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Technical Memorandum

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Subject: **Rideau River Flood Risk Mapping from Hogs Back to Rideau Falls**

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Executive Summary

This report provides a summary of the analytical methods used and underlying assumptions applied in the preparation of flood plain mapping for the Rideau River from Hogs Back to Rideau Falls. The project has been completed in accordance with the technical guidelines set out under the Canada-Ontario Flood Damage Reduction Program (FDRP) (MNR, 1986), and the technical guide for the flood hazard delineation in Ontario (MNR, 2002) as laid out by the Ontario Ministry of Natural Resources. The 1:100 year flood lines delineated here are suitable for use in the RVCA's regulation limits mapping (referred to in Section 12 of Ontario Regulation 174/06) and in municipal land use planning and development approval processes under the Planning Act.

Contents

Introduction

In 2012, The City of Ottawa and three conservation authorities (Mississippi, Rideau and South Nation) initiated a program for flood risk mapping within the boundary of the City. A four-year plan for mapping a number of high priority rivers and streams was made. As part of this program, the RVCA has identified 12 stream reaches, where the existing mapping would be updated or mapping will be created for the first time. One reach of the Rideau River (from Hogs Back to Rideau Falls) has been mapped during the first year of this project and this is the project completion report.

The 1984 mapping study by A. J. Robinson is now nearly 30 years old, and changes in the landscape have taken place along the shoreline and floodplain, such that the plotted flood limits in some locations may no longer accurately depict areas that are presently flood prone under regulatory flood conditions. It has been deemed desirable and necessary by the City of Ottawa to produce updated flood line mapping, to facilitate the implementation of the natural hazards policies of its Official Plan and the associated zoning by-laws. A funding contribution from the City has enabled the RVCA to prioritize this project within its ongoing, watershed-wide program of flood risk assessment and flood plain delineation.

This report provides a summary of the analytical methods used and underlying assumptions applied in the preparation of flood plain mapping for the Rideau River from Hogs Back to Rideau Falls (Figure 1). The project has been done in accordance with the technical guidelines set out under the Canada-Ontario Flood Damage Reduction Program (FDRP) (MNR, 1986), and the technical guide for the flood hazard delineation in Ontario (MNR, 2002) as laid out by the Ontario Ministry of Natural Resources. It also conforms to the ‘generic regulation’ guidelines of Conservation Ontario (2005). The 1:100 year flood lines delineated here are suitable for use in the RVCA’s regulation limits mapping (referred to in Section 12 of Ontario Regulation 174/06) and in municipal land use planning and development approval processes under the Planning Act.

The A. J. Robinson mapping has been used by RVCA for regulatory purposes since 1984. The present mapping, when endorsed by RVCA’s Board of Directors, will supersede the 1984 A. J. Robinson mapping.

Study Area

The study area extends from the downstream side of Hogs Back Dam to Rideau Falls, where the Rideau River flows into the Ottawa River (Figure 1). The area mapped is located entirely within the City of Ottawa. Shoreline properties are present along the most of the reach on one or both banks with areas prone to flooding near Stanley Avenue, Brantwood Park, Windsor Park and Brewer Park.

Previous Studies

Two flood plain mapping studies that included the reach from Rideau Falls to Hogs Back Dam have been completed in the past (M. M. Dillon, 1972; A. J. Robinson and Associates, 1984). The M. M. Dillon study covers a 38 km reach from the Ottawa River to Kars Bridge and used unpublished and published data spanning 1916-1972. Backwater calculations were completed by the standard step method and the calculated levels were plotted on contour maps obtained from the National Capital Commission.

The A. J. Robinson study covers an 11 km reach from Rideau Falls to Mooney's Bay and was completed using historical flows from 1947 to 1982 recorded at gauges upstream of the Hurdman Bridge and at Carleton University. Estimated flood flows for the 1:5, 1:10. 1:25 1:50 and 1:100 year return periods were determined. Flood water levels were estimated using HEC-2 models and the 1:100 year flood lines were plotted on mapping produced using aerial photography from 1982.

The Robinson study included a preliminary assessment of potential flood remediation projects and suggested that the construction of five remedial flood control dykes be considered: at Carleton University, Warrington Drive area, Windsor Park Phase II, Brantwood Park and New Edinburgh. These would be in addition to the two flood control dykes that had been built by RVCA up until that time (Brewer Park in 1975-76 and Windsor Park Phase I in 1983). None of these five potential projects were pursued by the City of Ottawa or RVCA. In 1996 the RVCA constructed a flood control wall at Rideau River Lane (in cooperation with the landowner group and the City of Ottawa). The Robinson study also included a review of ice jam-induced flood risks in the study area, and how they were managed at that time.

Topographical Mapping

LIDAR: High quality topography is the key to high quality flood risk mapping. Digital elevation models were derived from LIDAR data procured by the City of Ottawa. The exact date of when the LIDAR was flown is not known, but it appears to be sometime in 2007. This data set has an estimated vertical accuracy of 0.10 m. For this study, digital elevation models and 0.25 m elevation contours were derived from LIDAR data procured by the City of Ottawa. The City processed the data and the final product was provided to RVCA.

In some places, the LIDAR data was missing along the water line from the day(s) it was collected. Although these gaps do not affect the location of the flood line, RVCA staff carried out ground surveys during April 2013 to collect data to augment the LIDAR data for the purposes of flood line delineation.

The accuracy of the LIDAR data and associated contour lines was checked in the field by RVCA technicians. The true elevations of features on the ground that are identifiable on the mapping were determined using RVCA's survey grade GPS equipment (Trimble R8), and compared with the elevations indicated by the LIDAR spot heights or elevation contours, to determine that any differences between mapped and true elevations were within the accuracy prescribed by the FDRP standards.

In total, 112 spot heights and 70 contour crossings were verified (see Figure 3 and Tables 1 and 2). As described in the FDRP guidelines (MNR 1986), the spot height checks are considered satisfactory when 90% of the data points are within 0.33 m of the field measurement; for contour crossings, it is 0.50 m. As shown in Tables 1 and 2, these criteria have been adequately met. On average, the spot heights and contour crossings are within 6.8 and 10.7 cm respectively (Figure 4).

At the few locations where these criteria are not met, changes to the landscape since the date of air photo have been identified as the probable cause of the discrepancy. Data at these locations were disregarded in the DTM verification.

In some places, the LIDAR-derived contour was incongruent with spot heights and field measurement. This happened along the river's edge, and/or near buildings and other man-made structures, and appears to be due to omitting appropriate break-line features. However, the problem was localized and easily detectable; and once detected, we used the LIDAR spot heights (primary data) and ignored the contour lines (derived data).

Aerial photo: The DRAPE imagery was collected in May-July 2008 at a scale of 1:16,667. This high quality colored photo clearly shows the rivers, creeks, land use, houses, buildings, roads, infrastructure, vegetation and other details.

Air photo: The 2011 air photo was also available from the City of Ottawa. It is accurate, sharp and in colour, and shows various natural and man-made features clearly.

Building footprint: The 'building footprint' layer was provided by the City of Ottawa. It enables us to accurately draw flood lines around buildings. This data layer contained information collected over a number of years.

Hydrological Analysis

Discharge and water level data for the reach of the Rideau River from Hogs Back Dam to Rideau Falls were obtained from the Water Survey of Canada gauge of Rideau River at Ottawa (Water Survey of Canada 02LA004). The record at this location spans from 1933 to 2013, but year-round recording did not begin until 1947. The annual maximum mean daily flow records from 1947 to 2012 were used with the exception of 1948, which is missing the spring flood period[1]. Additionally, instantaneous peak flows are available for the period 1971 to 2010 (except 1974).

A water level gauge is also present on the Rideau River above Rideau Falls (WSC 02LA027), but at the time of this study only 4 years of data had been recorded. Additional gauges are located upstream of Hogs Back, but it was decided that the Rideau River at Ottawa gauge (also known as Carleton University gauge) would be used for the entire study reach. Figure 2 shows the locations of the gauges and Table 3 provides information on data availability.

Instantaneous peak flows for the entire data series for the Rideau River at Ottawa gauge spanning from 1947 to 2012 has been developed. Comparing instantaneous peak flows to maximum daily mean flows for the Rideau River at Ottawa gauge gives a ratio

[1] It is Water Survey of Canada's practice to publish streamflow data after all corrections have been made for any unusual conditions (e.g., presence of ice). They also inspect the gauge every four to six weeks. This was confirmed with WSC staff via an email of 30 November 2015. Therefore, all data published by WSC is deemed quality controlled and is suitable for standard hydrological analysis.

between 1.004 and 1.192 with a mean of 1.055 and a median of 1.038. Linear and polynomial fits were tried, and a second-order polynomial (Figure 5) provided the best fit. Table 4 shows how the annual maximum series of daily mean flow was converted to the instantaneous peak flow series.

The recorded flows on the Rideau River are modified by the flow release practice of Parks Canada at Poonamalie Dam.

An analysis of the relationship between the gauges Rideau at Ottawa (02LA004) and Rideau above Smith Falls (02LA005) was conducted to determine if an adjustment of Ottawa flows was required as had been done by A.J. Robinson (1984). Figure 6 shows the ratio between the Rideau above Smith Falls and Rideau at Ottawa, the average ratio for three periods, and the annual peaks for the Rideau at Ottawa gauge. Distinct changes in ratio occur in 1977 and 1991. A. J. Robinson increased the flows in the period between 1977 and 1982 by 7% to recognize and account for the effect of a change in operating practice at the Rideau Canal's Poonamlie Dam that was implemented after the 1976 flood event[2]. After that event (the highest flow on record for this study area), the Rideau Canal undertook to attempt to minimize releases out of Lower Rideau Lake while the downstream reaches of the Rideau River were approaching or at their peak. However, it was, and is, well understood that there is only a limited capacity in the reservoir lakes of the Rideau Waterway that can be used to achieve in this "flood abatement" benefit. It has never been demonstrated that any downstream flood abatement benefits can be achieved during extreme spring flood events by this kind of dam operation. The recorded flows since 1977 were therefore adjusted before being used in flood frequency analysis to remove the effect of artificial regulation. In other words, the adjusted flows are an estimate of what might have been experienced in Ottawa if the Rideau Canal not adopted

[2] During the Robinson (1984) study, several agencies, including the RVCA, Ministry of Natural Resources and Environment Canada, held in depth technical discussions about the best way to adjust the flow for man-made control, which resulted in this methodology. Since then, others have accepted this as a reasonable way to adjust flows and have used the same methodology, although using subsequently accumulated data.

In this methodology, the travel time from Poonamalie to Ottawa was not considered. Although the times of peak occurrences at Poonamalie are known, the times of the corresponding maxima of Poonamalie flood waves when they arrive at Ottawa are not known because of the large volumes of lateral inflows during flood events between the two locations from a drainage area twice the size of that above Poonamalie. Moreover, the 'desynchronized' flood peaks from areas of various size and shape make it difficult to isolate the effect of flow manipulation at Poonamalie on the hydrograph at Ottawa.

its practice of attempting to control releases from Lower Rideau Lake at the Poonamalie Dam.

The current analysis shows three distinct dam operation periods: 1970-1976, 1977-1990 and 1990-2012. Figure 6 shows the range of ratios between flows above Smith Falls to flow at the Rideau at Ottawa gauge. An increase in the ratio from 1991-2012 of 10.84% relative to 1977-1990 was found, and as a result the flow peaks for 1977-1990 were increased by 11% to offset the reduced flow from the Poonamalie Dam. The final flow series is presented in Table 4, and is considered representative of the current operating practice of Parks Canada[3].

A frequency analysis was conducted on the adjusted instantaneous peaks flows for the Rideau at Ottawa gauge for the years 1947 and 1949-2012, a total of 65 years. Table 4 shows the annual peaks analyzed for the Rideau at Ottawa gauge unadjusted and adjusted for dam operations. These data were selected because they represents the full data set available, have been adjusted using the same methodology as the previous study and were analyzed using current flood frequency analysis practices. Flood frequency analysis was done using Consolidated Frequency Analysis 3.1 (CFA), a program from Environment Canada (Pilon and Harvey, 1993). CFA was used to fit the following distributions:

- Generalized Extreme Value (GEV),
- Three-Parameter Lognormal (3PLN),
- Log Pearson Type III (LP3), and
- Wakeby (WBY).

Detailed CFA input and output files, along with a plot of the four distributions, are included in Appendix B. The GEV distribution was found to be the most appropriate flood distribution for our purpose. The ‘best fit’ distribution was chosen largely based on visual matching with data points and, to a lesser extent, by examining the computed

[3] In a meeting between RVCA and Parks Canada staff on 12 March 2015, the current operating policies for the dams along the Rideau Canal was clarified and confirmed by Parks Canada staff. During flood events, Parks Canada fully opens the dams and allows ‘free flowing’ condition at all structures.

statistics[4]. No attempt was made to identify or exclude outliers, since such practices, in our opinion, may fail to faithfully represent the measured data.

The flood flows for the Rideau River at Ottawa estimated here (GEV distribution) are compared, in Table 5, to those used by A. J. Robinson (1984), who used the three-parameter lognormal distribution. Figure 7 shows a plot of the current flood frequency distribution and the A. J. Robinson distribution. The 1:100 year flood flow of 644 m^3/s is 1.5% lower than the 1:100 year flow from the previous study, and the values presented in Table 6 are used for the hydraulic analysis of the Rideau River reach from Hogs Back Dam to Rideau Falls.

Increasing the flow toward the downstream end of the reach was considered. The drainage area at the Ottawa gauge is 3830 km^2 and the drainage area downstream of the St. Patrick Bridge is 3872 km^2. The difference of 42 km^2 represents an increase in drainage area of 1.1%, and the corresponding difference in discharge is negligible.

Hydraulic Computations

Following standard procedures (MNR, 1986; USACE, 1990, 2010), a steady-state hydraulic model of the Rideau River was built. The steady-state hydraulic model developed in HEC-2 by A. J. Robinson (1984) was converted to HEC-RAS and updated to present conditions. HEC-RAS software (version 4.1.0) developed by the US Army Corps of Engineers (USACE, 2010) was used. It uses the same back water calculation procedure as HEC-2 (USACE, 1990), which has been the industry standard since the 1970s, but with improved data processing and graphical capabilities.

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[4] There is considerable debate about how to find a balance between mathematical sophistication of flood frequency analysis and the inevitable error and uncertainty of data. Engineers and hydrologists tasked with practical problem are generally in favor of avoiding excessive emphasis on mathematical manipulation in view of the large uncertainty of hydrological data collected in the field. For example, Stedinger et al. (1993), in a state-of-the-art review (Chapter 18 of the Handbook of Hydrology edited by D. R. Maidment, 1993), states: “Probability plots are extremely useful for visually revealing the character of a data set. Plots are effective way to see what the data look like and to determine if fitted distributions appear consistent with the data. Analytical goodness-to-fit criteria are useful for gaining an appreciation for whether the lack of fit is likely to be due to sample-to-sample variability, or whether a particular departure of the data from a model is statistically significant. In most cases several distributions will provide statistically acceptable fits to the available data so that goodness-of-fit tests are unable to identify the “true” or “best” distribution to use. Such tests are valuable when they can demonstrate that some distributions appear inconsistent with the data.”

Cross-Sections: The cross-sections used in the modeling were imported from A. J. Robinson's 1984 study HEC-2 files. These cross-sections were based on the original 1970 bathymetry completed by Canadian Hydrometric Service for National Capital Commission (NCC); this data was checked and supplemented by Robinson during the summer of 1982. For the current project, the overbank portions of all the cross-sections were updated to account for current ground elevations taken from the LIDAR-based digital elevation model. The channel bottom was kept the same as that of the A. J. Robinson study. Performing surveys to verify the representativeness of the below-water portions of the cross-sections in the model was considered to be beyond the scope of the project.

In total, 134 cross-sections were used in the model. Distances between sections along the stream center and left and right overbanks were re-calculated using GIS software. Figure 2 shows the available hydrometric information and Figure 8 shows a schematic of the HEC-RAS model. Figure 9 shows the cross-sections in greater detail, along with the computed Regulatory Flood Levels (RFLs) and flood risk limits. The spacing between and alignment of river cross-sections within the model were not reviewed and remain unchanged from those of the Robinson HEC-2 model. In some locations, refinements in the cross-section spacing and alignment could have been made, but doing so was considered to be unnecessary, provided that the model calibration and verification steps (to be covered later in this report) demonstrate close agreement between computed and observed water surface elevations for actual flood events in the historical record.

Channel Roughness: Following standard procedures (Chow, 1959), the resistance of the channel under possible high water conditions was estimated from aerial photos. The Manning's roughness coefficient was generally between 0.025 and 0.05 in the main channel, and varied from 0.04 to 0.2 for the floodplains. These values were consistent with those found appropriate in earlier studies (A. J. Robinson, 1984), and were confirmed by the calibration process.

Rating Curve: Rating curve at the Rideau River at Ottawa gauge location was obtained from Water Survey of Canada (WSC) and was used in the calibration process (Figure 10).

Bridges/Structures: Within the study area there are 17 bridges and two dams (Table 7). As-built drawings for all the bridges within the reach were obtained. The bridges and associated cross-sections were updated to match the as-built information. As-built information for bridges was obtained from the City of Ottawa and the Ontario Ministry of Transportation. As-built information for the Rideau Falls Dams was obtained from Public Works and Government Services Canada (Murphy, 2013).

The design flows from the hydrologic analysis (discussed above), with return periods ranging from 2 to 500 years (Table 6), were used in the HEC-RAS model. Table 8 shows the flows that were input to the HEC-RAS model, including the flow split above Rideau Falls. Flows at the split above Rideau Falls were optimized by HEC-RAS.

The optimization was started using the A. J. Robinson flow split of 72% in the east channel and 28% in the west channel. After calibration the final optimized split is 65% in the east channel and 35% in the west channel for the 1:100 year flows. The split varies as flows decreased with larger flows in the east channel, where the 1:2 year flow split was 72% in the east and 28% in the west.

The boundary conditions, i.e., water levels at the downstream end (cross-sections 30 and 31), were set as the critical depths for Rideau Falls. Critical depth was selected because the Rideau Falls dams were modeled completely open and the drawdown for the falls governs the water level. This assumption is based on a discussion with Public Works and Government Services Canada about the operations of the dams under high flows (greater than 300 cms) (Potvin, 2013).

Once the model was set up, the computed profiles and other parameters were scrutinized to assess the reasonableness of model outputs. Special attention was given to the computed water level and energy profiles near bridges. Adjustments of model parameters – mainly the channel resistance and contraction and expansion coefficients – were made as necessary.

Calibration

By virtue of being a slightly modified version of the well calibrated Robinson's (1984) HEC-2 model[5], the current HEC-RAS model needed very little adjustment to be considered calibrated. The calibration/verification was done in four ways:

- By matching the rating curve at Carleton University gauge
- By matching water levels during 11 April 2014 flood event
- By matching water levels during 15 April 2014 flood event
- By matching historical observations at Rideau Valley Drive

At Carleton University (Figure 10), the previous model slightly underestimated the water level. The current model slightly overestimates water level, and is therefore on the conservative side. For the 100 year flow, it is about 5 cm above the WSC rating curve.

During the April 2014 flood (a close to 5 year event), high water levels were collected by RVCA staff using photographs and survey grade Trimble for two separate events with flows equal to 424 and 449 cms. As shown in Table 9, the model could compute water level with a reasonable degree of accurately. It overestimates at certain locations and underestimates at others, and yields a slightly conservative overall estimate of water level (5-8 cm). The particular variation along the channel of the discrepancy precluded any easy way to exactly fit the model with observed data at all locations, without using unrealistic hydraulic parameter. The dams at Rideau Falls were fully open during the April 2014 flood as confirmed by Public Works (Potvin, 2014); and our HEC-RAS model was set accordingly.

It has traditionally and widely been accepted that the calibration process is not meant to force the model to fit all observations, but to match the computed water surface profile to observed water levels within a certain limit. A rule of thumb used by the USACE (US Army Core of Engineers) specifies good calibration when the model predicts elevations within 30 cm of observation; whereas FEMA (US Federal Emergency Management Agency) suggests a 15 cm tolerance (Heastead Methods 2003). Our model

[5] A. J. Robinson (1984) calibrated the HEC-2 model by comparing the computed water level to available rating curves at Carleton University and Hurdman Bridge gauges. The model predicted the water level within 2 cm, but on the lower side (not conservative). The Hurdman gauge was decommissioned in 1966.

satisfies the USACE criterion by a wide margin and is very close to satisfying the FEMA criterion. Our approach of slight conservatism is also congruent with the current notion of the Precautionary Principle, which applies when there exist considerable scientific uncertainties about causality, magnitude, probability, and consequences of different course of action (UNESCO 2005).

At the Rideau Valley Drive, high water levels recorded by a private citizen were available since early 1970s (Table 10). The model matched the observed data very well for ice-free conditions (Figure 12) – exactly the conditions (open water) the model is meant to simulate. The presence of ice in the river induces higher water level, and this explains the difference in water level in Figure 12 during icy conditions. Overall, this set of data validates the model over many years. We note that, on average, the model slightly underestimates the water level at this location (by about 3.5 cm), whereas it overestimates by 3-5 cm during the 2014 flood events. This is well within the typical accuracy of hydrologic computation and water level measurements.

Based on the above reasoning, the model is considered well calibrated and suitable for flood hazard mapping[6].

Once calibrated, the model was run with the design floods. The 1:100 year computed water surface elevations and other parameters are shown in Table 11. A few typical water surface profiles and all cross-sections are included in Appendix A.

Computed water surface elevations for various flood events with return periods ranging from 2 to 500 years are presented in Tables 12 and 13. It should be pointed out that the model has been built and calibrated based on observed flood events in the 250-450 cms range occurring during spring freshet. Caution should be used when applying this model to simulate water surface profiles for flows outside this range, or for flows that occur during other seasons of the year. Such water surface profiles – simulated using the same parameters, especially the Manning's roughness coefficient – would be only approximate, and should be used with caution. This is because the river roughness can

[6] While we consider the model good enough for the purposes of floodplain mapping, we also recognize that further model adjustment/modification may be necessary for other purposes. It all depends on the purpose of the modeling and the features and phenomena a model is meant to capture. We therefore caution against using this model for other purposes without first confirming its suitability.

vary with flow magnitude, with higher resistance associated with lower flows, and with the time of the year (as related to presence of instream vegetation).

Sensitivity Analysis

A sensitivity analysis was conducted to determine how much the computed water surface elevations will vary with changes in the value used for the 1:100 year discharge. Six flow conditions were tested:

- 1:100 year flow increased by 5%
- 1:100 year flow increased by 10%
- 1:100 year flow increased by 20%
- 1:100 year flows decreased by 5%
- 1:100 year flow decreased by 10%
- 1:100 year flow decreased by 20%

Figures 13 and 14 show the computed water surface profiles and the differences in computed water levels for each condition. Figure 14 indicates that the computed water surface elevations are more sensitive to the discharge value in the steeper portions of the reach. The sensitivity analysis indicates that the computed water level can vary by about 0.10 to 0.25 m for a 10% variation in flow along most of the river reach, which is typical in the hydrologic estimation of design flow. For a 20% increase in flow, the water level can go up by 0.4 to 0.6 m.

The sensitivity analysis has demonstrated that the RVCA's policy of requiring a minimum of 0.30 metres of freeboard in the design of flood-proofing measures for buildings and structures within or adjacent to flood prone areas will generally be satisfactory. It also provides an indication of the potential effect of changes in the expected flood flows that might result from more gradual trends such as climate change.

Selection of Regulatory Flood Levels

As per Section 3 of the Provincial Policy Statement under the Planning Act (MMAH, 2005, 2014), the regulatory flood in Zone 2, which includes the RVCA, is the 1:100 year flood[7].

In this study, we have modeled the open water flooding and not the ice-induced flooding. This reach of the Rideau River, however, has historically experienced ice-induced flooding. This problem has been being managed by ice removal since late 1890s. Currently, the City of Ottawa mitigates the risk by an ice cutting/blasting operation. This has substantially reduced the ice-related flood risk and thus should be continued in the future. Our use of open water condition is largely been justified on the assumption that the City would continue its ice management[8].

Depending on the local hydraulic conditions, the computed water surface elevation, the energy grade or a value in between is generally taken as the Regulatory Flood Level (RFL). Engineering judgment is applied to recommend an appropriate value for the regulatory flood level at each cross-section, using the model outputs and considering hydraulic characteristics of the river reach, and the inherent limitations of numerical modeling.

When the stream velocity is relatively low and varies only gradually over relatively long river reaches, the water surface can generally be taken as the RFL.

However, near bridges, culverts and other water control structures and on steeper reaches where streamflow velocities are higher, and may change more abruptly, the computed water surface elevation may be substantially lower than the energy grade level, with the possibility that the water level may rise to the energy grade near obstacles and irregularities in the channel profile or cross-section which may not be represented in the hydraulic model. In such cases, the regulatory flood level is generally based on the

[7] Review of historical water level indicates that it never exceeded the estimated 1:100 year flood level. For instance, at Carleton University gauge, the highest water level (60.35 m) was recorded on 28 March 1976 and it is lower than the estimated flood level of 60.75 m. Therefore, the 1:100 year flood is the appropriate standard for flood mapping along the Rideau River.

[8] An email from the City of Ottawa dated 10 February 2016 is included in Appendix C. It seems logical for the City to continue its ice management program in the future. The flood risk would be much higher should the ice management be ever discontinued. Flood risk mapping under ice conditions would be imperative under such circumstances.

computed energy grade as a conservative approach, given that the numerical model is less likely to be a true representation of reality in such situations.

Another possible situation arises when the computed water surface profile is undulating, with downstream water levels occasionally higher than upstream levels. When this occurs it is more often an artifact from the simplifying assumptions of the modeling scheme than a reliable prediction of the actual differences in streamflow velocity and depth (and hence energy state) from one cross-section to the next. Accordingly, the regulatory flood level at the upstream cross-section is taken to be equivalent to the downstream water surface elevation in these situations.

In all cases, the RFL is always between the computed water level and energy grade line. Hence, for the sake of simplicity and consistency, the energy grade elevation is often used as the RFL as a standard practice in delineating flood hazard areas.

For the present study, the regulatory flood levels were set equal to the computed energy grade and are tabulated in Table 11, along with the computed water surface elevations and energy grades at each cross-section in the model.

Flood Line Delineation

Once the RFLs are established, the plotting of 1:100 year flood lines or flood risk limits is a relatively straightforward matter. Given the topographical information in the form of contour lines at 0.25 m interval, the inundated area below the RFLs can be easily delineated manually or by using automated computer programs. In the present case, it was done automatically using HEC-GeoRAS software of USACE (2011), and then checked manually with a focus on areas with complex topography, infrastructure, and overbank flow paths. The raw LIDAR spot heights were extensively used in the plotting the flood risk limit.

Field surveys were conducted by RVCA staff in 2013 to verify hydraulic connectivity through culvert opening and flood prone areas. This information was used in plotting the flood risk limit near culverts.

The record of site-specific information associated with RVCA's regulatory approval process since 2006 was compiled (Table 14). At ten locations, the site-specific information warranted adjustment of the flood lines; but for the vast majority of locations, no change was required. Available as-built drawings, building layer, and aerial photographs were used to determine the flood risk limit.

Buildings in the floodplain:

Presence of existing buildings within the floodplain and associated variation in the way a building could be exposed to flood risk required special attention. Recently, RVCA has consolidated a few rules for drawing flood lines in the vicinity of buildings (Appendix D), which have been followed in this study. Due to the limitations of the data and methodology used in the current mapping done at a large scale, and the small degree of (inevitable) subjectivity in drawing flood lines around buildings at a smaller scale, RVCA recommends that, should the need arises for accurate flood line delineation near buildings, site-specific information be taken into account when dealing with flood risk at these locations. It is the practice of RVCA to refine flood lines when more accurate information becomes available.

The regulatory flood lines and cross-sections have been incorporated as separate layers in RVCA's Geographical Information System (GIS). In this system, one can view the flood lines, cross-sections, design flow, water level, energy grade, RFL, and other computed parameters. The flood lines can be overlain on the aerial photography or any other base mapping layers that are in the system and at any scale that suits the user's need.

The regulatory flood line layer is maintained, and updated as required according to the established procedures of the RVCA (RVCA 2005).

Flood-Prone Areas

There are a few flood-prone areas along the Rideau River that warrant some discussion. They are described here in the order from upstream to downstream direction. Detailed maps with 2011 aerial photo and flood lines are also included (Figures 15a-e).

Carleton University and Brewer Park: During a 1:100 year flood event, the water from the Rideau River will find its way up the existing ditch west of the Bronson

Avenue, spread west into a few low spots within the Carleton University campus, overtop the Bronson Avenue and spread east over the Brewer Park (Figure 15a). All these areas will have a RFL of 59.42 m. The Brewer Park dyke east of Bronson Avenue and the corrugated steel flood wall extending up to Osborne Street are higher than 59.42 m and the flood levels range from 59.27 to 59.36 m in the River; thus the flood waters are essentially kept separated by the dyke-flood wall system at this location. Some areas around the Carleton University Sports Center used to be designated as 'areas of reduced flood risk' since they were below the flood level. However, these areas have been raised above the flood level, and as such, there is no area of reduced flood risk within the university (west of Bronson Avenue).

Warrington Drive and Windsor Park: Flood water is expected to pool behind the area enclosed by Warrington Drive and Bank Street. The low-level berm along Warrington Drive will be submerged during a 1:100 year flood event (Figure 15b). The water pooled in this area will find its way over the Bank Street in to Winsor Park, with a prevailing RFL of 59.22 m. This elevation is higher than the water level ranging from 58.80 to 59.07 m in the river. The Windsor Park Dyke, built at a higher elevation (ranging from 59.45 to 63.03 m), will keep the flood waters separated. As observed earlier by Robinson (1984), the Windsor Park pumping system is sufficient to drain local runoff originating from the protected area behind the dyke; nevertheless the area must remain an 'area of reduced flood risk' in accordance with RVCA and Provincial policy.

The effect of the slightly submerged Warrington Drive Dyke on the computed water level in the Rideau River was investigated by using 'ineffective flow areas' in the HEC-RAS model. Identical water profiles were obtained, implying that the dyke was not large enough to impact the river hydraulics.

Brantwood Park and Onslow Crescent: These areas are relatively low and are thus subjected to overbank flow from the river (Figure 15c). Many existing residences are present in the Onslow Crescent area, as was also identified in previous studies.

Kingsview Park and Vanier/Landry: The Kingsview Park is separated from the Rideau River by a National Capital Commission (NCC) pathway, now called North River Road (Figure 15d). As pointed out during the last mapping (Robinson 1984), the structural adequacy of this pathway (a slightly elevated embankment) has never been confirmed; no information is available at this time to suggest that the pathway can withstand the floodwater during a 1:100 year flood event, or that its presence can be relied upon in the long run. There is no public entity that maintains the recreational pathway for the flood protection benefit that it affords in its present state. It should also be noted that this location is known to be prone to ice-jam induced flooding except for the annual ice removal operation. Therefore, this area is still designated as an “area of reduced flood risk”. The RFL is 56.44 m at this location. The flood water can also be expected to overtop the Vanier Parkway and extend to Lundry Street to the north. In plotting the flood lines, we have taken into consideration the recent development in this area.

New Edinburgh and Stanley Park: On the north-east side of the Rideau River, the Stanley Avenue is lower than the flood level and is thus prone to overbank flooding (Figure 15e). As shown I this figure, the RFL varies from 55.30 to 55.39 m in this area. The recent shallow fill by NCC work in the Stanley Park area was taken into consideration in plotting the flood risk lines.

Project Deliverables

The key information or knowledge products generated from this project are:

1) The Flood Mapping Report (this Technical Memorandum) – which summarizes the analytical methods that were used and the underlying assumptions
2) The flood risk limit lines in GIS format (shape files) – identifying the extent of lands which are considered to be vulnerable to flooding during a regulatory flood event (1:100 year flood on the Rideau River)
3) The HEC-RAS model files (input and output)
4) The position and orientation of cross-sections used in the HEC-RAS model, in GIS format (shape files) – which, when used in conjunction with the HEC-RAS model output files, informs the user as to the estimated 1:100 year water surface elevation and the regulatory flood level for any location in the study area

A "documentation folder" containing working notes and relevant background information accumulated during the study process is maintained by the water resources engineering unit within RVCA's Watershed Science and Engineering Services department.

Closure

The hydrotechnical and cartographic procedures used in this study generally conform to present day standards for flood hazard delineation, as set out in the MNR's Natural Hazards Technical Guide (MNR, 2002). The resulting 1:100 year flood lines are suitable for use in the RVCA's regulation limits mapping (referred to in Section 12 of Ontario Regulation 174/06) and in municipal land use planning and development approval processes under the Planning Act. The water surface profiles generated in the study will also be of valuable use in the flood forecasting and warning services provided by the RVCA.

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References:

1. Conservation Ontario (2005). Guidelines for Developing Schedules of Regulated Areas. October 2005.
2. Chow, V. T. (1959). Open-Channel Hydraulics. McGraw-Hill, New York, NY.
3. Dillon (1972). Rideau River Flood Plain Mapping: Ottawa River – Kars Bridge. Prepared for the Rideau Valley Conservation Authority by M. M. Dillon Limited, Ottawa, July 1972.
4. Heastad Methods (2003). Floodplain Modeling Using HEC-RAS. Heastad Press, Waterbury, CT.
5. Maidment, D. R. (ed.) (1993). Handbook of Hydrology. McGraw-Hill, NY.
6. MMAH (2005). Provincial Policy Statement. Ontario Ministry of Municipal Affairs and Housing. Toronto: Queen's Printer.
7. MMAH (2014). 2014 Provincial Policy Statement. Ontario Ministry of Municipal Affairs and Housing, Queen's Printer, Toronto, Ontario, 30 April 2014.
8. MNR (1986). Flood Plain Management in Ontario – Technical Guidelines. Ontario Ministry of Natural Resources, Conservation Authorities and Water Management Branch. Toronto: Queen's Printer.
9. MNR (2002). Technical Guide – River & Stream systems: Flooding Hazard Limit. Ontario Ministry of Natural Resources, Water Resources Section, Peterborough, Ontario.
10. Murphy, K. (2013, February 27). Email communication with Public Works and Government Services Canada. "Data on Rideau Falls Dams".
11. Pilon, P. J., and Harvey, K. D. (1993). Consolidated Frequency Analysis (CFA) version 3.1 Reference Manual. Surveys and Information Systems Branch. Ottawa: Environment Canada, March 1993.
12. Potvin, E. (2013, March 14). Email communication with Public Works and Government Services Canada. "Re: Rideau Falls Data".
13. Potvin, E. (2014, August 27). Email communication with Public Works and Government Services Canada. "Re: Rideau Falls".

14. Robinson (1984). Report on Flood Risk Mapping of Rideau River from Mooneys Bay to Rideau Falls. Prepared for Rideau Valley Conservation Authority by A.J. Robinson and Associates Inc., Ottawa, March 1984.
15. RVCA (2005). RVCA Methods for Delineation of Regulation Limits in Accordance with Ontario Regulation 97/04. Rideau Valley Conservation Authority, Manotick, Ontario.
16. RVCA (2013). RVCA Flood Forecasting and Warning Manual. Rideau Valley Conservation Authority, Manotick, Ontario.
17. Stedinger, J. R., Vogel, R. M., and Foufoula-Georgiou, E. (1993). Frequency Analysis of Extreme Events. Chapter 18 in Handbook of Hydrology edited by D. R. Maidment. McGraw-Hill, NY.
18. UNESCO (2005). The Precautionary Principle. World Commission on the Ethics of Science and Technology (COMEST), UNESCO, Paris, France.
19. USACE (1990). HEC-2 – Water Surface Profiles – User's Manual. US Army Corps of Engineers, Hydrologic Engineering Center, Davis, CA.
20. USACE (2010). HEC-RAS – River Analysis System – Hydraulic Reference Manual. US Army Corps of Engineers, Hydrologic Engineering Center, Davis, CA.
21. USACE (2011). HEC-GeoRAS – GIS Tools for Support of HEC-RAS Using ArcGIS – User's Manual Version 4.3.93, US Army Corps of Engineers, Hydrologic Engineering Center, Davis, CA, February 2011.

Table 1 Field Verification of LIDAR Data (Spot Heights)

	Lidar Points	2013 RVCA Field Survey - Rideau River									
Location ID	Z (m)	X (m)	Y (m)	Z (m)	Horizontal Accuracy (m)	Veritcal Accuracy (m)	Date/Time	Field Observations	△Z (m)	|△Z| (cm)	|△Z|>0.33m
rideau-1	79.81	445534.66	5024503.11	80.05	0.007	0.011	4/6/2013 9:42		-0.235	23.5	
rideau-2	79.74	445532.93	5024501.16	79.92	0.007	0.011	4/6/2013 9:42		-0.176	17.6	
rideau-3	79.67	445530.69	5024498.43	79.75	0.007	0.010	4/6/2013 9:43		-0.082	8.2	
rideau-4	79.65	445528.17	5024495.33	79.56	0.007	0.011	4/6/2013 9:43		0.093	9.3	
rideau-5	79.64	445525.99	5024492.04	79.37	0.007	0.011	4/6/2013 9:43		0.275	27.5	
rideau-8	79.20	445518.29	5024483.42	78.97	0.008	0.013	4/6/2013 9:45		0.233	23.3	
rideau-9	78.92	445516.09	5024479.18	78.84	0.009	0.013	4/6/2013 9:45		0.079	7.9	
rideau-10	78.36	445520.17	5024470.75	78.63	0.010	0.013	4/6/2013 9:46		-0.274	27.4	
rideau-11	78.10	445521.84	5024467.96	78.27	0.010	0.015	4/6/2013 9:46		-0.174	17.4	
rideau-12	77.83	445523.56	5024465.45	77.98	0.009	0.013	4/6/2013 9:46		-0.154	15.4	
rideau-13	77.58	445525.62	5024462.55	77.65	0.009	0.014	4/6/2013 9:47		-0.070	7.0	
rideau-14	77.23	445527.91	5024459.38	77.33	0.009	0.013	4/6/2013 9:47		-0.101	10.1	
rideau-15	77.06	445530.43	5024455.77	77.07	0.013	0.016	4/6/2013 9:48		-0.005	0.5	
rideau-16	76.79	445532.82	5024452.22	76.79	0.012	0.015	4/6/2013 9:48		0.001	0.1	
rideau-17	76.54	445535.48	5024448.07	76.48	0.011	0.019	4/6/2013 9:48		0.060	6.0	
rideau-18	67.70	445201.64	5025354.30	67.66	0.010	0.013	4/6/2013 9:59		0.036	3.6	
rideau-19	67.51	445203.60	5025356.55	67.49	0.011	0.014	4/6/2013 9:59		0.017	1.7	
rideau-20	67.38	445206.17	5025359.23	67.33	0.009	0.012	4/6/2013 10:00		0.051	5.1	
rideau-21	67.10	445208.45	5025361.81	67.18	0.009	0.012	4/6/2013 10:00		-0.084	8.4	
rideau-22	67.08	445211.06	5025364.61	67.03	0.009	0.013	4/6/2013 10:01		0.053	5.3	
rideau-23	66.76	445213.99	5025367.82	66.84	0.010	0.013	4/6/2013 10:01		-0.083	8.3	
rideau-24	66.68	445217.07	5025371.08	66.64	0.009	0.012	4/6/2013 10:01		0.043	4.3	
rideau-25	66.41	445220.40	5025374.58	66.46	0.011	0.015	4/6/2013 10:02		-0.049	4.9	
rideau-26	66.24	445223.40	5025377.86	66.24	0.012	0.016	4/6/2013 10:02		0.000	0.0	
rideau-27	66.14	445225.49	5025380.05	66.15	0.013	0.016	4/6/2013 10:03		-0.014	1.4	
rideau-28	66.00	445227.81	5025382.60	65.94	0.015	0.019	4/6/2013 10:03		0.061	6.1	
rideau-29	65.75	445230.22	5025384.88	65.87	0.013	0.019	4/6/2013 10:04		-0.115	11.5	
rideau-30	65.64	445232.93	5025388.03	65.71	0.010	0.020	4/6/2013 10:06		-0.071	7.1	
rideau-31	59.31	446674.72	5026122.84	59.30	0.011	0.016	4/6/2013 10:33		0.009	0.9	
rideau-32	58.76	446677.11	5026130.29	58.72	0.008	0.011	4/6/2013 10:33		0.039	3.9	
rideau-33	58.71	446678.65	5026132.87	58.67	0.011	0.015	4/6/2013 10:34		0.042	4.2	
rideau-34	58.69	446680.32	5026135.60	58.62	0.011	0.014	4/6/2013 10:34		0.070	7.0	
rideau-35	58.52	446681.75	5026138.50	58.47	0.011	0.015	4/6/2013 10:34		0.050	5.0	
rideau-36	58.47	446683.12	5026140.68	58.35	0.010	0.014	4/6/2013 10:35		0.117	11.7	
rideau-37	58.34	446684.22	5026142.94	58.33	0.009	0.013	4/6/2013 10:35		0.013	1.3	
rideau-38	58.39	446685.19	5026144.70	58.33	0.013	0.016	4/6/2013 10:35		0.058	5.8	
rideau-39	58.40	446686.44	5026145.68	58.27	0.015	0.018	4/6/2013 10:35		0.132	13.2	
rideau-40	58.96	446623.27	5026095.85	58.95	0.013	0.019	4/6/2013 10:38		0.006	0.6	
rideau-41	58.88	446619.40	5026094.31	58.77	0.013	0.020	4/6/2013 10:39		0.113	11.3	
rideau-42	63.74	447185.14	5028812.92	63.73	0.011	0.013	4/6/2013 11:06		0.013	1.3	
rideau-43	63.61	447186.79	5028812.24	63.59	0.011	0.012	4/6/2013 11:06		0.016	1.6	
rideau-44	63.46	447188.87	5028813.29	63.39	0.010	0.011	4/6/2013 11:06		0.071	7.1	
rideau-45	63.03	447192.21	5028813.79	63.04	0.009	0.011	4/6/2013 11:07		-0.006	0.6	
rideau-46	62.69	447195.45	5028813.19	62.67	0.010	0.011	4/6/2013 11:07		0.021	2.1	
rideau-47	62.51	447197.96	5028814.75	62.47	0.009	0.011	4/6/2013 11:08		0.042	4.2	
rideau-48	62.04	447200.92	5028816.00	61.95	0.008	0.010	4/6/2013 11:08		0.089	8.9	
rideau-49	61.65	447203.94	5028816.96	61.54	0.010	0.011	4/6/2013 11:08		0.107	10.7	

	Lidar Points	2013 RVCA Field Survey - Rideau River									
Location ID	Z (m)	X (m)	Y (m)	Z (m)	Horizontal Accuracy (m)	Veritcal Accuracy (m)	Date/Time	Field Observations	△Z (m)	|△Z| (cm)	|△Z|>0.33m
rideau-50	61.17	447207.06	5028817.83	61.06	0.010	0.012	4/6/2013 11:09		0.107	10.7	
rideau-51	60.79	447209.98	5028818.94	60.70	0.009	0.012	4/6/2013 11:09		0.091	9.1	
rideau-52	60.42	447212.48	5028820.03	60.41	0.009	0.013	4/6/2013 11:09		0.011	1.1	
rideau-53	60.26	447214.69	5028821.76	60.22	0.009	0.013	4/6/2013 11:10		0.045	4.5	
rideau-59	58.95	447739.14	5029755.65	59.24	0.012	0.019	4/6/2013 11:23		-0.294	29.4	
rideau-60	58.96	447742.25	5029756.07	58.97	0.012	0.019	4/6/2013 11:24		-0.010	1.0	
rideau-61	58.56	447763.27	5029761.07	58.50	0.013	0.020	4/6/2013 11:25		0.062	6.2	
rideau-62	56.77	447830.14	5029780.36	56.60	0.013	0.020	4/6/2013 11:26		0.166	16.6	
rideau-63	56.86	447834.28	5029774.77	56.83	0.010	0.016	4/6/2013 11:27		0.027	2.7	
rideau-64	57.27	447840.24	5029768.84	57.17	0.011	0.016	4/6/2013 11:27		0.102	10.2	
rideau-65	61.64	447407.41	5031299.70	61.61	0.013	0.020	4/6/2013 11:55		0.029	2.9	
rideau-66	61.80	447406.30	5031301.41	61.75	0.013	0.020	4/6/2013 11:55		0.046	4.6	
rideau-67	61.97	447404.46	5031303.22	61.93	0.013	0.020	4/6/2013 11:56		0.041	4.1	
rideau-68	62.09	447403.45	5031306.14	62.10	0.012	0.020	4/6/2013 11:57		-0.014	1.4	
rideau-69	62.38	447401.44	5031308.78	62.33	0.013	0.020	4/6/2013 11:57		0.048	4.8	
rideau-70	62.66	447399.76	5031312.69	62.64	0.013	0.020	4/6/2013 11:58		0.019	1.9	
rideau-71	62.88	447397.38	5031314.52	62.86	0.013	0.020	4/6/2013 11:58		0.018	1.8	
rideau-72	63.12	447394.70	5031316.83	63.13	0.013	0.020	4/6/2013 11:59		-0.006	0.6	
rideau-73	63.41	447392.03	5031319.06	63.39	0.012	0.020	4/6/2013 11:59		0.024	2.4	
rideau-74	63.70	447388.77	5031321.18	63.69	0.013	0.019	4/6/2013 12:00		0.011	1.1	
rideau-75	63.90	447386.81	5031323.90	63.92	0.012	0.020	4/6/2013 12:00		-0.022	2.2	
rideau-76	57.01	447298.83	5031716.46	56.99	0.011	0.020	4/6/2013 12:10		0.016	1.6	
rideau-77	59.56	447258.21	5031747.19	59.52	0.010	0.020	4/6/2013 12:12		0.037	3.7	
rideau-78	59.37	447255.46	5031745.85	59.36	0.010	0.020	4/6/2013 12:12		0.010	1.0	
rideau-79	59.00	447253.24	5031744.56	58.90	0.010	0.020	4/6/2013 12:12		0.100	10.0	
rideau-80	58.37	447250.78	5031743.14	58.25	0.010	0.020	4/6/2013 12:13		0.124	12.4	
rideau-81	57.56	447248.21	5031741.89	57.55	0.010	0.019	4/6/2013 12:13		0.012	1.2	
rideau-82	57.00	447246.00	5031740.68	57.06	0.011	0.018	4/6/2013 12:13		-0.059	5.9	
rideau-83	56.96	447242.50	5031738.81	56.95	0.011	0.019	4/6/2013 12:14		0.009	0.9	
rideau-84	56.00	447311.19	5031763.91	56.02	0.012	0.020	4/6/2013 12:17		-0.021	2.1	
rideau-85	56.20	447309.92	5031758.17	56.30	0.012	0.020	4/6/2013 12:18		-0.097	9.7	
rideau-86	56.38	447309.21	5031754.66	56.47	0.011	0.019	4/6/2013 12:22		-0.085	8.5	
rideau-87	57.62	447892.62	5030274.13	57.54	0.009	0.018	4/6/2013 13:22		0.083	8.3	
rideau-88	57.59	447878.33	5030272.34	57.42	0.010	0.020	4/6/2013 13:23		0.168	16.8	
rideau-89	57.43	447860.71	5030269.96	57.33	0.010	0.020	4/6/2013 13:25		0.103	10.3	
rideau-90	57.16	447831.84	5030266.64	57.19	0.011	0.020	4/6/2013 13:27		-0.031	3.1	
rideau-91	57.37	447829.98	5030266.71	57.34	0.012	0.020	4/6/2013 13:28		0.026	2.6	
rideau-92	57.48	447827.78	5030267.22	57.55	0.013	0.020	4/6/2013 13:28		-0.067	6.7	
rideau-93	57.79	447814.70	5030265.23	57.71	0.008	0.016	4/6/2013 13:29		0.077	7.7	
rideau-94	57.53	447807.55	5030264.54	57.49	0.007	0.015	4/6/2013 13:29		0.036	3.6	
rideau-95	57.35	447801.46	5030264.77	57.27	0.008	0.015	4/6/2013 13:31		0.082	8.2	
rideau-96	57.40	447800.88	5030263.64	57.25	0.008	0.015	4/6/2013 13:31		0.146	14.6	
rideau-97	57.11	447793.74	5030265.47	57.03	0.008	0.015	4/6/2013 13:31		0.083	8.3	
rideau-98	57.02	447789.51	5030263.14	56.87	0.007	0.015	4/6/2013 13:32		0.147	14.7	
stanley-union-1	55.21	446010.70	5032140.13	55.23	0.013	0.020	04/29/2013 11:58:35		-0.023	2.3	
stanley-union-2	55.27	446025.49	5032133.11	55.23	0.013	0.020	04/29/2013 11:59:32		0.043	4.3	
stanley-rd1	55.75	446279.83	5032016.11	55.70	0.012	0.020	04/29/2013 12:12:29		0.050	5.0	
onslow-rd-1	58.24	447372.34	5028292.02	58.22	0.008	0.012	04/29/2013 12:59:17		0.019	1.9	

