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Technical Memo

December 6, 2010

To: Bruce Reid, P.Eng. Director
Watershed Sciences and Engineering Services

From: Ferdous Ahmed, Ph.D., P.Eng.
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Subject: **Tay River Flood Risk Mapping from Christie Lake to Glen Tay**

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Executive Summary

This is the project completion report of the Tay River Floodplain Mapping Project that was initiated in 2007 and completed recently (see Figure 1). This project covers the reach of the Tay River from the outlet of Christie Lake to Glen Tay Road. The mapping was 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. This brief report documents the work done so far. A separate "documentation folder" contains all pertinent background information, data, and analyses, and is available to anyone wishing to scrutinize the details. 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.

Introduction

Two previous flood mapping studies have been done on the Tay River (McCormick Rankin 1971 and FENCO 1981) in the pre-FDRP era. The McCormick study covered a 5 km reach of the river centered on the Town of Perth and was based on the available hydrological and topographical information. In the absence of streamflow data, the historical water level measurements at the Perth Basin (downstream of Gore Street) were analyzed to estimate the 1:100 year flood level and then the 1:100 year flood flow. The flood elevations were estimated by using the Manning's equation. This type of mapping will now be considered "approximate" by today's standard of floodplain delineation for regulation purposes (Conservation Ontario, 2005).

The FENCO study area extended from Glen Tay Road to the Tay Marsh. This mapping was based on good topographical data and, in the absence of sufficient hydrological data, conservative flood estimates. This pre-dates but is very close to the FDRP standards.

The McCormick mapping was superseded by the FENCO mapping, and now the latter is used for regulatory purposes by the RVCA. The need to extend the mapping both upstream and downstream of the currently mapped reach of the Tay River has been recognized for some time. In addition, a recent hydraulic analysis related to Haggart Dam concluded that the FENCO mapping is becoming obsolete and recommended that the mapping be revised to conform to present-day standards (RVCA, 2010a).

With the acquisition of accurate base mapping through the Source Water Protection funding in 2005-06 and the development of a detailed watershed model of the Tay Watershed in 2007, it became possible to embark on an FDRP-standard mapping of the Tay River from Christie Lake to Glen Tay (Figure 1).

Accordingly, RVCA began planning for a more comprehensive flood mapping. Field surveys were undertaken in 2007-08 to collect data on key cross-sections, bridge and culverts. This data was used in the flood mapping described in this report, as well as for the refinement of RVCA's watershed (Mike11) model.

High quality topography is the key to high quality mapping. Aerial photos at a 1:6000 scale were taken in May 2005 and, using them, a Digital Terrain Model (DTM) was derived in May 2006 by Base Mapping Company (see Figure 2). This DTM meets the FDRP specifications and is suitable for use in flood mapping.

The Mike11 model, originally developed in 2007 (RVCA, 2007), was updated in 2008 with new data on cross-sections, bridges and culverts. The model was thus able to simulate the river hydraulics better and this was reflected in the model performance. The long-term flow regime of the Tay River was simulated with this model and the simulated flows were used for statistical analysis and estimating design floods, which were then used in the flood mapping. The streamflow data collected at Perth and Port Elmsley was not of sufficient length and quality to conduct the typical statistical analysis to estimate design floods; hence the Mike11 model was used.

Study Area

The study area was essentially determined by the extent of the DTM (see Figures 1 and 2). At the downstream end (Glen Tay Road), the present mapping was tied to the existing mapping of the Tay River determined in 1980 (FENCO, 1981). The following streams were included in this study:

- Tay River – from Christie Lake outlet to Glen Tay Road
- Scotts Snye – entire stream

The entire area mapped is within the Tay Valley Township. There is no major settlement along this reach of the river, only some scattered rural residences.

Hydrological Analysis

The streamflow data collected at Perth and Port Elmsley is not of sufficient length and quality to perform a standard statistical analysis. This means that we have to estimate the design floods using other methods. We used the Mike11 model of the Tay Watershed to generate long-term (synthetic) flows at key locations and then performed statistical analysis to estimate design flows at those locations.

Determining design floods using long-term watershed simulation is a relatively new approach that is increasingly being used around the world to estimate flows at ungaged basins where long-term climatic data is available. The advantages of this method and its recent use are described by Boughton and Droop (2003) and DEFRA (2005). Advantages of this method over the traditional event-based methods are numerous and varied. The main advantage is the automatic accounting of antecedent moisture condition at every time step, which is taken into account in event based designs but in a rather arbitrary and/or conservative way. Integrated watershed models, like Mike11 used here, can also account for the heterogeneity of basins, river and lake attenuation, varied response time of basins, water control structures and their operation policy. With the development of sophisticated watershed modeling techniques and increasing computer power, this method is now being increasingly used in Europe, Australia, United States and South Africa.

An integrated hydrologic/hydraulic model of the Tay Watershed (Figure 3) was originally developed during 2005-2006 as reported in RVCA (2007). During the fall of 2007, 16 bridges/culverts and a number of low flow channels were surveyed. With this data, the Mike11 model of the Tay Watershed was updated in 2008. The details of the model are described elsewhere (RVCA, 2007) and are not repeated here.

This updated model was used to simulate the long-term flow series for a period from 1940 through 2007. The main assumptions in the long-term simulation are:

- Beveridges Dam: A typical year (2001) of log operation is assumed to be valid throughout the simulation period.
- Bolingbroke Dam: It is assumed that the "rule curve" can be achieved every year throughout the simulation period.

These assumptions are considered reasonable and are not expected to skew the statistical analyses using model-generated synthetic flows. On the long term, the main characteristics of the dams are expected to be fairly represented.

The model computed daily time series of flow and water level along the hydrodynamic network (Figure 3). The flow data was extracted at key locations (Figure 4) and was then subjected to standard flood frequency analysis. The CFA program of Environment Canada (Pilon and Harvey, 1993) was used; various frequency distributions were visually inspected to determine the most appropriate distribution at each flow calculation nodes. The design floods with various return periods are shown in Table 1. The first two years of simulated data was ignored in the statistical analysis to avoid the effects of initial condition, thus leaving 66 years of data (1942 through 2007) for the flood frequency analysis.

When compared to other estimates (Figures 5 and 6), our estimates are much lower than the FENCO (1981) estimate and slightly higher than the Genivar (2008) estimate. The FENCO estimate was based on the 2-day snowmelt event, which produces very high basin yield (see FENCO catchments in Figure 5). However, the routing procedure FENCO used gave very high attenuation[1] (in the order of 85-98%) along the lakes[2] (except at the Beveridges Dam where the attenuation was about 10%). As a result, the FENCO flow estimates along the Tay River are low downstream of lake outlets (e.g., downstream of Bob's Lake at Bolingbroke and Christie Lake) and high elsewhere, especially near the outlet of individual basins (e.g., at Perth and upstream of Beveridges Dam).

The GENIVER estimates, on the other hand, are based on flow transposition from other gage locations within the Rideau watershed. These estimates are roughly 20% lower than our estimates for the 1:100 year event, but matches better for more frequent events (Figure 6). Another estimate was made using the regression equations of FDRP (1986) recommended for flood mapping. These are somewhat higher than our estimate,

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[1] Flood attenuation is the reduction of flood flow peak which occurs when the flood passes through a lake or a long river reach. In case of the lake, the attenuation is made possible by the large storage provided by the lake. Attenuation is generally defined as the ratio of flow reduction to the incoming flow.

[2] Dynamic routing by Mike11 indicates only moderate attenuation through lakes (in the order of 5-20%).

but in general show the same trend. The values were taken from a recent report (RVCA, 2010b).

Taking all into account, we consider the design flows derived form the Mike11 model, as listed in Table 1, most suitable for flood hazard mapping within the Tay Watershed. We recommend that these flows be used for flood risk limit delineation by RVCA.

The flows listed in Table 1 have been used in the hydraulic analysis for the flood mapping of the Tay River from the Christie Lake to Glen Tay Road, as described in the following pages.

Data Used for Flood Hazard Mapping

Aerial photo: The aerial photo was collected on May 7-8, 2005 at a scale of 1:6000. This high quality black and white photo clearly shows the rivers, creeks, land use, houses, buildings, roads, infrastructure, vegetation and other details.

DTM: Base Mapping Company was commissioned by RVCA to produce a DTM from the aerial photos (Figure 2) in May 2006 for flood mapping purposes according to the specifications of FDRP program (MNR, 1986). Contour lines were drawn at 1.0 m intervals with 0.5 m interpolated lines. Other standard layers showing houses, roads, depressions, etc. were also produced.

Cross-Sections: River and flood plain cross-sections – the basic building blocks of hydraulic models – were generated from the high quality DTM using standard GIS software. For the most part this procedure captured the floodplain as well as most of the low flow channel in sufficient detail to be used in floodplain mapping. However, in some places, a substantial portion of the low flow channel was under water and field surveys of the low flow channel were conducted to supplement the DTM-generated profile. The surveying was conducted by RVCA staff in the fall of 2007. About 120 cross-sections were used in the model.

Channel Roughness: Following standard procedures (Chow, 1959), the resistance of the channel under possible high water conditions was estimated from aerial photos and occasional field inspections. The Manning's n was generally 0.035 in the main channel, and varied from 0.050 to 0.065 for the floodplains. These values were consistent with those found appropriate in earlier studies (FENCO, 1981).

Measured Flow: As already mentioned, the flow measurements at Perth and Port Elmsley were not directly used in the flood mapping. However, they were used only indirectly in the calibration and validation of the watershed model.

Bridges/Culverts: There are 17 bridges and culverts (Table 2) crossing the streams within the study area. Their physical dimensions and other pertinent data were collected from earlier studies (FENCO, 1981) where available, and were surveyed in the field in other cases. The survey was conducted by RVCA staff in the fall of 2007. The coefficients of contraction and expansion associated with bridges/culverts were estimated from available information using standard procedures (USACE, 1990, 2002).

Hydraulic Modeling

Following standard procedures (MNR, 1986; USACE, 1990, 2002), a steady-state hydraulic model of the Tay River and Scotts Snye was built. The HEC-RAS model (version 3.1.1) developed by US Corps of Engineers (USACE, 2002) was used. This has the same back water calculation procedure as HEC-2 (USACE, 1990) which has been the industry standard since 1970s, but with improved data processing and graphical capabilities.

About 120 cross-sections were used in the model. Distances between sections along the stream center and left and right overbanks were calculated using GIS software. Bridges and culverts were inserted at appropriate locations.

The design flows taken from the hydrologic analysis (discussed earlier), with return periods ranging from 2 to 500 years (Table 3), were used in the model. The water levels (Table 4) at the downstream end (cross-section 500) were taken or estimated from the FENCO (1981) report. The confluence and junction of the Tay River with Scotts Snye were designated as internal junctions with matching water levels in accordance with accepted procedures (USACE, 1990, 2002).

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 and culverts. Adjustments of model parameters – mainly the channel resistance and contraction and expansion coefficients – were made as necessary.

The 1:100 year computed water surface elevations and other parameters are shown in Table 5. 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 6a and 6b. It should be pointed out that the model has been built and tuned to simulate the 1:100 year flood levels; therefore the water surface elevations for other events – simulated using the same parameters, especially the Manning's n values – are only approximate. This is because the river roughness varies with flow magnitude, with higher resistance associated with lower flows.

In the absence of pertinent measurements, the validity of the HEC-RAS model was evaluated in two ways. First, the computed water levels were checked with those computed by the Mike11 model at several key locations (Figure 7). Please note that, in some cases, the locations were not exactly the same. Moreover, the HEC-RAS is a steady-state model where the energy equation is solved by the standard step method, whereas Mike11 is a fully unsteady model that solves the full dynamic equation. Considering these important points, the HEC-RAS simulation is seen to be corroborated well by the Mike11 simulation, often by a difference less than 10 cm.

Secondly, the stage-discharge relationship at the OMYA intake was assessed (Figure 8). The rating curve (obtained from OMYA) and the measurements on which the curve is based are compared to the rating curve that can be constructed by plotting the HEC-RAS-generated water levels against flood flows. Also plotted are the rating curves generated by the Mike11 model. At first glance, the data from the three sources do not match very well; however, this should be interpreted within the appropriate context. The vertical accuracy (or uncertainty) of the OMYA rating curve is about ±20 cm. The measurements are limited to low flow values within the main channel, although the extrapolation of the rating curve has been done in the overbank flow areas. The Mike11 data is pretty close to the rating curve for flows in the range from 15 to 30 cms, but lower for both smaller and higher flows. The water levels generated by HEC-RAS for lower flows might have been underestimated as a result of using the same manning's n as the 1:100 year flood. Considering all these, it is difficult to satisfactorily explain the discrepancy between the measurements and HEC-RAS points. However, the magnitude of the discrepancy is within the uncertainty (±20 cm) of the rating curve for the 1:100 year flood. This indicates that the computational error, if any, is not unacceptably high for the design event.

A sensitivity analysis of the computed water level to the design flow was conducted. The following five flow conditions were tested:

- all design flows increased by 10%
- all design flows increased by 20%
- all design flows increased by 30%
- all design flows decreased by 10%
- all design flows decreased by 20%

Figure 9 shows the computed water surface profiles and the increase in water level. Most of the change in water level occurs along the unobstructed reach of the streams. Near the bridges, the increase in water level is minimal, due to the constriction and high velocity, and thus the dominance of inertia in relation to bed resistance. However, the bridge constriction should not be counted on for the subdued change in water level, since the modification or removal of a bridge can cause the water level to bounce back to the "normal position".

The sensitivity analysis indicates that the computed water level can vary by about 20 to 30 cm for a 20% variation in flow, which is typical in hydrologic estimation of design flow. For a 30% increase in flow, the water level can go up by 40 to 50 cm at some locations. The sensitivity analysis will enable designers to take extra precaution when warranted or desired. It also gives an indication of what changes may come as a result of any changes in flood flows (due to natural causes like climate change or man-made causes like reservoir operation).

Regulatory Flood Levels

As per Section 3 of the Provincial Policy Statement under the Planning Act (MMAH, 2005), the regulatory flood in Zone 2, which includes the RVCA, is the 1:100 year flood. The computed water surface elevation is generally taken as the regulatory flood level (RFL).

However, near bridges, culverts and other water control structures, the computed water surface elevation may be substantially lower than the energy grade, with the possibility that the water level may rise to the energy grade near obstacles and under other perturbed situations, or if the bridge is enlarged or removed. In such cases, the regulatory flood level is taken as the computed energy grade.

Another possible situation is when the water surface profile is undulant, with downstream water levels occasionally higher than upstream levels. In such cases, it is possible that the water from the (higher) downstream end backs up upstream and elevates the water level. Therefore the upstream regulatory flood level is taken as the downstream water surface elevation.

In summary, the following algorithms were followed in determining the regulatory flood level:

- By default, set RFL equal to computed water surface elevation
- If the computed water surface level is lower than the computed energy grade by more than 5 cm, set RFL equal to computed energy grade
- If the RFL at any location is lower than the RFL at the next downstream section, set the RFL equal to downstream RFL

When these rules are followed, the RFLs always fall between the water surface elevation and energy grade, are equal to the water surface elevation most of time, and are equal to energy grade some of the times. And the RFLs always decrease in the downstream direction. These adjustments to model outputs are done because it is recognized that the numerical models can never be a perfect representation of real world hydraulic phenomena.

For the present study, the regulatory flood levels were computed this way and are tabulated in Table 5, along with the computed water surface elevations and energy grades.

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 0.5 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 manually because of the complexities of the topography and flow paths. However, this was cross-checked with the flood lines generated using the HEC-GeoRAS program version 4.0 (USACE, 2005), which has the ability to plot flood lines on topographical maps. This gave us an additional degree of quality control.

At the end, the flood lines were plotted on 1:5000 scale drawings for the entire study area. Since there was no dense urban area within the study reach, 1:2000 scale maps were not needed.

Flood Risk Maps

A set of flood map sheets is attached herewith, consisting of an index map and six 1:5000 scale map sheets.

The index map shows the overall study area, the river network, major settlements, road network, and other land marks. It also shows all the map sheets in outline and the overall flood risk limits, although at a much smaller scale.

In each of the map sheets, rivers and streams with flow directions, contour lines, spot elevations, building outlines, and other land marks are shown. Cross-sections with chainage and regulatory flood levels are also shown. The floodway, which is basically the entire floodplain for the one-zone areas like the present case, has been shaded for easy identification.

Public Consultation

An open house was held on October 6, 2009 at the Royal Canadian Legion in Perth. The draft flood maps were shown to the public. The technical steps involved in the mapping process were explained. How the flood maps are used by the RVCA and the municipalities was also discussed. The open house was attended by 37 members of the public as well as three RVCA Board Members and a municipal staff. The open house was well received and appreciated by the public. No major issue was identified in the open house. A few helpful suggestions were received and were taken care of afterwards. Several anecdotal observations on high water situations by local residents corroborated the validity of our modeling results. The public was happy with the mapping and there was no outstanding issue.

Project Deliverables

The end products of this project are:

1. The Flood Mapping Report (the current memo)
2. The flood risk map sheets
3. The HEC-RAS model files
4. The “documentation folder”

Closure

The design flows derived form the Mike11 model, as listed in Table 1, are our best estimate at the present time. We recommend that these flows be used for flood risk limit delineation by RVCA throughout the Tay Watershed.

The hydrotechnical and cartographic procedures used in this study conform to present day standards of flood hazard delineation, as per 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 will also be of valuable use in the flood forecasting and warning services of the RVCA.

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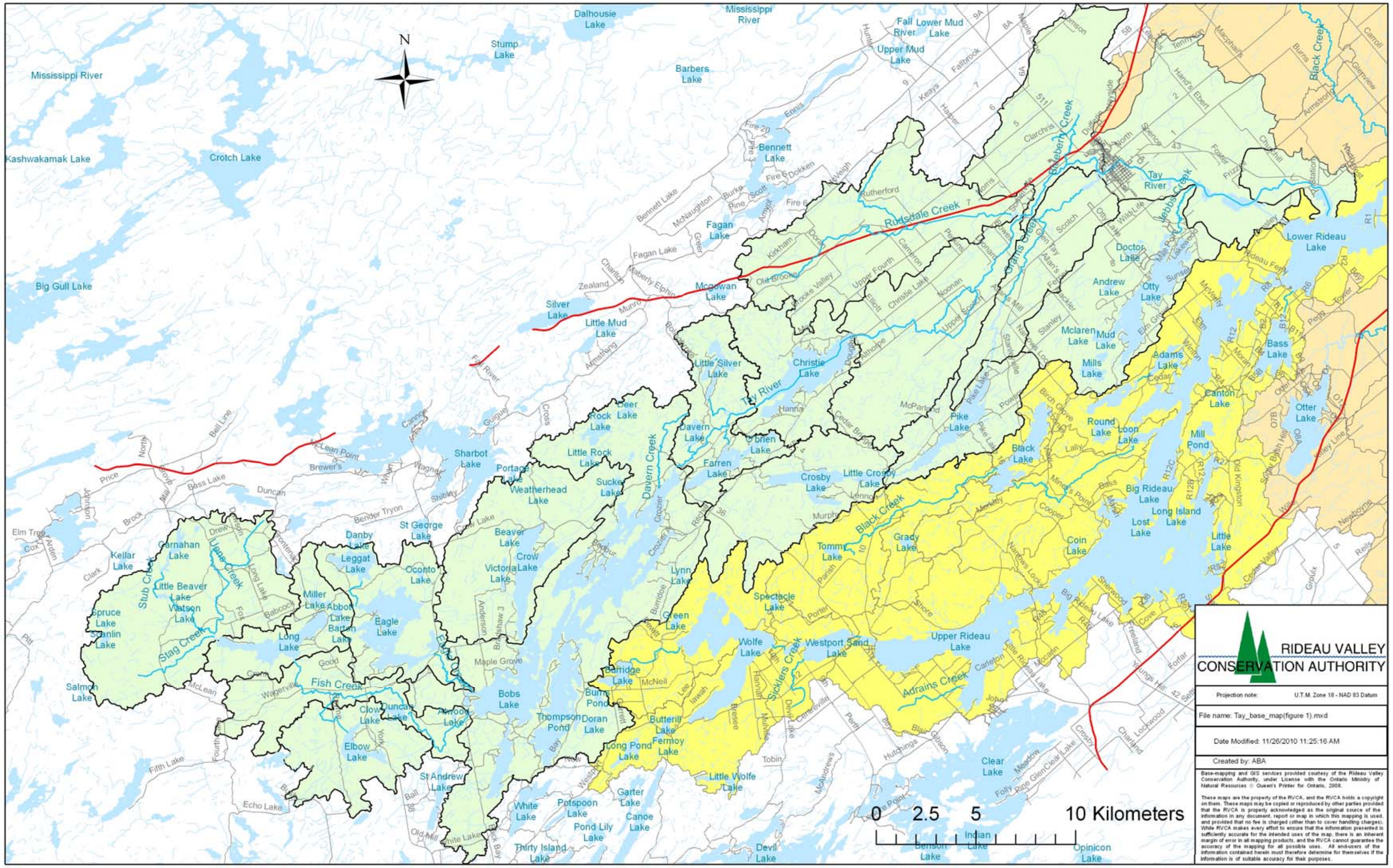


