



Environment

Prepared for:
Lockheed Martin Corporation

Prepared by:
AECOM
Latham, NY

2014 Revised Restoration Work Plan

West Branch of Bloody Brook Bloody Brook Voluntary Cleanup Program Onondaga County, New York

August 2014

Prepared for:

Lockheed Martin Corporation
Syracuse, New York

Prepared by:

AECOM Technical Services Northeast, Inc.
40 British American Boulevard
Latham, New York 12110

Contents

1.0 Introduction.....	1
1.1 Site Description.....	1
2.0 Existing Conditions.....	2
2.1 West Branch of Bloody Brook	2
2.2 Wooded Area.....	2
2.2.1 Wetland Delineation	2
2.3 Residential Area.....	3
2.4 Threatened and Endangered Species.....	3
3.0 Restoration Plan.....	4
3.1 WBBB Streambed.....	4
3.2 Wooded Area/ Wetlands.....	5
3.2.1 2014 Fall Planting Season Procedure	6
3.2.2 2015 Spring Planting Season Procedure	7
3.2.3 Care of Planting Stock.....	7
3.3 Residential Area.....	7
4.0 Monitoring.....	8
4.1 WBBB Streambed.....	8
4.2 Wooded Area/ Wetlands Restoration Monitoring	8
4.2.1 Soil Areas	9
4.2.2 Site Vegetation.....	9
4.2.3 Tree/Shrub Survival.....	9
4.2.4 Wetland Restoration Monitoring.....	9
4.3 Residential Area.....	11
4.4 Monitoring Report	11

List of Tables

- 1 Summary of Wetlands Delineated in the Wooded Area of the Remediation Site
- 2 2014 Tree Removal Summary
- 3 Summary of Restoration of Temporary Wetland Impacts Resulting from Site Remedial Activities
- 4 West Branch of Bloody Brook Species Planting Plan: Wetlands and Uplands (Phase 1)
- 5 Plant and Seed Quantity by Habitat Area

List of Figures

- 1 Site Location Map
- 2 Site Area Map
- 3 Proposed Wetland Plan with Existing Mapped Habitat
- 4 Existing Wetland Plan
- 5 2014 Tree Removal Summary Plan
- 6 Proposed Final Grading Plan 1 of 3
- 7 Restoration Details
- 8 Proposed Planting Plan
- 9 Planting Density and Typical Planting Pattern

List of Appendices

- A Armor Analysis Calculation Sheet
- B Restoration Detail Figures (RP Figures)
- C 2014 Project Planning Figures (PP Figures)
- D Hydraulic Analysis West Branch of Bloody Brook
- E Details of Weirs (RD Figures)
- F Proposed Seed Mixes

List of Acronyms and Abbreviations

amsl – above mean sea level

AECOM – AECOM USA, Inc.

cm/s – centimeters per second

CHA – Clough, Harbour & Associates LLP

dbh – diameter at breast height

Drainage District – Bloody Brook Drainage District

Lockheed Martin – Lockheed Martin Corporation

PEM – palustrine emergent wetland
PFO – palustrine forested wetland
PSS – palustrine shrub-scrub wetland
Revised RWP – Revised Restoration Work Plan
Shaw – Shaw Environmental, Inc.
Thruway – New York State Thruway
TOC – total organic content
USFWS – US Fish and Wildlife Service
WBBB – West Branch of Bloody Brook

**2014 REVISED RESTORATION WORK PLAN
WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK**

CERTIFICATION STATEMENT

I, Nickcole M. Evans, P.E., certify that I am currently a NYS registered professional engineer and that this 2014 Revised Restoration Work Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10). This work plan was also prepared in accordance with Paragraph II.B.2 of the Voluntary Cleanup Agreement for Remedial Investigation/Remedial Action between the New York State Department of Environmental Conservation and Lockheed Martin Corporation (Index #: D7-0001-01-09).



Nickcole M. Evans, P.E.
License Number 085978

In accordance with New York State Education Law, it is a violation for any person, unless he is acting under the direction of a licensed professional engineer, to alter this Work Plan in any way.

1.0 Introduction

Lockheed Martin Corporation (Lockheed Martin) has prepared this *2014 Revised Restoration Work Plan* (Revised RWP) in response to comments provided by the New York State Department of Environmental Conservation (NYSDEC) dated July 28, 2014. This Revised RWP describes the restoration activities to be completed in 2014 as a part of the West Branch of Bloody Brook (WBBB) remediation. The remediation, including construction and restoration activities, will be conducted in accordance with a Voluntary Cleanup Agreement between Lockheed Martin and NYSDEC (Index #: D7-0001-01-09, effective July 20, 2002). The remediation includes an approximately 5,000 foot long section of the WBBB, located between the New York State Thruway (Thruway) and Onondaga Lake Parkway, in the Town of Salina and a portion of the Village of Liverpool, Onondaga County, New York as shown on Figure 1. The March 2014 *Construction Work Plan* and the May 2014 *Construction Work Plan Addendum* include the remediation design and summarize the construction work to complete remediation activities at the WBBB site in accordance with the March 2014 *Decision Document*. WBBB remediation is expected to take three years to complete and is scheduled to start in 2014. This Revised RWP summarizes the restoration activities to be completed in 2014.

1.1 Site Description

The WBBB site has been broken into four distinct areas based on land use and characteristics as shown on Figure 2 and described below.

- **Wooded Area** – This portion of the site extends from the Thruway south (downstream) approximately 1,050 feet. This undeveloped area is irregularly shaped and relatively wide (i.e., greater than 150 feet). The wooded area is entirely within the Bloody Brook Drainage District (Drainage District) easement and is owned by the Town of Salina. The Drainage District easement provides Onondaga County personnel permanent access to Bloody Brook for various projects to improve and maintain drainage. Storm water drainage from the surrounding development enters the WBBB from the west via a drainage channel at the southern end of the wooded area.
- **Residential Area** – The residential area surrounds the wooded area commencing at the Thruway and extending downstream of the wooded area with residential properties abutting the Drainage District easement along the WBBB to the downstream side of Floradale Road. Disturbance to properties within the residential area during the 2014 construction activities will be isolated to the residential area commencing at the Thruway and surrounding the wooded area. The residential area located downstream of the wooded area to the downstream side of Floradale Road will not be disturbed during the 2014 construction activities and will not be discussed in this Revised RWP.
- **Apartment Complex Area** – The apartment complex is located on Pearl Street and Town Gardens Drive between the residential properties along Floradale Road and the commercial properties along Old Liverpool Road. This area of the WBBB site is not included in the 2014 construction activities and will not be discussed in this Revised RWP.
- **Commercial/Light Industrial Area** – The commercial/light industrial area extends from Old Liverpool Road to Onondaga Lake Parkway, which is not included in the 2014 construction activities and will not be discussed in this Revised RWP.

2.0 Existing Conditions

AECOM USA, Inc. (AECOM) scientists performed an ecological field survey from October 11 to 15, 2013, at the WBBB site. The survey included the identification of all trees greater than 12 inches diameter at breast height (dbh), habitat mapping, and searches for threatened and endangered species and identification of their potential habitat. Below is a summary of the existing conditions of areas of the WBBB site that will be disturbed during the 2014 construction activities.

2.1 West Branch of Bloody Brook

The WBBB consists of a narrow clay-lined channel with approximately six inches of sediment cover. The channel flow is from north to south and is mainly supported by local surface water runoff including large paved areas. This area is defined as a Confined River with rip-rap gabions directing most of the flow. Evidence of scour along the banks indicates periods of high flow resulting in minimal evidence of potential aquatic vegetation. The residential, apartment complex, and commercial/light industrial areas consist mainly of mowed lawns, trees, asphalt/concrete, and stone drainage all showing no evidence of aquatic vegetation.

2.2 Wooded Area

The wooded area is the largest area to be disturbed (approximately 2.8 acres). The wooded area consists of several vegetation cover types presented below. These areas have been located and defined during the October 2013 ecological survey. A brief summary of each cover type is provided below and the locations of the cover types are shown on Figure 3.

- 1.) Floodplain Forest – This habitat is located to the northwest of the site running along the northern edge of the brook from the Thruway (stream distance marker 0+00 to 4+00). The habitat landscape is dominated by cottonwoods.
- 2.) Mowed Lawns with Trees – This habitat is located on private properties surrounding the proposed excavation areas.
- 3.) Shrub Swamp – This habitat is located in two locations, one south of the Floodplain Forest and north of the WBBB running from stream distance marker 4+00 to 7+00; the other location along the southern edge of the WBBB from the Thruway (stream distance marker 0+00 to 2+50). The area is dominated by red osier dogwood.
- 4.) Reedgrass/Purple Loosestrife Marsh – This habitat is located in the larger northern portion of the WBBB site from stream distance marker 4+00 through 9+00. A common reed, *Phragmites australis*, dominates in the habitat. The density of the reed is hindered by increased ponding.
- 5.) Successional Old Field – This habitat borders the northern edge of the WBBB starting at stream distance marker 6+00 and ending at 8+50. The area is dominated by herbaceous species common to New York State.
- 6.) Successional Shrubland – This habitat is located north of the WBBB beginning at stream distance marker 4+00 and continues between the Successional Old Field and Reedgrass/Purple Loosestrife Marsh to stream distance marker 9+50. The area is vegetated with grey birch (*Betula populifolia*), grey dogwood, and red osier dogwood (*Cornus stolonifera*).

2.2.1 Wetland Delineation

The former course of the stream in the wooded area of the WBBB site was located further to the west of the current stream channel and is now largely dominated by wetlands. Lockheed Martin previously contracted Clough, Harbour & Associates LLP (CHA) to complete a wetland delineation

within a portion of the WBBB site. It included wetlands present in the wooded area of the site. CHA completed its wetland delineation on August 5, 2004 and issued a report dated March 2005. A reassessment of the status of the wetlands was conducted by Shaw Environmental, Inc. (Shaw) in July 2009. From the reassessment, Shaw determined the boundaries of the wetlands were unchanged from the August 2004 delineation. On April 12, 2012, AECOM performed a reassessment of the wetland boundaries to update the existing delineation using the Supplemental Guidance to the US Army Corps of Engineers 1987 Manual for the Northeastern US. Four wetland areas were identified and are summarized in Table 1 and shown on Figure 4. Prior to visiting the site to complete the wetland delineation activities, various maps and sources of background information were reviewed. Based on review of the regional NYSDEC Freshwater Wetland Map, no state wetlands were identified at or in the vicinity of the WBBB site. Additionally, the National Wetland Inventory Map did not identify any federally mapped wetlands at or in the vicinity of the WBBB site. The wetland delineation report is included as Appendix C of the February 2013 *Remedial Action Work Plan*.

2.3 Residential Area

In the residential area, residential properties abut the Drainage District easement. Many of these residences have fences installed on their properties which limit access and separate the Drainage District easement from the residential properties. Existing lawns, vegetation cover, trees, and landscaping features within a residential property will be documented and shown in a preconditions survey to facilitate restoration plans following the completion of the 2014 construction activities.

2.4 Threatened and Endangered Species

The US Fish and Wildlife Service (USFWS) provides a list of Natural Resources of Concern based on geographic coordinates provided. The list of “potential” species identified by USFWS include:

- American Hart's-Tongue Fern – a threatened fern;
- Indiana Bat – an endangered mammal;
- Bog Turtle – a threatened reptile; and
- Eastern Massasauga – a candidate reptile.

A habitat assessment of the site was performed during the site evaluation. No individuals of the “potential” species were observed. The site habitat is not a likely resource for American Hart's-Tongue Fern, Bog Turtle, or Eastern Massasauga.

Indiana Bats utilize dead and dying trees during the summer months. No Indiana Bats were observed during the habitat assessment. Potential trees Indiana Bats may use to roost in the summer months exist within the wooded area. In March 2014, 71 trees associated with the remediation activities proposed to be conducted in 2014 at the WBBB site were leveled. Tree leveling activities included the cutting of trees to a minimum of 3 feet above ground surface and were completed using hand tools and equipment. The activities did not result in any significant soil disturbance. All trees were leveled by March 31 to avoid any potential disturbance to the Indiana Bats. Table 2 and Figure 5 summarize the trees located within the portion of the site that will be disturbed during the 2014 construction activities and identifies those trees that were leveled during the March 2014 activities.

3.0 Restoration Plan

Following completion of soil removal activities, backfilling of excavations will commence. Prior to backfilling, an orange demarcation layer will be placed at the bottom of each excavation. Excavations will be backfilled with imported soil that meet the requirements of NYSDEC DER-10 Section 5.4(e). Excavations will be restored to the approximate grades shown on Figure 6. Final grading is subject to input from land owners and New York State Agencies. However, a minimum of two feet of clean backfill will be placed over all excavated areas.

Site restoration activities for 2014 will consist of backfill and restoration of the WBBB stream bed, wooded area, wetlands, and residential property. Where applicable, restoration activities will be discussed with property owners, Onondaga County, and NYSDEC. Specific details of restoration activities on private property will be coordinated with the owner. The following sections describe the restoration activities to be completed for each of the areas. Modifications to the restoration activities will be reviewed and approved by NYSDEC prior to implementation.

3.1 WBBB Streambed

Removed sediment within the WBBB will be replaced with a six-inch stone layer to control erosion only as needed. The channel will be replaced to the existing width and elevation, as practicable. A flow calculation (shown in Appendix A) was completed to determine projected flows through the WBBB. The projected flow has been used to establish final foundation and grading throughout the channel. Additional stone will be placed along some of the slopes of the soils immediately adjacent to the WBBB to reduce the potential for future erosion of up-gradient soils into the brook. Proposed WBBB restoration elevations and details to be completed in 2014 are shown on Figures RP, included as Appendix B of this Revised RWP.

The side slopes will be protected with approximately 6 inches of 2- to 4-inch stone to an elevation above ordinary high water. The bottom of the streambed will have stone added as needed for stabilization of the side slope.

Clumps of shrubs will be planted at intervals along the stream banks to further stabilize them. Each clump will be comprised of 6 to 10 live stakes of a shrub species (pussy willow, silky dogwood, red-osier dogwood, or similar). Each clump will be planted in the banks at the approximate level of ordinary high water with the individual live stakes extending to the saturated zone of the bank. The live stakes in each clump will be installed on approximately 18-inch centers in two staggered rows parallel to the brook flow. Each live stake clump will extend approximately 6 to 8 feet along the brook with approximately 7 to 8 stakes per group. The shrub clumps will be located on alternating sides of the stream every 50 to 100 feet.

On the outside bank at bends in the brook, larger clumps will be planted. Each shrub clump along the outside of the curve should extend approximately 12 to 16 feet along the brook with approximately 20 to 24 stakes per clump similarly spaced on 18-inch centers in 2 staggered rows. The purpose of the live stake shrubs is to stabilize the banks, improve the habitat value of the stream, provide shade, and decrease thermal loading. Proposed WBBB streambed restoration details are shown on Figure 7.

3.2 Wooded Area/ Wetlands

The disturbed land located in the wooded area is within the Drainage District easement, which is owned by the Town of Salina and managed by Onondaga County. To the extent practicable, these areas will be restored as described below. Site restoration activities will also be approved by the Town of Salina and Onondaga County personnel prior to implementing the proposed restoration. Restoration of the wooded area will include replacement of forest and shrub habitat removed during excavation and re-establishment of the upland, areas outside of the wetlands, and wetland habitat currently present at the WBBB site. Proposed planting details for the wooded area and wetlands to be completed in 2014 are shown on Figure 8 and Figures PP, included as Appendix C of this Revised RWP.

The footprint of the excavated areas in the wooded area will be backfilled and graded to provide two relatively flat areas where wetland habitat will be constructed. Table 3 compares the areas of existing wetland habitat to the areas of wetland habitat proposed for restoration. This represents an upgrade of habitat area and habitat quality. Figure 6 presents the proposed grading plan, and Figures RP (Appendix B) present the proposed grading plan and cross sections for the replacement wetlands. The hydrology of the replacement wetlands will be provided by the WBBB and any groundwater seepage from surrounding uplands.

The watershed of WBBB is approximately 0.99 square miles (634 acres) above the wooded area. A large portion of the watershed is covered with impervious surfaces (i.e., buildings and parking lots) resulting in storm runoff in WBBB that rises quickly in response to precipitation and drops quickly as precipitation ends. Hydrological calculations are provided in Appendix D. The replacement wetlands include a small (0.08 acre) shrub-scrub wetland connected to the WBBB north of the channel near the Thruway. The elevation is set to allow water input frequently at low flood levels and retain approximately 1-foot of water between flood events.

The second constructed wetland will be located in the former stream channel south of the existing WBBB. It will consist of two relatively flat areas stepped down the slope of the former channel and separated by a permanent low weir (Weir #2) to allow water to flow from the upper to the lower wetland areas. A water control weir (Weir #1) will be constructed between the WBBB and the upper wetland set at an elevation to allow flood flow into the wetland complex approximately every 4 weeks during the growing season (385.70 feet above mean sea level [amsl]). An outfall weir (Weir #3) at the bottom of the second wetland will allow overflow from the constructed wetlands to be directed back into WBBB. The elevation of the outfall weir is planned at 381.5 feet amsl. Each wetland will be graded to allow one foot of standing water within designated wetland areas. The water will freely flow from the WBBB during high flows (approximately once or twice per month) and slowly drain into the soils when not fed from the brook. Weirs with riprap will be installed to control the flow of water into and out of the wetland complex and protect the wetland vegetation and soil during high flows. The locations of the proposed weirs are shown on Figures 6 and 8 and Figures RP (Appendix B). Details of the weirs are shown on Figures RD-5 through RD-7, included in Appendix E of this Revised RWP.

The bottom and sides of the constructed wetland will consist of two soil layers totaling 2 feet in thickness over ordinary fill (structural fill) used to backfill the excavated areas (see Figure RD-1 in Appendix E). The desired rate of infiltration is approximately 1 inch per day. The lower 12-inch layer of the wetland liner corresponds to a hydraulic conductivity of $3.1\text{E-}05$ centimeters per second (cm/s) (with a range of $4.0\text{E-}05$ to $2.5\text{E-}05$ cm/s). The soil compaction, measured as standard Proctor maximum dry density, needed to achieve a hydraulic conductivity of $3.1\text{E-}05$ cm/s will depend on the low permeable source used. The compaction information will be determined by geotechnical laboratory tests on the low permeable material selected to be used for the wetland lining.

The compacted low permeability layer installed in the wetland will have 12 inches of non-compacted topsoil installed as a vegetation layer with a total organic carbon (TOC) content of 5 to 10%. In the upland areas, 6 inches of topsoil will be placed over ordinary fill. A number of trees that have been leveled on site will be saved for placement within the wetland as shown on Figure 7 and Figure RD-3 (Appendix E). Approximately 15-25 tree trunks will be preserved ranging from 5-foot to 20-foot in length. Tree trunks will be placed in wetland and upland areas to serve as "large woody debris" in upgrading the wildlife habitat.

The planting plan is presented on Figure 8 and Figures PP (Appendix C), and the planting details are shown on Figures RD-2 and RD-3 (Appendix E). The areas of restored wetland habitat are presented in Table 3. The planting plan of the wetlands has been integrated with the planting plan for restoration of the entire site.

The planting density for trees and shrubs is approximately 981 plants per acre (436 trees per acre and 545 shrubs per acre). Forested areas will be planted with a shrub understory. Emergent wetlands will be seeded with a wetland seed mix. Forested and shrub/scrub wetlands will also be seeded with a wetland seed mix to provide an emergent wetland cover as the trees and shrubs grow.

To provide a natural look to the forested and shrub/scrub plantings, trees and shrubs shall be placed in random with no identical tree or shrub placed directly next to its equal. A species planting plan and plant quantities by habitat area are provided in Tables 4 and 5, respectively. Plant density and a typical planting pattern are shown on Figure 9. Suggested upland and wetland seed mixes are provided in Appendix F.

3.2.1 2014 Fall Planting Season Procedure

After final grading is complete in the upland and wetland areas in the late fall of 2014, the installation of restoration vegetation will begin. Upland areas will be seeded with upland seed mixes as shown on Figure 8 and summarized in Tables 4 and 5. Steep slopes will be protected by installation of wood-wool (excelsior) erosion control mats stitched with biodegradable cotton thread. Excelsior or coconut erosion-control logs will be used to protect the brook and wetland margins as needed. Some areas of upland trees and shrubs may be planted through the erosion control mats in the fall of 2014. Upland tree and shrub planting will be completed during the spring (2015) planting season.

In the fall of 2014, Weir #1, at the top of the wetland complex, will be blocked using sandbags to prevent water within the WBBB from entering the complex. Hydration of the new wetlands will be by precipitation only for the fall/winter planting season. The wetland upstream of Weir #1 (planting area palustrine shrub-scrub wetland [PSS-1]) will be seeded with annual winter rye as a temporary erosion control cover. The wetland downstream of Weir #1 (planting area palustrine emergent wetland [PEM-1]) will be seeded with the emergent wetland seed mix.

Weir #2 will not be blocked with sandbags so that high water in the upstream wetlands may drain to the downstream wetlands in the event of heavy rainfall. The wetland downstream of Weir #2 consists of three planting areas: palustrine forested wetland (PFO-1), PSS-2, and PEM-2. PFO-1 and PSS-2 will be seeded using annual winter rye as a temporary erosion control cover. Area PEM-2 will be seeded with the emergent wetland seed mix. No trees or shrubs will be planted in the PFO-1, PSS-1, or PSS-2 areas during the fall planting season.

Weir #3 will not be covered with stone so that water from the upstream wetlands can flow out over the Bin Block into the WBBB during the fall and winter season.

3.2.2 2015 Spring Planting Season Procedure

During the April-May 2015 spring planting season, wetland trees will be planted in area PFO-1, and wetland shrubs will be planted in areas PSS-1 and PSS-2. Planting of upland areas with trees and shrubs will be completed in spring 2015, as well. The timing of the work will be coordinated between the site engineer and the landscape subcontractor.

The PFO and PSS areas will be planted using a "Pits and Mounds" technique. The PFO area will be planted with a combination of trees and shrubs; the PSS areas will be planted with shrubs only.

The "Pits and Mounds" technique is described as follows:

- The planting grid will be laid out with pin flags or stakes as shown in Figure 9.
- At the planting location, approximately 6 inches of top soil will be removed to form a soil cup; the root ball will be placed in the cup, and topsoil from the surrounding area will be scraped to the ball and tamped into place around the ball forming a mound around the root ball leaving the low scraped area surrounding the mound (Figure 7).

After the trees and shrubs are planted in the wetland areas, the areas will be over-seeded using the wetland seed mix included in Appendix F. After completion of the planting of upland trees and shrubs, reseeding with the upland seed mix included in Appendix F may be necessary to repair damaged areas.

As the spring season progresses the sandbags will be removed from Weir #1 to allow the WBBB to flood the wetlands when it periodically flashes to the Weir #1 elevation. The timing of the removal of sandbags will be coordinated between the site biologist and the site engineer based on spring weather and the condition of the planted stock. The final elevation of Weir #3 will be established by installation of stone in the weir opening to the final working elevation. The timing of the installation of stone at Weir #3 will be coordinated between the biologist and the site engineer based on the spring weather and the condition of the planted stock.

3.2.3 Care of Planting Stock

Planting stock will be thoroughly watered at the nursery before loading for transport to the site. The stock may be transported in enclosed trucks or, if in open trucks, they must be covered with a protective tarp cover. The stock will be transported in batches that can be planted within three days to minimize storage time. Stock held at the site before planting must be stored in the shade and must be watered to prevent desiccation.

3.3 Residential Area

Existing lawns, vegetation cover, trees, and landscaping features within a residential property will be documented and shown in a preconditions survey. Residential properties will be restored as close as practical to existing conditions with consideration for input from the homeowner. Residential areas will be backfilled to existing grade with ordinary fill and a 6 inch layer of topsoil. Residential properties will be restored as close as practical to existing conditions with consideration for input from the homeowner and will include the placement of sod, trees, and plantings similar to what was removed from the area.

4.0 Monitoring

As part of the restoration plan, a monitoring program will be implemented to monitor the success of the restoration plan. The restored areas will be inspected and monitored monthly for the first year after construction to document and fix any occurrence of erosion and to remove invasive species. The inspections shall document any occurrence of erosion and growth of invasive species, with focus on the brook banks and brook bed. The monitoring shall include photographic documentation of the condition of the wetlands after installation and at the end of the first growing season. Beginning in the second growing season, inspections will occur three times per growing season to document that seeded and replanted areas have established new growth. This shall include reforested areas, restored wetlands, and brook banks. Additional inspections shall be made and documented after the occurrence of any significant rainfall event exceeding the 2-year storm (2 inches in 24 hours for Syracuse area).

Findings shall be summarized in inspection reports, including photographs to document observed conditions. Reports shall include recommendations for repair of erosion and for any required replanting, if necessary. Inspection reports shall be submitted to Lockheed Martin and NYSDEC.

Necessary repairs to mitigate erosion shall be made immediately to prevent further loss of soil or sediment. Replanting, if necessary, shall be conducted as soon as favorable planting conditions exist, but no later than the next spring or fall season, whichever is earlier, suitable for the particular plant species.

Erosion control measures shall be removed after vegetation is fully established, as necessary. The following sections describe the monitoring program for each area.

4.1 WBBB Streambed

The streambed will be monitored on an annual basis for 5 years. The inspection will be conducted in the early summer during typical low flow conditions. Conducting monitoring during this time period will allow for more of the stream bed to be easily inspected.

The streambed inspection will consist of a visual inspection of the streambed for erosion of the placed material. If large areas of erosion are observed (i.e., 5 ft² material missing) these areas will be replaced. If areas are identified for replacement, an evaluation will be conducted to determine if the selected material needs to be changed.

4.2 Wooded Area/ Wetlands Restoration Monitoring

The wooded area /wetlands will be monitored on an annual basis for 5 years. Each year an on-site inspection will be completed by a qualified person (e.g., biologist). The information documented during the inspections will be used to calculate the percent survival of the target wetland plant species present versus the total number of plant species present. Target wetland species include those that were planted or seeded during wetland restoration. Corrective measures will be proposed when the survival percentage of the target wetland plant is less than 80% or when invasive species are present within the restored area at a density greater than 5%. Due to the existence of Phragmites stands that will remain in the immediate vicinity of the restored areas, corrective measures will need to be implemented to prevent the spread of Phragmites into the restored area. Recommendations for corrective measures may include adjustments to the wetland hydrology (e.g.,

adjust height of the weirs). In addition, invasive species (e.g., Phragmites) within areas that have been disturbed by the construction activities and restored in accordance to this Revised RWP may be eradicated by physical removal and replacement with target species. Consideration will be given to the eradication of the Phragmites stands in the immediate vicinity of the restored areas to further aid in establishing a more functional wetland and preventing the spread of Phragmites into restored areas. Recommendations for eradication include physical removal, mowing, and application of herbicides.

The two primary variables affecting the ability of the restored wetland to survive and successfully develop as designed are the attainment of the intended hydrologic regime and the ability of the wetland to resist the establishment of undesirable, invasive plant species. These two variables will be evaluated and documented during each inspection.

Following each inspection, a brief report will be prepared detailing the extent of vegetation cover to date, target plant species survival, and discussion of any problems encountered to date. Photographs documenting each site inspection will be taken. Proposed corrective measure activities and a proposed schedule for implementing corrective measures will be made as part of the monitoring report, if necessary. Any proposed corrective measures will be reviewed and approved by NYSDEC prior to implementation.

Inspection of the site will include observations of the soil area, vegetation, fences, piezometers, and general conditions of the site. A site inspection form will be filled out for each inspection. A letter report will also be prepared as a cover to the inspection form along with a photographic log to document conditions.

4.2.1 Soil Areas

During the routine inspections the site will be walked and areas of deterioration, water erosion, subsidence, or ponding will be evaluated. Monthly inspections will be performed during the growing season or after significant rainstorm events.

4.2.2 Site Vegetation

The site vegetation inspections will include inspection of the vegetative cover, trees, and shrubs. The vegetative cover will be inspected to insure that germination is covering all areas and that no large bare spots exist. Trees and shrubs will be inspected to insure that plantings are developing.

4.2.3 Tree/Shrub Survival

At the end of the growing season, the entire site will be walked, and all dead trees to be replaced will be flagged. A count of the number of dead trees for each species will be tallied for the landscape nursery. Shrubs will not be directly counted, but an estimate of the percent mortality will be compiled. In addition, an assessment of the species that had the highest success will be made, and replacements for dead shrubs will be selected from the list of the most successful species. Replacement trees and shrubs will be installed at the fall or spring planting period, depending on stock availability and site/weather conditions. Some dead trees will be left as standing wood habitat and the replacement tree installed nearby.

4.2.4 Wetland Restoration Monitoring

Groundwater levels in the wetlands will be monitored using shallow piezometers installed in four locations at the edge of inundation in the constructed wetlands. Surface water will be monitored using

four staff gauges installed in each of the three constructed wetlands. Progress in germination and growth of vegetation will be monitored using panoramic photographs taken periodically from five permanent photo points established in uplands surrounding the constructed wetlands. The approximate locations of the piezometers, staff gauges, and permanent photo points, are shown on Figures 3 and 8 and on Figures RP (Appendix B). In May or September of each monitoring year, vegetation will be quantitatively documented in each of the three permanent monitoring plots (2 installed in PEM-1 and 1 installed in PEM-2) and 3 monitoring transects. One approximately 50-foot transect is planned for PSS-1, one approximately 100-foot transect is planned for PFO-1, and one approximately 100-foot transect is planned for PSS-2. Each transect will be 2 feet wide. The locations of the monitoring plots and transects are shown on Figure 8, and the procedures for each are discussed in the following sections.

4.2.4.1 Plot Procedure

The 10-foot by 10-foot permanent plots will be marked at the corners with 1-inch PVC pipes or fiberglass posts extending at least 4 feet above the ground surface. The PEM monitoring plots identified in Figure 8 will be divided into nine 1-meter by 1-meter squares using string. The percent cover of foliage of each species of herbaceous vegetation in the square will be recorded for each of the nine squares (bare ground will be included as a cover type). The average percent cover for the entire plot will be calculated and presented along with the results of the individual plots (to show variability). Photos will also be taken of each plot.

4.2.4.2 Transect Procedure

A permanent transect will be established across PSS-1, PSS-2, and PFO-1 as shown in Figure 8. Moving from the wetland edge, each tree and shrub that has a canopy extending into the 2-foot wide transect will be recorded. In addition, the approximate area of canopy (as projected on the ground) will be recorded. The area of coverage for each species will be summed and expressed as a percent coverage of the total transect area. Thus, the data set will include a species frequency count, a coverage area for each individual, a total coverage (square feet) for each species, and a relative coverage as a percent cover. In PFO-1 trees and understory shrubs will be presented separately. The herbaceous layer will be quantified by placement of a 1-meter square at nine randomly selected points along each transect. The herbaceous cover will be quantified as described for the PEM plots:

- The percent cover of foliage of each species of herbaceous vegetation in the square meter will be recorded for each of the nine squares (bare ground will be included as a cover type). The average percent cover for the entire nine square meters will be calculated and presented along with the results of the individual plots (to show variability). Photos will also be taken of each plot.

4.2.4.3 Piezometer Installation

The piezometers will be installed to a depth of 3 to 4 feet below grade. A 2-foot length of 1.25-inch diameter Schedule 80 PVC slotted screen with sufficient riser to extend to grade +3 feet will be installed in the open borehole. A filter pack consisting of commercial quartz sand will be placed in the annular space around the screen to not less than 1-foot above the top of the screen. The remainder of the boring will be filled to grade with bentonite to seal the piezometer from the surface water to allow accurate water level measurements.

4.2.4.4 Staff Gage Installation

A staff gage will be installed on a steel post at four locations in constructed wetlands to monitor surface water present at the time of each monitoring visit. Staff gages will consist of commercially available signposts with measuring gages attached. The measuring gage will be highly visible for measuring the water level at the gage from a distance. The staff gages will be 3.5 feet long and graduated in 100th of foot increments.

Each gage will be affixed to six-foot steel signposts installed in the bed of the impounded area at the desired location. The gages will be installed with the base of the gage (zero point) in contact with the bed of the impoundment area so that the depth of water at that location can be readily measured without the need of conversion.

It is assumed that one of the gaging locations will be tied to the top of the outfall weir (Weir #3) structure and that absolute surface water elevation relative to the established site datum can be determined.

4.2.4.5 Photo Point Installation

Five locations will be selected that provide a panoramic overview of the constructed wetland areas for the purpose of collecting the time sequence of photographs required for the monitoring reports. Steel fence posts will be installed and labeled at each of these five locations to facilitate relocation during future monitoring events.

4.3 Residential Area

Residential areas will be visually inspected annually for a five year period. The inspection will included an evaluation of all plantings and any possible erosion. All plantings in residential areas will be inspected after the first year. Plantings will be replaced until they are successfully established for a period of one year. If erosion is observed, the affected area will be fixed and an evaluation conducted to determine the cause. In some cases an alternative material or plantings may be installed. Any modifications to the restoration will be discussed with the property owner and reviewed and approved by NYSDEC.

4.4 Monitoring Report

Collected data from field monitoring of the restored areas will be evaluated and documented in an annual monitoring report. The report will include a summary of

1. The monitoring activities described above;
2. Findings including photographs to document observed conditions;
3. Recommendations for repair of erosion and for re-plantings, if necessary; and
4. Any activities proposed or completed to correct any restoration failures or issues discovered during the monitoring activities.

TABLES

Table 1
Summary of Wetlands Delineated in the Wooded Area of the Remediation Site
West Branch of Bloody Brook
Bloody Brook Voluntary Cleanup Program
Onondaga County, New York

Wetland ID	Total Area in Square feet (sf)	Emergent Habitat (PEM) (sf)	Shrub-Scrub Habitat (PSS) (sf)	Forested Habitat (PFO) (sf)
Wetland A	334	334	0	0
Wetland B	51,094	43,569	7,525	0
Wetland C	240	240	0	0
Wetland D	8,042	2,768	5,274	0
Total	59,710	46,911	12,799	0

Table 2
2014 Tree Removal Summary
West Branch of Bloody Brook
Bloody Brook Voluntary Cleanup Program
Onondaga County, New York

Tree ID	Species	Figure Location (Column-Row)	Preserved/Leveled	Stem	DBH ¹ of Four Largest Stems (inches)				HEIGHT (feet)	CONDITION ²	CRZ ³ (radial feet from trunk)
					DBH	DBH	DBH	DBH			
T1	norway maple	9C	Preserved	Single	18	--	--	--	40	3	27
T2	silver maple	10D	Leveled	Triple	18	17	12	--	90	4	27
T3	eastern cottonwood	9E	Leveled	Single	24	--	--	--	75	4	36
T4	eastern cottonwood	8E	Preserved	Single	21	--	--	--	100	3	32
T5	eastern cottonwood	7E	Preserved	Single	23	--	--	--	100	3	35
T6	eastern cottonwood	7E	Preserved	Dual	27	21	--	--	100	3	41
T7	eastern cottonwood	7E	Preserved	Single	11	--	--	--	100	3	17
T8	white willow	7E	Preserved	Single	10	--	--	--	80	3	15
T9	eastern cottonwood	7E	Preserved	Single	15	--	--	--	80	3	23
T10	eastern cottonwood	7E	Preserved	Dual	17	13	--	--	100	4	26
T11	eastern cottonwood	7E	Preserved	Single	27	--	--	--	100	4	41
T12	Norway Spruce	6E	Preserved	Single	12	--	--	--	50	3	18
T13	Norway Spruce	6E	Preserved	Single	18	--	--	--	60	3	27
T14	Norway Spruce	6E	Preserved	Single	17	--	--	--	40	3	25
T15	Norway Spruce	6E	Preserved	Single	15	--	--	--	60	3	23
T16	white willow	6E	Preserved	Single	48	--	--	--	80	3	72
T17	eastern cottonwood	6E	Preserved	Single	25	--	--	--	70	3	38
T18	eastern cottonwood	6E	Preserved	Single	13	--	--	--	60	3	19
T19	eastern cottonwood	6E	Preserved	Single	19	--	--	--	70	3	29
T20	eastern cottonwood	6E	Preserved	Single	19	--	--	--	70	3	29
T21	eastern cottonwood	6E	Preserved	Single	14	--	--	--	70	3	21
T22	eastern cottonwood	6E	Preserved	Triple	25	20	18	--	70	4.5	38
T24	box elder	2C	Leveled	Single	13	--	--	--	UNK	3	20
T25	box elder	2C	Leveled	Single	14	--	--	--	UNK	4	21
T26	eastern cottonwood	2D	Preserved	Single	27	--	--	--	45	3	41
T27	eastern cottonwood	2D	Preserved	Single	22	--	--	--	UNK	3	33
T28	eastern cottonwood	2D	Preserved	Single	28	--	--	--	45	4	41
T29	eastern cottonwood	1D	Preserved	Single	19	--	--	--	45	3	29
T30	box elder	1D	Preserved	Triple	19	15	12	--	35	5	29
T31	eastern cottonwood	2D	Preserved	Single	23	--	--	--	45	3.5	35
T32	box elder	2D	Preserved	Single	20	--	--	--	30	4.5	29
T33	box elder	2D	Preserved	Single	17	--	--	--	35	3.5	25
T34	eastern cottonwood	2D	Preserved	Dual	21	16	--	--	45	4	32
T35	eastern cottonwood	2E	Preserved	Single	24	--	--	--	40	5	35
T36	eastern cottonwood	1E	Preserved	Dual	24	20	--	--	40	4.5	36
T37	eastern cottonwood	1E	Preserved	Single	21	--	--	--	40	3	32
T38	eastern cottonwood	1E	Preserved	Single	16	--	--	--	40	3	24
T39	eastern cottonwood	1E	Preserved	Single	24	--	--	--	44	3	36
T39a	eastern cottonwood	1E	Preserved	Single	16	--	--	--	70	3	24
T40	eastern cottonwood	1E	Preserved	Single	14	--	--	--	40	3	21
T41	box elder	2E	Preserved	Dual	21	6	--	--	40	5.5	32
T42	eastern cottonwood	2E	Preserved	Single	26	--	--	--	55	6	39
T43	box elder	2E	Preserved	Single	23	--	--	--	30	5.5	34
T44	eastern cottonwood	2D	Preserved	Single	24	--	--	--	45	4	36
T45	eastern cottonwood	2D	Preserved	Single	20	--	--	--	45	4	30
T46	eastern cottonwood	2D	Preserved	Single	15	--	--	--	45	4	23
T46a	UNK	2D	Preserved	Single	UNK	UNK	UNK	UNK	UNK	UNK	UNK
T47	eastern cottonwood	2D	Preserved	Single	21	--	--	--	55	3	32
T48	eastern cottonwood	2D	Preserved	Triple	19	15	12	--	55	3	28
T49	eastern cottonwood	3D	Preserved	Single	24	--	--	--	50	3.5	36
T50	box elder	2E	Preserved	Single	15	--	--	--	40	4	23
T50a	box elder	2E	Preserved	Single	16	--	--	--	55	3.5	24
T50b	eastern cottonwood	2E	Preserved	Single	25	--	--	--	55	3	38
T51	eastern cottonwood	3E	Preserved	Triple	27	19	14	--	45	3.5	41
T52	eastern cottonwood	3E	Preserved	Triple	25	21	12	--	40	4	38
T53	box elder	3E	Preserved	Single	15	--	--	--	75	4	23
T54	eastern cottonwood	3E	Preserved	Single	26	--	--	--	75	3	39
T55	Norway Spruce	3E	Preserved	Single	18	--	--	--	75	3	27
T56	Norway Spruce	3E	Preserved	Single	15	--	--	--	75	3	23
T57	Norway Spruce	3E	Preserved	Single	15	--	--	--	75	3	23
T58	Norway Spruce	3E	Preserved	Single	13	--	--	--	75	3	20
T59	eastern cottonwood	3E	Preserved	Dual	18	14	--	--	75	4.5	26
T60	box elder	3E	Preserved	Quad	18	18	16	15	75	4	27
T61	eastern cottonwood	3E	Preserved	Single	31	--	--	--	75	3.5	47
T62	eastern cottonwood	3E	Preserved	Single	20	--	--	--	40	6	30
T63	eastern cottonwood	3E	Preserved	Single	13	--	--	--	40	3.5	20
T64	box elder	3E	Preserved	Dual	12	8	--	--	45	4	18
T65	eastern cottonwood	3E	Preserved	Single	19	--	--	--	45	3	29
T66	eastern cottonwood	3E	Preserved	Single	12	--	--	--	40	3	18
T67	eastern cottonwood	3E	Preserved	Dual	31	7	--	--	45	3	47
T68	eastern cottonwood	3D	Preserved	Single	13	--	--	--	40	3.5	20
T69	black walnut	3E	Preserved	Single	17	--	--	--	45	3.5	26
T70	eastern cottonwood	3E	Preserved	Single	18	--	--	--	45	4	26
T71	eastern cottonwood	4E	Preserved	Dual	21	14	--	--	40	3	32
T72	eastern cottonwood	4E	Leveled	Single	34	--	--	--	60	3	51
T73	eastern cottonwood	4E	Leveled	Single	19	--	--	--	40	3	29
T74	eastern cottonwood	4E	Leveled	Single	35	--	--	--	60	4	52
T75	eastern cottonwood	4E	Leveled	Single	17	--	--	--	60	4	26
T76	eastern cottonwood	4E	Leveled	Single	16	--	--	--	60	4	23
T77	black walnut	4E	Leveled	Single	12	--	--	--	60	3	18
T78	eastern cottonwood	4E	Leveled	Dual	25	15	--	--	60	4	38

Table 2
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West Branch of Bloody Brook
Bloody Brook Voluntary Cleanup Program
Onondaga County, New York

Tree ID	Species	Figure Location (Column-Row)	Preserved/Leveled	Stem	DBH ¹ of Four Largest Stems (inches)				HEIGHT (feet)	CONDITION ²	CRZ ³ (radial feet from trunk)
					DBH	DBH	DBH	DBH			
T79	eastern cottonwood	4E	Leveled	Dual	40	15	--	--	60	4	59
T80	white pine	4E	Leveled	Single	12	--	--	--	60	3	18
T81	eastern cottonwood	4E	Leveled	Single	21	--	--	--	60	3	32
T82	eastern cottonwood	4E	Leveled	Single	49	--	--	--	80	4.5	74
T83	weeping willow	1B	Preserved	Single	38	--	--	--	80	4	57
T84	eastern cottonwood	2B	Preserved	Single	25	--	--	--	80	4.5	38
T85	weeping willow	1A	Preserved	Single	38	--	--	--	80	3.5	57
T86	box elder	1C	Leveled	Single	15	--	--	--	80	5	23
T86B	UNK	1C	Leveled	UNK	UNK	UNK	UNK	UNK	UNK	UNK	UNK
T87	box elder	2B	Leveled	Single	15	--	--	--	65	5.5	22
T88	eastern cottonwood	2C	Leveled	Triple	39	33	25	--	50	3.5	59
T89	black walnut	3C	Preserved	Single	15	--	--	--	50	3	23
T90	black walnut	3C	Preserved	Single	21	--	--	--	50	3	31
T91	eastern cottonwood	3C	Leveled	Single	34	--	--	--	55	4	50
T92	eastern cottonwood	3C	Leveled	Single	33	--	--	--	50	4	50
T93	black walnut	4C	Preserved	Single	23	--	--	--	35	3	35
T94	black walnut	4C	Preserved	Single	17	--	--	--	55	3	26
T95	UNK	4D	Preserved	Single	15	--	--	--	15	6	23
T96	black walnut	3C	Leveled	Single	18	--	--	--	55	3	26
T97	black walnut	3D	Leveled	Single	17	--	--	--	55	3	25
T98	box elder	3D	Leveled	Single	16	--	--	--	55	3.4	23
T99	eastern cottonwood	4D	Leveled	Single	24	--	--	--	55	3	36
T100	box elder	4D	Leveled	Dual	17	17	--	--	50	4.5	26
T101	box elder	4D	Leveled	Single	14	--	--	--	30	3	21
T102	box elder	4D	Leveled	Single	16	--	--	--	30	3.5	24
T103	box elder	5D	Leveled	Single	17	--	--	--	30	4	26
T104	eastern cottonwood	5D	Preserved	Single	25	--	--	--	30	3	38
T105	willow (salix sp.)	5E	Leveled	Single	14	--	--	--	30	3	20
T106	eastern cottonwood	5E	Leveled	Single	17	--	--	--	UNK	3	26
T107	eastern cottonwood	5E	Leveled	Single	18	--	--	--	80	3	26
T108	eastern cottonwood	5E	Leveled	Single	20	--	--	--	80	3	30
T109	eastern cottonwood	5E	Leveled	Single	19	--	--	--	80	3	29
T110	eastern cottonwood	5E	Leveled	Single	15	--	--	--	80	3	23
T111	eastern cottonwood	5E	Leveled	Single	25	--	--	--	80	3.5	37
T112	eastern cottonwood	5E	Leveled	Single	21	--	--	--	80	3	32
T113	eastern cottonwood	5E	Leveled	Single	22	--	--	--	80	3	33
T114	eastern cottonwood	5E	Leveled	Single	20	--	--	--	80	3	30
T115	eastern cottonwood	6E	Preserved	Single	19	--	--	--	80	4	29
T116	eastern cottonwood	6E	Preserved	Single	17	--	--	--	80	3	25
T117	eastern cottonwood	6E	Preserved	Single	17	6	--	--	80	3	26
T118	eastern cottonwood	6E	Preserved	Single	25	--	--	--	80	3	38
T119	box elder	5E	Leveled	Dual	13	11	--	--	80	4	20
T120	white pine	5F	Leveled	Single	17	--	--	--	80	6	25
T121	box elder	5F	Leveled	Triple	15	4	3	--	80	5	23
T122	eastern cottonwood	6F	Leveled	Single	34	--	--	--	80	3	51
T123	eastern cottonwood	5F	Leveled	Single	12	--	--	--	80	3	18
T124	eastern cottonwood	6F	Leveled	Single	32	--	--	--	80	3	48
T125	eastern cottonwood	6G	Leveled	Single	28	--	--	--	80	3	42
T125B	UNK	6G	Leveled	Single	UNK	UNK	UNK	UNK	UNK	UNK	UNK
T126	eastern cottonwood	6G	Preserved	Single	28	--	--	--	80	3	42
T128	red maple	7H	Leveled	Single	19	--	--	--	35	3.5	29
T129	eastern cottonwood	8F	Leveled	Dual	16	11	--	--	35	3	24
T130	eastern cottonwood	7E	Preserved	Single	15	--	--	--	60	4	23
T131	eastern cottonwood	7F	Preserved	Single	16	--	--	--	60	3	24
T132	eastern cottonwood	7E	Preserved	Single	20	--	--	--	85	3	30
T133	eastern cottonwood	7E	Preserved	Single	30	--	--	--	85	3	45
T134	eastern cottonwood	7F	Preserved	Single	16	--	--	--	80	3	24
T135	eastern cottonwood	7F	Preserved	Single	25	--	--	--	100	3	38
T136	eastern cottonwood	8G	Leveled	Single	23	--	--	--	85	3	35
T137	eastern cottonwood	7G	Leveled	Single	27	--	--	--	85	3	41
T138	eastern cottonwood	8G	Leveled	Single	29	--	--	--	85	3	43
T139	eastern cottonwood	8G	Leveled	Single	24	--	--	--	85	3	35
T140	eastern cottonwood	8G	Leveled	Single	26	--	--	--	85	3	39
T141	eastern cottonwood	8G	Leveled	Single	17	--	--	--	85	4	25
T142	eastern cottonwood	8G	Leveled	Single	15	--	--	--	85	3	23
T143	willow (salix sp.)	7I	Preserved	Single	42	--	--	--	40	4.5	63
T144	eastern cottonwood	8J	Preserved	Single	22	--	--	--	45	5	32
T145	eastern cottonwood	9J	Preserved	Single	42	--	--	--	55	3	63
T146	willow (salix sp.)	8J	Preserved	Single	39	--	--	--	40	4	32
T147	willow (salix sp.)	8H	Preserved	Single	32	--	--	--	45	4.5	63
T148	willow (salix sp.)	8H	Preserved	Single	24	--	--	--	28	5.5	58
T149	black walnut	8H	Preserved	Dual	19	13	--	--	35	3	48
T150	eastern cottonwood	8H	Preserved	Dual	24	17	--	--	45	4	36
T150A	eastern cottonwood	7G	Leveled	Single	16	--	--	--	45	4	24
T151	silver maple	9G	Preserved	Quad	26	7	8	4	40	3	39
T152	box elder	8G	Leveled	Single	16	--	--	--	35	3	24
T153	box elder	9F	Leveled	Dual	19	11	--	--	30	5	28
T154	box elder	9F	Preserved	Single	20	--	--	--	35	4.5	30
T155	eastern cottonwood	9F	Preserved	Single	39	--	--	--	50	3	59
T156	box elder	9F	Leveled	Single	13	--	--	--	UNK	3	19
T157	eastern cottonwood	9F	Leveled	Dual	23	12	--	--	UNK	4	35
T158	eastern cottonwood	9F	Leveled	Single	23	--	--	--	100	3	34

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West Branch of Bloody Brook
Bloody Brook Voluntary Cleanup Program
Onondaga County, New York

Tree ID	Species	Figure Location (Column-Row)	Preserved/Leveled	Stem	DBH ¹ of Four Largest Stems (inches)				HEIGHT (feet)	CONDITION ²	CRZ ³ (radial feet from trunk)
					DBH	DBH	DBH	DBH			
T159	eastern cottonwood	9F	Leveled	Single	27	--	--	--	100	3	40
T160	willow (salix sp.)	9F	Leveled	Single	19	--	--	--	80	4	29
T161	eastern cottonwood	9E	Leveled	Single	34	--	--	--	100	4	51
T162	eastern cottonwood	9F	Leveled	Single	18	--	--	--	80	5	27
T163	eastern cottonwood	9F	Leveled	Dual	28	25	--	--	100	3	42
T164	eastern cottonwood	9F	Leveled	Single	25	--	--	--	100	3	38
T165	eastern cottonwood	9E	Leveled	Single	38	--	--	--	100	4	57
T166	eastern cottonwood	10E	Preserved	Single	15	--	--	--	50	3	22
T167	box elder	10E	Preserved	Single	15	--	--	--	30	5	22
T168	box elder	10E	Preserved	Single	16	--	--	--	35	3.5	24
T169	box elder	10E	Preserved	Dual	16	11	--	--	35	3.5	24
T170	eastern cottonwood	10E	Preserved	Dual	23	18	--	--	70	4	35
T171	box elder	10E	Preserved	Single	13	--	--	--	70	4	20
T172	silver maple	11D	Preserved	Single	21	--	--	--	70	4	31
T173	red maple	10D	Preserved	Quad	15	15	11	4	60	3	23
T174	box elder	8F	Leveled	Single	16	--	--	--	30	3.5	24
T175	UNK	4D	Leveled	Single	10	--	--	--	UNK	6	15
T176	box elder	4D	Leveled	Single	16	--	--	--	60	3	24
T179	eastern cottonwood	6E	Preserved	Single	14	--	--	--	70	3.5	21
T990	box elder	9D	Preserved	Single	20	--	--	--	40	3.5	30
T991	norway spruce	4B	Preserved	Single	16	--	--	--	45	3	24
T992	dawn redwood	4C	Preserved	Single	18	--	--	--	60	3	27
T993	dawn redwood	4C	Preserved	Single	18	--	--	--	60	3	27
T994	black locust	10J	Preserved	Single	17	--	--	--	40	3	26
T995	red maple	4B	Preserved	Single	13	--	--	--	35	3	20
T996	eastern cottonwood	9F	Preserved	Single	24	--	--	--	50	3	36
T996a	eastern cottonwood	9F	Preserved	Single	18	--	--	--	50	3	27
T996b	eastern cottonwood	9F	Preserved	Single	24	--	--	--	60	3	36
T996c	eastern cottonwood	9F	Preserved	Single	26	--	--	--	60	3	39
T997	white pine	4E	Leveled	Single	13	--	--	--	40	3	20
T998	white pine	4F	Leveled	Single	16	--	--	--	60	3	24
T999	white pine	4F	Leveled	Single	14	--	--	--	60	4	21

Notes:

1. DBH - Diameter at Breast Height
2. Surveyed condition of a Tree
 - 1 - Specimen tree of quality similar to those found in arboretum
 - 2 - Park tree – tree of high quality, maintained, free of competition and nuisance species (e.g., climbing vines, etc.)
 - 3 - Average tree – some minor defects
 - 4 - Tree with some damage, decay, or structural flaws
 - 5 - Tree with major damage, decay, or structural flaws
 - 6 - Dead tree
3. CRZ - Critical Root Zone refers to the area at which soil disturbance will result in potential damage to the tree
4. UNK - Unknown at this time
5. "--" - Not applicable

Table 3
Summary of Restoration of Temporary Wetland Impacts Resulting from Site Remedial Activities
West Branch of Bloody Brook
Bloody Brook Voluntary Cleanup Program
Onondaga County, New York

Habitat Type	Total Area (Square feet)	Area Impacted (Square feet)	Area Restored (Square feet)
Palustrine Deciduous Forest	0	0	16,829
Palustrine Shrub/Scrub	12,799	12,632	12,161
Palustrine Emergent	46,911	37,025	27,832
Total	59,710	49,657	56,822

Table 4. West Branch of Bloody Brook Species Planting Plan: Wetlands and Uplands (Phase 1)

Common Name	Scientific Name	Ind. Status	Habitat Type	Number	Size
Trees					
Red maple	<i>Acer rubrum</i>	FAC	PFO & RIP	190	2.5"-3"
Pin oak	<i>Quercus palustris</i>	FACW	PFO & RIP	159	2.5"-3"
Black willow	<i>Salix niger</i>	FACW+	PFO	38	2.5"-3"
River birch	<i>Betula nigra</i>	FACW	PFO	26	2.5"-3"
Swamp white oak	<i>Quercus bicolor</i>	FACW+	PFO	10	2.5"-3"
Sugar maple	<i>Acer saccharum</i>	FACU-	UPF	155	2.5"-3"
American beech	<i>Fagus grandifolia</i>	UPL	UPF	125	2.5"-3"
Black cherry	<i>Prunus serotina</i>	FACU-	UPF & RIP	150	2.5"-3"
White pine	<i>Pinus strobus</i>	UPL	UPF	50	2.5"-3"
Eastern hemlock	<i>Tsuga canadensis</i>	UPL	UPF	163	2.5"-3"
Total Trees				1066	
Shrubs					
Silky dogwood	<i>Cornus amomum</i>	FACW+	PSS & PFO	180	3' Live stakes
Sandbar willow	<i>Salix exigua</i>	OBL	PFO & RIP	25	3' Live stakes
Elderberry	<i>Sambucus canadensis</i>	FACW-	PSS	102	3 gal
Buttonbush	<i>Cephalanthus occidentalis</i>	OBL	PSS	15	3 gal
Spice bush	<i>Lindera benzoin</i>	FACW-	PSS	30	3 gal
Pussy willow	<i>Salix discolor</i>	FACW	PSS & RIP	40	3 gal
Speckled alder	<i>Alnus incana</i>	FACW+	PSS & PFO	65	3 gal
Red chokeberry	<i>Aronia arbutifolia</i>	FACW+	PSS	30	3 gal
Northern arrowwood	<i>Viburnum dentatum</i>	FAC	UPF & RIP	348	3 gal
Grey dogwood	<i>Cornus racemosa</i>	UPL	UPF & RIP	412	3 gal
Nannyberry	<i>Viburnum lentago</i>	FAC	UPF & RIP	414	3 gal
Total Shrubs				1661	
Emergents					
Broadleaf cattail	<i>Typha latifolia</i>	OBL	PEM	300	Rhizomes
Blue flag iris	<i>Iris versicolor</i>	OBL	PEM	30	6 in pot
Woolgrass	<i>Scirpus cyperinus</i>	FACW+	PEM	50	4 in pot
Soft rush	<i>Juncus effusus</i>	FACW+	PEM	50	4 in pot
Sensitive fern	<i>Onoclea sensibilis</i>	FACW	PEM	50	4 in pot
Total Emergents				480	

* Unit price includes delivery and installation with 1 year guaranteed survival.

Seed mixes		Rate	Coverage area	Pounds pls
Riparian habitat	ERNMX-253	@20#/ac	1.183 acres	23.7
Forest Floor habitat	ERNMX-140	@20#/ac	0.5158 acres	10.3
Wetland habitat	ERNMX-251	@20#/ac	1.304 acres	26.1
Upland Meadow	ERNMX-105	@20#/ac	1.249 acres	25.0
Lawn		@30#/ac	0.4236 acres	12.708
Total				97.7

Table 5: Plant and Seed Quantity by Habitat Area

Habitat Area Name	Common Name	Scientific name	Common name	Size	Quantity
PFO 1 16,829 sf (0.3863 a)	Wetland forest	<i>Acer rubrum</i>	Red maple	2.5-3 in	50
		<i>Quercus palustris</i>	Pin oak	2.5-3 in	44
		<i>Salix niger</i>	Black willow	2.5-3 in	38
		<i>Betula nigra</i>	River birch	2.5-3 in	26
		<i>Quercus bicolor</i>	Swamp white oak	2.5-3 in	10
		<i>Cornus amomum</i>	Silky dogwood	Live stakes	108
		<i>Alnus incana</i>	Speckled alder	3 gal	45
		<i>Sambucus canadensis</i>	Elderberry	3 gal	57
					168
		Wetland Habitat (PA New England Province FACW Mix)	ERNMX-251	20#/acre	
PSS 1 3,533 sf (0.0811 a)	Shrub wetland	<i>Cornus amomum</i>	Silky dogwood	Live stakes	20
		<i>Cephalanthus occidentalis</i>	Buttonbush	3 gal	15
		<i>Sambucus canadensis</i>	Elderberry	3 gal	15
		<i>Alnus incana</i>	Speckled alder	3 gal	20
		<i>Aronia arbutifolia</i>	Red chokeberry	3gal	10
					80
		Wetland Habitat (PA New England Province FACW Mix)	ERNMX-251	20#/acre	
PSS 2 8,628 sf (0.1981 a)	Shrub wetland	<i>Cornus amomum</i>	Silky dogwood	Live stakes	52
		<i>Salix exigua</i>	Sandbar willow	Live stakes	25
		<i>Salix discolor</i>	Pussy willow	3 gal	40
		<i>Sambucus canadensis</i>	Elderberry	3 gal	30
		<i>Lindera benzoin</i>	Spice bush	3 gal	30
		<i>Aronia arbutifolia</i>	Red chokeberry	3gal	20
					197
		Wetland Habitat (PA New England Province FACW Mix)	ERNMX-251	20#/acre	
PEM 1 16,426 sf (0.3771 a)	Marsh	<i>Typha latifolia</i>	Broadleaf cattail	Rhizomes	200
		<i>Iris versicolor</i>	Blue flag iris	6 in. pot	20
		<i>Scirpus cyperinus</i>	Woolgrass	4 in. pot	35
		<i>Juncus effusus</i>	Soft rush	4 in. pot	35
		<i>Onoclea sensibilis</i>	Sensitive fern	4 in. pot	35
					325
		Wetland Habitat (PA New England Province FACW Mix)	ERNMX-251	20#/acre	
PEM 2 11,406 sf (0.2618 a)	Marsh	<i>Typha latifolia</i>	Broadleaf cattail	Rhizomes	100
		<i>Iris versicolor</i>	Blue flag iris	6 in. pot	10
		<i>Scirpus cyperinus</i>	Woolgrass	4 in. pot	15
		<i>Juncus effusus</i>	Soft rush	4 in. pot	15
		<i>Onoclea sensibilis</i>	Sensitive fern	4 in. pot	15
					155
		Wetland Habitat (PA New England Province FACW Mix)	ERNMX-251	20#/acre	
RIP 51,520 sf (1.183 a)	Stream banks	<i>Acer rubrum</i>	Red maple	2.5-3 in	140
		<i>Acer saccharum</i>	Sugar maple	2.5-3 in	100
		<i>Fagus grandifolia</i>	American beech	2.5-3 in	60
		<i>Quercus palustris</i>	Pin oak	2.5-3 in	115
		<i>Tsuga canadensis</i>	Eastern hemlock	2.5-3 in	130
		<i>Prunus serotina</i>	Black cherry	2.5-3 in	100
		<i>Viburnum dentatum</i>	Northern arrowwood	3 gal	170
		<i>Viburnum lentago</i>	Nannyberry	3 gal	170
		<i>Cornus racemosa</i>	Grey dogwood	3 gal	175
					1160
		Riparian Habitat (PA New England Province Riparian Mix)	ERNMX-253	@20#/ac	
UPF 1 8,675 sf (0.1992 a)	Upland forest	<i>Acer saccharum</i>	Sugar maple	2.5-3 in	30
		<i>Fagus grandifolia</i>	American beech	2.5-3 in	20
		<i>Prunus serotina</i>	Black cherry	2.5-3 in	20
		<i>Pinus strobus</i>	White pine	2.5-3 in	20
		<i>Tsuga canadensis</i>	Eastern hemlock	2.5-3 in	20
		<i>Viburnum dentatum</i>	Northern arrowwood	3 gal	40
		<i>Viburnum lentago</i>	Nannyberry	3 gal	40
		<i>Cornus racemosa</i>	Grey dogwood	3 gal	30
					220
		Forest Floor Habitat (Partially Shaded Area Roadside Mix)	ERNMX-140	@20#/ac	

Table 5. Continued

Habitat Area Name	Common Name	Scientific name	Common name	Size	Quantity
UPF 2 10,500 sf (0.2410 a)	Upland forest	<i>Acer saccharum</i>	Sugar maple	2.5-3 in	30
		<i>Fagus grandifolia</i>	American beech	2.5-3 in	20
		<i>Prunus serotina</i>	Black cherry	2.5-3 in	25
		<i>Pinus strobus</i>	White pine	2.5-3 in	25
		<i>Tsuga canadensis</i>	Eastern hemlock	2.5-3 in	30
		<i>Viburnum dentatum</i>	Northern arrowwood	3 gal	40
		<i>Cornus racemosa</i>	Grey dogwood	3 gal	40
		<i>Viburnum lentago</i>	Nannyberry	3 gal	25
					235
		Forest Floor Habitat (Partially Shaded Area Roadside Mix)	ERNMX-140	@20#/ac	
USS 3,291 sf (0.07555 a)	Shrub upland	<i>Cornus racemosa</i>	Grey dogwood	3 gal	35
		<i>Viburnum lentago</i>	Nannyberry	3 gal	40
					75
		Forest Floor Habitat (Partially Shaded Area Roadside Mix)	ERNMX-140	@20#/ac	
MOW 1 28,471 sf (0.6536 a)	Meadow	Upland Meadow (Northeastern U.S. Roadside Native Mix)	ERNMX-105	@20#/ac	
MOW 2 7,735 sf (0.1776 a)	Meadow	Upland Meadow (Northeastern U.S. Roadside Native Mix)	ERNMX-105	@20#/ac	
MOW 3, 13,068 sf (0.3000 a)	Meadow	Upland Meadow (Northeastern U.S. Roadside Native Mix)	ERNMX-105	@20#/ac	
MOW 4, 2,945 sf (0.0676 a)	Meadow	Upland Meadow (Northeastern U.S. Roadside Native Mix)	ERNMX-105	@20#/ac	
MOW 5, 2,204 sf (0.0506 a)	Meadow	Upland Meadow (Northeastern U.S. Roadside Native Mix)	ERNMX-105	@20#/ac	
Lawn 18,452 sf (0.4236 a)	Lawn	Cool season lawn mix		@30#/ac	

FIGURES



APPROXIMATE SCALE

REFERENCE:

1. NYSDOT 7.5 MIN TOPOGRAPHIC MAP OF SYRACUSE WEST, QUADRANGLE 1990, SCALE: 1" = 2000'.

AECOM

LOCKHEED MARTIN CORPORATION






SITE LOCATION MAP

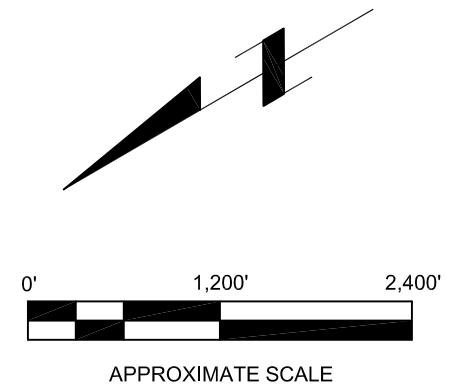
WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK

FILE NAME:	DRN	PROJECT NO.	DATE	FIGURE NO.
A1FIG1.dwg	—	60194430	11 / 2013	1



Legend

-  CURRENT BROOK ALIGNMENT
-  WOODED AREA
-  RESIDENTIAL AREA
-  APARTMENT COMPLEX AREA
-  COMMERCIAL-LIGHT INDUSTRIAL AREA

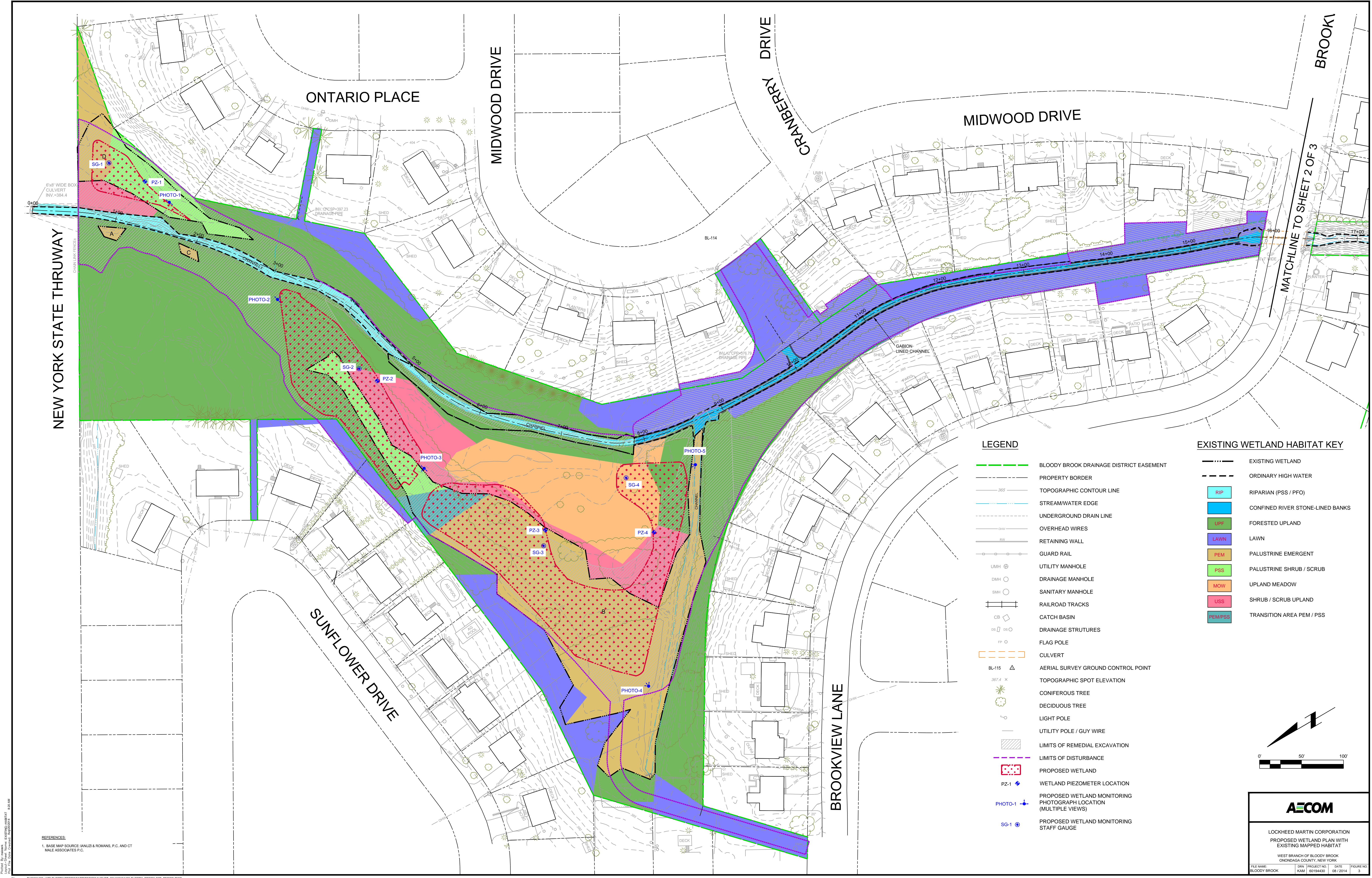


AECOM

LOCKHEED MARTIN CORPORATION
SITE AREA MAP

WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK

FILE NAME:	DRN	PROJECT NO.	DATE	FIGURE NO.
SiteAreaMap.dwg	--	60194430	03 / 2014	2



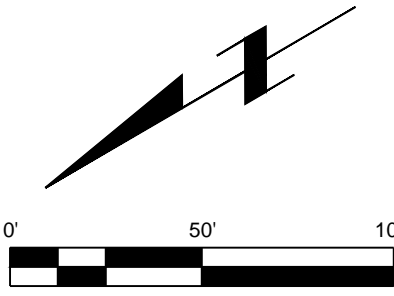
REFERENCES:
1. BASE MAP SOURCE: MANUZI & ROMANS, P.C. AND CT
MALE ASSOCIATES P.C.

LEGEND

- BLOODY BROOK DRAINAGE DISTRICT EASEMENT
- PROPERTY BORDER
- TOPOGRAPHIC CONTOUR LINE
- STREAMWATER EDGE
- UNDERGROUND DRAIN LINE
- OVERHEAD WIRES
- RETAINING WALL
- GUARD RAIL
- UTILITY MANHOLE
- DRAINAGE MANHOLE
- SANITARY MANHOLE
- RAILROAD TRACKS
- CATCH BASIN
- DRAINAGE STRUTURES
- FLAG POLE
- CULVERT
- AERIAL SURVEY GROUND CONTROL POINT
- TOPOGRAPHIC SPOT ELEVATION
- CONIFEROUS TREE
- DECIDUOUS TREE
- LIGHT POLE
- UTILITY POLE / GUY WIRE
- LIMITS OF REMEDIAL EXCAVATION
- LIMITS OF DISTURBANCE
- PROPOSED WETLAND
- WETLAND PIEZOMETER LOCATION
- PROPOSED WETLAND MONITORING PHOTOGRAPH LOCATION (MULTIPLE VIEWS)
- PROPOSED WETLAND MONITORING STAFF GAUGE

EXISTING WETLAND HABITAT KEY

- EXISTING WETLAND
- ORDINARY HIGH WATER
- RIP
- CONFINED RIVER STONE-LINED BANKS
- UPF
- FORESTED UPLAND
- LAWN
- PEM
- PALUSTRINE EMERGENT
- PSS
- PALUSTRINE SHRUB / SCRUB
- MOW
- UPLAND MEADOW
- USS
- SHRUB / SCRUB UPLAND
- PEMPSS
- TRANSITION AREA PEM / PSS



AECOM

LOCKHEED MARTIN CORPORATION
PROPOSED WETLAND PLAN WITH
EXISTING MAPPED HABITAT
WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK

FILE NAME: BLOODY BROOK
PROJECT NO: 60164630
DATE: 08/2014
FIGURE NO: 3

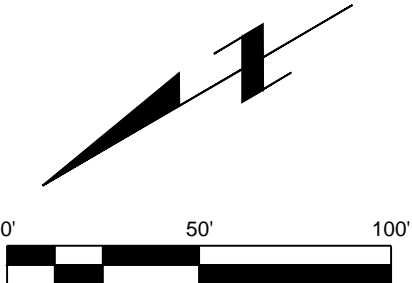


REFERENCES:
1. BASE MAP SOURCE: MANUZI & ROMANS, P.C. AND CT
MALE ASSOCIATES P.C.