	Lidar Points	2013 RVCA Field Survey - Rideau River										
Location ID	Z (m)	X (m)	Y (m)	Z (m)	Horizontal Accuracy (m)	Veritcal Accuracy (m)	Date/Time	Field Observations	△Z (m)	|△Z| (cm)	|△Z|>0.33m
onslow-rd-2	58.30	447407.59	5028237.63	58.25	0.009	0.013	04/29/2013 13:01:00		0.046	4.6	
onslow-rd-3	58.36	447461.50	5028182.69	58.33	0.010	0.014	04/29/2013 13:02:23		0.028	2.8	
onslow-rd-4	58.36	447489.46	5028107.10	58.32	0.009	0.013	04/29/2013 13:03:52		0.036	3.6	
belmont-rriver-1	57.84	447232.94	5027169.06	57.78	0.013	0.020	04/29/2013 13:33:00		0.060	6.0	
belmont-rriver-2	57.80	447225.21	5027156.23	57.77	0.014	0.019	04/29/2013 13:34:41		0.026	2.6	
belmont-rriver-3	57.56	447213.34	5027094.22	57.53	0.013	0.020	04/29/2013 13:38:17		0.034	3.4	
belmont-rriver-5	57.55	447211.25	5027084.49	57.50	0.014	0.017	04/29/2013 13:39:24		0.048	4.8	
rideurivr-1	58.52	447335.82	5027491.60	58.48	0.011	0.016	04/29/2013 13:47:16		0.039	3.9	
rideurivr-2	58.39	447332.87	5027496.74	58.40	0.012	0.020	04/29/2013 13:47:53		-0.013	1.3	
rideurivr-3	58.55	447340.24	5027490.47	58.45	0.014	0.020	04/29/2013 13:48:55		0.104	10.4	
warrington-1	58.78	446685.07	5026420.30	58.82	0.012	0.018	04/29/2013 13:59:36		-0.040	4.0	
warrington-3	59.12	446663.05	5026421.91	59.06	0.012	0.020	04/29/2013 14:01:13		0.063	6.3	
warrington-4	58.96	446632.46	5026432.76	58.92	0.011	0.020	04/29/2013 14:02:10		0.042	4.2	
warrington-6	59.06	446814.38	5026406.56	58.96	0.013	0.019	04/29/2013 14:08:29		0.100	10.0	
jamieson-1	60.08	437323.71	5024206.83	59.94	0.010	0.020	04/29/2013 14:44:32		0.138	13.8	
jamieson-2	60.14	437325.14	5024156.75	60.08	0.010	0.020	04/29/2013 14:46:13		0.056	5.6	
jamieson-3	60.12	437324.69	5024116.44	60.01	0.011	0.019	04/29/2013 14:48:02		0.107	10.7	
									Mean △Z :	6.8	no yes out of 112
									Median △Z :	5.0	
									Max △Z :	29.4	
									Min △Z :	0.0	

Discarded Points

rideau-6	79.69	445523.37	5024488.95	79.24	0.009	0.015	4/6/2013 9:44	parking lot under construction	0.454	45.4	Y
rideau-7	79.51	445520.48	5024486.16	79.09	0.009	0.015	4/6/2013 9:44	parking lot under construction	0.421	42.1	Y
rideau-54	62.30	447723.61	5029753.50	61.66	0.013	0.020	4/6/2013 11:21	deteriorating sloped pathway	0.644	64.4	Y
rideau-55	61.90	447725.84	5029753.05	61.32	0.012	0.020	4/6/2013 11:21	deteriorating sloped pathway	0.579	57.9	Y
rideau-56	60.23	447728.59	5029753.59	60.74	0.011	0.018	4/6/2013 11:22	deteriorating sloped pathway	-0.510	-51.0	Y
rideau-57	59.31	447731.93	5029753.91	60.11	0.013	0.018	4/6/2013 11:22	deteriorating sloped pathway	-0.803	-80.3	Y
rideau-58	58.90	447735.09	5029754.91	59.66	0.012	0.020	4/6/2013 11:23	deteriorating sloped pathway	-0.761	-76.1	Y

Table 2 Field verification of LIDAR data (contour crossings)

	Lidar Contours	2013 RVCA Field Survey - Rideau River									
Location Id	**Z (m)**	**X (m)**	**Y (m)**	**Z (m)**	**Horizontal Accuracy (m)**	**Veritcal Accuracy (m)**	**Date/Time**	**Field Observations**	**△Z (m)**	**|△Z| (cm)**	**|△Z|>0.5m**
rideau-1	79.75	5024503.11	445534.66	80.05	0.007	0.011	4/6/2013 9:42		-0.295	29.5	
rideau-8	79.25	5024483.42	445518.29	78.97	0.008	0.013	4/6/2013 9:45		0.283	28.3	
rideau-9	79.00	5024479.18	445516.09	78.84	0.009	0.013	4/6/2013 9:45		0.159	15.9	
rideau-10	78.25	5024470.75	445520.17	78.63	0.010	0.013	4/6/2013 9:46		-0.384	38.4	
rideau-11	78.00	5024467.96	445521.84	78.27	0.010	0.015	4/6/2013 9:46		-0.274	27.4	
rideau-12	77.75	5024465.45	445523.56	77.98	0.009	0.013	4/6/2013 9:46		-0.234	23.4	
rideau-13	77.50	5024462.55	445525.62	77.65	0.009	0.014	4/6/2013 9:47		-0.150	15.0	
rideau-14	77.25	5024459.38	445527.91	77.33	0.009	0.013	4/6/2013 9:47		-0.081	8.1	
rideau-15	77.00	5024455.77	445530.43	77.07	0.013	0.016	4/6/2013 9:48		-0.065	6.5	
rideau-16	77.00	5024452.22	445532.82	76.79	0.012	0.015	4/6/2013 9:48		0.211	21.1	
rideau-17	76.75	5024448.07	445535.48	76.48	0.011	0.019	4/6/2013 9:48		0.270	27.0	
rideau-18	67.75	5025354.30	445201.64	67.66	0.010	0.013	4/6/2013 9:59		0.086	8.6	
rideau-19	67.50	5025356.55	445203.60	67.49	0.011	0.014	4/6/2013 9:59		0.007	0.7	
rideau-20	67.25	5025359.23	445206.17	67.33	0.009	0.012	4/6/2013 10:00		-0.079	7.9	
rideau-21	67.00	5025361.81	445208.45	67.18	0.009	0.012	4/6/2013 10:00		-0.184	18.4	
rideau-22	66.75	5025364.61	445211.06	67.03	0.009	0.013	4/6/2013 10:01		-0.277	27.7	
rideau-23	66.75	5025367.82	445213.99	66.84	0.010	0.013	4/6/2013 10:01		-0.093	9.3	
rideau-27	66.00	5025380.05	445225.49	66.15	0.013	0.016	4/6/2013 10:03		-0.154	15.4	
rideau-29	65.75	5025384.88	445230.22	65.87	0.013	0.019	4/6/2013 10:04		-0.115	11.5	
rideau-31	59.25	5026122.84	446674.72	59.30	0.011	0.016	4/6/2013 10:33		-0.051	5.1	
rideau-33	58.75	5026132.87	446678.65	58.67	0.011	0.015	4/6/2013 10:34		0.082	8.2	
rideau-37	58.50	5026142.94	446684.22	58.33	0.009	0.013	4/6/2013 10:35		0.173	17.3	
rideau-39	58.25	5026145.68	446686.44	58.27	0.015	0.018	4/6/2013 10:35		-0.018	1.8	
rideau-40	59.00	5026095.85	446623.27	58.95	0.013	0.019	4/6/2013 10:38		0.046	4.6	
rideau-41	58.75	5026094.31	446619.40	58.77	0.013	0.020	4/6/2013 10:39		-0.017	1.7	
rideau-42	63.75	5028812.92	447185.14	63.73	0.011	0.013	4/6/2013 11:06		0.023	2.3	
rideau-43	63.50	5028812.24	447186.79	63.59	0.011	0.012	4/6/2013 11:06		-0.094	9.4	
rideau-45	63.00	5028813.79	447192.21	63.04	0.009	0.011	4/6/2013 11:07		-0.036	3.6	
rideau-48	62.00	5028816.00	447200.92	61.95	0.008	0.010	4/6/2013 11:08		0.049	4.9	
rideau-50	61.25	5028817.83	447207.06	61.06	0.010	0.012	4/6/2013 11:09		0.187	18.7	
rideau-52	60.75	5028820.03	447212.48	60.41	0.009	0.013	4/6/2013 11:09		0.341	34.1	
rideau-53	60.50	5028821.76	447214.69	60.22	0.009	0.013	4/6/2013 11:10		0.285	28.5	
rideau-61	58.50	5029761.07	447763.27	58.50	0.013	0.020	4/6/2013 11:25		0.002	0.2	
rideau-62	56.75	5029780.36	447830.14	56.60	0.013	0.020	4/6/2013 11:26		0.146	14.6	
rideau-63	57.00	5029774.77	447834.28	56.83	0.010	0.016	4/6/2013 11:27		0.167	16.7	
rideau-66	61.75	5031301.41	447406.30	61.75	0.013	0.020	4/6/2013 11:55		-0.004	0.4	
rideau-67	62.00	5031303.22	447404.46	61.93	0.013	0.020	4/6/2013 11:56		0.071	7.1	
rideau-70	62.75	5031312.69	447399.76	62.64	0.013	0.020	4/6/2013 11:58		0.109	10.9	
rideau-72	63.25	5031316.83	447394.70	63.13	0.013	0.020	4/6/2013 11:59		0.124	12.4	
rideau-74	63.75	5031321.18	447388.77	63.69	0.013	0.019	4/6/2013 12:00		0.061	6.1	
rideau-75	64.00	5031323.90	447386.81	63.92	0.012	0.020	4/6/2013 12:00		0.078	7.8	
rideau-76	57.00	5031716.46	447298.83	56.99	0.011	0.020	4/6/2013 12:10		0.006	0.6	
rideau-77	59.50	5031747.19	447258.21	59.52	0.010	0.020	4/6/2013 12:12		-0.023	2.3	
rideau-78	59.25	5031745.85	447255.46	59.36	0.010	0.020	4/6/2013 12:12		-0.110	11.0	
rideau-80	58.25	5031743.14	447250.78	58.25	0.010	0.020	4/6/2013 12:13		0.004	0.4	
rideau-82	57.00	5031740.68	447246.00	57.06	0.011	0.018	4/6/2013 12:13		-0.059	5.9	
rideau-83	57.00	5031738.81	447242.50	56.95	0.011	0.019	4/6/2013 12:14		0.049	4.9	

	Lidar Contours	2013 RVCA Field Survey - Rideau River										
Location Id	Z (m)	X (m)	Y (m)	Z (m)	Horizontal Accuracy (m)	Vertical Accuracy (m)	Date/Time	Field Observations	△Z (m)	|△Z| (cm)	|△Z|>0.5m
rideau-85	56.25	5031758.17	447309.92	56.30	0.012	0.020	4/6/2013 12:18		-0.047	4.7	
rideau-86	56.50	5031754.66	447309.21	56.47	0.011	0.019	4/6/2013 12:22		0.035	3.5	
rideau-88	57.50	5030272.34	447878.33	57.42	0.010	0.020	4/6/2013 13:23		0.078	7.8	
rideau-89	57.50	5030269.96	447860.71	57.33	0.010	0.020	4/6/2013 13:25		0.173	17.3	
rideau-90	57.25	5030266.64	447831.84	57.19	0.011	0.020	4/6/2013 13:27		0.059	5.9	
rideau-91	57.50	5030266.71	447829.98	57.34	0.012	0.020	4/6/2013 13:28		0.156	15.6	
rideau-94	57.50	5030264.54	447807.55	57.49	0.007	0.015	4/6/2013 13:29		0.006	0.6	
rideau-96	57.25	5030263.64	447800.88	57.25	0.008	0.015	4/6/2013 13:31		-0.004	0.4	
rideau-97	57.00	5030265.47	447793.74	57.03	0.008	0.015	4/6/2013 13:31		-0.027	2.7	
stanley-union-1	55.25	5032140.13	446010.70	55.23	0.013	0.020	04/29/2013 11:58:35		0.017	1.7	
stanley-rd1	55.75	5032016.11	446279.83	55.70	0.012	0.020	04/29/2013 12:12:29		0.050	5.0	
onslow-rd-1	58.25	5028292.02	447372.34	58.22	0.008	0.012	04/29/2013 12:59:17		0.029	2.9	
onslow-rd-2	58.25	5028237.63	447407.59	58.25	0.009	0.013	04/29/2013 13:01:00		-0.004	0.4	
onslow-rd-4	58.25	5028107.10	447489.46	58.32	0.009	0.013	04/29/2013 13:03:52		-0.074	7.4	
belmont-rriver-1	58.00	5027169.06	447232.94	57.78	0.013	0.020	04/29/2013 13:33:00		0.220	22.0	
belmont-rriver-3	57.50	5027094.22	447213.34	57.53	0.013	0.020	04/29/2013 13:38:17		-0.026	2.6	
rideurivr-1	58.50	5027491.60	447335.82	58.48	0.011	0.016	04/29/2013 13:47:16		0.019	1.9	
rideurivr-2	58.50	5027496.74	447332.87	58.40	0.012	0.020	04/29/2013 13:47:53		0.097	9.7	
warrington-1	59.00	5026420.30	446685.07	58.82	0.012	0.018	04/29/2013 13:59:36		0.180	18.0	
warrington-3	59.00	5026421.91	446663.05	59.06	0.012	0.020	04/29/2013 14:01:13	curb	-0.057	5.7	
warrington-5	59.25	5026400.58	446828.68	59.12	0.010	0.020	04/29/2013 14:06:59		0.126	12.6	
jamieson-1	60.00	5024206.83	437323.71	59.94	0.010	0.020	04/29/2013 14:44:32		0.058	5.8	
jamieson-2	60.25	5024156.75	437325.14	60.08	0.010	0.020	04/29/2013 14:46:13		0.166	16.6	
									Mean △Z :	10.7	no yes out of 70
									Median △Z :	7.8	
									Max △Z :	38.4	
									Min △Z :	0.2	

Discarded Points

rideau-54	62.25	5029753.50	447723.61	61.66	0.013	0.020	4/6/2013 11:21	deteriorating sloped pathway	0.594	59.4	Y
rideau-55	61.75	5029753.05	447725.84	61.32	0.012	0.020	4/6/2013 11:21	deteriorating sloped pathway	0.429	42.9	
rideau-56	60.25	5029753.59	447728.59	60.74	0.011	0.018	4/6/2013 11:22	deteriorating sloped pathway	-0.490	-49.0	
rideau-7	79.50	5024486.16	445520.48	79.09	0.009	0.015	4/6/2013 9:44	parking lot under construction	0.411	41.1	

Table 3 Hydrometric Gauge Information

Location	Station Number	Water Level		Flow		Source	Comments
		Start	End	Start	End		
Rideau River above Rideau Falls	02LA027	2010	2012			WSC	
Rideau River at Ottawa	02LA004	2002	2012	1933	2012	WSC	Instanteaneous Peaks (1971-1973,1975-2010)
Rideau River below Manotick (Long Island)	02LA012			1980	1996	WSC	
Rideau River below Manotick (Long Island)	02LA012			1997	2012	RVCA	
Rideau River below Merrickville (Andrewsville)	02LA011			1979	1996	WSC	
Rideau River below Merrickville (Andrewsville)	02LA011			2003	2011	RVCA	
Rideau River above Smiths Falls (Poonamalie)	02LA005			1970	1996	WSC	
Rideau River above Smiths Falls (Poonamalie)	02LA005	2003	2011	1997	2012	RVCA	

Table 4 Rideau River Flow at Carleton University (02LA004)

Year	Annual Max Daily Flow (cms)	Max Instantaneous Flow (cms)	Inst/Daily Ratio	Estimated Instantaneous Flow (cms) (computed by regression equation)	Final Instantaneous Flow Series (cms)	Flow increased by 11% (cms)	Final Flow Series (cms) (input to CFA)
1947	538			560.3	560.3		560.3
1948							
1949	379			392.8	392.8		392.8
1950	447			462.8	462.8		462.8
1951	419			433.7	433.7		433.7
1952	379			392.8	392.8		392.8
1953	331			344.7	344.7		344.7
1954	405			419.3	419.3		419.3
1955	493			511.5	511.5		511.5
1956	351			364.6	364.6		364.6
1957	133			159.2	159.2		159.2
1958	306			320.2	320.2		320.2
1959	413			427.5	427.5		427.5
1960	532			553.7	553.7		553.7
1961	193			213.3	213.3		213.3
1962	323			336.8	336.8		336.8
1963	442			457.6	457.6		457.6
1964	109			138.0	138.0		138.0
1965	146			170.7	170.7		170.7
1966	215			233.6	233.6		233.6
1967	311			325.1	325.1		325.1
1968	377			390.7	390.7		390.7
1969	328			341.8	341.8		341.8
1970	442			457.6	457.6		457.6
1971	496	513	1.0343		513.0		513.0
1972	535	578	1.0804		578.0		578.0
1973	447	464	1.0380		464.0		464.0
1974	396			410.0	410.0		410.0
1975	394	413	1.0482		413.0		413.0
1976	583	597	1.0240		597.0		597.0
1977	467	473	1.0128		473.0	525.0	525.0
1978	487	527	1.0821		527.0	585.0	585.0
1979	403	423	1.0496		423.0	469.5	469.5
1980	385	421	1.0935		421.0	467.3	467.3
1981	435	446	1.0253		446.0	495.1	495.1
1982	397	435	1.0957		435.0	482.9	482.9
1983	224	246	1.0982		246.0	273.1	273.1
1984	385	398	1.0338		398.0	441.8	441.8
1985	265	276	1.0415		276.0	306.4	306.4
1986	223	256	1.1480		256.0	284.2	284.2
1987	334	353	1.0569		353.0	391.8	391.8
1988	247	273	1.1053		273.0	303.0	303.0
1989	251	276	1.0996		276.0	306.4	306.4
1990	259	264	1.0193		264.0	293.0	293.0
1991	311	326	1.0482		326.0		326.0
1992	270	282	1.0444		282.0		282.0
1993	508	514	1.0118		514.0		514.0
1994	331	338	1.0211		338.0		338.0
1995	263	269	1.0228		269.0		269.0
1996	232	243	1.0474		243.0		243.0
1997	441	448	1.0159		448.0		448.0
1998	451	458	1.0155		458.0		458.0
1999	436	448	1.0275		448.0		448.0
2000	244	245	1.0041		245.0		245.0
2001	356	366	1.0281		366.0		366.0
2002	188	222	1.1809		222.0		222.0
2003	238	249	1.0462		249.0		249.0
2004	167	199	1.1916		199.0		199.0
2005	427	437	1.0234		437.0		437.0
2006	215	218	1.0140		218.0		218.0
2007	259	262	1.0116		262.0		262.0
2008	478	493	1.0314		493.0		493.0
2009	220	254	1.1545		254.0		254.0
2010	234	237	1.0128		237.0		237.0
2011	350.85			364.4	364.4		364.4
2012	214.03			232.7	232.7		232.7

Table 5 Results of Flood Frequency Analysis

Return Period (year)	Annual Probability of Exceedence (%)	Robinson (1984) Estimated Flood Quantile (cms)	RVCA (2014) Estimated Flood Quantile (cms)
1.003	99.7		62.7
1.05	95.2		174
1.25	80		268
2	50		369
5	20	513	475
10	10	552	529
20	5		572
25	4	598	
50	2	626	617
100	1	654	644
200	0.5		667
500	0.2		691
	Data used	1947-1982	1947-2012
	Distribution Used	3PLN	GEV

Table 6 Flood Estimates used in HEC-RAS

Return Period (year)	Annual Probability of Exceedence (%)	Discharge (cms)
2	50	369
5	20	475
10	10	529
20	5	572
50	2	617
100	1	644
200	0.5	667
500	0.2	691

Table 7 Bridge and Structure Information

River/Reach	Bridge	Chainage (m)	Bounding Cross Sections	Top of Deck (m)	Low Chord (m)	Deck Width (m)	Coefficient of Contraction	Coefficient of Expansion	Date of Drawing	Source
Rideau /West RF2Split	Sussex Drive (West)	135	145 & 125	57.97	56.86	23.5	0.3	0.5	2005	City of Ottawa
Rideau/East RF2Split	Sussex Drive (East)	124	134 & 114	58.40	57.58	24	0.3	0.5	2005	City of Ottawa
Rideau/West RF2Split	Minto Bridge (west)	390	396 & 385	57.53	56.57	10	0.3	0.5	2005, 2012	City of Ottawa
Rideau/East RF2Split	Minto Bridge (central)	391	396 & 387	57.45	56.73	10	0.3	0.5	2005	City of Ottawa
Rideau/East RF2Split	Minto Bridge (east)	391	396 & 387	56.98	55.98	10	0.3	0.5	2005	City of Ottawa
Rideau/HB2Split	Island Lodge Road	1404	1410 & 1399	59.20	58.36	12	0.1	0.3	1990	City of Ottawa
Rideau/HB2Split	Porter Island South (Pedestrian)	1513	1515 & 1511	58.40	57.91	4	0.1	0.3	1990	City of Ottawa
Rideau/HB2Split	St Patrick Street	1705	1720 & 1690	60.30	58.15	32	0.1	0.3	1990	City of Ottawa
Rideau/HB2Split	Cummings Bridge	2482	2490 & 2474	63.54	61.24	18	0.3	0.5	1999	City of Ottawa
Rideau/HB2Split	Hurdman Bridge (Highway 417)	4449	4464 & 4430	61.54	58.67	36.9	0.3	0.5	2012	MTO
Rideau/HB2Split	Pedestrian Bridge U/S of 417	4522	4524 & 4521	60.10	59.52	3.5	0.3	0.5	1999	City of Ottawa
Rideau/HB2Split	Transitway bridge U/S of 417	5044	5052 & 5037	61.48	58.86	15	0.1	0.3	1995	City of Ottawa
Rideau/HB2Split	McIlrain Bridge (Smyth Road)	6909	6920 & 6899	65.00	61.50	21	0.1	0.3	1963	City of Ottawa
Rideau/HB2Split	Billings Bridge (Bank Street)	8180	8189 & 8171	60.90	59.21	20	0.3	0.5	2010, 1984	City of Ottawa
Rideau/HB2Split	Dunbar Bridge (Bronson Avenue)	9503	9513 & 9493	66.76	62.84	34	0.1	0.3	1993	City of Ottawa
Rideau/HB2Split	O-Train Bridge	10008	10011 & 10006	67.44	63.03	5	0.1	0.3	2011	City of Ottawa
Rideau/HB2Split	Heron Bridge (North and South)	10856	10878 & 10834	76.00	72.45	44	0.1	0.3	1965, 1966	City of Ottawa

Reach	**Dam**			Deck (m)	Sill (m)	Deck Width (m)	Cc (-)	Ce (-)	Span (m)	
West RF2Split	Rideau Falls Dam (West)	34	37 & 30	56.17	52.3	11	0.1	0.3	33.8	PWGSC
East RF2Split	Rideau Falls Dam (East)	44	49 & 41	55.74	52.06	7.8	0.1	0.3	68.3	PWGSC

Table 8 Design Flows in HEC-RAS Model

			Return Period (year)							
River	**Reach**	**Station ID**	**2**	**5**	**10**	**20**	**50**	**100**	**200**	**500**
Rideau	HB2Split	11550	369.0	475.0	529.0	572.0	617.0	644.0	667.0	691.0
Rideau	West RF2Split	396	102.6	149.0	173.0	192.3	211.7	223.2	232.8	242.5
Rideau	East RF2Split	444	266.4	326.0	356.0	379.7	405.3	420.8	434.2	448.5

Table 9 Observed and computed water level during April 2014 flood event

	nearest cross section	April 11 2014 8:00 to 8:40 am Q=424 cms obs WL (m)	HEC-RAS Q=424 cms model WL (m)	WL difference (model-obs) (cm)	April 15 2014 7:25 to 7:45 pm Q=449 cms obs WL (m)	HEC-RAS Q=449 cms model WL (m)	WL difference (model-obs) (cm)
Carleton U Gauge (recorded)	x-10168	59.811	59.68	-13	59.887	59.80	-9
Leonard Avenue	x-8802	58.1425	58.32	18	58.2425	58.43	19
Rideau River Lane	x-8492	58.136	58.28	14	58.206	58.39	18
Warrington Drive at Wendover Ave	x-8450	58.179	58.27	9	58.249	58.39	14
Bank Street Bridge (upstream)	x-8189	57.88	58.03	15	57.96	58.14	18
Rideau River Drive (Belmont/Fentiman)	x-7327	57.7993	57.83	3	57.8755	57.93	5
Smyth Road Bridge (upstream)	x-6920	57.7825	57.76	-2	57.8525	57.86	1
Onslow Crescent at Glengarry Ave	x-6159	57.599	57.52	-8	57.669	57.62	-5
average WL difference				*5*			*8*

Table 10 Observed and computed water levels at the intersection of Rideau River Drive and Belmont Avenue

Year	Date of Observed Peak WL	Observed WL (m,amsl)	Flow during WL Observation (cms)	Simulated WL (m,amsl)	WL difference (obs. - sim.) (cm)	Ice Free Date
ICE FREE condition						
1971	Apr 15 - 19	58.09	496	58.13	-4	
1977	Mar 14	57.99	416	57.79	20	Mar 13
1978	Apr 14	58.12	487	58.09	3	Apr 5
1979	Mar 25	57.74	403	57.74	0	Mar 15
1982	Apr 1	57.79	397	57.71	8	Mar 30
1984	Apr 6	57.65	385	57.66	-1	Mar 28
1985	Mar 14	57.18	253	57.03	15	Mar 14
1987	Mar 26	57.53	334	57.42	11	Mar 24
1989	Mar 29	57.24	251	57.01	23	Mar 29
1993	Apr 11, 12	58.07	508	58.17	-10	Apr 6
1994	Apr 14	57.41	331	57.41	0	Apr 6
1997	Apr 7	57.84	441	57.9	-6	Mar 12
1998	Apr 2	57.90	449	57.93	-3	Mar 8
1999	Apr 8	57.83	436	57.88	-5	Mar 21
2001	Apr 10	57.53	356	57.53	0	Mar 29
2007	Apr 18	57.08	259	57.06	2	Mar 28
ICE IN RIVER condition						
1973	Mar 13	58.09	331	57.41	68	Mar 15
1976	Mar 28	58.77	583	58.45	32	Mar 29
1980	Mar 21	58.37	385	57.66	71	Mar 23
1981	Feb 21	58.51	356	57.53	98	Feb 22
1988	Mar 27	57.15	247	56.99	16	Mar 28
1992	Mar 28	57.39	181	56.65	74	Apr 3
1995	Jan 21	57.25	263	57.08	17	Mar 17
1996	Feb 25	57.57	230	56.92	65	Mar 2
2000	Feb 28	57.10	144	56.42	68	Mar 4

Table 11: Regulatory Flood Levels for 1:100 Year Flood Event

River	Reach	Xsec ID #	Q Total (m^3/s)	Computed WSEL (m)	EGL (m)	RFL (m)
Rideau River	West RF2Split	30	223.2	53.94	54.76	-
	West RF2Split	34	Rideau Falls Dam (West)			
	West RF2Split	37	223.2	54.14	54.80	54.80
	West RF2Split	48	223.2	54.62	54.85	54.85
	West RF2Split	67	223.2	54.70	54.88	54.88
	West RF2Split	75	223.2	54.73	54.89	54.89
	West RF2Split	125	223.2	54.84	54.94	54.94
	West RF2Split	135	Sussex Drive (West)			
	West RF2Split	145	223.2	54.88	54.96	54.96
	West RF2Split	190	223.2	54.81	55.07	55.07
	West RF2Split	355	223.2	55.12	55.36	55.36
	West RF2Split	385	223.2	55.29	55.42	55.42
	West RF2Split	390.5	Minto Bridge (West)			
	West RF2Split	396	223.2	55.29	55.43	55.43
	East RF2Split	31	420.8	53.38	54.14	-
	East RF2Split	41	420.8	53.63	54.41	-
	East RF2Split	43	Rideau Falls Dam (East)			
	East RF2Split	49	420.8	54.68	54.96	54.96
	East RF2Split	58	420.8	54.71	54.97	54.97
	East RF2Split	76	420.8	54.70	55.02	55.02
	East RF2Split	86	420.8	54.74	55.04	55.04
	East RF2Split	114	420.8	54.75	55.10	55.10
	East RF2Split	124	Sussex Drive (East)			
	East RF2Split	134	420.8	54.82	55.15	55.15
	East RF2Split	175	420.8	55.10	55.24	55.24
	East RF2Split	343	420.8	55.25	55.34	55.34
	East RF2Split	387	420.8	55.25	55.39	55.39
	East RF2Split	391.5	Minto Bridge (East)			
	East RF2Split	396	420.8	55.25	55.39	55.39
	East RF2Split	444	420.8	55.34	55.43	55.43
	HB2Split	506	644	55.40	55.46	55.46
	HB2Split	599	644	55.39	55.49	55.49
	HB2Split	632	644	55.38	55.51	55.51
	HB2Split	659	644	55.44	55.53	55.53
	HB2Split	846	644	55.52	55.59	55.59
	HB2Split	973	644	55.51	55.68	55.68
	HB2Split	1142	644	55.63	55.85	55.85
	HB2Split	1220	644	55.73	55.94	55.94
	HB2Split	1351	644	55.87	56.08	56.08
	HB2Split	1399	644	55.96	56.12	56.12

River	Reach	Xsec ID #	Q Total (m^3/s)	Computed WSEL (m)	EGL (m)	RFL (m)
Rideau River	HB2Split	1404.5	Island Lodge Road			
	HB2Split	1410	644	55.99	56.14	56.14
	HB2Split	1511	644	56.07	56.18	56.18
	HB2Split	1513	Porter Island South (Pedestrian)			
	HB2Split	1515	644	56.08	56.19	56.19
	HB2Split	1525	644	56.03	56.21	56.21
	HB2Split	1625	644	56.13	56.27	56.27
	HB2Split	1690	644	56.22	56.29	56.29
	HB2Split	1705	St Patrick Street			
	HB2Split	1720	644	56.22	56.30	56.30
	HB2Split	1801	644	56.23	56.33	56.33
	HB2Split	1953	644	56.27	56.36	56.36
	HB2Split	2135	644	56.31	56.40	56.40
	HB2Split	2317	644	56.37	56.44	56.44
	HB2Split	2377	644	56.37	56.47	56.47
	HB2Split	2474	644	56.42	56.53	56.53
	HB2Split	2482	Cummings Bridge			
	HB2Split	2489	644	56.49	56.59	56.59
	HB2Split	2512	644	56.52	56.60	56.60
	HB2Split	2662	644	56.58	56.64	56.64
	HB2Split	2809	644	56.62	56.73	56.73
	HB2Split	2928	644	56.71	56.78	56.78
	HB2Split	3129	644	56.72	56.82	56.82
	HB2Split	3175	644	56.67	56.86	56.86
	HB2Split	3352	644	56.81	57.03	57.03
	HB2Split	3520	644	56.92	57.17	57.17
	HB2Split	3690	644	57.10	57.28	57.28
	HB2Split	3801	644	57.11	57.37	57.37
	HB2Split	3909	644	57.29	57.44	57.44
	HB2Split	4019	644	57.35	57.49	57.49
	HB2Split	4178	644	57.40	57.64	57.64
	HB2Split	4327	644	57.62	57.76	57.76
	HB2Split	4399	644	57.64	57.80	57.80
	HB2Split	4406	644	57.65	57.80	57.80
	HB2Split	4434	644	57.65	57.83	57.83
	HB2Split	4449	Hurdman Bridge (Highway 417)			
	HB2Split	4464	644	57.73	57.89	57.89
	HB2Split	4470	644	57.73	57.89	57.89
	HB2Split	4516	644	57.81	57.93	57.93
	HB2Split	4521	644	57.83	57.94	57.94
	HB2Split	4522.5	Pedestrian Bridge U/S of 417			

River	Reach	Xsec ID #	Q Total (m^3/s)	Computed WSEL (m)	EGL (m)	RFL (m)
Rideau River	HB2Split	4524	644	57.86	57.96	57.96
	HB2Split	4690	644	57.88	58.04	58.04
	HB2Split	4857	644	58.03	58.13	58.13
	HB2Split	5037	644	58.10	58.17	58.17
	HB2Split	5044.5	Transitway bridge U/S of 417			
	HB2Split	5052	644	58.10	58.17	58.17
	HB2Split	5152	644	58.14	58.19	58.19
	HB2Split	5240	644	58.15	58.22	58.22
	HB2Split	5396	644	58.19	58.26	58.26
	HB2Split	5555	644	58.22	58.28	58.28
	HB2Split	5712	644	58.24	58.30	58.30
	HB2Split	5924	644	58.30	58.34	58.34
	HB2Split	6068	644	58.32	58.37	58.37
	HB2Split	6159	644	58.32	58.43	58.43
	HB2Split	6257	644	58.42	58.49	58.49
	HB2Split	6310	644	58.44	58.51	58.51
	HB2Split	6418	644	58.50	58.55	58.55
	HB2Split	6620	644	58.54	58.58	58.58
	HB2Split	6787	644	58.56	58.61	58.61
	HB2Split	6899	644	58.58	58.64	58.64
	HB2Split	6909.5	McIlrain Bridge (Smyth Road)			
	HB2Split	6920	644	58.58	58.64	58.64
	HB2Split	6971	644	58.59	58.65	58.65
	HB2Split	7168	644	58.64	58.70	58.70
	HB2Split	7327	644	58.68	58.73	58.73
	HB2Split	7424	644	58.70	58.75	58.75
	HB2Split	7576	644	58.73	58.78	58.78
	HB2Split	7670	644	58.74	58.80	58.80
	HB2Split	7776	644	58.77	58.82	58.82
	HB2Split	7891	644	58.79	58.84	58.84
	HB2Split	7994	644	58.80	58.89	58.89
	HB2Split	8101	644	58.86	58.96	58.96
	HB2Split	8171	644	58.87	59.07	59.07
	HB2Split	8180	Billings Bridge (Bank Street)			
	HB2Split	8189	644	58.91	59.10	59.10
	HB2Split	8250	644	59.05	59.16	59.16
	HB2Split	8355	644	59.16	59.22	59.22
	HB2Split	8450	644	59.23	59.25	59.25
	HB2Split	8492	644	59.24	59.26	59.26
	HB2Split	8572	644	59.25	59.27	59.27
	HB2Split	8610	644	59.25	59.28	59.28

River	Reach	Xsec ID #	Q Total (m^3/s)	Computed WSEL (m)	EGL (m)	RFL (m)
Rideau River	HB2Split	8707	644	59.26	59.28	59.28
	HB2Split	8802	644	59.28	59.30	59.30
	HB2Split	8985	644	59.30	59.30	59.30
	HB2Split	9077	644	59.30	59.31	59.31
	HB2Split	9207	644	59.30	59.31	59.31
	HB2Split	9313	644	59.30	59.33	59.33
	HB2Split	9413	644	59.32	59.34	59.34
	HB2Split	9493	644	59.30	59.36	59.36
	HB2Split	9503	Dunbar Bridge (Bronson Avenue)			
	HB2Split	9513	644	59.35	59.39	59.39
	HB2Split	9527	644	59.36	59.39	59.39
	HB2Split	9582	644	59.36	59.42	59.42
	HB2Split	9706	644	59.44	59.48	59.48
	HB2Split	10006	644	59.48	59.80	59.80
	HB2Split	10009	O-Train Bridge			
	HB2Split	10011	644	59.56	59.84	59.84
	HB2Split	10105	644	60.08	60.45	60.45
	HB2Split	10168	644	60.59	60.75	60.75
	HB2Split	10372	644	61.02	61.26	61.26
	HB2Split	10517	644	61.30	61.57	61.57
	HB2Split	10720	644	61.74	61.92	61.92
	HB2Split	10834	644	61.76	62.25	62.25
	HB2Split	10856	Heron Bridge (North and South)			
	HB2Split	10878	644	62.09	62.48	62.48
	HB2Split	10942	644	62.34	62.75	62.75
	HB2Split	11072	644	63.02	63.23	63.23
	HB2Split	11242	644	63.35	64.25	64.25
	HB2Split	11411	644	66.31	66.70	66.70
	HB2Split	11507	644	71.26	72.73	72.73
	HB2Split	11550	644	73.21	73.53	73.53
			Hog's Back Road			

NOTE:

RFL - Regulatory Flood Levels

EGL - Energy Grade Elevation

WSEL - Water Surface Elevation

Table 12: Flow and Computed Water Level for 50-Year to 500-Year Flood Events

River	Reach	Xsec ID #	Flow (m^3/s) and Computed WSEL (m) for Different Flood Events							
			Q500	WL500	Q200	WL200	Q100	WL100	Q50	WL50
Rideau River	West RF2Split	30	243	54.04	232.8	53.99	223.2	53.94	211.7	53.89
	West RF2Split	34	Rideau Falls Dam (West)							
	West RF2Split	37	243	54.24	232.8	54.19	223.2	54.14	211.7	54.07
	West RF2Split	48	243	54.75	232.8	54.68	223.2	54.62	211.7	54.54
	West RF2Split	67	243	54.83	232.8	54.76	223.2	54.70	211.7	54.62
	West RF2Split	75	243	54.87	232.8	54.80	223.2	54.73	211.7	54.65
	West RF2Split	125	243	54.98	232.8	54.91	223.2	54.84	211.7	54.76
	West RF2Split	135	Sussex Drive (West)							
	West RF2Split	145	243	55.02	232.8	54.95	223.2	54.88	211.7	54.80
	West RF2Split	190	243	54.96	232.8	54.89	223.2	54.81	211.7	54.72
	West RF2Split	355	243	55.23	232.8	55.17	223.2	55.12	211.7	55.06
	West RF2Split	385	243	55.39	232.8	55.34	223.2	55.29	211.7	55.23
	West RF2Split	390.5	Minto Bridge (West)							
	West RF2Split	396	243	55.40	232.8	55.35	223.2	55.29	211.7	55.23
	East RF2Split	31	449	53.44	434.2	53.41	420.8	53.38	405.3	53.34
	East RF2Split	41	449	53.70	434.2	53.66	420.8	53.63	405.3	53.59
	East RF2Split	43	Rideau Falls Dam (East)							
	East RF2Split	49	449	54.79	434.2	54.73	420.8	54.68	405.3	54.61
	East RF2Split	58	449	54.82	434.2	54.76	420.8	54.71	405.3	54.64
	East RF2Split	76	449	54.81	434.2	54.75	420.8	54.70	405.3	54.63
	East RF2Split	86	449	54.86	434.2	54.80	420.8	54.74	405.3	54.68
	East RF2Split	114	449	54.87	434.2	54.81	420.8	54.75	405.3	54.69
	East RF2Split	124	Sussex Drive (East)							
	East RF2Split	134	449	54.93	434.2	54.87	420.8	54.82	405.3	54.75
	East RF2Split	175	449	55.22	434.2	55.16	420.8	55.10	405.3	55.03
	East RF2Split	343	449	55.36	434.2	55.30	420.8	55.25	405.3	55.18
	East RF2Split	387	449	55.36	434.2	55.30	420.8	55.25	405.3	55.18
	East RF2Split	391.5	Minto Bridge (East)							
	East RF2Split	396	449	55.37	434.2	55.31	420.8	55.25	405.3	55.19
	East RF2Split	444	449	55.46	434.2	55.40	420.8	55.34	405.3	55.27
	HB2Split	506	691	55.52	667	55.46	644	55.40	617	55.33
	HB2Split	599	691	55.51	667	55.45	644	55.39	617	55.33
	HB2Split	632	691	55.50	667	55.44	644	55.38	617	55.32
	HB2Split	659	691	55.56	667	55.50	644	55.44	617	55.37
	HB2Split	846	691	55.64	667	55.58	644	55.52	617	55.45
	HB2Split	973	691	55.63	667	55.57	644	55.51	617	55.44
	HB2Split	1142	691	55.76	667	55.69	644	55.63	617	55.57
	HB2Split	1220	691	55.85	667	55.79	644	55.73	617	55.66
	HB2Split	1351	691	55.98	667	55.92	644	55.87	617	55.80
	HB2Split	1399	691	56.08	667	56.02	644	55.96	617	55.90

River	Reach	Xsec ID #	Flow (m^3/s) and Computed WSEL (m) for Different Flood Events							
			Q500	WL500	Q200	WL200	Q100	WL100	Q50	WL50
Rideau River	HB2Split	1404.5	Island Lodge Road							
	HB2Split	1410	691	56.10	667	56.04	644	55.99	617	55.92
	HB2Split	1511	691	56.19	667	56.13	644	56.07	617	56.01
	HB2Split	1513	Porter Island South (Pedestrian)							
	HB2Split	1515	691	56.19	667	56.13	644	56.08	617	56.01
	HB2Split	1525	691	56.14	667	56.08	644	56.03	617	55.96
	HB2Split	1625	691	56.25	667	56.19	644	56.13	617	56.06
	HB2Split	1690	691	56.34	667	56.27	644	56.22	617	56.15
	HB2Split	1705	St Patrick Street							
	HB2Split	1720	691	56.34	667	56.28	644	56.22	617	56.15
	HB2Split	1801	691	56.35	667	56.29	644	56.23	617	56.16
	HB2Split	1953	691	56.39	667	56.33	644	56.27	617	56.20
	HB2Split	2135	691	56.43	667	56.37	644	56.31	617	56.24
	HB2Split	2317	691	56.50	667	56.43	644	56.37	617	56.30
	HB2Split	2377	691	56.50	667	56.43	644	56.37	617	56.30
	HB2Split	2474	691	56.55	667	56.48	644	56.42	617	56.35
	HB2Split	2482	Cummings Bridge							
	HB2Split	2489	691	56.62	667	56.55	644	56.49	617	56.41
	HB2Split	2512	691	56.66	667	56.58	644	56.52	617	56.44
	HB2Split	2662	691	56.72	667	56.65	644	56.58	617	56.50
	HB2Split	2809	691	56.76	667	56.69	644	56.62	617	56.54
	HB2Split	2928	691	56.85	667	56.78	644	56.71	617	56.63
	HB2Split	3129	691	56.86	667	56.79	644	56.72	617	56.64
	HB2Split	3175	691	56.81	667	56.74	644	56.67	617	56.59
	HB2Split	3352	691	56.95	667	56.88	644	56.81	617	56.74
	HB2Split	3520	691	57.05	667	56.99	644	56.92	617	56.85
	HB2Split	3690	691	57.23	667	57.17	644	57.10	617	57.03
	HB2Split	3801	691	57.24	667	57.18	644	57.11	617	57.04
	HB2Split	3909	691	57.43	667	57.36	644	57.29	617	57.21
	HB2Split	4019	691	57.49	667	57.42	644	57.35	617	57.27
	HB2Split	4178	691	57.54	667	57.47	644	57.40	617	57.32
	HB2Split	4327	691	57.76	667	57.69	644	57.62	617	57.54
	HB2Split	4399	691	57.78	667	57.71	644	57.64	617	57.56
	HB2Split	4406	691	57.78	667	57.72	644	57.65	617	57.57
	HB2Split	4434	691	57.78	667	57.71	644	57.65	617	57.57
	HB2Split	4449	Hurdman Bridge (Highway 417)							
	HB2Split	4464	691	57.86	667	57.79	644	57.73	617	57.65
	HB2Split	4470	691	57.86	667	57.79	644	57.73	617	57.65
	HB2Split	4516	691	57.95	667	57.88	644	57.81	617	57.74
	HB2Split	4521	691	57.96	667	57.90	644	57.83	617	57.75
	HB2Split	4522.5	Pedestrian Bridge U/S of 417							
	HB2Split	4524	691	57.99	667	57.92	644	57.86	617	57.78

River	Reach	Xsec ID #	Flow (m^3/s) and Computed WSEL (m) for Different Flood Events							
			Q500	WL500	Q200	WL200	Q100	WL100	Q50	WL50
Rideau River	HB2Split	4690	691	58.01	667	57.95	644	57.88	617	57.80
	HB2Split	4857	691	58.17	667	58.10	644	58.03	617	57.95
	HB2Split	5037	691	58.24	667	58.17	644	58.10	617	58.01
	HB2Split	5044.5	Transitway bridge U/S of 417							
	HB2Split	5052	691	58.24	667	58.17	644	58.10	617	58.02
	HB2Split	5152	691	58.28	667	58.21	644	58.14	617	58.05
	HB2Split	5240	691	58.29	667	58.22	644	58.15	617	58.06
	HB2Split	5396	691	58.34	667	58.26	644	58.19	617	58.10
	HB2Split	5555	691	58.37	667	58.29	644	58.22	617	58.13
	HB2Split	5712	691	58.39	667	58.32	644	58.24	617	58.15
	HB2Split	5924	691	58.45	667	58.37	644	58.30	617	58.20
	HB2Split	6068	691	58.48	667	58.40	644	58.32	617	58.23
	HB2Split	6159	691	58.48	667	58.40	644	58.32	617	58.23
	HB2Split	6257	691	58.58	667	58.49	644	58.42	617	58.33
	HB2Split	6310	691	58.60	667	58.51	644	58.44	617	58.35
	HB2Split	6418	691	58.65	667	58.57	644	58.50	617	58.40
	HB2Split	6620	691	58.69	667	58.61	644	58.54	617	58.44
	HB2Split	6787	691	58.72	667	58.64	644	58.56	617	58.46
	HB2Split	6899	691	58.74	667	58.66	644	58.58	617	58.48
	HB2Split	6909.5	McIlrain Bridge (Smyth Road)							
	HB2Split	6920	691	58.74	667	58.66	644	58.58	617	58.48
	HB2Split	6971	691	58.75	667	58.67	644	58.59	617	58.49
	HB2Split	7168	691	58.81	667	58.72	644	58.64	617	58.54
	HB2Split	7327	691	58.84	667	58.76	644	58.68	617	58.58
	HB2Split	7424	691	58.87	667	58.79	644	58.70	617	58.60
	HB2Split	7576	691	58.90	667	58.82	644	58.73	617	58.63
	HB2Split	7670	691	58.91	667	58.83	644	58.74	617	58.64
	HB2Split	7776	691	58.94	667	58.86	644	58.77	617	58.67
	HB2Split	7891	691	58.96	667	58.88	644	58.79	617	58.69
	HB2Split	7994	691	58.97	667	58.89	644	58.80	617	58.70
	HB2Split	8101	691	59.03	667	58.95	644	58.86	617	58.76
	HB2Split	8171	691	59.04	667	58.95	644	58.87	617	58.77
	HB2Split	8180	Billings Bridge (Bank Street)							
	HB2Split	8189	691	59.47	667	58.99	644	58.91	617	58.81
	HB2Split	8250	691	59.60	667	59.14	644	59.05	617	58.95
	HB2Split	8355	691	59.69	667	59.25	644	59.16	617	59.05
	HB2Split	8450	691	59.75	667	59.32	644	59.23	617	59.12
	HB2Split	8492	691	59.76	667	59.33	644	59.24	617	59.13
	HB2Split	8572	691	59.76	667	59.34	644	59.25	617	59.14
	HB2Split	8610	691	59.77	667	59.34	644	59.25	617	59.14
	HB2Split	8707	691	59.77	667	59.35	644	59.26	617	59.15

River	Reach	Xsec ID #	Flow (m^3/s) and Computed WSEL (m) for Different Flood Events							
			Q500	WL500	Q200	WL200	Q100	WL100	Q50	WL50
Rideau River	HB2Split	8802	691	59.79	667	59.37	644	59.28	617	59.17
	HB2Split	8985	691	59.80	667	59.39	644	59.30	617	59.18
	HB2Split	9077	691	59.80	667	59.39	644	59.30	617	59.18
	HB2Split	9207	691	59.80	667	59.39	644	59.30	617	59.19
	HB2Split	9313	691	59.81	667	59.39	644	59.30	617	59.19
	HB2Split	9413	691	59.82	667	59.41	644	59.32	617	59.21
	HB2Split	9493	691	59.80	667	59.39	644	59.30	617	59.19
	HB2Split	9503	Dunbar Bridge (Bronson Avenue)							
	HB2Split	9513	691	59.84	667	59.44	644	59.35	617	59.23
	HB2Split	9527	691	59.85	667	59.45	644	59.36	617	59.24
	HB2Split	9582	691	59.85	667	59.45	644	59.36	617	59.24
	HB2Split	9706	691	59.92	667	59.53	644	59.44	617	59.33
	HB2Split	10006	691	59.91	667	59.57	644	59.48	617	59.38
	HB2Split	10008.5	O-Train Bridge							
	HB2Split	10011	691	59.97	667	59.64	644	59.56	617	59.45
	HB2Split	10105	691	60.40	667	60.16	644	60.08	617	59.98
	HB2Split	10168	691	60.87	667	60.68	644	60.59	617	60.49
	HB2Split	10372	691	61.25	667	61.10	644	61.02	617	60.92
	HB2Split	10517	691	61.52	667	61.39	644	61.30	617	61.20
	HB2Split	10720	691	61.95	667	61.83	644	61.74	617	61.64
	HB2Split	10834	691	61.95	667	61.84	644	61.76	617	61.66
	HB2Split	10856	Heron Bridge (North and South)							
	HB2Split	10878	691	62.30	667	62.18	644	62.09	617	61.99
	HB2Split	10942	691	62.54	667	62.43	644	62.34	617	62.23
	HB2Split	11072	691	63.21	667	63.11	644	63.02	617	62.91
	HB2Split	11242	691	63.55	667	63.45	644	63.35	617	63.24
	HB2Split	11411	691	66.38	667	66.35	644	66.31	617	66.28
	HB2Split	11507	691	71.42	667	71.34	644	71.26	617	71.18
	HB2Split	11550	691	73.40	667	73.30	644	73.21	617	73.10
			Hog's Back Road							

NOTE:

