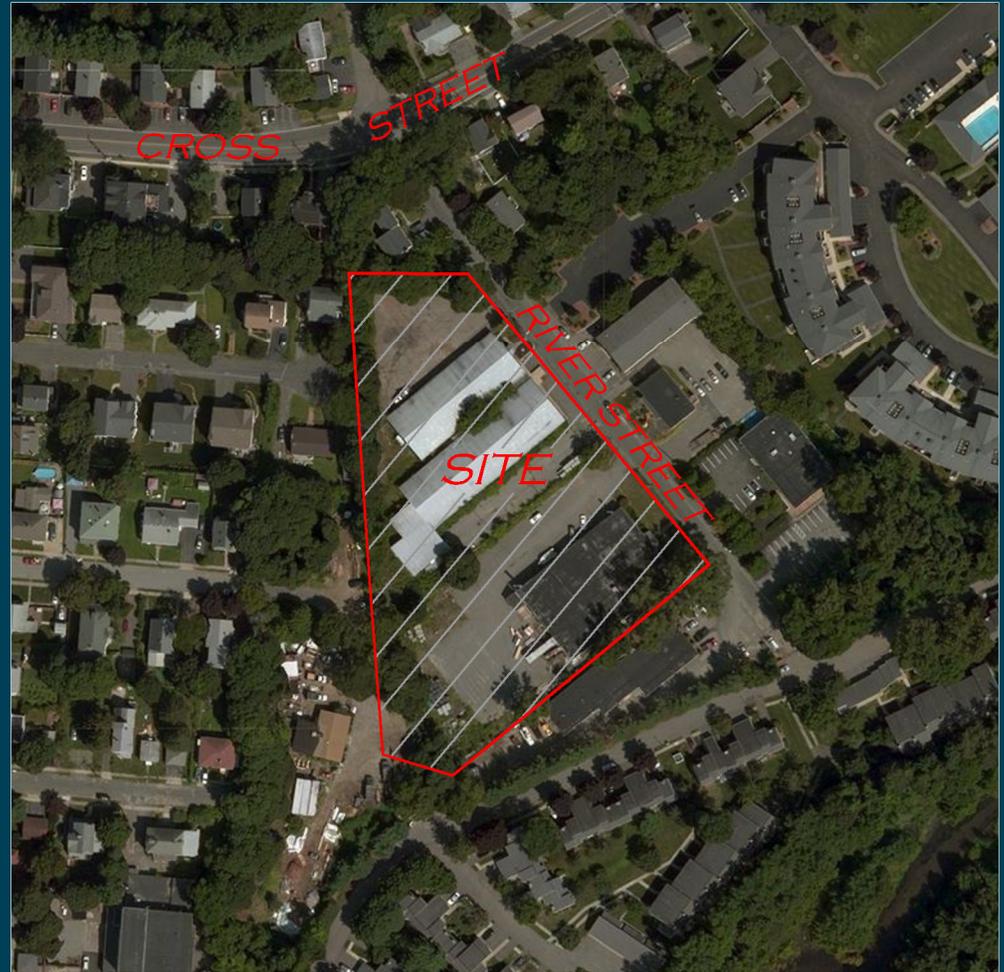




SITE LOCUS N.T.S.

ALLEN & MAJOR
ASSOCIATES, INC.



#19 & 35 RIVER ROAD
WINCHESTER, MASSACHUSETTS
SEWER AND DRAIN CCTV REPORT

PREPARED: MAY 16, 2019

CLIENT:
SLV RIVER STREET, LLC
c/o GEOFF ENGLER & JUSTIN KREBS
257 HILLSIDE AVENUE
NEEDHAM MA, 02494

PREPARED BY:
ALLEN & MAJOR ASSOCIATES, INC.
100 COMMERCE WAY, SUITE 5
WOBURN, MASSACHUSETTS 01801

A&M PROJECT NO. : 2459-01

*19 & 35 River Street Winchester –
Sewer and Drain CCTV Observations Report*

Table of Contents

INTRODUCTION	1
SEWER OBSERVATIONS	2
PHOTO 1 – INFILTRATION AT CO-44	2
PHOTO 2 – PVC PIPE PENETRATION.....	3
PHOTO 3 – SEDIMENT INFILTRATION AT CO-45.....	4
DRAINAGE OBSERVATIONS	5
EXHIBIT 1 - SEWER MANHOLE LOCATIONS PLAN	EXH-1
EXHIBIT 2 - BMC TABULAR AND GRAPHICAL REPORTS	EXH-2
EXHIBIT 3 – DRAIN MANHOLE LOCATIONS PLAN	EXH-3
EXHIBIT 4 – SEWER STUDY (BY FLOW ASSESSMENTS)	EXH-3
(SEWER STUDY UNDER SEPARATE COVER, PENDING)	



100 Commerce Way
Suite 5
Woburn, MA 01888-0118
Tel: (781) 935-6889
Fax: (781) 935-2896

Field Report #1

Client:	SLV River Street, LLC	Report Date:	Friday, May 10, 2019
Project:	19 and 35 River Street	A&M Project #:	2459-01
Location:	Winchester, MA	Contractor:	BMC Corporation, Sewer and Drain CCTV and Cleaning
Weather:	Sunny/Clear	Temperature:	56°F
Date of Site Visit:	Wednesday, April 24, 2019		
Time:	<i>From:</i> 7:00 AM <i>To:</i> 3:00 PM		
Present at Site:	Zach Caterino (BMC), Craig (BMC), David Robinson (A&M), Noah Crotty (A&M), Paul Gangi Jr., Winchester DPW Water and Sewer Supervisor		
Reported by:	David M. Robinson, EIT (A&M)		

The following was noted:

On April 24, 2019, a partial observation of the existing sewer and drainage pipe networks was performed by BMC Corporation (BMC) at the subject parcel located at 19 & 35 River Street, Winchester, MA (The Site). A street opening permit from the Winchester DPW was applied for and acquired prior to the commencement of work. A representative from the Winchester DPW was on-site for a portion of the sewer observation.

The purpose of the sewer and drainage network observation was to determine the condition, material, size and identify any potential issues of the existing structures and pipes for future tie-in from the subject parcel. The existing conditions base plan is entitled "Existing Conditions – 19-35 River Street, Winchester MA" surveyed by Allen & Major Associates, Inc, dated March 28, 2018 at an original scale of 1"=30'. Furthermore, the observation sought to review the existing pipes and manholes and confirm the size and material in comparison to the existing conditions plan, and determine pipe conditions, as well as jet and clean the sewer run only within River Street, as requested by the Town Engineering Department.

The observations were made by BMC utilizing a wheeled, electronic crawler device, which has multiple camera mounts with a live CCTV feed, as well as a forward-looking push cam which can be deployed into lateral pipes. No laterals were requested by the Town of Winchester to be observed or cleaned, and therefore no laterals were observed in either the sewer or drain infrastructure within River Street. The sewer line cleaning was performed utilizing a high-pressure jetting system and water and was monitored by camera. The sewer manhole cleanings were

performed with the use of a vactor truck and high-pressure water gun. Vactoring typically consists of spraying the structure interior as required with a high-pressure water stream, then using a vacuum to remove the debris broken up by the pressurized water stream. BMC then provided all video and detailed reports in pipe graphic and tabular form, as well as prudent photos, to A&M at the conclusion of the observations and cleaning on a flash drive, which were reviewed and formed the basis of this report. Those reports are included as **Exhibit 2** of this report. Videos of all pipe observations can be provided to the Town if requested.

Sewer Observations

The on-site observations began at sewer manhole CO-44 (see attached sewer line plan, **Exhibit 1**, for manhole location references). The interior of the manhole was layered in orange to brown sediment accumulations, and a small area of groundwater infiltration was noted on the manhole bench of CO-44, see **Photo 1**, below. Water levels were at approximately 0% at the inlet and outlet pipes within manhole CO-44.

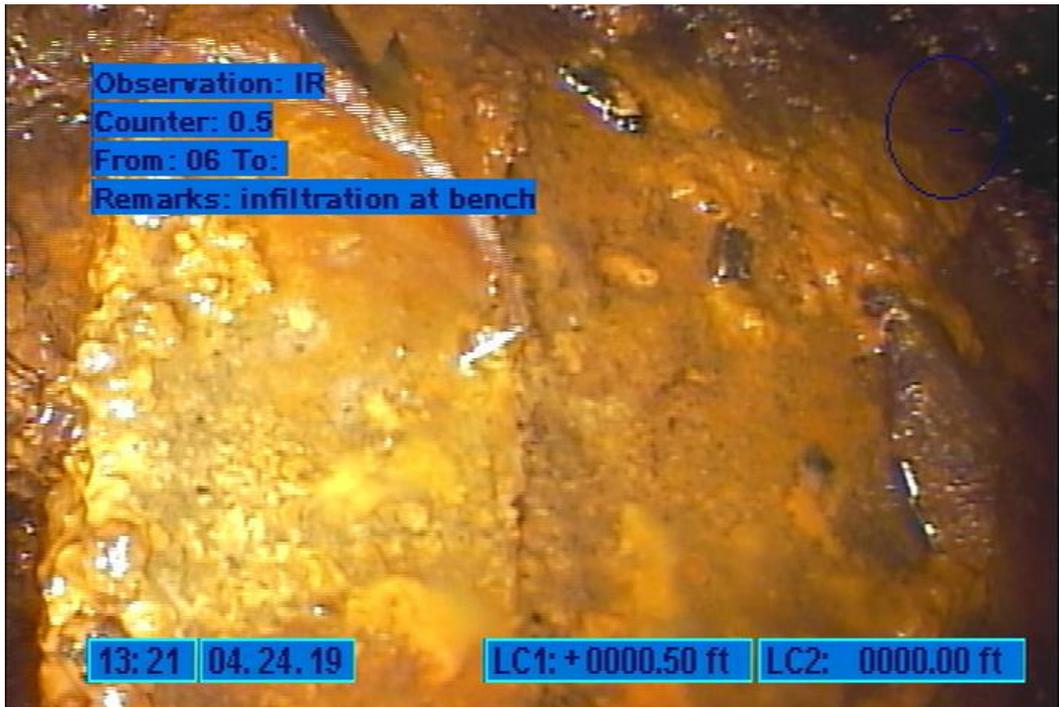


Photo 1 – Groundwater Infiltration at CO-44 bench

The 8" asbestos cement sewer line from CO-44 to CO-2 was surveyed by video observation and cleaned. The CCTV observation revealed a small break in the pipe joint at approximately 22.5 feet downstream of manhole CO-44. From 182.6 feet to 260.8 feet downstream, a sag was noted in the pipe, and water levels were up to 40% of the 8 inch pipe interior at this sag. Water levels at all other areas within the pipe were estimated at 10% maximum. A capped tap factory was noted at 280.6 feet. A tap factory is an area of a pipe main where one or more pipe laterals penetrate the main sidewalls. Sewer manhole CO-2 was penetrated at 290.0 feet downstream of CO-44, which ended the survey. An unknown PVC pipe with approximate diameter of 6 inches was noted as

penetrating CO-2 at the northern structure wall, however, no flow was noted at the pipe outlet within CO-2 and the unknown PVC pipe was not observed or cleaned as part of the Town requested sewer survey.

See **Photo 2**, below, showing the PVC pipe. The sewer line from CO-44 to CO-2 was then jetted and cleaned of any accumulated debris, which was minimal. Overall, the sewer line run appeared in generally good condition, with the exception of the small break at the pipe joint at 22.5 feet, no structural deficiencies were noted at the pipe walls nor significant root growth noted at the pipe joints. Refer to the included reports in **Exhibit 2** prepared by BMC Corporation for more information.

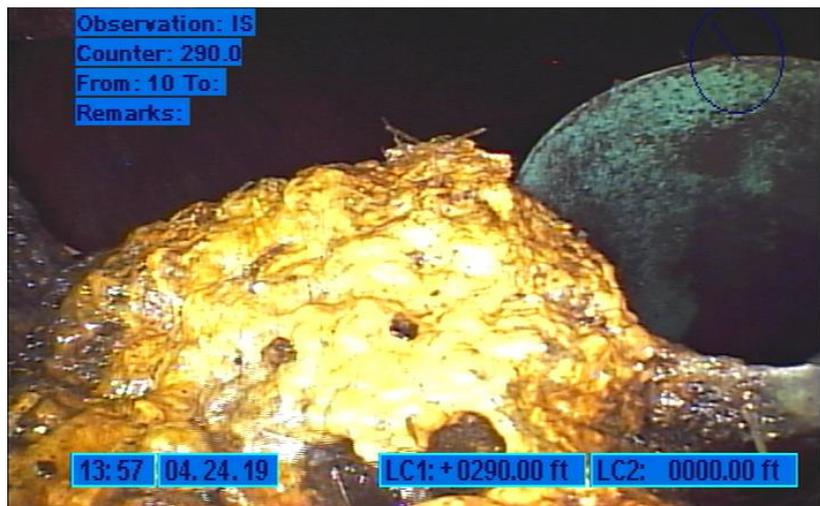


Photo 2 – Unknown PVC pipe penetration at northern wall of CO-2

Following the observation from CO-44 downstream to CO-2, the crawler was then inserted into the inlet pipe at CO-44, and proceeded upstream to CO-45. Water levels within the drain line from CO-44 to CO-45 were noted at about 5% of pipe diameter. The observation upstream from CO-44 to CO-45 revealed a small break in the pipe at approximately 6.5 feet upstream of CO-44. At approximately 127 feet upstream of CO-44, water levels increased to approximately 10% of pipe diameter, and several tap factories were noted along the survey. The survey continued to approximately 177 feet upstream of CO-44, where a significant debris and root growth impeded the survey, just downstream of CO-45. Refer to the included reports in **Exhibit 2** prepared by BMC Corporation for more information.

Following the observation from CO-44 to CO-45, sewer manhole CO-45 was opened and observed. The interior of sewer manhole CO-45 contained significant sediment and debris build-up and root growth. In some areas the sediment build-up was several feet deep and filled the manhole approximately halfway, see **Photo 3**, below. A subsequent cleaning and vector of the manhole revealed that multiple bricks were missing from the structure wall on the northwest side, which contributed to the inflow of groundwater and sediment, and root intrusion was noted. A&M would recommend repairing the break in the structure with brick and mortar at a minimum, or replacing the aging brick structure with a new precast unit, pending Town of Winchester preference. The 8 inch asbestos clay line from CO-45 to CO-44 was then cleaned and jetted, and

CO-45 was fully cleaned out of all sediment, root growth and debris. The sewer line was generally in good shape, and several sewer lateral tap factories were noted along its length. Refer to the reports included in **Exhibit 2** prepared by BMC Corporation for more information.



Photo 3 – Sediment Infiltration at CO-45 sump

Sewer manhole CO-46 was then opened and observed. The 8 inch asbestos cement sewer line between CO-46 and CO-45 was observed and water levels in the pipe were estimated between 5% at the start of the survey (CO-46) and 15% 148 feet downstream of CO-46, with several lateral tap break-ins noted along the length of pipe. At 156 feet in, a root ball was noted at the inlet to CO-45, blocking approximately 95% of the 8" pipe diameter. At this point the survey could not continue due to the blockage, and the survey was abandoned and the line jetted and cleaned. Overall, the sewer line run appeared in generally good condition, with no structural deficiencies noted to the pipe walls or significant root growth noted at the pipe joints. Refer to the reports included in **Exhibit 2** prepared by BMC Corporation for more information.

A crawler was inserted into the inlet pipe of sewer manhole CO-46 from CO-47 and proceeded upstream to CO-47, observing the 8 inch asbestos clay sewer line along the way. Overall, the sewer line run appeared in generally good condition, with no structural deficiencies noted to the pipe walls or significant root growth noted at the pipe joints. An approximate water level of 5% was noted within CO-46 and remained at that approximate level for the length of the survey. No significant items were noted along the sewer run except for multiple tap factories, as detailed in the reports prepared by BMC Corporation. CO-47 was then opened, observed and cleaned. Overall, the sewer manhole appeared in generally good condition, with no structural deficiencies noted to the side walls or bench and no significant root growth noted within the structure.

Overall, the sewer infrastructure surveyed was in generally good condition, with the exception of CO-45, which had multiple bricks and mortar missing from the northwest structure wall. This void shall be repaired with brick and mortar at a minimum, or the entire structure replaced with a new precast unit, pending Town review. With the exception of CO-45, all surveyed structures and lines appear in good condition for re-use, and have now been fully jetted and cleaned of accumulated debris. See the attached manhole location plan (**Exhibit 1**) and reports in **Exhibit 2** prepared by BMC Corporation for more detailed information.

Drainage Observations

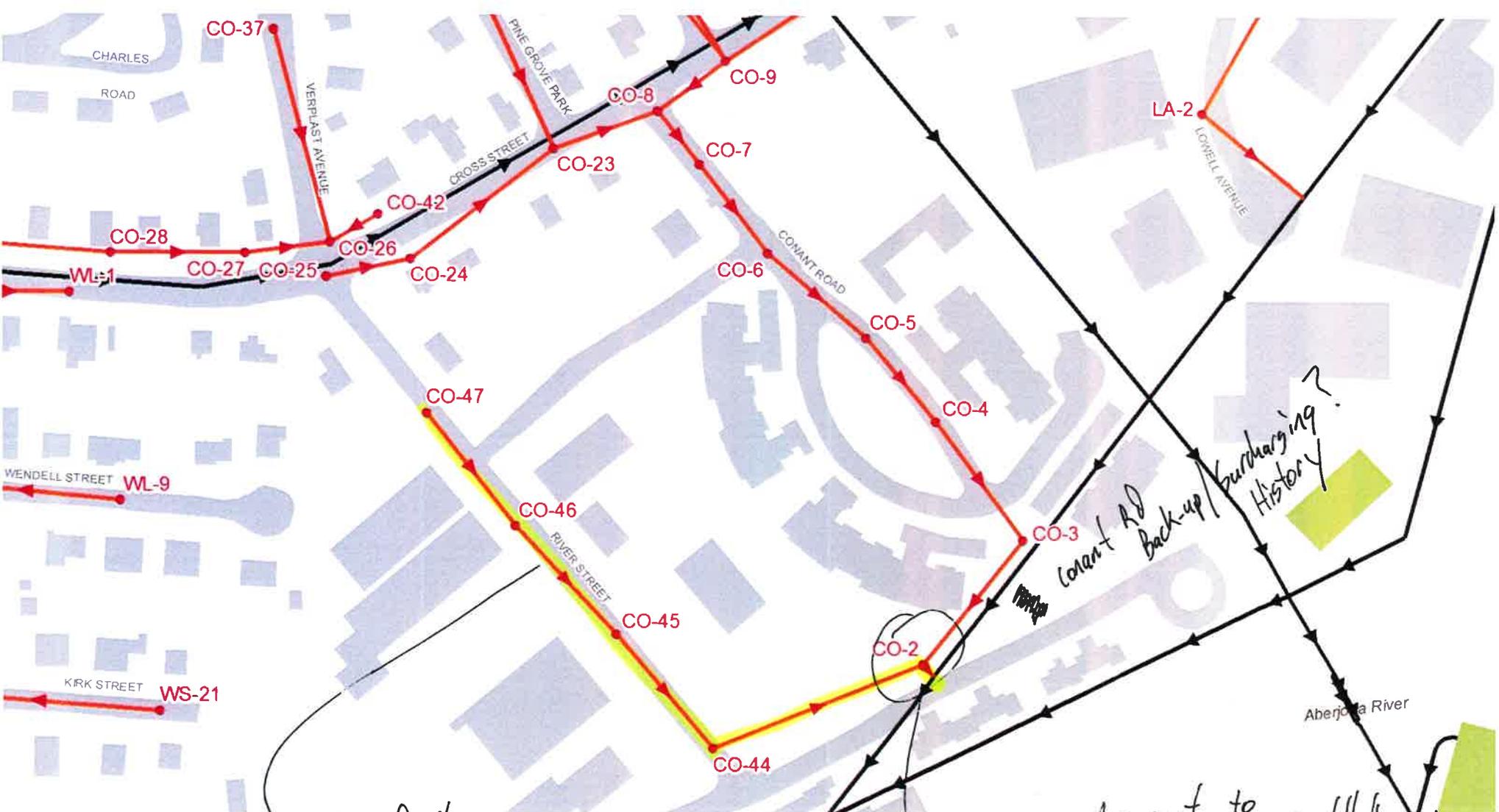
The drainage infrastructure observation began at DMH-2, where a crawler was inserted into the inlet pipe to DMH-2 and proceeded upstream to DMH-1. Refer to **Exhibit 3**, the Drain Manholes Location plan for River Street for manhole locations. No structural issues were noted within the DMH-2 manhole, and the water level was noted at approximately 0% within the manhole. As the crawler proceeded from DMH-2 to DMH-1, multiple cracks along the pipe floor and side walls were noted at approximately 67 feet upstream, and visible surface damage including visible reinforcing bars were noted at approximately 92 feet and 120 feet upstream. No significant groundwater inflow was noted. The survey terminated within manhole DMH-1 at 124 feet upstream of DMH-2. This manhole appeared in good condition with no significant structure damage or groundwater infiltration noted. At this time, no remedial actions are recommended as the proposed drainage tie-ins are downstream of DMH-2. The drainage lines and structures within River Street were not cleaned as part of this observation. The drain lines did not appear to be significantly accumulated with sediment and debris, and A&M would not recommend cleaning the drain lines until after construction has been completed.

The drainage survey continued at DMH-2 as the crawler proceeded from DMH-2 downstream towards DMH-3. The water level in DMH-2 was approximately 10% of the pipe diameter. At approximately 48 feet downstream of DMH-2, surface damage was visible along the drain pipe side wall, which exposed reinforcing bar along the pipe wall. At approximately 70 feet downstream, the water level increased to 25% of pipe diameter and debris build up and root intrusions were noted. Debris build up and a major root intrusion was also noted at approximately 80 feet downstream of DMH-2. At approximately 86 feet downstream of DMH-2, multiple minor cracks were noted along the pipe sidewalls, and debris build up and fine roots at joints were noted. The survey terminated approximately 98 feet downstream of DMH-2 at manhole DMH-3, where the sump was noted as full of debris. A&M would recommend cleaning the drainage lines and structures by jetting and vactor after construction.

The survey then continued at DMH-3, where a crawler was placed in the outlet pipe of DMH-3 and proceeded downstream towards DMH-4. Water levels in DMH-3 were noted as approximately 5% of pipe diameter and remained at or about that level for the duration of the observation. Some sediment and debris build-up were noted as well as fine root intrusions at pipe joints, but no significant structural damage was noted during the survey. The survey terminated approximately 128 feet downstream from DMH-3 at DMH-4, which appeared in good structural condition with minor sediment and debris deposits.

Overall, the drainage lines and structures appeared in good enough condition for re-use, however, A&M would recommend fully jetting and cleaning the drainage lines and vactoring the drainage structures after construction has completed.

Exhibit 1 - SEWER MANHOLE LOCATIONS PLAN



TV and clean
from CO-47 to MWAA
line.

Flow Assessment to
investigate meter installation here.
Contact WWS to confirm.
Install pressure depth to monitor
surcharge conditions.

Conant AD
Back-up/
Surcharging?
History

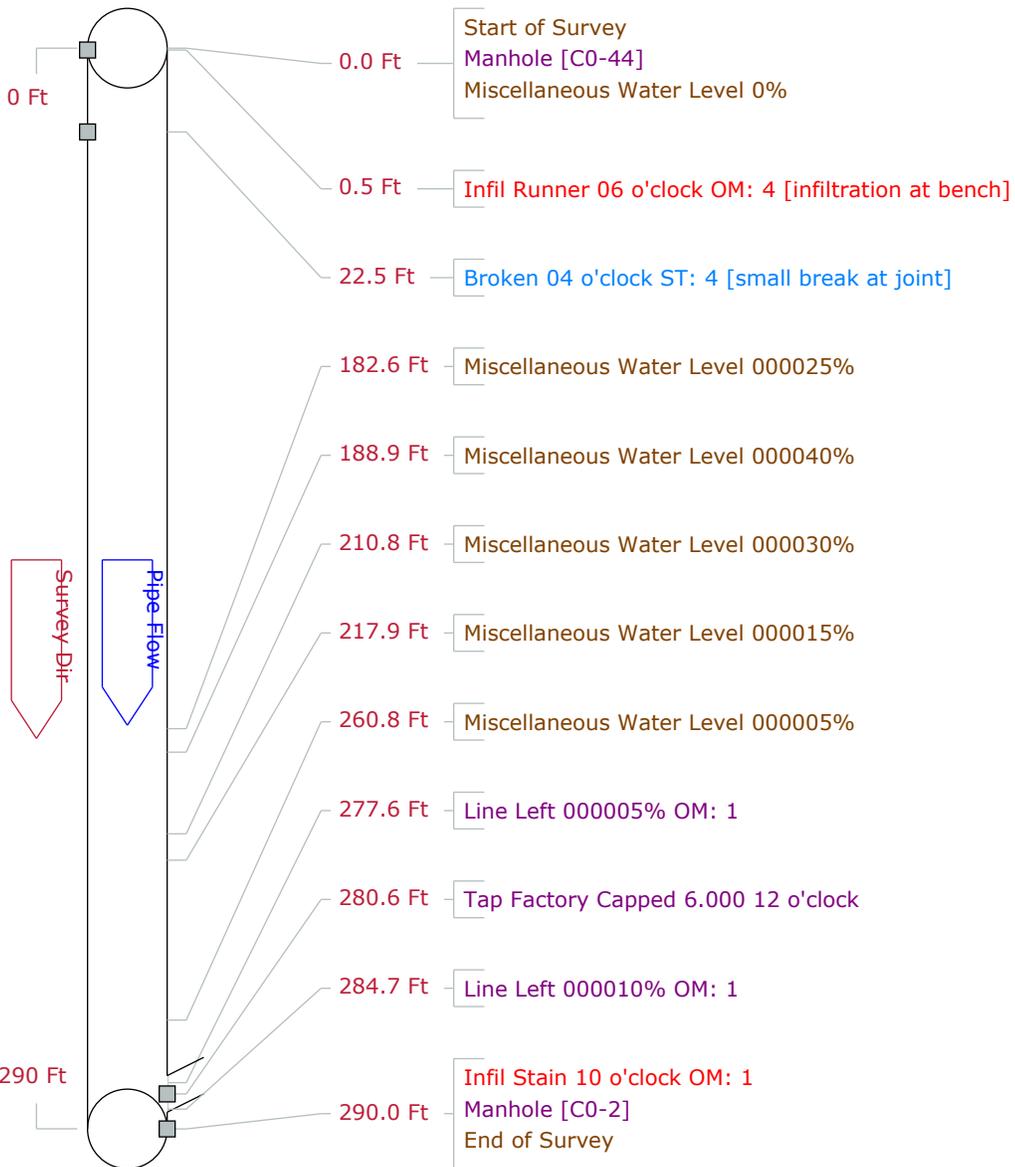
Aberjona River

Exhibit 2 – BMC CORP. REPORTS

Pipe Graphic Report of PLR C0-44

X for Allen Major

Setup	1	Surveyed By	ZC	Certificate #	614-06021733	Owner	
Reviewed By		Reviewer #		Work Order			
Customer				P/O #			
Media Label		Project	River St. Sewer				
Date	2019/04/24	Time	7:26	Weather		Pre-Cleaning L	Date Cleaned
Flow control		Survey Purpose					Direction Downstream
Street	River St.	City	Winchester	Drainage area			
Location Code		Pipe Use	Sanitary Sewage Pipe				
Location details		Height	8	Width	ins		
Shape	Circular	Material	Asbestos Cement	Lining			
Coating		Pipe Joint length	Ft	Total length	290.0	Ft	Structural O & M
Length Surveyed	290.00	Year Constructed		Year Renewed			Miscellaneous Constructional
Up	C0-44	Rim to invert		Grade to invert			Rim to grade Ft
Down	C0-2	Rim to invert		Grade to invert			Rim to grade Ft

