DEPARTMENT OF ENERGY & ENVIRONMENT

Congress Heights Recreation Center RSC

Final Design Report, June 2019

Congress Heights Recreation Center, District of Columbia
Contract Number CW64926

Government of the District of Columbia
Department of Energy of Environment
Watershed Protection Division
1200 First Street, NE 5th Floor
Washington, DC 20002

Contents

1 INTRODUCTION

The District Department of Energy and the Environment (DOEE) selected Biohabitats to provide design and construction services on restoration of a stormwater channel along the south side of the Congress Heights Recreation Center. The unnamed stormwater channel is a tributary of the Potomac River with a watershed lying entirely in the District of Columbia. The channel and riparian area (Project Area) have been degraded from uncontrolled stormwater that flows into the park from the surrounding neighborhood.

The goal of the Project is to restore the channel and riparian area, thereby restoring natural hydrology, preventing erosion, reducing stormwater pollution, and enhancing and creating wildlife habitat. Because of the high visibility of the Project Area and nature of the Project, the partners desire creative designs that will be attractive yet cost effective.

The specific objectives of the Project include:

1. Assessment of the contributing drainage areas;
2. Removal of invasive species in the woodlands through at least three treatments using chemical or mechanical means. Work must be performed by technicians that are trained and qualified and care must be taken to avoid impacting existing and newly planted vegetation;
3. Installing a “regenerative stormwater conveyance (RSC)” like system with boulder step pools that safely convey storm flows while encouraging stormwater treatment and infiltration in the gully along the approximately 300’ long existing conveyance channel. Care will be taken to minimize the number of trees removed in the installation of the RSC;
4. Cleaning and removing debris around the outfall to the RSC-like system to ensure conveyance of flows out of the gully area;
5. Creation of a trail through the gully area using wood chips or some other low-impact material and potentially using existing social trails through the area; and
6. Potentially directing stormwater from an existing catch basin on Wheeler Hill Drive into the project area to provide treatment for this untreated stormwater and add groundwater recharge to the project area.

The Project Area is located in the Potomac River watershed and is less than an acre in size. The recreation center recently received playground upgrades through the Play DC initiative which included some reduction in impervious surface and the installation of a bioretention cell. This project involves the restoration of woodlands and a woodland stormwater gully on the south side of the recreation center. Runoff enters the gully from the surrounding area, including the apartment complex to the east. A photographic log of the site is in Appendix A.

2 EXISTING CONDITIONS AND DATA COLLECTION

Biohabitats assessed the existing conditions at the Congress Heights Recreation Center through a desktop review of available GIS data, record drawings, multiple site visits. Topographic and tree surveys will be completed before the semi-final design submittal. Figure 1 below shows the approximate location of the study area.

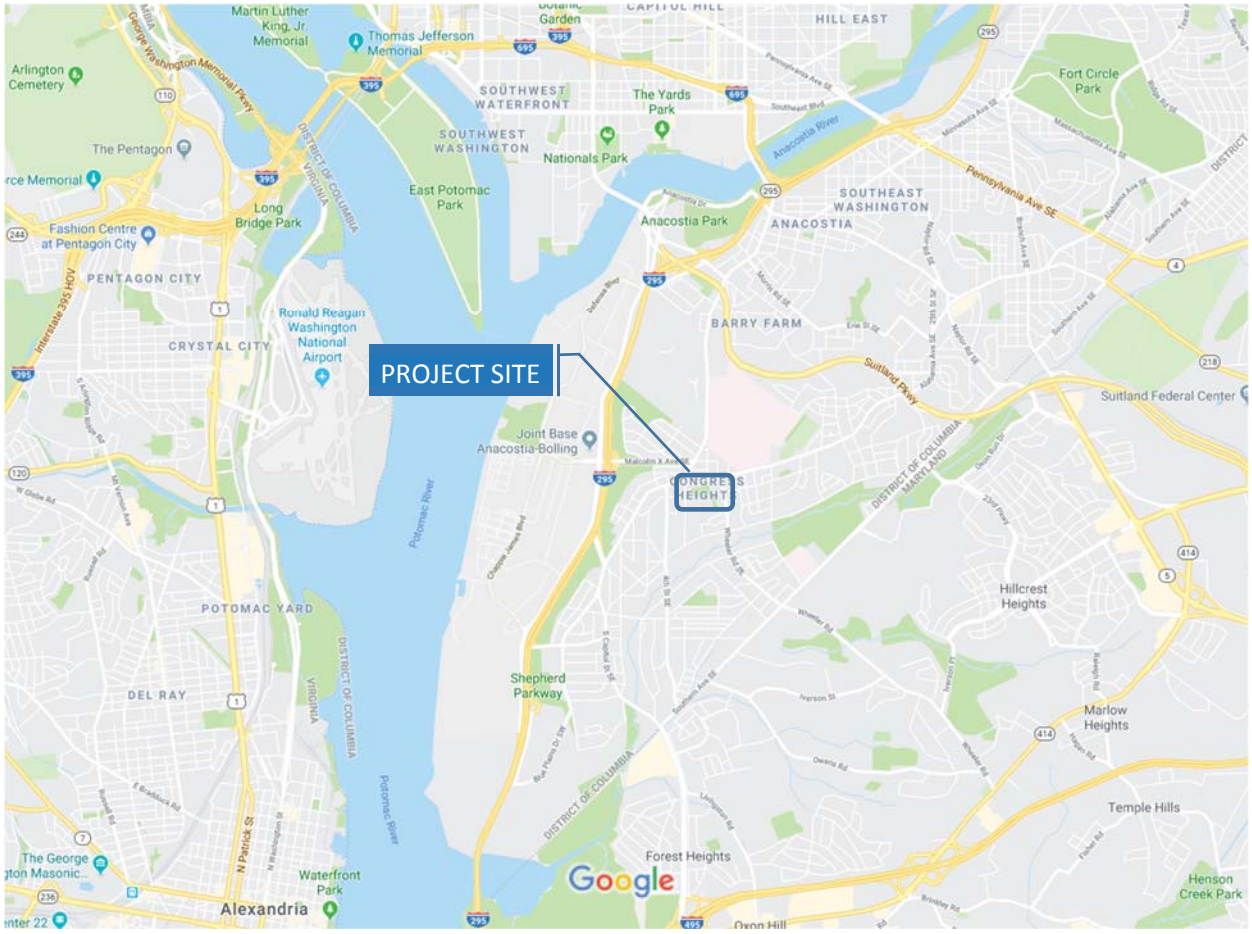


Figure 1: Project study area

2.1 GIS Data & Record Drawings

Biohabitats compiled a base map of the existing conditions from available GIS data (LiDAR, Property Lines, impervious surface layers, etc.) to inform the concept design submittal. Until the topographic survey was completed, a combination of GIS data and record drawings provided the best available data for concept design purposes. As needed for design purposes, specific components were visually verified to ensure consistency of information.

DOEE and DPR provided Biohabitats with record drawings for Congress Heights Recreation Center, dated 3/11/2014, and with record drawings for Monterey Park, dated February 1991. Biohabitats utilized topographic utility and easement information from the record drawings to develop the concept drawings.

2.2 Topographic and Tree Survey

A topographic survey was completed in February 2019 and used as the basemapping on the semi-final drawings. Trees greater than 8" were identified, tagged and located within the entire project area. In total, 107 trees with an 8" or greater diameter at breast height (DBH) were tagged, identified, located and condition assessed.

2.3 Wetlands and Surface Waters

The site is a contained forested upland area. No perennial stream channels were delineated on-site. The channel appears to have an ephemeral flow regime, with some areas of shallow surface water ponded in small bowled features in the channel bed. On December 11th, 2018 Environmental Scientists from Biohabitats investigated the channel for groundwater and soil characteristics at the upper extent of the stream channel. A sample plot using a 4" bucket auger was dug to 18 inches below the ground surface. There was no surface water present in the channel. The water table was present at 10 inches below the ground surface, and soil saturation was present at 6 inches below grade. The stream is characterized as an ephemeral stream and as such, a regulated Waters of the US (WUS). Data collected during this field reconnaissance can be found attached in Appendix A.

Pre-field data collection was performed to assess the potential for the presence of non-tidal wetlands in the project area. The National Wetland Inventory (NWI) map did not show the presence of known wetlands, and the NRCS Web Soil Survey did not indicate the presence of hydric soils. These maps are intended for regional and watershed data display and general guidance purposes; they do not necessarily reflect actual site conditions needed to make a formal wetland determination.
A wetland determination investigation was performed within the project area using the three-parameter approach- wetland hydrology, hydrophytic vegetation, and hydric soils in accordance with the 1987 Corp of Engineers Wetlands Delineation Manual- Technical Report 8711 (ASACE, 1987) and the Regional Supplement, Atlantic and Gulf Coastal Plain Region Version 2.0 (USACE, 2010). The field investigation completed on December 11, 2018 by Biohabitats wetland professionals determined the project area was absent of regulated non-tidal wetlands. A sample plot, on the floodplain, representative of the project area did not meet any of the three wetland indicators.
At the downstream extent of the channel, ponded surface water is present, but only as the result of a debris obstructed storm inlet that is supposed to receive any flow from the channel. It is a temporary feature and not part of the normal circumstances that reflect normal hydrology of the area.

2.4 Soils

Biohabitats utilized the United States Department of Agricultures (USDA) Natural Resources Conservation Service's (NRCS) Web Soil Survey to perform a preliminary analysis of the existing on-site soil characteristics. Table 1 provides a list of the soils present at the site. The full NRCS Custom Soil Resources Report has been attached in Appendix B.

Table 1. Soil Types Within the Study Area

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BeB	Beltsville-Urban land complex, 0 to 8 percent slopes	0.1	9.8%
CwD	Croom very gravelly sandy loam, 15 to 40 percent slopes	0.3	26.4%
U1	Udorthents	0.7	63.8%
Totals for Area of Interest		**1.1**	**100.0%**

Beltsville-Urban land complex (BeB) is a moderately well drained, non-hydric, silt loam soil in the Hydrologic Soil Group C, typically found in a flat landform setting. Croom very gravelly sandy loam (CwD) is a well-drained, non-hydric, gravelly sandy loam soil in the Hydrologic Soil Group C, typically found on moderate to steep slopes. Udorthents (U1) is a moderately well drained, non-hydric, silt loam soil in the Hydrologic Soil Group C, without a typical landform setting.

2.5 Geomorphology

The stream through Congress Heights is ephemeral and has a mostly dry bed without any presence of flow. There are portions of saturated soil conditions along the streambed and some small concave pooled areas with shallow ponding. Any surface water observed appeared to be the result of ephemeral flow that was captured in areas of the streambed that have eroded through headcutting. The system is largely driven by stormwater runoff from the surrounding watershed. The channel was determined to be a single reach, as geomorphic conditions do not change significantly from the upstream to downstream limits. The stream channel is currently in a state of disequilibrium exhibiting channel incision and widening throughout most of its length. Overall, the channel is unstable. Much of the channel's length contains visible signs of high rates of adjustment including lateral migration, toe slope failures, active headcutting, deep downcutting, and incision. These adjustments have created conditions that have greatly increased sediment supply, impaired downstream water quality, increased downstream aggradation impacts, and impacted infrastructure function. Alterations to the natural hydrology of the system is often the root cause of instability and can set into motion a series of major, sometimes rapid, channel adjustments that can be very detrimental to a stream ecosystem.

A cross section was taken at a location representative of the stream channel within Congress Heights Recreational Center. Geomorphology data collected during this field reconnaissance can be found attached in Appendix A. The channel classifies as a Rosgen Type F channel that is trending towards a Type G as it continues to incise. The incised channel has a high bank height ratio for much of its length with bank heights reaching up to five feet in some locations. This eliminates any floodplain connection and increases sediment supply via continued bank erosion. Determining bankfull conditions is very challenging in urbanized streams where typical field indicators can be elusive and higher levels of impervious cover create flashy flow regimes. During field evaluations, the team was able to identify few reliable field indicators of bankfull stage.

2.6 Biological Resources

Biohabitats will request the Preliminary Species List and Trust Resource Report and submit letters to the US Fish and Wildlife Services for Endangered Species Review.

A rapid Bioassessment of the stream channel was performed using the EPA Rapid Bioassessment protocol for low gradient streams. The data sheet can be found in Appendix A. Congress Heights scored 56 out of 200 which is in the Poor Condition Category. The major facts impacting the low score was the lack of water in the channel, and human impacts on the stream/riparian conditions. Both the bank stability and vegetative protection were low as well and are related to the low base flow and high peak flows during storm events as the system is primarily driven by stormwater runoff.

The project area contains a single uniform forest stand that is characterized as a mid-succession deciduous. There are only a few trees with DBH greater than 24" and majority of the trees are under 15". Dominant tree species are American Elm (*Ulmus americana*) and Black Locust (*Robinia pseudoacacia*). Many of the trees on site are in fair to poor condition from heavy vine growth and potential disease. There is very little understory that consists of American elm, and white mulberry.

Shrubs are nearly nonexistent. Deer impacts do not appear to have any adverse effect of the forest condition because it is such a small area surrounded by heavy urban development. No signs of deer herbivory were observed. The forest floor and herbaceous layer are comprised entirely of invasive species that are preventing a healthy regeneration and natural forest succession. English ivy dominates the landscape. Field investigators did observe a few sparse eastern black oak saplings under 12" in height suggesting the potential for succession to a higher quality forest. The forest however is unlikely to develop into high-quality habitat due to the abundance of invasive species within and surrounding the site.

2.7 Notable Site Visits

2.7.1 Project Kick-off (11/2/2018)

Staff from DOEE, DPR, and Biohabitats met on November 2nd, 2018 at the project site to kick-off the design-build contract for the DOEE DPR I projects. The attendees walked the site, discussing the original concept drawing produced by Biohabitats, design concerns, and possible alternatives.

2.7.2 Site Assessment (11/29/2018)

Staff from Biohabitats and Triangle met on November 29th, 2018 at the project site to review existing site conditions, discuss concept design alternatives and assess construction access locations.

2.7.3 Site Assessment (12/11/2018)

Staff from Biohabitats performed a wetland determination field investigation along with soil characterization, tree tagging and forest characterization, Rapid Bioassessment, and photographic documentation of the project area.

2.7.4 Site Assessment (2/27/2019)

Staff from Biohabitats performed a plan-in-hand site visit to review the proposed design elements and recently obtained topographic survey and identify any final design constraints.

3 HYDROLOGY and SWRv Computations

3.1 Stormwater Retention Volume (SWRv)

There is no requirement on this project to provide SWRv as: 1) there is no new impervious surface proposed for the Project, 2) the site will maintain natural land cover post construction, and 3) this is a voluntary retrofit to mitigate existing developed land.

3.2 Hydrologic Analysis

Biohabitats evaluated the existing hydrology of the Congress Heights Recreation Center watershed using HydroCAD modeling, which utilizes the SCS TR-20 runoff method calculation to complete a hydrologic analysis.

The contributing drainage area for the channel includes mainly high-density residential land, open space, and wooded parkland. Three drainage areas were delineated for the Project Area. One drainage area, referred to within this report as Direct RSC DA, drains directly to the existing channel. Another drainage area, Neighborhood Inlet DA, is captured by a drainage network within the adjacent neighborhood to the south, which enters the existing channel near the upstream end. The third drainage area, DS Flow, contains the drainage area to the existing micro-bioretention located within Congress Heights Recreational Center, which outfalls to the existing channel, and any additional area within the park that drains to the downstream end of the project. Stormdrain data came primarily from topographic survey and was supplemented with available GIS and as-built information.

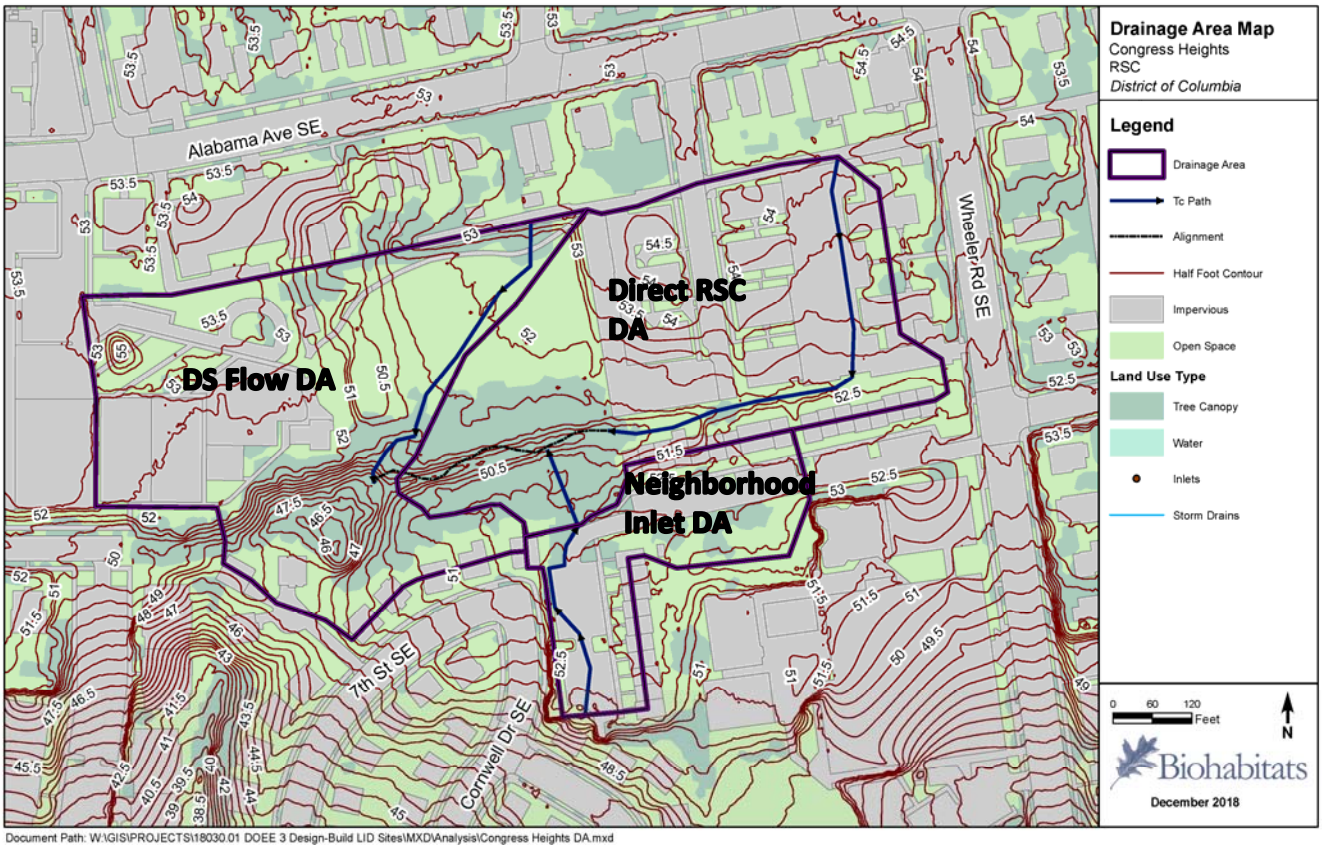


Figure 2 Drainage Area Map for Project

Figure 2 shows the drainage area that was delineated, as well as the corresponding time of concentration (Tc) path. A larger scale version of this Drainage Area Map can be found attached in Appendix A.

The drainage area was assessed based on its soils hydrologic soil group (HSG) and existing land use data to determine a curve number (CN). Wooded parkland was classified as woods in poor condition, based on site observations. The remainder of the contributing areas were classified as impervious or open space in fair condition. The land use can be seen in Figure 2, while Table 2 shows the curve number, impervious area, and total area for each drainage area.

Table 2. Land Use Breakdown for Contributing Drainage Areas

Drainage Area	Total Area (ac)	Imp Area (ac)	% Imp	CN
Direct RSC	6.265	3.092	49.6	89
Neighborhood Inlet	1.980	1.109	56.0	90
Downstream (DS) Flows	6.117	1.996	32.6	85
TOTAL AREA	**14.362**	**6.197**	**43.1**	**88**

After determining the drainage area's characteristics based on the soil and land use data from above, the time of concentration for the drainage area was determined. Table 3 displays the time of concentration (Tc) value for the site drainage area. A minimum time of concentration of 0.100 hours (6 minutes) is permitted and was substituted for any time of concentrations shorter than 0.100 hours.

Table 3. Time of Concentration (Tc) for site

Drainage Area	Tc (min)	Tc (hr)
Direct RSC	6	0.100
Neighborhood Inlet	6	0.100
Downstream (DS) Flows	15.7	0.262

Using this information, a HydroCAD model was created for the restoration reach to estimate the peak discharges associated with the 1-, 2-, 10-, 15-, 50- and 100-yr storm events. Current rainfall depths (NOAA 14) for DC were input for each rainfall return period and a Type II rainfall distribution was used for the model. The results from the HydroCAD model are summarized in Table 4 and a report has been included in Appendix C. These results were used in preliminary channel design calculations that are discussed in Section 6 of this report and area attached in Appendix D.

Table 4. Hydrologic Modeling Results

Reach	Peak Discharge Events (cfs)					
	1-yr	2-yr	10-yr	15-yr	50-yr	100-yr
Direct RSC	16.17	21.1	36.36	40.03	57.08	67.83
Neighborhood Inlet	5.55	7.17	12.16	13.36	18.91	22.42
Downstream (DS) Flows	9.46	12.9	23.95	26.68	39.36	47.41

4 HYDRAULICS

4.1 Existing Conditions Model

Biohabitats used HEC-RAS 5.03 1-dimensional steady flow modeling to produce an existing conditions hydraulics assessment of the unnamed stream running through Congress Heights Rec Center (Appendix E). The HEC-GeoRAS export function was used in conjunction with the field-run survey to produce a base model with river centerlines and cross-sections cut from the survey surface.

The topographic survey data was supplemented with 2-foot contour data generated from Lidar to create the base CAD surface. This data is projected in the NAD83 District of Columbia State Plane coordinate system with a vertical datum of NAV88. Existing condition cross-sections were located based on changes in channel geometry or slope. These cross-sections were cut from the base surface and imported directly to HEC-RAS. Left and right bank stations were located at the top of bank.

The Manning's 'n' values used in the HEC-RAS model were based on a visual examination of the stream channel and overbanks\ and by utilizing the methodology presented in the USGS Water Supply Paper 2339 (Arcement 1989). This methodology uses six variables which are scored based on a scale of severity or extremeness. The scores of the six variables, which are variation in cross section, effect of obstruction, amount of vegetation, degree of meandering, degree of irregularity, and base roughness are added together to get a composite Manning's 'n' value for the type of land use cover. The resulting Manning's 'n' for the existing channel and floodplain, which were utilized in this model, are listed in Table 5.

Table 5. Manning's 'n' values used for the HEC-RAS existing conditions model

Land Use	Manning's 'n'
Existing Channel	0.025
Floodplain	0.10

For all flow profiles, a normal depth was set for the upstream most cross-sections at an energy slope of 0.034 ft/ft. At the downstream end of the channel, an inlet controls the flow out of the system. In order to incorporate the effects of this downstream condition into the model, the estimated elevation (head) required over the inlet to push each storm event peak discharge through the inlet and connected storm drain system was calculated. These elevations were then entered as known water surface elevations associated with each peak discharge as the boundary condition for the downstream most cross-sections.

Boundary conditions for the hydraulics model also included the peak discharges from the hydrologic analysis run, assuming a mixed flow regime allowing both subcritical and supercritical flow for the reach. The peak discharges for the 1-, 2-, 10-, 15-, and 100-year storm events were taken from the accompanying hydrologic model. One flow change location, at the outfall of the micro-bioretention facility, was incorporated into the model. The flows shown in Table 6 below were set for the associated cross-sections.

Table 6. Hydraulic Model Flows

Cross Section Location	Cross Section ID	Peak Discharge Events (cfs)				
		1-yr	2-yr	10-yr	15-yr	100-yr
Upstream End	394.8	21.72	28.27	48.52	53.39	90.25
Micro-bioretention Outfall	151.78	31.18	41.17	72.47	80.07	137.66

4.2 Results - Existing Conditions

Results for the existing conditions hydraulics analysis are shown in Appendix E. As anticipated, the full 100-year storm is contained within the existing incised and over widened channel. This results in predicted high values, associated with the 100-year storm discharge, of in-channel shear stress (6.1 lb/sf maximum and 1.3 lb/sf average) and velocities (16.4 ft/s maximum and 6.6 ft/s average).

4.3 Proposed Conditions Model

The proposed conditions surface was created by meshing the proposed design 1-foot contours with the base surface. Cross-sections for the proposed model were located at the top and bottom of each proposed structure and elevations were generated from the composite surface. Proposed bank stations were set at the bankfull channel design elevation. Manning's 'n' values were computed for the channel and floodplain based on the same methodology used to determine existing conditions Manning's 'n' values. Table 7 states the resulting Manning's 'n' values used in the proposed model.

Table 7. Manning's 'n' values used for the HEC-RAS proposed condition model

Land Use	Manning's 'n'
Existing Channel	0.04
Floodplain	0.10

The same peak discharges for the 1-, 2-, 10-, 15-, and 100-year storm events used in the existing conditions model were also applied to the proposed conditions model. The model was run under a mixed flow regime allowing both subcritical and supercritical flow.

4.4 Results - Proposed Conditions

Results for the proposed conditions hydraulics analysis are shown in Appendix E. The restoration approach calls for filling the existing channel and creating a new bankfull channel at higher elevation. By raising the channel invert, the water surface elevation also rises. Figure 3 shows the existing and proposed water surface elevation. The maximum water surface rise is over 3.3 feet and directly correlates with the amount of fill within the channel. The average increase in water surface elevation is 0.4 feet.

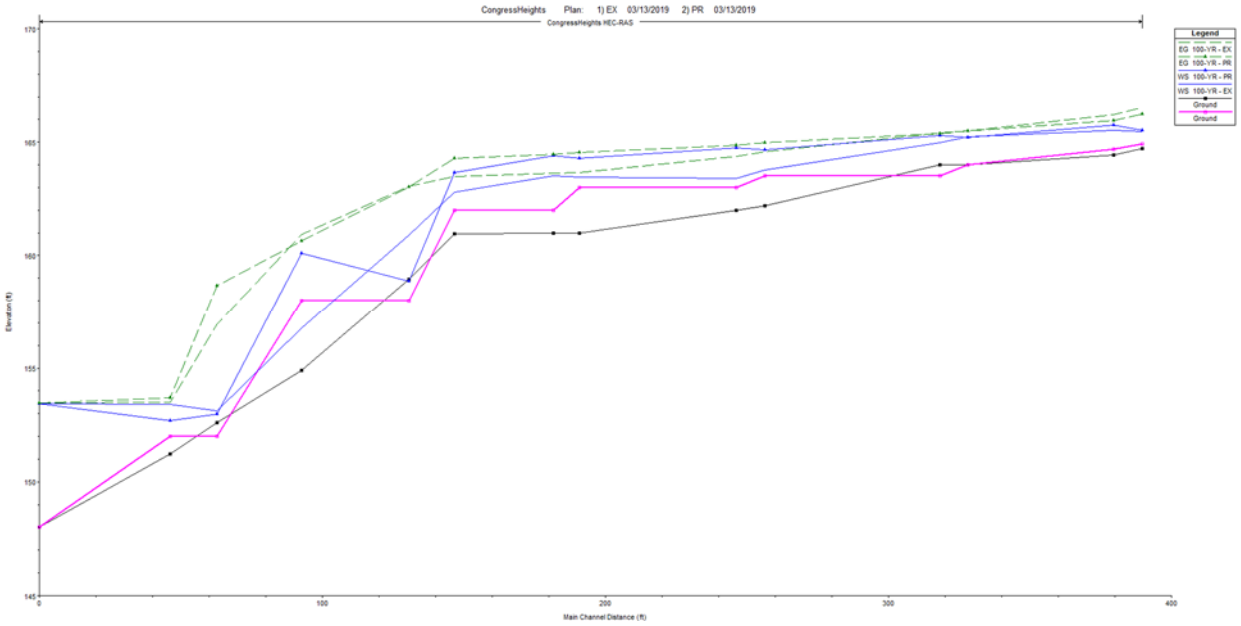


Figure 3. 100-year Water Surface Elevation Comparison

Figures 4 and 5 show the existing and proposed velocities for the 2- and 10-year storms. Within the upper, flatter reach, the maximum existing condition 10-year velocity of 7.0 ft/sec occurs, while at the lower, steeper reach, the maximum existing condition 10-year velocity of 14.8 ft/sec occurs (Figure 4). The upstream portion of the existing stream channel, which constitutes the majority of the channel, experiences average velocities of 4.2 ft/sec for flow events up to the 10-year storm at the upstream end, and average velocities of 9.0 ft/sec for flow events up to the 10-year storm at the downstream end. This is typical for a steep highly incised channel.

The proposed conditions channel velocities show an overall decrease from those seen in existing conditions for the 2- and 10-year storms (Figure 5), with the exception of the velocities seen within the lower reach. The maximum 10-year velocity decreases to 5.5 ft/sec for the upper reach and increases slightly to 17.4 ft/sec for the lower reach. The average proposed condition channel velocities decrease to 3.0 ft/sec for the upper reach and 8.6 ft/sec for flow events up to the 10-year storm. All substrate and structure material will be sized to remain stable during the range of velocities experienced by the restored channel.

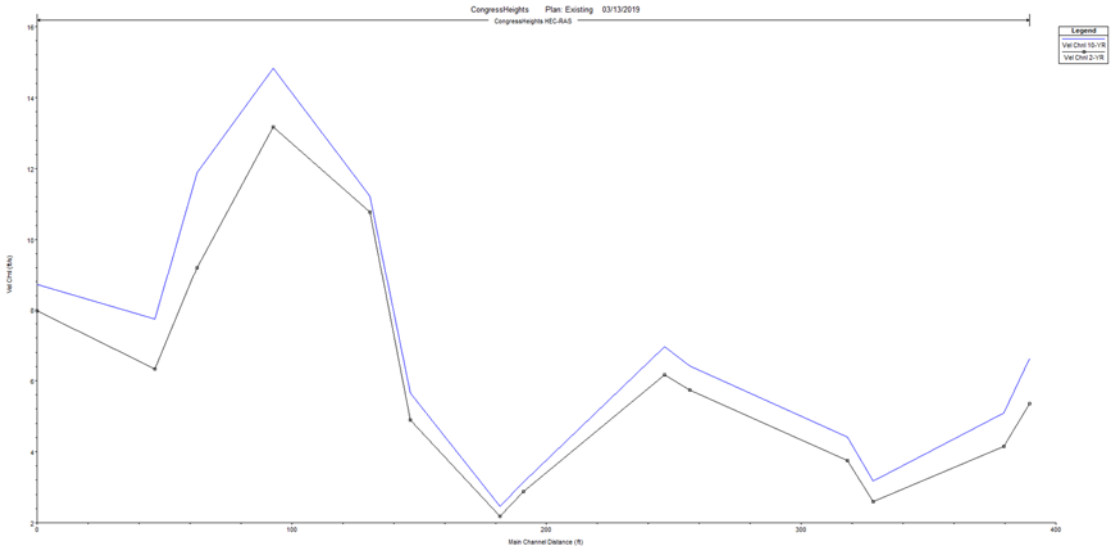


Figure 4. Existing Condition Velocities

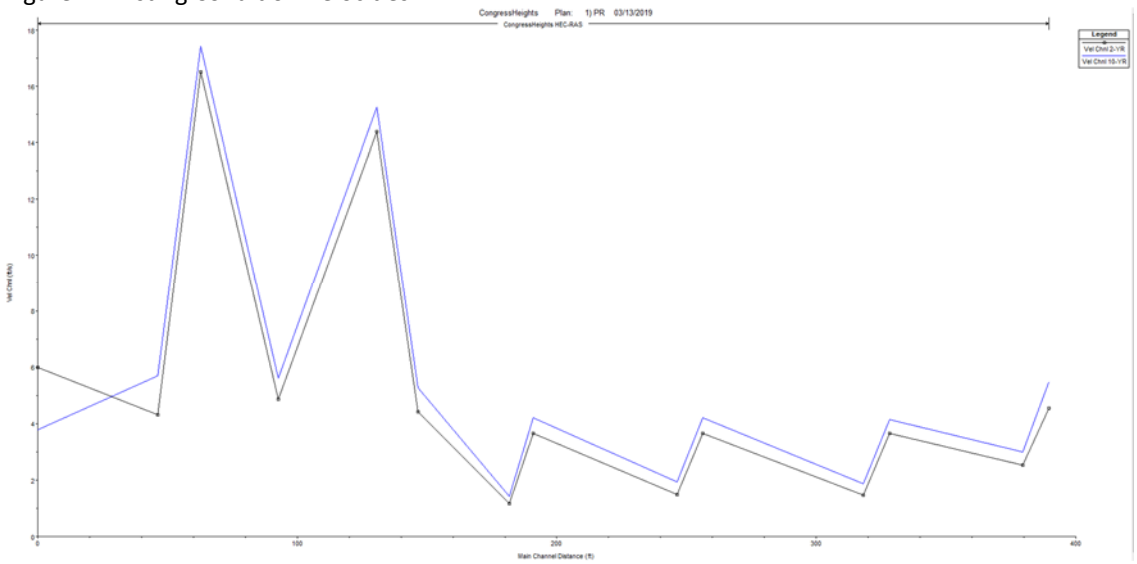


Figure 5. Proposed Condition Velocities

Figures 6 and 7 depict the existing and proposed conditions predicted shear stresses for the 2- and 10-year storms. Within the upper, flatter reach, the maximum existing condition 10-year shear stress of 1.0 lb/sf occurs, while at the lower, steeper reach, the maximum existing condition 10-year shear stress of 4.3 lb/sf occurs (Figure 6). The upstream portion of the existing stream channel, which constitutes the majority of the channel, experiences average shear stress of 0.5 lb/sf for flow events up to the 10-year storm at the upstream end, and average shear stress of 2.0 lb/sf for flow events up to the 10-year storm at the downstream end.

The proposed condition shear stresses generally increase but remain low. The increase is primarily caused by the addition of proposed structures which contain a greater local slope than existing conditions. Within the upper, flatter reach, the maximum proposed condition 10-year shear stress of 1.0 lb/sf occurs, while at the lower, steeper reach, the maximum proposed condition 10-year shear stress of 18.1 lb/sf occurs (Figure 7). This spike in shear stress is related to the proposed cascade structure, which will be constructed of boulder material to remain stable during high flows. The upstream portion of the proposed stream channel, which constitutes the majority of the channel, experiences average shear stress of 0.5 lb/sf for flow events up to the 10-year storm at the upstream reach, and average shear stress of 6.3 lb/sf at the downstream reach.

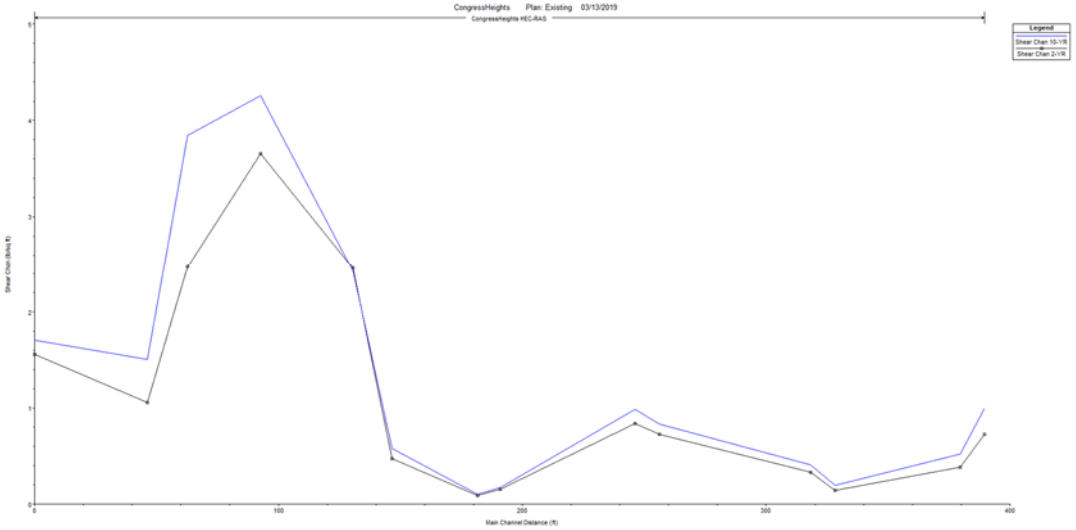


Figure 6. Existing Condition Shear Stresses

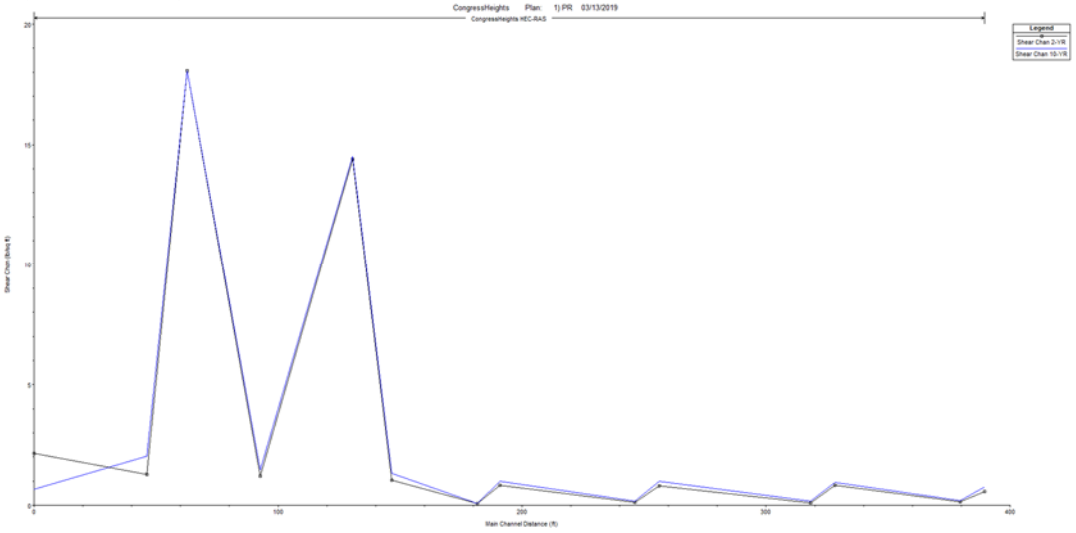


Figure 7. Proposed Condition Shear Stresses

5 SITE DESIGN CONSTRAINTS

The primary site constraints are driven by the elevation of the surrounding site features and stormwater infrastructure. At the upstream end of the project limit, the incoming stormwater channel enters the park area in close proximity to townhomes with walkout basements at an elevation near the channel invert. This results in a vertical constraint to the upstream proposed channel elevation tie-in. The storm drain inlet at the downstream limits of the project sets the downstream tie in elevation and location. These controlling elevations determine the overall channel slope of the project.