WSEL - Water Surface Elevation

Q500 - Flow rate of a 500 year flood event

WL500 - Water Surface Elevation of 500 year flood event

Q200 - Flow rate of a 200 year flood event

WL200 - Water Surface Elevation of 200 year flood event

Q100 - Flow rate of a 100 year flood event

WL100 - Water Surface Elevation of 100 year flood event

Q50 - Flow rate of a 50 year flood event

WL50 - Water Surface Elevation of 50 year flood event

Table 13: Flow and Computed Water Level for 2-Year to 20-Year Flood Events

River	Reach	Xsec ID #	Flow (m^3/s) and Computed WSEL (m) for Different Flood Events							
			Q20	WL20	Q10	WL10	Q5	WL5	Q2	WL2
Rideau River	West RF2Split	30	192.3	53.79	173	53.69	149	53.55	102.6	53.28
	West RF2Split	34	Rideau Falls Dam (West)							
	West RF2Split	37	192.3	53.96	173	53.85	149	53.71	102.6	53.40
	West RF2Split	48	192.3	54.40	173	54.27	149	54.08	102.6	53.70
	West RF2Split	67	192.3	54.47	173	54.33	149	54.14	102.6	53.74
	West RF2Split	75	192.3	54.50	173	54.36	149	54.17	102.6	53.77
	West RF2Split	125	192.3	54.61	173	54.46	149	54.26	102.6	53.84
	West RF2Split	135	Sussex Drive (West)							
	West RF2Split	145	192.3	54.65	173	54.49	149	54.29	102.6	53.87
	West RF2Split	190	192.3	54.57	173	54.41	149	54.19	102.6	53.85
	West RF2Split	355	192.3	54.96	173	54.87	149	54.77	102.6	54.57
	West RF2Split	385	192.3	55.13	173	55.03	149	54.91	102.6	54.67
	West RF2Split	390.5	Minto Bridge (West)							
	West RF2Split	396	192.3	55.13	173	55.03	149	54.92	102.6	54.67
	East RF2Split	31	379.7	53.27	356	53.22	326	53.14	266.4	52.97
	East RF2Split	41	379.7	53.53	356	53.46	326	53.38	266.4	53.21
	East RF2Split	43	Rideau Falls Dam (East)							
	East RF2Split	49	379.7	54.51	356	54.40	326	54.27	266.4	53.99
	East RF2Split	58	379.7	54.53	356	54.43	326	54.29	266.4	54.01
	East RF2Split	76	379.7	54.53	356	54.42	326	54.29	266.4	54.01
	East RF2Split	86	379.7	54.57	356	54.46	326	54.33	266.4	54.04
	East RF2Split	114	379.7	54.58	356	54.47	326	54.34	266.4	54.06
	East RF2Split	124	Sussex Drive (East)							
	East RF2Split	134	379.7	54.64	356	54.54	326	54.40	266.4	54.13
	East RF2Split	175	379.7	54.91	356	54.80	326	54.66	266.4	54.37
	East RF2Split	343	379.7	55.07	356	54.96	326	54.83	266.4	54.56
	East RF2Split	387	379.7	55.07	356	54.97	326	54.84	266.4	54.58
	East RF2Split	391.5	Minto Bridge (East)							
	East RF2Split	396	379.7	55.08	356	54.97	326	54.84	266.4	54.58
	East RF2Split	444	379.7	55.16	356	55.05	326	54.92	266.4	54.65
	HB2Split	506	572	55.22	529	55.12	475	54.99	369	54.72
	HB2Split	599	572	55.22	529	55.12	475	54.99	369	54.72
	HB2Split	632	572	55.21	529	55.11	475	54.98	369	54.72
	HB2Split	659	572	55.26	529	55.16	475	55.03	369	54.76
	HB2Split	846	572	55.34	529	55.23	475	55.09	369	54.80
	HB2Split	973	572	55.33	529	55.22	475	55.09	369	54.80
	HB2Split	1142	572	55.45	529	55.34	475	55.20	369	54.91
	HB2Split	1220	572	55.55	529	55.44	475	55.31	369	55.03
	HB2Split	1351	572	55.70	529	55.60	475	55.47	369	55.21
	HB2Split	1399	572	55.80	529	55.69	475	55.56	369	55.29
	HB2Split	1404.5	Island Lodge Road							

River	Reach	Xsec ID #	Flow (m^3/s) and Computed WSEL (m) for Different Flood Events							
			Q20	WL20	Q10	WL10	Q5	WL5	Q2	WL2
Rideau River	HB2Split	1410	572	55.82	529	55.71	475	55.58	369	55.30
	HB2Split	1511	572	55.89	529	55.79	475	55.65	369	55.36
	HB2Split	1513	Porter Island South (Pedestrian)							
	HB2Split	1515	572	55.90	529	55.79	475	55.65	369	55.36
	HB2Split	1525	572	55.85	529	55.75	475	55.61	369	55.33
	HB2Split	1625	572	55.95	529	55.84	475	55.70	369	55.40
	HB2Split	1690	572	56.03	529	55.92	475	55.77	369	55.46
	HB2Split	1705	St Patrick Street							
	HB2Split	1720	572	56.03	529	55.92	475	55.77	369	55.47
	HB2Split	1801	572	56.04	529	55.93	475	55.78	369	55.48
	HB2Split	1953	572	56.08	529	55.97	475	55.82	369	55.50
	HB2Split	2135	572	56.12	529	56.00	475	55.85	369	55.53
	HB2Split	2317	572	56.17	529	56.05	475	55.90	369	55.57
	HB2Split	2377	572	56.18	529	56.06	475	55.90	369	55.57
	HB2Split	2474	572	56.22	529	56.10	475	55.94	369	55.61
	HB2Split	2482	Cummings Bridge							
	HB2Split	2489	572	56.28	529	56.15	475	55.98	369	55.64
	HB2Split	2512	572	56.30	529	56.17	475	56.00	369	55.66
	HB2Split	2662	572	56.36	529	56.23	475	56.06	369	55.70
	HB2Split	2809	572	56.40	529	56.27	475	56.10	369	55.74
	HB2Split	2928	572	56.49	529	56.36	475	56.18	369	55.82
	HB2Split	3129	572	56.50	529	56.37	475	56.20	369	55.84
	HB2Split	3175	572	56.46	529	56.33	475	56.16	369	55.80
	HB2Split	3352	572	56.60	529	56.48	475	56.31	369	55.97
	HB2Split	3520	572	56.72	529	56.60	475	56.44	369	56.10
	HB2Split	3690	572	56.90	529	56.77	475	56.61	369	56.26
	HB2Split	3801	572	56.91	529	56.79	475	56.62	369	56.28
	HB2Split	3909	572	57.07	529	56.93	475	56.76	369	56.39
	HB2Split	4019	572	57.13	529	57.00	475	56.82	369	56.46
	HB2Split	4178	572	57.19	529	57.06	475	56.89	369	56.54
	HB2Split	4327	572	57.41	529	57.27	475	57.10	369	56.74
	HB2Split	4399	572	57.43	529	57.30	475	57.13	369	56.77
	HB2Split	4406	572	57.43	529	57.30	475	57.13	369	56.77
	HB2Split	4434	572	57.43	529	57.30	475	57.13	369	56.77
	HB2Split	4449	Hurdman Bridge (Highway 417)							
	HB2Split	4464	572	57.51	529	57.38	475	57.21	369	56.86
	HB2Split	4470	572	57.51	529	57.38	475	57.21	369	56.86
	HB2Split	4516	572	57.60	529	57.47	475	57.30	369	56.95
	HB2Split	4521	572	57.62	529	57.48	475	57.32	369	56.97
	HB2Split	4522.5	Pedestrian Bridge U/S of 417							
	HB2Split	4524	572	57.64	529	57.51	475	57.34	369	56.98
	HB2Split	4690	572	57.67	529	57.54	475	57.37	369	57.03
	HB2Split	4857	572	57.81	529	57.68	475	57.50	369	57.14

River	Reach	Xsec ID #	Flow (m^3/s) and Computed WSEL (m) for Different Flood Events							
			Q20	WL20	Q10	WL10	Q5	WL5	Q2	WL2
Rideau River	HB2Split	5037	572	57.87	529	57.74	475	57.56	369	57.18
	HB2Split	5044.5	Transitway bridge U/S of 417							
	HB2Split	5052	572	57.87	529	57.74	475	57.56	369	57.18
	HB2Split	5152	572	57.91	529	57.77	475	57.58	369	57.20
	HB2Split	5240	572	57.92	529	57.78	475	57.59	369	57.20
	HB2Split	5396	572	57.95	529	57.81	475	57.62	369	57.23
	HB2Split	5555	572	57.98	529	57.84	475	57.65	369	57.25
	HB2Split	5712	572	58.00	529	57.85	475	57.66	369	57.26
	HB2Split	5924	572	58.05	529	57.90	475	57.70	369	57.29
	HB2Split	6068	572	58.07	529	57.92	475	57.72	369	57.30
	HB2Split	6159	572	58.07	529	57.92	475	57.72	369	57.30
	HB2Split	6257	572	58.17	529	58.02	475	57.81	369	57.39
	HB2Split	6310	572	58.19	529	58.04	475	57.84	369	57.41
	HB2Split	6418	572	58.25	529	58.09	475	57.89	369	57.47
	HB2Split	6620	572	58.28	529	58.13	475	57.92	369	57.49
	HB2Split	6787	572	58.31	529	58.15	475	57.94	369	57.51
	HB2Split	6899	572	58.32	529	58.16	475	57.96	369	57.52
	HB2Split	6909.5	McIlrain Bridge (Smyth Road)							
	HB2Split	6920	572	58.32	529	58.17	475	57.96	369	57.52
	HB2Split	6971	572	58.33	529	58.18	475	57.97	369	57.53
	HB2Split	7168	572	58.38	529	58.22	475	58.01	369	57.56
	HB2Split	7327	572	58.41	529	58.25	475	58.04	369	57.59
	HB2Split	7424	572	58.44	529	58.27	475	58.06	369	57.60
	HB2Split	7576	572	58.46	529	58.29	475	58.08	369	57.62
	HB2Split	7670	572	58.47	529	58.31	475	58.09	369	57.62
	HB2Split	7776	572	58.50	529	58.33	475	58.11	369	57.64
	HB2Split	7891	572	58.52	529	58.35	475	58.13	369	57.66
	HB2Split	7994	572	58.53	529	58.36	475	58.14	369	57.67
	HB2Split	8101	572	58.59	529	58.42	475	58.19	369	57.72
	HB2Split	8171	572	58.60	529	58.44	475	58.22	369	57.75
	HB2Split	8180	Billings Bridge (Bank Street)							
	HB2Split	8189	572	58.64	529	58.47	475	58.25	369	57.78
	HB2Split	8250	572	58.77	529	58.59	475	58.37	369	57.88
	HB2Split	8355	572	58.87	529	58.69	475	58.45	369	57.95
	HB2Split	8450	572	58.93	529	58.75	475	58.51	369	58.00
	HB2Split	8492	572	58.94	529	58.76	475	58.51	369	58.01
	HB2Split	8572	572	58.95	529	58.77	475	58.53	369	58.02
	HB2Split	8610	572	58.95	529	58.77	475	58.53	369	58.02
	HB2Split	8707	572	58.96	529	58.78	475	58.54	369	58.03
	HB2Split	8802	572	58.98	529	58.80	475	58.55	369	58.04
	HB2Split	8985	572	59.00	529	58.81	475	58.57	369	58.05
	HB2Split	9077	572	59.00	529	58.81	475	58.57	369	58.05

River	Reach	Xsec ID #	Flow (m^3/s) and Computed WSEL (m) for Different Flood Events							
			Q20	WL20	Q10	WL10	Q5	WL5	Q2	WL2
Rideau River	HB2Split	9207	572	59.00	529	58.81	475	58.57	369	58.06
	HB2Split	9313	572	59.00	529	58.82	475	58.58	369	58.06
	HB2Split	9413	572	59.02	529	58.84	475	58.59	369	58.08
	HB2Split	9493	572	59.00	529	58.82	475	58.57	369	58.06
	HB2Split	9503	Dunbar Bridge (Bronson Avenue)							
	HB2Split	9513	572	59.05	529	58.86	475	58.62	369	58.10
	HB2Split	9527	572	59.06	529	58.87	475	58.63	369	58.11
	HB2Split	9582	572	59.06	529	58.87	475	58.63	369	58.11
	HB2Split	9706	572	59.14	529	58.95	475	58.71	369	58.19
	HB2Split	10006	572	59.22	529	59.06	475	58.85	369	58.40
	HB2Split	10009	O-Train Bridge							
	HB2Split	10011	572	59.28	529	59.12	475	58.90	369	58.44
	HB2Split	10105	572	59.81	529	59.65	475	59.44	369	58.98
	HB2Split	10168	572	60.31	529	60.14	475	59.91	369	59.43
	HB2Split	10372	572	60.75	529	60.58	475	60.37	369	59.92
	HB2Split	10517	572	61.04	529	60.87	475	60.66	369	60.20
	HB2Split	10720	572	61.47	529	61.29	475	61.07	369	60.59
	HB2Split	10834	572	61.50	529	61.33	475	61.12	369	60.67
	HB2Split	10856	Heron Bridge (North and South)							
	HB2Split	10878	572	61.81	529	61.63	475	61.40	369	60.68
	HB2Split	10942	572	62.05	529	61.87	475	61.64	369	60.97
	HB2Split	11072	572	62.73	529	62.55	475	62.32	369	61.78
	HB2Split	11242	572	63.14	529	63.04	475	62.87	369	62.57
	HB2Split	11411	572	66.15	529	66.02	475	65.88	369	65.53
	HB2Split	11507	572	71.03	529	70.88	475	70.69	369	70.30
	HB2Split	11550	572	72.92	529	72.73	475	72.50	369	72.00
			Hog's Back Road							

NOTE:

WSEL - Water Surface Elevation

Q20 - Flow rate of a 20 year flood event

WL20 - Water Surface Elevation of 20 year flood event

Q10 - Flow rate of a 10 year flood event

WL10 - Water Surface Elevation of 10 year flood event

Q5 - Flow rate of a 5 year flood event

WL5 - Water Surface Elevation of 5 year flood event

Q2 - Flow rate of a 2 year flood event

WL2 - Water Surface Elevation of 2 year flood event

Table 14: List of RVCA Regulation Permit Files

RVCA File #	Location	Year	Flood Line Change Required?	Brief Description	Closest HEC-RAS cross-section	Drawing Number
RV3-2606	35 Belmont Ave	2006	No	New two car semidetached garage, 440 sf.		
RV3-2706	37 Belmont Ave	2006	No	New two car semidetached garage, 440 sf.		
RV3-3906	46 Belmont Avenue	2006	No	506 sf addition.		
RV3-5306	179 Cameron Ave	2006	No	231 sf, 2 storey addition with basement.		
RV3-5106	115 Leonard Ave	2006	No	740 sf addition above the garage, not exceeding current bldg footprint.		
RV3-3106	34 Wendover	2006	No	Construction of 285 sf garage, home in flood line.		
RV3-2106	101 Seneca St	2006	No	547 sf addition.		
RV3-5406	67 Elliot Ave	2006	No	175 sf addition to existing residence.		
RV3-5606	110 Onslow Cres	2006	No	Replace existing garage structure.		
RV3-4806	49 Belgrave St	2006	No	Single family dwelling home addition.		
RV3-0106	243 Range Rd	2006	No	121 sf garden gazebo, replacement of existing retaining walls.		
RV3-4506	Chinese Embassy - 515 St Patrick St	2006	No	Shoreline alterations.		
RV3-0306	100 Island Lodge	2006	No	Stormwater management plan.		
RV3-6507	66 Belmont Ave	2007	No	Outside of flood line.		
RV3-4007	119 Leonard Ave	2007	No	Demolition of existing bldg and construction of a new 3 storey single family dwelling. In flood area.		
RV3-1807	100 Landry St	2007	Yes		1953 - 2377	IBI Group Inc, Claridge Homes, 100 Landry Street, Grading Plan, C-200 Rev 23, 15/10/2009
RV3-1307	1 John St	2007	No	Intake for power plant at Rideau Falls.		
RV3-0307	25 Wayling Ave	2007	No	Dock installation.		
RV3-4407	51 Glengarry Rd	2007	No	212 sf addition to family room of single dwelling home, inside flood line.		
RV3-1007	45 Belgrave St	2007	No	Single family dwelling home addition.		
RV3-6307	44 Belgrave St	2007	No	Addition built on multi unit rental property.		
RV3-5507	245 Range Rd	2007	No	New home construction, outside of flood line, inside of regulation area.		
RV3-4908	Carleton U.	2008	No	Shoreline erosion assessment, no permits issed, no topographical changes made.		
RV3-6008	14 Chesley Street	2008	No	325 sf addition to the rear of the house.		
RV3-5908	130 Ossington Ave	2008	No	Work cancelled		
RV3-1608	488 Sunnyside Ave	2008	No	3 unit row house, out of flood line.		

RVCA File #	Location	Year	Flood Line Change Required?	Brief Description	Closest HEC-RAS cross-section	Drawing Number
RV3-0208	100 Landry St	2008	Yes		1953 - 2377	IBI Group Inc, Claridge Homes, 100 Landry Street, Grading Plan, C-200 Rev 23, 15/10/2009
RV3-5508	247 North River Rd	2008	No	75 sf cover linking existing garage and dwelling.		
RV3-6108	247 North River Rd	2008	No	Pool and patio.		
RV3-0608	247 North River Rd	2008	No	Renovation, home inside flood line.		
RV3-6408	Springhurst -Lees Ave	2008	No	Sanitary sewer reconstruction.		
RV3-2609	Carleton U.	2009	Yes	River Building project, construction within flooded area.	10105, 10011	CSW Landscape Architects Ltd, Carleton University River Building, As Built Site Plan, L-1, 25/01/2013
RV3-2009	40 Osborne Street	2009	No	New 2nd floor unenclosed porch.		
RV3-8209	4 Windsor Avenue	2009	No	Construction of a 294 sf garage, 185 sf in front of existing garage, 60 sf addition to SE corner of dwelling.		
RV3-3809	Heron Rd	2009	No	Heron Rd bridge rehabilitation.		
RV3-3809	Heron Rd	2009	No	Heron Rd bridge rehabilitation.		
RV3-2409	119 & 121 Deschamps St	2009	Yes	Construction of 2 storey duplex, on flood line encompass bldg footprint if necessary.	1953 - 2377	IBI Group Inc, Claridge Homes, 100 Landry Street, Grading Plan, C-200 Rev 23, 15/10/2009
RV3-7309	100 Landry St	2009	Yes	Construction of 3, 3 storey condo bldgs, floodlines to encompass bldg footprint.	1953 - 2377	IBI Group Inc, Claridge Homes, 100 Landry Street, Grading Plan, C-200 Rev 23, 15/10/2009
RV3-7209	70 Landry St	2009	Yes	Construction of new Highrise 'B', floodlines to encompass bldg footprint.	1953 - 2377	IBI Group Inc, Claridge Homes, 100 Landry Street, Grading Plan, C-200 Rev 23, 15/10/2009
RV3-7109	100 Landry St	2009	Yes	Construction of 2, 3 storey condo bldgs, floodlines to encompass bldg footprint.	1953 - 2377	IBI Group Inc, Claridge Homes, 100 Landry Street, Grading Plan, C-200 Rev 23, 15/10/2009
RV3-5209	203 North River Rd	2009	Yes	Encompass bldg footprint in flood line.	2135	Annis, O'Sullivan, Vollebekk Ltd. 203 North River Road, Topographical Plan of Survey, 29/07/2008
RV3-0709	68 Onslow Cres	2009	No	Demolish and re-build of home inside flood line.		
RV35909	115 Stanley Avenue	2009	No	2 storey 567 sf addition on river side of the building.		
RV3-1209	Stanley Park	2009	No	Pathway in park.		
RV3-6109	Stanley Park	2009	Yes	Fill/landscaping added to Stanley Park.	632	Stantec Geomatics Ltd, Stanley Park City of Ottawa, Topographic Survey, 17/09/2010
RV3-1509	181 cameron avenue	2009	No	181 sf addition, reconstruction of front porch piers and 2nd storey sunroom.		
RV3-5510	7 Marco Lane	2010	No	Construction of a closed in sunroom.		
RV3-3710	151 Stanley Avenue	2010	No	Construction of a new gargae bldg, at rear of property, outside of flood line.		
RV3-4810	85 Range Road	2010	No	10 storey rental unit construction, not in flood line.		

RVCA File #	Location	Year	Flood Line Change Required?	Brief Description	Closest HEC-RAS cross-section	Drawing Number
RV3-0711	29 Belmont Ave	2011	No	Inside flood line, 242 sf addition to the back of the house.		
RV3-1511	23 Belmont Ave	2011	No	Inside flood line, 138 sf addition to the back of the house.		
RV3-1509	181 Cameron Ave	2011	No	Drain maintanence work		
RV3-6011	5 Raleigh Street	2011	No	Construction of new front entry, and 2nd floor dormer window. Home within flood line.		
RV3-1811	Heron Rd	2011	No	Heron Rd bridge rehabilitation.		
RV3-6511	439 Greensway Ave	2011	No	1088 sf 2 storey addition, inside flood line.		
RV3-4611	253 Greensway Avenue	2011	No	Entrance vestibule addition.		
RV3-6511	230 Greensway Avenue	2011	No	1088 sf two storey dwelling addition attached to existing dwelling, inside flood lines.		
RV3-0311	90 Landry St	2011	Yes	Construction of new Highrise 'A', floodlines to encompass bldg footprint.	1953 - 2377	IBI Group Inc, Claridge Homes, 100 Landry Street, Grading Plan, C-200 Rev 23, 15/10/2009
RV3-5711	94 Onslow Cres	2011	No	520 sf addition to the 2nd floor of a single family home inside flood line.		
RV3-7011	23 Belgrave St	2011	No	Constructing a shed.		
RV3-3911	120 Clegg St	2011	No	Brantwood Park new floatable dock.		
RV3-8211	185 Cameron Avenue	2011	No	Renovation and addition, bldg in flood plain.		
RV3-8111	46 Glengarry Rd	2011	No	Renovation and addition, bldg in flood plain.		
RV3-4512V	Carleton U.	2012	No	ON HOLD: Alumni bldg. expansion.		
RV3-6312	Carleton U.	2012	No	Artificial riparian boulders placed along shoreline.		
RV3-4312	Bank St. Bridge rehab	2012	No	Billings Bridge rehabilitation.		
RV3-0212	34A Brighton Ave	2012	No	New 3 storey dwelling. Edge of flood line, will not impact flood line.		
RV3-0312	34B Brighton Ave	2012	No	New 3 storey dwelling. Edge of flood line, will not impact flood line.		
RV3-6012	124 Ossington Avenue	2012	No	Replace existing garage, no change to footprint.		
RV3-6112	O train bridge	2012	No	Concrete debris removal.		
RV3-0812	122 Carillon St	2012	No	New 2-storey detached dwelling, full basement and attached garage, at edge of old flood line.		
RV3-2812	76 Onslow Cres	2012	No	538 sf addition to the 2nd floor of a single family home inside flood line.		
RV3-5212	Stanley Avenue	2012	No	Temporary sculpture.		
RV3-3312	Union Strreet Bridge	2012	No	Bridge rehabilitation		
RV3-1312	200 Lees Avenue	2012	No	New open air sports field facility at OttawaU.		
RV3-1612	Hwy 417	2012	No	Pipeline crossing beneath Rideau River.		
RV3-1313	Carleton U.	2013	No	3 storey vertical addition built on Herzberg bldg.		

Figure 1: Study Area

RIDEAU VALLEY CONSERVATION AUTHORITY

Map Scale: 1:50,000

Projection note: U.T.M. Zone 18 - NAD 83 Datum

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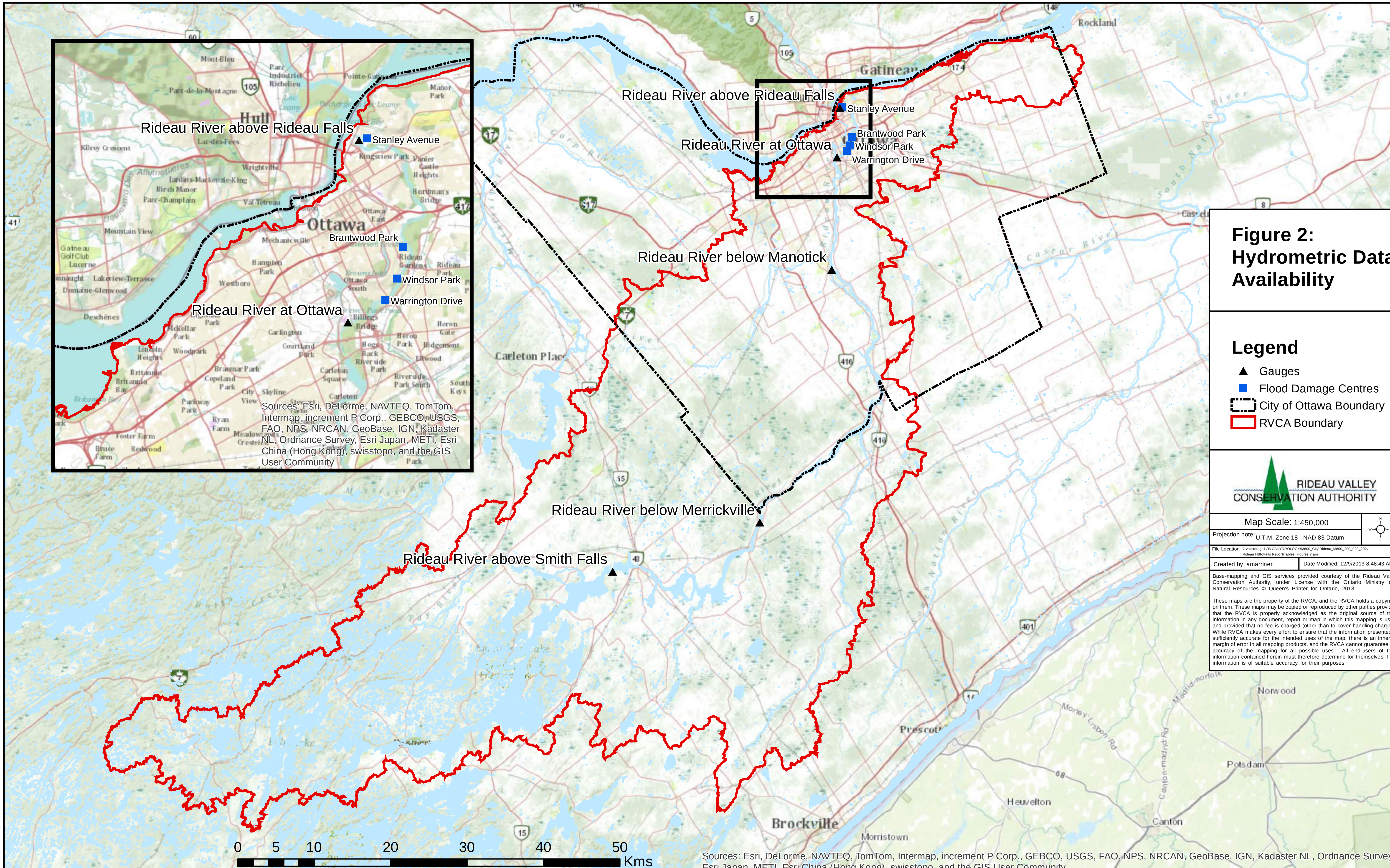

Figure 2: Hydrometric Data Availability

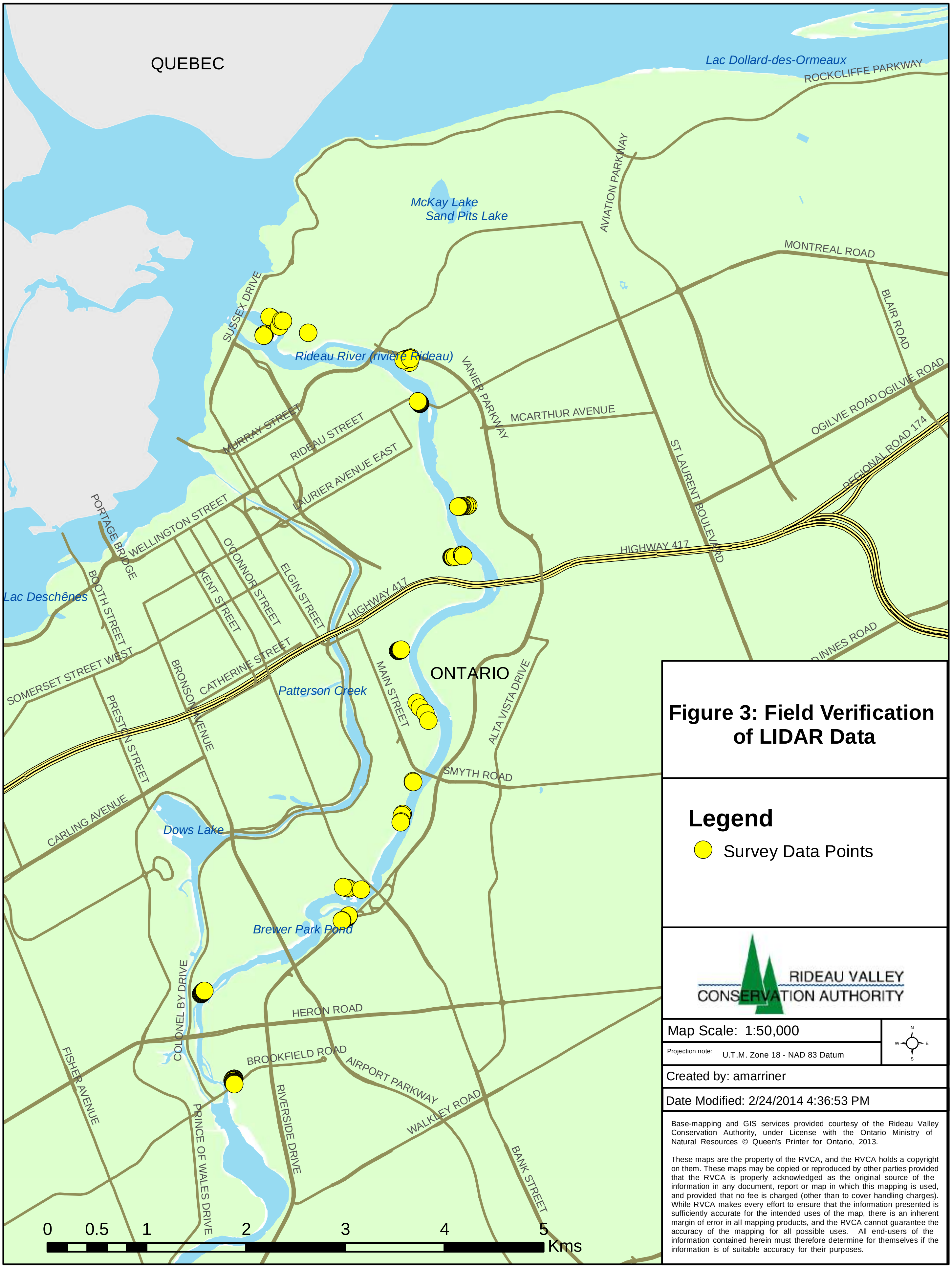

Figure 3: Field Verification of LIDAR Data

Legend

Survey Data Points

RIDEAU VALLEY CONSERVATION AUTHORITY

Map Scale: 1:50,000

Projection note: U.T.M. Zone 18 - NAD 83 Datum

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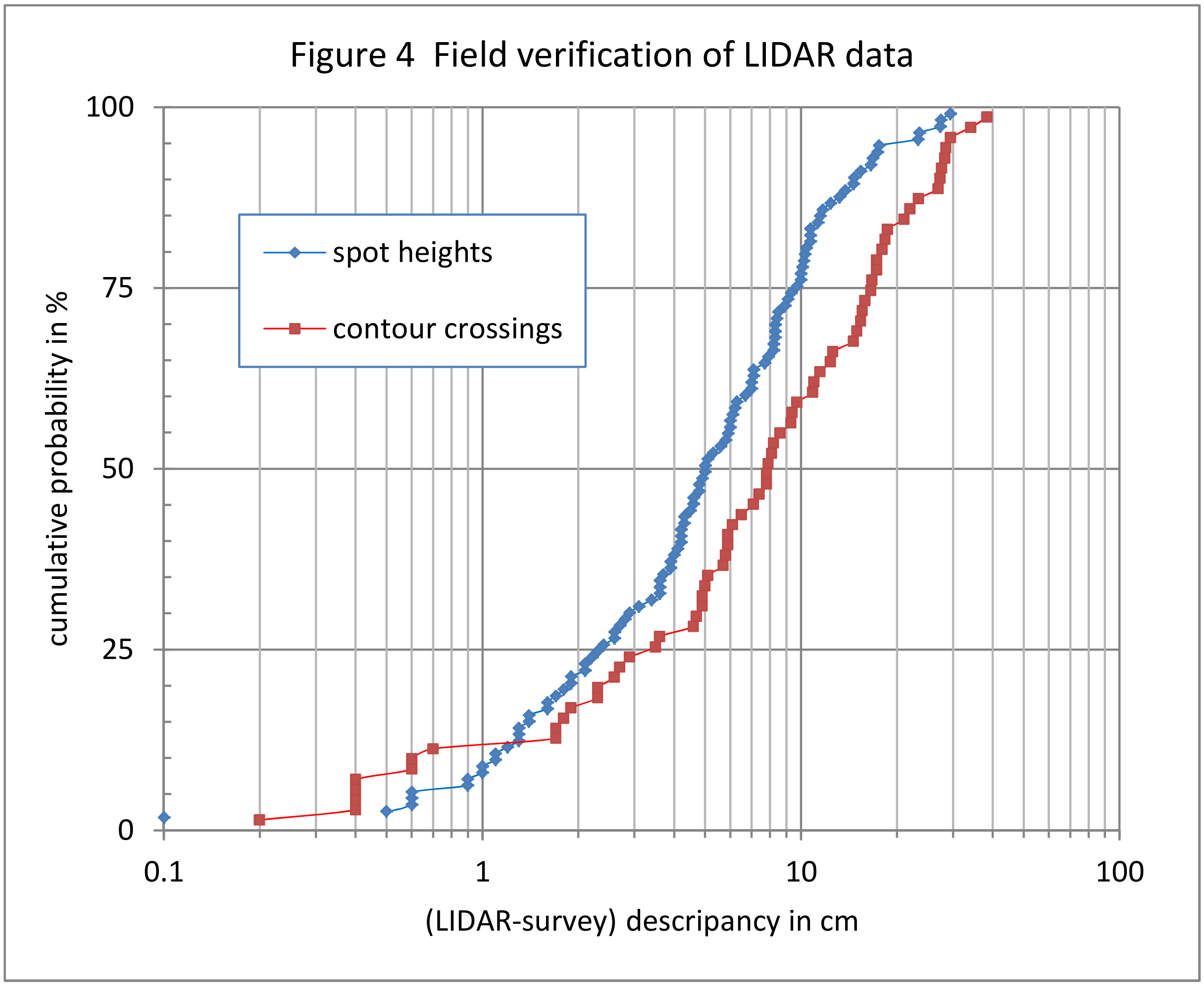
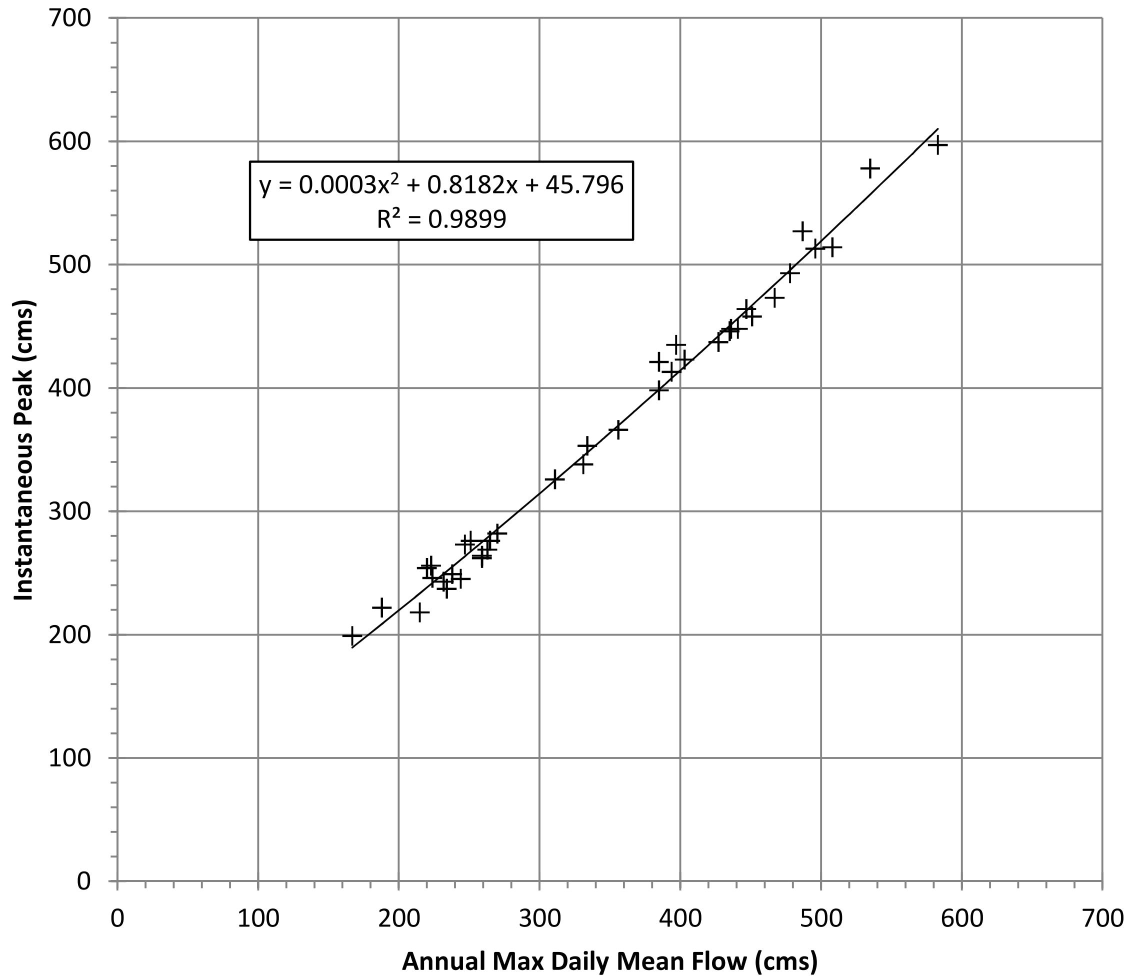


Figure 4 Field verification of LIDAR data
100
75
50
25
0
cumulative probability in %
spot heights
contour crossings
0.1
1
10
100
(LIDAR-survey) descripancy in cm

Figure 5 Relationship between daily mean and instantaneous flows



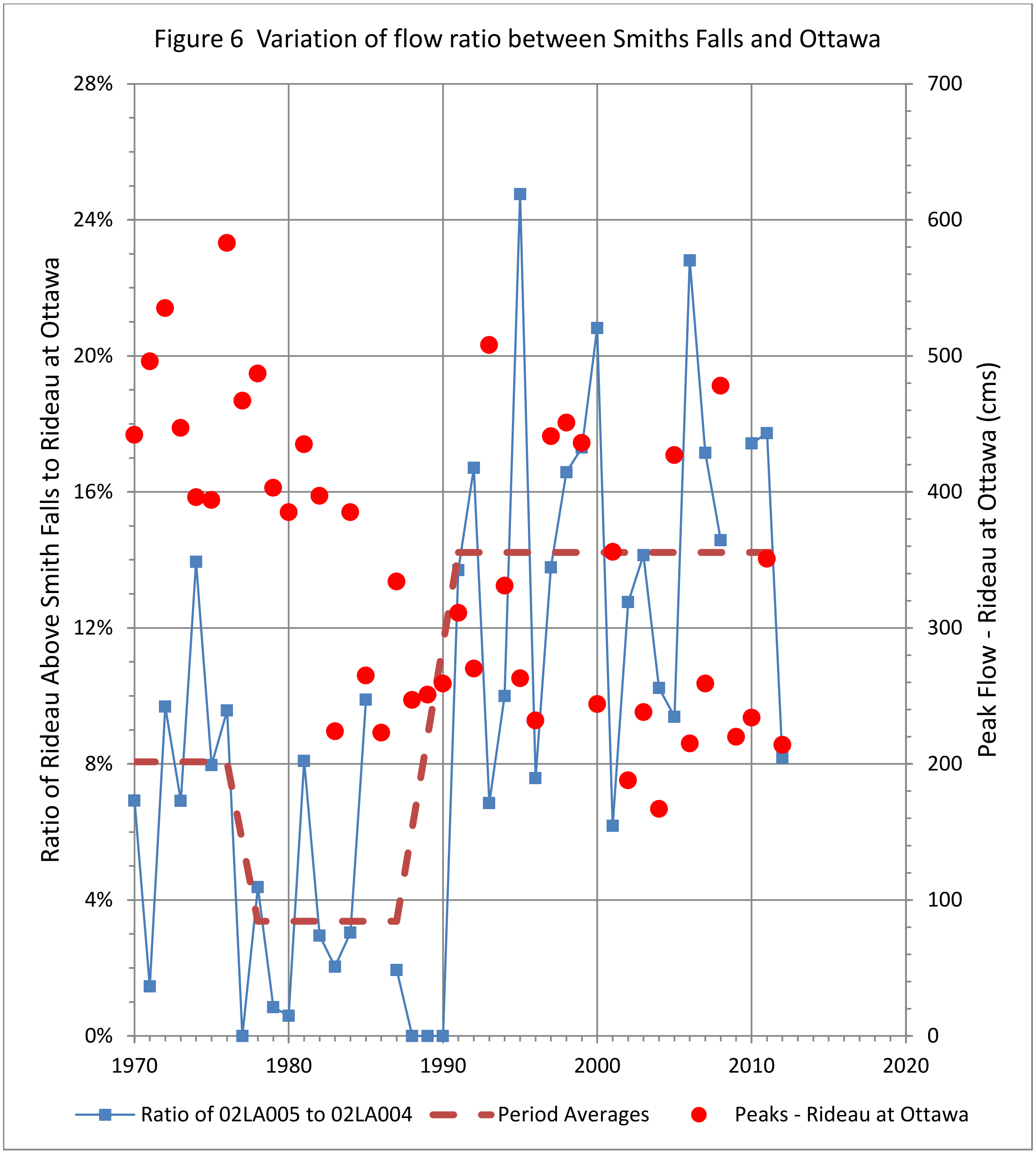


Figure 6 Variation of flow ratio between Smiths Falls and Ottawa
28%
24%
20%
16%
12%
8%
4%
0%
Ratio of Rideau Above Smith Falls to Rideau at Ottawa
700
600
500
400
300
200
100
0
Peak Flow - Rideau at Ottawa (cms)
1970
1980
1990
2000
2010
2020
Ratio of 02LA005 to 02LA004
Period Averages
Peaks - Rideau at Ottawa

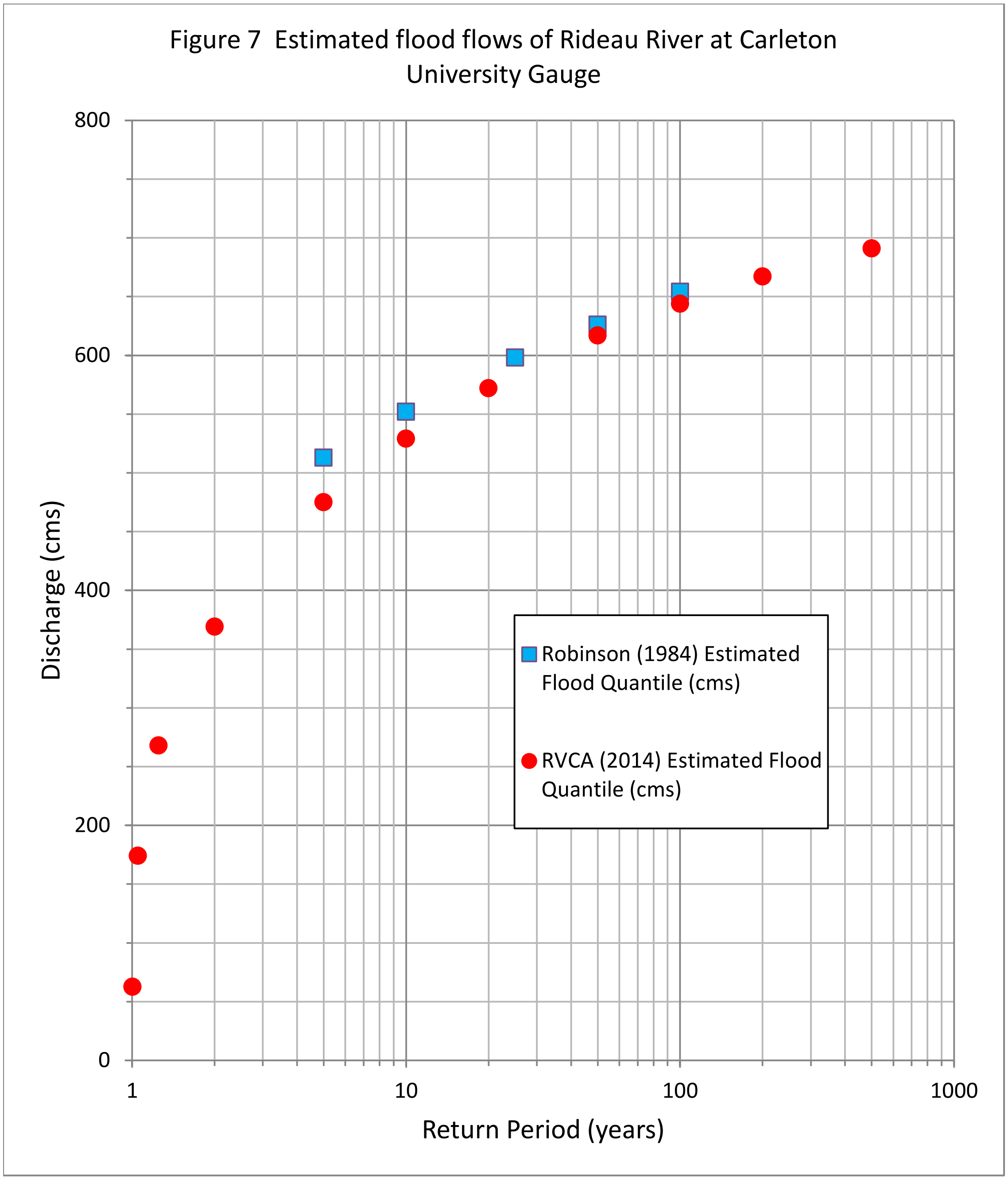


Figure 7 Estimated flood flows of Rideau River at Carleton University Gauge
800
600
400
200
0
Discharge (cms)
1
10
100
1000
Return Period (years)
Robinson (1984) Estimated Flood Quantile (cms)
RVCA (2014) Estimated Flood Quantile (cms)

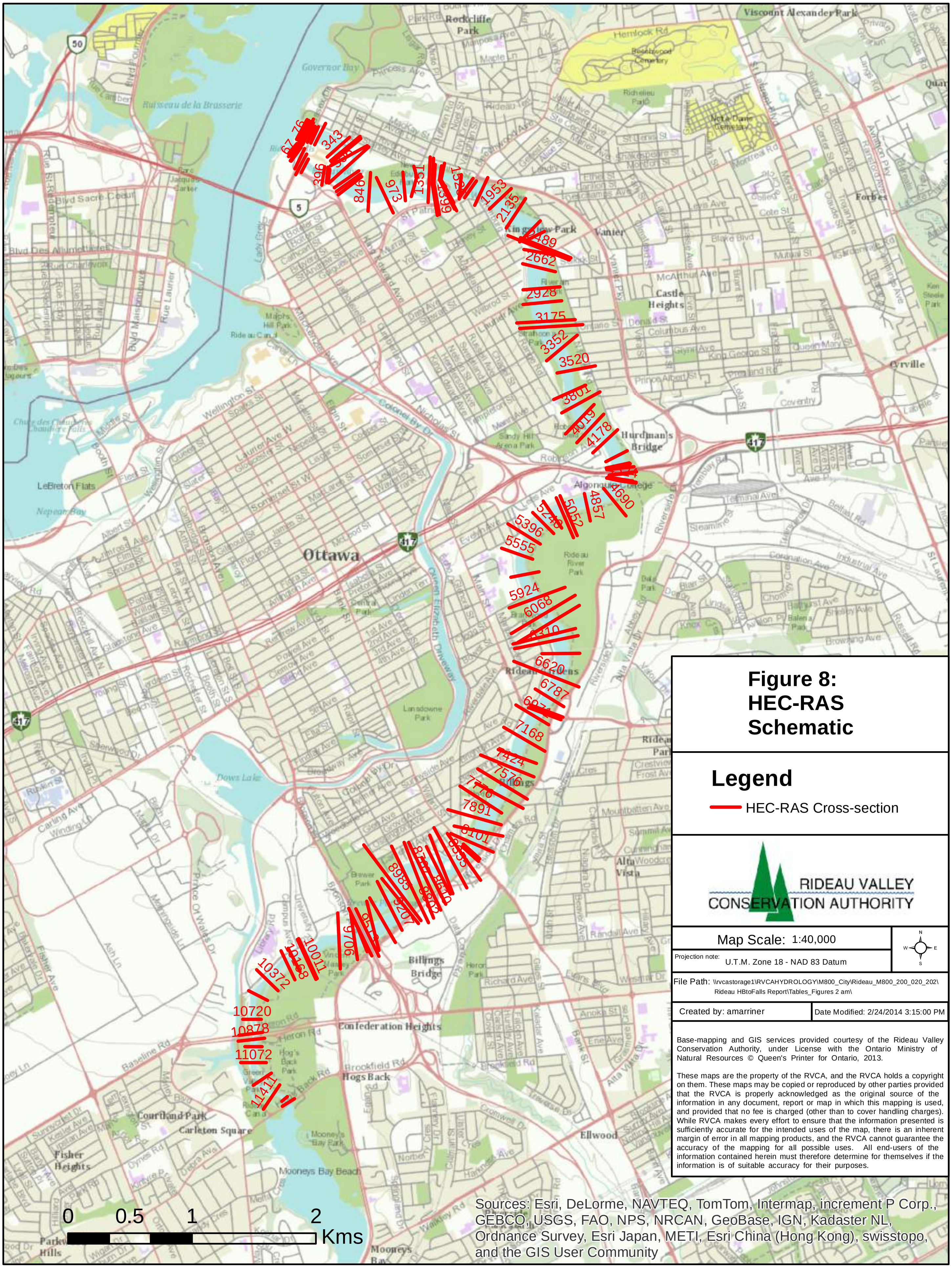


Figure 8: HEC-RAS Schematic

Legend

HEC-RAS Cross-section

RIDEAU VALLEY CONSERVATION AUTHORITY

Map Scale: 1:40,000

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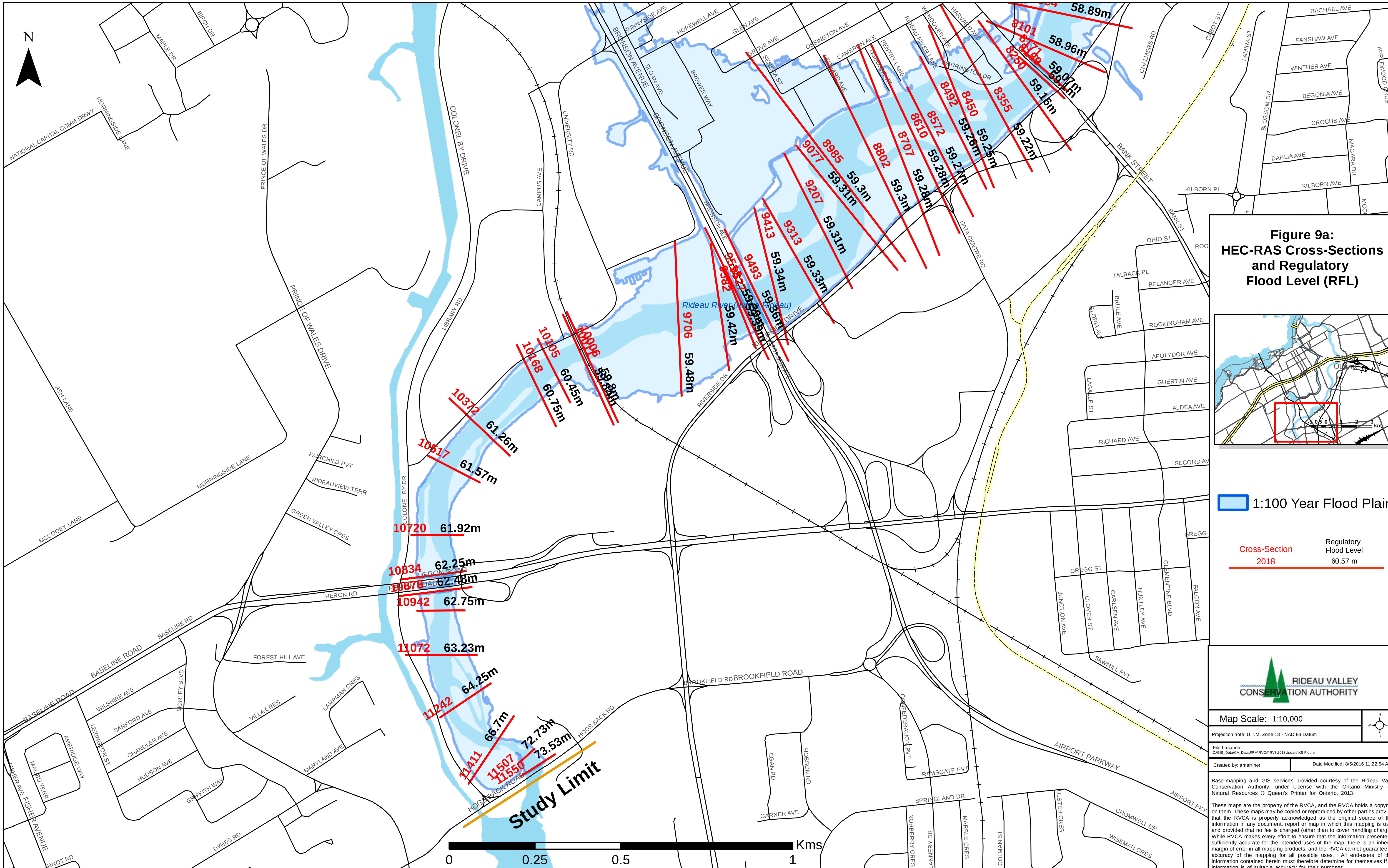
Figure 9a:
HEC-RAS Cross-Sections and Regulatory Flood Level (RFL)
1:100 Year Flood Plain
Cross-Section 2018
Regulatory Flood Level 60.57 m
RIDEAU VALLEY CONSERVATION AUTHORITY
Map Scale: 1:10,000
Projection note: U.T.M. Zone 18 - NAD 83 Datum
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N
0 0.25 0.5 1 Kms
Study Limit
Rideau River (Rivière Rideau)
58.89m
8101 58.96m
59.07m
8250 59.1m
8355 59.22m
8450 59.25m
8492 59.26m
8572 59.27m
8610 59.28m
8707 59.28m
8802 59.3m
8985 59.3m
9077 59.31m
9207 59.31m
9313 59.33m
9413 59.34m
9493 59.36m
59.42m
9706 59.48m
10105 60.45m
10168 60.75m
10372 61.26m
10517 61.57m
10720 61.92m
10834 62.25m
10878 62.48m
10942 62.75m
11072 63.23m
11242 64.25m
11411 66.7m
11507 72.73m
11550 73.53m
COLONEL BY DRIVE
BRONSON AVENUE
BANK STREET
HERON ROAD
BASELINE ROAD
PRINCE OF WALES DRIVE
BROOKFIELD ROAD
AIRPORT PARKWAY
HOGS BACK ROAD
RIVERSIDE DR
UNIVERSITY RD
LIBRARY RD
MORNINGSIDE LANE
NATIONAL CAPITAL COMM DRWY
MCCOOEY LANE
ASH LANE
FAIRCHILD PVT
RIDEAUVIEW TERR
GREEN VALLEY CRES
FOREST HILL AVE
VILLA CRES
LAMPMAN CRES
MARYLAND AVE
WILSHIRE AVE
SANFORD AVE
CHANDLER AVE
HUDSON AVE
GRIFFITH WAY
DYNES RD
MERIVALE RD
FISHER AVENUE
OHIO ST
BELANGER AVE
ROCKINGHAM AVE
APOLYDOR AVE
GUERTIN AVE
ALDEA AVE
RICHARD AVE
SECORD AVE
GREGG ST
KILBORN AVE
KILBORN PL
DAHLIA AVE
CROCUS AVE
BEGONIA AVE
WINTHER AVE
FANSHAW AVE
RACHAEL AVE
RAMSGATE PVT
SPRINGLAND DR
CONFEDERATION PVT
HOBSON RD
EGAN RD
GARNER AVE
CROMWELL DR
WISEMAN CRES
SAWMILL PVT
DATA CENTRE RD