LEGEND

- | | | | |
|--|---|--|-------------------------------|
| | BLOODY BROOK DRAINAGE DISTRICT EASEMENT | | LIMITS OF REMEDIAL EXCAVATION |
| | PROPERTY BORDER | | EXISTING WETLAND |
| | TOPOGRAPHIC CONTOUR LINE | | ORDINARY HIGH WATER |
| | STREAM/WATER EDGE | | DISTURBED WETLAND AREA |
| | UNDERGROUND DRAIN LINE | | |
| | OVERHEAD WIRES | | |
| | RETAINING WALL | | |
| | GUARD RAIL | | |
| | UTILITY MANHOLE | | |
| | DRAINAGE MANHOLE | | |
| | SANITARY MANHOLE | | |
| | RAILROAD TRACKS | | |
| | CATCH BASIN | | |
| | DRAINAGE STRUCTURES | | |
| | FLAG POLE | | |
| | CULVERT | | |
| | BL-115 AERIAL SURVEY GROUND CONTROL POINT | | |
| | 367.4 TOPOGRAPHIC SPOT ELEVATION | | |
| | CONIFEROUS TREE | | |
| | DECIDUOUS TREE | | |
| | LIGHT POLE | | |
| | UTILITY POLE / GUY WIRE | | |

NOTE:
WETLAND DELINEATION COMPLETED AUGUST 2012

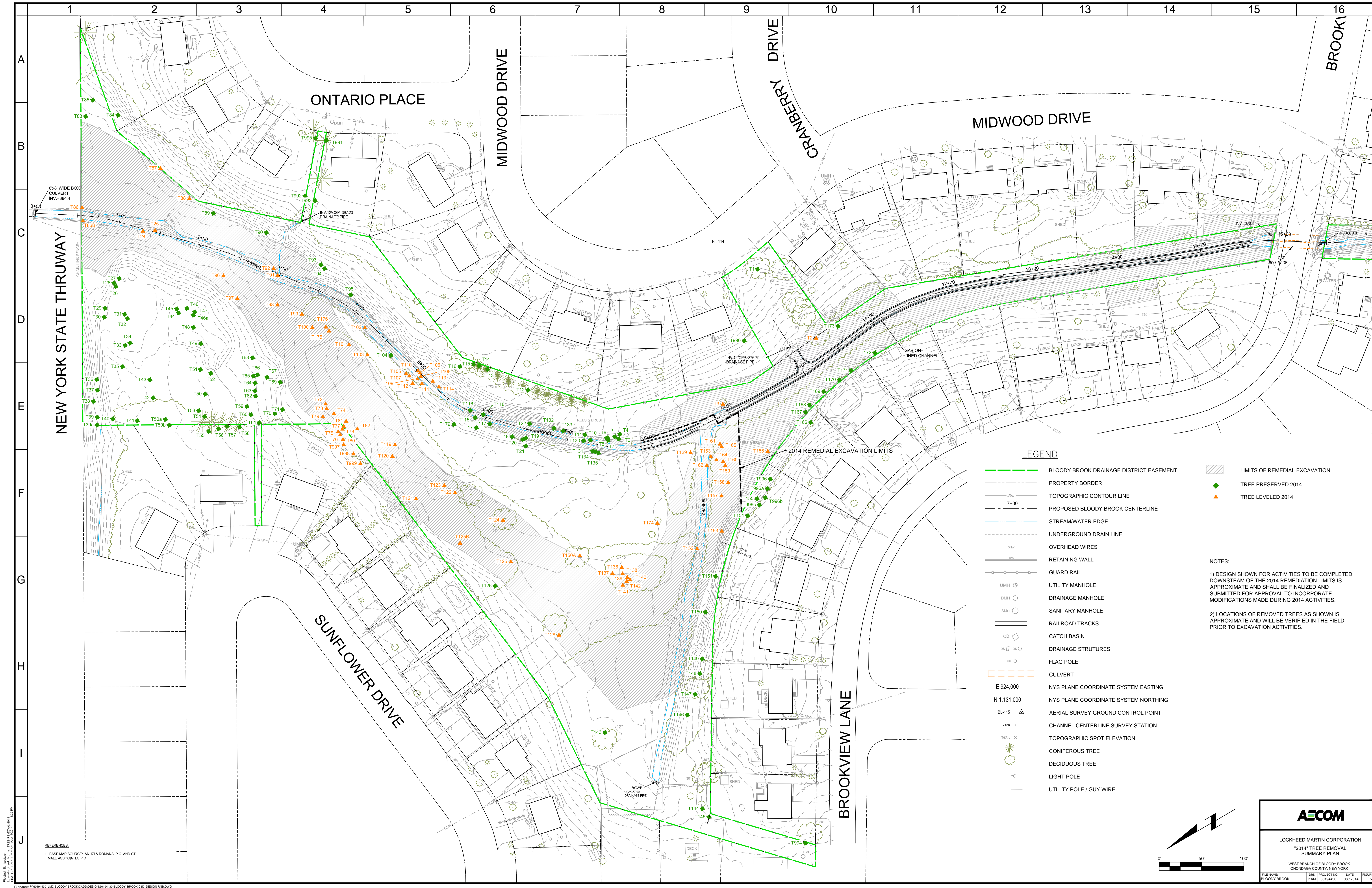


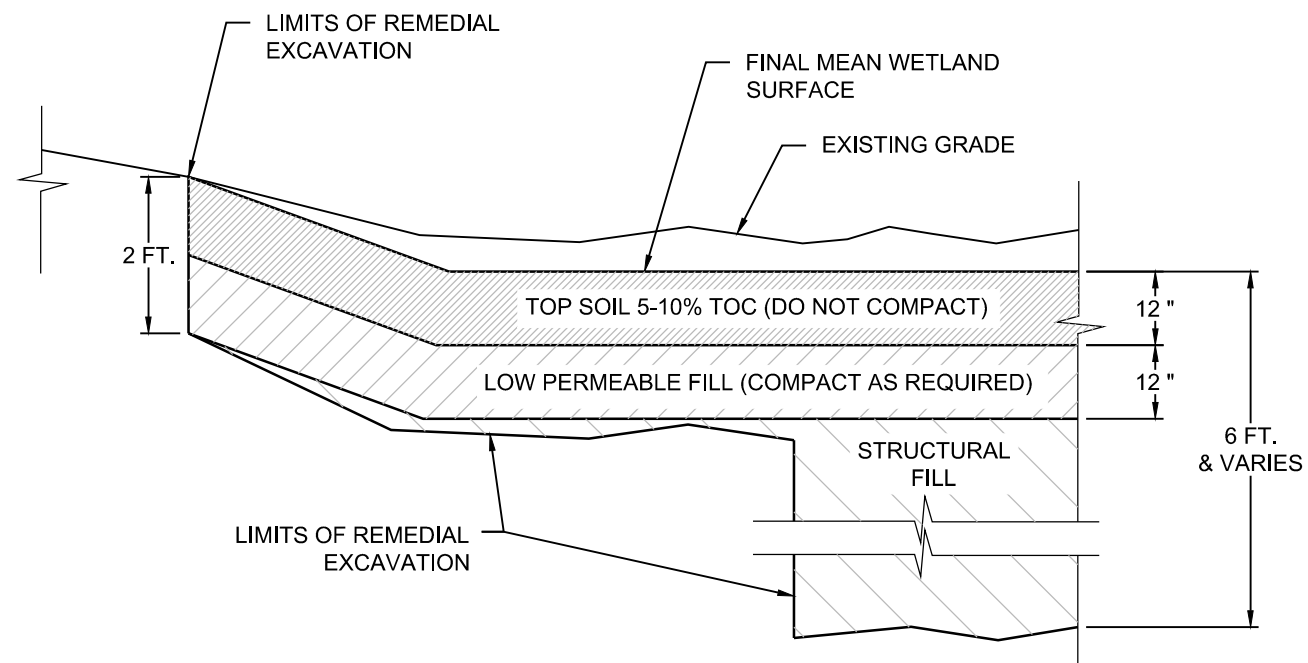
AECOM

LOCKHEED MARTIN CORPORATION
EXISTING WETLAND PLAN

WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK

FILE NAME: BLOODY BROOK	DRN PROJECT NO: 60184430	DATE: 08/2014	FIGURE NO: 4
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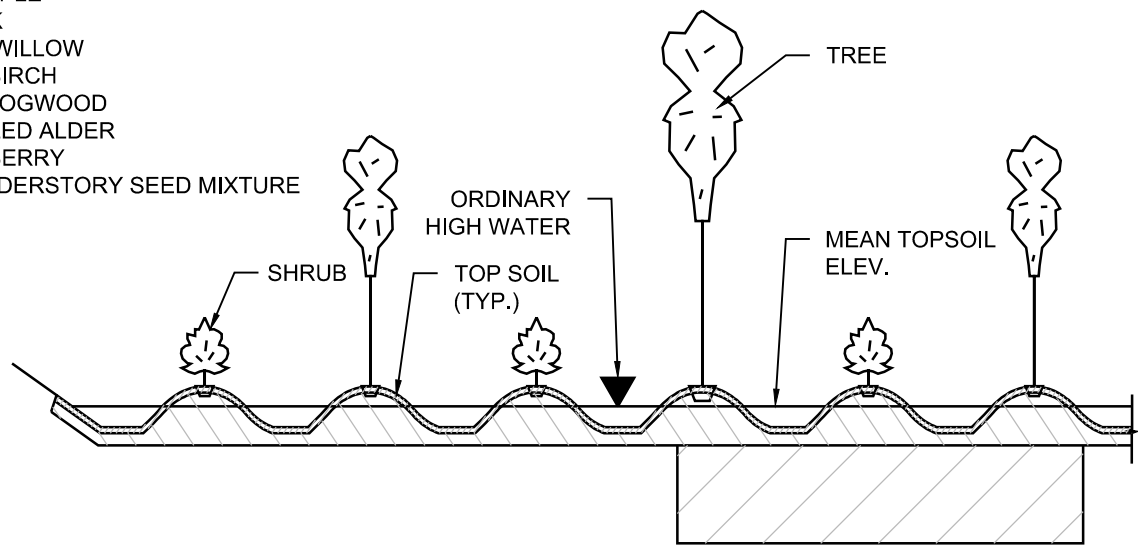
NOTE:
LOW PERMEABLE FILL SHALL MEET LINER PERM.
RATE OF 3.1 E-05 cm/sec (4.0 to 2.5 E -05 cm/sec)

TYPICAL WETLAND FILL SOIL DETAIL

(NOT TO SCALE)

PLANT TYPES

RED MAPLE
PIN OAK
BLACK WILLOW
RIVER BIRCH
SILKY DOGWOOD
SPECKLED ALDER
ELDERBERRY
PFO UNDERSTORY SEED MIXTURE

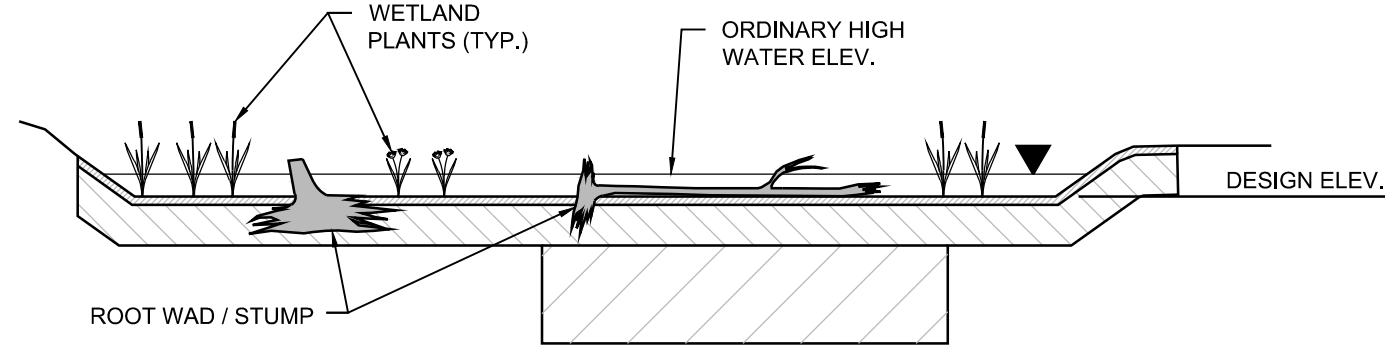


TYPICAL FORESTED WETLAND

(NOT TO SCALE)

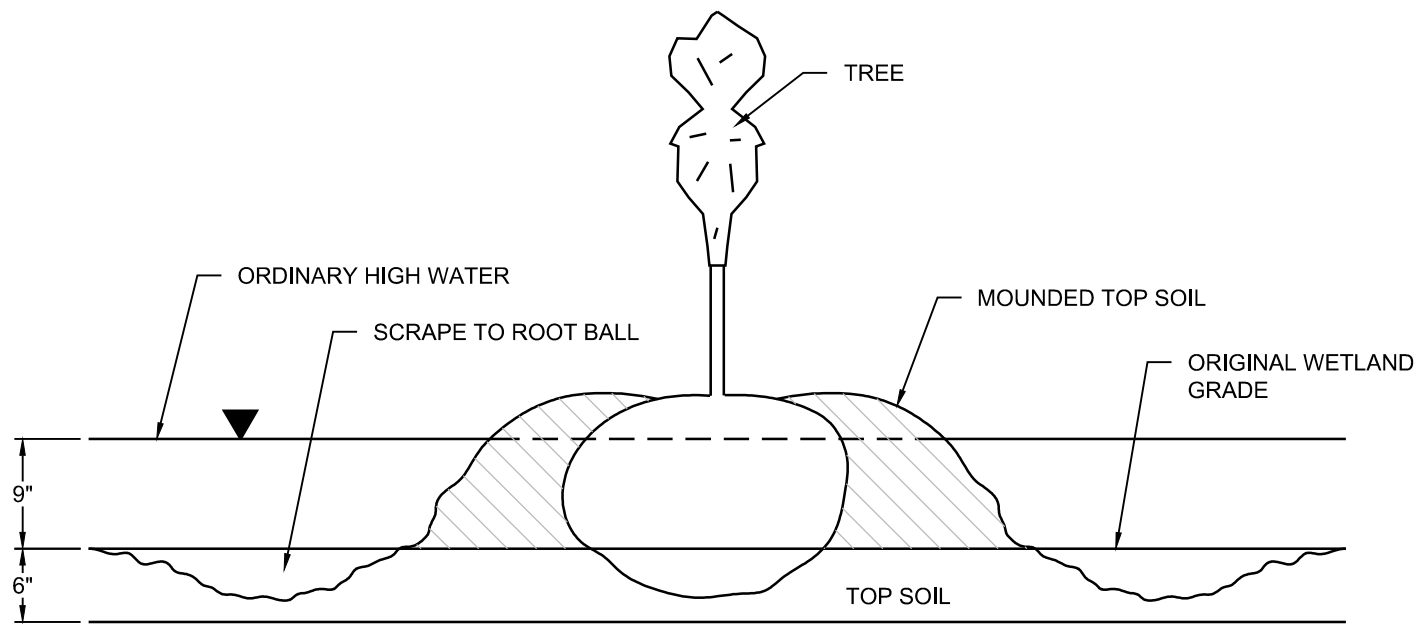
TYPICAL PLANT

BROAD LEAF CATTAIL
BLUE FLAG IRIS
WOOL GRASS
SOFT RUSH
SENSITIVE FERN
PEM UNDERSTORY SEED MIXTURE



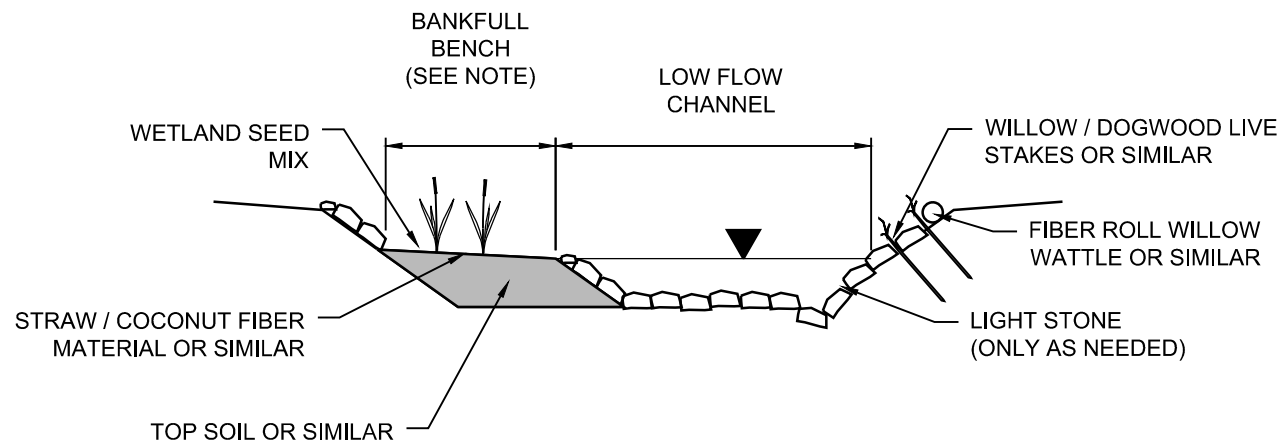
TYPICAL EMERGENT WETLAND

(NOT TO SCALE)



TYPICAL PIT AND MOUND INSTALLATION

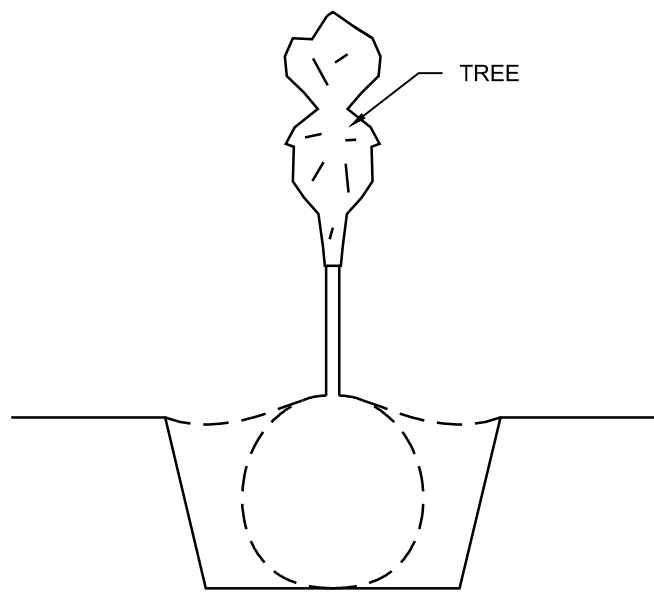
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TYPICAL BROOK

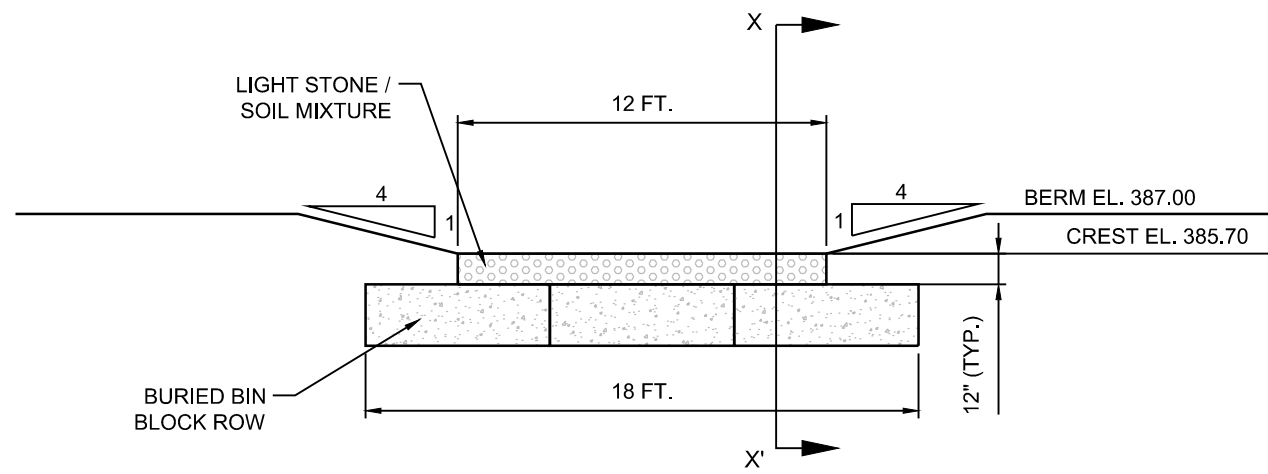
(NOT TO SCALE)

NOTE:
POTENTIAL USE OF WETLAND BENCH RESERVED
FOR STREAM RESTORATION AREAS BETWEEN
STATIONS 38+00 TO 45+50 +/-



TYPICAL UPLAND INSTALLATION

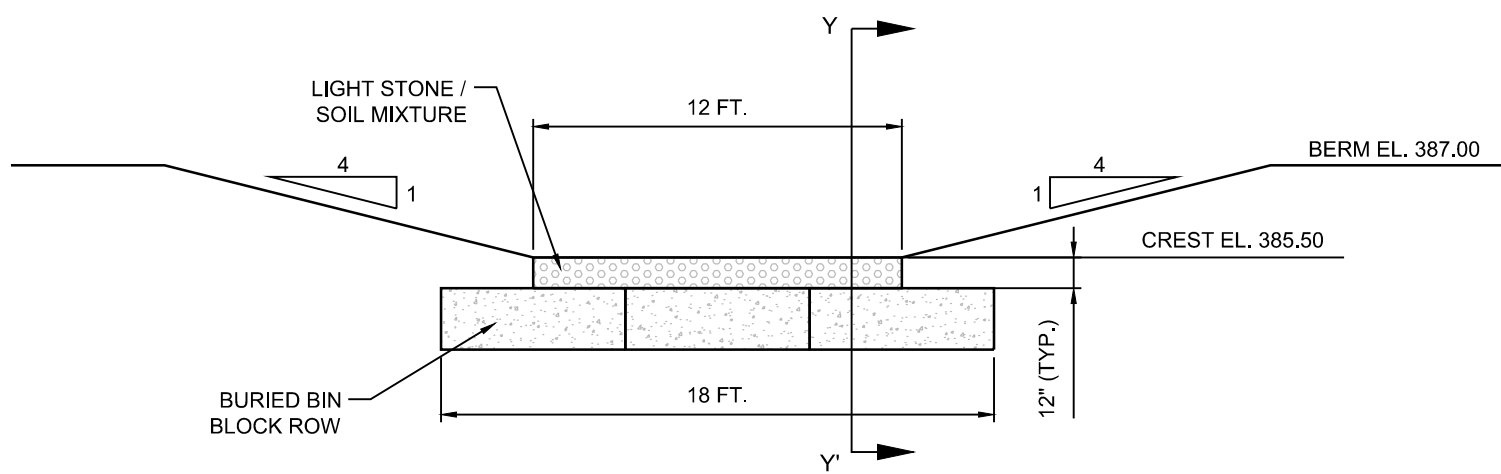
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ELEVATION

(NOT TO SCALE)

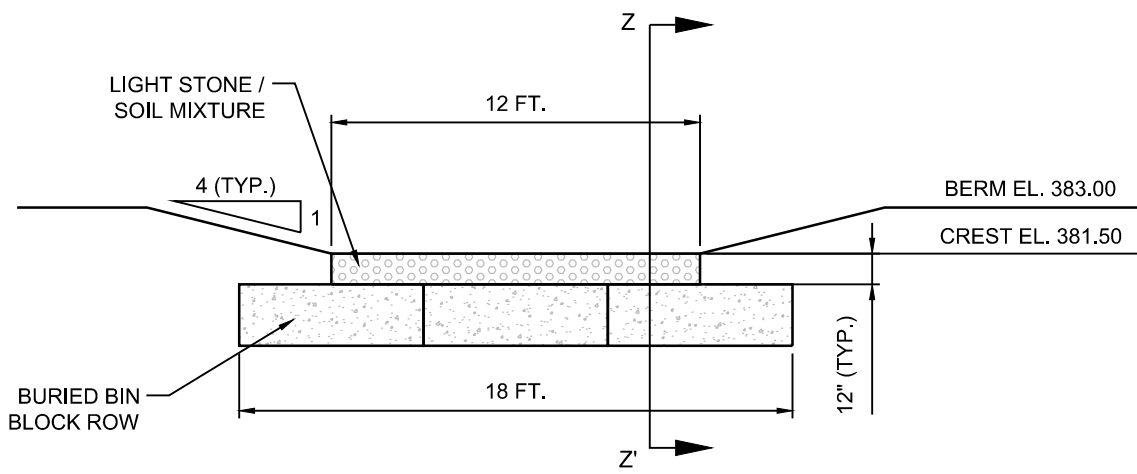
WEIR #1



ELEVATION

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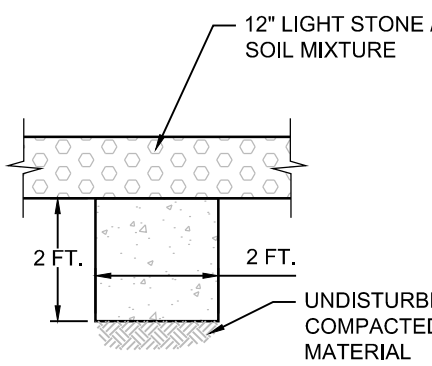
WEIR #2



ELEVATION

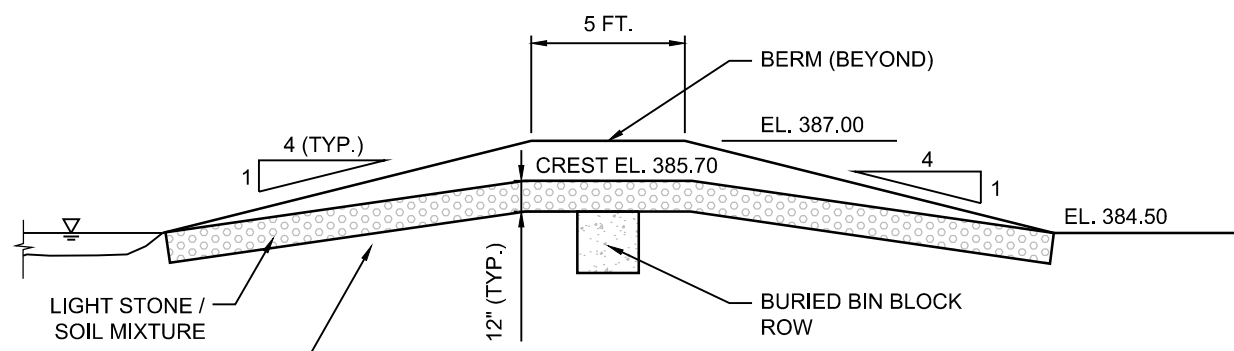
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WEIR #3



BIN BLOCK DETAIL

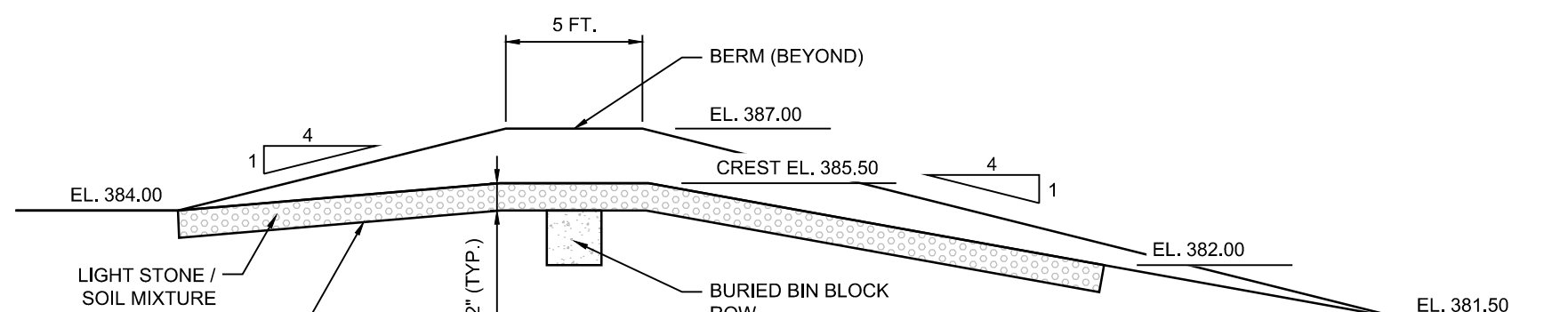
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SECTION X - X'

(NOT TO SCALE)

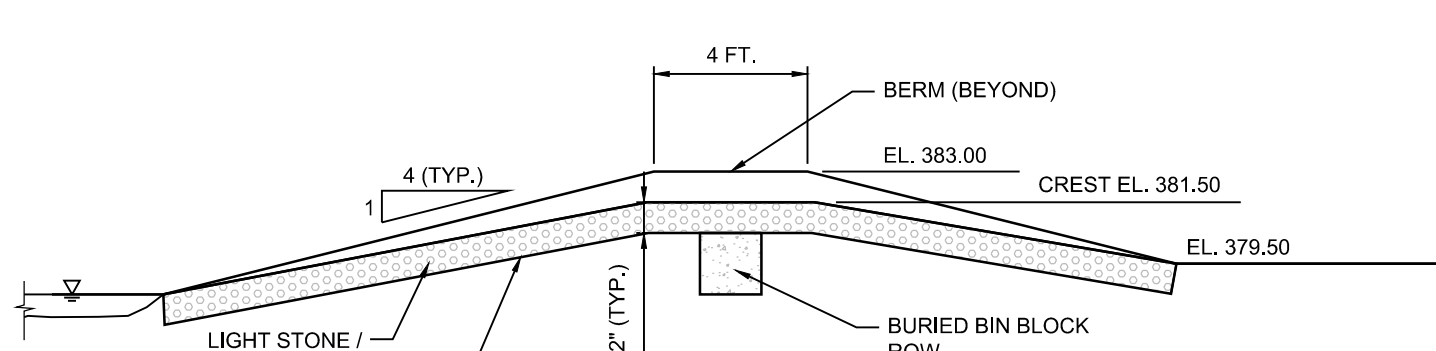
WEIR #1



SECTION Y - Y'

(NOT TO SCALE)

WEIR #2



SECTION Z - Z'

(NOT TO SCALE)

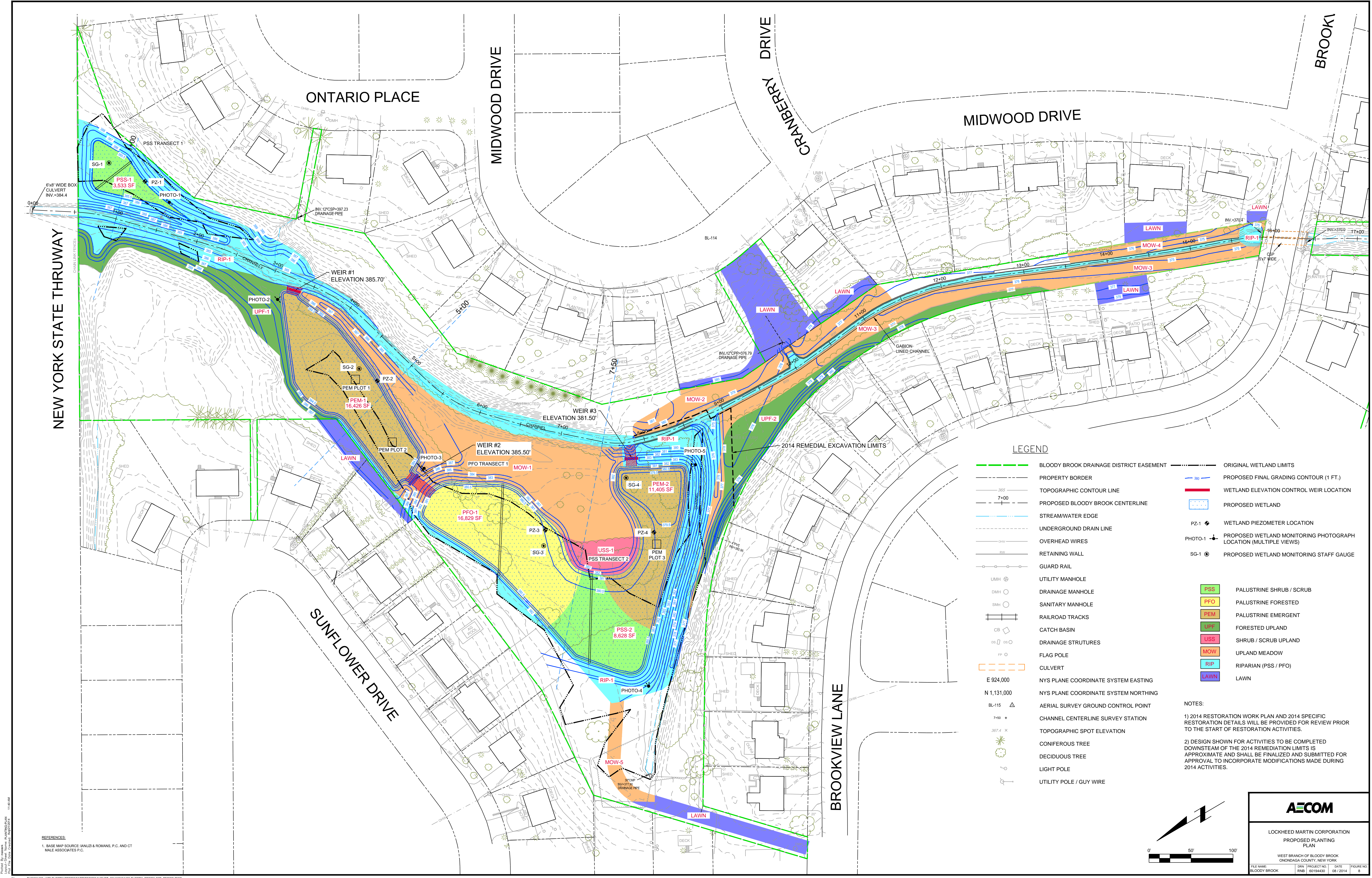
WEIR #3

AECOM

LOCKHEED MARTIN CORPORATION
RESTORATION
DETAILS

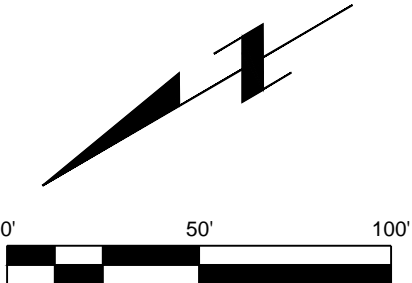
WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK

FILE NAME: BLOODY BROOK
PROJECT NO.: 60184530
DATE: 08/2014
FIGURE NO.: 7



LEGEND

- | | | | |
|--|---|--|--|
| | BLOODY BROOK DRAINAGE DISTRICT EASEMENT | | ORIGINAL WETLAND LIMITS |
| | PROPERTY BORDER | | PROPOSED FINAL GRADING CONTOUR (1 FT.) |
| | TOPOGRAPHIC CONTOUR LINE | | WETLAND ELEVATION CONTROL WEIR LOCATION |
| | PROPOSED BLOODY BROOK CENTERLINE | | PROPOSED WETLAND |
| | STREAM/WATER EDGE | | WETLAND PIEZOMETER LOCATION |
| | UNDERGROUND DRAIN LINE | | PROPOSED WETLAND MONITORING PHOTOGRAPH LOCATION (MULTIPLE VIEWS) |
| | OVERHEAD WIRES | | PROPOSED WETLAND MONITORING STAFF GAUGE |
| | RETAINING WALL | | |
| | GUARD RAIL | | |
| | UTILITY MANHOLE | | |
| | DRAINAGE MANHOLE | | |
| | SANITARY MANHOLE | | |
| | RAILROAD TRACKS | | |
| | CATCH BASIN | | |
| | DRAINAGE STRUTURES | | |
| | FLAG POLE | | |
| | CULVERT | | |
| | NYS PLANE COORDINATE SYSTEM EASTING | | |
| | NYS PLANE COORDINATE SYSTEM NORTHING | | |
| | AERIAL SURVEY GROUND CONTROL POINT | | |
| | CHANNEL CENTERLINE SURVEY STATION | | |
| | TOPOGRAPHIC SPOT ELEVATION | | |
| | CONIFEROUS TREE | | |
| | DECIDUOUS TREE | | |
| | LIGHT POLE | | |
| | UTILITY POLE / GUY WIRE | | |
-
- | | | |
|--|------|--------------------------|
| | PSS | PALUSTRINE SHRUB / SCRUB |
| | PFO | PALUSTRINE FORESTED |
| | PEM | PALUSTRINE EMERGENT |
| | UPF | FORESTED UPLAND |
| | USS | SHRUB / SCRUB UPLAND |
| | MOW | UPLAND MEADOW |
| | RIP | RIPIARIAN (PSS / PFO) |
| | LAWN | LAWN |
- NOTES:
- 1) 2014 RESTORATION WORK PLAN AND 2014 SPECIFIC RESTORATION DETAILS WILL BE PROVIDED FOR REVIEW PRIOR TO THE START OF RESTORATION ACTIVITIES.
- 2) DESIGN SHOWN FOR ACTIVITIES TO BE COMPLETED DOWNSTREAM OF THE 2014 REMEDIATION LIMITS IS APPROXIMATE AND SHALL BE FINALIZED AND SUBMITTED FOR APPROVAL TO INCORPORATE MODIFICATIONS MADE DURING 2014 ACTIVITIES.



AECOM

LOCKHEED MARTIN CORPORATION
PROPOSED PLANTING
PLAN

WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK

FILE NAME: BLOODY BROOK
PROJECT NO: 60184430
DATE: 08/2014
FIGURE NO: 8

REFERENCES:
1. BASE MAP SOURCE: MANUZI & ROMANS, P.C. AND CT
MALE ASSOCIATES P.C.

Figure 9. Planting Density and Typical Planting Pattern

Planting Density Chart for Rooted or Potted Stock								
1 acre = 43,560 Sq ft								
On-centers	8 X 8 Plot area	Plant A/plot	Plant B/plot	Plant A/acre	Plant B/acre	Plants/acre		
4 ft	1024 Sq ft	16	20	681	851	1532		
5 ft *	1600 Sq ft	16	20	436	545	981		
6 ft	2304 Sq ft	16	20	303	378	681		
7 ft	3136 Sq ft	16	20	222	278	500		
8 ft	4096 Sq ft	16	20	170	213	383		
* Assume planting on 5 foot centers								
Forest Habitat	{	PFO & UPF	Plant A = Tree Plant B = Shrub	Trees Understory				
Shrub Habitat	{	PSS & USS	Plant A = Shrub 1 Plant B = Shrub 2					
RIP	{		Plant A = Tree Plant B = Shrub	Trees Understory				

Typical Planting Pattern for 8 X 8 Planting Plot
(Plant at upper left corner)

A	B			A	B		B	A
B		A	B			A		B
A	B			A	B		B	A
B		A	B			A		B
A	B			A	B		B	A
B		A	B			A		B
A	B			A	B		B	A
B		A	B			A		B
A	B			A	B			

Note : Grid length varies with planting density (see density chart)

APPENDIX A

CLIENT: _____ SUBJECT: Armor Analysis
 PROJECT: Bloody Brook Prepared By CHF Date 02/06/14
Onondaga County, NY Reviewed By BA Date 02/06/14
 Approved By _____ Date _____

TASK

Determine required armor stone size in the upper and middle reaches of Bloody Brook. Analyze representative cross section in each reach. Design for the 100-year storm event.

REFERENCES

1. Maynard, S. 1998. Appendix A: Armor Layer Design. Guidance for In-Situ Subaqueous Capping of Contaminated Sediment. U.S. Army Engineer Waterways Experiment Station Vicksburg, Mississippi.
2. Palermo, M., Maynard, S., Miller, J., and Reible, D. 1998. Guidance for In-Situ Subaqueous Capping of Contaminated Sediments, EPA 905-B96-004, Great Lakes National Program Office, Chicago, IL. Available at <http://www.epa.gov/glnpo/sediment/iscmain>.

PROCEDURE

$$D_{50} = S_f C_s C_v C_T C_G d \left[\left(\frac{\tilde{a}_w}{\tilde{a}_s - \tilde{a}_w} \right)^{1/2} \frac{V}{\sqrt{K_1 g d}} \right]^{2.5}$$

where:

- D_{50} - characteristic stone size of which 50 percent is finer by weight, feet
- S_f - safety factor, minimum = 1.1 (**use 1.1**)
- C_s - stability coefficient for incipient failure: 0.30 for angular rock, 0.375 for rounded rock (**assume angular; use 0.30**)
- C_v - vertical velocity distribution coefficient: 1.0 for straight channels and inside of bends; 1.283-0.2 log (R/W) for outside of bends (**use 1.0**)
- C_T - thickness coefficient: typically 1.0 for flood flows (**use 1.0**)
- D_{85}/D_{15} - gradation uniformity coefficient: typical range = 1.8 to 3.5 (**assume 3.5**)
- C_G - gradation coefficient = $(D_{85}/D_{15})^{1/3}$ (**use $3.5^{1/3} = 1.52$**)
- d - local water depth, feet
- \tilde{a}_w - unit weight of water (62.4 lb/ft³)
- \tilde{a}_s - unit weight of stone (assume 165 lb/ft³)
- V - local depth averaged velocity
- K_1 - side slope correction factor
- G - gravitational constant (32.2 ft/sec²)
- R - Centerline radius of channel bend, feet
- W - Width of water surface at upstream end of bend, feet

The side slope correction factor, K_1 , can be calculated as:

$$K_1 = \sqrt{1 - \frac{\sin^2 \theta}{\sin^2 \phi}}$$

where:

- K_1 - side slope correction factor
- θ - side slope angle
- ϕ - angle of repose, armor (**assume 35 degrees**)

CLIENT: _____ SUBJECT: Armor Analysis

PROJECT: Bloody Brook

Onondaga County, NY

Prepared By CHF Date 02/06/14

Reviewed By BA Date 02/06/14

Approved By _____ Date _____

HYDRAULIC ANALYSIS

Hydraulic analyses were performed by AECOM. Results for two representative cross sections are summarized in the following table:

Storm Recurrence Interval	Reach	River Station	Total Flow (cfs)	Water Depth in Channel (feet)	Flow Velocity in Channel (ft/s)	Channel Side Slope Angle (degrees)
100-year	Upper	36	171	3.19	1.03	13
100-year	Middle	18	145.3	3.22	4.11	31

ARMOR ANALYSIS

Upper Reach, River Station 36:

$$K_1 = \sqrt{1 - \frac{\sin^2 13}{\sin^2 35}} = 0.92$$

$$D_{50} = (1.1)(0.30)(1.0)(1.0)(1.52)(3.19) \left[\left(\frac{62.4}{165 - 62.4} \right)^{1/2} \frac{1.03}{\sqrt{0.92(32.2)(3.19)}} \right]^{2.5} = 0.004' = 0.05''$$

Middle Reach, River Station 18:

$$K_1 = \sqrt{1 - \frac{\sin^2 31}{\sin^2 35}} = 0.44$$

$$D_{50} = (1.1)(0.30)(1.0)(1.0)(1.52)(3.22) \left[\left(\frac{62.4}{165 - 62.4} \right)^{1/2} \frac{4.11}{\sqrt{0.44(32.2)(3.22)}} \right]^{2.5} = 0.21' = 2.56''$$

CONCLUSIONS & RECOMMENDATIONS

- 1) In the upper reach, use sand-sized armor material with D_{50} of at least 0.05" (1.3 mm). (0.05" corresponds to medium sand.)
- 2) For the middle reach, use mixture of gravel and cobbles with D_{50} of at least 2.5" (65 mm). (2.5" corresponds to coarse gravel.)
- 3) Use of armor material having angular particles was assumed. If rounded particles are used, increase the D_{50} size by 25% (i.e., factor by 1.25).
- 4) A Uniformity Coefficient (D_{85}/D_{15}) of 3.5 was assumed for the armor material. Therefore, the Uniformity Coefficient of the specified armor material should not exceed 3.5.

CLIENT: _____	SUBJECT: <u>Armor Analysis</u>	Prepared By <u>CHF</u>	Date <u>02/06/14</u>
PROJECT: <u>Bloody Brook</u>	_____	Reviewed By <u>BA</u>	Date <u>02/06/14</u>
<u>Onondaga County, NY</u>	_____	Approved By _____	Date _____

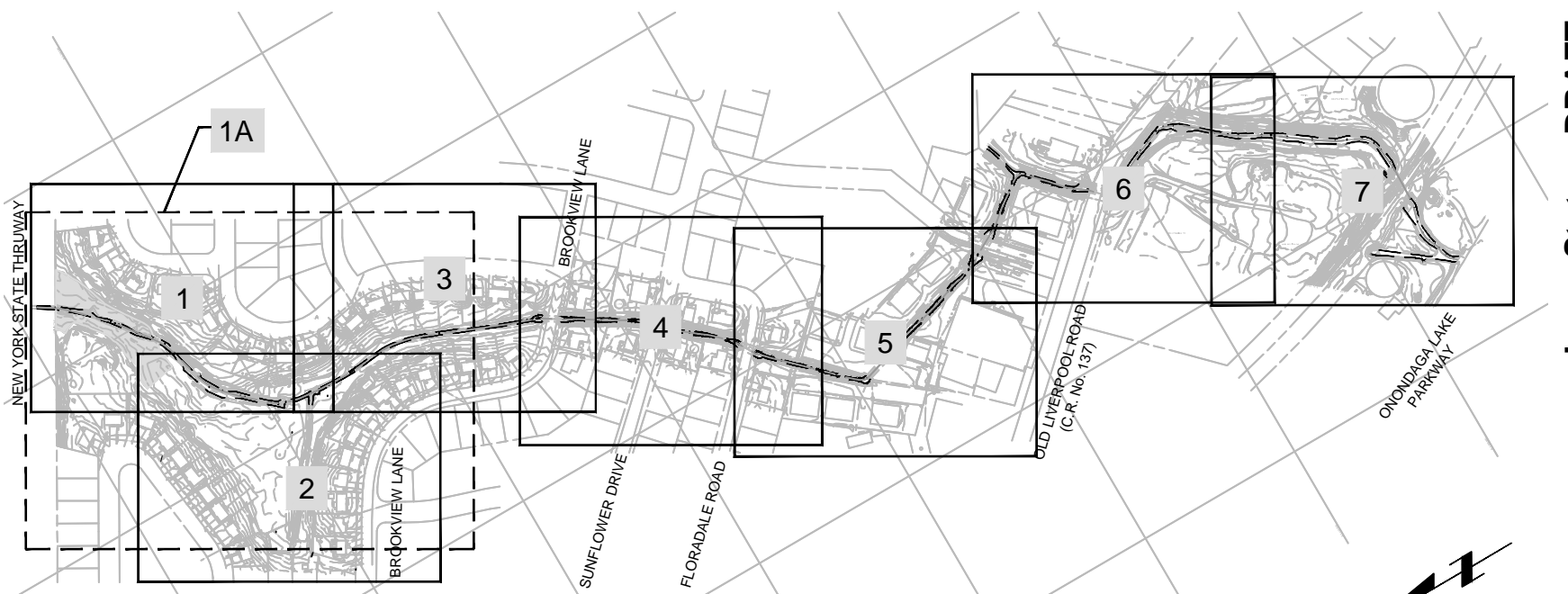
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- 5) The minimum thickness of the armor layer is directly related to the D_{50} , typically 1.5 times the D_{50} size. For placement in the wet, the armor layer thickness should be increased an additional 50 percent, totaling 2.25 times the D_{50} size. In summary, the armor layer for middle reach of Bloody Creek should have minimum thickness of 4 inches for dry placement and 6 inches for wet placement. From a constructability perspective, use a minimum armor layer thickness of 2 to 3 inches for the upper reach.

APPENDIX B

Issue Status: DRAFT

KEY MAP
NOTES AND
TYPICAL LEGEND

LOCKHEED MARTIN CORPORATION
WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK
Project No.: 60303286 Date: FEBRUARY 2014



KEY MAP

TYPICAL LEGEND

	FLAG POLE
	LIGHT POLE
	UTILITY POLE / GUY WIRE
	SANITARY MANHOLE
	UTILITY MANHOLE
	DRAINAGE STRUCTURES
	CATCH BASIN
	DRAINAGE MANHOLE
	FENCE
	CONIFEROUS TREE
	DECIDUOUS TREE
	PROPERTY LINE
	GUARD RAIL
	OVERHEAD WIRES
	RETAINING WALL
	TOPOGRAPHY (1 FT. INTERVAL)
	STREAM
	EASEMENT
	ORDINARY HIGH WATER
	EXISTING WETLAND BOUNDARY

PROJECT RESTORATION LEGEND

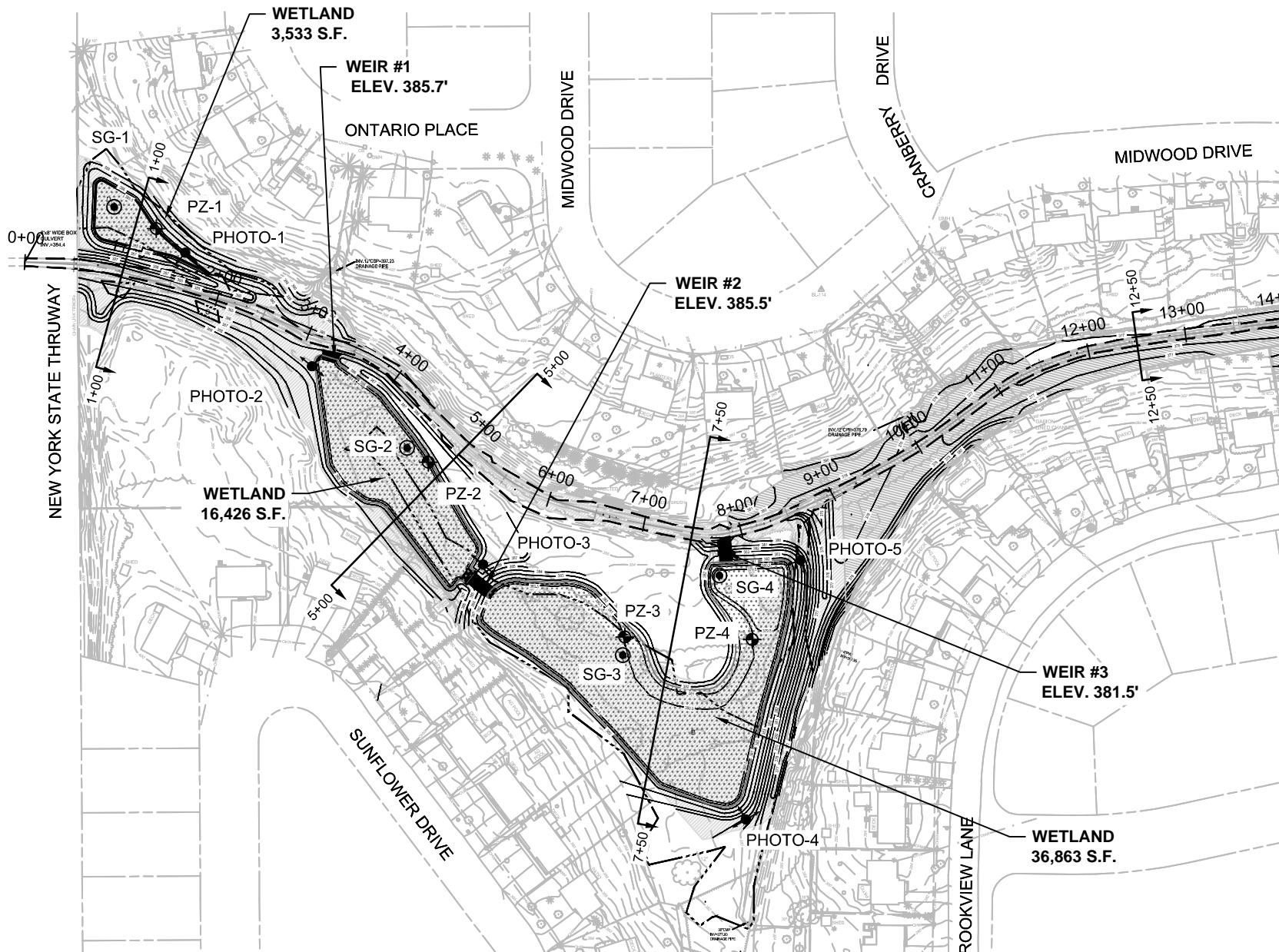
	LIMITS OF REMEDIAL EXCAVATION
	PROPOSED FINAL GRADING CONTOUR (1 FT.)
	WETLAND ELEVATION CONTROL WEIR LOCATION
	PROPOSED WETLAND AREA
	PROPOSED WETLAND PIEZOMETER LOCATION
	PROPOSED WETLAND MONITORING PHOTOGRAPH LOCATION (MULTIPLE VIEWS)
	PROPOSED WETLAND MONITORING STAFF GAUGE

DRAWING PACKAGE NOTE:

1. BLOCKS SHOWN ON THE KEY MAP DENOTE THE LOCATIONS OF FIGURES RP-1 THROUGH RP-7.

MAPPING REFERENCES:

1. BASE MAP SOURCE: IANUZI & ROMANS, P.C. AND CT MALE ASSOCIATES P.C.
2. THE VALUES SHOWN ARE BASED ON NEW YORK (CENTRAL ZONE) STATE PLANE COORDINATE SYSTEM NORTH AMERICAN DATUM 1983.



NOTE:
FOR TYPICAL LEGEND SEE DRAWING RP-LEG.

TOTAL AREA OF IMPACTED EXISTING WETLANDS	=	49,657 S.F.
TOTAL AREA OF RESTORED / NEW WETLANDS	=	56,822 S.F.

Issue Status: DRAFT

**RESTORATION PLAN
RP-1A
WETLAND AREA OVERVIEW**

**LOCKHEED MARTIN CORPORATION
WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK**

Project No.: 60303286 Date: AUGUST 2014



RP-1A

Issue Status: DRAFT

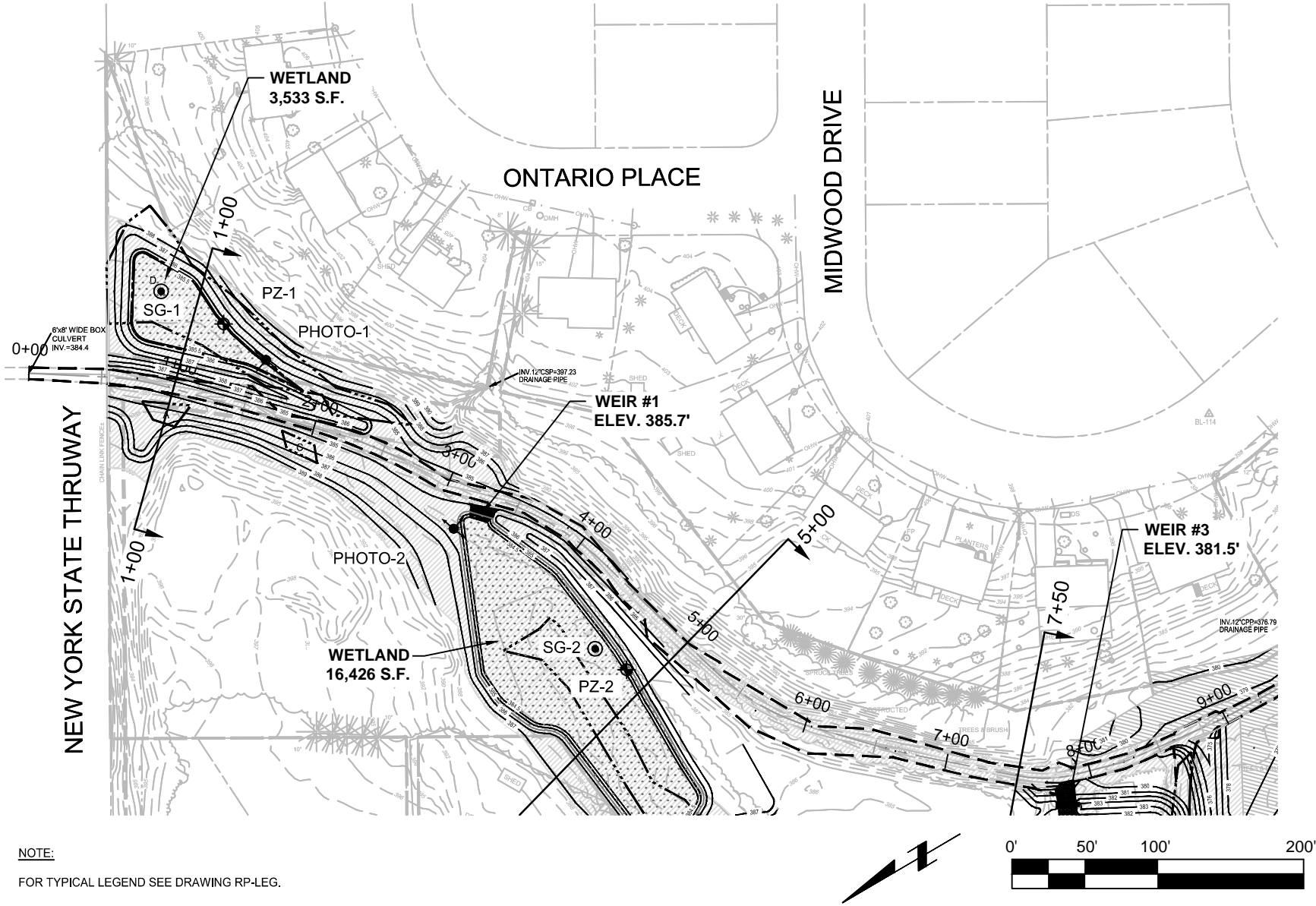


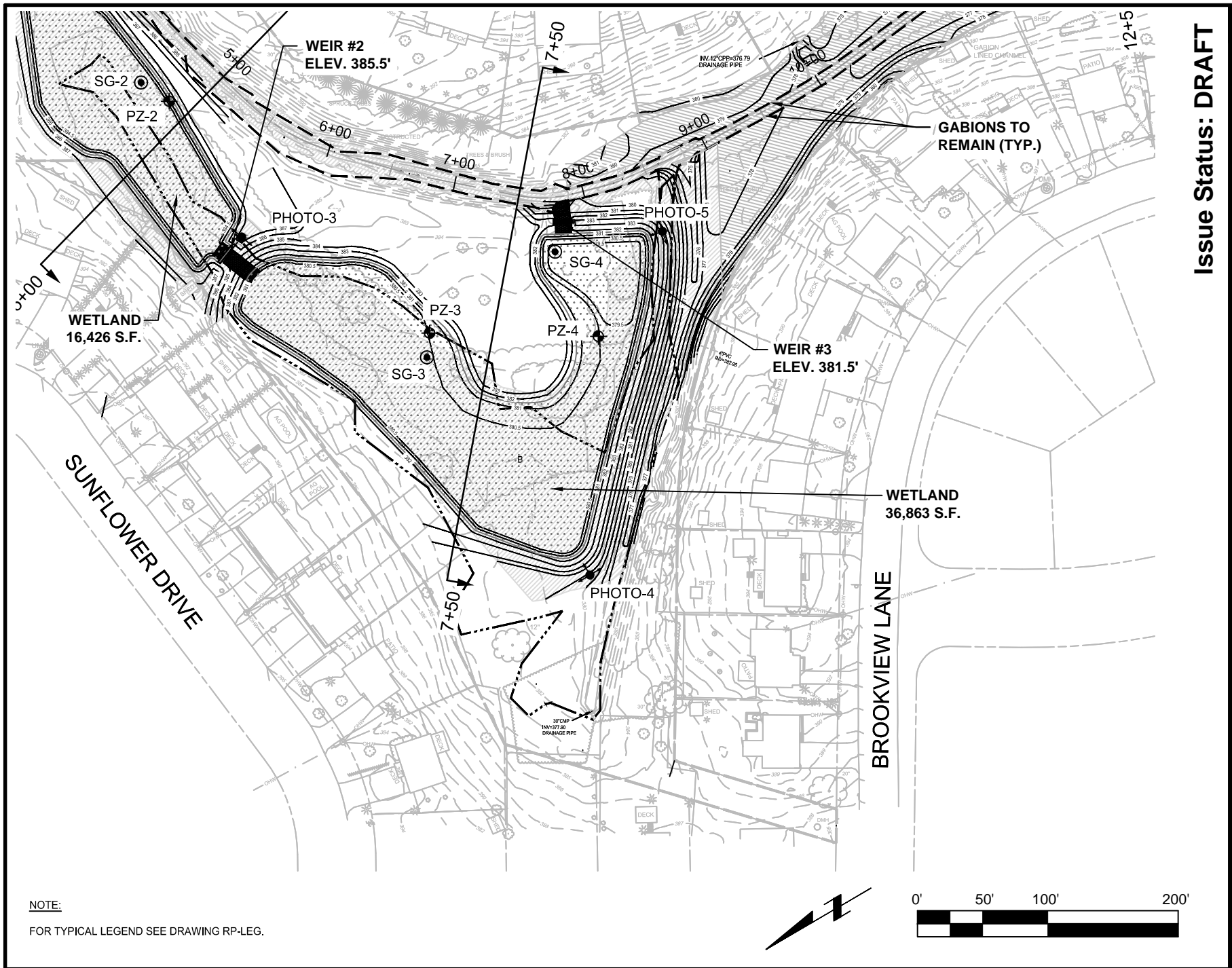
RP-1

RESTORATION PLAN
RP-1

LOCKHEED MARTIN CORPORATION
WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK

Project No.: 60303286 Date: FEBRUARY 2014





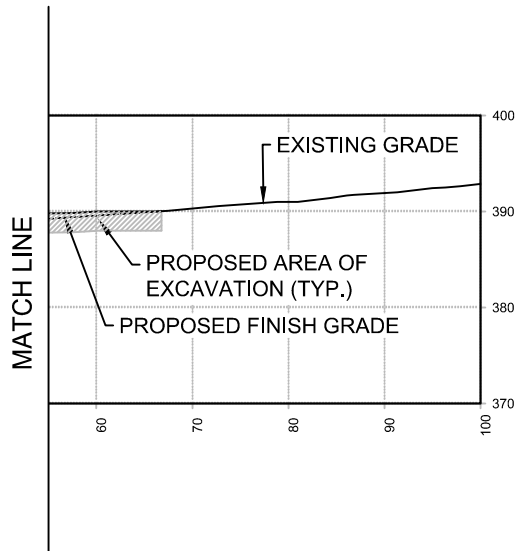
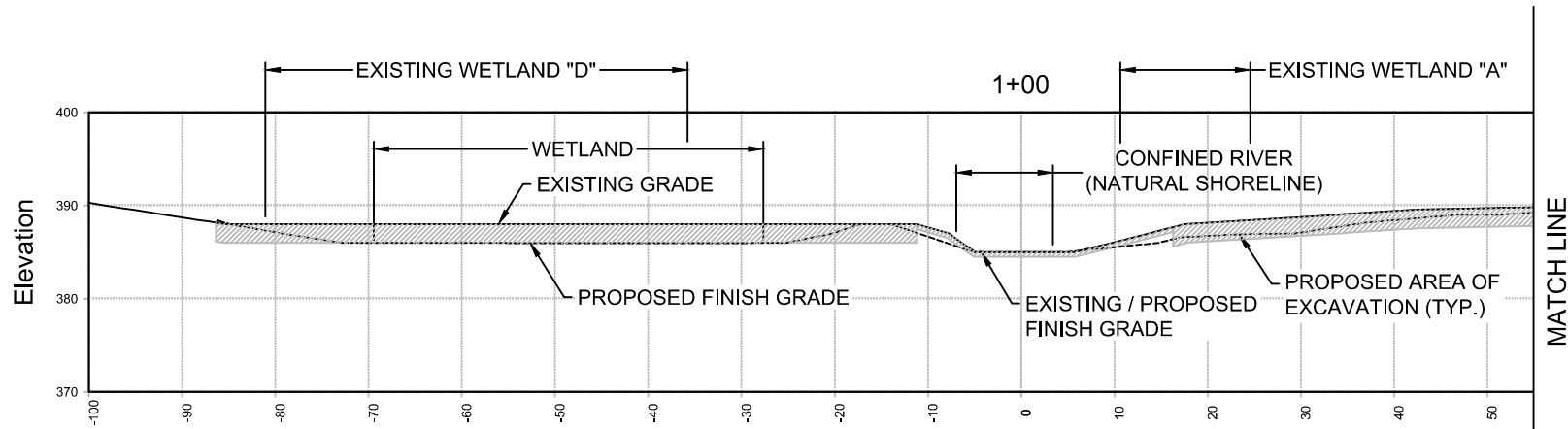
Issue Status: DRAFT

RESTORATION PLAN
RP-2

LOCKHEED MARTIN CORPORATION
WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK
Project No.: 60303286 Date: AUGUST 2014



RP-2

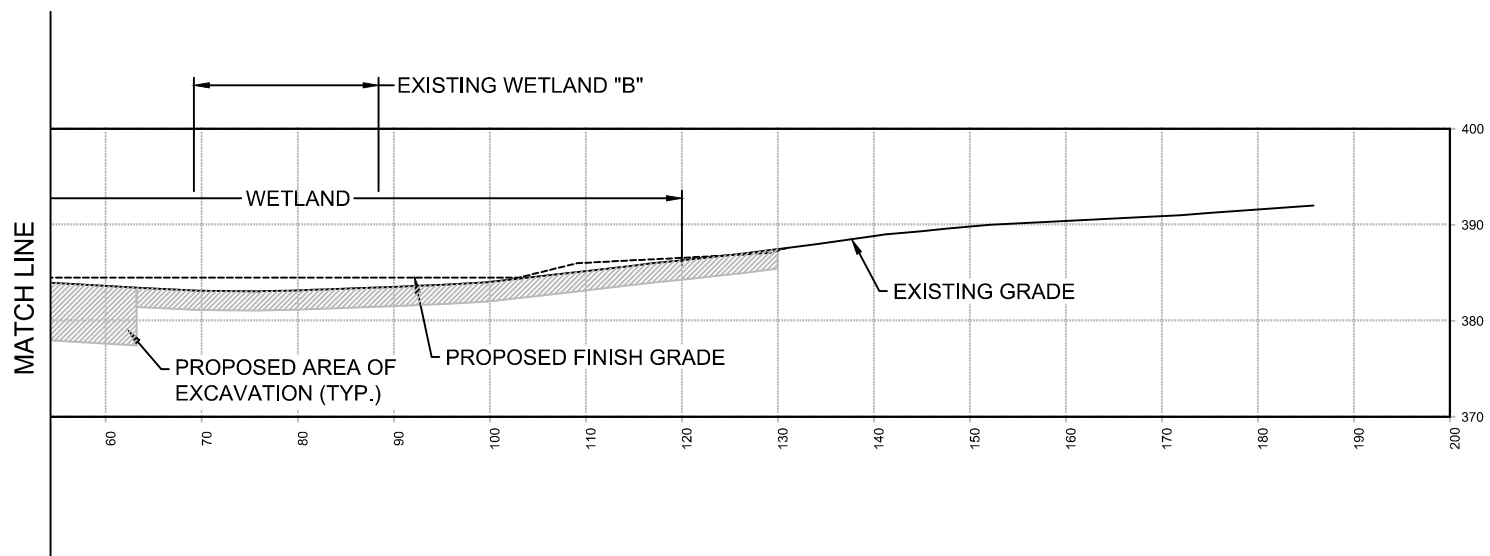
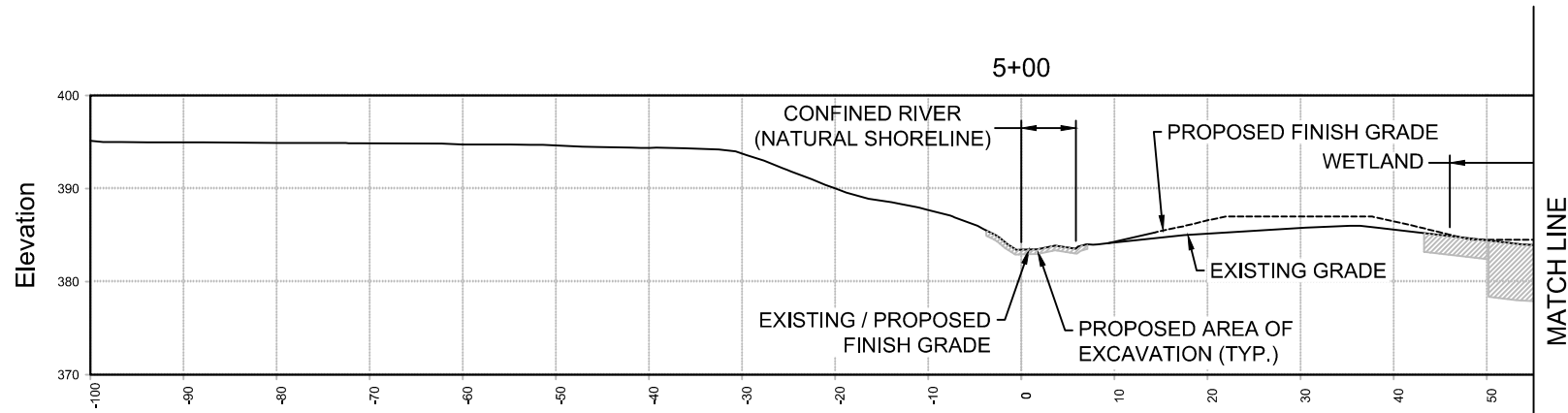