The site is located within a forested riparian area with many understory trees and several mature canopy trees. Although impacts to the forest canopy are unavoidable, and in some cases desirable, the restoration approach will be developed to maintain sufficient canopy cover and minimize construction impacts to natural resources.

Construction access can be gained to the Project Area from two identified entrance points, but each has constraints. Both access points have been included on the plans so as to allow for flexibility during construction.

1. From the northwest, access is possible off Alabama Ave SE, via the Martin Luther King Jr Elementary School parking lot. An asphalt road off this parking lot is the main entrance to the Rec Center. Constraints posed by this access include bringing large equipment through a heavily used parking area, possible asphalt damage to the parking lot and Rec Center entrance, blocking a portion of public use of the Rec Center, and a long distance across turf fields to the Project Area. This access point is preferred if construction proceeds in the summer and the heavy traffic within this area no longer poses a constraint.
2. From the northeast, access is possible from what appears to be a private alley off 8th St SE that will require coordination and approval from with landowner. A section of chain link fence will be removed to enter park area. This entrance will require routing the access path around the baseball field but will be kept to the perimeter of the park area and reduce distance from roadway to Project Area.

Once access is gained into the wooded Project Area, access will be limited primarily to a narrow corridor along the existing channel to minimize impacts. Sufficient space for staging and stockpile area has been included on the plans along the northern fence line between the woods and the baseball field.

A possible sanitary sewer manhole was located onsite, but all initial indications are that it is not an active line. DC Water has confirmed it is not their asset, and DPR does not operate any sanitary sewers on their property. It may have been built during development of the area in anticipation of Savannah St being extended through the Project Area. Visual inspection from the surface indicates no evidence of an active sewer therefore, for the time being, this is not considered a site constraint.

Private property ownership of the residential homes along the south side of the channel may be a site constraint that limits the extent of work. The 100-year water surface elevation of the channel will increase as a result of the proposed improvements, but the increase will not result in hydraulic trespass onto any adjacent private properties.

6 PROPOSED DESIGN

The proposed design aims to meet the project goals through the installation of a Regenerative Storm Conveyance (RSC) design approach that safely conveys storm flows through the site while providing ecological and habitat improvements. Additionally, the proposed design includes upgrades to the existing trails along the channel.

6.1 Regenerative Stormwater Conveyance Approach

The Regenerative Stormwater Conveyance (RSC) restoration approach for this project is primarily focused on increasing the interaction between surface and groundwater flows and creating a broad, shallow flowpath for larger stormwater flows. Rather than restoring the channel at its current elevation, the proposed design is focused on raising the elevation of the channel bed to provide a connection with geomorphic surfaces that are currently suspended above and along the existing channel. Reconnection of the channel to these surfaces is important for both channel stability and ecological function in the degraded reach, as it reduces velocity and concentrated flows within the channel. This regenerative approach is appropriate for low-order stormwater-dominated channels that have become incised, like the ephemeral stormwater-dominated channel within this Project Area.

This approach raises the elevation of the channel bed throughout the deeper sections at the upstream end of the Project Area for approximately 210 linear feet, between 0 and 2.5 feet in depth depending on the degree of current channel incision. To achieve this, a significant volume of channel fill is required. To support the project's water quality goals of maximizing infiltration and filtration, fill material will be comprised mainly of imported clean sand mixed with wood chip material. To maximize conversion of surface flows to groundwater, a highly porous, imported sand material will be used as channel fill at the upstream end of the project where there is a vertical separation of the channel invert to the groundwater table. At the downstream end of the Project Area, along the steeper middle and flat lower sections, the use of on-site excavated materials generated from structure installation and bank grading, as channel fill may be considered to balance the cut/fill of the site. Here, because the groundwater appears to be near the surface, the use of imported sand is less critical to achieving a functioning system.

From a groundwater perspective, raising the channel invert may increase the groundwater elevation adjacent to the channel. Typically, groundwater flows laterally toward the stream channel. Raising the stream invert restores a subterranean reservoir of the riparian area while minimizing removal of riparian forest. With groundwater closer to the surface, wetland conditions may establish along the stream corridor by supporting wetland hydrology and thus supporting wetland soils and hydrophytic vegetation. In addition, an increased hydroperiod allows for more rapid establishment of native riparian vegetative communities, and suppression of non-native invasive species through development of a hydrologic regime outside of their normal tolerance range.

To minimize disturbance to surrounding native riparian communities, the proposed alignment generally follows the existing alignment with a few exceptions to improve planform geometry. Creation of lateral and vertical channel stability will be accomplished through construction of a series of broad and shallow rock riffles (typically 0.5' drop per riffle), pools, and boulder cascades at the downstream tie-in location (greater than 1' drop per cascade). These structures are designed to provide repetitive grade control along the project reach and convey large storm events.

In cross section, the proposed instream structures are sized and shaped to "nest" within the existing channel banks. Due to the low depth of flow and high roughness value associated with broad parabolic cross sections, the channel velocities will be slowed. Although sediment supply in the restored reach is expected to be low, the geometry promotes sediment deposition on the floodplain and the retention of carbon within the riparian system. The riffle structures also promote a diversity of in-stream habitat by forming short backwatered pools during stormflow conditions, thus maximizing hyporheic exchange.

6.2 Constructed Riffle and Cascade

A constructed riffle is an artificially steepened facet of the stream bed that is engineered with specific dimensions and profile to prevent channel degradation and promote development of specific hydraulic criteria. The riffle profile is typically roughened with coarse cobbles, boulders, and logs to slow the flow of water, and the cross-section is typically broad and shallow to increase flow width as flow increases, with minimal change in depth.

The design cross sections of the riffles are shaped to accommodate and spread storm flows across a broad, shallow area (approximately 1 foot deep and 24 feet wide) before expanding onto the adjacent floodplain. The two upstream most riffles drop 0.5 feet within the stream channel and the downstream most riffle drops 1 foot. The riffle cross-sections are designed to carry the combined 15-year storm flow from the two upstream drainage areas, Direct RSC DA and Neighborhood Inlet DA. Appendix D contains the typical static cross section design spreadsheets for the riffles. The location of each structure and their relative spacing is based on numerous factors in planform (e.g., tree saves, eroded hillslopes, valley topography, location of outfalls, pool size) and profile (e.g., existing knickpoints, locations/elevations of floodplain surfaces to reconnect to, elevation relative to adjacent upstream property).

At the downstream end of the project, two cascade structures (one 4-foot and one 6-foot drop) are necessary to safely convey storm flows from the elevated upstream channel to the existing storm drain inlet within an armored flowpath. The 4-foot drop structures will have a cross section approximately 1.5 feet deep and 20 feet wide and the 6-foot drop structures will have a cross section approximately 2 feet deep and 16 feet wide, appropriate dimensions to concentrate and safely convey large storm flows along an armored flowpath of the cascade down the steep slopes of the middle to lower reach. The cascade cross-sections are designed to carry the combined 100-year storm flow from all three Project Area drainage areas. Appendix D also contains the typical static cross section design spreadsheets for the cascades.

Immediately upstream of the existing storm drain inlet that serves as the outfall for the channel, an at-grade riffle will be constructed to convey flows efficiently to the outfall. This riffle will be constructed at the existing grade, with some minor grading adjustments at the upstream end to tie the structure into proposed elevations. The riffle will be approximately 1 foot deep and 12 feet wide, with an overall drop of 4 feet. The at-grade riffle cross-section is designed to carry the 2-year flow from all three Project Area drainage areas, with larger storm flows expanding into the proposed wetland area before returning to the existing stormdrain. The riffle will be constructed to minimize impacts to the surrounding proposed wetland area.

Riffle and cascade structures will incorporate locally quarried gravel and cobble sized material to provide general channel protection at structure locations with the use of boulders to create and maintain stable grade control. Existing native streambed material may be salvaged and incorporated into the constructed riffle structures. Riffles will also incorporate logs harvested on-site to provide additional channel protection.

Using Shield's equation and Ishbash curve, computations determined that 6-inch D50 sized bed material will be sufficient to provide armoring of the upstream riffle structures and 12-inch D50 sized bed material will be sufficient for the at-grade riffle structure at the maximum shear stress event, likely during smaller, frequent storm events when the energy slope is driven by the local facet slope of the structure. Preliminary computations suggest that the 4-foot drop and the 6-foot drop cascades will require a 30/70 mixture of Class II and Class III bed material.

6.2.1 Proposed Channel Typical Sections

The stream channel typical sections of the grade control structures are broken into four configurations that differ based on the steepness of the structure. Grade control structures elevations were driven by top of bank tie in locations, and steepness of the structures was driven by the valley slope. The dimensions and channel material sizing are described below. The overall design approach is to armor the full width of the existing channel to maximize flow width and minimize flow depth, thus reducing in-channel shear stress to maximum extent practicable. Due to the confined valley width and steepness, there is little opportunity to reconnect surface flows to a floodplain. Channel tie in elevation past the typical sections are set at the existing top of bank elevation to minimize grading and associated impacts. At one location (station 3+75 to station 4+00), a reinforced woody toe will be required due to a sharp bend in the alignment of the RSC.

- 0.5' Drop Riffle: 24' Wide x 1' Deep, Channel Bed Material D50 = 6". This grade control structure dimension is sized to convey the 15-year storm peak flow. Larger storms will expand onto the overbank riparian area. The proposed channel bed material is sized to be stable on storm events up to the 100-year storm peak flow.
- 1.0' Drop Riffle: 24' Wide x 1' Deep, Channel Bed Material D50 = 6". This grade control structure dimension is sized to convey the 15-year storm peak flow. Larger storms will expand onto the overbank riparian area. The proposed channel bed material is sized to be stable on storm events up to the 100-year storm peak flow.
- 4' Drop Cascade: 20' Wide x 1.5' Deep, Channel Bed Material D50 = 24". This grade control structure dimension is sized to convey the 100-year storm peak flow. The proposed channel bed material is sized to be stable on storm events up to the 100-year storm peak flow.
- 6' Drop Cascade: 16' Wide x 2.0' Deep, Channel Bed Material D50 = 24". This grade control structure dimension is sized to convey the 100-year storm peak flow. The proposed channel bed material is sized to be stable on storm events up to the 100-year storm peak flow.
- 4.0' Drop At-Grade Riffle: 12' Wide x 1' Deep, Channel Bed Material D50 = 12". This grade control structure dimension is sized to convey the 2-year storm peak flow. Larger storms will expand onto the overbank riparian area. The proposed channel bed material is sized to be stable on storm events up to the 100-year storm peak flow.

6.2.2 Proposed Channel Planform Alignment

The channel planform alignment generally follows the existing channel geometry, to minimize impacts to the adjacent riparian areas. This relatively straight planform is consistent with a steep B-type riffle-pool and/or step-pool dominated stream in narrow, moderately sloped valleys.

6.3 Downstream Sweetbay Magnolia Bog and Storm Drain Tie-In

Prior to the channel entering the closed storm drain system via the drop inlet, the downstream project limit on DPR property was re-evaluated based on updated topographic survey to allow for the establishment of a wetland area that could support Sweetbay Magnolia bog. Per the Oxon Run Watershed Implementation Plan, "*Prior to its development, the Oxon Run watershed contained some of*

the most unique ecosystems in the District and the region. This area is underlain by gravel terrace sediments that are highly acidic and composed of layers of well-drained gravel and sandy sediments over fine silt and clay layers. The underlying geology combined with rolling topography created an environment rich in springs and seeps, and composed of complex and diverse microecosystems. These micro-ecosystems provided habitat for a diversity of wildlife species, many dependent on these environments for food, forage, and breeding habitat. Remnants of these ecosystems still exist in the Oxon Run watershed. These remnants are part of an important network of protected habitats spanning the District and surrounding region that support species of greatest conservation need such as the wood duck, red shouldered hawk, brown thrasher, gray fox, opossum, flying squirrel, box turtle, painted turtle, and queen snake. This network of habitats is also vital for the support of populations of more common wildlife such as the sharp-shinned hawk, downy woodpecker, white-tailed deer, red fox, grey squirrel, and raccoon.

The largest remnant habitats are within the National Park Service (NPS) portion of Oxon Run Park and the NPS portion of Bald Eagle Hill Park. Oxon Run Park contains one of the rarest and most unique ecosystems in the region, the Sweetbay Magnolia bog. These bogs only occur in gravelly sediments along the fall line within northern Virginia, the District and Central Maryland where hilly terrain abuts floodplain bottomlands, and where the porous gravelly soil is underlain by restricting clay layers. These conditions create numerous seeps and springs that feed together and spread across the floodplain, creating an extremely acidic (pH 4-5), low nutrient, bog environment."

While reviewing the design, we identified a hillside seep that appears to provide sufficient hydrology to support this proposed bog area. To allow for sufficient bottomland space, we have refined the downstream structure locations. Further analysis of the underlying soils will be performed to confirm the gradation and pH of this area.

After flowing through the proposed bog, the stormwater will enter a maintained closed storm drain inlet that be cleaned of debris within the 25' easement area to ensure positive flow into the storm drain.

6.4 Landscape Plan

The site in its pre-construction state is a disturbed forest area with limited clearings, dominated by invasive vines and minimal native groundcover. Initial steps to control invasive plant species will be taken at the start of construction by application of herbicide through foliar spray, targeted application to cut stems, and spreading of woodchips from on-site trees after initial treatment. Treatment will include two additional applications of herbicide in the Spring and Fall during the one-year warranty.

The landscape plan proposes five planting approaches in response to the proposed hydrology, sunlight, and invasive species pressure.

1. Upland areas requiring grading or equipment access shall be planted with native trees, shrubs, and woodland meadow seed typical of the coastal plain regions. The chosen species provide rapid growth and germination, which is necessary to suppress invasive species after initial control measures are taken and invasive cover has been removed.
2. In upland area with preserved trees, woodchips shall be spread to 6-inch depth to smother vines after initial treatment and then shall interplanted with the same coastal plain tree and shrub plant community.
3. The RSC channel consists of woodland herbaceous and grass plugs proposed along the bed between riffles and maintain the central flow path clear of vegetation.

4. Near-edge slopes adjacent to the channel shall be interplanted with woodland floodplain shrub species.
5. The magnolia bog plant community is indicative of local populations of this habitat type. Soil testing will further inform the suitability of the species mix.

6.5 Trail Improvements

An informal footpath currently exists on both sides of the existing channel, connecting adjacent neighborhoods to Congress Heights Recreational Center. The informal trail will be retained in proposed conditions. An existing channel crossing will also be maintained along the top of a proposed riffle within the channel. The ability to cross the stream will remain possible due to two factors. The first is the raising of the channel bottom to within 1 or 2 feet of the top of bank elevation, thus eliminating the steep vertical slopes that are a pedestrian barrier under existing conditions. The second are large, flat boulders that sit several inches above the stream bottom and water level during typical base flows, which will act as "stepping stone" crossings at several riffles throughout the park. Increasing public access to waterways not only allows for recreation and varied walking paths; it also creates a shared sense of responsibility to protect these important natural environments.

7 Required Permits

For this project we anticipate the need for the following permits:

- US Army Corps of Engineers Section 404/401 due to impacts within regulated waterway – Based on project size, it should qualify for the Chesapeake Bay TMDL RGP Category II. This is a self-verifying authorization and work may commence without written notification from the Corp after submitting necessary forms and application.
- DCRA Building Permit for grading activity
- DOEE Sediment Control and Stormwater Management Review due to disturbance greater than 5,000 sq ft
- DOEE Water Quality Division due to construction within a stream
- DOEE Fisheries and Wildlife Division due to construction impacts to aquatic or terrestrial habitat
- DDOT Public Space Permit for construction access off a public right-of-way
- EPA NOI for the NPDES Construction Permit

For this project, we do not anticipate the need for the following permits:

- No SHPO archeological investigation because we are primarily building this project in fill. Any excavation that will be done is located in areas that have previously been excavated for utility work
- No FEMA reviews, as there is no work within a 100-year floodplain area
- No DCWater utility review, as there is not proposed modification to the DCWater storm drain structure at the downstream end of the project

8 Engineer's Estimate of Probable Construction Cost

The engineer's estimate of probable construction cost based on the semi-final design plans comes in on budget. Below is a breakdown of the construction estimate that is currently under review with Triangle Contracting and ER&M, the construction subcontractors contracted to implement the project.

- Construction Oversight/Management and Bonding = $39,200
- Mobilization/access/erosion and sediment control measures = $102,480
- RSC structures, media and related grading = $241,840
- Site improvements (landscaping, footpath, invasive species control) = $40,410
- **Total Cost = $423,930**

APPENDIX A. EXISTING CONDITIONS DOCUMENTATION

Photographic Log

Congress Heights- Existing Conditions
Site Photographs – December 11, 2018

Upstream extent facing upstream

Upstream extent facing downstream

Typical floodplain

Partial sediment obstructed RCP in stream channel on left bank

Congress Heights- Existing Conditions
Site Photographs – December 11, 2018


Debris jam facing downstream


Head cut from debris jam facing


Additional head cut facing upstream


Stream channel at footpath crossing

Congress Heights- Existing Conditions
Site Photographs – December 11, 2018

Rip rap outfall channel on right bank.
No outfall from bioretention facility located.

Sediment and debris obstructed inlet at downstream extent

Typical riparian condition at footpath

Sanitary sewer facing bioretention facility

Congress Heights- Existing Conditions
Site Photographs – December 11, 2018

Drainage Area Map

Drainage Area Map

Congress Heights
RSC
District of Columbia

Legend

- Drainage Area
- Tc Path
- Alignment
- Half Foot Contour
- Impervious
- Open Space

Land Use Type

- Tree Canopy
- Water
- Inlets
- Storm Drains

Alabama Ave SE
Wheeler Rd SE
7th St SE
Cornwell Dr SE

Direct RSC Drainage Area
DS Flow Drainage Area
Neighborhood Inlet Drainage Area

0 60 120
Feet

N

Biohabitats

December 2018

Document Path: W:\GIS\PROJECTS\18030.01 DOEE 3 Design-Build LID Sites\MXD\Analysis\Congress Heights DA.mxd

Wetland Determination Data Forms

Congress
In channel Soil Profile.

WETLAND DETERMINATION DATA FORM – Atlantic and Gulf Coastal Plain Region

Project/Site: Congress Heights City/County: Washington DC Sampling Date: 12/11/18
Applicant/Owner: District of Columbia State: DC Sampling Point: Plot X
Investigator(s): J. Reagan / B. Salladin Section, Township, Range: Congress Heights
Landform (hillslope, terrace, etc.): Stream channel Local relief (concave, convex, none): Concave Slope (%): 2
Subregion (LRR or MLRA): MLRA 149A Lat: _____ Long: _____ Datum: _____
Soil Map Unit Name: Udorthents (Ud) NWI classification: None
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)
Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No _____
Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ___ No ✓	Is the Sampled Area within a Wetland? Stream Channel (WUS) Yes ___ No ✓
Hydric Soil Present?	Yes ___ No ✓	
Wetland Hydrology Present?	Yes ✓ No ___	

Remarks:
In stream channel. (ephemeral?) dry bed.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ✓ High Water Table (A2)
- ✓ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ✓ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15) **(LRR U)**
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ✓ Sparsely Vegetated Concave Surface (B8)
- ✓ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ✓ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present?	Yes ___	No ✓	Depth (inches): ___
Water Table Present?	Yes ✓	No ___	Depth (inches): 10
Saturation Present? (includes capillary fringe)	Yes ✓	No ___	Depth (inches): 6

Ephemeral Stream Channel

Wetland Hydrology Present? Yes ___ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

N/A.
Sample Plot taken to Characterize Soil Profile within ephemeral stream channel

VEGETATION (Four Strata) – Use scientific names of plants.

Sampling Point: Plot X

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Elm	35		
2. Cotton Wood	35		
3.			
4.			
5.			
6.			
7.			
8.			
	= Total Cover		

50% of total cover: _____ 20% of total cover: _____

Sapling/Shrub Stratum (Plot size: 30')			
1. Elm	20		
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	= Total Cover		

50% of total cover: _____ 20% of total cover: _____

Herb Stratum (Plot size: 30')			
1. Ivy on Slopes adjacent			
2.			
3.			
4. N/A			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	= Total Cover		

50% of total cover: _____ 20% of total cover: _____

Woody Vine Stratum (Plot size: 30')			
1. N/A			
2.			
3.			
4.			
5.			
	= Total Cover		

50% of total cover: _____ 20% of total cover: _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: _____ (A)

Total Number of Dominant Species Across All Strata: _____ (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: _____ (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes _____ No _____

Remarks: (If observed, list morphological adaptations below).

N/A

Congress Heights

SOIL

Sampling Point: Plot X

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-6	10 YR 2/1	100					Sil	
6-12	10 YR 3/2	80	7.5YR 5/6	20	C	M	Sil	
12+	7.5YR 5/6	75	7.5YR 5/1	25	D	M	SCl	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Organic Bodies (A6) **(LRR P, T, U)**
- ___ 5 cm Mucky Mineral (A7) **(LRR P, T, U)**
- ___ Muck Presence (A8) **(LRR U)**
- ___ 1 cm Muck (A9) **(LRR P, T)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Coast Prairie Redox (A16) **(MLRA 150A)**
- ___ Sandy Mucky Mineral (S1) **(LRR O, S)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) **(LRR P, S, T, U)**
- ___ Polyvalue Below Surface (S8) **(LRR S, T, U)**
- ___ Thin Dark Surface (S9) **(LRR S, T, U)**
- ___ Loamy Mucky Mineral (F1) **(LRR O)**
- ___ Loamy Gleyed Matrix (F2)
- ✓ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) **(LRR U)**
- ___ Depleted Ochric (F11) **(MLRA 151)**
- ___ Iron-Manganese Masses (F12) **(LRR O, P, T)**
- ___ Umbric Surface (F13) **(LRR P, T, U)**
- ___ Delta Ochric (F17) **(MLRA 151)**
- ___ Reduced Vertic (F18) **(MLRA 150A, 150B)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 149A)**
- ___ Anomalous Bright Loamy Soils (F20) **(MLRA 149A, 153C, 153D)**

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) **(LRR O)**
- ___ 2 cm Muck (A10) **(LRR S)**
- ___ Reduced Vertic (F18) **(outside MLRA 150A,B)**
- ___ Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- ___ Anomalous Bright Loamy Soils (F20) **(MLRA 153B)**
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ___

Depth (inches): ___

Hydric Soil Present? Yes ✓ No ___

Remarks:

N/A

12/11/18
JR/BS

Congress

WETLAND DETERMINATION DATA FORM – Atlantic and Gulf Coastal Plain Region

Project/Site: Congress Heights City/County: Washington DC Sampling Date: 12/11/18
Applicant/Owner: District of Columbia State: D.C Sampling Point: Plot 1
Investigator(s): J. Reagan / B. Salladin Section, Township, Range: Congress Heights
Landform (hillslope, terrace, etc.): Floodplain. Local relief (concave, convex, none): None - Slope (%): 3
Subregion (LRR or MLRA): MLRA 149A Lat: Long: Datum:
Soil Map Unit Name: Udorthents (U1) NWI classification: None.
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ___ (If no, explain in Remarks.)
Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No ___
Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ___	No ✓	**Is the Sampled Area within a Wetland?** Yes ___ No ✓
Hydric Soil Present?	Yes ___	No ✓	
Wetland Hydrology Present?	Yes ___	No ✓	

Remarks:
Sample plot is representative of floodplain characteristics within entire project area.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15) **(LRR U)**
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ✓ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present?	Yes ___	No ✓	Depth (inches): ___
Water Table Present?	Yes ___	No ✓	Depth (inches): ___
Saturation Present? (includes capillary fringe)	Yes ___	No ✓	Depth (inches): ___

Wetland Hydrology Present? Yes ___ No ✓

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
No hydrology indicators present

Congress

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: Plot 1

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Elm	40	Y	FAC
2. Black Locust	40	Y	UPL
3.			
4.			
5.			
6.			
7.			
8.			
	80 = Total Cover		
50% of total cover: 40	20% of total cover: 16		
Sapling/Shrub Stratum (Plot size: 30')			
1. Elm.	25	Y	FAC
2. Bush honeysuckle	15	Y	FACU
3.			
4.			
5.			
6.			
7.			
8.			
	40 = Total Cover		
50% of total cover: 20	20% of total cover: 8		
Herb Stratum (Plot size: 30')			
1. English Ivy	90	Y	FACU
2. Japanese honeysuckle	5	N	FACU
3. Black Oak 12" Sapling.	1	N	FACU
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	96 = Total Cover		
50% of total cover: 48	20% of total cover: 19		
Woody Vine Stratum (Plot size: 30')			
1. English Ivy.	5	Y	FACU
2.			
3.			
4.			
5.			
	5 = Total Cover		
50% of total cover: 2.5	20% of total cover: 1		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33% (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ___ No ✓

Remarks: (If observed, list morphological adaptations below).

grape and poison ivy vines present but have been cut. None living.

Congress Heights

SOIL

Sampling Point: Plot 1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-2	10YR 3/2	100	N/A				Sil	w/ Rubble
2-6	10YR 4/6	100	N/A				SiCl	small gravel & rock
6-18	10YR 4/2	100	N/A				Sil	more gravel, higher sand content

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Organic Bodies (A6) **(LRR P, T, U)**
- ___ 5 cm Mucky Mineral (A7) **(LRR P, T, U)**
- ___ Muck Presence (A8) **(LRR U)**
- ___ 1 cm Muck (A9) **(LRR P, T)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Coast Prairie Redox (A16) **(MLRA 150A)**
- ___ Sandy Mucky Mineral (S1) **(LRR O, S)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) **(LRR P, S, T, U)**
- ___ Polyvalue Below Surface (S8) **(LRR S, T, U)**
- ___ Thin Dark Surface (S9) **(LRR S, T, U)**
- ___ Loamy Mucky Mineral (F1) **(LRR O)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) **(LRR U)**
- ___ Depleted Ochric (F11) **(MLRA 151)**
- ___ Iron-Manganese Masses (F12) **(LRR O, P, T)**
- ___ Umbric Surface (F13) **(LRR P, T, U)**
- ___ Delta Ochric (F17) **(MLRA 151)**
- ___ Reduced Vertic (F18) **(MLRA 150A, 150B)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 149A)**
- ___ Anomalous Bright Loamy Soils (F20) **(MLRA 149A, 153C, 153D)**

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) **(LRR O)**
- ___ 2 cm Muck (A10) **(LRR S)**
- ___ Reduced Vertic (F18) **(outside MLRA 150A,B)**
- ___ Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- ___ Anomalous Bright Loamy Soils (F20) **(MLRA 153B)**
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ___ No ✓

Remarks:

No hydric soil indicators present

Lots of rubble and debris in soil profile.

Geomorphology Data Forms

Cross Sectional Dimension

This Worksheet:

1) Start by entering the sections "Reference ID" used on the profile sheet.

2) Entering surveyed values for "Distance" and "FS" in the worksheets to the right.

3) The "BS" column can be ignored unless the instrument was moved in the midst of surveying a cross section, in which case a turning point FS and BS are entered.

4) The spreadsheet provides values inferred from the data entered however these should be checked. Values entered take precedence.

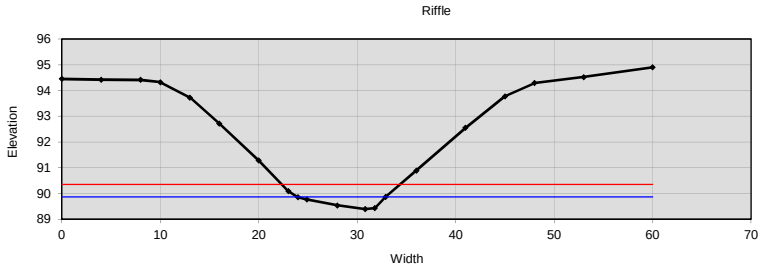
Reach:		min	max
slope (%)	0.041		
discharge rate	1		
width flood prone area	12.0	---	---
low bank height		---	---

Riffle - Run:		min	max
x-area bankfull	2.6	---	---
width bankfull	9.0	---	---
mean depth	0.29	---	---
max depth	0.5	---	---
hydraulic radius	0.3		
width depth ratio	31.0	---	---

Pool:		min	max
x-area pool			
width pool			
max depth pool			
hydraulic radius			

Reference Reach | hints

Cross Section 1



Bankfull Dimensions	
2.6	x-section area (ft.sq.)
9.0	width (ft)
0.3	mean depth (ft)
0.5	max depth (ft)
9.1	wetted parimeter (ft)
0.3	hyd radi (ft)
31.0	width-depth ratio

Flood Dimensions	
12.0	W flood prone area (ft)
1.3	entrenchment ratio
---	low bank height (ft)
---	low bank height ratio

Materials	
---	D50 (mm)
---	D84 (mm)
0	threshold grain size (mm):

Bankfull Flow	
0.3	velocity (ft/s)
0.7	discharge rate (cfs)
0.09	Froude number

Flow Resistance	
0.050	Manning's roughness
0.44	D'Arcy-Weisbach fric.
---	resistance factor u/u*
---	relative roughness

Forces & Power	
0.041	channel slope (%)
0.01	shear stress (lb/sq.ft.)
0.06	shear velocity (ft/s)
0.002	unit strm power (lb/ft/s)

Cross Section

reference ID	1	
instrument height	100	---
longitudinal station		---

Bankfull Stage

FS	10.13	= 89.87 elev
elevation		---

Low Bank Height

FS		---
elevation		

Flood Prone Area

width fpa		12.0

Channel Slope

percent slope	0.041	---

Flow Resistance

Manning's "n"	0.05	---
D'Arcy - Weisbach "f"		---

Note:

Estimated channel slope from GIS contours, XS located just DS of LB outfall

Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bkf	Notes
0		100	5.55	94.45	☐	EOP
4		100	5.58	94.42	☐	
8		100	5.59	94.41	☐	
10		100	5.68	94.32	☐	LTOB
13		100	6.28	93.72	☐	
16		100	7.29	92.71	☐	
20		100	8.72	91.28	☐	
23		100	9.91	90.09	☐	
24		100	10.15	89.85	☐	LBOB
24.9		100	10.24	89.76	☐	LEOW
28		100	10.47	89.53	☐	
30.8		100	10.61	89.39	☐	TWG
31.8		100	10.57	89.43	☐	REOW/RB
32.9		100	10.13	89.87	☐	BF
36		100	9.11	90.89	☐	
41		100	7.45	92.55	☐	
45		100	6.23	93.77	☐	RTOB
48		100	5.71	94.29	☐	
53		100	5.48	94.52	☐	
60		100	5.1	94.9	☐	
					☐	
					☐	
					☐	
					☐	
					☐	
					☐	
					☐	

Rapid Bioassessment Data Forms

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME Un name'd Trib.	LOCATION Congress Heights Rec. Center
STATION #_____ RIVERMILE_____	STREAM CLASS Ephemeral
LAT _____ LONG _____	RIVER BASIN Potomac River
STORET #	AGENCY
INVESTIGATORS JR / BS.	
FORM COMPLETED BY J. Reagan	DATE 12/11/18 TIME 13:43 AM (PM)
REASON FOR SURVEY Existing Conditions	

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 7	20 19 18 17 16	15 14 13 12 11	10 9 8 (7) 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE 6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 (6)	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE 1	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 (1) 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 5	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	(5) 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 1	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 (1) 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 12	20 19 18 17 16	15 14 13 (12) 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE 4	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 (4) 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 4 (LB)	Left Bank 10 9	8 7 6	5 (4) 3	2 1 0
SCORE 4 (RB)	Right Bank 10 9	8 7 6	5 (4) 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 3 (LB)	Left Bank 10 9	8 7 6	5 4 (3)	2 1 0
SCORE 3 (RB)	Right Bank 10 9	8 7 6	5 4 (3)	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 3 (LB)	Left Bank 10 9	8 7 6	5 4 (3)	2 1 0
SCORE 3 (RB)	Right Bank 10 9	8 7 6	5 4 (3)	2 1 0

Total Score 56

APPENDIX B. NRCS SOIL SURVEY DATA

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: District of Columbia
Survey Area Data: Version 12, Sep 10, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 3, 2015—Feb 22, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BdB	Beltsville silt loam, 0 to 8 percent slopes	6.9	17.3%
BeB	Beltsville-Urban land complex, 0 to 8 percent slopes	16.8	42.2%
CdC	Chillum-Urban land complex, 8 to 15 percent slopes	1.2	3.1%
CeC	Christiana silt loam, 8 to 15 percent slopes	0.1	0.1%
CeD	Christiana silt loam, 15 to 40 percent slopes	0.9	2.1%
CwD	Croom very gravelly sandy loam, 15 to 40 percent slopes	2.3	5.8%
U1	Udorthents	1.6	4.1%
Ub	Urban land	3.9	9.7%
UcB	Urban land-Beltsville complex, 0 to 8 percent slopes	6.2	15.5%
Totals for Area of Interest		**39.8**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas

are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

District of Columbia

BdB—Beltsville silt loam, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 49s8
Elevation: 80 to 650 feet
Mean annual precipitation: 35 to 55 inches
Mean annual air temperature: 48 to 61 degrees F
Frost-free period: 160 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Beltsville and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Beltsville

Typical profile

H1 - 0 to 14 inches: silt loam
H2 - 14 to 25 inches: silt loam
H3 - 25 to 50 inches: silt loam
H4 - 50 to 72 inches: sandy loam

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 20 to 40 inches to fragipan
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

BeB—Beltsville-Urban land complex, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 49s9
Elevation: 10 to 650 feet
Mean annual precipitation: 30 to 55 inches
Mean annual air temperature: 45 to 64 degrees F
Frost-free period: 160 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 40 percent
Beltsville and similar soils: 40 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Landform: Flats

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: No

Description of Beltsville

Typical profile

H1 - 0 to 14 inches: silt loam
H2 - 14 to 25 inches: silt loam
H3 - 25 to 50 inches: silt loam
H4 - 50 to 72 inches: sandy loam

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 20 to 40 inches to fragipan
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Sassafras

Percent of map unit: 5 percent
Hydric soil rating: No

Bourne

Percent of map unit: 5 percent
Hydric soil rating: No

Chillum

Percent of map unit: 5 percent
Hydric soil rating: No

Matapeake

Percent of map unit: 5 percent
Hydric soil rating: No

CdC—Chillum-Urban land complex, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 49sr
Elevation: 20 to 370 feet
Mean annual precipitation: 30 to 55 inches
Mean annual air temperature: 45 to 61 degrees F
Frost-free period: 160 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Chillum and similar soils: 40 percent
Urban land: 40 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chillum

Typical profile

A - 0 to 2 inches: silt loam
E - 2 to 9 inches: gravelly loam
Bt1 - 9 to 12 inches: gravelly loam
Bt2 - 12 to 24 inches: clay loam
2BC - 24 to 34 inches: loamy sand
3C - 34 to 72 inches: gravelly silty clay loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Urban Land

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 10 inches to
Runoff class: Very high

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: No

Minor Components

Bourne

Percent of map unit: 5 percent
Hydric soil rating: No

Croom

Percent of map unit: 5 percent
Hydric soil rating: No

Sassafras

Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed soils

Percent of map unit: 5 percent
Hydric soil rating: No

CeC—Christiana silt loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 49sv
Elevation: 150 to 350 feet
Mean annual precipitation: 40 to 46 inches
Mean annual air temperature: 50 to 57 degrees F
Frost-free period: 170 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Christiana and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Christiana

Typical profile

H1 - 0 to 10 inches: silt loam
H2 - 10 to 75 inches: silty clay

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.57 in/hr)
Depth to water table: More than 80 inches

Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Hydric soil rating: No

CeD—Christiana silt loam, 15 to 40 percent slopes

Map Unit Setting

National map unit symbol: 49sw
Elevation: 150 to 350 feet
Mean annual precipitation: 40 to 46 inches
Mean annual air temperature: 50 to 57 degrees F
Frost-free period: 170 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Christiana and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Christiana

Typical profile

H1 - 0 to 10 inches: silt loam
H2 - 10 to 75 inches: silty clay

Properties and qualities

Slope: 15 to 40 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Hydric soil rating: No

CwD—Croom very gravelly sandy loam, 15 to 40 percent slopes

Map Unit Setting

National map unit symbol: 49t4
Elevation: 20 to 370 feet
Mean annual precipitation: 30 to 46 inches
Mean annual air temperature: 46 to 59 degrees F
Frost-free period: 160 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Croom and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Croom

Typical profile

Ap1 - 0 to 1 inches: very gravelly sandy loam
Ap2 - 1 to 9 inches: loam
Bt1 - 9 to 13 inches: very gravelly clay loam
Bt2 - 13 to 30 inches: extremely gravelly sandy clay loam
Bt3 - 30 to 54 inches: extremely gravelly sandy clay loam
BCt - 54 to 66 inches: extremely gravelly sandy clay loam
BC - 66 to 80 inches: extremely gravelly coarse sandy loam

Properties and qualities

Slope: 15 to 40 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Hydric soil rating: No

U1—Udorthents

Map Unit Composition

Udorthents and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Properties and qualities

Slope: 0 to 10 percent
Depth to restrictive feature: 10 inches to
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: No

Ub—Urban land

Map Unit Setting

National map unit symbol: 49wq
Frost-free period: 175 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 10 inches to
Runoff class: Very high

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: No

UcB—Urban land-Beltsville complex, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 49wr
Elevation: 20 to 650 feet
Mean annual precipitation: 30 to 55 inches
Mean annual air temperature: 45 to 61 degrees F
Frost-free period: 160 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 70 percent
Beltsville and similar soils: 10 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 10 inches to
Runoff class: Very high

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: No

Description of Beltsville

Typical profile

H1 - 0 to 14 inches: silt loam
H2 - 14 to 25 inches: silt loam
H3 - 25 to 50 inches: silt loam
H4 - 50 to 72 inches: sandy loam

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 20 to 40 inches to fragipan
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Chillum

Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed soils

Percent of map unit: 5 percent
Hydric soil rating: No

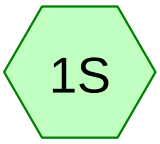
Sassafras

Percent of map unit: 5 percent
Hydric soil rating: No

Bourne

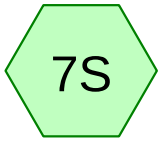
Percent of map unit: 5 percent
Hydric soil rating: No

