

ANNEX I-D

**HEADPOND INUNDATION MAPPING IVANHOE RIVER THE CHUTES
HYDRAULIC REPORT**



Xeneca Power and Development Headpond Inundation Mapping

**Ivanhoe River
Site #13-The Chutes**

Hydraulic Report

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1.0 Introduction

This report summarizes the analysis carried out to define hydraulic backwater flood elevations and develop digital flood line inundation mapping for The Chutes Site, located on the Ivanhoe River.

This report will summarize a generalized overall methodology used in the construction of the HEC-RAS models for The Chutes Site and provide commentary on key project requirements and assumptions used within the modelling. The terms “flood” and “inundation” have been used regularly in this report and have been intended to be understood in the same context.

2.0 Project Purpose and Scope

The purpose of this report is to develop a steady state and un-steady state hydraulic model using the latest HEC-RAS 4.1.0 software and provide flood inundation mapping for The Chutes Site. The hydraulic model will replicate a number of flow scenarios during existing conditions as well as flow conditions that will be anticipated after construction of a proposed hydroelectric dam.

A total of six flow profiles have been selected to be simulated using the steady state model, outlined in **Table 1** below.

Table 1: Simulated Flow Profiles

Flow Description	Flow	Flow Condition Modeled	
		Existing Conditions	Proposed Conditions
Calibration Flow	21.0	X	
Validation Flow	75.4	X	
Long Term Average Flow (LTAF)	30.2	X	X
*High Water Mark Flow (HWM)	N/A	X	
1:2 Year Flood Flow	206.4	X	X
1:100 Year Flood Flow	506.0	X	X

*High Water Mark Flow- N/A, refer to Section 4.3.2 below for additional commentary

The HWM flow for The Chutes Site has not been provided but rather will be determined through the modeling. The Chutes site is remote and there are no structures or Town(s) in close proximity to the site where a High Water Mark can be confirmed. Commentary outlining the computational procedure has been outlined in **Section 4.3.2** below.

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The un-steady state hydraulic model has been developed to represent operating conditions associated with the proposed dam. This modeling scenario will be further discussed in **Section 5.0** below.

The HEC-RAS model iterations were completed to calibrate to a desired vertical tolerance of $\pm 0.1\text{m}$. Given the absence of low flow geometry in key areas of each reach, a desired vertical tolerance of 0.1m may not be achievable. Key areas would include but are not limited to sections of turbulent flow through rapids, riffle crests, area's experiencing split flow scenarios, etc. The use of survey data, aerial photography, site photos, measured flows and available mapping has bee used to calibrate each model. Please refer to **Section 4.1** for additional details on the calibration procedure.

The hydraulic model will be further validated using pro-rated hydrometric data from the Water Survey of Canada and water surface elevation data extracted from LIDAR mapping. Further commentary has been provided in **Section 4.2** outlining the validation procedure.

3.0 Background Information

The preparation of this report and the hydraulic modeling outlined in this report draws information from several sources. These sources include LIDAR Reports/Mapping, conceptual drawings, hydrology reports, survey/bathymetry data, measured flow data and Water Survey of Canada Hydrometric data, etc. This background information has been referenced accordingly within this report.

4.0 Steady State Hydraulic Modeling

Survey and bathymetry data has been provided for The Chutes Site and provided by BPR Engineeringⁱ. A total of eight survey sections (Section ID -3 to 4) has been provided for The Chutes Site. These survey sections have been located upstream, downstream and in the close vicinity of the proposed structure. Bathymetry data has also been provided key non-turbulent areas upstream and downstream of the proposed structure.

Beyond the limits of survey and bathymetry data, LIDAR mapping was provided by Xeneca Power (Xeneca) and obtained by a flight over the project site on June 25, 2009 by Terrapointⁱⁱ. The mapping extends approximately 900m downstream to 6400m upstream of the proposed structure.

Steady state modeling for this report has been completed using cross sectional survey/bathymetry data as well as using available LIDAR data. The location and alignment of the survey sections have been maintained in the modeling. Additional cross

sections have been cut and added to the model in key locations throughout each reach that may have an impact on the flood elevations. These locations include but are not limited to river profile changes, expansion/contraction of the anticipated floodplain, areas in close proximity to the proposed structure, etc.

4.1 Calibration Procedure

The calibration of the existing condition HEC-Ras modeling has been completed using a four step iteration process. The iteration process has been started with minimal data and further moving to a more complex model. Applicable manning's coefficients for the main channel section and overbanks have been selected by observing site photos and aerial photography for each site. Generally, a manning's $n=0.10$ has been applied to the overbank areas for thick dense wooded vegetation. A manning's $n=0.03-0.035$ has been applied to the main channel and corresponds to the USGS Verified Roughness Characteristics of Natural Channels. These coefficients correspond to values outlined in Table 3-1 of the Hec-Ras Hydraulic Reference Manual.

For the calibration procedures, a known survey water elevation of 287.17m was used as downstream boundary condition. A measured flow of $21.0\text{m}^3/\text{s}$ was used for the calibration procedure. Computed HEC-RAS water surface elevations were then compared with surveyed water surface elevations. Measured flows and survey data have been provided by BPR Engineering¹.

Firstly, a simplistic model consisting of only survey cross sections within the model was created. In general, computed water surface elevations at the downstream survey cross sections was observed to be within the required 0.1m vertical tolerance with noticeable differences outside the tolerance of 0.1m moving upstream. These results can be attributed to the normal flow conditions experienced at the downstream limits of the site and absence of required data in key areas of the model required to produce the required water surface elevations moving towards the upstream limits of the sites. Results of this first iteration are summarized on within **Appendix A** on **Figure 1**- with the column heading **1-Water Elev(m)**.

Secondly, building on the first iteration, additional cross sections were added to the model. These additional cross sections utilized the available LIDAR data and survey bathymetry data in the model. Again, computed HEC-Ras water surface elevations were then compared with surveyed water surface elevations. Generally the vertical separation between the computed water elevations and surveyed water elevations improved but yet were still outside the required tolerance. Results from the second iteration are summarized within **Appendix A** on **Figure 1**- with the column heading **2-Water Elev(m)**.

Thirdly, after observing the results from the second iteration, additional cross sections were again added to the model. These additional cross sections were cut using LIDAR data only and added in key control areas of the reach. Again, computed HEC-Ras water surface elevations were then compared with surveyed water surface elevations.

Generally the computed water surface elevations were observed to be higher than the surveyed water elevations. This can be attributed the absence of low flow geometry within the newly created sections. Results from the third iteration are summarized within Appendix A on **Figure 1**- with the column heading **3-Water Elev(m)**.

Finally, maintaining the same quantity and locations of cross sections of the third iteration, low flow geometry was added to LIDAR cross sections below the LIDAR water surface elevation. The low flow geometry has been interpolated from surveyed/bathymetry cross sections in close proximity to the LIDAR section. The low flow geometry has been adjusted to both vertically and horizontally to fit the newly added LIDAR Sections. Again, computed HEC-Ras water surface elevations were then compared with surveyed water surface elevations. The depth of the low flow geometry at each cross section was further adjusted where applicable to produce computed results within the desired vertical tolerance. Results from the fourth iteration are summarized within **Appendix A** on **Figure 1**- with the column heading **4-Water Elev(m)**.

Calibration and validation results for each site have been provided on **Figure 1 of Appendix A**

The calibration result comparison tables illustrated on **Figure 1 in Appendix A** have been provided at survey cross section locations only. These locations have been selected for comparison purposes only as there are two known data sets (measured flow and survey low geometry) in which computed water surface elevations and surveyed water surface elevations may be accurately compared. The calibration water surface elevations for The Chutes Site has been modeled to within 0.27m of the surveyed water elevations. This vertical range in water surface elevations is outside the desired vertical tolerance of 0.1m, however, commentary supporting the calibration results has been provided in **Section 4.2** below.

4.2 Validation Procedure

The validation procedure for The Chutes site has built on the calibrated model results as outlined in **Section 4.1.1** above. Flows for the modeling validation have been calculated for each site based on pro-rating downstream hydrometric data back to the project site. Accordingly, this process involves two components.

Firstly a flow ratio was developed. The flow ratio is calculated by dividing product the drainage area (km^2) and runoff depth (mm) of the project site by the product of the

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drainage area (km^2) and runoff depth (mm) at the downstream river gage. Data used for the development of the flow ratio has been acquired from HATCH Engineeringⁱⁱ.

Secondly, hydrometric flow data was obtained from the river gage downstream of the project site from the Water Survey of Canada (WSC) on the same day as the LIDAR data for each site was completed. This flow was further multiplied by the flow ratio as outlined above to determine the validation flow for each site.

$$\text{Flow Ratio} = \frac{[\text{Site Runoff (mm)} \times \text{Site Drainage Area } (\text{km}^2)]}{[\text{WSC Runoff (mm)} \times \text{WSC Drainage Area } (\text{km}^2)]}$$

$$\text{Flow Ratio} = \frac{[350.4(\text{mm}) \times 2723(\text{km}^2)]}{[353.3(\text{mm}) \times 1612(\text{km}^2)]} = 1.68$$

LIDAR mapping was obtained by a flight over the project site on June 25, 2009 by Terrapointⁱⁱⁱ, The Chutes site is located downstream of the Ivanhoe River Gage 04LC003. Accordingly a flow of $45\text{m}^3/\text{s}$ has observed on June 25, 2009 and used for pro-rating the validation flow to The Chutes Site as illustrated below.

$$\text{The Chutes Validation Flow } (\text{m}^3/\text{s}) = \text{Flow Ratio} \times \text{WSC Flow } (\text{m}^3/\text{s})$$

$$\text{The Chutes Validation Flow } (\text{m}^3/\text{s}) = 1.68 \times 45(\text{m}^3/\text{s}) = 75.38 \text{ m}^3/\text{s}$$

For the validation procedure, a known survey water elevation of 287.50m was used as downstream boundary condition. Using the LIDAR water surface elevations and newly acquired validation flow, the computed HEC-Ras water surface elevations were then compared with LIDAR water surface elevations throughout the model. Generally, the vertical elevation differences range from $0\pm 0.3\text{m}$ depending on location within the reach.

The LIDAR water surface elevations that have been referenced in the validation procedure; have been referenced from the LIDAR mapping at HEC-RAS cross sections. As it is understood that the LIDAR contours in the vicinity of a water surface may reflect the top of bank and not necessarily the actual water surface, two Civil 3D TIN surfaces were created. One TIN surface was created using the provided LIDAR point data and a second surface was created using the provided LIDAR contour mapping. Centerline of river profiles of each surface was further completed. Comparing the two profiles, elevation differences of $0\pm 1.5\text{m}$ have been observed. To determine the applicability of either data set, the computed HEC-Ras water surface elevations from the validation procedure was compared to the water surface elevations provided by the LIDAR contours and the LIDAR point's data. Generally, the water surface elevations produced by the LIDAR contours produced a more accurate fit with the validation flows.

Accordingly, the water surface elevations produced by the LIDAR contours have been used for comparison purposes for the validation procedure.

Validation results have been generally summarized within **Appendix A** on **Figure 1** with the column heading **5-Water Elev(m)**.

4.3 Construction of the Full Reach Model

The calibration procedure and validation procedure as outlined in **Sections 4.4.1 and 4.1.2** outlined above was initially confined to the limits of the survey cross sections. Generally, the surveyed cross sections have been spaced at regular intervals of 200-300m, with one cross section located in the close vicinity of the proposed dam and three or four cross sections located upstream and downstream of the dam respectively. This would produce a total short reach length of approximately 1000m. Anticipating a requirement to define a tailwater condition applicable for a number of flow scenarios and also a requirement to compare flood elevations (existing vs. proposed) in the head pond area of the reach, the HEC-Ras model was further extended downstream and upstream to the limits of the LIDAR mapping.

Additional cross sections have been added to the limits of the mapping in a similar format as outlined in **Section 4.1**. Generally, the limits of the mapping have produced a total modeled reach length of 7.0km.

4.3.1 Boundary Conditions

The steady state flow conditions associated with the steady state modeling was completed using a mixed flow computation procedure. The mixed flow regime requires boundary conditions to be defined at the upstream and downstream limits of the site and allows for computations of subcritical and supercritical flow.

The calibration and validation procedures listed above both utilize a known water surface elevation as a downstream boundary condition within each of the HEC-RAS model. As downstream water elevations are not known for other flow scenarios two methods have been explored to determine downstream boundary conditions.

Firstly, the normal depth boundary condition has been explored. This method assumes a normal laminar flow within a reach and accordingly a numerical river profile slope is entered as a boundary condition. As survey data typically only extends a short distance downstream of the project site and therefore the normal depth slope has been iterated to observe flood water fluctuations in the reach. Given the relatively flat nature of the downstream limits of The Chutes, it has been observed that small fluctuations in the normal depth slope have large impacts on the water surface elevations.

Observing the fluctuations of the downstream computed water surface elevations using a normal depth slope as a boundary condition, an alternative method was further explored. Utilizing HEC-RAS's computational abilities, the critical depth boundary condition was selected.

Using aerial photography and site photos, the Ivanhoe River was explored and observed downstream of the project limits. The purpose of this exploration has been to determine a location of rapids downstream of the project limits at which it was anticipated that flows would enter a supercritical state.

Downstream of the project limits, flows within the Ivanhoe River appear to be laminar for a distance of approximately 40km. Further beyond the 40km threshold, flows enter a supercritical state through a series of rapids. Accordingly, the 40km threshold has been used in the HEC-RAS model for further computational purposes.

The most downstream survey cross section (**Survey Section (SS4)**, Burnside Section ID 102) was then copied to a distance of 40km downstream. To utilize the iteration capabilities of HEC-Ras, a total of 10 copied cross sections(SS4), spaced at 1m apart, have been further coded into the model at this location. By selecting critical depth as a boundary condition, HEC-RAS will default to a critical depth at the most downstream cross section. HEC-RAS then further performs a series of water surface iterations with the upstream cross sections in search for a normal depth flow condition. By coding a series of cross section is close proximity to one another, it has been observed that normal depth flow conditions are experienced prior to the limits of these copied cross sections. Therefore normal depth flow conditions are also produced back to downstream limits of The Chutes Site. Additional information supporting the critical depth boundary condition applicability and water surface elevation iteration procedure can be referenced in Chapter 2 of the HEC-RAS Reference Manual^{vi}.

To determine the validity of this critical depth boundary condition, the computed water surface elevations for the Calibration Flow and Validation flow were then compared to the surveyed and LIDAR water surface elevations respectively. The computed water surface elevations (using the critical depth boundary condition) for both flow scenarios have produced comparable results ($\pm 0.20\text{m}$) to those produced with a known water surface boundary condition. The LTAF flow was then further explored. It has been noted, in the majority of the project sites that the LTAF flow is greater than the calibration flow, yet less than the validation flow. Computed water surface elevations for the LTAF flow, seem to fit quite well between the calibration and validation water surface elevations, also utilizing the critical depth boundary condition. Therefore, this boundary condition has been employed for all project sites.

The upstream boundary condition was also explored. Surveyed and LIDAR water surface elevations at the upstream limits of each site were observed to be relatively flat and therefore experiencing normal depth flow conditions. For calibration and validation purposes a known water surface elevation was used. For all other flow scenarios the normal depth slope method was used, assuming a relatively flat slope of 0.0001m/m.

Additional commentary discussing the sensitivity of each boundary condition will be outlined in **Section 4.3.3** below.

4.3.2 High Water Mark Methodology

As initially discussed in **Section 2.0** above, the High Water Mark (HWM) peak flow for The Chutes Site has not been provided. Accordingly, the HWM flow will be determined through a series of modeling iterations. Evidence of the HWM elevations have been provided by BPR Engineering^j and have been identified at each survey section in the field. The HWM elevations have been identified by observing historical flood elevation scaring on rocks, trees, etc. Typically, multiple high water mark elevations have been provided at each survey section.

It has been assumed that a flow range rather than a single flow would be more representative of the high water elevations within each reach. Accordingly, an average surveyed elevation has been used at each cross section for determination of a corresponding flow scenario. Iterating several flows scenarios, a high water mark flow range for The Chutes has been determined to be 30-45m³/s. The range of flow scenarios and comparisons between the computer water surface elevations and surveyed elevations have been provided in **Figure 3 in Appendix A**,

It has been noted that with flow range 30-45m³/s, the HWM flood elevations are lower than those determined during the validation process with a flow of 75.38m³/s. Using a flow of 75.38m³/s provides water surface elevation fluctuations of 1-2m when compared to compared to the surveyed elevations. Typically, the HWM flow would produce flood elevations comparable with a 1-2 year flow. Accordingly, it has been assumed that the HWM flow range producing elevations outlined on **Figure 3 of Appendix A** are an anomaly and therefore do not represent a typical HWM flood elevation range.

4.3.3 Sensitivity Analysis

A sensitivity analysis was completed to determine an effect of varying manning's roughness coefficients, upstream and downstream boundary conditions.

Typical manning's n values as outlined in **Section 4.1** above were varied ± 20% of the initial estimated value. Computed water surface elevation fluctuations have been

observed to be $\pm 0.10\text{m}$ for increasing or decreasing roughness coefficients. This fluctuation is minor and has not been assumed to have a significant impact on the computed water surface elevations.

As previously discussed in **Section 4.3.1**, a sensitivity analysis was completed by varying the downstream boundary condition. The normal depth boundary condition has been observed to be quite sensitive to the downstream normal depth slope computations. Accordingly, the critical depth boundary condition has been used for The Chutes Site.

The normal depth slope of the upstream boundary condition has been varied $\pm 20\%$ of the initially estimated channel slope. This boundary condition has been observed to have a negligible impact of computed water surface elevations.

4.4 Proposed Conditions

Steady state hydraulic modeling of the proposed structure has built on the existing conditions modeling previously discussed. The proposed structure of each project site has been coded into HEC-RAS geometric data as an Inline Structure. Conceptual drawings the proposed structure has been provided by HATCH Engineeringⁱⁱⁱ. These drawings have been used to identify key dimensions, location and orientation of the proposed structure.

The spillway was been identified as an Ogee Weir Crest shape. Accordingly, the ogee weir coefficient has been computed internally by HEC-RAS based on the spillway approach height and design energy head. The design energy head has been assumed to be 1.5m for The Chutes Site.

Proposed condition flows have been adjusted in the vicinity of the structure in accordance with the configuration of the dam. At the upstream limits of the proposed structure, design flows as provided in by Xeneca have been subtracted from each flow scenario as a portion of flows approaching the structure would be used for producing electricity. Downstream of the proposed structure the design flows have been re-added to each flow scenario at the limits of the spillway

4.5 Existing vs. Proposed Condition Comparison

It has been observed that computed water surface elevation differences between existing and proposed conditions are most noticeable within the head pond area upstream of the structure. Flood elevation increases have been noted to be in the range 0.2-7.20m depending on location. Extents of the head pond area, existing versus

proposed comparisons of computed water elevations for the LTAF, 2-year and 100-year flow scenarios illustrated within **Figure 5 in Appendix A**.

Specific attention and observation has been directed to the Inundation Limit of each of the LTAF, 2 and 100-year flow scenarios. For the purpose of this report the Inundation Limit will be defined as the location of reach upstream of the proposed hydroelectric dam where there is a zero water surface elevation difference between the existing and proposed condition flood elevations. As outlined in **Figure #5, in Appendix A** the Inundation Limit for the LTAF, 2-year and 100-year peak flows exceed the limits of the provided LIDAR mapping.

Table 2: LTAF Inundation Limit Comparison

General		Inundation Limit Summary		
Flow Description	Flow (m ³ /s)	Existing Inundation Area (ha)	Proposed Inundation Area (ha)	Inundation Length (km)
Long Term Average Flow (LTAF)	30.2	46	59	+6.4km

The existing condition inundation area outlined in **Table 2** above has been provided at the LIDAR water surface. The existing condition LTAF peak flow produces a flood elevation lower than the LIDAR water surface and accordingly a measured inundation area could not be determined.

Comparing the existing condition and proposed condition flood elevations, as illustrated in **Figure 5 of Appendix A**, the LTAF flood elevations produce a 0.07m difference at the LIDAR mapping limits. Both the 2-year and 100-year comparisons yield a 0.2m difference at the mapping limits. Therefore, the full extent of the Inundation Limit for the Chutes Site could not be determined.

HEC-RAS output summaries have been provided in **Appendix B**. Floodplain mapping outlining the floodlines for the flow scenarios outlined in **Table 1**, have been provided in **Appendix C**.

5.0 Un-Steady State Modeling

HEC-Ras has the unique ability to model variations in flow within a standard time step. Often flow hydrographs are used in unsteady state hydraulic models which correspond with hydrologic runoff, typical daily dam operations, dam break analysis, etc. Unsteady state hydraulic modeling has been completed downstream of the proposed structure. The unsteady state model will define flow pulsing characteristics and reflect normal

operating conditions. The un-steady state modeling will provide an understanding of flow conditions moving downstream of the proposed structure associated with attenuation of the pulse curve. The proposed unsteady state hydrograph shape, criteria and duration for each site has been provided by ORTECH Environmental and outlined on **Figure 6** in **Appendix A**.

Given the limited availability of known river geometry at the downstream limits of several of the project sites, a simplistic modeling approach has been used. To avoid numerical model instability associated with turbulent flowing waters, the un-steady state modeling has been completed assuming normal flow conditions within each section of reach. This assumption of normal flow conditions is consistent with exploratory observations outlined in **Section 4.3.1** above. The downstream reach length of interest for The Chutes Site has been identified by ORTECH Environmental to be 3km.

Typically the peak pulse flows provided have been observed to be less than the validation peak flows. Therefore the flow pulsing scenario will be sensitive to the low flow geometry of the river below the LIDAR bank stations. Accordingly, a simple model has been created consisting of survey cross sections only (most downstream survey cross section only SS4). The length of the overall model has been compiled based on the specific area of interest as outlined above. Cross section iterations were performed such that the maximum distance between cross sections is 100m.

Downstream boundary conditions have been completed by developing a fictitious stage discharge curve. This discharge curve has been developed using a series of flow scenarios based corresponding to the provided flow hydrograph and assumed riverbed slope. Typical river bed slopes have been assumed at 0.05-0.1% a sensitivity analysis has been completed by adjusting the assumed channel slope by $\pm 30\%$ of the original assumed river slope. The attenuation of the pulse curve has been determined to be quite sensitive to the assumed red bed profile.

6.0 Conclusions and Recommendations

The results of the steady, un-steady state modelling and flood line mapping for each of The Chutes site outlined in this report have been included within **Appendices A-C**. Digital modelling files have been provided on a CD and included at the back of this report.

