

**NATURAL HAZARDS STUDY**

**HUNTINGWOOD TRAILS  
TOWN OF COLLINGWOOD**

**PREPARED FOR:  
HUNTINGWOOD TRAILS (COLLINGWOOD) LTD.**

**PREPARED BY:  
C.F. CROZIER & ASSOCIATES INC.  
40 HURON STREET, SUITE 301  
COLLINGWOOD, ONTARIO  
L9Y 4R3**

**JANUARY 2011  
UPDATED JULY 2019**

**CFCA FILE NO. 281-2769**

The material in this report reflects best judgment in light of the information available at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibilities of such third parties. C.F. Crozier & Associates Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.



| Revision Number | Date         | Comments                       |
|-----------------|--------------|--------------------------------|
| Rev. 0          | June 2009    | Natural Hazards Study          |
| Rev. 1          | January 2011 | Natural Hazards Study          |
| Rev. 2          | July 2019    | Natural Hazards Study Addendum |

## TABLE OF CONTENTS

|       |                                                         |    |
|-------|---------------------------------------------------------|----|
| 1.0   | INTRODUCTION.....                                       | 1  |
| 2.0   | BACKGROUND & OMB HISTORY .....                          | 1  |
| 3.0   | SITE DESCRIPTION .....                                  | 2  |
| 4.0   | NATURAL HAZARDS .....                                   | 2  |
| 4.1   | FLOODING HAZARDS .....                                  | 3  |
| 4.1.1 | PREVIOUS FLOODLINE ASSESSMENTS .....                    | 3  |
| 4.1.2 | EXISTING CONDITIONS HYDRAULIC ASSESSMENT .....          | 4  |
|       | UPSTREAM HYDRAULIC ANALYSIS (SPILL ZONE 'A') .....      | 5  |
|       | EXISTING EAST OVERBANK MODELLING (SPILL ZONE 'B') ..... | 6  |
|       | MODELLING RESULTS.....                                  | 7  |
| 4.1.3 | POST-DEVELOPMENT CONDITIONS HYDRAULIC ASSESSMENT .....  | 9  |
|       | MODELLING SET-UP .....                                  | 9  |
|       | MODELLING RESULTS .....                                 | 10 |
| 4.2   | EROSION HAZARDS .....                                   | 11 |
| 4.2.1 | MEANDER BELT ALLOWANCE .....                            | 11 |
| 5.0   | TOTAL HAZARD LIMIT .....                                | 12 |
| 6.0   | CONCLUSIONS .....                                       | 12 |

## LIST OF FIGURES

- Figure 1:** Site Location
- Figure 2:** Concept Plan
- Figure 3:** Existing Conditions Natural Hazard Limits Plan
- Figure 4:** Post Development Conditions Natural Hazard Limits Plan

## APPENDICES

- Appendix A:** Silver Creek Main Branch – HEC-RAS Modelling
- Appendix B:** Meander Belt Calculations
- Appendix C:** OMB Background Material
- Appendix D:** Supplementary Analysis



## 1.0 INTRODUCTION

CF Crozier & Associates Inc. (Crozier) was retained by Huntingwood Trails (Collingwood) Ltd. to complete a Natural Hazards Study in relation to the Huntingwood Trails Development. The 49 ha property is legally described as part of Lots 47, 48 & 49 Concession 12, Town of Collingwood. The subject property is bounded by Highway 26 and Silver Creek Drive to the north, the Silver Glen Preserve subdivision to the east, the Forest Drive Subdivision to the west and the Georgian Trail to the south. **Figure 1** shows the location of the property.

Silver Creek bisects the site dividing the proposed land into two development areas: east of Silver Creek (Development Area #1) and west of Silver Creek (Development Area #2). To the east of Silver Creek the plan is comprised of approximately 919 m of access roadway, 52 townhouse units, and 10 semi-detached units. To the west of Silver Creek, the plan is comprised of 88 single family lots, 20 semi-detached units, approximately 1074 m of access roads and a stormwater management facility. The access roadways will be designed per the Town of Collingwood's development standards. A walkway and roads provide access to the Georgian Trail and Environmental Protection Areas within the site. The subject subdivision plan reflecting a total unit count of 170 units is presented as **Figure 2**.

## 2.0 BACKGROUND & OMB HISTORY

In connection with the applications for an Official Plan Amendment, Zoning By-Law Amendment and Draft Plan of Subdivision for the subject lands, three reports were prepared by Crozier in 2011:

- Functional Servicing & Stormwater Management Report,
- Natural Hazards Study and,
- Traffic Impact Study

The "Natural Hazards Study, Huntingwood Trails Development" was prepared to determine the natural hazards associated with potential flooding and erosion of Silver Creek across the subject property.

Following the preparation of this study, in June 2012, Huntingwood appealed its application for an Official Plan Amendment to the Ontario Municipal Board. In connection with this appeal and ongoing discussions with the Town and Conservation Authority, additional analysis surrounding the floodplain and spill flows from Silver Creek was completed in relation to the identification of the natural hazards surrounding the development areas. As such, a *Huntingwood Trails Flood Hazard Assessment Memo* was prepared in September 2013 to verify the identification of a Spill Zone and the Silver Creek floodplain on the subject property.

Additional analysis regarding the spill flow from Silver Creek upstream of the subject lands was completed by Crozier in March 2014. The purpose of this additional analysis was to confirm the volumetric flow rates of spill upstream of the Georgian Trail, the direction and final outlet for the spill flows, and to validate the flow rate through the Huntingwood Development Site used for the prior floodplain analysis.

The analysis and findings of the aforementioned supplemental works have been summarized in a *Supplementary Flood Hazard Analysis Summary* (Crozier, 2019) which has been included in **Appendix D** of this report.

The Decision and Order regarding the OMB hearing was issued on July 31, 2014 outlining the approved development area extents as well as requirements of future approvals. Refer to **Appendix**

C for supporting OMB documentation including the Natural Hazards Witness Statement and the Official Plan decision documents.

This addendum to the 2011 Natural Hazards Study has been prepared in accordance with the following requirement of the OMB approved Official Plan Amendment as paraphrased below:

*Current and future Planning Act applications shall be supported by:*

- II. *a natural hazards assessment prepared to the satisfaction of the Town and the NVCA demonstrating that all proposed development will be located in accordance with Section 3.1 of the Provincial Policy Statement*

### **3.0 SITE DESCRIPTION**

Historic use of the subject property has been primarily for agriculture. A small farm house and barn set back approximately 350 m from Silver Creek Drive remain onsite. Much of the property is currently utilized as pasture lands for cattle.

The site generally slopes from the southwest to the northeast with an average slope of less than 1%. The main branch of Silver Creek enters the subject site along the southern property line after passing beneath the Georgian Trail via a former railway bridge. Silver Creek exhibits a pool - riffle sequence throughout the site with an average stream width of approximately 5 metres, average bankfull depth of approximately 1.5 metres and a bankfull width of 7.5m at the largest amplitude meander. Downstream of the site, Silver Creek passes beneath Highway 26 via a 7.5 m x 1.5 m concrete box culvert en route to its eventual outlet at Georgian Bay.

Vegetation to the west of Silver Creek is primarily pasture with clumps of sparse trees. In some instances tree cover has been cleared right up to the creek edge, while in other areas a small buffer of tree cover has been maintained. All drainage from the western portion of the site outlets to Silver Creek upstream of Highway 26.

Vegetal cover to the east of Silver Creek is more varied. A strip of pasture land has been established running alongside the creek edge and the Highway 26 right of way. The remaining lands abutting the Georgian Trail and adjacent Silver Glen Preserve subdivision are a mixture of forested and meadow areas. During the springtime a number of closed depressions contain standing water. Drainage for the eastern portion of the site also drains from southwest to northeast and is primarily collected and conveyed in an intermittent drainage channel which outlets under Highway 26 via a 5.5 m x 1.7 m box culvert. There is virtually no surface runoff contributing to Silver Creek from the lands located east of the creek.

A portion of the northeast corner of the property is part of a Ministry of Natural Resources (MNR) Provincially Significant Wetland (PSW). A number of closed depressions in the southeast quadrant of the site have also been identified as wetlands. These environmental areas are identified on **Figure 2**, Concept Plan. Refer to the Environmental Impact Statement (EIS) Addendum (2019) prepared by Crozier & Associates for further details.

### **4.0 NATURAL HAZARDS**

Provincial Policy Statement (PPS) 3.1.1 defines hazardous lands adjacent to river and stream systems consisting of flooding and/or erosion prone areas. Flooding hazards are associated with the inundation limits resulting from a Regional storm event. Erosion hazards are dependent on the characteristics of the stream overbank topography and are associated with the meandering of the stream channel or erosion and failure of river bank slopes.

The natural hazards assessment undertaken herein is in accordance with the methodology outlined in the Ministry of Natural Resources publication "Understanding Natural Hazards" (MNR, 2001). Results from this technical guideline include recommended development setbacks based on the hazards associated with Silver Creek. A detailed assessment of each component of the natural hazards is presented below.

#### 4.1 Flooding Hazards

The floodplain of Silver Creek is defined as a "one-zone" floodplain per the Town of Collingwood Official Plan (2019). Notwithstanding, spill zones have also been identified along Silver Creek. These spill zones exist to the south of the Georgian Trail, to the south of Highway 26 on the subject lands and to the north of Highway 26 on the Consulate property ((CCL, 1989), (Crozier, 2008)).

MNR (2001) provides direction on the interpretation and management flood hazards. "One-zone" floodplain is considered high risk to the public and property. Consequently, new development is directed outside of the "one-zone" floodplain.

Areas susceptible to spill waters are treated in a different manner than one-zone floodplain. Spill is generally characterized by shallow, lower velocity conditions in which flow leaves a watershed to enter a different system. Section 4.13 of the "Technical Guide – River and Stream Systems: Flooding Hazard Limits" (MNR, 2002) provides the following commentary:

*"The effect of spills moving into another watershed should be assessed to determine the potential flood risks. Alternative measures should be investigated to prevent the spill moving into the adjacent watershed".*

##### 4.1.1 Previous Floodline Assessments

As explained above, Silver Creek bisects the property and flows in a northerly direction towards Georgian Bay. With a tributary watershed exceeding 26 km<sup>2</sup> upstream of Highway 26, Silver Creek experiences flooding conditions on occasion. In 1989, a Cumming Cockburn Limited ("CCL") study entitled "Floodline Mapping Study of Silver Creek, Spring Creek, & Village of Angus" was prepared under the auspices of the Federal Provincial Flood Damage Reduction Program for the Nottawasaga Valley Conservation Authority (NVCA). The study delineated the limits of the Silver Creek floodplain on the subject lands and identified the areas along Silver Creek which are subject to spill conditions.

One of the spill areas identified in the CCL (1989) report was located on the subject lands along Silver Creek at Highway 26. This spill area was denoted Spill Zone 'B', where a portion of the flood flows from Silver Creek were said to be conveyed easterly along the south side of Highway 26 toward the Silver Glen Preserve residential development and Cranberry Resort Links golf course and residential development. Since 1989, there have been a number of further flood studies examining Silver Creek. Most recently, Crozier (2007) re-evaluated the Silver Creek floodplain as supporting studies to the proposed residential development "The Preserve at Georgian Bay" proposed by Consulate Development Inc. While this study thoroughly evaluated the Silver Creek floodplain and spill areas north of Highway 26, the study did not examine flood conditions of the subject lands. Consequently, the CCL (1989) work represents the most current accepted floodplain study on record for the subject lands.

The CCL Study used a Regional Storm (Timmins) peak flow of 78 m<sup>3</sup>/s through the subject lands, derived from an approach flow of 109m<sup>3</sup>/s upstream of the Georgian Trail less 31 m<sup>3</sup>/s spill flow

westerly towards Watercourse #1, denoted as Spill Zone 'A', prior to entering the upstream end of the Huntingwood lands. Watercourse #1 is located west of the subject lands beyond the Forest Drive subdivision as shown in the Spill 'A' Analysis Plan in **Appendix D**. Through the subject lands, the CCL study concluded that there was a spill flow of 31 m<sup>3</sup>/s to the east, denoted as Spill Zone 'B', leaving a remaining 47 m<sup>3</sup>/s at the downstream end of the Huntingwood site upstream of Highway 26.

#### 4.1.2 Existing Conditions Hydraulic Assessment

The floodline assessment across the Huntingwood lands presented herein builds upon work previously undertaken (Crozier, 2007) concerning Silver Creek. The purpose of the analysis is to update the CCL (1989) delineation of the Regional floodline across the Huntingwood lands based on thorough examination of site conditions and use of accurate site specific topographic mapping. The HEC-RAS modelling completed for the analyses related to this report used HEC-RAS 4.0.

Silver Creek was previously modeled by CCL using the HEC-2 computer model. A total of six hydraulic sections were evaluated along a 700 m portion of Silver Creek extending from the Georgian Trail to Highway 26. Spill Zone 'B' was also identified upstream of Highway 26 flowing in an easterly direction, however the CCL study did not include a detailed hydraulic assessment of the spill reach.

As part of the updated hydraulic modelling undertaken in connection with the Huntingwood Trails development, eleven cross sections have been used along the Main Channel through the subject site to evaluate the floodplain hydraulics of Silver Creek from the Georgian Trail to Highway 26. The approximate location of the six original HEC-2 cross sections completed by CCL (1989) have been preserved. In order to better define the internal floodplain, five new cross sections were added to the model across the subject lands. All cross sections were generated using updated air-photo based topographic mapping produced by First Base Solutions (2008). The contour map of the site and surrounding lands consists of a 0.5-metre contour interval. This mapping is consistent with what was applied to the Consulate Development project and is considered acceptable for use in this floodline assessment.

In addition to updating the modelling of the Main Channel, a detailed assessment of Spill Zone 'B' and the east overbank system has been undertaken as part of the updated hydraulic modelling to assess the hydraulic separation between the Main Channel and the spill flow to the east and to analyze the hydraulic characteristics of the spill flow. The two HEC-RAS reaches are connected through lateral structures implemented along the east bank of the Main Channel which act as weirs to determine the incremental flow lost from the Main Channel to Spill Zone B. Nine cross sections were generated for the Spill Zone B model across the subject lands, matching into the Main Channel sections. Additional sections downstream of the new cross sections from previous HEC-RAS modelling of Silver Glen Preserve were also used in the Spill model.

Manning's roughness values have been set at 0.045 for the main channel to reflect the stony pool/riffle sequence, 0.05 for the west overbank to reflect the pasture land use and 0.07 for the east overbank areas to reflect the mix of pasture lands and moderately treed areas. For the Spill Flow B portion of the model, Manning's roughness values were set at 0.07 for the entire cross section to represent shallow flows in moderately vegetated / pasture areas with poorly defined channels. At the downstream limits of the Spill Zone B profile, the Manning's roughness was increased to 0.1 to represent the dense vegetative conditions. These values were considered representative of onsite land uses and are consistent with or more conservative than those applied in the original HEC-2 model (ie. 0.045 for main channel, 0.05 for overbank areas) used by CCL.

The downstream portion of the Silver Creek model located to the north of the subject site on the Consulate lands was used to ensure model stability. This model was previously approved by the NVCA in connection with the OMB decision concerning the Consulate Development Inc. hearing. The downstream limit of the model occurs at Georgian Bay; the 100-year long-term high water level of 177.4 m was used as the downstream boundary condition.

For Spill Zone B the downstream portion of the model, located to the east of the subject site on the Silver Glen Preserve and Cranberry Trail lands, was used to ensure model stability. This model was previously approved by the NVCA as part of the approvals for Silver Glen Preserve development and accounts for flood conveyance infrastructure installed as part of that development. The downstream limit of the model occurs east of Cranberry Trail; the normal depth was used as the downstream boundary condition.

#### Upstream Hydraulic Analysis (Spill Zone 'A')

In March 2014, Crozier completed additional analysis regarding Silver Creek flows upstream of the subject lands to confirm the appropriateness of the application of the Regulatory flow of 78 m<sup>3</sup>/s as utilized in the CCL Study. Upstream of the Huntingwood lands, Silver Creek conveys 109 m<sup>3</sup>/s towards Georgian Trail. The CCL Study established the existence of a spill condition south of the Georgian Trail on Silver Creek, denoted as Spill Zone 'A'. This spill flow occurs due to insufficient capacity of the Georgian Trail culverts to convey the Regional Event, combined with low elevations in the west overbank of Silver Creek upstream of the Trail. Based on their assessment of these hydraulic components, CCL established that Spill 'A', in the amount of 31 m<sup>3</sup>/s, breaches the west bank of the Silver Creek floodplain and spills westerly into Watercourse #1. The remaining 78 m<sup>3</sup>/s has historically been used as the Regulatory flow for the Huntingwood site and downstream lands.

To assess the flows upstream of the Georgian Trail, additional cross sections were added to the HEC-RAS model upstream of Georgian Trail, complete with lateral structures to assess spill flow on either side of Silver Creek. The detailed analysis and the resulting conclusions have been summarized in a *Supplementary Flood Hazard Analysis Summary Memo* that can be found in **Appendix D**.

The supplemental modelling concluded that there is spill over the west bank of Silver Creek upstream of the Georgian Trail, that is directed west to Watercourse #1 in the magnitude of 34 m<sup>3</sup>/s. It was also determined that spill occurs from Silver Creek over the low points of Georgian Trail on both the east and west sides of Silver Creek. A spill of 18 m<sup>3</sup>/s occurs to the west of Silver Creek and enters the Forest Drive subdivision, eventually joining Watercourse #1. The remainder (4 m<sup>3</sup>/s) spills easterly into the Huntingwood Trails development and joins Spill Zone 'B'.

Per the computed spill flows upstream of Georgian Trail, 53 m<sup>3</sup>/s enters Silver Creek at the upstream end of the Huntingwood Trails development area (downstream of Georgian Trail). Previous analysis of Silver Creek by Cumming & Cockburn Ltd (CCL) had not considered the spill flow over Georgian Trail and applied a flow of 78 m<sup>3</sup>/s through the Huntingwood site. The 2011 floodplain analysis completed for the Huntingwood Natural Hazards Study used the CCL flow of 78 m<sup>3</sup>/s. To maintain a conservative design, this flow has been maintained as the Regulatory flow through the site for the purpose of delineating existing flood hazards downstream of the Georgian Trail.

**Table 1** summarizes the main channel flow rates and spill flow rates surrounding Silver Creek upstream of the Georgian Trail.

**Table 1: Silver Creek Main Channel and Spill Flow Summary Upstream of Huntingwood Lands**

| Location                                | Description                      | Updated Flows (m <sup>3</sup> /s) | CCL Flows (m <sup>3</sup> /s) | Type of Flow | Direction of Flow | Downstream Channel                 |
|-----------------------------------------|----------------------------------|-----------------------------------|-------------------------------|--------------|-------------------|------------------------------------|
| Silver Creek Upstream of Georgian Trail | Silver Creek                     | 109                               | 109                           | Main Channel | North             | Silver Creek                       |
| Upstream of Georgian Trail              | Overbank Spill from Silver Creek | 34                                | 31                            | Spill        | West              | Watercourse 1                      |
| Georgian Trail                          | Spill over Georgian Trail        | 18                                | -                             | Spill        | West              | Forest Subdivision / Watercourse 1 |
| Georgian Trail                          | Spill over Georgian Trail        | 4                                 | -                             | Spill        | East              | Spill Zone 'B'                     |
| Upstream end of Huntingwood             | Silver Creek                     | 53                                | 78                            | Main Channel | North             | Silver Creek                       |

#### Existing East Overbank Modelling (Spill Zone 'B')

Crozier completed a *Huntingwood Trails Flood Hazard Assessment Memo (September 2013)* to supplement the 2011 *Natural Hazards Study* and to better characterize Spill Zone 'B' and the Silver Creek Floodplain on the subject property. The HEC-RAS modelling presented in the 2011 *Natural Hazards Study* was updated to better represent the flow conditions on site through modifying the cross sections to remain perpendicular, and to incorporate the findings of the additional spill analysis. Refer to **Appendix D** for the *Huntingwood Trails Flood Hazard Assessment Memo (September 2013)* for additional information.

Silver Creek exhibits a defined drainage divide on its east side throughout the Huntingwood Lands. From this divide, the topography is predominantly in a northeast direction, with contours generally aligned at 45 degree angles from the overall northward trajectory of the Silver Creek main channel. Slopes in the east overbank generally exceed the slopes in the main channel and west overbank (approximately 0.7% in the west overbank/main channel, and 1-1.2% in the east overbank immediately adjacent the creek). Some distance from the main channel the contours deflect slightly northward once again, but the overall direction of fall remains in the northeasterly direction, away from the main channel.

These topographic conditions are characteristic of spill: flow leaves the main watercourse (Silver Creek) entering an overbank (east overbank) where it is conveyed away from the main watercourse via a defined onsite drainage route, never to return to the system.

Based on the discussion of topography above, the following points can be made pertaining to the spill flow from the east bank of Silver Creek:

- Due to the change in slope from the main channel to the east overbank immediately adjacent the creek, it is not appropriate for a single straight east/west cross section to encompass both the west overbank/main creek floodplain system and the east overbank system due to the discontinuity in slope regime across the section.
- Due to the change in direction of slope, it is not appropriate for a single straight east / west cross section to encompass both the West Overbank / Main Channel floodplain system and the east overbank system, as it conflicts with the assumption of one-dimensional flow.
- Due to the directionality of the topography in the east overbank, flows breaching the east overbank of the creek move away from the creek and become hydraulically disconnected from the main system.

Given the above, the HEC-RAS hydraulic model establishes distinct flood levels through Spill Zone B and illustrates that energy grade lines are lower, thus representing a separate profile from the Silver Creek system.

Flow spilling from the Main Channel profile to the Spill Zone B profile was simulated by the application of lateral weirs. The weir elevations were determined from the site topography, taking the height of the drainage divide located in the east overbank between each cross section to develop the weir profiles. In this way, the height of the main channel water surface elevation over the drainage divide determines how much spill flow is lost to the Spill Zone B profile.

A lateral weir exists between each cross section on the Main Channel profile model from Section 1830 to Section 785. It was assumed that the distance required for expansion of flow immediately downstream of the Georgian Trail bridge would preclude significant spill from occurring between Section 1840 and 1830.

The lateral weirs were coded using the Standard Weir Equation for broad-crested weirs representative of the wide, rounded shape of the drainage divide on the east side of Silver Creek. Weir computations were performed based on water surface elevation rather than energy grade line, as the velocity head in the main channel does not act in the direction of weir flow (ie. only the elevation component of the total energy in the main channel acts to cause lateral outflow). A discharge coefficient of 0.8 was used to represent an imperfect weir whose efficiency is decreased by variations in topography and the presence of vegetation. The HEC-RAS weir computations also account for the submergence of the weir due to water surface elevations in the receiving channel (ie. tailwater conditions due to flow in Spill Zone B).

### Modelling Results

Results from the existing conditions HEC-RAS hydraulic analysis of Silver Creek across the subject lands are illustrated on **Figure 3**. The detailed output is provided in **Appendix A**. Computed water surface elevations within the Main Channel of Silver Creek were between -0.38 lower to +0.47 m higher than those of the CCL Study through the main portion of the site. These elevation changes are due to the more conservative roughness coefficients, more accurate topographic mapping, modified direction of cross sections, and incorporation of the lateral structures and spill analysis utilized in the subject analysis. Refer to **Table 2** for a comparison of existing conditions Regional water surface elevations.

**Table 2: Comparison of Existing Conditions Regional Water Surface Elevations between CCL (1989) and Crozier (2019) – Silver Creek Main Channel**

| Cross Section ID | Description                                        | Regional Water Surface Elevation (m) |                | Change (+/- m) |
|------------------|----------------------------------------------------|--------------------------------------|----------------|----------------|
|                  |                                                    | CCL (1989)                           | Crozier (2019) |                |
| 1851             | Upstream of Georgian Trail                         | ---                                  | 187.82         | ---            |
| 1850             | Upstream of Georgian Trail                         | ---                                  | 186.89         | ---            |
| 1845             | Georgian Trail Culvert                             |                                      |                |                |
| 1840             | Updated CCL Section / Downstream of Georgian Trail | 185.91                               | 186.38         | +0.47          |
| 1830             |                                                    | ---                                  | 185.91         | ---            |
| 1820             |                                                    | ---                                  | 185.27         | ---            |
| 1810             | Updated CCL Section                                | 184.06                               | 184.12         | +0.06          |
| 1800             |                                                    | ---                                  | 183.63         | ---            |
| 1790             | Updated CCL Section                                | 182.98                               | 183.08         | +0.10          |
| 1780             |                                                    | ---                                  | 182.44         | ---            |
| 1770             | Updated CCL Section                                | 182.05                               | 182.05         | Nil            |
| 1760             | Updated CCL Section                                | 182.08                               | 181.70         | -0.38          |
| 785              | Updated CCL Section, Highway 26 (upstream)         | 181.86                               | 181.70         | -0.16          |

Results from the existing conditions HEC-RAS hydraulic analysis of the Silver Creek profile and Spill Zone B profile are summarized in **Table 3**. This assessment was based on the Regional peak flow of 78 m<sup>3</sup>/s, consistent with the previously approved CCL (1989) study and as discussed in this report.

**Table 3: Hydraulic Assessment Results (Existing Conditions)**

| Cross Section ID                  | Flow (m <sup>3</sup> /s) | W.S. Elev (m) | Flow Leaving (m <sup>3</sup> /s) | Cross Section ID                    | Flow (m <sup>3</sup> /s) | W.S. Elev (m) |
|-----------------------------------|--------------------------|---------------|----------------------------------|-------------------------------------|--------------------------|---------------|
| <b>Silver Creek/West Overbank</b> |                          |               |                                  |                                     |                          |               |
| 1851                              | 78.0                     | 187.82        |                                  |                                     |                          |               |
| 1850                              | 78.0                     | 186.89        |                                  |                                     |                          |               |
| 1845                              | Georgian Trail Culvert   |               |                                  |                                     |                          |               |
| 1840                              | 78.0                     | 186.38        | 0.0                              | <b>East Overbank (Spill Zone B)</b> |                          |               |
| 1830                              | 78.0                     | 185.91        | 6.6                              | 1830                                | 1.0*                     | 185.55        |
| 1820                              | 71.4                     | 185.27        | 17.0                             | 1820                                | 7.6                      | 185.02        |
| 1810                              | 54.4                     | 184.12        | 6.6                              | 1810                                | 24.6                     | 183.68        |
| 1800                              | 47.8                     | 183.63        | 4.5                              | 1800                                | 31.2                     | 183.40        |
| 1790                              | 43.3                     | 183.08        | 1.2                              | 1790                                | 35.7                     | 182.82        |
| 1780                              | 42.1                     | 182.44        | 0.1                              | 1780                                | 36.9                     | 182.29        |
| 1770                              | 42.0                     | 182.05        | 5.8                              | 1770                                | 37.0                     | 181.98        |
| 1760                              | 36.2                     | 181.70        | 5.2                              | 1760                                | 42.8                     | 181.21        |
| 785                               | 31.0                     | 181.70        | 0.0                              | 1750                                | 48.0                     | 180.75        |

\* Flow of 1.0cms applied at upstream limit of Spill Zone B for model stability only.

The Regional floodline located on the west side of Silver Creek is defined on **Figure 3**. Between Highway 26 and the Georgian Trail, the floodline is generally 30 to 80 m from Silver Creek and encroaches into existing residential areas along Silver Creek Drive immediately upstream of Highway 26 in an ineffective area of the floodplain.



Within the subject property, a total spill (Spill Flow 'B') of 48 m<sup>3</sup>/s (includes the 1.0 m<sup>3</sup>/s applied at the upstream end of the spill model) overtops the east bank of Silver Creek through the site and is directed northeast. Due to the existing site topography, these spill flows become hydrologically disconnected from the Silver Creek system.

The results of the analysis confirm that spill from the main channel occurs along much of the length of the east overbank of Silver Creek through the Subject Lands, resulting in a total Spill Zone B flow of 48 m<sup>3</sup>/s within the subject lands. This result suggests that the CCL estimate of the magnitude of Spill Zone B (31 m<sup>3</sup>/s) was an underestimate of the true spill flow based on existing site topography.

The eastern portion of the Silver Creek floodplain consists of various shallow spill flow areas that are located along the eastern bank of Silver Creek. This was confirmed through field reconnaissance of drainage completed by Crozier during the Spring of 2009 and spill flow tracking of an actual spill event in January 2011. Unlike the CCL report which defined a floodline along the east side of Silver Creek and only a limited spill area adjacent to Highway 26, our review of the hydraulic conditions based on the more detailed contours concludes spill occurs in multiple locations across the eastern portion of the subject property.

An examination of the water surface elevations and energy grade lines indicates that the main channel and Spill Zone B reaches act as separate hydraulic systems. The water surface and energy grade elevations in the Spill Zone B profile are both lower than those in the Silver Creek/west overbank profile, confirming that Spill Zone B is hydraulically disconnected from Silver Creek and is a true spill. Flow that has breached the drainage divide on east side of the creek does not remain in the Silver Creek system but rather exits the system as spill flow through Spill Zone B. Once the east bank of Silver Creek is breached, flood waters are removed from the Silver Creek system flowing in an unconfined nature in a north-easterly direction through the subject lands eventually reaching Highway 26 and draining towards Silver Glen Preserve and Cranberry Trail. Refer to **Appendix D** for the detailed modelling output from the *Huntingwood Trails Flood Hazard Assessment Memo*.

#### 4.1.3 Post-Development Conditions Hydraulic Assessment

As described above, Crozier has updated the previous floodplain modelling analysis from the CCL Study across the subject site. This updated model of existing conditions was then used to evaluate the effects of the proposed Huntingwood Trails development on the natural hazards posed by Silver Creek.

The access road and proposed development for the eastern development area (DA #1) will be flood proofed from the existing spill within Spill Zone 'B'. The spill will be maintained across the subject lands as in the existing condition.

The western development area (DA #2) has been set outside the Silver Creek Regional floodplain, save and except a portion of the site access roadway at Silver Creek Drive. The site access roadway to the western development area will be flood proofed and will confine the post-development flood inundation limit to the eastern boundary of the right of way. Existing properties to the west of the subject development which are currently in the Regional floodplain will be removed from the floodplain.

#### Modelling Set-up

The post-development model for Silver Creek was developed by modifying the existing conditions hydraulic sections across the proposed development areas. At this stage, the development areas

were modeled as blocked obstructions in HEC-RAS up to the proposed development limits. Upon detailed design, the grading plan will be used to update and finalize the HEC-RAS model.

As noted above, the access roadway to the western development area will encroach into a portion of the ineffective Regional floodplain. This encroachment is located toward the downstream portion of Silver Creek on the subject property where ineffective flow areas exist due to the downstream flow impediments of Silver Creek Drive. Accordingly, the access roadway into the site has been modeled as a blocked obstruction.

The addition of Development Area #1 and the eastern access roadway were modeled using blocked obstructions at the development and roadway limits through the Spill B Zone Reach.

### Modelling Results

Post-development hydraulic conditions demonstrate that there will be no significant increases in water surface elevations through the Main Channel and Spill Zone B with the addition of the proposed Huntingwood development and access roadways.

The modelling confirms that there is no additional spill over the east bank of Silver Creek leaving the system, with a total of 48 m<sup>3</sup>/s leaving the system through the subject lands as in existing conditions. Slight variances in spill flow distribution are noted through the Huntingwood lands but are considered insignificant (in all cases noted less than 1" or 2.5cm). Spill has been maintained through the lands east of Silver Creek, while incorporating the proposed access road construction to DA#1. **Table 4** summarizes the comparison of pre-development and post-development flows. The change in water surface elevations from existing conditions to post-development is negligible or nil and as such has not been included in the Table.

**Table 4: Existing Conditions and Post-Development Water Surface Elevation and Flow Comparison**

| Cross Section ID                  | Flow (Post-Dev) (m <sup>3</sup> /s) | Existing W.S. Elev (m) | Post-Dev W.S. Elev (m) | Flow Leaving (Post-Dev) (m <sup>3</sup> /s) | Cross Section ID                    | Flow (Post-Dev) (m <sup>3</sup> /s) | Existing W.S. Elev (m) | Post-Dev W.S. Elev (m) |
|-----------------------------------|-------------------------------------|------------------------|------------------------|---------------------------------------------|-------------------------------------|-------------------------------------|------------------------|------------------------|
| <b>Silver Creek/West Overbank</b> |                                     |                        |                        |                                             |                                     |                                     |                        |                        |
| 1851                              | 78                                  | 187.82                 | 187.82                 |                                             |                                     |                                     |                        |                        |
| 1850                              | 78                                  | 186.89                 | 186.89                 |                                             |                                     |                                     |                        |                        |
| 1845                              | Georgian Trail Culvert              |                        |                        |                                             |                                     |                                     |                        |                        |
| 1840                              | 78                                  | 186.38                 | 186.38                 | 0                                           | <b>East Overbank (Spill Zone B)</b> |                                     |                        |                        |
| 1830                              | 78                                  | 185.91                 | 185.91                 | 6.5                                         | 1830                                | 1.0*                                | 185.55                 | 185.55                 |
| 1820                              | 71.5                                | 185.27                 | 185.28                 | 16.8                                        | 1820                                | 7.5                                 | 185.02                 | 185.02                 |
| 1810                              | 54.7                                | 184.12                 | 184.13                 | 6.7                                         | 1810                                | 24.3                                | 183.68                 | 183.68                 |
| 1800                              | 48                                  | 183.63                 | 183.63                 | 4.5                                         | 1800                                | 31.0                                | 183.40                 | 183.39                 |
| 1790                              | 43.5                                | 183.08                 | 183.08                 | 1.2                                         | 1790                                | 35.5                                | 182.82                 | 182.84                 |
| 1780                              | 42.3                                | 182.44                 | 182.44                 | 0.1                                         | 1780                                | 36.7                                | 182.29                 | 182.30                 |
| 1770                              | 42.2                                | 182.05                 | 182.05                 | 6.0                                         | 1770                                | 36.8                                | 181.98                 | 181.98                 |
| 1760                              | 36.2                                | 181.70                 | 181.70                 | 5.2                                         | 1760                                | 42.8                                | 181.21                 | 181.21                 |
| 785                               | 31                                  | 181.70                 | 181.70                 | 0.0                                         | 1750                                | 48.0                                | 180.75                 | 180.75                 |

\* Flow of 1.0cms applied at upstream limit of Spill Zone B for model stability only.

The detailed grading of the development will ensure that lots and roadways adjacent to the floodplain have a minimum of 0.3 m flood-proofing above the Regional water surface elevation.

The post-development floodline delineation is illustrated on **Figure 4** and the detailed output from the HEC-RAS model is provided in **Appendix A**.

The flood-proofing measures proposed along the west side of Silver Creek will provide public benefit as several existing residential properties on Silver Creek Drive will be removed from the Silver Creek Regional floodplain.

## 4.2 Erosion Hazards

An erosion hazard assessment of the main branch of Silver Creek was prepared as part of the overall natural hazards assessment described herein. Silver Creek is classified as an “unconfined system” according to the MNR publication *Understanding Natural Hazards* (MNR, 2001). This document defines an unconfined system as those systems where the watercourse is not located within a valley corridor with discernable slopes, but relatively flat to gently rolling plains and is not confined by valley walls. This is consistent with the characteristics of Silver Creek within the study area. Accordingly, the erosion hazard limit associated with unconfined systems is defined by the meander belt allowance.

The meander belt allowance is defined by the maximum extent that a channel migrates (MNR, 2001). A detailed assessment of the meander belt on a reach-specific assessment has been undertaken herein.

### 4.2.1 Meander Belt Allowance

In order to develop the meander belt allowance for the subject watercourse, a field assessment of the geomorphic characteristics of Silver Creek throughout the subject property was undertaken by Crozier as part of the 2011 Natural Hazards Study. This assessment was completed using the Rosgen Classification System and detailed air photo topographic survey of the subject lands with reference to the methodology and data presented in the MNR (1996) publication *Morphological Relationships of Rural Watercourses in Southern Ontario and Selected Methods in Fluvial Geomorphology*.

Utilizing the relationships presented in the *Morphological Relationships of Rural Watercourses in Southern Ontario and Selected Methods in Fluvial Geomorphology* (MNR, 1996), the meander belt width was calculated based on the bankfull stream width, measured at the largest amplitude meander. The meander belt width computed using this methodology ranged from 95 m to 119 m over the three reaches analyzed. This meander belt width is centered on the meander belt axis of each respective stream reach. Refer to **Figure 3** for the extents of the meander belt and to **Appendix B** for detailed calculations.

Through the previous commenting process, NVCA requested a peer review of the meander belt delineation be completed. Parish Geomorphic completed a technical review of the meander belt limits presented in the earlier Crozier work. This review concluded that the meander belt values previously determined by Crozier resulted in a conservative result that is appropriate for the site. A copy of the Parish Geomorphic *Huntingwood Trails – Meander Belt Width Assessment Technical Review (July 2011)* is included in **Appendix B**.

## 5.0 TOTAL HAZARD LIMIT

The total natural hazard limit is described by the greater of the flooding limits and the meander belt allowance. The recommended natural hazard limit associated with the Silver Creek through the site is presented in **Figure 4**. This total natural hazard limit was adopted for the subject lands in order to determine the allowable development areas and establish the development plan which forms the basis of this application.

## 6.0 CONCLUSIONS

This study provides an assessment of the natural hazards associated with the Silver Creek which affect the proposed development from the perspective of potential flooding and erosion. Detailed hydraulic analysis was completed by expanding previously approved HEC-RAS models to determine the flooding and spill conditions associated with Silver Creek and to evaluate the impacts of the proposed development on these floodlines. Additionally, a meander belt assessment of Silver Creek across the subject site was conducted to determine the erosion hazard limits associated with the unconfined system.

As the proposed development respects the flooding and erosion hazards onsite as determined through this analysis we confirm the proposed development application meets the tests of Section 3.1 of the Provincial Policy Statement. Based on the above, we recommend approval of the uses sought for the subject lands from the perspective of natural hazards management.

Respectfully Submitted,

C.F. CROZIER & ASSOCIATES INC.



Jonathan M. Proctor, P.Eng.  
Associate

JP/je

C.F. CROZIER & ASSOCIATES INC.



Jessie Elder, EIT

Enclosure

J:\200\281 - Huntingwood - Skelton Farm\2769\Reports\July 2019 Natural Hazards\2019.07.26 Natural Hazards.doc

## **APPENDIX A**

### Silver Creek Main Branch – HEC-RAS Modelling

Main Channel HEC-RAS Output Table (Pre & Post-Development)

Main Channel Pre-Development HEC-RAS Sections

Spill Zone B Pre-Development HEC-RAS Sections

Spill Zone B HEC-RAS Output Table (Pre & Post-Development)

Main Channel Post-Development HEC-RAS Sections

Spill Zone B Post-Development HEC-RAS Sections

# SILVER CREEK MAIN CHANNEL

HEC-RAS River: Silver Creek Reach: MainLower Profile: Regional

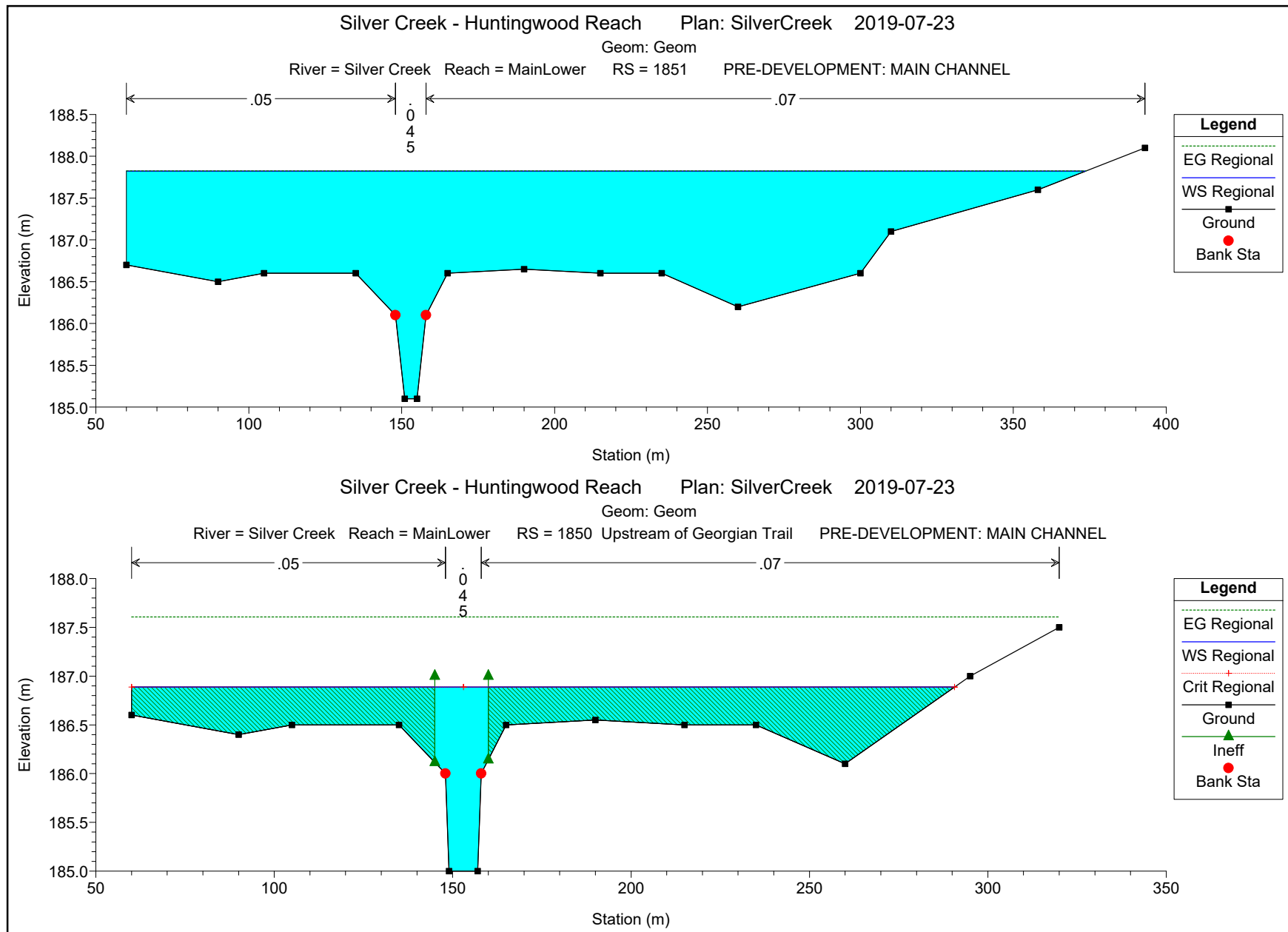
| Reach     | River Sta | Profile  | Plan    | Q Total<br>(m3/s) | Min Ch El<br>(m) | W.S. Elev<br>(m) | Crit W.S.<br>(m) | E.G. Elev<br>(m) | E.G. Slope<br>(m/m) | Vel Chnl<br>(m/s) | Flow Area<br>(m2) | Top Width<br>(m) | Froude # Chl |
|-----------|-----------|----------|---------|-------------------|------------------|------------------|------------------|------------------|---------------------|-------------------|-------------------|------------------|--------------|
| MainLower | 1851      | Regional | Pre-Dev | 78.00             | 185.10           | 187.82           |                  | 187.83           | 0.000120            | 0.43              | 357.26            | 313.62           | 0.09         |
| MainLower | 1851      | Regional | post    | 78.00             | 185.10           | 187.82           |                  | 187.83           | 0.000120            | 0.43              | 357.26            | 313.62           | 0.09         |
| MainLower | 1850      | Regional | Pre-Dev | 78.00             | 185.00           | 186.89           | 186.89           | 187.61           | 0.015848            | 3.91              | 22.01             | 230.65           | 0.93         |
| MainLower | 1850      | Regional | post    | 78.00             | 185.00           | 186.89           | 186.89           | 187.61           | 0.015848            | 3.91              | 22.01             | 230.65           | 0.93         |
| MainLower | 1845      |          |         | Culvert           |                  |                  |                  |                  |                     |                   |                   |                  |              |
| MainLower | 1840      | Regional | Pre-Dev | 78.00             | 184.40           | 186.38           | 186.38           | 186.82           | 0.010389            | 3.06              | 31.66             | 172.66           | 0.75         |
| MainLower | 1840      | Regional | post    | 78.00             | 184.40           | 186.38           | 186.38           | 186.82           | 0.010389            | 3.06              | 31.66             | 172.66           | 0.75         |
| MainLower | 1830      | Regional | Pre-Dev | 78.00             | 184.00           | 185.91           | 185.91           | 186.09           | 0.006943            | 2.45              | 64.31             | 145.10           | 0.59         |
| MainLower | 1830      | Regional | post    | 78.00             | 184.00           | 185.91           | 185.91           | 186.10           | 0.006979            | 2.45              | 63.20             | 133.00           | 0.59         |
| MainLower | 1825      |          |         | Lat Struct        |                  |                  |                  |                  |                     |                   |                   |                  |              |
| MainLower | 1820      | Regional | Pre-Dev | 71.39             | 183.52           | 185.27           | 185.27           | 185.43           | 0.010221            | 2.43              | 57.07             | 150.70           | 0.69         |
| MainLower | 1820      | Regional | post    | 71.48             | 183.52           | 185.28           | 185.28           | 185.43           | 0.010174            | 2.42              | 56.32             | 136.00           | 0.69         |
| MainLower | 1815      |          |         | Lat Struct        |                  |                  |                  |                  |                     |                   |                   |                  |              |
| MainLower | 1810      | Regional | Pre-Dev | 54.42             | 182.32           | 184.12           | 184.12           | 184.31           | 0.006745            | 2.21              | 42.88             | 109.24           | 0.58         |
| MainLower | 1810      | Regional | post    | 54.74             | 182.32           | 184.13           | 184.13           | 184.31           | 0.006725            | 2.21              | 43.19             | 109.27           | 0.58         |
| MainLower | 1805      |          |         | Lat Struct        |                  |                  |                  |                  |                     |                   |                   |                  |              |
| MainLower | 1800      | Regional | Pre-Dev | 47.79             | 181.89           | 183.63           |                  | 183.70           | 0.004515            | 1.56              | 51.98             | 135.55           | 0.47         |
| MainLower | 1800      | Regional | post    | 48.04             | 181.89           | 183.63           |                  | 183.71           | 0.004491            | 1.56              | 52.32             | 135.00           | 0.47         |
| MainLower | 1795      |          |         | Lat Struct        |                  |                  |                  |                  |                     |                   |                   |                  |              |
| MainLower | 1790      | Regional | Pre-Dev | 43.32             | 181.52           | 183.08           | 183.08           | 183.21           | 0.007257            | 2.11              | 42.71             | 147.98           | 0.58         |
| MainLower | 1790      | Regional | post    | 43.51             | 181.52           | 183.08           | 183.08           | 183.21           | 0.007140            | 2.09              | 43.21             | 147.00           | 0.58         |
| MainLower | 1785      |          |         | Lat Struct        |                  |                  |                  |                  |                     |                   |                   |                  |              |
| MainLower | 1780      | Regional | Pre-Dev | 42.09             | 180.70           | 182.44           | 182.38           | 182.56           | 0.005421            | 1.85              | 41.35             | 108.51           | 0.51         |
| MainLower | 1780      | Regional | post    | 42.28             | 180.70           | 182.44           | 182.38           | 182.56           | 0.005398            | 1.85              | 41.62             | 108.71           | 0.51         |
| MainLower | 1775      |          |         | Lat Struct        |                  |                  |                  |                  |                     |                   |                   |                  |              |
| MainLower | 1770      | Regional | Pre-Dev | 42.01             | 180.58           | 182.05           | 182.05           | 182.18           | 0.009294            | 1.96              | 37.75             | 283.57           | 0.65         |
| MainLower | 1770      | Regional | post    | 42.20             | 180.58           | 182.05           | 182.05           | 182.18           | 0.009381            | 1.97              | 37.74             | 119.74           | 0.65         |
| MainLower | 1765      |          |         | Lat Struct        |                  |                  |                  |                  |                     |                   |                   |                  |              |
| MainLower | 1760      | Regional | Pre-Dev | 36.19             | 180.17           | 181.70           | 181.28           | 181.71           | 0.000735            | 0.54              | 105.78            | 254.64           | 0.18         |
| MainLower | 1760      | Regional | post    | 36.19             | 180.17           | 181.70           | 181.28           | 181.71           | 0.000853            | 0.58              | 96.89             | 153.01           | 0.19         |
| MainLower | 801       |          |         | Lat Struct        |                  |                  |                  |                  |                     |                   |                   |                  |              |
| MainLower | 785       | Regional | Pre-Dev | 30.96             | 179.60           | 181.70           | 180.42           | 181.70           | 0.000019            | 0.15              | 421.64            | 457.70           | 0.03         |
| MainLower | 785       | Regional | post    | 31.03             | 179.60           | 181.70           | 180.42           | 181.70           | 0.000019            | 0.15              | 423.13            | 449.00           | 0.03         |
| MainLower | 775       | Regional | Pre-Dev | 30.96             | 179.51           | 181.70           | 180.41           | 181.70           | 0.000020            | 0.15              | 418.14            | 413.00           | 0.03         |
| MainLower | 775       | Regional | post    | 31.03             | 179.51           | 181.70           | 180.41           | 181.70           | 0.000020            | 0.15              | 419.80            | 413.08           | 0.03         |
| MainLower | 755       |          |         | Culvert           |                  |                  |                  |                  |                     |                   |                   |                  |              |
| MainLower | 735       | Regional | Pre-Dev | 30.96             | 179.40           | 180.70           | 180.31           | 180.71           | 0.001123            | 0.53              | 126.25            | 824.51           | 0.16         |
| MainLower | 735       | Regional | post    | 31.03             | 179.40           | 180.70           | 180.32           | 180.71           | 0.001124            | 0.53              | 126.39            | 824.72           | 0.16         |
| MainLower | 590       | Regional | Pre-Dev | 30.96             | 179.30           | 180.54           | 180.25           | 180.54           | 0.001621            | 0.59              | 128.81            | 663.63           | 0.18         |
| MainLower | 590       | Regional | post    | 31.03             | 179.30           | 180.54           | 180.25           | 180.54           | 0.001622            | 0.59              | 128.98            | 663.88           | 0.18         |
| MainLower | 490       | Regional | Pre-Dev | 30.96             | 179.20           | 180.22           | 180.14           | 180.25           | 0.007071            | 1.14              | 53.84             | 439.81           | 0.38         |
| MainLower | 490       | Regional | post    | 31.03             | 179.20           | 180.22           | 180.14           | 180.25           | 0.007065            | 1.14              | 53.95             | 440.10           | 0.38         |
| MainLower | 450       | Regional | Pre-Dev | 30.96             | 179.13           | 179.98           | 179.76           | 180.00           | 0.005364            | 0.82              | 70.02             | 235.72           | 0.31         |
| MainLower | 450       | Regional | post    | 31.03             | 179.13           | 179.98           | 179.76           | 180.00           | 0.005367            | 0.82              | 70.14             | 235.93           | 0.31         |
| MainLower | 410       | Regional | Pre-Dev | 30.96             | 178.10           | 179.15           | 179.15           | 179.24           | 0.023244            | 1.94              | 38.84             | 202.39           | 0.67         |
| MainLower | 410       | Regional | post    | 31.03             | 178.10           | 179.15           | 179.15           | 179.24           | 0.023246            | 1.94              | 38.92             | 202.60           | 0.67         |
| MainLower | 320       | Regional | Pre-Dev | 30.96             | 177.20           | 178.18           |                  | 178.19           | 0.002517            | 0.66              | 94.23             | 235.73           | 0.22         |
| MainLower | 320       | Regional | post    | 31.03             | 177.20           | 178.18           |                  | 178.19           | 0.002519            | 0.66              | 94.35             | 235.85           | 0.22         |
| MainLower | 222       | Regional | Pre-Dev | 30.96             | 177.10           | 177.94           |                  | 177.96           | 0.007271            | 0.97              | 76.67             | 312.36           | 0.37         |
| MainLower | 222       | Regional | post    | 31.03             | 177.10           | 177.94           |                  | 177.96           | 0.007265            | 0.97              | 76.84             | 312.72           | 0.37         |
| MainLower | 155       | Regional | Pre-Dev | 30.96             | 176.70           | 177.69           |                  | 177.70           | 0.002199            | 0.62              | 103.97            | 342.65           | 0.21         |
| MainLower | 155       | Regional | post    | 31.03             | 176.70           | 177.69           |                  | 177.70           | 0.002200            | 0.62              | 104.14            | 342.98           | 0.21         |
| MainLower | 5         | Regional | Pre-Dev | 30.96             | 176.00           | 177.12           | 177.12           | 177.21           | 0.015852            | 1.64              | 44.44             | 267.01           | 0.55         |

## SILVER CREEK MAIN CHANNEL

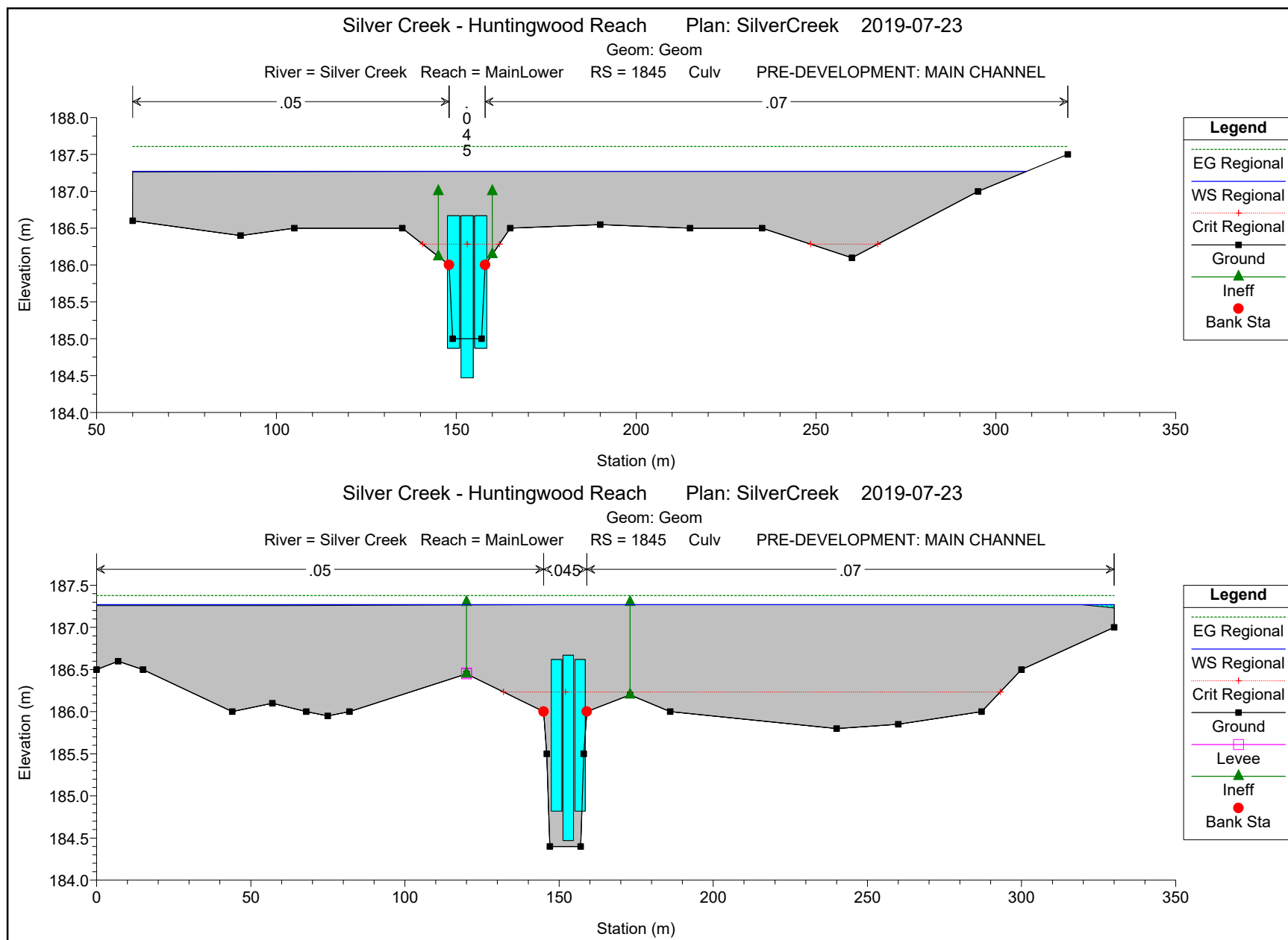
HEC-RAS River: Silver Creek Reach: MainLower Profile: Regional (Continued)

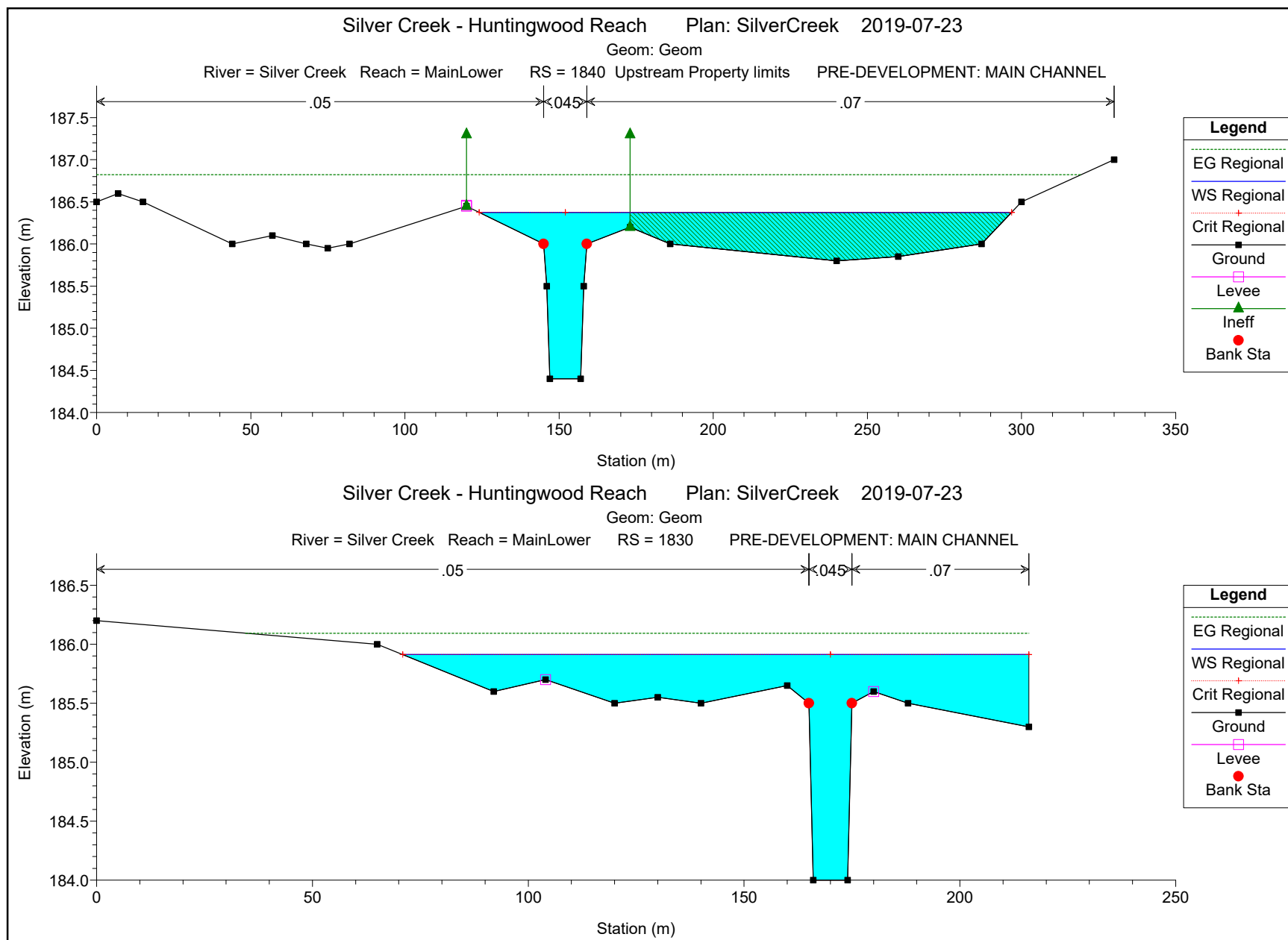
| Reach     | River Sta | Profile  | Plan | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|-----------|-----------|----------|------|---------|-----------|-----------|-----------|-----------|------------|----------|-----------|-----------|--------------|
|           |           |          |      | (m3/s)  | (m)       | (m)       | (m)       | (m)       | (m/m)      | (m/s)    | (m2)      | (m)       |              |
| MainLower | 5         | Regional | post | 31.03   | 176.00    | 177.12    | 177.12    | 177.21    | 0.015870   | 1.64     | 44.52     | 267.19    | 0.55         |