APPENDIX C. HYDROLOGIC ANALYSIS

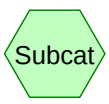


Congress Heights Direct RSC

Congress Heights Neighborhood Inlet



Congress Heights DS Flows



Drainage Diagram for Congress Heights
Prepared by Biohabitats Inc., Printed 12/11/2018

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.904	77	Woods, Poor, HSG C (1S, 2S, 7S)
4.005	79	50-75% Grass cover, Fair, HSG C (1S, 2S, 7S)
1.710	83	Woods, Poor, HSG D (1S, 2S, 7S)
0.546	84	50-75% Grass cover, Fair, HSG D (1S, 2S, 7S)
4.817	98	Paved parking, HSG C (1S, 2S, 7S)
1.380	98	Paved parking, HSG D (1S, 2S, 7S)
14.362		**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
10.726	HSG C	1S, 2S, 7S
3.636	HSG D	1S, 2S, 7S
0.000	Other	
14.362		**TOTAL AREA**

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Fill (inches)
1	2S	0.00	0.00	99.0	0.0100	0.025	18.0	0.0	3.0

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Congress Heights Direct Runoff Area=6.265 ac 49.35% Impervious Runoff Depth>1.41"
Flow Length=564' Tc=6.0 min CN=89 Runoff=16.17 cfs 0.734 af

Subcatchment 2S: Congress Heights Runoff Area=1.980 ac 56.01% Impervious Runoff Depth>1.48"
Flow Length=357' Tc=5.1 min CN=90 Runoff=5.55 cfs 0.245 af

Subcatchment 7S: Congress Heights DS Runoff Area=6.117 ac 32.63% Impervious Runoff Depth>1.13"
Flow Length=383' Tc=15.7 min CN=85 Runoff=9.46 cfs 0.576 af

Total Runoff Area = 14.362 ac Runoff Volume = 1.555 af Average Runoff Depth = 1.30"
56.85% Pervious = 8.165 ac 43.15% Impervious = 6.197 ac

Summary for Subcatchment 1S: Congress Heights Direct RSC

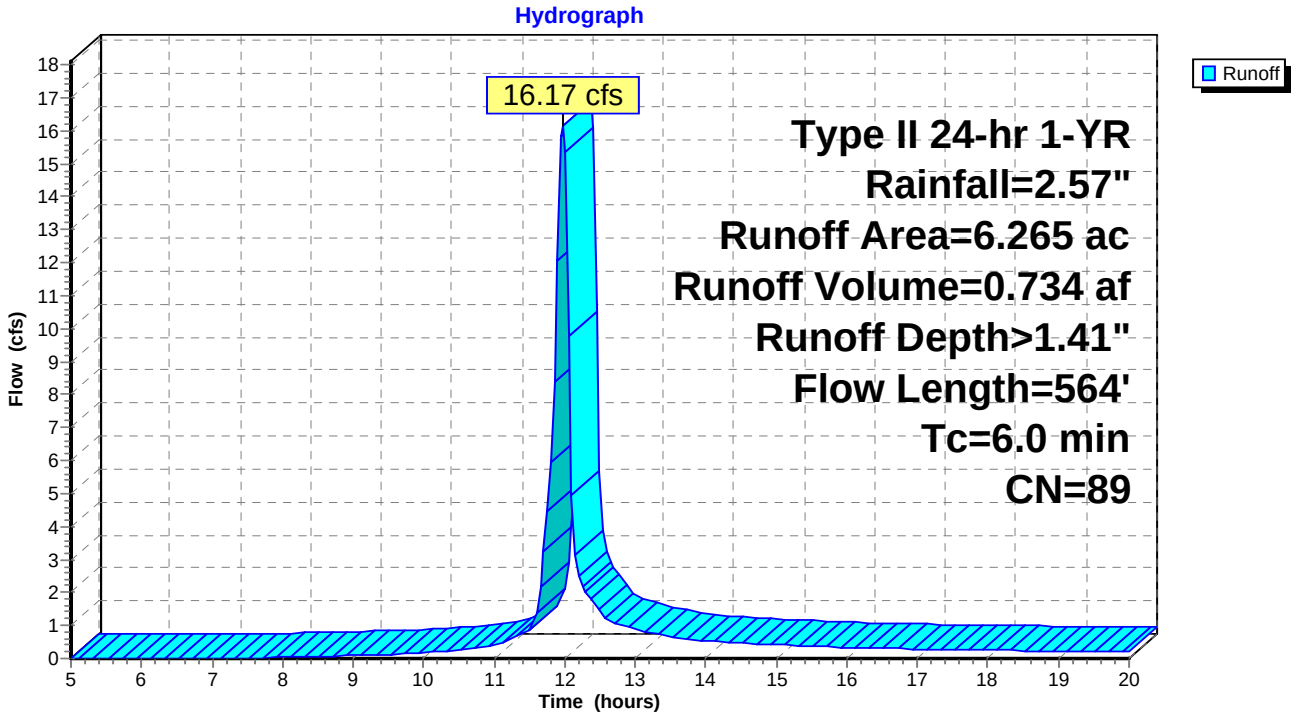
Runoff = 16.17 cfs @ 11.97 hrs, Volume= 0.734 af, Depth> 1.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-YR Rainfall=2.57"

Area (ac)	CN	Description
1.522	79	50-75% Grass cover, Fair, HSG C
0.217	84	50-75% Grass cover, Fair, HSG D
2.797	98	Paved parking, HSG C
0.295	98	Paved parking, HSG D
0.263	77	Woods, Poor, HSG C
1.171	83	Woods, Poor, HSG D
6.265	89	Weighted Average
3.173		50.65% Pervious Area
3.092		49.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	100	0.0074	0.92		**Sheet Flow, Sheet Flow- Paved Road** Smooth surfaces n= 0.011 P2= 3.17"
1.5	164	0.0076	1.77		**Shallow Concentrated Flow, Shallow Conc - Paved** Paved Kv= 20.3 fps
2.7	300	0.0067	1.86	5.94	**Channel Flow, Grassed Channel** Area= 3.2 sf Perim= 8.2' r= 0.39' n= 0.035 Earth, dense weeds
6.0	564	Total			

Subcatchment 1S: Congress Heights Direct RSC



Summary for Subcatchment 2S: Congress Heights Neighborhood Inlet

[49] Hint: Tc<2dt may require smaller dt

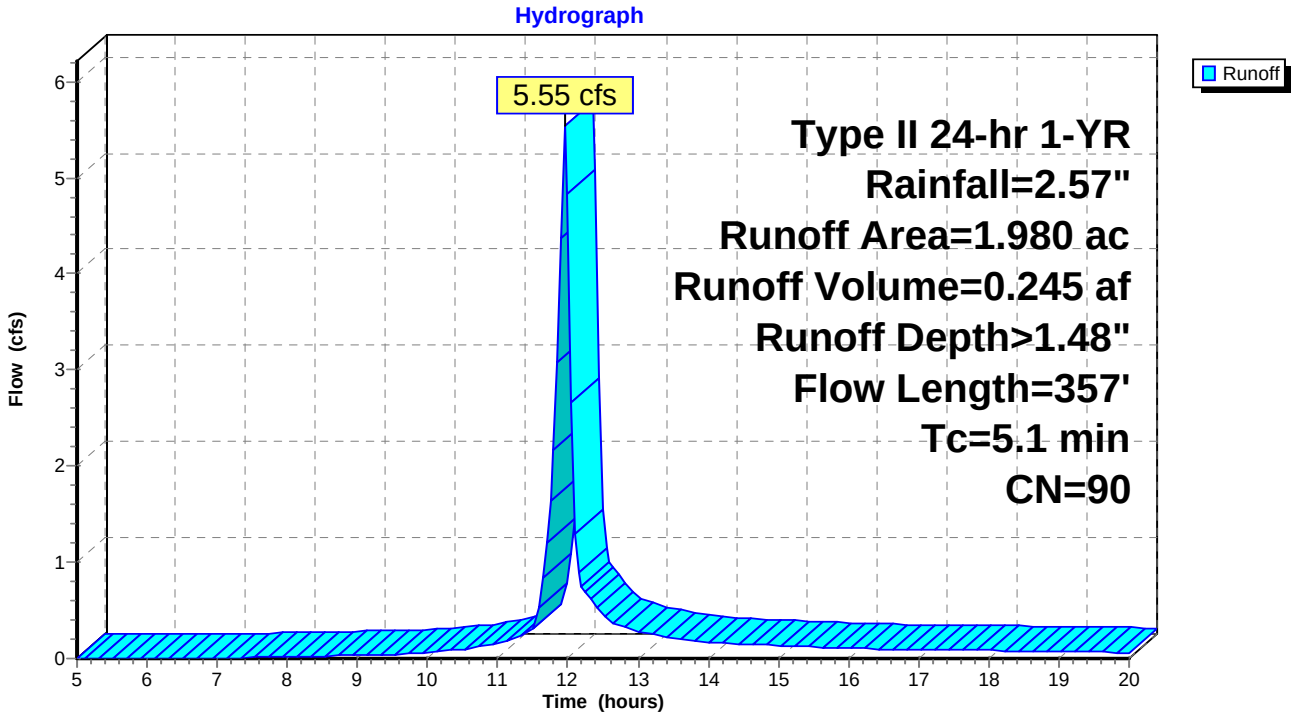
Runoff = 5.55 cfs @ 11.96 hrs, Volume= 0.245 af, Depth> 1.48"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-YR Rainfall=2.57"

Area (ac)	CN	Description
0.439	79	50-75% Grass cover, Fair, HSG C
0.026	84	50-75% Grass cover, Fair, HSG D
0.847	98	Paved parking, HSG C
0.262	98	Paved parking, HSG D
0.301	77	Woods, Poor, HSG C
0.105	83	Woods, Poor, HSG D
1.980	90	Weighted Average
0.871		43.99% Pervious Area
1.109		56.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	100	0.0025	0.60		**Sheet Flow, Sheet Flow- Paved Lot** Smooth surfaces n= 0.011 P2= 3.17"
0.4	42	0.0060	1.57		**Shallow Concentrated Flow, Shallow Conc - Paved** Paved Kv= 20.3 fps
1.3	116	0.0043	1.48	0.89	**Channel Flow, Curb and Gutter** Area= 0.6 sf Perim= 5.0' r= 0.12' n= 0.016 Asphalt, rough
0.6	99	0.0100	2.92	4.60	**Pipe Channel, Pipe Flow** 18.0" Round w/ 3.0" fill Area= 1.6 sf Perim= 4.6' r= 0.34' n= 0.025 Corrugated metal
5.1	357	Total			

Subcatchment 2S: Congress Heights Neighborhood Inlet



Summary for Subcatchment 7S: Congress Heights DS Flows

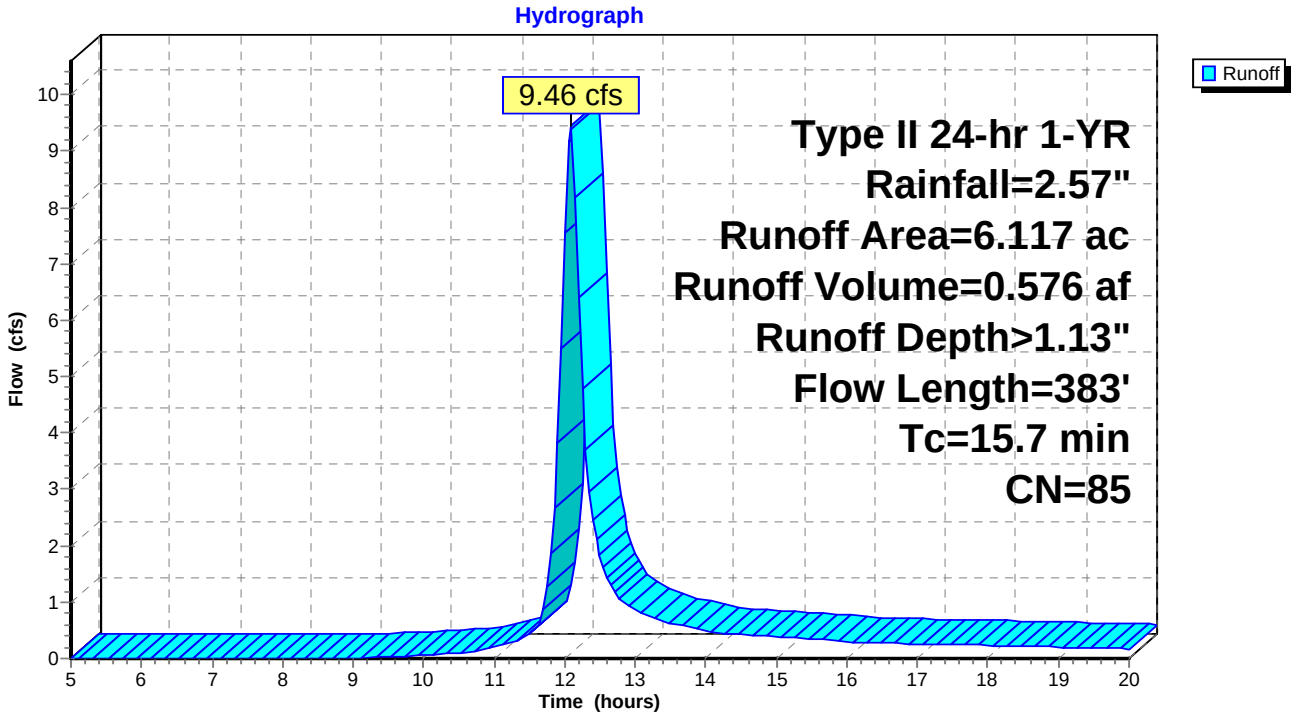
Runoff = 9.46 cfs @ 12.08 hrs, Volume= 0.576 af, Depth> 1.13"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-YR Rainfall=2.57"

Area (ac)	CN	Description
2.044	79	50-75% Grass cover, Fair, HSG C
0.303	84	50-75% Grass cover, Fair, HSG D
1.173	98	Paved parking, HSG C
0.823	98	Paved parking, HSG D
1.340	77	Woods, Poor, HSG C
0.434	83	Woods, Poor, HSG D
6.117	85	Weighted Average
4.121		67.37% Pervious Area
1.996		32.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.8	100	0.0104	0.13		**Sheet Flow, Sheet Flow- Baseball Field** Grass: Short n= 0.150 P2= 3.17"
2.6	200	0.0065	1.30		**Shallow Concentrated Flow, Shallow Conc - Baseball Field** Unpaved Kv= 16.1 fps
0.3	83	0.0300	4.01	13.23	**Channel Flow, Grassed Channel** Area= 3.3 sf Perim= 8.2' r= 0.40' n= 0.035 Earth, dense weeds
15.7	383	Total			

Subcatchment 7S: Congress Heights DS Flows



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Congress Heights Direct Runoff Area=6.265 ac 49.35% Impervious Runoff Depth>1.86"
Flow Length=564' Tc=6.0 min CN=89 Runoff=21.10 cfs 0.972 af

Subcatchment 2S: Congress Heights Runoff Area=1.980 ac 56.01% Impervious Runoff Depth>1.95"
Flow Length=357' Tc=5.1 min CN=90 Runoff=7.17 cfs 0.321 af

Subcatchment 7S: Congress Heights DS Runoff Area=6.117 ac 32.63% Impervious Runoff Depth>1.55"
Flow Length=383' Tc=15.7 min CN=85 Runoff=12.90 cfs 0.789 af

Total Runoff Area = 14.362 ac Runoff Volume = 2.082 af Average Runoff Depth = 1.74"
56.85% Pervious = 8.165 ac 43.15% Impervious = 6.197 ac

Summary for Subcatchment 1S: Congress Heights Direct RSC

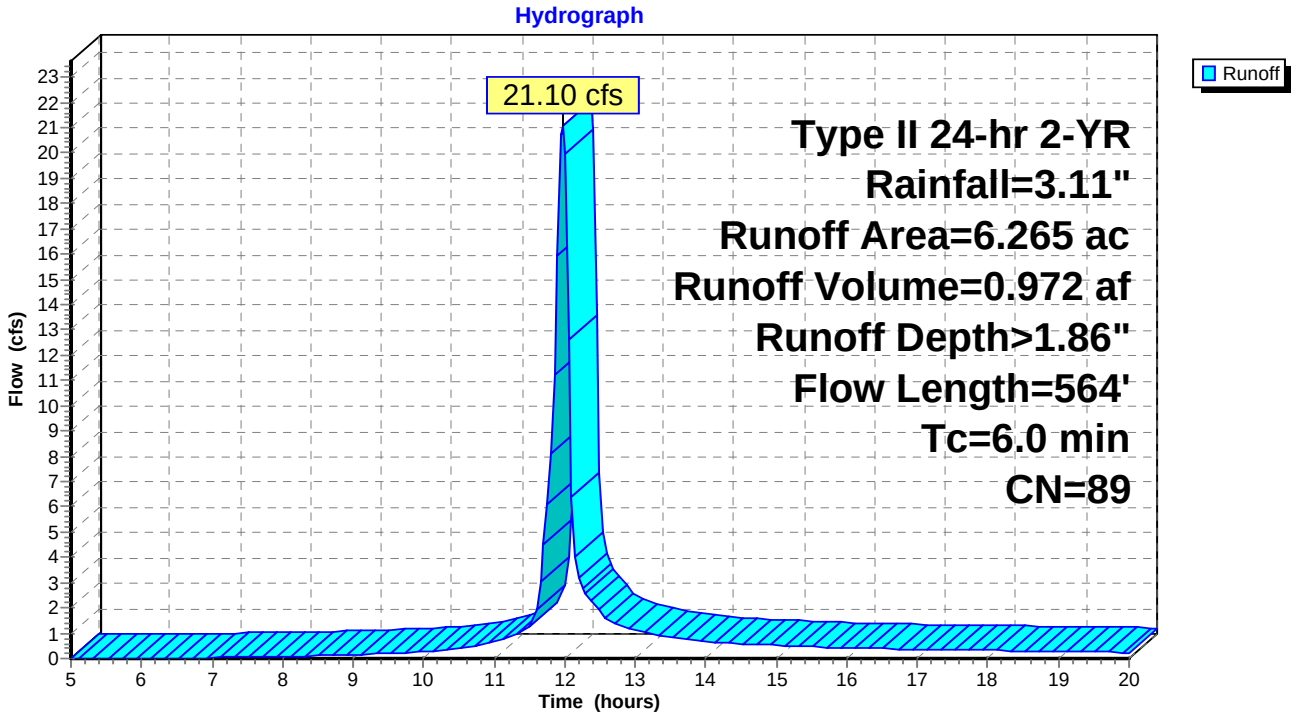
Runoff = 21.10 cfs @ 11.97 hrs, Volume= 0.972 af, Depth> 1.86"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YR Rainfall=3.11"

Area (ac)	CN	Description
1.522	79	50-75% Grass cover, Fair, HSG C
0.217	84	50-75% Grass cover, Fair, HSG D
2.797	98	Paved parking, HSG C
0.295	98	Paved parking, HSG D
0.263	77	Woods, Poor, HSG C
1.171	83	Woods, Poor, HSG D
6.265	89	Weighted Average
3.173		50.65% Pervious Area
3.092		49.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	100	0.0074	0.92		**Sheet Flow, Sheet Flow- Paved Road** Smooth surfaces n= 0.011 P2= 3.17"
1.5	164	0.0076	1.77		**Shallow Concentrated Flow, Shallow Conc - Paved** Paved Kv= 20.3 fps
2.7	300	0.0067	1.86	5.94	**Channel Flow, Grassed Channel** Area= 3.2 sf Perim= 8.2' r= 0.39' n= 0.035 Earth, dense weeds
6.0	564	Total			

Subcatchment 1S: Congress Heights Direct RSC



Summary for Subcatchment 2S: Congress Heights Neighborhood Inlet

[49] Hint: Tc<2dt may require smaller dt

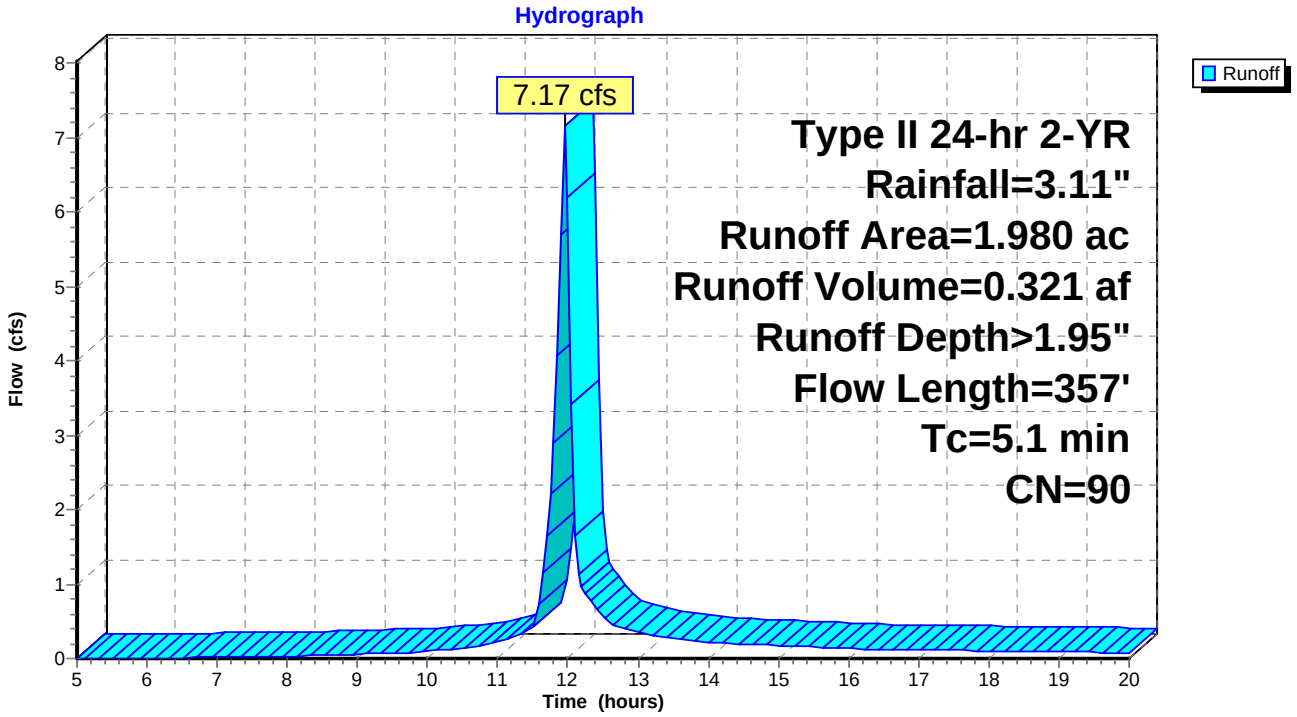
Runoff = 7.17 cfs @ 11.96 hrs, Volume= 0.321 af, Depth> 1.95"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YR Rainfall=3.11"

Area (ac)	CN	Description
0.439	79	50-75% Grass cover, Fair, HSG C
0.026	84	50-75% Grass cover, Fair, HSG D
0.847	98	Paved parking, HSG C
0.262	98	Paved parking, HSG D
0.301	77	Woods, Poor, HSG C
0.105	83	Woods, Poor, HSG D
1.980	90	Weighted Average
0.871		43.99% Pervious Area
1.109		56.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	100	0.0025	0.60		**Sheet Flow, Sheet Flow- Paved Lot** Smooth surfaces n= 0.011 P2= 3.17"
0.4	42	0.0060	1.57		**Shallow Concentrated Flow, Shallow Conc - Paved** Paved Kv= 20.3 fps
1.3	116	0.0043	1.48	0.89	**Channel Flow, Curb and Gutter** Area= 0.6 sf Perim= 5.0' r= 0.12' n= 0.016 Asphalt, rough
0.6	99	0.0100	2.92	4.60	**Pipe Channel, Pipe Flow** 18.0" Round w/ 3.0" fill Area= 1.6 sf Perim= 4.6' r= 0.34' n= 0.025 Corrugated metal
5.1	357	Total			

Subcatchment 2S: Congress Heights Neighborhood Inlet



Summary for Subcatchment 7S: Congress Heights DS Flows

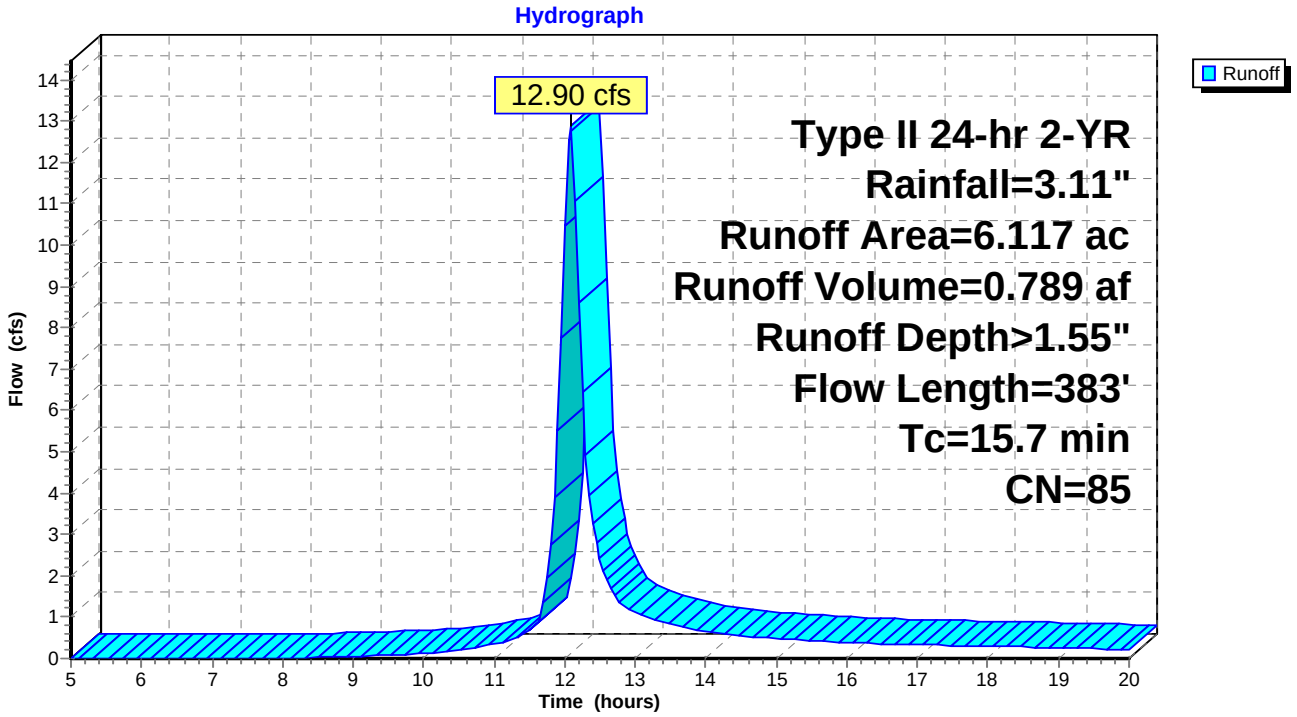
Runoff = 12.90 cfs @ 12.08 hrs, Volume= 0.789 af, Depth> 1.55"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YR Rainfall=3.11"

Area (ac)	CN	Description
2.044	79	50-75% Grass cover, Fair, HSG C
0.303	84	50-75% Grass cover, Fair, HSG D
1.173	98	Paved parking, HSG C
0.823	98	Paved parking, HSG D
1.340	77	Woods, Poor, HSG C
0.434	83	Woods, Poor, HSG D
6.117	85	Weighted Average
4.121		67.37% Pervious Area
1.996		32.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.8	100	0.0104	0.13		**Sheet Flow, Sheet Flow- Baseball Field** Grass: Short n= 0.150 P2= 3.17"
2.6	200	0.0065	1.30		**Shallow Concentrated Flow, Shallow Conc - Baseball Field** Unpaved Kv= 16.1 fps
0.3	83	0.0300	4.01	13.23	**Channel Flow, Grassed Channel** Area= 3.3 sf Perim= 8.2' r= 0.40' n= 0.035 Earth, dense weeds
15.7	383	Total			

Subcatchment 7S: Congress Heights DS Flows



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Congress Heights Direct Runoff Area=6.265 ac 49.35% Impervious Runoff Depth>3.33"
Flow Length=564' Tc=6.0 min CN=89 Runoff=36.36 cfs 1.738 af

Subcatchment 2S: Congress Heights Runoff Area=1.980 ac 56.01% Impervious Runoff Depth>3.43"
Flow Length=357' Tc=5.1 min CN=90 Runoff=12.16 cfs 0.566 af

Subcatchment 7S: Congress Heights DS Runoff Area=6.117 ac 32.63% Impervious Runoff Depth>2.93"
Flow Length=383' Tc=15.7 min CN=85 Runoff=23.95 cfs 1.496 af

Total Runoff Area = 14.362 ac Runoff Volume = 3.799 af Average Runoff Depth = 3.17"
56.85% Pervious = 8.165 ac 43.15% Impervious = 6.197 ac

Summary for Subcatchment 1S: Congress Heights Direct RSC

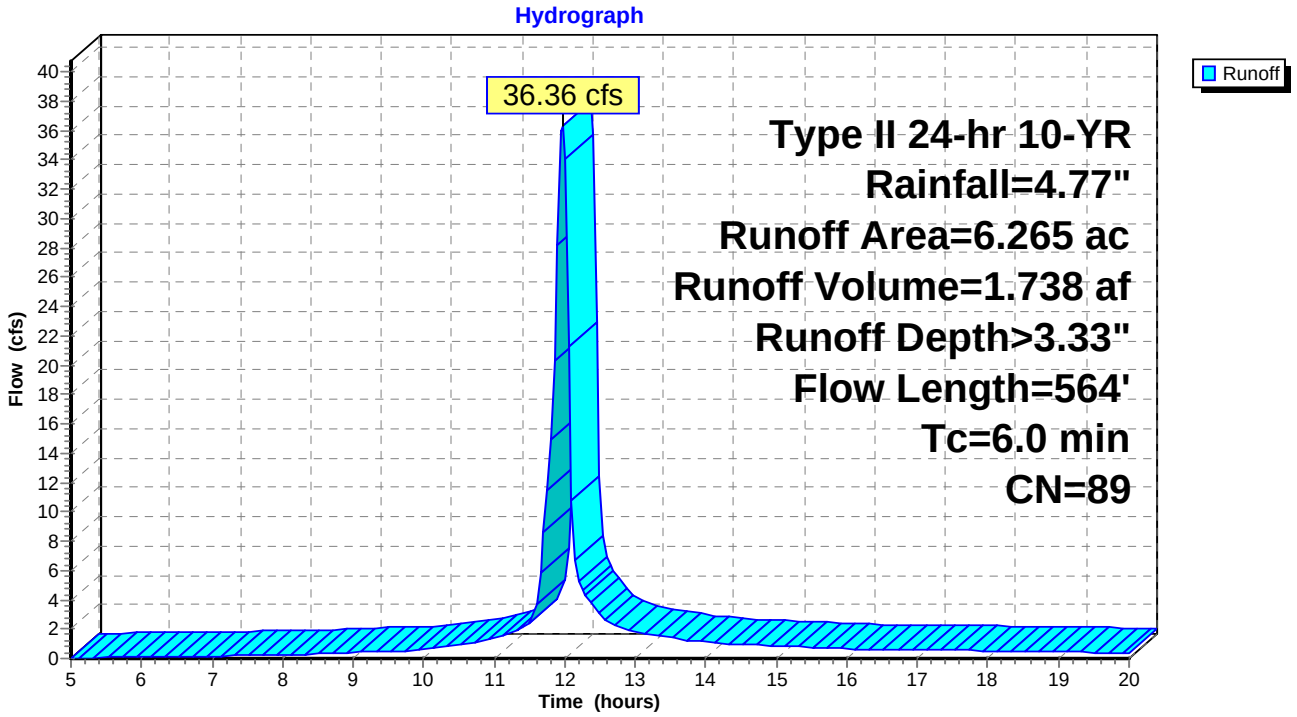
Runoff = 36.36 cfs @ 11.97 hrs, Volume= 1.738 af, Depth> 3.33"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-YR Rainfall=4.77"

Area (ac)	CN	Description
1.522	79	50-75% Grass cover, Fair, HSG C
0.217	84	50-75% Grass cover, Fair, HSG D
2.797	98	Paved parking, HSG C
0.295	98	Paved parking, HSG D
0.263	77	Woods, Poor, HSG C
1.171	83	Woods, Poor, HSG D
6.265	89	Weighted Average
3.173		50.65% Pervious Area
3.092		49.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	100	0.0074	0.92		**Sheet Flow, Sheet Flow- Paved Road** Smooth surfaces n= 0.011 P2= 3.17"
1.5	164	0.0076	1.77		**Shallow Concentrated Flow, Shallow Conc - Paved** Paved Kv= 20.3 fps
2.7	300	0.0067	1.86	5.94	**Channel Flow, Grassed Channel** Area= 3.2 sf Perim= 8.2' r= 0.39' n= 0.035 Earth, dense weeds
6.0	564	Total			

Subcatchment 1S: Congress Heights Direct RSC



Summary for Subcatchment 2S: Congress Heights Neighborhood Inlet

[49] Hint: Tc<2dt may require smaller dt

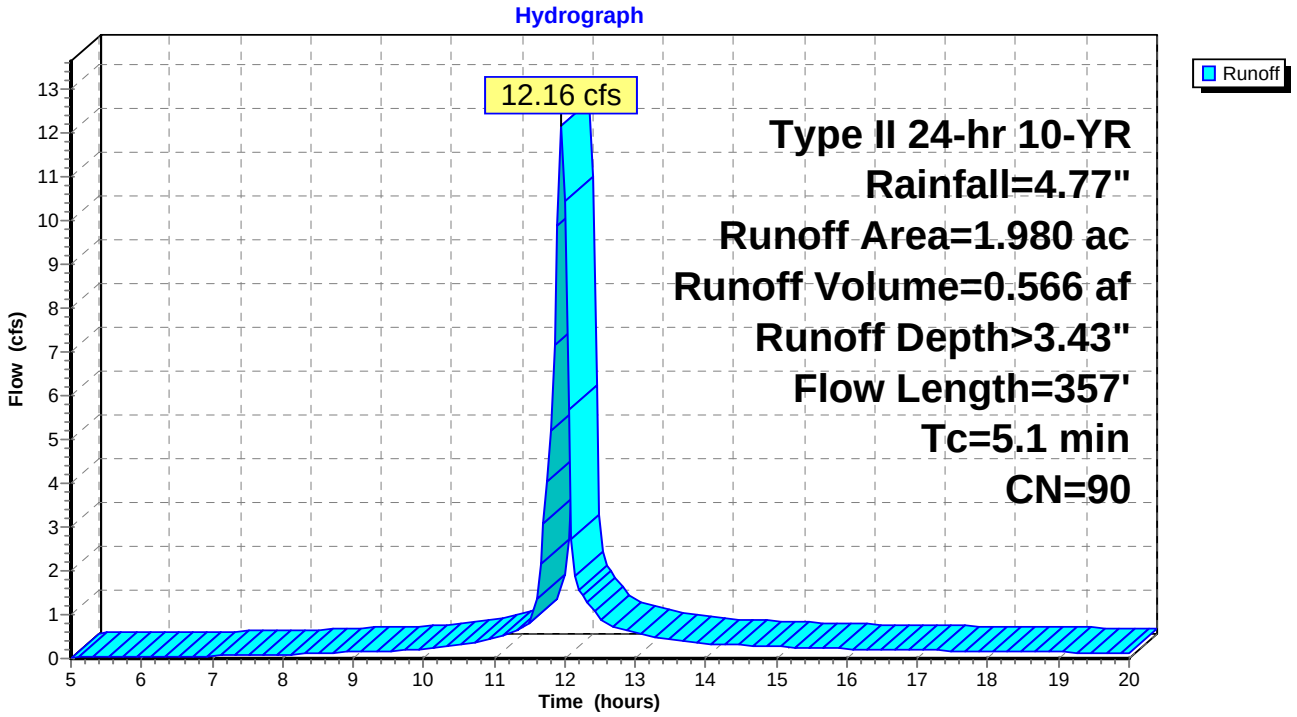
Runoff = 12.16 cfs @ 11.95 hrs, Volume= 0.566 af, Depth> 3.43"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-YR Rainfall=4.77"

Area (ac)	CN	Description
0.439	79	50-75% Grass cover, Fair, HSG C
0.026	84	50-75% Grass cover, Fair, HSG D
0.847	98	Paved parking, HSG C
0.262	98	Paved parking, HSG D
0.301	77	Woods, Poor, HSG C
0.105	83	Woods, Poor, HSG D
1.980	90	Weighted Average
0.871		43.99% Pervious Area
1.109		56.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	100	0.0025	0.60		**Sheet Flow, Sheet Flow- Paved Lot** Smooth surfaces n= 0.011 P2= 3.17"
0.4	42	0.0060	1.57		**Shallow Concentrated Flow, Shallow Conc - Paved** Paved Kv= 20.3 fps
1.3	116	0.0043	1.48	0.89	**Channel Flow, Curb and Gutter** Area= 0.6 sf Perim= 5.0' r= 0.12' n= 0.016 Asphalt, rough
0.6	99	0.0100	2.92	4.60	**Pipe Channel, Pipe Flow** 18.0" Round w/ 3.0" fill Area= 1.6 sf Perim= 4.6' r= 0.34' n= 0.025 Corrugated metal
5.1	357	Total			