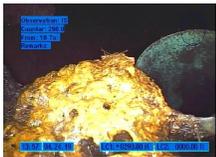


PipeLogix Inc.
 Phone: 866-299-3150
 Fax: 760-406-6023

Work Order			Setup 1
Video	Survey Date	2019/04/24	
Path to picture files	C:\FLEX6\Snaps\2019 WINCHESTER\		
Path to video files	C:\FLEX6\Movies\2019 WINCHESTER\		
Path to media files	C:\FLEX6\Media\2019 WINCHESTER\		



Video Index Count 0.5 Ft
Code **Infil Runner**
Remarks infiltration at bench
File Name 2.jpg



Video Index Count 290.0 Ft
Code **Infil Stain**
Remarks
File Name 3.jpg

Tabular Report of PSR C0-44

for Allen Major

Setup 1	Surveyed By ZC	Certificate # 614-06021733	Owner
Reviewed By	Reviewer #	Work Order	
Customer		P/O #	
Media Label	Project River St. Sewer		
Date 2019/04/24	Time 7:26	Weather	Pre-Cleaning L
Flow control	Survey Purpose		Date Cleaned
Inspection Status	Complete Inspection	Consequence Of Failure	Pressure
Inspection Technology Used	<input type="checkbox"/> CCTV <input type="checkbox"/> Laser <input type="checkbox"/> Sonar <input type="checkbox"/> Sidewall <input type="checkbox"/> Zoom <input type="checkbox"/> Other		

Street River St.	City Winchester	Drainage area
Location Code	Pipe Use Sanitary Sewage Pipe	
Location details	Height 8	Width ins
Shape Circular	Material Asbestos Cement	Lining
Coating	Pipe Joint length Ft	Total length 290.0 Ft
Length Surveyed 290.0 Ft	Year Constructed	Year Renewed
Up C0-44	Rim to invert	Grade to invert
Northing	Easting	Elevation
Down C0-2	Rim to invert	Grade to invert
Northing	Easting	Elevation
Coordinate System	Vertical Datum	
GPS Accuracy	Structural O & M Miscellaneous Constructional	
Additional info		

Count	Video	CD Code	Val1	Val2	%	Jnt	Fr	To	ImRef	Remarks
0.0		ST Start of Survey								
0.0		AMH Manhole								C0-44
0.0		MWL Miscellaneous Water Level			0.000					
0.5		IR Infil Runner					06			infiltration at bench
22.5		B Broken					04			small break at joint
182.6		MWL Miscellaneous Water Level			25.000					
188.9		MWL Miscellaneous Water Level			40.000					
210.8		MWL Miscellaneous Water Level			30.000					
217.9		MWL Miscellaneous Water Level			15.000					
260.8		MWL Miscellaneous Water Level			5.000					
277.6		LL Line Left			5.000					
280.6		TFC Tap Factory Capped	6.000				12			
284.7		LL Line Left			10.000					
290.0		IS Infil Stain					10			
290.0		AMH Manhole								C0-2
290.0		FH End of Survey								

290.0 Ft Total Length Surveyed

Scores	Structural: Pipe Rating 4	Pipe Ratings Index 4	Quick Rating 4100
	O&M: Pipe Rating 7	Pipe Ratings Index 1.8	Quick Rating 4113
	Overall Pipe Rating 11	Pipe Ratings Index 5.8	Quick Rating 4213

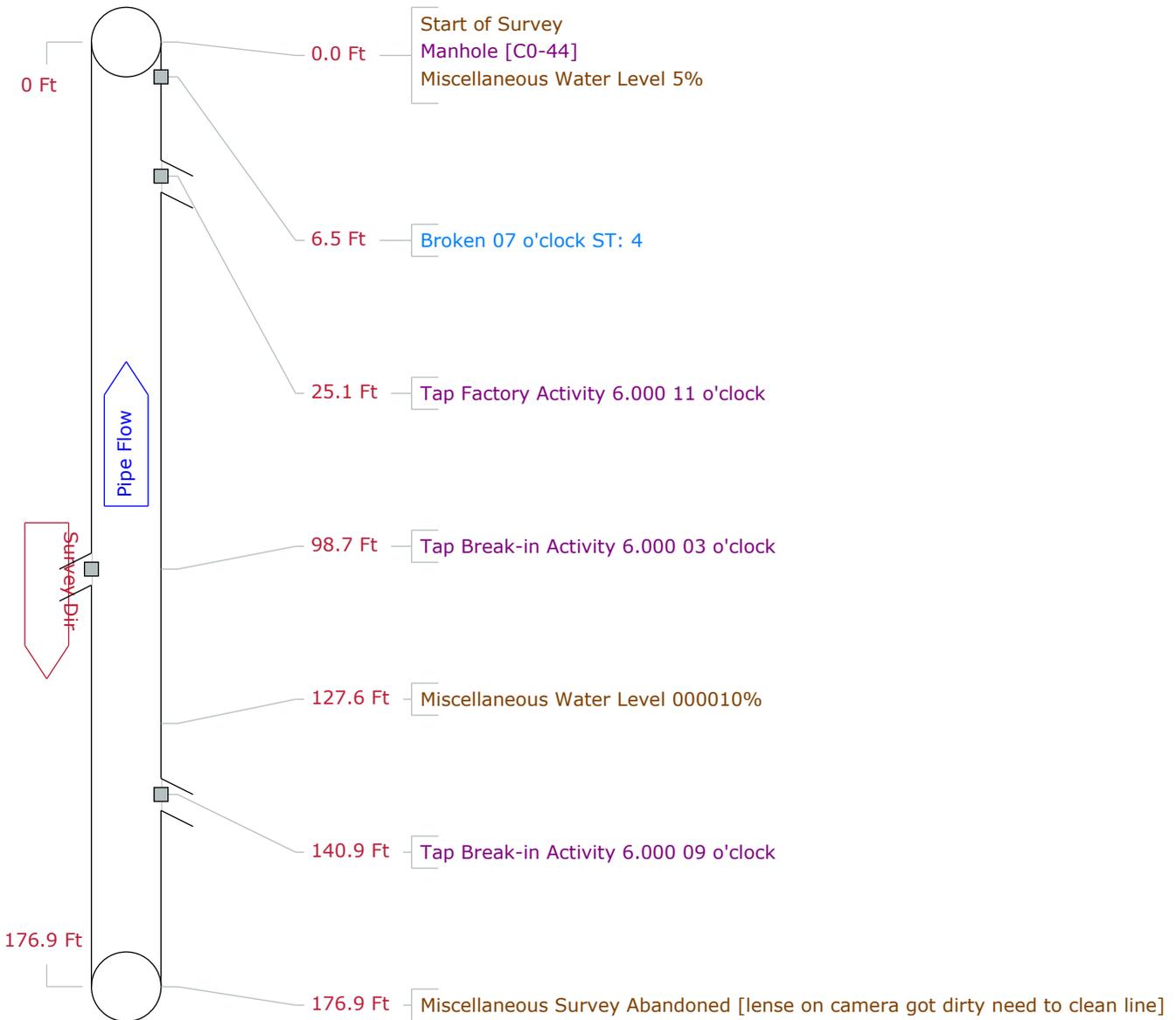


PipeLogix Inc.
 Phone: 866-299-3150
 Fax: 760-406-6023

Pipe Graphic Report of PLR CO-45

X for Allen Major

Setup	2	Surveyed By	ZC	Certificate #	614-06021733	Owner	
Reviewed By		Reviewer #		Work Order			
Customer				P/O #			
Media Label		Project	River St. Sewer				
Date	2019/04/24	Time	8:21	Weather		Pre-Cleaning L	Date Cleaned
Flow control		Survey Purpose					Direction Upstream
Street	River St.	City	Winchester	Drainage area			
Location Code		Pipe Use	Sanitary Sewage Pipe				
Location details		Height	8	Width	ins		
Shape	Circular	Material	Asbestos Cement	Lining			
Coating		Pipe Joint length	Ft	Total length	Ft	Structural	O & M
Length Surveyed	176.90 Ft	Year Constructed		Year Renewed		Miscellaneous	Constructional
Up	CO-45	Rim to invert		Grade to invert		Rim to grade	Ft
Down	C0-44	Rim to invert		Grade to invert		Rim to grade	Ft



PipeLogix Inc.
 Phone: 866-299-3150
 Fax: 760-406-6023

Tabular Report of PSR CO-45

for Allen Major

Setup	2	Surveyed By	ZC	Certificate #	614-06021733	Owner	
Reviewed By		Reviewer #		Work Order			
Customer				P/O #			
Media Label		Project	River St. Sewer				
Date	2019/04/24	Time	8:21	Weather		Pre-Cleaning	L
Flow control		Survey Purpose				Direction	Up
Inspection Status	Complete Inspection	Consequence Of Failure		Pressure			
Inspection Technology Used	<input type="checkbox"/> CCTV <input type="checkbox"/> Laser <input type="checkbox"/> Sonar <input type="checkbox"/> Sidewall <input type="checkbox"/> Zoom <input type="checkbox"/> Other						

Street	River St.	City	Winchester	Drainage area	
Location Code		Pipe Use	Sanitary Sewage Pipe		
Location details		Height	8	Width	ins
Shape	Circular	Material	Asbestos Cement	Lining	
Coating		Pipe Joint length	Ft	Total length	Ft
Length Surveyed	176.9 Ft	Year Constructed		Year Renewed	
Up	CO-45	Rim to invert		Grade to invert	
Northing		Easting		Elevation	
Down	CO-44	Rim to invert		Grade to invert	
Northing		Easting		Elevation	
Coordinate System		Vertical Datum			
GPS Accuracy					
Additional info					Structural O & M Miscellaneous Constructional

Count	Video	CD Code	Val1	Val2	%	Jnt	Fr	To	ImRef	Remarks
0.0		ST Start of Survey								
0.0		AMH Manhole								C0-44
0.0		MWL Miscellaneous Water Level			5.000					
6.5		B Broken					07			
25.1		TFA Tap Factory Activity	6.000				11			
98.7		TBA Tap Break-in Activity	6.000				03			
127.6		MWL Miscellaneous Water Level			10.000					
140.9		TBA Tap Break-in Activity	6.000				09			
176.9		MSA Miscellaneous Survey Abandoned								lense on camera got dirty nee...

176.9 Ft Total Length Surveyed

Scores	Structural:	Pipe Rating 4	Pipe Ratings Index 4	Quick Rating 4100
	O&M:	Pipe Rating 0	Pipe Ratings Index 0	Quick Rating 0000
	Overall	Pipe Rating 4	Pipe Ratings Index 4	Quick Rating 4100

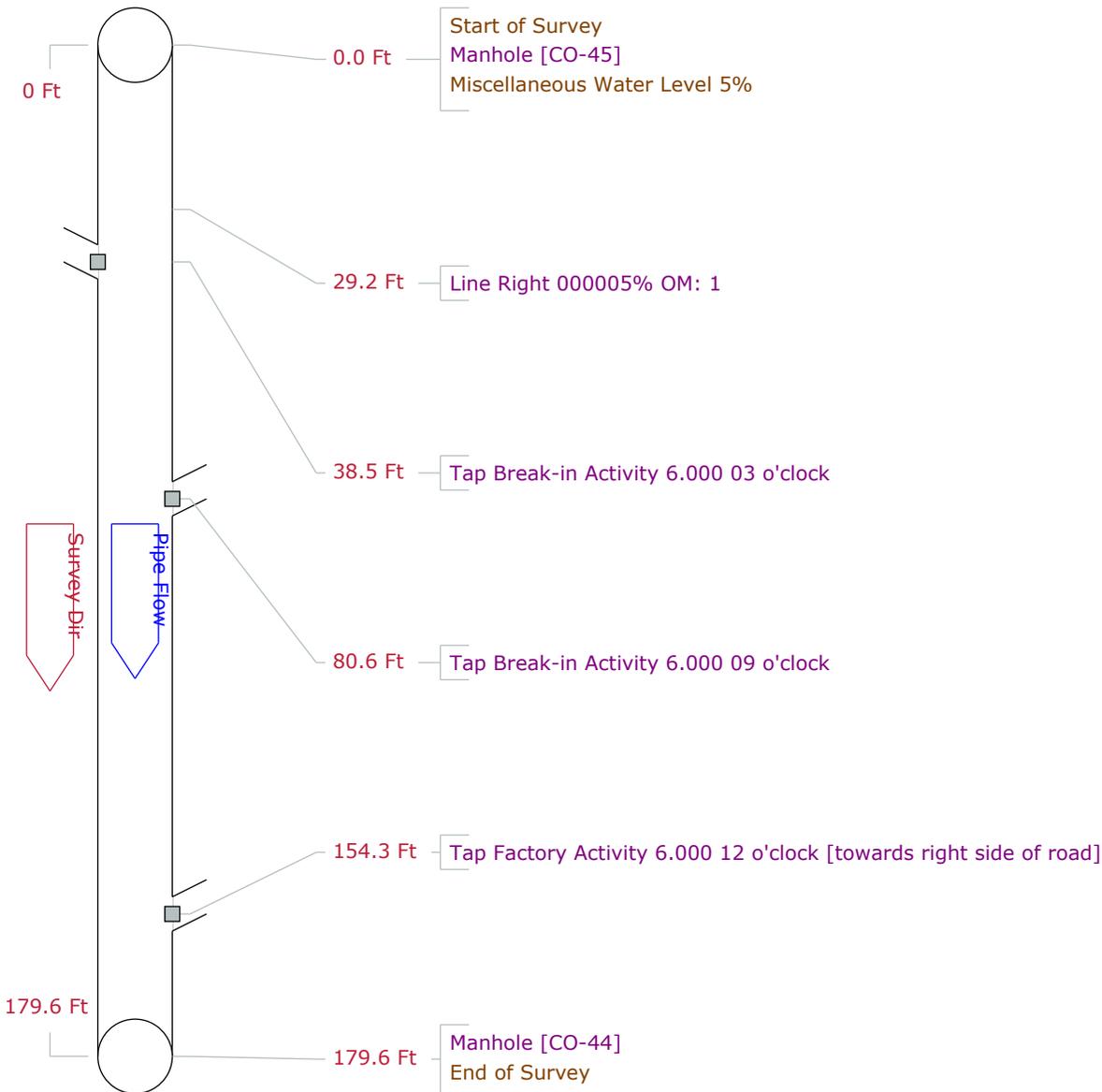


PipeLogix Inc.
 Phone: 866-299-3150
 Fax: 760-406-6023

Pipe Graphic Report of PLR CO-45

X for Allen Major

Setup	8	Surveyed By	ZC	Certificate #	614-06021733	Owner	
Reviewed By		Reviewer #		Work Order			
Customer				P/O #			
Media Label		Project	River St. Sewer				
Date	2019/04/24	Time	12:47	Weather		Pre-Cleaning H	Date Cleaned
Flow control		Survey Purpose					Direction Downstream
Street	River St.	City	Winchester	Drainage area			
Location Code		Pipe Use	Sanitary Sewage Pipe				
Location details		Height	8	Width	ins		
Shape	Circular	Material	Asbestos Cement	Lining			
Coating		Pipe Joint length	Ft	Total length	179.6	Ft	Structural O & M
Length Surveyed	179.60 Ft	Year Constructed		Year Renewed			Miscellaneous Constructional
Up	CO-45	Rim to invert		Grade to invert			Rim to grade Ft
Down	CO-44	Rim to invert		Grade to invert			Rim to grade Ft



PipeLogix Inc.
 Phone: 866-299-3150
 Fax: 760-406-6023

Tabular Report of PSR CO-45

for Allen Major

Setup 8	Surveyed By ZC	Certificate # 614-06021733	Owner
Reviewed By	Reviewer #	Work Order	
Customer		P/O #	
Media Label	Project River St. Sewer		
Date 2019/04/24	Time 12:47	Weather	Pre-Cleaning H
Flow control	Survey Purpose		Date Cleaned
Inspection Status Complete Inspection	Consequence Of Failure	Pressure	
Inspection Technology Used	<input type="checkbox"/> CCTV <input type="checkbox"/> Laser <input type="checkbox"/> Sonar <input type="checkbox"/> Sidewall <input type="checkbox"/> Zoom <input type="checkbox"/> Other		

Street River St.	City Winchester	Drainage area
Location Code	Pipe Use Sanitary Sewage Pipe	
Location details	Height 8	Width ins
Shape Circular	Material Asbestos Cement	Lining
Coating	Pipe Joint length Ft	Total length 179.6 Ft
Length Surveyed 179.6 Ft	Year Constructed	Year Renewed
Up CO-45	Rim to invert	Grade to invert
Northing	Easting	Elevation
Down CO-44	Rim to invert	Grade to invert
Northing	Easting	Elevation
Coordinate System	Vertical Datum	
GPS Accuracy	Structural O & M Miscellaneous Constructional	
Additional info		

Count	Video	CD Code	Val1	Val2	%	Jnt	Fr	To	ImRef	Remarks
0.0		ST Start of Survey								
0.0		AMH Manhole								CO-45
0.0		MWL Miscellaneous Water Level			5.000					
29.2		LR Line Right			5.000					
38.5		TBA Tap Break-in Activity	6.000				03			
80.6		TBA Tap Break-in Activity	6.000				09			
154.3		TFA Tap Factory Activity	6.000				12			towards right side of road
179.6		AMH Manhole								CO-44
179.6		FH End of Survey								

179.6 Ft Total Length Surveyed

Scores	Structural: Pipe Rating 0	Pipe Ratings Index 0	Quick Rating 0000
	O&M: Pipe Rating 1	Pipe Ratings Index 1	Quick Rating 1100
	Overall Pipe Rating 1	Pipe Ratings Index 1	Quick Rating 1100

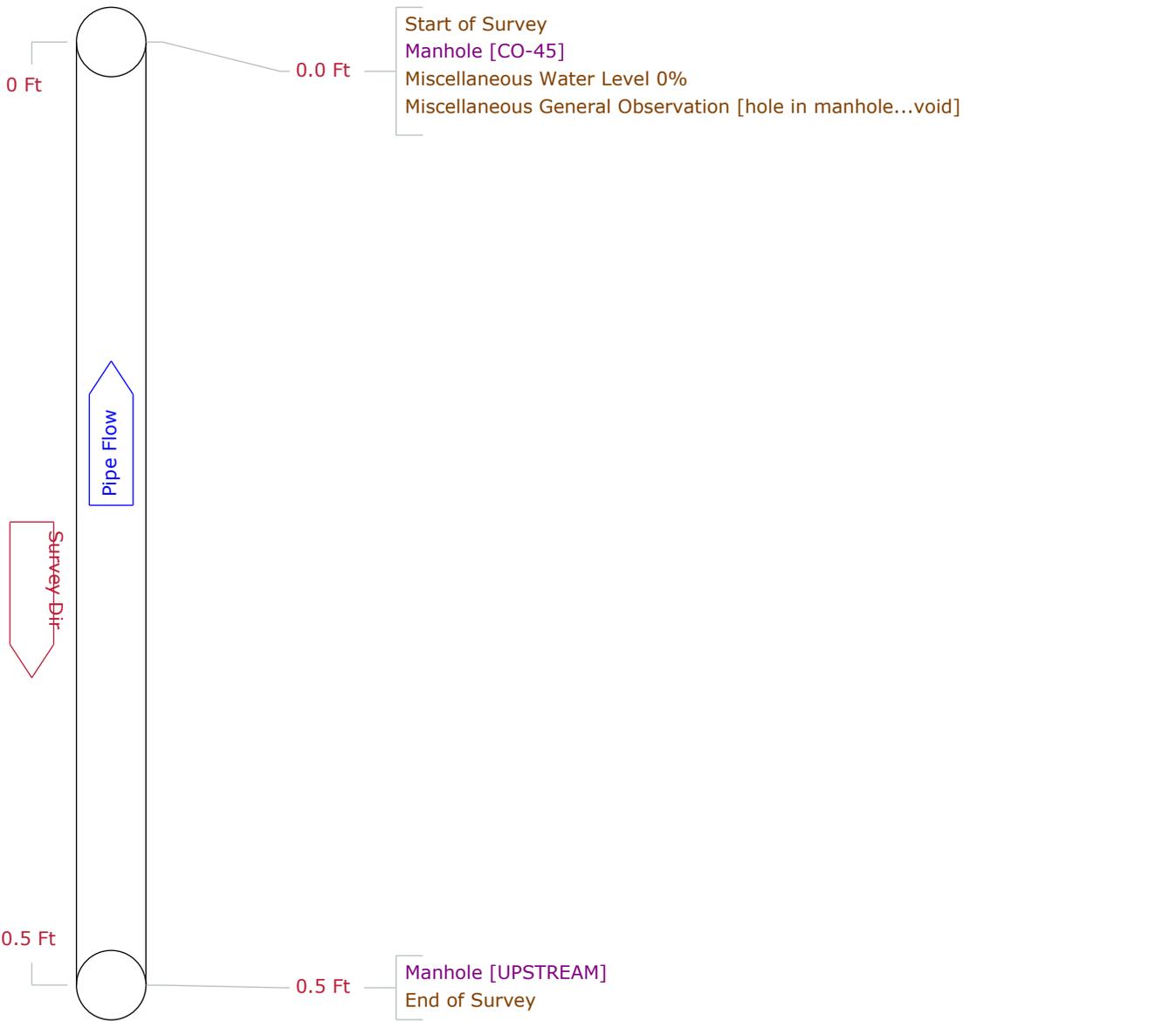


PipeLogix Inc.
 Phone: 866-299-3150
 Fax: 760-406-6023

Pipe Graphic Report of PLR UPSTREAM

X for Allen Major

Setup	9	Surveyed By	ZC	Certificate #	614-06021733	Owner	
Reviewed By		Reviewer #		Work Order			
Customer				P/O #			
Media Label		Project	River St. Sewer				
Date	2019/04/24	Time	13:07	Weather		Pre-Cleaning H	Date Cleaned
Flow control		Survey Purpose					Direction Upstream
Street	River St.	City	Winchester	Drainage area			
Location Code		Pipe Use	Sanitary Sewage Pipe				
Location details		Height	8	Width	ins		
Shape	Circular	Material	Asbestos Cement	Lining			
Coating		Pipe Joint length	Ft	Total length	0.5	Ft	Structural O & M
Length Surveyed	00.50	Year Constructed		Year Renewed			Miscellaneous Constructional
Up	UPSTREAM	Rim to invert		Grade to invert		Rim to grade	Ft
Down	CO-45	Rim to invert		Grade to invert		Rim to grade	Ft



PipeLogix Inc.
 Phone: 866-299-3150
 Fax: 760-406-6023

Tabular Report of PSR UPSTREAM

for Allen Major

Setup	9	Surveyed By	ZC	Certificate #	614-06021733	Owner	
Reviewed By		Reviewer #		Work Order			
Customer				P/O #			
Media Label		Project	River St. Sewer				
Date	2019/04/24	Time	13:07	Weather		Pre-Cleaning H	Date Cleaned
Flow control		Survey Purpose					Direction Up
Inspection Status	Complete Inspection	Consequence Of Failure		Pressure			
Inspection Technology Used	<input type="checkbox"/> CCTV <input type="checkbox"/> Laser <input type="checkbox"/> Sonar <input type="checkbox"/> Sidewall <input type="checkbox"/> Zoom <input type="checkbox"/> Other						

Street	River St.	City	Winchester	Drainage area	
Location Code		Pipe Use	Sanitary Sewage Pipe		
Location details		Height	8	Width	ins
Shape	Circular	Material	Asbestos Cement	Lining	
Coating		Pipe Joint length	Ft	Total length	0.5 Ft
Length Surveyed	0.5 Ft	Year Constructed		Year Renewed	
Up	UPSTREAM	Rim to invert		Grade to invert	Rim to grade Ft
Northing		Easting		Elevation	
Down	CO-45	Rim to invert		Grade to invert	Rim to grade Ft
Northing		Easting		Elevation	
Coordinate System		Vertical Datum			
GPS Accuracy					
Additional info					Structural O & M Miscellaneous Constructional

Count	Video	CD Code	Val1	Val2	%	Jnt	Fr	To	ImRef	Remarks
0.0		ST Start of Survey								
0.0		AMH Manhole								CO-45
0.0		MWL Miscellaneous Water Level			0.000					
0.0		MGO Miscellaneous General Observation								hole in manhole...void
0.5		AMH Manhole								UPSTREAM
0.5		FH End of Survey								

0.5 Ft Total Length Surveyed

Scores	Structural:	Pipe Rating 0	Pipe Ratings Index 0	Quick Rating 0000
	O&M:	Pipe Rating 0	Pipe Ratings Index 0	Quick Rating 0000
	Overall	Pipe Rating 0	Pipe Ratings Index 0	Quick Rating 0000