Figure 1 Tay River Basin

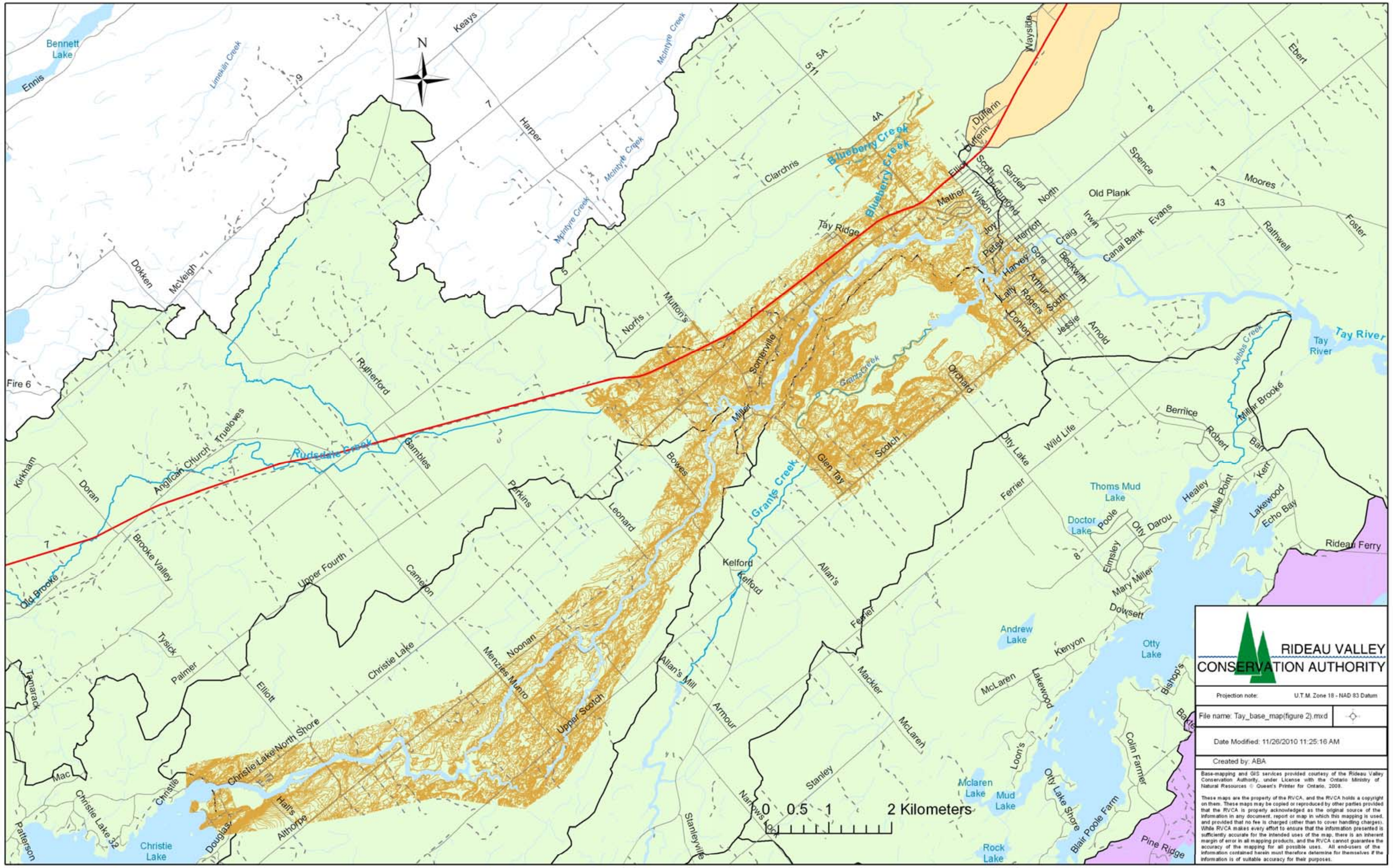


Figure 2 Extent of Aerial Photo

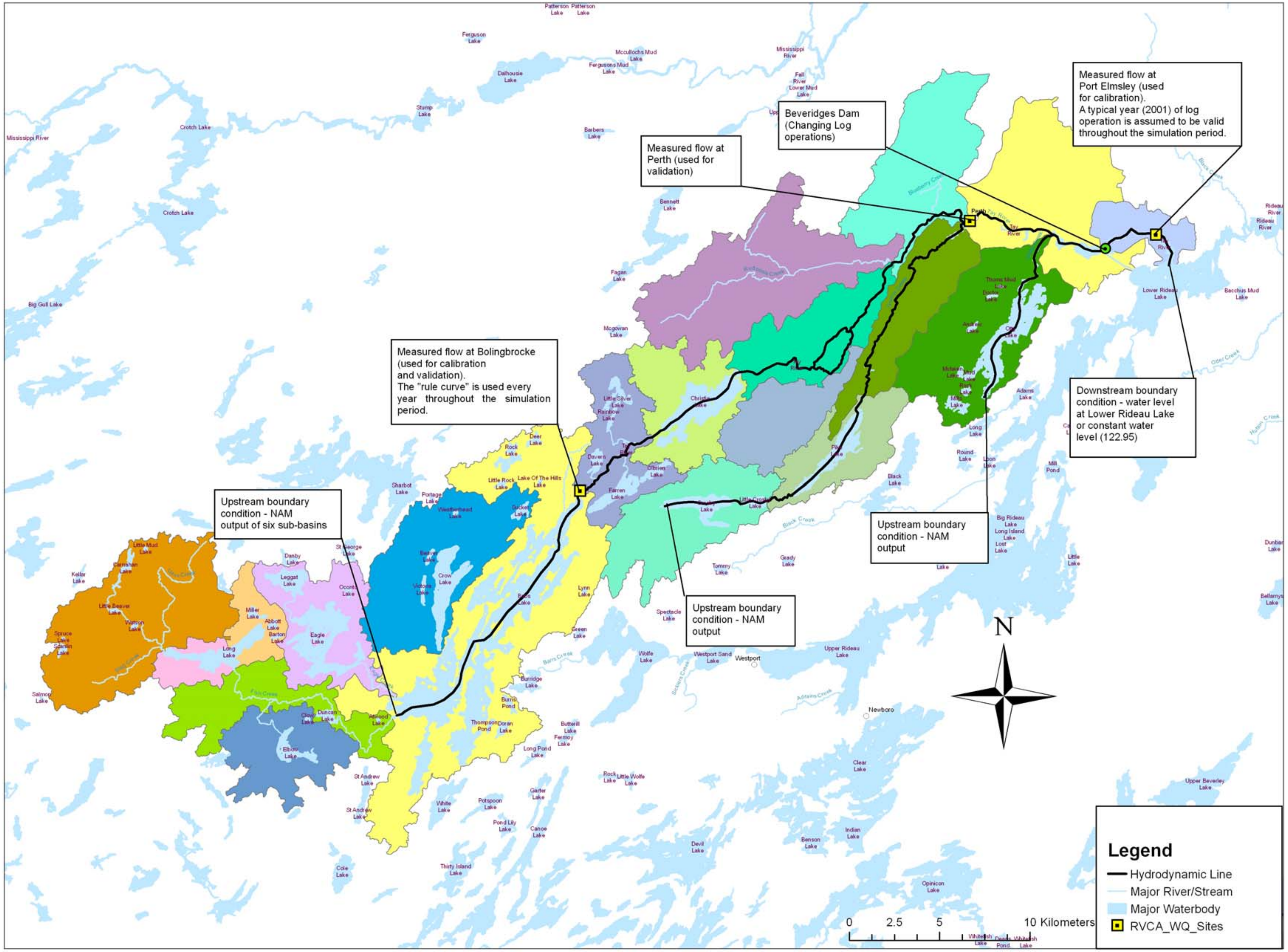


Figure 3 Mike11 Model Schematic

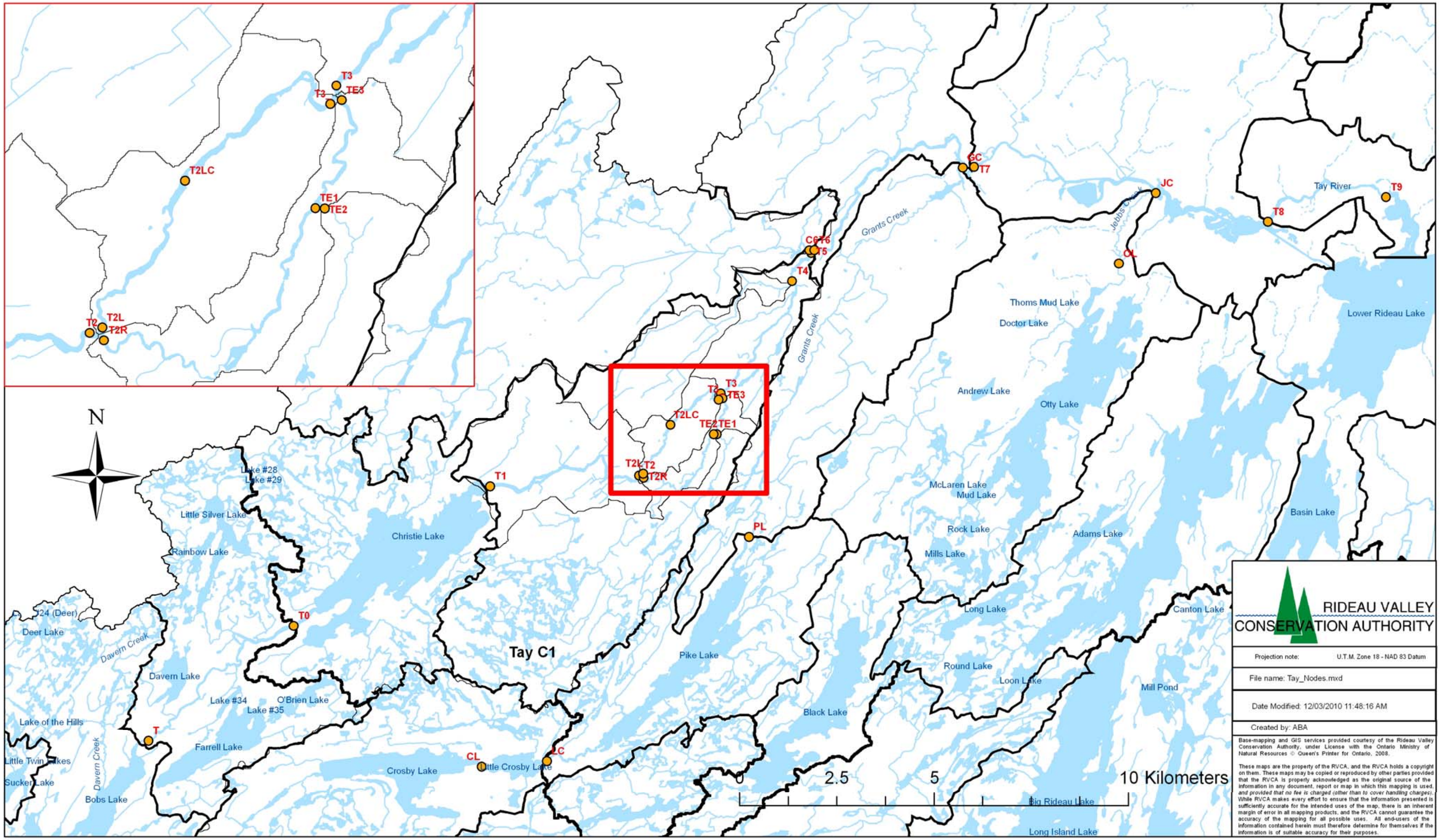


Figure 4 Data Extraction Points

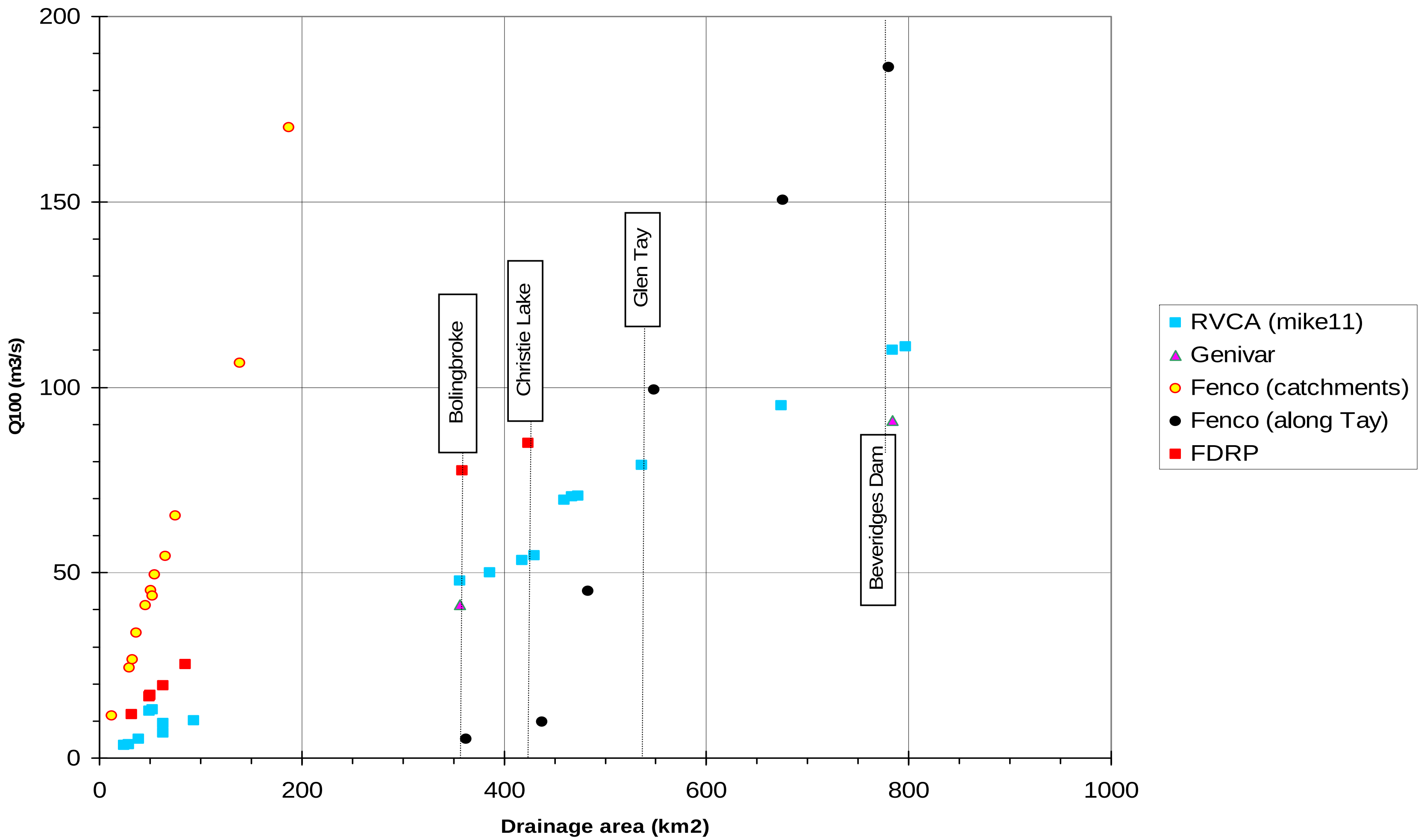
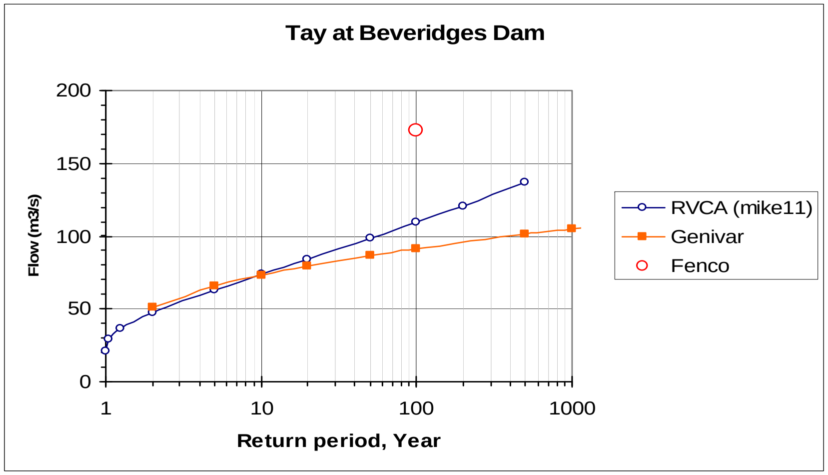
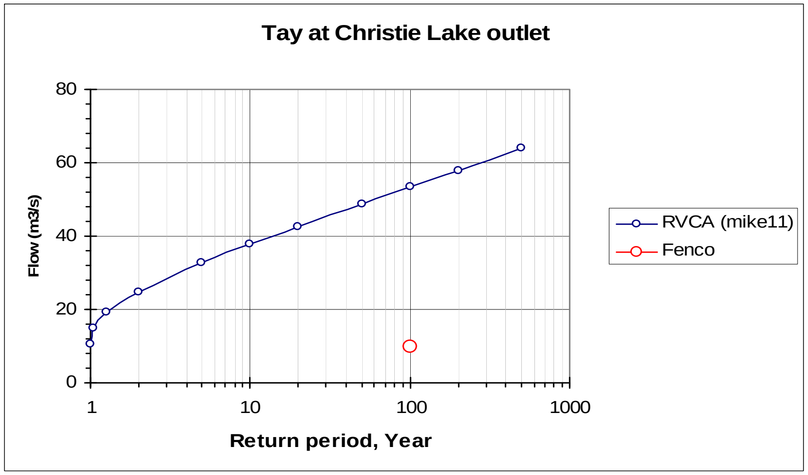
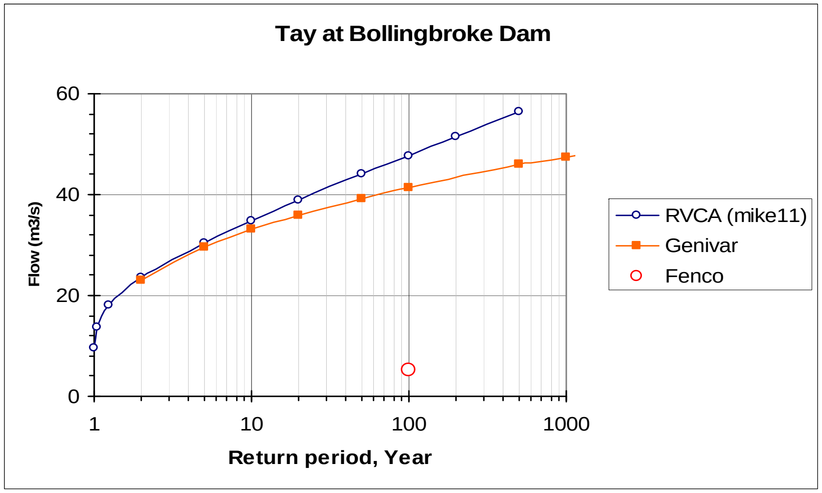


