.71
F9c	2611.818	Regional	184.13	135.67	139.48	139.12	139.84	0.003870	3.34	113.04	85.39	0.63
F9c	2459.970	100 year	47.60	134.82	137.56		137.77	0.002949	2.08	31.96	41.59	0.51
F9c	2459.970	Regional	184.13	134.82	139.03		139.33	0.002769	2.98	115.69	72.03	0.54
F9c	2358.700	100 year	47.60	134.48	136.69	136.58	137.23	0.010039	3.25	14.64	11.04	0.90
F9c	2358.700	Regional	184.13	134.48	138.17	138.17	138.88	0.006577	4.18	57.76	50.24	0.82
F9c	2183.293	100 year	47.60	133.07	135.41	135.22	135.82	0.006245	2.90	18.36	30.62	0.73
F9c	2183.293	Regional	184.13	133.07	136.04	136.40	137.18	0.014699	5.57	50.59	68.50	1.19
F9c	2057.916	100 year	47.60	131.98	134.08	134.08	134.72	0.012706	3.55	13.40	10.59	1.01
F9c	2057.916	Regional	184.13	131.98	135.84	135.84	136.36	0.004735	3.71	72.43	70.01	0.70
F9c	1914.734	100 year	47.60	130.99	133.82	133.08	133.96	0.001972	1.77	36.89	67.49	0.42
F9c	1914.734	Regional	184.13	130.99	135.13	134.33	135.20	0.000721	1.53	175.44	127.35	0.28
F9c	1744.457	100 year	47.60	130.82	133.56	132.92	133.65	0.001477	1.60	55.15	93.93	0.37
F9c	1744.457	Regional	184.13	130.82	135.03	133.98	135.08	0.000592	1.48	224.70	132.31	0.26
F9c	1609.319	100 year	47.60	130.43	133.13	132.56	133.37	0.002836	2.29	33.37	52.69	0.52
F9c	1609.319	Regional	184.13	130.43	134.65	134.03	134.92	0.002332	3.02	123.49	66.10	0.51
F9c	1529.355	100 year	47.60	130.23	132.88	132.35	133.13	0.003072	2.36	30.01	41.05	0.54
F9c	1529.355	Regional	184.13	130.23	134.27	133.89	134.68	0.003497	3.59	113.34	77.95	0.62
F9c	1409.454	100 year	47.60	129.59	131.96	131.96	132.50	0.010020	3.62	22.23	28.83	0.86
F9c	1409.454	Regional	184.13	129.59	133.09	133.09	133.93	0.012114	5.52	76.47	61.69	1.03
F9c	1325.243	100 year	47.60	129.18	131.69	131.15	131.88	0.002778	2.10	38.37	62.69	0.50
F9c	1325.243	Regional	184.13	129.18	133.17	132.43	133.38	0.002007	2.67	145.07	81.06	0.47
F9c	1209.205	100 year	47.60	128.92	130.77	130.77	131.30	0.009771	3.29	16.65	21.17	0.91
F9c	1209.205	Regional	184.13	128.92	132.20	132.20	132.93	0.006828	4.46	77.84	60.34	0.85
F9e	8894.10	100 year	14.57	134.05	134.83	134.56	134.87	0.002707	1.16	27.63	60.21	0.45
F9e	8894.10	Regional	11.46	134.05	134.75	134.52	134.78	0.002729	1.07	23.00	55.98	0.44
F9e	8894.092	100 year	14.57	134.07	134.75	134.58	134.80	0.003935	1.30	20.97	49.68	0.53
F9e	8894.092	Regional	11.46	134.07	134.66	134.52	134.71	0.004310	1.24	16.95	46.57	0.54
F9e	8894.09	100 year	14.57	133.80	134.43	134.42	134.63	0.011994	2.02	8.91	25.12	0.89
F9e	8894.09	Regional	11.46	133.80	134.36	134.34	134.53	0.012363	1.86	7.25	22.31	0.89
F9e	8886.49	100 year	14.57	133.49	134.29		134.38	0.004437	1.41	13.35	28.24	0.56
F9e	8886.49	Regional	11.46	133.49	134.22		134.29	0.004222	1.27	11.37	27.04	0.54
F9e	8530.47	100 year	14.57	132.88	133.58	133.58	133.78	0.013699	2.12	8.85	24.23	0.95
F9e	8530.47	Regional	11.46	132.88	133.50	133.50	133.69	0.015760	2.02	6.97	21.93	0.99
F9e	8515.13	100 year	14.57	131.54	132.61	132.51	132.80	0.007564	1.99	8.53	19.38	0.74
F9e	8515.13	Regional	11.46	131.54	132.53	132.41	132.68	0.007069	1.78	7.12	15.76	0.71
F9e	8503.16	100 year	14.57	131.12	132.00	132.00	132.26	0.013543	2.26	6.66	14.29	0.96
F9e	8503.16	Regional	11.46	131.12	131.91	131.91	132.14	0.014975	2.13	5.46	12.71	0.98
F9e	8282.69	100 year	14.57	129.77	130.91	130.90	131.16	0.011737	2.42	8.49	16.63	0.91
F9e	8282.69	Regional	11.46	129.77	130.74	130.82	131.07	0.019355	2.67	5.75	15.88	1.13
F9e	8281.61	100 year	14.57	129.29	130.47	130.47	130.83	0.013421	2.68	5.84	9.36	0.98
F9e	8281.61	Regional	11.46	129.29	130.33	130.36	130.67	0.016686	2.63	4.54	8.50	1.06