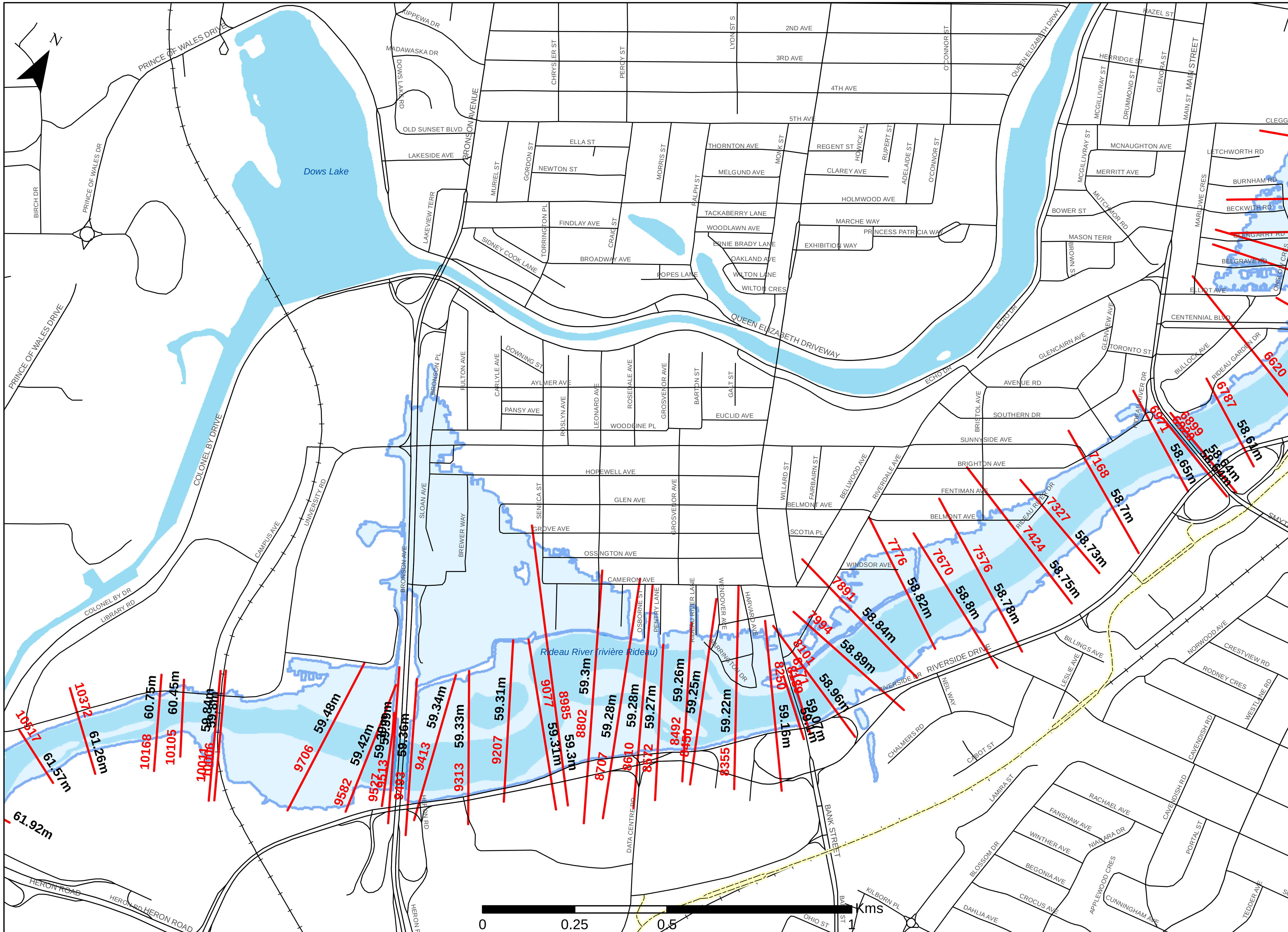

Figure 9b: HEC-RAS Cross-Sections and Regulatory Flood Level (RFL)

1:100 Year Flood Plain

Cross-Section	Regulatory Flood Level
2018	60.57 m

RIDEAU VALLEY CONSERVATION AUTHORITY

Map Scale: 1:10,000

Projection note: U.T.M. Zone 18 - NAD 83 Datum

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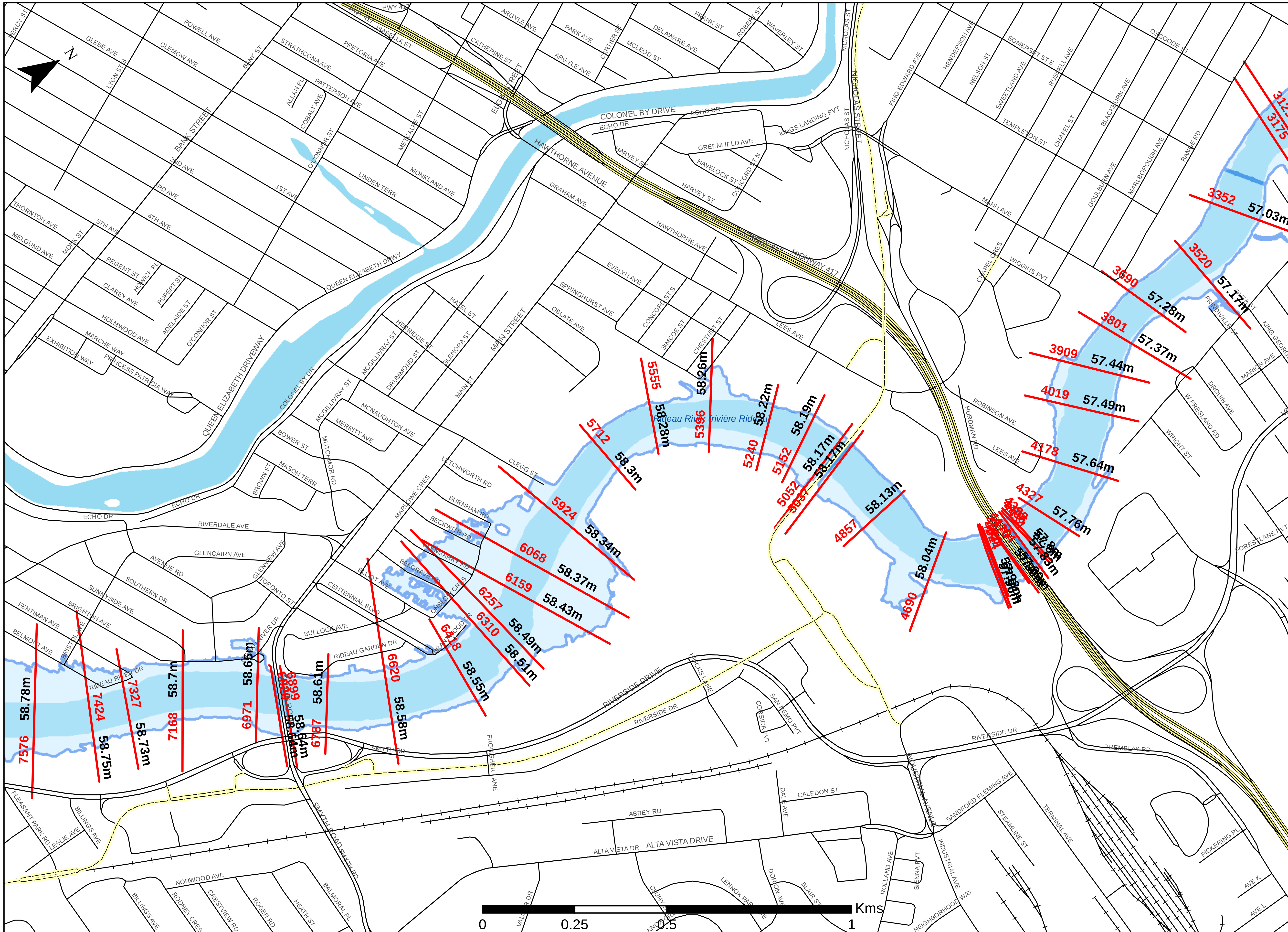

Figure 9c: HEC-RAS Cross-Sections and Regulatory Flood Level (RFL)

1:100 Year Flood Plain

Cross-Section	Regulatory Flood Level
2018	60.57 m

RIDEAU VALLEY CONSERVATION AUTHORITY

Map Scale: 1:10,000

Projection note: U.T.M. Zone 18 - NAD 83 Datum

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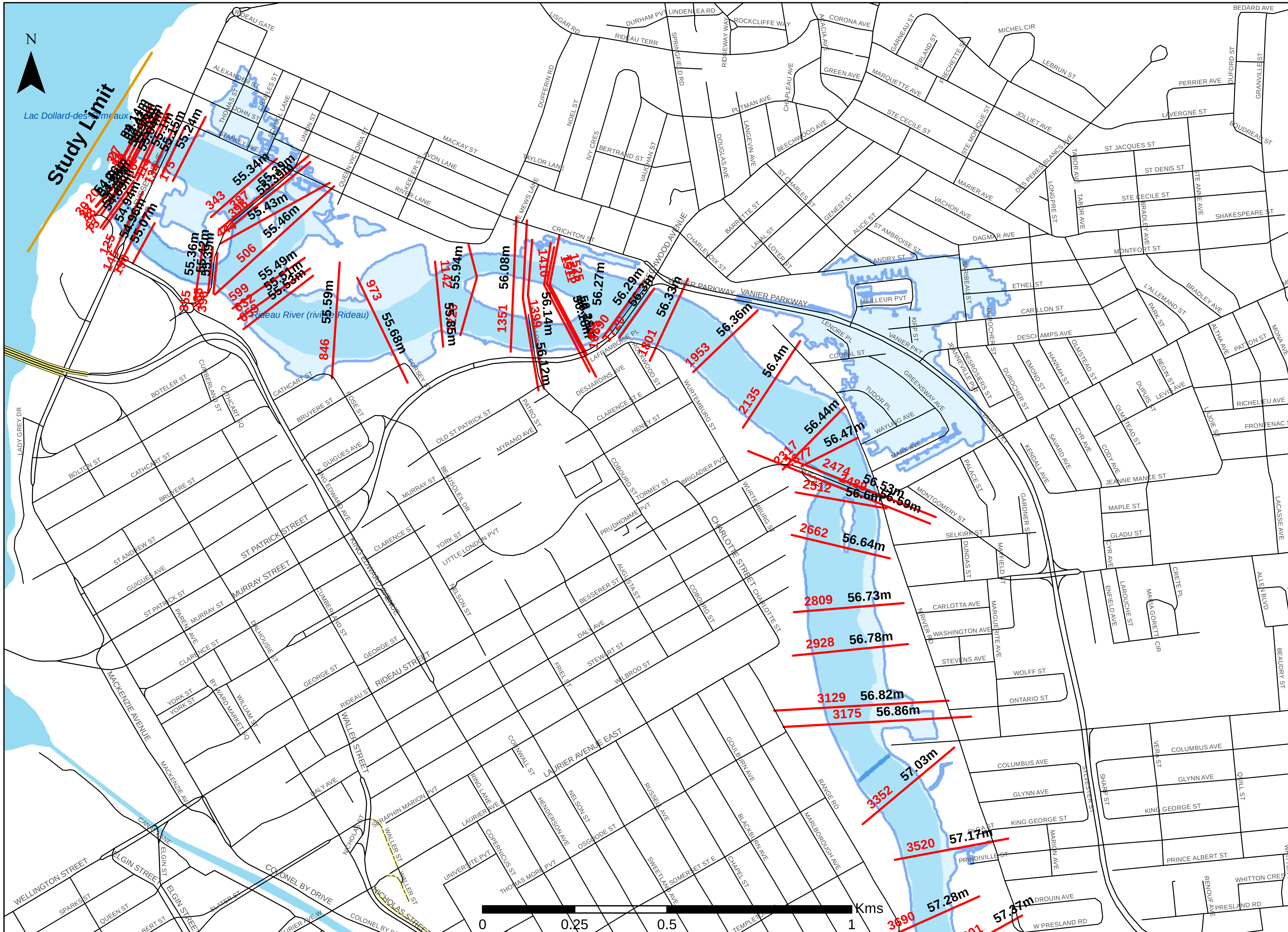
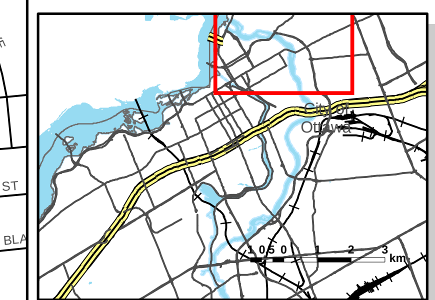


Figure 9d:
HEC-RAS Cross-Sections and Regulatory Flood Level (RFL)



1:100 Year Flood Plain

Cross-Section	Regulatory Flood Level
2018	60.57 m

RIDEAU VALLEY CONSERVATION AUTHORITY

Map Scale: 1:10,000

Projection note: U.T.M. Zone 18 - NAD 83 Datum

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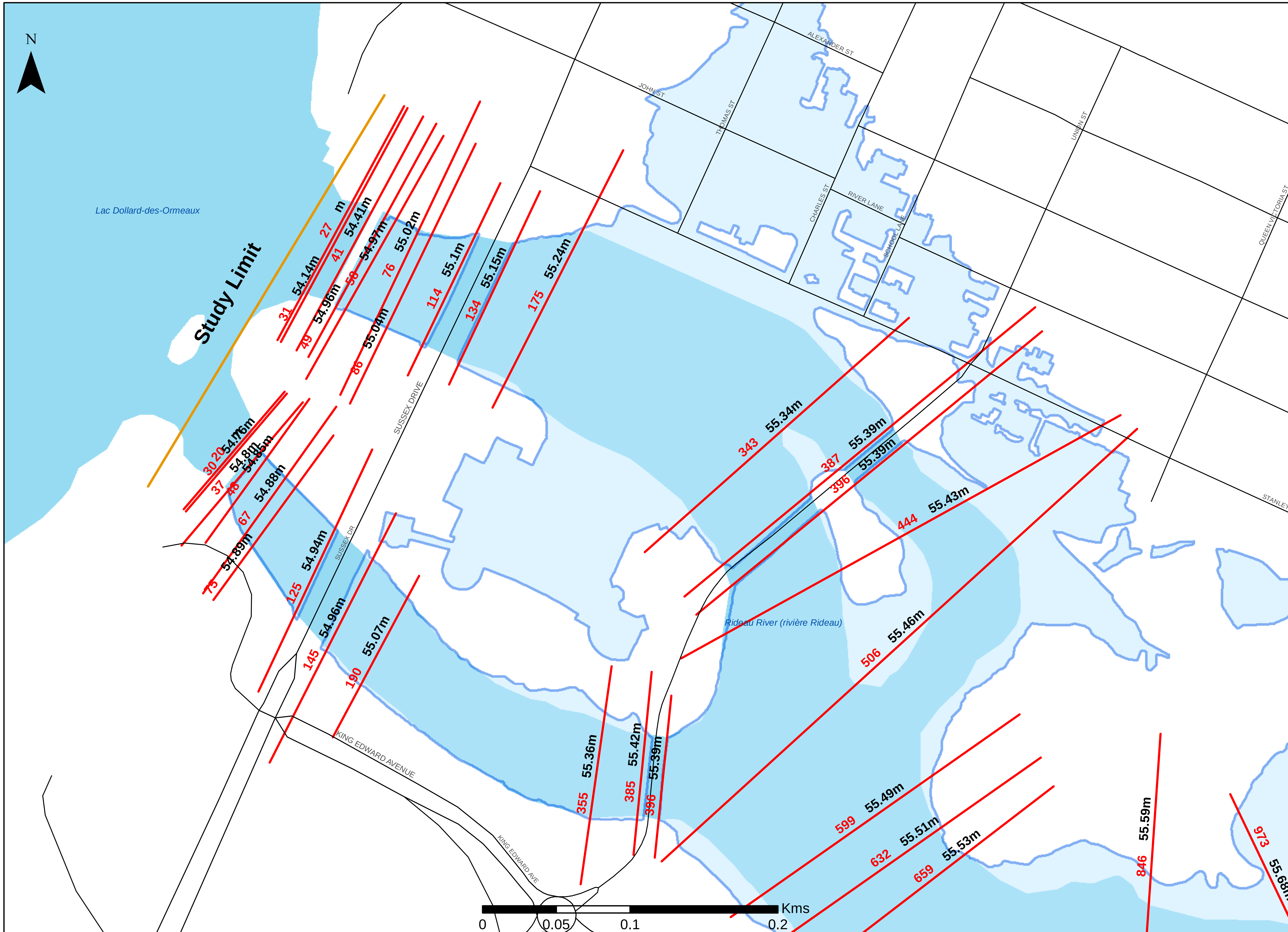
Figure 9e: HEC-RAS Cross-Sections and Regulatory Flood Level (RFL)



1:100 Year Flood Plain

Cross-Section 2018	Regulatory Flood Level 60.57 m

RIDEAU VALLEY CONSERVATION AUTHORITY

Map Scale: 1:2,500

Projection note: U.T.M. Zone 18 - NAD 83 Datum

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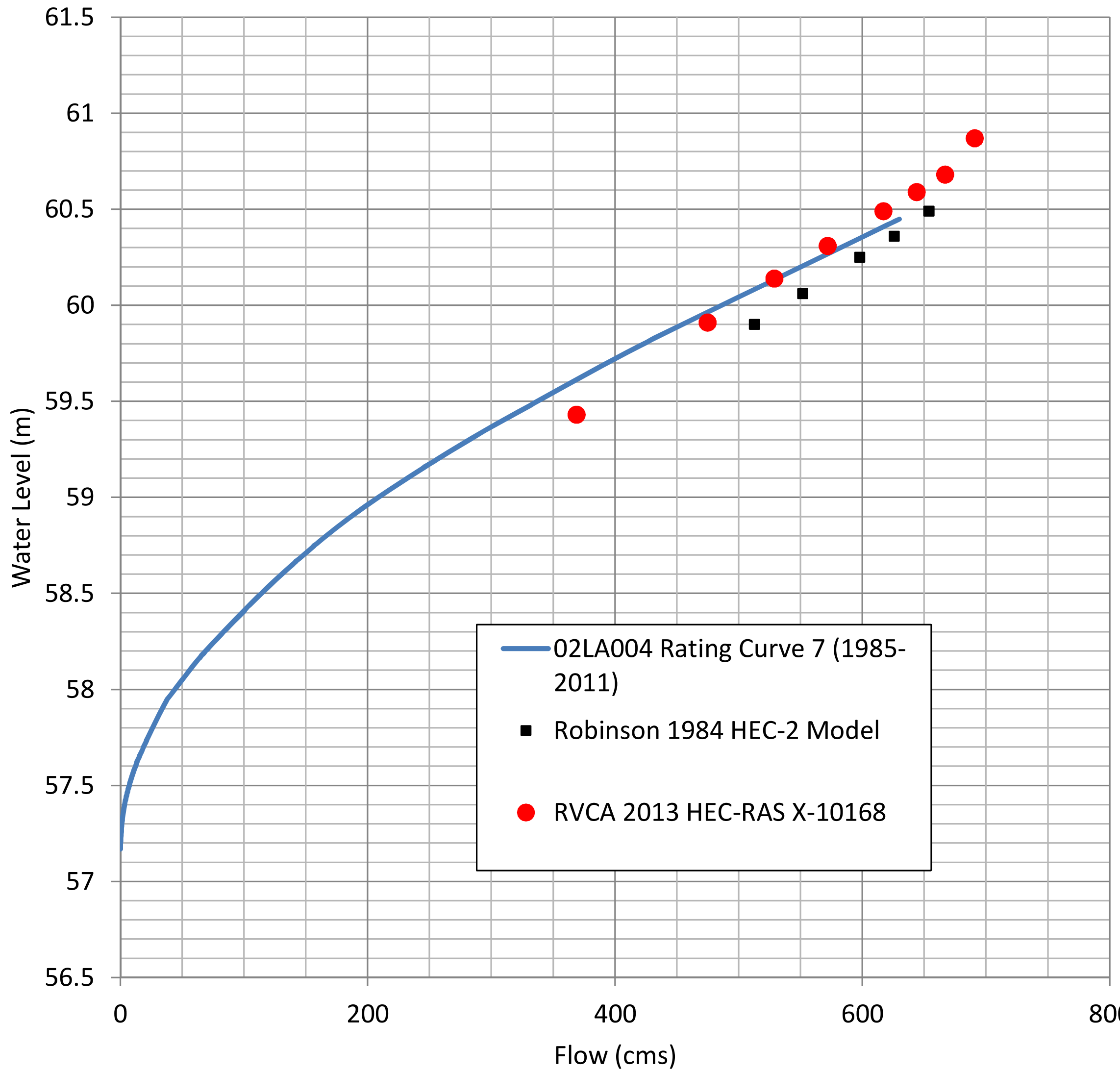
Figure 10 Calibration of HEC-RAS model at Carleton University gauge



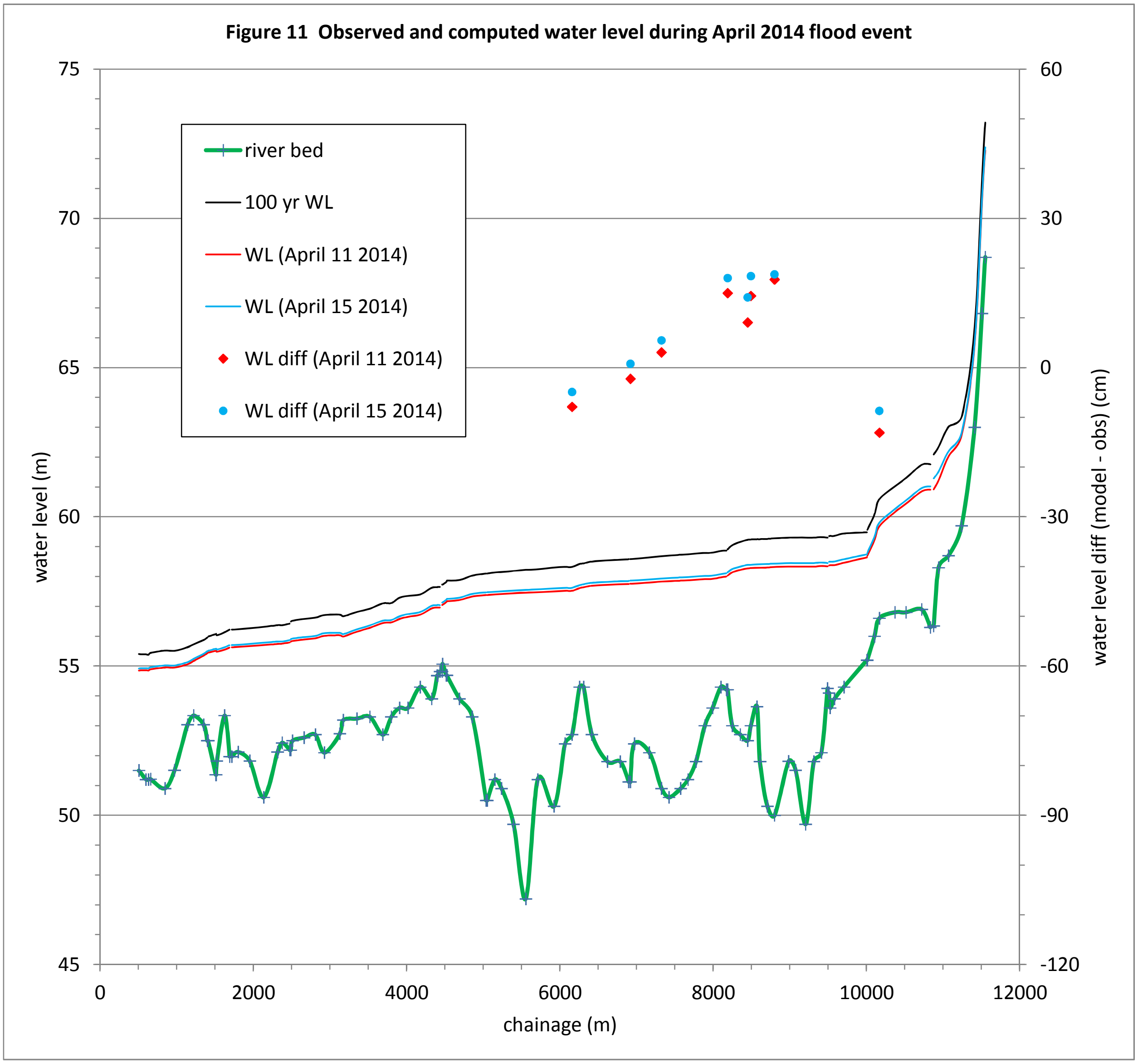
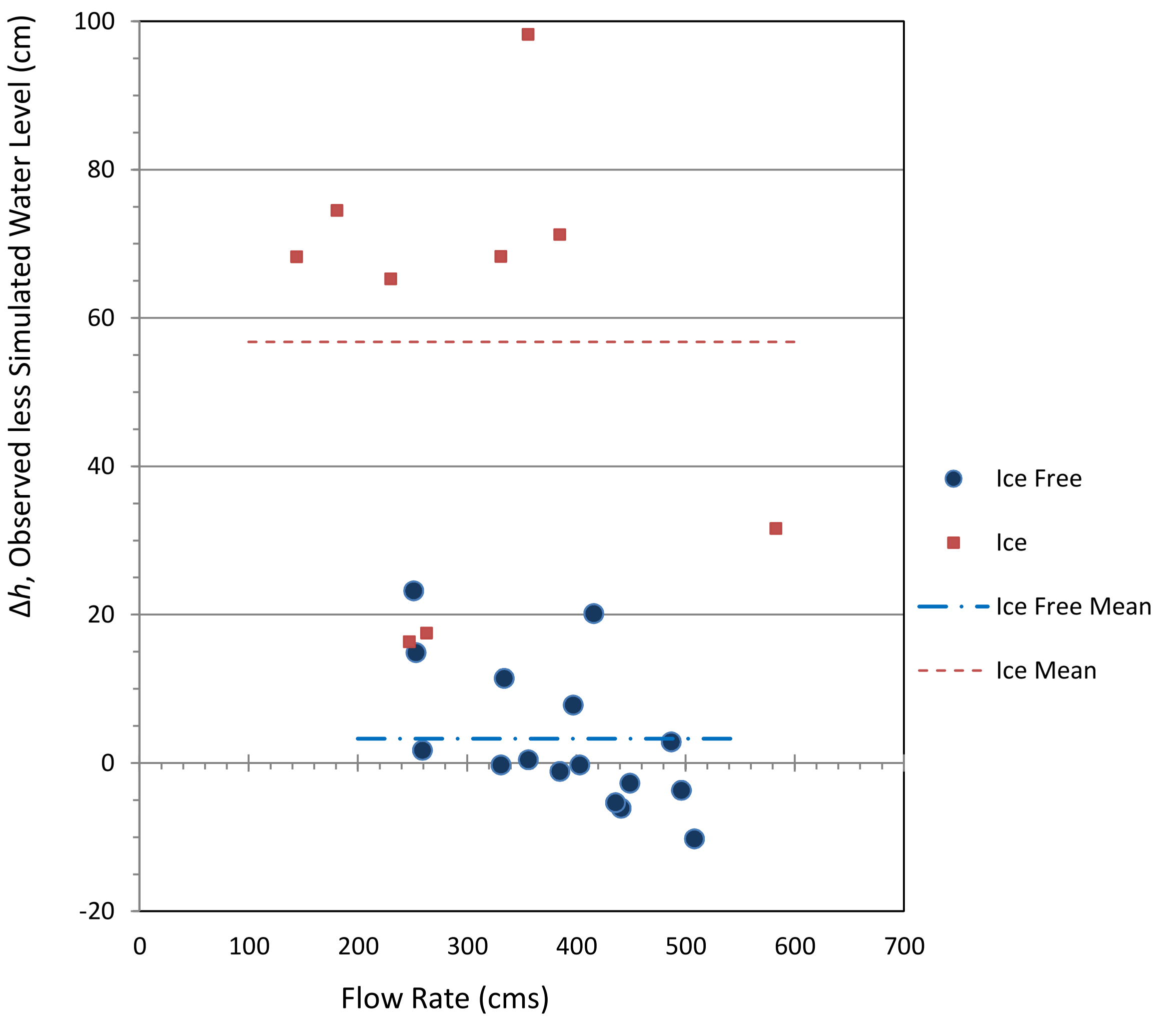


Figure 11 Observed and computed water level during April 2014 flood event
river bed
100 yr WL
WL (April 11 2014)
WL (April 15 2014)
WL diff (April 11 2014)
WL diff (April 15 2014)
water level (m)
water level diff (model - obs) (cm)
chainage (m)
75
70
65
60
55
50
45
60
30
0
-30
-60
-90
-120
0
2000
4000
6000
8000
10000
12000

Figure 12 Observed and computed water levels at Belmont Avenue



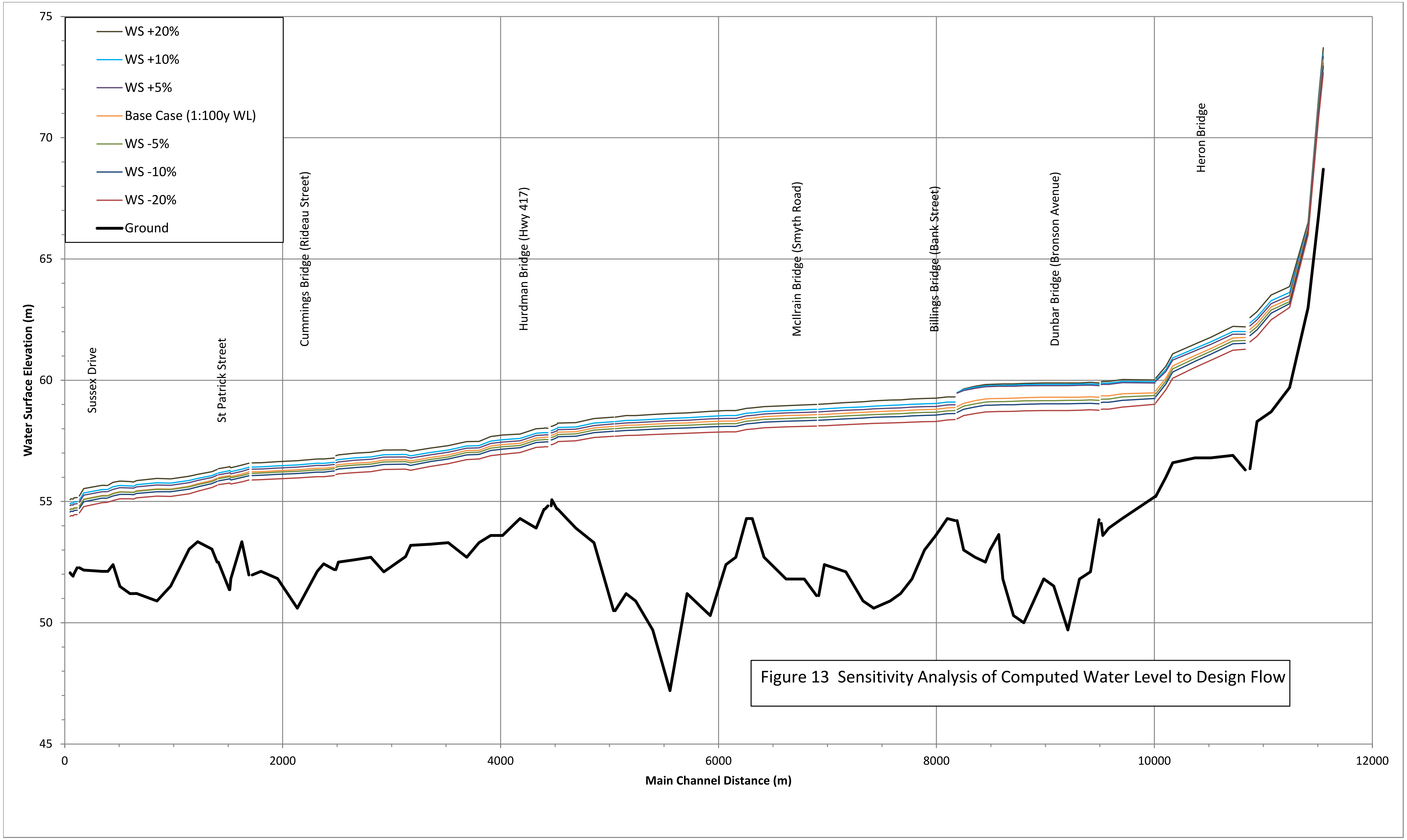


Figure 13 Sensitivity Analysis of Computed Water Level to Design Flow

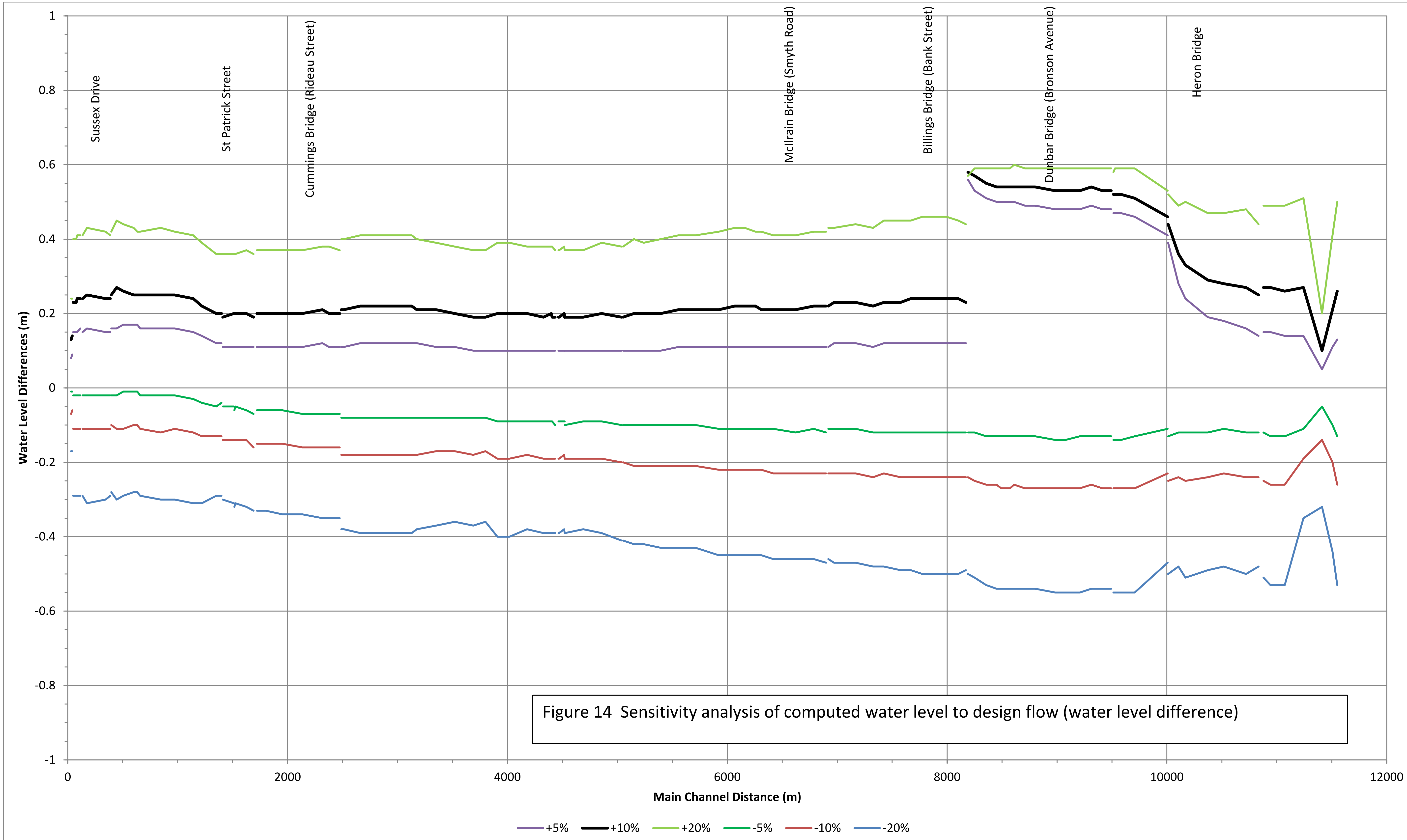


Figure 14 Sensitivity analysis of computed water level to design flow (water level difference)

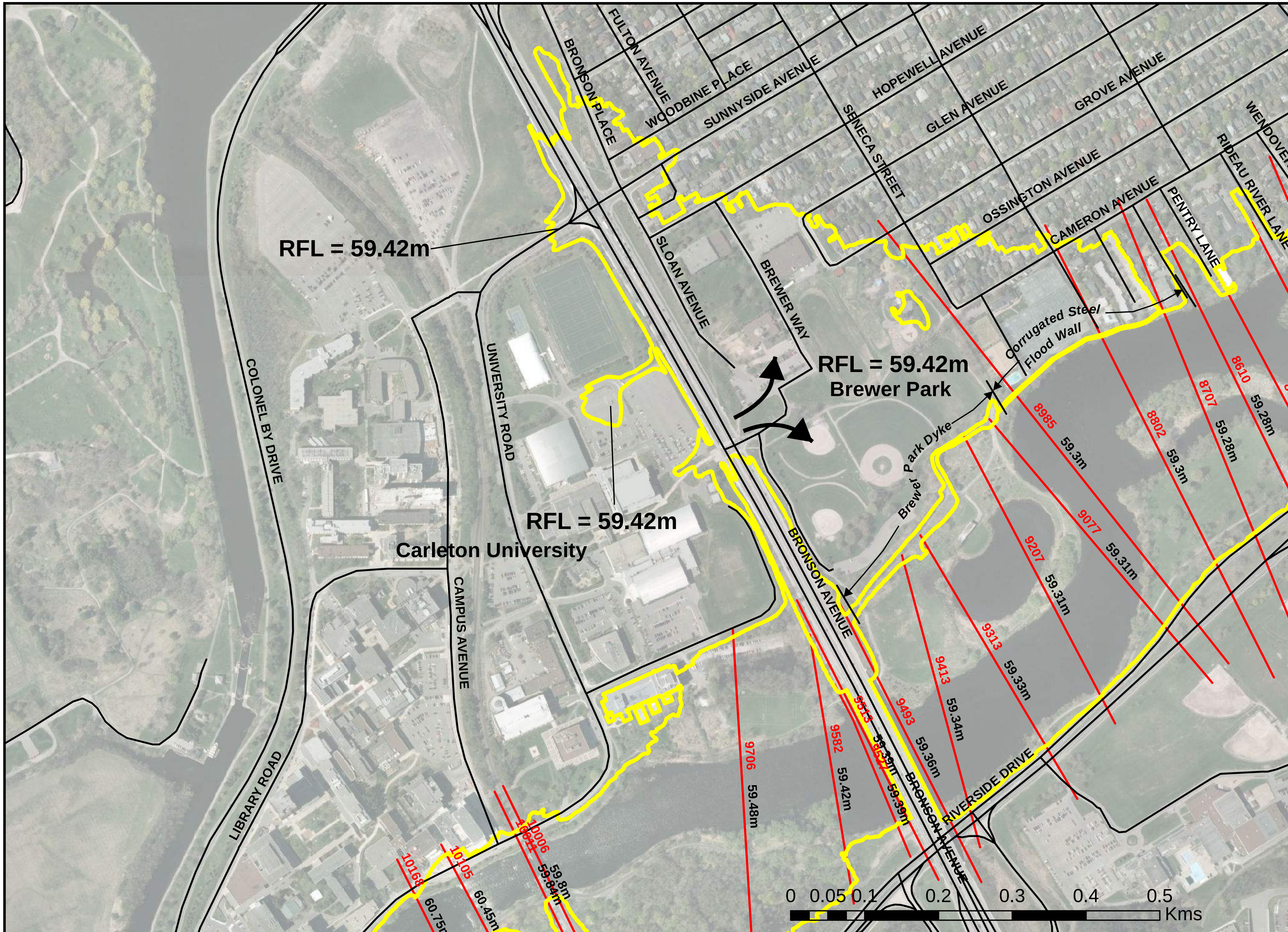


Figure 15a: Carleton University and Brewer Park

Legend

- 1:100 Year Flood Line
- XS Elevations

RIDEAU VALLEY CONSERVATION AUTHORITY

Map Scale: 1:5,000

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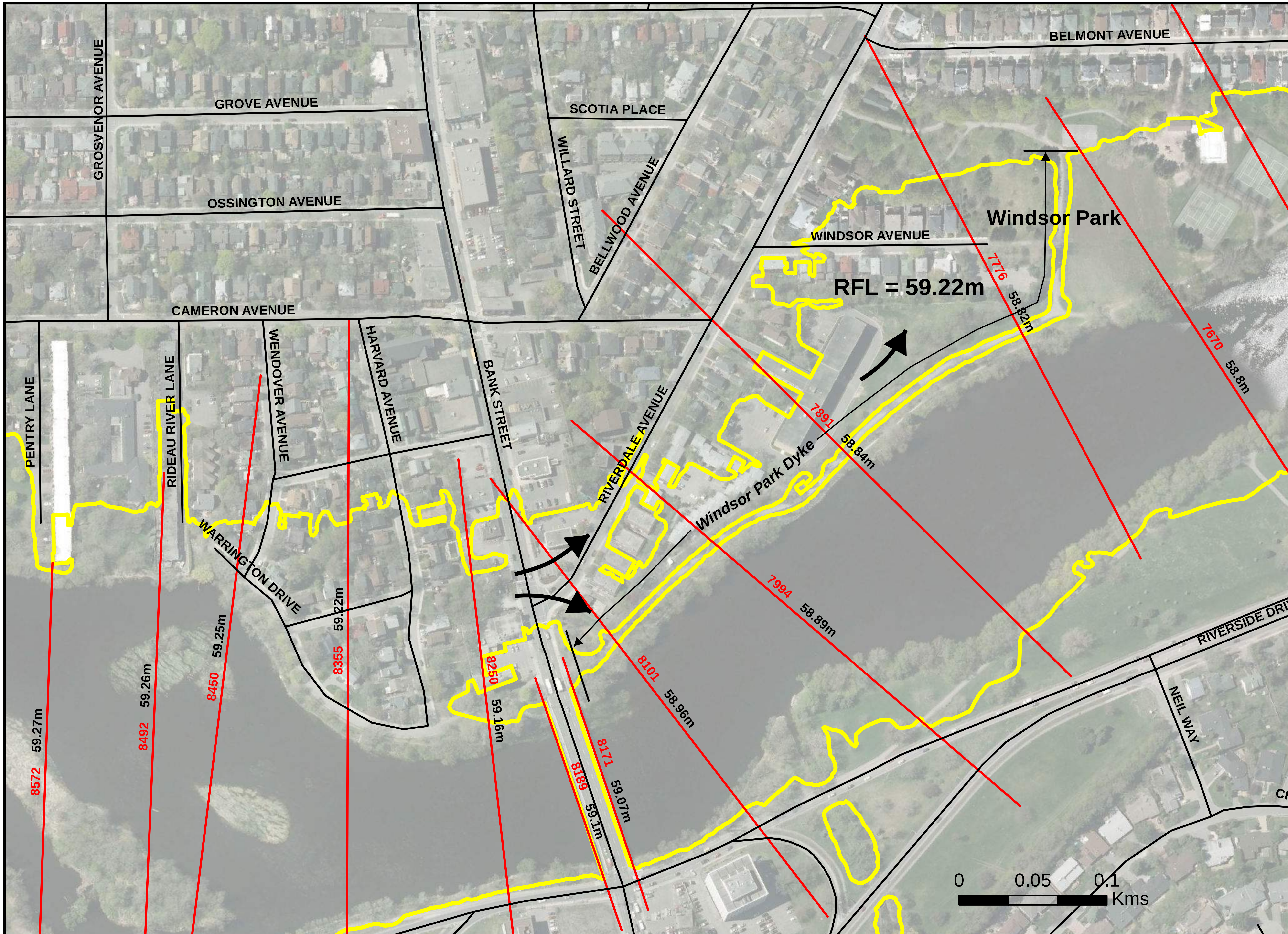