The hydraulic methodology, commentary and results outlined in this report have been based on available information, correspondence and key assumptions made during the course of the project. The results in this hydraulic report have been prepared for the preliminary stages only of determining floodline inundation elevations for each respective site. It is recommended that additional reconnaissance be completed to better define

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downstream boundary conditions, calibration of additional flows with corresponding surveyed water surface elevations, flow conditions in critical areas, etc.

The modeling, analysis and presentation of the inundation mapping have been prepared using the best available information at the time of writing of this report. The results of this report and mapping are to be used in the Environmental Assessment of the proposed hydro-electric dams. It is Burnside's understanding that the hydroelectric dam is conceptual at this stage and as such the inundation mapping should be verified as detailed design progresses.

If you have any questions, or require further information, please do not hesitate to contact the undersigned.

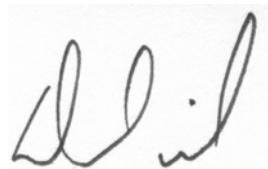
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Reference Material

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ⁱⁱⁱ Chutes Hydropower Development Conceptual Site Development Layout-Plate 1-9. Hatch Engineering. October 2009.

^{iv} Environment Canada. Daily Discharge for Ivanhoe River at Foleyet (04LC003). [Online] 25 June. 2009.

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^{ix} Terrapoint #: 2008-172-C (C1 and C2 inclusive). Terrapoint. August 5, 2009.



Appendix A

Hydraulic Summary Tables

Project Name: Xeneca FIT Contract- Headpond Inundation mapping
 Project No.: PCG019617
 Site: 13_Ivanhoe River- The Chute
 River: Ivanhoe River
 Designed by: T.Lozon
 Checked by: D.Miller
 Date Created: 6-May-11



Figure #1-Site #13- Ivanhoe River (The Chute)- Existing Conditions Calibration and Validation

General Data					Existing Conditions-Calibration										Existing Conditions-Validation			
Survey Section#	Burnside X-Sec ID	Cumulative Length (m)	LB-Surveyed Water Elev (m)	RB-Surveyed Water Elev (m)	Calibration Flow (m³/s)	Surveyed Water Elev (m)	1-Water Elev (m)	1-Water Elev Diff (m)	2- Water Elev (m)	2-Water Elev Diff (m)	3- Water Elev (m)	3-Water Elev Diff (m)	4- Water Elev (m)	4-Water Elev Diff (m)	Validation Flow (m³/s)	LIDAR Water Elev (m)	5-Water Elev (m)	5-Water Elev Diff (m)
-3	305	589.96	294.202	294.222		294.22	293.77	-0.45	293.77	-0.45	295.51	1.29	294.49	0.27		295.50	295.27	-0.23
-2	303	437.19	294.201	294.209		294.21	293.77	-0.44	293.77	-0.44	295.51	1.30	294.48	0.27		295.50	295.26	-0.24
-1	301	282.98	294.211	294.197		294.20	293.51	-0.69	293.52	-0.68	295.5	1.30	294.46	0.26		295.00	295.14	0.14
0	206	88.60	292.681	292.677	21.00	292.68	291.19	-1.49	291.2	-1.48	293.18	0.50	292.74	0.06		293.50	293.58	0.08
1	200	-95.10	287.236	287.143		287.14	287.18	0.04	287.18	0.04	287.18	0.04	287.18	0.04		288.50	288.52	0.02
2	108	-156.34	287.153	287.176		287.18	287.18	0.00	287.18	0.00	287.18	0.00	287.18	0.00		288.50	288.52	0.02
3	105	-213.74	287.166	287.151		287.15	287.17	0.02	287.17	0.02	287.17	0.02	287.17	0.02		288.50	288.51	0.01
4	102	-432.91		287.17		287.17	287.17	0.00	287.17	0.00	287.17	0.00	287.17	0.00		288.50	288.50	0.00

Modelling Iterations

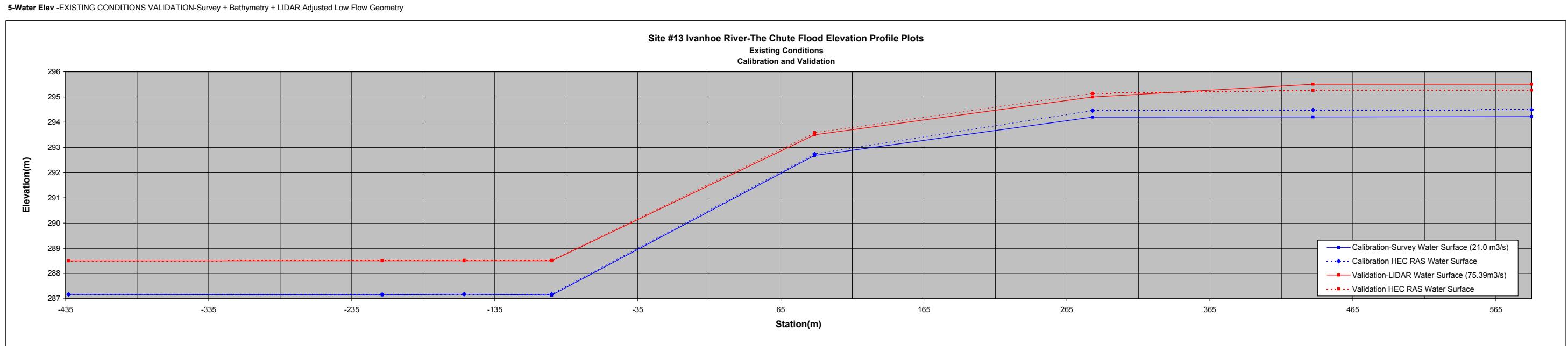
- 1-Water Elev -EXISTING CONDITIONS CALIBRATION-Survey Data Only
- 2-Water Elev -EXISTING CONDITIONS CALIBRATION- Survey+ Bathymetry
- 3-Water Elev -EXISTING CONDITIONS VALIDATION-Survey + Bathymetry + LIDAR
- 4-Water Elev -EXISTING CONDITIONS VALIDATION-Survey + Bathymetry + LIDAR Adjusted Low Flow Geometry
- 5-Water Elev -EXISTING CONDITIONS VALIDATION-Survey + Bathymetry + LIDAR Adjusted Low Flow Geometry

Data Legend

- Known Data
- Modelling Results
- Governing Modelling Iteration

VALIDATION DATA

Area 2723 km²
 Runoff 350.4 mm
 Ivanhoe River 1612 km²
 The Chutes 353.3 mm
 Calculated Ratio= 1.68
 Measured Flow(m³/s)= 45 Ivanhoe River Gage 04LD001 June 25, 2009
 Validation Flow= 75.39 m³/s

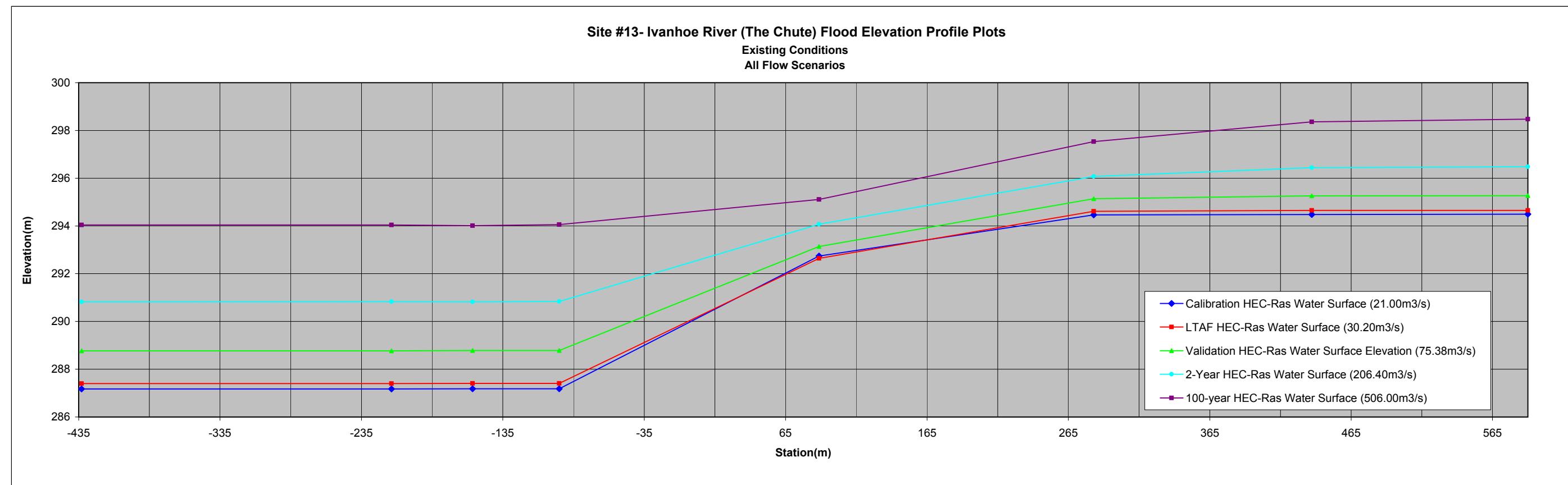


Project Name: Xeneca FIT Contract- Headpond Inundation mapping
 Project No.: PCG019617
 Site: 13_Ivanhoe River- The Chute
 River: Ivanhoe River
 Designed by: T.Lozon
 Checked by: D.Miller
 Date Created: 6-May-11



Figure #2-Site #13- Ivanhoe River (The Chute)- Existing Conditions Flow Profiles

General Data			Calibration		Long Term Average Flow		Validation		2-Year		100-Year	
Survey Section#	Burnside X-Sec ID	Cumulative Length (m)	Calibration Flow (m3/s)	Calibration Water Elev (m)	LTAF Flow(m3/s)	LTAF Water Elev (m)	Validation Flow (m3/s)	LIDAR Water Elev (m)	2-year Flow(m3/s)	2-year Water Elev (m)	100-Year Flow(m3/s)	100-Year Water Elev (m)
-4	305	589.96		294.49		294.65		295.27		296.48		298.47
-3	303	437.19		294.48		294.65		295.26		296.44		298.36
-2	301	282.98		294.46		294.61		295.14		296.07		297.53
-1	206	88.60	21.00	292.74	30.20	292.64	75.38	293.14	206.40	294.07	506.00	295.11
0	200	-95.10		287.18		287.41		288.78		290.84		294.06
1	108	-156.34		287.18		287.41		288.78		290.82		294.01
2	105	-213.74		287.17		287.40		288.77		290.83		294.04
3	102	-432.91		287.17		287.40		288.77		290.82		294.04



Project Name: Xeneca FIT Contract- Headpond Inundation mapping
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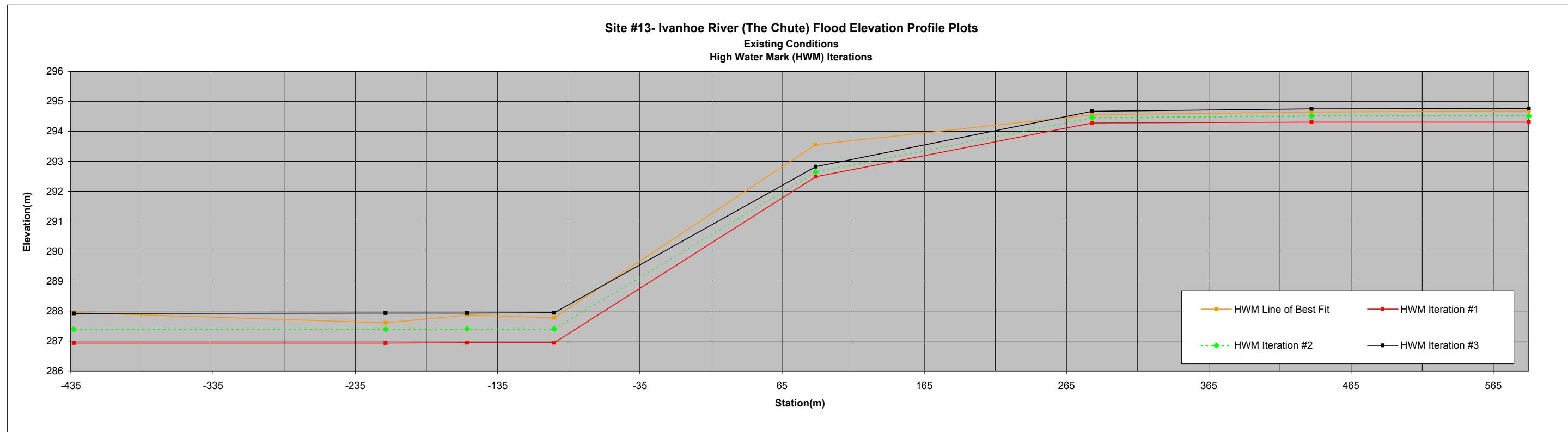
Figure #3-Site #13- Ivanhoe River (The Chute) - Existing Conditions- High Water Mark (HWM) Iterations

General Data			HWM Survey Data			HWM Iteration #1			HWM Iteration #2			HWM Iteration #3		
Survey Section#	Burnside X-Sec ID	Cumulative Length (m)	HWM Elev #1 (m)	HWM Elev #2 (m)	HWM Elev Average (m)	HWM Flow (m3/s)	HMF Water Elev (m)	HWM Water Elev Diff (m)	HWM Flow (m3/s)	HMF Water Elev (m)	HWM Water Elev Diff (m)	HWM Flow (m3/s)	HMF Water Elev (m)	HWM Water Elev Diff (m)
-3	305	589.96	294.61	294.75	294.68		294.31	-0.37		294.51	-0.17		294.76	0.08
-2	303	437.19	294.54	294.76	294.65		294.31	-0.34		294.51	-0.14		294.75	0.10
-1	301	282.98	294.53	294.57	294.55		294.28	-0.27		294.46	-0.09		294.67	0.12
0	206	88.60	293.23	293.89	293.56	20	292.48	-1.08	30	292.64	-0.92	45	292.82	-0.74
1	200	-95.10	287.76	287.78	287.77		286.94	-0.83		287.40	-0.37		287.94	0.17
2	108	-156.34	287.97	287.77	287.87		286.94	-0.93		287.40	-0.47		287.93	0.06
3	105	-213.74	287.36	287.85	287.60		286.93	-0.67		287.39	-0.21		287.93	0.33
4	102	-432.91	287.98	287.91	287.95		286.93	-1.02		287.39	-0.56		287.92	-0.03

High Water Mark Flow Range			
Survey Section#	Burnside X-Sec ID	Flow (m3/s)	Accuracy (m)
-3	305	45	0.08
-2	303	45	0.1
-1	301	30-45	-0.09 to 0.12
0	206		
1	200	35	0.03
2	108	45	0.06
3	105		
4	102	45	-0.03

High Water Mark Notes

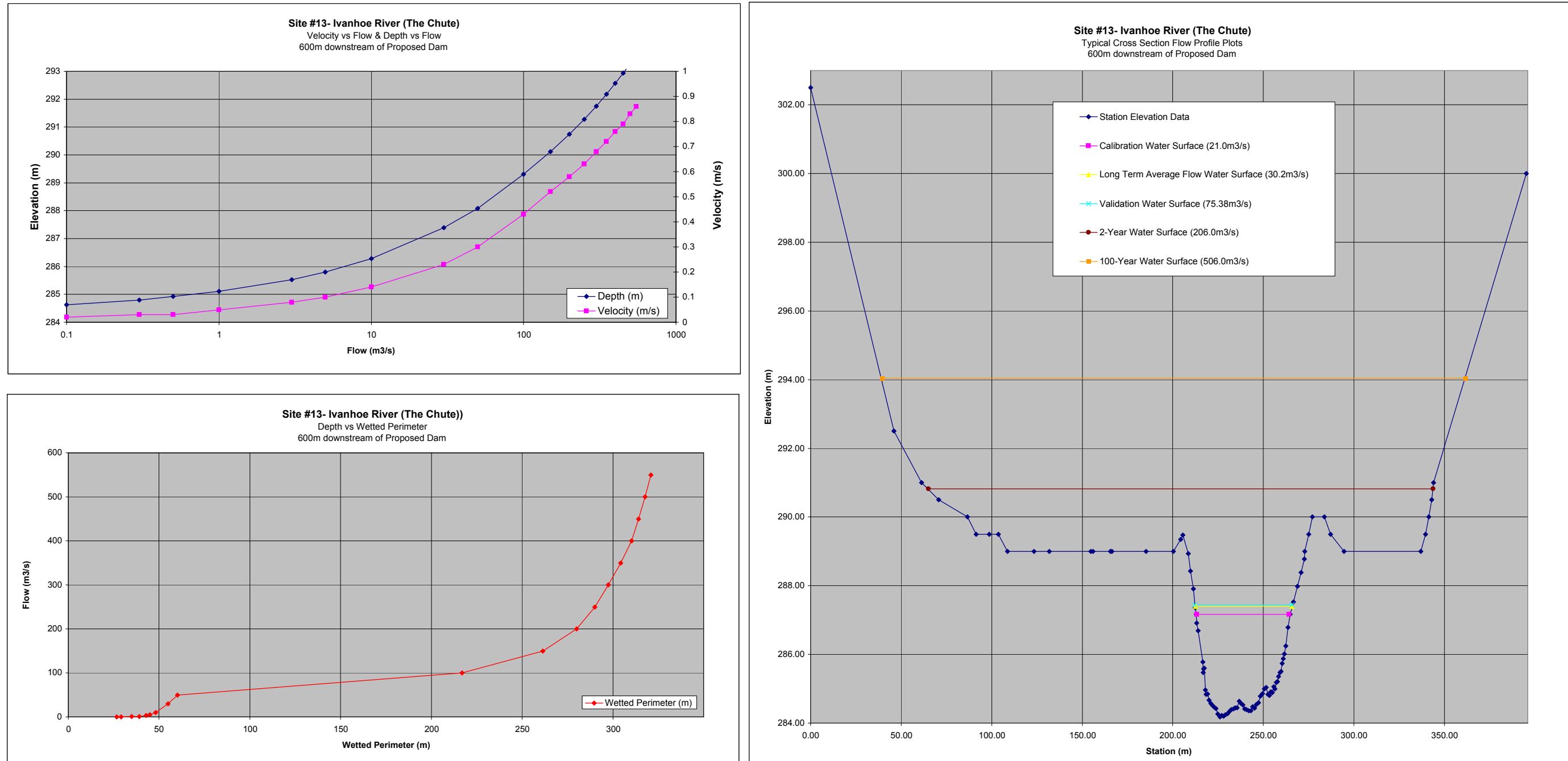
- The High Water Flow Mark range for the Ivanhoe River Chutes Site has been determined to be 30-45m3/s



Project Name: Xeneca FIT Contract- Headpond Inundation mapping
 Project No.: PCG019617
 Site: 13_Ivanhoe River- The Chute
 River: Ivanhoe River
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 Date Created: 6-May-11



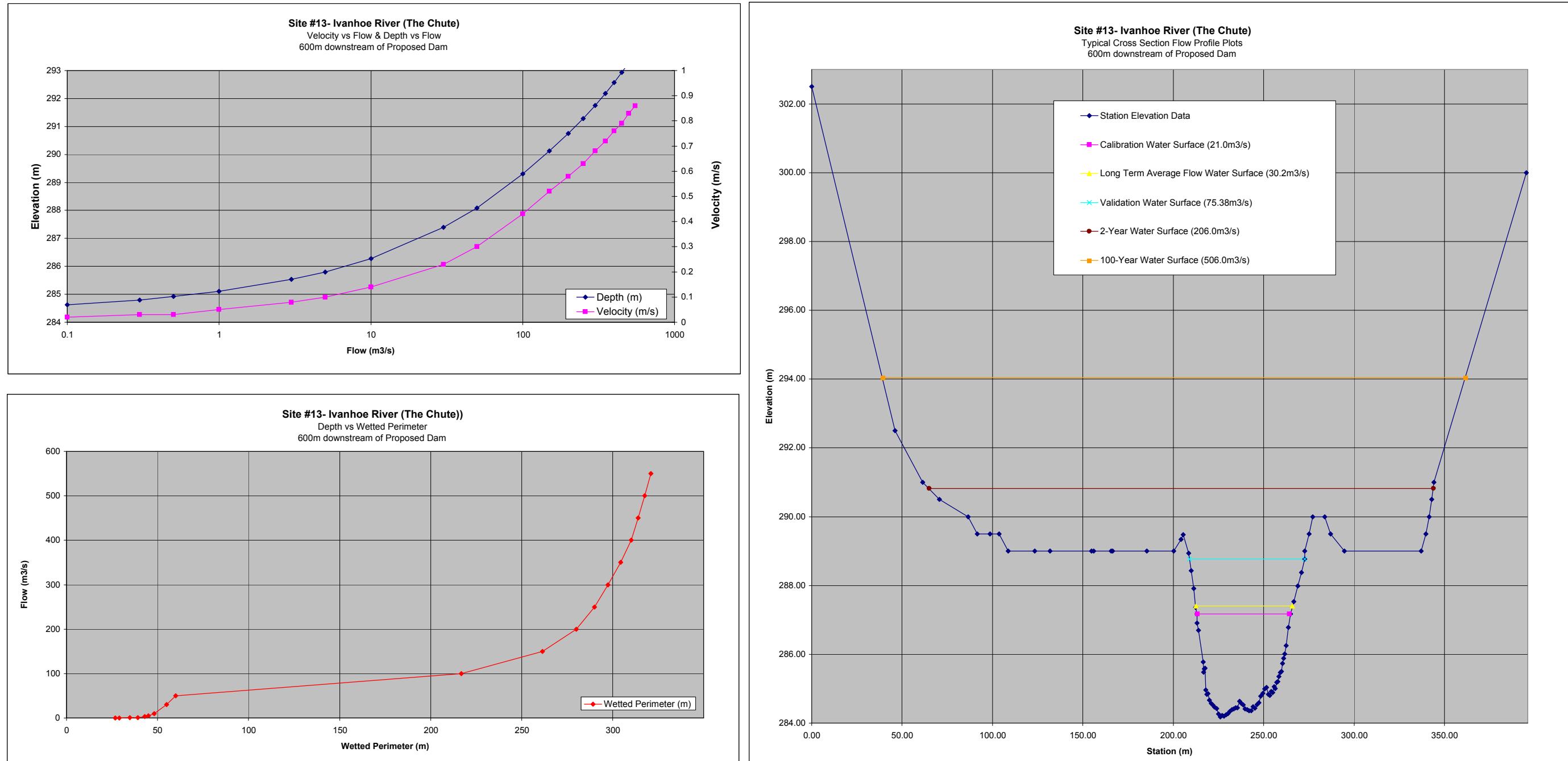
Figure #4-Site #13- Ivanhoe River (The Chute) - Existing Condition Typical Cross Section Plots