Figure 5 Comparison of 1:100 Year Flow Estimates







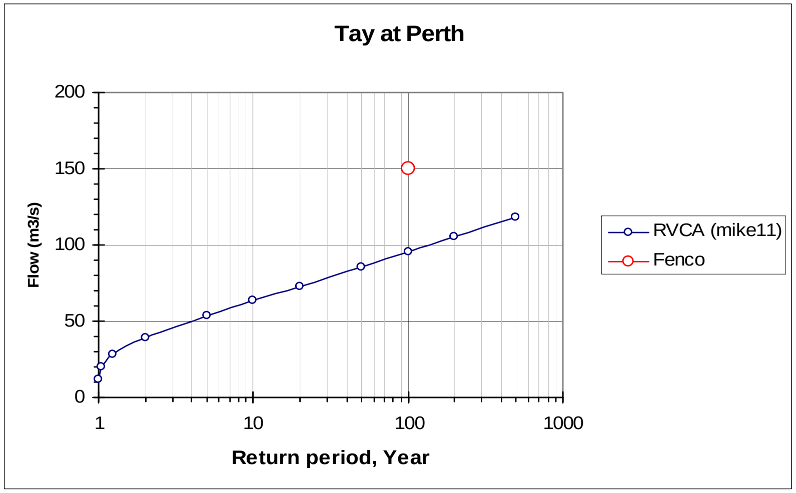


Figure 6 Comparison of Flows

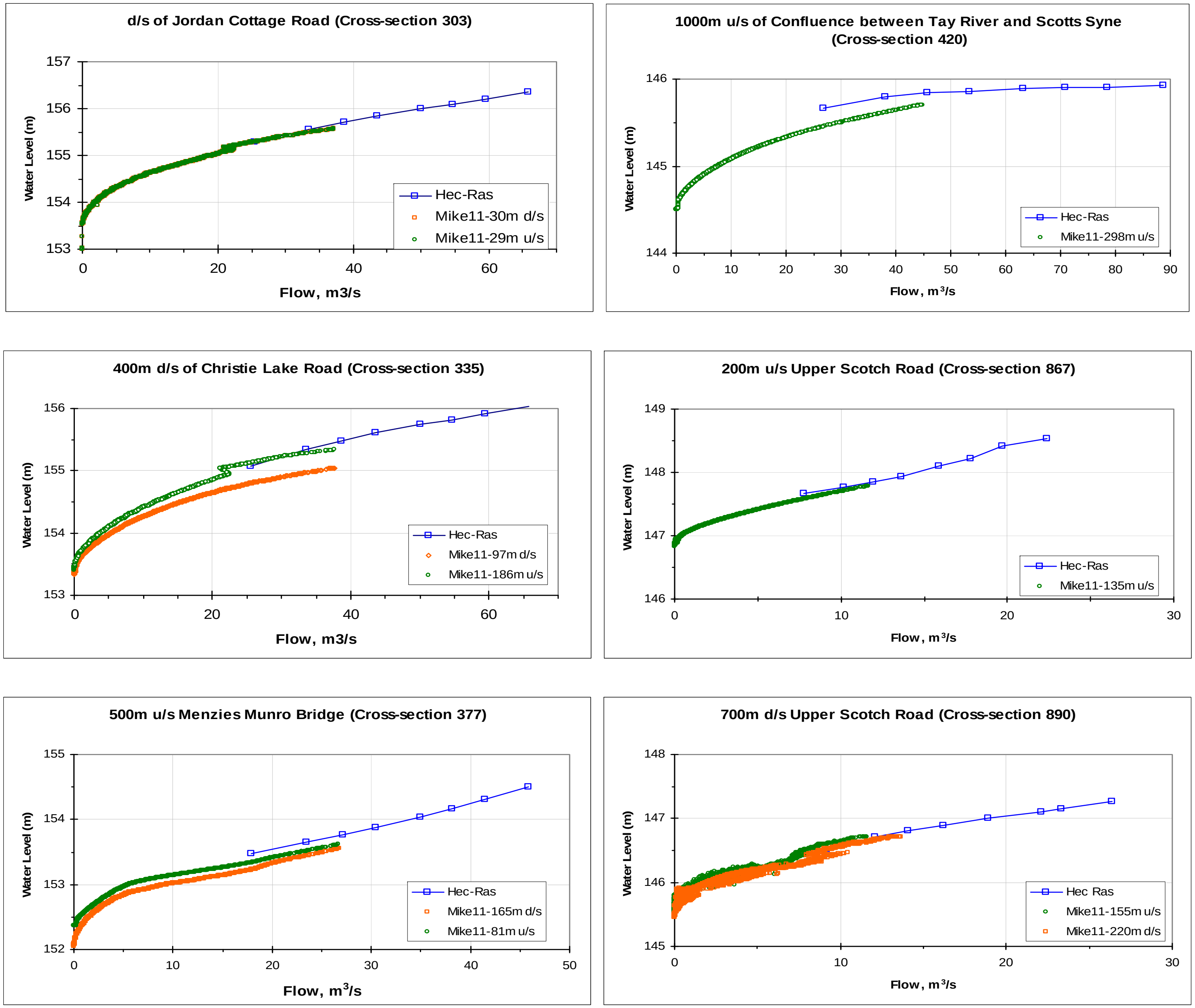


Figure 7 Comparison of Stage-Discharge Relationships

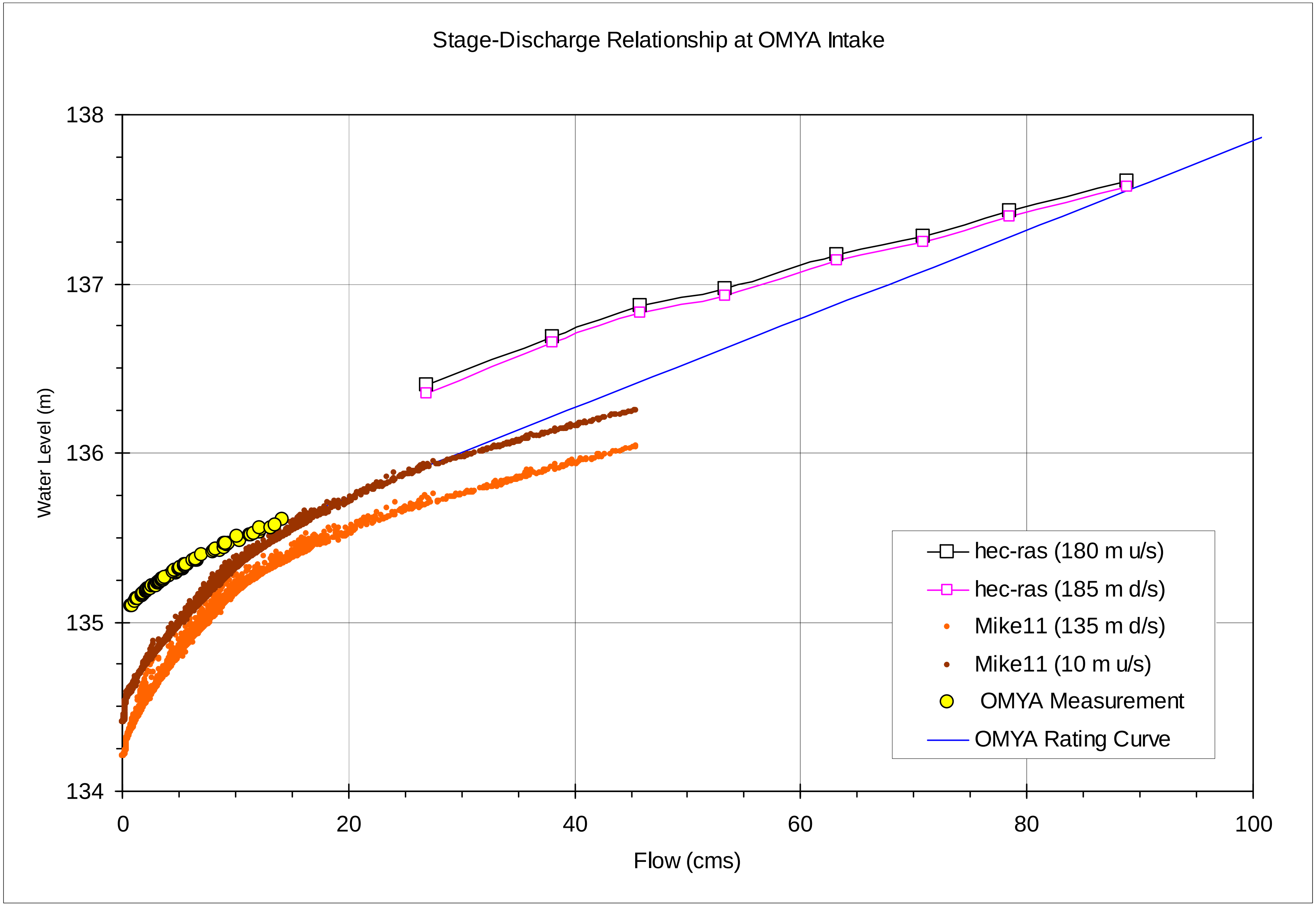


Figure 8 Stage-discharge Relationship at OMYA Intake

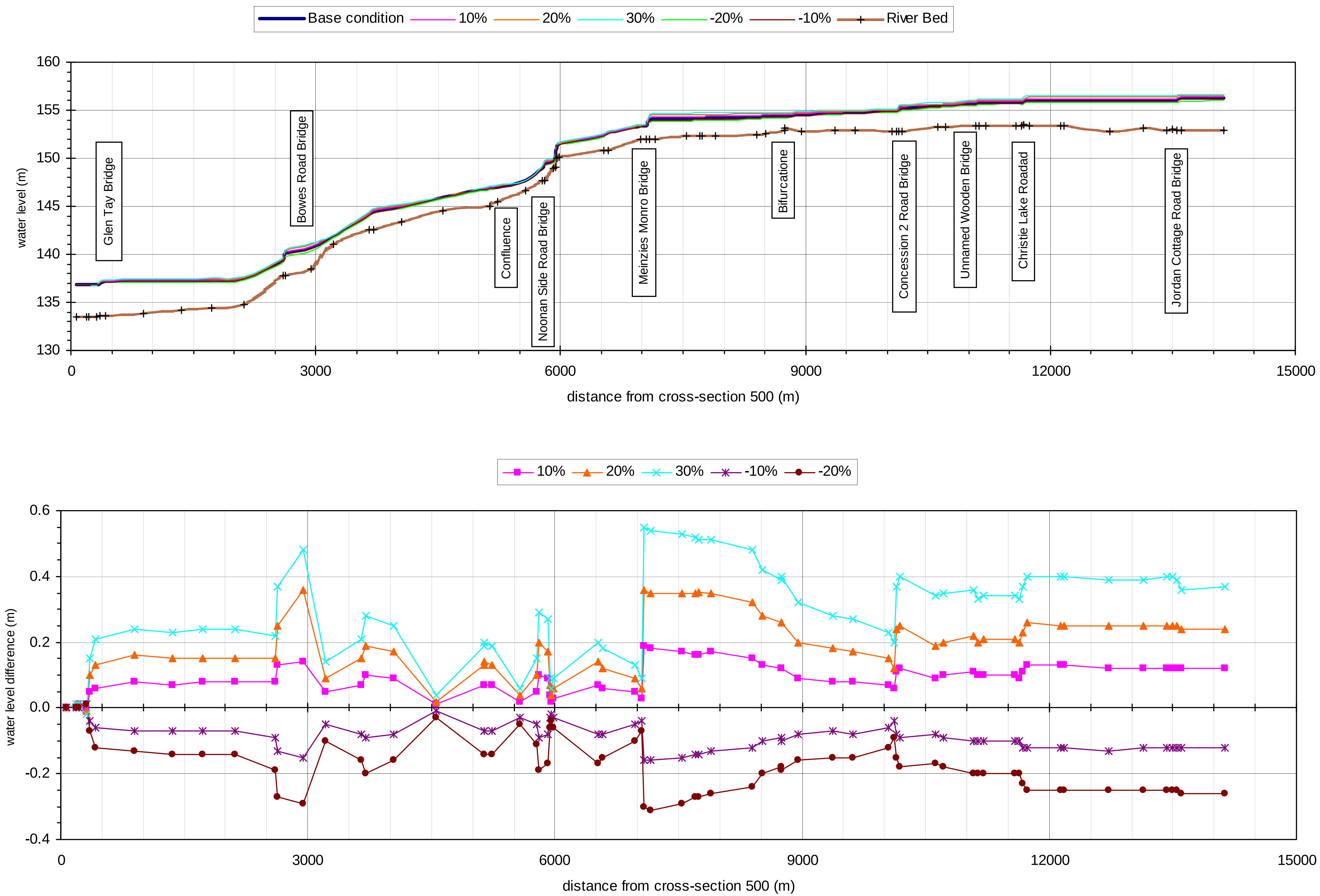


Figure 9 Sensitivity Analysis of Computed Water Level

Table 1 Flood Flows at Various Locations

Return Period	Bollingbroke Dam (d/s)	Christie Inlet	Christie Outlet	At bifurcation	Left at start - bifurcated	Right at start - bifurcated	LeftCentre - bifurcated	Tay2East before source point	Tav C1 outlet	Left bifurcated flow near confluence	Right bifurcated flow near confluence	At confluence	OMYA Water Intake	Prior to Rudsdale creek	Rudsdale creek outlet	Glen Tay Rd bridge (d/s)	Tay at Perth	Beveridges Dam (d/s)	Tav at Port Elmslev	Crosby Lake outlet	Little Crosby Lake outlet	Pike Lake outlet	Grants Creek outfall	Otty Lake outlet at Rideau Ferry Rd	Jebbs Creek outfall
	T	**T0**	**T1**	**T2**	**T2L**	**T2R**	**T2LC**	**TE1**	**TE2**	**T3_**	**TE3**	**T3**	**T4**	**T5**	**C6**	**T6**	**T7**	**T8**	**T9**	**CL**	**LC**	**PL**	**GC**	**OL**	**JC**
(year)	**Flow, m^3/s**																								
1.003	9.5	11.8	10.7	11.0	7.5	3.5	7.6	4.4	0.7	7.5	4.8	6.2	6.5	6.5	1.8	8.5	11.9	21.3	21.0	0.9	1.2		2.1	2.6	2.6
1.05	13.7	16.1	14.8	15.2	10.4	4.8	10.5	5.3	1.0	8.2	5.9	12.2	12.5	12.6	2.7	15.0	19.9	29.1	28.9	1.1	1.5	2.1	3.1	3.3	3.3
1.25	18.0	20.3	19.1	19.5	13.5	6.1	13.6	6.3	1.3	10.9	7.2	18.3	18.6	18.7	3.5	21.6	27.9	36.9	36.9	1.4	1.9	2.7	4.1	4.2	4.2
2	23.5	25.9	24.9	25.5	17.7	7.9	17.9	7.8	1.7	17.4	9.2	26.4	26.8	26.9	4.6	30.5	38.7	47.8	47.9	1.7	2.5	3.5	5.3	5.4	5.4
5	30.5	32.9	32.7	33.5	23.2	10.3	23.5	10.2	2.2	27.3	12.1	37.5	38.0	38.1	5.9	42.8	53.4	63.1	63.4	2.3	3.2	4.5	6.8	7.3	7.3
10	34.9	37.2	37.7	38.7	26.8	11.9	27.1	11.9	2.6	32.9	14.1	45.1	45.7	45.8	6.8	51.3	63.3	73.7	74.2	2.6	3.7	5.1	7.7	8.5	8.6
20	38.9	41.3	42.5	43.6	30.2	13.5	30.5	13.6	2.9	37.3	16.2	52.5	53.2	53.3	7.6	59.5	72.9	84.2	85.0	2.9	4.1	5.6	8.5	9.7	9.9
50	44.1	46.4	48.7	50.0	34.6	15.4	34.9	15.9	3.2	41.6	18.9	62.2	63.0	63.2	8.7	70.6	85.5	98.5	99.4	3.3	4.7	6.3	9.5	11.4	11.7
100	***47.8***	***50.1***	***53.3***	***54.7***	***37.8***	***16.9***	***38.2***	***17.8***	***3.5***	***44.1***	***21.1***	***69.6***	***70.6***	***70.8***	***9.4***	***79.0***	***95.1***	***110.0***	***111.0***	***3.6***	***5.2***	***6.8***	***10.2***	***12.7***	***13.1***
200	51.5	53.7	58.0	59.5	41.1	18.4	41.5	19.7	3.8	46.0	23.3	77.1	78.2	78.5	10.1	87.7	105.0	121.0	122.0	4.0	5.6	7.3	10.9	14.0	14.5
500	56.4	58.5	64.1	65.8	45.4	20.4	45.9	22.4	4.2	47.9	26.4	87.2	88.6	88.8	11.1	99.4	118.0	137.0	138.0	4.4	6.2	8.0	11.7	15.7	16.5
Flood frequency distribution	***3LN***	***3LN***	***3LN***	***3LN***	***3LN***	***3LN***	***3LN***	***3LN***	***3LN***	***WBY***	***3LN***	***GEV***	***GEV***	***GEV***	***GEV***	***GEV***	***GEV***	***GEV***	***GEV***	***3LN***	***3LN***	***3LN***	***3LN***	***3LN***	***3LN***

Note:

Flood frequency distributions used: GEV (Gumbel Extreme Value), 3LN (Three Log Normal), LP III (Log Pearsen III), and Wakeby (WBY)

Table 2 Bridges and Culverts

Reach	Name	Bridges/ Culvert	Chainage	Bounding xsecs (ID)	Deck Top (m)	Low chord (m)	Deck width (m)	Source
Tay2A	Glen Tay Bridge	B	577.50	480 & 485	138.09	136.59	9.70	FENCO (1981)
Tay2A	Bowes Road Bridge	B	2856.00	429 & 430	141.93	140.93	8.00	RVCA Survey (Aug-Sep 2007)
Tay2A	Wildgoose Private Crossing	B	3920.00	424 & 425	145.45	145.18	3.50	RVCA Survey (Aug-Sep 2007)
Tay2B	Noonan Side Road Bridge	B	671.50	397 & 398	151.06	150.81	8.50	RVCA Survey (Aug-Sep 2007)
Tay2B	Meinzies Monro Bridge	B	1956.70	382 & 383	154.77	154.12	8.50	RVCA Survey (Aug-Sep 2007)
Tay2C	Concession 2 Bridge	B	1545.65	348 & 349	155.94	154.94	8.00	RVCA Survey (Aug-Sep 2007)
Tay2C	Dougal Private Crossing	B	2093.60	338 & 340	156.87	155.87	3.50	RVCA Survey (Aug-Sep 2007)
Tay2C	Unnamed Wooden Bridge	B	2523.00	336 & 337	155.17	154.96	4.00	RVCA Survey (Aug-Sep 2007)
Tay2C	Christie Lake Road	B	3075.24	327 & 328	156.70	156.25	7.90	RVCA Survey (Aug-Sep 2007)
Tay2C	Jordan Cottage Road Bridge	B	4980.00	300 & 303	155.93	155.00	4.00	RVCA Survey (Aug-Sep 2007)
Scotts Snye	Noonan Side Road Bridge	B	65.90	899 & 900	148.21	147.96	9.05	RVCA Survey (Aug-Sep 2007)
Scotts Snye	Brady Private Crossing	B	1734.72	883 & 885	147.38	147.13	4.30	RVCA Survey (Aug-Sep 2007)
Scotts Snye	Upper Scotch Line Culvert	C	2034.00	876 & 877	148.62	148.37	18.00	RVCA Survey (Aug-Sep 2007)
Scotts Snye	Morrison Private Crossing	B	2185.50	867 & 870	148.08	148.00	3.70	RVCA Survey (Aug-Sep 2007)
Scotts Snye	Preston Private Crossing	B	2560.00	863 & 864	148.01	147.80	3.65	RVCA Survey (Aug-Sep 2007)
Scotts Snye	Rathwell Private Crossing	B	2835.05	857 & 860	149.94	149.80	2.00	RVCA Survey (Aug-Sep 2007)
Scotts Snye	Upper Scotch Line Culvert	C	3715.00	820 & 822	155.07	154.82	18.60	RVCA Survey (Aug-Sep 2007)

Table 3 Design Flows in HEC-RAS Model

River/Creek	Reach	River Station #	Xsec ID	Estimated Design Flow in m³/s for Different Flood Events							
				500 yr	200 yr	100 yr	50 yr	20 yr	10 yr	5 yr	2 yr
TAY	Tay2A	244.371	500	99.80	88.10	79.40	70.90	59.80	51.50	43.00	30.60
TAY	Tay2A	560.125	485	99.80	88.10	79.40	70.90	59.80	51.50	43.00	30.60
TAY	Tay2A	593.502	480	99.40	87.70	79.00	70.60	59.50	51.30	42.80	30.50
TAY	Tay2A	664.187	470	99.40	87.70	79.00	70.60	59.50	51.30	42.80	30.50
TAY	Tay2A	1137.32	460	88.80	78.50	70.80	63.20	53.30	45.80	38.10	26.90
TAY	Tay2A	5380.33	410	88.80	78.50	70.80	63.20	53.30	45.80	38.10	26.90
TAY	Tay2B	23.7604	403	47.90	46.00	44.10	41.60	37.30	32.90	27.30	17.40
TAY	Tay2B	1940.74	383	47.90	46.00	44.10	41.60	37.30	32.90	27.30	17.40
TAY	Tay2B	3629.13	363	45.90	41.50	38.20	34.90	30.50	27.10	23.50	17.90
TAY	Tay2C	152.679	360	65.80	59.50	54.70	50.00	43.60	38.70	33.50	25.50
TAY	Tay2C	5537.99	250	65.80	59.50	54.70	50.00	43.60	38.70	33.50	25.50
Scotts Snye	Scotts Snye	54.9379	900	26.40	23.30	22.10	18.90	16.20	14.10	12.10	9.20
Scotts Snye	Scotts Snye	1718.77	885	26.40	23.30	22.10	18.90	16.20	14.10	12.10	9.20
Scotts Snye	Scotts Snye	4714.17	810	22.40	19.70	17.80	15.90	13.60	11.90	10.20	7.80

Table 4 Downstream Boundary Condition

Return Period Years	Flow of Water m^3/s	Water Surface Elev m
500	99.80	136.99
200	88.10	136.93
100	79.40	136.85
50	70.90	136.81
20	59.80	136.68
10	51.50	136.60
5	43.00	136.52
2	30.60	136.24

Table 5 Regulatory Flood Levels for 1:100 Year Flood Event

River/Creek	Reach	River Station	Xsec ID	Q (total)	Computed WSEL	EGL	RFL
			#	m^3/s	m	m	m
TAY RIVER	Tay2A	244.371	500	79.40	136.85	136.85	Outside Study Limit
	Tay2A	309.746	498	79.40	136.85	136.85	
	Tay2A	430.130	495	79.40	136.85	136.86	
	Tay2A	459.997	490	79.40	136.85	136.86	
	Tay2A	560.126	485	79.40	136.82	136.90	
	Tay2A	577.500	Glen Tay Road Bridge				
	Tay2A	593.502	480	79.00	137.03	137.16	137.16
	Tay2A	664.188	470	79.00	137.17	137.23	137.23
	Tay2A	1137.321	460	70.80	137.24	137.24	137.24
	Tay2A	1601.435	450	70.80	137.25	137.25	137.25
	Tay2A	1963.644	445	70.80	137.28	137.29	137.28
	Tay2A	2364.532	440	70.80	137.46	137.48	137.46
	Tay2A	2841.859	430	70.80	139.41	139.95	139.95
	Tay2A	2856.000	Bowes Road Bridge				
	Tay2A	2871.233	429	70.80	140.08	140.33	140.33
	Tay2A	3183.436	428	70.80	140.68	140.72	140.68
	Tay2A	3461.330	427	70.80	141.86	142.19	142.19
	Tay2A	3892.428	425	70.80	144.17	144.33	144.33
	Tay2A	3920.000	Wildgoose Private Crossing				
	Tay2A	3951.251	424	70.80	144.45	144.56	144.56
	Tay2A	4292.497	423	70.80	144.93	144.96	144.93
	Tay2A	4804.420	420	70.80	145.90	146.12	146.12
	Tay2A	5380.333	410	70.80	146.93	146.95	146.93
	Tay2B	23.760	403	44.10	146.94	146.95	146.94
	Tay2B	122.438	400	44.10	146.98	146.99	146.98
	Tay2B	460.000	399	44.10	147.64	147.79	147.79
	Tay2B	659.126	398	44.10	149.01	149.19	149.19
	Tay2B	671.500	Noonan Side Road Bridge				
	Tay2B	690.395	397	44.10	149.44	149.56	149.56
	Tay2B	803.688	395	44.10	149.76	149.85	149.85
	Tay2B	828.899	394wier	44.10	150.40	150.61	150.61
	Tay2B	841.118	393(fixed weir)	44.10	151.27	151.41	151.41
	Tay2B	875.467	392	44.10	151.48	151.51	151.48
	Tay2B	1411.781	390	44.10	152.40	152.55	152.55
	Tay2B	1467.367	387	44.10	152.66	152.74	152.74
	Tay2B	1863.693	385	44.10	153.33	153.35	153.33
	Tay2B	1940.746	383	44.10	153.39	153.57	153.57
	Tay2B	1956.700	Meinzies Monro Bridge				
	Tay2B	1973.999	382	38.20	154.03	154.11	154.11
	Tay2B	2044.126	380	38.20	154.13	154.13	154.13
	Tay2B	2423.260	377	38.20	154.16	154.16	154.16
	Tay2B	2597.757	376	38.20	154.19	154.20	154.19