HEC-RAS Plan: MF (Continued)

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)	
F9e	8170	100 year	14.57	128.58	129.19	129.41	129.90	0.053309	3.74	3.90	8.98	1.81
F9e	8170	Regional	11.46	128.58	129.14	129.31	129.69	0.044326	3.27	3.50	8.61	1.64
F9f	3400	100 year	48.35	126.79	129.12	128.47	129.35	0.003425	2.15	22.48	14.31	0.55
F9f	3400	Regional	187.57	126.79	129.72	130.16	131.05	0.015492	5.36	51.92	67.35	1.21
F9f	3027	100 year	48.35	126.08	127.73	127.73	128.34	0.051200	3.44	14.06	11.81	1.01
F9f	3027	Regional	187.57	126.08	129.64	129.32	129.84	0.008763	2.48	113.21	94.78	0.48
F9f	2674	100 year	48.35	124.65	126.99	126.30	127.21	0.003177	2.09	23.15	14.57	0.53
F9f	2674	Regional	187.57	124.65	128.47	128.12	129.12	0.004804	3.70	64.91	42.33	0.71
F9f	2289	100 year	48.35	124.35	126.38	126.01	126.72	0.005586	2.57	18.83	13.33	0.69
F9f	2289	Regional	187.57	124.35	128.14	127.73	128.57	0.003504	3.25	92.47	61.52	0.61
F9f	1992	100 year	48.35	123.81	125.64		126.09	0.008388	2.98	16.25	12.53	0.83
F9f	1992	Regional	187.57	123.81	127.33	127.18	128.12	0.006250	4.17	60.26	36.54	0.81
F9f	1583	100 year	48.35	122.25	124.10	124.07	124.80	0.012553	3.71	13.02	8.90	0.98
F9f	1583	Regional	187.57	122.25	126.21	126.21	127.22	0.008050	4.75	54.78	31.39	0.86
F9f	1207	100 year	48.35	121.09	122.75	122.75	123.35	0.012307	3.42	14.14	11.84	1.00
F9f	1207	Regional	187.57	121.09	126.49	124.30	126.57	0.000449	1.60	229.78	87.06	0.24
F9f	911	100 year	48.35	119.85	121.84	121.50	122.20	0.006011	2.64	18.31	13.31	0.71
F9f	911	Regional	187.57	119.85	126.50		126.53	0.000157	1.13	331.79	88.23	0.15
F9f	574	100 year	48.35	119.07	121.77		121.87	0.001322	1.61	58.07	58.46	0.34
F9f	574	Regional	187.57	119.07	126.50		126.52	0.000085	0.86	470.46	111.99	0.10
F9f	476	100 year	48.35	118.66	121.42	120.37	121.75	0.002038	2.54	19.05	33.65	0.49
F9f	476	Regional	187.57	118.66	126.49	122.88	126.51	0.000100	0.94	443.75	121.51	0.11
F9f	400		Culvert									
F9f	325	100 year	48.35	118.63	120.34	120.34	121.19	0.010002	4.09	11.82	18.87	1.00
F9f	325	Regional	187.57	118.63	121.88	121.88	122.67	0.006423	4.59	73.50	47.07	0.84
F9f	194	100 year	48.35	118.30	119.61	119.94	120.59	0.021422	4.66	15.25	25.85	1.35
F9f	194	Regional	187.57	118.30	120.71	121.14	122.10	0.017821	6.54	61.65	56.54	1.37