Project Name: Xeneca FIT Contract- Headpond Inundation mapping
 Project No.: PCG019617
 Site: 13_Ivanhoe River- The Chute
 River: Ivanhoe River
 Designed by: T.Lozon
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 Date Created: 6-May-11



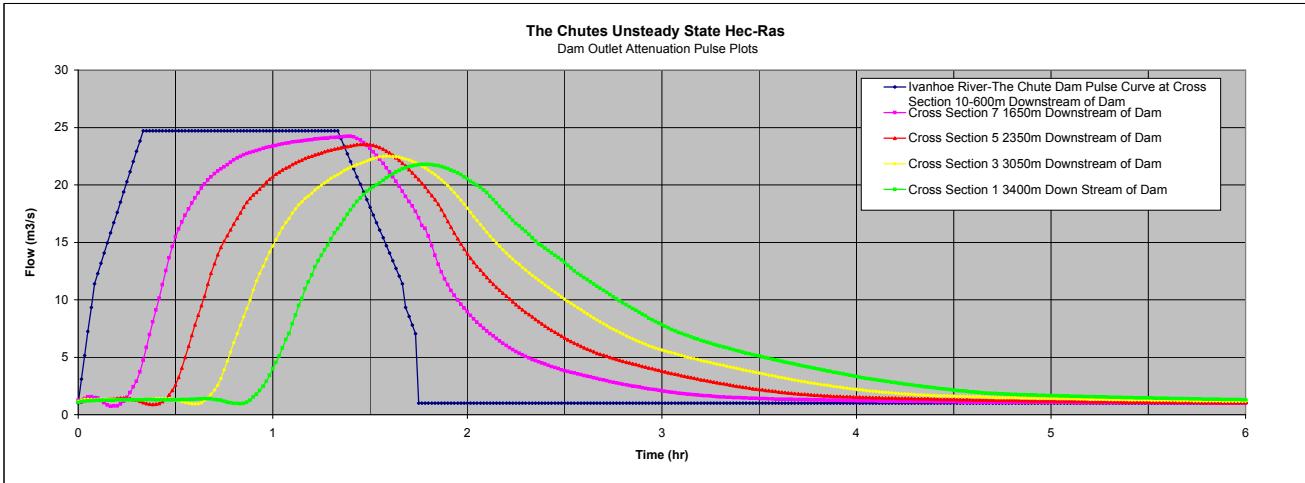
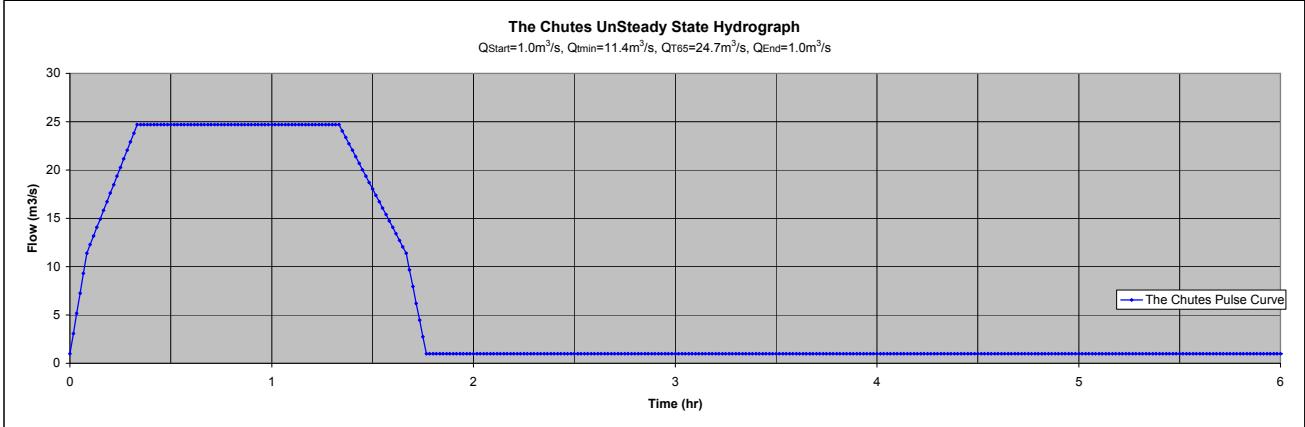
Figure #4-Site #13- Ivanhoe River (The Chute) - Existing Condition Typical Cross Section Plots



Project Name: Xeneca FIT Contract- Headpond Inundation mapping
 Project No.: PCG019617
 Site: 12_Wanatango Falls
 River: Frederick House River
 Designed by: T.Lozon
 Checked by: D.Miller
 Date Created: 6-May-11



Figure #6-Site #13-The Chutes- Unsteady State Attenuation Pulse Curve





Appendix B

HEC-RAS Output Tables

Site #13- The Chutes
 Existing Conditions
 2-year Flow Results

Reach	River Sta	Profile	Q Total (m³/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	W.P. Total (m)	Flow Area (m²)	Top Width (m)	Froude # Chl
INUNDATION	345	2-YEAR	206.4	296.7	299.82	298.29	299.85	0.000229	0.74	156.81	278.82	156.37	0.18
INUNDATION	344	2-YEAR	206.4	296.6	299.15		299.36	0.00221	2.01	70.55	102.6	69.99	0.53
INUNDATION	343	2-YEAR	206.4	296.01	299.11		299.22	0.000735	1.44	70.94	143.08	69.23	0.32
INUNDATION	342	2-YEAR	206.4	295.4	299.18		299.19	0.000051	0.43	193.46	476.61	192.85	0.09
INUNDATION	341	2-YEAR	206.4	294.95	299.16		299.17	0.000056	0.46	331.88	468.54	331.21	0.09
INUNDATION	340	2-YEAR	206.4	294.85	299.13		299.14	0.000037	0.38	217	549.08	216.32	0.08
INUNDATION	339	2-YEAR	206.4	294.85	299.06		299.1	0.00025	0.93	95.34	222.49	94.05	0.19
INUNDATION	338	2-YEAR	206.4	294.85	298.84		298.9	0.00048	1.04	117.24	198.74	115.99	0.25
INUNDATION	337	2-YEAR	206.4	294.85	298.64		298.69	0.000261	0.97	98.3	216.44	97.32	0.2
INUNDATION	331	2-YEAR	206.4	294.85	298.02		298.31	0.002062	2.39	65.9	93.39	64.71	0.53
INUNDATION	330	2-YEAR	206.4	294.8	298.05		298.17	0.000793	1.53	79.4	139.9	78.53	0.34
INUNDATION	328	2-YEAR	206.4	294.6	297.69		297.98	0.002363	2.4	51	86.49	49.67	0.56
INUNDATION	327	2-YEAR	206.4	294.5	297.45		297.92	0.002784	3.04	40.53	75.54	39.49	0.64
INUNDATION	326	2-YEAR	206.4	294.5	297.43		297.88	0.00329	2.96	39.37	70.27	38.36	0.67
INUNDATION	325	2-YEAR	206.4	294.5	297.05	297.05	297.75	0.008286	3.71	42.01	55.71	41.18	1.01
INUNDATION	321	2-YEAR	206.4	293.5	297.15	295.38	297.19	0.000227	0.85	161.78	261.13	161.1	0.18
INUNDATION	317	2-YEAR	206.4	293.5	297.15		297.16	0.000066	0.51	168	410.12	167.37	0.1
INUNDATION	316	2-YEAR	206.4	293.5	297.13		297.16	0.000118	0.68	158.92	326.51	157.06	0.13
INUNDATION	315	2-YEAR	206.4	293.5	297.12		297.15	0.000165	0.79	134.1	280.21	131.97	0.16
INUNDATION	314	2-YEAR	206.4	293.5	297.1		297.14	0.000212	0.87	99.62	236.71	98.54	0.18
INUNDATION	310	2-YEAR	206.4	293.45	296.99		297.06	0.000466	1.18	82.76	174.47	81.81	0.26
INUNDATION	309	2-YEAR	206.4	293.3	296.94	295.45	297.01	0.000513	1.21	83.2	169.9	144.17	0.27
INUNDATION	308.5	Lat Struct											
INUNDATION	308	2-YEAR	206.4	293.25	296.09	295.92	296.68	0.005795	3.41	38.86	60.53	37.3	0.85
INUNDATION	305	2-YEAR	206.4	289.21	296.48		296.49	0.000019	0.43	150.4	517.6	147.89	0.06
INUNDATION	303	2-YEAR	206.4	290.14	296.44		296.48	0.000095	0.92	78.93	242.65	75.92	0.13
INUNDATION	301	2-YEAR	206.4	292.47	296.07		296.42	0.001707	2.64	48.7	91.24	44.72	0.5
INUNDATION	300	2-YEAR	206.4	293.7	296.03		296.32	0.002081	2.39	56.47	89.51	55.38	0.54
INUNDATION	209.2	2-YEAR	206.4	293.25	295.33	295.33	296.11	0.007821	3.9	37.57	53.39	37.13	1
INUNDATION	209.1	2-YEAR	206.4	293.2	294.78	295.04	295.85	0.015641	4.6	42.55	45.53	42.29	1.36
INUNDATION	209	2-YEAR	206.4	292.8	294.74	294.75	295.47	0.00706	3.8	46.62	58.37	46.28	0.99
INUNDATION	208	2-YEAR	206.4	291	294.21	292.8	294.3	0.000552	1.33	81.8	158.64	81.2	0.28
INUNDATION	207	2-YEAR	206.4	290	294.24		294.28	0.000218	0.93	94.05	225.34	93.11	0.18
INUNDATION	206	2-YEAR	206.4	290.11	294.07	292.57	294.26	0.000859	2.06	56.71	136.97	52.68	0.37
INUNDATION	205	2-YEAR	206.4	290	294.13		294.22	0.000448	1.32	64.84	157.61	63.52	0.26
INUNDATION	204.2	2-YEAR	206.4	291.5	293.47	293.47	294.14	0.008869	3.49	46.3	57.13	43.76	0.93
INUNDATION	204	2-YEAR	206.4	289.7	291.98	292.58	293.79	0.015019	6.02	59.91	38.09	57.69	1.35
INUNDATION	203	2-YEAR	206.4	288.9	291.84		291.9	0.00032	0.96	82.51	194.34	79.9	0.21
INUNDATION	202	2-YEAR	206.4	288.5	290.92	290.92	291.78	0.007681	4.12	29.97	50.13	28.92	1
INUNDATION	201	2-YEAR	206.4	286.3	290.76	288.8	290.9	0.000735	1.66	50.25	124.62	48.15	0.33
INUNDATION	200	2-YEAR	206.4	285.03	290.84		290.86	0.000039	0.56	98.86	383.44	90.5	0.08
INUNDATION	109	2-YEAR	206.4	286	290.84		290.86	0.00005	0.61	94.62	350.34	93.17	0.1
INUNDATION	108	2-YEAR	206.4	283.6	290.82		290.85	0.000057	0.82	73.87	280.62	66.51	0.1
DOWNSTREAM	105	2-YEAR	206.4	285.39	290.83		290.84	0.000042	0.58	138.8	411.93	136.16	0.09
DOWNSTREAM	102	2-YEAR	206.4	284.18	290.82		290.84	0.00003	0.59	281.67	670.77	278.95	0.08
DOWNSTREAM	10	2-YEAR	206.4	284.18	286.22		286.67	0.004788	2.96	47.88	69.68	46.96	0.78
DOWNSTREAM	9	2-YEAR	206.4	284.18	286.21		286.66	0.004886	2.98	47.82	69.23	46.9	0.78
DOWNSTREAM	8	2-YEAR	206.4	284.18	286.2		286.66	0.004989	3	47.76	68.76	46.85	0.79
DOWNSTREAM	7	2-YEAR	206.4	284.18	286.19		286.66	0.0051	3.02	47.7	68.27	46.79	0.8
DOWNSTREAM	6	2-YEAR	206.4	284.18	286.18		286.65	0.005218	3.05	47.64	67.77	46.73	0.81
DOWNSTREAM	5	2-YEAR	206.4	284.18	286.17		286.65	0.005364	3.07	47.56	67.17	46.66	0.82
DOWNSTREAM	4	2-YEAR	206.4	284.18	286.15		286.64	0.005524	3.1	47.48	66.53	46.58	0.83
DOWNSTREAM	3	2-YEAR	206.4	284.18	286.14		286.64	0.005699	3.13	47.4	65.87	46.5	0.84
DOWNSTREAM	2	2-YEAR	206.4	284.18	286.12	285.97	286.63	0.005926	3.17	47.29	65.04	46.41	0.86
DOWNSTREAM	1	2-YEAR	206.4	284.18	285.97	285.97	286.61	0.00834	3.54	46.34	58.23	45.51	1

Site #13-The Chutes
 Existing Conditions
 100-year Flow Results

Reach	River Sta	Station (m)	Profile	Q Total (m³/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	W.P. Total (m)	Flow Area (m²)	Top Width (m)	Froude # Chl
INUNDATION	345	6395.72	100-YEAR	506	296.7	301.33	298.95	301.38	0.000192	0.93	193.66	542.31	193.06	0.18
INUNDATION	344	5493.72	100-YEAR	506	296.6	300.81		301.01	0.001141	1.99	108.83	254.81	108.08	0.41
INUNDATION	343	5403.99	100-YEAR	506	296.01	300.82		300.91	0.000569	1.28	203.83	397.55	201.73	0.28
INUNDATION	342	5357.51	100-YEAR	506	295.4	300.86		300.88	0.000054	0.61	255.84	851.19	255.02	0.1
INUNDATION	341	5042.74	100-YEAR	506	294.95	300.85		300.87	0.000052	0.63	570.73	1205.73	570.02	0.1
INUNDATION	340	4334.1	100-YEAR	506	294.85	300.82		300.83	0.000039	0.54	613.73	1135.13	612.64	0.08
INUNDATION	339	3957.09	100-YEAR	506	294.85	300.72		300.8	0.000263	1.25	204.53	454.24	202.92	0.21
INUNDATION	338	3356.01	100-YEAR	506	294.85	300.58		300.64	0.000245	1.15	292.64	584.4	291.27	0.2
INUNDATION	337	2746.95	100-YEAR	506	294.85	300.39		300.48	0.000248	1.36	168.73	441.5	167.59	0.21
INUNDATION	331	2123.92	100-YEAR	506	294.85	299.73		300.14	0.001395	2.95	110.97	247	109.59	0.49
INUNDATION	330	2051.59	100-YEAR	506	294.8	299.83		300.02	0.000572	1.95	124.74	322.25	123.69	0.32
INUNDATION	328	1920.25	100-YEAR	506	294.6	299.42		299.87	0.001522	3	65.79	185.96	64.02	0.5
INUNDATION	327	1900.71	100-YEAR	506	294.5	298.26	298.26	299.72	0.005975	5.44	45.82	109.49	44.43	0.98
INUNDATION	326	1890.18	100-YEAR	506	294.5	297.95	298.22	299.63	0.009063	5.74	42.17	90.81	40.94	1.16
INUNDATION	325	1869.72	100-YEAR	506	294.5	298.2	296.16	299.41	0.006474	4.91	55.9	111.2	54.87	0.99
INUNDATION	321	1688.34	100-YEAR	506	293.5	298.73		298.8	0.000207	1.16	186.2	537.23	185.27	0.19
INUNDATION	317	1491.94	100-YEAR	506	293.5	298.73		298.76	0.000079	0.77	213.25	708.82	212.46	0.12
INUNDATION	316	1462.52	100-YEAR	506	293.5	298.72		298.76	0.000125	0.96	272.13	702.8	270.11	0.15
INUNDATION	315	1405.18	100-YEAR	506	293.5	298.71		298.75	0.000167	1.1	280.05	647.27	277.67	0.17
INUNDATION	314	1375.98	100-YEAR	506	293.5	298.66		298.74	0.000238	1.28	152.02	441.26	150.58	0.21
INUNDATION	310	1109.57	100-YEAR	506	293.45	298.55		298.66	0.000382	1.54	256.64	491.24	255.26	0.26
INUNDATION	309	1015.79	100-YEAR	506	293.3	298.52	296.38	298.62	0.000382	1.53	280.1	518.43	278.53	0.26
INUNDATION	308.5		Lat Struct											
INUNDATION	308	788.84	100-YEAR	455.15	293.25	297.78	296.99	298.4	0.002791	3.48	49.99	131.25	47.72	0.65
INUNDATION	305	589.96	100-YEAR	455.15	289.21	298.17		298.2	0.000034	0.7	202.46	819.27	199.8	0.08
INUNDATION	303	437.19	100-YEAR	455.15	290.14	298.07		298.18	0.000168	1.48	131.18	402.52	127.98	0.18
INUNDATION	301	282.98	100-YEAR	455.15	292.47	297.31		298.05	0.00233	3.92	64.42	155.8	60.09	0.62
INUNDATION	300	241.55	100-YEAR	455.15	293.7	297.44		297.88	0.001629	3.01	67.37	176.73	65.69	0.52
INUNDATION	209.2	196.02	100-YEAR	455.15	293.25	296.42	296.42	297.67	0.006296	4.99	46.52	97.94	45.77	0.98
INUNDATION	209.1	175.03	100-YEAR	455.15	293.2	295.51	296.03	297.42	0.014509	6.14	47.86	78.9	47.38	1.42
INUNDATION	209	147.8	100-YEAR	455.15	292.8	295.48	295.76	296.99	0.009463	5.52	53.85	94.53	53.23	1.18
INUNDATION	208	115.87	100-YEAR	455.15	291	295.35	293.61	295.54	0.000663	1.92	108.43	263.96	107.56	0.33
INUNDATION	207	101.82	100-YEAR	455.15	290	295.4		295.51	0.000306	1.41	99.23	336.85	97.66	0.23
INUNDATION	206	88.6	100-YEAR	455.15	290.11	295.01	293.69	295.46	0.001515	3.25	89.81	238.46	81.22	0.51
INUNDATION	205	69.78	100-YEAR	455.15	290	295.15		295.37	0.000716	2.08	69.21	224.62	67.33	0.35
INUNDATION	204.2	47.6	100-YEAR	455.15	291.5	294.57	294.57	295.3	0.005464	3.99	89.72	121.5	86.46	0.8
INUNDATION	204	23.8	100-YEAR	455.15	289.7	292.63	293.31	294.96	0.018234	7.57	68.53	77.95	65.44	1.52
INUNDATION	203	0	100-YEAR	455.15	288.9	293.67	290.7	293.76	0.000245	1.18	97.55	352.76	92.74	0.2
INUNDATION	202	-24.8	100-YEAR	455.15	288.5	292.81	292.17	293.66	0.003584	4.07	38.45	111.9	36.48	0.74
INUNDATION	201	-56.74	100-YEAR	455.15	286.3	293.26	290.15	293.42	0.000369	1.77	65.55	264.13	62.55	0.26
INUNDATION	200	-95.1	100-YEAR	455.15	285.03	293.34		293.38	0.000045	0.8	114.9	627.53	105.31	0.09
INUNDATION	109	-126.79	100-YEAR	455.15	286	293.34		293.37	0.000005	0.83	106.16	595.57	103.09	0.1
INUNDATION	108	-156.34	100-YEAR	455.15	283.6	293.29		293.37	0.000085	1.24	108.68	498.69	100.25	0.13
DOWNSTREAM	105	-213.74	100-YEAR	506	285.39	293.32		293.35	0.000052	0.87	174.27	801.95	170.98	0.1
DOWNSTREAM	102	-432.91	100-YEAR	506	284.18	293.31		293.34	0.000038	0.83	318.05	1416.09	314.92	0.09
DOWNSTREAM	10	N/A	100-YEAR	506	284.18	287.35		288.17	0.0046	4.02	54.75	126.05	53.28	0.82
DOWNSTREAM	9	N/A	100-YEAR	506	284.18	287.34		288.17	0.004664	4.04	54.65	125.52	53.19	0.83
DOWNSTREAM	8	N/A	100-YEAR	506	284.18	287.33		288.17	0.00473	4.05	54.56	124.97	53.1	0.83
DOWNSTREAM	7	N/A	100-YEAR	506	284.18	287.32		288.16	0.00481	4.07	54.45	124.33	52.99	0.84
DOWNSTREAM	6	N/A	100-YEAR	506	284.18	287.3		288.16	0.004895	4.09	54.34	123.66	52.88	0.85
DOWNSTREAM	5	N/A	100-YEAR	506	284.18	287.29		288.15	0.004985	4.12	54.22	122.97	52.76	0.85
DOWNSTREAM	4	N/A	100-YEAR	506	284.18	287.28		288.15	0.005094	4.14	54.08	122.17	52.63	0.86
DOWNSTREAM	3	N/A	100-YEAR	506	284.18	287.26		288.15	0.005211	4.17	53.94	121.32	52.49	0.87
DOWNSTREAM	2	N/A	100-YEAR	506	284.18	287.24	287.04	288.14	0.005356	4.21	53.76	120.32	52.32	0.88
DOWNSTREAM	1	N/A	100-YEAR	506	284.18	287.04	287.04	288.12	0.00708	4.59	52.59	110.18	51.29	1