	Tay2B	2625.561	375	38.20	154.20	154.20	154.20
	Tay2B	2786.586	374	38.20	154.21	154.22	154.21
	Tay2B	3285.718	370	38.20	154.28	154.31	154.28
	Tay2B	3407.402	365	38.20	154.36	154.37	154.36
	Tay2B	3629.139	363	38.20	154.40	154.40	154.40
	Tay2C	152.680	360	54.70	154.38	154.42	154.38
	Tay2C	368.359	357	54.70	154.55	154.56	154.55
	Tay2C	776.829	355	54.70	154.68	154.69	154.68
	Tay2C	1023.538	353	54.70	154.75	154.76	154.75
	Tay2C	1465.962	350	54.70	154.89	154.90	154.89
	Tay2C	1526.047	349	54.70	154.87	155.00	155.00
	Tay2C	1545.650	Concession 2 Bridge				
	Tay2C	1558.590	348	54.70	155.06	155.16	155.16
	Tay2C	1600.361	345	54.70	155.19	155.21	155.19
	Tay2C	2026.387	340	54.70	155.44	155.49	155.49
	Tay2C	2093.600	Dougal Private Crossing				
	Tay2C	2120.912	338	54.70	155.52	155.57	155.52
	Tay2C	2496.332	337	54.70	155.68	155.74	155.74
	Tay2C	2523.000	Unnamed Wooden Bridge				
	Tay2C	2540.370	336	54.70	155.79	155.82	155.79
	Tay2C	2615.674	335	54.70	155.82	155.82	155.82
	Tay2C	2987.563	330	54.70	155.84	155.85	155.84
	Tay2C	3054.625	328	54.70	155.81	155.92	155.92
	Tay2C	3075.235	Christie Lake Road				
	Tay2C	3090.636	327	54.70	155.98	156.07	156.07
	Tay2C	3147.530	325	54.70	156.08	156.09	156.08
	Tay2C	3543.548	322	54.70	156.09	156.09	156.09
	Tay2C	3585.045	321	54.70	156.09	156.09	156.09
	Tay2C	4137.738	320	54.70	156.10	156.10	156.10
	Tay2C	4551.223	315	54.70	156.10	156.10	156.10
	Tay2C	4833.916	310	54.70	156.10	156.10	156.10
	Tay2C	4906.529	305	54.70	156.10	156.11	156.10
	Tay2C	4965.206	303	54.70	156.10	156.12	156.10
	Tay2C	4980.000	Jordan Cottage Road Bridge				
	Tay2C	5012.969	300	54.70	156.24	156.26	156.24
	Tay2C	5537.999	250	54.70	156.26	156.26	156.26
Scotts Snye	Scotts Snye	54.938	900	22.10	146.93	146.95	146.93
	Scotts Snye	65.900	Noonan Side Road Bridge				
	Scotts Snye	85.936	899	22.10	146.96	147.05	147.05
	Scotts Snye	492.922	897	22.10	147.08	147.08	147.08
	Scotts Snye	991.151	895	22.10	147.09	147.09	147.09
	Scotts Snye	1432.316	890	22.10	147.10	147.10	147.10
	Scotts Snye	1718.774	885	22.10	147.10	147.17	147.17
	Scotts Snye	1734.720	Brady Private Crossing				
	Scotts Snye	1742.916	883	17.80	147.76	147.82	147.82
	Scotts Snye	1852.837	880	17.80	147.83	147.83	147.83
	Scotts Snye	2019.013	877	17.80	147.83	147.85	147.83

	Scotts Snye	2034.000	Upper Scotch Line Culvert				
	Scotts Snye	2042.292	876	17.80	147.99	148.01	147.99
	Scotts Snye	2074.882	875	17.80	148.01	148.01	148.01
	Scotts Snye	2171.385	870	17.80	147.98	148.05	148.05
	Scotts Snye	2185.500	Morrison Private Crossing				
	Scotts Snye	2202.864	867	17.80	148.21	148.29	148.29
	Scotts Snye	2503.605	865	17.80	148.43	148.44	148.43
	Scotts Snye	2547.598	864	17.80	148.42	148.47	148.47
	Scotts Snye	2560.000	Preston Private Crossing				
	Scotts Snye	2571.380	863	17.80	148.54	148.59	148.59
	Scotts Snye	2809.062	860	17.80	148.73	148.91	148.91
	Scotts Snye	2835.050	Rathwell Private Crossing				
	Scotts Snye	2851.744	857	17.80	150.32	150.36	150.32
	Scotts Snye	2950.574	855	17.80	150.36	150.36	150.36
	Scotts Snye	3102.223	850	17.80	150.36	150.36	150.36
	Scotts Snye	3199.053	840	17.80	150.36	150.37	150.36
	Scotts Snye	3243.152	830	17.80	150.80	151.04	151.04
	Scotts Snye	3507.560	825	17.80	152.82	152.95	152.95
	Scotts Snye	3697.935	822	17.80	153.41	153.53	153.53
	Scotts Snye	3715.000	Upper Scotch Line Culvert				
	Scotts Snye	3726.498	820	17.80	153.88	153.92	153.88
	Scotts Snye	4121.302	815	17.80	154.09	154.09	154.09
	Scotts Snye	4621.113	813	17.80	154.29	154.29	154.29
	Scotts Snye	4714.170	810	17.80	154.34	154.34	154.34

Note:

RFL - Regulatory Flood Levels
EGL - Energy Grade Elevation
WSEL - Water Surface Elevation

Table 6a Computed Water Surface Elevations for Different Flood Events

River/ Creek	Reach	River Station	Xsec ID #	Flow (m^3/s) and Computed WSEL (m) for Different Flood Events: Q500	WL500	Q200	WL200	Q100	WL100	Q50	WL50
TAY RIVER	Tay2A	244.371	500	99.80	136.99	88.10	136.93	79.40	136.85	70.90	136.81
	Tay2A	309.746	498	99.80	136.99	88.10	136.93	79.40	136.85	70.90	136.81
	Tay2A	430.130	495	99.80	137.00	88.10	136.93	79.40	136.85	70.90	136.81
	Tay2A	459.997	490	99.80	137.00	88.10	136.94	79.40	136.85	70.90	136.81
	Tay2A	560.126	485	99.80	136.95	88.10	136.89	79.40	136.82	70.90	136.79
	Tay2A	577.500	Glen Tay Road Bridge								
	Tay2A	593.502	480	99.40	137.32	87.70	137.17	79.00	137.03	70.60	136.95
	Tay2A	664.188	470	99.40	137.49	87.70	137.32	79.00	137.17	70.60	137.06
	Tay2A	1137.321	460	88.80	137.57	78.50	137.40	70.80	137.24	63.20	137.13
	Tay2A	1601.435	450	88.80	137.57	78.50	137.40	70.80	137.25	63.20	137.14
	Tay2A	1963.644	445	88.80	137.61	78.50	137.43	70.80	137.28	63.20	137.17
	Tay2A	2364.532	440	88.80	137.74	78.50	137.58	70.80	137.46	63.20	137.37
	Tay2A	2841.859	430	88.80	139.59	78.50	139.50	70.80	139.41	63.20	139.31
	Tay2A	2856.000	Bowes Road Bridge								
	Tay2A	2871.233	429	88.80	140.40	78.50	140.22	70.80	140.08	63.20	139.94
	Tay2A	3183.436	428	88.80	141.11	78.50	140.83	70.80	140.68	63.20	140.52
	Tay2A	3461.330	427	88.80	141.98	78.50	141.91	70.80	141.86	63.20	141.80
	Tay2A	3892.428	425	88.80	144.35	78.50	144.25	70.80	144.17	63.20	144.09
	Tay2A	3920.000	Wildgoose Private Crossing								
	Tay2A	3951.251	424	88.80	144.69	78.50	144.56	70.80	144.45	63.20	144.35
	Tay2A	4292.497	423	88.80	145.14	78.50	145.02	70.80	144.93	63.20	144.84
	Tay2A	4804.420	420	88.80	145.93	78.50	145.91	70.80	145.90	63.20	145.89
	Tay2A	5380.333	410	88.80	147.09	78.50	147.00	70.80	146.93	63.20	146.86
	Tay2B	23.760	403	47.90	147.11	46.00	147.02	44.10	146.94	41.60	146.87
	Tay2B	122.438	400	47.90	147.14	46.00	147.05	44.10	146.98	41.60	146.91
	Tay2B	460.000	399	47.90	147.66	46.00	147.65	44.10	147.64	41.60	147.62
	Tay2B	659.126	398	47.90	149.05	46.00	149.03	44.10	149.01	41.60	148.98
	Tay2B	671.500	Noonan Side Road Bridge								
	Tay2B	690.395	397	47.90	149.53	46.00	149.49	44.10	149.44	41.60	149.39
	Tay2B	803.688	395	47.90	149.84	46.00	149.80	44.10	149.76	41.60	149.71
	Tay2B	828.899	394wier	47.90	150.43	46.00	150.42	44.10	150.40	41.60	150.38
	Tay2B	841.118	393(fixed weir)	47.90	151.29	46.00	151.29	44.10	151.27	41.60	151.26
	Tay2B	875.467	392	47.90	151.51	46.00	151.49	44.10	151.48	41.60	151.46
	Tay2B	1411.781	390	47.90	152.46	46.00	152.43	44.10	152.40	41.60	152.35
	Tay2B	1467.367	387	47.90	152.71	46.00	152.68	44.10	152.66	41.60	152.61
	Tay2B	1863.693	385	47.90	153.37	46.00	153.35	44.10	153.33	41.60	153.30
	Tay2B	1940.746	383	47.90	153.41	46.00	153.40	44.10	153.39	41.60	153.37
	Tay2B	1956.700	Meinzies Monro Bridge								
	Tay2B	1973.999	382	45.90	154.40	41.50	154.19	38.20	154.03	34.90	153.90
	Tay2B	2044.126	380	45.90	154.49	41.50	154.28	38.20	154.13	34.90	153.99
	Tay2B	2423.260	377	45.90	154.51	41.50	154.31	38.20	154.16	34.90	154.03
	Tay2B	2597.757	376	45.90	154.54	41.50	154.33	38.20	154.19	34.90	154.06

	Tay2B	2625.561	375	45.90	154.55	41.50	154.34	38.20	154.20	34.90	154.07
	Tay2B	2786.586	374	45.90	154.56	41.50	154.35	38.20	154.21	34.90	154.09
	Tay2B	3285.718	370	45.90	154.61	41.50	154.41	38.20	154.28	34.90	154.18
	Tay2B	3407.402	365	45.90	154.64	41.50	154.47	38.20	154.36	34.90	154.27
	Tay2B	3629.139	363	45.90	154.66	41.50	154.50	38.20	154.40	34.90	154.32
	Tay2C	152.680	360	65.80	154.64	59.50	154.48	54.70	154.38	50.00	154.29
	Tay2C	368.359	357	65.80	154.76	59.50	154.63	54.70	154.55	50.00	154.48
	Tay2C	776.829	355	65.80	154.86	59.50	154.75	54.70	154.68	50.00	154.62
	Tay2C	1023.538	353	65.80	154.93	59.50	154.82	54.70	154.75	50.00	154.69
	Tay2C	1465.962	350	65.80	155.04	59.50	154.95	54.70	154.89	50.00	154.84
	Tay2C	1526.047	349	65.80	155.00	59.50	154.93	54.70	154.87	50.00	154.83
	Tay2C	1545.650	Concession 2 Bridge								
	Tay2C	1558.590	348	65.80	155.31	59.50	155.14	54.70	155.06	50.00	154.99
	Tay2C	1600.361	345	65.80	155.45	59.50	155.28	54.70	155.19	50.00	155.11
	Tay2C	2026.387	340	65.80	155.63	59.50	155.51	54.70	155.44	50.00	155.37
	Tay2C	2093.600	Dougal Private Crossing								
	Tay2C	2120.912	338	65.80	155.73	59.50	155.60	54.70	155.52	50.00	155.44
	Tay2C	2496.332	337	65.80	155.90	59.50	155.77	54.70	155.68	50.00	155.60
	Tay2C	2523.000	Unnamed Wooden Bridge								
	Tay2C	2540.370	336	65.80	155.99	59.50	155.87	54.70	155.79	50.00	155.71
	Tay2C	2615.674	335	65.80	156.03	59.50	155.91	54.70	155.82	50.00	155.74
	Tay2C	2987.563	330	65.80	156.05	59.50	155.93	54.70	155.84	50.00	155.76
	Tay2C	3054.625	328	65.80	156.01	59.50	155.89	54.70	155.81	50.00	155.73
	Tay2C	3075.235	Christie Lake Road								
	Tay2C	3090.636	327	65.80	156.21	59.50	156.07	54.70	155.98	50.00	155.88
	Tay2C	3147.530	325	65.80	156.34	59.50	156.19	54.70	156.08	50.00	155.98
	Tay2C	3543.548	322	65.80	156.35	59.50	156.20	54.70	156.09	50.00	155.99
	Tay2C	3585.045	321	65.80	156.35	59.50	156.20	54.70	156.09	50.00	155.99
	Tay2C	4137.738	320	65.80	156.35	59.50	156.20	54.70	156.10	50.00	155.99
	Tay2C	4551.223	315	65.80	156.36	59.50	156.21	54.70	156.10	50.00	156.00
	Tay2C	4833.916	310	65.80	156.36	59.50	156.21	54.70	156.10	50.00	156.00
	Tay2C	4906.529	305	65.80	156.36	59.50	156.21	54.70	156.10	50.00	156.00
	Tay2C	4965.206	303	65.80	156.35	59.50	156.21	54.70	156.10	50.00	156.00
	Tay2C	4980.000	Jordan Cottage Road Bridge								
	Tay2C	5012.969	300	65.80	156.48	59.50	156.34	54.70	156.24	50.00	156.14
	Tay2C	5537.999	250	65.80	156.50	59.50	156.37	54.70	156.26	50.00	156.16
Scotts Snye	Scotts Snye	54.938	900	26.40	147.09	23.30	147.00	22.10	146.93	18.90	146.86
	Scotts Snye	65.900	Noonan Side Road Bridge								
	Scotts Snye	85.936	899	26.40	147.12	23.30	147.03	22.10	146.96	18.90	146.88
	Scotts Snye	492.922	897	26.40	147.25	23.30	147.15	22.10	147.08	18.90	146.98
	Scotts Snye	991.151	895	26.40	147.26	23.30	147.15	22.10	147.09	18.90	146.99
	Scotts Snye	1432.316	890	26.40	147.27	23.30	147.16	22.10	147.10	18.90	147.00
	Scotts Snye	1718.774	885	26.40	147.26	23.30	147.17	22.10	147.10	18.90	147.01
	Scotts Snye	1734.720	Brady Private Crossing								
	Scotts Snye	1742.916	883	22.40	148.04	19.70	147.87	17.80	147.76	15.90	147.61
	Scotts Snye	1852.837	880	22.40	148.14	19.70	147.96	17.80	147.83	15.90	147.68
	Scotts Snye	2019.013	877	22.40	148.13	19.70	147.96	17.80	147.83	15.90	147.68

Scotts Snye	2034.000	Upper Scotch Line Culvert								
Scotts Snye	2042.292	876	22.40	148.31	19.70	148.13	17.80	147.99	15.90	147.84
Scotts Snye	2074.882	875	22.40	148.34	19.70	148.15	17.80	148.01	15.90	147.85
Scotts Snye	2171.385	870	22.40	148.31	19.70	148.12	17.80	147.98	15.90	147.82
Scotts Snye	2185.500	Morrison Private Crossing								
Scotts Snye	2202.864	867	22.40	148.53	19.70	148.41	17.80	148.21	15.90	148.10
Scotts Snye	2503.605	865	22.40	148.72	19.70	148.59	17.80	148.43	15.90	148.32
Scotts Snye	2547.598	864	22.40	148.71	19.70	148.58	17.80	148.42	15.90	148.32
Scotts Snye	2560.000	Preston Private Crossing								
Scotts Snye	2571.380	863	22.40	148.80	19.70	148.68	17.80	148.54	15.90	148.45
Scotts Snye	2809.062	860	22.40	148.97	19.70	148.85	17.80	148.73	15.90	148.63
Scotts Snye	2835.050	Rathwell Private Crossing								
Scotts Snye	2851.744	857	22.40	150.54	19.70	150.41	17.80	150.32	15.90	150.23
Scotts Snye	2950.574	855	22.40	150.60	19.70	150.46	17.80	150.36	15.90	150.27
Scotts Snye	3102.223	850	22.40	150.60	19.70	150.46	17.80	150.36	15.90	150.27
Scotts Snye	3199.053	840	22.40	150.59	19.70	150.46	17.80	150.36	15.90	150.26
Scotts Snye	3243.152	830	22.40	150.90	19.70	150.85	17.80	150.80	15.90	150.76
Scotts Snye	3507.560	825	22.40	152.96	19.70	152.88	17.80	152.82	15.90	152.75
Scotts Snye	3697.935	822	22.40	153.57	19.70	153.48	17.80	153.41	15.90	153.34
Scotts Snye	3715.000	Upper Scotch Line Culvert								
Scotts Snye	3726.498	820	22.40	154.11	19.70	153.98	17.80	153.88	15.90	153.78
Scotts Snye	4121.302	815	22.40	154.29	19.70	154.17	17.80	154.09	15.90	154.01
Scotts Snye	4621.113	813	22.40	154.41	19.70	154.34	17.80	154.29	15.90	154.25
Scotts Snye	4714.170	810	22.40	154.44	19.70	154.38	17.80	154.34	15.90	154.31

Table 6b Computed Water Surface Elevations for Different Flood Events

River/ Creek	Reach	River Station	Xsec ID	Flow (m^3/s) and Computed WSEL (m) for Different Flood Events							
			#	Q20	WL20	Q10	WL10	Q5	WL5	Q2	WL2
TAY RIVER	Tay2A	244.371	500	59.80	136.68	51.50	136.60	43.00	136.52	30.60	136.24
	Tay2A	309.746	498	59.80	136.68	51.50	136.60	43.00	136.52	30.60	136.24
	Tay2A	430.130	495	59.80	136.68	51.50	136.60	43.00	136.52	30.60	136.24
	Tay2A	459.997	490	59.80	136.68	51.50	136.60	43.00	136.52	30.60	136.24
	Tay2A	560.126	485	59.80	136.66	51.50	136.59	43.00	136.51	30.60	136.24
	Tay2A	577.500	Glen Tay Road Bridge								
	Tay2A	593.502	480	59.50	136.76	51.30	136.69	42.80	136.53	30.50	136.25
	Tay2A	664.188	470	59.50	136.86	51.30	136.77	42.80	136.60	30.50	136.30
	Tay2A	1137.321	460	53.30	136.93	45.80	136.83	38.10	136.65	26.90	136.34
	Tay2A	1601.435	450	53.30	136.93	45.80	136.83	38.10	136.65	26.90	136.35
	Tay2A	1963.644	445	53.30	136.97	45.80	136.87	38.10	136.69	26.90	136.40
	Tay2A	2364.532	440	53.30	137.22	45.80	137.13	38.10	136.85	26.90	136.52
	Tay2A	2841.859	430	53.30	139.17	45.80	139.06	38.10	138.94	26.90	138.75
	Tay2A	2856.000	Bowes Road Bridge								
	Tay2A	2871.233	429	53.30	139.74	45.80	139.59	38.10	139.42	26.90	139.15
	Tay2A	3183.436	428	53.30	140.32	45.80	140.16	38.10	139.99	26.90	139.72
	Tay2A	3461.330	427	53.30	141.73	45.80	141.68	38.10	141.62	26.90	141.51
	Tay2A	3892.428	425	53.30	143.97	45.80	143.87	38.10	143.77	26.90	143.59
	Tay2A	3920.000	Wildgoose Private Crossing								
	Tay2A	3951.251	424	53.30	144.20	45.80	144.09	38.10	143.96	26.90	143.74
	Tay2A	4292.497	423	53.30	144.73	45.80	144.63	38.10	144.54	26.90	144.34
	Tay2A	4804.420	420	53.30	145.86	45.80	145.84	38.10	145.80	26.90	145.67
	Tay2A	5380.333	410	53.30	146.75	45.80	146.67	38.10	146.58	26.90	146.28
	Tay2B	23.760	403	37.30	146.76	32.90	146.68	27.30	146.59	17.40	146.29
	Tay2B	122.438	400	37.30	146.81	32.90	146.73	27.30	146.64	17.40	146.40
	Tay2B	460.000	399	37.30	147.60	32.90	147.58	27.30	147.54	17.40	147.41
	Tay2B	659.126	398	37.30	148.92	32.90	148.86	27.30	148.78	17.40	148.59
	Tay2B	671.500	Noonan Side Road Bridge								
	Tay2B	690.395	397	37.30	149.29	32.90	149.19	27.30	149.05	17.40	148.79
	Tay2B	803.688	395	37.30	149.63	32.90	149.55	27.30	149.45	17.40	149.31
	Tay2B	828.899	394wier	37.30	150.35	32.90	150.32	27.30	150.26	17.40	150.15
	Tay2B	841.118	393(fixed weir)	37.30	151.24	32.90	151.22	27.30	151.19	17.40	151.12
	Tay2B	875.467	392	37.30	151.43	32.90	151.40	27.30	151.35	17.40	151.25
	Tay2B	1411.781	390	37.30	152.27	32.90	152.18	27.30	152.05	17.40	151.76
	Tay2B	1467.367	387	37.30	152.54	32.90	152.47	27.30	152.37	17.40	152.18
	Tay2B	1863.693	385	37.30	153.26	32.90	153.21	27.30	153.14	17.40	153.02
	Tay2B	1940.746	383	37.30	153.34	32.90	153.30	27.30	153.25	17.40	153.14
	Tay2B	1956.700	Meinzies Monro Bridge								
	Tay2B	1973.999	382	30.50	153.74	27.10	153.62	23.50	153.50	17.90	153.31
	Tay2B	2044.126	380	30.50	153.83	27.10	153.71	23.50	153.58	17.90	153.38
	Tay2B	2423.260	377	30.50	153.88	27.10	153.77	23.50	153.65	17.90	153.47
	Tay2B	2597.757	376	30.50	153.92	27.10	153.81	23.50	153.70	17.90	153.53
	Tay2B	2625.561	375	30.50	153.93	27.10	153.82	23.50	153.71	17.90	153.54