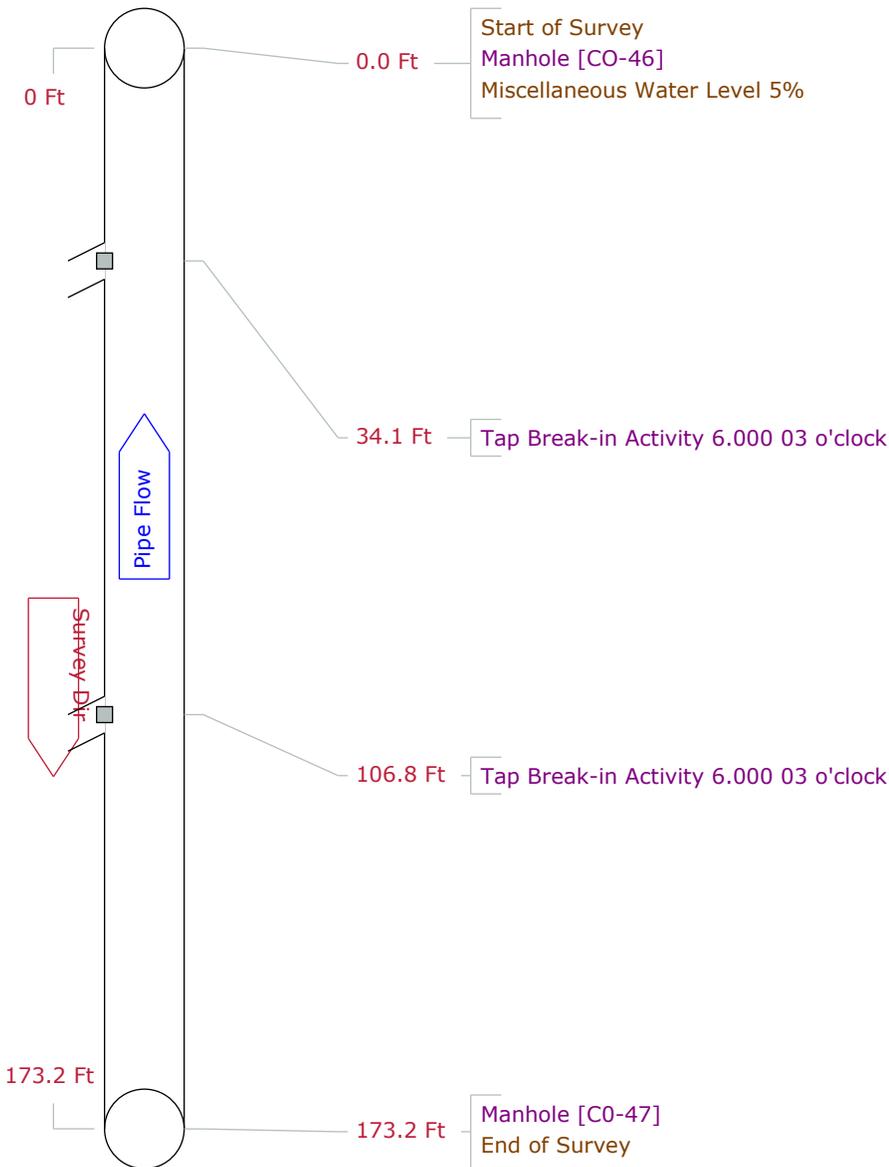


PipeLogix Inc.
 Phone: 866-299-3150
 Fax: 760-406-6023

Pipe Graphic Report of PLR C0-47

X for Allen Major

Setup	4	Surveyed By	ZC	Certificate #	614-06021733	Owner	
Reviewed By		Reviewer #		Work Order			
Customer				P/O #			
Media Label		Project	River St. Sewer				
Date	2019/04/24	Time	10:17	Weather		Pre-Cleaning L	Date Cleaned
Flow control		Survey Purpose					Direction Upstream
Street	River St.	City	Winchester	Drainage area			
Location Code		Pipe Use	Sanitary Sewage Pipe				
Location details		Height	8	Width	ins		
Shape	Circular	Material	Asbestos Cement	Lining			
Coating		Pipe Joint length	Ft	Total length	173.2	Ft	Structural O & M
Length Surveyed	173.20	Year Constructed		Year Renewed			Miscellaneous Constructional
Up	C0-47	Rim to invert		Grade to invert			Rim to grade Ft
Down	CO-46	Rim to invert		Grade to invert			Rim to grade Ft



PipeLogix Inc.
 Phone: 866-299-3150
 Fax: 760-406-6023

Tabular Report of PSR C0-47

for Allen Major

Setup	4	Surveyed By	ZC	Certificate #	614-06021733	Owner	
Reviewed By		Reviewer #		Work Order			
Customer				P/O #			
Media Label		Project	River St. Sewer				
Date	2019/04/24	Time	10:17	Weather		Pre-Cleaning	L
Flow control		Survey Purpose				Date Cleaned	
Inspection Status	Complete Inspection	Consequence Of Failure		Pressure		Direction	Up
Inspection Technology Used	<input type="checkbox"/> CCTV <input type="checkbox"/> Laser <input type="checkbox"/> Sonar <input type="checkbox"/> Sidewall <input type="checkbox"/> Zoom <input type="checkbox"/> Other						

Street	River St.	City	Winchester	Drainage area	
Location Code		Pipe Use	Sanitary Sewage Pipe		
Location details		Height	8	Width	ins
Shape	Circular	Material	Asbestos Cement	Lining	
Coating		Pipe Joint length	Ft	Total length	173.2 Ft
Length Surveyed	173.2 Ft	Year Constructed		Year Renewed	
Up	C0-47	Rim to invert		Grade to invert	
Northing		Easting		Elevation	
Down	CO-46	Rim to invert		Grade to invert	
Northing		Easting		Elevation	
Coordinate System		Vertical Datum			
GPS Accuracy					
Additional info					

Structural	O & M
Miscellaneous	Constructional

Count	Video	CD Code	Val1	Val2	%	Jnt	Fr	To	ImRef	Remarks
0.0		ST Start of Survey								
0.0		AMH Manhole								CO-46
0.0		MWL Miscellaneous Water Level			5.000					
34.1		TBA Tap Break-in Activity	6.000					03		
106.8		TBA Tap Break-in Activity	6.000					03		
173.2		AMH Manhole								CO-47
173.2		FH End of Survey								

173.2 Ft Total Length Surveyed

Scores	Structural:	Pipe Rating 0	Pipe Ratings Index 0	Quick Rating 0000
	O&M:	Pipe Rating 0	Pipe Ratings Index 0	Quick Rating 0000
	Overall	Pipe Rating 0	Pipe Ratings Index 0	Quick Rating 0000

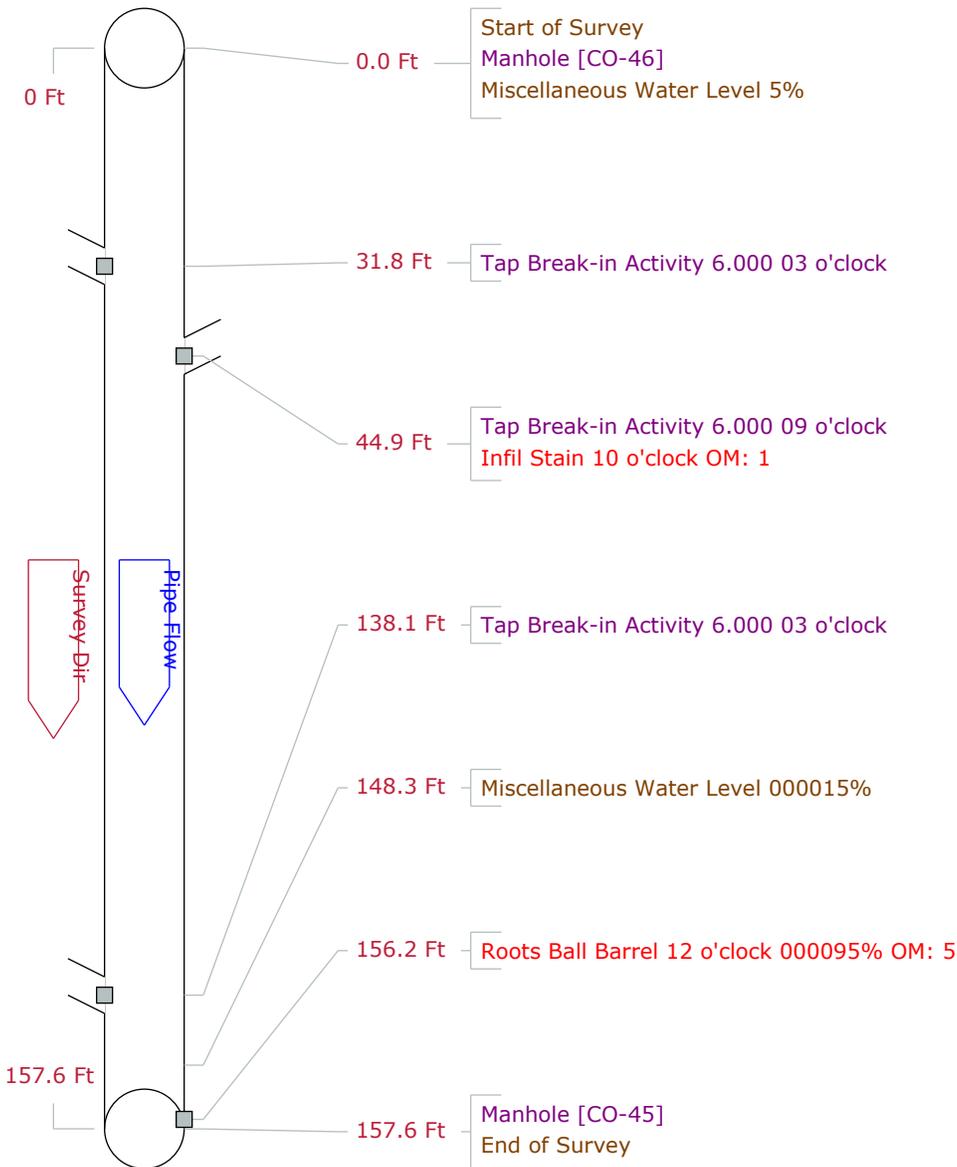


PipeLogix Inc.
 Phone: 866-299-3150
 Fax: 760-406-6023

Pipe Graphic Report of PLR CO-46

X for Allen Major

Setup	3	Surveyed By	ZC	Certificate #	614-06021733	Owner	
Reviewed By		Reviewer #		Work Order			
Customer				P/O #			
Media Label		Project	River St. Sewer				
Date	2019/04/24	Time	9:46	Weather		Pre-Cleaning L	Date Cleaned
Flow control		Survey Purpose					Direction Downstream
Street	River St.	City	Winchester	Drainage area			
Location Code		Pipe Use	Sanitary Sewage Pipe				
Location details		Height	8	Width	ins		
Shape	Circular	Material	Asbestos Cement	Lining			
Coating		Pipe Joint length	Ft	Total length	157.6	Ft	Structural O & M
Length Surveyed	157.60 Ft	Year Constructed		Year Renewed			Miscellaneous Constructional
Up	CO-46	Rim to invert		Grade to invert			Rim to grade Ft
Down	CO-45	Rim to invert		Grade to invert			Rim to grade Ft



PipeLogix Inc.
 Phone: 866-299-3150
 Fax: 760-406-6023

Tabular Report of PSR CO-46

for Allen Major

Setup	3	Surveyed By	ZC	Certificate #	614-06021733	Owner	
Reviewed By		Reviewer #		Work Order			
Customer				P/O #			
Media Label		Project	River St. Sewer				
Date	2019/04/24	Time	9:46	Weather		Pre-Cleaning	L
Flow control		Survey Purpose				Date Cleaned	
Inspection Status	Complete Inspection	Consequence Of Failure		Pressure		Direction	Down
Inspection Technology Used	<input type="checkbox"/> CCTV <input type="checkbox"/> Laser <input type="checkbox"/> Sonar <input type="checkbox"/> Sidewall <input type="checkbox"/> Zoom <input type="checkbox"/> Other						

Street	River St.	City	Winchester	Drainage area	
Location Code		Pipe Use	Sanitary Sewage Pipe		
Location details		Height	8	Width	ins
Shape	Circular	Material	Asbestos Cement	Lining	
Coating		Pipe Joint length	Ft	Total length	157.6 Ft
Length Surveyed	157.6 Ft	Year Constructed		Year Renewed	
Up	CO-46	Rim to invert		Grade to invert	
Northing		Easting		Elevation	
Down	CO-45	Rim to invert		Grade to invert	
Northing		Easting		Elevation	
Coordinate System		Vertical Datum			
GPS Accuracy					
Additional info					

Structural	O & M
Miscellaneous	Constructional

Count	Video	CD Code	Val1	Val2	%	Jnt	Fr	To	ImRef	Remarks
0.0		ST Start of Survey								
0.0		AMH Manhole								CO-46
0.0		MWL Miscellaneous Water Level			5.000					
31.8		TBA Tap Break-in Activity	6.000					03		
44.9		TBA Tap Break-in Activity	6.000					09		
44.9		IS Infil Stain						10		
138.1		TBA Tap Break-in Activity	6.000					03		
148.3		MWL Miscellaneous Water Level			15.000					
156.2		RBB Roots Ball Barrel			95.000			12		
157.6		AMH Manhole								CO-45
157.6		FH End of Survey								

157.6 Ft Total Length Surveyed

Scores	Structural:	Pipe Rating 0	Pipe Ratings Index 0	Quick Rating 0000
	O&M:	Pipe Rating 6	Pipe Ratings Index 3	Quick Rating 5111
	Overall	Pipe Rating 6	Pipe Ratings Index 3	Quick Rating 5111

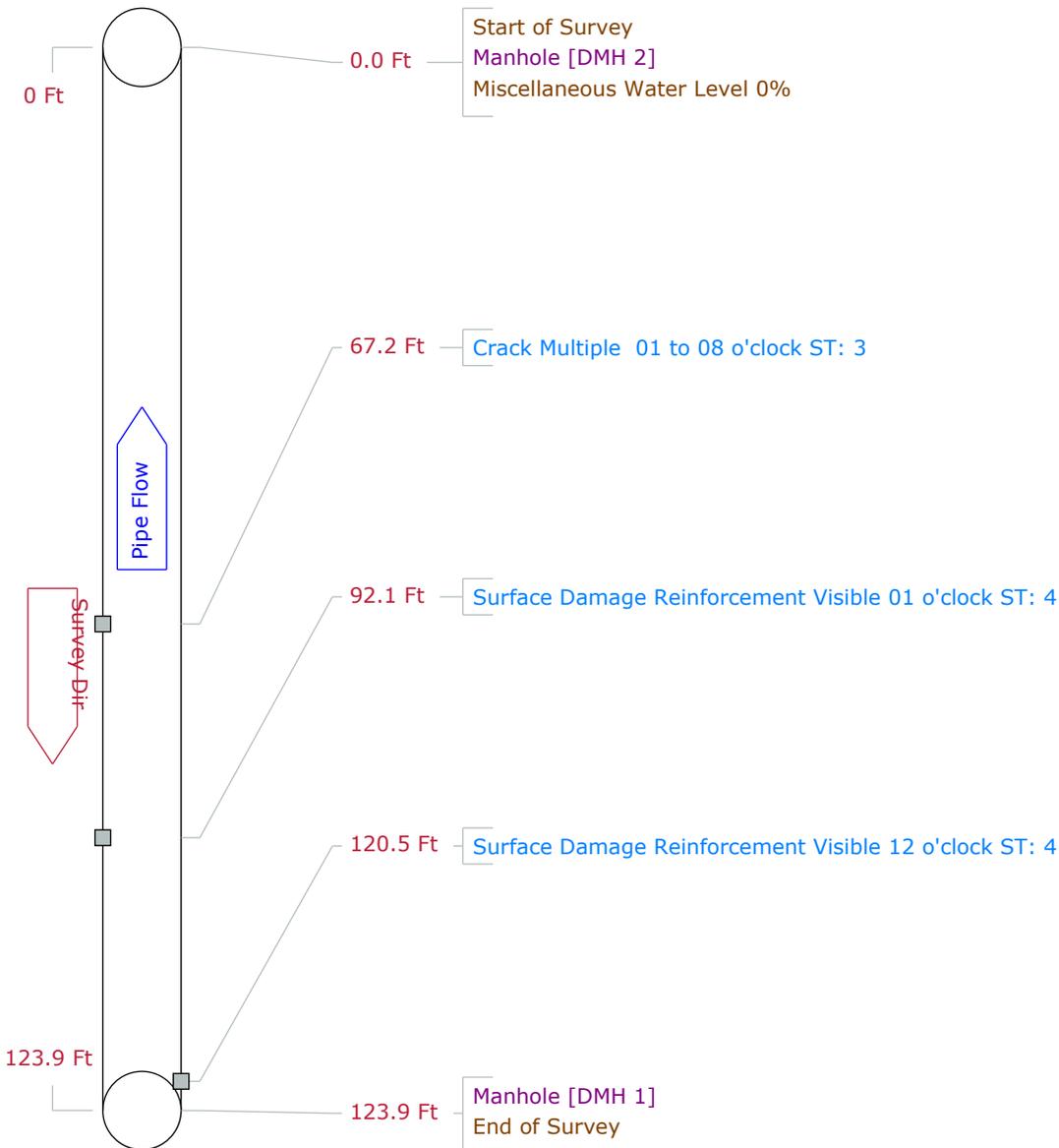


PipeLogix Inc.
 Phone: 866-299-3150
 Fax: 760-406-6023

Pipe Graphic Report of PLR DMH 1

X for Allen Major

Setup	5	Surveyed By	ZC	Certificate #	614-06021733	Owner	
Reviewed By		Reviewer #		Work Order			
Customer				P/O #			
Media Label		Project	River St. Sewer				
Date	2019/04/24	Time	11:49	Weather		Pre-Cleaning	N
Flow control		Survey Purpose				Date Cleaned	
Street	River St.	City	Winchester	Drainage area			
Location Code				Pipe Use	Stormwater Pipe		
Location details				Height	12	Width	ins
Shape	Circular	Material	Reinforced Concrete Pipe	Lining			
Coating		Pipe Joint length	Ft	Total length	123.9	Ft	Structural O & M
Length Surveyed	123.90 Ft	Year Constructed		Year Renewed			Miscellaneous Constructional
Up	DMH 1	Rim to invert		Grade to invert		Rim to grade	Ft
Down	DMH 2	Rim to invert		Grade to invert		Rim to grade	Ft



PipeLogix Inc.
Phone: 866-299-3150
Fax: 760-406-6023

Tabular Report of PSR DMH 1

for Allen Major

Setup	5	Surveyed By	ZC	Certificate #	614-06021733	Owner	
Reviewed By		Reviewer #		Work Order			
Customer				P/O #			
Media Label		Project	River St. Sewer				
Date	2019/04/24	Time	11:49	Weather		Pre-Cleaning	N
Flow control		Survey Purpose				Date Cleaned	
Inspection Status	Complete Inspection	Consequence Of Failure		Pressure		Direction	Up
Inspection Technology Used	<input type="checkbox"/> CCTV <input type="checkbox"/> Laser <input type="checkbox"/> Sonar <input type="checkbox"/> Sidewall <input type="checkbox"/> Zoom <input type="checkbox"/> Other						

Street	River St.	City	Winchester	Drainage area	
Location Code		Pipe Use	Stormwater Pipe		
Location details		Height	12	Width	ins
Shape	Circular	Material	Reinforced Concrete Pipe	Lining	
Coating		Pipe Joint length	Ft	Total length	123.9 Ft
Length Surveyed	123.9 Ft	Year Constructed		Year Renewed	
Up	DMH 1	Rim to invert		Grade to invert	
Northing		Easting		Elevation	
Down	DMH 2	Rim to invert		Grade to invert	
Northing		Easting		Elevation	
Coordinate System		Vertical Datum			
GPS Accuracy					
Additional info					Structural O & M Miscellaneous Constructional

Count	Video	CD Code	Val1	Val2	%	Jnt	Fr	To	ImRef	Remarks
0.0		ST Start of Survey								
0.0		AMH Manhole								DMH 2
0.0		MWL Miscellaneous Water Level			0.000					
67.2		CM Crack Multiple					01	08		
92.1		SRV Surface Damage Reinforcement Vis					01			
120.5		SRV Surface Damage Reinforcement Vis					12			
123.9		AMH Manhole								DMH 1
123.9		FH End of Survey								

123.9 Ft Total Length Surveyed

Scores	Structural:	Pipe Rating 11	Pipe Ratings Index 3.7	Quick Rating 4231
	O&M:	Pipe Rating 0	Pipe Ratings Index 0	Quick Rating 0000
	Overall	Pipe Rating 11	Pipe Ratings Index 3.7	Quick Rating 4231

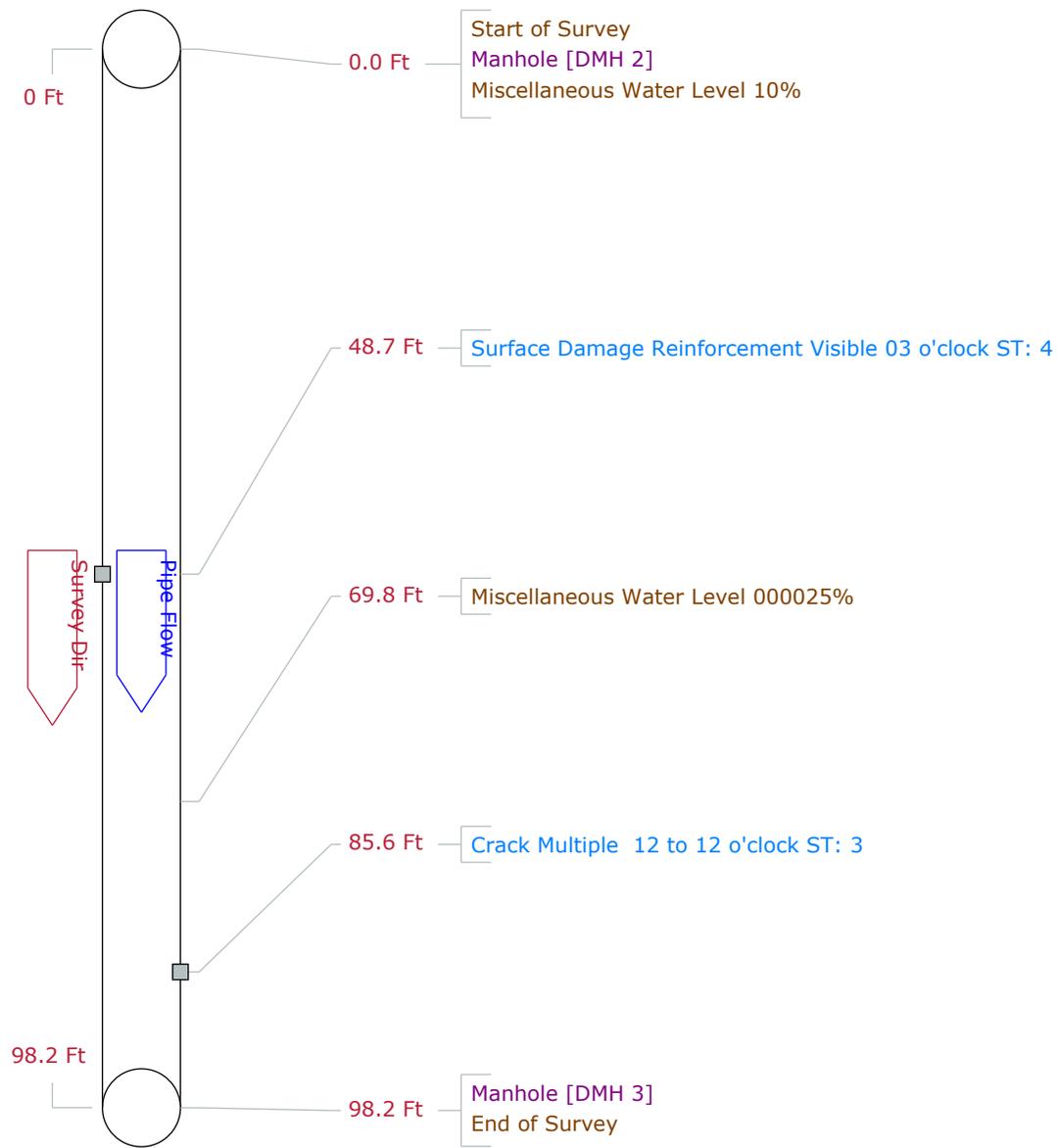


PipeLogix Inc.
 Phone: 866-299-3150
 Fax: 760-406-6023

Pipe Graphic Report of PLR DMH 2

X for Allen Major

Setup	6	Surveyed By	ZC	Certificate #	614-06021733	Owner	
Reviewed By		Reviewer #		Work Order			
Customer				P/O #			
Media Label		Project	River St. Sewer				
Date	2019/04/24	Time	12:08	Weather		Pre-Cleaning	N
Flow control		Survey Purpose				Date Cleaned	
Street	River St.	City	Winchester	Drainage area			
Location Code		Pipe Use	Stormwater Pipe				
Location details		Height	12	Width	ins		
Shape	Circular	Material	Reinforced Concrete Pipe	Lining			
Coating		Pipe Joint length	Ft	Total length	98.2	Ft	Structural O & M
Length Surveyed	98.20	Year Constructed		Year Renewed			Miscellaneous Constructional
Up	DMH 2	Rim to invert		Grade to invert		Rim to grade	Ft
Down	DMH 3	Rim to invert		Grade to invert		Rim to grade	Ft



PipeLogix Inc.
 Phone: 866-299-3150
 Fax: 760-406-6023

Tabular Report of PSR DMH 2

for Allen Major

Setup 6	Surveyed By ZC	Certificate # 614-06021733	Owner
Reviewed By	Reviewer #	Work Order	
Customer		P/O #	
Media Label	Project River St. Sewer		
Date 2019/04/24	Time 12:08	Weather	Pre-Cleaning N
Flow control	Survey Purpose		Date Cleaned
Inspection Status Complete Inspection	Consequence Of Failure	Pressure	Direction Down
Inspection Technology Used	<input type="checkbox"/> CCTV <input type="checkbox"/> Laser <input type="checkbox"/> Sonar <input type="checkbox"/> Sidewall <input type="checkbox"/> Zoom <input type="checkbox"/> Other		

Street River St.	City Winchester	Drainage area
Location Code	Pipe Use Stormwater Pipe	
Location details	Height 12	Width ins
Shape Circular	Material Reinforced Concrete Pipe	Lining
Coating	Pipe Joint length Ft	Total length 98.2 Ft
Length Surveyed 98.2 Ft	Year Constructed	Year Renewed
Up DMH 2	Rim to invert	Grade to invert
Northing	Easting	Elevation
Down DMH 3	Rim to invert	Grade to invert
Northing	Easting	Elevation
Coordinate System	Vertical Datum	
GPS Accuracy	Structural O & M Miscellaneous Constructional	
Additional info		

Count	Video	CD Code	Val1	Val2	%	Jnt	Fr	To	ImRef	Remarks
0.0		ST Start of Survey								
0.0		AMH Manhole								DMH 2
0.0		MWL Miscellaneous Water Level			10.000					
48.7		SRV Surface Damage Reinforcement Vis					03			
69.8		MWL Miscellaneous Water Level			25.000					
85.6		CM Crack Multiple					12	12		
98.2		AMH Manhole								DMH 3
98.2		FH End of Survey								

98.2 Ft Total Length Surveyed

Scores	Structural: Pipe Rating 7	Pipe Ratings Index 3.5	Quick Rating 4131
	O&M: Pipe Rating 0	Pipe Ratings Index 0	Quick Rating 0000
	Overall Pipe Rating 7	Pipe Ratings Index 3.5	Quick Rating 4131

