FEDERAL LOCAL BRIDGE PROGRAM

State Project No. 0135-0344 (Constr.)

FINAL

HYDRAULIC REPORT

BRIDGE NO. 04070

Wire Mill Road over Haviland Brook

City of Stamford

Prepared by: Gregory D. Gerrish, P.E. Digitally signed by Gregory D. Gerrish, P.E. Date: 2023.08.24 07:44:24-04'00' Date: _____

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Issued July 2023
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HYDRAULIC REPORT

BRIDGE NO. 04070

WIRE MILL ROAD OVER HAVILAND BROOK

CITY OF STAMFORD

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INTRODUCTION

General

Bridge No. 04070, Wire Mill Road over Haviland Brook, is scheduled for replacement as part of the Federal Local Bridge (Design Managed by State) Program. This Hydraulic Analysis Report is prepared to satisfy the requirements of the CTDOT Drainage Manual for this project. A Hydrologic Report has been prepared and submitted prior to the preparation of this report, which documents the development of design flows to be applied to the hydraulic design of this bridge. Those recommended flows were approved by the Department on December 13, 2022. This bridge is located at the mouth of Haviland Brook and confluence with the Rippowam River. Due to the location of the subject bridge on Haviland Brook, the project site is within the limits of the Rippowam River floodplain (Zone AE) but outside of the regulated floodway. The Rippowam River has been studied in detail with established base flood elevations and a calculated floodway corridor. However, Haviland Brook itself was not studied in detail (there are no regulated flow rates to evaluate) and the replacement of Bridge No. 04070 will have no effect on the Rippowam River floodplain. As such, a separate regulatory analysis has not been prepared, and this hydraulic analysis documents the expected influence of the proposed work on the approximate flood zone of Haviland Brook. Design of the rehabilitation of the subject crossing specifically avoided grading changes within the Rippowam River floodplain to avoid potential impacts to the Rippowam River available flood storage.

A Scour Analysis Report is also prepared under separate cover to detail foundation design requirements.

The hydraulic engineer visited the site to perform an evaluation, layout hydraulic cross sectioning for survey, and complete the "Data Collection and Field Review" portion of this report. Natural, existing, and proposed conditions of this project have been analyzed to satisfy the requirements of Section 13a-94 and Sections 25-68b through 25-68h of the Connecticut General Statutes, as revised.

Existing Site Conditions

Bridge No. 04070, built in 1957, is a single span steel multi-girder and cast in place concrete deck superstructure. There is a bituminous concrete wearing surface with no known waterproofing membrane system. The superstructure is supported by reinforced concrete abutments and wingwalls. The total structure length is 25 feet with a max span length of 20 feet. The bridge roadway width from curb-to-curb measures 30 feet 6 inches and has an out-to-out width of 33 feet 6 inches. The roadway provides one lane of traffic in each direction with temporary barriers along the shoulders preventing live loads from the fascia girders. Wire Mill Road is an urban local road supporting an average daily traffic count of 1820 vehicles per day. There are no sidewalks on the bridge or along the approaches.

The **deck** is in serious condition (overall rating = 3). The approach is in fair condition (overall rating = 5). Both the bridge and approaches bituminous concrete overlay exhibit random longitudinal, transverse, and areas of map cracking that open to 1 inch wide. Areas of reveling and bituminous patches can be seen throughout the overlay as well. There are isolated potholes in the west bound lane up to 1

foot in diameter and 2 inches deep with water ponding. Along the curb/rail base are hollow sounding areas extending full length. The deck joints have been paved over, resulting in transverse cracks up to full length of the joint. The concrete deck underside has extensive hollow areas up to full width and length of the bay. The deck underside also exhibits areas of light to heavy scaling, map cracking, and transverse/longitudinal cracks. The overall deterioration of the deck underside is approximately 75 percent.

Concrete rail bases along both fasciae have areas of light to moderate scaling throughout. Both the south and north two galvanized pipe railings experiences areas of rust at the post bases and welds. The southwest end has a broken weld in the bottom horizontal rail, the east end of the south rail has a 2" high perforation at the bottom pipe to post connection. There are 6-inch diameter through deck drains at all four corners of the structure that are paved over and missing extensions, causing drainage onto the deck soffit and superstructure. Poor drainage is resulting in heavy deterioration in the fascia girders and deck soffits near the drains.

All four corners of the structure are missing an approach guide rail system. Bituminous concrete pavement at both approaches has random longitudinal, transverse, and areas of map cracking all opening to 1 inch wide. There is a 6-foot-long x 2-foot-wide x 2-inch-deep pothole with water ponding in the northeast approach. There are areas of light to moderate raveling throughout with isolated areas of heavy raveling and bituminous patches. There is a speed bump at the west approach. There is a small area of runoff erosion adjacent to the west end of the south rail base 6 inches long x 12 inches wide x 8 inches deep.

The **superstructure** is in serious condition (overall rating = 3). The steel plate bearings utilized on this structure exhibit backed off anchor bolts, short anchor bolts, and pack rust between plates. The interior bearings have areas of light spotty rust, while the fascia bearings at both abutments have heavy and laminated rust with section loss up to ¼ of an inch deep in the bearing plates. The superstructure consists of nine rolled steel girders. The fascia girders have areas of heavy laminated rust with severe section loss. Girder G-1 has full height section loss in the web resulting in up to 55.6 percent web loss for shear and bearing at the high stress region. G-1 bottom flange has a maximum section loss of 59 percent in front of the bearing. Girder G-9's web has section loss with a recorded minimum of 0.197 inches (D-meter) remaining at the west abutment. G-9 has 59.2 percent web loss for shear and up to 64 percent web loss for bearing. The bottom flange to G-9 has approximately 3 inches minimum width remaining resulting in up to 61.8 percent section loss directly in front of the bearing. Both fascia girders top flanges have 3/16 of an inch section loss due to leakage from the adjacent deck drain. Light to moderate rust and isolated areas of heavy rust with section loss can be found on the diaphragms. Barriers have been placed on the bridge roadway over both fascia girders to prevent live loads.

The **substructure** is in satisfactory condition (overall rating = 6). The reinforced concrete abutment stems have vertical hairline cracks up to full height and isolated horizontal cracks up to full length with efflorescence and rust and isolated horizontal cracks up to full length. There is also map cracking up to 3 feet x 1 foot high with hollow areas up to 1-foot-long x 4 inches high and moderate scaling along the waterline. Bearing pedestals have hairline vertical and horizontal cracks and spalls up to 7 inches long x 5 inches wide x 3 inches deep. The abutment backwalls exhibit isolated hairline horizontal cracks

up to 2 feet long and vertical hairline cracks up to full height with efflorescence. Abutment 1 backwall in bay 8 has a full height x full width of bay area of hairline map cracking and isolated shallow rebars up to 8 inches high with light scaling throughout. The wingwalls have vertical cracks up to full height x up to 1/8-inch-wide with efflorescence. Horizontal cracks up to 1/8" wide along the concrete pour joints.

The **channel and channel protection** are in satisfactory condition (overall rating = 6). The channel bottom consists of cobbles, sand, gravel, and small boulders. Approximately 50 feet upstream of the bridge is a dam with a spillway that has a 25-foot-long x 15-foot-wide x 42-inch-deep scour hole. There is a 11-foot-wide x 4-foot-long x 3-foot-high area of displaced boulders near wingwall 1A. There is an 8-foot diameter x 7-foot-high area of tree debris near girder 1. There is a 12-foot-long x 20-foot-wide x 1-foot-high aggradation at the inlet that is causing minor scour along the abutments. There is light to moderate undercutting of the channel embankments except for the northeast embankment which is protected by a rip rap extending from the end of the northeast wingwall to the dam upstream.

Recommended Rehabilitation

Based upon field investigation and engineering analysis of this structure, the existing structure is found to be structurally deficient and functionally obsolete due to the condition of the deck and superstructure. For these reasons, it is recommended that this bridge be replaced.

The recommended rehabilitation of the Bridge No. 04070 crossing is to replace the existing structure with precast prestressed concrete deck units supported on integral cast-in-place concrete abutments supported on an H-pile foundation driven to bedrock.

National Flood Hazard Layer FIRMette

FEMA

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth
- Regulatory Floodway *Zone AE, AO, AH, VE, AR*

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 — Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

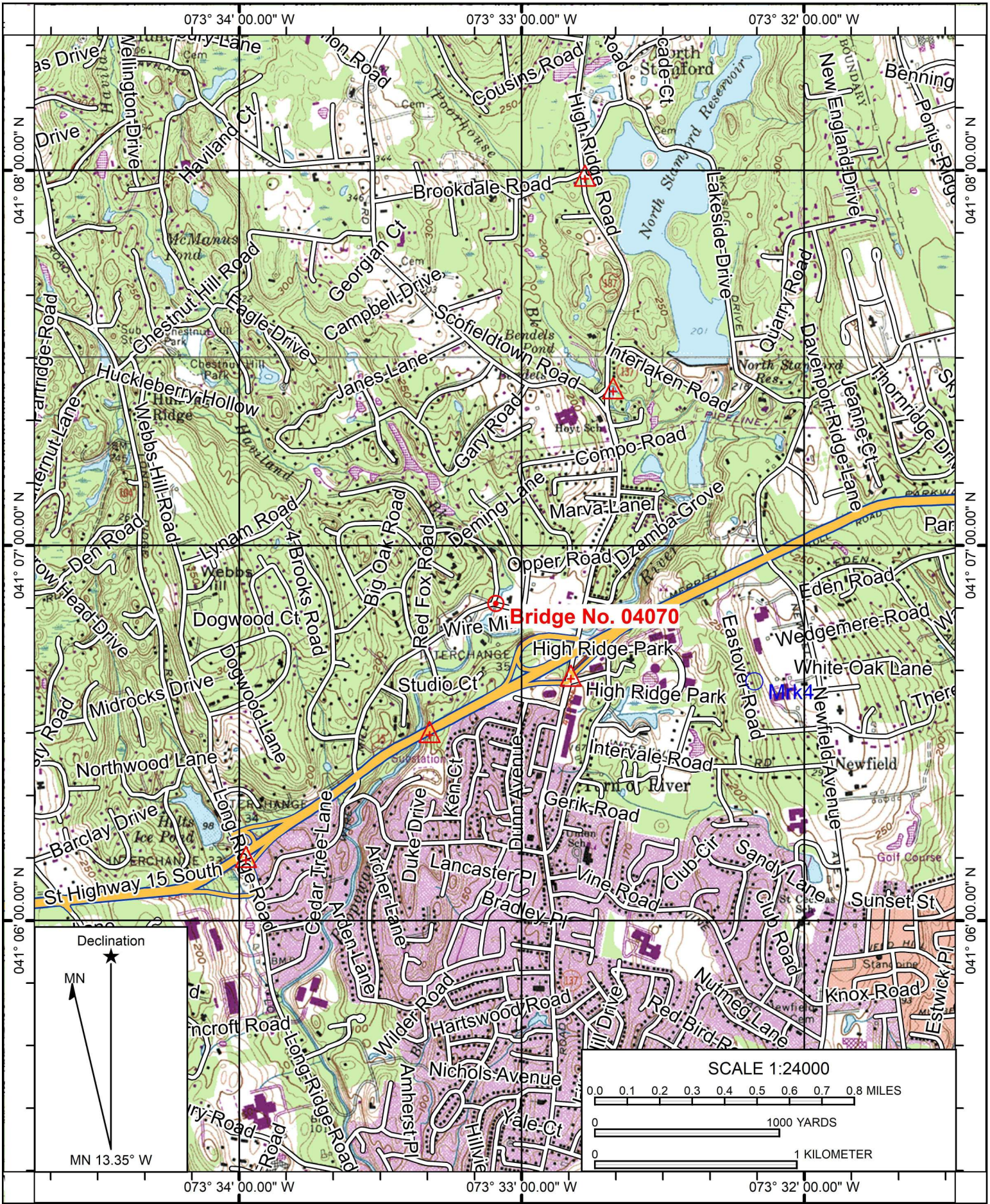
MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The base map shown complies with FEMA's base map accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 5/14/2018 at 2:38:16 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

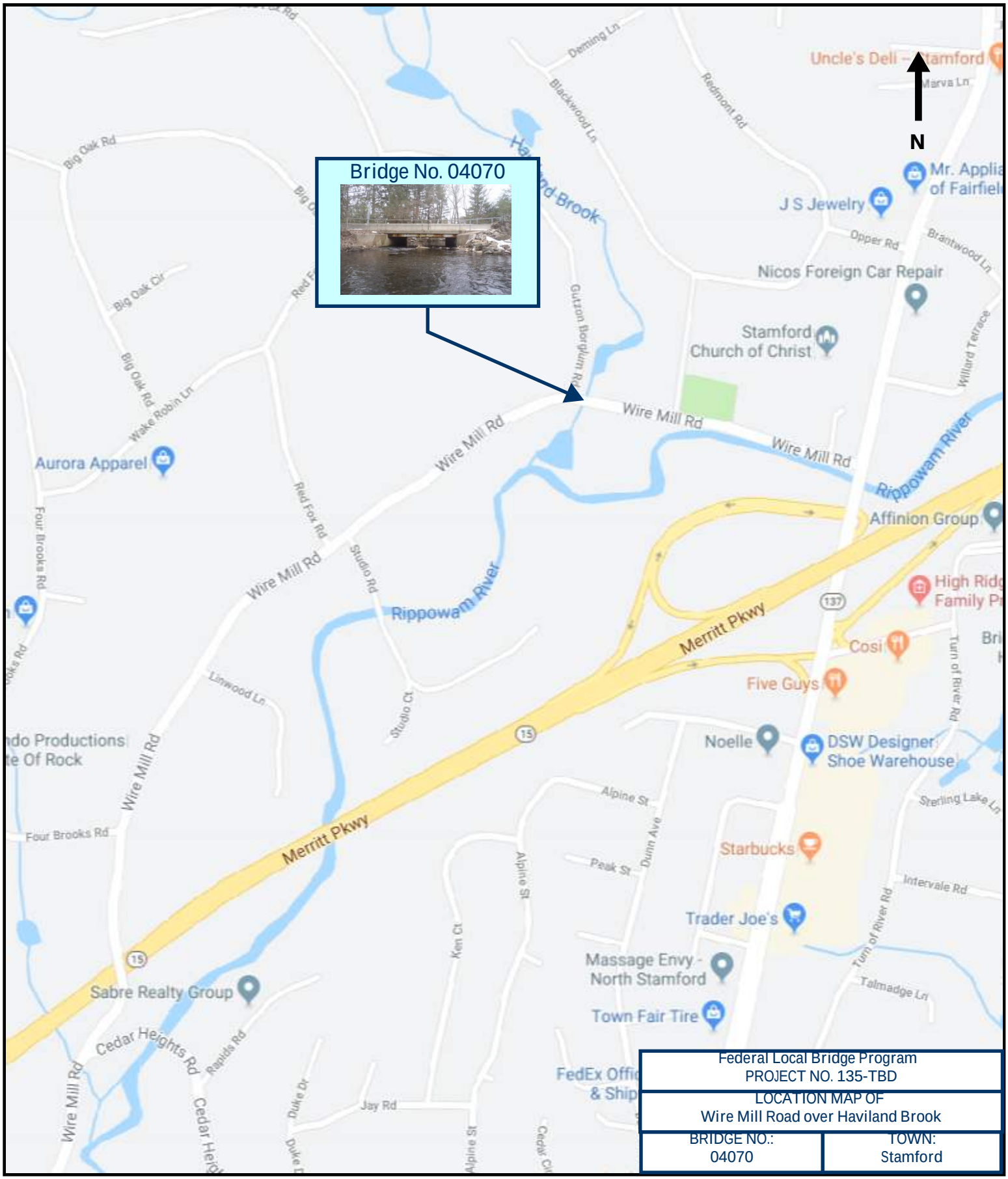
This map image is void if the one or more of the following map elements do not appear: base map imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.



Name: STAMFORD
Date: 06/12/18
Scale: 1 inch = 2,000 ft.

Location: 041° 06' 50.76" N, 073° 33' 05.73" W
Wire Mill Road Over Haviland Brook

Datum: NAD27


Bridge No. 04070
N
Wire Mill Rd
Rippowam River
Merritt Pkwy
Haviland Brook
Uncle's Deli - Stamford
J S Jewelry
Nicos Foreign Car Repair
Stamford Church of Christ
Aurora Apparel
Affinion Group
Cosi
Five Guys
Noelle
DSW Designer Shoe Warehouse
Starbucks
Trader Joe's
Massage Envy - North Stamford
Town Fair Tire
Sabre Realty Group
Federal Local Bridge Program
PROJECT NO. 135-TBD
LOCATION MAP OF
Wire Mill Road over Haviland Brook
BRIDGE NO.: 04070
TOWN: Stamford

Federal Local Bridge Program PROJECT NO. 135-TBD	
Aerial View of: Wire Mill Road over Haviland River	
BRIDGE NO.: 04070	TOWN: Stamford

HYDRAULIC DATA
For recommended alternate

1) Location

a) Town(s): Stamford State Project No.(s): 135-344

b) Highway: Wire Mill Road Station(s):

c) Location Relative to Highway Landmark: ± 1400 feet west of intersection with SR 137

d) Stream: Haviland Brook

e) Location Relative to Stream Landmark: Approx. 90 feet upstream from confluence of Haviland with Rippowam River.

2) Design Flood

a) Hydrologic Procedure Used for Design: 2020 Connecticut Regional Regression Equations

b) Hydrologic Procedure Used by FEMA: N/A

c) Drainage Area: 3.7 square miles

d) ConnDOT Drainage Manual Structure Classification: Intermediate

e) Design Storm Frequency: 100-year

f) Required Underclearance at Design Discharge: 1-foot

g) Design Discharge:

i. D.O.T. Design: 800-cfs

ii. FEMA:

iii. SCEL:

3) Hydraulic Analysis Procedure

a) Model Used and Version No.: HEC-RAS v. 6.3.1

b) Flow Regime: Mixed

c) Boundary Conditions (starting water surface at the ends of the river system – i.e. known water surface, normal depth, critical depth, rating curve, etc.):

i. Downstream: Normal Depth (slope 0.001 $^{ft}/_{ft}$)

ii. Upstream: Normal Depth (slope 0.017 $^{ft}/_{ft}$)

d) Other Method(s):

4) Hydraulic Control (i.e. culvert/bridge, dam (weir), channel construction, tide, known water surface elevation, etc.)

a) Type of Control: Bridge and adjacent stone walls and wood fences

b) Location Relative to Proposed Construction: Immediate

5) Coefficients of Roughness

a) Downstream:	Channel	0.035	Overbank	0.012-0.07
b) At Crossing:	Channel	0.035	Enclosed Conduit	
c) Upstream:	Channel	0.035	Overbank	0.012-0.07

6) Existing Structures

Upstream:

a) Type: Dam

b) Gross Waterway Opening:

At Site:

a) Type: Simple span girder and concrete deck on concrete abutments with spread footing.

b) Gross Waterway Opening: 80 sq. ft.

c) Effective Waterway Opening: 80 sq. ft. (pressure flow)

d) Overall Width of Waterway Opening: 20 feet

e) Effective Depth of Waterway Opening: 4.0 ft – hydraulic depth / 4.5 ft – max depth

f) Minimum Low Chord Elevation: 132.1 feet

g) Minimum Roadway Elevation: 134.6 feet (overtopping elevation)

h) Computed Water Surface Elevation at Approach Section Upstream of Structure at Design Discharge: 135.2 feet (section 205.8)

i) Underclearance at Design Discharge: 0.0 feet (pressure flow)

j) Mean Velocity of Channel: 9.5 fps (open vel through crossing)

Downstream:

a) Type: N/A

b) Gross Waterway Opening:

7) Proposed Structure

a) Type: Prestressed concrete deck units on pile supported integral abutments

b) Gross Waterway Opening: 129.4 sq. ft.

c) Effective Waterway Opening: 129.4 sq. ft. (pressure flow)

d) Overall Width of Waterway Opening: 33 feet

e) Effective Depth of Waterway Opening: 3.9 feet – hydraulic depth / 4.8 ft – max depth

f) Minimum Low Chord Elevation: 132.5 feet

g) Minimum Roadway Elevation: 134.6 feet (overtopping elevation)

h) Computed Water Surface Elevation at Approach Section Upstream of Structure at Design Discharge: 133.9 feet (section 205.8)

i) Maximum Regulatory Elevation: 1' over natural = 134.7 feet at section 205.8

j) Other Controlling Water Surface Elevation (If Below Maximum Regulatory Elev.):
1' of freeboard = 133.6 feet.

k) Difference in Water Surface Elevation (Approach Section) Proposed vs. Existing and Proposed vs. Regulatory @ Design Discharge: Proposed – existing = -1.3'
Proposed – regulatory = -0.8'

l) Underclearance at Design Discharge with Respect to Structure Low Chord:
0.0 feet (pressure)

m) Mean Velocity Through Structure: 6.2 fps (open vel through crossing)

8) Remarks

a) Navigational Requirements: N/A

b) Tidal Conditions: N/A

c) Record Floods: 11/1927, 8/1955, 10/1955, 1/1978, 1/1979 (Bridge in place since 1957)

d) Average Daily Flow:
(Q_{AD}(cfs) = [A (sm)]$^{0.98}$ * 1.87) = 7-cfs

e) Average Spring Flow:
(Q_{AS}(cfs) = [A (sm)]$^{0.988}$ * 3.62) = 13-cfs

f) Flood Hazard Zone: Zone AE

g) Vertical Datum: NAVD '88

HYDROLOGY

Watershed Properties

The drainage area of Haviland Brook at the 04070 crossing (and mouth) was delineated to be 3.72 square miles using the online USGS StreamStats v4.11.1 watershed analysis system and verified against USGS Quadrangles 106 and 113 (Pound Ridge and Stamford, respectively). The watershed is designated a tributary to the Rippowam River Subregional drainage basin (Basin No. 7405) as identified on a map titled "Natural Drainage Basins in Connecticut" compiled by the State of Connecticut Department of Energy and Environmental Protection (CTDEEP) 1981, revised 1991. The subregional drainage basin is part of the Southwest Western Complex Regional Basin (No. 74) of the Southwest Coast Major Basin (No. 7). The studied basin falls entirely within Fairfield County. Bridge No. 04070 is classified as an intermediate structure with a drainage area between 1 and 10 square miles.

Approximately 67% of the watershed area is characterized as wooded area. Twenty-four percent of the watershed is classified as developed, however of that developed classification, 17% of the watershed falls within the subcategory of developed: open space. This leaves 7% of the watershed exhibiting low to high intensity development which would include parcels with single family houses to built up urban centers and large constructed surfaces. The remaining 9% of the watershed land cover consists of pastures, grasslands and shrublands (1%), open water (1%) and wetland areas (7%).

This location is noted as having been witness to historical flooding; notably the floods of November 1927 (100-year), August 1955 (<100-year), October 1955 (500-year), January 1978 (50-75-year) and January 1979 (50-year), though the structure has only been in place since 1957.

Peak Flow Methods Used

The design flow frequency curve was estimated through application of the USGS 2020 Regional Regression Equations computed by StreamStats (v. 4.11.1).

Recommended Peak Flows

The following table presents the recommended flow rates for hydraulic design. The detailed analysis is offered in the Hydrologic Report, issued November 2022, in Appendix B.

Table 1 – Recommended flow rates for rehabilitation of Bridge No. 04070

Frequency	Discharge Rate
2-yr	200-cfs
10-yr	420-cfs
25-yr	560-cfs
50-yr	670-cfs
100-yr	800-cfs
200-yr	890-cfs
500-yr	1070-cfs

HYDRAULIC ANALYSIS METHODOLOGY

Hydraulic analysis of Bridge No. 04070 is performed using the Hydrologic Engineering Center's River Analysis System (HEC-RAS) version 6.3.1. A plan view of the river, showing the arrangement of surveyed river cross-sections follows this section.

Bridge No. 04070 is an intermediate structure, i.e., drainage area greater than 1 square mile and less than 10 square miles. The actual drainage area is 3.7 square miles.

Due to the proximity of the crossing with the Rippowam River and the expansive breadth of the Rippowam River floodplain, this structure is located within a regulated floodplain (Zone AE), outside of the established Rippowam River floodway. However, this reach of Haviland Brook itself has not been studied in detail by FEMA and there are no regulatory flow rates to evaluate. Development of the rehabilitation of Bridge No. 04070 included avoidance of grading (i.e., embankment or profile improvements) so as to not impact the flood storage of the Rippowam River floodplain. Due to the alignment of the Wire Mill Road Bridge No. 04070, changes to the structure will not influence the flow patterns of the Rippowam River since the deck is in-line with the flood flows.

Cross sections are arranged with the intent of evaluating hydraulics on the flows contributed by the Haviland Brook watershed. This is problematic as the floodplain areas for Haviland Brook and Rippowam River adjacent to Wire Mill Road are combined.

Wire Mill Road is at grade with the floodplain, both upstream and downstream, and runs parallel to the upstream approach reach of the Rippowam River. Sections defining the upstream limits of the Haviland Brook model reflect a high point in the Northeast quadrant of the floodplain and subsequently afford a better definition of the Haviland overbank areas. Starting downstream of the dam in the approach reach, the left overbank is not as clearly defined, and section placement did not facilitate capture of the entire calculated flow elevation. This is continuous across the roadway to the exit reach of Haviland and the confluence with the Rippowam. As the sections were not able to be carried to fully contain the calculated flow elevation, an assumption is made that the flow further to the left would not be impacting the hydraulics at the bridge. Like ineffective flow areas, this flow is simply not interacting with the crossing. When HEC-RAS finds flows not contained in the input cross sections, the program will extend the cross section vertically to perform the calculations. This section extension does not increase the wetted perimeter of the section and thus does not influence the friction slope of the result. The extension effectively establishes a full-slip boundary which would assume that flows outside of the section are behaving similarly to the flows at the limit of the section. In actuality, those flows would be removed from the flows interacting with the studied crossing, however under this standard steady state analysis approach, each section computes hydraulic properties using the same total flow rate. For this study, this condition is considered conservative in evaluation of the design hydraulics as well as the design scour.

In addition to the complexities involved with modeling the expansive floodplain, there are several features in the studied reach that were addressed. The biggest influencer of hydraulics of this reach at flood flows are stone walls and solid picket fences that line either side of Wire Mill Road. Upstream there is a stone wall with breaks for driveway access. This stone wall is set back from the bridge section approximately 10 feet and stands an average of 3.5 feet above the adjacent floodplain grade. An

additional section (180.8) is defined between the stone wall and the upstream face of the bridge to evaluate flows overtopping the road (weir flow over the embankment). On the downstream face of the crossing, there is a stone wall and solid picket fence that stands almost 6 feet from grade. This obstruction is immediately at the exit face of the crossing and as such is modeled into the bounding section to reflect the obstruction to flows over the roadway. These flow obstructions as well as a house in the floodplain northeast of the crossing are coded into the model geometry using blocked obstructions. Upstream, these walls influence the approach flow to the crossing, and downstream, the obstructions effectively increase the embankment/deck height of the crossing. These walls are private appurtenances and will not be improved or modified as part of this project.

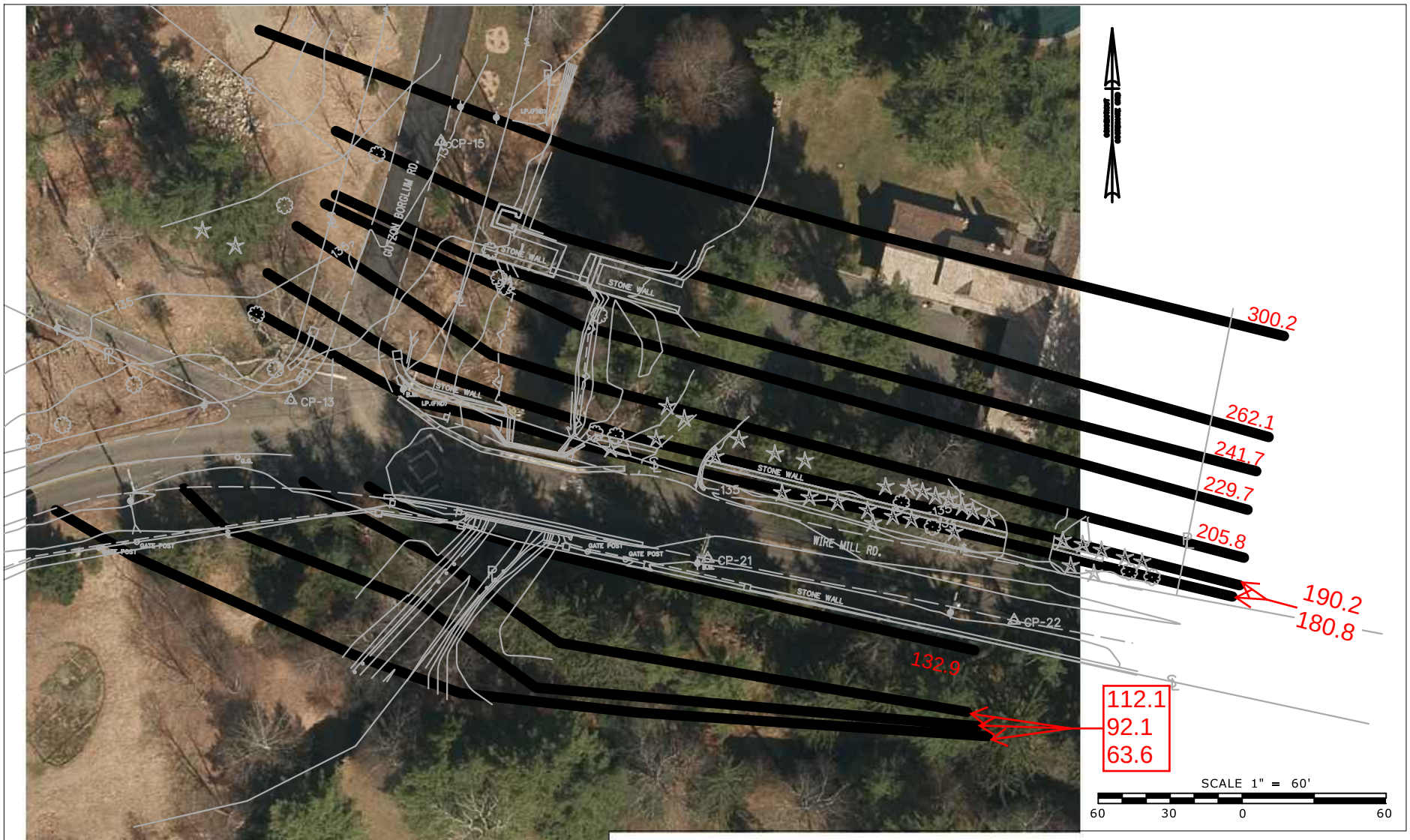
A Manning's Roughness Coefficient of 0.035 is used for the upstream and downstream channel reach. For the overbanks, the roughness varies between 0.012, 0.04 and 0.07, reflecting paved areas, maintained lawns and wooded areas, respectively. Values of 0.1 and 0.3 are used for the contraction and expansion dynamic head losses for the open channel sections, and 0.3 and 0.5 within the approach and exit reaches of the bridge.

This reach of Haviland Brook exhibits a mixed flow regime, and accordingly is the solution scheme the HEC-RAS model is based on. Upstream, the flood flows are generally subcritical, and downstream the flows transition to supercritical due in part to the overtopping condition computed and also the grade of Haviland Brook. The starting water surface (boundary condition) is based on normal depth at the downstream limit, with an estimated energy slope of 0.017-$^{ft}/_{ft}$ and normal depth at the upstream limit with an estimated energy slope of 0.001-$^{ft}/_{ft}$.

The procedure used by the HEC-RAS program is based on the solution of the one-dimensional energy equation for steady, gradually varied flow. The computation of losses through the bridge involves either the Energy Equation using friction and contraction/expansion losses, a momentum balance, or in the case that there are piers supporting the structure, the Yarnell Equation. For low flow conditions, the program first uses the momentum equation to identify the class of flow through the structure (i.e., either wholly subcritical, mixed sub and supercritical, or wholly supercritical). Computed water surface elevations (CWSEL) are then determined at defined cross sections upstream and downstream of the bridge, as well as at the immediate faces of the bridge. The solution with the highest energy grade is then applied.

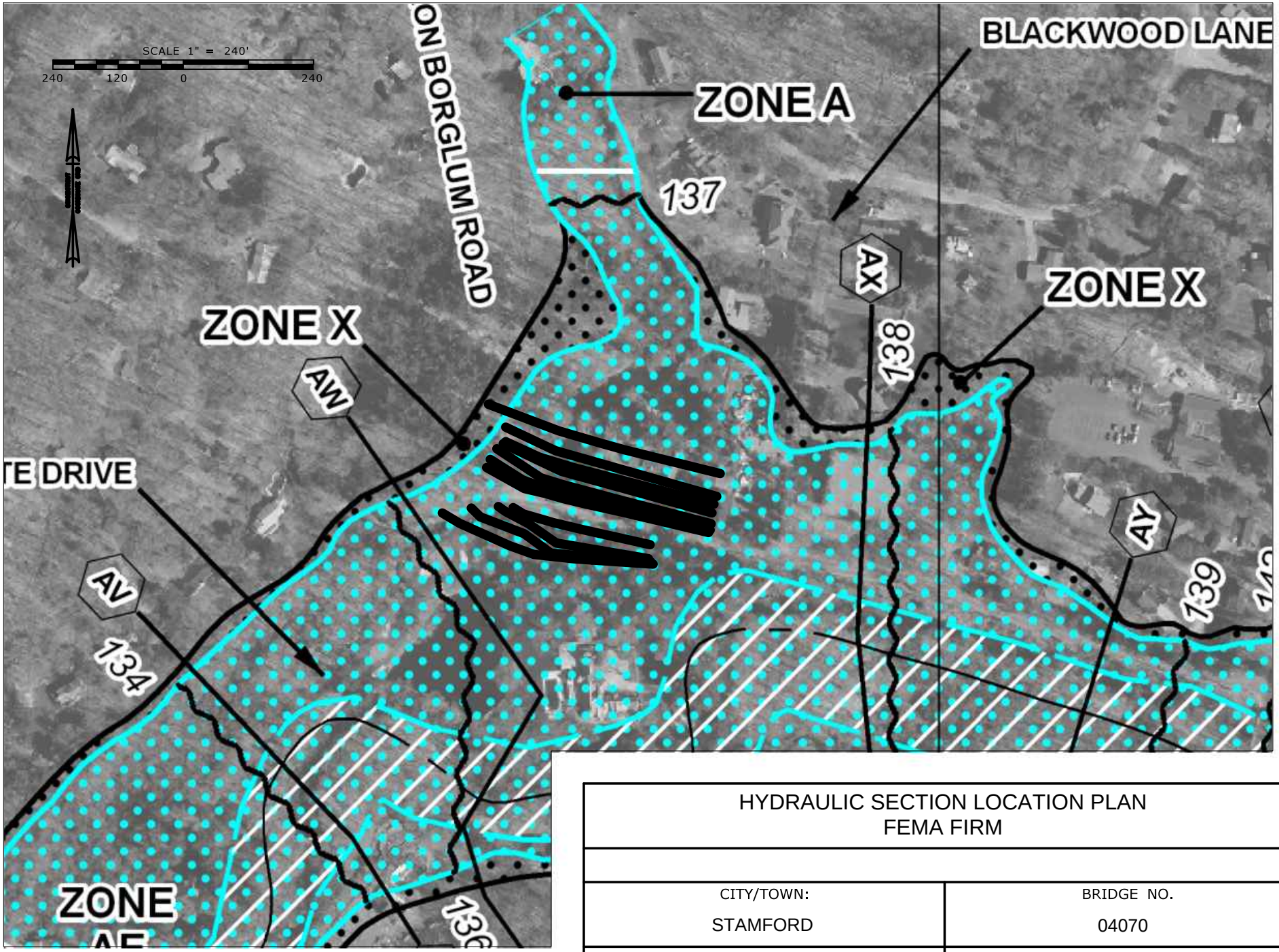
Both pressure and weir flow are predicted to occur at this site. The program recognizes two forms of orifice flow and uses a sluice gate equation for inlet control conditions or a full flowing orifice equation for submerged tailwater flow conditions. Once pressure flow is computed, the pressure flow answer is compared to the low flow energy grade line, and the higher of the two is used. When the CWSEL is greater than the low point in the roadway, the elevation is revised using the standard weir equation. In situations where the roadway is highly submerged, the program reverts to the standard energy equation.

All elevations referenced in this report refer to the NAVD '88 unless otherwise specified.



HYDRAULIC SECTION LOCATION PLAN

CITY/TOWN:	BRIDGE NO.
STAMFORD	04070
STATE PROJECT NO.: 135-344	DATE: NOVEMBER 2020



HYDRAULIC SECTION LOCATION PLAN
FEMA FIRM

CITY/TOWN:	BRIDGE NO.
STAMFORD	04070
STATE PROJECT NO.: 135-344	DATE: NOVEMBER 2020

WATER SURFACE PROFILE ANALYSIS

Natural Condition

The natural condition is simulated by eliminating the bridge structure between cross sections 132.9 and 180.8. It is presented in the Hydraulic Analysis Methodology section of this report that section 180.8 is included to reflect the limit of the upstream stone wall obstructions, which are offset by 10 feet from the upstream bridge face. This section by placement includes portions of the wingwalls. To reflect the natural condition, this section also is removed.

Generally, with a natural condition analysis, the natural condition is prepared by removing all man-made features of the floodplain and then compared to the profile with only the proposed structure in place. This gives an indication of the total backwater influence of the proposed condition. In this case, with the presence of the walls upstream and downstream, as well as the dam 70 feet upstream, approximating the natural condition is problematic. For this analysis, to evaluate the backwater condition of the crossing, only those changes noted above are made. Maintaining the floodplain features in the natural model and comparing to the proposed condition still affords an evaluation of the backwater condition of the proposed bridge. This approach would assume that the dam and the stone walls/fence will remain in place for the lifetime of the crossing.

The computed natural water surface elevation for the 100-year storm of the most upstream cross-section (river station 300.2) is 135.5 feet. This section is located approximately 124.4 feet upstream from the project location. The natural water surface elevation at the upstream approach cross-section (river station 205.8) is 133.7 feet. The approach section is located upstream of the existing and proposed bridges. Although the bridge is not present in the natural condition model, the elevation at the approach section is often compared to the natural conditions to evaluate the backwater developed by the crossing.

A comparison of the natural condition profile to those of the existing and proposed conditions is noted in the summary and conclusion section.

A printout of the HEC-RAS Standard Table 1 is included in Appendix D. The water surface elevation profile plot for the natural condition is shown on the next page.

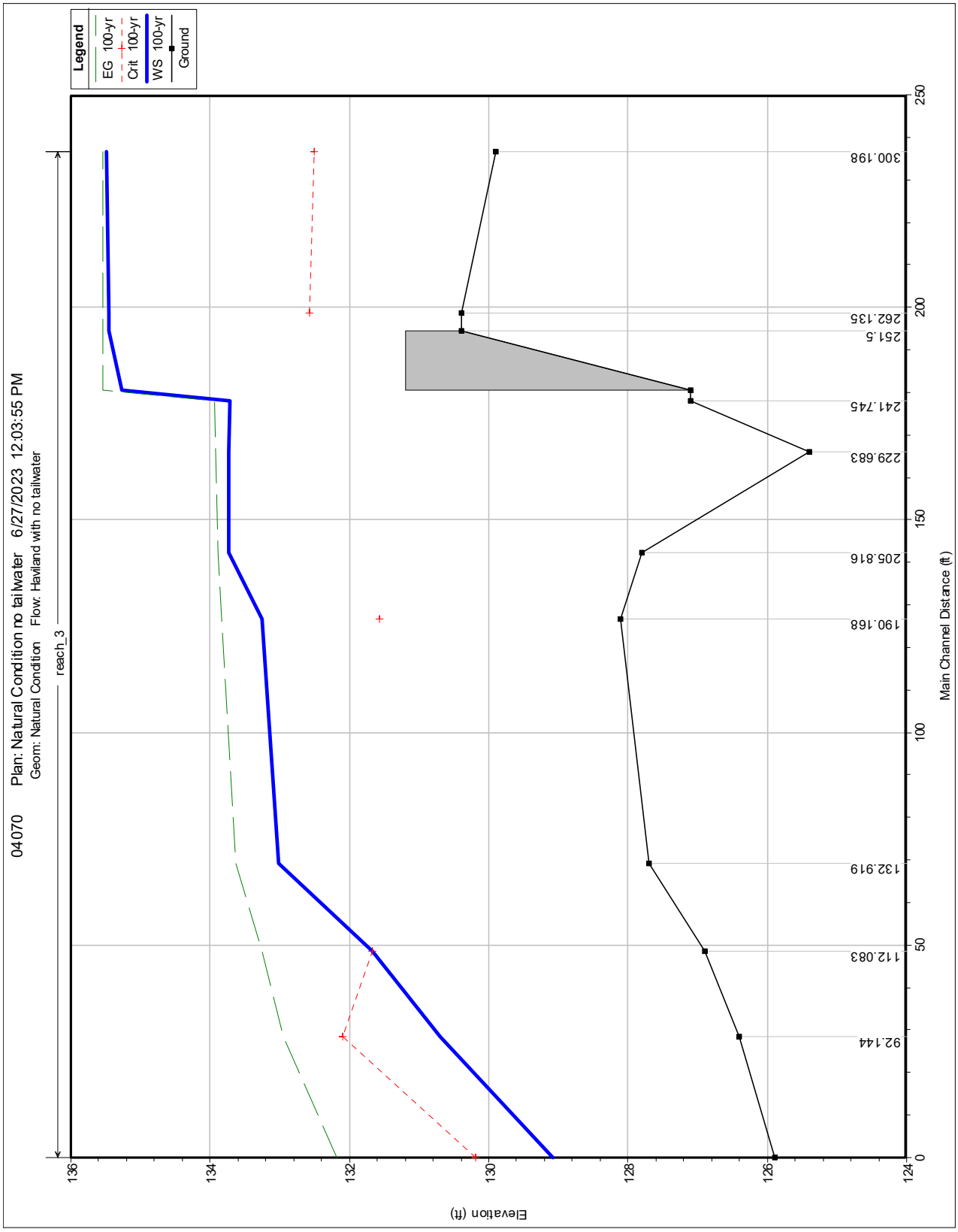


Figure 1 – Natural Condition 100-year Profile

Existing Condition

The existing condition is evaluated by passing the 100-year storm flow of 800-cfs through the existing bridge constriction located at section 161.5. The existing bridge opening, geometry and river topography are obtained through a field survey prior to the hydraulic analysis.

The water surface elevation for the 100-year flood event of the most upstream cross-section (river station 300.2) for the existing condition is 135.5 feet. The water surface elevation at the upstream approach section to the bridge (river station 205.8) for the 100-year flood is 135.2 feet.

The computed water surface elevation at the upstream face of the existing bridge section for the 100-year storm is 135.1 feet. This water surface elevation indicates weir flow at the existing bridge as the minimum roadway surface elevation is 134.6 feet.

A comparison of the existing condition profile to those of the natural and proposed conditions is noted in the summary and conclusion section.

Printouts of HEC-RAS standard Table 1 and the Culvert Output table are included in Appendix E. the water surface elevation profile plot for the existing condition is shown on the next page.

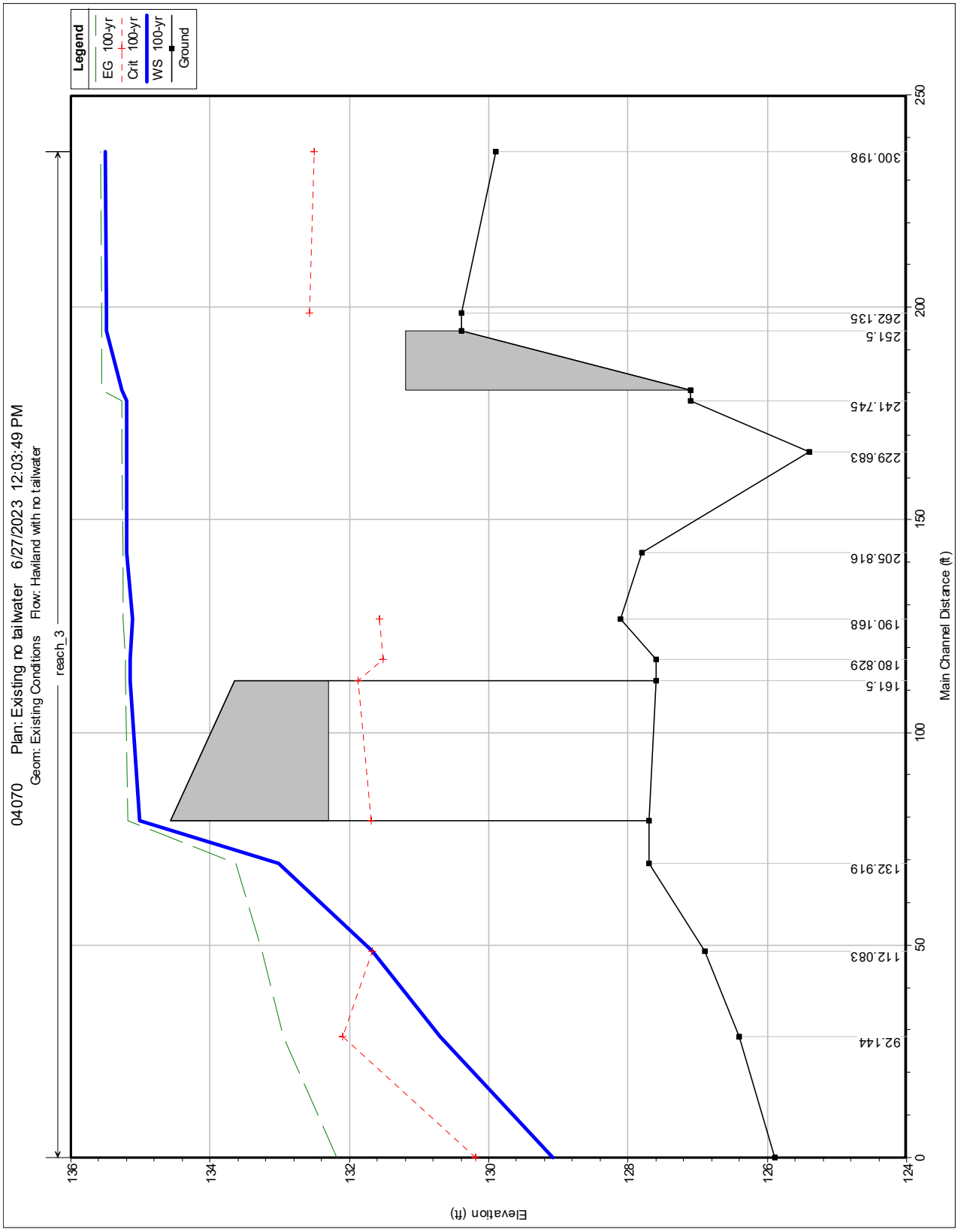


Figure 2 – Existing Condition 100-year Profile

Proposed Condition

The proposed condition includes replacing the existing structure with precast prestressed concrete deck units supported on integral cast-in-place concrete abutments. The new abutments will be supported on H-pile foundations driven to bedrock. The clear span will be widened from 20 feet to 33 feet and the low chord elevation will be raised 0.4 feet. The existing abutments will be cut down and capped, facilitating the construction of wildlife shelves (approximately 6 feet wide) on either side. The bridge width in the direction of flow will be maintained. The deck units would be topped with a composite 6-inch reinforced concrete shear slab. A membrane waterproofing and 3-inch bituminous concrete wearing surface would overlay the deck.

This proposed alternate is evaluated by running the 100-year storm flow of 800 through the proposed constriction located at section 161.5. This run utilized the existing river topography that was obtained through a field survey prior to the hydraulic analysis with the proposed bridge geometry depicted on the construction plans.

The water surface elevation for the 100-year storm of the most upstream cross-section (river station 300.2) for the proposed condition is 135.5 feet. The water surface elevation at the upstream approach section to the bridge (river station 205.8) for the 100-year storm is 133.9 feet.

The computed water surface elevation at the upstream face of the proposed bridge section for the 100-year storm is 133.3 feet. This water surface elevation indicates pressure flow at the proposed bridge as the maximum low chord of the bridge is 132.7 feet; however, the roadway is calculated to be dry with a surface elevation of 133.6 feet and an overtopping elevation of 134.6 feet.

A comparison of the proposed condition profile to those of the existing and natural conditions is noted in the summary and conclusion section.

Printouts of HEC-RAS standard Table 1 and the Culvert Output table for each alternate are included in Appendix F.

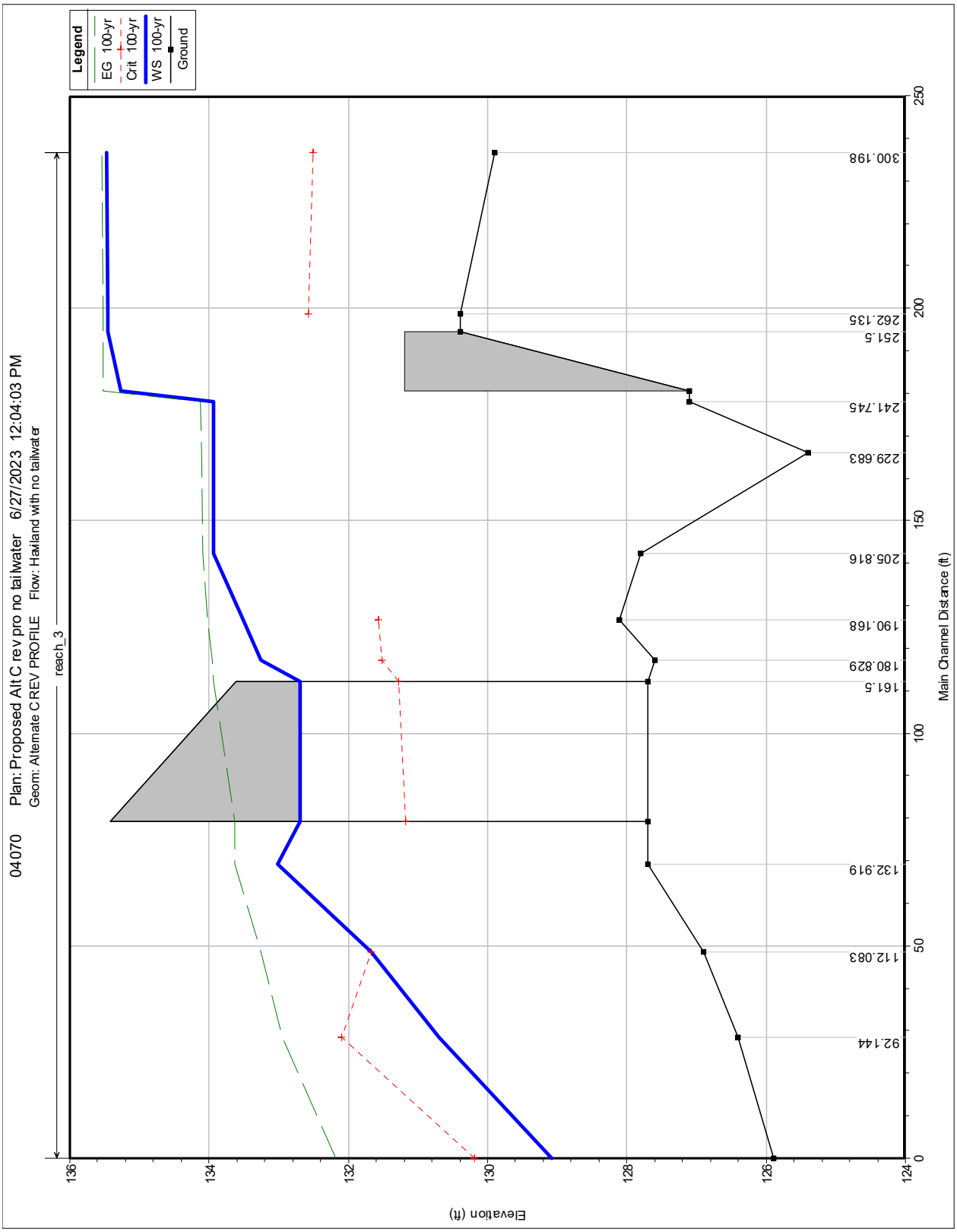


Figure 3 – Replacement structure / Deck units on integral abutments

Site evaluation considering backwater influences from the Rippowam River

Hydraulic design analysis for the replacement of Bridge No. 04070 is documented in the preceding sections. For an evaluation of the existing and proposed site conditions, design flows from Haviland Brook are computed with a starting tailwater elevation of the Rippowam River which is commensurate with the joint probability of occurrence of flooding conditions from each contributing catchment. Elevations for the Rippowam River are scaled from the published flood profile of the Fairfield County Flood Insurance Study.

The Haviland Brook Watershed with an aerial extent of 3.7 square miles is 6.7 times smaller than the Rippowam River at this location (watershed size = 25 square miles). This is a size ratio of approximately 10:1. Based on Table 8-3 of the CTDOT Drainage Manual, this would result in a 50-year starting tailwater elevation on the Rippowam River occurring when Haviland Brook experiences a 100-year flow event. Additionally, as a check, the 50-year flow event from Haviland Watershed is computed with a 100-year flow elevation from the Rippowam River. The tailwater elevations for this analysis are taken from the 2013 Fairfield County Flood Insurance Study (included in Appendix F). The following table presents the boundary conditions (flow and starting water surface elevation) for this site conditions analysis.

Table 2 – Boundary conditions for site assessment

10:1 mainstream to tributary	Design Event	Check Event
Haviland Brook	Q_{100} = 800-cfs	Q_{50} = 670-cfs
Rippowam River	$WSEL_{50}$ = 136.0’	$WSEL_{100}$ = 136.8’

The following section includes the calculated flow elevations for Haviland Brook under these regional flooding considerations.

The results of a 100-year event occurring on Haviland Brook with a concurrent 50-year flow elevation on the Rippowam River indicates that the proposed flow elevations upstream from the project site are approximately 0.2 feet lower than existing. The check event of a 50-year flow on Haviland Brook reaching the 100-year flood elevation on the Rippowam River presents that the proposed approach flow will be the same as existing. As an additional check, the 100-year flow is checked with the 100-year tailwater, as would be processed for a flood insurance study of Haviland Brook. That result indicates that the proposed approach flow is calculated 0.04 feet lower than existing conditions.

The following section presents the comparative water surface profile plots and comparison tables for the natural and existing conditions and recommended replacement.