Subcatchment 2S: Congress Heights Neighborhood Inlet



Summary for Subcatchment 7S: Congress Heights DS Flows

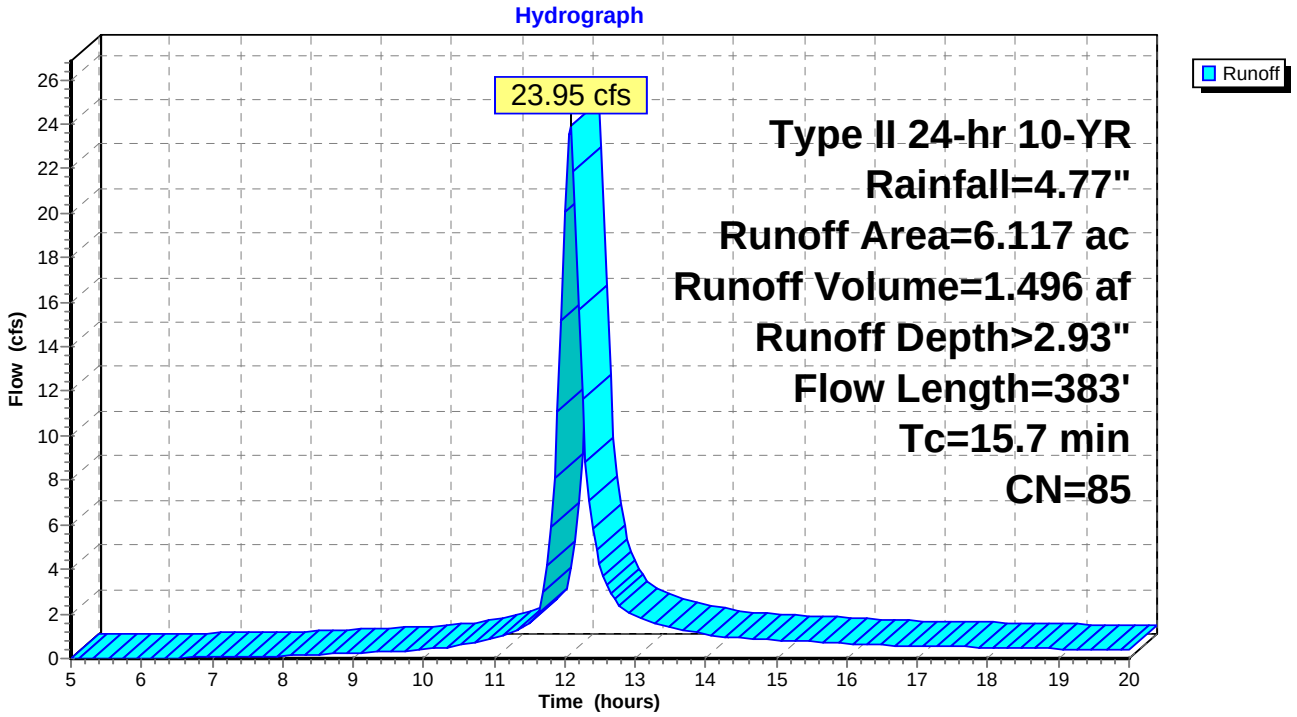
Runoff = 23.95 cfs @ 12.08 hrs, Volume= 1.496 af, Depth> 2.93"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-YR Rainfall=4.77"

Area (ac)	CN	Description
2.044	79	50-75% Grass cover, Fair, HSG C
0.303	84	50-75% Grass cover, Fair, HSG D
1.173	98	Paved parking, HSG C
0.823	98	Paved parking, HSG D
1.340	77	Woods, Poor, HSG C
0.434	83	Woods, Poor, HSG D
6.117	85	Weighted Average
4.121		67.37% Pervious Area
1.996		32.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.8	100	0.0104	0.13		**Sheet Flow, Sheet Flow- Baseball Field** Grass: Short n= 0.150 P2= 3.17"
2.6	200	0.0065	1.30		**Shallow Concentrated Flow, Shallow Conc - Baseball Field** Unpaved Kv= 16.1 fps
0.3	83	0.0300	4.01	13.23	**Channel Flow, Grassed Channel** Area= 3.3 sf Perim= 8.2' r= 0.40' n= 0.035 Earth, dense weeds
15.7	383	Total			

Subcatchment 7S: Congress Heights DS Flows



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Congress Heights Direct Runoff Area=6.265 ac 49.35% Impervious Runoff Depth>3.69"
Flow Length=564' Tc=6.0 min CN=89 Runoff=40.03 cfs 1.926 af

Subcatchment 2S: Congress Heights Runoff Area=1.980 ac 56.01% Impervious Runoff Depth>3.79"
Flow Length=357' Tc=5.1 min CN=90 Runoff=13.36 cfs 0.625 af

Subcatchment 7S: Congress Heights DS Runoff Area=6.117 ac 32.63% Impervious Runoff Depth>3.28"
Flow Length=383' Tc=15.7 min CN=85 Runoff=26.68 cfs 1.673 af

Total Runoff Area = 14.362 ac Runoff Volume = 4.224 af Average Runoff Depth = 3.53"
56.85% Pervious = 8.165 ac 43.15% Impervious = 6.197 ac

Summary for Subcatchment 1S: Congress Heights Direct RSC

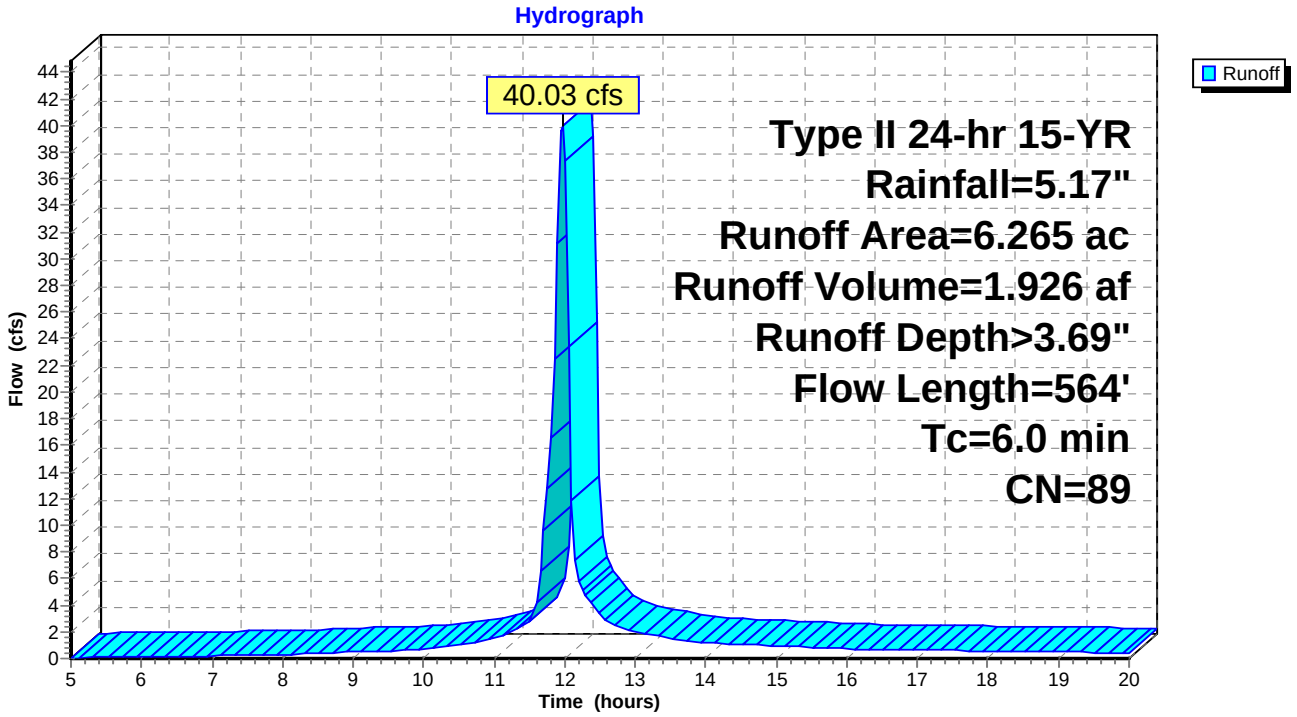
Runoff = 40.03 cfs @ 11.96 hrs, Volume= 1.926 af, Depth> 3.69"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 15-YR Rainfall=5.17"

Area (ac)	CN	Description
1.522	79	50-75% Grass cover, Fair, HSG C
0.217	84	50-75% Grass cover, Fair, HSG D
2.797	98	Paved parking, HSG C
0.295	98	Paved parking, HSG D
0.263	77	Woods, Poor, HSG C
1.171	83	Woods, Poor, HSG D
6.265	89	Weighted Average
3.173		50.65% Pervious Area
3.092		49.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	100	0.0074	0.92		**Sheet Flow, Sheet Flow- Paved Road** Smooth surfaces n= 0.011 P2= 3.17"
1.5	164	0.0076	1.77		**Shallow Concentrated Flow, Shallow Conc - Paved** Paved Kv= 20.3 fps
2.7	300	0.0067	1.86	5.94	**Channel Flow, Grassed Channel** Area= 3.2 sf Perim= 8.2' r= 0.39' n= 0.035 Earth, dense weeds
6.0	564	Total			

Subcatchment 1S: Congress Heights Direct RSC



Summary for Subcatchment 2S: Congress Heights Neighborhood Inlet

[49] Hint: Tc<2dt may require smaller dt

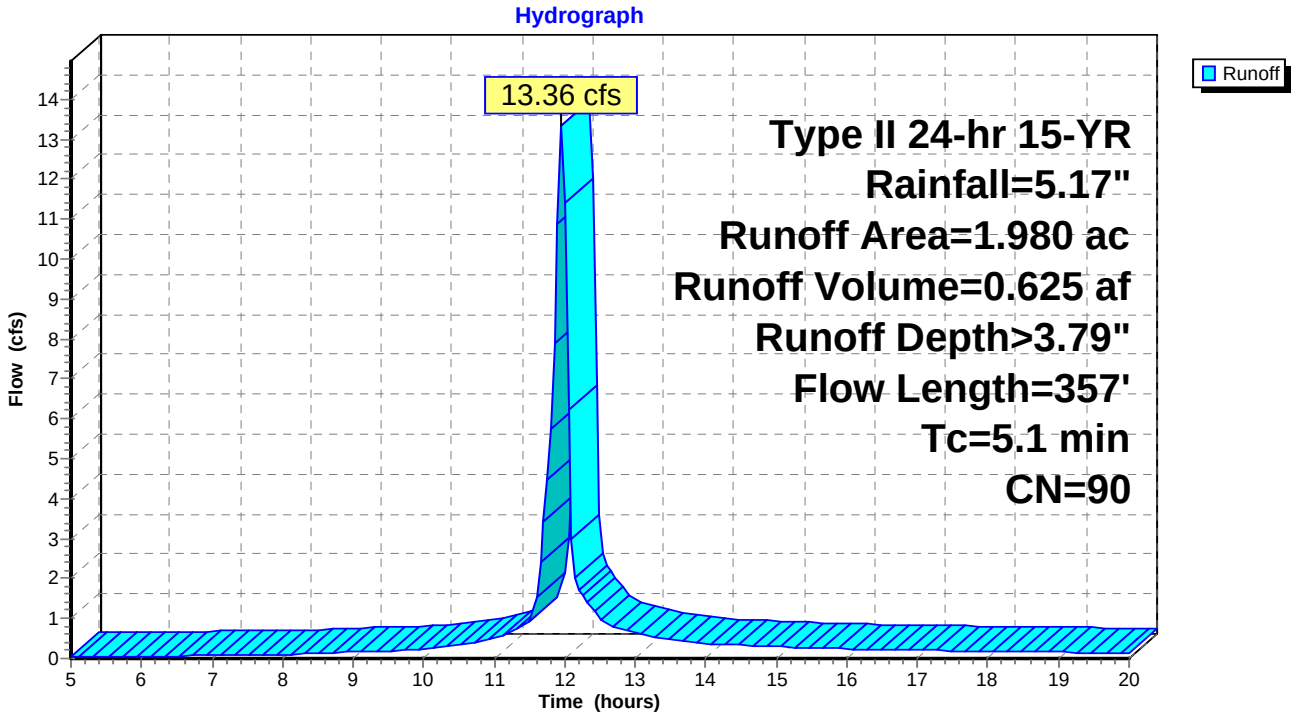
Runoff = 13.36 cfs @ 11.95 hrs, Volume= 0.625 af, Depth> 3.79"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 15-YR Rainfall=5.17"

Area (ac)	CN	Description
0.439	79	50-75% Grass cover, Fair, HSG C
0.026	84	50-75% Grass cover, Fair, HSG D
0.847	98	Paved parking, HSG C
0.262	98	Paved parking, HSG D
0.301	77	Woods, Poor, HSG C
0.105	83	Woods, Poor, HSG D
1.980	90	Weighted Average
0.871		43.99% Pervious Area
1.109		56.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	100	0.0025	0.60		**Sheet Flow, Sheet Flow- Paved Lot** Smooth surfaces n= 0.011 P2= 3.17"
0.4	42	0.0060	1.57		**Shallow Concentrated Flow, Shallow Conc - Paved** Paved Kv= 20.3 fps
1.3	116	0.0043	1.48	0.89	**Channel Flow, Curb and Gutter** Area= 0.6 sf Perim= 5.0' r= 0.12' n= 0.016 Asphalt, rough
0.6	99	0.0100	2.92	4.60	**Pipe Channel, Pipe Flow** 18.0" Round w/ 3.0" fill Area= 1.6 sf Perim= 4.6' r= 0.34' n= 0.025 Corrugated metal
5.1	357	Total			

Subcatchment 2S: Congress Heights Neighborhood Inlet



Summary for Subcatchment 7S: Congress Heights DS Flows

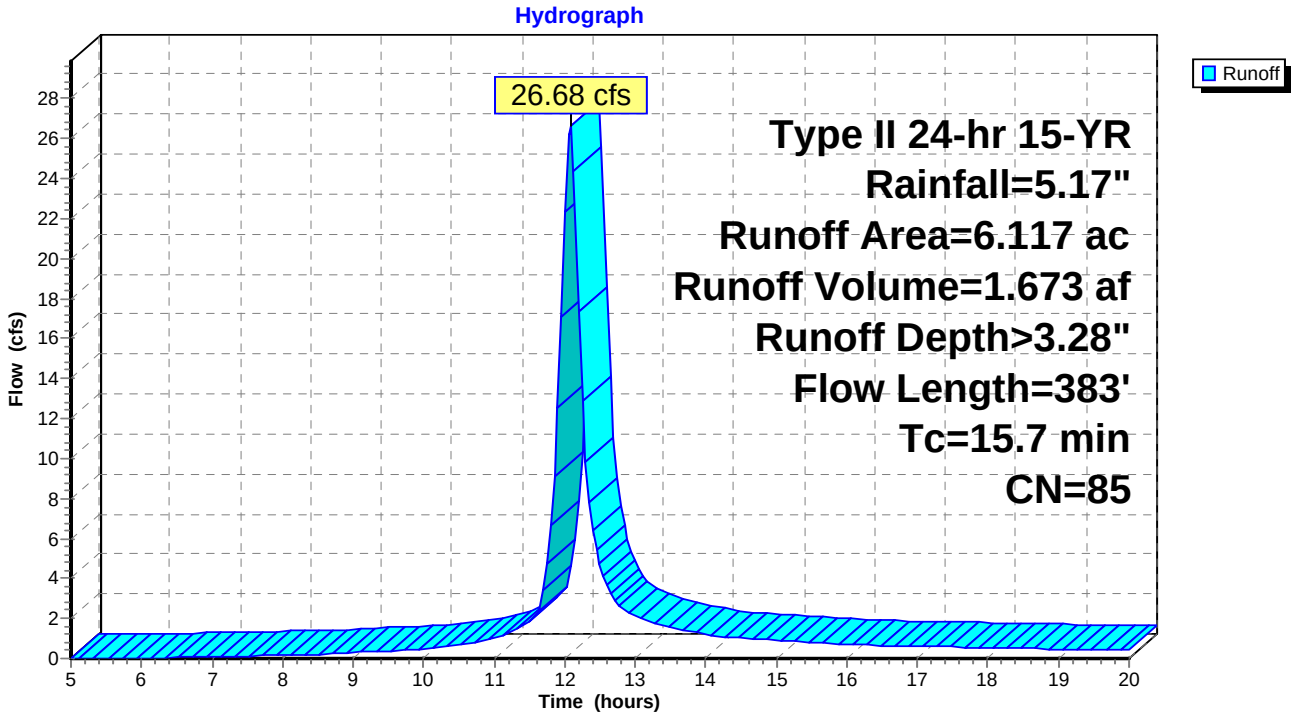
Runoff = 26.68 cfs @ 12.07 hrs, Volume= 1.673 af, Depth> 3.28"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 15-YR Rainfall=5.17"

Area (ac)	CN	Description
2.044	79	50-75% Grass cover, Fair, HSG C
0.303	84	50-75% Grass cover, Fair, HSG D
1.173	98	Paved parking, HSG C
0.823	98	Paved parking, HSG D
1.340	77	Woods, Poor, HSG C
0.434	83	Woods, Poor, HSG D
6.117	85	Weighted Average
4.121		67.37% Pervious Area
1.996		32.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.8	100	0.0104	0.13		**Sheet Flow, Sheet Flow- Baseball Field** Grass: Short n= 0.150 P2= 3.17"
2.6	200	0.0065	1.30		**Shallow Concentrated Flow, Shallow Conc - Baseball Field** Unpaved Kv= 16.1 fps
0.3	83	0.0300	4.01	13.23	**Channel Flow, Grassed Channel** Area= 3.3 sf Perim= 8.2' r= 0.40' n= 0.035 Earth, dense weeds
15.7	383	Total			

Subcatchment 7S: Congress Heights DS Flows



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Congress Heights Direct Runoff Area=6.265 ac 49.35% Impervious Runoff Depth>5.39"
Flow Length=564' Tc=6.0 min CN=89 Runoff=57.08 cfs 2.813 af

Subcatchment 2S: Congress Heights Runoff Area=1.980 ac 56.01% Impervious Runoff Depth>5.49"
Flow Length=357' Tc=5.1 min CN=90 Runoff=18.91 cfs 0.906 af

Subcatchment 7S: Congress Heights DS Runoff Area=6.117 ac 32.63% Impervious Runoff Depth>4.95"
Flow Length=383' Tc=15.7 min CN=85 Runoff=39.36 cfs 2.522 af

Total Runoff Area = 14.362 ac Runoff Volume = 6.241 af Average Runoff Depth = 5.21"
56.85% Pervious = 8.165 ac 43.15% Impervious = 6.197 ac

Summary for Subcatchment 1S: Congress Heights Direct RSC

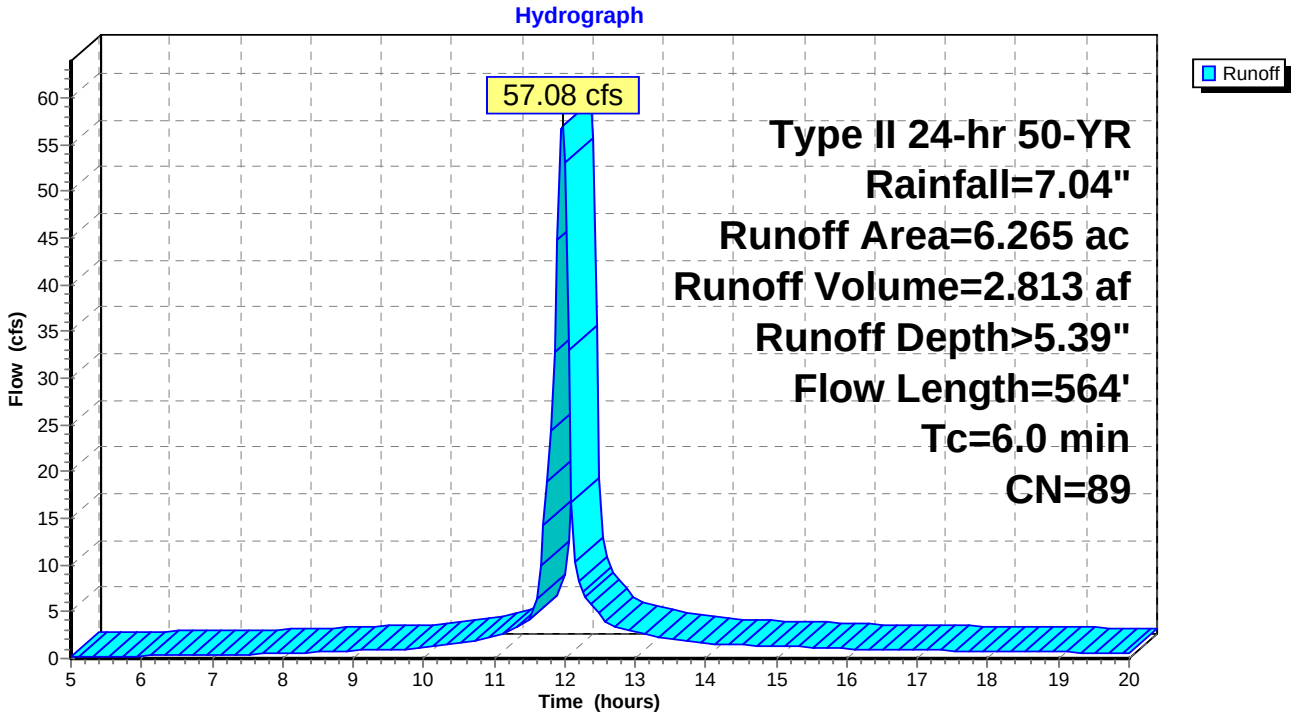
Runoff = 57.08 cfs @ 11.96 hrs, Volume= 2.813 af, Depth> 5.39"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 50-YR Rainfall=7.04"

Area (ac)	CN	Description
1.522	79	50-75% Grass cover, Fair, HSG C
0.217	84	50-75% Grass cover, Fair, HSG D
2.797	98	Paved parking, HSG C
0.295	98	Paved parking, HSG D
0.263	77	Woods, Poor, HSG C
1.171	83	Woods, Poor, HSG D
6.265	89	Weighted Average
3.173		50.65% Pervious Area
3.092		49.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	100	0.0074	0.92		**Sheet Flow, Sheet Flow- Paved Road** Smooth surfaces n= 0.011 P2= 3.17"
1.5	164	0.0076	1.77		**Shallow Concentrated Flow, Shallow Conc - Paved** Paved Kv= 20.3 fps
2.7	300	0.0067	1.86	5.94	**Channel Flow, Grassed Channel** Area= 3.2 sf Perim= 8.2' r= 0.39' n= 0.035 Earth, dense weeds
6.0	564	Total			

Subcatchment 1S: Congress Heights Direct RSC



Summary for Subcatchment 2S: Congress Heights Neighborhood Inlet

[49] Hint: Tc<2dt may require smaller dt

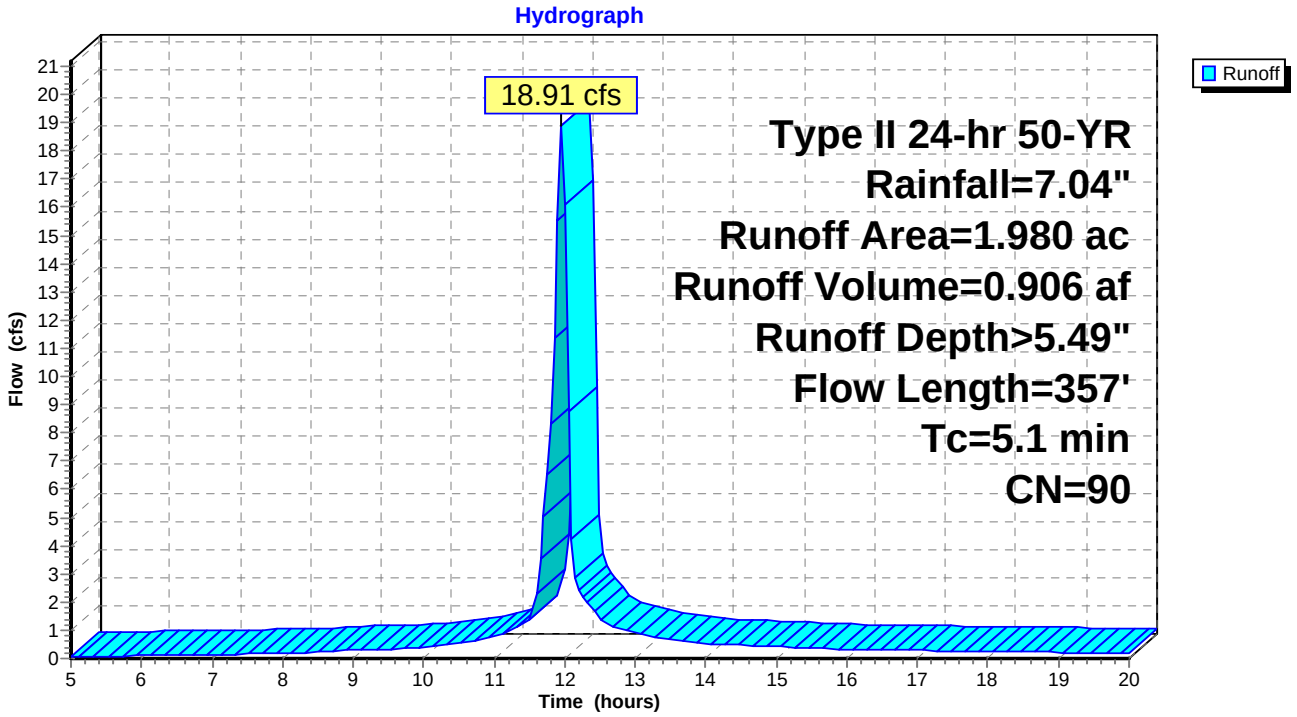
Runoff = 18.91 cfs @ 11.95 hrs, Volume= 0.906 af, Depth> 5.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 50-YR Rainfall=7.04"

Area (ac)	CN	Description
0.439	79	50-75% Grass cover, Fair, HSG C
0.026	84	50-75% Grass cover, Fair, HSG D
0.847	98	Paved parking, HSG C
0.262	98	Paved parking, HSG D
0.301	77	Woods, Poor, HSG C
0.105	83	Woods, Poor, HSG D
1.980	90	Weighted Average
0.871		43.99% Pervious Area
1.109		56.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	100	0.0025	0.60		**Sheet Flow, Sheet Flow- Paved Lot** Smooth surfaces n= 0.011 P2= 3.17"
0.4	42	0.0060	1.57		**Shallow Concentrated Flow, Shallow Conc - Paved** Paved Kv= 20.3 fps
1.3	116	0.0043	1.48	0.89	**Channel Flow, Curb and Gutter** Area= 0.6 sf Perim= 5.0' r= 0.12' n= 0.016 Asphalt, rough
0.6	99	0.0100	2.92	4.60	**Pipe Channel, Pipe Flow** 18.0" Round w/ 3.0" fill Area= 1.6 sf Perim= 4.6' r= 0.34' n= 0.025 Corrugated metal
5.1	357	Total			

Subcatchment 2S: Congress Heights Neighborhood Inlet



Summary for Subcatchment 7S: Congress Heights DS Flows

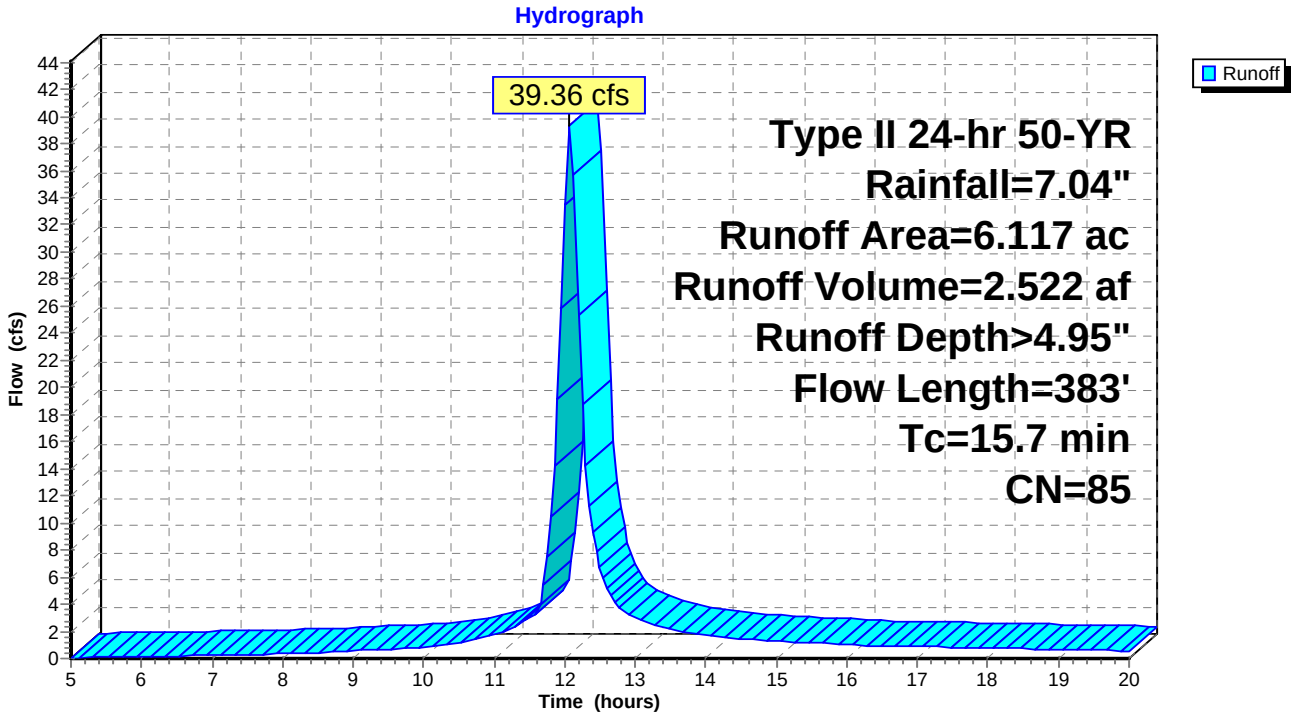
Runoff = 39.36 cfs @ 12.07 hrs, Volume= 2.522 af, Depth> 4.95"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 50-YR Rainfall=7.04"

Area (ac)	CN	Description
2.044	79	50-75% Grass cover, Fair, HSG C
0.303	84	50-75% Grass cover, Fair, HSG D
1.173	98	Paved parking, HSG C
0.823	98	Paved parking, HSG D
1.340	77	Woods, Poor, HSG C
0.434	83	Woods, Poor, HSG D
6.117	85	Weighted Average
4.121		67.37% Pervious Area
1.996		32.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.8	100	0.0104	0.13		**Sheet Flow, Sheet Flow- Baseball Field** Grass: Short n= 0.150 P2= 3.17"
2.6	200	0.0065	1.30		**Shallow Concentrated Flow, Shallow Conc - Baseball Field** Unpaved Kv= 16.1 fps
0.3	83	0.0300	4.01	13.23	**Channel Flow, Grassed Channel** Area= 3.3 sf Perim= 8.2' r= 0.40' n= 0.035 Earth, dense weeds
15.7	383	Total			

Subcatchment 7S: Congress Heights DS Flows



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Congress Heights Direct Runoff Area=6.265 ac 49.35% Impervious Runoff Depth>6.47"
Flow Length=564' Tc=6.0 min CN=89 Runoff=67.83 cfs 3.380 af

Subcatchment 2S: Congress Heights Runoff Area=1.980 ac 56.01% Impervious Runoff Depth>6.58"
Flow Length=357' Tc=5.1 min CN=90 Runoff=22.42 cfs 1.086 af

Subcatchment 7S: Congress Heights DS Runoff Area=6.117 ac 32.63% Impervious Runoff Depth>6.02"
Flow Length=383' Tc=15.7 min CN=85 Runoff=47.41 cfs 3.070 af

Total Runoff Area = 14.362 ac Runoff Volume = 7.535 af Average Runoff Depth = 6.30"
56.85% Pervious = 8.165 ac 43.15% Impervious = 6.197 ac

Summary for Subcatchment 1S: Congress Heights Direct RSC

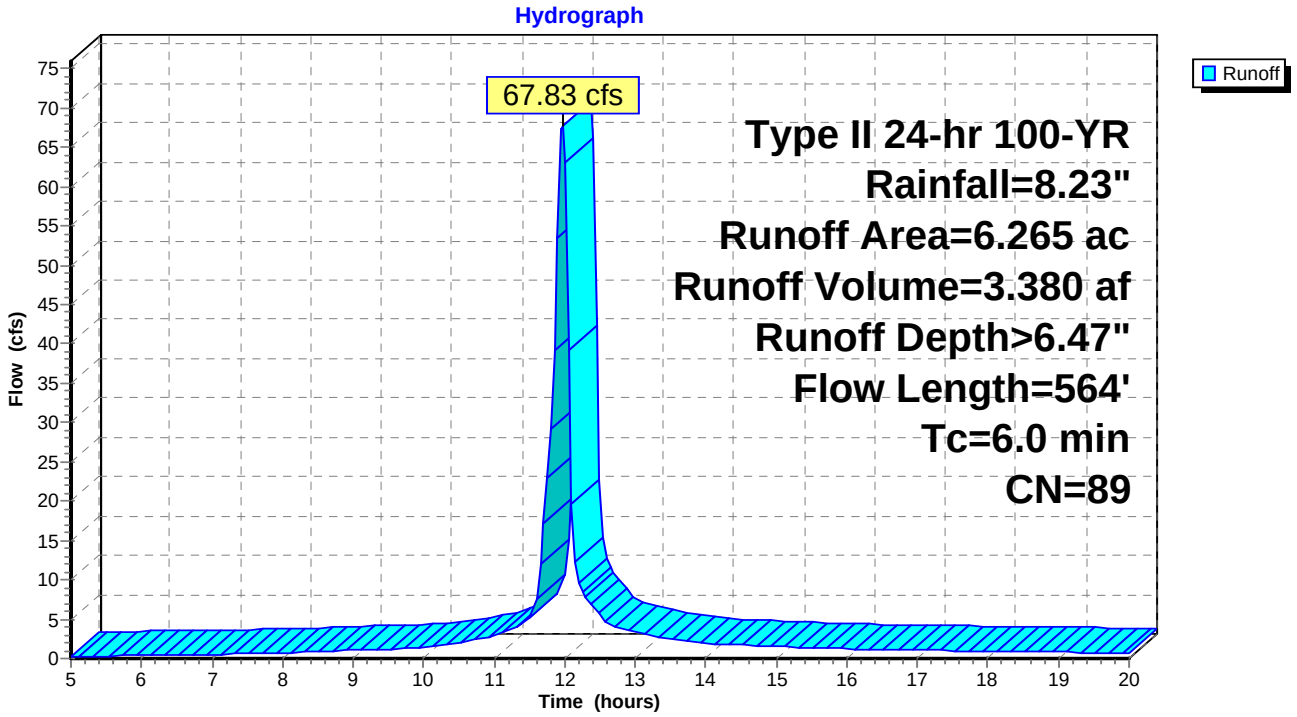
Runoff = 67.83 cfs @ 11.96 hrs, Volume= 3.380 af, Depth> 6.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YR Rainfall=8.23"

Area (ac)	CN	Description
1.522	79	50-75% Grass cover, Fair, HSG C
0.217	84	50-75% Grass cover, Fair, HSG D
2.797	98	Paved parking, HSG C
0.295	98	Paved parking, HSG D
0.263	77	Woods, Poor, HSG C
1.171	83	Woods, Poor, HSG D
6.265	89	Weighted Average
3.173		50.65% Pervious Area
3.092		49.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	100	0.0074	0.92		**Sheet Flow, Sheet Flow- Paved Road** Smooth surfaces n= 0.011 P2= 3.17"
1.5	164	0.0076	1.77		**Shallow Concentrated Flow, Shallow Conc - Paved** Paved Kv= 20.3 fps
2.7	300	0.0067	1.86	5.94	**Channel Flow, Grassed Channel** Area= 3.2 sf Perim= 8.2' r= 0.39' n= 0.035 Earth, dense weeds
6.0	564	Total			

Subcatchment 1S: Congress Heights Direct RSC



Summary for Subcatchment 2S: Congress Heights Neighborhood Inlet

[49] Hint: Tc<2dt may require smaller dt

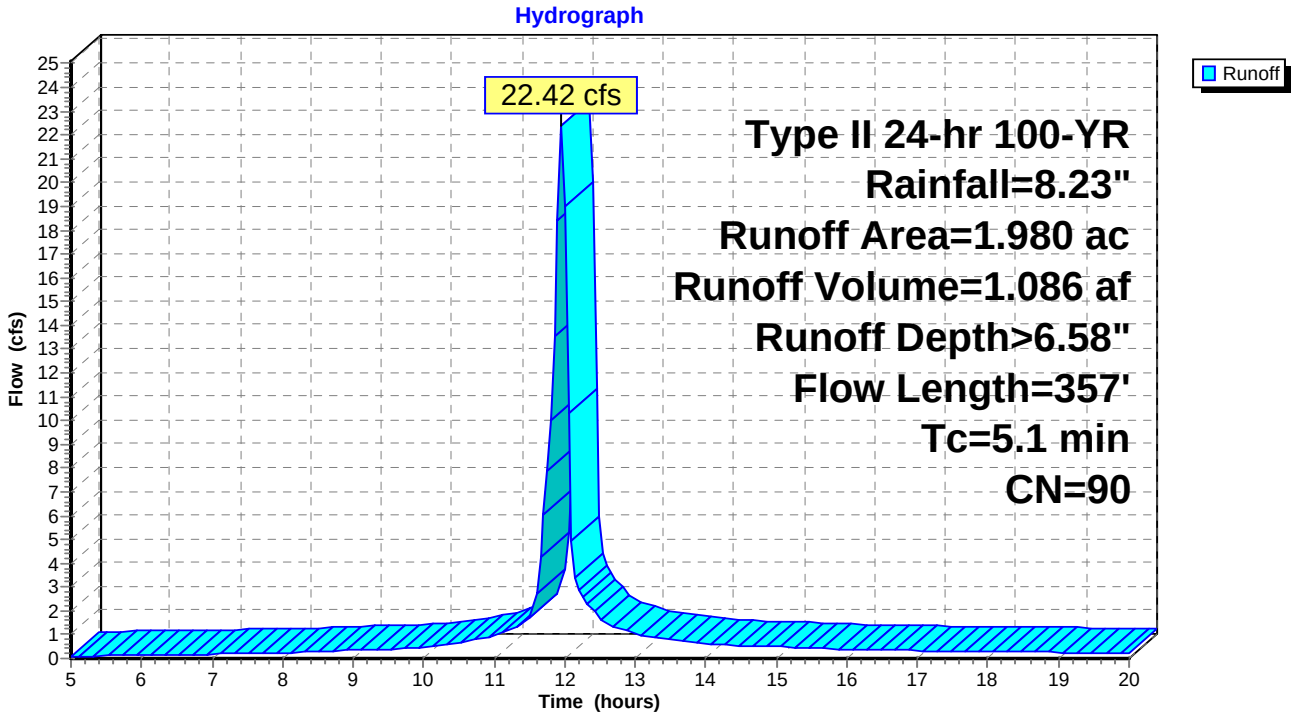
Runoff = 22.42 cfs @ 11.95 hrs, Volume= 1.086 af, Depth> 6.58"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YR Rainfall=8.23"