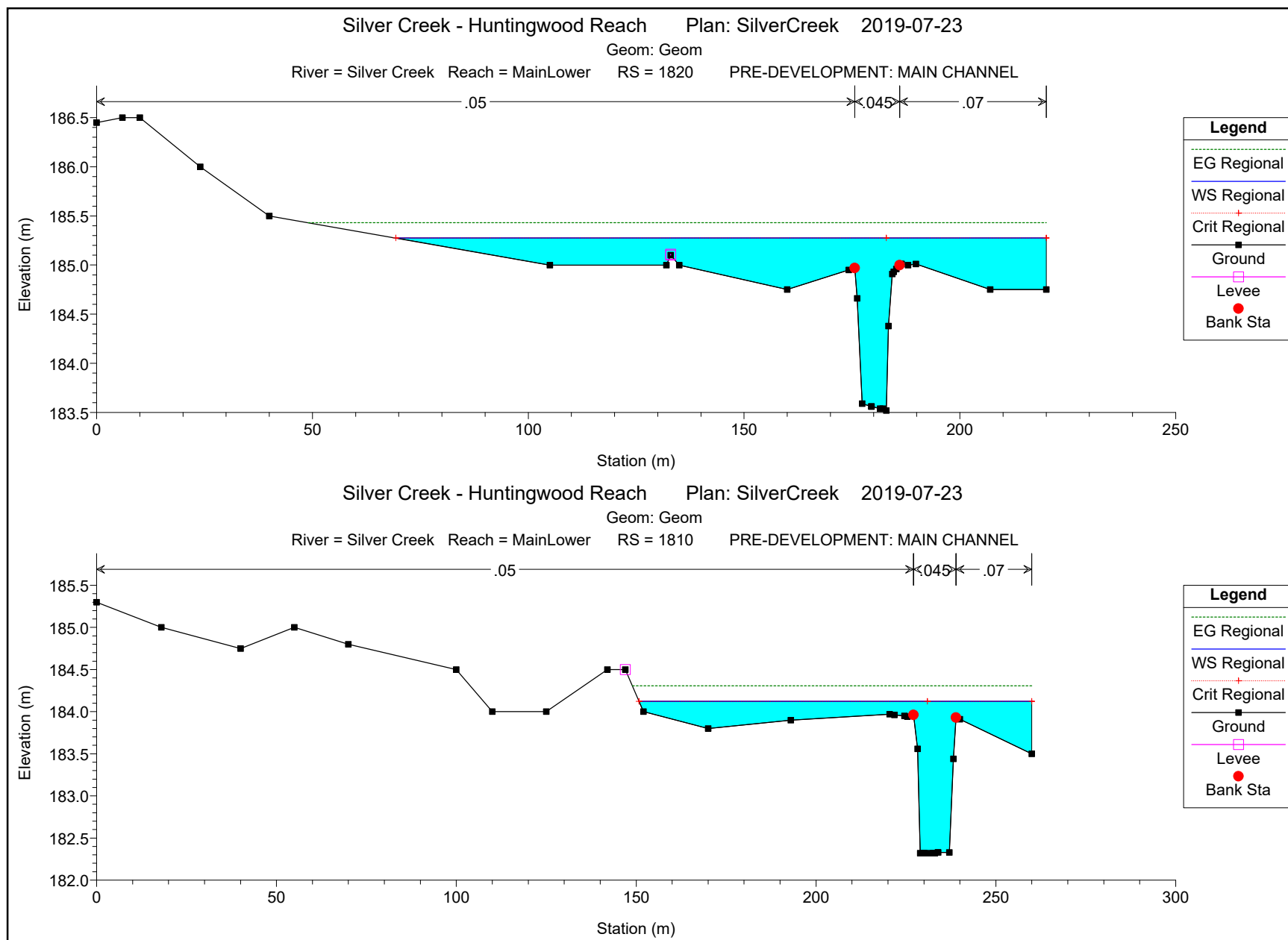
## SILVER CREEK MAIN CHANNEL - PRE-DEVELOPMENT

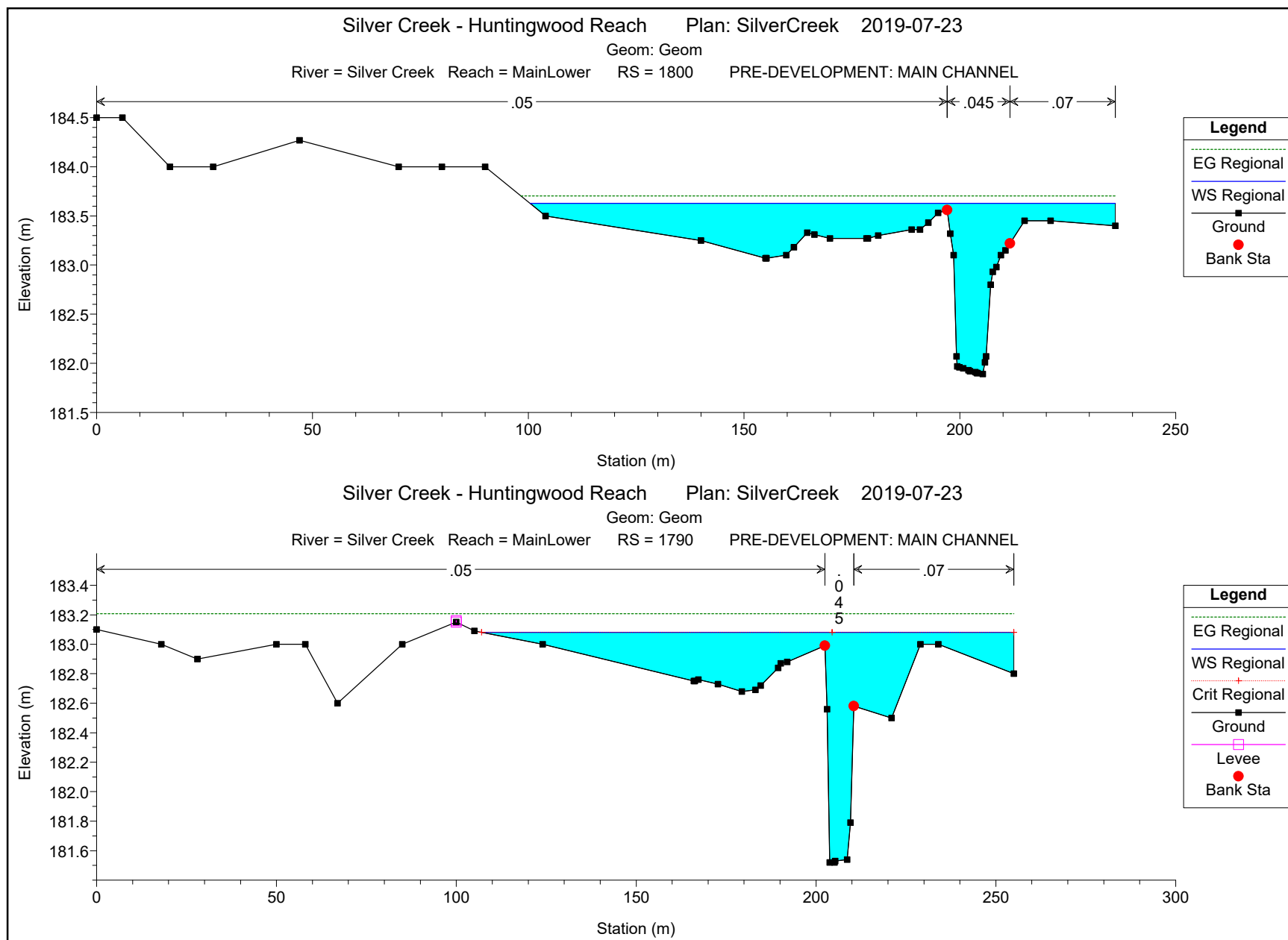


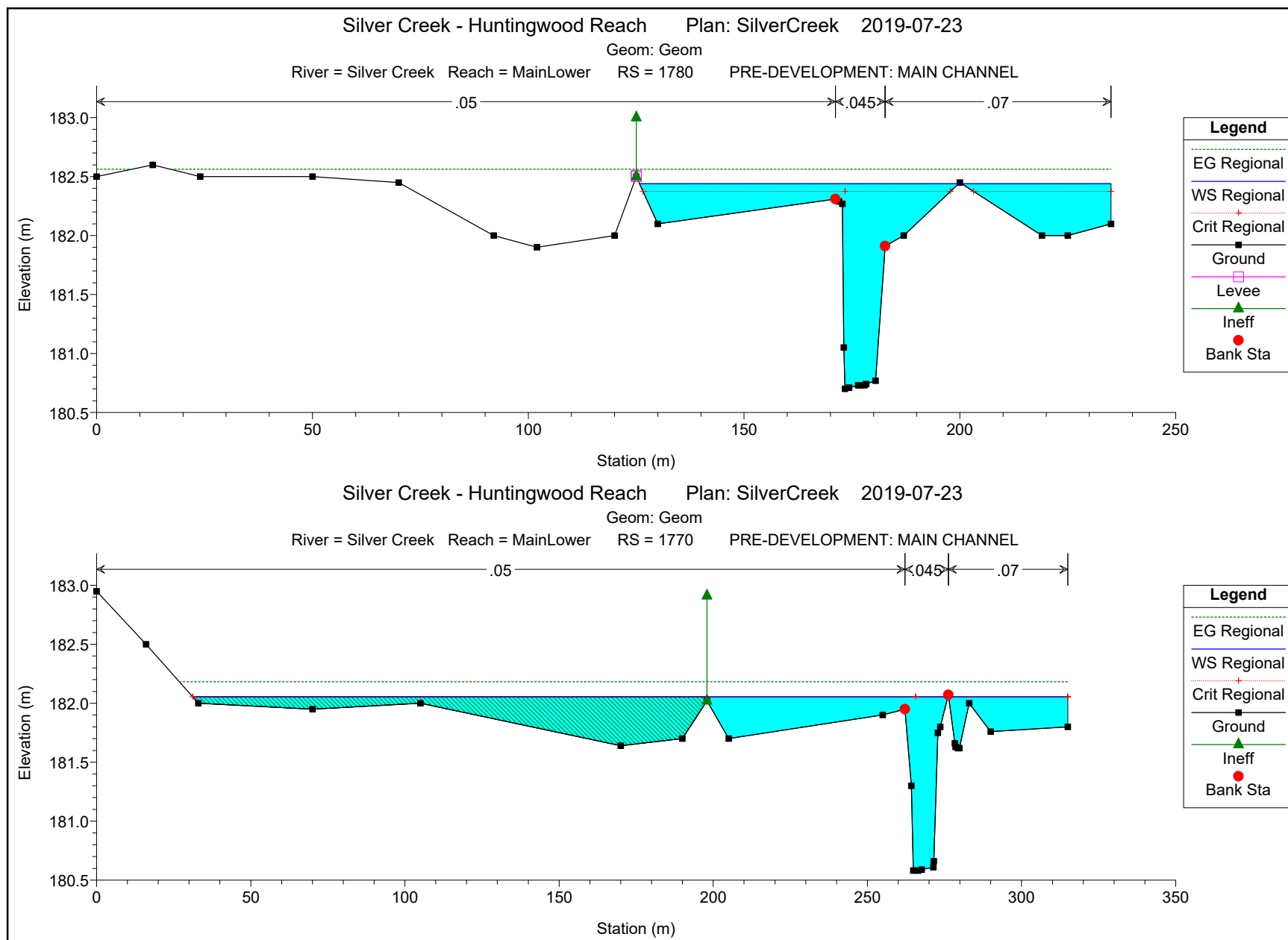


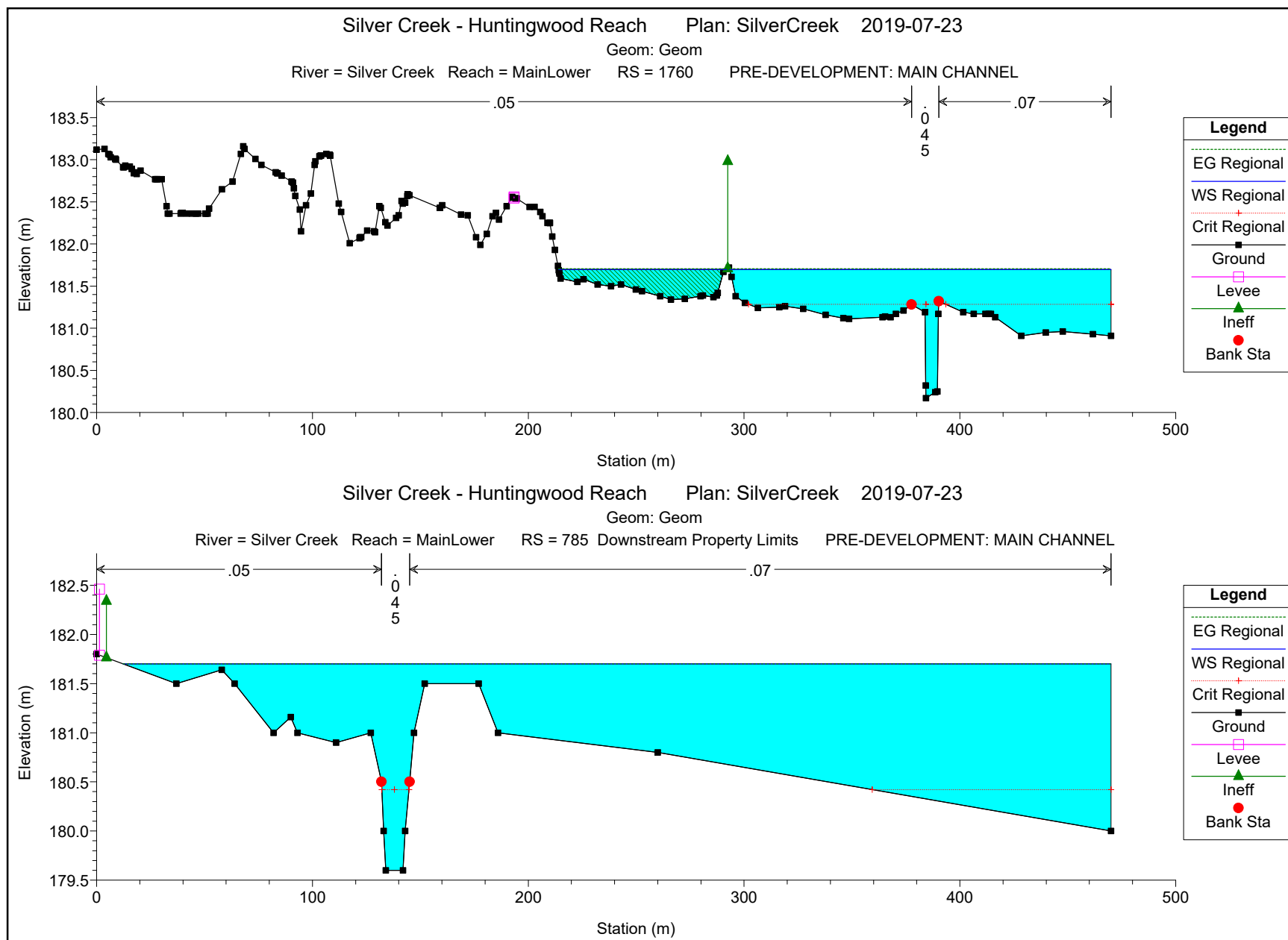


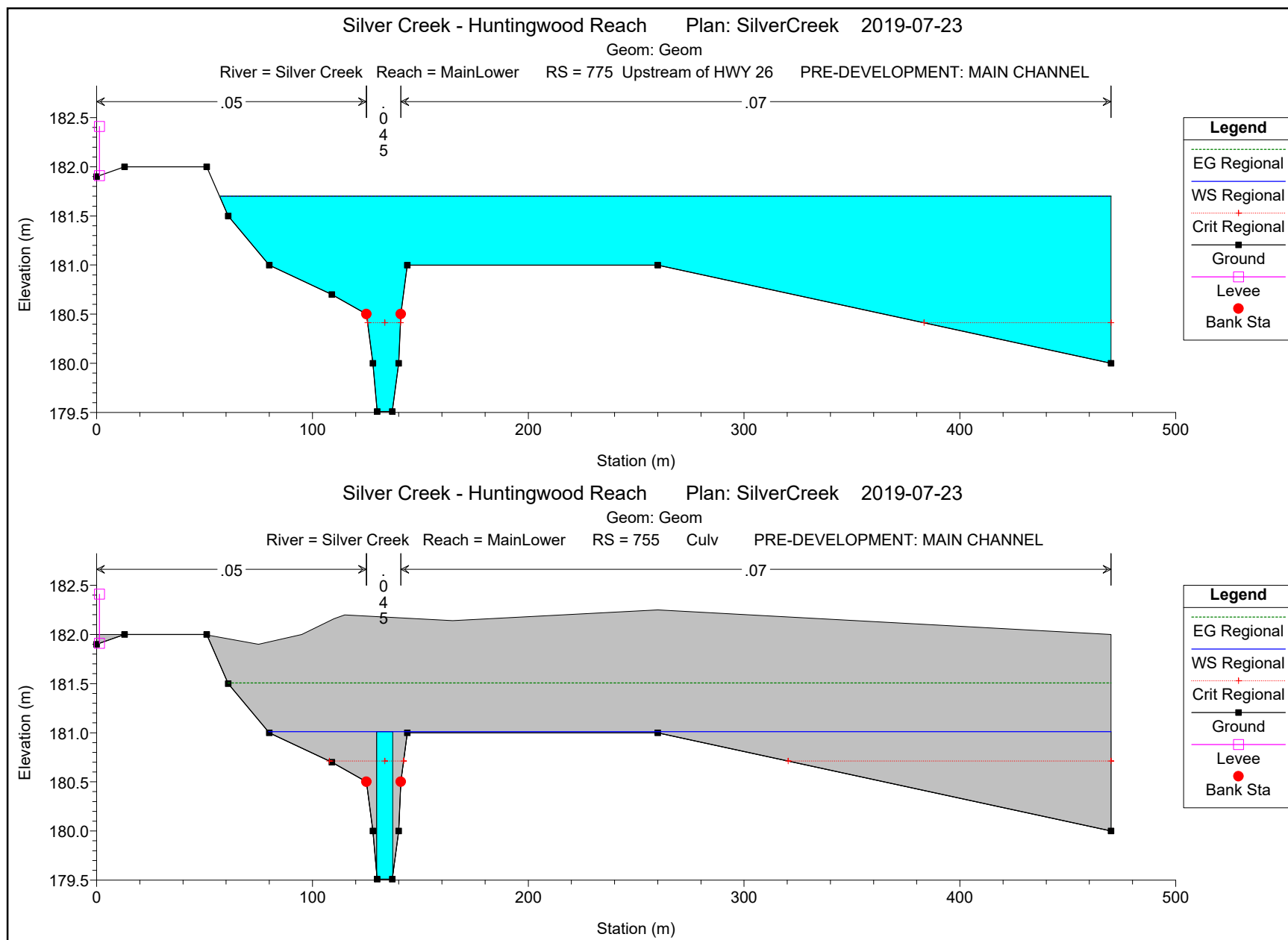


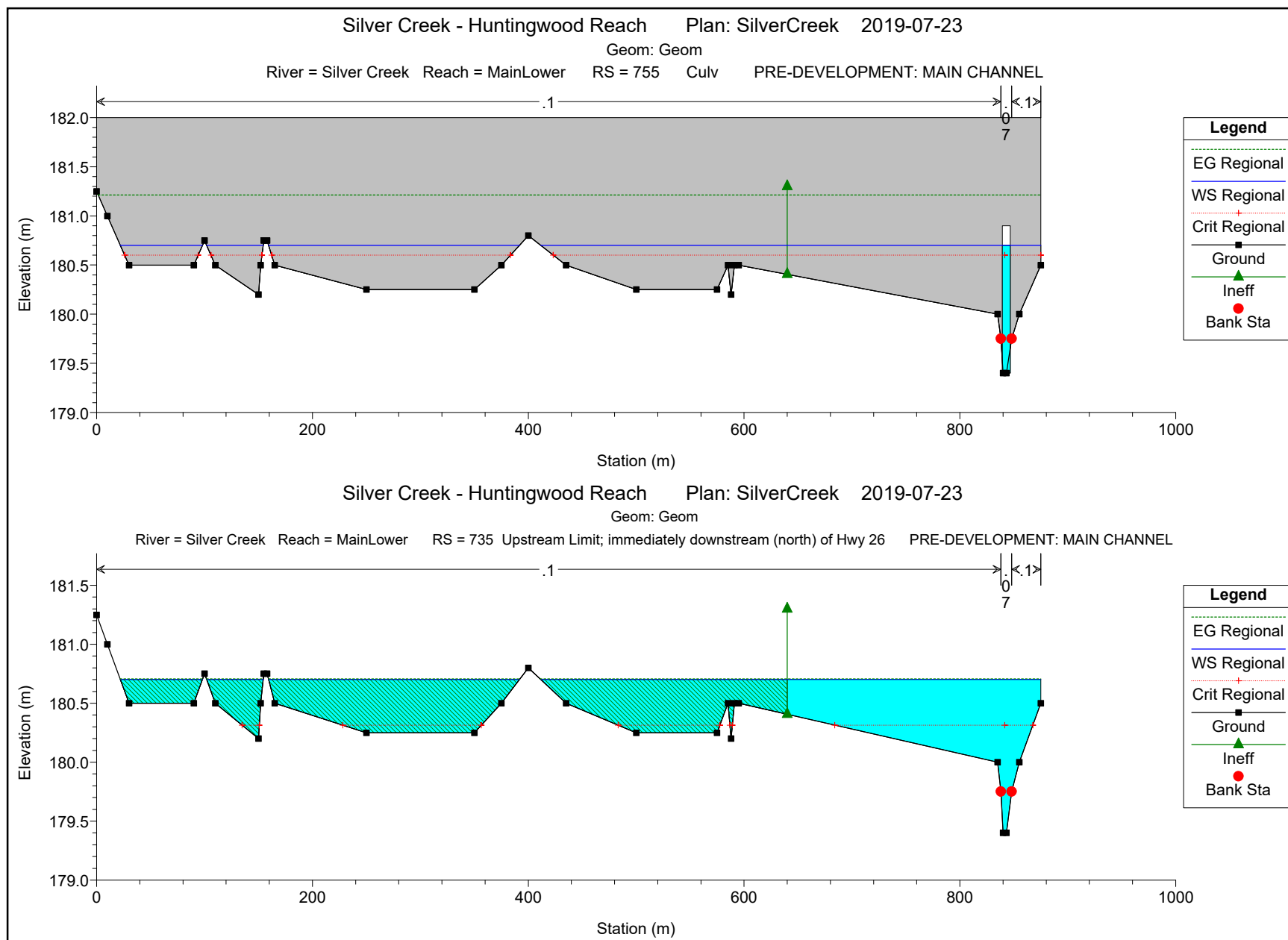




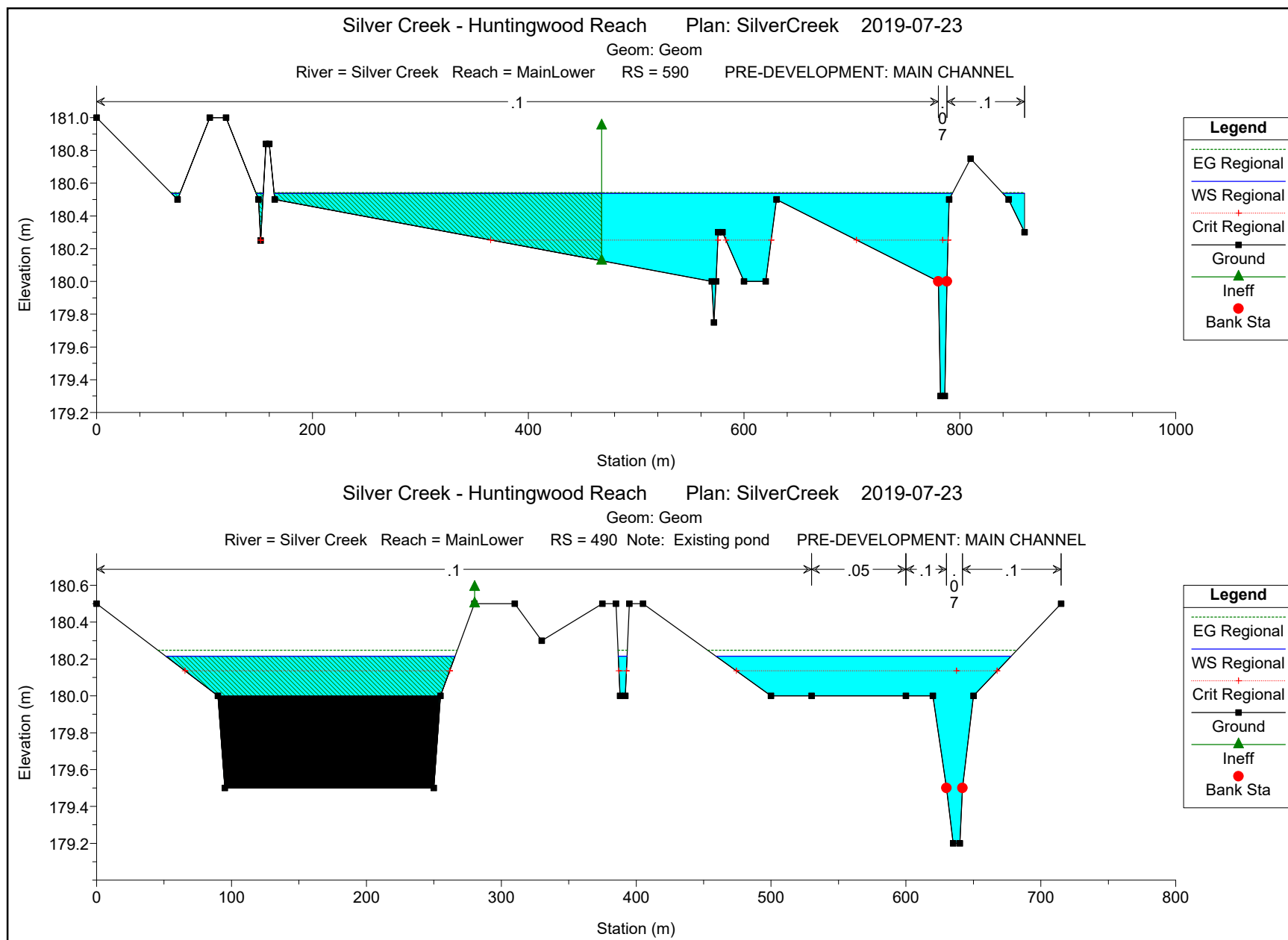


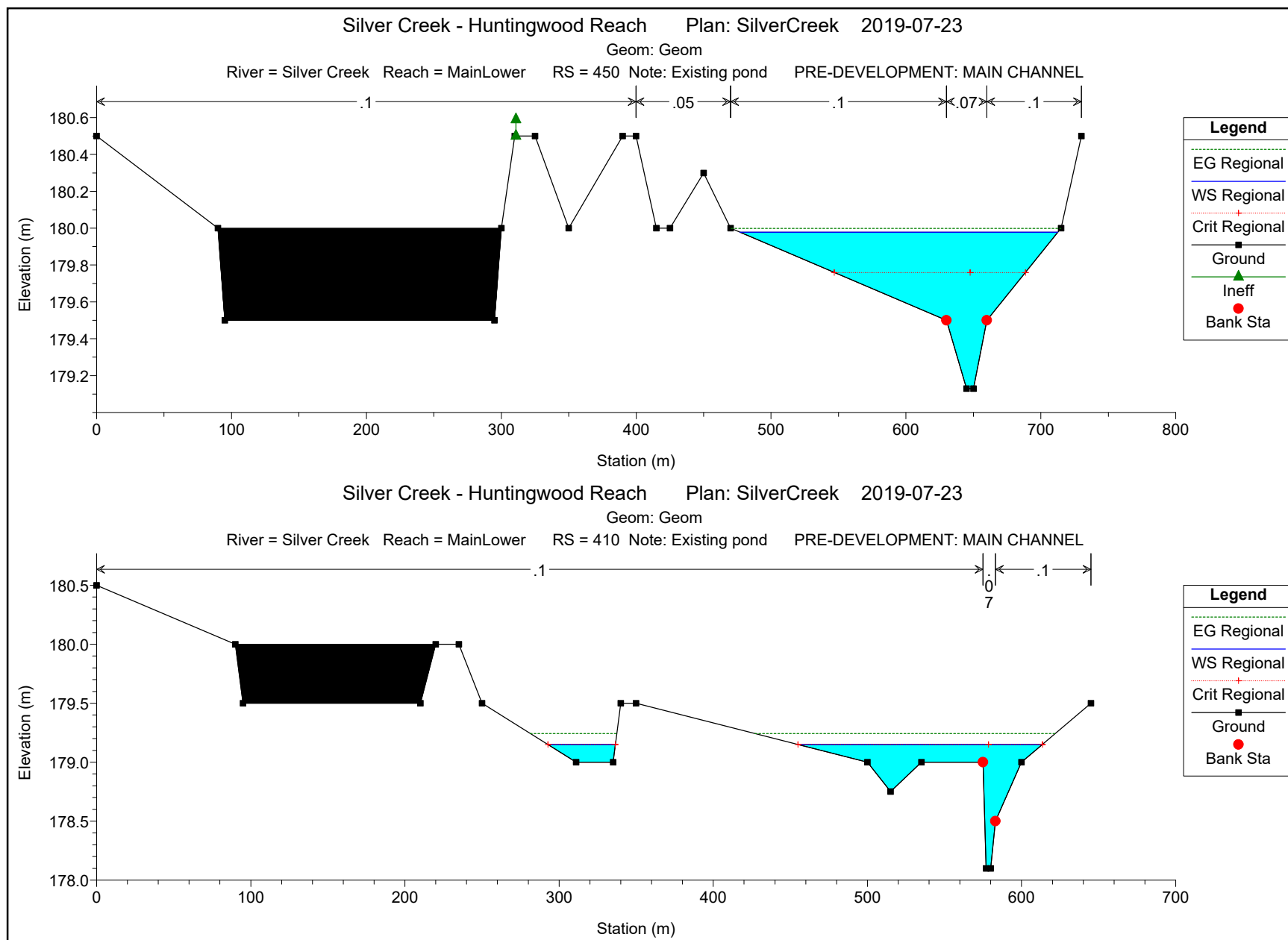


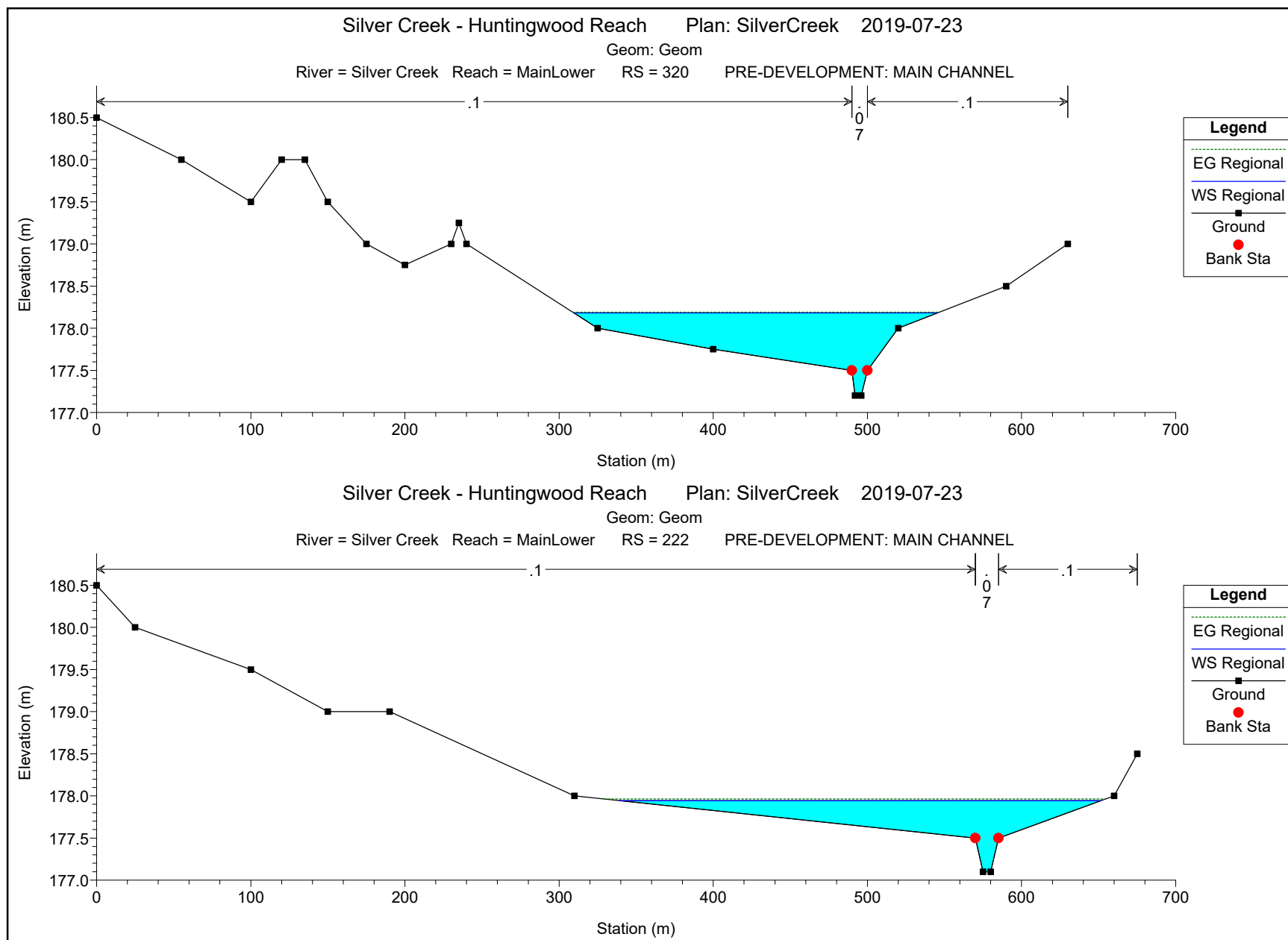


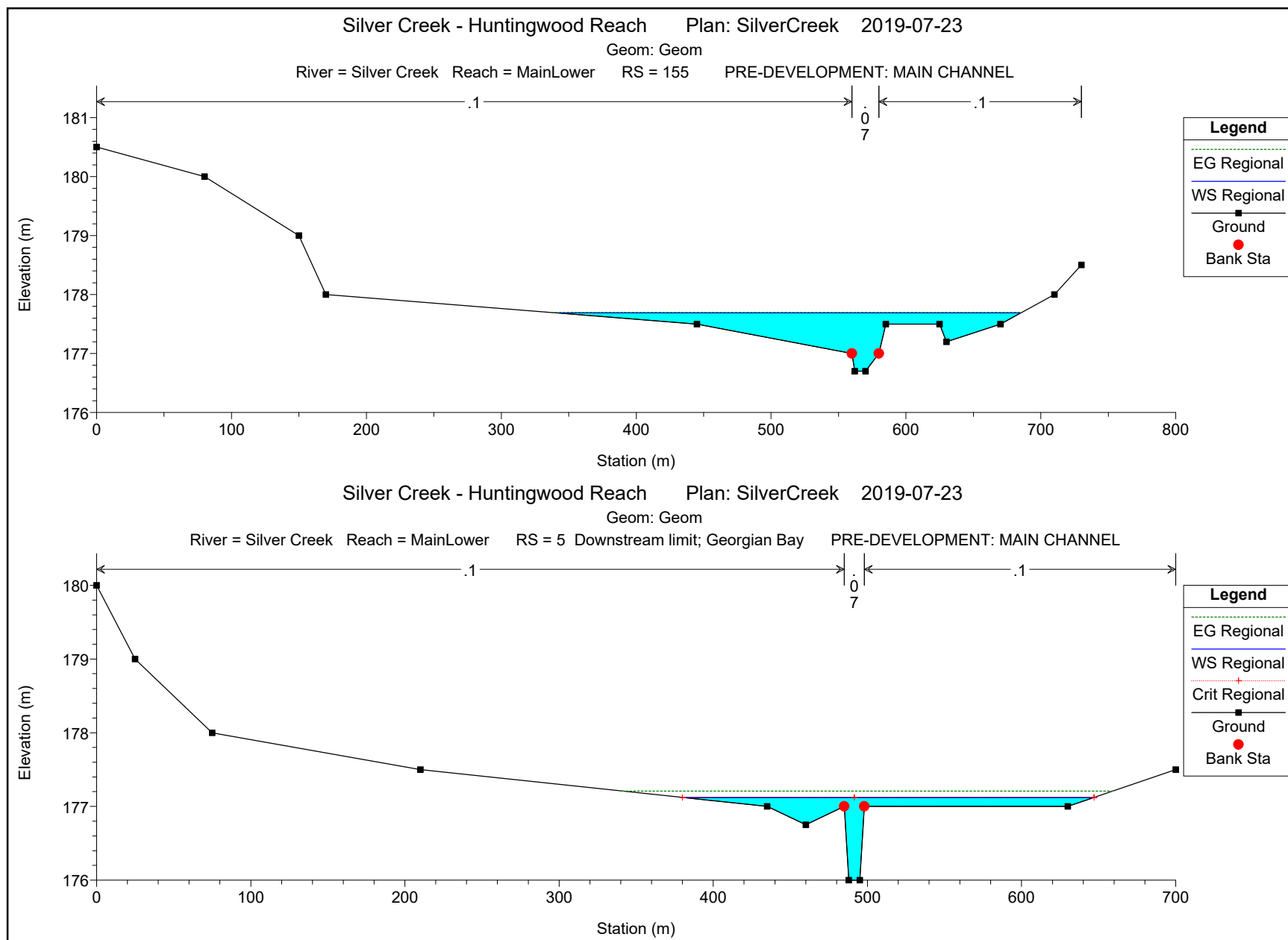




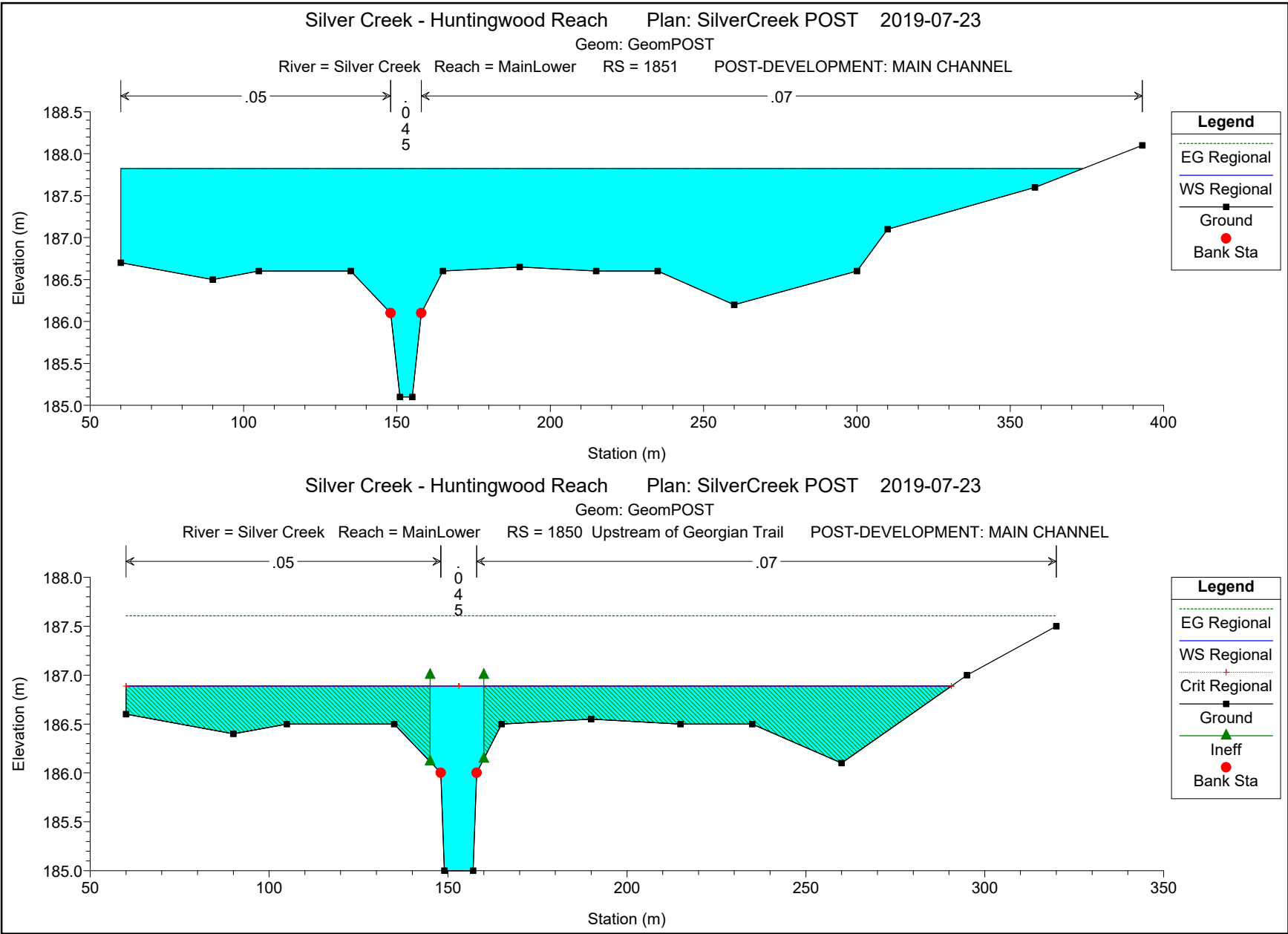


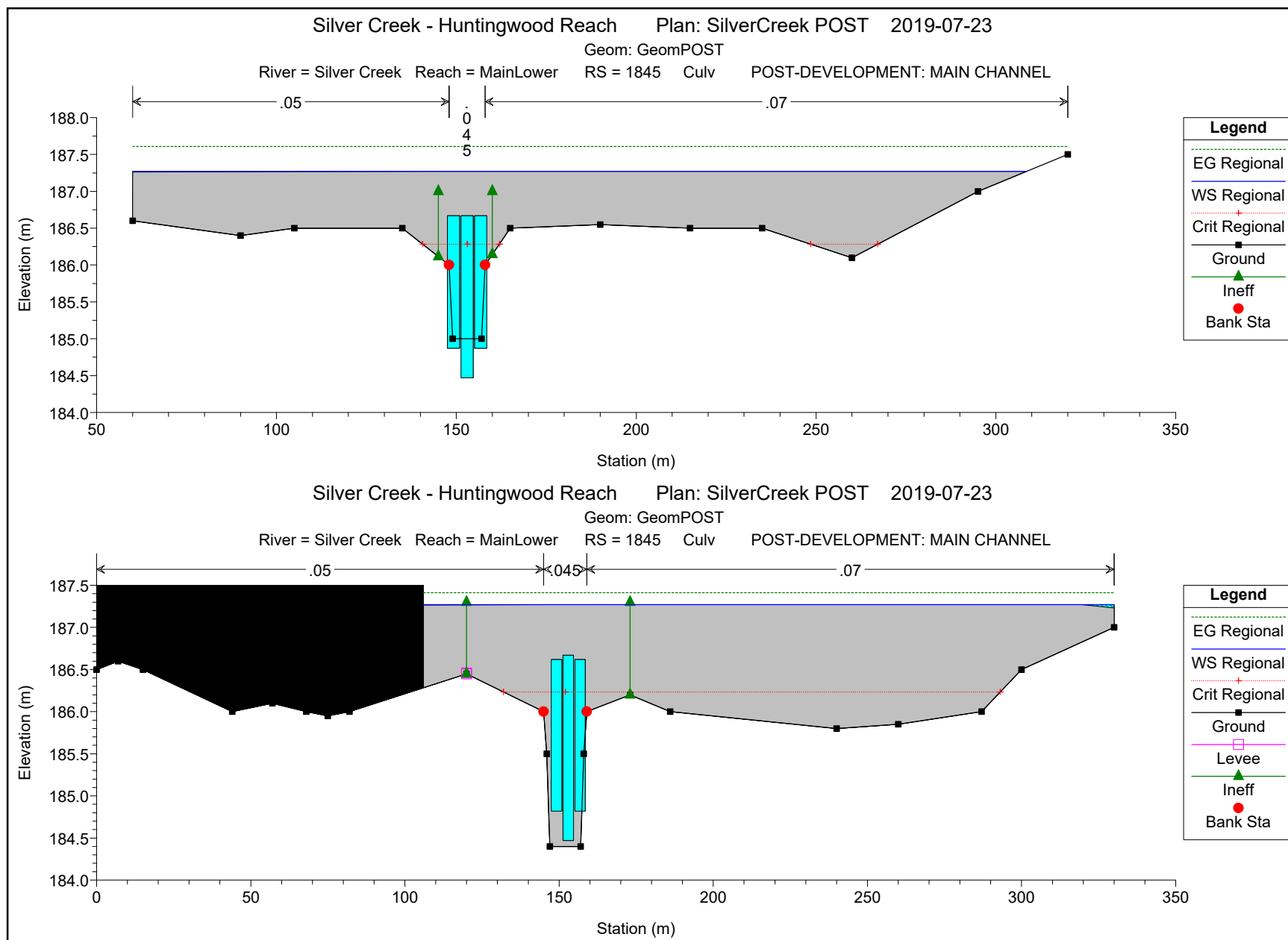


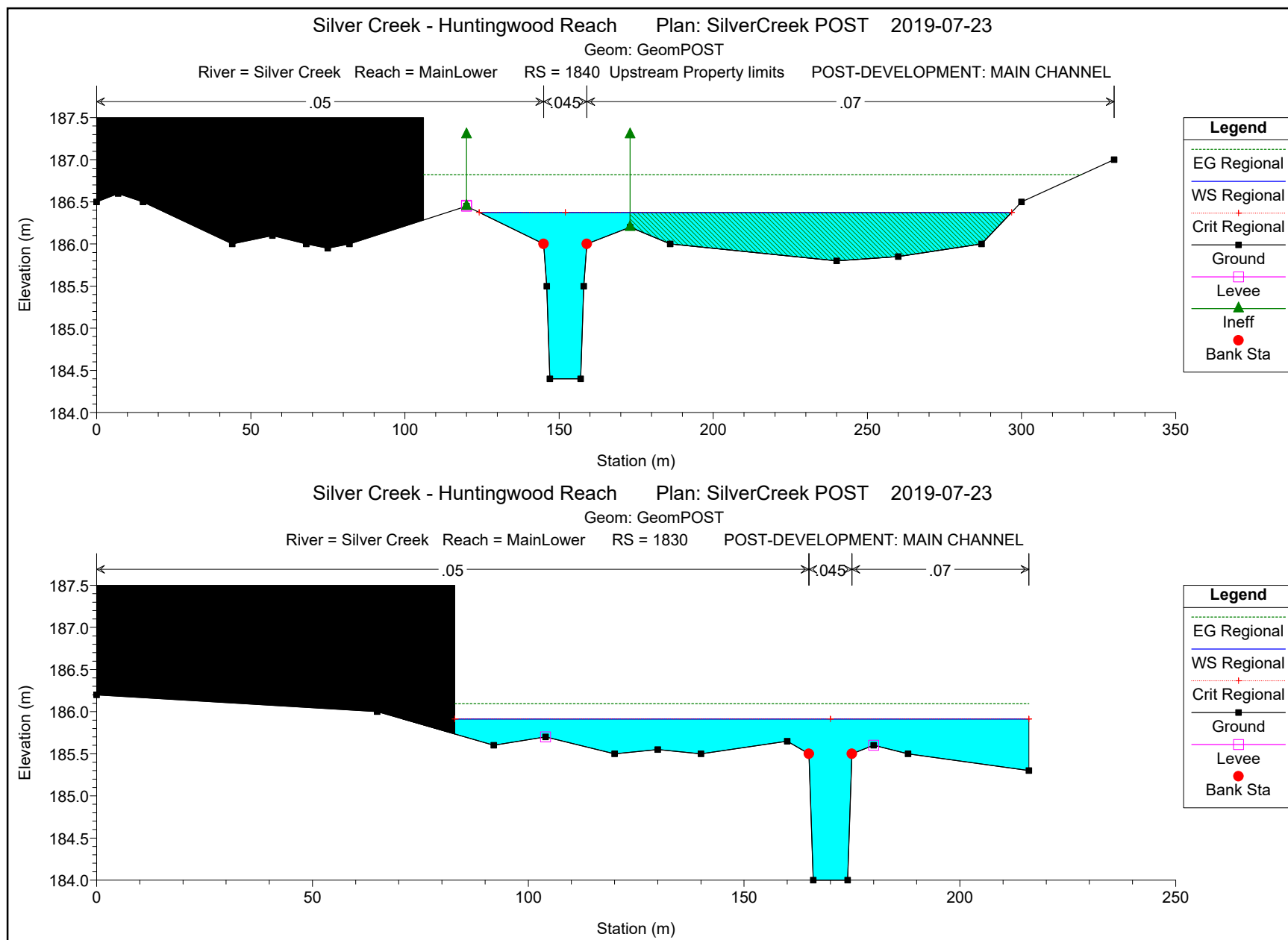


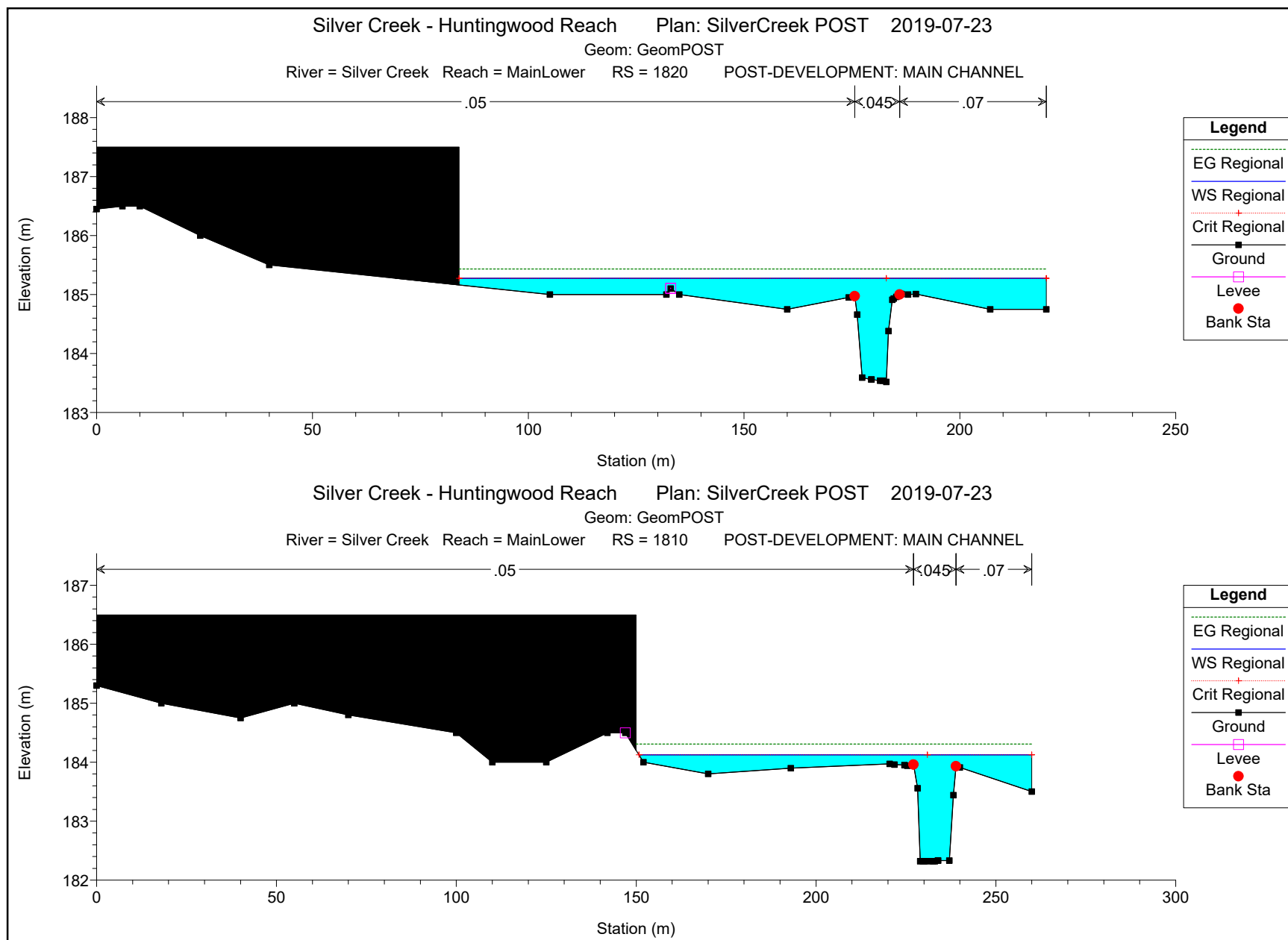


SILVER CREEK MAIN CHANNEL - POST-DEVELOPMENT

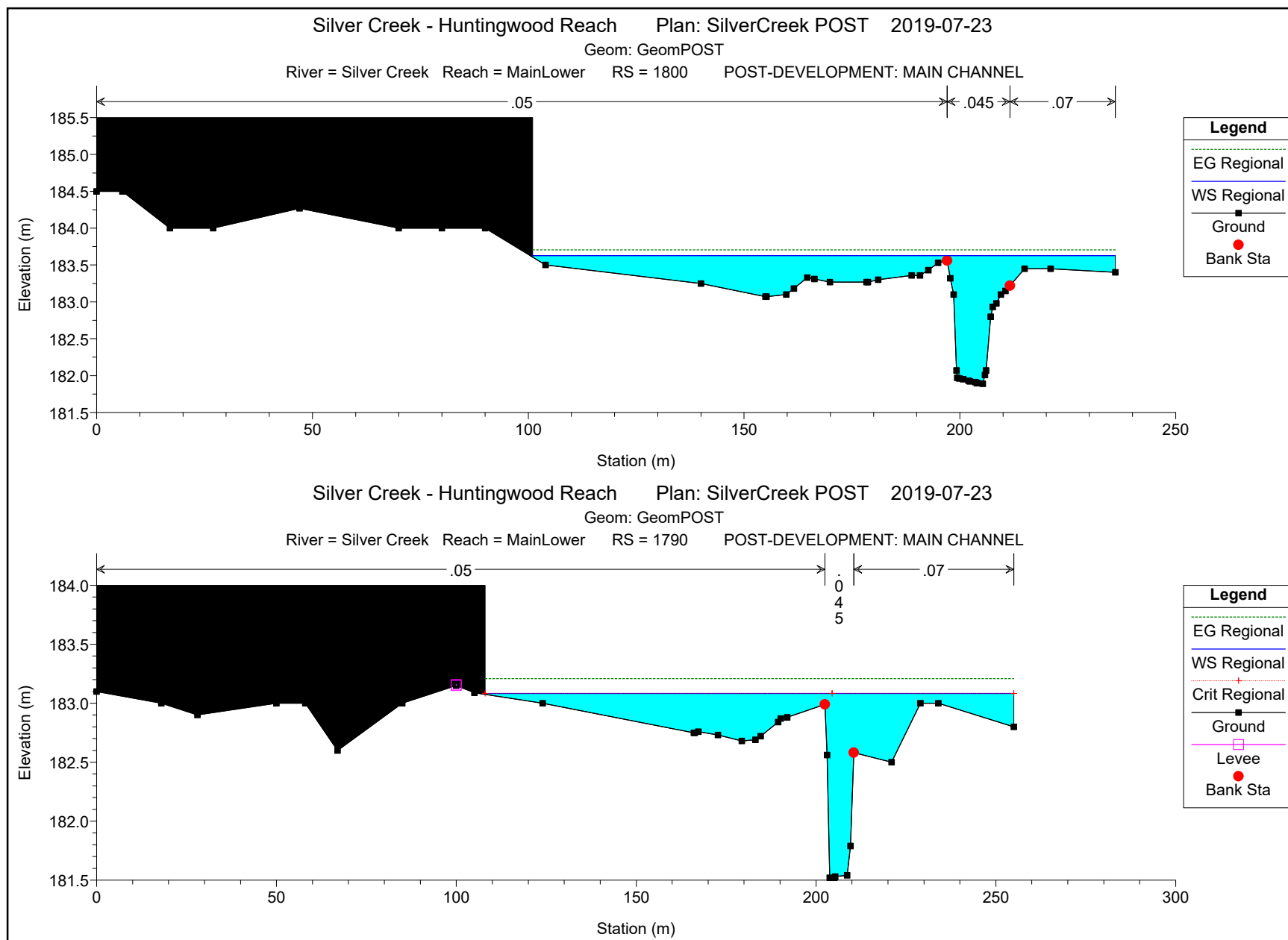


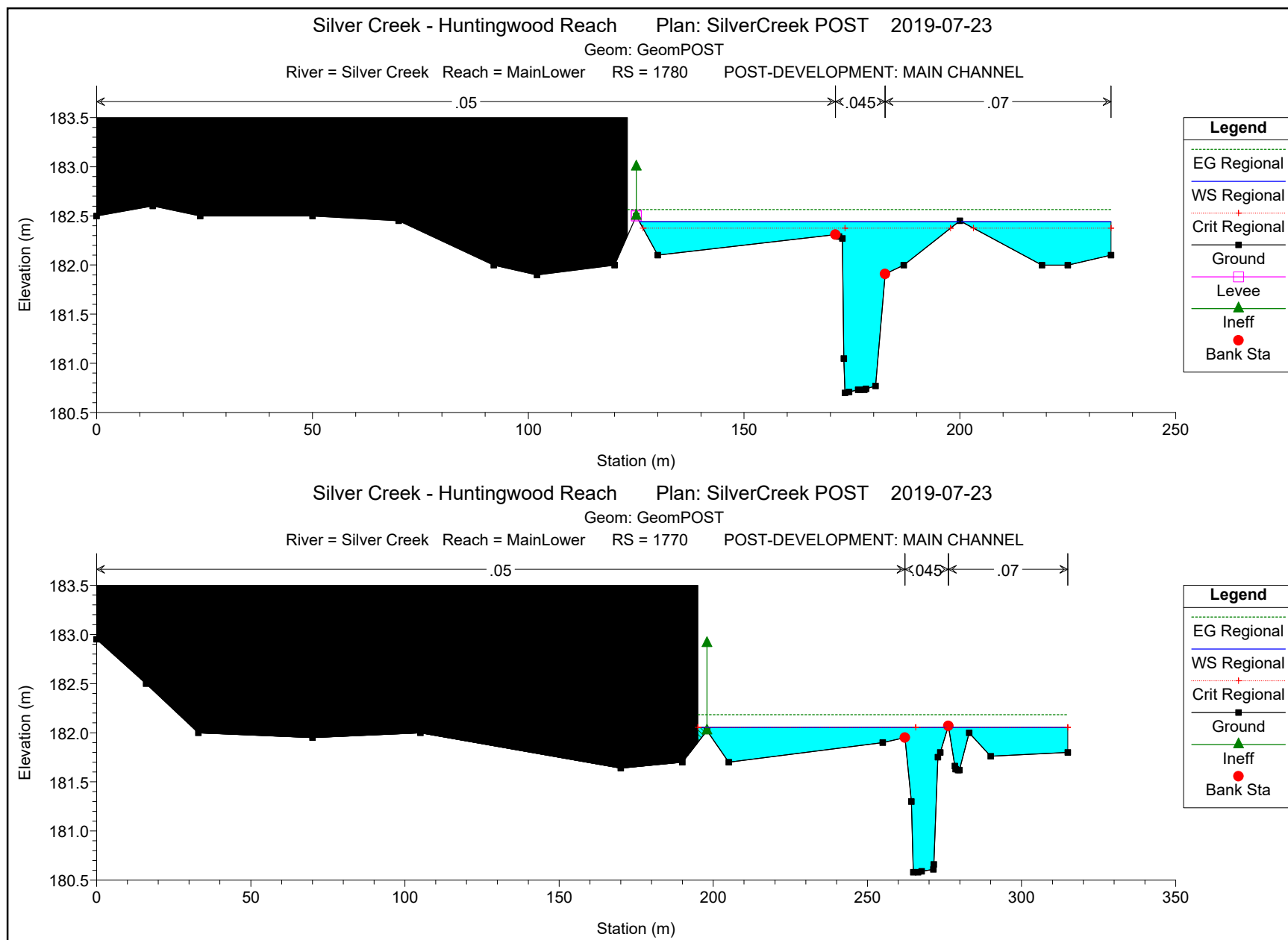


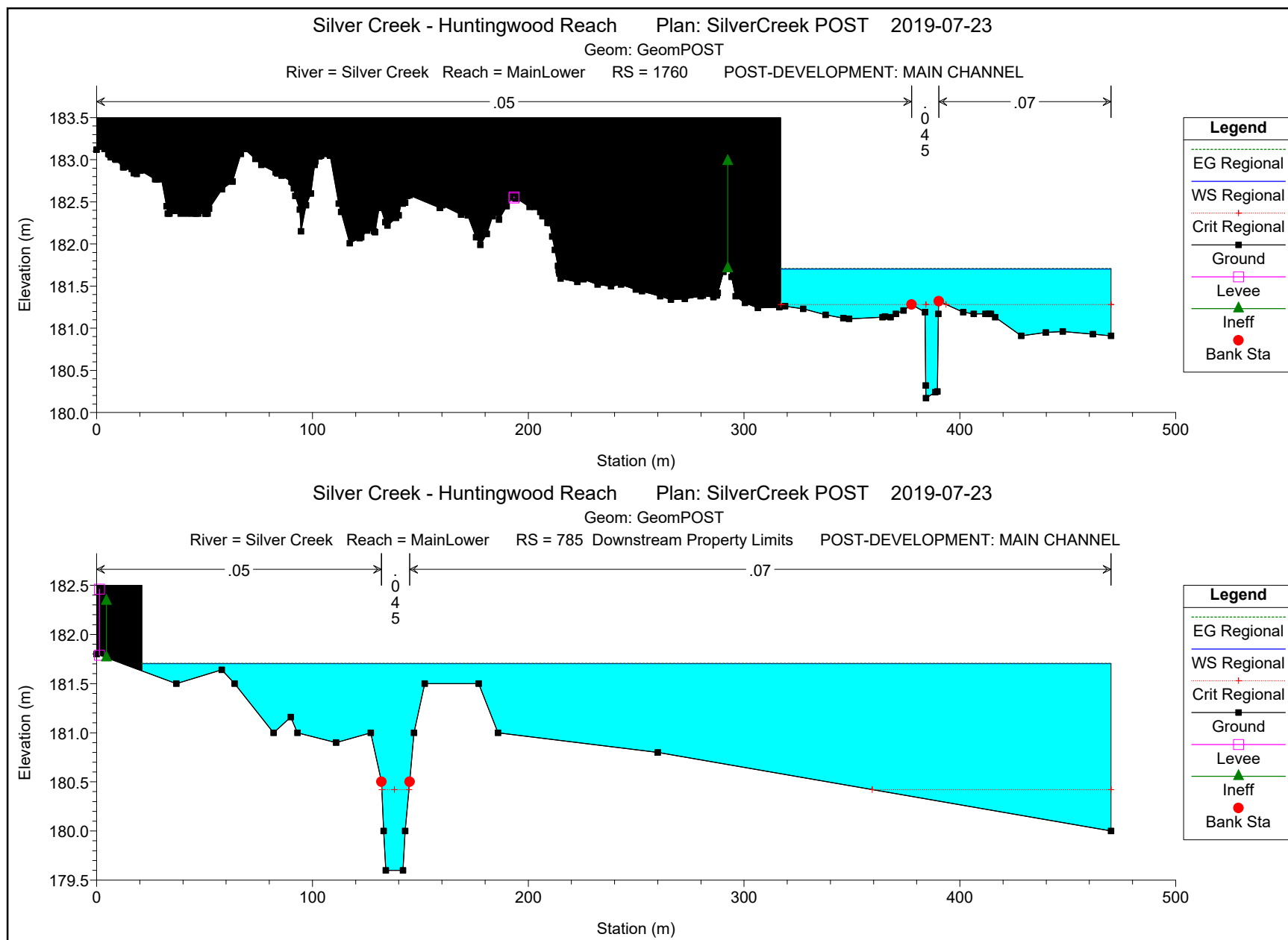


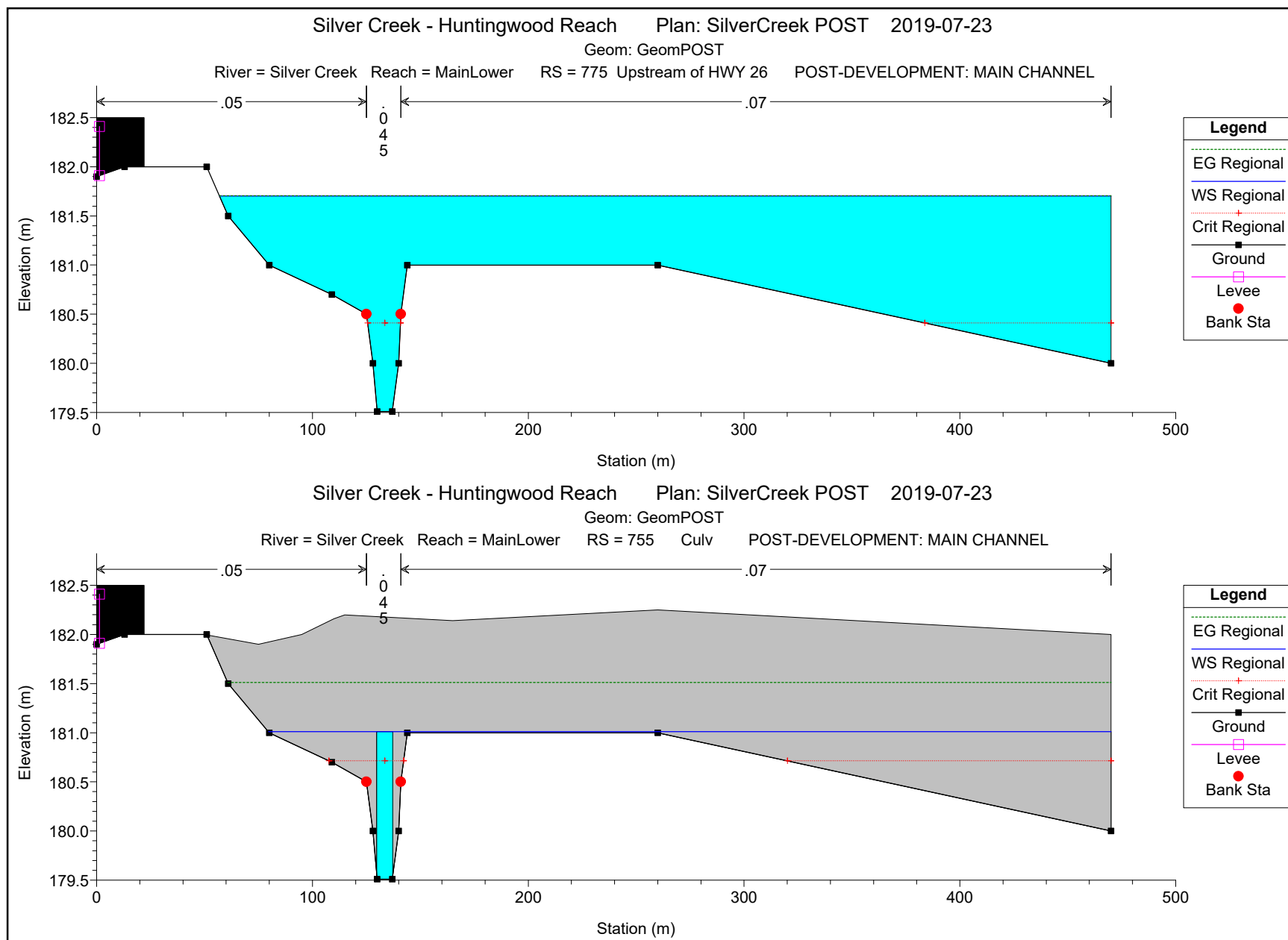


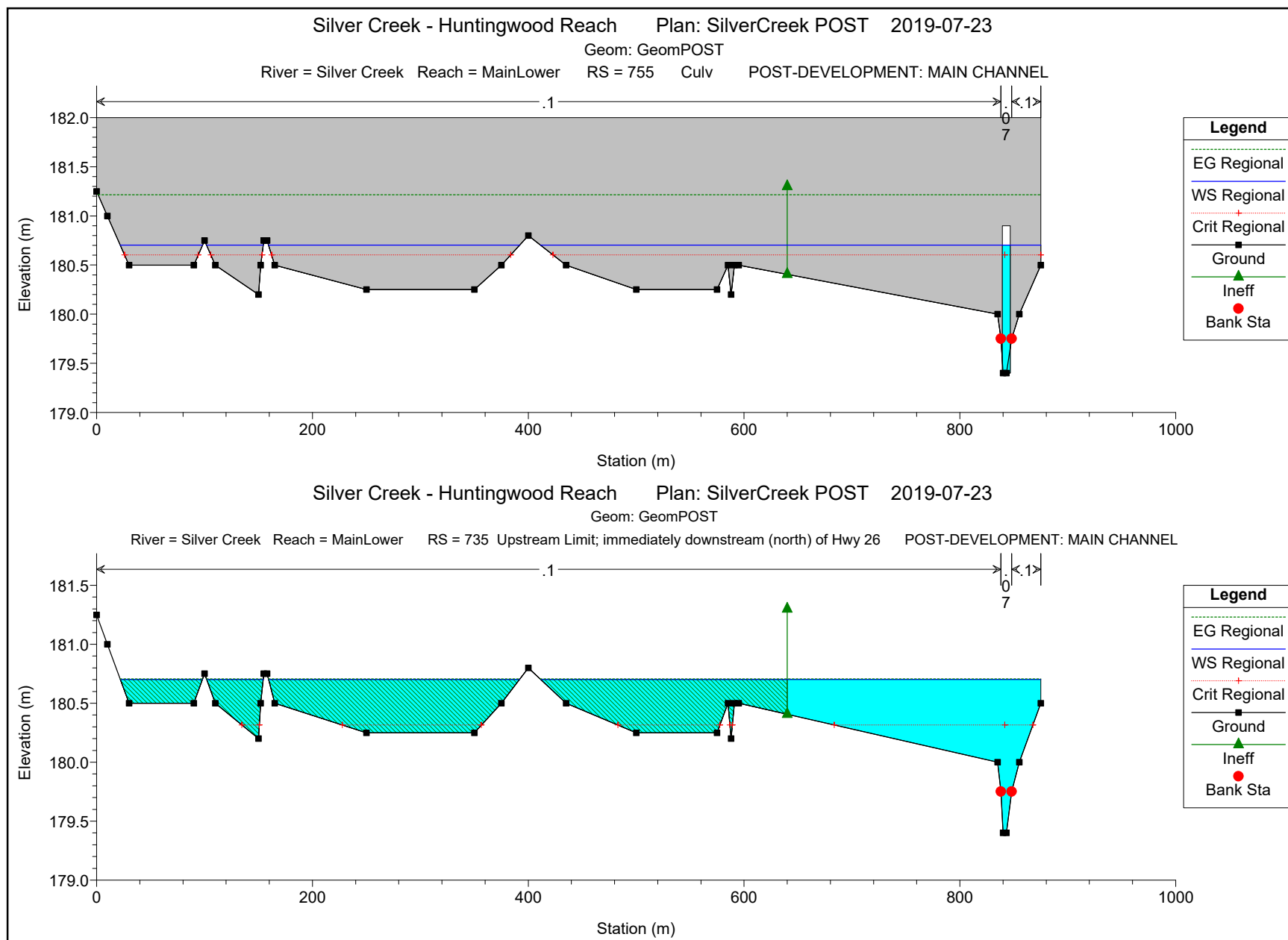


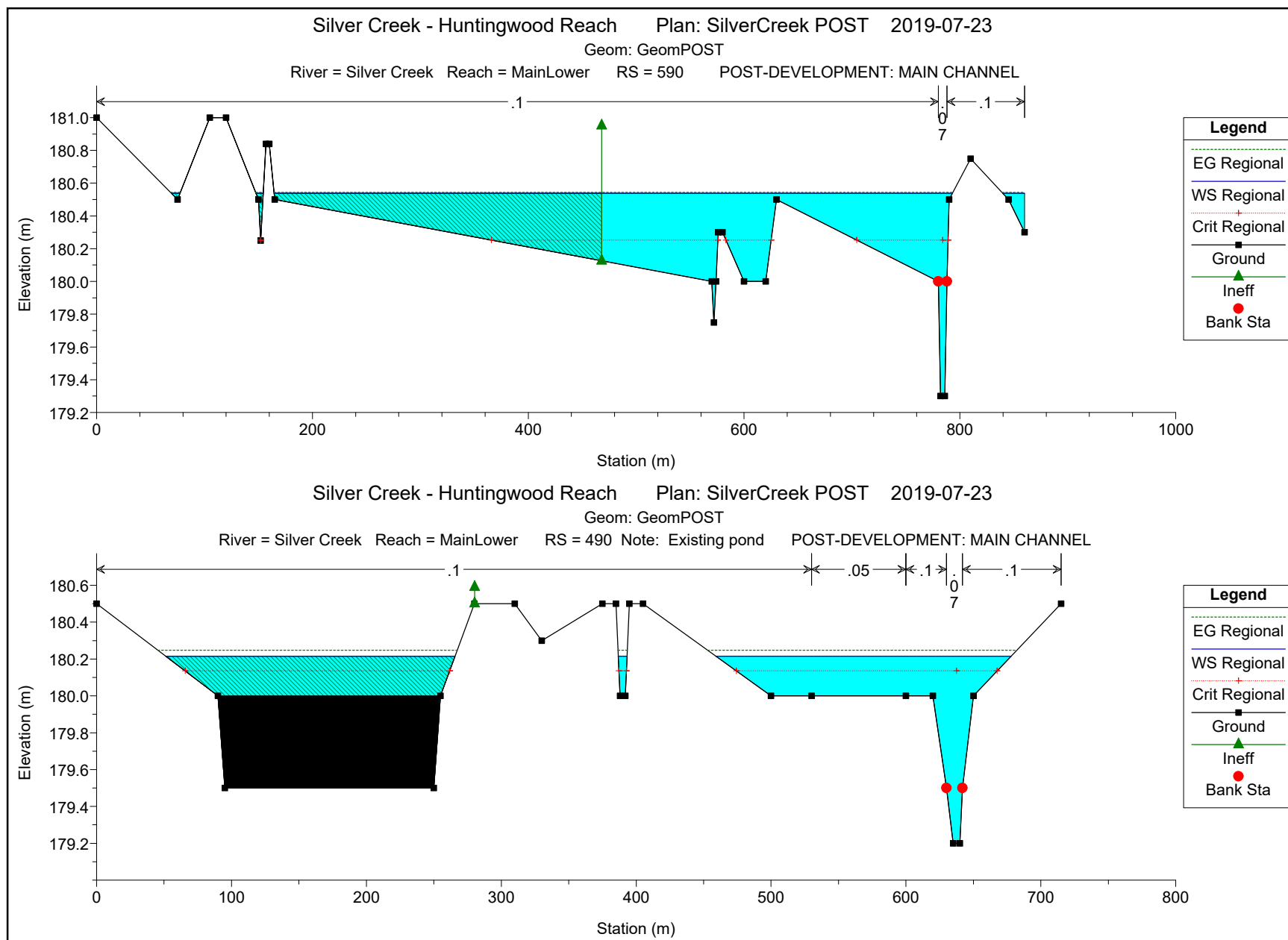


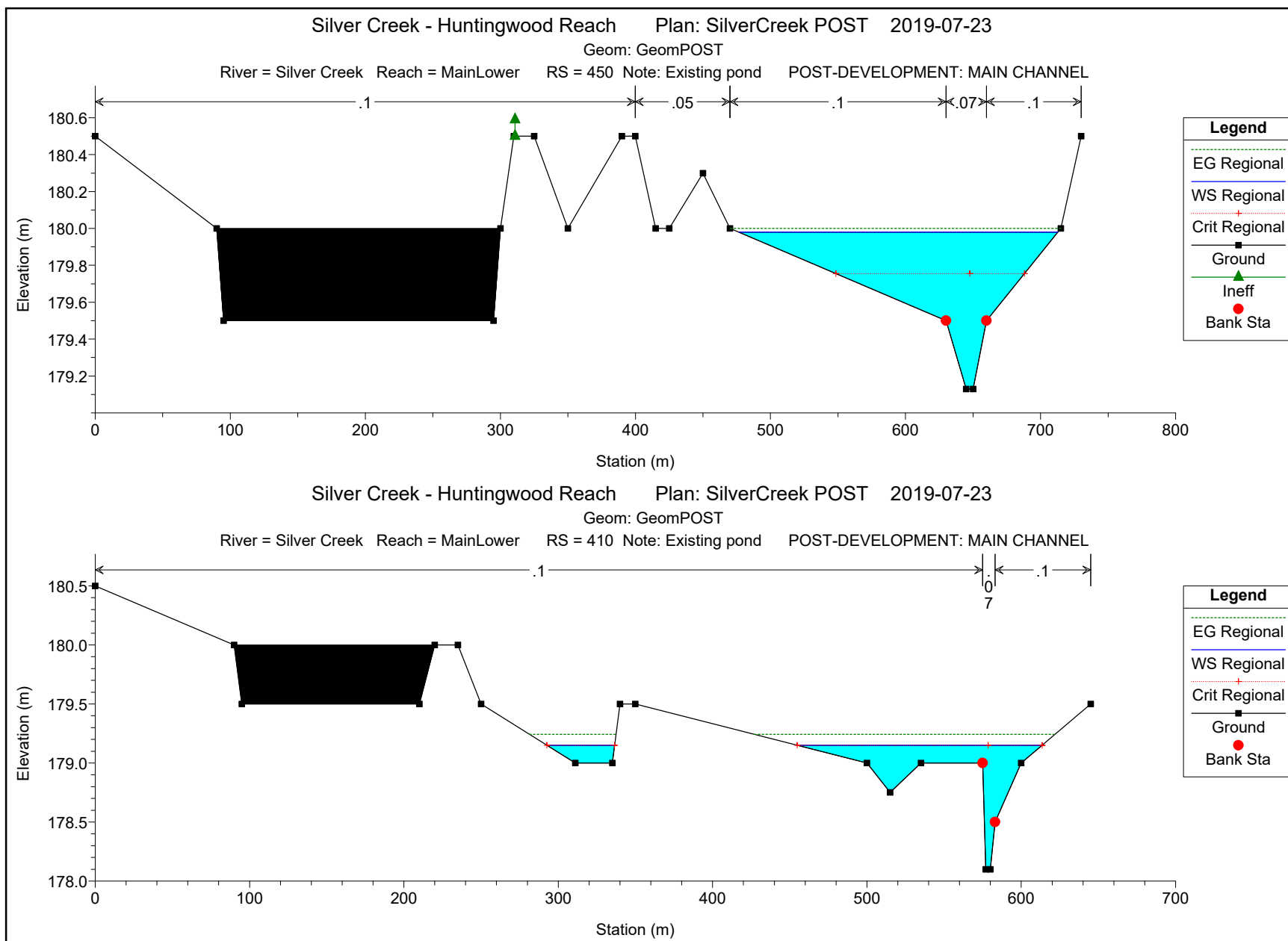


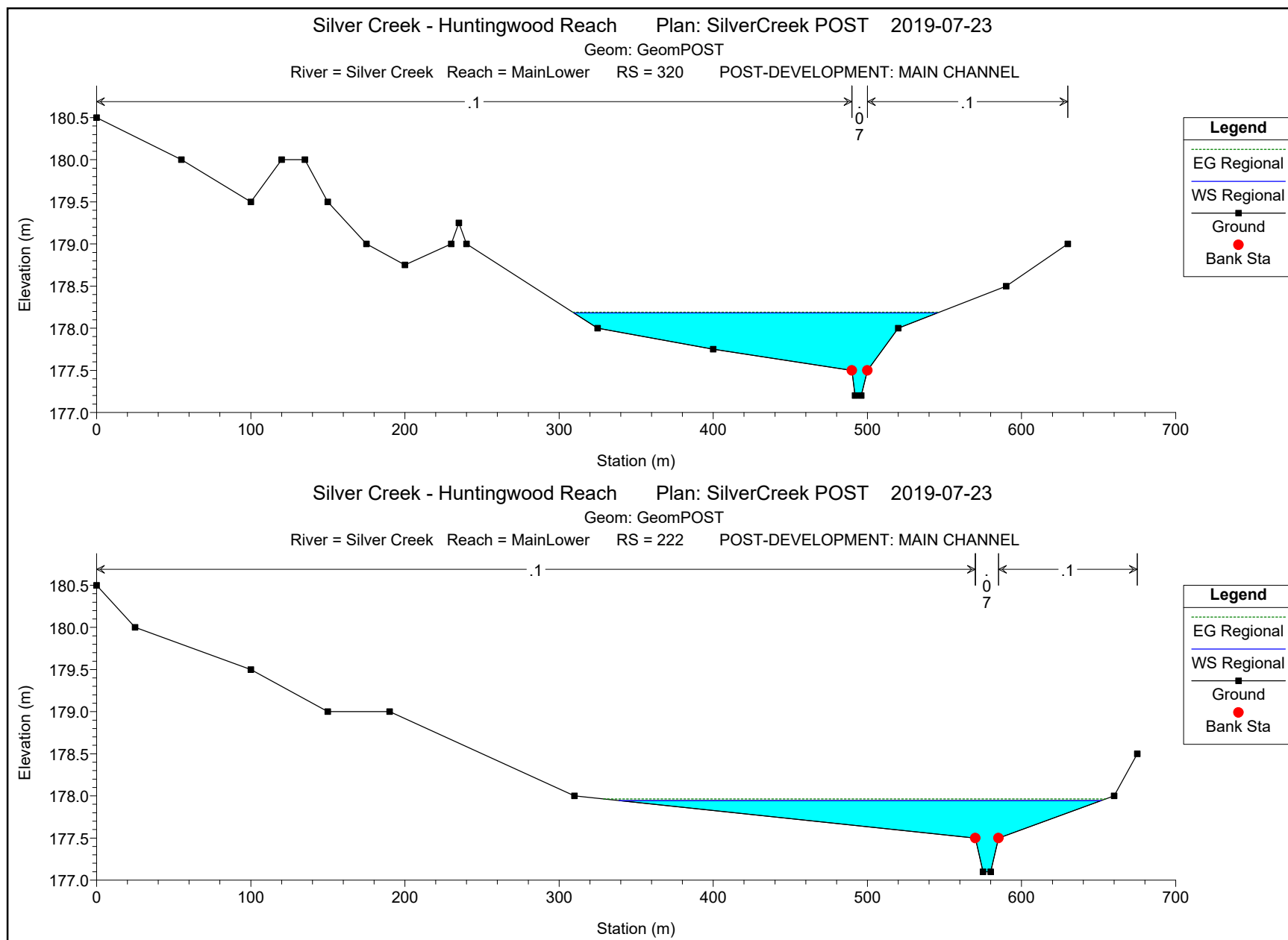




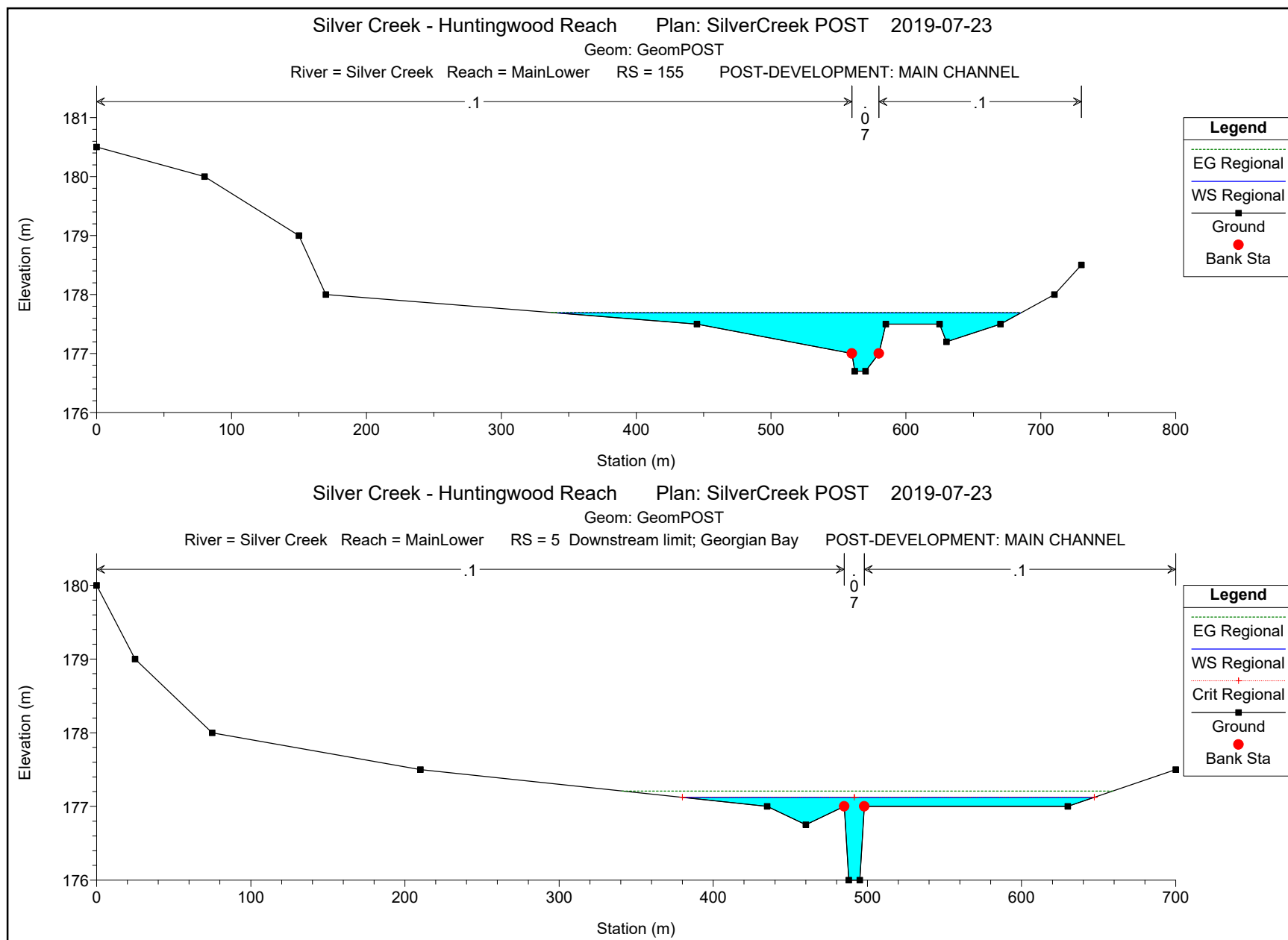












# SPILL ZONE B

HEC-RAS River: RIVER-1 Reach: Reach-1 Profile: Regional

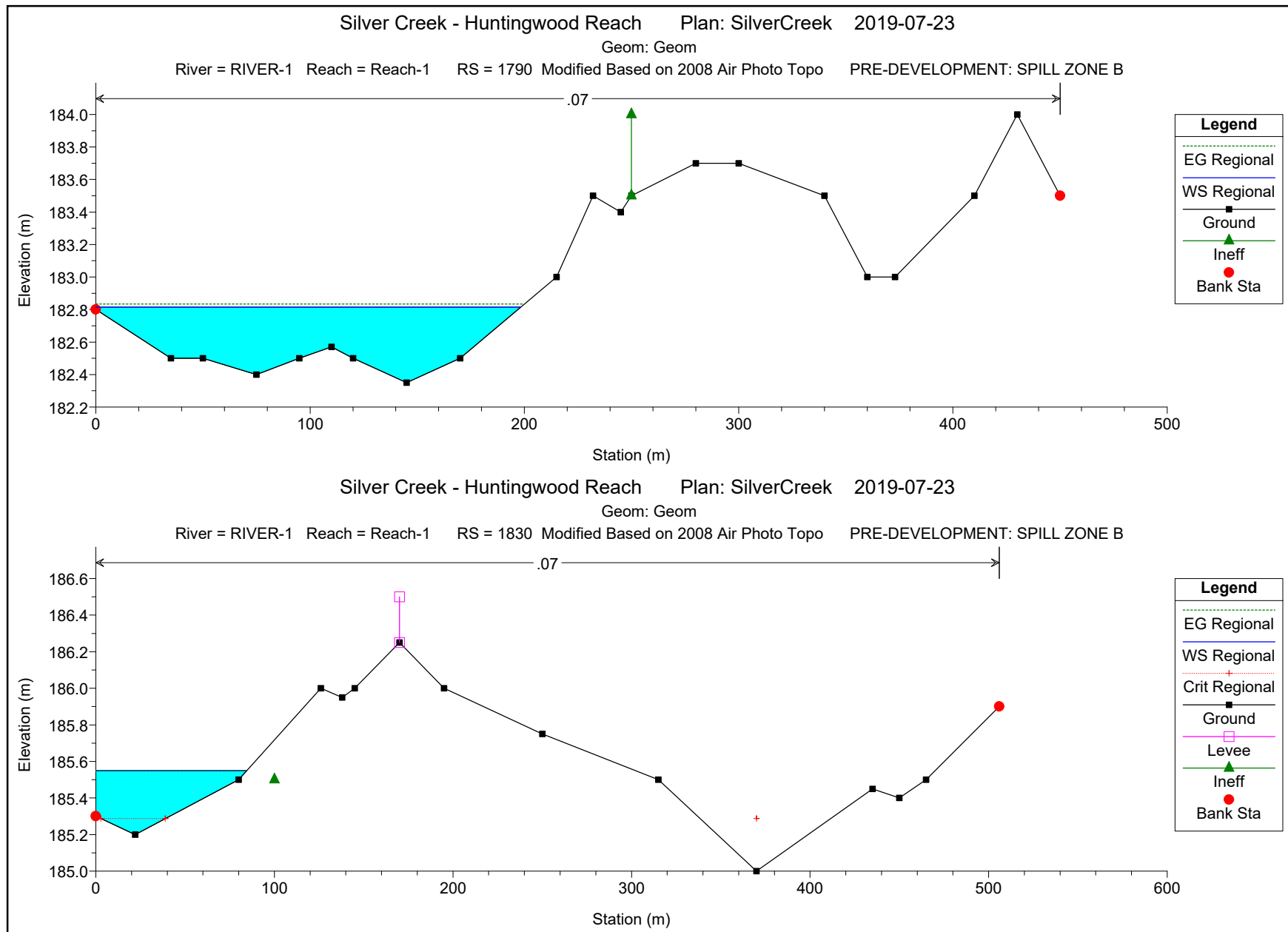
| Reach   | River Sta | Profile  | Plan    | Q Total<br>(m3/s) | Min Ch El<br>(m) | W.S. Elev<br>(m) | Crit W.S.<br>(m) | E.G. Elev<br>(m) | E.G. Slope<br>(m/m) | Vel Chnl<br>(m/s) | Flow Area<br>(m2) | Top Width<br>(m) | Froude # Chl |
|---------|-----------|----------|---------|-------------------|------------------|------------------|------------------|------------------|---------------------|-------------------|-------------------|------------------|--------------|
| Reach-1 | 1830      | Regional | Pre-Dev | 1.00              | 185.00           | 185.55           | 185.29           | 185.55           | 0.000114            | 0.05              | 18.24             | 84.52            | 0.04         |
| Reach-1 | 1830      | Regional | post    | 1.00              | 185.00           | 185.55           | 185.29           | 185.55           | 0.000117            | 0.06              | 18.10             | 84.37            | 0.04         |
| Reach-1 | 1820      | Regional | Pre-Dev | 7.61              | 183.50           | 185.02           | 185.02           | 185.04           | 0.186943            | 0.63              | 12.11             | 371.88           | 1.11         |
| Reach-1 | 1820      | Regional | post    | 7.52              | 183.50           | 185.02           | 185.02           | 185.04           | 0.178956            | 0.63              | 11.85             | 346.95           | 1.10         |
| Reach-1 | 1810      | Regional | Pre-Dev | 24.58             | 183.00           | 183.68           |                  | 183.69           | 0.001936            | 0.34              | 72.05             | 294.47           | 0.17         |
| Reach-1 | 1810      | Regional | post    | 24.26             | 183.00           | 183.68           |                  | 183.69           | 0.002025            | 0.36              | 67.21             | 273.44           | 0.18         |
| Reach-1 | 1800      | Regional | Pre-Dev | 31.21             | 182.75           | 183.40           |                  | 183.43           | 0.010037            | 0.78              | 40.16             | 163.42           | 0.39         |
| Reach-1 | 1800      | Regional | post    | 30.96             | 182.75           | 183.39           |                  | 183.42           | 0.009814            | 0.82              | 37.56             | 138.43           | 0.39         |
| Reach-1 | 1790      | Regional | Pre-Dev | 35.68             | 182.35           | 182.82           |                  | 182.83           | 0.009595            | 0.62              | 57.93             | 198.36           | 0.36         |
| Reach-1 | 1790      | Regional | post    | 35.49             | 182.35           | 182.84           |                  | 182.86           | 0.008783            | 0.62              | 56.97             | 178.83           | 0.35         |
| Reach-1 | 1780      | Regional | Pre-Dev | 36.91             | 181.93           | 182.29           |                  | 182.31           | 0.010056            | 0.56              | 65.91             | 269.56           | 0.36         |
| Reach-1 | 1780      | Regional | post    | 36.72             | 181.93           | 182.30           |                  | 182.32           | 0.011942            | 0.61              | 60.41             | 247.81           | 0.39         |
| Reach-1 | 1770      | Regional | Pre-Dev | 36.99             | 181.40           | 181.98           | 181.70           | 181.99           | 0.003075            | 0.41              | 91.07             | 249.97           | 0.21         |
| Reach-1 | 1770      | Regional | post    | 36.80             | 181.40           | 181.98           |                  | 181.99           | 0.003067            | 0.42              | 88.80             | 236.72           | 0.22         |
| Reach-1 | 1760      | Regional | Pre-Dev | 42.81             | 180.90           | 181.21           | 181.21           | 181.28           | 0.095370            | 1.24              | 34.66             | 233.66           | 1.02         |
| Reach-1 | 1760      | Regional | post    | 42.81             | 180.90           | 181.21           | 181.21           | 181.28           | 0.090359            | 1.21              | 35.25             | 234.11           | 1.00         |
| Reach-1 | 1750      | Regional | Pre-Dev | 48.04             | 179.50           | 180.75           |                  | 180.76           | 0.000765            | 0.24              | 202.58            | 262.08           | 0.08         |
| Reach-1 | 1750      | Regional | post    | 47.97             | 179.50           | 180.75           |                  | 180.75           | 0.000779            | 0.24              | 201.44            | 255.00           | 0.09         |
| Reach-1 | 1740      | Regional | Pre-Dev | 48.04             | 179.20           | 180.74           |                  | 180.74           | 0.000377            | 0.22              | 229.71            | 206.94           | 0.06         |
| Reach-1 | 1740      | Regional | post    | 47.97             | 179.20           | 180.73           |                  | 180.73           | 0.000354            | 0.21              | 239.29            | 221.11           | 0.06         |
| Reach-1 | 1730      |          |         | Lat Struct        |                  |                  |                  |                  |                     |                   |                   |                  |              |
| Reach-1 | 1720      | Regional | Pre-Dev | 29.83             | 179.30           | 180.73           |                  | 180.73           | 0.000198            | 0.15              | 202.03            | 190.92           | 0.05         |
| Reach-1 | 1720      | Regional | post    | 29.97             | 179.30           | 180.73           |                  | 180.73           | 0.000177            | 0.14              | 221.64            | 229.55           | 0.04         |
| Reach-1 | 1703      | Regional | Pre-Dev | 29.83             | 179.40           | 180.72           | 179.79           | 180.73           | 0.000556            | 0.28              | 117.73            | 172.45           | 0.08         |
| Reach-1 | 1703      | Regional | post    | 29.97             | 179.40           | 180.72           | 179.79           | 180.72           | 0.000308            | 0.20              | 170.02            | 244.12           | 0.06         |
| Reach-1 | 1696.5    |          |         | Bridge            |                  |                  |                  |                  |                     |                   |                   |                  |              |
| Reach-1 | 1690      | Regional | Pre-Dev | 29.83             | 179.76           | 180.68           | 180.18           | 180.68           | 0.002005            | 0.37              | 88.05             | 138.61           | 0.14         |
| Reach-1 | 1690      | Regional | post    | 29.97             | 179.76           | 180.68           | 180.18           | 180.69           | 0.001985            | 0.37              | 88.60             | 138.72           | 0.14         |
| Reach-1 | 1675      | Regional | Pre-Dev | 29.83             | 179.76           | 180.64           | 180.23           | 180.65           | 0.002516            | 0.43              | 82.56             | 140.97           | 0.15         |
| Reach-1 | 1675      | Regional | post    | 29.97             | 179.76           | 180.65           | 180.23           | 180.65           | 0.002480            | 0.43              | 83.18             | 141.01           | 0.15         |
| Reach-1 | 1648      | Regional | Pre-Dev | 29.83             | 179.21           | 180.62           |                  | 180.63           | 0.000612            | 0.24              | 123.05            | 125.47           | 0.08         |
| Reach-1 | 1648      | Regional | post    | 29.97             | 179.21           | 180.63           |                  | 180.63           | 0.000608            | 0.24              | 123.63            | 125.49           | 0.08         |
| Reach-1 | 1627      | Regional | Pre-Dev | 29.83             | 179.34           | 180.60           |                  | 180.60           | 0.000993            | 0.30              | 100.00            | 107.30           | 0.10         |
| Reach-1 | 1627      | Regional | post    | 29.97             | 179.34           | 180.60           |                  | 180.61           | 0.000986            | 0.30              | 100.51            | 107.32           | 0.10         |
| Reach-1 | 1590      | Regional | Pre-Dev | 29.83             | 179.09           | 180.27           | 179.97           | 180.49           | 0.014769            | 2.11              | 14.15             | 86.03            | 0.63         |
| Reach-1 | 1590      | Regional | post    | 29.97             | 179.09           | 180.27           | 179.97           | 180.50           | 0.014704            | 2.11              | 14.22             | 86.06            | 0.63         |
| Reach-1 | 1570      |          |         | Culvert           |                  |                  |                  |                  |                     |                   |                   |                  |              |
| Reach-1 | 1560      | Regional | Pre-Dev | 29.83             | 178.92           | 180.20           | 179.75           | 180.22           | 0.001260            | 0.53              | 56.79             | 66.54            | 0.18         |
| Reach-1 | 1560      | Regional | post    | 29.97             | 178.92           | 180.20           | 179.76           | 180.22           | 0.001259            | 0.53              | 56.97             | 66.55            | 0.18         |
| Reach-1 | 1550      | Regional | Pre-Dev | 29.83             | 178.80           | 180.17           | 179.64           | 180.20           | 0.003517            | 0.66              | 45.60             | 187.60           | 0.23         |
| Reach-1 | 1550      | Regional | post    | 29.97             | 178.80           | 180.18           | 179.64           | 180.20           | 0.003515            | 0.66              | 45.75             | 187.61           | 0.23         |
| Reach-1 | 1527      | Regional | Pre-Dev | 29.83             | 178.74           | 180.08           | 179.68           | 180.13           | 0.002663            | 0.96              | 30.91             | 217.78           | 0.35         |
| Reach-1 | 1527      | Regional | post    | 29.97             | 178.74           | 180.09           | 179.68           | 180.13           | 0.002661            | 0.97              | 31.02             | 217.79           | 0.35         |
| Reach-1 | 1505      | Regional | Pre-Dev | 29.83             | 178.55           | 180.06           |                  | 180.11           | 0.002153            | 0.92              | 32.36             | 37.62            | 0.32         |
| Reach-1 | 1505      | Regional | post    | 29.97             | 178.55           | 180.07           |                  | 180.11           | 0.002155            | 0.92              | 32.45             | 37.65            | 0.32         |
| Reach-1 | 1500      |          |         | Lat Struct        |                  |                  |                  |                  |                     |                   |                   |                  |              |
| Reach-1 | 1480      | Regional | Pre-Dev | 25.65             | 178.53           | 180.06           |                  | 180.07           | 0.000417            | 0.55              | 46.37             | 33.77            | 0.15         |
| Reach-1 | 1480      | Regional | post    | 25.80             | 178.53           | 180.06           |                  | 180.07           | 0.000420            | 0.56              | 46.45             | 33.78            | 0.15         |
| Reach-1 | 1461      | Regional | Pre-Dev | 25.65             | 178.77           | 180.04           |                  | 180.06           | 0.000770            | 0.67              | 38.44             | 33.66            | 0.20         |
| Reach-1 | 1461      | Regional | post    | 25.80             | 178.77           | 180.04           |                  | 180.06           | 0.000774            | 0.67              | 38.52             | 33.67            | 0.20         |
| Reach-1 | 1440.1    | Regional | Pre-Dev | 25.65             | 178.90           | 179.94           |                  | 180.01           | 0.003788            | 1.23              | 21.70             | 28.25            | 0.42         |
| Reach-1 | 1440.1    | Regional | post    | 25.80             | 178.90           | 179.94           |                  | 180.01           | 0.003810            | 1.24              | 21.75             | 28.26            | 0.42         |
| Reach-1 | 1440      | Regional | Pre-Dev | 25.65             | 179.30           | 179.64           | 179.64           | 179.75           | 0.034320            | 1.45              | 17.70             | 84.81            | 1.01         |
| Reach-1 | 1440      | Regional | post    | 25.80             | 179.30           | 179.64           | 179.64           | 179.75           | 0.034250            | 1.45              | 17.79             | 84.95            | 1.01         |

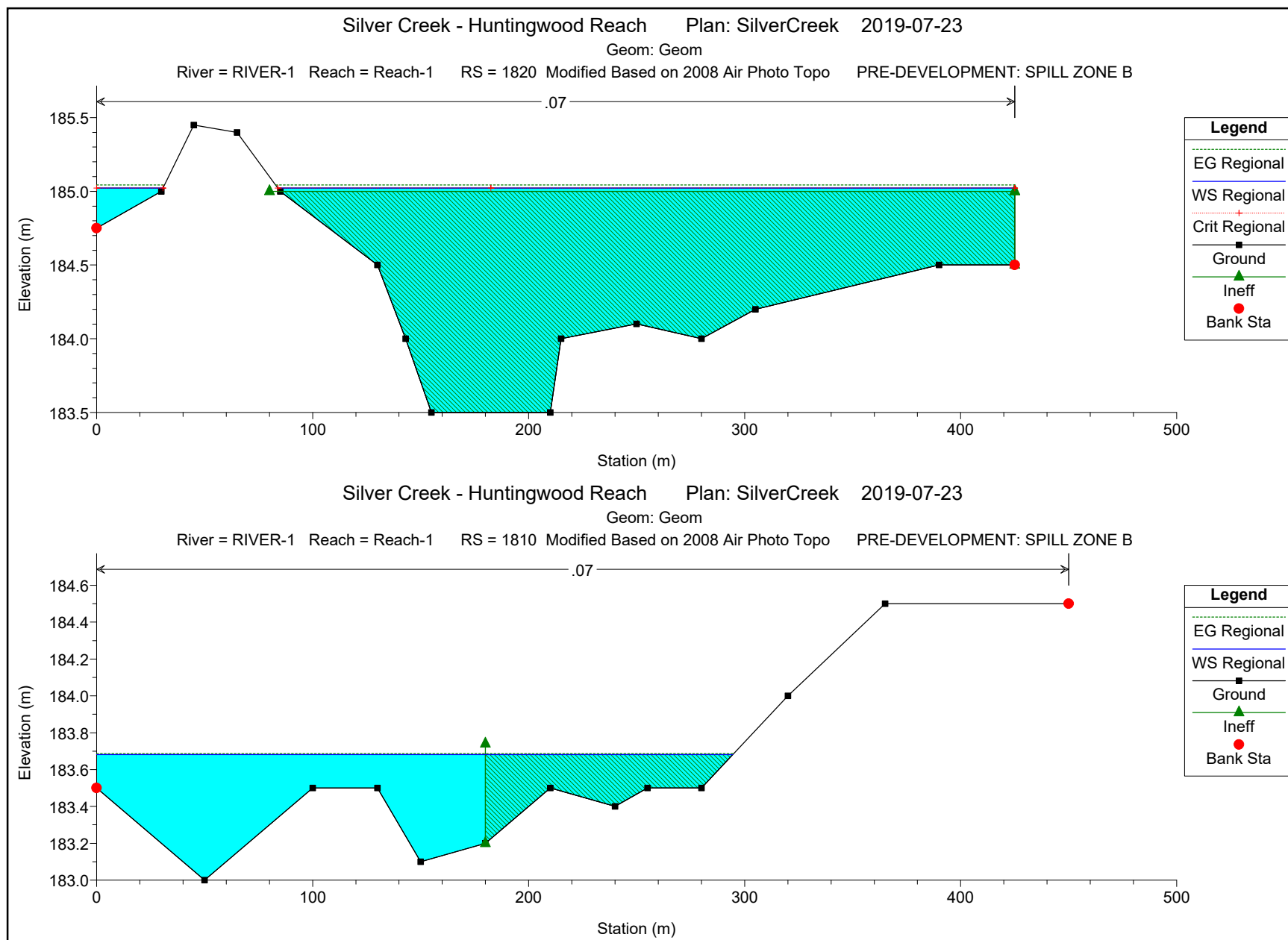
## SPILL ZONE B

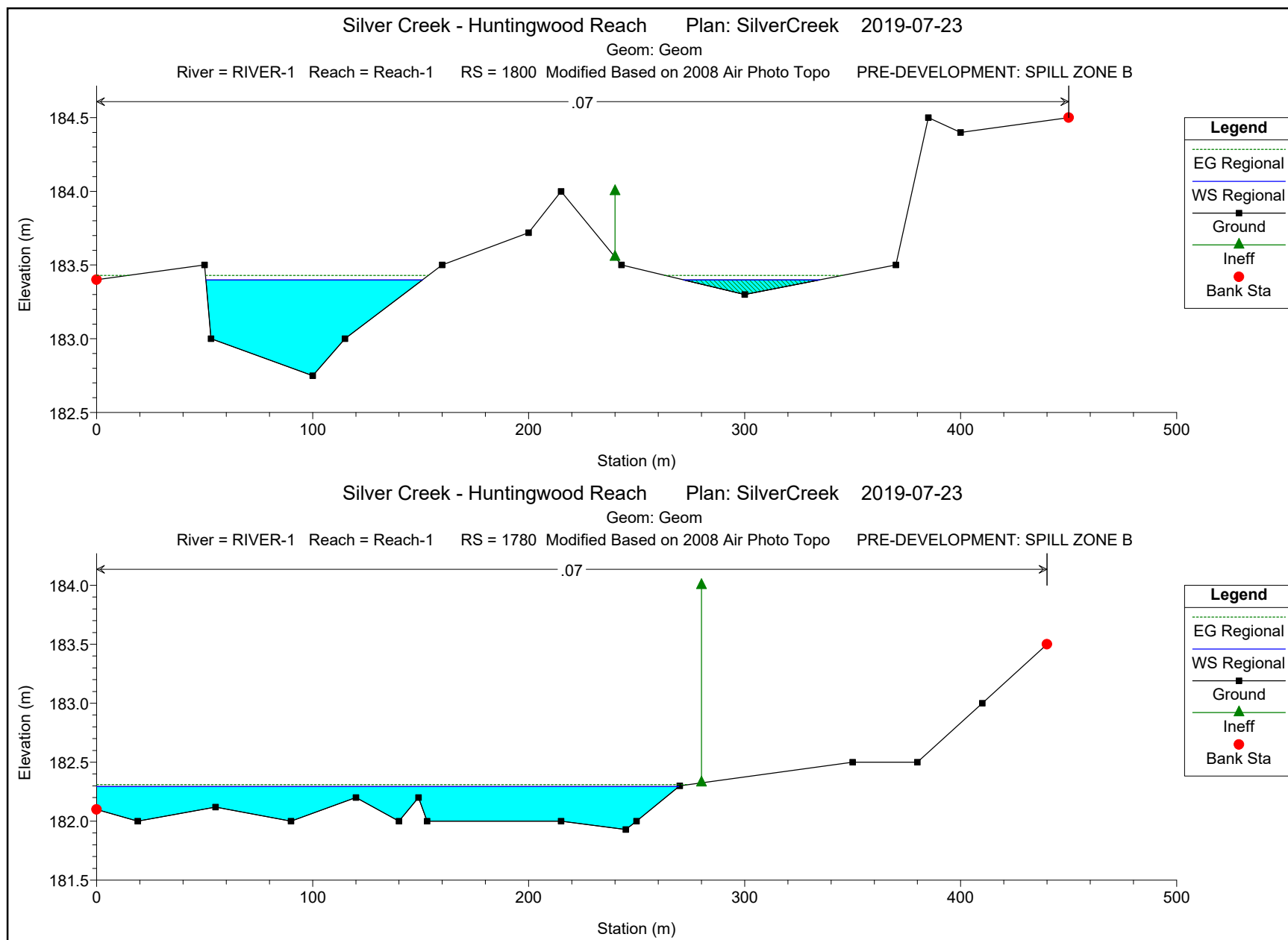
HEC-RAS River: RIVER-1 Reach: Reach-1 Profile: Regional (Continued)

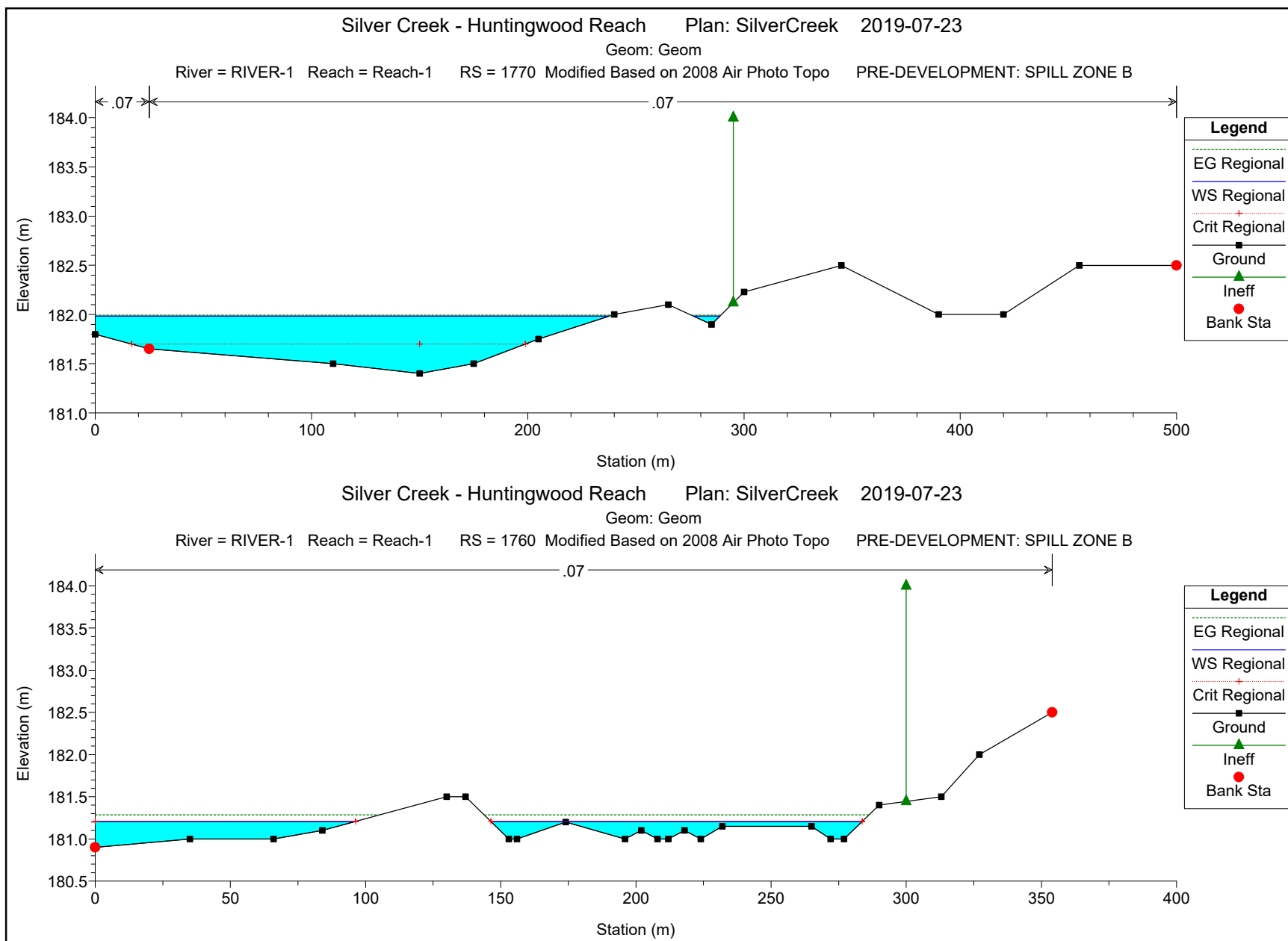
| Reach   | River Sta | Profile  | Plan    | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---------|-----------|----------|---------|---------|-----------|-----------|-----------|-----------|------------|----------|-----------|-----------|--------------|
|         |           |          |         | (m3/s)  | (m)       | (m)       | (m)       | (m)       | (m/m)      | (m/s)    | (m2)      | (m)       |              |
| Reach-1 | 1315      | Regional | Pre-Dev | 25.65   | 178.15    | 179.35    |           | 179.38    | 0.002439   | 0.71     | 35.96     | 68.38     | 0.31         |
| Reach-1 | 1315      | Regional | post    | 25.80   | 178.15    | 179.35    |           | 179.38    | 0.002440   | 0.71     | 36.11     | 68.49     | 0.31         |
| Reach-1 | 1274      | Regional | Pre-Dev | 25.65   | 178.14    | 179.29    |           | 179.31    | 0.001087   | 0.71     | 46.52     | 81.11     | 0.23         |
| Reach-1 | 1274      | Regional | post    | 25.80   | 178.14    | 179.30    |           | 179.31    | 0.001088   | 0.71     | 46.69     | 81.19     | 0.23         |
| Reach-1 | 1232      | Regional | Pre-Dev | 25.65   | 178.48    | 179.21    |           | 179.24    | 0.002646   | 0.82     | 30.90     | 52.71     | 0.34         |
| Reach-1 | 1232      | Regional | post    | 25.80   | 178.48    | 179.21    |           | 179.24    | 0.002653   | 0.82     | 31.00     | 52.73     | 0.34         |
| Reach-1 | 1192      | Regional | Pre-Dev | 25.65   | 178.37    | 179.03    |           | 179.09    | 0.005606   | 1.21     | 25.67     | 71.09     | 0.49         |
| Reach-1 | 1192      | Regional | post    | 25.80   | 178.37    | 179.03    |           | 179.09    | 0.005609   | 1.21     | 25.78     | 71.24     | 0.49         |
| Reach-1 | 1149      | Regional | Pre-Dev | 25.65   | 178.27    | 178.99    |           | 179.00    | 0.000871   | 0.47     | 62.03     | 129.79    | 0.19         |
| Reach-1 | 1149      | Regional | post    | 25.80   | 178.27    | 178.99    |           | 179.00    | 0.000872   | 0.47     | 62.23     | 129.81    | 0.19         |
| Reach-1 | 1096.2    | Regional | Pre-Dev | 25.65   | 178.25    | 178.82    |           | 178.83    | 0.001298   | 0.48     | 58.41     | 147.13    | 0.23         |
| Reach-1 | 1096.2    | Regional | post    | 25.80   | 178.25    | 178.83    |           | 178.84    | 0.001298   | 0.48     | 58.63     | 147.16    | 0.23         |
| Reach-1 | 1096.1    | Regional | Pre-Dev | 25.65   | 178.25    | 178.82    |           | 178.83    | 0.001299   | 0.48     | 58.40     | 147.13    | 0.23         |
| Reach-1 | 1096.1    | Regional | post    | 25.80   | 178.25    | 178.83    |           | 178.84    | 0.001299   | 0.48     | 58.61     | 147.16    | 0.23         |
| Reach-1 | 1096      | Regional | Pre-Dev | 25.65   | 178.25    | 178.82    | 178.58    | 178.83    | 0.001301   | 0.48     | 58.38     | 147.12    | 0.23         |
| Reach-1 | 1096      | Regional | post    | 25.80   | 178.25    | 178.83    | 178.58    | 178.84    | 0.001301   | 0.48     | 58.59     | 147.16    | 0.23         |