WATER SURFACE PROFILE PLOTS

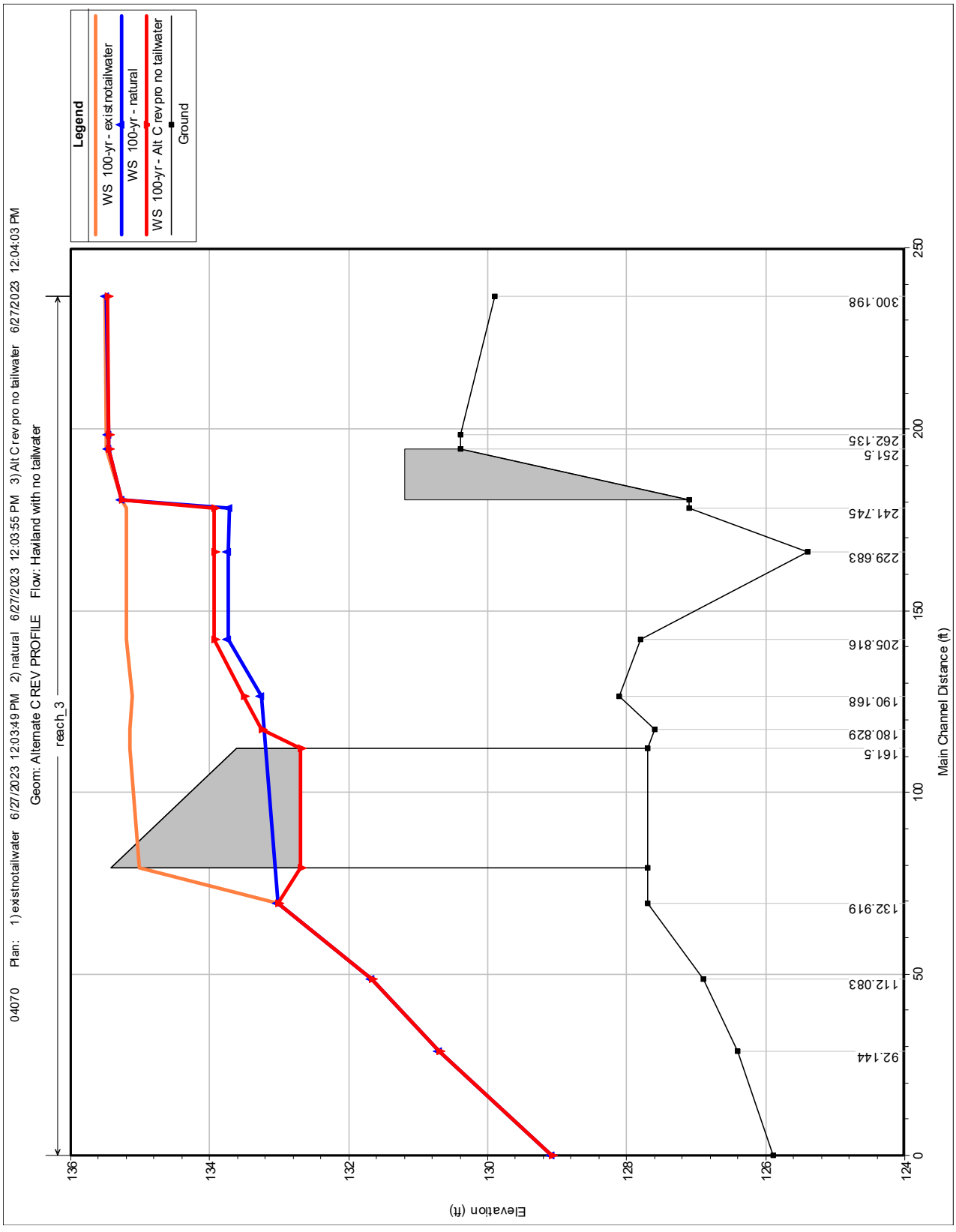


Figure 4 – Existing, Proposed and Natural 100-year flow profile (no tailwater effects from Rippowam River)

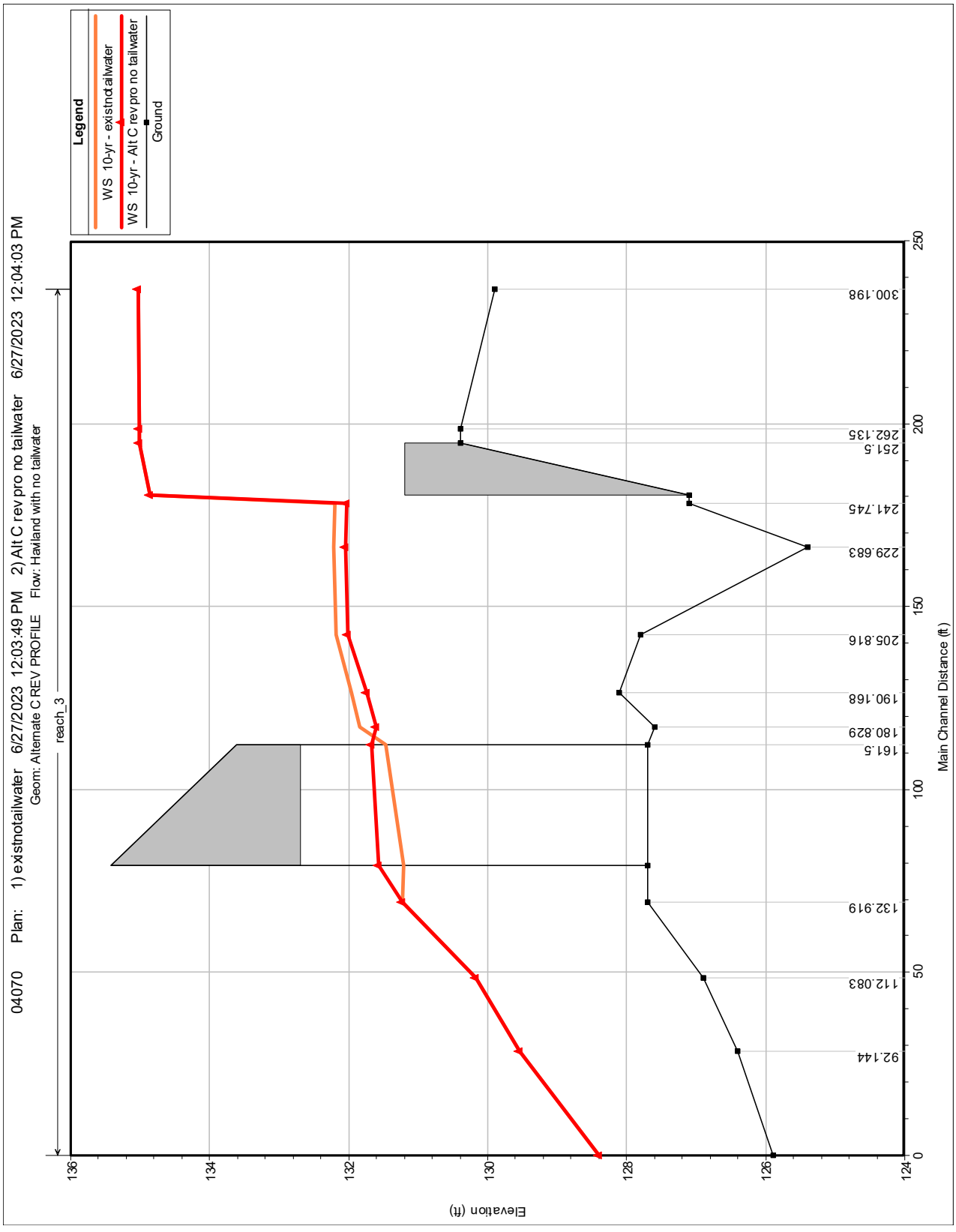


Figure 5 – Existing and Proposed 10-year flow profile (no tailwater effects from Rippowam River)

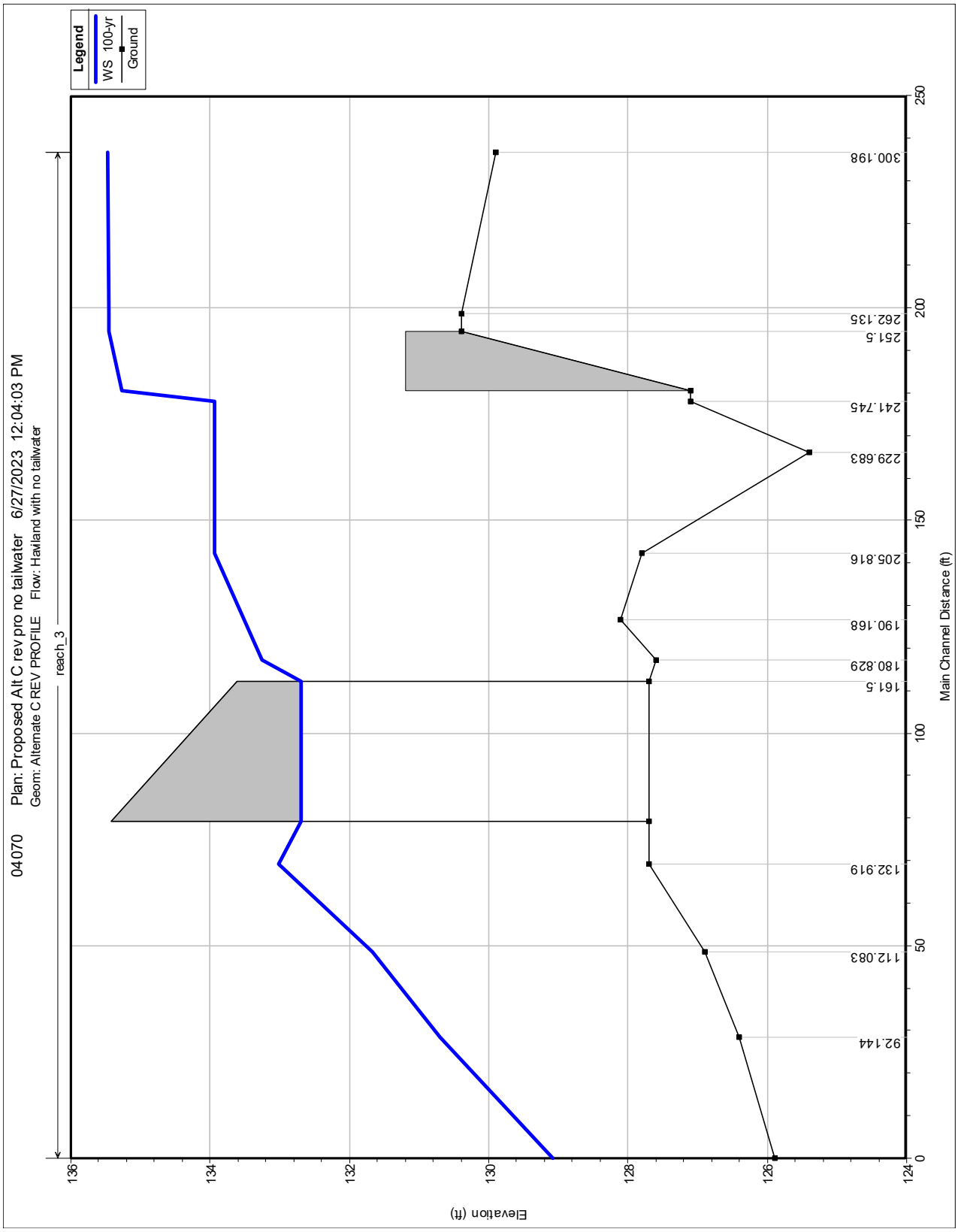


Figure 6 – Proposed 100-year flow profile (no tailwater effects from Rippowam River)

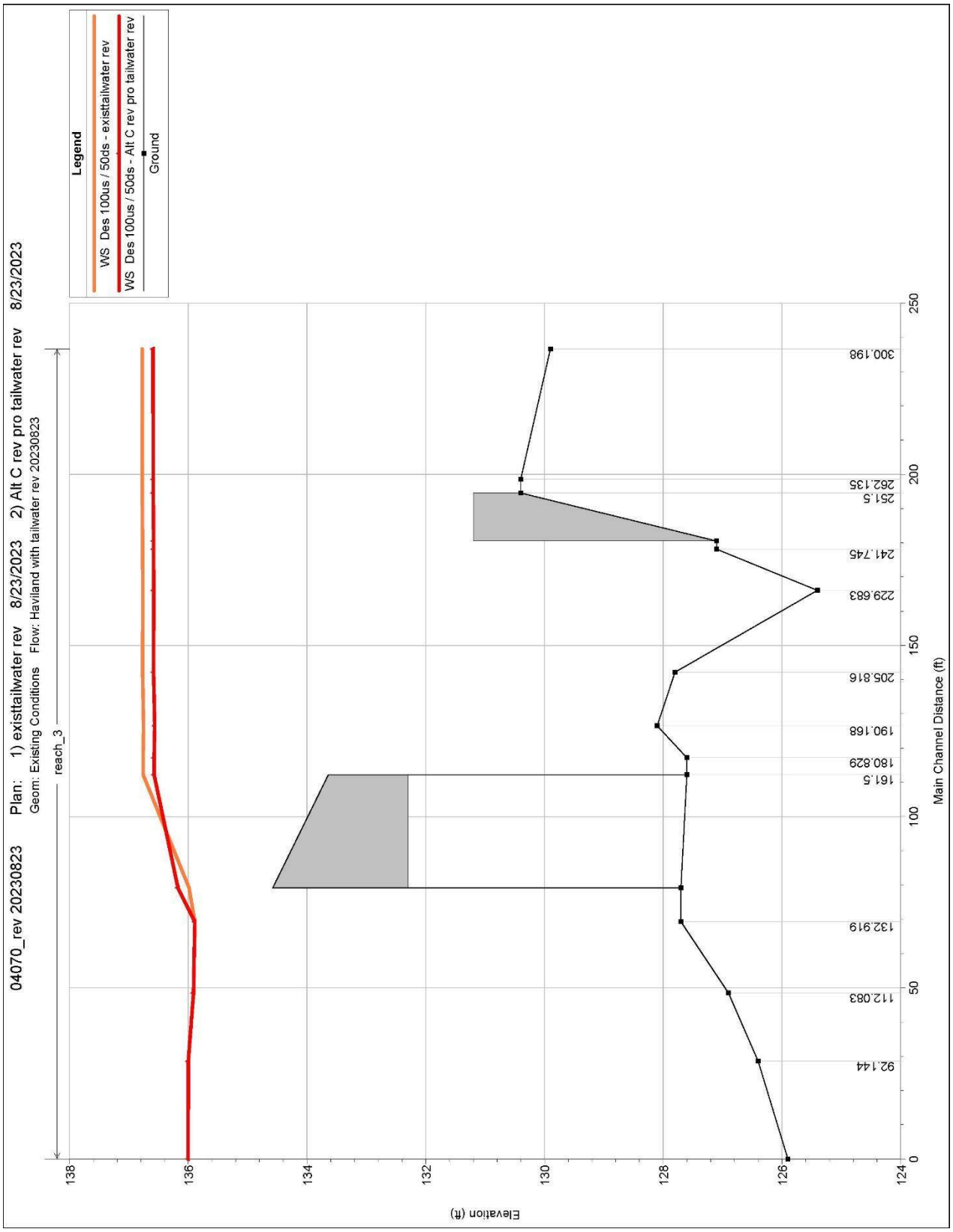


Figure 7 – Existing and proposed design flow profile (100-year flow with 50-year starting WSEL)

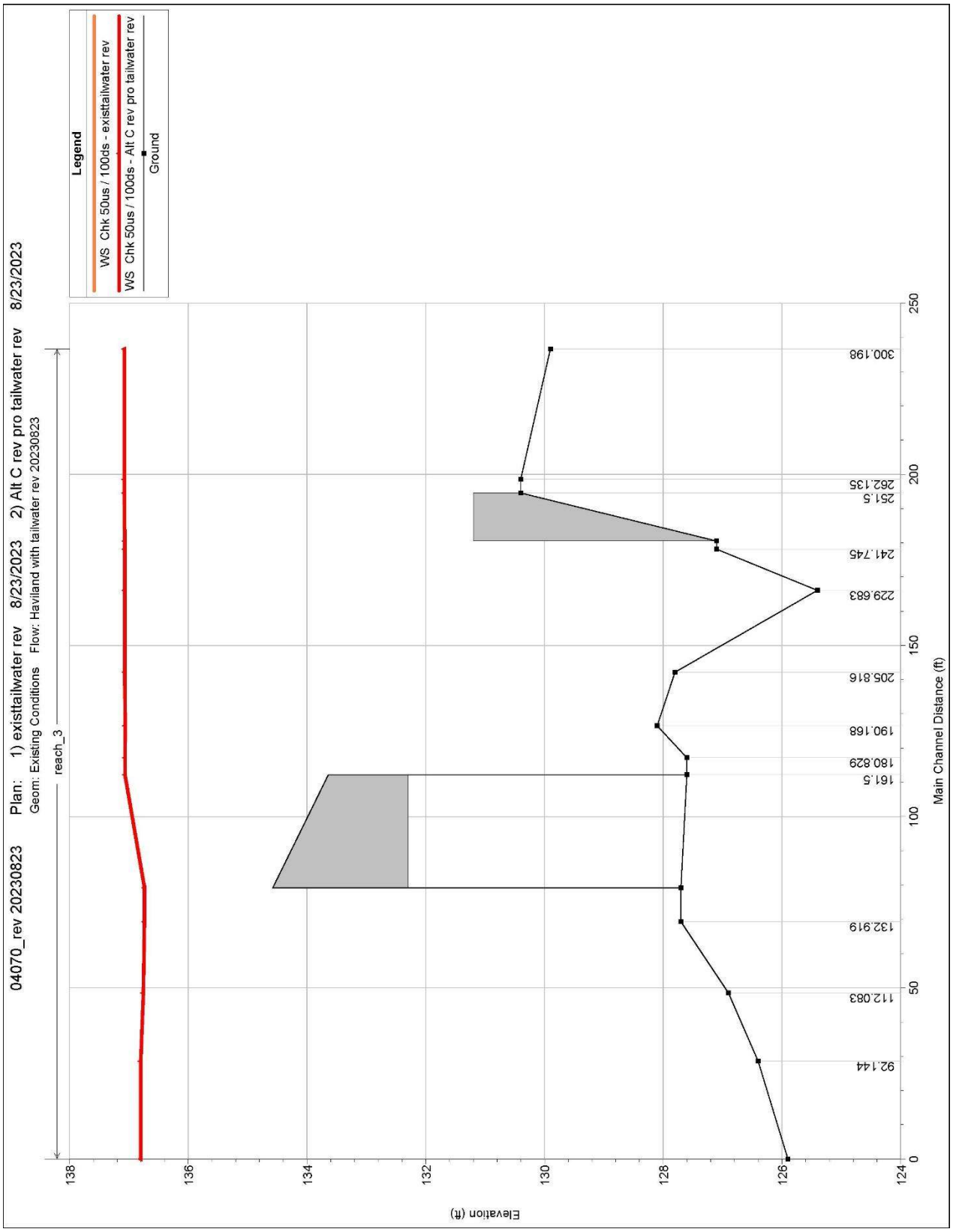


Figure 8 – Existing and proposed check flow profile (50-year flow with 100-year starting WSEL)

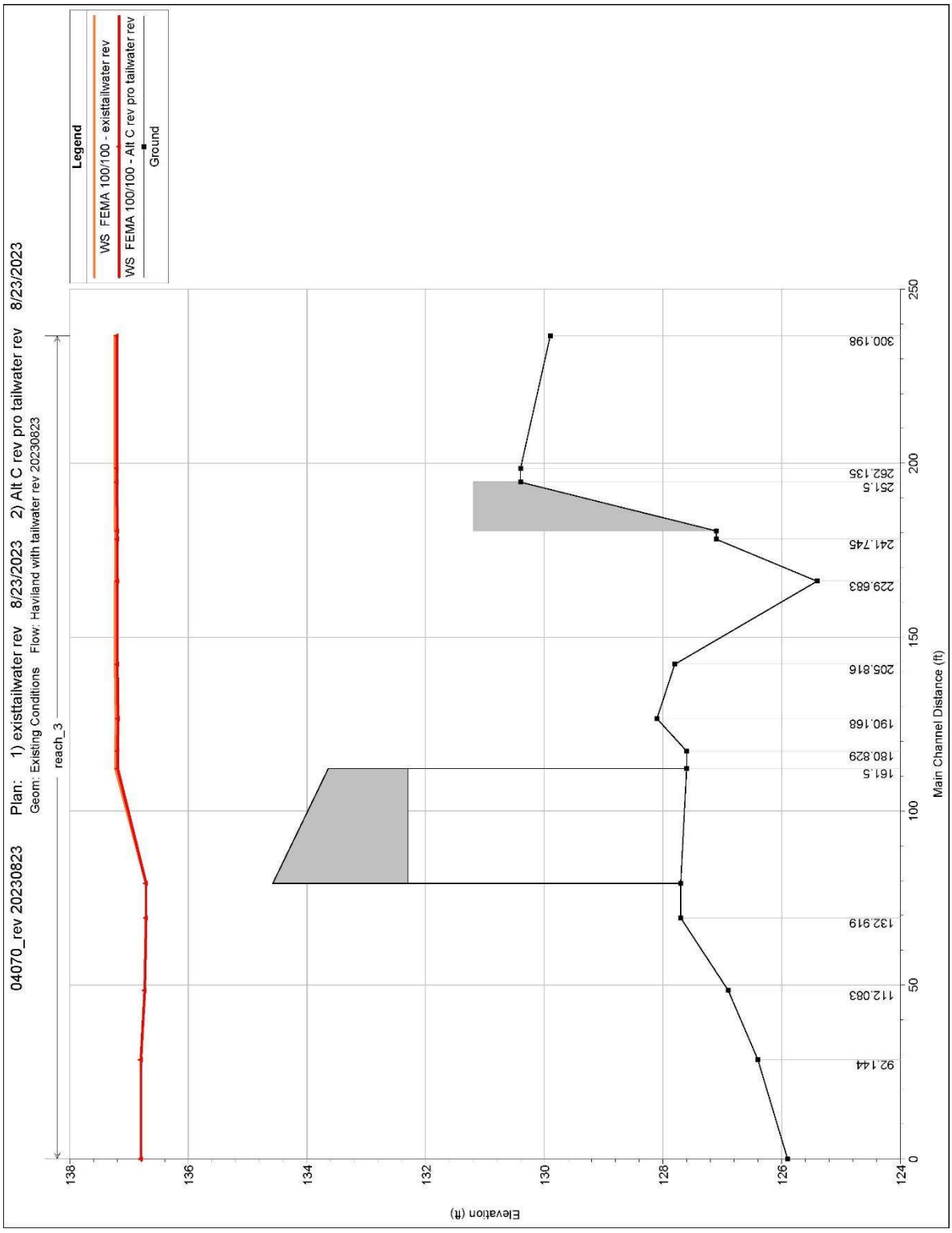


Figure 9 – Existing and proposed FIS approach (100-year flow with 100-year starting WSEL)

COMPARISON TABLES

Table 3 – Existing vs. proposed and proposed vs. natural 100-year water surface elevation (no tailwater influence)

River Sta	Existing W.S. Elev (ft)	Proposed W.S. Elev (ft)	Natural W.S. Elev (ft)	Difference Proposed - Existing (ft)	Difference Proposed - Natural (ft)
300.198	135.5	135.5	135.5	0.0	0.0
262.135	135.5	135.5	135.5	0.0	0.0
251.5		Dam			
241.745	135.2	133.9	133.7	-1.3	0.2
229.683	135.2	133.9	133.7	-1.3	0.2
205.816	135.2	133.9	133.7	-1.3	0.2
190.168	135.1	133.5	133.3	-1.6	0.2
180.829	135.1	133.3		-1.8	
161.5		Bridge 04070			
132.919	133.0	133.0	133.0	0.0	0.0
112.083	131.7	131.7	131.7	0.0	0.0
92.144	130.7	130.7	130.7	0.0	0.0
63.607	129.1	129.1	129.1	0.0	0.0

Table 4 – Existing vs. proposed and proposed vs natural 100-year channel velocity (no tailwater influence)

				Difference			
River Sta	Existing Vel Chnl (ft/s)	Proposed Vel Chnl (ft/s)	Natural Vel Chnl (ft/s)	Proposed - Existing (ft/s)	Percent change from existing %	Proposed - Natural (ft/s)	Percent change from natural
300.198	2.0	2.0	2.0	0.0	0%	0.0	0%
262.135	2.2	2.3	2.2	0.1	5%	0.1	5%
251.5		Dam					
241.745	2.6	3.7	3.9	1.1	42%	-0.2	-5%
229.683	2.4	3.4	3.6	1.0	42%	-0.2	-6%
205.816	2.2	3.3	3.5	1.1	50%	-0.2	-6%
190.168	3.2	5.7	6.1	2.5	78%	-0.4	-7%
180.829	2.5	6.6		4.1	164%		
161.5		Bridge 04070					
132.919	6.7	6.7	6.7	0.0	0%	0.0	0%
112.083	10.5	10.5	10.5	0.0	0%	0.0	0%
92.144	12.4	12.4	12.4	0.0	0%	0.0	0%
63.607	14.4	14.4	14.4	0.0	0%	0.0	0%

Table 5 – Existing and proposed 10-year water surface elevation (no tailwater influence)

River Sta	Existing W.S. Elev (ft)	Proposed W.S. Elev (ft)	Difference Proposed - Existing (ft)
300.198	135.0	135.0	0.0
262.135	135.0	135.0	0.0
251.5	Dam		
241.745	132.2	132.0	-0.2
229.683	132.2	132.0	-0.2
205.816	132.2	132.0	-0.2
190.168	132.0	131.7	-0.3
180.829	131.8	131.6	-0.2
161.5	Bridge 04070		
132.919	131.2	131.2	0.0
112.083	130.2	130.2	0.0
92.144	129.5	129.5	0.0
63.607	128.4	128.4	0.0

Table 6 - Existing vs. proposed 10-year channel velocity (no tailwater influence)

River Sta	Existing Vel Chnl (ft/s)	Proposed Vel Chnl (ft/s)	Difference Proposed - existing (ft/s)	Difference Percent change from existing %
300.198	1.2	1.2	0.0	0%
262.135	1.4	1.4	0.0	0%
251.5	Dam			
241.745	3.0	3.1	0.1	3%
229.683	2.7	2.8	0.1	4%
205.816	2.9	3.0	0.1	3%
190.168	4.4	4.8	0.4	9%
180.829	4.9	5.2	0.3	6%
161.5	Bridge 04070			
132.919	5.9	5.9	0.0	0%
112.083	9.0	9.0	0.0	0%
92.144	10.0	10.0	0.0	0%
63.607	11.1	11.1	0.0	0%

Table 7 – Design tailwater condition (100- year flow with 50-year tailwater)

River Sta	Existing W.S. Elev (ft)	Proposed W.S. Elev (ft)	Difference Proposed - Existing (ft)
300.198	136.78	136.59	-0.19
262.135	136.77	136.59	-0.18
251.5	Dam		
241.745	136.77	136.58	-0.19
229.683	136.77	136.58	-0.19
205.816	136.77	136.58	-0.19
190.168	136.75	136.57	-0.18
180.829	136.76	136.57	-0.19
161.5	Bridge 04070		
132.919	135.89	135.89	0.00
112.083	135.91	135.91	0.00
92.144	136.00	136.00	0.00
63.607	136.00	136.00	0.00

Table 8 – Check tailwater condition (50-year flow with 100-year tailwater)

River Sta	Existing W.S. Elev (ft)	Proposed W.S. Elev (ft)	Difference Proposed - Existing (ft)
300.198	137.08	137.08	0.00
262.135	137.08	137.08	0.00
251.5	Dam		
241.745	137.07	137.07	0.00
229.683	137.07	137.07	0.00
205.816	137.07	137.07	0.00
190.168	137.06	137.06	0.00
180.829	137.06	137.06	0.00
161.5	Bridge 04070		
132.919	136.74	136.74	0.00
112.083	136.75	136.75	0.00
92.144	136.80	136.80	0.00
63.607	136.80	136.80	0.00

Table 9 – Flood Insurance Study approach for confluence (100-year flow with 100-year tailwater)

River Sta	Existing W.S. Elev (ft)	Proposed W.S. Elev (ft)	Difference Proposed - Existing (ft)
300.198	137.24	137.20	-0.04
262.135	137.24	137.20	-0.04
251.5	Dam		
241.745	137.23	137.19	-0.04
229.683	137.23	137.19	-0.04
205.816	137.23	137.20	-0.03
190.168	137.22	137.18	-0.04
180.829	137.23	137.19	-0.04
161.5	Bridge 04070		
132.919	136.71	136.71	0.00
112.083	136.73	136.73	0.00
92.144	136.80	136.80	0.00
63.607	136.80	136.80	0.00

SUMMARY AND CONCLUSIONS

The hydraulic analyses conducted and documented in this report include evaluations of hydraulic performance for both riverine scenarios (flows generated from the Haviland Brook catchment) as well as performance under tailwater control from potential Rippowam River flood conditions.

Riverine flooding with no tailwater control indicates that for the 100-year design flood, the existing condition is not considered hydraulically adequate, with an approach design flow elevation of 135.2 feet overtopping Wire Mill Road. The proposed structure replacement alleviates roadway overtopping, though the structure will still operate under pressure flow conditions. Freeboard of 1-foot to the hydraulic control (roadway low point) is not met as the approach flow elevation is 133.9 feet and the roadway low point overtopping elevation 134.6 feet. For this reason, the proposed structure is not considered hydraulically adequate either. Underclearance requirements for an intermediate structure do not need to be met due to the integral abutments proposed as the foundation. The bridge deck is positively connected to the foundation and buoyancy and uplift of the bridge deck is of no concern. Providing a hydraulically adequate bridge would require adverse impacts to not only the t-intersection with Gutzon Borglum Road immediately to the west, but also a private driveway immediately to the east, as well as additional embankment grading, increasing impacts to private properties.

To implement lower design criteria for this structure, it is shown that on this local municipal road:

1. The roadway is close to the adjacent floodplain grade
2. The proposed design water surface elevation is not increased nor will cause additional damages to flooding over what is shown presently

The computed water surface elevation for the 100-year storm at the upstream limit of the modeling (River Station 300.2) for the proposed condition is 135.5 feet. At this section, the existing, proposed and natural conditions have achieved convergence.

The computed water surface elevation for the proposed 100-year event at the approach section to the crossing (River Station 205.8) is 133.9 feet. This is 1.3 feet lower than the 100-year flow elevation at this location for the existing condition and 0.2 feet greater than the 100-year natural condition profile elevation.

The computed water surface elevation at the upstream face of the proposed bridge for the 100-year flood event is 132.7 feet. This water surface elevation indicates pressure flow as the proposed maximum bottom chord elevation for the replacement structure is 132.7 feet. This is an improvement over existing conditions as Wire Mill Road is currently expected to overtop during design flooding events.

Analysis of the velocity changes for the approach reach to the subject project indicate that through reduction of backwater to the crossing, velocities are increase in the approach reach. For all sections up to the bridge approach section, those increases are 50% or less. Within the contraction reach, the increases in flow velocity are calculated to be upwards of 165%. In terms of actual resultant flow velocity, the proposed velocities within the contraction reach are not exorbitant at 6.6-feet-per-second and are on par with the estimated natural condition flow velocity. Additionally, downstream of the exit reach of the bridge, the flow velocities calculated are greater, upwards of 14-fps. As the proposed

condition returns flow velocities closer to estimated natural conditions, the channel is considered to be stable under proposed condition velocities with the assumption that the channel was formed by the natural conditions. Through the crossing, the proposed open bridge velocity is reduced from existing; 9.5-fps currently to 6.2-fps proposed.

Water surface elevations are reduced upwards of 0.3 feet for the 10-year event in the upstream reach of Haviland Brook. Through the bridge, velocities decrease compared to existing conditions due to the increased hydraulic opening, resulting in an increased water surface elevation of 0.4 feet at the downstream face for the 10-year event. Existing and proposed water surface profiles converge downstream of the bridge. Throughout the river reach proposed water surface elevations more closely approximate natural conditions.

Riverine flooding with backwater influence from the Rippowam River indicates that the entire site will be inundated during extreme events on the Rippowam River. Based on prescribed joint probability of high flow for the Rippowam River and Haviland Brook, both the 50- and 100-year tailwater conditions will flood the area of interest by at least 1-foot over the Wire Mill roadway elevation. In all conditions evaluated, the proposed bridge is shown to minimally reduce the overall flooding condition due to the increase in effective area afforded by the proposed crossing.

Appendices

Appendix A – Site Photographs
Appendix B – Hydrologic Report
Appendix C – Data Collection and Field Review Forms
Appendix D – Natural Conditions Analysis
Appendix E – Existing Conditions Analysis
Appendix F – Proposed Conditions Analysis
Appendix G – Cross Section Plots
Appendix H – CTDOT Inspection Report

Appendix A – Site Photographs

1. Looking east over Bridge

2. Looking west over bridge

3. Upstream Elevation

4. Deck underside

5. Girder Deterioration

6. Abutment backwall

7. Deck Drainage

Appendix B – Hydrologic Report

FEDERAL LOCAL BRIDGE PROGRAM

State Project No. 0135-0344 (Constr.)

FINAL

HYDROLOGIC REPORT

BRIDGE NO. 04070

Wire Mill Road over Haviland Brook

City of Stamford

Prepared by: Digitally signed by Eric W. Buckley Date: 2022.11.21 14:31:27-05'00' Date: 11/21/2022

Eric Buckley

Checked by: Thomas M. Ryan, P.E. Digitally signed by Thomas M. Ryan, P.E. DN: C=US, E=tryan@cjmpc.com, OU="Close, Jensen and Miller, P.C.", CN="Thomas M. Ryan, P.E." Date: 2022.11.21 15:05:54-05'00' Date: _____

Thomas M. Ryan, P.E.
ConnDOT Approved Hydraulic Engineer

Approved by: John H. Miller Date: 2022.11.22 06:08:34-05'00' Date: _____

John H. Miller, P.E., L.S.

STATE OF CONNECTICUT JOHN H. MILLER NO. 4142 LICENSED PROFESSIONAL ENGINEER

Close, Jensen and Miller, P.C.
Wethersfield, Connecticut
Issued November 2022
Revised _____

HYDROLOGIC REPORT

BRIDGE NO. 04070

WIRE MILL ROAD OVER HAVILAND BROOK

CITY OF STAMFORD

TABLE OF CONTENTS

STAMFORD QUADRANGLE
CONNECTICUT
TOPOGRAPHIC SERIES

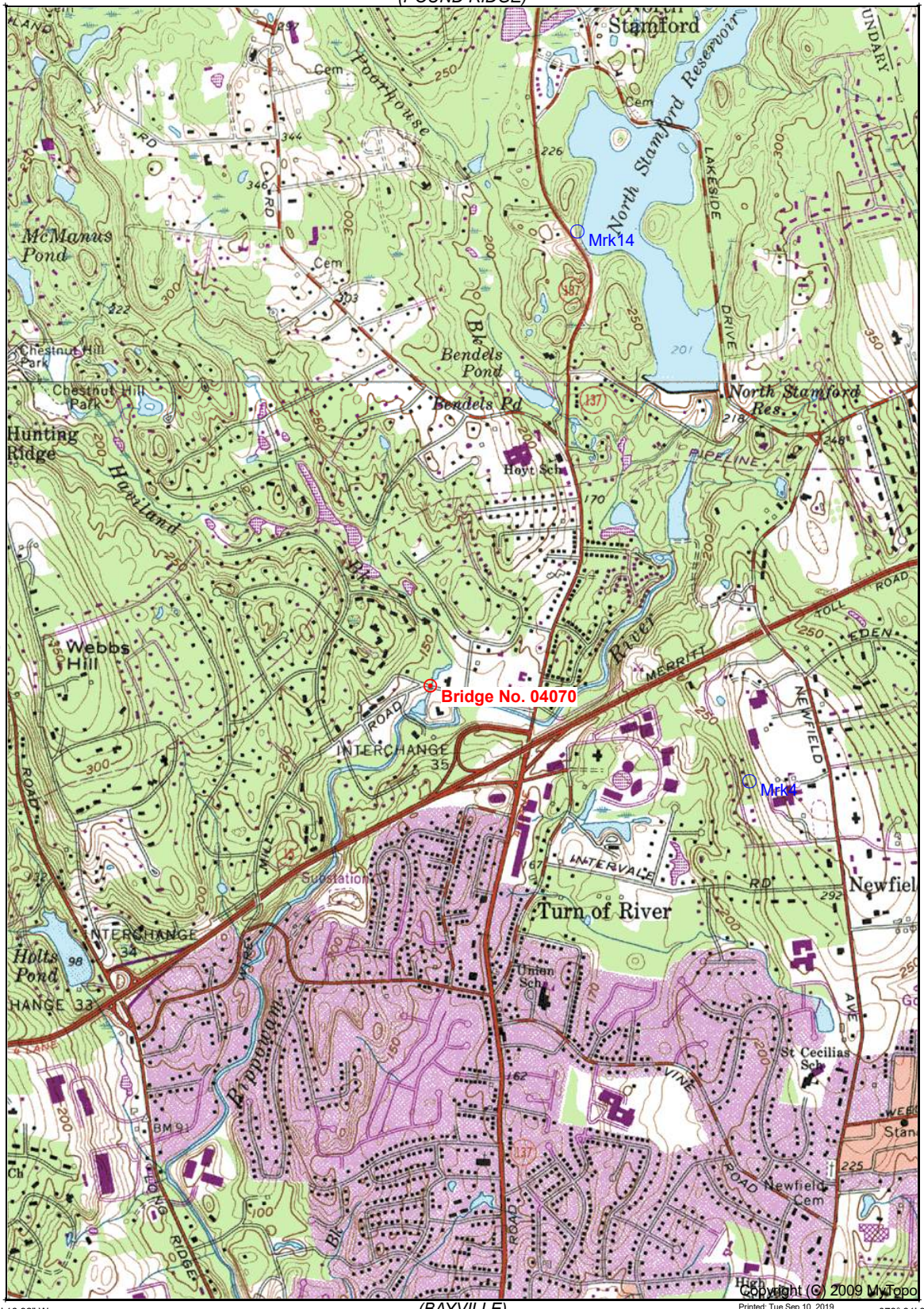
(MOUNT KISCO)

073° 34' 16.92" W
041° 08' 19.14" N

(POUND RIDGE)

073° 31' 39.91" W
041° 08' 19.14" N

(NORWALK NORTH)



(GLENVILLE)

(NORWALK SOUTH)

041° 05' 31.57" N
073° 34' 16.92" W

(BAYVILLE)

041° 05' 31.57" N
073° 31' 39.91" W

Printed: Tue Sep 10, 2019

(MAMARONECK)

(LLOYD HARBOR)

SCALE 1:24000

Declination

MN GN

GN 0.95° E
MN 13.35° W

0 1
MILE

0 1000
YARDS

0 1
KILOMETER

CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM 1929

Produced by MyTopo Terrain Navigator
Topography based on USGS 1:24,000 Maps

North American 1983 Datum (NAD83)
Polyconic Projection

To place on the predicted North American 1927 move the projection lines 11M N and 36M E

STAMFORD, CT
1960

INTRODUCTION

Bridge No. 04070 is recommended for rehabilitation as part of the State Administered Federal Local Bridge Program. A separate Rehabilitation Study Report, which details the scope of repairs for this bridge, has been submitted to the Connecticut Department of Transportation (CTDOT) for approval. This report is intended to satisfy the detailed hydrologic analysis criteria described in the CTDOT Drainage Manual (DM).

Bridge No. 04070, built in 1957, is a single simple span structure situated on Wire Mill Road approximately 0.3 miles west of High Ridge Road (Rte. 137) and 50 feet east of Gutzon Borglum Road in the City of Stamford.

The bridge is comprised of a reinforced concrete deck and steel beam superstructure supported on cast in place concrete abutments and wingwalls. The total structure length and width measure 25 feet and 33.5 feet, respectively. The roadway over the bridge has a curb-to-curb width of 30.5 feet with approaches that taper out from a travelway width of 22 feet. In front of each guiderail are jersey type barriers directing live loads away from the fascia beams.

The deck rating is based on the condition of the concrete deck and is in serious condition (Overall rating = 3). The underside of the concrete deck has extensive hollow areas up to full width and full length of the bay. There are areas of light to heavy scaling, areas of map cracking with cracks up to 1/16-inch wide. The overall underside of the concrete deck deterioration is 74.2%.

The superstructure is also in a serious condition with an overall rating of 3. The superstructure consists of 9 rolled steel girders. The fascia girders have areas of heavy laminated rust with severe section loss at the girder ends over both abutments.

The substructure is in satisfactory condition with an overall rating of 6. The abutment stems have random vertical hairline cracks up to full height and isolated horizontal cracks up to full length. Each abutment exhibits moderate scaling along the waterline with isolated hollow areas up to 15” x 12” and random areas of rust staining. Bearing pedestals have hairline cracks, hollow areas up to 1’ long x 4” high and spalls up to 1’ x full height x 3” deep with and without exposed rebar.

The channel is in satisfactory condition (overall rating = 6). The channel bottom consists of cobbles, sand and gravel. Approximately 50 feet upstream of the bridge is a dam with a spillway causing a 25’ x 15’ x 42” deep scour hole. There is light to moderate undercutting of the channel embankments except for the northeast embankment which is protected by riprap extending from the end of the northeast wingwall to the dam upstream.

The 2016 Average Daily Traffic (ADT) on the bridge is 1678 vehicles, with 3% truck traffic.

Based on field inspection and engineering analysis of the structure, the existing bridge is structurally deficient. Its structural deficiency is primarily a result of the deteriorated condition of the deck and superstructure. As a result, it is recommended that the structure be rehabilitated by superstructure replacement with minor corrections to the substructure.

HYDROLOGY

Watershed Properties

The drainage area of Haviland Brook at the 04070 crossing (and mouth) was delineated to be 3.72 square miles using the online USGS StreamStats v4.11.1 watershed analysis system and verified against USGS Quadrangles 106 and 113 (Pound Ridge and Stamford, respectively). The watershed is designated a tributary to the Rippowam River Subregional drainage basin (Basin No. 7405) as identified on a map titled "Natural Drainage Basins in Connecticut" compiled by the State of Connecticut Department of Energy and Environmental Protection (CTDEEP) 1981, revised 1991. The subregional drainage basin is part of the Southwest Western Complex Regional Basin (No. 74) of the Southwest Coast Major Basin (No. 7). The studied basin falls entirely within Fairfield County. Bridge No. 04070 is classified as an intermediate structure with a drainage area between 1 and 10 square miles.

Approximately 67% of the watershed area is characterized as wooded area. Twenty-four percent of the watershed is classified as developed, however of that developed classification, 17% of the watershed falls within the subcategory of developed: open space. This developed open space as defined in the Coastal Change Analysis Program (C-CAP)[1]:

> *contains areas with a mixture of some constructed materials, but mostly managed grasses or low-lying vegetation planted in developed areas for recreation, erosion control, or aesthetic purposes. These areas are maintained by human activity such as fertilization and irrigation, are distinguished by enhanced biomass productivity, and can be recognized through vegetative indices based on spectral characteristics. Constructed surfaces account for less than 20 percent of the total land cover.*

This leaves 7% of the watershed exhibiting low to high intensity development which would include parcels with single family houses all the way up to built up urban centers and large constructed surfaces. The remaining 9% of the watershed land cover consists of pastures, grasslands and shrublands (1%), open water (1%) and wetland areas (7%).

The total drainage path through the watershed measures approximately 17,000 feet with an overall main channel slope of approximately 53 feet per mile from an elevation change of 170 feet.

This location is noted as having been witness to historical flooding; notably the floods of November 1927 (100-year), August 1955 (<100-year), October 1955 (500-year), January 1978 (50-75-year) and January 1979 (50-year), though the structure has only been in place since 1957.

[1] NOAA Coastal Change Analysis Program, 2010 Regional Land Cover Data – Coastal United States.

Peak Flow Methods Used

Bridge No. 04070 is located in a FEMA regulated floodplain designated Zone A. A Zone A floodplain is one that has been identified on FEMA Flood Insurance Rate Mapping, however the flood area has been determined by approximate methods. A formal hydrologic or hydraulic evaluation has not been prepared by FEMA for this stream.

Various hydrologic assessment methods were evaluated for use in determining design flow rates for the subject crossing.

This watershed generally falls within the range of acceptable values for the explanatory parameters of the U.S. Geological Survey (USGS) Regional Regression Equations (RRE) for Connecticut (Ahearn, 2020), specifically, the percent of soil type C or D, the 24-hour rainfall rates and the drainage area of the studied watershed, with one exception. The 2-year, 24-hour rainfall rate is $^{3}/_{100}$-inch higher than the upper threshold. This results in extrapolated results and the prediction errors are not known. As the rainfall for the 2-year is just over the maximum limit, and only for the 2-year event, the results are considered acceptable with the understanding that all other rainfall rates do meet the application requirements. As such, the Connecticut RRE are used to estimate the flow-frequency curve at Bridge No. 04070.

Table 1 – results of Connecticut Regional Regression Equations at Bridge 04070

Event	Resultant Runoff (cfs)
2-yr	201
10-yr	419
25-yr	557
50-yr	674
100-yr	804
200-yr	893
500-yr	1070

As part of the analysis, the level of development in the watershed is evaluated to determine if adjustment to the regression results is required for the level of urbanization. For watersheds that exhibit greater than 15% development, urban adjustment factors are recommended to be applied to the result of flows developed through the use of USGS Rural Regional Regression Equations. For this watershed, development (in relation to urbanization adjustments) is only considered to consist of those areas that are classified as low, medium or high intensity development; the developed open space is not considered. The preceding section documents the percent land use/land cover for the watershed. With only 7% of the watershed considered developed, the characteristics of the watershed do not warrant an urbanization adjustment to the results of the Connecticut RRE.

An attempt was made to locate a stream gauge that could be used to evaluate peak flows for Haviland Brook, however, this stream does not have any historical or current gauge data. A gauge was found in the region that is considered for calibration of the regional regression estimates. Gauge No. 01208700, Little River at Oxford exhibits similar characteristics as the watershed contributing to the Wire Mill Road crossing. The following table summarizes the similar characteristics between the gauge site and project site.

Table 2 – Watershed comparison of project site and gauge station 01208700

Location	Drainage Area (mi^2)	C/D soil type (%)	Stream Slope ($^{ft}/_{mi}$)	Wetlands (%)	Rainfall (in)				
					2-year	10-year	25-year	50-year	100-year
Bridge No 04070	3.72	33.22	58.8	0.99	3.35[2]	5.44	6.64	7.54	8.44
Gauge Station 01208700	4.63	43.26	62.0[3]	0.10[3]	3.27	5.57	6.89	7.88	8.87

Three sets of flood flows have been prepared for Gauge No. 01208700, documented in the USGS Scientific Investigations Report (SIR) 2020-5054. These are the flood flows based on peak flow analysis of the gauge data, flood flows calculated with the USGS RRE and flood flows generated through a weighted average of the gauge and regression analysis results. It is held that the most accurate estimate of flood flows for a gauging station is a weighted average of the statistical data from the yearly peak flow record and the estimate generated from the RRE. The weighted average of these two estimates takes into account the length of record at the gauge and the average equivalent years of record associated with the RRE.

In order to evaluate and possibly calibrate the results of the regression equations at the project site, a correction factor is generated for each frequency considered at the comparable gauged watershed. This correction factor is determined as the ratio of the weighted average to the regression estimates at the gauge. The following table presents the frequency specific correction factor:

Table 3 – Development of correction factor from weighted estimates to regression equation estimates at Gauge No. 01208700.

Event	Weighted estimates	Regression equation estimates	Calculated correction factor
2-yr	242-cfs	246-cfs	0.98
10-yr	592-cfs	631-cfs	0.94
25-yr	839-cfs	882-cfs	0.95
50-yr	1050-cfs	1100-cfs	0.95
100-yr	1310-cfs	1330-cfs	0.98
500-yr	1940-cfs	1830-cfs	1.06

Table 2, with a calculated correction factor hovering about 1 for all events, shows that the 2020 RRE for this gage site closely reflect the observed flood flows for all events analyzed. With the evidence of the correlation between the RRE and the observed flows, further calibration of the flow estimates at the project site, Bridge 04070, is not considered.

[2] Max limit for 24-hour, 2-year precipitation is 3.32 inches, per SIR 2020 5054
[3] Calculated with StreamStats v.4.11.1

Conclusions and Recommended Peak Flows

Flow frequency rates are developed for Haviland Brook at the Wire Mill Road crossing in Stamford using USGS 2020 Regional Regression Equations. Methodology for flood flow development includes comparison to a similar gaged watershed. Calibration factors are developed from a gauged watershed with similar characteristics as the study catchment. It is shown that the gauged watershed comparable to the subject watershed presents similar flows to what is estimated by the regression equations, and no correction to the flows developed at the project site are considered. The following table presents the recommended design flow rates (rounded) for the subsequent replacement of Bridge No. 04070.

Table 4 – Recommended design flow rates for the replacement of Bridge No. 04070 (design event in bold)

Event	Resultant Runoff (cfs)
2-yr	200
10-yr	420
25-yr	560
50-yr	670
100-yr	**800**
200-yr	890
500-yr	1070

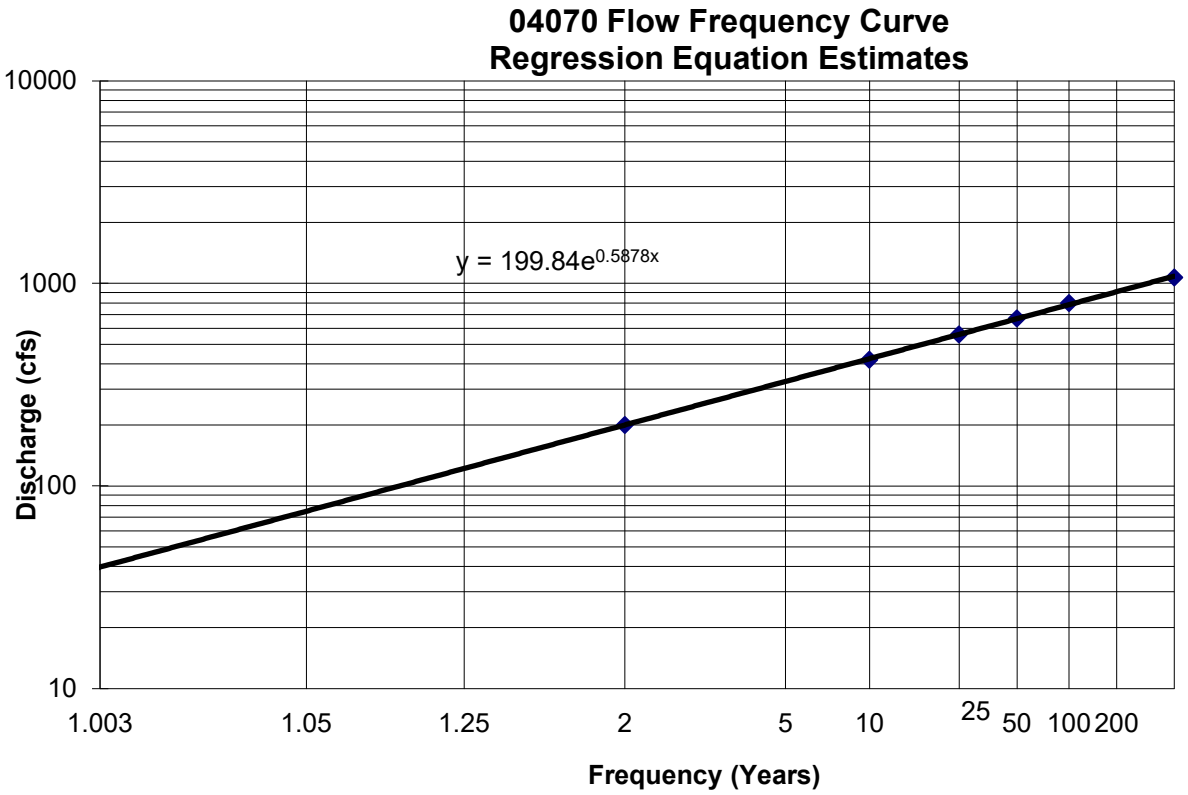


Figure 1 – Flow frequency curve for Bridge No 04070

Recommendations

The Haviland Brook floodplain, as discussed earlier in this report, is designated a Zone A, having not been studied by detailed methods for the FEMA Flood Insurance Rate Mapping. Bridge No. 04070 is situated at the confluence of Haviland Brook with the Rippowam River, which is a studied watercourse and includes a designed floodway. Bridge 04070 is in the Rippowam floodplain but outside of the floodway.

For the purposes of hydraulic design, it is anticipated that two tailwater scenarios will be considered. The first scenario will incorporate a starting water surface elevation for the modeling corresponding to the appropriate stage of the Rippowam River with respect to the joint probability of peak flood timing in order to determine the maximum flooding potential of the area. The other scenario will use a lower starting water surface elevation, either corresponding to the normal flow elevation of the Rippowam River or normal depth resulting from the streambed slope of Haviland Brook (whichever is greater). This second design scenario will be utilized to determine the hydraulic adequacy of the bridge based on the flows contributed by the upstream catchment. Due to Wire Mill Road being situated in the floodplain of the Rippowam River, it is not appropriate to determine hydraulic adequacy for the subject structure from the backwater effects of the Rippowam River. In order to remove Wire Mill Road from the floodplain, it would be necessary to raise not only the structure but also more than 2000 feet of roadway approaches, which is generally outside of the scope of bridge replacements and also would cause significant changes to the floodplain of the Rippowam River.

For bridge scour evaluation, it is anticipated to apply the 200- and 500-year flow event (and overtopping as applicable) with a corresponding tailwater similar to scenario 2 above. Typically, greater scour depths are equated to high flows through a structure with a lower tailwater elevation, so that there are no throttling effects from the tailwater to the approach flow.

For analysis showing adherence to regulatory requirements for designated floodplains, it is anticipated to use the 100-year water surface of the Rippowam River as the starting tailwater elevation along with the 100-year discharge of Haviland Brook, in line with typical analysis applications at river confluences as part of the National Flood Insurance Program.

Appendices

Appendix A	–	FEMA Data
Appendix B	–	Regression Equation Evaluation
Appendix C	–	C-CAP 2010 Land Use

APPENDICES

Appendix A – FEMA Data

National Flood Hazard Layer FIRMette

FEMA

Feet

0 250 500 1,000 1,500 2,000

1:6,000

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth
- Regulatory Floodway *Zone AE, AO, AH, VE, AR*

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The base map shown complies with FEMA's base map accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/18/2018 at 1:37:04 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: base map imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Location	Period of Record
Saugatuck River (Lower Reach) near Westport, Connecticut	1932-1960
Quinnipac River at Wallingford, Connecticut	1932-1980
Pomperang River at Southbury, Connecticut	1932-1980
Blind Brook at Rye, New York	1943-1980
Pequabuck River at Forestville, Connecticut	1941-1980

Average parameters were developed for the streams, and these parameters were applied to the study streams. The computed flows were adjusted based on a discharge-drainage area relationship.

Within Stamford, several water-supply reservoirs have been developed. For the purpose of the original study, the reservoirs were assumed to be full, therefore, to have a negligible effect on reducing flood peaks.

Also in the original study, tidal flood stage frequencies were developed from an analysis of tidal data collected at the Stamford hurricane barrier tidal gage and from additional information (Reference 33). The Stamford gage has been operated since 1968 by the National Oceanic and Atmospheric Administration (NOAA).

In the November 17, 1993, revision, hydrologic analyses were performed by the USACE to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each stream record from six USGS gaging stations in the region using a log-Pearson Type III distribution (Reference 60).

The adopted discharge frequencies for the Rippowam River (Upper Reach) and Rippowam River (Lower Reach) and its tributaries, Toilsome, Haviland, and Poorhouse Brooks, were based on a mean per square mile of 1.99, a standard deviation of 0.290, and an adopted skew of 0.5, which agreed closely with the data developed in a recent USACE flood control study for the basin.

Similarly, on the main stem of the Noroton River, the statistically developed flows were within specified limits of the flow values used in an earlier FIS; therefore, the higher earlier flow values were adopted. The developed statistical parameters were used in computing the adopted flows for Springdale Brook.

PWG received from the USACE a study prepared by Leonard Jackson Associates. This study had higher flow values than those developed by the USACE. These greater flows were used by PWG for the restudy of the East Branch Mianus River and the Noroton River. The USACE agreed to the larger flows on these two streams.

In the Town of Stratford, the NRCS booklet, “A Method of Estimating Volume and Rate of Runoff in Small Watersheds,” was used to determine the flood frequency-discharge values for Bruce Brook, Tanners Brook, and Pumpkin Ground Brook (Reference 46). For the streams studied by detailed methods, storms of the selected recurrence intervals were computed. The 0.2-percent-annual-chance rainfall intensity was determined by the extrapolation of a curve fit to the 10-, 2- and 1-percent-annual-chance rainfall intensities probability graph. In the second revision, flood frequency-discharge values for Long Brook

TABLE 5 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT-ANNUAL-CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE
POPLAR PLAINS BROOK					
At confluence with Saugatuck River (Lower Reach)	0.94	145	195	245	480
PUMPKIN GROUND BROOK					
At confluence with Long Brook	6.12	1,165	1,640	1,895	2,875
At Beaver Dam Lake	1.15	935	1,330	1,550	2,290
PUTNAM PARK BROOK					
Upstream of confluence of Wolf Pit Brook	0.93	130	175	220	320
RIDGEFIELD BROOK					
At State Route 35	2.60	125	185	235	410
RIPPOWAM RIVER (LOWER REACH)					
At the mouth	37.5	2,900	5,800	7,400	9,300
At the Stillwater Pond	33.4	2,670	5,350	6,820	8,580
Downstream of confluence of Haviland Brook	28.7	2,400	4,800	6,140	7,710
Upstream of confluence of Haviland Brook	24.6	2,160	4,320	5,500	6,920
RIPPOWAM RIVER (UPPER REACH)					
At New Canaan-Stamford corporate limits	34.85	1,760	3,170	3,910	7,060
Upstream of confluence of Laurel Brook	5.15	720	1,240	1,550	2,700
Upstream of Lockwood Pond	4.33	610	1,040	1,300	2,270
At Siscowit Reservoir	3.46	480	830	1,040	1,810

Appendix B – Regression Equation Evaluation

04010 Wire Mill

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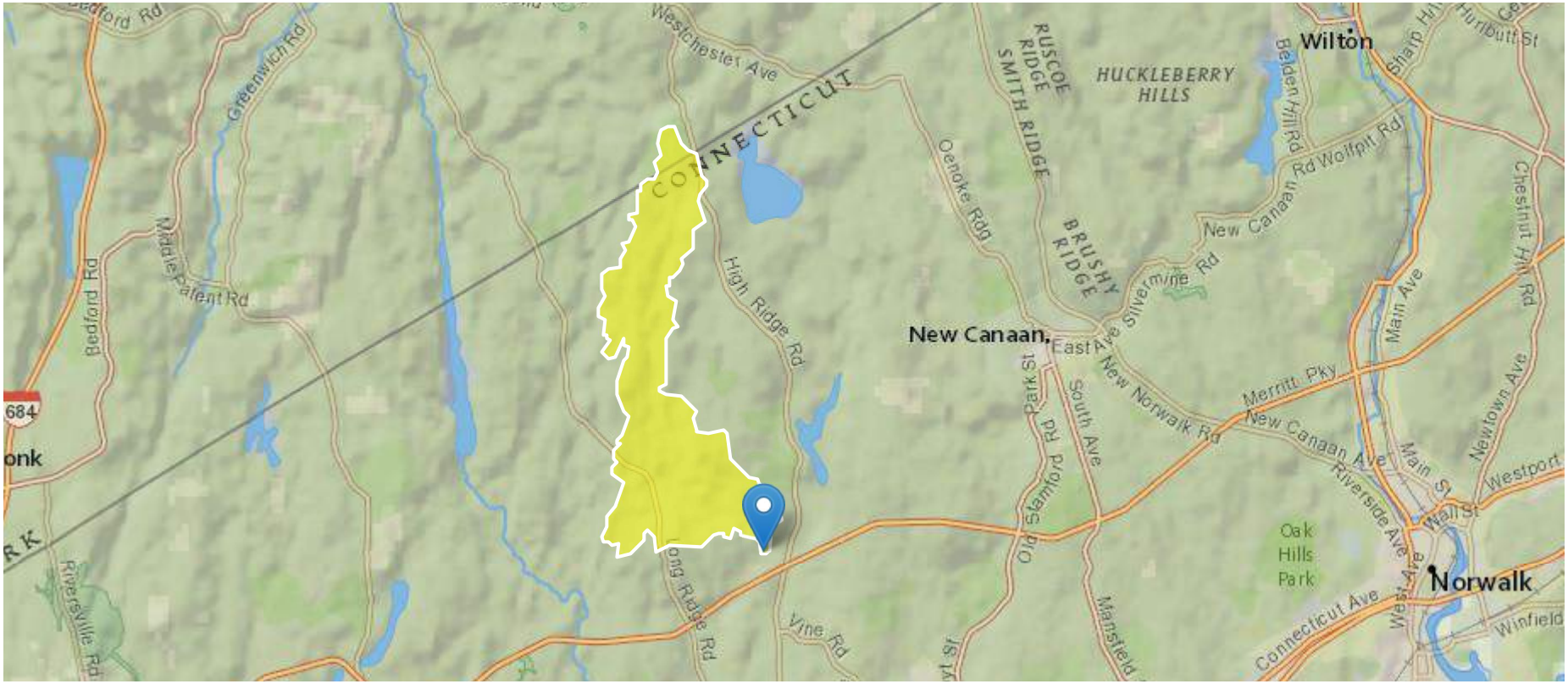
Workspace ID: CT20221121140805202000
Clicked Point (Latitude, Longitude): 41.11415, -73.55108
Time: 2022-11-21 09:08:26 -0500



November 2022

Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
CAT1ROADS	Length of interstates lmtd access highways and ramps for lmtd access highways, includes cloverleaf interchanges (USGS Ntl Transp Dataset)	0	miles
CAT2ROADS	Length of sec hwy or maj connecting roads; main arteries & hwys not lmtd access, usually in the US Hwy or State Hwy systems (USGS Ntl Transp Dataset)	0	miles
CAT3ROADS	Length of local connecting roads; roads that collect traffic from local roads & connect towns, subdivisions & neighborhoods (USGS Nat Transp Dataset)	1.75	miles
CAT4ROADS	Length of local roads; generally paved street, road, or byway that usually have single lane of traffic in each direction (USGS Ntnl Transp Dataset)	28.2	miles
CROSCOUNT1	Number of intersections between streams and roads, where the roads are interstate, limited access highway, or ramp (CAT1ROADS)	0	dimensionless
CROSCOUNT2	Number of intersections between streams and roads, where the roads are secondary highway or major connecting road (CAT2ROADS)	0	dimensionless
CROSCOUNT3	Number of intersections between streams and roads, where roads are local conecting roads (CAT3ROADS)	4	dimensionless
CROSCOUNT4	Number of intersections between streams and roads, where roads are local roads (CAT4ROADS)	47	dimensionless
CRSDFT	Percentage of area of coarse-grained stratified drift	3.07	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	58.8	feet per mi
DRNAREA	Area that drains to a point on a stream	3.72	square miles
ELEV	Mean Basin Elevation	322	feet
I24H100Y	Maximum 24-hour precipitation that occurs on average once in 100 years	8.44	inches
I24H10Y	Maximum 24-hour precipitation that occurs on average once in 10 years	5.44	inches
I24H200Y	Maximum 24-hour precipitation that occurs on average once in 200 years	9.65	inches

Parameter Code	Parameter Description	Value	Unit
I24H25Y	Maximum 24-hour precipitation that occurs on average once in 25 years	6.64	inches
I24H2Y	Maximum 24-hour precipitation that occurs on average once in 2 years - Equivalent to precipitation intensity index	3.35	inches
I24H500Y	Maximum 24-hour precipitation that occurs on average once in 500 years	11.25	inches
I24H50Y	Maximum 24-hour precipitation that occurs on average once in 50 years	7.54	inches
I24H5Y	Maximum 24-hour precipitation that occurs on average once in 5 years	4.54	inches
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	32.4	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	4.05	percent
LFPLENGTH	Length of longest flow path	6.09	miles
MAPM	Mean Annual Precip Basin Average	50.822	inches
NOVAVPRE	Mean November Precipitation	4.5	inches
PRCWINTER	Mean annual precipitation for December through February	3.9	inches
SGSL	Total stream length intersecting sand and gravel deposits (in miles)	2.23	miles
SOILPERM	Average Soil Permeability	3.902	inches per hour
SSURGOCCDD	Percentage of area with hydrologic soil types C, D, or C/D from SSURGO	0.3322	percent
STRMTOT	total length of all mapped streams (1:24,000-scale) in the basin	16	miles
WETLAND	Percentage of Wetlands	0.99	percent

Peak-Flow Statistics

Peak-Flow Statistics Parameters [Statewide DA only SIR 2020 5054]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.72	square miles	0.69	325

Peak-Flow Statistics Parameters [Statewide Multiparameter SIR 2020 5054]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.72	square miles	0.69	325
I24H2Y	24 Hour 2 Year Precipitation	3.35	inches	2.77	3.32
SSURGOCCDD	Percent soil type C or D from SSURGO	0.3322	percent	0.118	0.945
I24H5Y	24 Hour 5 Year Precipitation	4.54	inches	4	4.7
I24H10Y	24 Hour 10 Year Precipitation	5.44	inches	4.86	5.79
I24H25Y	24 Hour 25 Year Precipitation	6.64	inches	5.99	7.22
I24H50Y	24 Hour 50 Year Precipitation	7.54	inches	6.81	8.3
I24H100Y	24 Hour 100 Year Precipitation	8.44	inches	7.62	9.38
I24H200Y	24 Hour 200 YearPrecipitation	9.65	inches	8.7	11.22
I24H500Y	24 Hour 500 Year Precipitation	11.25	inches	10.1	13.64

Peak-Flow Statistics Flow Report [Statewide DA only SIR 2020 5054]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
Drainage Area Only 50-percent AEP flood	178	ft^3/s	35
Drainage Area Only 20-percent AEP flood	310	ft^3/s	35
Drainage Area Only 10-percent AEP flood	420	ft^3/s	36.3

Statistic	Value	Unit	ASEp
Drainage Area Only 4-percent AEP flood	583	ft^3/s	37.8
Drainage Area Only 2-percent AEP flood	721	ft^3/s	39.8
Drainage Area Only 1-percent AEP flood	877	ft^3/s	42.4
Drainage Area Only 0.5-percent AEP flood	1050	ft^3/s	44.4
Drainage Area Only 0.2-percent AEP flood	1310	ft^3/s	48

Peak-Flow Statistics Disclaimers [Statewide Multiparameter SIR 2020 5054]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Peak-Flow Statistics Flow Report [Statewide Multiparameter SIR 2020 5054]

Statistic	Value	Unit
50-percent AEP flood	201	ft^3/s
20-percent AEP flood	333	ft^3/s
10-percent AEP flood	419	ft^3/s
4-percent AEP flood	557	ft^3/s
2-percent AEP flood	674	ft^3/s
1-percent AEP flood	804	ft^3/s
0.5-percent AEP flood	893	ft^3/s
0.2-percent AEP flood	1070	ft^3/s

Peak-Flow Statistics Flow Report [Area-Averaged]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
Drainage Area Only 50-percent AEP flood	178	ft^3/s	35
Drainage Area Only 20-percent AEP flood	310	ft^3/s	35
Drainage Area Only 10-percent AEP flood	420	ft^3/s	36.3
Drainage Area Only 4-percent AEP flood	583	ft^3/s	37.8
Drainage Area Only 2-percent AEP flood	721	ft^3/s	39.8
Drainage Area Only 1-percent AEP flood	877	ft^3/s	42.4
Drainage Area Only 0.5-percent AEP flood	1050	ft^3/s	44.4
Drainage Area Only 0.2-percent AEP flood	1310	ft^3/s	48
50-percent AEP flood	201	ft^3/s	
20-percent AEP flood	333	ft^3/s	
10-percent AEP flood	419	ft^3/s	
4-percent AEP flood	557	ft^3/s	
2-percent AEP flood	674	ft^3/s	
1-percent AEP flood	804	ft^3/s	
0.5-percent AEP flood	893	ft^3/s	
0.2-percent AEP flood	1070	ft^3/s	

Peak-Flow Statistics Citations

Ahearn, E.A., and Hodgkins, G.A.,2020, Estimating flood magnitude and frequency on streams and rivers in Connecticut, based on data through water year 2015: U.S. Geological Survey Scientific Investigations Report 2020–5054, 42 p. (https://doi.org/10.3133/sir20205054)

Bankfull Statistics

Bankfull Statistics Parameters [Appalachian Highlands D Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.72	square miles	0.07722	940.1535

Bankfull Statistics Parameters [New England P Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.72	square miles	3.799224	138.999861

Bankfull Statistics Parameters [USA Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.72	square miles	0.07722	59927.7393

Bankfull Statistics Flow Report [Appalachian Highlands D Bieger 2015]

Statistic	Value	Unit
Bieger_D_channel_width	26.2	ft
Bieger_D_channel_depth	1.63	ft
Bieger_D_channel_cross_sectional_area	43.5	ft^2

Bankfull Statistics Disclaimers [New England P Bieger 2015]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Bankfull Statistics Flow Report [New England P Bieger 2015]

Statistic	Value	Unit

Statistic	Value	Unit
Bieger_P_channel_width	36.5	ft
Bieger_P_channel_depth	1.84	ft
Bieger_P_channel_cross_sectional_area	67.6	ft^2

Bankfull Statistics Flow Report [USA Bieger 2015]

Statistic	Value	Unit
Bieger_USA_channel_width	19.7	ft
Bieger_USA_channel_depth	1.59	ft
Bieger_USA_channel_cross_sectional_area	34.7	ft^2

Bankfull Statistics Flow Report [Area-Averaged]

Statistic	Value	Unit
Bieger_D_channel_width	26.2	ft
Bieger_D_channel_depth	1.63	ft
Bieger_D_channel_cross_sectional_area	43.5	ft^2
Bieger_P_channel_width	36.5	ft
Bieger_P_channel_depth	1.84	ft
Bieger_P_channel_cross_sectional_area	67.6	ft^2
Bieger_USA_channel_width	19.7	ft
Bieger_USA_channel_depth	1.59	ft
Bieger_USA_channel_cross_sectional_area	34.7	ft^2

Bankfull Statistics Citations

Bieger, Katrin; Rathjens, Hendrik; Allen, Peter M.; and Arnold, Jeffrey G.,2015, Development and Evaluation of Bankfull Hydraulic Geometry Relationships for the Physiographic Regions of the United States, Publications from USDA-ARS / UNL Faculty, 17p. (https://digitalcommons.unl.edu/usdaarsfacpub/1515?utm_source=digitalcommons.unl.edu%2Fusdaarsfacpub%2F1515&utm_medium=PDF&utm_campaign=PDFCoverPages)

Application Version: 4.11.1
StreamStats Services Version: 1.2.22
NSS Services Version: 2.2.1

Basin Characteristics at gage 01208700
from SIR 2020-5054

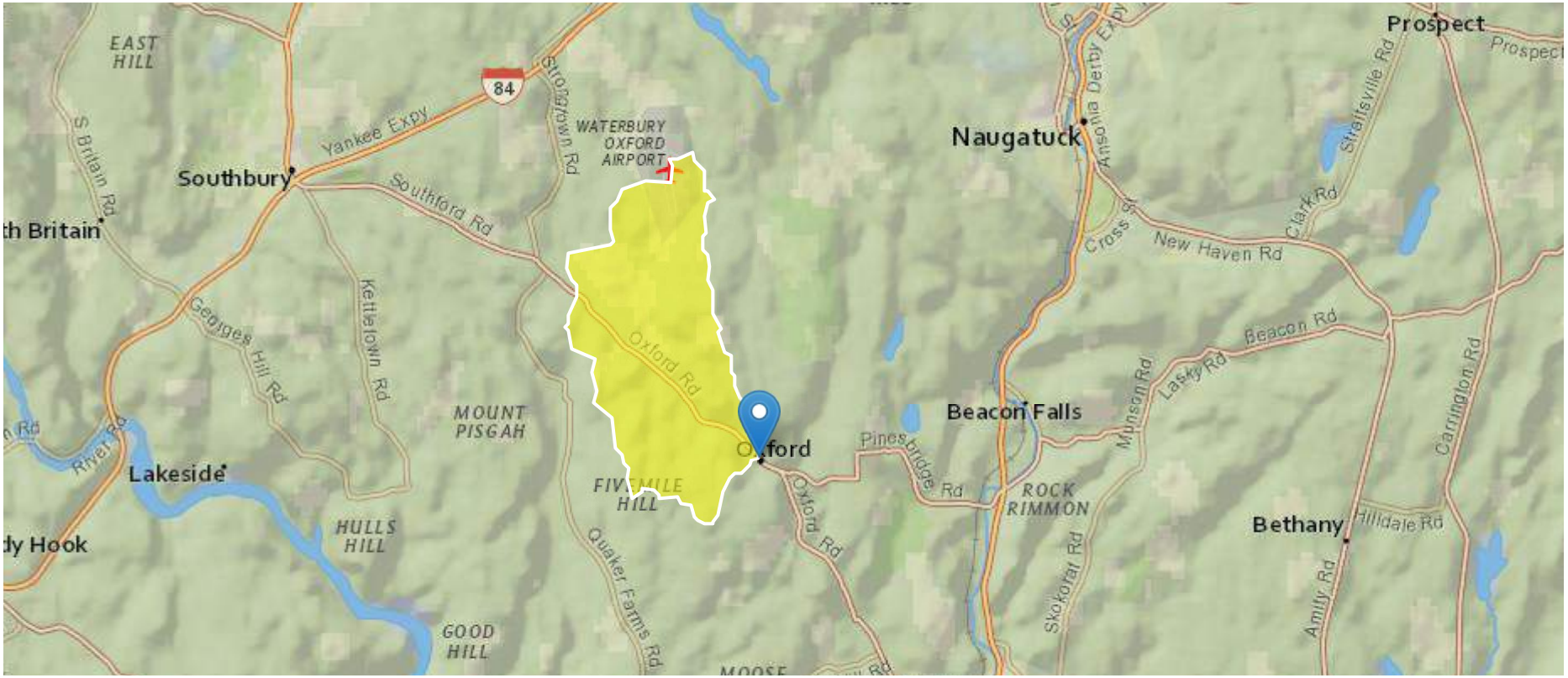
Basin and climatic characteristics for streamgages used in the flood-frequency regression equations for Connecticut.