Area (ac)	CN	Description
0.439	79	50-75% Grass cover, Fair, HSG C
0.026	84	50-75% Grass cover, Fair, HSG D
0.847	98	Paved parking, HSG C
0.262	98	Paved parking, HSG D
0.301	77	Woods, Poor, HSG C
0.105	83	Woods, Poor, HSG D
1.980	90	Weighted Average
0.871		43.99% Pervious Area
1.109		56.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	100	0.0025	0.60		**Sheet Flow, Sheet Flow- Paved Lot** Smooth surfaces n= 0.011 P2= 3.17"
0.4	42	0.0060	1.57		**Shallow Concentrated Flow, Shallow Conc - Paved** Paved Kv= 20.3 fps
1.3	116	0.0043	1.48	0.89	**Channel Flow, Curb and Gutter** Area= 0.6 sf Perim= 5.0' r= 0.12' n= 0.016 Asphalt, rough
0.6	99	0.0100	2.92	4.60	**Pipe Channel, Pipe Flow** 18.0" Round w/ 3.0" fill Area= 1.6 sf Perim= 4.6' r= 0.34' n= 0.025 Corrugated metal
5.1	357	Total			

Subcatchment 2S: Congress Heights Neighborhood Inlet



Summary for Subcatchment 7S: Congress Heights DS Flows

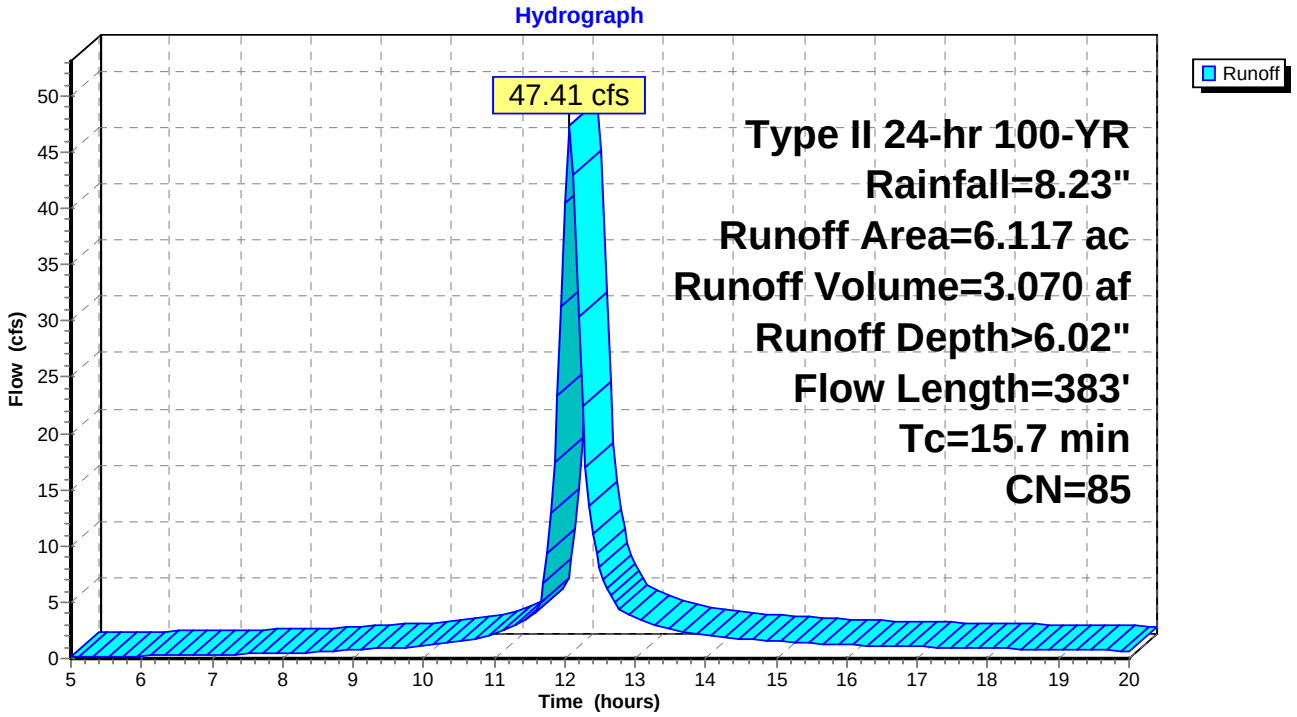
Runoff = 47.41 cfs @ 12.07 hrs, Volume= 3.070 af, Depth> 6.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YR Rainfall=8.23"

Area (ac)	CN	Description
2.044	79	50-75% Grass cover, Fair, HSG C
0.303	84	50-75% Grass cover, Fair, HSG D
1.173	98	Paved parking, HSG C
0.823	98	Paved parking, HSG D
1.340	77	Woods, Poor, HSG C
0.434	83	Woods, Poor, HSG D
6.117	85	Weighted Average
4.121		67.37% Pervious Area
1.996		32.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.8	100	0.0104	0.13		**Sheet Flow, Sheet Flow- Baseball Field** Grass: Short n= 0.150 P2= 3.17"
2.6	200	0.0065	1.30		**Shallow Concentrated Flow, Shallow Conc - Baseball Field** Unpaved Kv= 16.1 fps
0.3	83	0.0300	4.01	13.23	**Channel Flow, Grassed Channel** Area= 3.3 sf Perim= 8.2' r= 0.40' n= 0.035 Earth, dense weeds
15.7	383	Total			

Subcatchment 7S: Congress Heights DS Flows



APPENDIX D. PRELIMINARY CHANNEL DESIGN CALCULATIONS

Channel Cross-Section Design

Project: Congress Heights
Design Reach: Upper Riffles - 0.5' drop
Designer: RW
Date: 3/7/2019

Q_2, cfs	Q_{15}, cfs	Q_{100}, cfs	Reach Length, ft	Reach Elev Change, ft	water surface slope (ft/ft)
28.3	53.4	90.3	210	3	0.012

top width, ft	constr. d, ft.	t/d (must be >=10)	structure drop, ft.	structure length, ft.	local slope, ft/ft
24	1.000	24.000	0.500	10.000	0.050

D_{50}, in.	V_{max}, fps	flow regime	min thickness of rock, ft.	Wp, ft	Vol. rock, cy
6	6.8	Subcritical	1.2	24.111	11
	4.9	Supercritical			

Flow Analysis: Q2, cfs
Selected Slope: 0.050 (Local Slope)

depth of flow, ft.	top width at depth, ft.	n	Froude number	flow regime
0.65	19.349	0.057	0.7341	subcritical

Area, ft2	Wp, ft	Rh, ft.	V, fps	Q, cfs
8.385	19.408	0.432	3.36	28.16

V_{max}, fps	Q req'd, cfs
6.8	28.27

Flow Analysis: Q15, cfs
Selected Slope: 0.050 (Local Slope)

depth of flow, ft.	top width at depth, ft.	n	Froude number	flow regime
0.83	21.865	0.052	0.8359	subcritical

Area, ft2	Wp, ft	Rh, ft.	V, fps	Q, cfs
12.099	21.949	0.551	4.32	52.28

V_{max}, fps	Q req'd, cfs
6.8	53.39

Flow Analysis: Q100, cfs
Selected Slope: 0.050 (Local Slope)

depth of flow, ft.	top width at depth, ft.	n	Froude number	flow regime
1.00	24.000	0.049	0.9134	subcritical

Area, ft2	Wp, ft	Rh, ft.	V, fps	Q, cfs
16.000	24.111	0.664	5.18	82.93

V_{max}, fps	Q req'd, cfs
6.8	90.25

Flow Analysis: Q100, cfs
Selected Slope: 0.012 (Water Surface Slope)

depth of flow, ft.	top width at depth, ft.	n	Froude number	flow regime
1.00	24.000	0.049	0.4457	subcritical

Area, ft2	Wp, ft	Rh, ft.	V, fps	Q, cfs
16.000	24.111	0.664	2.53	40.46

V_{max}, fps	Q req'd, cfs
6.8	90.25

Channel Cross-Section Design

Project: Congress Heights
Design Reach: Upper Riffles - 1' drop
Designer: RW
Date: 3/7/2019

Q_2, cfs	Q_{15}, cfs	Q_{100}, cfs	Reach Length, ft	Reach Elev Change, ft	water surface slope (ft/ft)
28.3	53.4	90.3	210	3	0.012

top width, ft	constr. d, ft.	t/d (must be >=10)	structure drop, ft.	structure length, ft.	local slope, ft/ft
24	1.000	24.000	1.000	10.000	0.100

D_{50}, in.	V_{max}, fps	flow regime	min thickness of rock, ft.	Wp, ft	Vol. rock, cy
9	8.3	Subcritical	1.8	24.111	16
	6.0	Supercritical			

Flow Analysis: Q2, cfs
Selected Slope: 0.100 (Local Slope)

depth of flow, ft.	top width at depth, ft.	n	Froude number	flow regime
0.63	19.049	0.075	0.7799	subcritical

Area, ft2	Wp, ft	Rh, ft.	V, fps	Q, cfs
8.001	19.105	0.419	3.51	28.10

V_{max}, fps	Q req'd, cfs
8.3	28.27

Flow Analysis: Q15, cfs
Selected Slope: 0.100 (Local Slope)

depth of flow, ft.	top width at depth, ft.	n	Froude number	flow regime
0.80	21.466	0.066	0.9207	subcritical

Area, ft2	Wp, ft	Rh, ft.	V, fps	Q, cfs
11.449	21.546	0.531	4.67	53.50

V_{max}, fps	Q req'd, cfs
8.3	53.39

Flow Analysis: Q100, cfs
Selected Slope: 0.100 (Local Slope)

depth of flow, ft.	top width at depth, ft.	n	Froude number	flow regime
0.98	23.759	0.060	1.0402	supercritical

Area, ft2	Wp, ft	Rh, ft.	V, fps	Q, cfs
15.522	23.867	0.650	5.84	90.70

V_{max}, fps	Q req'd, cfs
6.0	90.25

Flow Analysis: Q100, cfs
Selected Slope: 0.012 (Water Surface Slope)

depth of flow, ft.	top width at depth, ft.	n	Froude number	flow regime
1.00	24.000	0.060	0.3630	subcritical

Area, ft2	Wp, ft	Rh, ft.	V, fps	Q, cfs
16.000	24.111	0.664	2.06	32.96

V_{max}, fps	Q req'd, cfs
8.3	90.25

Channel Cross-Section Design

Project: Congress Heights
Design Reach: Lower 4' Cascades
Designer: RW
Date: 3/7/2019

Q_2, cfs	Q_{15}, cfs	Q_{100}, cfs	Reach Length, ft	Reach Elev Change, ft	water surface slope (ft/ft)
41.2	80.1	137.7	185	15	0.081

top width, ft	constr. d, ft.	t/d (must be >=10)	structure drop, ft.	structure length, ft.	local slope, ft/ft
20	1.500	13.333	4.000	16.000	0.250

D_{50}, in.	V_{max}, fps	flow regime	min thickness of rock, ft.	Wp, ft	Vol. rock, cy
20	12.4	Subcritical	4	20.300	48
	8.9	Supercritical			

Flow Analysis: Q2, cfs
Selected Slope: 0.250 (Local Slope)

depth of flow, ft.	top width at depth, ft.	n	Froude number	flow regime
0.91	15.578	0.118	0.8267	subcritical

Area, ft2	Wp, ft	Rh, ft.	V, fps	Q, cfs
9.451	15.720	0.601	4.47	42.29

V_{max}, fps	Q req'd, cfs
12.4	41.17

Flow Analysis: Q15, cfs
Selected Slope: 0.250 (Local Slope)

depth of flow, ft.	top width at depth, ft.	n	Froude number	flow regime
1.13	17.359	0.099	1.0269	supercritical

Area, ft2	Wp, ft	Rh, ft.	V, fps	Q, cfs
13.077	17.555	0.745	6.19	81.01

V_{max}, fps	Q req'd, cfs
8.9	80.07

Flow Analysis: Q100, cfs
Selected Slope: 0.250 (Local Slope)

depth of flow, ft.	top width at depth, ft.	n	Froude number	flow regime
1.36	19.044	0.087	1.1975	supercritical

Area, ft2	Wp, ft	Rh, ft.	V, fps	Q, cfs
17.266	19.303	0.895	7.92	136.83

V_{max}, fps	Q req'd, cfs
8.9	137.66

Flow Analysis: Q100, cfs
Selected Slope: 0.081 (Water Surface Slope)

depth of flow, ft.	top width at depth, ft.	n	Froude number	flow regime
1.50	20.000	0.082	0.7331	subcritical

Area, ft2	Wp, ft	Rh, ft.	V, fps	Q, cfs
20.000	20.300	0.985	5.10	101.90

V_{max}, fps	Q req'd, cfs
12.4	137.66

Channel Cross-Section Design

Project: Congress Heights
Design Reach: Lower 6' Cascades
Designer: RW
Date: 3/7/2019

Q_2, cfs	Q_{15}, cfs	Q_{100}, cfs	Reach Length, ft	Reach Elev Change, ft	water surface slope (ft/ft)
41.2	80.1	137.7	185	15	0.081

top width, ft	constr. d, ft.	t/d (must be >=10)	structure drop, ft.	structure length, ft.	local slope, ft/ft
16	2.000	8.000	6.000	30.000	0.200

D_{50}, in.	V_{max}, fps	flow regime	min thickness of rock, ft.	Wp, ft	Vol. rock, cy
20	12.4	Subcritical	4	16.667	74
	8.9	Supercritical			

Flow Analysis: Q2, cfs
Selected Slope: 0.200 (Local Slope)

depth of flow, ft.	top width at depth, ft.	n	Froude number	flow regime
1.06	11.648	0.104	0.8592	subcritical

Area, ft2	Wp, ft	Rh, ft.	V, fps	Q, cfs
8.231	11.905	0.691	5.02	41.32

V_{max}, fps	Q req'd, cfs
12.4	41.17

Flow Analysis: Q15, cfs
Selected Slope: 0.200 (Local Slope)

depth of flow, ft.	top width at depth, ft.	n	Froude number	flow regime
1.35	13.145	0.087	1.0549	supercritical

Area, ft2	Wp, ft	Rh, ft.	V, fps	Q, cfs
11.831	13.515	0.875	6.96	82.28

V_{max}, fps	Q req'd, cfs
8.9	80.07

Flow Analysis: Q100, cfs
Selected Slope: 0.200 (Local Slope)

depth of flow, ft.	top width at depth, ft.	n	Froude number	flow regime
1.64	14.489	0.078	1.2103	supercritical

Area, ft2	Wp, ft	Rh, ft.	V, fps	Q, cfs
15.841	14.984	1.057	8.80	139.32

V_{max}, fps	Q req'd, cfs
8.9	137.66

Flow Analysis: Q100, cfs
Selected Slope: 0.081 (Water Surface Slope)

depth of flow, ft.	top width at depth, ft.	n	Froude number	flow regime
1.95	15.799	0.072	0.8574	subcritical

Area, ft2	Wp, ft	Rh, ft.	V, fps	Q, cfs
20.538	16.441	1.249	6.79	139.54

V_{max}, fps	Q req'd, cfs
12.4	137.66

Channel Cross-Section Design

Project: Congress Heights
Design Reach: At Grade Riffle
Designer: RW
Date: 3/11/2019

Q_2, cfs	Q_{15}, cfs	Q_{100}, cfs	Reach Length, ft	Reach Elev Change, ft	water surface slope (ft/ft)
41.2	80.1	137.7	46	4	0.086

top width, ft	constr. d, ft.	t/d (must be >=10)	structure drop, ft.	structure length, ft.	local slope, ft/ft
12	1.000	12.000	4.000	46.000	0.087

D_{50}, in.	V_{max}, fps	flow regime	min thickness of rock, ft.	Wp, ft	Vol. rock, cy
12	9.6	Subcritical	2.4	12.222	50
	6.9	Supercritical			

Flow Analysis: Q2, cfs
Selected Slope: 0.087 (Local Slope)

depth of flow, ft.	top width at depth, ft.	n	Froude number	flow regime
1.00	12.000	0.071	0.8150	subcritical

Area, ft2	Wp, ft	Rh, ft.	V, fps	Q, cfs
8.000	12.222	0.655	4.62	37.00

V_{max}, fps	Q req'd, cfs
9.6	41.20

Flow Analysis: Q15, cfs
Selected Slope: 0.087 (Local Slope)

depth of flow, ft.	top width at depth, ft.	n	Froude number	flow regime
0.95	11.696	0.073	0.7875	subcritical

Area, ft2	Wp, ft	Rh, ft.	V, fps	Q, cfs
7.408	11.902	0.622	4.36	32.26

V_{max}, fps	Q req'd, cfs
9.6	80.10

Flow Analysis: Q100, cfs
Selected Slope: 0.087 (Local Slope)

depth of flow, ft.	top width at depth, ft.	n	Froude number	flow regime
1.00	12.000	0.071	0.8150	subcritical

Area, ft2	Wp, ft	Rh, ft.	V, fps	Q, cfs
8.000	12.222	0.655	4.62	37.00

V_{max}, fps	Q req'd, cfs
9.6	137.70

Flow Analysis: Q100, cfs
Selected Slope: 0.086 (Water Surface Slope)

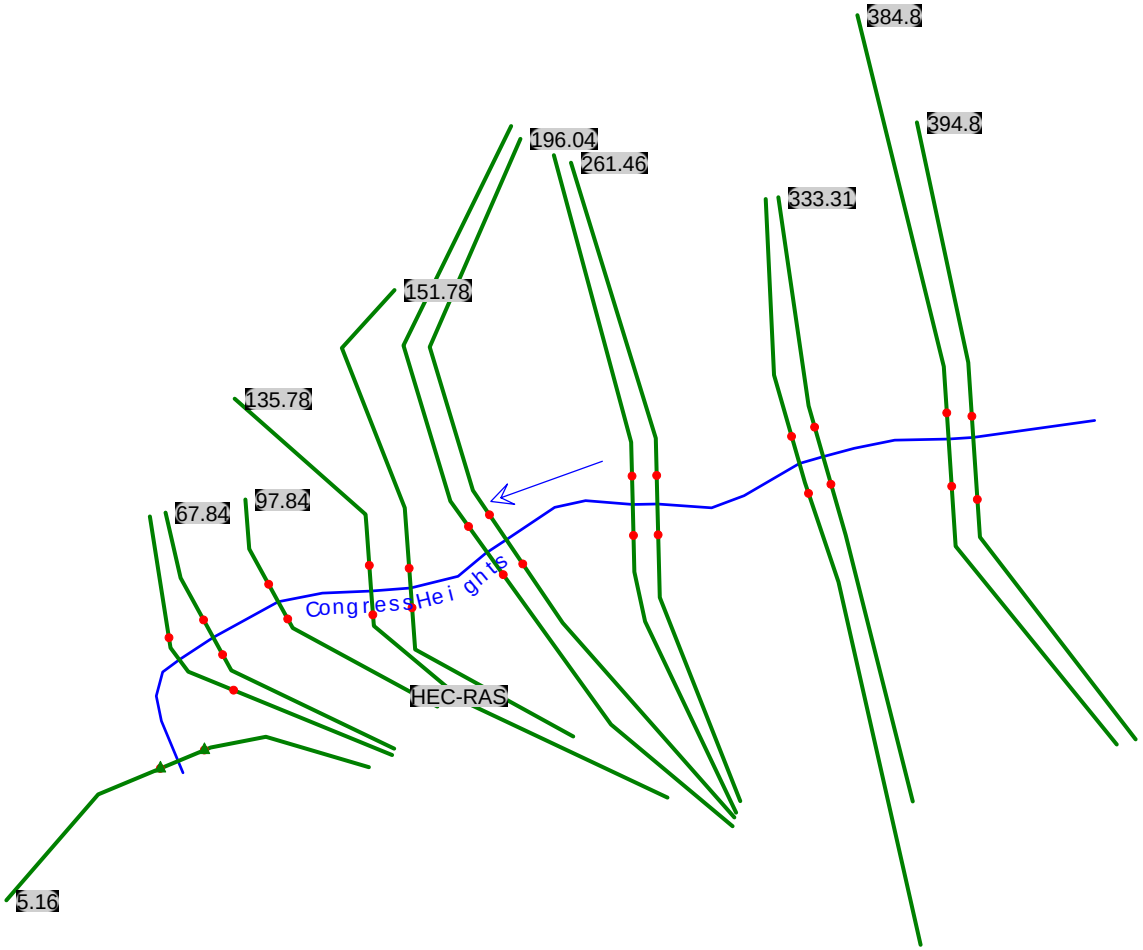
depth of flow, ft.	top width at depth, ft.	n	Froude number	flow regime
1.00	12.000	0.071	0.8124	subcritical

Area, ft2	Wp, ft	Rh, ft.	V, fps	Q, cfs
8.000	12.222	0.655	4.61	36.88

V_{max}, fps	Q req'd, cfs
9.6	137.70

APPENDIX E. HYDRAULIC ANALYSIS

Cross Section Layout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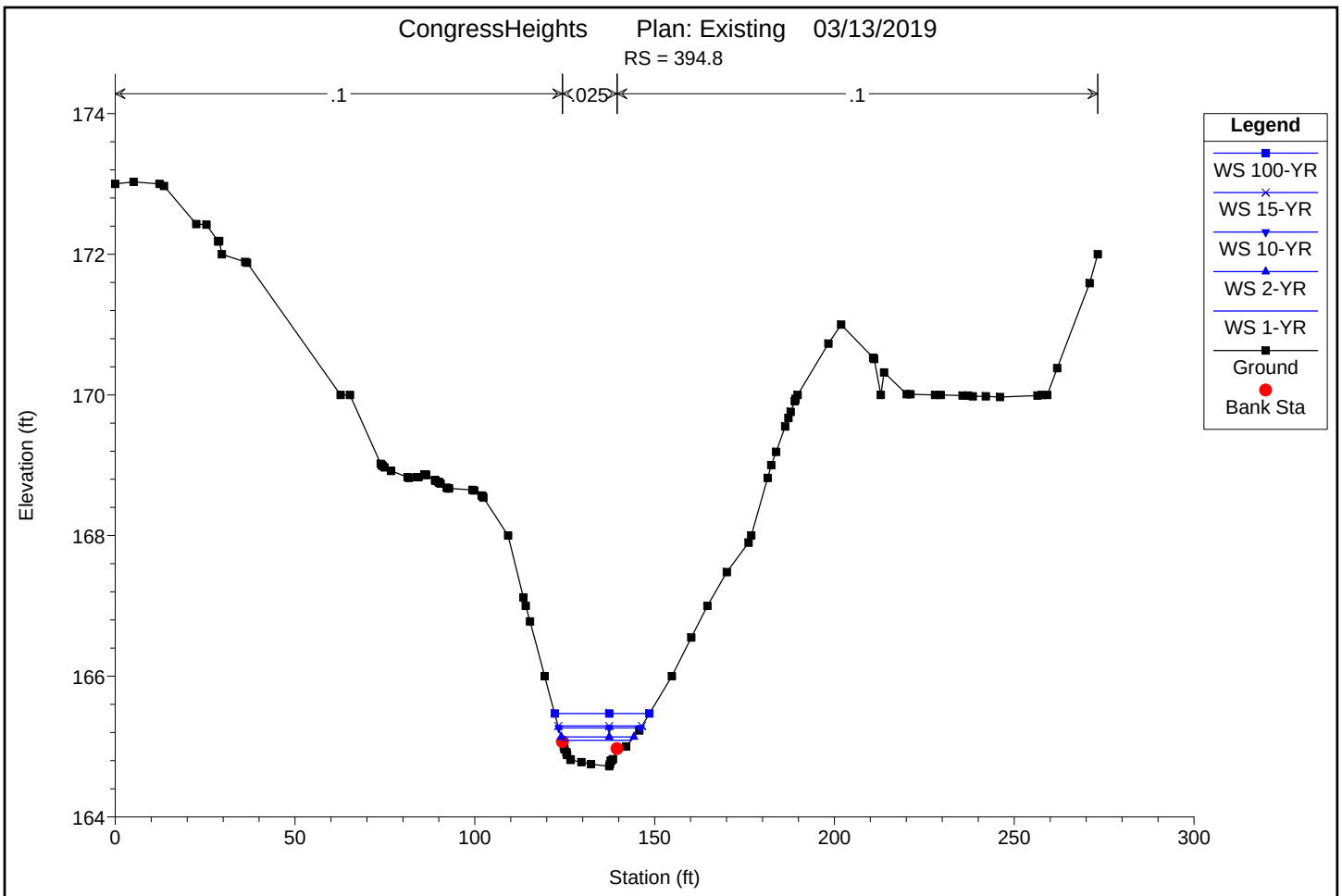
Congress Heights
HEC-RAS
5.16