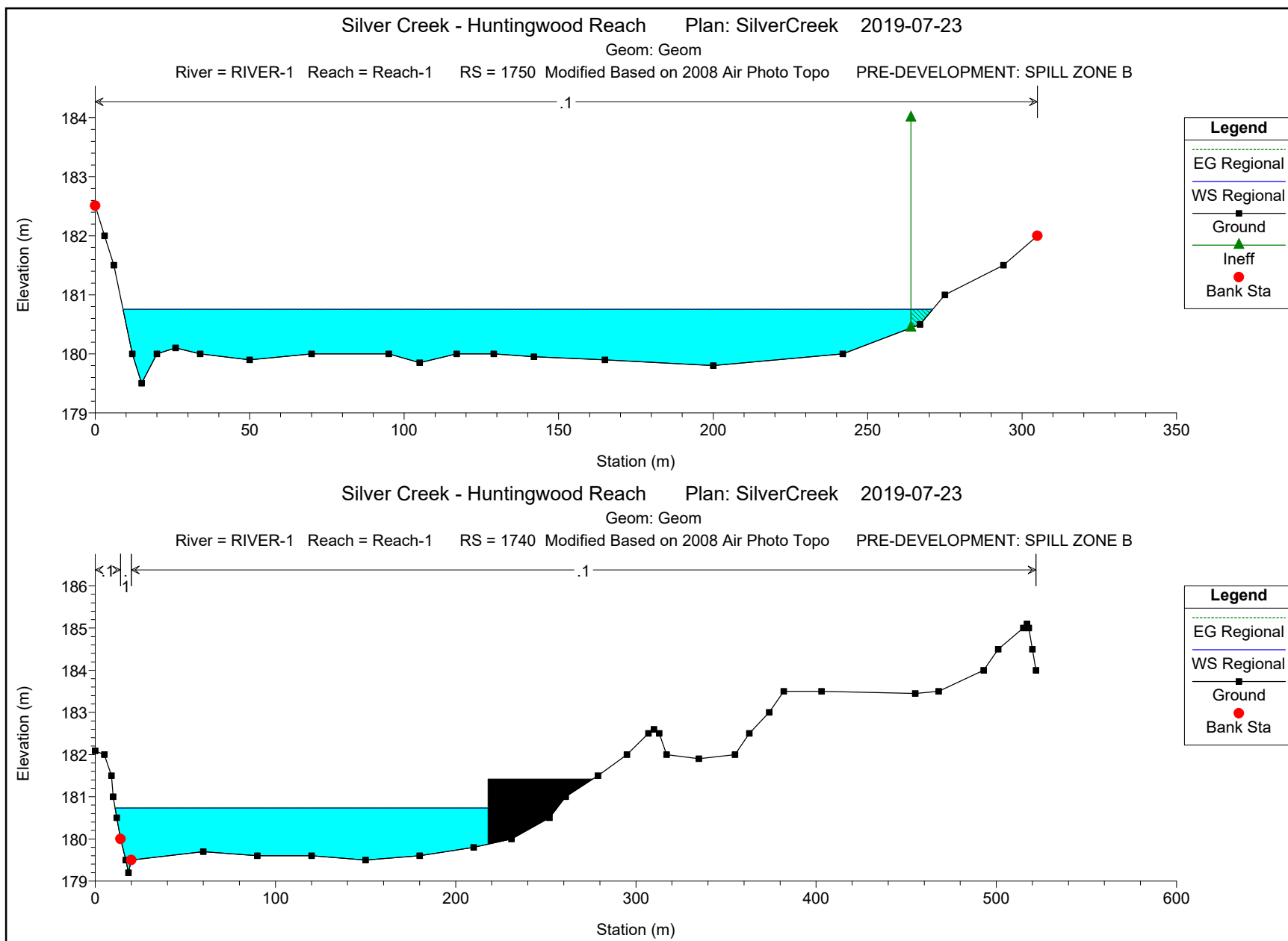
## SPILL ZONE B - PRE-DEVELOPMENT



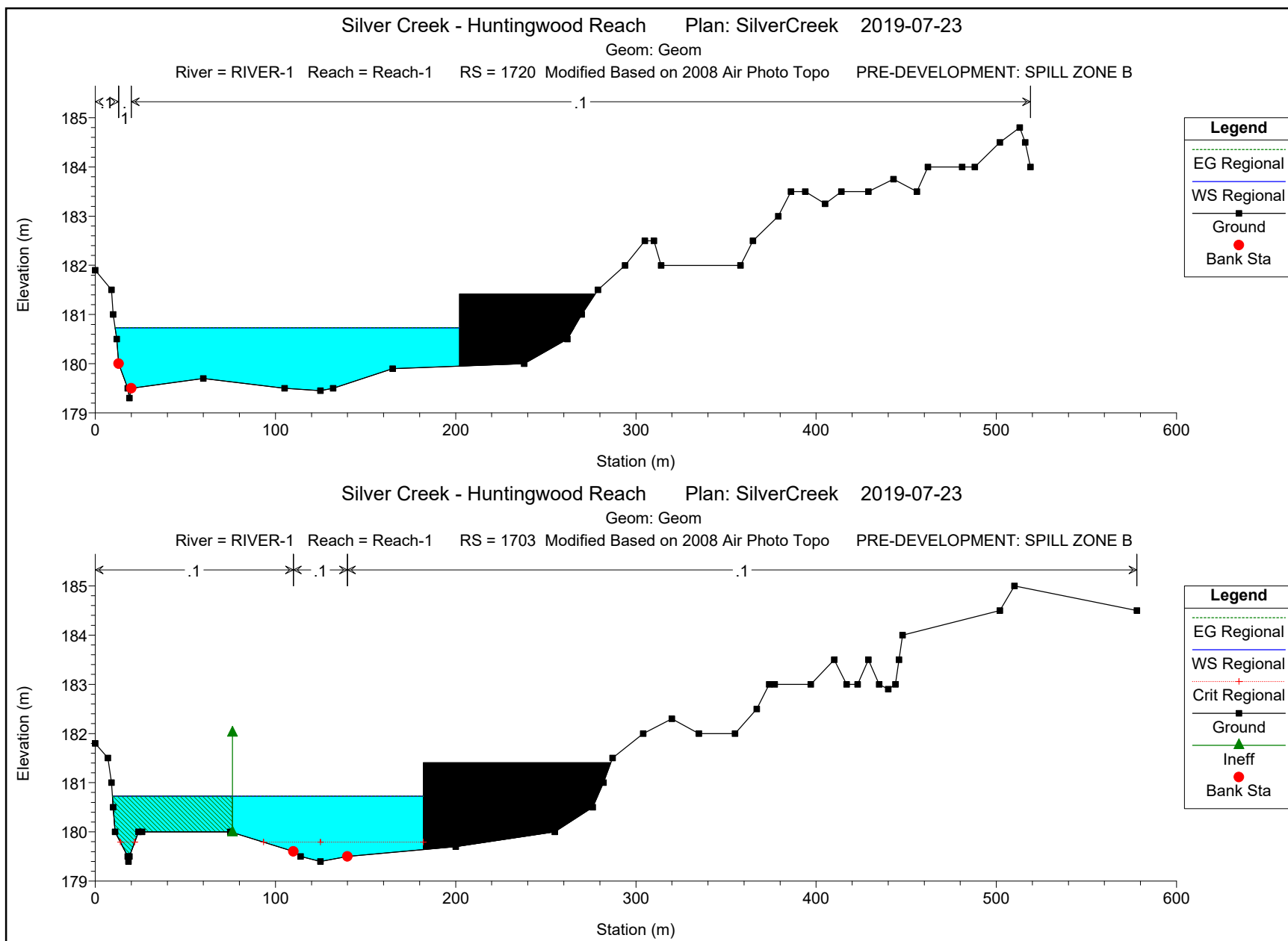


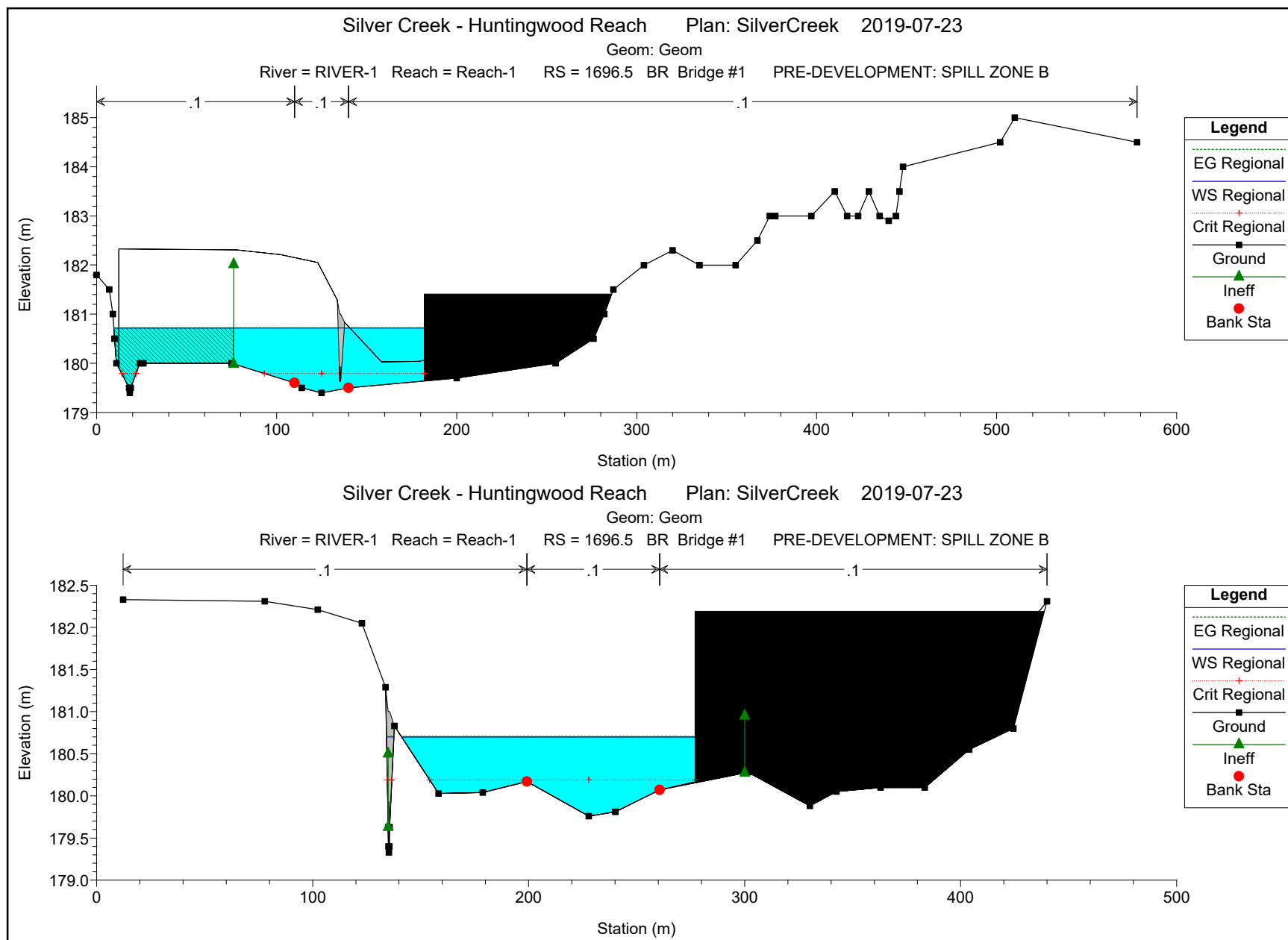


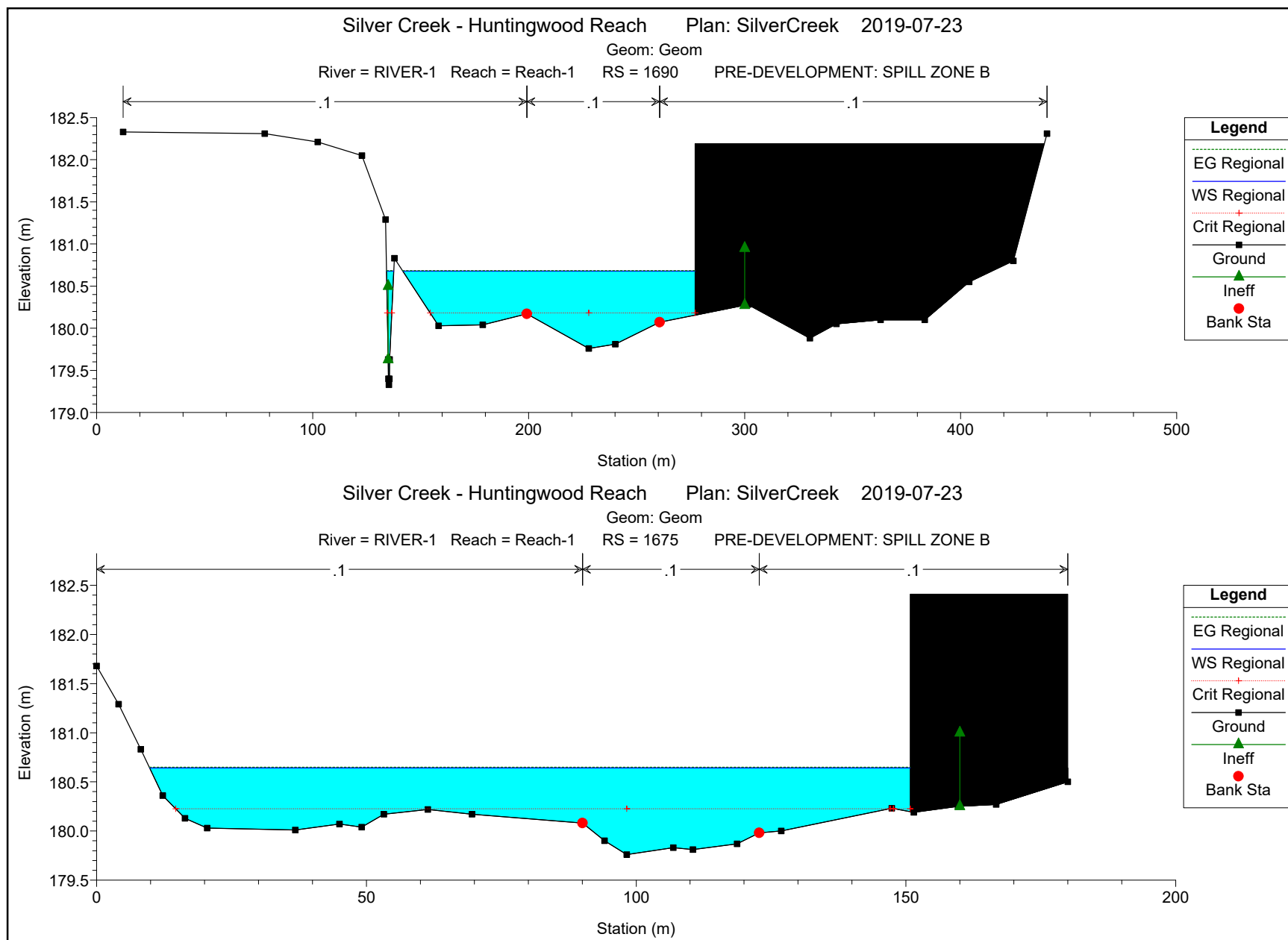


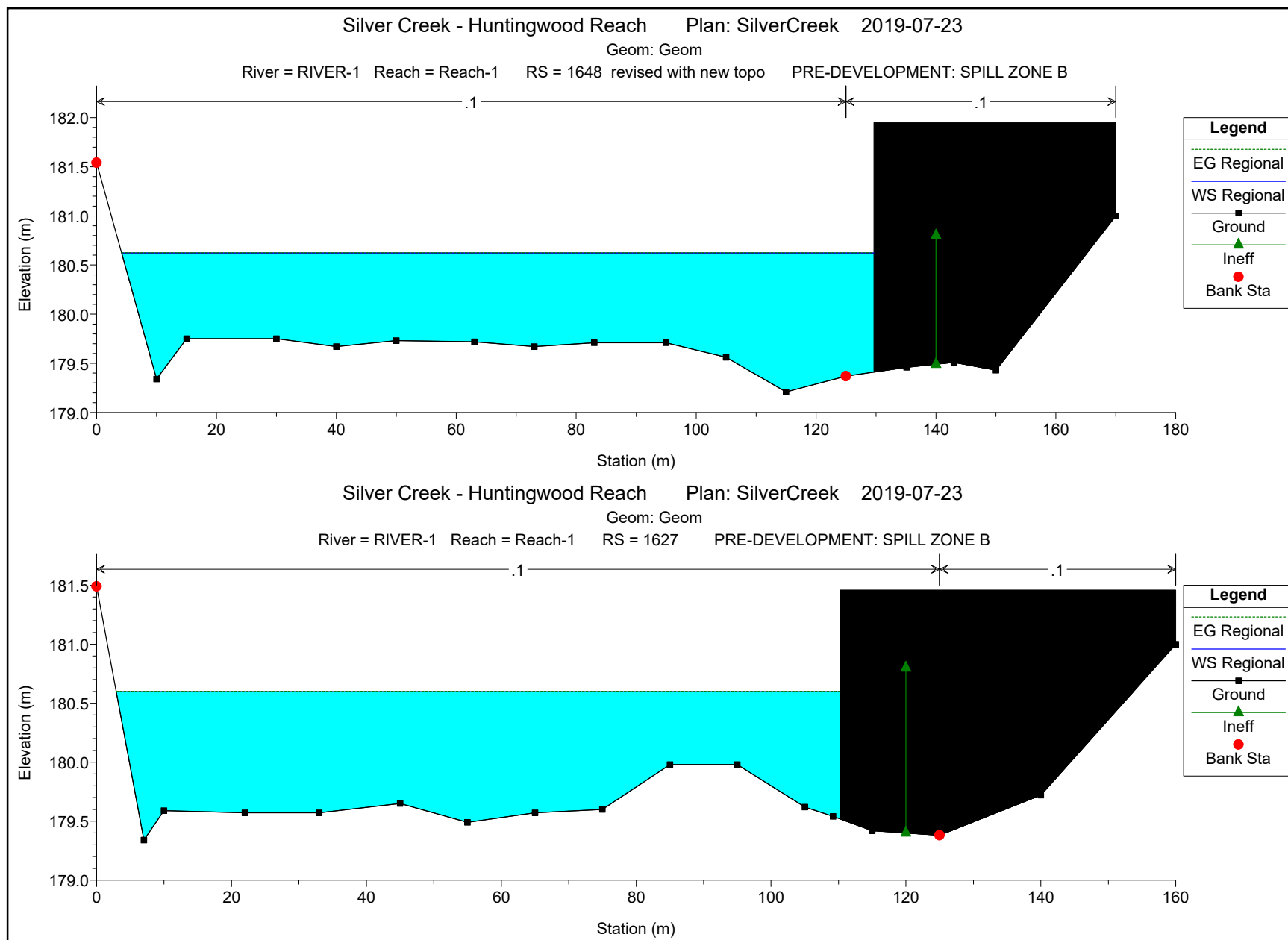


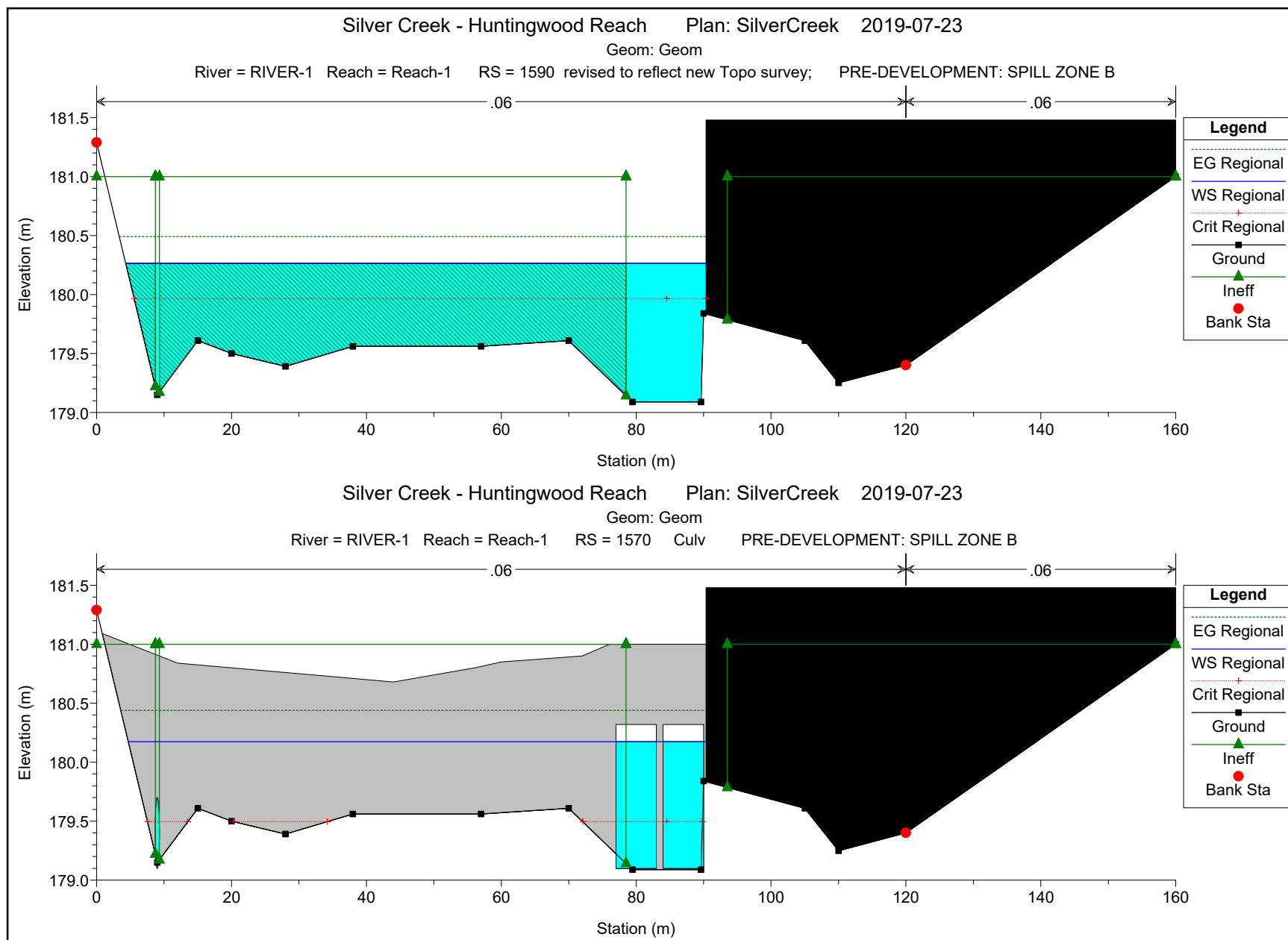


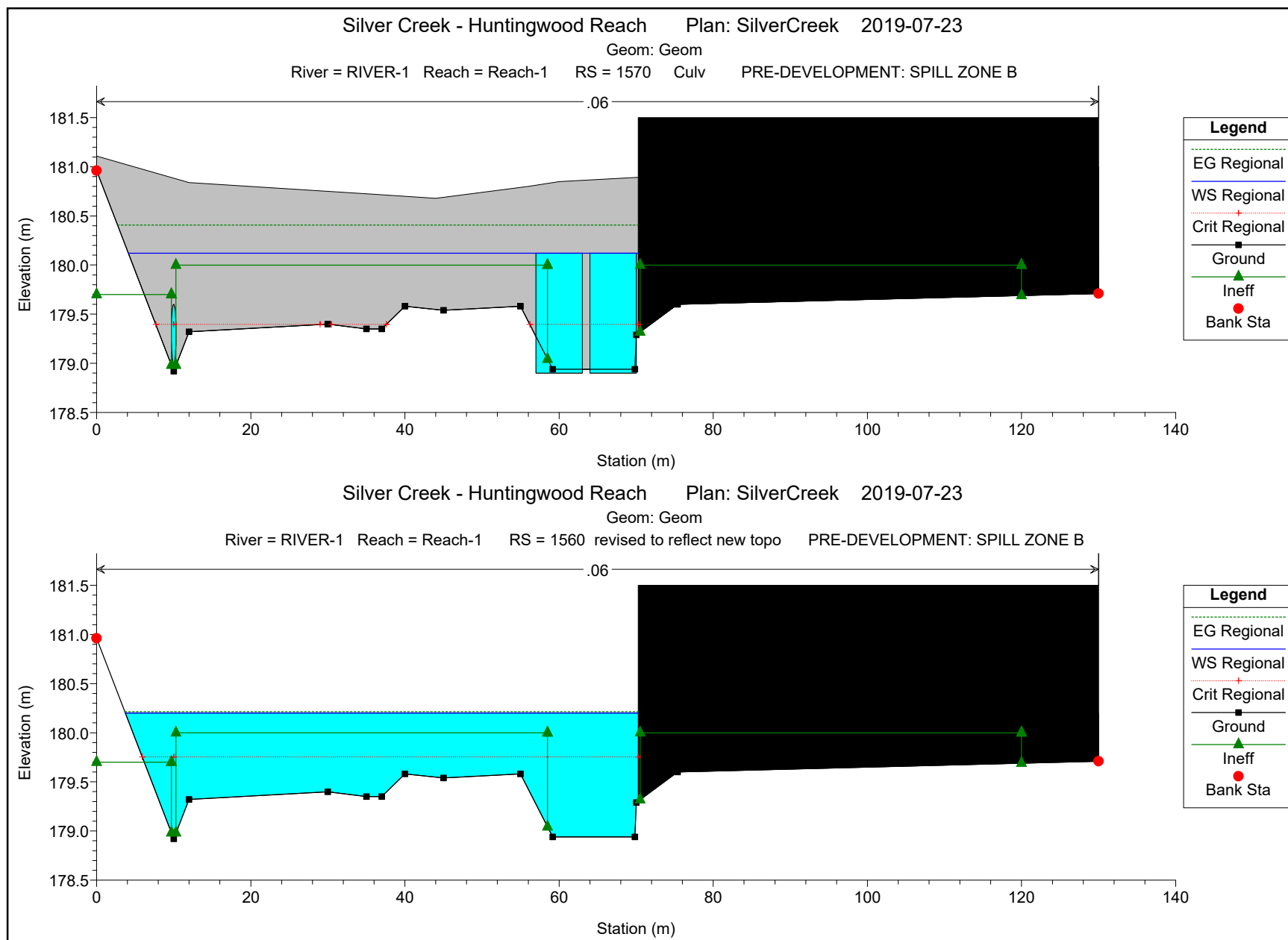


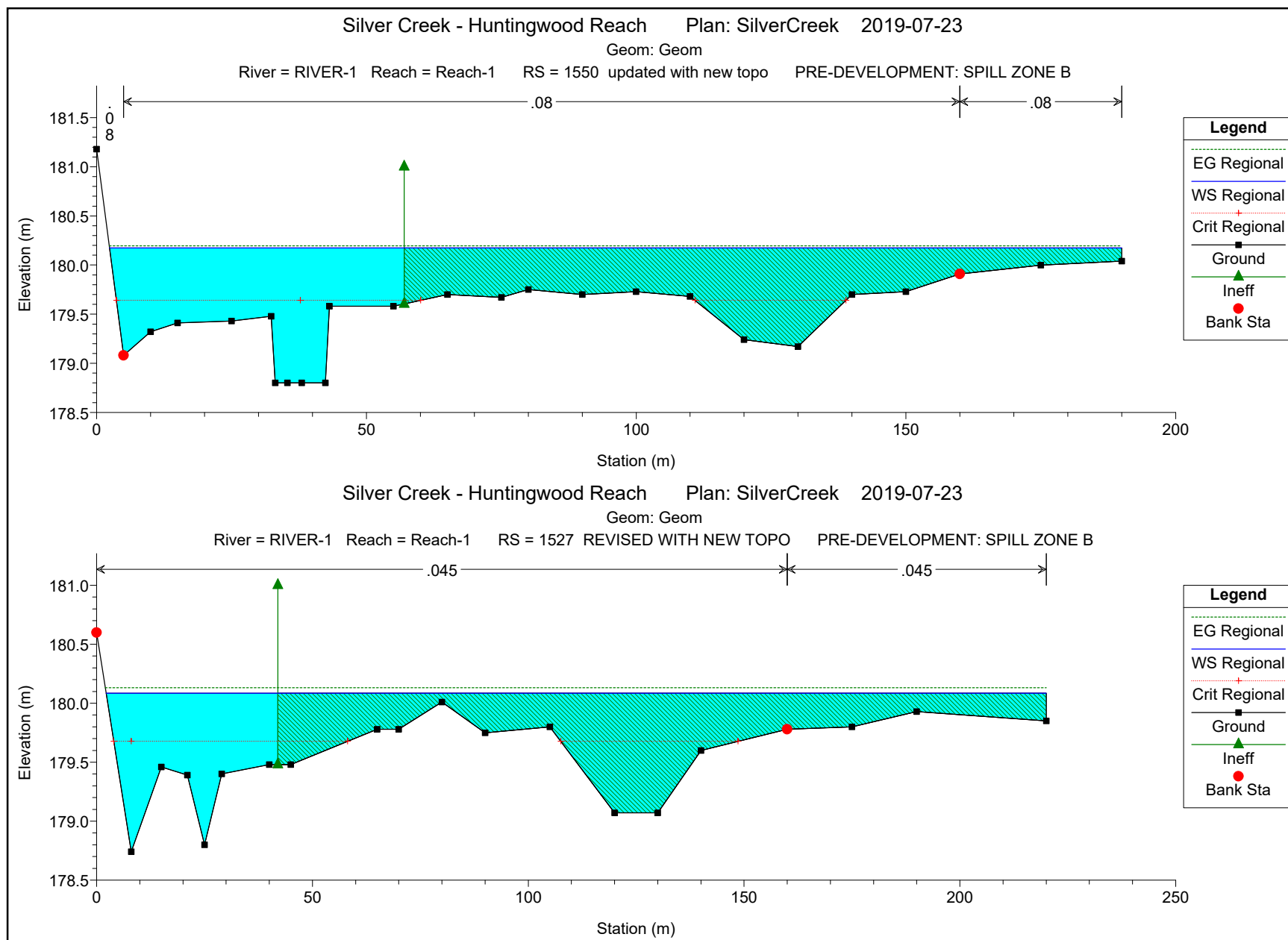


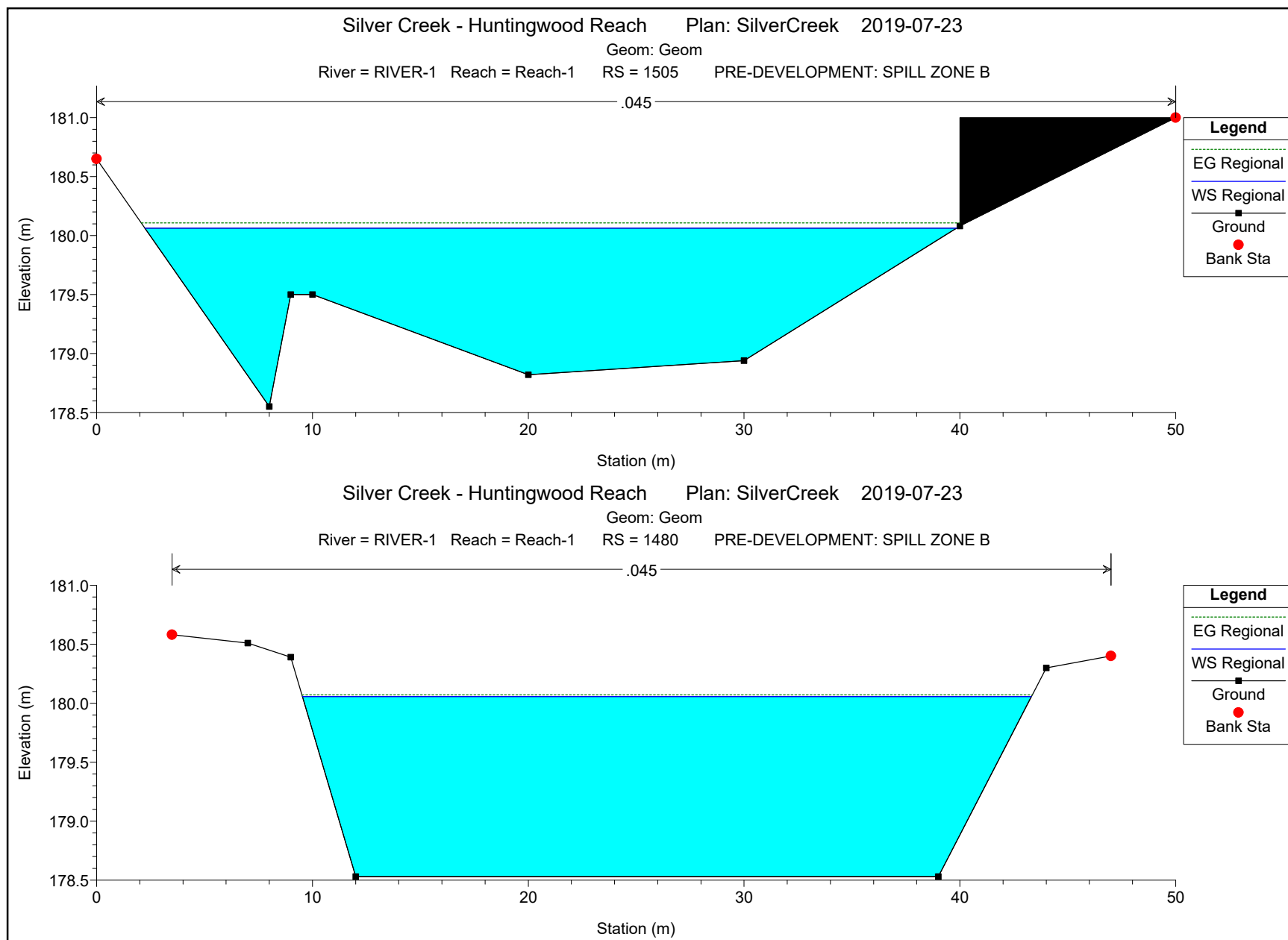




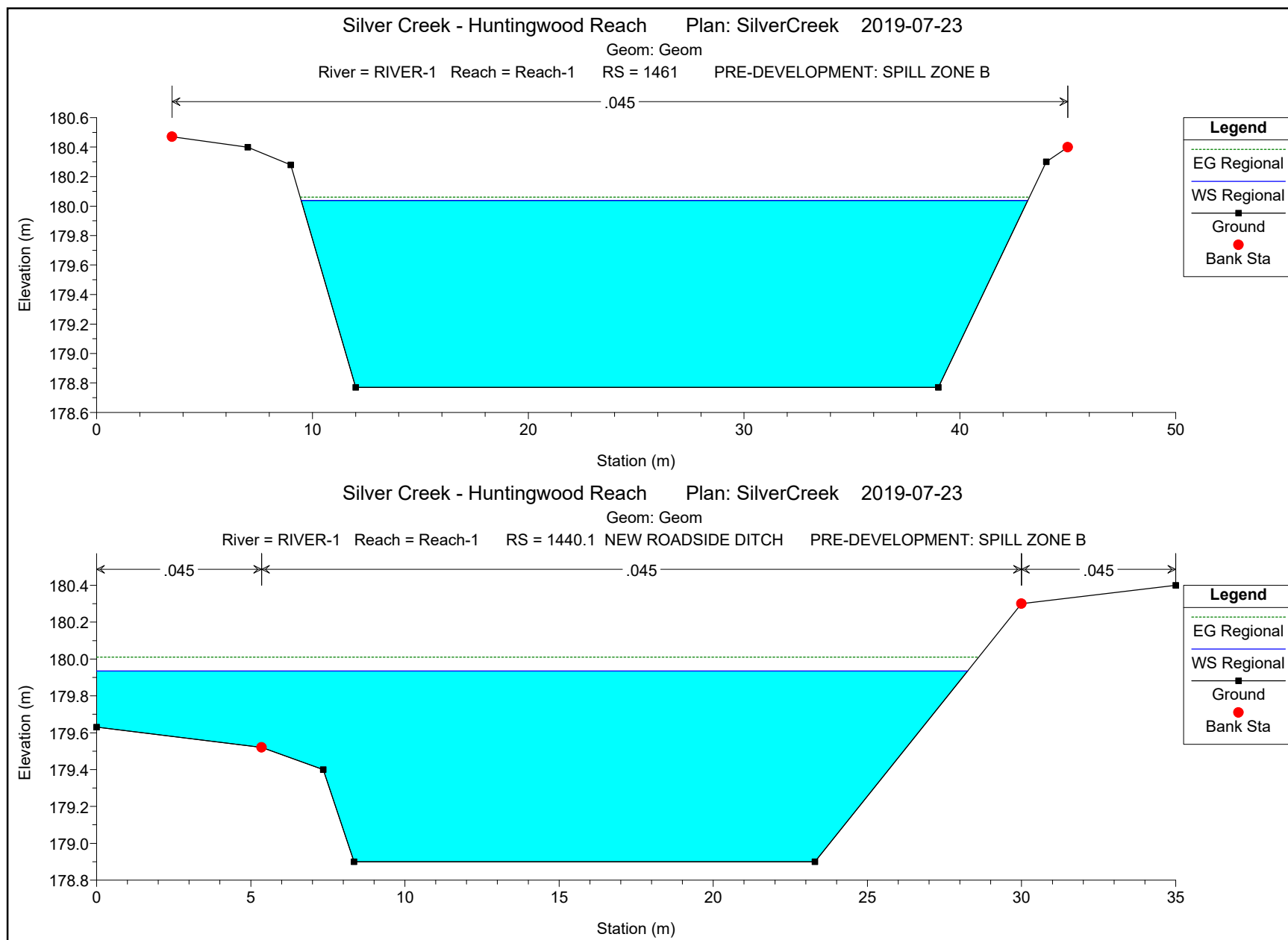


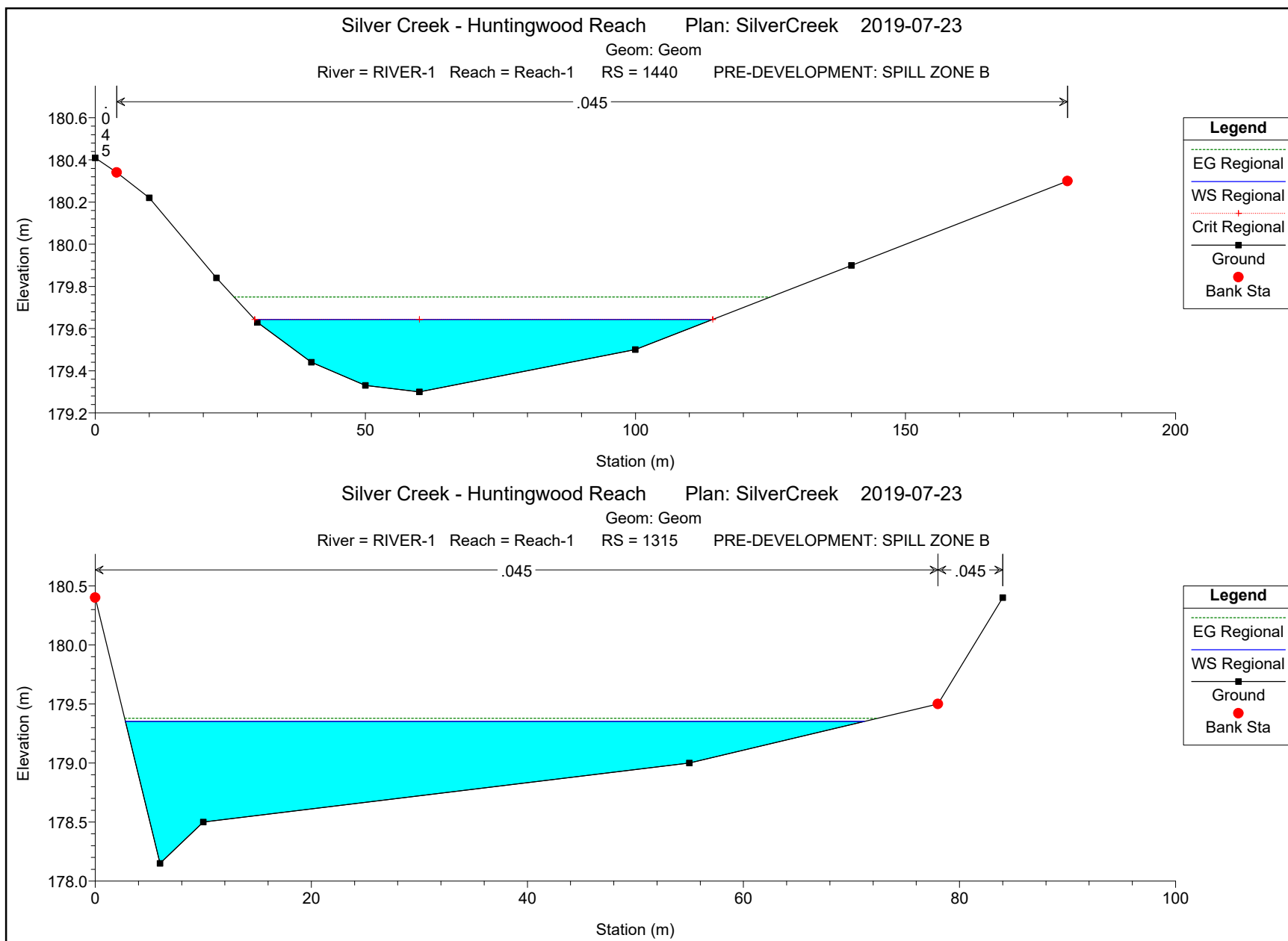


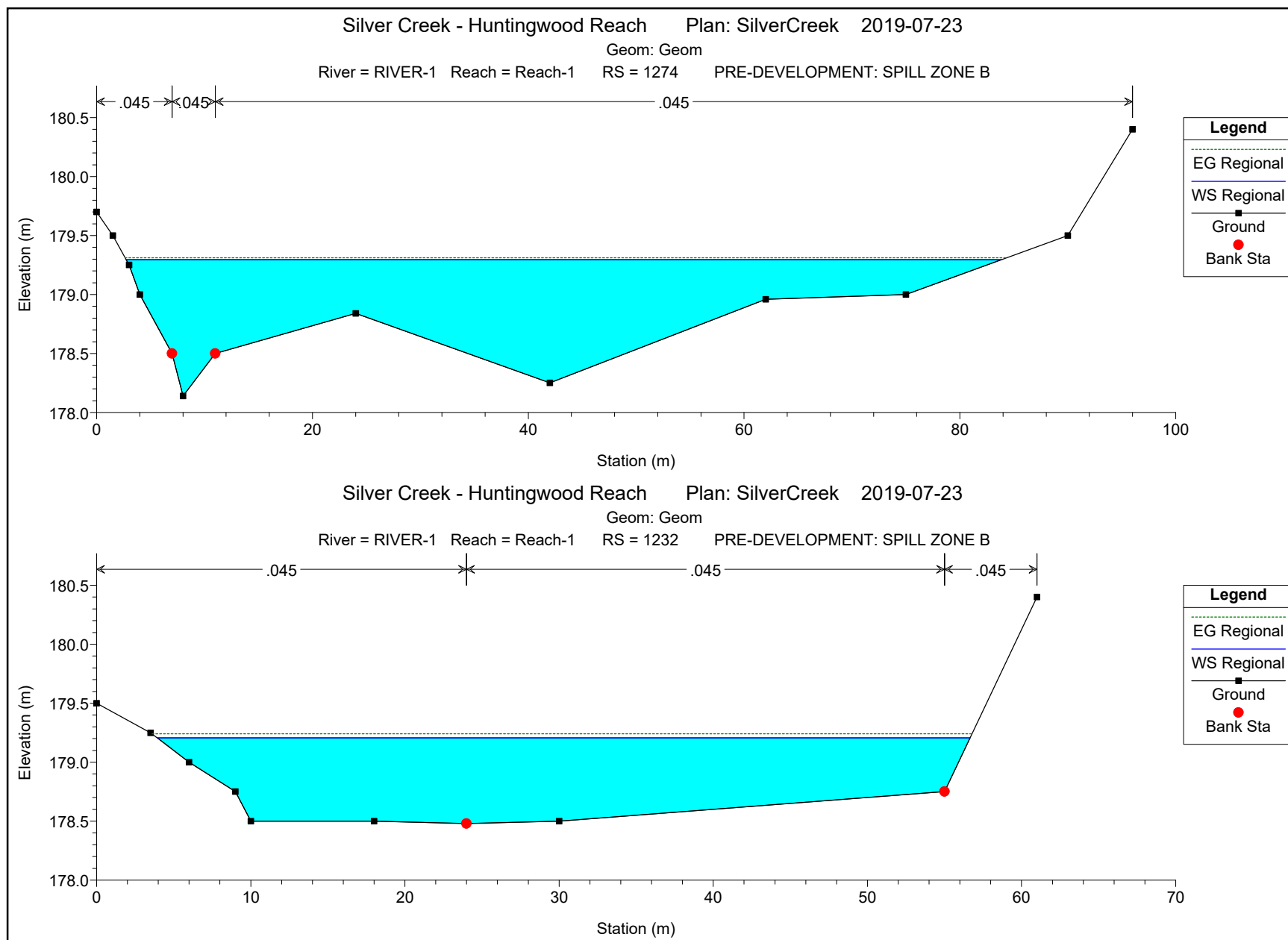


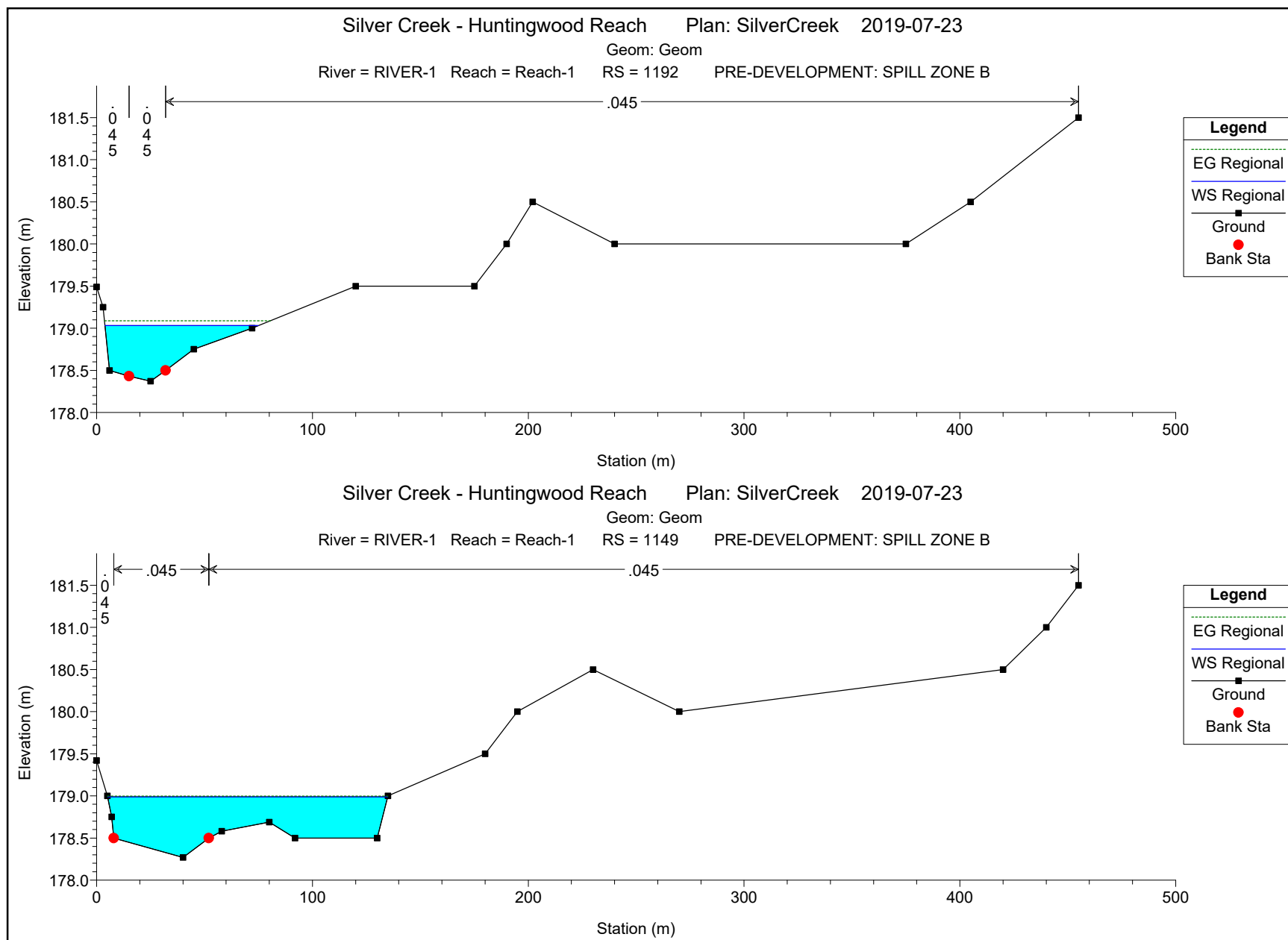


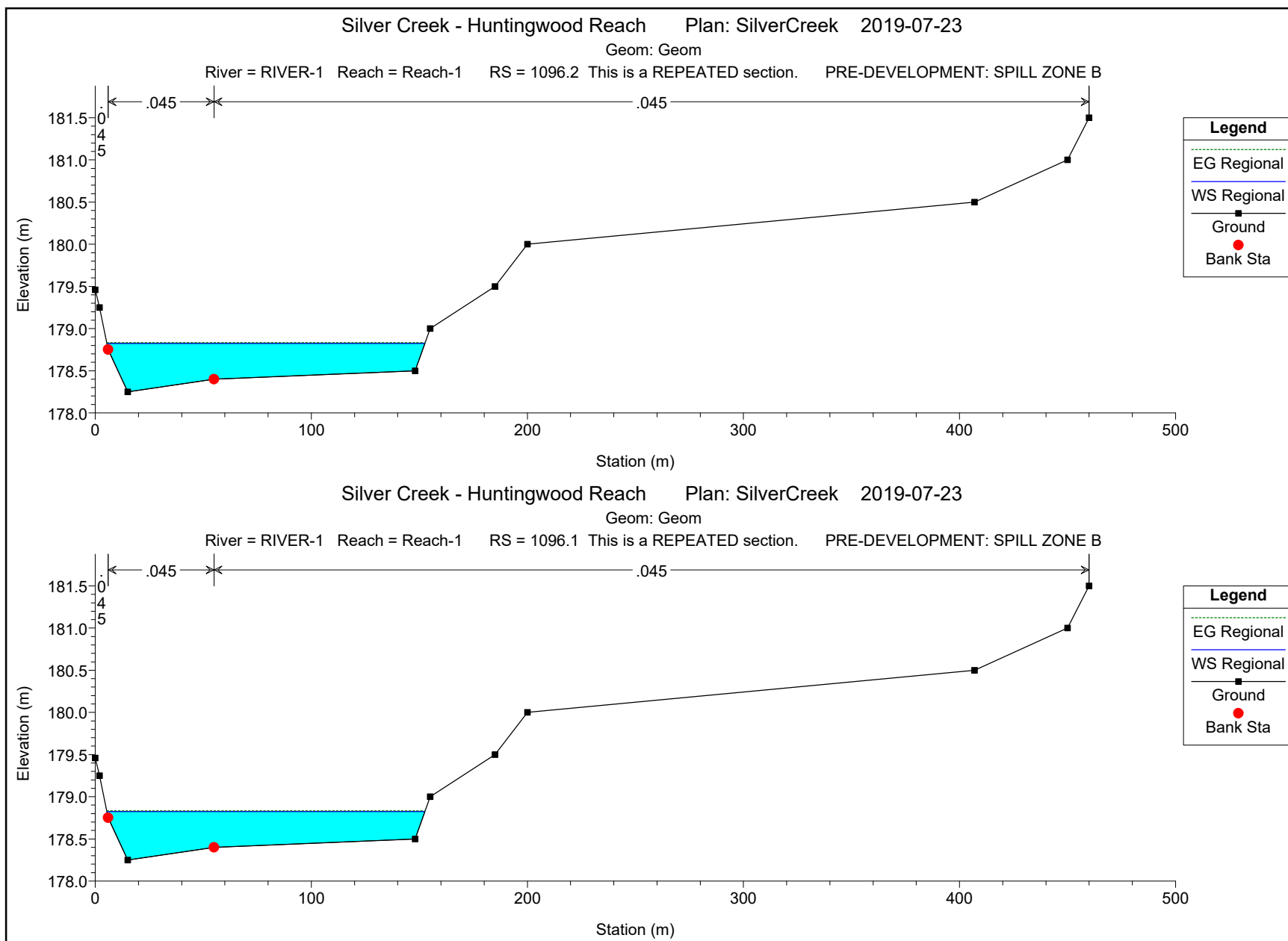








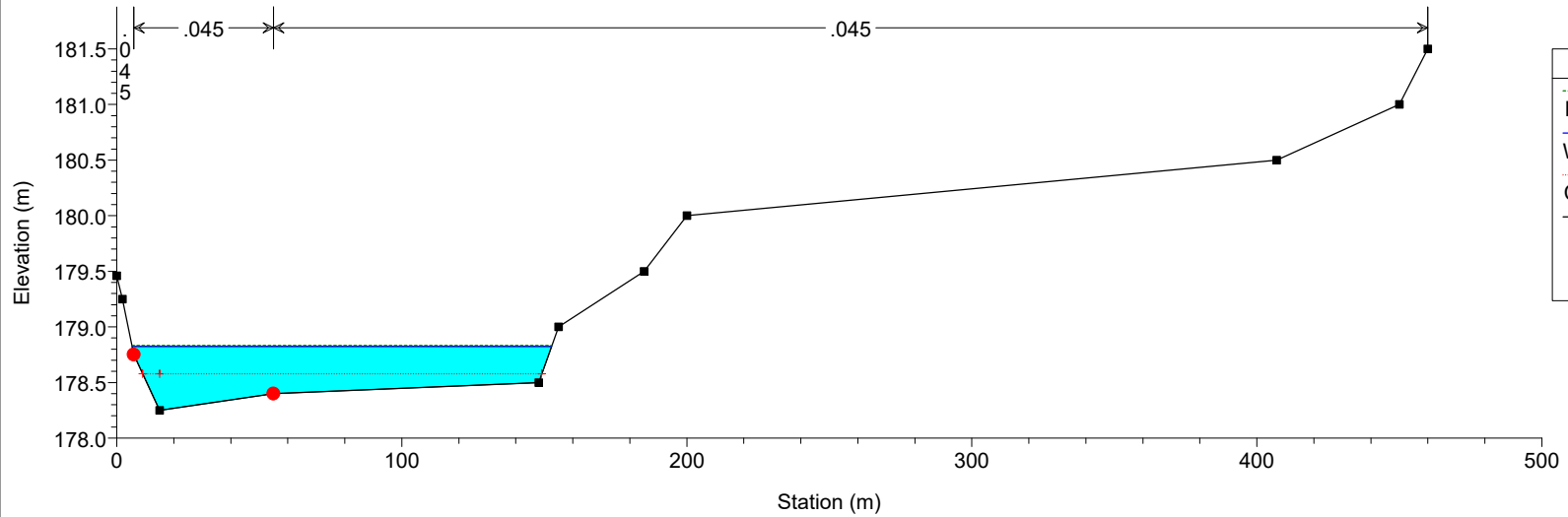




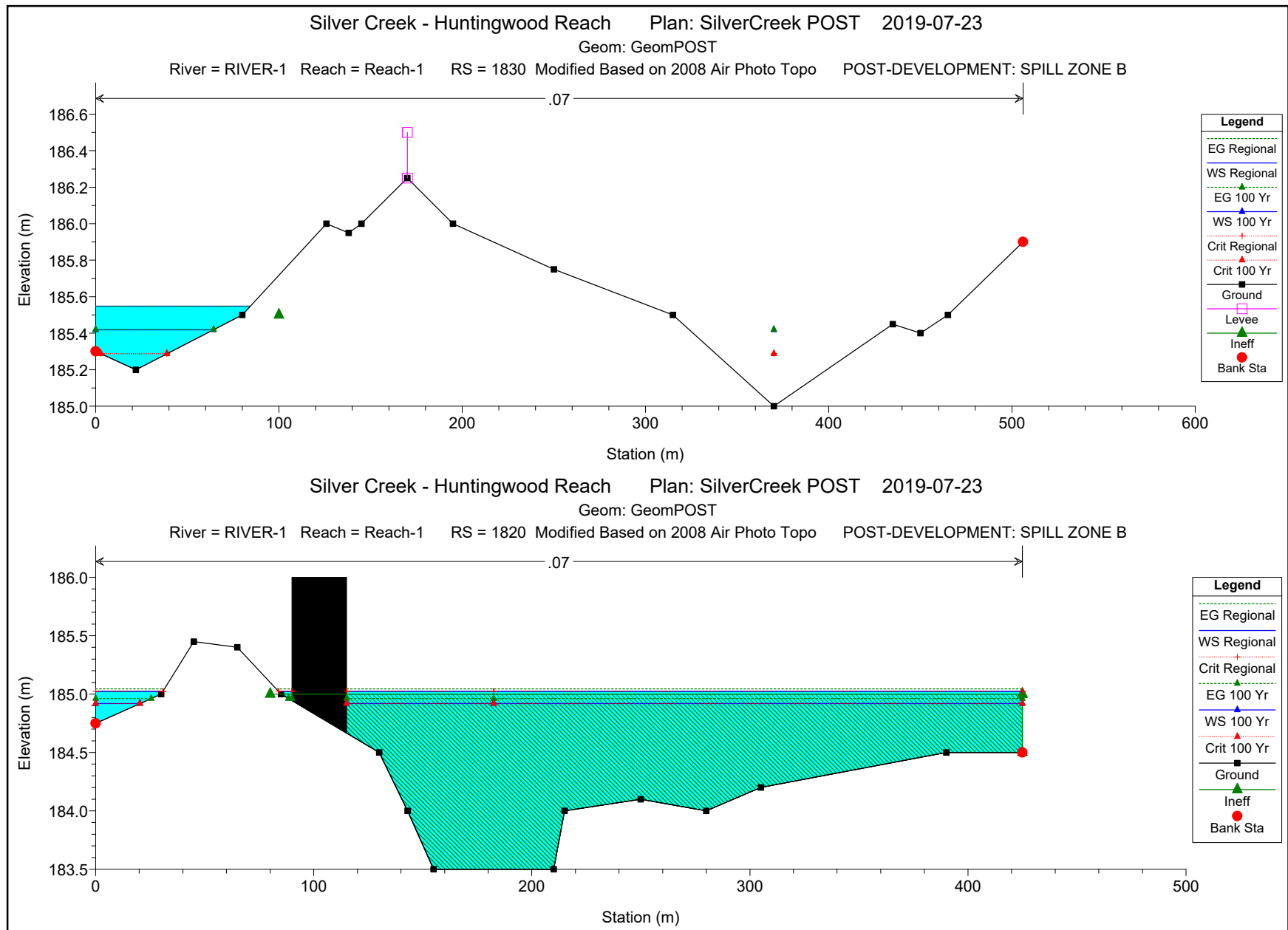
# Silver Creek - Huntingwood Reach    Plan: SilverCreek    2019-07-23

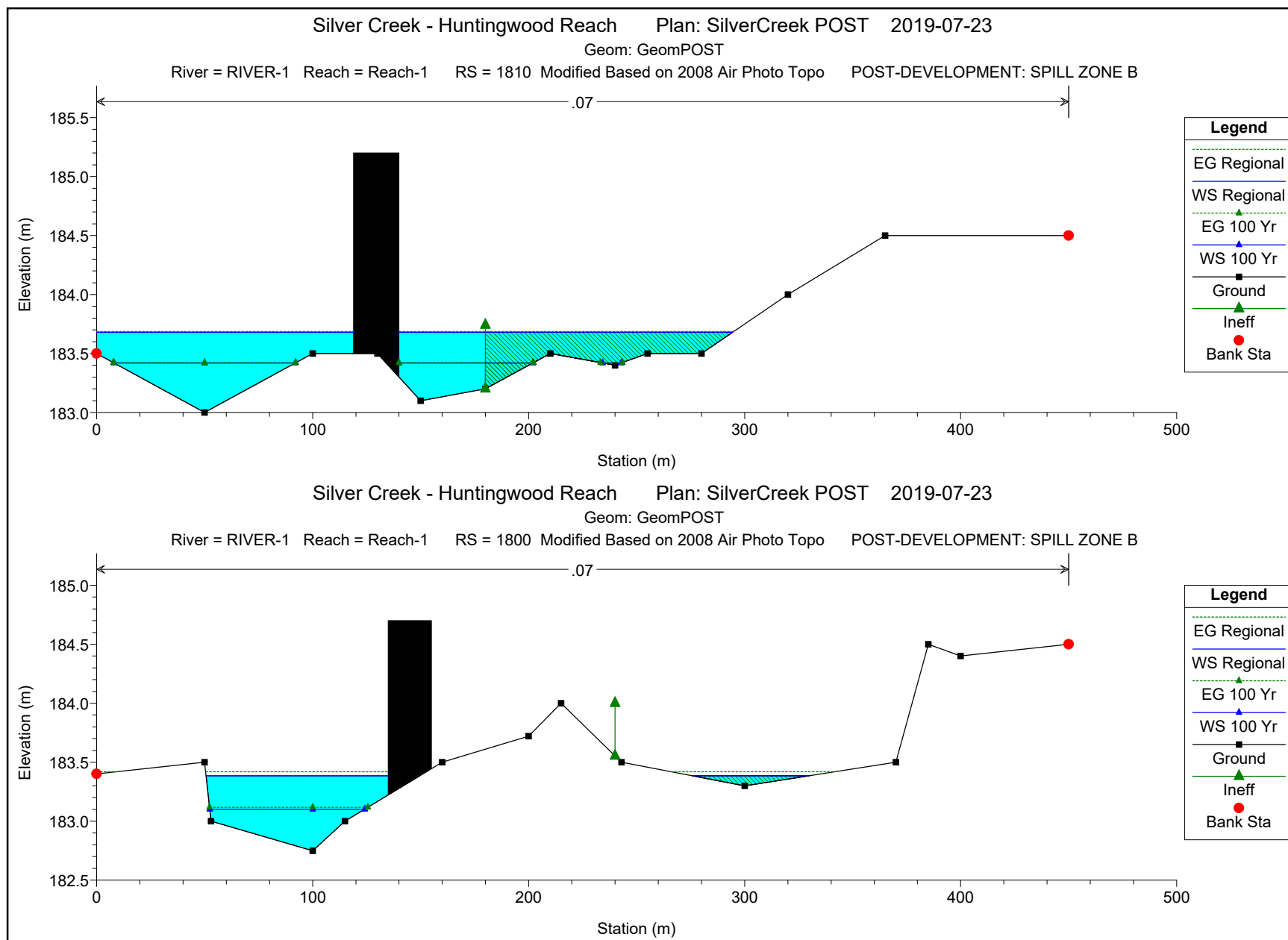
Geom: Geom

River = RIVER-1    Reach = Reach-1    RS = 1096    SWATH BETWEEN BUILDING LIMITED TO 10 METERS, INV. 179.61    PRE-DEVELOPMENT: SPILL ZONE B

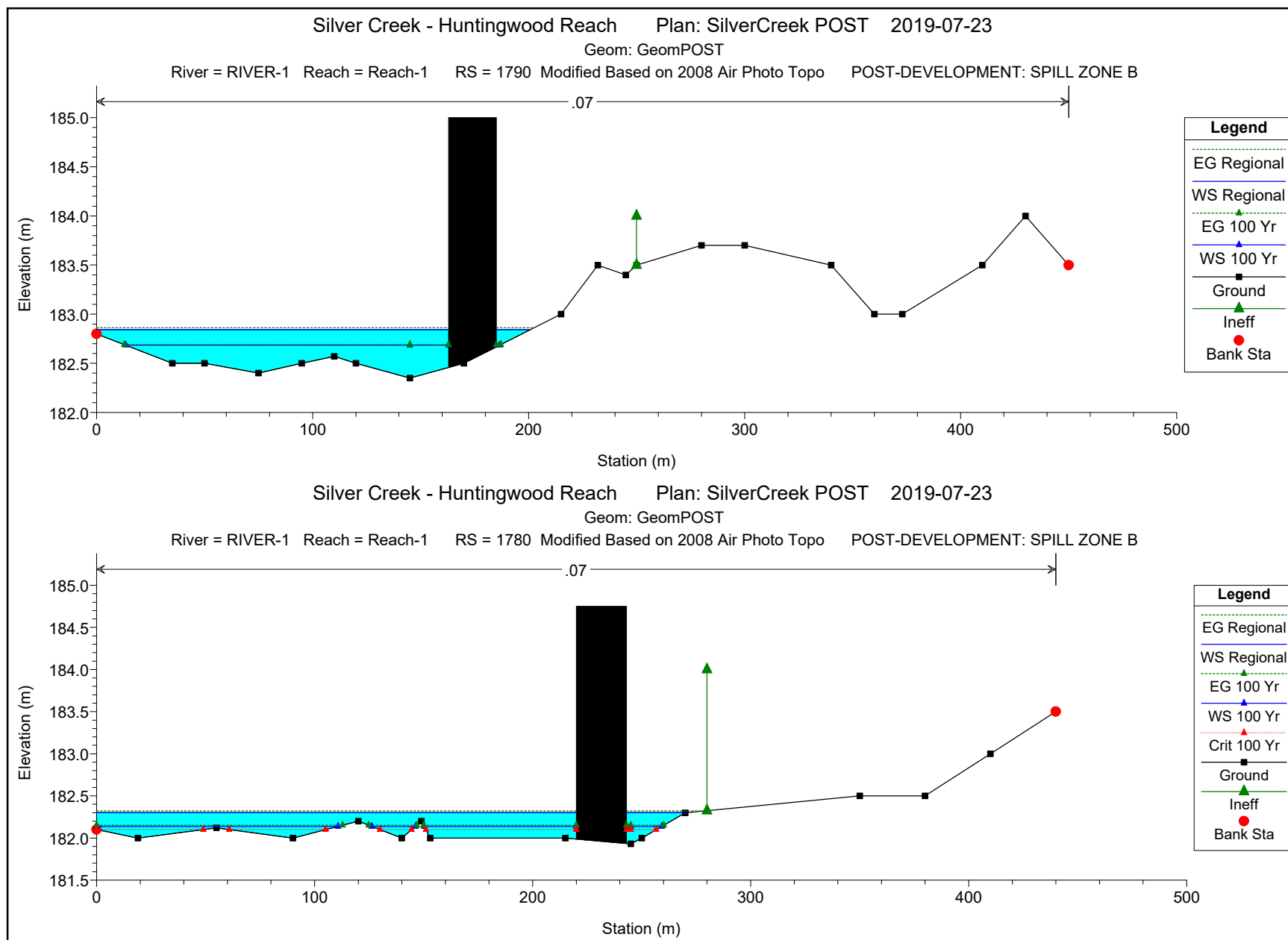


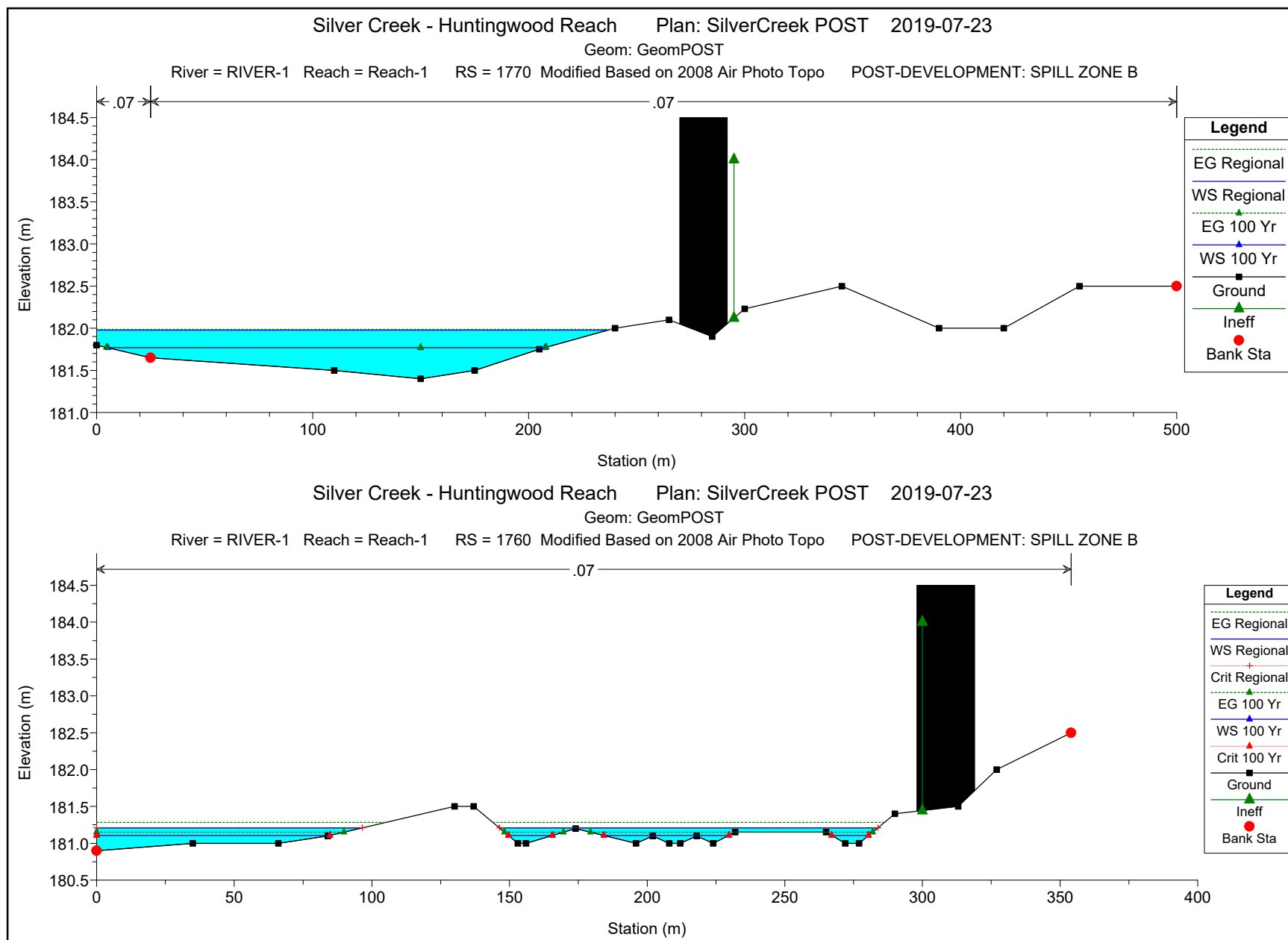
## SPILL ZONE B - POST-DEVELOPMENT







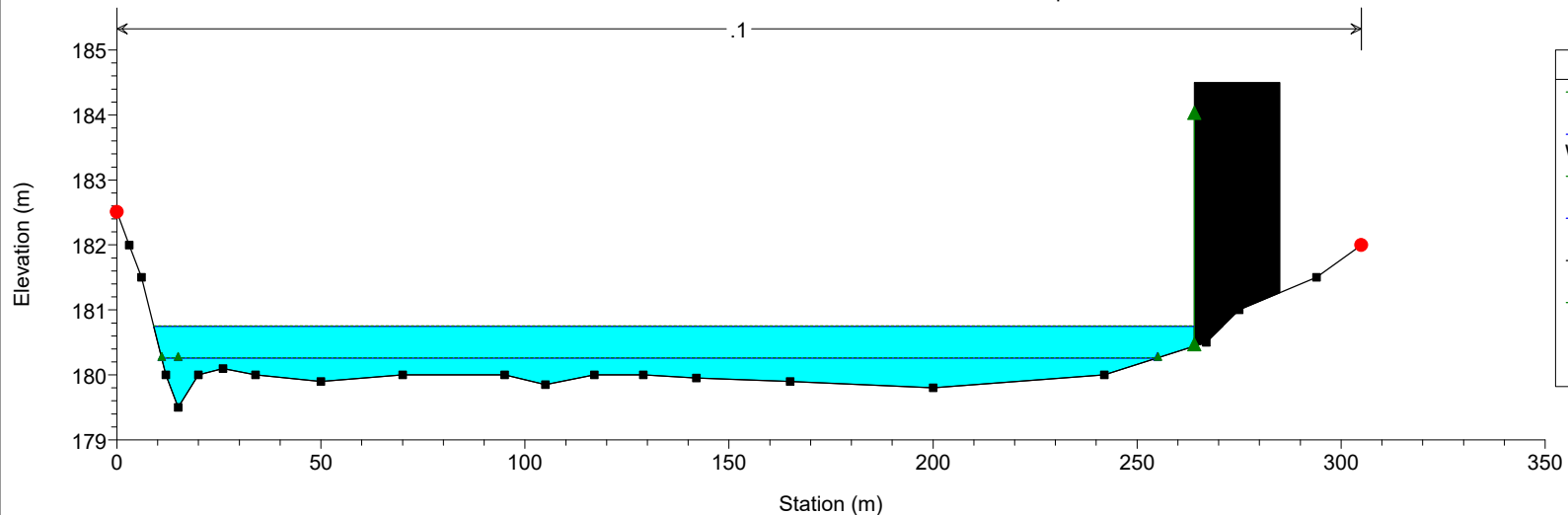




# Silver Creek - Huntingwood Reach Plan: SilverCreek POST 2019-07-23

Geom: GeomPOST

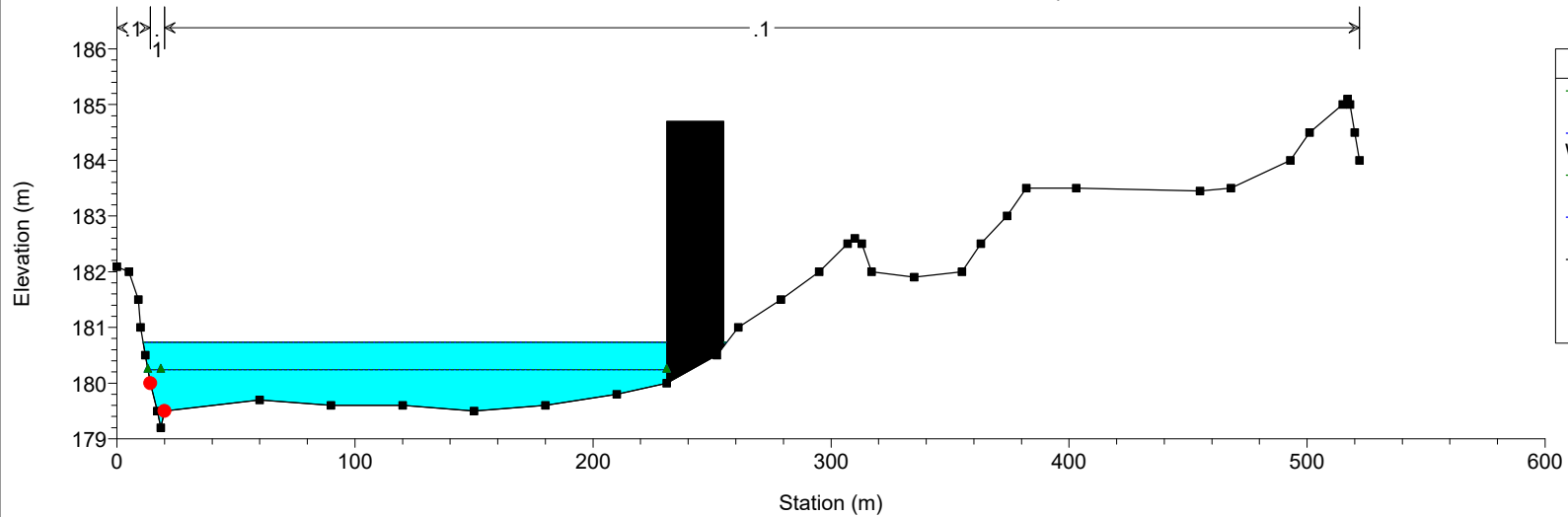
River = RIVER-1 Reach = Reach-1 RS = 1750 Modified Based on 2008 Air Photo Topo POST-DEVELOPMENT: SPILL ZONE B



# Silver Creek - Huntingwood Reach Plan: SilverCreek POST 2019-07-23

Geom: GeomPOST

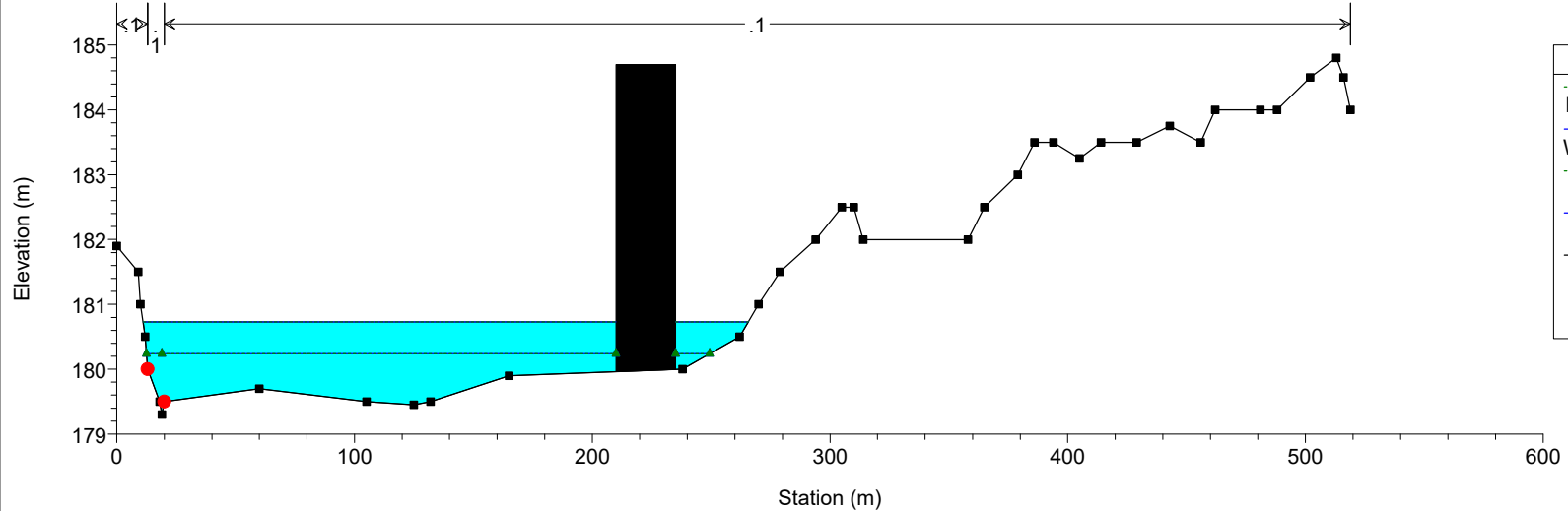
River = RIVER-1 Reach = Reach-1 RS = 1740 Modified Based on 2008 Air Photo Topo POST-DEVELOPMENT: SPILL ZONE B



# Silver Creek - Huntingwood Reach Plan: SilverCreek POST 2019-07-23

Geom: GeomPOST

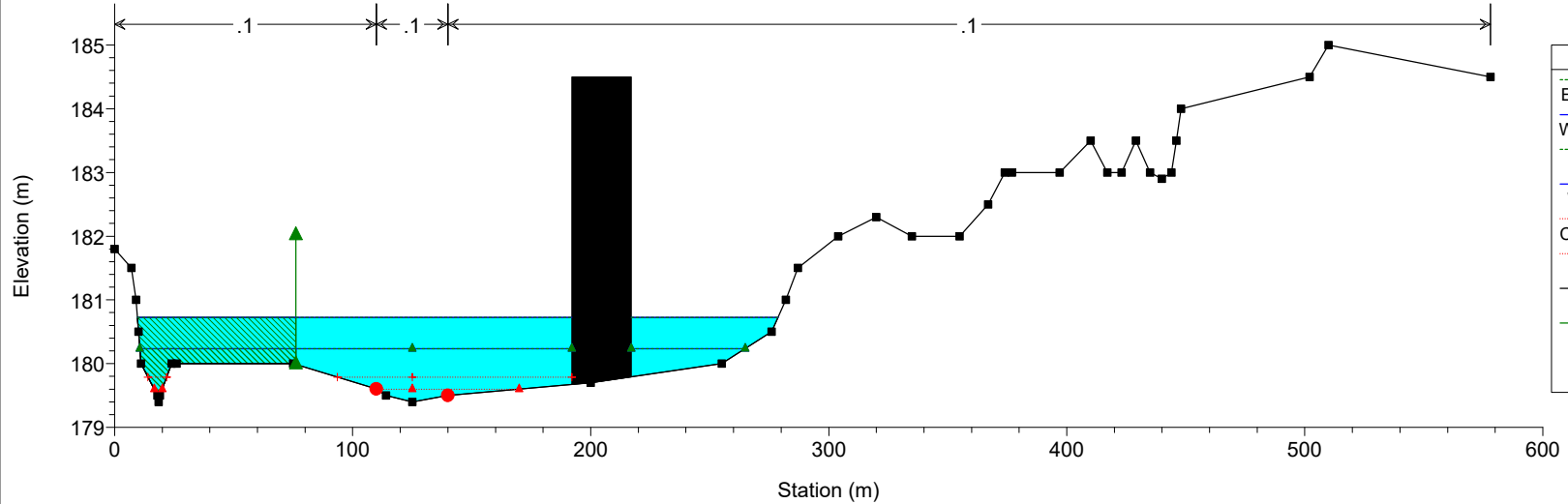
River = RIVER-1 Reach = Reach-1 RS = 1720 Modified Based on 2008 Air Photo Topo POST-DEVELOPMENT: SPILL ZONE B

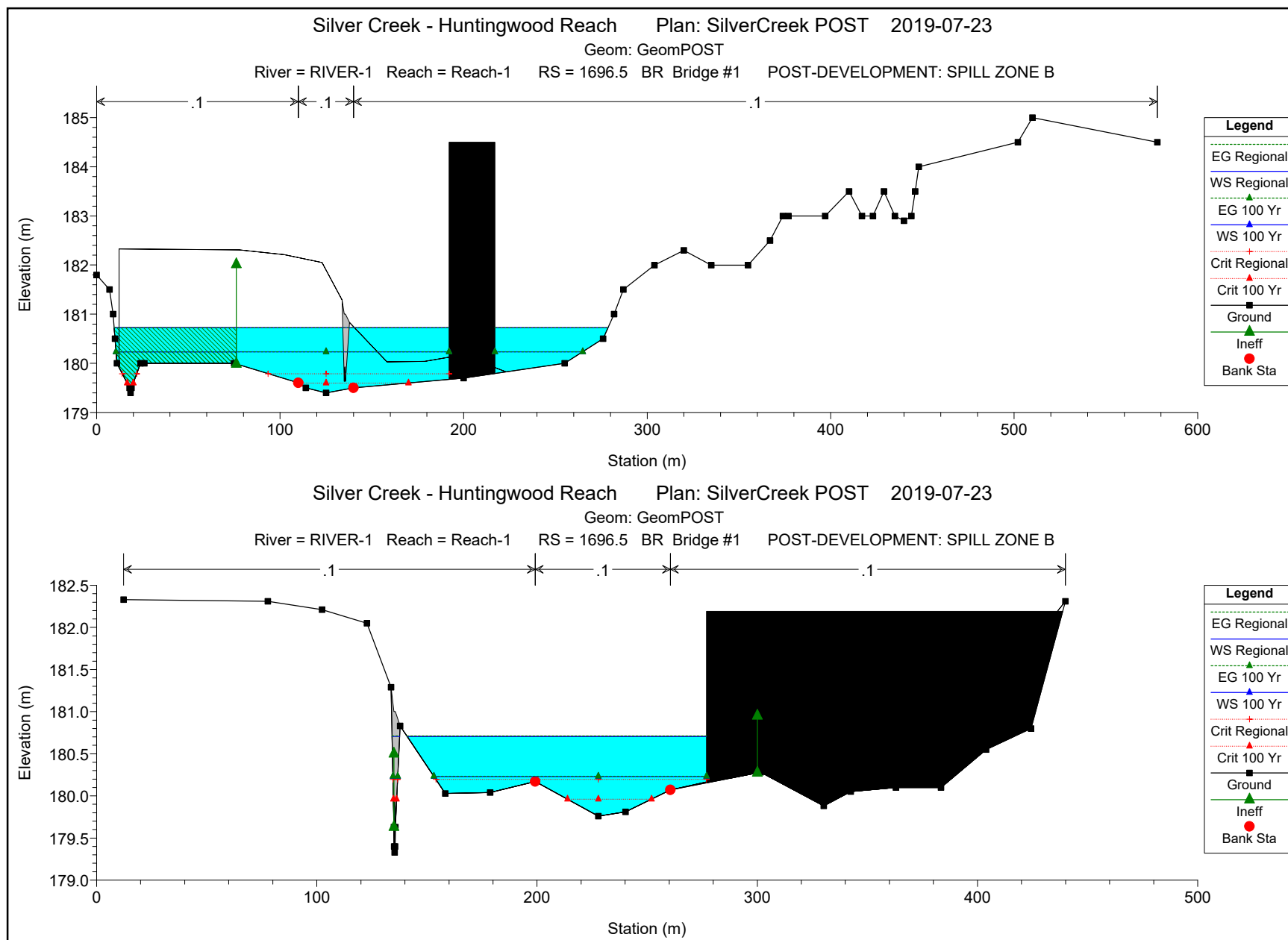


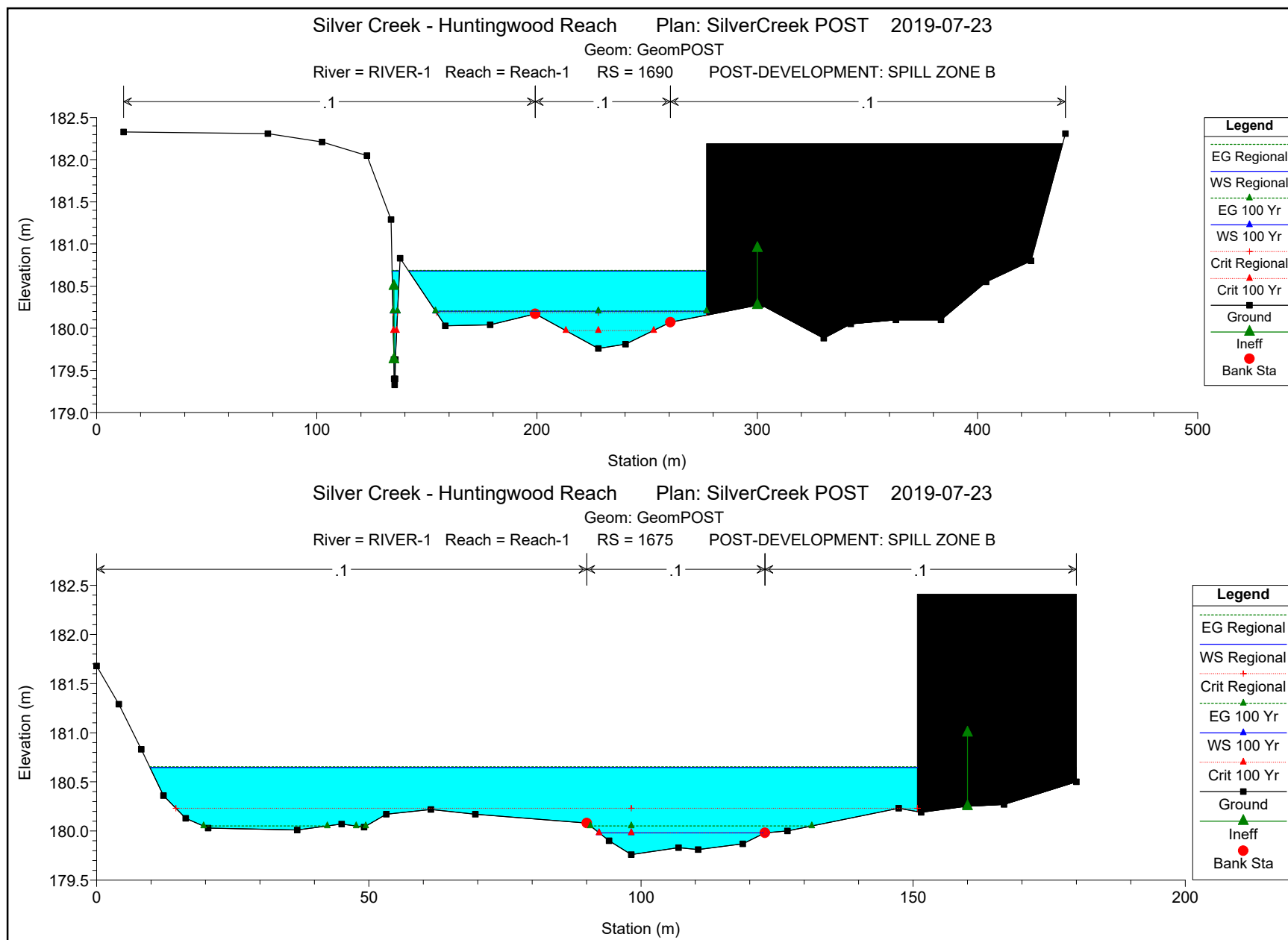
# Silver Creek - Huntingwood Reach Plan: SilverCreek POST 2019-07-23