[mi, mile; ft, feet; E BR, East Branch; CT, Connecticut; MA., Massachusetts; NY, New York; RI, Rhode Island; Hydrologic characteristics determined using digital

Streamgage identification number	Streamgage name	Drainage Area (mi^2)	2-year, 24-hour rainfall (inches)	5-year, 24-hour rainfall (inches)	10-year, 24-hour rainfall (inches)	25-year, 24-hour rainfall (inches)	50-year, 24-hour rainfall (inches)	100-year, 24-hour rainfall (inches)	200-year, 24-hour rainfall (inches)	500-year, 24-hour rainfall (inches)	Area classified as hydrologic soils C, C/D, or D (decimal percent)
01208700	Little River at Oxford, CT	4.63	3.27	4.58	5.57	6.89	7.88	8.87	10.33	12.26	0.4326

StreamStats Report at gage 01208700

Region ID: CT
Workspace ID: CT20221121161358647000
Clicked Point (Latitude, Longitude): 41.43430, -73.11730
Time: 2022-11-21 11:14:21 -0500



Collapse All

Basin Characteristics

Additional calculated basin characteristics
for Gage 01208700
from StreamStats

Parameter Code	Parameter Description	Value	Unit
CAT1ROADS	Length of interstates lmtd access highways and ramps for lmtd access highways, includes cloverleaf interchanges (USGS Ntl Transp Dataset)	0	miles
CAT2ROADS	Length of sec hwy or maj connecting roads; main arteries & hwys not lmtd access, usually in the US Hwy or State Hwy systems (USGS Ntl Transp Dataset)	0	miles
CAT3ROADS	Length of local connecting roads; roads that collect traffic from local roads & connect towns, subdivisions & neighborhoods (USGS Nat Transp Dataset)	2.68	miles
CAT4ROADS	Length of local roads; generally paved street, road, or byway that usually have single lane of traffic in each direction (USGS Ntnl Transp Dataset)	18.3	miles
CROSCOUNT1	Number of intersections between streams and roads, where the roads are interstate, limited access highway, or ramp (CAT1ROADS)	0	dimensionless
CROSCOUNT2	Number of intersections between streams and roads, where the roads are secondary highway or major connecting road (CAT2ROADS)	0	dimensionless
CROSCOUNT3	Number of intersections between streams and roads, where roads are local conecting roads (CAT3ROADS)	5	dimensionless
CROSCOUNT4	Number of intersections between streams and roads, where roads are local roads (CAT4ROADS)	14	dimensionless
CRSDFT	Percentage of area of coarse-grained stratified drift	8.73	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	62	feet per mi
DRNAREA	Area that drains to a point on a stream	4.63	square miles
ELEV	Mean Basin Elevation	586	feet
I24H100Y	Maximum 24-hour precipitation that occurs on average once in 100 years	8.87	inches
I24H10Y	Maximum 24-hour precipitation that occurs on average once in 10 years	5.57	inches
I24H200Y	Maximum 24-hour precipitation that occurs on average once in 200 years	10.33	inches
I24H25Y	Maximum 24-hour precipitation that occurs on average once in 25 years	6.89	inches

Additional calculated basin characteristics for Gage 01208700 from StreamStats

Parameter Code	Parameter Description	Value	Unit
I24H2Y	Maximum 24-hour precipitation that occurs on average once in 2 years - Equivalent to precipitation intensity index	3.27	inches
I24H500Y	Maximum 24-hour precipitation that occurs on average once in 500 years	12.26	inches
I24H50Y	Maximum 24-hour precipitation that occurs on average once in 50 years	7.88	inches
I24H5Y	Maximum 24-hour precipitation that occurs on average once in 5 years	4.58	inches
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	13.2	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	3.12	percent
LFPLENGTH	Length of longest flow path	4.95	miles
MAPM	Mean Annual Precip Basin Average	51.405	inches
NOVAVPRE	Mean November Precipitation	4.7	inches
PRCWINTER	Mean annual precipitation for December through February	4	inches
SGSL	Total stream length intersecting sand and gravel deposits (in miles)	2.73	miles
SOILPERM	Average Soil Permeability	3.416	inches per hour
SSURGOCCDD	Percentage of area with hydrologic soil types C, D, or C/D from SSURGO	0.4268	percent
STRMTOT	total length of all mapped streams (1:24,000-scale) in the basin	10.8	miles
WETLAND	Percentage of Wetlands	0.0976	percent

Additional calculated basin characteristics for Gage 01208700 from StreamStats

Application Version: 4.11.1
StreamStats Services Version: 1.2.22
NSS Services Version: 2.2.1

Calculated flows at gage 01208700
from SIR 2020-5054

Flood discharges for the 50-, 20-, 10-, 4-, 2-, 1-, 0.5-, and 0.2-percent annual exceedance probabilities for streamflow-gaging stations in Connecticut and vicinity.

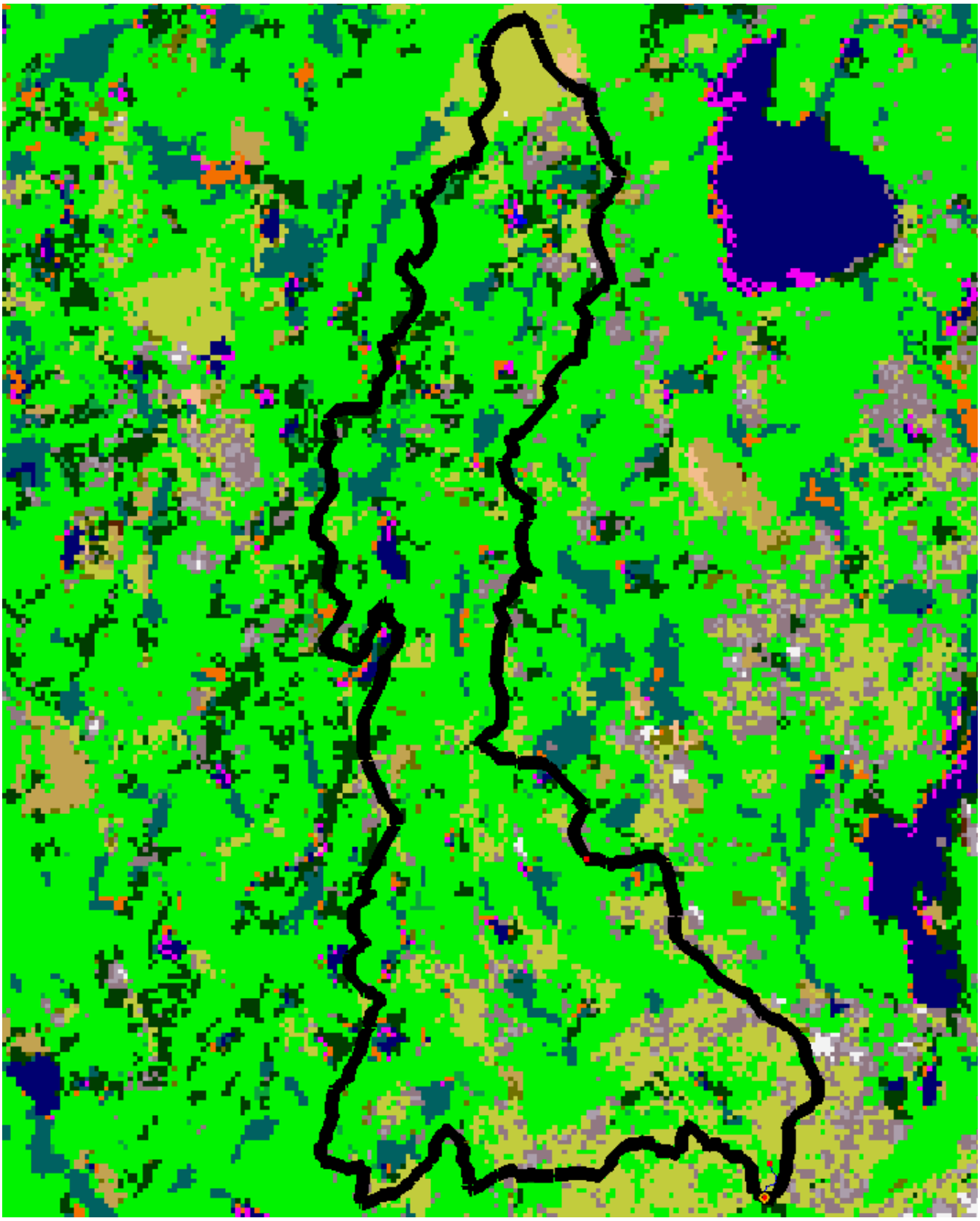
Streamgage identification number	Streamgage name	Water years of peak flows used in analysis	Regulated	Site used in multiple linear regression	Frequency analysis method	Flood discharges, in cubic feet per second, for indicated annual exceedance probability, in percent							
						50	20	10	4	2	1	0.5	0.2
01208700	Little River	1960-84			LP3	242	420	575	818	1,040	1,300	1,600	2,070
					RRE	246	470	631	882	1,100	1,330	1,510	1,830
					WGTD	242	433	592	839	1,050	1,310	1,550	1,940

	Gauge 01208700	Little River at Oxford			Bridge No. 04070	
	Gauge flows	Regression estimates	correction from regression to weighted	Weighted results	*Regression estimates	calibration results
2-yr	242	246	0.98	242	201	198
10-yr	575	631	0.94	592	419	393
25-yr	818	882	0.95	839	557	530
50-yr	1040	1100	0.95	1050	674	643
100-yr	1300	1330	0.98	1310	804	792
500-yr	2070	1830	1.06	1940	1070	1134

*recommend regression estimates without calibration

Appendix C – C-CAP 2010 Land Use

Coastal Change Analysis Program (C-CAP)
Raster Land Use Land Cover grid



Coastal Change Analysis Program (C-CAP)

NOAA Office for Coastal Management

Regional Land Cover Classification Scheme

The following information provides a description of land cover classes used with NOAA's Coastal Change Analysis Program (C-CAP) Regional land cover products. These classes have been targeted as important indicators of coastal ecosystems and have been identified as features that can be consistently and accurately derived primarily through remote-sensing means.

These descriptions have been revised from those originally published in *NOAA Coastal Change Analysis Program (C-CAP): Guidance for Regional Implementation*.

Unclassified

Background (0) – areas within the image file limits but containing no data values.

Unclassified (1) – areas in which land cover cannot be determined; these include clouds and deep shadow.

Developed Land

Developed, High Intensity (2) – contains significant land area and is covered by concrete, asphalt, and other constructed materials. Vegetation, if present, occupies less than 20 percent of the landscape. Constructed materials account for 80 to 100 percent of the total cover. This class includes heavily built-up urban centers and large constructed surfaces in suburban and rural areas with a variety of land uses.

Developed, Medium Intensity (3) – contains areas with a mixture of constructed materials and vegetation or other cover. Constructed materials account for 50 to 79 percent of total area. This class commonly includes multi- and single-family housing areas, especially in suburban neighborhoods, but may include all types of land use.

Developed, Low Intensity (4) – contains areas with a mixture of constructed materials and substantial amounts of vegetation or other cover. Constructed materials account for 21 to 49 percent of total area. This subclass commonly includes single-family housing areas, especially in rural neighborhoods, but may include all types of land use.

Developed, Open Space (5) – contains areas with a mixture of some constructed materials, but mostly managed grasses or low-lying vegetation planted in developed areas for recreation, erosion control, or aesthetic purposes. These areas are maintained by human activity such as fertilization and irrigation, are distinguished by enhanced biomass productivity, and can be recognized through vegetative indices based on spectral characteristics. Constructed surfaces account for less than 20 percent of total land cover.

Agricultural Land

Cultivated Crops (6) – contains areas intensely managed for the production of annual crops. Crop vegetation accounts for greater than 20 percent of total vegetation. This class also includes all land being actively tilled.

Pasture/Hay (7) – contains areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle and not tilled. Pasture/hay vegetation accounts for greater than 20 percent of total vegetation.

Grassland

Grassland/Herbaceous (8) – contains areas dominated by grammanoid or herbaceous vegetation, generally greater than 80 percent of total vegetation. These areas are not subject to intensive management such as tilling but can be utilized for grazing.

Forest Land

Deciduous Forest (9) – contains areas dominated by trees generally greater than 5 meters tall and greater than 20 percent of total vegetation cover. More than 75 percent of the tree species shed foliage simultaneously in response to seasonal change.

Evergreen Forest (10) – contains areas dominated by trees generally greater than 5 meters tall and greater than 20 percent of total vegetation cover. More than 75 percent of the tree species maintain their leaves all year. Canopy is never without green foliage.

Mixed Forest (11) – contains areas dominated by trees generally greater than 5 meters tall, and greater than 20 percent of total vegetation cover. Neither deciduous nor evergreen species are greater than 75 percent of total tree cover. *Both coniferous and broad-leaved evergreens are included in this category.*

Scrub Land

Scrub/Shrub (12) – contains areas dominated by shrubs less than 5 meters tall with shrub canopy typically greater than 20 percent of total vegetation. This class includes tree shrubs, young trees in an early successional stage, or trees stunted from environmental conditions.

Barren Land

Barren Land (20) – contains areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits, and other accumulations of earth material. Generally, vegetation accounts for less than 10 percent of total cover.

Tundra (24) – is categorized as a treeless region beyond the latitudinal limit of the boreal forest in pole-ward regions and above the elevation range of the boreal forest in high mountains. In the United States, tundra occurs primarily in Alaska.

Perennial Ice/Snow (25) – includes areas characterized by a perennial cover of ice and/or snow, generally greater than 25 percent of total cover.

Palustrine Wetlands

Palustrine Forested Wetland (13) – includes tidal and nontidal wetlands dominated by woody vegetation greater than or equal to 5 meters in height, and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts is below 0.5 percent. Total vegetation coverage is greater than 20 percent.

Palustrine Scrub/Shrub Wetland (14) – includes tidal and nontidal wetlands dominated by woody vegetation less than 5 meters in height, and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts is below 0.5 percent. Total vegetation coverage is greater than 20 percent. *Species present could be true shrubs, young trees and shrubs, or trees that are small or stunted due to environmental conditions.*

Palustrine Emergent Wetland (Persistent) (15) – includes tidal and nontidal wetlands dominated by persistent emergent vascular plants, emergent mosses or lichens, and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts is below 0.5 percent. Total vegetation cover is greater than 80 percent. *Plants generally remain standing until the next growing season.*

Estuarine Wetlands

Estuarine Forested Wetland (16) – includes tidal wetlands dominated by woody vegetation greater than or equal to 5 meters in height, and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts is equal to or greater than 0.5 percent. Total vegetation coverage is greater than 20 percent.

Estuarine Scrub/Shrub Wetland (17) – includes tidal wetlands dominated by woody vegetation less than 5 meters in height, and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts is equal to or greater than 0.5 percent. Total vegetation coverage is greater than 20 percent.

Estuarine Emergent Wetland (18) – Includes all tidal wetlands dominated by erect, rooted, herbaceous hydrophytes (excluding mosses and lichens). These wetlands occur in tidal areas in which salinity due to ocean-derived salts is equal to or greater than 0.5 percent and are present for most of the growing season in most years. Total vegetation cover is greater than 80 percent. *Perennial plants usually dominate these wetlands.*

Barren Land

Unconsolidated Shore (19) – includes material such as silt, sand, or gravel that is subject to inundation and redistribution due to the action of water. Substrates lack vegetation except for pioneering plants that become established during brief periods when growing conditions are favorable.

Water and Submerged Lands

Open Water (21) – includes areas of open water, generally with less than 25 percent cover of vegetation or soil.

Palustrine Aquatic Bed (22) – includes tidal and nontidal wetlands and deepwater habitats in which salinity due to ocean-derived salts is below 0.5 percent and which are dominated by plants that grow and form a continuous cover principally on or at the surface of the water. These include algal mats, detached floating mats, and rooted vascular plant assemblages. Total vegetation cover is greater than 80 percent.

Estuarine Aquatic Bed (23) – includes tidal wetlands and deepwater habitats in which salinity due to ocean-derived salts is equal to or greater than 0.5 percent and which are dominated by plants that grow and form a continuous cover principally on or at the surface of the water. These include algal mats, kelp beds, and rooted vascular plant assemblages. Total vegetation cover is greater than 80 percent.

HSG	Land Use Description	CN	Area mi^2	Product CN x A
C	Deciduous Forest	60	2.146	128.74
D	Deciduous Forest	67	0.011	0.74
B	Deciduous Forest	50	0.063	3.148
C	Developed Open Space	70	0.535	37.427
D	Developed Open Space	80	0.091	7.276
B	Developed Open Space	55	0.017	0.932
C	Evergreen Forest	60	0.21	12.571
B	Evergreen Forest	50	0.013	0.644
C	Grassland	71	0.001	0.105
D	High-Intensity Developed	85	0	0.031
C	High-Intensity Developed	80	0.002	0.147
B	High-Intensity Developed	70	0	0.026
C	Low-Intensity Developed	73	0.212	15.51
D	Low-Intensity Developed	80	0.001	0.059
B	Low-Intensity Developed	60	0.017	1.038
C	Medium-Intensity Developed	76	0.024	1.847
B	Medium-Intensity Developed	64	0.001	0.094
D	Medium-Intensity Developed	82	0.001	0.06
C	Mixed Forest	60	0.039	2.342
B	Mixed Forest	50	0.003	0.147
C	Palustrine Aquatic Bed	99	0.002	0.182
C	Palustrine Emergent Wetland	71	0.012	0.863
C	Palustrine Forested Wetland	70	0.197	13.816
D	Palustrine Forested Wetland	77	0	0.028
B	Palustrine Forested Wetland	55	0.005	0.263
C	Palustrine Scrub/Shrub Wetland	71	0.035	2.458
B	Palustrine Scrub/Shrub Wetland	58	0.001	0.043
C	Pasture/Hay	74	0.018	1.362
D	Pasture/Hay	80	0.001	0.059
C	Shrub/Scrub	65	0.027	1.747
B	Shrub/Scrub	48	0.001	0.035
D	Shrub/Scrub	73	0	0.027
C	Water	99	0.031	3.062
B	Water	99	0	0.036

	area	%	
	0.643	17%	
		total	less open space
	0.901	24%	7%
	2.485	67%	
	0.252	7%	
	0.048	1%	
	0.031	1%	

CN	(Weighted) = Total Product \ Total Area
===	==========
	63.7085

3.717

Appendix C – Data Collection and Field Review Forms

Appendix A – Forms

- **Data Collection and Field Review (pages 9.A-1 to 9.A-11)**
- **Hydraulic Data (pages 9.A-13 to 9.A-16)**

DATA COLLECTION AND FIELD REVIEW

I. GENERAL PROJECT DATA

Bridge No.: 04070
Town: Stamford
County: Fairfield
Feature carried: Wire Mill Road
Feature crossed: Haviland Brook
Quadrangle: 00113 / Stamford
DEP watershed basin no.: 7405

Functional class:

- ☐ urban principal arterial-interstate
- ☐ urban principal arterial-other expwy.
- ☐ urban principal arterial-other
- ☐ urban minor arterial
- ☐ urban collector
- ☒ urban local
- ☐ rural principal arterial-interstate
- ☐ rural principal arterial-other expwy.
- ☐ rural principal arterial-other
- ☐ rural minor arterial
- ☐ rural major collector
- ☐ rural minor collector
- ☐ rural local

Year built: 1957
Year of reconstruction: N/A
Overall NBIS structure rating: 2
NBIS Item 113: 5
USGS total scour index: 48
Sufficiency rating: 30.4

Plans available? ☒ yes ☐ no

II. SUPERSTRUCTURE INFORMATION

Bridge width: 33.5 ~~m~~ (ft)
Bridge length: 20 ~~m~~ (ft)
Number of spans: 1
Bridge skew: 0 (degrees)

Bearing connection type: ☐ positive connection ☒ no positive connection

III. HYDROLOGIC AND HYDRAULIC INFORMATION

Watershed area: 3.7 ~~km^2~~ (sq. mi.)

Is it tidally influenced? ☐ yes ☒ no

What information is available?

- ☐ hydraulic report
- ☒ scour report
- ☐ floodway analysis report
- ☐ SCEL analysis
- ☒ comparative report
- ☐ FEMA F.I.S.
- ☐ Other: _____

	Source	2 Yr. Event	10 Yr. Event	50 Yr. Event	100 Yr. Event	500 Yr. Event
Flow rates ~~m³/s~~ (cfs)						
	Design	200	420	670	800	1070
Precipitation ~~mm~~ (in)	Atlas 14	3.05	5.52	7.54	8.46	11.1
Tidal elevations m (ft)	N/A					

Elevations ~~m~~ (ft.)							
At Structure			Water Surface at Approach Cross Section				
Streambed	Low Chord	Roadway	2 Yr. Event	10 Yr. Event	50 Yr. Event	100 Yr. Event	500 Yr. Event
127.6	132.1	134.2	130.6	132.2	134.2	135.2	136.2

Pressure flow at design storm? ☒ yes ☐ underclearance ____ m (ft.)

Comments: Approach section=205.8. Headwater elevations are largely driven by stone walls and wooden fences on both sides of the travelway, in addition to the constrictive nature of the bridge.

IV. SITE DATA

A. Existing structure(s) – Provide sketch of culvert/structure with dimensions and brief description.

See attached site photos.

Comments: Include structure or culvert type and condition. Note particularly any scour adjacent to abutments or at culvert outlet and the presence of debris or sediment. Also note the location of any utilities in the area of the crossing.

Scour is negligible in the vicinity of the crossing. Streambed is primarily cobble and gravel with an estimated d_{50} of 75mm. There is noted deposition of material in the mid-span of the bridge. Past inspection reports indicate no adverse impacts due to scour.

B. High water marks – Describe the nature and location of any apparent high water marks and relate to a date of occurrence, if possible.

None noted

C. Maximum allowable headwater – Describe the nature of the apparent controlling feature and note its location.

Roadway edge at elevation ± 134 feet on the east approach.

D. Fish passage requirements – Comment on the apparent need for fish passage or impediments to same; such as dams or restrictive crossings in the area.

Existing bridge is a clear span over a natural channel. Fish passage is unrestricted at the project location. Approximately 70 feet upstream from the project site is a dam which restricts further passage north.

V. PERIPHERAL SITE DATA

A. Hydraulic control – Note location and description.

Under areal flooding conditions, the hydraulic control would be the flood elevation of the Rippowam River floodplain at the mouth of Haviland Brook, approximately 90 feet downstream from the crossing.

B. Upstream and downstream structures – Provide sketches and brief descriptions of existing bridges/culverts. Include dimensions.

Comments: _____

C. Watershed area – Check watershed boundaries for accuracy. Note current land uses within watershed.

Watershed area is 3.7 square miles. Major land use categories and extents are 67% wooded area, 17% developed open space, 7% low to high intensity development.

D. Flow control structures within watershed – Note the location and type of all significant flow control structures (dams, etc.) within the watershed. Provide sketches with dimensions as required.

No major flow control in Haviland Brook watershed.

E. Site photographs – Attach to report. Include an index and sketch of photograph locations.

VI. STREAM CHANNEL AND RELATED ASPECTS

A. Stream characterization

Twenty Groupings of Stream Characteristics (check box)

	Identifier	Drainage Area	Streambed Slope	Streambed Soils	Land Use
☐	A	Large	Low	SD	S/F
☐	B	Large	Low	SD	Urban
☐	C	Large	Moderate	SD	Forested
☐	D	Medium	Moderate	SD	Urban
☐	E	Medium	Moderate	SD	S/F
☐	F	Medium	Moderate	CLAY	S/F
☐	G	Medium	Moderate	TILL	S/F
☐	H	Medium	Moderate	SD	Forested
☐	I	Medium	Moderate	TILL	Forested
☐	J	Small	Low	SD	Urban
☐	K	Small	Moderate	TILL	Urban
☐	L	Small	Low	SD	S/F
☐	M	Small	Moderate	SD	S/F
☐	N	Small	Moderate	SD	Forested
☐	O	Small	Low	CLAY	S/F
☐	P	Small	Steep	TILL	S/F
☒	Q	Small	Moderate	TILL	S/F
☐	R	Small	Low	TILL	S/F
☐	S	Small	Moderate	TILL	Forested
☐	T	Small	Steep	TILL	Forested

Drainage area
Small ≤ 64.75km^2 (25 mi^2)
Medium > 64.75km^2 (25 mi^2) and ≤ 259 km^2 (100 mi^2)
Large > 259 km^2 (100 mi^2)

Streambed slope
Low ≤ 4.76 m/km (25 ft/mi)
Moderate > 4.76 m/km (25 ft/mi) and ≤ 19.05 m/km (100 ft.mi)
Steep > 19.05 m/km (100 ft/mi)

Streambed soils SD = Stratified Drift

Land Use S/F = Suburban or Farming

B. Channel stability

Previous NBIS Item 61 rating: 6

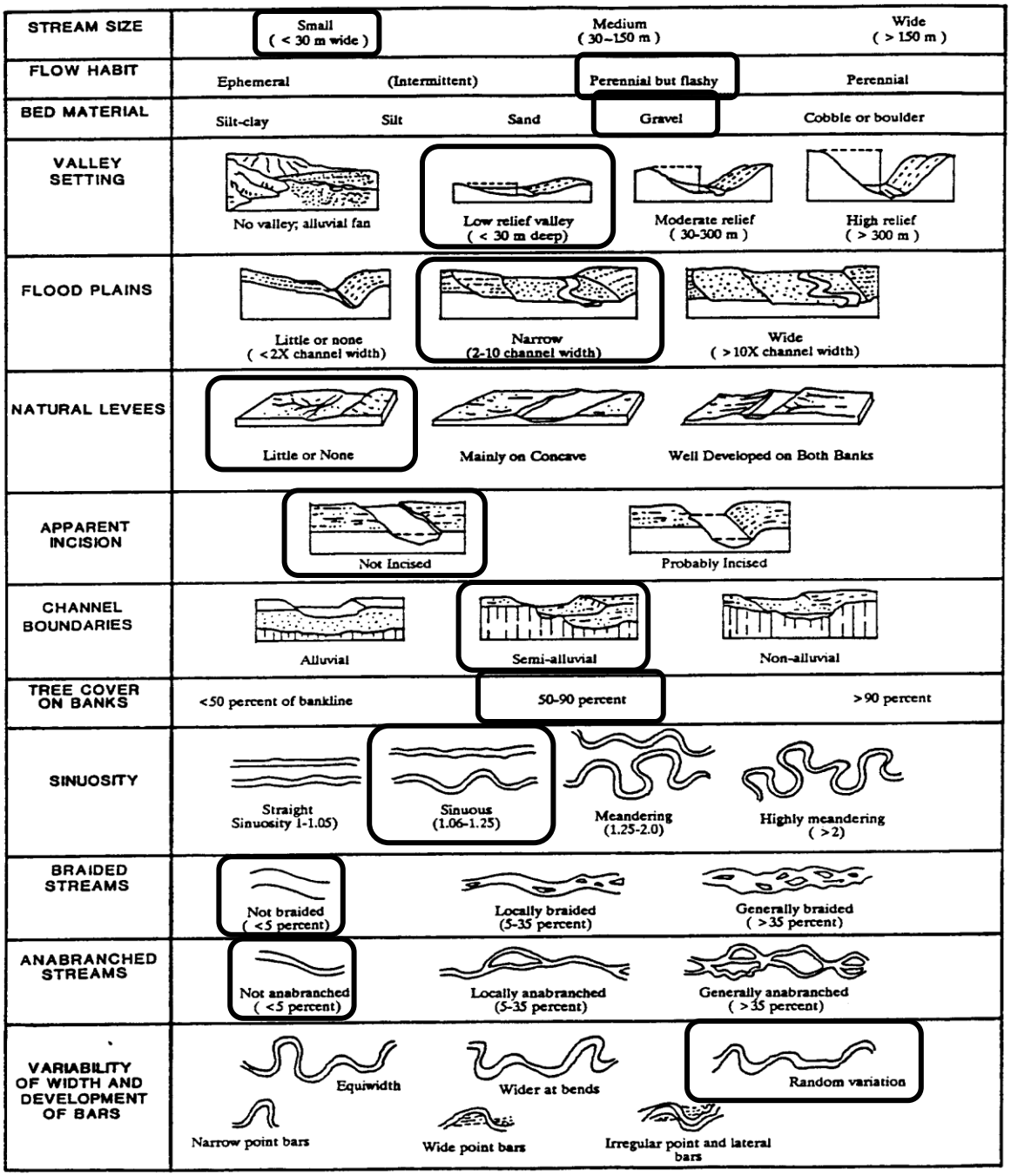
Lateral stability: ☒ stable ☐ unstable

Bank erosion:
☐ none ☒ light fluvial erosion ☐ heavy fluvial erosion ☐ mass wasting

Streambed: ☒ stable ☐ aggradating ☐ degrading

Armoring potential: ☐ none ☐ low ☐ moderate ☒ high

Geomorphic factors that affect stream stability (circle factors that apply)



Source: Adapted From Brice and Blodgett, 1978

(See also FHWA HEC-20, "Stream Stability at Highway Structures" for discussion of the above factors)

Secondary bed material: ☐ sand ☐ gravel ☒ boulders ☐ manmade ☐ silt/clay ☒ cobble ☐ bedrock

Bank protection

Type ☐ none ☐ modified ☒ intermediate ☐ standard ☐ concrete ☐ slope paving ☐ absent ☐ other

Condition ☐ n/a ☒ good ☐ weathered ☐ slumped ☐ poor ☐ missing ☐ fair

Comment on the need (if any) for training walls, cutoff walls or special slope or channel protection.

Riprap embankment protection along the northeast embankment only. There is minor undercutting of stream banks both upstream and downstream, exposing tree roots. Vegetation has largely stabilized the streambanks.

C. Channel and overbank roughness coefficients

Basic channel description: ☐ channel in earth ☐ channel cut into rock ☐ channel fine gravel ☒ channel coarse gravel

Surface irregularity of channel:

☐ smooth – best obtainable section for materials involved
☒ minor – slightly eroded or scoured side slopes
☐ moderate – moderately sloughed or eroded side slopes.
☐ severe – badly sloughed banks of natural channels or badly eroded sides of man-made channels - jagged and irregular sides or bottom sections of channels in rock.

Variations in shape and size of cross sections

☐ changes in size or shape occurring gradually
☒ large and small sections alternating occasionally or shape changes causing occasional shifting of main flow from side to side.
☐ large and small sections alternating frequently or shape changes causing frequent shifting of main flow from side to side.

Channel obstructions – (Judge the relative effect of obstructions – consider the degree to which the obstructions reduce the average cross sectional area, character of obstructions, and location and spacing of obstructions).

NOTE: Smooth or rounded objects create less turbulence than sharp, angular objects.

The effect of obstructions is:

☐ negligible
☒ minor
☐ appreciable
☐ severe

Degree of vegetation - (Note amount and character of foliage).

The effect of vegetative growth upon flow conditions is:
☒ LOW - Dense growths of flexible turf grasses where average depth of flow is 2 to 3 times the height of vegetation. Supple seedling tree switches where the average depth of flow is 3 to 4 times the height of the vegetation.
☐ MEDIUM - Turf grasses where the average depth of flow is 1 to 2 times the height of vegetation. Stemmy grasses, weeds or tree seedlings, (moderate cover), average depth of flow 2 to 3 times the height of vegetation. Bushy growths, (moderately dense), along channel side slopes with no significant vegetation along channel bottom.
☐ HIGH - Turf grasses where average height is about equal to the average depth of flow. Willow of Cottonwood trees 8 to 10 years old with some weeds or brush. Bushy growths about 1 year old with some weeks. No significant vegetation along channel bottom.
☐ VERY HIGH - Turf grasses where the average depth of flow is less than one half the height of vegetation. Bushy growths about 1 year old intergrown with weeds. Dense growth of cattails along channel bottom. Trees intergrown with weeds and brush (thick growth).

Additional comments:

_____
_____
_____
_____
_____

VII. HYDRAULIC VULNERABILITY

Previous Item 71 rating: _____

Is there confluence present? ☒ yes ☐ no

Angle of attack (flood flow): ☐ yes ☒ no

Bends in channel: ☐ upstream of bridge ☐ downstream of bridge ☒ straight channel reach ☐ at bridge

Velocity order of magnitude: 10 ~~m/s~~ (ft/s), at design flow

Trapping potential: ☐ low ☒ medium ☐ high

Debris potential: ☐ low ☒ moderate ☐ high

Overtopping relief: ☐ none ☐ left approach ☐ right approach ☒ on bridge ☐ relief bridge ☐ cannot be determined

Primary bed material: ☐ sand ☒ gravel ☐ boulders ☐ manmade
☐ silt/clay ☐ cobble ☐ bedrock

Comments: _____

VIII. VISUAL SCOUR EVIDENCE

USGS observed scour index: 26

History of scour problem: ☐ yes ☐ no

Comments: Erosion and scour are rated 8 and 7, respectively. Aggregation is noted at the mid-span of the crossing, which is directing flows towards the abutments, though there is no indication of active scour associated with the crossing, or any settlement issues.

Note: Comment should address any evidence of scour at ALL substructure units.

CONTRACTION SCOUR SUSCEPTIBILITY

Channel width upstream: 35 ~~m~~ (ft.)
Channel width under bridge: 20 ~~m~~ (ft.)
Channel width ratio (channel width upstream / channel width under the bridge: 1.75:1

Overbank flow: ☒ yes ☐ no

Percent of flow in main channel of the approach section:
☐ >90% ☐ 75%-90% ☒ 50%-75% ☐ 25%-50% ☐ <25%

Average bed material size (D_{50}):
@ approach section 75 mm (~~in~~) ☐ sample taken for sieve analysis
@ bridge 75 mm (~~in~~) ☐ sample taken for sieve analysis

Contraction scour susceptibility rating: ☒ low ☐ medium ☐ high

Comments: Particle size estimated as coarse gravel >> small cobble. Contraction scour is limited by the estimated grain size.

ABUTMENT SUSCEPTIBILITY

Which abutment is worst?: ☒ left ☐ right

Observed scour depth: 0 ~~m~~ (ft.) Remaining embedment in river bed: 4 ~~m~~ (ft)

Abutment shape: ☐ vertical ☒ vertical with wingwalls ☐ spillthrough

Abutment location: ☒ in channel ☐ at bank ☐ set back

Abutment foundation: ☐ unknown ☒ spread footing ☐ pile bent ☐ friction piles ☐ EB piles ☐ set in rock

Pile type: ☐ metal ☐ concrete ☐ timber ☒ N/A

Pile length: N/A ~~m~~ (feet)

Abutment material: ☐ timber ☒ concrete ☐ metal ☐ stone

Angle of inclination: 0 (degrees)

Primary bed material: ☐ sand ☒ gravel ☐ boulders ☐ manmade ☐ silt/clay ☐ cobble ☐ bedrock

Are borings available? ☒ yes ☐ no

Abutment protection

Type:	☐ modified	☐ intermediate	☐ standard	☐ slope paving
	☐ concrete	☐ other	☐ absent	☒ none
Permanent or Temporary:		☐ n/a	☐ permanent	☐ temporary
Condition:	☐ good	☐ weathered	☐ slumped	☐ missing
	☐ fair	☐ poor	☒ N/A	

Abutment exposure due to scour:

☐ none ☒ no exposure ☐ footing exposed ☐ piles exposed
☐ undermining ☐ settlement ☐ failed

Abutment susceptibility rating ☒ low ☐ medium ☐ high

Comments: _____

PIER SUSCEPTIBILITY

Worst pier number: _____
Observed scour depth: _____ m (ft.) Remaining embedment in river bed: _____ m (ft)

Angle of attack flood flow: _____ (degrees)

Pier foundation: ☐ unknown ☐ spread footing ☐ pile bent
☐ EB piles ☐ set in rock ☐ friction piles ☐ N/A

Pile type: ☐ metal ☐ concrete ☐ timber ☐ N/A

Pile length: _____

Pier material:
☐ concrete ☐ stone ☐ wood ☐ metal ☐ N/A

Pier shape: ☐ solid pier with square nose ☐ solid pier with round nose
☐ solid pier with sharp nose ☐ column with square nose ☐ column with round nose
☐ column with sharp nose ☐ cylinders/group of cylinders

Pier width: _____ Pier dimensions: _____

Cap/Footing dimensions: _____

Pier exposure due to scour: ☐ none ☐ no exposure ☐ footing exposed
☐ piles exposed ☐ undermining ☐ settlement
☐ failed

Pier protection

Type:	☐ modified	☐ intermediate	☐ standard	☐ slope paving
	☐ concrete	☐ other	☐ absent	☐ none
Permanent or Temporary:		☐ n/a	☐ permanent	☐ temporary
Condition:	☐ good	☐ weathered	☐ slumped	☐ missing
	☐ fair	☐ poor	☐ N/A	

Primary bed material: ☐ sand ☐ gravel ☐ boulders ☐ manmade
☐ silt/clay ☐ cobble ☐ bedrock

Are borings available? ☐ yes ☐ no

Pier susceptibility rating ☐ low ☐ medium ☐ high

Comments: _____

_____

_____

_____

Appendix D – Natural Conditions Analysis

HEC-RAS Plan: natural River: Reach: reach_3 Profile: 100-yr

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach_3	300.198	100-yr	800.00	129.90	135.5	132.50	135.55	0.000337	2.0	453.72	245.94	0.17
reach_3	262.135	100-yr	800.00	130.40	135.5	132.58	135.53	0.000396	2.2	464.06	317.89	0.19
reach_3	251.5		Inl Struct									
reach_3	241.745	100-yr	800.00	127.10	133.7		133.94	0.000861	3.9	267.72	103.36	0.29
reach_3	229.683	100-yr	800.00	125.40	133.7		133.92	0.000692	3.6	279.86	113.04	0.26
reach_3	205.816	100-yr	800.00	127.80	133.7		133.89	0.000751	3.5	301.09	114.51	0.27
reach_3	190.168	100-yr	800.00	128.10	133.3	131.56	133.83	0.003241	6.1	132.08	40.47	0.50
reach_3	132.919	100-yr	800.00	127.70	133.0		133.64	0.002974	6.7	148.27	40.70	0.53
reach_3	112.083	100-yr	800.00	126.90	131.7	131.66	133.25	0.009334	10.5	91.51	121.75	0.90
reach_3	92.144	100-yr	800.00	126.40	130.7	132.10	132.94	0.016392	12.4	73.49	26.82	1.17
reach_3	63.607	100-yr	800.00	125.90	129.1	130.19	132.17	0.039365	14.4	61.94	35.29	1.69

Appendix E – Existing Conditions Analysis

EXISTING CONDITIONS
NO TAILWATER

HEC-RAS Plan: existnotailwater River: Reach: reach_3

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach_3	300.198	2-yr	200.00	129.90	134.3	131.50	134.36	0.000064	0.7	279.46	94.44	0.07
reach_3	300.198	10-yr	420.00	129.90	135.0	131.97	135.05	0.000145	1.2	360.59	154.27	0.11
reach_3	300.198	25-yr	560.00	129.90	135.2	132.19	135.27	0.000211	1.5	396.98	193.09	0.14
reach_3	300.198	50-yr	670.00	129.90	135.4	132.35	135.40	0.000269	1.8	422.60	228.04	0.15
reach_3	300.198	100-yr	800.00	129.90	135.5	132.50	135.57	0.000330	2.0	458.68	249.18	0.17
reach_3	300.198	200-yr	890.00	129.90	135.8	132.61	135.89	0.000294	2.0	547.03	294.04	0.16
reach_3	300.198	500-yr	1070.00	129.90	136.3	132.81	136.34	0.000266	2.0	685.69	319.85	0.16
reach_3	262.135	2-yr	200.00	130.40	134.3	131.49	134.35	0.000083	0.8	247.96	101.31	0.08
reach_3	262.135	10-yr	420.00	130.40	135.0	131.95	135.04	0.000182	1.4	346.38	207.41	0.13
reach_3	262.135	25-yr	560.00	130.40	135.2	132.20	135.26	0.000258	1.7	393.86	252.45	0.15
reach_3	262.135	50-yr	670.00	130.40	135.3	132.38	135.39	0.000323	2.0	425.31	288.72	0.17
reach_3	262.135	100-yr	800.00	130.40	135.5	132.58	135.55	0.000386	2.2	470.91	322.25	0.19
reach_3	262.135	200-yr	890.00	130.40	135.8	132.71	135.88	0.000321	2.1	585.55	366.41	0.17
reach_3	262.135	500-yr	1070.00	130.40	136.3	132.95	136.32	0.000270	2.1	761.64	398.78	0.16
reach_3	251.5		Inl Struct									
reach_3	241.745	2-yr	200.00	127.10	130.7		130.78	0.000793	2.3	90.92	37.03	0.25
reach_3	241.745	10-yr	420.00	127.10	132.2		132.33	0.000747	3.0	157.77	51.71	0.26
reach_3	241.745	25-yr	560.00	127.10	133.7		133.81	0.000428	2.8	265.82	102.72	0.20
reach_3	241.745	50-yr	670.00	127.10	134.2		134.29	0.000438	3.0	319.88	128.46	0.21
reach_3	241.745	100-yr	800.00	127.10	135.2		135.27	0.000280	2.6	515.54	263.07	0.17
reach_3	241.745	200-yr	890.00	127.10	135.8		135.83	0.000199	2.3	698.45	344.14	0.15
reach_3	241.745	500-yr	1070.00	127.10	136.2		136.29	0.000186	2.3	870.52	396.58	0.14
reach_3	229.683	2-yr	200.00	125.40	130.7		130.76	0.000458	1.9	104.99	34.07	0.19
reach_3	229.683	10-yr	420.00	125.40	132.2		132.32	0.000559	2.7	164.49	48.99	0.22
reach_3	229.683	25-yr	560.00	125.40	133.7		133.80	0.000345	2.5	277.17	112.19	0.18
reach_3	229.683	50-yr	670.00	125.40	134.2		134.28	0.000354	2.7	337.45	149.11	0.19
reach_3	229.683	100-yr	800.00	125.40	135.2		135.27	0.000238	2.4	541.67	290.18	0.16
reach_3	229.683	200-yr	890.00	125.40	135.8		135.83	0.000178	2.2	732.78	359.32	0.14
reach_3	229.683	500-yr	1070.00	125.40	136.2		136.29	0.000172	2.3	909.96	405.51	0.14
reach_3	205.816	2-yr	200.00	127.80	130.6		130.74	0.001310	2.5	82.78	45.51	0.30
reach_3	205.816	10-yr	420.00	127.80	132.2		132.30	0.000822	2.9	167.62	64.35	0.26
reach_3	205.816	25-yr	560.00	127.80	133.7		133.79	0.000376	2.4	298.02	110.49	0.19
reach_3	205.816	50-yr	670.00	127.80	134.2		134.27	0.000383	2.6	358.64	161.44	0.19
reach_3	205.816	100-yr	800.00	127.80	135.2		135.26	0.000227	2.2	628.82	410.49	0.15

EXISTING CONDITIONS
NO TAILWATER

HEC-RAS Plan: existnotailwater River: Reach: reach_3 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach_3	205.816	200-yr	890.00	127.80	135.8		135.82	0.000157	2.0	879.96	440.26	0.13
reach_3	205.816	500-yr	1070.00	127.80	136.2		136.28	0.000145	2.0	1086.30	451.53	0.12
reach_3	190.168	2-yr	200.00	128.10	130.5	129.69	130.69	0.003898	3.9	51.68	27.66	0.50
reach_3	190.168	10-yr	420.00	128.10	132.0	130.53	132.26	0.002584	4.4	94.51	32.10	0.43
reach_3	190.168	25-yr	560.00	128.10	133.5	130.95	133.76	0.001345	4.0	139.24	46.29	0.32
reach_3	190.168	50-yr	670.00	128.10	133.9	131.24	134.24	0.001481	4.4	151.39	62.35	0.34
reach_3	190.168	100-yr	800.00	128.10	135.1	131.56	135.24	0.000617	3.2	375.94	214.65	0.22
reach_3	190.168	200-yr	890.00	128.10	135.7	131.77	135.81	0.000411	2.7	510.87	227.65	0.18
reach_3	190.168	500-yr	1070.00	128.10	136.2	132.18	136.27	0.000404	2.7	629.82	290.70	0.18
reach_3	180.829	2-yr	200.00	127.60	130.4	129.51	130.66	0.003507	3.8	52.14	23.69	0.46
reach_3	180.829	10-yr	420.00	127.60	131.8	130.35	132.22	0.003332	4.9	85.98	24.12	0.46
reach_3	180.829	25-yr	560.00	127.60	133.4	130.82	133.73	0.002090	4.5	127.02	50.13	0.37
reach_3	180.829	50-yr	670.00	127.60	133.9	131.15	134.21	0.001837	4.4	173.71	156.56	0.35
reach_3	180.829	100-yr	800.00	127.60	135.1	131.52	135.21	0.000423	2.5	565.59	409.71	0.17
reach_3	180.829	200-yr	890.00	127.60	135.7	131.76	135.79	0.000231	1.9	826.56	453.22	0.13
reach_3	180.829	500-yr	1070.00	127.60	136.2	132.22	136.25	0.000189	1.8	1040.52	463.83	0.12
reach_3	161.5		Bridge									
reach_3	132.919	2-yr	200.00	127.70	129.8		130.23	0.007228	5.2	40.05	25.33	0.69
reach_3	132.919	10-yr	420.00	127.70	131.2		131.75	0.004161	5.9	80.90	32.60	0.58
reach_3	132.919	25-yr	560.00	127.70	132.0		132.56	0.003328	6.1	108.86	37.18	0.54
reach_3	132.919	50-yr	670.00	127.70	132.5		133.09	0.003156	6.4	127.49	40.70	0.53
reach_3	132.919	100-yr	800.00	127.70	133.0		133.64	0.002974	6.7	148.27	40.70	0.53
reach_3	132.919	200-yr	890.00	127.70	133.5		134.13	0.002518	6.6	169.68	40.70	0.49
reach_3	132.919	500-yr	1070.00	127.70	133.4		134.32	0.003992	8.1	164.23	40.70	0.62
reach_3	112.083	2-yr	200.00	126.90	129.1	129.13	129.91	0.015027	7.1	28.94	19.30	0.98
reach_3	112.083	10-yr	420.00	126.90	130.2	130.17	131.39	0.012517	9.0	49.92	21.79	0.97
reach_3	112.083	25-yr	560.00	126.90	130.7	130.68	132.16	0.012049	10.0	61.67	24.24	0.98
reach_3	112.083	50-yr	670.00	126.90	131.2	131.17	132.70	0.010379	10.2	75.11	30.45	0.93
reach_3	112.083	100-yr	800.00	126.90	131.7	131.66	133.25	0.009334	10.5	91.51	121.75	0.90
reach_3	112.083	200-yr	890.00	126.90	131.7	131.66	133.63	0.011553	11.7	91.51	121.75	1.01
reach_3	112.083	500-yr	1070.00	126.90	132.8	132.78	134.09	0.006165	10.0	152.60	286.13	0.76
reach_3	92.144	2-yr	200.00	126.40	128.7	128.79	129.58	0.017799	7.4	27.80	19.71	1.06
reach_3	92.144	10-yr	420.00	126.40	129.5	129.83	131.07	0.018290	10.0	45.08	22.66	1.15

EXISTING CONDITIONS
NO TAILWATER

HEC-RAS Plan: existnotailwater River: Reach: reach_3 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach_3	92.144	25-yr	560.00	126.40	130.0	130.35	131.84	0.017863	11.1	55.42	24.26	1.17
reach_3	92.144	50-yr	670.00	126.40	130.3	130.76	132.38	0.017537	11.8	63.26	25.40	1.18
reach_3	92.144	100-yr	800.00	126.40	130.7	132.10	132.94	0.016392	12.4	73.49	26.82	1.17
reach_3	92.144	200-yr	890.00	126.40	130.9	132.22	133.31	0.015964	12.8	80.08	27.70	1.16
reach_3	92.144	500-yr	1070.00	126.40	131.5	132.35	133.82	0.013668	12.9	127.67	168.22	1.10
reach_3	63.607	2-yr	200.00	125.90	127.9	128.12	128.88	0.033924	8.1	24.87	24.68	1.38
reach_3	63.607	10-yr	420.00	125.90	128.4	128.98	130.30	0.037211	11.1	39.81	30.46	1.55
reach_3	63.607	25-yr	560.00	125.90	128.7	129.41	131.06	0.038643	12.6	48.23	32.61	1.62
reach_3	63.607	50-yr	670.00	125.90	128.9	129.70	131.59	0.039174	13.5	54.59	33.88	1.66
reach_3	63.607	100-yr	800.00	125.90	129.1	130.19	132.17	0.039365	14.4	61.94	35.29	1.69
reach_3	63.607	200-yr	890.00	125.90	129.2	130.40	132.54	0.039125	15.0	67.08	36.25	1.70
reach_3	63.607	500-yr	1070.00	125.90	129.5	131.29	133.10	0.035785	15.6	79.32	38.42	1.66

EXISTING CONDITIONS
NO TAILWATER

Plan: existnotailwater reach_3 RS: 161.5 Profile: 10-yr

E.G. US. (ft)	132.22	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	131.84	E.G. Elev (ft)	132.11	131.88
Q Total (cfs)	420.00	W.S. Elev (ft)	131.47	131.21
Q Bridge (cfs)	420.00	Crit W.S. (ft)	130.58	130.40
Q Weir (cfs)		Max Chl Dpth (ft)	3.80	3.51
Weir Sta Lft (ft)		Vel Total (ft/s)	6.40	6.55
Weir Sta Rgt (ft)		Flow Area (sq ft)	65.60	64.10
Weir Submerg		Froude # Chl	0.58	0.62
Weir Max Depth (ft)		Specif Force (cu ft)	191.64	189.58
Min El Weir Flow (ft)	134.59	Hydr Depth (ft)	3.28	3.20
Min El Prs (ft)	132.30	W.P. Total (ft)	26.81	25.11
Delta EG (ft)	0.47	Conv. Total (cfs)	5057.5	5082.8
Delta WS (ft)	0.61	Top Width (ft)	20.00	20.00
BR Open Area (sq ft)	80.11	Frctn Loss (ft)	0.23	0.05
BR Open Vel (ft/s)	6.55	C & E Loss (ft)	0.01	0.08
BR Sluice Coef		Shear Total (lb/sq ft)	1.05	1.09
BR Sel Method	Energy only	Power Total (lb/ft s)	6.75	7.13

Plan: existnotailwater reach_3 RS: 161.5 Profile: 100-yr

E.G. US. (ft)	135.21	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	135.14	E.G. Elev (ft)	135.21	135.17
Q Total (cfs)	800.00	W.S. Elev (ft)	135.14	135.01
Q Bridge (cfs)	761.29	Crit W.S. (ft)	131.88	131.68
Q Weir (cfs)	38.71	Max Chl Dpth (ft)	7.47	7.31
Weir Sta Lft (ft)	181.30	Vel Total (ft/s)	1.96	8.27
Weir Sta Rgt (ft)	222.00	Flow Area (sq ft)	408.48	96.75
Weir Submerg	0.00	Froude # Chl	0.19	0.56
Weir Max Depth (ft)	0.63	Specif Force (cu ft)	616.46	629.30
Min El Weir Flow (ft)	134.59	Hydr Depth (ft)	1.00	2.38
Min El Prs (ft)	132.30	W.P. Total (ft)	459.96	88.62
Delta EG (ft)	1.57	Conv. Total (cfs)		
Delta WS (ft)	2.12	Top Width (ft)	409.71	40.70
BR Open Area (sq ft)	80.11	Frctn Loss (ft)		
BR Open Vel (ft/s)	9.50	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)		
BR Sel Method	Press/Weir	Power Total (lb/ft s)		