Figure 15b: Warrington Drive and Windsor Park

Legend

- XS Elevations
- 1:100 Year Flood Line

RIDEAU VALLEY CONSERVATION AUTHORITY

Map Scale: 1:2,500

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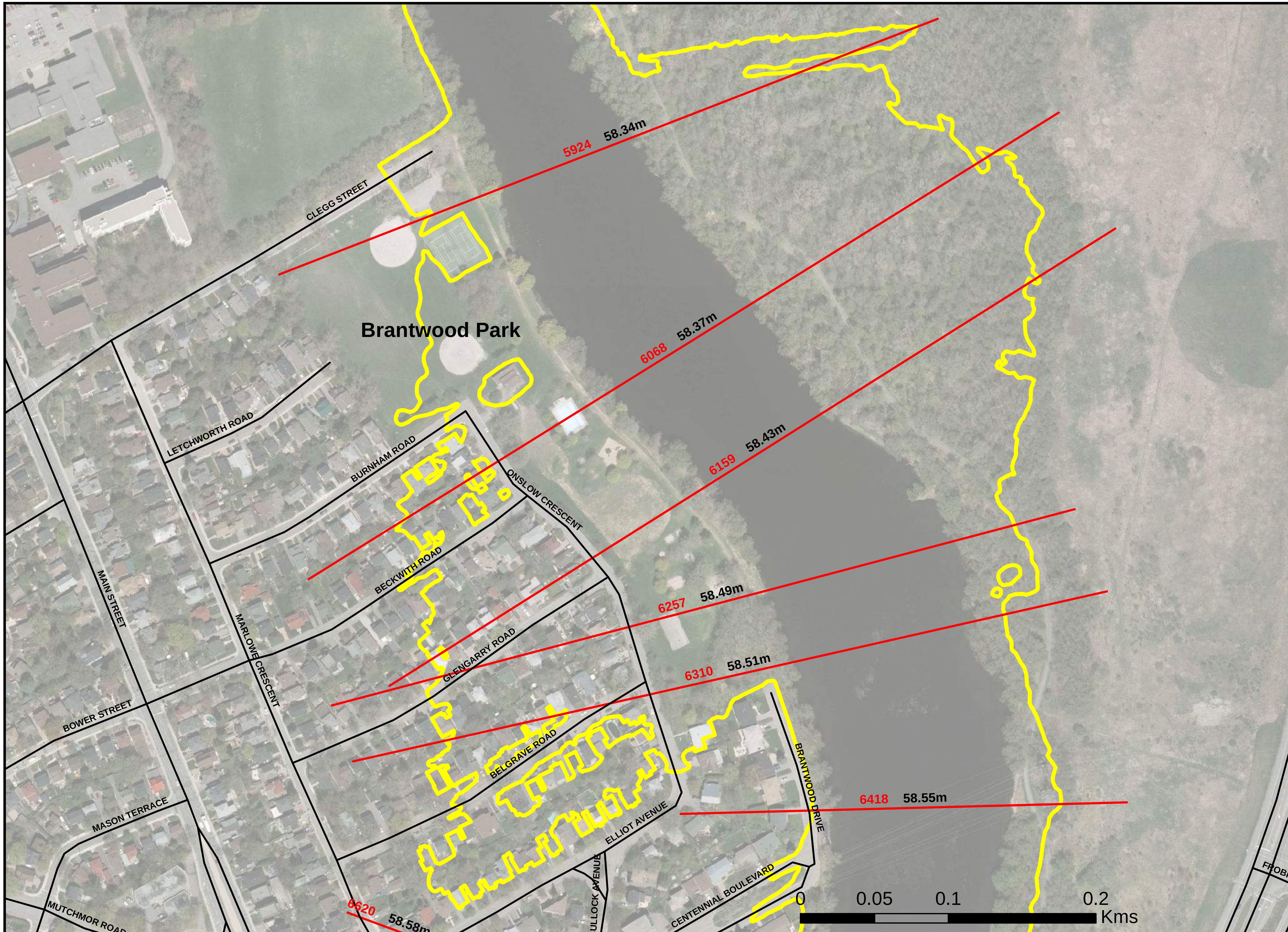

Figure 15c: Brantwood Park and Onslow Crescent

Legend

- XS Elevations
- 1:100 Year Flood Line

RIDEAU VALLEY CONSERVATION AUTHORITY

Map Scale: 1:2,500

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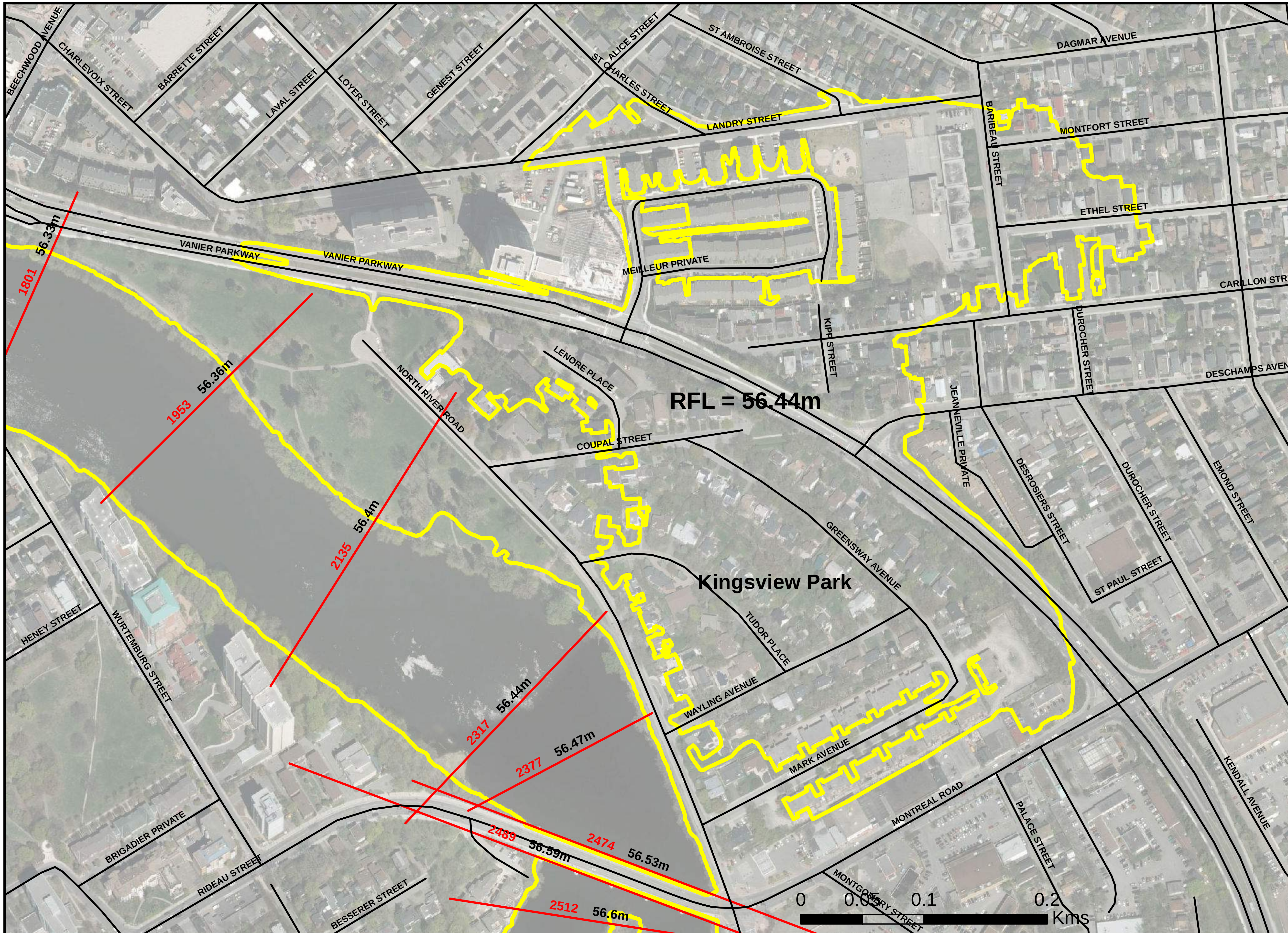

Figure 15d: Kingsview Park and Vanier/Landry

Legend

- XS Elevations
- 1:100 Year Flood Line

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Map Scale: 1:3,000

Projection note: U.T.M. Zone 18 - NAD 83 Datum

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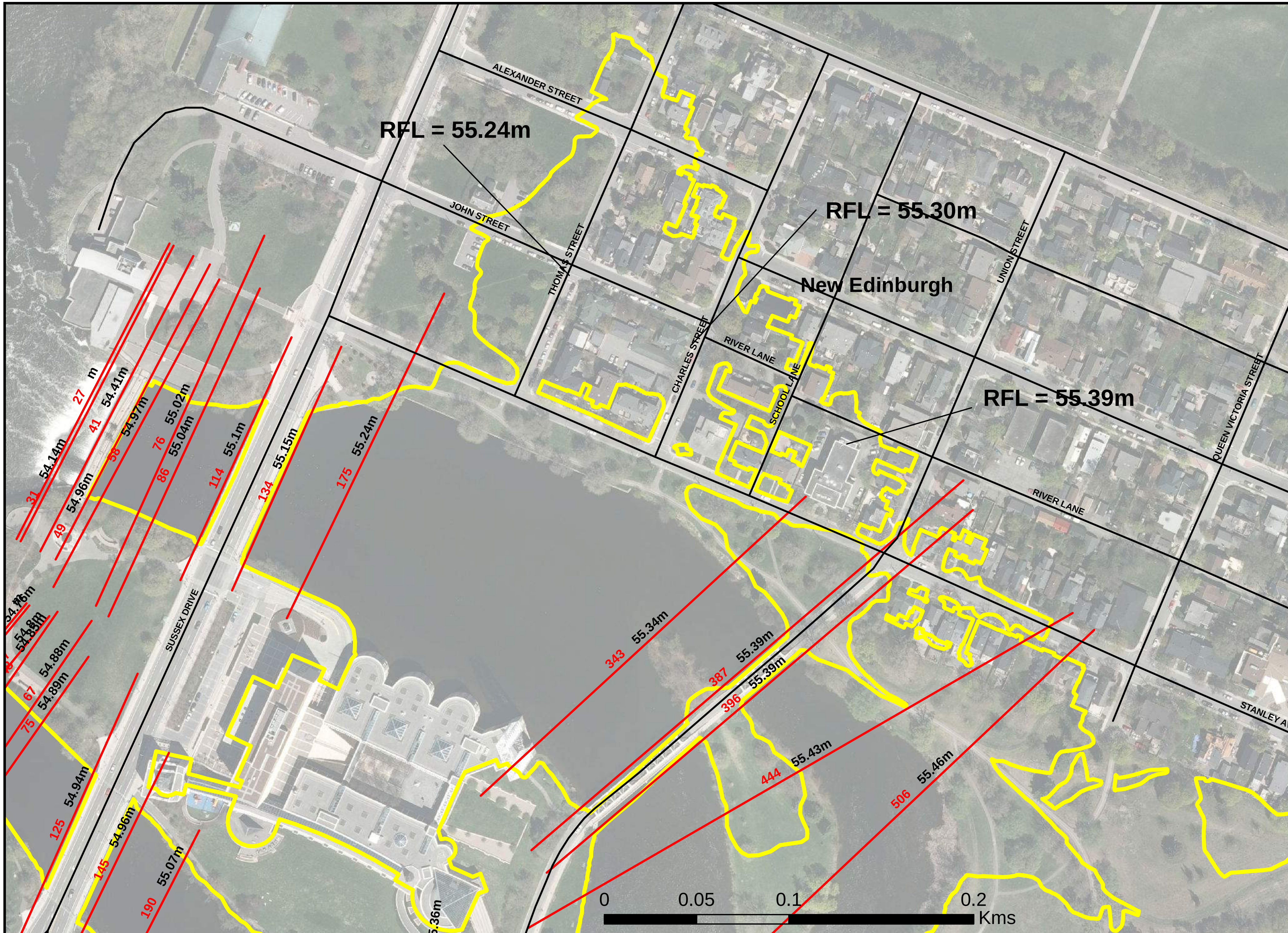

Figure 15e: New Edinburgh and Stanley Park

Legend

- XS Elevations
- 1:100 Year Flood Line

RIDEAU VALLEY CONSERVATION AUTHORITY

Map Scale: 1:2,000

Projection note: U.T.M. Zone 18 - NAD 83 Datum

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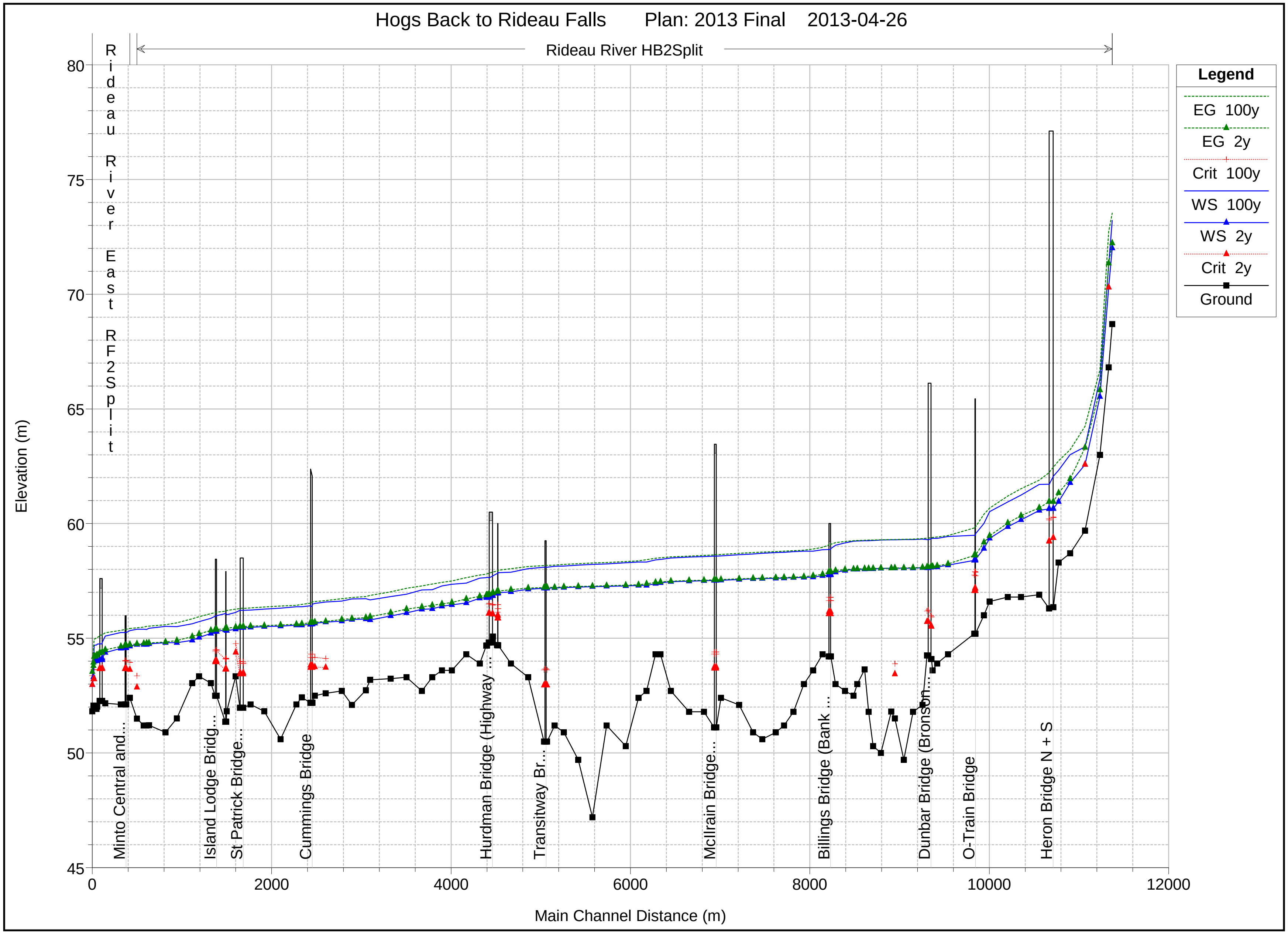
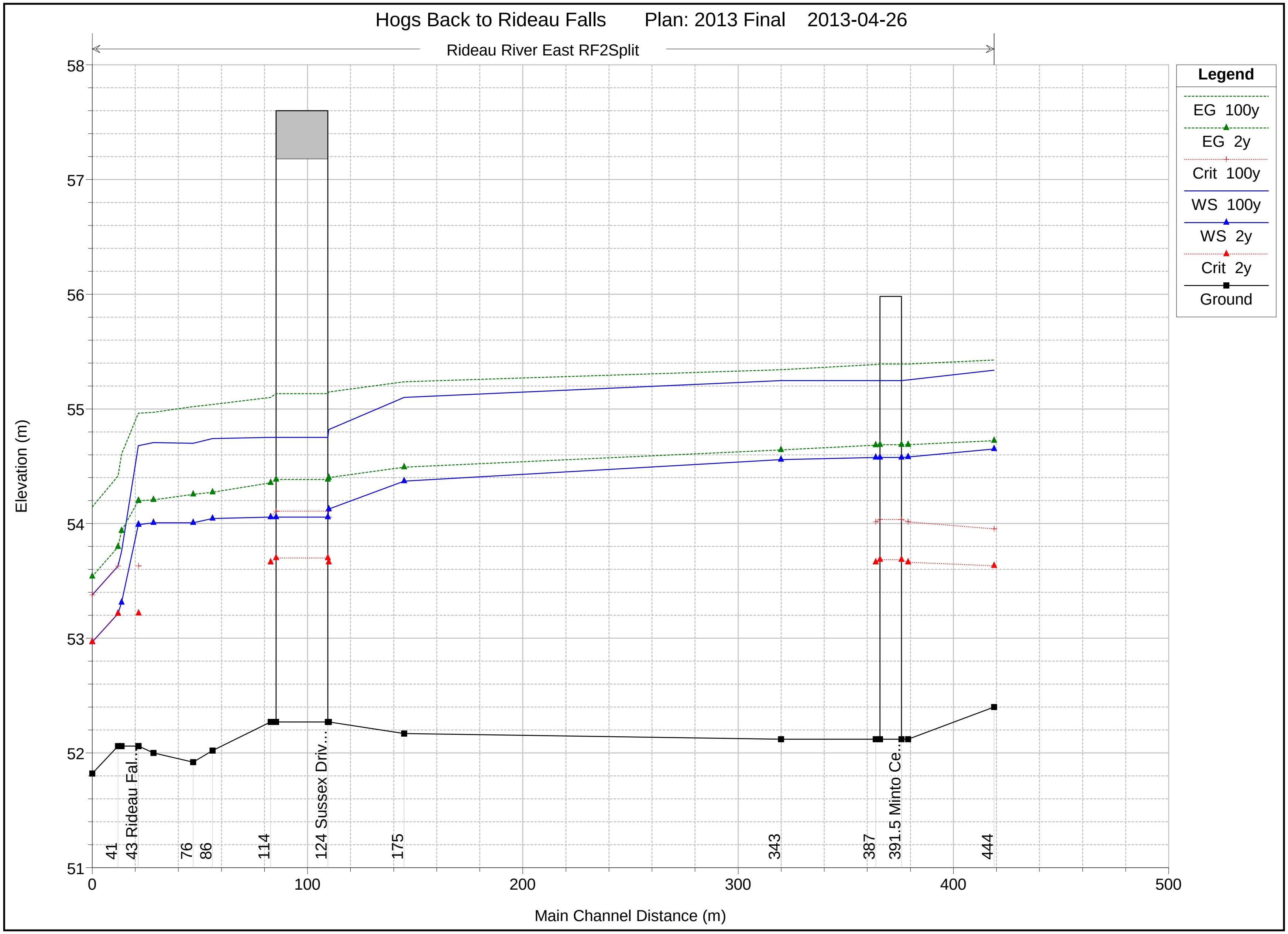
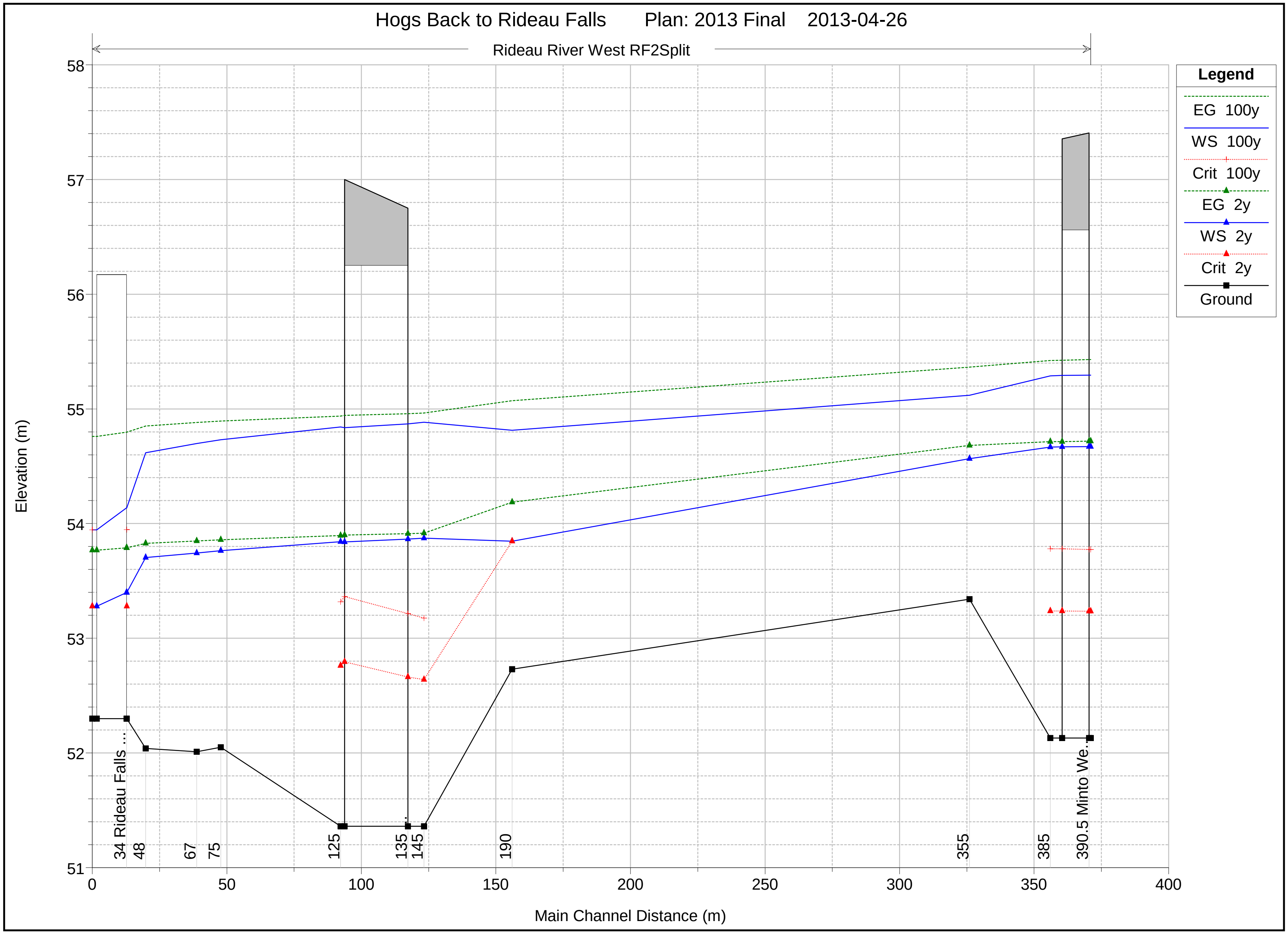
Appendix A

HEC-RAS Profiles and Cross-Sections

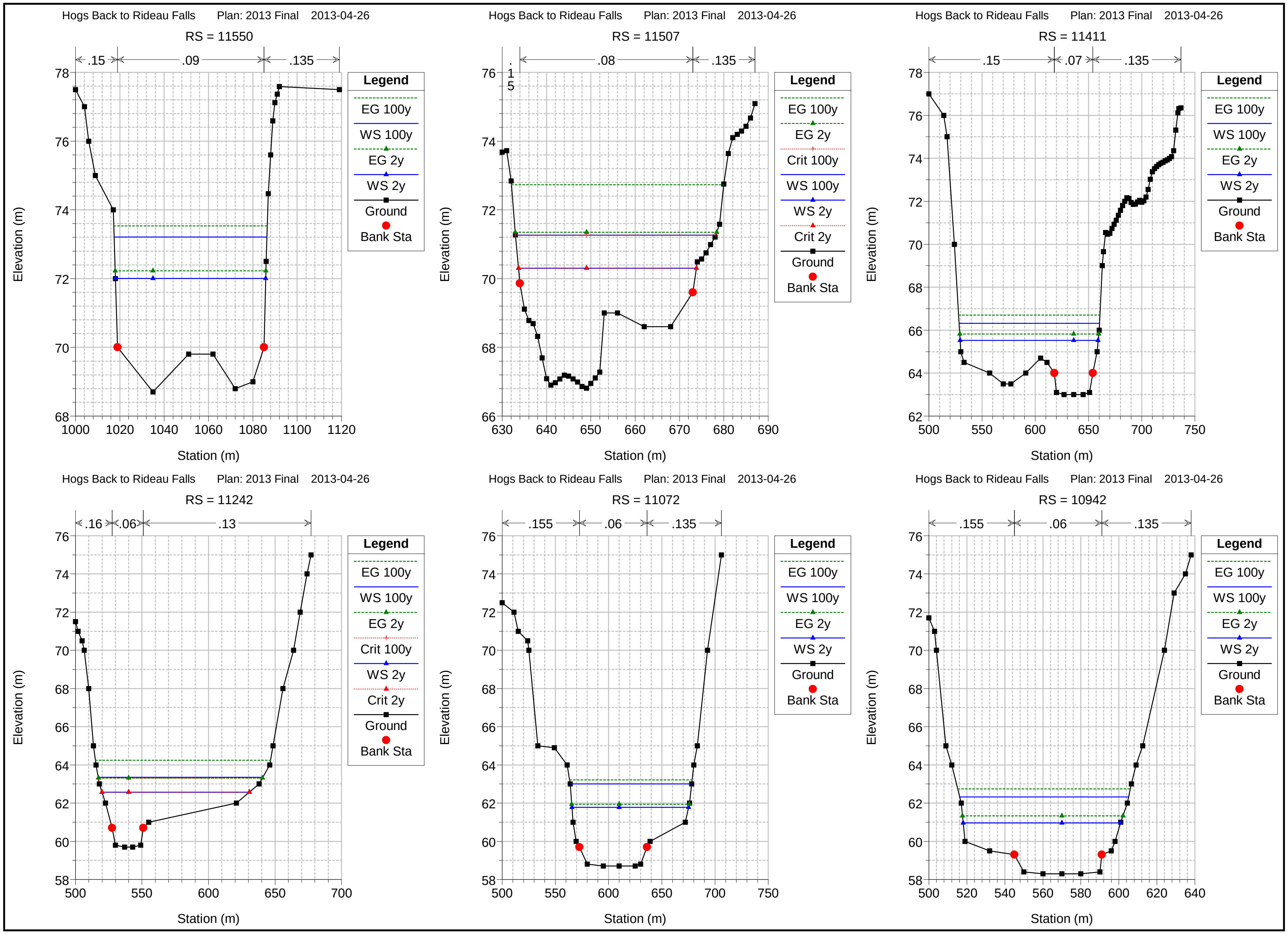


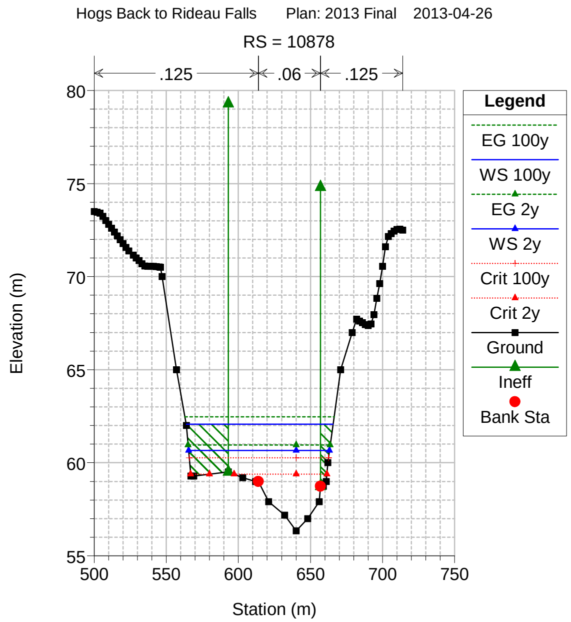
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
Rideau River HB2Split
Rideau River East RF2Split
Legend
EG 100y
EG 2y
Crit 100y
WS 100y
WS 2y
Crit 2y
Ground
Elevation (m)
Main Channel Distance (m)
80
75
70
65
60
55
50
45
0
2000
4000
6000
8000
10000
12000
Minto Central and...
Island Lodge Bridg...
St Patrick Bridge...
Cummings Bridge
Hurdman Bridge (Highway ...
Transitway Br...
McIlrain Bridge...
Billings Bridge (Bank ...
Dunbar Bridge (Bronson...
O-Train Bridge
Heron Bridge N + S

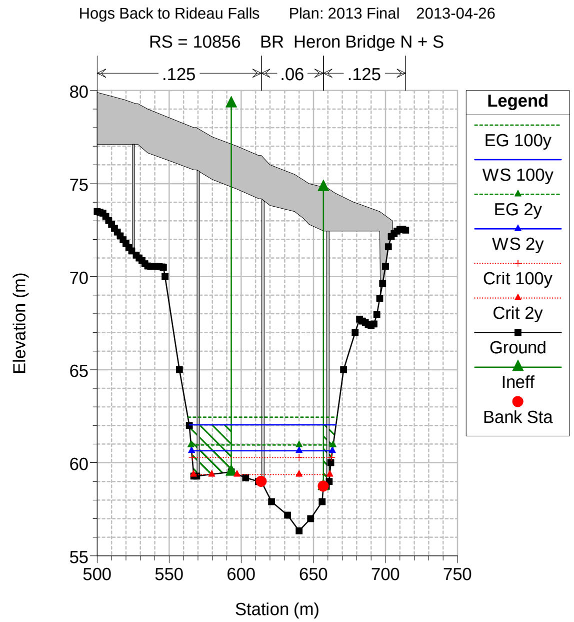

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
Rideau River East RF2Split
Legend
EG 100y
EG 2y
Crit 100y
WS 100y
WS 2y
Crit 2y
Ground
Elevation (m)
Main Channel Distance (m)
41
43 Rideau Fal...
76
86
114
124 Sussex Driv...
175
343
387
391.5 Minto Ce...
444
58
57
56
55
54
53
52
51
0
100
200
300
400
500

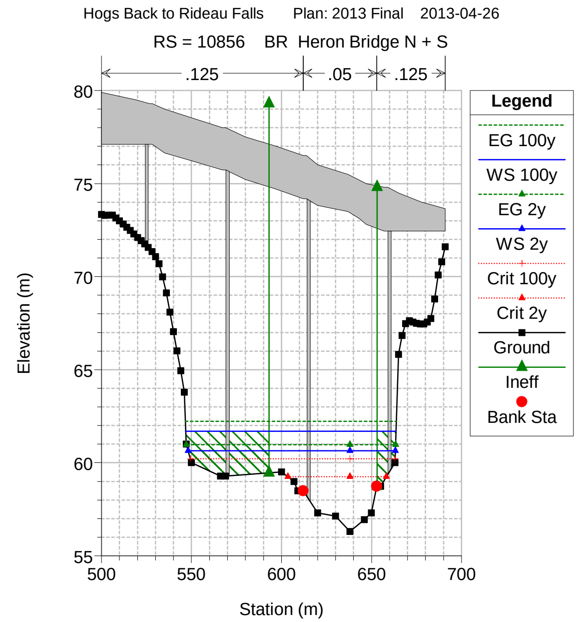


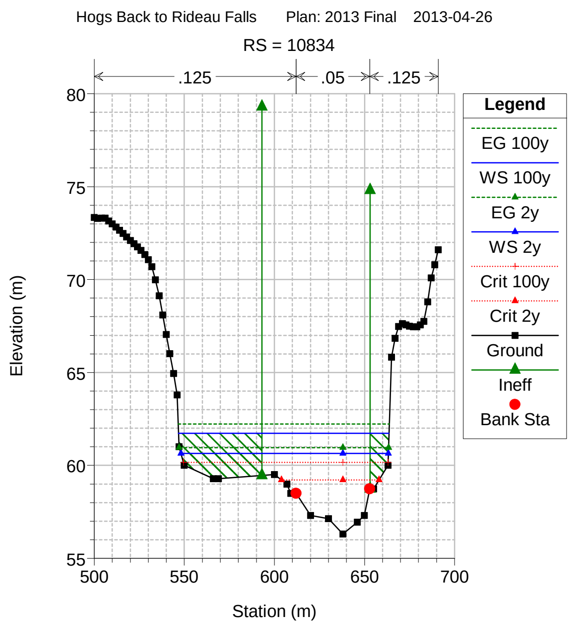
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
Rideau River West RF2Split
Legend
EG 100y
WS 100y
Crit 100y
EG 2y
WS 2y
Crit 2y
Ground
Elevation (m)
Main Channel Distance (m)
34 Rideau Falls ...
48
67
75
125
135
145
190
355
385
390.5 Minto We...
58
57
56
55
54
53
52
51
0
50
100
150
200
250
300
350
400

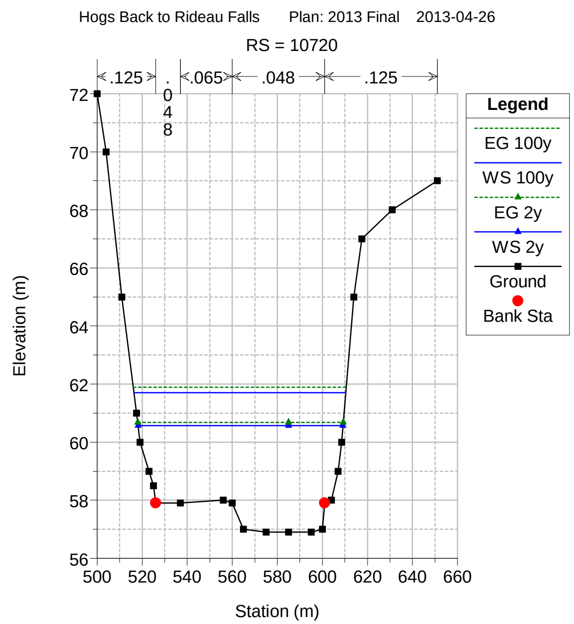

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 11550
.15
.09
.135
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 11507
.08
.135
Legend
EG 100y
EG 2y
Crit 100y
WS 100y
WS 2y
Crit 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 11411
.15
.07
.135
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 11242
.16
.06
.13
Legend
EG 100y
WS 100y
EG 2y
Crit 100y
WS 2y
Crit 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 11072
.155
.06
.135
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 10942
.155
.06
.135
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)

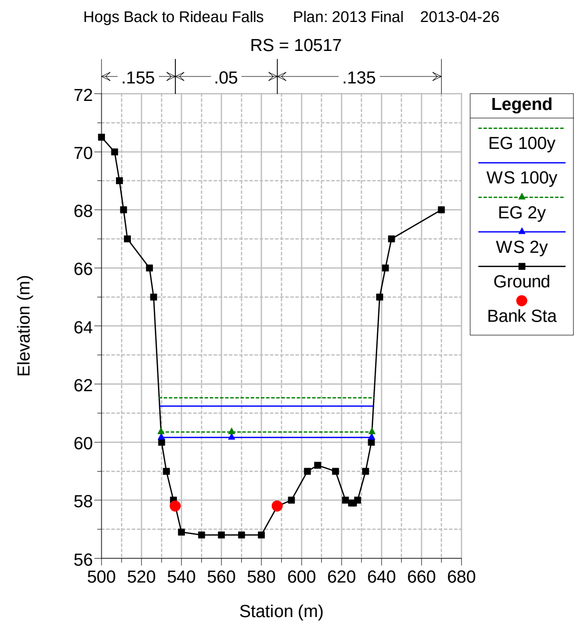

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 10878
.125
.06
.125
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta

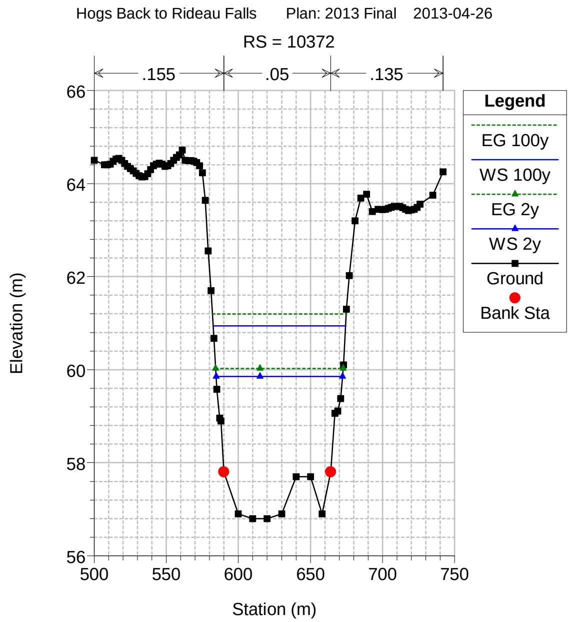

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 10856 BR Heron Bridge N + S
.125
.06
.125
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta

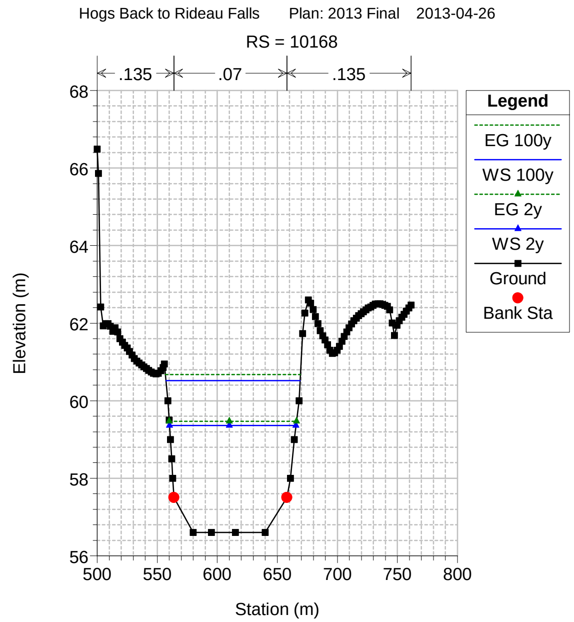

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 10856 BR Heron Bridge N + S
.125
.05
.125
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta

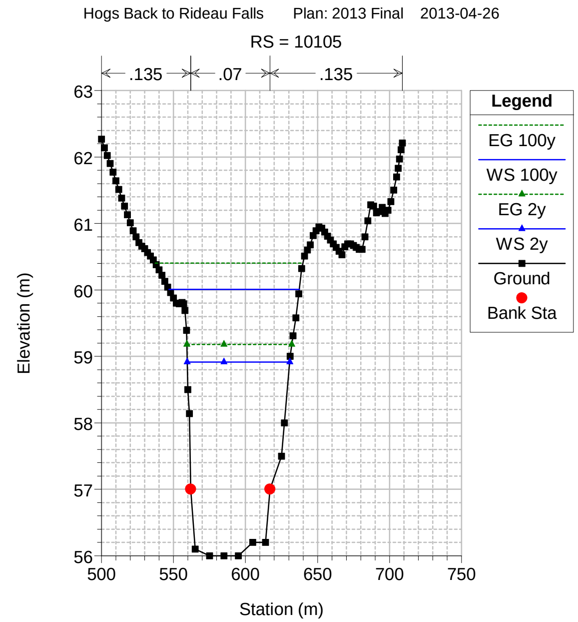

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 10834
.125
.05
.125
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta

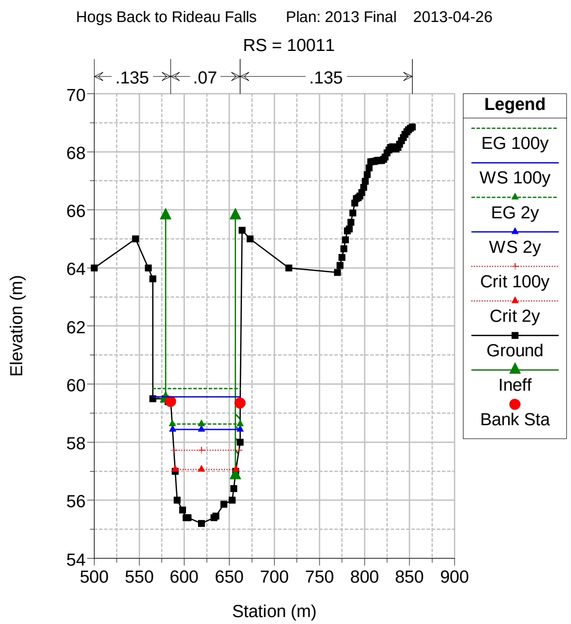

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 10720
.125
.048
.065
.048
.125
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta

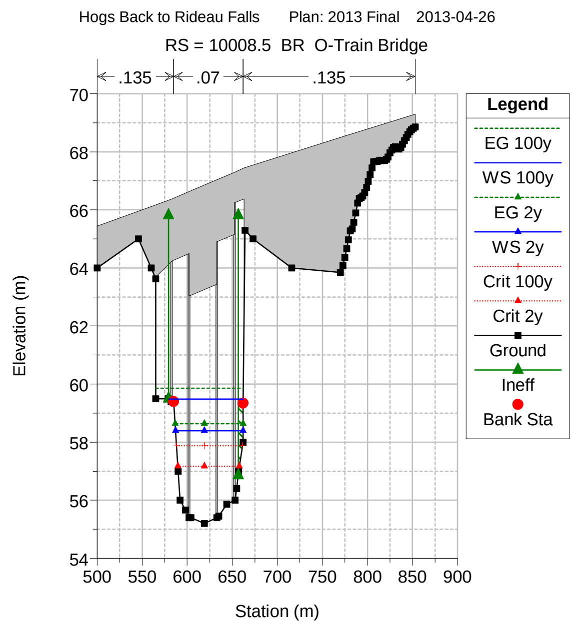

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 10517
.155
.05
.135
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta

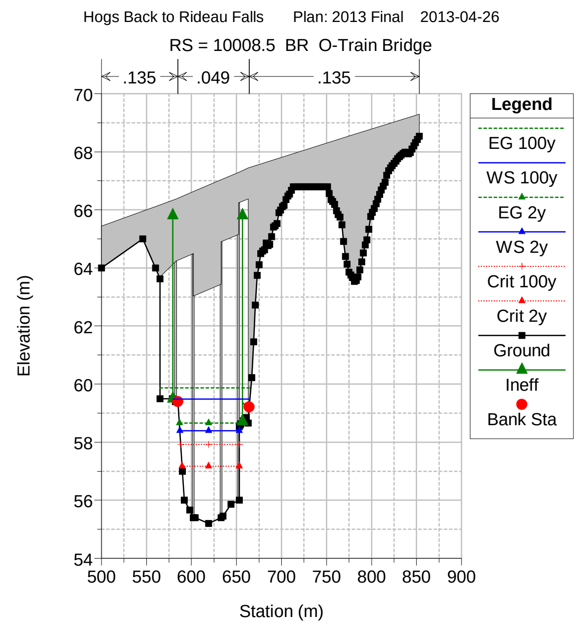

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 10372
.155
.05
.135
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta

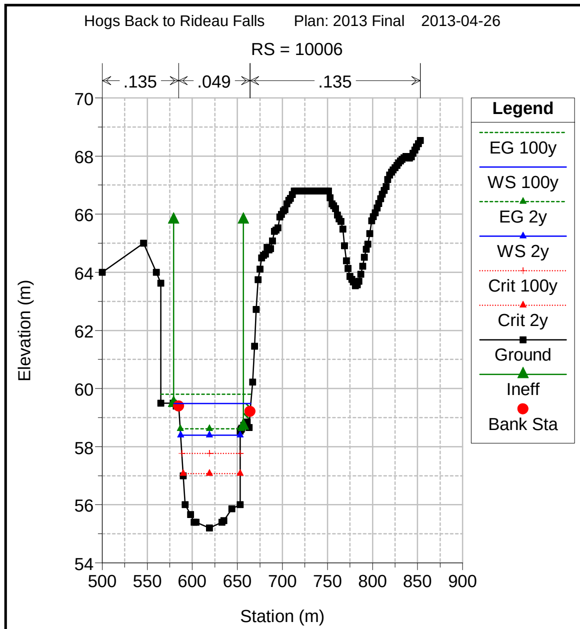

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 10168
.135
.07
.135
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta

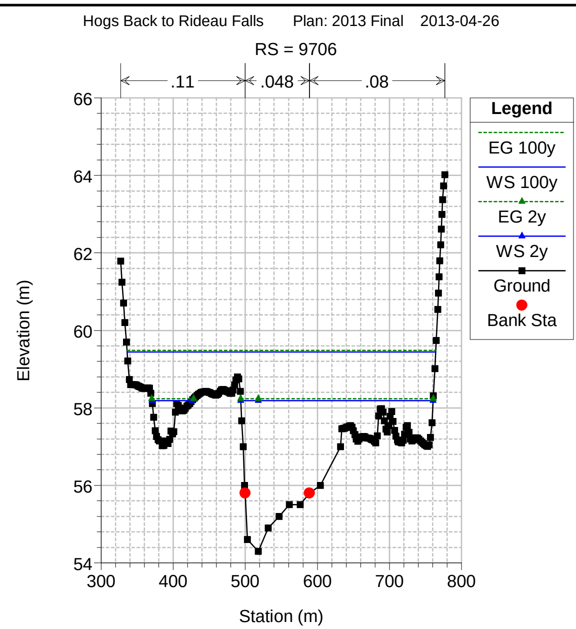

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 10105
.135
.07
.135
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta

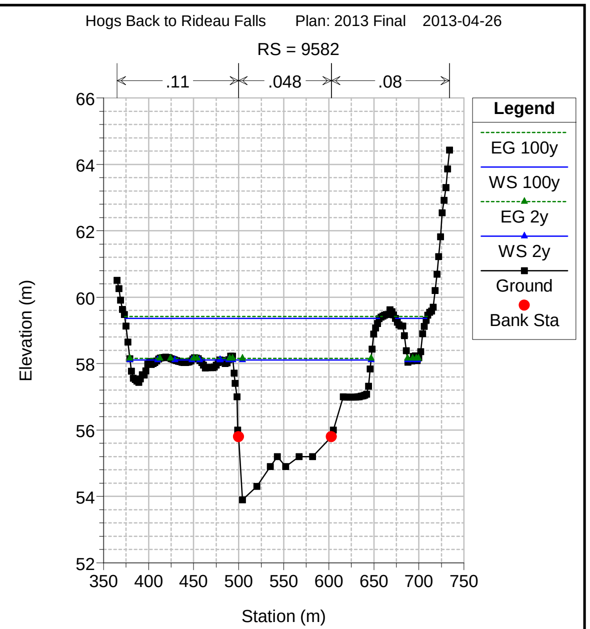

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 10011
.135
.07
.135
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta

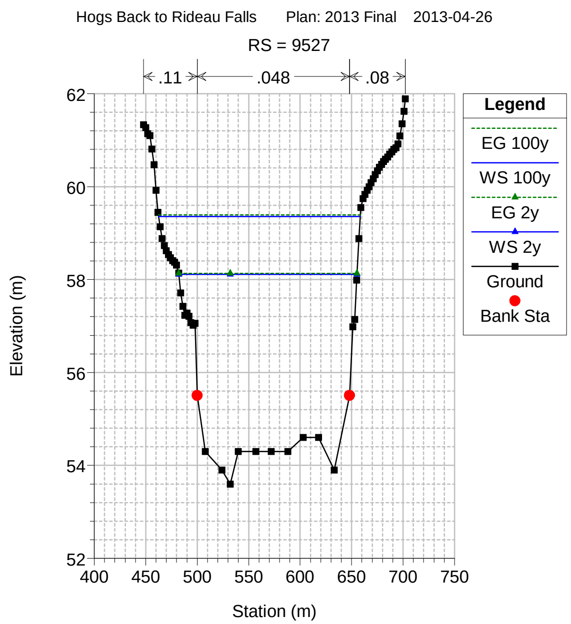

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 10008.5 BR O-Train Bridge
.135
.07
.135
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta

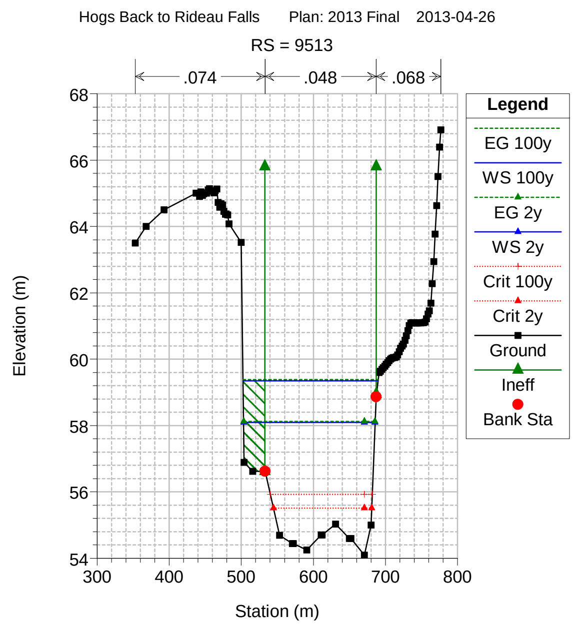

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 10008.5 BR O-Train Bridge
.135
.049
.135
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta

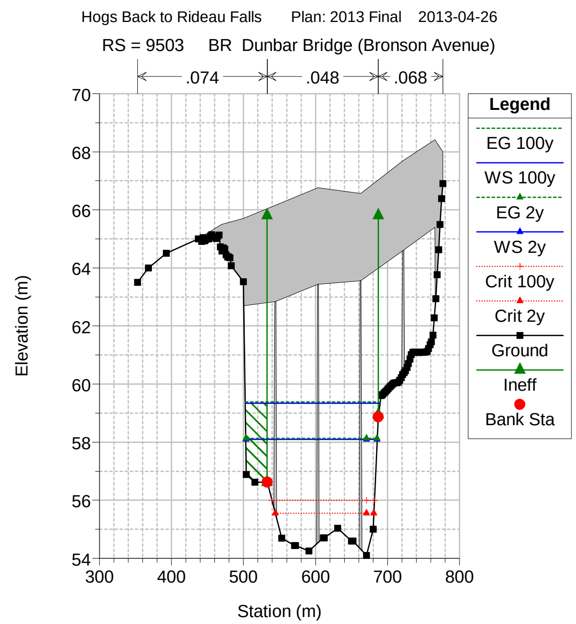

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 10006
.135 .049 .135
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta