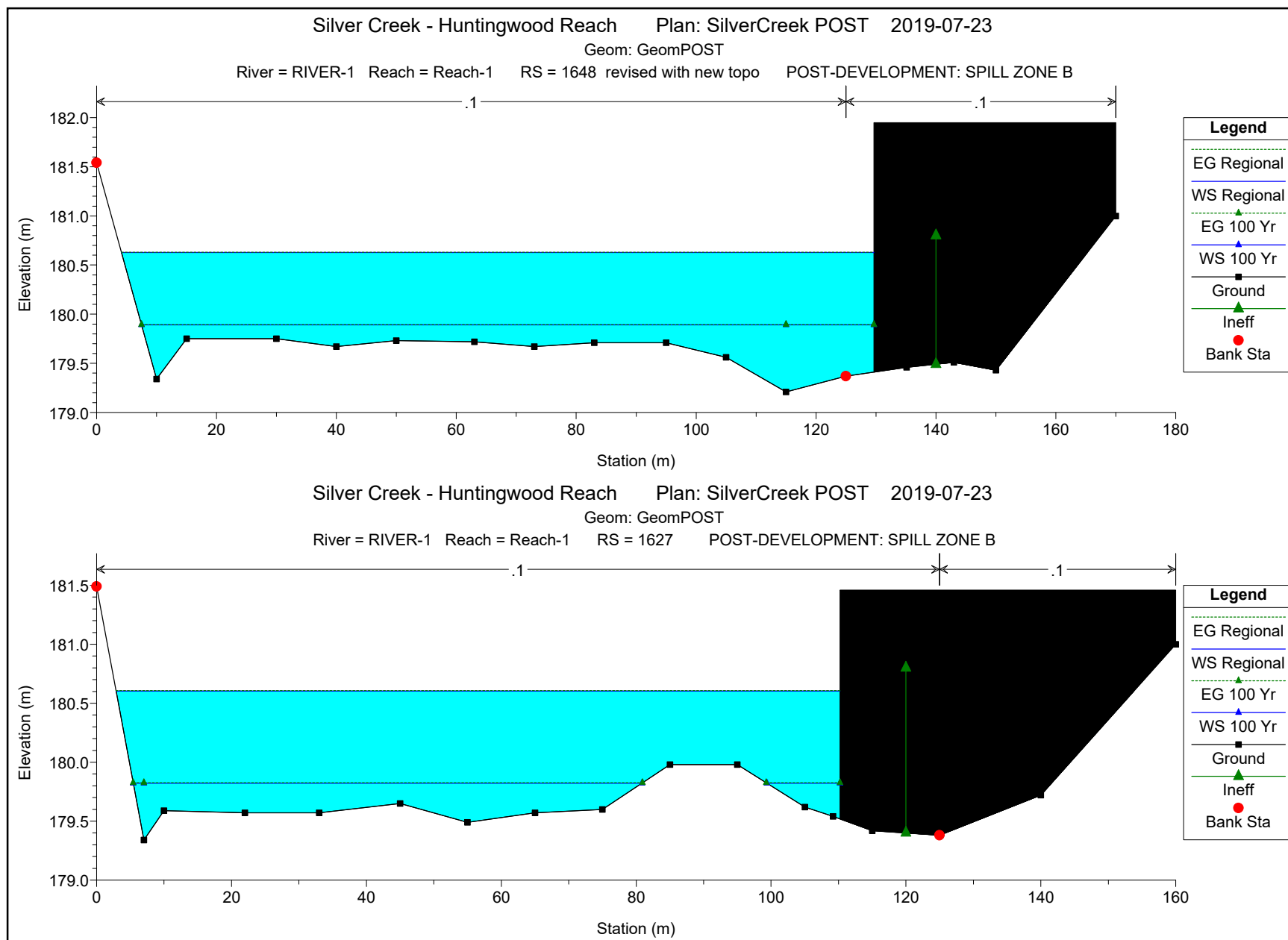
Geom: GeomPOST

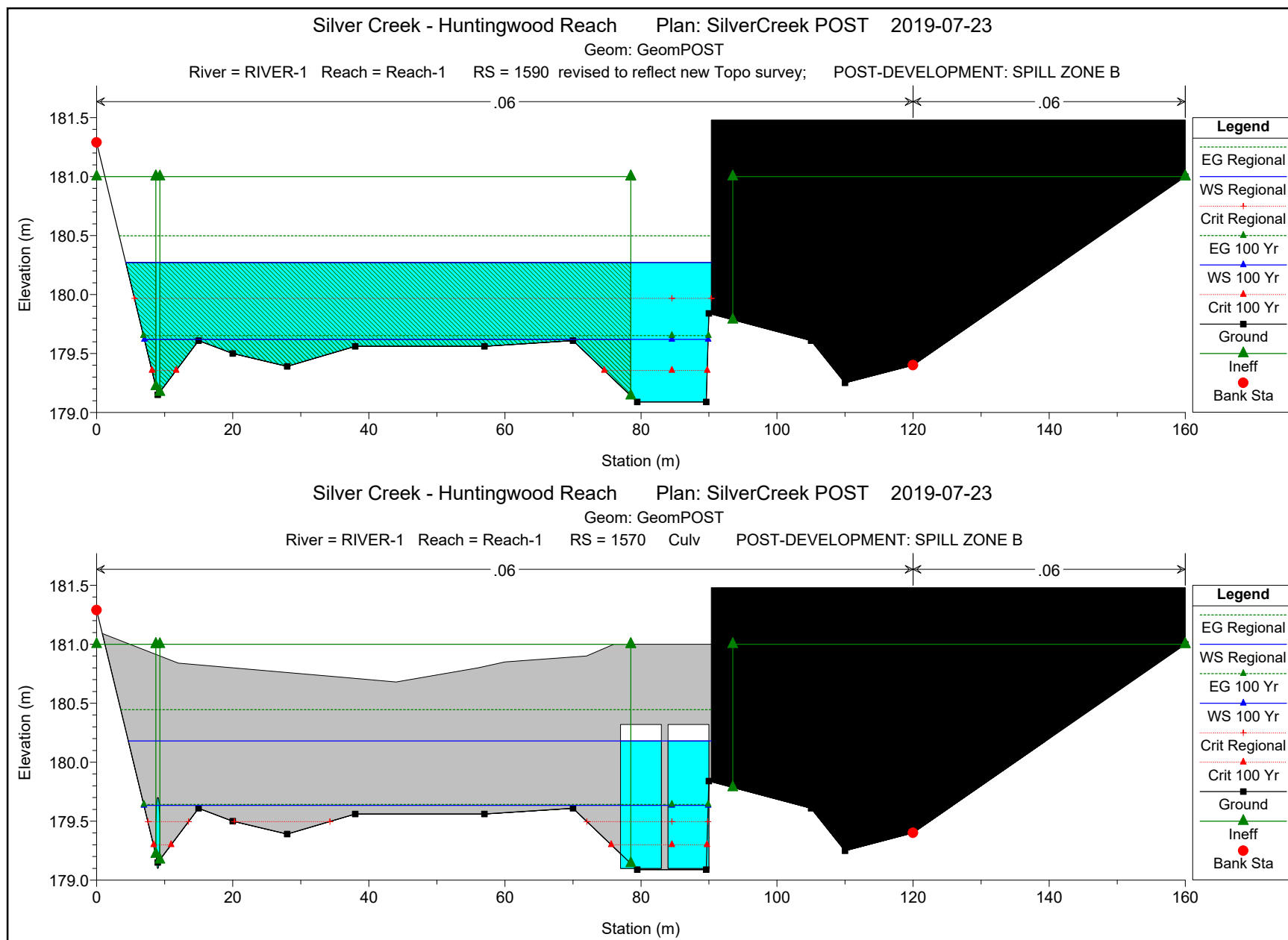
River = RIVER-1 Reach = Reach-1 RS = 1703 Modified Based on 2008 Air Photo Topo POST-DEVELOPMENT: SPILL ZONE B



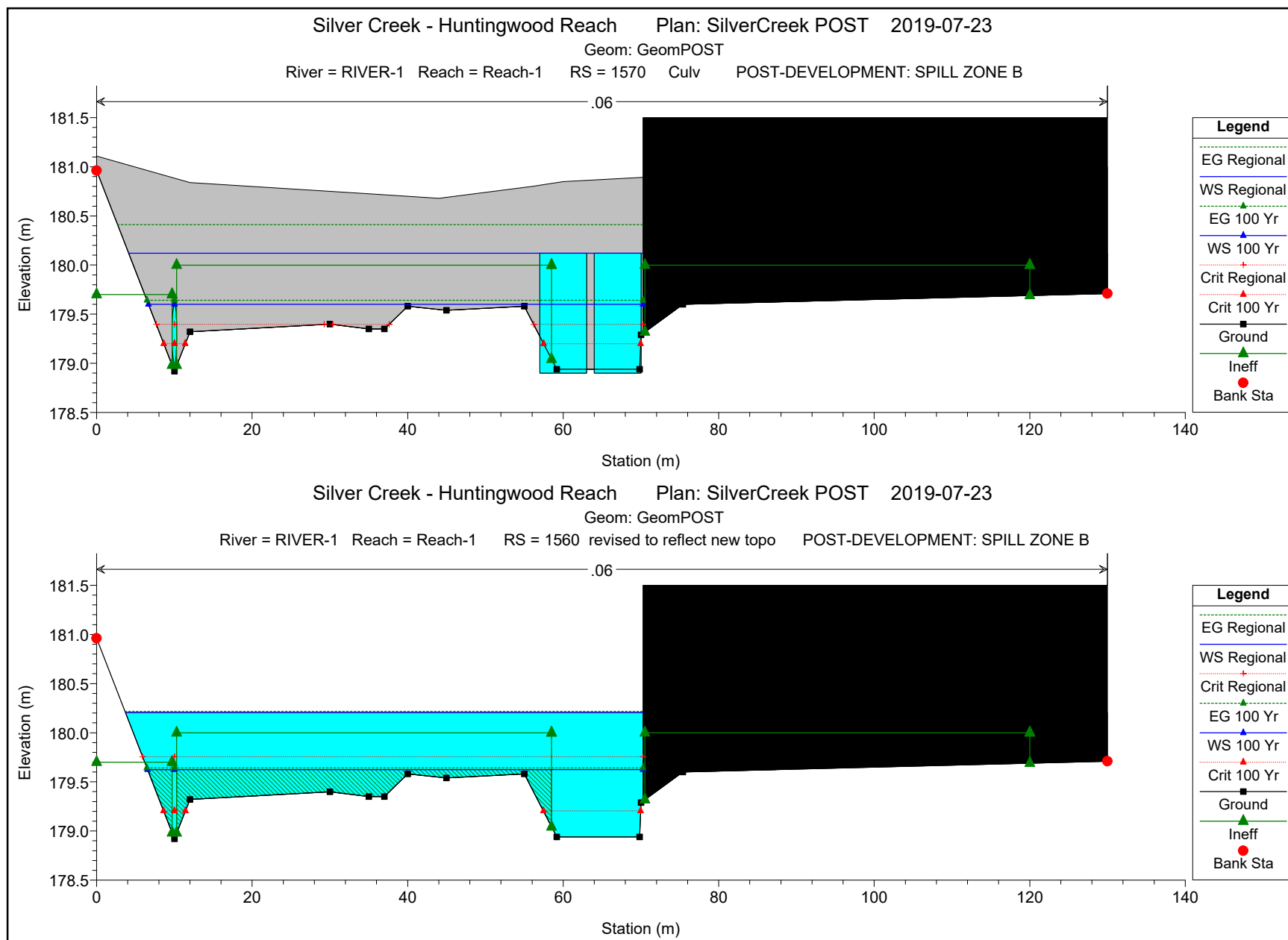


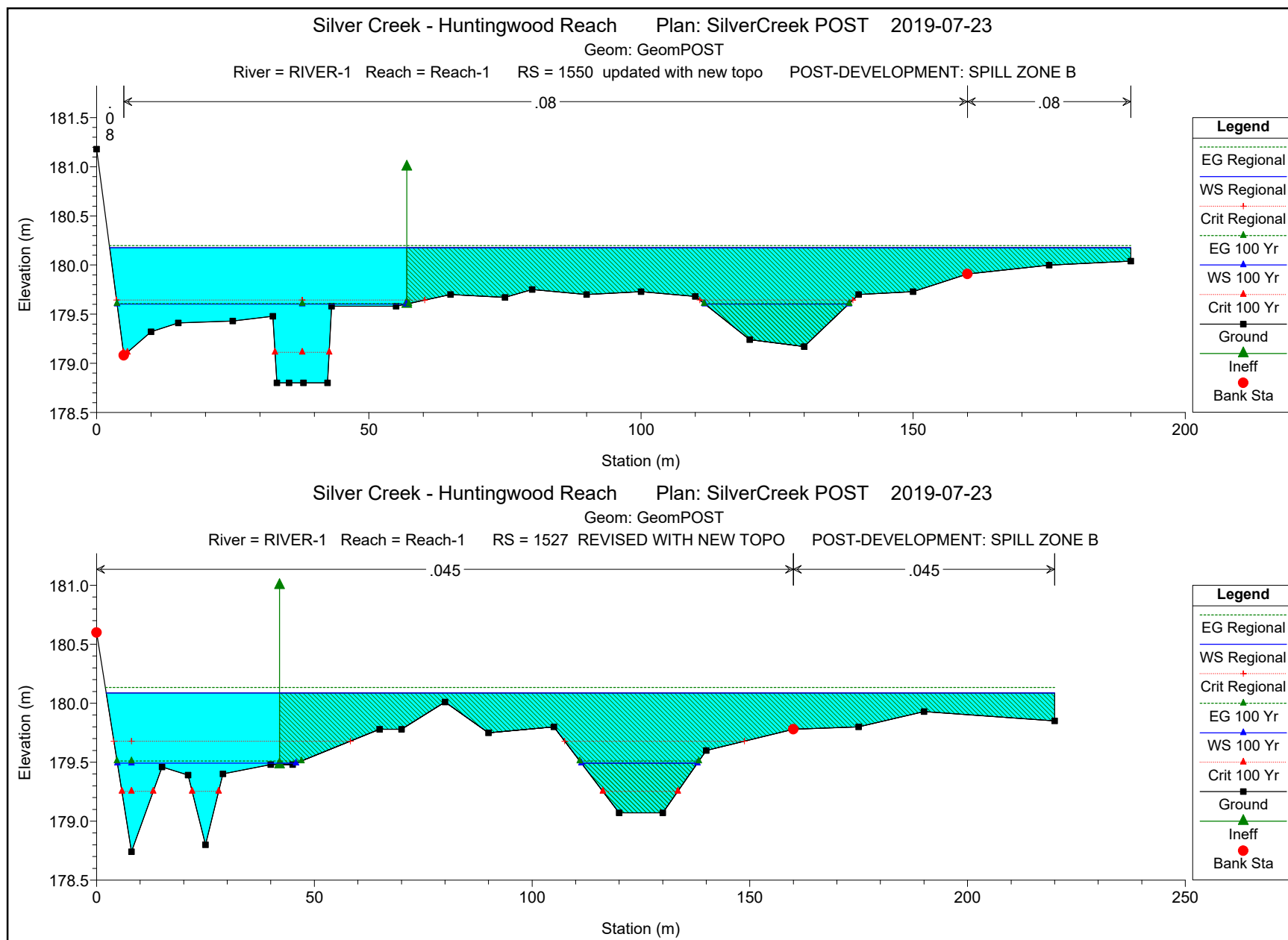


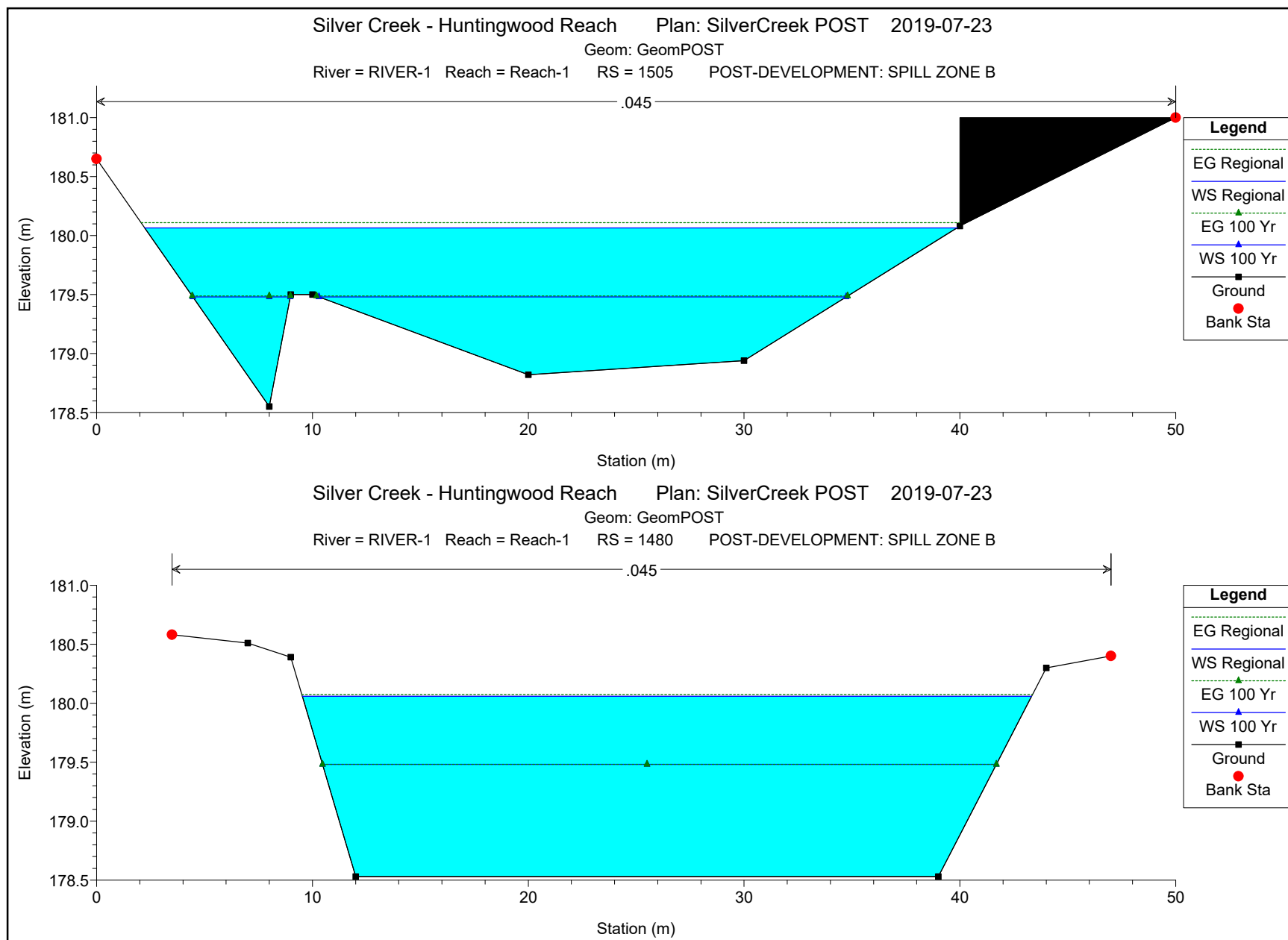


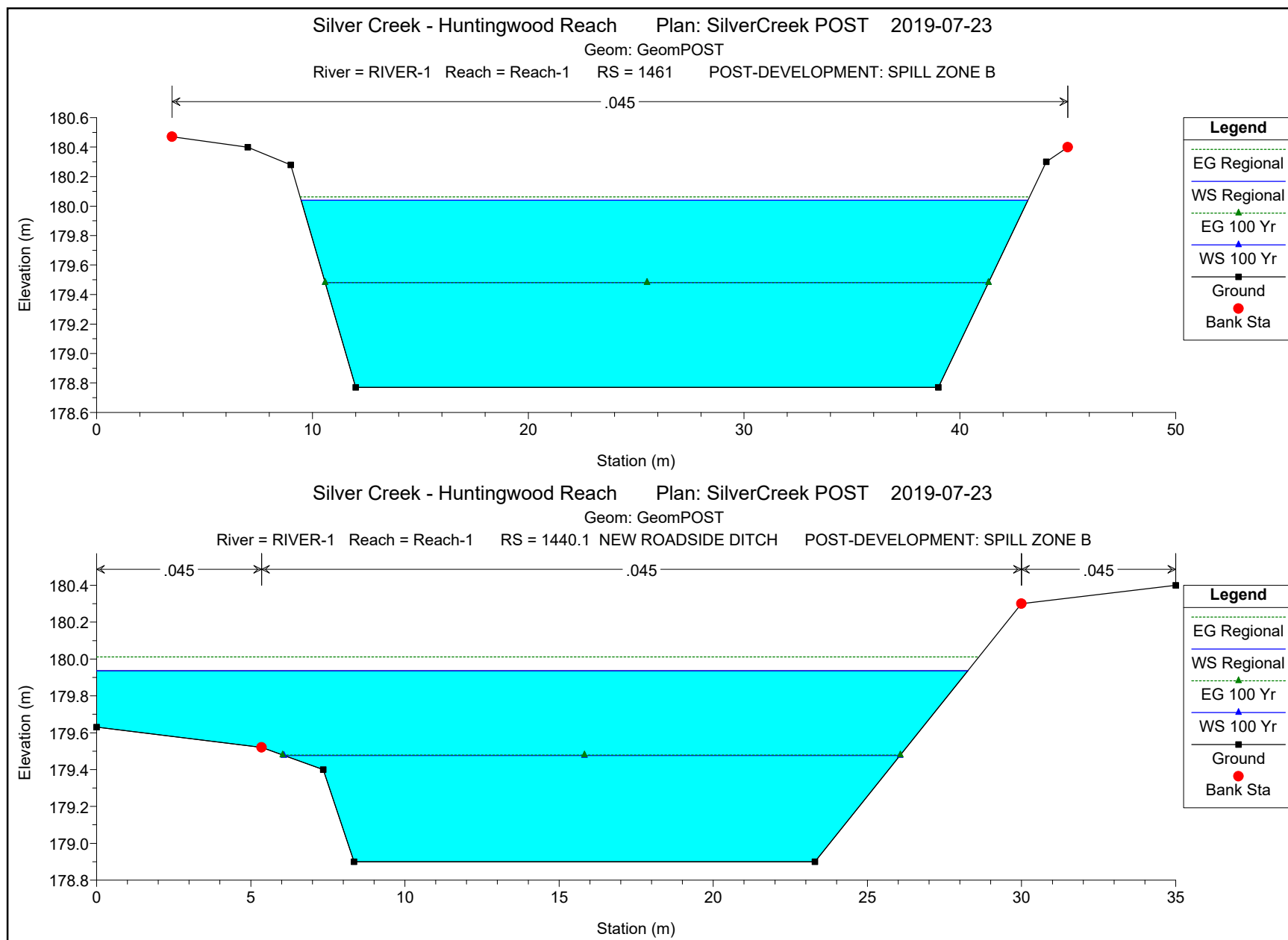








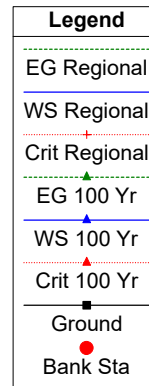
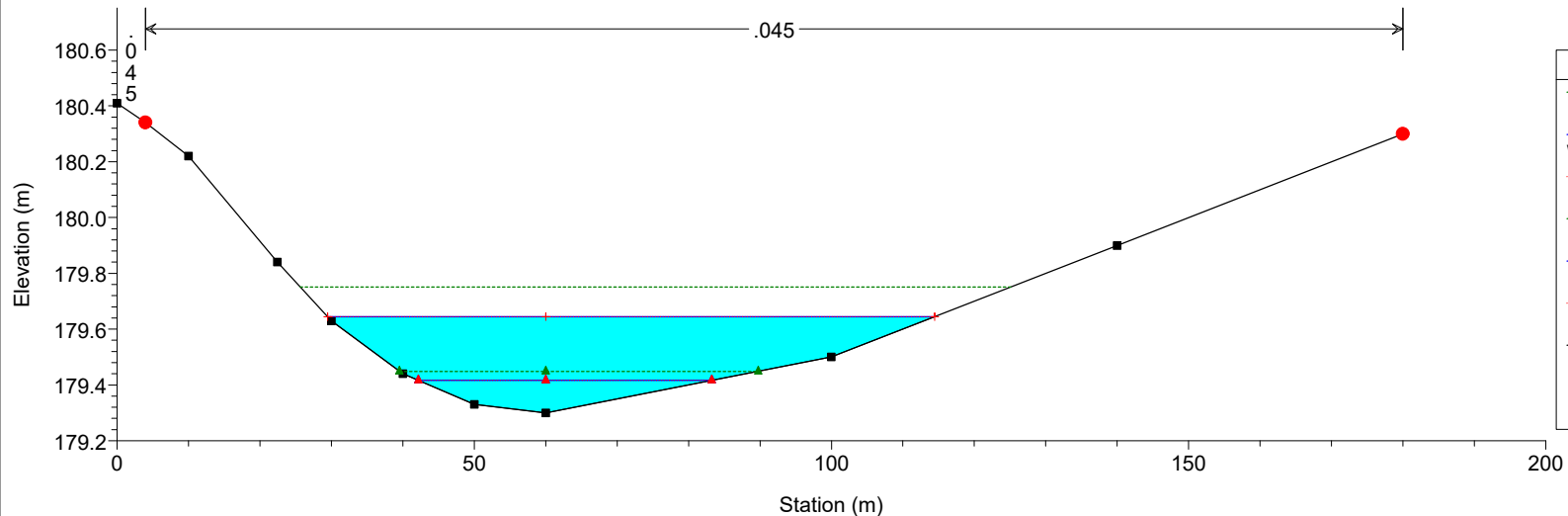




# Silver Creek - Huntingwood Reach Plan: SilverCreek POST 2019-07-23

Geom: GeomPOST

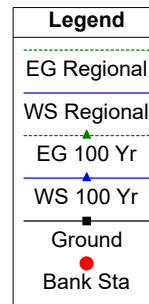
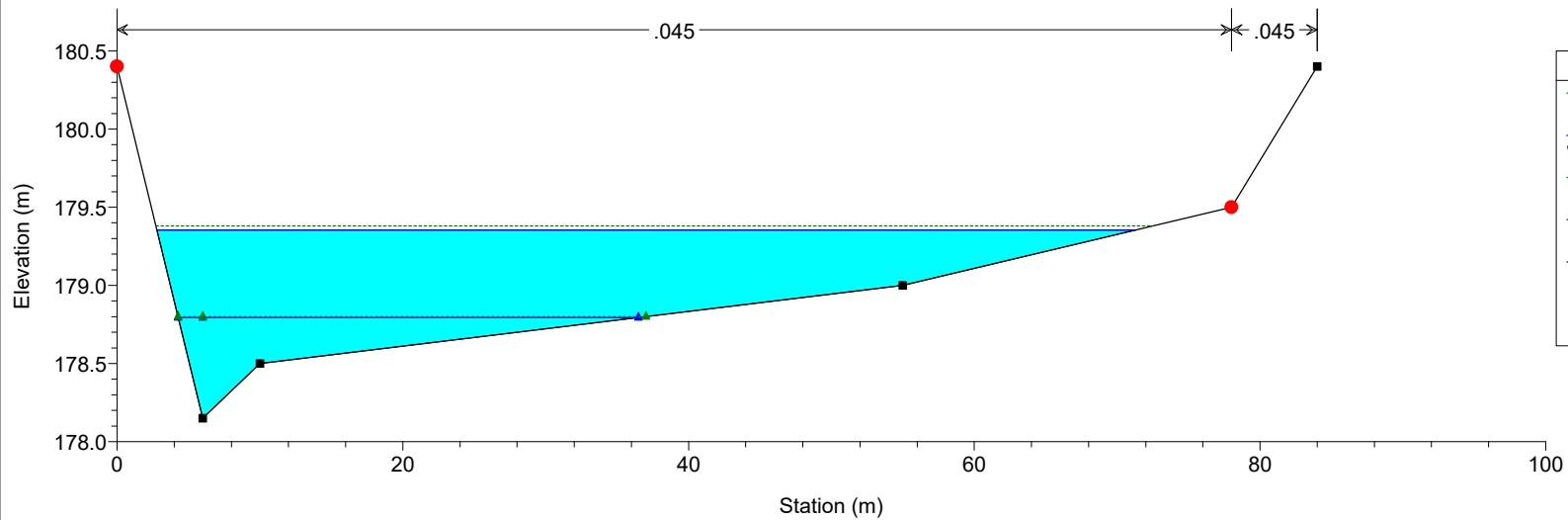
River = RIVER-1 Reach = Reach-1 RS = 1440 POST-DEVELOPMENT: SPILL ZONE B

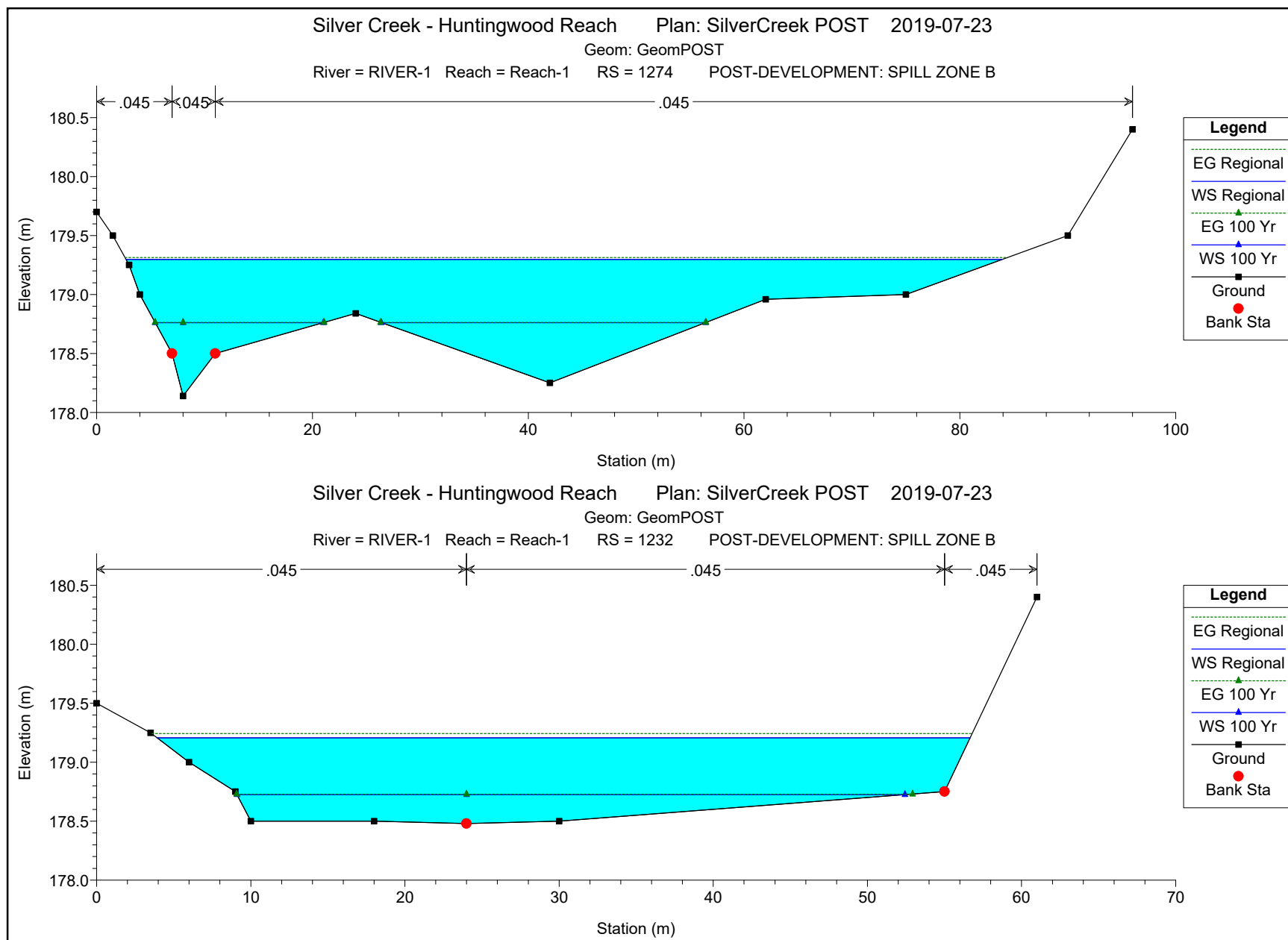


# Silver Creek - Huntingwood Reach Plan: SilverCreek POST 2019-07-23

Geom: GeomPOST

River = RIVER-1 Reach = Reach-1 RS = 1315 POST-DEVELOPMENT: SPILL ZONE B

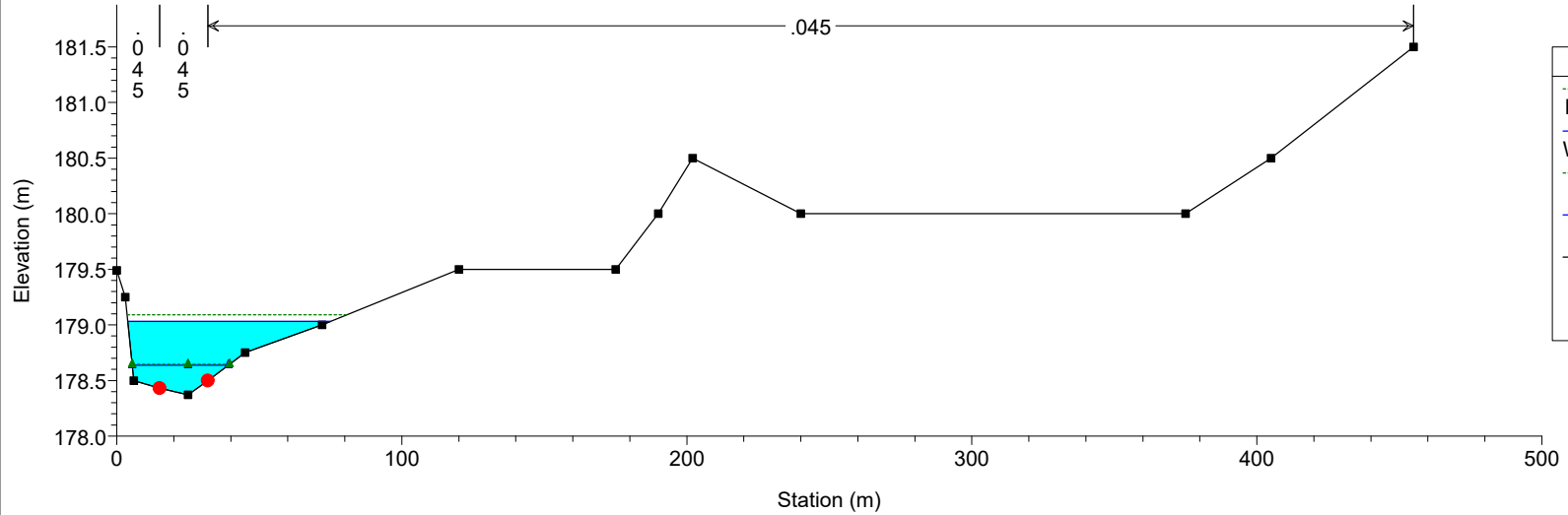




# Silver Creek - Huntingwood Reach Plan: SilverCreek POST 2019-07-23

Geom: GeomPOST

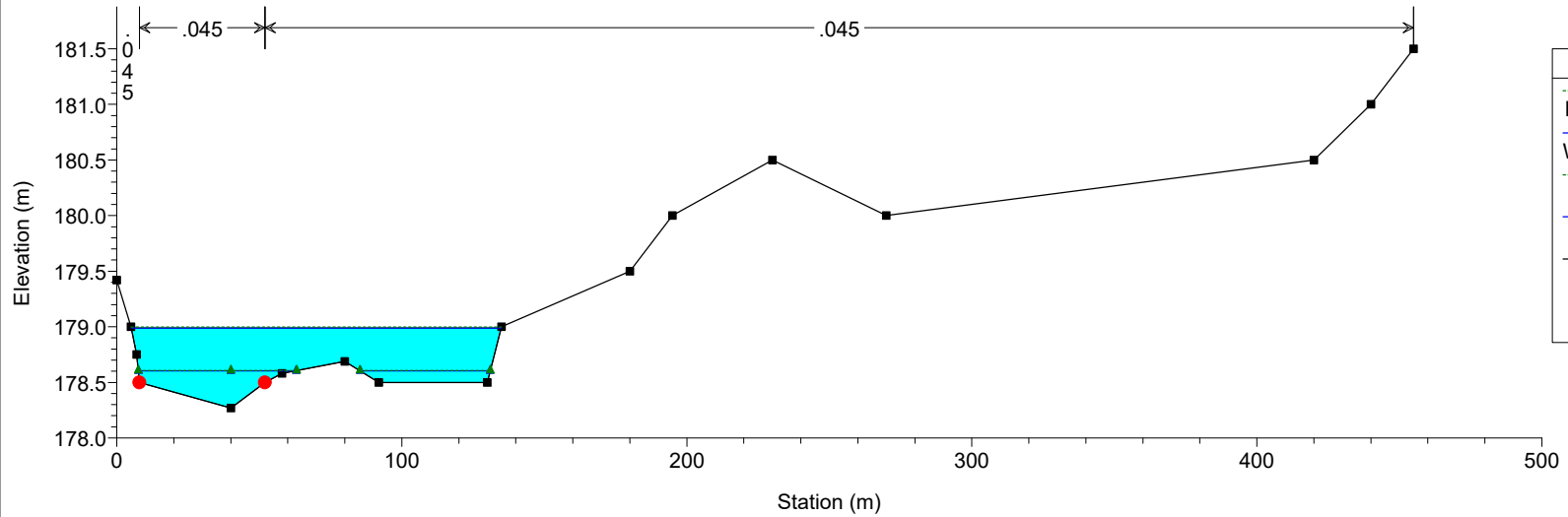
River = RIVER-1 Reach = Reach-1 RS = 1192 POST-DEVELOPMENT: SPILL ZONE B



# Silver Creek - Huntingwood Reach Plan: SilverCreek POST 2019-07-23

Geom: GeomPOST

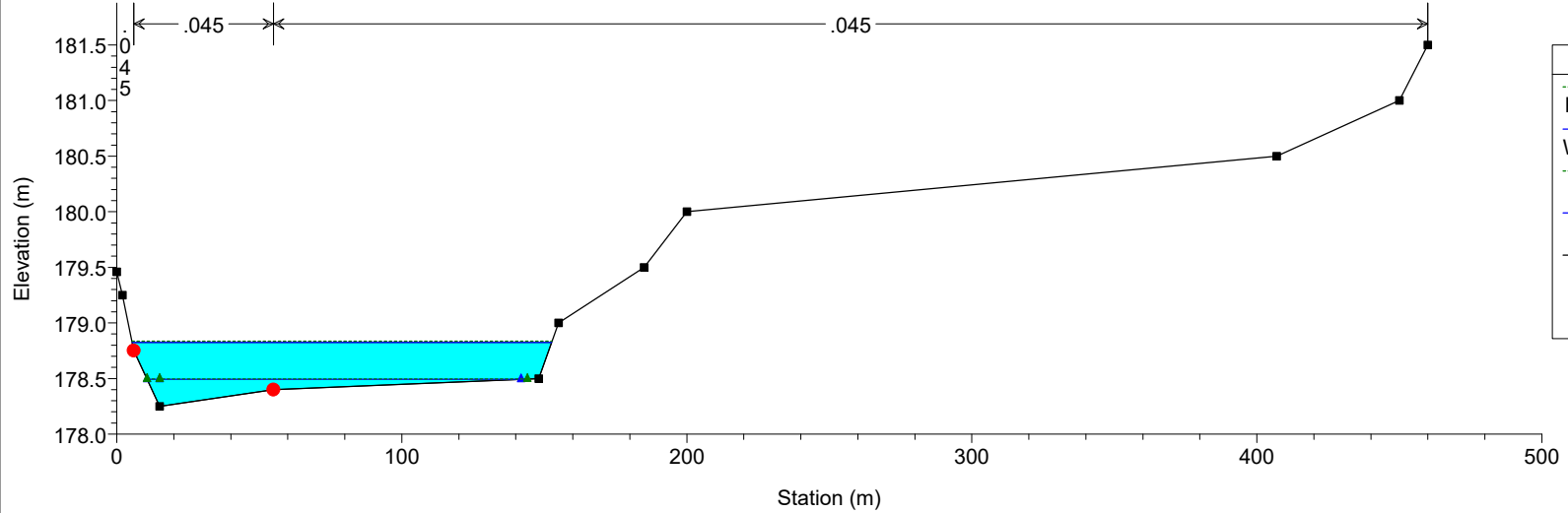
River = RIVER-1 Reach = Reach-1 RS = 1149 POST-DEVELOPMENT: SPILL ZONE B



# Silver Creek - Huntingwood Reach Plan: SilverCreek POST 2019-07-23

Geom: GeomPOST

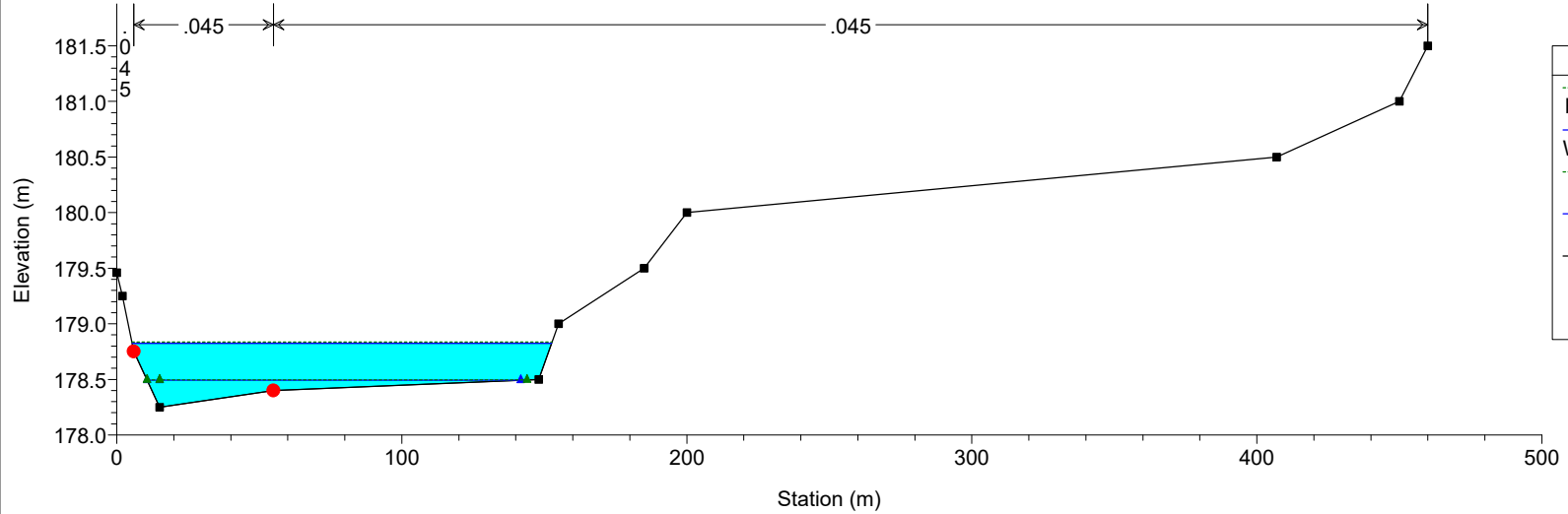
River = RIVER-1 Reach = Reach-1 RS = 1096.2 This is a REPEATED section. POST-DEVELOPMENT: SPILL ZONE B



# Silver Creek - Huntingwood Reach Plan: SilverCreek POST 2019-07-23

Geom: GeomPOST

River = RIVER-1 Reach = Reach-1 RS = 1096.1 This is a REPEATED section. POST-DEVELOPMENT: SPILL ZONE B







## **APPENDIX B**

### Meander Belt Calculations

#### Meander Belt Analysis

#### Parish Geomorphic – Meander Belt Width Assessment Technical Review



**HUNTINGWOOD - MEANDER BELT ANALYSIS**

**Reach Characteristics**

**Reach # 1**

|                        |          |                     |        |
|------------------------|----------|---------------------|--------|
| Upper Elevation        | 181.45 m | Entrenchment Ratio  | 31.3   |
| Lower Elevation        | 179.85 m | Width / Depth Ratio | 5.3    |
| Reach Length           | 285 m    | Sinuosity           | 1.05   |
| Channel Length         | 298 m    | Valley Slope        | 0.0056 |
| Bankfull Channel Width | 6.4 m    | Channel Slope       | 0.0054 |
| Bankfull Channel Depth | 1.2 m    |                     |        |
| Flood Prone Width      | 200 m    |                     |        |

**Rosgen Classification E**

Meander Belt Width  $\Gamma = AW_b^B$

**Type E**

|            |             |   |
|------------|-------------|---|
| A =        | 6.69        |   |
| B =        | 1.43        |   |
| $W_b$      | 6.4         | m |
| $\Gamma =$ | <b>95.1</b> | m |

**Reach # 2**

|                        |          |                     |        |
|------------------------|----------|---------------------|--------|
| Upper Elevation        | 183.85 m | Entrenchment Ratio  | 12.0   |
| Lower Elevation        | 181.45 m | Width / Depth Ratio | 3.8    |
| Reach Length           | 284 m    | Sinuosity           | 1.51   |
| Channel Length         | 430 m    | Valley Slope        | 0.0085 |
| Bankfull Channel Width | 7.5 m    | Channel Slope       | 0.0056 |
| Bankfull Channel Depth | 2 m      |                     |        |
| Flood Prone Width      | 90 m     |                     |        |

**Rosgen Classification E**

Meander Belt Width  $\Gamma = AW_b^B$

**Type E**

|            |              |   |
|------------|--------------|---|
| A =        | 6.69         |   |
| B =        | 1.43         |   |
| $W_b$      | 7.5          | m |
| $\Gamma =$ | <b>119.3</b> | m |

**Reach # 3**

|                        |          |                     |        |
|------------------------|----------|---------------------|--------|
| Upper Elevation        | 185.5 m  | Entrenchment Ratio  | 23.1   |
| Lower Elevation        | 183.85 m | Width / Depth Ratio | 4.6    |
| Reach Length           | 163 m    | Sinuosity           | 1.10   |
| Channel Length         | 180 m    | Valley Slope        | 0.0101 |
| Bankfull Channel Width | 6.5 m    | Channel Slope       | 0.0092 |
| Bankfull Channel Depth | 1.4 m    |                     |        |
| Flood Prone Width      | 150 m    |                     |        |

**Rosgen Classification E**

Meander Belt Width  $\Gamma = AW_b^B$

**Type E**

|            |             |   |
|------------|-------------|---|
| A =        | 6.69        |   |
| B =        | 1.43        |   |
| $W_b$      | 6.5         | m |
| $\Gamma =$ | <b>97.3</b> | m |

July 20, 2011

PGL Ref: 01-11-48

Chris Crozier, P.Eng.  
C.F.Crozier & Associates Inc  
110 Pine Street  
Collingwood, Ontario L9Y 2N9

Dear Chris,

**RE: Huntingwood Trails – Meander Belt Width Assessment  
Technical Review**

As requested, I have reviewed the Natural Hazards Study for the proposed Huntingwood Trails development. Specifically, the review focused on the hazard assessment of Silver Creek. The hazards, in this context, include erosion and channel migration, which were assessed through a meander belt width procedure. The results of the meander belt width assessment were then applied, in conjunction with the regulatory floodplain, to determine the width and configuration of the corridor/valley of the creek for the development. In this instance, it appears that the meander belt width was the governing parameter and resulted in a corridor width varying from approximately 95m to 120m. While the resulting values are appropriate, it is worth noting that the approach and methods are not necessarily the standard, typical approach. First of all, the author divided Silver Creek into 3 reaches although the rationale for the reach delineation was not provided. Additionally, although not noted, it is apparent from the maps that the creek had likely been altered in the past, as the downstream section Reach 1 had been straightened. However, subsequent discussions with the author revealed that more exhaustive analyses were completed including a historic evaluation of the creek.

The standard methodology for the meander belt width delineation normally relies on measurements from topographic mapping and aerial imagery, instead of empirical equations. In the case of Reach 1, the meander bend width of the unaltered reach (Reach 2) would be used as a surrogate for the downstream altered reach. However, the end result is appropriate as the author's approach produced a reasonable and conservative value. If the traditional approach was used, the meander belt width for Reach 2 would be

75m. A factor of safety /setback would then be applied, which would typically be 10% of the meander belt width on both sides, resulting in a final corridor width of 90m. This value would be used for both Reach 1 and Reach 2. The values presented by the author are 120m and 95 m, respectively. Thus, while the applied methods were not typical, they resulted in a conservative result that is appropriate for this site.

I trust you'll find this review to be beneficial and satisfactory for submission to the NVCA. If there any questions, please do not hesitate to call.

Respectfully submitted,

A handwritten signature in blue ink, appearing to read 'J. Parish', is positioned above the printed name.

(digitally signed)

John Parish, M.A., P.Geo.  
PARISH Geomorphic Ltd.

## **APPENDIX C**

### OMB Supporting Documents

Joint Witness Statement of Chris Crozier, Jon Proctor, Les Pataky – Natural Hazards –  
September 2013

OMB Decision – July 2014

**ONTARIO MUNICIPAL BOARD**  
***Commission des affaires municipales de l'Ontario***

Huntingwood Trails (Collingwood) Ltd. Has appealed to the Ontario Municipal Board under subsection 22(7) of the *Planning Act*, R.S.O. 1990, c. P.13, as amended, from Council's neglect to enact a proposed amendment to the Official Plan for the Official Plan for the Town of Collingwood to remove lands legally described as Part of Lots 47, 48, and 49, Concession 12, from the Mountain Road West Corridor Secondary Plan Study Area and designate the lands for development.

**Approval Authority File No. D09111**  
**O.M.B. File No. PL120784**

**JOINT WITNESS STATEMENT OF**

Christopher F. Crozier, P.Eng., Jonathan M. Proctor, P.Eng.,  
and Leslie A. Pataky, P.Eng.

C.F. CROZIER & ASSOCIATES INC.

Our address and other contact information are at the end of this Witness Statement. Our qualifications are set out in the *Curriculum Vitae*, which are **Attachment 1** to this Witness Statement. Our signed Acknowledgments of Expert's Duty forms are **Attachment 2** to this Witness Statement.

We will give factual and expert opinion evidence in the discipline of natural hazards and, more specifically, the subject of floodplain and spill management. Our evidence will address Issue 16 of the approved Issues List. Servicing and stormwater management are addressed in a separate Joint Witness Statement of Christopher Crozier and Jonathan Proctor.

**Christopher F. Crozier, P.Eng. Consulting Engineer**

I am a Professional Consulting Engineer registered by the Professional Engineers of Ontario with twenty-three (23) years of experience. I am the President of CF Crozier & Associates Inc., a consulting engineering firm which I founded in 2004 that now operates offices in Collingwood and Milton, Ontario.

Over my career, I have specialized in servicing, stormwater management and water resources including natural hazard management for the land development industry and have completed engineering design for residential and commercial/industrial developments throughout Southern Ontario with a greater focus in the Collingwood area over the past ten years. I have completed floodplain modelling, designed flood improvements and engineered conveyance channels, examined impacts of floodlines

through developments and authored natural hazard assessments. I have been involved in the assessment of natural hazards for properties both immediately downstream and adjacent to the subject lands.

I hold a Bachelor of Engineering and Management from McMaster University (1990).

**Jonathan M. Proctor, P.Eng.**

I am a Professional Engineer registered by the Professional Engineers of Ontario with seven (7) years of experience. I work as a Project Engineer with CF Crozier & Associates Inc. working out of the firm's Collingwood Office.

Over my career, I have specialized servicing, stormwater management and water resources for the land development industry having completed engineering design for residential and commercial/industrial developments. I have completed floodplain modelling, designed flood improvements and engineered conveyance channels, examined impacts of floodlines through developments, completed erosion hazard studies and authored natural hazard assessments. I have been involved in the assessment of natural hazards for properties both immediately downstream and adjacent to the subject lands.

I hold a Bachelor of Science in Engineering (Honours Program, 2006) from the University of Guelph where I specialized in Water Resource Engineering.

**Leslie A. Pataky, P.Eng.**

I am a Professional Engineer registered by the Professional Engineers of Ontario with thirty-nine (39) years of experience, including thirty-one (31) years working for the Ontario Ministry of Natural Resources (MNR). I am currently a senior project engineer with CF Crozier & Associates Inc. Over my career, I have undertaken floodplain mapping, designed flood mitigation measures (e.g. channels, dams, dykes), undertaken hazard assessments, reviewed municipal planning documents, reviewed development proposals for consistency with natural hazards and stormwater management policies, provided technical support to municipalities and conservation authorities on implementation of natural hazards policy and made recommendations to the provincial government related to the approval of Special Policy Areas. I was the senior engineer on the Steering Committee that developed the *Technical Guide, River and Stream Systems; Flooding Hazard Limit (2002)* which provides technical standards for establishing the extent of the Regulatory Floodplain and direction on implementation of flood hazard policies.

I hold a Bachelor of Applied Science in civil engineering (Honours, 1974) from the University of Toronto.



## **Retainer**

C.F Crozier & Associates Inc. was retained in 2008 to provide engineering services in connection with planning applications relating to the development of a 49 hectare property legally described as Part of Lots 47, 48 and 49, Concession 12, Town of Collingwood, referred to as the "Huntingwood Trails Development" or the "Subject Property".

Our office initiated an investigation into the onsite natural hazards including floodplain, spill zone and erosion hazards for the reach of Silver Creek through the Subject Property. The scope of our work included review of relevant background reports, field visits and measurements, calculations, computer modeling and results interpretation.

Our findings were used to develop conceptual development plans in concert with other team members (including planning and environmental disciplines). The findings of our natural hazards assessment were incorporated in the report "Natural Hazards Study Huntingwood Trails (Collingwood) Ltd. (Crozier, January 2011) ("the Natural Hazards Study").

## **Previous Studies and Background Information**

In 1989, Cumming Cockburn Limited (CCL) conducted a study respecting the Silver Creek floodplain under the auspices of the Federal Flood Damage Reduction Program for the Nottawasaga Valley Conservation Authority ("NVCA"). This study mapped the Regulatory Floodplain along a 5 km reach of Silver Creek extending from the outlet at Georgian Bay. The study also identified two spill zones along Silver Creek, namely; a westerly spill upstream of the Georgian Trail identified as Spill Zone 'A' and an easterly spill upstream of Highway 26 through the Subject Lands, identified as Spill Zone 'B'.

Since 1989, other studies have been completed which have delineated the Regulatory Floodplain along Silver Creek and addressed the hazard associated with Spill Zone B, based on the original framework provided by CCL. These studies were prepared in connection with development applications for lands to the east of the Subject Lands, including Cranberry Links (C.C. Tatham, 1993) and Silver Glen Preserve (Crozier, 2006), and to the north of the Subject Lands for The Consulate Development (Crozier, 2007 & 2008). These other studies confirmed that spill conditions continued to be identified on the east side of Silver Creek and recommended floodproofing techniques to eliminate the spill hazard such that development could occur. Development approvals have been obtained for these properties on this basis.

### **Summary of Natural Hazards Assessment for the Subject Property**

We prepared a "Natural Hazards Study" for the proposed Huntingwood Trails Development in January 2011. This report is attached to this Witness Statement as **Attachment 3**. Further information from our office was provided in response to comments received by the NVCA and is enclosed as **Attachment 4**.

The subject lands consist of a 49 hectare property which has been historically used primarily for agriculture. Silver Creek enters the property from the south after passing beneath the Georgian Trail via a former railway bridge. Silver Creek bisects the property into two distinct halves West and East of the creek. Drainage from the West portion of the site outlets to Silver Creek proper upstream of a concrete box culvert for the Creek beneath Highway 26, while the east portion of the site primarily outlets to an existing concrete box culvert beneath Highway 26 in the northeast corner of the site.

The Natural Hazards Study outlines the previous floodplain studies completed within the Silver Creek watershed. The floodplain assessment for the Subject Property builds upon the previous model undertaken and approved as part of the downstream Consulate development. The model was extended upstream of Highway 26 to capture the 700 m section of Silver Creek through the Subject Property utilizing more refined 0.5 m contours produced for the site, field measurements and additional modeling cross sections. The Regulatory storm flow of  $78 \text{ m}^3/\text{s}$  as accepted across the subject lands through the CCL study was utilized in the model. Similarly, the Regulatory flow immediately upstream of Highway 26 was reduced due to the estimate of spill flows leaving the system associated with Spill Zone 'B' as determined through the CCL study.

Results of the updated Floodplain modeling indicated that the floodplain on the west portion of the Subject Property extends approximately 30 to 80 m from the Creek edge. Modeling for the east portion of the Subject Property illustrated a series of shallow spill flow areas in which floodwaters breach the drainage divide of the Silver Creek system over a broader area than originally identified by CCL and flow away from Silver Creek in a northeasterly direction through Spill Zone 'B'. Given that floodwaters breaching the drainage divide never return to the Silver Creek channel, we concluded that these flows were in fact spill flows.

The floodplain model was then updated to include the proposed development areas along the west and east side of the Creek to confirm that proposed floodproofing within the spill zone on the east side of the Creek and entrance roadway accessing the property along the west side of the Creek was sufficient and did not cause offsite impacts to flood levels. Further, the impacts of berming to eliminate Spill Zone 'B' were investigated as numerous properties within the spill zone are currently known to be flood susceptible. This updated analysis illustrated that the proposed development could be adequately floodproofed and that proposed flood impacts

upstream and downstream of the property were not aggravated. We also identified that there were potential benefits for currently at-risk areas within the Silver Creek watershed and Spill Zone 'B' as a result of the proposed flood improvements on the Subject Property.

Analysis of onsite erosion hazard was completed. Calculations of an appropriate meander belt allowance were completed utilizing morphological relationships and onsite field reconnaissance. The results of this study produced a meander belt width ranging from 95 m to 119 m centered on the meander axis of the Creek.

The results of the flood analysis and erosion analysis were combined to create a total hazard limit and set the developable limits across the site. Proposed residential development was directed to areas outside of the floodplain and erosion hazard limits. These limits are illustrated on an Existing Conditions Natural Hazard Limits Plan and a Post Development Conditions Natural Hazard Limits Plan included with the report as Figures 3 and Figures 4, respectively.

In response to comments received from the NVCA on April 29<sup>th</sup>, 2011, supplemental material was provided to the NVCA on July 22, 2011. Most notably this information included mapping of the Silver Creek floodplain/spill flow interface along the drainage divide for Silver Creek (Amended Figure 3) illustrating the floodplain limit on the east side of Silver Creek. Additionally, a peer review of the erosion assessment entitled "Huntingwood Trails – Meander Belt Width Assessment Technical Review" (Parish Geomorphics, July 2011) was included, confirming that the final meander belt corridor width specified was a conservative result appropriate for the site.

Spill flow routes across the site have been observed through visits to the site in high runoff periods in 2009, 2011 and 2013. Photographs of onsite spill flow routes and drainage paths are indicative of spill flow drainage directions and support our technical floodplain modeling findings.

We also undertook supplementary work in response to comments from the NVCA with respect to the spill hazard analysis and mapping. Our supplementary work includes multiple reach hydraulic (HEC-RAS) modeling aimed at refining the Regulatory Floodplain limits and delineation of spill conditions on-site. The hydraulic analysis includes analysis of more frequent events. This supplemental modeling illustrates that flood flows breaching the Silver Creek drainage divide on the east side of the creek have a lower water surface and energy grades than flows in the Silver Creek floodplain and thus are spill flows.

Updated modeling also includes verification of flows lost through Spill Zone 'A' and Spill Zone 'B'. The results of these analyses indicate that flows lost to the spill zones are higher than originally calculated by CCL. As such, the modeling of Regulatory floodplain limits along the main branch of Silver Creek overestimates the flow

contained within the system and resultant limits of the floodplain on the Subject Lands.

## **Issues and Opinions**

Our opinions and the reasons for those opinions follow.

**Issue 16:** *Has the Appellant demonstrated that the OPA is consistent with the natural hazard policies of PPS (policy 3.1) and in conformity with the relevant policies of the Town's Official Plan? In particular, has the extent of the flooding hazard on or adjacent to the site, including spill areas, been properly delineated?*

In our opinion, the proposed OPA is consistent with the objectives and flood hazard policies of the *Provincial Policy Statement, 2005* ("PPS") and in conformity with the relevant sections of the *Town of Collingwood Official Plan* (the "Town OP").

## **Policy Overview**

The PPS provides direction on matters of provincial interest, including natural hazards. Part IV "Vision for Ontario's Land Use Planning System", states:

*The Provincial Policy Statement directs development away from areas of natural and human-made hazards, where these hazards cannot be mitigated. This preventative approach supports provincial and municipal financial well-being over the long term, protects public health and safety, and minimizes cost, risk and social disruption.*

Section 3.0 of the PPS sets out policies respecting development and natural hazards. The stated objective and policies in this section provide municipalities some discretion on ways of achieving responsible development. The policy objective is:

*Development shall be directed away from areas of natural or human-made hazards where there is an unacceptable risk to public health or safety or of property damage.*

Relevant policies relating to the proposed development from section 3.1, *Natural Hazards*, are included below:

*3.1.1 Development shall generally be directed to areas outside of:*

*b) hazardous lands adjacent to river, stream and small inland lake systems which are impacted by flooding hazards and/or erosion hazards;*

3.1.6 Further to policy 3.1.5, and except as prohibited in policies 3.1.2 and 3.1.4, development and site alteration may be permitted in those portions of hazardous lands and hazardous sites where the effects and risk to public safety are minor so as to be managed or mitigated in accordance with provincial standards, as determined by the demonstration and achievement of all of the following:

- a) development and site alteration is carried out in accordance with floodproofing standards, protection works standards, and access standards;
- b) vehicles and people have a way of safely entering and exiting the area during times of flooding, erosion and other emergencies;
- c) new hazards are not created and existing hazards are not aggravated; and
- d) no adverse environmental impacts will result.

The PPS objectives with respect to natural hazards are incorporated into section 4.1 of the Town OP, which outlines the relevant natural hazard policies for the Town, including section 4.1.2. (10) which states the Town's objective:

*"To prevent the occurrence of development on lands having inherent environmental hazards such as poor drainage, inundation, flooding, erosion, steep slopes or any other physical conditions which could endanger life or property."*

The Town OP goes on to clarify the floodplain management approach further in Section 4.1.3.10.2 which states:

*"With the exception of the Black Ash Creek Special Policy Area, the One-Zone Concept as defined by the regulatory flood shall regulate the Silver Creek, Black Ash Creek and Batteaux River Floodplains."*

## **Discussion**

The *Technical Guide - River & Stream Systems: Flooding Hazard Limit* (MNR, 2002), (the "Technical Guide"), provides direction on flood hazard identification and implementation of PPS policies.

Flooding hazards are described in the PPS as including the inundation of areas adjacent to a river system that are not ordinarily covered by water. For the Subject Property which is located in Zone 3, the flood standard is the greater of the flood resulting from the Timmins storm (1961), transposed over the watershed or one hundred year flood. The "flood plain" is the area, usually low lands adjoining a

watercourse, which has been or may be subject to flooding hazards. In the One-Zone concept, new development in the floodplain is to be prohibited or restricted in accordance with the requirements of the PPS. This concept is presented in Figure 1 below.

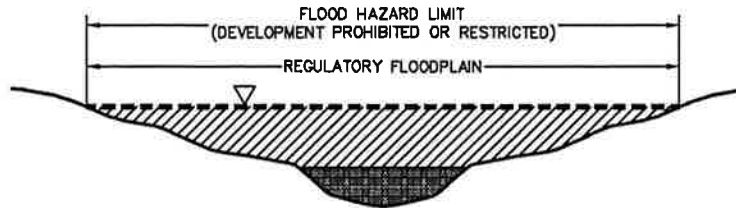


FIGURE 1: FLOOD HAZARD LIMIT FOR ONE ZONE POLICY APPROACH.

The Technical Guide addresses situations where flood waters are not contained in the Regulatory Floodplain and a portion of flood flows spill over-land as illustrated in Figure 2.

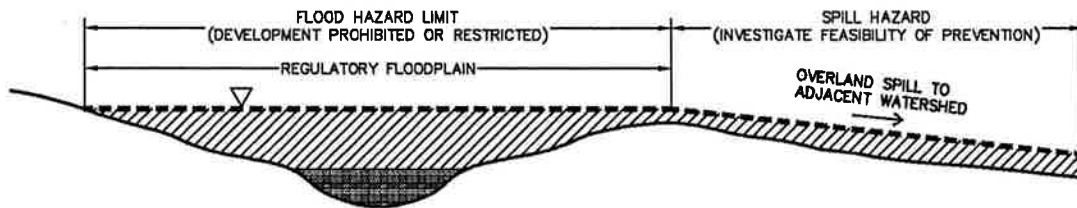


FIGURE 2: FLOOD HAZARD LIMIT FOR ONE ZONE POLICY APPROACH WITH SPILL.

Section 4.3 of the Technical Guide states:

*In the case of ill-defined channels or top of banks combined with high flows, flood flows can overtop the banks and spill over-land. Frequently, this spill will move into another watershed or join the same watercourse at a distance downstream.*

*The effects of spills moving into another watershed should be assessed to determine the potential flood risks. Alternative measures should be investigated to prevent the spill moving into the adjacent watershed. If the amount of spill is relatively small, less than 10% of the peak flow, the flood plain mapping for the watershed should be based on the original flow, without any reduction for the spill. For larger spills, allowance for the reduced flow should only be made where the review of alternatives proves that the spill cannot be prevented, either because there are no feasible alternatives or the cost when compared to the potential benefits are too high.*

The preferred floodplain management approach is to eliminate spills where feasible. This is commonly achieved by placing fill in the spill area to create a height of land that contains flood flows within the Regulatory Floodplain. This approach is consistent with a One-Zone approach, as filling is outside the Regulatory Floodplain and there is no loss of watercourse storage/conveyance capacity. However, the elimination of spills may increase downstream flows. Accordingly, the offsite impacts need to be assessed to ensure that new hazards are not created and existing hazards are not aggravated.

### **Flood Hazard Assessment Overview of Silver Creek (Proposed Conditions) for the Subject Lands**

The existing spill along the east side of Silver Creek is considered to be a hazard, but is characterized by generally shallow depths and low velocities. As such, the spill hazard in the proposed development area can be readily eliminated by filling to raise ground elevations above the Regulatory Flood level, which will provide appropriate protection of life and property in accordance with PPS and the Town OP. These lands will be completely dry flood-proofed, such that they will no longer be subject to the spill hazard. Safe ingress and egress to and from the Subject Lands will be available via the extension of an existing roadway from Silver Glen Preserve.

Filling of the development area will eliminate the spill from the proposed development areas but will not eliminate Spill Zone 'B' and the associated hazard for lands downstream of the Subject Property. While not specifically required for development to proceed on the Subject Lands, elimination of Spill Zone 'B' has additional benefits. Filling between the east development areas and the south side of Highway 26 to create a landform barrier is proposed to block Spill Zone 'B' from traveling east. An additional culvert beneath Highway 26 at Silver Creek is required in order to safely pass the additional flood flow (i.e. existing spill flow which currently outlets to the east). In our opinion, the proposed development can eliminate flood hazards associated with Spill Zone 'B' on the east side of the Subject Lands, eliminate flood hazards on external lands to the east, and will not create new hazards or aggravate existing hazards downstream on Silver Creek, as discussed further in subsequent sections below.

The proposed development on the west side of Silver Creek is outside the current Regulatory Floodplain Limits, with one exception at the northern area of the site near Silver Creek Drive where an access road is proposed. We rely on the opinion and evidence of Mr. Alex Fleming that site access to the western development area is necessary at this location and an evaluation of access options supports the proposed location as the most appropriate alternative. Filling along the alignment of the access road is proposed to provide dry access and egress to and from the Subject Lands from Silver Creek Drive.

The encroachment of the west access road into the Regulatory Floodplain will cut off an area of flooding inundation in the vicinity of Silver Creek Drive. The proposed west access road may also be used to raise the grade of Silver Creek Drive at an existing sag to contain the floodwaters within Silver Creek proper, depending on the extent of any reduction or elimination of Spill Zone 'B'.

Through correspondence received from the NVCA in email of August 14, 2013 (email K. Northcott / C. Crozier), the Town has indicated a desire to eliminate Spill Zone 'A' (upstream and to the west of the subject lands) at some point in the future to eliminate nuisance drainage issues and flood protect existing residences. Our hydraulic analysis has confirmed that both the eastern and western development lands can be adequately floodproofed to accommodate the potential additional flows from Spill Zone 'A' such that the Huntingwood Trails Development would not constrain the ability of the Municipality to proceed with this initiative in the future.

#### Downstream Flood Risk Assessment

The conclusions of Section G.5 of *Adaptive Management of Stream Corridors in Ontario: Common Law Aspects of Water Management for Public Bodies* (MNR, 2001) provides guidance on floodplain management decisions for public approval authorities, as floodplain management decisions must consider riparian rights based on common law principles. For example, the document provides that:

*"A riparian owner has a right to the water of the stream flow in its natural state, unpolluted."*

*"An upper riparian owner has the right to natural drainage in the water course and a lower owner is obliged to accept that drainage."*

*"However, the drainage by the upper riparian owner must be reasonable and must not increase the volume by artificial means."*

Any modification by the upstream riparian owner must fully consider the impact of such on the lower owner and the lower owner's riparian rights must be considered.

As noted earlier, the preferred floodplain management approach is to eliminate spills where feasible, subject to a risk assessment. This involves understanding the magnitude of the spill flow under all flood conditions, the flow path of the spill waters leaving Silver Creek, and the impact of cutting off all or a part of the spill on downstream lands.

Within the Subject Property, the East Spill flow (Spill Zone 'B') follows a north easterly/easterly direction away from Silver Creek. The spill waters extend east of the site across residential, golf course and environmental protection lands before crossing Highway 26 at three locations east of Silver Creek. The spill route makes its way



along the north side of Highway 26 towards Princeton Shores Boulevard before flowing in a northerly direction. The accumulation of spill flow from Silver Creek relieves itself by overtopping Princeton Shores Boulevard and Bartlett Boulevard at numerous locations during the Regional Flood before reaching Georgian Bay. The flow route of Spill 'B' has been documented in previous studies, most notably the flood hazard study respecting The Consulate East Lands (Crozier, 2007).

A condition of the approval of The Consulate East Lands is the requirement for flood mitigation works to alleviate the subject spill at Princeton Shores Boulevard consisting of twin box culverts and channelization to Georgian Bay. To date these works have not been designed or constructed.

Presently, properties along Princeton Shores Boulevard and Bartlett Boulevard continue to be at flood risk due to the Silver Creek spill flow conditions.

Compounding the flood risk faced by the Princeton Shores and Bartlett Boulevard properties is interruption of ingress/egress faced by the residents of the Cranberry Links Development as a result of the Spill Zone 'B'. This is exacerbated by the fact that Cranberry Trail West, which acts as the sole entrance to hundreds of homes at the present time, did not include a cross culvert to convey spill flows beneath the roadway when originally constructed. It is not uncommon to see this roadway flooded due to intense rainfall and/or snowmelt events, temporarily interrupting and/or disrupting traffic flow to and from the Cranberry Links Development.

Unlike Spill Zone 'B', the downstream floodplain limits of Silver Creek below Highway 26 are undeveloped, encompassing environmental lands on the Consulate West Lands property.

Our evaluation of the impacts on the riparian rights of the downstream landowner resulting from the reduction or elimination of the Spill Zone 'B' on the Subject Lands concluded that the blocking of Spill Zone 'B' will not impinge upon future development areas of the downstream Consulate West Lands. Further, we have confirmed, through consultation with the applicant's natural heritage consultant that the natural heritage implications of blocking the spill flow to downstream wetlands can be mitigated through implementing design measures to allow low flows to follow the spill flow route but direct large spill events back to Silver Creek proper.

As such it is our opinion that, although not required to proceed with the Huntingwood Trails Development proposal, the introduction of measures to eliminate Spill Zone 'B' on the Subject Property provides a significant benefit to existing flood susceptible areas, and, therefore, it should be undertaken in partnership with the Town and Conservation Authority.

## **Conclusions**

Based on the foregoing, it is our opinion that the proposed OPA meets the policies of PPS and the Town OP from a natural hazards perspective. The development of Huntingwood Trails provides a valuable opportunity to realize a reduction to the flood damages to existing private property within the Silver Creek watershed and Spill Zone 'B' while not aggravating flood hazards elsewhere. As such we support the approval of the OPA from a natural hazards management perspective.

## **List of Documents and Reports to Be Relied On**

We will rely upon the following documentation, with which to support our evidence:

- *Natural Hazards Study, Huntingwood Trails (Collingwood)*. (Crozier, January 2011);
- *Functional Servicing & Stormwater Management Report, Huntingwood Trails (Collingwood)*, (Crozier, January 2011);
- *NVCA Review Comments, File #D09111, D14211 & D120111* (Dated April 29<sup>th</sup>, 2011);
- *Crozier Engineering Comments Response, Huntingwood Trails (Collingwood) Inc.* (Dated July 22, 2011);
- *Huntingwood Trails – Meander Belt Width Assessment Technical Review*, (Parish Geomorphic, July 2011);
- *NVCA Review Comments, File #D09111, D14211 & D120111* (Dated October 26<sup>th</sup>, 2011);
- *Huntingwood Trails Supplemental HEC-RAS Spill Flow Modelling Assessment & Mapping*, (Crozier, September 2013);
- *Site Photos of Property and Floodplain Events*, (2008-Present);
- *Report to the Nottawasaga Valley Conservation Authority on Floodline Mapping and Flood Control Study Silver Creek, Spring Creek, and the Village of Angus*, (Cumming Cockburn Limited, 1989);
- *Floodline Analysis Report, The Preserve at Georgian Bay, Town of Collingwood*, (Crozier, 2007) and subsequent schedules associated with OMB Decision No. 2517;
- *Natural Hazards Assessment, Consulate-West Lands, Town of Collingwood*, (Crozier, 2008);
- *Stormwater Management Implementation Report, Georgian Green Residential Development*, (Crozier, 2006);
- *Floodline Analysis Report, Georgian Green Residential Development*, (Crozier, 2006);
- *Understanding Natural Hazards*, (Ontario Ministry of Natural Resources, 2001);
- *Technical Guide- River and Stream Systems: Flooding Hazard Limit*, (Ontario Ministry of Natural Resources, 2002);

- *Adaptive Management of Stream Corridors in Ontario: Section G.5 Common Law Aspects of Watercourse Management for Public Bodies*, (Ontario Ministry of Natural Resources 2001);
- *Provincial Policy Statement*, (Ministry of Municipal Affairs and Housing, 2005); and
- Email Correspondence Brian MacDonald, Town of Collingwood/Kate Northcott, Nottawasaga Valley Conservation Authority, dated August 12, 2013, received August 14, 2013, including attached sketch.

**Address and Contact Information**

40 Huron Street, Suite 301, Collingwood, Ontario

T: 705-446-3510

E: [ccrozier@cfcrozier.ca](mailto:ccrozier@cfcrozier.ca), [jproctor@cfcrozier.ca](mailto:jproctor@cfcrozier.ca), [lpataky@cfcrozier.ca](mailto:lpataky@cfcrozier.ca)



---

September 4, 2013



---

September 4, 2013



---

September 4, 2013

**Ontario Municipal Board**  
Commission des affaires municipales  
de l'Ontario



**ISSUE DATE:** July 31, 2014

**CASE NO(S):** PL120784

Huntingwood Trails (Collingwood) Ltd. has appealed to the Ontario Municipal Board under subsection 22(7) of the *Planning Act*, R.S.O. 1990, c. P.13, as amended, from Council's neglect to enact a proposed amendment to the Official Plan for the Town of Collingwood to remove lands legally described as Part of Lots 47, 48 and 49, Concession 12, from the Mountain Road West Corridor Secondary Plan Study Area and designate the lands for development (Approval Authority File No. D09111) OMB File No. PL120784

**Heard:**

June 26, 2014 in Collingwood, Ontario

**APPEARANCES:**

**Parties**

**Counsel**

Huntingwood Trails (Collingwood) Ltd.

S. Rosenthal  
M. McDermid

Town of Collingwood

L.F. Longo

County of Simcoe

M. Green  
S. Hahn

Nottawasaga Valley Conservation Authority

K.C. Hill

**DECISION DELIVERED BY M. CARTER-WHITNEY AND ORDER OF THE BOARD**

[1] On January 28, 2011, Huntingwood Trails (Collingwood) Ltd ("Applicant") applied for an Official Plan Amendment ("OPA") of the Town of Collingwood Official Plan ("Town OP") to permit development of a 436 unit residential community on 48.97 hectares ("ha") of lands legally described as Part of Lots 47, 48 and 49, Concession 12 ("subject property") in the Town of Collingwood ("Town"), County of Simcoe ("County").

[2] The Town Council failed to make a decision on the OPA application within 180 days of the date of the application being filed. On June 28, 2012, the Applicant filed an appeal, under s. 22(7) of the *Planning Act*, of Council's failure to make a decision to the Ontario Municipal Board ("Board").

[3] At the commencement of the hearing, the parties advised that they had reached a settlement agreement. Mr. Longo, counsel for the Town, advised the Board that after the settlement was reached, it took some time to secure approval from the Town and County Councils. While the public was informed of the settlement as soon as possible, in June 2014, confidentiality among the parties was required prior to that in order to achieve a mediated resolution.

[4] The Board heard evidence concerning the settlement agreement from David Slade, who was qualified as an expert land use planner, and from Johnathan Proctor, who was qualified as an expert in the area of water resource engineering and natural hazard issues. While the Board had granted participant status to a number of individuals at a pre-hearing conference, only the following participants testified at the hearing: Donald Avery, on behalf of the Blue Mountain Watershed Trust Foundation ("Foundation"); Carlo Palermo; and Jim Dalziel.

[5] Mr. Slade provided details of the revised OPA arising from the settlement. He described the subject property, noting that it includes the following significant environmental features: Silver Creek; the Silver Creek Provincially Significant Wetlands complex ("PSWs"); and Category 1 and 2 Woodlands. He said there is an existing single family dwelling on the property, which is generally vacant with the exception of minor agricultural use (grazing cattle) in recent years. Under the Town OP, the current land use designations on the subject property are Rural, Rural Residential and Environmental Protection. He also described the adjacent properties, which include the Silver Glen condominium development to the east and the Forest subdivision to the west.

[6] Mr. Slade gave an overview of the changes to the development proposal as a result of the settlement agreement, and provided the Board with a detailed review of the provisions of the revised OPA. He noted that the subject lands are proposed to be redesignated to the Residential and Environmental Protection designations under the Town OP, with a substantial portion of the subject property being removed from having any development potential and placed in the Environmental Protection designation, as shown in Schedule 'A2' to the revised OPA, attached as Attachment 1. Mr. Slade said that this would leave two areas proposed for development: a 2.7 ha area on the east side of the subject property that was proposed for development in the original proposal ("Development Area #1"); and a 9.4 ha area on the west side of the subject property that has been reduced in size relative to the original proposal ("Development Area #2"). The total number of units proposed for the subject property, including both development areas, has been reduced from 436 to a maximum of 179 units (up to 67 units in Development Area #1 and 112 units in Development Area #2). Development Area #1 is proposed for medium density development to a maximum of 25 units per gross ha, and Development Area #2 is proposed for low density development to a maximum of 12 units per gross ha.

[7] Mr. Slade noted that Development Area #1, which is in the Town's Municipal Service Area 2, may be developed and serviced in advance of Development Area #2, which is in Municipal Service Area 3 and requires further review. He stated that access and servicing to Development Area #1 would occur from the adjacent Silver Glen development to the east, noting that the Applicant's engineering consultant had determined there is sufficient surplus water and sanitary sewer servicing capacity to accommodate the proposed 67 units. He said that the engineering studies had indicated that Development Area #2 also could be serviced using existing infrastructure after additional studies are prepared and improvements are made.

[8] Mr. Slade testified that all of the remaining lands on the subject property, a total of 75.3 % of the site, are proposed to be dedicated to the Town. Under the agreement, 21.9 ha of the lands (44.8% of the site) are to be dedicated to the Town when

Development Area #1 is developed, including PSWs and land with environmental features on the east side of the subject property. When Development Area #2 is developed, 14.9 ha of the lands (30.5% of the site) are to be dedicated to the Town, including the Silver Creek flood plain and buffer lands on the west side of the subject property. He also stated that, prior to development proceeding, further studies would be required with respect to: mitigation of any negative impacts on the natural heritage features or their ecological functions; natural hazard assessment; and species at risk. In relation to Development Area #2, the Applicant also would be required to submit: a water and sanitary sewer servicing strategy; a stormwater management plan that includes a strategy for addressing Silver Creek drainage patterns and spill areas; and a transportation study to be circulated to the Ministry of Transportation for review and comment.

[9] Mr. Slade provided his opinion that the revised OPA is consistent with the policies of the Provincial Policy Statement, 2014 ("PPS"), and conforms to the Growth Plan for the Greater Golden Horseshoe, 2006 ("Growth Plan") and the current Official Plan of the County of Simcoe ("County OP"). He also stated that, in his opinion, the revised OPA represents good planning and is in the public interest.

[10] With respect to the PPS, Mr. Slade noted that the revised OPA is consistent with its policies directing growth to settlement areas, promoting the efficient use of land and existing infrastructure, and providing a range of housing densities under policy 1.1.3. He also testified that the designation of lands within the Environmental Protection designation and the dedication of 75.3% of the subject property to the Town is consistent with the 2.1 natural heritage policies, 2.2 water policies, and 3.1 natural hazard policies in the PPS.

[11] In providing his opinion that the revised OPA conforms to the Growth Plan, Mr. Slade noted that the Town is defined as a primary settlement area under the Growth Plan and referred the Board to policy 6.3.2.1, which permits development to be approved in settlement areas in excess of what is needed to accommodate the

distribution of population and employment forecasts in Schedule 7 of the Growth Plan, provided the development meets the criteria set out in that section. The Minutes of Settlement (filed as Exhibit 2, Tab 2) state that the parties agree that Development Area #1 and the portion of Development Area #2 currently designated Rural Residential One, which Mr. Slade testified are on "lands for urban uses" as of January 19, 2012, are permitted to be approved in excess of what is needed to accommodate the forecasts in Schedule 7. The Minutes of Settlement further state that the parties agree that the approval of an additional population of 300 people for the remaining 7.6 ha portion of Development Area #2 meets the requirements and criteria of policy 6.3.2.2 of the Growth Plan. Mr. Slade provided his opinion that the revised OPA conforms to policies 6.3.2.1 and 6.3.2.2 of the Growth Plan.

[12] Mr. Slade noted that the Board partially approved policies 3.5.10 and 3.5.11 of the County OP on April 15, 2014 in case no. PL091167. He stated that, due to a subsequent further settlement, the entirety of policies 3.5.10 to 3.5.13 have now been approved by the Board, resulting in a maximum population figure of 20,000 for the County. Mr. Slade provided his opinion that the revised OPA conforms to policies 3.5.10 to 3.5.13 and the allocation of 300 persons meets the criteria of those policies. He also testified that the County and the Town support the allocation of 300 persons to the proposed development.

[13] Mr. Slade directed the Board to s. 11.5 of the Town OP, which sets out guidelines and criteria for the preparation of a secondary plan review of the Mountain Road West Corridor. He provided his opinion that it would not be necessary to commence a secondary plan review prior to the proposed development on the subject property because the engineering studies indicate that both development areas can be serviced using existing infrastructure once approved. He testified that the subject lands could be developed independently with no prejudice to the secondary plan review.

[14] While the participants were satisfied with some aspects of the settlement agreement, they continued to express some concerns about the proposed development.



[15] Mr. Avery testified on behalf of the Foundation, which had been granted special participant status to call an environmental consultant to give evidence on buffers between wetlands and residential development or any other development and site alteration on the property that could harm the ecological functions of the wetlands. He said that a consultant had been retained but she would not provide evidence as there had not been sufficient time for her to study the revised OPA.

[16] Mr. Avery stated that the preservation of wetlands and the quality or width of buffers depends on the measures put in place to prevent negative effects from human access, and the balance between human access and the preservation of sensitive natural areas can best be accomplished by the creation of a management plan. He testified that the Foundation has obtained agreement that such a plan will be prepared at the appropriate time for lands that are transferred from private ownership to the public realm. He said that the Foundation supported the transfer of the land to public ownership.

[17] However, Mr. Avery expressed concern that vehicle access to the proposed development areas may be permitted through lands designated Environmental Protection, stating that an access road could constitute a negative buffer that would encroach on the protected area. He also expressed concern about the lack of information provided to the Foundation concerning the settlement prior to June 6, 2014 when the Foundation was informed that an agreement had been reached.

[18] Mr. Palermo, a resident of the Forest subdivision west of the subject property, expressed support for the modification providing for single family detached dwellings adjacent to the Forest subdivision, although he maintained that the proposed density would be higher than the density of the existing subdivision. Mr. Palermo also raised concerns about the Silver Creek flood plain on the subject property, noting the presence of a drainage ditch is adjacent to existing properties on Silver Creek Drive and a culvert under the existing road. He said there is water in the ditch during most of the year and, during the spring, he has observed water rise above the culvert and flood onto the road

and beyond. He expressed concern that changes to the subject property may create flooding issues along Silver Creek Drive.

[19] Mr. Proctor responded specifically to Mr. Palermo's concerns about drainage, stating that he had been engaged with this project since 2008 and had monitored the impacts of spring drainage and extreme rainfalls on the subject property over this time. He said he is familiar with the drainage ditch to which Mr. Palermo referred, and that it drains water across the rear of the Silver Creek Drive lots into the Silver Creek drainage system on the subject property. He testified that the Applicant has plans to accommodate the drainage through to Silver Creek so that there will be no impact on the properties on Silver Creek Drive. He noted that the revised OPA would require that Silver Creek drainage patterns be addressed, and that the Applicant would work with the Town and the Nottawasaga Valley Conservation Authority in the course of obtaining future approvals. He provided his opinion that it would be possible to meet the requirements of policy 3.1 of the PPS in relation to natural hazards.

[20] Mr. Dalziel is a director of the Silver Glen condominium corporation east of the subject property. He noted that the revised OPA states that vehicular access and servicing for Development Area #1 "shall occur from the adjacent residential development to the east". He stated his understanding that the condominium road is private and expressed concern that there is an assumption that access to this development area would be granted, noting that the Applicant had not approached the condominium corporation about the issue of access. He raised concerns about increasing construction and regular traffic through the Silver Glen condominium property. Under cross-examination, Mr. Dalziel acknowledged that the Applicant would be required to contact the condominium corporation at the appropriate time in relation to road layouts and connections to private roads on the Silver Glen condominium property.

[21] During the hearing, the parties advised the Board of two typographical errors in the revised OPA filed as Exhibit 2, Tab 1. Following the hearing, Mr. Longo provided a corrected revised version of the OPA, attached as Attachment 1.

[22] Having reviewed the provisions of the revised OPA and considered all of the evidence before it, the Board finds that the revised OPA is consistent with the PPS and conforms to the policies of the Growth Plan and the County OP. The Board is satisfied that the concerns raised by the participants either have been addressed by the evidence provided by Mr. Slade and Mr. Proctor, or will be addressed by the Applicant in the course of obtaining future required approvals.

## **ORDER**

[23] The appeal is allowed in part and the Town of Collingwood Official Plan is amended as set out in Attachment 1 to this Order, and as amended is approved.

*"M. Carter-Whitney"*

M. CARTER-WHITNEY  
MEMBER

### **Ontario Municipal Board**

A constituent tribunal of Environment and Land Tribunals Ontario

Website: [www.elfto.gov.on.ca](http://www.elfto.gov.on.ca) Telephone: 416-212-6349 Toll Free: 1-866-448-2248

# ATTACHMENT 1

## PART B—THE AMENDMENT

### INTRODUCTORY STATEMENT

All of this part of the document entitled "Part B — The Amendment" consisting of the following text constitutes Amendment No. \_\_\_\_\_ to the Official Plan of the Town of Collingwood.

### DETAILS OF THE AMENDMENT

The Official Plan is hereby amended as follows;

- Item 1:**      **Official Plan Schedule 'A' Land Use** is hereby amended by redesignating the subject lands from the "Rural, Rural Residential and Environmental Protection" designations to the "Residential and Environmental Protection" designations for those lands recognized as Part of Lots 47, 48 and 49, Concession 12 (formerly Township of Nottawasaga), Town of Collingwood, County of Simcoe as indicated on the attached schedule A-1.
- Item 2:**      **Official Plan Schedule 'A2' Land Use Detail** attached hereto is hereby inserted as a new schedule to the Town of Collingwood Official Plan.
- Item 3:**      **Official Plan Schedule 'B' Environmental Protection** is hereby amended by redesignating a portion of the subject lands from the Category 1 Woodland designation to the Category 2 Woodland designation and designating new Category 1 Woodland and Category 1 Wetlands as indicated on the attached schedule B-1.
- Item 4:**      **Official Plan Schedule 'C' Residential Densities** is hereby amended by redesignating the subject lands to the "Low Density Residential" and "Medium Density Residential" designation(s) for those lands recognized as Part of Lots 47, 48 and 49, Concession 12 (formerly Township of Nottawasaga), Town of Collingwood, County of Simcoe as indicated on the attached schedule C-1.
- Item 5:**      **Official Plan Schedule 'E' Municipal Service Areas** is hereby amended by redesignating a portion of the subject lands to "Service Area 2" as indicated on the attached schedule E-1.

The following special policies apply to the subject lands as identified on Schedule A1 to this Amendment:

---

#### **Section 4.3.4.5.8.13 Part Lot 48, Concession 12**

##### **Development Area #1:**

- a. The area identified as Development Area #1 (DA #1) on Schedule 'A2' is permitted a maximum density of 25 units per gross hectare. The uses permitted shall be limited to semi-detached dwellings, small-lot single detached dwellings, duplex dwellings, triplex dwellings, four-plex dwellings, townhouses, home occupations, residential intensification uses and those public uses itemized on Figure 3. Vehicular access and servicing shall occur from the adjacent residential development to the east.
- b. It will be a condition of draft approval of the development that the lands identified in hatching adjacent to DA #1 shall be dedicated to the Town of Collingwood upon registration of the development as per the subdivision/condominium and/or consent process.
- c. The required 5% parkland dedication for the development of DA #1 shall be satisfied by the dedication of lands within the hatching area.
- d. The lands shown in hatching include a multitude of environmental and open space features, including Provincially Significant Wetlands as well as all appropriate buffers associated with these features.
- e. On the basis of the designation and dedication of these lands identified in hatching, it is confirmed that no further natural heritage studies or buffers are required. Despite this policy, in addition to whatever studies are identified as required by Section 8.13, current and future *Planning Act* applications shall be supported by:
  - i. details demonstrating that the proposed development mitigates any negative impacts on the natural heritage features or their ecological functions through appropriate measures to the satisfaction of the Town and the NVCA;
  - ii. a natural hazard assessment prepared to the satisfaction of the Town and the NVCA demonstrating that all proposed development will be located in accordance with Section 3.1 of the Provincial Policy Statement; and,
  - iii. details demonstrating that the proposed development satisfies the requirements of the Provincial Policy Statement and the *Endangered Species Act* with respect to species at risk.
- f. The completion of a Secondary Plan and secondary plan studies and requirements as per the policies of Section 8.10.2 shall not be required prior to development occurring on the lands designated as DA # 1.
- g. All current and future applications under the *Planning Act* on the lands designated as DA # 1 shall be circulated to the MTO for review and comment.