EXISTING CONDITIONS WITH TAILWATER

HEC-RAS Plan: existtailwater rev River: Reach: reach_3

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach_3	300.198	Des 100us / 50ds	800.00	129.90	136.78	132.50	136.80	0.000091	1.26	852.07	351.39	0.09
reach_3	300.198	Chk 50us / 100ds	670.00	129.90	137.08	132.35	137.09	0.000048	0.95	960.16	364.25	0.07
reach_3	300.198	FEMA 100/100	800.00	129.90	137.24	132.50	137.25	0.000059	1.07	1019.76	369.54	0.08
reach_3	262.135	Des 100us / 50ds	800.00	130.40	136.77	132.58	136.79	0.000086	1.25	966.30	418.30	0.09
reach_3	262.135	Chk 50us / 100ds	670.00	130.40	137.08	132.38	137.09	0.000044	0.93	1094.56	430.08	0.07
reach_3	262.135	FEMA 100/100	800.00	130.40	137.24	132.58	137.25	0.000054	1.04	1164.95	436.41	0.07
reach_3	251.5		Inl Struct									
reach_3	241.745	Des 100us / 50ds	800.00	127.10	136.77		136.79	0.000064	1.43	1092.69	433.63	0.08
reach_3	241.745	Chk 50us / 100ds	670.00	127.10	137.07		137.08	0.000034	1.07	1225.64	445.34	0.06
reach_3	241.745	FEMA 100/100	800.00	127.10	137.23		137.24	0.000042	1.20	1298.55	451.63	0.07
reach_3	229.683	Des 100us / 50ds	800.00	125.40	136.77		136.78	0.000061	1.41	1131.13	428.20	0.08
reach_3	229.683	Chk 50us / 100ds	670.00	125.40	137.07		137.08	0.000033	1.06	1261.49	432.21	0.06
reach_3	229.683	FEMA 100/100	800.00	125.40	137.23		137.24	0.000042	1.20	1331.74	434.35	0.07
reach_3	205.816	Des 100us / 50ds	800.00	127.80	136.77		136.78	0.000051	1.22	1326.02	464.28	0.07
reach_3	205.816	Chk 50us / 100ds	670.00	127.80	137.07		137.08	0.000028	0.92	1467.19	471.63	0.06
reach_3	205.816	FEMA 100/100	800.00	127.80	137.23		137.24	0.000035	1.04	1544.13	475.59	0.06
reach_3	190.168	Des 100us / 50ds	800.00	128.10	136.75	131.56	136.78	0.000132	1.63	795.35	302.59	0.10
reach_3	190.168	Chk 50us / 100ds	670.00	128.10	137.06	131.24	137.08	0.000070	1.22	889.95	309.18	0.08
reach_3	190.168	FEMA 100/100	800.00	128.10	137.22	131.56	137.24	0.000087	1.38	939.73	312.59	0.09
reach_3	180.829	Des 100us / 50ds	800.00	127.60	136.76	131.52	136.77	0.000059	1.07	1296.52	476.23	0.07
reach_3	180.829	Chk 50us / 100ds	670.00	127.60	137.06	131.15	137.07	0.000031	0.80	1443.40	483.20	0.05
reach_3	180.829	FEMA 100/100	800.00	127.60	137.23	131.52	137.23	0.000038	0.90	1521.56	486.87	0.06
reach_3	161.5		Bridge									
reach_3	132.919	Des 100us / 50ds	800.00	127.70	135.89		136.09	0.000556	3.91	265.01	40.70	0.25
reach_3	132.919	Chk 50us / 100ds	670.00	127.70	136.74		136.85	0.000271	2.92	299.59	40.70	0.17
reach_3	132.919	FEMA 100/100	800.00	127.70	136.71		136.87	0.000391	3.50	298.48	40.70	0.21
reach_3	112.083	Des 100us / 50ds	800.00	126.90	135.91	131.66	136.04	0.000400	3.46	340.31	310.00	0.21
reach_3	112.083	Chk 50us / 100ds	670.00	126.90	136.75	131.17	136.82	0.000185	2.51	390.84	310.00	0.15
reach_3	112.083	FEMA 100/100	800.00	126.90	136.73	131.66	136.83	0.000266	3.01	389.65	310.00	0.17
reach_3	92.144	Des 100us / 50ds	800.00	126.40	136.00		136.00	0.000030	0.98	1725.12	369.00	0.06
reach_3	92.144	Chk 50us / 100ds	670.00	126.40	136.80		136.80	0.000013	0.68	2020.50	369.00	0.04

EXISTING CONDITIONS WITH TAILWATER

HEC-RAS Plan: existtailwater rev River: Reach: reach_3 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach_3	92.144	FEMA 100/100	800.00	126.40	136.80		136.80	0.000018	0.81	2020.43	369.00	0.05
reach_3	63.607	Des 100us / 50ds	800.00	125.90	136.00	130.20	136.00	0.000018	0.78	2178.54	405.95	0.05
reach_3	63.607	Chk 50us / 100ds	670.00	125.90	136.80	129.70	136.80	0.000008	0.55	2503.30	405.95	0.03
reach_3	63.607	FEMA 100/100	800.00	125.90	136.80	130.19	136.80	0.000011	0.66	2503.30	405.95	0.04

EXISTING CONDITIONS WITH TAILWATER

Plan: existtailwater rev reach_3 RS: 161.5 Profile: Des 100us / 50ds

E.G. US. (ft)	136.77	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	136.76	E.G. Elev (ft)	136.77	136.65
Q Total (cfs)	800.00	W.S. Elev (ft)	136.76	135.98
Q Bridge (cfs)	484.46	Crit W.S. (ft)	131.88	131.68
Q Weir (cfs)	315.54	Max Chl Dpth (ft)	9.08	8.28
Weir Sta Lft (ft)	181.30	Vel Total (ft/s)	0.70	5.87
Weir Sta Rgt (ft)	222.00	Flow Area (sq ft)	1139.41	136.28
Weir Submerg	0.57	Froude # Chl	0.06	0.38
Weir Max Depth (ft)	2.19	Specif Force (cu ft)	1809.61	680.85
Min El Weir Flow (ft)	134.59	Hydr Depth (ft)	2.39	3.35
Min El Prs (ft)	132.30	W.P. Total (ft)	528.21	90.56
Delta EG (ft)	0.68	Conv. Total (cfs)		
Delta WS (ft)	0.87	Top Width (ft)	476.23	40.70
BR Open Area (sq ft)	80.11	Frctn Loss (ft)		
BR Open Vel (ft/s)	6.05	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)		
BR Sel Method	Press/Weir	Power Total (lb/ft s)		

Plan: existtailwater rev reach_3 RS: 161.5 Profile: Chk 50us / 100ds

E.G. US. (ft)	137.07	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	137.06	E.G. Elev (ft)	137.07	136.90
Q Total (cfs)	670.00	W.S. Elev (ft)	137.06	136.74
Q Bridge (cfs)	293.77	Crit W.S. (ft)	131.47	131.27
Q Weir (cfs)	376.23	Max Chl Dpth (ft)	9.39	9.04
Weir Sta Lft (ft)	181.30	Vel Total (ft/s)	0.52	4.01
Weir Sta Rgt (ft)	222.00	Flow Area (sq ft)	1286.29	166.93
Weir Submerg	0.86	Froude # Chl	0.04	0.25
Weir Max Depth (ft)	2.49	Specif Force (cu ft)	2172.25	729.51
Min El Weir Flow (ft)	134.59	Hydr Depth (ft)	2.66	4.10
Min El Prs (ft)	132.30	W.P. Total (ft)	535.49	92.07
Delta EG (ft)	0.22	Conv. Total (cfs)		
Delta WS (ft)	0.33	Top Width (ft)	483.20	40.70
BR Open Area (sq ft)	80.11	Frctn Loss (ft)		
BR Open Vel (ft/s)	3.67	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)		
BR Sel Method	Press/Weir	Power Total (lb/ft s)		

Plan: existtailwater rev reach_3 RS: 161.5 Profile: FEMA 100/100

E.G. US. (ft)	137.23	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	137.23	E.G. Elev (ft)	137.23	137.09
Q Total (cfs)	800.00	W.S. Elev (ft)	137.23	136.71
Q Bridge (cfs)	375.48	Crit W.S. (ft)	131.88	131.68
Q Weir (cfs)	424.53	Max Chl Dpth (ft)	9.55	9.01
Weir Sta Lft (ft)	181.30	Vel Total (ft/s)	0.59	4.82
Weir Sta Rgt (ft)	222.00	Flow Area (sq ft)	1364.44	165.82
Weir Submerg	0.79	Froude # Chl	0.05	0.30
Weir Max Depth (ft)	2.66	Specif Force (cu ft)	2390.45	762.67
Min El Weir Flow (ft)	134.59	Hydr Depth (ft)	2.80	4.07
Min El Prs (ft)	132.30	W.P. Total (ft)	539.32	92.02
Delta EG (ft)	0.36	Conv. Total (cfs)		
Delta WS (ft)	0.52	Top Width (ft)	486.87	40.70
BR Open Area (sq ft)	80.11	Frctn Loss (ft)		
BR Open Vel (ft/s)	4.69	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)		
BR Sel Method	Press/Weir	Power Total (lb/ft s)		

Appendix F – Proposed Conditions Analysis

PROPOSED CONDITIONS
NO TAILWATER

HEC-RAS Plan: Alt C rev pro no tailwater River: Reach: reach_3

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach_3	300.198	2-yr	200.00	129.90	134.3	131.50	134.36	0.000064	0.7	279.46	94.44	0.07
reach_3	300.198	10-yr	420.00	129.90	135.0	131.97	135.05	0.000145	1.2	360.59	154.28	0.11
reach_3	300.198	25-yr	560.00	129.90	135.2	132.19	135.27	0.000211	1.5	396.68	192.76	0.14
reach_3	300.198	50-yr	670.00	129.90	135.4	132.35	135.41	0.000267	1.8	424.29	229.56	0.15
reach_3	300.198	100-yr	800.00	129.90	135.5	132.50	135.54	0.000340	2.0	451.15	245.15	0.17
reach_3	300.198	200-yr	890.00	129.90	135.5	132.61	135.62	0.000392	2.2	469.37	251.76	0.19
reach_3	300.198	500-yr	1070.00	129.90	135.7	132.81	135.79	0.000486	2.5	509.48	278.40	0.21
reach_3	262.135	2-yr	200.00	130.40	134.3	131.49	134.35	0.000083	0.8	247.96	101.31	0.08
reach_3	262.135	10-yr	420.00	130.40	135.0	131.95	135.04	0.000182	1.4	346.38	207.41	0.13
reach_3	262.135	25-yr	560.00	130.40	135.2	132.20	135.26	0.000258	1.7	393.44	252.18	0.15
reach_3	262.135	50-yr	670.00	130.40	135.3	132.38	135.40	0.000320	2.0	427.46	292.72	0.17
reach_3	262.135	100-yr	800.00	130.40	135.5	132.58	135.52	0.000401	2.3	460.66	315.84	0.19
reach_3	262.135	200-yr	890.00	130.40	135.5	132.71	135.60	0.000456	2.4	483.67	325.72	0.20
reach_3	262.135	500-yr	1070.00	130.40	135.7	132.95	135.77	0.000552	2.7	533.35	348.96	0.23
reach_3	251.5		Inl Struct									
reach_3	241.745	2-yr	200.00	127.10	130.6		130.70	0.000881	2.4	87.86	36.21	0.26
reach_3	241.745	10-yr	420.00	127.10	132.0		132.17	0.000870	3.1	148.93	50.02	0.28
reach_3	241.745	25-yr	560.00	127.10	133.3		133.48	0.000557	3.0	231.49	90.48	0.23
reach_3	241.745	50-yr	670.00	127.10	133.6		133.77	0.000657	3.4	256.15	99.42	0.25
reach_3	241.745	100-yr	800.00	127.10	133.9		134.12	0.000739	3.7	290.54	114.86	0.27
reach_3	241.745	200-yr	890.00	127.10	134.7		134.82	0.000541	3.5	396.73	186.07	0.24
reach_3	241.745	500-yr	1070.00	127.10	135.0		135.21	0.000571	3.7	477.73	247.20	0.24
reach_3	229.683	2-yr	200.00	125.40	130.6		130.68	0.000495	2.0	102.19	33.73	0.20
reach_3	229.683	10-yr	420.00	125.40	132.0		132.16	0.000639	2.8	156.28	46.44	0.23
reach_3	229.683	25-yr	560.00	125.40	133.4		133.47	0.000440	2.8	240.16	96.70	0.20
reach_3	229.683	50-yr	670.00	125.40	133.6		133.76	0.000526	3.1	266.99	107.61	0.22
reach_3	229.683	100-yr	800.00	125.40	133.9		134.11	0.000597	3.4	304.63	122.27	0.24
reach_3	229.683	200-yr	890.00	125.40	134.7		134.81	0.000441	3.2	419.12	185.49	0.21
reach_3	229.683	500-yr	1070.00	125.40	135.0		135.20	0.000481	3.4	502.24	259.53	0.22
reach_3	205.816	2-yr	200.00	127.80	130.6		130.66	0.001510	2.7	78.65	44.52	0.32
reach_3	205.816	10-yr	420.00	127.80	132.0		132.14	0.000993	3.0	156.14	62.14	0.29
reach_3	205.816	25-yr	560.00	127.80	133.4		133.45	0.000506	2.7	261.48	97.79	0.22
reach_3	205.816	50-yr	670.00	127.80	133.6		133.74	0.000581	3.0	288.17	104.43	0.23
reach_3	205.816	100-yr	800.00	127.80	133.9		134.09	0.000669	3.3	325.56	124.35	0.25

PROPOSED CONDITIONS
NO TAILWATER

HEC-RAS Plan: Alt C rev pro no tailwater River: Reach: reach_3 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach_3	205.816	200-yr	890.00	127.80	134.7		134.79	0.000445	3.0	460.05	270.41	0.21
reach_3	205.816	500-yr	1070.00	127.80	135.1		135.18	0.000452	3.1	578.71	338.06	0.21
reach_3	190.168	2-yr	200.00	128.10	130.3	129.69	130.60	0.004782	4.1	48.26	27.29	0.55
reach_3	190.168	10-yr	420.00	128.10	131.7	130.53	132.09	0.003221	4.8	88.22	31.45	0.48
reach_3	190.168	25-yr	560.00	128.10	133.1	130.95	133.42	0.001751	4.4	128.04	37.08	0.37
reach_3	190.168	50-yr	670.00	128.10	133.3	131.24	133.69	0.002214	5.0	133.18	40.86	0.41
reach_3	190.168	100-yr	800.00	128.10	133.5	131.56	134.03	0.002726	5.7	139.54	46.51	0.46
reach_3	190.168	200-yr	890.00	128.10	134.4	131.77	134.75	0.001571	4.8	233.54	186.57	0.35
reach_3	190.168	500-yr	1070.00	128.10	134.8	132.18	135.14	0.001484	4.8	316.84	208.70	0.34
reach_3	180.829	2-yr	200.00	127.60	130.3	129.51	130.56	0.004238	4.1	49.08	23.65	0.50
reach_3	180.829	10-yr	420.00	127.60	131.6	130.35	132.03	0.004105	5.2	80.24	24.05	0.51
reach_3	180.829	25-yr	560.00	127.60	133.0	130.82	133.37	0.002550	4.9	114.04	24.47	0.40
reach_3	180.829	50-yr	670.00	127.60	133.1	131.15	133.63	0.003411	5.7	117.04	24.76	0.46
reach_3	180.829	100-yr	800.00	127.60	133.3	131.52	133.95	0.004676	6.6	120.67	30.54	0.55
reach_3	180.829	200-yr	890.00	127.60	134.5	131.76	134.69	0.001481	4.2	307.28	309.77	0.32
reach_3	180.829	500-yr	1070.00	127.60	134.9	132.22	135.07	0.001108	3.9	463.77	398.93	0.28
reach_3	161.5		Bridge									
reach_3	132.919	2-yr	200.00	127.70	129.8		130.23	0.007228	5.2	40.05	25.33	0.69
reach_3	132.919	10-yr	420.00	127.70	131.2		131.75	0.004161	5.9	80.90	32.60	0.58
reach_3	132.919	25-yr	560.00	127.70	132.0		132.56	0.003328	6.1	108.86	37.18	0.54
reach_3	132.919	50-yr	670.00	127.70	132.5		133.09	0.003156	6.4	127.49	40.70	0.53
reach_3	132.919	100-yr	800.00	127.70	133.0		133.64	0.002974	6.7	148.27	40.70	0.53
reach_3	132.919	200-yr	890.00	127.70	133.5		134.13	0.002518	6.6	169.68	40.70	0.49
reach_3	132.919	500-yr	1070.00	127.70	133.4		134.32	0.003992	8.1	164.23	40.70	0.62
reach_3	112.083	2-yr	200.00	126.90	129.1	129.13	129.91	0.015027	7.1	28.94	19.30	0.98
reach_3	112.083	10-yr	420.00	126.90	130.2	130.17	131.39	0.012517	9.0	49.92	21.79	0.97
reach_3	112.083	25-yr	560.00	126.90	130.7	130.68	132.16	0.012049	10.0	61.67	24.24	0.98
reach_3	112.083	50-yr	670.00	126.90	131.2	131.17	132.70	0.010379	10.2	75.11	30.45	0.93
reach_3	112.083	100-yr	800.00	126.90	131.7	131.66	133.25	0.009334	10.5	91.51	121.75	0.90
reach_3	112.083	200-yr	890.00	126.90	131.7	131.66	133.63	0.011553	11.7	91.51	121.75	1.01
reach_3	112.083	500-yr	1070.00	126.90	132.8	132.78	134.09	0.006165	10.0	152.60	286.13	0.76
reach_3	92.144	2-yr	200.00	126.40	128.7	128.79	129.58	0.017799	7.4	27.80	19.71	1.06
reach_3	92.144	10-yr	420.00	126.40	129.5	129.83	131.07	0.018290	10.0	45.08	22.66	1.15

PROPOSED CONDITIONS
NO TAILWATER

HEC-RAS Plan: Alt C rev pro no tailwater River: Reach: reach_3 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach_3	92.144	25-yr	560.00	126.40	130.0	130.35	131.84	0.017863	11.1	55.42	24.26	1.17
reach_3	92.144	50-yr	670.00	126.40	130.3	130.76	132.38	0.017537	11.8	63.26	25.40	1.18
reach_3	92.144	100-yr	800.00	126.40	130.7	132.10	132.94	0.016392	12.4	73.49	26.82	1.17
reach_3	92.144	200-yr	890.00	126.40	130.9	132.22	133.31	0.015964	12.8	80.08	27.70	1.16
reach_3	92.144	500-yr	1070.00	126.40	131.5	132.35	133.82	0.013668	12.9	127.67	168.22	1.10
reach_3	63.607	2-yr	200.00	125.90	127.9	128.12	128.88	0.033924	8.1	24.87	24.68	1.38
reach_3	63.607	10-yr	420.00	125.90	128.4	128.98	130.30	0.037211	11.1	39.81	30.46	1.55
reach_3	63.607	25-yr	560.00	125.90	128.7	129.41	131.06	0.038643	12.6	48.23	32.61	1.62
reach_3	63.607	50-yr	670.00	125.90	128.9	129.70	131.59	0.039174	13.5	54.59	33.88	1.66
reach_3	63.607	100-yr	800.00	125.90	129.1	130.19	132.17	0.039365	14.4	61.94	35.29	1.69
reach_3	63.607	200-yr	890.00	125.90	129.2	130.40	132.54	0.039125	15.0	67.08	36.25	1.70
reach_3	63.607	500-yr	1070.00	125.90	129.5	131.29	133.10	0.035785	15.6	79.32	38.42	1.66

PROPOSED CONDITIONS
NO TAILWATER

Plan: Alt C rev pro no tailwater reach_3 RS: 161.5 Profile: 10-yr

E.G. US. (ft)	132.03	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	131.61	E.G. Elev (ft)	131.94	131.85
Q Total (cfs)	420.00	W.S. Elev (ft)	131.66	131.57
Q Bridge (cfs)	420.00	Crit W.S. (ft)	130.36	130.26
Q Weir (cfs)		Max Chl Dpth (ft)	3.96	3.87
Weir Sta Lft (ft)		Vel Total (ft/s)	4.23	4.20
Weir Sta Rgt (ft)		Flow Area (sq ft)	99.39	99.95
Weir Submerg		Froude # Chl	0.37	0.38
Weir Max Depth (ft)		Specif Force (cu ft)	210.53	215.21
Min El Weir Flow (ft)	135.42	Hydr Depth (ft)	3.01	3.03
Min El Prs (ft)	132.70	W.P. Total (ft)	40.15	38.38
Delta EG (ft)	0.29	Conv. Total (cfs)	7720.8	8259.9
Delta WS (ft)	0.37	Top Width (ft)	33.00	33.00
BR Open Area (sq ft)	129.41	Frctn Loss (ft)	0.09	0.03
BR Open Vel (ft/s)	4.23	C & E Loss (ft)	0.00	0.07
BR Sluice Coef		Shear Total (lb/sq ft)	0.46	0.42
BR Sel Method	Energy only	Power Total (lb/ft s)	1.93	1.77

Plan: Alt C rev pro no tailwater reach_3 RS: 161.5 Profile: 100-yr

E.G. US. (ft)	133.95	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	133.26	E.G. Elev (ft)	133.95	133.64
Q Total (cfs)	800.00	W.S. Elev (ft)	132.70	132.70
Q Bridge (cfs)	800.00	Crit W.S. (ft)	131.28	131.18
Q Weir (cfs)		Max Chl Dpth (ft)	5.00	5.00
Weir Sta Lft (ft)		Vel Total (ft/s)	6.18	6.01
Weir Sta Rgt (ft)		Flow Area (sq ft)	129.41	133.05
Weir Submerg		Froude # Chl	0.49	0.48
Weir Max Depth (ft)		Specif Force (cu ft)	429.58	444.08
Min El Weir Flow (ft)	135.42	Hydr Depth (ft)		
Min El Prs (ft)	132.70	W.P. Total (ft)	78.33	73.44
Delta EG (ft)	0.31	Conv. Total (cfs)	7678.2	8564.1
Delta WS (ft)	0.24	Top Width (ft)		
BR Open Area (sq ft)	129.41	Frctn Loss (ft)		
BR Open Vel (ft/s)	6.18	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)	1.12	0.99
BR Sel Method	Press Only	Power Total (lb/ft s)	6.92	5.93

PROPOSED CONDITIONS
NO TAILWATER

HEC-RAS HEC-RAS 6.3.1 September 2022
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X    X
X     X  X        X           X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X           X  X     X    X        X
X     X  X        X    X      X   X    X    X        X
X     X  XXXXXX    XXXX       X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: 04070
Project File : 04070.prj
Run Date and Time: 6/27/2023 12:04:03 PM

Project in English units

PLAN DATA

Plan Title: Proposed Alt C rev pro no tailwater
Plan File : r:\Liaison\Federal Local Bridge Program\1. Project Files\04070, SPN 135-344, List R\6. Permits\i. Flood Management Certification Applictaion\0135-0344_HEC-RAS_Final\04070.p12

Geometry Title: Alternate C REV PROFILE
Geometry File : r:\Liaison\Federal Local Bridge Program\1. Project Files\04070, SPN 135-344, List R\6. Permits\i. Flood Management Certification Applictaion\0135-0344_HEC-RAS_Final\04070.g08

Flow Title : Haviland with no tailwater
Flow File : r:\Liaison\Federal Local Bridge Program\1. Project Files\04070, SPN 135-344, List R\6. Permits\i. Flood Management Certification Applictaion\0135-0344_HEC-RAS_Final\04070.f01

Plan Summary Information:
Number of: Cross Sections = 11 Multiple Openings = 0
Culverts = 0 Inline Structures = 1
Bridges = 1 Lateral Structures = 0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20

PROPOSED CONDITIONS
NO TAILWATER

```
    Maximum difference tolerance         =  0.3
    Flow tolerance factor                =  0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method:         Average Conveyance
    Computational Flow Regime:     Mixed Flow
```

FLOW DATA

Flow Title: Haviland with no tailwater
Flow File : r:\Liaison\Federal Local Bridge Program\1. Project Files\04070, SPN 135-344, List R\6. Permits\i. Flood Management Certification Applictaion\0135-0344_HEC-RAS_Final\04070.f01

Flow Data (cfs)

River	Reach	RS	2-yr	10-yr	25-yr	50-yr	100-yr	200-yr	500-yr	1.25-yr
	reach_3	300.198	200	420	560	670	800	890	1070	120

River	Reach	RS	ADF	ASF	1.05-yr	1.5-yr
	reach_3	300.198	7	13	75	155

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
	reach_3	2-yr	Normal S = 0.001	Normal S = 0.017
	reach_3	10-yr	Normal S = 0.001	Normal S = 0.017
	reach_3	25-yr	Normal S = 0.001	Normal S = 0.017
	reach_3	50-yr	Normal S = 0.001	Normal S = 0.017
	reach_3	100-yr	Normal S = 0.001	Normal S = 0.017
	reach_3	200-yr	Normal S = 0.001	Normal S = 0.017
	reach_3	500-yr	Normal S = 0.001	Normal S = 0.017

GEOMETRY DATA

Geometry Title: Alternate C REV PROFILE
Geometry File : r:\Liaison\Federal Local Bridge Program\1. Project Files\04070, SPN 135-344, List R\6. Permits\i. Flood Management Certification Applictaion\0135-0344_HEC-RAS_Final\04070.g08

PROPOSED CONDITIONS
NO TAILWATER

CROSS SECTION

RIVER:
REACH: reach_3 RS: 300.198

INPUT
Description:
Station Elevation Data num= 204

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-65	138.2	0	135.35	1.65	135.41	3.3	135.35	4.95	135.21
6.6	135.3	8.24	135.25	9.89	135.22	11.54	135.21	13.19	135.17
14.84	135.17	16.49	135.14	18.14	135.15	19.79	135.13	21.43	135.16
23.08	135.14	24.73	135.16	26.38	135.26	28.03	135.27	29.68	135.36
31.33	135.29	32.98	135.29	34.62	135.3	36.27	135.3	37.92	135.33
39.57	135.34	41.22	135.36	42.87	135.43	44.52	135.45	46.17	135.5
47.81	135.49	49.46	135.58	51.11	135.59	52.76	135.64	54.41	135.7
56.06	135.78	57.71	135.91	59.36	135.96	61	135.98	62.65	136.05
64.3	136.27	65.95	136.39	67.6	136.47	69.25	136.58	70.9	136.62
72.55	136.5	74.2	136.47	75.84	136.48	77.49	136.49	79.14	136.51
80.79	136.44	82.44	136.41	84.09	136.38	85.74	136.35	87.39	136.31
89.03	136.27	90.68	136.22	92.33	136.15	93.98	136.09	95.63	136
97.28	135.97	98.93	135.94	100.58	135.91	102.22	135.88	103.87	135.85
105.52	135.82	107.17	135.85	108.82	135.86	110.47	135.84	112.12	135.84
113.77	135.85	115.41	135.85	117.06	135.85	118.71	135.85	120.36	135.86
122.01	135.86	123.66	135.86	125.31	135.87	126.96	135.9	128.61	135.94
130.25	135.91	131.9	135.86	133.55	135.85	135.2	135.81	136.85	135.76
138.5	135.75	140.15	135.81	141.8	135.84	143.44	135.84	145.09	135.84
146.74	135.83	148.39	135.83	150.04	135.8	151.69	135.8	153.34	135.81
154.99	135.81	156.63	135.82	158.28	135.83	159.93	135.84	161.58	135.84
163.23	135.85	164.88	135.86	166.53	135.87	168.18	135.87	169.82	135.87
171.47	135.62	173.12	135.4	174.77	135.43	176.42	135.4	178.07	135.32
179.72	135.28	181.37	135.29	183.02	135.27	184.67	135.24	186.32	135.24
187.97	135.2	189.63	135.18	191.28	135.12	192.93	135.06	194.58	135.05
196.23	135.04	197.88	135	199.54	134.95	201.19	134.91	202.84	134.85
204.49	134.82	206.1	135.1	216.97	134.84	223.1	134.7	226.8	134.1
228.8	132.2	229.23	132.13	235.7	131.1	244.8	131	256.2	130.5
258.8	131.8	266.1	132.1	274.7	131.1	297.3	130.6	303.9	129.9
309.8	131.7	314.8	133.2	317.21	134.44	318.1	134.9	340.2	134.3
360.7	135.3	361.23	135.18	361.49	135.2	362.77	135.29	364.32	135.18
365.86	135.27	367.4	135.34	368.95	135.43	370.49	135.56	372.03	135.58
373.58	135.62	375.12	135.72	376.67	135.78	378.21	135.74	379.75	135.71
379.8	135.71	381.3	135.62	382.84	135.61	384.39	135.6	385.93	135.58
387.47	135.6	389.02	135.6	390.56	135.61	392.11	135.69	393.65	135.79
395.19	135.79	396.74	135.8	398.28	135.87	399.83	136.01	401.37	136.1
402.91	136.1	404.46	136.21	406	136.36	407.54	136.5	409.09	136.68
410.63	136.77	412.18	136.8	413.72	136.84	415.26	136.96	416.81	137.07
418.35	137.23	419.9	137.35	421.44	137.5	422.98	137.65	424.53	137.83
426.07	137.98	427.62	138.13	429.16	138.27	430.7	138.34	432.25	138.51
433.79	138.65	435.33	138.8	436.88	138.88	438.42	138.93	439.97	139.01
441.51	139.1	443.05	139.26	444.6	139.42	446.14	139.53		

PROPOSED CONDITIONS
NO TAILWATER

Manning's n Values num= 7

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
-65	.04	80.79	.04	216.97	.07	229.23	.035	317.21	.04
361.49	.012	379.8	.04						

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
229.23	317.21	40.41	38.06	34.97	.1	.3

Blocked Obstructions num= 1

Sta L	Sta R	Elev
79	171	150

CROSS SECTION

RIVER:
REACH: reach_3 RS: 262.135

INPUT
Description:
Station Elevation Data num= 207

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-65	138.2	0	135.48	1.63	135.28	3.25	135.14	4.88	134.94
6.5	134.88	8.13	134.78	9.75	134.72	11.38	134.65	13	134.55
14.63	134.51	16.26	134.46	17.88	134.42	19.51	134.46	21.13	134.49
22.76	134.55	24.38	134.5	26.01	134.49	27.64	134.5	29.26	134.57
30.89	134.58	32.51	134.63	34.14	134.64	35.76	134.63	37.39	134.66
39.01	134.73	40.64	134.79	42.27	134.84	43.89	134.83	45.52	134.83
47.14	134.79	48.77	134.84	50.39	134.86	52.02	134.89	53.65	134.9
55.27	134.99	56.9	135.05	58.52	135.11	60.15	135.18	61.77	135.16
63.4	135.18	65.02	135.2	66.65	135.26	68.28	135.44	69.9	135.55
71.53	135.7	73.15	135.85	74.78	135.89	76.4	135.89	78.03	136
79.66	136.08	81.28	135.99	82.91	135.84	84.53	135.81	85.06	135.81
86.16	135.81	87.78	135.79	89.41	135.78	91.03	135.74	92.66	135.74
94.29	135.73	95.91	135.71	97.54	135.69	99.16	135.66	100.79	135.66
102.41	135.64	104.04	135.63	105.67	135.59	107.29	135.58	108.92	135.58
110.54	135.56	112.17	135.55	113.79	135.5	115.42	135.52	117.04	135.54
118.67	135.56	120.3	135.66	121.92	135.61	123.55	135.47	125.17	135.32
126.8	135.33	128.42	135.31	130.05	135.29	131.68	135.28	133.3	135.29
134.93	135.27	136.55	135.29	138.18	135.37	139.8	135.46	141.43	135.38
143.05	135.31	144.68	135.32	146.31	135.32	147.93	135.31	149.56	135.32
151.18	135.39	152.81	135.41	154.43	135.45	156.06	135.44	157.69	135.47
159.31	135.61	160.94	135.64	162.56	135.62	164.19	135.71	165.81	135.72
167.44	135.72	169.06	135.72	170.69	135.66	172.32	135.7	173.94	135.63
175.57	135.52	177.19	135.41	178.82	135.48	180.44	135.48	182.07	135.41
183.7	135.36	185.32	135.34	186.95	135.34	188.57	135.32	190.2	135.27
191.82	135.24	193.45	135.21	195.07	135.18	196.7	135.15	198.33	135.1
199.95	135.05	201.58	135.12	203.2	135.02	204.83	135.05	206.45	135.11
208.08	135.09	209.71	135.07	211.33	135.14	212.96	135.1	214.58	135.03
214.75	135.02	216.21	134.89	217.83	134.83	219.46	134.81	221.08	134.79
222.71	134.83	224.34	134.77	225.96	134.73	227.59	134.7	229.21	134.66

PROPOSED CONDITIONS
NO TAILWATER

```
  230.84  134.67   231.8   134.9   244.9   134.9   246.7   134.4   252.9   133.3
   260.7   131.4   271.2   130.8   291.7   130.6     304   130.4   317.9   131.3
   325.3   133.5  325.37   133.5  342.15  134.07  343.63  134.03  345.11  134.14
  346.58  134.21  348.06  134.32  349.54  134.43  351.02  134.47   352.5  134.49
  353.98  134.61  355.46  134.59  356.94  134.62  358.42  134.59   359.9  134.64
  361.38  134.69  362.86  134.73  364.33  134.73  365.81  134.76  365.99  134.77
  367.29   134.8  368.77  134.91  370.25  134.95  371.73   135.1  373.21  135.09
  374.69  135.11  376.17  135.21  377.65   135.2  379.13  135.23  380.61  135.23
  382.08  135.26  383.56  135.28  384.24  135.22  385.04  135.16  386.52  135.19
     388   135.2  389.48  135.37  390.96  135.34  392.44  135.33  393.92   135.4
   395.4  135.53  396.88  135.64  398.36  135.65  399.83  135.67  401.31  135.73
  402.79  135.79  404.27  135.84  405.75  135.89  407.23  135.93  408.71     136
  410.19  136.03     470     140

Manning's n Values        num=       7
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
     -65     .04   85.06     .04  214.75     .07   252.9    .035  325.37     .04
  365.99    .012  384.24     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         252.9  325.37            52.85   20.39   57.74             .1       .3
Blocked Obstructions     num=       1
   Sta L   Sta R    Elev
      84     118     150

INLINE STRUCTURE


RIVER:
REACH: reach_3            RS: 251.5

INPUT
Description:
Distance from Upstream XS =       4
Deck/Roadway Width        =      14
Weir Coefficient          =     2.6
 Weir Embankment Coordinates    num =       17
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
   246.8   134.2   251.1   134.2   252.6   134.9   266.4   134.8   288.1   134.8
   288.2   132.5   289.2   132.5   289.3   133.9   292.3   133.9   292.4   131.2
   303.3   131.2   303.4   133.8   320.8   133.8   325.3   133.8   325.4   137.2
   335.6   137.2   335.7   134.4

Upstream Embankment side slope             =       0 horiz. to 1.0 vertical
Downstream Embankment side slope           =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .98
Elevation at which weir flow begins        =
Weir crest shape                           = Broad Crested


CROSS SECTION
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PROPOSED CONDITIONS
NO TAILWATER

RIVER:
REACH: reach_3 RS: 241.745

INPUT
Description:
Station Elevation Data num= 197

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-80	138.2	0	134.91	1.64	134.84	3.28	134.77	4.93	134.68
6.57	134.6	8.21	134.54	9.85	134.46	11.49	134.33	13.14	134.28
14.78	134.26	16.42	134.29	18.06	134.31	19.7	134.43	21.35	134.35
22.99	134.28	24.63	134.25	26.27	134.23	27.91	134.29	29.56	134.41
31.2	134.5	32.84	134.51	34.48	134.49	36.12	134.54	37.77	134.57
39.41	134.59	41.05	134.61	42.69	134.62	44.33	134.74	45.98	134.8
47.62	134.81	49.26	134.83	50.9	134.86	52.54	134.91	54.19	134.96
55.83	135	57.47	135.04	59.11	135.08	60.75	134.96	62.4	135.05
64.04	135.24	65.68	135.44	67.32	135.67	68.96	135.82	70.61	135.98
72.25	136.15	73.89	136.36	75.53	136.54	77.17	136.19	78.82	136.07
80.46	135.98	82.1	135.87	83.56	135.74	83.74	135.72	85.38	135.74
87.03	135.73	88.67	135.72	90.31	135.71	91.95	135.7	93.59	135.69
95.24	135.68	96.88	135.67	98.52	135.66	100.16	135.65	101.8	135.64
103.45	135.63	105.09	135.62	106.73	135.61	108.37	135.58	110.01	135.54
111.66	135.58	113.3	135.62	114.94	135.66	116.58	135.7	118.22	135.58
119.87	135.57	121.51	135.47	123.15	135.32	124.79	135.3	126.43	135.33
128.07	135.27	129.72	135.22	131.36	135.33	133	135.14	134.64	135.1
136.28	135.19	137.93	135.28	139.57	135.46	141.21	135.73	142.85	135.81
144.49	135.86	146.14	135.92	147.78	136	149.42	135.75	151.06	135.78
152.7	135.77	154.35	135.74	155.99	135.72	157.63	135.81	159.27	135.91
160.91	136.05	162.56	136.2	164.2	136.21	165.84	136.25	167.48	136.25
169.12	136.27	170.77	136.33	172.41	136.37	174.05	136.35	175.69	136.32
177.33	136.28	178.98	136.18	180.62	136.12	182.26	136.11	183.9	135.95
185.54	135.75	187.19	135.44	188.83	135.35	190.47	135.26	192.11	135.22
193.75	135.2	195.4	135.3	197.04	135.19	198.68	135.21	200.32	135.21
201.96	135.3	203.61	135.08	205.25	135.21	206.89	135.06	208.53	134.97
210.17	134.88	211.82	134.91	213.23	134.9	213.46	134.9	215.1	134.82
216.74	134.7	218.38	134.61	220.03	134.48	221.67	134.43	223.31	134.37
224.95	134.32	226.59	134.22	228.24	134.17	229.88	134.09	231.52	134.05
233.16	133.99	234.8	133.88	236.45	133.88	238.09	133.79	238.5	134.1
259.4	133	277.7	133	286.24	128.34	286.5	128.2	292.9	127.1
297.3	127.1	302.3	127.2	308.3	128.5	316.1	129.4	317.85	130.4
318.2	130.6	336.4	132.9	347.2	133.6	356.5	134.2	357.93	134.16
359.43	134.31	360.93	134.49	362.43	134.52	363.92	134.58	364.64	134.62
365.42	134.66	366.92	134.68	368.42	134.78	369.91	134.84	371.41	134.83
372.91	134.92	374.4	134.99	375.9	134.93	377.4	134.95	378.9	135
380.39	134.97	381.89	134.88	383.39	134.76	383.45	134.76	384.89	134.85
386.38	134.87	387.88	134.9	389.38	134.92	390.88	135.04	392.37	135.25
393.87	135.21	395.37	135.22	396.87	135.23	398.36	135.24	399.86	135.25
401.36	135.23	470	140						

Manning's n Values num= 7

PROPOSED CONDITIONS
NO TAILWATER

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
-80	.04	83.56	.04	213.23	.07	286.24	.035	317.85	.04
364.64	.012	383.45	.04						

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
286.24	317.85	13.2	12.06	8.67	.1	.3

Blocked Obstructions num= 1

Sta L	Sta R	Elev
84	119	150

CROSS SECTION

RIVER:
REACH: reach_3 RS: 229.683

INPUT
Description:
Station Elevation Data num= 211

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	134.41	1.63	134.36	3.26	134.32	4.89	134.27	6.52	134.2
8.14	134.14	9.77	134.09	11.4	134	13.03	134.01	14.66	134.02
16.29	134.02	17.92	133.99	19.55	133.99	21.17	134	22.8	133.99
24.43	133.98	26.06	134.08	27.69	134.19	29.32	134.26	30.95	134.35
32.58	134.36	34.2	134.43	35.83	134.62	37.46	134.68	39.09	134.77
40.72	134.88	42.35	135	43.98	134.98	45.61	134.91	47.23	134.81
48.86	134.9	50.49	134.78	52.12	134.71	53.75	134.63	55.38	134.58
57.01	134.53	58.64	134.73	60.26	135.04	61.89	135.36	63.52	135.72
65.15	136.03	66.78	136.22	68.41	136.42	70.04	136.2	71.67	136.11
73.29	136.04	74.92	135.97	76.55	135.9	78.18	135.83	79.81	135.76
81.44	135.69	83.07	135.61	84.7	135.53	86.32	135.47	87.95	135.22
89.58	135.21	91.21	135.2	92.84	135.15	94.47	135.24	96.1	135.26
97.73	135.22	99.36	135.16	100.98	135.17	102.61	135.2	104.24	135.26
105.87	135.3	107.5	135.32	109.13	135.27	110.76	135.3	112.39	135.32
114.01	135.34	115.64	135.34	117.27	135.25	118.9	135.17	120.53	135.05
122.16	134.93	123.79	134.98	125.42	134.96	127.04	134.98	128.32	135.01
128.67	135.01	130.3	135.06	131.93	135.03	133.56	135.51	135.19	135.83
136.83	136.1	138.48	136.07	140.12	135.91	141.77	136.02	143.42	136.16
145.06	136.27	146.71	136.05	148.35	135.84	150	135.75	151.64	135.87
153.29	136.08	154.94	135.91	156.58	135.79	158.23	135.66	159.87	135.55
161.52	135.46	163.16	135.55	164.81	135.6	166.45	135.62	168.1	135.64
169.75	135.64	171.39	135.64	173.04	135.65	174.68	135.68	176.33	135.84
177.97	136.01	179.62	136.16	181.27	136.27	182.91	136.36	184.56	136.45
186.2	136.58	187.85	136.75	189.49	136.62	191.14	136.42	192.79	136.26
194.43	135.87	196.08	135.33	197.72	135.23	199.37	135.13	201.01	135.19
202.66	135.07	204.3	135.07	205.95	135.14	207.6	135.11	209.24	135.05
210.89	134.99	212.53	134.97	213.73	134.94	214.18	134.93	215.82	134.93
217.47	134.92	219.12	134.82	220.76	134.74	222.41	134.69	224.05	134.67
225.7	134.64	227.34	134.59	228.99	134.5	230.63	134.32	232.28	134.16
233.93	134.05	235.57	133.86	237.22	133.81	238.86	133.72	239.7	133.9
257.7	132.7	265.4	133.3	267	133.3	274.9	133.1	280.7	132.4

PROPOSED CONDITIONS
NO TAILWATER

283.1	131	285.22	129.64	287	128.5	294.4	126.3	299.1	125.4
306.3	127.2	312.5	128.7	318.92	131.21	319.4	131.4	343	133.2
344.37	133.34	345.85	133.43	347.33	133.42	348.8	133.46	350.28	133.49
351.76	133.63	353.23	133.66	354.71	133.7	356.19	133.85	357.67	133.99
359.14	134.07	360.62	134.16	362.1	134.35	363.58	134.52	365.05	134.49
366.21	134.56	366.53	134.58	368.01	134.83	369.49	134.73	370.96	134.69
372.44	134.71	373.92	134.75	375.39	134.81	376.87	134.86	378.35	134.83
379.83	134.9	381.3	134.97	382.78	134.84	384.26	134.88	385.33	134.87
385.74	134.86	387.21	134.9	388.69	134.88	390.17	134.87	391.65	134.83
393.12	134.9	394.6	134.96	396.08	134.94	397.55	135.03	399.03	135.09
400.51	135.12	401.99	135.15	403.46	135.17	404.94	135.14	406.42	135.12
471	140								

Manning's n Values num= 7

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.07	128.32	.04	213.73	.07	285.22	.035	318.92	.04
366.21	.012	385.33	.04						

Bank Sta: Left	Right	Lengths: Left Channel		Right	Coeff Contr.	Expan.
285.22	318.92		23.03	23.87	26.04	.1	.3

CROSS SECTION

RIVER:
REACH: reach_3 RS: 205.816

INPUT
Description:
Station Elevation Data num= 190

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	134.14	1.63	134.14	3.27	134.13	4.9	134.13	6.54	134.12
8.17	134.1	9.8	134.09	11.44	134.07	13.07	134.03	14.7	133.98
16.34	134.01	17.97	134.05	19.61	134.06	21.24	134.12	22.87	134.17
24.51	134.13	26.14	134.18	27.77	134.14	29.41	134.13	31.04	134.19
32.68	134.23	34.31	134.27	35.94	134.31	37.58	134.36	39.21	134.4
40.85	134.31	42.48	134.36	44.11	134.39	45.75	134.45	47.38	134.45
49.01	134.48	50.65	134.52	52.28	134.56	53.92	134.6	55.55	134.63
57.18	134.58	58.82	134.66	60.45	134.74	62.08	134.85	63.72	135.01
65.35	135.06	66.99	135.07	68.62	135.13	70.25	135.2	71.89	135.23
73.52	135.08	75.16	134.7	76.79	134.54	78.42	134.46	80.06	134.4
81.69	134.39	83.32	134.4	84.96	134.39	86.59	134.47	88.23	134.44
89.86	134.46	91.49	134.45	93.13	134.42	94.76	134.36	96.39	134.49
98.03	134.47	99.66	134.65	101.3	134.66	102.93	134.6	104.56	134.56
106.2	134.53	107.83	134.44	109.47	134.58	111.1	134.64	112.73	134.67
114.37	134.68	116	134.7	117.63	134.7	119.27	134.72	120.9	134.77
122.54	134.8	124.17	134.88	125.8	134.91	127.44	134.93	129.07	134.96
130.7	135.02	132.34	135.06	133.97	135.06	135.61	135.13	137.24	135.16
138.87	135.17	140.51	135.15	142.14	135.15	143.78	135.16	145.41	135.16
147.04	135.18	148.68	135.21	150.31	135.16	151.94	135.15	153.58	135.14
155.21	135.15	156.85	135.12	158.48	135.12	160.11	135.21	161.75	135.27

PROPOSED CONDITIONS
NO TAILWATER

163.38	135.5	165.02	135.24	166.65	135.22	168.28	135.21	169.92	134.93
171.55	135.24	173.18	135.25	174.82	135.16	176.45	135.12	178.09	135.13
179.72	135.02	181.35	135.26	182.98	135.18	184.62	135.15	186.25	135.12
187.88	135.1	189.51	135.08	191.14	135.1	192.78	135.09	193.5	135.2
212.6	135.1	237.1	134.4	241.9	134.2	271.2	132.7	279.7	132.3
285.6	130.8	286.4	130.6	289	128.6	298.6	127.8	308.8	128.3
316.5	128.8	321.31	129.38	344.85	132.23	346.28	132.44	347.71	132.54
349.14	132.63	350.58	132.75	352.01	132.86	353.44	133.03	354.87	133.23
356.31	133.36	357.74	133.62	359.17	133.93	360.6	133.79	362.03	133.7
363.47	133.74	364.9	133.71	366.33	133.67	367.76	133.69	369.2	133.75
370.63	133.84	371.92	134.03	372.06	134.05	373.49	134.27	374.93	134.25
376.36	134.33	377.79	134.44	379.22	134.45	380.65	134.47	382.09	134.52
383.52	134.59	384.95	134.66	386.38	134.67	387.82	134.68	389.25	134.74
390.68	134.75	391.88	134.72	392.11	134.71	393.55	134.63	394.98	134.55
396.41	134.54	397.84	134.54	399.27	134.53	400.71	134.64	402.14	134.69
403.57	134.64	405	134.66	406.44	134.71	407.87	134.73	409.3	134.72
410.73	134.79	412.17	134.81	413.6	134.81	415.03	134.87	416.46	134.91
417.9	134.89	419.33	134.92	420.76	134.93	422.19	135.04	543	140

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.07	285.6	.035	321.31	.04	371.92	.012	391.88	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
285.6	321.31	15.85	15.65	18.34	.1	.3

CROSS SECTION

RIVER:
REACH: reach_3 RS: 190.168

INPUT
Description:
Station Elevation Data num= 203

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	133.92	1.63	133.97	3.26	134.01	4.88	134.06	6.51	134.1
8.14	134.15	9.77	134.23	11.4	134.26	13.02	134.29	14.65	134.32
16.28	134.34	17.91	134.38	19.54	134.41	21.16	134.45	22.79	134.42
24.42	134.43	26.05	134.52	27.68	134.38	29.3	134.24	30.93	134.18
32.56	134.09	34.19	134.01	35.82	133.95	37.44	133.91	39.07	133.96
42.33	133.96	43.96	133.98	45.58	134	47.21	134.03	48.84	134.07
50.47	134.12	52.1	134.17	53.72	134.23	55.35	134.25	56.98	134.29
58.61	134.33	60.24	134.34	61.86	134.39	63.49	134.56	65.12	134.7
66.75	134.77	68.37	134.79	70	134.81	71.63	134.86	73.26	134.77
74.89	134.49	76.51	134.5	78.14	134.48	79.77	134.39	81.41	134.28
83.06	134.08	84.7	134.05	86.34	134.04	87.98	133.99	89.63	133.96
91.27	133.97	92.91	134.03	94.56	134.11	97.84	134.23	99.48	134.28
101.13	134.32	102.77	134.38	104.41	134.44	106.05	134.47	107.7	134.5
109.34	134.45	110.98	134.38	112.63	134.42	114.27	134.49	115.91	134.53
117.55	134.47	119.2	134.45	120.84	134.5	122.48	134.54	124.12	134.58

PROPOSED CONDITIONS
NO TAILWATER

125.77	134.62	127.41	134.67	129.05	134.71	130.7	134.76	132.34	134.83
133.98	134.89	135.62	134.91	137.27	134.9	140.55	134.9	142.19	134.88
143.84	134.85	145.48	134.9	147.12	134.92	148.76	134.9	150.41	134.73
152.05	134.76	153.74	134.8	155.42	134.83	157.11	134.85	158.8	134.81
160.48	134.79	162.17	134.84	163.86	134.88	165.55	134.92	167.23	134.96
168.92	134.96	170.61	134.88	172.29	134.85	173.98	134.83	175.67	134.8
177.35	134.79	179.04	134.82	180.73	134.86	182.41	134.86	184.1	134.88
185.79	134.91	187.47	134.98	189.16	134.87	190.85	135.03	191.7	135.1
207.8	135.2	216.3	135.2	230.3	134.5	239.6	134.3	257.1	134.1
270.4	133.2	278.3	133.1	284.3	131.08	288.1	129.8	289.2	128.4
299.9	128.4	303.3	128.1	308.6	128.1	314.2	130.1	315.85	130.3
327.4	131.7	328.03	131.56	329.61	131.8	331.18	131.97	332.76	131.89
334.34	131.92	335.91	132.01	337.49	132.26	339.06	132.5	340.64	132.59
342.22	132.6	343.79	132.57	345.37	132.52	346.94	132.49	348.52	132.61
350.1	132.71	351.67	132.64	353.25	132.7	354.82	132.9	356.4	133.07
357.98	133.03	359.41	133.2	360.85	133.31	362.29	133.32	363.73	133.3
365.17	133.22	366.61	133.16	368.05	133.21	369.49	133.35	370.92	133.47
372.36	133.41	373.11	133.45	373.8	133.48	375.24	133.55	376.68	133.55
378.12	133.59	379.56	133.77	380.99	133.74	382.43	133.72	383.87	133.86
385.31	133.89	386.75	133.88	388.19	133.91	389.63	133.99	391.06	134.08
392.5	134.07	392.68	134.07	393.94	134.05	395.38	134.05	396.82	134.01
398.26	134.15	399.7	134.16	401.13	134.27	402.57	134.39	404.01	134.49
405.45	134.43	406.89	134.34	408.33	134.3	409.77	134.36	411.2	134.4
412.64	134.37	414.08	134.3	415.52	134.25	416.96	134.33	418.4	134.42
419.84	134.36	421.28	134.38	422.71	134.38	424.15	134.41	425.59	134.43
427.03	134.39	428.47	134.39	548	140				

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.07	284.3	.035	315.85	.04	373.11	.012	392.68	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
284.3	315.85	9.54	9.34	10.36	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	285	134	F
315	548	134	F

Blocked Obstructions num= 4

Sta L	Sta R	Elev	Sta L	Sta R	Elev	Sta L	Sta R	Elev
58	79.4	137.7	99.3	228.5	138	249.4	275	138
313.8	366.9	136						

CROSS SECTION

RIVER:
REACH: reach_3 RS: 180.829

INPUT
Description:
Station Elevation Data num= 225

PROPOSED CONDITIONS
NO TAILWATER

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	133.73	1.66	133.77	3.32	133.8	4.99	133.84	6.65	133.88
8.31	133.92	9.97	133.91	11.64	133.92	13.3	133.94	14.96	134.27
16.62	134.01	18.29	133.96	19.95	133.97	21.61	133.85	23.27	133.83
24.94	133.96	26.6	133.9	28.26	133.8	29.92	133.8	31.59	133.72
33.25	133.68	34.91	133.69	36.57	133.7	38.24	133.71	41.56	133.71
43.22	133.72	44.89	133.74	48.21	133.8	49.87	133.85	51.54	133.86
53.2	133.9	54.86	133.93	56.52	134.03	58.19	134.08	59.85	134.21
61.51	134.31	63.17	134.42	64.84	134.53	66.5	134.64	68.16	134.66
69.82	134.6	71.49	134.52	73.15	134.44	74.81	134.37	76.47	134.29
78.14	134.21	79.8	134.13	81.46	134.06	83.12	133.98	84.79	133.93
86.45	133.95	88.11	133.97	89.77	133.98	91.44	133.98	93.1	134
94.76	134.04	96.42	134.07	98.09	134.09	101.41	134.13	103.07	134.15
104.74	134.17	106.4	134.18	108.06	134.15	109.72	134.19	111.39	134.14
113.05	134.06	114.71	134	116.37	134	118.04	134.21	119.7	134.33
121.36	134.37	123.02	134.41	124.69	134.44	126.35	134.52	128.01	134.57
129.67	134.64	131.34	134.68	133	134.7	134.66	134.66	136.32	134.67
137.99	134.63	139.65	134.58	141.31	134.53	142.97	134.6	144.64	134.63
146.3	134.69	147.96	134.62	149.62	134.51	151.29	134.53	152.95	134.54
154.61	134.58	156.27	134.61	157.98	134.61	159.68	134.6	161.38	134.55
163.09	134.52	164.79	134.49	166.49	134.45	168.19	134.42	169.9	134.38
171.6	134.37	173.3	134.46	175.01	134.46	176.71	134.45	178.41	134.43
180.12	134.39	181.82	134.4	183.52	134.48	185.22	134.67	186.93	134.85
188.63	134.98	190.33	135.21	192.04	135.14	193.74	135.39	195.44	135.34
197.15	135.32	198.85	135.55	200.55	135.61	202.25	135.53	203.96	135.52
205.66	135.56	207.36	135.69	209.07	135.56	210.77	135.46	212.47	135.51
214.18	135.55	215.88	135.53	217.58	135.42	219.28	135.2	220.99	134.88
222.69	134.64	224.39	134.42	226.1	134.37	227.8	134.17	229.5	134
231.21	134.01	232.91	134	234.52	134	236.13	133.99	237.75	133.99
239.36	133.95	240.97	134.01	242.59	134.01	244.2	134	245.81	133.98
247.43	134.03	249.04	134.05	250.65	134.03	252.26	133.99	253.88	133.97
254.6	134.1	277.1	134.1	282.75	133.24	283.7	133.1	285	127.6
291.7	128.1	298.4	128.4	302.5	128.3	307.9	128.6	308.2	133.1
310.96	133.62	313.5	134.1	342.2	133.4	343.57	133.65	345.33	133.67
347.09	133.7	348.85	133.63	350.29	133.66	351.74	133.66	353.19	133.73
354.64	133.72	356.08	133.65	357.53	133.36	358.98	133.43	360.43	133.39
360.85	133.37	361.88	133.32	363.32	133.3	364.77	133.31	366.22	133.33
367.67	133.28	369.11	133.24	370.56	133.25	372.01	133.25	373.46	133.29
374.9	133.33	376.35	133.38	377.8	133.35	379.25	133.45	380.69	133.58
382.14	133.68	383.59	133.7	385.04	133.72	386.49	133.68	387.93	133.64
389.38	133.72	390.83	133.81	392.28	133.77	392.34	133.77	393.72	133.7
395.17	133.72	396.62	133.75	398.07	133.97	399.51	134.21	400.96	134.41
402.41	134.5	403.86	134.44	405.3	134.64	406.75	134.55	408.2	134.54
409.65	134.73	411.1	134.86	412.54	134.93	413.99	134.81	415.44	134.85
416.89	134.67	418.33	134.67	419.78	134.64	421.23	134.66	422.68	134.7
424.12	134.75	425.57	134.74	427.02	134.71	428.47	134.66	550	140

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.07	282.75	.035	310.96	.04	360.85	.012	392.34	.04

PROPOSED CONDITIONS
NO TAILWATER

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
282.75	310.96	48.98	47.91	48.24	.3	.5

BRIDGE

RIVER:
REACH: reach_3 RS: 161.5

INPUT
Description:
Distance from Upstream XS = 5
Deck/Roadway Width = 33
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates
num= 26

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
2.8	134		78.3	134.1		153.2	134	
215.4	134.1		252.5	134.5		268	134.7	
268	137.2		272	138.3		275.5	138.3	
275.5	135.4		279.5	135.5		279.5	135.5	132.5
282.5	135.5	132.5	303.5	135.6	132.6	312.5	135.6	132.7
312.5	135.6		316.5	135.7		316.5	138.6	
320	138.6		324	137.5		324	135	
338.5	134.6		351.5	134.3		361.5	133.9	
372.5	133.7		394.7	133.5				

Upstream Bridge Cross Section Data
Station Elevation Data num= 225

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	133.73	1.66	133.77	3.32	133.8	4.99	133.84	6.65	133.88
8.31	133.92	9.97	133.91	11.64	133.92	13.3	133.94	14.96	134.27
16.62	134.01	18.29	133.96	19.95	133.97	21.61	133.85	23.27	133.83
24.94	133.96	26.6	133.9	28.26	133.8	29.92	133.8	31.59	133.72
33.25	133.68	34.91	133.69	36.57	133.7	38.24	133.71	41.56	133.71
43.22	133.72	44.89	133.74	48.21	133.8	49.87	133.85	51.54	133.86
53.2	133.9	54.86	133.93	56.52	134.03	58.19	134.08	59.85	134.21
61.51	134.31	63.17	134.42	64.84	134.53	66.5	134.64	68.16	134.66
69.82	134.6	71.49	134.52	73.15	134.44	74.81	134.37	76.47	134.29
78.14	134.21	79.8	134.13	81.46	134.06	83.12	133.98	84.79	133.93
86.45	133.95	88.11	133.97	89.77	133.98	91.44	133.98	93.1	134
94.76	134.04	96.42	134.07	98.09	134.09	101.41	134.13	103.07	134.15
104.74	134.17	106.4	134.18	108.06	134.15	109.72	134.19	111.39	134.14
113.05	134.06	114.71	134	116.37	134	118.04	134.21	119.7	134.33
121.36	134.37	123.02	134.41	124.69	134.44	126.35	134.52	128.01	134.57
129.67	134.64	131.34	134.68	133	134.7	134.66	134.66	136.32	134.67
137.99	134.63	139.65	134.58	141.31	134.53	142.97	134.6	144.64	134.63
146.3	134.69	147.96	134.62	149.62	134.51	151.29	134.53	152.95	134.54
154.61	134.58	156.27	134.61	157.98	134.61	159.68	134.6	161.38	134.55
163.09	134.52	164.79	134.49	166.49	134.45	168.19	134.42	169.9	134.38
171.6	134.37	173.3	134.46	175.01	134.46	176.71	134.45	178.41	134.43

PROPOSED CONDITIONS
NO TAILWATER

180.12	134.39	181.82	134.4	183.52	134.48	185.22	134.67	186.93	134.85
188.63	134.98	190.33	135.21	192.04	135.14	193.74	135.39	195.44	135.34
197.15	135.32	198.85	135.55	200.55	135.61	202.25	135.53	203.96	135.52
205.66	135.56	207.36	135.69	209.07	135.56	210.77	135.46	212.47	135.51
214.18	135.55	215.88	135.53	217.58	135.42	219.28	135.2	220.99	134.88
222.69	134.64	224.39	134.42	226.1	134.37	227.8	134.17	229.5	134
231.21	134.01	232.91	134	234.52	134	236.13	133.99	237.75	133.99
239.36	133.95	240.97	134.01	242.59	134.01	244.2	134	245.81	133.98
247.43	134.03	249.04	134.05	250.65	134.03	252.26	133.99	253.88	133.97
254.6	134.1	271.9	134.1	279.5	129.3	286	129.3	286	127.7
291.7	128.1	298.4	128.4	302.5	128.3	306	128.5	306	129.4
312.5	129.4	319.6	133.9	342.2	133.4	343.57	133.65	345.33	133.67
347.09	133.7	348.85	133.63	350.29	133.66	351.74	133.66	353.19	133.73
354.64	133.72	356.08	133.65	357.53	133.36	358.98	133.43	360.43	133.39
360.85	133.37	361.88	133.32	363.32	133.3	364.77	133.31	366.22	133.33
367.67	133.28	369.11	133.24	370.56	133.25	372.01	133.25	373.46	133.29
374.9	133.33	376.35	133.38	377.8	133.35	379.25	133.45	380.69	133.58
382.14	133.68	383.59	133.7	385.04	133.72	386.49	133.68	387.93	133.64
389.38	133.72	390.83	133.81	392.28	133.77	392.34	133.77	393.72	133.7
395.17	133.72	396.62	133.75	398.07	133.97	399.51	134.21	400.96	134.41
402.41	134.5	403.86	134.44	405.3	134.64	406.75	134.55	408.2	134.54
409.65	134.73	411.1	134.86	412.54	134.93	413.99	134.81	415.44	134.85
416.89	134.67	418.33	134.67	419.78	134.64	421.23	134.66	422.68	134.7
424.12	134.75	425.57	134.74	427.02	134.71	428.47	134.66	550	140

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.07	271.9	.035	319.6	.04	360.85	.012	392.34	.04

Bank Sta: Left	Right	Coeff Contr.	Expan.
279.5	312.5	.3	.5

Downstream Deck/Roadway Coordinates

num= 26

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-91.9	134		-16.4	134.1		58.5	134	
120.7	134.1		157.8	134.5		173.3	134.7	
173.3	137.2		177.3	138.3		180.8	138.3	
180.8	135.4		184.8	135.5		184.8	135.5	132.5
187.8	135.5	132.5	208.8	135.6	132.6	217.8	135.6	132.7
217.8	135.6		221.8	135.7		221.8	138.6	
225.3	138.6		229.3	137.5		229.3	135	
243.8	134.6		256.8	134.3		266.8	133.9	
277.8	133.7		300	133.5				

Downstream Bridge Cross Section Data

Station Elevation Data num= 112

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	132.02	1.67	132.05	3.34	132.06	5.02	132.07	6.69	132.06
8.36	132.1	10.03	132.14	11.7	132.07	13.37	131.9	15.05	131.83
16.72	131.79	18.39	131.72	20.06	131.75	21.73	131.73	23.4	131.69

PROPOSED CONDITIONS
NO TAILWATER