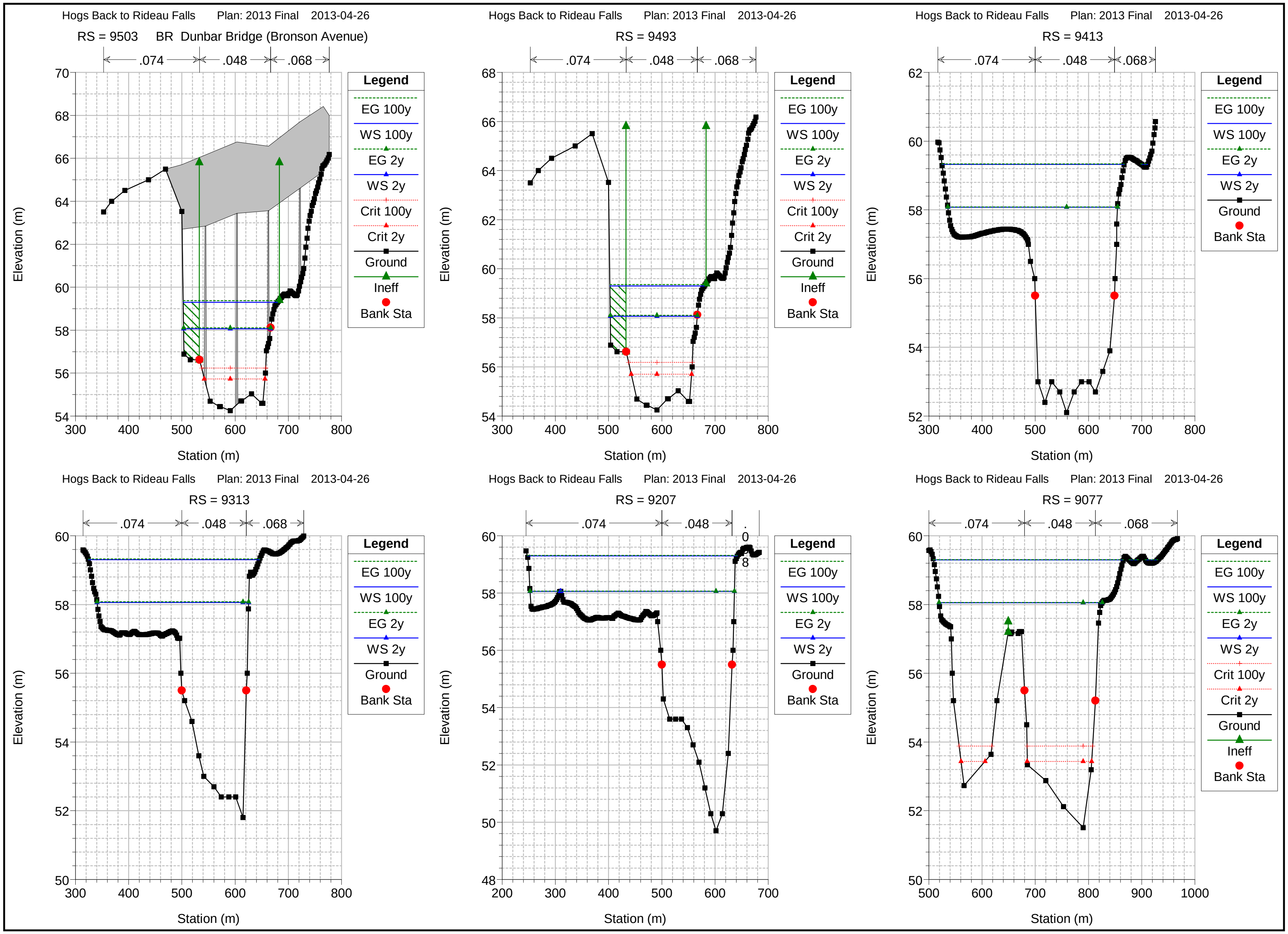

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 9706
.11 .048 .08
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta


Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 9582
.11 .048 .08
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta

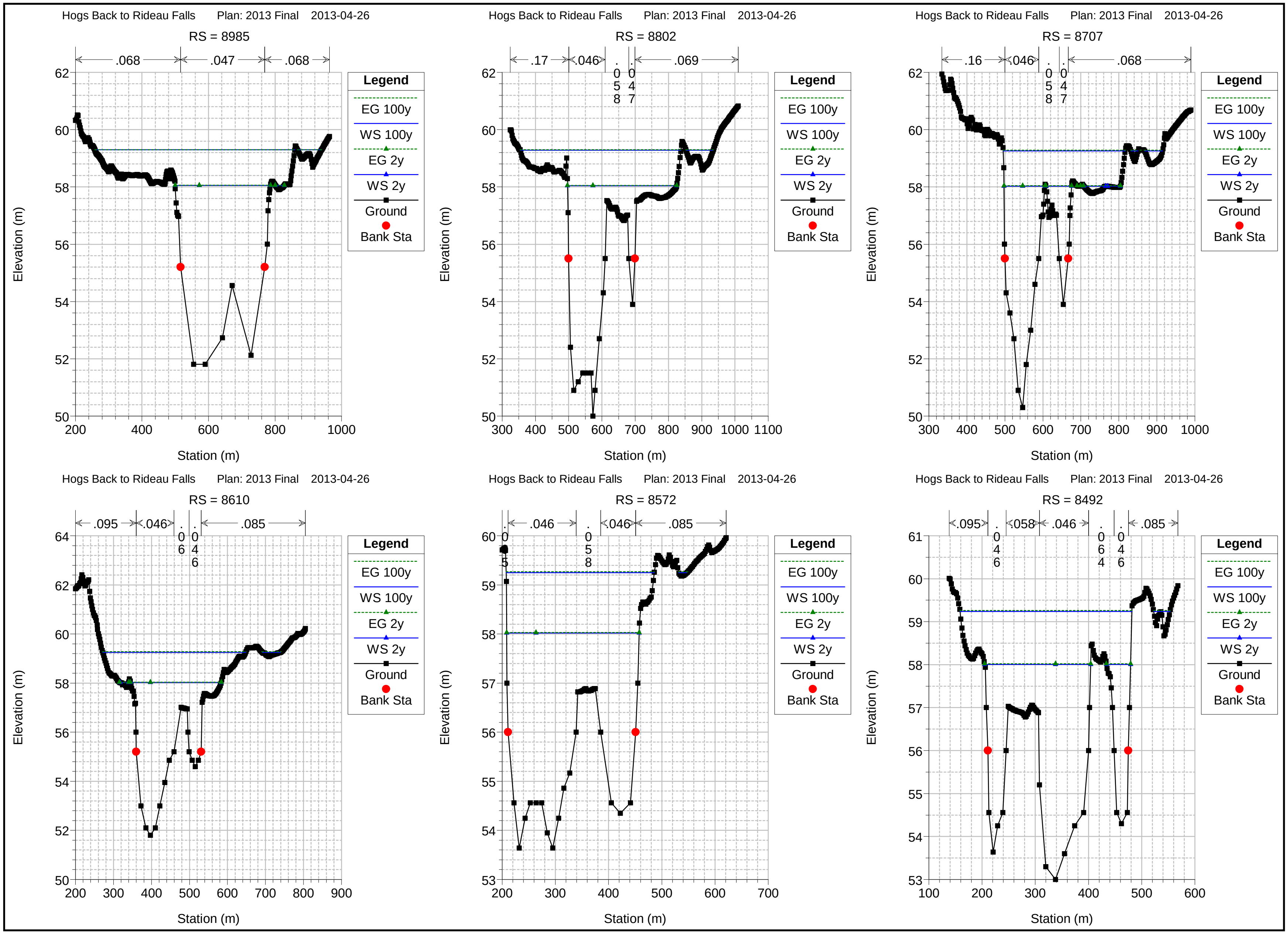

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 9527
.11 .048 .08
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta

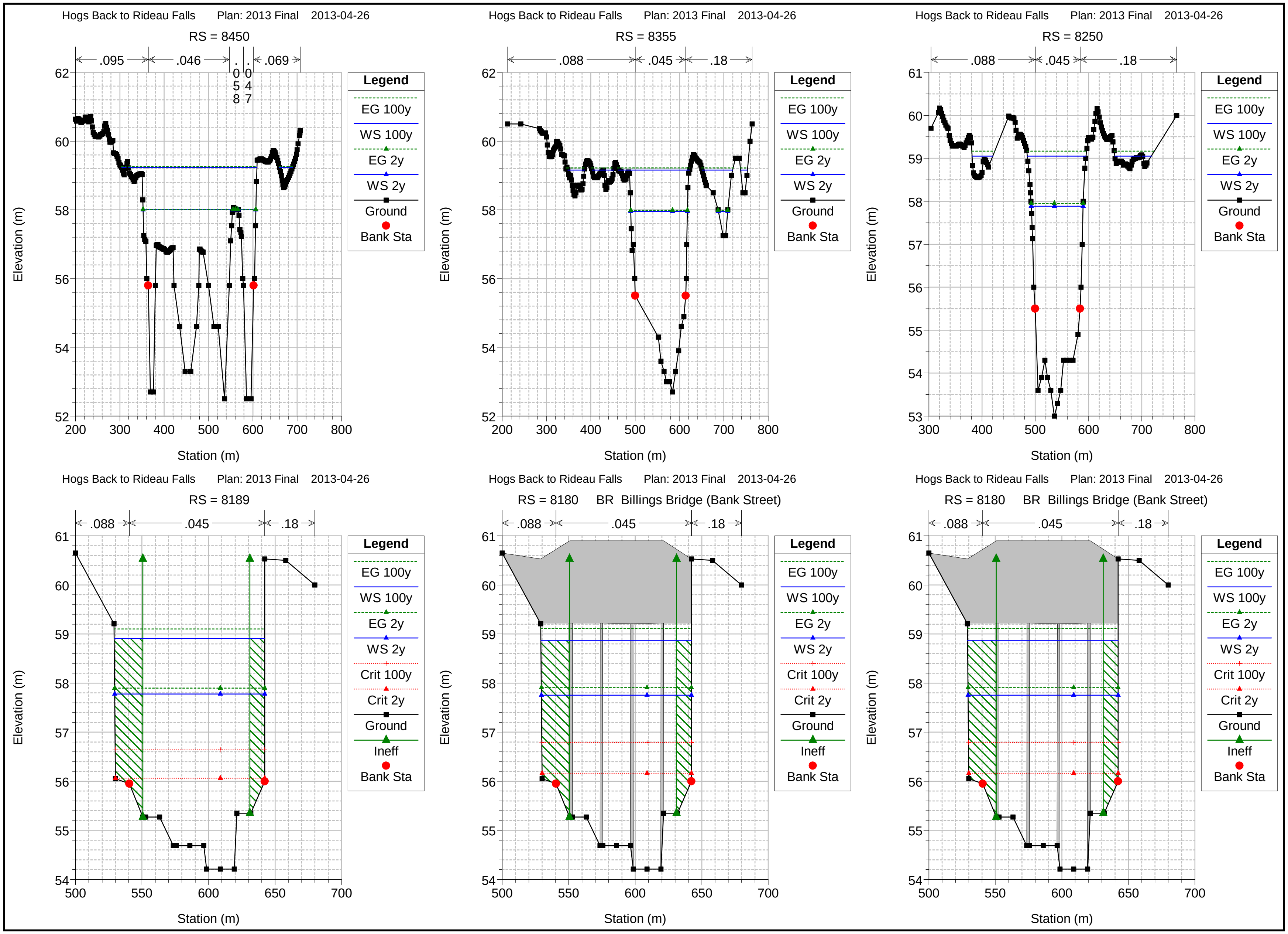

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 9513
.074 .048 .068
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta

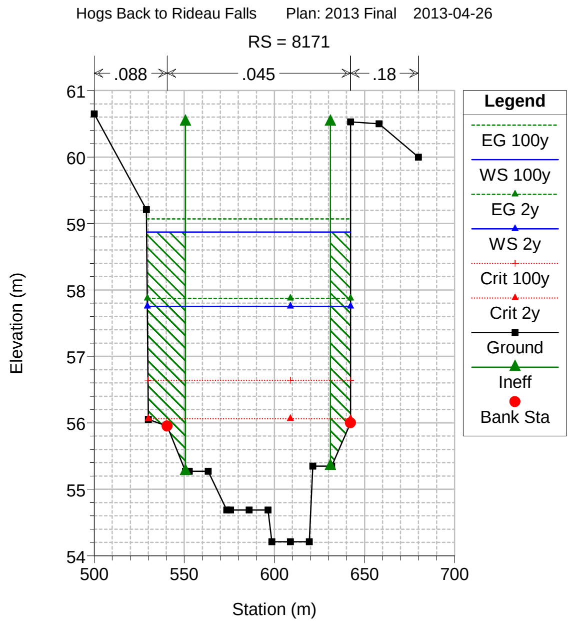

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 9503 BR Dunbar Bridge (Bronson Avenue)
.074 .048 .068
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta

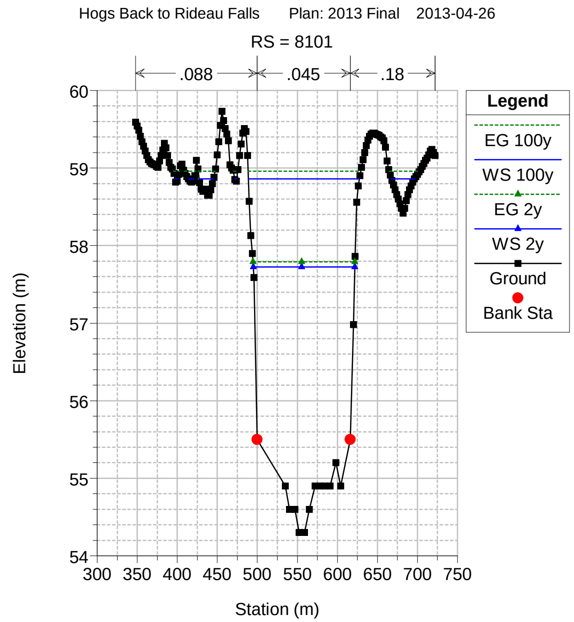


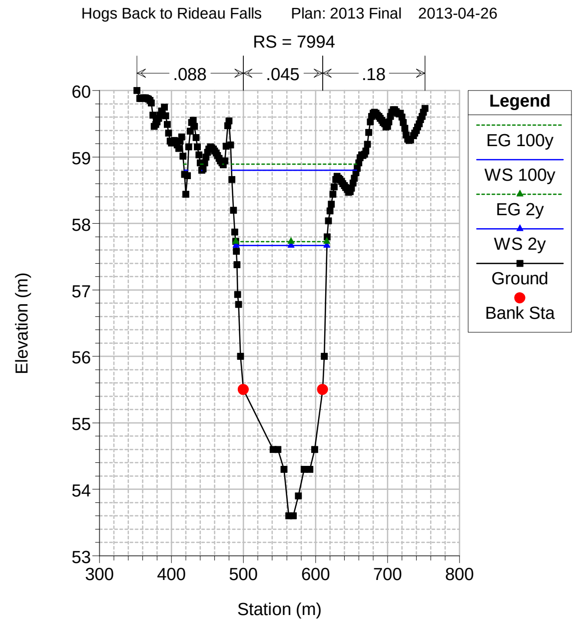
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 9503 BR Dunbar Bridge (Bronson Avenue)
.074 .048 .068
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 9493
.074 .048 .068
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 9413
.074 .048 .068
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 9313
.074 .048 .068
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 9207
.074 .048
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 9077
.074 .048 .068
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta

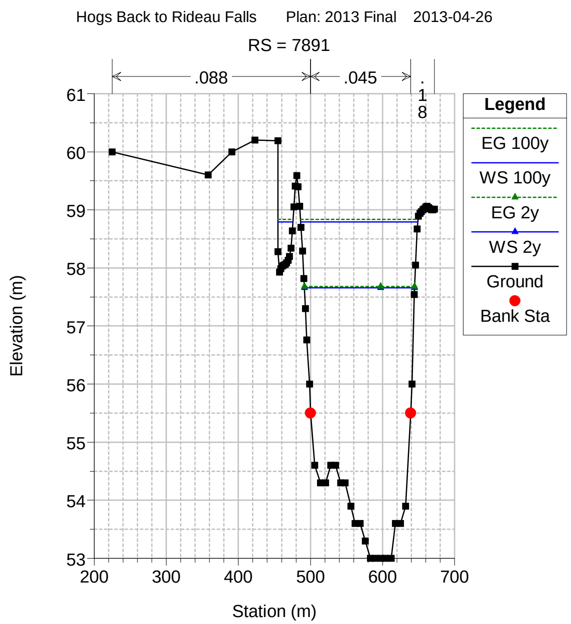

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 8985
.068 .047 .068
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 8802
.17 .046 .058 .047 .069
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 8707
.16 .046 .058 .047 .068
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 8610
.095 .046 .06 .046 .085
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 8572
.05 .046 .058 .046 .085
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 8492
.095 .046 .058 .046 .064 .046 .085
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)

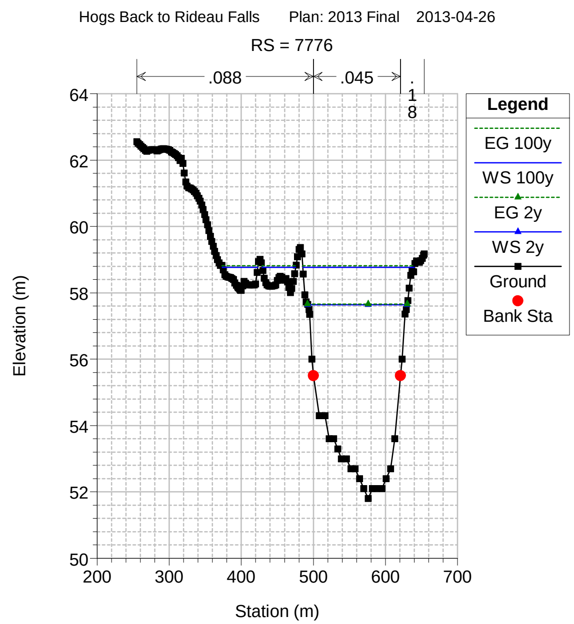

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 8450
.095
.046
.058
.047
.069
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 8355
.088
.045
.18
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 8250
.088
.045
.18
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 8189
.088
.045
.18
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 8180 BR Billings Bridge (Bank Street)
.088
.045
.18
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 8180 BR Billings Bridge (Bank Street)
.088
.045
.18
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

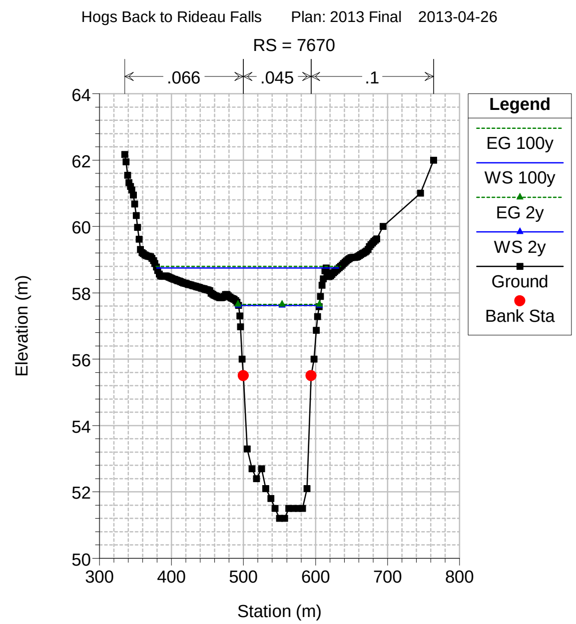

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 8171
.088
.045
.18
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

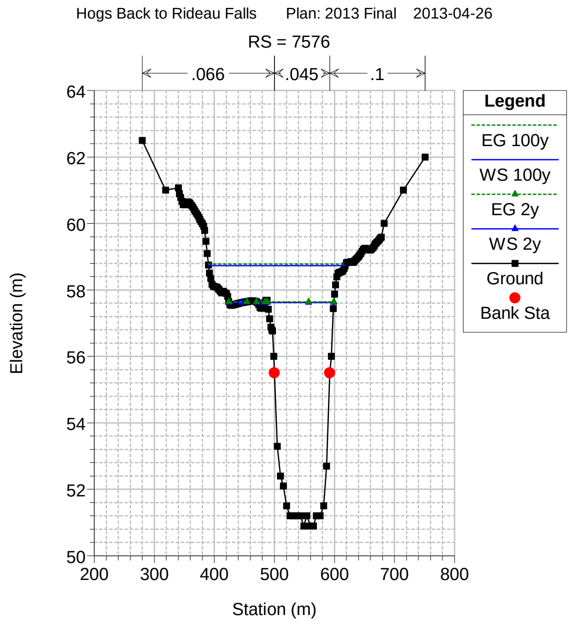

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 8101
.088
.045
.18
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)

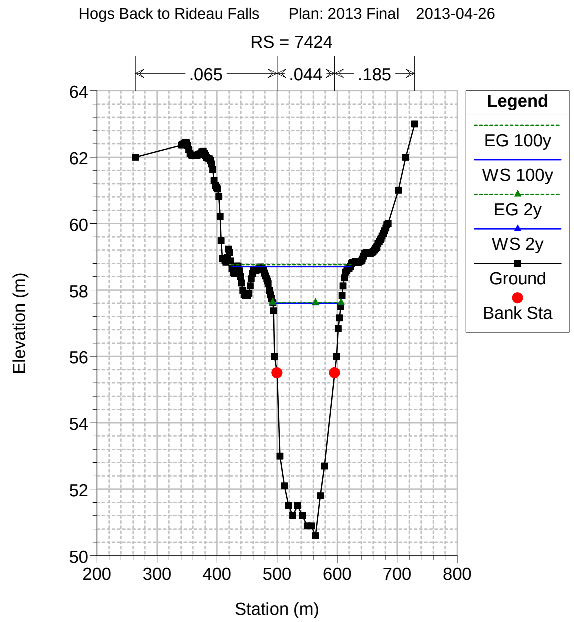

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 7994
.088
.045
.18
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)

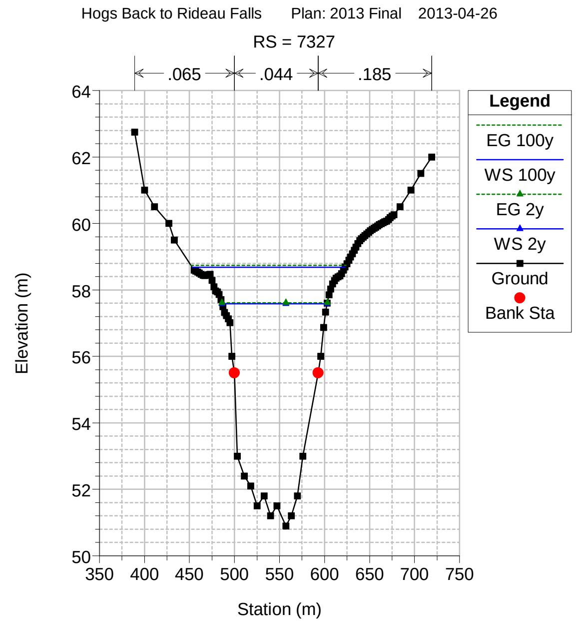

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 7891
.088
.045
.18
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)

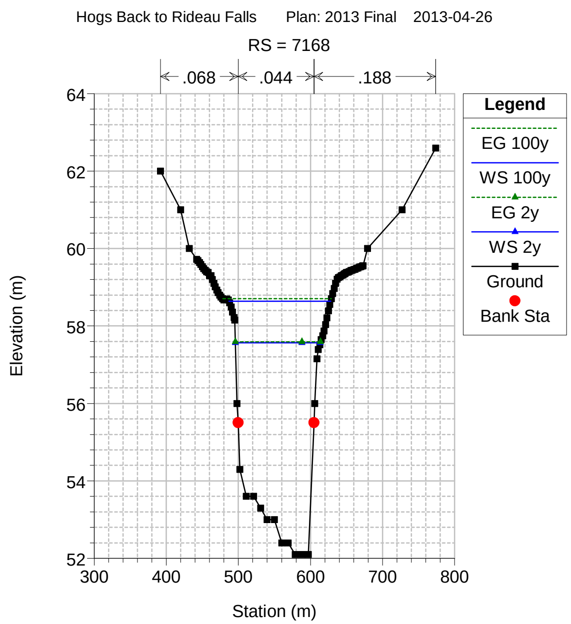

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 7776
.088
.045
.18
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)

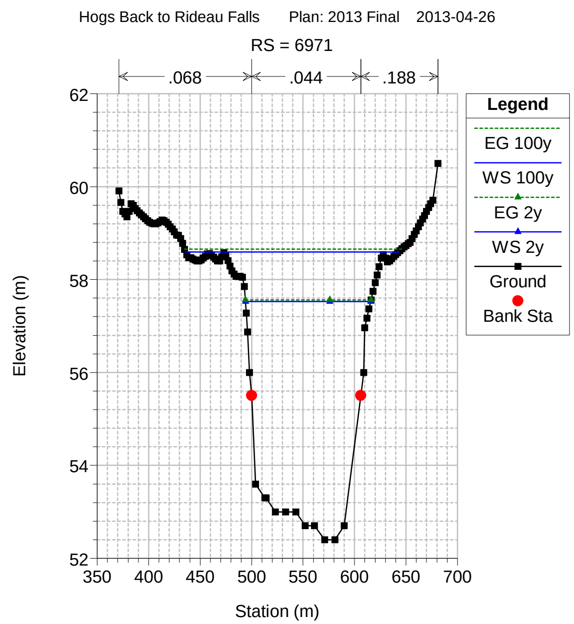

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 7670
.066
.045
.1
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)

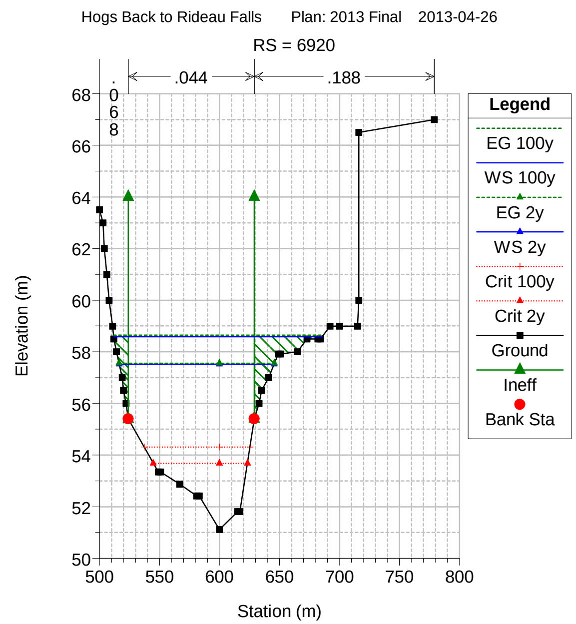

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 7576
.066
.045
.1
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)

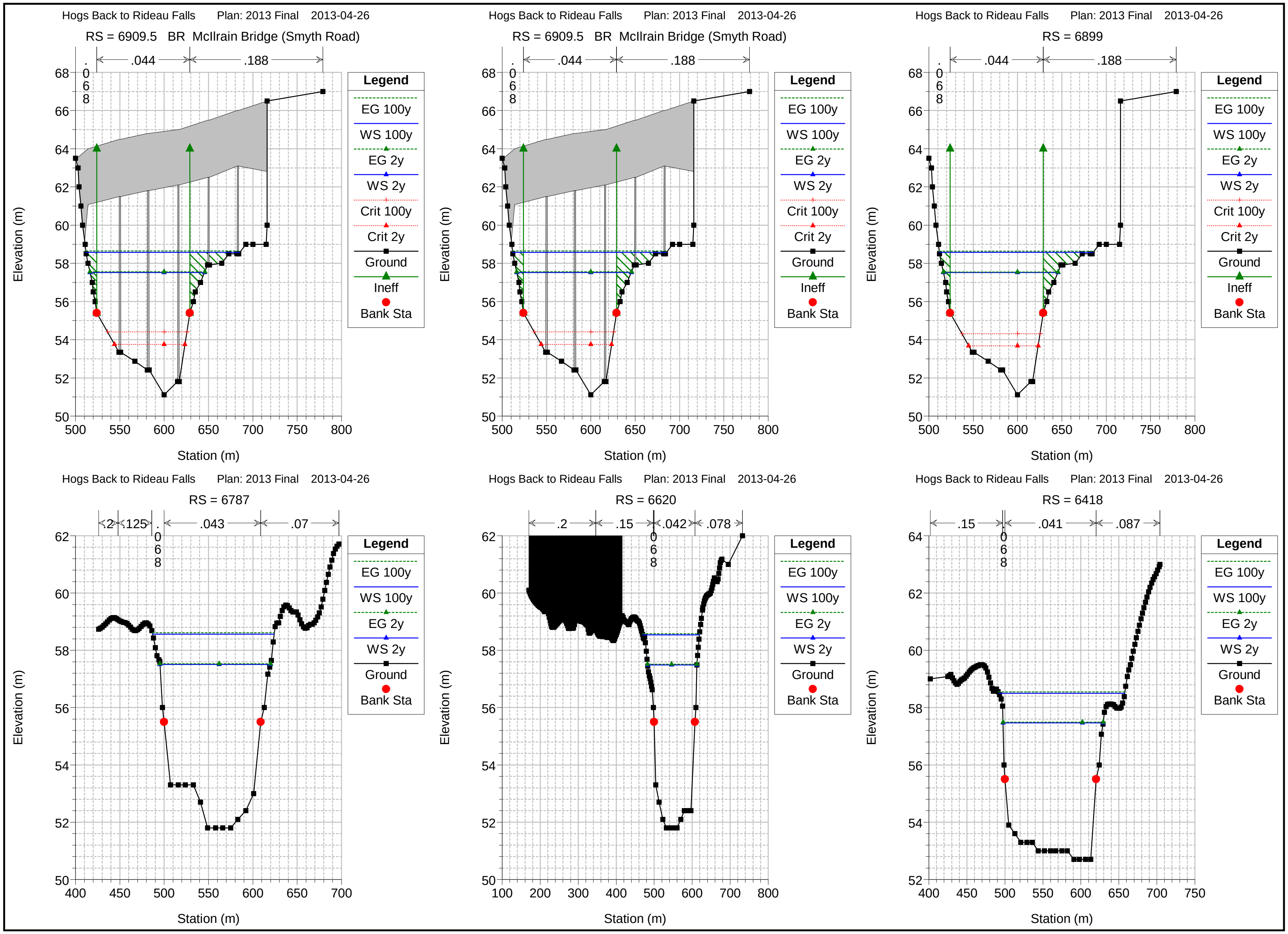

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 7424
.065
.044
.185
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)

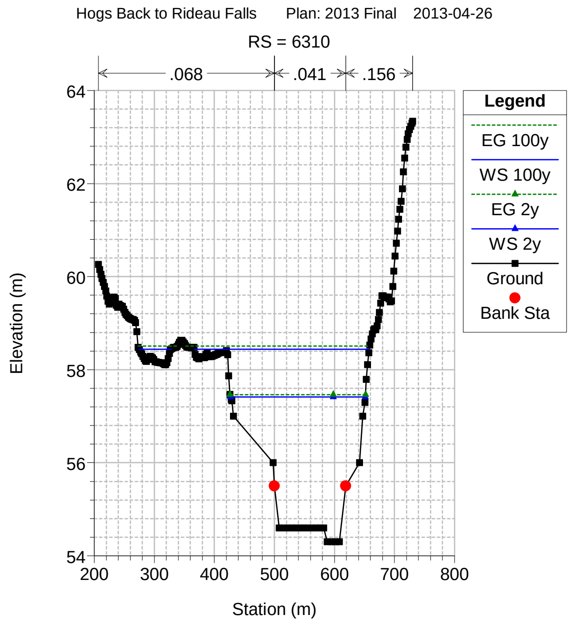

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 7327
.065
.044
.185
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)

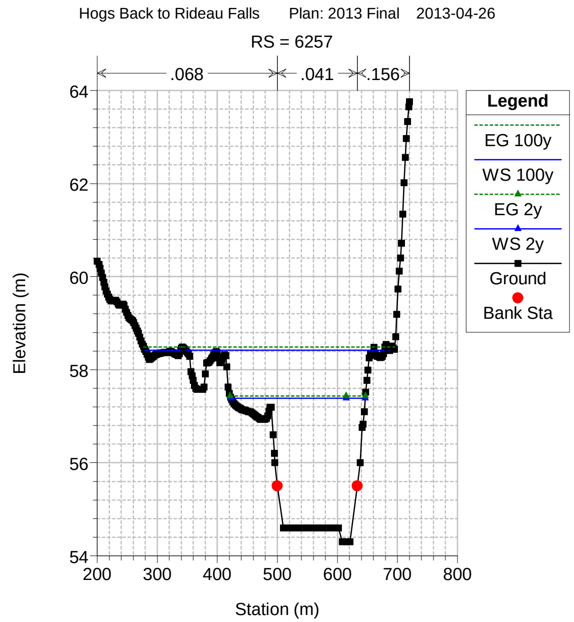

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 7168
.068
.044
.188
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)

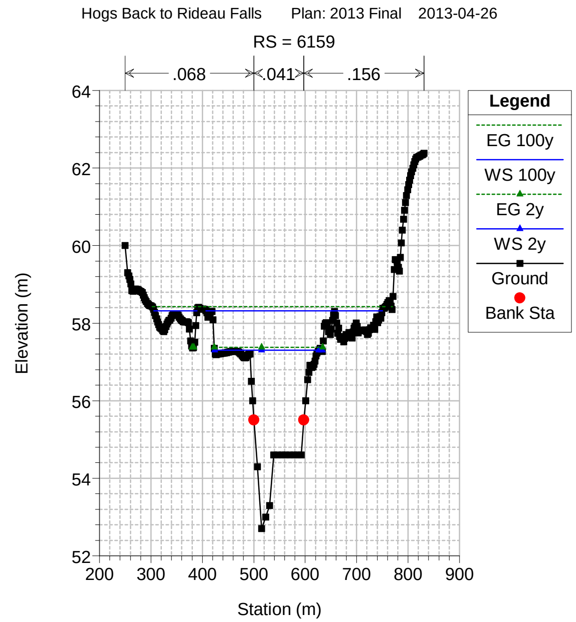

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 6971
.068
.044
.188
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)

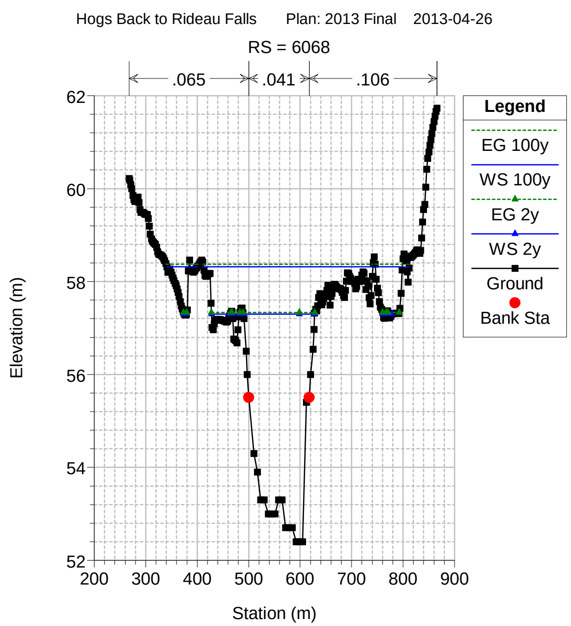

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 6920
.068
.044
.188
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

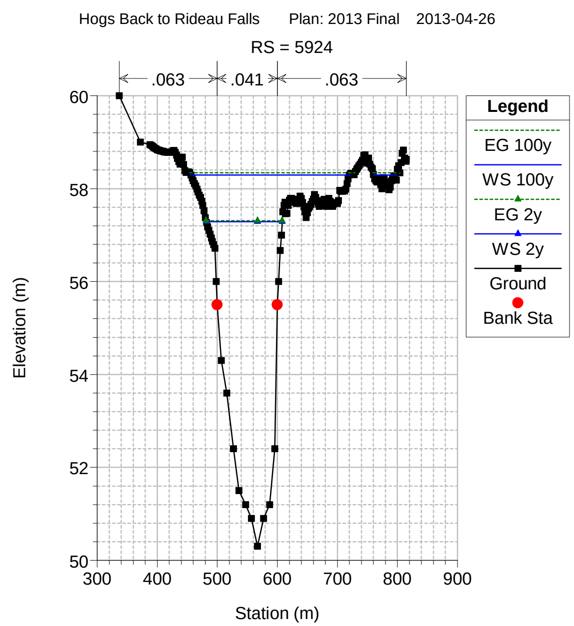

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 6909.5 BR McIlrain Bridge (Smyth Road)
.044
.188
.068
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 6909.5 BR McIlrain Bridge (Smyth Road)
.044
.188
.068
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 6899
.044
.188
.068
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 6787
.2
.125
.068
.043
.07
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 6620
.2
.15
.068
.042
.078
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 6418
.15
.068
.041
.087
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)

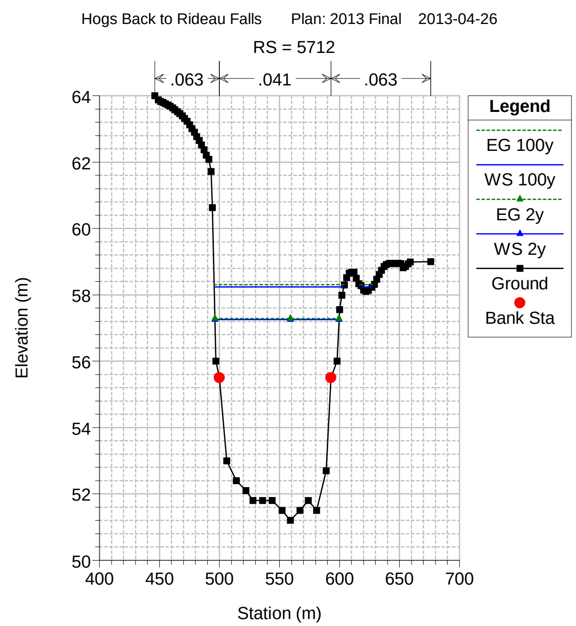

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 6310
.068
.041
.156
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)

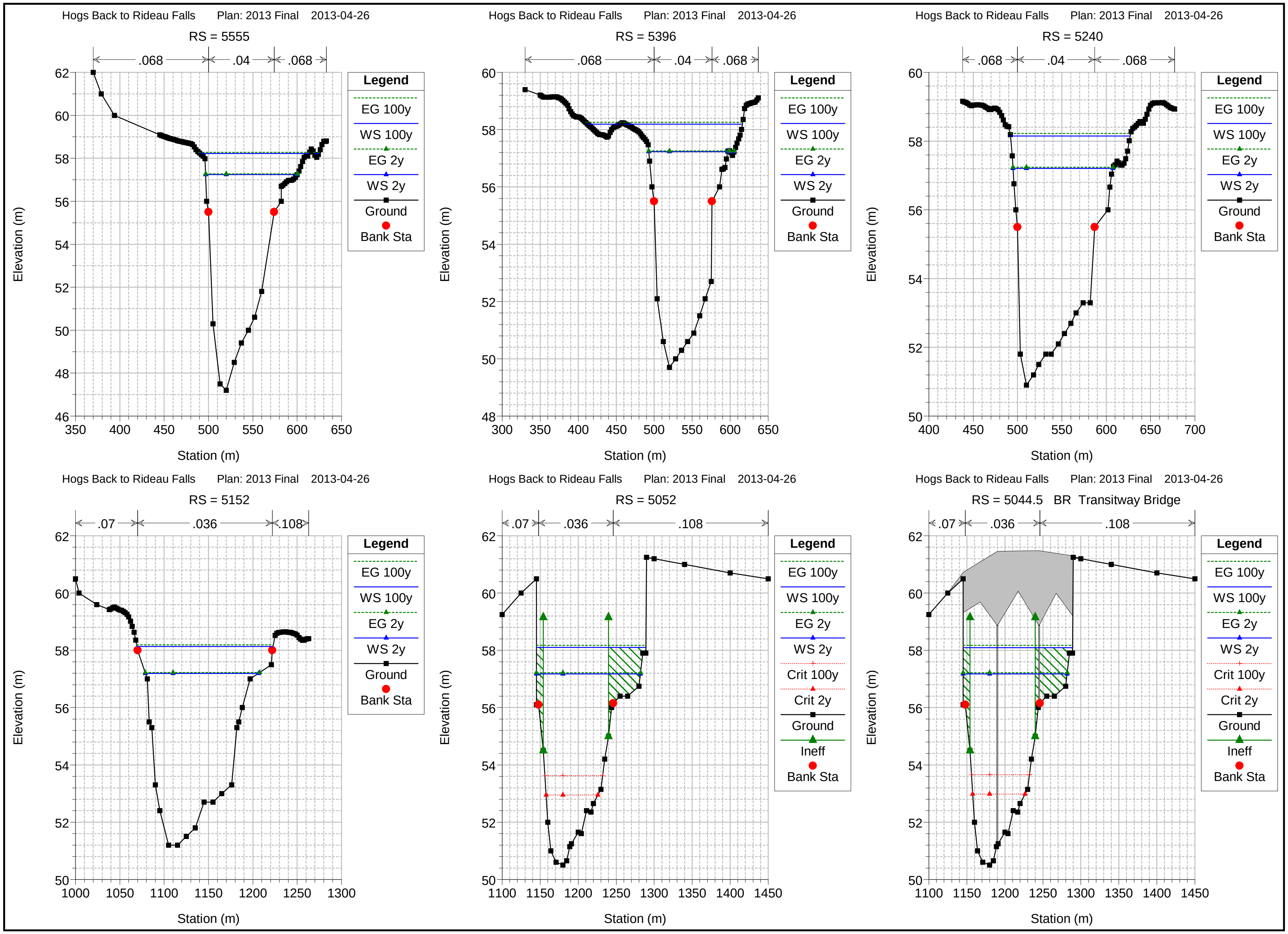

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 6257
.068
.041
.156
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)


Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 6159
.068
.041
.156
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)

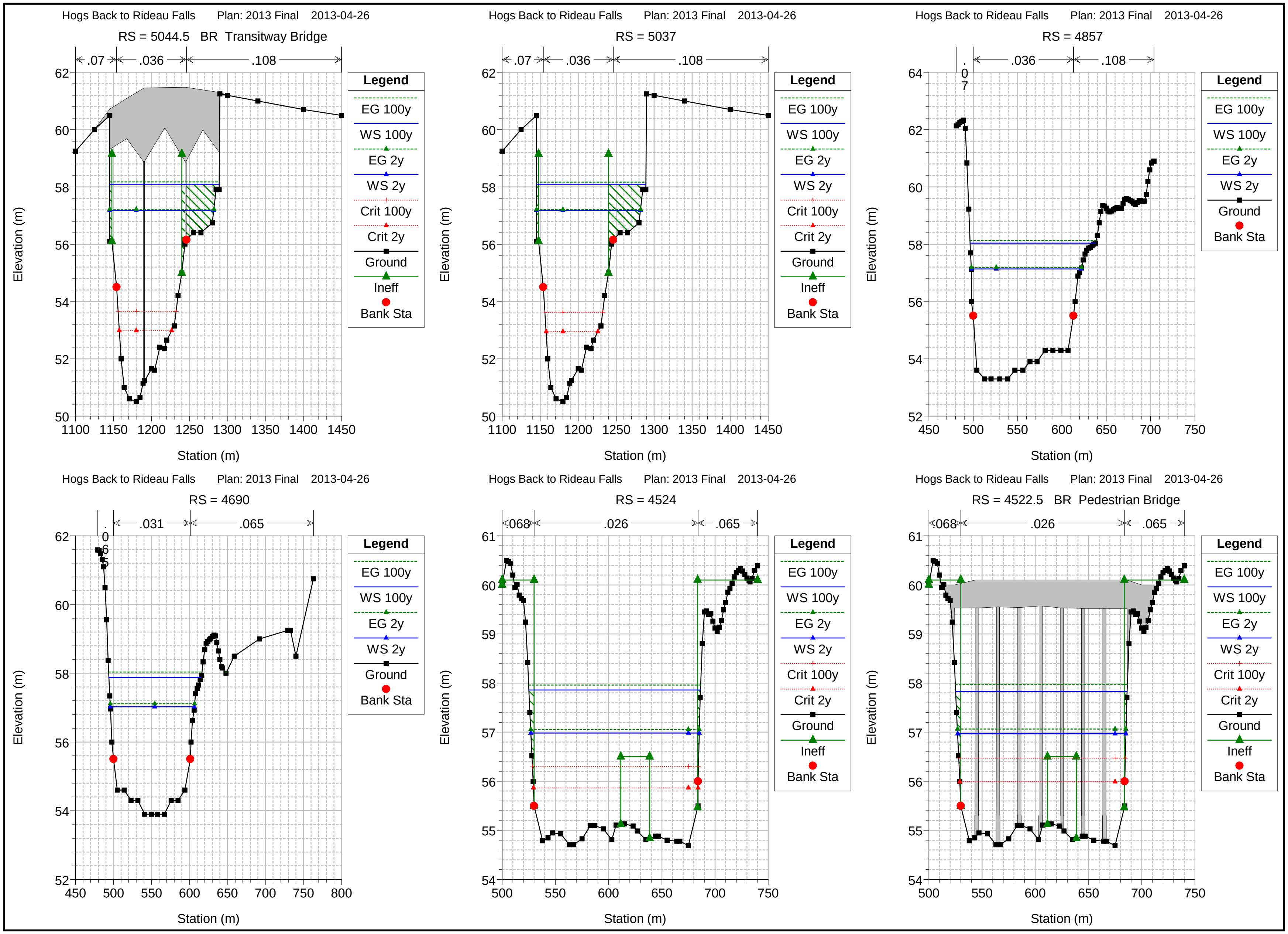

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 6068
.065
.041
.106
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)

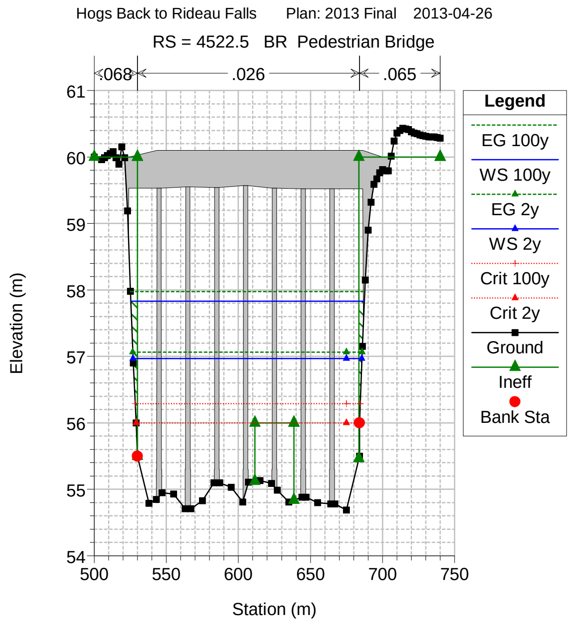

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 5924
.063
.041
.063
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)

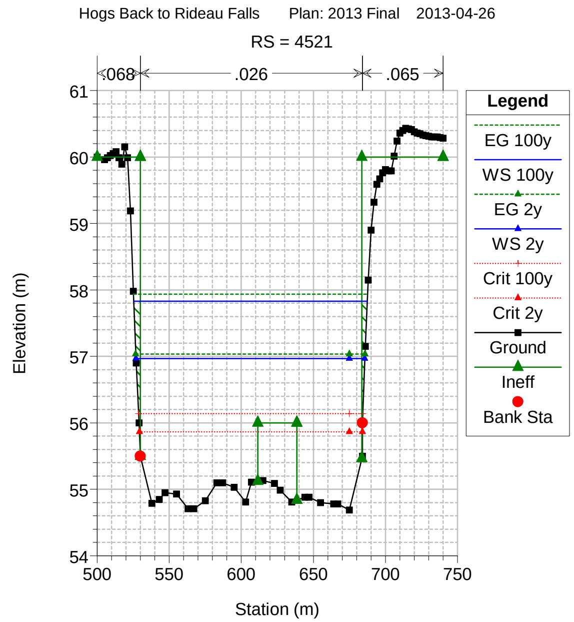

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 5712
.063
.041
.063
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)

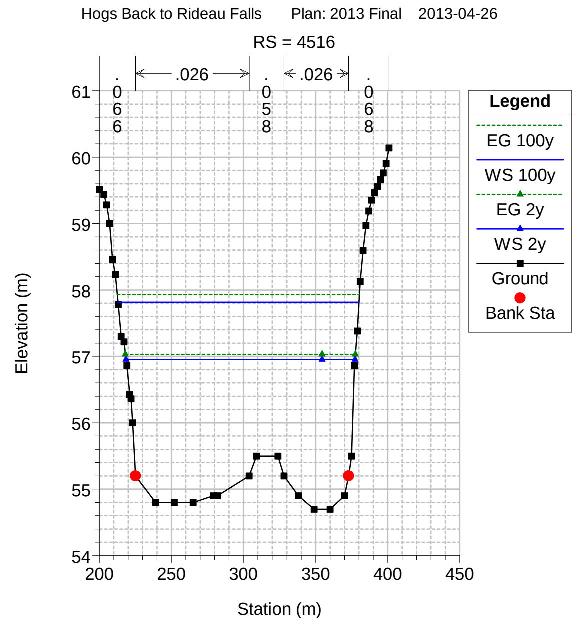


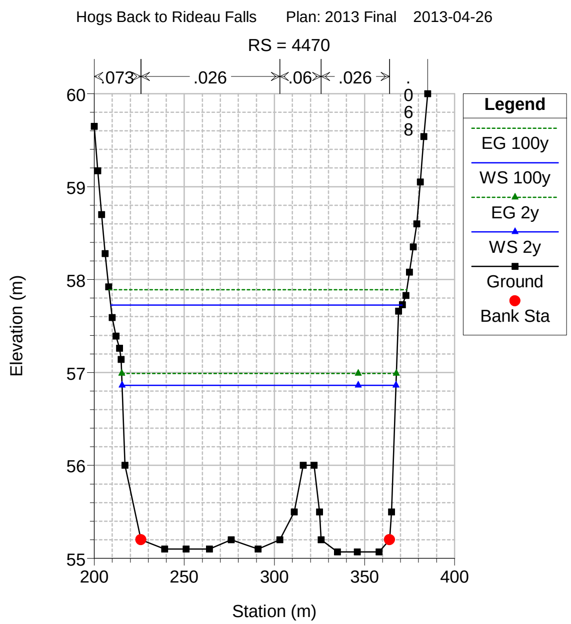
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 5555
.068
.04
.068
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 5396
.068
.04
.068
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 5240
.068
.04
.068
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 5152
.07
.036
.108
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 5052
.07
.036
.108
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 5044.5 BR Transitway Bridge
.07
.036
.108
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