Site #13- The Chutes
 Existing Conditions
 Calibration Results

Reach	River Sta	Station (m)	Profile	Q Total (m³/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	W.P. Total (m)	Flow Area (m²)	Top Width (m)	Froude # Chl
CHUTE	305	589.96	CALIB	21	289.21	294.49	289.97	294.49	0.000001	0.07	96.27	292.41	94.14	0.01
CHUTE	303	437.19	CALIB	21	290.14	294.48		294.49	0.000005	0.16	47.99	134.31	46.08	0.03
CHUTE	301	282.98	CALIB	21	292.47	294.46		294.48	0.000286	0.63	30.41	33.74	28.16	0.18
CHUTE	300	241.55	CALIB	21	293.7	294.36		294.44	0.004601	1.28	38.34	16.38	38.28	0.63
CHUTE	209.2	196.02	CALIB	21	293.25	294.06		294.2	0.006092	1.63	25.89	12.87	25.76	0.74
CHUTE	209.1	175.03	CALIB	21	293.2	293.81	293.81	294.02	0.012497	2	26.81	10.52	26.73	1.02
CHUTE	209	147.8	CALIB	21	292.8	293.44	293.45	293.66	0.013417	2.09	25.3	10.06	25.22	1.06
CHUTE	208	115.87	CALIB	21	291	292.74	291.65	292.75	0.000103	0.36	54.26	58.8	53.9	0.11
CHUTE	207	101.82	CALIB	21	290	292.75		292.75	0.000027	0.21	73.34	99.68	72.82	0.06
CHUTE	206	88.6	CALIB	21	290.11	292.74	291.2	292.75	0.000056	0.37	50.07	70.97	47.19	0.09
CHUTE	205	69.78	CALIB	21	290	292.74		292.75	0.000037	0.27	49.95	77.18	49.1	0.07
CHUTE	204.2	47.6	CALIB	21	291.5	292.49	292.49	292.72	0.011123	2.67	36.82	18.04	35.65	0.97
CHUTE	204	23.8	CALIB	21	289.7	290.01	290.38	291.9	0.21206	6.09	13.8	3.45	13.69	3.87
CHUTE	203	0	CALIB	21	288.9	289.56	288.5	289.58	0.001145	0.7	50.52	48.01	49.71	0.32
CHUTE	202	-24.8	CALIB	21	288.5	289.19	289.19	289.45	0.011343	2.25	18.54	9.34	18.16	1
CHUTE	201	-56.74	CALIB	21	286.3	286.75	287.06	288.21	0.183289	5.37	16.98	3.91	16.76	3.54
CHUTE	200	-95.1	CALIB	21	285.03	287.18	285.99	287.19	0.000057	0.25	81.01	82.57	76.27	0.08
CHUTE	109	-126.79	CALIB	21	286	287.18		287.18	0.000114	0.36	58.94	59.03	58.74	0.11
CHUTE	108	-156.34	CALIB	21	283.6	287.18		287.18	0.00001	0.2	42.58	106.4	39.37	0.04
CHUTE	105	-213.74	CALIB	21	285.39	287.17		287.18	0.000085	0.3	70.48	69.26	69.14	0.1
CHUTE	102	-432.91	CALIB	21	284.18	287.17	284.8	287.17	0.00001	0.18	53.13	116.67	51.7	0.04

Site #13-The Chutes

Existing Conditions

High Water Mark Flow Results

Reach	River Sta	Station (m)	Profile	Q Total (m³/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	W.P. Total (m)	Flow Area (m²)	Top Width (m)	Froude # Chl
INUNDATION	345	6395.72	HWM4	35	296.7	298.39	297.39	298.4	0.000201	0.42	101.95	84.2	101.77	0.15
INUNDATION	344	5493.72	HWM4	35	296.6	297.57	297.57	297.81	0.011433	2.15	34.63	16.26	34.47	1
INUNDATION	343	5403.99	HWM4	35	296.01	297.27	296.65	297.31	0.000746	0.86	43.75	40.49	43.18	0.28
INUNDATION	342	5357.51	HWM4	35	295.4	297.29		297.29	0.000062	0.25	154.87	141.31	154.71	0.08
INUNDATION	341	5042.74	HWM4	35	294.95	297.27		297.28	0.000046	0.24	129.81	144.02	129.53	0.07
INUNDATION	340	4334.1	HWM4	35	294.85	297.25		297.25	0.000027	0.19	158.59	182.46	158.34	0.06
INUNDATION	339	3957.09	HWM4	35	294.85	297.22		297.23	0.000175	0.48	65.09	73.3	64.51	0.14
INUNDATION	338	3356.01	HWM4	35	294.85	297.08		297.1	0.000268	0.58	56.19	60.85	55.61	0.18
INUNDATION	337	2746.95	HWM4	35	294.85	296.94		296.95	0.000226	0.5	69.65	69.75	69.23	0.16
INUNDATION	331	2123.92	HWM4	35	294.85	296.53		296.62	0.0002187	1.36	31.8	25.8	31.23	0.48
INUNDATION	330	2051.59	HWM4	35	294.8	296.46		296.5	0.001037	0.93	46.98	37.73	46.61	0.33
INUNDATION	328	1920.25	HWM4	35	294.6	296.11		296.25	0.00398	1.68	29.13	20.82	28.66	0.63
INUNDATION	327	1900.71	HWM4	35	294.5	296.1		296.18	0.001544	1.26	30.87	27.86	30.27	0.41
INUNDATION	326	1890.18	HWM4	35	294.5	296.06		296.16	0.002177	1.41	28.53	24.75	27.91	0.48
INUNDATION	325	1869.72	HWM4	35	294.5	295.74	295.74	296.06	0.010715	2.48	23.13	14.11	22.57	1
INUNDATION	321	1688.34	HWM4	35	293.5	295.42	294.36	295.43	0.000234	0.48	78	72.28	77.63	0.16
INUNDATION	317	1491.94	HWM4	35	293.5	295.4		295.4	0.000071	0.26	144.8	132.61	144.61	0.09
INUNDATION	316	1462.52	HWM4	35	293.5	295.39		295.4	0.000152	0.38	112.94	94.66	112.19	0.13
INUNDATION	315	1405.18	HWM4	35	293.5	295.38		295.39	0.000203	0.47	96.94	78.61	96.14	0.16
INUNDATION	314	1375.98	HWM4	35	293.5	295.37		295.38	0.000221	0.46	83.85	75.61	83.54	0.16
INUNDATION	310	1109.57	HWM4	35	293.45	295.28		295.3	0.000487	0.67	59.97	52.18	59.57	0.23
INUNDATION	309	1015.79	HWM4	35	293.3	295.23	294.31	295.25	0.000474	0.69	55.62	51.06	55.15	0.23
INUNDATION	308.5		Lat Struct											
INUNDATION	308	788.84	HWM4	35	293.25	294.61	294.61	294.93	0.01057	2.51	22.33	13.97	21.82	1
INUNDATION	305	589.96	HWM4	35	289.21	294.73	290.2	294.73	0.000002	0.11	97.97	315.3	95.77	0.02
INUNDATION	303	437.19	HWM4	35	290.14	294.72		294.73	0.000012	0.24	48.78	145.4	46.66	0.04
INUNDATION	301	282.98	HWM4	35	292.47	294.68		294.72	0.000469	0.89	31.22	39.92	28.76	0.23
INUNDATION	300	241.55	HWM4	35	293.7	294.57		294.67	0.00358	1.43	40.53	24.53	40.37	0.58
INUNDATION	209.2	196.02	HWM4	35	293.25	294.22		294.44	0.007129	2.03	28.05	17.22	27.88	0.83
INUNDATION	209.1	175.03	HWM4	35	293.2	293.99	293.99	294.24	0.011405	2.22	31.92	15.75	31.82	1.01
INUNDATION	209	147.8	HWM4	35	292.8	293.6	293.63	293.9	0.013333	2.44	28.45	14.35	28.34	1.09
INUNDATION	208	115.87	HWM4	35	291	292.71	291.8	292.73	0.000312	0.61	53.6	57.05	53.24	0.19
INUNDATION	207	101.82	HWM4	35	290	292.72		292.72	0.000078	0.36	72.89	97.64	72.37	0.1
INUNDATION	206	88.6	HWM4	35	290.11	292.7	291.38	292.72	0.000167	0.63	49.95	69.16	47.11	0.15
INUNDATION	205	69.78	HWM4	35	290	292.71		292.72	0.000011	0.46	49.41	75.41	48.57	0.12
INUNDATION	204.2	47.6	HWM4	35	291.5	292.46	292.46	292.69	0.010075	2.5	36.35	17.02	35.21	0.92
INUNDATION	204	23.8	HWM4	35	289.7	290.18	290.63	292.03	0.107936	6.02	14.29	5.82	14.04	2.98
INUNDATION	203	0	HWM4	35	288.9	289.8	288.68	288.92	0.000242	0.4	53.89	59.99	52.92	0.15
INUNDATION	202	-24.8	HWM4	35	288.5	289.41	289.41	289.75	0.010329	2.59	20.17	13.5	19.71	1
INUNDATION	201	-56.74	HWM4	35	286.3	287.97	287.27	288.05	0.001082	1.23	23.87	28.42	22.61	0.35
INUNDATION	200	-95.1	HWM4	35	285.03	288.02		288.02	0.000024	0.24	85.34	147.37	79.68	0.06
INUNDATION	109	-126.79	HWM4	35	286	288.02		288.02	0.000046	0.31	71.38	113.38	71.04	0.08
INUNDATION	108	-156.34	HWM4	35	283.6	288.02		288.02	0.000012	0.25	45.95	140.59	42.11	0.04
DOWNSTREAM	105	-213.74	HWM4	35	285.39	288.01	286.12	288.02	0.000057	0.27	80.15	131.54	78.58	0.07
DOWNSTREAM	102	-432.91	HWM4	35	284.18	288.01		288.01	0.000018	0.22	59.5	162.72	57.8	0.04
DOWNSTREAM	10	N/A	HWM4	35	284.18	285.23		285.32	0.007914	1.33	40.48	26.25	40.13	0.53
DOWNSTREAM	9	N/A	HWM4	35	284.18	285.21		285.31	0.008351	1.36	40.41	25.82	40.08	0.54
DOWNSTREAM	8	N/A	HWM4	35	284.18	285.2		285.3	0.008845	1.38	40.31	25.35	39.99	0.55
DOWNSTREAM	7	N/A	HWM4	35	284.18	285.19		285.29	0.009285	1.41	39.8	24.86	39.48	0.57
DOWNSTREAM	6	N/A	HWM4	35	284.18	285.18		285.28	0.009948	1.44	39.59	24.3	39.28	0.58
DOWNSTREAM	5	N/A	HWM4	35	284.18	285.16		285.27	0.010819	1.48	39.51	23.67	39.21	0.61
DOWNSTREAM	4	N/A	HWM4	35	284.18	285.14		285.26	0.011939	1.52	39.42	22.96	39.13	0.64
DOWNSTREAM	3	N/A	HWM4	35	284.18	285.12		285.25	0.010349	1.59	39.31	22.08	39.03	0.67
DOWNSTREAM	2	N/A	HWM4	35	284.18	285.09		285.23	0.016164	1.67	39.15	20.91	38.89	0.73
DOWNSTREAM	1	N/A	HWM4	35	284.18	284.97	284.97	285.2	0.032338	2.13	36.06	16.43	35.89	1

Site #13- The Chutes

Existing Conditions

Long Term Average Flow (LTAF) Results

Reach	River Sta	Station (m)	Profile	Q Total (m³/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	W.P. Total (m)	Flow Area (m²)	Top Width (m)	Froude # Chl
INUNDATION	345	6395.72	LTAF	30.2	296.7	298.31	297.35	298.32	0.000194	0.4	97.17	76.34	96.99	0.14
INUNDATION	344	5493.72	LTAF	30.2	296.6	297.52	297.52	297.74	0.011887	2.09	33.05	14.43	32.9	1.01
INUNDATION	343	5403.99	LTAF	30.2	296.01	297.16	296.6	297.19	0.000814	0.85	42.04	35.53	41.53	0.29
INUNDATION	342	5357.51	LTAF	30.2	295.4	297.17		297.18	0.000065	0.24	142.75	123.64	142.61	0.08
INUNDATION	341	5042.74	LTAF	30.2	294.95	297.16		297.16	0.000044	0.23	119.78	129.39	119.51	0.07
INUNDATION	340	4334.1	LTAF	30.2	294.85	297.13		297.14	0.000026	0.18	146.55	164.62	146.32	0.06
INUNDATION	339	3957.09	LTAF	30.2	294.85	297.1		297.11	0.000166	0.46	60.59	66.21	60.04	0.14
INUNDATION	338	3356.01	LTAF	30.2	294.85	296.98		296.99	0.000261	0.55	53.36	54.96	52.81	0.17
INUNDATION	337	2746.95	LTAF	30.2	294.85	296.83		296.85	0.000215	0.48	64.37	62.77	63.98	0.16
INUNDATION	331	2123.92	LTAF	30.2	294.85	296.44		296.53	0.002158	1.3	30.24	23.24	29.7	0.47
INUNDATION	330	2051.59	LTAF	30.2	294.8	296.37		296.41	0.001026	0.89	44.36	33.86	44	0.32
INUNDATION	328	1920.25	LTAF	30.2	294.6	296.03		296.16	0.004135	1.63	28.12	18.58	27.69	0.63
INUNDATION	327	1900.71	LTAF	30.2	294.5	296.02		296.1	0.001538	1.19	30.22	25.45	29.65	0.4
INUNDATION	326	1890.18	LTAF	30.2	294.5	295.98		296.07	0.002135	1.34	27.9	22.58	27.3	0.47
INUNDATION	325	1869.72	LTAF	30.2	294.5	295.67	295.67	295.97	0.011237	2.41	22.34	12.55	21.84	1.01
INUNDATION	321	1688.34	LTAF	30.2	293.5	295.32	294.3	295.33	0.000236	0.47	74.02	64.56	73.7	0.16
INUNDATION	317	1491.94	LTAF	30.2	293.5	295.3		295.3	0.000071	0.26	136.95	118.21	136.78	0.09
INUNDATION	316	1462.52	LTAF	30.2	293.5	295.29		295.3	0.000158	0.38	106.21	83.54	105.55	0.13
INUNDATION	315	1405.18	LTAF	30.2	293.5	295.28		295.29	0.000239	0.46	90.63	69.07	89.92	0.16
INUNDATION	314	1375.98	LTAF	30.2	293.5	295.27		295.29	0.000227	0.45	79.44	67.26	79.16	0.16
INUNDATION	310	1109.57	LTAF	30.2	293.45	295.17		295.19	0.000485	0.65	55.29	46.3	54.93	0.23
INUNDATION	309	1015.79	LTAF	30.2	293.3	295.13	294.24	295.15	0.000461	0.66	51.42	45.67	51	0.22
INUNDATION	308.5		Lat Struct											
INUNDATION	308	788.84	LTAF	30.2	293.25	294.52	294.52	294.84	0.010442	2.5	19.21	12.08	18.78	1
INUNDATION	305	589.96	LTAF	30.2	289.21	294.65	290.13	294.65	0.000002	0.1	97.51	307.99	95.33	0.02
INUNDATION	303	437.19	LTAF	30.2	290.14	294.65		294.65	0.000009	0.21	48.53	141.87	46.48	0.04
INUNDATION	301	282.98	LTAF	30.2	292.47	294.61		294.64	0.000408	0.81	31.08	37.98	28.71	0.22
INUNDATION	300	241.55	LTAF	30.2	293.7	294.5		294.6	0.003835	1.38	40.31	21.94	40.2	0.59
INUNDATION	209.2	196.02	LTAF	30.2	293.25	294.18		294.36	0.006854	1.91	27.63	15.85	27.48	0.8
INUNDATION	209.1	175.03	LTAF	30.2	293.2	293.93	293.93	294.17	0.011534	2.17	29.62	13.94	29.52	1.01
INUNDATION	209	147.8	LTAF	30.2	292.8	293.55	293.58	293.83	0.013685	2.35	27.42	12.84	27.32	1.09
INUNDATION	208	115.87	LTAF	30.2	291	292.65	291.75	292.66	0.00277	0.56	52.28	53.59	51.93	0.18
INUNDATION	207	101.82	LTAF	30.2	290	292.65		292.66	0.000068	0.33	71.82	92.84	71.31	0.09
INUNDATION	206	88.6	LTAF	30.2	290.11	292.64	291.32	292.65	0.000114	0.56	49.06	66.19	46.28	0.13
INUNDATION	205	69.78	LTAF	30.2	290	292.64		292.65	0.000092	0.42	48.46	72.31	47.63	0.11
INUNDATION	204.2	47.6	LTAF	30.2	291.5	292.41	292.41	292.62	0.010071	2.43	35.57	15.4	34.48	0.92
INUNDATION	204	23.8	LTAF	30.2	289.7	290.13	290.55	291.94	0.12623	5.97	14.14	5.06	13.93	3.16
INUNDATION	203	0	LTAF	30.2	288.9	289.7	288.62	289.72	0.00231	0.36	52.58	54.83	51.69	0.15
INUNDATION	202	-24.8	LTAF	30.2	288.5	289.34	289.34	289.66	0.010557	2.49	19.56	12.13	19.13	1
INUNDATION	201	-56.74	LTAF	30.2	286.3	286.83	287.2	288.51	0.15073	5.75	17.75	5.25	17.43	3.34
INUNDATION	200	-95.1	LTAF	30.2	285.03	287.41	286.1	287.42	0.000063	0.3	81.75	99.9	76.76	0.08
INUNDATION	109	-126.79	LTAF	30.2	286	287.4		287.41	0.000127	0.42	62.28	72.62	62.05	0.12
INUNDATION	108	-156.34	LTAF	30.2	283.6	287.41		287.41	0.000016	0.26	43.71	115.37	40.35	0.05
DOWNSTREAM	105	-213.74	LTAF	30.2	285.39	287.4	286.07	287.41	0.000091	0.35	72.69	85.23	71.29	0.1
DOWNSTREAM	102	-432.91	LTAF	30.2	284.18	287.4		287.4	0.000015	0.24	55.11	128.6	53.62	0.05
DOWNSTREAM	10	N/A	LTAF	30.2	284.18	285.08		285.19	0.004591	1.47	39.1	20.54	38.85	0.65
DOWNSTREAM	9	N/A	LTAF	30.2	284.18	285.07		285.19	0.004795	1.49	39.07	20.27	38.82	0.66
DOWNSTREAM	8	N/A	LTAF	30.2	284.18	285.07		285.18	0.005024	1.51	39.03	19.98	38.79	0.67
DOWNSTREAM	7	N/A	LTAF	30.2	284.18	285.06		285.18	0.005285	1.54	38.99	19.67	38.75	0.69
DOWNSTREAM	6	N/A	LTAF	30.2	284.18	285.05		285.17	0.005565	1.56	38.85	19.34	38.62	0.7
DOWNSTREAM	5	N/A	LTAF	30.2	284.18	285.04		285.17	0.005923	1.6	38.61	18.93	38.39	0.73
DOWNSTREAM	4	N/A	LTAF	30.2	284.18	285.03		285.16	0.006314	1.63	38.17	18.49	37.96	0.75
DOWNSTREAM	3	N/A	LTAF	30.2	284.18	285.01		285.16	0.006738	1.68	37.5	18	37.3	0.77
DOWNSTREAM	2	N/A	LTAF	30.2	284.18	285		285.15	0.007363	1.74	36.65	17.37	36.47	0.8
DOWNSTREAM	1	N/A	LTAF	30.2	284.18	284.92	284.92	285.14	0.012137	2.06	34.95	14.67	34.8	1.01