#### **Section 4.3.4.4.5.8 Part Lots 48 and 49, Concession 12**

##### **Development Area #2**

- a. The area identified as Development Area #2 (DA #2) on Schedule 'A2' is permitted a maximum density of 12 units per gross hectare. The uses permitted shall be limited to single-detached dwellings, semi-detached dwellings, small-lot single-detached, duplex dwellings, home occupations, residential intensification uses, and those public uses itemized on Figure 3. All residential units that back upon the western and northern boundary of the subject property (adjacent to the Forest Subdivision) shall be single-detached dwellings. Vehicular access may occur from Forest Drive and/or Silver Creek Drive and may be established through lands designated Environmental Protection as permitted by Section 4.1.3.1.
- b. It will be a condition of draft approval of the development that the lands identified in cross hatching adjacent to DA #2 shall be dedicated to the Town of Collingwood upon registration of the development as per the subdivision/condominium and/or consent process.
- c. The required 5% parkland dedication for the development of DA #2 shall be satisfied by the dedication of lands within the cross hatching area.
- d. The lands shown in cross hatching include a multitude of environmental and open space features including the floodplain of the Silver Creek and all appropriate buffers to those features.
- e. On the basis of the designation and dedication of these lands identified in cross hatching, it is confirmed that no further natural heritage studies or buffers are required. Despite this policy, in addition to whatever studies are identified as required by Section 8.13, current and future *Planning Act* applications shall be supported by:
  - i. details demonstrating that the proposed development mitigates any negative impacts on the natural heritage features or their ecological functions through appropriate measures to the satisfaction of the Town and the NVCA;
  - ii. a natural hazard assessment prepared to the satisfaction of the Town and the NVCA demonstrating that all proposed development will be located in accordance with Section 3.1 of the Provincial Policy Statement; and,
  - iii. details demonstrating that the proposed development satisfies the requirements of the Provincial Policy Statement and the *Endangered Species Act* with respect to species at risk.
- f. The completion of a Secondary Plan and requirements and studies as per the policies of Section 8.10.2 and the Service Area 3 policies of Section 3.6.3 shall not be required prior to development occurring on the lands designated as DA # 2.

- g. All current and future applications under the *Planning Act* on the lands designated as DA # 2 shall be circulated to the MTO for review and comment.
- h. All current and future applications for zoning, site plan control approval, severances and/or plan of subdivisions/condominiums shall include submission of the following studies in addition to whatever studies are identified as required by Section 8.13, with the exception of natural heritage studies:
  - i. a water and sanitary sewer servicing strategy that examines potential regional opportunities and constraints;
  - ii. a stormwater management plan that includes a strategy for addressing Silver Creek drainage patterns and spill areas; and
  - iii. a transportation study (including active transportation and transit) that explores potential linkages with adjacent development. This study shall also be circulated to the MTO for review and comment.

#### **IMPLEMENTATION AND INTERPRETATION**

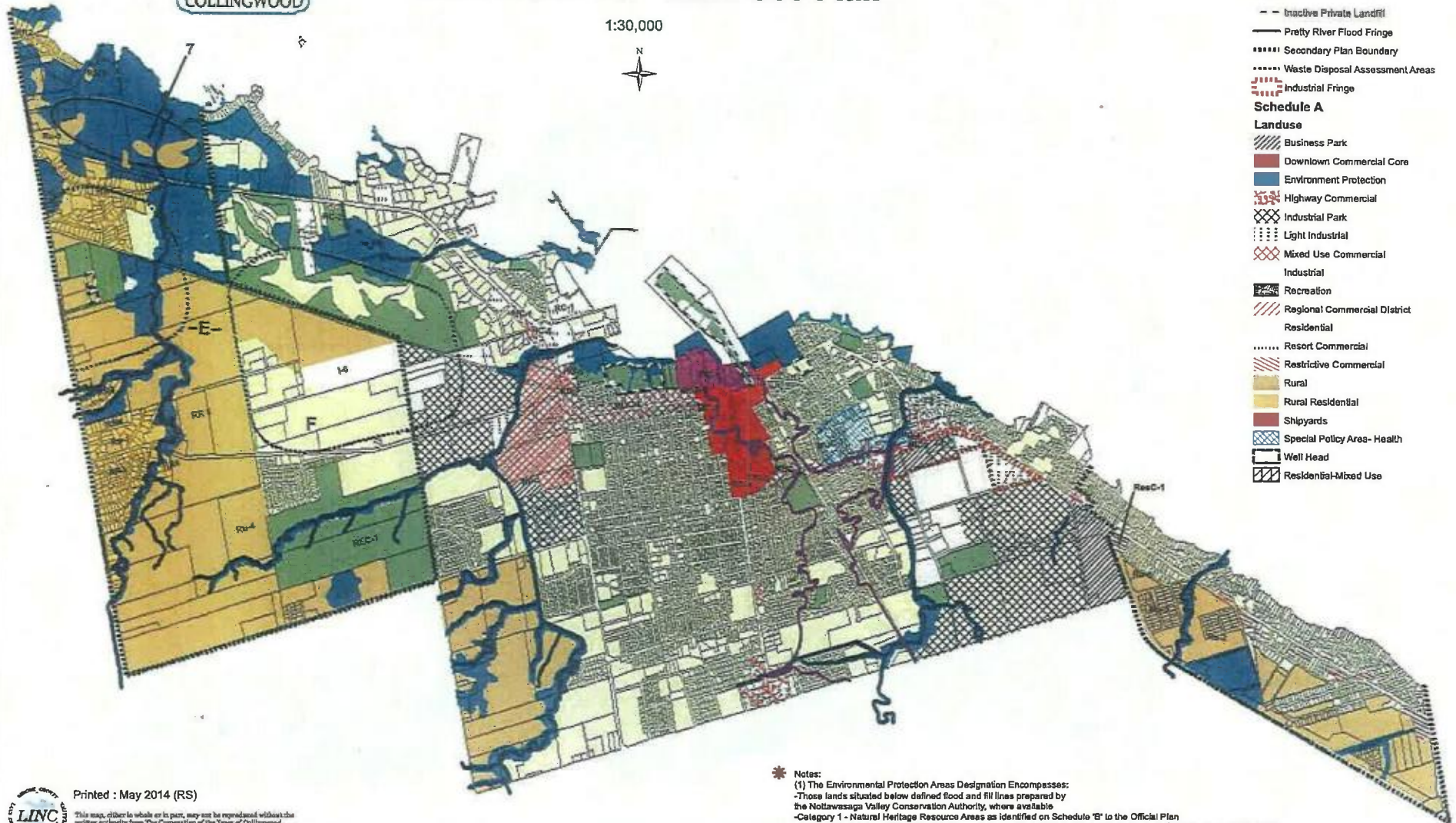
The implementation and interpretation of this Amendment shall be in accordance with the respective policies of the Official Plan, as well as through a Zoning Bylaw Amendment for the subject lands under Sections 34 and 36 of the *Planning Act*, R.S.O. 1990, c. P. 13, as amended.





# **Official Plan of the Town of Collingwood** **SCHEDULE 'A1'- Land Use Plan**

1:30,000



## **Legend**

- - - Inactive Private Landfill
- Pretty River Flood Fringe
- ..... Secondary Plan Boundary
- ..... Waste Disposal Assessment Areas
- Industrial Fringe
- Schedule A**
- Landuse**
- Business Park
- Downtown Commercial Core
- Environment Protection
- Highway Commercial
- Industrial Park
- Light Industrial
- Mixed Use Commercial
- Industrial
- Recreation
- Regional Commercial District
- Residential
- Resort Commercial
- Restrictive Commercial
- Rural
- Rural Residential
- Shipyards
- Special Policy Area- Health
- Well Head
- Residential-Mixed Use

## **\* Notes:**

- (1) The Environmental Protection Areas Designation Encompasses:
  - Those lands situated below defined flood and fill lines prepared by the Nottawasaga Valley Conservation Authority, where available
  - Category 1 - Natural Heritage Resource Areas as identified on Schedule 'B' to the Official Plan
  - Areas derived using a "Top of Bank" approach along certain water courses where flood and/or fill lines are not available
- (2) Environmental Protection areas along the Nottawasaga Bay shoreline are shown conceptually
- (3) The precise location of the Environmental Protection areas designation shall, in all cases, be determined as development proceeds in consultation with The County of Simcoe (Nottawasaga Valley Conservation Authority) and the Town of Collingwood.



Printed : May 2014 (RS)

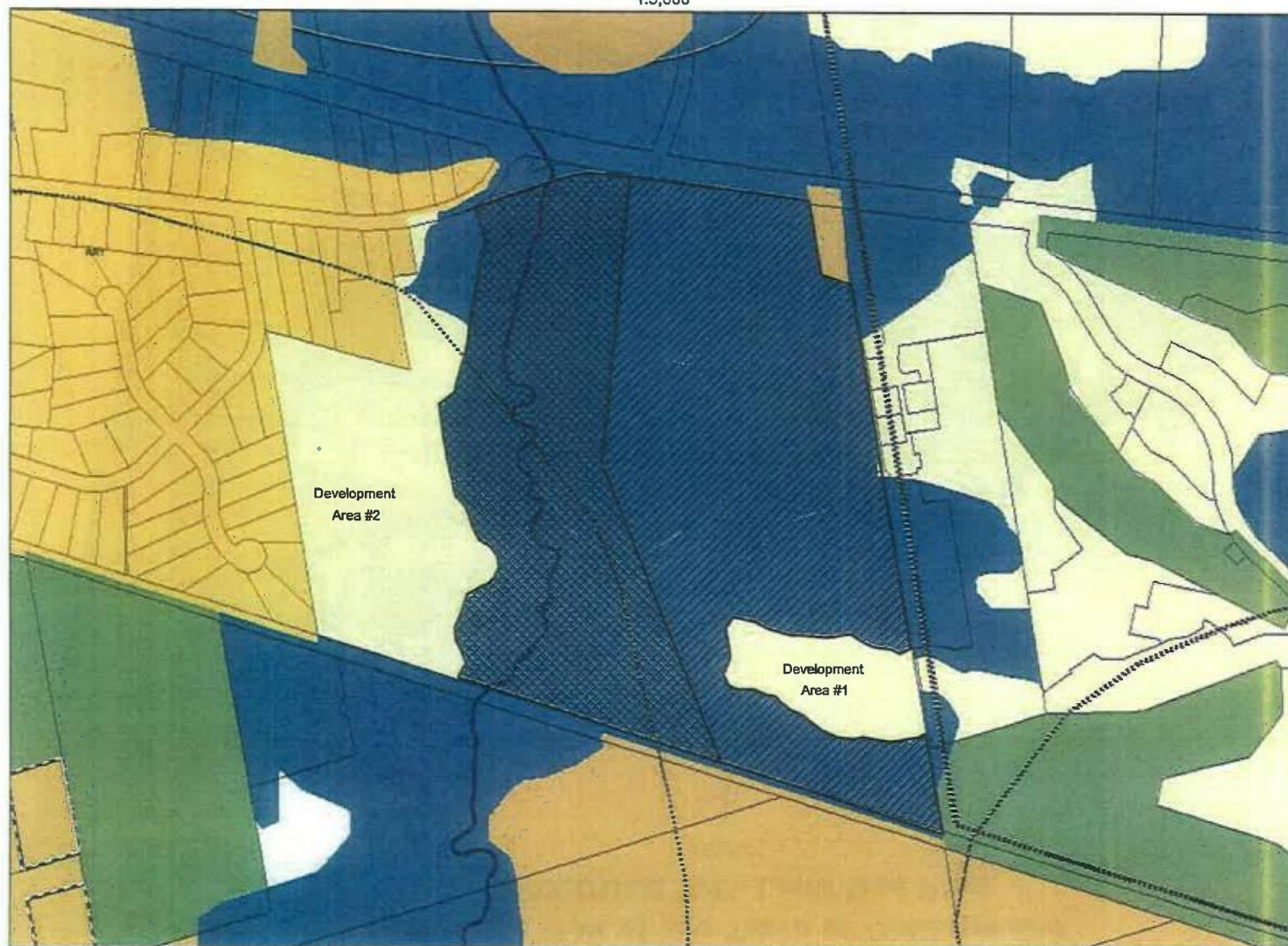
This map, either in whole or in part, may not be reproduced without the written authority from The Corporation of the Town of Collingwood. Copyright The Corporation of the Town of Collingwood. Land Information Network Cooperative - LINC 2009. The Ontario Ministry of Natural Resources (Copyright - Queen's Printer 2007). ©Township Enterprises Inc. and its suppliers all rights reserved, and Members of the Ontario Geospatial Data Exchange. THIS IS NOT A PLAN OF SURVEY.





# Official Plan of the Town of Collingwood **SCHEDULE 'A2' - Land Use Plan - Detail**

1:5,000



## **Legend**

- Inactive Private Landfill
- Pretty River Flood Fringe
- ..... Secondary Plan Boundary
- ..... Waste Disposal Assessment Areas
- Industrial Fringe

## **Schedule A**

### **Landuse**

- Business Park
- Downtown Commercial Core
- Environment Protection
- Highway Commercial
- Industrial Park
- Light Industrial
- Mixed Use Commercial
- Industrial
- Recreation
- Regional Commercial District
- Residential
- Resort Commercial
- Restrictive Commercial
- Rural
- Rural Residential
- Shipyards
- Special Policy Area- Health
- Well Head
- Residential-Mixed Use
- Lands to be dedicated as per 4.3.4.5.8.13
- Lands to be dedicated as per 4.3.4.4.5.8



Printed : May 2014 (RS)



This map, whether in whole or in part, may not be reproduced without the written authority from The Corporation of the Town of Collingwood. Copyright The Corporation of the Town of Collingwood. Land Information Network Corporation - 2010 2007 The Ontario Ministry of Natural Resources (Copyright - Queen's Printer 2007). Cartimati Inc. and its suppliers all rights reserved, and Members of the Ontario Geospatial Data Exchange. THIS IS NOT A PLAN OF SURVEY.





# Official Plan of the Town of Collingwood **SCHEDULE 'B1' - Environmental Protection- Natural Heritage Resource Areas**

Legend

-- Fish

**SCHEDULE B**

**NATURAL\_FE**

CATEGORY 1 VALLEYLANDS

CATEGORY 1 WETLANDS

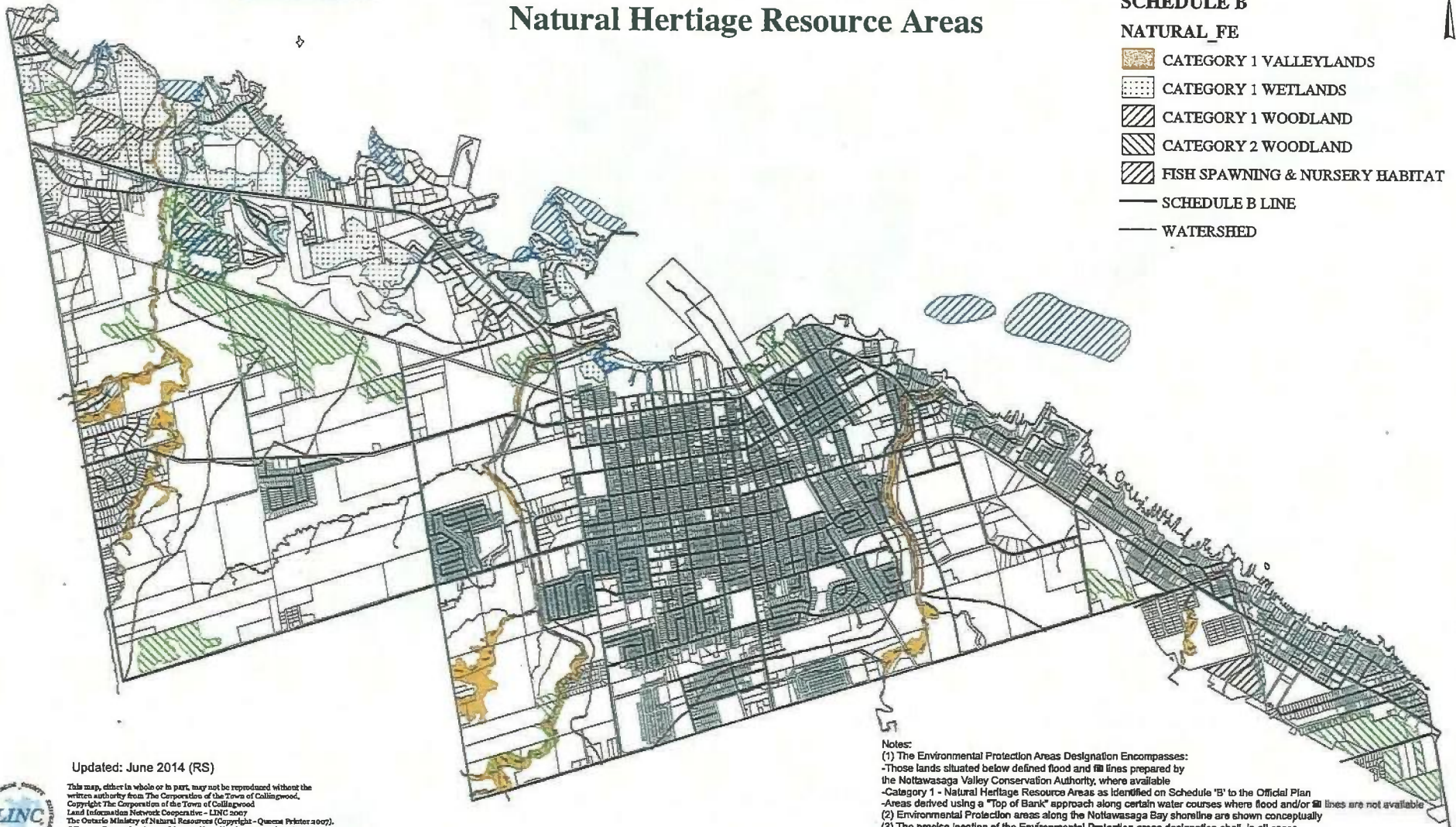
CATEGORY 1 WOODLAND

CATEGORY 2 WOODLAND

FISH SPAWNING & NURSERY HABITAT

SCHEDULE B LINE

WATERSHED



Updated: June 2014 (RS)



This map, either in whole or in part, may not be reproduced without the written authority from The Corporation of the Town of Collingwood.  
 Copyright The Corporation of the Town of Collingwood.  
 Land Information Network Cooperative - LINC 2007  
 The Ontario Ministry of Natural Resources (Copyright - Queen's Printer 2007).  
 All other rights reserved and to suppliers all rights reserved, and  
 Members of the Ontario Geospatial Data Exchange.  
 THIS IS NOT A PLAN OF SURVEY.

**Notes:**

- (1) The Environmental Protection Areas Designation Encompasses:  
 -Those lands situated below defined flood and lines prepared by the Nottawasaga Valley Conservation Authority, where available  
 -Category 1 - Natural Heritage Resource Areas as identified on Schedule 'B' to the Official Plan  
 -Areas derived using a "Top of Bank" approach along certain water courses where flood and/or lines are not available
- (2) Environmental Protection areas along the Nottawasaga Bay shoreline are shown conceptually
- (3) The precise location of the Environmental Protection areas designation shall, in all cases, be determined as development proceeds in consultation with The County of Simcoe (Nottawasaga Valley Conservation Authority) and the Town of Collingwood.



# Official Plan of the Town of Collingwood SCHEDULE 'C' - Residential Density

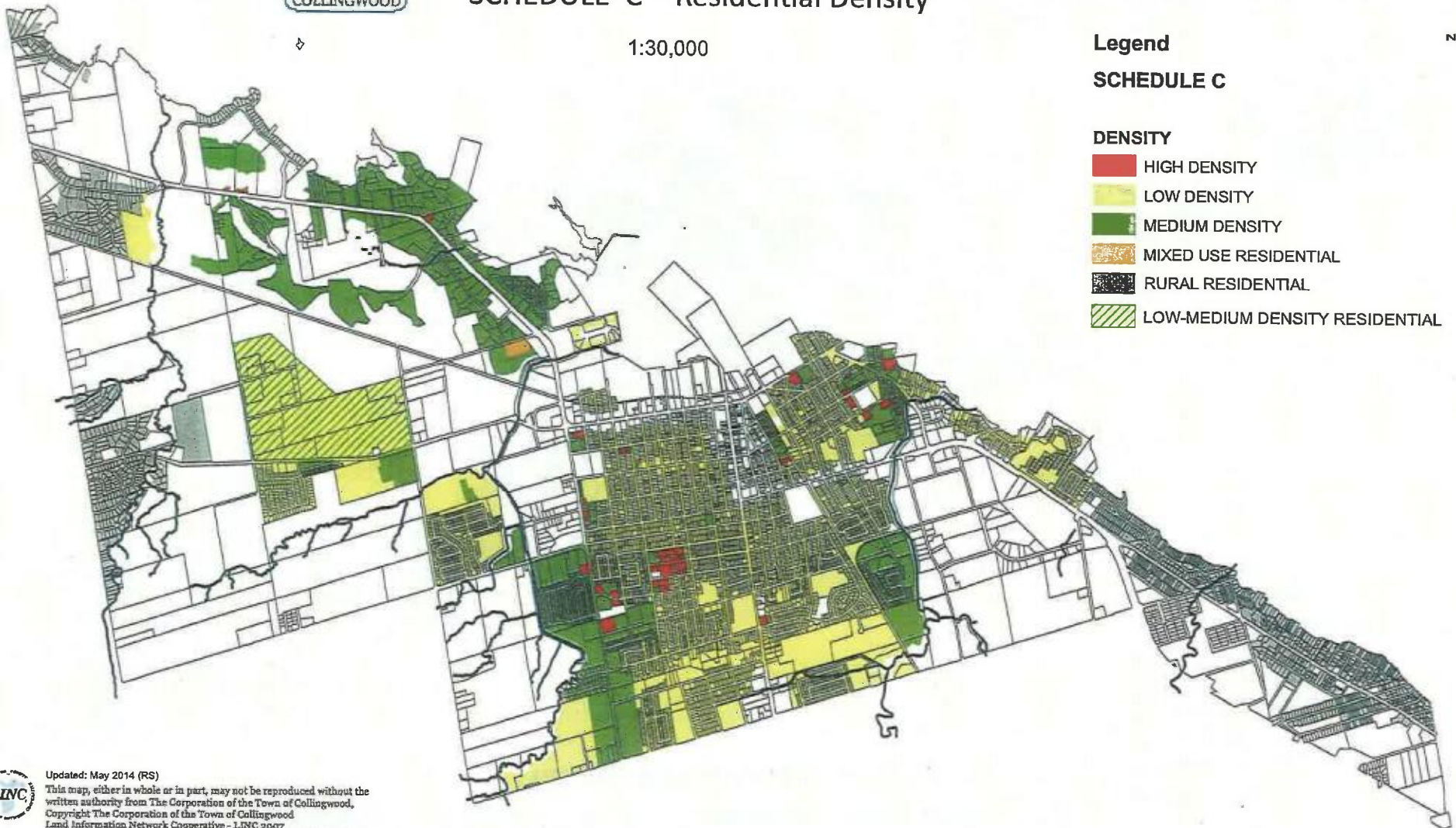
1:30,000

## Legend

### SCHEDULE C

#### DENSITY

-  HIGH DENSITY
-  LOW DENSITY
-  MEDIUM DENSITY
-  MIXED USE RESIDENTIAL
-  RURAL RESIDENTIAL
-  LOW-MEDIUM DENSITY RESIDENTIAL



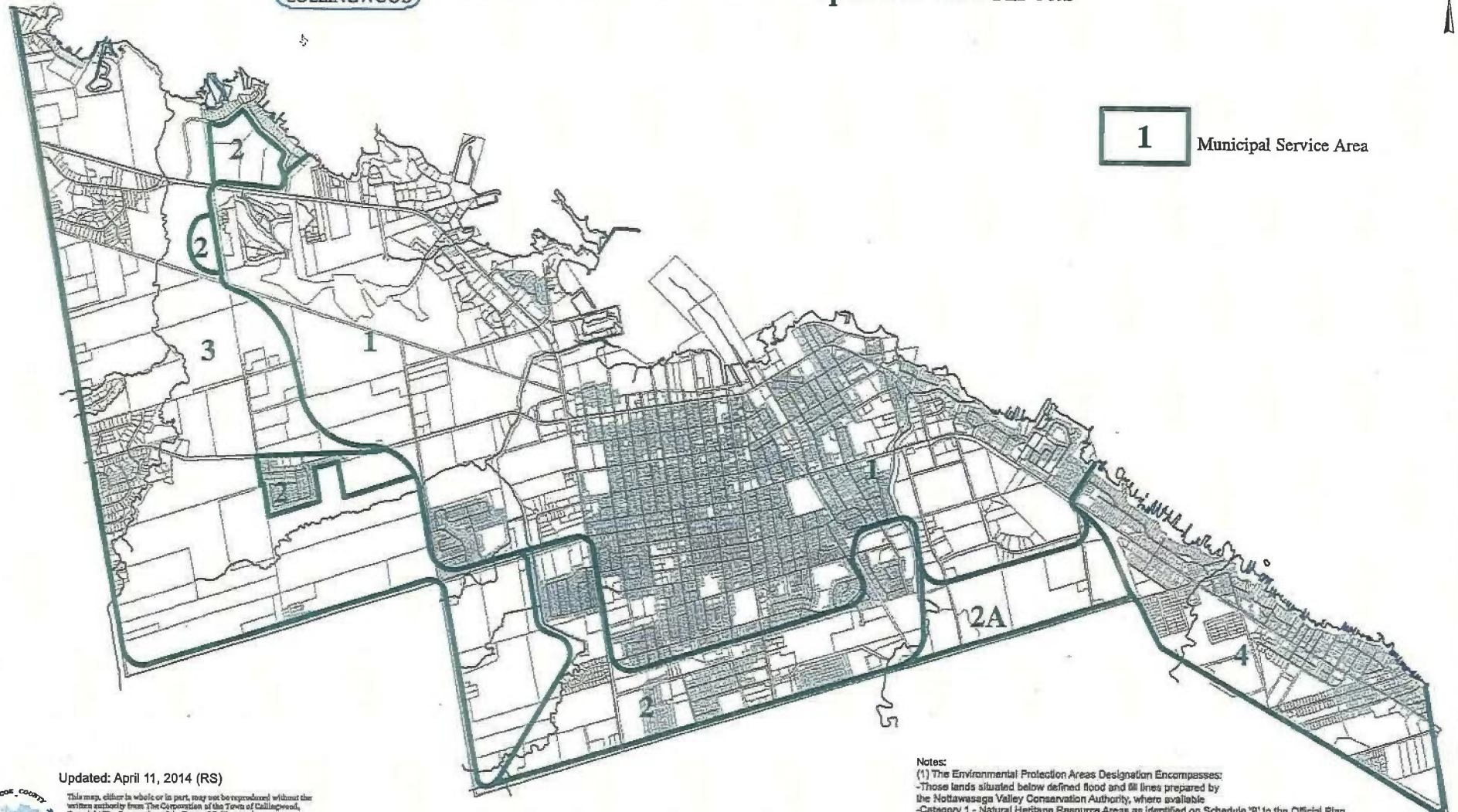
Updated: May 2014 (RS)

This map, either in whole or in part, may not be reproduced without the written authority from The Corporation of the Town of Collingwood.  
Copyright The Corporation of the Town of Collingwood  
Land Information Network Cooperative - LINC 2007  
The Ontario Ministry of Natural Resources (Copyright - Queens Printer 2007).  
©Teranet Enterprises Inc. and its suppliers all rights reserved, and  
Members of the Ontario Geospatial Data Exchange.  
THIS IS NOT A PLAN OF SURVEY.





# Official Plan of the Town of Collingwood SCHEDULE 'E1' - Municipal Service Areas



Updated: April 11, 2014 (RS)



This map, either in whole or in part, may not be reproduced without the written authority from The Corporation of the Town of Collingwood. Copyright The Corporation of the Town of Collingwood. Land Information Network Cooperative - LINC 2007. The Ontario Ministry of Natural Resources (Copyright - Queen's Printer 2007). ©Tetrad Enterprises Inc. and its suppliers all rights reserved, and Members of the Ontario Geospatial Data Exchange. THIS IS NOT A PLAIN GP SURVEY.

## Notes:

- (1) The Environmental Protection Areas Designation Encompasses:
  - Those lands situated below defined flood and 100 lines prepared by the Nottawasaga Valley Conservation Authority, where available
  - Category 1 - Natural Heritage Resource Areas as identified on Schedule 'B' to the Official Plan
  - Areas derived using a "Top of Bank" approach along certain water courses where flood and/or 100 lines are not available
- (2) Environmental Protection areas along the Nottawasaga Bay shoreline are shown conceptually
- (3) The precise location of the Environmental Protection areas designation shall, in all cases, be determined as development proceeds in consultation with The County of Simcoe (Nottawasaga Valley Conservation Authority) and the Town of Collingwood.

## **APPENDIX D**

### Supplementary Analysis

#### Supplementary Flood Hazard Analysis Summary Memo

**MEMO**

---

|             |                                                                               |                    |          |
|-------------|-------------------------------------------------------------------------------|--------------------|----------|
| <b>DATE</b> | July 29, 2019                                                                 | <b>PROJECT NO.</b> | 281-2769 |
| <b>RE</b>   | Huntingwood Trails Development<br>Supplementary Flood Hazard Analysis Summary |                    |          |

---

|             |                     |
|-------------|---------------------|
| <b>TO</b>   | Jon Proctor, P.Eng. |
| <b>FROM</b> | Jessie Elder, EIT   |
| <b>CC</b>   |                     |

---

This memorandum has been prepared to summarize the findings of the supplementary floodplain and spill analyses completed for the identification of natural hazards surrounding Silver Creek at the location of the Huntingwood Trails Development in the Town of Collingwood.

**1.0 BACKGROUND**

C.F. Crozier & Associates (Crozier) was retained by Huntingwood Trails (Collingwood) Ltd. to complete a Natural Hazards Study in support of the Huntingwood Trails Development in the Town of Collingwood. Silver Creek bisects the site dividing the proposed land into two development areas: east of Silver Creek (Development Area #1) and west of Silver Creek (Development Area #2).

A number of studies have been prepared to assess the natural hazards on site in support of the development. Following the submission of a Natural Hazards Study (Crozier, 2011) the development was appealed to the Ontario Municipal Board (OMB). This appeal brought forth the requirement for supplemental analysis in relation to the identification of the natural hazards surrounding the development, specifically the flooding hazards and spill zones that had been identified on site in previous studies.

The following supplementary analyses were prepared subsequent to the 2011 Natural Hazards Study:

- Huntingwood Trails Flood Hazard Assessment Memo – September 2013
- Huntingwood Developments Spill 'A' Analysis – March 2014

The Huntingwood Trails Flood Hazard Assessment Memo and associated hydraulic modelling updates were prepared to assess the Spill surrounding Silver Creek that had been identified in historic reports including the 1989 Cumming & Cockburn Limited ("CCL") Study entitled "Floodline Mapping of Silver Creek, Spring Creek, & Village of Angus" and confirmed through the modelling prepared for the 2011 Natural Hazards Study (Crozier).

The Huntingwood Development Spill 'A' Analysis was prepared to confirm appropriateness of using the volumetric flowrate of 78 m<sup>3</sup>/s in the hydraulic modelling through the Huntingwood Development lands per the findings of the CCL Study.

The following sections of this memorandum have been prepared to summarize the above noted supplementary analyses.

## **2.0 HUNTINGWOOD TRAILS FLOOD HAZARD ASSESSMENT MEMO**

### **2.1 Introduction**

The Huntingwood Trails Flood Hazard Assessment Memo and accompanying hydraulic modelling were prepared to verify the identification of Spill Zone B and the Silver Creek floodplain located on the Huntingwood Trails property (the "Subject Lands"). This technical memo supplements the Natural Hazards Report Huntingwood Trails (Collingwood) Ltd. (Crozier, January 2011).

Reference to Spill Zone B is per the original nomenclature provided by Cumming & Cockburn Limited in their report entitled "Floodline Mapping Study of Silver Creek, Spring Creek and the Village of Angus" (CCL, 1989).

Conclusions reached in this supplemental analysis are consistent with those of our original report (Crozier, 2011), namely that spill occurs in multiple locations along the eastern overbank of Silver Creek through the Subject Lands (Spill Zone B); and a defined floodplain is located on the west side of Silver Creek through the Subject Lands establishing a Regulatory floodplain.

### **2.2 Review of Hydraulic Modelling Principles**

The following is a review of open channel flow characteristics. This is followed by a review of hydraulic modelling protocol applicable to HEC-RAS given the flow characteristics of Silver Creek.

#### **2.2.1 Open Channel Flow**

According to Sturm (2001), open channel flow is defined as flow that occurs with a free surface. Under open channel flow conditions, flow energy is comprised of elevation and velocity terms only, with no pressure component. Open channel flow occurs between points of different total energies, in the direction of decreasing total energy.

Open channel flow may be categorized in several ways, as described below:

- 1) Steady flow: velocity and depth do not vary as a function of time
- 2) Unsteady Flow: velocity and depth vary as a function of time
- 3) Uniform Flow: depth does not vary for a given length of channel
- 4) Gradually Varied Flow: depth changes gradually over a given length of channel
- 5) Rapidly Varied Flow: depth changes rapidly over a given length of channel
- 6) Spatially Varied Flow: discharge varies in the direction of flow

Open channel flow in natural channels, such as Silver Creek, is often represented as gradually varied, steady flow for the purposes of establishing Regulatory flood limits. For this type of flow condition, boundary resistance is the paramount factor in determining water surface elevation

and discharge, as opposed to rapidly varied flow where channel structure and slope become the dictating factors (Sturm, 2001).

The presence of spill effects introduce the component of spatially varied flow, as lateral outflow from the channel causes changes in discharge along the channel length. This is characteristic of Spill Zone B along the east side of Silver Creek through the Subject Lands.

### 2.2.2 Application of HEC-RAS

The HEC-RAS hydraulic model is the industry standard model for use in most floodplain investigations. HEC-RAS completes water surface profile computations using the standard step method between cross sections, applying the following assumptions for steady state modelling (US Army Corps of Engineers, 2010):

- Channel has a rigid boundary
- Flow is gradually varied
- Flow is one-dimensional
- Fluid properties are constant

Embedded in the assumptions of gradually varied flow is the assumption that friction slope is approximately equal to the bed slope, and that the friction slope is approximately constant and can be averaged between adjacent cross sections (US Army Corps of Engineers, 2010). The "Technical Guide – River and Stream Systems: Flooding Hazard Limits" (MNR, 2002) identifies HEC-RAS as an appropriate hydraulic modelling software for use in flood hazard delineation, provided that these assumptions are valid.

Review of the characteristics of the west and east overbank areas lead us to determine the modelling approach that is most appropriate to establish the flood profile based on flood conditions occurring.

### 2.2.3 West Overbank and Main Channel

The topography of the west overbank generally falls in a north/northeast direction towards Highway 26 and the main channel of Silver Creek. During high stage storm events, main channel flows from Silver Creek enter the west overbank and utilize conveyance capacity that is available in the western overbank. Because of the topography in the west overbank, flows remain hydraulically connected to the main channel, constituting a floodplain of Silver Creek. Flow in the west overbank and main channel satisfy the conditions of gradually varied, one dimensional flow, and as such are modeled as a continuous floodplain with cross sections oriented in the east-west direction. The energy grade line of this system falls from north to south, following the natural topography of the site.

### 2.2.4 East Overbank (Spill Zone B)

The conditions of the east overbank differ from that of the west overbank. Silver Creek exhibits a defined drainage divide on its east side. From this divide, the topography is predominantly in a northeast direction, with contours generally aligned at 45 degree angles from the overall northward trajectory of the main channel. Slopes in the east overbank generally exceed the slopes in the main channel and west overbank (approximately 0.7% in the west overbank/main channel, and 1-1.2% in the east overbank immediately adjacent the creek). Some distance from



the main channel the contours deflect slightly northward once again, but the overall direction of fall remains in the northeasterly direction, away from the main channel.

These topographic conditions are characteristic of spill: flow leaves the main watercourse (Silver Creek) entering an overbank (east overbank) where it is conveyed away from the main watercourse via a defined onsite drainage route, never to return to the system.

Based on the discussion of topography above, the following points can be made pertaining to the spill flow from the east bank of Silver Creek:

- Due to the change in slope from the main channel to the east overbank immediately adjacent the creek, it is not appropriate for a single straight east/west cross section to encompass both the west overbank/main creek floodplain system and the east overbank system due to the discontinuity in slope regime across the section.
- Due to the change in direction of slope, it is not appropriate for a single straight east / west cross section to encompass both the West Overbank / Main Channel floodplain system and the East Overbank system, as it conflicts with the assumption of one-dimensional flow.
- Due to the directionality of the topography in the east overbank, flows breaching the east overbank of the creek move away from the creek and become hydraulically disconnected from the main system.

Given the above, we have updated the HEC-RAS hydraulic model to establish distinct flood levels through Spill Zone B and illustrate that energy grade lines are lower, thus representing a separate profile from the Silver Creek system.

The contribution of flow into the Spill Zone B profile was generated from the Main Channel/West Overbank hydraulic model by applying lateral structures to calculate the magnitude of flow breaching the main channel into the east overbank between each cross section along the Main Channel model. The lateral structures were coded as weirs; each lateral structure connected to the adjacent cross sections of the Spill Zone B HEC-RAS model to account for tailwater effects. In this way, the spatially varied conditions (per Section 2.1) of the Main Channel and Spill Zone B were represented, while local flow computations between cross sections still remained valid based on the assumption of spatially uniform flow.

The gradually varied flow assumption embedded in the HEC-RAS modelling approach also remains valid for the two independent reaches while the rapidly varied nature of the spill locations themselves are captured using the lateral weir structures. This configuration accounts for the dominant effects of boundary friction in the areas of gradually varied flow (ie. the reaches themselves), while also accounting for the importance of structure and slope in the representation of rapidly varied flows (ie. at the spill locations).

Details concerning the parameterization of the model and computation options are discussed in Section 2.3.

## **2.3 Hydraulic Modelling Methodology**

The supplemental hydraulic modelling was undertaken on the basis of the approach outlined above based on Existing Conditions, following the protocol of the Ministry of Natural Resources publication "Understanding Natural Hazards" (MNR, 2001) and "Technical Guide- River and Stream Systems: Flooding Hazard Limits" (MNR, 2002).

### 2.3.1 Silver Creek (Main Channel) and West Overbank Profile

The hydraulic profile for Silver Creek and the west overbank has been extended further upstream south of the Georgian Trail. The model continues to extend downstream to Georgian Bay per the original report (Crozier, 2011).

Eleven cross sections have been used to evaluate the floodplain hydraulics of the west overbank and main channel through the Subject Lands. The orientation of the cross sections is shown on the attached updated section plan. All cross sections were generated using updated air-photo based topographic mapping produced by First Base Solutions (2008). The contour map of the site and surrounding lands consists of a 0.5-metre contour interval.

At the downstream limit of the Subject Lands, Silver Creek crosses Highway 26 via an existing 7.5m x 1.5m concrete box culvert. The modelling of this culvert is consistent with our previous report (Crozier, 2011).

Silver Creek crosses the Georgian Trail before entering the Subject Lands. The crossing, as well as two upstream cross sections, were added to the model to determine the water surface elevation upstream of the Trail. The upstream most cross section (XS 1851) was copied from cross section 1850 and the elevations adjusted by 0.1m for model stability. Contour elevations for the lands upstream of the Subject Lands were sourced from Town of Collingwood Base Mapping. The mapping was cross referenced to the First Base Solutions (2008) mapping to ensure consistency of datum.

The Silver Creek crossing at the Georgian Trail consists of a wooden bridge structure spanning approximately 11m, with soffit approximately 2.1m above the creek bed at the deepest point. The bridge consists of two wooden piers of 0.4m width within the channel flow area, and is bounded on each bank by wingwalls oriented parallel to the direction of flow.

The Manning's roughness coefficients used in the Silver Creek/west overbank model were consistent with the values used in our original report (Crozier, 2011).

The Regional peak flow of 78 m<sup>3</sup>/s was applied to the Main Channel/west overbank profile consistent with the peak flow utilized by CCL (1989) on Silver Creek through the subject property.

### 2.3.2 East Overbank Profile (Spill Zone B)

As identified in the original Natural Hazards Study for the Subject Lands (Crozier, 2011), Spill Zone B has been observed to occur along the Silver Creek drainage divide adjacent the east overbank of the Main Channel throughout the site. In essence water builds within the Main Channel and breaches the drainage divide where it enters a broad draw which heads in a northeastern direction away from the Silver Creek. This secondary draw was modeled as an independent profile to confirm flow characteristics.

All cross sections of Spill Zone B on the site were generated using updated air-photo based topographic mapping produced by First Base Solutions (2008). The contour map of the site and surrounding lands consists of a 0.5-metre contour interval.

Manning's roughness values were set at 0.07 for the entire cross section to represent shallow flows in moderately vegetated / pasture areas with poorly defined channels. At the downstream

limits of the Spill Zone B profile, the Manning's roughness was increased to 0.1 to represent the more dense vegetative conditions.

The downstream portion of the Spill Zone B model located to the east of the subject site on the Silver Glen Preserve and Cranberry Trail lands was used to ensure model stability. This model was previously approved by the NVCA as part of the approvals for Silver Glen Preserve development and accounts for flood conveyance infrastructure installed as part of that development. The downstream limit of the model occurs east of Cranberry Trail; the normal depth was used as the downstream boundary condition.

Flow spilling from the Main Channel profile to the Spill Zone B profile was simulated by the application of lateral weirs. The weir elevations were determined from the site topography, taking the height of the drainage divide located in the east overbank between each cross section to develop the weir profiles. In this way, the height of the main channel water surface elevation over the drainage divide determines how much spill flow is lost to the Spill Zone B profile.

A lateral weir exists between each cross section on the Main Channel profile model from Section 1830 to Section 785. It was assumed that the distance required for expansion of flow immediately downstream of the Georgian Trail bridge would preclude significant spill from occurring between Section 1840 and 1830.

The lateral weirs were coded using the Standard Weir Equation for broad-crested weirs representative of the wide, rounded shape of the drainage divide on the east side of Silver Creek. Weir computations were performed based on water surface elevation rather than energy grade line, as the velocity head in the main channel does not act in the direction of weir flow (ie. only the elevation component of the total energy in the main channel acts to cause lateral outflow). A discharge coefficient of 0.8 was used to represent an imperfect weir whose efficiency is decreased by variations in topography and the presence of vegetation. The HEC-RAS weir computations also account for the submergence of the weir due to water surface elevations in the receiving channel (ie. tailwater conditions due to flow in Spill Zone B).

## **2.4 Hydraulic Modelling Results**

Results from the existing conditions HEC-RAS hydraulic analysis of the Silver Creek profile and Spill Zone B profile are summarized in Table 1. This assessment was based on the Regional peak flow of 78 m<sup>3</sup>/s, consistent with the previously approved CCL (1989) study. Refer to Section 3.0 for further discussion regarding the Regional peak flow of 78 m<sup>3</sup>/s.

The results of the analysis confirm that spill from the main channel occurs along much of the length of the east overbank of Silver Creek through the Subject Lands, resulting in a total Spill Zone B flow of 48 m<sup>3</sup>/s from the main channel (includes 1.0 m<sup>3</sup>/s added for model stability). This result suggests that the CCL estimate of the magnitude of Spill Zone B (30.8m<sup>3</sup>/s) was an underestimate of the true spill flow based on existing site topography.

An examination of the water surface elevations and energy grade lines (see attached detailed output) indicates that the main channel and Spill Zone B reaches do, in fact, act as separate hydraulic systems. The water surface and energy grade elevations in Spill Zone B profile are both lower than those in the Silver Creek/west overbank profile, confirming that Spill Zone B is hydraulically disconnected from Silver Creek. Flow that has breached the drainage divide on

east side of the creek does not remain in the Silver Creek system but rather exits the system as spill flow through Spill Zone B.

Table 1: Hydraulic Assessment Results (Existing Conditions)

| Cross Section ID                  | Flow (m <sup>3</sup> /s) | W.S. Elev (m) | Flow Leaving | Cross Section ID                    | Flow (m <sup>3</sup> /s) | W.S. Elev (m) |
|-----------------------------------|--------------------------|---------------|--------------|-------------------------------------|--------------------------|---------------|
| <b>Silver Creek/West Overbank</b> |                          |               |              |                                     |                          |               |
| 1851                              | 78.0                     | 187.82        |              |                                     |                          |               |
| 1850                              | 78.0                     | 187.89        |              |                                     |                          |               |
| 1845                              | Georgian Trail Culvert   |               |              |                                     |                          |               |
| 1840                              | 78.0                     | 186.38        | 0.0          | <b>East Overbank (Spill Zone B)</b> |                          |               |
| 1830                              | 78.0                     | 185.91        | 7            | 1830                                | 1.0*                     | 185.55        |
| 1820                              | 71.3                     | 185.28        | 17           | 1820                                | 7.7                      | 185.02        |
| 1810                              | 54.3                     | 184.13        | 7            | 1810                                | 24.7                     | 183.68        |
| 1800                              | 47.7                     | 183.63        | 4            | 1800                                | 31.3                     | 183.40        |
| 1790                              | 43.3                     | 183.08        | 1            | 1790                                | 35.7                     | 182.82        |
| 1780                              | 42.1                     | 182.44        | 0            | 1780                                | 36.9                     | 182.29        |
| 1770                              | 42.0                     | 182.05        | 9            | 1770                                | 37.0                     | 181.98        |
| 1760                              | 36.2                     | 181.70        | 5            | 1760                                | 42.9                     | 181.21        |
| 785                               | 31.0                     | 181.70        | 0            | 1750                                | 48.1                     | 180.75        |

\* Flow of 1.0cms applied at upstream limit of Spill Zone B for model stability only.

## 2.5 Conclusions

We conclude the following based on the existing conditions hydraulic analysis of Silver Creek on the Huntingwood site:

- 1) The Western overbanks and Main Channel of Silver Creek behave as a united hydraulic system across the subject lands conveying flows northward from the Georgian Trail to Highway 26. This portion of the site is considered "floodplain".
- 2) The east overbank of Silver Creek on the Huntingwood site facilitates spill flow to the east.
- 3) Spill from Silver Creek to the Spill Zone B reach occurs at multiple locations throughout the subject lands and is primarily dictated by the topography of the east overbank of Silver Creek.
- 4) The original estimate of the magnitude of spills by CCL has underestimated the flows contributing to Spill Zone B.
- 5) Flow that breaches the east bank becomes hydraulically disconnected from the Main Channel of Silver Creek and is conveyed in a northeasterly direction towards Highway 26 and Silver Glen Preserve. This portion of the flow is a "spill flow".

## 3.0 HUNTINGWOOD DEVELOPMENT SPILL 'A' ANALYSIS

This supplemental analysis, modelling and figure were prepared to summarize our hydraulic analysis of Spill 'A' on Silver Creek south of the Huntingwood Developments site in the Town of Collingwood.

Cumming Cockburn Ltd (CCL) previously established the existence of a spill condition south of the Georgian Trail on Silver Creek. The spill (denoted Spill 'A') occurs due to insufficient capacity of the Georgian Trail culverts to convey the Regional Event, combined with low elevations in the west overbank of Silver Creek upstream of the Trail. Based on their assessment of these hydraulic components, CCL established that Spill 'A', in the amount of 31 m<sup>3</sup>/s, breaches the west bank of the Silver Creek floodplain and spills into Watercourse #1 to the west. The remaining 78 m<sup>3</sup>/s has historically been used as the Regulatory flow for the Huntingwood site and downstream lands. CCL also established the existence of a Spill 'B' in the eastern portion of the Huntingwood Lands, as discussed in Section 2.0.

Crozier has undertaken the re-assessment of Spill 'A' to confirm the appropriateness of the 78 m<sup>3</sup>/s Regulatory flow on the Huntingwood site (note that this Regulatory flow was used to complete the Spill 'B' analysis). To begin the Spill 'A' re-assessment, Crozier undertook the following tasks:

- Survey of the Georgian Trail, tied into the Huntingwood site-specific air-photo topographic data to more accurately represent to Trail profile relative to site topography;
- HEC-RAS modelling of the updated Trail profile and previously measured Silver Creek culvert crossing;
- Review of Town of Collingwood Base mapping upstream of the Trail to assess the nature of the Silver Creek floodplain; and,
- Review of topography of west overbank of Silver Creek and the Watercourse #1 system to identify potential spill locations and the factors that may impact the magnitude of Spill 'A'.

This review revealed that, as described by CCL, the flow restriction at the Georgian Trail combined with low overbanks west of Silver Creek would facilitate a spill flow condition. Two possible hydraulic controls were identified that could dictate the magnitude of Spill 'A':

- 1) The restriction provided by the natural topography at the watershed divide between Silver Creek and Watercourse #1; or
- 2) The restriction provided at the Watercourse #1 crossing of the Georgian Trail.

Hydraulic assessment of each potential "pinch point" revealed that the watershed divide between Silver Creek and Watercourse #1 was the most restrictive. As such, this topographic feature and its impacts on Spill 'A' were incorporated into the model, as discussed below.

Three cross sections were established upstream of the Georgian Trail on Silver Creek (cross sections 1850, 1860 and 1870). These cross sections span from the Watercourse #1/Silver Creek watershed divide on the west side of Silver Creek to a height of land (which contains the floodplain) on the east side of Silver Creek. A lateral structure (LS 1855) was applied between cross sections 1850 and 1860, reflecting the natural topography of the watershed divide. Spill 'A' occurs across this lateral structure. A second lateral structure (LS 1865) was included between cross sections 1860 and 1870 to confirm that spill did not also occur further upstream than anticipated. This was determined not to be the case (ie. no flow occurs across LS 1865). The full 109 m<sup>3</sup>/s approach flow was applied to the upstream limit of the model.

The results of the modelling are illustrated on the enclosed Spill 'A' Analysis Plan, and are summarized below:

- Backwater effects from the Georgian Trail cause a spill across LS 1855 into the Watercourse #1 system, with a magnitude of 34 m<sup>3</sup>/s;
- The elevation of the Regional WSEL upstream of the Trail is such that spill occurs over the low points of the Trail (below elevation 187.32m);
- A portion (approximately 4 m<sup>3</sup>/s) spills over the Trail east of the Creek, and joins the Spill 'B' flows on the Huntingwood site;
- The remainder of the flow that overtops the Trail (18 m<sup>3</sup>/s) enters the Forest Drive subdivision west of the Huntingwood site;
- Spill flow tracking by Crozier staff confirms that flow entering the Forest Drive subdivision joins the Watercourse #1 system and does not return to Silver Creek.

Our assessment of Spill 'A' confirms the existence of a spill upstream of the Georgian Trail. Furthermore, a portion of the flow that overtops the Trail is also lost to the Watercourse #1 system, reducing the anticipated Regional flow on the Huntingwood site to 57 m<sup>3</sup>/s, 4 m<sup>3</sup>/s of which is immediately tributary to Spill 'B'. Based on these findings, we conclude that CCL underestimated the magnitude of Spill 'A' to provide a conservative Regulatory flow of 78 m<sup>3</sup>/s on the Huntingwood site.

**Table 2** summarizes the main channel flow rates and spill flow rates surrounding Silver Creek upstream of the Georgian Trail.

*Table 2: Silver Creek Main Channel and Spill Flow Summary Upstream of Huntingwood Lands*

| Location                                | Description                      | Updated Flows (m <sup>3</sup> /s) | CCL Flows (m <sup>3</sup> /s) | Type of Flow | Direction of Flow | Downstream Channel                 |
|-----------------------------------------|----------------------------------|-----------------------------------|-------------------------------|--------------|-------------------|------------------------------------|
| Silver Creek Upstream of Georgian Trail | Silver Creek                     | 109                               | 109                           | Main Channel | North             | Silver Creek                       |
| Upstream of Georgian Trail              | Overbank Spill from Silver Creek | 34                                | 31                            | Spill        | West              | Watercourse 1                      |
| Georgian Trail                          | Spill over Georgian Trail        | 18                                | -                             | Spill        | West              | Forest Subdivision / Watercourse 1 |
| Georgian Trail                          | Spill over Georgian Trail        | 4                                 | -                             | Spill        | East              | Spill Zone 'B'                     |
| Upstream end of Huntingwood             | Silver Creek                     | 53                                | 78                            | Main Channel | North             | Silver Creek                       |

To uphold a conservative design, the flow of 78 m<sup>3</sup>/s will be maintained as the Regulatory flow of Silver Creek at the upstream end of the subject site for the purposes of determining the existing conditions floodplain hazard limits through the site.

#### 4.0 CONCLUSION

The conclusions of the supplemental analyses described in this memorandum have been used in preparation of the Natural Hazards Study Addendum (Crozier, 2019). Refer to the enclosures for the supporting HEC-RAS modelling results and accompanying Figures presenting the results.

Sincerely,

**C.F. CROZIER & ASSOCIATES INC.**



Jessie Elder, EIT

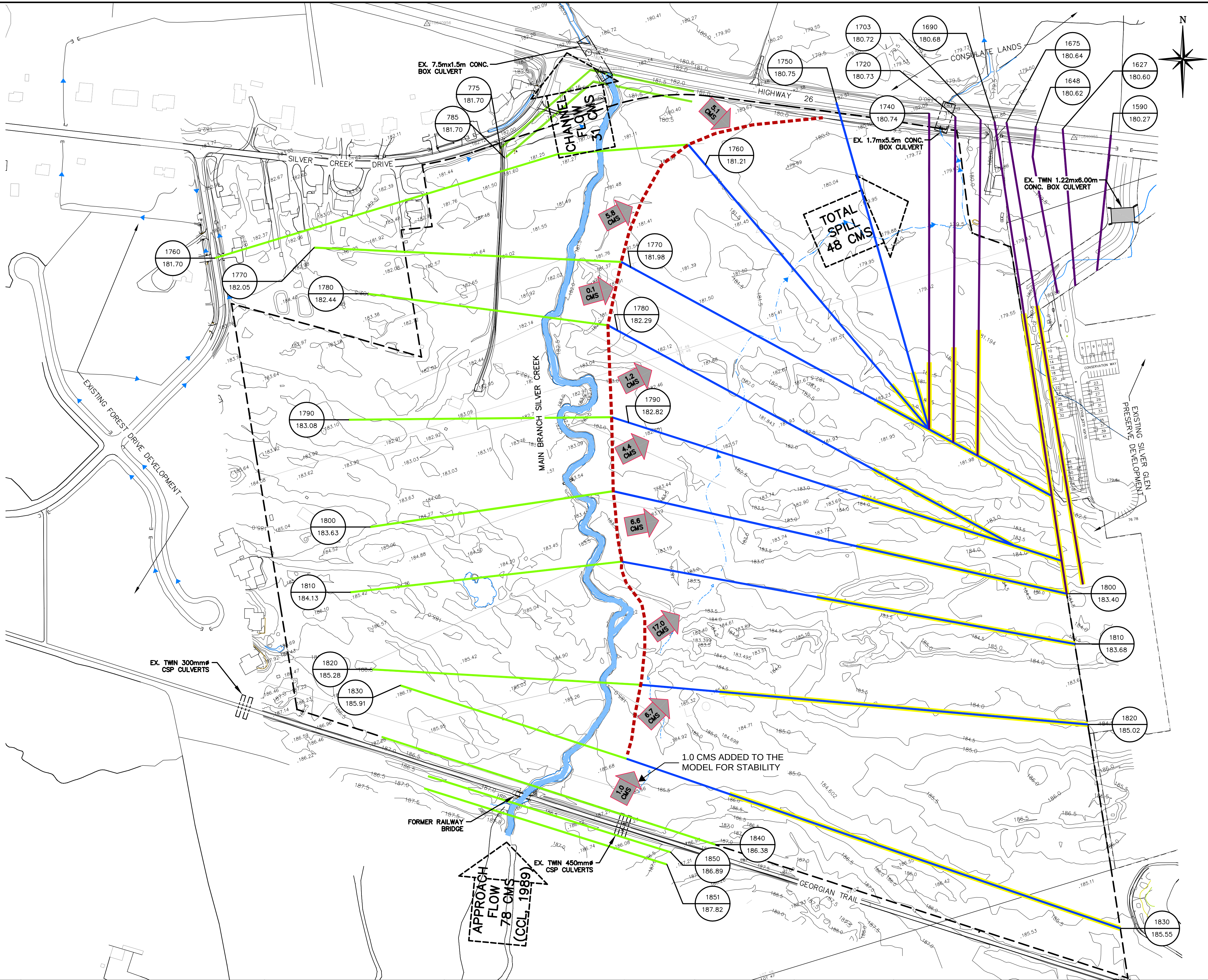
/je

Encl.

Huntingwood Trails Flood Assessment Memo Supporting Documentation (September 2013)  
Existing Conditions Natural Hazard Limits Plan  
HEC-RAS Output Table and Sections  
Huntingwood Development Spill 'A' Analysis Supporting Documentation (March 2014)  
Spill 'A' Analysis Plan  
HEC-RAS Output Table and Sections

J:\200\281 - Huntingwood - Skelton Farm\2769\Memos\2019.07.26 Flood Analysis Summary\2019.07.26 Flood Analysis Summary.docx





**LEGEND**

- 1690 HEC-RAS SECTION ID
- xxx.xx REGIONAL W/S ELEVATION (m)
- REGIONAL FLOW DIRECTION
- 1.2 CMS INCREMENTAL SPILL FLOW
- MAIN CHANNEL CROSS SECTION
- NEW SPILL ROUTE CROSS SECTION
- SPILL ROUTE CROSS SECTION FROM PREVIOUS MODELING (SILVER GLEN PRESERVE)
- INEFFECTIVE FLOW AREA
- SPILL FLOW INTERFACE
- PROPERTY LIMITS
- SILVER CREEK WATERCOURSE
- EXISTING INTERMITTENT DRAINAGE CHANNEL
- EXISTING CONTOUR (0.5m INTERVAL)
- EXISTING INTERMITTENT DITCH AS OBSERVED DURING FIELD SITE WALK (FEB 2009)
- HEC RAS SECTION FROM CROZIER 2011 STUDY

NOTE:  
CONTOURS GENERATED BY FIRST BASE SOLUTIONS  
(AIR PHOTO 2006)

1. THIS DRAWING IS THE EXCLUSIVE PROPERTY OF C.F. CROZIER & ASSOCIATES INC. AND THE REPRODUCTION OF ANY PART WITHOUT PRIOR WRITTEN CONSENT OF THIS OFFICE IS STRICTLY PROHIBITED.

2. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS, LEVELS, AND DATUMS ON SITE AND REPORT ANY DISCREPANCIES OR OMISSIONS TO THIS OFFICE PRIOR TO CONSTRUCTION.

3. THIS DRAWING IS TO BE READ AND UNDERSTOOD IN CONJUNCTION WITH ALL OTHER PLANS AND DOCUMENTS APPLICABLE TO THIS PROJECT.

4. DO NOT SCALE THE DRAWINGS.

5. ALL EXISTING UNDERGROUND UTILITIES TO BE VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO CONSTRUCTION.

Town

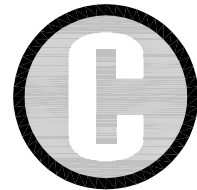
| No. | ISSUE / REVISION                    | DATE: MM/DD/YYYY | Engineer |
|-----|-------------------------------------|------------------|----------|
| 0   | FUNCTIONAL SERVICING AND SWM REPORT | 01/24/2011       |          |
| 1   | REVISED PER NVCA COMMENTS           | 07/22/2011       |          |
| 2   | REVISED FOR SPILL ANALYSIS          | 09/19/2013       |          |
|     |                                     |                  |          |
|     |                                     |                  |          |
|     |                                     |                  |          |

Engineer

Engineer

HUNTINGWOOD DEVELOPMENTS  
TOWN OF COLLINGWOOD

EXISTING CONDITIONS  
NATURAL HAZARD LIMITS PLAN



**CROZIER & ASSOCIATES**  
Consulting Engineers

110 PINE STREET,  
COLLINGWOOD, ON L9Y 2N9  
705 446-3510 T  
705 446-3520 F  
WWW.CFCROZIER.CA  
INFO@CFCROZIER.CA

|          |        |           |            |          |          |
|----------|--------|-----------|------------|----------|----------|
| Drawn By | J.O.   | Design By | J.P.       | Project  | 281-2769 |
| Scale    | 1:2000 | Date      | 09/18/2013 | Check By | C.F.C.   |

Fig. 3



# MAIN CHANNEL OUTPUT

HEC-RAS Plan: SilverCreek River: Silver Creek Reach: MainLower

| Reach     | River Sta | Profile  | Q Total<br>(m3/s) | Min Ch El<br>(m) | W.S. Elev<br>(m) | Crit W.S.<br>(m) | E.G. Elev<br>(m) | E.G. Slope<br>(m/m) | Vel Chnl<br>(m/s) | Flow Area<br>(m2) | Top Width<br>(m) | Froude # Chl |
|-----------|-----------|----------|-------------------|------------------|------------------|------------------|------------------|---------------------|-------------------|-------------------|------------------|--------------|
| MainLower | 1851      | Regional | 78.00             | 185.10           | 187.82           |                  | 187.83           | 0.000120            | 0.43              | 357.26            | 313.62           | 0.09         |
| MainLower | 1851      | 100 Yr   | 44.50             | 185.10           | 187.08           | 186.71           | 187.09           | 0.000515            | 0.70              | 146.93            | 249.60           | 0.17         |
| MainLower | 1850      | Regional | 78.00             | 185.00           | 186.89           | 186.89           | 187.61           | 0.015848            | 3.91              | 22.01             | 230.65           | 0.93         |
| MainLower | 1850      | 100 Yr   | 44.50             | 185.00           | 186.62           | 186.41           | 186.97           | 0.009587            | 2.72              | 17.92             | 220.05           | 0.71         |
| MainLower | 1845      |          | Culvert           |                  |                  |                  |                  |                     |                   |                   |                  |              |
| MainLower | 1840      | Regional | 78.00             | 184.40           | 186.38           | 186.38           | 186.82           | 0.010369            | 3.06              | 31.66             | 172.66           | 0.75         |
| MainLower | 1840      | 100 Yr   | 44.50             | 184.40           | 186.14           | 185.62           | 186.37           | 0.006272            | 2.15              | 21.78             | 145.28           | 0.57         |
| MainLower | 1830      | Regional | 78.00             | 184.00           | 185.91           | 185.91           | 186.09           | 0.006943            | 2.45              | 64.31             | 145.10           | 0.59         |
| MainLower | 1830      | 100 Yr   | 44.50             | 184.00           | 185.62           | 185.41           | 185.95           | 0.010522            | 2.67              | 25.86             | 101.61           | 0.70         |
| MainLower | 1825      |          | Lat Struct        |                  |                  |                  |                  |                     |                   |                   |                  |              |
| MainLower | 1820      | Regional | 71.28             | 183.52           | 185.28           | 185.28           | 185.43           | 0.009909            | 2.40              | 57.72             | 151.26           | 0.68         |
| MainLower | 1820      | 100 Yr   | 43.92             | 183.52           | 185.16           | 185.16           | 185.29           | 0.008419            | 2.07              | 40.89             | 136.04           | 0.62         |
| MainLower | 1815      |          | Lat Struct        |                  |                  |                  |                  |                     |                   |                   |                  |              |
| MainLower | 1810      | Regional | 54.31             | 182.32           | 184.13           | 184.13           | 184.31           | 0.006662            | 2.19              | 43.05             | 109.25           | 0.57         |
| MainLower | 1810      | 100 Yr   | 36.56             | 182.32           | 183.85           | 183.65           | 184.18           | 0.011485            | 2.58              | 17.82             | 45.18            | 0.73         |
| MainLower | 1805      |          | Lat Struct        |                  |                  |                  |                  |                     |                   |                   |                  |              |
| MainLower | 1800      | Regional | 47.70             | 181.89           | 183.63           |                  | 183.70           | 0.004520            | 1.56              | 51.88             | 135.53           | 0.47         |
| MainLower | 1800      | 100 Yr   | 37.36             | 181.89           | 183.55           |                  | 183.63           | 0.004501            | 1.49              | 41.88             | 132.85           | 0.46         |
| MainLower | 1795      |          | Lat Struct        |                  |                  |                  |                  |                     |                   |                   |                  |              |
| MainLower | 1790      | Regional | 43.30             | 181.52           | 183.08           | 183.08           | 183.21           | 0.007238            | 2.10              | 42.74             | 148.02           | 0.58         |
| MainLower | 1790      | 100 Yr   | 35.03             | 181.52           | 183.03           | 183.03           | 183.16           | 0.006642            | 1.97              | 36.09             | 138.20           | 0.56         |
| MainLower | 1785      |          | Lat Struct        |                  |                  |                  |                  |                     |                   |                   |                  |              |
| MainLower | 1780      | Regional | 42.07             | 180.70           | 182.44           | 182.38           | 182.56           | 0.005394            | 1.85              | 41.42             | 108.56           | 0.51         |
| MainLower | 1780      | 100 Yr   | 34.28             | 180.70           | 182.37           | 181.98           | 182.49           | 0.005277            | 1.76              | 33.88             | 102.59           | 0.50         |
| MainLower | 1775      |          | Lat Struct        |                  |                  |                  |                  |                     |                   |                   |                  |              |
| MainLower | 1770      | Regional | 41.98             | 180.58           | 182.05           | 182.05           | 182.18           | 0.009275            | 1.96              | 37.76             | 283.58           | 0.65         |
| MainLower | 1770      | 100 Yr   | 34.28             | 180.58           | 182.01           | 182.01           | 182.13           | 0.008369            | 1.84              | 32.81             | 281.10           | 0.61         |
| MainLower | 1765      |          | Lat Struct        |                  |                  |                  |                  |                     |                   |                   |                  |              |
| MainLower | 1760      | Regional | 36.15             | 180.17           | 181.70           | 181.28           | 181.71           | 0.000735            | 0.54              | 105.72            | 254.62           | 0.18         |
| MainLower | 1760      | 100 Yr   | 31.90             | 180.17           | 181.59           | 181.28           | 181.60           | 0.001081            | 0.60              | 86.57             | 250.33           | 0.21         |
| MainLower | 801       |          | Lat Struct        |                  |                  |                  |                  |                     |                   |                   |                  |              |
| MainLower | 785       | Regional | 30.95             | 179.60           | 181.70           | 180.42           | 181.70           | 0.000019            | 0.15              | 421.48            | 457.66           | 0.03         |
| MainLower | 785       | 100 Yr   | 29.31             | 179.60           | 181.59           | 180.41           | 181.59           | 0.000024            | 0.16              | 372.78            | 434.93           | 0.04         |
| MainLower | 775       | Regional | 30.95             | 179.51           | 181.70           | 180.41           | 181.70           | 0.000020            | 0.15              | 418.00            | 413.00           | 0.03         |
| MainLower | 775       | 100 Yr   | 29.31             | 179.51           | 181.59           | 180.40           | 181.59           | 0.000025            | 0.16              | 373.29            | 410.83           | 0.04         |
| MainLower | 755       |          | Culvert           |                  |                  |                  |                  |                     |                   |                   |                  |              |
| MainLower | 735       | Regional | 30.95             | 179.40           | 180.70           | 180.31           | 180.71           | 0.001123            | 0.53              | 126.24            | 824.50           | 0.16         |
| MainLower | 735       | 100 Yr   | 29.31             | 179.40           | 180.69           | 180.30           | 180.69           | 0.001099            | 0.52              | 122.71            | 819.09           | 0.15         |
| MainLower | 590       | Regional | 30.95             | 179.30           | 180.54           | 180.25           | 180.54           | 0.001621            | 0.59              | 128.80            | 663.61           | 0.18         |
| MainLower | 590       | 100 Yr   | 29.31             | 179.30           | 180.53           | 180.25           | 180.53           | 0.001599            | 0.58              | 124.61            | 657.37           | 0.18         |
| MainLower | 490       | Regional | 30.95             | 179.20           | 180.22           | 180.14           | 180.25           | 0.007069            | 1.14              | 53.83             | 439.80           | 0.38         |
| MainLower | 490       | 100 Yr   | 29.31             | 179.20           | 180.20           | 180.13           | 180.24           | 0.007229            | 1.14              | 50.91             | 432.45           | 0.38         |
| MainLower | 450       | Regional | 30.95             | 179.13           | 179.98           | 179.76           | 180.00           | 0.005367            | 0.82              | 69.99             | 235.66           | 0.31         |
| MainLower | 450       | 100 Yr   | 29.31             | 179.13           | 179.97           | 179.74           | 179.99           | 0.005141            | 0.80              | 67.99             | 231.98           | 0.31         |
| MainLower | 410       | Regional | 30.95             | 178.10           | 179.15           | 179.15           | 179.24           | 0.023226            | 1.94              | 38.85             | 202.40           | 0.67         |
| MainLower | 410       | 100 Yr   | 29.31             | 178.10           | 179.13           | 179.13           | 179.23           | 0.024576            | 1.97              | 35.72             | 194.18           | 0.68         |
| MainLower | 320       | Regional | 30.95             | 177.20           | 178.18           |                  | 178.19           | 0.002517            | 0.68              | 94.22             | 235.72           | 0.22         |
| MainLower | 320       | 100 Yr   | 29.31             | 177.20           | 178.17           |                  | 178.18           | 0.002471            | 0.65              | 91.15             | 232.77           | 0.22         |
| MainLower | 222       | Regional | 30.95             | 177.10           | 177.94           |                  | 177.96           | 0.007272            | 0.97              | 76.65             | 312.32           | 0.37         |
| MainLower | 222       | 100 Yr   | 29.31             | 177.10           | 177.93           |                  | 177.95           | 0.007421            | 0.97              | 72.53             | 303.36           | 0.37         |

# MAIN CHANNEL OUTPUT

HEC-RAS Plan: SilverCreek River: Silver Creek Reach: MainLower (Continued)

| Reach     | River Sta | Profile  | Q Total<br>(m3/s) | MIn Ch El<br>(m) | W.S. Elev<br>(m) | Crit W.S.<br>(m) | E.G. Elev<br>(m) | E.G. Slope<br>(m/m) | Vel Chnl<br>(m/s) | Flow Area<br>(m2) | Top Width<br>(m) | Froude # Chl |
|-----------|-----------|----------|-------------------|------------------|------------------|------------------|------------------|---------------------|-------------------|-------------------|------------------|--------------|
| MainLower | 155       | Regional | 30.95             | 176.70           | 177.69           |                  | 177.70           | 0.002199            | 0.62              | 103.95            | 342.63           | 0.21         |
| MainLower | 155       | 100 Yr   | 29.31             | 176.70           | 177.67           |                  | 177.68           | 0.002180            | 0.61              | 99.51             | 334.36           | 0.21         |
| MainLower | 5         | Regional | 30.95             | 176.00           | 177.12           | 177.12           | 177.21           | 0.015852            | 1.64              | 44.43             | 266.99           | 0.55         |
| MainLower | 5         | 100 Yr   | 29.31             | 176.00           | 177.11           | 177.11           | 177.20           | 0.015446            | 1.61              | 42.36             | 262.37           | 0.55         |

# SPILL ZONE 'B' OUTPUT

HEC-RAS Plan: SilverCreek River: RIVER-1 Reach: Reach-1

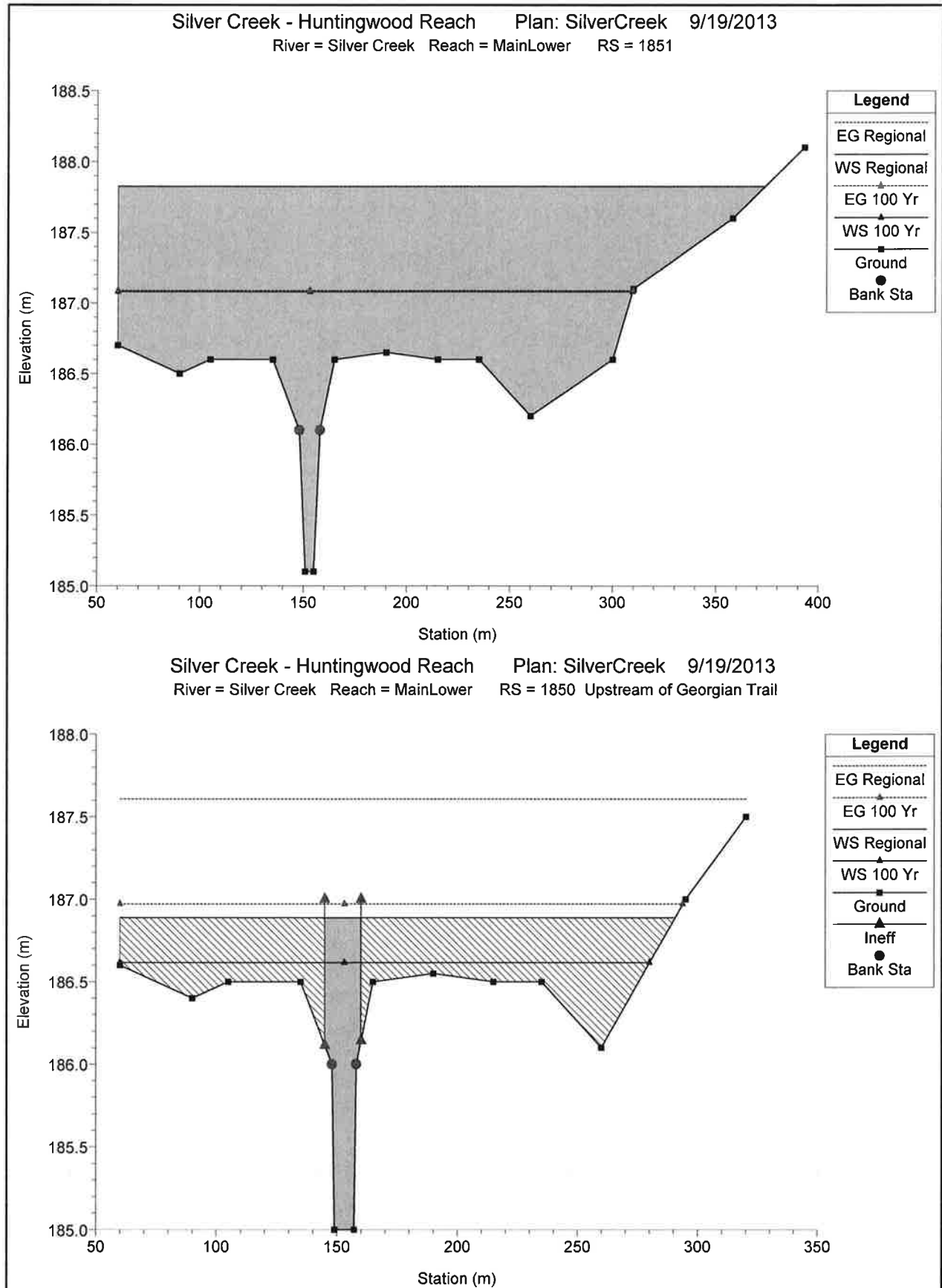
| Reach   | River Sta | Profile  | Q Total<br>(m3/s) | Min Ch El<br>(m) | W.S. Elev<br>(m) | Crit W.S.<br>(m) | E.G. Elev<br>(m) | E.G. Slope<br>(m/m) | Vel Chnl<br>(m/s) | Flow Area<br>(m2) | Top Width<br>(m) | Froude # Chl |
|---------|-----------|----------|-------------------|------------------|------------------|------------------|------------------|---------------------|-------------------|-------------------|------------------|--------------|
| Reach-1 | 1830      | Regional | 1.00              | 185.00           | 185.55           | 185.29           | 185.55           | 0.000112            | 0.05              | 18.36             | 84.66            | 0.04         |
| Reach-1 | 1830      | 100 Yr   | 1.00              | 185.00           | 185.42           | 185.29           | 185.42           | 0.001080            | 0.12              | 8.33              | 64.27            | 0.11         |
| Reach-1 | 1820      | Regional | 7.72              | 183.50           | 185.02           | 185.02           | 185.04           | 0.185305            | 0.63              | 12.24             | 371.91           | 1.11         |
| Reach-1 | 1820      | 100 Yr   | 1.58              | 183.50           | 184.92           | 184.92           | 184.96           | 0.113771            | 0.92              | 1.71              | 352.96           | 1.01         |
| Reach-1 | 1810      | Regional | 24.69             | 183.00           | 183.68           |                  | 183.69           | 0.001937            | 0.34              | 72.23             | 294.55           | 0.17         |
| Reach-1 | 1810      | 100 Yr   | 6.94              | 183.00           | 183.42           |                  | 183.42           | 0.002280            | 0.25              | 28.17             | 160.23           | 0.17         |
| Reach-1 | 1800      | Regional | 31.30             | 182.75           | 183.40           |                  | 183.43           | 0.010124            | 0.78              | 40.12             | 163.11           | 0.39         |
| Reach-1 | 1800      | 100 Yr   | 8.14              | 182.75           | 183.10           |                  | 183.12           | 0.012834            | 0.56              | 14.57             | 71.78            | 0.40         |
| Reach-1 | 1790      | Regional | 35.70             | 182.35           | 182.82           |                  | 182.83           | 0.009601            | 0.62              | 57.94             | 198.37           | 0.36         |
| Reach-1 | 1790      | 100 Yr   | 10.47             | 182.35           | 182.67           | 182.55           | 182.68           | 0.005143            | 0.33              | 31.51             | 170.67           | 0.25         |
| Reach-1 | 1780      | Regional | 36.93             | 181.93           | 182.29           |                  | 182.31           | 0.010048            | 0.56              | 65.96             | 269.57           | 0.36         |
| Reach-1 | 1780      | 100 Yr   | 11.22             | 181.93           | 182.13           |                  | 182.14           | 0.025993            | 0.49              | 23.00             | 235.73           | 0.50         |
| Reach-1 | 1770      | Regional | 37.02             | 181.40           | 181.98           | 181.70           | 181.99           | 0.003079            | 0.41              | 91.08             | 249.98           | 0.21         |
| Reach-1 | 1770      | 100 Yr   | 11.22             | 181.40           | 181.77           |                  | 181.77           | 0.002509            | 0.27              | 42.76             | 202.47           | 0.18         |
| Reach-1 | 1760      | Regional | 42.85             | 180.90           | 181.21           | 181.21           | 181.28           | 0.094964            | 1.23              | 34.73             | 233.71           | 1.02         |
| Reach-1 | 1760      | 100 Yr   | 13.60             | 180.90           | 181.11           | 181.11           | 181.15           | 0.108035            | 0.94              | 14.39             | 159.25           | 1.00         |
| Reach-1 | 1750      | Regional | 48.05             | 179.50           | 180.75           |                  | 180.76           | 0.000765            | 0.24              | 202.64            | 262.09           | 0.08         |
| Reach-1 | 1750      | 100 Yr   | 16.19             | 179.50           | 180.26           |                  | 180.26           | 0.001978            | 0.21              | 77.93             | 244.05           | 0.12         |
| Reach-1 | 1740      | Regional | 48.05             | 179.20           | 180.74           |                  | 180.74           | 0.000377            | 0.22              | 229.76            | 206.94           | 0.06         |
| Reach-1 | 1740      | 100 Yr   | 16.19             | 179.20           | 180.24           |                  | 180.24           | 0.000300            | 0.13              | 127.35            | 204.96           | 0.05         |
| Reach-1 | 1730      |          | Lat Struct        |                  |                  |                  |                  |                     |                   |                   |                  |              |
| Reach-1 | 1720      | Regional | 29.84             | 179.30           | 180.73           |                  | 180.73           | 0.000197            | 0.15              | 202.08            | 190.93           | 0.05         |
| Reach-1 | 1720      | 100 Yr   | 4.93              | 179.30           | 180.24           |                  | 180.24           | 0.000041            | 0.04              | 108.02            | 189.47           | 0.02         |
| Reach-1 | 1703      | Regional | 29.84             | 179.40           | 180.72           | 179.79           | 180.73           | 0.000556            | 0.28              | 117.76            | 172.45           | 0.08         |
| Reach-1 | 1703      | 100 Yr   | 4.93              | 179.40           | 180.24           | 179.60           | 180.24           | 0.000100            | 0.08              | 66.05             | 171.47           | 0.03         |
| Reach-1 | 1696.5    |          | Bridge            |                  |                  |                  |                  |                     |                   |                   |                  |              |
| Reach-1 | 1690      | Regional | 29.84             | 179.76           | 180.68           | 180.19           | 180.68           | 0.002004            | 0.37              | 88.09             | 138.61           | 0.14         |
| Reach-1 | 1690      | 100 Yr   | 4.93              | 179.76           | 180.20           | 179.97           | 180.20           | 0.002687            | 0.22              | 24.96             | 125.14           | 0.13         |
| Reach-1 | 1675      | Regional | 29.84             | 179.76           | 180.64           | 180.23           | 180.65           | 0.002514            | 0.43              | 82.60             | 140.97           | 0.15         |
| Reach-1 | 1675      | 100 Yr   | 4.93              | 179.76           | 179.98           | 179.98           | 180.05           | 0.185904            | 1.16              | 4.25              | 30.55            | 0.99         |
| Reach-1 | 1648      | Regional | 29.84             | 179.21           | 180.62           |                  | 180.63           | 0.000612            | 0.24              | 123.09            | 125.47           | 0.08         |
| Reach-1 | 1648      | 100 Yr   | 4.93              | 179.21           | 179.89           |                  | 179.89           | 0.001337            | 0.15              | 32.41             | 122.14           | 0.09         |
| Reach-1 | 1627      | Regional | 29.84             | 179.34           | 180.60           |                  | 180.60           | 0.000992            | 0.30              | 100.04            | 107.31           | 0.10         |
| Reach-1 | 1627      | 100 Yr   | 4.93              | 179.34           | 179.82           |                  | 179.82           | 0.004390            | 0.25              | 19.86             | 86.13            | 0.17         |
| Reach-1 | 1590      | Regional | 29.84             | 179.09           | 180.27           | 179.97           | 180.49           | 0.014764            | 2.11              | 14.16             | 86.04            | 0.63         |
| Reach-1 | 1590      | 100 Yr   | 4.93              | 179.09           | 179.62           | 179.36           | 179.65           | 0.005784            | 0.80              | 6.17              | 82.85            | 0.36         |
| Reach-1 | 1570      |          | Culvert           |                  |                  |                  |                  |                     |                   |                   |                  |              |
| Reach-1 | 1560      | Regional | 29.84             | 178.92           | 180.20           | 179.75           | 180.22           | 0.001260            | 0.53              | 56.81             | 66.54            | 0.18         |
| Reach-1 | 1560      | 100 Yr   | 4.93              | 178.92           | 179.62           | 179.20           | 179.64           | 0.002318            | 0.60              | 8.28              | 63.70            | 0.23         |
| Reach-1 | 1550      | Regional | 29.84             | 178.80           | 180.17           | 179.64           | 180.20           | 0.003517            | 0.66              | 45.61             | 187.60           | 0.23         |
| Reach-1 | 1550      | 100 Yr   | 4.93              | 178.80           | 179.60           | 179.11           | 179.61           | 0.003986            | 0.33              | 14.78             | 79.38            | 0.20         |
| Reach-1 | 1527      | Regional | 29.84             | 178.74           | 180.08           | 179.68           | 180.13           | 0.002663            | 0.96              | 30.92             | 217.78           | 0.35         |
| Reach-1 | 1527      | 100 Yr   | 4.93              | 178.74           | 179.49           | 179.25           | 179.51           | 0.005832            | 0.61              | 8.08              | 67.57            | 0.42         |
| Reach-1 | 1505      | Regional | 29.84             | 178.55           | 180.06           |                  | 180.11           | 0.002153            | 0.92              | 32.36             | 37.62            | 0.32         |
| Reach-1 | 1505      | 100 Yr   | 4.93              | 178.55           | 179.48           |                  | 179.49           | 0.000974            | 0.39              | 12.56             | 28.94            | 0.19         |
| Reach-1 | 1500      |          | Lat Struct        |                  |                  |                  |                  |                     |                   |                   |                  |              |
| Reach-1 | 1480      | Regional | 25.66             | 178.53           | 180.06           |                  | 180.07           | 0.000417            | 0.55              | 46.37             | 33.77            | 0.15         |
| Reach-1 | 1480      | 100 Yr   | 2.15              | 178.53           | 179.48           |                  | 179.48           | 0.000015            | 0.08              | 27.70             | 31.22            | 0.03         |
| Reach-1 | 1461      | Regional | 25.66             | 178.77           | 180.04           |                  | 180.06           | 0.000770            | 0.67              | 38.45             | 33.66            | 0.20         |
| Reach-1 | 1461      | 100 Yr   | 2.15              | 178.77           | 179.48           |                  | 179.48           | 0.000039            | 0.10              | 20.52             | 30.73            | 0.04         |

## SPILL ZONE 'B' OUTPUT

HEC-RAS Plan: SilverCreek River: RIVER-1 Reach: Reach-1 (Continued)

| Reach   | River Sta | Profile  | Q Total<br>(m3/s) | Min Ch El<br>(m) | W.S. Elev<br>(m) | Crit W.S.<br>(m) | E.G. Elev<br>(m) | E.G. Slope<br>(m/m) | Vel Chnl<br>(m/s) | Flow Area<br>(m2) | Top Width<br>(m) | Froude # Chl |
|---------|-----------|----------|-------------------|------------------|------------------|------------------|------------------|---------------------|-------------------|-------------------|------------------|--------------|
| Reach-1 | 1440.1    | Regional | 25.66             | 178.90           | 179.94           |                  | 180.01           | 0.003790            | 1.23              | 21.71             | 28.25            | 0.42         |
| Reach-1 | 1440.1    | 100 Yr   | 2.15              | 178.90           | 179.48           |                  | 179.48           | 0.000256            | 0.22              | 9.78              | 19.98            | 0.10         |
| Reach-1 | 1440      | Regional | 25.66             | 179.30           | 179.64           | 179.64           | 179.75           | 0.034322            | 1.45              | 17.71             | 84.81            | 1.01         |
| Reach-1 | 1440      | 100 Yr   | 2.15              | 179.30           | 179.42           | 179.42           | 179.45           | 0.048869            | 0.80              | 2.69              | 41.02            | 1.00         |
| Reach-1 | 1315      | Regional | 25.66             | 178.15           | 179.35           |                  | 179.38           | 0.002439            | 0.71              | 35.97             | 68.39            | 0.31         |
| Reach-1 | 1315      | 100 Yr   | 2.15              | 178.15           | 178.79           |                  | 178.80           | 0.002069            | 0.34              | 6.32              | 32.17            | 0.25         |
| Reach-1 | 1274      | Regional | 25.66             | 178.14           | 179.30           |                  | 179.31           | 0.001087            | 0.71              | 46.54             | 81.12            | 0.23         |
| Reach-1 | 1274      | 100 Yr   | 2.15              | 178.14           | 178.76           |                  | 178.76           | 0.000464            | 0.27              | 10.96             | 45.60            | 0.13         |
| Reach-1 | 1232      | Regional | 25.66             | 178.48           | 179.21           |                  | 179.24           | 0.002647            | 0.82              | 30.91             | 52.71            | 0.34         |
| Reach-1 | 1232      | 100 Yr   | 2.15              | 178.48           | 178.72           |                  | 178.73           | 0.001830            | 0.25              | 7.21              | 43.31            | 0.22         |
| Reach-1 | 1192      | Regional | 25.66             | 178.37           | 179.03           |                  | 179.09           | 0.005606            | 1.21              | 25.67             | 71.10            | 0.49         |
| Reach-1 | 1192      | 100 Yr   | 2.15              | 178.37           | 178.64           |                  | 178.65           | 0.002388            | 0.40              | 5.91              | 33.75            | 0.27         |
| Reach-1 | 1149      | Regional | 25.66             | 178.27           | 178.99           |                  | 179.00           | 0.000871            | 0.47              | 62.04             | 129.79           | 0.19         |
| Reach-1 | 1149      | 100 Yr   | 2.15              | 178.27           | 178.60           |                  | 178.61           | 0.000460            | 0.17              | 14.48             | 100.95           | 0.12         |
| Reach-1 | 1096.2    | Regional | 25.66             | 178.25           | 178.82           |                  | 178.83           | 0.001298            | 0.48              | 58.43             | 147.13           | 0.23         |
| Reach-1 | 1096.2    | 100 Yr   | 2.15              | 178.25           | 178.49           |                  | 178.50           | 0.001292            | 0.24              | 11.29             | 131.01           | 0.19         |
| Reach-1 | 1096.1    | Regional | 25.66             | 178.25           | 178.82           |                  | 178.83           | 0.001299            | 0.48              | 58.41             | 147.13           | 0.23         |
| Reach-1 | 1096.1    | 100 Yr   | 2.15              | 178.25           | 178.49           |                  | 178.50           | 0.001297            | 0.24              | 11.27             | 130.88           | 0.19         |
| Reach-1 | 1096      | Regional | 25.66             | 178.25           | 178.82           | 178.58           | 178.83           | 0.001301            | 0.48              | 58.39             | 147.13           | 0.23         |
| Reach-1 | 1096      | 100 Yr   | 2.15              | 178.25           | 178.49           | 178.39           | 178.50           | 0.001302            | 0.24              | 11.26             | 130.76           | 0.19         |