Issue Status: DRAFT

RESTORATION SECTION
RP-SEC-1
STATION 1+00

LOCKHEED MARTIN CORPORATION
WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK
Project No.: 60303286 Date: FEBRUARY 2014

AECOM
RP-SEC-1

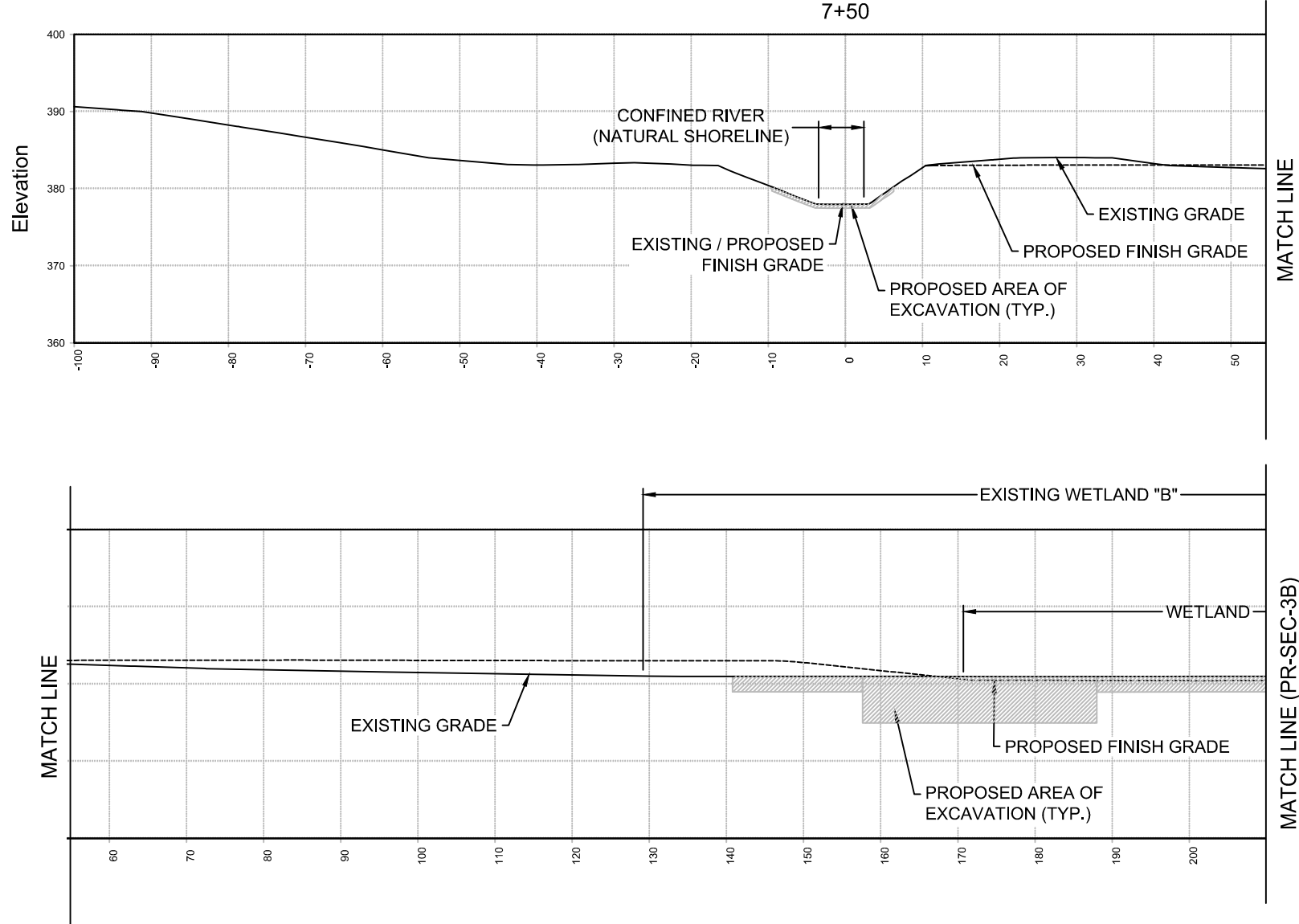


Issue Status: DRAFT

RESTORATION SECTION
RP-SEC-2
STATION 5+00

LOCKHEED MARTIN CORPORATION
WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK
Project No.: 60303286 Date: FEBRUARY 2014

ALCOM
RP-SEC-2



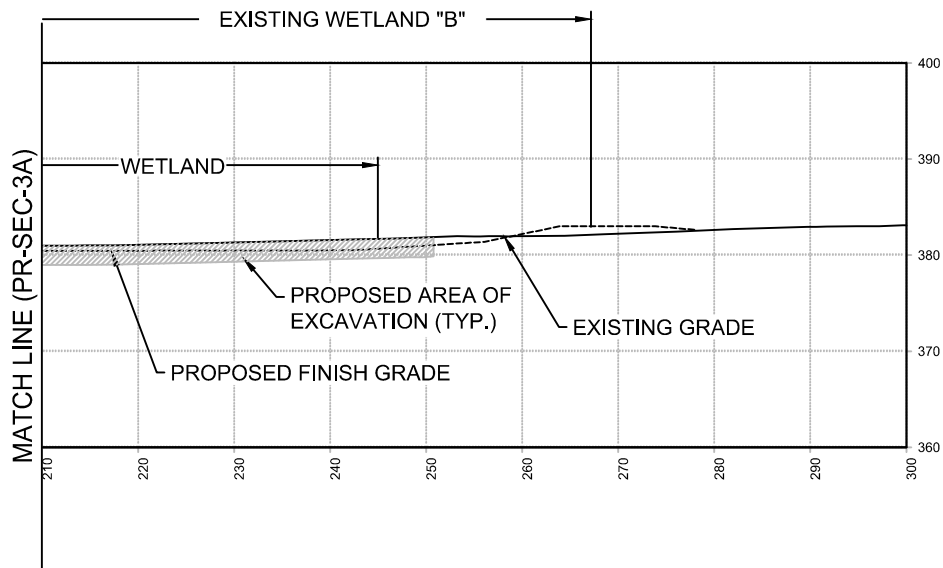
Issue Status: DRAFT

RESTORATION SECTION
RP-SEC-3A
STATION 7+50

LOCKHEED MARTIN CORPORATION
WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK
Project No.: 60303286 Date: FEBRUARY 2014



RP-SEC-3A



Issue Status: DRAFT

RESTORATION SECTION
RP-SEC-3B
STATION 7+50

LOCKHEED MARTIN CORPORATION
WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK

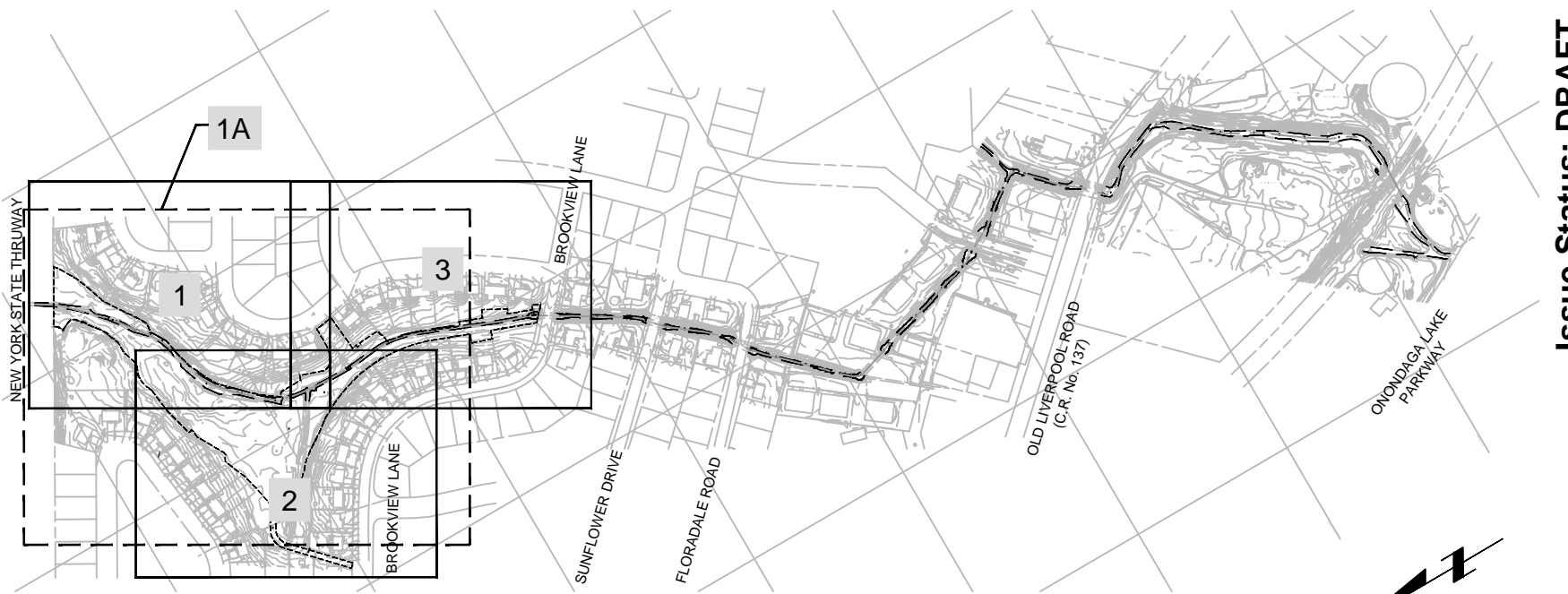
Project No.: 60303286 Date: FEBRUARY 2014



RP-SEC-3B

APPENDIX C

Issue Status: DRAFT



KEY MAP

TYPICAL LEGEND

FP	FLAG POLE
LP	LIGHT POLE
UP	UTILITY POLE / GUY WIRE
SMH	SANITARY MANHOLE
UMH	UTILITY MANHOLE
DS	DRAINAGE STRUCTURES
CB	CATCH BASIN
DMH	DRAINAGE MANHOLE
F	FENCE
CT	CONIFEROUS TREE
DT	DECIDUOUS TREE
PL	PROPERTY LINE
GR	GUARD RAIL
OW	OVERHEAD WIRES
RW	RETAINING WALL
TO	TOPOGRAPHY (1 FT. INTERVAL)
ST	STREAM
EA	EASEMENT
OH	ORDINARY HIGH WATER

PROJECT PLANTING LEGEND

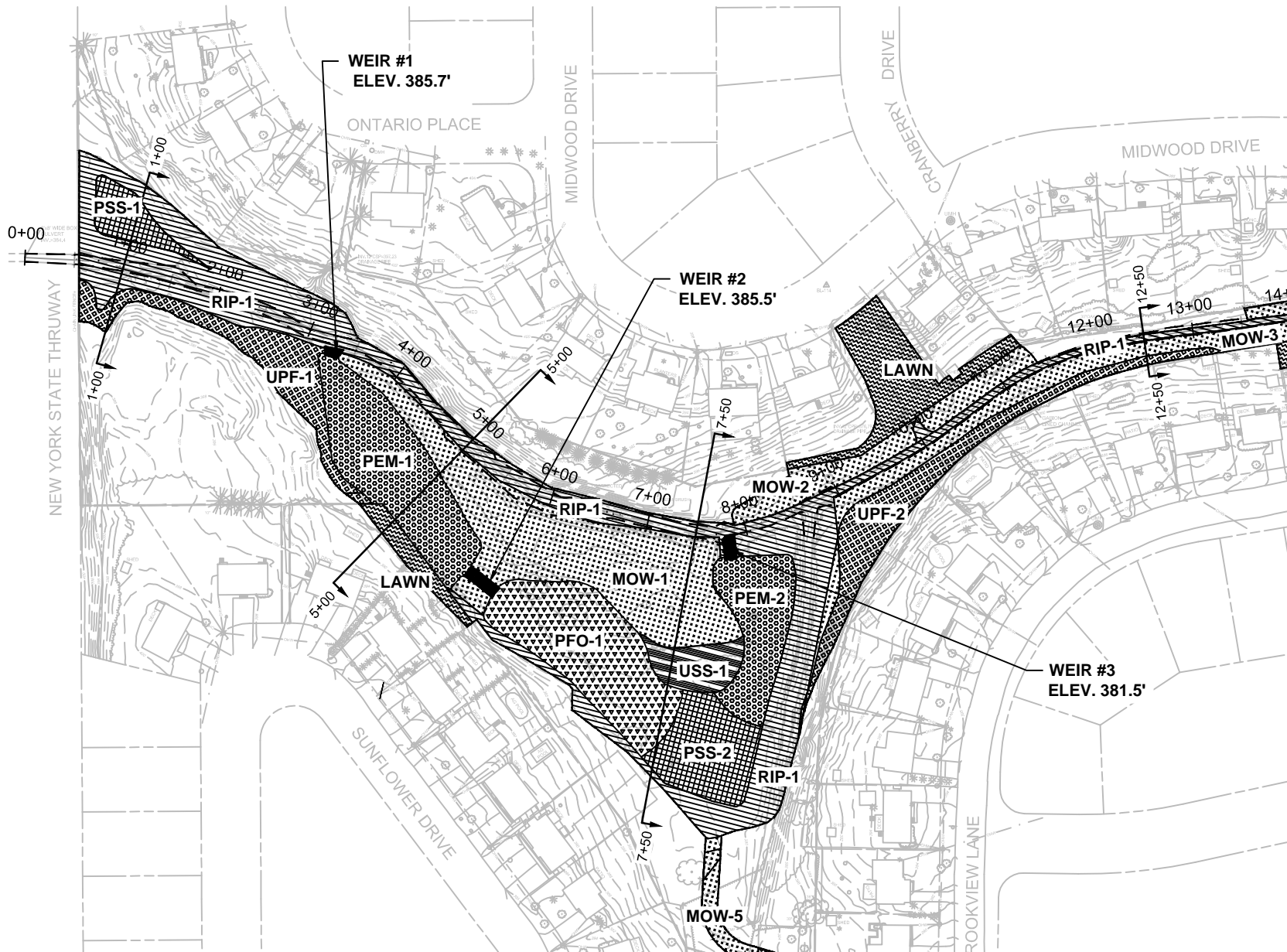
WE	WETLAND ELEVATION CONTROL WEIR LOCATION
PSS	PALUSTRINE SHRUB / SCRUB
PFO	PALUSTRINE FORESTED
PEM	PALUSTRINE EMERGENT
UPF	FORESTED UPLAND
USS	SHRUB / SCRUB UPLAND
MOW	UPLAND MEADOW
RIP	RIPARIAN (PSS / PFO)
LAWN	LAWN

DRAWING PACKAGE NOTE:

1. BLOCKS SHOWN ON THE KEY MAP DENOTE THE LOCATIONS OF FIGURES PP-1 THROUGH PP-3.

MAPPING REFERENCES:

1. BASE MAP SOURCE: IANUZI & ROMANS, P.C. AND CT MALE ASSOCIATES P.C.
2. THE VALUES SHOWN ARE BASED ON NEW YORK (CENTRAL ZONE) STATE PLANE COORDINATE SYSTEM NORTH AMERICAN DATUM 1983.



NOTE:
FOR TYPICAL LEGEND SEE DRAWING PP-LEG.

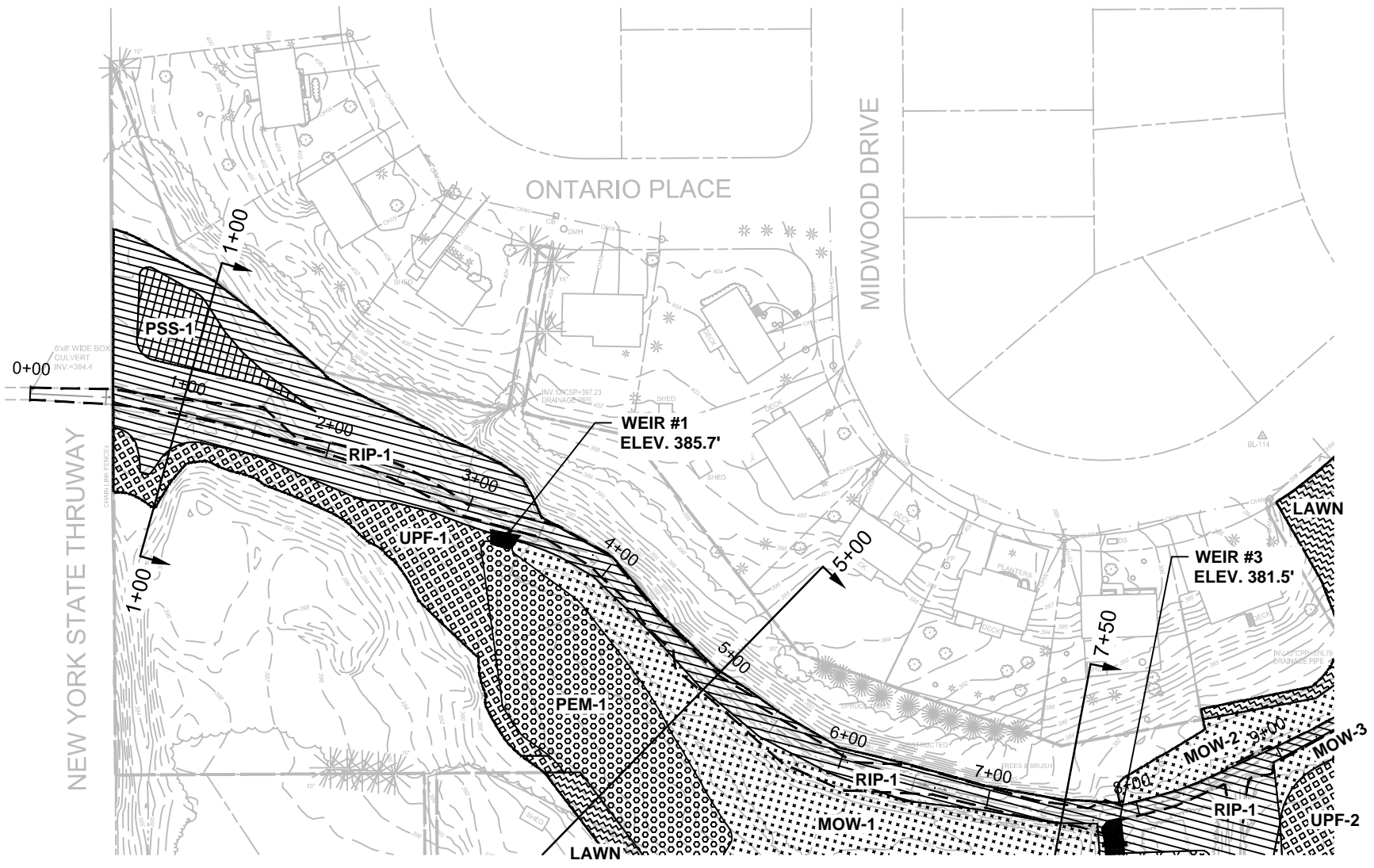
Issue Status: DRAFT

LOCKHEED MARTIN CORPORATION
WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK
Project No.: 60303286 Date: AUGUST 2014

PLANTING PLAN
PP-1A
WETLAND AREA OVERVIEW



PP-1A



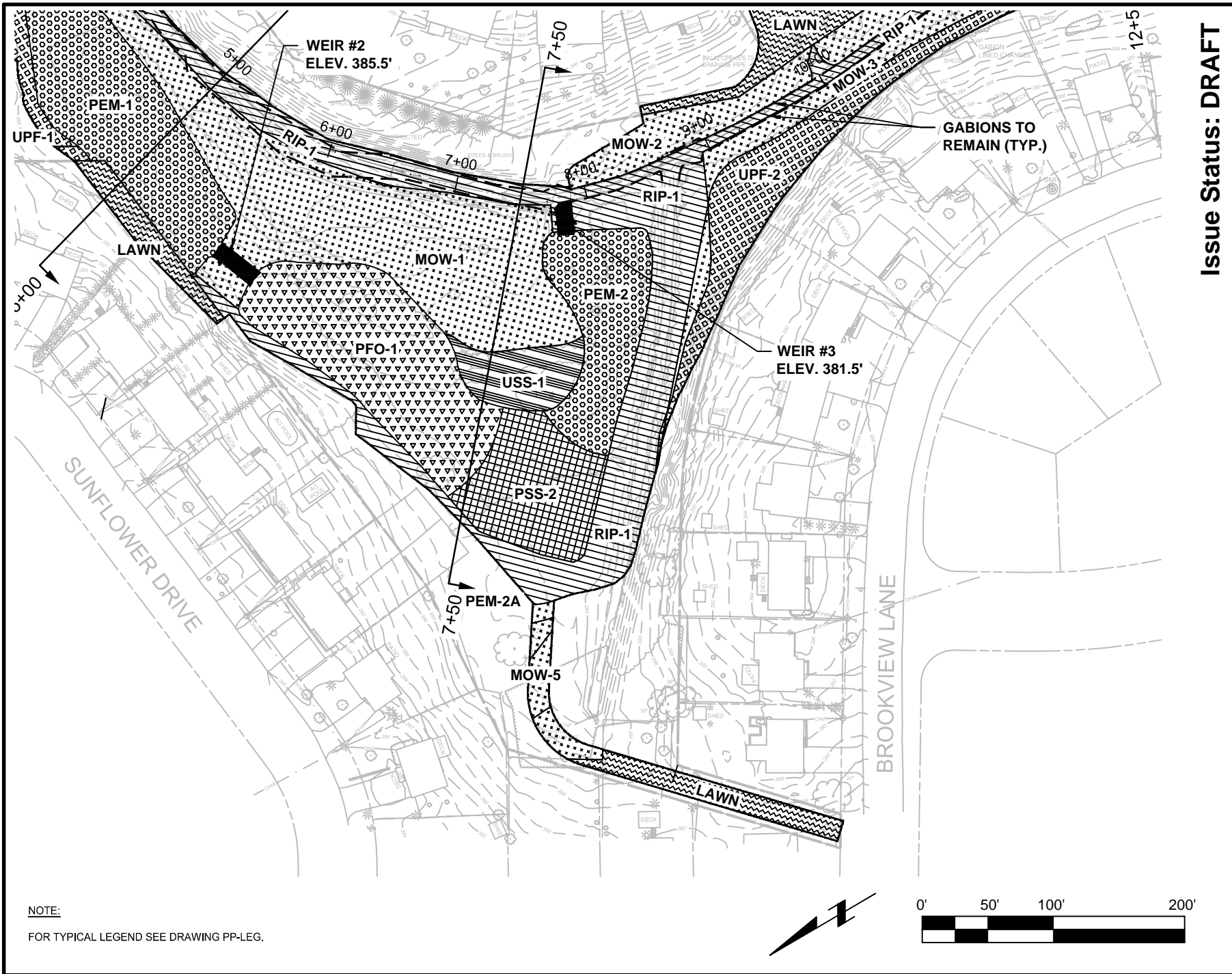
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PLANTING PLAN
PP-1

LOCKHEED MARTIN CORPORATION
WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK
Project No.: 60303286 Date: AUGUST 2014



PP-1



Issue Status: DRAFT

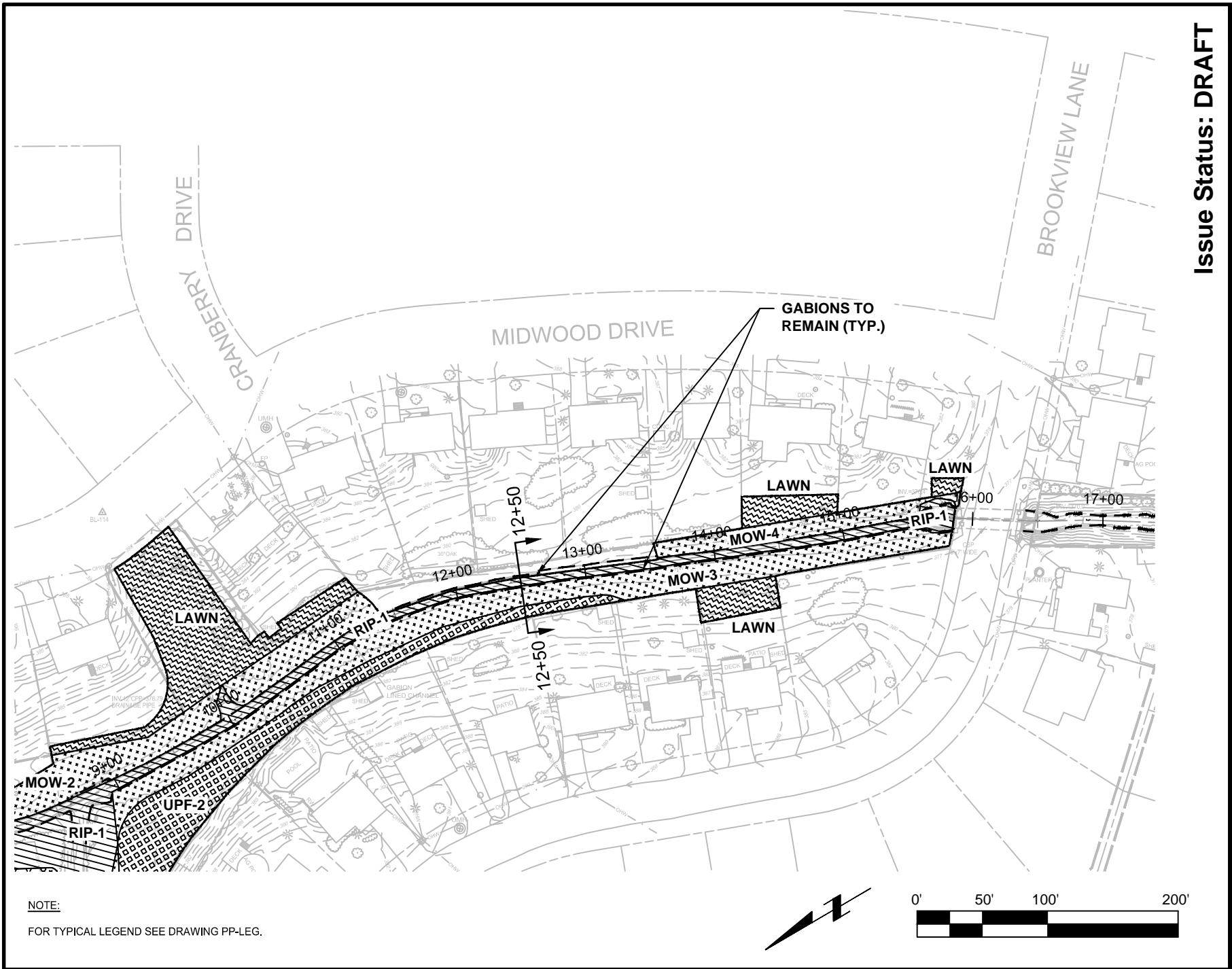
PLANTING PLAN
PP-2

LOCKHEED MARTIN CORPORATION
WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK

Project No.: 60303286 Date: AUGUST 2014

AECOM

PP-2



Issue Status: DRAFT

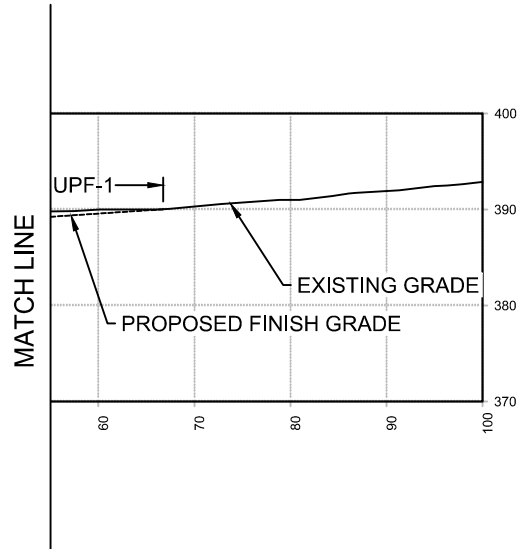
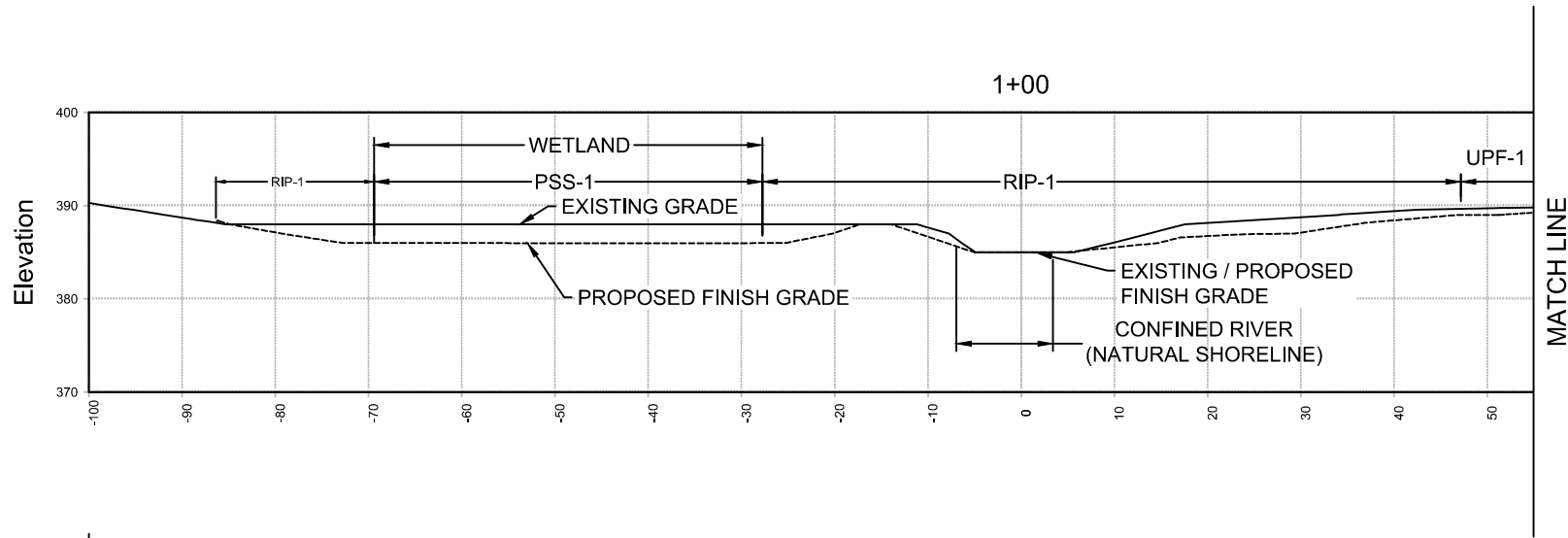
PLANTING PLAN
PP-3

LOCKHEED MARTIN CORPORATION
WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK

Project No.: 60303286 Date: FEBRUARY 2014



PP-3

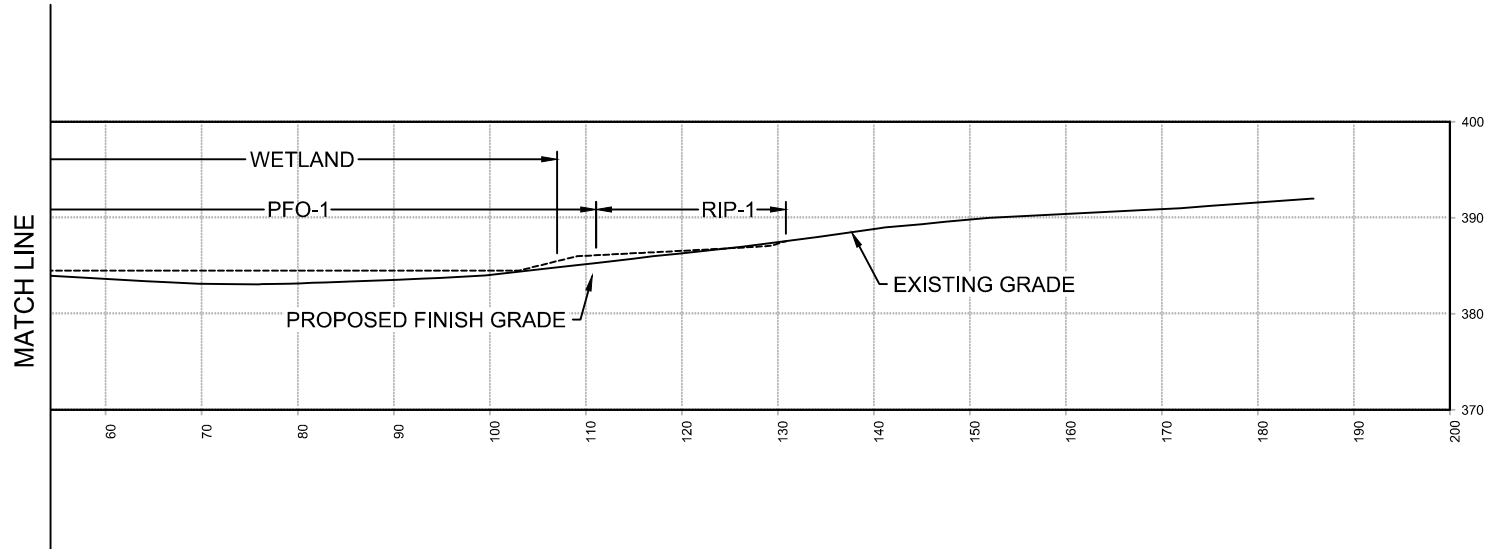
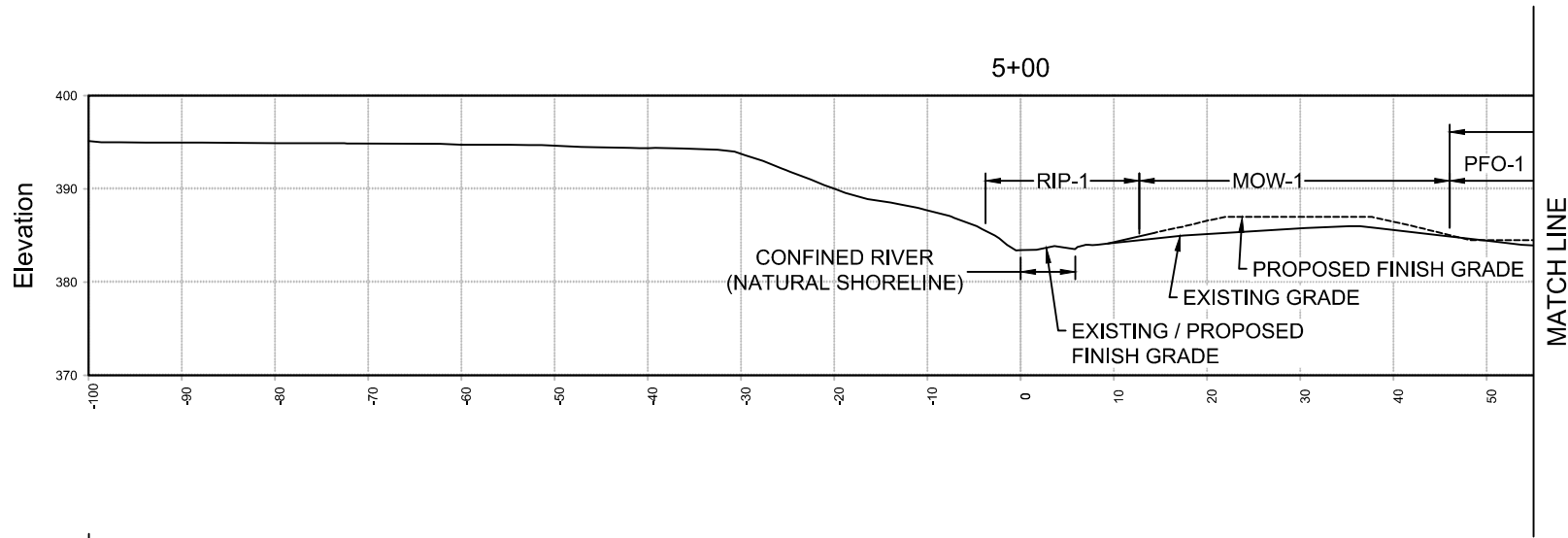


Issue Status: DRAFT

PLANTING SECTION
PP-SEC-1
STATION 1+00

LOCKHEED MARTIN CORPORATION
WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK
Project No.: 60303286 Date: FEBRUARY 2014

AECOM
PP-SEC-1

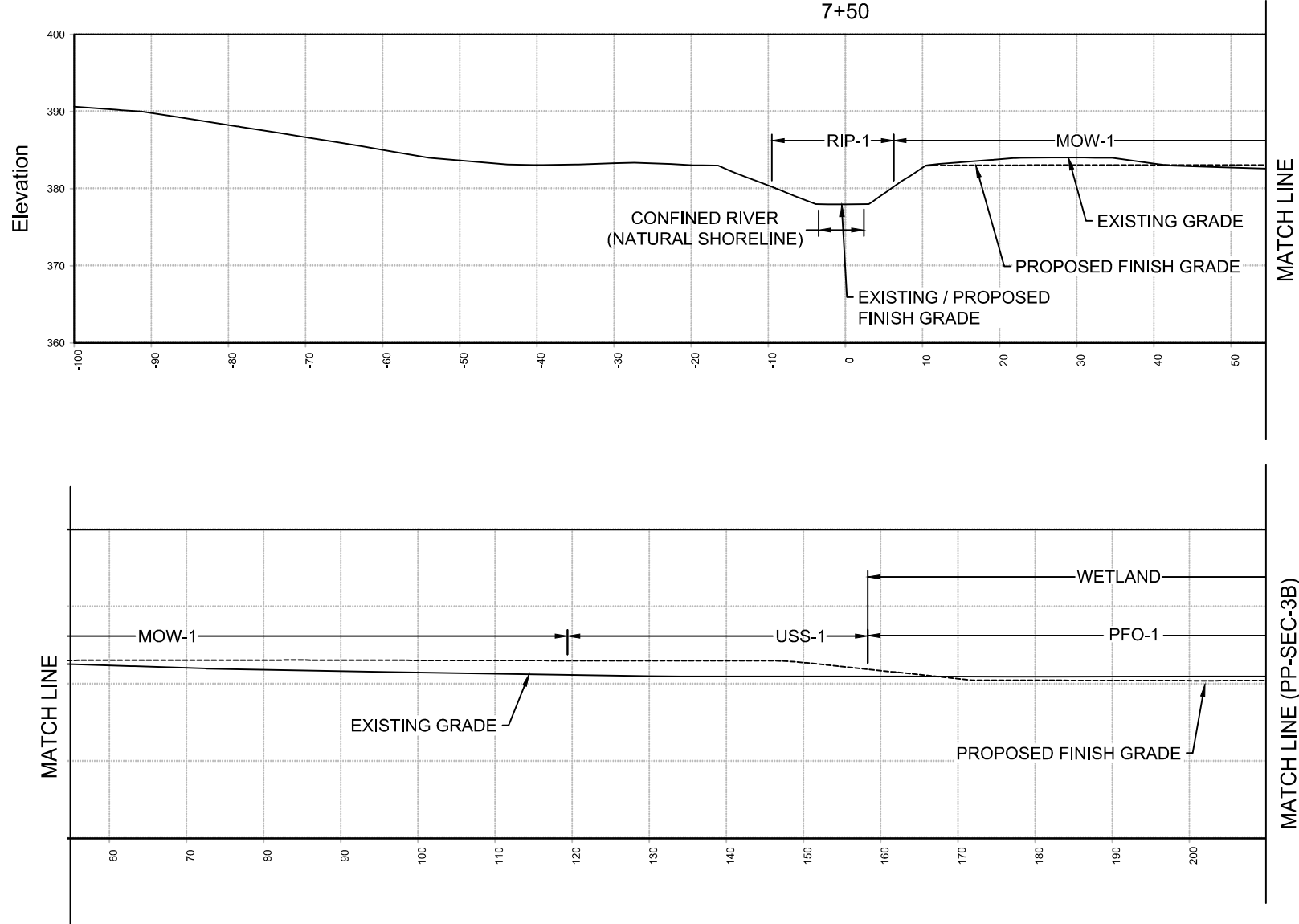


Issue Status: DRAFT

PLANTING SECTION
PP-SEC-2
STATION 5+00

LOCKHEED MARTIN CORPORATION
WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK
Project No.: 60303286 Date: FEBRUARY 2014

AECOM
PP-SEC-2

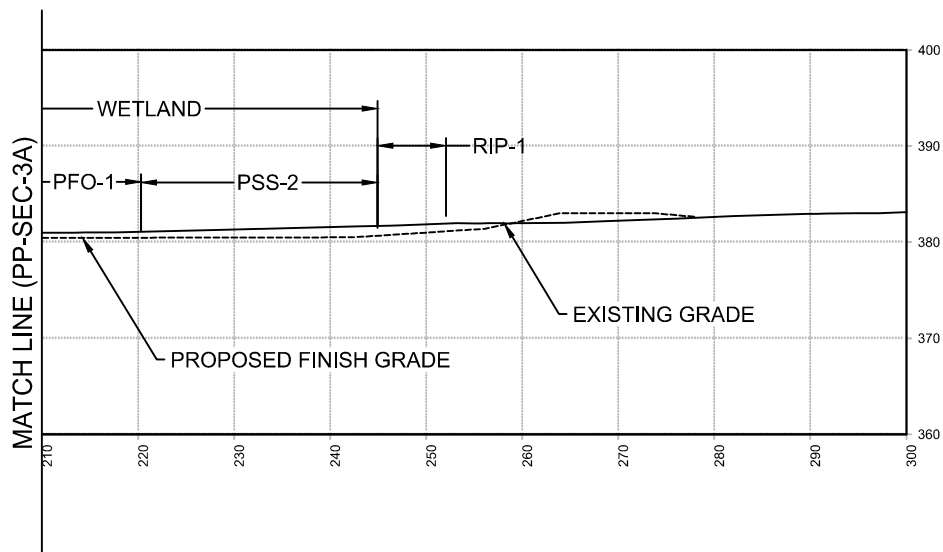


Issue Status: DRAFT

PLANTING SECTION
PP-SEC-3A
STATION 7+50

LOCKHEED MARTIN CORPORATION
WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK
Project No.: 60303286 Date: FEBRUARY 2014

AECOM
PP-SEC-3A



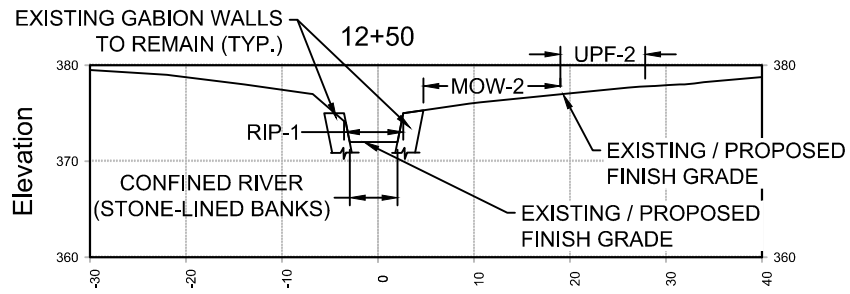
Issue Status: DRAFT

PLANTING SECTION
PP-SEC-3B
STATION 7+50

LOCKHEED MARTIN CORPORATION
WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK
Project No.: 60303286 Date: FEBRUARY 2014



PP-SEC-3B



Issue Status: DRAFT

LOCKHEED MARTIN CORPORATION
 WEST BRANCH OF BLOODY BROOK
 ONONDAGA COUNTY, NEW YORK
 Project No.: 60303286 Date: FEBRUARY 2014

PLANTING SECTION
 PP-SEC-4
 STATION
 12+50

AECOM
 PP-SEC-4

APPENDIX D

Technical Memorandum

Hydraulic Analysis West Branch of Bloody Brook Onondaga County, New York

Prepared for:

AECOM
40 British American Boulevard
Latham, New York 12110

Prepared by:

AECOM
500 Southborough Drive
South Portland, Maine 04106

AECOM Project No. 60303286

January 2014

TABLE OF CONTENTS

1	INTRODUCTION	1
1.1	Project Location	1
1.2	Technical Approach	1
1.2.1	Data Review	1
1.2.2	USGS StreamStats Review	1
1.2.3	Hydraulic Modeling (HEC-RAS)	1
2	DATA REVIEW	1
3	USGS STREAMSTATS REVIEW	2
4	HYDRAULIC MODELING (HEC-RAS)	2
4.1	Existing Conditions Model	2
4.1.1	Model Construction	2
4.1.2	Model Calibration	3
4.2	Proposed Conditions Model	3
4.2.1	Model Construction	3
4.2.2	Monthly Maximum Event	3
5	RECOMMENDATIONS	4
	REFERENCES	4

TABLES

Table 1 - Water Depth Summary at Gage Location

Table 2 - Monthly Maximum Water Depth Summary at Gage Location

FIGURES

Figure 1 - Project Location Map

Figure 2 – Grading Plan

Figure 3 - Water Depth Summary from July 31, 2012 to November 5, 2012

Figure 4 - Water Depth Summary from April 12, 2013 to October 21, 2013

Figure 5 - Drainage Area for WBBB Upstream of Brookview Lane (USGS, 2013)

Figure 6 - Existing Conditions HEC-RAS Model Extent

Figure 7 - Proposed Conditions HEC-RAS Model Extent

APPENDICES

Appendix A - USGS StreamStats Estimates

Appendix B - HEC-RAS Existing Conditions Model Output

Appendix C - HEC-RAS Proposed Conditions Model Output

1 INTRODUCTION

The following memorandum summarizes the hydraulic analyses performed for a portion of the West Branch of Bloody Brook (WBBB) in Onondaga County, New York. The hydraulic analysis was performed as part of remedial activities along WBBB. The objective of this analysis was to determine the adequate height of proposed weir #1 to control flow into a wetland area adjacent to WBBB following the restoration activities. The purpose of the weir is to allow flow to the wetland approximately once a month during the spring, summer and fall months (assumed to be March to October). The weir should not permit a significant continuous flow to the wetland. The following memorandum summarizes the technical approach and the results of the hydraulic analysis.

1.1 Project Location

This hydraulic analysis focused on a portion of WBBB running from a culvert on the southern edge of the New York State Thruway (Interstate 90) to a culvert crossing at Brookview Lane, as shown on Figure 1. The proposed weir location is shown on the grading plan shown on Figure 2.

1.2 Technical Approach

The hydraulic analysis consisted of the following three tasks:

1.2.1 Data Review

A stream gage was deployed along WBBB for portions of 2012 and 2013. The gage was located approximately 150 feet upstream of the Brookview Lane culvert location. The stream gage recorded water depth on hourly intervals from July 31, 2012 to November 5, 2012 and April 12, 2013 to October 21, 2013. This data was analyzed to determine a stream elevation that would correspond to a monthly maximum level at the stream gage location, which through the use of a hydraulic model, would be used to determine an adequate weir setting that would correspond to this monthly maximum stream elevation.

1.2.2 USGS StreamStats Review

The United States Geological Survey (USGS) StreamStats web utility for New York was reviewed for basin characteristics and streamflow information for the WBBB drainage basin. The information gathered through StreamStats was used to compare to the flow estimates determined through the data analysis.

1.2.3 Hydraulic Modeling (HEC-RAS)

The hydraulic modeling was conducted using a HEC-RAS model of WBBB, from just downstream of the Thruway culvert to the Brookview Lane culvert location. An existing conditions model was constructed to calibrate the model to field data collected at the stream gage location. The calibrated model was then updated to reflect the proposed design, including the proposed weir locations in the wetland areas. The monthly maximum elevation was run through the proposed conditions model to determine an adequate weir height for weir #1.

2 DATA REVIEW

The water depth data collected at the stream gage location was analyzed to determine an appropriate monthly maximum value. The monthly maximum value was used in the hydraulic model to estimate the wetland weir elevation, as described in Section 4.

The stream gage recorded water depth on hourly intervals from July 31, 2012 to November 5, 2012 and April 12, 2013 to October 21, 2013. The following tables and figures summarize key aspects of the data analysis. Table 1 summarizes the average and maximum water depths and their corresponding water surface elevations (WSE) for each month on record.

Figure 3 is a time series plot of the water depth and corresponding WSE for the 2012 data. Similarly, Figure 4 contains the time series data for the 2013 months. Note that the gage location's channel elevation was approximated to be 370.40 feet based on the average elevation recorded across the stream channel during the installation of the gage.

October 2012 had the lowest maximum depth value of 1.74 feet. The highest depth recorded occurred in September 2013 and was 3.27 feet. The majority of the other months have a maximum depth of approximately 2 feet. Table 2 shows the number of times the 1.74-foot water depth is exceeded each month. For comparison, the next lowest monthly depth of 1.92 feet (from July 2013) is also shown on Table 2. Each month exceeds the 1.74-foot depth at least once, but no more than twice, which occurs for six of the ten months. With the exception of October 2012, each month exceeds the 1.92-foot depth at least once with three months having two depths greater than 1.92 feet. Note that for the number of times exceeded, each event was counted as only one occurrence as some events had two peaks occur within a one day period.

In summary, the depth of 1.92 feet (or a WSE of 372.32 feet) is a close approximation of the maximum monthly water depth based on the ten months of data collected along WBBB. While one month did not reach this elevation (October 2012), the other nine months reached this elevation with only three months having multiple events. On average, this depth was reached 1.2 times per month over the ten month period of record.

3 USGS STREAMSTATS REVIEW

The USGS StreamStats for New York utility is a web-based program that enables basin delineation and peak flow estimates for locations within New York. As a reference to use for the hydraulic analysis, the StreamStats tool was used to delineate the drainage basin for the project location using the Brookview Lane culvert crossing as the starting delineation point. Figure 5 shows the drainage basin delineated by StreamStats, which measures 0.99 square miles. The peak flow estimates were obtained to use as a comparison to the flow values calculated for the hydraulic modeling. Appendix A contains the StreamStats output with the basin characteristics and peak flow estimates. A 1.25-year flow is estimated to be 54.5 cubic feet per second (cfs) at this location.

4 HYDRAULIC MODELING (HEC-RAS)

Since the gage location is located approximately 1,150 feet downstream of the proposed wetland weir #1 location, a hydraulic model was constructed as a way to relate the stream data collected at the gage to the proposed weir location. First, an existing conditions model was constructed and calibrated to depth and velocity data collected at the gage during an August 2013 field visit. The calibrated model was then adjusted to incorporate the proposed wetland design and run for the monthly maximum flow condition determined from the data analysis. The following sections describe the modeling in greater detail.

4.1 Existing Conditions Model

4.1.1 Model Construction

The existing conditions model was constructed using the HEC-GeoRAS toolkit for ArcGIS. HEC-GeoRAS is able to process geospatial data and create importable HEC-RAS geometry data. A three-dimensional surface generated from the existing conditions survey was imported into HEC-GeoRAS (AECOM, 2013). The center lines for the main channel and the wetland and cross-sectional cut lines were traced within ArcGIS. HEC-GeoRAS exports the cross-sectional elevation data and calculates the reach lengths to enable a clean import into the HEC-RAS model. Figure 6 shows the extent of the existing conditions model.

The lower portion of WBBB (i.e., downstream of the confluence with the wetland) is confined within a stone gabion channel, as seen on Figure 3. The detail of the gabion channel is not accurately represented in the three-dimensional surface used to cut the cross-section elevation data in HEC-GeoRAS. Therefore, the gabion channels were manually inserted into the HEC-RAS model based on a typical channel width of 5 feet and a typical wall height of 4 feet.

4.1.2 *Model Calibration*

The existing conditions model was calibrated to a single data point recorded during an August 2013 site visit. During the site visit, a water depth of 0.7 feet and a velocity of 0.40 feet per second were recorded at the gage location. Assuming a rectangular channel shape with a 5 foot width, the flow was calculated to be 1.4 cfs. The HEC-RAS model was given a flow of 1.4 cfs at the gage location and the channel roughness value was adjusted until the model predicted a flow depth of 0.7 feet at the gage location. A main channel Manning's roughness of 0.095 was needed to achieve the recorded depth of 0.7 feet at a flow of 1.4 cfs. While this roughness value is higher than typical values used for constructed channels, the gabion baskets and the jagged nature of the stones within them, along with debris present in the channel (see Figure 3), may be contributing to a higher than typical roughness value for the main channel.

The existing conditions model output for the calibration run is contained in Appendix B. Since only the lower reach of WBBB was of interest in the calibration run, the wetland was assumed to receive a negligible flow for the 1.4 cfs flow condition.

4.2 *Proposed Conditions Model*

4.2.1 *Model Construction*

Similar to the existing conditions HEC-RAS model, HEC-GeoRAS was used to construct the proposed conditions model. A three-dimensional surface of the proposed grading (contours shown on Figure 2) was created and imported into HEC-GeoRAS and used to generate the cross-sectional elevation data. Cross-sections were placed at the three proposed weir locations within the wetland areas. The cross-section locations along the main channel of WBBB were kept in the same locations as the existing conditions model. Since the wetland configurations vary from existing and proposed conditions, the cross-sections in the wetland areas are slightly different for each model. Figure 8 shows the extent of the proposed conditions model.

4.2.2 *Monthly Maximum Event*

As determined in the water depth data analysis from Section 2, the approximate monthly maximum event was determined to be when the gage depth reaches 1.92 feet for a WSE of 372.32 feet. The proposed conditions HEC-RAS model was run at various flow rates until a depth of 1.92 feet was achieved at the gage location. A flow of 9.4 cfs achieved the desired depth.

Initially, the proposed model was run with all of the 9.4 cfs running through the main channel and no flow entering the wetland area. This was done to approximate the water depth at the weir #1 location to guide the initial setting of the weir depth. Then an iteration of model runs was done to refine the weir elevation. The flow distribution between the main channel and the wetland was varied until the WSE at the main channel cross-section upstream of weir #1 (cross-section #36, Station 305) was equal to the wetland WSE upstream of weir #1 (cross-section #35.5). The resulting WSE at the two cross-sections was 385.8 feet and the weir #1 elevation was set at 385.7 feet. The HEC-RAS model output for the monthly maximum flow condition of 9.4 cfs with a weir height of 385.7 feet is included in Appendix C.

5 RECOMMENDATIONS

Based on the data analysis from ten months of recorded water depth data and the hydraulic modeling of existing and proposed conditions, the wetland weir #1 located near river station 3+00 should be set at an elevation of 385.7 feet. This elevation will control flow to the wetland at approximately one event per month based on the ten months of data from 2012 and 2013.

REFERENCES

1. AECOM, 2013. "Existing Conditions Plan, West Branch of Bloody Brook, Onondaga County, New York." November 2013.
2. USGS, 2013. "StreamStats for New York." Accessed via internet on December 3, 2013 (http://water.usgs.gov/osw/streamstats/new_york.html).

Tables

Table 1
Water Depth Summary at Gage Location
Hydraulic Analysis
West Branch of Bloody Brook
Bloody Brook Voluntary Cleanup Program
Onondaga County, New York

Month	Average Depth (ft)	Average WSE (ft)	Maximum Depth (ft)	Maximum WSE (ft)
August 2012	0.55	370.95	2.15	372.55
September 2012	0.55	370.95	3.01	373.41
October 2012	0.60	371.00	1.74	372.14
April 2013 ^A	0.75	371.15	1.95	372.35
May 2013	0.66	371.06	2.19	372.59
June 2013	0.75	371.15	3.26	373.66
July 2013	0.65	371.05	1.92	372.32
August 2013	0.62	371.02	2.09	372.49
September 2013	0.63	371.03	3.27	373.67
October 2013 ^B	0.64	371.04	1.93	372.33
Full Period	0.64	371.04	3.27	373.67
Notes: A: Partial month, from April 12 to April 30 B: Partial month, from October 1 to October 21				

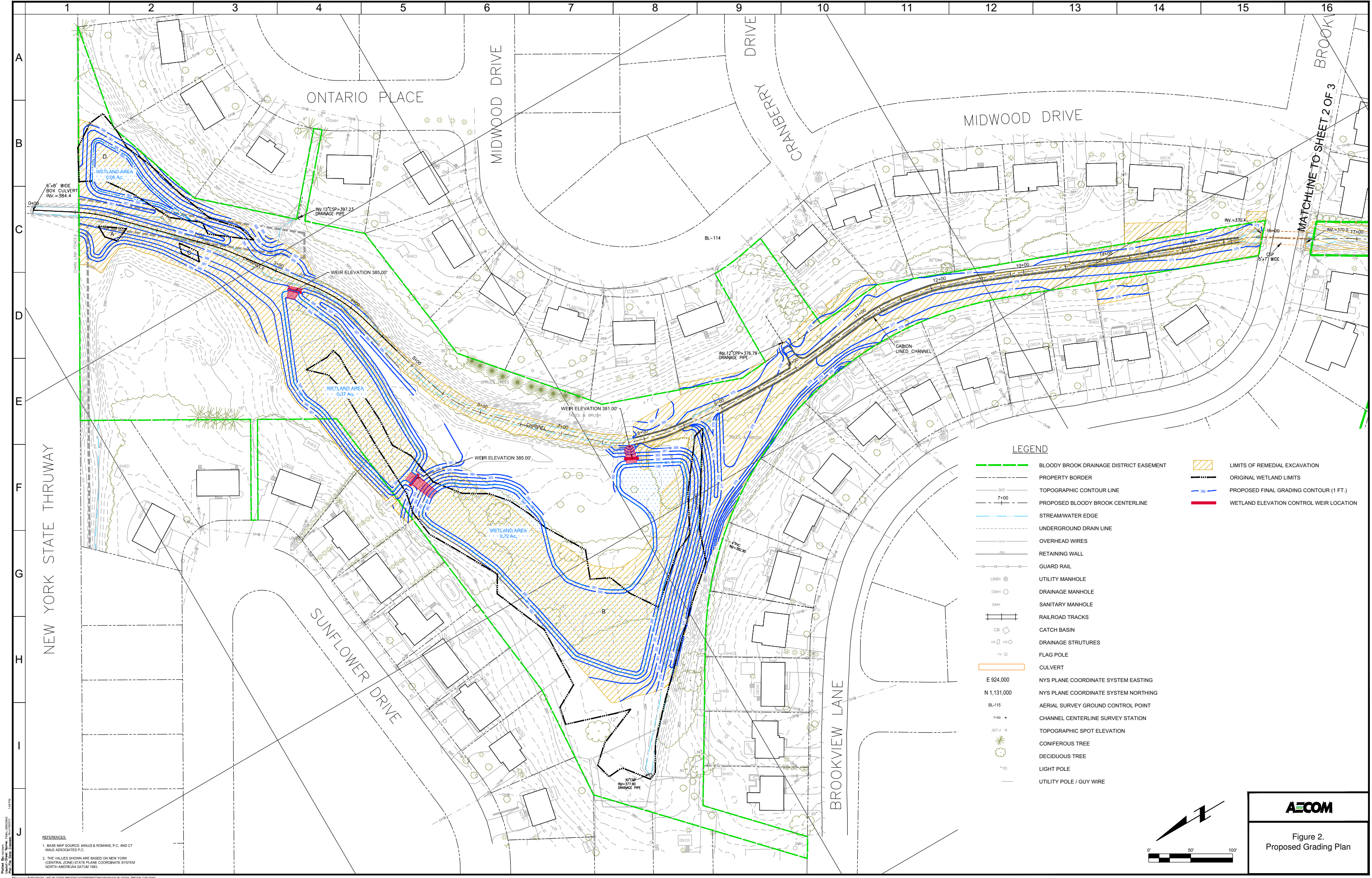
Table 2
Monthly Maximum Water Depth Summary at Gage Location
Hydraulic Analysis
West Branch of Bloody Brook
Bloody Brook Voluntary Cleanup Program
Onondaga County, New York

Month	Number of Times Exceeded	
	Depth = 1.74 ft (WSE = 372.14 ft)	Depth = 1.92 ft (WSE = 372.32 ft)
August 2012	2	2
September 2012	2	1
October 2012	1	0
April 2013 ^A	1	1
May 2013	2	2
June 2013	2	2
July 2013	2	1
August 2013	1	1
September 2013	1	1
October 2013 ^B	2	1
Full Period	16	12
Average per Month	1.6	1.2
Notes: A: Partial month, from April 12 to April 30 B: Partial month, from October 1 to October 21		

Figures

Figure 1
Project Location Map
Hydraulic Analysis
West Branch of Bloody Brook
Bloody Brook Voluntary Cleanup Program
Onondaga County, New York





NEW YORK STATE THRUWAY

SUNFLOWER DRIVE

MIDWOOD DRIVE

DRIVE

CRANBERRY

MIDWOOD DRIVE

BROOKVIEW LANE

MATCHLINE TO SHEET 2 OF 3

LEGEND

- BLOODY BROOK DRAINAGE DISTRICT EASEMENT
- PROPERTY BORDER
- TOPOGRAPHIC CONTOUR LINE
- PROPOSED BLOODY BROOK CENTERLINE
- STREAM/WATER EDGE
- UNDERGROUND DRAIN LINE
- OVERHEAD WIRES
- RETAINING WALL
- GUARD RAIL
- UTILITY MANHOLE
- DRAINAGE MANHOLE
- SANITARY MANHOLE
- RAILROAD TRACKS
- CATCH BASIN
- DRAINAGE STRUCTURES
- FLAG POLE
- CULVERT
- NYS PLANE COORDINATE SYSTEM EASTING
- NYS PLANE COORDINATE SYSTEM NORTHING
- AERIAL SURVEY GROUND CONTROL POINT
- CHANNEL CENTERLINE SURVEY STATION
- TOPOGRAPHIC SPOT ELEVATION
- CONIFEROUS TREE
- DECIDUOUS TREE
- LIGHT POLE
- UTILITY POLE / GUY WIRE
- LIMITS OF REMEDIAL EXCAVATION
- ORIGINAL WETLAND LIMITS
- PROPOSED FINAL GRADING CONTOUR (1 FT.)
- WETLAND ELEVATION CONTROL WEIR LOCATION

REFERENCES:
1. BASE MAP SOURCE: IANUZZI & ROMANS, P.C. AND GT
MALE ASSOCIATES P.C.
2. THE VALUES SHOWN ARE BASED ON NEW YORK
(CENTRAL ZONE) STATE PLANE COORDINATE SYSTEM
NORTH AMERICAN DATUM 1983.

AECOM

Figure 2.
Proposed Grading Plan

Figure 3
Water Depth Summary from July 31, 2012 to November 5, 2012
Hydraulic Analysis
West Branch of Bloody Brook
Bloody Brook Voluntary Cleanup Program
Onondaga County, New York

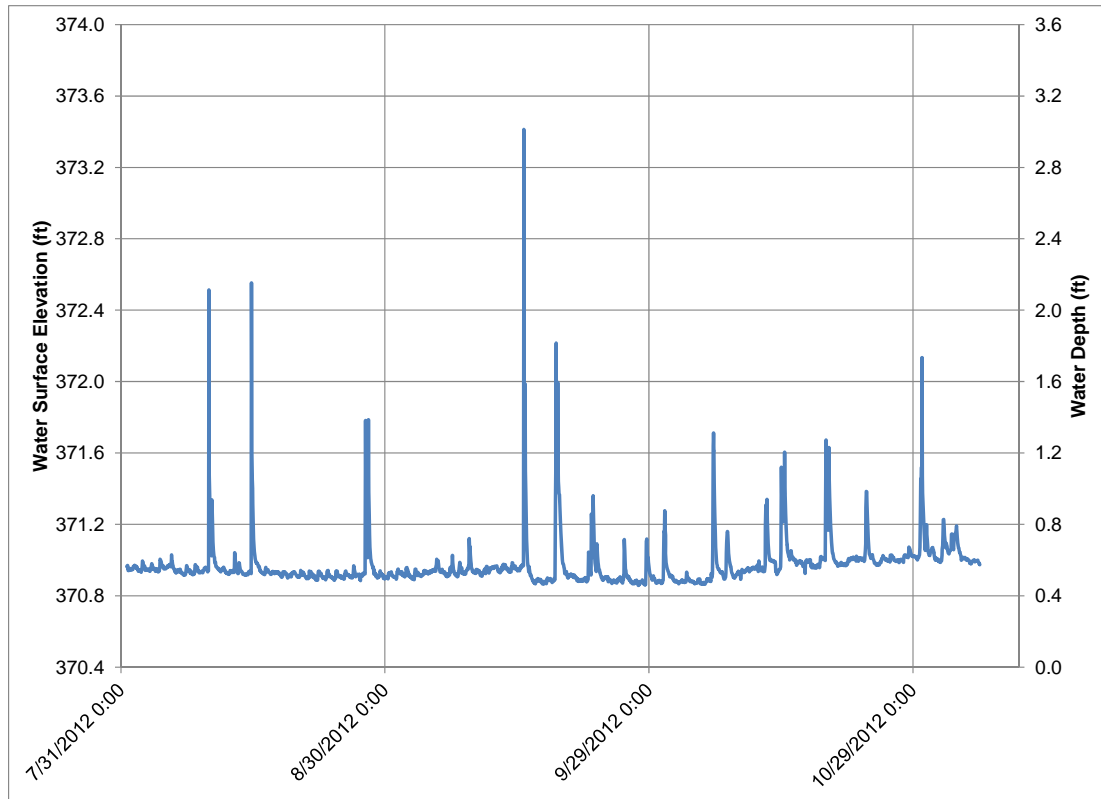
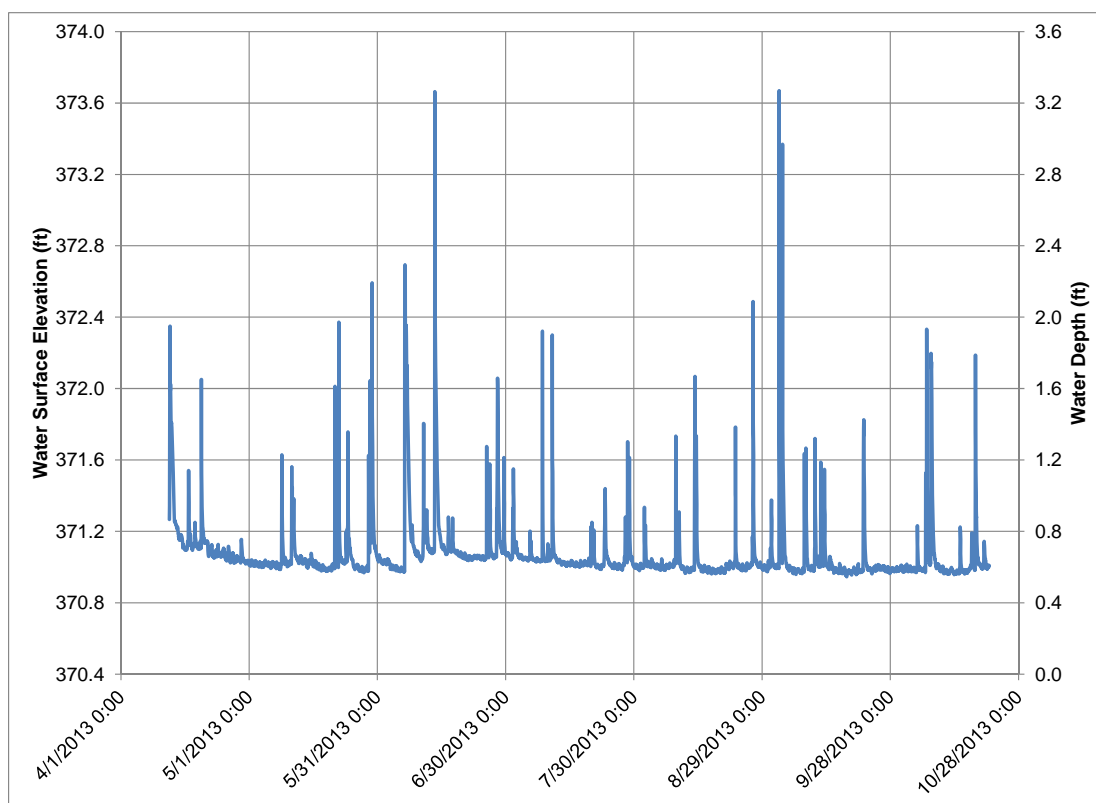


Figure 4
Water Depth Summary from April 12, 2013 to October 21, 2013
Hydraulic Analysis
West Branch of Bloody Brook
Bloody Brook Voluntary Cleanup Program
Onondaga County, New York



**West Branch of Bloody Brook
Bloody Brook Voluntary Cleanup Program
Onondaga County, New York**

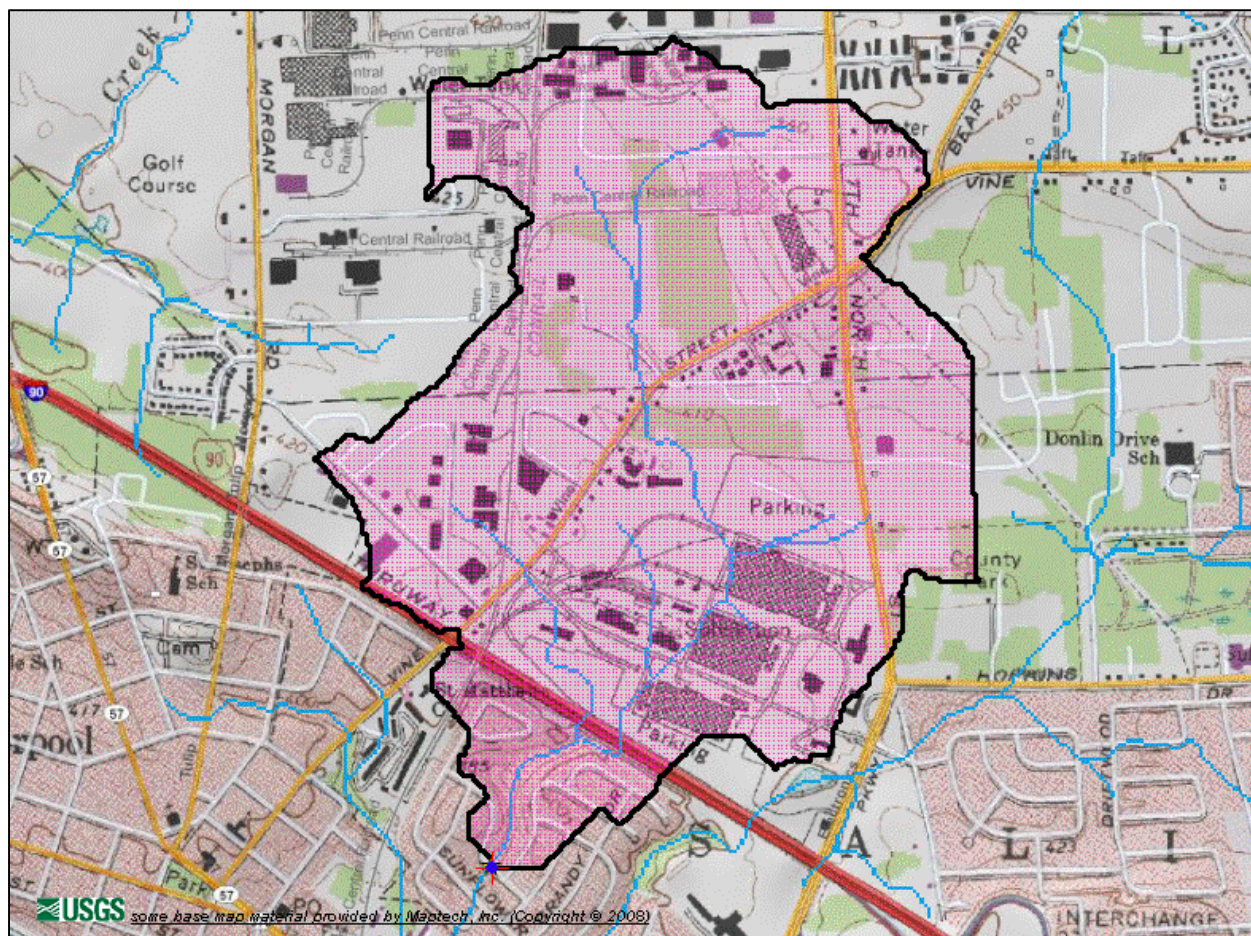
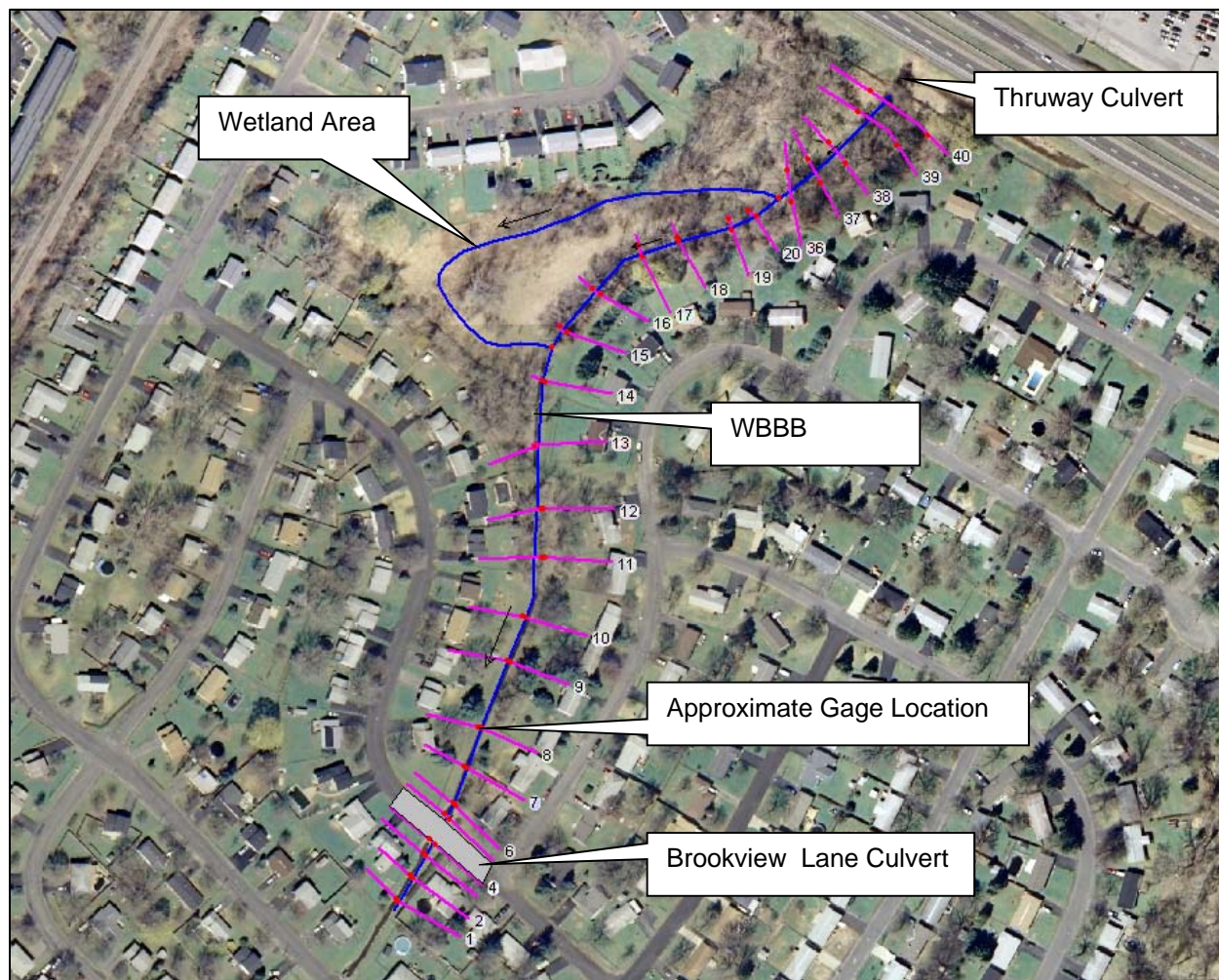


Figure 6
Existing Conditions HEC-RAS Model Extent
Hydraulic Analysis
West Branch of Bloody Brook
Bloody Brook Voluntary Cleanup Program
Onondaga County, New York



Notes:

1. Red lines indicate location of cross sections used during analysis (see Appendices)
2. Wetland Area flow shown occurs during high storm events

This aerial map illustrates the proposed wetland area and associated infrastructure in the Brookview Lane area. The map features several key elements:

- Wetland Area:** Indicated by a blue line and surrounding pink lines, showing the proposed wetland boundary.
- Thruway Culvert:** Located in the upper right corner, showing the culvert structure.
- WBBB:** A boundary line, likely the Wetland Boundary, shown as a blue line.
- Approximate Gage Location:** Marked by a pink line and a small black arrow, indicating the proposed location for a water level gauge.
- Brookview Lane Culvert:** Located in the lower left corner, showing the culvert structure.
- Numbered Points:** A series of numbered points (1-40) are plotted along the wetland boundary and surrounding areas, likely representing specific locations of interest or data points.