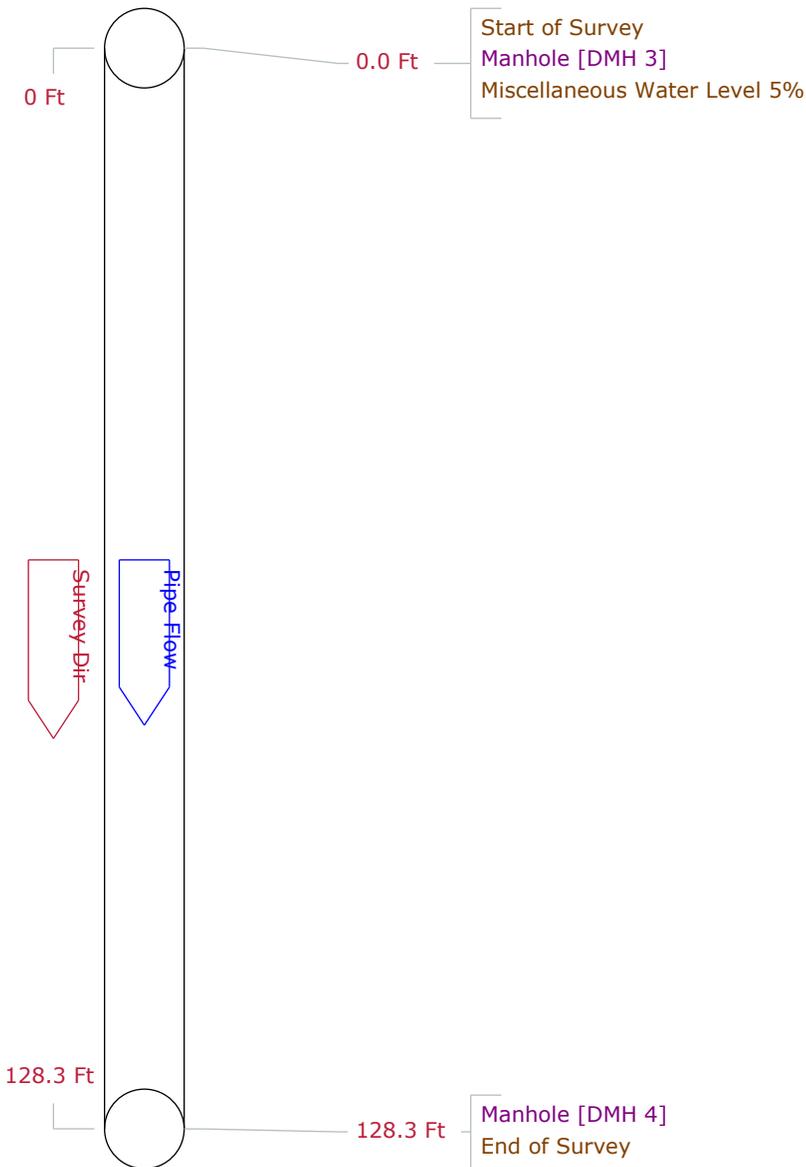


PipeLogix Inc.
 Phone: 866-299-3150
 Fax: 760-406-6023

Pipe Graphic Report of PLR DMH 3

X for Allen Major

Setup	7	Surveyed By	ZC	Certificate #	614-06021733	Owner	
Reviewed By		Reviewer #		Work Order			
Customer				P/O #			
Media Label		Project	River St. Sewer				
Date	2019/04/24	Time	12:12	Weather		Pre-Cleaning	N
Flow control		Survey Purpose				Date Cleaned	
Street	River St.	City	Winchester	Drainage area			
Location Code		Pipe Use	Stormwater Pipe				
Location details		Height	12	Width	ins		
Shape	Circular	Material	Reinforced Concrete Pipe	Lining			
Coating		Pipe Joint length	Ft	Total length	128.3	Ft	Structural O & M
Length Surveyed	128.30 Ft	Year Constructed		Year Renewed			Miscellaneous Constructional
Up	DMH 3	Rim to invert		Grade to invert		Rim to grade	Ft
Down	DMH 4	Rim to invert		Grade to invert		Rim to grade	Ft



PipeLogix Inc.
Phone: 866-299-3150
Fax: 760-406-6023

Tabular Report of PSR DMH 3

for Allen Major

Setup	7	Surveyed By	ZC	Certificate #	614-06021733	Owner	
Reviewed By		Reviewer #		Work Order			
Customer				P/O #			
Media Label		Project	River St. Sewer				
Date	2019/04/24	Time	12:12	Weather		Pre-Cleaning	N
Flow control		Survey Purpose				Date Cleaned	
Inspection Status	Complete Inspection	Consequence Of Failure		Pressure		Direction	Down
Inspection Technology Used	<input type="checkbox"/> CCTV <input type="checkbox"/> Laser <input type="checkbox"/> Sonar <input type="checkbox"/> Sidewall <input type="checkbox"/> Zoom <input type="checkbox"/> Other						

Street	River St.	City	Winchester	Drainage area	
Location Code		Pipe Use	Stormwater Pipe		
Location details		Height	12	Width	ins
Shape	Circular	Material	Reinforced Concrete Pipe	Lining	
Coating		Pipe Joint length	Ft	Total length	128.3 Ft
Length Surveyed	128.3 Ft	Year Constructed		Year Renewed	
Up	DMH 3	Rim to invert		Grade to invert	
Northing		Easting		Elevation	
Down	DMH 4	Rim to invert		Grade to invert	
Northing		Easting		Elevation	
Coordinate System		Vertical Datum			
GPS Accuracy					
Additional info					Structural O & M Miscellaneous Constructional

Count	Video	CD Code	Val1	Val2	%	Jnt	Fr	To	ImRef	Remarks
0.0		ST Start of Survey								
0.0		AMH Manhole								DMH 3
0.0		MWL Miscellaneous Water Level			5.000					
128.3		AMH Manhole								DMH 4
128.3		FH End of Survey								

128.3 Ft Total Length Surveyed

Scores	Structural:	Pipe Rating 0	Pipe Ratings Index 0	Quick Rating 0000
	O&M:	Pipe Rating 0	Pipe Ratings Index 0	Quick Rating 0000
	Overall	Pipe Rating 0	Pipe Ratings Index 0	Quick Rating 0000



PipeLogix Inc.
 Phone: 866-299-3150
 Fax: 760-406-6023

Exhibit 3 – DRAINAGE MANHOLE LOCATIONS PLAN

TOWN OF WINCHESTER, MASS
PLAN & PROFILE OF DRAIN
RIVER STREET

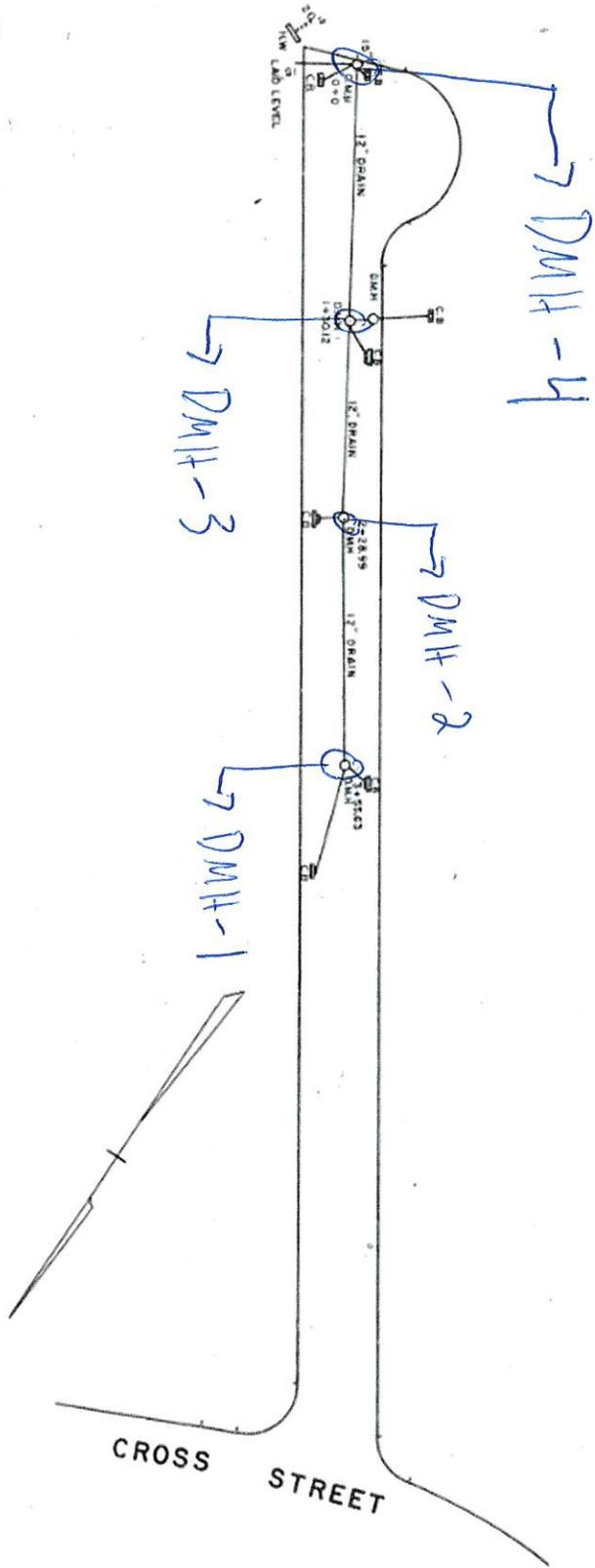


Exhibit 4 – SEWER STUDY

8-WEEK SEWER MONITORING OF PRESSURE AND SURCHARGING
WITHIN CO-2

REPORT PENDING AS OF MAY 16, 2019

The H.L. Turner Group Inc.

27 Locke Road Concord, NH 03301 t: 603.228.1122 hlturner.com

March 26, 2019

SLV River Street, LLC
C/O Geoff Engler & Justin Krebs
257 Hillside Avenue
Needham, MA 02494

Subject: 19 – 35 River Street; Winchester, MA
Hydraulic Analysis Flood Study - Aberjona River

Dear Mr. Traina:

This technical letter report summarizes assumptions, inputs, data sources and results for a hydraulic analysis of the Aberjona River in the vicinity of River Street in Winchester, MA. The analysis assesses impacts of a proposed development at 19 and 35 River Street currently in the conceptual design and permitting phase. This analysis does not provide hydraulic modeling analysis adequate to obtain a Letter of Map Revision/Amendment (LOMR/LOMA) from the Federal Emergency Management Agency (FEMA). However it serves as a basis to assess impacts of the proposed project to current effective 100-year base flood elevations (BFEs), and evaluate if the current project design results in a “no rise” effect.

Hydraulic Models

The Hydrologic Engineering Center River Analysis System (HEC-RAS) hydraulic modeling program was used to develop an existing and proposed conditions hydraulic model for the reach section of the Aberjona River between Swanton Street and the railroad crossing approximately 1,870 feet upstream of Swanton Street, in Winchester, MA. The two river crossing locations, Swanton Street and the railroad bridge, approximately correspond to the FEMA Flood Insurance Study (FIS) model cross sections “S” and “T” respectively.

Cross section elevation data is based on National Oceanographic and Atmospheric Administration (NOAA) digital elevation models (DEMs) from 2005 as obtained from European Petroleum Survey Group (EPSG) in North American Vertical Datum of 1988 (NAVD88) vertical datum. Cross section locations and frequency were chosen by the modeler to provide the most accurate determination of impact to base flood elevations from the proposed project. Bridge opening for the Swanton Street bridge crossing is based on measurement in ArcGIS online.

Technical Letter Report.docx ttg

1

Flood flows are based on the current effective Flood Insurance Study (FIS) for Middlesex County, Massachusetts dated July 6, 2016. Flows include the 10-, 50-, 100-, and 500-year flood flows. The FIS Table 8 provides flood flows for the Aberjona River at the Washington Street Crossing (upstream of the project), and upstream of Horn Pond Brook (downstream of the project); for conservatism, flows based on the just upstream of Horn Pond Brook were used in the models, 600 cfs, 930 cfs, 1190 cfs, and 2410 cfs respectively. Channel and overbank roughness (Manning's "n") values are based on the FIS Table 10, and flood elevations based on the FIS Table 12. The base flood elevation (BFE) is the same as the 100-year flood flow water surface elevation (WSEL)

This data was put into a HEC-RAS model using a Civil Geo platform (GeoHECRAS) to maintain GIS compatibility for mapping of results. The modeled BFE in the existing conditions model was intentionally higher than the current effective FIS identified BFE and flood WSELs. This was done in order for the modeled BFE flood delineation to be consistent with the current effective BFE delineation. This insures changes between the existing and proposed modeled conditions are adequately evaluated.

The proposed condition model was developed by modifying cross section geometry and obstructions for cross sections that pass through the proposed development at 19 and 35 River Street (cross sections 2183, 2241, 2308, and 2383) and added cross sections 2148, 2212, 2274, 2348 to prevent the model from interpreting the garage columns as consistent solid walls. Grading elevations are based on the Allen & Major drawing "C-2459-01 Grading and Drainage". Size and spacing of proposed parking garage columns is based on EMBARC Studio's drawing "A16 Ground Floor Plan", assumed to be 2 ft x 2 ft in area.

Results

Table 1 attached summarizes the differences between modeled existing and proposed conditions. There are insignificant increases between the two models (0.01 ft) primarily for the 500-year flood event. There are no increases in elevation for the 100-year (BFE) flood event, and no changes to the 100-year base flood event floodplain delineation. The "floodway" is based on the BFE. As such, with no change to the BFE delineation or elevation, no changes would be expected to the floodway delineation or elevation.

Conclusions

Based on the assumptions defined above, the proposed project has no impacts on the 100-year BFE.



Subsequent Steps

If a LOMA or LOMR is sought, or a regulatory entity requests, a more formal analysis may be required. The model serving as the basis for the current effective FIS and Flood Rate Insurance Map (FIRM) would need to be obtained from the FEMA Engineering Library. A “duplicate effective” model would need to be developed based on the FEMA Data, with the Existing Conditions model developed under this effort furthered into a “Revised Effective” model, to include a floodway analysis, and the Proposed Conditions model developed under this effort furthered into the “Proposed Effective” model including a floodway analysis. These models are then submitted as part of the LOMR or LOMA application package.

Should you have any questions or require any additional assistance, please feel free to contact us at 603.228.1122, ext 129 for Bob Carter, or ext 124 for Michael Hansen.

Sincerely,
The H.L. Turner Group, Inc.



Robert K Carter, CSS, CFM
Senior Project Engineer III, Associate



Michael Hansen, P.E., CFM
Senior VP of Civil Engineering

Attachments

- Plan view of Model worksheet (separate 24" x 36" document)
- Summary Comparison Matrix Table
- Modeled Cross sections
- Summary Tables for each model



Differences between Proposed and Conditions HEC RAS models for the Aberjona River in Winchester, MA in the vicinity of River Street

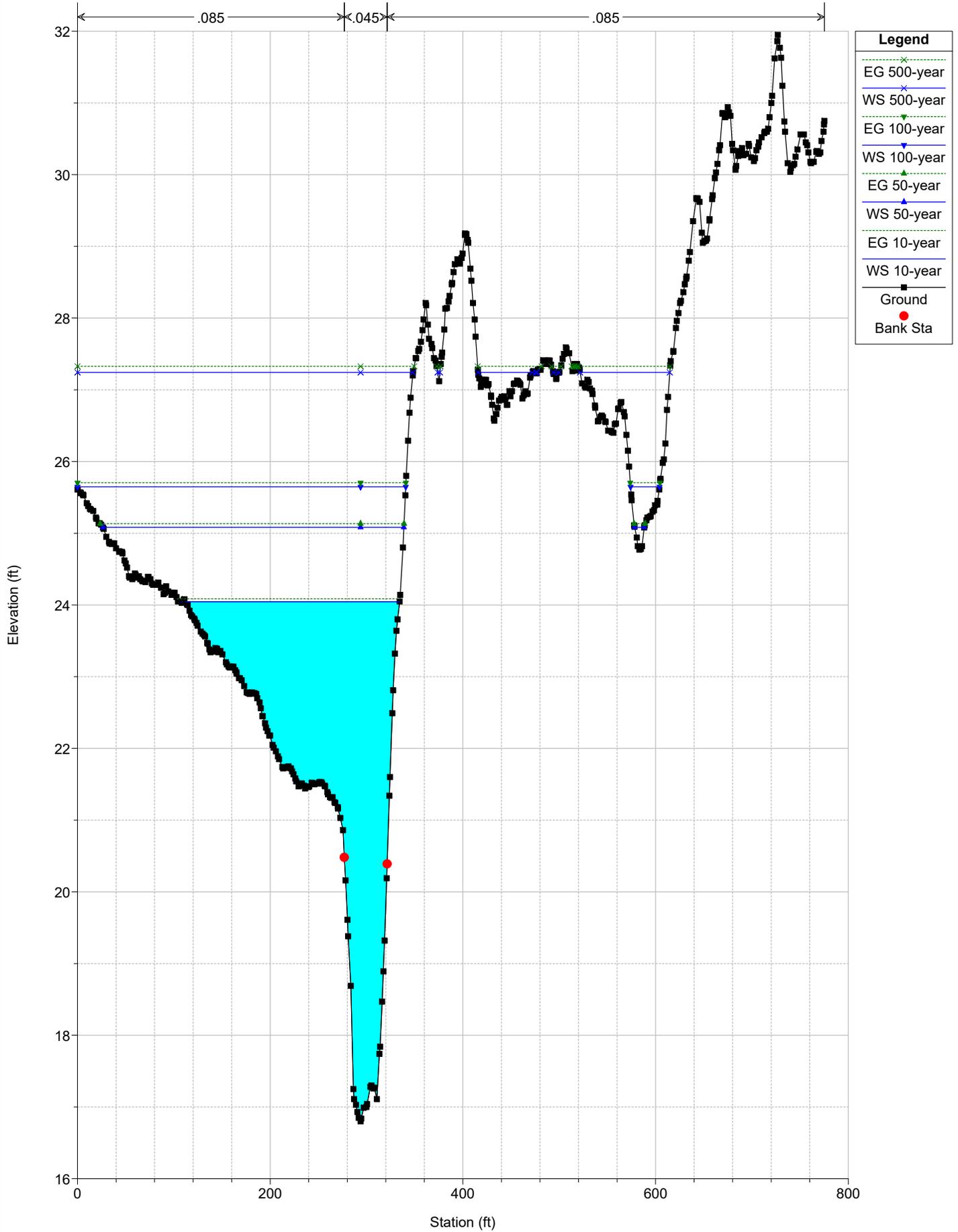
River Sta	Profile	Q Total	Difference in WSEL (proposed - existing)	Difference in Velocity (proposed - existing)	Existing Conditions WSEL	Proposed Conditions WSEL	
		(cfs)	(ft)	(fps)	(ft)	(ft)	
3259	10 year	600	0	0	24.05	24.05	
3259	50 year	930	0	0	25.08	25.08	
3259	100 year	1190	0	0	25.65	25.65	
3259	500 year	2410	0	-0.01	27.24	27.24	
3211	10 year	600	0	0	24	24	
3211	50 year	930	0	-0.01	25.03	25.03	
3211	100 year	1190	0	0	25.58	25.59	
3211	500 year	2410	0.01	-0.01	27.16	27.16	
3017	10 year	600	0	0	24.02	24.02	
3017	50 year	930	0	0	25.06	25.06	
3017	100 year	1190	0	0	25.62	25.62	
3017	500 year	2410	0	0	27.2	27.2	
2849	10 year	600	0	0	24.01	24.01	
2849	50 year	930	0	0	25.05	25.05	
2849	100 year	1190	0	0	25.6	25.61	
2849	500 year	2410	0	0	27.17	27.17	
2688	10 year	600	0	0	23.99	23.99	
2688	50 year	930	0.01	0	25.01	25.02	
2688	100 year	1190	0	0	25.57	25.57	
2688	500 year	2410	0	0	27.12	27.12	
2566	10 year	600	0	0	23.99	23.99	
2566	50 year	930	0.01	0	25.01	25.01	
2566	100 year	1190	0	0	25.56	25.57	
2566	500 year	2410	0	-0.01	27.1	27.11	
2457	10 year	600	0	0	23.99	23.99	
2457	50 year	930	0	0	25.01	25.01	
2457	100 year	1190	0	0	25.56	25.57	
2457	500 year	2410	0.01	0	27.11	27.11	
2383	10 year	600	0.01	0	23.99	23.99	
2383	50 year	930	0	0.01	25.01	25.01	
2383	100 year	1190	0	0.01	25.56	25.57	
2383	500 year	2410	0	0.02	27.11	27.11	
2348	10 year	600	Proposed Conditions Model only				23.99
2348	50 year	930					25.01
2348	100 year	1190					25.56
2348	500 year	2410					27.11
2308	10 year	600	0	0	23.99	23.99	
2308	50 year	930	0	-0.01	25.01	25.01	
2308	100 year	1190	0	-0.02	25.56	25.56	

River Sta	Profile	Q Total	Difference in WSEL (proposed - existing)	Difference in Velocity (proposed - existing)	Existing Conditions WSEL	Proposed Conditions WSEL	
		(cfs)	(ft)	(fps)	(ft)	(ft)	
2308	500 year	2410	0	-0.05	27.1	27.1	
2274	10 year	600	Proposed Conditions Model only				23.99
2274	50 year	930					25.01
2274	100 year	1190					25.56
2274	500 year	2410					27.1
2241	10 year	600	0	0	23.99	23.99	
2241	50 year	930	0	0	25.01	25.01	
2241	100 year	1190	0	-0.02	25.56	25.56	
2241	500 year	2410	0.01	-0.05	27.09	27.1	
2212	10 year	600	Proposed Conditions Model only				23.99
2212	50 year	930					25.01
2212	100 year	1190					25.56
2212	500 year	2410					27.1
2183	10 year	600	0	-0.05	23.99	23.99	
2183	50 year	930	0	-0.16	25.01	25.01	
2183	100 year	1190	0	-0.21	25.56	25.56	
2183	500 year	2410	0.01	-0.42	27.09	27.1	
2148	10 year	600	Proposed Conditions Model only				23.98
2148	50 year	930					25.01
2148	100 year	1190					25.56
2148	500 year	2410					27.09
2022	10 year	600	0	0	23.98	23.98	
2022	50 year	930	0	0	25	25	
2022	100 year	1190	0	0	25.55	25.55	
2022	500 year	2410	0	0	27.07	27.07	
1818	10 year	600	0	0	23.97	23.97	
1818	50 year	930	0	0	24.98	24.98	
1818	100 year	1190	0	0	25.53	25.53	
1818	500 year	2410	0	0	27.03	27.03	
1602	10 year	2705	0	0	23.96	23.96	
1602	50 year	3274	0	0	24.98	24.98	
1602	100 year	3843	0	0	25.52	25.52	
1602	500 year	4412	0	0	27.01	27.01	
1315	10 year	4981	0	0	23.95	23.95	
1315	50 year	5550	0	0	24.95	24.95	
1315	100 year	6119	0	0	25.48	25.48	
1315	500 year	6688	0	0	26.93	26.93	
1214	Culvert	Swanton Street					
1103	10 year	4981	0	0	23	23	
1103	50 year	5550	0	0	20.44	20.44	
1103	100 year	6119	0	0	23.5	23.5	

River Sta	Profile	Q Total	Difference in WSEL (proposed - existing)	Difference in Velocity (proposed - existing)	Existing Conditions WSEL	Proposed Conditions WSEL
		(cfs)	(ft)	(fps)	(ft)	(ft)
1103	500 year	6688	0	0	26.75	26.75
1000	10 year	4981	0	0	21.03	21.03
1000	50 year	5550	0	0	22.11	22.11
1000	100 year	6119	0	0	22.78	22.78
1000	500 year	6688	0	0	25.37	25.37

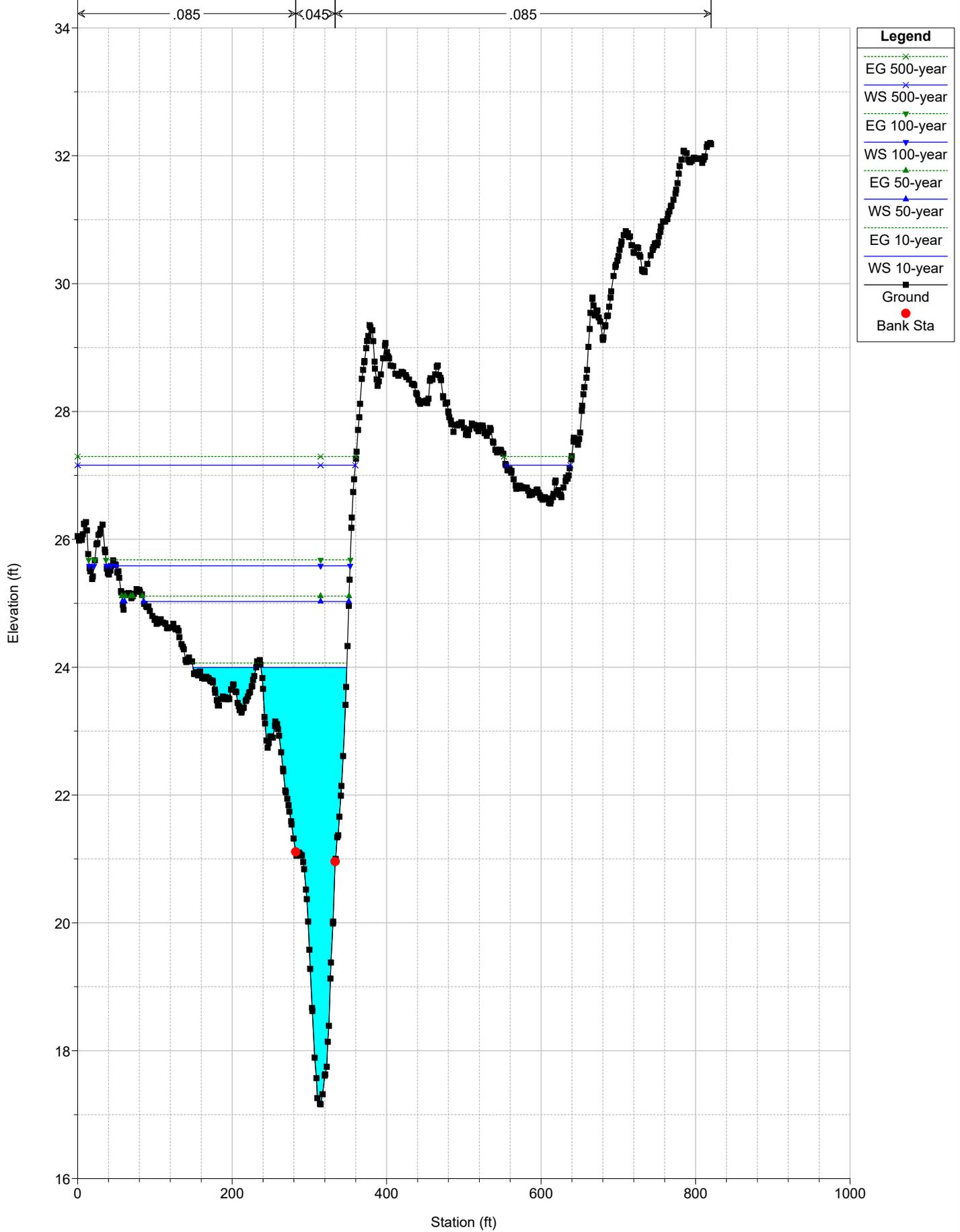
HEC-RAS Model Plan: Proposed Conditions Analysis 3/21/2019