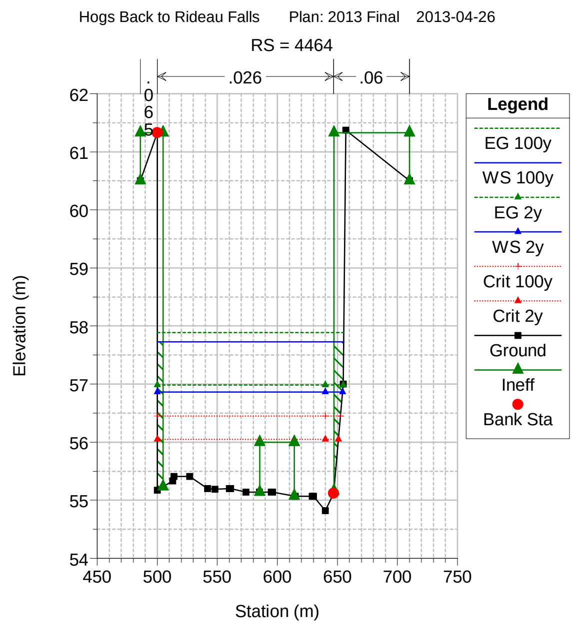

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 5044.5 BR Transitway Bridge
.07 .036 .108
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 5037
.07 .036 .108
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 4857
.07 .036 .108
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 4690
.065 .031 .065
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 4524
.068 .026 .065
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 4522.5 BR Pedestrian Bridge
.068 .026 .065

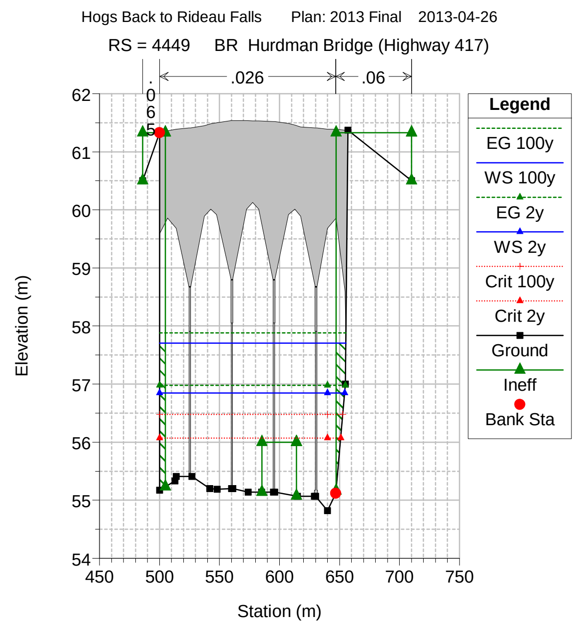

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 4522.5 BR Pedestrian Bridge
.068
.026
.065
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

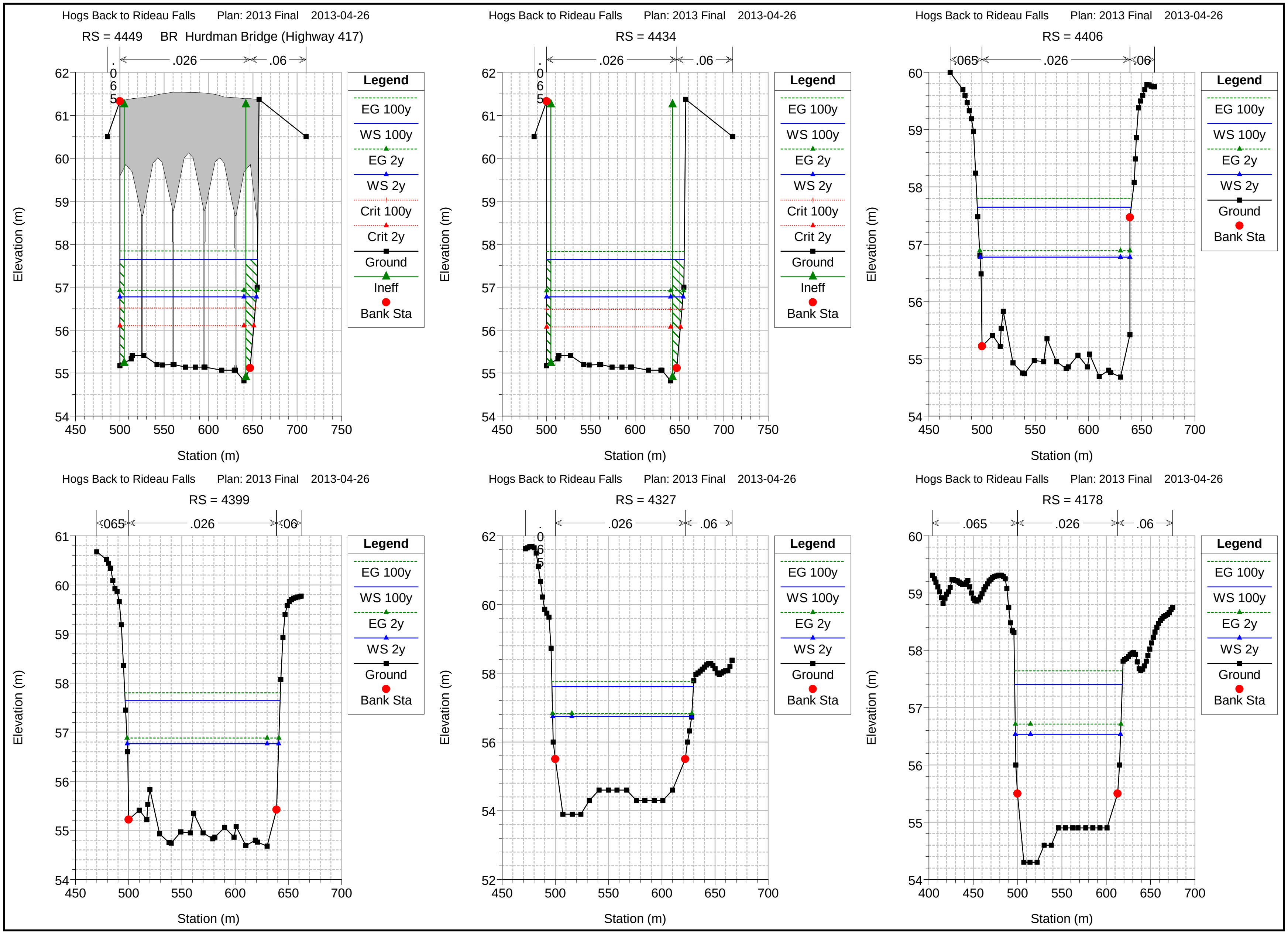

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 4521
.068
.026
.065
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

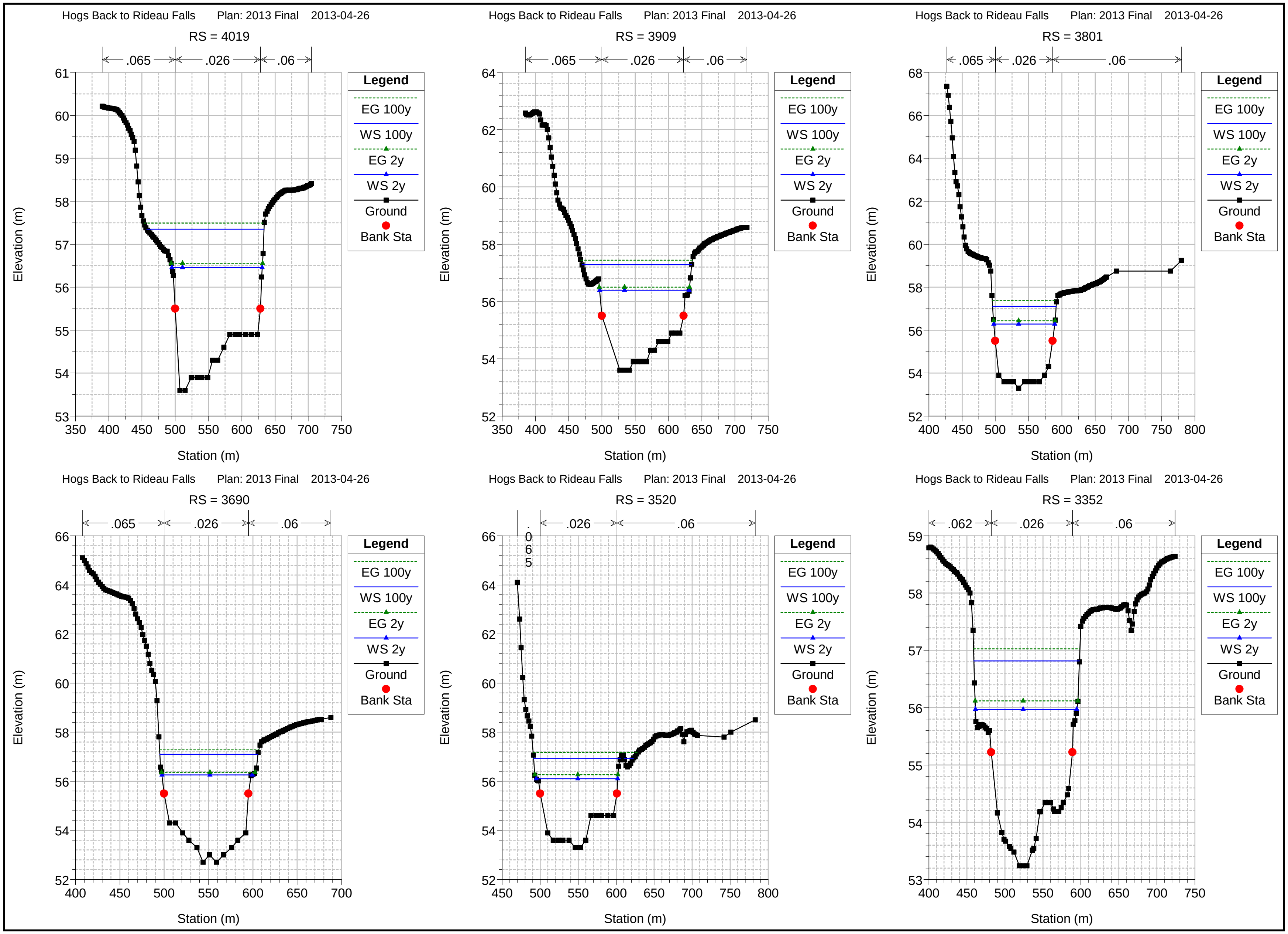

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 4516
.066
.026
.058
.026
.068
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)

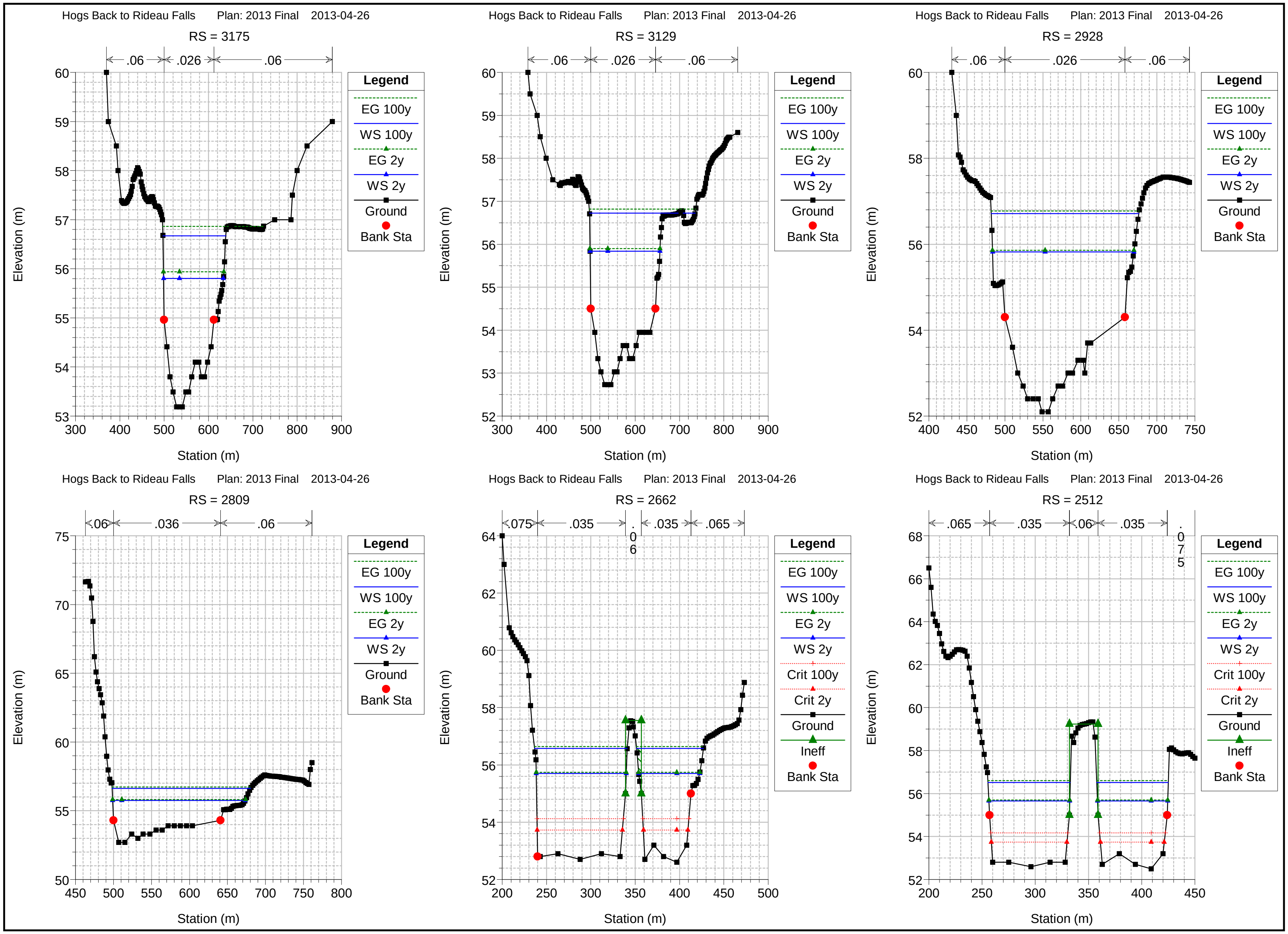

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 4470
.073
.026
.06
.026
.068
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)


Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 4464
.065
.026
.06
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

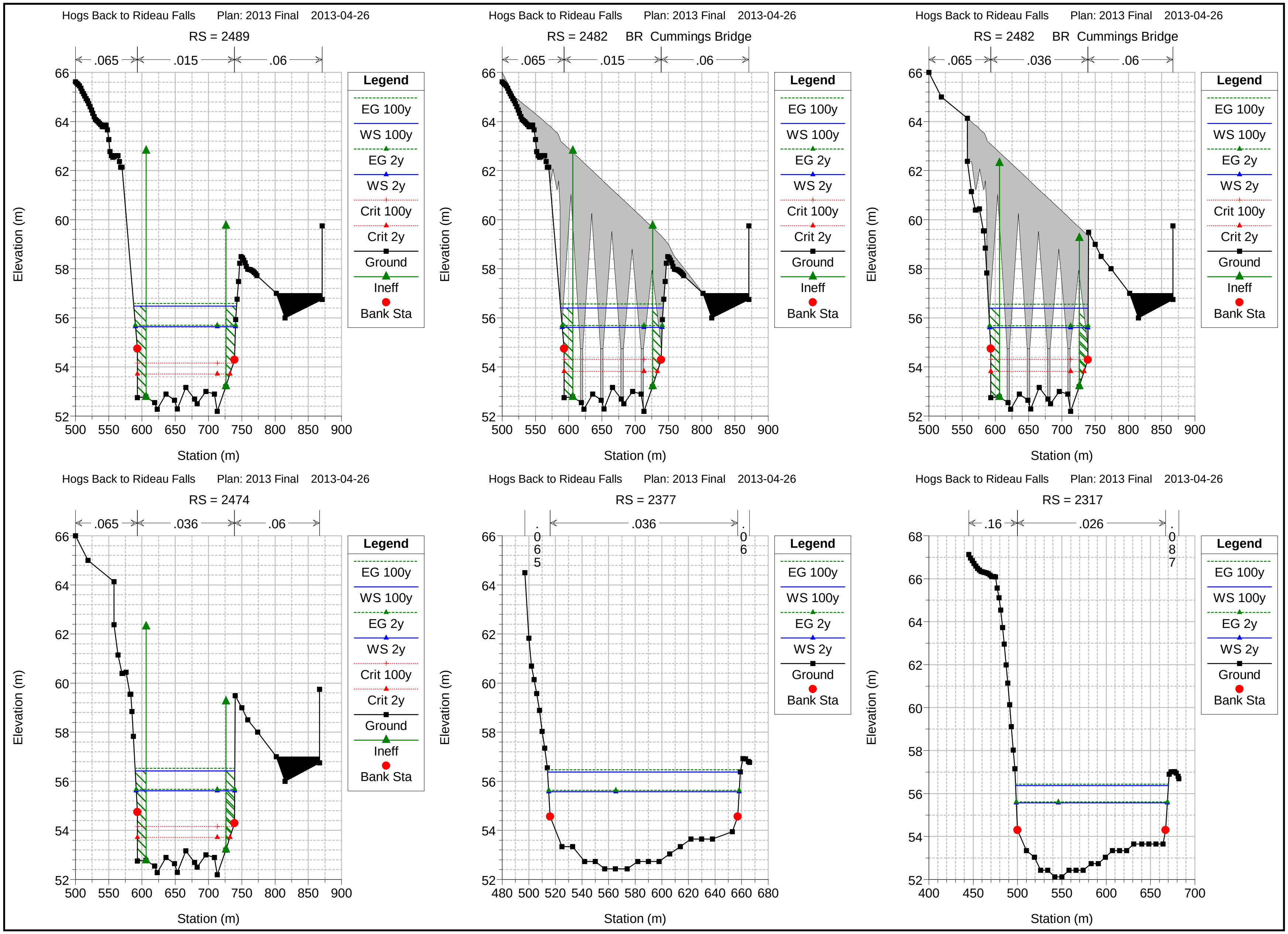

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 4449 BR Hurdman Bridge (Highway 417)
.065
.026
.06
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)


Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 4449 BR Hurdman Bridge (Highway 417)
.065
.026
.06
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 4434
.065
.026
.06
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 4406
.065
.026
.06
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 4399
.065
.026
.06
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 4327
.065
.026
.06
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 4178
.065
.026
.06
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)

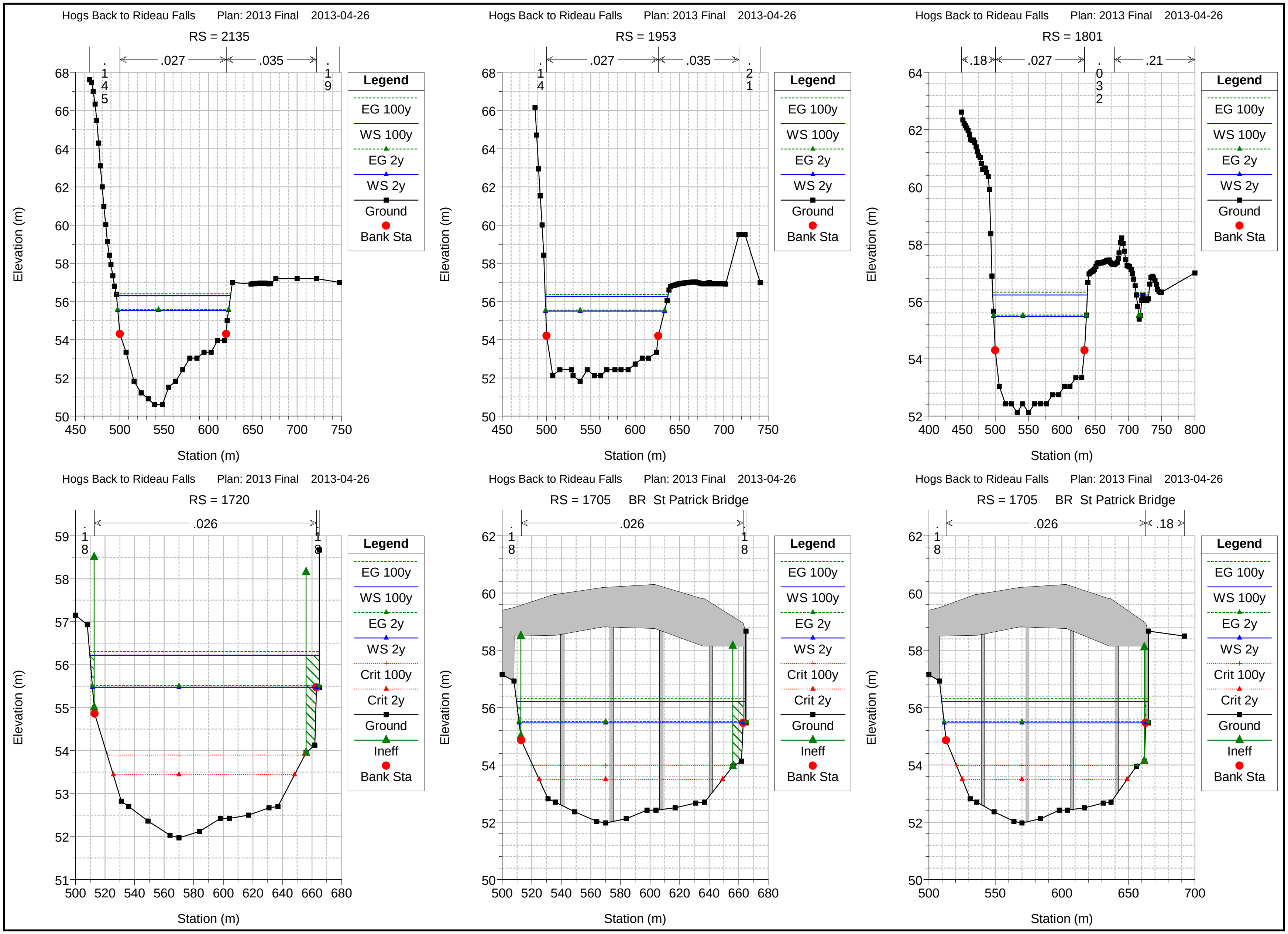

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 4019
.065
.026
.06
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 3909
.065
.026
.06
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 3801
.065
.026
.06
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 3690
.065
.026
.06
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 3520
.065
.026
.06
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 3352
.062
.026
.06
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)

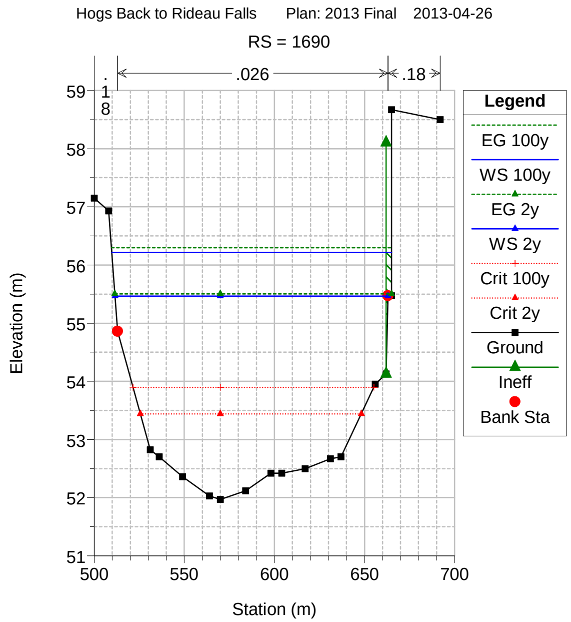


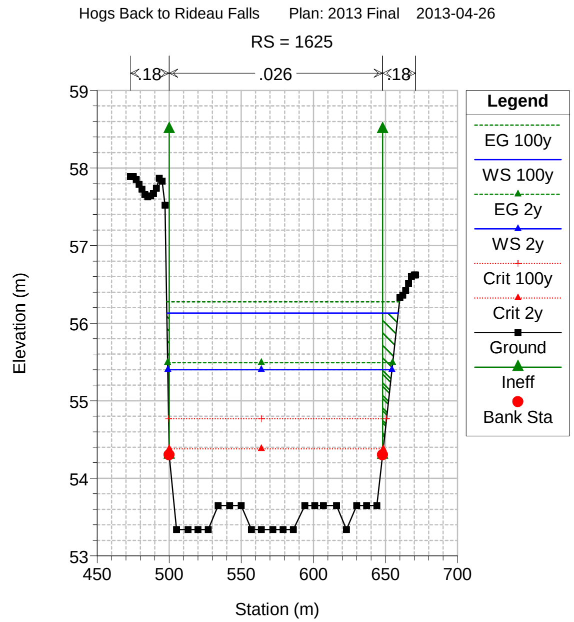
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 3175
.06 .026 .06
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 3129
.06 .026 .06
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 2928
.06 .026 .06
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 2809
.06 .036 .06
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 2662
.075 .035 .06 .035 .065
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 2512
.065 .035 .06 .035 .075
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

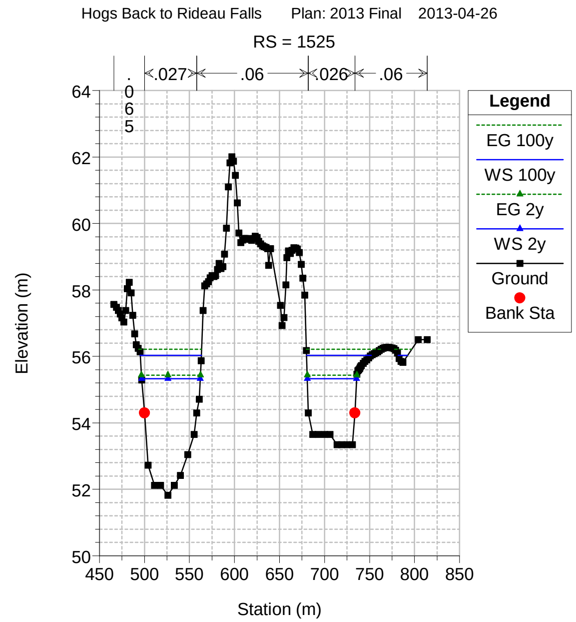


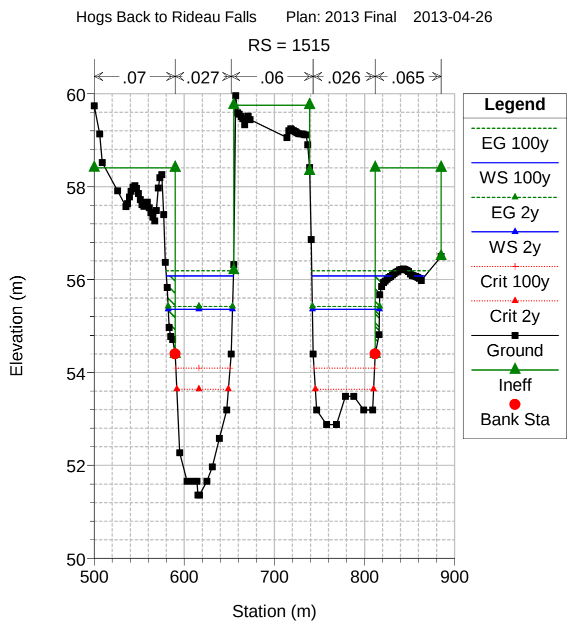
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 2489
.065 .015 .06
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 2482 BR Cummings Bridge
.065 .015 .06
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 2482 BR Cummings Bridge
.065 .036 .06
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 2474
.065 .036 .06
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 2377
.065 .036 .06
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 2317
.16 .026 .087

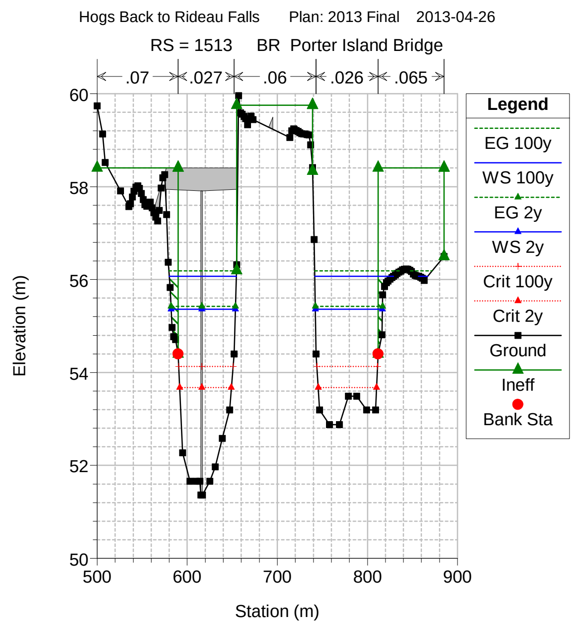

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 2135
.027
.035
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 1953
.027
.035
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 1801
.18
.027
.21
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 1720
.026
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 1705 BR St Patrick Bridge
.026
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 1705 BR St Patrick Bridge
.026
.18
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta

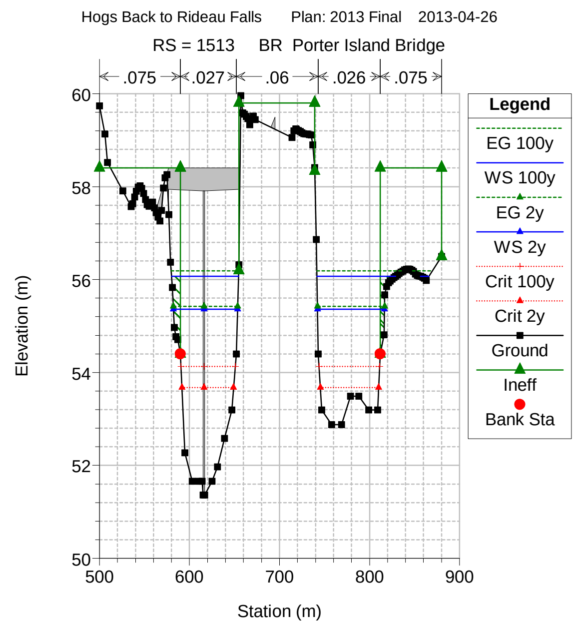

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 1690
.18
.026
.18
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta

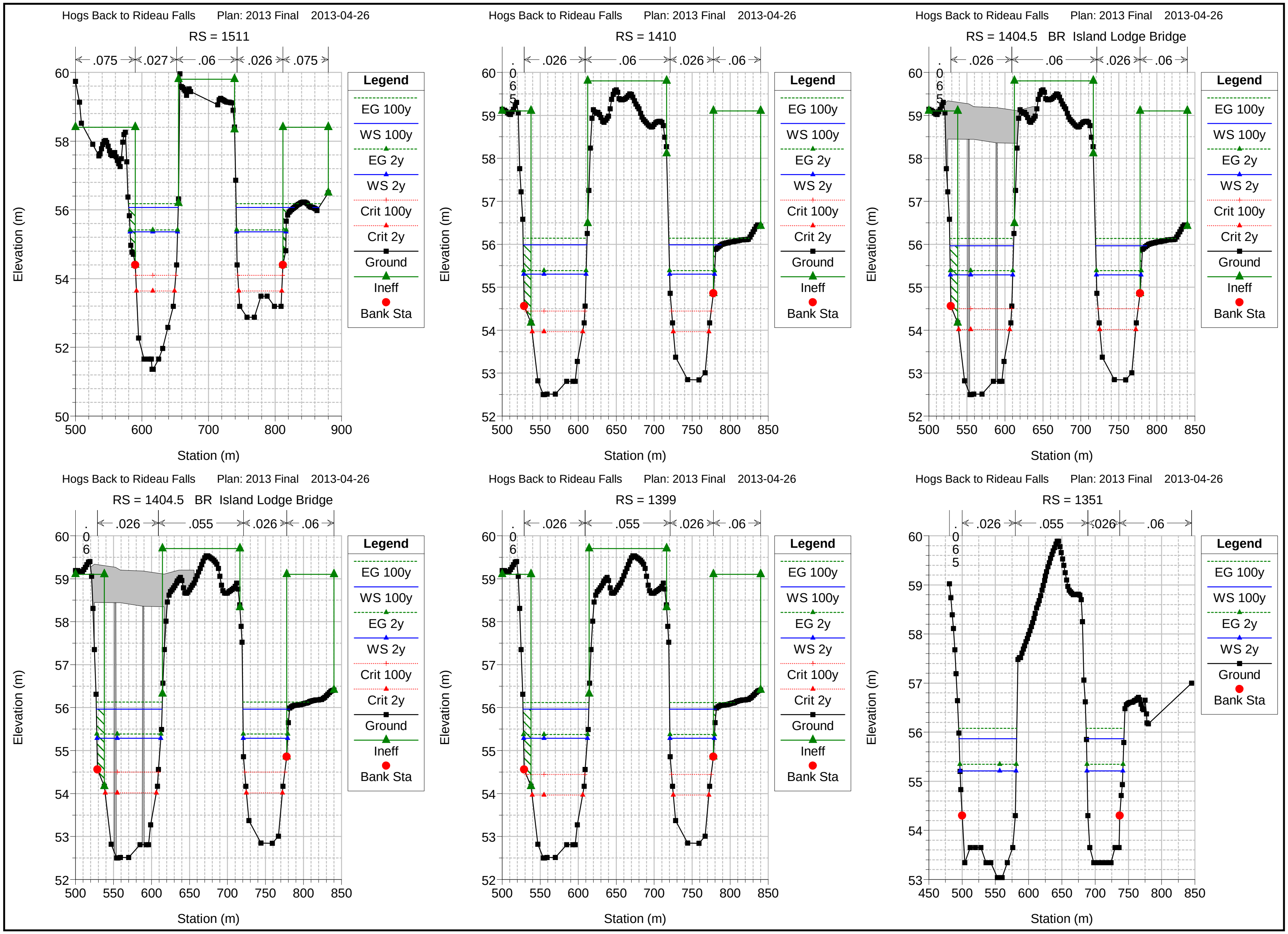

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 1625
.18
.026
.18
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta

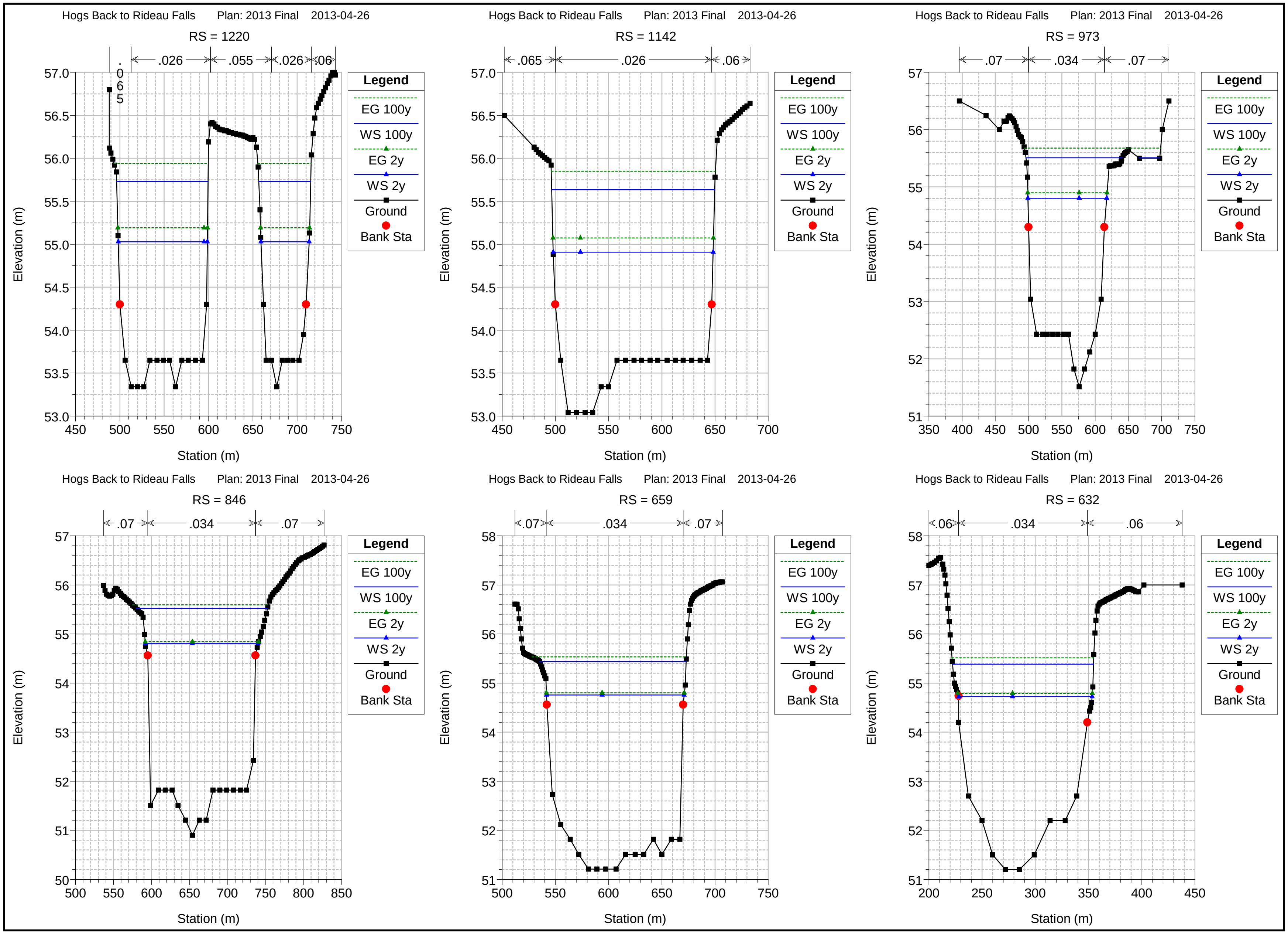

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 1525
.065
.027
.06
.026
.06
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta

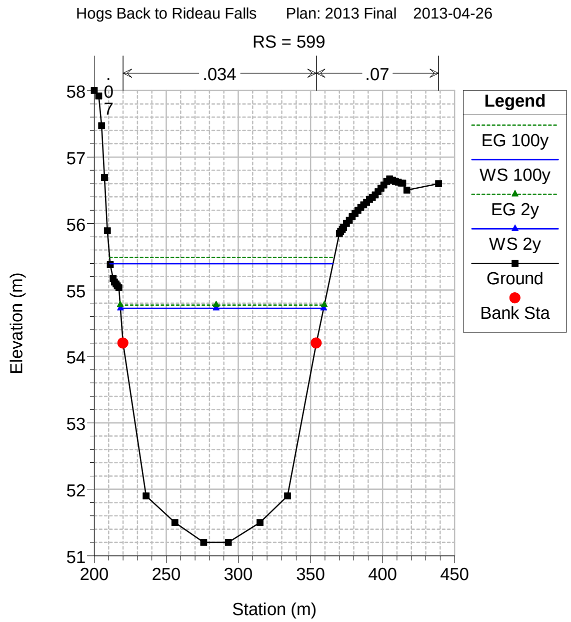

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 1515
.07
.027
.06
.026
.065
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta

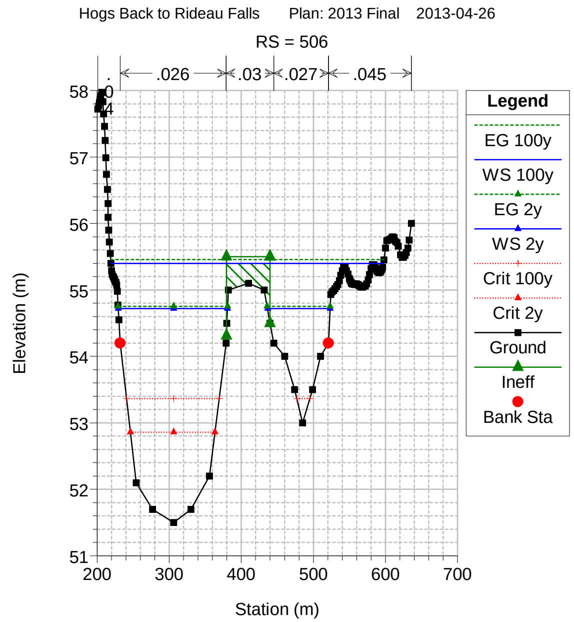

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 1513 BR Porter Island Bridge
.07
.027
.06
.026
.065
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta

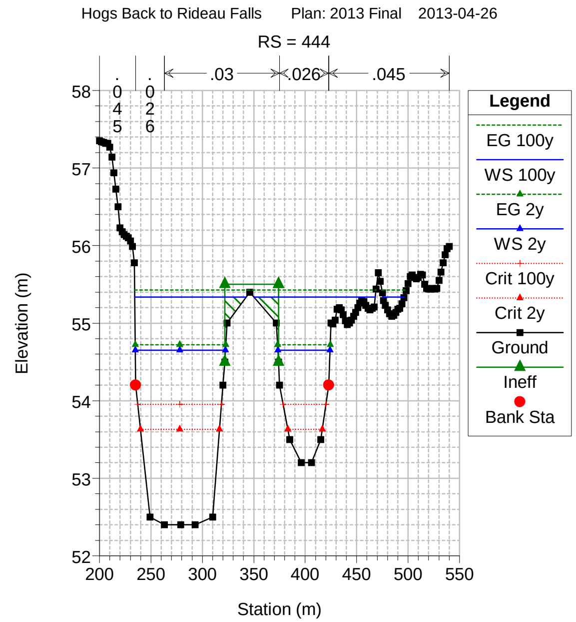

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 1513 BR Porter Island Bridge
.075
.027
.06
.026
.075
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta

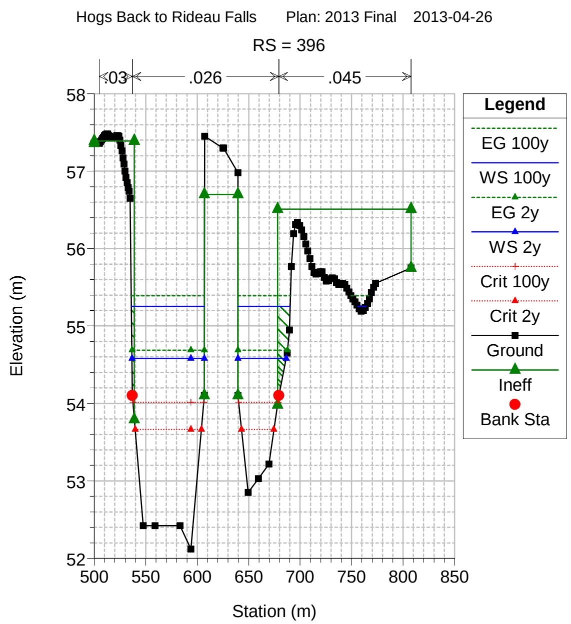

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 1511
.075 .027 .06 .026 .075
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 1410
.065 .026 .06 .026 .06
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 1404.5 BR Island Lodge Bridge
.065 .026 .06 .026 .06
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 1404.5 BR Island Lodge Bridge
.06 .026 .055 .026 .06
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 1399
.06 .026 .055 .026 .06
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 1351
.065 .026 .055 .026 .06
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)

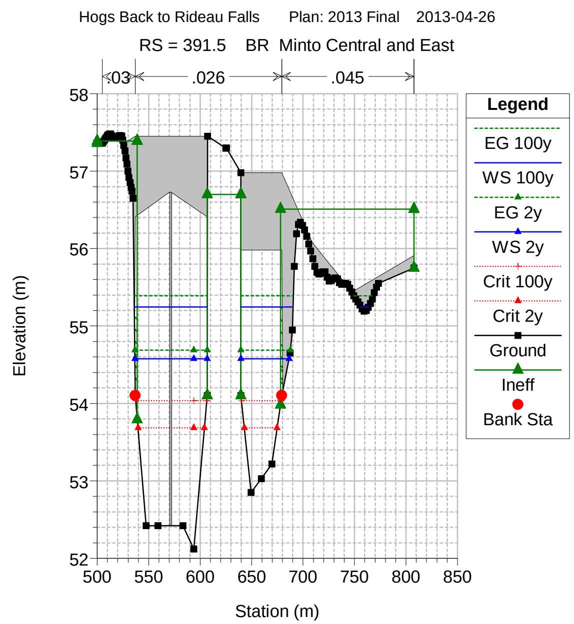

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 1220
.026
.055
.026
.06
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 1142
.065
.026
.06
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 973
.07
.034
.07
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 846
.07
.034
.07
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 659
.07
.034
.07
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 632
.06
.034
.06
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta

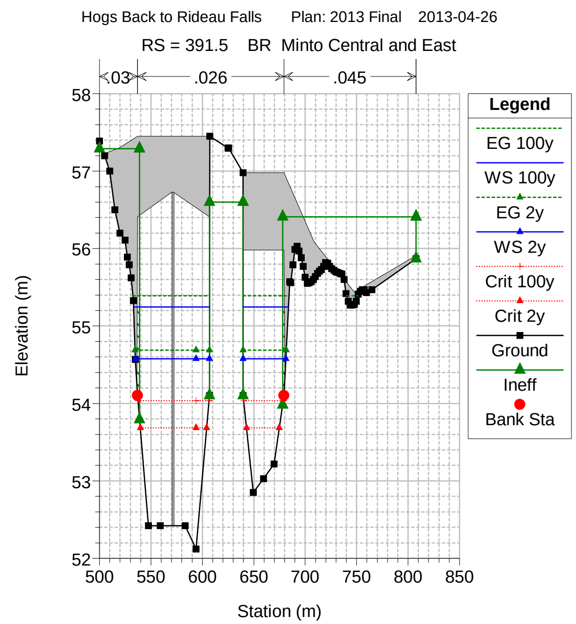

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 599
.034
.07
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)

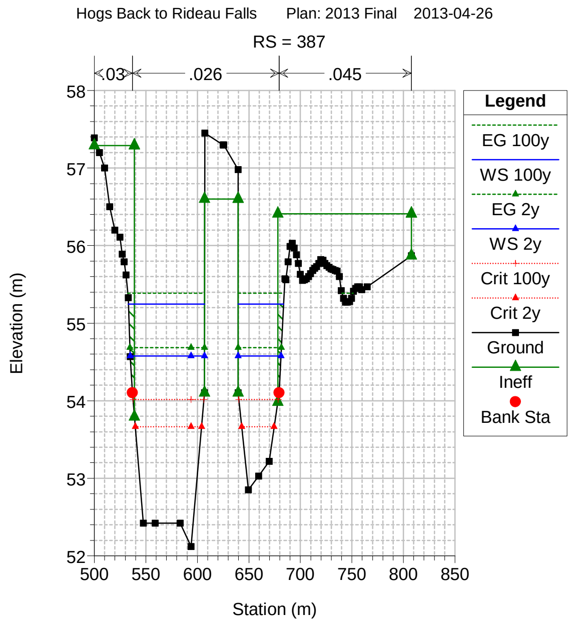

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 506
.026
.03
.027
.045
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

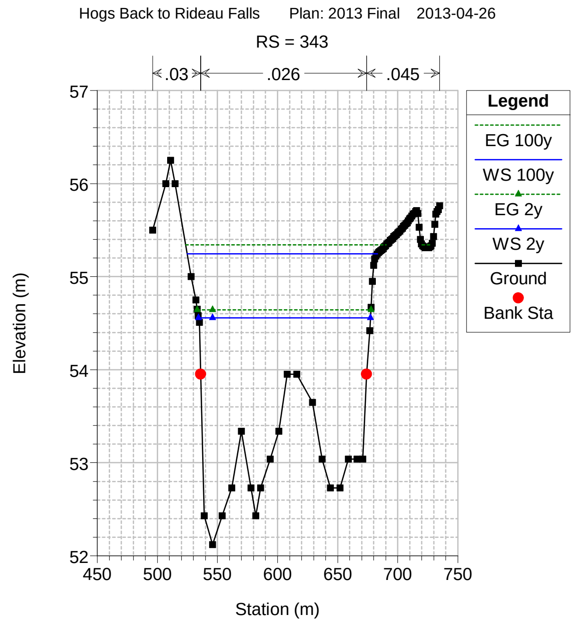

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 444
.03
.026
.045
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

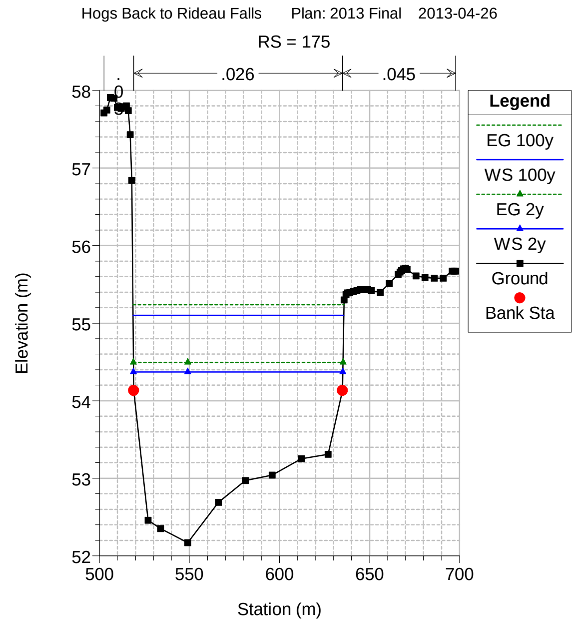

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 396
.03
.026
.045
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

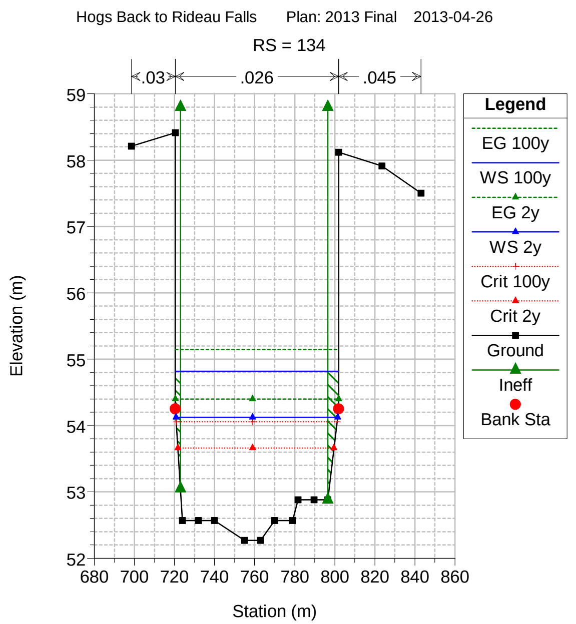

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 391.5 BR Minto Central and East
.03
.026
.045
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