1. Red lines indicate location of cross sections used during analysis (see Appendices)
2. Wetland Area flow shown occurs during high storm events

Appendix A: USGS StreamStats Estimates



New York StreamStats

Basin Characteristics Report

Date: Tue Dec 3 2013 11:39:07 Mountain Standard Time

NAD27 Latitude: 43.1039 (43 06 14)

NAD27 Longitude: -76.1973 (-76 11 50)

NAD83 Latitude: 43.1040 (43 06 14)

NAD83 Longitude: -76.1969 (-76 11 49)

ReachCode: 04140201010845

Measure: 45.08

Parameter	Value
Area that drains to a point on a stream in square miles.	0.99
Main-channel 10-85 slope, in feet per mile	31.9
Main-channel stream length, in miles	2.13
10-85 slope of lower half of main channel in feet per mile.	35.3
10-85 slope of upper half of main channel in feet per mile.	44
Total length of all elevation contours in drainage area in miles	0.76564809
Average basin slope, in feet per mile.	77
Slope ratio. Ratio of main channel slope to basin slope	0.41
Basin Lag factor.	0.0527
Percentage of basin at or above 1200 ft elevation	0
Basin storage. Percentage of total drainage area shown as lakes, ponds and swamps	0
Percent of area covered by forest	24.6
Mean annual runoff in inches.	18.8
Seasonal maximum snow depth, 50th percentile, in inches	19.8
Mean annual precipitation in inches.	38.8
Urban Land Use percentage (1992)	46.9



New York StreamStats

Streamstats Ungaged Site Report

Date: Tue Dec 3 2013 11:40:52 Mountain Standard Time

Site Location: New_York

NAD27 Latitude: 43.1039 (43 06 14)

NAD27 Longitude: -76.1973 (-76 11 50)

NAD83 Latitude: 43.1040 (43 06 14)

NAD83 Longitude: -76.1969 (-76 11 49)

ReachCode: 04140201010845

Measure: 45.08

Drainage Area: 0.99 mi²

Percent Urban: 46.9 %

Warning: Urban Area is greater than 15 percent

Peak Flows Region Grid Basin Characteristics

100% 2006 Full Region 6 (0.99 mi²)

Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	0.99	0.58	2467
Slope Ratio NY (dimensionless)	0.41	0.019	0.698
Percentage of Basin Above 1200 ft (percent)	0	0	100
Percent Storage (percent)	0	0	5.98
Mean Annual Runoff in inches (inches)	18.8	9.49	22.77

Bank Full Region Grid Basin Characteristics

100% Bankfull Region 7 SIR2009 5144 (0.99 mi²)

Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	0.99 (below min value 1.07)	1.07	349

Warning: Some parameters are outside the suggested range. Estimates will be extrapolations with unknown errors.

Peak Flows Region Grid Streamflow Statistics

Statistic	Flow (ft ³ /s)	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
PK1_25	54.5	35	2.3		
PK1_5	65	33	2		
PK2	77.5	32	1.9		
PK5	106	32	2.4		
PK10	124	33	3.1		
PK25	144	34	3.9		
PK50	158	36	4.5		
PK100	171	37	4.9		
PK200	184	39	5.2		
PK500	200	41	5.5		

Bank Full Region Grid Streamflow Statistics

Statistic	Flow (ft ³ /s)	Estimation Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
BFAREA	15.8				
BFDPTH	1.47				
BFFLOW	36.8				
BFWDTH	10.8				

Appendix B: HEC-RAS Existing Conditions Model Output

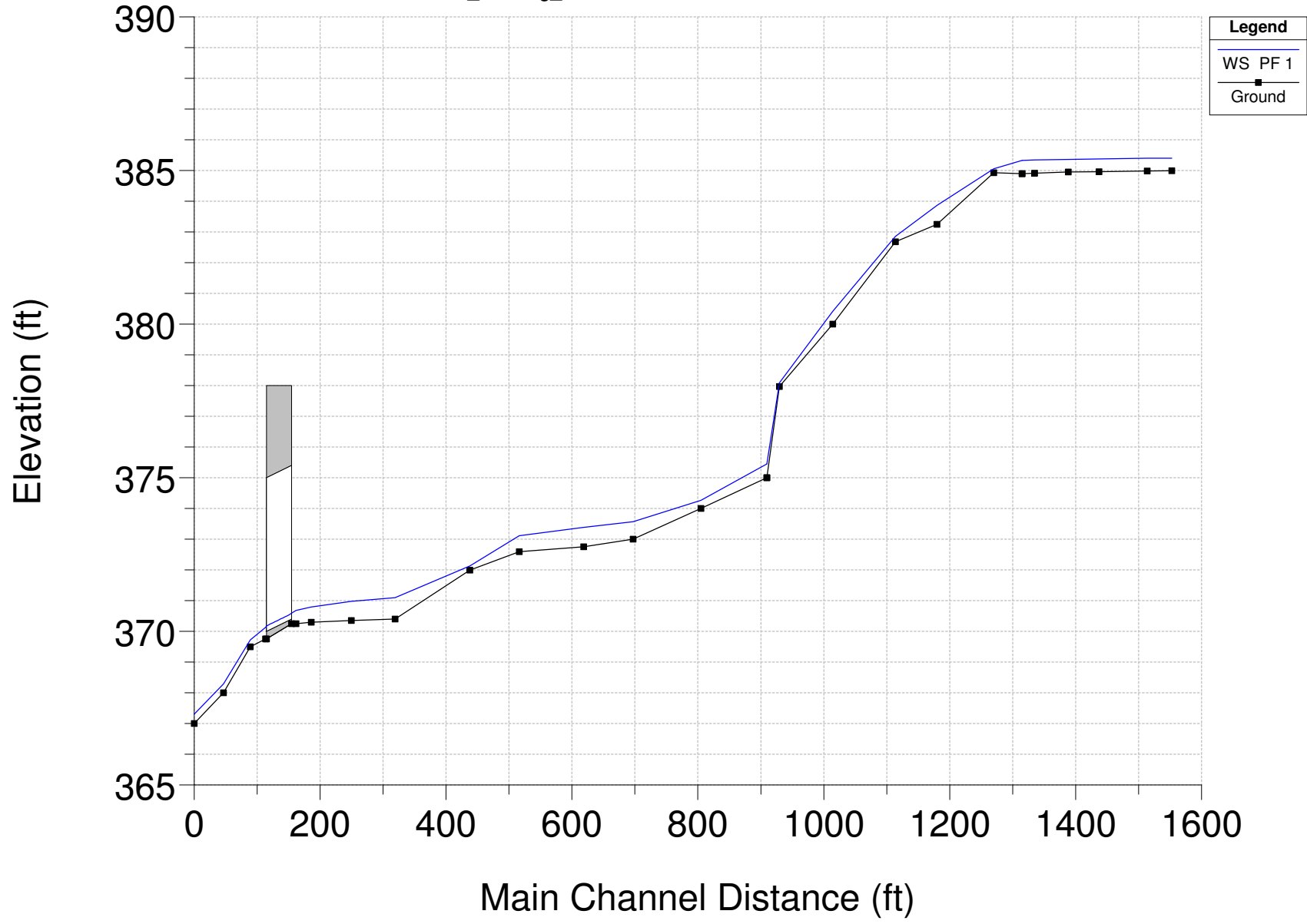
Summary Table, page 16

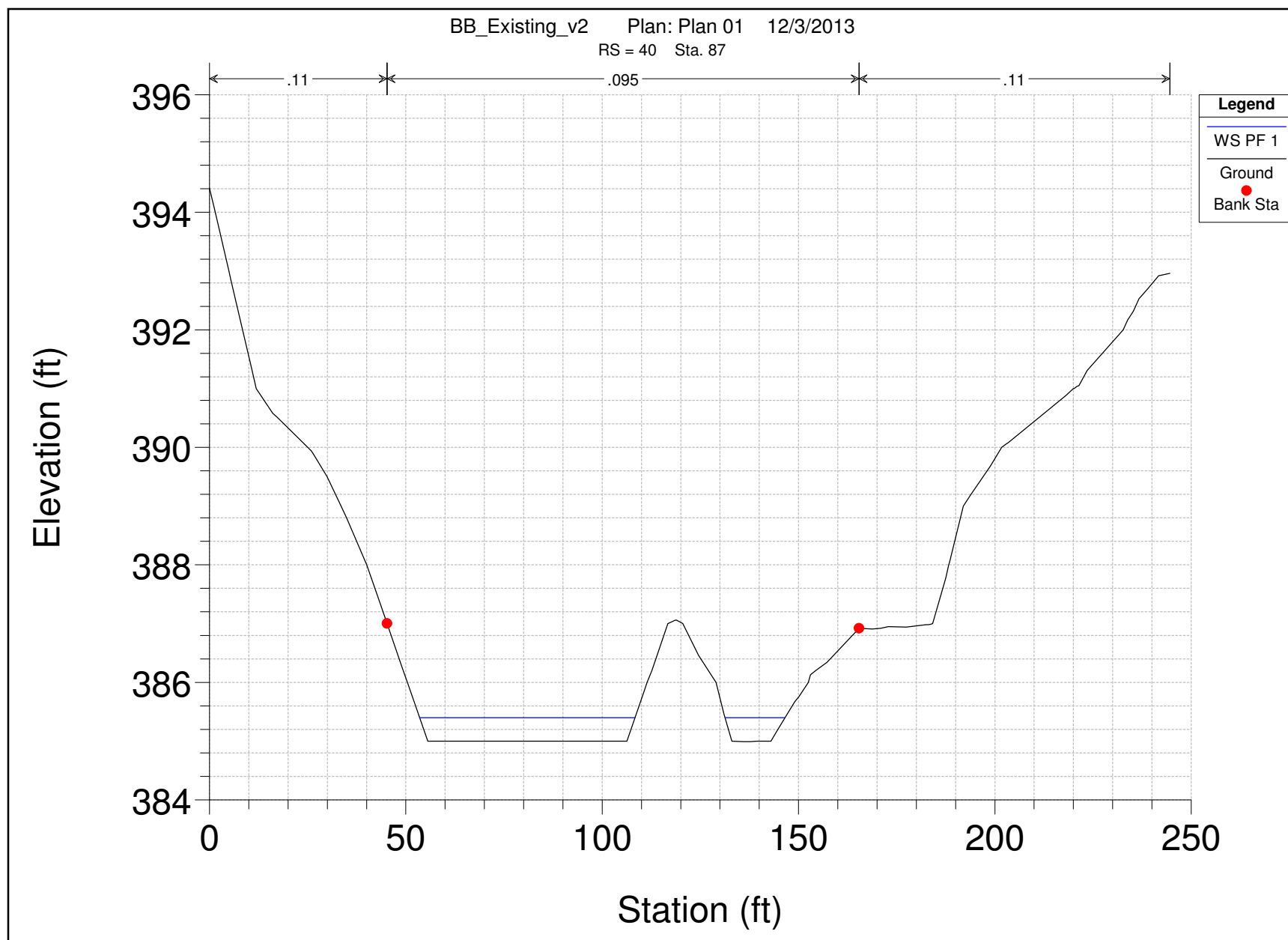
Profile Plot, page 17

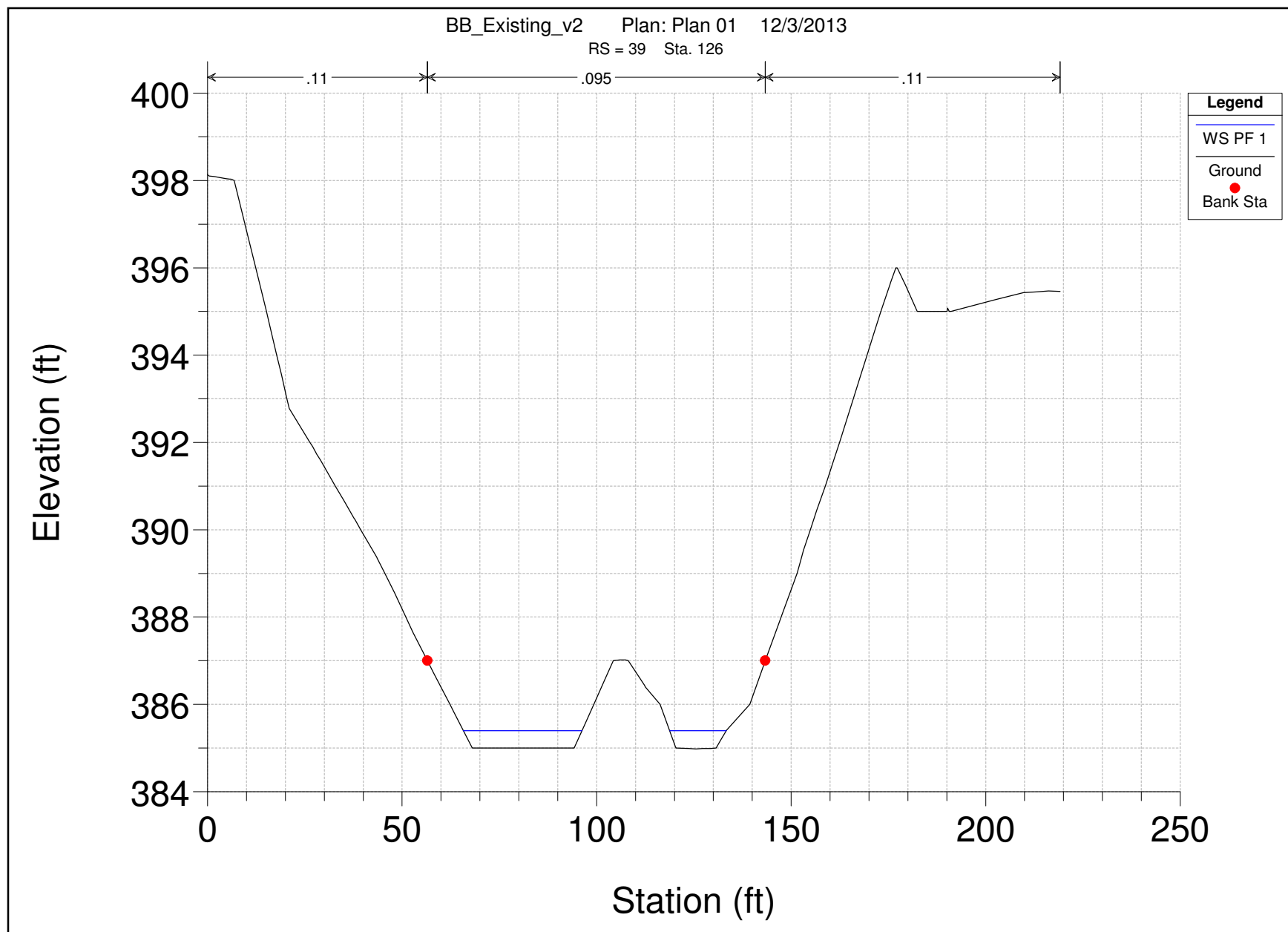
Cross-Section Plots, pages 18 to 44

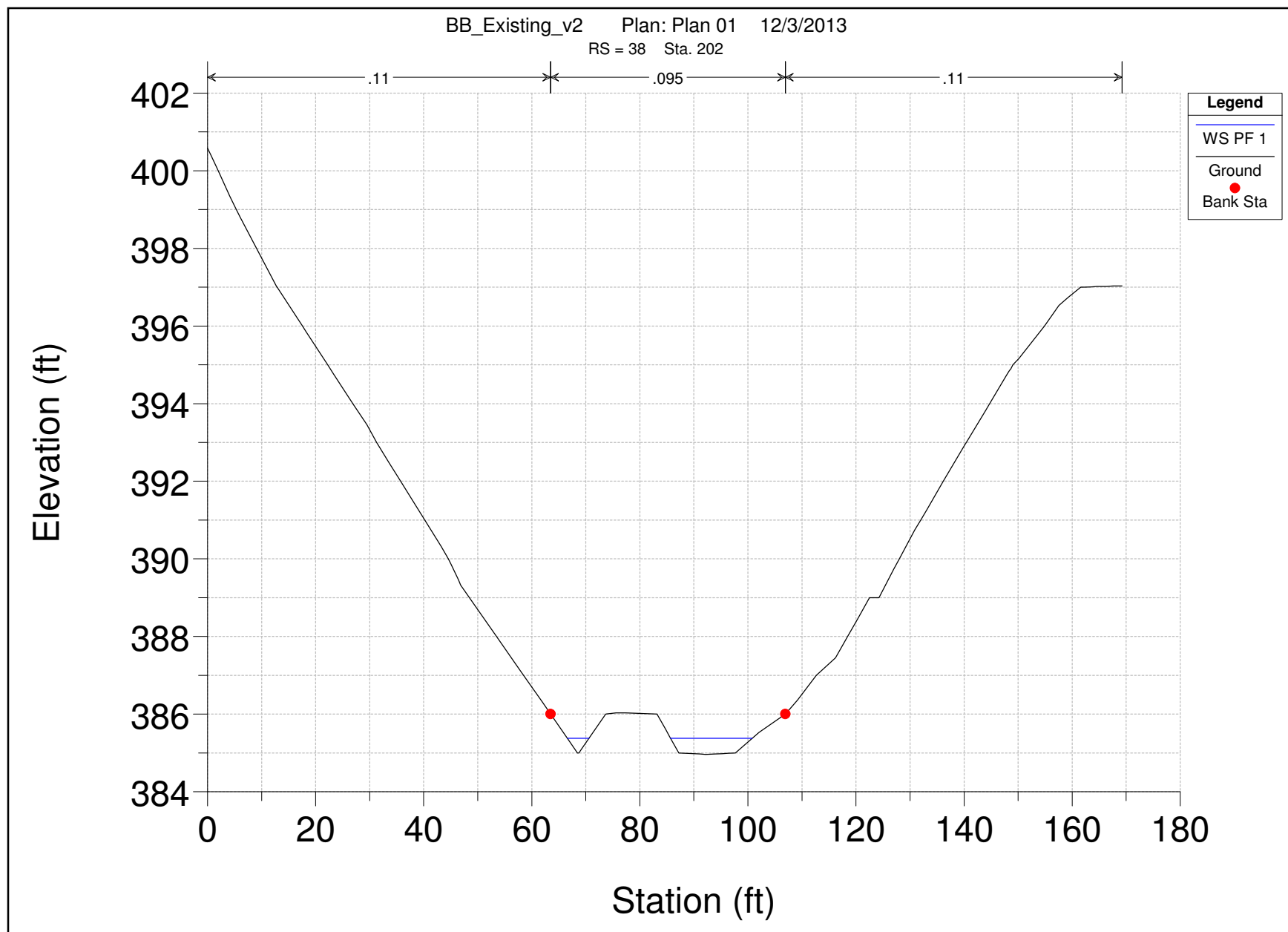
HEC-RAS Plan: Plan 01 Profile: PF 1

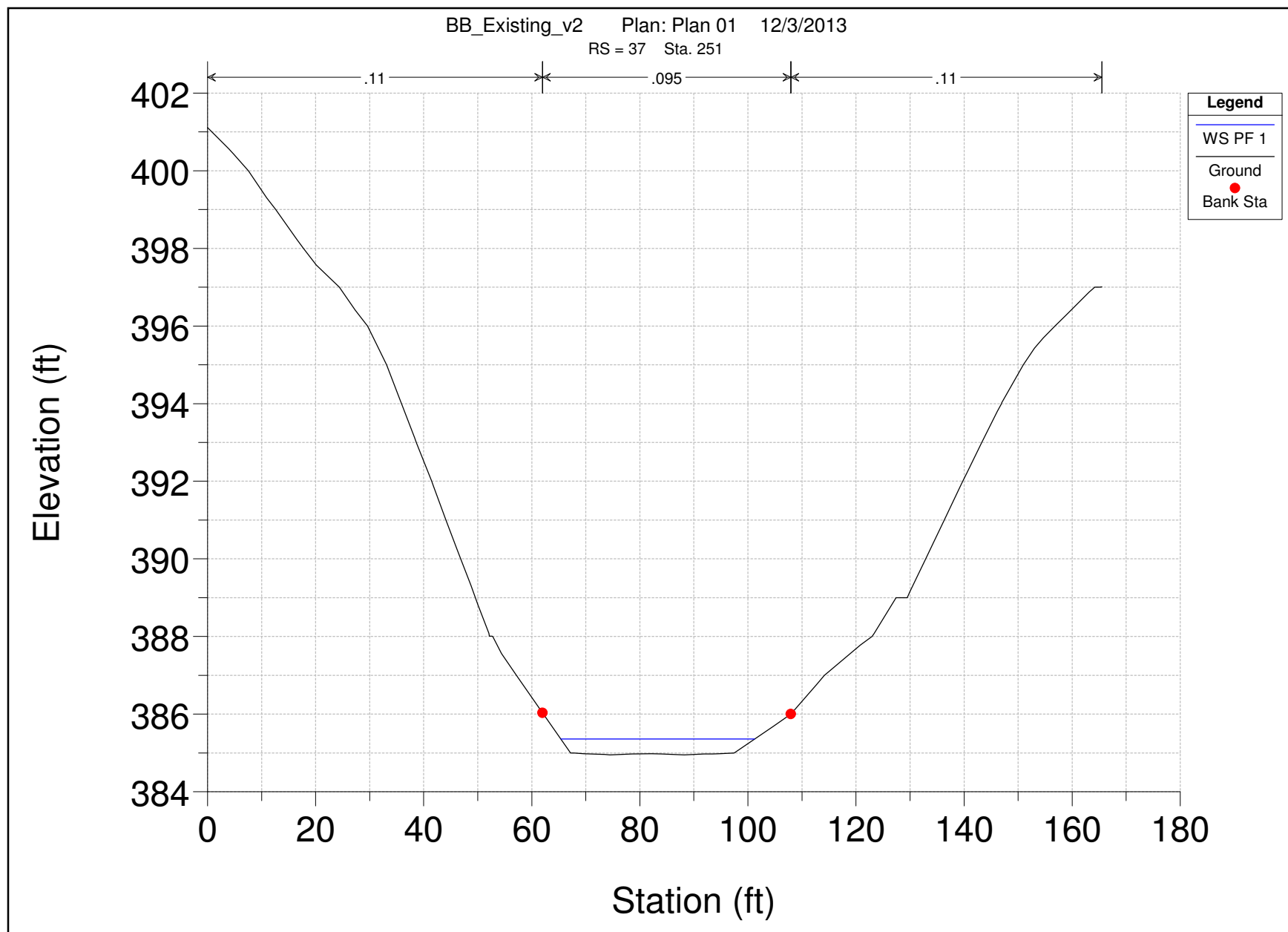
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Hydr Depth
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)
Upper	40	PF 1	1.40	384.99	385.40	385.02	385.40	0.000043	0.05	26.21	70.12	0.02	0.37
Upper	39	PF 1	1.40	384.98	385.40		385.40	0.000118	0.09	16.29	45.04	0.03	0.36
Upper	38	PF 1	1.40	384.96	385.38		385.38	0.001150	0.24	5.85	19.15	0.08	0.31
Upper	37	PF 1	1.40	384.95	385.36		385.36	0.000196	0.11	12.74	35.85	0.03	0.36
Upper	36	PF 1	1.40	384.91	385.35		385.35	0.000309	0.13	10.84	33.64	0.04	0.32
Middle	20	PF 1	1.40	384.90	385.33		385.33	0.001825	0.32	4.39	13.27	0.10	0.33
Middle	19	PF 1	1.40	384.93	385.05		385.07	0.107931	0.99	1.41	16.56	0.60	0.09
Middle	18	PF 1	1.40	383.25	383.87	383.52	383.87	0.004852	0.54	2.58	7.12	0.16	0.36
Middle	17	PF 1	1.40	382.68	382.86		382.91	0.195493	1.88	0.74	5.18	0.88	0.14
Middle	16	PF 1	1.40	380.00	380.41	380.18	380.42	0.009215	0.63	2.21	7.96	0.21	0.28
Middle	15	PF 1	1.40	377.97	378.09	378.09	378.14	0.302119	1.83	0.76	7.74	1.03	0.10
Lower	14	PF 1	1.40	375.00	375.45	375.13	375.46	0.005729	0.62	2.25	5.00	0.16	0.45
Lower	13	PF 1	1.40	374.00	374.27	374.13	374.28	0.030243	1.05	1.33	5.00	0.36	0.27
Lower	12	PF 1	1.40	373.00	373.57		373.57	0.002807	0.49	2.83	5.00	0.12	0.57
Lower	11	PF 1	1.40	372.75	373.38		373.38	0.002005	0.44	3.16	5.00	0.10	0.63
Lower	10	PF 1	1.40	372.59	373.11	372.72	373.12	0.003616	0.54	2.61	5.00	0.13	0.52
Lower	9	PF 1	1.40	371.99	372.12	372.12	372.19	0.275110	2.08	0.67	5.00	1.00	0.13
Lower	8	PF 1	1.40	370.40	371.10	370.53	371.10	0.001472	0.40	3.49	5.00	0.08	0.70
Lower	7	PF 1	1.40	370.35	370.98		370.98	0.002036	0.45	3.14	5.00	0.10	0.63
Lower	6	PF 1	1.40	370.30	370.79		370.80	0.004345	0.57	2.46	5.00	0.14	0.49
Lower	5	PF 1	1.40	370.25	370.68	370.38	370.69	0.004782	0.55	2.53	6.73	0.16	0.38
Lower	4.1		Culvert										
Lower	4	PF 1	1.40	369.75	370.13		370.14	0.007473	0.64	2.18	6.52	0.20	0.34
Lower	3	PF 1	1.40	369.50	369.72		369.75	0.054387	1.26	1.11	5.00	0.47	0.22
Lower	2	PF 1	1.40	368.00	368.29		368.31	0.022770	0.96	1.45	5.00	0.31	0.29
Lower	1	PF 1	1.40	367.00	367.30	367.13	367.32	0.020014	0.92	1.51	5.00	0.30	0.30