River = Aberjona River Reach = RR Brdg-Swanton RS = 3259



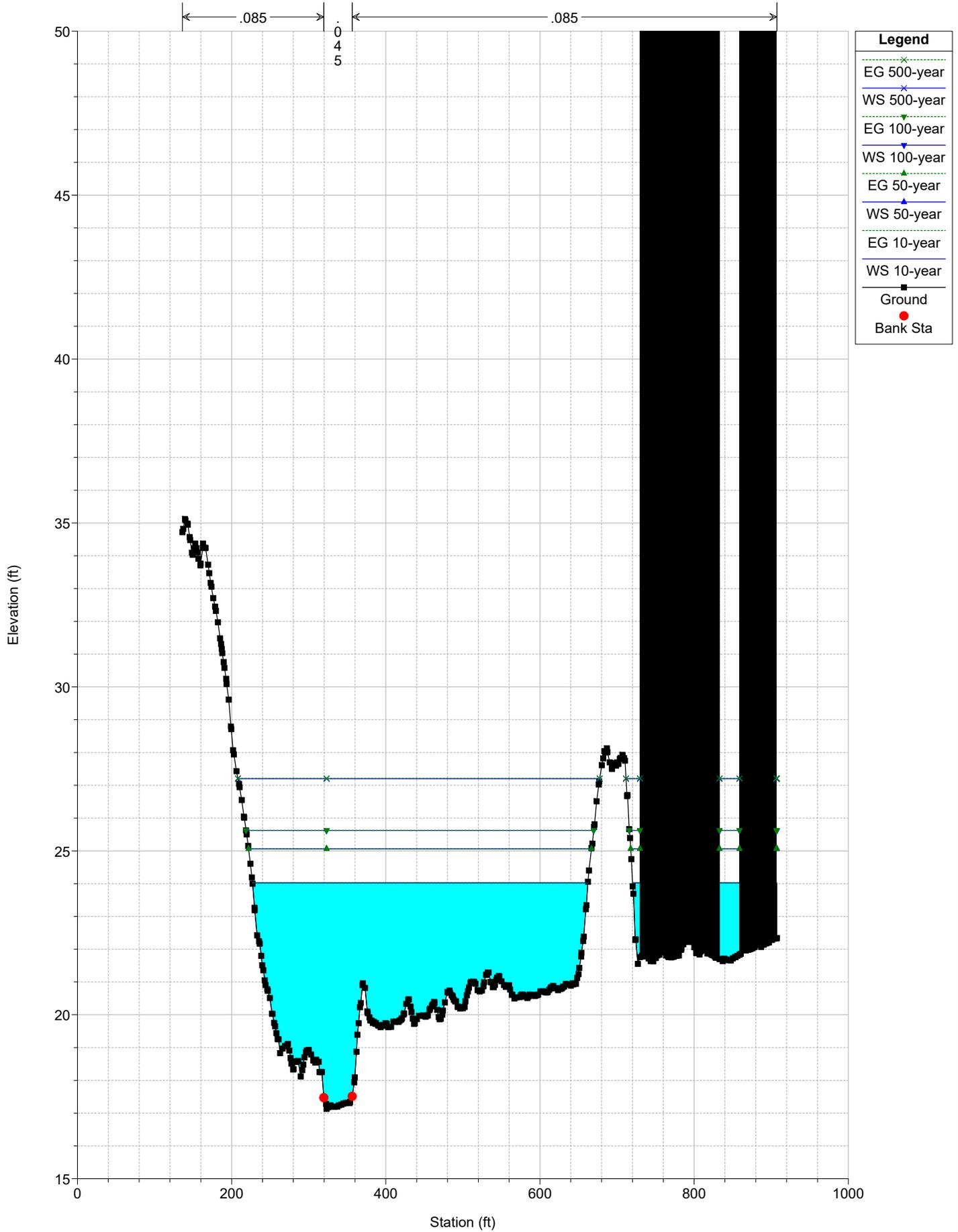
HEC-RAS Model Plan: Proposed Conditions Analysis 3/21/2019

River = Aberjona River Reach = RR Brdg-Swanton RS = 3211



HEC-RAS Model Plan: Proposed Conditions Analysis 3/21/2019

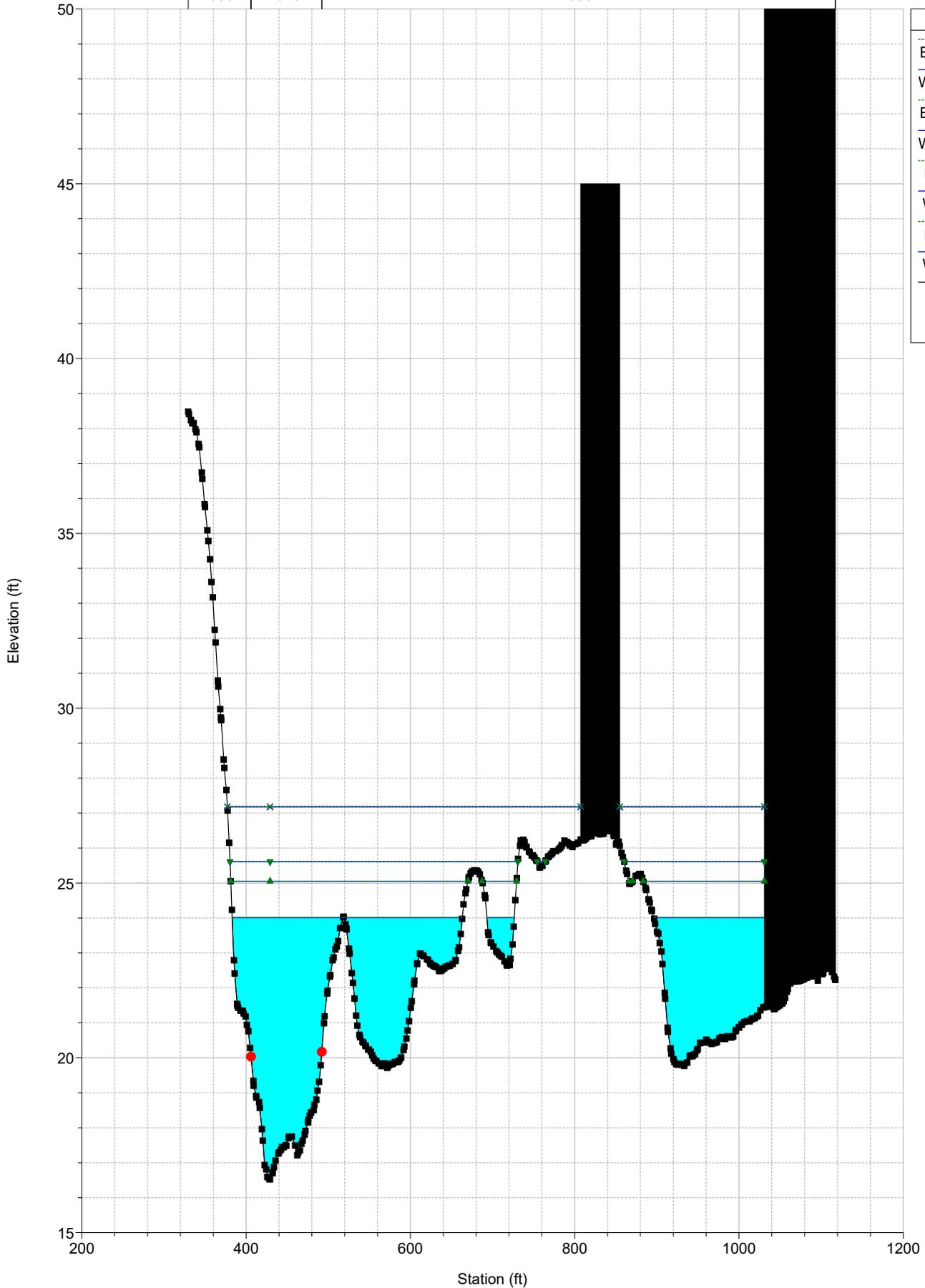
River = Aberjona River Reach = RR Brdg-Swanton RS = 3017



HEC-RAS Model Plan: Proposed Conditions Analysis 3/21/2019

River = Aberjona River Reach = RR Brdg-Swanton RS = 2849

← .085 → | ← .045 → | ← .085 →

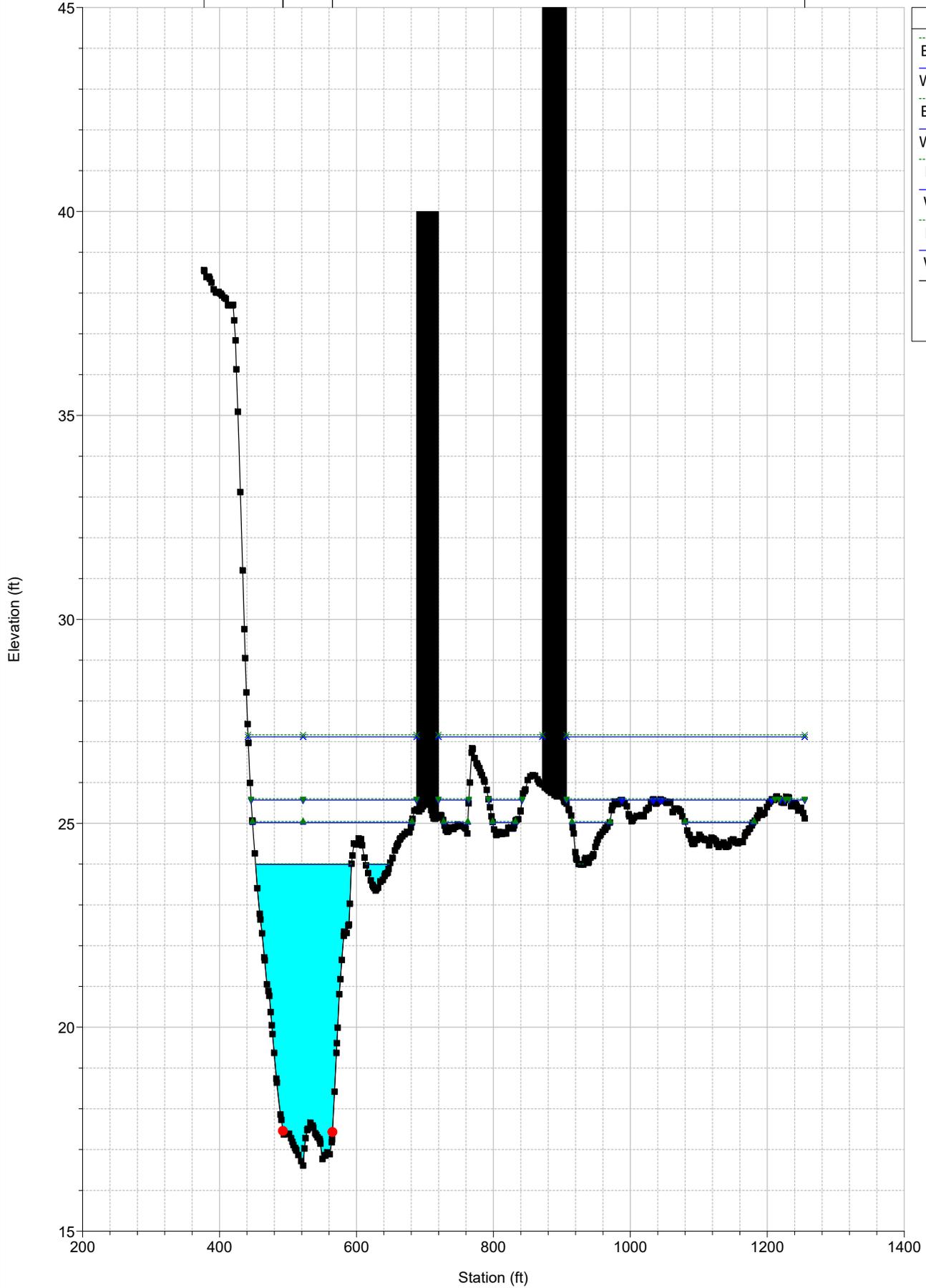


Legend	
EG 500-year	Green dashed line with 'x' markers
WS 500-year	Blue solid line with 'x' markers
EG 100-year	Green dashed line with downward triangle markers
WS 100-year	Blue solid line with downward triangle markers
EG 50-year	Green dashed line with upward triangle markers
WS 50-year	Blue solid line with upward triangle markers
EG 10-year	Green dashed line with upward triangle markers
WS 10-year	Blue solid line with upward triangle markers
Ground	Black solid line with square markers
Bank Sta	Red solid circle

HEC-RAS Model Plan: Proposed Conditions Analysis 3/21/2019

River = Aberjona River Reach = RR Brdg-Swanton RS = 2688

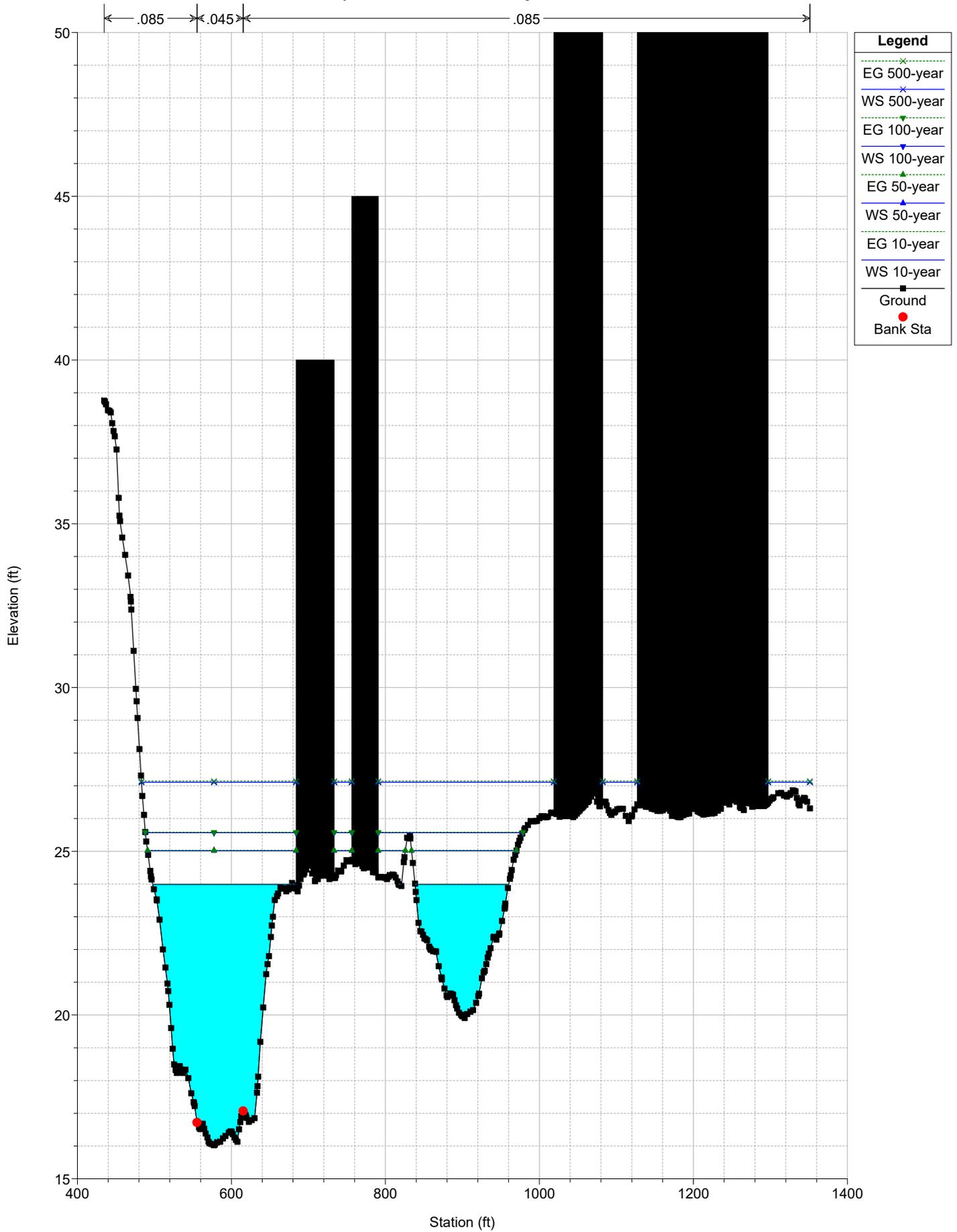
← .085 → | ← .045 → | ← .085 →



Legend	
EG 500-year	✕
WS 500-year	✕
EG 100-year	▼
WS 100-year	▼
EG 50-year	▲
WS 50-year	▲
EG 10-year	▲
WS 10-year	▲
Ground	■
Bank Sta	●

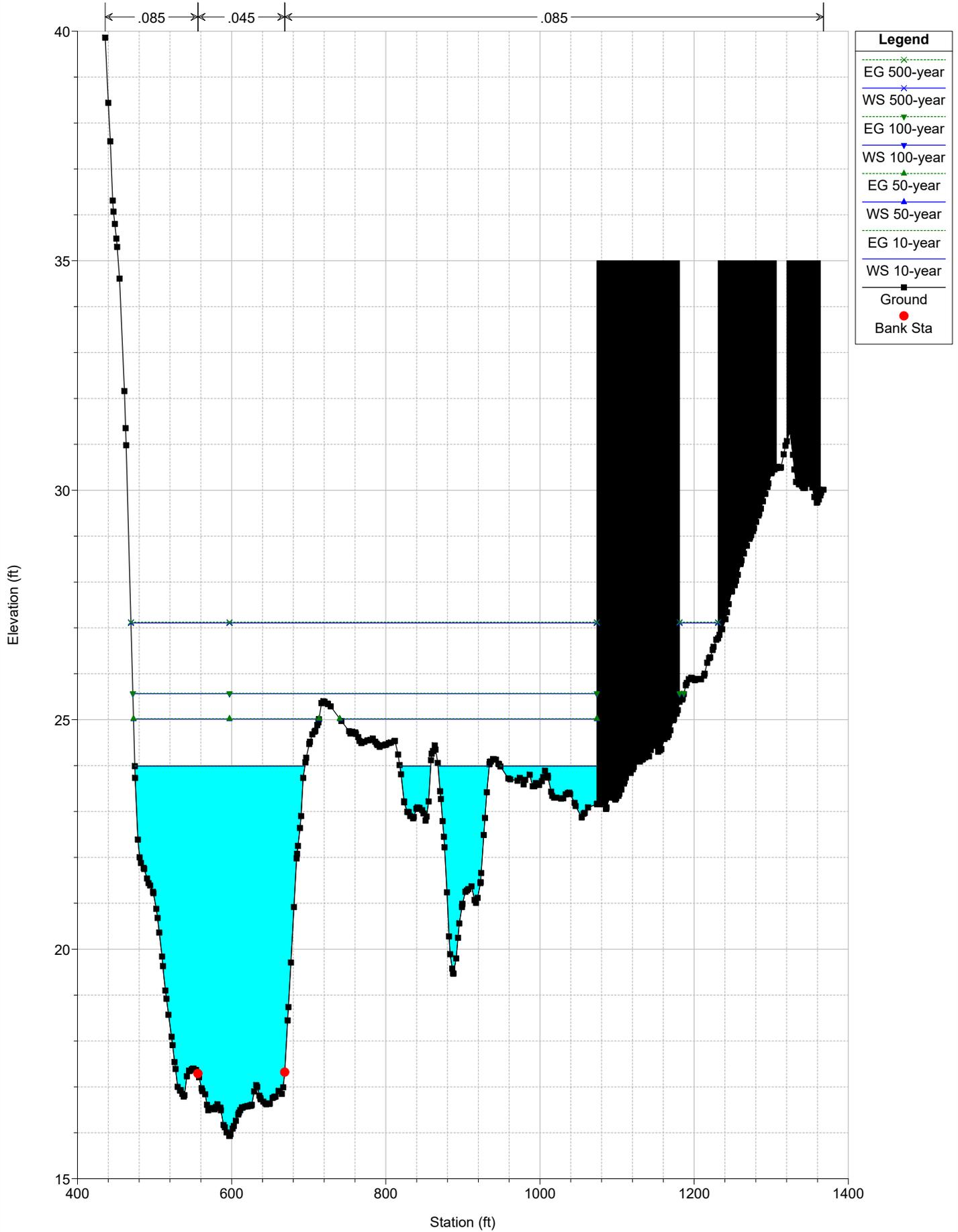
HEC-RAS Model Plan: Proposed Conditions Analysis 3/21/2019

River = Aberjona River Reach = RR Brdg-Swanton RS = 2566



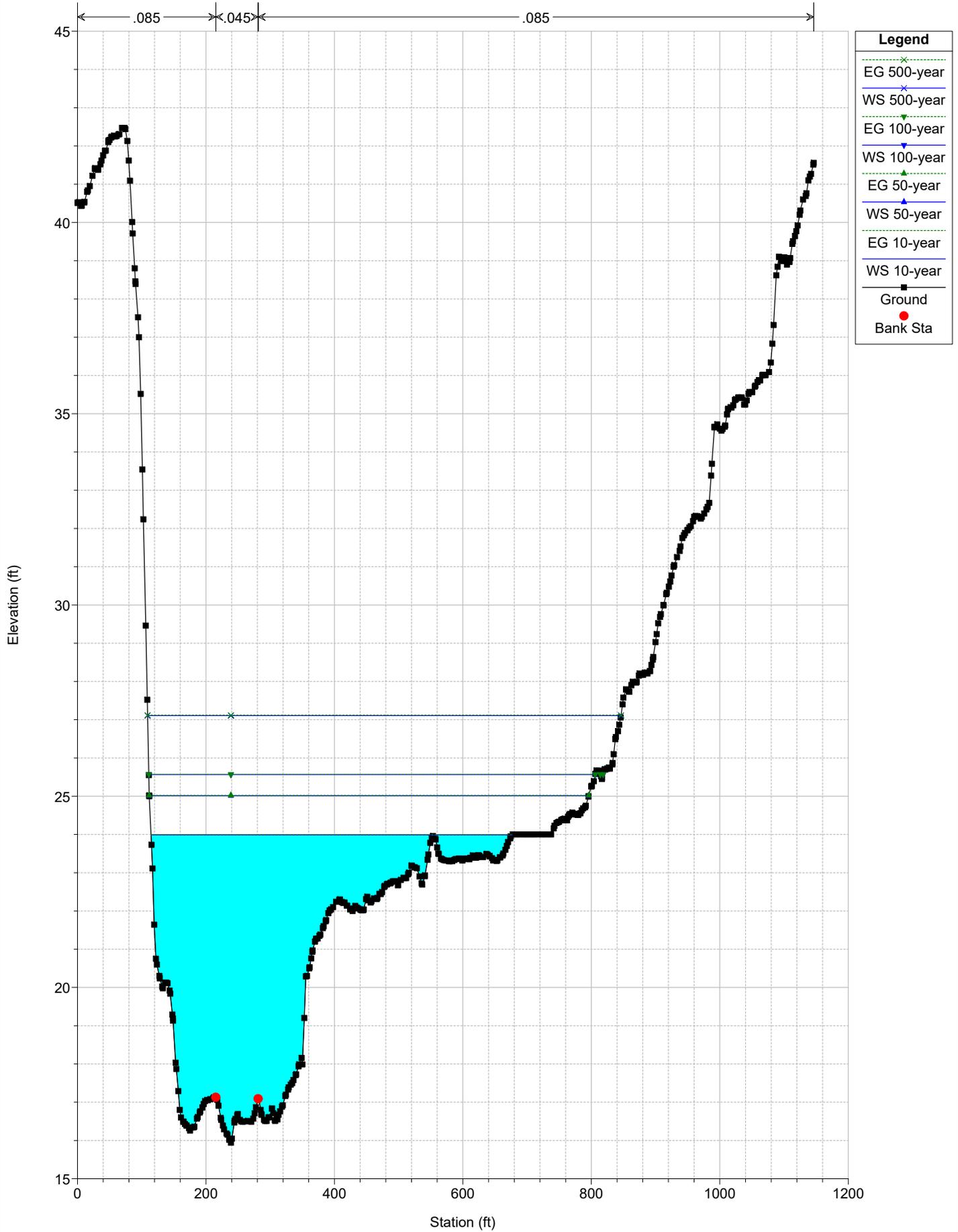
HEC-RAS Model Plan: Proposed Conditions Analysis 3/21/2019

River = Aberjona River Reach = RR Brgd-Swanton RS = 2457



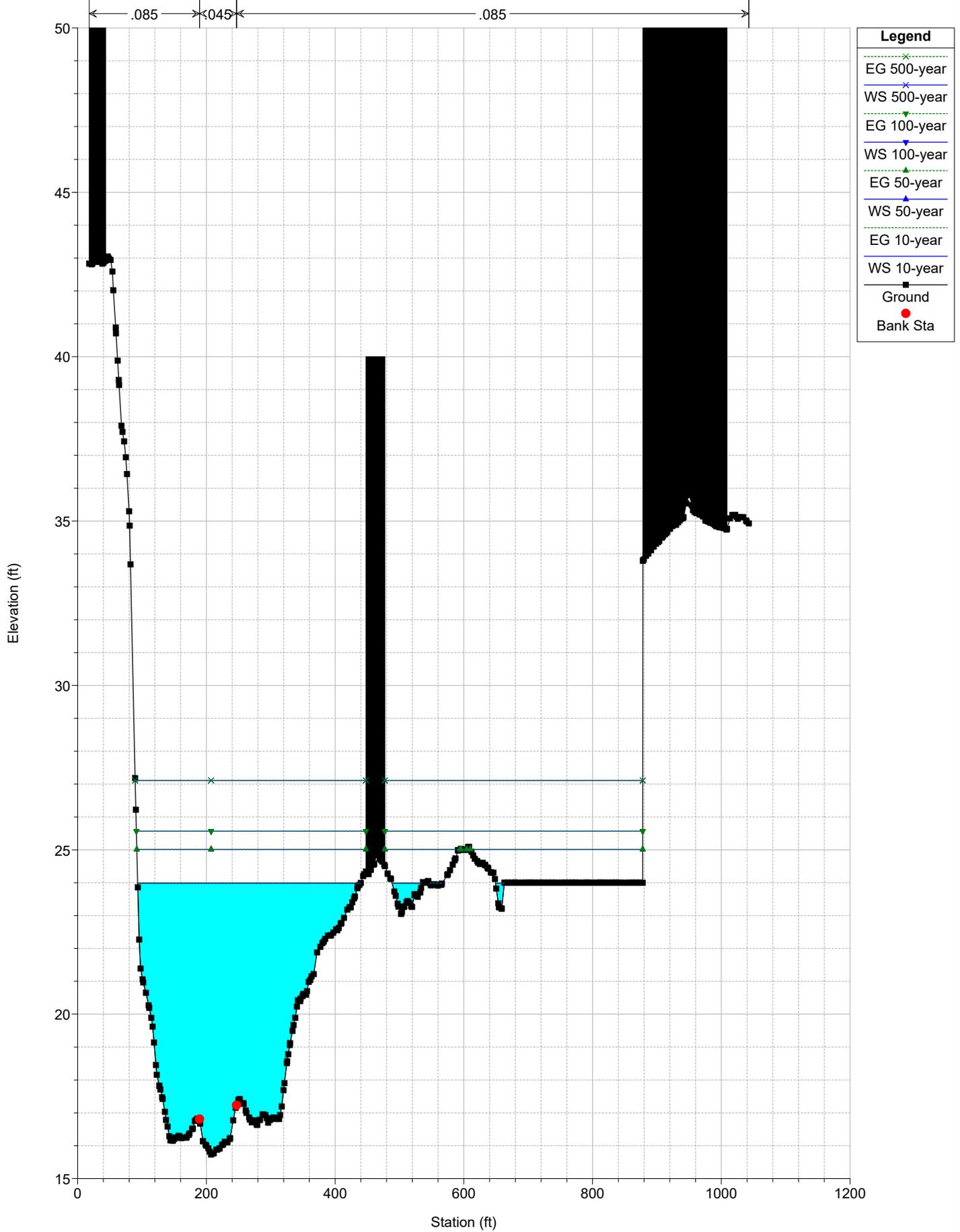
HEC-RAS Model Plan: Proposed Conditions Analysis 3/21/2019