```
   25.08  131.63   26.75  131.49   28.42  131.49   30.09  131.74   31.76  131.68
   33.43  131.69   35.11  131.72   36.78  131.78   38.45  131.78   40.12  131.84
   41.79  131.89   43.46  131.88   45.14  131.78   46.81  131.72   48.48  131.77
   50.15  131.95   51.82  131.93   53.49  132.03   55.17  132.16   56.84  132.16
   58.51  132.12   60.18  132.02   61.85  131.89   63.52  131.73    65.2  131.68
   66.87  131.72   68.54  131.71   70.21  131.73   71.88   131.8   73.55  132.01
   75.23  132.09    76.9  131.98   78.57  132.02   80.24  132.06   81.91  132.08
   83.58  132.14   85.26  132.11   86.93  132.01    88.6  132.04   90.27  132.06
   91.94  132.07   93.61     132   95.29  132.02   96.96   132.1   98.63  132.15
   100.3  132.11  101.97  132.11  103.64  132.13  105.32  132.09  106.99  132.07
  108.66  131.92  110.33  131.97     112  132.04  113.67  131.99  115.35  132.13
  117.02  132.25  118.69  132.31  120.36  132.35  122.03  132.43   123.7  132.49
  125.38  132.53  127.05  132.53  128.72  132.39   175.1   132.7   183.4   131.4
   185.5   129.3     192   129.3     192   128.3   192.8     128   204.8   127.7
   208.6     128     212   129.4   218.5   129.4   222.6   132.5   233.4   133.2
  233.78  133.03  235.38  133.04  236.99  133.03   238.6  133.17   240.2  132.98
  241.59  133.16  242.98  133.28  244.37  133.31  245.77  133.45  247.16  133.48
  248.55  133.51  249.94  133.67  251.33  133.57  252.72  133.53  254.11  133.57
  254.52  133.57   255.5  133.56  256.89  133.57  258.28  133.61  259.67   133.6
  261.06  133.52  262.45  133.51

Manning's n Values        num=       4
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
       0     .07   183.4    .035   222.6     .04  254.52    .012

Bank Sta: Left   Right    Coeff Contr.   Expan.
         185.5   218.5             .3       .5
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
       0   181.3   138.3     222  262.45     139

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .98
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Pressure and Weir flow
           Submerged Inlet Cd          =
           Submerged Inlet + Outlet Cd =      .8
           Max Low Cord                =
```

PROPOSED CONDITIONS
NO TAILWATER

Additional Bridge Parameters
Add Friction component to Momentum
Do not add Weight component to Momentum
Class B flow critical depth computations use critical depth
inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION

RIVER:
REACH: reach_3 RS: 132.919

INPUT
Description:
Station Elevation Data num= 111

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	132.02	1.67	132.05	3.34	132.06	5.02	132.07	6.69	132.06
8.36	132.1	10.03	132.14	11.7	132.07	13.37	131.9	15.05	131.83
16.72	131.79	18.39	131.72	20.06	131.75	21.73	131.73	23.4	131.69
25.08	131.63	26.75	131.49	28.42	131.49	30.09	131.74	31.76	131.68
33.43	131.69	35.11	131.72	36.78	131.78	38.45	131.78	40.12	131.84
41.79	131.89	43.46	131.88	45.14	131.78	46.81	131.72	48.48	131.77
50.15	131.95	51.82	131.93	53.49	132.03	55.17	132.16	56.84	132.16
58.51	132.12	60.18	132.02	61.85	131.89	63.52	131.73	65.2	131.68
66.87	131.72	68.54	131.71	70.21	131.73	71.88	131.8	73.55	132.01
75.23	132.09	76.9	131.98	78.57	132.02	80.24	132.06	81.91	132.08
83.58	132.14	85.26	132.11	86.93	132.01	88.6	132.04	90.27	132.06
91.94	132.07	93.61	132	95.29	132.02	96.96	132.1	98.63	132.15
100.3	132.11	101.97	132.11	103.64	132.13	105.32	132.09	106.99	132.07
108.66	131.92	110.33	131.97	112	132.04	113.67	131.99	115.35	132.13
117.02	132.25	118.69	132.31	120.36	132.35	122.03	132.43	123.7	132.49
125.38	132.53	127.05	132.53	128.72	132.39	175.1	132.7	180.5	132
185	131	189.6	129	191.11	128.53	192.8	128	204.8	127.7
208.6	128	212.21	129.47	218.9	132.2	233.4	133.2	233.78	133.03
235.38	133.04	236.99	133.03	238.6	133.17	240.2	132.98	241.59	133.16
242.98	133.28	244.37	133.31	245.77	133.45	247.16	133.48	248.55	133.51
249.94	133.67	251.33	133.57	252.72	133.53	254.11	133.57	254.52	133.57
255.5	133.56	256.89	133.57	258.28	133.61	259.67	133.6	261.06	133.52
262.45	133.51								

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.07	191.11	.035	212.21	.04	254.52	.012

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
191.11	212.21	25.53	20.84	18.44	.3	.5

Blocked Obstructions num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev
0	181.3	138.3	222	262.45	139

PROPOSED CONDITIONS
NO TAILWATER

CROSS SECTION

RIVER:
REACH: reach_3 RS: 112.083

INPUT
Description:
Station Elevation Data num= 150

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	131.41	1.74	131.49	3.48	131.51	5.22	131.55	6.96	131.59
8.7	131.54	10.44	131.75	12.17	131.66	13.91	131.62	15.65	131.55
17.39	131.42	19.13	131.34	20.87	131.26	22.61	131.18	24.35	131.23
26.09	131.27	27.83	131.29	29.57	131.3	31.31	131.29	33.05	131.57
34.79	131.54	36.52	131.54	38.26	131.45	40	131.38	41.74	131.31
43.48	131.3	45.22	131.32	46.96	131.34	48.7	131.31	50.44	131.31
52.18	131.38	53.92	131.45	55.66	131.46	57.4	131.46	59.14	131.53
60.87	131.38	62.61	131.34	64.35	131.32	66.09	131.33	67.83	131.37
69.57	131.37	71.31	131.34	73.05	131.38	74.79	131.48	76.53	131.57
78.27	131.64	80.01	131.71	81.75	131.61	83.48	131.46	85.22	131.58
86.96	131.62	88.7	131.65	90.44	131.68	92.18	131.71	93.92	131.75
95.66	131.76	97.4	131.94	99.14	131.93	100.88	132	102.62	132.14
104.36	132.21	106.1	132.14	107.83	132.18	109.57	132.09	111.31	132.05
113.05	132.01	114.79	132.09	116.53	132.12	118.27	132.01	120.01	132.03
121.75	131.98	123.49	132.1	125.23	132.18	126.97	132.15	128.71	132.13
130.44	132.11	132.18	132.08	133.92	132.07	135.66	132.1	137.4	132.12
139.14	132.02	140.88	132	142.62	131.96	144.36	132.25	146.1	132.34
147.84	132.43	149.58	132.35	151.32	132.2	153.06	132.07	154.79	132.04
156.53	131.81	158.27	131.74	160.01	131.77	161.75	131.87	163.49	131.93
165.23	131.9	166.97	131.88	168.71	131.88	170.45	131.86	172	132.1
191.9	132.2	208.3	130.6	210.41	128.06	210.8	127.6	218.5	126.9
227.22	128.47	227.4	128.5	228.5	128.6	229.1	129.6	234.6	131.9
244.9	131.8	245.39	131.99	246.87	131.9	248.35	131.93	249.82	131.94
251.3	132.01	252.78	132.07	254.25	132.11	255.73	132.15	257.21	132.22
258.68	132.32	260.16	132.32	261.64	132.36	263.11	132.39	264.59	132.35
266.07	132.46	267.54	132.39	269.02	132.3	270.5	132.35	271.97	132.41
273.45	132.37	274.93	132.35	276.4	132.46	277.88	132.58	279.36	132.69
280.83	132.69	282.31	132.7	283.78	132.76	285.26	132.76	286.73	132.8
288.2	132.82	289.68	132.86	291.15	132.88	292.62	132.92	294.1	132.98
295.57	132.94	297.04	132.95	297.31	132.95	298.51	132.96	310	133.5

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.07	210.41	.035	227.22	.04	297.31	.012

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
210.41	227.22	20.14	19.81	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	188.8	138.3	F
248.8	310	139	F

PROPOSED CONDITIONS
NO TAILWATER

CROSS SECTION

RIVER:
REACH: reach_3 RS: 92.144

INPUT
Description:
Station Elevation Data num= 165

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	131.19	1.85	131.12	3.69	131.09	5.54	131.06	7.39	131.08
9.24	131.13	11.08	131.25	12.93	131.1	14.78	131.18	16.63	131.23
18.47	131.08	20.32	131.02	22.17	130.99	24.02	130.96	25.86	131
27.71	131.02	29.56	131.04	31.41	131.06	33.25	131.09	35.1	131.04
36.95	131.11	38.8	130.99	40.64	131.03	42.49	131.12	44.34	131.19
46.19	131.19	48.03	131.18	49.88	131.18	51.73	131.17	53.58	131.23
55.42	131.31	57.27	131.37	59.12	131.43	60.96	131.62	62.81	131.71
64.66	131.63	66.51	131.45	68.35	131.45	70.2	131.45	72.05	131.34
73.9	131.27	75.74	131.27	77.59	131.29	79.44	131.22	81.29	131.32
83.13	131.3	84.98	131.3	86.83	131.3	88.68	131.31	90.52	131.36
92.37	131.47	94.22	131.6	96.07	131.65	97.91	131.71	99.76	131.77
101.61	131.84	103.46	131.78	105.3	131.77	107.15	131.91	109	132
110.85	132.04	112.69	131.93	114.54	131.81	116.39	131.69	118.23	131.61
120.08	131.61	121.93	131.61	123.78	131.58	125.62	131.59	127.47	131.63
129.32	131.67	131.17	131.62	133.01	131.68	134.86	131.73	136.71	131.68
138.56	131.72	140.4	131.64	142.25	131.51	144.1	131.54	145.95	131.56
147.79	131.52	149.64	131.53	151.49	131.55	153.34	131.5	155.18	131.47
157.03	131.48	158.88	131.53	160.73	131.52	162.57	131.5	164.42	131.48
166.27	131.46	168.12	131.44	169.96	131.42	171.81	131.4	173.66	131.38
175.5	131.52	184.3	131.8	201.9	131.9	221.7	131.4	227.34	127.44
227.4	127.4	235.2	126.4	244.63	128.48	244.7	128.5	250.2	131
268.7	132.1	269.28	132.01	270.85	132.08	272.42	131.95	273.99	131.76
275.56	131.59	277.14	131.7	278.71	131.78	280.28	131.75	281.85	131.75
283.42	131.71	284.99	131.74	286.56	131.75	288.14	131.77	289.71	131.58
291.28	131.52	292.85	131.47	294.42	131.41	295.99	131.43	297.57	131.48
299.14	131.52	300.71	131.42	302.28	131.37	303.85	131.31	305.42	131.18
307	131.38	308.57	131.39	310.14	131.35	311.71	131.33	313.28	131.25
314.85	131.24	316.43	131.21	318	131.19	319.57	131.19	321.14	131.22
322.71	131.23	324.28	131.33	325.85	131.56	327.43	131.66	329	131.73
330.57	131.68	332.14	131.67	333.51	131.7	334.88	131.75	336.25	131.87
337.63	131.92	339	131.96	340.37	131.98	341.74	131.91	343.11	132.02
344.48	132.08	345.85	132.17	347.22	132.23	348.59	132.27	349.96	132.33
351.34	132.4	352.71	132.42	354.08	132.53	355.45	132.49	369	133.4

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.07	227.34	.035	244.63	.04	355.45	.012

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
227.34	244.63	25.52	28.54	32.22	.1	.3

PROPOSED CONDITIONS
NO TAILWATER

CROSS SECTION

RIVER:
REACH: reach_3 RS: 63.607

INPUT
Description:
Station Elevation Data num= 201

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	131.03	1.88	130.89	3.76	130.73	5.63	130.58	7.51	130.46
9.39	130.43	11.27	130.36	13.15	130.23	15.02	130.07	16.9	130.02
18.78	130.04	20.66	130.16	22.54	129.94	24.41	129.97	26.29	130.27
28.17	130.19	30.05	130.13	31.93	130.12	33.8	130.14	35.68	130.19
37.56	130.26	39.44	130.45	41.32	130.5	43.19	130.41	45.07	130.34
46.95	130.14	48.83	130.03	50.71	130.21	52.58	130.41	54.46	130.52
56.34	130.62	58.22	130.59	60.1	130.59	61.97	130.64	63.85	130.61
65.73	130.62	67.61	130.71	69.49	130.72	71.36	130.74	73.24	130.75
75.12	130.78	77	130.78	78.88	130.72	80.75	130.82	82.63	130.73
84.51	130.73	86.39	130.69	88.26	130.56	90.14	130.57	92.02	130.68
93.9	130.82	95.78	130.95	97.65	131.08	99.53	131.08	101.41	131.1
103.29	131.13	105.17	131.19	107.04	131.21	108.92	131.3	110.8	131.13
112.68	130.85	114.56	130.59	116.43	130.46	118.31	130.26	120.19	130.11
122.07	130.08	123.95	130.24	125.82	130.62	127.7	131.08	129.58	131.06
131.46	131.08	133.34	131.09	135.21	130.98	137.09	130.61	138.97	130.95
140.85	131.02	142.73	130.99	144.6	130.94	146.48	130.9	148.28	130.87
150.09	130.91	151.89	130.95	153.69	130.96	155.49	130.87	157.3	130.56
159.1	130.21	160.9	130.22	162.7	130.19	164.51	130.08	166.31	130.04
168.11	130.09	169.91	130.19	171.72	130.47	173.52	130.62	175.32	130.58
177.12	130.56	178.93	130.62	180.73	130.74	182.53	130.77	184.33	130.69
186.14	130.57	187.94	130.46	189.74	130.41	191.54	130.16	193.35	129.94
195.15	129.73	196.95	129.64	198.75	129.83	200.56	130.05	202.36	130.27
204.16	130.49	205.96	130.71	206.3	131	222.9	130.4	238.76	127.56
239.1	127.5	251.7	125.9	261.9	127.89	265	128.5	267.2	130.6
279.2	131.8	287.2	131.3	288.72	131.41	290.26	131.42	291.79	131.41
293.33	131.38	294.86	131.34	296.39	131.31	297.93	131.24	299.46	131.19
300.99	131.15	302.53	131.04	304.06	130.95	305.59	131.02	307.13	131.23
308.66	131.39	310.19	131.51	311.73	131.61	313.26	131.63	314.79	131.66
316.33	131.61	317.86	131.61	319.39	131.6	320.93	131.61	322.46	131.67
324	131.63	325.53	131.65	327.06	131.37	328.6	131.23	330.13	131.17
331.66	131.47	333.2	131.37	334.73	131.28	336.26	131.17	337.8	131.16
339.33	131.25	340.86	131.28	342.4	131.6	343.93	131.8	345.46	132.01
347	132.06	348.53	132.08	350.06	132.07	351.6	131.98	353.13	131.91
354.67	131.85	356.2	131.78	357.73	131.71	359.27	131.65	360.8	131.59
362.33	131.56	363.87	131.49	365.4	131.42	366.93	131.38	368.47	131.63
369.91	131.87	371.35	131.75	372.79	131.75	374.23	131.85	375.67	131.82
377.12	131.79	378.56	131.76	380	131.89	381.44	131.95	382.88	131.88
384.32	131.93	385.77	131.93	387.21	132.06	388.65	132.2	390.09	132.24
391.53	132.23	392.97	132.22	394.42	132.35	395.86	132.43	397.3	132.46
398.74	132.58	400.18	132.71	401.62	132.68	403.06	132.79	404.51	132.91

PROPOSED CONDITIONS
NO TAILWATER

405.95 132.96

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.07	238.76	.035	261.9	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
238.76	261.9	0	0	.1	.3

SUMMARY OF MANNING'S N VALUES

River:

Reach	River Sta.	n1	n2	n3	n4	n5	n6	n7
reach_3	300.198	.04	.04	.07	.035	.04	.012	.04
reach_3	262.135	.04	.04	.07	.035	.04	.012	.04
reach_3	251.5	Inl Struct						
reach_3	241.745	.04	.04	.07	.035	.04	.012	.04
reach_3	229.683	.07	.04	.07	.035	.04	.012	.04
reach_3	205.816	.07	.035	.04	.012	.04		
reach_3	190.168	.07	.035	.04	.012	.04		
reach_3	180.829	.07	.035	.04	.012	.04		
reach_3	161.5	Bridge						
reach_3	132.919	.07	.035	.04	.012			
reach_3	112.083	.07	.035	.04	.012			
reach_3	92.144	.07	.035	.04	.012			
reach_3	63.607	.07	.035	.04				

SUMMARY OF REACH LENGTHS

River:

Reach	River Sta.	Left	Channel	Right
reach_3	300.198	40.41	38.06	34.97
reach_3	262.135	52.85	20.39	57.74
reach_3	251.5	Inl Struct		
reach_3	241.745	13.2	12.06	8.67
reach_3	229.683	23.03	23.87	26.04
reach_3	205.816	15.85	15.65	18.34
reach_3	190.168	9.54	9.34	10.36
reach_3	180.829	48.98	47.91	48.24
reach_3	161.5	Bridge		
reach_3	132.919	25.53	20.84	18.44
reach_3	112.083	20.14	19.94	19.81

reach_3	92.144	25.52	28.54	32.22
reach_3	63.607	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River:

Reach	River Sta.	Contr.	Expan.
reach_3	300.198	.1	.3
reach_3	262.135	.1	.3
reach_3	251.5	Inl Struct	
reach_3	241.745	.1	.3
reach_3	229.683	.1	.3
reach_3	205.816	.1	.3
reach_3	190.168	.3	.5
reach_3	180.829	.3	.5
reach_3	161.5	Bridge	
reach_3	132.919	.3	.5
reach_3	112.083	.1	.3
reach_3	92.144	.1	.3
reach_3	63.607	.1	.3

ERRORS WARNINGS AND NOTES
Errors Warnings and Notes for Plan : Alt C rev pro no tailwater

River: Reach: reach_3 RS: 300.198 Profile: 25-yr
Warning:Divided flow computed for this cross-section.
River: Reach: reach_3 RS: 205.816 Profile: 25-yr
Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
River: Reach: reach_3 RS: 190.168 Profile: 25-yr
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.
River: Reach: reach_3 RS: 161.5 Profile: 25-yr
Note: The downstream water surface is below the minimum elevation for pressure flow. The sluice gate equations were used for pressure flow.
River: Reach: reach_3 RS: 132.919 Profile: 25-yr
Warning:The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
River: Reach: reach_3 RS: 112.083 Profile: 25-yr
Warning:The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The

PROPOSED CONDITIONS
NO TAILWATER

```
          program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River:   Reach: reach_3     RS: 92.144     Profile: 25-yr
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River:   Reach: reach_3     RS: 63.607     Profile: 25-yr
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
```

PROPOSED CONDITIONS WITH TAILWATER

HEC-RAS Plan: Alt C rev pro tailwater rev River: Reach: reach_3

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach_3	300.198	Des 100us / 50ds	800.00	129.90	136.59	132.50	136.61	0.000109	1.35	788.27	343.07	0.10
reach_3	300.198	Chk 50us / 100ds	670.00	129.90	137.08	132.35	137.09	0.000048	0.95	959.83	364.22	0.07
reach_3	300.198	FEMA 100/100	800.00	129.90	137.20	132.50	137.22	0.000061	1.08	1006.05	368.31	0.08
reach_3	262.135	Des 100us / 50ds	800.00	130.40	136.59	132.58	136.61	0.000105	1.35	889.85	411.12	0.10
reach_3	262.135	Chk 50us / 100ds	670.00	130.40	137.08	132.38	137.08	0.000044	0.93	1094.18	430.05	0.07
reach_3	262.135	FEMA 100/100	800.00	130.40	137.20	132.58	137.21	0.000056	1.05	1148.74	434.96	0.08
reach_3	251.5		Inl Struct									
reach_3	241.745	Des 100us / 50ds	800.00	127.10	136.58		136.60	0.000076	1.53	1013.38	426.50	0.09
reach_3	241.745	Chk 50us / 100ds	670.00	127.10	137.07		137.08	0.000034	1.07	1225.26	445.31	0.06
reach_3	241.745	FEMA 100/100	800.00	127.10	137.19		137.21	0.000044	1.22	1281.77	450.19	0.07
reach_3	229.683	Des 100us / 50ds	800.00	125.40	136.58		136.60	0.000072	1.50	1052.80	422.16	0.09
reach_3	229.683	Chk 50us / 100ds	670.00	125.40	137.07		137.08	0.000033	1.06	1261.10	432.19	0.06
reach_3	229.683	FEMA 100/100	800.00	125.40	137.19		137.21	0.000043	1.22	1315.58	433.86	0.07
reach_3	205.816	Des 100us / 50ds	800.00	127.80	136.58		136.60	0.000059	1.30	1241.14	459.81	0.08
reach_3	205.816	Chk 50us / 100ds	670.00	127.80	137.07		137.08	0.000028	0.92	1466.78	471.61	0.06
reach_3	205.816	FEMA 100/100	800.00	127.80	137.20		137.20	0.000036	1.06	1526.48	474.68	0.06
reach_3	190.168	Des 100us / 50ds	800.00	128.10	136.57	131.56	136.60	0.000157	1.75	739.23	298.61	0.11
reach_3	190.168	Chk 50us / 100ds	670.00	128.10	137.06	131.24	137.08	0.000070	1.23	889.68	309.16	0.08
reach_3	190.168	FEMA 100/100	800.00	128.10	137.18	131.56	137.20	0.000090	1.40	928.04	311.79	0.09
reach_3	180.829	Des 100us / 50ds	800.00	127.60	136.57	131.52	136.59	0.000072	1.16	1208.56	472.01	0.07
reach_3	180.829	Chk 50us / 100ds	670.00	127.60	137.06	131.15	137.07	0.000031	0.80	1442.97	483.18	0.05
reach_3	180.829	FEMA 100/100	800.00	127.60	137.19	131.52	137.20	0.000040	0.91	1503.38	486.02	0.06
reach_3	161.5		Bridge									
reach_3	132.919	Des 100us / 50ds	800.00	127.70	135.89		136.09	0.000556	3.91	265.01	40.70	0.25
reach_3	132.919	Chk 50us / 100ds	670.00	127.70	136.74		136.85	0.000271	2.92	299.59	40.70	0.17
reach_3	132.919	FEMA 100/100	800.00	127.70	136.71		136.87	0.000391	3.50	298.48	40.70	0.21
reach_3	112.083	Des 100us / 50ds	800.00	126.90	135.91	131.66	136.04	0.000400	3.46	340.31	310.00	0.21
reach_3	112.083	Chk 50us / 100ds	670.00	126.90	136.75	131.17	136.82	0.000185	2.51	390.84	310.00	0.15
reach_3	112.083	FEMA 100/100	800.00	126.90	136.73	131.66	136.83	0.000266	3.01	389.65	310.00	0.17
reach_3	92.144	Des 100us / 50ds	800.00	126.40	136.00		136.00	0.000030	0.98	1725.12	369.00	0.06
reach_3	92.144	Chk 50us / 100ds	670.00	126.40	136.80		136.80	0.000013	0.68	2020.50	369.00	0.04

PROPOSED CONDITIONS WITH TAILWATER

HEC-RAS Plan: Alt C rev pro tailwater rev River: Reach: reach_3 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach_3	92.144	FEMA 100/100	800.00	126.40	136.80		136.80	0.000018	0.81	2020.43	369.00	0.05
reach_3	63.607	Des 100us / 50ds	800.00	125.90	136.00	130.20	136.00	0.000018	0.78	2178.54	405.95	0.05
reach_3	63.607	Chk 50us / 100ds	670.00	125.90	136.80	129.70	136.80	0.000008	0.55	2503.30	405.95	0.03
reach_3	63.607	FEMA 100/100	800.00	125.90	136.80	130.19	136.80	0.000011	0.66	2503.30	405.95	0.04

PROPOSED CONDITIONS WITH TAILWATER

Plan: Alt C rev pro tailwater rev reach_3 RS: 161.5 Profile: Des 100us / 50ds

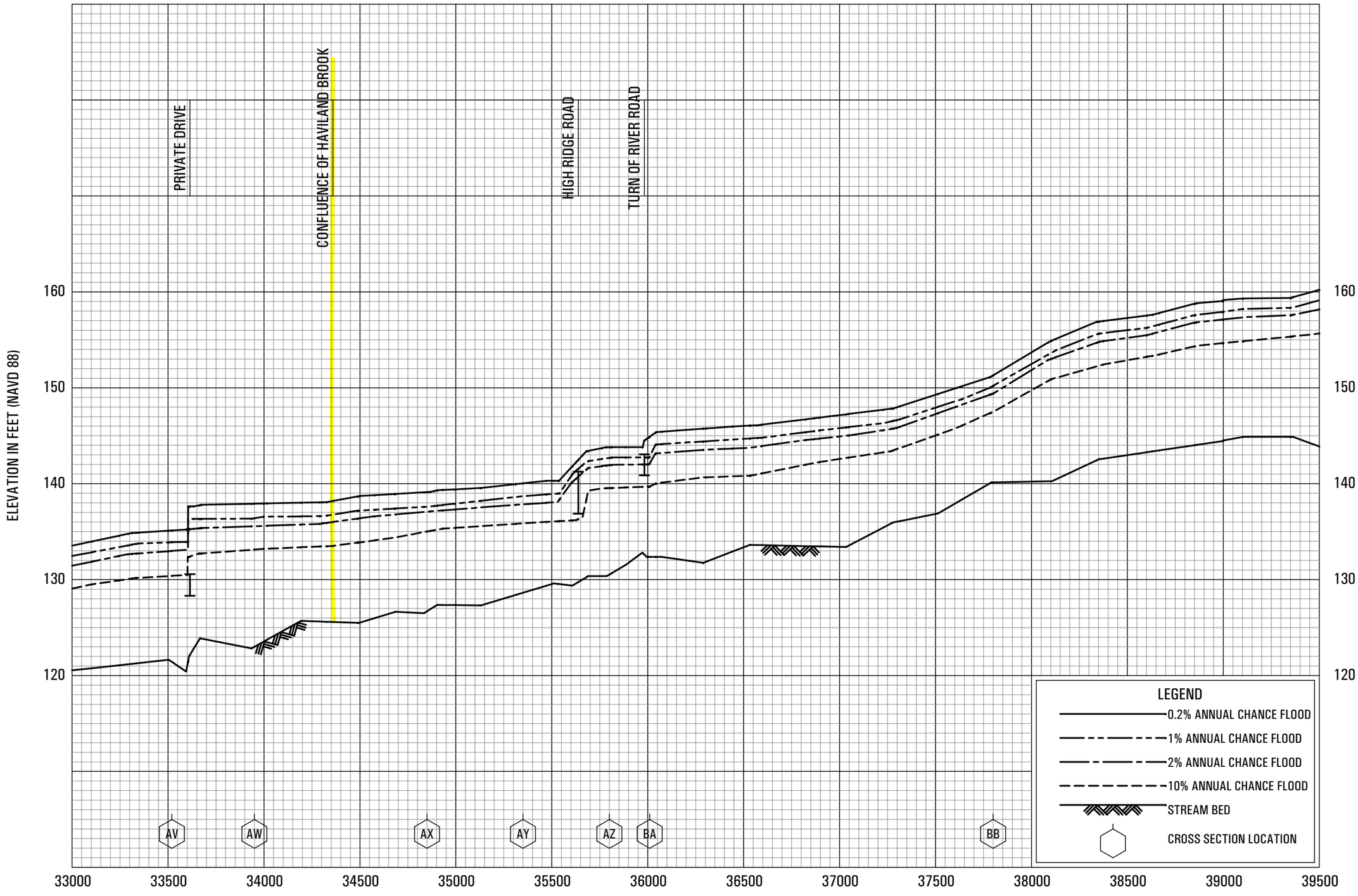
E.G. US. (ft)	136.59	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	136.57	E.G. Elev (ft)	136.59	136.48
Q Total (cfs)	800.00	W.S. Elev (ft)	136.57	136.17
Q Bridge (cfs)	690.21	Crit W.S. (ft)	131.28	131.18
Q Weir (cfs)	109.79	Max Chl Dpth (ft)	8.87	8.47
Weir Sta Lft (ft)	181.30	Vel Total (ft/s)	0.78	5.07
Weir Sta Rgt (ft)	221.80	Flow Area (sq ft)	1022.74	157.87
Weir Submerg	0.32	Froude # Chl	0.07	0.31
Weir Max Depth (ft)	1.17	Specif Force (cu ft)	1768.10	891.04
Min El Weir Flow (ft)	135.42	Hydr Depth (ft)	2.24	3.90
Min El Prs (ft)	132.70	W.P. Total (ft)	541.07	115.17
Delta EG (ft)	0.50	Conv. Total (cfs)		
Delta WS (ft)	0.69	Top Width (ft)	457.01	40.50
BR Open Area (sq ft)	129.41	Frctn Loss (ft)		
BR Open Vel (ft/s)	5.33	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)		
BR Sel Method	Press/Weir	Power Total (lb/ft s)		

Plan: Alt C rev pro tailwater rev reach_3 RS: 161.5 Profile: Chk 50us / 100ds

E.G. US. (ft)	137.07	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	137.06	E.G. Elev (ft)	137.07	136.92
Q Total (cfs)	670.00	W.S. Elev (ft)	137.06	136.74
Q Bridge (cfs)	475.04	Crit W.S. (ft)	130.99	130.89
Q Weir (cfs)	194.96	Max Chl Dpth (ft)	9.36	9.04
Weir Sta Lft (ft)	181.30	Vel Total (ft/s)	0.54	3.71
Weir Sta Rgt (ft)	221.80	Flow Area (sq ft)	1249.79	180.77
Weir Submerg	0.78	Froude # Chl	0.04	0.22
Weir Max Depth (ft)	1.66	Specif Force (cu ft)	2314.33	937.26
Min El Weir Flow (ft)	135.42	Hydr Depth (ft)	2.67	4.46
Min El Prs (ft)	132.70	W.P. Total (ft)	554.71	116.30
Delta EG (ft)	0.22	Conv. Total (cfs)		
Delta WS (ft)	0.33	Top Width (ft)	468.18	40.50
BR Open Area (sq ft)	129.41	Frctn Loss (ft)		
BR Open Vel (ft/s)	3.67	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)		
BR Sel Method	Press/Weir	Power Total (lb/ft s)		

Plan: Alt C rev pro tailwater rev reach_3 RS: 161.5 Profile: FEMA 100/100

E.G. US. (ft)	137.20	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	137.19	E.G. Elev (ft)	137.20	137.03
Q Total (cfs)	800.00	W.S. Elev (ft)	137.19	136.71
Q Bridge (cfs)	579.33	Crit W.S. (ft)	131.28	131.18
Q Weir (cfs)	220.67	Max Chl Dpth (ft)	9.49	9.01
Weir Sta Lft (ft)	181.30	Vel Total (ft/s)	0.61	4.45
Weir Sta Rgt (ft)	221.80	Flow Area (sq ft)	1308.33	179.67
Weir Submerg	0.70	Froude # Chl	0.05	0.27
Weir Max Depth (ft)	1.78	Specif Force (cu ft)	2478.90	966.31
Min El Weir Flow (ft)	135.42	Hydr Depth (ft)	2.78	4.44
Min El Prs (ft)	132.70	W.P. Total (ft)	558.17	116.25
Delta EG (ft)	0.33	Conv. Total (cfs)		
Delta WS (ft)	0.48	Top Width (ft)	471.02	40.50
BR Open Area (sq ft)	129.41	Frctn Loss (ft)		
BR Open Vel (ft/s)	4.48	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)		
BR Sel Method	Press/Weir	Power Total (lb/ft s)		



FLOOD PROFILES

RIPPOWAM RIVER (LOWER REACH)

FEDERAL EMERGENCY MANAGEMENT AGENCY

FAIRFIELD COUNTY, CT

(ALL JURISDICTIONS)

326P

HEC-RAS HEC-RAS 6.3.1 September 2022
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X    X
X     X  X        X           X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X           X  X     X    X        X
X     X  X        X    X      X   X    X    X        X
X     X  XXXXXX    XXXX       X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: 04070_rev 20230823
Project File : 04070_rev20230823.prj
Run Date and Time: 8/23/2023 12:29:37 PM

Project in English units

PLAN DATA

Plan Title: Proposed Alt C Rev pro w tailwater rev
Plan File : r:\Liaison\Federal Local Bridge Program\1. Project Files\04070, SPN 135-344, List R\6. Permits\i. Flood Management Certification Applictaion\2. FMC final submission Aug2023\0135-0344_HEC-RAS\04070_rev20230823.p04

Geometry Title: Alternate C REV PROFILE
Geometry File : r:\Liaison\Federal Local Bridge Program\1. Project Files\04070, SPN 135-344, List R\6. Permits\i. Flood Management Certification Applictaion\2. FMC final submission Aug2023\0135-0344_HEC-RAS\04070_rev20230823.g08

Flow Title : Haviland with tailwater rev 20230823
Flow File : r:\Liaison\Federal Local Bridge Program\1. Project Files\04070, SPN 135-344, List R\6. Permits\i. Flood Management Certification Applictaion\2. FMC final submission Aug2023\0135-0344_HEC-RAS\04070_rev20230823.f03

Plan Summary Information:

Number of:	Cross Sections	= 11	Multiple Openings	=	0
	Culverts	= 0	Inline Structures	=	1
	Bridges	= 1	Lateral Structures	=	0

Computational Information
    Water surface calculation tolerance = 0.01
    Critical depth calculation tolerance = 0.01
    Maximum number of iterations   = 20
    Maximum difference tolerance   = 0.3
    Flow tolerance factor   = 0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method: Average Conveyance
    Computational Flow Regime: Mixed Flow

FLOW DATA

Flow Title: Haviland with tailwater rev 20230823
Flow File : r:\Liaison\Federal Local Bridge Program\1. Project Files\04070, SPN 135-344, List R\6. Permits\i. Flood Management Certification Applictaion\2. FMC final submission Aug2023\0135-0344_HEC-RAS\04070_rev20230823.f03

Flow Data (cfs)

River	Reach	RS	Des 100us / 50ds	Chk 50us / 100ds	FEMA 100/100
	reach_3	300.198	800	670	800

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
	reach_3	Des 100us / 50ds	Normal S = 0.001	Known WS = 136
	reach_3	Chk 50us / 100ds	Normal S = 0.001	Known WS = 136.8
	reach_3	FEMA 100/100	Normal S = 0.001	Known WS = 136.8

GEOMETRY DATA

Geometry Title: Alternate C REV PROFILE
Geometry File : r:\Liaison\Federal Local Bridge Program\1. Project Files\04070, SPN 135-344, List R\6. Permits\i. Flood Management Certification Applictaion\2. FMC final submission Aug2023\0135-0344_HEC-RAS\04070_rev20230823.g08

CROSS SECTION

RIVER:
REACH: reach_3 RS: 300.198

INPUT
Description:
Station Elevation Data num= 204

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-65	138.2	0	135.35	1.65	135.41	3.3	135.35	4.95	135.21
6.6	135.3	8.24	135.25	9.89	135.22	11.54	135.21	13.19	135.17
14.84	135.17	16.49	135.14	18.14	135.15	19.79	135.13	21.43	135.16
23.08	135.14	24.73	135.16	26.38	135.26	28.03	135.27	29.68	135.36
31.33	135.29	32.98	135.29	34.62	135.3	36.27	135.3	37.92	135.33
39.57	135.34	41.22	135.36	42.87	135.43	44.52	135.45	46.17	135.5
47.81	135.49	49.46	135.58	51.11	135.59	52.76	135.64	54.41	135.7
56.06	135.78	57.71	135.91	59.36	135.96	61	135.98	62.65	136.05
64.3	136.27	65.95	136.39	67.6	136.47	69.25	136.58	70.9	136.62
72.55	136.5	74.2	136.47	75.84	136.48	77.49	136.49	79.14	136.51
80.79	136.44	82.44	136.41	84.09	136.38	85.74	136.35	87.39	136.31
89.03	136.27	90.68	136.22	92.33	136.15	93.98	136.09	95.63	136
97.28	135.97	98.93	135.94	100.58	135.91	102.22	135.88	103.87	135.85
105.52	135.82	107.17	135.85	108.82	135.86	110.47	135.84	112.12	135.84
113.77	135.85	115.41	135.85	117.06	135.85	118.71	135.85	120.36	135.86
122.01	135.86	123.66	135.86	125.31	135.87	126.96	135.9	128.61	135.94
130.25	135.91	131.9	135.86	133.55	135.85	135.2	135.81	136.85	135.76
138.5	135.75	140.15	135.81	141.8	135.84	143.44	135.84	145.09	135.84
146.74	135.83	148.39	135.83	150.04	135.8	151.69	135.8	153.34	135.81
154.99	135.81	156.63	135.82	158.28	135.83	159.93	135.84	161.58	135.84
163.23	135.85	164.88	135.86	166.53	135.87	168.18	135.87	169.82	135.87
171.47	135.62	173.12	135.4	174.77	135.43	176.42	135.4	178.07	135.32
179.72	135.28	181.37	135.29	183.02	135.27	184.67	135.24	186.32	135.24
187.97	135.2	189.63	135.18	191.28	135.12	192.93	135.06	194.58	135.05
196.23	135.04	197.88	135	199.54	134.95	201.19	134.91	202.84	134.85
204.49	134.82	206.1	135.1	216.97	134.84	223.1	134.7	226.8	134.1
228.8	132.2	229.23	132.13	235.7	131.1	244.8	131	256.2	130.5
258.8	131.8	266.1	132.1	274.7	131.1	297.3	130.6	303.9	129.9
309.8	131.7	314.8	133.2	317.21	134.44	318.1	134.9	340.2	134.3
360.7	135.3	361.23	135.18	361.49	135.2	362.77	135.29	364.32	135.18
365.86	135.27	367.4	135.34	368.95	135.43	370.49	135.56	372.03	135.58
373.58	135.62	375.12	135.72	376.67	135.78	378.21	135.74	379.75	135.71

379.8	135.71	381.3	135.62	382.84	135.61	384.39	135.6	385.93	135.58
387.47	135.6	389.02	135.6	390.56	135.61	392.11	135.69	393.65	135.79
395.19	135.79	396.74	135.8	398.28	135.87	399.83	136.01	401.37	136.1
402.91	136.1	404.46	136.21	406	136.36	407.54	136.5	409.09	136.68
410.63	136.77	412.18	136.8	413.72	136.84	415.26	136.96	416.81	137.07
418.35	137.23	419.9	137.35	421.44	137.5	422.98	137.65	424.53	137.83
426.07	137.98	427.62	138.13	429.16	138.27	430.7	138.34	432.25	138.51
433.79	138.65	435.33	138.8	436.88	138.88	438.42	138.93	439.97	139.01
441.51	139.1	443.05	139.26	444.6	139.42	446.14	139.53		

Manning's n Values num= 7

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
-65	.04	80.79	.04	216.97	.07	229.23	.035	317.21	.04
361.49	.012	379.8	.04						

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
229.23	317.21	40.41	38.06	34.97	.1	.3

Blocked Obstructions num= 1

Sta L	Sta R	Elev
79	171	150

CROSS SECTION

RIVER:
REACH: reach_3 RS: 262.135

INPUT
Description:
Station Elevation Data num= 207

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-65	138.2	0	135.48	1.63	135.28	3.25	135.14	4.88	134.94
6.5	134.88	8.13	134.78	9.75	134.72	11.38	134.65	13	134.55
14.63	134.51	16.26	134.46	17.88	134.42	19.51	134.46	21.13	134.49
22.76	134.55	24.38	134.5	26.01	134.49	27.64	134.5	29.26	134.57
30.89	134.58	32.51	134.63	34.14	134.64	35.76	134.63	37.39	134.66
39.01	134.73	40.64	134.79	42.27	134.84	43.89	134.83	45.52	134.83
47.14	134.79	48.77	134.84	50.39	134.86	52.02	134.89	53.65	134.9
55.27	134.99	56.9	135.05	58.52	135.11	60.15	135.18	61.77	135.16
63.4	135.18	65.02	135.2	66.65	135.26	68.28	135.44	69.9	135.55
71.53	135.7	73.15	135.85	74.78	135.89	76.4	135.89	78.03	136
79.66	136.08	81.28	135.99	82.91	135.84	84.53	135.81	85.06	135.81
86.16	135.81	87.78	135.79	89.41	135.78	91.03	135.74	92.66	135.74
94.29	135.73	95.91	135.71	97.54	135.69	99.16	135.66	100.79	135.66
102.41	135.64	104.04	135.63	105.67	135.59	107.29	135.58	108.92	135.58
110.54	135.56	112.17	135.55	113.79	135.5	115.42	135.52	117.04	135.54
118.67	135.56	120.3	135.66	121.92	135.61	123.55	135.47	125.17	135.32
126.8	135.33	128.42	135.31	130.05	135.29	131.68	135.28	133.3	135.29
134.93	135.27	136.55	135.29	138.18	135.37	139.8	135.46	141.43	135.38
143.05	135.31	144.68	135.32	146.31	135.32	147.93	135.31	149.56	135.32

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  151.18  135.39  152.81  135.41  154.43  135.45  156.06  135.44  157.69  135.47
  159.31  135.61  160.94  135.64  162.56  135.62  164.19  135.71  165.81  135.72
  167.44  135.72  169.06  135.72  170.69  135.66  172.32   135.7  173.94  135.63
  175.57  135.52  177.19  135.41  178.82  135.48  180.44  135.48  182.07  135.41
   183.7  135.36  185.32  135.34  186.95  135.34  188.57  135.32   190.2  135.27
  191.82  135.24  193.45  135.21  195.07  135.18   196.7  135.15  198.33   135.1
  199.95  135.05  201.58  135.12   203.2  135.02  204.83  135.05  206.45  135.11
  208.08  135.09  209.71  135.07  211.33  135.14  212.96   135.1  214.58  135.03
  214.75  135.02  216.21  134.89  217.83  134.83  219.46  134.81  221.08  134.79
  222.71  134.83  224.34  134.77  225.96  134.73  227.59   134.7  229.21  134.66
  230.84  134.67   231.8   134.9   244.9   134.9   246.7   134.4   252.9   133.3
   260.7   131.4   271.2   130.8   291.7   130.6     304   130.4   317.9   131.3
   325.3   133.5  325.37   133.5  342.15  134.07  343.63  134.03  345.11  134.14
  346.58  134.21  348.06  134.32  349.54  134.43  351.02  134.47   352.5  134.49
  353.98  134.61  355.46  134.59  356.94  134.62  358.42  134.59   359.9  134.64
  361.38  134.69  362.86  134.73  364.33  134.73  365.81  134.76  365.99  134.77
  367.29   134.8  368.77  134.91  370.25  134.95  371.73   135.1  373.21  135.09
  374.69  135.11  376.17  135.21  377.65   135.2  379.13  135.23  380.61  135.23
  382.08  135.26  383.56  135.28  384.24  135.22  385.04  135.16  386.52  135.19
     388   135.2  389.48  135.37  390.96  135.34  392.44  135.33  393.92   135.4
   395.4  135.53  396.88  135.64  398.36  135.65  399.83  135.67  401.31  135.73
  402.79  135.79  404.27  135.84  405.75  135.89  407.23  135.93  408.71     136
  410.19  136.03     470     140

Manning's n Values        num=       7
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
     -65     .04   85.06     .04  214.75     .07   252.9    .035  325.37     .04
  365.99    .012  384.24     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         252.9  325.37            52.85   20.39   57.74             .1       .3
Blocked Obstructions     num=       1
   Sta L   Sta R    Elev
      84     118     150

INLINE STRUCTURE


RIVER:
REACH: reach_3            RS: 251.5

INPUT
Description:
Distance from Upstream XS =       4
Deck/Roadway Width        =      14
Weir Coefficient          =     2.6
 Weir Embankment Coordinates    num =       17
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
   246.8   134.2   251.1   134.2   252.6   134.9   266.4   134.8   288.1   134.8
   288.2   132.5   289.2   132.5   289.3   133.9   292.3   133.9   292.4   131.2
```

303.3	131.2	303.4	133.8	320.8	133.8	325.3	133.8	325.4	137.2
335.6	137.2	335.7	134.4						

Upstream Embankment side slope = 0 horiz. to 1.0 vertical
Downstream Embankment side slope = 0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .98
Elevation at which weir flow begins =
Weir crest shape = Broad Crested

CROSS SECTION

RIVER:
REACH: reach_3 RS: 241.745

INPUT
Description:
Station Elevation Data num= 197

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-80	138.2	0	134.91	1.64	134.84	3.28	134.77	4.93	134.68
6.57	134.6	8.21	134.54	9.85	134.46	11.49	134.33	13.14	134.28
14.78	134.26	16.42	134.29	18.06	134.31	19.7	134.43	21.35	134.35
22.99	134.28	24.63	134.25	26.27	134.23	27.91	134.29	29.56	134.41
31.2	134.5	32.84	134.51	34.48	134.49	36.12	134.54	37.77	134.57
39.41	134.59	41.05	134.61	42.69	134.62	44.33	134.74	45.98	134.8
47.62	134.81	49.26	134.83	50.9	134.86	52.54	134.91	54.19	134.96
55.83	135	57.47	135.04	59.11	135.08	60.75	134.96	62.4	135.05
64.04	135.24	65.68	135.44	67.32	135.67	68.96	135.82	70.61	135.98
72.25	136.15	73.89	136.36	75.53	136.54	77.17	136.19	78.82	136.07
80.46	135.98	82.1	135.87	83.56	135.74	83.74	135.72	85.38	135.74
87.03	135.73	88.67	135.72	90.31	135.71	91.95	135.7	93.59	135.69
95.24	135.68	96.88	135.67	98.52	135.66	100.16	135.65	101.8	135.64
103.45	135.63	105.09	135.62	106.73	135.61	108.37	135.58	110.01	135.54
111.66	135.58	113.3	135.62	114.94	135.66	116.58	135.7	118.22	135.58
119.87	135.57	121.51	135.47	123.15	135.32	124.79	135.3	126.43	135.33
128.07	135.27	129.72	135.22	131.36	135.33	133	135.14	134.64	135.1
136.28	135.19	137.93	135.28	139.57	135.46	141.21	135.73	142.85	135.81
144.49	135.86	146.14	135.92	147.78	136	149.42	135.75	151.06	135.78
152.7	135.77	154.35	135.74	155.99	135.72	157.63	135.81	159.27	135.91
160.91	136.05	162.56	136.2	164.2	136.21	165.84	136.25	167.48	136.25
169.12	136.27	170.77	136.33	172.41	136.37	174.05	136.35	175.69	136.32
177.33	136.28	178.98	136.18	180.62	136.12	182.26	136.11	183.9	135.95
185.54	135.75	187.19	135.44	188.83	135.35	190.47	135.26	192.11	135.22
193.75	135.2	195.4	135.3	197.04	135.19	198.68	135.21	200.32	135.21
201.96	135.3	203.61	135.08	205.25	135.21	206.89	135.06	208.53	134.97
210.17	134.88	211.82	134.91	213.23	134.9	213.46	134.9	215.1	134.82
216.74	134.7	218.38	134.61	220.03	134.48	221.67	134.43	223.31	134.37
224.95	134.32	226.59	134.22	228.24	134.17	229.88	134.09	231.52	134.05
233.16	133.99	234.8	133.88	236.45	133.88	238.09	133.79	238.5	134.1

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   259.4     133   277.7     133  286.24  128.34   286.5   128.2   292.9   127.1
   297.3   127.1   302.3   127.2   308.3   128.5   316.1   129.4  317.85   130.4
   318.2   130.6   336.4   132.9   347.2   133.6   356.5   134.2  357.93  134.16
  359.43  134.31  360.93  134.49  362.43  134.52  363.92  134.58  364.64  134.62
  365.42  134.66  366.92  134.68  368.42  134.78  369.91  134.84  371.41  134.83
  372.91  134.92   374.4  134.99   375.9  134.93   377.4  134.95   378.9     135
  380.39  134.97  381.89  134.88  383.39  134.76  383.45  134.76  384.89  134.85
  386.38  134.87  387.88   134.9  389.38  134.92  390.88  135.04  392.37  135.25
  393.87  135.21  395.37  135.22  396.87  135.23  398.36  135.24  399.86  135.25
  401.36  135.23     470     140

Manning's n Values        num=       7
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
     -80     .04   83.56     .04  213.23     .07  286.24    .035  317.85     .04
  364.64    .012  383.45     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        286.24  317.85             13.2   12.06    8.67             .1       .3
Blocked Obstructions     num=       1
   Sta L   Sta R    Elev
      84     119     150

CROSS SECTION


RIVER:
REACH: reach_3            RS: 229.683

INPUT
Description:
Station Elevation Data    num=     211
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  134.41    1.63  134.36    3.26  134.32    4.89  134.27    6.52   134.2
    8.14  134.14    9.77  134.09    11.4     134   13.03  134.01   14.66  134.02
   16.29  134.02   17.92  133.99   19.55  133.99   21.17     134    22.8  133.99
   24.43  133.98   26.06  134.08   27.69  134.19   29.32  134.26   30.95  134.35
   32.58  134.36    34.2  134.43   35.83  134.62   37.46  134.68   39.09  134.77
   40.72  134.88   42.35     135   43.98  134.98   45.61  134.91   47.23  134.81
   48.86   134.9   50.49  134.78   52.12  134.71   53.75  134.63   55.38  134.58
   57.01  134.53   58.64  134.73   60.26  135.04   61.89  135.36   63.52  135.72
   65.15  136.03   66.78  136.22   68.41  136.42   70.04   136.2   71.67  136.11
   73.29  136.04   74.92  135.97   76.55   135.9   78.18  135.83   79.81  135.76
   81.44  135.69   83.07  135.61    84.7  135.53   86.32  135.47   87.95  135.22
   89.58  135.21   91.21   135.2   92.84  135.15   94.47  135.24    96.1  135.26
   97.73  135.22   99.36  135.16  100.98  135.17  102.61   135.2  104.24  135.26
  105.87   135.3   107.5  135.32  109.13  135.27  110.76   135.3  112.39  135.32
  114.01  135.34  115.64  135.34  117.27  135.25   118.9  135.17  120.53  135.05
  122.16  134.93  123.79  134.98  125.42  134.96  127.04  134.98  128.32  135.01
  128.67  135.01   130.3  135.06  131.93  135.03  133.56  135.51  135.19  135.83
  136.83   136.1  138.48  136.07  140.12  135.91  141.77  136.02  143.42  136.16
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  145.06  136.27  146.71  136.05  148.35  135.84     150  135.75  151.64  135.87
  153.29  136.08  154.94  135.91  156.58  135.79  158.23  135.66  159.87  135.55
  161.52  135.46  163.16  135.55  164.81   135.6  166.45  135.62   168.1  135.64
  169.75  135.64  171.39  135.64  173.04  135.65  174.68  135.68  176.33  135.84
  177.97  136.01  179.62  136.16  181.27  136.27  182.91  136.36  184.56  136.45
   186.2  136.58  187.85  136.75  189.49  136.62  191.14  136.42  192.79  136.26
  194.43  135.87  196.08  135.33  197.72  135.23  199.37  135.13  201.01  135.19
  202.66  135.07   204.3  135.07  205.95  135.14   207.6  135.11  209.24  135.05
  210.89  134.99  212.53  134.97  213.73  134.94  214.18  134.93  215.82  134.93
  217.47  134.92  219.12  134.82  220.76  134.74  222.41  134.69  224.05  134.67
   225.7  134.64  227.34  134.59  228.99   134.5  230.63  134.32  232.28  134.16
  233.93  134.05  235.57  133.86  237.22  133.81  238.86  133.72   239.7   133.9
   257.7   132.7   265.4   133.3     267   133.3   274.9   133.1   280.7   132.4
   283.1     131  285.22  129.64     287   128.5   294.4   126.3   299.1   125.4
   306.3   127.2   312.5   128.7  318.92  131.21   319.4   131.4     343   133.2
  344.37  133.34  345.85  133.43  347.33  133.42   348.8  133.46  350.28  133.49
  351.76  133.63  353.23  133.66  354.71   133.7  356.19  133.85  357.67  133.99
  359.14  134.07  360.62  134.16   362.1  134.35  363.58  134.52  365.05  134.49
  366.21  134.56  366.53  134.58  368.01  134.83  369.49  134.73  370.96  134.69
  372.44  134.71  373.92  134.75  375.39  134.81  376.87  134.86  378.35  134.83
  379.83   134.9   381.3  134.97  382.78  134.84  384.26  134.88  385.33  134.87
  385.74  134.86  387.21   134.9  388.69  134.88  390.17  134.87  391.65  134.83
  393.12   134.9   394.6  134.96  396.08  134.94  397.55  135.03  399.03  135.09
  400.51  135.12  401.99  135.15  403.46  135.17  404.94  135.14  406.42  135.12
     471     140

Manning's n Values        num=       7
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
       0     .07  128.32     .04  213.73     .07  285.22    .035  318.92     .04
  366.21    .012  385.33     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        285.22  318.92            23.03   23.87   26.04             .1       .3

CROSS SECTION


RIVER:
REACH: reach_3            RS: 205.816

INPUT
Description:
Station Elevation Data    num=     190
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  134.14    1.63  134.14    3.27  134.13     4.9  134.13    6.54  134.12
    8.17   134.1     9.8  134.09   11.44  134.07   13.07  134.03    14.7  133.98
   16.34  134.01   17.97  134.05   19.61  134.06   21.24  134.12   22.87  134.17
   24.51  134.13   26.14  134.18   27.77  134.14   29.41  134.13   31.04  134.19
   32.68  134.23   34.31  134.27   35.94  134.31   37.58  134.36   39.21   134.4
   40.85  134.31   42.48  134.36   44.11  134.39   45.75  134.45   47.38  134.45
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   49.01  134.48   50.65  134.52   52.28  134.56   53.92   134.6   55.55  134.63
   57.18  134.58   58.82  134.66   60.45  134.74   62.08  134.85   63.72  135.01
   65.35  135.06   66.99  135.07   68.62  135.13   70.25   135.2   71.89  135.23
   73.52  135.08   75.16   134.7   76.79  134.54   78.42  134.46   80.06   134.4
   81.69  134.39   83.32   134.4   84.96  134.39   86.59  134.47   88.23  134.44
   89.86  134.46   91.49  134.45   93.13  134.42   94.76  134.36   96.39  134.49
   98.03  134.47   99.66  134.65   101.3  134.66  102.93   134.6  104.56  134.56
   106.2  134.53  107.83  134.44  109.47  134.58   111.1  134.64  112.73  134.67
  114.37  134.68     116   134.7  117.63   134.7  119.27  134.72   120.9  134.77
  122.54   134.8  124.17  134.88   125.8  134.91  127.44  134.93  129.07  134.96
   130.7  135.02  132.34  135.06  133.97  135.06  135.61  135.13  137.24  135.16
  138.87  135.17  140.51  135.15  142.14  135.15  143.78  135.16  145.41  135.16
  147.04  135.18  148.68  135.21  150.31  135.16  151.94  135.15  153.58  135.14
  155.21  135.15  156.85  135.12  158.48  135.12  160.11  135.21  161.75  135.27
  163.38   135.5  165.02  135.24  166.65  135.22  168.28  135.21  169.92  134.93
  171.55  135.24  173.18  135.25  174.82  135.16  176.45  135.12  178.09  135.13
  179.72  135.02  181.35  135.26  182.98  135.18  184.62  135.15  186.25  135.12
  187.88   135.1  189.51  135.08  191.14   135.1  192.78  135.09   193.5   135.2
   212.6   135.1   237.1   134.4   241.9   134.2   271.2   132.7   279.7   132.3
   285.6   130.8   286.4   130.6     289   128.6   298.6   127.8   308.8   128.3
   316.5   128.8  321.31  129.38  344.85  132.23  346.28  132.44  347.71  132.54
  349.14  132.63  350.58  132.75  352.01  132.86  353.44  133.03  354.87  133.23
  356.31  133.36  357.74  133.62  359.17  133.93   360.6  133.79  362.03   133.7
  363.47  133.74   364.9  133.71  366.33  133.67  367.76  133.69   369.2  133.75
  370.63  133.84  371.92  134.03  372.06  134.05  373.49  134.27  374.93  134.25
  376.36  134.33  377.79  134.44  379.22  134.45  380.65  134.47  382.09  134.52
  383.52  134.59  384.95  134.66  386.38  134.67  387.82  134.68  389.25  134.74
  390.68  134.75  391.88  134.72  392.11  134.71  393.55  134.63  394.98  134.55
  396.41  134.54  397.84  134.54  399.27  134.53  400.71  134.64  402.14  134.69
  403.57  134.64     405  134.66  406.44  134.71  407.87  134.73   409.3  134.72
  410.73  134.79  412.17  134.81   413.6  134.81  415.03  134.87  416.46  134.91
   417.9  134.89  419.33  134.92  420.76  134.93  422.19  135.04     543     140

Manning's n Values        num=       5
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
       0     .07   285.6    .035  321.31     .04  371.92    .012  391.88     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         285.6  321.31             15.85   15.65   18.34             .1       .3

CROSS SECTION


RIVER:
REACH: reach_3            RS: 190.168

INPUT
Description:
Station Elevation Data    num=     203
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
```

0	133.92	1.63	133.97	3.26	134.01	4.88	134.06	6.51	134.1
8.14	134.15	9.77	134.23	11.4	134.26	13.02	134.29	14.65	134.32
16.28	134.34	17.91	134.38	19.54	134.41	21.16	134.45	22.79	134.42
24.42	134.43	26.05	134.52	27.68	134.38	29.3	134.24	30.93	134.18
32.56	134.09	34.19	134.01	35.82	133.95	37.44	133.91	39.07	133.96
42.33	133.96	43.96	133.98	45.58	134	47.21	134.03	48.84	134.07
50.47	134.12	52.1	134.17	53.72	134.23	55.35	134.25	56.98	134.29
58.61	134.33	60.24	134.34	61.86	134.39	63.49	134.56	65.12	134.7
66.75	134.77	68.37	134.79	70	134.81	71.63	134.86	73.26	134.77
74.89	134.49	76.51	134.5	78.14	134.48	79.77	134.39	81.41	134.28
83.06	134.08	84.7	134.05	86.34	134.04	87.98	133.99	89.63	133.96
91.27	133.97	92.91	134.03	94.56	134.11	97.84	134.23	99.48	134.28
101.13	134.32	102.77	134.38	104.41	134.44	106.05	134.47	107.7	134.5
109.34	134.45	110.98	134.38	112.63	134.42	114.27	134.49	115.91	134.53
117.55	134.47	119.2	134.45	120.84	134.5	122.48	134.54	124.12	134.58
125.77	134.62	127.41	134.67	129.05	134.71	130.7	134.76	132.34	134.83
133.98	134.89	135.62	134.91	137.27	134.9	140.55	134.9	142.19	134.88
143.84	134.85	145.48	134.9	147.12	134.92	148.76	134.9	150.41	134.73
152.05	134.76	153.74	134.8	155.42	134.83	157.11	134.85	158.8	134.81
160.48	134.79	162.17	134.84	163.86	134.88	165.55	134.92	167.23	134.96
168.92	134.96	170.61	134.88	172.29	134.85	173.98	134.83	175.67	134.8
177.35	134.79	179.04	134.82	180.73	134.86	182.41	134.86	184.1	134.88
185.79	134.91	187.47	134.98	189.16	134.87	190.85	135.03	191.7	135.1
207.8	135.2	216.3	135.2	230.3	134.5	239.6	134.3	257.1	134.1
270.4	133.2	278.3	133.1	284.3	131.08	288.1	129.8	289.2	128.4
299.9	128.4	303.3	128.1	308.6	128.1	314.2	130.1	315.85	130.3
327.4	131.7	328.03	131.56	329.61	131.8	331.18	131.97	332.76	131.89
334.34	131.92	335.91	132.01	337.49	132.26	339.06	132.5	340.64	132.59
342.22	132.6	343.79	132.57	345.37	132.52	346.94	132.49	348.52	132.61
350.1	132.71	351.67	132.64	353.25	132.7	354.82	132.9	356.4	133.07
357.98	133.03	359.41	133.2	360.85	133.31	362.29	133.32	363.73	133.3
365.17	133.22	366.61	133.16	368.05	133.21	369.49	133.35	370.92	133.47
372.36	133.41	373.11	133.45	373.8	133.48	375.24	133.55	376.68	133.55
378.12	133.59	379.56	133.77	380.99	133.74	382.43	133.72	383.87	133.86
385.31	133.89	386.75	133.88	388.19	133.91	389.63	133.99	391.06	134.08
392.5	134.07	392.68	134.07	393.94	134.05	395.38	134.05	396.82	134.01
398.26	134.15	399.7	134.16	401.13	134.27	402.57	134.39	404.01	134.49
405.45	134.43	406.89	134.34	408.33	134.3	409.77	134.36	411.2	134.4
412.64	134.37	414.08	134.3	415.52	134.25	416.96	134.33	418.4	134.42
419.84	134.36	421.28	134.38	422.71	134.38	424.15	134.41	425.59	134.43
427.03	134.39	428.47	134.39	548	140				

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.07	284.3	.035	315.85	.04	373.11	.012	392.68	.04

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
284.3	315.85	9.54	9.34	10.36	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent