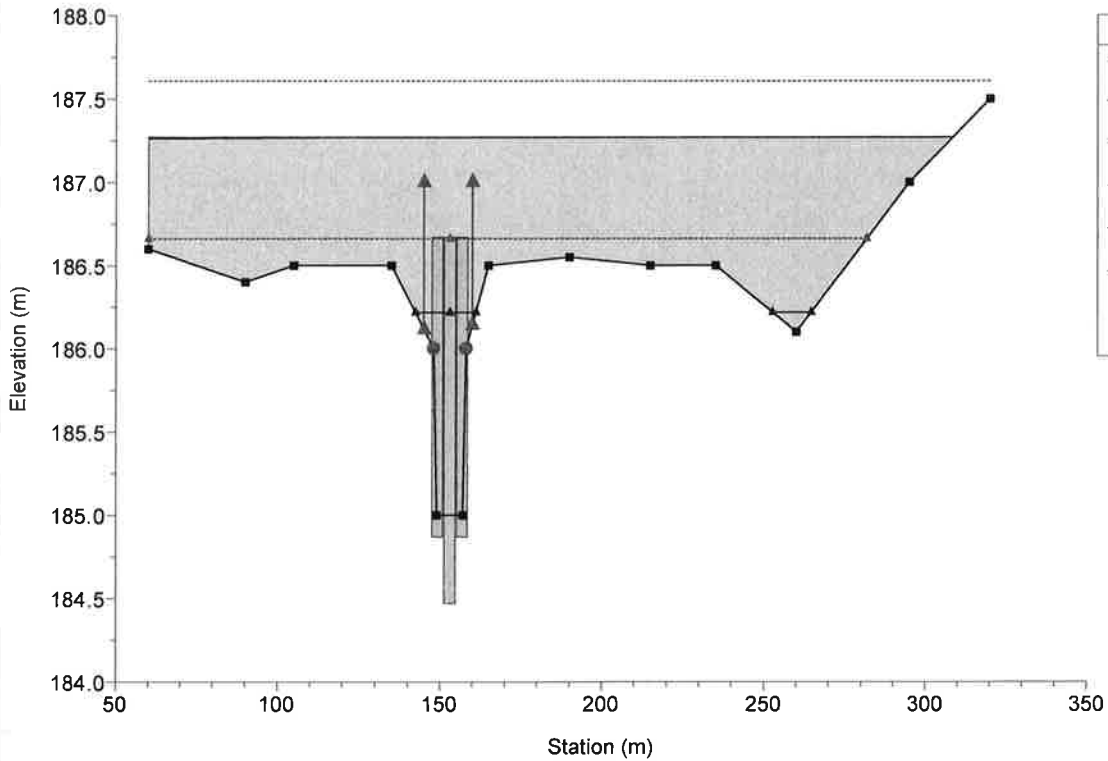
# MAIN CHANNEL OUTPUT





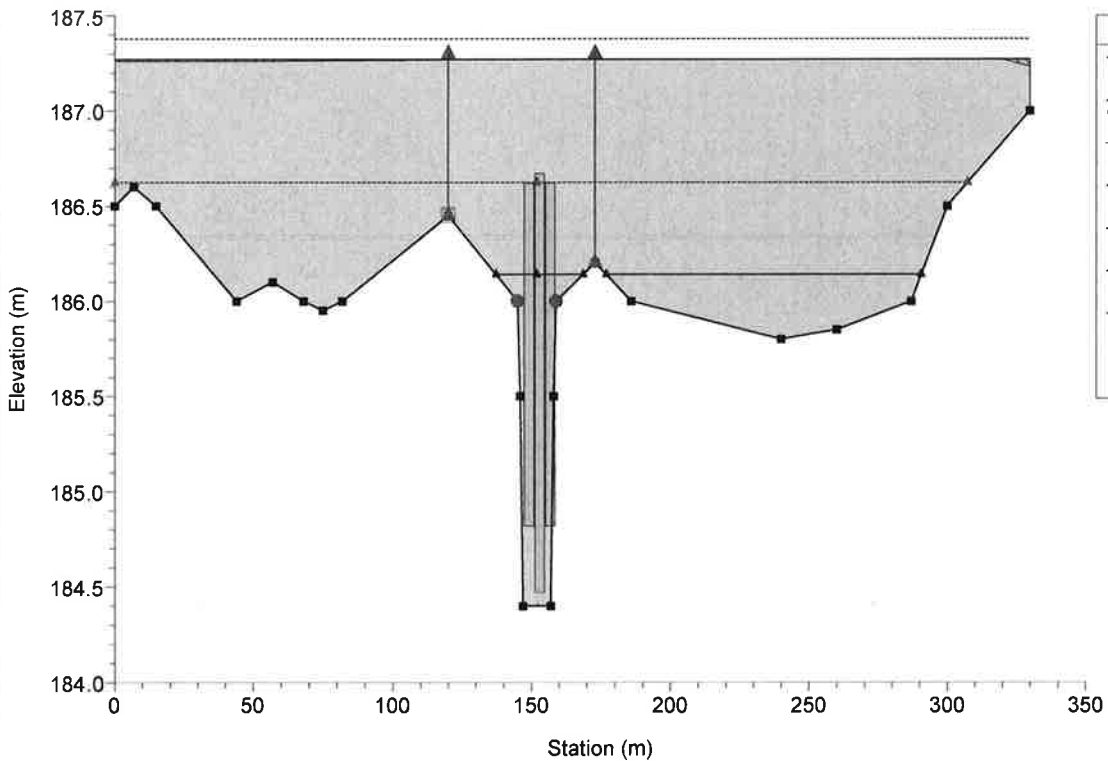
# Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013

River = Silver Creek Reach = MainLower RS = 1845 Culv

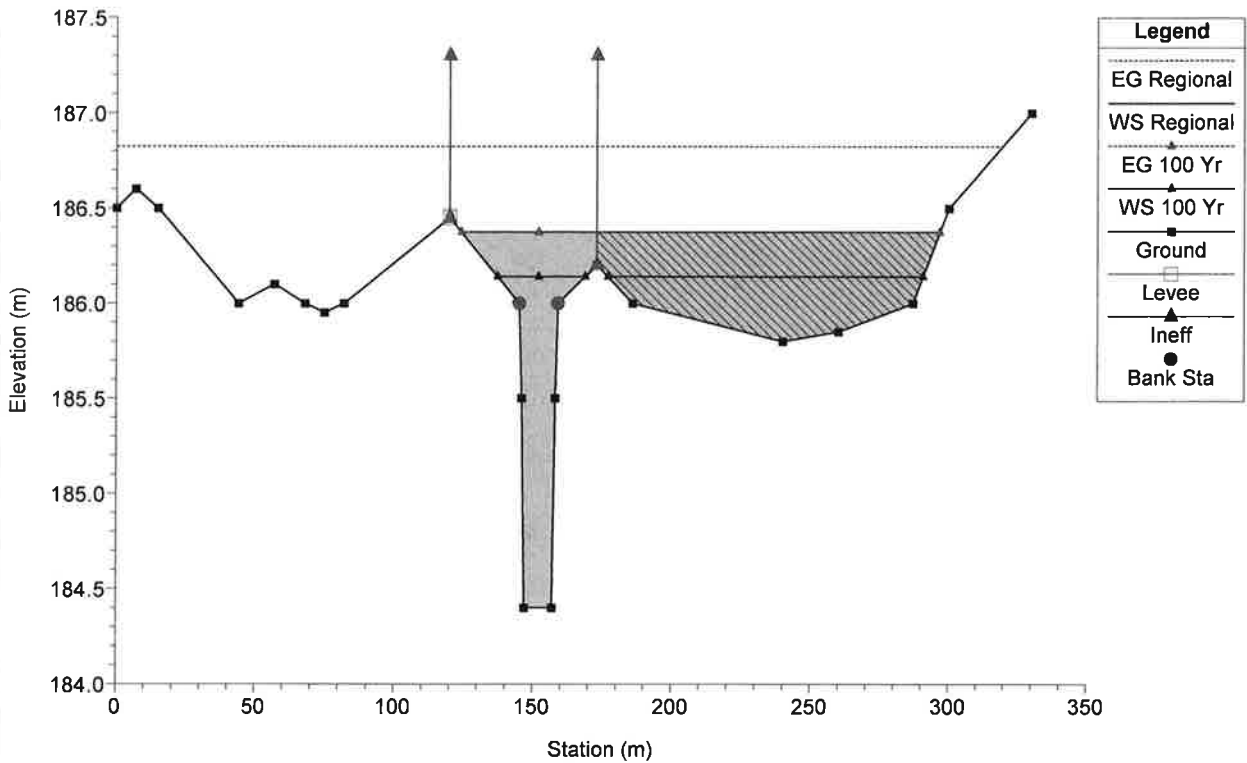


# Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013

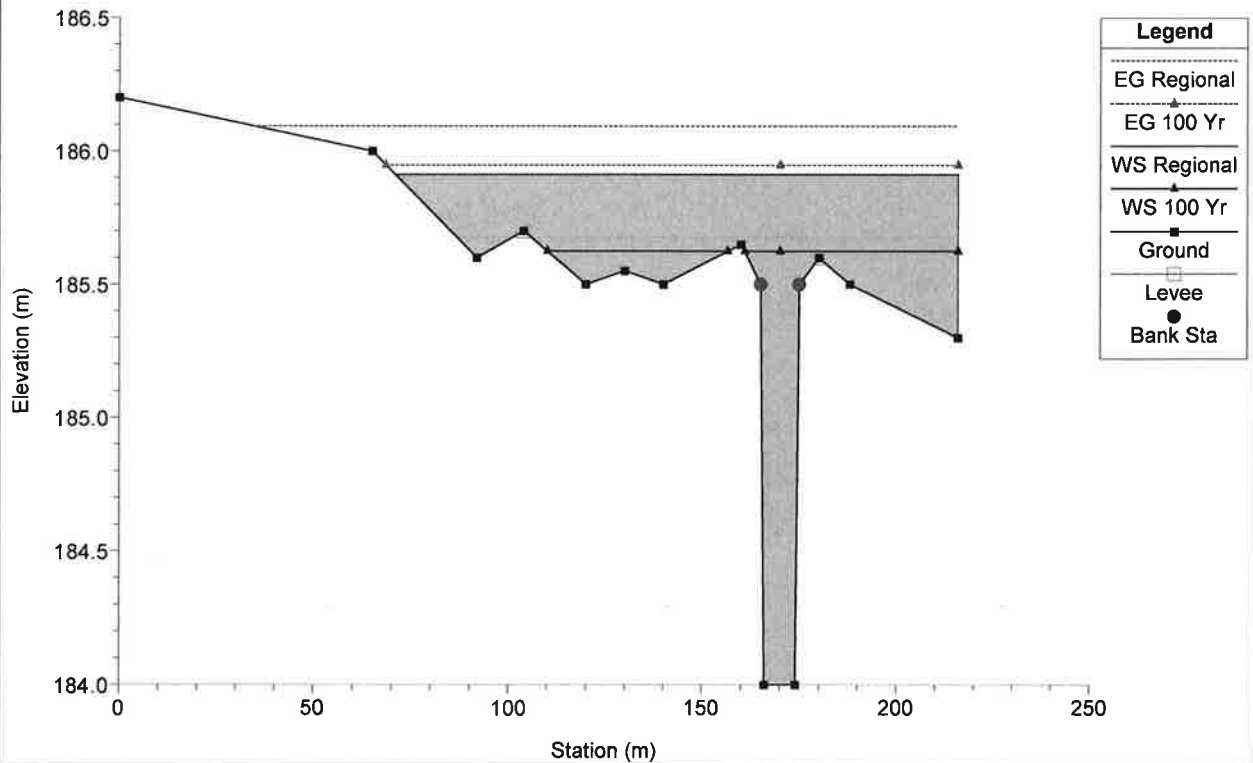
River = Silver Creek Reach = MainLower RS = 1845 Culv



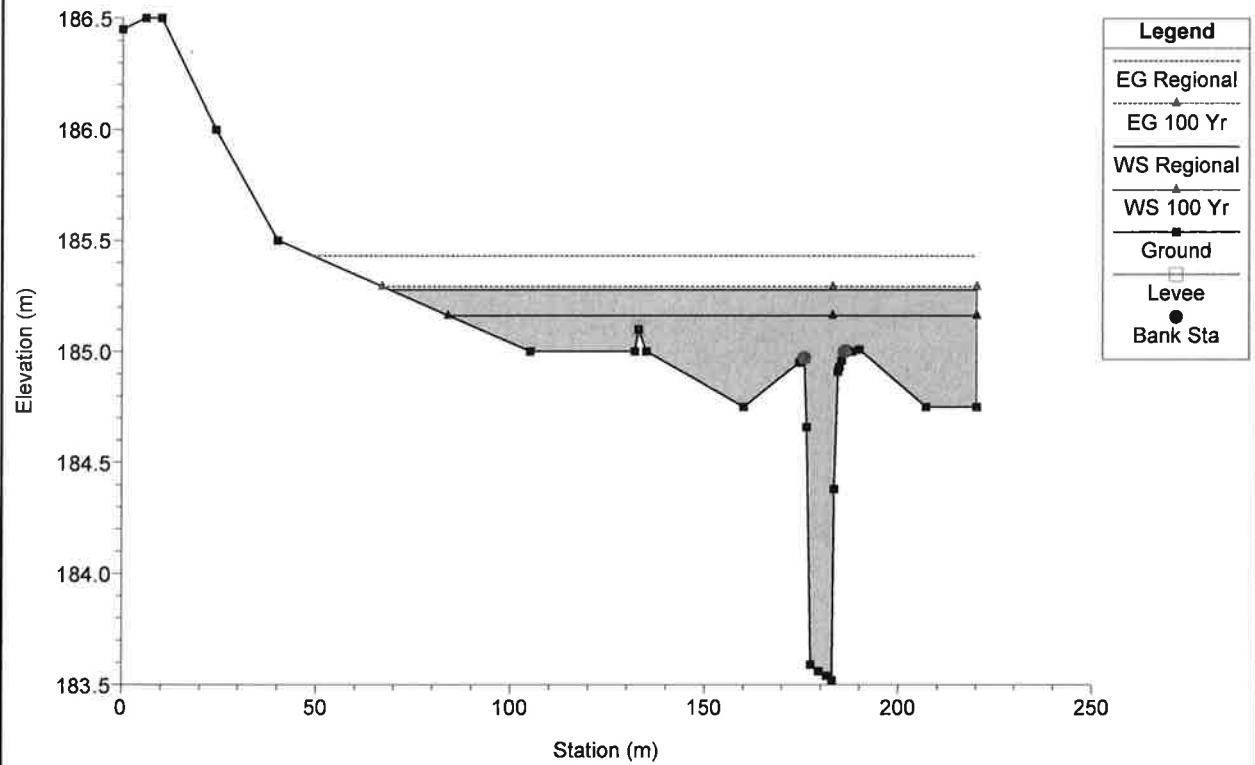
Silver Creek - Huntingwood Reach      Plan: SilverCreek    9/19/2013  
 River = Silver Creek    Reach = MainLower    RS = 1840    Upstream Property limits



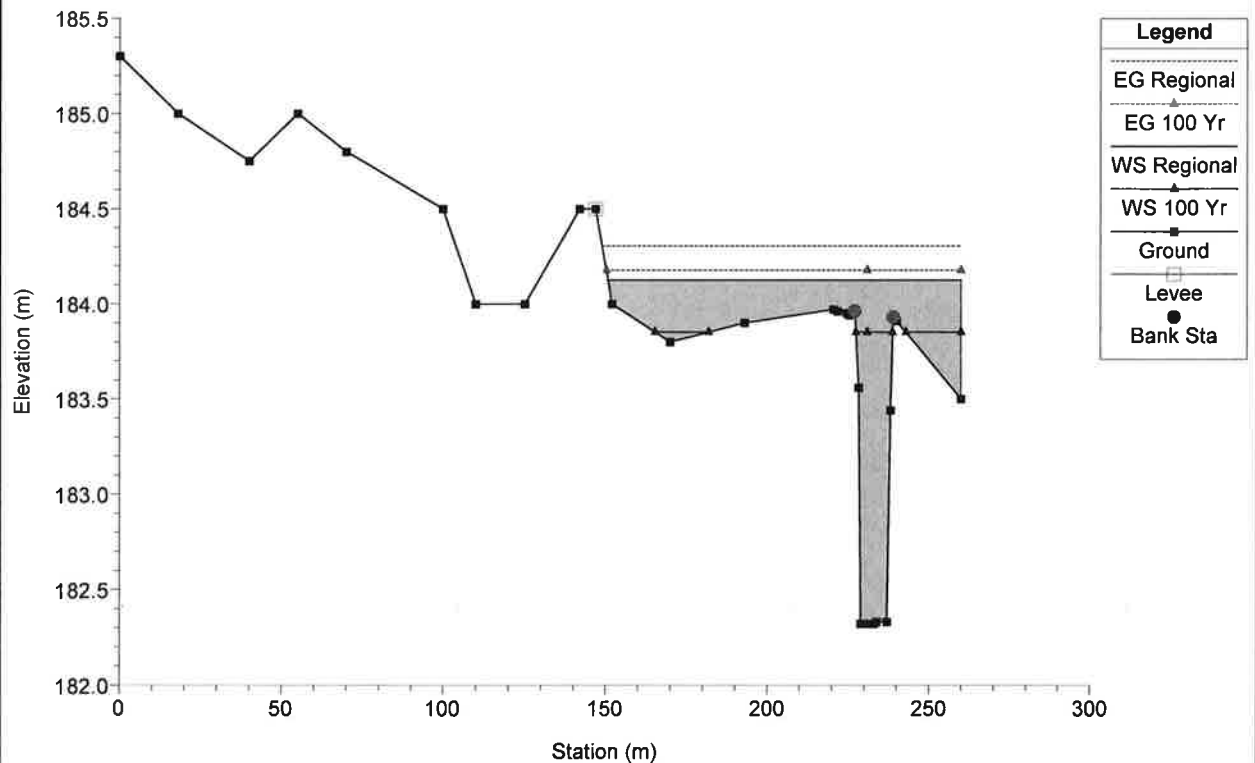
Silver Creek - Huntingwood Reach      Plan: SilverCreek    9/19/2013  
 River = Silver Creek    Reach = MainLower    RS = 1830



Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013  
 River = Silver Creek Reach = MainLower RS = 1820



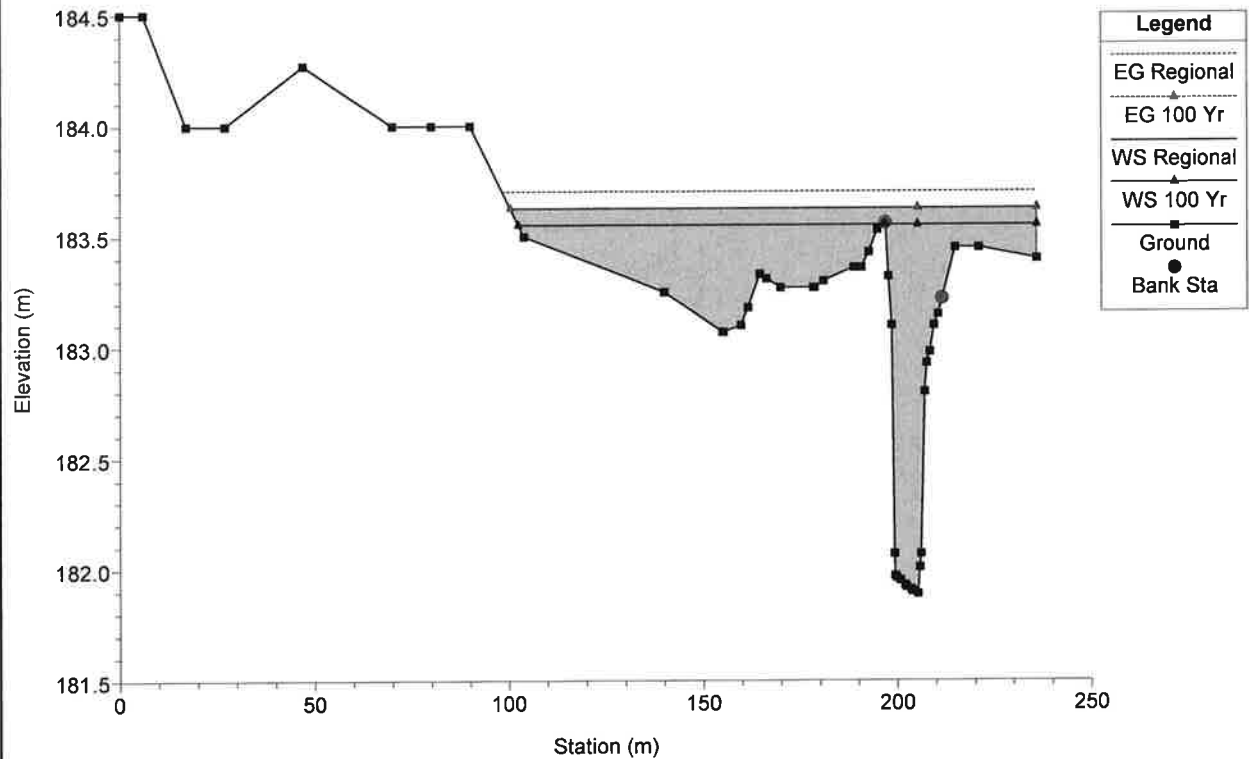
Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013  
 River = Silver Creek Reach = MainLower RS = 1810





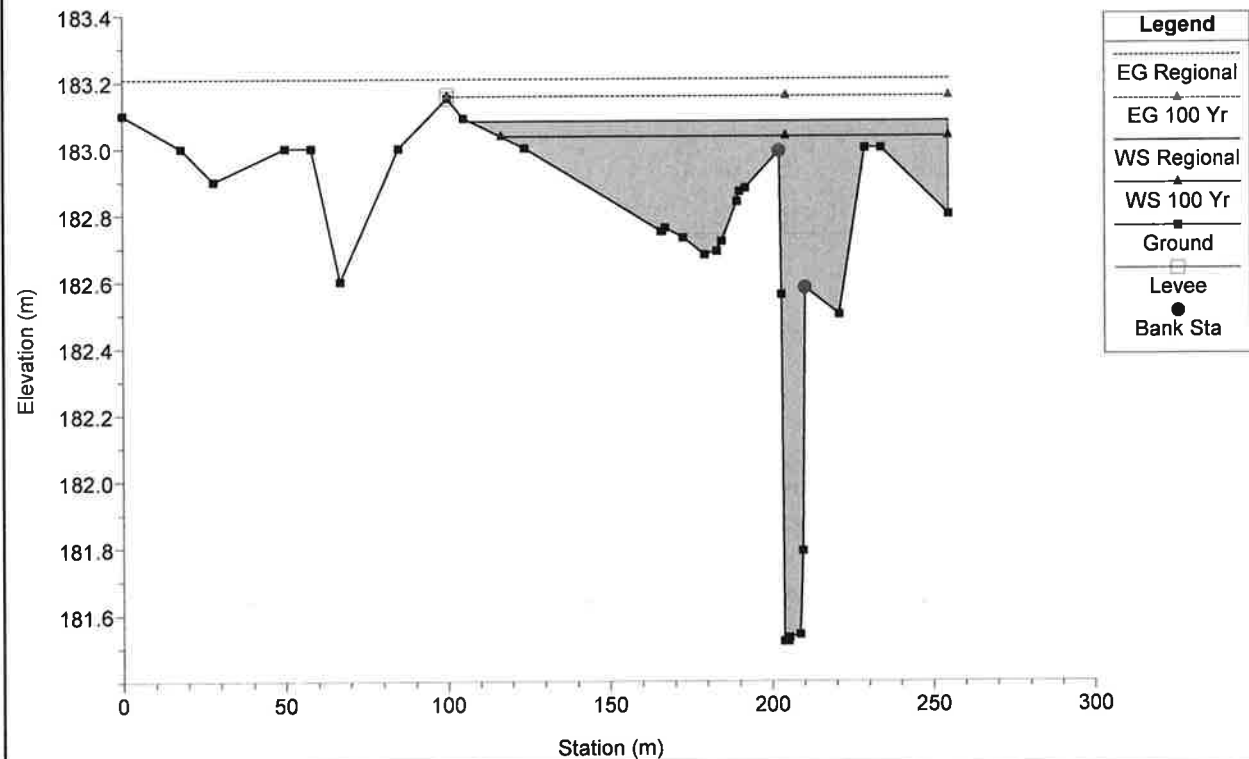
# Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013

River = Silver Creek Reach = MainLower RS = 1800



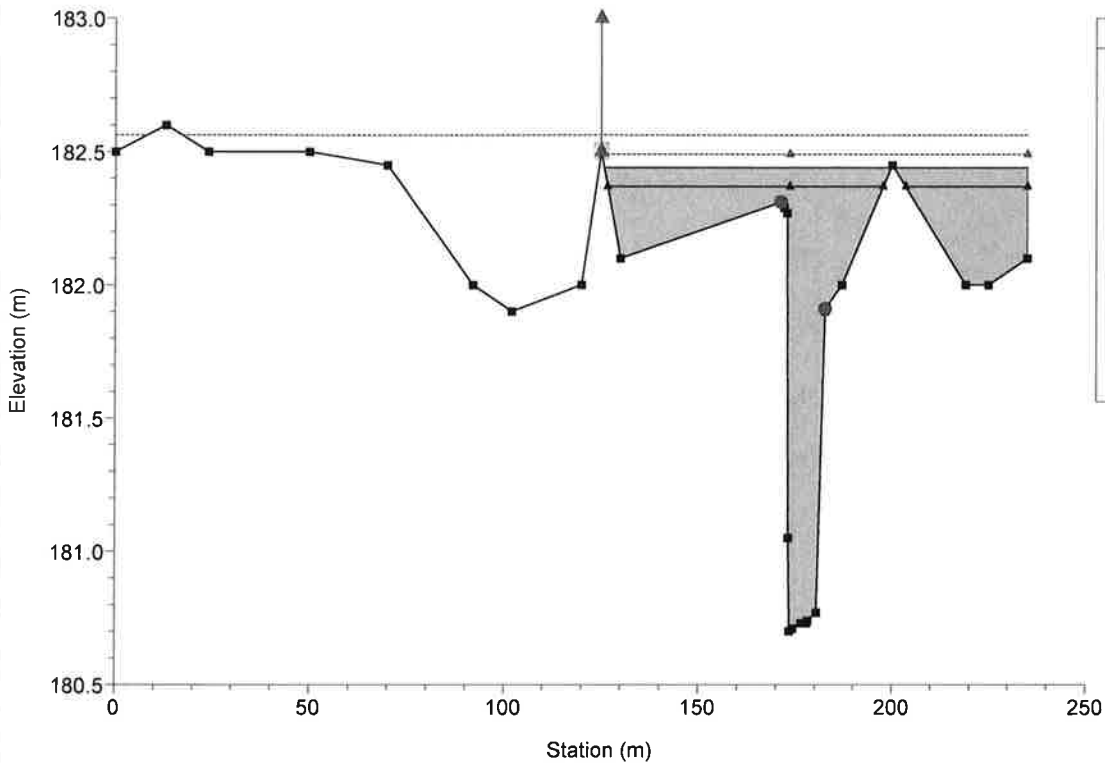
# Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013

River = Silver Creek Reach = MainLower RS = 1790



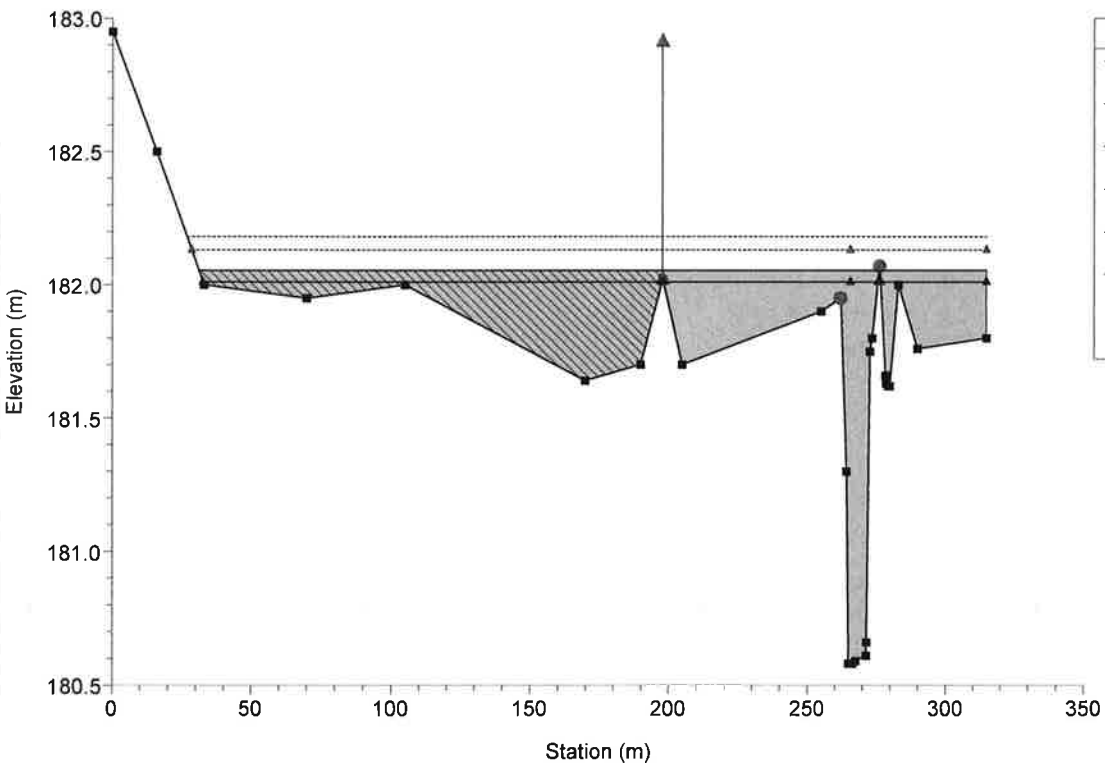
# Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013

River = Silver Creek Reach = MainLower RS = 1780



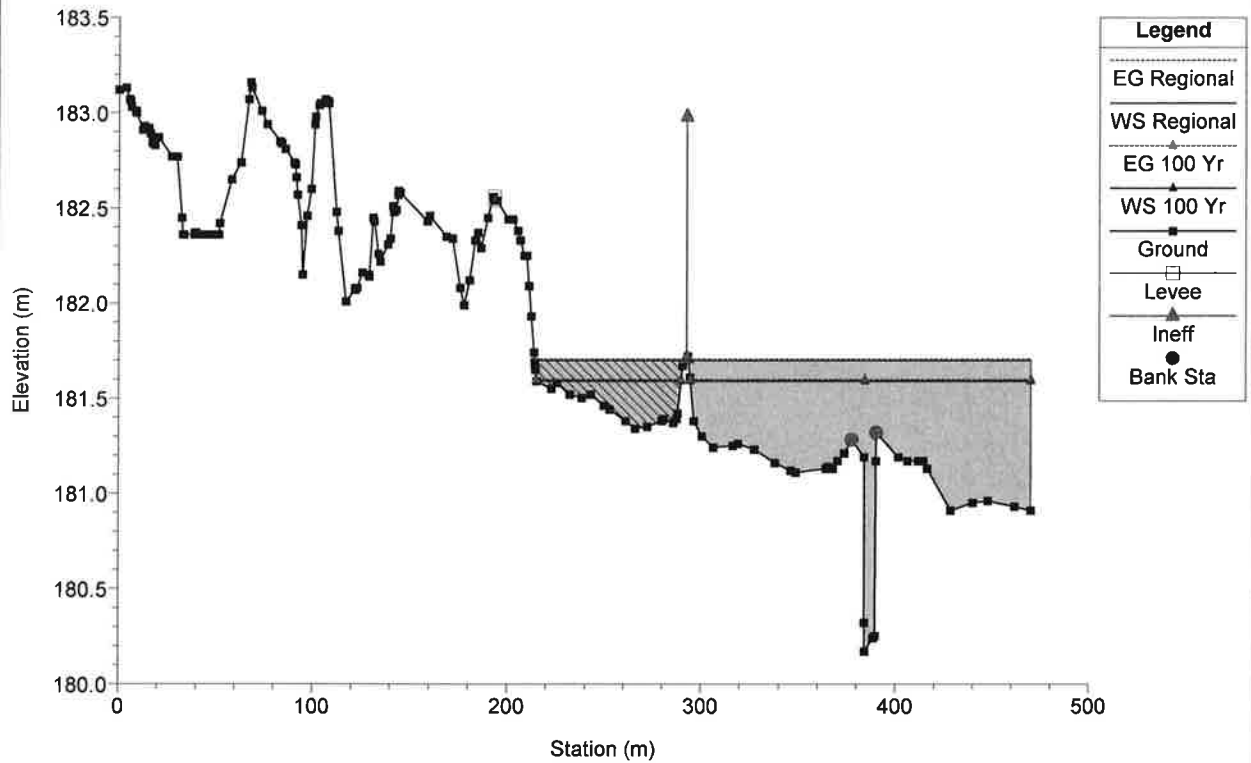
# Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013

River = Silver Creek Reach = MainLower RS = 1770



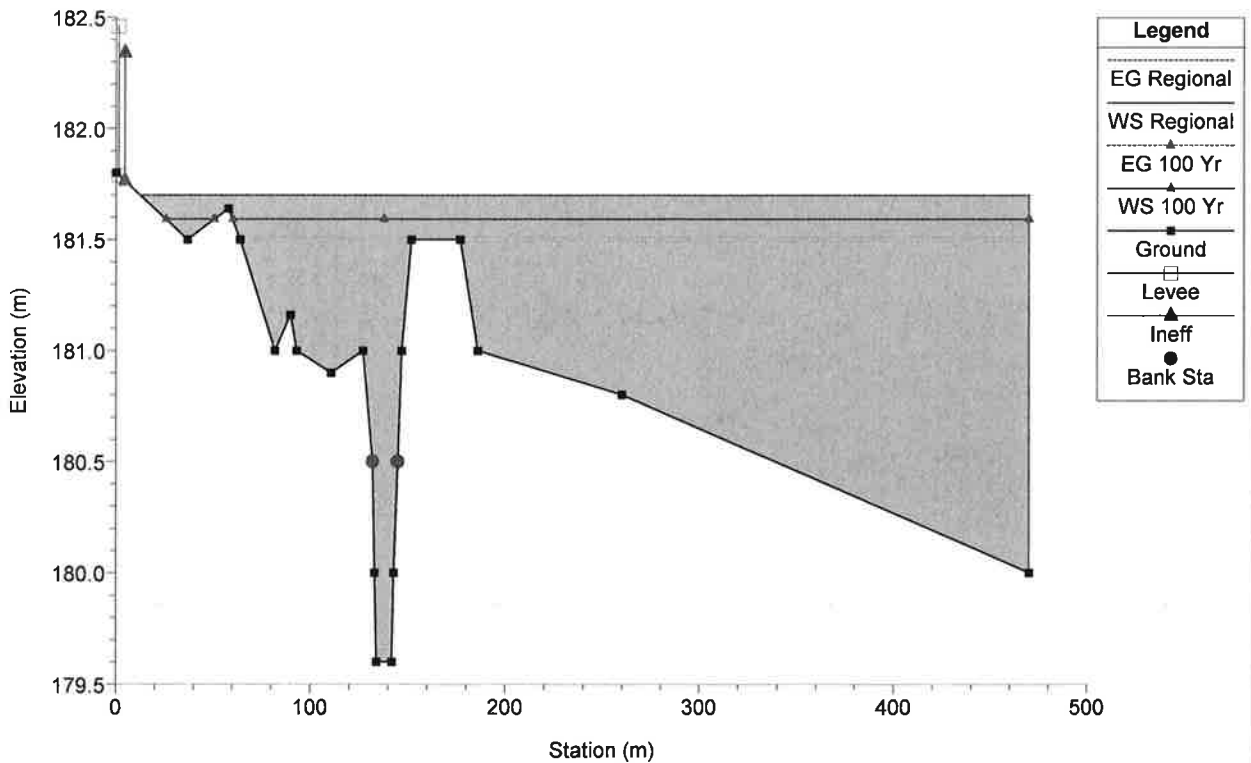
# Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013

River = Silver Creek Reach = MainLower RS = 1760

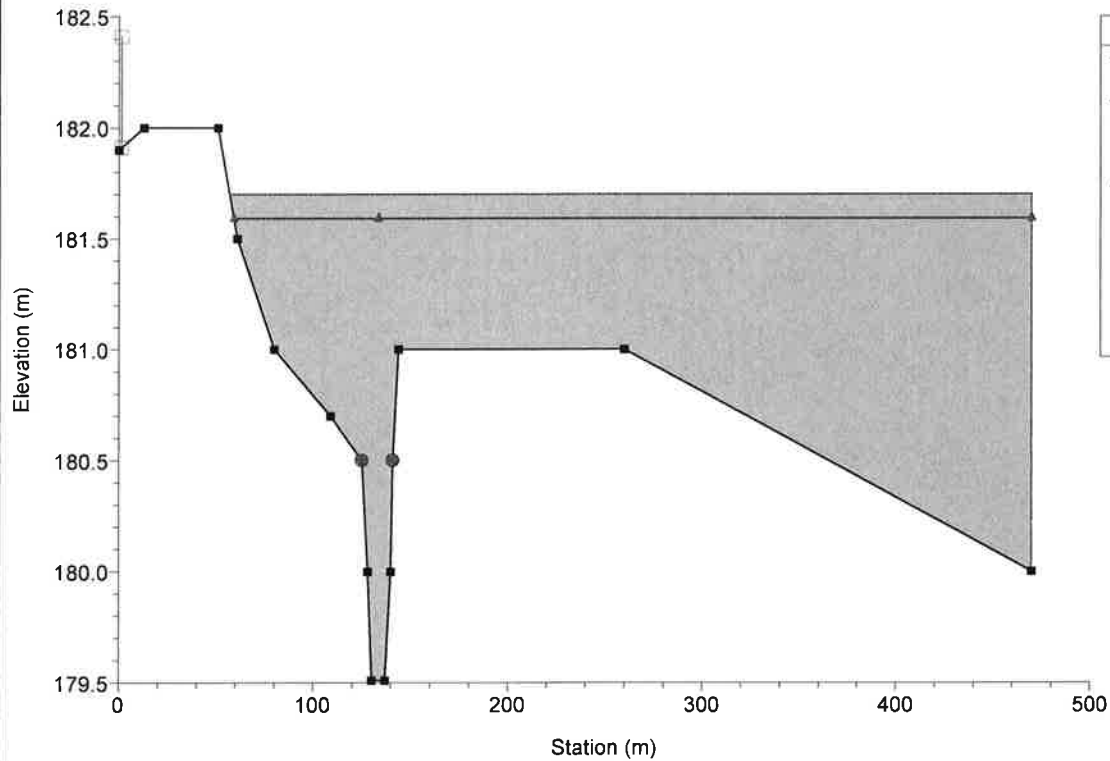


## Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013

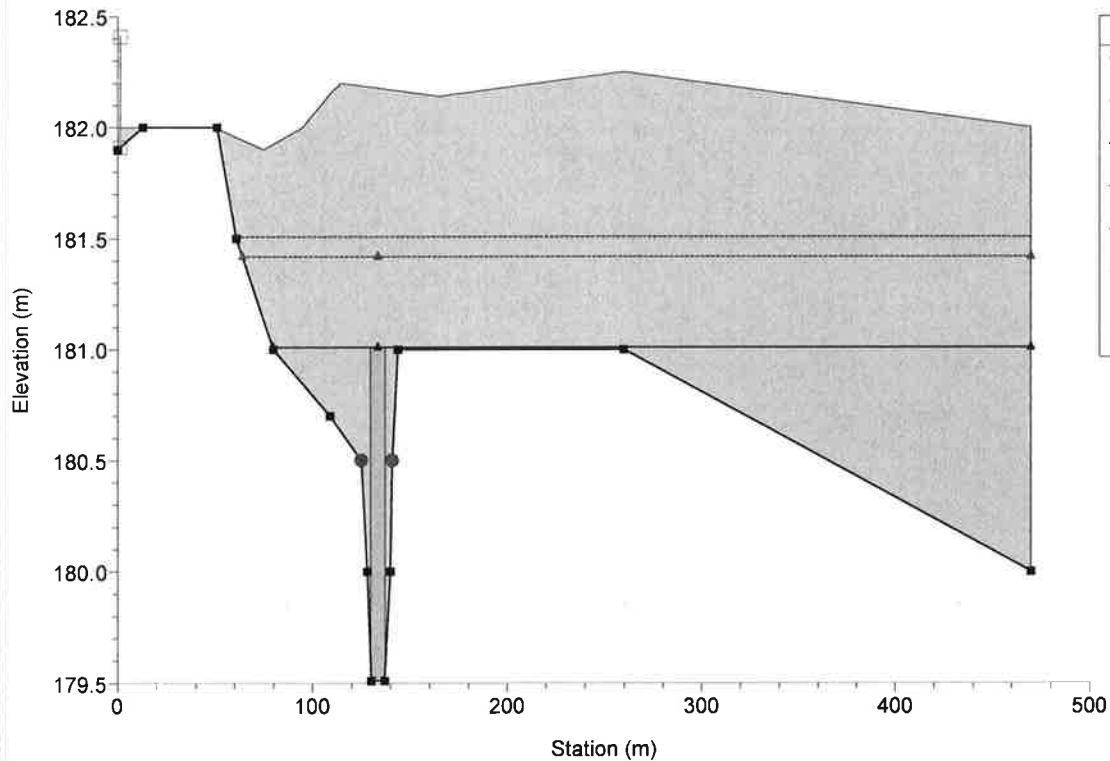
River = Silver Creek Reach = MainLower RS = 785 Downstream Property Limits



Silver Creek - Huntingwood Reach      Plan: SilverCreek    9/19/2013  
 River = Silver Creek    Reach = MainLower    RS = 775    Upstream of HWY 26

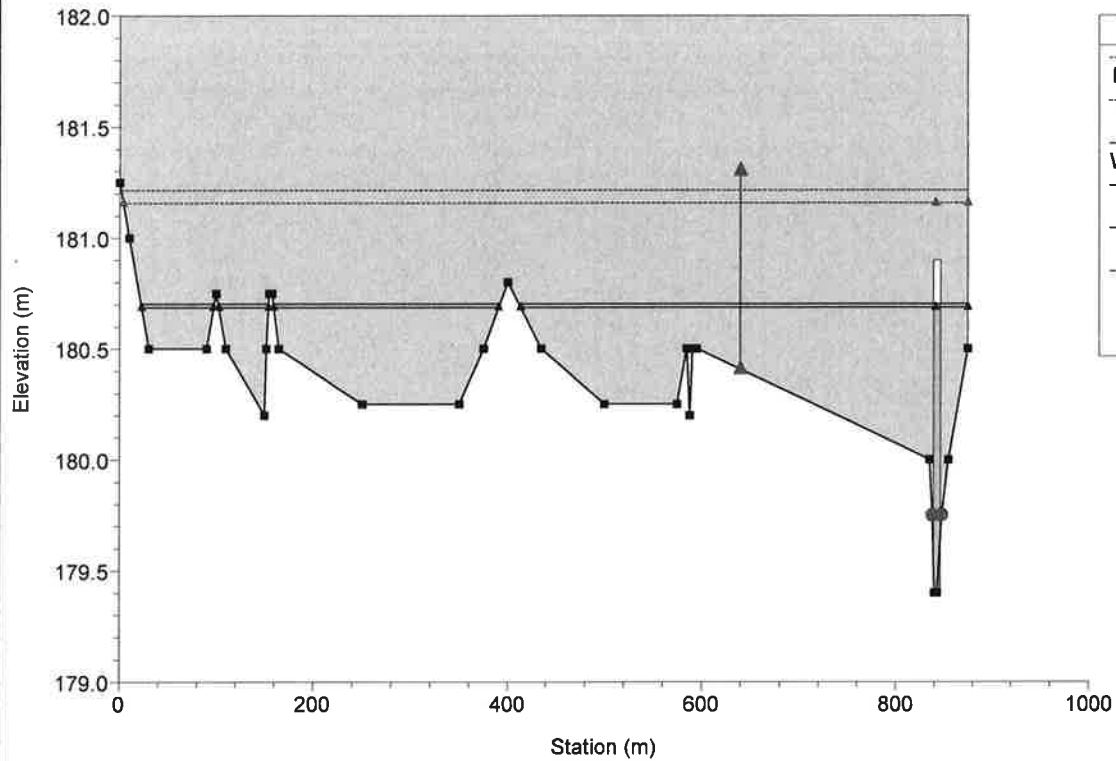


Silver Creek - Huntingwood Reach      Plan: SilverCreek    9/19/2013  
 River = Silver Creek    Reach = MainLower    RS = 755    Culv



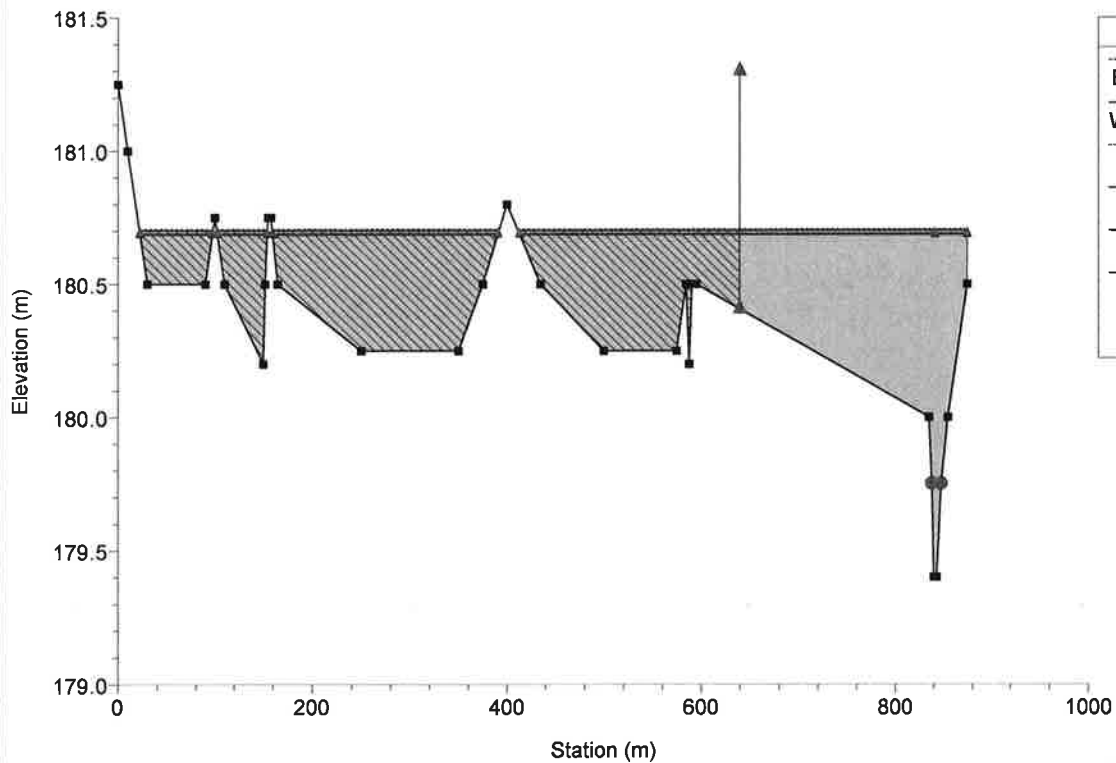
# Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013

River = Silver Creek Reach = MainLower RS = 755 Culv

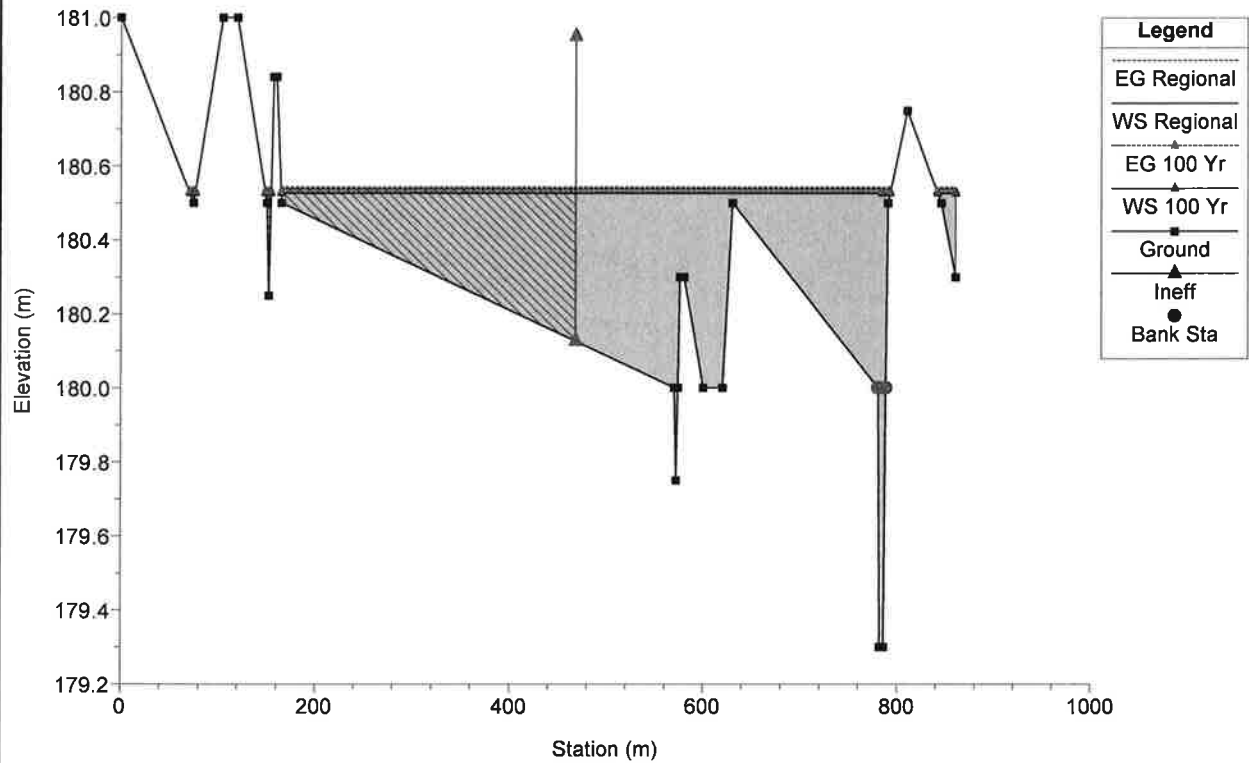


# Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013

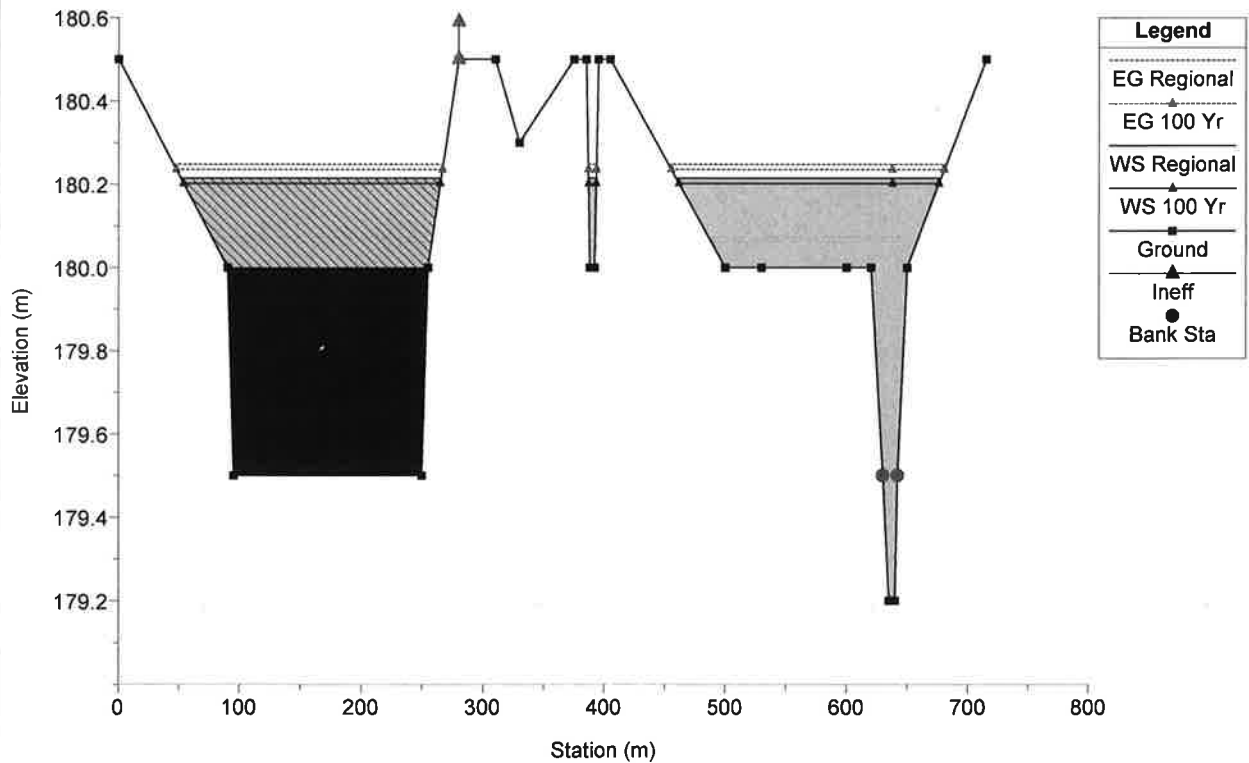
River = Silver Creek Reach = MainLower RS = 735 Upstream Limit; immediately downstream (north) of Hwy 26



Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013  
 River = Silver Creek Reach = MainLower RS = 590

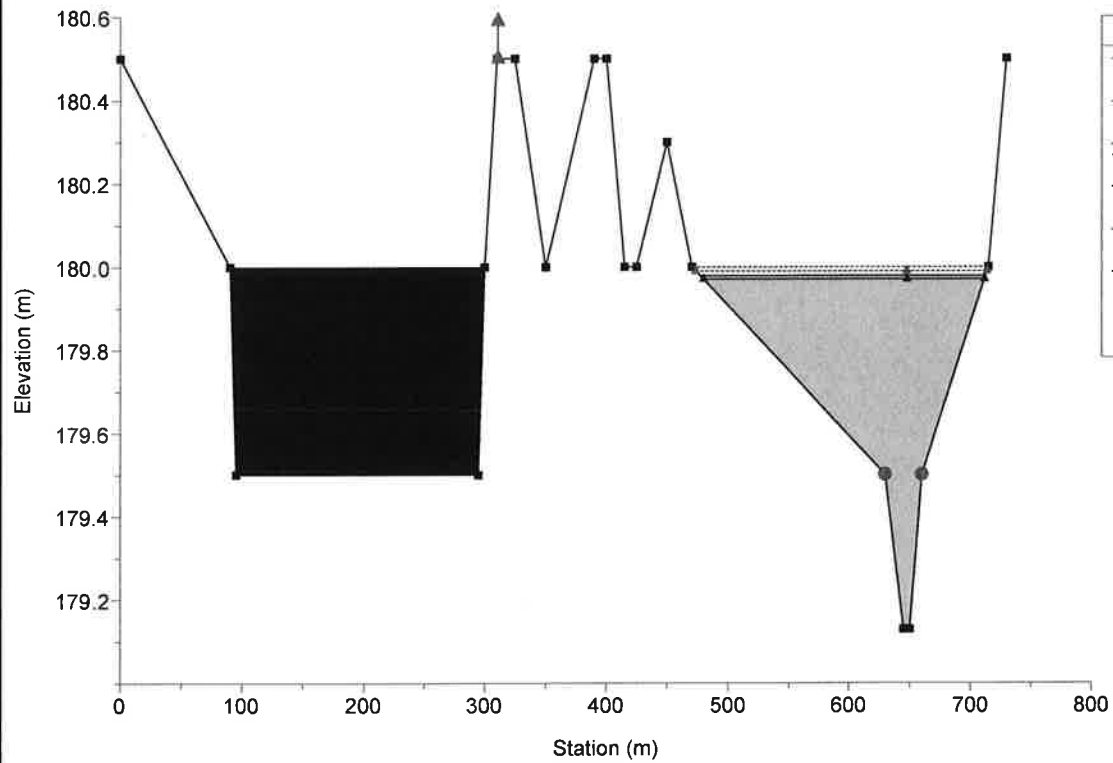


Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013  
 River = Silver Creek Reach = MainLower RS = 490 Note: Existing pond



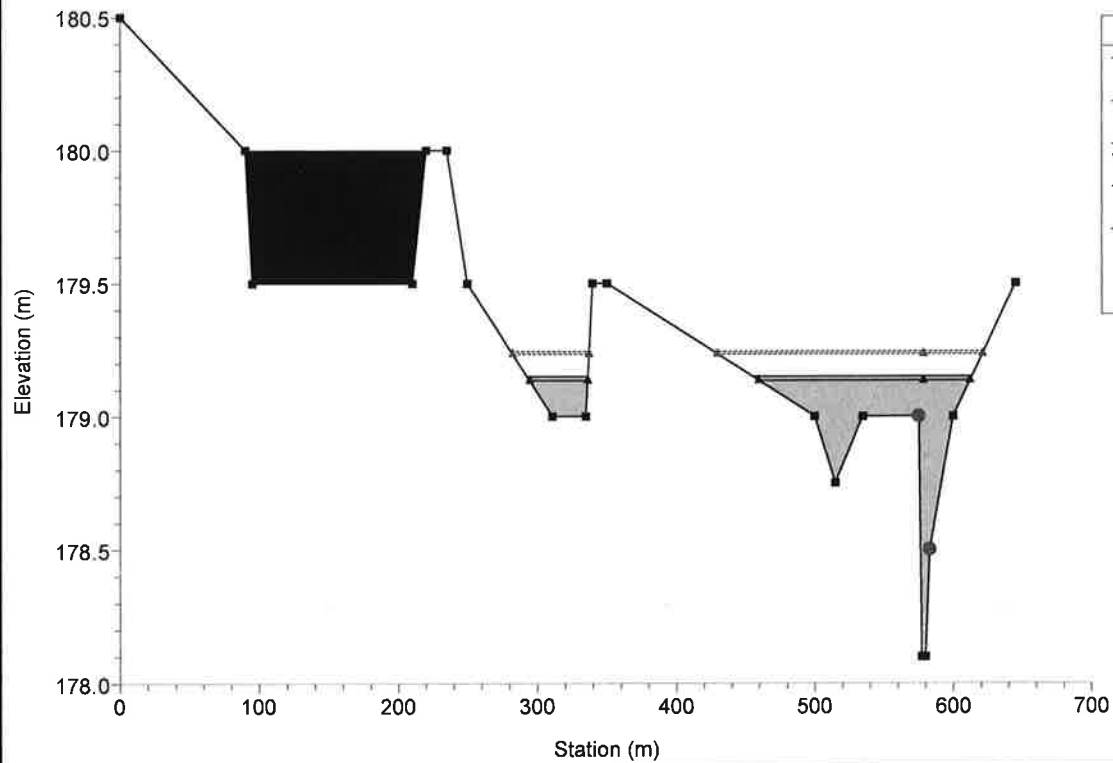
# Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013

River = Silver Creek Reach = MainLower RS = 450 Note: Existing pond



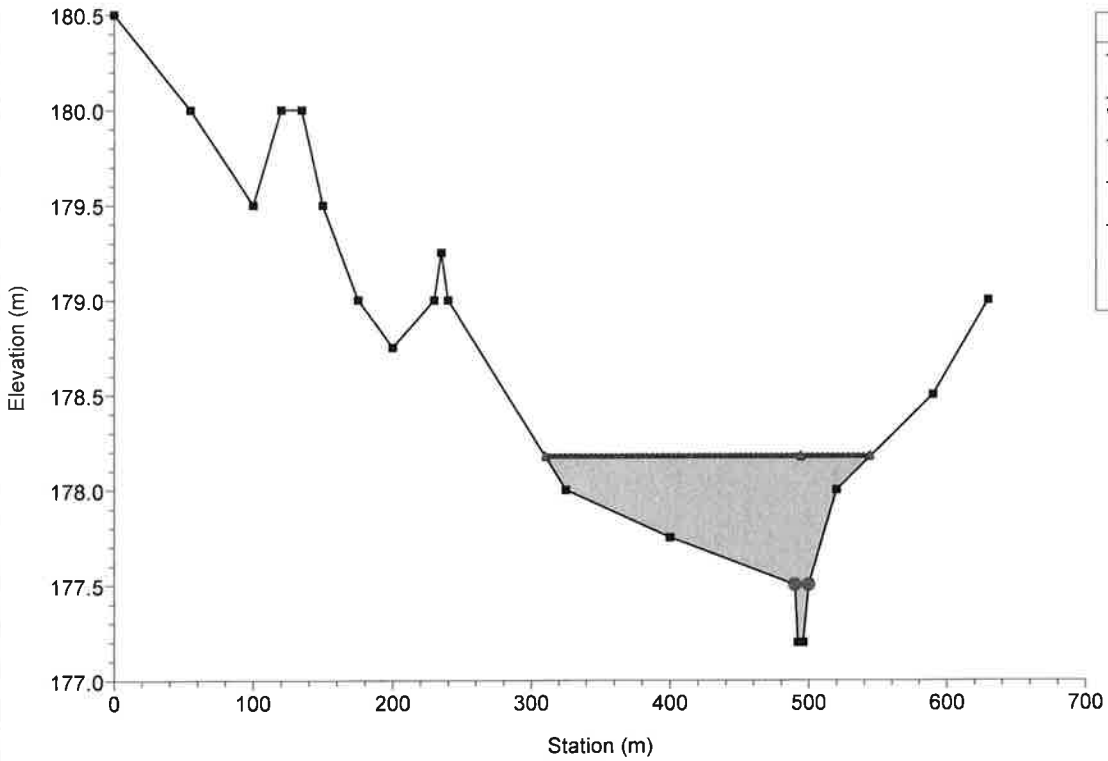
# Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013

River = Silver Creek Reach = MainLower RS = 410 Note: Existing pond



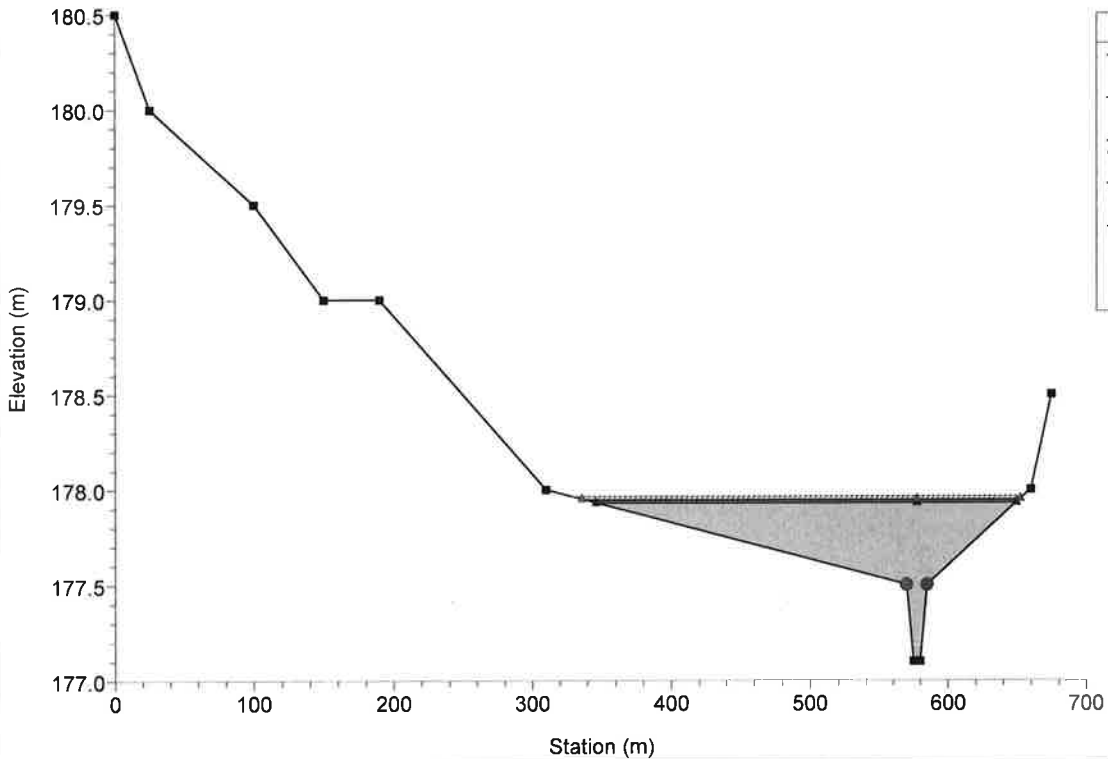
# Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013

River = Silver Creek Reach = MainLower RS = 320



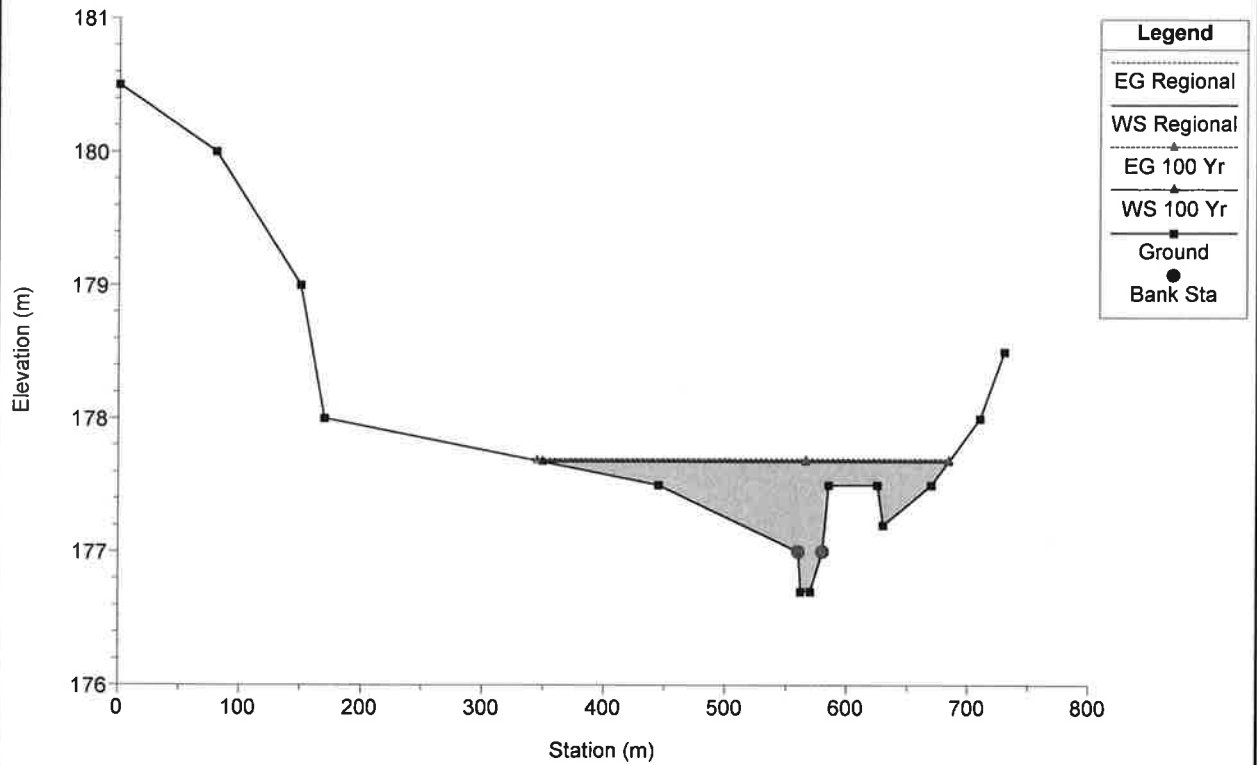
# Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013

River = Silver Creek Reach = MainLower RS = 222

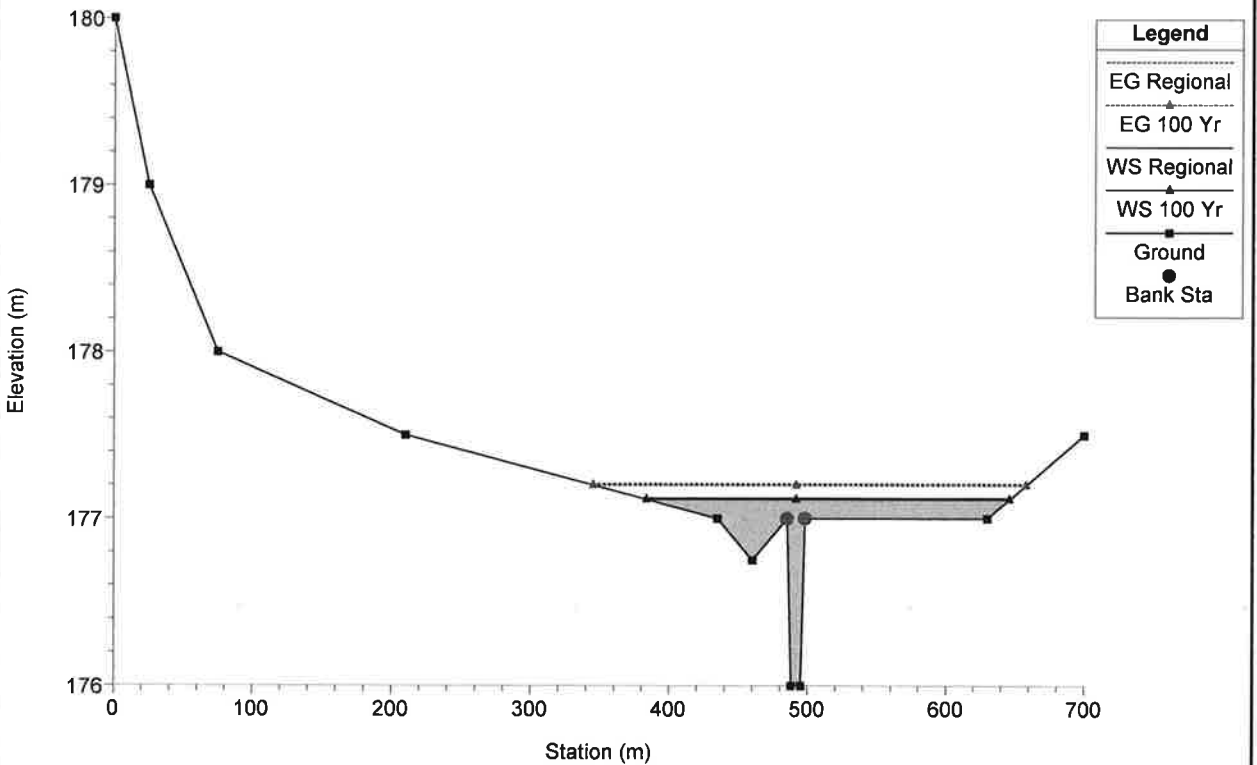




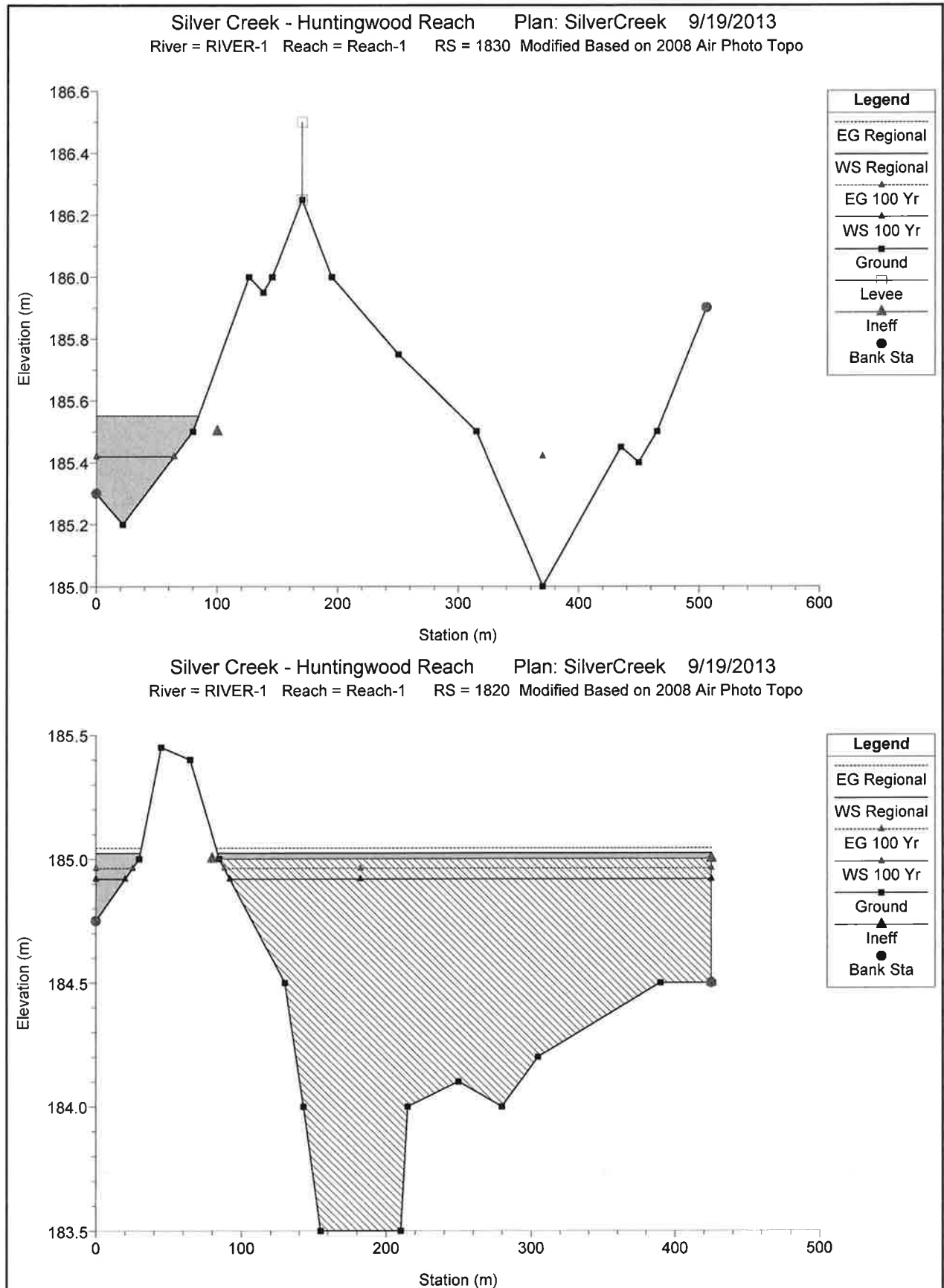
Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013  
 River = Silver Creek Reach = MainLower RS = 155



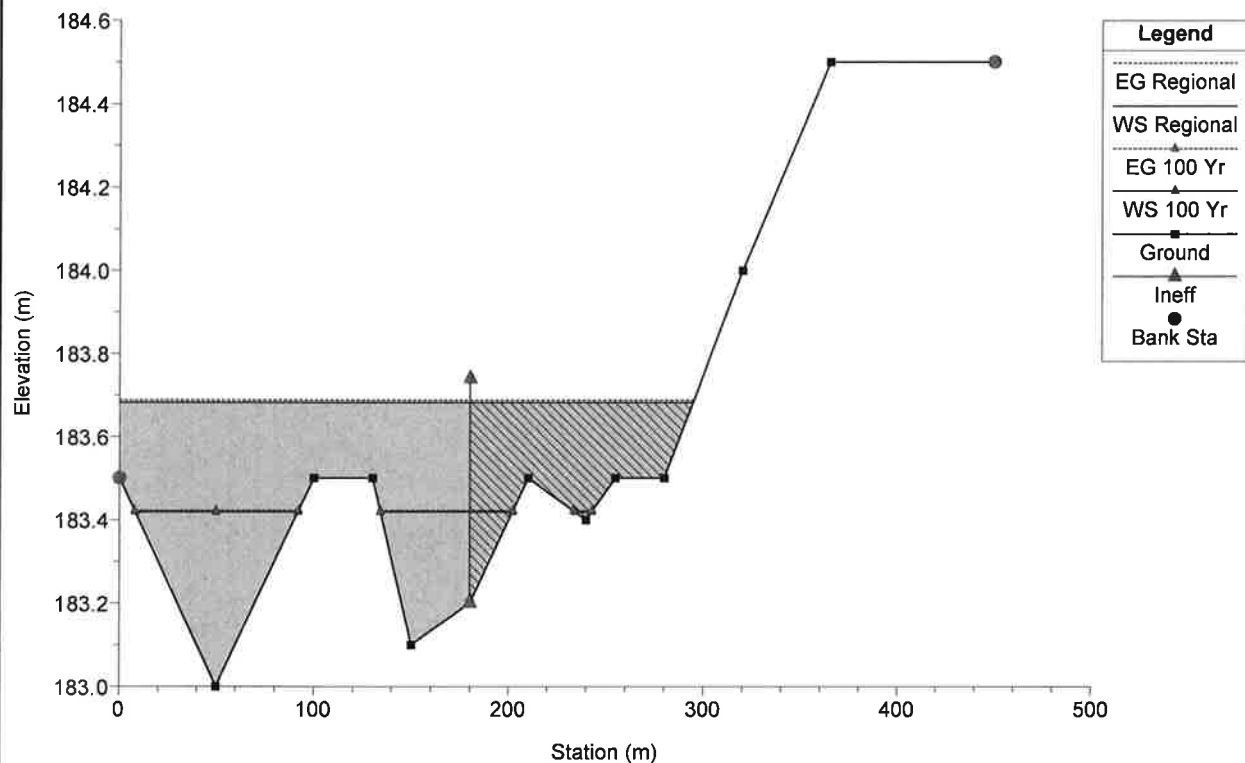
Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013  
 River = Silver Creek Reach = MainLower RS = 5 Downstream limit; Georgian Bay



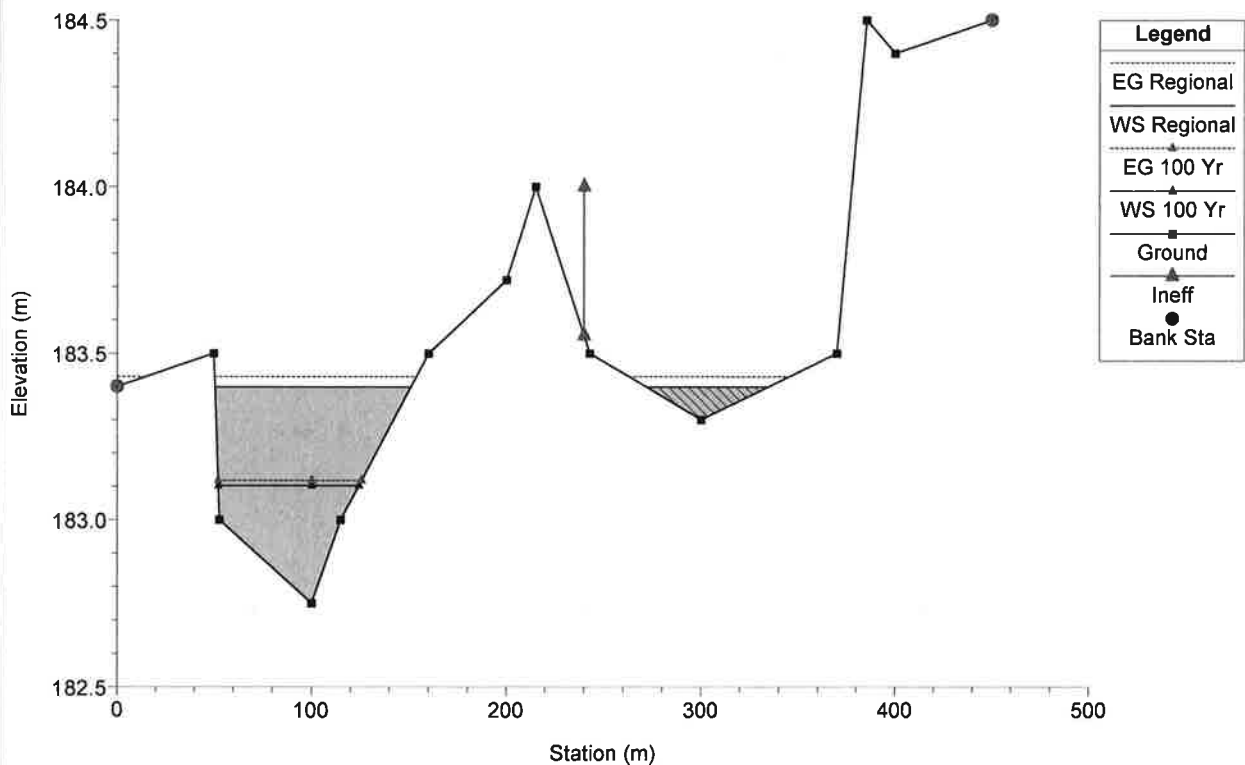
## SPILL ZONE 'B' OUTPUT



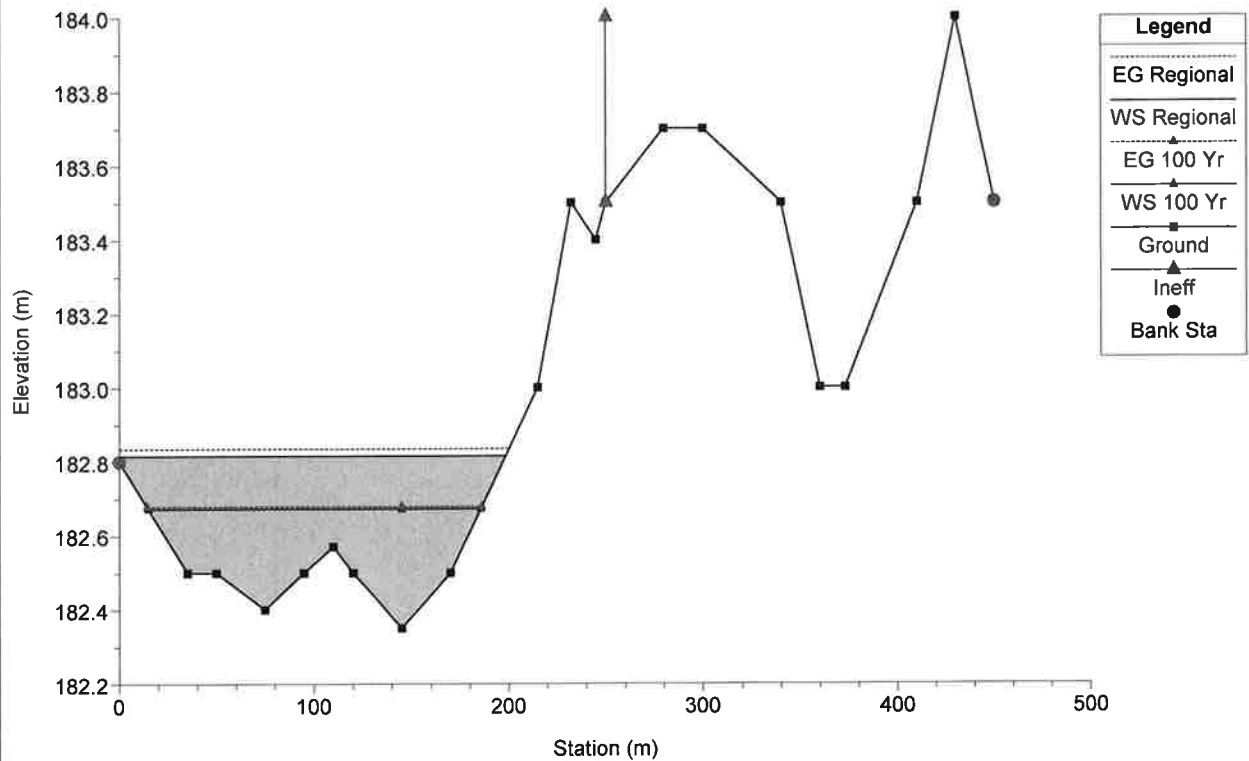
Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013  
 River = RIVER-1 Reach = Reach-1 RS = 1810 Modified Based on 2008 Air Photo Topo



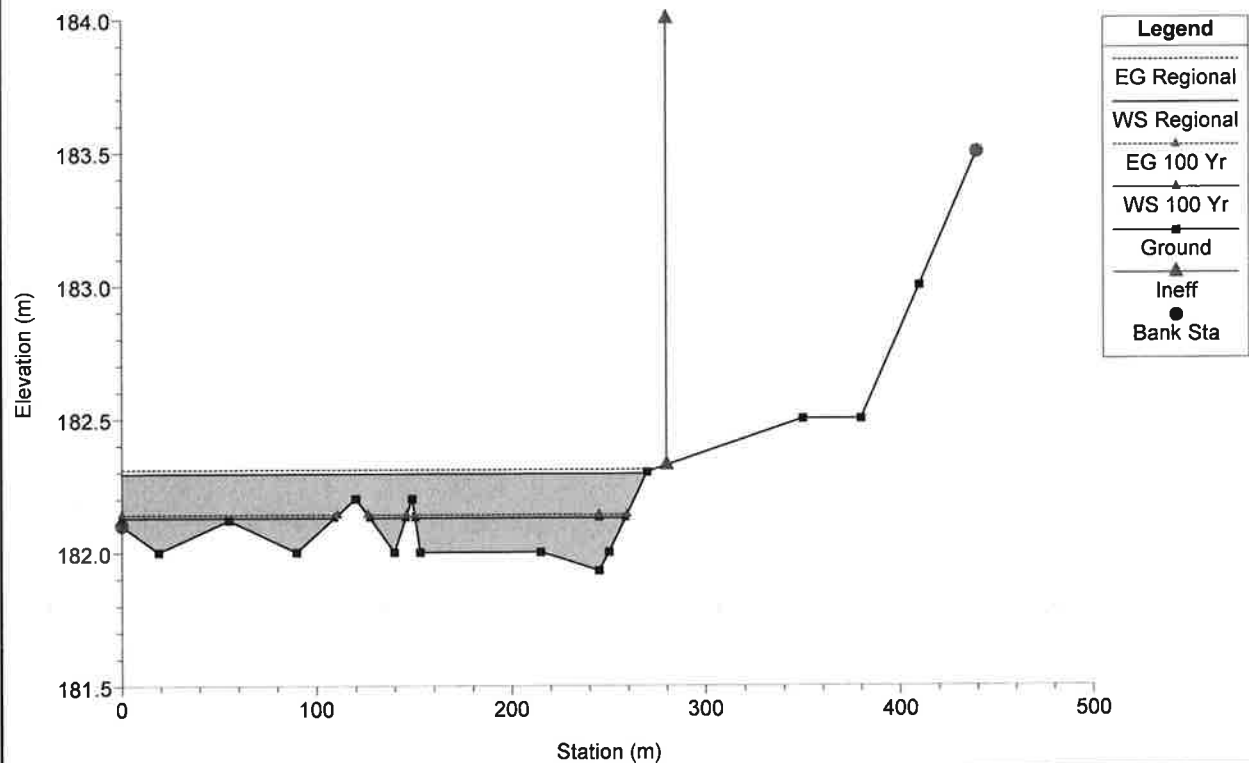
Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013  
 River = RIVER-1 Reach = Reach-1 RS = 1800 Modified Based on 2008 Air Photo Topo