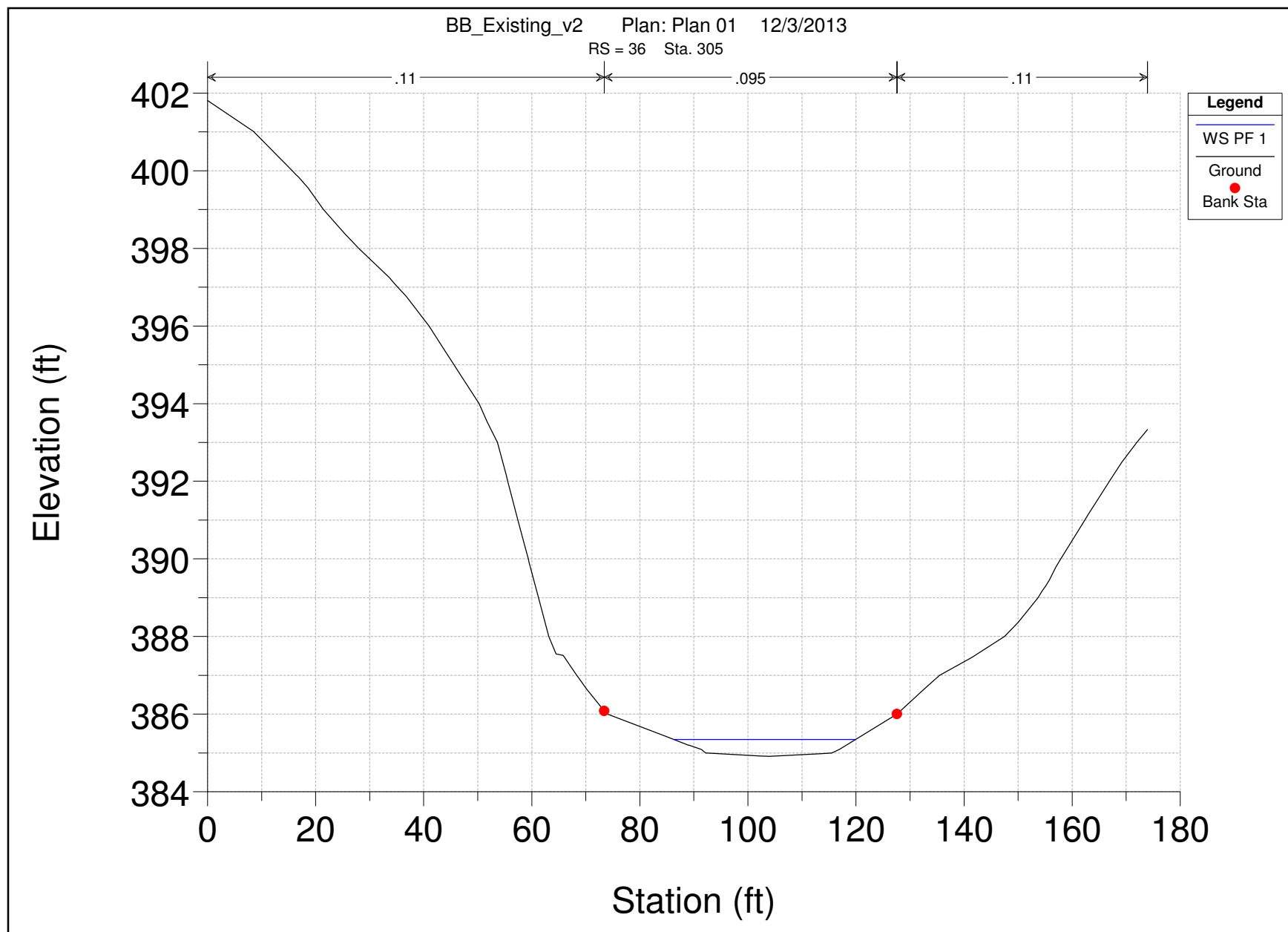


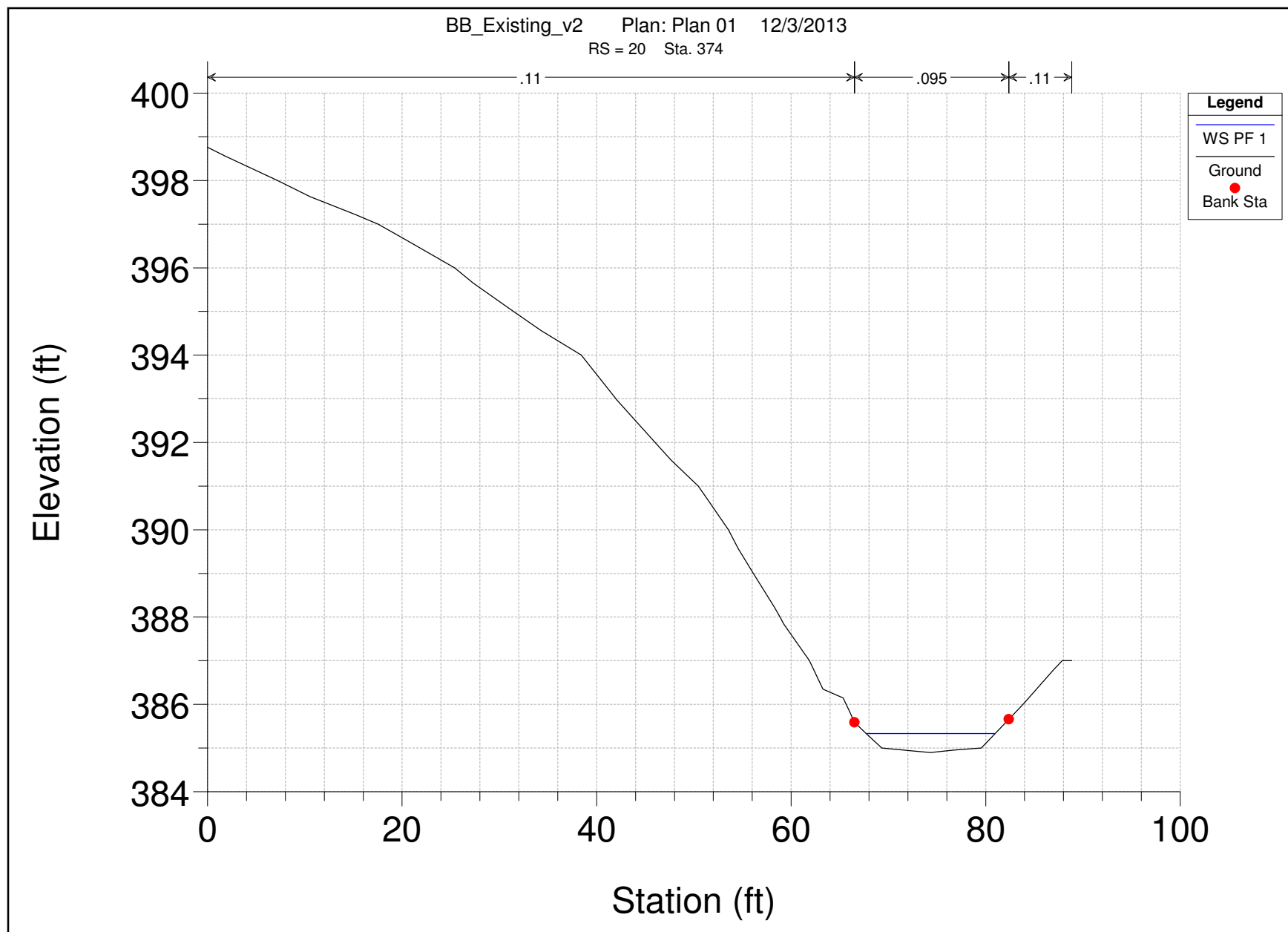


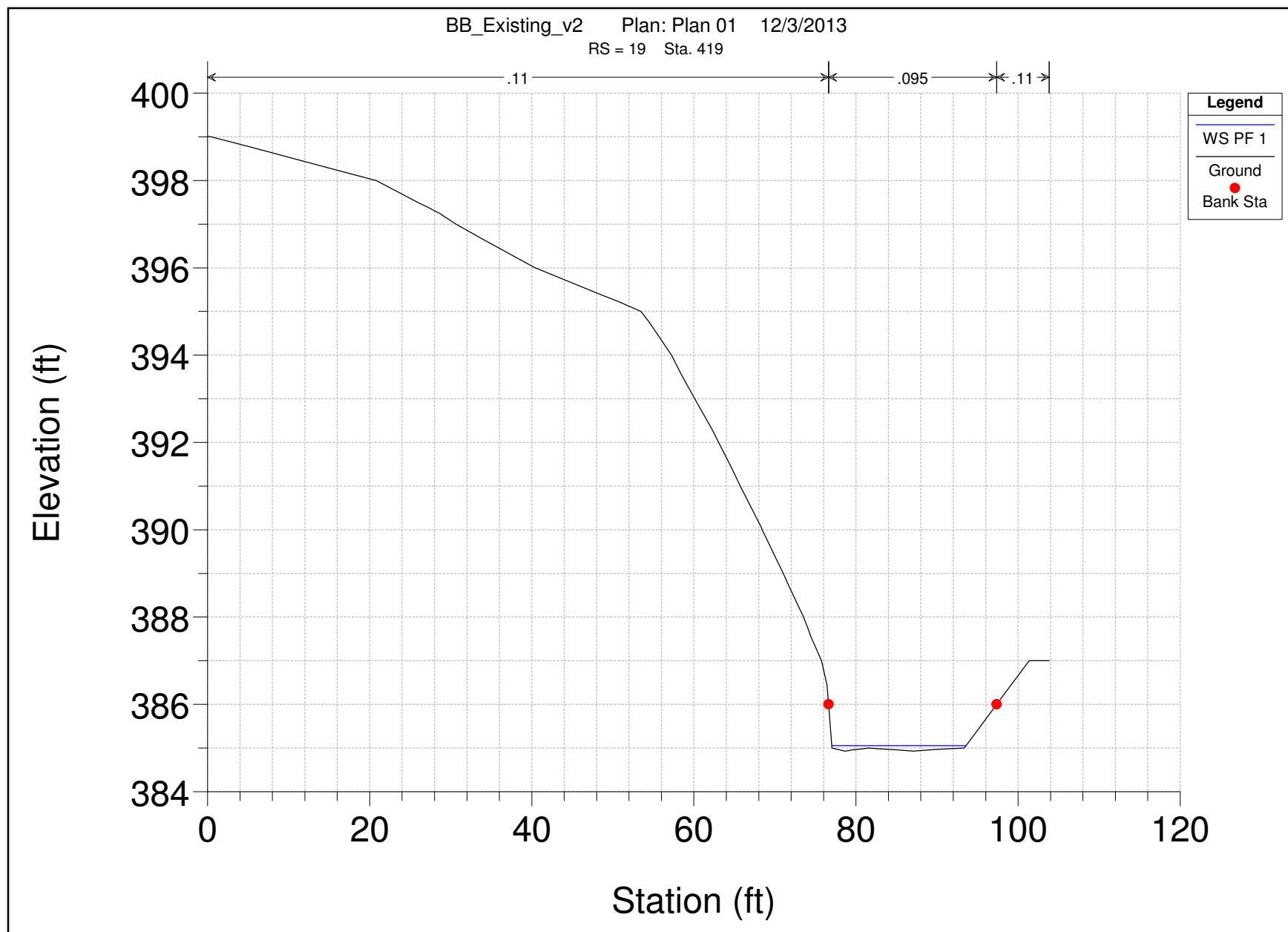


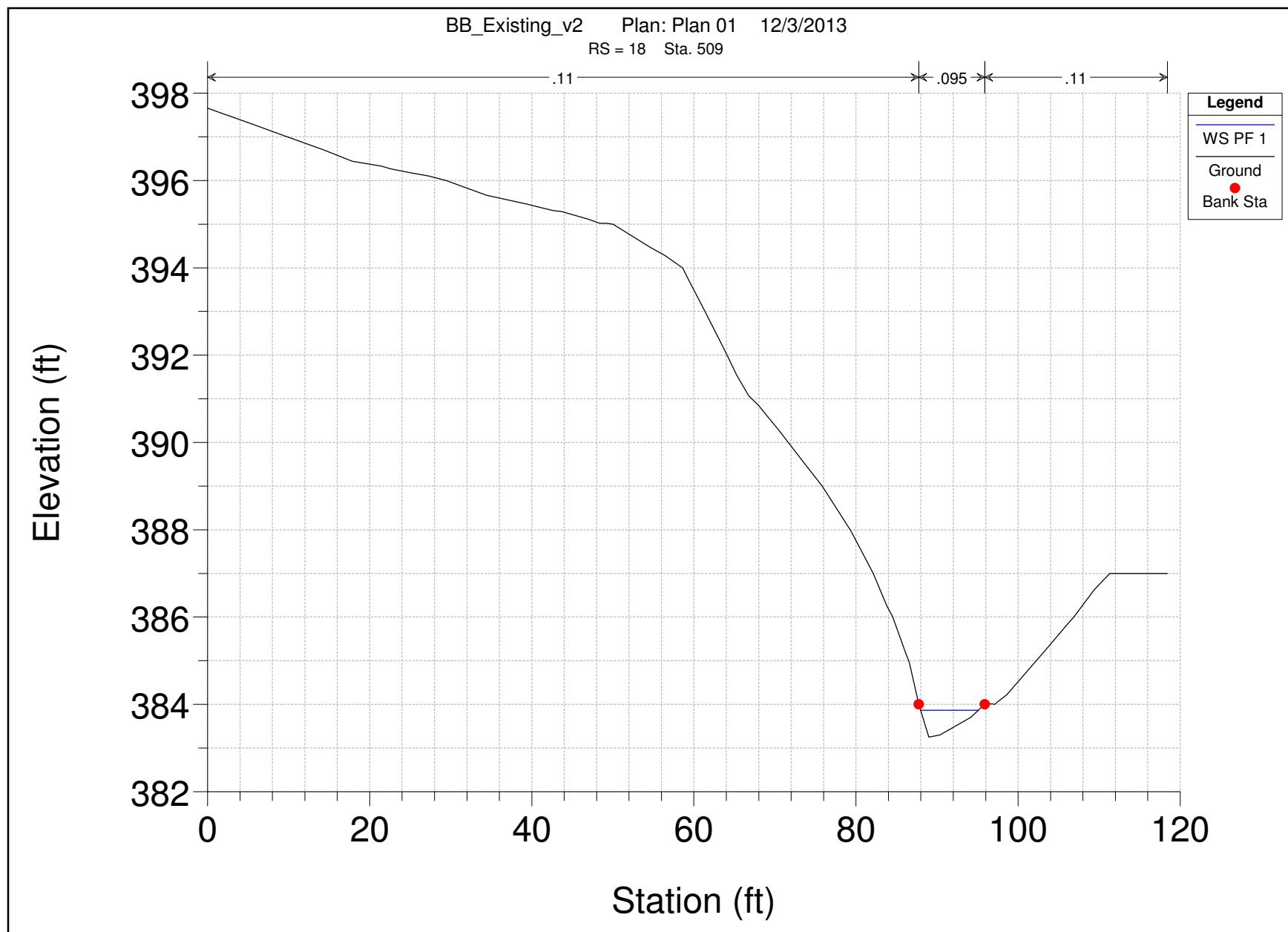


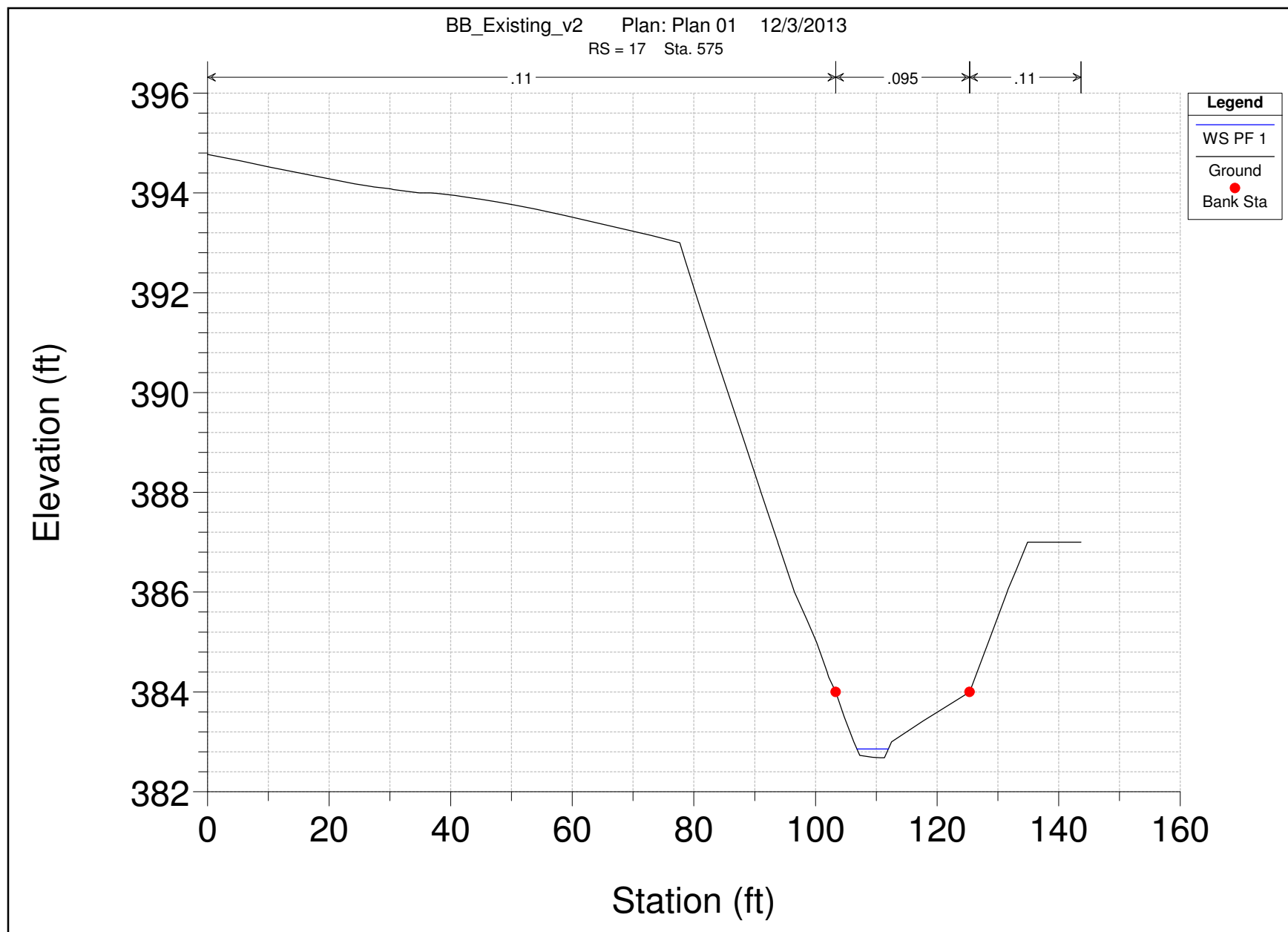


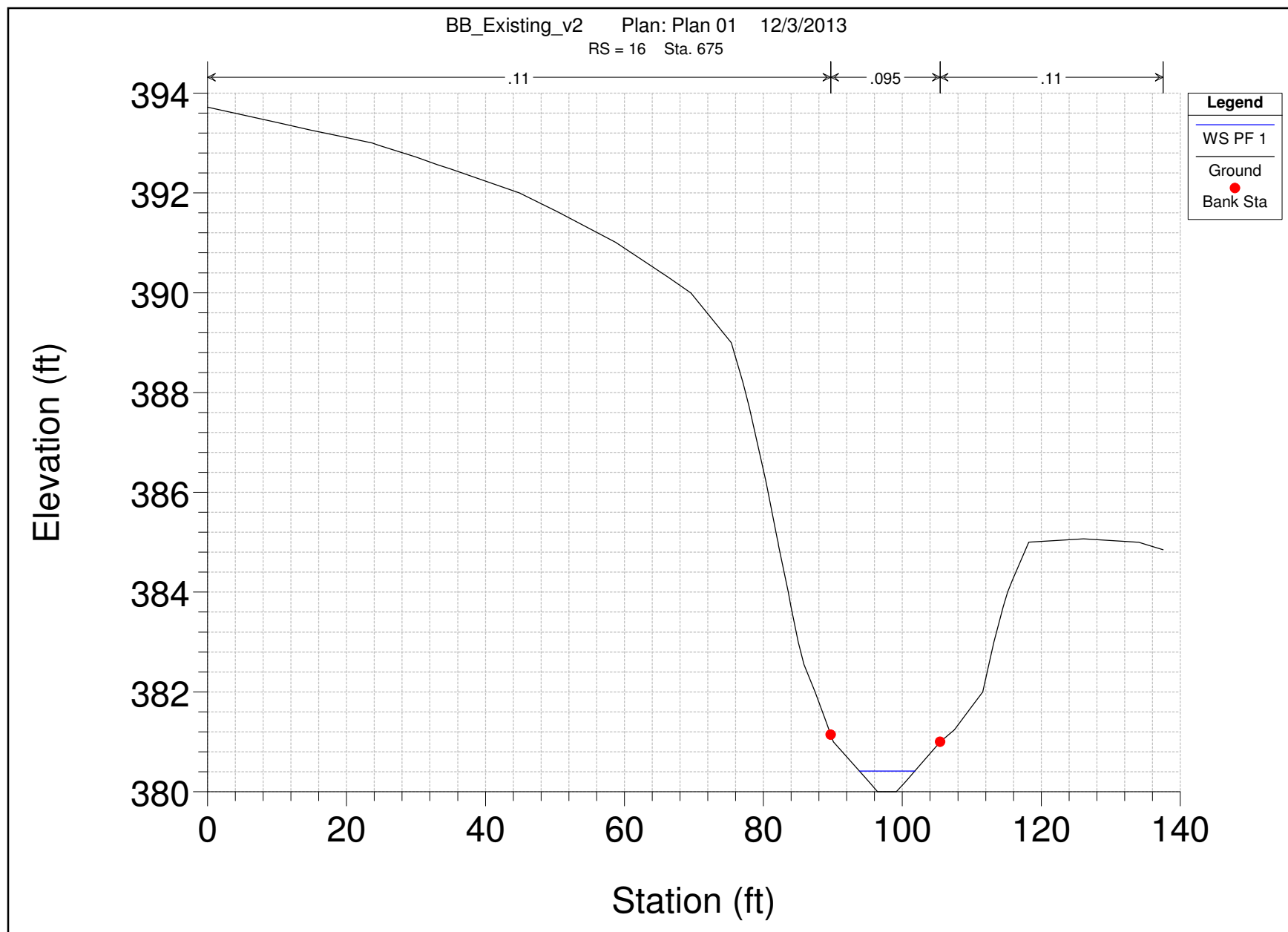


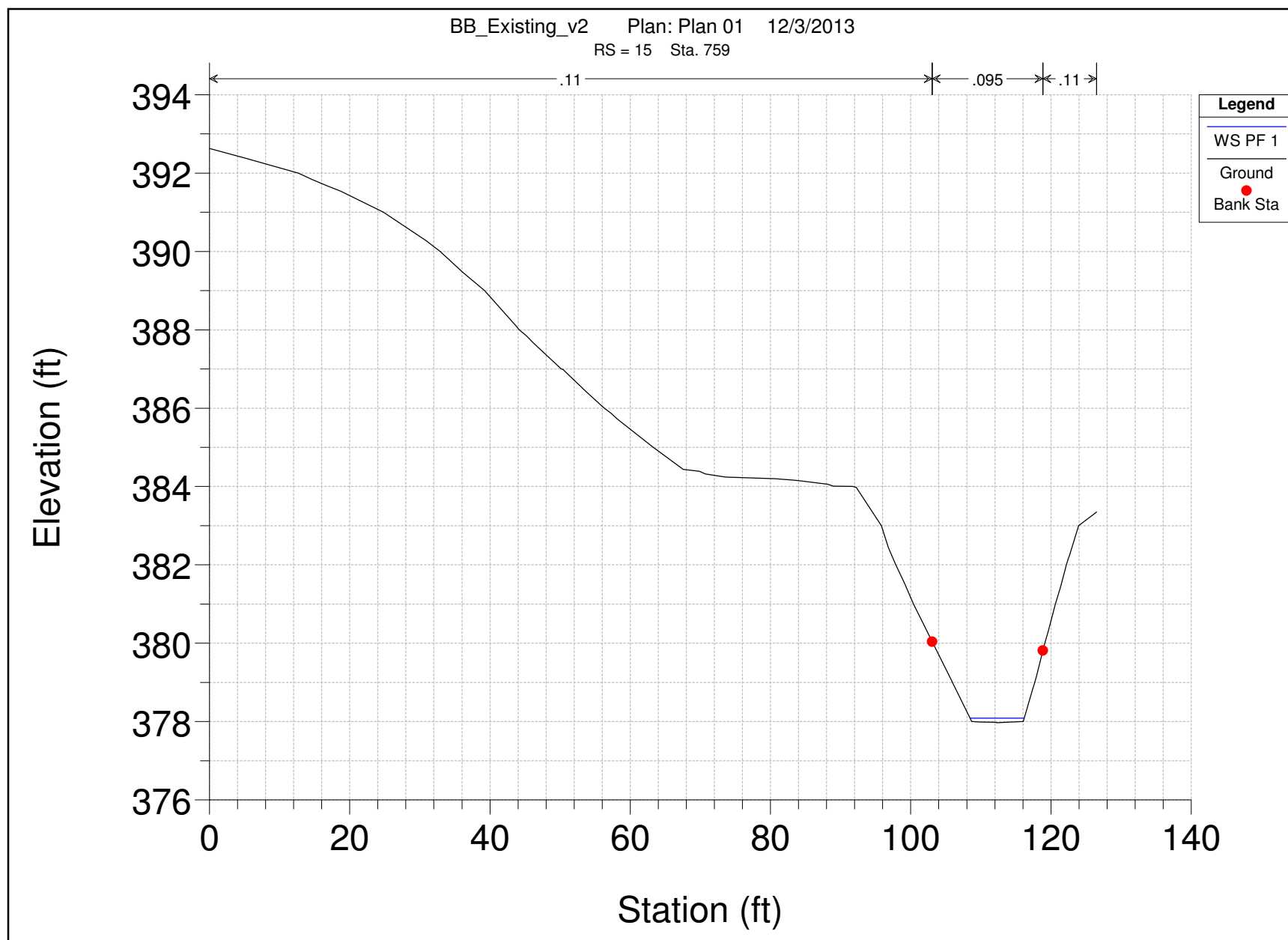


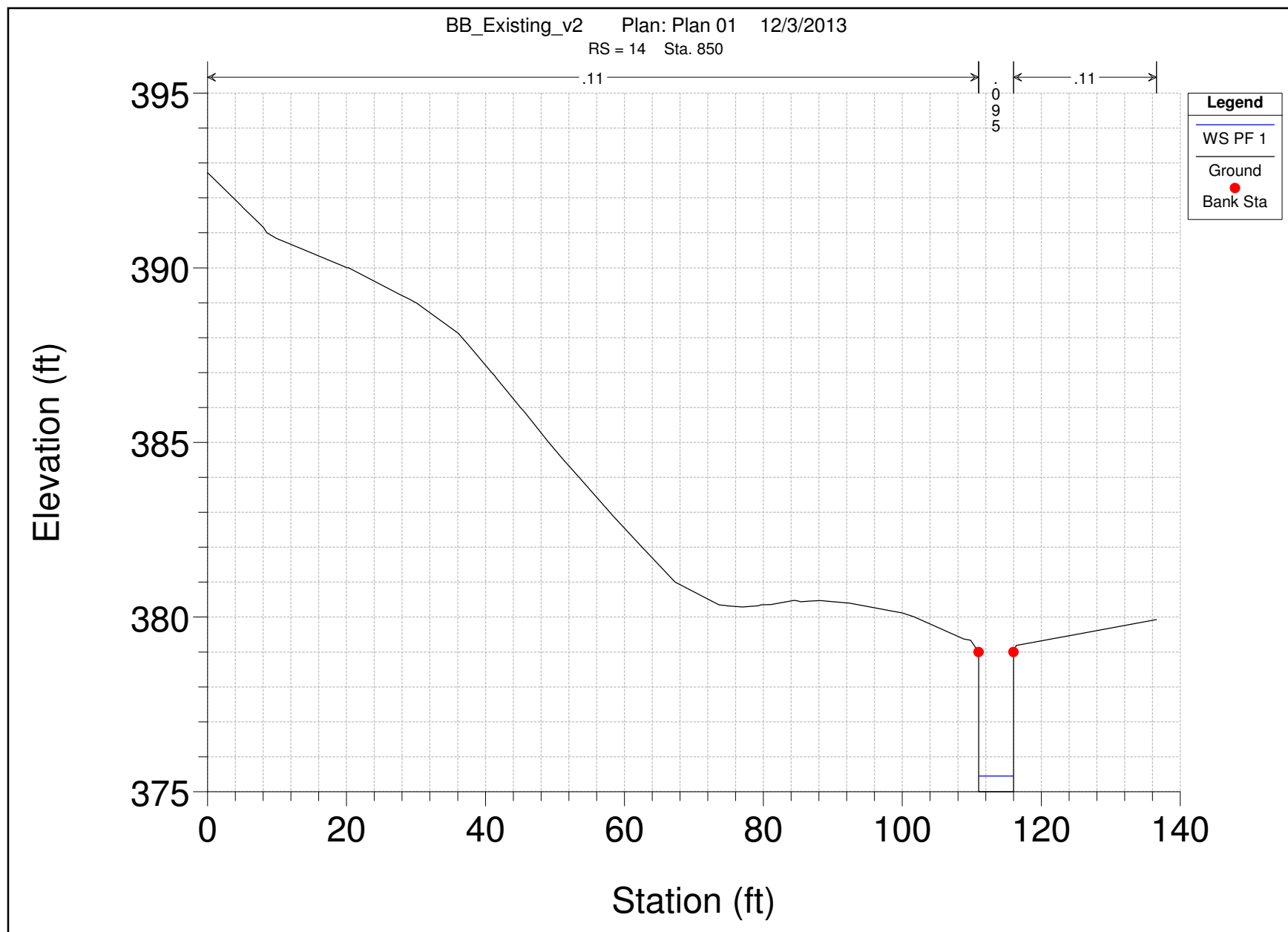


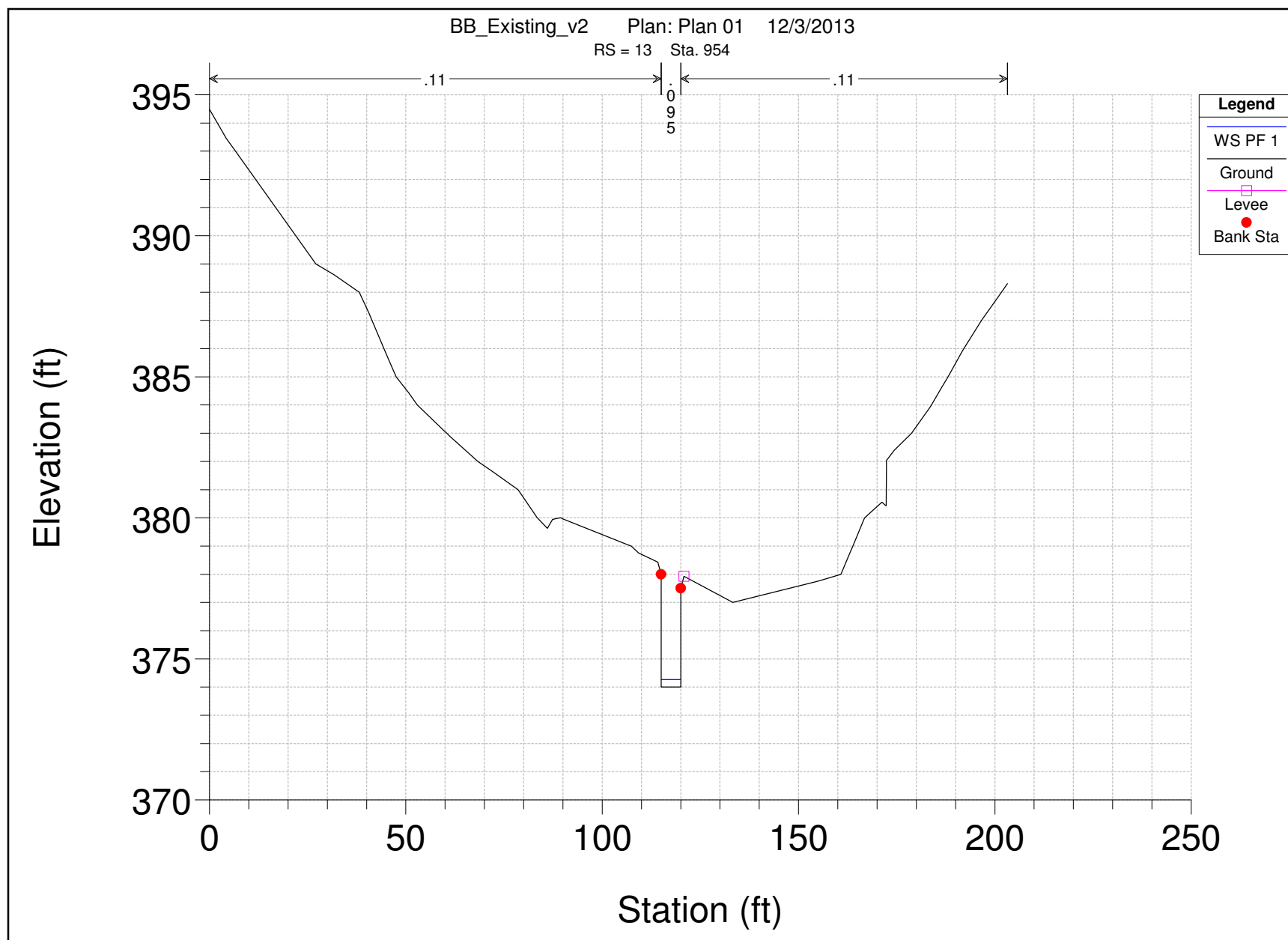


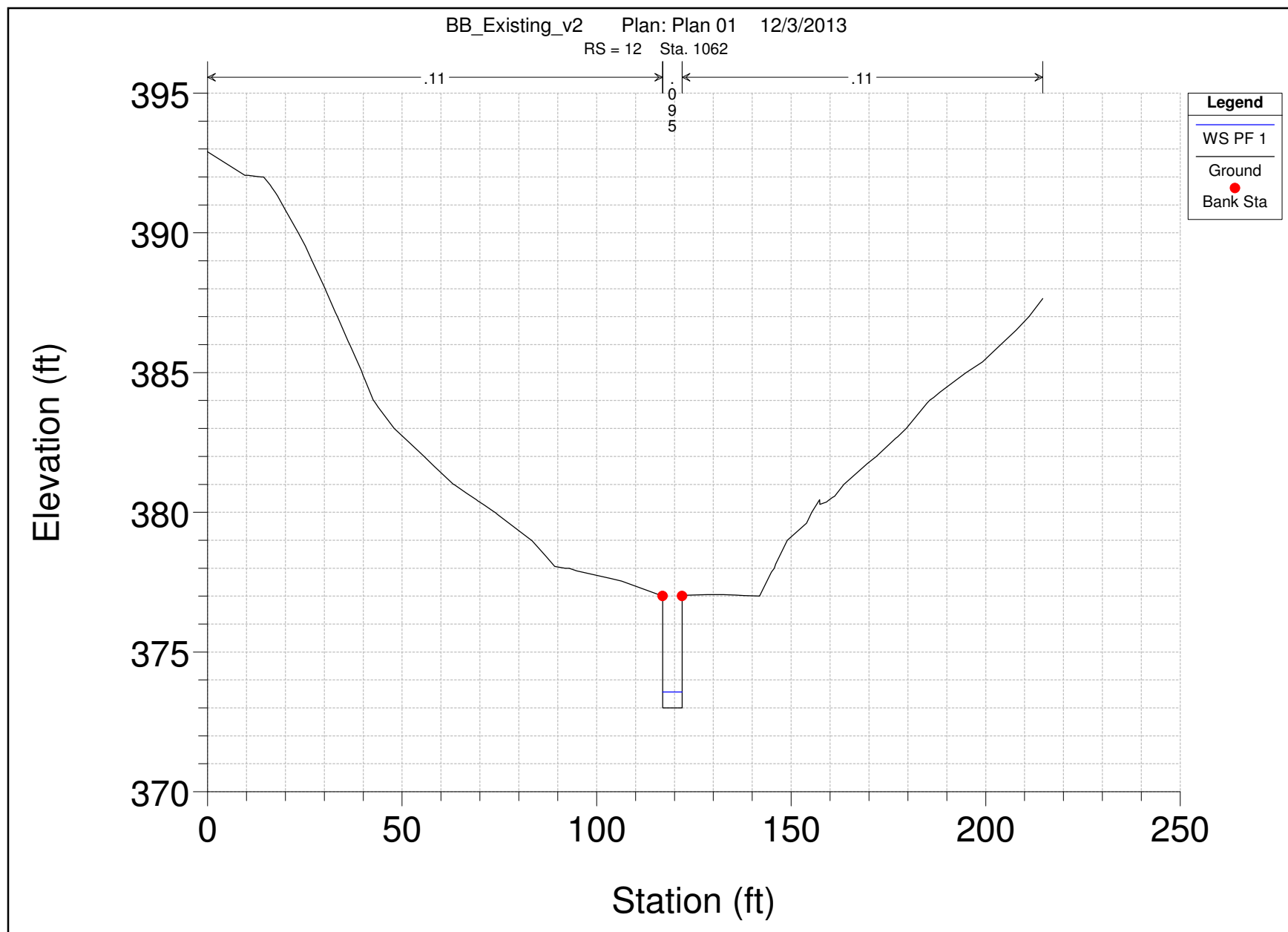


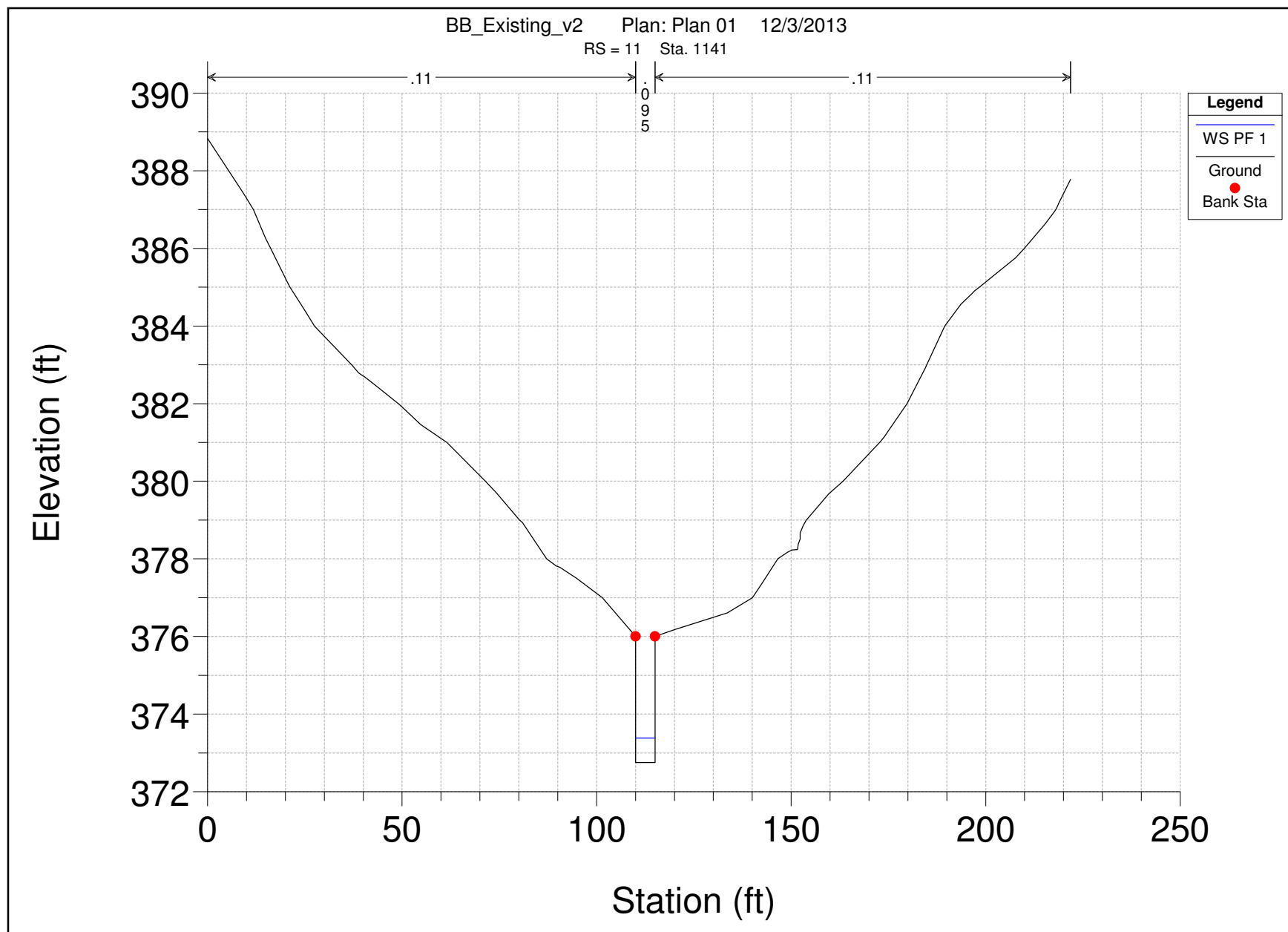


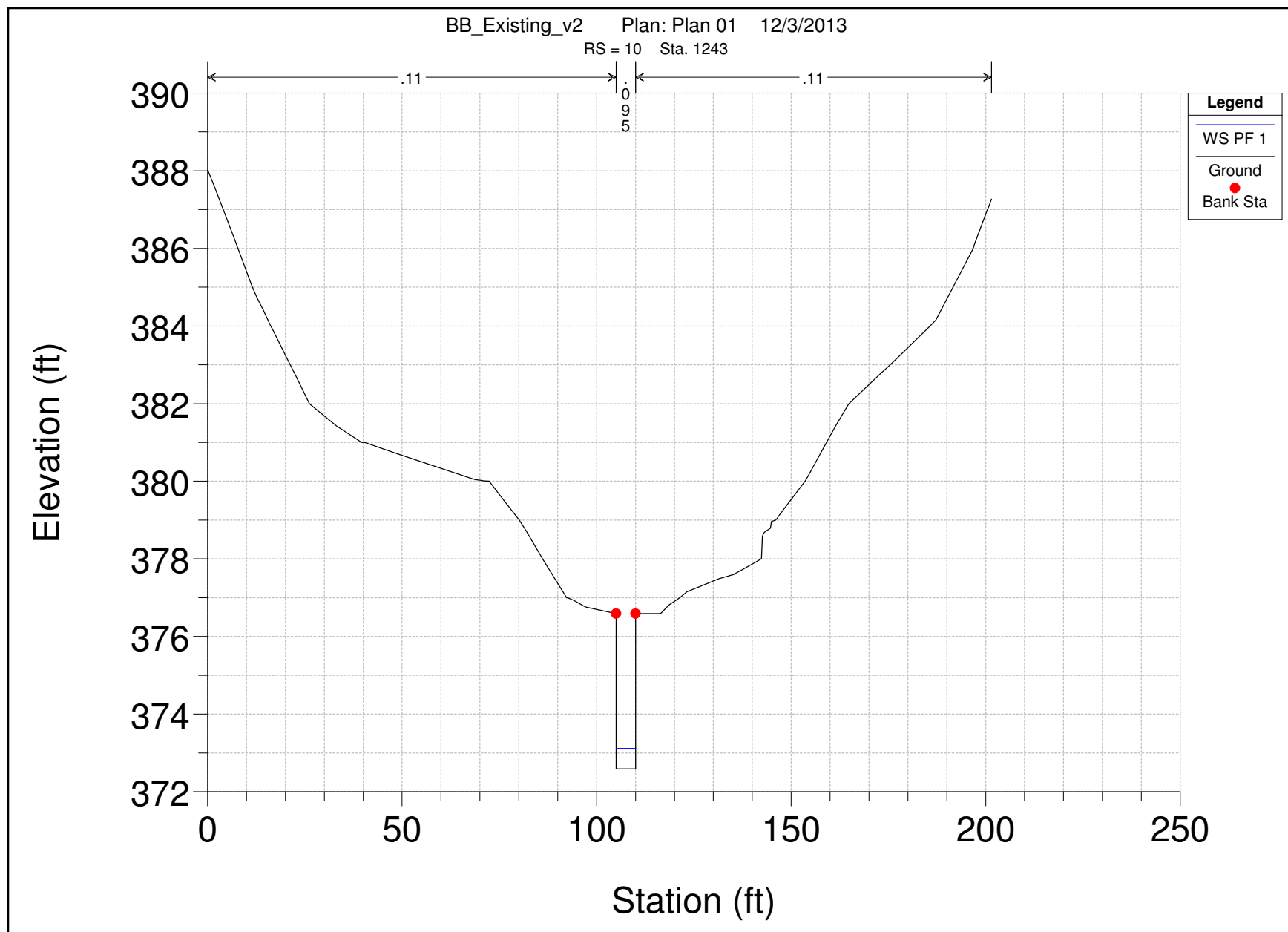


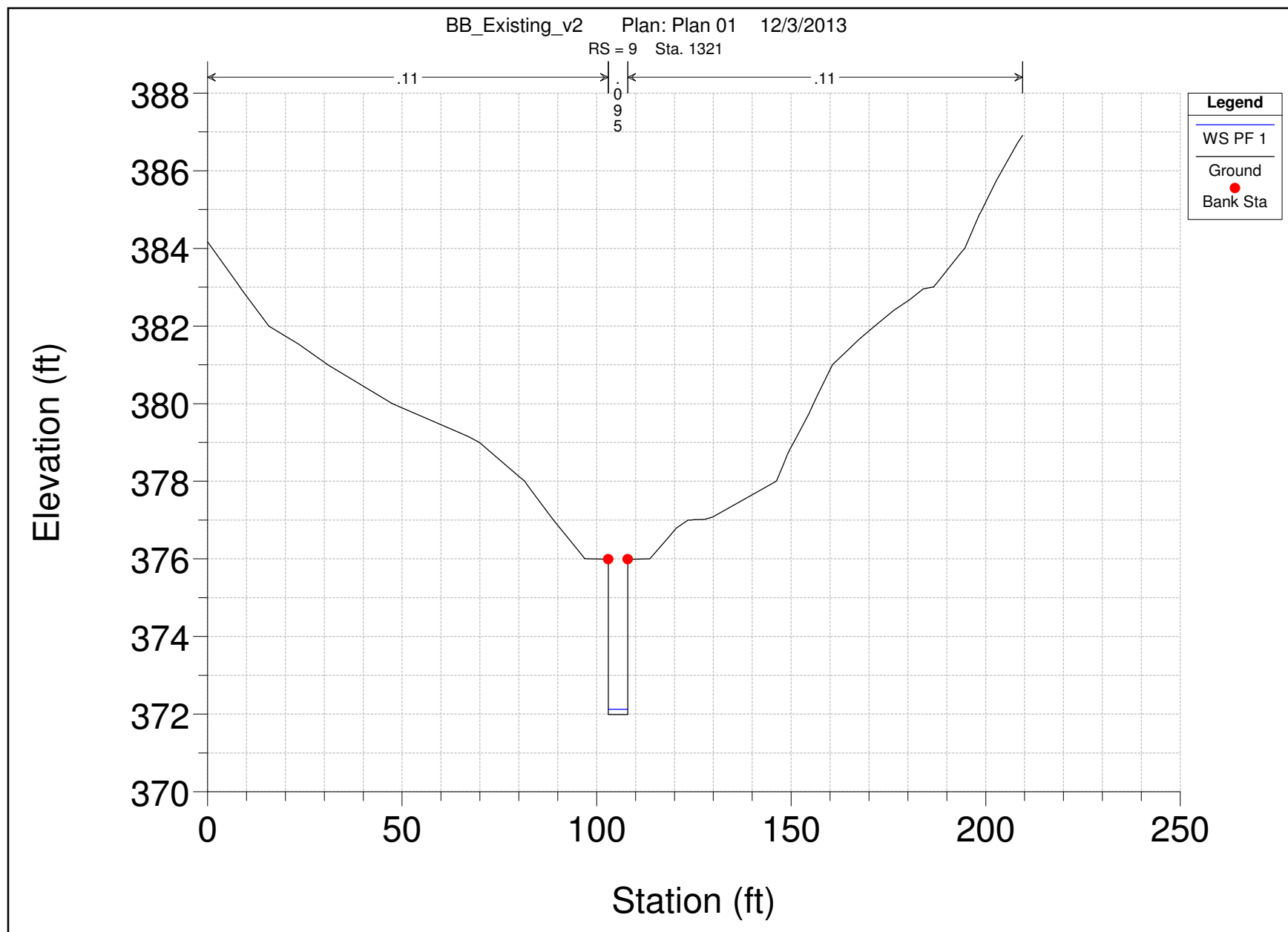


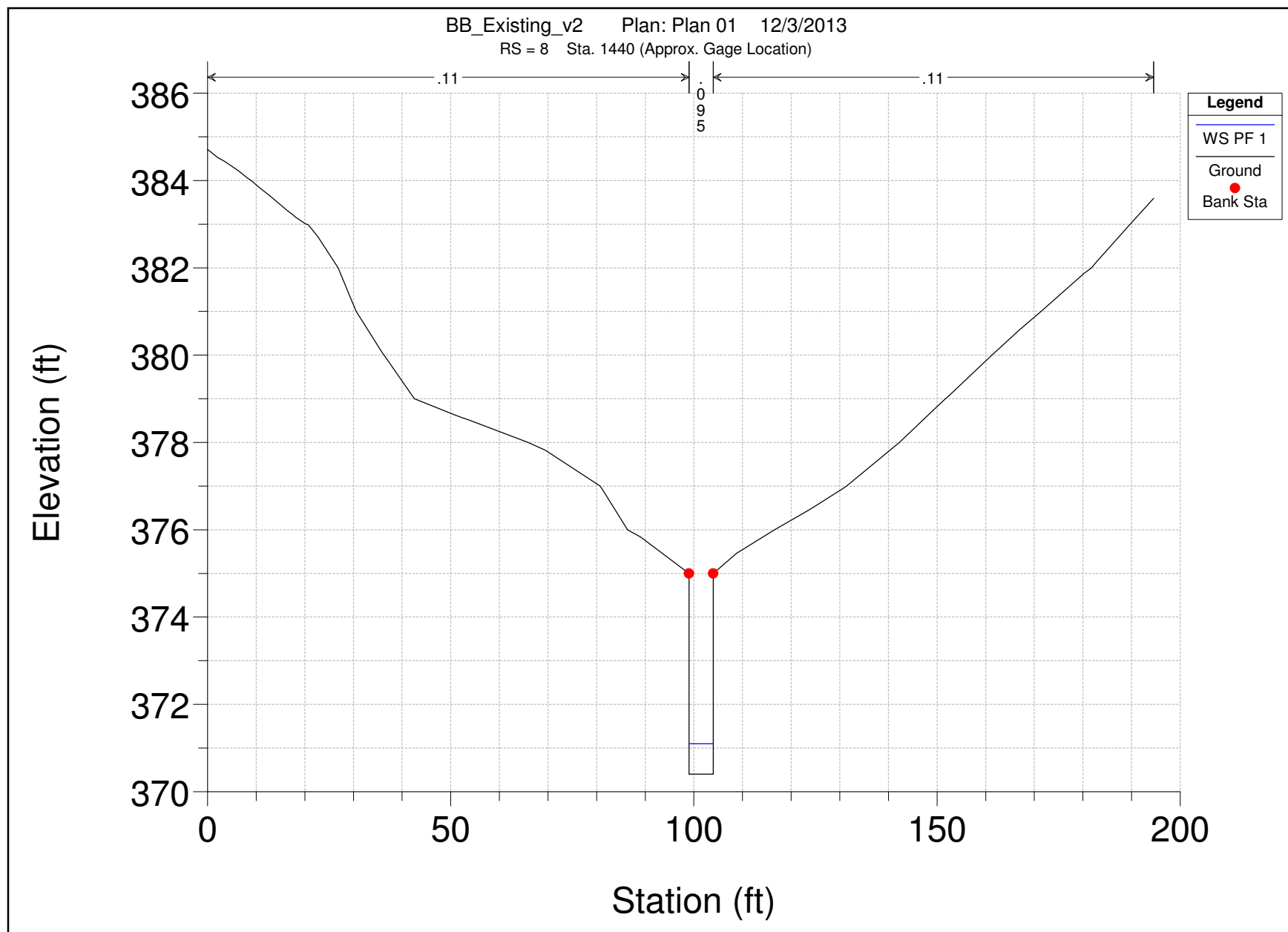


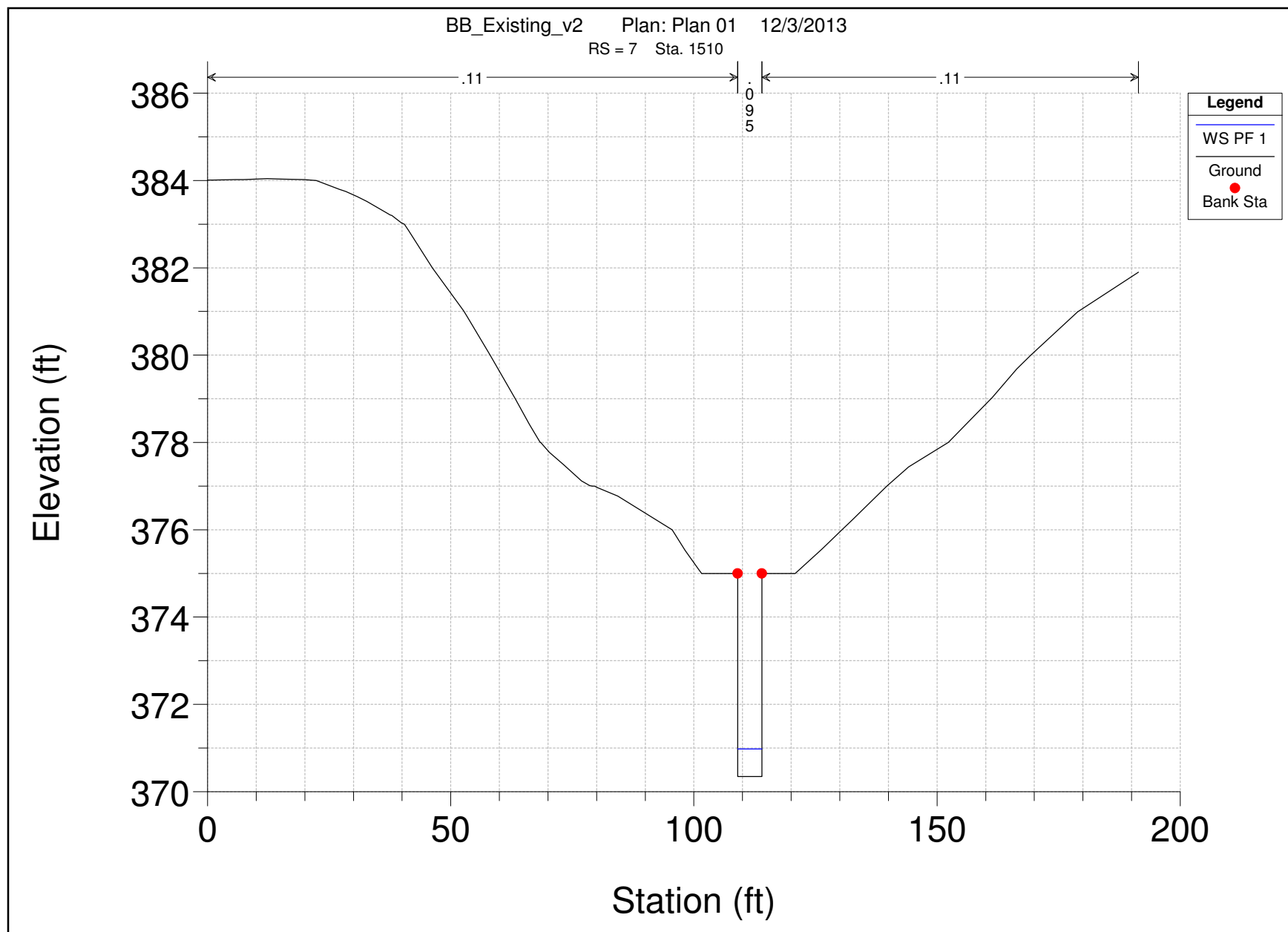


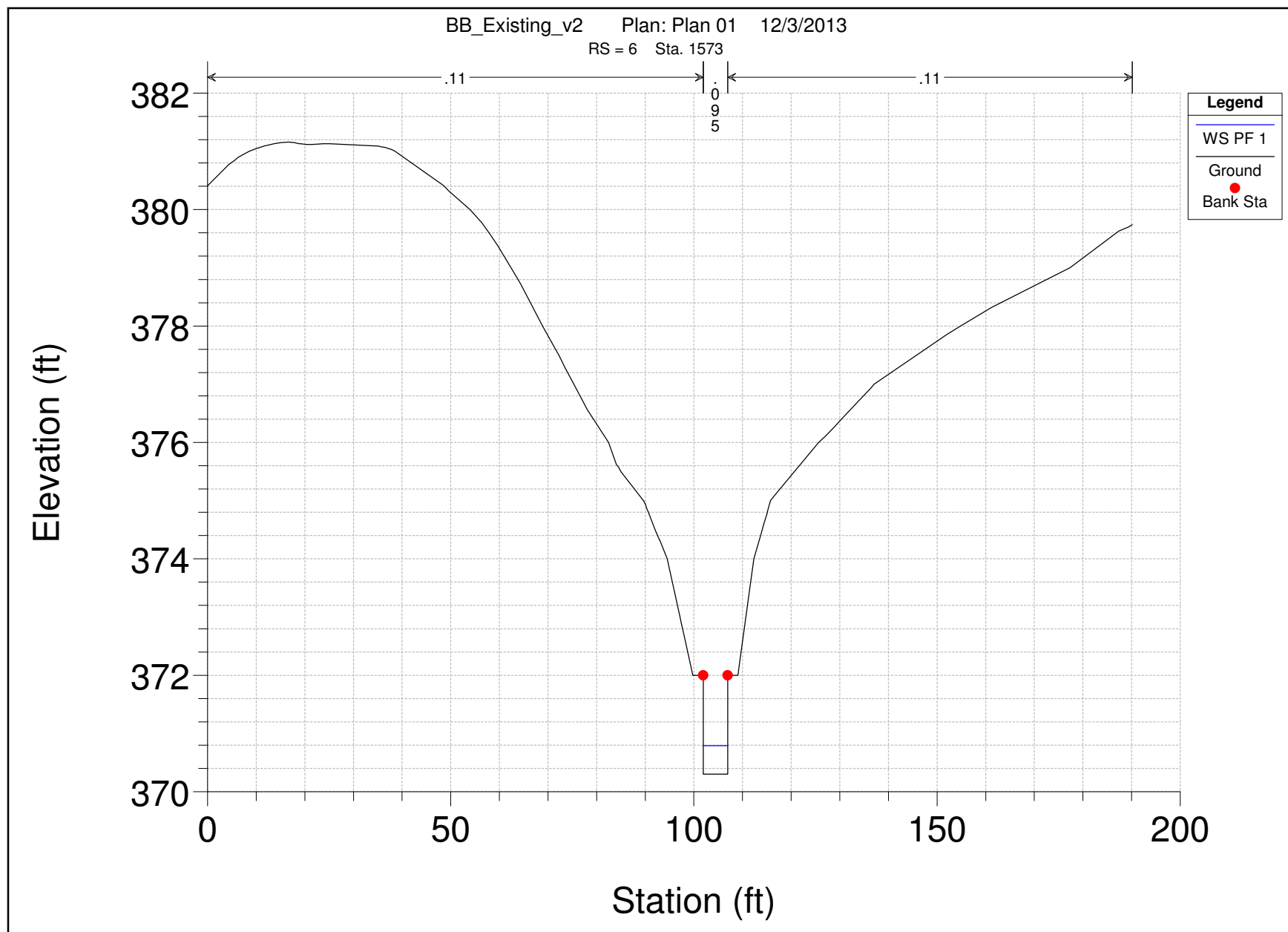


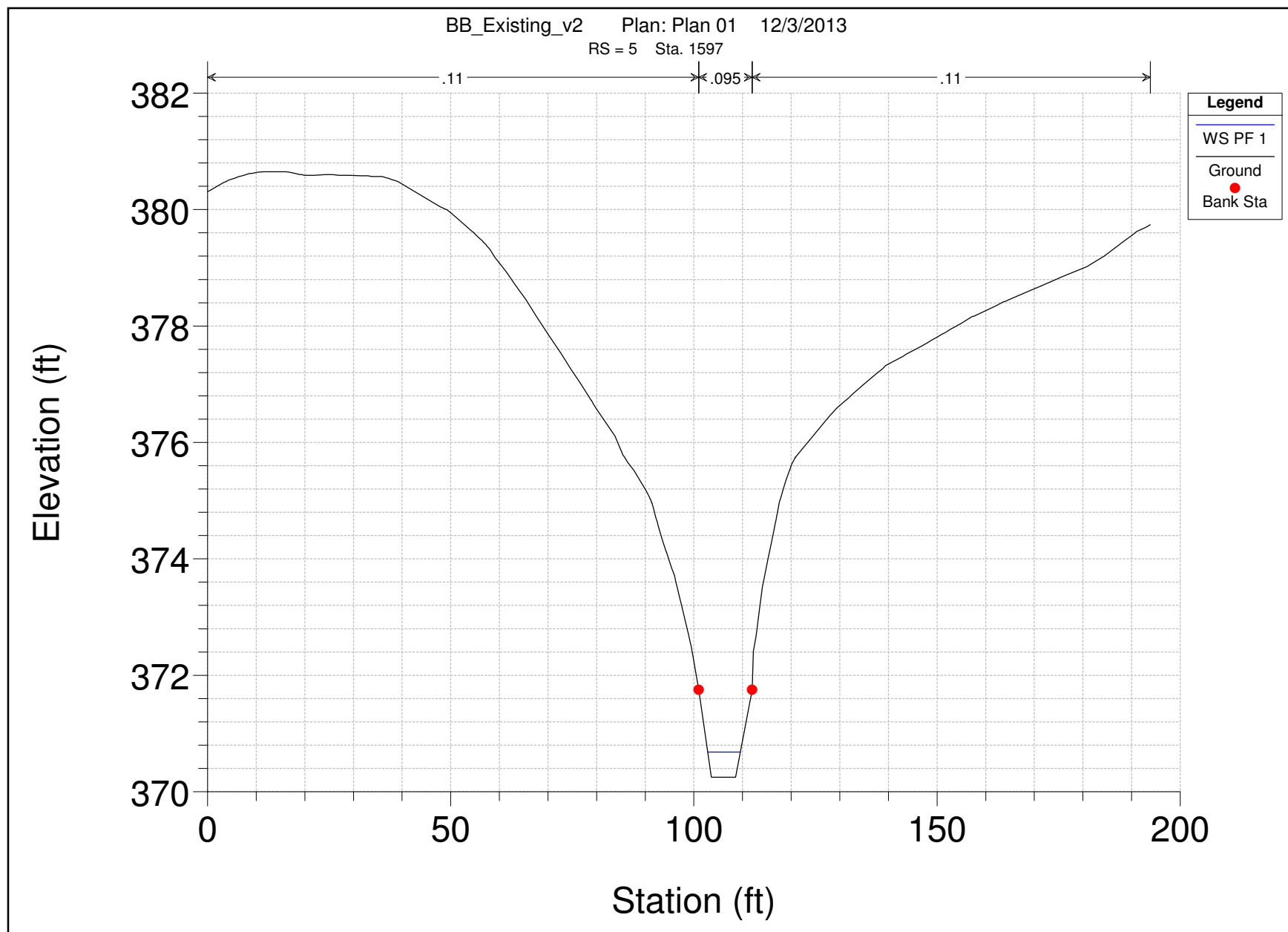


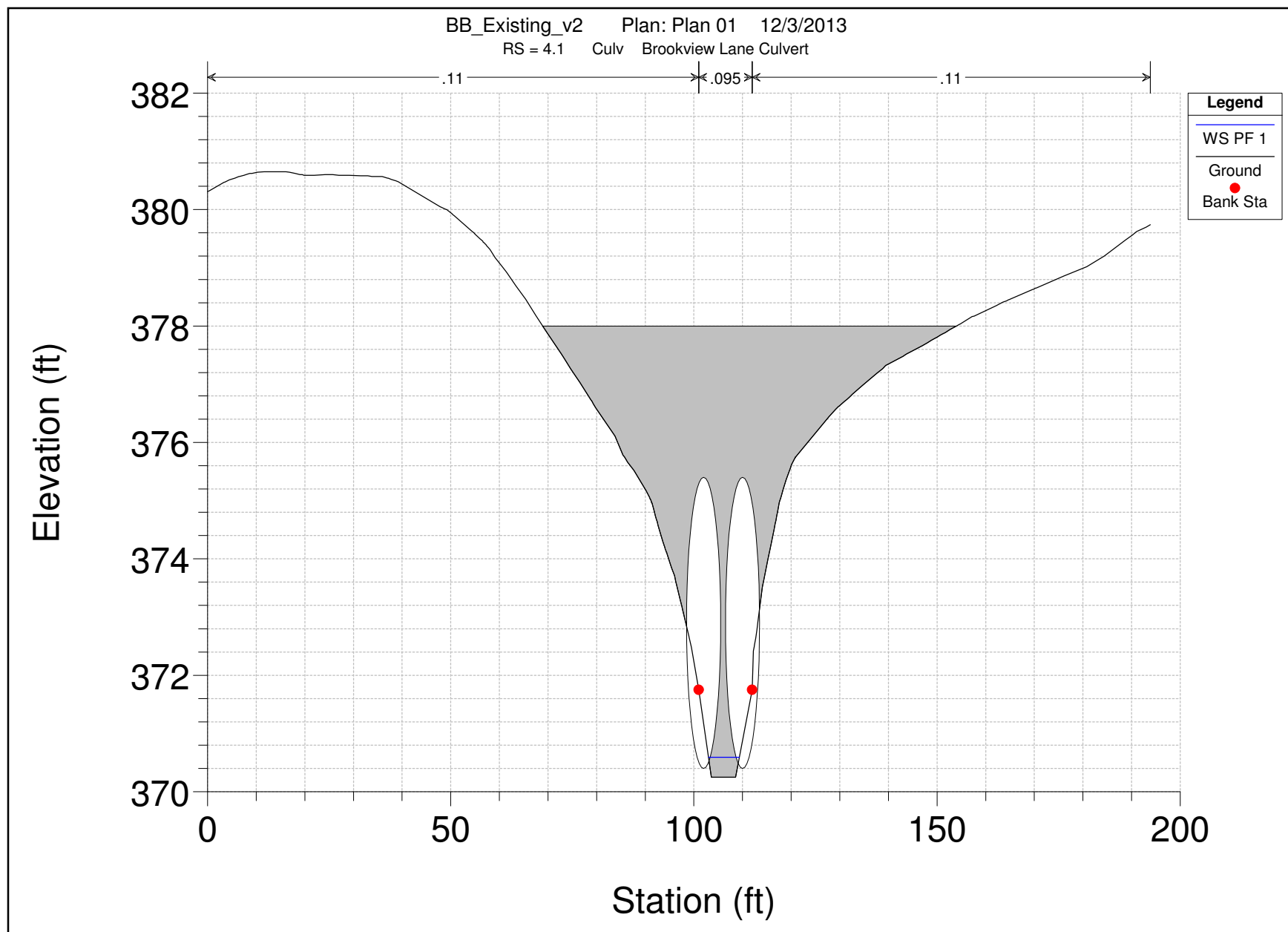


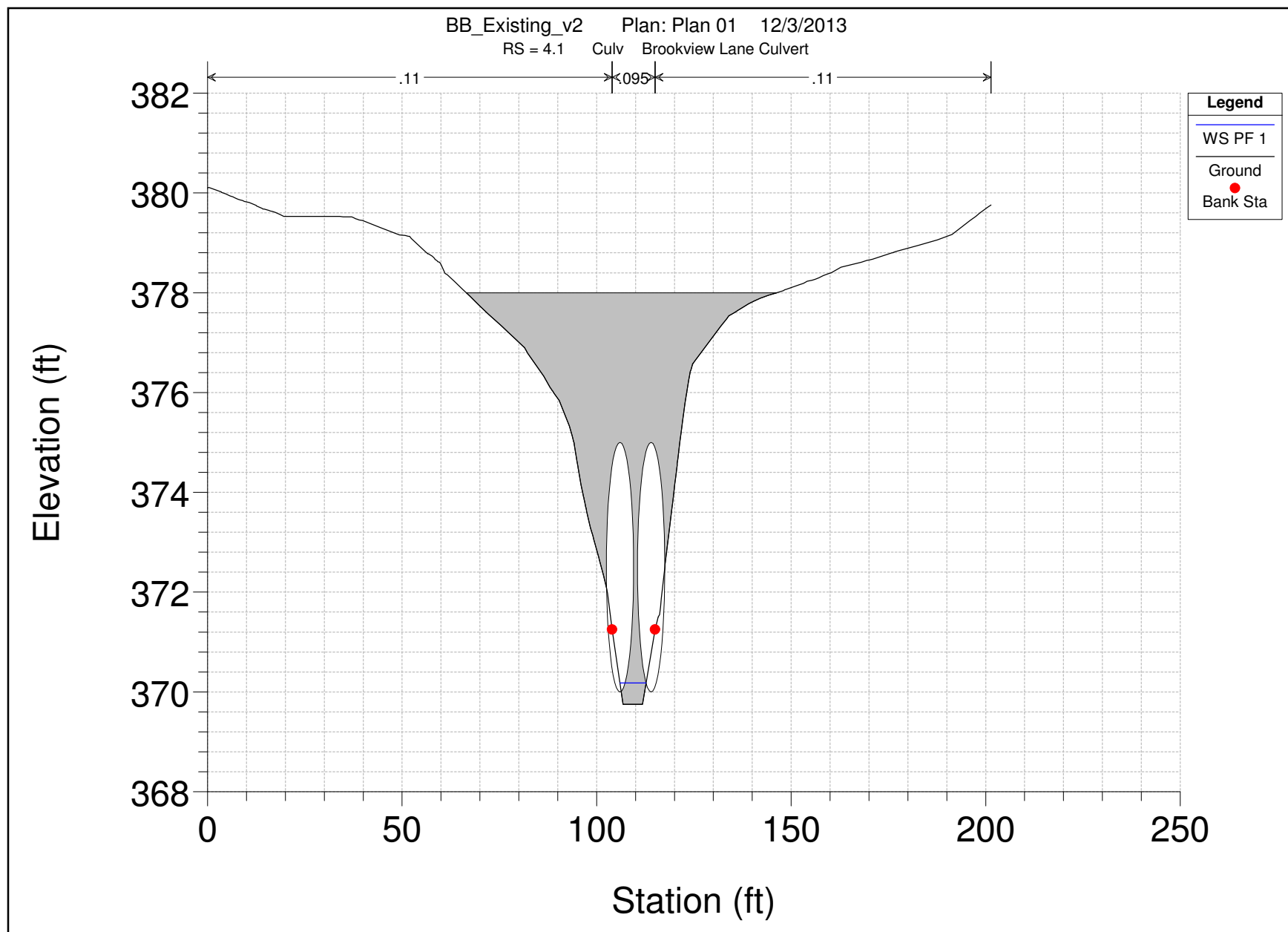


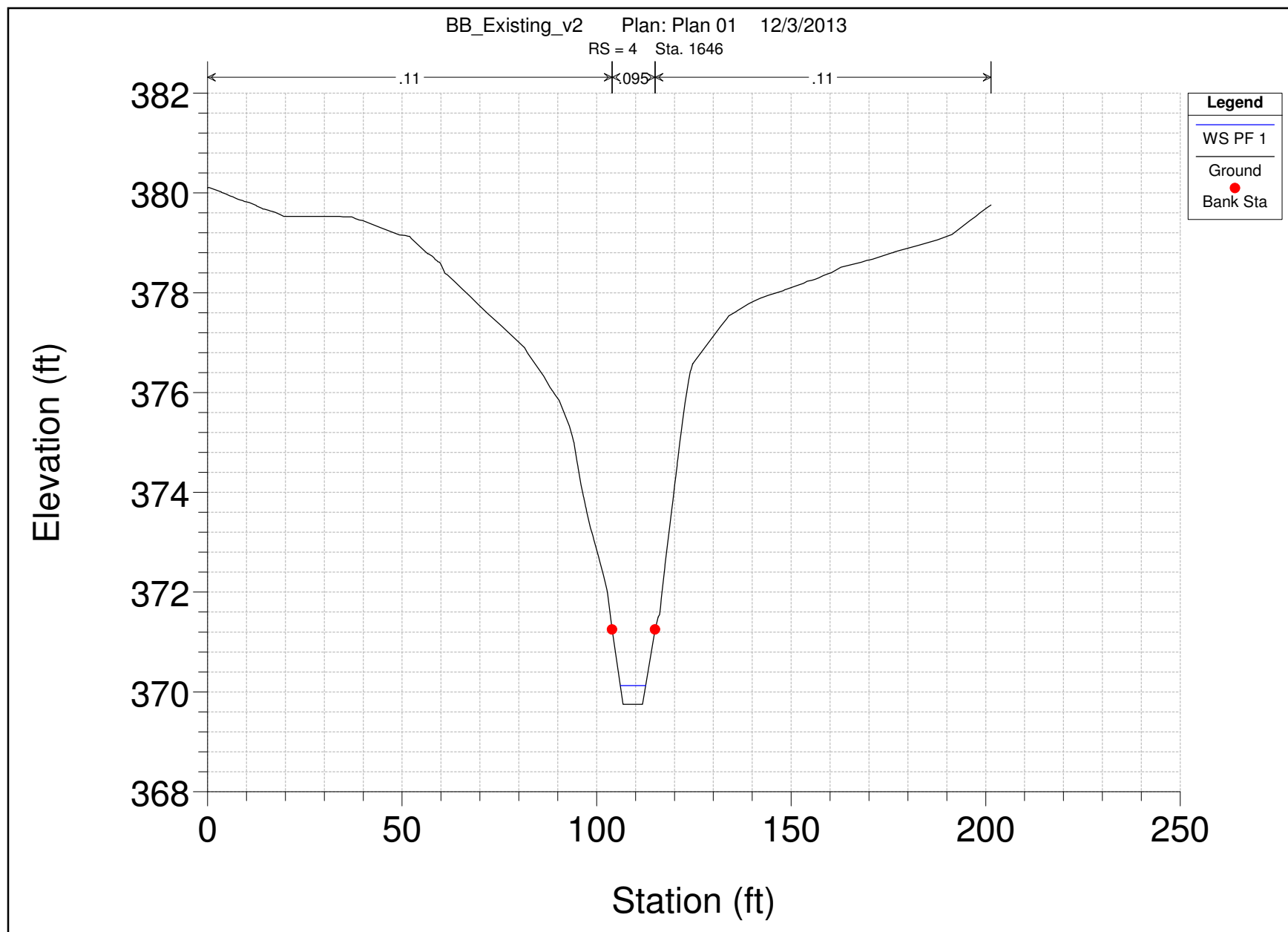


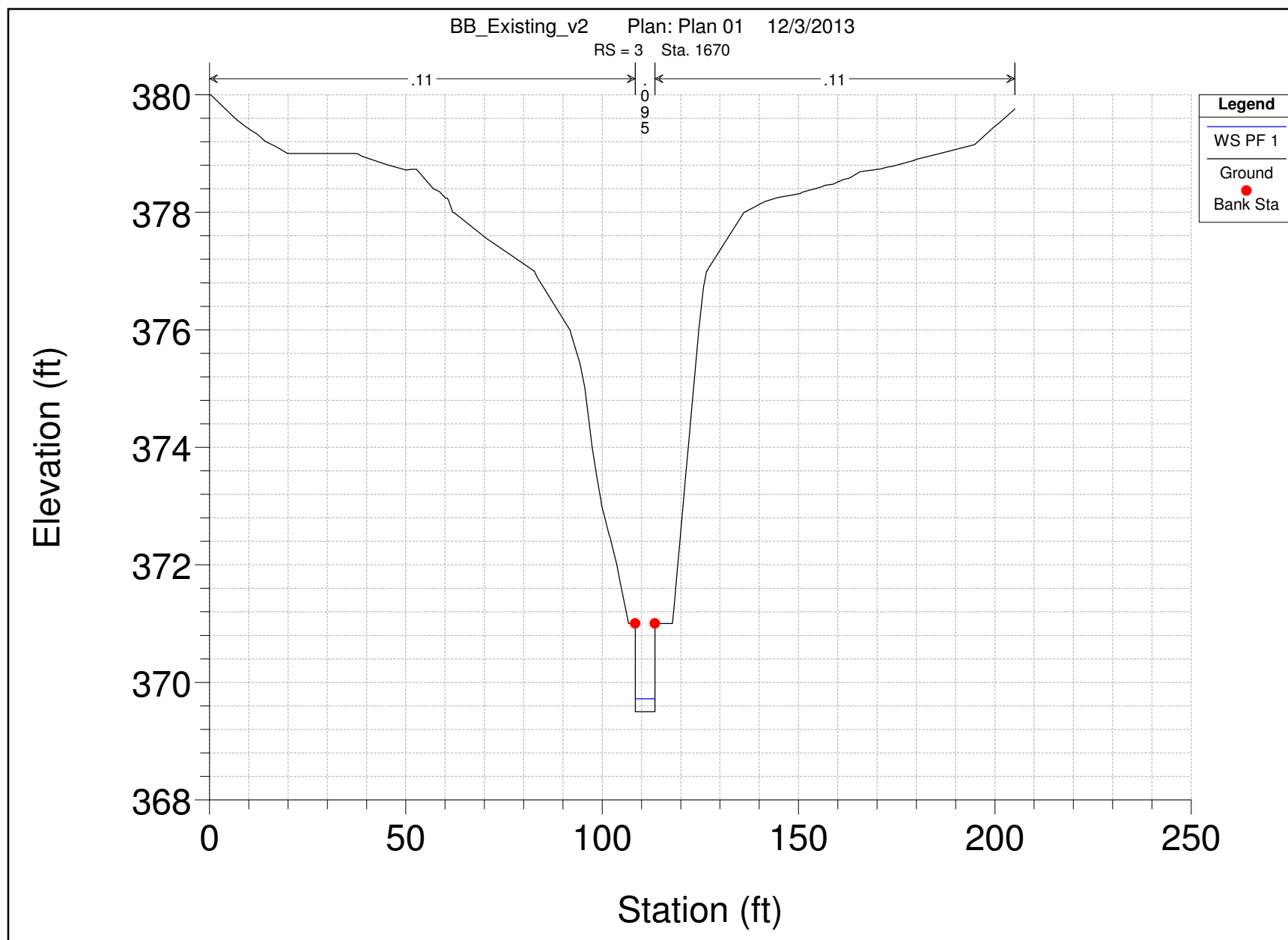


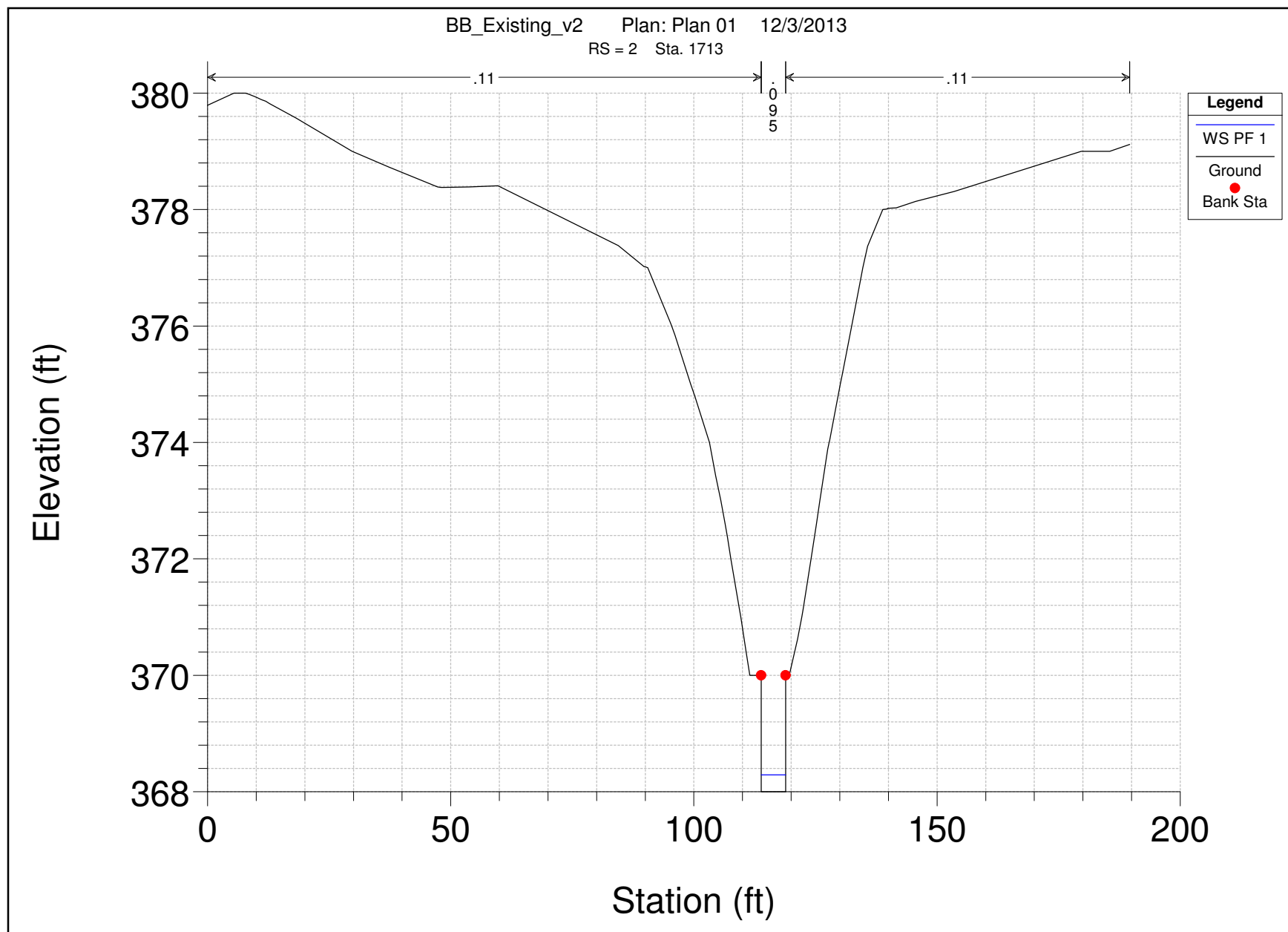


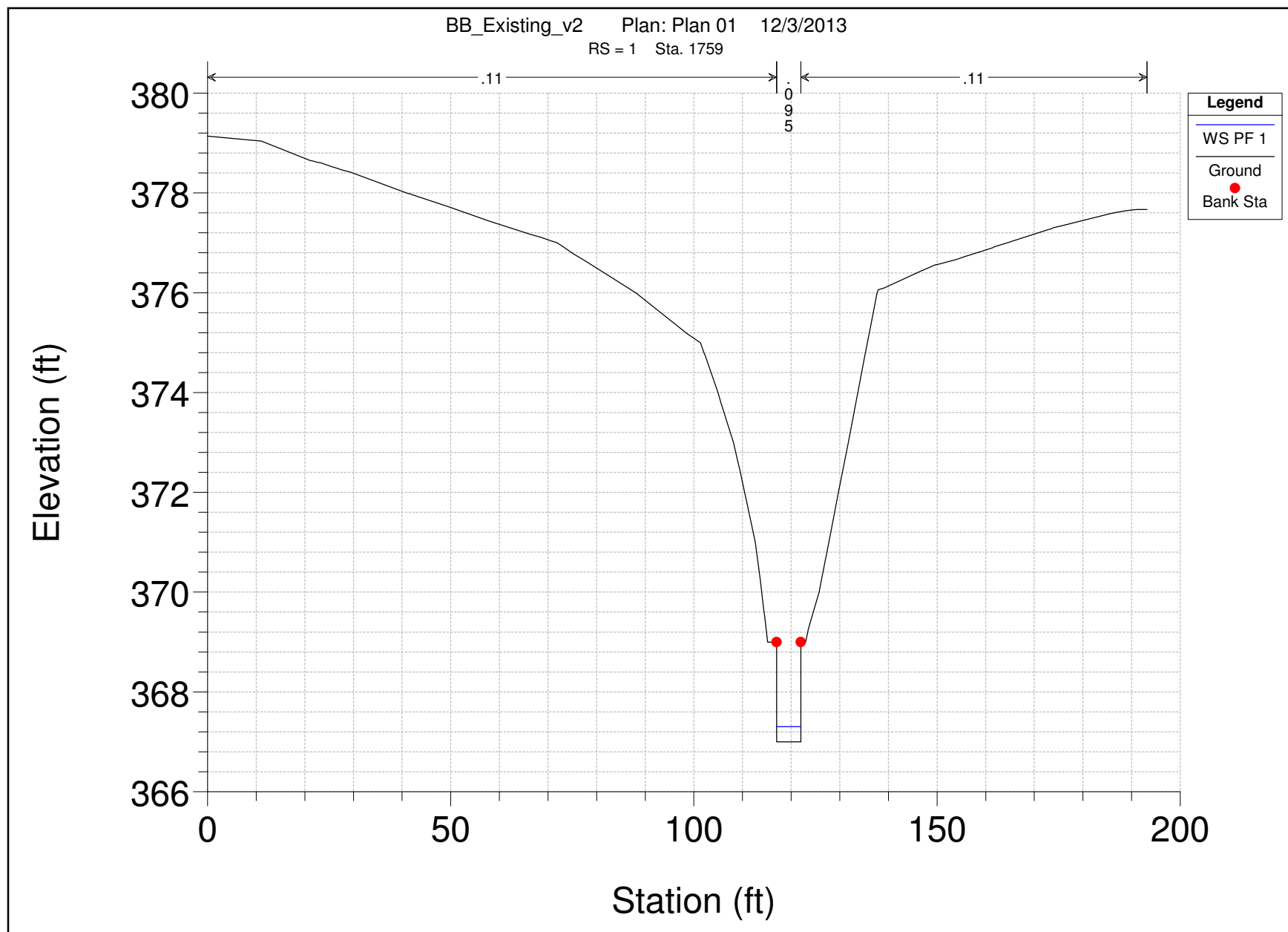












Appendix C: HEC-RAS Proposed Conditions Model Output

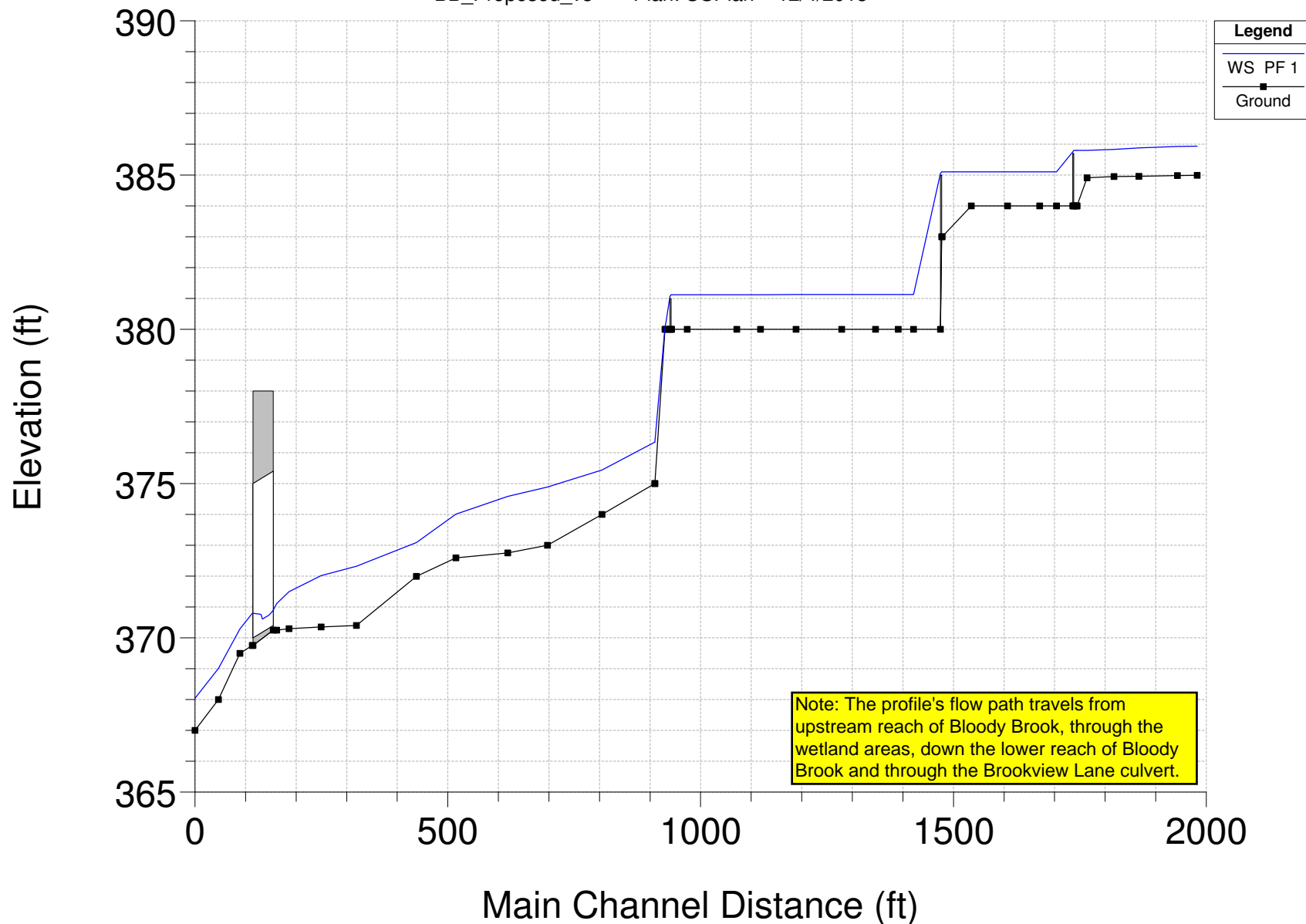
Summary Table, page 46

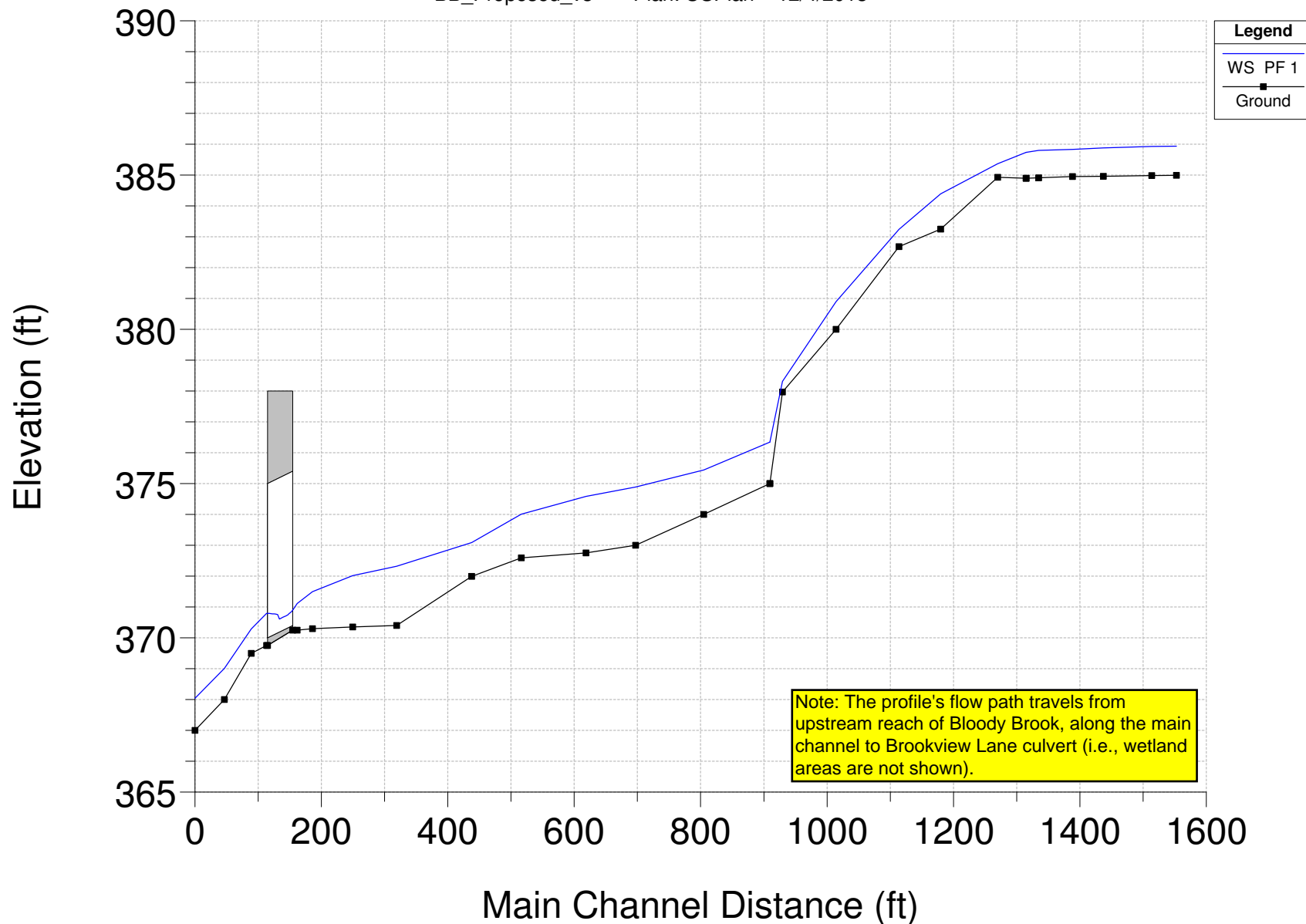
Profile Plots, pages 47 and 48

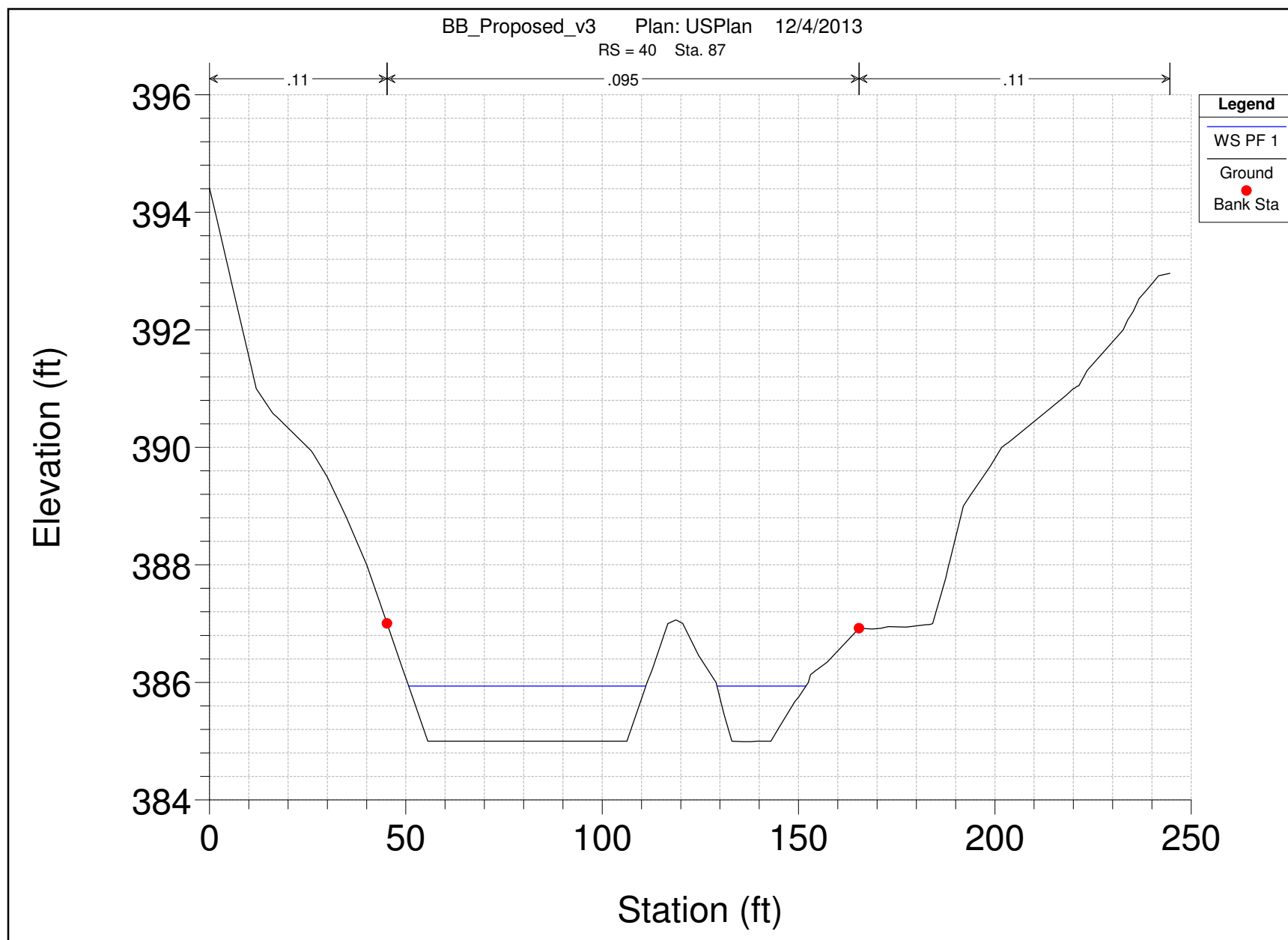
Cross-Section Plots, pages 49 to 96

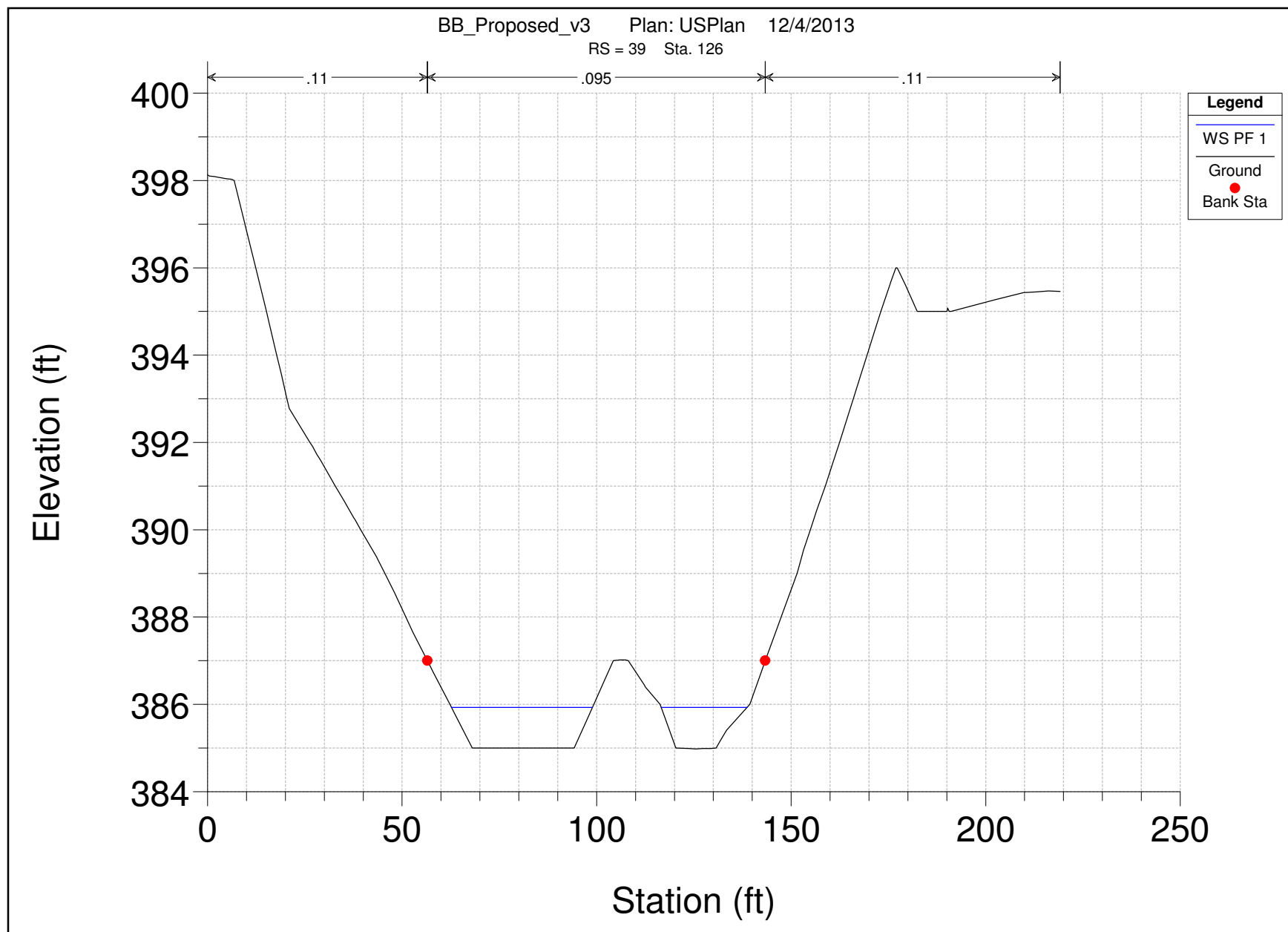
HEC-RAS Plan: USPlan Profile: PF 1

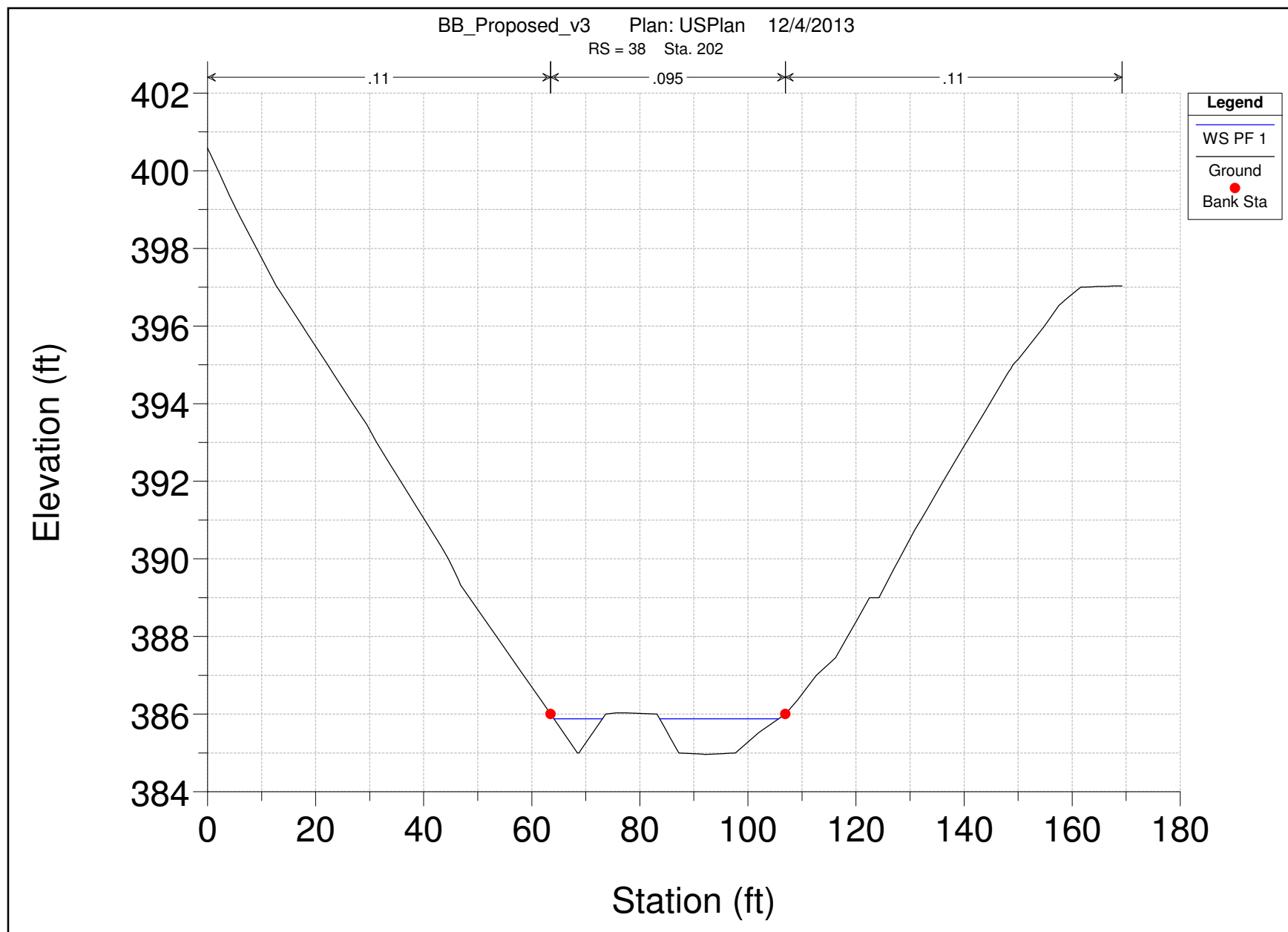
River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Hydr Depth
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)
Wetland	Wetland	35.5	PF 1	1.40	384.00	385.80		385.80	0.000012	0.05	29.43	18.98	0.01	1.55
Wetland	Wetland	35	PF 1	1.40	384.00	385.80	384.06	385.80	0.000012	0.05	29.43	18.98	0.01	1.55
Wetland	Wetland	34.1		Inl Struct										
Wetland	Wetland	34	PF 1	1.40	384.00	385.10		385.10	0.000009	0.03	44.89	45.74	0.01	0.98
Wetland	Wetland	33	PF 1	1.40	384.00	385.10		385.10	0.000003	0.02	72.74	70.50	0.00	1.03
Wetland	Wetland	32	PF 1	1.40	384.00	385.10		385.10	0.000003	0.02	79.31	76.45	0.00	1.04
Wetland	Wetland	31	PF 1	1.40	384.00	385.10		385.10	0.000004	0.02	68.37	66.54	0.00	1.03
Wetland	Wetland	30	PF 1	1.40	383.00	385.10	383.07	385.10	0.000009	0.05	30.83	16.64	0.01	1.85
Wetland	Wetland	29.1		Inl Struct										
Wetland	Wetland	29	PF 1	1.40	380.00	381.12		381.12	0.000004	0.02	67.57	64.80	0.00	1.04
Wetland	Wetland	28	PF 1	1.40	380.00	381.12		381.12	0.000002	0.02	83.06	78.57	0.00	1.06
Wetland	Wetland	27	PF 1	1.40	380.00	381.12		381.12	0.000002	0.02	91.98	86.40	0.00	1.06
Wetland	Wetland	26	PF 1	1.40	380.00	381.12		381.12	0.000005	0.02	62.97	104.32	0.00	0.60
Wetland	Wetland	25	PF 1	1.40	380.00	381.12		381.12	0.000002	0.01	104.15	153.06	0.00	0.68
Wetland	Wetland	24	PF 1	1.40	380.00	381.12	380.04	381.12	0.000013	0.03	41.11	49.35	0.01	0.83
Wetland	Wetland	23	PF 1	1.40	380.00	381.12		381.12	0.000027	0.05	28.96	62.14	0.01	0.47
Wetland	Wetland	22	PF 1	1.40	380.00	381.12		381.12	0.000002	0.02	89.71	84.48	0.00	1.06
Wetland	Wetland	21.5	PF 1	1.40	380.00	381.12	380.08	381.12	0.000093	0.10	13.95	12.94	0.02	1.08
Wetland	Wetland	21.1		Inl Struct										
Wetland	Wetland	21	PF 1	1.40	380.00	380.22		380.23	0.018416	0.52	2.69	12.12	0.19	0.22
Wetland	Wetland	20.9	PF 1	1.40	380.00	380.08	380.08	380.11	0.679307	1.55	0.90	11.99	1.00	0.08
Bloody Brook	Upper	40	PF 1	9.40	384.99	385.94	385.09	385.94	0.000106	0.14	67.26	83.02	0.03	0.81
Bloody Brook	Upper	39	PF 1	9.40	384.98	385.93		385.93	0.000278	0.21	43.79	58.32	0.04	0.75
Bloody Brook	Upper	38	PF 1	9.40	384.96	385.88		385.89	0.002160	0.51	18.44	31.08	0.12	0.59
Bloody Brook	Upper	37	PF 1	9.40	384.95	385.84		385.84	0.000551	0.30	31.60	43.23	0.06	0.73
Bloody Brook	Upper	36	PF 1	9.40	384.91	385.80		385.80	0.000806	0.32	29.26	47.47	0.07	0.62
Bloody Brook	Middle	20	PF 1	8.00	384.90	385.74		385.75	0.004212	0.76	10.50	16.51	0.17	0.64
Bloody Brook	Middle	19	PF 1	8.00	384.93	385.37		385.39	0.020696	1.17	6.84	17.95	0.33	0.38
Bloody Brook	Middle	18	PF 1	8.00	383.25	384.39		384.41	0.006696	1.11	7.83	12.12	0.21	0.65
Bloody Brook	Middle	17	PF 1	8.00	382.68	383.24		383.32	0.090453	2.32	3.46	9.88	0.69	0.35
Bloody Brook	Middle	16	PF 1	8.00	380.00	380.89	380.46	380.91	0.010873	1.07	7.50	14.04	0.26	0.53
Bloody Brook	Middle	15	PF 1	8.00	377.97	378.31	378.31	378.46	0.201608	3.09	2.59	8.72	1.00	0.30
Bloody Brook	Lower	14	PF 1	9.40	375.00	376.34	375.48	376.37	0.009599	1.40	6.71	5.00	0.21	1.34
Bloody Brook	Lower	13	PF 1	9.40	374.00	375.44	374.47	375.46	0.007883	1.31	7.19	5.00	0.19	1.44
Bloody Brook	Lower	12	PF 1	9.40	373.00	374.89		374.90	0.003681	1.00	9.44	5.00	0.13	1.89
Bloody Brook	Lower	11	PF 1	9.40	372.75	374.59		374.60	0.003978	1.02	9.18	5.00	0.13	1.84
Bloody Brook	Lower	10	PF 1	9.40	372.59	374.01		374.04	0.008175	1.32	7.10	5.00	0.20	1.42
Bloody Brook	Lower	9	PF 1	9.40	371.99	373.09		373.13	0.017325	1.72	5.48	5.00	0.29	1.10
Bloody Brook	Lower	8	PF 1	9.40	370.40	372.32		372.33	0.003521	0.98	9.59	5.00	0.12	1.92
Bloody Brook	Lower	7	PF 1	9.40	370.35	372.02		372.04	0.005188	1.13	8.34	5.00	0.15	1.67
Bloody Brook	Lower	6	PF 1	9.40	370.30	371.50		371.54	0.013360	1.57	5.99	5.00	0.25	1.20
Bloody Brook	Lower	5	PF 1	9.40	370.25	371.11	370.70	371.15	0.019125	1.63	5.78	8.44	0.35	0.68
Bloody Brook	Lower	4.1		Culvert										
Bloody Brook	Lower	4	PF 1	9.40	369.75	370.79		370.82	0.009515	1.27	7.37	9.17	0.25	0.80
Bloody Brook	Lower	3	PF 1	9.40	369.50	370.29		370.38	0.045710	2.38	3.95	5.00	0.47	0.79
Bloody Brook	Lower	2	PF 1	9.40	368.00	369.01		369.06	0.021955	1.86	5.05	5.00	0.33	1.01
Bloody Brook	Lower	1	PF 1	9.40	367.00	368.04	367.48	368.09	0.020035	1.80	5.21	5.00	0.31	1.04