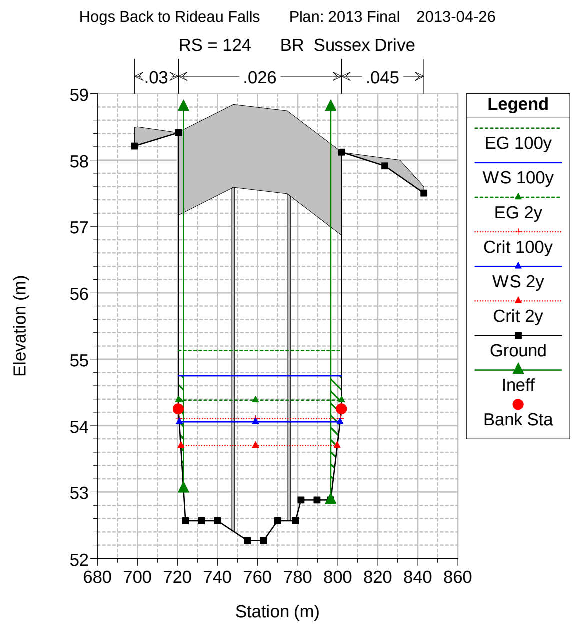

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 391.5 BR Minto Central and East
.03
.026
.045
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

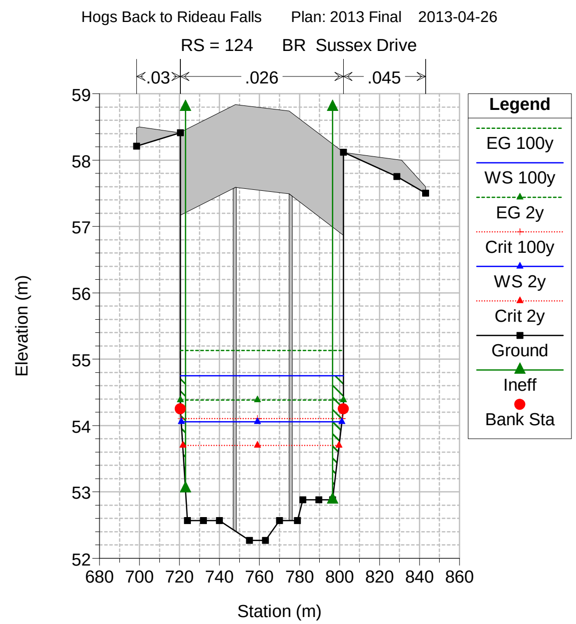

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 387
.03
.026
.045
Elevation (m)
Station (m)
52 53 54 55 56 57 58
500 550 600 650 700 750 800 850
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta

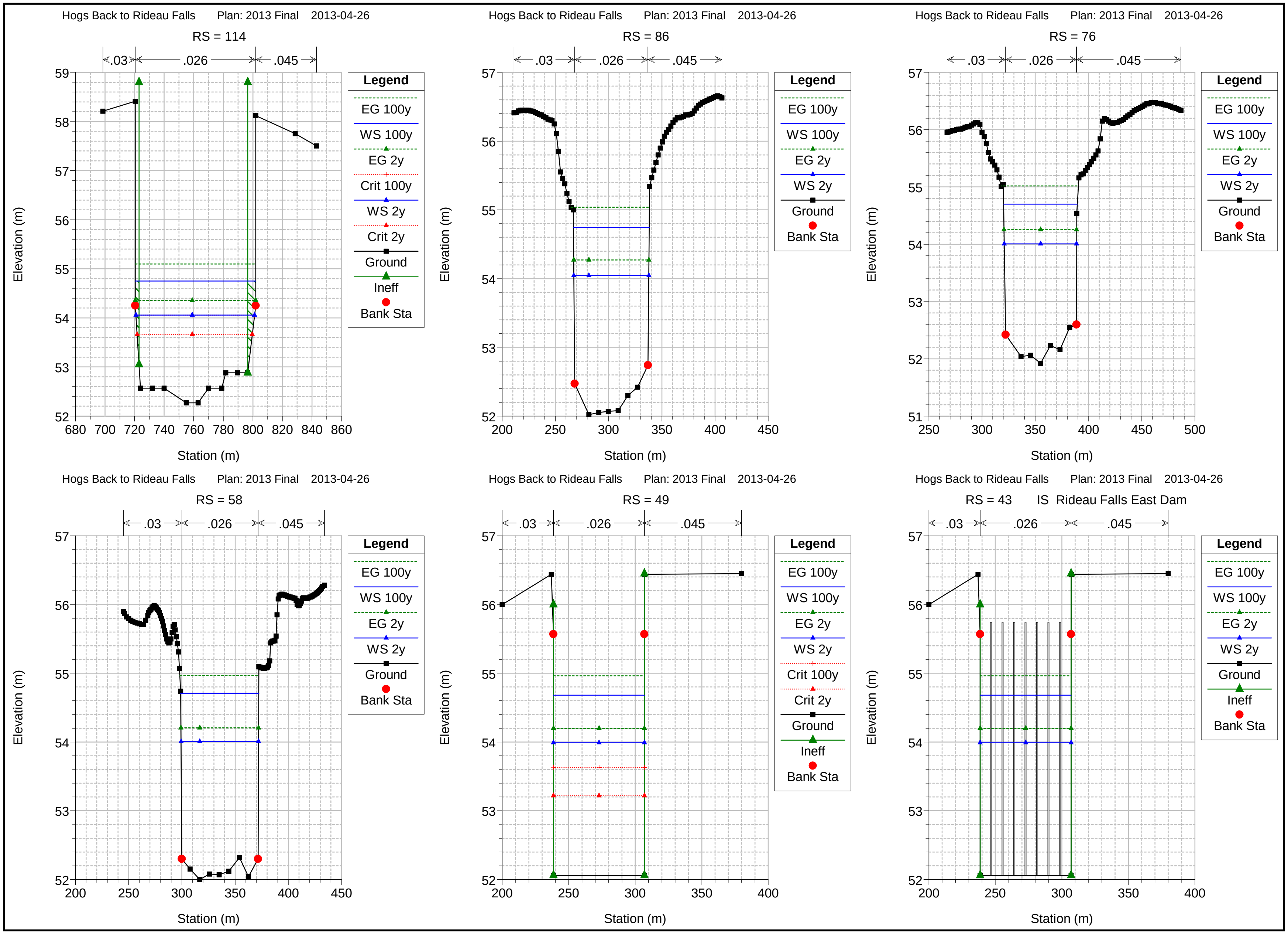

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 343
.03
.026
.045
Elevation (m)
Station (m)
52 53 54 55 56 57
450 500 550 600 650 700 750
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta

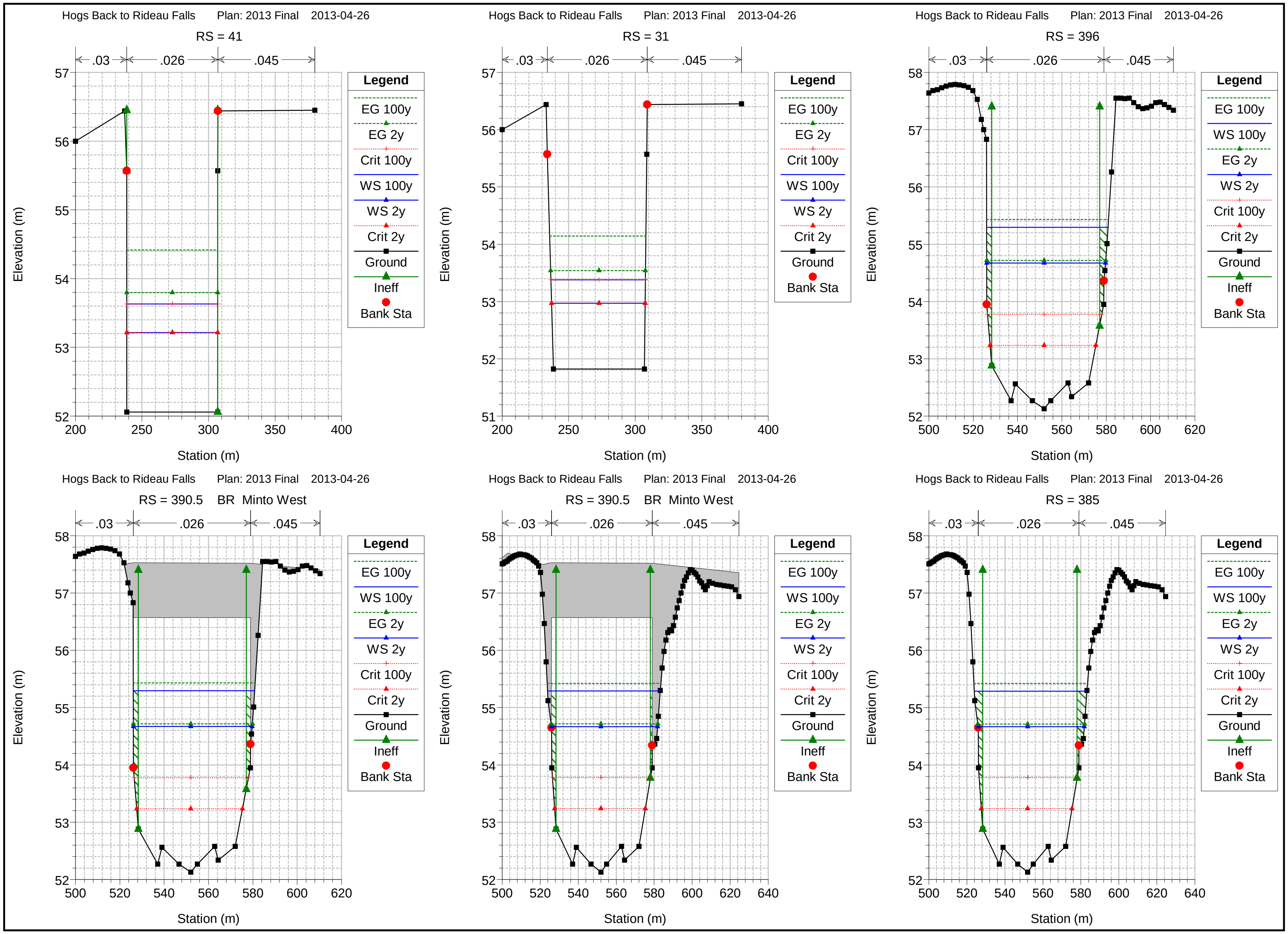

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 175
.026
.045
Elevation (m)
Station (m)
52 53 54 55 56 57 58
500 550 600 650 700
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta


Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 134
.03
.026
.045
Elevation (m)
Station (m)
52 53 54 55 56 57 58 59
680 700 720 740 760 780 800 820 840 860
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta

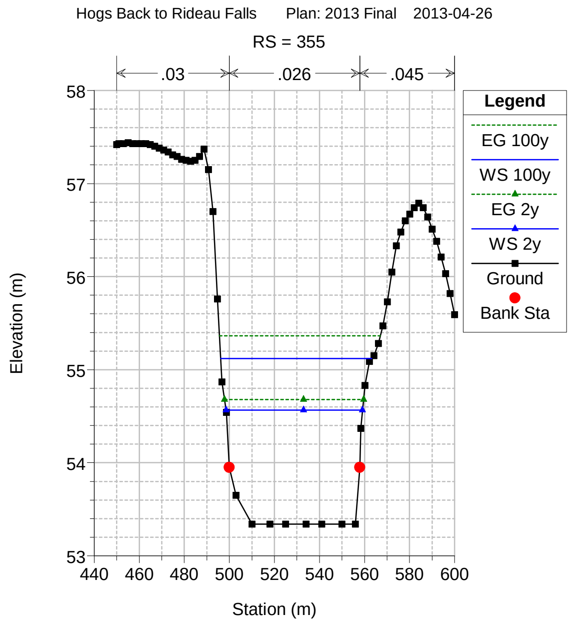

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 124 BR Sussex Drive
.03
.026
.045
Elevation (m)
Station (m)
52 53 54 55 56 57 58 59
680 700 720 740 760 780 800 820 840 860
Legend
EG 100y
WS 100y
EG 2y
Crit 100y
WS 2y
Crit 2y
Ground
Ineff
Bank Sta

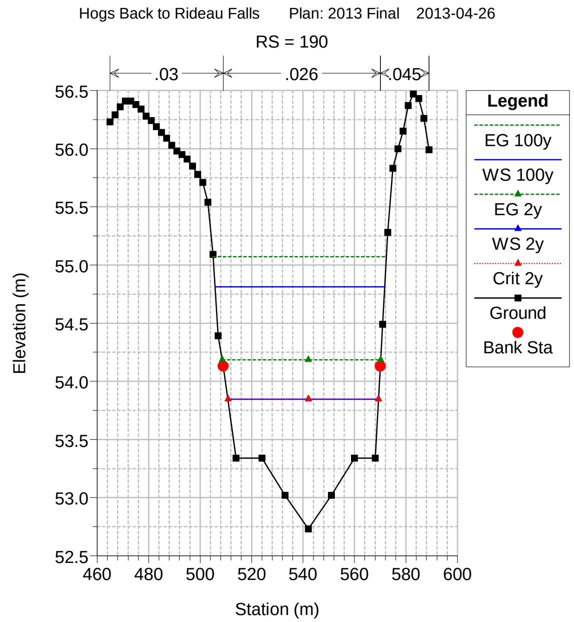

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 124 BR Sussex Drive
.03
.026
.045
Elevation (m)
Station (m)
52 53 54 55 56 57 58 59
680 700 720 740 760 780 800 820 840 860
Legend
EG 100y
WS 100y
EG 2y
Crit 100y
WS 2y
Crit 2y
Ground
Ineff
Bank Sta

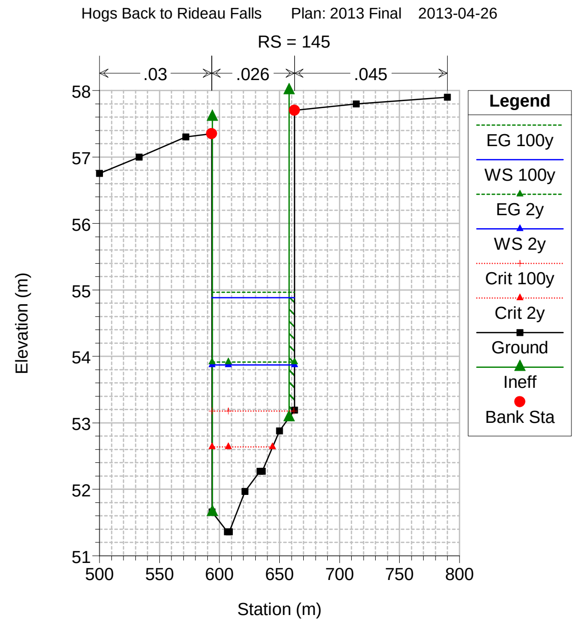

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 114
.03
.026
.045
Legend
EG 100y
WS 100y
EG 2y
Crit 100y
WS 2y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 86
.03
.026
.045
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 76
.03
.026
.045
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 58
.03
.026
.045
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 49
.03
.026
.045
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 43 IS Rideau Falls East Dam
.03
.026
.045
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

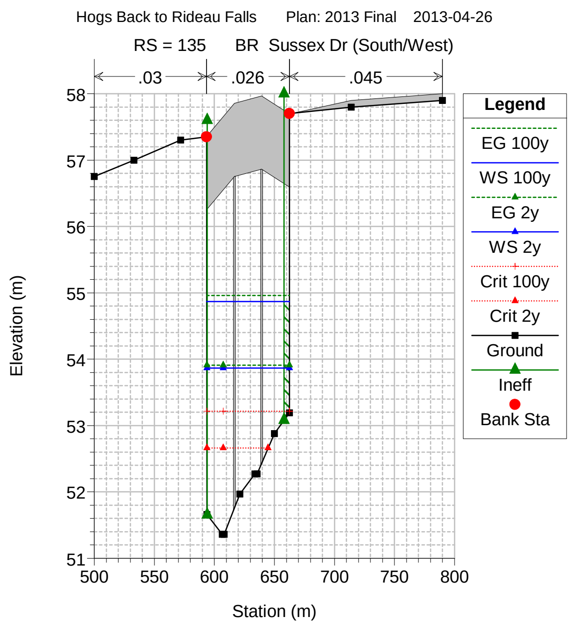


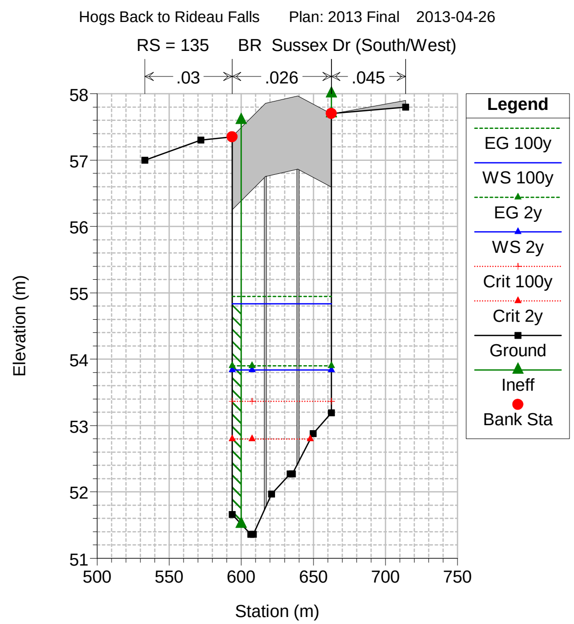
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 41
.03 .026 .045
Legend
EG 100y
EG 2y
Crit 100y
WS 100y
WS 2y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 31
.03 .026 .045
Legend
EG 100y
EG 2y
Crit 100y
WS 100y
WS 2y
Crit 2y
Ground
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 396
.03 .026 .045
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 390.5 BR Minto West
.03 .026 .045
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 390.5 BR Minto West
.03 .026 .045
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 385
.03 .026 .045
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

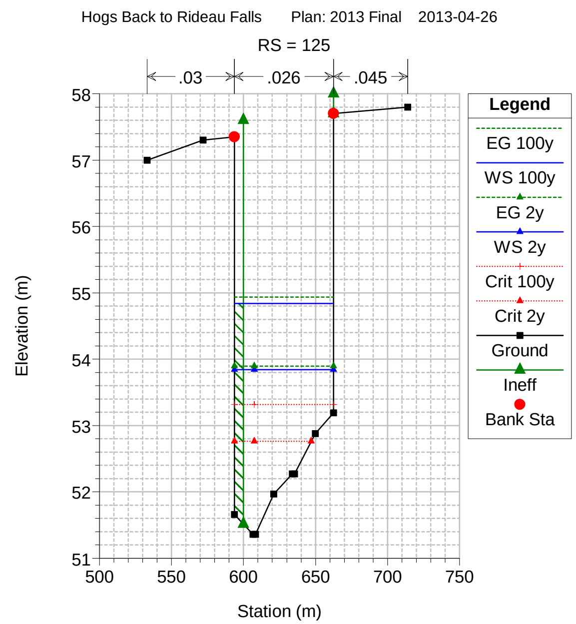

Hogs Back to Rideau Falls   Plan: 2013 Final   2013-04-26
RS = 355
.03
.026
.045
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta

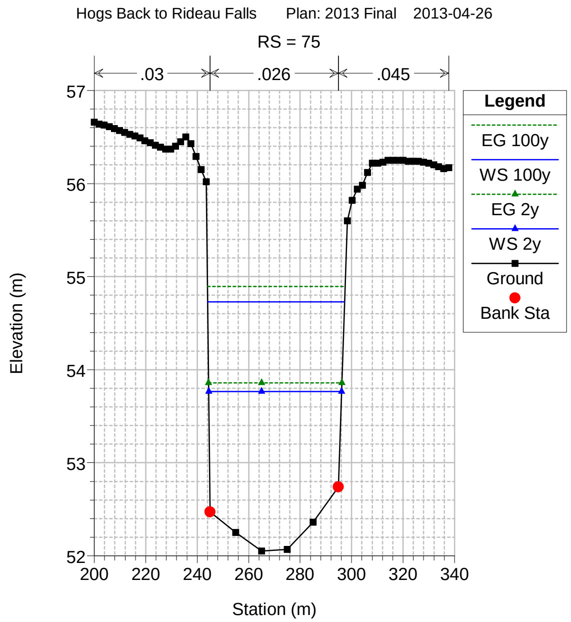

Hogs Back to Rideau Falls   Plan: 2013 Final   2013-04-26
RS = 190
.03
.026
.045
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 2y
Ground
Bank Sta

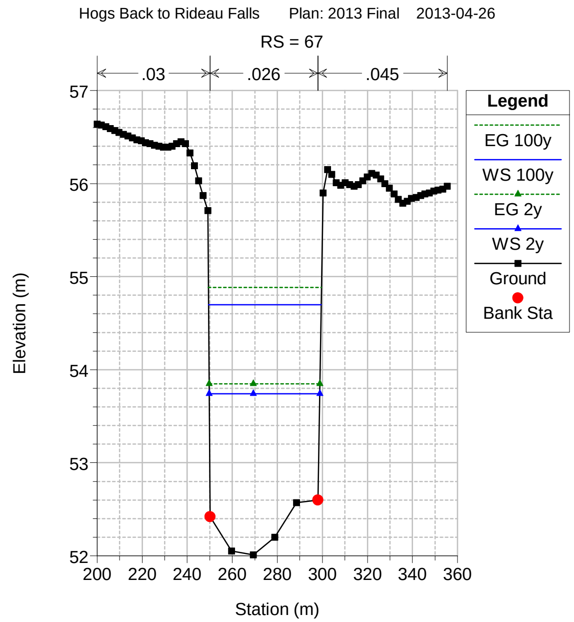

Hogs Back to Rideau Falls   Plan: 2013 Final   2013-04-26
RS = 145
.03
.026
.045
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta

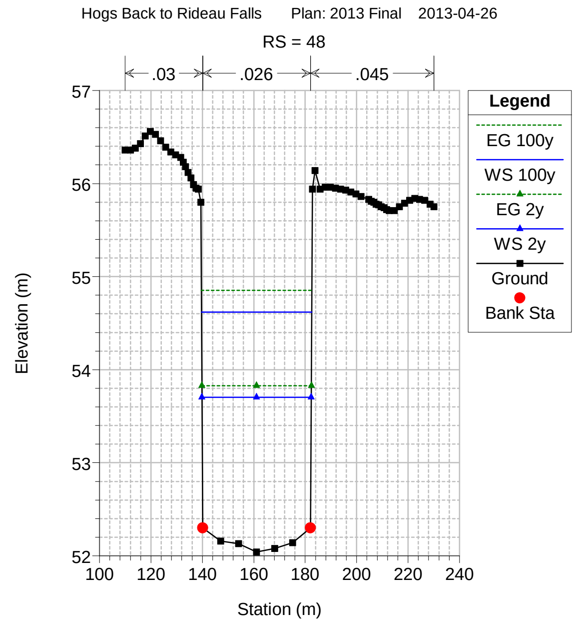

Hogs Back to Rideau Falls   Plan: 2013 Final   2013-04-26
RS = 135   BR Sussex Dr (South/West)
.03
.026
.045
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta

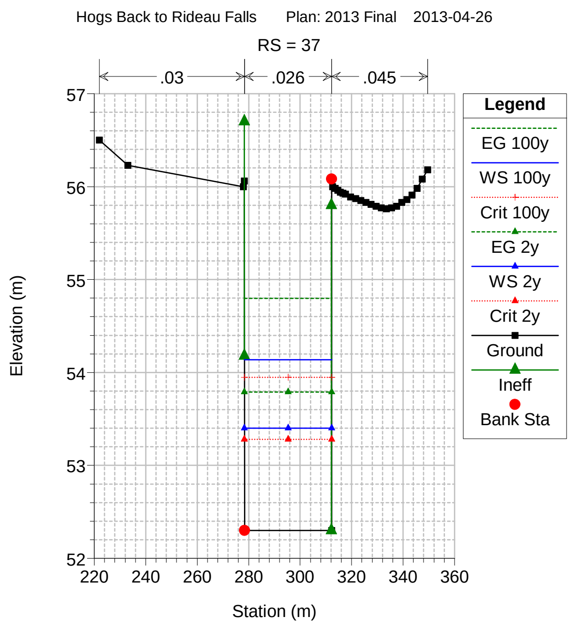

Hogs Back to Rideau Falls   Plan: 2013 Final   2013-04-26
RS = 135   BR Sussex Dr (South/West)
.03
.026
.045
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta

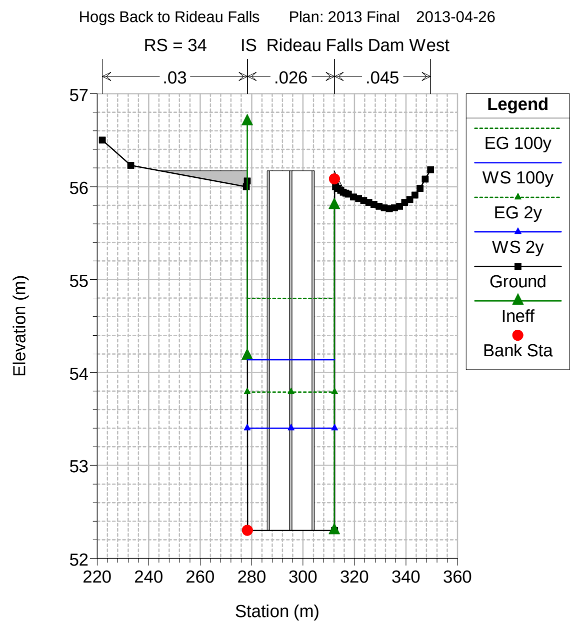

Hogs Back to Rideau Falls   Plan: 2013 Final   2013-04-26
RS = 125
.03
.026
.045
Elevation (m)
Station (m)
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Crit 100y
Crit 2y
Ground
Ineff
Bank Sta

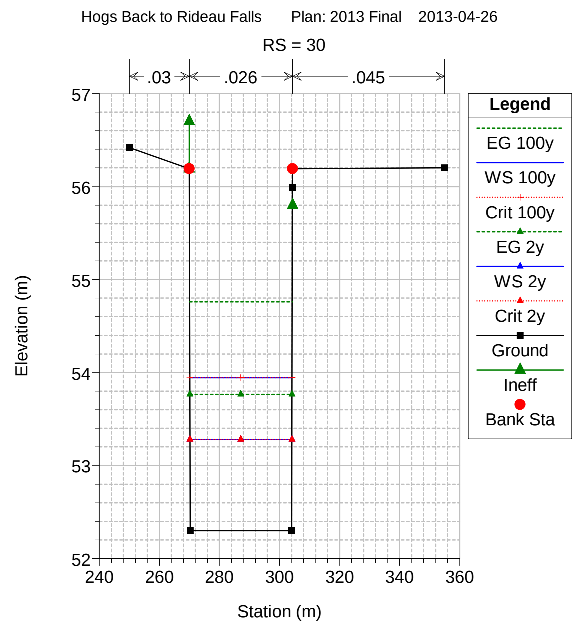

Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 75
.03
.026
.045
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)


Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 67
.03
.026
.045
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)


Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 48
.03
.026
.045
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Bank Sta
Elevation (m)
Station (m)


Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 37
.03
.026
.045
Legend
EG 100y
WS 100y
Crit 100y
EG 2y
WS 2y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)


Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 34 IS Rideau Falls Dam West
.03
.026
.045
Legend
EG 100y
WS 100y
EG 2y
WS 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)


Hogs Back to Rideau Falls Plan: 2013 Final 2013-04-26
RS = 30
.03
.026
.045
Legend
EG 100y
WS 100y
Crit 100y
EG 2y
WS 2y
Crit 2y
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

Appendix B

CFA Input and Output Files

CFA Input File (Rideau River at Ottawa – 02LA004)

```
02LA004
Rideau River at Ottawa -Inst77-91 +11 (1947-2012)
65          3830
65      Number of Observations
3830    Area
02LA004     1947      4    560.3
02LA004     1949     03    392.8
02LA004     1950     04    462.8
02LA004     1951     04    433.7
02LA004     1952     04    392.8
02LA004     1953     03    344.7
02LA004     1954     04    419.3
02LA004     1955     04    511.5
02LA004     1956     04    364.6
02LA004     1957     03    159.2
02LA004     1958     03    320.2
02LA004     1959     04    427.5
02LA004     1960     04    553.7
02LA004     1961     03    213.3
02LA004     1962     04    336.8
02LA004     1963     03    457.6
02LA004     1964     04    138.0
02LA004     1965     12    170.7
02LA004     1966     03    233.6
02LA004     1967     04    325.1
02LA004     1968     03    390.7
02LA004     1969     04    341.8
02LA004     1970     04    457.6
02LA004     1971     04    513.0
02LA004     1972     04    578.0
02LA004     1973     03    464.0
02LA004     1974     04    410.0
02LA004     1975     04    413.0
02LA004     1976     03    597.0
02LA004     1977     03    525.0
02LA004     1978     04    585.0
02LA004     1979     03    469.5
02LA004     1980     03    467.3
02LA004     1981     02    495.1
02LA004     1982     04    482.9
02LA004     1983     03    273.1
02LA004     1984     04    441.8
02LA004     1985     03    306.4
02LA004     1986     05    284.2
02LA004     1987     03    391.8
02LA004     1988     03    303.0
02LA004     1989     03    306.4
02LA004     1990     03    293.0
02LA004     1991     04    326.0
02LA004     1992     04    282.0
02LA004     1993     04    514.0
02LA004     1994     04    338.0
02LA004     1995     01    269.0
02LA004     1996     01    243.0
02LA004     1997     04    448.0
02LA004     1998     03    458.0
02LA004     1999     04    448.0
02LA004     2000     04    245.0
02LA004     2001     04    366.0
02LA004     2002     04    222.0
02LA004     2003     03    249.0
02LA004     2004     03    199.0
02LA004     2005     04    437.0
02LA004     2006     12    218.0
02LA004     2007     04    262.0
02LA004     2008     04    493.0
02LA004     2009      5    254.0
02LA004     2010     03    237.0
02LA004     2011     03    364.4
02LA004     2012     03    232.7
```

CFA Output File (Rideau River at Ottawa – 02LA004)

```
             --- SPEARMAN TEST FOR INDEPENDENCE ---

   02LA004          Rideau River at Ottawa -Inst77-91 +11 (1947-2012)
   ANNUAL MAXIMUM DAILY FLOW SERIES  1947 TO 2012  DRAINAGE AREA =  3830.000

   SPEARMAN RANK ORDER SERIAL CORRELATION COEFF =  .341    D.F.= 61
                      CORRESPONDS TO STUDENTS T = 2.830
                   CRITICAL T VALUE AT 5% LEVEL = 1.671        SIGNIFICANT
                       -    -   -   -  1%   -   = 2.389        SIGNIFICANT

   Interpretation: The null hypothesis is that the correlation is zero.

   At the 1% level of significance, the correlation is significantly
   different from zero. That is, the data display highly significant
   serial dependence.



          --- SPEARMAN TEST FOR TREND ---

   02LA004          Rideau River at Ottawa -Inst77-91 +11 (1947-2012)
   ANNUAL MAXIMUM DAILY FLOW SERIES  1947 TO 2012  DRAINAGE AREA =  3830.000

   SPEARMAN RANK ORDER CORRELATION COEFF =  .283    D.F.= 63
               CORRESPONDS TO STUDENTS T = 2.341
            CRITICAL T VALUE AT 5% LEVEL = 1.999        SIGNIFICANT
                -    -   -   -  1%   -   = 2.658    NOT SIGNIFICANT

   Interpretation: The null hypothesis is that the serial(lag-one) correlation
                   is zero.

   At the 5% level of significance, the correlation is significantly
   different from zero, but is not so at the 1% level of significance.  That is,
   the trend is significant but not highly so.



          --- RUN TEST FOR GENERAL RANDOMNESS ---

   02LA004          Rideau River at Ottawa -Inst77-91 +11 (1947-2012)
   ANNUAL MAXIMUM DAILY FLOW SERIES  1947 TO 2012  DRAINAGE AREA =  3830.000

   THE NUMBER OF RUNS ABOVE AND BELOW THE MEDIAN (RUNAB) = 24
         THE NUMBER OF OBSERVATIONS ABOVE THE MEDIAN(N1) = 32
         THE NUMBER OF OBSERVATIONS BELOW THE MEDIAN(N2) = 32

   (NOTE: Z IS THE STANDARD NORMAL VARIATE.)

   For this test, Z =  2.268
   Critical Z value at the 5% level = 1.960                SIGNIFICANT
   Critical Z value at the 1% level = 2.575            NOT SIGNIFICANT

   Interpretation: The null hypothesis is that the data are random.

   At the 5% level of significance, the null hypothesis is rejected,
   but not so at the 1% level of significance.  That is,
   the data are significantly non-random, but not highly so.
```

--- MANN-WHITNEY SPLIT SAMPLE TEST FOR HOMOGENEITY ---

```
02LA004          Rideau River at Ottawa -Inst77-91 +11 (1947-2012)
ANNUAL MAXIMUM FLOW SERIES  1947 TO 2012   DRAINAGE AREA=  3830.000

SPLIT BY TIME SPAN, SUBSAMPLE 1 SAMPLE SIZE= 32
                    SUBSAMPLE 2 SAMPLE SIZE= 33

(NOTE: Z IS THE STANDARD NORMAL VARIATE.)
                        For this test, Z = -2.323
CRITICAL Z VALUE AT 5% SIGNIFICANT LEVEL = -1.645        SIGNIFICANT
   -     -   -   -  1%      -        -   = -2.326    NOT SIGNIFICANT

Interpretation: The null hypothesis is that there is no
                location difference between the two samples.

At the 5% level of significance, there is a significant difference
in location, but not so at the 1% level. That is, the
location difference is significant, but not highly so.
```

WSC STATION NO=02LA004
WSC STATION NAME=Rideau River at Ottawa -Inst77-91 +11 (1947-2012)

MONTH (1)	YEAR (2)	DATA (3)	ORDERED (4)	RANK (5)	PROB. (6) (%)	RET. PERIOD (7) (YEARS)
4	1947	560.300	597.000	1	.92	108.667
3	1949	392.800	585.000	2	2.45	40.750
4	1950	462.800	578.000	3	3.99	25.077
4	1951	433.700	560.300	4	5.52	18.111
4	1952	392.800	553.700	5	7.06	14.174
3	1953	344.700	525.000	6	8.59	11.643
4	1954	419.300	514.000	7	10.12	9.879
4	1955	511.500	513.000	8	11.66	8.579
4	1956	364.600	511.500	9	13.19	7.581
3	1957	159.200	495.100	10	14.72	6.792
3	1958	320.200	493.000	11	16.26	6.151
4	1959	427.500	482.900	12	17.79	5.621
4	1960	553.700	469.500	13	19.33	5.175
3	1961	213.300	467.300	14	20.86	4.794
4	1962	336.800	464.000	15	22.39	4.466
3	1963	457.600	462.800	16	23.93	4.179
4	1964	138.000	458.000	17	25.46	3.928
12	1965	170.700	457.600	18	26.99	3.705
3	1966	233.600	457.600	19	28.53	3.505
4	1967	325.100	448.000	20	30.06	3.327
3	1968	390.700	448.000	21	31.60	3.165
4	1969	341.800	441.800	22	33.13	3.019
4	1970	457.600	437.000	23	34.66	2.885
4	1971	513.000	433.700	24	36.20	2.763
4	1972	578.000	427.500	25	37.73	2.650
3	1973	464.000	419.300	26	39.26	2.547
4	1974	410.000	413.000	27	40.80	2.451
4	1975	413.000	410.000	28	42.33	2.362
3	1976	597.000	392.800	29	43.87	2.280
3	1977	525.000	392.800	30	45.40	2.203
4	1978	585.000	391.800	31	46.93	2.131
3	1979	469.500	390.700	32	48.47	2.063
3	1980	467.300	366.000	33	50.00	2.000
2	1981	495.100	364.600	34	51.53	1.940
4	1982	482.900	364.400	35	53.07	1.884
3	1983	273.100	344.700	36	54.60	1.831
4	1984	441.800	341.800	37	56.13	1.781
3	1985	306.400	338.000	38	57.67	1.734
5	1986	284.200	336.800	39	59.20	1.689
3	1987	391.800	326.000	40	60.74	1.646
3	1988	303.000	325.100	41	62.27	1.606

3	1989	306.400	320.200	42	63.80	1.567
3	1990	293.000	306.400	43	65.34	1.531
4	1991	326.000	306.400	44	66.87	1.495
4	1992	282.000	303.000	45	68.40	1.462
4	1993	514.000	293.000	46	69.94	1.430
4	1994	338.000	284.200	47	71.47	1.399
1	1995	269.000	282.000	48	73.01	1.370

WSC STATION NO=02LA004
WSC STATION NAME=Rideau River at Ottawa -Inst77-91 +11 (1947-2012)

MONTH (1)	YEAR (2)	DATA (3)	ORDERED (4)	RANK (5)	PROB. (6) (%)	RET. PERIOD (7) (YEARS)
1	1996	243.000	273.100	49	74.54	1.342
4	1997	448.000	269.000	50	76.07	1.315
3	1998	458.000	262.000	51	77.61	1.289
4	1999	448.000	254.000	52	79.14	1.264
4	2000	245.000	249.000	53	80.67	1.240
4	2001	366.000	245.000	54	82.21	1.216
4	2002	222.000	243.000	55	83.74	1.194
3	2003	249.000	237.000	56	85.28	1.173
3	2004	199.000	233.600	57	86.81	1.152
4	2005	437.000	232.700	58	88.34	1.132
12	2006	218.000	222.000	59	89.88	1.113
4	2007	262.000	218.000	60	91.41	1.094
4	2008	493.000	213.300	61	92.94	1.076
5	2009	254.000	199.000	62	94.48	1.058
3	2010	237.000	170.700	63	96.01	1.042
3	2011	364.400	159.200	64	97.55	1.025
3	2012	232.700	138.000	65	99.08	1.009

FREQUENCY ANALYSIS - GENERALIZED EXTREME VALUE DISTRIBUTION
02LA004 Rideau River at Ottawa -Inst77-91 +11 (1947-2012)

SAMPLE STATISTICS

	MEAN	S.D.	C.V.	C.S.	C.K.
X SERIES	370.968	116.142	.313	.005	2.229
LN X SERIES	5.862	.343	.059	-.599	2.886
L-MOM RATIO	370.968	67.216	.181	-.001	.039

X(MIN)= 138.000 TOTAL SAMPLE SIZE= 65
X(MAX)= 597.000 NO. OF LOW OUTLIERS= 0
LOWER OUTLIER LIMIT OF X= 131.416 NO. OF ZERO FLOWS= 0

SOLUTION OBTAINED VIA L - MOMENTS

DISTRIBUTION IS UPPER BOUNDED AT (U+A/K)= .7803E+03
GEV PARAMETERS: U= 327.54 A= 118.463 K= .262

FLOOD FREQUENCY REGIME

RETURN PERIOD	EXCEEDANCE PROBABILITY	FLOOD
1.003	.997	62.7
1.050	.952	174

1.250	.800	268
2.000	.500	369
5.000	.200	475
10.000	.100	529
20.000	.050	572
50.000	.020	617
100.000	.010	644
200.000	.005	667
500.000	.002	691

FREQUENCY ANALYSIS - THREE-PARAMETER LOGNORMAL DISTRIBUTION
02LA004 Rideau River at Ottawa -Inst77-91 +11 (1947-2012)

SAMPLE STATISTICS

	MEAN	S.D.	C.V.	C.S.	C.K.
X SERIES	370.968	116.142	.313	.005	2.229
LN X SERIES	5.862	.343	.059	-.599	2.886
LN(X-A) SERIES	10.280	.004	.000	-.001	2.228

X(MIN)= 138.000 TOTAL SAMPLE SIZE= 65
X(MAX)= 597.000 NO. OF LOW OUTLIERS= 0
LOWER OUTLIER LIMIT OF X= 131.416 NO. OF ZERO FLOWS= 0

SOLUTION OBTAINED VIA MAXIMUM LIKELIHOOD

3LN PARAMETERS: A=-28760.350 M=10.280 S= .004

FLOOD FREQUENCY REGIME

RETURN PERIOD	EXCEEDANCE PROBABILITY	FLOOD
1.003	.997	53.2
1.050	.952	178
1.250	.800	273
2.000	.500	371
5.000	.200	469
10.000	.100	520
20.000	.050	562
50.000	.020	610
100.000	.010	642
200.000	.005	671
500.000	.002	707

FREQUENCY ANALYSIS - LOG PEARSON TYPE III DISTRIBUTION
02LA004 Rideau River at Ottawa -Inst77-91 +11 (1947-2012)

SAMPLE STATISTICS

	MEAN	S.D.	C.V.	C.S.	C.K.
X SERIES	370.968	116.142	.313	.005	2.229
LN X SERIES	5.862	.343	.059	-.599	2.886

X(MIN)= 138.000 TOTAL SAMPLE SIZE= 65
X(MAX)= 597.000 NO. OF LOW OUTLIERS= 0
LOWER OUTLIER LIMIT OF X= 131.416 NO. OF ZERO FLOWS= 0

SOLUTION OBTAINED VIA MAXIMUM LIKELIHOOD

DISTRIBUTION IS UPPER BOUNDED AT M= 646.3
LP3 PARAMETERS: A= -.2146   B= 2.840   LOG(M)= 6.471
M = 646.3

FLOOD FREQUENCY REGIME

RETURN PERIOD	EXCEEDANCE PROBABILITY	FLOOD
1.003	.997	81.1
1.050	.952	174
1.250	.800	270
2.000	.500	376
5.000	.200	476
10.000	.100	521
20.000	.050	553
50.000	.020	583
100.000	.010	599
200.000	.005	611
500.000	.002	623

FREQUENCY ANALYSIS - WAKEBY DISTRIBUTION
02LA004   Rideau River at Ottawa -Inst77-91 +11 (1947-2012)

SAMPLE STATISTICS

	MEAN	S.D.	C.V.	C.S.	C.K.
X SERIES	370.968	116.142	.313	.005	2.229
LN X SERIES	5.862	.343	.059	-.599	2.886
L-MOM RATIO	370.968	67.216	.181	-.001	.039

X(MIN)=   138.000   TOTAL SAMPLE SIZE= 65
X(MAX)=   597.000   NO. OF LOW OUTLIERS=   0
LOWER OUTLIER LIMIT OF X= 131.416   NO. OF ZERO FLOWS=   0

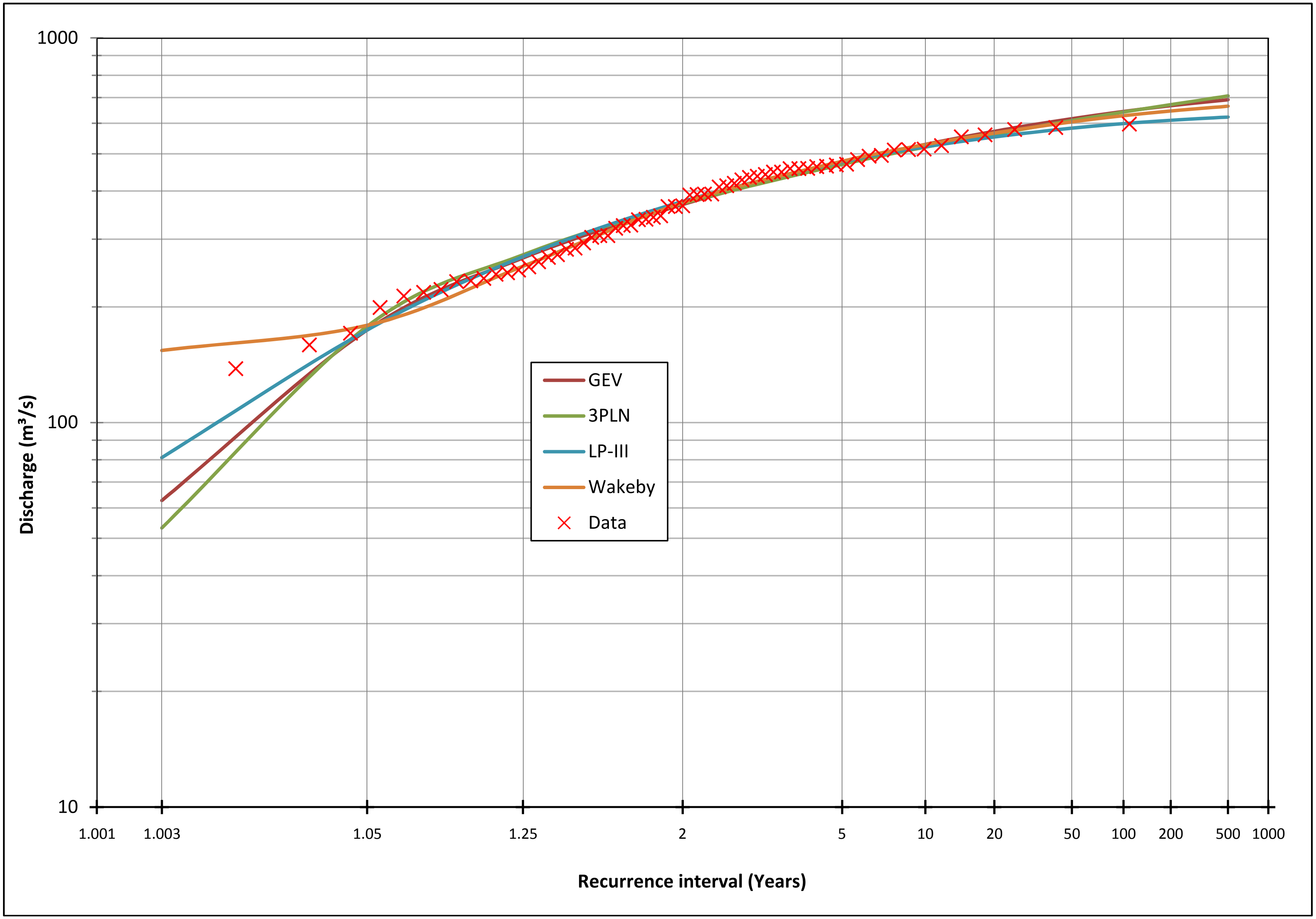
THE FOLLOWING WAKEBY PARAMETERS WERE OBTAINED VIA L-MOMENTS

M= 152.315   A=   170.173   B= 2.62   C=   -399.217   D= -.314
DISTRIBUTION IS UPPER BOUNDED AT E= .7217E+03

FLOOD FREQUENCY REGIME

RETURN PERIOD	EXCEEDANCE PROBABILITY	FLOOD
1.003	.997	154
1.050	.952	179
1.250	.800	255
2.000	.500	373
5.000	.200	478
10.000	.100	528
20.000	.050	566
50.000	.020	605
100.000	.010	628
200.000	.005	646
500.000	.002	665

Figure B1 Frequency Analysis Distributions from CFA_3.1 for the Rideau River at Ottawa Stream Gauge.



Appendix C

City of Ottawa Email Regarding Ice Removal

Ferdous Ahmed

From: Denyes, Bryden <Bryden.Denyes@ottawa.ca>
Sent: Wednesday, February 10, 2016 5:52 AM
To: Ferdous Ahmed
Cc: Showler, Steve; Cover, Kevin
Subject: Rideau River Ice Removal and Flood Plain Mapping

Good Morning Mr. Ahmed,

The City of Ottawa understands that the Rideau Valley Conservation Authority has updated the mapping for the Rideau River from Hogg's Back to the Ottawa River. Consistent with the analyses completed for the prior flood plain mapping, the updated flood plain mapping is based on the assumption of 'open water'. It is our understanding that this assumption is based on the ice removal program maintained by the City of Ottawa. This letter confirms the maintenance of the ice removal program at the City of Ottawa for the purpose of reducing flood risks. The following are some key points describing the ice removal program:

1. ice removal takes place between Rideau Falls and Bank St Bridge at the Bank and Riverside intersection
2. the purpose of the ice flush is to remove all ice throughout this corridor to prevent ice jams at certain locations which effect some existing flood prone areas
3. explosives are the prime source of ice removal between Rideau Falls and Stanley Park then the amphibious excavator takes over removing the remainder of ice
4. water flows play a large factor in the ice flush over 300 cubic metres per second can pose some dangerous challenges and under 100 cubic metres per second can prolong the operation
5. there are several partners in this operation with whom we coordinate our work:
   - Energy Ottawa
   - Parks Canada
   - PWGCA (Public Works, Government of Canada?)
   - Rideau Valley Conservation Authority
   - National Capital Commission
6. Staff remain on the river until the ice flush is complete

Thank you for your work updating the flood plain mapping for the Rideau River.

Please contact me if you require any additional information regarding our program.

Thanks

Bryden

Bryden Denyes
Area Manager, Core Roads | GS, Routes - Centrale
Roads Services | Service routier
City of Ottawa | Ville d'Ottawa
Tel.|Tél. 613-564-3742
c: 613-608-0871

Appendix D

Buildings in Floodplain – RVCA Policy

Ferdous Ahmed

From: Ewan Hardie
Sent: Wednesday, June 29, 2016 10:35 AM
To: Ferdous Ahmed
Subject: Buildings in the Floodplain Guidelines

Hi Ferdous,
As discussed at recent meetings please consider the following guidelines when undertaking floodplain mapping projects

Effective June 13th 2016, when plotting floodlines RVCA staff will use the following guidelines in order to apply a conservative approach to the delineation of the regulatory floodplain, specifically in areas that have buildings that are in the floodplain or affected by the floodplain:

1. Include any buildings in the floodplain that have any part of the footprint touching the floodplain. This is done to be conservative based on the lack of knowledge on the conditions around the buildings: soil conditions, window wells, walk out doors, building egress are all not known at the time of a floodplain mapping study so it is wise to adopt a conservative approach and include building footprints in the floodplain.
2. With regards to dry islands in and around buildings, islands will be removed if they did not meet the minimum mapping unit acceptable for the data. An envelope of 2 metres around building footprints is to be considered. If the floodplain comes close to or is in this 2m building envelope the entire envelope should be included in the floodplain. This approach is also consistent with the above approach (building footprints) in that the lack of knowledge of the conditions around the building forces the uses of a conservative approach, which is to remove the islands
3. In cases where a building has been included in the floodplain (because of the above criteria), the adjacent building will need to be included in the floodplain as well because of a lack of data in between the buildings and/or the 2m building envelope rule.
4. In the case of townhome or connected type buildings and the floodplain touching the foundations, the building footprint should be included up to the next visible unit partition where the elevation changes

Thanks

Ewan Hardie

Director
Watershed Science and Engineering Services
Rideau Valley Conservation Authority
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