Existing Cross Sections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WS 2-YR
WS 1-YR
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Station (ft)
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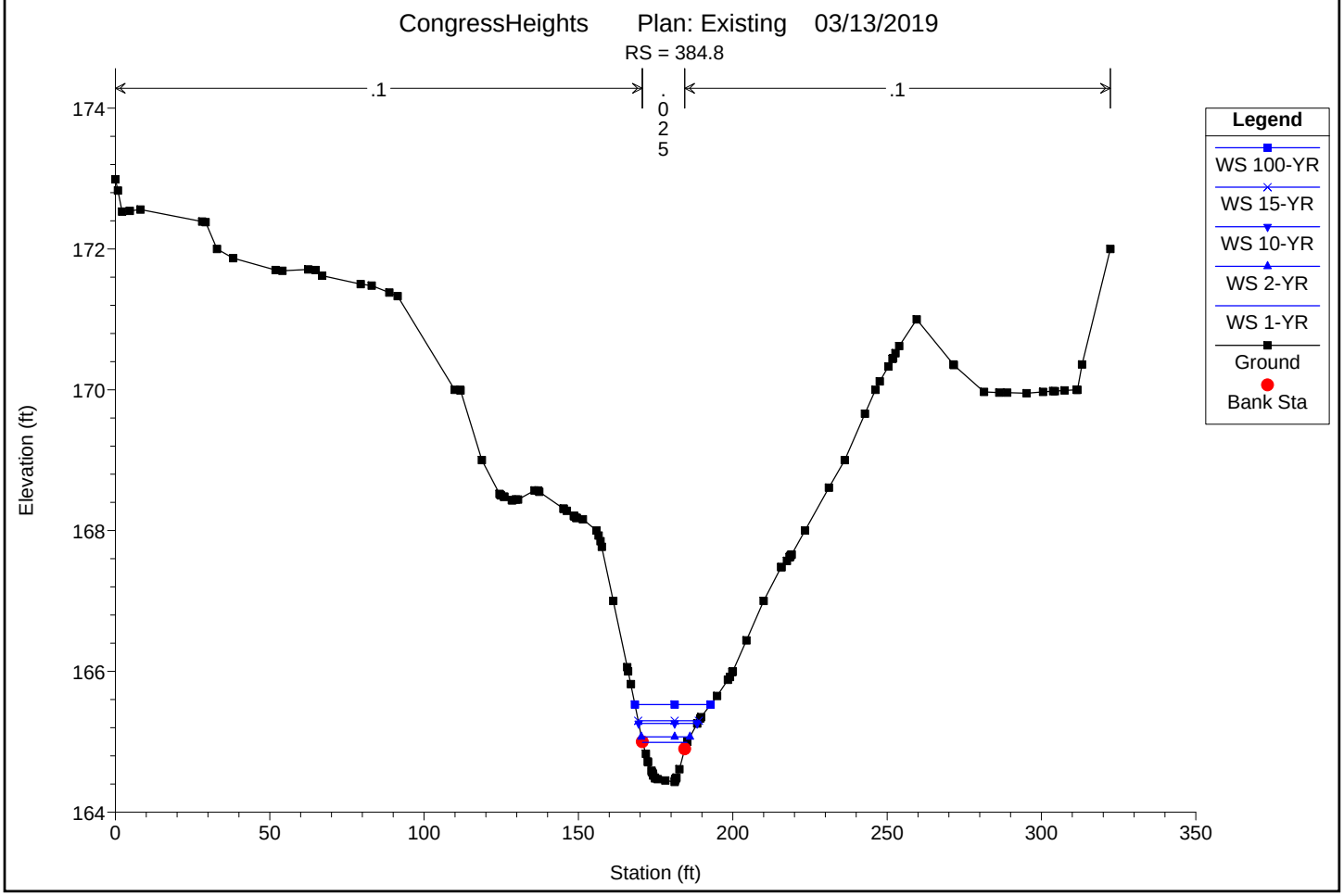
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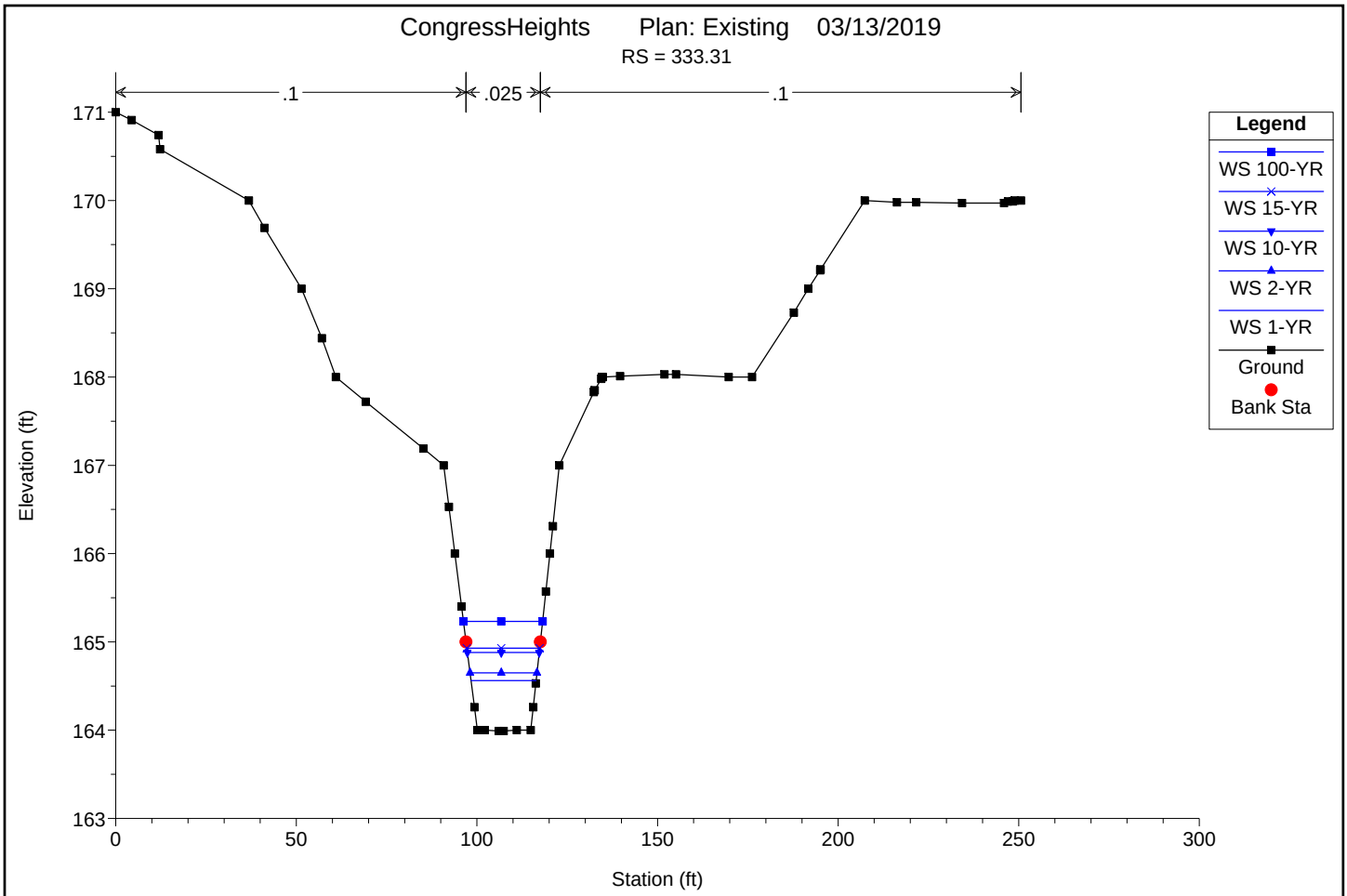
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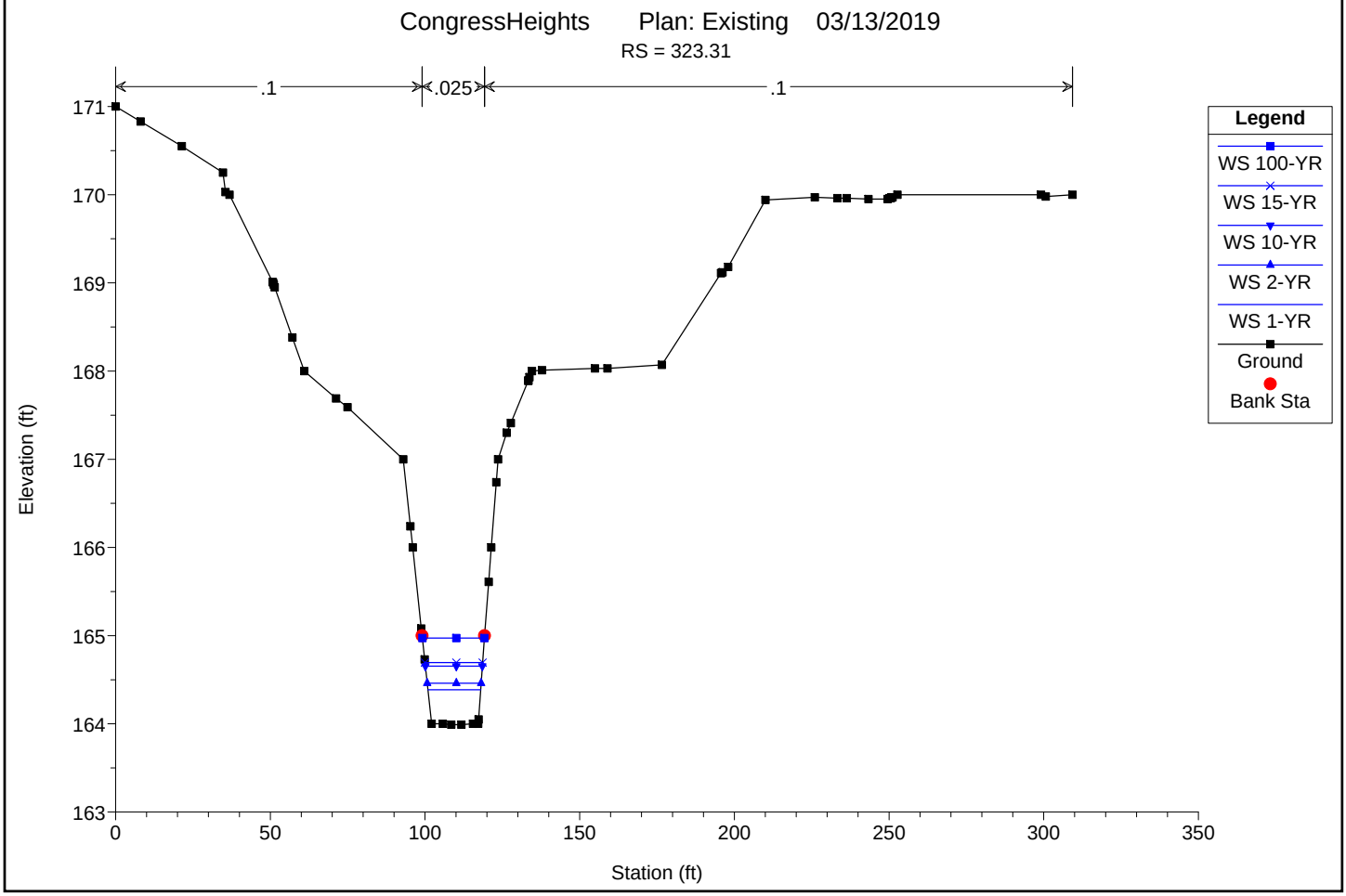
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WS 1-YR
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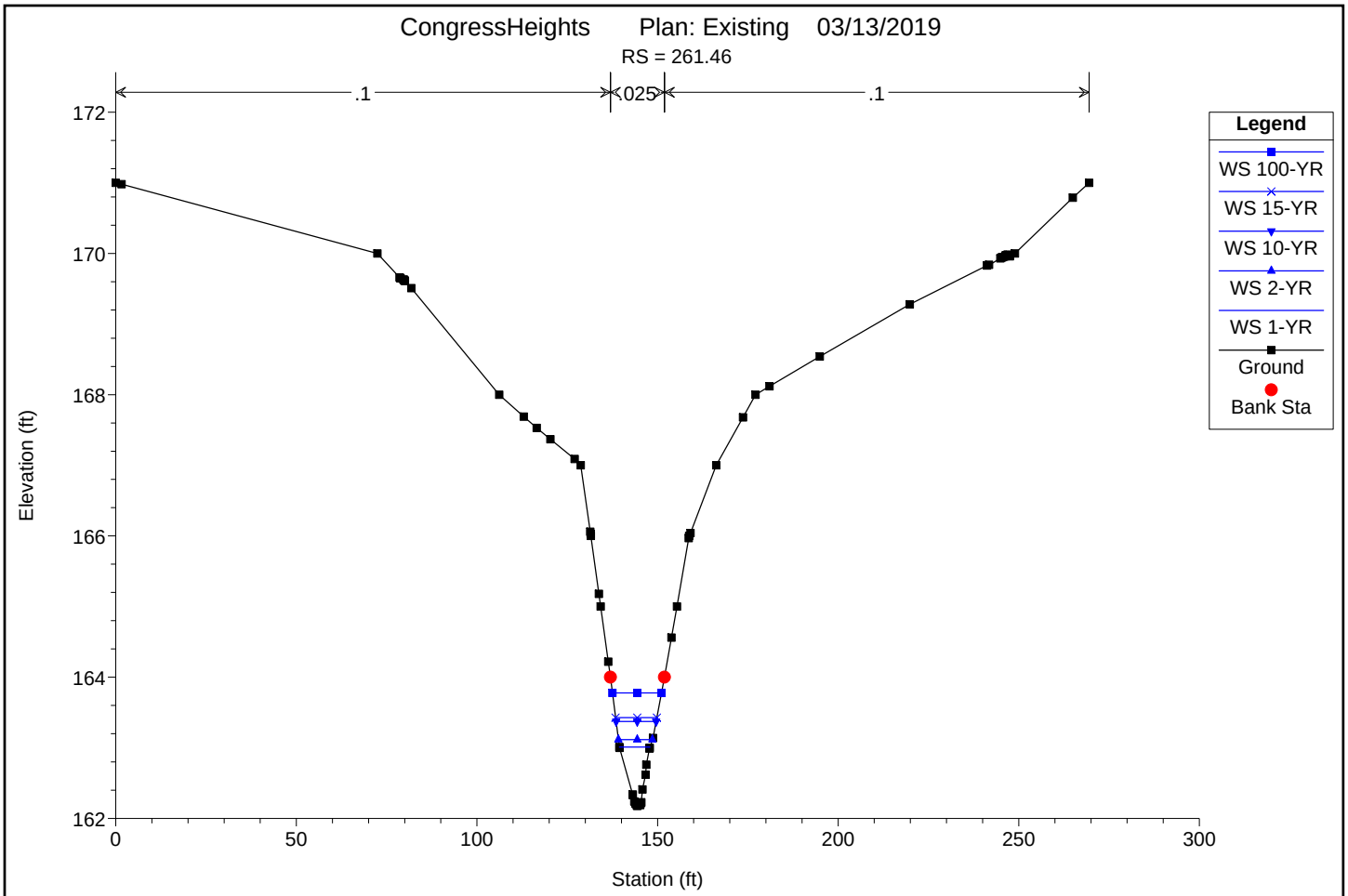
Bank Sta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WS 2-YR
WS 1-YR
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Station (ft)
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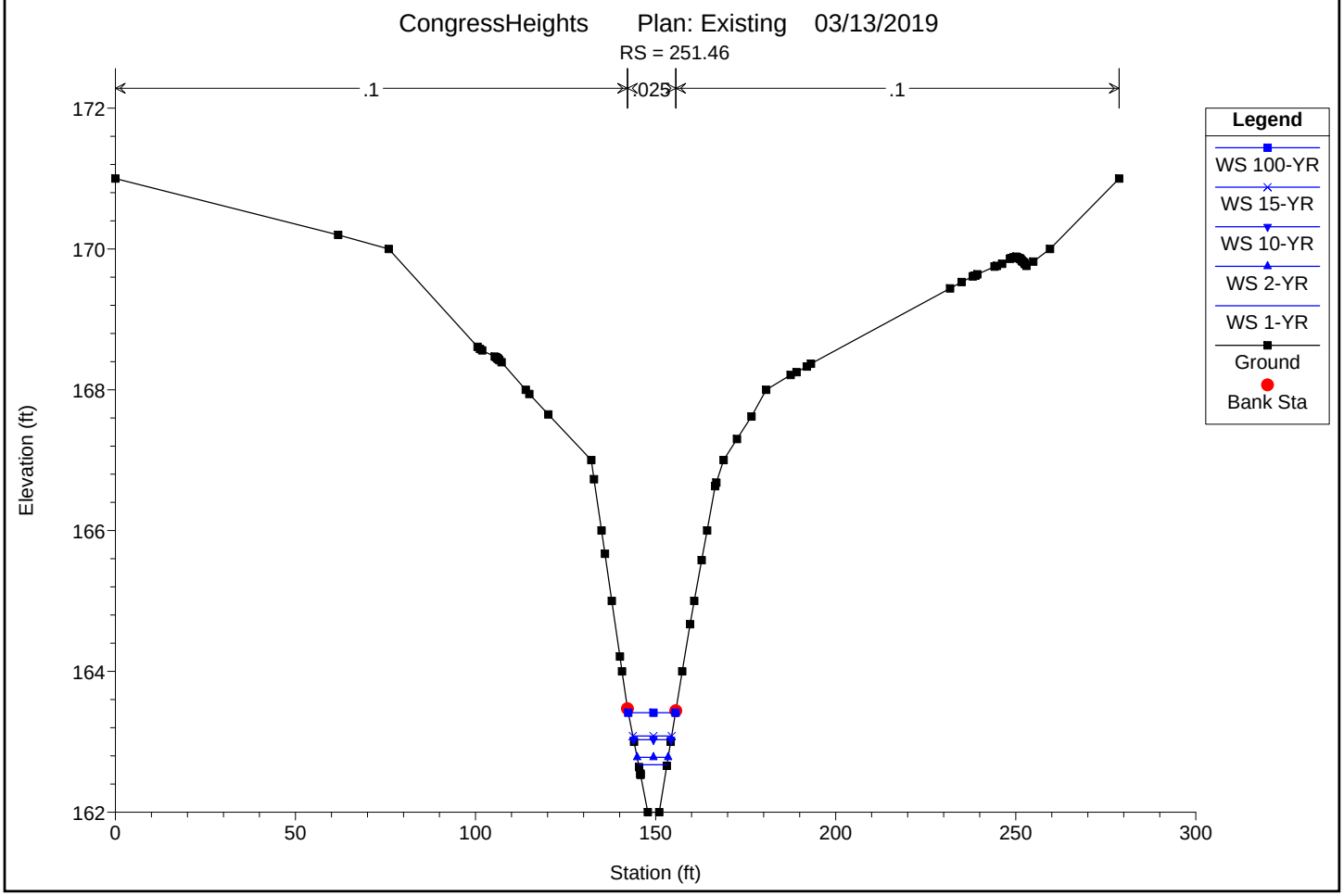
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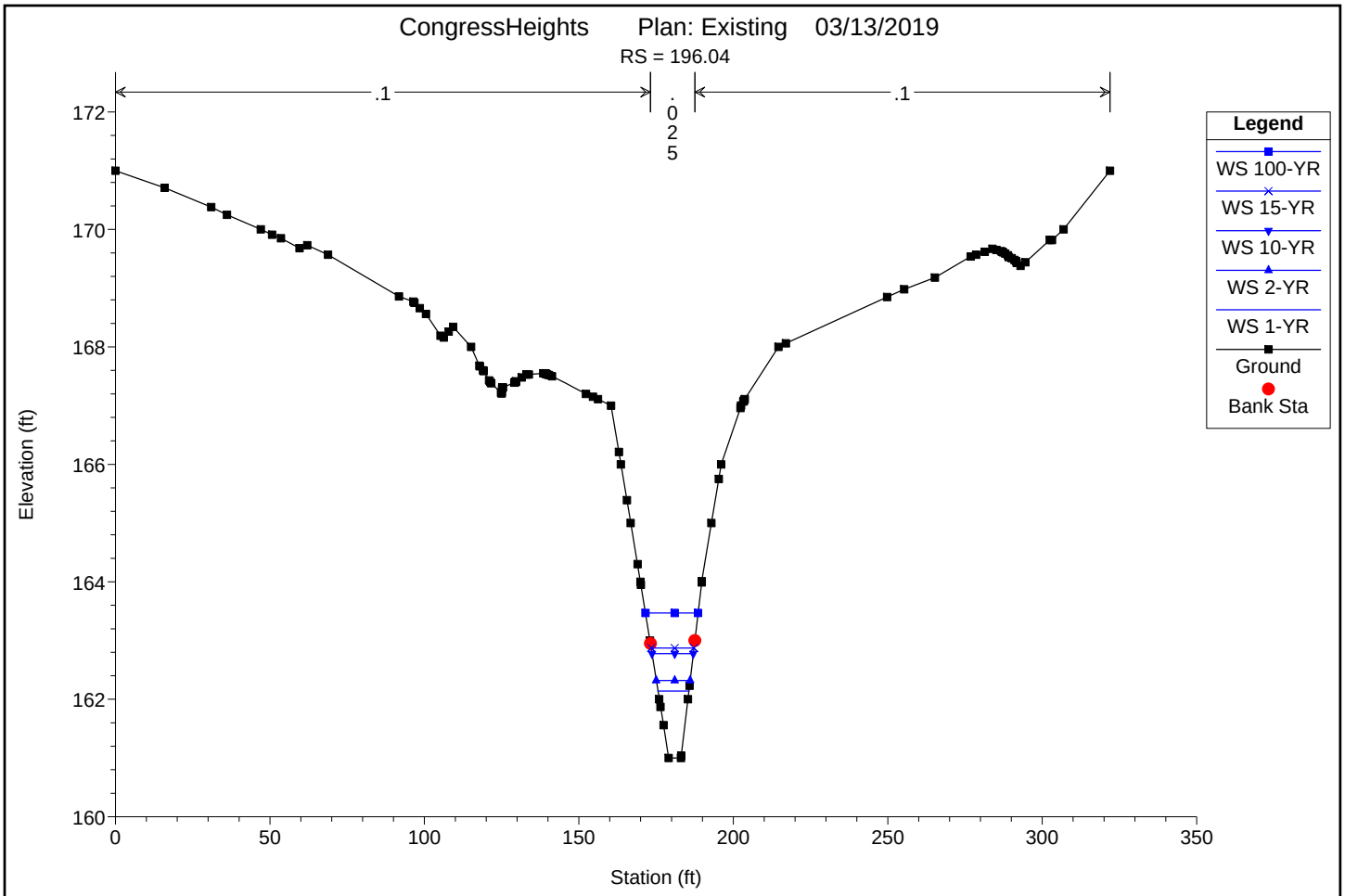
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Ground
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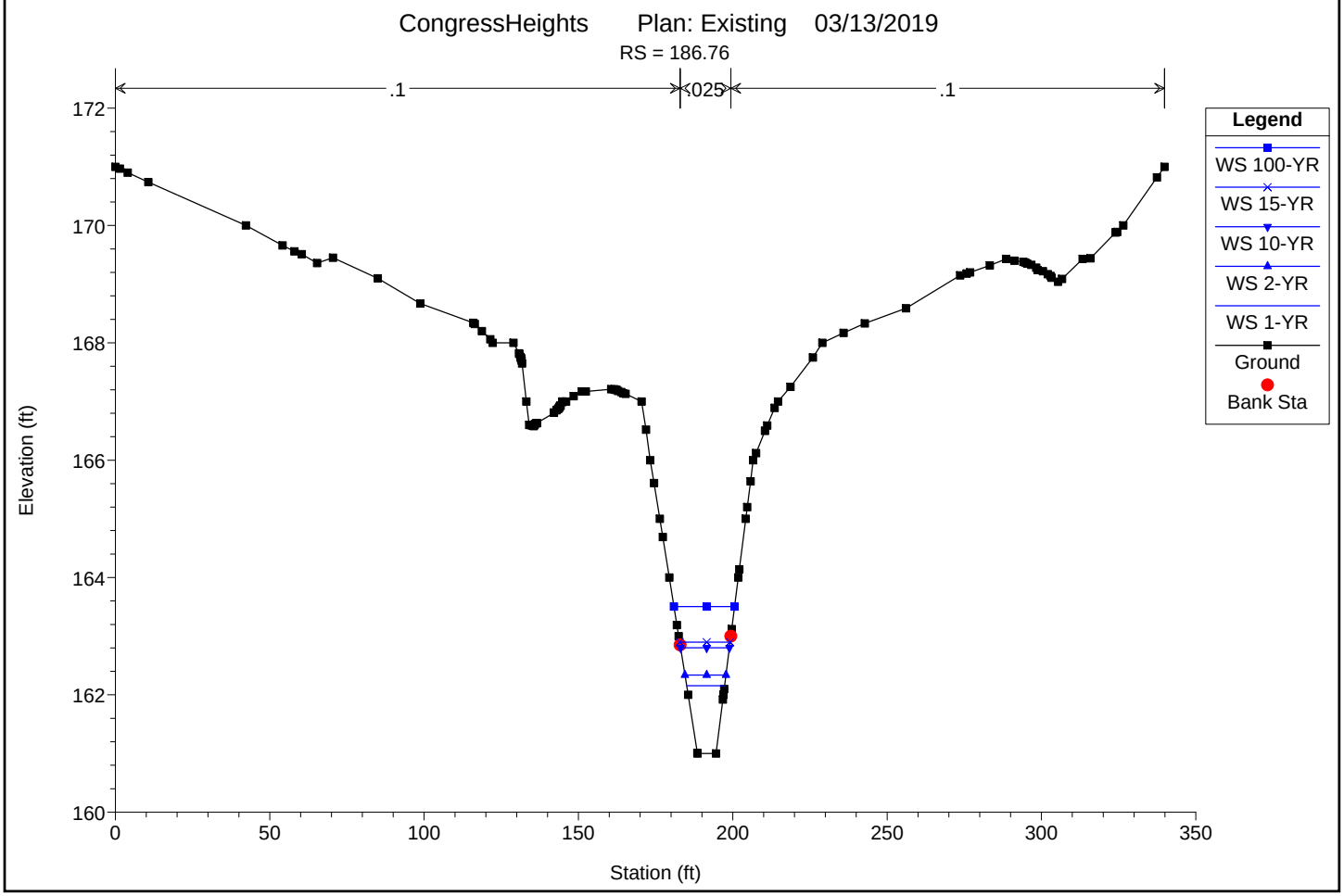
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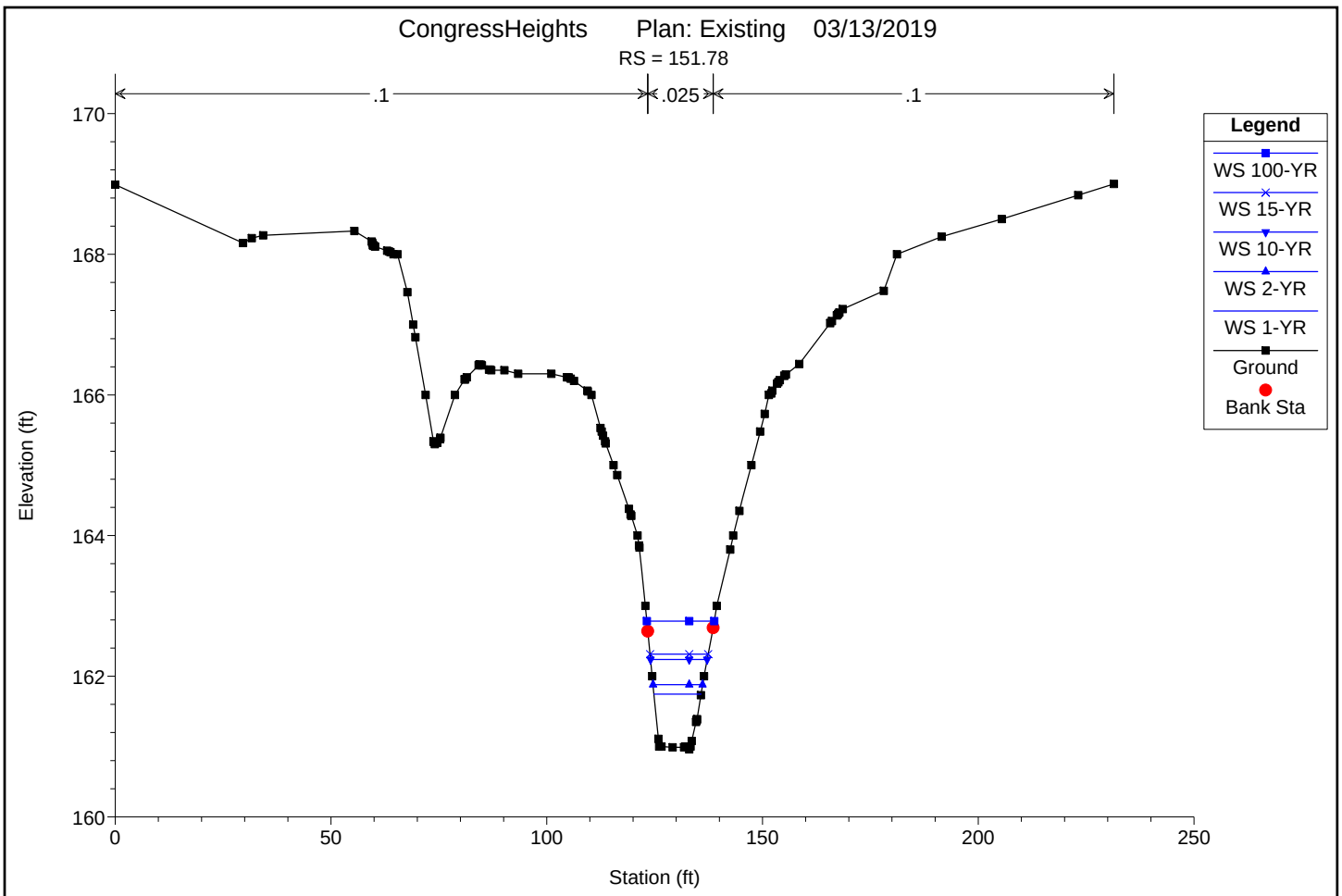
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Station (ft)
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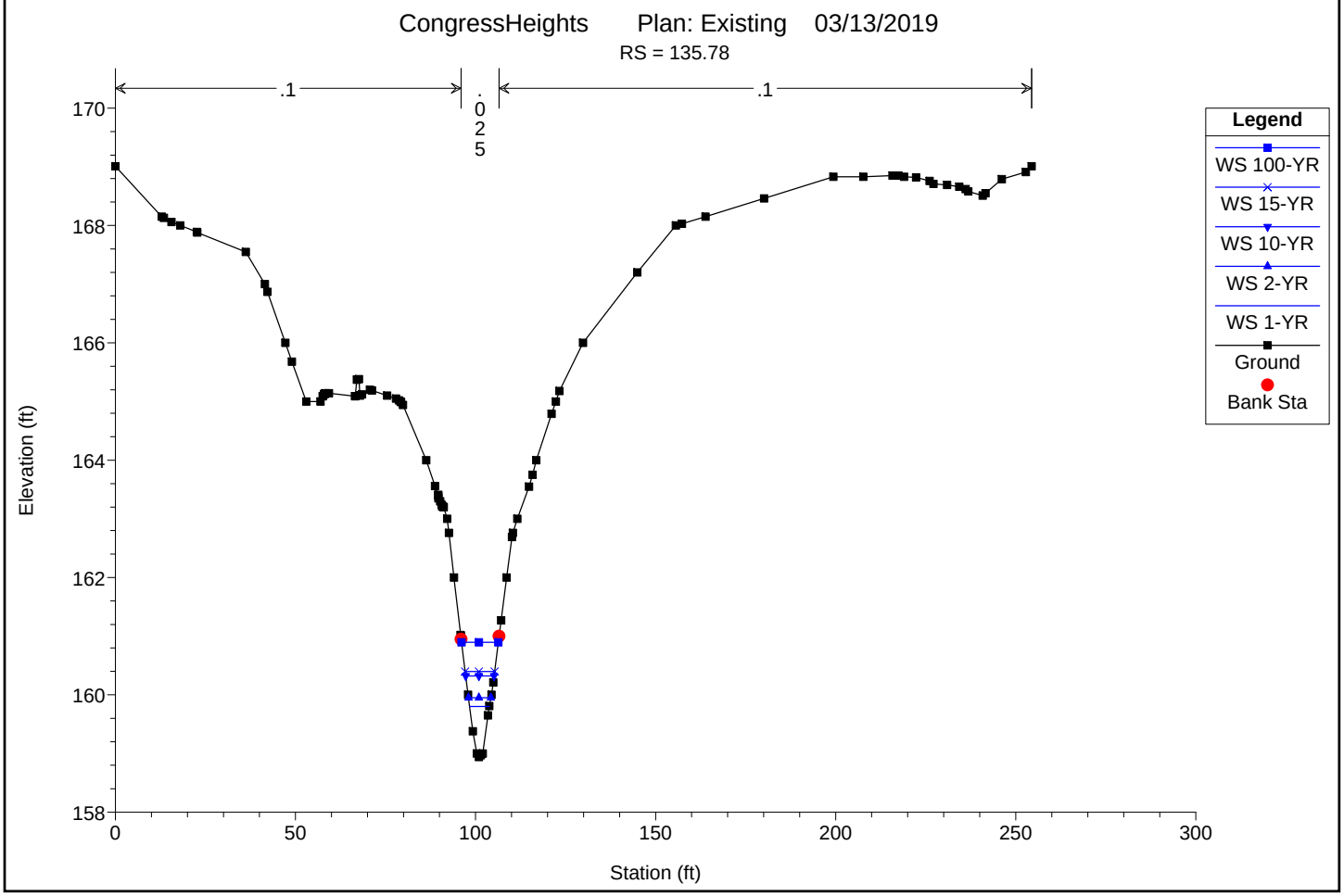
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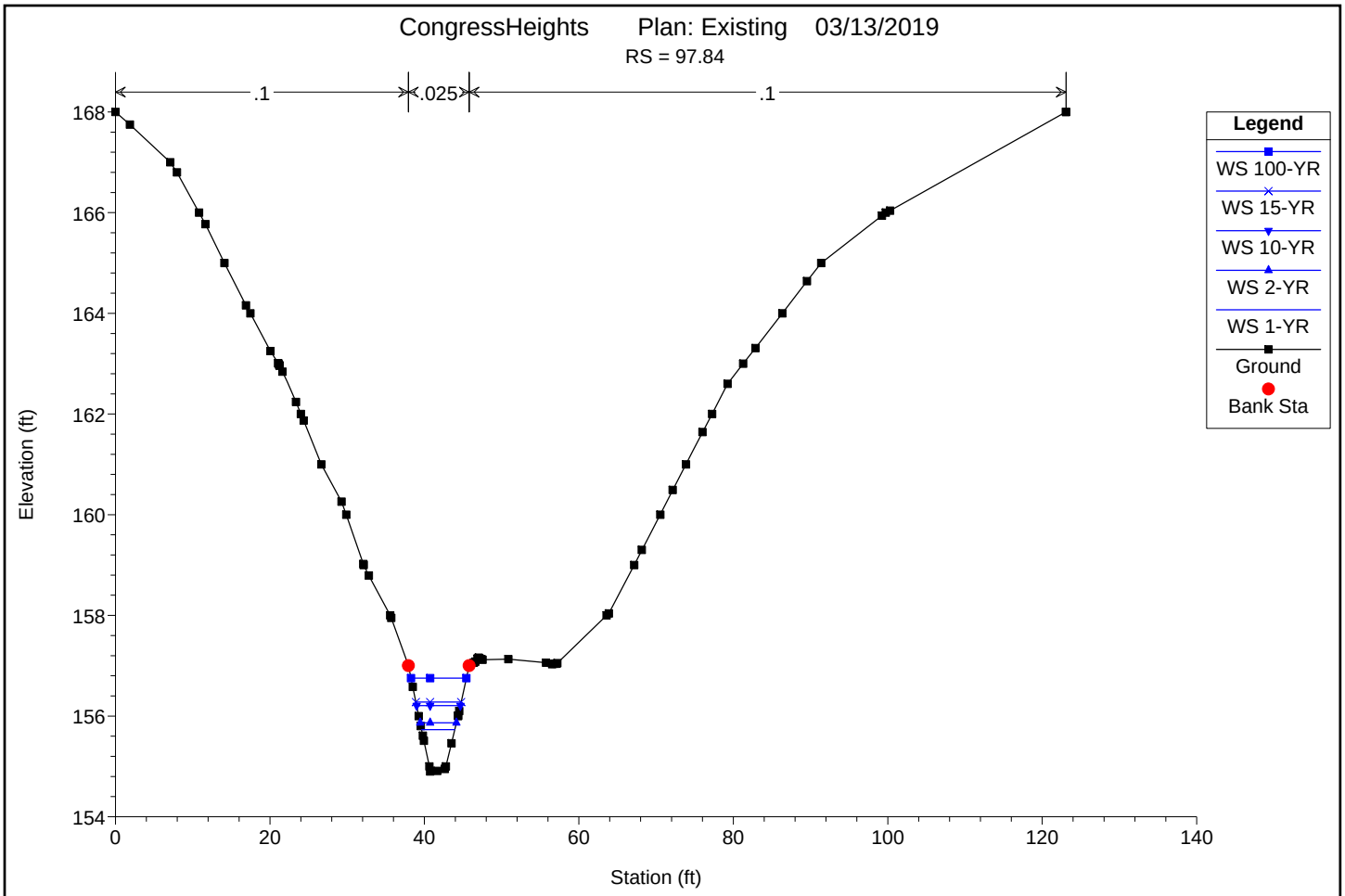
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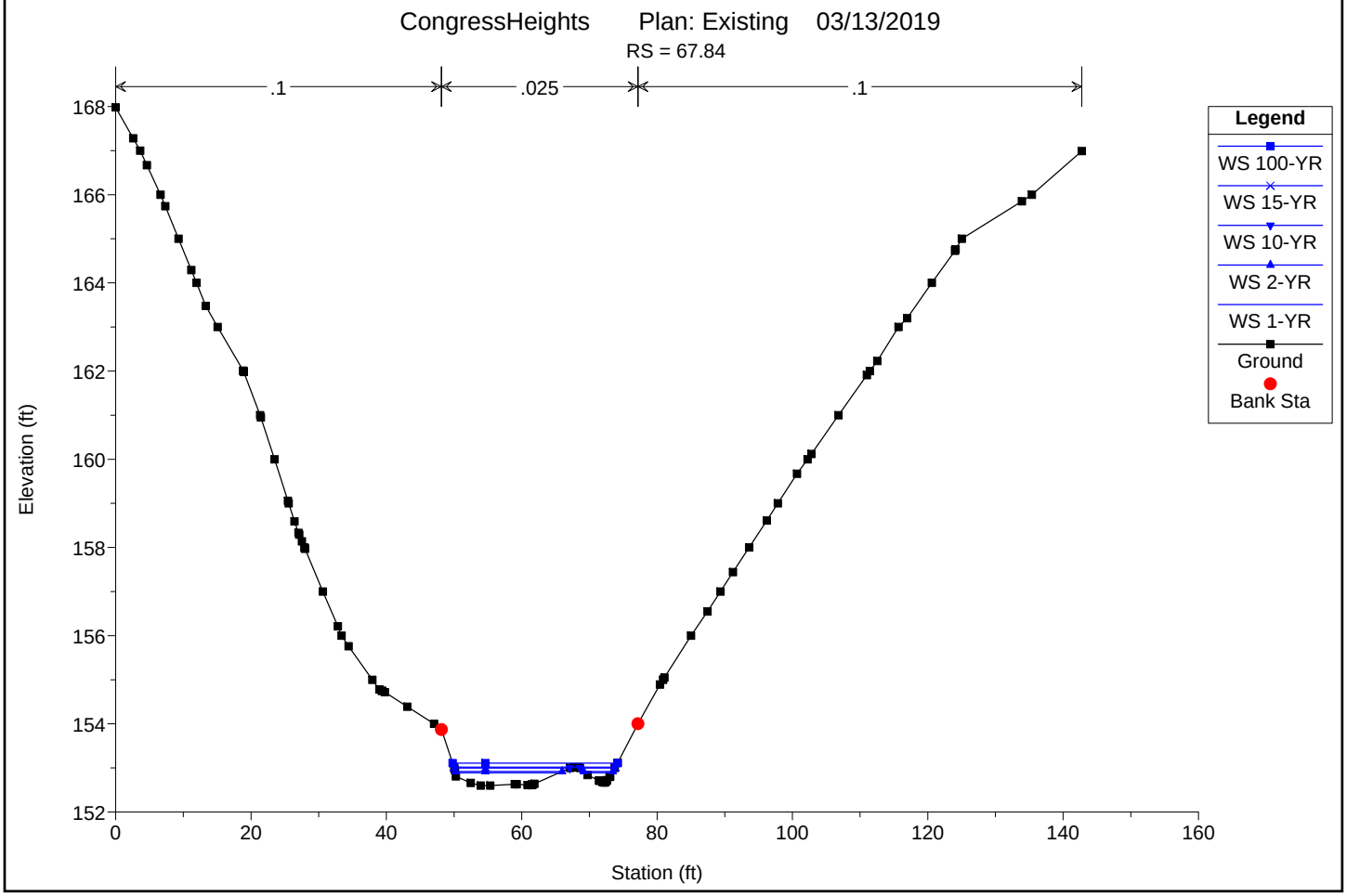
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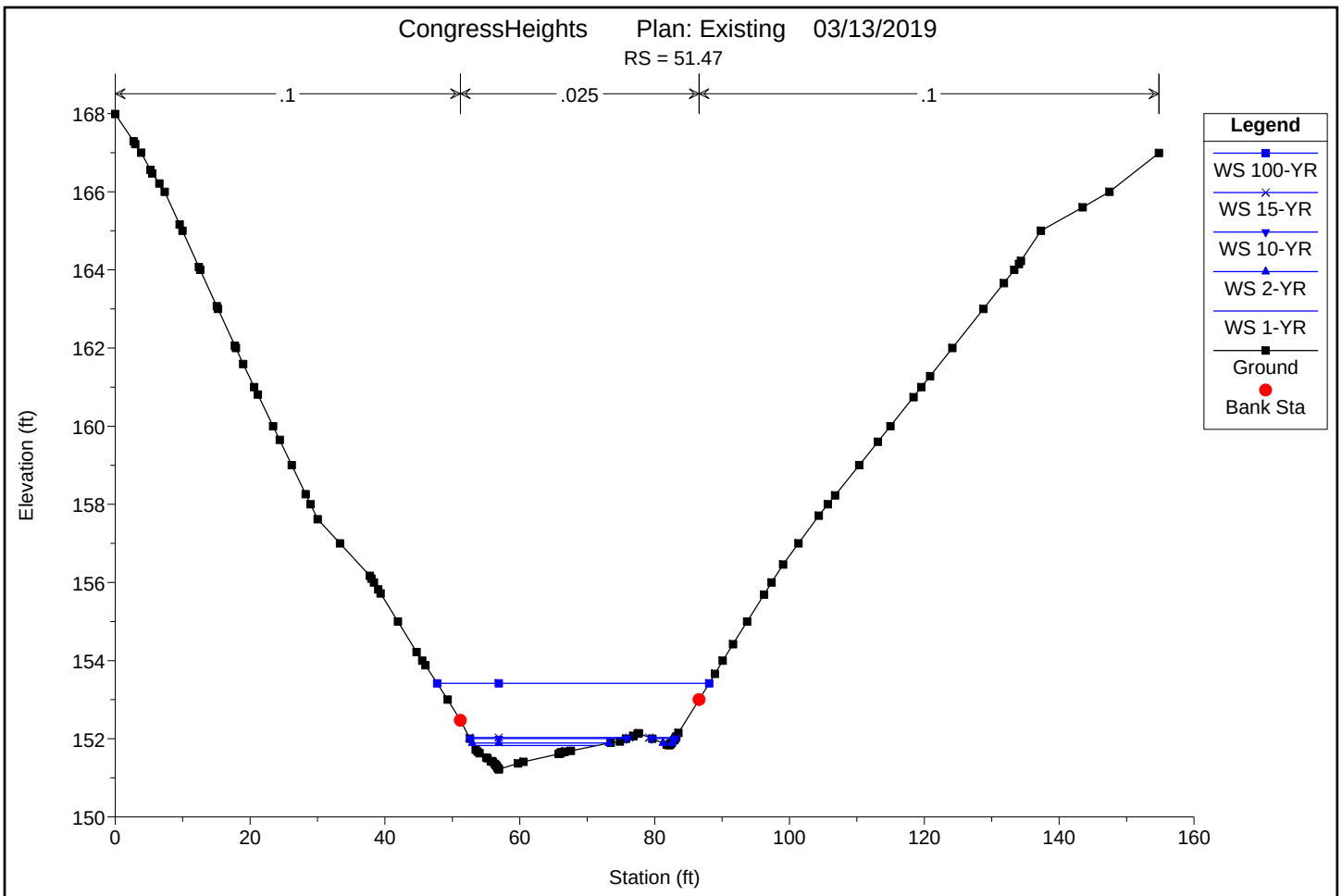
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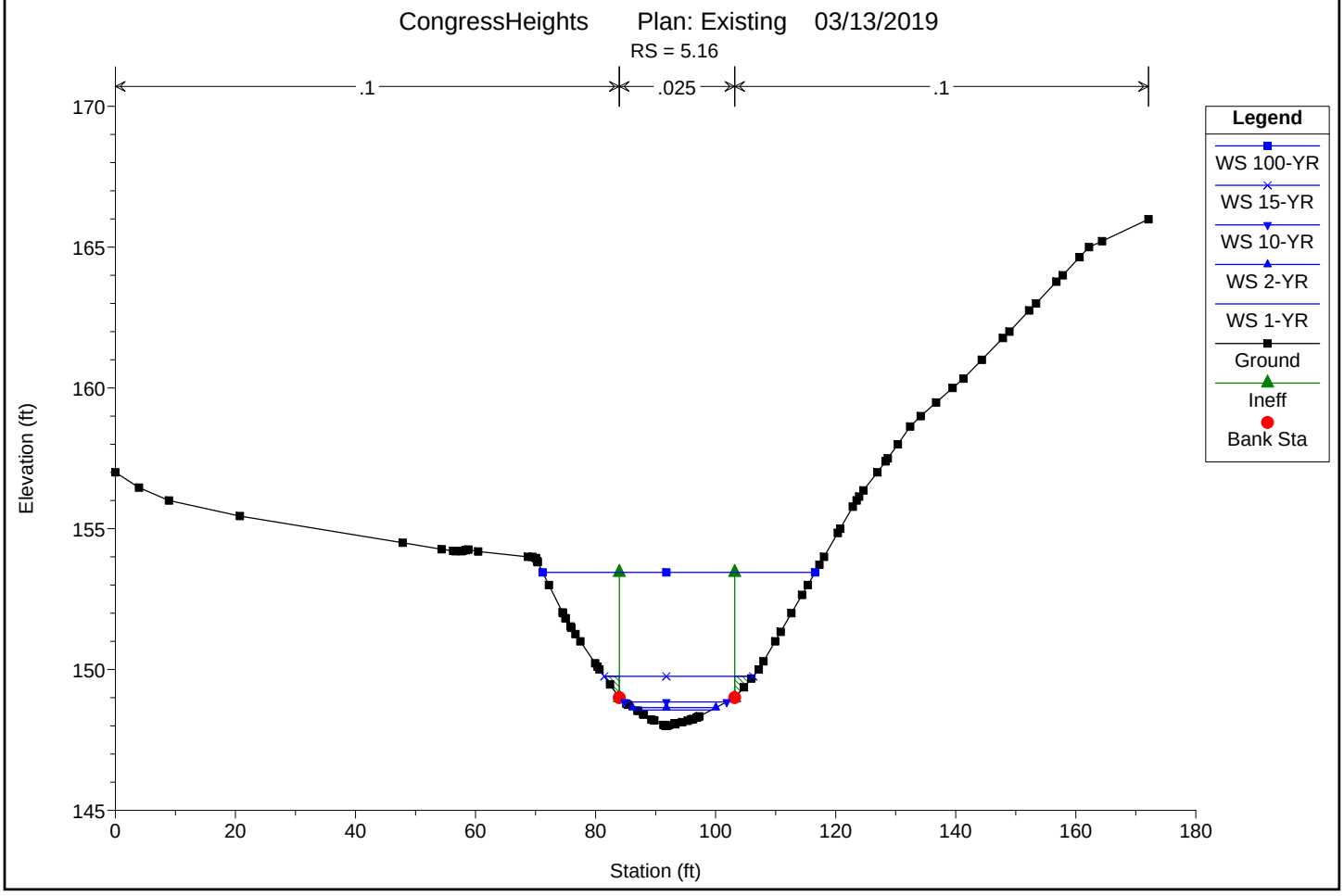
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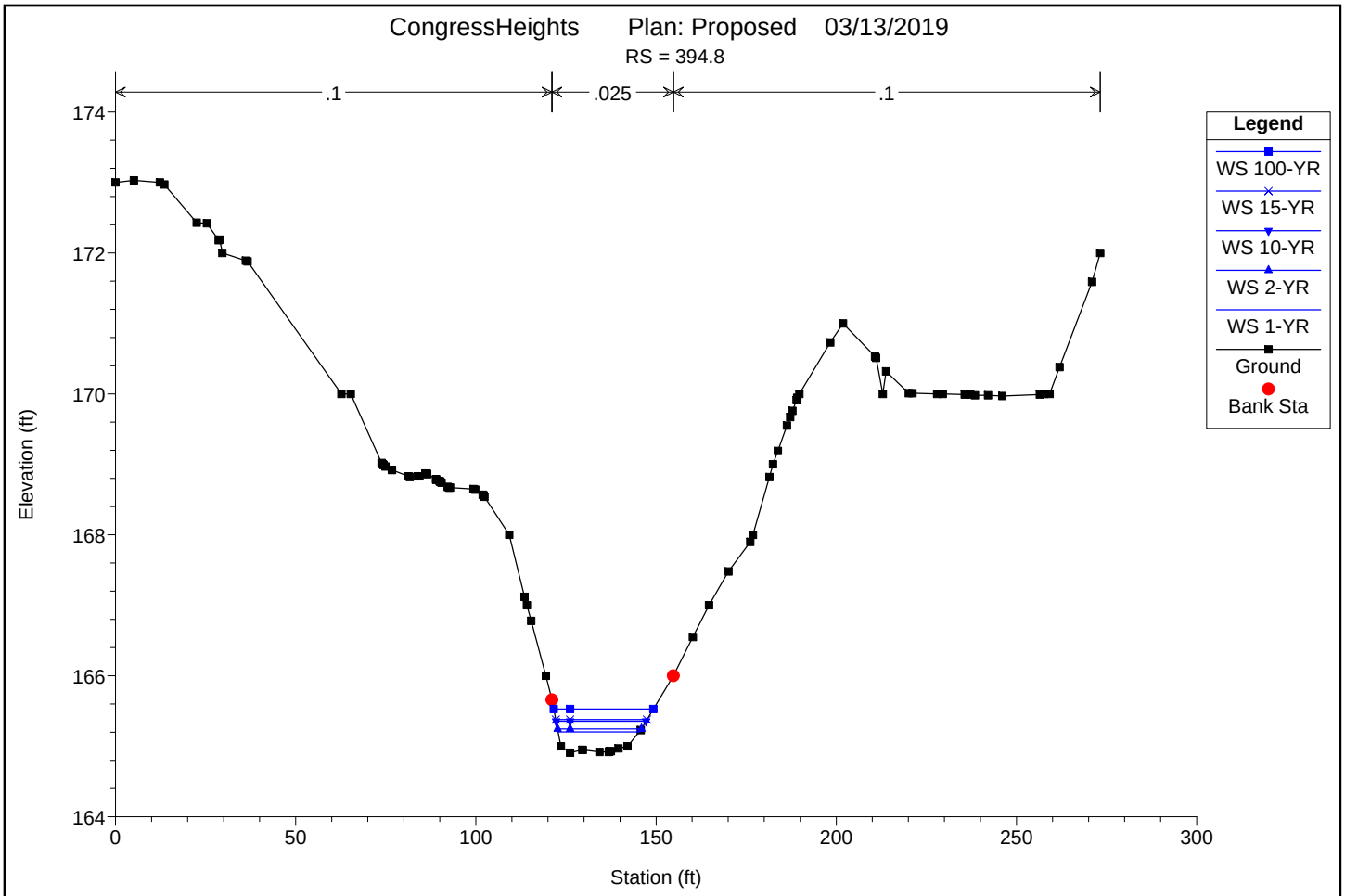
Proposed Cross Sections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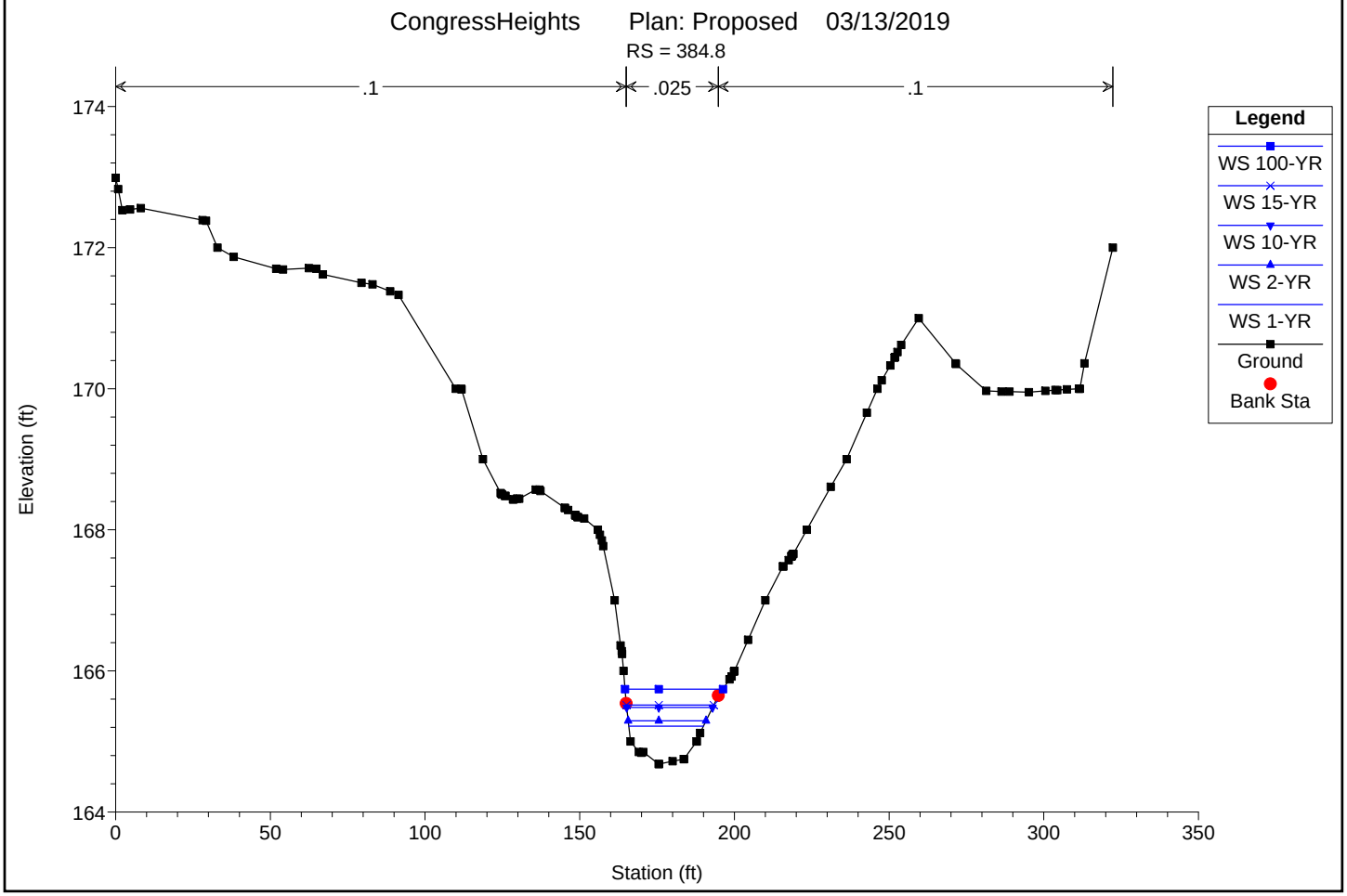
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WS 1-YR
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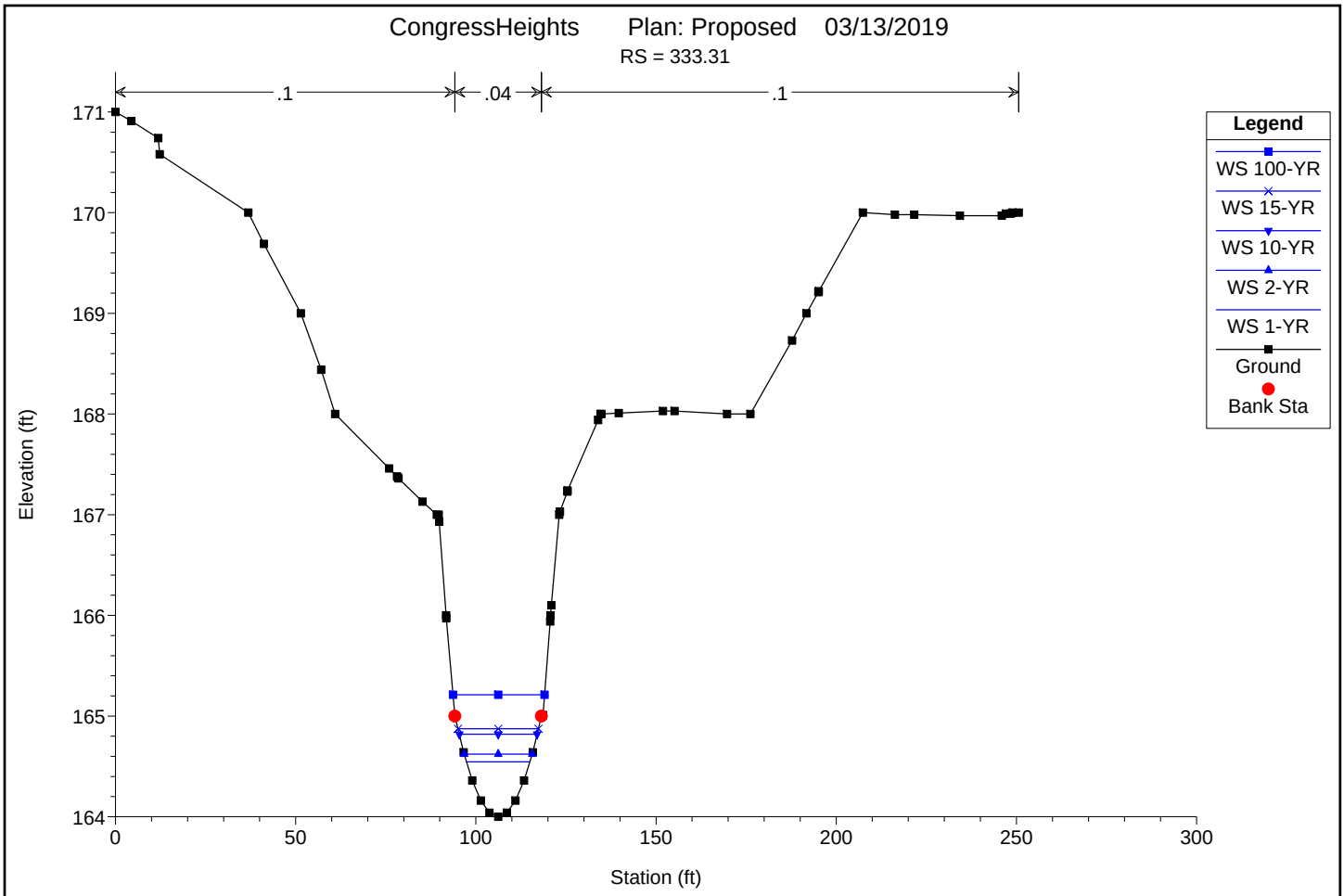
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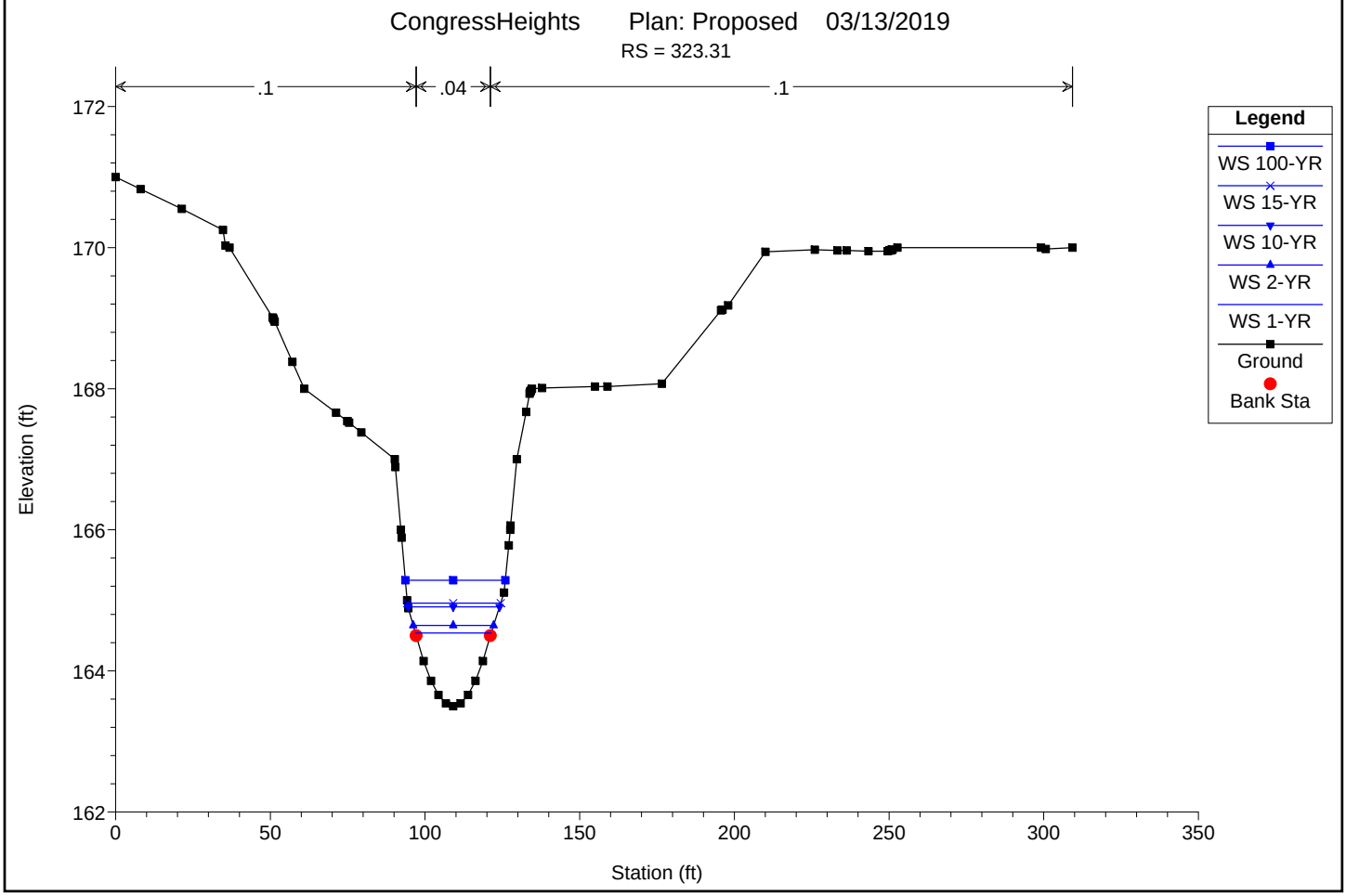
Ground
Bank Sta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WS 1-YR
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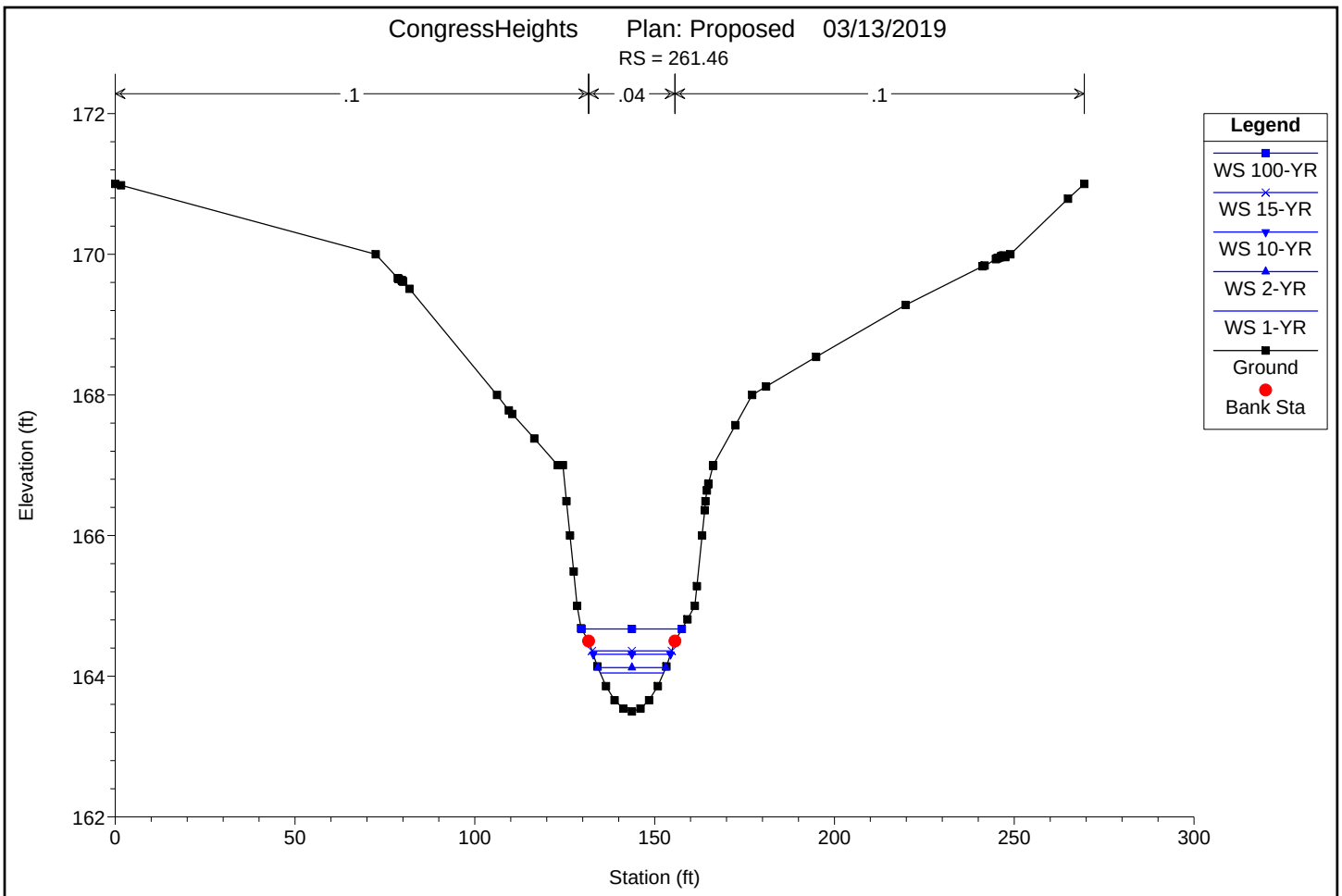
Bank Sta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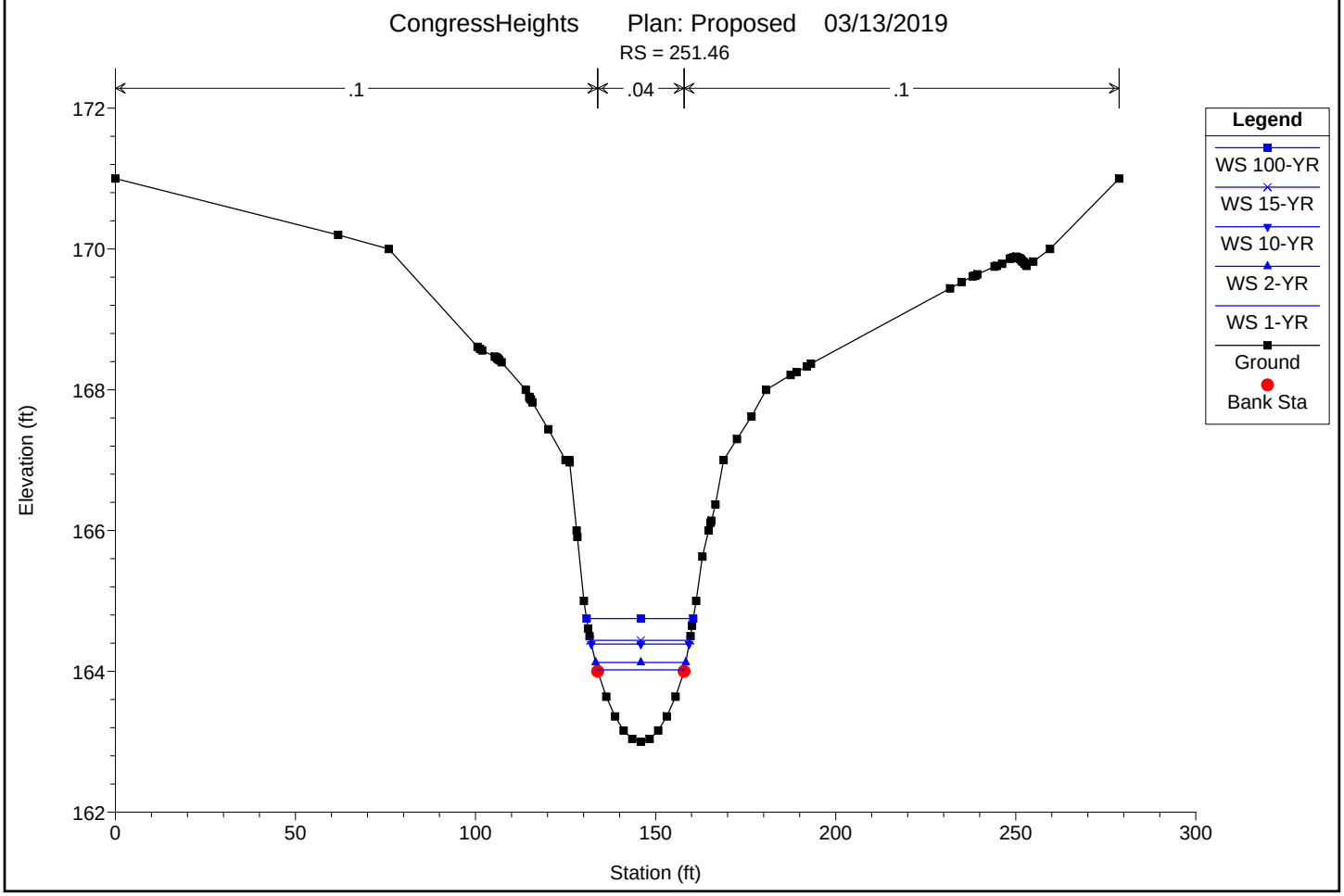
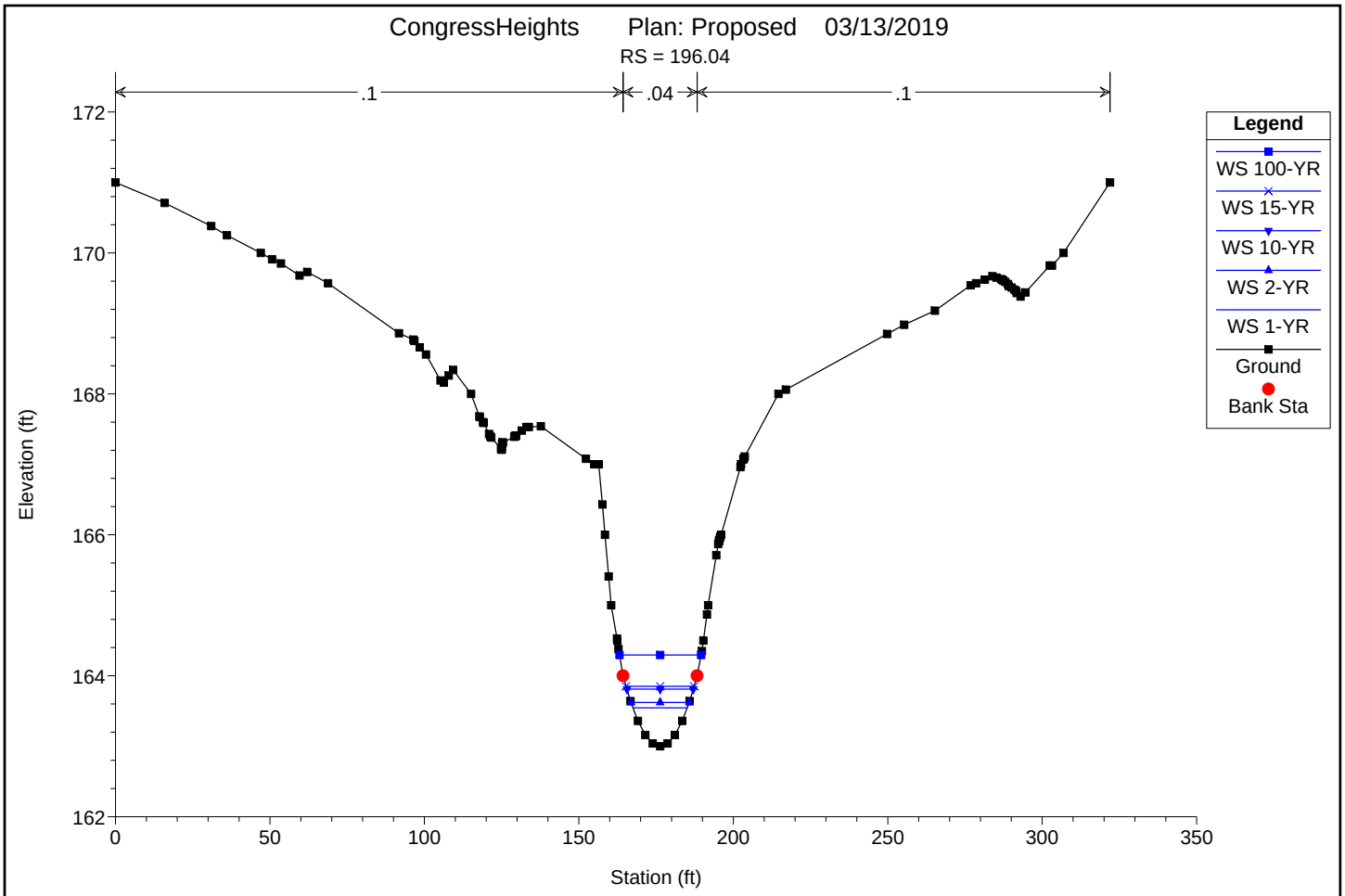
162
0
50
100
150
200
250
300
Station (ft)
Legend
WS 100-YR
WS 15-YR
WS 10-YR
WS 2-YR
WS 1-YR
Ground
Bank Sta