	Tay2B	2786.586	374	30.50	153.95	27.10	153.85	23.50	153.74	17.90	153.56
	Tay2B	3285.718	370	30.50	154.04	27.10	153.93	23.50	153.83	17.90	153.67
	Tay2B	3407.402	365	30.50	154.16	27.10	154.04	23.50	153.93	17.90	153.77
	Tay2B	3629.139	363	30.50	154.22	27.10	154.11	23.50	154.01	17.90	153.84
	Tay2C	152.680	360	43.60	154.19	38.70	154.08	33.50	153.98	25.50	153.80
	Tay2C	368.359	357	43.60	154.39	38.70	154.32	33.50	154.17	25.50	154.02
	Tay2C	776.829	355	43.60	154.53	38.70	154.44	33.50	154.28	25.50	154.11
	Tay2C	1023.538	353	43.60	154.59	38.70	154.50	33.50	154.34	25.50	154.16
	Tay2C	1465.962	350	43.60	154.77	38.70	154.70	33.50	154.59	25.50	154.34
	Tay2C	1526.047	349	43.60	154.78	38.70	154.73	33.50	154.65	25.50	154.41
	Tay2C	1545.650	Concession 2 Bridge								
	Tay2C	1558.590	348	43.60	154.90	38.70	154.83	33.50	154.73	25.50	154.48
	Tay2C	1600.361	345	43.60	155.01	38.70	154.91	33.50	154.80	25.50	154.55
	Tay2C	2026.387	340	43.60	155.27	38.70	155.14	33.50	155.02	25.50	154.79
	Tay2C	2093.600	Dougal Private Crossing								
	Tay2C	2120.912	338	43.60	155.33	38.70	155.20	33.50	155.08	25.50	154.85
	Tay2C	2496.332	337	43.60	155.48	38.70	155.34	33.50	155.21	25.50	154.97
	Tay2C	2523.000	Unnamed Wooden Bridge								
	Tay2C	2540.370	336	43.60	155.59	38.70	155.46	33.50	155.32	25.50	155.05
	Tay2C	2615.674	335	43.60	155.61	38.70	155.48	33.50	155.35	25.50	155.07
	Tay2C	2987.563	330	43.60	155.63	38.70	155.50	33.50	155.37	25.50	155.11
	Tay2C	3054.625	328	43.60	155.61	38.70	155.49	33.50	155.36	25.50	155.11
	Tay2C	3075.235	Christie Lake Road								
	Tay2C	3090.636	327	43.60	155.74	38.70	155.61	33.50	155.47	25.50	155.20
	Tay2C	3147.530	325	43.60	155.83	38.70	155.68	33.50	155.54	25.50	155.25
	Tay2C	3543.548	322	43.60	155.84	38.70	155.69	33.50	155.55	25.50	155.27
	Tay2C	3585.045	321	43.60	155.84	38.70	155.69	33.50	155.55	25.50	155.27
	Tay2C	4137.738	320	43.60	155.84	38.70	155.70	33.50	155.55	25.50	155.27
	Tay2C	4551.223	315	43.60	155.85	38.70	155.70	33.50	155.55	25.50	155.28
	Tay2C	4833.916	310	43.60	155.85	38.70	155.70	33.50	155.56	25.50	155.28
	Tay2C	4906.529	305	43.60	155.85	38.70	155.71	33.50	155.56	25.50	155.28
	Tay2C	4965.206	303	43.60	155.85	38.70	155.71	33.50	155.56	25.50	155.28
	Tay2C	4980.000	Jordan Cottage Road Bridge								
	Tay2C	5012.969	300	43.60	155.98	38.70	155.81	33.50	155.64	25.50	155.33
	Tay2C	5537.999	250	43.60	155.99	38.70	155.83	33.50	155.65	25.50	155.34
Scotts Snye	Scotts Snye	54.938	900	16.20	146.76	14.10	146.68	12.10	146.58	9.20	146.29
	Scotts Snye	65.900	Noonan Side Road Bridge								
	Scotts Snye	85.936	899	16.20	146.78	14.10	146.70	12.10	146.60	9.20	146.32
	Scotts Snye	492.922	897	16.20	146.87	14.10	146.78	12.10	146.68	9.20	146.42
	Scotts Snye	991.151	895	16.20	146.88	14.10	146.79	12.10	146.69	9.20	146.44
	Scotts Snye	1432.316	890	16.20	146.89	14.10	146.81	12.10	146.71	9.20	146.48
	Scotts Snye	1718.774	885	16.20	146.91	14.10	146.82	12.10	146.73	9.20	146.51
	Scotts Snye	1734.720	Brady Private Crossing								
	Scotts Snye	1742.916	883	13.60	147.41	11.90	147.21	10.20	146.98	7.80	146.71
	Scotts Snye	1852.837	880	13.60	147.47	11.90	147.27	10.20	147.04	7.80	146.76
	Scotts Snye	2019.013	877	13.60	147.47	11.90	147.27	10.20	147.04	7.80	146.76
	Scotts Snye	2034.000	Upper Scotch Line Culvert								

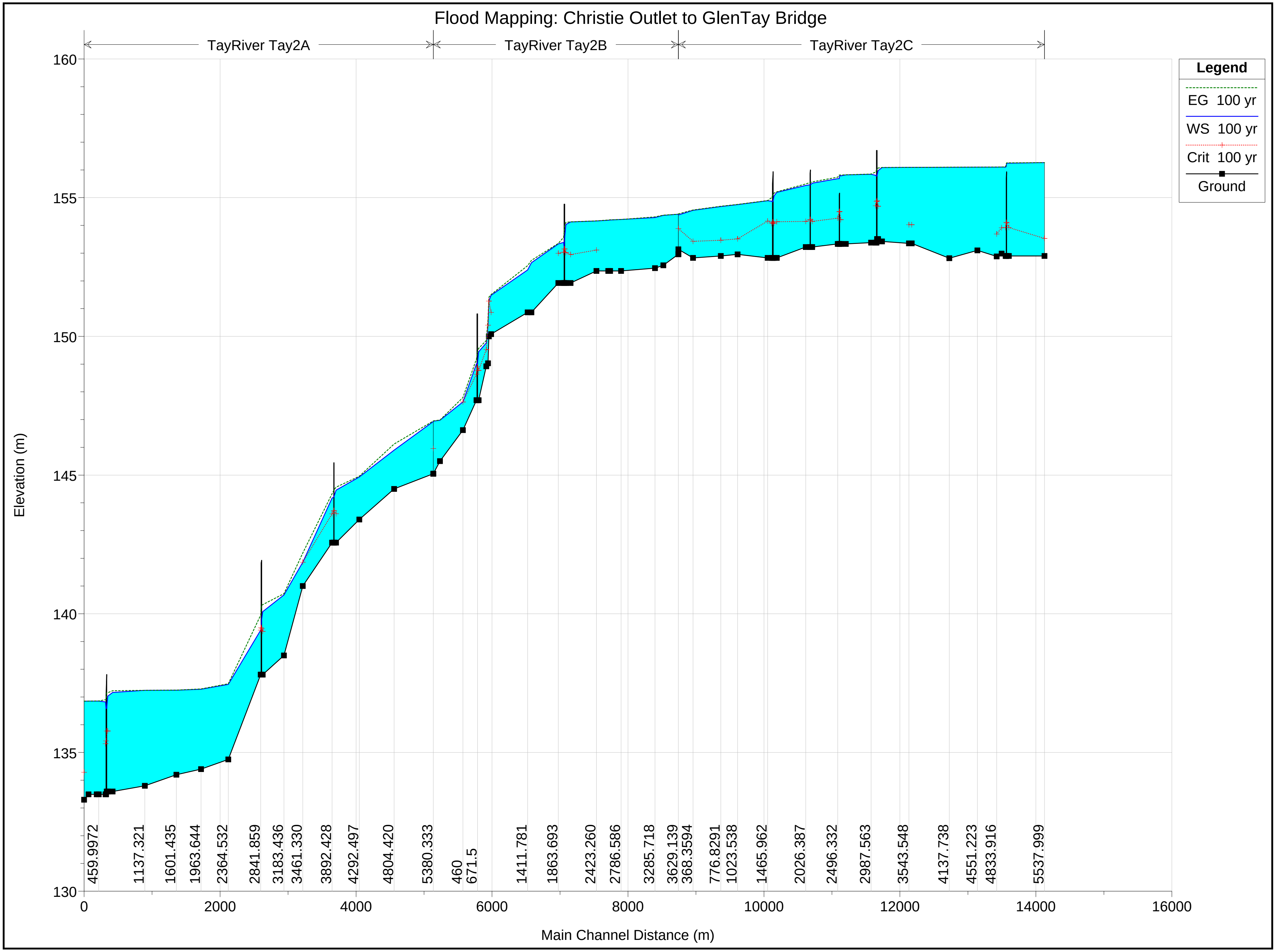
Scotts Snye	2042.292	876	13.60	147.63	11.90	147.45	10.20	147.26	7.80	147.05
Scotts Snye	2074.882	875	13.60	147.65	11.90	147.46	10.20	147.27	7.80	147.06
Scotts Snye	2171.385	870	13.60	147.60	11.90	147.39	10.20	147.29	7.80	147.23
Scotts Snye	2185.500	Morrison Private Crossing								
Scotts Snye	2202.864	867	13.60	147.93	11.90	147.85	10.20	147.77	7.80	147.67
Scotts Snye	2503.605	865	13.60	148.18	11.90	148.10	10.20	148.01	7.80	147.88
Scotts Snye	2547.598	864	13.60	148.18	11.90	148.10	10.20	148.01	7.80	147.89
Scotts Snye	2560.000	Preston Private Crossing								
Scotts Snye	2571.380	863	13.60	148.31	11.90	148.22	10.20	148.12	7.80	147.96
Scotts Snye	2809.062	860	13.60	148.50	11.90	148.41	10.20	148.31	7.80	148.14
Scotts Snye	2835.050	Rathwell Private Crossing								
Scotts Snye	2851.744	857	13.60	150.12	11.90	149.69	10.20	149.48	7.80	149.17
Scotts Snye	2950.574	855	13.60	150.15	11.90	149.72	10.20	149.51	7.80	149.19
Scotts Snye	3102.223	850	13.60	150.15	11.90	149.72	10.20	149.51	7.80	149.20
Scotts Snye	3199.053	840	13.60	150.15	11.90	149.71	10.20	149.48	7.80	149.27
Scotts Snye	3243.152	830	13.60	150.70	11.90	150.66	10.20	150.61	7.80	150.51
Scotts Snye	3507.560	825	13.60	152.67	11.90	152.60	10.20	152.53	7.80	152.41
Scotts Snye	3697.935	822	13.60	153.25	11.90	153.17	10.20	153.09	7.80	152.97
Scotts Snye	3715.000	Upper Scotch Line Culvert								
Scotts Snye	3726.498	820	13.60	153.65	11.90	153.55	10.20	153.45	7.80	153.29
Scotts Snye	4121.302	815	13.60	153.85	11.90	153.75	10.20	153.65	7.80	153.49
Scotts Snye	4621.113	813	13.60	154.15	11.90	154.10	10.20	154.05	7.80	153.99
Scotts Snye	4714.170	810	13.60	154.24	11.90	154.21	10.20	154.17	7.80	154.12

Appendix A

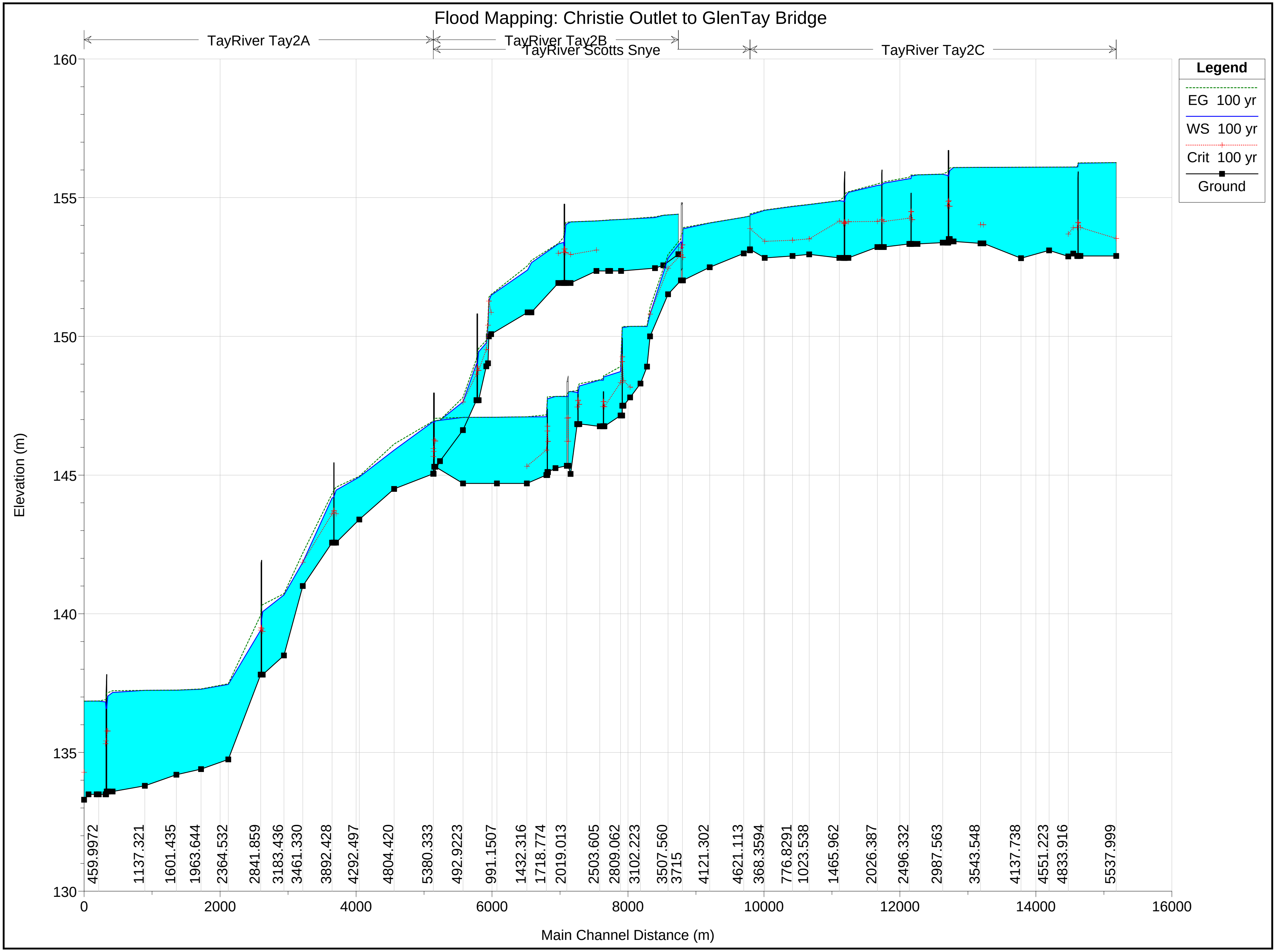
HEC-RAS Model Output

Longitudinal Profiles

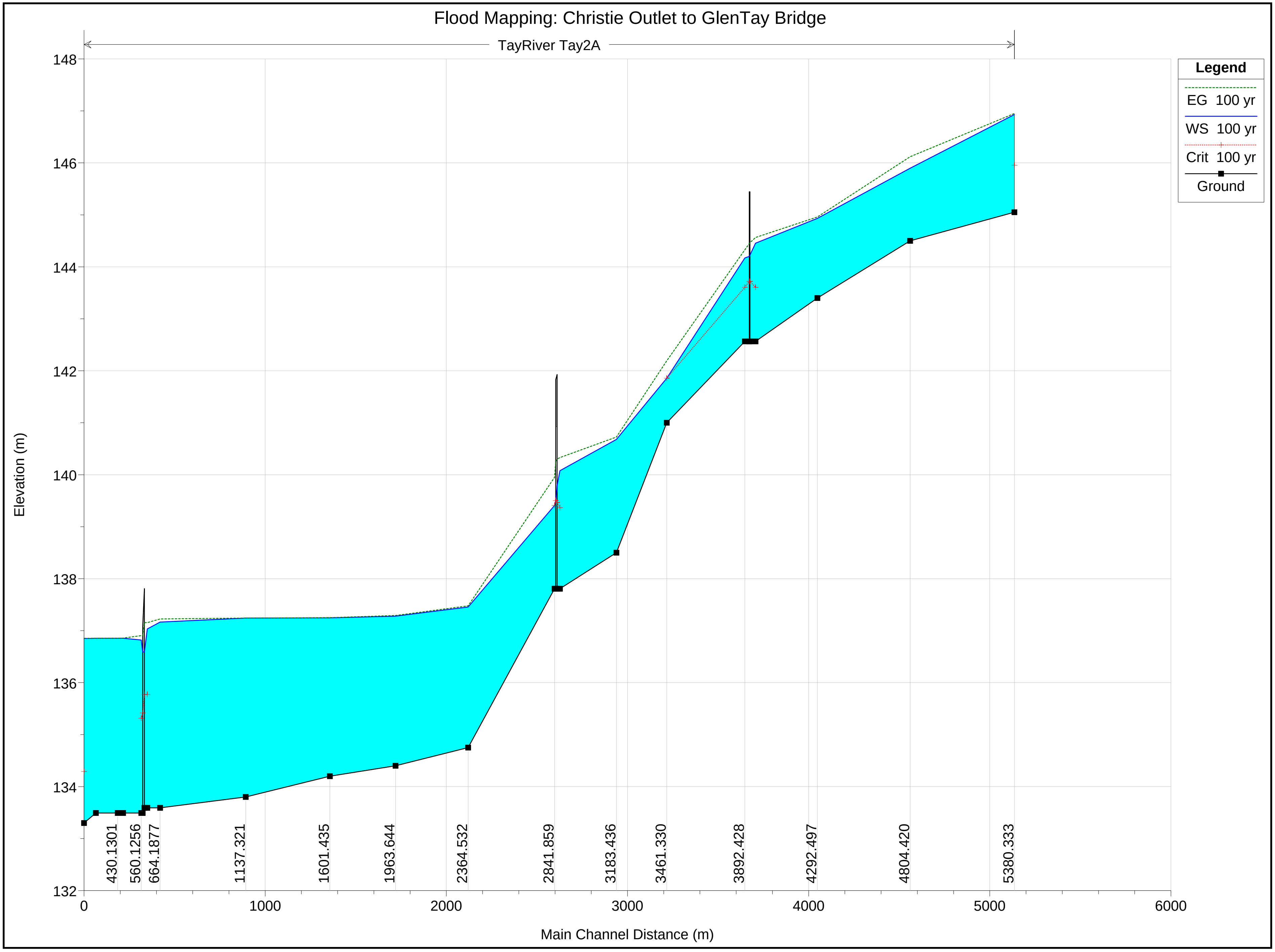
Cross-Sections



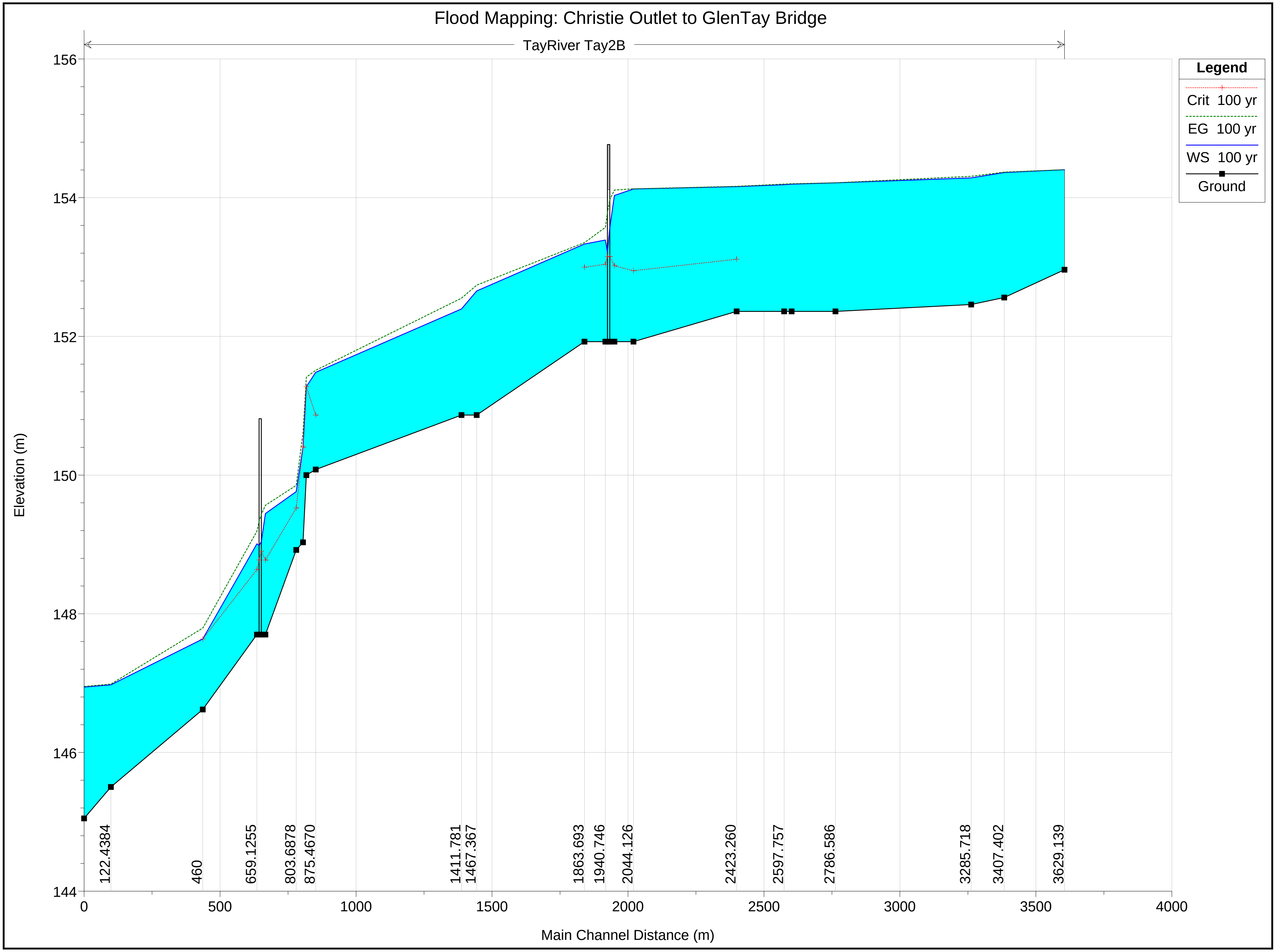
Flood Mapping: Christie Outlet to GlenTay Bridge
TayRiver Tay2A
TayRiver Tay2B
TayRiver Tay2C
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Elevation (m)
Main Channel Distance (m)
160
155
150
145
140
135
130
0
2000
4000
6000
8000
10000
12000
14000
16000
459.9972
1137.321
1601.435
1963.644
2364.532
2841.859
3183.436
3461.330
3892.428
4292.497
4804.420
5380.333
460
671.5
1411.781
1863.693
2423.260
2786.586
3285.718
3629.139
368.3594
776.8291
1023.538
1465.962
2026.387
2496.332
2987.563
3543.548
4137.738
4551.223
4833.916
5537.999