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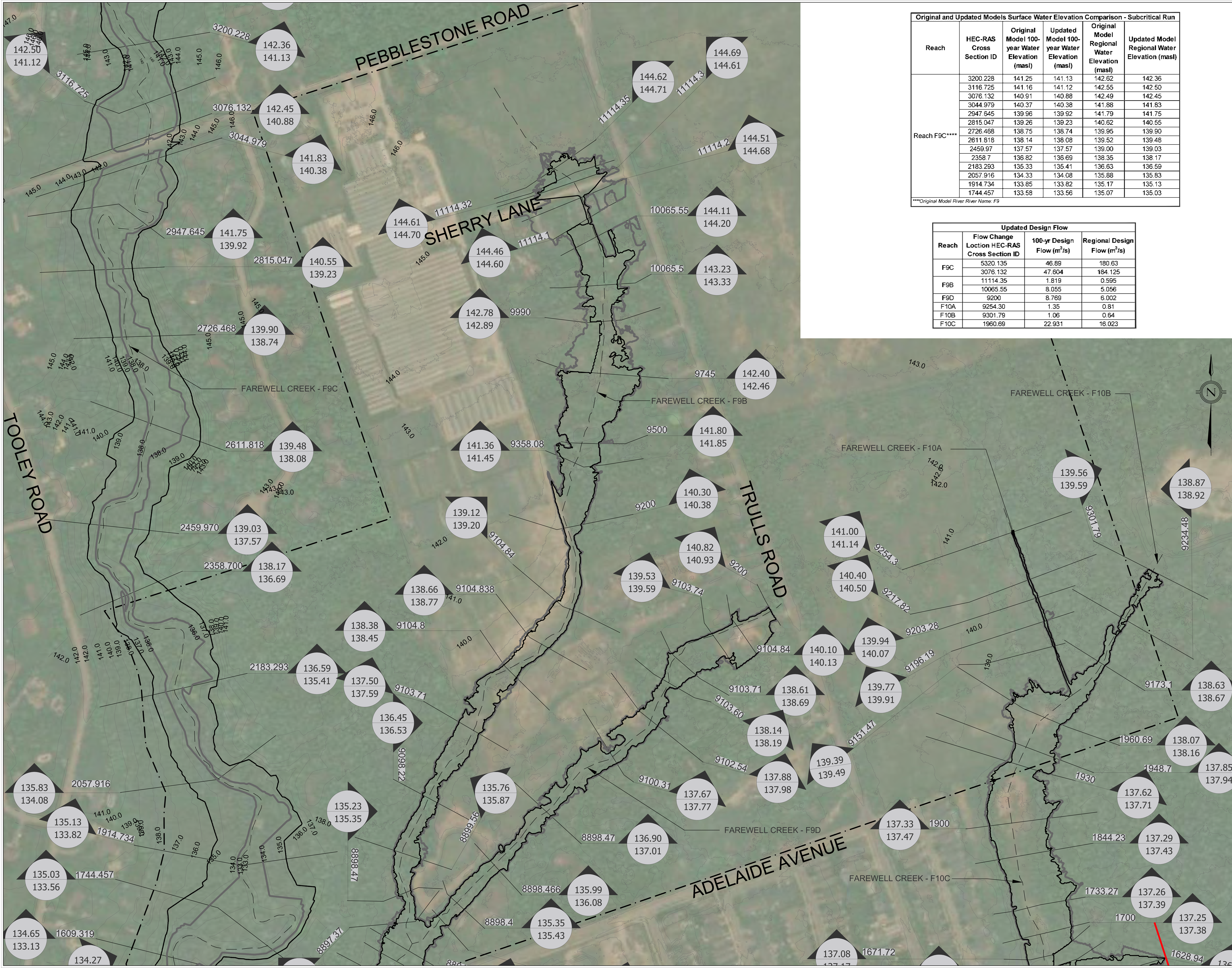
[THE DIFFERENCE IS OUR PEOPLE]