Site #13- The Chutes
 Existing Conditions
 Validation Results

Reach	River Sta	Station (m)	Profile	Q Total (m³/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	W.P. Total (m)	Flow Area (m²)	Top Width (m)	Froude # Chl
INUNDATION	345	6395.72	VALID 2	75.38	296.7	298.88	297.7	298.9	0.00023	0.53	134.42	143.07	134.13	0.16
INUNDATION	344	5493.72	VALID 2	75.38	296.6	297.91	297.91	298.24	0.010439	2.52	47.02	29.92	46.78	1.01
INUNDATION	343	5403.99	VALID 2	75.38	296.01	297.92	296.97	297.98	0.000678	1.06	53.21	71.39	52.27	0.29
INUNDATION	342	5357.51	VALID 2	75.38	295.4	297.95		297.96	0.000049	0.3	176.93	253.69	176.61	0.08
INUNDATION	341	5042.74	VALID 2	75.38	294.95	297.94		297.94	0.000051	0.31	159.04	240.53	158.56	0.08
INUNDATION	340	4334.1	VALID 2	75.38	294.85	297.91		297.91	0.000032	0.25	193.87	299.87	193.46	0.06
INUNDATION	339	3957.09	VALID 2	75.38	294.85	297.87		297.88	0.000206	0.63	80.64	120.45	79.67	0.16
INUNDATION	338	3356.01	VALID 2	75.38	294.85	297.7		297.73	0.000329	0.75	73	100.68	72.08	0.2
INUNDATION	337	2746.95	VALID 2	75.38	294.85	297.53		297.56	0.000248	0.65	85.43	116.63	84.71	0.18
INUNDATION	331	2123.92	VALID 2	75.38	294.85	297.06		297.2	0.002224	1.66	41.83	45.4	40.84	0.5
INUNDATION	330	2051.59	VALID 2	75.38	294.8	297.01		297.07	0.000981	1.1	62.74	68.26	62.07	0.34
INUNDATION	328	1920.25	VALID 2	75.38	294.6	296.65		296.84	0.003463	1.92	40.42	39.21	39.71	0.62
INUNDATION	327	1900.71	VALID 2	75.38	294.5	296.63		296.78	0.001669	1.75	35.07	44.78	34.32	0.46
INUNDATION	326	1890.18	VALID 2	75.38	294.5	296.58		296.76	0.002376	1.87	32.7	40.34	31.95	0.53
INUNDATION	325	1869.72	VALID 2	75.38	294.5	296.2	296.2	296.65	0.009532	2.96	29.33	25.46	28.64	1
INUNDATION	321	1688.34	VALID 2	75.38	293.5	295.99	294.77	296.01	0.000244	0.63	90.13	119.82	89.58	0.17
INUNDATION	317	1491.94	VALID 2	75.38	293.5	295.98		295.99	0.000066	0.34	157.76	221.23	157.43	0.09
INUNDATION	316	1462.52	VALID 2	75.38	293.5	295.97		295.98	0.00013	0.48	128.66	164.98	127.35	0.13
INUNDATION	315	1405.18	VALID 2	75.38	293.5	295.96		295.97	0.000189	0.57	112.34	139.56	110.96	0.15
INUNDATION	314	1375.98	VALID 2	75.38	293.5	295.95		295.97	0.000208	0.59	92.87	127.24	92.32	0.16
INUNDATION	310	1109.57	VALID 2	75.38	293.45	295.85		295.88	0.000445	0.84	69.05	89.88	68.36	0.23
INUNDATION	309	1015.79	VALID 2	75.38	293.3	295.81	294.75	295.84	0.000468	0.88	63.98	85.88	63.18	0.24
INUNDATION	308.5		Lat Struct											
INUNDATION	308	788.84	VALID 2	75.38	293.25	295.08	295.08	295.52	0.009446	2.94	29.7	25.65	28.94	1
INUNDATION	305	589.96	VALID 2	75.38	289.21	295.27	290.66	295.27	0.000006	0.21	102.05	368.46	99.68	0.03
INUNDATION	303	437.19	VALID 2	75.38	290.14	295.26		295.27	0.000032	0.44	52.67	171.08	49.91	0.07
INUNDATION	301	282.98	VALID 2	75.38	292.47	295.14		295.25	0.000875	1.46	36.53	53.91	33.15	0.33
INUNDATION	300	241.55	VALID 2	75.38	293.7	295.03		295.18	0.002556	1.73	42.11	43.66	41.58	0.54
INUNDATION	209.2	196.02	VALID 2	75.38	293.25	294.52	294.52	294.95	0.009573	2.91	30.66	25.88	30.42	1.01
INUNDATION	209.1	175.03	VALID 2	75.38	293.2	294.26	294.34	294.72	0.013409	2.99	36.92	25.2	36.77	1.15
INUNDATION	209	147.8	VALID 2	75.38	292.8	294	294.01	294.39	0.010126	2.78	36	27.13	35.84	1.02
INUNDATION	208	115.87	VALID 2	75.38	291	293.17	292.11	293.21	0.000497	0.9	62.88	83.76	62.47	0.25
INUNDATION	207	101.82	VALID 2	75.38	290	293.19		293.2	0.000147	0.57	80.42	133.31	79.83	0.14
INUNDATION	206	88.6	VALID 2	75.38	290.11	293.14	291.73	293.2	0.000371	1.08	51.48	90.01	48.2	0.23
INUNDATION	205	69.78	VALID 2	75.38	290	293.15		293.18	0.000248	0.76	56.06	98.59	55.09	0.18
INUNDATION	204.2	47.6	VALID 2	75.38	291.5	292.77	292.77	293.14	0.010036	2.94	39.47	28.17	37.83	0.95
INUNDATION	204	23.8	VALID 2	75.38	289.7	290.62	291.18	292.58	0.047758	6.2	15.5	12.16	14.85	2.19
INUNDATION	203	0	VALID 2	75.38	288.9	290.46	289.15	290.5	0.000279	0.62	61.6	97.58	60.03	0.18
INUNDATION	202	-24.8	VALID 2	75.38	288.5	289.88	289.88	290.41	0.000907	3.23	22.81	23.37	22.12	1
INUNDATION	201	-56.74	VALID 2	75.38	286.3	288.7	287.73	288.83	0.001232	1.63	27.94	46.12	26.33	0.39
INUNDATION	200	-95.1	VALID 2	75.38	285.03	288.78		288.79	0.000036	0.37	87.26	208.7	80.75	0.07
INUNDATION	109	-126.79	VALID 2	75.38	286	288.78		288.79	0.000063	0.44	80.7	171.51	80.21	0.1
INUNDATION	108	-156.34	VALID 2	75.38	283.6	288.78		288.79	0.000028	0.44	48.22	173.25	43.69	0.07
DOWNSTREAM	105	-213.74	VALID 2	75.38	285.39	288.77	286.47	288.78	0.000043	0.4	85.42	193.2	83.54	0.08
DOWNSTREAM	102	-432.91	VALID 2	75.38	284.18	288.77		288.78	0.000022	0.38	65.71	209.02	63.81	0.06
DOWNSTREAM	10	N/A	VALID 2	75.38	284.18	285.47		285.69	0.004759	2.08	42.08	36.23	41.59	0.71
DOWNSTREAM	9	N/A	VALID 2	75.38	284.18	285.46		285.69	0.004887	2.1	41.99	35.91	41.5	0.72
DOWNSTREAM	8	N/A	VALID 2	75.38	284.18	285.45		285.68	0.00503	2.12	41.93	35.58	41.45	0.73
DOWNSTREAM	7	N/A	VALID 2	75.38	284.18	285.44		285.68	0.005211	2.14	41.87	35.18	41.39	0.74
DOWNSTREAM	6	N/A	VALID 2	75.38	284.18	285.43		285.67	0.005411	2.17	41.8	34.76	41.32	0.75
DOWNSTREAM	5	N/A	VALID 2	75.38	284.18	285.42		285.67	0.005636	2.2	41.72	34.31	41.25	0.77
DOWNSTREAM	4	N/A	VALID 2	75.38	284.18	285.41		285.67	0.00589	2.23	41.64	33.84	41.18	0.78
DOWNSTREAM	3	N/A	VALID 2	75.38	284.18	285.4		285.66	0.006223	2.27	41.54	33.25	41.09	0.8
DOWNSTREAM	2	N/A	VALID 2	75.38	284.18	285.38	285.28	285.65	0.006643	2.31	41.42	32.57	40.98	0.83
DOWNSTREAM	1	N/A	VALID 2	75.38	284.18	285.28	285.28	285.64	0.01027	2.65	40.79	28.4	40.41	1.01

Site #13-The Chutes
 Proposed Conditions
 2-year Flow Results

Reach	River Sta	Station (m)	Profile	Q Total (m³/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	W.P. Total (m)	Flow Area (m²)	Top Width (m)	Froude # Chl
INUNDATION	345	6395.72	2-YEAR	206.4	296.7	300.02	298.29	300.04	0.000167	0.66	162.14	310.86	161.68	0.15
INUNDATION	344	5493.72	2-YEAR	206.4	296.6	299.61	299.73	0.001042	1.49	85.54	138.86	84.94	0.37	
INUNDATION	343	5403.99	2-YEAR	206.4	296.01	299.57	299.64	0.000072	1.15	123.51	179.7	121.62	0.3	
INUNDATION	342	5357.51	2-YEAR	206.4	295.4	299.61	299.61	0.000032	0.37	210	563.71	209.31	0.07	
INUNDATION	341	5042.74	2-YEAR	206.4	294.95	299.6	299.6	0.000032	0.39	355.74	618.28	355.05	0.07	
INUNDATION	340	4334.1	2-YEAR	206.4	294.85	299.58	299.58	0.000022	0.32	296.59	653.62	295.79	0.06	
INUNDATION	339	3957.09	2-YEAR	206.4	294.85	299.54	299.57	0.000148	0.77	103.31	269.14	101.94	0.15	
INUNDATION	338	3356.01	2-YEAR	206.4	294.85	299.44	299.47	0.000185	0.75	209.24	295.11	207.96	0.16	
INUNDATION	337	2746.95	2-YEAR	206.4	294.85	299.35	299.38	0.00011	0.75	117.86	291.02	116.79	0.13	
INUNDATION	331	2123.92	2-YEAR	206.4	294.85	299.15	299.25	0.000435	1.47	98.19	185.67	96.89	0.26	
INUNDATION	330	2051.59	2-YEAR	206.4	294.8	299.17	299.21	0.000184	0.98	111.03	244.28	110.06	0.17	
INUNDATION	328	1920.25	2-YEAR	206.4	294.6	299.08	299.18	0.000356	1.36	63.51	164.55	61.85	0.24	
INUNDATION	327	1900.71	2-YEAR	206.4	294.5	299.01	299.16	0.000473	1.76	49.04	143.89	47.17	0.29	
INUNDATION	326	1890.18	2-YEAR	206.4	294.5	299.02	299.15	0.000451	1.63	46.89	137.03	45.1	0.27	
INUNDATION	325	1869.72	2-YEAR	206.4	294.5	299.03	299.14	0.000407	1.49	65.52	160.29	64.33	0.26	
INUNDATION	321	1688.34	2-YEAR	206.4	293.5	299.09	299.09	0.000025	0.43	190.83	603.68	189.85	0.07	
INUNDATION	317	1491.94	2-YEAR	206.4	293.5	299.09	299.09	0.00001	0.29	221.51	785.33	220.67	0.04	
INUNDATION	316	1462.52	2-YEAR	206.4	293.5	299.08	299.09	0.000015	0.35	276.31	801.38	274.22	0.05	
INUNDATION	315	1405.18	2-YEAR	206.4	293.5	299.08	299.09	0.00002	0.4	286.42	752.67	283.98	0.06	
INUNDATION	314	1375.98	2-YEAR	206.4	293.5	299.08	299.09	0.000028	0.47	156.88	505.22	155.34	0.07	
INUNDATION	310	1109.57	2-YEAR	206.4	293.45	299.07	299.08	0.000038	0.53	259.87	624.5	258.3	0.08	
INUNDATION	309	1015.79	2-YEAR	206.4	293.3	299.06	295.45	299.07	0.000036	0.52	284.44	671.95	282.67	0.08
INUNDATION	308.5	Lat Struct												
INUNDATION	308	788.84	2-YEAR	206.4	293.25	298.99	295.92	299.05	0.000178	1.11	63.76	196.69	135.45	0.17
INUNDATION	305	589.96	2-YEAR	206.4	289.21	299.03	299.03	0.000005	0.28	221.12	997.57	218.28	0.03	
INUNDATION	303	437.19	2-YEAR	206.4	290.14	299.02	299.03	0.000021	0.57	144	530.99	140.57	0.07	
INUNDATION	301	282.98	2-YEAR	206.4	292.47	298.95	299.02	0.000139	1.2	85.76	271.44	81.08	0.16	
INUNDATION	300	241.55	2-YEAR	206.4	293.7	298.97	299.01	0.000093	0.92	78.37	284.85	76.06	0.13	
INUNDATION	209.2	196.02	2-YEAR	206.4	293.25	298.94	299	0.000125	1.1	79.28	246.31	77.95	0.16	
INUNDATION	209.1	175.03	2-YEAR	206.4	293.2	298.95	298.99	0.000088	0.95	88.53	288.2	87.06	0.13	
INUNDATION	209	147.8	2-YEAR	206.4	292.8	298.95	298.99	0.000074	0.91	100.73	339.18	99.1	0.12	
INUNDATION	208	115.87	2-YEAR	206.4	291	298.97	298.98	0.000011	0.4	144.26	705.51	142.03	0.05	
INUNDATION	207	101.82	2-YEAR	206.4	290	298.97	298.98	0.000007	0.32	114.58	708.55	111.03	0.04	
INUNDATION	206	88.6	2-YEAR	206.4	290.11	298.96	292.57	298.98	0.000028	0.68	139.9	623.2	129.17	0.08
INUNDATION	205	69.78	2-YEAR	206.4	290	298.97	298.98	0.000012	0.44	122.11	589.93	118.52	0.05	
INUNDATION	204.2	47.6	2-YEAR	206.4	291.5	298.97	298.97	0.000019	0.46	128.93	601.5	123.95	0.06	
INUNDATION	204	23.8	2-YEAR	168.4	289.7	298.97	298.01	298.97	0.000001	86.39	496.48	137.42	0	
INUNDATION	203.5	Inl Struct												
INUNDATION	203	0	2-YEAR	168.4	288.9	297.91	297.91	297.91	0.000006	88.4	547.13	143.28	0	
INUNDATION	202	-24.8	2-YEAR	168.4	288.5	289.48	290.68	295.97	0.176464	11.28	20.65	14.93	20.16	4.18
INUNDATION	201	-56.74	2-YEAR	168.4	286.3	290.79	288.53	290.88	0.000475	1.34	50.5	126.02	48.4	0.26
INUNDATION	200	-95.1	2-YEAR	168.4	285.03	290.84	290.85	0.000026	0.46	98.86	383.42	90.49	0.07	
INUNDATION	109	-126.79	2-YEAR	168.4	286	290.84	290.85	0.000033	0.5	94.63	350.47	93.17	0.08	
INUNDATION	108	-156.34	2-YEAR	168.4	283.6	290.83	290.85	0.000038	0.67	73.97	281.14	66.61	0.08	
DOWNTSTREAM	105	-213.74	2-YEAR	206.4	285.39	290.83	290.84	0.000042	0.58	138.81	411.99	136.17	0.09	
DOWNTSTREAM	102	-432.91	2-YEAR	206.4	284.18	290.82	290.84	0.000003	0.59	281.68	670.9	278.96	0.08	
DOWNTSTREAM	10	N/A	2-YEAR	206.4	284.18	286.21	286.66	0.004851	2.97	47.84	69.38	46.92	0.78	
DOWNTSTREAM	9	N/A	2-YEAR	206.4	284.18	286.2	286.66	0.004953	2.99	47.78	68.92	46.87	0.79	
DOWNTSTREAM	8	N/A	2-YEAR	206.4	284.18	286.19	286.66	0.005061	3.02	47.72	68.44	46.81	0.8	
DOWNTSTREAM	7	N/A	2-YEAR	206.4	284.18	286.18	286.65	0.005176	3.04	47.66	67.94	46.75	0.8	
DOWNTSTREAM	6	N/A	2-YEAR	206.4	284.18	286.17	286.65	0.005318	3.06	47.58	67.35	46.68	0.81	
DOWNTSTREAM	5	N/A	2-YEAR	206.4	284.18	286.16	286.64	0.005473	3.09	47.51	66.73	46.61	0.83	
DOWNTSTREAM	4	N/A	2-YEAR	206.4	284.18	286.14	286.64	0.005643	3.12	47.42	66.08	46.53	0.84	
DOWNTSTREAM	3	N/A	2-YEAR	206.4	284.18	286.13	286.64	0.005856	3.16	47.32	65.29	46.44	0.85	
DOWNTSTREAM	2	N/A	2-YEAR	206.4	284.18	286.11	286.63	0.006134	3.21	47.2	64.32	46.32	0.87	
DOWNTSTREAM	1	N/A	2-YEAR	206.4	284.18	285.97	285.97	286.61	0.008453	3.56	46.3	57.97	45.46	1.01

Site #13- The Chutes
 Proposed Conditions
 100-year Flow Results

Reach	River Sta	Station (m)	Profile	Q Total (m³/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	W.P. Total (m)	Flow Area (m²)	Top Width (m)	Froude # Chl
INUNDATION	345	6395.72	100-YEAR	506	296.7	301.53	298.95	301.57	0.000156	0.88	198.99	580.23	198.38	0.16
INUNDATION	344	5493.72	100-YEAR	506	296.6	301.13		301.28	0.000794	1.75	114.51	289.92	113.72	0.35
INUNDATION	343	5403.99	100-YEAR	506	296.01	301.15		301.21	0.000349	1.1	216.32	464.6	214.17	0.23
INUNDATION	342	5357.51	100-YEAR	506	295.4	301.18		301.19	0.000042	0.57	273.38	933.29	272.54	0.09
INUNDATION	341	5042.74	100-YEAR	506	294.95	301.16		301.18	0.00004	0.57	589.87	1389.65	589.15	0.09
INUNDATION	340	4334.1	100-YEAR	506	294.85	301.14		301.15	0.00003	0.49	728.11	1352.63	726.97	0.07
INUNDATION	339	3957.09	100-YEAR	506	294.85	301.06		301.13	0.00019	1.13	522.69	545.77	520.98	0.18
INUNDATION	338	3356.01	100-YEAR	506	294.85	300.97		301.02	0.000162	1.01	317.96	703.93	316.53	0.17
INUNDATION	337	2746.95	100-YEAR	506	294.85	300.84		300.91	0.000173	1.21	184.73	519.65	183.56	0.18
INUNDATION	331	2123.92	100-YEAR	506	294.85	300.43		300.69	0.000746	2.42	126.48	327.28	125.02	0.37
INUNDATION	330	2051.59	100-YEAR	506	294.8	300.49		300.62	0.000327	1.64	137.56	407.75	136.43	0.25
INUNDATION	328	1920.25	100-YEAR	506	294.6	300.25		300.54	0.000747	2.41	73.15	241.9	71.16	0.37
INUNDATION	327	1900.71	100-YEAR	506	294.5	299.92		300.49	0.001373	3.46	59.09	191.44	56.9	0.51
INUNDATION	326	1890.18	100-YEAR	506	294.5	299.96		300.45	0.001218	3.12	51.39	181.14	49	0.47
INUNDATION	325	1869.72	100-YEAR	506	294.5	300.02		300.39	0.000984	2.75	79.96	232.39	78.63	0.42
INUNDATION	321	1688.34	100-YEAR	506	293.5	300.23		300.26	0.000065	0.81	214.86	832.19	213.76	0.11
INUNDATION	317	1491.94	100-YEAR	506	293.5	300.23		300.25	0.000028	0.56	302.64	1080.41	301.66	0.07
INUNDATION	316	1462.52	100-YEAR	506	293.5	300.23		300.25	0.00004	0.66	331.84	1134.9	329.61	0.09
INUNDATION	315	1405.18	100-YEAR	506	293.5	300.23		300.24	0.00005	0.75	344.3	1101.14	341.72	0.1
INUNDATION	314	1375.98	100-YEAR	506	293.5	300.2		300.24	0.000077	0.91	263.87	716.93	262.19	0.12
INUNDATION	310	1109.57	100-YEAR	506	293.45	300.18		300.22	0.000091	0.96	272.96	916.71	271.04	0.13
INUNDATION	309	1015.79	100-YEAR	506	293.3	300.17	296.38	300.21	0.000086	0.93	301.74	996.45	299.68	0.13
INUNDATION	308.5		Lat Struct											
INUNDATION	308	788.84	100-YEAR	506	293.25	299.92	297.18	300.15	0.000526	2.18	119.38	287.28	206.61	0.31
INUNDATION	305	589.96	100-YEAR	506	289.21	300.06		300.07	0.000018	0.58	244.66	1234.36	241.73	0.06
INUNDATION	303	437.19	100-YEAR	506	290.14	300		300.07	0.000077	1.19	154.56	675.11	150.82	0.13
INUNDATION	301	282.98	100-YEAR	506	292.47	299.74		300.02	0.000521	2.53	106.19	341.51	101.43	0.32
INUNDATION	300	241.55	100-YEAR	506	293.7	299.8		299.97	0.000323	1.9	82.51	349.5	79.85	0.25
INUNDATION	209.2	196.02	100-YEAR	506	293.25	299.68		299.94	0.000468	2.33	106.61	314.07	105.24	0.31
INUNDATION	209.1	175.03	100-YEAR	506	293.2	299.72		299.91	0.000323	2	103.96	362.01	102.38	0.26
INUNDATION	209	147.8	100-YEAR	506	292.8	299.73		299.9	0.00028	1.93	118.2	423	116.47	0.24
INUNDATION	208	115.87	100-YEAR	506	291	299.82		299.86	0.000043	0.86	175.96	836.94	173.54	0.1
INUNDATION	207	101.82	100-YEAR	506	290	299.83		299.85	0.000028	0.71	161.37	831.77	157.38	0.08
INUNDATION	206	88.6	100-YEAR	506	290.11	299.76	293.87	299.85	0.000115	1.49	149.94	729.94	138.97	0.16
INUNDATION	205	69.78	100-YEAR	506	290	299.79		299.83	0.000051	0.96	134.24	691.72	130.5	0.11
INUNDATION	204.2	47.6	100-YEAR	506	291.5	299.8		299.83	0.000075	0.99	141.69	708.83	136.56	0.11
INUNDATION	204	23.8	100-YEAR	468	289.7	299.79	298.01	299.82	0.000053		86.39	566.34	144.32	0
INUNDATION	203.5		Ini Struct											
INUNDATION	203	0	100-YEAR	468	288.9	297.91	297.91	297.94	0.00005		88.4	547.18	143.28	0
INUNDATION	202	-24.8	100-YEAR	468	288.5	290.73	292.23	296.28	0.05477	10.44	28.98	44.84	28.02	2.63
INUNDATION	201	-56.74	100-YEAR	468	286.3	293.25	290.2	293.42	0.000392	1.83	65.51	263.61	62.51	0.27
INUNDATION	200	-95.1	100-YEAR	468	285.03	293.34		293.38	0.000048	0.82	114.88	627.2	105.29	0.1
INUNDATION	109	-126.79	100-YEAR	468	286	293.34		293.37	0.000053	0.86	106.14	595.22	103.08	0.11
INUNDATION	108	-156.34	100-YEAR	468	283.6	293.29		293.37	0.00009	1.28	108.64	498.07	100.21	0.14
DOWNSTREAM	105	-213.74	100-YEAR	506	285.39	293.31		293.35	0.000052	0.87	174.24	801.39	170.95	0.11
DOWNSTREAM	102	-432.91	100-YEAR	506	284.18	293.31		293.34	0.000038	0.83	290.14	1374.58	282.76	0.09
DOWNSTREAM	10	N/A	100-YEAR	506	284.18	287.35		288.17	0.004584	4.01	54.77	126.19	53.3	0.82
DOWNSTREAM	9	N/A	100-YEAR	506	284.18	287.34		288.17	0.004647	4.03	54.68	125.66	53.21	0.83
DOWNSTREAM	8	N/A	100-YEAR	506	284.18	287.33		288.17	0.004712	4.05	54.59	125.12	53.12	0.83
DOWNSTREAM	7	N/A	100-YEAR	506	284.18	287.32		288.16	0.004792	4.07	54.48	124.48	53.02	0.84
DOWNSTREAM	6	N/A	100-YEAR	506	284.18	287.31		288.16	0.004875	4.09	54.36	123.81	52.91	0.84
DOWNSTREAM	5	N/A	100-YEAR	506	284.18	287.29		288.15	0.004964	4.11	54.25	123.13	52.79	0.85
DOWNSTREAM	4	N/A	100-YEAR	506	284.18	287.28		288.15	0.005071	4.14	54.11	122.33	52.66	0.86
DOWNSTREAM	3	N/A	100-YEAR	506	284.18	287.26		288.15	0.005187	4.17	53.96	121.5	52.52	0.87
DOWNSTREAM	2	N/A	100-YEAR	506	284.18	287.25	287.04	288.14	0.005315	4.2	53.81	120.59	52.36	0.88
DOWNSTREAM	1	N/A	100-YEAR	506	284.18	287.04	287.04	288.12	0.007084	4.59	52.59	110.16	51.29	1