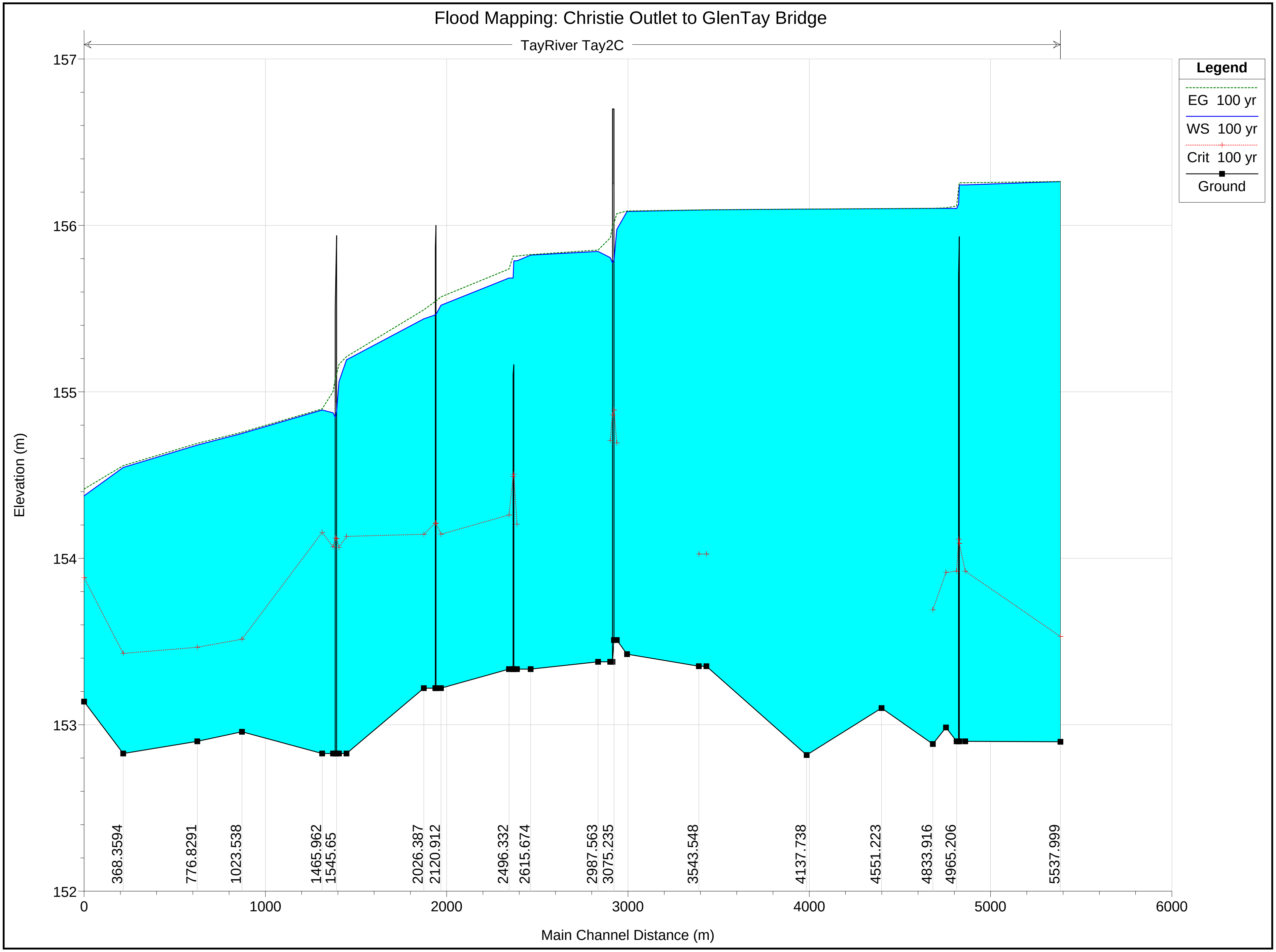
Flood Mapping: Christie Outlet to GlenTay Bridge
TayRiver Tay2A
TayRiver Tay2B
TayRiver Scotts Snye
TayRiver Tay2C
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Elevation (m)
Main Channel Distance (m)
160
155
150
145
140
135
130
0
2000
4000
6000
8000
10000
12000
14000
16000
459.9972
1137.321
1601.435
1963.644
2364.532
2841.859
3183.436
3461.330
3892.428
4292.497
4804.420
5380.333
492.9223
991.1507
1432.316
1718.774
2019.013
2503.605
2809.062
3102.223
3507.560
3715
4121.302
4621.113
368.3594
776.8291
1023.538
1465.962
2026.387
2496.332
2987.563
3543.548
4137.738
4551.223
4833.916
5537.999

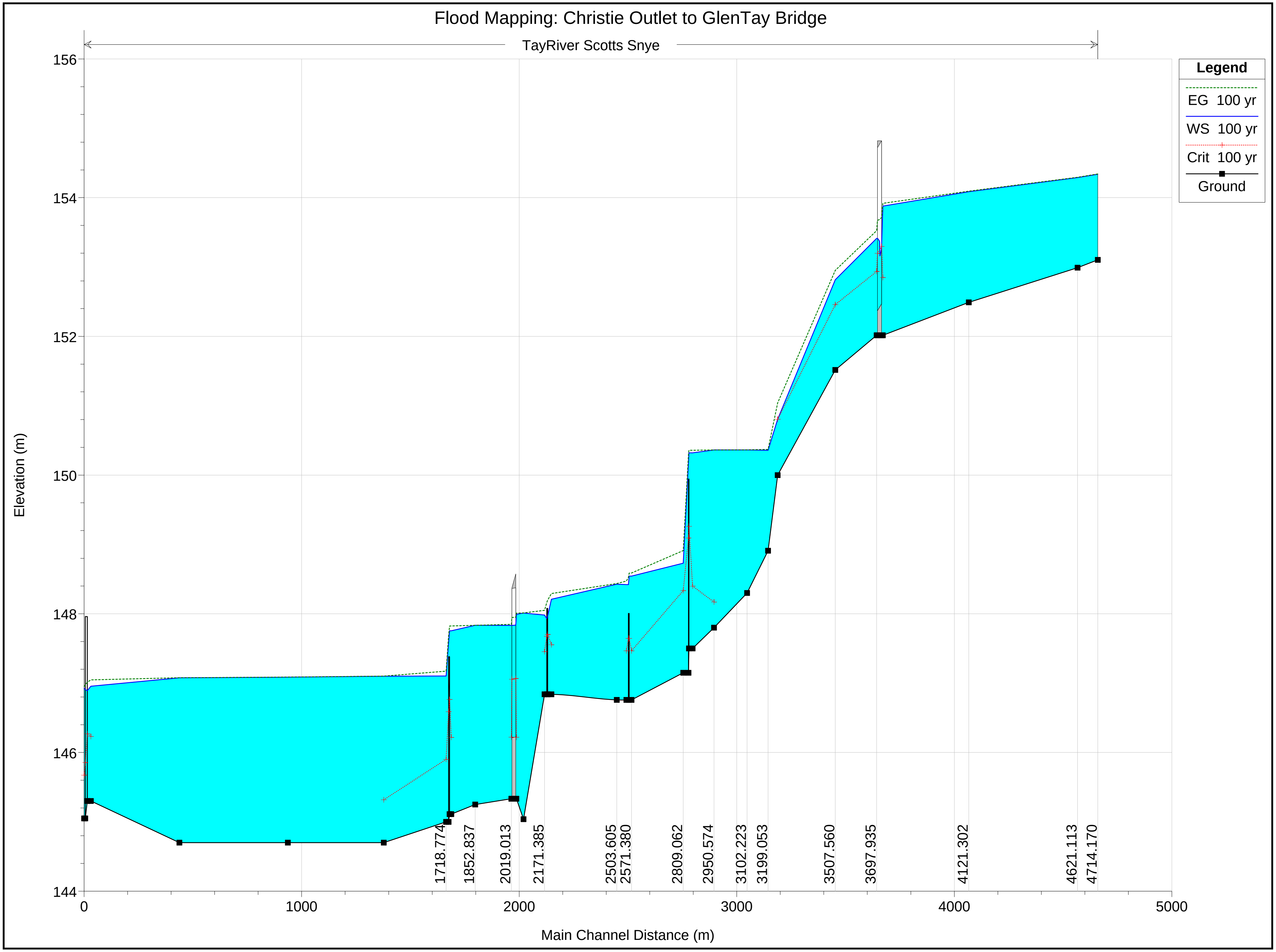


Flood Mapping: Christie Outlet to GlenTay Bridge
TayRiver Tay2A
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Elevation (m)
Main Channel Distance (m)
148
146
144
142
140
138
136
134
132
0
1000
2000
3000
4000
5000
6000
430.1301
560.1256
664.1877
1137.321
1601.435
1963.644
2364.532
2841.859
3183.436
3461.330
3892.428
4292.497
4804.420
5380.333

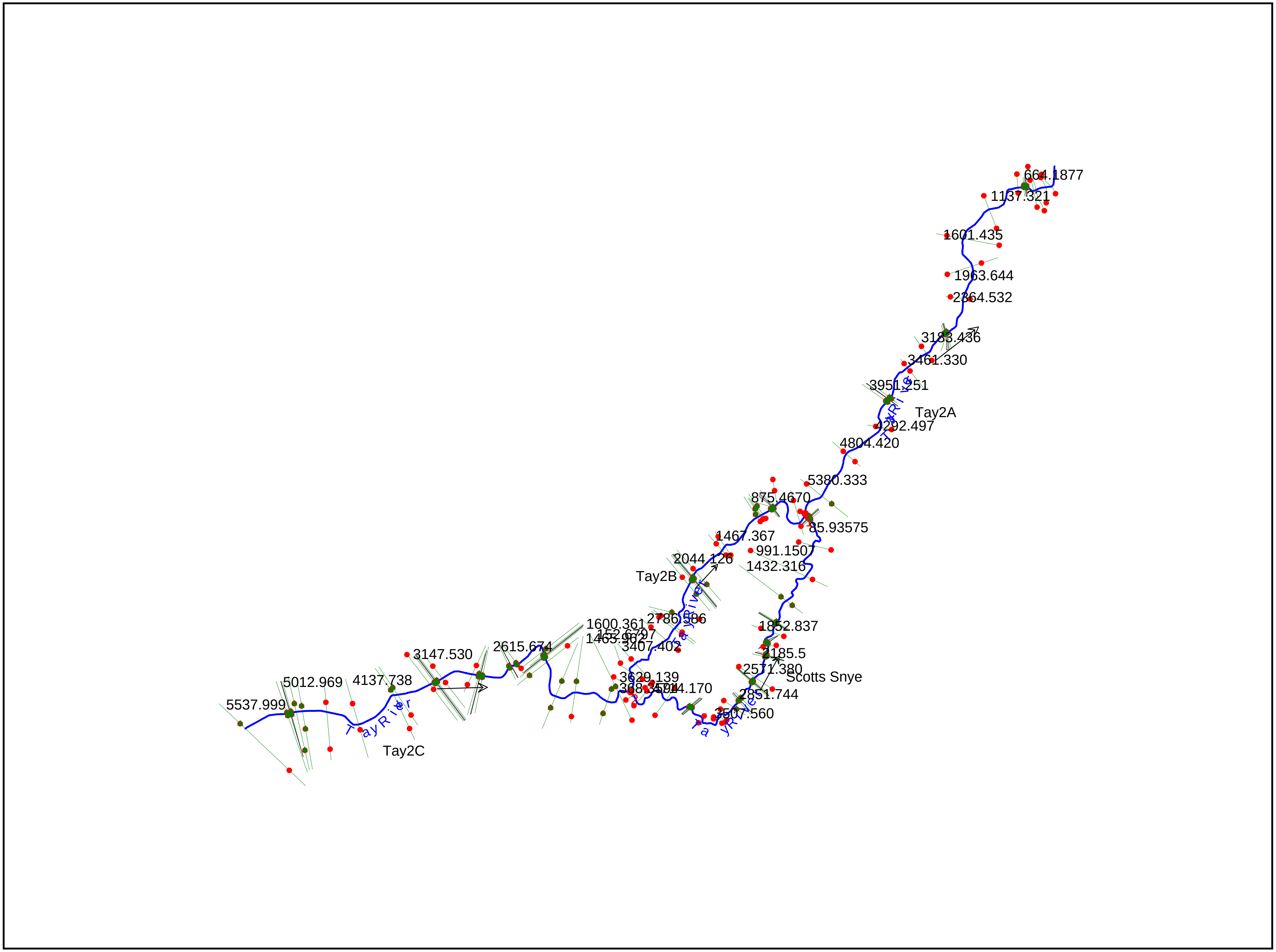


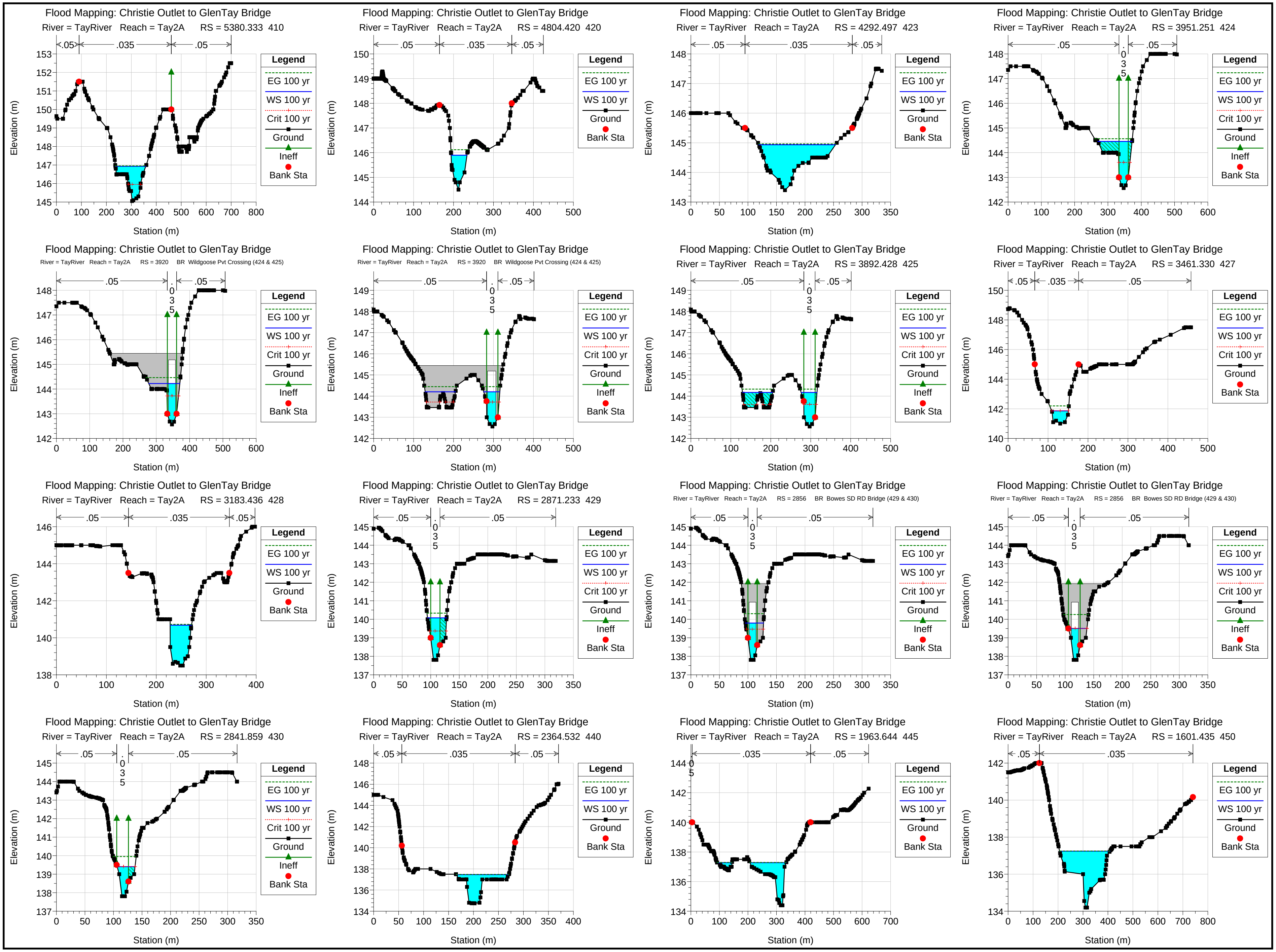
Flood Mapping: Christie Outlet to GlenTay Bridge
TayRiver Tay2B
Legend
Crit 100 yr
EG 100 yr
WS 100 yr
Ground
Elevation (m)
156
154
152
150
148
146
144
122.4384
460
659.1255
803.6878
875.4670
1411.781
1467.367
1863.693
1940.746
2044.126
2423.260
2597.757
2786.586
3285.718
3407.402
3629.139
0
500
1000
1500
2000
2500
3000
3500
4000
Main Channel Distance (m)


Flood Mapping: Christie Outlet to GlenTay Bridge
TayRiver Tay2C
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Elevation (m)
157
156
155
154
153
152
368.3594
776.8291
1023.538
1465.962
1545.65
2026.387
2120.912
2496.332
2615.674
2987.563
3075.235
3543.548
4137.738
4551.223
4833.916
4965.206
5537.999
0
1000
2000
3000
4000
5000
6000
Main Channel Distance (m)

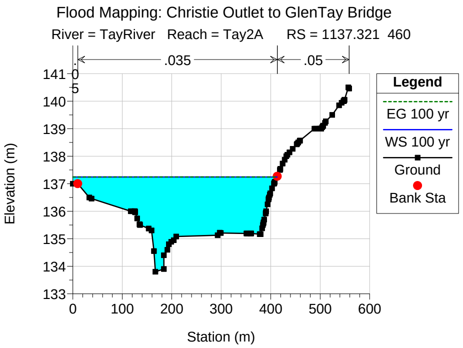


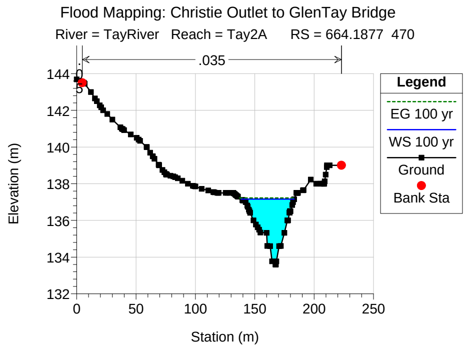
Flood Mapping: Christie Outlet to GlenTay Bridge
TayRiver Scotts Snye
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Elevation (m)
Main Channel Distance (m)
156
154
152
150
148
146
144
0
1000
2000
3000
4000
5000
1718.774
1852.837
2019.013
2171.385
2503.605
2571.380
2809.062
2950.574
3102.223
3199.053
3507.560
3697.935
4121.302
4621.113
4714.170

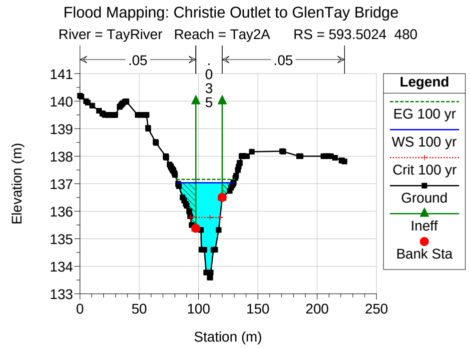

664.1877
1137.321
1601.435
1963.644
2364.532
3183.436
3461.330
3951.251
Tay2A
4292.497
4804.420
5380.333
875.4670
85.93575
1467.367
991.1507
2044.126
Tay2B
1432.316
1600.361
2786.586
3407.402
1852.837
1185.5
2571.380
Scotts Snye
3629.139
2851.744
3507.560
2615.674
3147.530
4137.738
5012.969
5537.999
Tay2C
Tay River

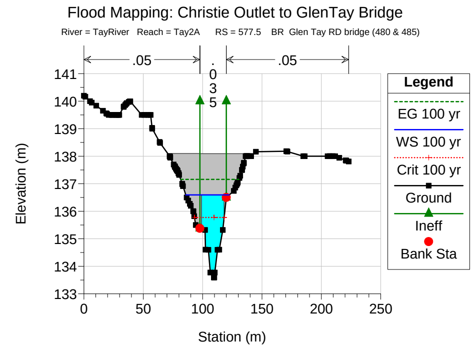


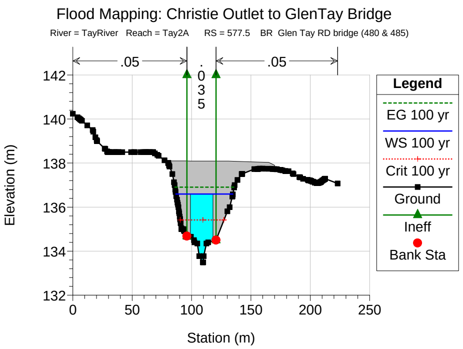
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2A RS = 5380.333 410
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2A RS = 4804.420 420
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2A RS = 4292.497 423
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2A RS = 3951.251 424
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2A RS = 3920 BR Wildgoose Pvt Crossing (424 & 425)
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2A RS = 3920 BR Wildgoose Pvt Crossing (424 & 425)
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2A RS = 3892.428 425
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2A RS = 3461.330 427
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2A RS = 3183.436 428
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2A RS = 2871.233 429
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2A RS = 2856 BR Bowes SD RD Bridge (429 & 430)
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2A RS = 2856 BR Bowes SD RD Bridge (429 & 430)
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2A RS = 2841.859 430
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2A RS = 2364.532 440
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2A RS = 1963.644 445
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2A RS = 1601.435 450
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

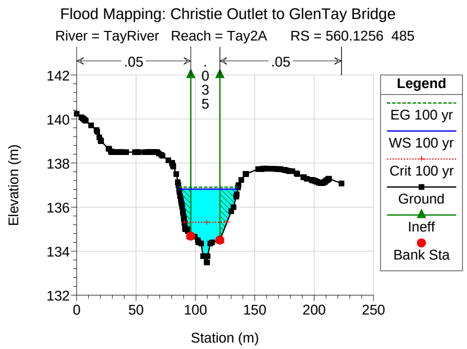

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2A RS = 1137.321 460
.035
.05
Elevation (m)
Station (m)
Legend
EG 100 yr
WS 100 yr
Ground
Bank Sta

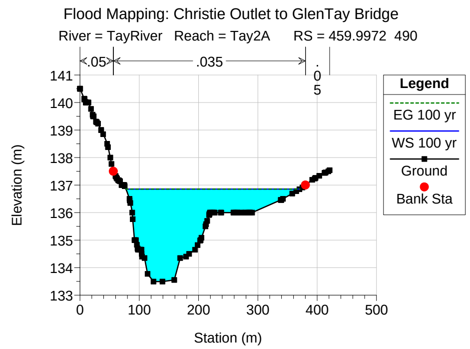

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2A RS = 664.1877 470
.035
Elevation (m)
Station (m)
Legend
EG 100 yr
WS 100 yr
Ground
Bank Sta