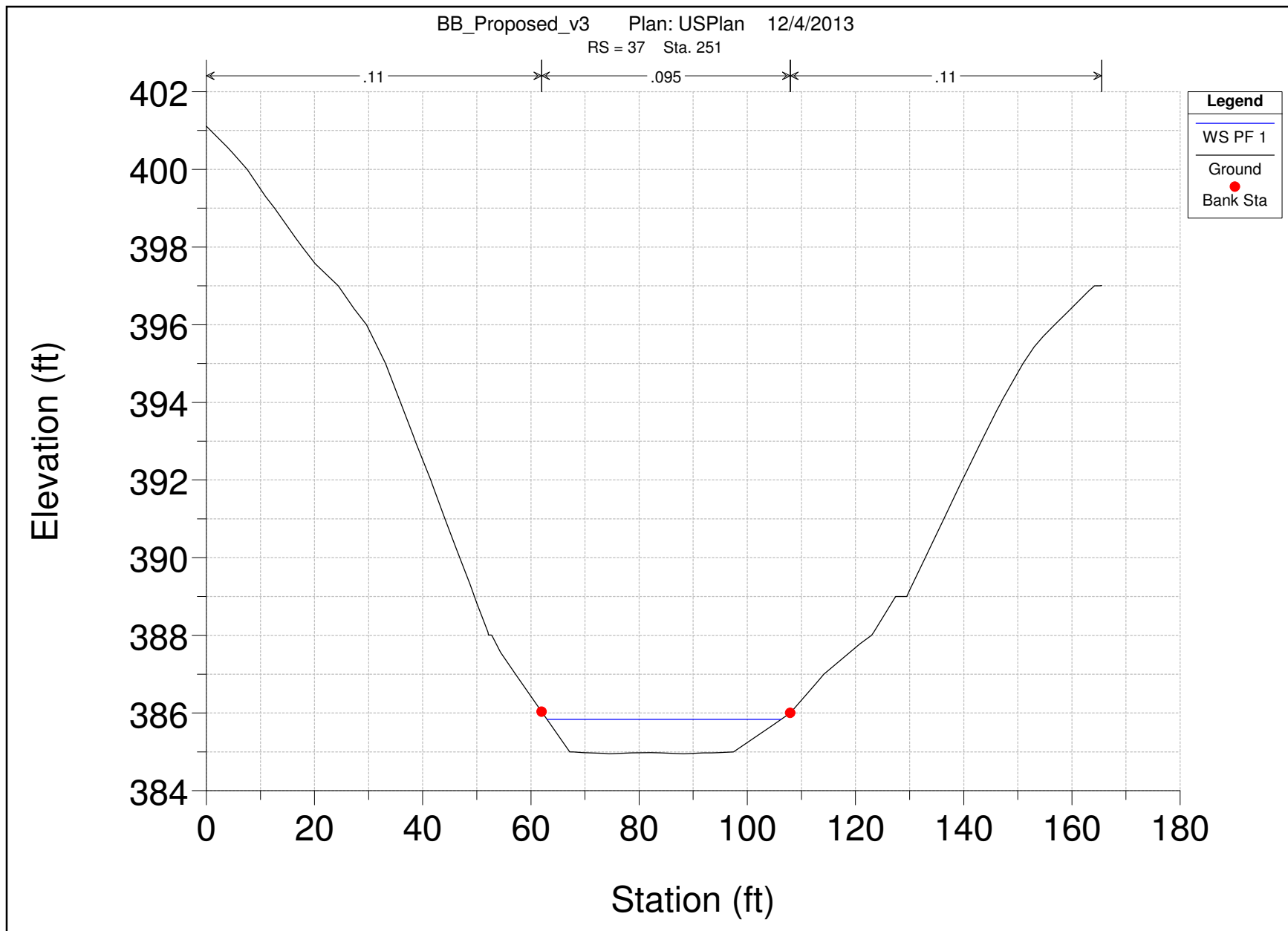


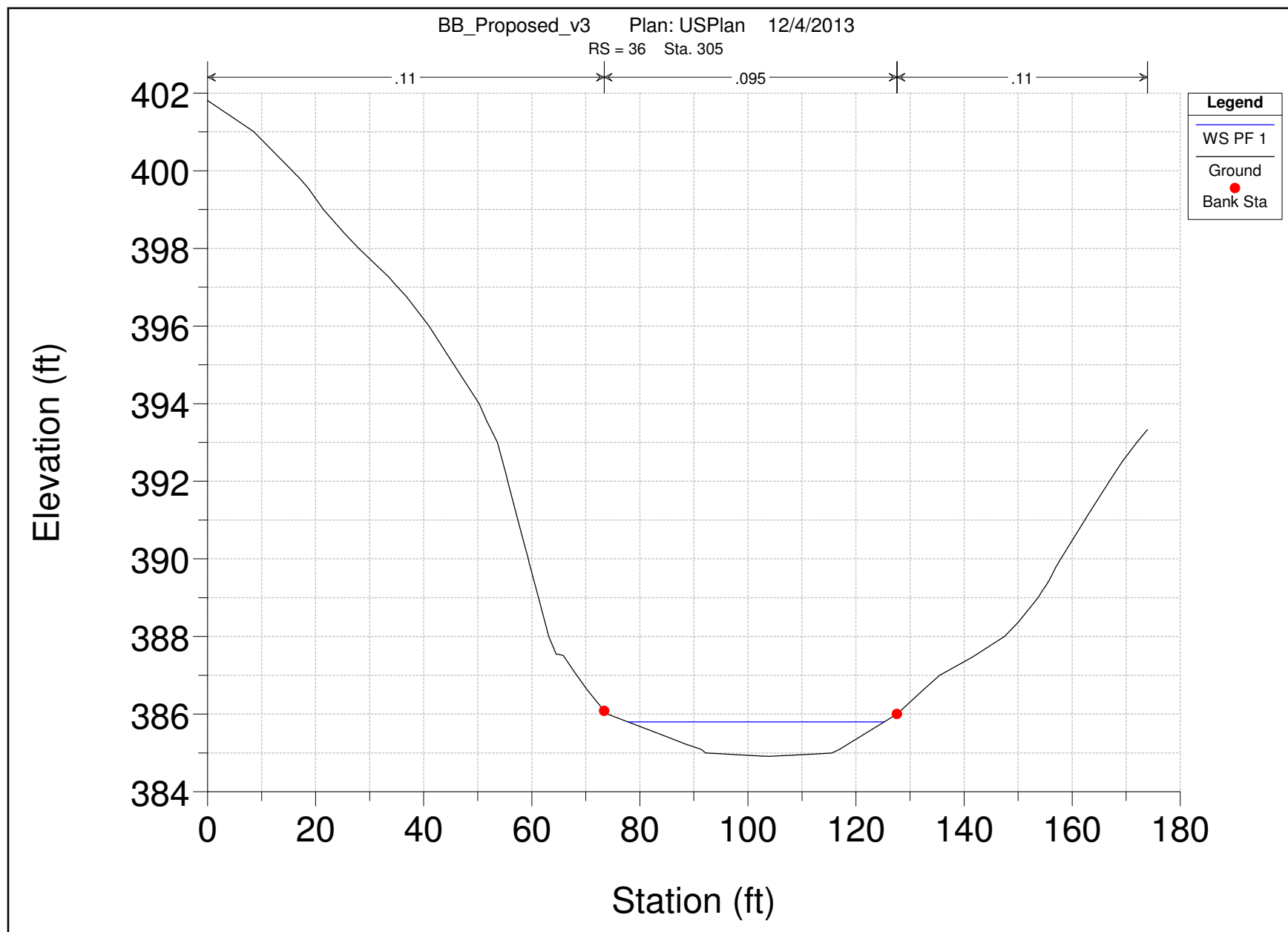


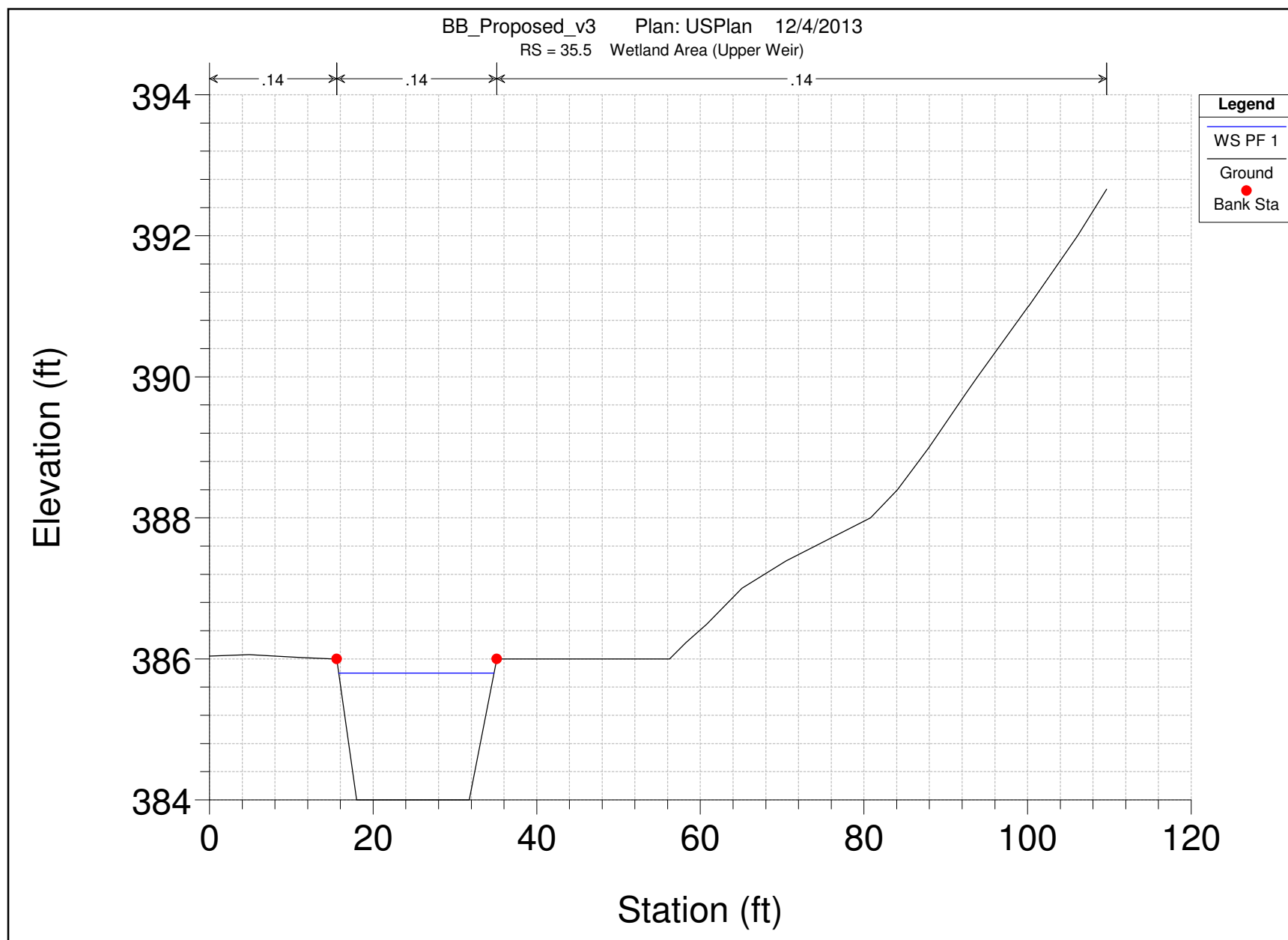


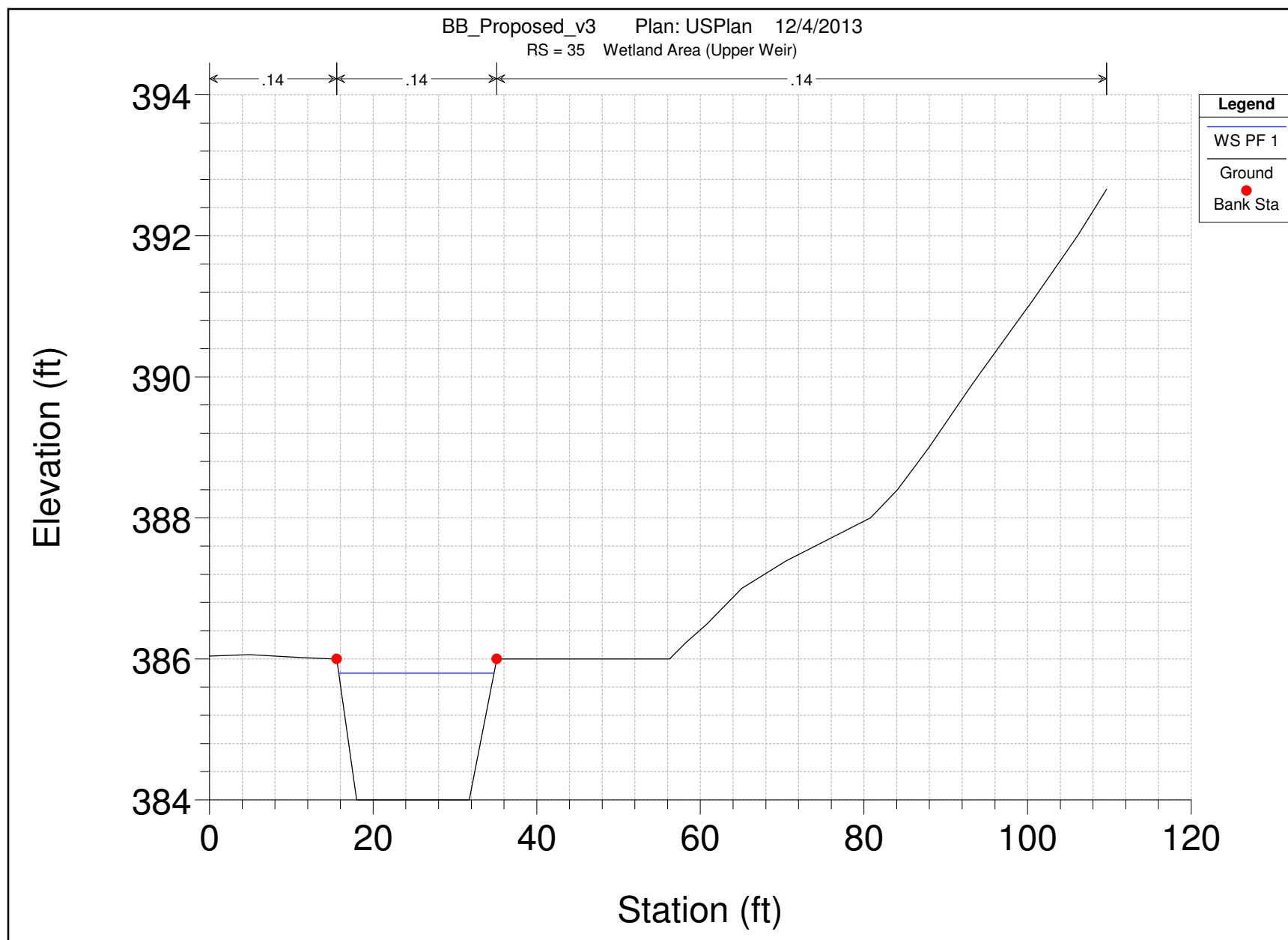


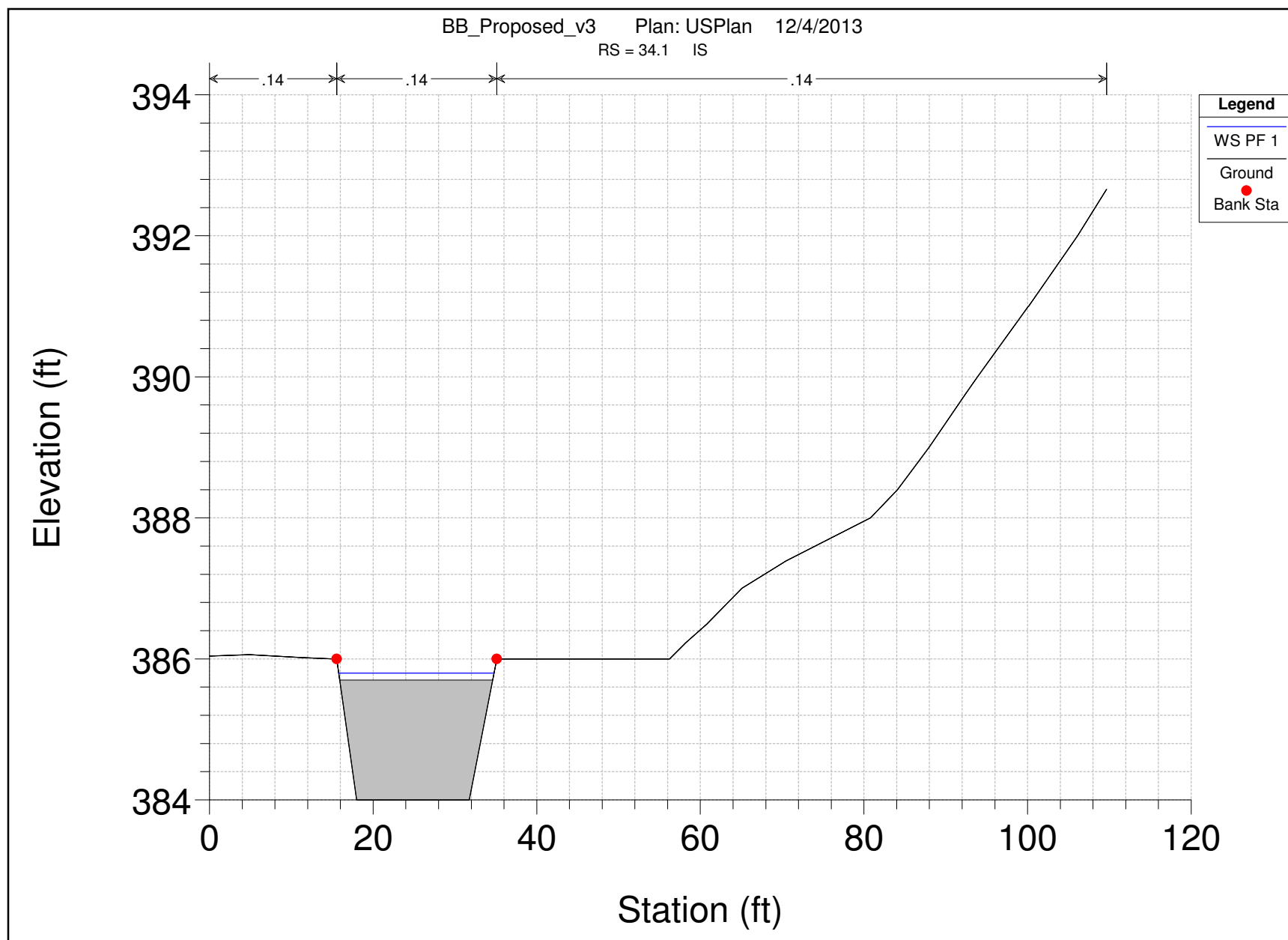


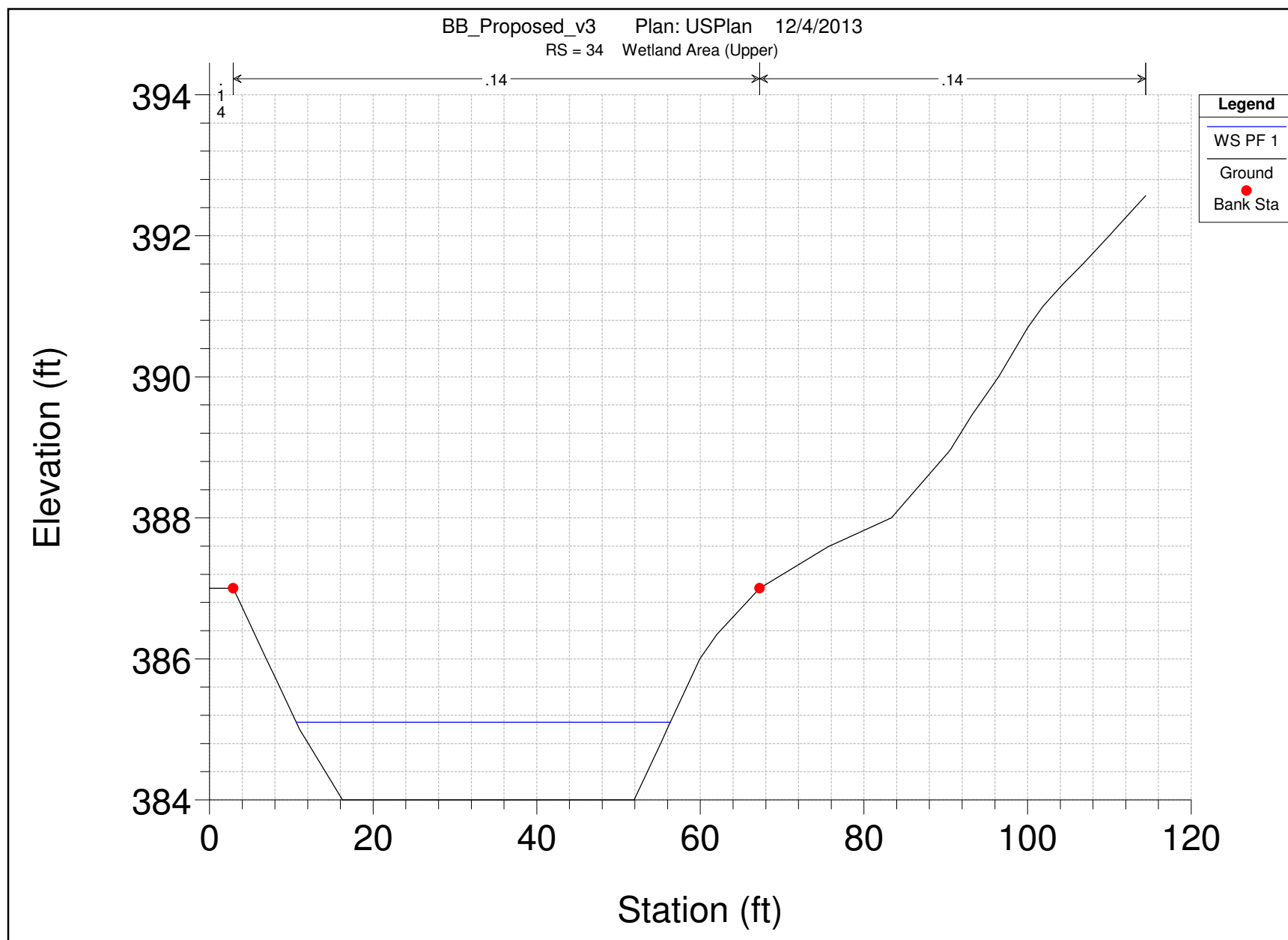


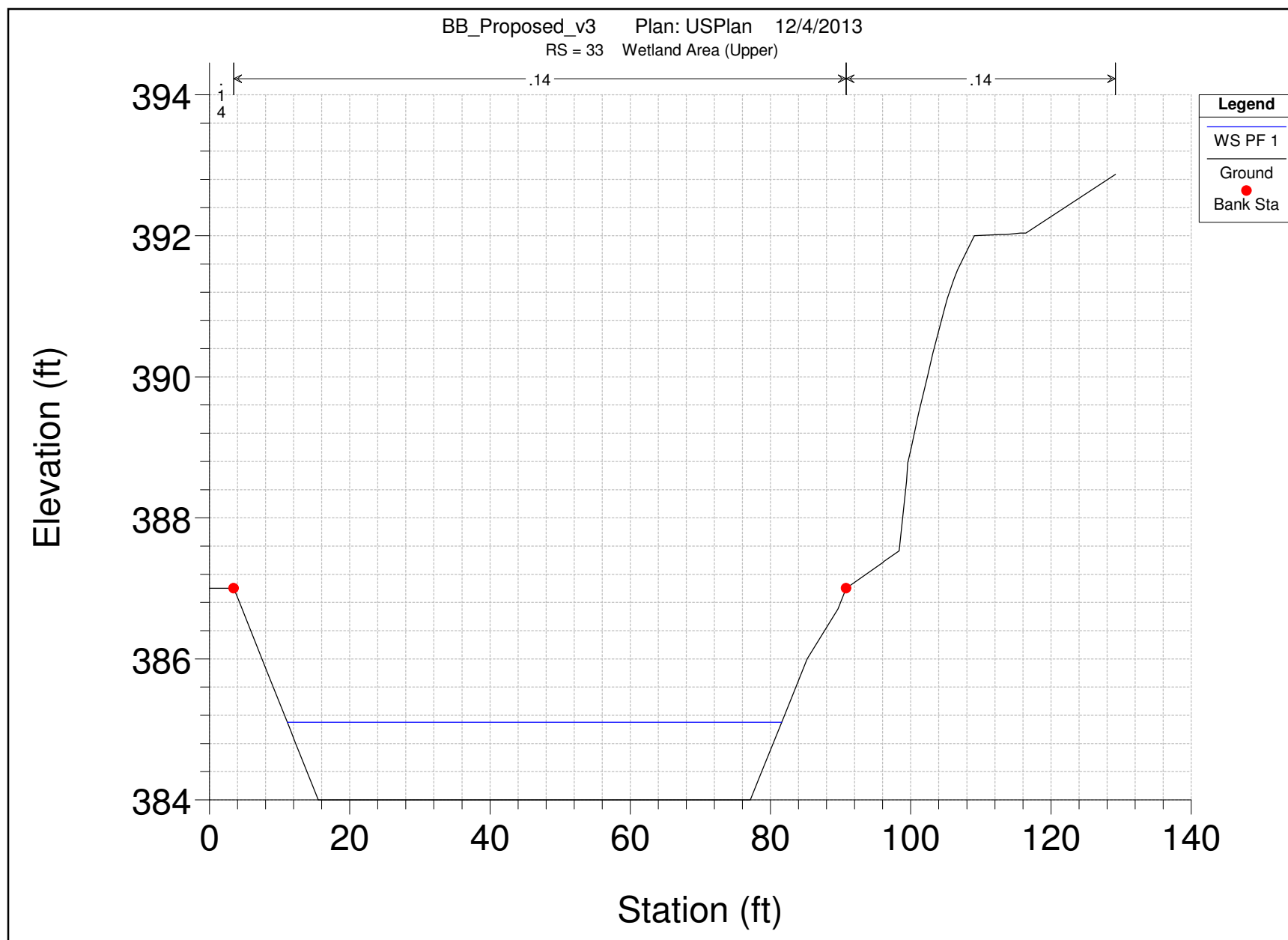


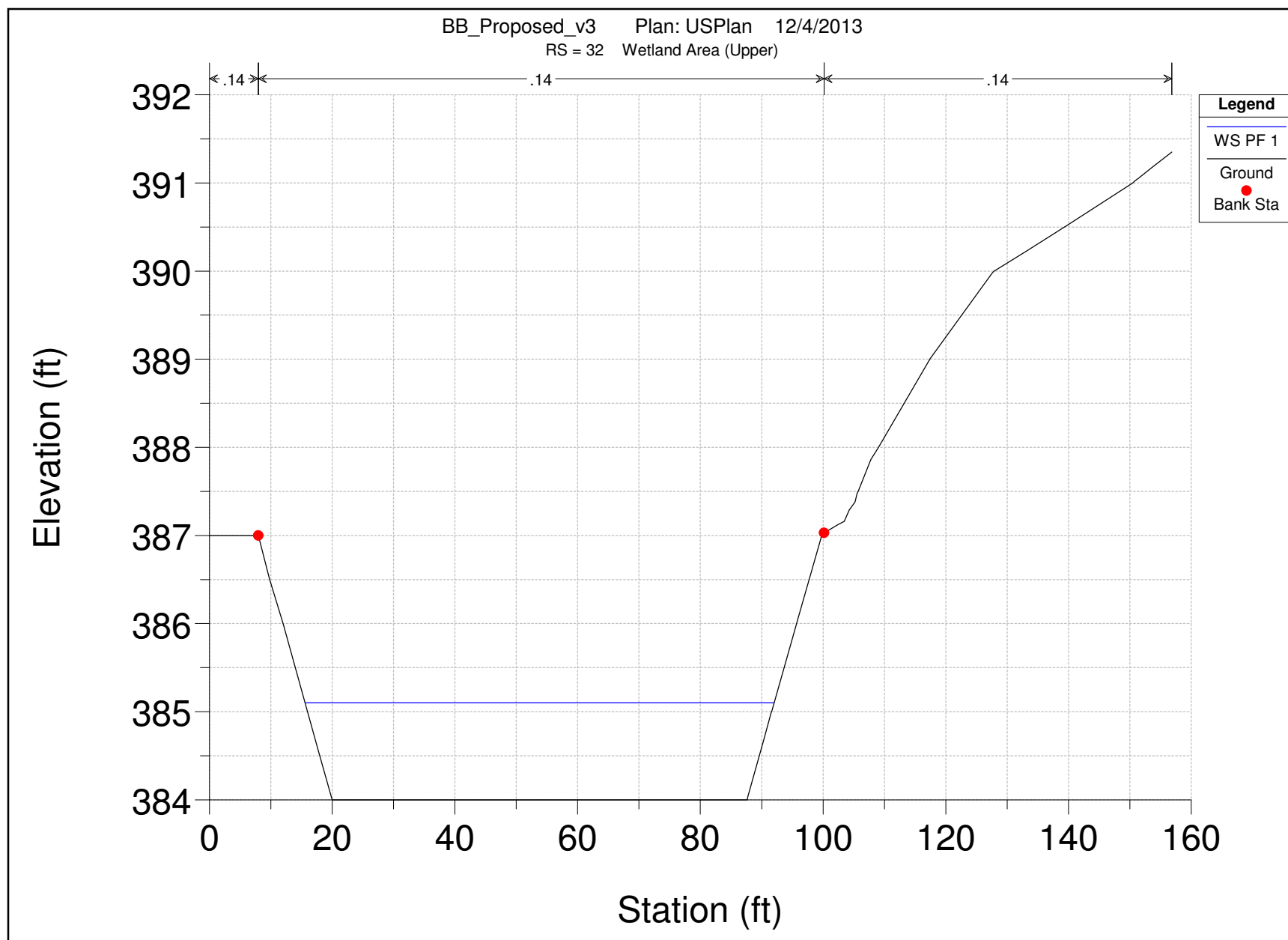


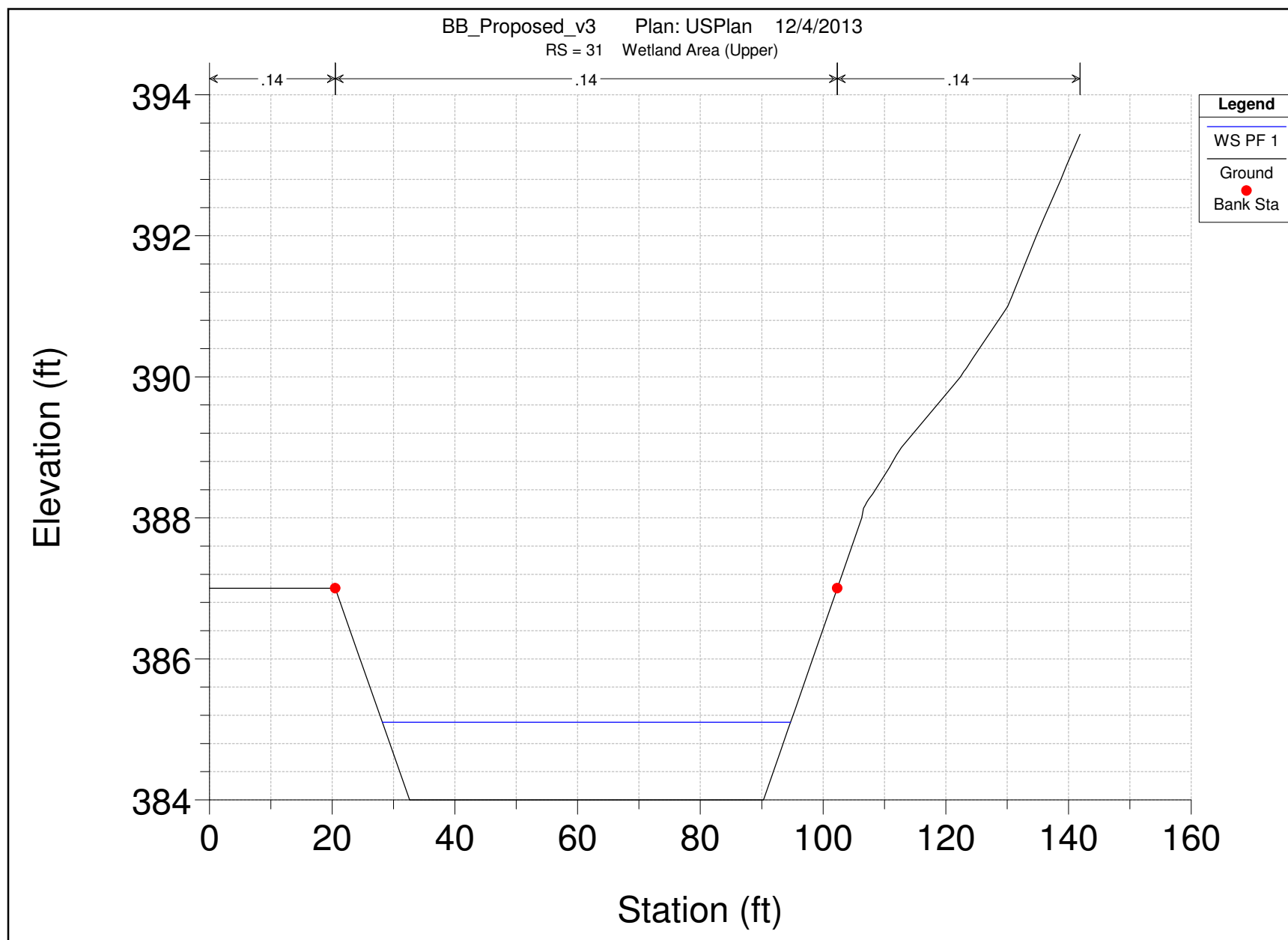


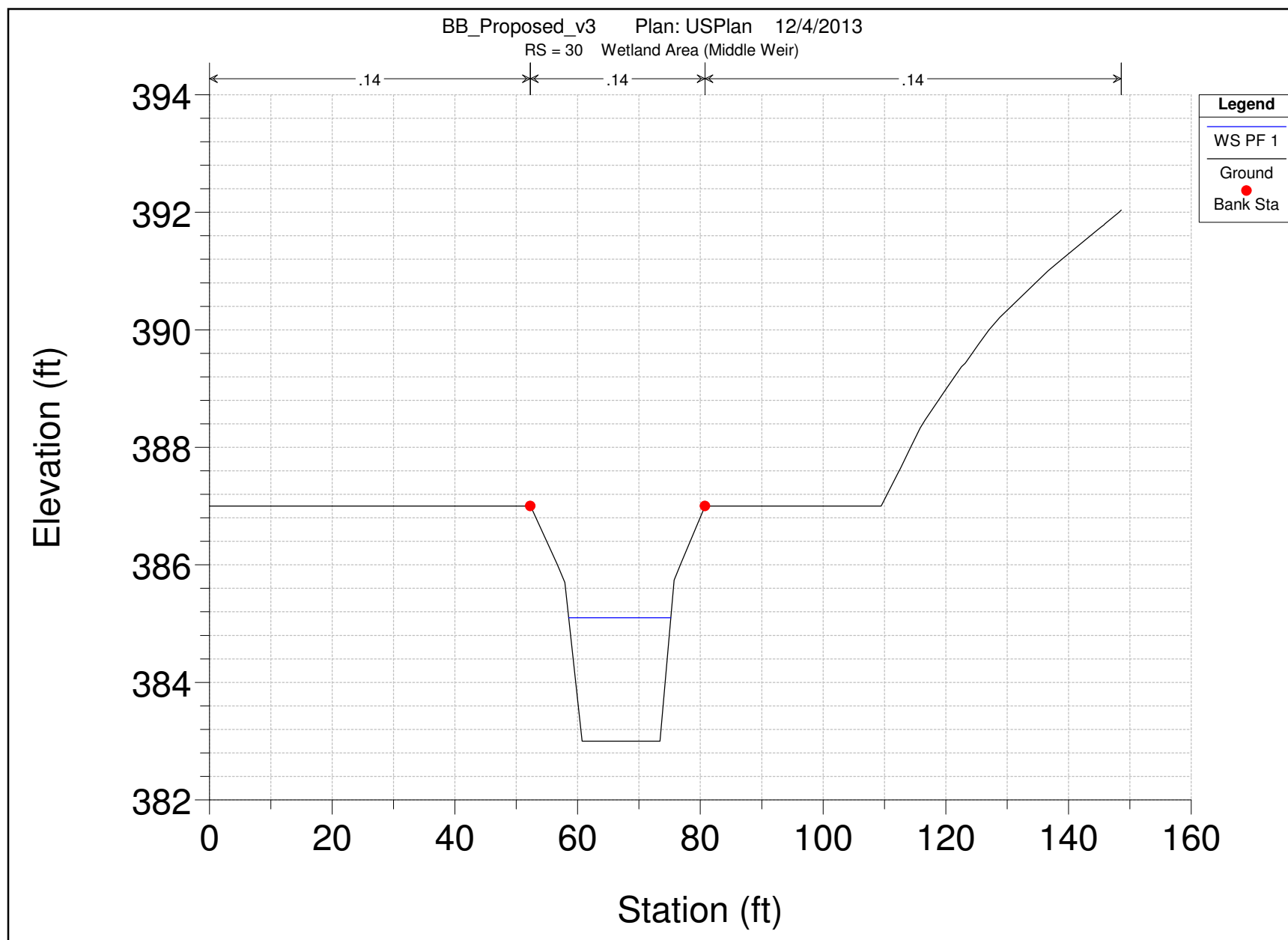


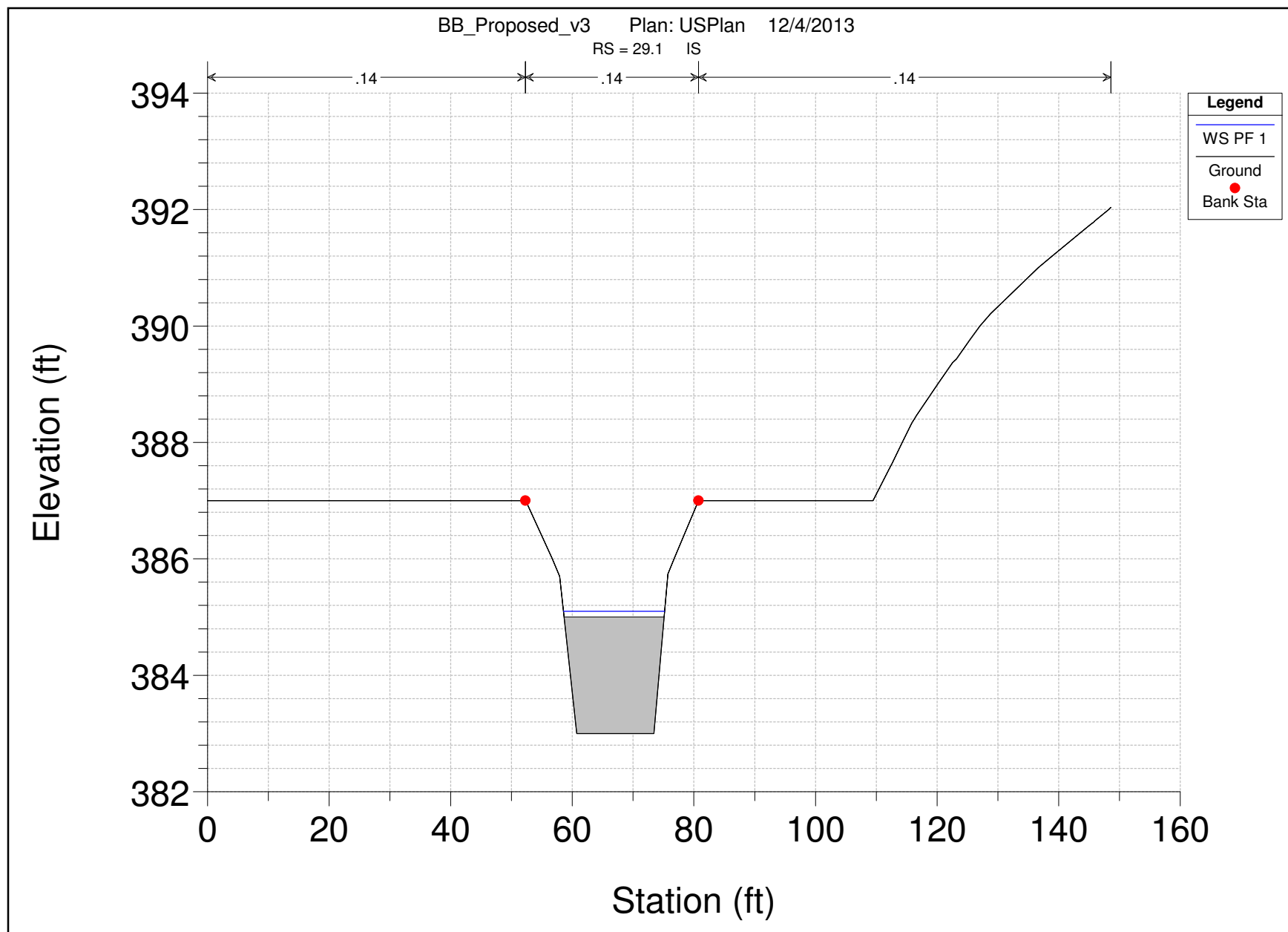


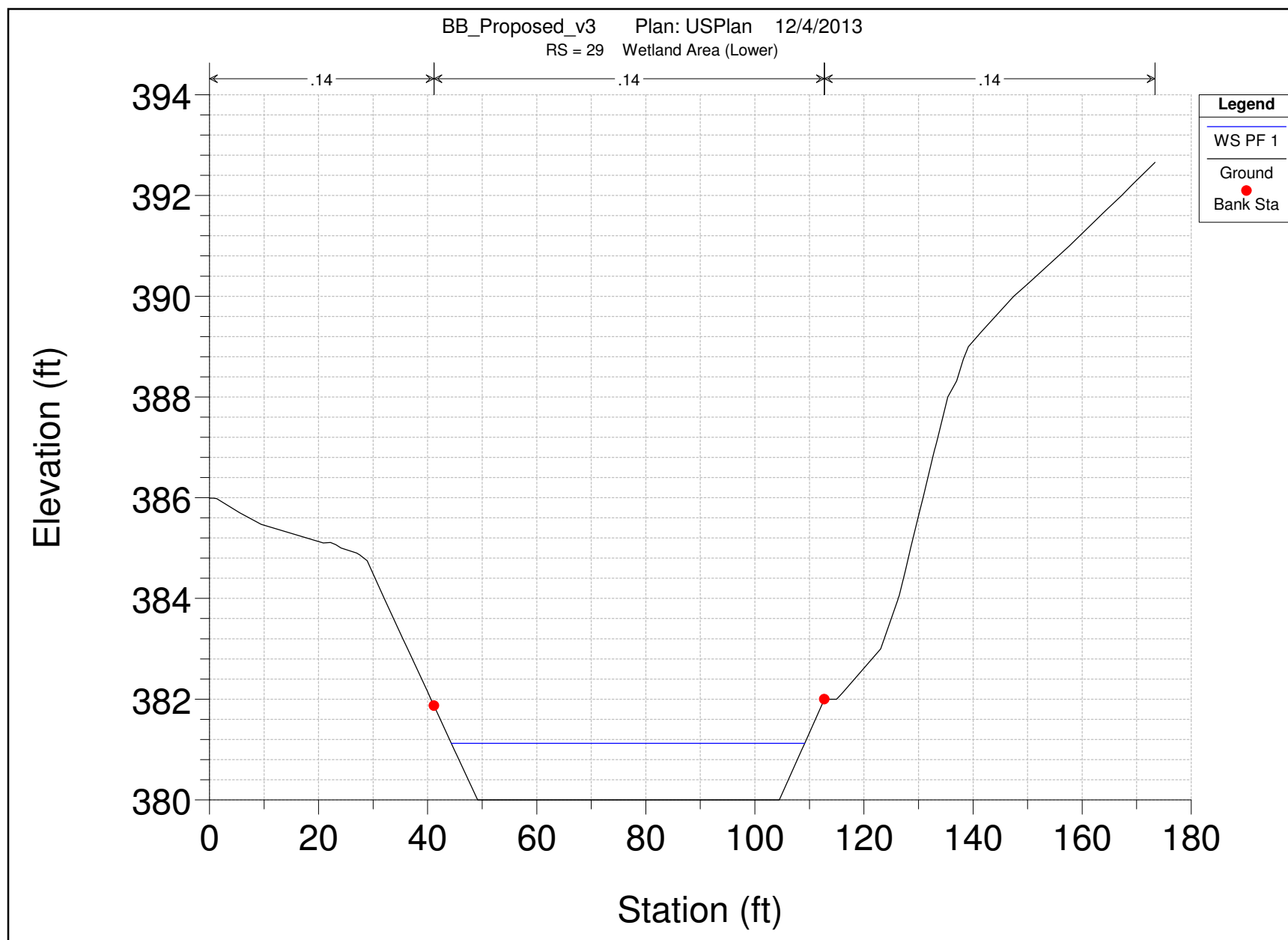


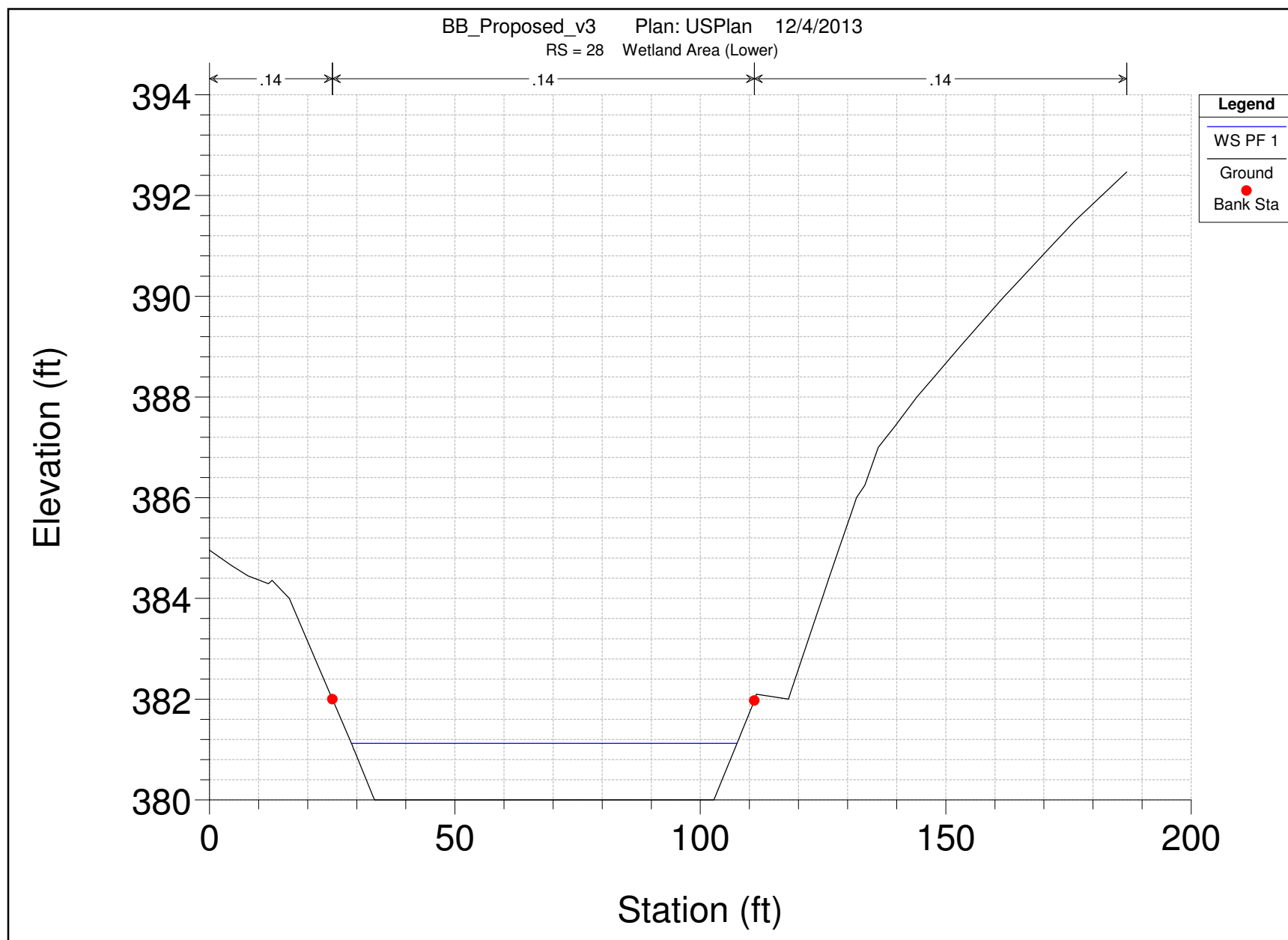


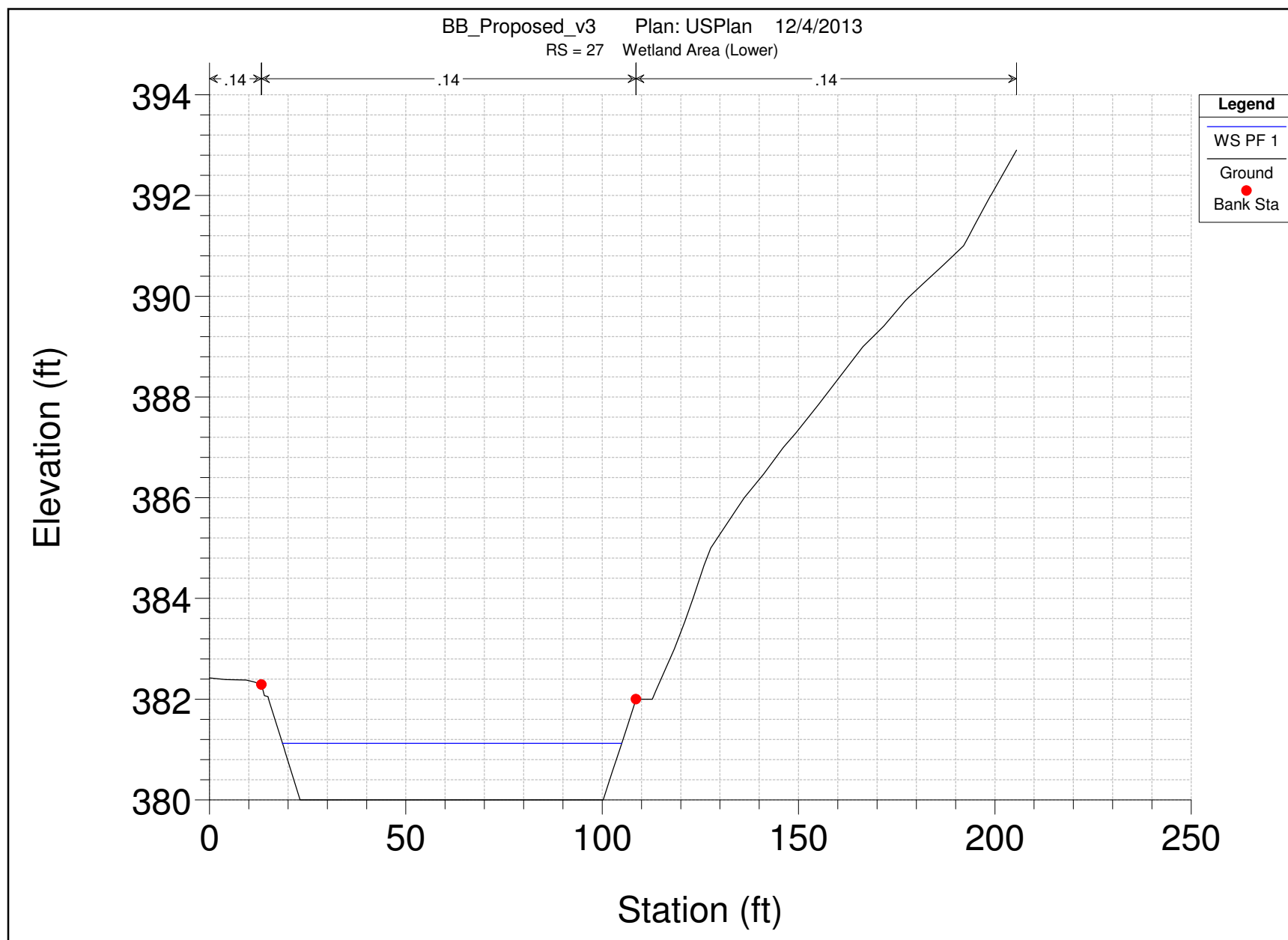


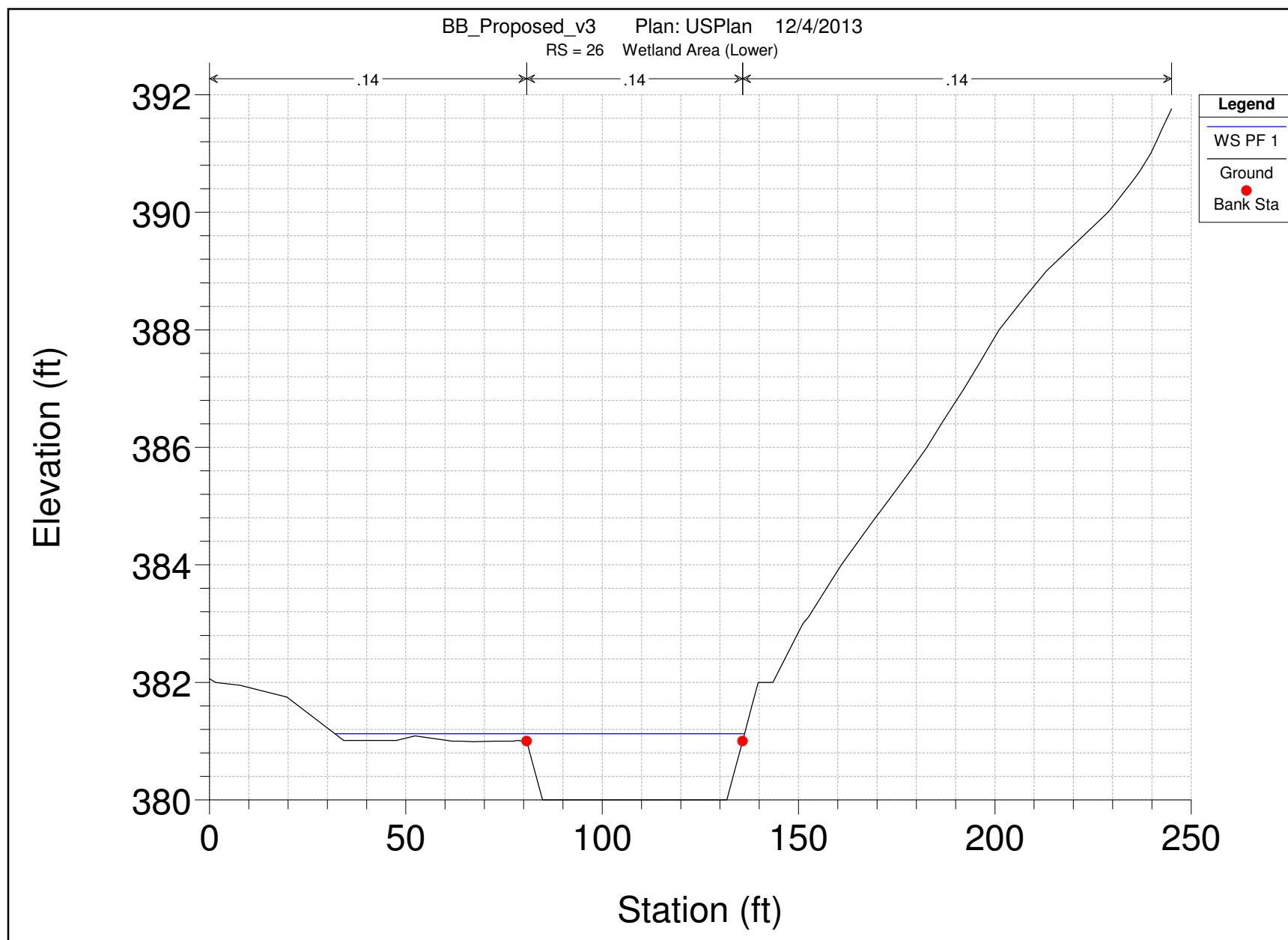


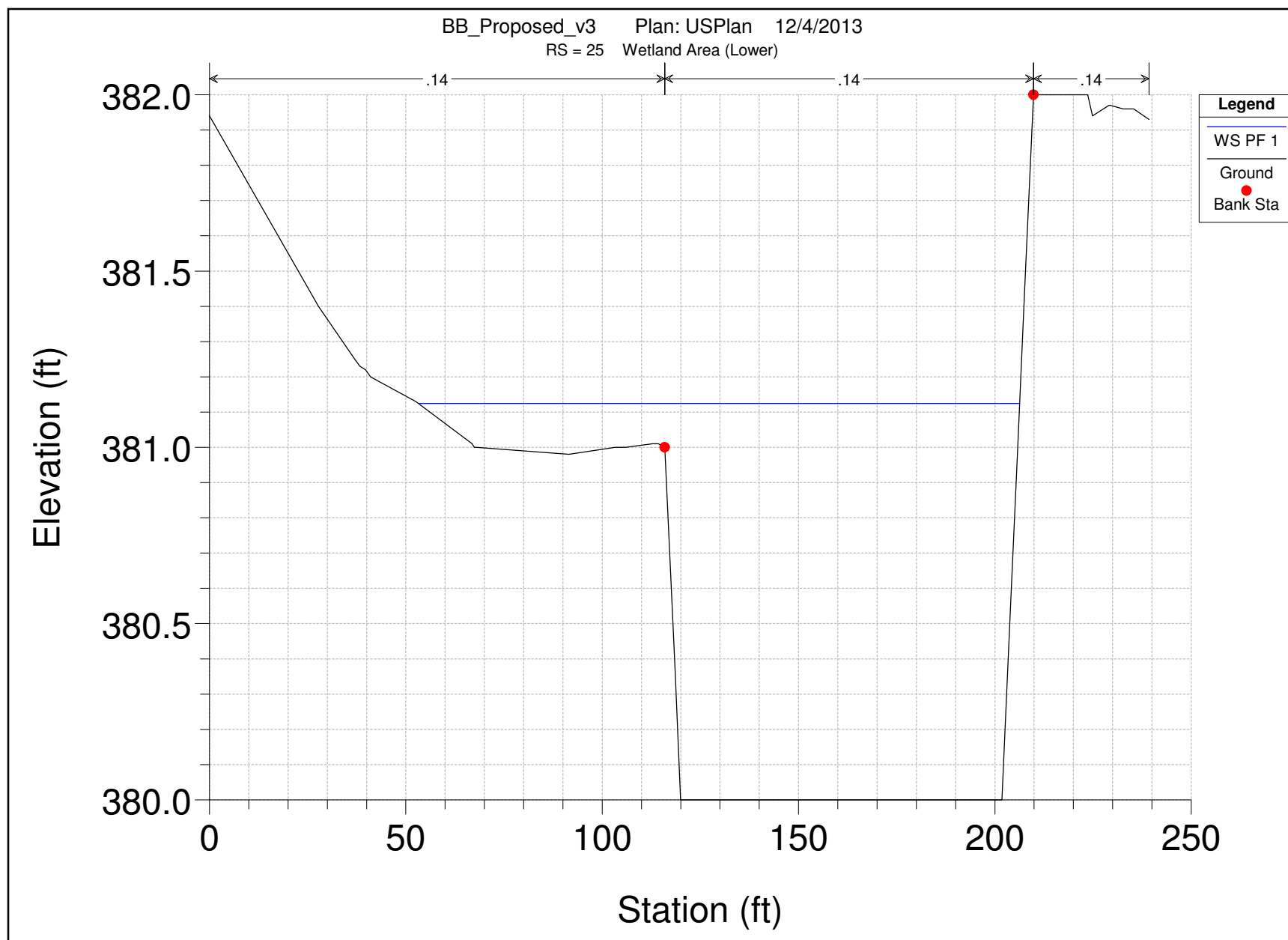


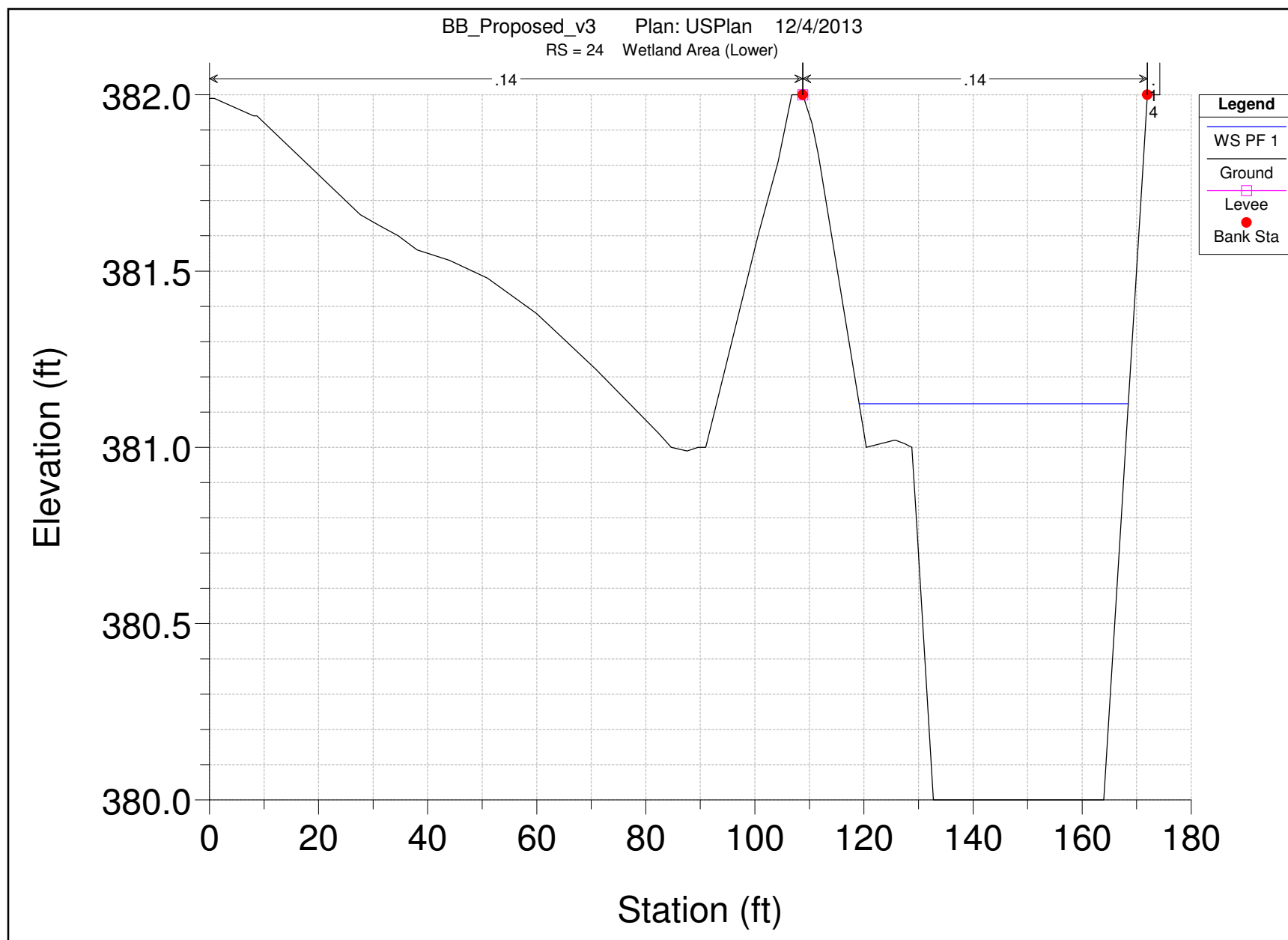


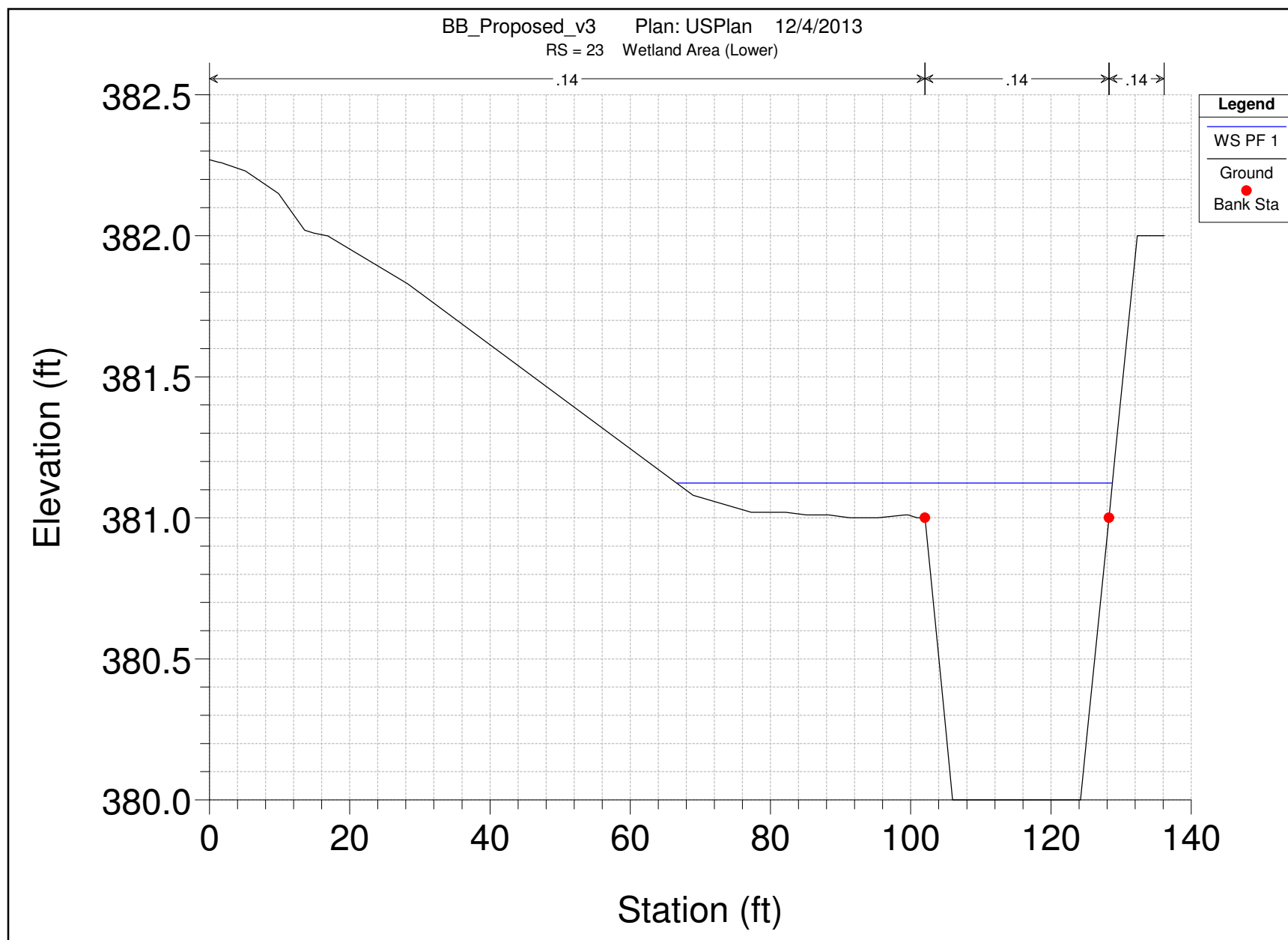


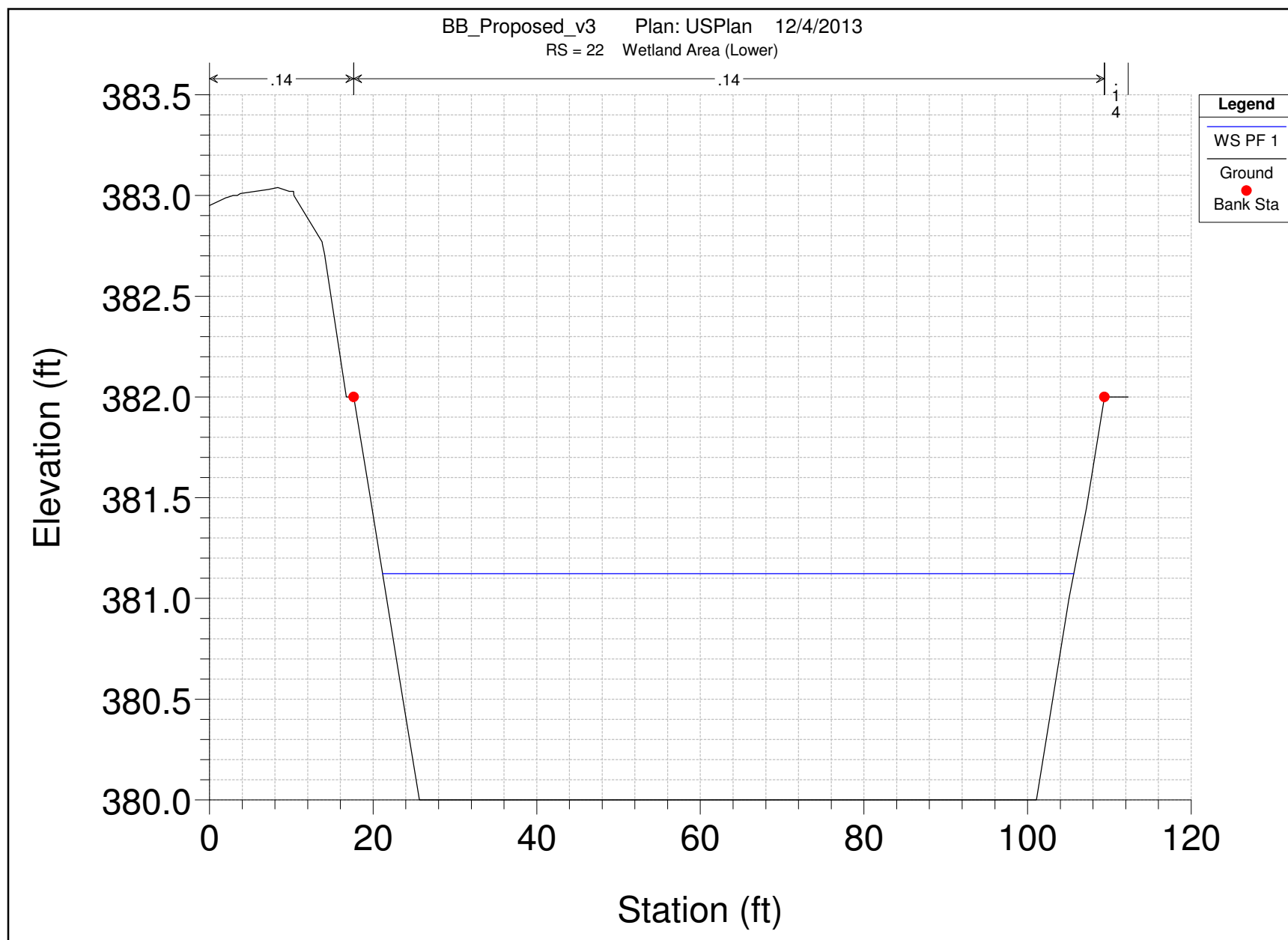


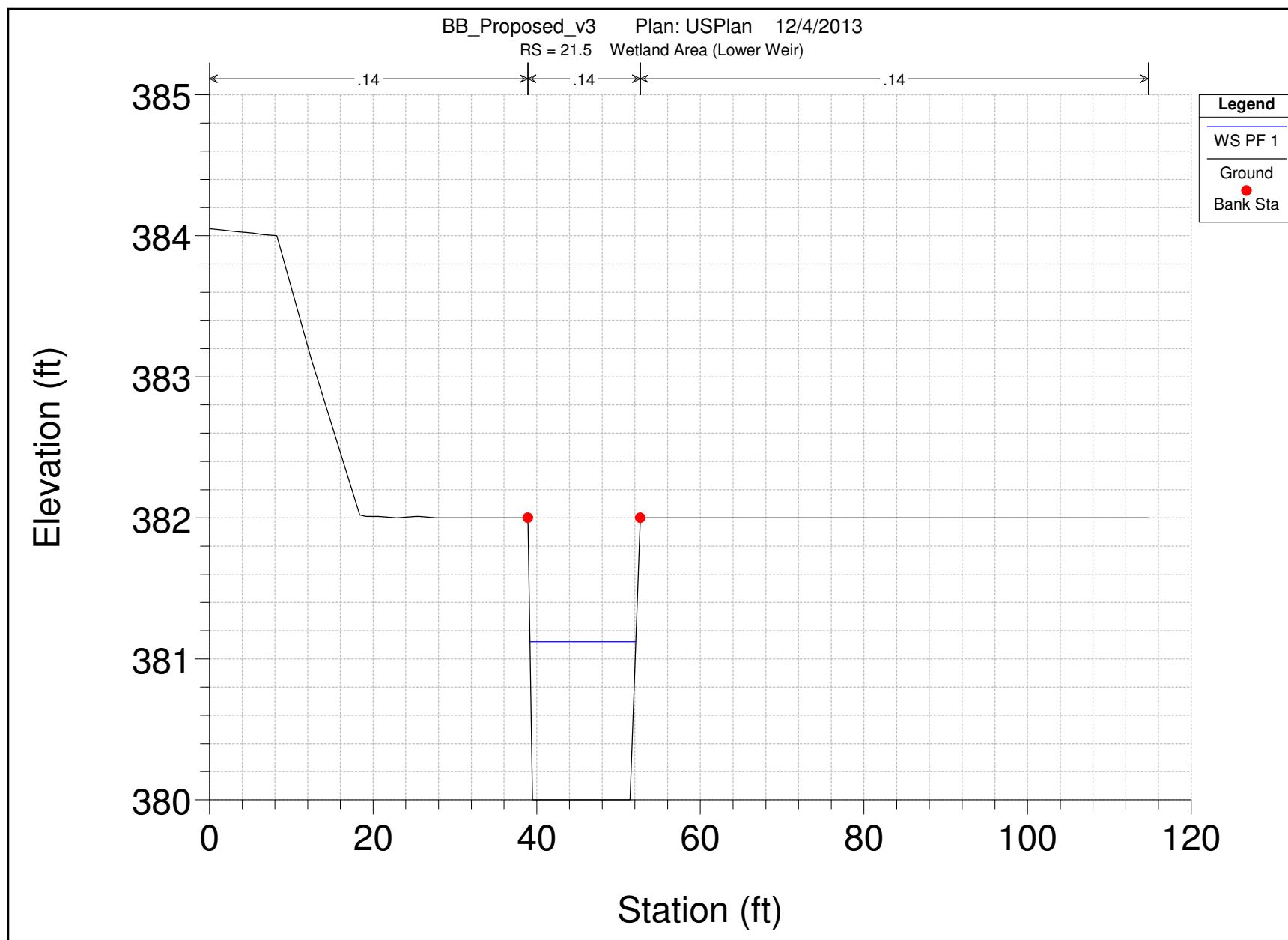


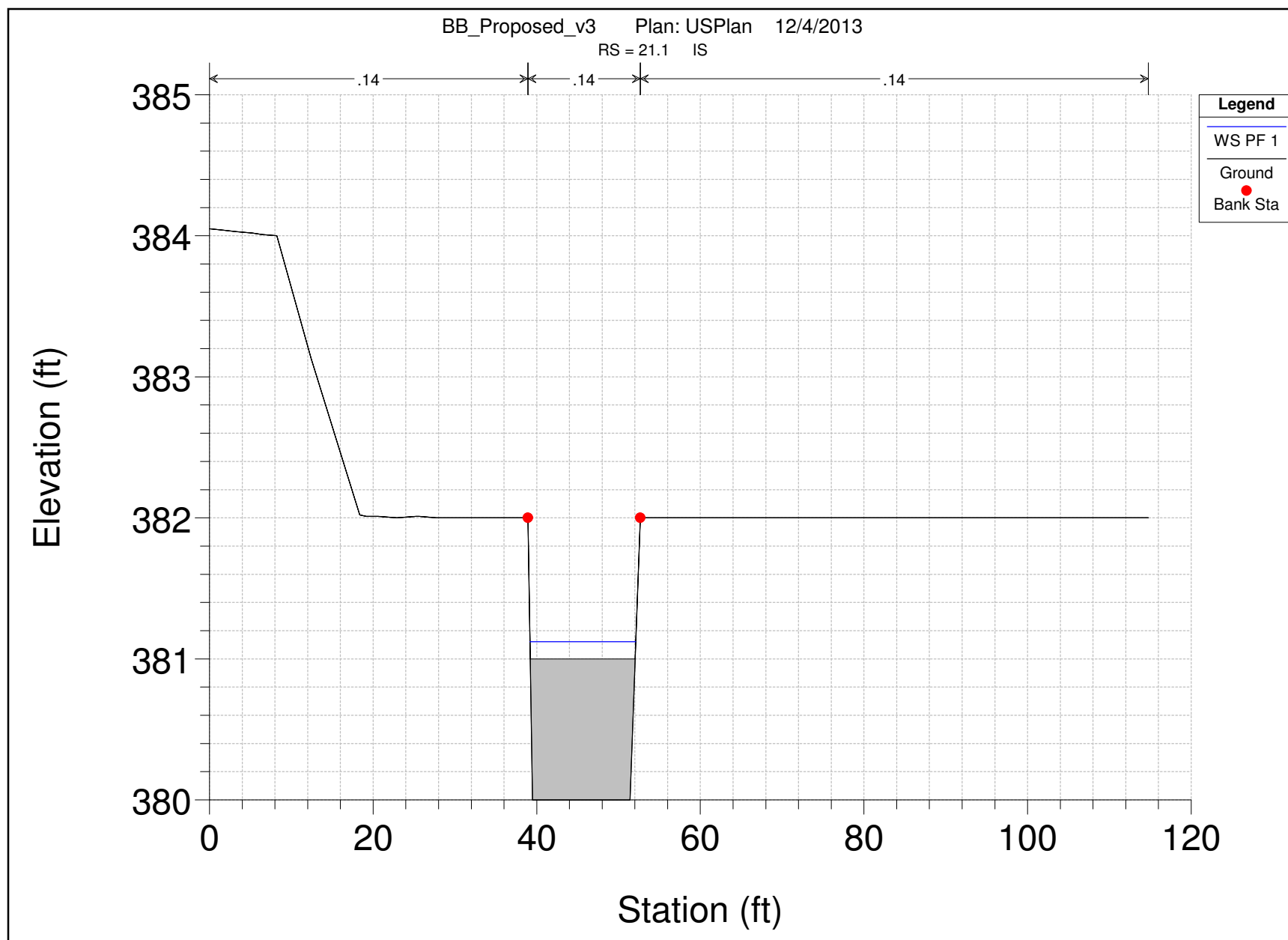


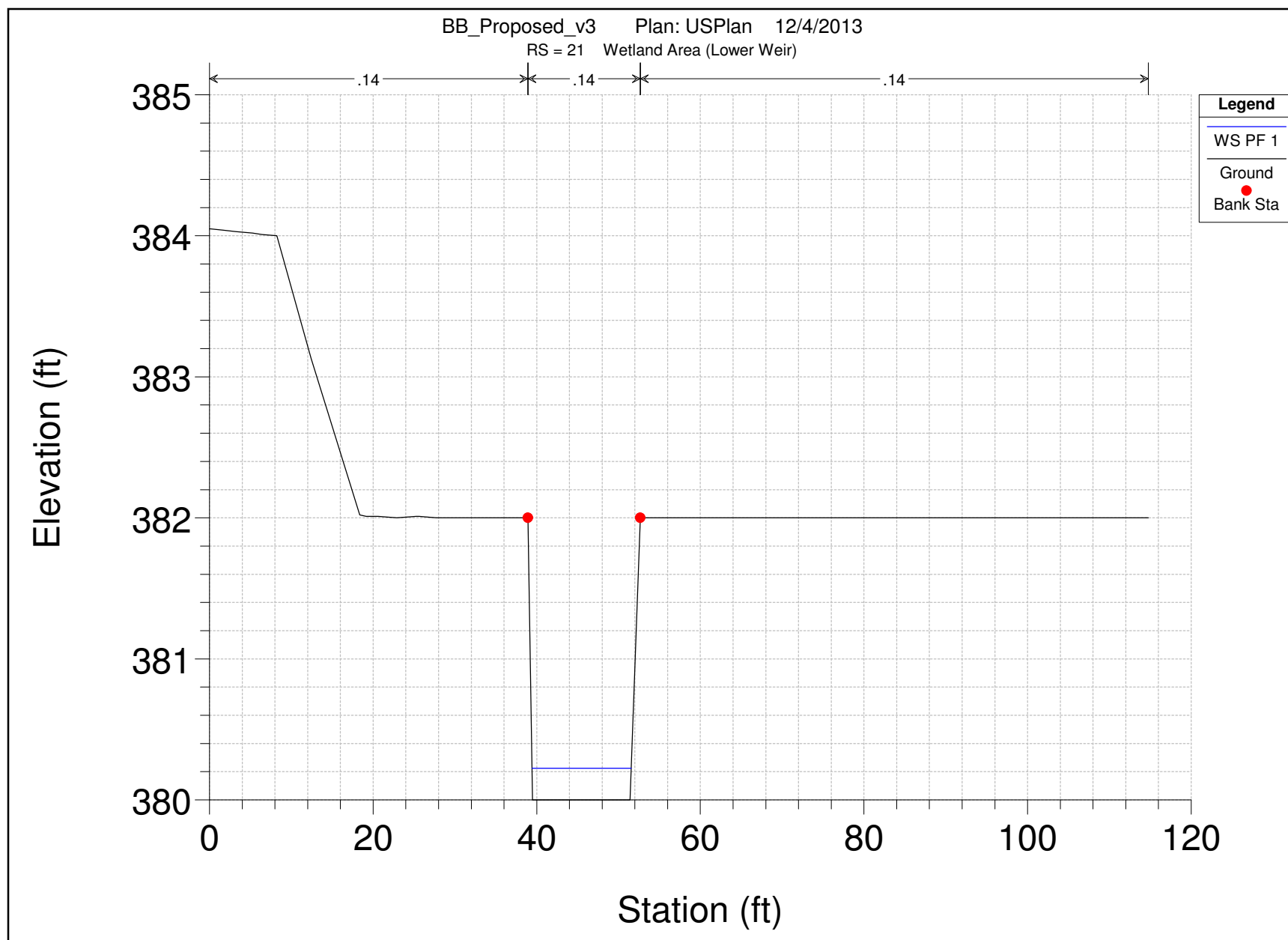


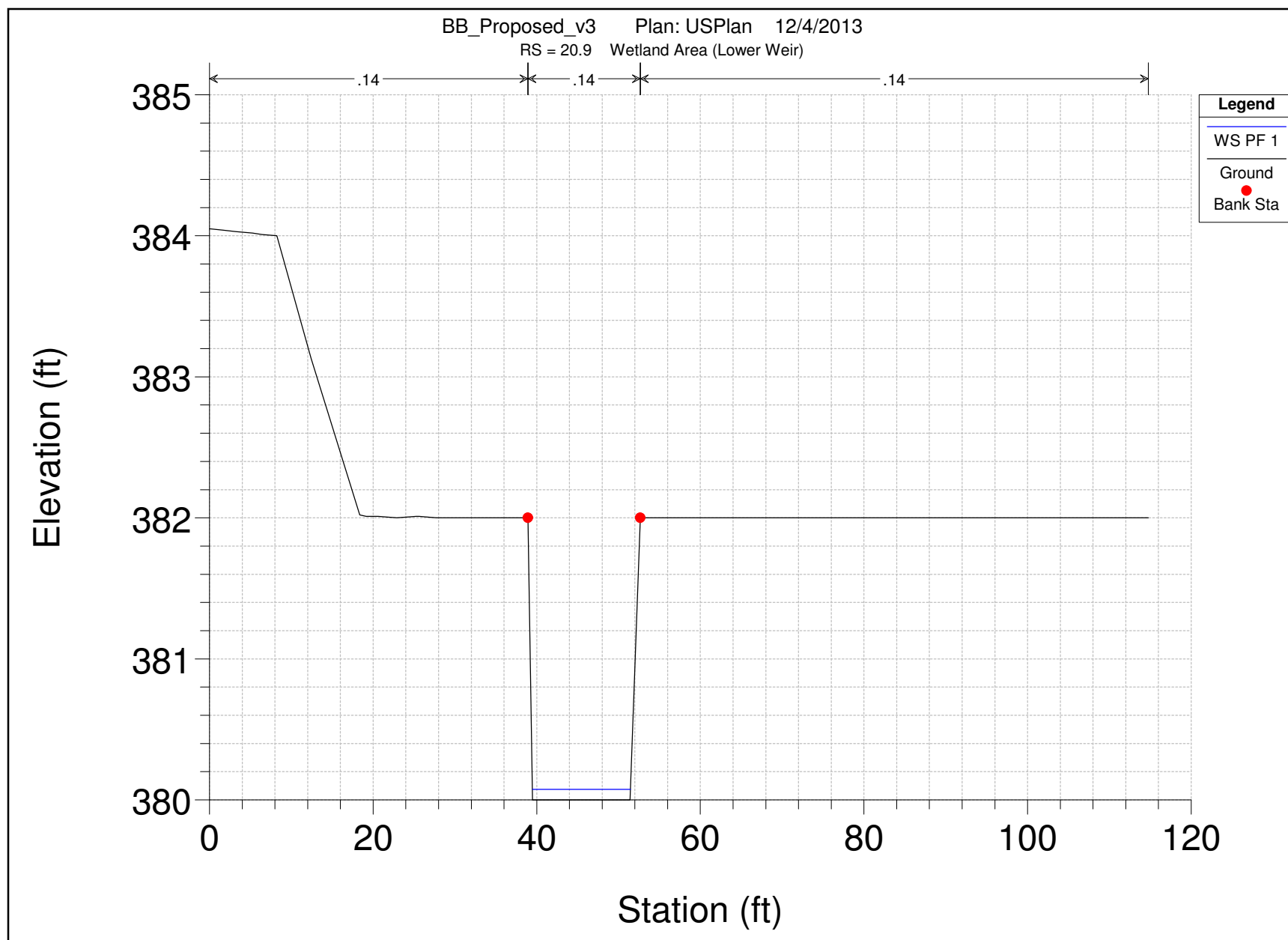


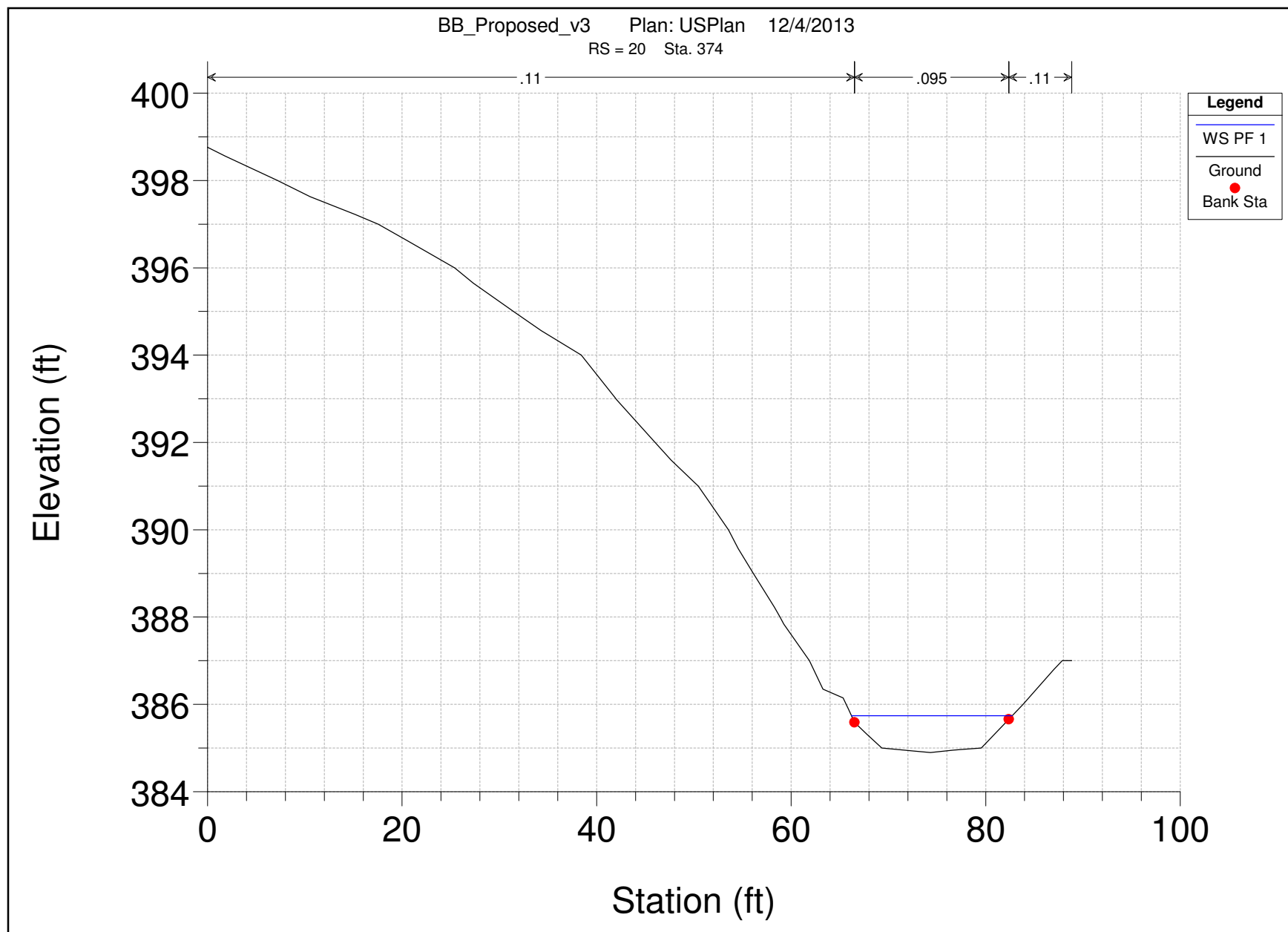


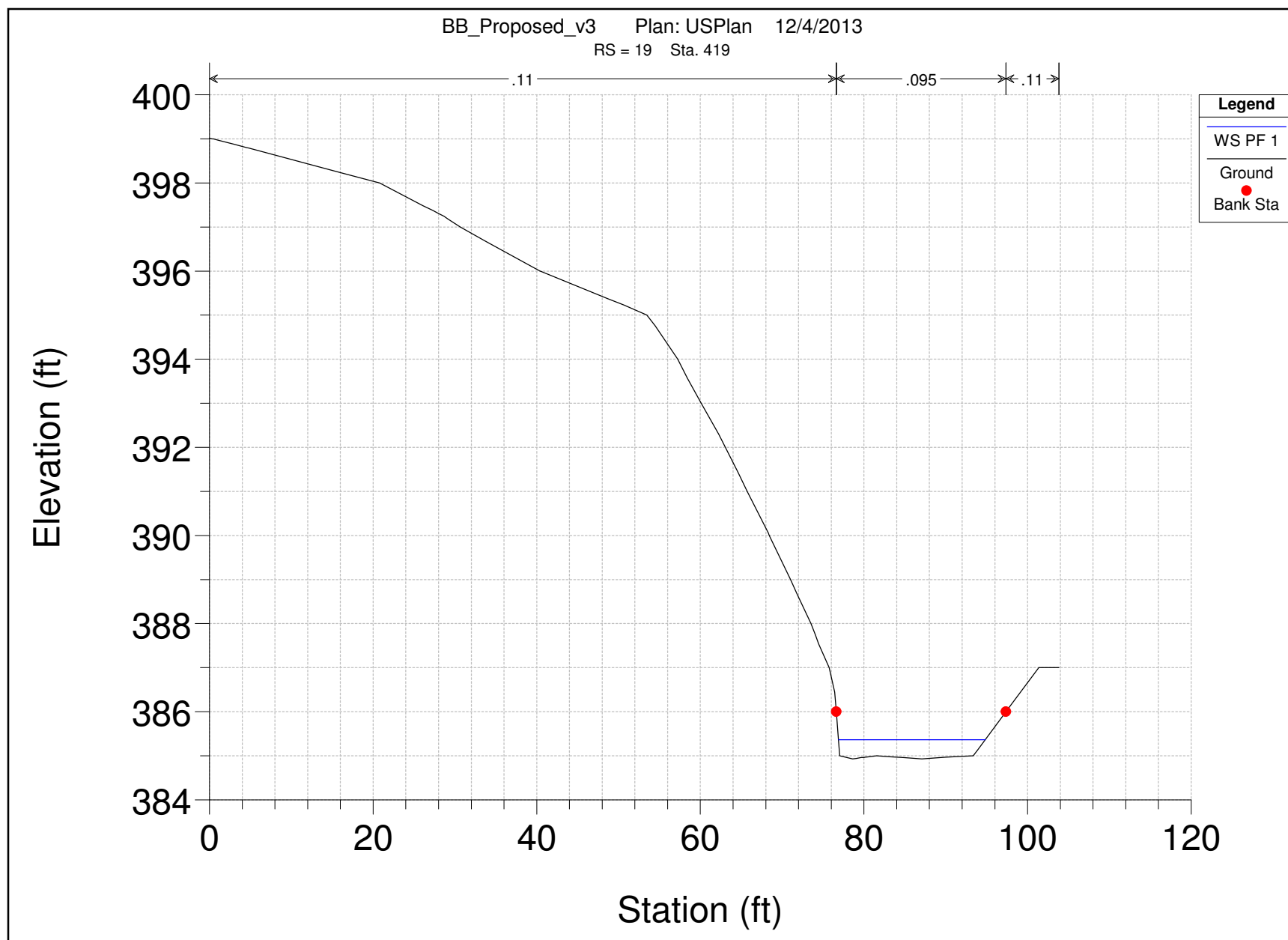


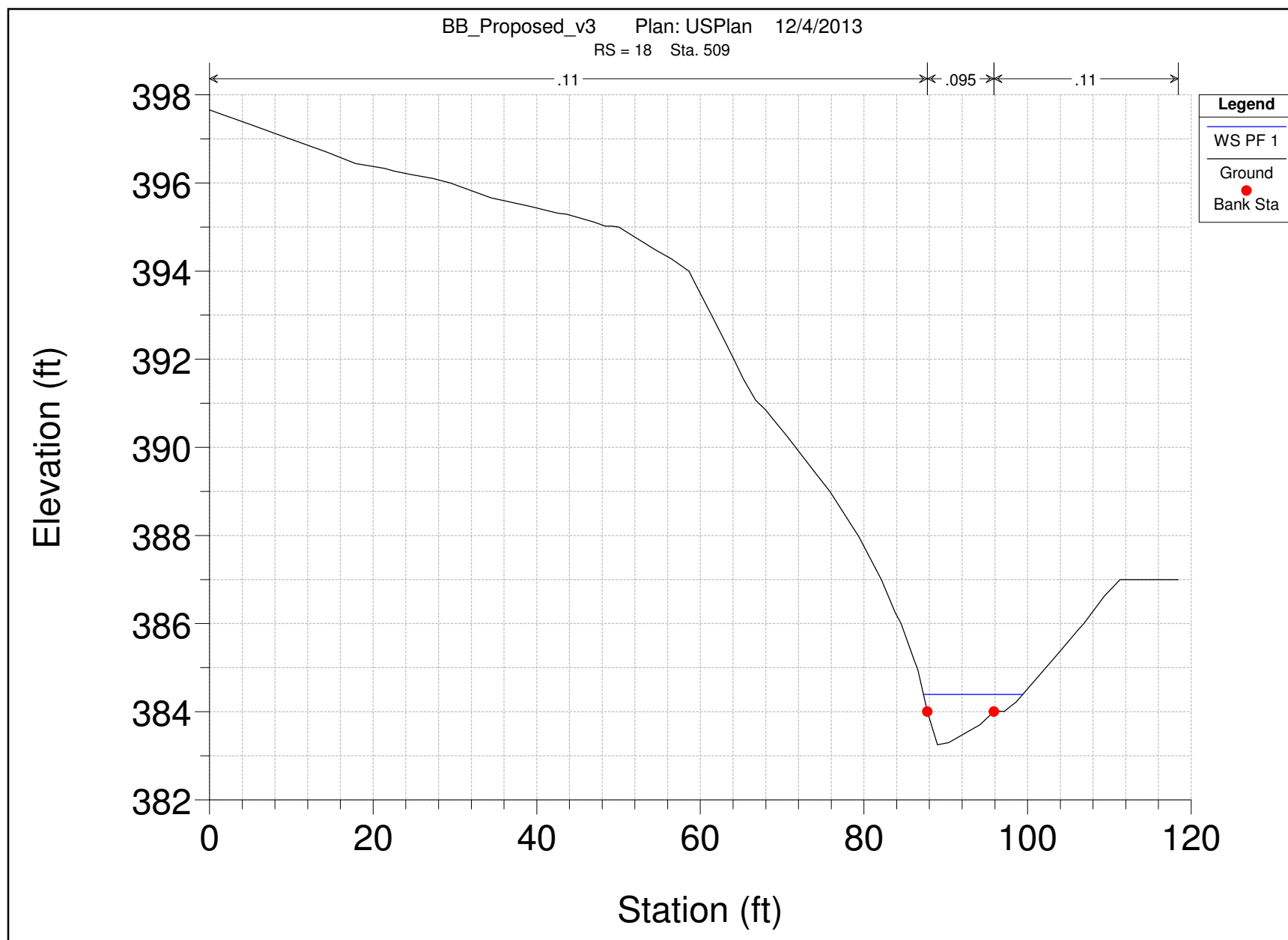


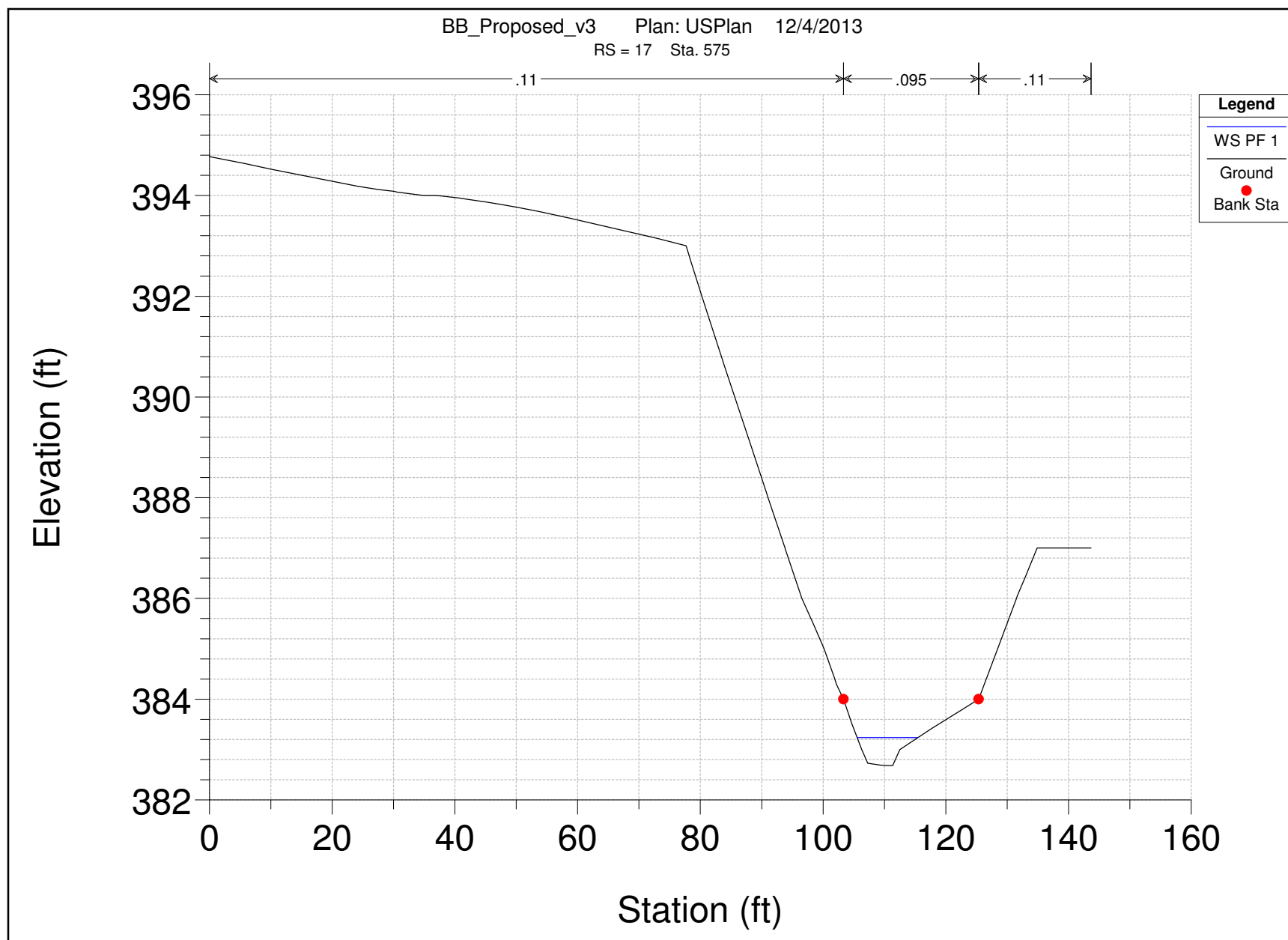


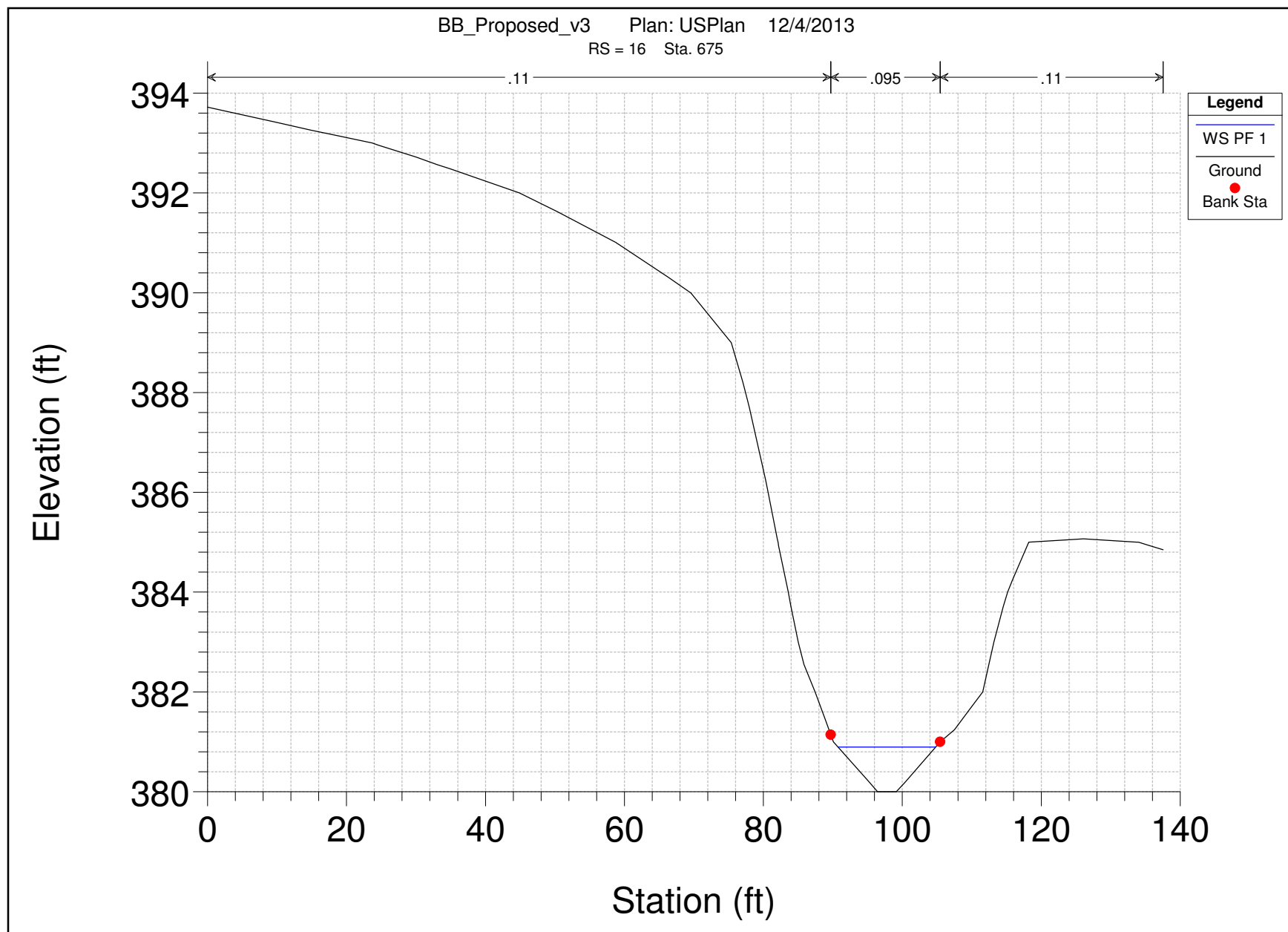


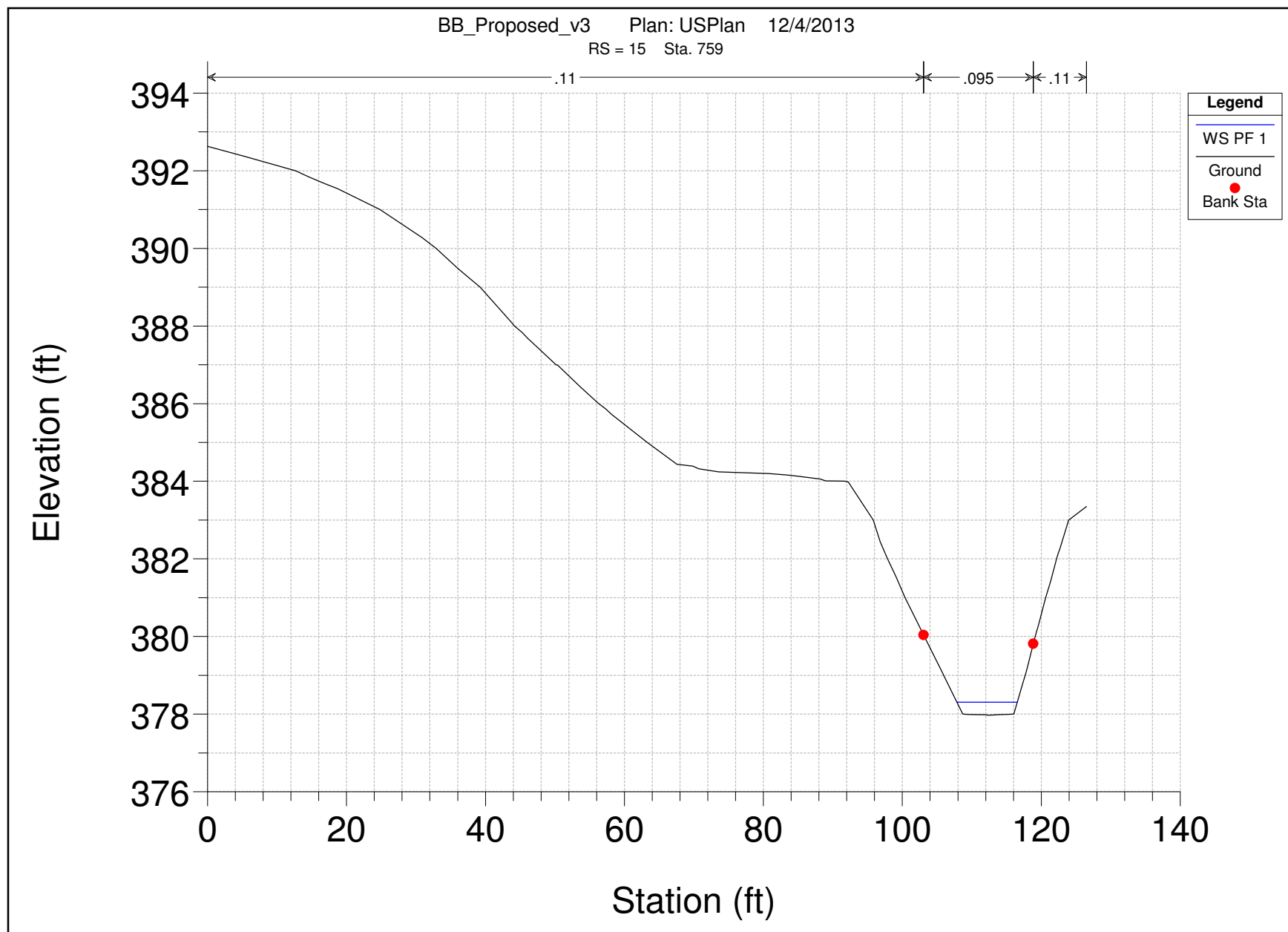


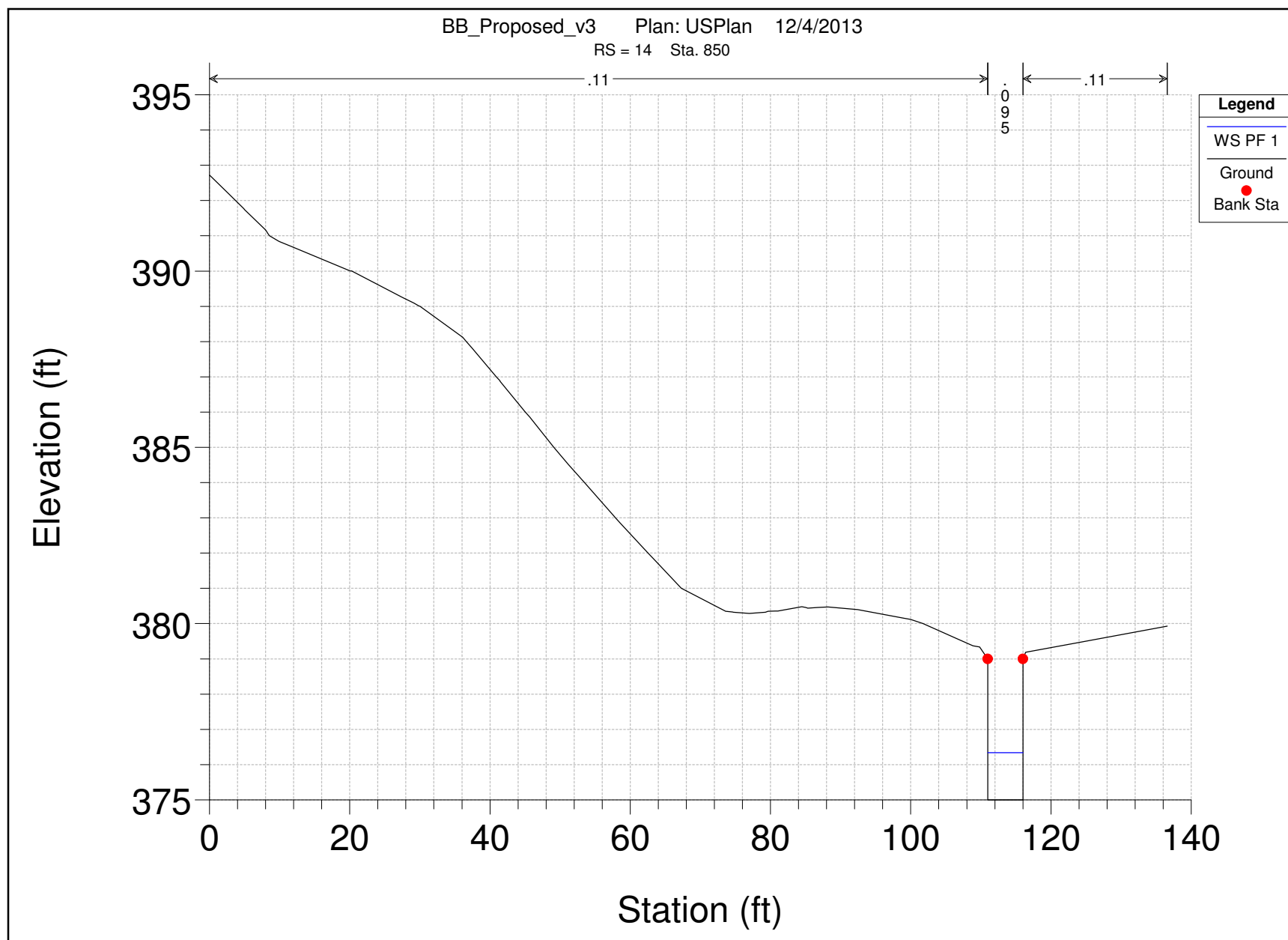


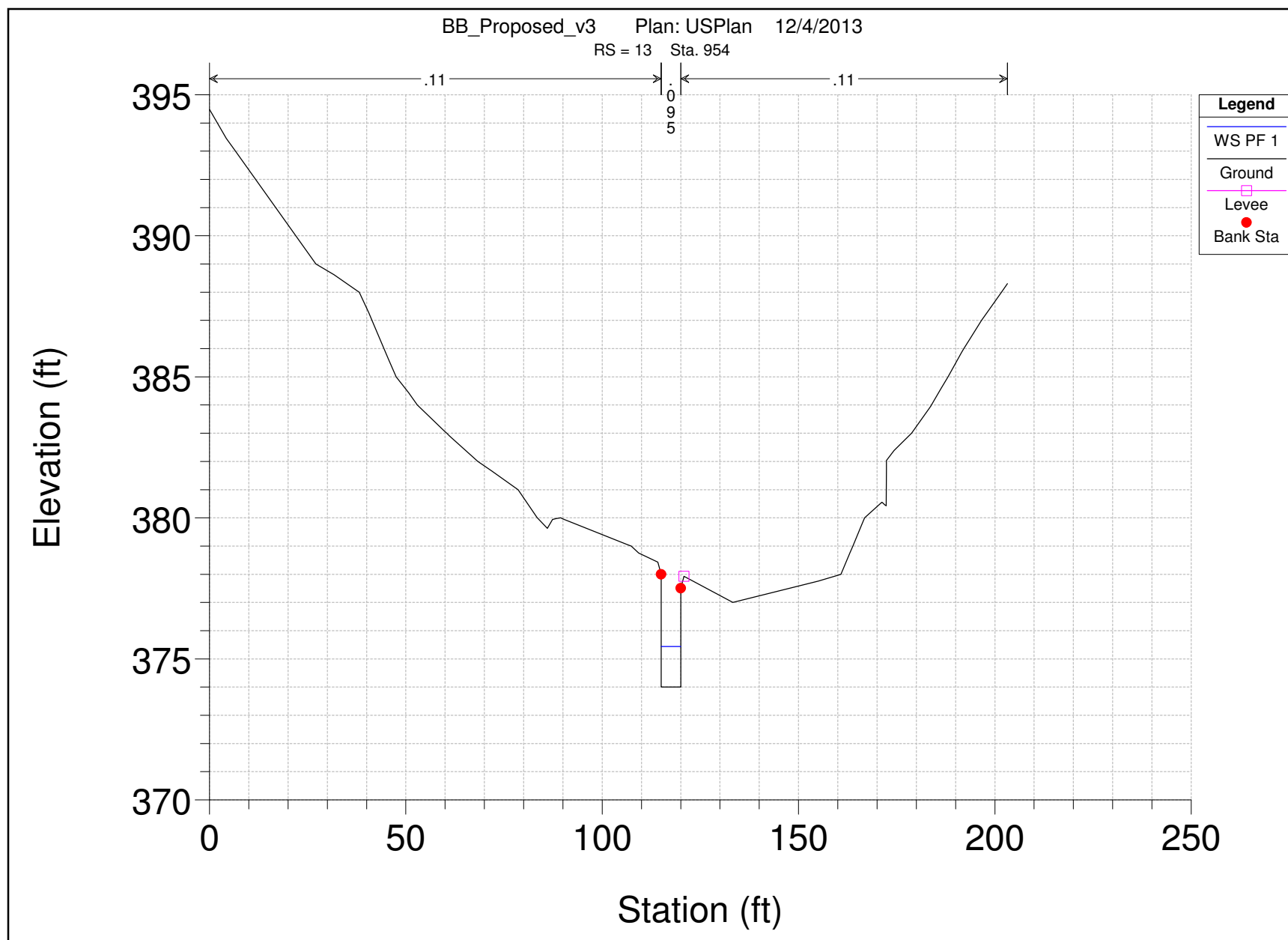


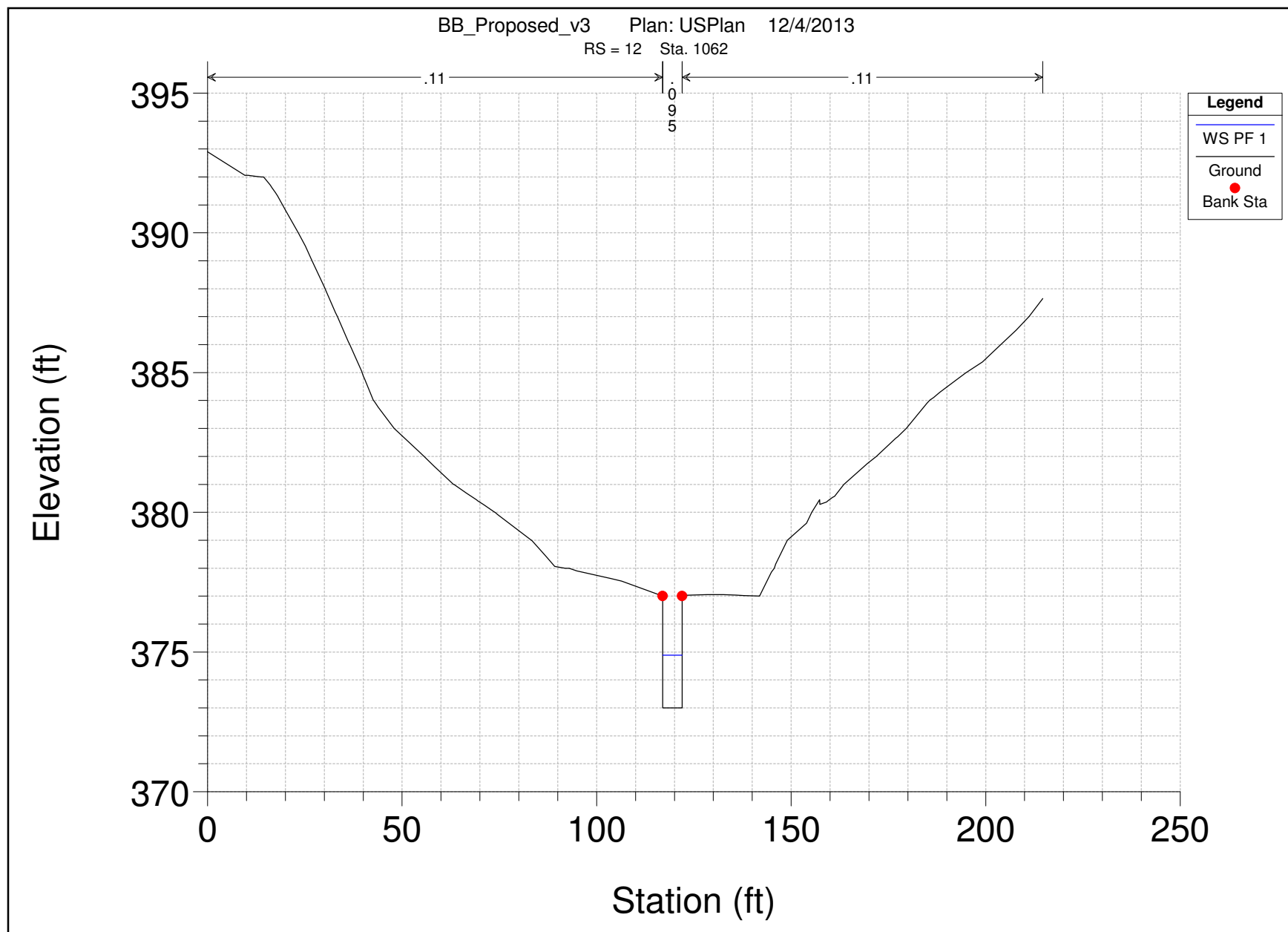


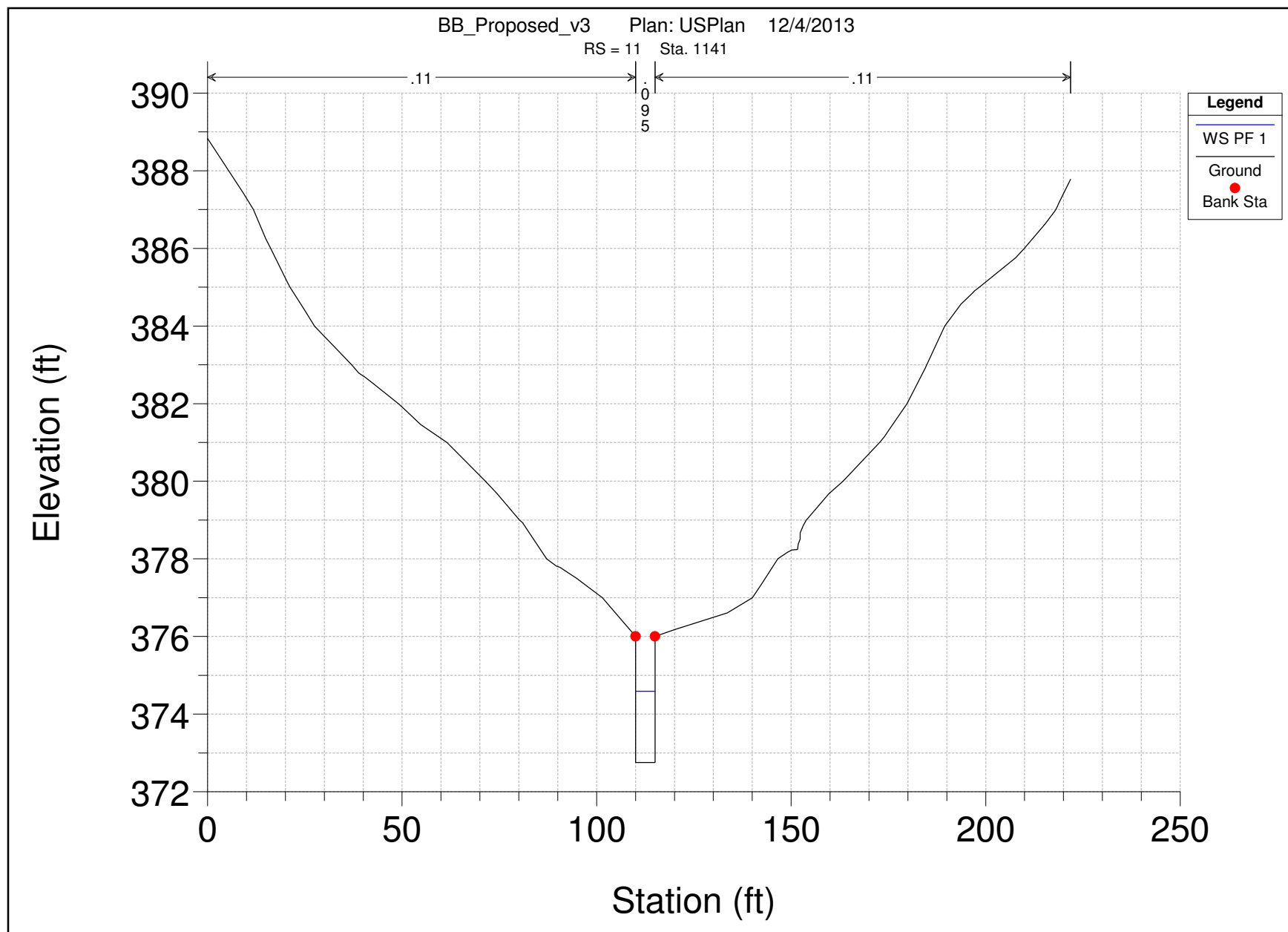


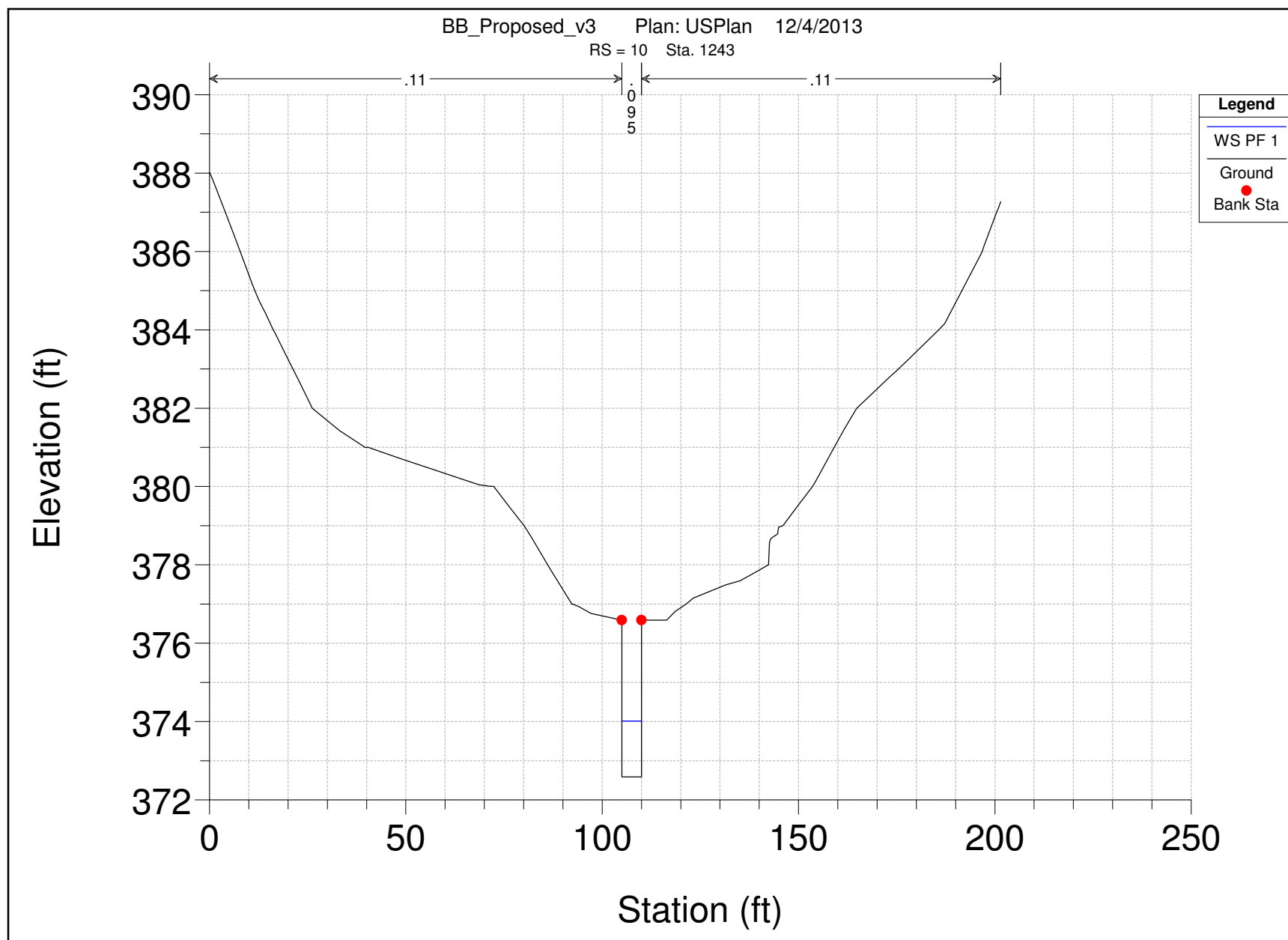


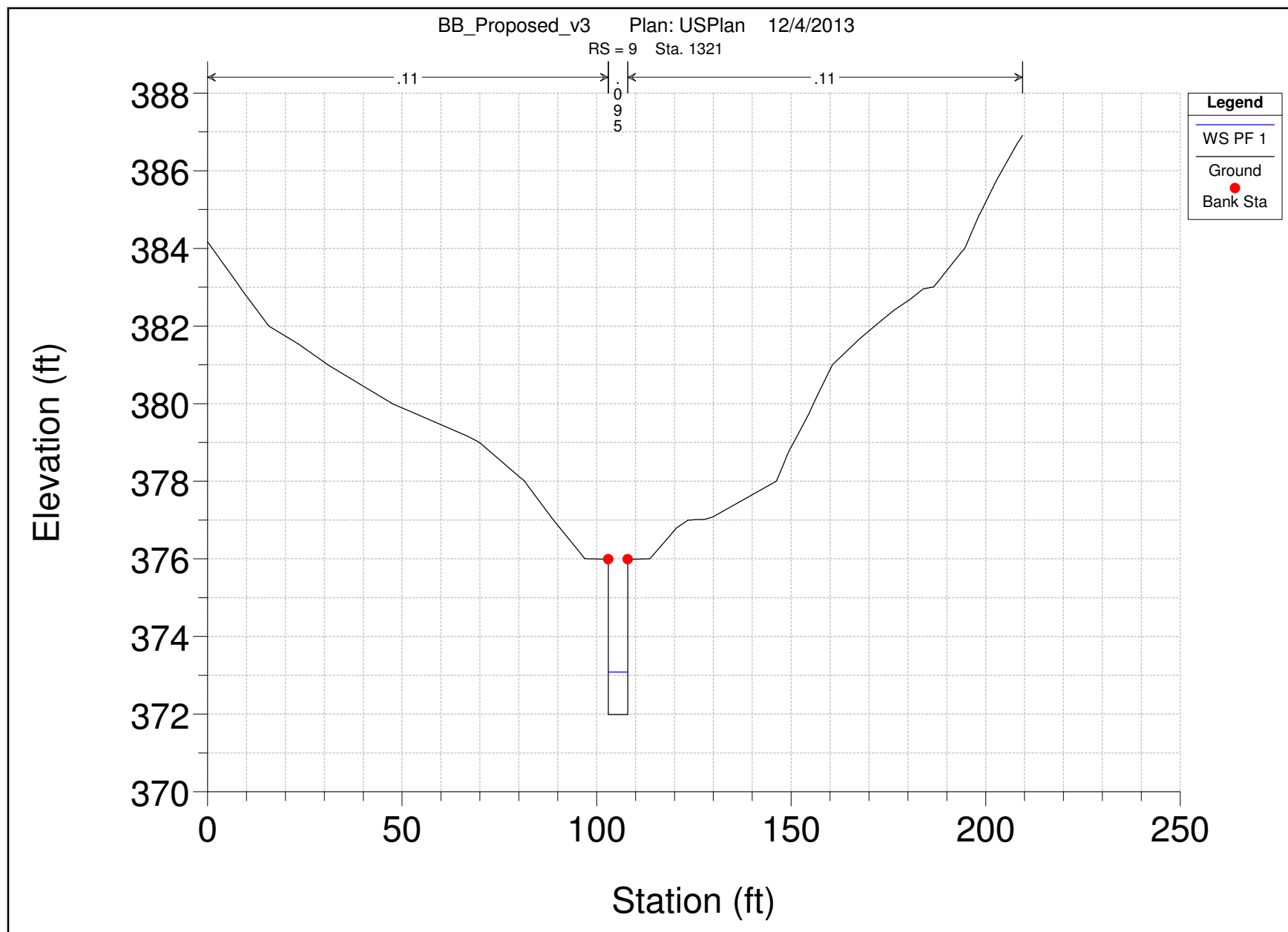


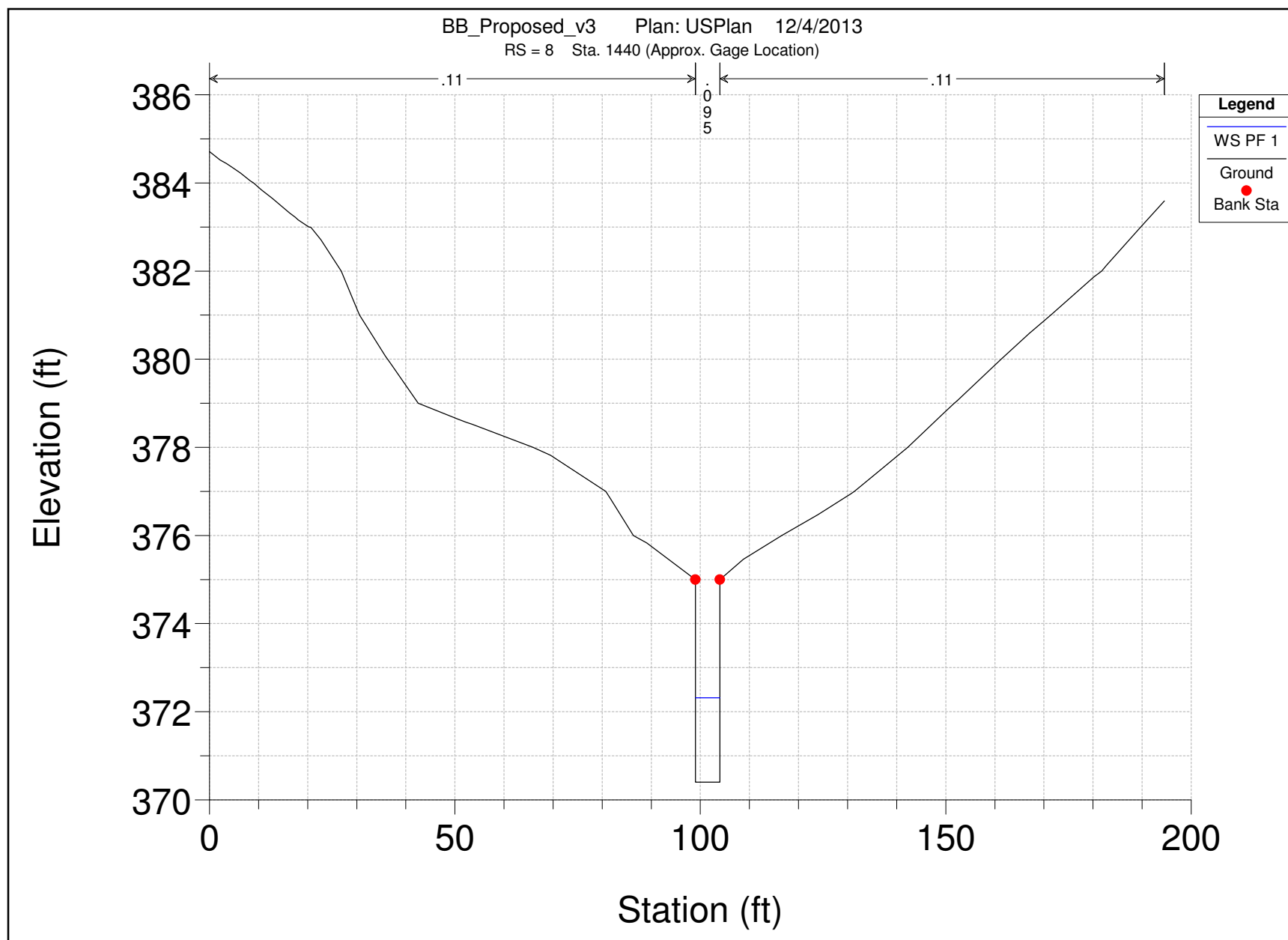


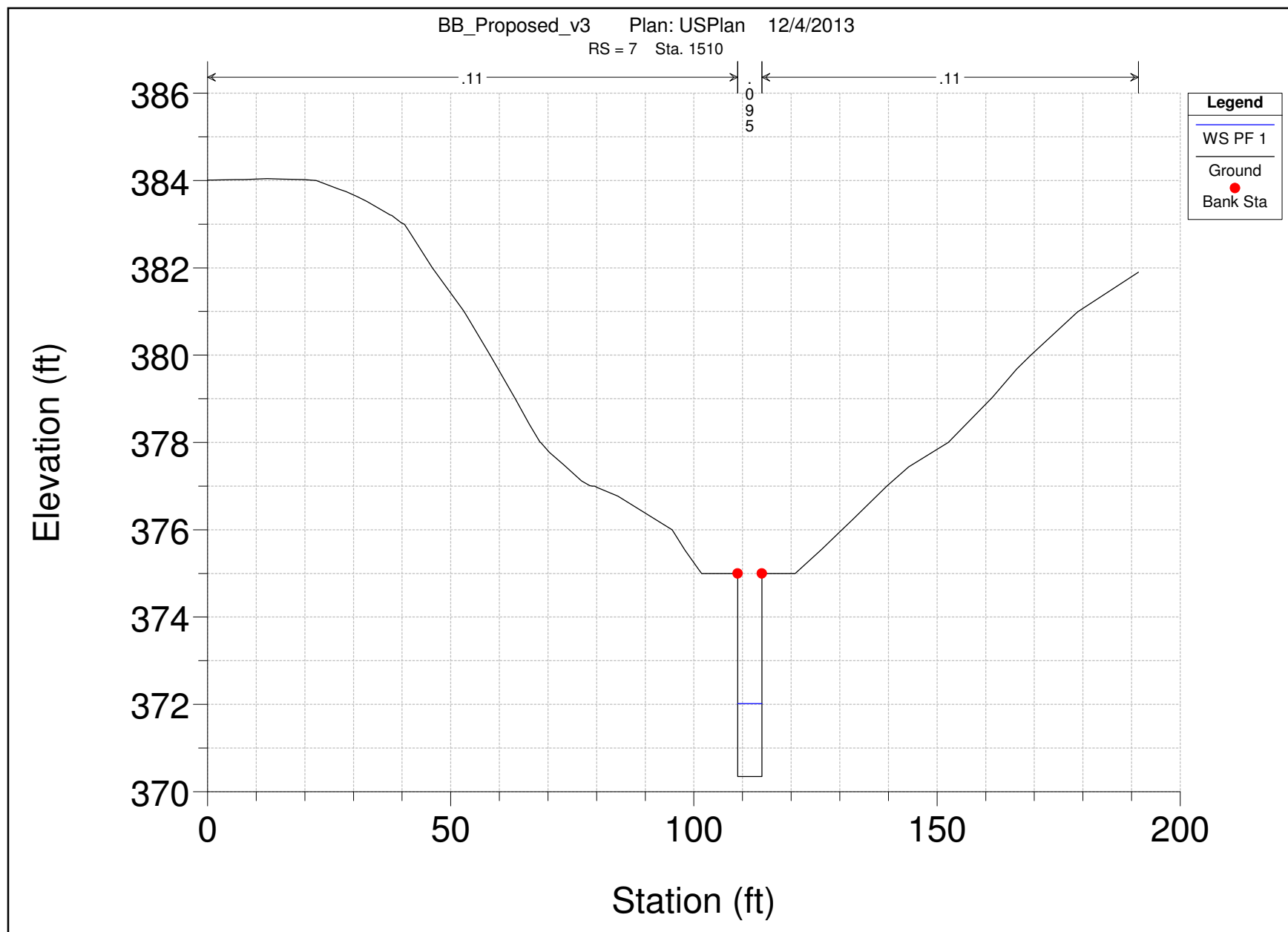


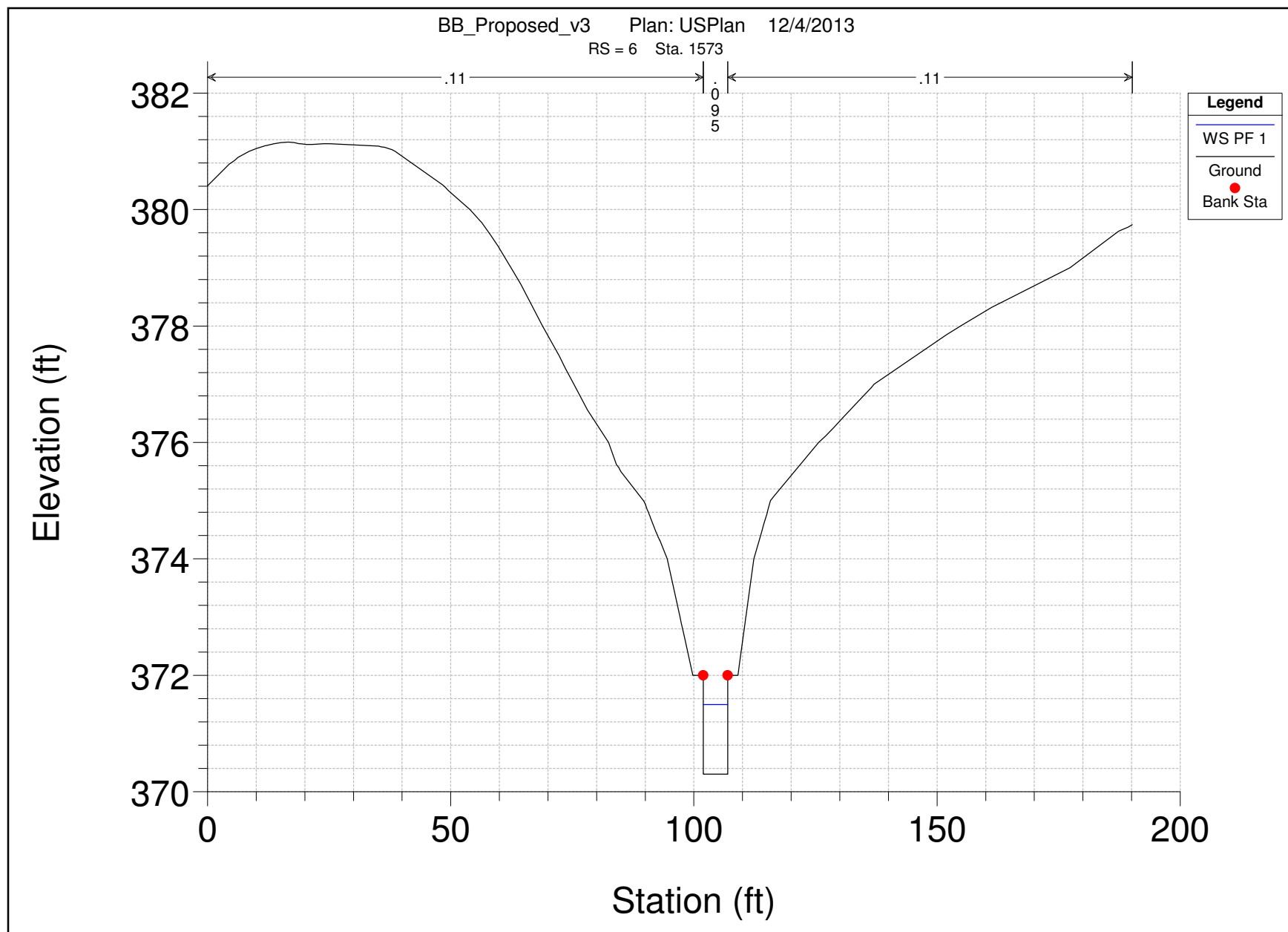


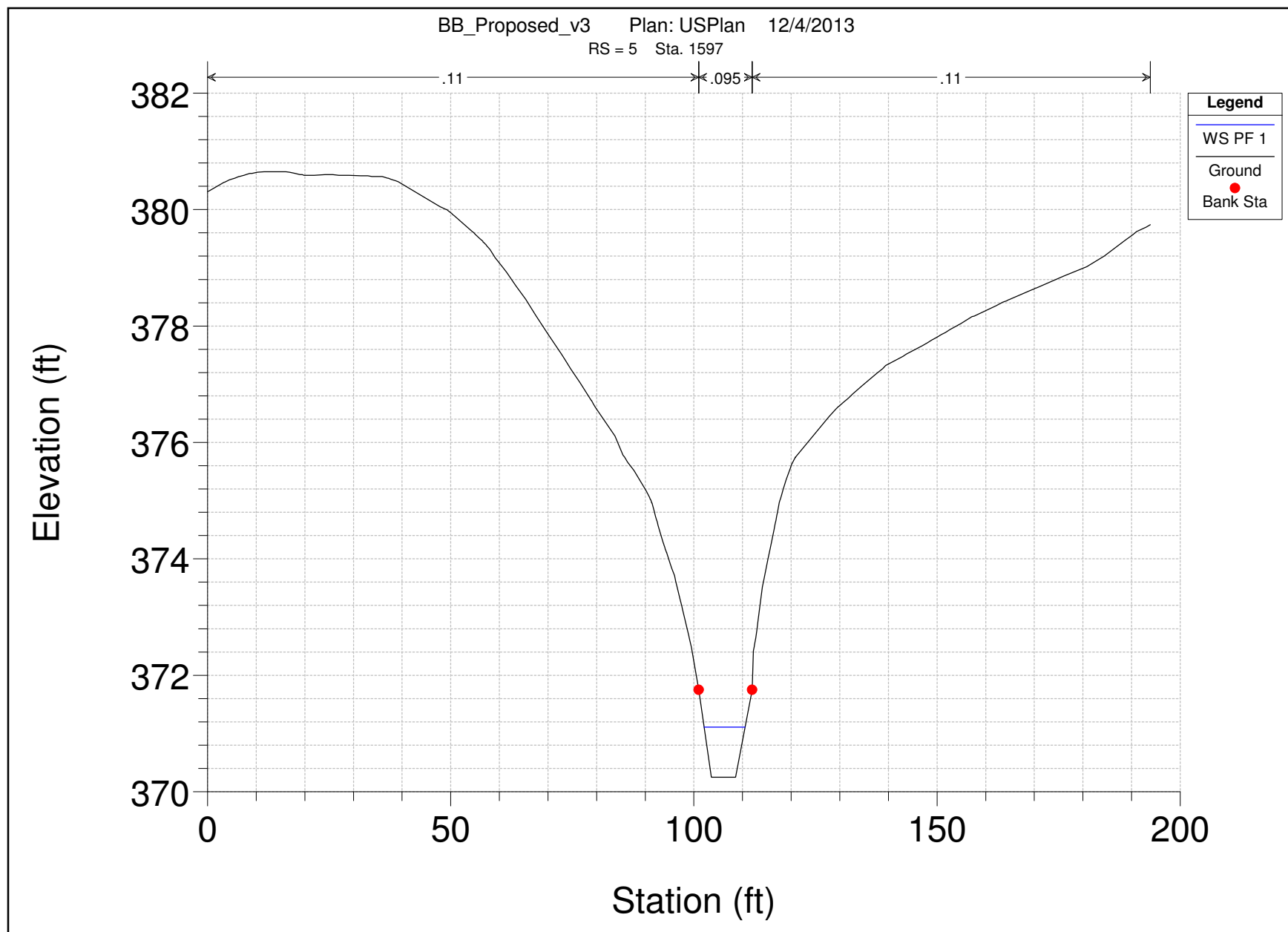


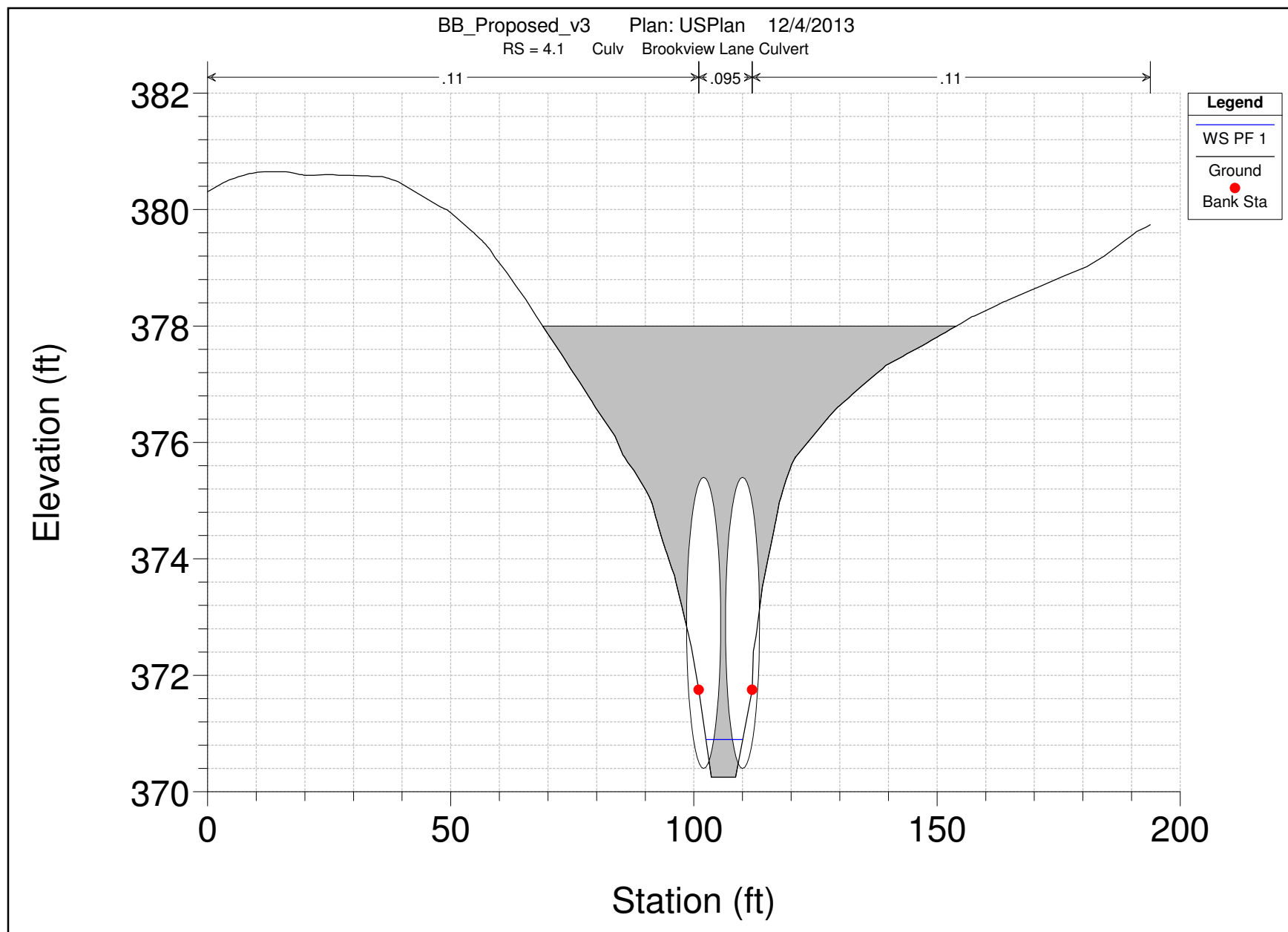


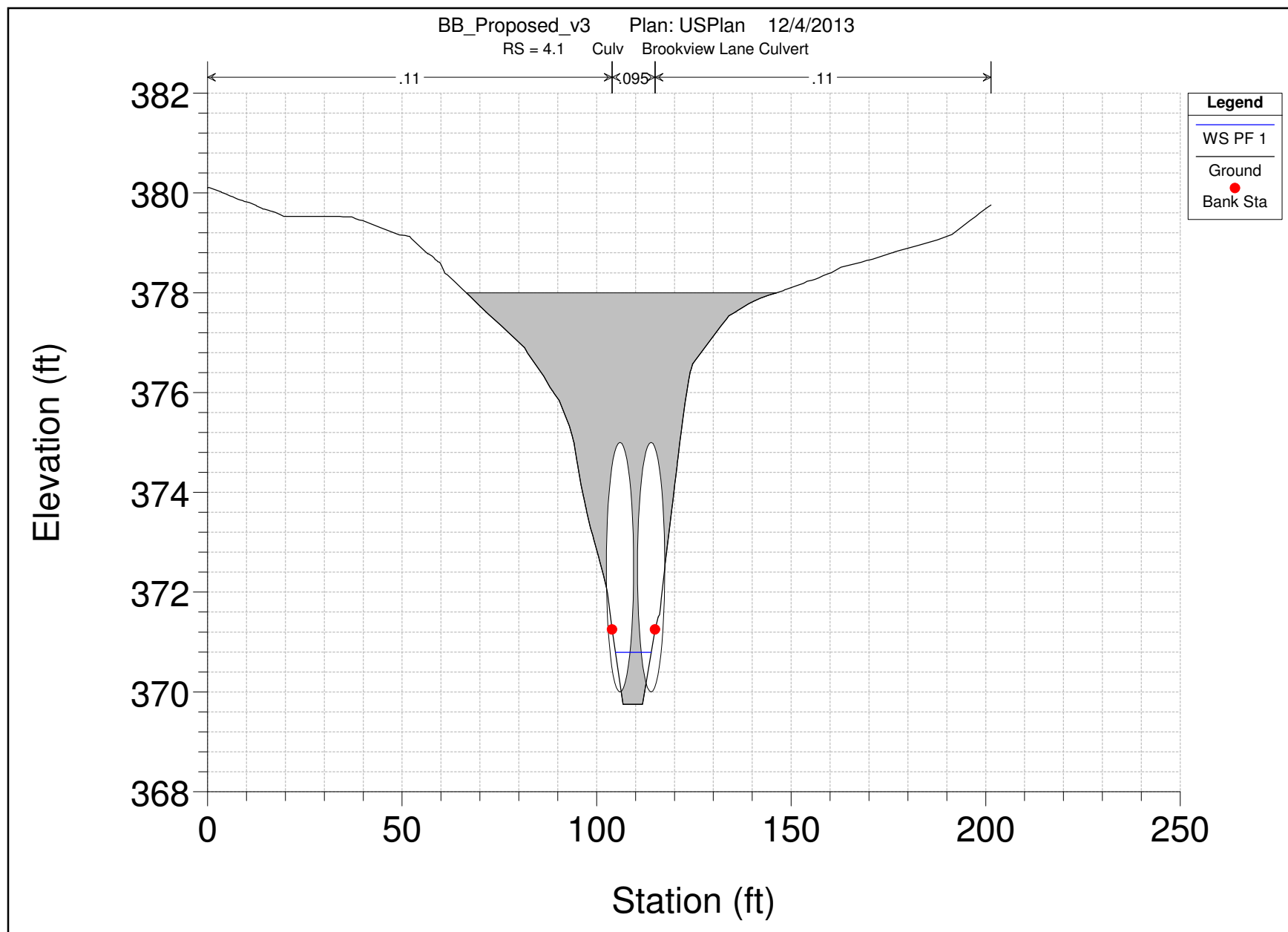


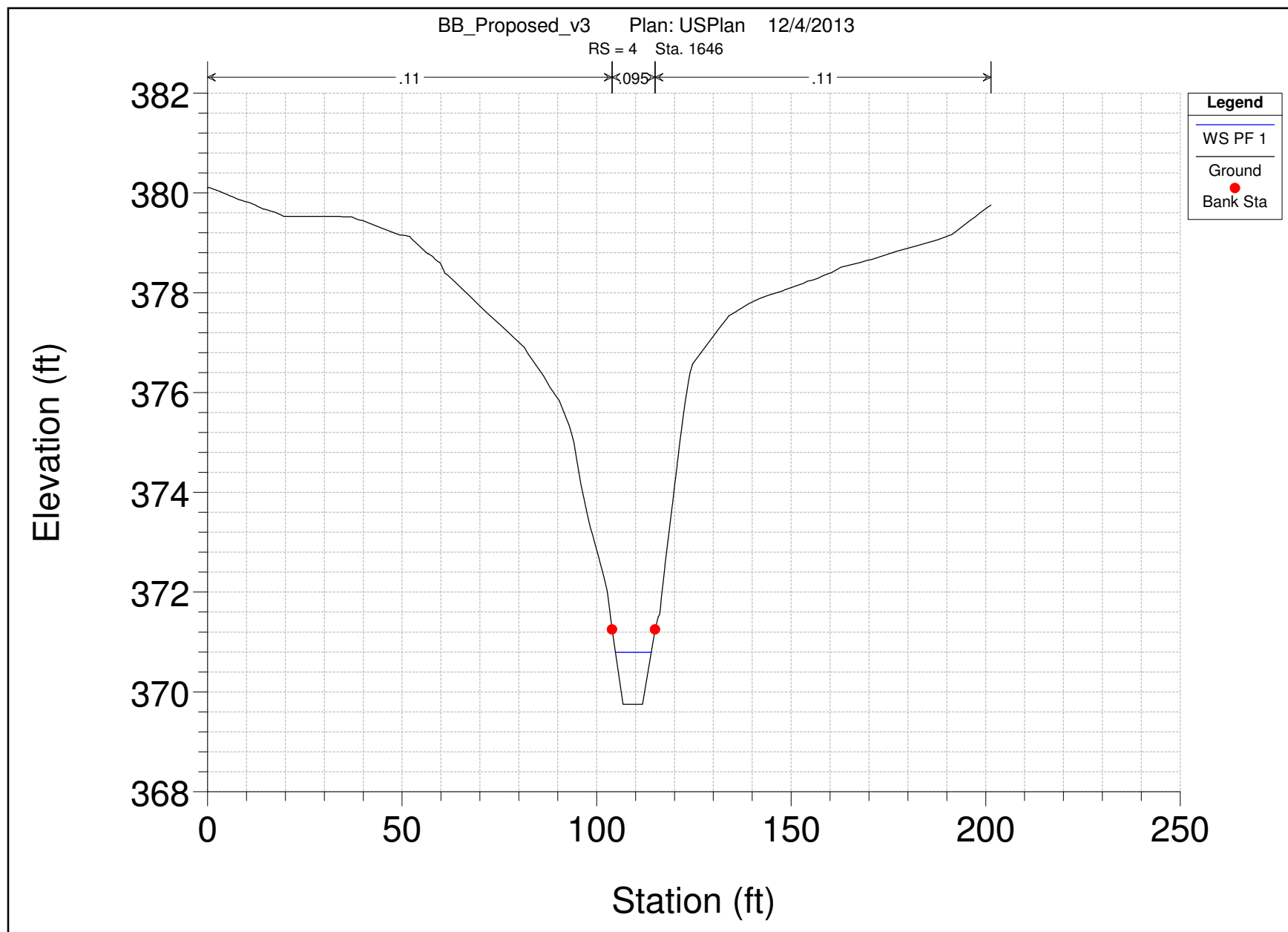


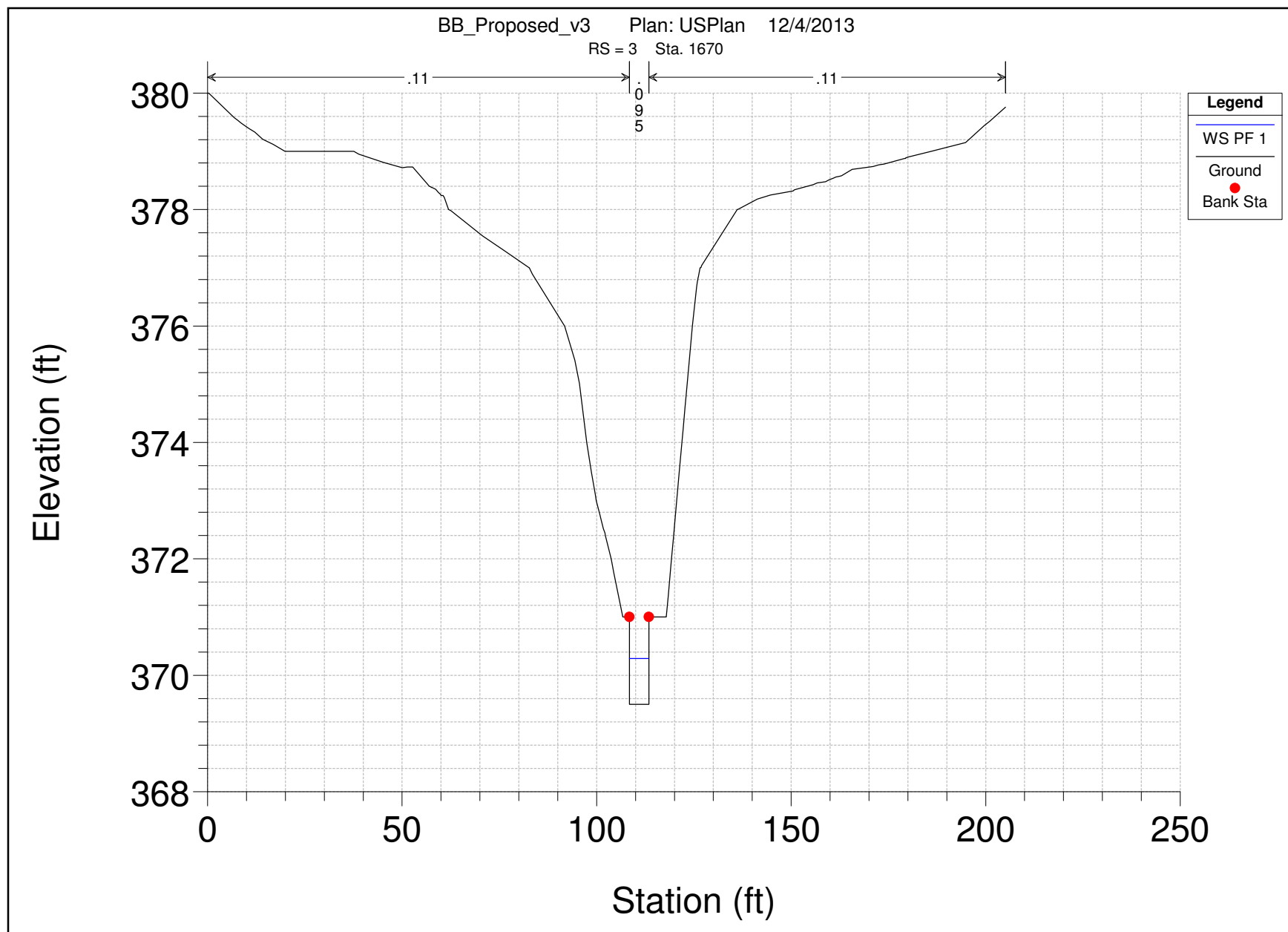


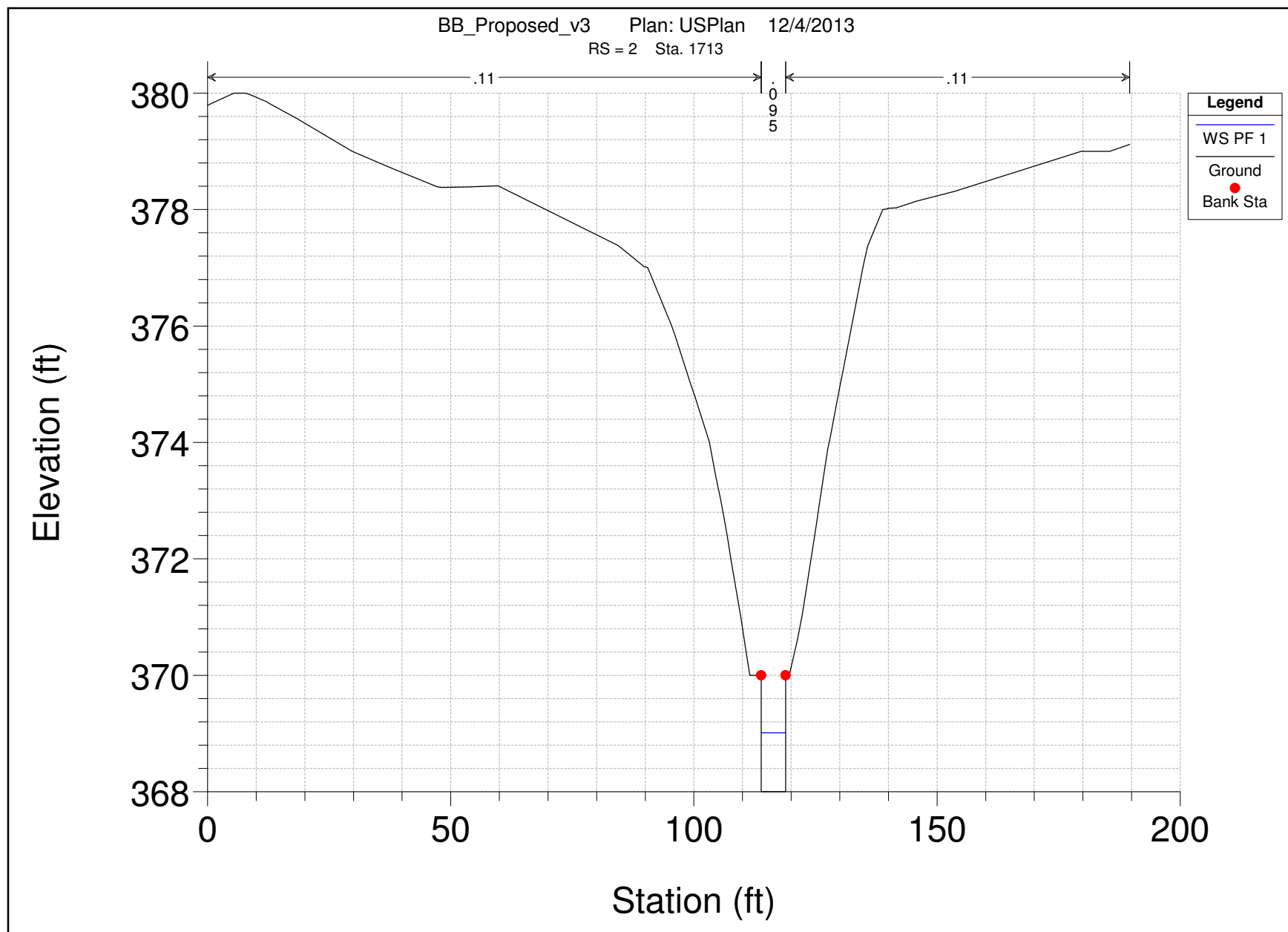


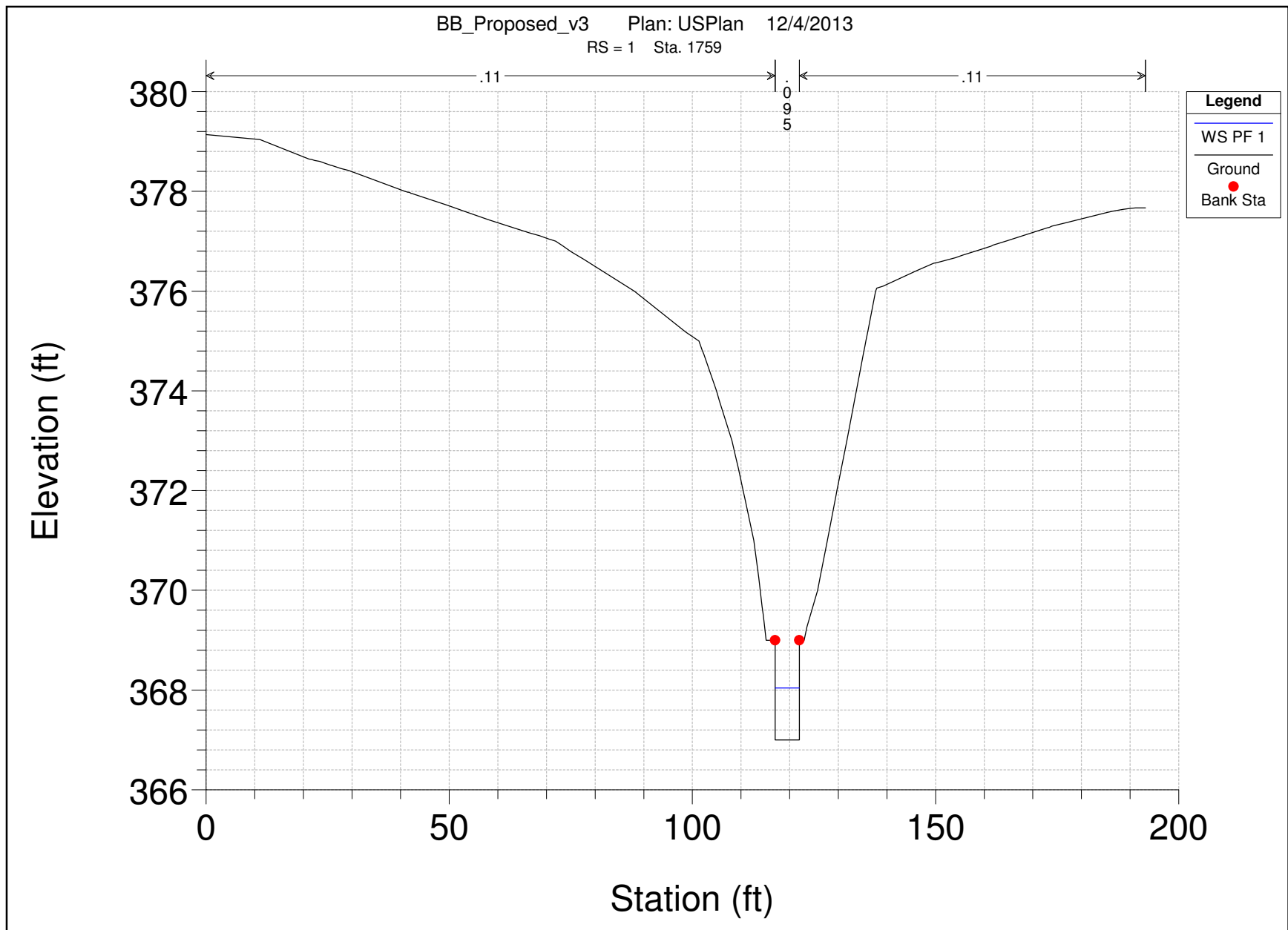










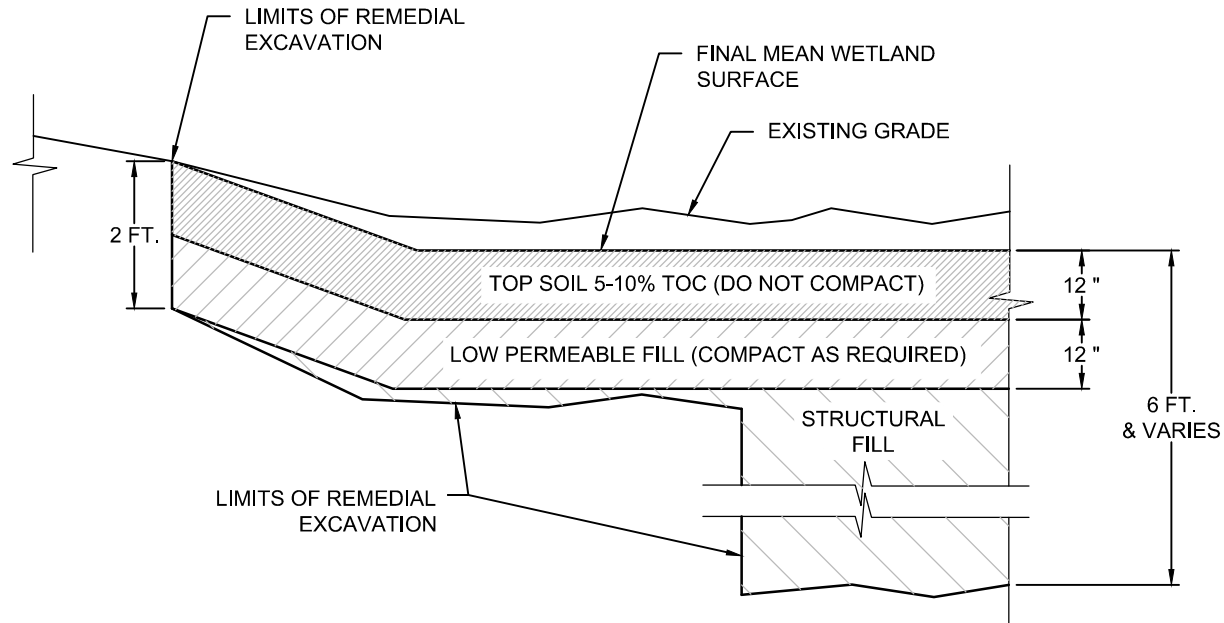


APPENDIX E

Issue Status: DRAFT



RD-1



NOTE:
LOW PERMEABLE FILL SHALL MEET LINER PERM.
RATE OF $3.1 \text{ E-}05 \text{ cm/sec}$ ($4.0 \text{ to } 2.5 \text{ E-}05 \text{ cm/sec}$)

TYPICAL WETLAND FILL SOIL DETAIL

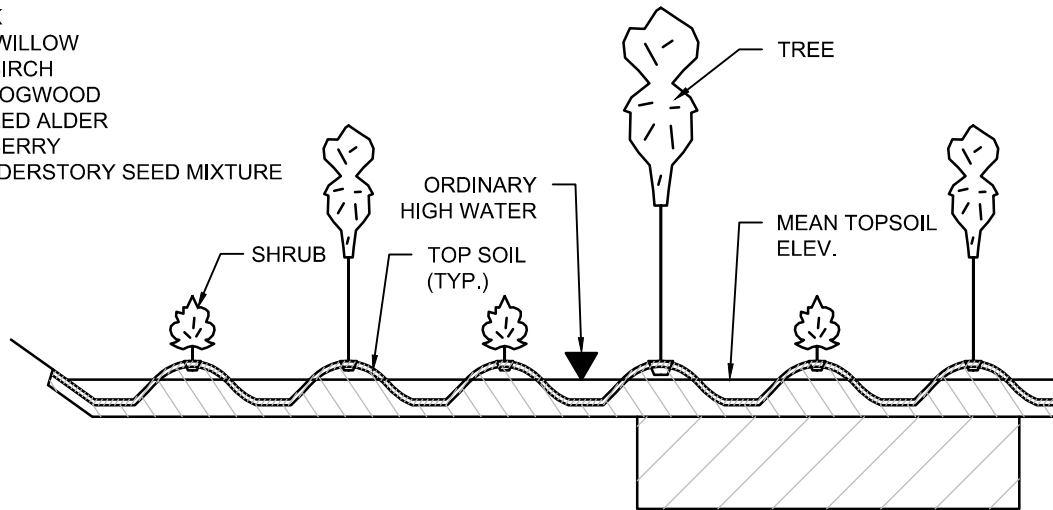
(NOT TO SCALE)

TYPICAL DETAIL
RD-1

LOCKHEED MARTIN CORPORATION
WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK
Project No.: 60303286 Date: AUGUST 2014

PLANT TYPES

RED MAPLE
PIN OAK
BLACK WILLOW
RIVER BIRCH
SILKY DOGWOOD
SPECKLED ALDER
ELDERBERRY
PFO UNDERSTORY SEED MIXTURE



TYPICAL FORESTED WETLAND

(NOT TO SCALE)

Issue Status: DRAFT

AECOM

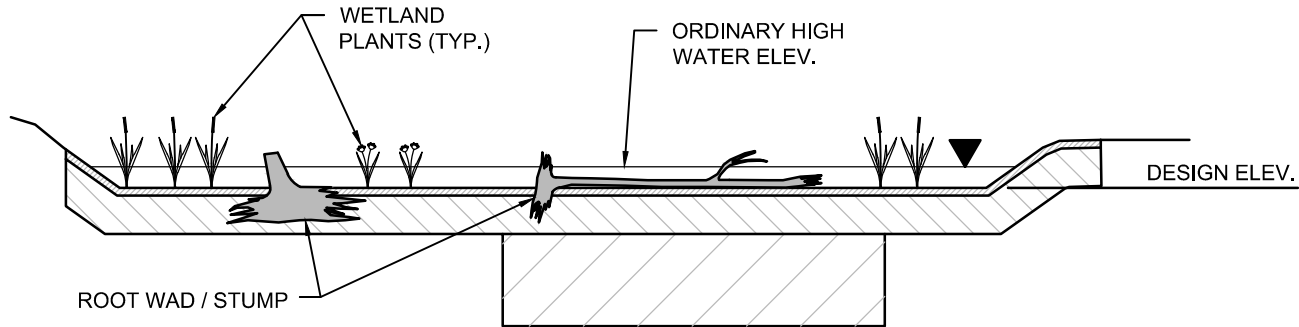
RD-2

TYPICAL DETAIL
RD-2

LOCKHEED MARTIN CORPORATION
WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK
Project No.: 60303286 Date: AUGUST 2014

TYPICAL PLANT

BROAD LEAF CATTAIL
BLUE FLAG IRIS
WOOL GRASS
SOFT RUSH
SENSITIVE FERN
PEM UNDERSTORY SEED MIXTURE



TYPICAL EMERGENT WETLAND

(NOT TO SCALE)

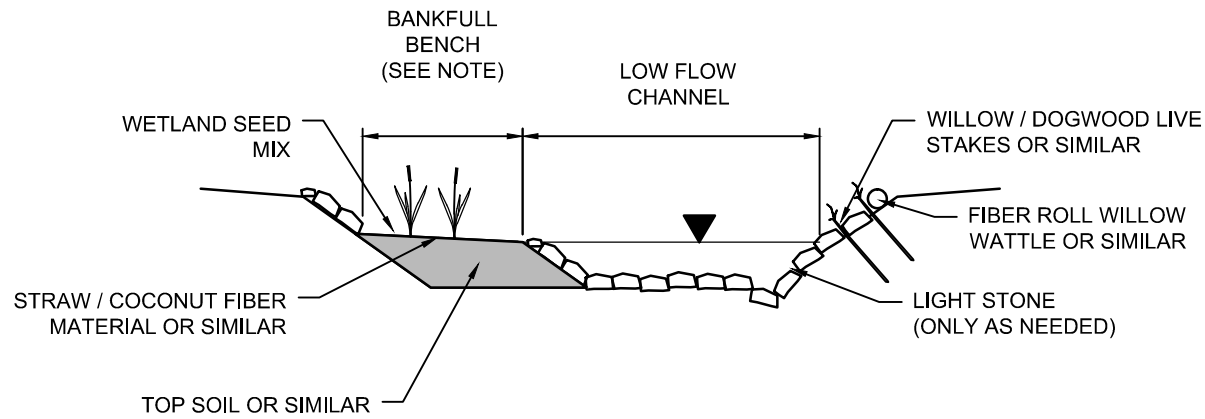
Issue Status: DRAFT

AECOM

RD-3

TYPICAL DETAIL
RD-3

LOCKHEED MARTIN CORPORATION
WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK
Project No.: 60303286 Date: AUGUST 2014

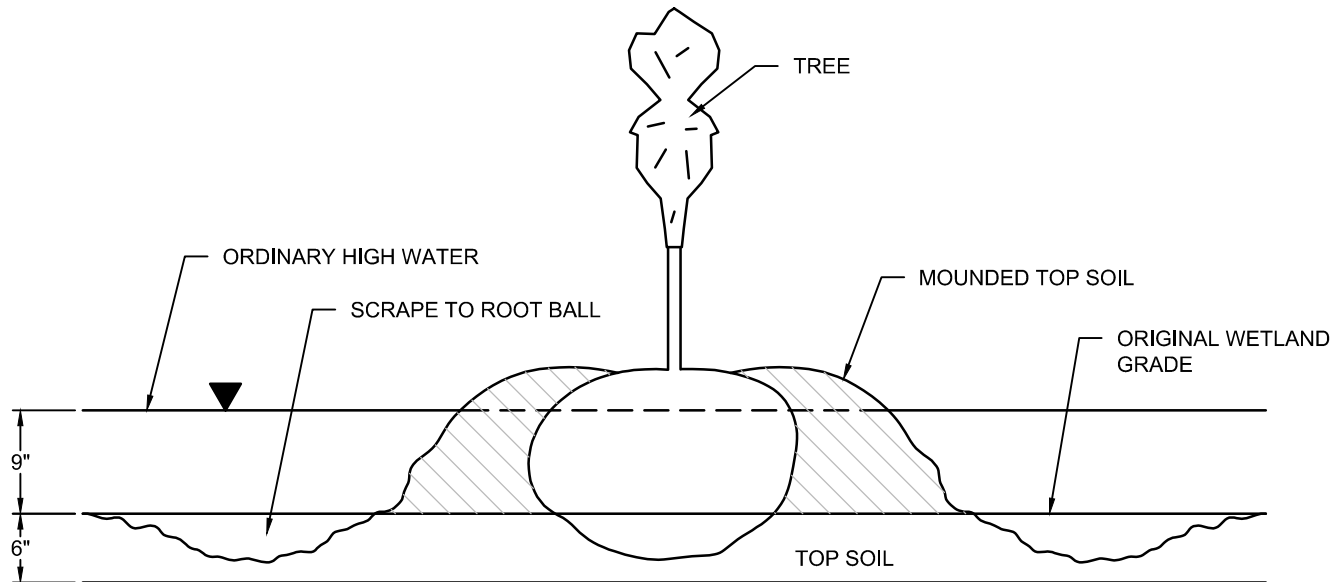


TYPICAL BROOK
(NOT TO SCALE)

NOTE:
POTENTIAL USE OF WETLAND BENCH RESERVED
FOR STREAM RESTORATION AREAS BETWEEN
STATIONS 38+00 TO 45+50 +/-

TYPICAL DETAIL
RD-4

LOCKHEED MARTIN CORPORATION
WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK
Project No.: 60303286 Date: AUGUST 2014



TYPICAL PIT AND MOUND INSTALLATION

(NOT TO SCALE)

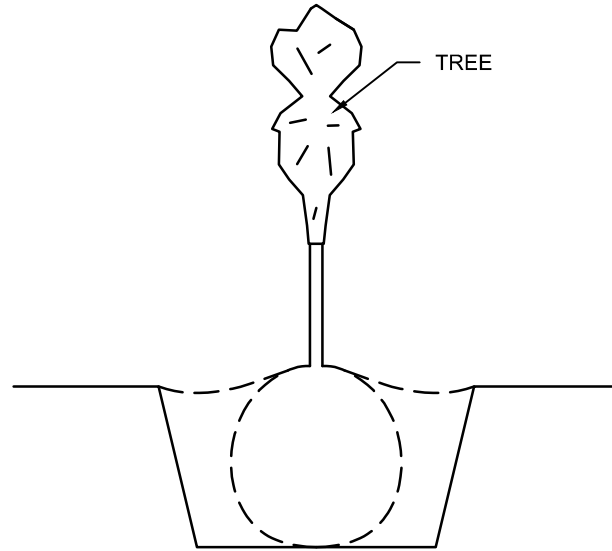
Issue Status: DRAFT

AZCOM

RD-5

TYPICAL DETAIL
RD-5

LOCKHEED MARTIN CORPORATION
WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK
Project No.: 60303286 Date: AUGUST 2014



TYPICAL UPLAND INSTALLATION
(NOT TO SCALE)

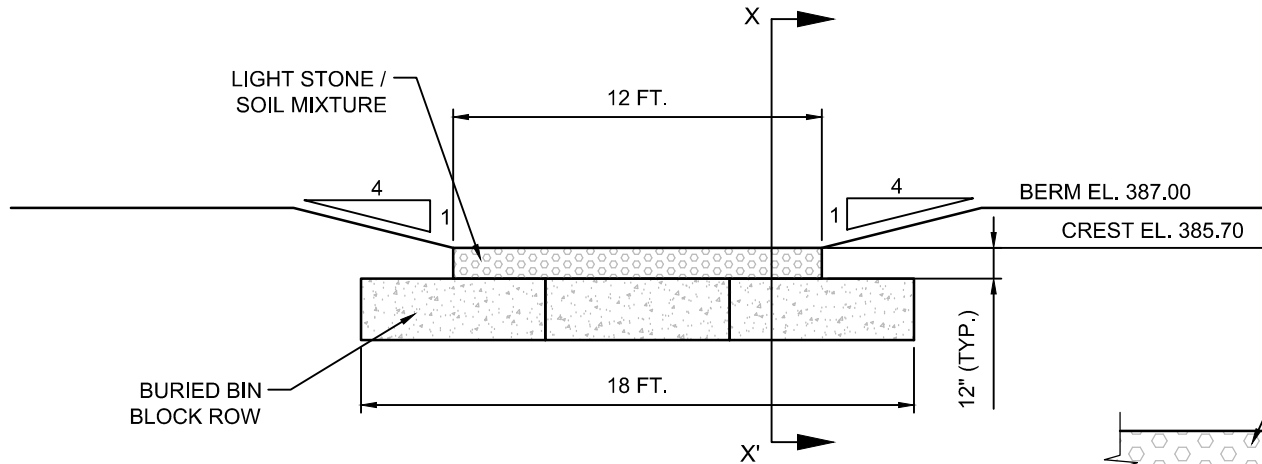
Issue Status: DRAFT

TYPICAL DETAIL
RD-6

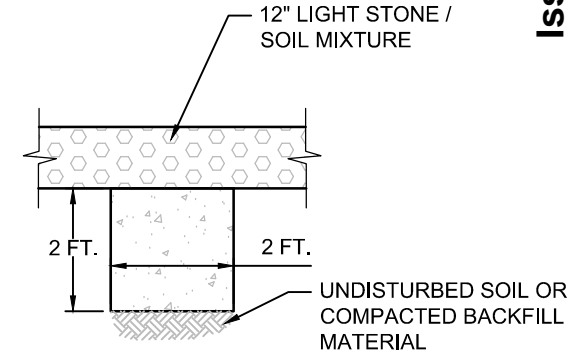
LOCKHEED MARTIN CORPORATION
WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK
Project No.: 60303286 Date: AUGUST 2014



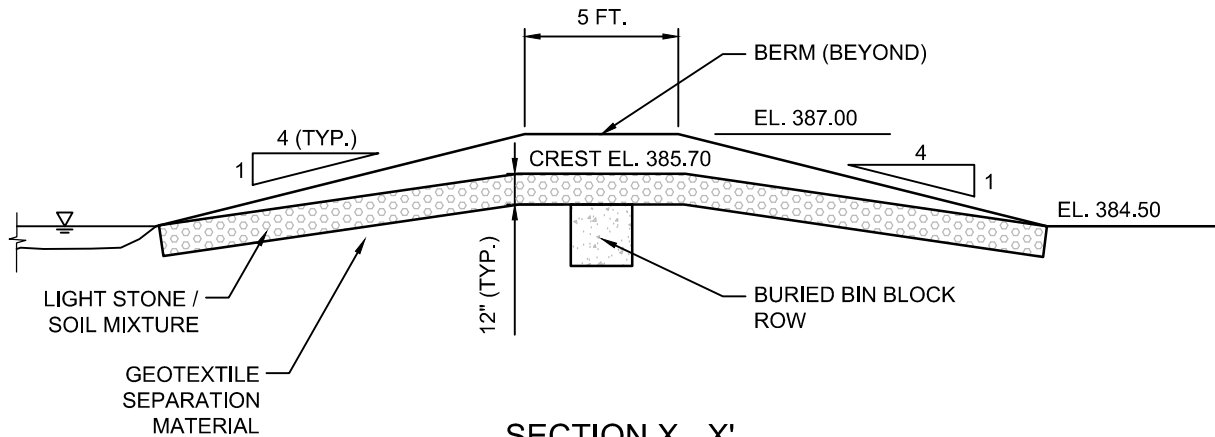
RD-6



ELEVATION
(NOT TO SCALE)
WEIR #1



BIN BLOCK DETAIL
(NOT TO SCALE)



SECTION X - X'
(NOT TO SCALE)
WEIR #1

Issue Status: DRAFT

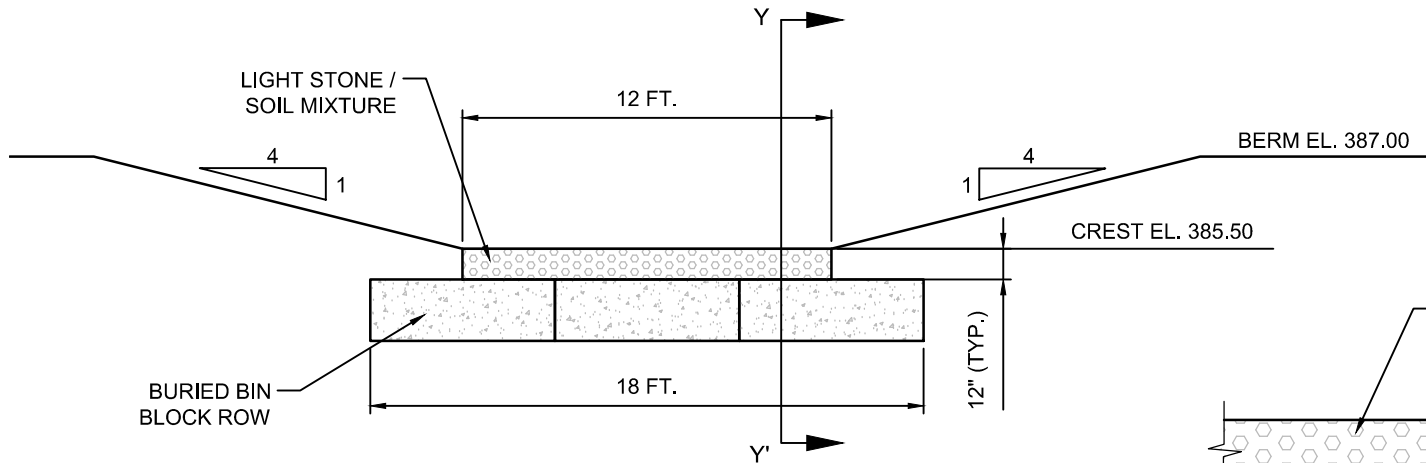
ALCOM

RD-7

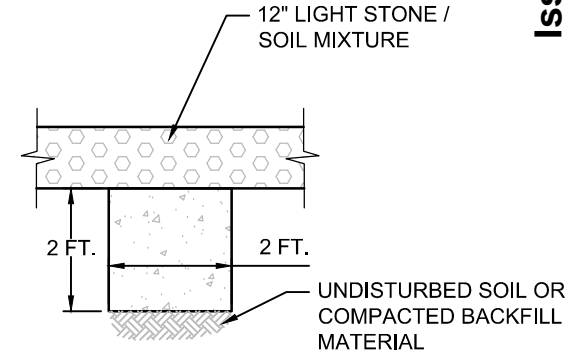
TYPICAL DETAIL
RD-7