Site #13- The Chutes

Proposed Conditions

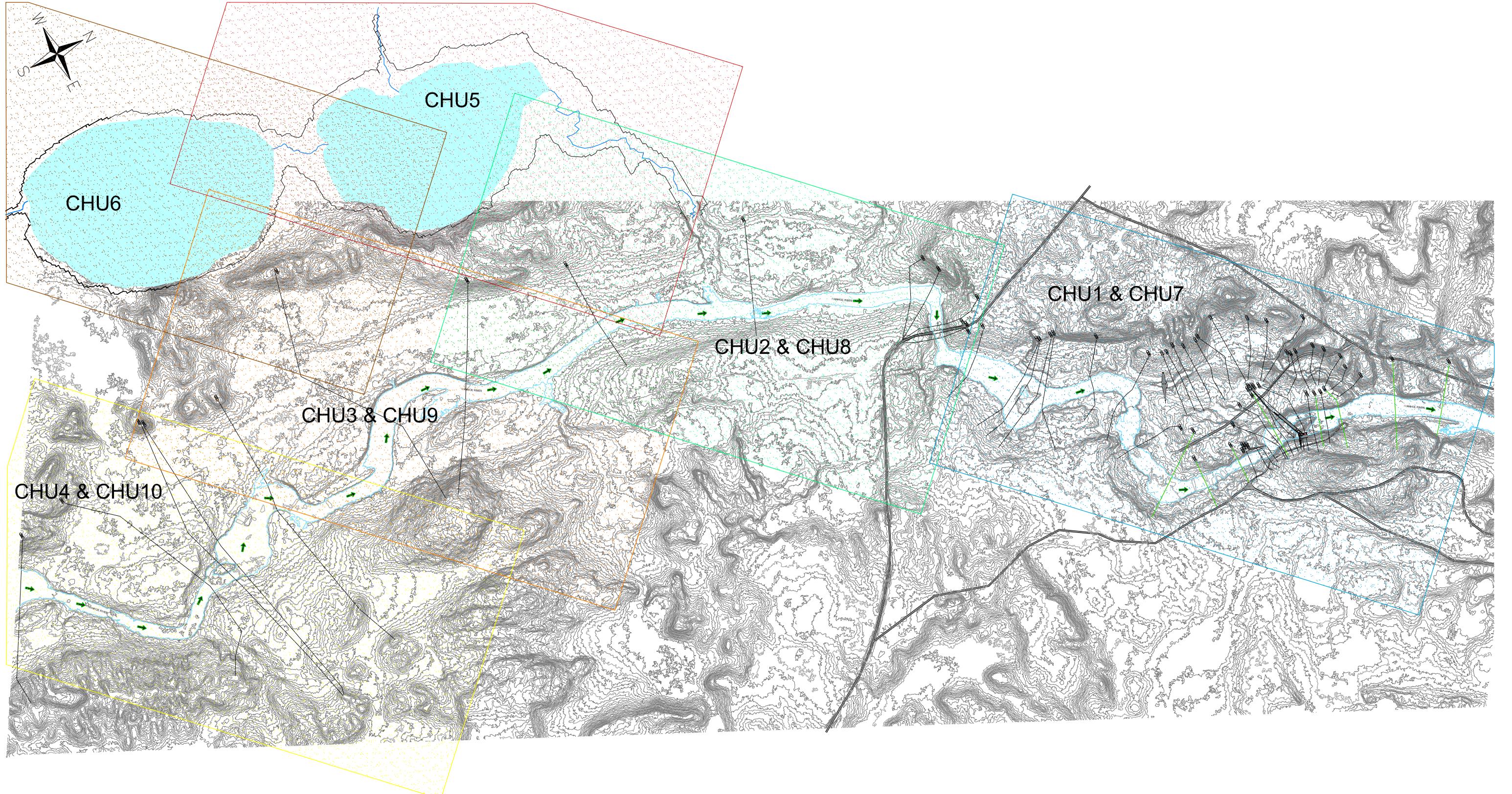
Long Term Average Flow Results

Reach	River Sta	Station (m)	Profile	Q Total (m³/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	W.P. Total (m)	Flow Area (m²)	Top Width (m)	Froude # Chl
INUNDATION	345	6395.72	LTAF	30.2	296.6	298.07	297.35	298.38	0.000155	0.36	100.99	83.02	100.81	0.13
INUNDATION	344	5493.72	LTAF	30.2	296.01	298.07		298.1	0.000912	0.8	53.02	37.67	52.7	0.3
INUNDATION	343	5403.99	LTAF	30.2	296.01	298.07		298.08	0.000081	0.38	55.25	79.16	54.21	0.1
INUNDATION	342	5357.51	LTAF	30.2	295.4	298.07		298.07	0.000006	0.11	178.01	274.77	177.66	0.03
INUNDATION	341	5042.74	LTAF	30.2	294.95	298.07		298.07	0.000006	0.12	160.64	261.78	160.13	0.03
INUNDATION	340	4334.1	LTAF	30.2	294.85	298.07		298.07	0.000004	0.09	196.12	330.41	195.67	0.02
INUNDATION	339	3957.09	LTAF	30.2	294.85	298.06		298.06	0.000023	0.22	81.88	136.1	80.82	0.05
INUNDATION	338	3356.01	LTAF	30.2	294.85	298.05		298.05	0.000027	0.24	76.64	126.19	75.53	0.06
INUNDATION	337	2746.95	LTAF	30.2	294.85	298.04		298.04	0.000014	0.19	90.6	160.13	89.74	0.04
INUNDATION	331	2123.92	LTAF	30.2	294.85	298.02		298.02	0.000044	0.35	65.83	93.25	64.64	0.08
INUNDATION	330	2051.59	LTAF	30.2	294.8	298.02		298.02	0.000018	0.23	78.73	137.29	77.87	0.05
INUNDATION	328	1920.25	LTAF	30.2	294.6	298.01		298.02	0.00003	0.3	54.04	102.95	52.63	0.06
INUNDATION	327	1900.71	LTAF	30.2	294.5	298.01		298.02	0.000029	0.36	44.13	98.34	42.85	0.07
INUNDATION	326	1890.18	LTAF	30.2	294.5	298.01		298.01	0.00003	0.33	42.46	93.23	41.21	0.07
INUNDATION	325	1869.72	LTAF	30.2	294.5	298.01		298.01	0.00003	0.32	53.77	100.86	52.78	0.07
INUNDATION	321	1688.34	LTAF	30.2	293.5	298.01		298.01	0.000002	0.09	176.92	407.22	176.12	0.02
INUNDATION	317	1491.94	LTAF	30.2	293.5	298.01		298.01	0.000001	0.06	190.91	563	190.18	0.01
INUNDATION	316	1462.52	LTAF	30.2	293.5	298.01		298.01	0.000001	0.07	256.34	515.48	254.4	0.01
INUNDATION	315	1405.18	LTAF	30.2	293.5	298.01		298.01	0.000001	0.08	259.79	460.05	257.49	0.01
INUNDATION	314	1375.98	LTAF	30.2	293.5	298.01		298.01	0.000002	0.09	142.06	346.81	140.78	0.02
INUNDATION	310	1109.57	LTAF	30.2	293.45	298.01		298.01	0.000002	0.11	242.89	357.74	241.61	0.02
INUNDATION	309	1015.79	LTAF	30.2	293.3	298.01	294.24	298.01	0.000003	0.12	167.82	291.88	240.68	0.02
INUNDATION	308.5		Lat Struct											
INUNDATION	308	788.84	LTAF	30.2	293.25	298.01	294.52	298.01	0.000001	0.21	52.24	142.21	49.92	0.04
INUNDATION	305	589.96	LTAF	30.2	289.21	298.01		298.01	0	0.05	199.61	786.35	196.97	0.01
INUNDATION	303	437.19	LTAF	30.2	290.14	298.01		298.01	0.000001	0.1	129.73	394.28	126.54	0.01
INUNDATION	301	282.98	LTAF	30.2	292.47	298.01		298.01	0.000006	0.22	74.04	200.96	69.57	0.03
INUNDATION	300	241.55	LTAF	30.2	293.7	298.01		298.01	0.000004	0.17	70.04	214.8	68.1	0.03
INUNDATION	209.2	196.02	LTAF	30.2	293.25	298.01		298.01	0.000005	0.2	61.66	183.78	60.49	0.03
INUNDATION	209.1	175.03	LTAF	30.2	293.2	298.01		298.01	0.000004	0.17	68.6	216.89	67.27	0.03
INUNDATION	209	147.8	LTAF	30.2	292.8	298.01		298.01	0.000003	0.16	78.46	257.77	77.02	0.02
INUNDATION	208	115.87	LTAF	30.2	291	298.01		298.01	0	0.07	127.65	578.15	125.68	0.01
INUNDATION	207	101.82	LTAF	30.2	290	298.01		298.01	0	0.05	110.26	602.94	107.21	0.01
INUNDATION	206	88.6	LTAF	30.2	290.11	298.01	291.32	298.01	0.000001	0.11	117.15	508.99	106.97	0.01
INUNDATION	205	69.78	LTAF	30.2	290	298.01		298.01	0	0.08	111.26	481.67	107.87	0.01
INUNDATION	204.2	47.6	LTAF	30.2	291.5	298.01		298.01	0.000001	0.08	120.67	486.49	115.95	0.01
INUNDATION	204	23.8	LTAF	0	289.7	298.01		298.01	0	0	86.39	414.73	132.57	0
INUNDATION	203.5		Inl Struct											
INUNDATION	203	0	LTAF	0	288.9	297.91	297.91	297.91	0		88.4	547.13	143.28	0
INUNDATION	202	-24.8	LTAF	0	288.5	288.51		288.51	0.097897	0.3	0.67	0	0.67	1.37
INUNDATION	201	-56.74	LTAF	30.2	286.3	287.06	287.2	287.57	0.023251	3.16	19.49	9.56	18.96	1.42
INUNDATION	200	-95.1	LTAF	30.2	285.03	287.41	286.1	287.42	0.000063	0.3	81.75	99.9	76.76	0.08
INUNDATION	109	-126.79	LTAF	30.2	286	287.4		287.41	0.000127	0.42	62.28	72.62	62.05	0.12
INUNDATION	108	-156.34	LTAF	30.2	283.6	287.41		287.41	0.000016	0.26	43.71	115.37	40.35	0.05
DOWNSTREAM	105	-213.74	LTAF	30.2	285.39	287.4	286.07	287.41	0.000091	0.35	72.69	85.23	71.29	0.1
DOWNSTREAM	102	-432.91	LTAF	30.2	284.18	287.4		287.4	0.000015	0.24	55.11	128.6	53.62	0.05
DOWNSTREAM	10	N/A	LTAF	30.2	284.18	285.08		285.19	0.004591	1.47	39.1	20.54	38.85	0.65
DOWNSTREAM	9	N/A	LTAF	30.2	284.18	285.07		285.19	0.004795	1.49	39.07	20.27	38.82	0.66
DOWNSTREAM	8	N/A	LTAF	30.2	284.18	285.07		285.18	0.005024	1.51	39.03	19.98	38.79	0.67
DOWNSTREAM	7	N/A	LTAF	30.2	284.18	285.06		285.18	0.005285	1.54	38.99	19.67	38.75	0.69
DOWNSTREAM	6	N/A	LTAF	30.2	284.18	285.05		285.17	0.005565	1.56	38.85	19.34	38.62	0.7
DOWNSTREAM	5	N/A	LTAF	30.2	284.18	285.04		285.17	0.005923	1.6	38.61	18.93	38.39	0.73
DOWNSTREAM	4	N/A	LTAF	30.2	284.18	285.03		285.16	0.006314	1.63	38.17	18.49	37.96	0.75
DOWNSTREAM	3	N/A	LTAF	30.2	284.18	285.01		285.16	0.006738	1.68	37.5	18	37.3	0.77
DOWNSTREAM	2	N/A	LTAF	30.2	284.18	285		285.15	0.007363	1.74	36.65	17.37	36.47	0.8
DOWNSTREAM	1	N/A	LTAF	30.2	284.18	284.92	284.92	285.14	0.012137	2.06	34.95	14.67	34.8	1.01



Appendix C

Figures



LEGEND

- (115) MODEL CROSS SECTION ID
- FLOW DIRECTION
- CROSS-SECTION TYPE:
 - SECTION WITH INTERPOLATED LOW FLOW GEOMETRY
 - ORIGINAL SURVEY SECTION

EDGE OF WATER

- EXISTING CONDITIONS LTAF FLOOD ELEVATION (30.20 m3/s)
- PROPOSED CONDITIONS LTAF FLOOD ELEVATION (30.20 m3/s)
- EXISTING CONDITIONS HWM FLOOD ELEVATION (35.00 m3/s)
- EXISTING CONDITIONS 2-YEAR FLOOD ELEVATION (206.40 m3/s)
- PROPOSED CONDITIONS 2-YEAR FLOOD ELEVATION (206.40 m3/s)
- EXISTING CONDITIONS 100-YEAR FLOOD ELEVATION (506.00 m3/s)
- PROPOSED CONDITIONS 100-YEAR FLOOD ELEVATION (506.00 m3/s)



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CLIENT

ORTECH ENVIRONMENTAL
804 SOUTHDOWN ROAD
MISSISSAUGA, ONTARIO

SCALE NTS



DRAWING TITLE

IVANHOE RIVER – THE CHUTES
KEYPLAN

DRAWN BY

K.B.

CHECKED BY

T.R.L.

SCALE

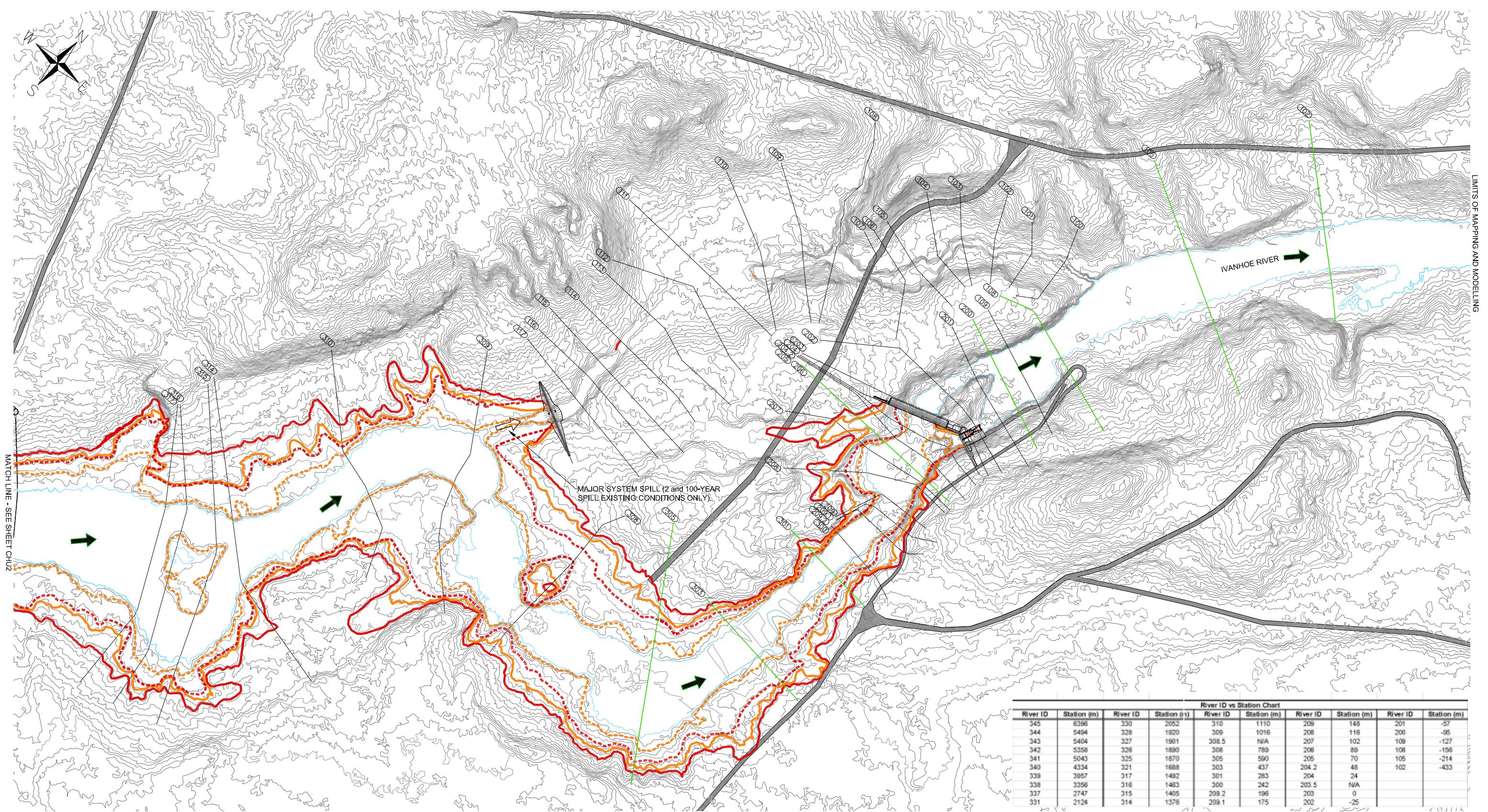
N.T.S.

PROJECT NO.

PCG019617

CHUK

PRELIMINARY PLAN ONLY



PRELIMINARY PLAN ONLY

LEGEND

- (115) MODEL CROSS SECTION ID
- EDGE OF WATER
- EXISTING CONDITIONS LTAF FLOOD ELEVATION (30.20 m3/s)
- PROPOSED CONDITIONS LTAF FLOOD ELEVATION (30.20 m3/s)
- EXISTING CONDITIONS HWM FLOOD ELEVATION (35.00 m3/s)
- EXISTING CONDITIONS 2-YEAR FLOOD ELEVATION (206.40 m3/s)
- PROPOSED CONDITIONS 2-YEAR FLOOD ELEVATION (206.40 m3/s)
- EXISTING CONDITIONS 100-YEAR FLOOD ELEVATION (506.00 m3/s)
- PROPOSED CONDITIONS 100-YEAR FLOOD ELEVATION (506.00 m3/s)
- CROSS-SECTION TYPE: SECTION WITH INTERPOLATED LOW FLOW GEOMETRY
- ORIGINAL SURVEY SECTION
- FLOW DIRECTION



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CLIENT

ORTECH ENVIRONMENTAL
804 SOUTHDOWN ROAD
MISSISSAUGA, ONTARIO

SCALE 1:5000

0 50 100 150 200 250

DRAWING TITLE

IVANHOE RIVER – THE CHUTES
2 & 100YR FLOODLINES (EXISTING & PROPOSED)

DRAWN BY

K.B.

CHECKED BY

T.R.L.

SCALE

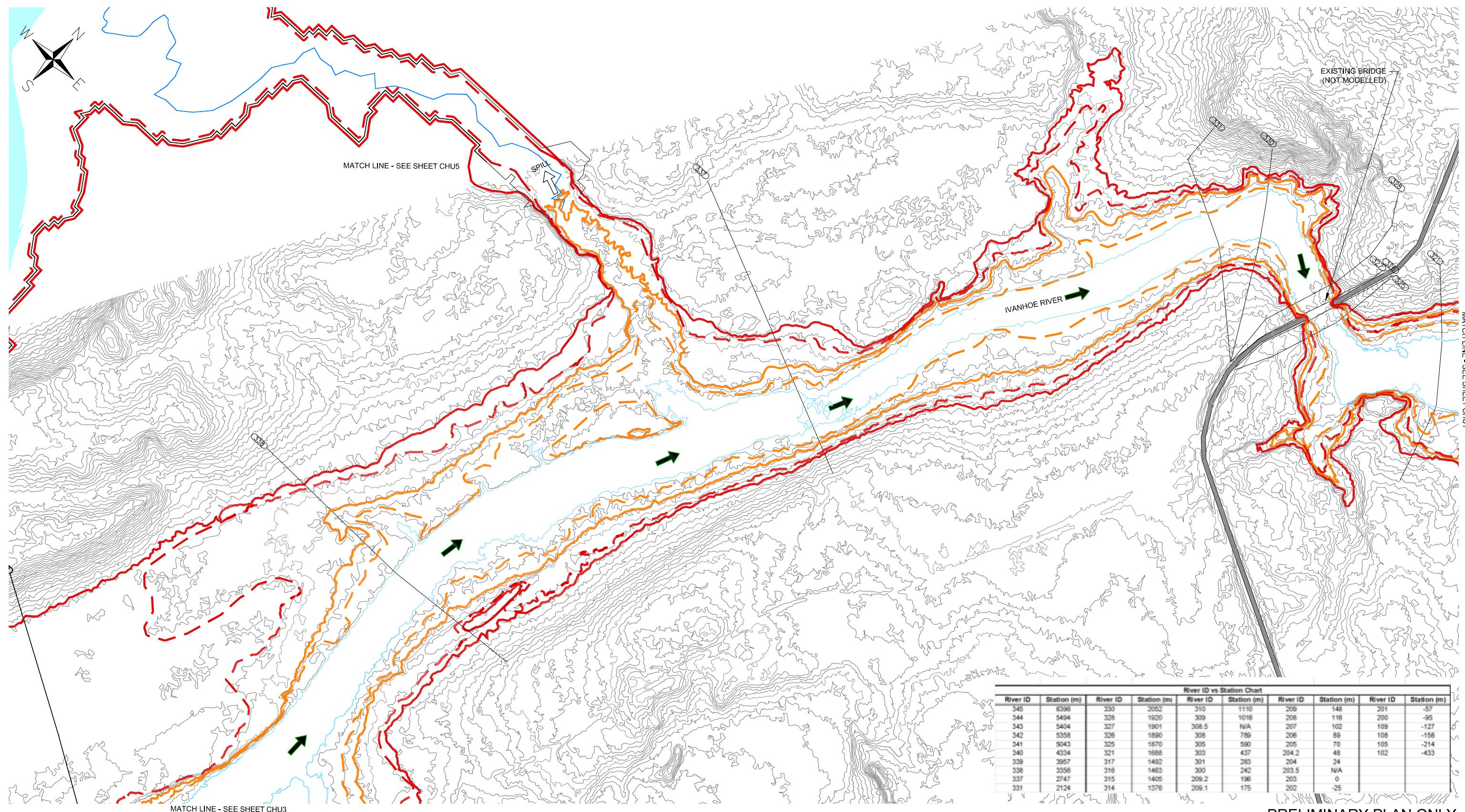
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PROJECT NO.