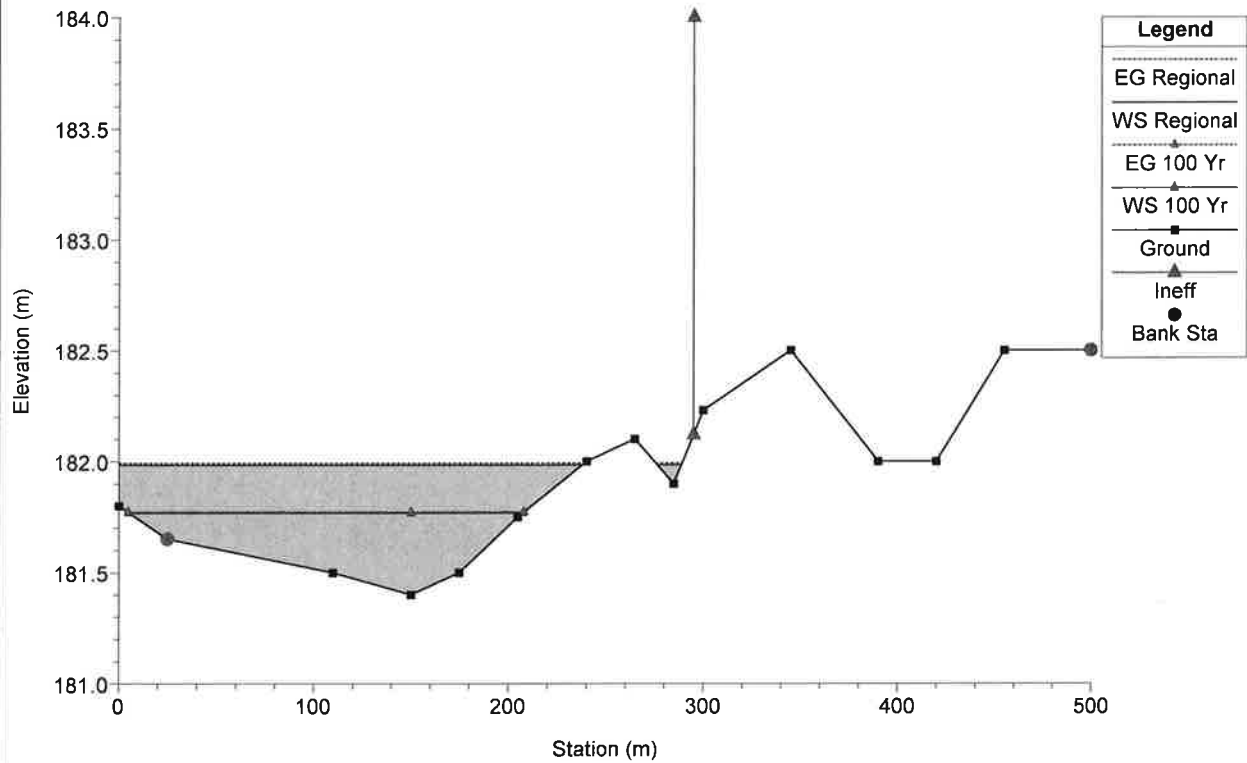
Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013  
 River = RIVER-1 Reach = Reach-1 RS = 1790 Modified Based on 2008 Air Photo Topo



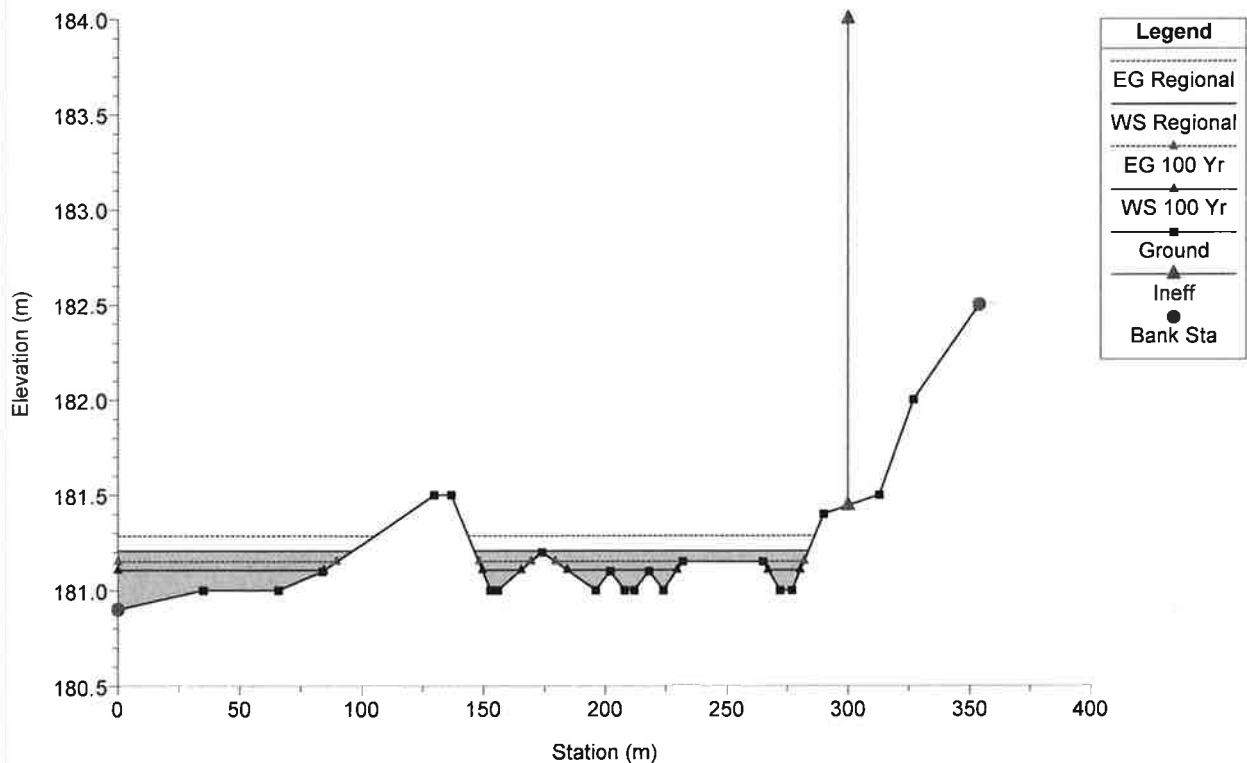
Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013  
 River = RIVER-1 Reach = Reach-1 RS = 1780 Modified Based on 2008 Air Photo Topo



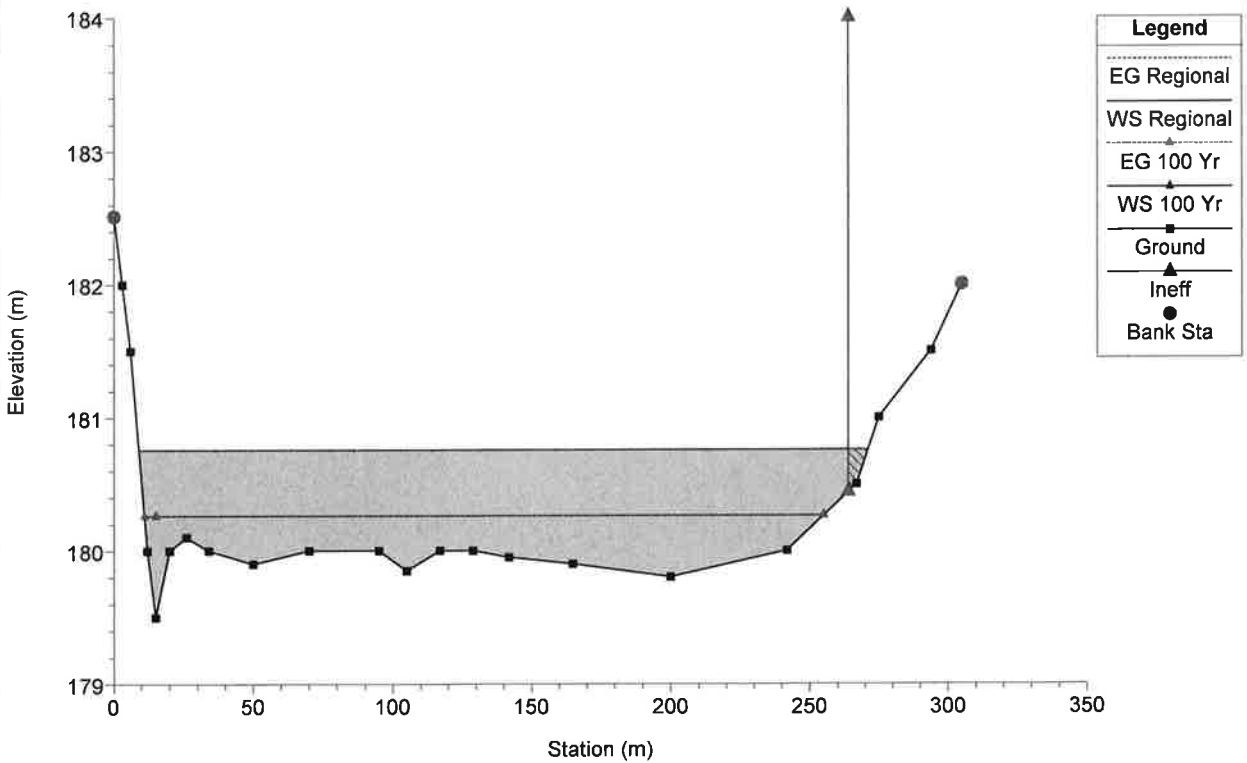
Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013  
 River = RIVER-1 Reach = Reach-1 RS = 1770 Modified Based on 2008 Air Photo Topo



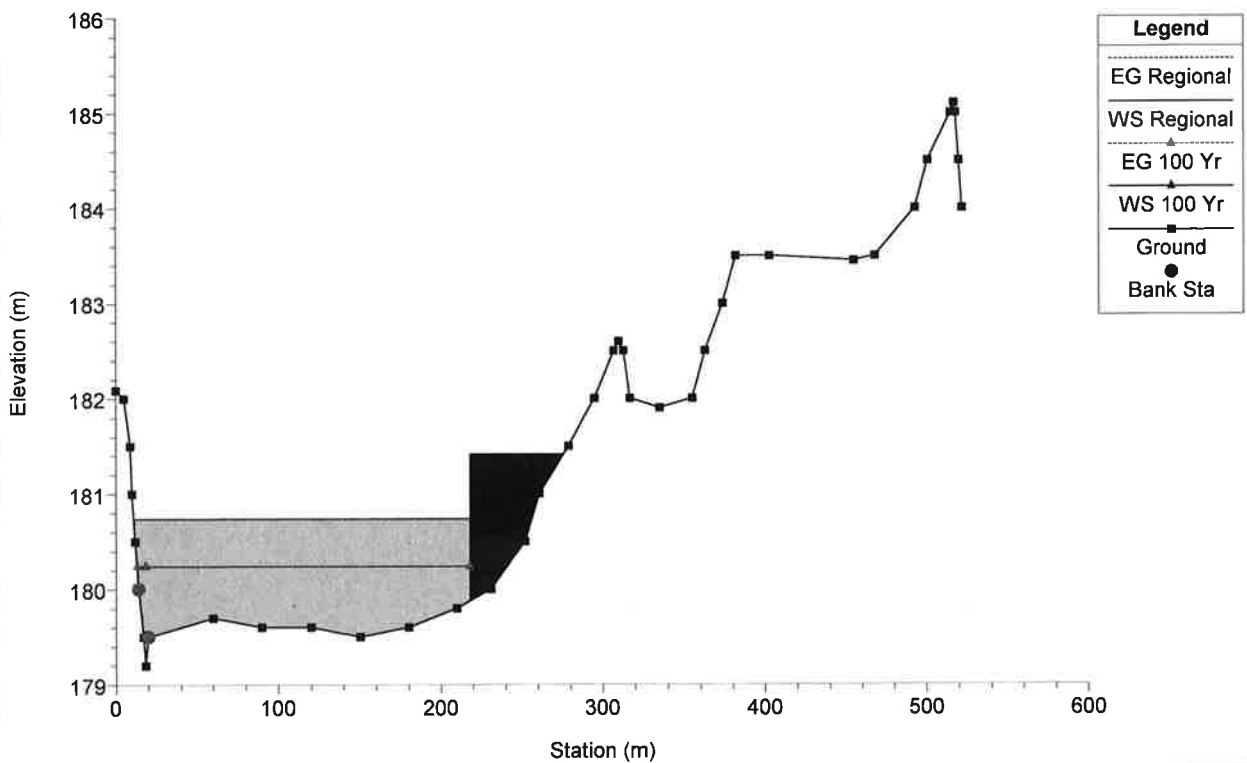
Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013  
 River = RIVER-1 Reach = Reach-1 RS = 1760 Modified Based on 2008 Air Photo Topo



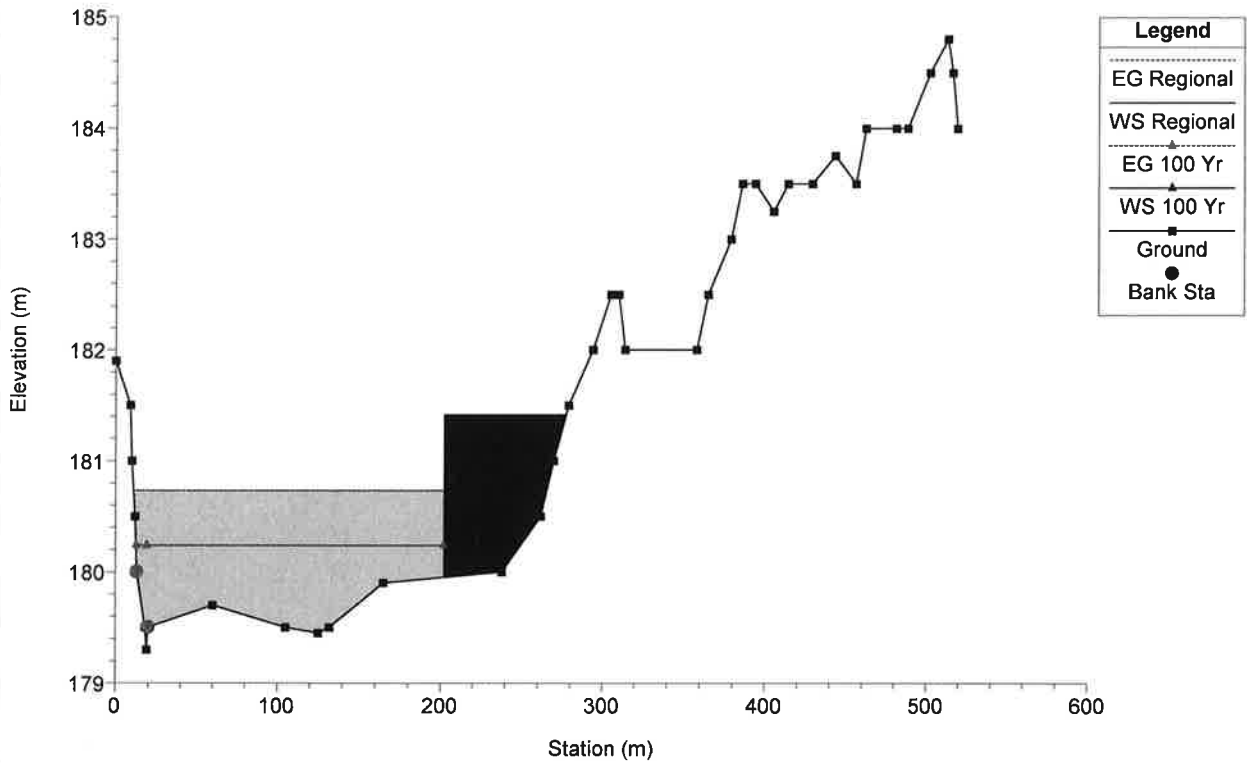
Silver Creek - Huntingwood Reach      Plan: SilverCreek    9/19/2013  
 River = RIVER-1    Reach = Reach-1    RS = 1750    Modified Based on 2008 Air Photo Topo



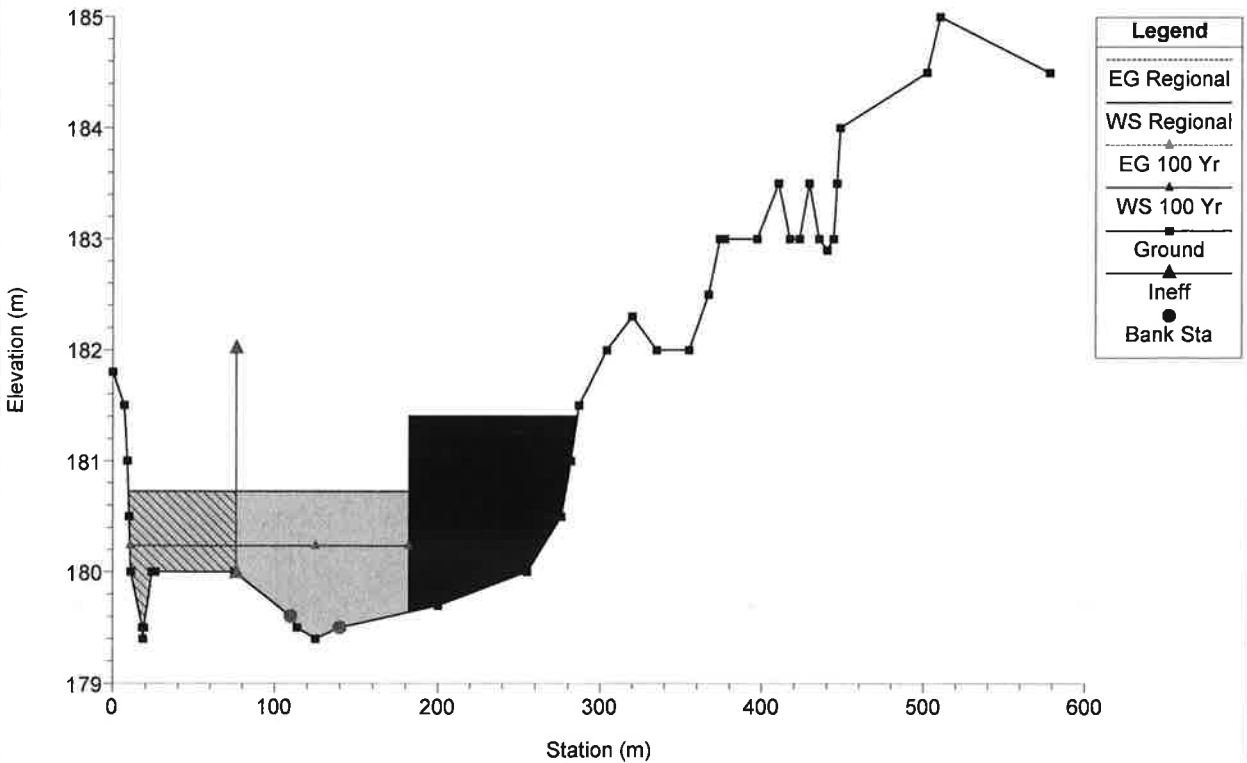
Silver Creek - Huntingwood Reach      Plan: SilverCreek    9/19/2013  
 River = RIVER-1    Reach = Reach-1    RS = 1740    Modified Based on 2008 Air Photo Topo



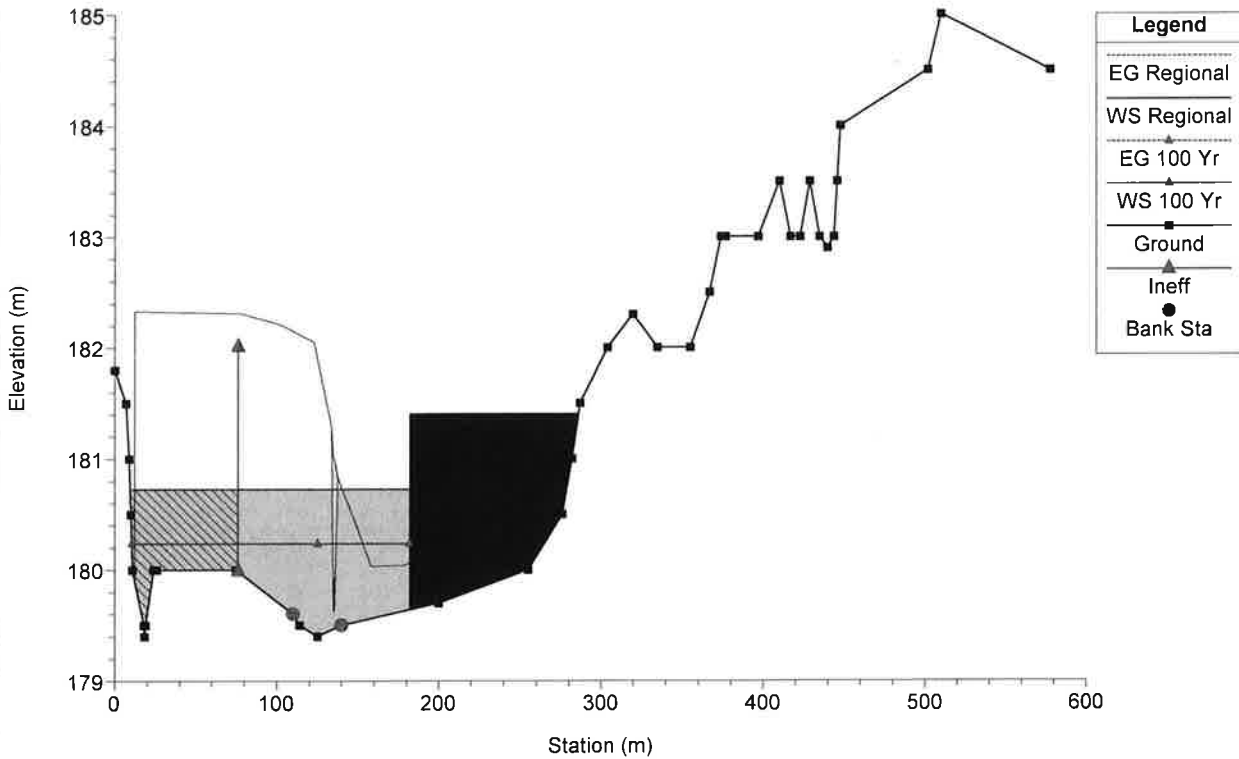
Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013  
 River = RIVER-1 Reach = Reach-1 RS = 1720 Modified Based on 2008 Air Photo Topo



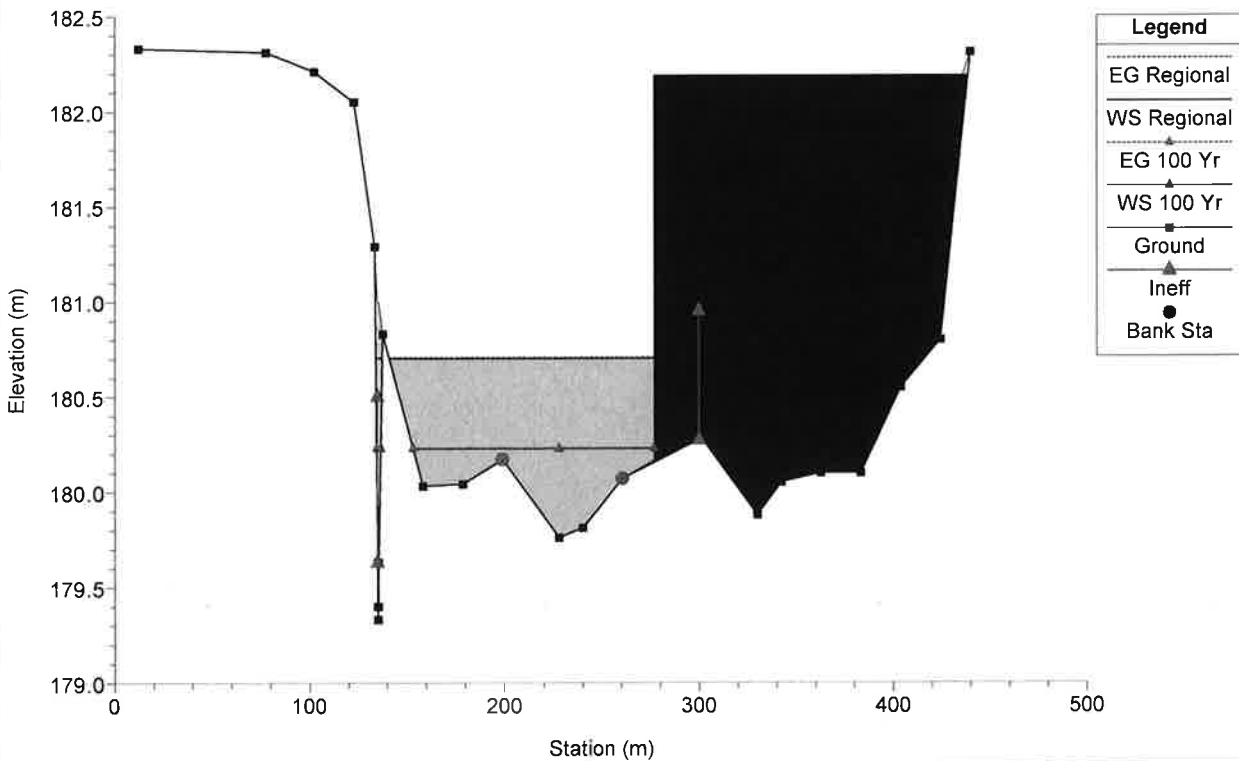
Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013  
 River = RIVER-1 Reach = Reach-1 RS = 1703 Modified Based on 2008 Air Photo Topo



Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013  
 River = RIVER-1 Reach = Reach-1 RS = 1696.5 BR Bridge #1

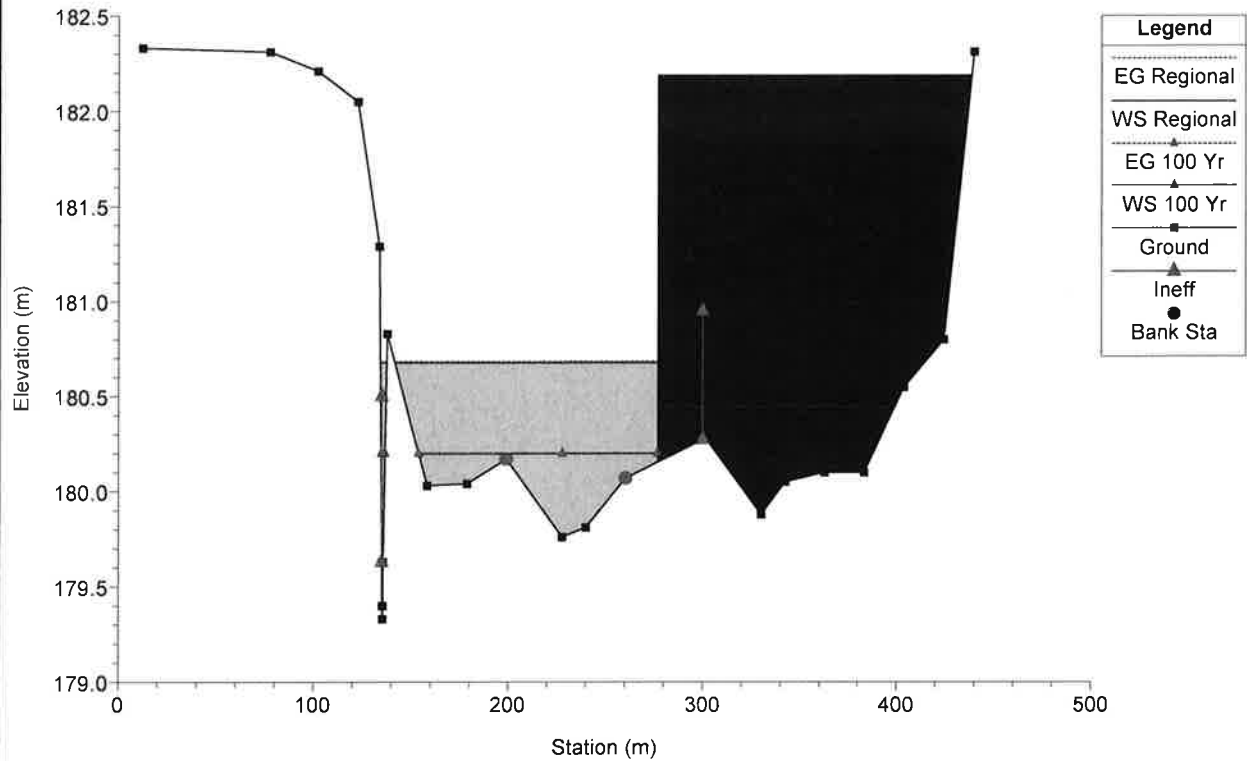


Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013  
 River = RIVER-1 Reach = Reach-1 RS = 1696.5 BR Bridge #1

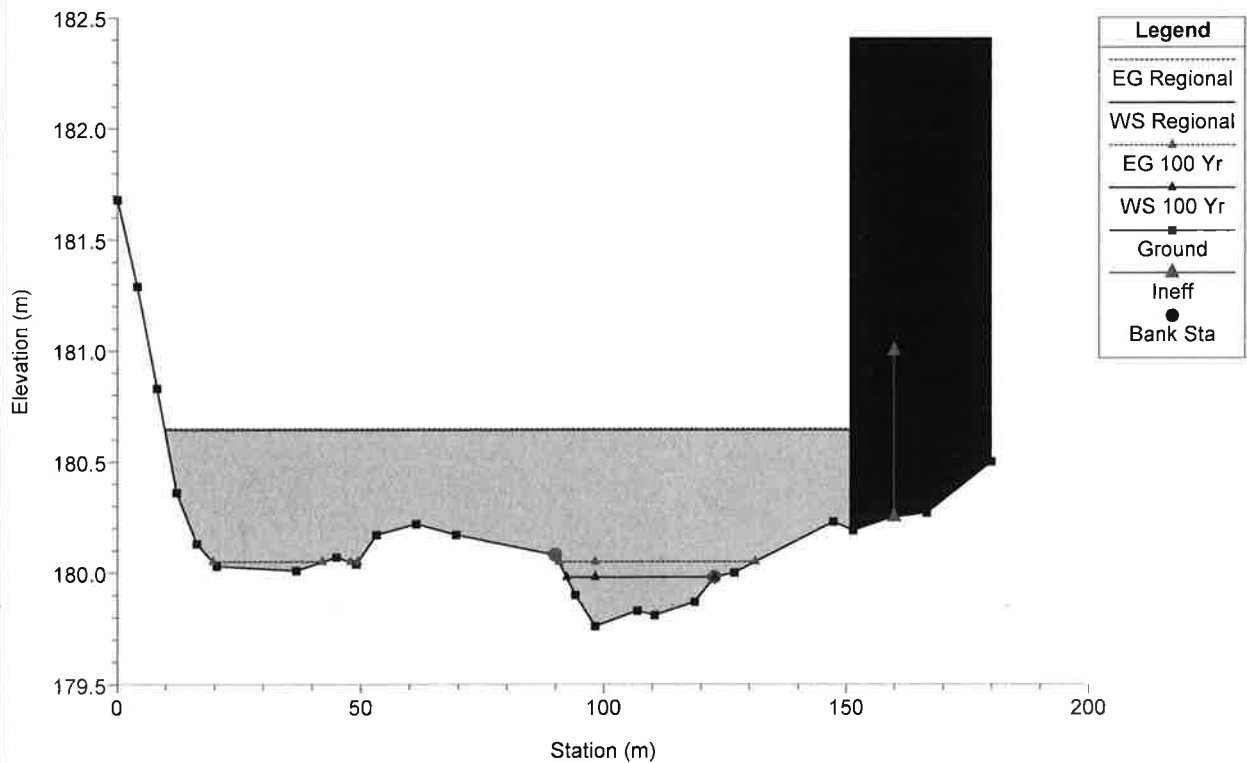




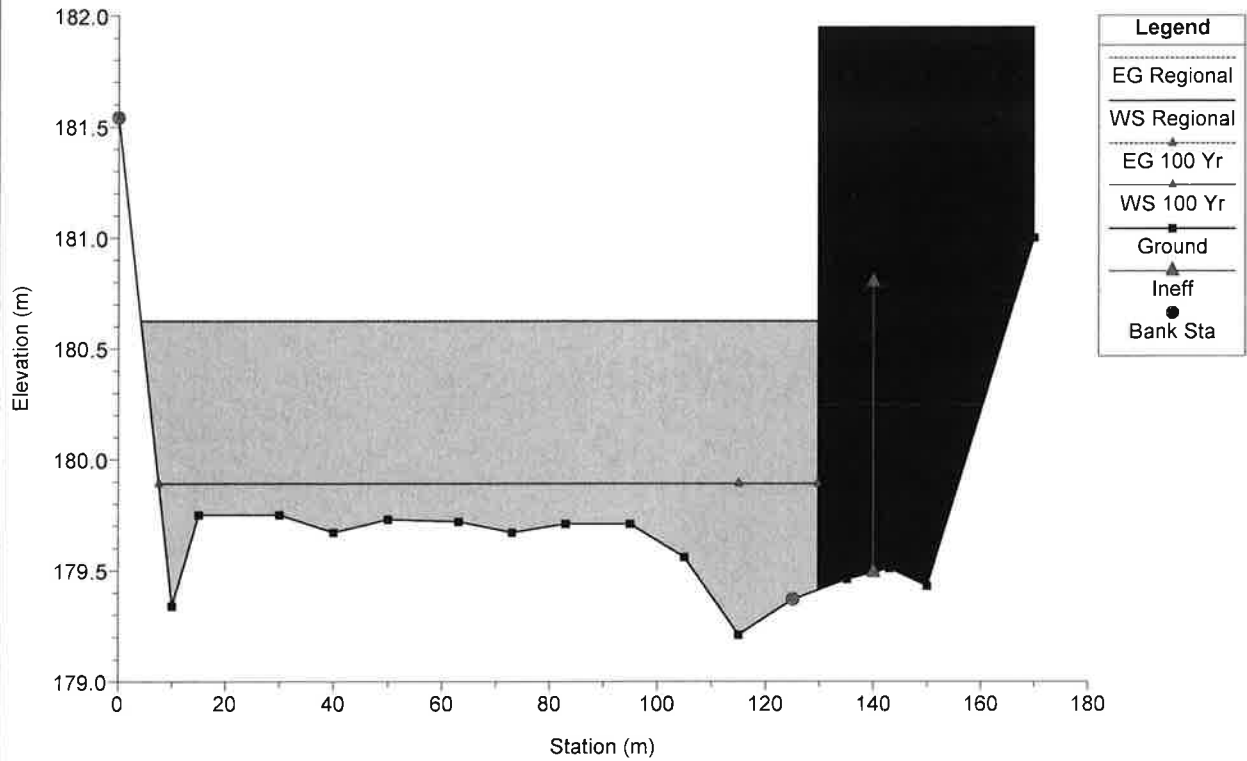
Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013  
 River = RIVER-1 Reach = Reach-1 RS = 1690



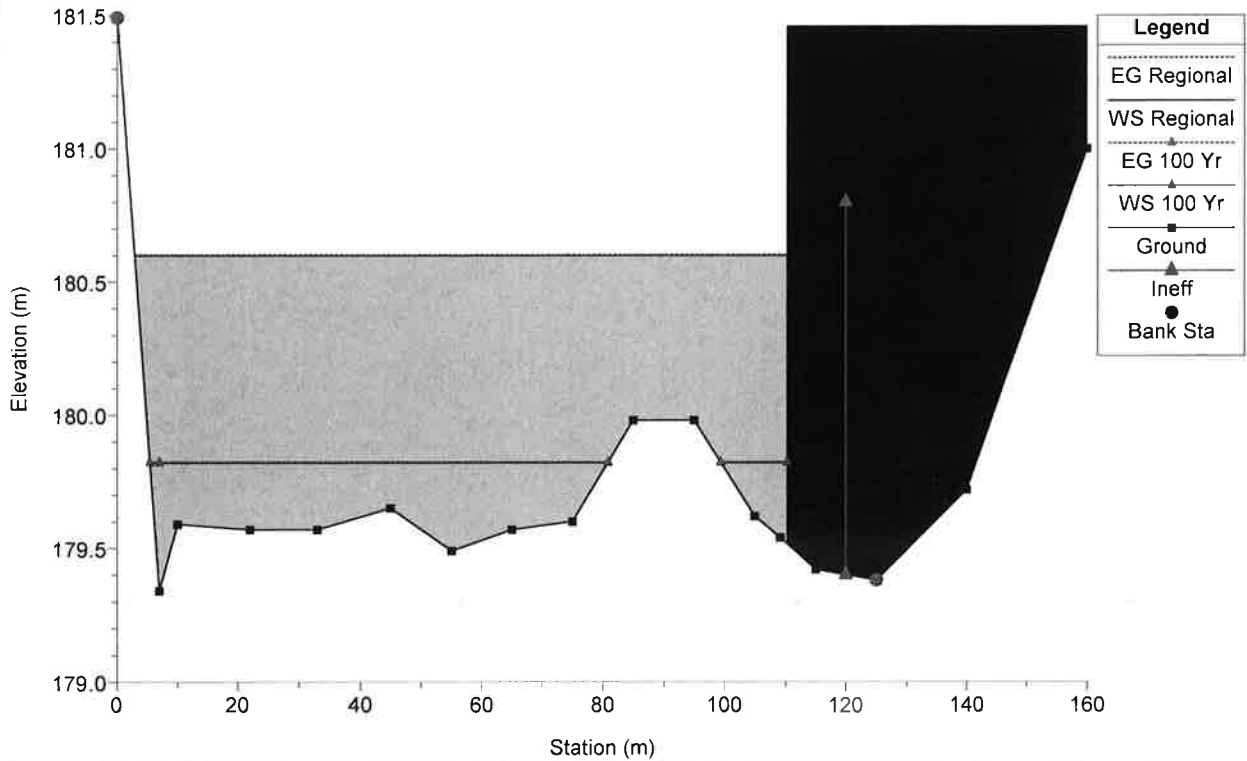
Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013  
 River = RIVER-1 Reach = Reach-1 RS = 1675



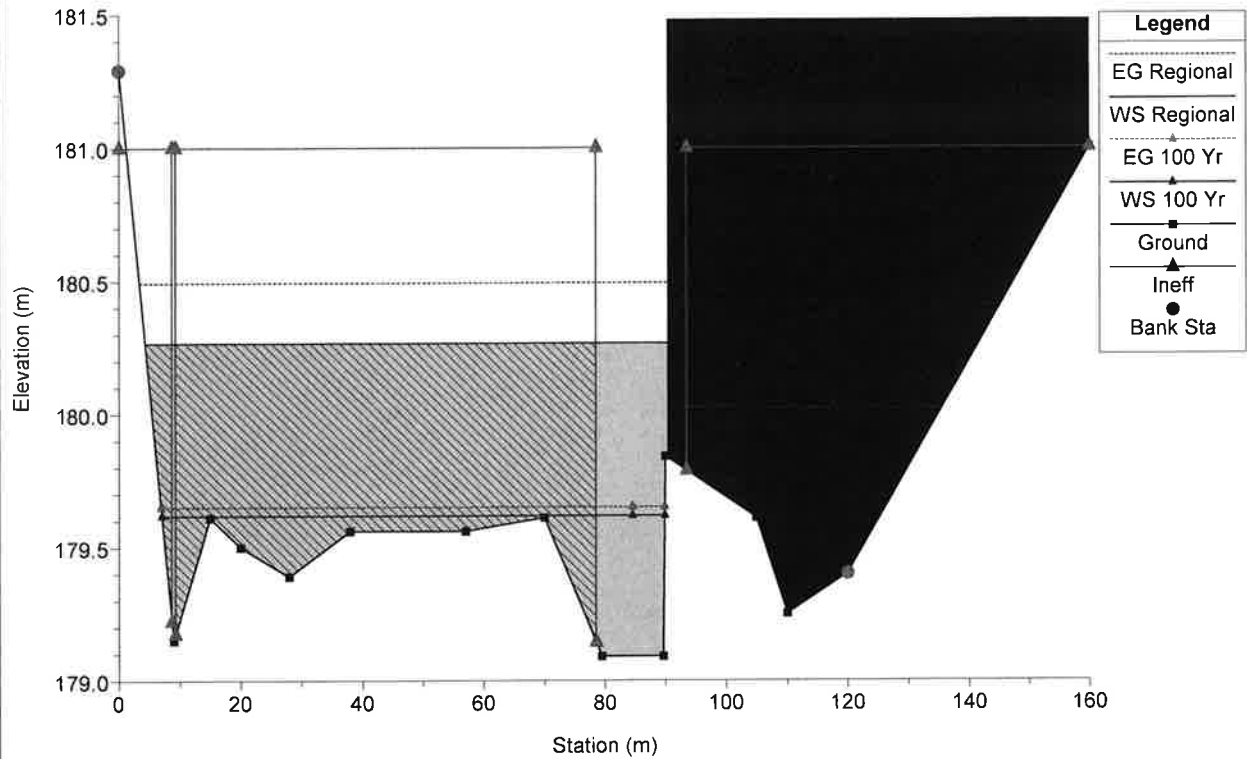
Silver Creek - Huntingwood Reach      Plan: SilverCreek    9/19/2013  
 River = RIVER-1    Reach = Reach-1    RS = 1648    revised with new topo



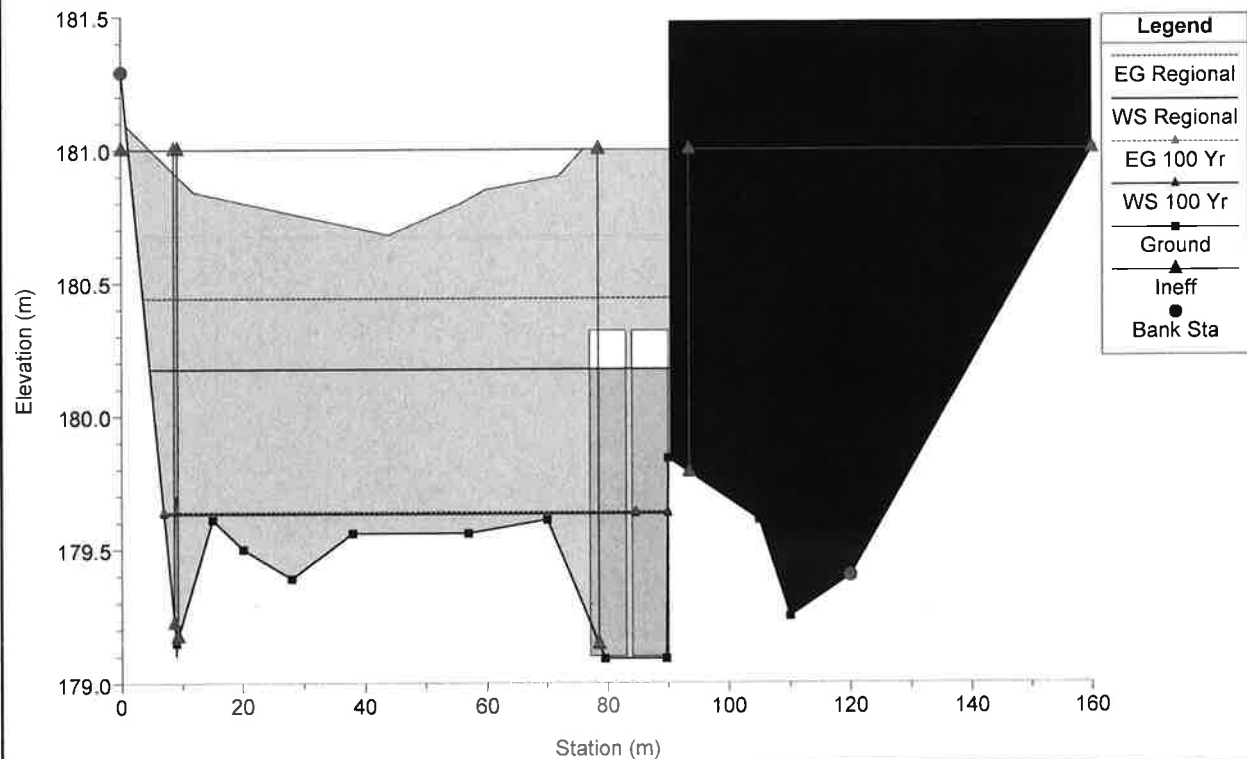
Silver Creek - Huntingwood Reach      Plan: SilverCreek    9/19/2013  
 River = RIVER-1    Reach = Reach-1    RS = 1627



Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013  
 River = RIVER-1 Reach = Reach-1 RS = 1590 revised to reflect new Topo survey;

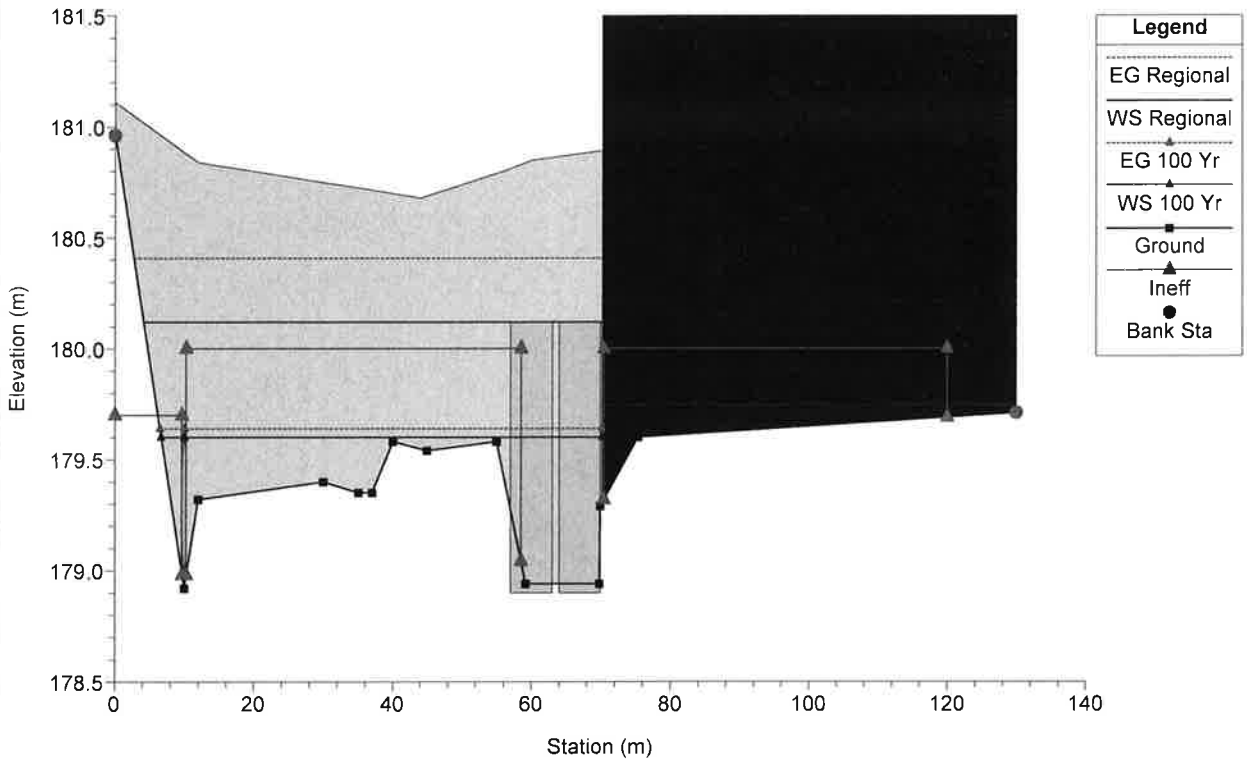


Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013  
 River = RIVER-1 Reach = Reach-1 RS = 1570 Culv



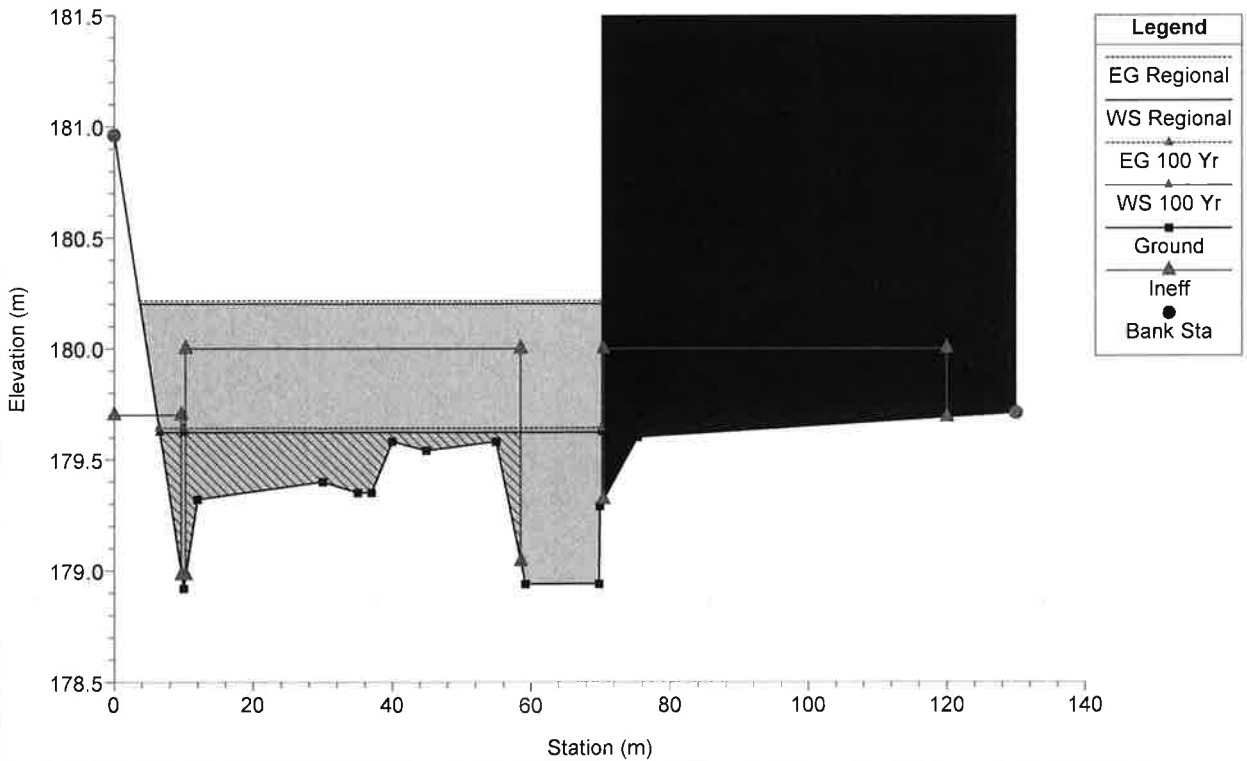
# Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013

River = RIVER-1 Reach = Reach-1 RS = 1570 Culv



# Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013

River = RIVER-1 Reach = Reach-1 RS = 1560 revised to reflect new topo

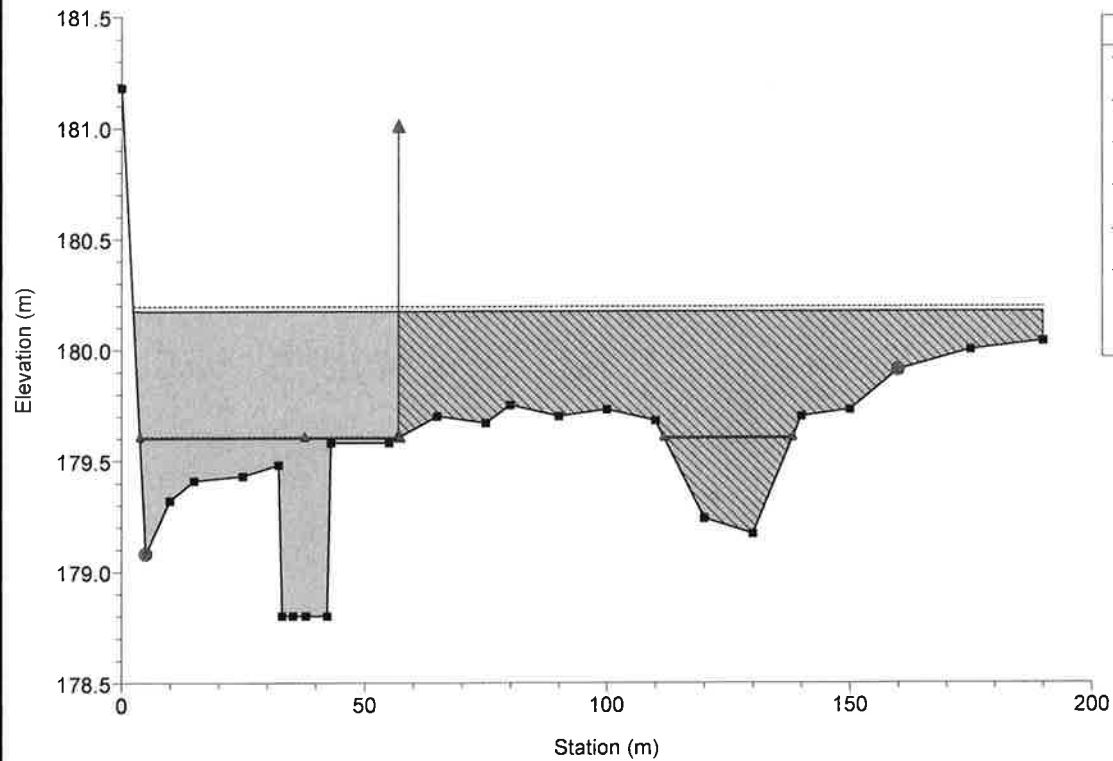


# Silver Creek - Huntingwood Reach

Plan: SilverCreek 9/19/2013

River = RIVER-1 Reach = Reach-1

RS = 1550 updated with new topo

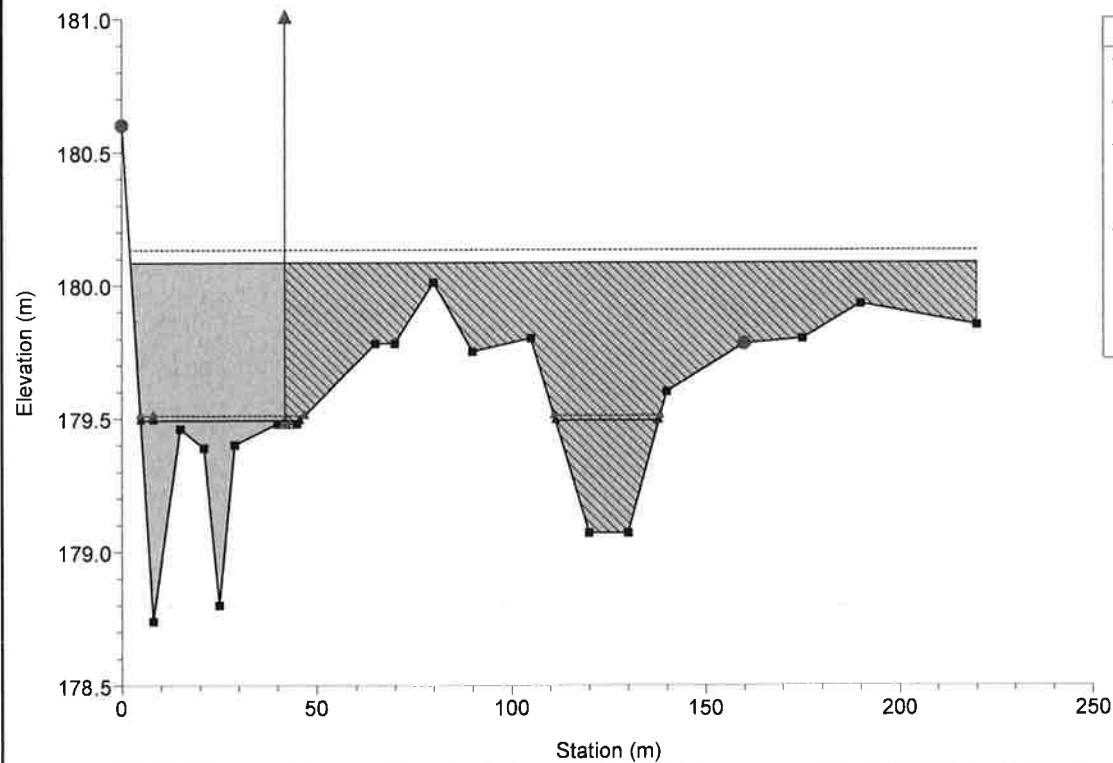


# Silver Creek - Huntingwood Reach

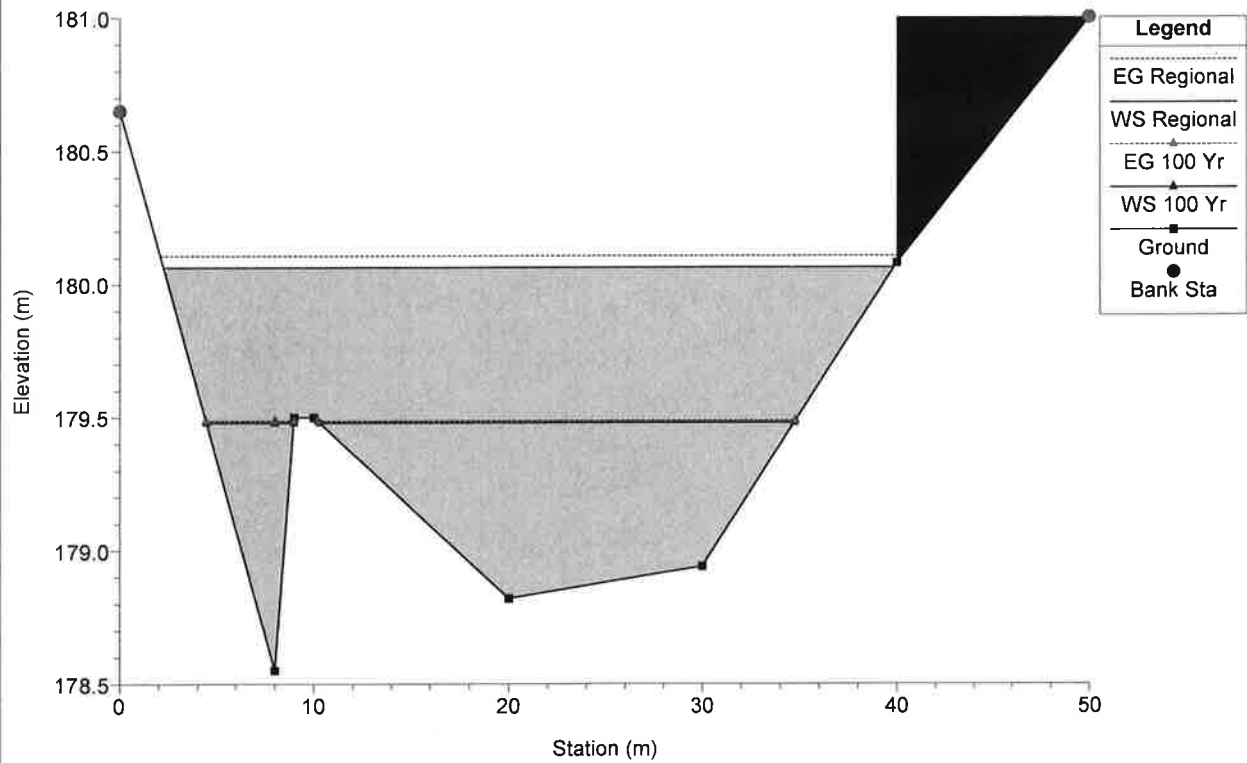
Plan: SilverCreek 9/19/2013

River = RIVER-1 Reach = Reach-1

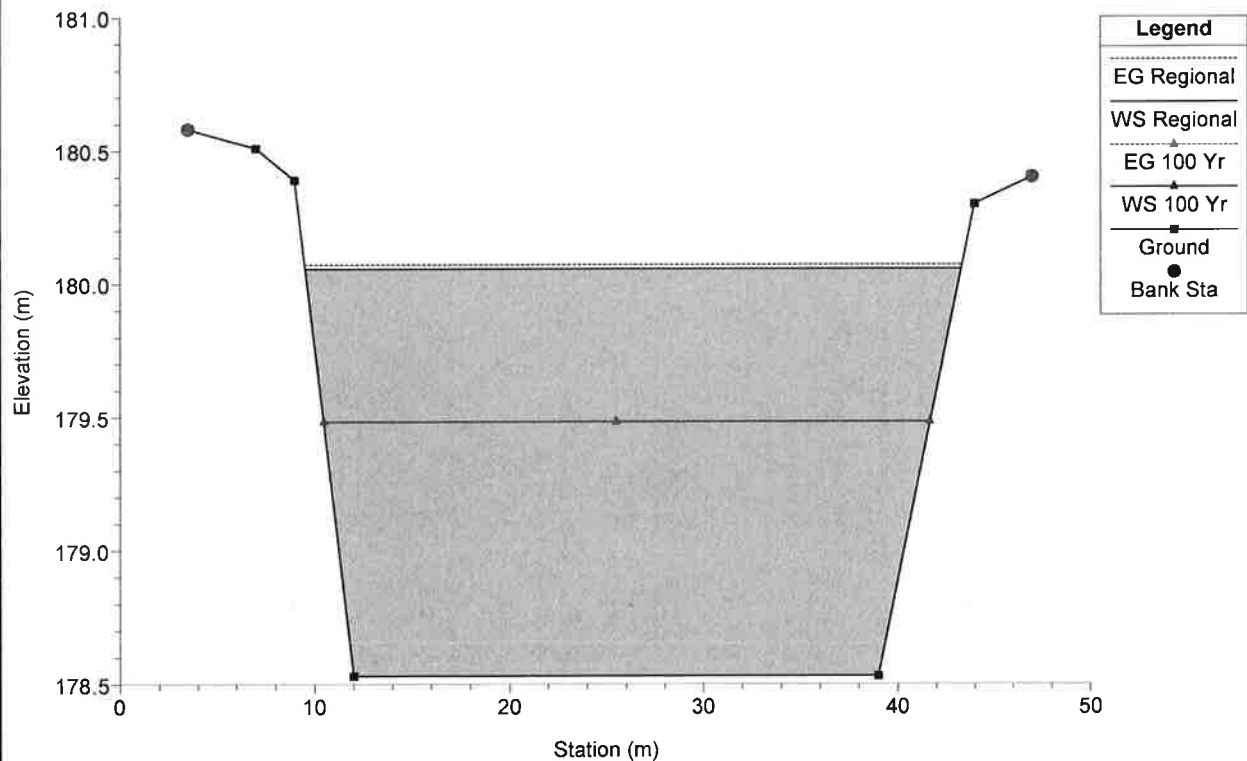
RS = 1527 REVISED WITH NEW TOPO



Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013  
 River = RIVER-1 Reach = Reach-1 RS = 1505

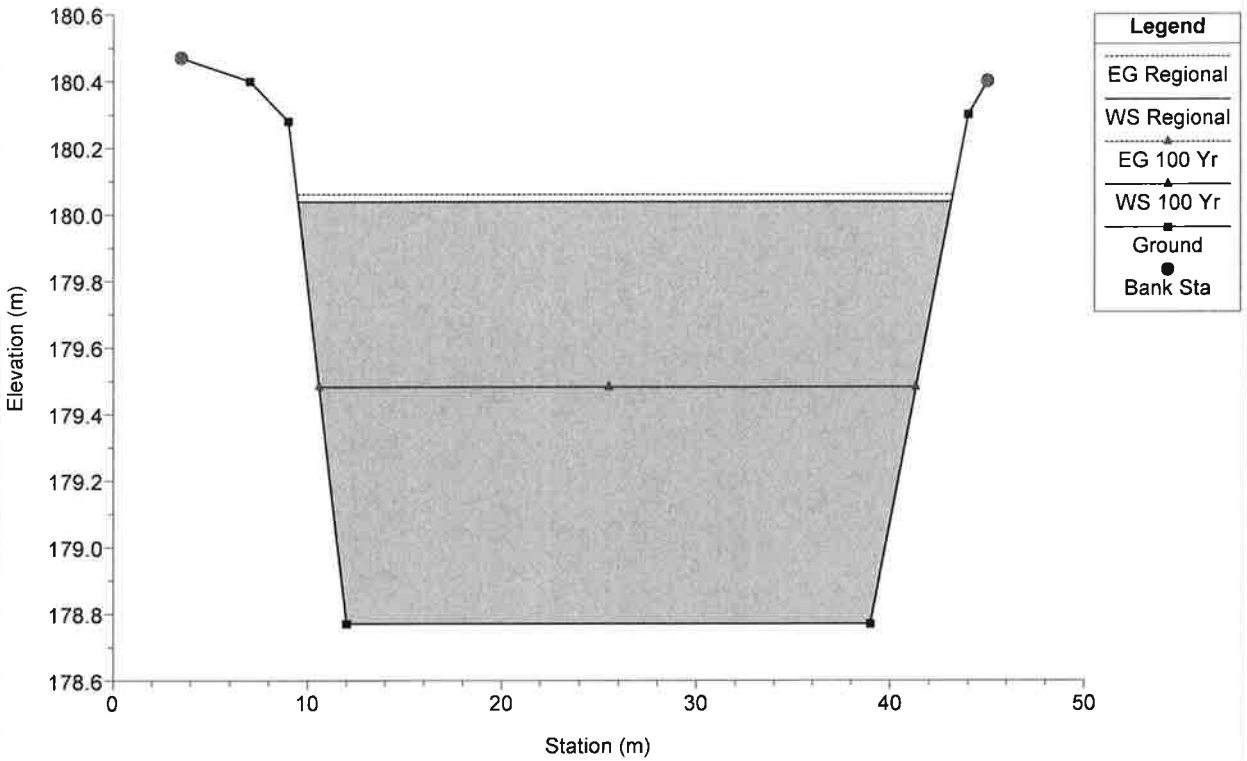


Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013  
 River = RIVER-1 Reach = Reach-1 RS = 1480



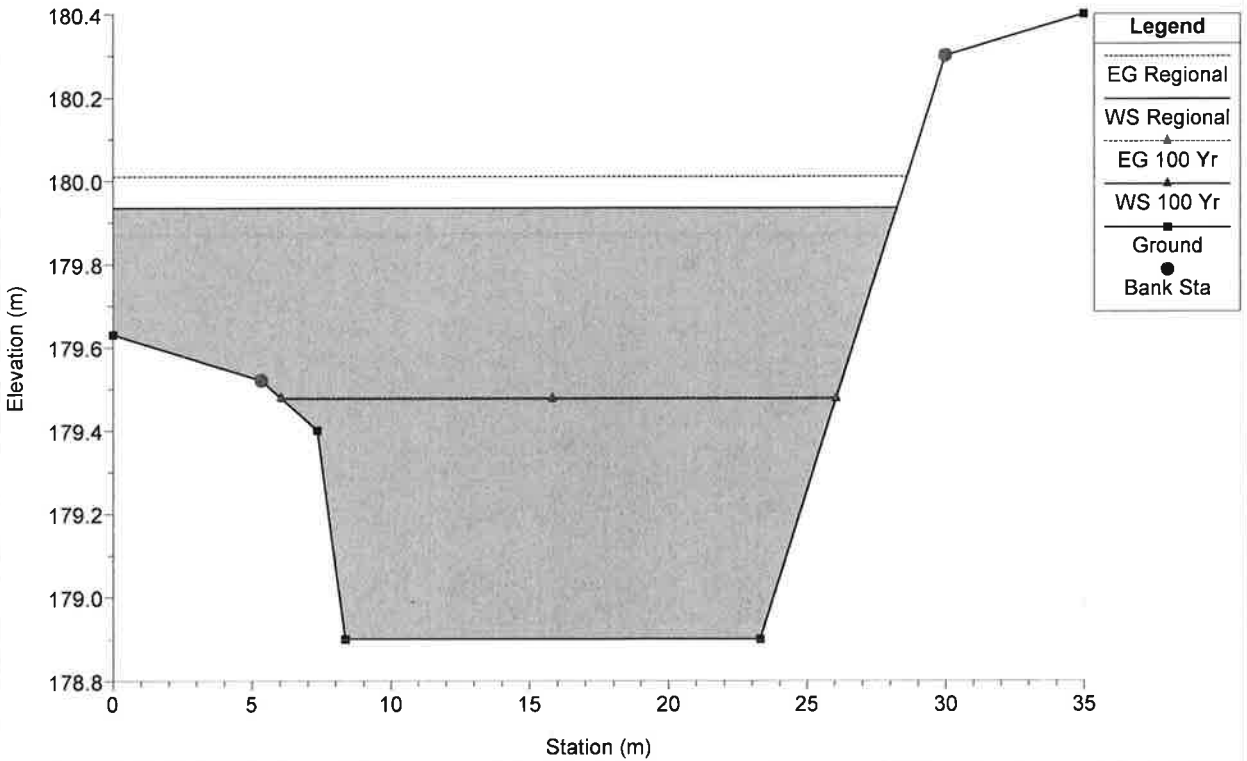
# Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013

River = RIVER-1 Reach = Reach-1 RS = 1461



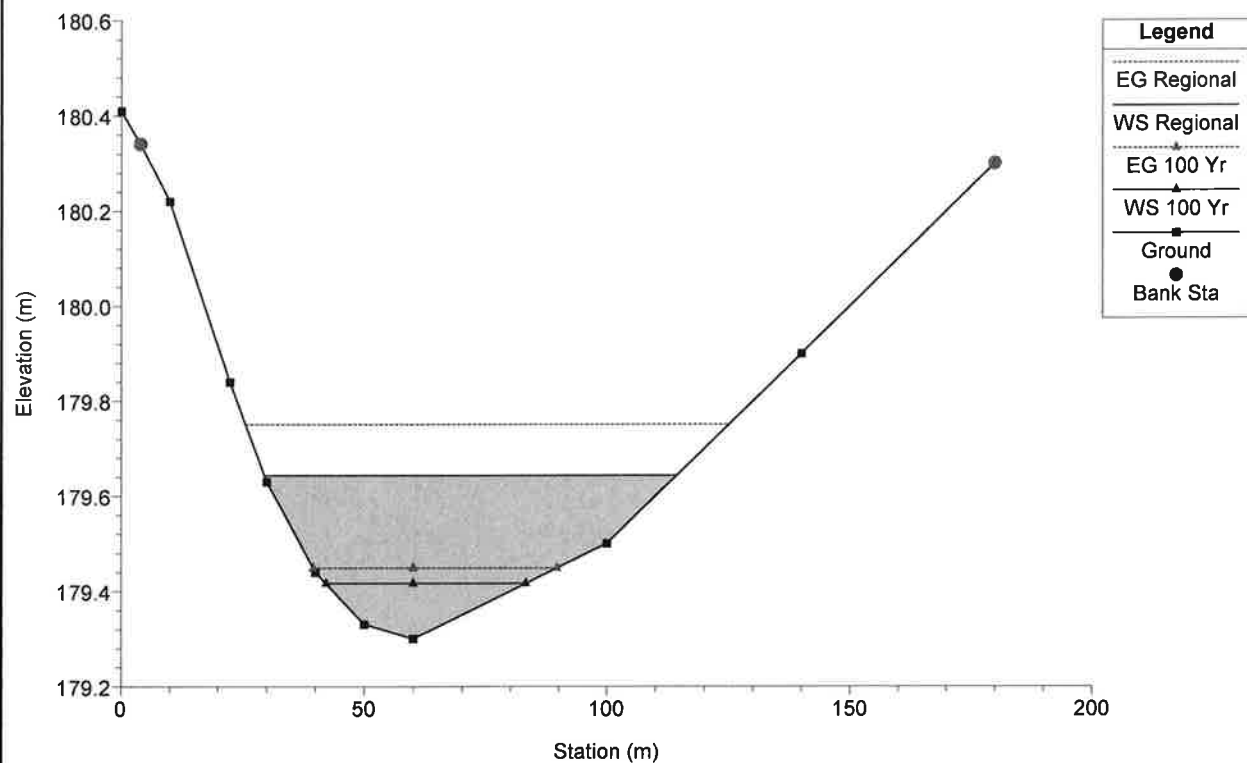
# Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013

River = RIVER-1 Reach = Reach-1 RS = 1440.1 NEW ROADSIDE DITCH



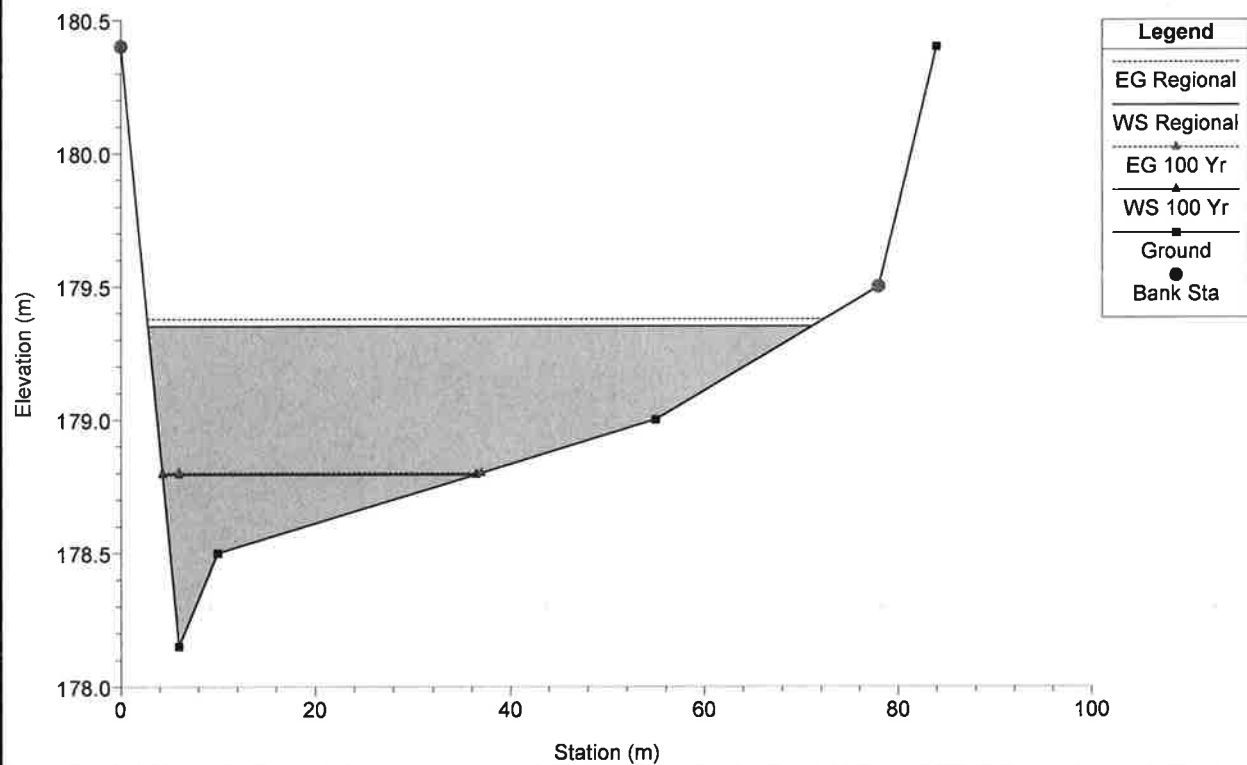
# Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013

River = RIVER-1 Reach = Reach-1 RS = 1440



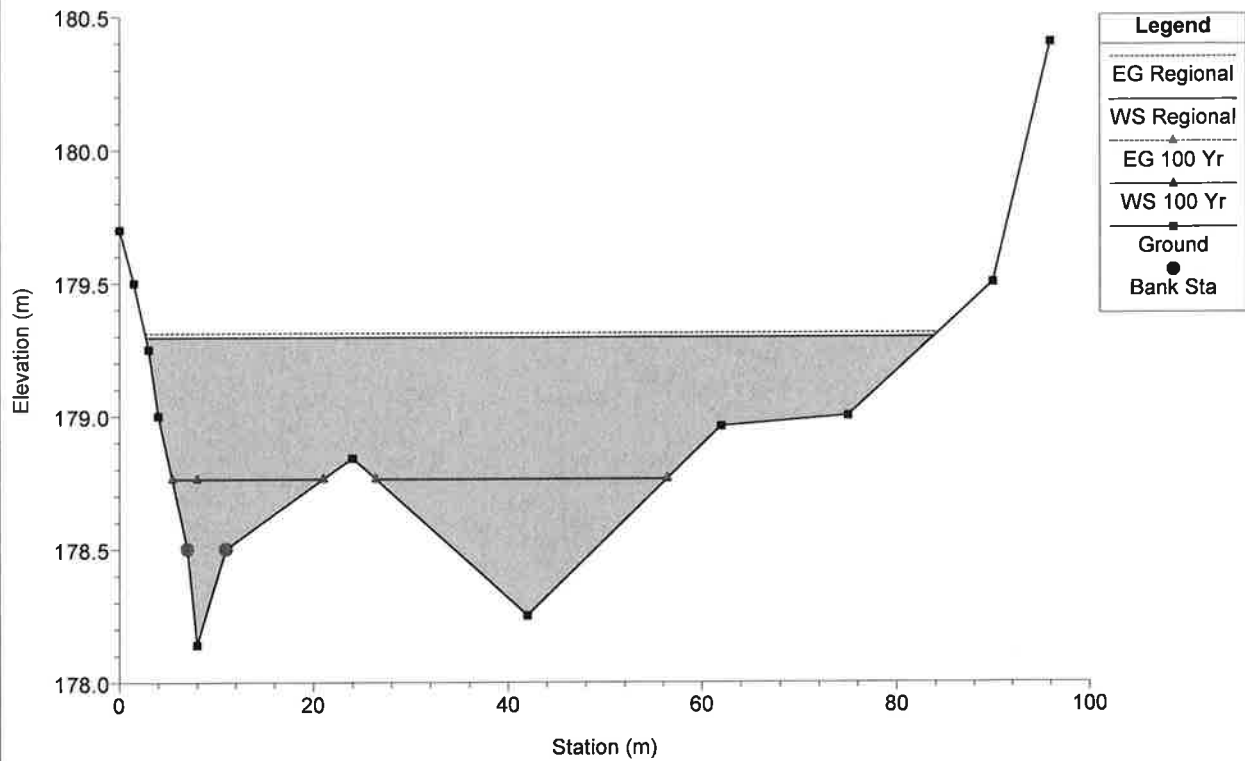
# Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013

River = RIVER-1 Reach = Reach-1 RS = 1315

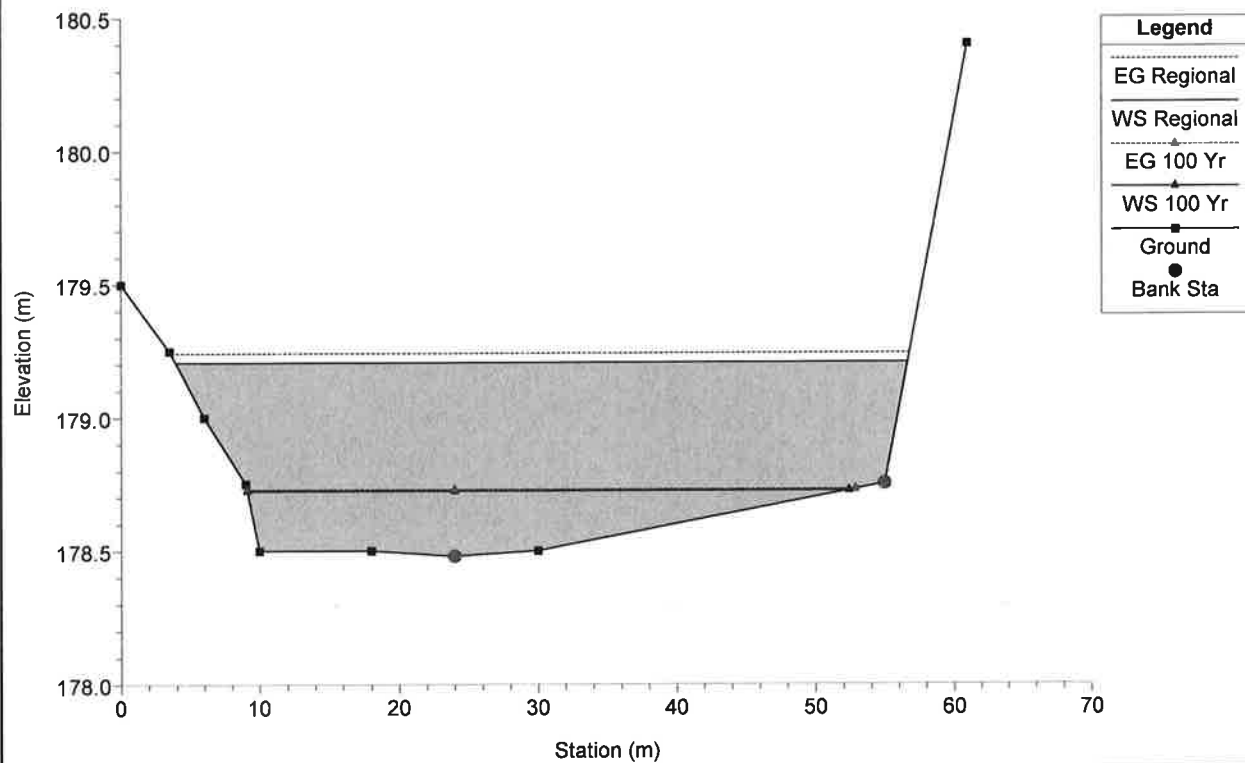




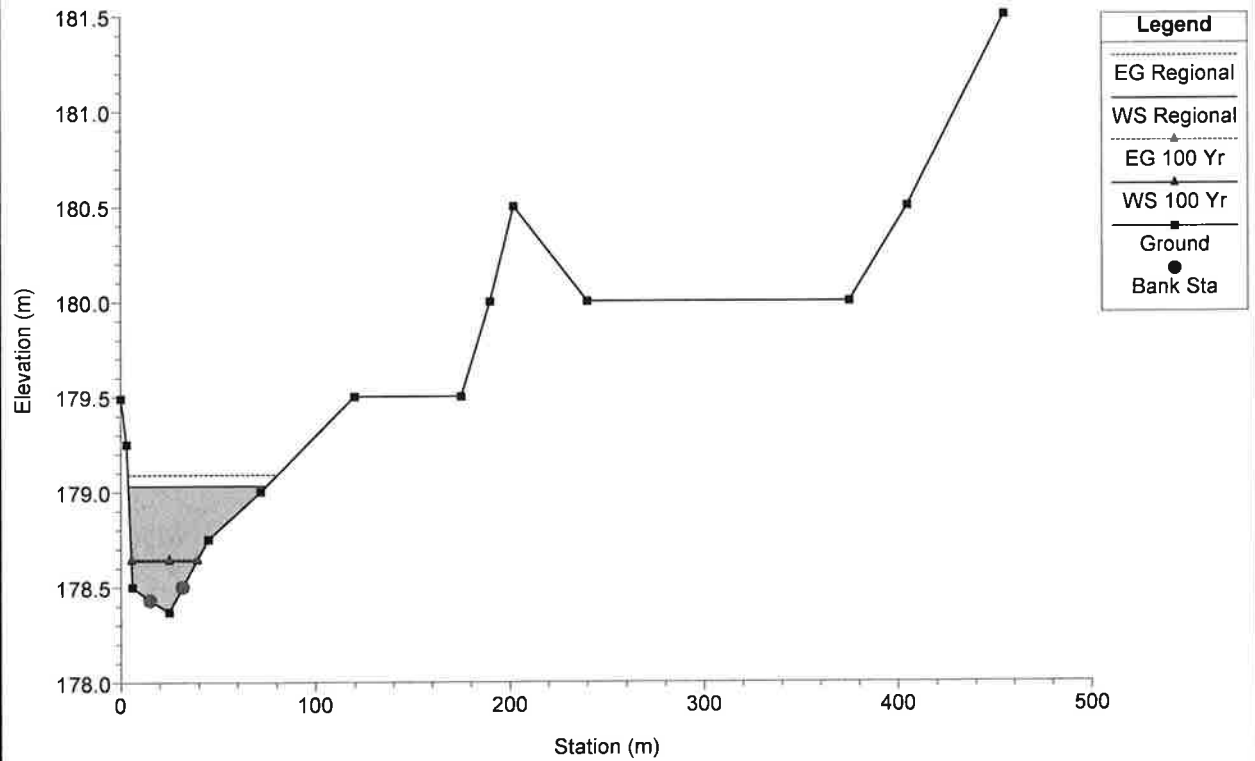
Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013  
 River = RIVER-1 Reach = Reach-1 RS = 1274



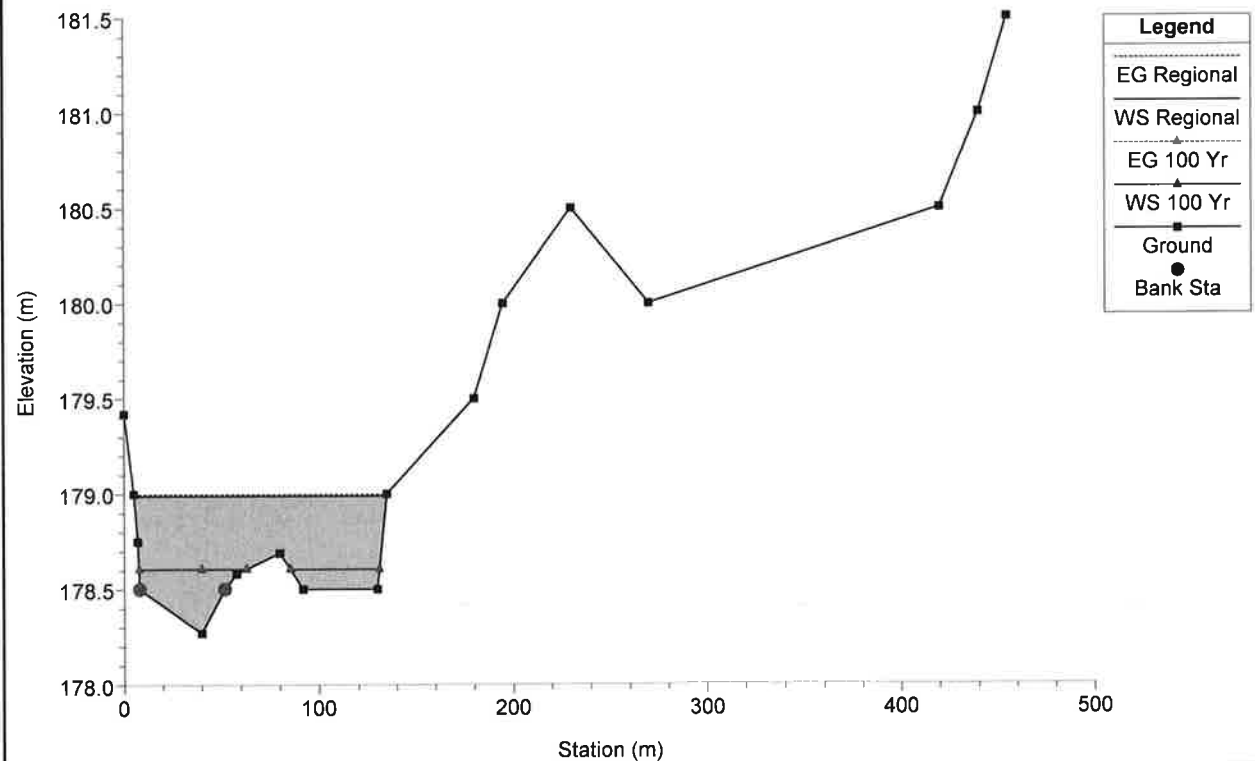
Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013  
 River = RIVER-1 Reach = Reach-1 RS = 1232



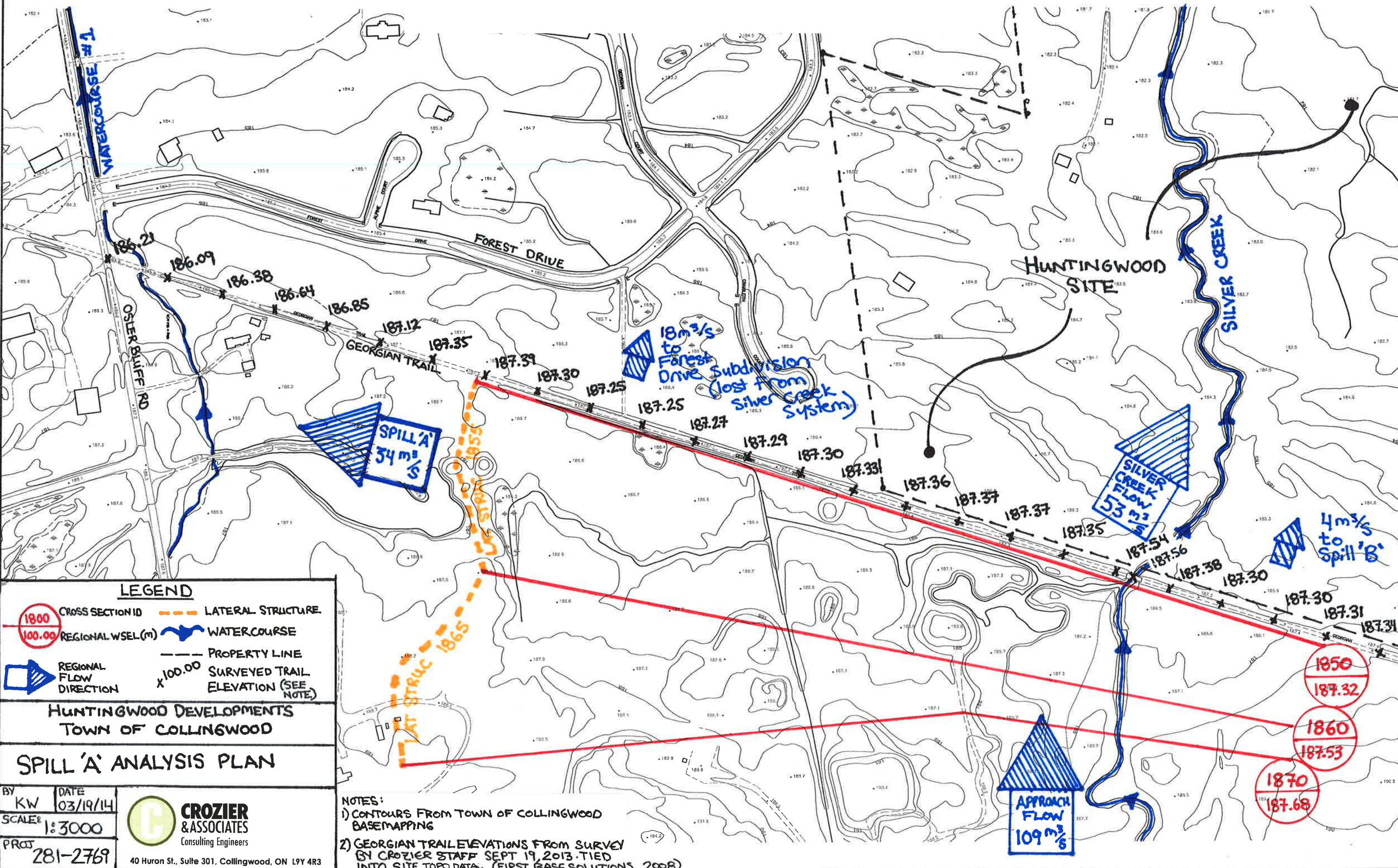
Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013  
 River = RIVER-1 Reach = Reach-1 RS = 1192