River = Aberjona River Reach = RR Brdg-Swanton RS = 2383



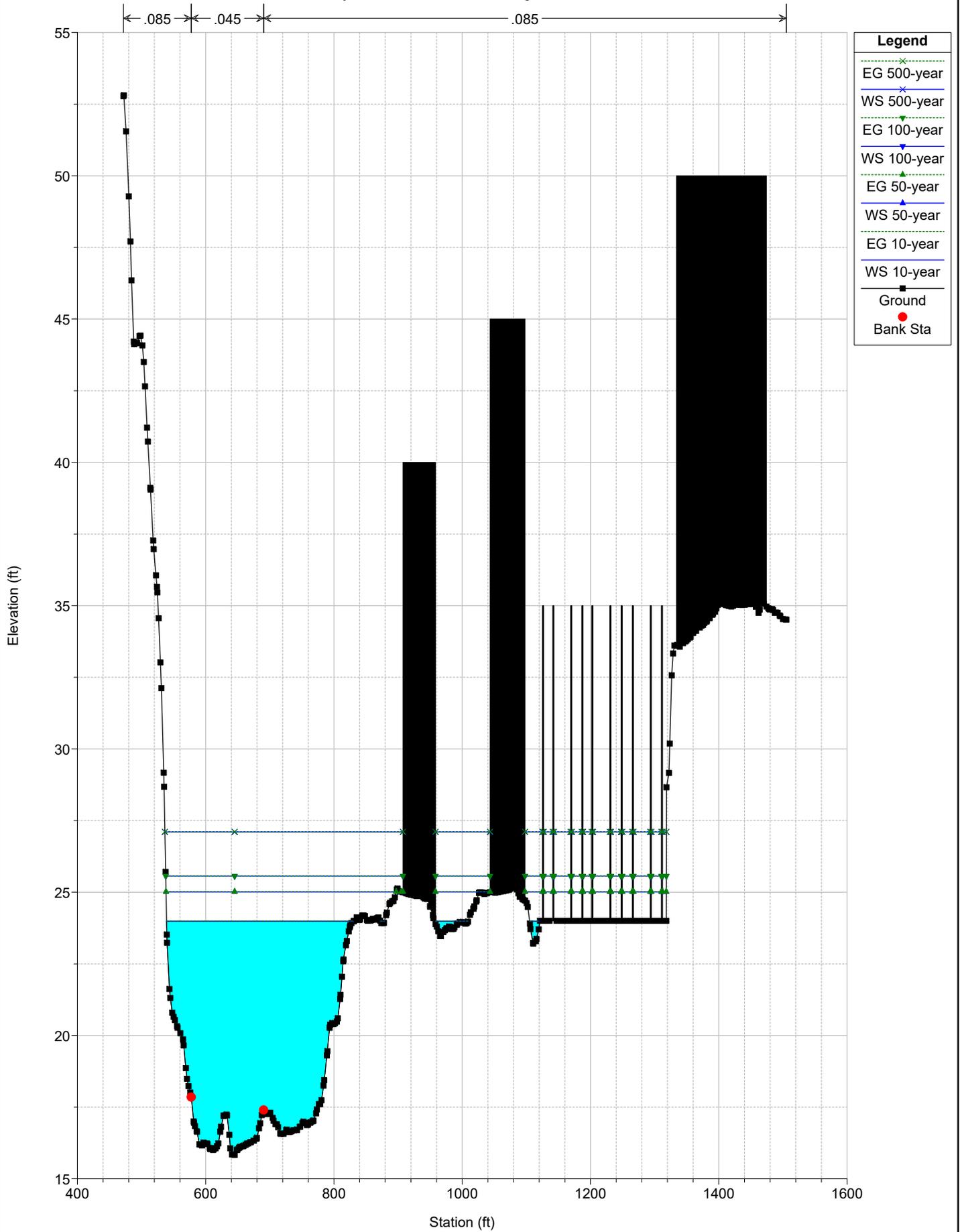
HEC-RAS Model Plan: Proposed Conditions Analysis 3/21/2019

River = Aberjona River Reach = RR Brdg-Swanton RS = 2348



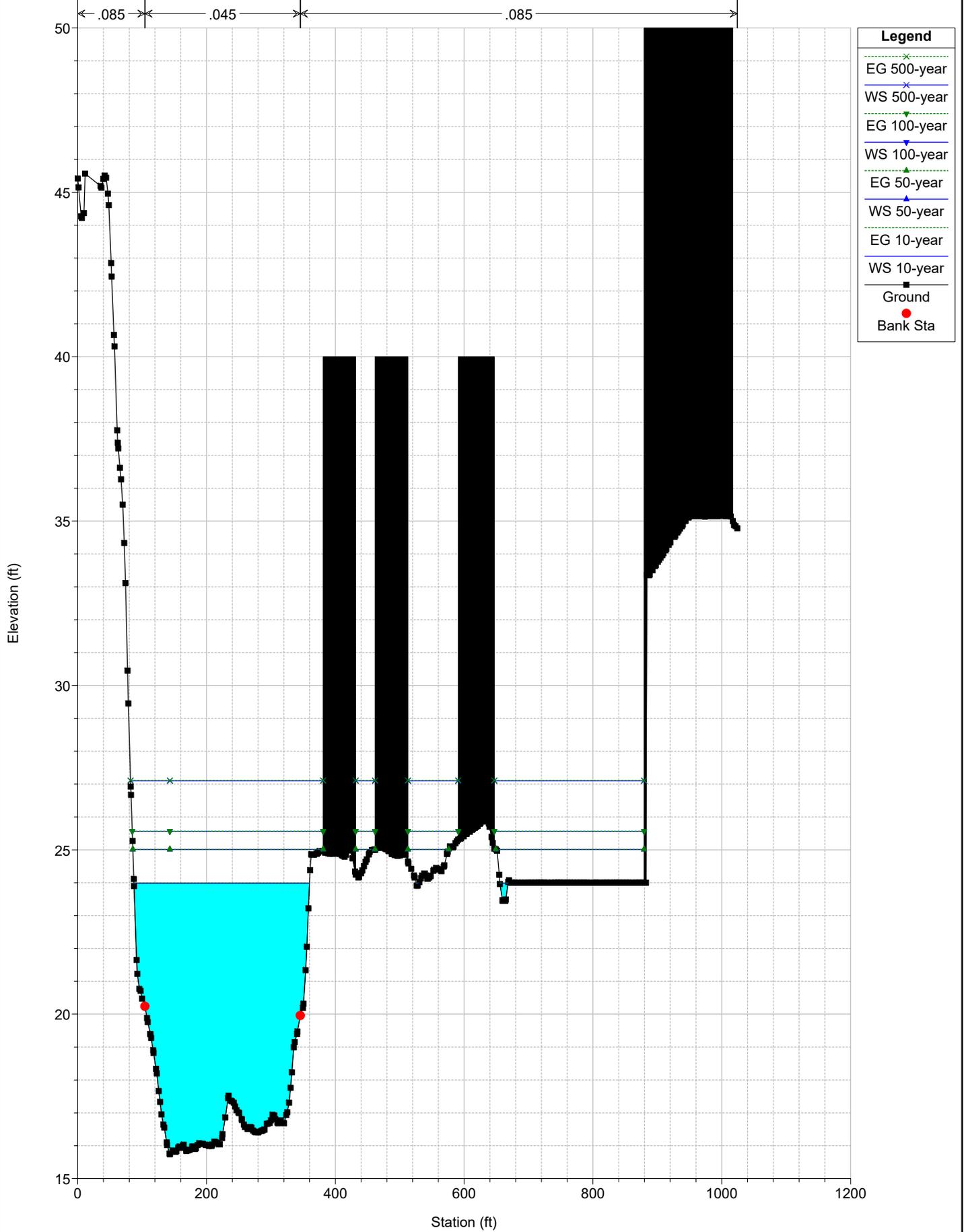
HEC-RAS Model Plan: Proposed Conditions Analysis 3/21/2019

River = Aberjona River Reach = RR Brdg-Swanton RS = 2308



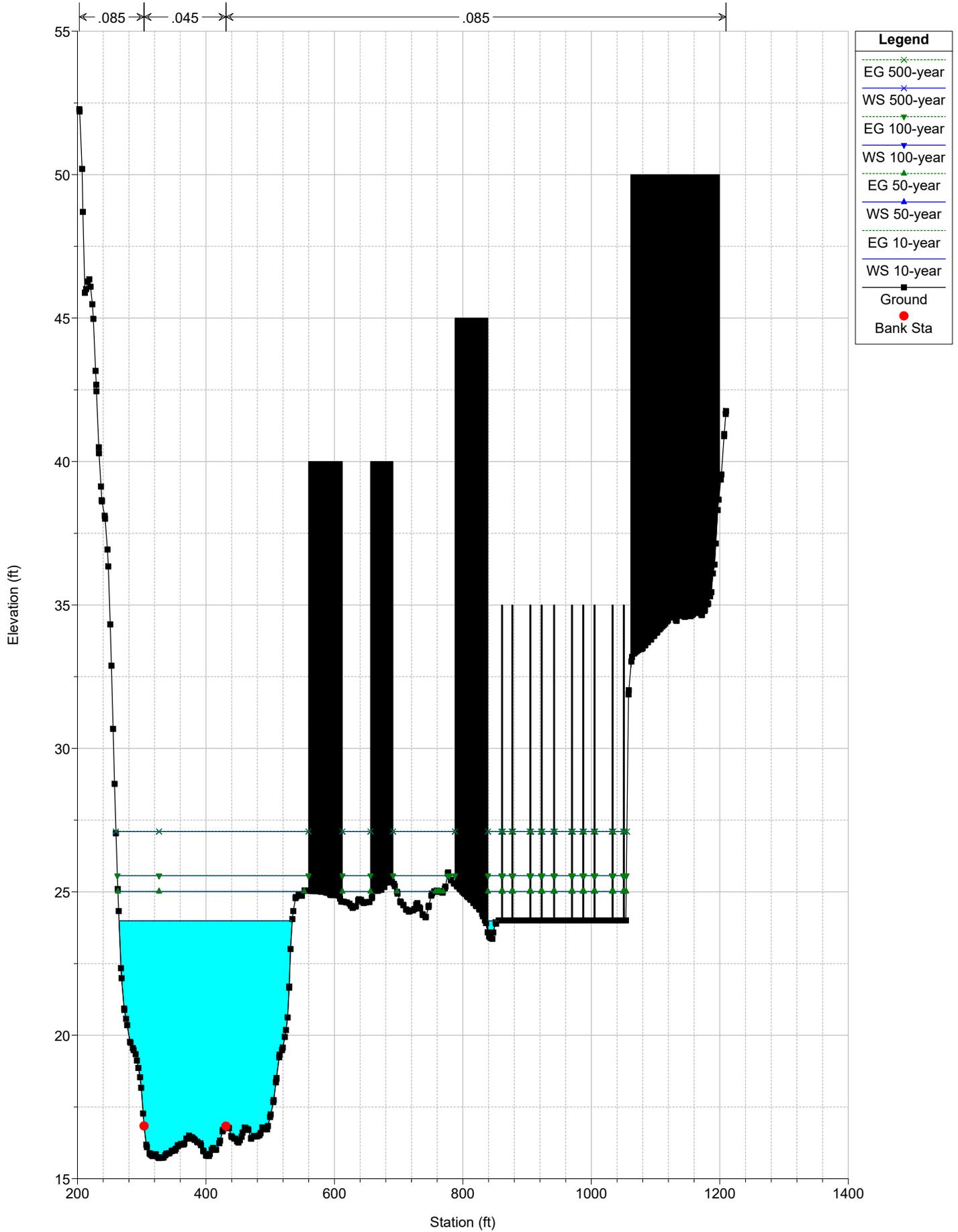
HEC-RAS Model Plan: Proposed Conditions Analysis 3/21/2019

River = Aberjona River Reach = RR Brdg-Swanton RS = 2274



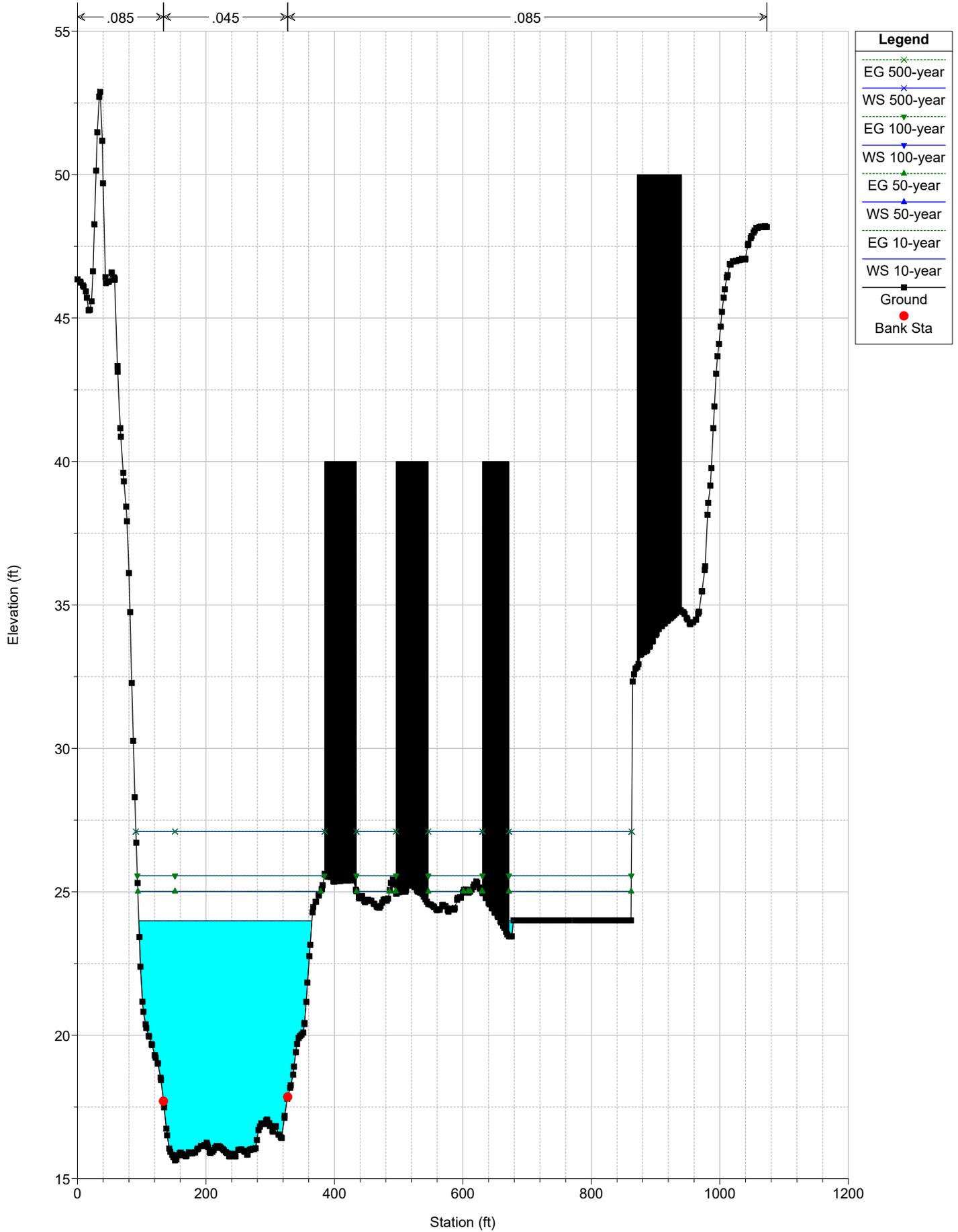
HEC-RAS Model Plan: Proposed Conditions Analysis 3/21/2019

River = Aberjona River Reach = RR Brdg-Swanton RS = 2241



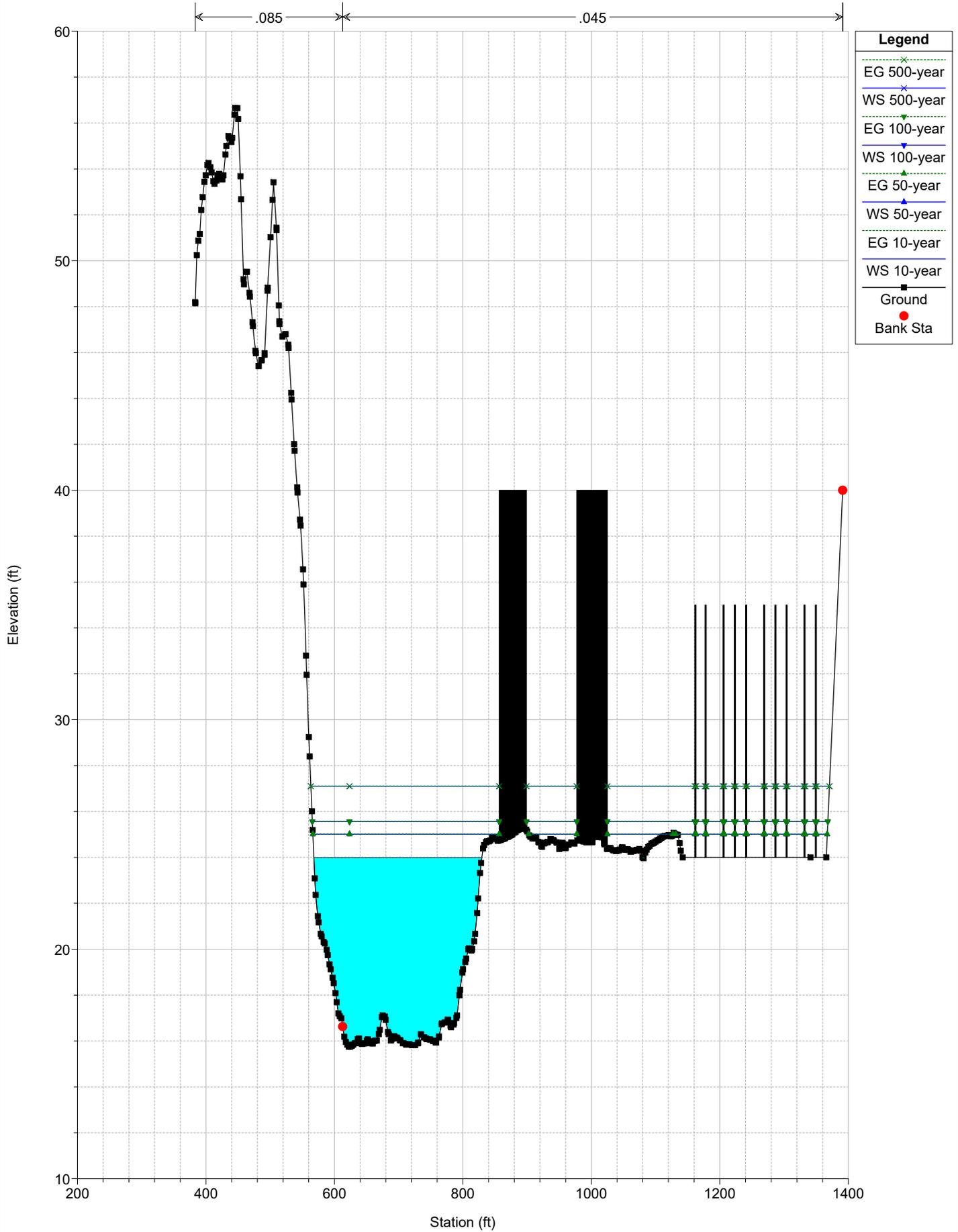
HEC-RAS Model Plan: Proposed Conditions Analysis 3/21/2019

River = Aberjona River Reach = RR Brdg-Swanton RS = 2212



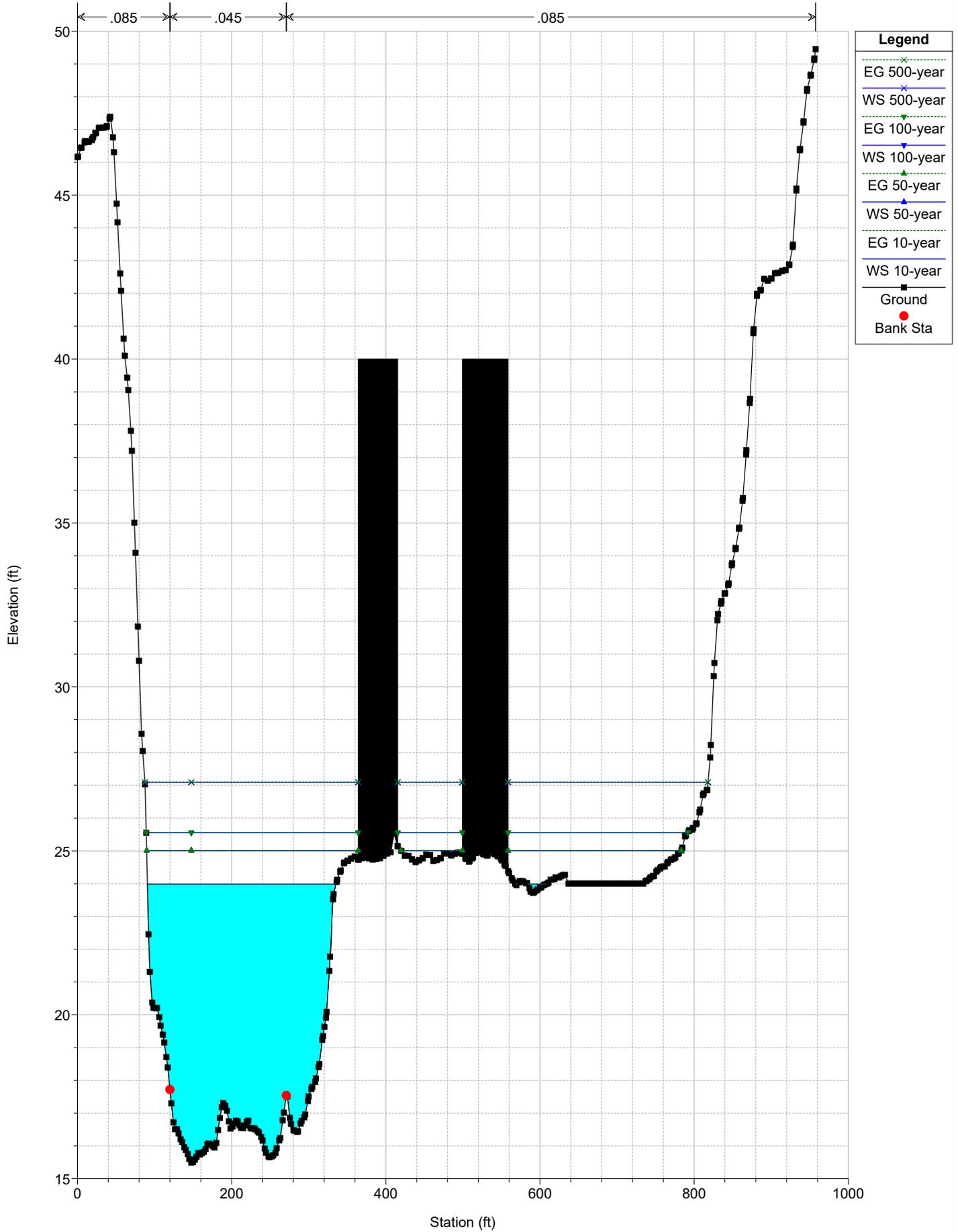
HEC-RAS Model Plan: Proposed Conditions Analysis 3/21/2019

River = Aberjona River Reach = RR Brdg-Swanton RS = 2183



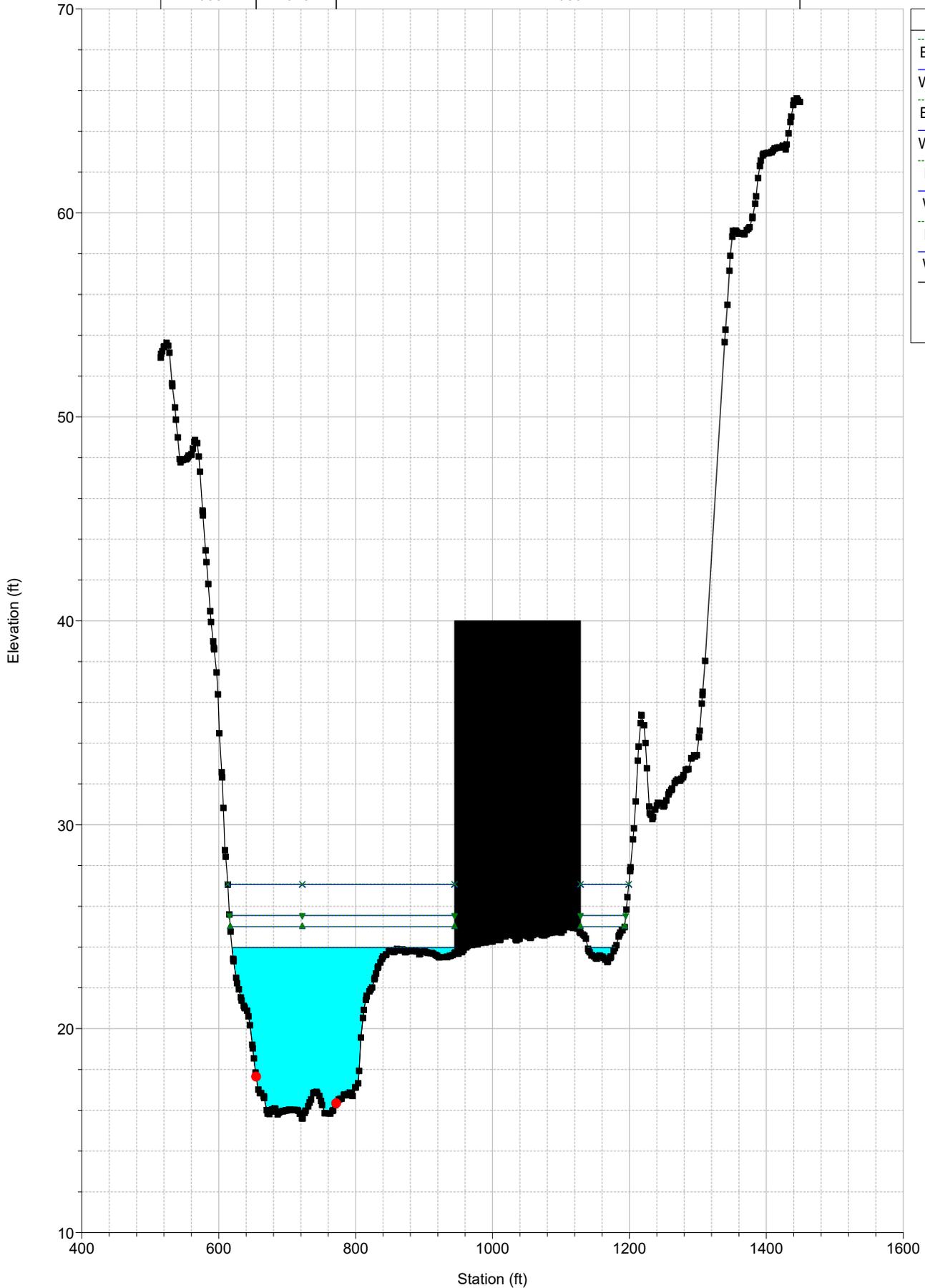
HEC-RAS Model Plan: Proposed Conditions Analysis 3/21/2019