CongressHeights Plan: Proposed 03/13/2019
RS = 251.46
.1
.04
.1
Elevation (ft)
172
170
168
166
164
162
0
50
100
150
200
250
300
Station (ft)
Legend
WS 100-YR
WS 15-YR
WS 10-YR
WS 2-YR
WS 1-YR
Ground
Bank Sta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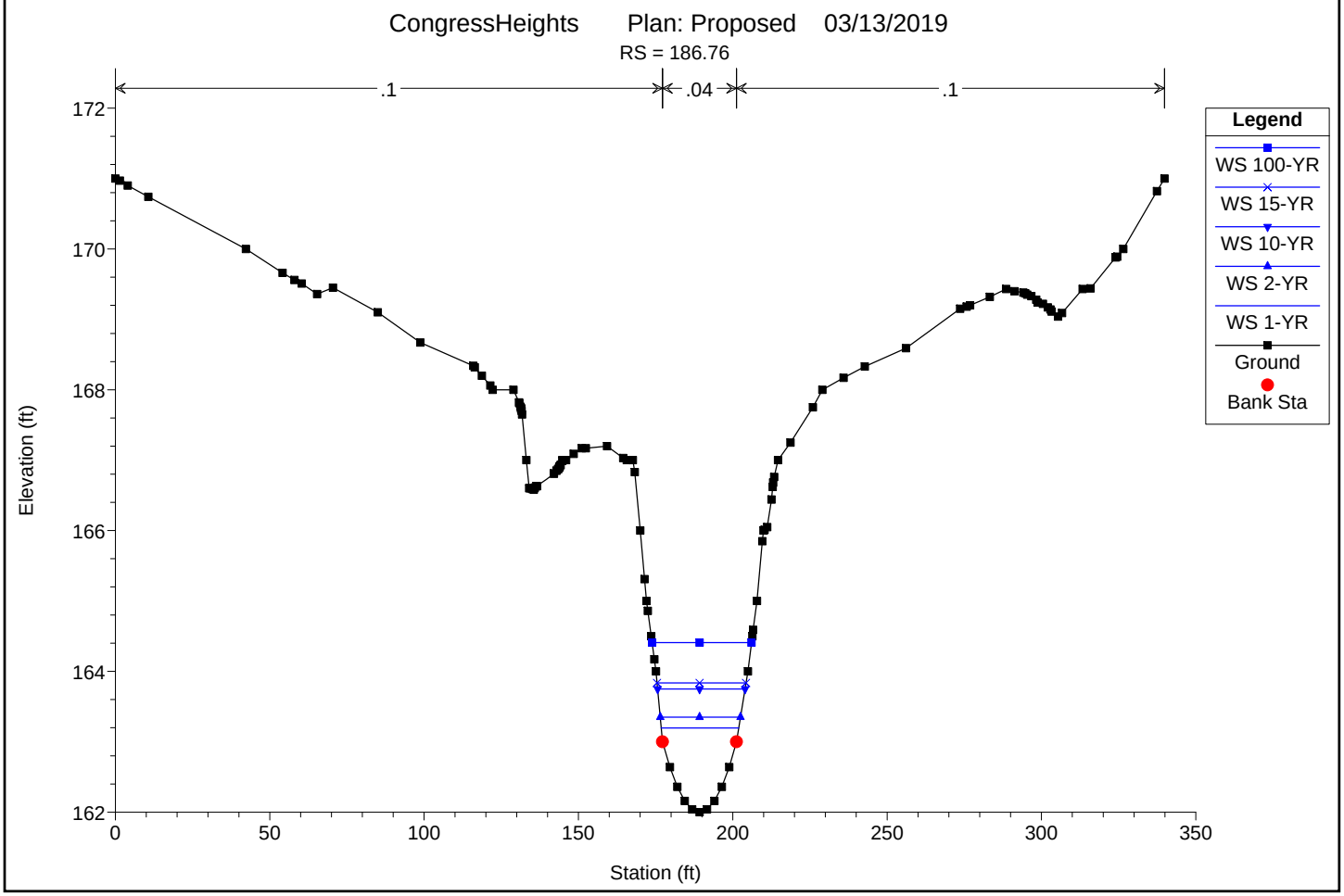
.04
.1
Legend
WS 100-YR
WS 15-YR
WS 10-YR
WS 2-YR
WS 1-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
162
164
166
168
170
172
0
50
100
150
200
250
300
350


CongressHeights Plan: Proposed 03/13/2019
RS = 186.76
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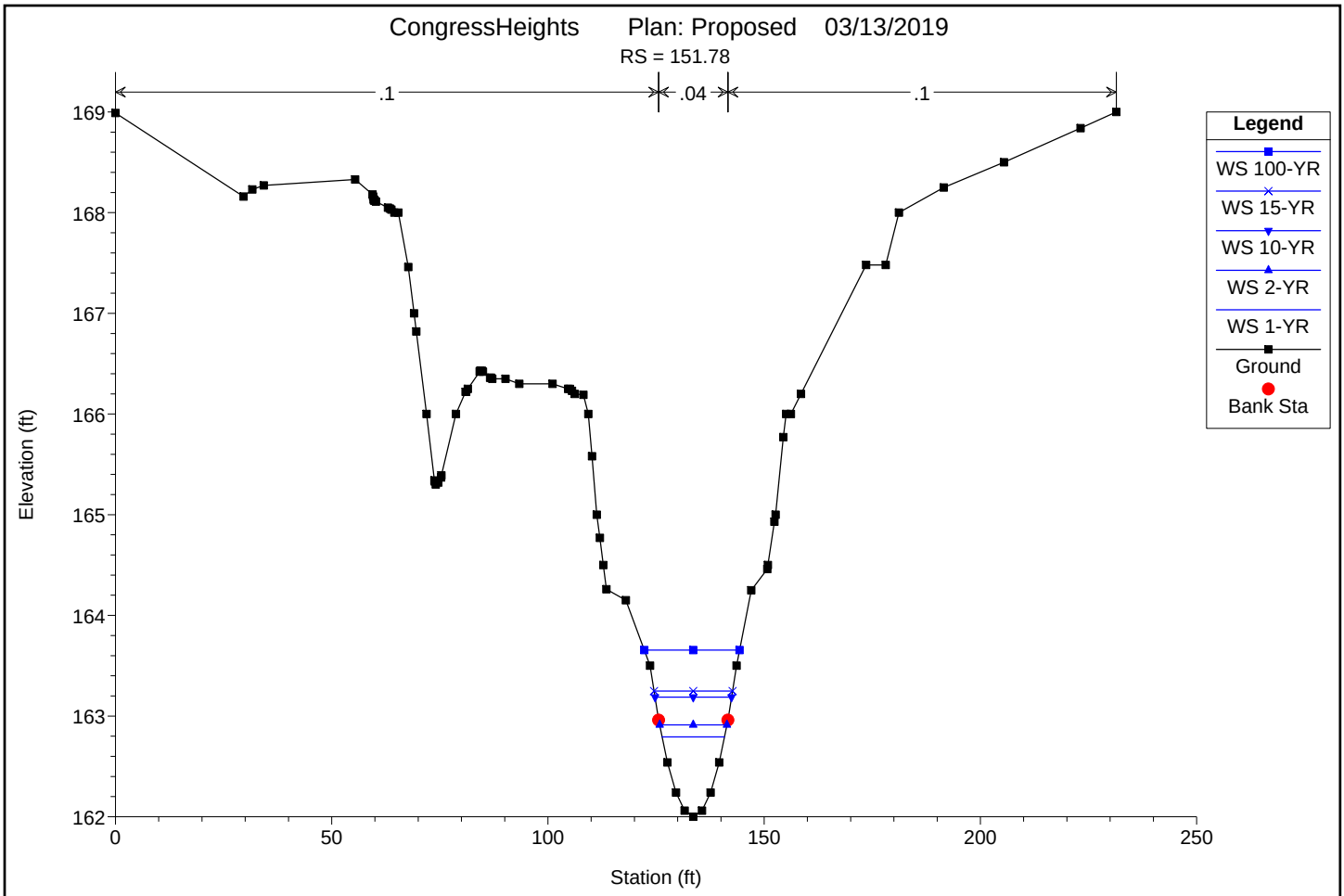
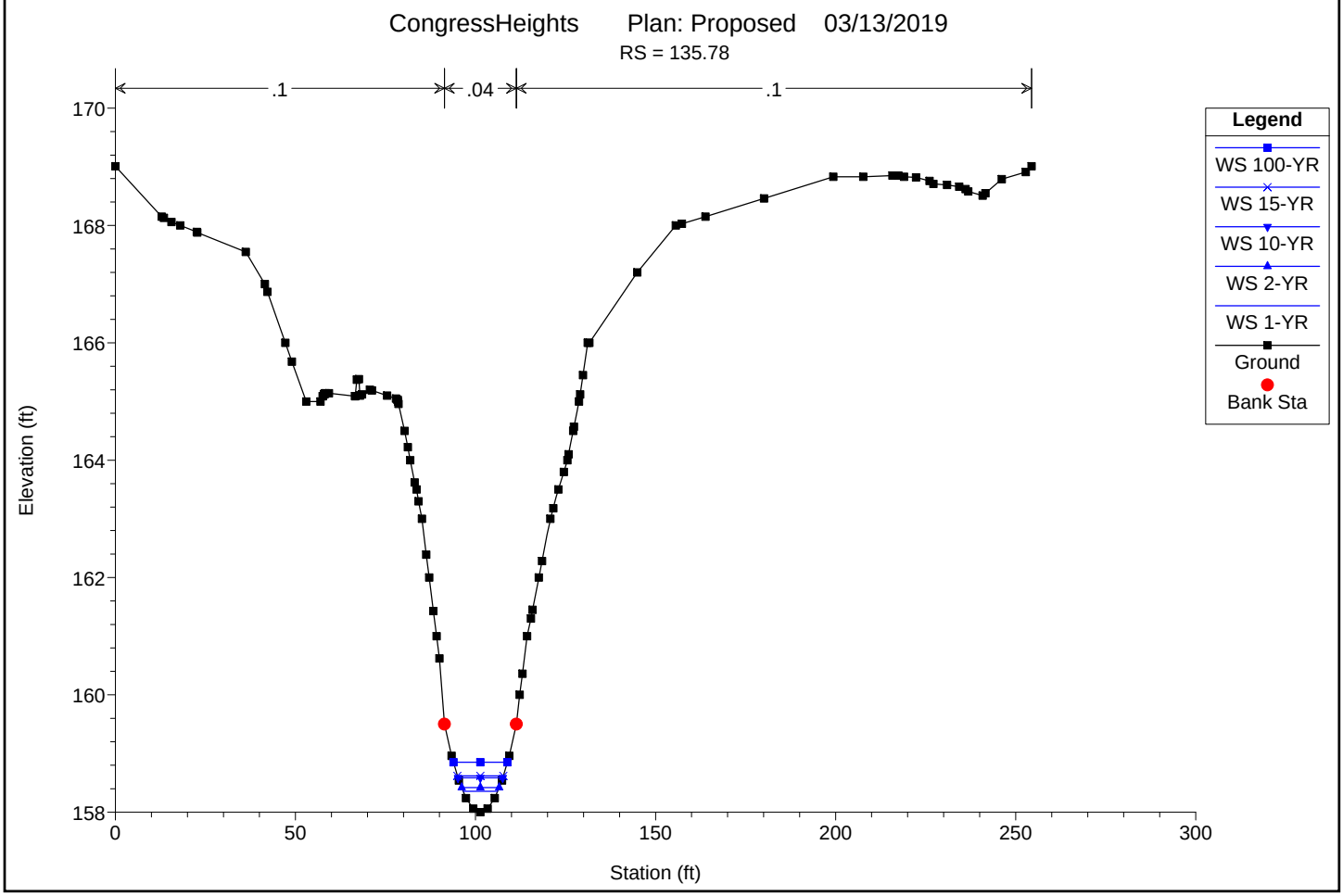
.04
.1
Legend
WS 100-YR
WS 15-YR
WS 10-YR
WS 2-YR
WS 1-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
162
164
166
168
170
172
0
50
100
150
200
250
300
350