Silver Creek - Huntingwood Reach Plan: SilverCreek 9/19/2013  
 River = RIVER-1 Reach = Reach-1 RS = 1149







**LEGEND**

 CROSS SECTION ID     LATERAL STRUCTURE

 REGIONAL WSEL (m)     WATERCOURSE

 REGIONAL FLOW DIRECTION     PROPERTY LINE

 SURVEYED TRAIL ELEVATION (SEE NOTE)

**HUNTINGWOOD DEVELOPMENTS**  
**TOWN OF COLLINGWOOD**

**SPILL 'A' ANALYSIS PLAN**

|       |          |
|-------|----------|
| BY    | DATE     |
| KW    | 03/19/14 |
| SCALE | 1:3000   |
| PROJ  | 281-2769 |



**CROZIER & ASSOCIATES**  
Consulting Engineers  
40 Huron St., Suite 301, Collingwood, ON L9Y 4R3

**NOTES:**

1) CONTOURS FROM TOWN OF COLLINGWOOD BASEMAPPING

2) GEORGIAN TRAIL ELEVATIONS FROM SURVEY BY CROZIER STAFF SEPT 19, 2013. TIED INTO SITE TOPO DATA, (FIRST BASE SOLUTIONS, 2008)

1850  
187.32

1860  
187.53

1870  
187.68

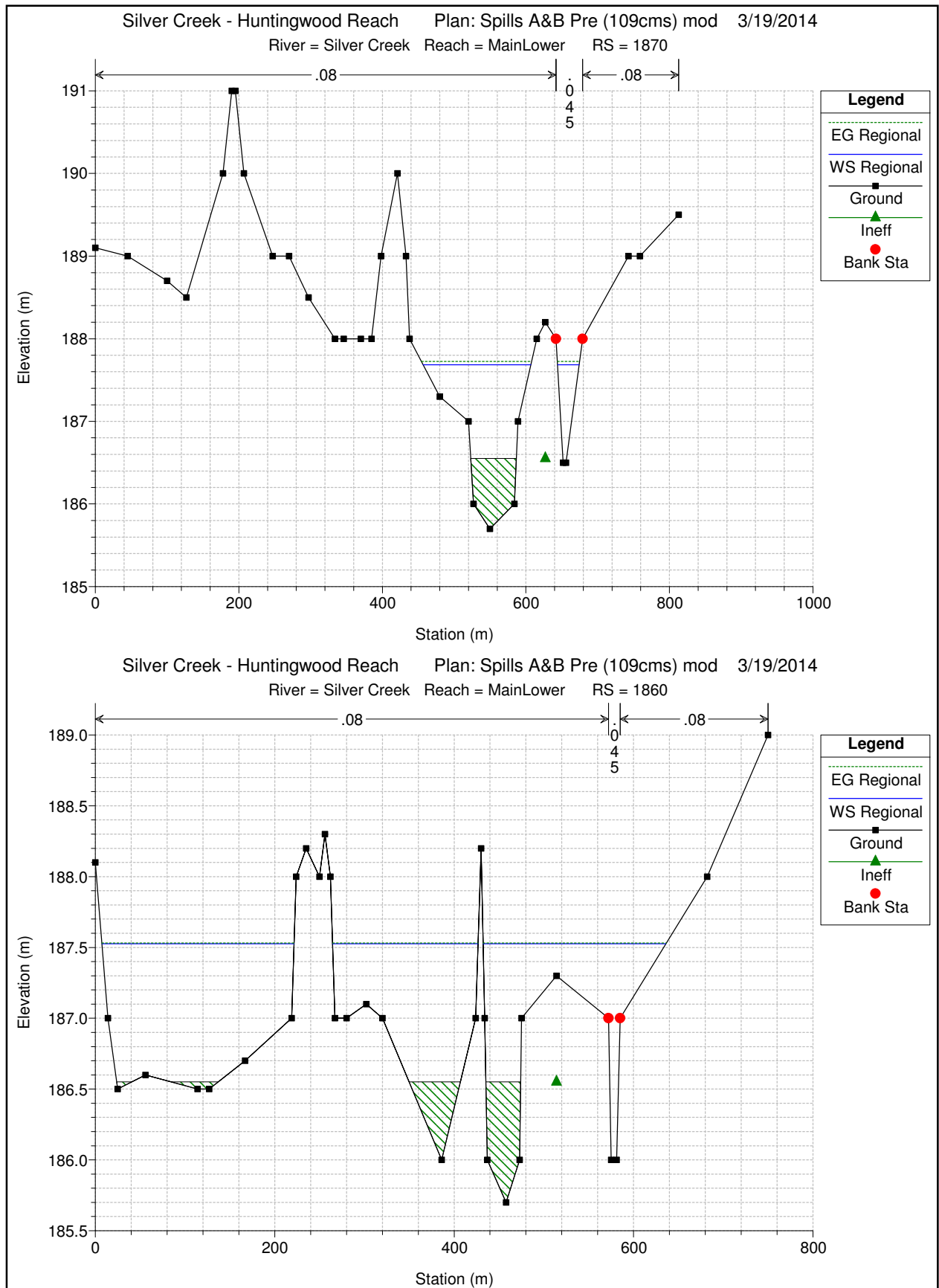


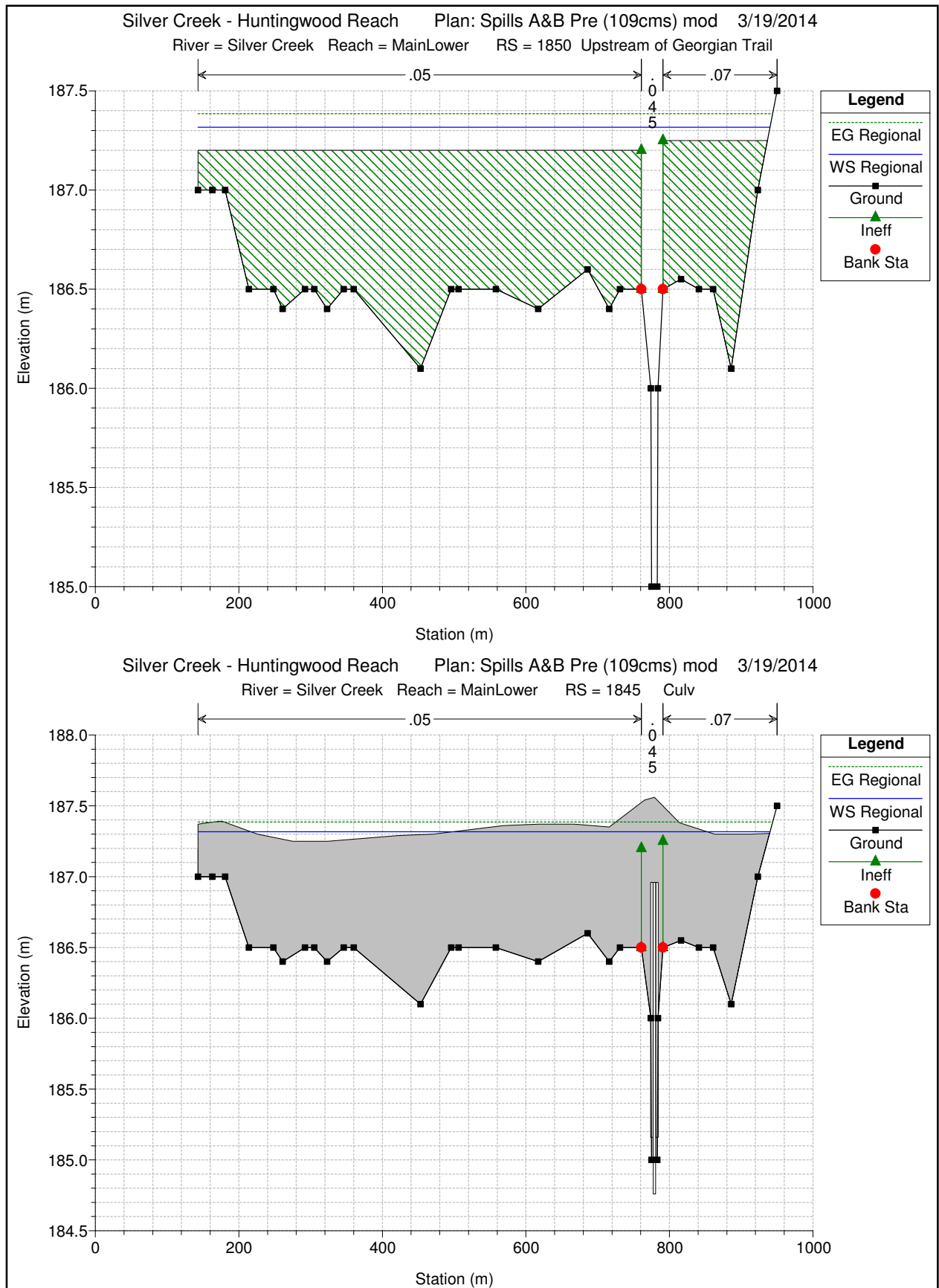
# SPILL 'A' ANALYSIS OUTPUT

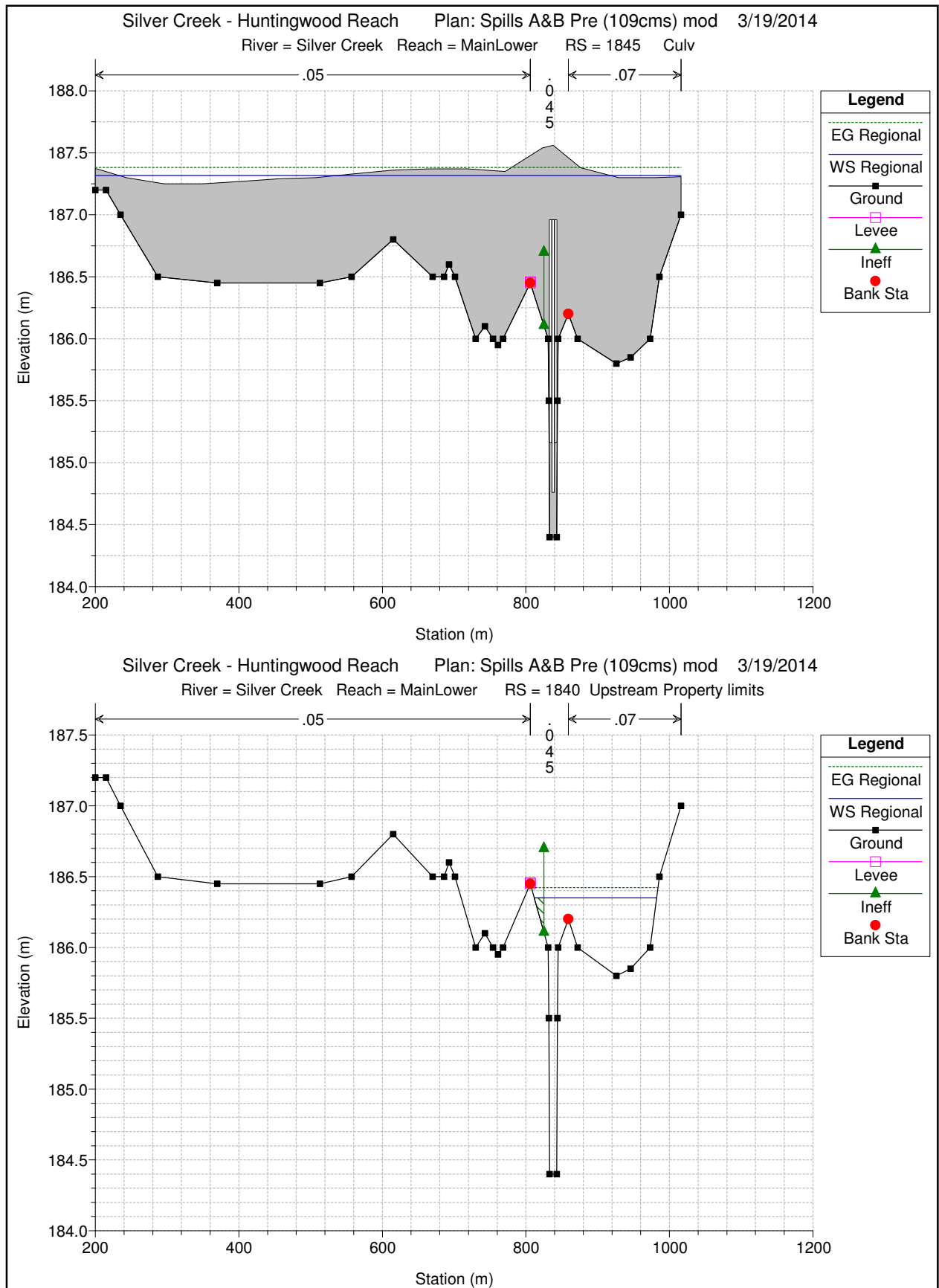
HEC-RAS Plan: A&Bmod Profile: Regional

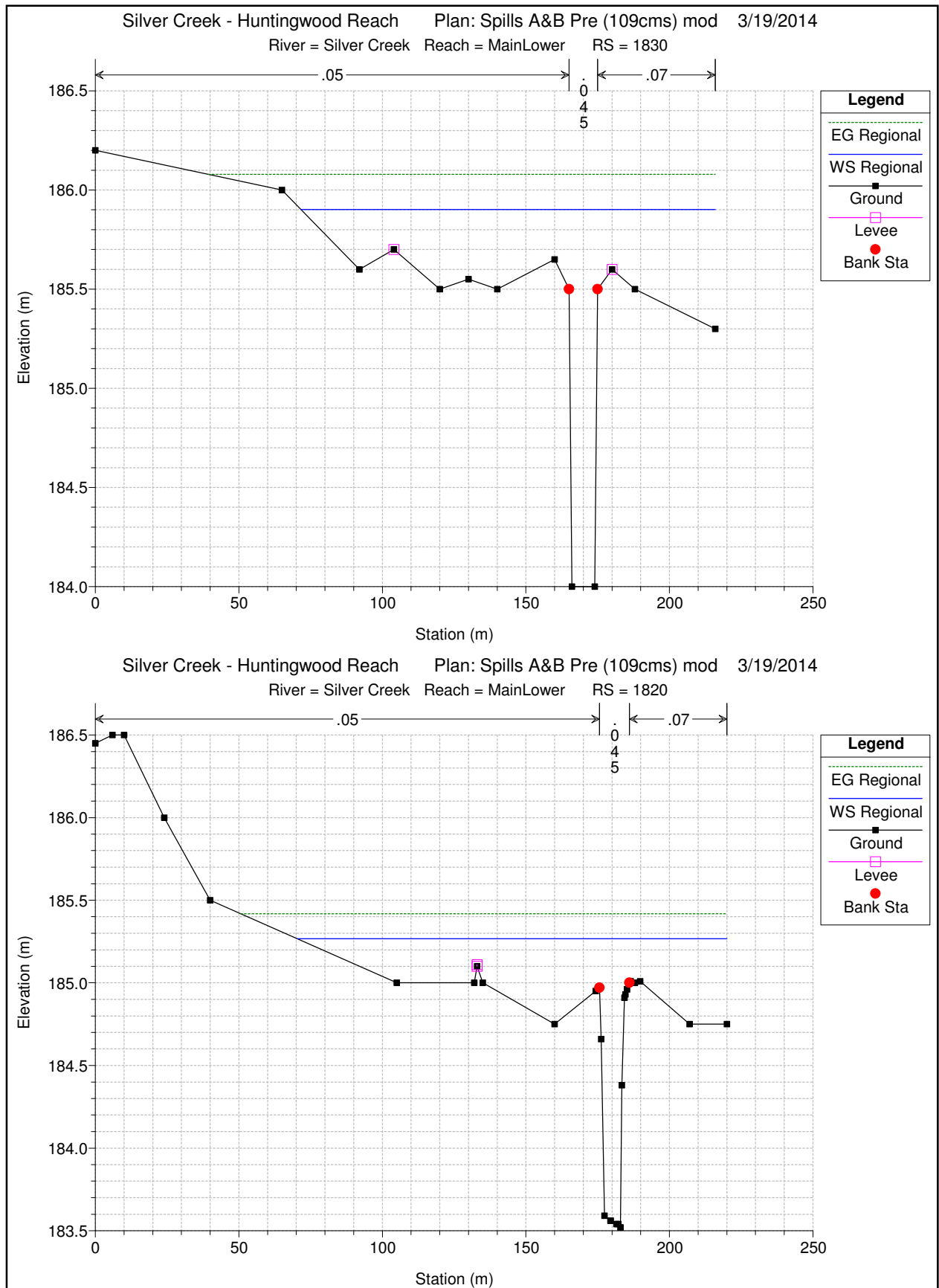
| River        | Reach     | River Sta | Profile    | Q Total<br>(m3/s) | Min Ch El<br>(m) | W.S. Elev<br>(m) | Crit W.S.<br>(m) | E.G. Elev<br>(m) | E.G. Slope<br>(m/m) | Vel Chnl<br>(m/s) | Flow Area<br>(m2) | Top Width<br>(m) | Froude # Chl |
|--------------|-----------|-----------|------------|-------------------|------------------|------------------|------------------|------------------|---------------------|-------------------|-------------------|------------------|--------------|
| Silver Creek | MainLower | 1870      | Regional   | 109.00            | 186.50           | 187.68           |                  | 187.72           | 0.004577            | 1.15              | 129.19            | 179.96           | 0.45         |
| Silver Creek | MainLower | 1865      | Lat Struct |                   |                  |                  |                  |                  |                     |                   |                   |                  |              |
| Silver Creek | MainLower | 1860      | Regional   | 109.00            | 186.00           | 187.53           |                  | 187.53           | 0.000656            | 0.65              | 390.81            | 580.39           | 0.19         |
| Silver Creek | MainLower | 1855      | Lat Struct |                   |                  |                  |                  |                  |                     |                   |                   |                  |              |
| Silver Creek | MainLower | 1850      | Regional   | 74.84             | 185.00           | 187.32           | 186.72           | 187.39           | 0.002243            | 1.32              | 125.18            | 797.08           | 0.35         |
| Silver Creek | MainLower | 1845      | Culvert    |                   |                  |                  |                  |                  |                     |                   |                   |                  |              |
| Silver Creek | MainLower | 1840      | Regional   | 74.79             | 184.40           | 186.35           | 186.20           | 186.42           | 0.005841            | 1.48              | 79.89             | 170.53           | 0.52         |
| Silver Creek | MainLower | 1830      | Regional   | 74.79             | 184.00           | 185.90           | 185.90           | 186.08           | 0.006764            | 2.40              | 62.68             | 144.33           | 0.58         |
| Silver Creek | MainLower | 1825      | Lat Struct |                   |                  |                  |                  |                  |                     |                   |                   |                  |              |
| Silver Creek | MainLower | 1820      | Regional   | 68.55             | 183.52           | 185.27           | 185.27           | 185.42           | 0.009952            | 2.39              | 55.81             | 149.61           | 0.68         |
| Silver Creek | MainLower | 1815      | Lat Struct |                   |                  |                  |                  |                  |                     |                   |                   |                  |              |
| Silver Creek | MainLower | 1810      | Regional   | 52.46             | 182.32           | 184.11           | 184.11           | 184.29           | 0.006642            | 2.18              | 41.66             | 109.12           | 0.57         |
| Silver Creek | MainLower | 1805      | Lat Struct |                   |                  |                  |                  |                  |                     |                   |                   |                  |              |
| Silver Creek | MainLower | 1800      | Regional   | 46.26             | 181.89           | 183.62           |                  | 183.69           | 0.004504            | 1.55              | 50.64             | 135.27           | 0.47         |
| Silver Creek | MainLower | 1795      | Lat Struct |                   |                  |                  |                  |                  |                     |                   |                   |                  |              |
| Silver Creek | MainLower | 1790      | Regional   | 42.09             | 181.52           | 183.07           | 183.07           | 183.20           | 0.007207            | 2.09              | 41.68             | 146.49           | 0.58         |
| Silver Creek | MainLower | 1785      | Lat Struct |                   |                  |                  |                  |                  |                     |                   |                   |                  |              |
| Silver Creek | MainLower | 1780      | Regional   | 40.93             | 180.70           | 182.43           | 182.37           | 182.55           | 0.005405            | 1.84              | 40.27             | 107.67           | 0.51         |
| Silver Creek | MainLower | 1775      | Lat Struct |                   |                  |                  |                  |                  |                     |                   |                   |                  |              |
| Silver Creek | MainLower | 1770      | Regional   | 40.88             | 180.58           | 182.05           | 182.05           | 182.17           | 0.009075            | 1.93              | 37.24             | 283.36           | 0.64         |
| Silver Creek | MainLower | 1765      | Lat Struct |                   |                  |                  |                  |                  |                     |                   |                   |                  |              |
| Silver Creek | MainLower | 1760      | Regional   | 35.55             | 180.17           | 181.69           | 181.28           | 181.69           | 0.000761            | 0.54              | 103.47            | 253.74           | 0.18         |
| Silver Creek | MainLower | 801       | Lat Struct |                   |                  |                  |                  |                  |                     |                   |                   |                  |              |
| Silver Creek | MainLower | 785       | Regional   | 30.74             | 179.60           | 181.69           | 180.42           | 181.69           | 0.000020            | 0.15              | 415.65            | 456.09           | 0.03         |
| Silver Creek | MainLower | 775       | Regional   | 30.74             | 179.51           | 181.69           | 180.41           | 181.69           | 0.000020            | 0.15              | 412.73            | 412.74           | 0.04         |
| Silver Creek | MainLower | 755       | Culvert    |                   |                  |                  |                  |                  |                     |                   |                   |                  |              |
| Silver Creek | MainLower | 735       | Regional   | 30.74             | 179.40           | 180.70           | 180.31           | 180.70           | 0.001120            | 0.53              | 125.78            | 823.79           | 0.16         |
| Silver Creek | MainLower | 590       | Regional   | 30.74             | 179.30           | 180.54           | 180.25           | 180.54           | 0.001619            | 0.59              | 128.24            | 662.78           | 0.18         |
| Silver Creek | MainLower | 490       | Regional   | 30.74             | 179.20           | 180.21           | 180.13           | 180.25           | 0.007087            | 1.14              | 53.46             | 438.87           | 0.38         |
| Silver Creek | MainLower | 450       | Regional   | 30.74             | 179.13           | 179.98           | 179.75           | 180.00           | 0.005359            | 0.82              | 69.61             | 234.97           | 0.31         |
| Silver Creek | MainLower | 410       | Regional   | 30.74             | 178.10           | 179.15           | 179.15           | 179.24           | 0.023196            | 1.93              | 38.60             | 201.77           | 0.67         |
| Silver Creek | MainLower | 320       | Regional   | 30.74             | 177.20           | 178.18           |                  | 178.19           | 0.002511            | 0.66              | 93.82             | 235.34           | 0.22         |
| Silver Creek | MainLower | 222       | Regional   | 30.74             | 177.10           | 177.94           |                  | 177.96           | 0.007290            | 0.97              | 76.12             | 311.17           | 0.37         |
| Silver Creek | MainLower | 155       | Regional   | 30.74             | 176.70           | 177.69           |                  | 177.69           | 0.002196            | 0.62              | 103.38            | 341.58           | 0.21         |
| Silver Creek | MainLower | 5         | Regional   | 30.74             | 176.00           | 177.12           | 177.12           | 177.21           | 0.015794            | 1.63              | 44.18             | 266.42           | 0.55         |
| RIVER-1      | Reach-1   | 1830      | Regional   | 0.10              | 185.00           | 185.51           | 185.23           | 185.51           | 0.000002            | 0.01              | 14.73             | 80.61            | 0.01         |
| RIVER-1      | Reach-1   | 1820      | Regional   | 6.33              | 183.50           | 185.02           | 185.02           | 185.04           | 0.122119            | 0.51              | 12.32             | 371.92           | 0.90         |
| RIVER-1      | Reach-1   | 1810      | Regional   | 22.43             | 183.00           | 183.66           |                  | 183.67           | 0.001903            | 0.33              | 68.55             | 292.91           | 0.17         |
| RIVER-1      | Reach-1   | 1800      | Regional   | 28.63             | 182.75           | 183.37           |                  | 183.40           | 0.010214            | 0.76              | 37.55             | 144.11           | 0.39         |
| RIVER-1      | Reach-1   | 1790      | Regional   | 32.79             | 182.35           | 182.80           |                  | 182.82           | 0.009245            | 0.59              | 55.57             | 197.29           | 0.35         |
| RIVER-1      | Reach-1   | 1780      | Regional   | 33.96             | 181.93           | 182.28           |                  | 182.29           | 0.010642            | 0.55              | 61.55             | 268.48           | 0.37         |
| RIVER-1      | Reach-1   | 1770      | Regional   | 34.01             | 181.40           | 181.96           | 181.69           | 181.97           | 0.003029            | 0.40              | 86.09             | 244.22           | 0.21         |
| RIVER-1      | Reach-1   | 1760      | Regional   | 39.34             | 180.90           | 181.20           | 181.20           | 181.27           | 0.096924            | 1.20              | 32.68             | 231.83           | 1.02         |
| RIVER-1      | Reach-1   | 1750      | Regional   | 44.15             | 179.50           | 180.69           |                  | 180.69           | 0.000853            | 0.24              | 186.30            | 260.80           | 0.09         |
| RIVER-1      | Reach-1   | 1740      | Regional   | 44.15             | 179.20           | 180.67           |                  | 180.67           | 0.000389            | 0.21              | 216.27            | 206.68           | 0.06         |
| RIVER-1      | Reach-1   | 1730      | Lat Struct |                   |                  |                  |                  |                  |                     |                   |                   |                  |              |
| RIVER-1      | Reach-1   | 1720      | Regional   | 27.07             | 179.30           | 180.67           |                  | 180.67           | 0.000200            | 0.14              | 189.61            | 190.66           | 0.05         |
| RIVER-1      | Reach-1   | 1703      | Regional   | 27.07             | 179.40           | 180.66           | 179.78           | 180.66           | 0.000558            | 0.27              | 110.85            | 172.32           | 0.08         |
| RIVER-1      | Reach-1   | 1696.5    | Bridge     |                   |                  |                  |                  |                  |                     |                   |                   |                  |              |
| RIVER-1      | Reach-1   | 1690      | Regional   | 27.07             | 179.76           | 180.61           | 180.17           | 180.61           | 0.002389            | 0.38              | 78.33             | 136.61           | 0.15         |
| RIVER-1      | Reach-1   | 1675      | Regional   | 27.07             | 179.76           | 180.56           | 180.21           | 180.57           | 0.003295            | 0.46              | 71.41             | 140.28           | 0.17         |
| RIVER-1      | Reach-1   | 1648      | Regional   | 27.07             | 179.21           | 180.54           |                  | 180.54           | 0.000671            | 0.24              | 112.75            | 125.09           | 0.08         |
| RIVER-1      | Reach-1   | 1627      | Regional   | 27.07             | 179.34           | 180.51           |                  | 180.52           | 0.001119            | 0.30              | 90.91             | 107.03           | 0.10         |
| RIVER-1      | Reach-1   | 1590      | Regional   | 27.07             | 179.09           | 180.18           | 179.91           | 180.40           | 0.015646            | 2.07              | 13.09             | 85.67            | 0.64         |
| RIVER-1      | Reach-1   | 1570      | Culvert    |                   |                  |                  |                  |                  |                     |                   |                   |                  |              |
| RIVER-1      | Reach-1   | 1560      | Regional   | 27.07             | 178.92           | 180.15           | 179.71           | 180.17           | 0.001250            | 0.50              | 53.62             | 66.31            | 0.18         |
| RIVER-1      | Reach-1   | 1550      | Regional   | 27.07             | 178.80           | 180.13           | 179.62           | 180.15           | 0.003505            | 0.63              | 43.04             | 187.49           | 0.23         |
| RIVER-1      | Reach-1   | 1527      | Regional   | 27.07             | 178.74           | 180.04           | 179.65           | 180.08           | 0.002655            | 0.93              | 29.13             | 217.59           | 0.35         |
| RIVER-1      | Reach-1   | 1505      | Regional   | 27.07             | 178.55           | 180.02           |                  | 180.06           | 0.002069            | 0.88              | 30.71             | 37.06            | 0.31         |
| RIVER-1      | Reach-1   | 1500      | Lat Struct |                   |                  |                  |                  |                  |                     |                   |                   |                  |              |
| RIVER-1      | Reach-1   | 1480      | Regional   | 23.02             | 178.53           | 180.01           |                  | 180.03           | 0.000370            | 0.51              | 44.92             | 33.58            | 0.14         |
| RIVER-1      | Reach-1   | 1461      | Regional   | 23.02             | 178.77           | 180.00           |                  | 180.02           | 0.000693            | 0.62              | 37.07             | 33.45            | 0.19         |
| RIVER-1      | Reach-1   | 1440.1    | Regional   | 23.02             | 178.90           | 179.91           |                  | 179.97           | 0.003420            | 1.15              | 20.88             | 28.11            | 0.40         |
| RIVER-1      | Reach-1   | 1440      | Regional   | 23.02             | 179.30           | 179.63           | 179.63           | 179.73           | 0.034179            | 1.40              | 16.45             | 82.74            | 1.00         |
| RIVER-1      | Reach-1   | 1315      | Regional   | 23.02             | 178.15           | 179.31           |                  | 179.34           | 0.002412            | 0.69              | 33.45             | 66.57            | 0.31         |
| RIVER-1      | Reach-1   | 1274      | Regional   | 23.02             | 178.14           | 179.26           |                  | 179.27           | 0.001060            | 0.68              | 43.60             | 79.81            | 0.23         |
| RIVER-1      | Reach-1   | 1232      | Regional   | 23.02             | 178.48           | 179.17           |                  | 179.21           | 0.002541            | 0.77              | 29.23             | 52.28            | 0.33         |
| RIVER-1      | Reach-1   | 1192      | Regional   | 23.02             | 178.37           | 179.00           |                  | 179.06           | 0.005552            | 1.16              | 23.76             | 68.35            | 0.48         |
| RIVER-1      | Reach-1   | 1149      | Regional   | 23.02             | 178.27           | 178.96           |                  | 178.97           | 0.000846            | 0.45              | 58.49             | 129.29           | 0.19         |
| RIVER-1      | Reach-1   | 1096.2    | Regional   | 23.02             | 178.25           | 178.80           |                  | 178.81           | 0.001298            | 0.46              | 54.66             | 146.57           | 0.22         |
| RIVER-1      | Reach-1   | 1096.1    | Regional   | 23.02             | 178.25           | 178.80           |                  | 178.81           | 0.001299            | 0.46              | 54.64             | 146.56           | 0.22         |
| RIVER-1      | Reach-1   | 1096      | Regional   | 23.02             | 178.25           | 178.80           | 178.57           | 178.81           | 0.001301            | 0.46              | 54.62             | 146.56           | 0.22         |

# SPILL 'A' ANALYSIS OUTPUT

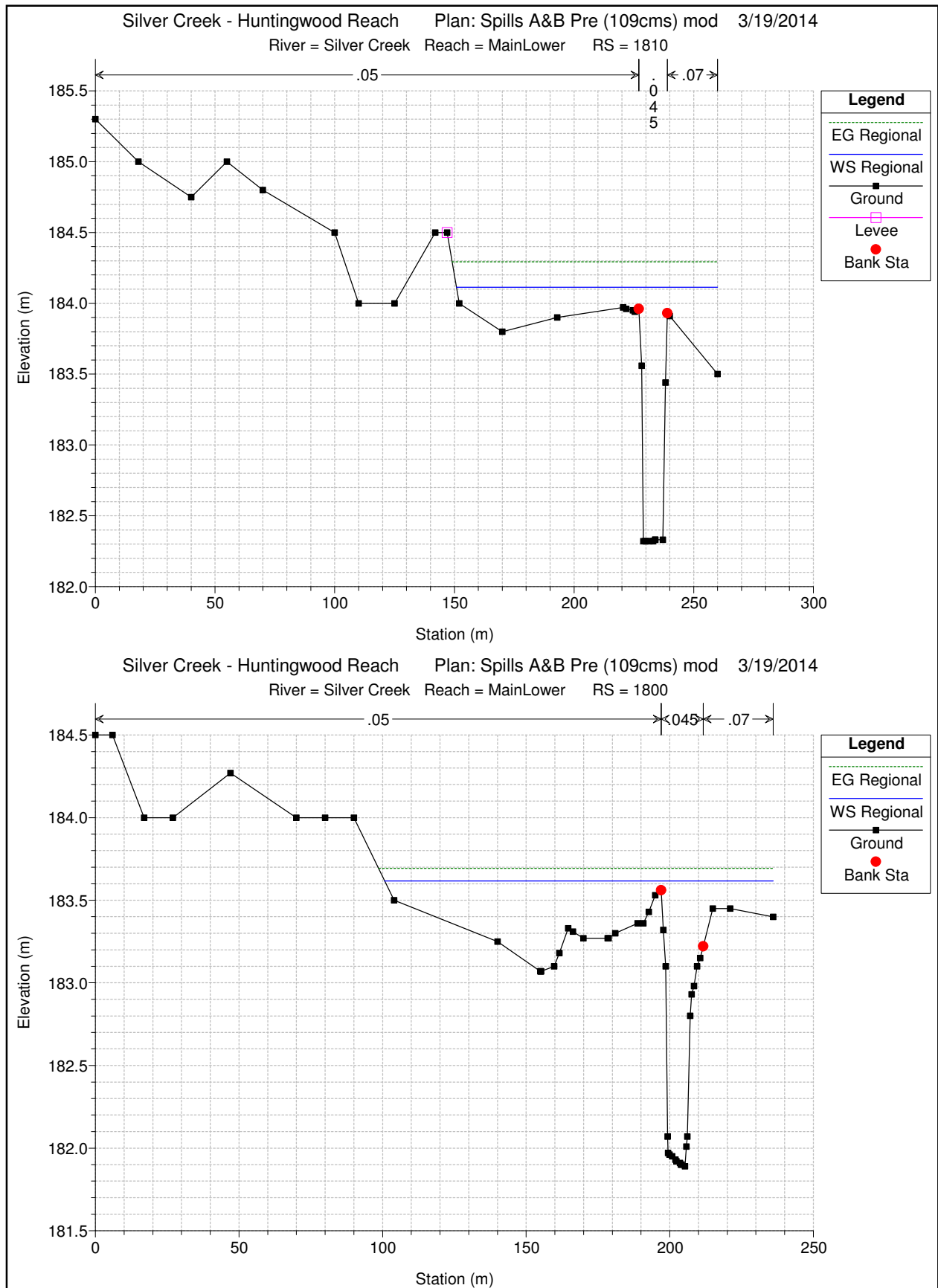


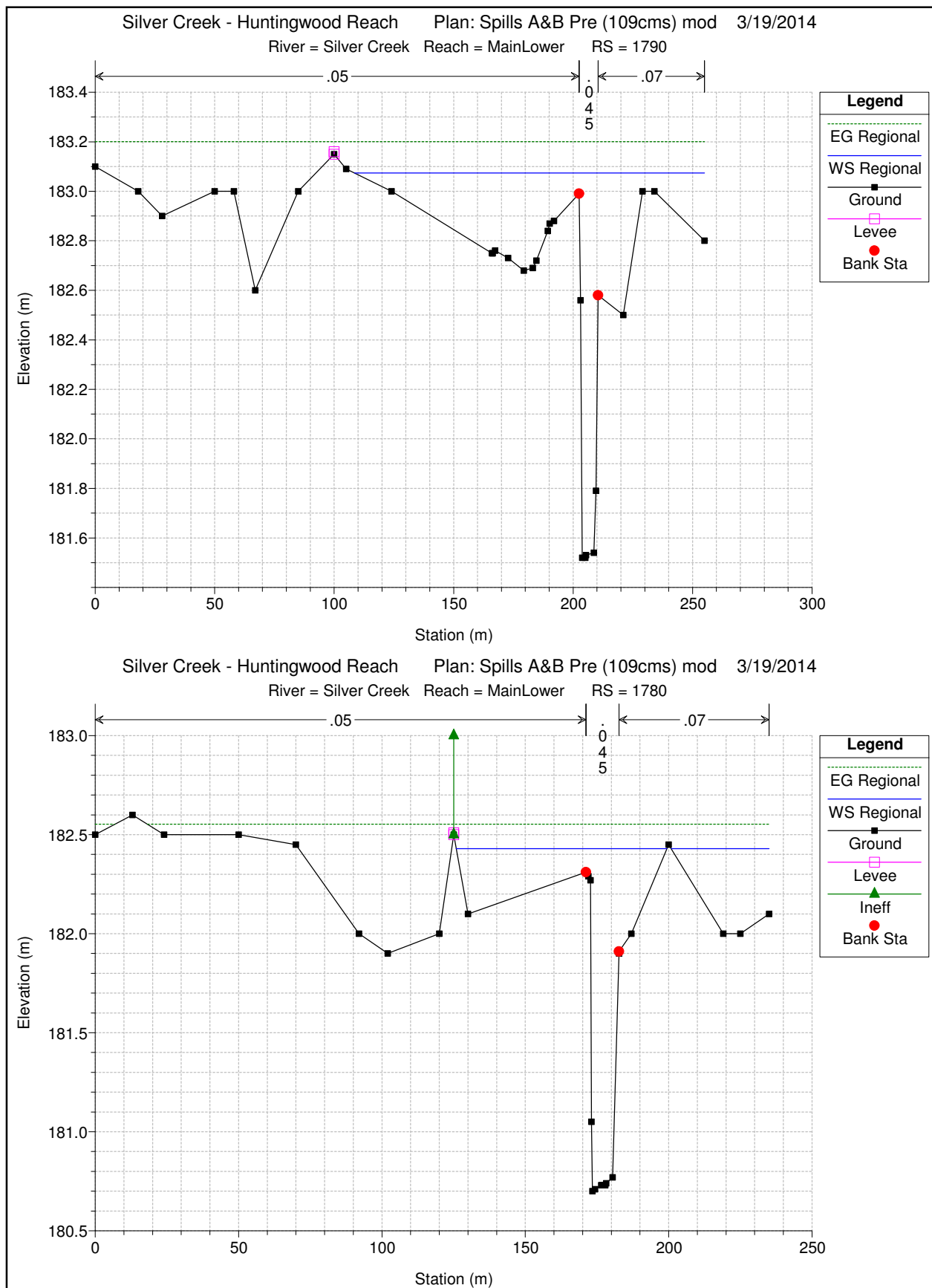


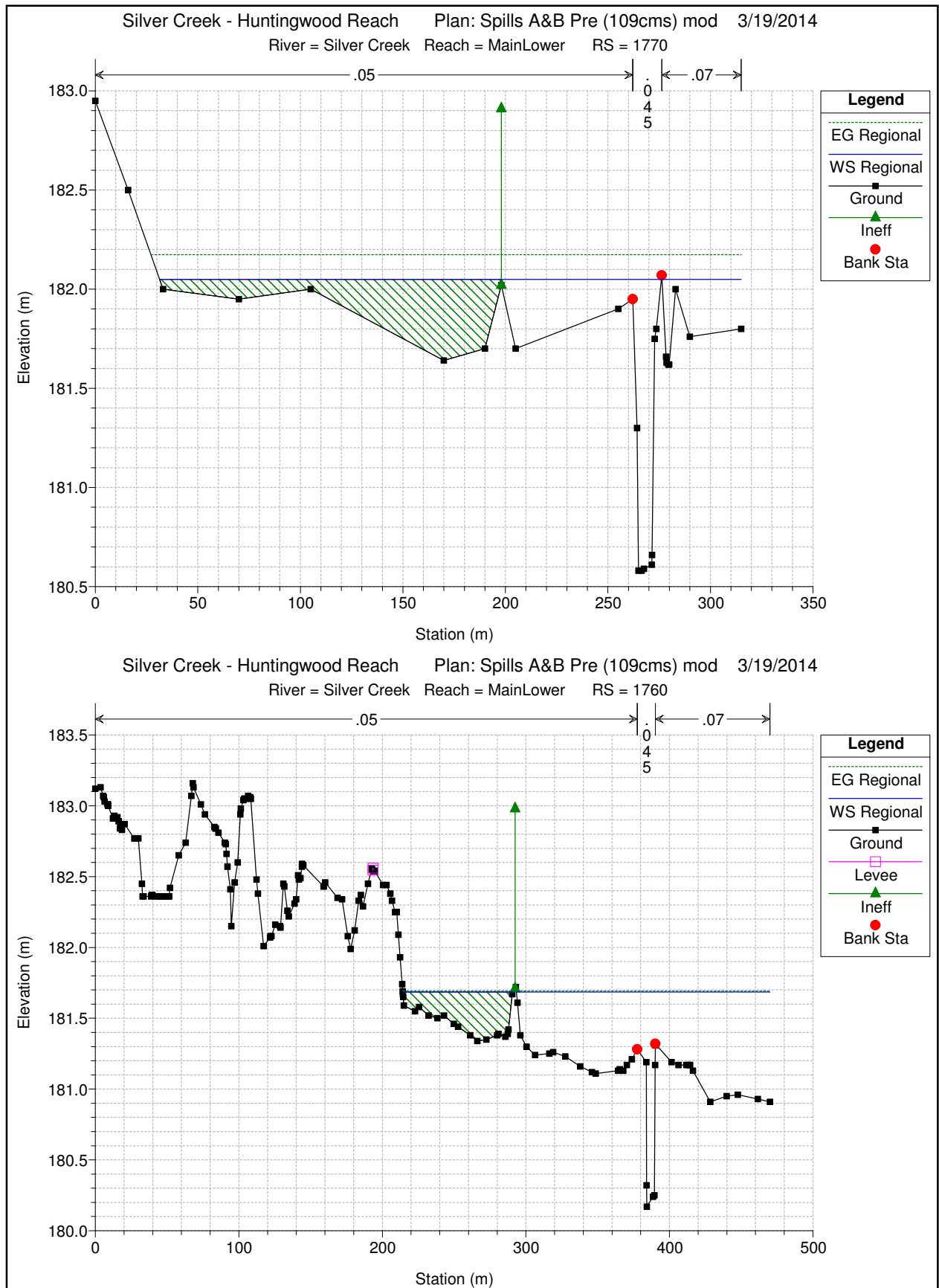


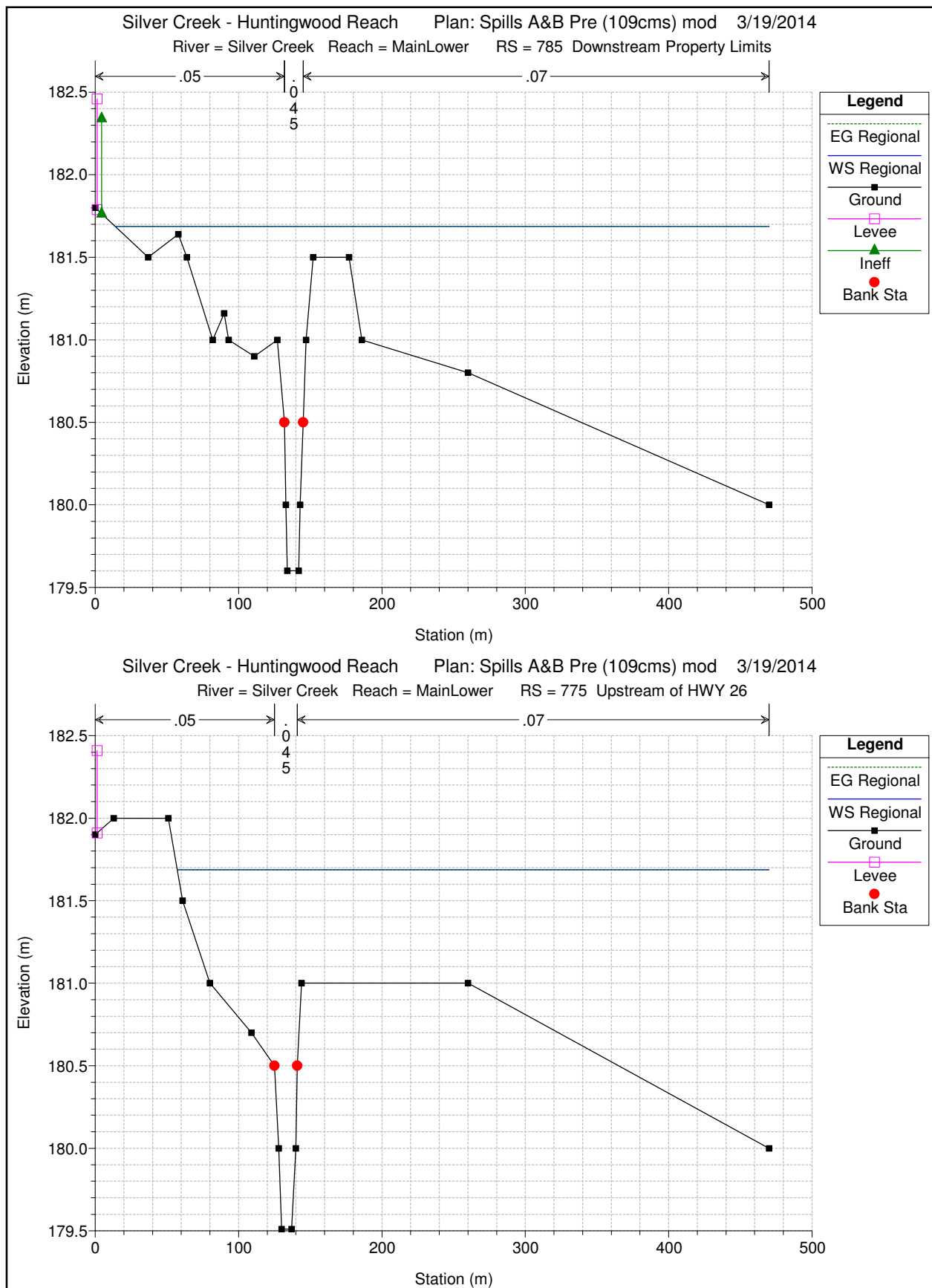


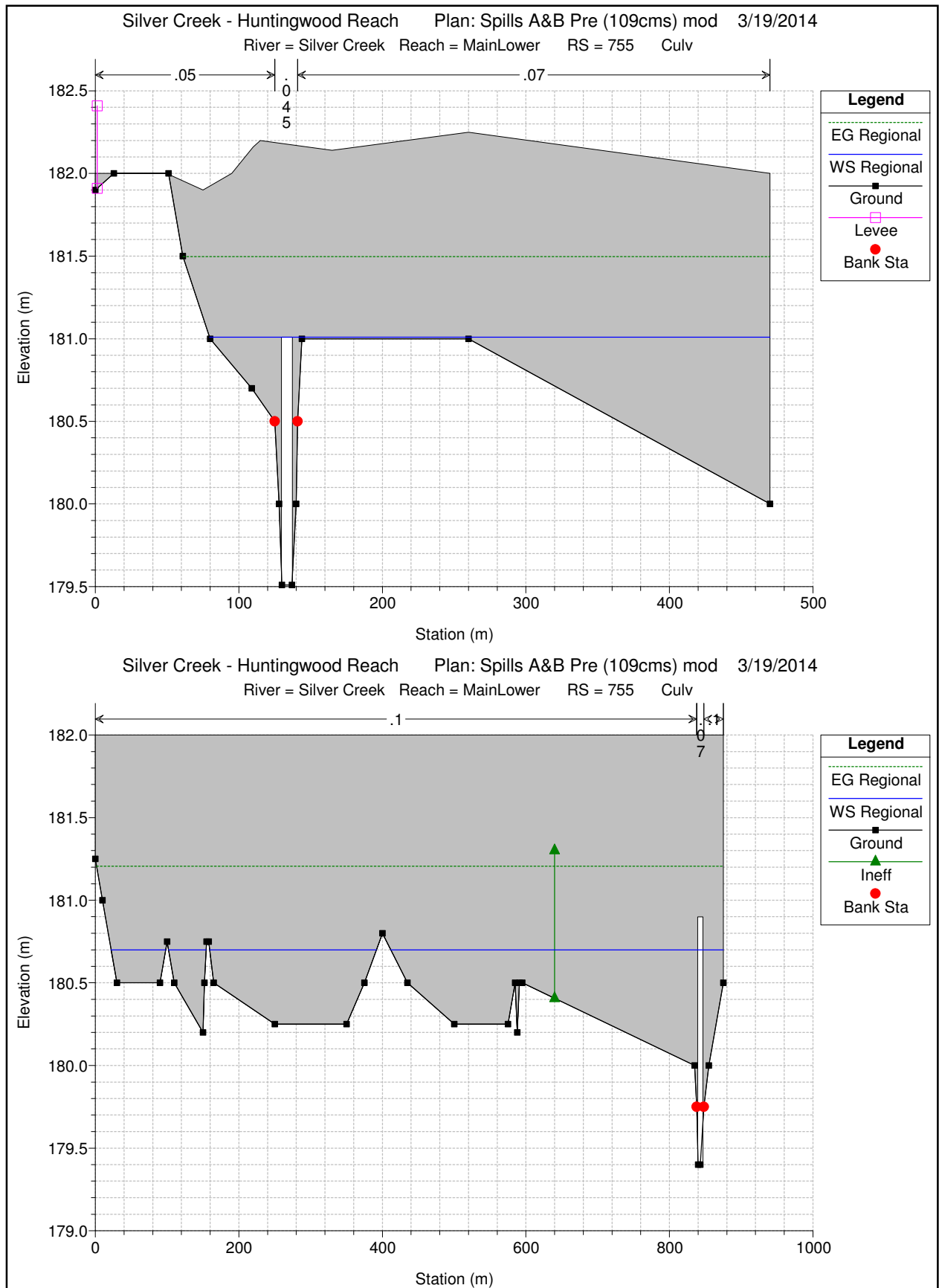


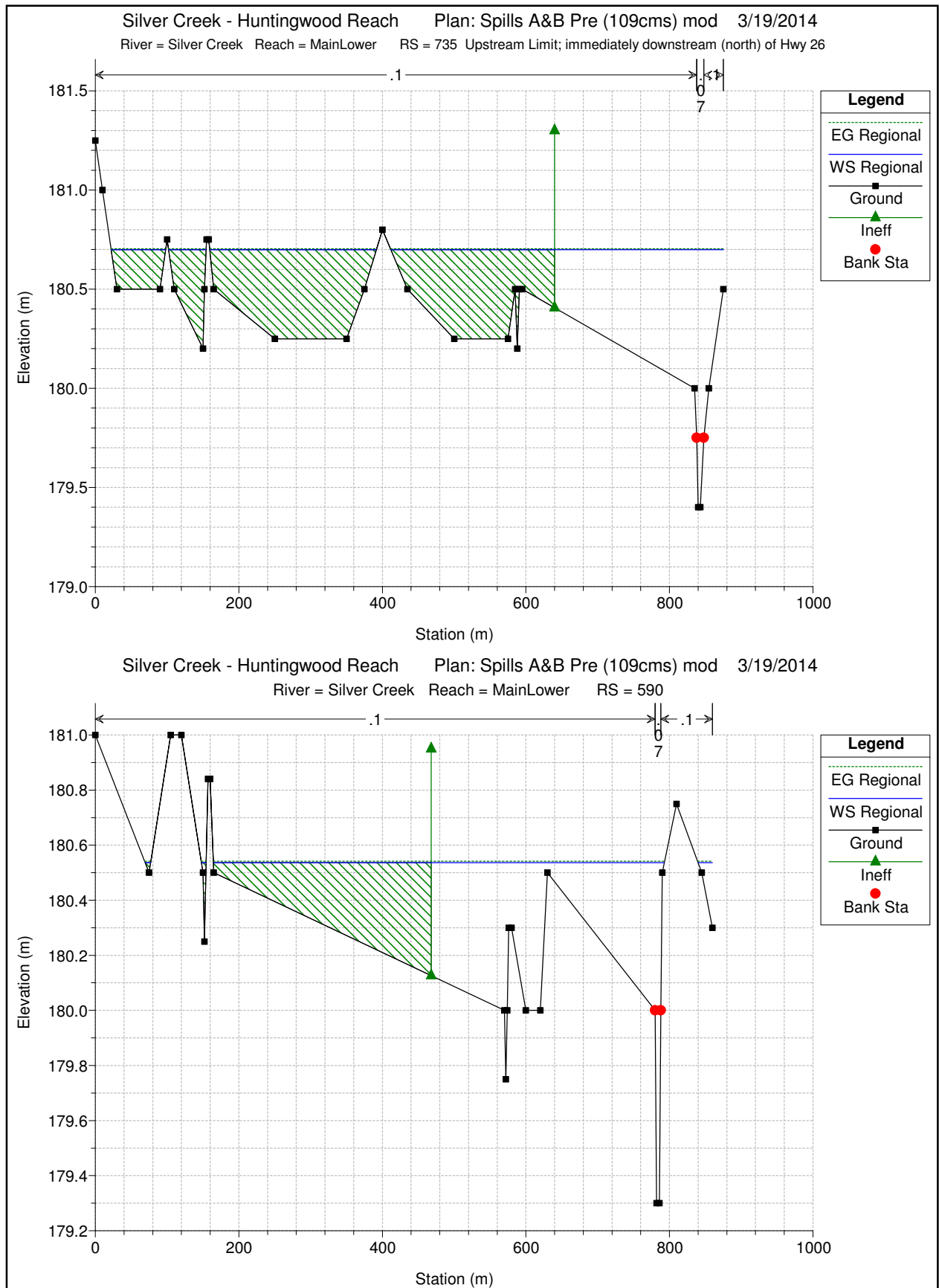


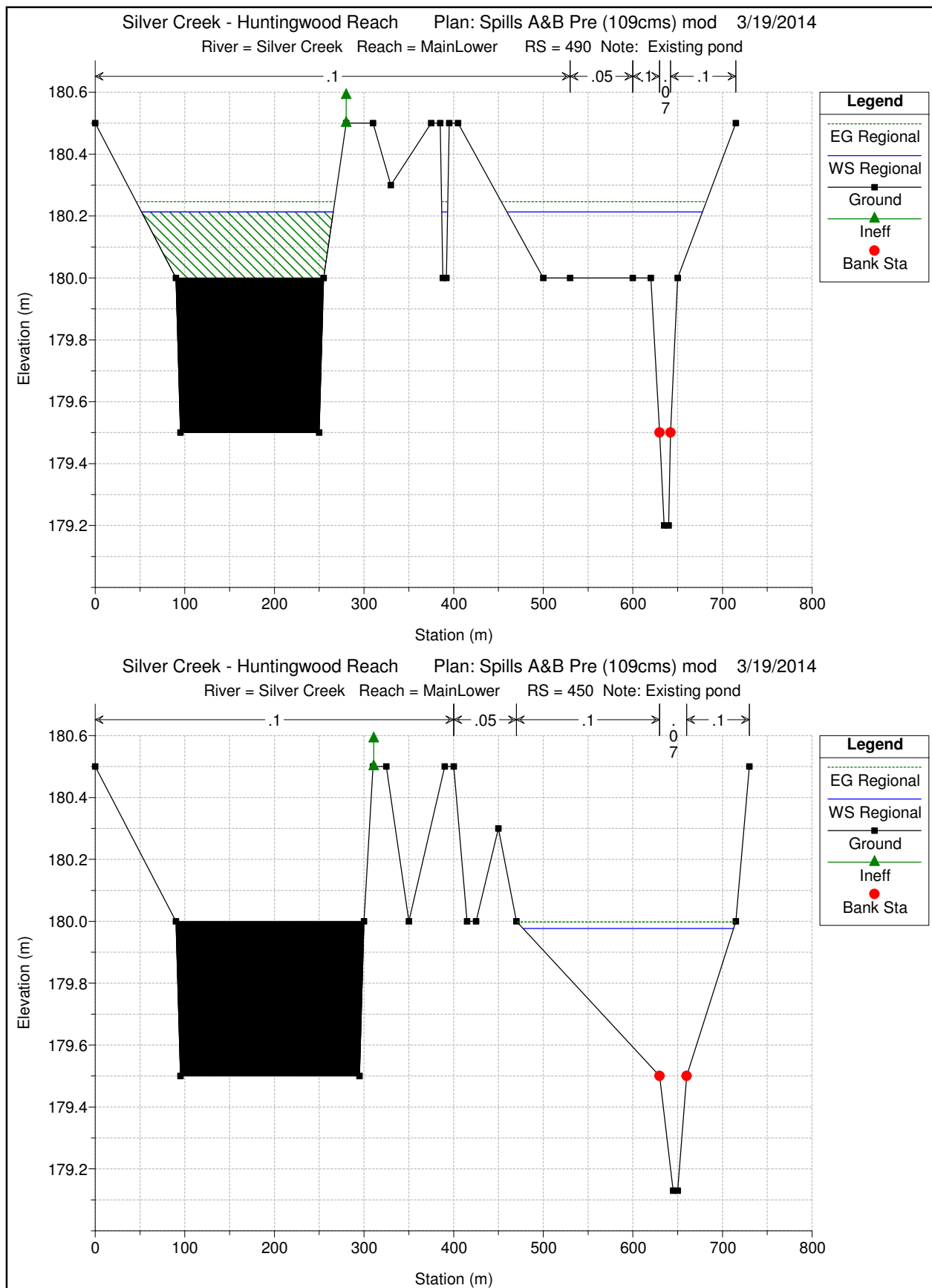


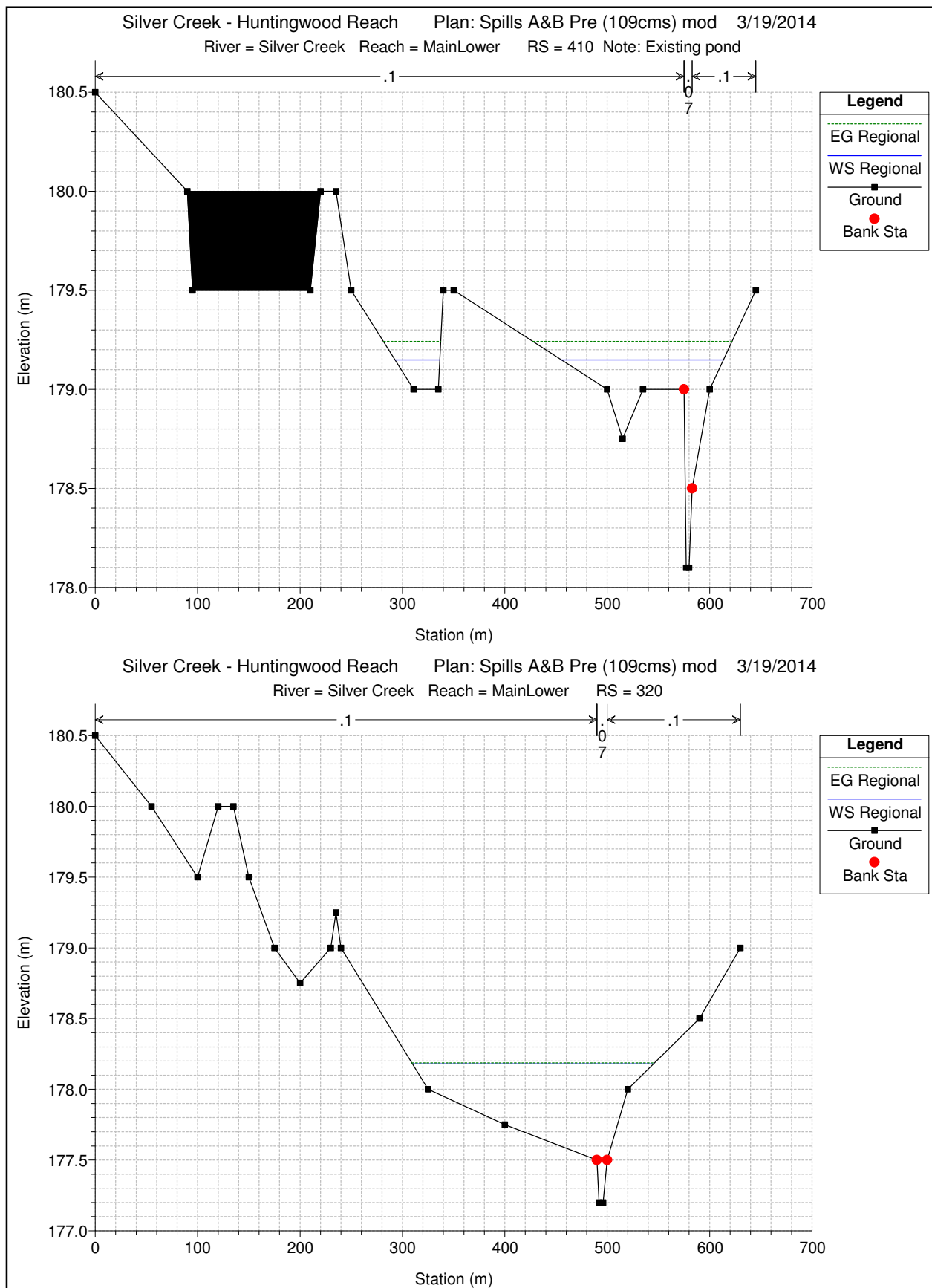




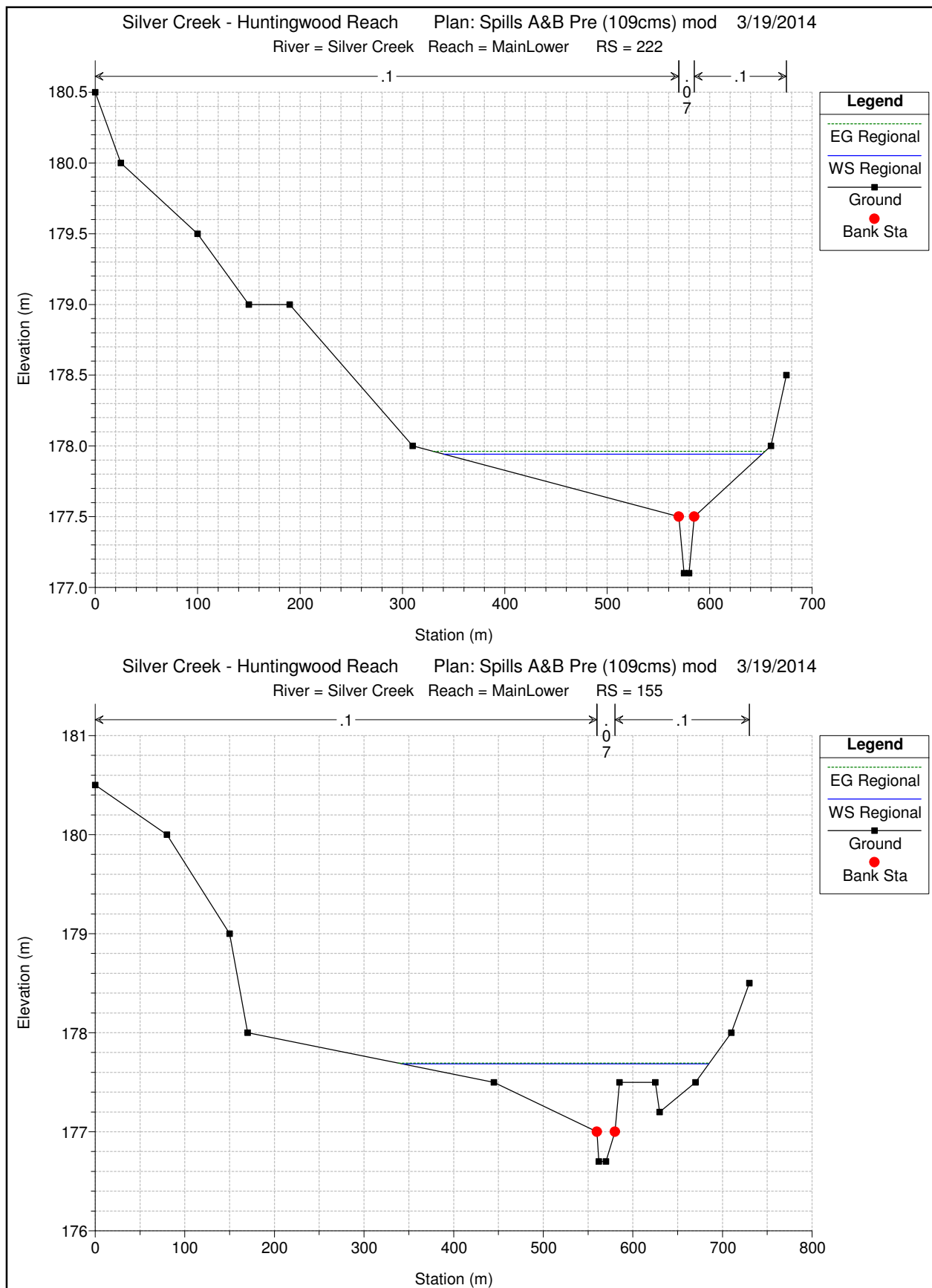






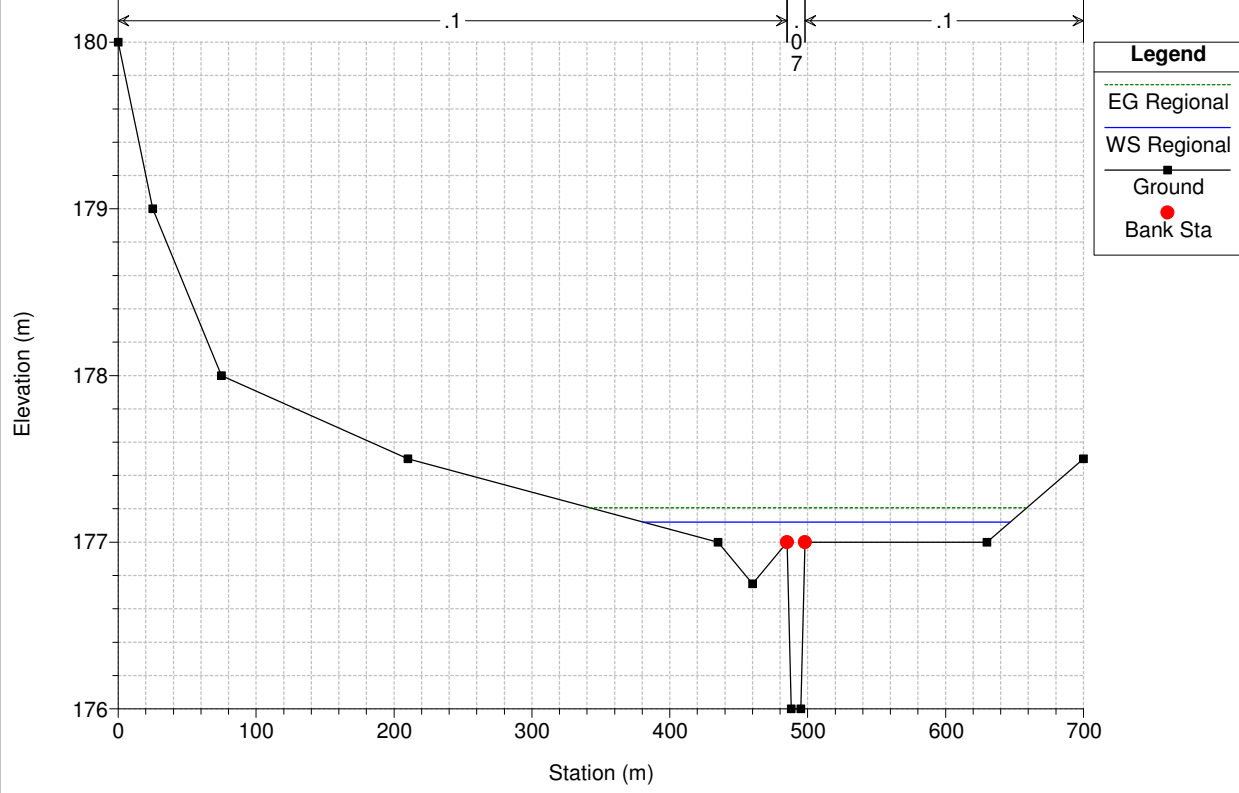






Silver Creek - Huntingwood Reach Plan: Spills A&B Pre (109cms) mod 3/19/2014

River = Silver Creek Reach = MainLower RS = 5 Downstream limit; Georgian Bay



## FIGURES

- Figure 1:** Site Location
- Figure 2:** Concept Plan
- Figure 3:** Existing Conditions Natural Hazard Limits Plan
- Figure 4:** Post-Development Conditions Natural Hazard Limits Plan

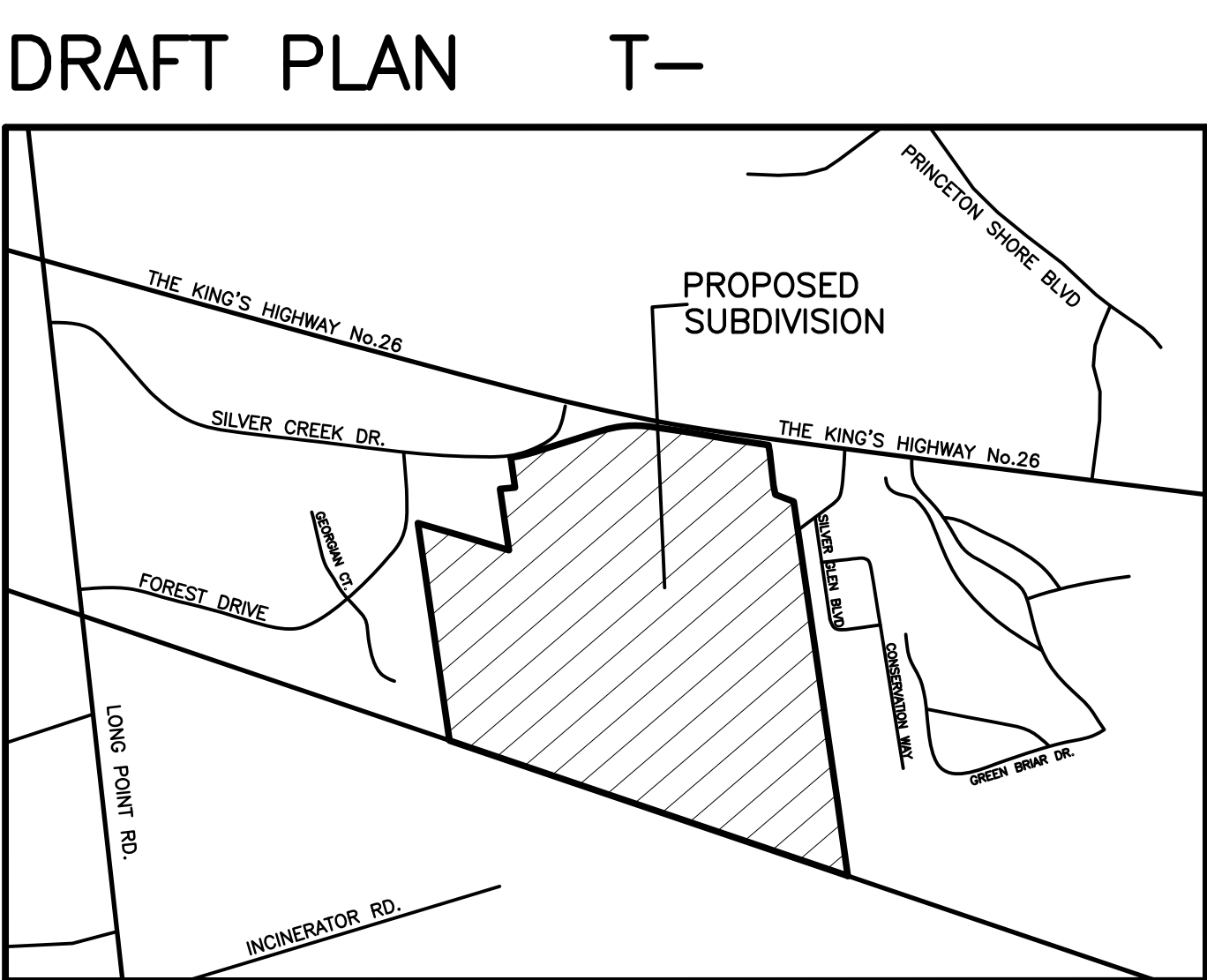
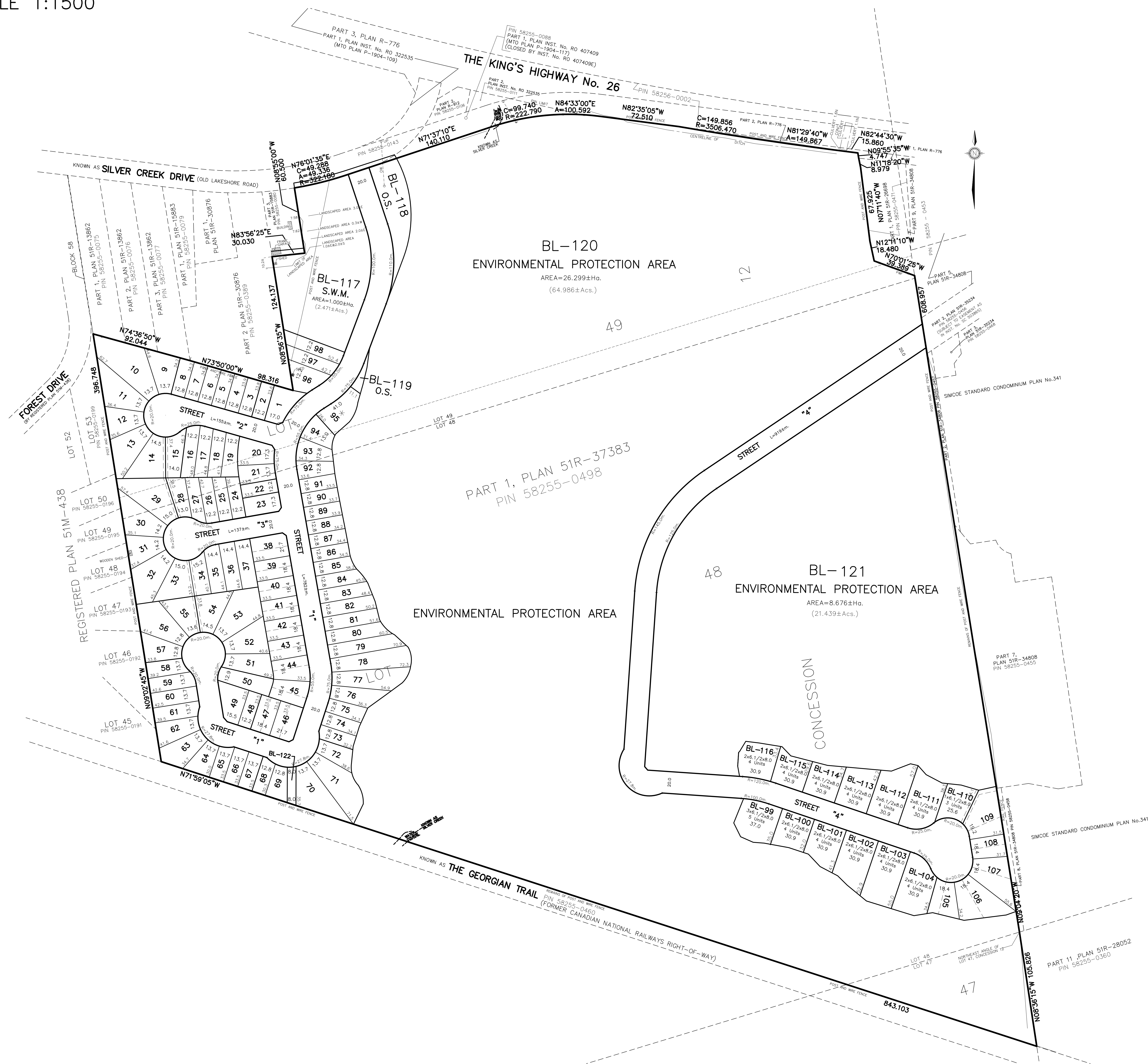


|          |                                                |  |  |                                                                                                                                                                                                                                                                                                              |           |            |          |          |         |        |
|----------|------------------------------------------------|--|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|------------|----------|----------|---------|--------|
| Project  | HUNTINGWOOD DEVELOPMENT<br>TOWN OF COLLINGWOOD |  |  | <div><div><b>CROZIER &amp; ASSOCIATES</b><br/>Consulting Engineers</div></div> <div>110 PINE STREET,<br/>COLLINGWOOD, ON L9Y 2N9<br/>705 446-3510 T<br/>705 446-3520 F<br/>WWW.CFCROZIER.CA<br/>INFO@CFCROZIER.CA</div> |           |            |          |          |         |        |
| Drawing  | SITE LOCATION                                  |  |  |                                                                                                                                                                                                                                                                                                              |           |            |          |          |         |        |
| Drawn By |                                                |  |  | J.E.                                                                                                                                                                                                                                                                                                         | Design By | J.E.       | Project  | 281-2769 |         |        |
| Scale    |                                                |  |  | N.T.S.                                                                                                                                                                                                                                                                                                       | Date      | 07/29/2019 | Check By | J.P.     | Drawing | Fig. 1 |



DRAFT PLAN OF SUBDIVISION  
PART OF LOTS 47, 48 AND 49, CONCESSION 12  
TOWN OF COLLINGWOOD  
(GEOGRAPHIC TOWNSHIP OF NOTTAWASAGA)  
COUNTY OF SIMCOE

SCALE 1:1500



KEY PLAN N.T.S.

SECTION 51, PLANNING ACT,  
ADDITIONAL INFORMATION

- A. AS SHOWN ON DRAFT PLAN
- B. AS SHOWN ON DRAFT PLAN
- C. AS SHOWN ON DRAFT PLAN
- D. SEE SCHEDULE OF LAND USE
- E. AS SHOWN ON DRAFT PLAN
- F. AS SHOWN ON DRAFT PLAN
- G. AS SHOWN ON DRAFT PLAN
- H. MUNICIPAL PIPED WATER AVAILABLE AT TIME OF DEVELOPMENT
- I. CLAY-LOAM
- J. AS SHOWN ON DRAFT PLAN
- K. SANITARY AND STORM SEWERS, GARBAGE COLLECTION, FIRE PROTECTION
- L. AS SHOWN ON DRAFT PLAN

SURVEYOR'S CERTIFICATE

I HEREBY CERTIFY THAT THE BOUNDARIES OF THE LAND TO BE SUBDIVIDED AS SHOWN ON THIS PLAN, AND THEIR RELATIONSHIP TO THE ADJACENT LAND ARE ACCURATELY AND CORRECTLY SHOWN.

DATE -----, 2019  
DAN DZALDOV  
SCHEFFER DZALDOV BENNETT LTD.  
REGISTERED LAND SURVEYOR  
CONCESSION 12, TOWNSHIP OF NOTTAWASAGA, COUNTY OF SIMCOE, ONTARIO

OWNER'S CERTIFICATE

I AUTHORIZE KLM PLANNING PARTNERS INC. TO PREPARE AND SUBMIT THIS DRAFT PLAN OF SUBDIVISION TO THE TOWN OF COLLINGWOOD FOR APPROVAL.

OWNER  
HUNTINGWOOD TRAILS (COLLINGWOOD) LTD.

152 DALEMOUNT AVENUE  
TORONTO  
ONTARIO  
M6B 3C9  
EDWARD WEISZ  
A.S.O.

SCHEDULE OF LAND USE

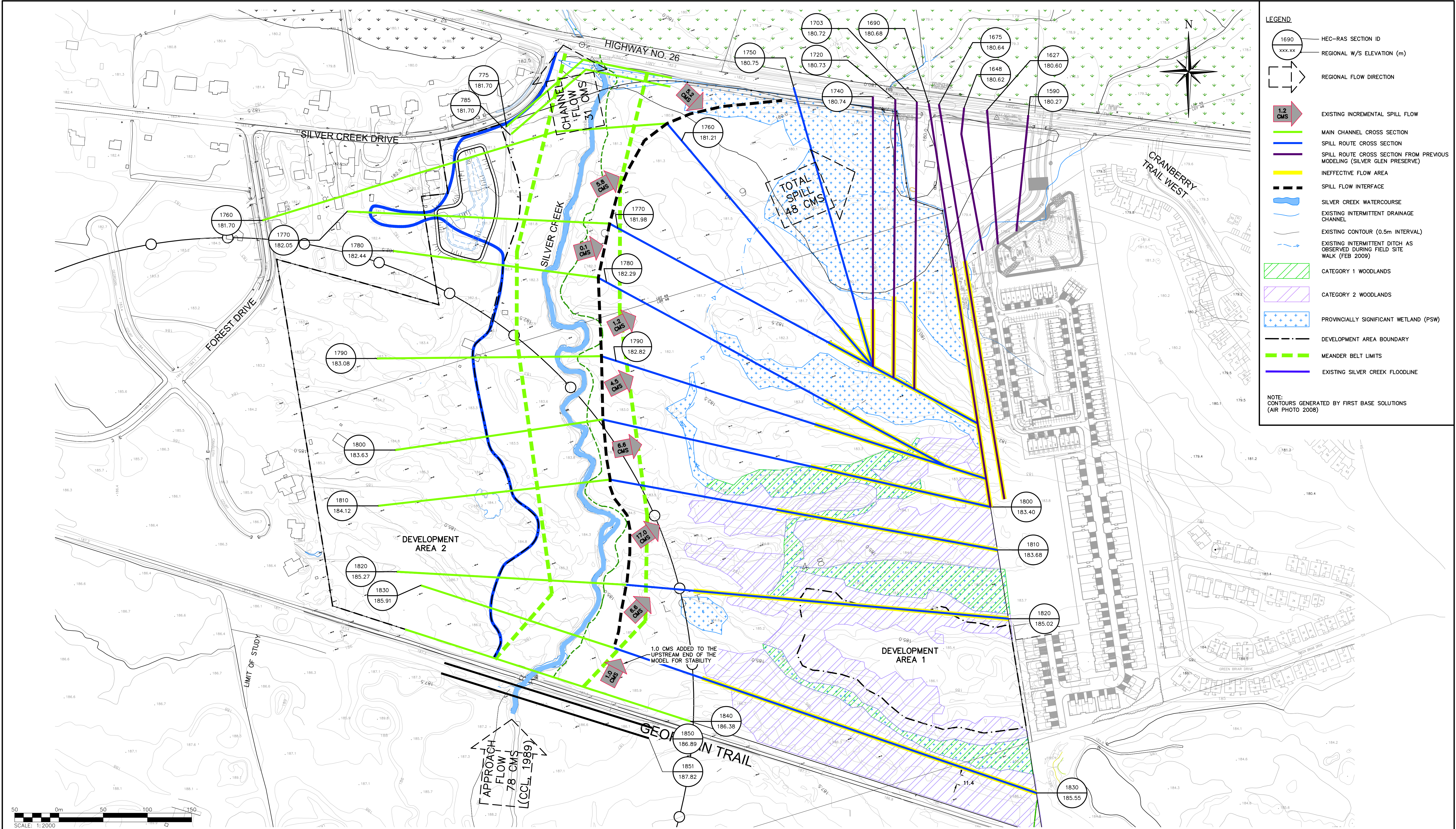
TOTAL AREA OF LAND TO BE SUBDIVIDED = 48.962±Hq. (120.988±Ac.)

| DETACHED DWELLINGS                                                                                               | BLOCKS | LOTS | UNITS | ±Hq.   | ±Ac.    |
|------------------------------------------------------------------------------------------------------------------|--------|------|-------|--------|---------|
| LOTS 1, 9-14, 20, 21, 23, 29-37, 51-54, 58-67, 70-72 and 95<br>MIN. LOT FRONTAGE=13.7m. MIN. LOT AREA=536.8sq.m. |        | 37   | 37    | 3.044  | 7.522   |
| LOTS 3-8, 15, 50, 55-57, 68, 69 and 73-94<br>MIN. LOT FRONTAGE=12.2m. MIN. LOT AREA=401.8sq.m.                   |        | 35   | 35    | 2.052  | 5.071   |
| LOTS 2, 16-19, 22, 24-28, 48, 49 and 96-98<br>MIN. LOT FRONTAGE=12.2m. MIN. LOT AREA=402.8sq.m.                  |        | 16   | 16    | 0.861  | 2.127   |
| SEMI-DETACHED DWELLINGS<br>LOTS 38-47 and 105-109<br>MIN. LOT FRONTAGE=18.0m. MIN. LOT AREA=562.8sq.m.           |        | 15   | 30    | 1.160  | 2.866   |
| STREET TOWNHOUSES<br>BLOCKS 99-104 and 110-116<br>MIN. FRONTAGE 8.1m. MIN. FRONTAGE 8.1m.                        |        | 13   | 52    | 1.624  | 4.013   |
| SUBTOTAL                                                                                                         | 13     | 103  | 170   | 8.741  | 21.599  |
| BLOCK 117 - STORM WATER MANAGEMENT                                                                               | 1      |      |       | 1.000  | 2.471   |
| BLOCKS 118 & 119 - OPEN SPACE                                                                                    | 2      |      |       | 0.233  | 0.576   |
| BLOCKS 120 & 121 - ENVIRONMENTAL PROTECTION AREA                                                                 | 2      |      |       | 34.975 | 86.425  |
| BLOCK 122 - WALKWAY                                                                                              | 1      |      |       | 0.027  | 0.067   |
| STREETS<br>20.0m. WIDE TOTAL LENGTH= 1993m. AREA= 3.986Hq.                                                       |        |      |       | 3.986  | 9.850   |
| TOTAL                                                                                                            | 19     | 103  | 170   | 48.962 | 120.988 |

NOTE - ELEVATIONS RELATED TO CANADIAN GEODETIC DATUM

FIG. 2  
PROJECT No. P-3083  
SCALE 1:1500 JULY 23, 2019  
( 3083DES4 ) X-REF: ( 3083MAS2 & 3083TOPO1 )  
KLM DWG. No. - 19:1  
64 JARDIN DRIVE - UNIT 1B, CONCORD ONTARIO L4K 3P3  
PLANNING PARTNERS INC. TEL: (905) 669-4055 FAX: (905) 669-0097 design@klmplanning.com  
Planning • Design • Development





**LEGEND**

- 1690 HEC-RAS SECTION ID
- xxx.xx REGIONAL W/S ELEVATION (m)
- REGIONAL FLOW DIRECTION
- 1.2 CMS EXISTING INCREMENTAL SPILL FLOW
- MAIN CHANNEL CROSS SECTION
- SPILL ROUTE CROSS SECTION
- SPILL ROUTE CROSS SECTION FROM PREVIOUS MODELING (SILVER GLEN PRESERVE)
- INEFFECTIVE FLOW AREA
- SPILL FLOW INTERFACE
- SILVER CREEK WATERCOURSE
- EXISTING INTERMITTENT DRAINAGE CHANNEL
- EXISTING CONTOUR (0.5m INTERVAL)
- EXISTING INTERMITTENT DITCH AS OBSERVED DURING FIELD SITE WALK (FEB 2009)
- CATEGORY 1 WOODLANDS
- CATEGORY 2 WOODLANDS
- PROVINCIAL SIGNIFICANT WETLAND (PSW)
- DEVELOPMENT AREA BOUNDARY
- MEANDER BELT LIMITS
- EXISTING SILVER CREEK FLOODLINE

**NOTE:**  
CONTOURS GENERATED BY FIRST BASE SOLUTIONS  
(AIR PHOTO 2008)

1. THIS DRAWING IS THE EXCLUSIVE PROPERTY OF C.F. CROZIER & ASSOCIATES INC. AND THE REPRODUCTION OF ANY PART WITHOUT PRIOR WRITTEN CONSENT OF THIS OFFICE IS STRICTLY PROHIBITED.

2. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS, LEVELS, AND DATUMS ON SITE AND REPORT ANY DISCREPANCIES OR OMISSIONS TO THIS OFFICE PRIOR TO CONSTRUCTION.

3. THIS DRAWING IS TO BE READ AND UNDERSTOOD IN CONJUNCTION WITH ALL OTHER PLANS AND DOCUMENTS APPLICABLE TO THIS PROJECT.

4. DO NOT SCALE THE DRAWINGS.

5. ALL EXISTING UNDERGROUND UTILITIES TO BE VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO CONSTRUCTION.

**TEMPORARY BENCHMARKS**

TBM#1—

TBM#2—

TBM#3—

Town

| No. | ISSUE                                       | DATE: MM/DD/YYYY |
|-----|---------------------------------------------|------------------|
| 0   | ISSUED FOR JULY 2019 NATURAL HAZARDS REPORT | 07/29/2019       |
|     |                                             |                  |
|     |                                             |                  |
|     |                                             |                  |
|     |                                             |                  |

Engineer

Engineer

Project

**HUNTINGWOOD TRAILS**  
**TOWN OF COLLINGWOOD**

Drawing

**EXISTING CONDITIONS**  
**NATURAL HAZARDS LIMITS PLAN**

**PRELIMINARY**  
NOT TO BE USED FOR CONSTRUCTION

**CROZIER**  
CONSULTING ENGINEERS

THE HARBOUREDGE BUILDING,  
40 HURON STREET, SUITE 301,  
COLLINGWOOD, ON L9Y 4R3  
705 446-3510 T  
705 446-3520 F  
WWW.CFCROZIER.CA  
INFO@CFCROZIER.CA

Drawn By J.E. Design By J.E. Project 281-2769

Check By J.P. Check By J.P. Scale 1:2000 Drawing FIG 3