LOCKHEED MARTIN CORPORATION
WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK
Project No.: 60303286 Date: AUGUST 2014

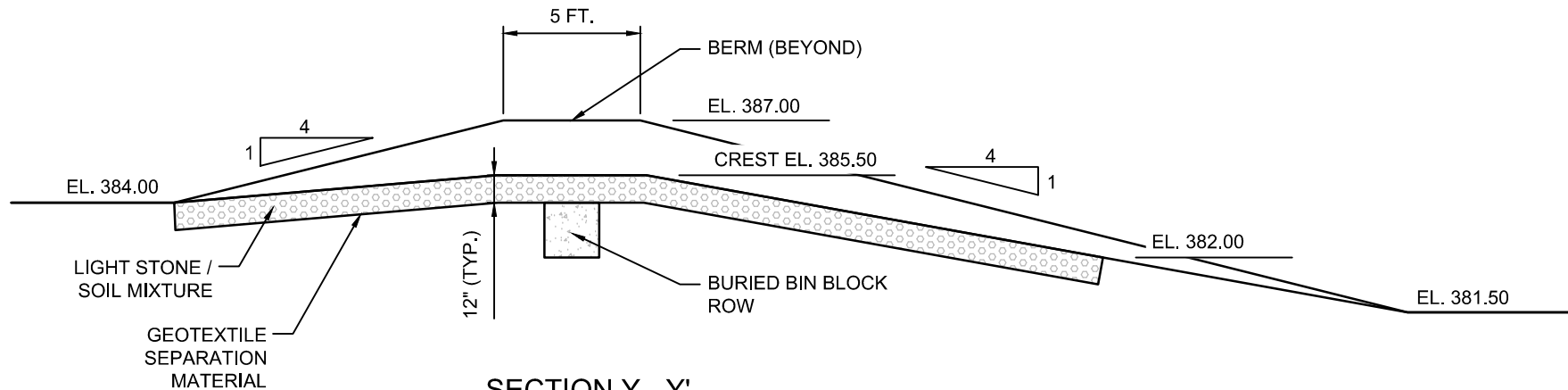
Issue Status: DRAFT



ELEVATION
(NOT TO SCALE)
WEIR #2



BIN BLOCK DETAIL
(NOT TO SCALE)

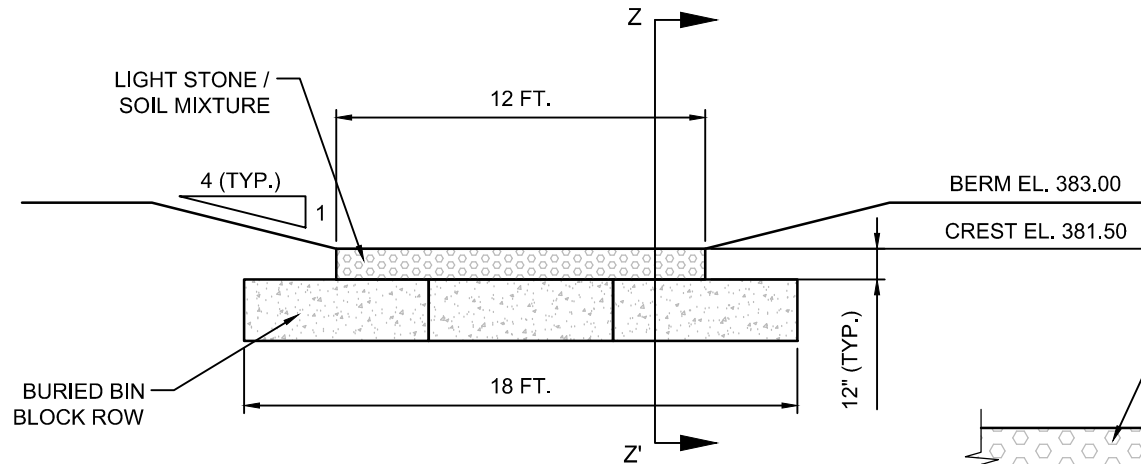


SECTION Y - Y'
(NOT TO SCALE)
WEIR #2

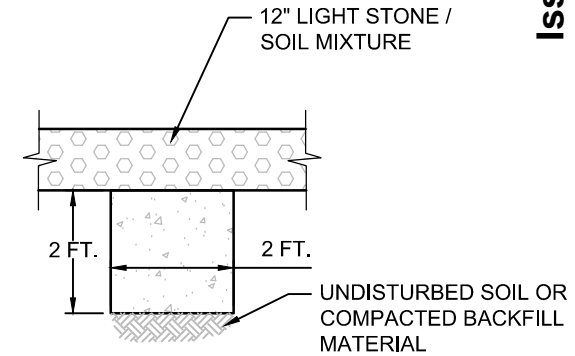
TYPICAL DETAIL
RD-8

LOCKHEED MARTIN CORPORATION
WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK
Project No.: 60303286 Date: AUGUST 2014

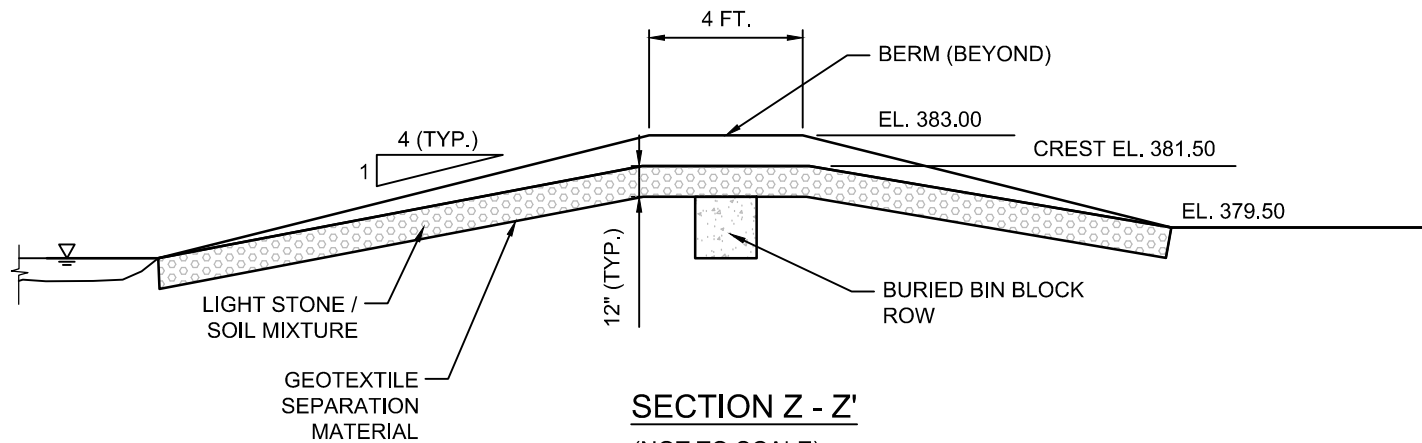
Issue Status: DRAFT



ELEVATION
(NOT TO SCALE)
WEIR #3



BIN BLOCK DETAIL
(NOT TO SCALE)



SECTION Z - Z'
(NOT TO SCALE)
WEIR #3

TYPICAL DETAIL
RD-9

LOCKHEED MARTIN CORPORATION
WEST BRANCH OF BLOODY BROOK
ONONDAGA COUNTY, NEW YORK
Project No.: 60303286 Date: AUGUST 2014

APPENDIX F

PA New England Province Riparian Mix

ERNMX # ERNMX-253
Seeding Rate Approximately 20 lb per acre
Mix Type Wet Meadow & Wetland Sites

- 14% [Little Bluestem, Fort Indiantown Gap-PA Ecotype \(Schizachyrium scoparium, Fort Indiantown Gap-PA Ecotype\)](#)
- 14% [Indiangrass, PA Ecotype \(Sorghastrum nutans, PA Ecotype\)](#)
- 10% [Riverbank Wildrye, PA Ecotype \(Elymus riparius, PA Ecotype\)](#)
- 10% [Virginia Wildrye, PA Ecotype \(Elymus virginicus, PA Ecotype\)](#)
- 9% [Deertonque, 'Tioga' \(Panicum clandestinum \(Dichanthelium c.\), 'Tioga'\)](#)
- 8% [Big Bluestem, 'Niagara' \(Andropogon gerardii, 'Niagara'\)](#)
- 7% [Fox Sedge, PA Ecotype \(Carex vulpinoidea, PA Ecotype\)](#)
- 2% [Switchgrass, 'Shelter' \(Panicum virgatum, 'Shelter'\)](#)
- 2% [Boneset, PA Ecotype \(Eupatorium perfoliatum, PA Ecotype\)](#)
- 2% [Soft Rush \(Juncus effusus\)](#)
- 2% [Swamp Milkweed, PA Ecotype \(Asclepias incarnata, PA Ecotype\)](#)
- 2% [Autumn Bentgrass, PA Ecotype \(Agrostis perennans, PA Ecotype\)](#)
- 2% [Wild Senna, VA & WV Ecotype \(Senna hebecarpa \(Cassia h.\), VA & WV Ecotype\)](#)
- 2% [Oxeye Sunflower, PA Ecotype \(Heliopsis helianthoides, PA Ecotype\)](#)
- 2% [Blue Vervain, PA Ecotype \(Verbena hastata, PA Ecotype\)](#)
- 2% [Partridge Pea, PA Ecotype \(Chamaecrista fasciculata \(Cassia f.\), PA Ecotype\)](#)
- 1% [Wild Bergamot, PA Ecotype \(Monarda fistulosa, PA Ecotype\)](#)
- 1% [Redtop Panicgrass, PA Ecotype \(Panicum rigidulum \(P. stipitatum\), PA Ecotype\)](#)
- 1% [Joe Pye Weed, PA Ecotype \(Eupatorium fistulosum, PA Ecotype\)](#)
- 1% [Flat Topped White Aster, PA Ecotype \(Aster umbellatus \(Doellingeria umbellata\), PA Ecotype\)](#)
- 1% [Purplestem Aster, PA Ecotype \(Aster puniceus \(Symphyotrichum puniceum\), PA Ecotype\)](#)
- 1% [Zigzag Aster, PA Ecotype \(Aster prenanthoides \(Symphyotrichum p.\), PA Ecotype\)](#)
- 1% [New England Aster \(Aster novae-angliae \(Symphyotrichum n.\)\)](#)
- 1% [New York Ironweed, PA Ecotype \(Vernonia noveboracensis, PA Ecotype\)](#)
- 1% [Many Leaved Bulrush, PA Ecotype \(Scirpus polyphyllus, PA Ecotype\)](#)
- 1% [Spotted Joe Pye Weed, PA Ecotype \(Eupatorium maculatum \(Eupatoriadelphus maculatus\), PA Ecotype\)](#)

Total: 100%

Northeastern U.S. Roadside Native Mix

ERNMX # ERNMX-105

Seeding Rate Approximately 20 lb per acre, or 1/2 lb per 1,000 sq ft

Mix Type Upland & Meadow Sites

- 24% [Big Bluestem, 'Prairie View'-IN Ecotype \(Andropogon gerardii, 'Prairie View'-IN Ecotype\)](#)
- 20% [Sideoats Grama, 'Butte' \(Bouteloua curtipendula, 'Butte'\)](#)
- 19% [Virginia Wildrye, PA Ecotype \(Elymus virginicus, PA Ecotype\)](#)
- 5% [Broomsedge, MO Ecotype \(Andropogon virginicus, MO Ecotype\)](#)
- 5% [Blackeyed Susan, Coastal Plain NC Ecotype \(Rudbeckia hirta, Coastal Plain NC Ecotype\)](#)
- 4% [Partridge Pea, PA Ecotype \(Chamaecrista fasciculata \(Cassia f.\), PA Ecotype\)](#)
- 4% [Purple Coneflower \(Echinacea purpurea\)](#)
- 3% [Ohio Spiderwort, PA Ecotype \(Tradescantia ohimensis, PA Ecotype\)](#)
- 2% [Swamp Milkweed, PA Ecotype \(Asclepias incarnata, PA Ecotype\)](#)
- 2% [Wild Senna, VA & WV Ecotype \(Senna hebecarpa \(Cassia h.\), VA & WV Ecotype\)](#)
- 2% [Oxeye Sunflower, PA Ecotype \(Heliopsis helianthoides, PA Ecotype\)](#)
- 2% [Zigzag Aster, PA Ecotype \(Aster prenanthoides \(Symphyotrichum p.\), PA Ecotype\)](#)
- 2% [Blue False Indigo, Southern WV Ecotype \(Baptisia australis, Southern WV Ecotype\)](#)
- 2% [Flat Topped White Aster, PA Ecotype \(Aster umbellatus \(Doellingeria umbellata\), PA Ecotype\)](#)