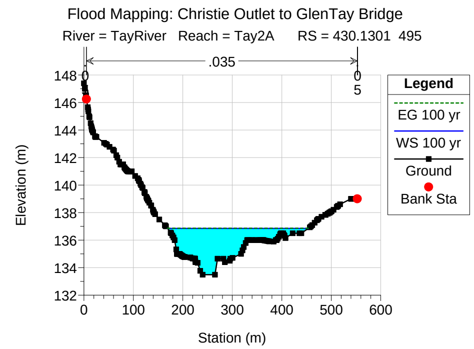

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2A RS = 593.5024 480
.05
.05
Elevation (m)
Station (m)
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta

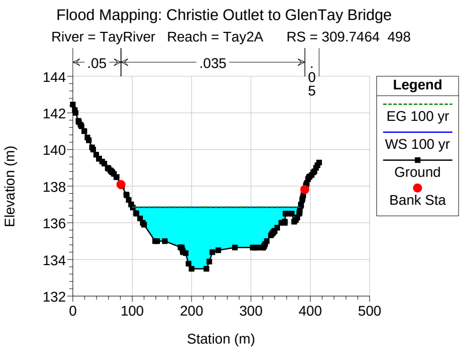

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2A RS = 577.5 BR Glen Tay RD bridge (480 & 485)
.05
.05
Elevation (m)
Station (m)
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta

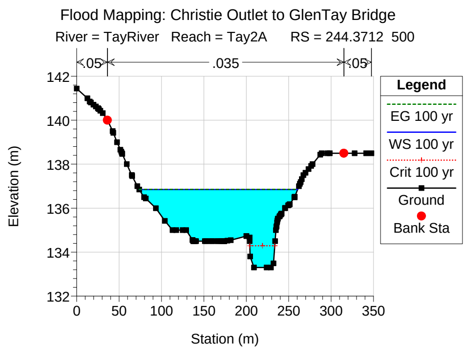

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2A RS = 577.5 BR Glen Tay RD bridge (480 & 485)
.05
.05
Elevation (m)
Station (m)
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta

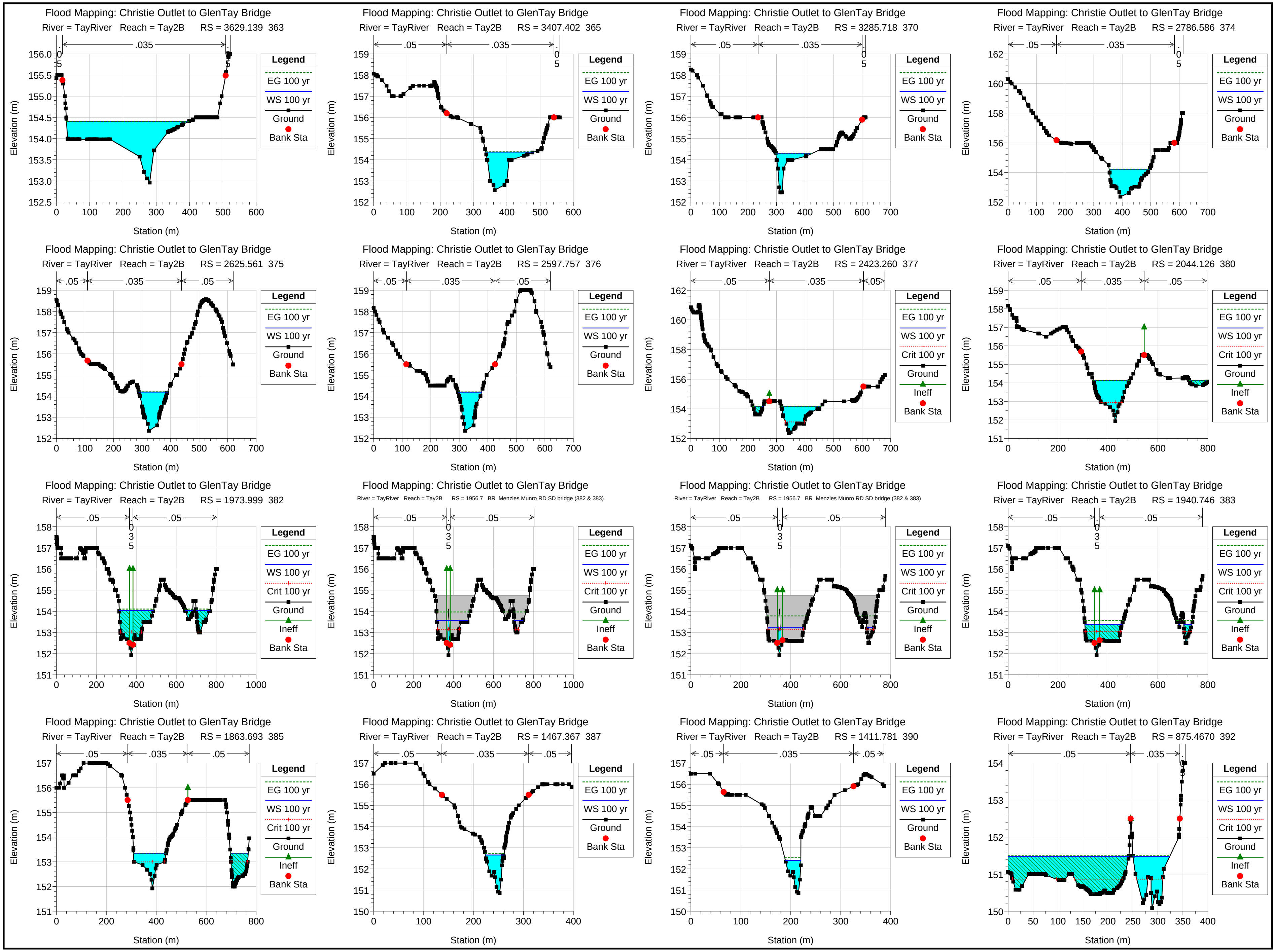

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2A RS = 560.1256 485
.05
.05
Elevation (m)
Station (m)
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta

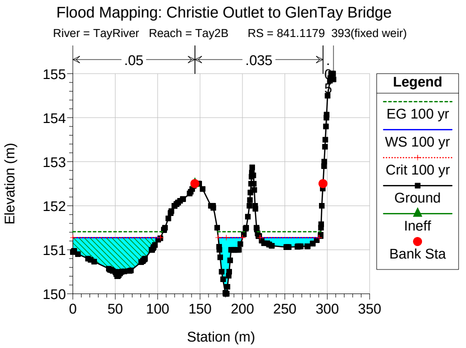

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2A RS = 459.9972 490
.05
.035
Elevation (m)
Station (m)
Legend
EG 100 yr
WS 100 yr
Ground
Bank Sta

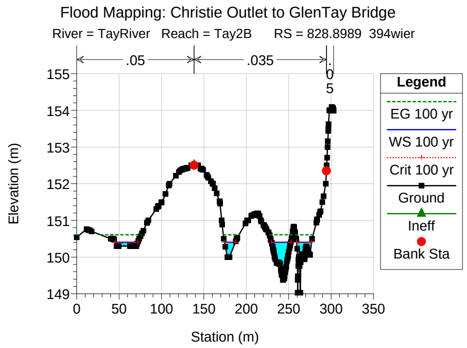

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2A RS = 430.1301 495
.035
Elevation (m)
Station (m)
Legend
EG 100 yr
WS 100 yr
Ground
Bank Sta

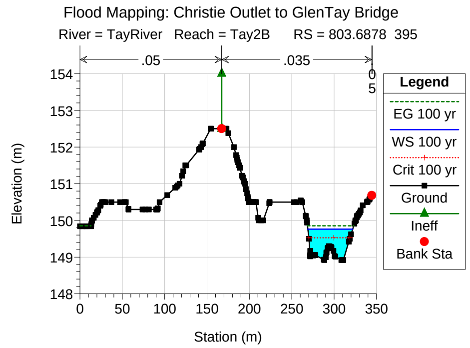

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2A RS = 309.7464 498
.05
.035
Elevation (m)
Station (m)
Legend
EG 100 yr
WS 100 yr
Ground
Bank Sta

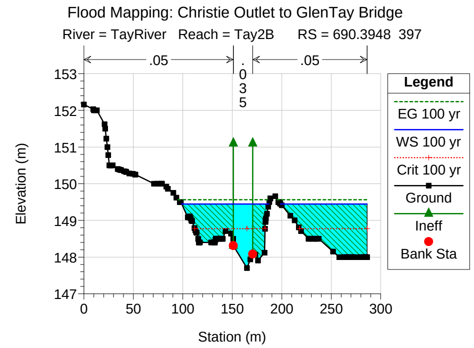

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2A RS = 244.3712 500
.05
.035
.05
Elevation (m)
Station (m)
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Bank Sta

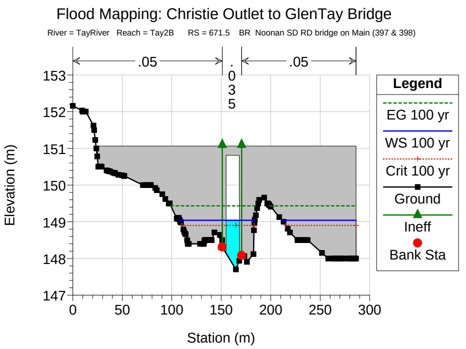

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2B RS = 3629.139 363
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2B RS = 3407.402 365
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2B RS = 3285.718 370
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2B RS = 2786.586 374
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2B RS = 2625.561 375
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2B RS = 2597.757 376
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2B RS = 2423.260 377
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2B RS = 2044.126 380
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2B RS = 1973.999 382
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2B RS = 1956.7 BR Menzies Munro RD SD bridge (382 & 383)
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2B RS = 1956.7 BR Menzies Munro RD SD bridge (382 & 383)
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2B RS = 1940.746 383
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2B RS = 1863.693 385
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2B RS = 1467.367 387
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2B RS = 1411.781 390
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2B RS = 875.4670 392
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

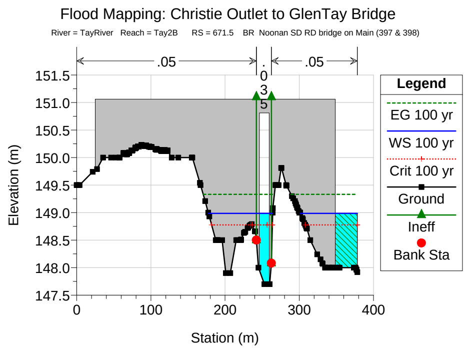

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2B RS = 841.1179 393(fixed weir)
Elevation (m)
Station (m)
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta

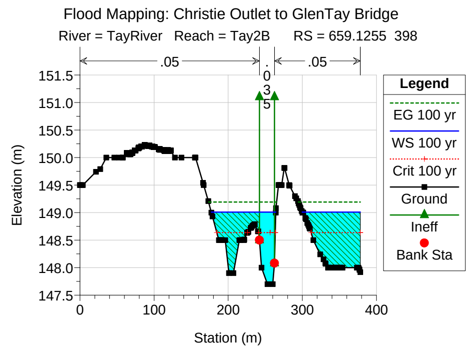

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2B RS = 828.8989 394wier
Elevation (m)
Station (m)
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta

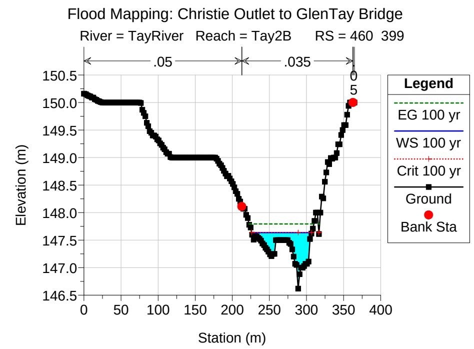

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2B RS = 803.6878 395
Elevation (m)
Station (m)
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta

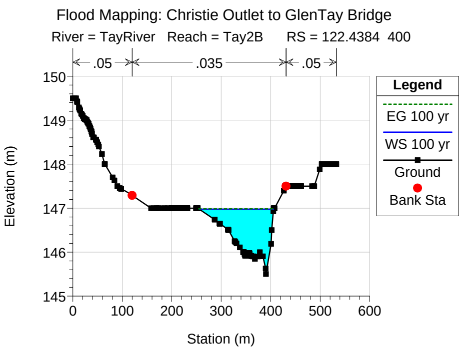

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2B RS = 690.3948 397
Elevation (m)
Station (m)
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta

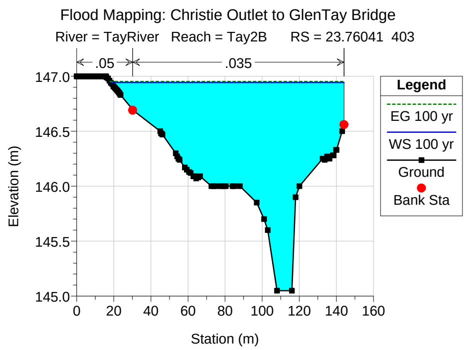

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2B RS = 671.5 BR Noonan SD RD bridge on Main (397 & 398)
Elevation (m)
Station (m)
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta

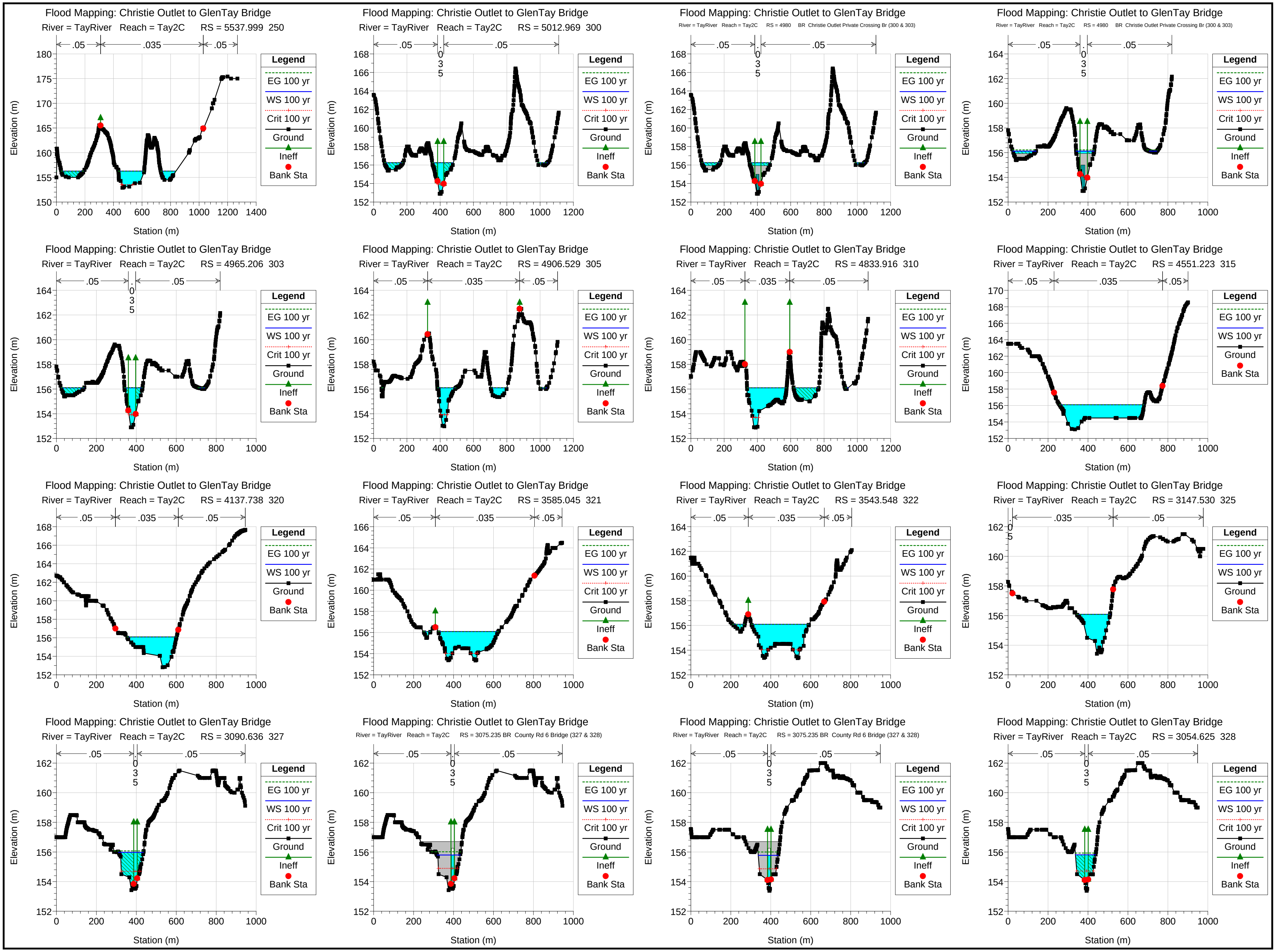

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2B RS = 671.5 BR Noonan SD RD bridge on Main (397 & 398)
Elevation (m)
Station (m)
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta

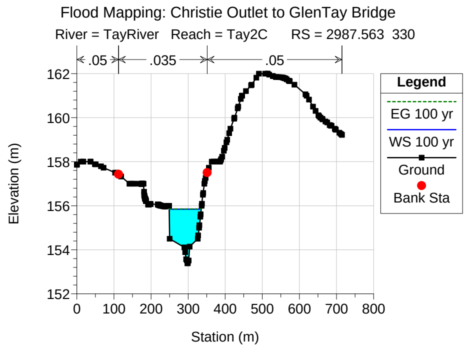

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2B RS = 659.1255 398
Elevation (m)
Station (m)
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta

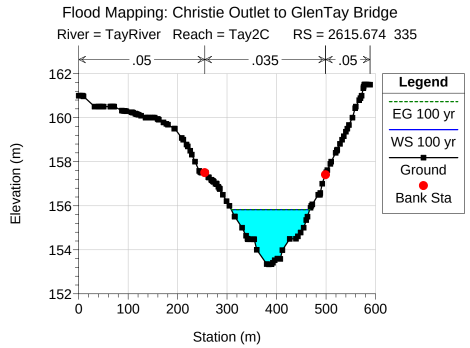

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2B RS = 460 399
Elevation (m)
Station (m)
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Bank Sta

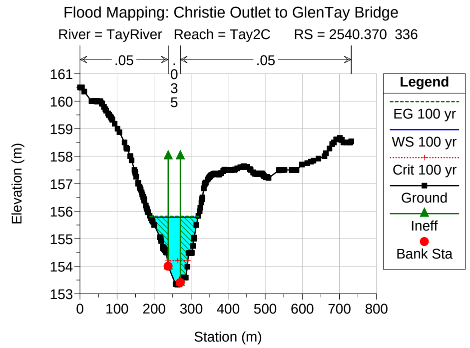

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2B RS = 122.4384 400
Elevation (m)
Station (m)
Legend
EG 100 yr
WS 100 yr
Ground
Bank Sta

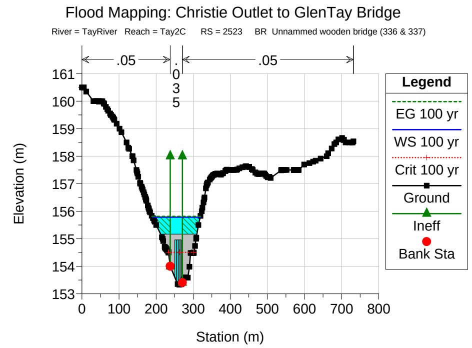

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2B RS = 23.76041 403
Elevation (m)
Station (m)
Legend
EG 100 yr
WS 100 yr
Ground
Bank Sta

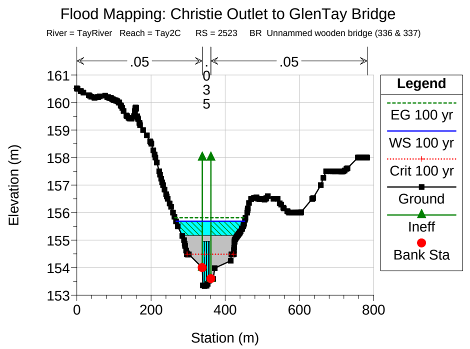

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 5537.999 250
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 5012.969 300
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 4980 BR Christie Outlet Private Crossing Br (300 & 303)
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 4980 BR Christie Outlet Private Crossing Br (300 & 303)
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 4965.206 303
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 4906.529 305
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 4833.916 310
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 4551.223 315
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 4137.738 320
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 3585.045 321
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 3543.548 322
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 3147.530 325
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 3090.636 327
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 3075.235 BR County Rd 6 Bridge (327 & 328)
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 3075.235 BR County Rd 6 Bridge (327 & 328)
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 3054.625 328
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

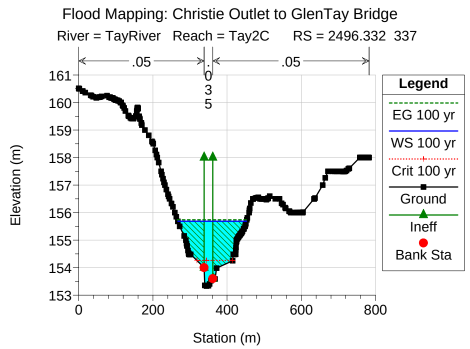

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 2987.563 330
Legend
EG 100 yr
WS 100 yr
Ground
Bank Sta
Elevation (m)
Station (m)

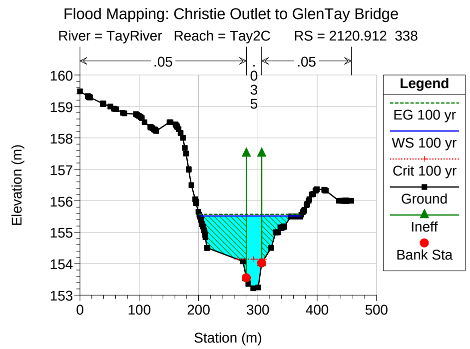

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 2615.674 335
Legend
EG 100 yr
WS 100 yr
Ground
Bank Sta
Elevation (m)
Station (m)

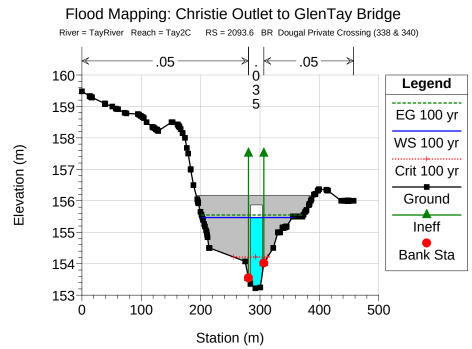

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 2540.370 336
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