```
       0     285     134       F
     315     548     134       F
Blocked Obstructions     num=       4
   Sta L   Sta R    Elev   Sta L   Sta R    Elev   Sta L   Sta R    Elev
      58    79.4   137.7    99.3   228.5     138   249.4     275     138
   313.8   366.9     136

CROSS SECTION


RIVER:
REACH: reach_3            RS: 180.829

INPUT
Description:
Station Elevation Data    num=     225
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  133.73    1.66  133.77    3.32   133.8    4.99  133.84    6.65  133.88
    8.31  133.92    9.97  133.91   11.64  133.92    13.3  133.94   14.96  134.27
   16.62  134.01   18.29  133.96   19.95  133.97   21.61  133.85   23.27  133.83
   24.94  133.96    26.6   133.9   28.26   133.8   29.92   133.8   31.59  133.72
   33.25  133.68   34.91  133.69   36.57   133.7   38.24  133.71   41.56  133.71
   43.22  133.72   44.89  133.74   48.21   133.8   49.87  133.85   51.54  133.86
    53.2   133.9   54.86  133.93   56.52  134.03   58.19  134.08   59.85  134.21
   61.51  134.31   63.17  134.42   64.84  134.53    66.5  134.64   68.16  134.66
   69.82   134.6   71.49  134.52   73.15  134.44   74.81  134.37   76.47  134.29
   78.14  134.21    79.8  134.13   81.46  134.06   83.12  133.98   84.79  133.93
   86.45  133.95   88.11  133.97   89.77  133.98   91.44  133.98    93.1     134
   94.76  134.04   96.42  134.07   98.09  134.09  101.41  134.13  103.07  134.15
  104.74  134.17   106.4  134.18  108.06  134.15  109.72  134.19  111.39  134.14
  113.05  134.06  114.71     134  116.37     134  118.04  134.21   119.7  134.33
  121.36  134.37  123.02  134.41  124.69  134.44  126.35  134.52  128.01  134.57
  129.67  134.64  131.34  134.68     133   134.7  134.66  134.66  136.32  134.67
  137.99  134.63  139.65  134.58  141.31  134.53  142.97   134.6  144.64  134.63
   146.3  134.69  147.96  134.62  149.62  134.51  151.29  134.53  152.95  134.54
  154.61  134.58  156.27  134.61  157.98  134.61  159.68   134.6  161.38  134.55
  163.09  134.52  164.79  134.49  166.49  134.45  168.19  134.42   169.9  134.38
   171.6  134.37   173.3  134.46  175.01  134.46  176.71  134.45  178.41  134.43
  180.12  134.39  181.82   134.4  183.52  134.48  185.22  134.67  186.93  134.85
  188.63  134.98  190.33  135.21  192.04  135.14  193.74  135.39  195.44  135.34
  197.15  135.32  198.85  135.55  200.55  135.61  202.25  135.53  203.96  135.52
  205.66  135.56  207.36  135.69  209.07  135.56  210.77  135.46  212.47  135.51
  214.18  135.55  215.88  135.53  217.58  135.42  219.28   135.2  220.99  134.88
  222.69  134.64  224.39  134.42   226.1  134.37   227.8  134.17   229.5     134
  231.21  134.01  232.91     134  234.52     134  236.13  133.99  237.75  133.99
  239.36  133.95  240.97  134.01  242.59  134.01   244.2     134  245.81  133.98
  247.43  134.03  249.04  134.05  250.65  134.03  252.26  133.99  253.88  133.97
   254.6   134.1   277.1   134.1  282.75  133.24   283.7   133.1     285   127.6
   291.7   128.1   298.4   128.4   302.5   128.3   307.9   128.6   308.2   133.1
  310.96  133.62   313.5   134.1   342.2   133.4  343.57  133.65  345.33  133.67
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  347.09   133.7  348.85  133.63  350.29  133.66  351.74  133.66  353.19  133.73
  354.64  133.72  356.08  133.65  357.53  133.36  358.98  133.43  360.43  133.39
  360.85  133.37  361.88  133.32  363.32   133.3  364.77  133.31  366.22  133.33
  367.67  133.28  369.11  133.24  370.56  133.25  372.01  133.25  373.46  133.29
   374.9  133.33  376.35  133.38   377.8  133.35  379.25  133.45  380.69  133.58
  382.14  133.68  383.59   133.7  385.04  133.72  386.49  133.68  387.93  133.64
  389.38  133.72  390.83  133.81  392.28  133.77  392.34  133.77  393.72   133.7
  395.17  133.72  396.62  133.75  398.07  133.97  399.51  134.21  400.96  134.41
  402.41   134.5  403.86  134.44   405.3  134.64  406.75  134.55   408.2  134.54
  409.65  134.73   411.1  134.86  412.54  134.93  413.99  134.81  415.44  134.85
  416.89  134.67  418.33  134.67  419.78  134.64  421.23  134.66  422.68   134.7
  424.12  134.75  425.57  134.74  427.02  134.71  428.47  134.66     550     140

Manning's n Values        num=       5
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
       0     .07  282.75    .035  310.96     .04  360.85    .012  392.34     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        282.75  310.96            48.98   47.91   48.24             .3       .5

BRIDGE


RIVER:
REACH: reach_3            RS: 161.5

INPUT
Description:
Distance from Upstream XS =       5
Deck/Roadway Width        =      33
Weir Coefficient          =     2.6
Upstream  Deck/Roadway Coordinates
    num=      26
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
     2.8     134            78.3   134.1           153.2     134
   215.4   134.1           252.5   134.5             268   134.7
     268   137.2             272   138.3           275.5   138.3
   275.5   135.4           279.5   135.5           279.5   135.5   132.5
   282.5   135.5   132.5   303.5   135.6   132.6   312.5   135.6   132.7
   312.5   135.6           316.5   135.7           316.5   138.6
     320   138.6             324   137.5             324     135
   338.5   134.6           351.5   134.3           361.5   133.9
   372.5   133.7           394.7   133.5

Upstream Bridge Cross Section Data
Station Elevation Data    num=     225
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  133.73    1.66  133.77    3.32   133.8    4.99  133.84    6.65  133.88
    8.31  133.92    9.97  133.91   11.64  133.92    13.3  133.94   14.96  134.27
   16.62  134.01   18.29  133.96   19.95  133.97   21.61  133.85   23.27  133.83
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24.94	133.96	26.6	133.9	28.26	133.8	29.92	133.8	31.59	133.72
33.25	133.68	34.91	133.69	36.57	133.7	38.24	133.71	41.56	133.71
43.22	133.72	44.89	133.74	48.21	133.8	49.87	133.85	51.54	133.86
53.2	133.9	54.86	133.93	56.52	134.03	58.19	134.08	59.85	134.21
61.51	134.31	63.17	134.42	64.84	134.53	66.5	134.64	68.16	134.66
69.82	134.6	71.49	134.52	73.15	134.44	74.81	134.37	76.47	134.29
78.14	134.21	79.8	134.13	81.46	134.06	83.12	133.98	84.79	133.93
86.45	133.95	88.11	133.97	89.77	133.98	91.44	133.98	93.1	134
94.76	134.04	96.42	134.07	98.09	134.09	101.41	134.13	103.07	134.15
104.74	134.17	106.4	134.18	108.06	134.15	109.72	134.19	111.39	134.14
113.05	134.06	114.71	134	116.37	134	118.04	134.21	119.7	134.33
121.36	134.37	123.02	134.41	124.69	134.44	126.35	134.52	128.01	134.57
129.67	134.64	131.34	134.68	133	134.7	134.66	134.66	136.32	134.67
137.99	134.63	139.65	134.58	141.31	134.53	142.97	134.6	144.64	134.63
146.3	134.69	147.96	134.62	149.62	134.51	151.29	134.53	152.95	134.54
154.61	134.58	156.27	134.61	157.98	134.61	159.68	134.6	161.38	134.55
163.09	134.52	164.79	134.49	166.49	134.45	168.19	134.42	169.9	134.38
171.6	134.37	173.3	134.46	175.01	134.46	176.71	134.45	178.41	134.43
180.12	134.39	181.82	134.4	183.52	134.48	185.22	134.67	186.93	134.85
188.63	134.98	190.33	135.21	192.04	135.14	193.74	135.39	195.44	135.34
197.15	135.32	198.85	135.55	200.55	135.61	202.25	135.53	203.96	135.52
205.66	135.56	207.36	135.69	209.07	135.56	210.77	135.46	212.47	135.51
214.18	135.55	215.88	135.53	217.58	135.42	219.28	135.2	220.99	134.88
222.69	134.64	224.39	134.42	226.1	134.37	227.8	134.17	229.5	134
231.21	134.01	232.91	134	234.52	134	236.13	133.99	237.75	133.99
239.36	133.95	240.97	134.01	242.59	134.01	244.2	134	245.81	133.98
247.43	134.03	249.04	134.05	250.65	134.03	252.26	133.99	253.88	133.97
254.6	134.1	271.9	134.1	279.5	129.3	286	129.3	286	127.7
291.7	128.1	298.4	128.4	302.5	128.3	306	128.5	306	129.4
312.5	129.4	319.6	133.9	342.2	133.4	343.57	133.65	345.33	133.67
347.09	133.7	348.85	133.63	350.29	133.66	351.74	133.66	353.19	133.73
354.64	133.72	356.08	133.65	357.53	133.36	358.98	133.43	360.43	133.39
360.85	133.37	361.88	133.32	363.32	133.3	364.77	133.31	366.22	133.33
367.67	133.28	369.11	133.24	370.56	133.25	372.01	133.25	373.46	133.29
374.9	133.33	376.35	133.38	377.8	133.35	379.25	133.45	380.69	133.58
382.14	133.68	383.59	133.7	385.04	133.72	386.49	133.68	387.93	133.64
389.38	133.72	390.83	133.81	392.28	133.77	392.34	133.77	393.72	133.7
395.17	133.72	396.62	133.75	398.07	133.97	399.51	134.21	400.96	134.41
402.41	134.5	403.86	134.44	405.3	134.64	406.75	134.55	408.2	134.54
409.65	134.73	411.1	134.86	412.54	134.93	413.99	134.81	415.44	134.85
416.89	134.67	418.33	134.67	419.78	134.64	421.23	134.66	422.68	134.7
424.12	134.75	425.57	134.74	427.02	134.71	428.47	134.66	550	140

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.07	271.9	.035	319.6	.04	360.85	.012	392.34	.04

Bank Sta: Left	Right	Coeff Contr.	Expan.
279.5	312.5	.3	.5

Downstream Deck/Roadway Coordinates

num= 26

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-91.9	134		-16.4	134.1		58.5	134	
120.7	134.1		157.8	134.5		173.3	134.7	
173.3	137.2		177.3	138.3		180.8	138.3	
180.8	135.4		184.8	135.5		184.8	135.5	132.5
187.8	135.5	132.5	208.8	135.6	132.6	217.8	135.6	132.7
217.8	135.6		221.8	135.7		221.8	138.6	
225.3	138.6		229.3	137.5		229.3	135	
243.8	134.6		256.8	134.3		266.8	133.9	
277.8	133.7		300	133.5				

Downstream Bridge Cross Section Data

Station Elevation Data num= 112

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	132.02	1.67	132.05	3.34	132.06	5.02	132.07	6.69	132.06
8.36	132.1	10.03	132.14	11.7	132.07	13.37	131.9	15.05	131.83
16.72	131.79	18.39	131.72	20.06	131.75	21.73	131.73	23.4	131.69
25.08	131.63	26.75	131.49	28.42	131.49	30.09	131.74	31.76	131.68
33.43	131.69	35.11	131.72	36.78	131.78	38.45	131.78	40.12	131.84
41.79	131.89	43.46	131.88	45.14	131.78	46.81	131.72	48.48	131.77
50.15	131.95	51.82	131.93	53.49	132.03	55.17	132.16	56.84	132.16
58.51	132.12	60.18	132.02	61.85	131.89	63.52	131.73	65.2	131.68
66.87	131.72	68.54	131.71	70.21	131.73	71.88	131.8	73.55	132.01
75.23	132.09	76.9	131.98	78.57	132.02	80.24	132.06	81.91	132.08
83.58	132.14	85.26	132.11	86.93	132.01	88.6	132.04	90.27	132.06
91.94	132.07	93.61	132	95.29	132.02	96.96	132.1	98.63	132.15
100.3	132.11	101.97	132.11	103.64	132.13	105.32	132.09	106.99	132.07
108.66	131.92	110.33	131.97	112	132.04	113.67	131.99	115.35	132.13
117.02	132.25	118.69	132.31	120.36	132.35	122.03	132.43	123.7	132.49
125.38	132.53	127.05	132.53	128.72	132.39	175.1	132.7	183.4	131.4
185.5	129.3	192	129.3	192	128.3	192.8	128	204.8	127.7
208.6	128	212	129.4	218.5	129.4	222.6	132.5	233.4	133.2
233.78	133.03	235.38	133.04	236.99	133.03	238.6	133.17	240.2	132.98
241.59	133.16	242.98	133.28	244.37	133.31	245.77	133.45	247.16	133.48
248.55	133.51	249.94	133.67	251.33	133.57	252.72	133.53	254.11	133.57
254.52	133.57	255.5	133.56	256.89	133.57	258.28	133.61	259.67	133.6
261.06	133.52	262.45	133.51						

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.07	183.4	.035	222.6	.04	254.52	.012

Bank Sta: Left	Right	Coeff Contr.	Expan.
185.5	218.5	.3	.5

Blocked Obstructions num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev
0	181.3	138.3	222	262.45	139

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Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .98
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Pressure and Weir flow
           Submerged Inlet Cd          =
           Submerged Inlet + Outlet Cd =      .8
           Max Low Cord                =

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION


RIVER:
REACH: reach_3            RS: 132.919

INPUT
Description:
Station Elevation Data    num=     111
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  132.02    1.67  132.05    3.34  132.06    5.02  132.07    6.69  132.06
    8.36   132.1   10.03  132.14    11.7  132.07   13.37   131.9   15.05  131.83
   16.72  131.79   18.39  131.72   20.06  131.75   21.73  131.73    23.4  131.69
   25.08  131.63   26.75  131.49   28.42  131.49   30.09  131.74   31.76  131.68
   33.43  131.69   35.11  131.72   36.78  131.78   38.45  131.78   40.12  131.84
   41.79  131.89   43.46  131.88   45.14  131.78   46.81  131.72   48.48  131.77
   50.15  131.95   51.82  131.93   53.49  132.03   55.17  132.16   56.84  132.16
   58.51  132.12   60.18  132.02   61.85  131.89   63.52  131.73    65.2  131.68
   66.87  131.72   68.54  131.71   70.21  131.73   71.88   131.8   73.55  132.01
   75.23  132.09    76.9  131.98   78.57  132.02   80.24  132.06   81.91  132.08
   83.58  132.14   85.26  132.11   86.93  132.01    88.6  132.04   90.27  132.06
   91.94  132.07   93.61     132   95.29  132.02   96.96   132.1   98.63  132.15
   100.3  132.11  101.97  132.11  103.64  132.13  105.32  132.09  106.99  132.07
```

```
  108.66  131.92  110.33  131.97     112  132.04  113.67  131.99  115.35  132.13
  117.02  132.25  118.69  132.31  120.36  132.35  122.03  132.43   123.7  132.49
  125.38  132.53  127.05  132.53  128.72  132.39   175.1   132.7   180.5     132
     185     131   189.6     129  191.11  128.53   192.8     128   204.8   127.7
   208.6     128  212.21  129.47   218.9   132.2   233.4   133.2  233.78  133.03
  235.38  133.04  236.99  133.03   238.6  133.17   240.2  132.98  241.59  133.16
  242.98  133.28  244.37  133.31  245.77  133.45  247.16  133.48  248.55  133.51
  249.94  133.67  251.33  133.57  252.72  133.53  254.11  133.57  254.52  133.57
   255.5  133.56  256.89  133.57  258.28  133.61  259.67   133.6  261.06  133.52
  262.45  133.51

Manning's n Values        num=       4
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
       0     .07  191.11    .035  212.21     .04  254.52    .012

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.    Expan.
        191.11  212.21             25.53   20.84   18.44             .3       .5
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
       0   181.3   138.3     222  262.45     139

CROSS SECTION


RIVER:
REACH: reach_3            RS: 112.083

INPUT
Description:
Station Elevation Data    num=     150
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  131.41    1.74  131.49    3.48  131.51    5.22  131.55    6.96  131.59
     8.7  131.54   10.44  131.75   12.17  131.66   13.91  131.62   15.65  131.55
   17.39  131.42   19.13  131.34   20.87  131.26   22.61  131.18   24.35  131.23
   26.09  131.27   27.83  131.29   29.57   131.3   31.31  131.29   33.05  131.57
   34.79  131.54   36.52  131.54   38.26  131.45      40  131.38   41.74  131.31
   43.48   131.3   45.22  131.32   46.96  131.34    48.7  131.31   50.44  131.31
   52.18  131.38   53.92  131.45   55.66  131.46    57.4  131.46   59.14  131.53
   60.87  131.38   62.61  131.34   64.35  131.32   66.09  131.33   67.83  131.37
   69.57  131.37   71.31  131.34   73.05  131.38   74.79  131.48   76.53  131.57
   78.27  131.64   80.01  131.71   81.75  131.61   83.48  131.46   85.22  131.58
   86.96  131.62    88.7  131.65   90.44  131.68   92.18  131.71   93.92  131.75
   95.66  131.76    97.4  131.94   99.14  131.93  100.88     132  102.62  132.14
  104.36  132.21   106.1  132.14  107.83  132.18  109.57  132.09  111.31  132.05
  113.05  132.01  114.79  132.09  116.53  132.12  118.27  132.01  120.01  132.03
  121.75  131.98  123.49   132.1  125.23  132.18  126.97  132.15  128.71  132.13
  130.44  132.11  132.18  132.08  133.92  132.07  135.66   132.1   137.4  132.12
  139.14  132.02  140.88     132  142.62  131.96  144.36  132.25   146.1  132.34
  147.84  132.43  149.58  132.35  151.32   132.2  153.06  132.07  154.79  132.04
  156.53  131.81  158.27  131.74  160.01  131.77  161.75  131.87  163.49  131.93
```

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  165.23   131.9  166.97  131.88  168.71  131.88  170.45  131.86     172   132.1
   191.9   132.2   208.3   130.6  210.41  128.06   210.8   127.6   218.5   126.9
  227.22  128.47   227.4   128.5   228.5   128.6   229.1   129.6   234.6   131.9
   244.9   131.8  245.39  131.99  246.87   131.9  248.35  131.93  249.82  131.94
   251.3  132.01  252.78  132.07  254.25  132.11  255.73  132.15  257.21  132.22
  258.68  132.32  260.16  132.32  261.64  132.36  263.11  132.39  264.59  132.35
  266.07  132.46  267.54  132.39  269.02   132.3   270.5  132.35  271.97  132.41
  273.45  132.37  274.93  132.35   276.4  132.46  277.88  132.58  279.36  132.69
  280.83  132.69  282.31   132.7  283.78  132.76  285.26  132.76  286.73   132.8
   288.2  132.82  289.68  132.86  291.15  132.88  292.62  132.92   294.1  132.98
  295.57  132.94  297.04  132.95  297.31  132.95  298.51  132.96     310   133.5

Manning's n Values        num=       4
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
       0     .07  210.41    .035  227.22     .04  297.31    .012

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        210.41  227.22            20.14   19.94   19.81             .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0   188.8   138.3       F
   248.8     310     139       F

CROSS SECTION


RIVER:
REACH: reach_3            RS: 92.144

INPUT
Description:
Station Elevation Data    num=     165
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  131.19    1.85  131.12    3.69  131.09    5.54  131.06    7.39  131.08
    9.24  131.13   11.08  131.25   12.93   131.1   14.78  131.18   16.63  131.23
   18.47  131.08   20.32  131.02   22.17  130.99   24.02  130.96   25.86     131
   27.71  131.02   29.56  131.04   31.41  131.06   33.25  131.09    35.1  131.04
   36.95  131.11    38.8  130.99   40.64  131.03   42.49  131.12   44.34  131.19
   46.19  131.19   48.03  131.18   49.88  131.18   51.73  131.17   53.58  131.23
   55.42  131.31   57.27  131.37   59.12  131.43   60.96  131.62   62.81  131.71
   64.66  131.63   66.51  131.45   68.35  131.45    70.2  131.45   72.05  131.34
    73.9  131.27   75.74  131.27   77.59  131.29   79.44  131.22   81.29  131.32
   83.13   131.3   84.98   131.3   86.83   131.3   88.68  131.31   90.52  131.36
   92.37  131.47   94.22   131.6   96.07  131.65   97.91  131.71   99.76  131.77
  101.61  131.84  103.46  131.78   105.3  131.77  107.15  131.91     109     132
  110.85  132.04  112.69  131.93  114.54  131.81  116.39  131.69  118.23  131.61
  120.08  131.61  121.93  131.61  123.78  131.58  125.62  131.59  127.47  131.63
  129.32  131.67  131.17  131.62  133.01  131.68  134.86  131.73  136.71  131.68
  138.56  131.72   140.4  131.64  142.25  131.51   144.1  131.54  145.95  131.56
  147.79  131.52  149.64  131.53  151.49  131.55  153.34   131.5  155.18  131.47
```

157.03	131.48	158.88	131.53	160.73	131.52	162.57	131.5	164.42	131.48
166.27	131.46	168.12	131.44	169.96	131.42	171.81	131.4	173.66	131.38
175.5	131.52	184.3	131.8	201.9	131.9	221.7	131.4	227.34	127.44
227.4	127.4	235.2	126.4	244.63	128.48	244.7	128.5	250.2	131
268.7	132.1	269.28	132.01	270.85	132.08	272.42	131.95	273.99	131.76
275.56	131.59	277.14	131.7	278.71	131.78	280.28	131.75	281.85	131.75
283.42	131.71	284.99	131.74	286.56	131.75	288.14	131.77	289.71	131.58
291.28	131.52	292.85	131.47	294.42	131.41	295.99	131.43	297.57	131.48
299.14	131.52	300.71	131.42	302.28	131.37	303.85	131.31	305.42	131.18
307	131.38	308.57	131.39	310.14	131.35	311.71	131.33	313.28	131.25
314.85	131.24	316.43	131.21	318	131.19	319.57	131.19	321.14	131.22
322.71	131.23	324.28	131.33	325.85	131.56	327.43	131.66	329	131.73
330.57	131.68	332.14	131.67	333.51	131.7	334.88	131.75	336.25	131.87
337.63	131.92	339	131.96	340.37	131.98	341.74	131.91	343.11	132.02
344.48	132.08	345.85	132.17	347.22	132.23	348.59	132.27	349.96	132.33
351.34	132.4	352.71	132.42	354.08	132.53	355.45	132.49	369	133.4

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.07	227.34	.035	244.63	.04	355.45	.012

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
227.34	244.63	25.52	28.54	32.22	.1	.3

CROSS SECTION

RIVER:
REACH: reach_3 RS: 63.607

INPUT
Description:
Station Elevation Data num= 201

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	131.03	1.88	130.89	3.76	130.73	5.63	130.58	7.51	130.46
9.39	130.43	11.27	130.36	13.15	130.23	15.02	130.07	16.9	130.02
18.78	130.04	20.66	130.16	22.54	129.94	24.41	129.97	26.29	130.27
28.17	130.19	30.05	130.13	31.93	130.12	33.8	130.14	35.68	130.19
37.56	130.26	39.44	130.45	41.32	130.5	43.19	130.41	45.07	130.34
46.95	130.14	48.83	130.03	50.71	130.21	52.58	130.41	54.46	130.52
56.34	130.62	58.22	130.59	60.1	130.59	61.97	130.64	63.85	130.61
65.73	130.62	67.61	130.71	69.49	130.72	71.36	130.74	73.24	130.75
75.12	130.78	77	130.78	78.88	130.72	80.75	130.82	82.63	130.73
84.51	130.73	86.39	130.69	88.26	130.56	90.14	130.57	92.02	130.68
93.9	130.82	95.78	130.95	97.65	131.08	99.53	131.08	101.41	131.1
103.29	131.13	105.17	131.19	107.04	131.21	108.92	131.3	110.8	131.13
112.68	130.85	114.56	130.59	116.43	130.46	118.31	130.26	120.19	130.11
122.07	130.08	123.95	130.24	125.82	130.62	127.7	131.08	129.58	131.06
131.46	131.08	133.34	131.09	135.21	130.98	137.09	130.61	138.97	130.95
140.85	131.02	142.73	130.99	144.6	130.94	146.48	130.9	148.28	130.87

```
  150.09  130.91  151.89  130.95  153.69  130.96  155.49  130.87   157.3  130.56
   159.1  130.21   160.9  130.22   162.7  130.19  164.51  130.08  166.31  130.04
  168.11  130.09  169.91  130.19  171.72  130.47  173.52  130.62  175.32  130.58
  177.12  130.56  178.93  130.62  180.73  130.74  182.53  130.77  184.33  130.69
  186.14  130.57  187.94  130.46  189.74  130.41  191.54  130.16  193.35  129.94
  195.15  129.73  196.95  129.64  198.75  129.83  200.56  130.05  202.36  130.27
  204.16  130.49  205.96  130.71   206.3     131   222.9   130.4  238.76  127.56
   239.1   127.5   251.7   125.9   261.9  127.89     265   128.5   267.2   130.6
   279.2   131.8   287.2   131.3  288.72  131.41  290.26  131.42  291.79  131.41
  293.33  131.38  294.86  131.34  296.39  131.31  297.93  131.24  299.46  131.19
  300.99  131.15  302.53  131.04  304.06  130.95  305.59  131.02  307.13  131.23
  308.66  131.39  310.19  131.51  311.73  131.61  313.26  131.63  314.79  131.66
  316.33  131.61  317.86  131.61  319.39   131.6  320.93  131.61  322.46  131.67
     324  131.63  325.53  131.65  327.06  131.37   328.6  131.23  330.13  131.17
  331.66  131.47   333.2  131.37  334.73  131.28  336.26  131.17   337.8  131.16
  339.33  131.25  340.86  131.28   342.4   131.6  343.93   131.8  345.46  132.01
     347  132.06  348.53  132.08  350.06  132.07   351.6  131.98  353.13  131.91
  354.67  131.85   356.2  131.78  357.73  131.71  359.27  131.65   360.8  131.59
  362.33  131.56  363.87  131.49   365.4  131.42  366.93  131.38  368.47  131.63
  369.91  131.87  371.35  131.75  372.79  131.75  374.23  131.85  375.67  131.82
  377.12  131.79  378.56  131.76     380  131.89  381.44  131.95  382.88  131.88
  384.32  131.93  385.77  131.93  387.21  132.06  388.65   132.2  390.09  132.24
  391.53  132.23  392.97  132.22  394.42  132.35  395.86  132.43   397.3  132.46
  398.74  132.58  400.18  132.71  401.62  132.68  403.06  132.79  404.51  132.91
  405.95  132.96

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .07  238.76    .035   261.9     .04

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.    Expan.
        238.76   261.9                0       0       0             .1       .3



SUMMARY OF MANNING'S N VALUES

River:


      Reach          River Sta.       n1        n2        n3        n4        n5
   n6        n7


 reach_3              300.198            .04       .04       .07      .035       .04
    .012       .04
 reach_3              262.135            .04       .04       .07      .035       .04
    .012       .04
 reach_3              251.5        Inl Struct
```

reach_3	241.745		.04	.04	.07	.035	.04
.012	.04						
reach_3	229.683		.07	.04	.07	.035	.04
.012	.04						
reach_3	205.816		.07	.035	.04	.012	.04
reach_3	190.168		.07	.035	.04	.012	.04
reach_3	180.829		.07	.035	.04	.012	.04
reach_3	161.5	Bridge					
reach_3	132.919		.07	.035	.04	.012	
reach_3	112.083		.07	.035	.04	.012	
reach_3	92.144		.07	.035	.04	.012	
reach_3	63.607		.07	.035	.04		

SUMMARY OF REACH LENGTHS

River:

Reach	River Sta.	Left	Channel	Right
reach_3	300.198	40.41	38.06	34.97
reach_3	262.135	52.85	20.39	57.74
reach_3	251.5	Inl Struct		
reach_3	241.745	13.2	12.06	8.67
reach_3	229.683	23.03	23.87	26.04
reach_3	205.816	15.85	15.65	18.34
reach_3	190.168	9.54	9.34	10.36
reach_3	180.829	48.98	47.91	48.24
reach_3	161.5	Bridge		
reach_3	132.919	25.53	20.84	18.44
reach_3	112.083	20.14	19.94	19.81
reach_3	92.144	25.52	28.54	32.22
reach_3	63.607	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River:

Reach	River Sta.	Contr.	Expan.
reach_3	300.198	.1	.3
reach_3	262.135	.1	.3
reach_3	251.5	Inl Struct	
reach_3	241.745	.1	.3
reach_3	229.683	.1	.3
reach_3	205.816	.1	.3
reach_3	190.168	.3	.5
reach_3	180.829	.3	.5
reach_3	161.5	Bridge	
reach_3	132.919	.3	.5
reach_3	112.083	.1	.3
reach_3	92.144	.1	.3
reach_3	63.607	.1	.3

ERRORS WARNINGS AND NOTES
Errors Warnings and Notes for Plan : Alt C rev pro tailwater rev

River: Reach: reach_3 RS: 300.198 Profile: FEMA 100/100
Warning:Divided flow computed for this cross-section.
River: Reach: reach_3 RS: 241.745 Profile: FEMA 100/100
Warning:Divided flow computed for this cross-section.
River: Reach: reach_3 RS: 229.683 Profile: FEMA 100/100
Warning:The cross-section end points had to be extended vertically for the computed water surface.
River: Reach: reach_3 RS: 205.816 Profile: FEMA 100/100
Warning:The cross-section end points had to be extended vertically for the computed water surface.
Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
This may indicate the need for additional cross sections.
River: Reach: reach_3 RS: 190.168 Profile: FEMA 100/100
Warning:Divided flow computed for this cross-section.
Warning:The cross-section end points had to be extended vertically for the computed water surface.
Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.
River: Reach: reach_3 RS: 161.5 Profile: FEMA 100/100
Note: The downstream water surface is above the minimum elevation required for orifice flow. The orifice flow equation was
used for pressure flow.

River: Reach: reach_3 RS: 161.5 Profile: FEMA 100/100 Upstream
  Note: For the cross section inside the bridge at the upstream end, the water surface and energy have been projected from
  the upstream cross section. The selected bridge modeling method does not compute answers inside the bridge.
River: Reach: reach_3 RS: 161.5 Profile: FEMA 100/100 Downstream
  Note: For the cross section inside the bridge at the downstream end, the energy is based on critical depth over the weir.
  The water surface has been projected.
River: Reach: reach_3 RS: 112.083 Profile: FEMA 100/100
  Warning:The cross-section end points had to be extended vertically for the computed water surface.
  Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
  This may indicate the need for additional cross sections.
  Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.
River: Reach: reach_3 RS: 92.144 Profile: FEMA 100/100
  Warning:The cross-section end points had to be extended vertically for the computed water surface.

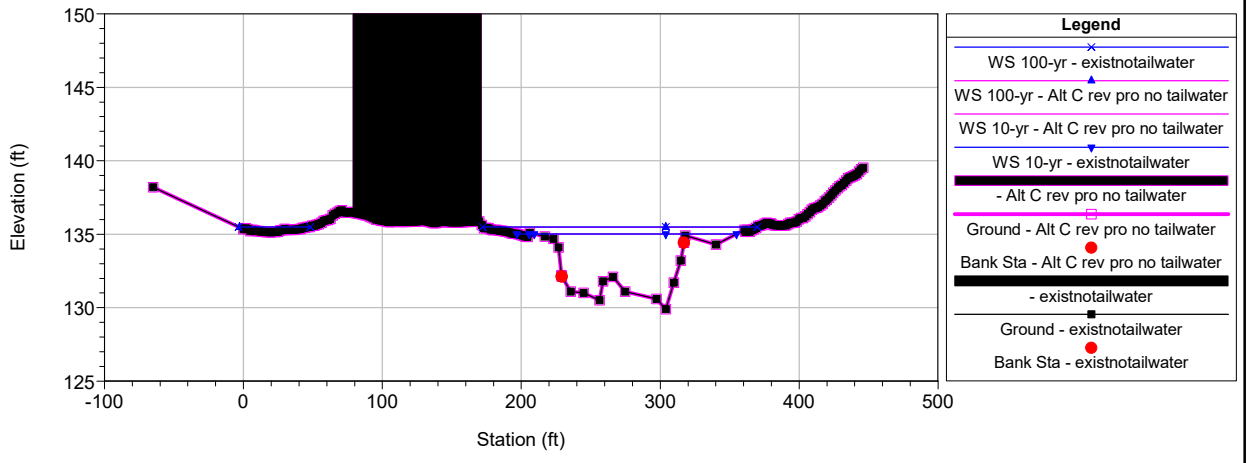
Appendix G – Cross Section Plots

EXISTING AND PROPOSED SECTIONS
NO TAILWATER

04070 Plan: 1) existnotailwater 12:03:49 PM 2) Alt C rev pro no tailwater 12:04:03 PM

Geom: Existing Conditions Flow: Haviland with no tailwater

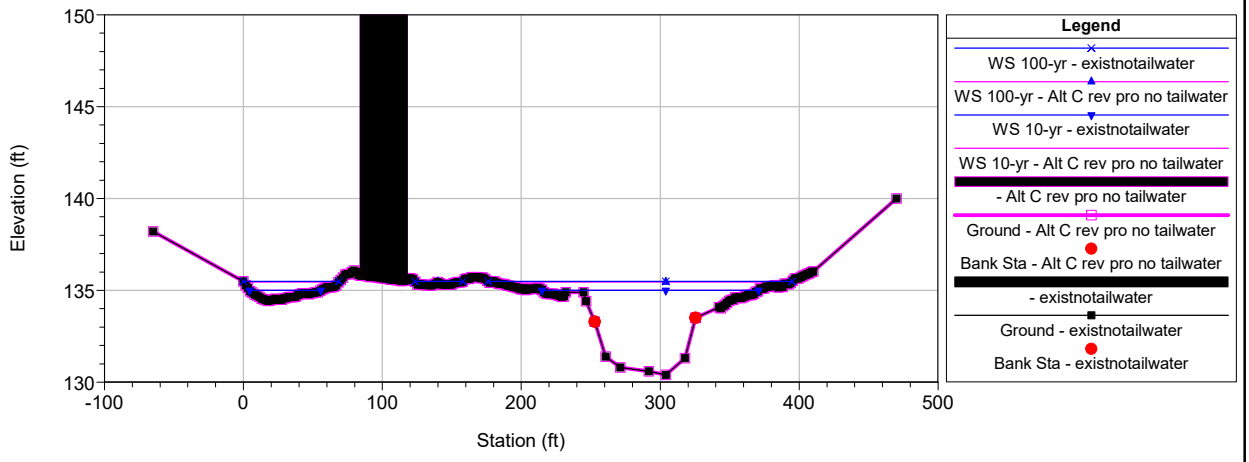
River = Reach = reach_3 RS = 300.198



04070 Plan: 1) existnotailwater 12:03:49 PM 2) Alt C rev pro no tailwater 12:04:03 PM

Geom: Existing Conditions Flow: Haviland with no tailwater

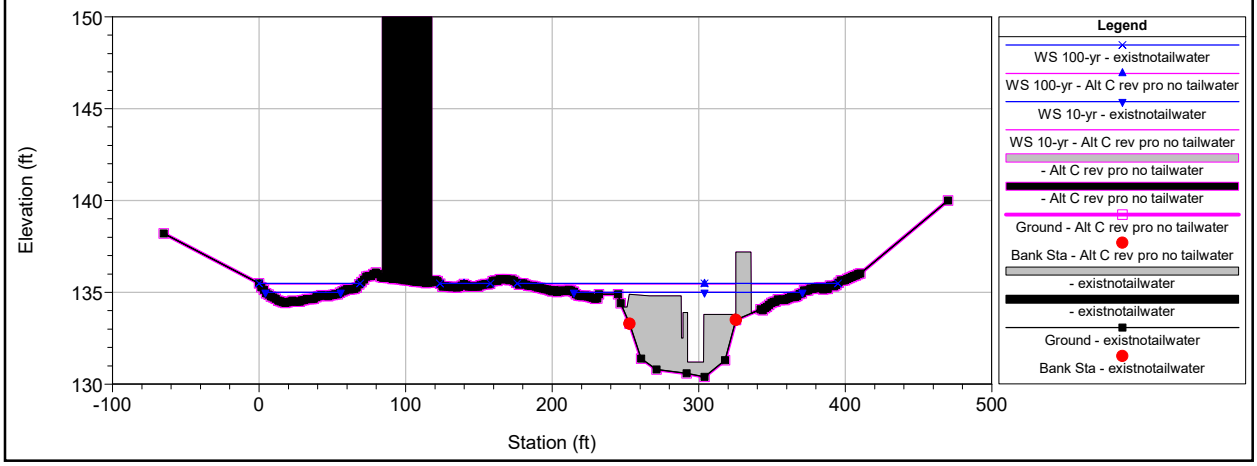
River = Reach = reach_3 RS = 262.135



04070 Plan: 1) existnotailwater 12:03:49 PM 2) Alt C rev pro no tailwater 12:04:03 PM

Geom: Existing Conditions Flow: Haviland with no tailwater

River = Reach = reach_3 RS = 251.5 IS

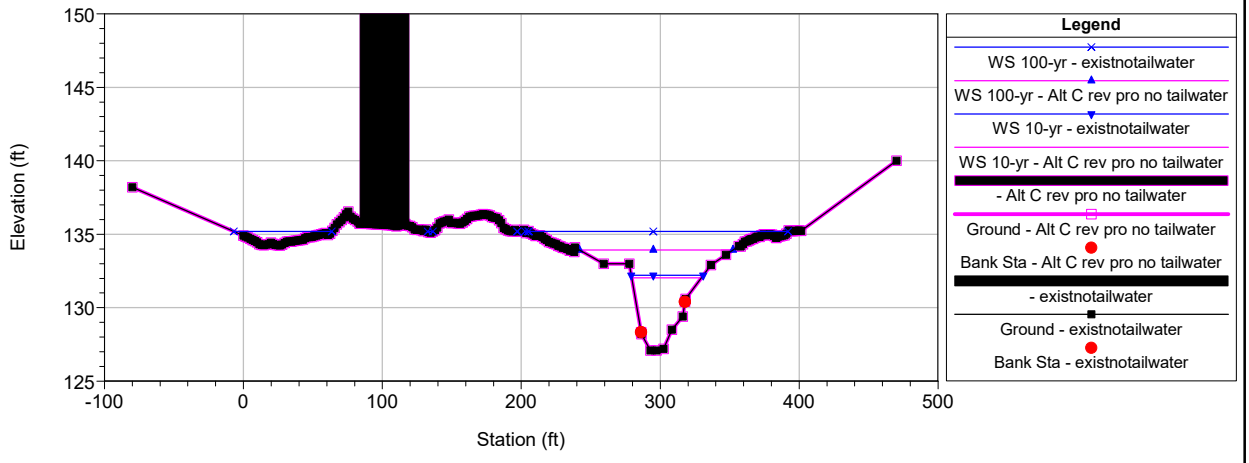


EXISTING AND PROPOSED SECTIONS
NO TAILWATER

04070 Plan: 1) existnotailwater 12:03:49 PM 2) Alt C rev pro no tailwater 12:04:03 PM

Geom: Existing Conditions Flow: Haviland with no tailwater

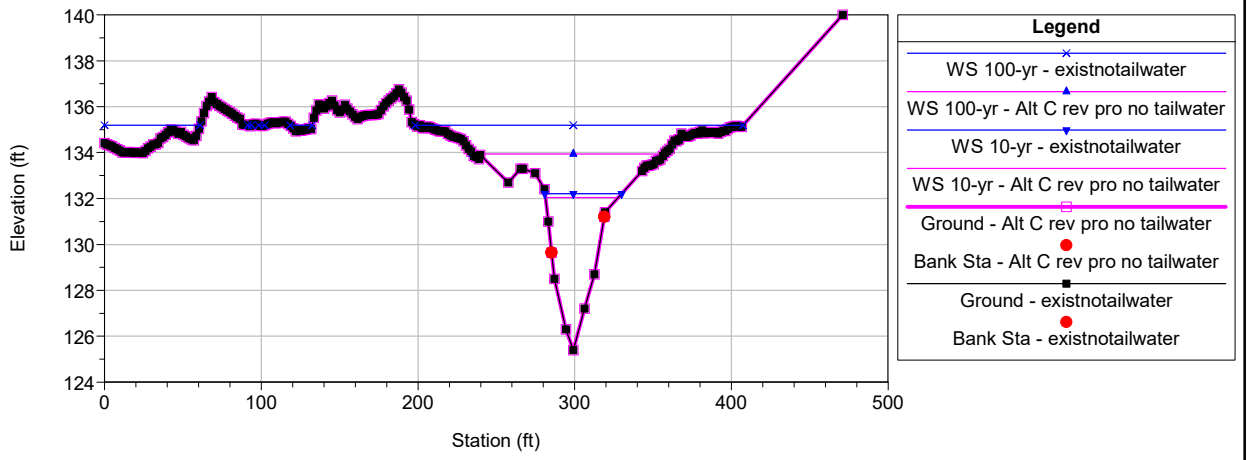
River = Reach = reach_3 RS = 241.745



04070 Plan: 1) existnotailwater 12:03:49 PM 2) Alt C rev pro no tailwater 12:04:03 PM

Geom: Existing Conditions Flow: Haviland with no tailwater

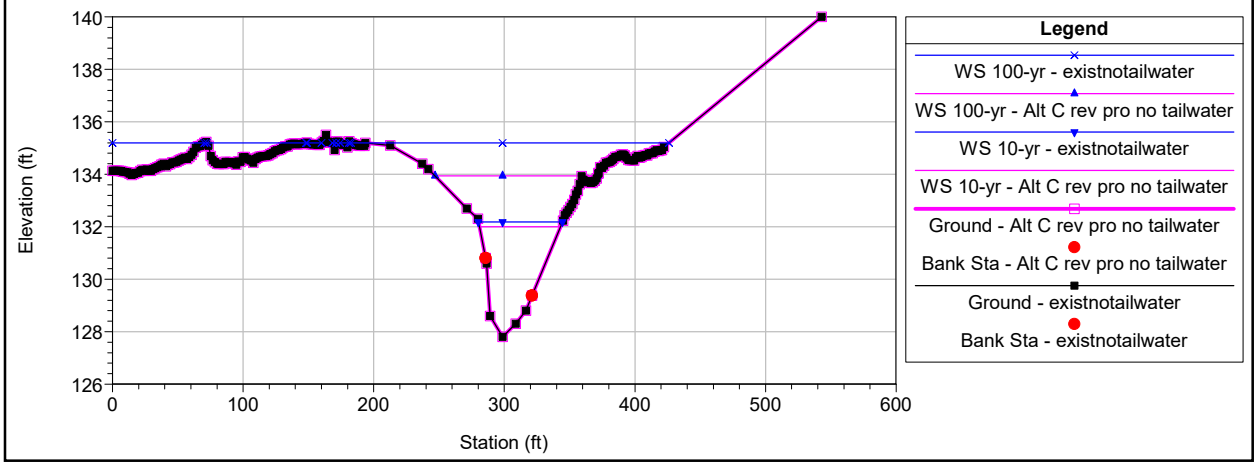
River = Reach = reach_3 RS = 229.683



04070 Plan: 1) existnotailwater 12:03:49 PM 2) Alt C rev pro no tailwater 12:04:03 PM

Geom: Existing Conditions Flow: Haviland with no tailwater

River = Reach = reach_3 RS = 205.816

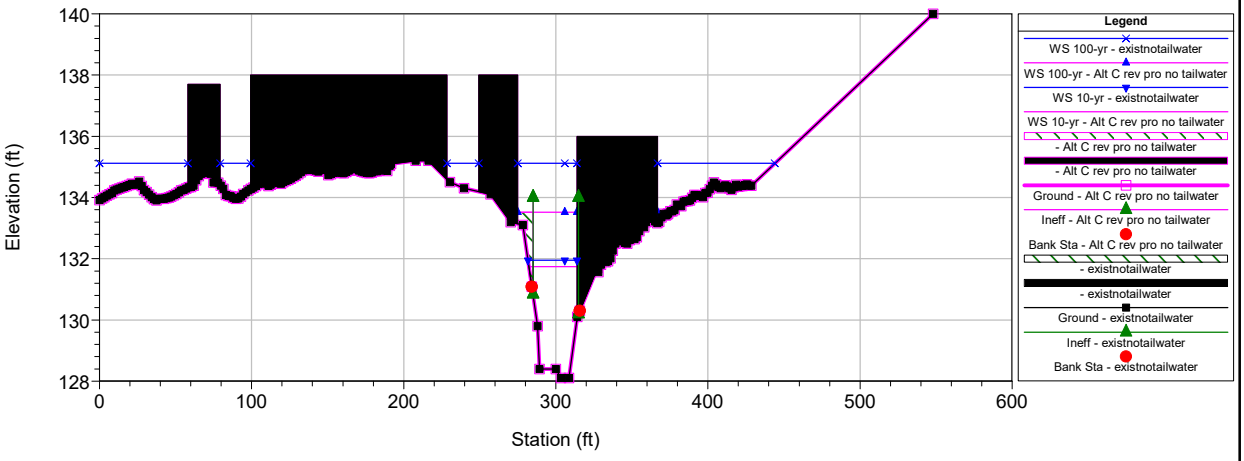


EXISTING AND PROPOSED SECTIONS
NO TAILWATER

04070 Plan: 1) existnotailwater 12:03:49 PM 2) Alt C rev pro no tailwater 12:04:03 PM

Geom: Existing Conditions Flow: Haviland with no tailwater

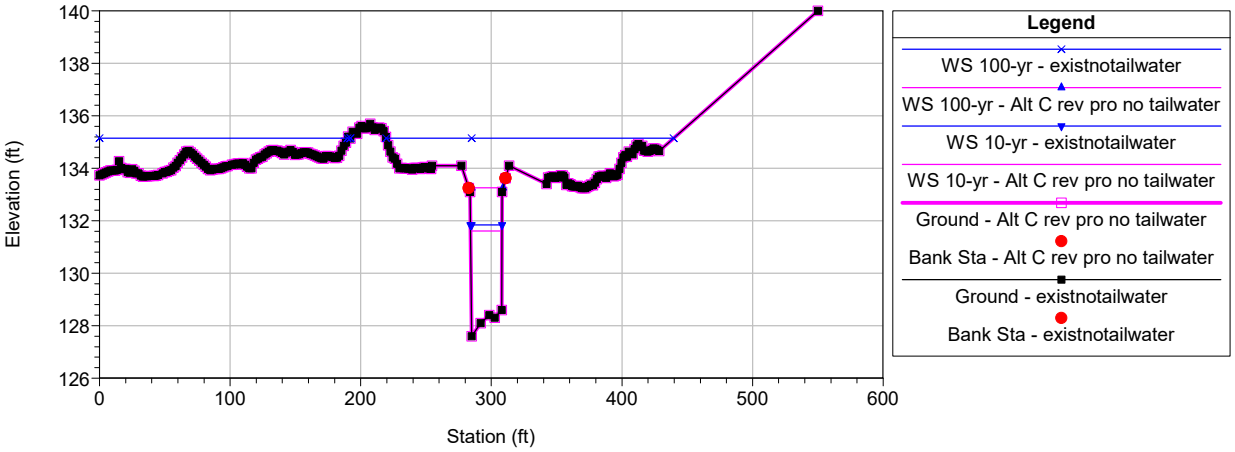
River = Reach = reach_3 RS = 190.168



04070 Plan: 1) existnotailwater 12:03:49 PM 2) Alt C rev pro no tailwater 12:04:03 PM

Geom: Existing Conditions Flow: Haviland with no tailwater

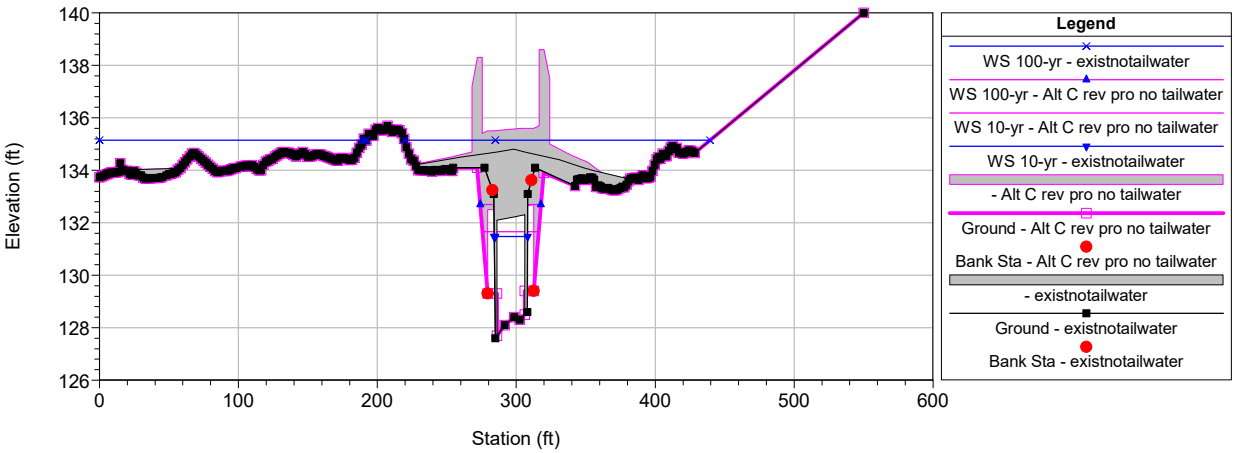
River = Reach = reach_3 RS = 180.829



04070 Plan: 1) existnotailwater 12:03:49 PM 2) Alt C rev pro no tailwater 12:04:03 PM

Geom: Existing Conditions Flow: Haviland with no tailwater

River = Reach = reach_3 RS = 161.5 BR

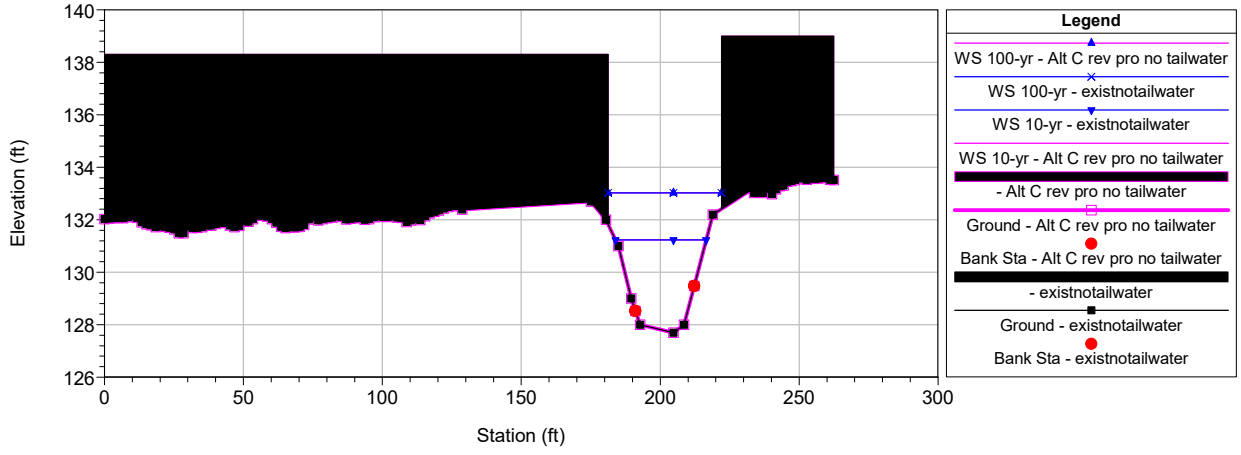


EXISTING AND PROPOSED SECTIONS
NO TAILWATER

04070 Plan: 1) existnotailwater 12:03:49 PM 2) Alt C rev pro no tailwater 12:04:03 PM

Geom: Existing Conditions Flow: Haviland with no tailwater

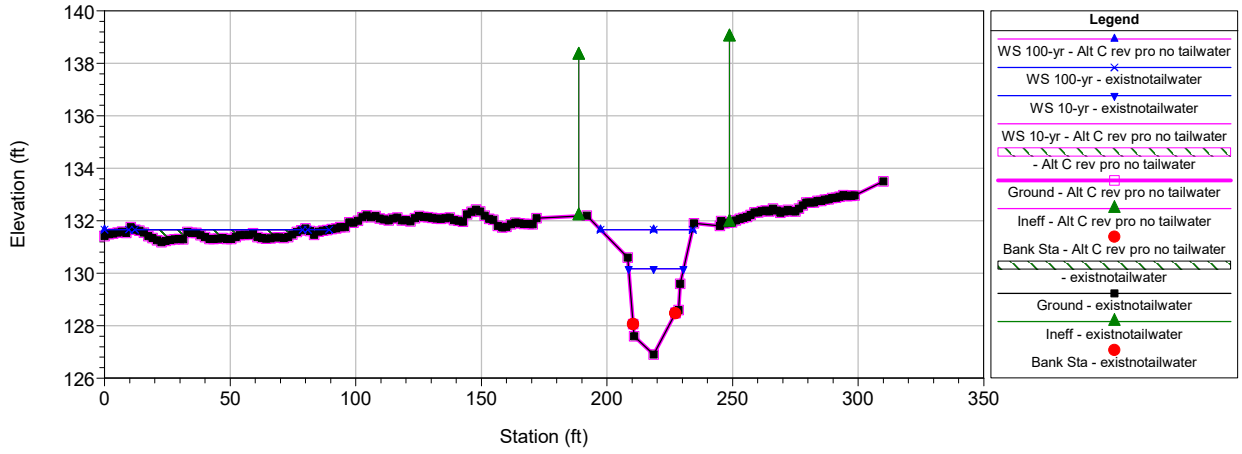
River = Reach = reach_3 RS = 132.919



04070 Plan: 1) existnotailwater 12:03:49 PM 2) Alt C rev pro no tailwater 12:04:03 PM

Geom: Existing Conditions Flow: Haviland with no tailwater

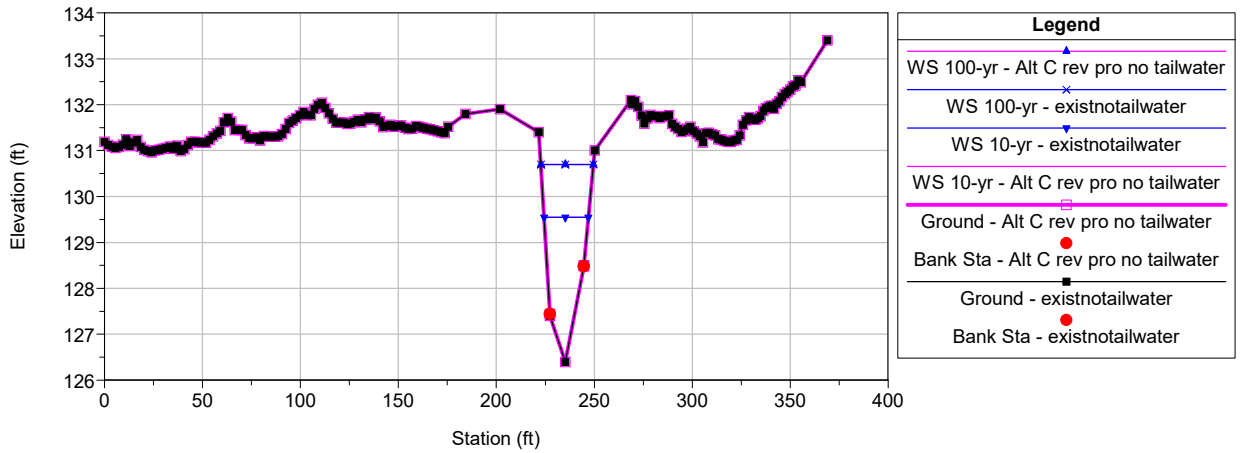
River = Reach = reach_3 RS = 112.083



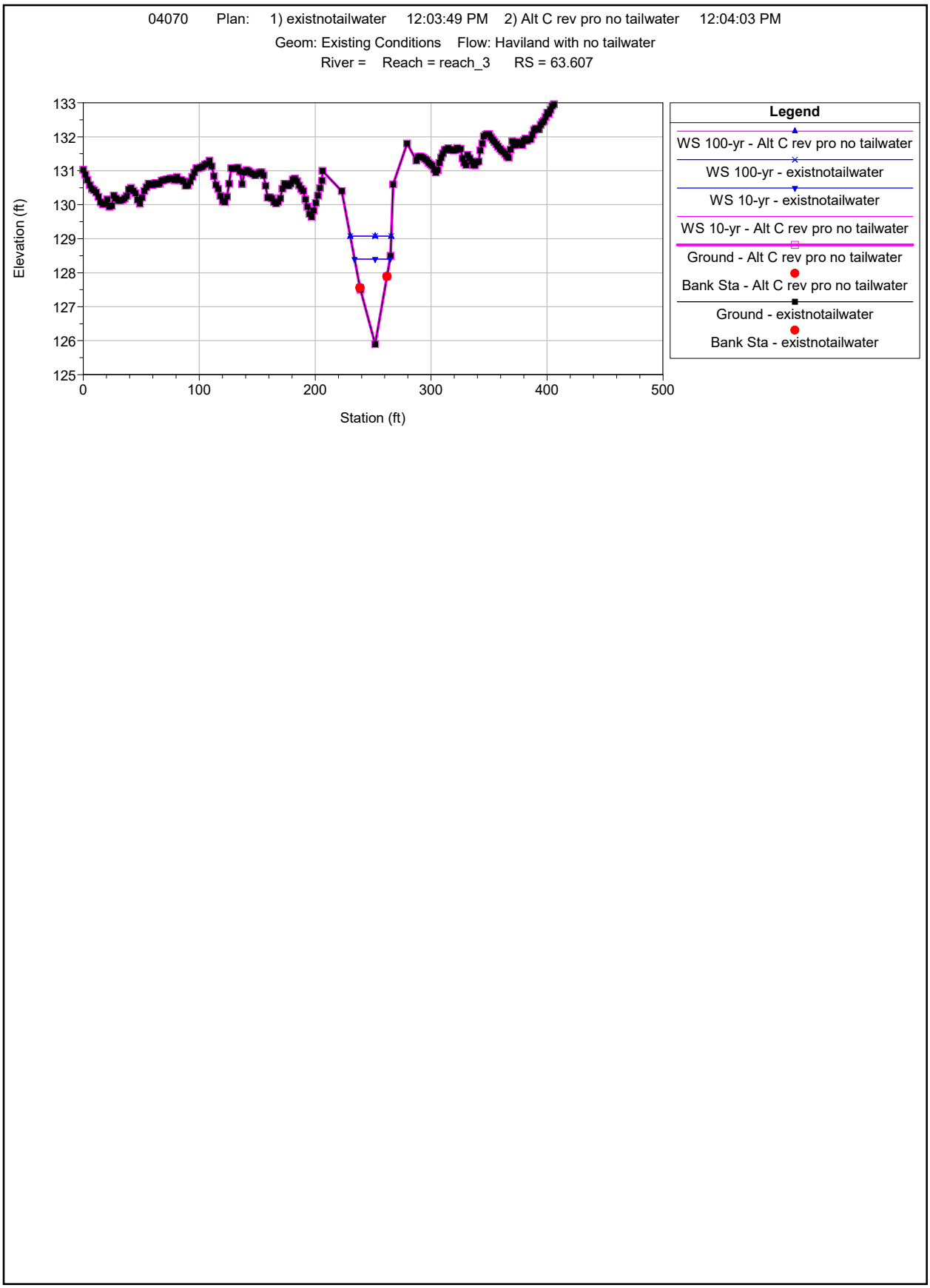
04070 Plan: 1) existnotailwater 12:03:49 PM 2) Alt C rev pro no tailwater 12:04:03 PM