PCG019617

FIGURE NUMBER

CHU1



River ID vs Station Chart									
River ID	Station (m)	River ID	Station (m)	River ID	Station (m)	River ID	Station (m)	River ID	Station (m)
345	6396	330	2052	310	1110	208	148	201	-57
344	5494	328	1920	309	1016	208	116	200	-95
343	5404	327	1901	308.5	N/A	207	102	109	-127
342	5358	325	1890	308	789	206	89	108	-156
341	5043	325	1870	305	590	205	70	105	-214
340	4334	321	1668	303	437	204.2	46	102	-433
339	3957	317	1492	301	283	204	24		
338	3356	316	1463	300	242	203.5	N/A		
337	2747	315	1405	209.2	196	203	0		
331	2124	314	1376	209.1	175	202	-25		

PRELIMINARY PLAN ONLY

LEGEND

- (115) MODEL CROSS SECTION ID
- EDGE OF WATER
- FLOW DIRECTION
- CROSS-SECTION TYPE:
 - SECTION WITH INTERPOLATED LOW FLOW GEOMETRY
 - ORIGINAL SURVEY SECTION

- EXISTING CONDITIONS LTAF FLOOD ELEVATION (30.20 m3/s)
- PROPOSED CONDITIONS LTAF FLOOD ELEVATION (30.20 m3/s)
- EXISTING CONDITIONS HWM FLOOD ELEVATION (35.00 m3/s)
- EXISTING CONDITIONS 2-YEAR FLOOD ELEVATION (206.40 m3/s)
- PROPOSED CONDITIONS 2-YEAR FLOOD ELEVATION (206.40 m3/s)
- EXISTING CONDITIONS 100-YEAR FLOOD ELEVATION (506.00 m3/s)
- PROPOSED CONDITIONS 100-YEAR FLOOD ELEVATION (506.00 m3/s)



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DRAWING TITLE
IVANHOE RIVER – THE CHUTES
2 & 100YR FLOODLINES (EXISTING & PROPOSED)

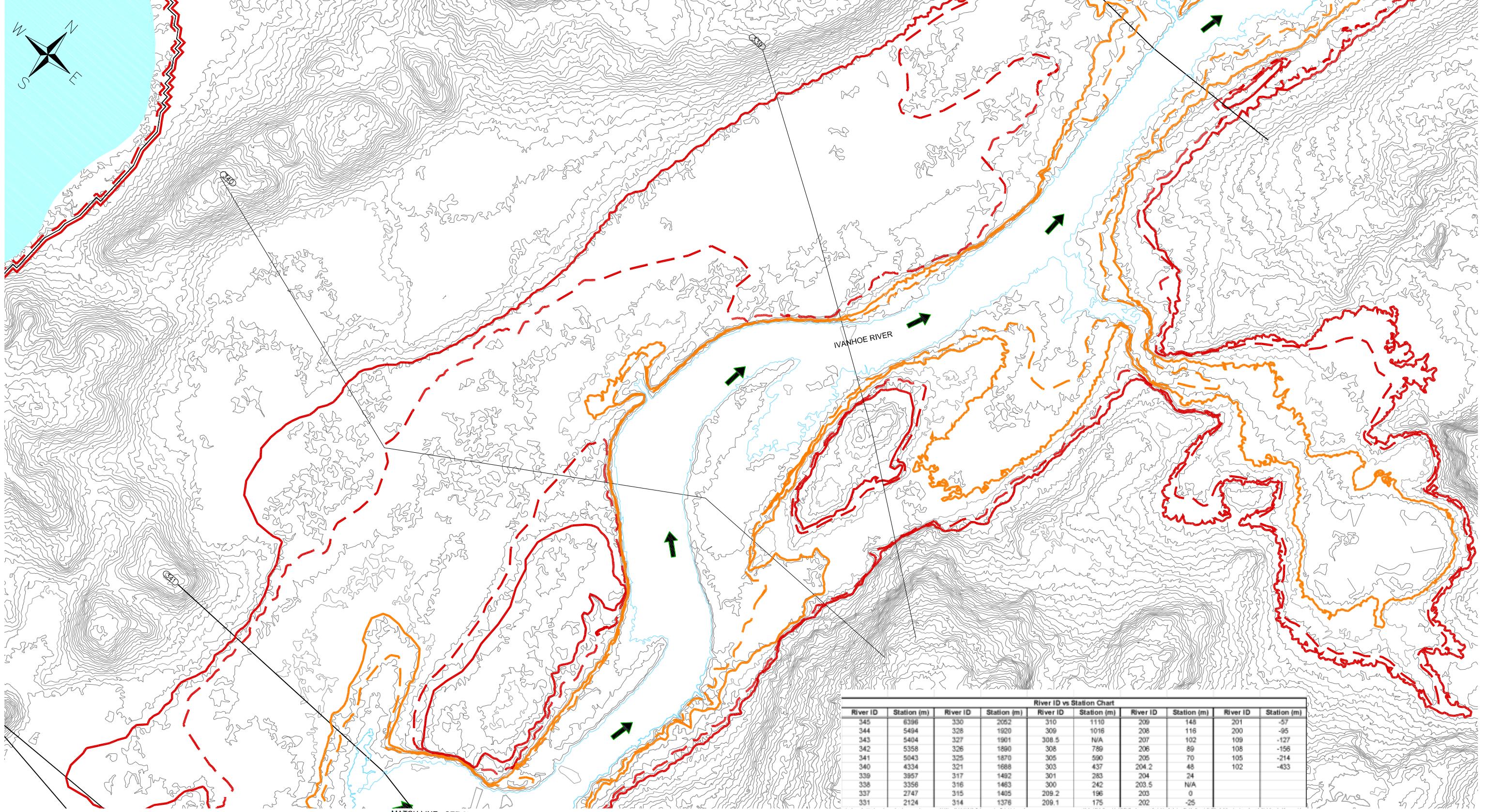
DRAWN BY
K.B.

CHECKED BY
T.R.L.

FIGURE NUMBER
CHU2

SCALE 1:5000
0 50 100 150 200 250

SCALE
1:5000
PROJECT NO.
PCG019617



River ID vs Station Chart							
River ID	Station (m)	River ID	Station (m)	River ID	Station (m)	River ID	Station (m)
345	6396	330	2052	310	1110	209	148
344	5494	328	1920	309	1016	208	116
343	5404	327	1901	308.5	N/A	207	102
342	5358	326	1890	308	789	206	89
341	5043	325	1870	305	590	205	70
340	4334	321	1688	303	437	204.2	48
339	3857	317	1492	301	283	204	24
338	3356	316	1463	300	242	203.5	N/A
337	2747	315	1405	299.2	196	203	0
331	2124	314	1376	299.1	175	202	-25

PRELIMINARY PLAN ONLY

LEGEND

- (115) MODEL CROSS SECTION ID
- EDGE OF WATER
- EXISTING CONDITIONS LTAF FLOOD ELEVATION (30.20 m3/s)
- PROPOSED CONDITIONS LTAF FLOOD ELEVATION (30.20 m3/s)
- EXISTING CONDITIONS HWM FLOOD ELEVATION (35.00 m3/s)
- EXISTING CONDITIONS 2-YEAR FLOOD ELEVATION (206.40 m3/s)
- PROPOSED CONDITIONS 2-YEAR FLOOD ELEVATION (206.40 m3/s)
- EXISTING CONDITIONS 100-YEAR FLOOD ELEVATION (506.00 m3/s)
- PROPOSED CONDITIONS 100-YEAR FLOOD ELEVATION (506.00 m3/s)
- SECTION WITH INTERPOLATED LOW FLOW GEOMETRY
- ORIGINAL SURVEY SECTION



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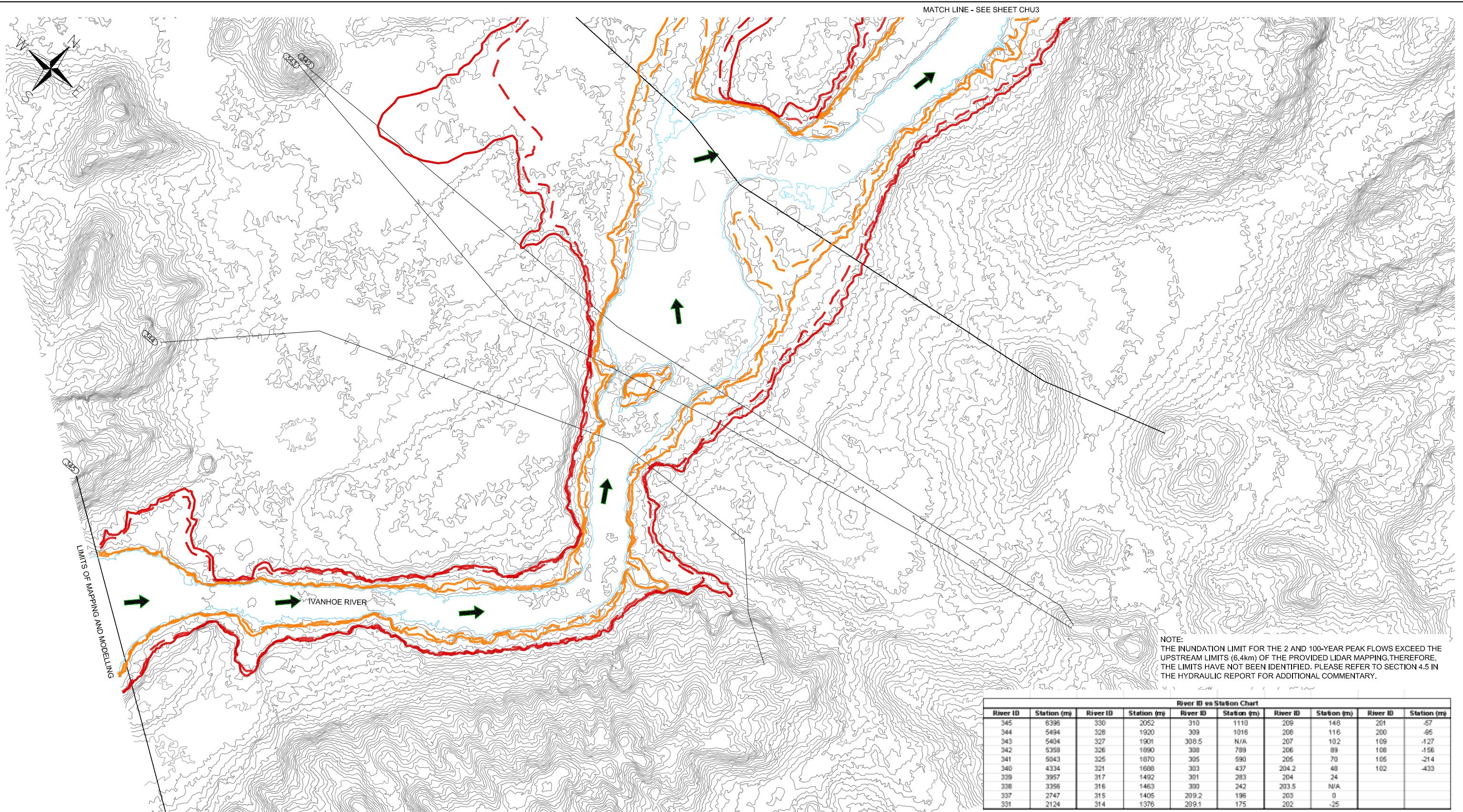
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MISSISSAUGA, ONTARIO

DRAWING TITLE
IVANHOE RIVER – THE CHUTES
2 & 100YR FLOODLINES (EXISTING & PROPOSED)

SCALE 1:5000
0 50 100 150 200 250

DRAWN BY
K.B.
CHECKED BY
T.R.L.
SCALE
1:5000
PROJECT NO.
PCG019617

FIGURE NUMBER
CHU3



River ID vs Station Chart									
River ID	Station (m)	River ID	Station (m)	River ID	Station (m)	River ID	Station (m)	River ID	Station (m)
345	6396	330	2052	310	1110	209	148	201	-57
344	5494	328	1920	309	1018	206	118	200	-95
343	5404	327	1901	308.5	N/A	207	102	109	-127
342	5358	326	1890	308	789	206	89	108	-156
341	5043	325	1870	305	590	205	70	105	-214
340	4334	321	1688	303	437	204.2	48	102	-433
339	3957	317	1492	301	283	204	24		
338	3356	316	1463	300	242	203.5	N/A		
337	2747	315	1405	209.2	196	203	0		
331	2124	314	1376	209.1	175	202	-25		

PRELIMINARY PLAN ONLY

LEGEND

- (115) MODEL CROSS SECTION ID
- FLOW DIRECTION
- CROSS-SECTION TYPE:
 - SECTION WITH INTERPOLATED LOW FLOW GEOMETRY
 - ORIGINAL SURVEY SECTION

- EDGE OF WATER
- EXISTING CONDITIONS LTAF FLOOD ELEVATION (30.20 m3/s)
- PROPOSED CONDITIONS LTAF FLOOD ELEVATION (30.20 m3/s)
- EXISTING CONDITIONS HWM FLOOD ELEVATION (35.00 m3/s)
- EXISTING CONDITIONS 2-YEAR FLOOD ELEVATION (206.40 m3/s)
- PROPOSED CONDITIONS 2-YEAR FLOOD ELEVATION (206.40 m3/s)
- EXISTING CONDITIONS 100-YEAR FLOOD ELEVATION (506.00 m3/s)
- PROPOSED CONDITIONS 100-YEAR FLOOD ELEVATION (506.00 m3/s)



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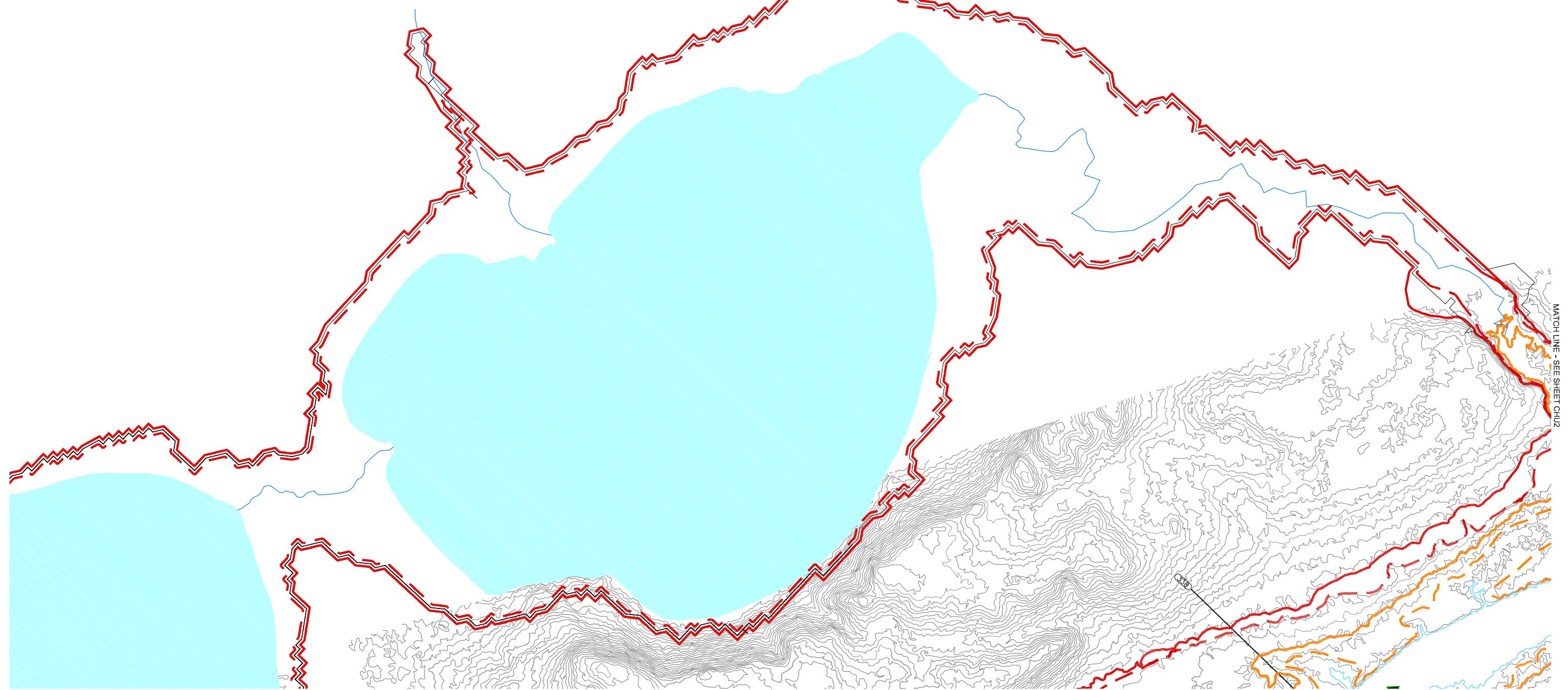
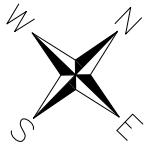
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DRAWING TITLE
IVANHOE RIVER – THE CHUTES
2 & 100YR FLOODLINES (EXISTING & PROPOSED)

SCALE 1:5000
0 50 100 150 200 250

DRAWN BY
K.B.
CHECKED BY
T.R.L.
SCALE
1:5000
PROJECT NO.
PCG019617

FIGURE NUMBER
CHU4



MATCH LINE - SEE SHEET CHU6

LEGEND

- The diagram shows a green arrow pointing right, labeled "115" above it, indicating the "FLOW DIRECTION". Below the arrow is the text "CROSS-SECTION TYPE:". To the right of the arrow, a line labeled "SECTION WITH INTERPOLATED LOW FLOW GEOMETRY" extends downwards. Another line labeled "ORIGINAL SURVEY SECTION" extends downwards from the bottom left. The text "MODEL CROSS SECTION ID" is centered at the top.



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River ID vs Station Chart									
River ID	Station (m)	River ID	Station (m)	River ID	Station (m)	River ID	Station (m)	River ID	Station (m)
345	6396	330	2052	310	1110	209	148	201	-57
344	5494	328	1920	309	1016	208	116	200	-95
343	5404	327	1901	308.5	N/A	207	102	109	-127
342	5358	326	1890	308	789	206	89	108	-156
341	5043	325	1870	305	590	205	70	105	-214
340	4334	321	1688	303	437	204.2	48	102	-433
339	3957	317	1492	301	283	204	24		
338	3356	316	1463	300	242	203.5	N/A		
337	2747	315	1405	209.2	196	203	0		
331	2124	314	1376	209.1	175	202	-25		

PRELIMINARY PLAN ONLY

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MISSISSAUGA, ONTARIO

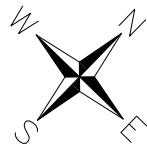
DRAWING TITLE
IVANHOE RIVER – THE CHUTES
2 & 100YR FLOODLINES (EXISTING & PROPOSED)

SCALE 1: 5000

DRAWN BY
K.B.
SCALE

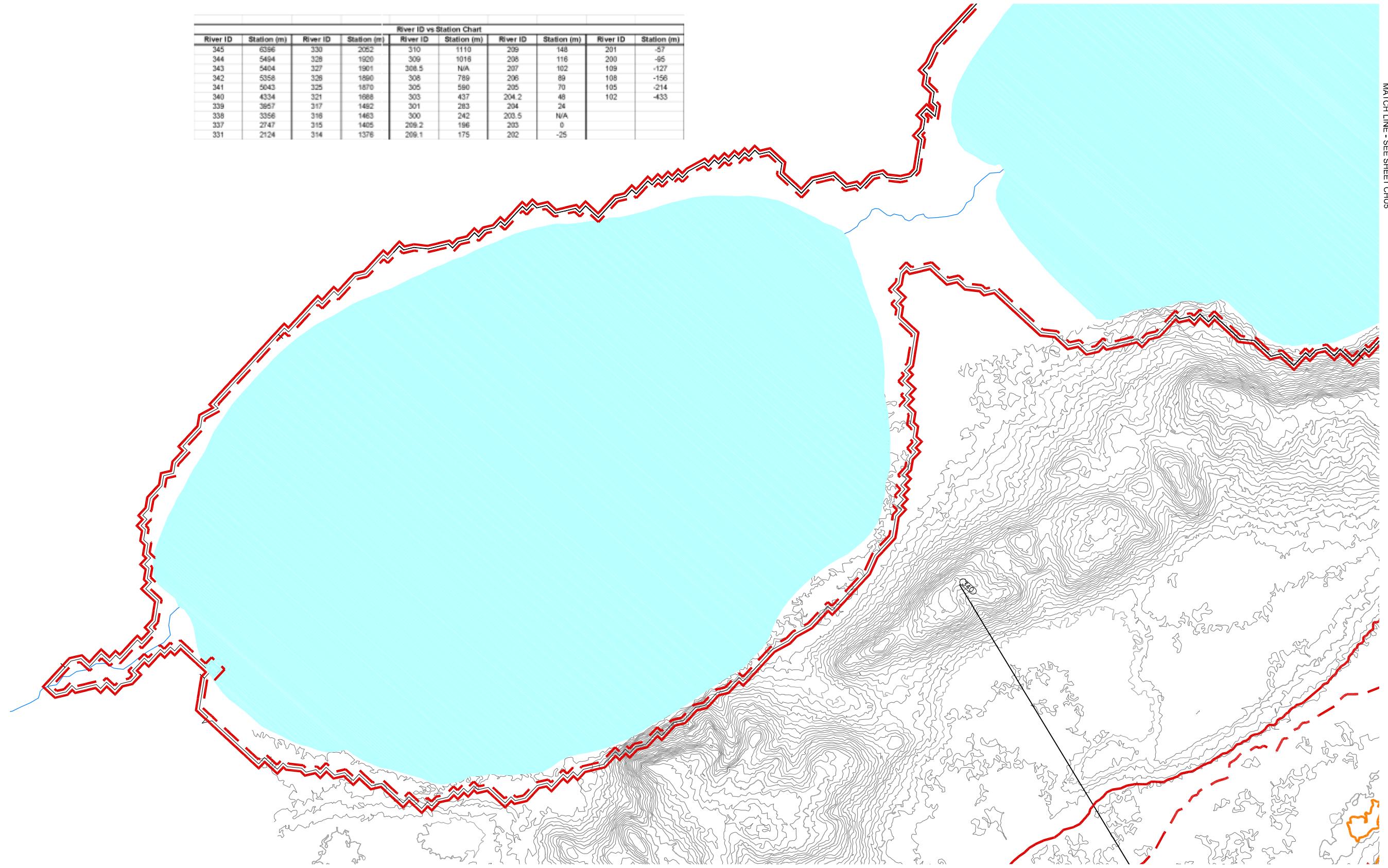
FIGURE NUMBER

CHU5



River ID vs Station Chart							
River ID	Station (m)	River ID	Station (m)	River ID	Station (m)	River ID	Station (m)
345	6396	330	2052	310	1110	209	148
344	5494	328	1920	309	1016	208	116
343	5404	327	1901	308.5	N/A	207	102
342	5358	326	1890	308	789	206	89
341	5043	325	1870	305	590	205	70
340	4334	321	1688	303	437	204.2	48
339	3857	317	1492	301	283	204	24
338	3356	316	1463	300	242	203.5	N/A
337	2747	315	1405	209.2	196	203	0
331	2124	314	1376	209.1	175	202	-25

MATCH LINE - SEE SHEET CHUS



PRELIMINARY PLAN ONLY

LEGEND

- (115) MODEL CROSS SECTION ID
- FLOW DIRECTION
- CROSS-SECTION TYPE:
 - SECTION WITH INTERPOLATED LOW FLOW GEOMETRY
 - ORIGINAL SURVEY SECTION