River = Aberjona River Reach = RR Brdg-Swanton RS = 2148



HEC-RAS Model Plan: Proposed Conditions Analysis 3/21/2019

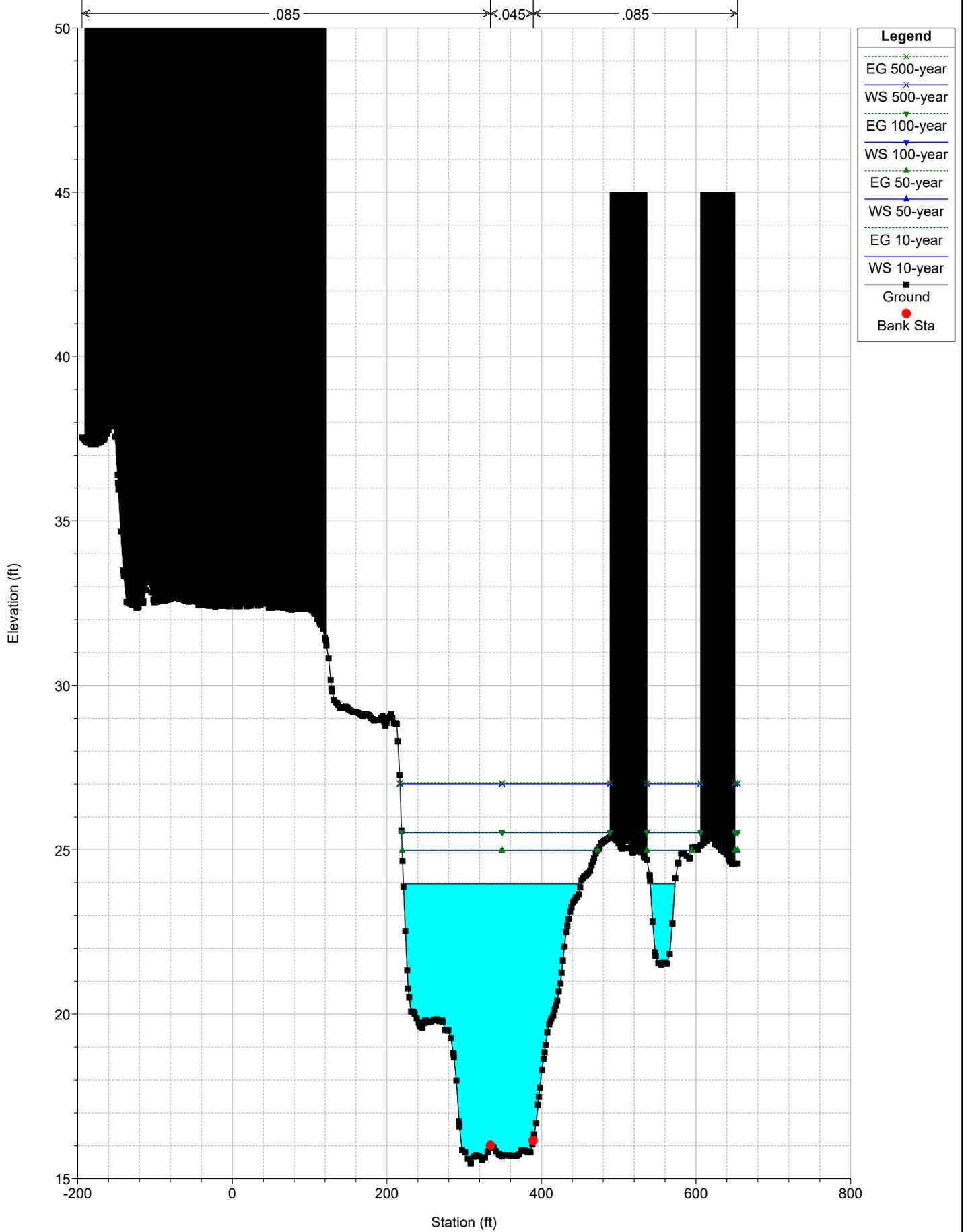
River = Aberjona River Reach = RR Brdg-Swanton RS = 2022



Legend	
EG 500-year	---x---
WS 500-year	---x---
EG 100-year	---v---
WS 100-year	---v---
EG 50-year	---^---
WS 50-year	---^---
EG 10-year	---^---
WS 10-year	---^---
Ground	---■---
Bank Sta	●

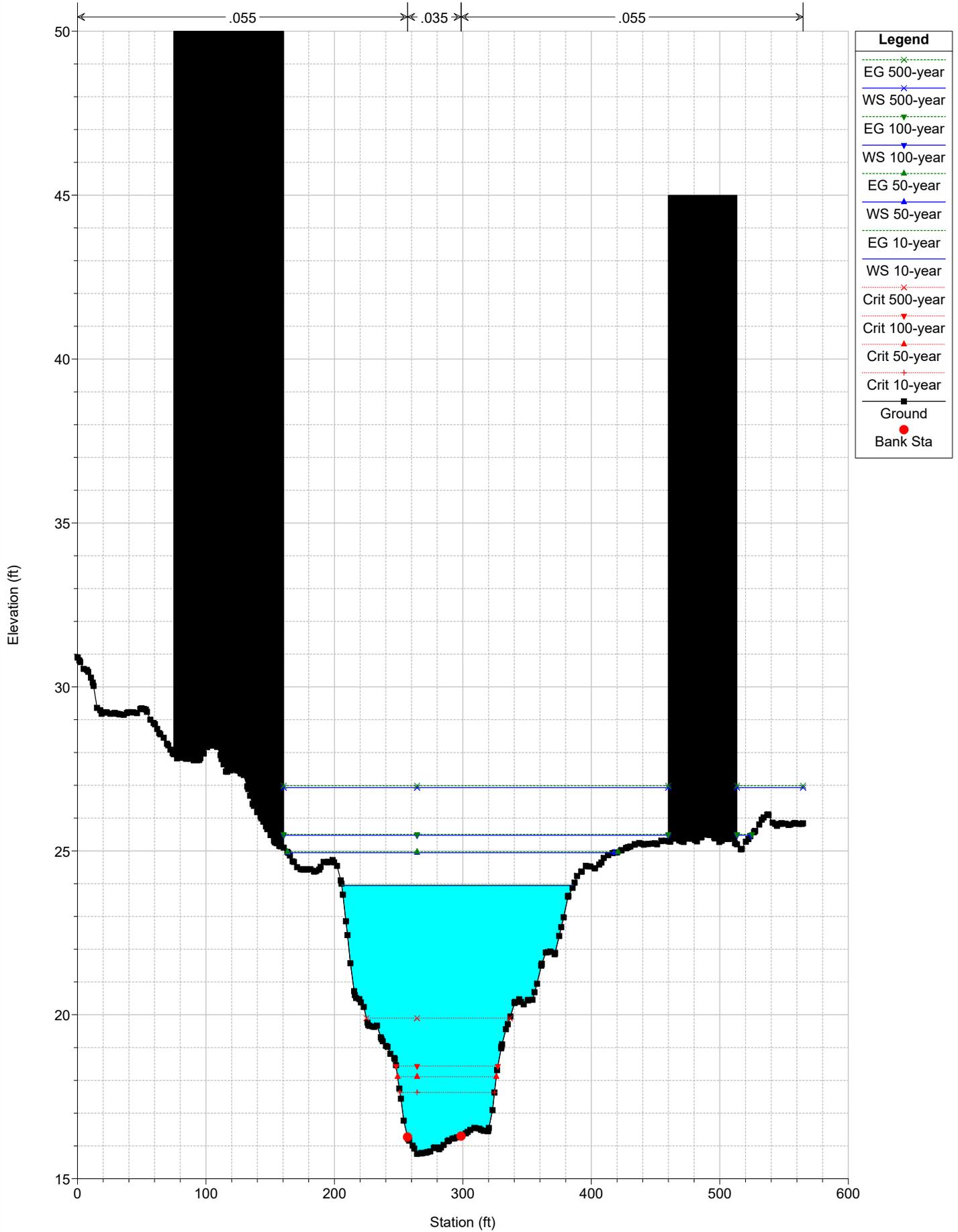
HEC-RAS Model Plan: Proposed Conditions Analysis 3/21/2019

River = Aberjona River Reach = RR Brdg-Swanton RS = 1602



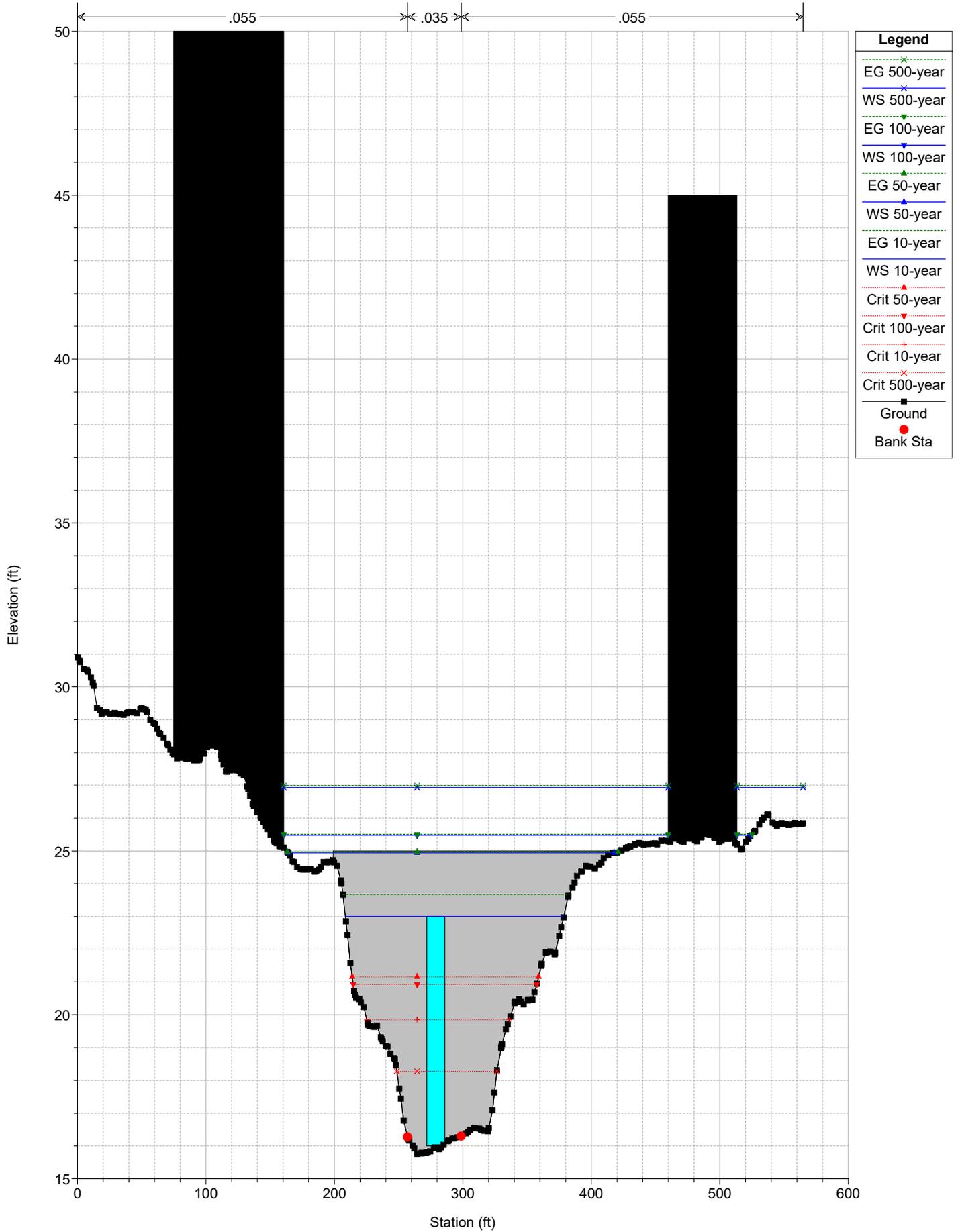
HEC-RAS Model Plan: Proposed Conditions Analysis 3/21/2019

River = Aberjona River Reach = RR Brdg-Swanton RS = 1315



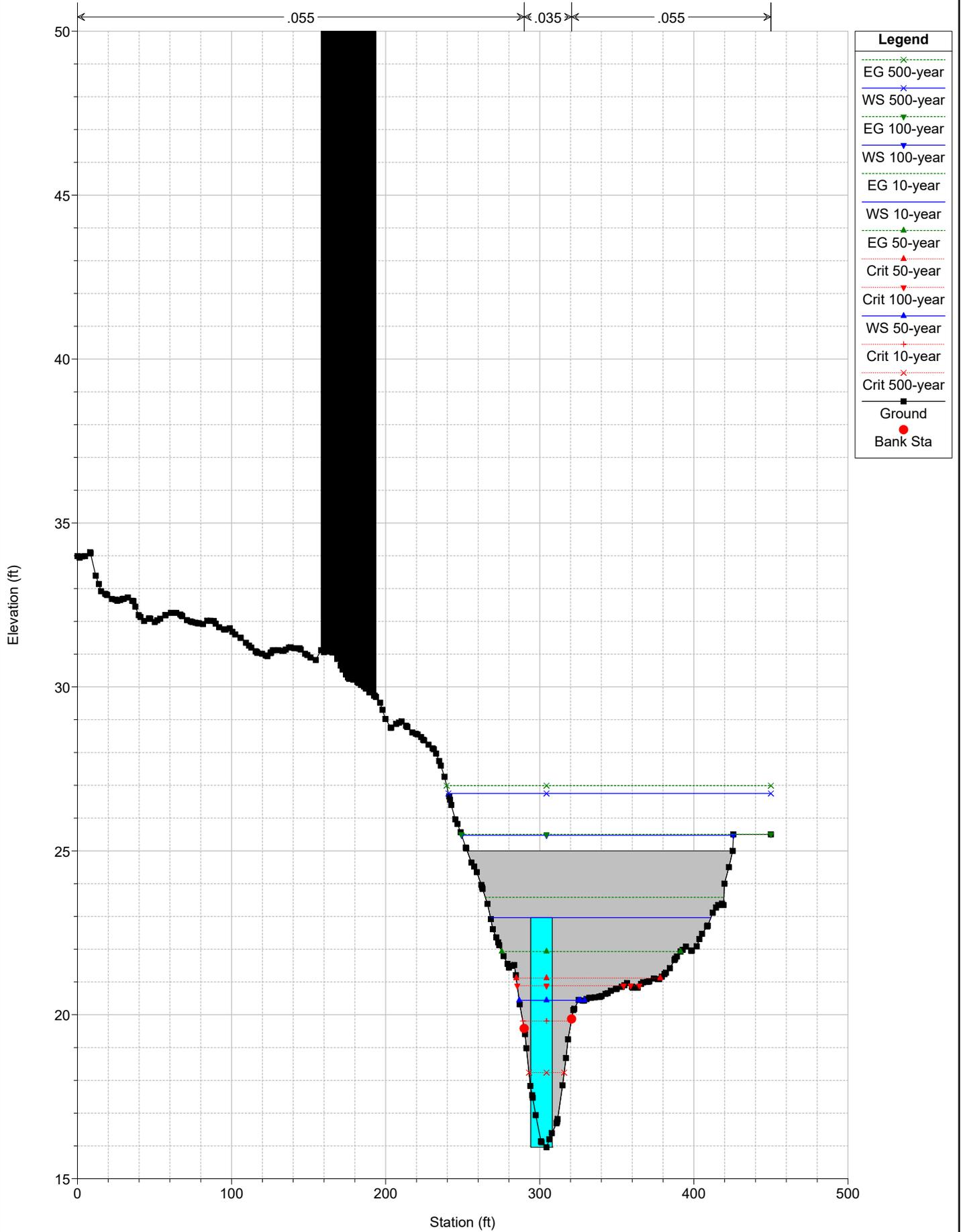
HEC-RAS Model Plan: Proposed Conditions Analysis 3/21/2019

River = Aberjona River Reach = RR Brdg-Swanton RS = 1214 Culv



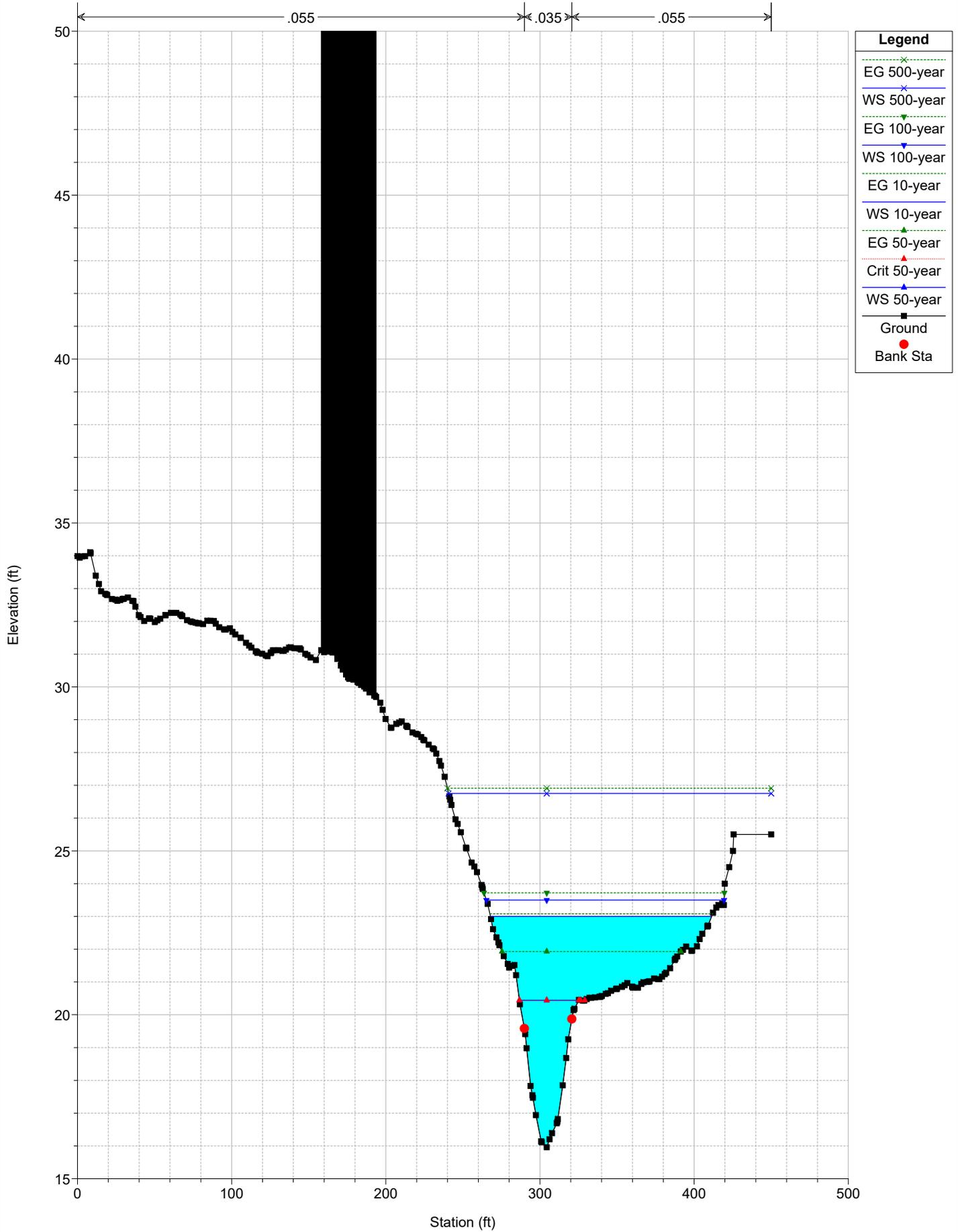
HEC-RAS Model Plan: Proposed Conditions Analysis 3/21/2019

River = Aberjona River Reach = RR Brdg-Swanton RS = 1214 Culv



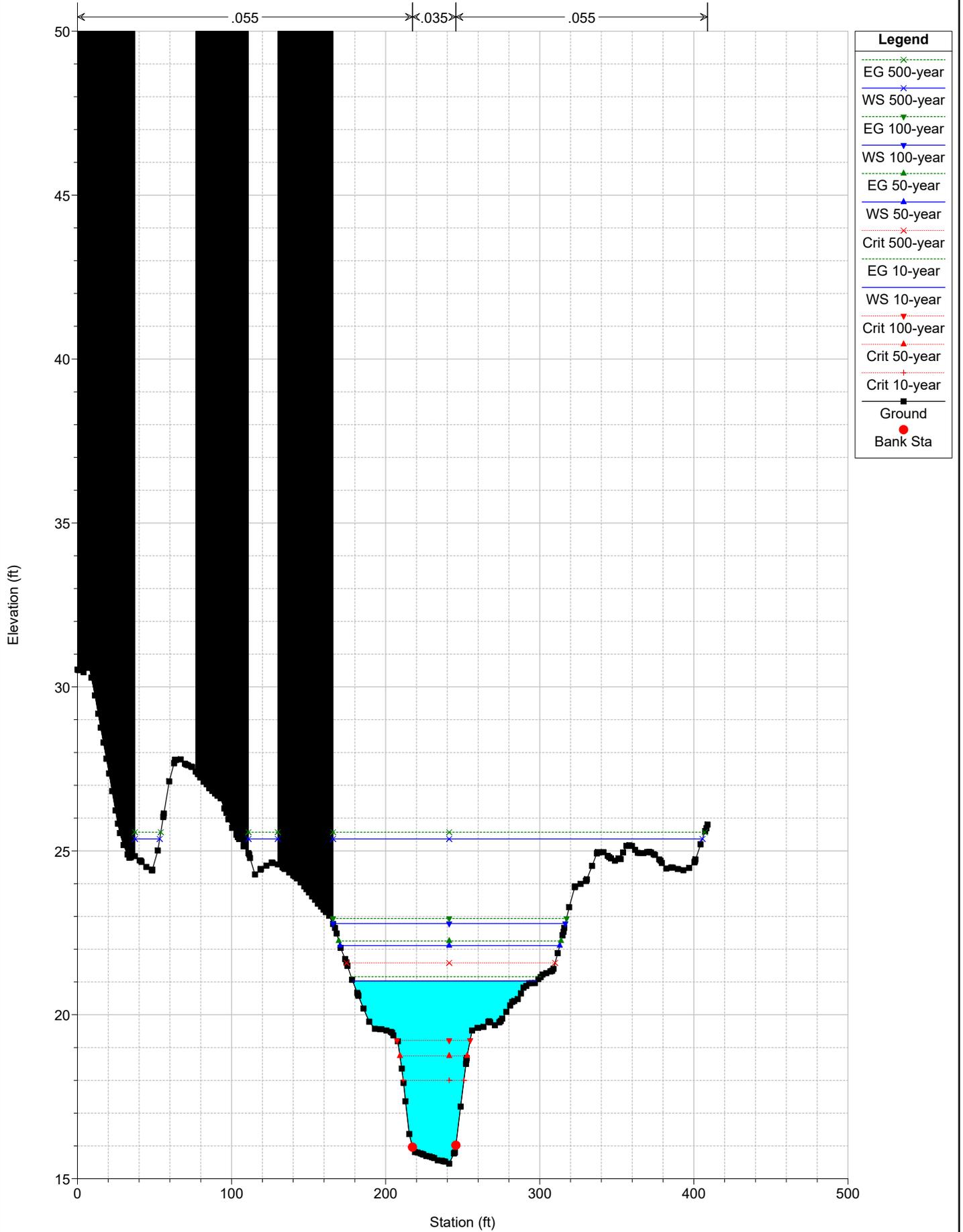
HEC-RAS Model Plan: Proposed Conditions Analysis 3/21/2019