Appendix D

Floodplain Mapping Drawings



Original and Updated Models Surface Water Elevation Comparison - Subcritical Run					
Reach	HEC-RAS Cross Section ID	Original Model 100-year Water Elevation (masl)	Updated Model 100-year Water Elevation (masl)	Original Model Regional Water Elevation (masl)	Updated Model Regional Water Elevation (masl)
Reach F9C****	3200.228	141.25	141.13	142.62	142.36
	3116.725	141.16	141.12	142.55	142.50
	3076.132	140.91	140.88	142.49	142.45
	3044.979	140.37	140.38	141.88	141.83
	2947.645	139.96	139.92	141.79	141.75
	2815.047	139.26	139.23	140.62	140.55
	2726.468	138.75	138.74	139.95	139.90
	2611.818	138.14	138.08	139.52	139.48
	2459.97	137.57	137.57	139.00	139.03
	2358.7	136.82	136.69	138.35	138.17
	2183.293	135.33	135.41	136.63	136.59
	2057.916	134.33	134.08	135.88	135.83
	1914.734	133.85	133.82	135.17	135.13
	1744.457	133.58	133.56	135.07	135.03

****Original Model River River Name: F9

Updated Design Flow			
Reach	Flow Change Loction HEC-RAS Cross Section ID	100-yr Design Flow (m^3/s)	Regional Design Flow (m^3/s)
F9C	5320.135	46.89	180.63
	3076.132	47.604	184.125
F9B	11114.35	1.819	0.595
	10065.55	8.055	5.056
F9D	9200	8.769	6.002
F10A	9254.30	1.35	0.81
F10B	9301.79	1.06	0.64
F10C	1960.69	22.931	16.023

KEY PLAN
SCALE: N.T.S.

LEGEND:

- SITE PROPERTY LINE
- 145 EXISTING COUNTOUR
- FAREWELL CREEK (WATERCOURSE)
- HEC-RAS SECTION
- 100-YEAR FLOODLINE
- REGIONAL FLOODLINE
- HEC-RAS SECTION ID (3116.725)
- REGIONAL FLOOD ELEVATION (142.50)
- 100-YEAR FLOOD ELEVATION (141.12)
- IDENTIFIED SPILL LOCATION

TOPOGRAPHIC DIGITAL ELEVATION MODEL (2 SOURCES OF TOPOGRAPHIC INFORMATION)

1- GOLDEN HORSESHOE DEM PURCHASED FROM: FIRST BASE SOLUTIONS
DATED: 2002 - VERTICAL DATUM: CGVD28

2- ONTARIO DTM DERIVED FROM LIDAR
ORIGINAL VERTICAL DATUM: CGVD2013
ADJUSTED TO CGVD28: RAISED BY 0.379m AS PER COSINE STATION REPORT (ID: 00820058015)

AERIAL MAP INFORMATION

BING MAPS AERIAL IMAGERY SCREEN SHOT(S) REPRINTED WITH PERMISSION FROM MICROSOFT CORPORATION

Notes

1. The contractor shall verify all dimensions, levels, and datums on site and report any discrepancies or omissions to this office prior to construction.
2. This drawing is to be read and understood in conjunction with all other plans and documents applicable to this project.

No.	Issue / Revision	Date	Auth.
1	ISSUED FOR REVIEW AND COORDINATION	24/01/19	JJS
2	ISSUED FOR SUBMISSION TO CLOCA	24/05/01	JJS
3	ISSUED FOR PHASE 1 SUBMISSION TO MUNICIPALITY OF CLARINGTON AND FAREWELL HEIGHTS LANDOWNERS GROUP	24/11/29	JJS

LICENSED PROFESSIONAL ENGINEER
J.J. SMITH
100058930
Nov 29, 2024
PROVINCE OF ONTARIO

BURNSIDE

R.J. Burnside & Associates Limited
1465 Pickering Parkway
Pickering, Ontario, L1V 7G7
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Fax: (905) 420-5247
web www.rjburnside.com