CongressHeights Plan: Proposed 03/13/2019
RS = 151.78
.1
.04
.1
Legend
WS 100-YR
WS 15-YR
WS 10-YR
WS 2-YR
WS 1-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
169
168
167
166
165
164
163
162
0
50
100
150
200
250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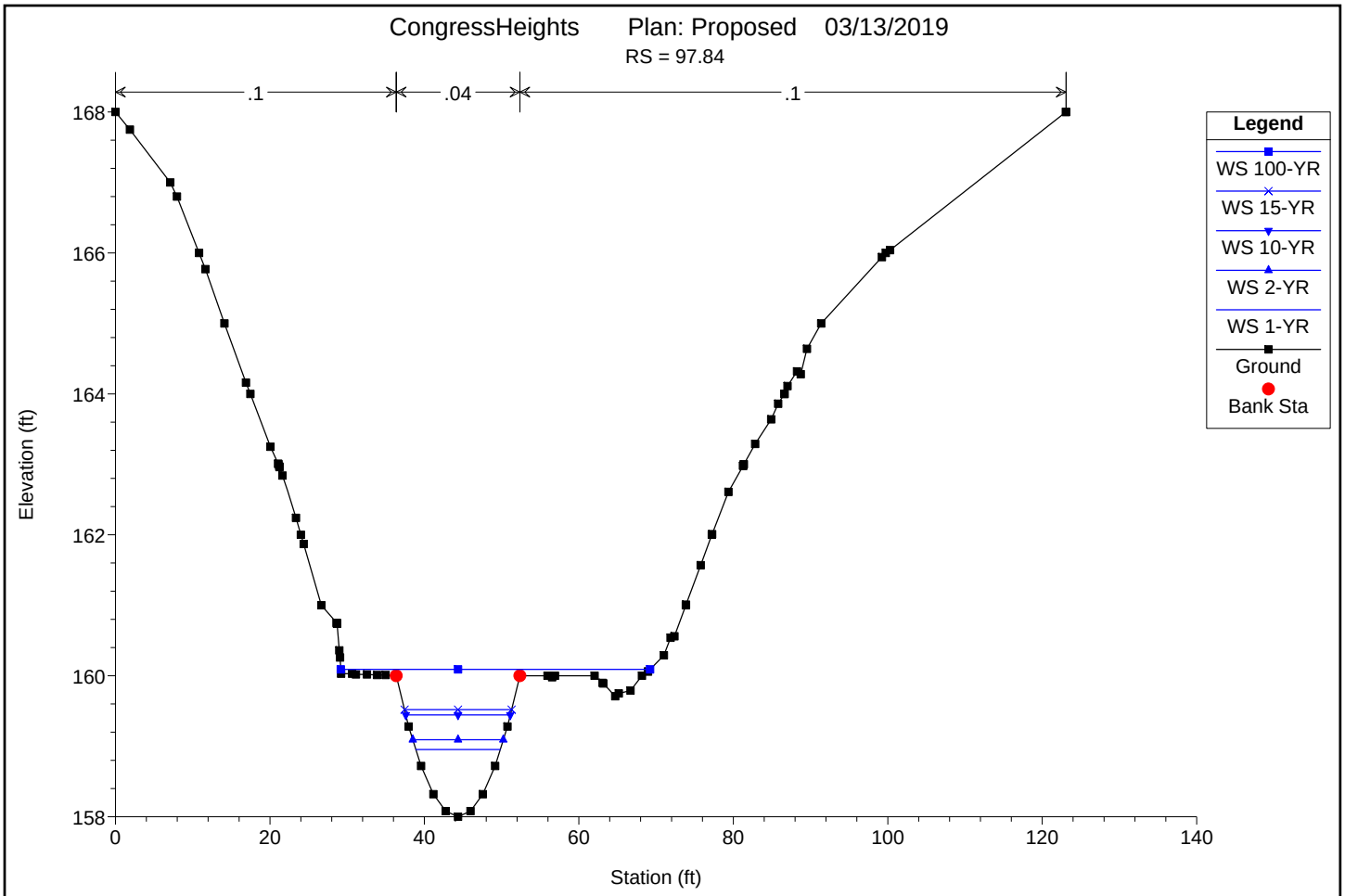
.1
.04
.1
Legend
WS 100-YR
WS 15-YR
WS 10-YR
WS 2-YR
WS 1-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
170
168
166
164
162
160
158
0
50
100
150
200
250
300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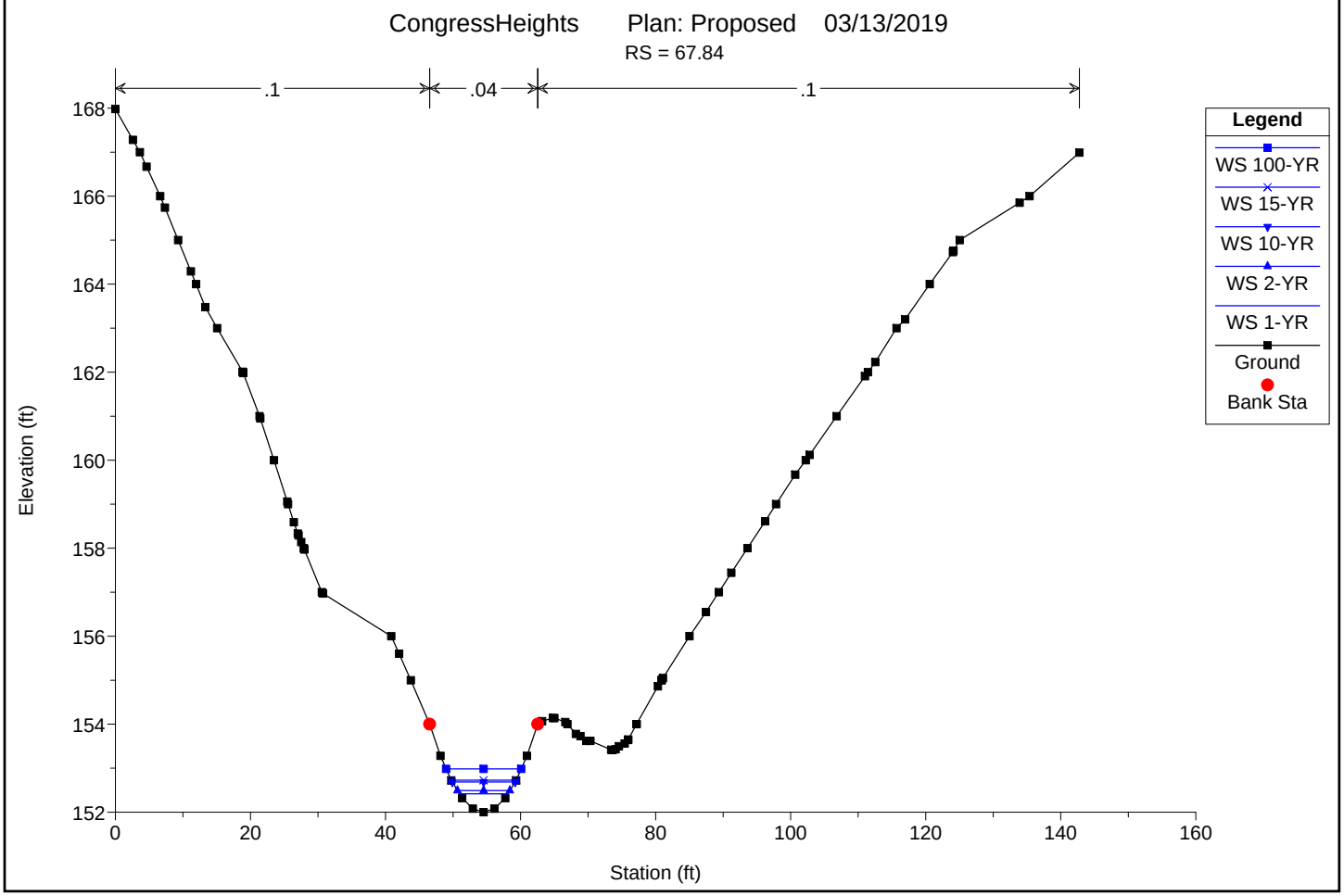
.04
.1
Legend
WS 100-YR
WS 15-YR
WS 10-YR
WS 2-YR
WS 1-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
168
166
164
162
160
158
0
20
40
60
80
100
120
140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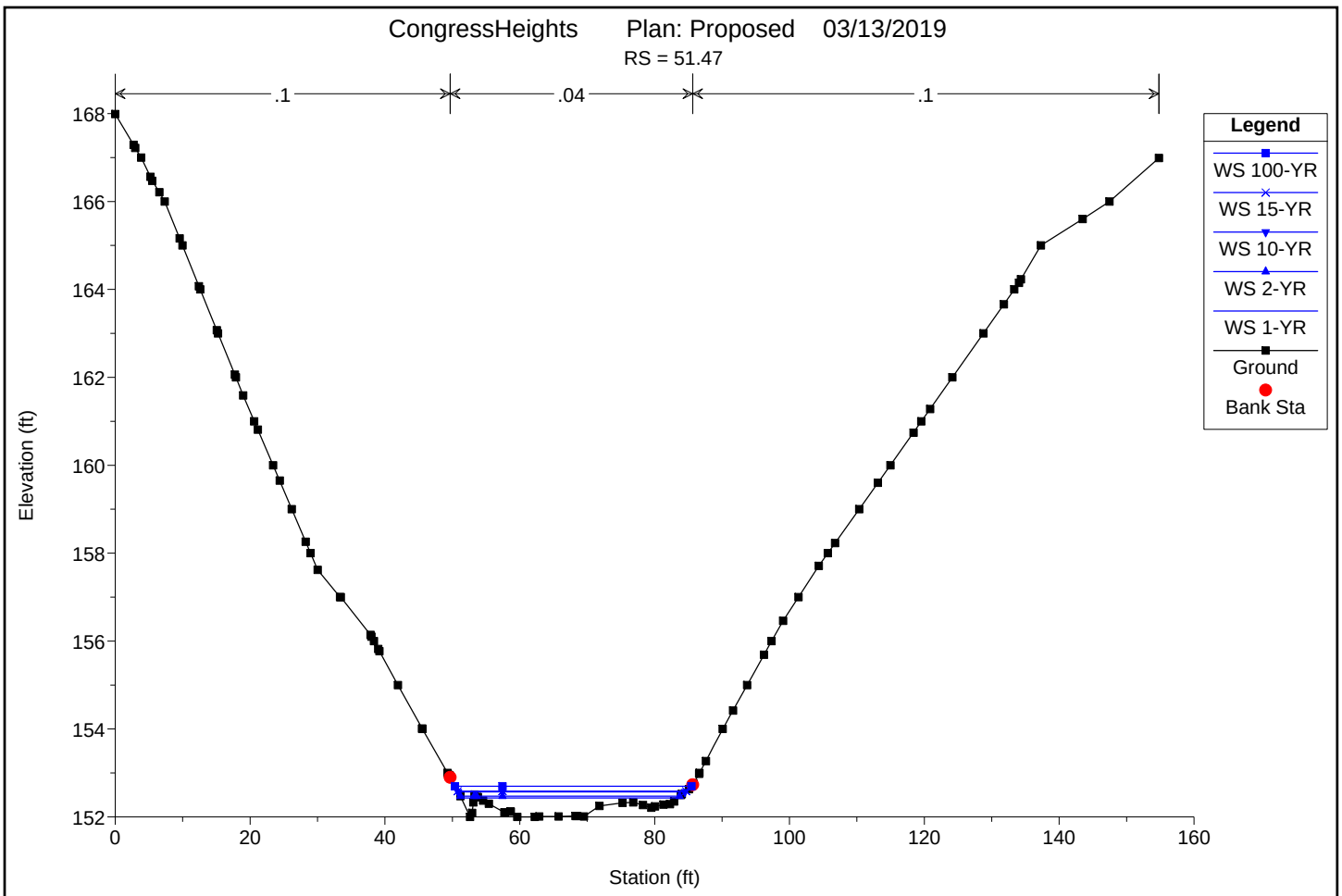
RS = 67.84
.1
.04
.1
Legend
WS 100-YR
WS 15-YR
WS 10-YR
WS 2-YR
WS 1-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
168
166
164
162
160
158
156
154
152
0
20
40
60
80
100
120
140
160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.04
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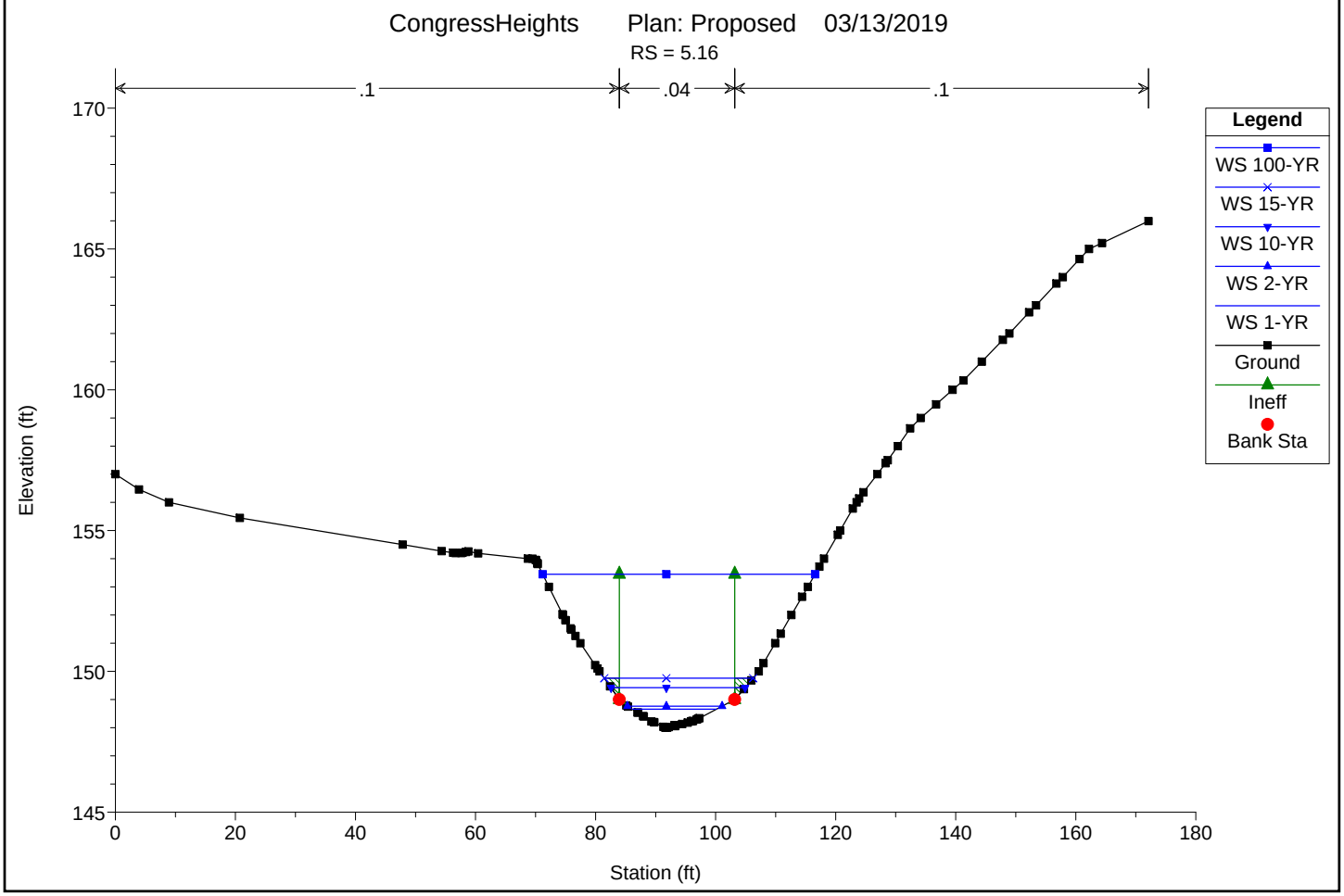
Legend
WS 100-YR
WS 15-YR
WS 10-YR
WS 2-YR
WS 1-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)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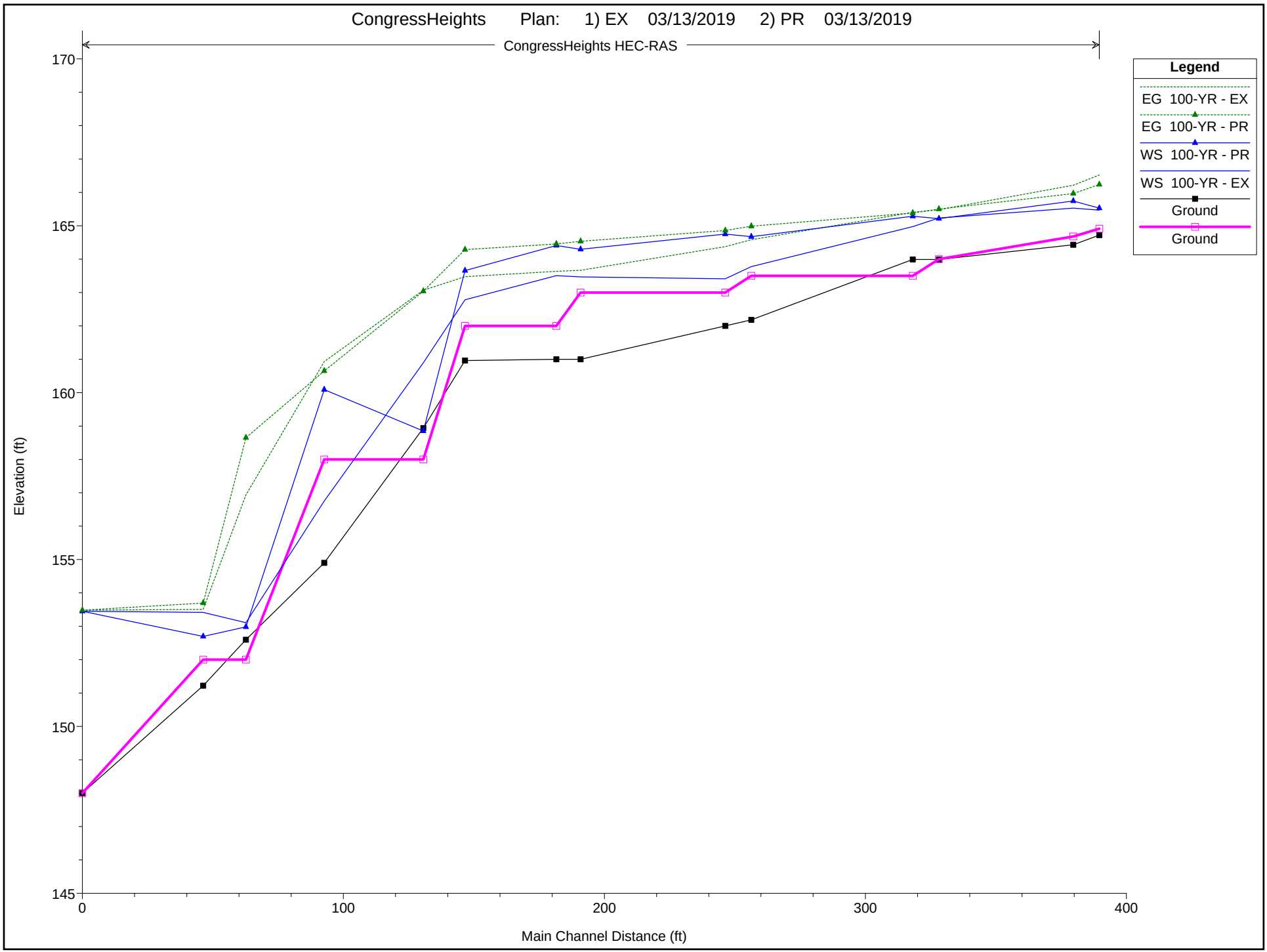
RS = 5.16
.1
.04
.1
Legend
WS 100-YR
WS 15-YR
WS 10-YR
WS 2-YR
WS 1-YR
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

100 Year Water Surface


CongressHeights Plan: 1) EX 03/13/2019 2) PR 03/13/2019
CongressHeights HEC-RAS
Legend
EG 100-YR - EX
EG 100-YR - PR
WS 100-YR - PR
WS 100-YR - EX
Ground
Ground
Elevation (ft)
170
165
160
155
150
145
0
100
200
300
400
Main Channel Distance (ft)

HEC-RAS Output

HEC-RAS River: CongressHeights Reach: HEC-RAS

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
HEC-RAS	394.8	1-YR	EX	21.72	164.72	165.09	165.19	165.45	0.034047	4.84	4.78	19.21	1.57
HEC-RAS	394.8	1-YR	PR	21.72	164.91	165.20	165.28	165.47	0.034055	4.15	5.24	22.50	1.52
HEC-RAS	394.8	2-YR	EX	28.27	164.72	165.14	165.27	165.58	0.034012	5.36	5.76	20.25	1.61
HEC-RAS	394.8	2-YR	PR	28.27	164.91	165.25	165.34	165.57	0.034042	4.54	6.22	23.27	1.55
HEC-RAS	394.8	10-YR	EX	48.52	164.72	165.27	165.46	165.93	0.034010	6.62	8.51	22.80	1.70
HEC-RAS	394.8	10-YR	PR	48.52	164.91	165.36	165.50	165.82	0.033962	5.48	8.85	24.96	1.62
HEC-RAS	394.8	15-YR	EX	53.39	164.72	165.29	165.51	166.01	0.034014	6.87	9.13	23.26	1.72
HEC-RAS	394.8	15-YR	PR	53.39	164.91	165.38	165.53	165.88	0.034034	5.67	9.42	25.31	1.64
HEC-RAS	394.8	100-YR	EX	90.25	164.72	165.47	165.79	166.52	0.034020	8.42	13.51	26.28	1.81
HEC-RAS	394.8	100-YR	PR	90.25	164.91	165.53	165.74	166.24	0.034004	6.74	13.38	27.63	1.71
HEC-RAS	384.8	1-YR	EX	21.72	164.43	164.99	165.00	165.21	0.013084	3.79	5.77	14.45	1.03
HEC-RAS	384.8	1-YR	PR	21.72	164.68	165.22	165.11	165.30	0.005373	2.32	9.38	24.13	0.65
HEC-RAS	384.8	2-YR	EX	28.27	164.43	165.07	165.08	165.34	0.012557	4.15	6.94	15.75	1.04
HEC-RAS	384.8	2-YR	PR	28.27	164.68	165.29	165.18	165.39	0.005296	2.52	11.22	25.15	0.67
HEC-RAS	384.8	10-YR	EX	48.52	164.43	165.26	165.31	165.66	0.012248	5.10	10.27	18.99	1.09
HEC-RAS	384.8	10-YR	PR	48.52	164.68	165.48	165.33	165.62	0.005192	2.99	16.24	27.74	0.69
HEC-RAS	384.8	15-YR	EX	53.39	164.43	165.30	165.36	165.73	0.012381	5.31	10.99	19.67	1.10
HEC-RAS	384.8	15-YR	PR	53.39	164.68	165.52	165.37	165.67	0.005309	3.10	17.20	28.21	0.70
HEC-RAS	384.8	100-YR	EX	90.25	164.43	165.53	165.68	166.21	0.013696	6.71	16.06	24.51	1.21
HEC-RAS	384.8	100-YR	PR	90.25	164.68	165.74	165.59	165.97	0.005516	3.79	23.91	31.66	0.75
HEC-RAS	333.31	1-YR	EX	21.72	163.99	164.56	164.39	164.65	0.003832	2.34	9.27	18.03	0.58
HEC-RAS	333.31	1-YR	PR	21.72	164.00	164.55	164.55	164.73	0.033544	3.44	6.32	17.58	1.01
HEC-RAS	333.31	2-YR	EX	28.27	163.99	164.65	164.47	164.75	0.003965	2.60	10.87	18.54	0.60
HEC-RAS	333.31	2-YR	PR	28.27	164.00	164.62	164.62	164.83	0.032062	3.66	7.73	18.90	1.01
HEC-RAS	333.31	10-YR	EX	48.52	163.99	164.88	164.66	165.04	0.004132	3.17	15.28	19.89	0.64
HEC-RAS	333.31	10-YR	PR	48.52	164.00	164.82	164.81	165.09	0.028185	4.14	11.72	21.59	0.99
HEC-RAS	333.31	15-YR	EX	53.39	163.99	164.93	164.70	165.10	0.004138	3.28	16.28	20.18	0.64
HEC-RAS	333.31	15-YR	PR	53.39	164.00	164.87	164.85	165.14	0.025740	4.13	12.93	22.32	0.96
HEC-RAS	333.31	100-YR	EX	90.25	163.99	165.23	164.98	165.48	0.004139	4.01	22.64	21.91	0.68
HEC-RAS	333.31	100-YR	PR	90.25	164.00	165.21		165.50	0.016236	4.31	21.12	25.40	0.81
HEC-RAS	323.31	1-YR	EX	21.72	163.99	164.39	164.39	164.57	0.012978	3.46	6.28	17.05	1.00
HEC-RAS	323.31	1-YR	PR	21.72	163.50	164.54	164.05	164.56	0.001994	1.30	16.73	24.50	0.27
HEC-RAS	323.31	2-YR	EX	28.27	163.99	164.46	164.46	164.68	0.012333	3.75	7.54	17.43	1.01
HEC-RAS	323.31	2-YR	PR	28.27	163.50	164.64	164.12	164.68	0.002086	1.46	19.45	25.98	0.29
HEC-RAS	323.31	10-YR	EX	48.52	163.99	164.65	164.65	164.96	0.011111	4.41	11.01	18.42	1.00
HEC-RAS	323.31	10-YR	PR	48.52	163.50	164.91		164.96	0.002358	1.88	26.80	29.56	0.32
HEC-RAS	323.31	15-YR	EX	53.39	163.99	164.69	164.69	165.01	0.010942	4.53	11.77	18.63	1.01
HEC-RAS	323.31	15-YR	PR	53.39	163.50	164.96		165.02	0.002439	1.97	28.31	30.10	0.33
HEC-RAS	323.31	100-YR	EX	90.25	163.99	164.97	164.97	165.40	0.009879	5.26	17.15	20.04	1.00
HEC-RAS	323.31	100-YR	PR	90.25	163.50	165.28		165.38	0.002904	2.55	38.52	32.30	0.37
HEC-RAS	261.46	1-YR	EX	21.72	162.18	163.01	163.14	163.47	0.023978	5.46	3.98	8.48	1.41
HEC-RAS	261.46	1-YR	PR	21.72	163.50	164.05	164.05	164.23	0.032940	3.41	6.36	17.62	1.00
HEC-RAS	261.46	2-YR	EX	28.27	162.18	163.12	163.26	163.63	0.022916	5.74	4.93	9.42	1.40
HEC-RAS	261.46	2-YR	PR	28.27	163.50	164.12	164.12	164.33	0.031943	3.65	7.74	18.91	1.01
HEC-RAS	261.46	10-YR	EX	48.52	162.18	163.37	163.54	164.01	0.020146	6.41	7.56	11.07	1.37
HEC-RAS	261.46	10-YR	PR	48.52	163.50	164.31	164.31	164.59	0.029388	4.20	11.55	21.49	1.01
HEC-RAS	261.46	15-YR	EX	53.39	162.18	163.43	163.60	164.09	0.019598	6.53	8.18	11.41	1.36
HEC-RAS	261.46	15-YR	PR	53.39	163.50	164.36	164.35	164.64	0.027457	4.22	12.64	22.15	0.99
HEC-RAS	261.46	100-YR	EX	90.25	162.18	163.78	163.98	164.58	0.017036	7.19	12.54	13.58	1.32
HEC-RAS	261.46	100-YR	PR	90.25	163.50	164.67	164.60	164.99	0.018996	4.51	20.30	27.91	0.87
HEC-RAS	251.46	1-YR	EX	21.72	162.00	162.67	162.84	163.20	0.027242	5.85	3.72	7.88	1.50
HEC-RAS	251.46	1-YR	PR	21.72	163.00	164.02	163.55	164.05	0.002153	1.33	16.34	24.17	0.28
HEC-RAS	251.46	2-YR	EX	28.27	162.00	162.78	162.96	163.37	0.025917	6.17	4.58	8.63	1.49
HEC-RAS	251.46	2-YR	PR	28.27	163.00	164.13	163.62	164.16	0.002247	1.50	18.95	25.03	0.30
HEC-RAS	251.46	10-YR	EX	48.52	162.00	163.03	163.26	163.78	0.024205	6.95	6.98	10.41	1.50
HEC-RAS	251.46	10-YR	PR	48.52	163.00	164.39	163.81	164.45	0.002536	1.92	25.75	27.14	0.33
HEC-RAS	251.46	15-YR	EX	53.39	162.00	163.08	163.32	163.86	0.023817	7.09	7.53	10.78	1.50
HEC-RAS	251.46	15-YR	PR	53.39	163.00	164.44		164.50	0.002597	2.01	27.21	27.57	0.34
HEC-RAS	251.46	100-YR	EX	90.25	162.00	163.41	163.67	164.37	0.021796	7.87	11.47	13.11	1.48
HEC-RAS	251.46	100-YR	PR	90.25	163.00	164.75		164.86	0.003209	2.64	36.06	29.62	0.39
HEC-RAS	196.04	1-YR	EX	21.72	161.00	162.14	161.81	162.26	0.003051	2.73	7.95	10.06	0.54
HEC-RAS	196.04	1-YR	PR	21.72	163.00	163.55	163.55	163.73	0.033455	3.43	6.33	17.58	1.01
HEC-RAS	196.04	2-YR	EX	28.27	161.00	162.32	161.94	162.45	0.002876	2.88	9.83	10.99	0.54
HEC-RAS	196.04	2-YR	PR	28.27	163.00	163.62	163.62	163.83	0.032079	3.66	7.73	18.90	1.01
HEC-RAS	196.04	10-YR	EX	48.52	161.00	162.78	162.26	162.93	0.002468	3.15	15.42	13.35	0.52
HEC-RAS	196.04	10-YR	PR	48.52	163.00	163.81	163.81	164.09	0.029381	4.20	11.55	21.49	1.01
HEC-RAS	196.04	15-YR	EX	53.39	161.00	162.87	162.32	163.03	0.002402	3.20	16.71	13.84	0.51
HEC-RAS	196.04	15-YR	PR	53.39	163.00	163.85	163.85	164.14	0.028903	4.30	12.42	22.02	1.01
HEC-RAS	196.04	100-YR	EX	90.25	161.00	163.47	162.73	163.67	0.001817	3.57	25.91	17.02	0.47
HEC-RAS	196.04	100-YR	PR	90.25	163.00	164.29		164.53	0.011994	3.93	23.27	26.43	0.71
HEC-RAS	186.76	1-YR	EX	21.72	161.00	162.16		162.22	0.001512	2.05	10.61	12.32	0.39

HEC-RAS River: CongressHeights Reach: HEC-RAS (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
HEC-RAS	186.76	1-YR	PR	21.72	162.00	163.20	162.55	163.21	0.000999	1.06	20.67	25.13	0.20
HEC-RAS	186.76	2-YR	EX	28.27	161.00	162.34		162.41	0.001469	2.18	12.94	13.30	0.39
HEC-RAS	186.76	2-YR	PR	28.27	162.00	163.35	162.62	163.37	0.000975	1.16	24.60	26.02	0.20
HEC-RAS	186.76	10-YR	EX	48.52	161.00	162.80		162.90	0.001350	2.46	19.71	15.82	0.39
HEC-RAS	186.76	10-YR	PR	48.52	162.00	163.75	162.81	163.78	0.000933	1.42	35.47	28.33	0.21
HEC-RAS	186.76	15-YR	EX	53.39	161.00	162.90		163.00	0.001314	2.51	21.25	16.34	0.39
HEC-RAS	186.76	15-YR	PR	53.39	162.00	163.84	162.85	163.87	0.000924	1.47	37.94	28.83	0.21
HEC-RAS	186.76	100-YR	EX	90.25	161.00	163.50		163.63	0.001062	2.89	32.15	19.65	0.37
HEC-RAS	186.76	100-YR	PR	90.25	162.00	164.41		164.46	0.000876	1.78	55.39	32.21	0.22
HEC-RAS	151.78	1-YR	EX	31.18	160.96	161.74	161.74	162.06	0.011063	4.52	6.91	10.91	1.00
HEC-RAS	151.78	1-YR	PR	31.18	162.00	162.79	162.79	163.06	0.029731	4.14	7.54	14.41	1.01
HEC-RAS	151.78	2-YR	EX	41.17	160.96	161.88	161.88	162.25	0.010721	4.89	8.42	11.48	1.01
HEC-RAS	151.78	2-YR	PR	41.17	162.00	162.91	162.91	163.22	0.028305	4.42	9.32	15.54	1.01
HEC-RAS	151.78	10-YR	EX	72.47	160.96	162.24	162.24	162.74	0.009845	5.65	12.82	13.11	1.01
HEC-RAS	151.78	10-YR	PR	72.47	162.00	163.19	163.19	163.62	0.024951	5.27	13.93	17.69	1.00
HEC-RAS	151.78	15-YR	EX	80.07	160.96	162.32	162.32	162.84	0.009685	5.79	13.84	13.47	1.01
HEC-RAS	151.78	15-YR	PR	80.07	162.00	163.25	163.25	163.71	0.024232	5.43	15.01	18.14	1.00
HEC-RAS	151.78	100-YR	EX	137.66	160.96	162.78	162.78	163.48	0.008918	6.67	20.65	15.64	1.01
HEC-RAS	151.78	100-YR	PR	137.66	162.00	163.66	163.66	164.29	0.020668	6.41	23.08	22.05	0.98
HEC-RAS	135.78	1-YR	EX	31.18	158.94	159.80	160.28	161.54	0.077894	10.58	2.95	5.45	2.54
HEC-RAS	135.78	1-YR	PR	31.18	158.00	158.36	158.80	161.40	0.993738	13.99	2.23	9.56	5.11
HEC-RAS	135.78	2-YR	EX	41.17	158.94	159.95	160.46	161.75	0.068525	10.77	3.82	6.24	2.43
HEC-RAS	135.78	2-YR	PR	41.17	158.00	158.42	158.91	161.64	0.842977	14.38	2.86	10.41	4.84
HEC-RAS	135.78	10-YR	EX	72.47	158.94	160.32	160.91	162.28	0.050746	11.22	6.46	7.86	2.18
HEC-RAS	135.78	10-YR	PR	72.47	158.00	158.59	159.21	162.20	0.612287	15.25	4.75	12.43	4.35
HEC-RAS	135.78	15-YR	EX	80.07	158.94	160.40	160.99	162.39	0.048431	11.33	7.07	8.18	2.15
HEC-RAS	135.78	15-YR	PR	80.07	158.00	158.62	159.27	162.32	0.577669	15.43	5.19	12.76	4.27
HEC-RAS	135.78	100-YR	EX	137.66	158.94	160.90	161.53	163.07	0.036837	11.82	11.65	10.23	1.95
HEC-RAS	135.78	100-YR	PR	137.66	158.00	158.85	159.64	163.04	0.427331	16.42	8.39	14.96	3.87
HEC-RAS	97.84	1-YR	EX	31.18	154.90	155.73	156.33	158.11	0.102495	12.37	2.52	4.30	2.85
HEC-RAS	97.84	1-YR	PR	31.18	158.00	158.95	158.95	159.27	0.028335	4.53	6.88	10.94	1.01
HEC-RAS	97.84	2-YR	EX	41.17	154.90	155.87	156.55	158.57	0.098936	13.18	3.12	4.69	2.85
HEC-RAS	97.84	2-YR	PR	41.17	158.00	159.09	159.10	159.46	0.027411	4.87	8.45	11.73	1.01
HEC-RAS	97.84	10-YR	EX	72.47	154.90	156.21	157.10	159.62	0.090113	14.82	4.89	5.66	2.81
HEC-RAS	97.84	10-YR	PR	72.47	158.00	159.45	159.45	159.93	0.025144	5.60	12.93	13.54	1.01
HEC-RAS	97.84	15-YR	EX	80.07	154.90	156.28	157.25	159.82	0.087999	15.08	5.31	5.86	2.79
HEC-RAS	97.84	15-YR	PR	80.07	158.00	159.52	159.52	160.03	0.024709	5.74	13.94	13.86	1.01
HEC-RAS	97.84	100-YR	EX	137.66	154.90	156.75	157.87	160.93	0.075245	16.39	8.40	7.17	2.67
HEC-RAS	97.84	100-YR	PR	137.66	158.00	160.09	160.09	160.65	0.017581	6.03	25.56	40.04	0.90
HEC-RAS	67.84	1-YR	EX	31.18	152.60	152.89	153.12	153.91	0.160063	8.10	3.85	19.27	3.20
HEC-RAS	67.84	1-YR	PR	31.18	152.00	152.42	152.95	156.39	1.067921	15.99	1.95	7.19	5.41
HEC-RAS	67.84	2-YR	EX	41.17	152.60	152.92	153.20	154.24	0.179001	9.20	4.47	20.10	3.44
HEC-RAS	67.84	2-YR	PR	41.17	152.00	152.49	153.09	156.72	0.910377	16.50	2.49	7.77	5.13
HEC-RAS	67.84	10-YR	EX	72.47	152.60	153.00	153.40	155.19	0.225398	11.88	6.10	22.20	3.99
HEC-RAS	67.84	10-YR	PR	72.47	152.00	152.69	153.45	157.41	0.658253	17.43	4.16	9.33	4.60
HEC-RAS	67.84	15-YR	EX	80.07	152.60	153.02	153.44	155.35	0.240625	12.25	6.53	23.82	4.13
HEC-RAS	67.84	15-YR	PR	80.07	152.00	152.73	153.53	157.54	0.623007	17.60	4.55	9.64	4.52
HEC-RAS	67.84	100-YR	EX	137.66	152.60	153.11	153.74	156.94	0.274803	15.69	8.77	24.36	4.61
HEC-RAS	67.84	100-YR	PR	137.66	152.00	152.98	154.00	158.65	0.483101	19.10	7.21	11.11	4.18
HEC-RAS	51.47	1-YR	EX	31.18	151.22	151.83	152.00	152.37	0.052609	5.92	5.26	18.31	1.95
HEC-RAS	51.47	1-YR	PR	31.18	152.00	152.43	152.48	152.65	0.061325	3.76	8.29	31.39	1.29
HEC-RAS	51.47	2-YR	EX	41.17	151.22	151.89	152.08	152.51	0.056386	6.33	6.51	21.59	2.03
HEC-RAS	51.47	2-YR	PR	41.17	152.00	152.47	152.55	152.76	0.068951	4.31	9.55	32.18	1.40
HEC-RAS	51.47	10-YR	EX	72.47	151.22	152.01	152.26	152.94	0.069045	7.74	9.37	26.74	2.30
HEC-RAS	51.47	10-YR	PR	72.47	152.00	152.57	152.72	153.07	0.087171	5.70	12.72	33.64	1.63
HEC-RAS	51.47	15-YR	EX	80.07	151.22	152.03	152.30	153.02	0.069619	7.96	10.06	27.66	2.33
HEC-RAS	51.47	15-YR	PR	80.07	152.00	152.59	152.75	153.14	0.091017	5.99	13.37	33.90	1.68
HEC-RAS	51.47	100-YR	EX	137.66	151.22	153.42	152.56	153.51	0.000883	2.41	58.88	40.34	0.33
HEC-RAS	51.47	100-YR	PR	137.66	152.00	152.70	152.99	153.70	0.122687	8.02	17.16	35.07	2.02
HEC-RAS	5.16	1-YR	EX	31.18	148.00	148.57	148.83	149.47	0.073696	7.62	4.09	12.54	2.35
HEC-RAS	5.16	1-YR	PR	31.18	148.00	148.66	148.83	149.19	0.091265	5.85	5.33	14.07	1.68
HEC-RAS	5.16	2-YR	EX	41.17	148.00	148.65	148.94	149.63	0.067472	7.96	5.17	13.88	2.30
HEC-RAS	5.16	2-YR	PR	41.17	148.00	148.76	148.94	149.32	0.079156	5.99	6.88	15.77	1.60
HEC-RAS	5.16	10-YR	EX	72.47	148.00	148.85	149.18	150.03	0.056535	8.71	8.32	17.07	2.20
HEC-RAS	5.16	10-YR	PR	72.47	148.00	149.42	149.18	149.64	0.010600	3.79	19.11	22.33	0.67
HEC-RAS	5.16	15-YR	EX	80.07	148.00	149.76	149.24	149.91	0.001896	3.12	25.65	24.80	0.48
HEC-RAS	5.16	15-YR	PR	80.07	148.00	149.76	149.24	149.91	0.004853	3.12	25.65	24.80	0.48
HEC-RAS	5.16	100-YR	EX	137.66	148.00	153.45	149.59	153.48	0.000067	1.42	96.61	45.39	0.11
HEC-RAS	5.16	100-YR	PR	137.66	148.00	153.45	149.59	153.48	0.000173	1.42	96.61	45.39	0.11