- EDGE OF WATER
- EXISTING CONDITIONS LTAF FLOOD ELEVATION (30.20 m3/s)
- PROPOSED CONDITIONS LTAF FLOOD ELEVATION (30.20 m3/s)
- EXISTING CONDITIONS HWM FLOOD ELEVATION (35.00 m3/s)
- EXISTING CONDITIONS 2-YEAR FLOOD ELEVATION (206.40 m3/s)
- PROPOSED CONDITIONS 2-YEAR FLOOD ELEVATION (206.40 m3/s)
- EXISTING CONDITIONS 100-YEAR FLOOD ELEVATION (506.00 m3/s)
- PROPOSED CONDITIONS 100-YEAR FLOOD ELEVATION (506.00 m3/s)



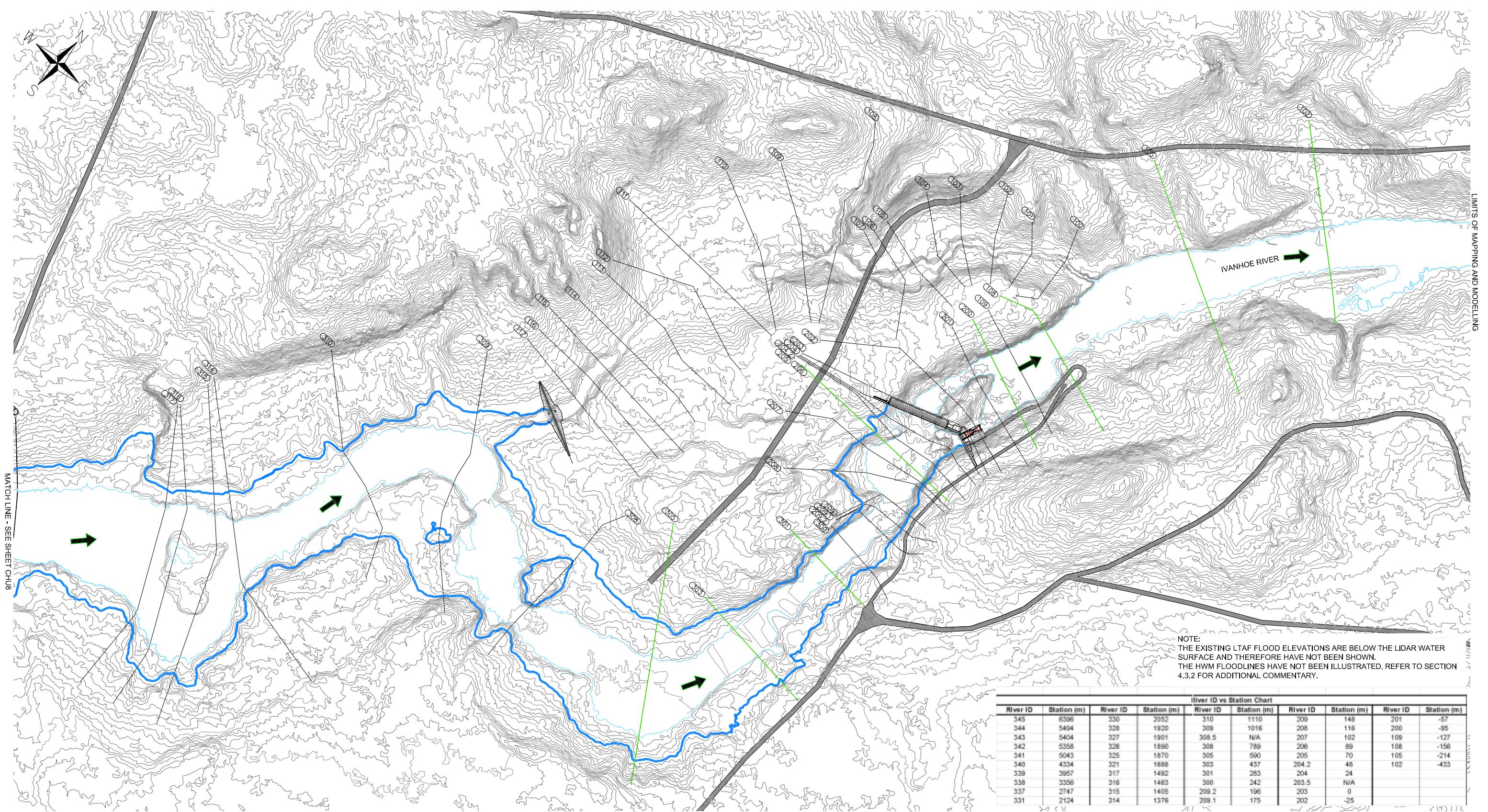
CLIENT
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804 SOUTHDOWN ROAD
MISSISSAUGA, ONTARIO

SCALE 1:5000
0 50 100 150 200 250

DRAWING TITLE
IVANHOE RIVER - THE CHUTES
2 & 100YR FLOODLINES (EXISTING & PROPOSED)

DRAWN BY
K.B. CHECKED BY
T.R.L.
SCALE
1:5000 PROJECT NO.
PCG019617

FIGURE NUMBER
CHU6



PRELIMINARY PLAN ONLY

LEGEND

- (115) MODEL CROSS SECTION ID
- EDGE OF WATER
- EXISTING CONDITIONS LTAF FLOOD ELEVATION (30.20 m3/s)
- PROPOSED CONDITIONS LTAF FLOOD ELEVATION (30.20 m3/s)
- EXISTING CONDITIONS HWM FLOOD ELEVATION (35.00 m3/s)
- EXISTING CONDITIONS 2-YEAR FLOOD ELEVATION (206.40 m3/s)
- PROPOSED CONDITIONS 2-YEAR FLOOD ELEVATION (206.40 m3/s)
- EXISTING CONDITIONS 100-YEAR FLOOD ELEVATION (506.00 m3/s)
- PROPOSED CONDITIONS 100-YEAR FLOOD ELEVATION (506.00 m3/s)
- CROSS-SECTION TYPE:
- SECTION WITH INTERPOLATED LOW FLOW GEOMETRY
- ORIGINAL SURVEY SECTION
- FLOW DIRECTION



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SCALE 1:5000

0 50 100 150 200 250

DRAWING TITLE

IVANHOE RIVER – THE CHUTES
LTAF (EXISTING & PROPOSED) & HWM (EXISTING) FLOODLINE

DRAWN BY

K.B.

CHECKED BY

T.R.L.

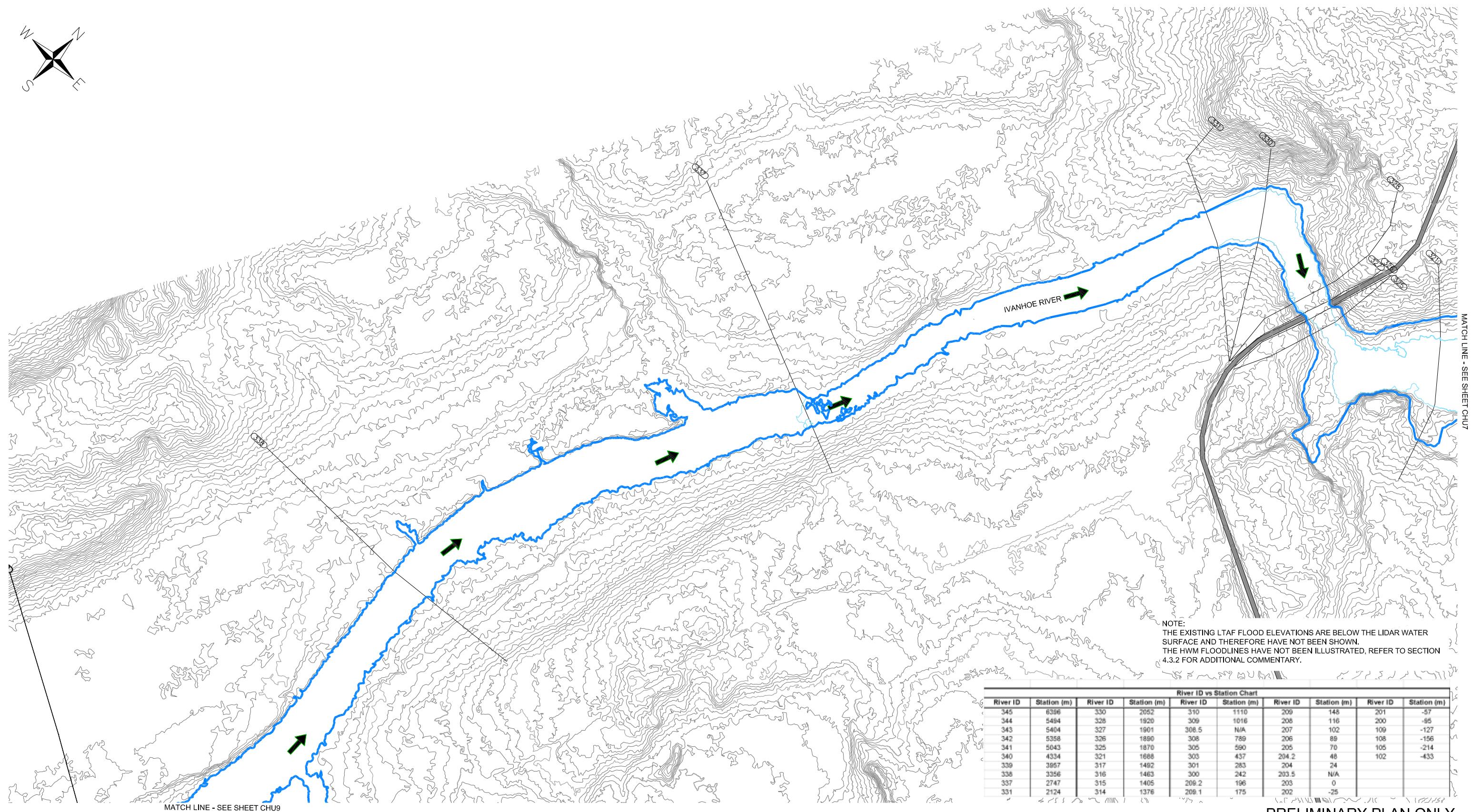
SCALE

1:5000

PROJECT NO.

PCG019617

FIGURE NUMBER
CHU7



PRELIMINARY PLAN ONLY

River ID vs Station Chart									
River ID	Station (m)	River ID	Station (m)	River ID	Station (m)	River ID	Station (m)	River ID	Station (m)
345	6396	330	2052	310	1110	208	148	201	-57
344	5494	328	1920	309	1016	208	116	200	-85
343	5404	327	1901	308.5	N/A	207	102	109	-127
342	5358	326	1890	308	789	206	88	108	-156
341	5043	325	1870	305	590	205	70	105	-214
340	4334	321	1688	303	437	204.2	48	102	-433
339	3957	317	1482	301	283	204	24		
338	3356	316	1463	300	242	203.5	N/A		
337	2747	315	1405	209.2	196	203	0		
331	2124	314	1376	208.1	175	202	-25		

NOTE:
THE EXISTING LTAF FLOOD ELEVATIONS ARE BELOW THE LIDAR WATER SURFACE AND THEREFORE HAVE NOT BEEN SHOWN.
THE HWM FLOODLINES HAVE NOT BEEN ILLUSTRATED, REFER TO SECTION 4.3.2 FOR ADDITIONAL COMMENTARY.

LEGEND

- The diagram shows two horizontal lines representing stream segments. The top segment is black and labeled "SECTION WITH INTERPOLATED LOW FLOW GEOMETRY". The bottom segment is green and labeled "ORIGINAL SURVEY SECTION". A large green arrow points to the left, indicating the direction of flow. Above the segments, the text "CROSS-SECTION TYPE:" is followed by a callout pointing to the black segment. To the right of the segments, the text "MODEL CROSS SECTION ID" is above "FLOW DIRECTION", both aligned with the center of the segments.



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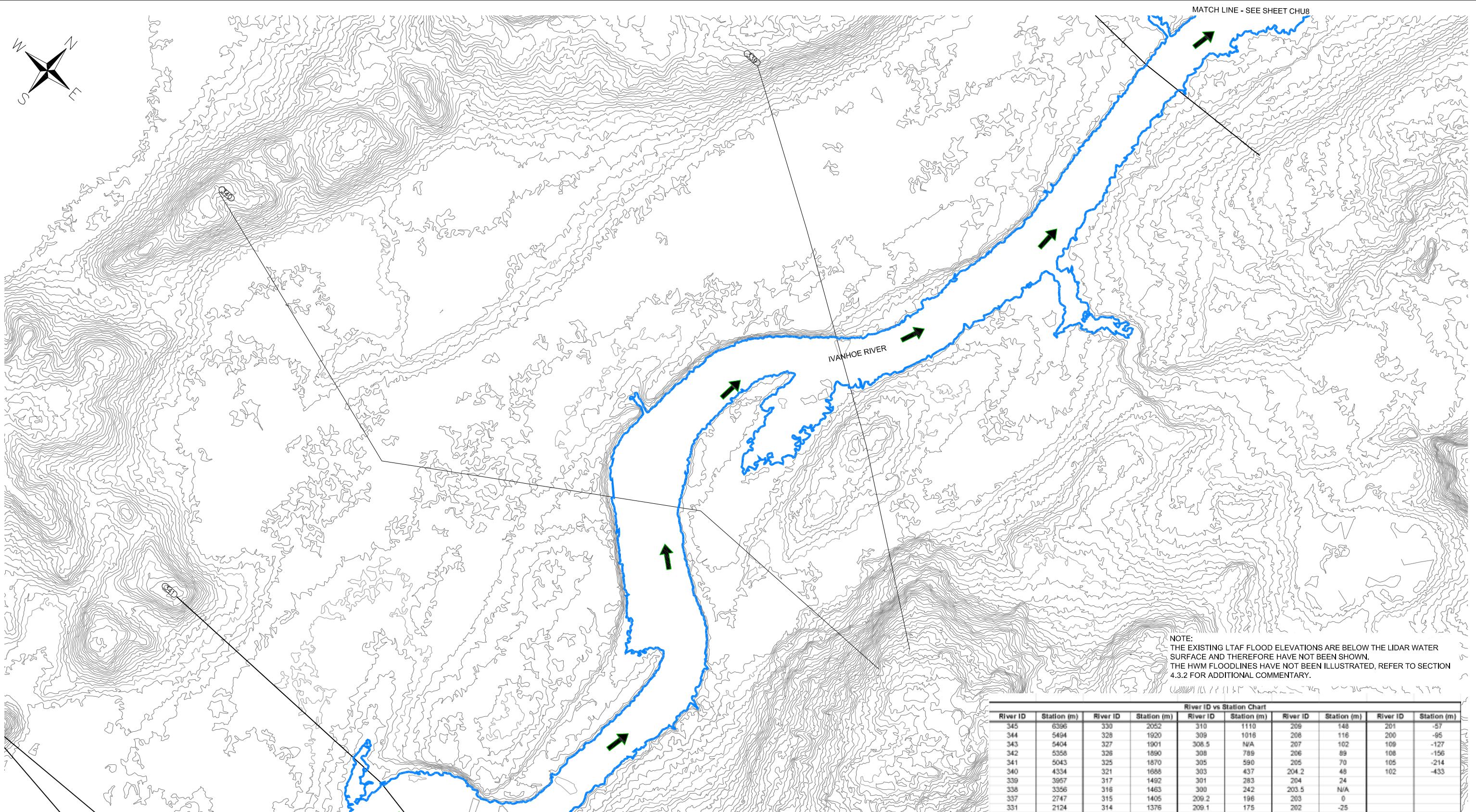
DRAWING TITLE
IVANHOE RIVER – THE CHUTES
LTAF (EXISTING & PROPOSED) & HWM (EXISTING) FLOODLINE

SCALE 1: 5000

K.B.
SCALE

T.R.L.
PROJECT NO.

CHU8



River ID vs Station Chart									
River ID	Station (m)	River ID	Station (m)	River ID	Station (m)	River ID	Station (m)	River ID	Station (m)
345	6396	330	2052	310	1110	209	148	201	-57
344	5494	328	1920	309	1018	208	116	200	-95
343	5404	327	1901	308.5	N/A	207	102	109	-127
342	5358	326	1890	308	789	206	89	108	-156
341	5043	325	1870	305	590	205	70	105	-214
340	4334	321	1688	303	437	204.2	48	102	-433
339	3957	317	1492	301	283	204	24		
338	3356	316	1463	300	242	203.5	N/A		
337	2747	315	1405	209.2	196	203	0		
331	2124	314	1376	209.1	175	202	-25		

PRELIMINARY PLAN ONLY

LEGEND

- (115) MODEL CROSS SECTION ID
- EDGE OF WATER
- EXISTING CONDITIONS LTAF FLOOD ELEVATION (30.20 m³/s)
- PROPOSED CONDITIONS LTAF FLOOD ELEVATION (30.20 m³/s)
- EXISTING CONDITIONS HWM FLOOD ELEVATION (35.00 m³/s)
- EXISTING CONDITIONS 2-YEAR FLOOD ELEVATION (206.40 m³/s)
- PROPOSED CONDITIONS 2-YEAR FLOOD ELEVATION (206.40 m³/s)
- EXISTING CONDITIONS 100-YEAR FLOOD ELEVATION (506.00 m³/s)
- PROPOSED CONDITIONS 100-YEAR FLOOD ELEVATION (506.00 m³/s)
- FLOW DIRECTION
- CROSS-SECTION TYPE:
- SECTION WITH INTERPOLATED LOW FLOW GEOMETRY
- ORIGINAL SURVEY SECTION



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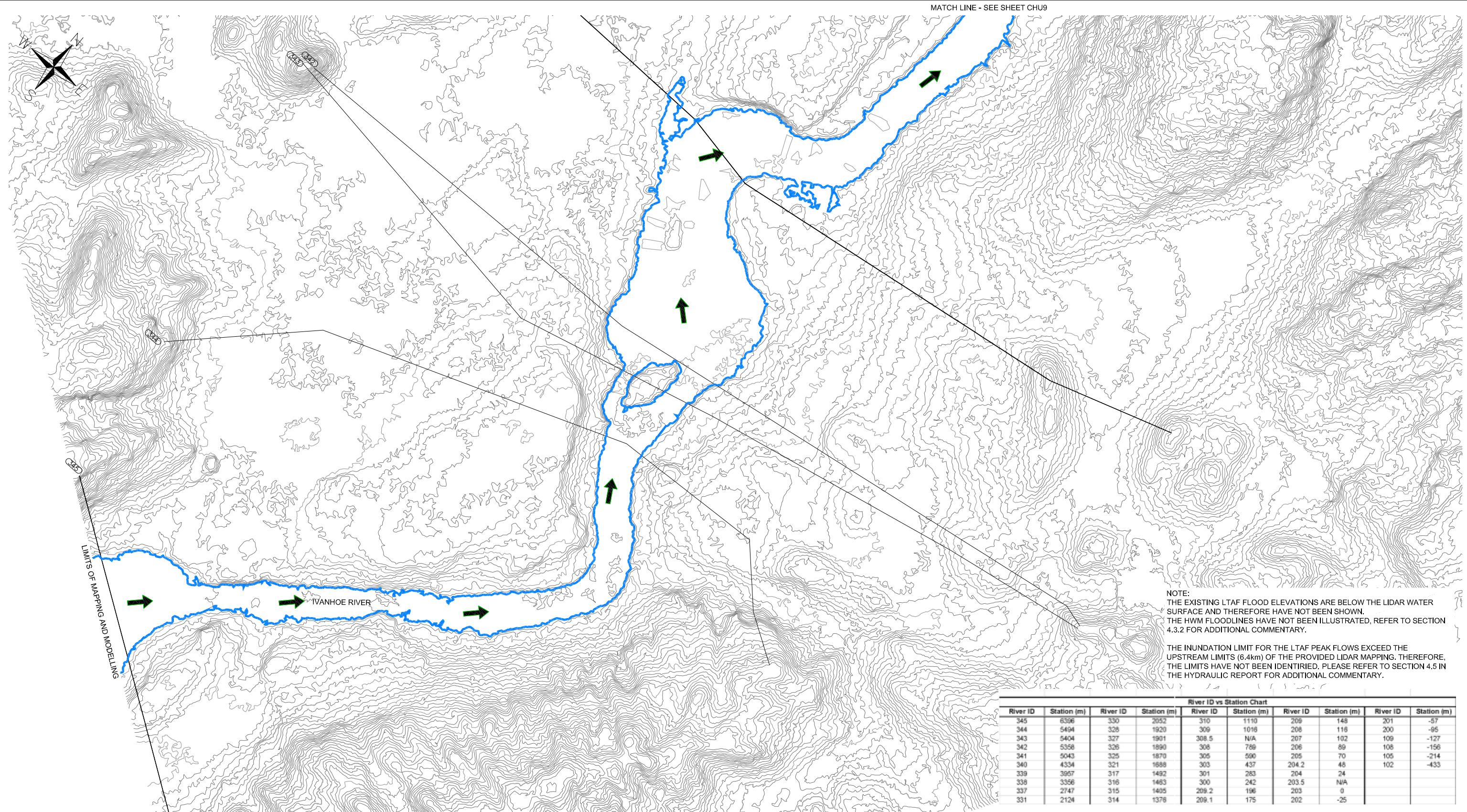
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MISSISSAUGA, ONTARIO

SCALE 1:5000
0 50 100 150 200 250

DRAWING TITLE
IVANHOE RIVER – THE CHUTES
LTAF (EXISTING & PROPOSED) & HWM (EXISTING) FLOODLINE

DRAWN BY K.B. CHECKED BY T.R.L.
SCALE 1:5000 PROJECT NO. PCG019617

FIGURE NUMBER
CHU9



PRELIMINARY PLAN ONLY

LEGEND

- The diagram shows two horizontal lines representing stream segments. The top line is black and labeled 'SECTION WITH INTERPOLATED LOW FLOW GEOMETRY'. The bottom line is green and labeled 'ORIGINAL SURVEY SECTION'. A green arrow points from the label 'CROSS-SECTION TYPE:' to the top line. Another green arrow points from the label 'FLOW DIRECTION' to the top line. A bracket on the right side groups both lines, with an arrow pointing to it labeled '(115)'.



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DRAWING TITLE
IVANHOE RIVER – THE CHUTES
LTAF (EXISTING & PROPOSED) & HWM (EXISTING) FLOODLINE

DRAWN BY
K.B.
SCALE
1: 5000

FIGURE NUMBER
CHU10