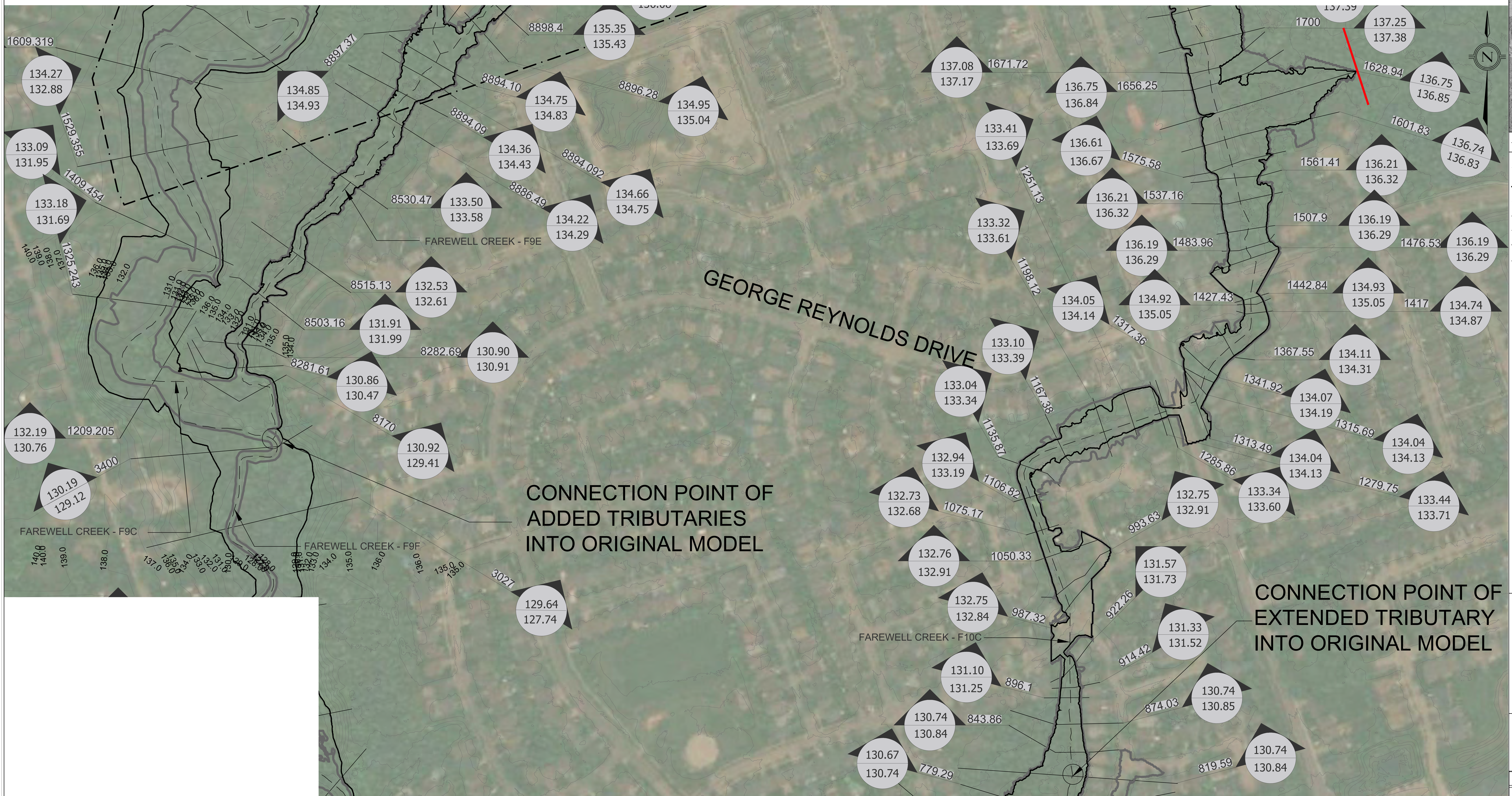
TRUSTEE: FAREWELL HEIGHTS LANDOWNERS GROUP

FOR: MUNICIPALITY OF CLARINGTON

Project Name:
FAREWELL HEIGHTS SECONDARY PLAN
ADELAIDE AVENUE & TRULLS ROAD
CLARINGTON, ON

Drawing Title
FLOODPLAIN MAPPING PLAN - NORTH

Drawn	Checked	Designed	Checked	Date	Drawing No.
GP	JS	SF	JS	24/11/27	FP1
Project No. 300056758		Contract No.		Revision No.	
Scale 1:2,000		0 40 80 120m			



KEY PLAN
SCALE: N.T.S.