Geom: Existing Conditions Flow: Haviland with no tailwater

River = Reach = reach_3 RS = 92.144



EXISTING AND PROPOSED SECTIONS
NO TAILWATER

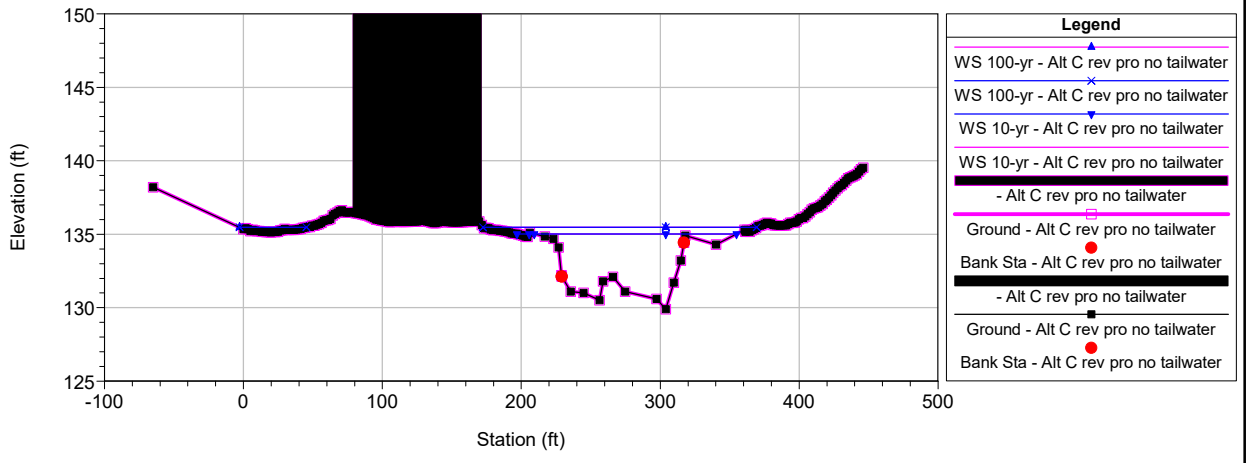


PROPOSED SECTIONS
NO TAILWATER

04070 Plan: 1) Alt C rev pro no tailwater 12:04:03 PM 2) Alt C rev pro no tailwater 12:04:03 PM

Geom: Alternate C REV PROFILE Flow: Haviland with no tailwater

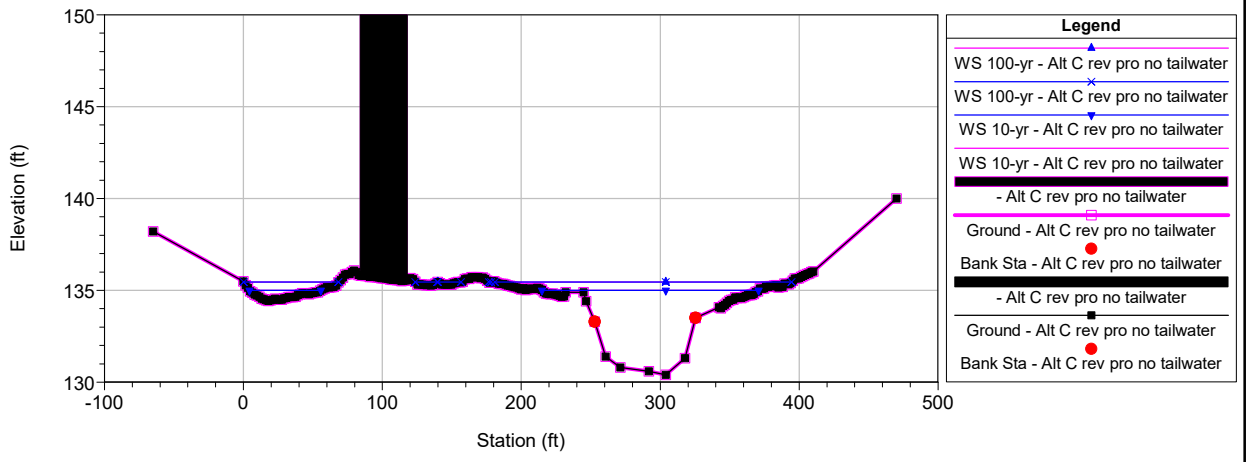
River = Reach = reach_3 RS = 300.198



04070 Plan: 1) Alt C rev pro no tailwater 12:04:03 PM 2) Alt C rev pro no tailwater 12:04:03 PM

Geom: Alternate C REV PROFILE Flow: Haviland with no tailwater

River = Reach = reach_3 RS = 262.135



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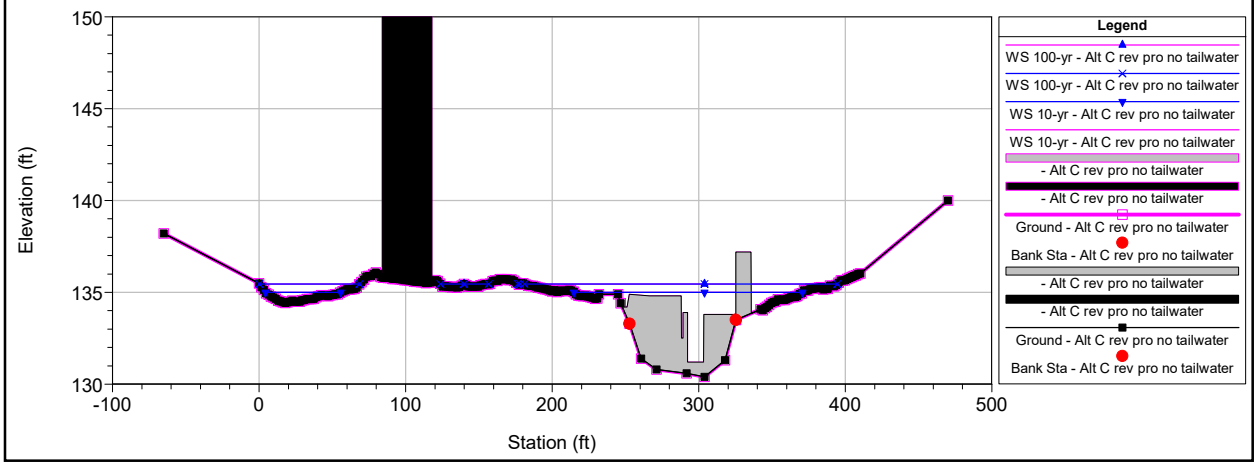
Geom: Alternate C REV PROFILE Flow: Haviland with no tailwater

River = Reach = reach_3 RS = 251.5 IS



PROPOSED SECTIONS
NO TAILWATER

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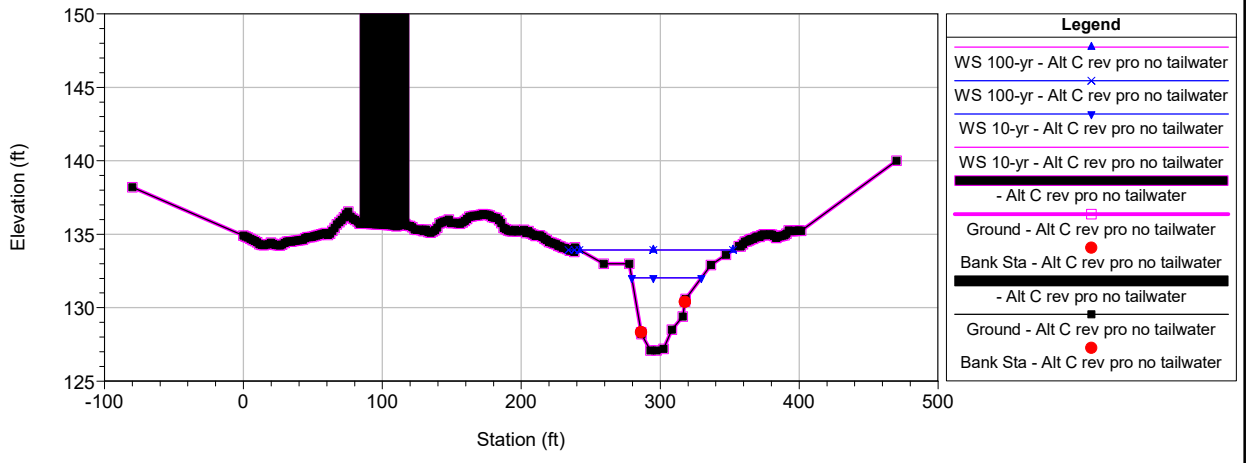
Geom: Alternate C REV PROFILE Flow: Haviland with no tailwater

River = Reach = reach_3 RS = 241.745



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Geom: Alternate C REV PROFILE Flow: Haviland with no tailwater

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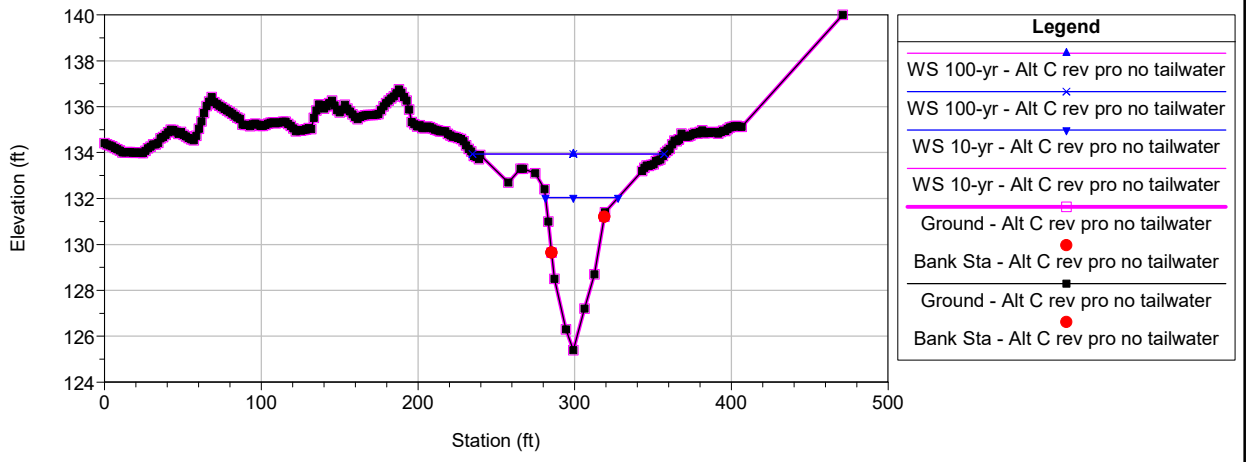

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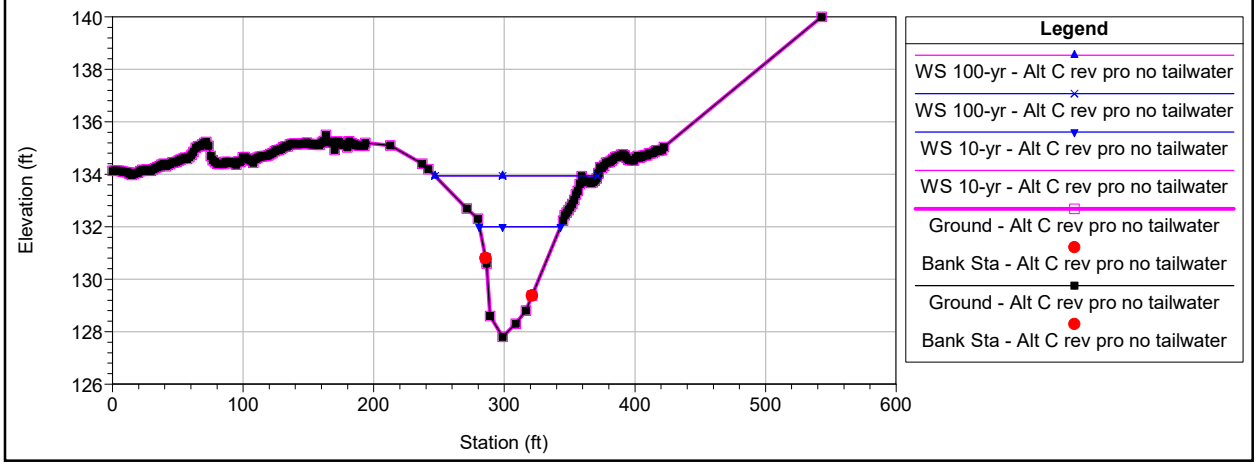

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NO TAILWATER

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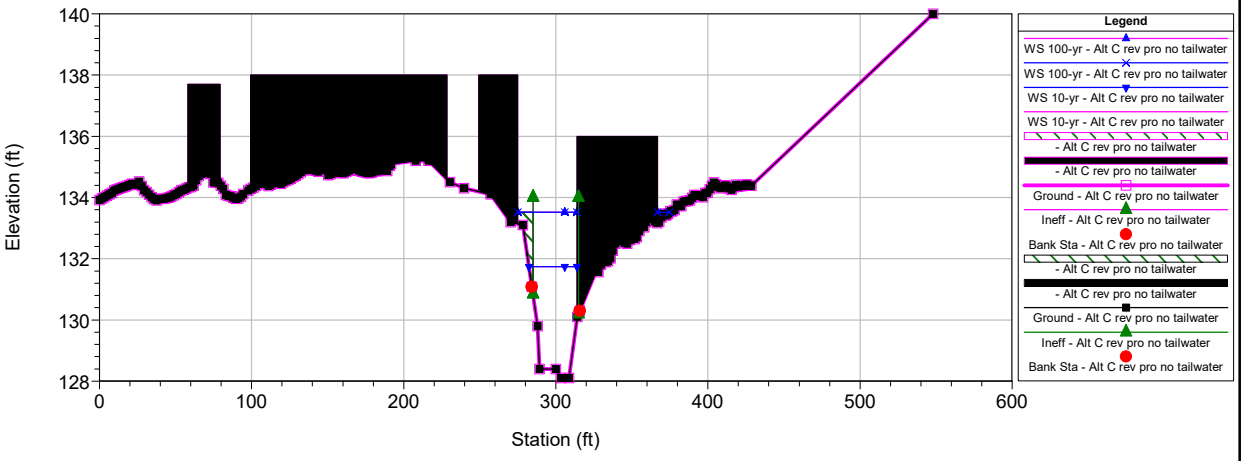

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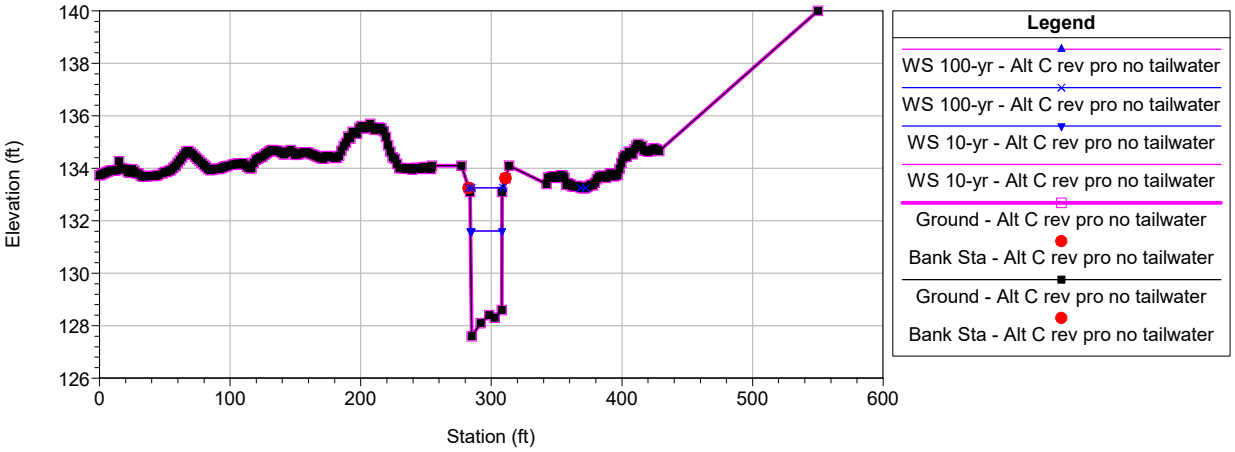

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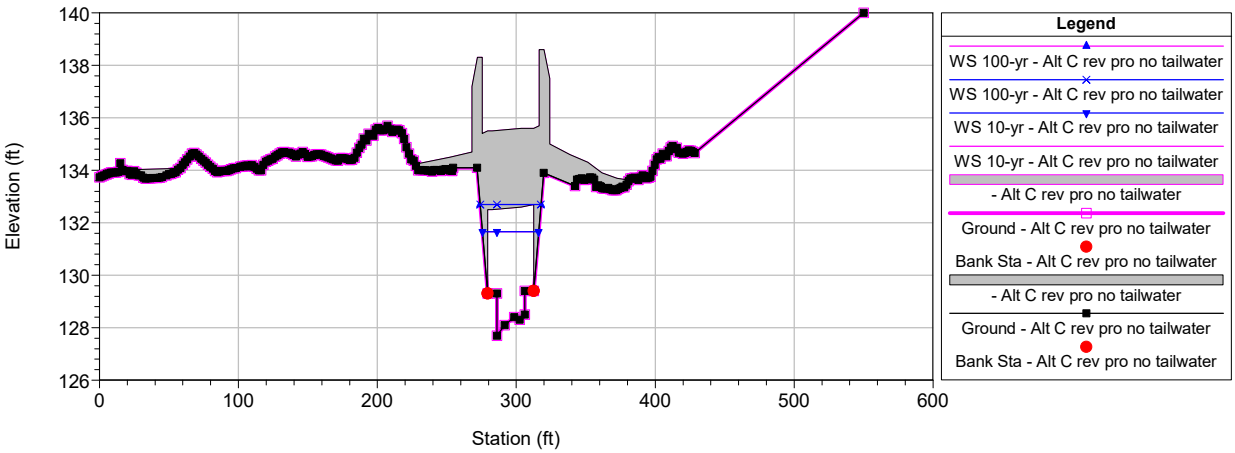

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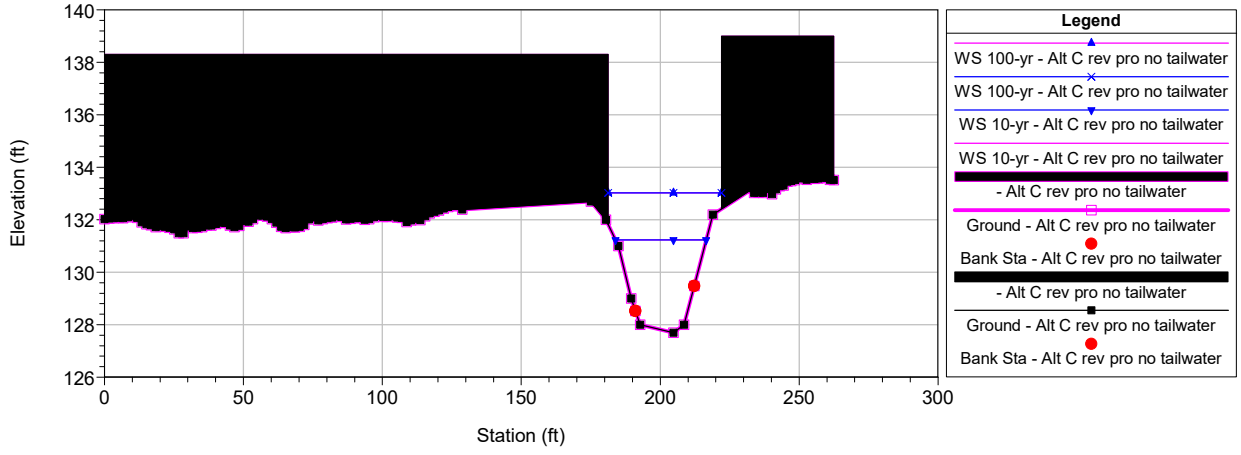

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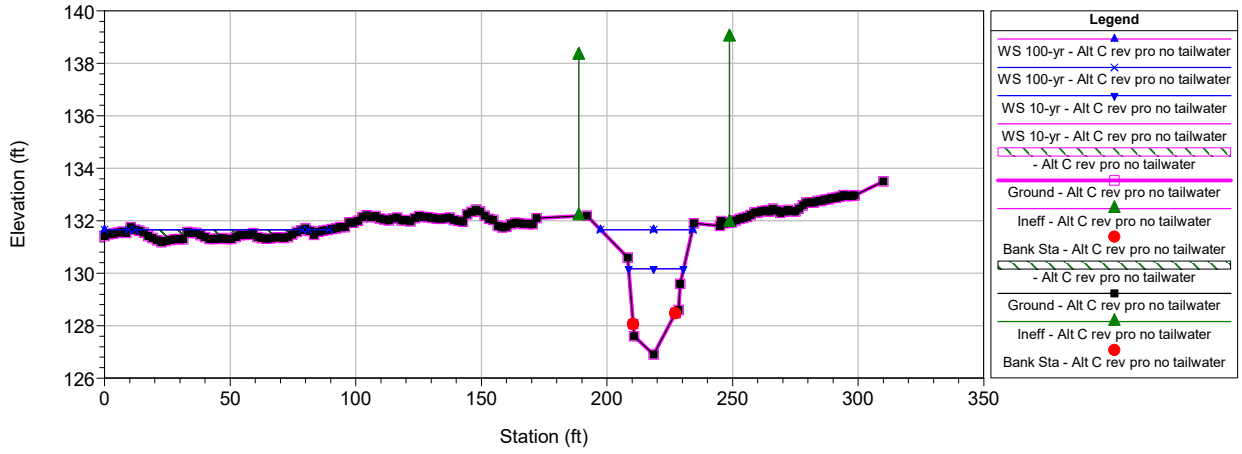

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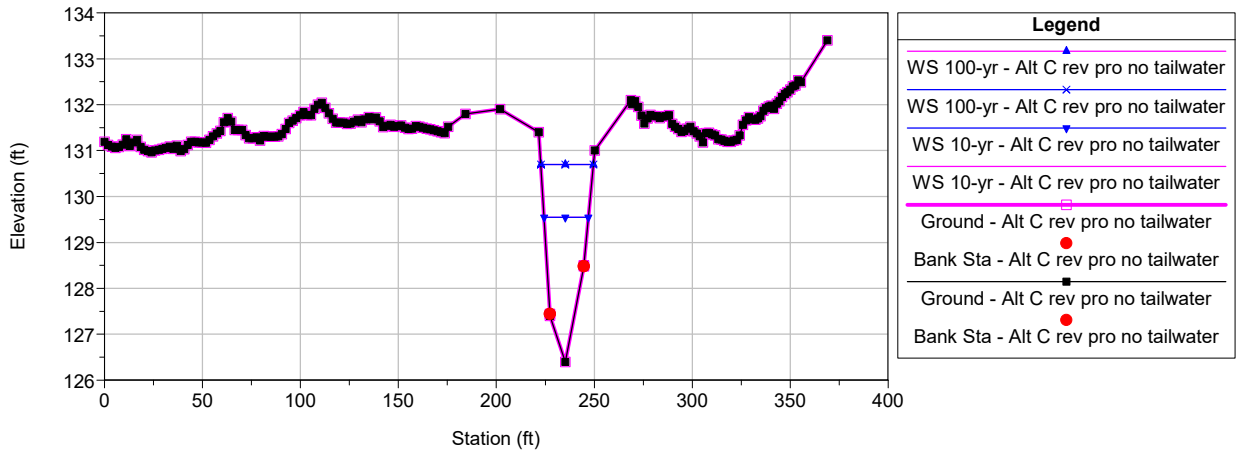
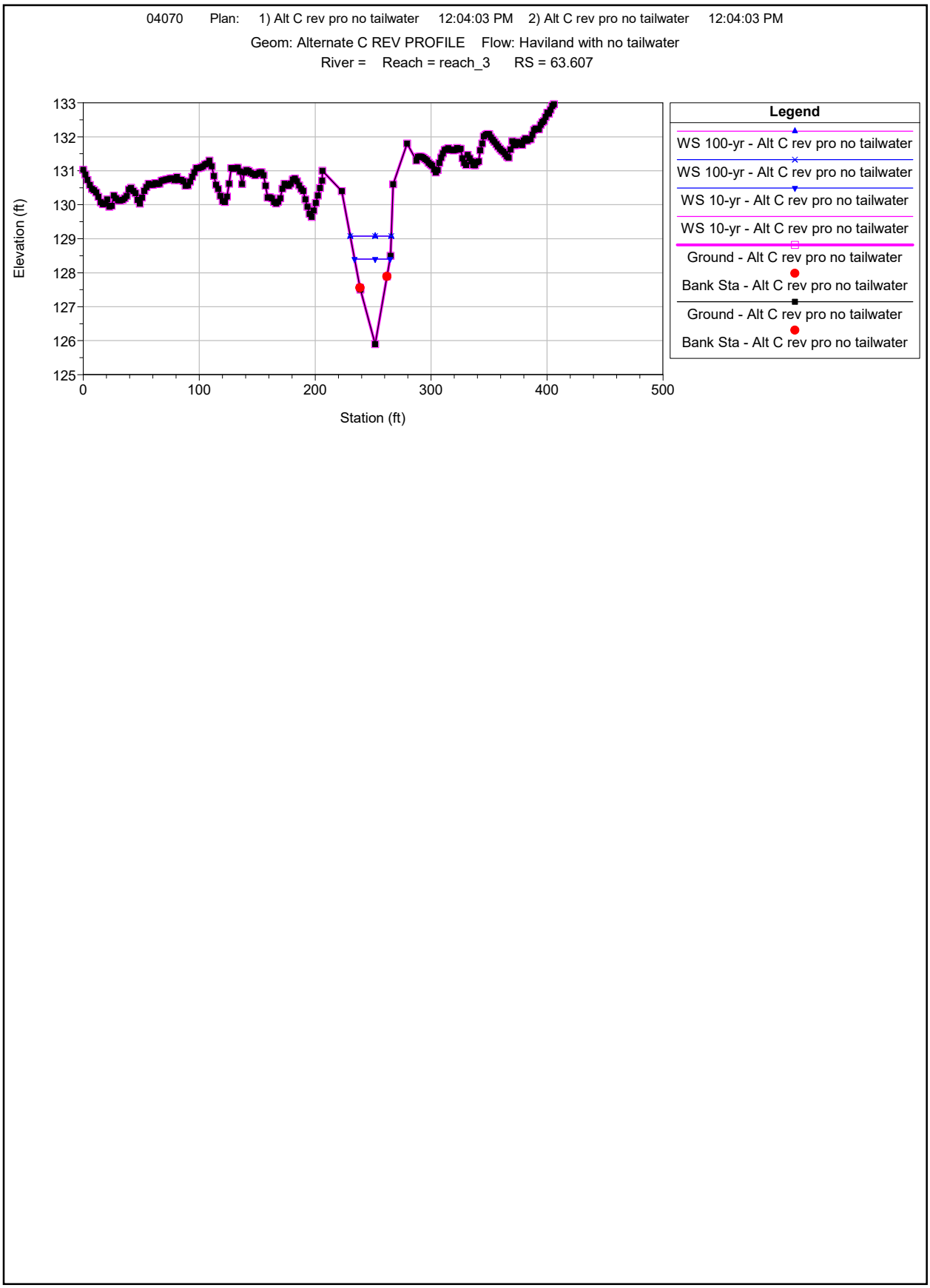


PROPOSED SECTIONS
NO TAILWATER



Appendix H – CTDOT Inspection Report

Inspection Type: Routine and Special

BRIDGE NO. 04070

73070 - STAMFORD

WIRE MILL ROAD

over

HAVILAND BROOK

Routine and Special Inspection

3/07/2023

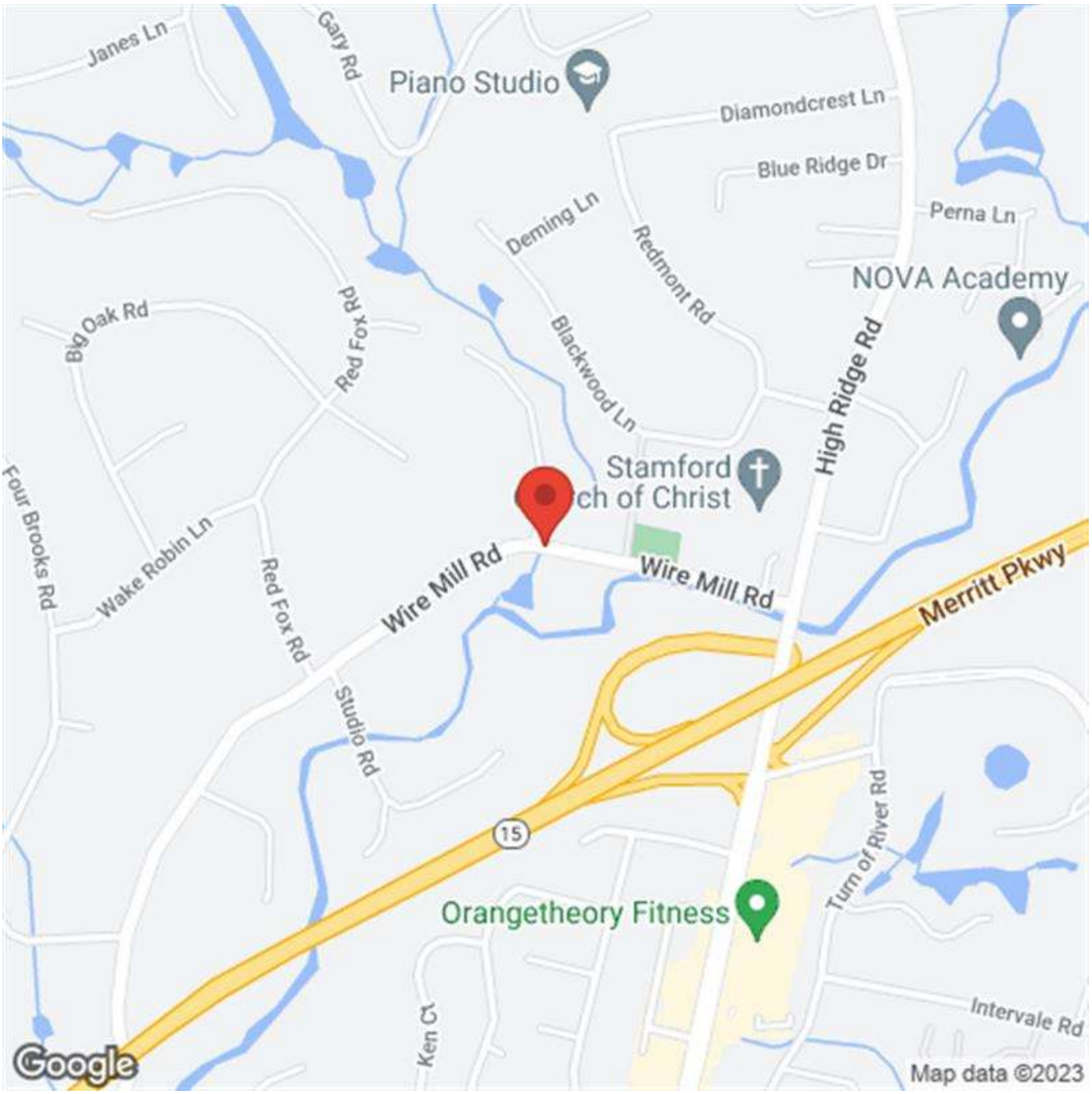
Inspected by: Team 7

TABLE OF CONTENTS

Form: Location
Inspection type: Routine,Special
Inspection Date: 3/07/2023
Inspected by: Team 7

:Bridge No 04070

Town: STAMFORD
Carried: WIRE MILL ROAD
Crossed: HAVILAND BROOK
Inventory Route: Non-NHS



Location Map # 1

Form: BRI-19, Rev. 2/15
Inspection type: Routine,Special
Inspection Date: 3/07/2023
Inspected by: Team 7

:Bridge No 04070

Town: STAMFORD
Carried: WIRE MILL ROAD
Crossed: HAVILAND BROOK
Inventory Route: Non-NHS

STRUCTURE INVENTORY & APPRAISAL

INSPECTION

Structurally Deficient Y **Functionally Obsolete** N

Sufficiency Rating 30.3

(90) Inspection Date **(91) Frequency** 24

Indepth Insp No **Proposed next Indepth Year**

Deck Survey Date 1/1/1900 **Class** 01

Access 0 - None **Flagman** 0

	Frequency	Date	Type
Fracture			
Underwater			
Special	12		J Corrosion / Section loss

IDENTIFICATION

Bridge Name 04070

Town Code - Name 73070 - STAMFORD

(5) Inventory Route

(A) Record Type 1: Route carried "on" the structure

(B) Signing Prefix 5 - CITY STREET

(C) Level of Service 0 - NONE OF THE BELOW

(D) Route Number. 00000

(E) Dir Suffix 0 - NOT APPLICABLE

(6A) Featured Intersected HAVILAND BROOK

(6B) Critical Facility Indicator

(7) Facility Carried WIRE MILL ROAD

(9) Location 0.3 MI W OF ROUTE 137

(11) Mile Post 0.00 Miles

(16) Latitude 41 Deg. 6 Min. 50.82 Sec.

(17) Longitude -73 Deg. 33 Min. 3.62 Sec.

(98) Border Bridge

(A) State Code (B) Percent Responsibility %

(C) Border Town Name

(99) Border Bridge Structure No.

STRUCTURE TYPE & MATERIALS

(43) Structure Type, Main

A) Material 3 - Steel

B) Design Type 02 - Stringer/Multi-beam or Girder

(44) Structure Type, Approach

A) Material 0 - Other

B) Design Type 00 - Other

(45) Number of Spans, Main Unit 001

(46) Number of Approach Spans 0000

(107) Deck Structure Type 1 - Concrete Cast-in-Place

(108) Wearing Surface/Protection Systems

A) Type of Wearing Surface 6 - Bituminous

B) Type of Membrane 0 - None

C) Type of Deck Protection 0 - None

Substructure

A) Material 2 - CONCRETE

B) Design Type 1 - FULL HEIGHT STEM

Paint

Type

Year

Comment

GEOMETRIC DATA

(48) Length of Maximum Span 22 ft.

(49) Structure Length 25 ft.

(50) Curb or Sidewalk Widths

A) Left 0 ft. 0 in. B) Right 0 ft. 0 in.

(51) Bridge Roadway Width Curb to Curb 30 ft. 6 in.

(52) Deck Width, Out to Out 33 ft. 6 in.

(32) Approach Roadway Width 30 ft.

Form: BRI-19, Rev. 2/15
Inspection type: Routine,Special
Inspection Date: 3/07/2023
Inspected by: Team 7

:Bridge No 04070

Town: STAMFORD
Carried: WIRE MILL ROAD
Crossed: HAVILAND BROOK
Inventory Route: Non-NHS

(33) Bridge Median: 0 - No median

Deck Area: 838 sq. ft.

(34) Skew Angle: 00 deg.

(35) Structure Flared: 0 - No flare

(10) Inv. Rte. Min. Vert. Clearance: 99 ft. 99 in.

(47) Inv. Rte. Total Horiz. Clr.: 30 ft. 6 in.

Log Inv. Rte. Total Horiz. Clr.: 30 ft. 6 in.

RLog Inv. Rte. Total Horiz. Clr.: 0 ft. 0 in.

(53) Min. Vert. Clearance Over Bridge: 99 ft. 99 in.

(54) Log-Min. Vert. Underclearance: N ref. 0 ft. 0 in.

(55) Min. Lat Underclearance on Right: N ref. 0 ft. 0 in.

(56) Min. Lat Underclearance on Left: 0 ft. 0 in.

AGE AND SERVICE

Year Built: 1957 (106) Year Reconstructed:

(42) Type of Service

A) On: 1 - Highway

B) Under: 5 - Waterway

(28) Number of Lanes

A) On: 02 B) Under: 00

(29) Average Daily Traffic: 1900

Is Above Half ADT?: No

(109) Precent Truck: 3 %

(30) Years of ADT: 2023

(19) Bypass, Detour Length: 3 Miles

CONDITION

(58) Deck: 3

(59) Superstructure: 3

(60) Substructure: 6

(61) Channel & Channel Protections: 6

(62) Culverts: N

(36) Traffic Safety Features

A) Bridge Railings: 0

B) Transitions: 0

C) Approach Guardrail: 0

D) Approach Guardrail Ends: 0

APPRAISALS

(67) Structural Evaluation: 2

(68) Deck Geometry: 5

(69) Underclearances, Vert. & Horiz.: N

(71) Waterway Adequacy: 7

(72) Approach Roadway Alignment: 6

(113) Scour Critical: 5

COMMENTS

Item 29 based on 1% increase per year.

Special Inspection to monitor section losses on fascia beams. RDJ_7/29/11

WATERWAY

Drainage Basin Waterway: 7405 - Rippowam River

(38) Navigation Control: 0 - No navigation control on waterway (bridge permit not required)

(39) Navigation Vertical Clearance: 0 ft.

(40) Navigation Horiz. Clr.: 0 ft.

(111) Pier/Abutment Navigation:

(116) Vert-Lift Brg Nav Min: 0 ft. 0 In.

CLASSIFICATION

(112) NBIS Bridge Length: Yes

(104) Highway System: 0 - Structure/Route is NOT on NHS

(26) Functional Class: 17 - Urban - Collector

(100) Defense Highway: 0 - Not a STRAHNET route

(101) Parallel Structure: N - No parallel structure

(102) Direction of Traffic: 2 - 2-way traffic

Form: BRI-19, Rev. 2/15
Inspection type: Routine,Special
Inspection Date: 3/07/2023
Inspected by: Team 7

:Bridge No 04070

Town: STAMFORD
Carried: WIRE MILL ROAD
Crossed: HAVILAND BROOK
Inventory Route: Non-NHS

(103) Temporary Structure	
(110) Designated National Network	0 - Inventory route not on network
(20) Toll	3 - On Free Road
(21) Maintain	04 - City or Municipal Highway Agency
(22) Owner	04 - City or Municipal Highway Agency
Report Class	L - LOCAL
(37) Historical Significance	5 - Not eligible for National Register

POSTED SIGNS

Other Posted Sign 1	
Other Posted Sign 2	

	Actual	Recomended	
Posted Load Single Unit Truck			tons
Posted Load Semi-Trailer Truck			tons
Posted Load 4 Axle Truck			tons
Posted Load 3S2 Truck			tons
All Vehicles	14	15	tons

Posted Vert. Clearance on Bridge		ft.	in.
Posted Vert. Underclearance		ft.	in.
Posted Speed Limit on Bridge		m.p.h.	

OTHER FEATURES

Fence Required	No
Fence Present	No
Fence Type	Blank
Fence Height	
Fence Material	Blank
Fence Top Type	Blank
Barrel Ladders	No
Stand Pipes	No
Catwalks	No
Moveable Inspection System	No
Haunches Present over Roadway	NO

PROPOSED IMPROVEMENTS

(75A) Type of Work Proposed	31 - Replacement - Load/Geometry
(75B) Work Done By	1 - Work to be done by contract
(76) Length of Structure Improvement	ft.
(94) Bridge Improvement Cost	$
(95) Roadway Improvement Cost	$
(96) Total Project Cost	$ 1550
(97) Year of Improvement Estimate	2018
(114) Future ADT	2823
(115) Year of Future ADT	2043
DOT Bridge Program List No	FLBP
Project No	0135-0344
Advertised Date	09/06/2023

LOAD RATING & POSTING

(31) Design Load	A - HL 93
(63) Operating Rating Type	8 - Load and Resistance Factor (LRFR) rating reported by rating factor (RF) method using HL93 loading
(64) Operating Rating	0.46
(65) Inventory Rating Type	8 - Load and Resistance Factor (LRFR) rating reported by rating factor (RF) method using HL93 loading
(66) Inventory Rating	0.36
Evaluation Code	F - Load & Resistance Factor Rating
Year of Evaluation	2013
(70) Bridge Posting	2 - 20.0-29.9% below legal loads
(41) Structure Status	P - Posted for Load

Utilities	1 | Gas

Form: BRI-19, Rev. 2/15
Inspection type: Routine,Special
Inspection Date: 3/07/2023
Inspected by: Team 7

:Bridge No 04070

Town: STAMFORD
Carried: WIRE MILL ROAD
Crossed: HAVILAND BROOK
Inventory Route: Non-NHS

INSPECTOR'S SIGNATURES:

1)  Date: 03/23/2023

2)  Date: 03/30/2023

3) Date:

4) Date:

P.E. SIGNATURE: Date:

P.E. #

Reviewed By:  Date: 04/03/2023

Carl DeLucia

Form: BRI-18, Rev. 1/14
Inspection type: Routine,Special
Inspection Date: 3/07/2023
Inspected by: Team 7

:Bridge No 04070

Town: STAMFORD
Carried: WIRE MILL ROAD
Crossed: HAVILAND BROOK
Inventory Route: Non-NHS

FIELD INSPECTION REPORT

Location:	0.3 MI W OF ROUTE 137	Year Built:	1957	Snooper Required:	☐
Main Material:	3 - Steel	Year Rebuilt		Snooper Used:	☐
Main Design:	02 - Stringer/Multi-beam or				

Inspectors:

Lead Inspector:	Mathew Zoccali
Inspector:	Task:
Area,07	BSE - Inspector
Delucia,Carl	BSE - TE3 Rail - Transportation Engineer 3
Gonzalez,David	BSE - Inspector Rail - Inspector
Zoccali,Mathew	BSE - Inspector Rail - Inspector

Visits:

Visit Date:	Temp:	Start Time:	End Time:
03/07/2023	40	11:15 AM	12:45 PM

58. DECK:

Reinforced Concrete Deck — Overall Rating: 3

Rating		
Overlay:	8	Bituminous concrete: No deficiencies.
Deck - Str. Condition:	3	Underside of concrete deck: - Hollow areas up to full width x full length of the bay. - Light scaling. - Longitudinal and map hairline cracks. - Isolated transverse hairline cracks up to full width. - Honeycombing up to full length x full width of bays by 1/2" deep. - Damp areas mainly around the through-deck drains. - Bay 3: Light to medium scale throughout. - Bay 6: Map hairline cracks with leakage near abutment 1. - The overall underside of concrete deck deterioration is approximately 75%.
Curbs:	5	Concrete rail bases: - Light to moderate scaling throughout. - Random longitudinal, transverse, diagonal and map cracking open up to 1/8" wide. - Northwest corner has a 1'-8" long x 1' wide x 4" deep corner spall at the east end and a 1'-6" long x 1'-3" wide x 4" deep spall at the west end. - Average curb reveals were 3/4" on the south side and 1-1/4" on the north side.
Median:	N	
Sidewalks:	N	
Parapet:	N	
Railing:	6	Galvanized two pipe railings: - The north railing has areas of spotty rust. - The south railing has heavy rust at the post bases and welds. Repaired areas with additional vertical posts have been previously added. - The southwest end has a broken weld in the bottom horizontal rail at the second post from abutment 1. - The east end of the south rail has a 2" high perforation at the bottom pipe to post connection, second post from abutment 2.
Paint:	N	
Fence:	N	

Drains:	4	6" diameter free fall deck drains at all four corners. - Deck drains are paved over at the top and are missing extensions at the underside. - Active leakage at the deck drains that is causing deterioration of the deck soffit and the superstructure beneath. - The grate for the northeast deck drain is missing and grate on the northwest corner has 100% section loss.
Lighting Standard:	N	

Overall Utility Condition Rating: 7 - Good

Utility Type/Size

1 | Gas	6" diameter insulated utility in Bay 7 that is not hung/supported from the structure.

Construction Joints:	N	
Expansion Joint:	N	

Haunches Present over travelway? NO

APPROACH CONDITION:

Bituminous pavement with no guide rails. Overall Rating: 8

Rating

Approach Slab:	N	
Relief Joints:	N	
Approach Guide Rail:	N	No approach guide rails.
Approach Pavement:	8	Bituminous concrete: No deficiencies.
Approach Embankment:	7	Previously noted run-off erosion has been repaired.

Trafic Safety Features

Bridge Railings:	0	Does not meet current standards (open metal pipe railing).
Transitions:	0	No approach guide rails.
Approach Guardrails:	0	No approach guide rails.
Approach Guardrail Ends:	0	No approach guide rails.

59. SUPERSTRUCTURE:

Rolled steel multi-girder. Overall Rating: 3

Rating

Bearing Devices:	4	Steel plate bearings at both abutments. - Fascia bearings at both abutments have laminated rust with section loss up to 1/4" deep and up to 75% section loss of the anchor bolts and nuts. - Impacted rust between the plates, up to 3/4" thick. - Anchor bolt nuts are backed off up to 1/8" and there are short anchor bolts at random locations. - The interior bearings have areas of spotty rust. - Bearing #2 at both abutments and bearing #8 at abutment 1 have moderate to heavy rust adjacent to deck drains.
Stringers:	N	
Girders:	3	Nine (9) rolled steel girders: Girders 1 and 9 (fascia girders): - Areas of heavy laminated rust with severe section loss at the ends over both abutments. - Top flanges at the ends have up to full length x full width x 3/16" deep section loss.

		Girder #2 - Peeling paint with light to heavy rust. Girder #1: - D-Meter readings were taken in the web at the center line of the bearings and 2' from the center line of bearings at both ends. - The web has section loss with a minimum measured thickness of 0.150" remaining at abutment 2, resulting in up to 58% shear loss and up to 73% bearing loss. - Web appears to be buckling up to 3/16" at both abutments. - Bottom flange is down to 4" wide at 19" from abutment 1. Girder #9: - D-Meter readings were taken in the web at the center line of bearings and 2' from the center line of bearings at both ends. - The web has section loss with a minimum measured thickness of 0" (full perforation) remaining at abutment 1, resulting in up to 76% in shear loss and up to 100% in bearing loss. - The web appears to be buckling up to 3/16" at both abutments. - Perforations in the end of the web at abutment 1 up to 5" x 2" with surrounding section loss. - Bottom flange has as little as knife edge remaining at the edges, 1/4" remaining near the web and 3" remaining width within 39" of the centerline of bearing. - Bottom flange 4' out from the centerline of bearing at abutment 2 (near quarter span) has up to 52% section loss. Interior girders #2-8: - Areas of peeling paint with light to moderate rust. - Underside of top flanges exhibit light to moderate rust throughout. - Concrete jersey barriers and plastic water filled barriers placed along the shoulders to restrict live load from girders 1 and 9 are in good condition.
Floor Beams:	N	
Trusses - General:	N	
Trusses - Portals:	N	
Trusses - Bracing:	N	
Paint:	5	Less than 50% of the painted surfaces are rusting.
Rust:	4	See items "Bearing Devices" and “Girders” above.
Machinery Movable Span:	N	
Rivets & Bolts:	N	
Welds - Cracks:	8	
Timber Decay:	N	
Concrete Cracking:	N	
Collision Damage:	8	
Member Alignment:	8	
Deflection Under Load:	N	(N) Normal, (E) Excessive.
Vibration Under Load:	N	(N) Normal, (E) Excessive.
Stand Pipes:	N	
Catwalks:		
Movable Inspection System:		
Barrel Ladders:	N	

Are Barrel Ladders OSHA Compliant? NA

60. SUBSTRUCTURE:

Reinforced concrete abutments and wingwalls. Overall Rating: 6

	Rating	
Abutments - Stem:	6	- Vertical hairline cracks up to full height, some with efflorescence and/or rust. - Map hairline cracking up to 3' wide x 1' high. - Moderate scaling along the waterline. Abutment 1: - Bearing pedestals 4, 7, 8 and 9 have spalls, up to 10" long x 6" wide x 3" deep. - Area of map hairline cracks in the top at girder #3, 3' x 1'. Abutment 2: - Pedestal #2 has a small spall, 3" long x 6" wide x 1/2" deep.
Abutments - Backwall:	6	- Vertical, horizontal and map hairline cracks, some with efflorescence. - Areas of light to medium scale. - Some exposed shallow rusted rebar, up to 8". - Backwall # 1 in bay 8 has map cracking open up to 1/16", full width of bay.
Abutments - Footings:	N	
Abutments - Settlement:	8	
Abutments - Wingwalls:	5	- Vertical cracks up to full height x up to 1/8" wide with efflorescence. - Horizontal cold joints open up to 1/8". - Wingwall 1B: Map hairline cracks totaling approximately 20 sq.ft.
Piers/Bents - Caps:	N	
Piers/Bents - Pile Bent:	N	
Piers/Bents - Columns:	N	
Piers/Bents - Footings:	N	
Piers/Bents - Settlement:	N	
Erosion - Scour:	7	Erosion - Rating = 8. Scour - Rating = 7.
Concrete Crack - Spall:	5	See items "Abutments - Stem", "Abutments - Backwall" and "Abutments - Wingwalls" above.
Steel Corrosion:	N	
Paint:	N	
Timber Decay:	N	
Collision Damage:	8	
Debris:	6	Light to heavy accumulation of sand and debris on the abutment seats.

61. CHANNEL AND CHANNEL PROTECTION:

Channel bottom consists of sand, gravel, cobbles and boulders. Overall Rating: 6

	Rating	
Channel - Scour:	7	Low water during inspection.
Embankment - Erosion:	6	- Upstream and downstream embankments have undercutting up to 1' high with exposed tree roots. - 11' wide x 4' long x 3' high area of displaced boulders near wingwall 1A.
Debris:	6	Light to moderate timber debris.
Vegetation:	8	
Channel Change:	6	- A dam/spillway approximately 50’ upstream of the bridge. - Aggradation at the inlet, 12' long x 20' wide x 1' high. - The channel flow favors abutment 2.
Fender - System:	N	

Spur Dikes and Jetties:	N	
Rip Rap:	7	Rip-rap protection along the northeast embankment only.

62. CULVERTS AND RETAINING WALLS:

Overall Rating: N

Rating		
Barrel:	N	
Concrete:	N	
Steel:	N	
Timber:	N	
Headwall:	N	
Cutoff Wall:	N	
Debris:	N	
Retaining Wall System:	N	
Footing:	N	

LOAD POSTING:

Rating		
Single Unit (Tons):		
Semi Trailer (Tons):		
4 Axle (Tons):		
3S2 (Tons):		
All Vechicles:	14	Warning signs at the southwest and northeast corners of the bridge and both approaches with a Load Posting of 14 Tons (general restriction for all vehicles). According to load rating completed in 2014 using Load and Resistance Factor Method, the bridge has an Inventory Rating of 15 Tons but is posted for 14 Tons.
Advanced Warning:	All Approaches	Advance warning signs in place at both approaches.
Warning At Bridge:	All Approaches	Warning signs at the bridge at both approaches.
Legibility:	Adequate	
Visibility:	Adequate	

VERTICAL CLEARANCE POSTING

Min. Vert Under Clearance:		Ft		In	
Posted Clearance Under Bridge:		Ft		In	
Posted Clearance On Bridge:		Ft		In	
Advanced Warning:	False				
Warning At Bridge:					
Legibility:					
Visibility:					

NOTES / COMMENTS:

Character of Traffic: Light volume with mixed weights.

Additional Notes:

- Bridge ID painted on the north fascia.
- Bridge is logged from west to east and girder 1 is located at the north fascia, which is consistent with the plans and the previous report.
- Haviland Brook flows from north to south.

- Waders were used for inspection.

Additional Comments:

National Bridge Elements
Inspection type: Routine,Special
Inspection Date: 3/07/2023
Inspected by: Team 7

:Bridge No 04070

Town: STAMFORD
Carried: WIRE MILL ROAD
Crossed: HAVILAND BROOK
Inventory Route: Non-NHS

	Environment	Total Quantity	Units	Condition State 1	Condition State 2	Condition State 3	Condition State 4
12 - Reinforced Concrete Deck	Mod.	838	sq. ft.	210	209	419	0
1080 - Delamination/Spall/Patched Area		419		0	0	419	0
1120 - Efflorescence/Rust Staining		139		0	139	0	0
1130 - Cracking (RC and Other)		70		0	70	0	0
510 - Wearing Surfaces		763	sq. ft.	572	191	0	0
3230 - Effectiveness (Wearing Surface)		191		0	191	0	0
107 - Steel Open Girder/Beam	Mod.	225	ft.	50	90	85	0
1000 - Corrosion		175		0	90	85	0
515 - Steel Protective Coating		921	sq. ft.	270	0	335	316
3440 - Effectiveness (Steel Protective Coatings)		651		0	0	335	316
215 - Reinforced Concrete Abutment	Mod.	67	ft.	45	22	0	0
1080 - Delamination/Spall/Patched Area		3		0	3	0	0
1130 - Cracking (RC and Other)		19		0	19	0	0
311 - Movable Bearing	Mod.	9	each	0	5	4	0
1000 - Corrosion		7		0	5	2	0
2240 - Loss Bearing Area		2		0	0	2	0
515 - Steel Protective Coating		9	sq. ft.	0	5	2	2
3440 - Effectiveness (Steel Protective Coatings)		9		0	5	2	2
313 - Fixed Bearing	Mod.	9	each	0	5	4	0
1000 - Corrosion		7		0	5	2	0
2240 - Loss Bearing Area		2		0	0	2	0
515 - Steel Protective Coating		9	sq. ft.	0	5	2	2
3440 - Effectiveness (Steel Protective Coatings)		9		0	5	2	2
330 - Metal Bridge Railing	Mod.	50	ft.	42	7	1	0
1000 - Corrosion		8		0	7	1	0

SPECIAL INSPECTION

Inspectors:

Lead Inspector:	Mathew Zoccali
Inspector:	Task:
Area,07	BSE - Inspector
Delucia,Carl	BSE - TE3 Rail - Transportation Engineer 3
Gonzalez,David	BSE - Inspector Rail - Inspector
Zoccali,Mathew	BSE - Inspector Rail - Inspector

Visits:

Visit Date:	Temp:	Start Time:	End Time:
03/07/2023	40	11:15 AM	12:45 PM

Special Inspection Type: J Corrosion / Section loss

Inspection Description: Check the fascia girders for increases in section losses.

Feature Inspected: Primarily fascia girders (#1 and #9).

The superstructure consists of nine rolled steel girders.

Inspection Results: Fascia girders have areas of heavy laminated rust with severe section loss at the ends over both abutments.

Girder #1 - No increases in web section loss near both abutments since the last inspection.

Girder #2 - Peeling paint with light to heavy rust on the web and flanges at both ends.

Girder #9 - Negligible increase in web section loss at abutment 1 since the last inspection.

Girder #1:
- D-Meter readings were taken at the web at the center line of the bearings and 2' from the center line of bearings at both ends. The web has section loss with a minimum measured thickness of 0.150" remaining at abutment 2, resulting in up to 58% shear loss and up to 73% bearing loss.
- Web appears to be buckling up to 3/16" at both abutments.
- Bottom flange is down to 4" wide at 19" from abutment 1.

Girder #9:
- D-Meter readings were taken at the web at the center line of bearings and 2' from the center line of bearings at both ends. The web has section loss with a minimum measured thickness of 0" (full perforation) remaining at abutment 1, resulting in up to 76% in shear loss and up to 100% in bearing loss.
- The web appears to be buckling up to 3/16" at both abutments.
- Perforations in the end of the web at abutment 1 up to 5" x 2" with surrounding section loss.
- Bottom flange has as little as knife edge remaining at the edges, 1/4" remaining near the web and 3" remaining width within 39" of the centerline of bearing. The bottom flange 4' out from the centerline of bearing at abutment 2 (near quarter span) has up to 52% section loss.

Top flanges at the fascia girders ends have up to full length x full width x 3/16" deep section loss.

Interior Girders:
- Areas of peeling paint with light to moderate rust.
- Underside of top flanges exhibit light to moderate rust throughout.

Concrete jersey barriers and plastic water filled barriers placed along the shoulders to restrict live load from girders #1 and #9 are in good condition.

03/02/2021: No significant changes since previous inspection.

3/8/2022: No significant changes since last inspection.

3/7/2023: No significant changes since the previous inspection.

Action To Be Taken: Continue to monitor the fascia girders on a 12-month Special Inspection.

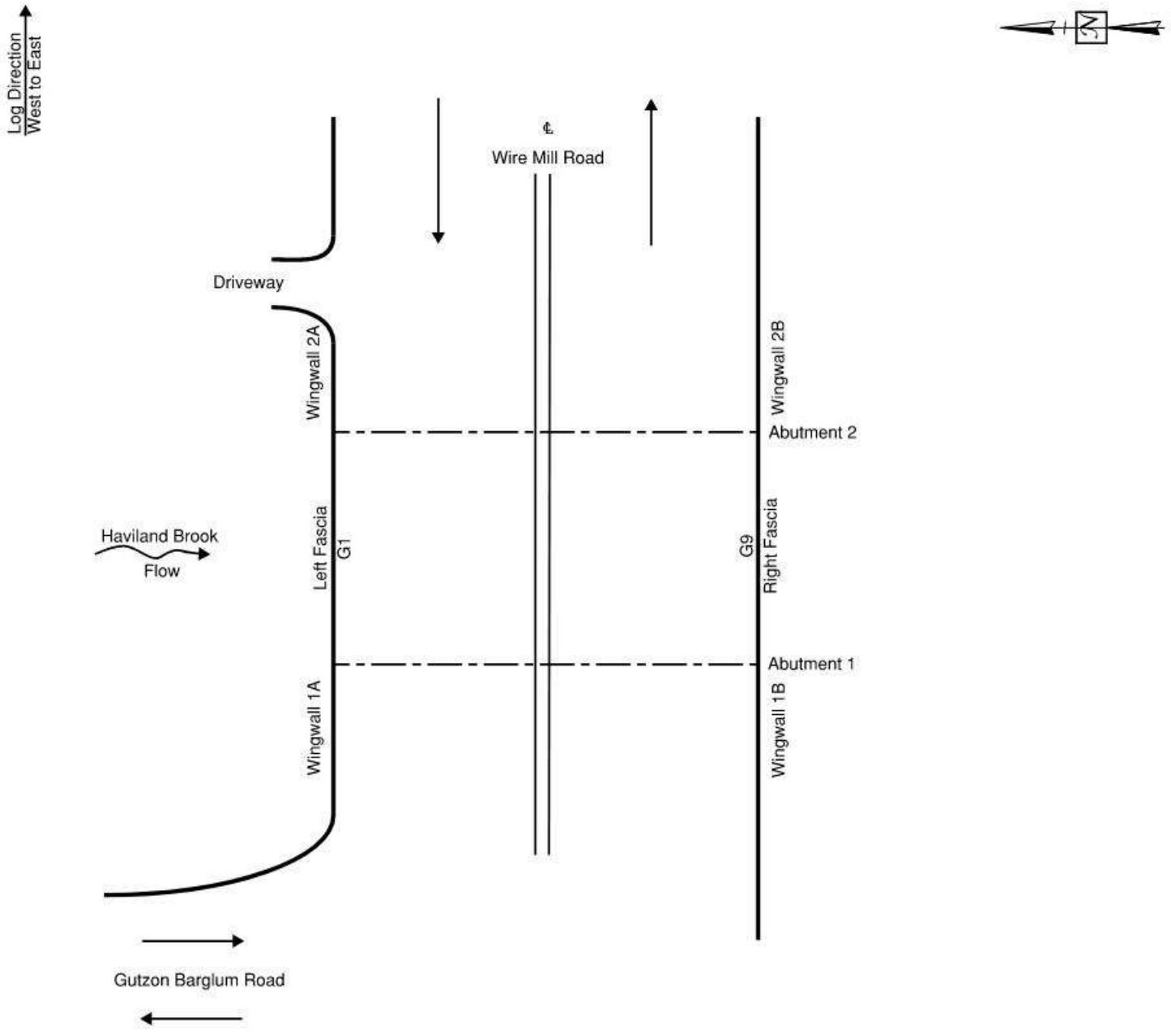
Continue to restrict live load from fascia girders.

Sketches
Inspection type: Routine,Special
Inspection Date: 3/07/2023
Inspected by: Team 7

:Bridge No 04070

Town: STAMFORD
Carried: WIRE MILL ROAD
Crossed: HAVILAND BROOK
Inventory Route: Non-NHS

CREW: Team 7	DATE: 03/03/2017	BRIDGE NO.: 04070



Key Plan
N.T.S.