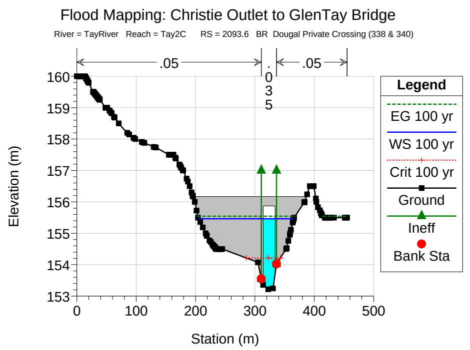

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 2523 BR Unnammed wooden bridge (336 & 337)
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

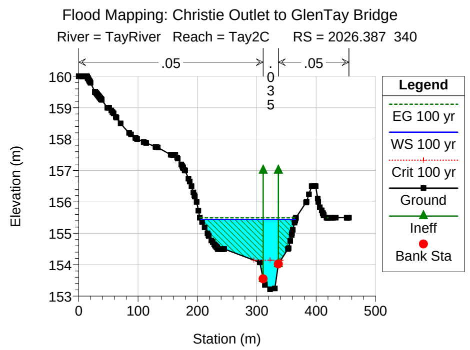

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 2523 BR Unnammed wooden bridge (336 & 337)
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

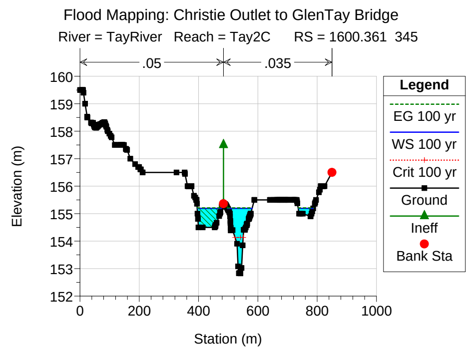

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 2496.332 337
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

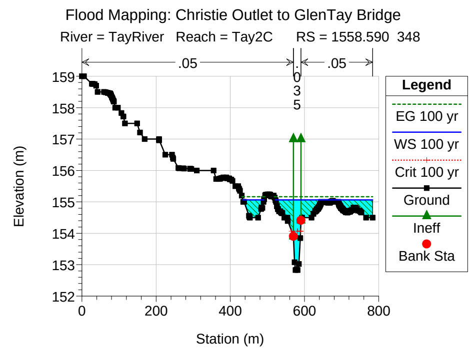

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 2120.912 338
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

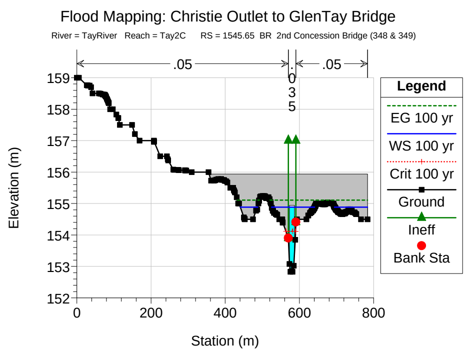

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 2093.6 BR Dougal Private Crossing (338 & 340)
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

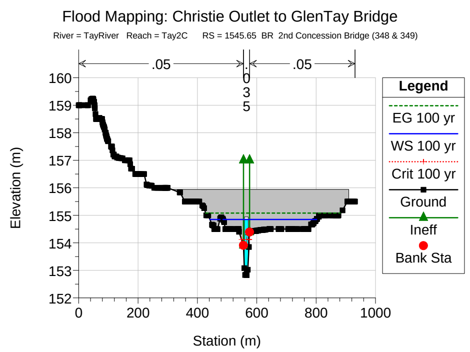

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 2093.6 BR Dougal Private Crossing (338 & 340)
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

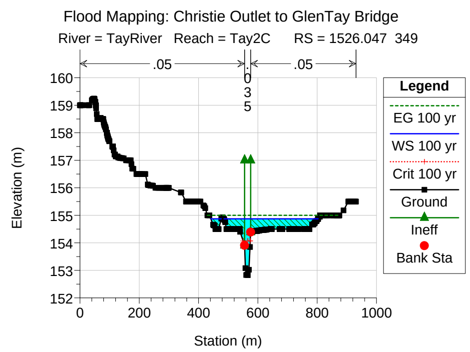

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 2026.387 340
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

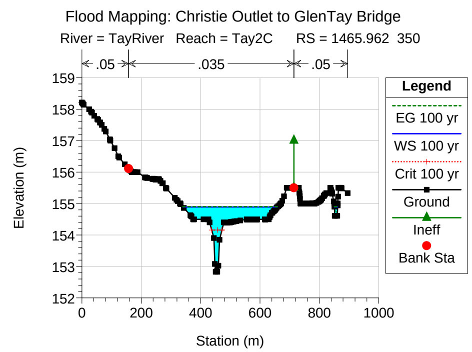

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 1600.361 345
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

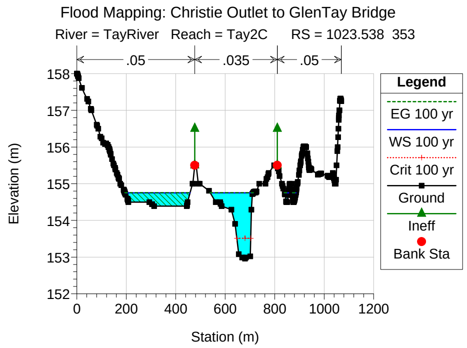

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 1558.590 348
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)


Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 1545.65 BR 2nd Concession Bridge (348 & 349)
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

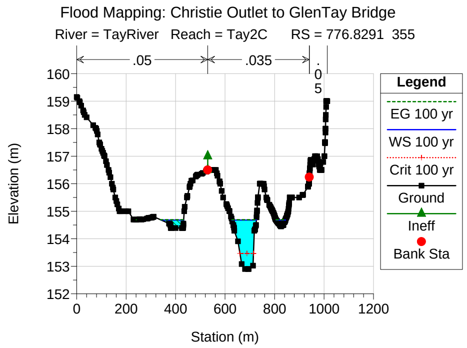

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 1545.65 BR 2nd Concession Bridge (348 & 349)
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)


Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 1526.047 349
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

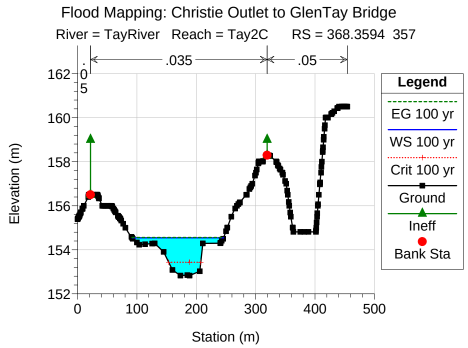

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 1465.962 350
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)



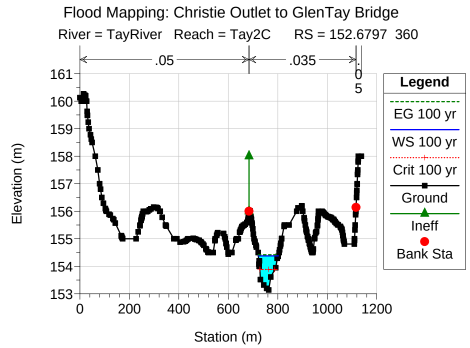
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 1023.538 353
.05
.035
.05
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)



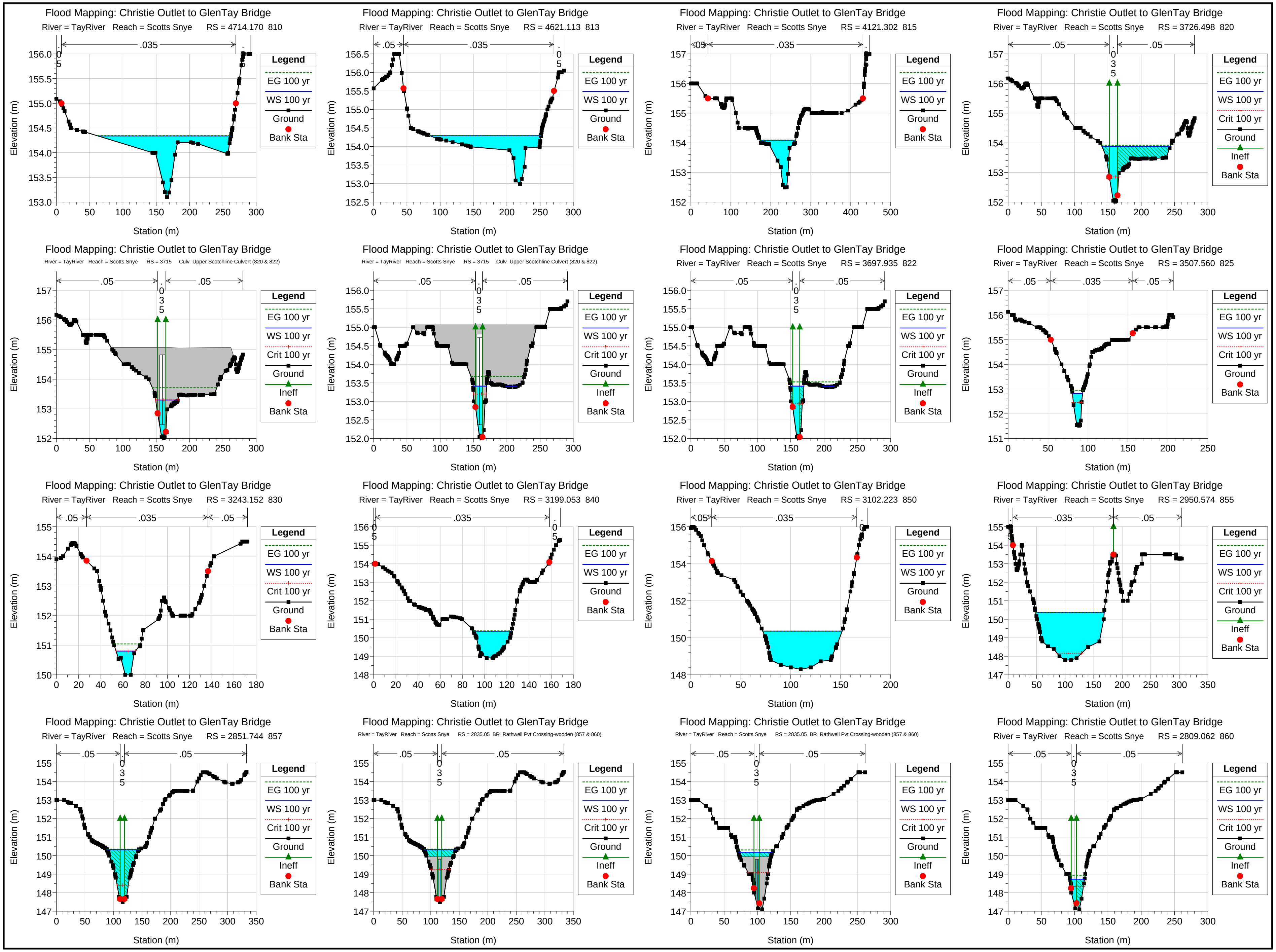
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 776.8291 355
.05
.035
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

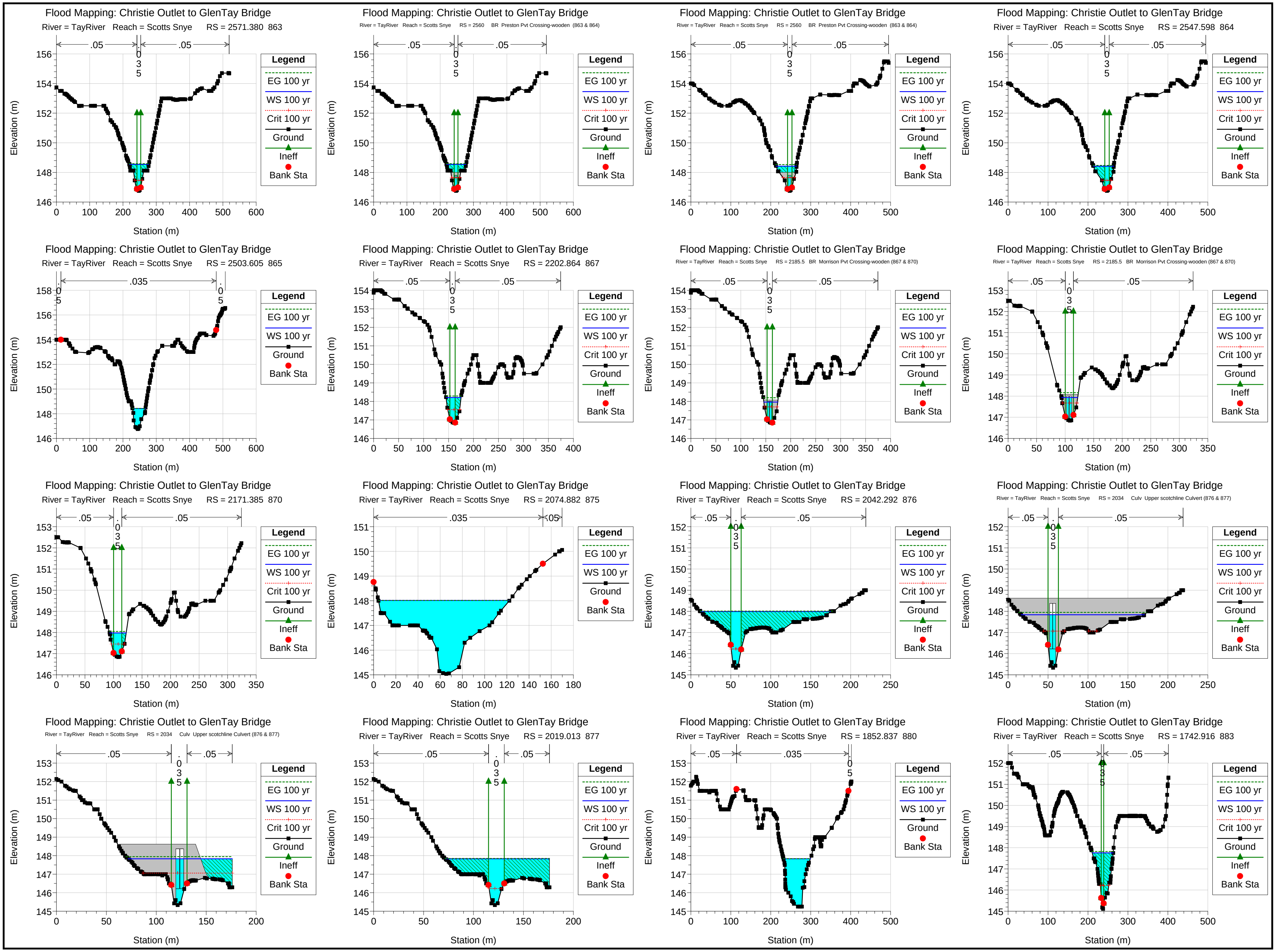


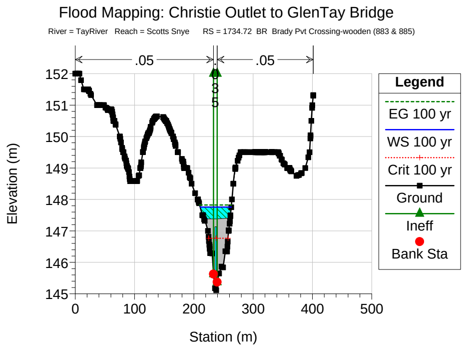
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 368.3594 357
.035
.05
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

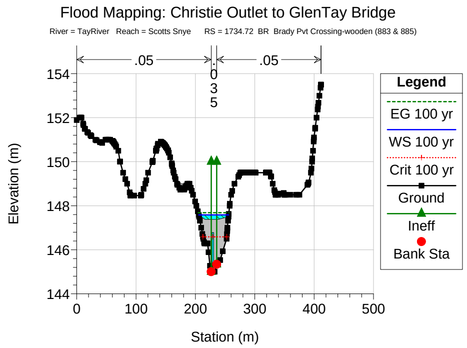


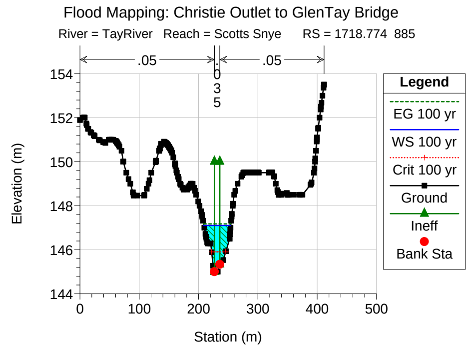
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Tay2C RS = 152.6797 360
.05
.035
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

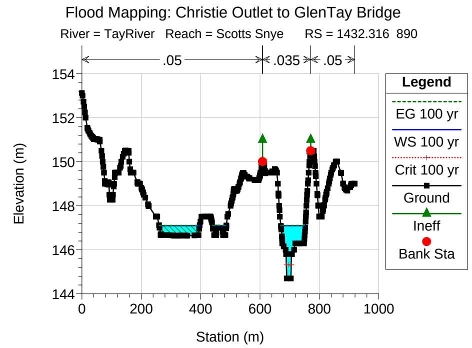

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 4714.170 810
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 4621.113 813
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 4121.302 815
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 3726.498 820
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 3715 Culv Upper Scotchline Culvert (820 & 822)
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 3715 Culv Upper Scotchline Culvert (820 & 822)
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 3697.935 822
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 3507.560 825
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 3243.152 830
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 3199.053 840
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 3102.223 850
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 2950.574 855
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 2851.744 857
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 2835.05 BR Rathwell Pvt Crossing-wooden (857 & 860)
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 2835.05 BR Rathwell Pvt Crossing-wooden (857 & 860)
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 2809.062 860
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

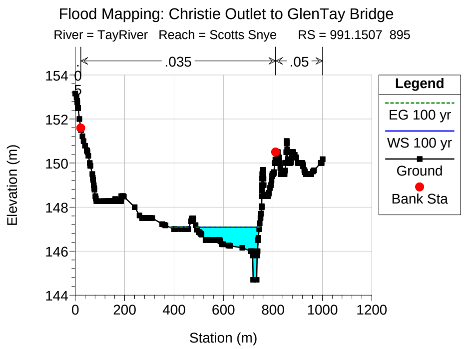

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 2571.380 863
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 2560 BR Preston Pvt Crossing-wooden (863 & 864)
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 2560 BR Preston Pvt Crossing-wooden (863 & 864)
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 2547.598 864
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 2503.605 865
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 2202.864 867
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 2185.5 BR Morrison Pvt Crossing-wooden (867 & 870)
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 2185.5 BR Morrison Pvt Crossing-wooden (867 & 870)
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 2171.385 870
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 2074.882 875
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 2042.292 876
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 2034 Culv Upper scotchline Culvert (876 & 877)
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 2034 Culv Upper scotchline Culvert (876 & 877)
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 2019.013 877
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 1852.837 880
Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 1742.916 883
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

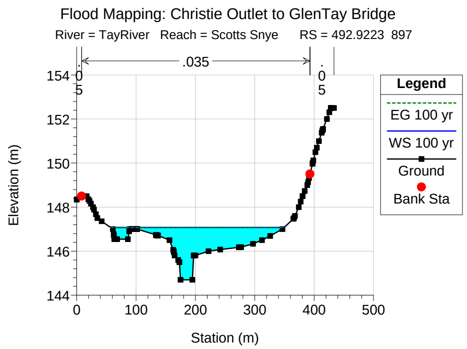

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 1734.72 BR Brady Pvt Crossing-wooden (883 & 885)
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

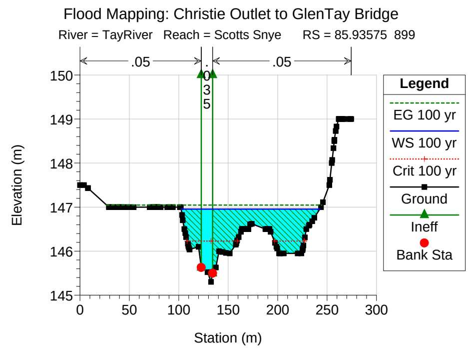

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 1734.72 BR Brady Pvt Crossing-wooden (883 & 885)
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

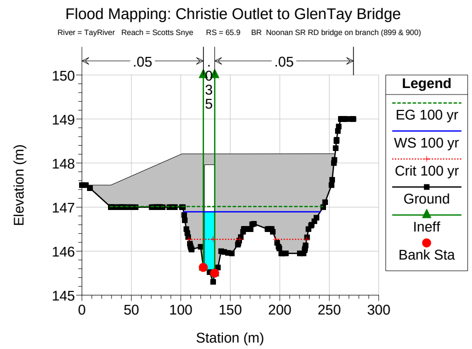

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 1718.774 885
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

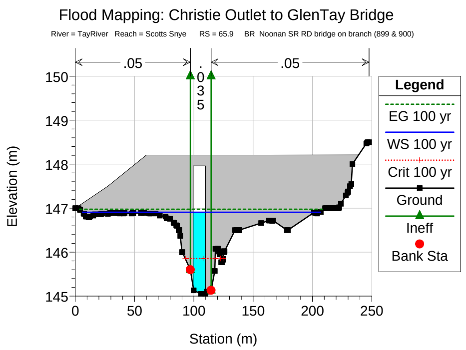

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 1432.316 890
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

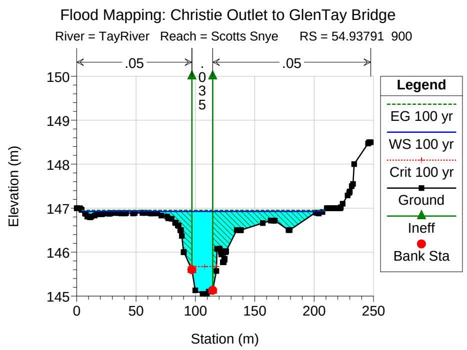

Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 991.1507 895
Legend
EG 100 yr
WS 100 yr
Ground
Bank Sta
Elevation (m)
Station (m)


Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 492.9223 897
Legend
EG 100 yr
WS 100 yr
Ground
Bank Sta
Elevation (m)
Station (m)


Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 85.93575 899
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)


Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 65.9 BR Noonan SR RD bridge on branch (899 & 900)
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)


Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 65.9 BR Noonan SR RD bridge on branch (899 & 900)
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)


Flood Mapping: Christie Outlet to GlenTay Bridge
River = TayRiver Reach = Scotts Snye RS = 54.93791 900
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)