LEGEND:

- SITE PROPERTY LINE
- 145 EXISTING COUNTOUR
- FAREWELL CREEK (WATERCOURSE)
- HEC-RAS SECTION
- 100-YEAR FLOODLINE
- REGIONAL FLOODLINE
- 3116.725 HEC-RAS SECTION ID
- 142.50 REGIONAL FLOOD ELEVATION
- 141.12 100-YEAR FLOOD ELEVATION
- IDENTIFIED SPILL LOCATION

Original and Updated Models Surface Water Elevation Comparison - Subcritical Run

Reach	HEC-RAS Cross Section ID	Original Model 100-year Water Elevation (masl)	Updated Model 100-year Water Elevation (masl)	Original Model Regional Water Elevation (masl)	Updated Model Regional Water Elevation (masl)
Reach F9C****	1609.319	133.15	133.13	134.68	134.65
	1529.355	132.85	132.88	134.19	134.27
	1409.454	132.05	131.95	133.37	133.09
	1325.243	131.69	131.69	133.21	133.18
	1209.205	130.8	130.76	132.27	132.19
Reach F9F****	3400*	129.01	129.12	130.20	130 .19
	3027**	128.18	127.74	129.71	129.64
	2674***	127.00	126.99	128.52	128.47

*Original Model Cross Section ID: 1036.199
**Original Model Cross Section ID: 922.7108
***Original Model Cross Section ID: 815.0424
****Original Model River River Name: F9

Updated Design Flow

Reach	Flow Change Loction HEC-RAS Cross Section ID	100-yr Design Flow (m^3/s)	Regional Design Flow (m^3/s)
F9E	8894.10	13.717	11.46
F9F	3400	48.326	187.566

TOPOGRAPHIC DIGITAL ELEVATION MODEL
(2 SOURCES OF TOPOGRAPHIC INFORMATION)
1- GOLDEN HORSESHOE DEM PURCHASED FROM: FIRST BASE SOLUTIONS
DATED: 2002 - VERTICAL DATUM: CGVD28

2- ONTARIO DTM DERIVED FROM LIDAR
ORIGINAL VERTICAL DATUM: CGVD2013
ADJUSTED TO CGVD28: RAISED BY 0.379m AS PER COSINE STATION REPORT (ID: 00820058015)

AERIAL MAP INFORMATION

Notes

1. The contractor shall verify all dimensions, levels, and datums on site and report any discrepancies or omissions to this office prior to construction.
2. This drawing is to be read and understood in conjunction with all other plans and documents applicable to this project.

No.	Issue / Revision	Date	Auth.
1	ISSUED FOR REVIEW AND COORDINATION	24/01/19	JJS
2	ISSUED FOR SUBMISSION TO CLOCA	24/05/01	JJS
3	ISSUED FOR PHASE 1 SUBMISSION TO MUNICIPALITY OF CLARINGTON AND FAREWELL HEIGHTS LANDOWNERS GROUP	24/11/29	JJS

LICENSED PROFESSIONAL ENGINEER
J.J. SMITH
100058930
Nov 29, 2024
PROVINCE OF ONTARIO

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TRUSTEE: FAREWELL HEIGHTS LANDOWNERS GROUP

FOR: MUNICIPALITY OF CLARINGTON

Project Name:
FAREWELL HEIGHTS SECONDARY PLAN
ADELAIDE AVENUE & TRULLS ROAD
CLARINGTON, ON

Drawing Title
FLOODPLAIN MAPPING PLAN - SOUTH

Drawn	Checked	Designed	Checked	Date	Drawing No.
GP	JS	SF	JS	24/11/27	FP2
Project No. 300056758		Contract No.		Revision No.	
Scale 1:2,000		0 40 80 120m			

R.J. Burnside & Associates Limited