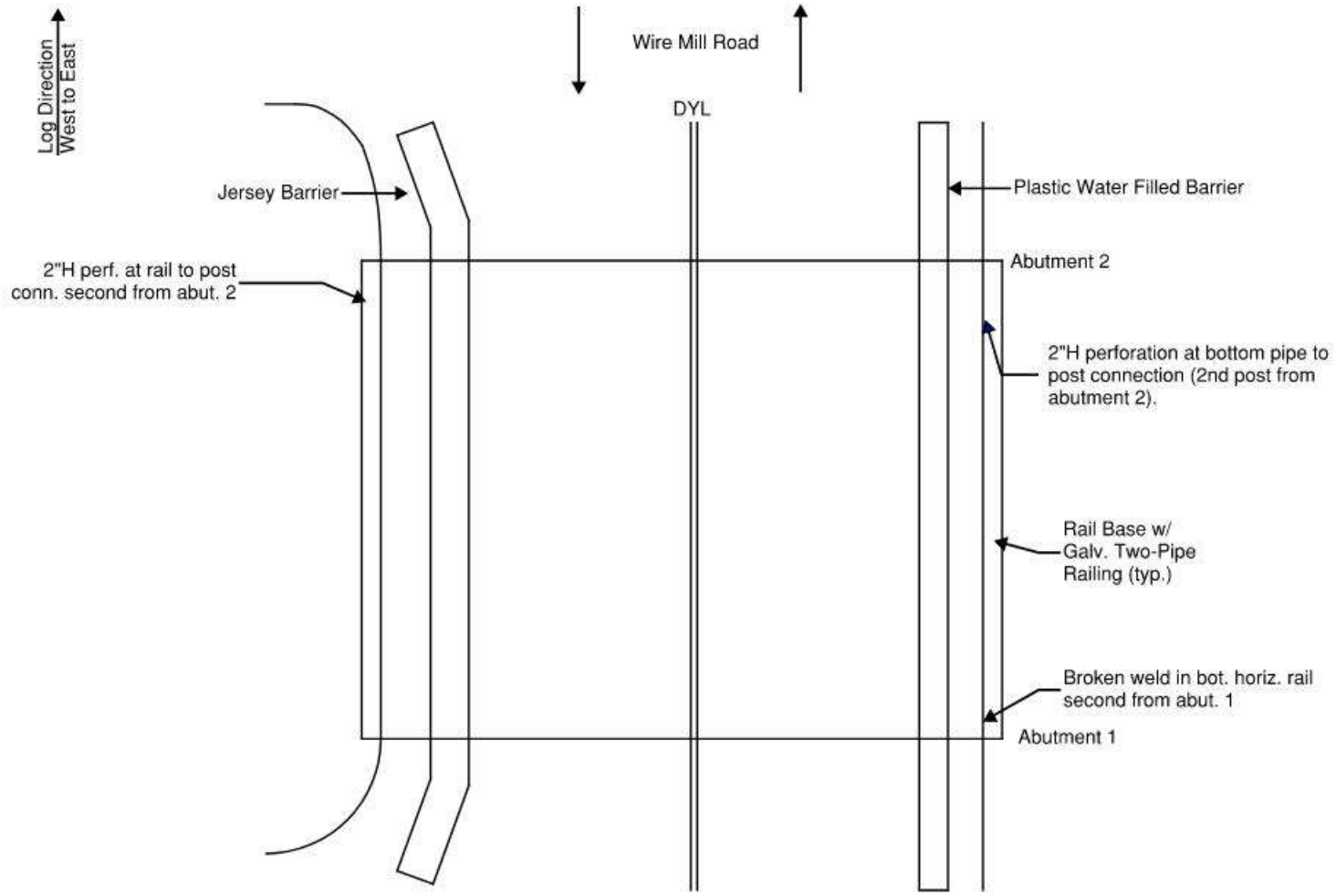
REVISION 1	DATE: 03/07/23	CREW: Team 7 No Revison	REVISION 3	DATE:	CREW:
REVISION 2	DATE:	CREW:	REVISION 4	DATE:	CREW:

Sketches
Inspection type: Routine,Special
Inspection Date: 3/07/2023
Inspected by: Team 7

:Bridge No 04070

Town: STAMFORD
Carried: WIRE MILL ROAD
Crossed: HAVILAND BROOK
Inventory Route: Non-NHS

CREW: MRJ, VVB (TSC)	DATE: 03/11/2019	BRIDGE NO.: 04070



LEGEND:
- HOLLOW AREA
- SHALLOW REBAR
- SPALL AREA
- SPALL AREA WITH EXPOSED REBAR
- MAPCRACKS
- HAIRLINE CRACKS
- HONEYCOMB AREA
- SCALE AREA
- EFFLORESCENCE PRESENT
- DYL DOUBLE YELLOW LINE

Top of Deck
N.T.S.

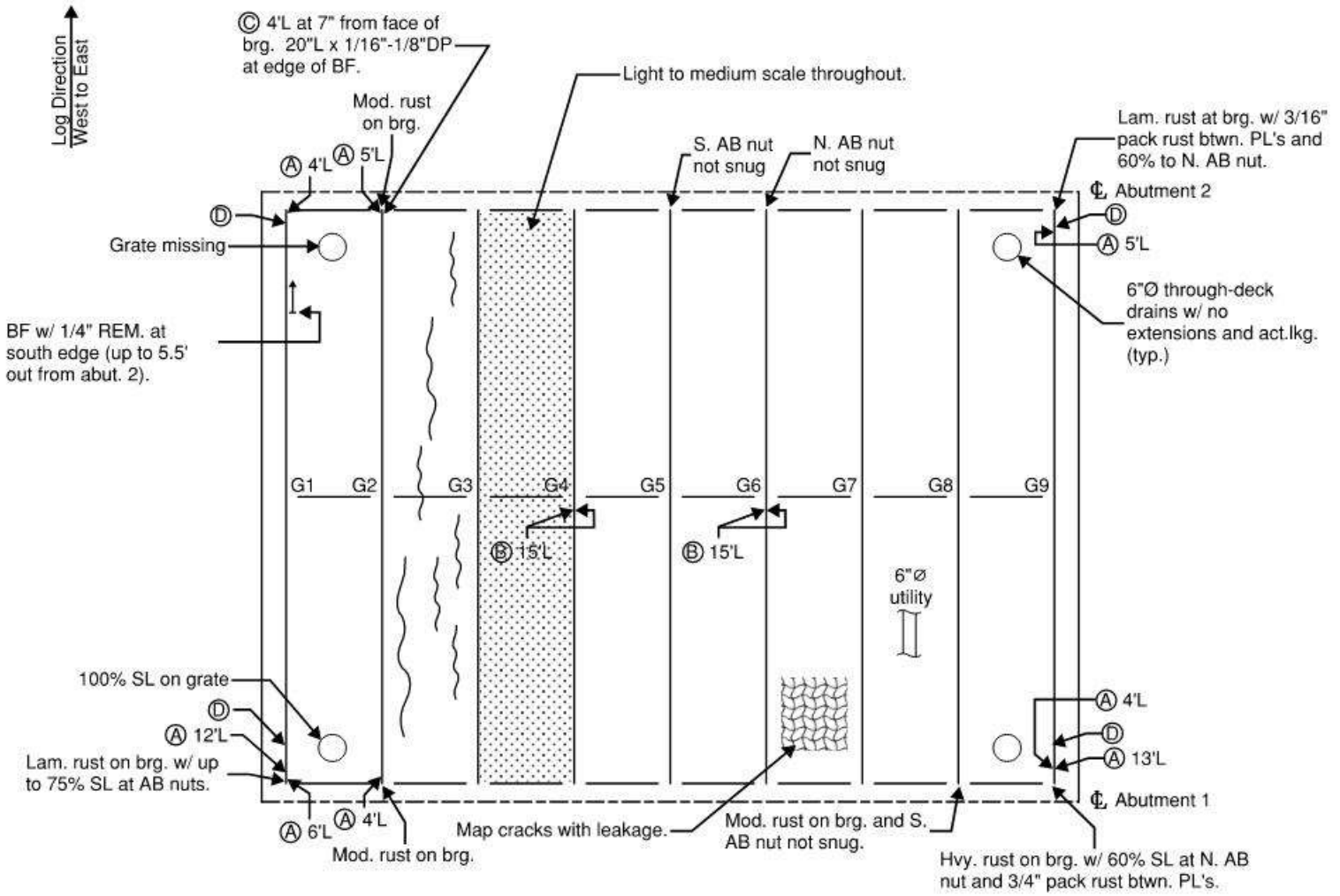
REVISION 1	DATE: 03/02/2021	CREW: TEAM 7	REVISION 3	DATE: 03/07/23	CREW: Team 7 No Revison
REVISION 2	DATE: 03/08/22	CREW: Team 7 No Revison	REVISION 4	DATE:	CREW:

Sketches
Inspection type: Routine,Special
Inspection Date: 3/07/2023
Inspected by: Team 7

:Bridge No 04070

Town: STAMFORD
Carried: WIRE MILL ROAD
Crossed: HAVILAND BROOK
Inventory Route: Non-NHS

CREW: MRJ, VVB (TSC)	DATE: 03/11/2019	BRIDGE NO.: 04070



LEGEND:
- HOLLOW AREA
- SHALLOW REBAR
- SPALL AREA
- SPALL AREA WITH EXPOSED REBAR
- MAPCRACKS
- HAIRLINE CRACKS
- HONEYCOMB AREA
- SCALE AREA
- EFFLORESCENCE PRESENT

Underside of Deck and Framing
N.T.S.

Deterioration Notes:
- Ⓐ Section loss at top flange (up to 3/16" deep).
- Ⓑ Moderate to heavy rust on top flange, no section loss.
- Ⓒ Bottom flange with heavy laminated rust.
- Ⓓ See D-Meter and Bottom Flange sketches for conditions.

REVISION 1	DATE: 03/05/2020	CREW: TEAM 7 - No Revisions	REVISION 3	DATE: 03/08/22	CREW: Team 7 No Revison
REVISION 2	DATE: 03/02/2021	CREW: TEAM 7	REVISION 4	DATE: 03/07/23	CREW: Team 7 No Revison

Sketches
Inspection type: Routine,Special
Inspection Date: 3/07/2023
Inspected by: Team 7

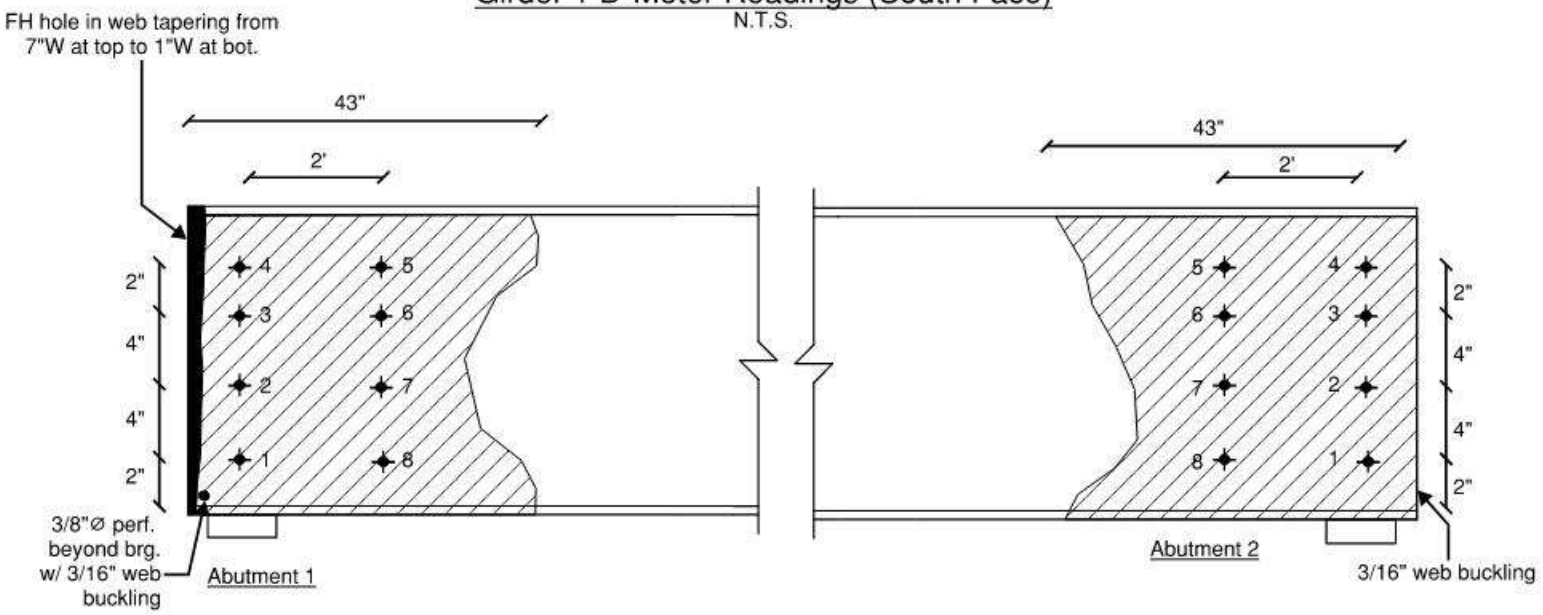
:Bridge No 04070

Town: STAMFORD
Carried: WIRE MILL ROAD
Crossed: HAVILAND BROOK
Inventory Route: Non-NHS

CREW: MRJ, VVB (TSC)	DATE: 03/11/2019	BRIDGE NO.: 04070

Girder 1 D-Meter Readings (South Face)

N.T.S.



Abutment 1

Date \ Loc.	1	2	3	4	5	6	7	8
03/11/2019	0.236"	0.374"	0.382"	0.423"	0.489"	0.557"	0.559"	0.200"
03/05/2020	0.236"	0.293"	0.371"	0.420"	0.480"	0.505"	0.505"	0.200"
03/02/2021	0.236"	0.325"	0.381"	0.422"	0.480"	0.505"	0.505"	0.200"
03/08/2022	0.236"	0.325"	0.381"	0.422"	0.480"	0.505"	0.505"	0.200"
03/07/2023	0.236"	0.325"	0.381"	0.422"	0.480"	0.505"	0.505"	0.200"

Abutment 2

Date \ Loc.	1	2	3	4	5	6	7	8
03/11/2019	0.150"	0.340"	0.270"	0.230"	0.321"	0.331"	0.381"	0.382"
03/05/2020	0.150"	0.291"	0.270"	0.230"	0.320"	0.331"	0.380"	0.380"
03/02/2021	0.150"	0.320"	0.270"	0.230"	0.319"	0.331"	0.380"	0.380"
03/08/2022	0.150"	0.320"	0.270"	0.230"	0.319"	0.331"	0.380"	0.380"
03/07/2023	0.150"	0.320"	0.270"	0.230"	0.319"	0.331"	0.380"	0.380"

Calibration G1 Mid Span: 0.562"
Girder Depth = 15"
Max. Tapered Flange Thickness = 3/4"

Worst Case Shear Loss:
Avg. Remaing = (0.150" + 0.291" + 0.270" + 0.230") / 4 = 0.2353"
Avg. Loss = (0.5625" - 0.2353") = 0.327"
Avg. Loss Area = (15" - 2(3/4")) x 0.327" = 4.4145 in²
Original Area = (15" - 2(3/4")) x 9/16" = 7.59375 in²
Percent Shear Loss = (4.4145 / 7.59375) x 100 = 58%

Legend:
Section Loss
D-Meter Measurement Point

REVISION 1	DATE: 03/05/2020	CREW: TEAM 7	REVISION 3	DATE: 03/08/22	CREW: Team 7
REVISION 2	DATE: 03/02/2021	CREW: TEAM 7	REVISION 4	DATE: 03/07/23	CREW: Team 7

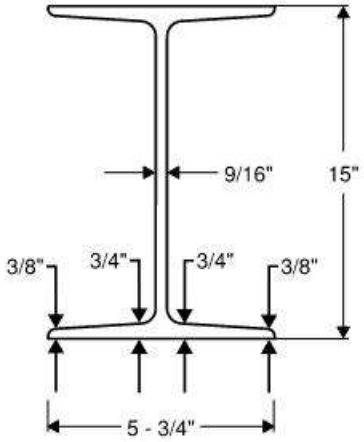
Sketches
Inspection type: Routine,Special
Inspection Date: 3/07/2023
Inspected by: Team 7

:Bridge No 04070

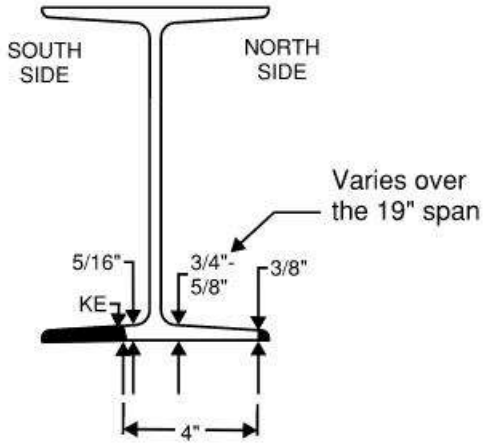
Town: STAMFORD
Carried: WIRE MILL ROAD
Crossed: HAVILAND BROOK
Inventory Route: Non-NHS

CREW: Team 1	DATE: 03-15-2018	BRIDGE NO.: 04070

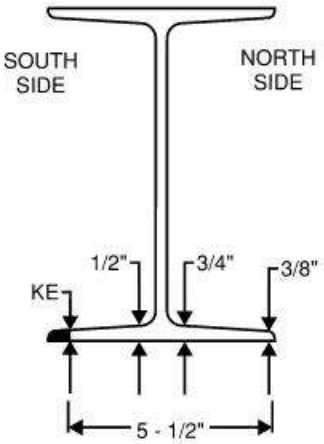
GIRDER 1 BOTTOM FLANGE NEAR ABUTMENT 1



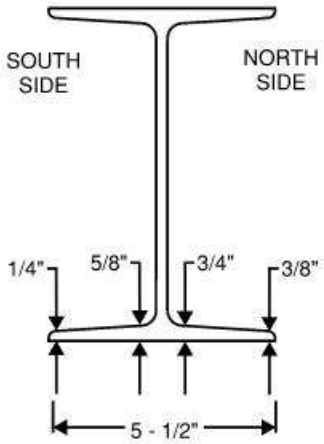
ORIGINAL SECTION (S-SHAPE BEAM)
N.T.S.



From Bearing Out 19"
REMAINING SECTION (LOOKING WEST)
N.T.S.



From Bearing Out 2'
REMAINING SECTION (LOOKING WEST)
N.T.S.



From Bearing Out 4'
REMAINING SECTION (LOOKING WEST)
N.T.S.

REVISION 1	DATE: 03/07/23	CREW: Team 7 No Revison	REVISION 3	DATE:	CREW:
REVISION 2	DATE:	CREW:	REVISION 4	DATE:	CREW:

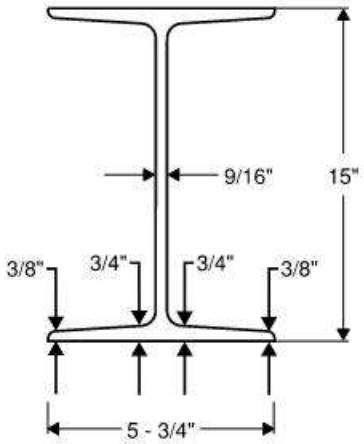
Sketches
Inspection type: Routine,Special
Inspection Date: 3/07/2023
Inspected by: Team 7

:Bridge No 04070

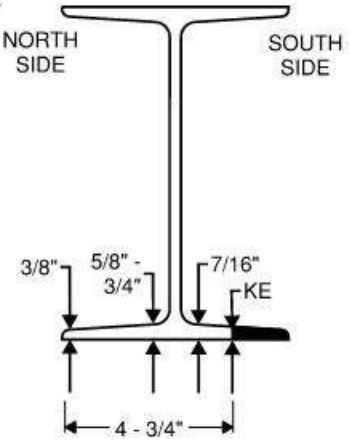
Town: STAMFORD
Carried: WIRE MILL ROAD
Crossed: HAVILAND BROOK
Inventory Route: Non-NHS

CREW: Team 1	DATE: 03-15-2018	BRIDGE NO.: 04070

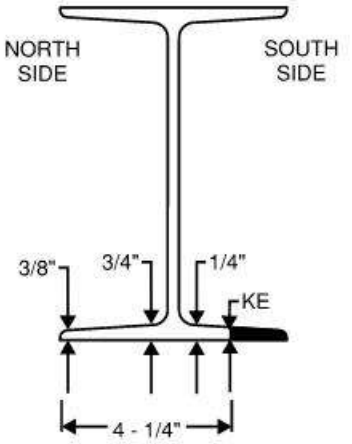
GIRDER 1 BOTTOM FLANGE NEAR ABUTMENT 2



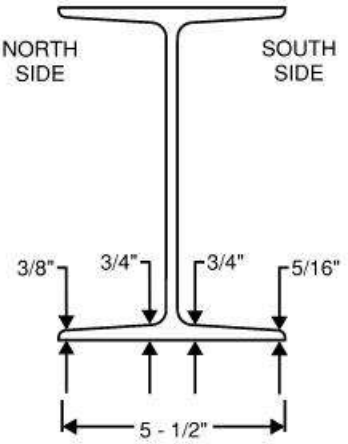
ORIGINAL SECTION (S-SHAPE BEAM)
N.T.S.



From Bearing Out 34"
REMAINING SECTION (LOOKING EAST)
N.T.S.



From Bearing Out 2'
REMAINING SECTION (LOOKING EAST)
N.T.S.



From Bearing Out 4'
REMAINING SECTION (LOOKING EAST)
N.T.S.

REVISION 1	DATE: 03/07/23	CREW: Team 7 No Revison	REVISION 3	DATE:	CREW:
REVISION 2	DATE:	CREW:	REVISION 4	DATE:	CREW:

Sketches
Inspection type: Routine,Special
Inspection Date: 3/07/2023
Inspected by: Team 7

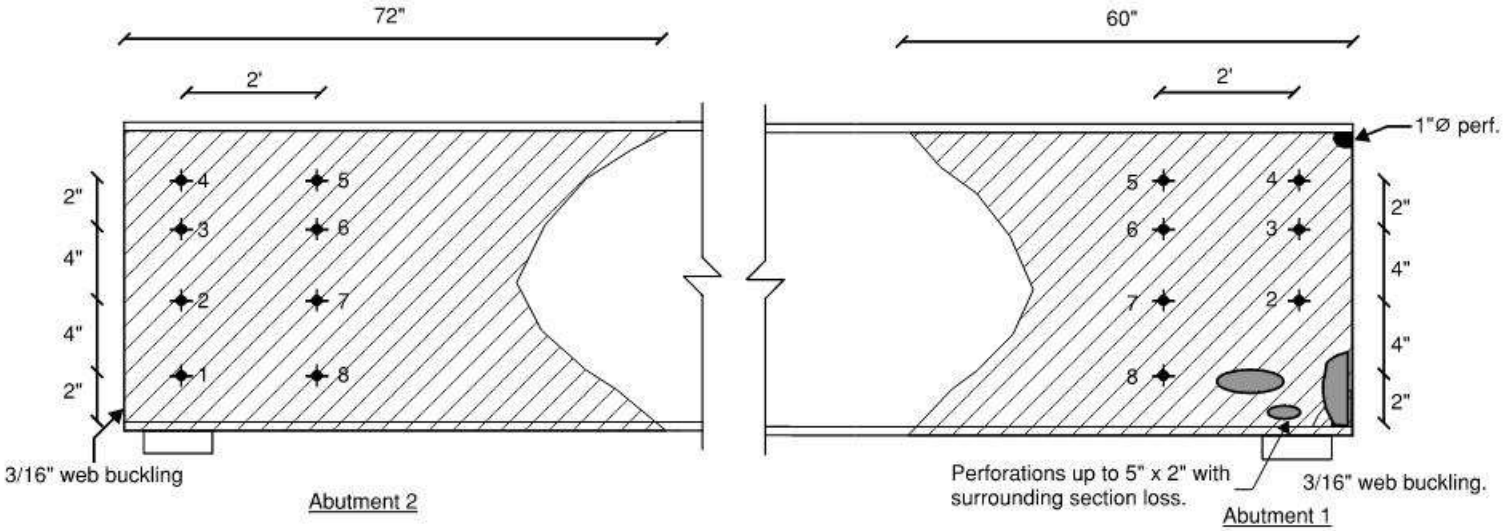
:Bridge No 04070

Town: STAMFORD
Carried: WIRE MILL ROAD
Crossed: HAVILAND BROOK
Inventory Route: Non-NHS

CREW: MRJ, VVB (TSC)	DATE: 03/11/2019	BRIDGE NO.: 04070

Girder 9 D-Meter Readings (North Face)

N.T.S.



Abutment 1

Date \ Loc.	1	2	3	4	5	6	7	8
03/03/2017	0.198"	0.220"	0.215"	0.260"	*	*	*	*
03/11/2019	0.125"	0.194"	0.200"	0.190"	0.420"	0.290"	0.265"	0.230"
03/05/2020	0"	0.150"	0.200"	0.190"	0.420"	0.290"	0.250"	0.230"
03/02/2021	0"	0.150"	0.200"	0.190"	0.420"	0.290"	0.250"	0.230"
03/08/2022	0"	0.150"	0.200"	0.190"	0.420"	0.290"	0.250"	0.230"
03/07/2023	0"	0.150"	0.200"	0.190"	0.420"	0.290"	0.250"	0.230"

Abutment 2

Date \ Loc.	1	2	3	4	5	6	7	8
03/03/2017	0.350"	0.464"	0.454"	0.420"	*	*	*	*
03/11/2019	0.178"	0.388"	0.400"	0.410"	0.319"	0.313"	0.361"	0.251"
03/05/2020	0.178"	0.380"	0.400"	0.410"	0.310"	0.310"	0.361"	0.251"
03/02/2021	0.178"	0.380"	0.400"	0.410"	0.310"	0.310"	0.361"	0.251"
03/08/2022	0.178"	0.380"	0.400"	0.410"	0.310"	0.310"	0.361"	0.251"
03/07/2023	0.178"	0.380"	0.400"	0.410"	0.310"	0.310"	0.361"	0.251"

Legend:
- Section Loss
- D-Meter Measurement Point

* Measurements were not taken in 2017.

Calibration G9 Mid Span: 0.563"
Web Depth = 15"
Max. Tapered Flange Thickness = 3/4"

Worst Case Shear Loss:
Avg. Remaing = (0" + 0.150" + 0.200" + 0.190") / 4 = 0.135"
Avg. Loss = (0.5625" - 0.135") = 0.4275"
Avg. Loss Area = (15" - 2(3/4")) x 0.4275" = 5.77125 in²
Original Area = (15" - 2(3/4")) x 9/16" = 7.59375 in²
Percent Shear Loss = (5.77125 / 7.59375) x 100 = 76%

REVISION 1	DATE: 03/05/2020	CREW: TEAM 7	REVISION 3	DATE: 03/08/22	CREW: Team 7
REVISION 2	DATE: 03/02/2021	CREW: TEAM 7	REVISION 4	DATE: 03/07/23	CREW: Team 7

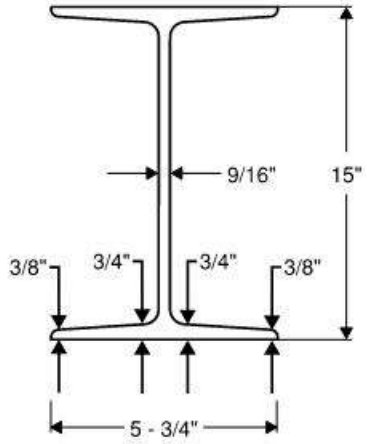
Sketches
Inspection type: Routine,Special
Inspection Date: 3/07/2023
Inspected by: Team 7

:Bridge No 04070

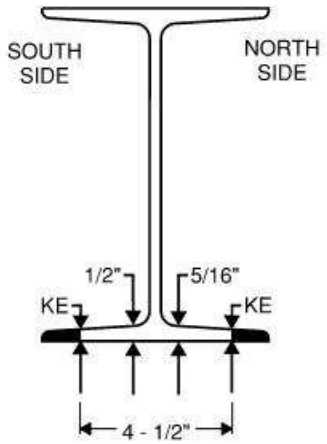
Town: STAMFORD
Carried: WIRE MILL ROAD
Crossed: HAVILAND BROOK
Inventory Route: Non-NHS

CREW: Team 1	DATE: 03-15-2018	BRIDGE NO.: 04070

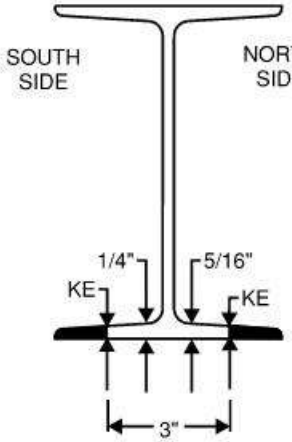
GIRDER 9 BOTTOM FLANGE NEAR ABUTMENT 1



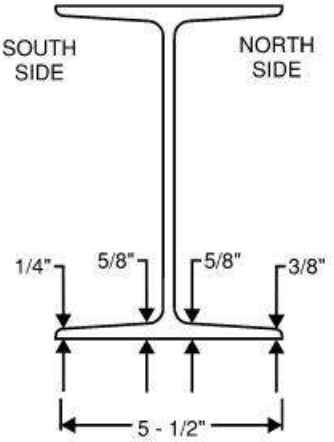
ORIGINAL SECTION (S-SHAPE BEAM)
N.T.S.



From Bearing Out 39"
REMAINING SECTION (LOCKING WEST)
N.T.S.



From Bearing Out 2'
REMAINING SECTION (LOCKING WEST)
N.T.S.



From Bearing Out 4'
REMAINING SECTION (LOCKING WEST)
N.T.S.

REVISION 1	DATE: 03/07/23	CREW: Team 7 No Revison	REVISION 3	DATE:	CREW:
REVISION 2	DATE:	CREW:	REVISION 4	DATE:	CREW:

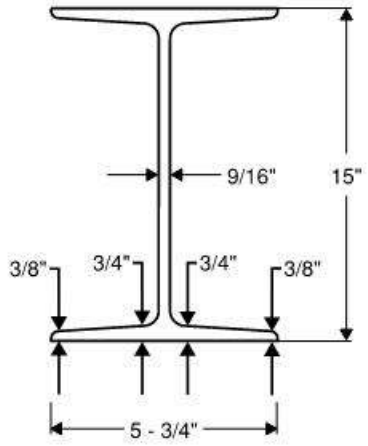
Sketches
Inspection type: Routine,Special
Inspection Date: 3/07/2023
Inspected by: Team 7

:Bridge No 04070

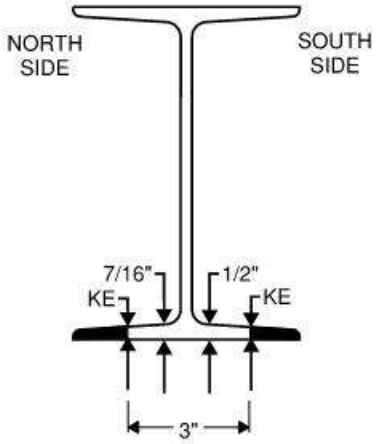
Town: STAMFORD
Carried: WIRE MILL ROAD
Crossed: HAVILAND BROOK
Inventory Route: Non-NHS

CREW: Team 1	DATE: 03-15-2018	BRIDGE NO.: 04070

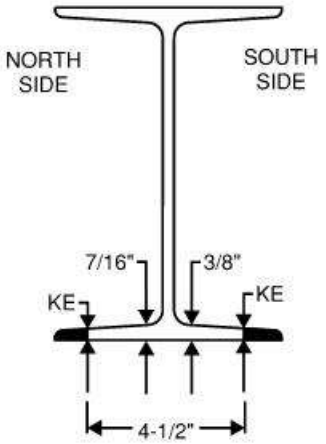
GIRDER 9 BOTTOM FLANGE NEAR ABUTMENT 2



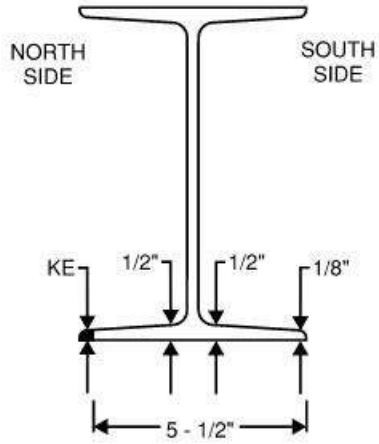
ORIGINAL SECTION (S-SHAPE BEAM)
N.T.S.



From Bearing Out 39"
REMAINING SECTION (LOOKING EAST)
N.T.S.



From Bearing Out 2'
REMAINING SECTION (LOOKING EAST)
N.T.S.



From Bearing Out 4'
REMAINING SECTION (LOOKING EAST)
N.T.S.

Bottom Flange SL @ 4' from CL BRG:
A_Orig. = 5.75"[(3/8"+3/4")/2] = 3.23 in^2
A_Rem = 2.625"[(0"+1/2")/2] + 2.875"[(1/8")+1/2")/2] = 1.55 in^2
%_Loss = 1-(1.55/3.23) = 52%

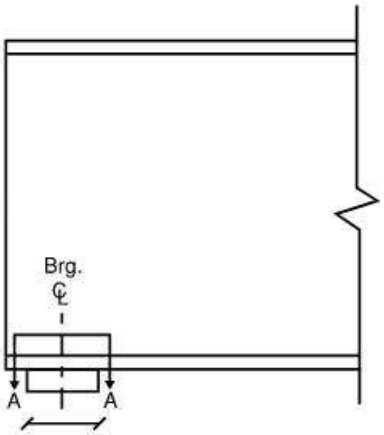
REVISION 1	DATE: 03/07/23	CREW: Team 7 No Revison	REVISION 3	DATE:	CREW:
REVISION 2	DATE:	CREW:	REVISION 4	DATE:	CREW:

Sketches
Inspection type: Routine,Special
Inspection Date: 3/07/2023
Inspected by: Team 7

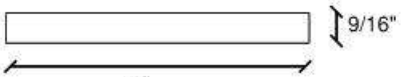
:Bridge No 04070

Town: STAMFORD
Carried: WIRE MILL ROAD
Crossed: HAVILAND BROOK
Inventory Route: Non-NHS

CREW: MRJ, VVB (TSC)	DATE: 03/11/2019	BRIDGE NO.: 04070



Typical Girder Elevation at Bearing Area
N.T.S.



Section A-A
Bearing Area for Girder Web
N.T.S.

Girder 1 Abutment 1
Original Bearing Area = 9" x 9/16" = 5.0625 in²
Section Loss = 0.5625" - 0.236" = 0.27025"
Bearing Loss = 9" x 0.27025" = 2.43225 in²
Percent Bearing Loss = (2.43225 / 5.0625) x 100 = 48%

Girder 1 Abutment 2
Original Bearing Area = 9" x 9/16" = 5.0625 in²
Section Loss = 0.5625" - 0.150" = 0.4125"
Bearing Loss = 9" x 0.4125" = 3.7125 in²
Percent Bearing Loss = (3.7125 / 5.0625) x 100 = 73%

Girder 9 Abutment 1
Original Bearing Area = 9" x 9/16" = 5.0625 in²
Section Loss = 0.5625" - 0" = 0.5625"
Bearing Loss = 9" x 0.5625" = 5.0625 in²
Percent Bearing Loss = (5.0625 / 5.0625) x 100 = 100%

Girder 9 Abutment 2
Original Bearing Area = 9" x 9/16" = 5.0625 in²
Section Loss = 0.5625" - 0.178" = 0.3845"
Bearing Loss = 9" x 0.3845" = 3.4605 in²
Percent Bearing Loss = (3.4605 / 5.0625) x 100 = 68%

Bearing Loss Calculations

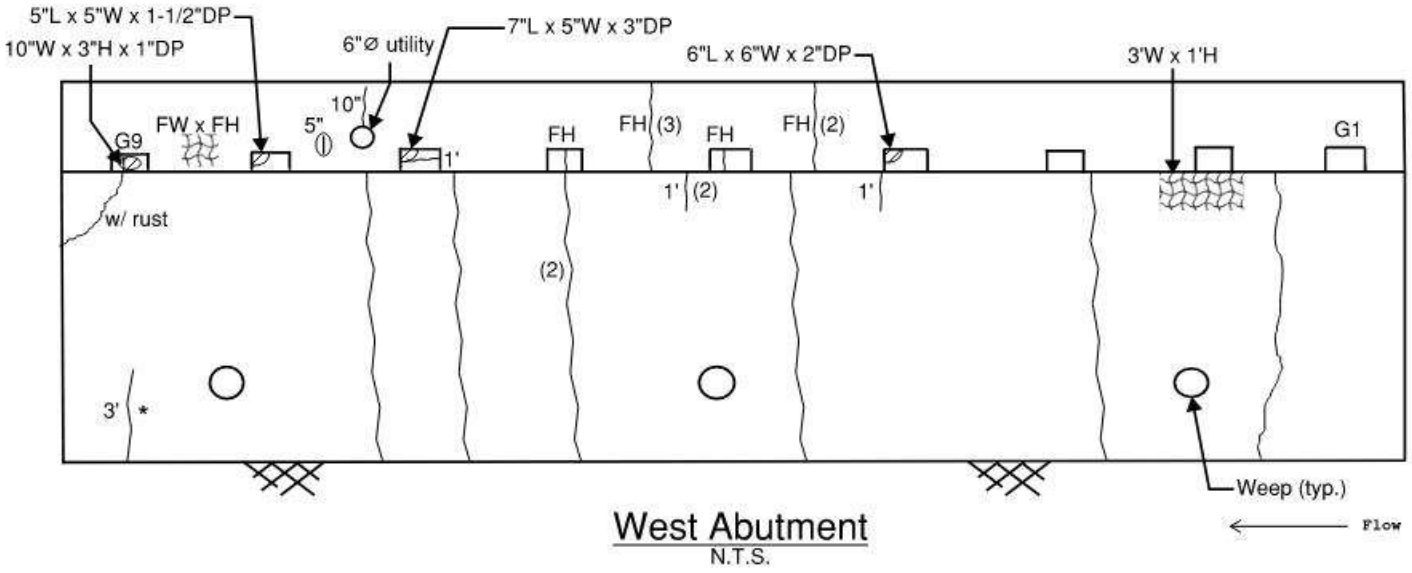
REVISION 1	DATE: 03/05/2020	CREW: TEAM 7	REVISION 3	DATE: 03/08/22	CREW: Team 7 No Revison
REVISION 2	DATE: 03/02/2021	CREW: TEAM 7 - No Revisions	REVISION 4	DATE: 03/07/23	CREW: Team 7 No Revison

Sketches
Inspection type: Routine,Special
Inspection Date: 3/07/2023
Inspected by: Team 7

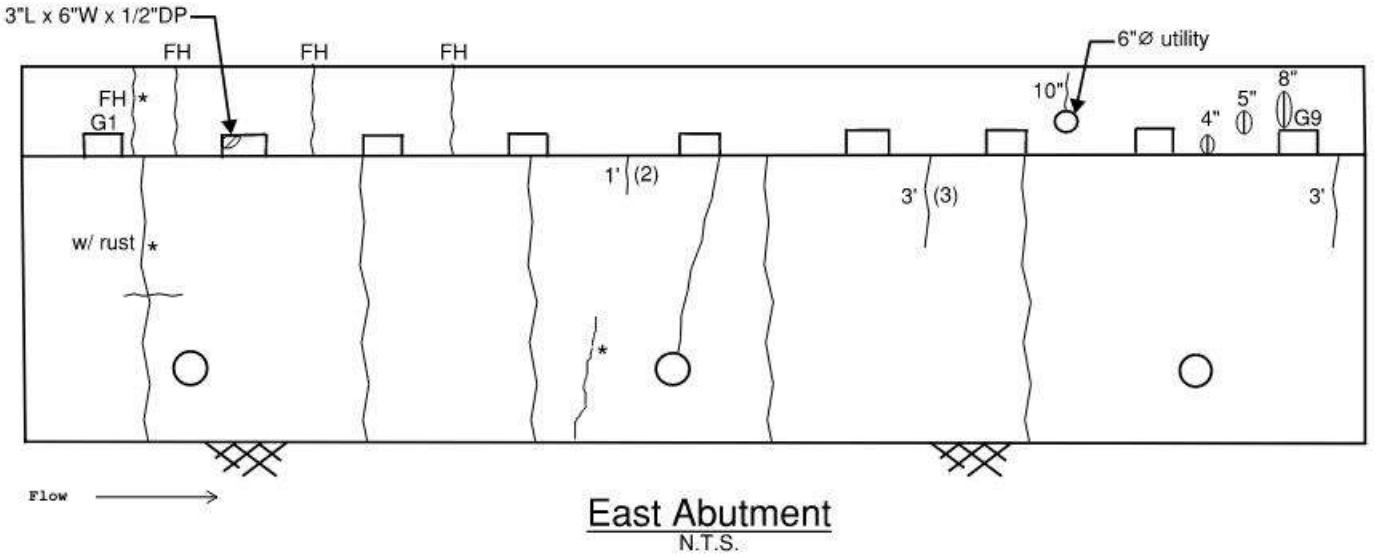
:Bridge No 04070

Town: STAMFORD
Carried: WIRE MILL ROAD
Crossed: HAVILAND BROOK
Inventory Route: Non-NHS

CREW: Team 7	DATE: 03/03/2017	BRIDGE NO. 04070



West Abutment
N.T.S.



East Abutment
N.T.S.

LEGEND:
- HOLLOW AREA
- SHALLOW REBAR
- SPALL AREA
- SPALL AREA WITH EXPOSED REBAR
- MAPCRACKS
- HAIRLINE CRACKS
- HONEYCOMB AREA
- SCALE AREA
- EFFLORESCENCE PRESENT

General Notes:
- Stems have isolated horizontal cracks up to full length, moderate scale along the waterline and random rust stains. There are hollow areas up to 1' long x 4" high.
- Moderate scaling along the waterline.
- Backwalls have isolated horizontal cracks up to 2' long and light scaling.
- Minor scour along abutments due to aggradation in channel.
- Light to heavy accumulation of sand and debris on seats.

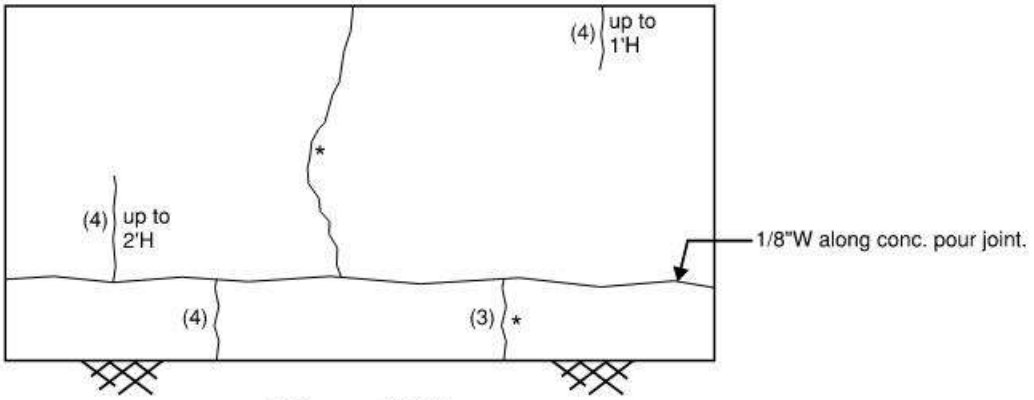
REVISION 1	DATE: 03/11/2019	CREW: VVB, MRJ (TSC)	REVISION 3	DATE: 03/07/23	CREW: Team 7 No Revison
REVISION 2	DATE: 03/02/2021	CREW: TEAM 7 - No Revisions	REVISION 4	DATE:	CREW:

Sketches
Inspection type: Routine,Special
Inspection Date: 3/07/2023
Inspected by: Team 7

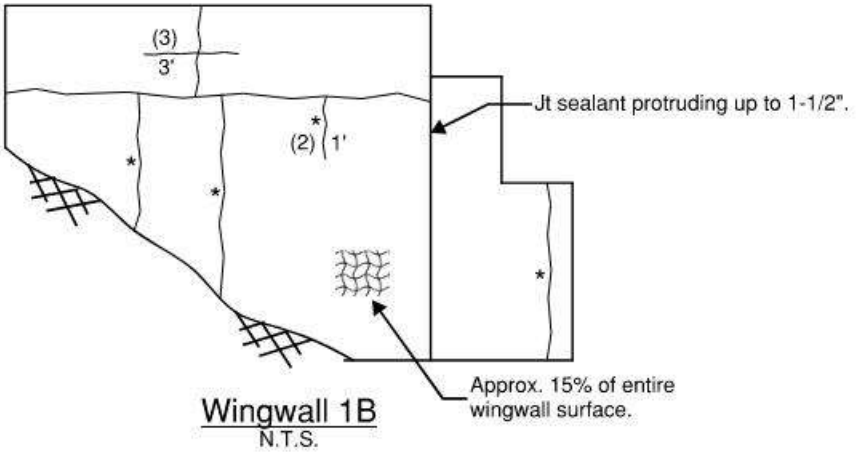
:Bridge No 04070

Town: STAMFORD
Carried: WIRE MILL ROAD
Crossed: HAVILAND BROOK
Inventory Route: Non-NHS

CREW: VVB, MRJ (TSC)	DATE: 03/11/2019	BRIDGE NO.: 04070



Wingwall 1A
N.T.S.



Wingwall 1B
N.T.S.

LEGEND:
- HOLLOW AREA
- SHALLOW REBAR
- SPALL AREA
- SPALL AREA WITH EXPOSED REBAR
- MAPCRACKS
- HAIRLINE CRACKS
- HONEYCOMB AREA
- SCALE AREA
- EFFLORESCENCE PRESENT

General Notes:
- Scaling along the waterline.

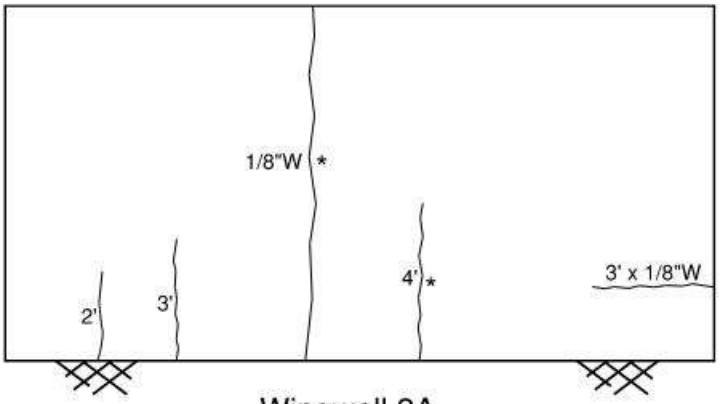
REVISION 1	DATE: 03/02/2021	CREW: TEAM 7 - No Revisions	REVISION 3	DATE:	CREW:
REVISION 2	DATE: 03/07/23	CREW: Team 7 No Revison	REVISION 4	DATE:	CREW:

Sketches
Inspection type: Routine,Special
Inspection Date: 3/07/2023
Inspected by: Team 7

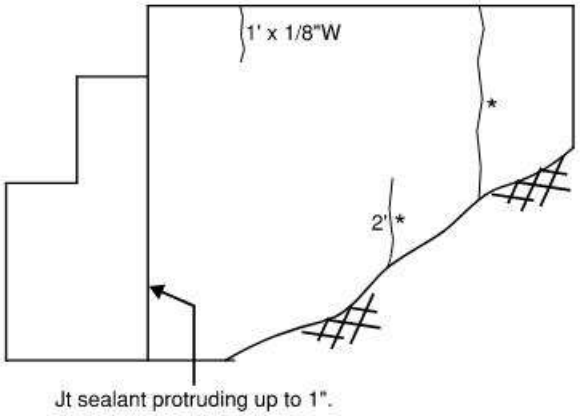
:Bridge No 04070

Town: STAMFORD
Carried: WIRE MILL ROAD
Crossed: HAVILAND BROOK
Inventory Route: Non-NHS

CREW: VVB, MRJ (TSC)	DATE: 03/11/2019	BRIDGE NO.: 04070



Wingwall 2A
N.T.S.



Wingwall 2B
N.T.S.

LEGEND:
- HOLLOW AREA
- SHALLOW REBAR
- SPALL AREA
- SPALL AREA WITH EXPOSED REBAR
- MAPCRACKS
- HAIRLINE CRACKS
- HONEYCOMB AREA
- SCALE AREA
- EFFLORESCENCE PRESENT *

General Notes:

- See "Wingwalls 1A and 1B" general notes.

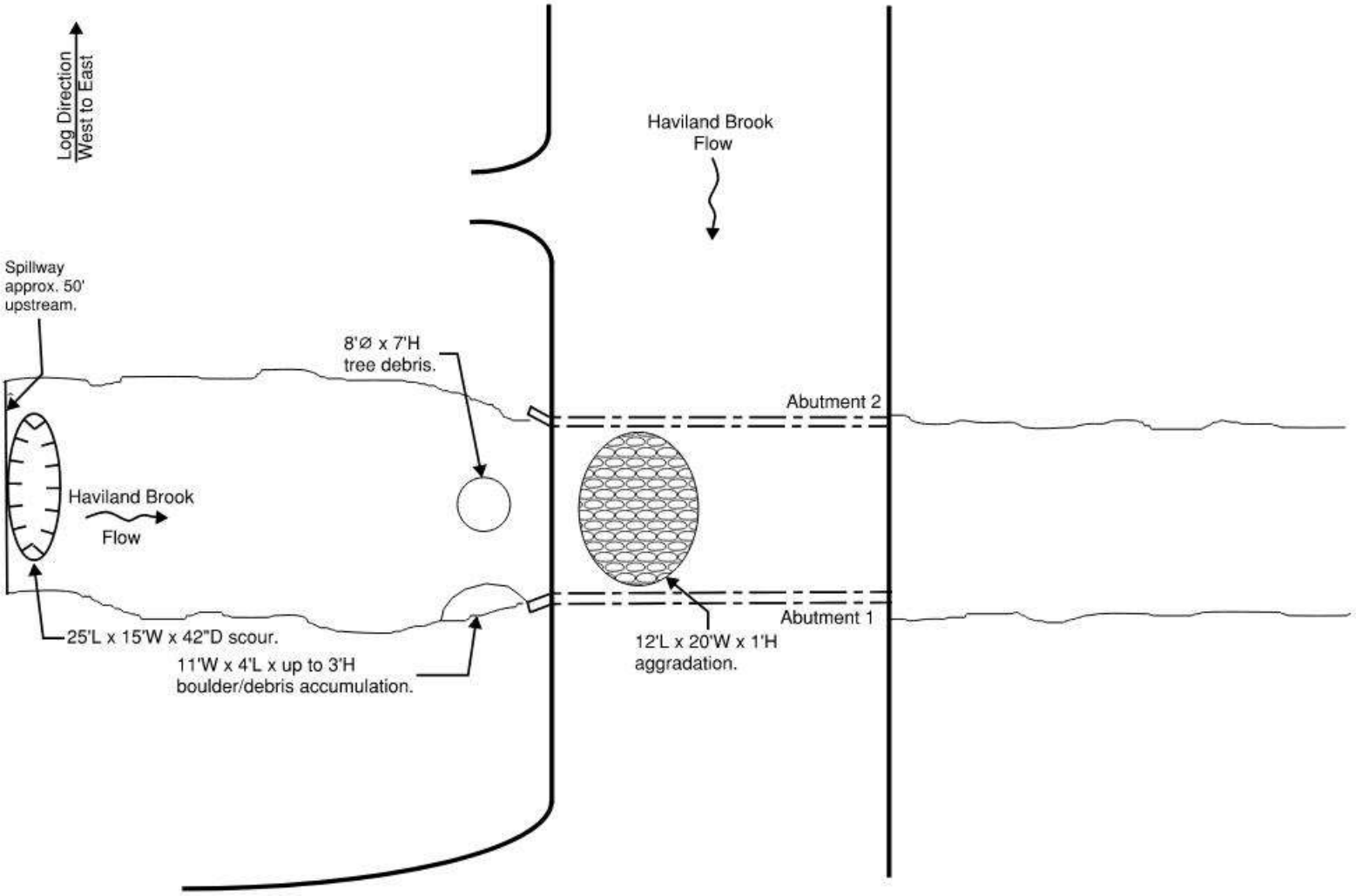
REVISION 1	DATE: 03/02/2021	CREW: TEAM 7 - No Revisions	REVISION 3	DATE:	CREW:
REVISION 2	DATE: 03/07/23	CREW: Team 7 No Revison	REVISION 4	DATE:	CREW:

Sketches
Inspection type: Routine,Special
Inspection Date: 3/07/2023
Inspected by: Team 7

:Bridge No 04070

Town: STAMFORD
Carried: WIRE MILL ROAD
Crossed: HAVILAND BROOK
Inventory Route: Non-NHS

CREW: Team 7	DATE: 03/03/2017	BRIDGE NO.: 04070



General Notes:
- Channel bottom consists of sand, gravel, cobbles and small boulders.
- Upstream and downstream embankments have undercutting up to 1' high with exposed tree roots.
- Light to moderate debris along the embankments.
- Channel flow favors abutment 2.
- Rip rap along the northeast embankment only.

LEGEND:
- HOLLOW AREA
- SHALLOW REBAR
- SPALL AREA
- SPALL AREA WITH EXPOSED REBAR
- MAPCRACKS
- HAIRLINE CRACKS
- HONEYCOMB AREA
- SCALE AREA
- EFFLORESCENCE PRESENT

Channel Plan
N.T.S.

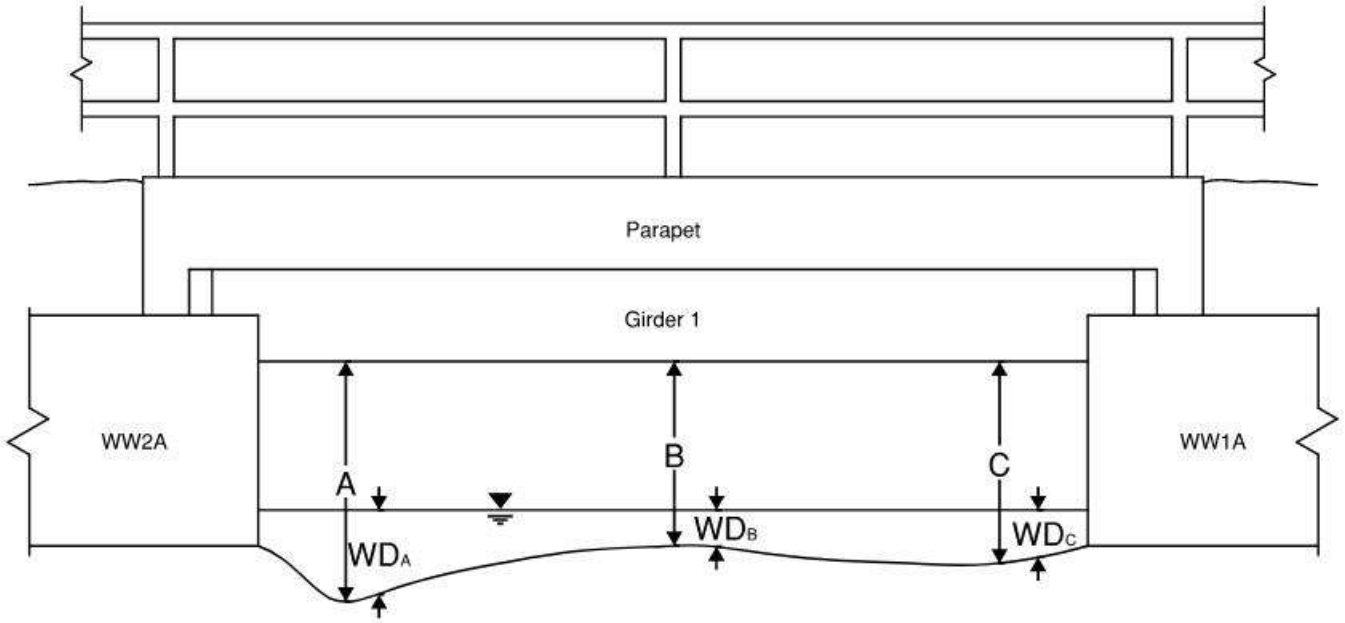
REVISION 1	DATE: 03/11/2019	CREW: VVB, MRJ (TSC)	REVISION 3	DATE: 03/07/23	CREW: Team 7 No Revison
REVISION 2	DATE: 03/02/2021	CREW: TEAM 7 - No Revisions	REVISION 4	DATE:	CREW:

Sketches
Inspection type: Routine,Special
Inspection Date: 3/07/2023
Inspected by: Team 7

:Bridge No 04070

Town: STAMFORD
Carried: WIRE MILL ROAD
Crossed: HAVILAND BROOK
Inventory Route: Non-NHS

CREW: MRJ, VVB (TSC)	DATE: 03/11/2019	BRIDGE NO.: 04070



Location / Date	A	WDA	B	WDB	C	WDC
03/11/2019	5'-0"	1'-10"	4'-1"	0'-9"	4'-4"	1'-0"
03/02/2021	4'-9"	1-10"	3'-11"	9"	4'-5"	1'-4"
03/07/2023	4'-10"	1-08"	4'-02"	12"	3'-11"	0'-7"

General Notes:
- Measurements were taken at each abutment and at midspan.

Channel Measurements at Inlet
(North Elevation)
N.T.S.

REVISION 1	DATE: 03/02/2021	CREW: TEAM 7	REVISION 3	DATE:	CREW:
REVISION 2	DATE: 03/07/23	CREW: Team 7	REVISION 4	DATE:	CREW:

Form: Asset Photos
Inspection type: Routine,Special
Inspection Date: 3/07/2023
Inspected by: Team 7

:Bridge No 04070

Town: STAMFORD
Carried: WIRE MILL ROAD
Crossed: HAVILAND BROOK
Inventory Route: Non-NHS

Photo Number: 1 Photo Taken: 03/07/2023

Bridge ID

Photo Number: 2 Photo Taken: 03/07/2023

Looking east from west approach

Photo Number: 3 Photo Taken: 03/07/2023

Looking west from east approach

Photo Number: 4 Photo Taken: 03/07/2023

Looking east from bridge

Photo Number: 5 Photo Taken: 03/07/2023

Looking west from bridge

Photo Number: 6 Photo Taken: 03/07/2023

Typical overlay

Photo Number: 7 Photo Taken: 03/07/2023

North jersey barrier

Photo Number: 8 Photo Taken: 03/07/2023

South plastic water filled barrier

Photo Number: 9 Photo Taken: 03/07/2023

North elevation (inlet)

Photo Number: 10 Photo Taken: 03/07/2023

Abutment 1

Photo Number: 11 Photo Taken: 03/07/2023

Abutment 2

Photo Number: 12 Photo Taken: 03/07/2023

Wingwall 1A

Photo Number: 13 Photo Taken: 03/07/2023

Wingwall 2A

Photo Number: 14 Photo Taken: 03/07/2023

G-1 at abutment 1

Photo Number: 15 Photo Taken: 03/07/2023

G-2 at abutment 1

Photo Number: 16 Photo Taken: 03/07/2023

G-1 at abutment 2

Photo Number: 17 Photo Taken: 03/07/2023

G-2 at abutment 1

Photo Number: 18 Photo Taken: 03/07/2023

Underside

Photo Number: 19 Photo Taken: 03/07/2023

G-9 at abutment 1 north face

Photo Number: 20 Photo Taken: 03/07/2023

G-8 at abutment 1 south face

Photo Number: 21 Photo Taken: 03/07/2023

G-9 at abutment 1 south face

Photo Number: 22 Photo Taken: 03/07/2023

G-9 at abutment 2 south face

Photo Number: 23 Photo Taken: 03/07/2023

G-9 at abutment 2 north face

Photo Number: 24 Photo Taken: 03/07/2023

G-8 at abutment 2

Photo Number: 25 Photo Taken: 03/07/2023

South elevation (outlet)

Photo Number: 26 Photo Taken: 03/07/2023

Wingwall 1B

Photo Number: 27 Photo Taken: 03/07/2023

Wingwall 2B

Photo Number: 28 Photo Taken: 03/07/2023

Bearings from G-1 at abutment 1

Photo Number: 29 Photo Taken: 03/07/2023

Bearings from G-1 at abutment 2

Photo Number: 30 Photo Taken: 03/07/2023

Looking upstream

Form: Asset Photos
Inspection type: Routine,Special
Inspection Date: 3/07/2023
Inspected by: Team 7

:Bridge No 04070

Town: STAMFORD
Carried: WIRE MILL ROAD
Crossed: HAVILAND BROOK
Inventory Route: Non-NHS

Photo Number: 31 Photo Taken: 03/07/2023

Looking downstream