River = Aberjona River Reach = RR Brdg-Swanton RS = 1103



HEC-RAS Model Plan: Proposed Conditions Analysis 3/21/2019

River = Aberjona River Reach = RR Brdg-Swanton RS = 1000



HEC-RAS Plan: Existing Conditions River: Aberjona River Reach: RR Brdg-Swanton (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
RR Brdg-Swanton	1214		600.00	16.80	24.05		24.08	0.000261	1.77	565.00	223.21	0.13
			930.00	16.80	25.08		25.13	0.000300	2.10	856.57	322.47	0.14
RR Brdg-Swanton	1103	10 year	1690.00	16.96	25.06		25.06	0.000399	2.58	1059.46	379.69	0.19
RR Brdg-Swanton	1103	50 year	2930.00	16.96	20.24	20.44	27.93	0.002660	9.80	1797.96	596.88	0.99
RR Brdg-Swanton	1103	100 year	1190.00	15.96	23.50		23.72	0.001011	4.41	444.61	154.18	0.31
RR Brdg-Swanton	1103	500 year	2600.00	15.96	26.06		26.06	0.000526	4.29	1062.96	299.26	0.28
			930.00	17.16	25.03		25.11	0.000579	2.56	602.35	268.52	0.19
RR Brdg-Swanton	1000	10 year	1690.00	15.46	25.68	18.00	25.66	0.000699	2.78	269.76	319.26	0.29
RR Brdg-Swanton	1000	50 year	2930.00	15.46	22.16	18.75	22.29	0.000799	3.69	1332.78	442.69	0.25
RR Brdg-Swanton	1000	100 year	1190.00	15.46	22.78	19.22	22.94	0.000597	3.83	532.02	150.76	0.25
RR Brdg-Swanton	1000	500 year	2600.00	15.46	26.02	21.58	26.03	0.000999	0.75	1028.96	274.99	0.25
RR Brdg-Swanton	3017	50 year	930.00	17.13	25.06		25.06	0.000048	0.90	2317.18	483.36	0.06
RR Brdg-Swanton	3017	100 year	1190.00	17.13	25.62		25.63	0.000057	1.02	2590.61	491.46	0.06
RR Brdg-Swanton	3017	500 year	2410.00	17.13	27.20		27.21	0.000106	1.57	3382.75	513.88	0.09
RR Brdg-Swanton	2849	10 year	600.00	16.52	24.01		24.02	0.000045	0.74	1445.66	447.18	0.05
RR Brdg-Swanton	2849	50 year	930.00	16.52	25.05		25.05	0.000054	0.90	1923.60	482.91	0.06
RR Brdg-Swanton	2849	100 year	1190.00	16.52	25.60		25.62	0.000065	1.03	2207.53	530.42	0.07
RR Brdg-Swanton	2849	500 year	2410.00	16.52	27.17		27.19	0.000113	1.55	3128.17	606.30	0.09
RR Brdg-Swanton	2688	10 year	600.00	16.61	23.99		24.01	0.000081	1.06	723.49	176.04	0.07
RR Brdg-Swanton	2688	50 year	930.00	16.61	25.01		25.04	0.000114	1.39	1016.94	454.64	0.09
RR Brdg-Swanton	2688	100 year	1190.00	16.61	25.57		25.60	0.000134	1.58	1316.08	657.27	0.10
RR Brdg-Swanton	2688	500 year	2410.00	16.61	27.12		27.17	0.000201	2.16	2434.72	745.78	0.12
RR Brdg-Swanton	2566	10 year	600.00	16.03	23.99		24.00	0.000048	0.88	1207.24	308.91	0.06
RR Brdg-Swanton	2566	50 year	930.00	16.03	25.01		25.03	0.000064	1.12	1572.56	387.35	0.07
RR Brdg-Swanton	2566	100 year	1190.00	16.03	25.56		25.58	0.000080	1.30	1790.73	406.46	0.08
RR Brdg-Swanton	2566	500 year	2410.00	16.03	27.10		27.14	0.000154	2.00	2530.82	551.08	0.11
RR Brdg-Swanton	2457	10 year	600.00	15.93	23.99		23.99	0.000021	0.57	1562.13	452.63	0.04
RR Brdg-Swanton	2457	50 year	930.00	15.93	25.01		25.02	0.000029	0.74	2088.90	574.02	0.04
RR Brdg-Swanton	2457	100 year	1190.00	15.93	25.56		25.57	0.000036	0.85	2414.99	607.44	0.05
RR Brdg-Swanton	2457	500 year	2410.00	15.93	27.11		27.12	0.000067	1.30	3398.17	654.45	0.07
RR Brdg-Swanton	2383	10 year	600.00	15.94	23.99		23.99	0.000024	0.62	2015.95	623.41	0.04
RR Brdg-Swanton	2383	50 year	930.00	15.94	25.01		25.02	0.000030	0.75	2687.32	684.17	0.05
RR Brdg-Swanton	2383	100 year	1190.00	15.94	25.56		25.57	0.000035	0.85	3068.12	699.41	0.05
RR Brdg-Swanton	2383	500 year	2410.00	15.94	27.11		27.12	0.000064	1.27	4186.52	736.97	0.07
RR Brdg-Swanton	2308	10 year	600.00	15.83	23.99		23.99	0.000015	0.49	1797.18	370.26	0.03
RR Brdg-Swanton	2308	50 year	930.00	15.83	25.01		25.02	0.000023	0.67	2265.09	519.30	0.04
RR Brdg-Swanton	2308	100 year	1190.00	15.83	25.56		25.57	0.000029	0.78	2556.49	531.44	0.05
RR Brdg-Swanton	2308	500 year	2410.00	15.83	27.10		27.11	0.000060	1.24	3376.76	536.83	0.07
RR Brdg-Swanton	2241	10 year	600.00	15.72	23.99		23.99	0.000011	0.44	1831.86	288.52	0.03
RR Brdg-Swanton	2241	50 year	930.00	15.72	25.01		25.01	0.000018	0.60	2202.37	463.80	0.04
RR Brdg-Swanton	2241	100 year	1190.00	15.72	25.56		25.57	0.000024	0.72	2472.91	504.50	0.04
RR Brdg-Swanton	2241	500 year	2410.00	15.72	27.09		27.11	0.000052	1.18	3255.74	513.91	0.06
RR Brdg-Swanton	2183	10 year	600.00	15.75	23.99		23.99	0.000010	0.42	1774.09	353.76	0.03
RR Brdg-Swanton	2183	50 year	930.00	15.75	25.01		25.01	0.000016	0.57	2249.72	608.46	0.03
RR Brdg-Swanton	2183	100 year	1190.00	15.75	25.56		25.56	0.000021	0.67	2589.68	622.17	0.04
RR Brdg-Swanton	2183	500 year	2410.00	15.75	27.09		27.10	0.000044	1.08	3548.49	628.48	0.06
RR Brdg-Swanton	2022	10 year	600.00	15.60	23.98		23.99	0.000021	0.59	1379.85	365.06	0.04
RR Brdg-Swanton	2022	50 year	930.00	15.60	25.00		25.01	0.000029	0.76	1765.37	392.43	0.05
RR Brdg-Swanton	2022	100 year	1190.00	15.60	25.55		25.56	0.000037	0.89	1981.04	395.03	0.05
RR Brdg-Swanton	2022	500 year	2410.00	15.60	27.07		27.09	0.000080	1.44	2586.63	401.93	0.08
RR Brdg-Swanton	1818	10 year	600.00	16.14	23.97		23.98	0.000058	0.95	1048.61	232.74	0.06
RR Brdg-Swanton	1818	50 year	930.00	16.14	24.98		25.00	0.000079	1.21	1331.59	347.33	0.07
RR Brdg-Swanton	1818	100 year	1190.00	16.14	25.53		25.55	0.000097	1.40	1540.31	399.10	0.08
RR Brdg-Swanton	1818	500 year	2410.00	16.14	27.03		27.07	0.000187	2.15	2159.03	416.86	0.12
RR Brdg-Swanton	1602	10 year	600.00	15.67	23.96		23.97	0.000033	0.77	1353.35	261.77	0.05
RR Brdg-Swanton	1602	50 year	930.00	15.67	24.98		24.99	0.000049	1.02	1640.36	314.23	0.06
RR Brdg-Swanton	1602	100 year	1190.00	15.67	25.52		25.53	0.000064	1.20	1820.75	342.55	0.07
RR Brdg-Swanton	1602	500 year	2410.00	15.67	27.01		27.04	0.000137	1.94	2332.21	344.63	0.10
RR Brdg-Swanton	1315	10 year	600.00	15.76	23.95	17.63	23.96	0.000038	1.04	920.28	180.50	0.07
RR Brdg-Swanton	1315	50 year	930.00	15.76	24.95	18.11	24.97	0.000064	1.47	1130.36	254.01	0.09
RR Brdg-Swanton	1315	100 year	1190.00	15.76	25.48	18.44	25.51	0.000085	1.75	1282.14	310.33	0.10
RR Brdg-Swanton	1315	500 year	2410.00	15.76	26.93	19.90	26.99	0.000155	2.60	1777.49	350.74	0.14

HEC-RAS Plan: Proposed Conditions River: Aberjona River Reach: RR Brdg-Swanton

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
RR Brdg-Swanton	3259	10-year	600.00	16.80	24.05		24.09	0.000261	1.77	565.04	223.23	0.13
RR Brdg-Swanton	3259	50-year	930.00	16.80	25.08		25.13	0.000299	2.10	856.96	322.58	0.14
RR Brdg-Swanton	3259	100-year	1190.00	16.80	25.65		25.70	0.000329	2.31	1053.66	370.67	0.15
RR Brdg-Swanton	3259	500-year	2410.00	16.80	27.24		27.33	0.000459	3.09	1705.58	507.22	0.18
RR Brdg-Swanton	3211	10-year	600.00	17.16	24.00		24.06	0.000555	2.20	367.90	193.27	0.18
RR Brdg-Swanton	3211	50-year	930.00	17.16	25.03		25.11	0.000579	2.55	602.70	268.57	0.19
RR Brdg-Swanton	3211	100-year	1190.00	17.16	25.59		25.68	0.000608	2.78	767.23	315.40	0.19
RR Brdg-Swanton	3211	500-year	2410.00	17.16	27.16		27.29	0.000787	3.66	1343.27	442.81	0.23
RR Brdg-Swanton	3017	10-year	600.00	17.13	24.02		24.03	0.000040	0.75	1822.48	471.48	0.05
RR Brdg-Swanton	3017	50-year	930.00	17.13	25.06		25.07	0.000048	0.90	2317.79	483.37	0.06
RR Brdg-Swanton	3017	100-year	1190.00	17.13	25.62		25.63	0.000056	1.02	2591.32	491.48	0.06
RR Brdg-Swanton	3017	500-year	2410.00	17.13	27.20		27.21	0.000106	1.57	3384.03	513.93	0.09
RR Brdg-Swanton	2849	10-year	600.00	16.52	24.01		24.02	0.000045	0.74	1445.74	447.19	0.05
RR Brdg-Swanton	2849	50-year	930.00	16.52	25.05		25.06	0.000054	0.90	1924.21	483.01	0.06
RR Brdg-Swanton	2849	100-year	1190.00	16.52	25.61		25.62	0.000065	1.03	2208.31	530.50	0.07
RR Brdg-Swanton	2849	500-year	2410.00	16.52	27.17		27.19	0.000113	1.55	3129.71	606.31	0.09
RR Brdg-Swanton	2688	10-year	600.00	16.61	23.99		24.01	0.000081	1.06	723.53	176.18	0.07
RR Brdg-Swanton	2688	50-year	930.00	16.61	25.02		25.04	0.000114	1.39	1017.52	454.87	0.09
RR Brdg-Swanton	2688	100-year	1190.00	16.61	25.57		25.60	0.000134	1.58	1317.07	658.31	0.10
RR Brdg-Swanton	2688	500-year	2410.00	16.61	27.12		27.17	0.000201	2.16	2436.68	745.79	0.12
RR Brdg-Swanton	2566	10-year	600.00	16.03	23.99		24.00	0.000048	0.88	1207.29	308.94	0.06
RR Brdg-Swanton	2566	50-year	930.00	16.03	25.01		25.03	0.000064	1.12	1573.06	387.38	0.07
RR Brdg-Swanton	2566	100-year	1190.00	16.03	25.57		25.58	0.000080	1.30	1791.34	406.50	0.08
RR Brdg-Swanton	2566	500-year	2410.00	16.03	27.11		27.14	0.000154	1.99	2532.27	551.09	0.11
RR Brdg-Swanton	2457	10-year	600.00	15.93	23.99		23.99	0.000021	0.57	1562.22	452.64	0.04
RR Brdg-Swanton	2457	50-year	930.00	15.93	25.01		25.02	0.000029	0.74	2089.64	574.09	0.04
RR Brdg-Swanton	2457	100-year	1190.00	15.93	25.57		25.57	0.000036	0.85	2415.90	607.47	0.05
RR Brdg-Swanton	2457	500-year	2410.00	15.93	27.11		27.13	0.000067	1.30	3399.89	654.46	0.07
RR Brdg-Swanton	2383	10-year	600.00	15.94	23.99		23.99	0.000024	0.62	1982.98	562.52	0.04
RR Brdg-Swanton	2383	50-year	930.00	15.94	25.01		25.02	0.000031	0.76	2654.19	684.19	0.05
RR Brdg-Swanton	2383	100-year	1190.00	15.94	25.57		25.57	0.000036	0.86	3035.14	699.48	0.05
RR Brdg-Swanton	2383	500-year	2410.00	15.94	27.11		27.12	0.000065	1.29	4154.36	736.99	0.07
RR Brdg-Swanton	2348	10-year	600.00	15.73	23.99		23.99	0.000022	0.60	1869.42	427.26	0.04
RR Brdg-Swanton	2348	50-year	930.00	15.73	25.01		25.02	0.000029	0.76	2584.90	748.48	0.04
RR Brdg-Swanton	2348	100-year	1190.00	15.73	25.56		25.57	0.000034	0.86	3002.07	757.12	0.05
RR Brdg-Swanton	2348	500-year	2410.00	15.73	27.11		27.12	0.000063	1.29	4170.70	759.10	0.07
RR Brdg-Swanton	2308	10-year	600.00	15.83	23.99		23.99	0.000015	0.49	1795.41	365.00	0.03
RR Brdg-Swanton	2308	50-year	930.00	15.83	25.01		25.02	0.000023	0.66	2409.95	645.87	0.04
RR Brdg-Swanton	2308	100-year	1190.00	15.83	25.56		25.57	0.000028	0.76	2770.21	654.96	0.04
RR Brdg-Swanton	2308	500-year	2410.00	15.83	27.10		27.11	0.000056	1.19	3778.55	656.33	0.06
RR Brdg-Swanton	2274	10-year	600.00	15.74	23.99		23.99	0.000008	0.34	1813.27	290.05	0.02
RR Brdg-Swanton	2274	50-year	930.00	15.74	25.01		25.02	0.000012	0.46	2381.38	619.15	0.03
RR Brdg-Swanton	2274	100-year	1190.00	15.74	25.56		25.57	0.000015	0.54	2730.25	637.23	0.03
RR Brdg-Swanton	2274	500-year	2410.00	15.74	27.10		27.11	0.000031	0.87	3712.38	639.78	0.05
RR Brdg-Swanton	2241	10-year	600.00	15.72	23.99		23.99	0.000011	0.44	1830.77	285.89	0.03
RR Brdg-Swanton	2241	50-year	930.00	15.72	25.01		25.01	0.000018	0.60	2357.29	594.64	0.04
RR Brdg-Swanton	2241	100-year	1190.00	15.72	25.56		25.57	0.000023	0.70	2698.08	630.39	0.04
RR Brdg-Swanton	2241	500-year	2410.00	15.72	27.10		27.11	0.000048	1.13	3672.97	636.58	0.06
RR Brdg-Swanton	2212	10-year	600.00	15.64	23.99		23.99	0.000008	0.37	1807.64	276.47	0.02
RR Brdg-Swanton	2212	50-year	930.00	15.64	25.01		25.01	0.000013	0.50	2324.72	586.41	0.03
RR Brdg-Swanton	2212	100-year	1190.00	15.64	25.56		25.57	0.000016	0.59	2663.00	627.78	0.03
RR Brdg-Swanton	2212	500-year	2410.00	15.64	27.10		27.11	0.000035	0.96	3629.77	631.01	0.05
RR Brdg-Swanton	2183	10-year	600.00	15.75	23.99		23.99	0.000009	0.37	1737.73	262.64	0.02
RR Brdg-Swanton	2183	50-year	930.00	15.75	25.01		25.01	0.000035	0.41	2305.63	682.63	0.04
RR Brdg-Swanton	2183	100-year	1190.00	15.75	25.56		25.56	0.000035	0.46	2686.04	692.09	0.04
RR Brdg-Swanton	2183	500-year	2410.00	15.75	27.10		27.11	0.000051	0.66	3753.89	696.81	0.05
RR Brdg-Swanton	2148	10-year	600.00	15.49	23.98		23.99	0.000012	0.44	1636.52	270.35	0.03
RR Brdg-Swanton	2148	50-year	930.00	15.49	25.01		25.01	0.000019	0.60	2108.88	578.53	0.04
RR Brdg-Swanton	2148	100-year	1190.00	15.49	25.56		25.56	0.000024	0.71	2431.15	592.08	0.04
RR Brdg-Swanton	2148	500-year	2410.00	15.49	27.09		27.10	0.000050	1.13	3363.50	620.03	0.06

HEC-RAS Plan: Proposed Conditions River: Aberjona River Reach: RR Brdg-Swanton (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
RR Brdg-Swanton	2022	10-year	600.00	15.60	23.98		23.99	0.000021	0.59	1379.85	365.06	0.04
RR Brdg-Swanton	2022	50-year	930.00	15.60	25.00		25.01	0.000029	0.76	1765.37	392.43	0.05
RR Brdg-Swanton	2022	100-year	1190.00	15.60	25.55		25.56	0.000037	0.89	1981.04	395.03	0.05
RR Brdg-Swanton	2022	500-year	2410.00	15.60	27.07		27.09	0.000080	1.44	2586.63	401.93	0.08
RR Brdg-Swanton	1818	10-year	600.00	16.14	23.97		23.98	0.000058	0.95	1048.61	232.74	0.06
RR Brdg-Swanton	1818	50-year	930.00	16.14	24.98		25.00	0.000079	1.21	1331.59	347.33	0.07
RR Brdg-Swanton	1818	100-year	1190.00	16.14	25.53		25.55	0.000097	1.40	1540.31	399.10	0.08
RR Brdg-Swanton	1818	500-year	2410.00	16.14	27.03		27.07	0.000187	2.15	2159.03	416.86	0.12
RR Brdg-Swanton	1602	10-year	600.00	15.67	23.96		23.97	0.000033	0.77	1353.35	261.77	0.05
RR Brdg-Swanton	1602	50-year	930.00	15.67	24.98		24.99	0.000049	1.02	1640.36	314.23	0.06
RR Brdg-Swanton	1602	100-year	1190.00	15.67	25.52		25.53	0.000064	1.20	1820.75	342.55	0.07
RR Brdg-Swanton	1602	500-year	2410.00	15.67	27.01		27.04	0.000137	1.94	2332.21	344.63	0.10
RR Brdg-Swanton	1315	10-year	600.00	15.76	23.95	17.63	23.96	0.000038	1.04	920.28	180.50	0.07
RR Brdg-Swanton	1315	50-year	930.00	15.76	24.95	18.11	24.97	0.000064	1.47	1130.36	254.01	0.09
RR Brdg-Swanton	1315	100-year	1190.00	15.76	25.48	18.44	25.51	0.000085	1.75	1282.14	310.33	0.10
RR Brdg-Swanton	1315	500-year	2410.00	15.76	26.93	19.90	26.99	0.000155	2.60	1777.49	350.74	0.14
RR Brdg-Swanton	1214		Culvert									
RR Brdg-Swanton	1103	10-year	600.00	15.96	23.00		23.08	0.000388	2.58	370.46	143.49	0.19
RR Brdg-Swanton	1103	50-year	930.00	15.96	20.44	20.44	21.93	0.012531	9.80	97.00	41.27	0.99
RR Brdg-Swanton	1103	100-year	1190.00	15.96	23.50		23.72	0.001011	4.41	444.61	154.18	0.31
RR Brdg-Swanton	1103	500-year	2410.00	15.96	26.75		26.91	0.000526	4.23	1032.08	209.23	0.24
RR Brdg-Swanton	1000	10-year	600.00	15.46	21.03	18.00	21.16	0.000597	3.18	289.15	119.50	0.24
RR Brdg-Swanton	1000	50-year	930.00	15.46	22.11	18.75	22.25	0.000598	3.59	432.78	142.60	0.25
RR Brdg-Swanton	1000	100-year	1190.00	15.46	22.78	19.22	22.94	0.000597	3.83	532.02	150.76	0.25
RR Brdg-Swanton	1000	500-year	2410.00	15.46	25.37	21.58	25.57	0.000598	4.71	1016.06	274.90	0.27

Title: **Hydrant Flow Test Summary**
 Project: **Project Street**
 Date: April 16, 2019
 Start Time: 9:45pm
 End Time: 10:50 PM
 A&M#: 2459-01
 Location: 19 & 35 River Street
 Performed By: Dave Robinson, A&M, Steven Lee, A&M
 Witnessed By: Steve and Tom, Winchester DPW
 Purpose of test: Determine static & residual pressure for 8" Transite water main in River Street.
 Pitot Gauge: 2" Pitotless Nozzle + Little Hose Monster
 Pressure Gauge: 2-1/2" Static/Residual Pressure Gauge



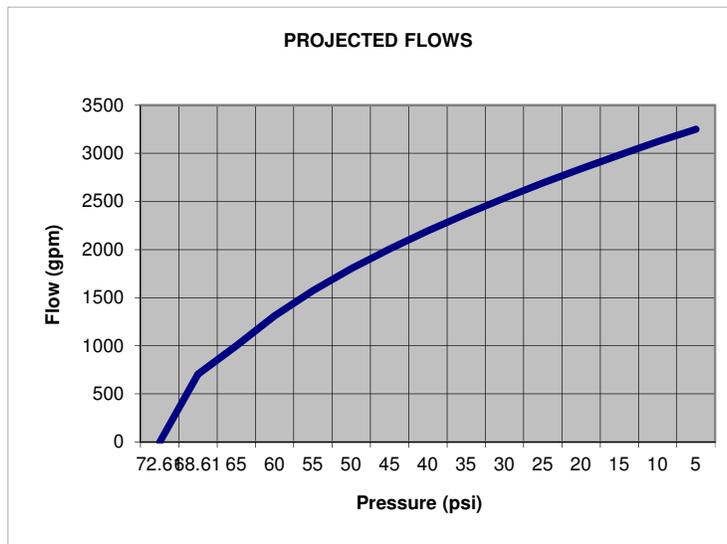
Commerce Way 100
 Woburn, MA 01801
 Tel: (781) 935-6889
 Fax: (781) 935-2896

HYDRANT A (PRESSURE)	Observed Pressure (psi)	Gauge Correction* (psi)	Corrected Pressure (psi)	Pressure Drop (psi)	Elevation (feet)
STATIC	62	10.61	72.61	0	50.0
RESIDUAL	58	10.61	68.61	4.00	50.0

HYDRANT B (FLOW)	Orifice Diameter	Pitot Reading (psi)	Hose Monster K Factor	Flow Rate (gpm)	Elevation (feet)
OUTLET	2.0	20.5	156.00	706	25.5

PROJECTED RESULTS**

Flow (gpm)	Residual (psi)
0	72.61
706	68.61
1000	65
1313	60
1573	55
1800	50
2005	45
2193	40
2369	35
2534	30
2691	25
2840	20
2982	15
3119	10
3252	5



SEE ATTACHED SKETCH FOR HYDRANT LOCATIONS
 SEE ATTACHED SHEET FOR FLOW RATE FACTORS AND FORMULA

Equation:
 $Q_2 = Q_1 * (S - R_2)^{0.54} / (S - R_1)^{0.54}$

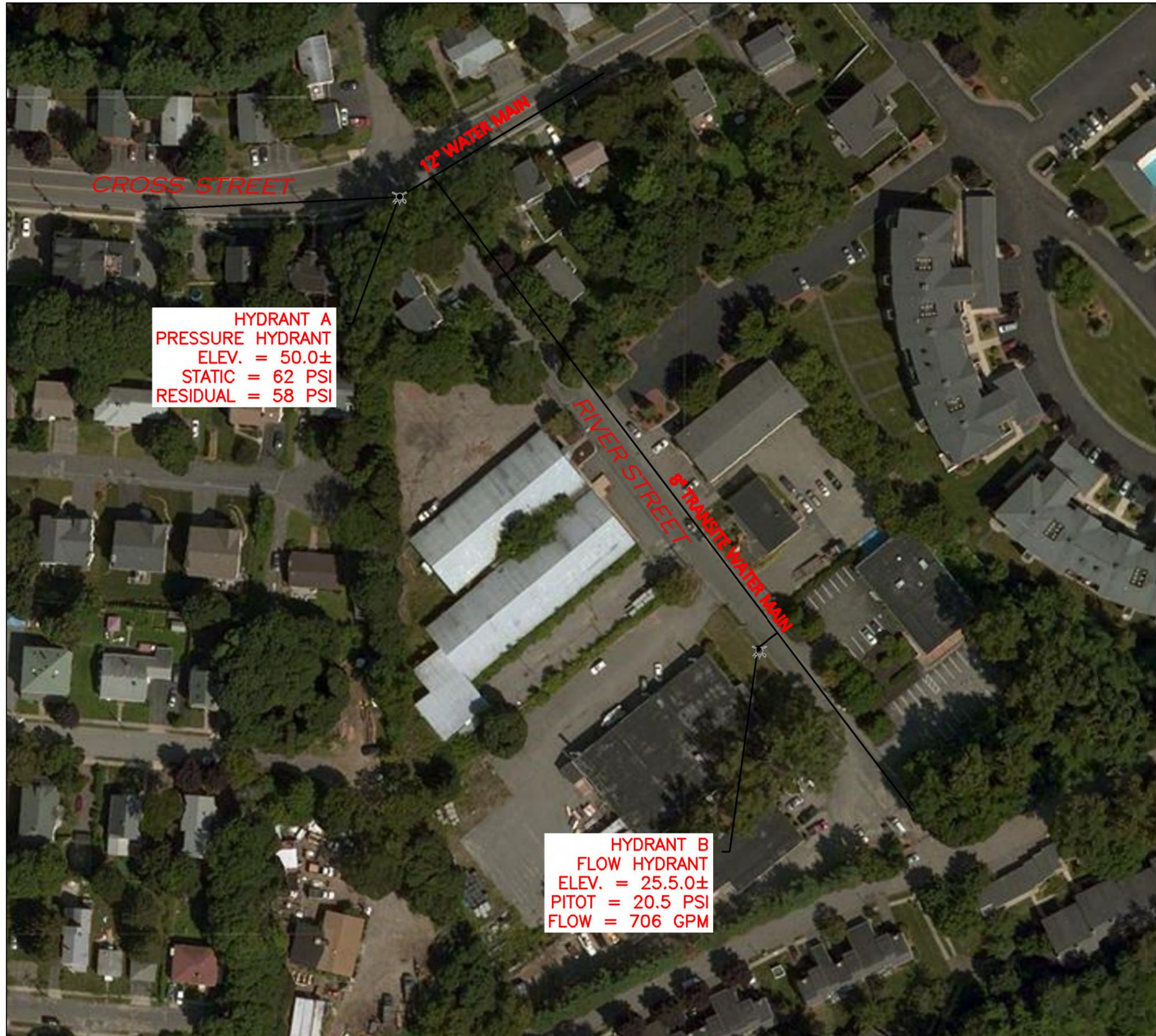
Where:

S=Static Pressure R₂=Projected Pressure Q₂=Projected Flow Rate Q₁=Measured Flow Rate
 R₁=Residual Pressure Q₁=Measured Flow Rate

Represent values obtained during the field investigation on **April 16, 2019**.

***Gauge correction** - If the static gauge is at a different elevation than the pitot, the gauge reading must be corrected:
 For each 12" of elevation that the static gauge is **ABOVE** the pitot, **INCREASE** the gauge reading by 0.433 PSI.
 For each 12" of elevation that the static gauge is **BELOW** the pitot, **DECREASE** the gauge reading by 0.433 PSI.

****Hydrant flow results** represent the pressure and flow values obtained on the date and time indicated and are not representative of other factors that may affect the municipal water system outside of the test window. Adequacy and consistency of flow availability shall be determined by a fire protection engineer. Fire protection engineer should also consult with the municipal water officials as part of the due diligence/design process.



HYDRANT A
PRESSURE HYDRANT
 ELEV. = 50.0±
 STATIC = 62 PSI
 RESIDUAL = 58 PSI

HYDRANT B
FLOW HYDRANT
 ELEV. = 25.5.0±
 PITOT = 20.5 PSI
 FLOW = 706 GPM



APPLICANT/OWNER:
 SLV RIVER STREET, LLC
 c/o GEOFF ENGLER & JUSTIN KREBS
 257 HILLSIDE AVENUE
 NEEDHAM, MA, 02494

PROJECT:
 MULTI-FAMILY RESIDENTIAL
 19-35 RIVER STREET
 WINCHESTER, MA

PROJECT NO.	2459-01	DATE:	04-22-2019
SCALE:	NOT TO SCALE	DWG. NAME:	SKETCH
DESIGNED BY:	DMR	CHECKED BY:	CMQ

PREPARED BY:



ALLEN & MAJOR ASSOCIATES, INC.
 civil & structural engineering ♦ land surveying
 environmental consulting ♦ landscape architecture
 www.allenmajor.com
 100 COMMERCE WAY
 WOBURN MA 01801-8501
 TEL: (781) 935-6889
 FAX: (781) 935-2896
 WOBURN, MA ♦ LAKEVILLE, MA ♦ MANCHESTER, NH

THIS DRAWING HAS BEEN PREPARED IN ELECTRONIC FORMAT. CLIENT/CLIENT'S REPRESENTATIVE OR CONSULTANT MAY BE PROVIDED COPIES OF DRAWINGS AND SPECIFICATIONS ON MAGNETIC MEDIA FOR HIS/HER INFORMATION AND USE FOR SPECIFIC APPLICATION TO THIS PROJECT. DUE TO THE POTENTIAL THAT THE MAGNETIC INFORMATION MAY BE MODIFIED UNINTENTIONALLY OR OTHERWISE, ALLEN & MAJOR ASSOCIATES, INC. MAY REMOVE ALL INDICATION OF THE DOCUMENT'S AUTHORSHIP ON THE MAGNETIC MEDIA. PRINTED REPRESENTATIONS OF THE DRAWINGS AND SPECIFICATIONS ISSUED SHALL BE THE ONLY RECORD COPIES OF ALLEN & MAJOR ASSOCIATES, INC.'S WORK PRODUCT.

DRAWING TITLE:	SHEET No.
HYDRANT FLOW TEST SKETCH	SK