- 1% [Wild Bergamot, PA Ecotype \(Monarda fistulosa, PA Ecotype\)](#)
- 1% [Early Goldenrod, PA Ecotype \(Solidago juncea, PA Ecotype\)](#)
- 1% [New England Aster, PA Ecotype \(Aster novae-angliae \(Symphyotrichum n.\), PA Ecotype\)](#)
- 1% [Marsh \(Dense\) Blazing Star \(Spiked Gayfeather\), PA Ecotype \(Liatris spicata, PA Ecotype\)](#)

Total: 100%

PA New England Province FACW Mix

ERNMX # ERNMX-251

Seeding Rate Approximately 20 lb per acre

Mix Type Wet Meadow & Wetland Sites

- 24% [Fox Sedge, PA Ecotype \(Carex vulpinoidea, PA Ecotype\)](#)
- 20% [Virginia Wildrye, PA Ecotype \(Elymus virginicus, PA Ecotype\)](#)
- 10% [Lurid \(Shallow\) Sedge, PA Ecotype \(Carex lurida, PA Ecotype\)](#)
- 5% [Hop Sedge, PA Ecotype \(Carex lupulina, PA Ecotype\)](#)
- 4% [Blue Vervain, PA Ecotype \(Verbena hastata, PA Ecotype\)](#)
- 3% [Green Bulrush, PA Ecotype \(Scirpus atrovirens, PA Ecotype\)](#)
- 3% [Soft Rush \(Juncus effusus\)](#)
- 2% [Swamp Milkweed, PA Ecotype \(Asclepias incarnata, PA Ecotype\)](#)
- 2% [Wood Reedgrass, PA Ecotype \(Cinna arundinacea, PA Ecotype\)](#)
- 2% [Boneset, PA Ecotype \(Eupatorium perfoliatum, PA Ecotype\)](#)
- 2% [Cosmos \(Bristly\) Sedge, PA Ecotype \(Carex comosa, PA Ecotype\)](#)
- 2% [Oxeye Sunflower, PA Ecotype \(Heliopsis helianthoides, PA Ecotype\)](#)
- 2% [Redtop Panicgrass, PA Ecotype \(Panicum rigidulum \(P. stipitatum\), PA Ecotype\)](#)
- 2% [Sensitive Fern \(Onoclea sensibilis\)](#)
- 1% [Joe Pye Weed, PA Ecotype \(Eupatorium fistulosum, PA Ecotype\)](#)
- 1% [Pennsylvania Smartweed, PA Ecotype \(Polygonum pensylvanicum, PA Ecotype\)](#)
- 1% [Spotted Joe Pye Weed, PA Ecotype \(Eupatorium maculatum \(Eupatoriadelphus maculatus\), PA Ecotype\)](#)
- 1% [Northern Long Sedge, PA Ecotype \(Carex folliculata, PA Ecotype\)](#)
- 1% [Slender Mountainmint \(Pycnanthemum tenuifolium\)](#)
- 1% [Flat Topped White Aster, PA Ecotype \(Aster umbellatus \(Doellingeria umbellata\), PA Ecotype\)](#)
- 1% [Bladder \(Star\) Sedge, PA Ecotype \(Carex intumescens, PA Ecotype\)](#)
- 1% [Rattlesnake Grass, PA Ecotype \(Glyceria canadensis, PA Ecotype\)](#)
- 1% [Many Leaved Bulrush, PA Ecotype \(Scirpus polyphyllus, PA Ecotype\)](#)
- 1% [Great Blue Lobelia, PA Ecotype \(Lobelia siphilitica, PA Ecotype\)](#)
- 1% [New York Ironweed, PA Ecotype \(Vernonia noveboracensis, PA Ecotype\)](#)
- 1% [Narrowleaf Blue Eyed Grass \(Sisyrinchium angustifolium\)](#)
- 1% [Brown Bulrush, PA Ecotype \(Scirpus pendulus, PA Ecotype\)](#)
- 1% [New England Aster \(Aster novae-angliae \(Symphyotrichum n.\)\)](#)
- 1% [Zigzag Aster, PA Ecotype \(Aster prenanthoides \(Symphyotrichum p.\), PA Ecotype\)](#)
- 1% [Purplestem Aster, PA Ecotype \(Aster puniceus \(Symphyotrichum puniceum\), PA Ecotype\)](#)
- 1% [Square Stemmed Monkeyflower, PA Ecotype \(Mimulus ringens, PA Ecotype\)](#)

Total: 100%

Partially Shaded Area Roadside Mix

ERNMX # ERNMX-140

Seeding Rate Approximately 20 lb per acre, or 1/2 lb per 1,000 sq ft

Mix Type Woodland Openings, Partially Shaded Sites & Shrubby Sites Associated with Bioengineering

- 20% [Virginia Wildrye, PA Ecotype \(Elymus virginicus, PA Ecotype\)](#)
- 17% [Creeping Red Fescue \(Festuca rubra\)](#)
- 17% [Deertongue, 'Tioga' \(Panicum clandestinum \(Dichanthelium c.\), 'Tioga'\)](#)
- 10% [Autumn Bentgrass, Albany Pine Bush-NY Ecotype \(Agrostis perennans, Albany Pine Bush-NY Ecotype\)](#)
- 6% [Tall White Beardtongue \(Penstemon digitalis\)](#)
- 5% [Partridge Pea, PA Ecotype \(Chamaecrista fasciculata \(Cassia f.\), PA Ecotype\)](#)
- 4% [Purple Coneflower \(Echinacea purpurea\)](#)
- 4% [Zigzag Aster, PA Ecotype \(Aster prenanthoides \(Symphyotrichum p.\), PA Ecotype\)](#)
- 4% [Blackeyed Susan, Coastal Plain NC Ecotype \(Rudbeckia hirta, Coastal Plain NC Ecotype\)](#)
- 3% [Marsh \(Dense\) Blazing Star \(Spiked Gayfeather\), PA Ecotype \(Liatris spicata, PA Ecotype\)](#)
- 3% [Ohio Spiderwort, PA Ecotype \(Tradescantia ohimensis, PA Ecotype\)](#)
- 2% [Thimbleweed, PA Ecotype \(Anemone virginiana, PA Ecotype\)](#)
- 2% [Oxeye Sunflower, PA Ecotype \(Heliopsis helianthoides, PA Ecotype\)](#)
- 1% [Blue False Indigo, Southern WV Ecotype \(Baptisia australis, Southern WV Ecotype\)](#)
- 1% [Wild Bergamot, PA Ecotype \(Monarda fistulosa, PA Ecotype\)](#)
- 1% [Slender Bushclover, VA Ecotype \(Lespedeza virginica, VA Ecotype\)](#)

Total: 100%